North Carolina Department of Transportation

Traffic Management & Signal Systems Unit
DESIGN MANUAL

Introduction

The North Carolina Department of Transportation's Traffic Management and Signal Systems Unit has prepared this Design Manual as a medium for the presentation of commonly used design practices. It also serves as a format to present new design standards and practices, and to ensure more uniformity in the design of traffic signal plans, electrical details, and communications cable routing plans prepared for the NCDOT.

The intention of this Manual is not to provide an explanation or solution to every design problem encountered. This Manual is not a substitute for sound engineering judgment, experience, or knowledge, nor does it prohibit the application of new ideas and innovations.

This Manual is based on established practices and is supplemented by recent research. This Manual will require adjustments, additions, and deletions to keep abreast of improved technology resulting from continuing research and experience.

I hope this Manual presents valuable information in an understandable format that will provide the designer with many years of practical use.

Approved for implementation (Signals & Geometrics Section)
On December 1, 1995
Revised (Signals & Geometrics Section)
October 1, 1999
Revised
July 30, 2004

Greg Fuller

Greg A. Fuller, PE
Traffic Management and Signal Systems Engineer

TRAFFIC MANAGEMENT & SIGNAL SYSTEMS UNIT
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Table of Contents

ITS & SIGNALS UNIT
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Design Manual

Signal Design Section

Transportation Mobility and Safety Division

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

Signal Design Section

Part 1

Table of Contents

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.

2070L Term	NEMA Equivalent	170 Equivalent
Call Detector	Place Call During Phase	Calling
Delay	Delay	Delay
Dual Entry	Dual Entry	Double Entry
Extension/Gap	Passage/Gap	Vehicle Extension
Full Time Delay	Inhibit Delay During Green?	Full Time Delay
Maximum Green	Maximum 1	Maximum Limit
Max Recall	Max Recall	Max Recall
Max Variable Initial	Maximum Initial	Maximum Initial
Minimum Gap	Minimum Gap	Minimum Gap
Min Green	Minimum Green	Minimum Initial
Min Recall	Min Recall	Vehicle Recall
Ped Recall	Ped Recall	Ped Recall
Red Clearance	Red Clearance	Red Clearance
Sec per Actuation	Sec per Actuation	Add per Vehicle
Soft Recall	Soft Recall	Soft Recall
Stop Bar Time	-	Type 3 Limit
Stretch	Extend	Carry
Time Before Reduction	Time Before Reduction	Reduce 0.1 Sec Every
Time to Reduce	Time to Reduce	
Vehicle Call Memory	Vehicle Call Memory	Vehicle Call Memory
Yellow Clearance	Yellow Change Interval	Yellow Change Interval
-	-	Alternate Extension
-	-	Count
-	-	Extension
-	-	Maximum Gap

Controller Terms

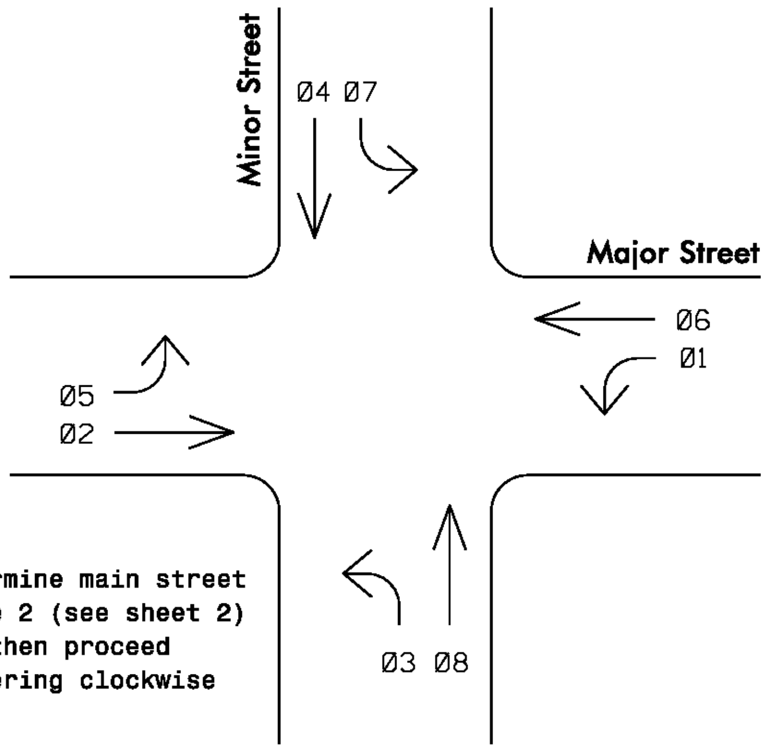
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 1.0

SHEET 1 OF 1

Standard NEMA Orientation
Dual Ring Cabinet

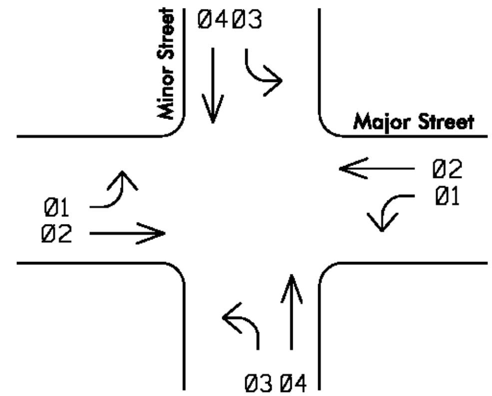


Determine main street
phase 2 (see sheet 2)
and then proceed
numbering clockwise

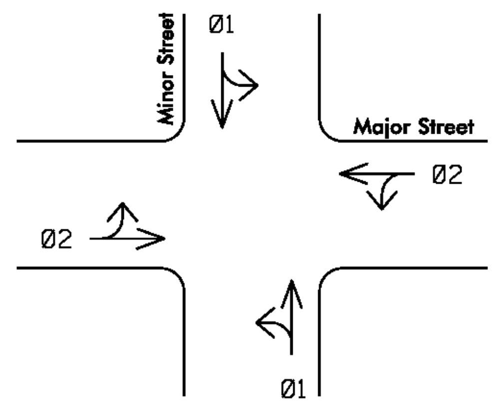
Sum of phases for each major street approach is 7.
(1+6=7 and 2+5=7)

Sum of phases for each minor street approach is 11.
(3+8=11 and 4+7=11)

Standard NEMA Orientation
Single Ring 4 Phase Cabinet



Standard NEMA Orientation
Single Ring 2 Phase Cabinet



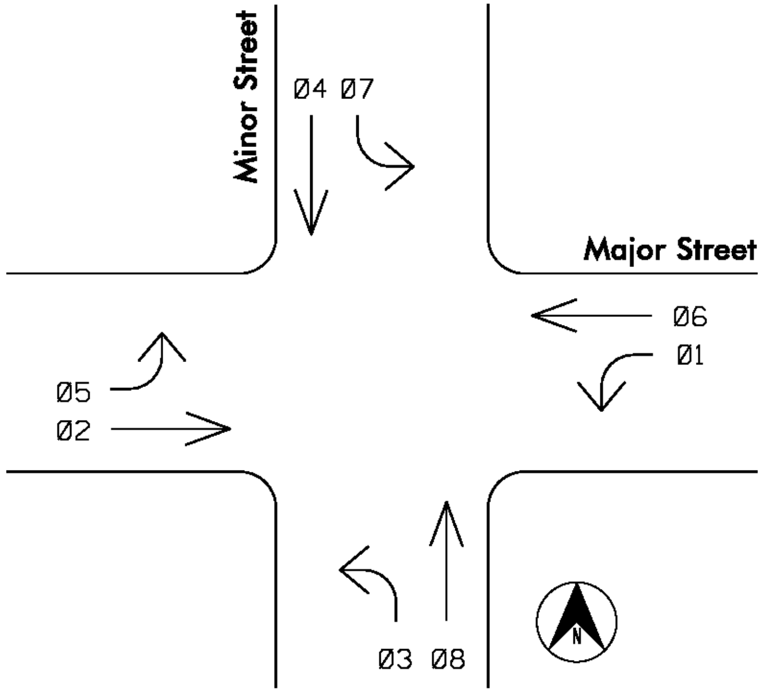
Numbering of NEMA Phases

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO.
2.0
SHEET 1 OF 4

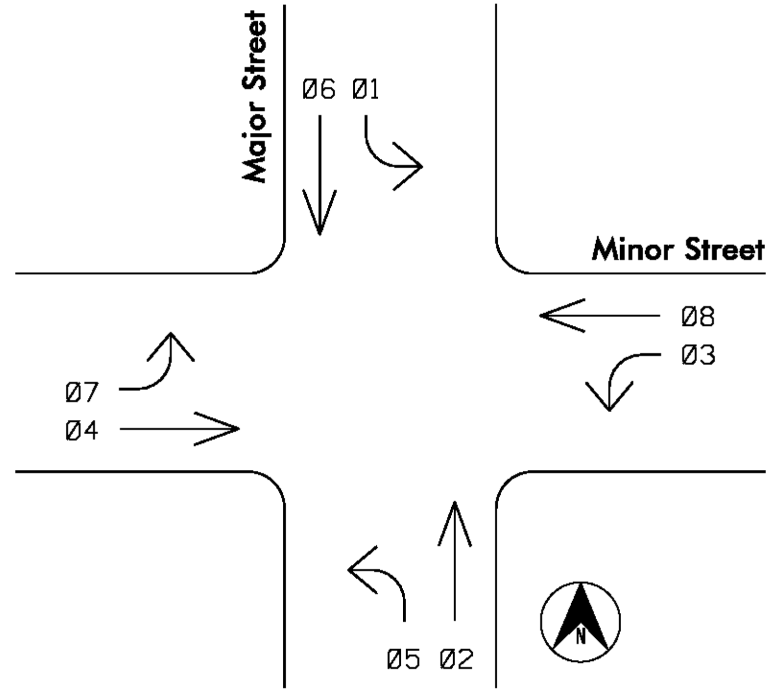
Standard NEMA Orientation
Dual Ring Cabinet
Major Street runs East–West



Phase Numbering

Phase 2 - Eastbound through movement
Phase 4 - Southbound through movement
Phase 6 - Westbound through movement
Phase 8 - Northbound through movement
Pair turning movements with the through movements if an exclusive left turn phase (protected or protected/permissive) is not used.
If location is being added to an existing system, match phase numbering to the system.

Standard NEMA Orientation
Dual Ring Cabinet
Major Street runs North–South



Phase Numbering

Phase 2 - Northbound through movement
Phase 4 - Eastbound through movement
Phase 6 - Southbound through movement
Phase 8 - Westbound through movement
Pair turning movements with the through movements if an exclusive left turn phase (protected or protected/permissive) is not used.
If location is being added to an existing system, match phase numbering to the system.

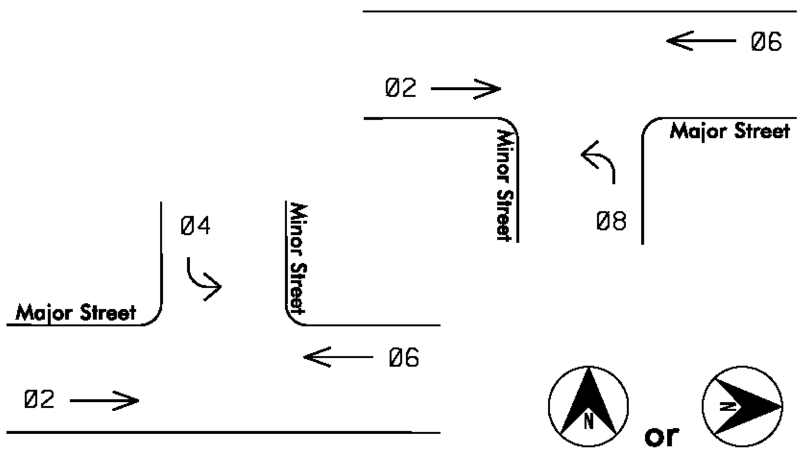
Numbering of NEMA Phases

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO.
2.0

Determining Movement Phase Numbers
Tee Intersections

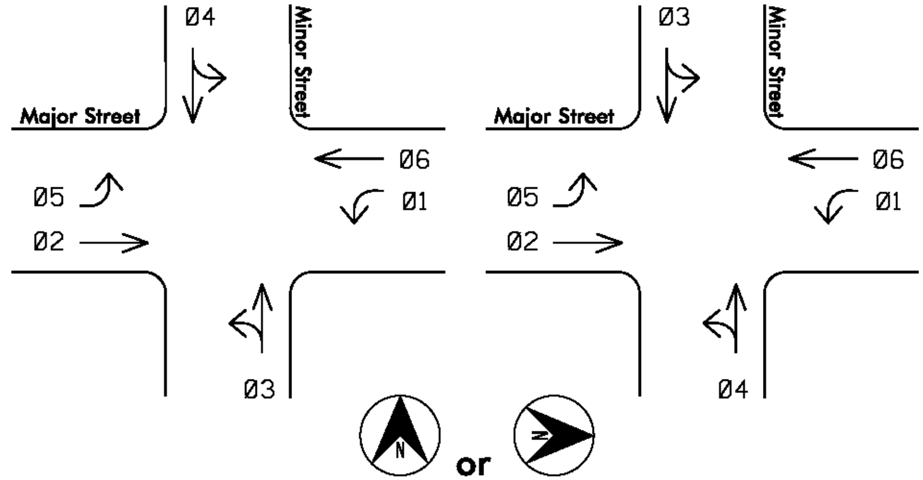


Phase Numbering

Movement numbering will conform to standard NEMA phasing shown on Sheet 1.
Phase 2 - Eastbound or Northbound through movement
Phase 4 - Southbound or Eastbound Stem of Tee movement
Phase 6 - Westbound or Southbound through movement
Phase 8 - Northbound or Westbound Stem of Tee movement

NOTE: For 2070 SE-PAC, there must be a phase in Ring 1 for phase 2 to operate. This means that there must be a phase 2 for phase 6 to operate and there must be a phase 4 if using phase 8. For Tee intersections on SE-PAC use phase 4 for the stem of the Tee.

Determining Movement Phase Numbers
Split Side Streets



Phase Numbering

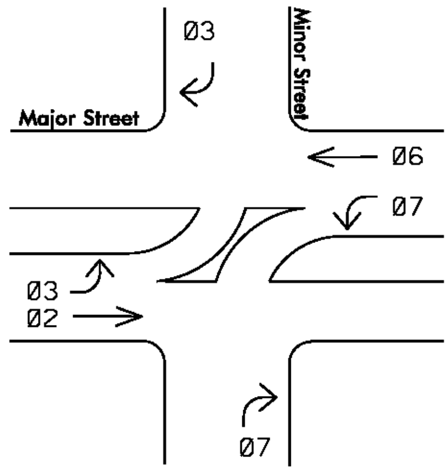
Main street movement numbering will conform to standard NEMA phasing shown on Sheet 1.
For side street movement numbering:
- If one approach is desired to be serviced first, label it phase 3 and the other approach phase 4.
- If there is no desire for either approach to be serviced first, label phase 4 for the eastbound or southbound movement and phase 3 for the westbound or northbound movement.

Numbering of NEMA Phases

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
2.0
SHEET 3 OF 4

Determining Superstreet Phase Numbers
Cross Intersections w/"Leftovers"



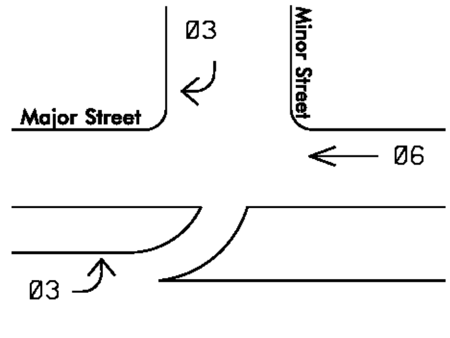
Phase Numbering

Main street through movement numbering will conform to standard NEMA phasing shown on Sheet 1.

For left turn and side street movement numbering:

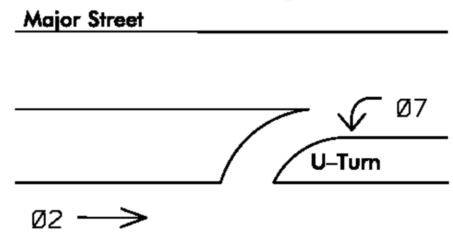
- Phase should be an odd number on the opposite side of NEMA barrier (3 or 7).
- Sum of phases used at a superstreet signal should total 9 (2+7=9 or 3+6=9).
- At a cross, each "pair" of movements should be controlled by separate controllers and cabinets to facilitate system coordination

Determining Superstreet Phase Numbers
U–Turn Only, Tee, or Unsignalized Right Turns



Phase 2 Unsignalized

Phase 6 Unsignalized



Phase Numbering

Main street through movement numbering will conform to standard NEMA phasing shown on Sheet 1.

No signal heads needed for through movement adjacent to left turn movement if there is no signalized conflicting movment.

For left turn movement numbering:

- Phase should be an odd number on the opposite side of NEMA barrier (3 or 7).
- Sum of phases used at a superstreet signal should total 9 (2+7=9 or 3+6=9).
- At a cross, each "pair" of movements should be controlled by separate controllers and cabinets to facilitate system coordination

Numbering of NEMA Phases

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

2–Phase
Dual–Ring Cabinet

PHASING DIAGRAM

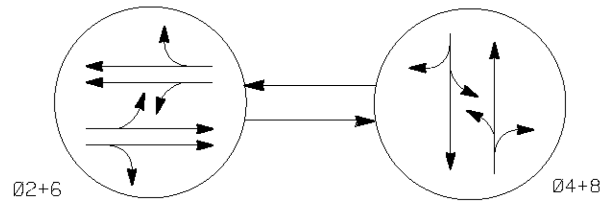


TABLE OF OPERATION			
SIGNAL FACE	PHASE		
	Ø2+6	Ø4+8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 2–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.1

SHEET 1 OF 1

3-Phase
Minimum Recall
Protected or Protected/Permissive
at Cross Intersection
Dual-Ring Cabinet

PHASING DIAGRAM

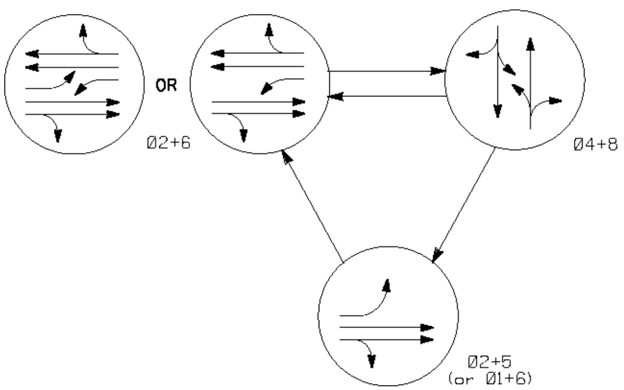


TABLE OF OPERATION

SIGNAL FACE	PHASE			
	Ø +	Ø 2 + 6	Ø 4 + 8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

3-Phase
Minimum Recall
Protected or Protected/Permissive
at Tee Intersection
Dual-Ring Cabinet

PHASING DIAGRAM

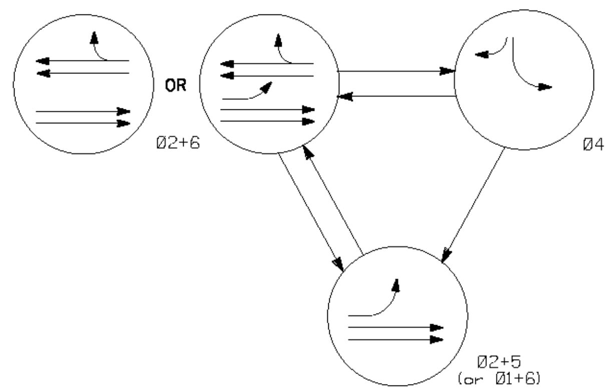


TABLE OF OPERATION

SIGNAL FACE	PHASE			
	Ø +	Ø 2 + 6	Ø 4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 3-Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

3-Phase
Minimum Recall
Split-Side Street
Dual-Ring Cabinet

PHASING DIAGRAM

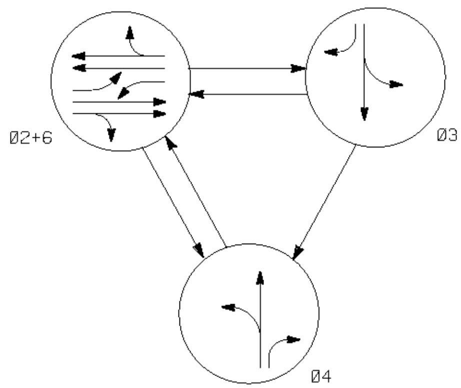


TABLE OF OPERATION				
SIGNAL FACE	PHASE			
	Ø2+6	Ø3	Ø4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

3-Phase
Minimum Recall
Lagging Left Operation
Protected or Protected/Permissive
at Tee Intersection
Dual-Ring Cabinet

PHASING DIAGRAM

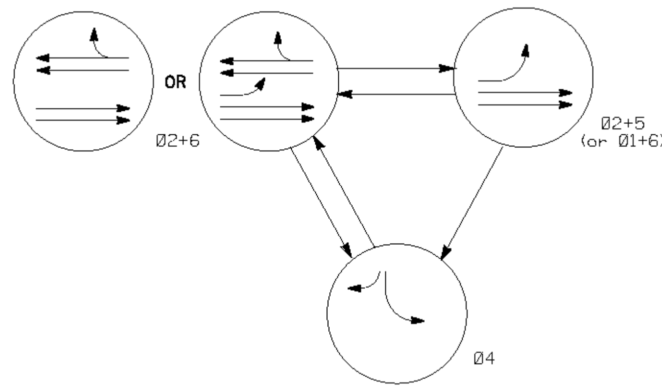


TABLE OF OPERATION				
SIGNAL FACE	PHASE			
	Ø2+6	Ø +	Ø4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 3-Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.2

4–Phase
Minimum Recall
Protected/Permissive Main Street
Split–Side Street
Dual–Ring Cabinet

PHASING DIAGRAM

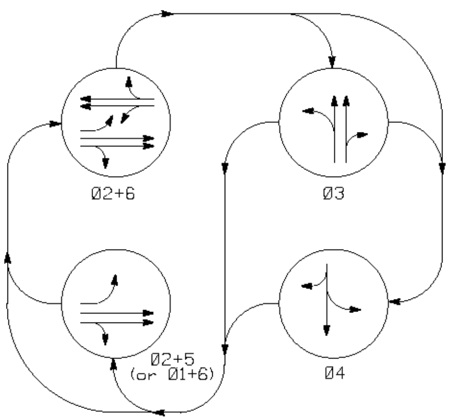


TABLE OF OPERATION					
SIGNAL FACE	PHASE				
	Ø +	Ø 2+6	Ø 3	Ø 4	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

4–Phase
Minimum Recall
Protected/Permissive Main Street
Protected/Permissive Side Street
Dual–Ring Cabinet

PHASING DIAGRAM

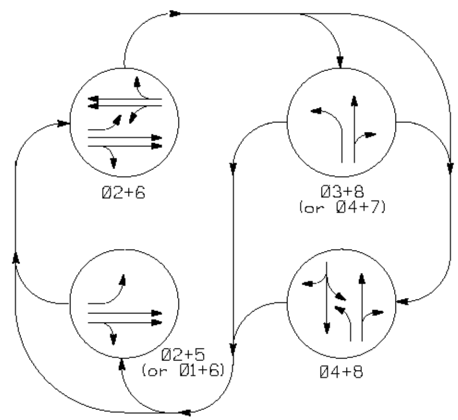


TABLE OF OPERATION					
SIGNAL FACE	PHASE				
	*	Ø 2+6	**	Ø 4+8	FLASH

Use appropriate omit note(s)

* Ø2+5 or Ø1+6 (Major Street Lefts)
** Ø3+8 or Ø4+7 (Minor Street Lefts)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 4–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

4–Phase
Minimum Recall
Protected Main Street
Split–Side Street
Dual–Ring Cabinet

PHASING DIAGRAM

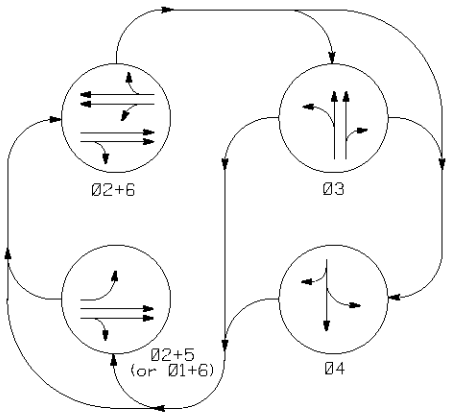


TABLE OF OPERATION					
	PHASE				
SIGNAL FACE	Ø +	Ø 2 + 6	Ø 3	Ø 4	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

4–Phase
Minimum Recall
Lead–Lag Operation
Dual–Ring Cabinet

PHASING DIAGRAM

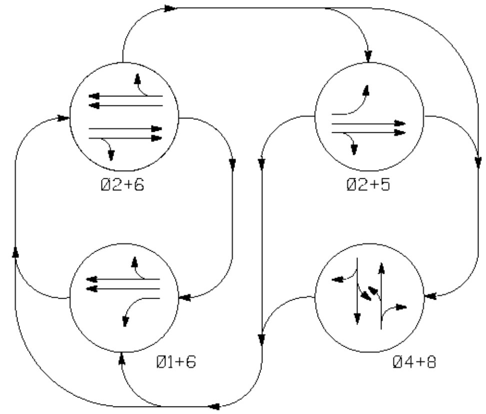


TABLE OF OPERATION					
	PHASE				
SIGNAL FACE	Ø 1 + 6	Ø 2 + 6	Ø 2 + 5	Ø 4 + 8	FLASH

With older controllers, the phase numbering may need to be modified

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 4–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
2.1.3

4–Phase
Soft Recall
Protected/Permissive Main Street
Split–Side Street
Dual–Ring Cabinet

PHASING DIAGRAM

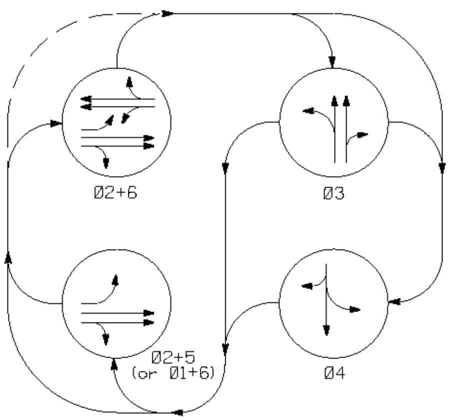


TABLE OF OPERATION

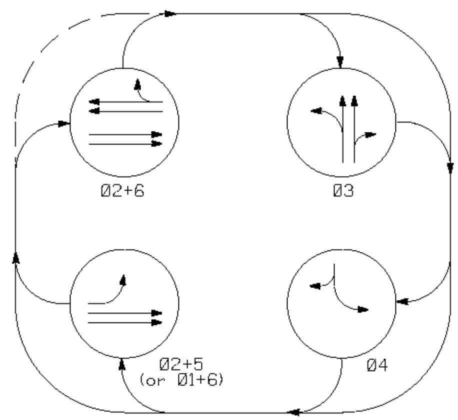
SIGNAL FACE	PHASE Ø +	Ø 2 + 6	Ø 3	Ø 4	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

4–Phase
Soft Recall
Protected Main Street
Split–Side Street
Dual–Ring Cabinet

PHASING DIAGRAM



Ø3 approach is one–way only

TABLE OF OPERATION

SIGNAL FACE	PHASE Ø +	Ø 2 + 6	Ø 3	Ø 4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 4–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.3

5–Phase
Minimum Recall
Protected/Permissive

PHASING DIAGRAM

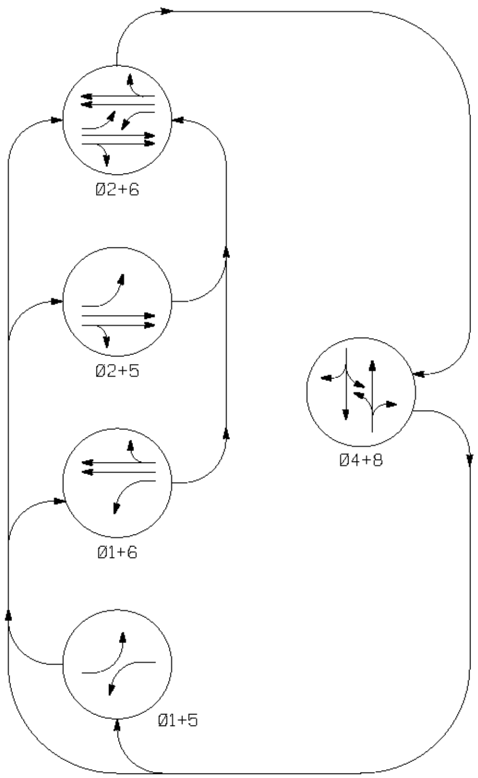


TABLE OF OPERATION

SIGNAL FACE	PHASE					
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø4+8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

5–Phase
Minimum Recall
Protected

PHASING DIAGRAM

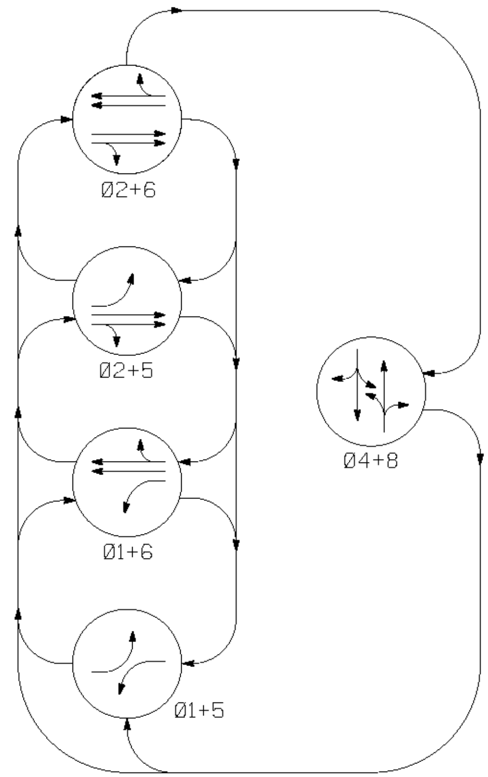


TABLE OF OPERATION

SIGNAL FACE	PHASE					
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø4+8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 5–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 2.1.4

5–Phase
Soft Recall
Protected

PHASING DIAGRAM

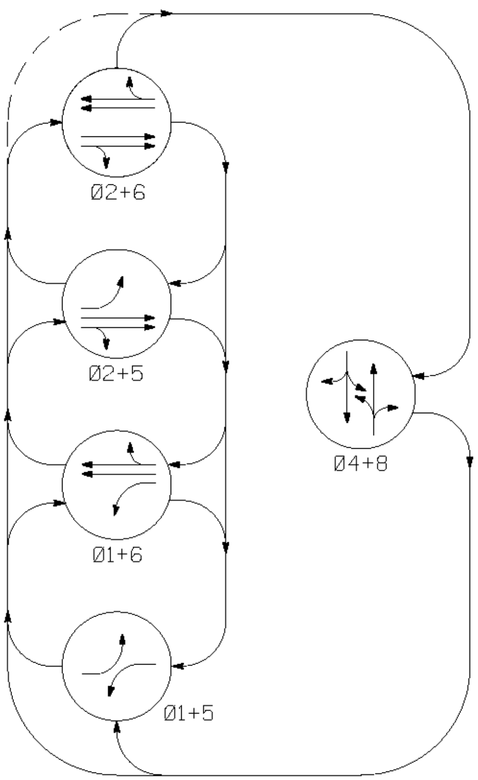


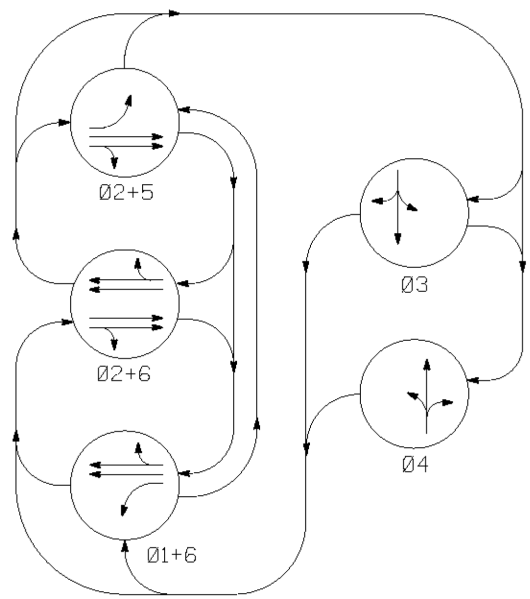
TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø4+8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

5–Phase
Minimum Recall
Lead–Lag Operation
Split Side Street

PHASING DIAGRAM



With older controllers, the phase numbering may need to be modified

TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+6	Ø2+6	Ø2+5	Ø3	Ø4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 5–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.4

6–Phase
Minimum Recall
Protected/Permissive Main Street
Split Side Street

PHASING DIAGRAM

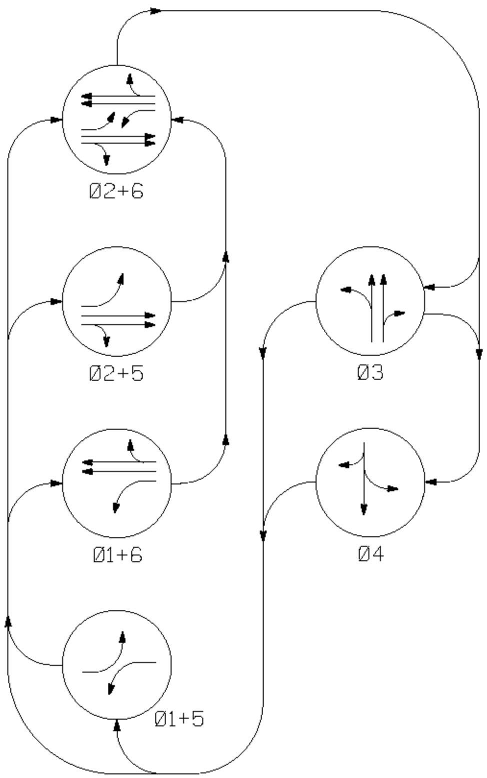


TABLE OF OPERATION

SIGNAL FACE	PHASE						
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3	Ø4	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

6–Phase
Minimum Recall
Protected/Permissive Main Street
Protected/Permissive Side Street

PHASING DIAGRAM

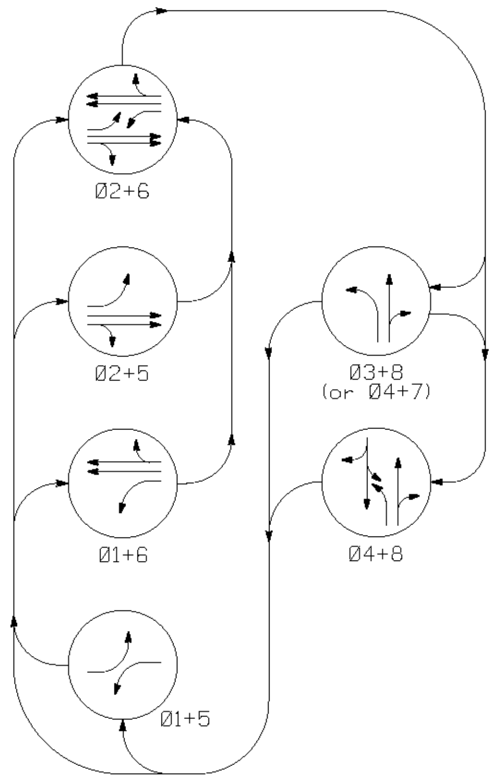


TABLE OF OPERATION

SIGNAL FACE	PHASE						
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø +	Ø4+8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 6–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.5

SHEET 1 OF 3

6–Phase
Minimum Recall
Protected Main Street
Split Side Street

PHASING DIAGRAM

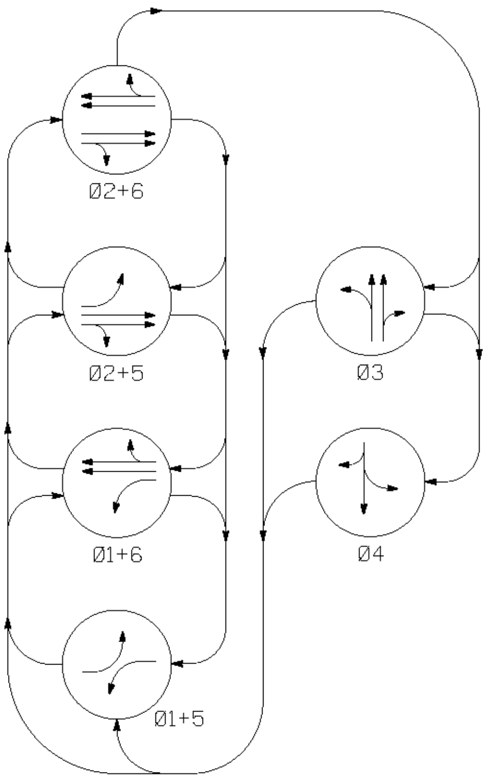


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø 1 + 5	Ø 1 + 6	Ø 2 + 5	Ø 2 + 6	Ø 3	Ø 4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

6–Phase
Minimum Recall
Protected Main Street
Protected/Permissive Side Street

PHASING DIAGRAM

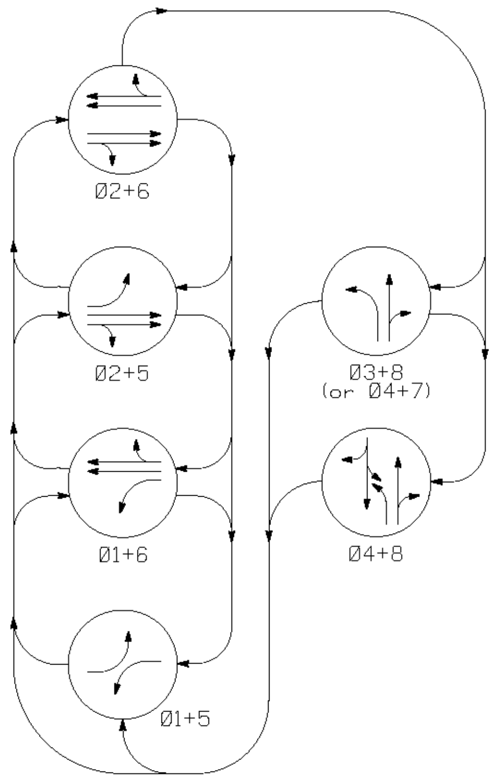


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø 1 + 5	Ø 1 + 6	Ø 2 + 5	Ø 2 + 6	Ø +	Ø 4 + 8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 6–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

6–Phase
Soft Recall
Protected Main Street
Split Side Street

PHASING DIAGRAM

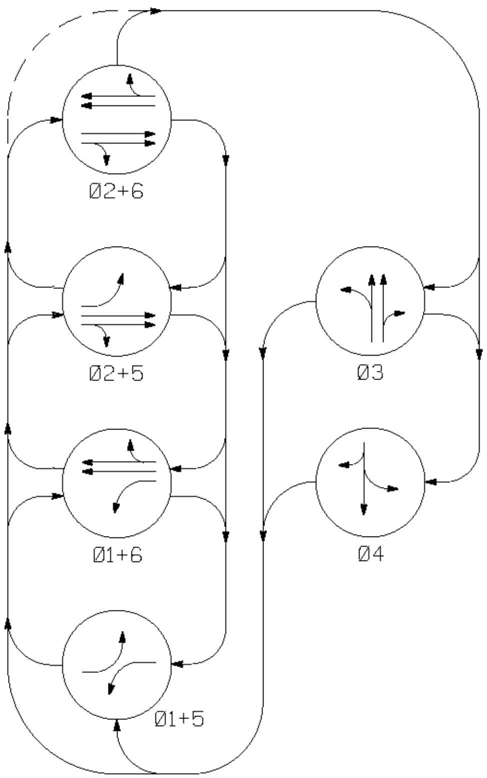


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3	Ø4	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

6–Phase
Soft Recall
Protected Main Street
Protected/Permissive Side Street

PHASING DIAGRAM

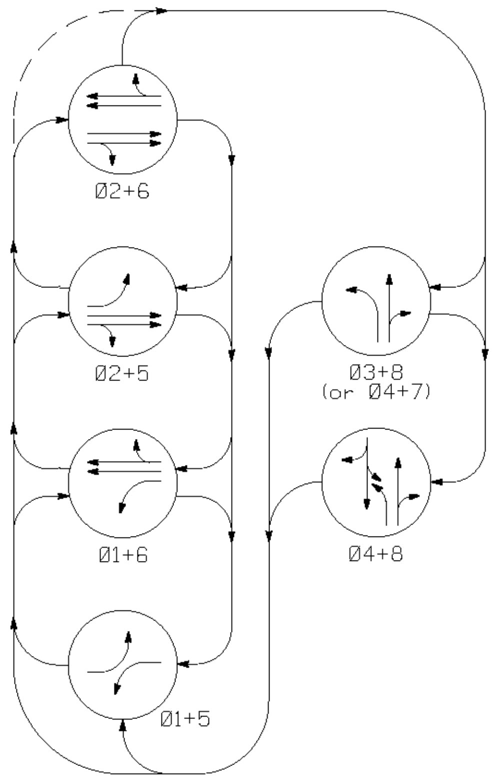


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø +	Ø4+8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 6–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 2.1.5

7-04

7–Phase
Minimum Recall
Lead–Lag Main Street

PHASING DIAGRAM

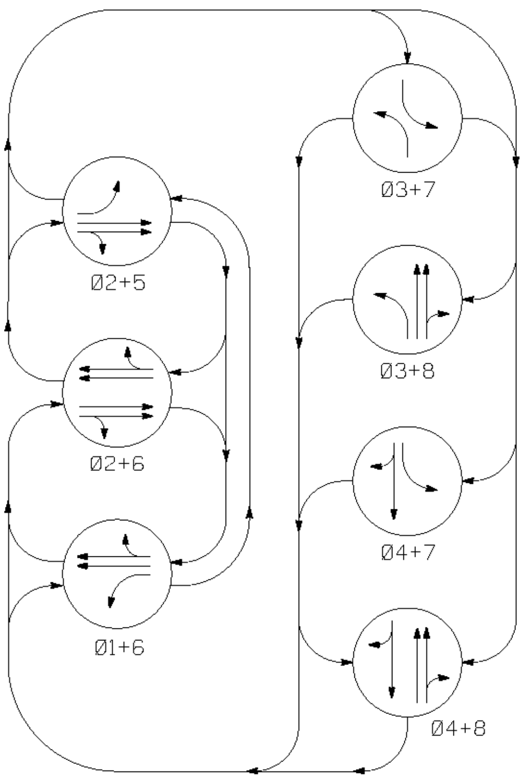


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+6	Ø2+6	Ø2+5	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

With older controllers, the phase numbering may need to be modified

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

7–Phase
Minimum Recall
Lead–Lag Side Street

PHASING DIAGRAM

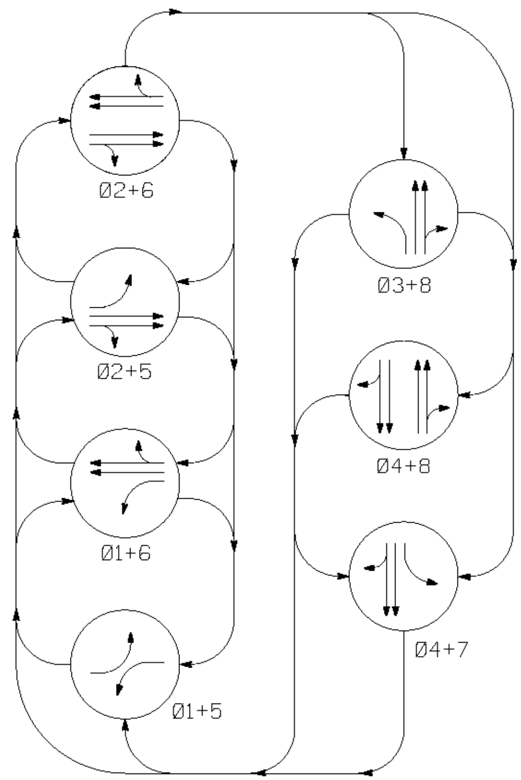


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+8	Ø4+8	Ø4+7	FLASH

With older controllers, the phase numbering may need to be modified

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 7–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.6

SHEET 1 OF 1

8–Phase
Minimum Recall
Protected/Permissive Main Street
Protected/Permissive Side Street

PHASING DIAGRAM

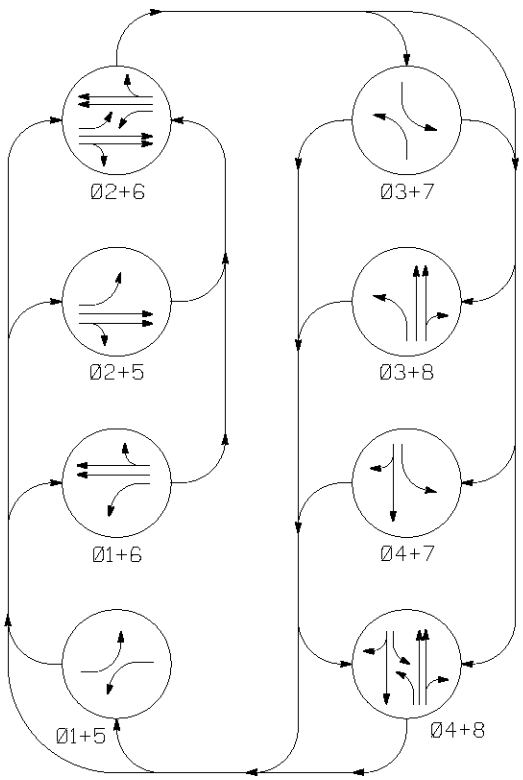


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

8–Phase
Minimum Recall
Protected/Permissive Main Street
Protected Side Street

PHASING DIAGRAM

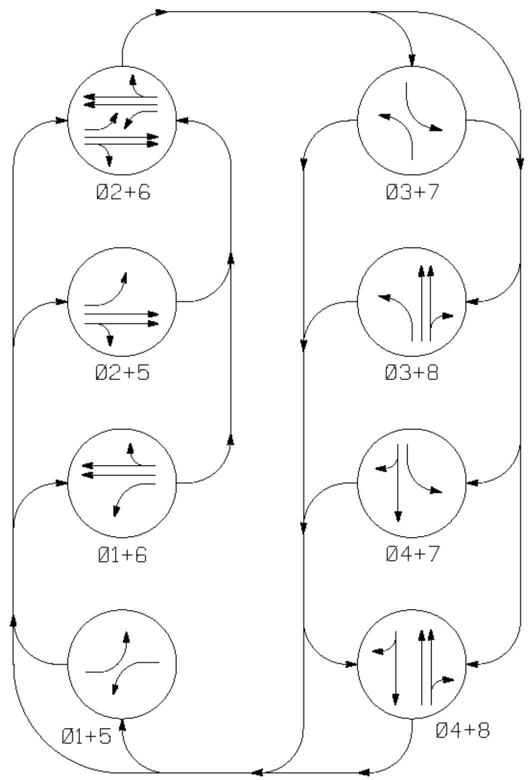


TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 8–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.7

8–Phase
Minimum Recall
Protected Main Street
Protected/Permissive Side Street

PHASING DIAGRAM

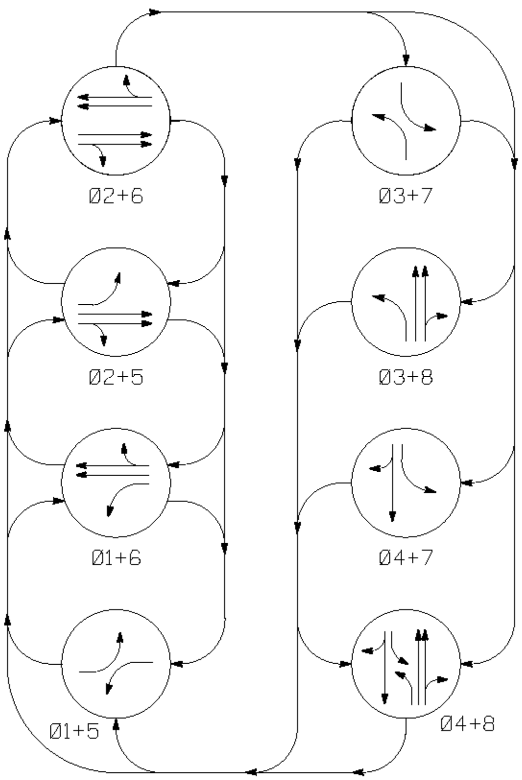


TABLE OF OPERATION

SIGNAL FACE	PHASE								
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

8–Phase
Minimum Recall
Protected Main Street
Protected Side Street

PHASING DIAGRAM

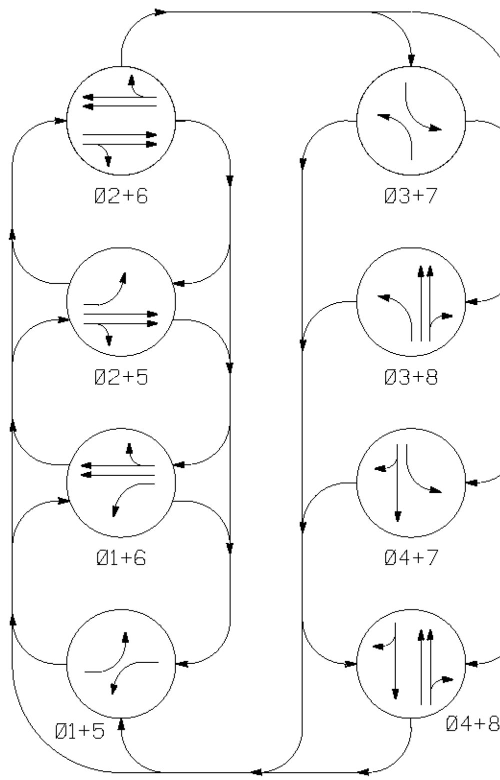


TABLE OF OPERATION

SIGNAL FACE	PHASE								
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 8–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

8–Phase
Minimum Recall
Protected and Protected/Permissive Main Street
Protected and Protected/Permissive Side Street

PHASING DIAGRAM

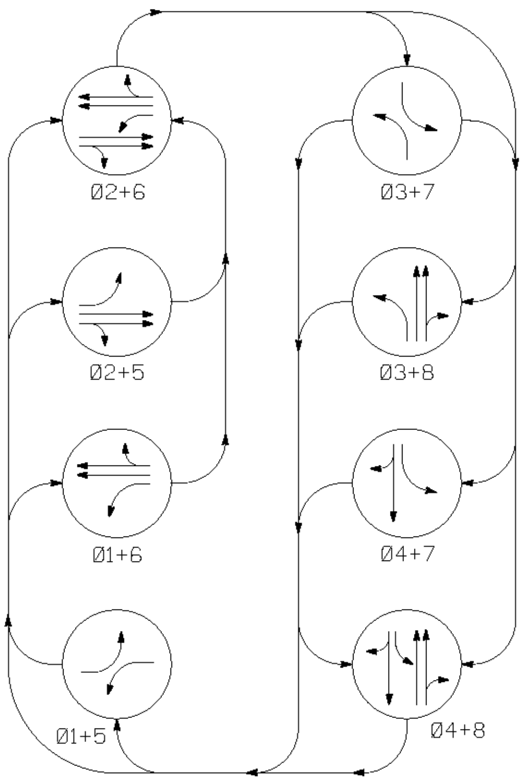


TABLE OF OPERATION

SIGNAL FACE	PHASE								
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

Use appropriate omit note(s)

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

8–Phase
Soft Recall
Protected Main Street
Protected Side Street

PHASING DIAGRAM

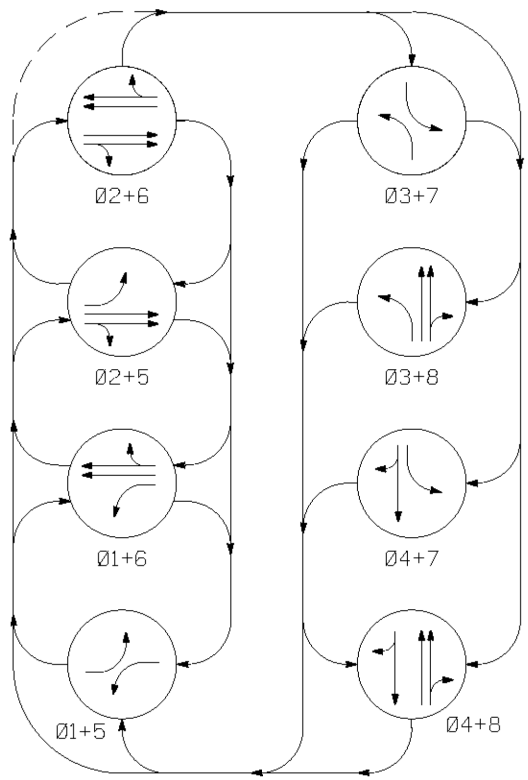


TABLE OF OPERATION

SIGNAL FACE	PHASE								
	Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø3+7	Ø3+8	Ø4+7	Ø4+8	FLASH

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: 8–Phase Operation

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 2.1.7

The use of Dallas Phasing is prohibited in the 2009 MUTCD.

This page has been removed from the Design Manual.

Dallas Left Turn Phasing

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO.
2.2

SHEET 1 OF 1

Red Revert Backup Protection

Yellow Trap and Dynamic Backup Control

A "yellow trap" occurs when a traffic signal cycles directly from concurrent through phases to a fully protected phase opposing a permitted phase (also known as "backing up"). This situation is avoided in a signal design whenever possible. Typically, phase omits or forcing the signal to cycle through the side street (even if there are no vehicle calls) to serve the protected phase have been used to protect against a "yellow trap."

Red Revert

Red revert is a feature in 2070 Oasis software that allows the signal to cycle from a permissive left turn phase on the major street to a protected phase and avoid a "yellow trap." Red revert simulates an all red "dummy" phase by clearing the through phase(s) to red for a brief interval before cycling to the adjacent protected left turn phase and then returning to green again; the opposing through phase will stay red for the duration of the protected turning phase.

The time that the adjacent through phase displays red before returning to green is a function of the red revert time. Typically the red revert time is programmed to (at least) 5 seconds to avoid the appearance of improper operation.

Conditions for Use

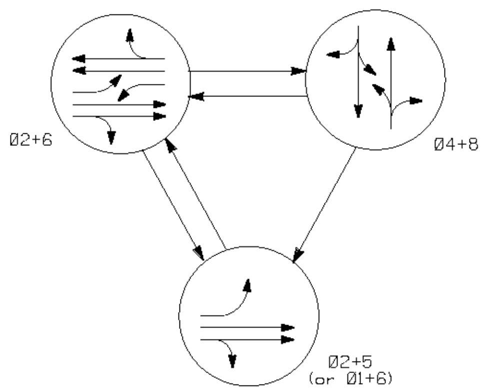
1. Used only with 2070 Oasis Software
2. Cannot be used with NEMA TS-1, TS-2, 170, or other 2070 software (such as SE-PAC, NAZTEC, or the Cary Signal System)
3. Used only on the major street (phases 2+6)
4. May be used when there is one or two protected/ permissive phases (1 and/or 5) on the major street
5. Use in conjuncion with 5 section (doghouse) heads.
6. Use in place of phase omit and clearing through the side street.
7. Do NOT use with Railroad Preemption if the major street is the approach that crosses the tracks and is used in the Track Clearance Phase.

When Used On Plans:

-Typically set red revert time for phase 2 (and/or 6) to 5.0 seconds.
-Default red revert time for all other phases is 2.0 seconds.
-Use the following note on plans:
Enable backup protect for phase 2 (and/or 6) to allow the controller to clear from phase 2+6 to phase 2+5 (and/or 1+6) by progressing though an all red display.

3 Phase
Minimum Recall
Protected/Permissive Left One Direction
Permissive Only Left Other Direction

PHASING DIAGRAM

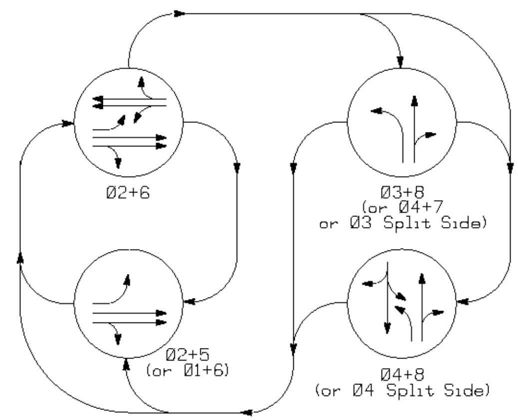


Use Red Revert for Phase 2 (6 if 1+6 is used)

NOTE: TRAFFIC MOVEMENTS ARE
SHOWN FOR ILLUSTRATIVE
PURPOSES ONLY

4 Phase
Minimum Recall
Protected/Permissive Left One Direction of Major Street
Permissvie Left on Other Direction of Major Street
Protected/Permissive Side Street
OR Split Side Street

PHASING DIAGRAM



Use Red Revert for Phase 2 (6 if 1+6 is used)
Use appropriate omit note(s) for side street

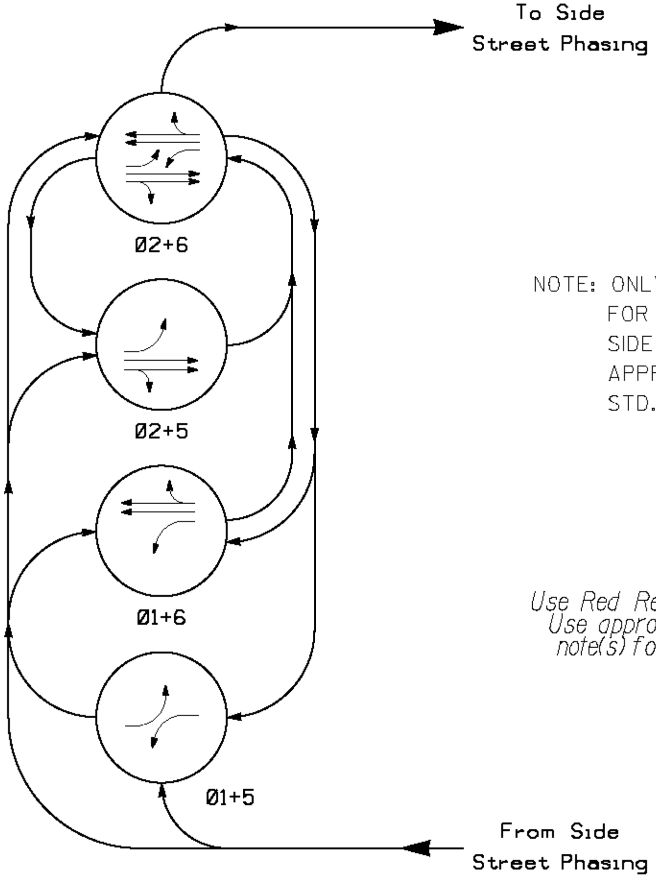
NOTE: TRAFFIC MOVEMENTS ARE
SHOWN FOR ILLUSTRATIVE
PURPOSES ONLY

Phasing Typicals: Red Revert Operation

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

5-8 Phase
Minimum Recall
Protected/Permissive Main Street w/Red Revert

PHASING DIAGRAM



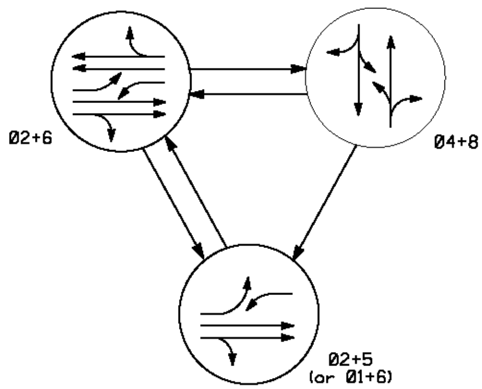
NOTE: ONLY PHASING DIAGRAM FOR MAJOR IS SHOWN. FOR SIDE STREET PHASING, SEE APPROPRIATE PHASING IN STD. 2.1.

Use Red Revert for Phases 2 and 6
Use appropriate omit or lead/lag note(s) for side street as needed

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

3 Phase
Minimum Recall
Protected/Permissive Left One Direction
Permissive Only Left Other Direction

PHASING DIAGRAM



Phase 5 may be lagged (Phase 1 if 1+6 is used)

THIS ASSUMES A 4 SECTION FYA IS USED FOR THE LEFT TURN ON ONE APPROACH (PHASE 5) AND A 3 SECTION FYA IS USED FOR THE LEFT TURN ON THE OTHER APPROACH OF MAIN STREET

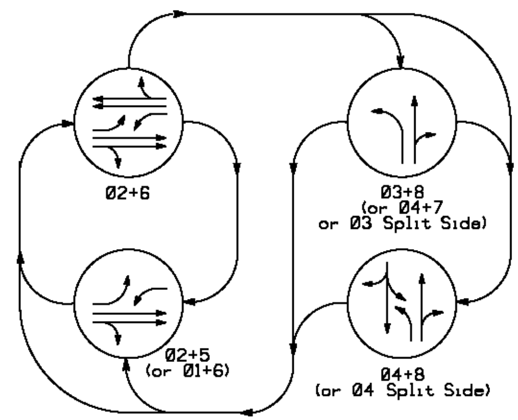
NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

TABLE OF OPERATION

SIGNAL FACE	PHASE Ø2+5	Ø2+6	Ø4+8	FLASH
51	←	←FY	←R	←Y
61	←FY	←FY	←R	←Y

4 Phase
Minimum Recall
Protected/Permissive Left One Direction of Main Street
Permissvie Left on Other Direction of Main Street
Protected/Permissive Side Street
OR Split Side Street

PHASING DIAGRAM



Phase 5 may be lagged (Phase 1 if 1+6 is used)

THIS ASSUMES A 4 SECTION FYA IS USED FOR THE LEFT TURN ON ONE APPROACH (PHASE 5) AND A 3 SECTION FYA IS USED FOR THE LEFT TURN ON THE OTHER APPROACH OF MAIN STREET

NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

TABLE OF OPERATION

SIGNAL FACE	PHASE Ø2+5	Ø2+6	Ø3+8	Ø4+8	FLASH
51	←	←FY	←R	←R	←Y
61	←FY	←FY	←R	←R	←Y

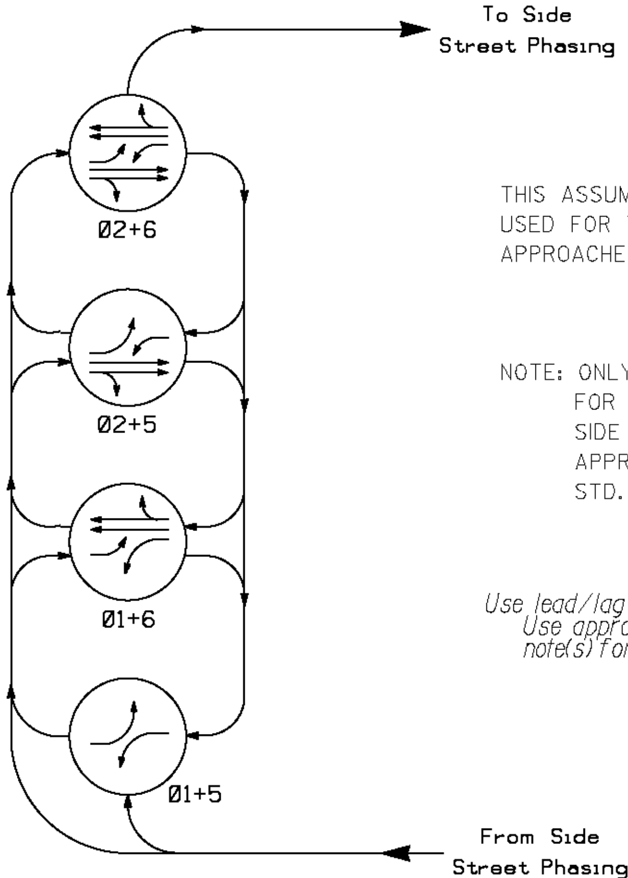
Phasing Typicals: Flashing Yellow Arrow

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 2.4
SHEET 1 OF 2

5-8 Phase
Minimum Recall
Protected/Permissive Main Street

PHASING DIAGRAM



THIS ASSUMES A 4 SECTION FYA IS USED FOR THE LEFT TURN ON BOTH APPROACHES OF THE MAIN STREET

NOTE: ONLY PHASING DIAGRAM FOR MAJOR IS SHOWN. FOR SIDE STREET PHASING, SEE APPROPRIATE PHASING IN STD. 2.1.

Use lead/lag notes for Phases 1 and 5
Use appropriate omit or lead/lag note(s) for side street as needed

TABLE OF OPERATION

SIGNAL FACE	PHASE Ø1+5	Ø1+6	Ø2+5	Ø2+6	Ø4+8	FLASH
11	←	←	←FY	←FY	←R	←Y
51	←	←FY	←	←FY	←R	←Y

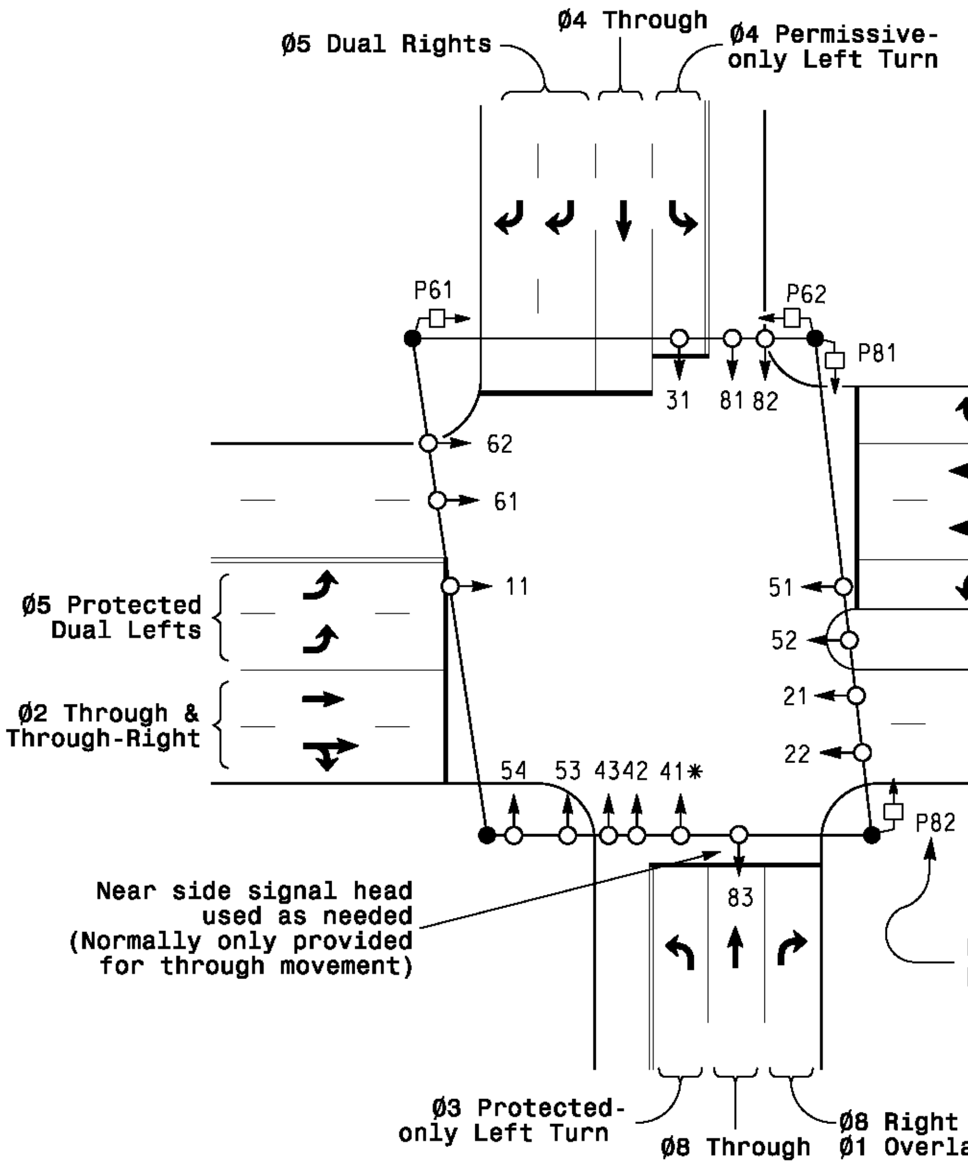
NOTE: TRAFFIC MOVEMENTS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY

Phasing Typicals: Flashing Yellow Arrow

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

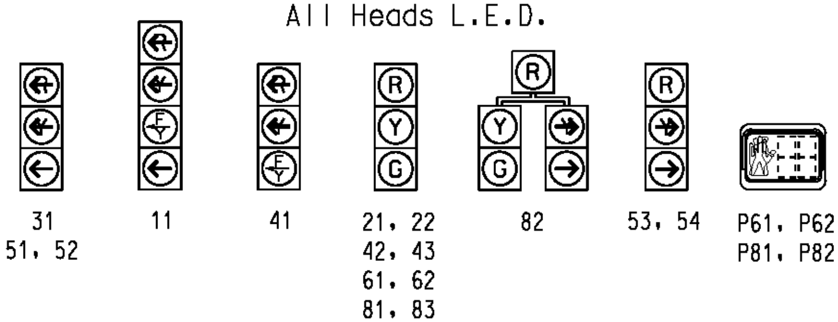
12-10

STD. NO.
2.4
SHEET 2 OF 2



SIGNAL FACE I.D.

All Heads L.E.D.



Typically signal heads are labeled according to their right-of-way phase (first digit) and from inside to outside (second digit). Five section heads are labeled according to their permissive phase.

* If signal head 41 is not used or not required, it may be omitted. The left turn would be controlled by the shared green balls of the through movement. Signal heads 42 and 43 should then be heads 41 and 42, respectively.

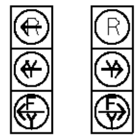
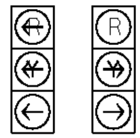
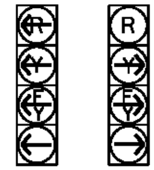
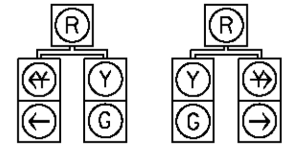
Typical Numbering of Signal Heads

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO.
3.0
SHEET 1 OF 6

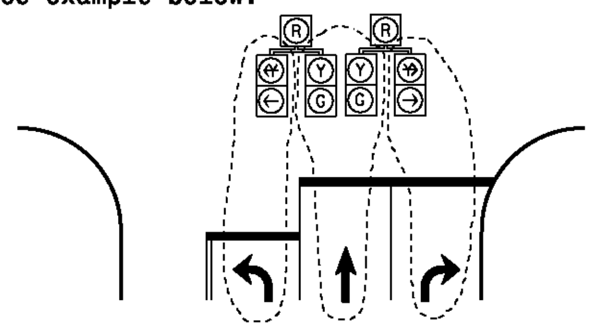
Signal Head Types

CONFIGURATION	 3-Section	 3-Section	 3-Section	 4-Section Vertical	 4-Section	 5-Section
USAGE	All situations where other signal heads are not recommended	Permitted Turn	Protected Turn	Split Side Street RR Clearance Phasing EV Preempt Phasing	Protected/ Permissive Turn	Protected/ Permissive Turn
PLACEMENT	Lane Line or Lane ℄	Lane ℄	Lane ℄	Lane Line or Lane ℄	Lane ℄	Lane Line

Number of Signal Faces

A minimum of two signal faces is required for the through movement. This total includes the through signal face belonging to the 5-section "shared" head that may control adjacent left or right turn lanes.

Clarification: A 5-section head is an assembly of 2 signal faces which share a common red ball indication. See example below.



This approach display has 2 signal heads each of which is comprised of 2 signal faces for a total of 4 signal faces. Two of the faces belong to the through move, and one each belongs to the left and right turns. Because the center two faces control the through (major) move, it is in conformance with the above requirement.

Per Section 4D.11 of the 2009 MUTCD, if the 85th percentile, posted, statutory, or design speed is 45 MPH or more, one signal head should be used per each through lane on the approach.

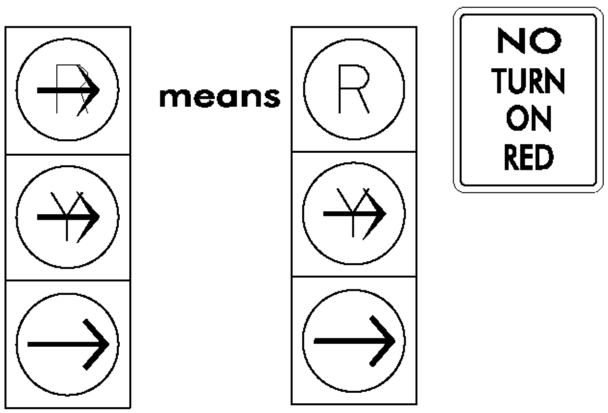
Use of CIRCULAR RED vs. RED ARROW

(Section 4D.04 of the 2009 MUTCD)

As stated in the MUTCD, and in accordance with NC General Statute 20-158, vehicles facing a steady CIRCULAR RED signal shall stop at the marked stop line and shall remain stopped until a signal indication to proceed is displayed unless the vehicle is turning right. A vehicle is permitted to make a right on CIRCULAR RED, subject to applicable traffic laws and yielding the right of way to other roadway users, unless a traffic control device, such as a sign, is in place prohibiting a turn on red.

As stated in the MUTCD, vehicles facing a steady RED ARROW signal shall stop at the marked stop line and shall remain stopped until a signal indication to proceed is displayed. A vehicle shall NOT make a right turn on a RED ARROW.

In North Carolina, vehicles are prohibited from making a left turn on red from a one way street onto another one way street at all times.



It shall be the NCDOT practice to display a CIRCULAR RED whenever possible and allow right turns on red. This may include the use of a CIRCULAR RED indication in a head otherwise containing GREEN and YELLOW ARROWs.

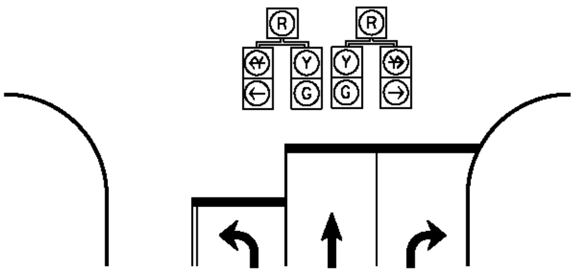
If it is intended to prohibit right turns on red at an intersection, one of the following shall be displayed:

- If the signal head contains CIRCULAR YELLOW and GREENs, a CIRCULAR RED shall be used in conjunction with a "NO TURN ON RED" sign (R10-16).
- If the signal head only has YELLOW and GREEN ARROWs, a RED ARROW shall be used. No sign is needed as a RED ARROW means no turn on red.

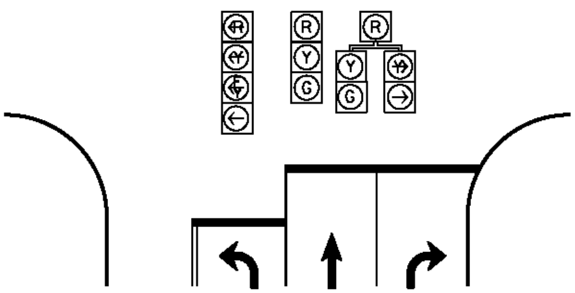
Use of 4 Section (Protected/Permissive) Flashing Yellow Arrow Signal Faces

Traditionally, a 5 section "doghouse" head has been used for protected/permissive turning movements. This head has a combination of CIRCULAR and ARROW displays, and is often used as "shared" head between the turning movement and the through movement, although the head could be used exclusively for the turning movement.

The new preferred display for protected/permissive left turns is the Flashing Yellow Arrow (FYA). This head is intended to be an exclusive head for the turn lane and displays only ARROW indications. A FYA is displayed for the permissive movement, instead of the traditional CIRCULAR GREEN. Vehicles may make the turn indicated by the FYA after yielding to pedestrians and conflicting movements. A solid GREEN ARROW is used to indicated a protected movement. The FYA head should be centered over the turn lane(s). Note that the FYA head is an exclusive for the left turn, and 2 signal heads containing CIRCULAR RED, YELLOW, and GREEN displays are still required for the through movement.



This approach display has 2 signal heads each of which is comprised of 2 signal faces for a total of 4 signal faces. Two of the faces belong to the through move, and one each belongs to the left and right turns. Because the center two faces control the through (major) move, it is in conformance with the requirement for 2 signal faces for the through movment. The 5 section head may still be used in limited situations.



FYAs for left turns should be used:

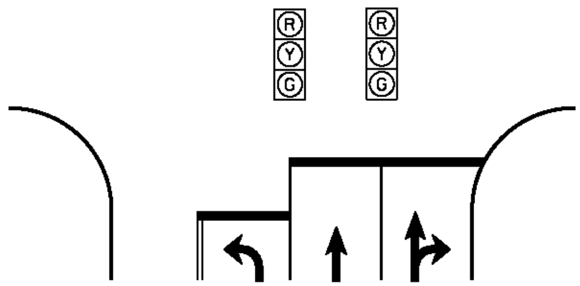
- When the turn lanes are offset (separated from the through lanes)
- When the opposing travel lanes use (3-section or 4-section) FYAs or fully protected (single or dual) lefts to avoid "yellow trap"
- Along corridors, where other FYA displays are used for left turns
- At Railroad preempt locations, which eliminate the need for blankout signs

When FYAs are used for left turns, the yellow and red clearance times should be the same for concurrent through phases (2+6 and/or 4+8).

NOTE: FYAs for right turns may be used on a limited basis as determined by Engineering judgment. When used, the FYA head should replace the 5 section shared "doghouse" head for the right turn. As a result, it may be necessary to add an addtional 3 section CIRCULAR head for the through movement.

Use of 3–Section (Permissive) Left Turn Flashing Yellow Arrow Signal Faces

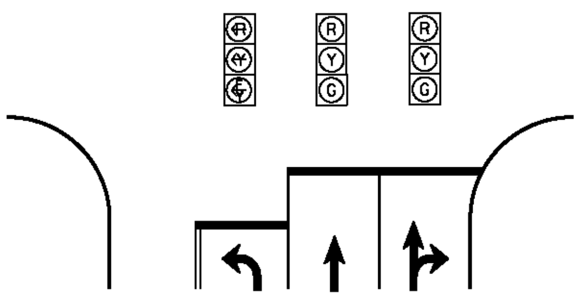
Traditionally, a CIRCULAR GREEN display has been used to indicate a permissive movement. Vehicles may turn right or left as allowed on a CIRCULAR GREEN after yielding to pedestrians and conflicting movements.



A CIRCULAR GREEN may be used as a shared display with the through movement. In the example shown, the signal heads are mounted over the lane lines (extended) and are classified as shared heads, because the head display is "shared" by vehicles in adjacent lanes (left and through or the through and through-right). The two "shared" heads meet the requirements for through signal displays. When an FYA is not used for the left turn display, the signal heads should be mounted over the lane line extended instead of as shown in Std. 3.2. IN NO CASE shall a CIRCULAR GREEN display be located directly over or in front of a left turn lane.

Optional Permissive Left Turn Signal Display

An optional display for permissive turns is the Flashing Yellow Arrow (FYA). Vehicles observing an FYA may make the turn indicated by the flashing yellow arrow after yielding to pedestrians and conflicting movements, the same as a CIRCULAR GREEN. The FYA head should be centered over the turn lane(s). Note that the FYA is an exclusive head for the left turn, and 2 signal heads containing CIRCULAR RED, YELLOW, and GREEN displays are still required for the through movement.



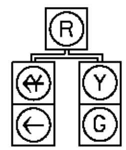
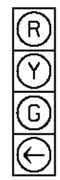
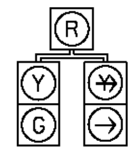
FYAs for left turns should be used:
- When the turn lanes are offset (separated from the through lanes)
- When the opposing travel lanes use (3-section or 4-section) FYAs or fully protected (single or dual) lefts to avoid "yellow trap"
- Along corridors, where other FYA displays are used for left turns
- At Railroad preempt locations, which eliminate the need for blankout signs

When FYAs are used for left turns, the yellow and red clearance times should be the same for concurrent through phases (2+6 and/or 4+8).

FYAs for right turns may be used on a limited basis as determined by Engineering judgment.

Programming for Flashing Operation of Signal Heads

Signals typically may flash during certain types of malfunctions or equipment failures. For statewide consistency, traffic signal heads should be set to flash the displays shown in the event of flashing operation:

SIGNAL HEAD										
MAJOR STREET	←R	←Y	Y	Y	←Y	Y	Y→	Y	Y→	Y→
MINOR STREET	←R	←R	R	R	←R	R	R	R	R	R

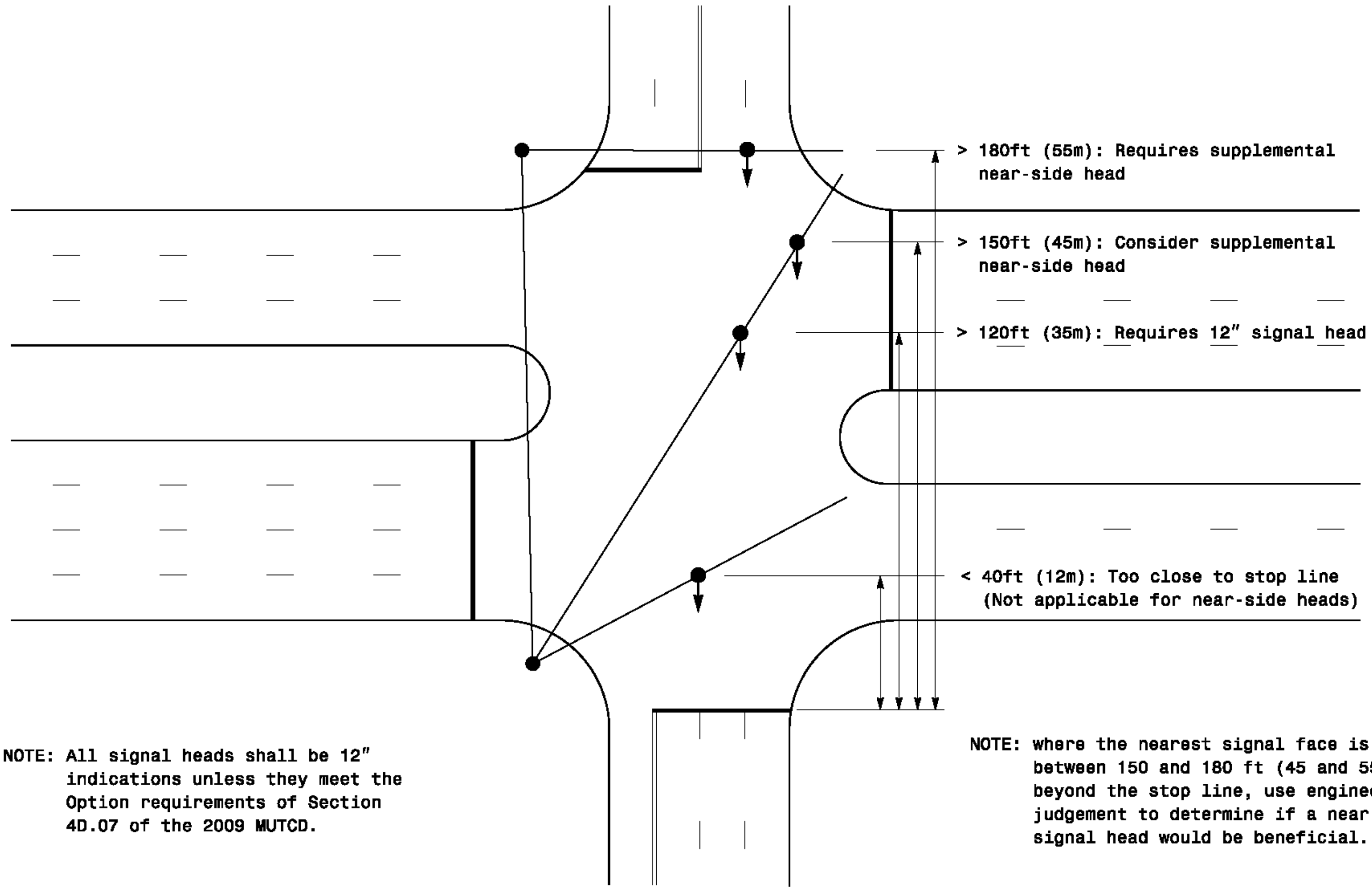
Flashing display does not change if a RED ARROW is used in place of a CIRCULAR RED for right turn displays.

At some intersections, such as those utilizing Railroad Preemption, engineering judgement may be used to modify or alter the flashing operation. This modification may include flashing the minor street through movements yellow and the main street red or using a red flash on all approaches (equivalent of an all way stop).

Program all signal heads on the same approach to flash concurrently.

Allowable Signal Head Distance from Stopbar

(Section 4D.14 of the 2009 MUTCD)



NOTE: All signal heads shall be 12″ indications unless they meet the Option requirements of Section 4D.07 of the 2009 MUTCD.

NOTE: where the nearest signal face is located between 150 and 180 ft (45 and 55 m) beyond the stop line, use engineering judgement to determine if a near side signal head would be beneficial.

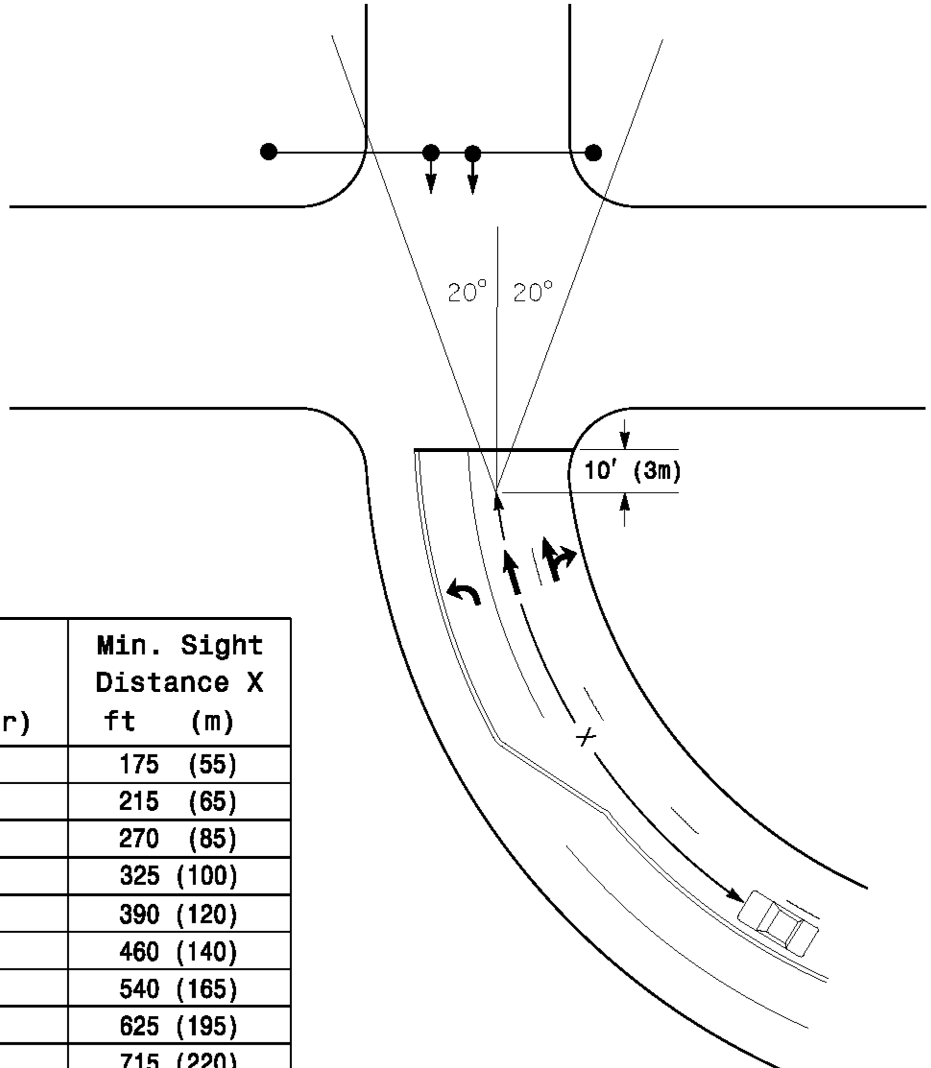
MUTCD Requirements for Signal Heads

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO. 3.1

Signal Face Visibility Parameters



Speed mph (km/hr)	Min. Sight Distance X ft (m)
20 (32)	175 (55)
25 (40)	215 (65)
30 (48)	270 (85)
35 (56)	325 (100)
40 (64)	390 (120)
45 (72)	460 (140)
50 (80)	540 (165)
55 (88)	625 (195)
60 (96)	715 (220)

To conform to section 4D.13 of the 2009 MUTCD, locate one, and preferably both, signal heads within a cone of vision extending 20 degrees to the left and right of the centerline of all the approach lanes in the direction of travel.

To conform to section 4D.12 of the 2009 MUTCD, the driver should be able to continuously view the signal face from the minimum sight distance for the 85th percentile speed.

Where this visibility requirement cannot be met, erect a suitable sign (such as a Signal Ahead Sign) to warn approaching traffic (Section 4D.12 of the 2009 MUTCD) or install a supplemental near side head.

MUTCD Requirements for Signal Heads

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.1

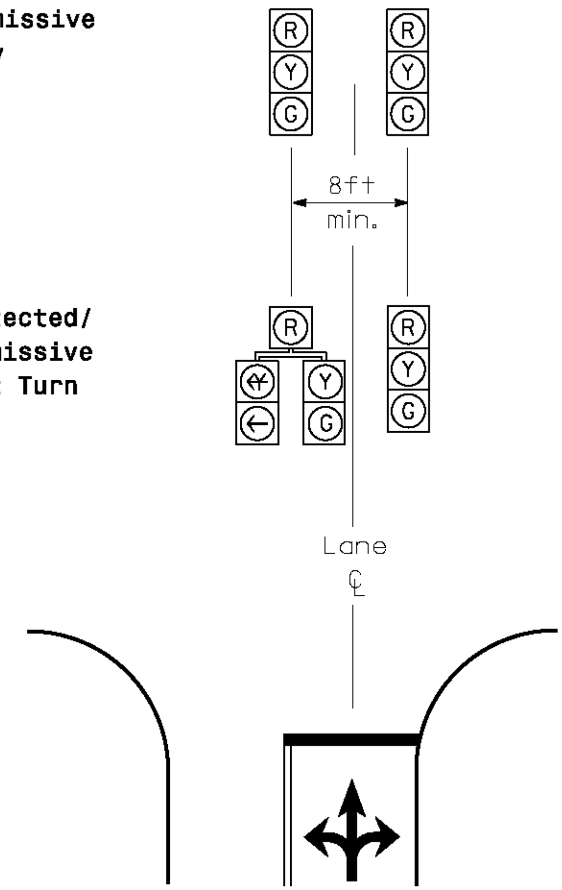
SHEET 2 OF 2

CASE 1

Standard Main or Side Street Signal Head Configuration

1A - Permissive Only

1B - Protected/ Permissive Left Turn



CASE 2

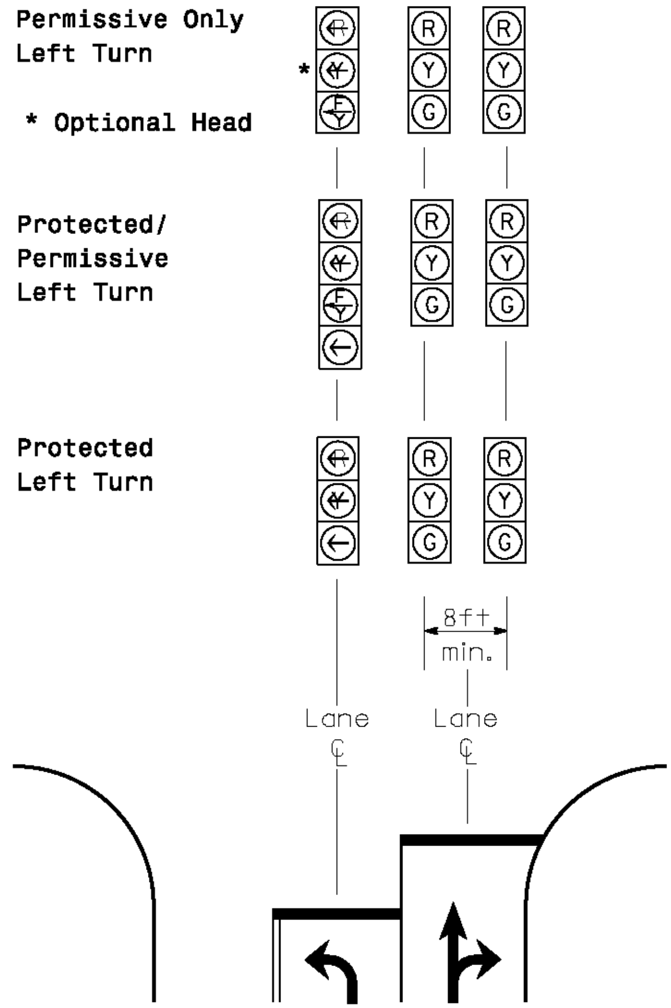
Standard Main or Side Street Signal Head Configuration

2A - Permissive Only Left Turn

* Optional Head

2B - Protected/ Permissive Left Turn

2C - Protected Left Turn



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

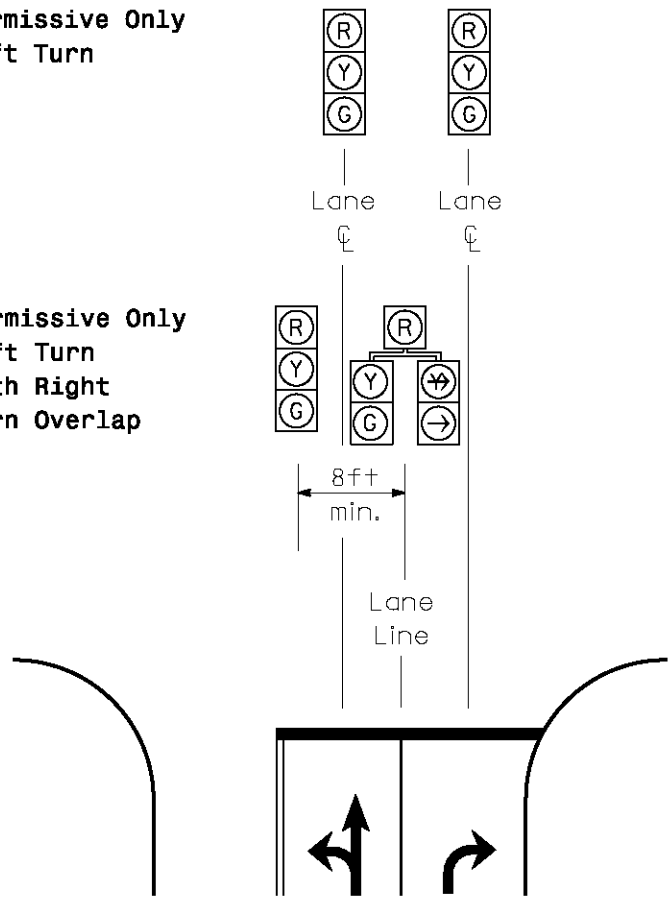
STD. NO. 3.2

CASE 3 (1 OF 2)

Standard Main or Side Street Signal Head Configuration

3A - Permissive Only Left Turn

3AR - Permissive Only Left Turn with Right Turn Overlap

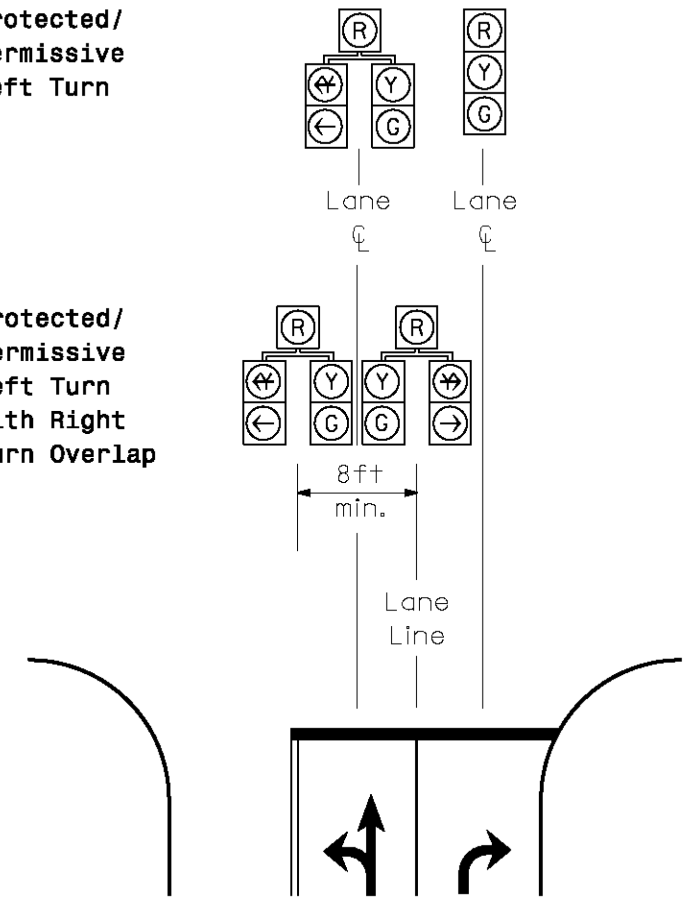


CASE 3 (2 OF 2)

Standard Main or Side Street Signal Head Configuration

3B - Protected/ Permissive Left Turn

3BR - Protected/ Permissive Left Turn with Right Turn Overlap



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

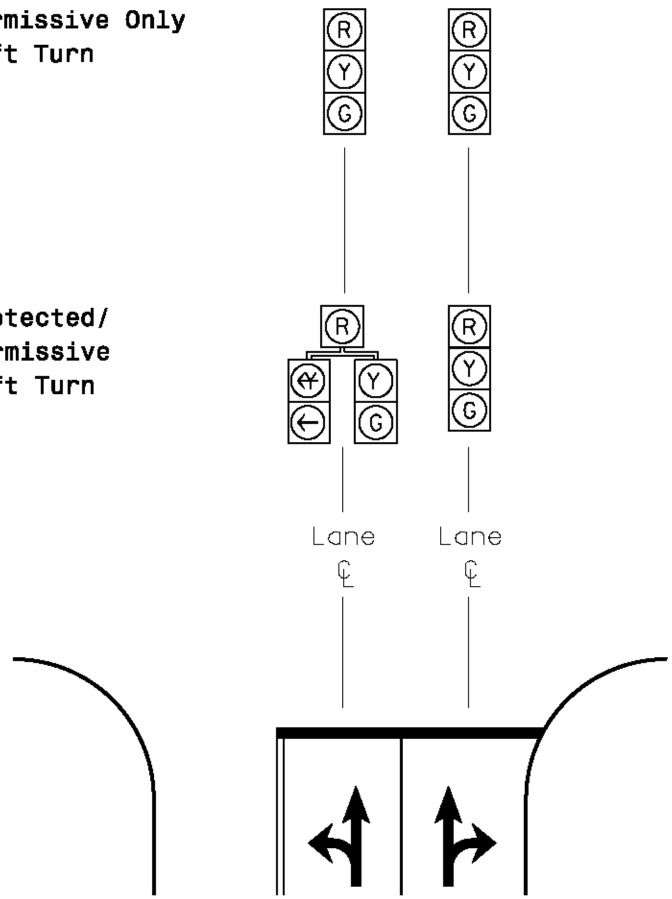
STD. NO. 3.2

CASE 4

Standard Main or Side Street
Signal Head Configuration

4A - Permissive Only
Left Turn

4B - Protected/
Permissive
Left Turn



CASE 5 (1 OF 3)

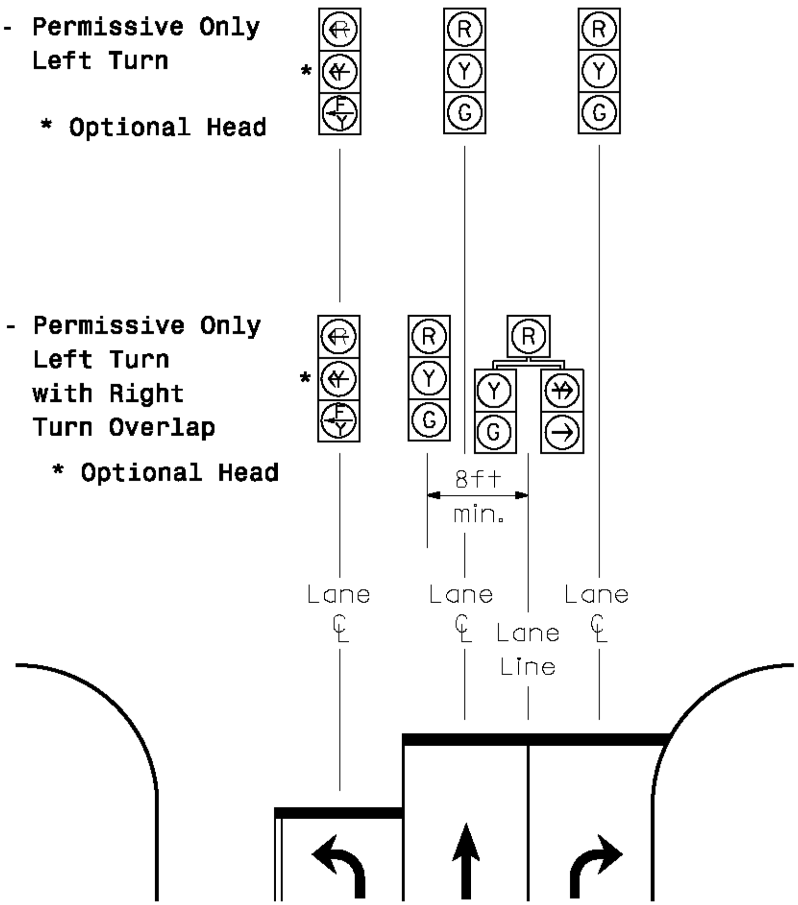
Standard Main or Side Street
Signal Head Configuration

5A - Permissive Only
Left Turn

* Optional Head

5AR - Permissive Only
Left Turn
with Right
Turn Overlap

* Optional Head



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

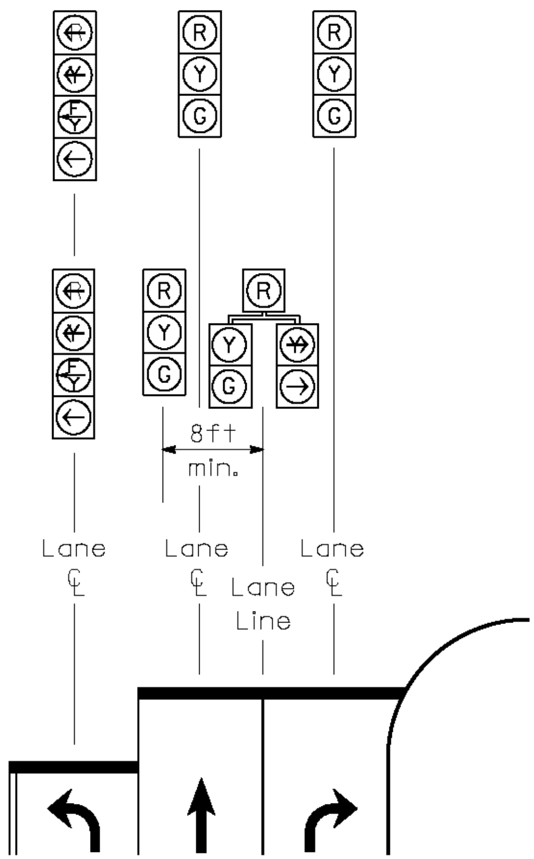
STD. NO.
3.2
SHEET 3 OF 24

CASE 5 (2 OF 3)

Standard Main or Side Street Signal Head Configuration

5B - Protected/ Permissive Left Turn

5BR - Protected/ Permissive Left Turn with Right Turn Overlap

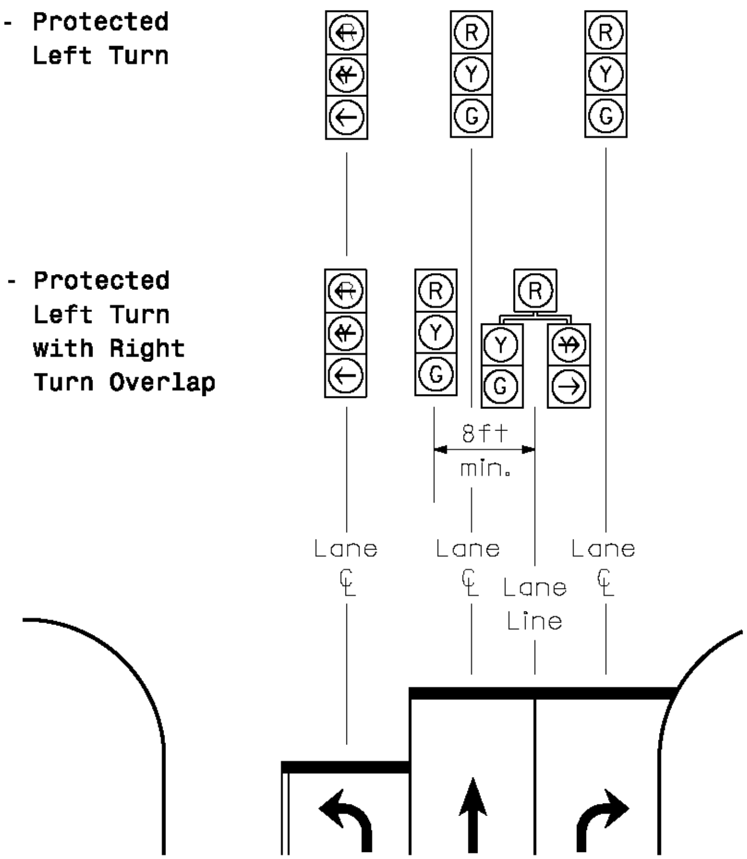


CASE 5 (3 OF 3)

Standard Main or Side Street Signal Head Configuration

5C - Protected Left Turn

5CR - Protected Left Turn with Right Turn Overlap



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO. 3.2

CASE 6

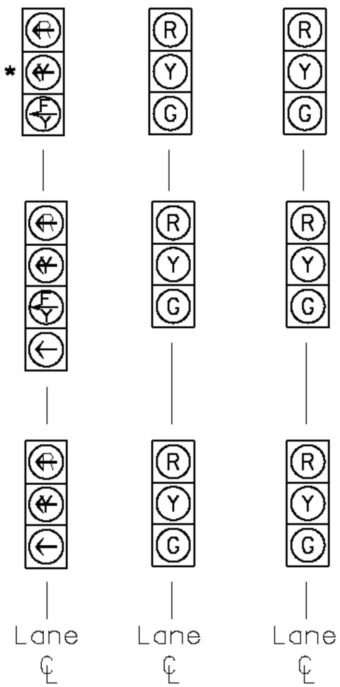
Standard Main or Side Street
Signal Head Configuration

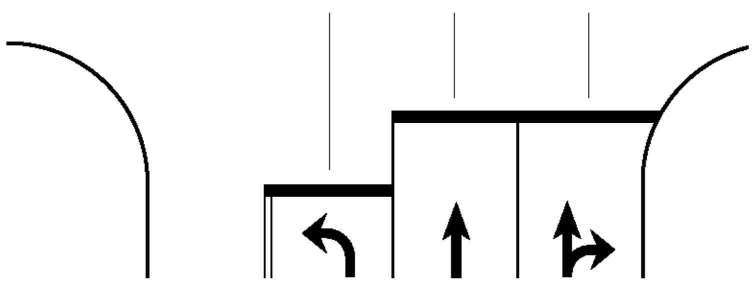
6A - Permissive Only
Left Turn

* Optional Head

6B - Protected/
Permissive
Left Turn

6C - Protected
Left Turn





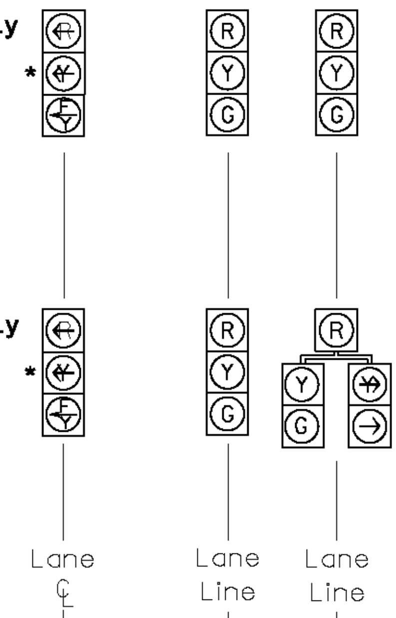
CASE 7 (1 OF 3)

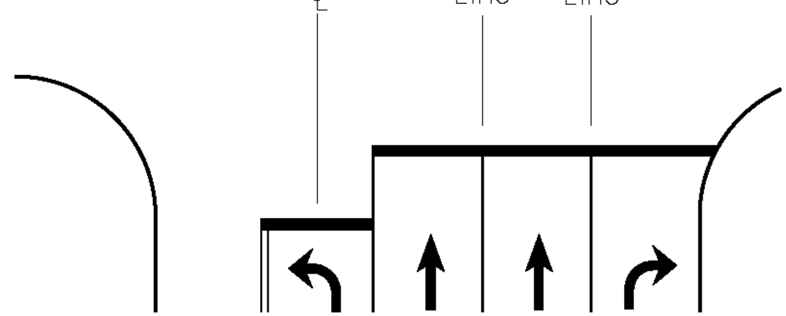
Standard Main or Side Street
Signal Head Configuration

7A - Permissive Only
Left Turn

* Optional Head
If not used, a 3
section CIRCULAR
head may be added
on the lane line

7AR - Permissive Only
Left Turn
with Right
Turn Overlap





Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

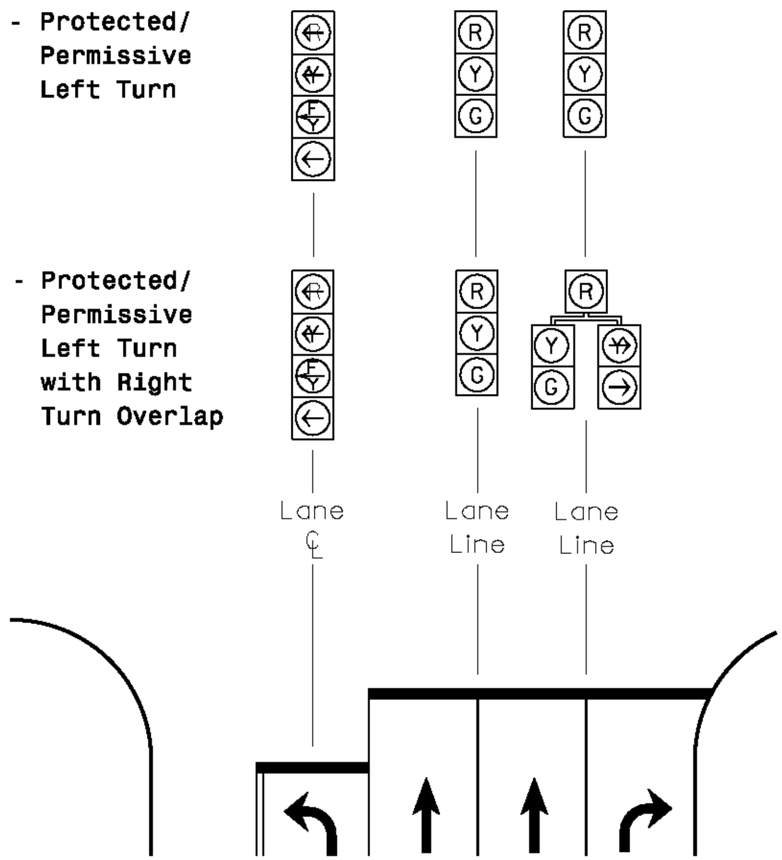
STD. NO.
3.2
SHEET 5 OF 24

CASE 7 (2 of 3)

Standard Main or Side Street Signal Head Configuration

7B - Protected/ Permissive Left Turn

7BR - Protected/ Permissive Left Turn with Right Turn Overlap

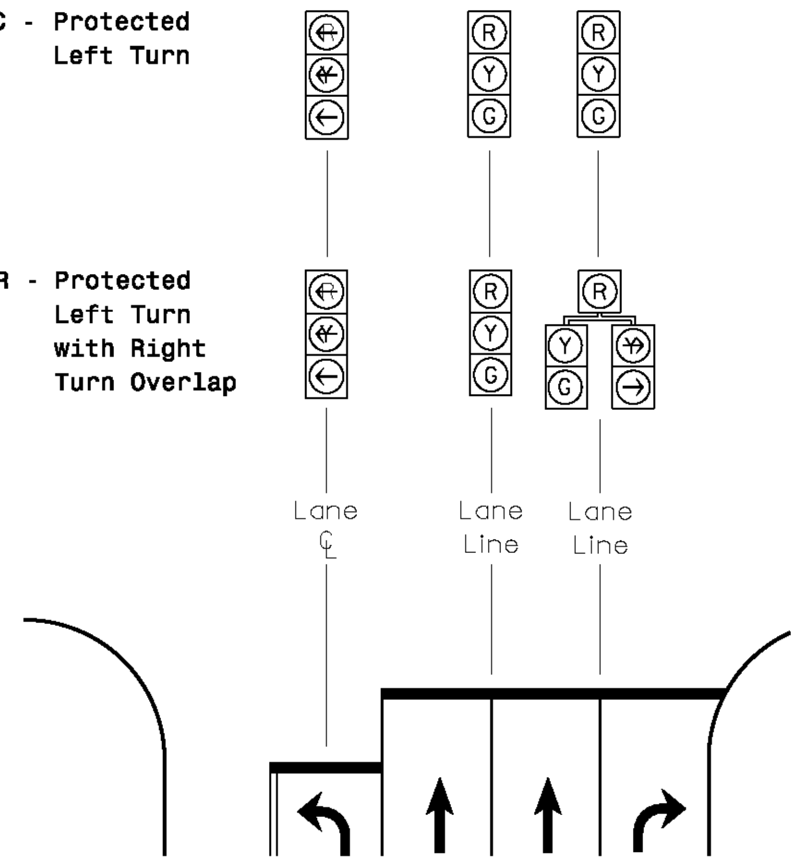


CASE 7 (3 OF 3)

Standard Main or Side Street Signal Head Configuration

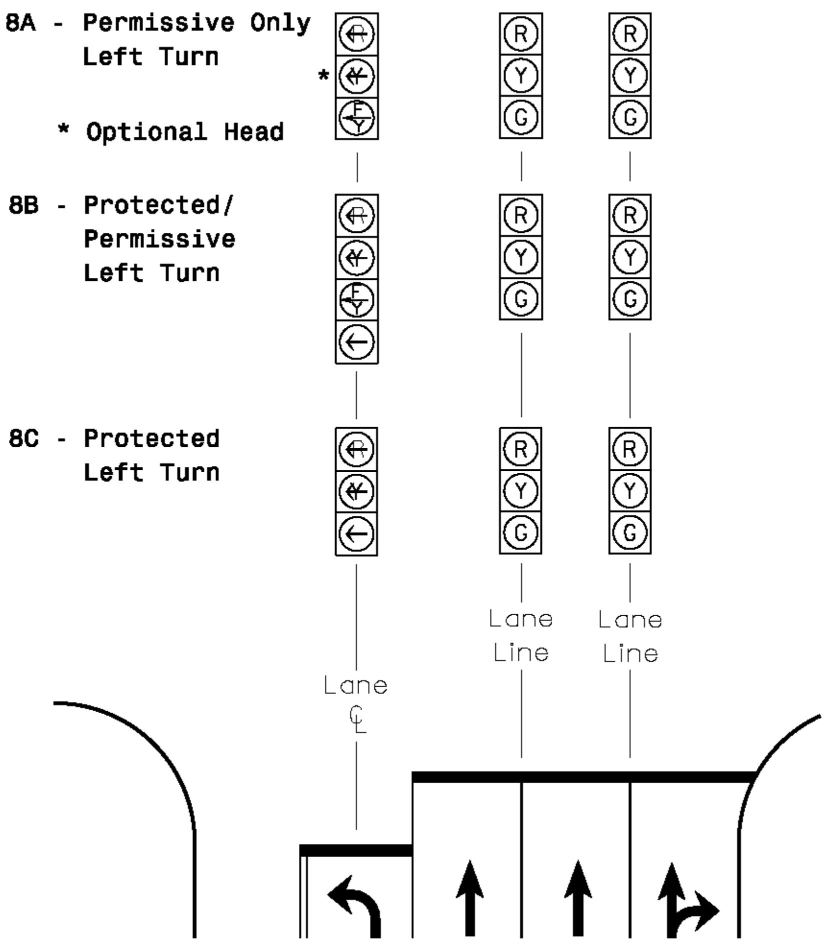
7C - Protected Left Turn

7CR - Protected Left Turn with Right Turn Overlap



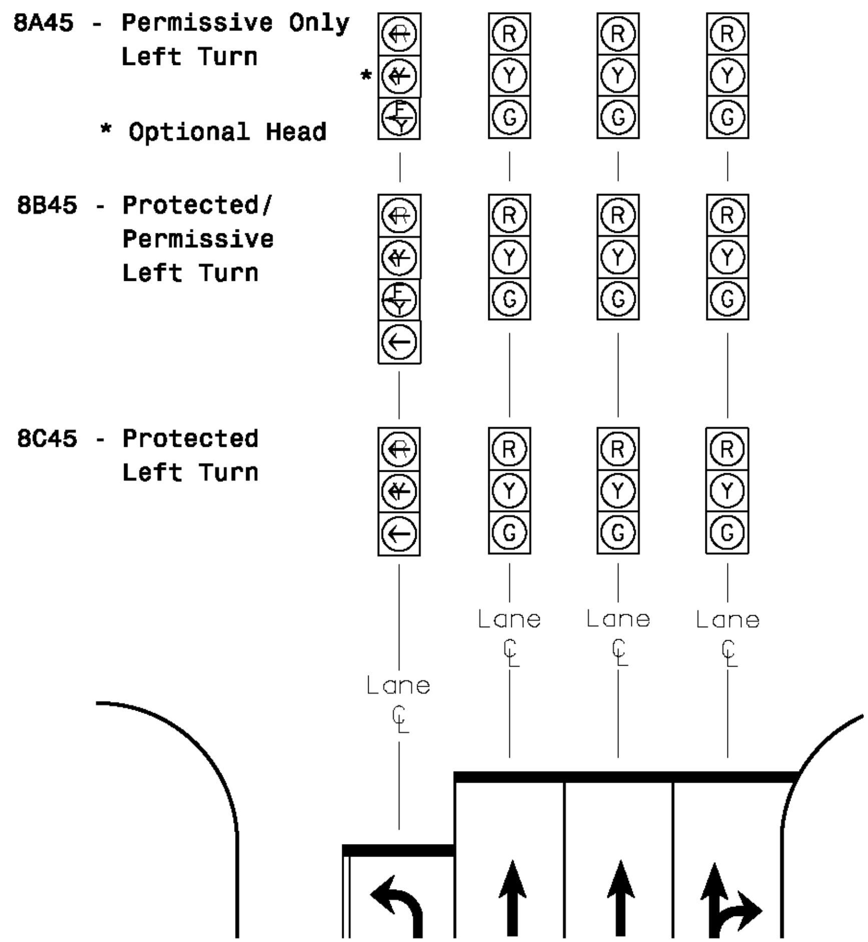
CASE 8 (1 OF 2)
(Speeds less than 45 MPH)

Standard Main or Side Street Signal Head Configuration



CASE 8 (2 OF 2)
(Speeds 45 MPH or above)

Standard Main or Side Street Signal Head Configuration

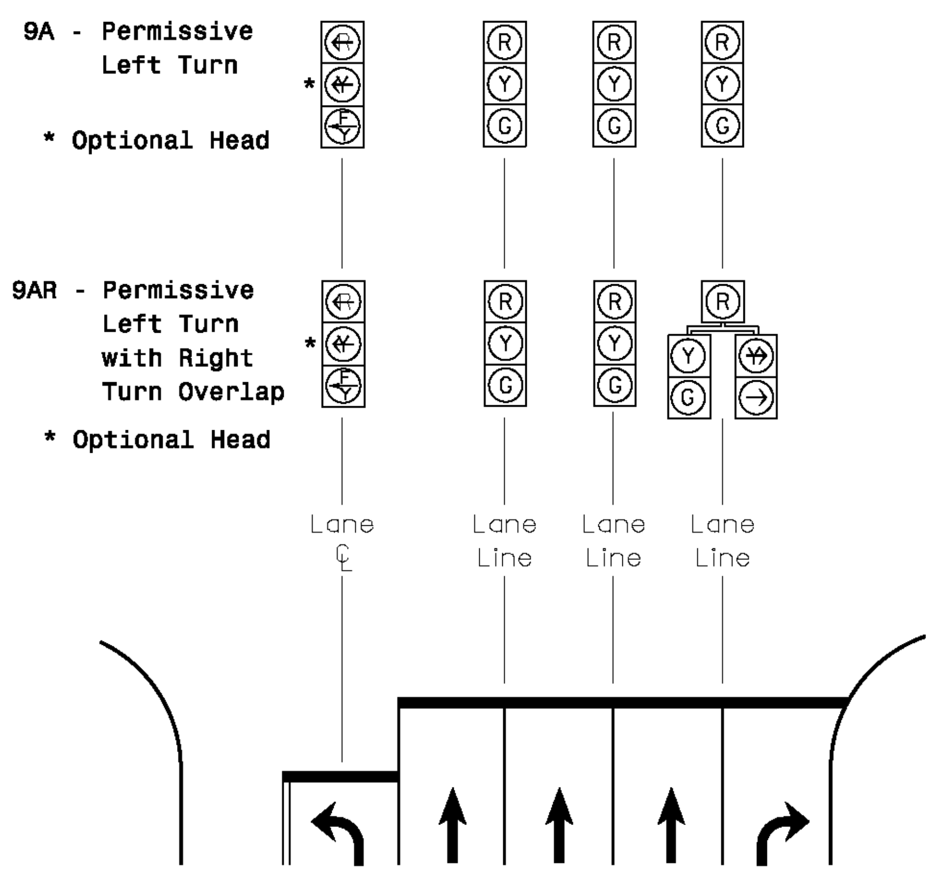


Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

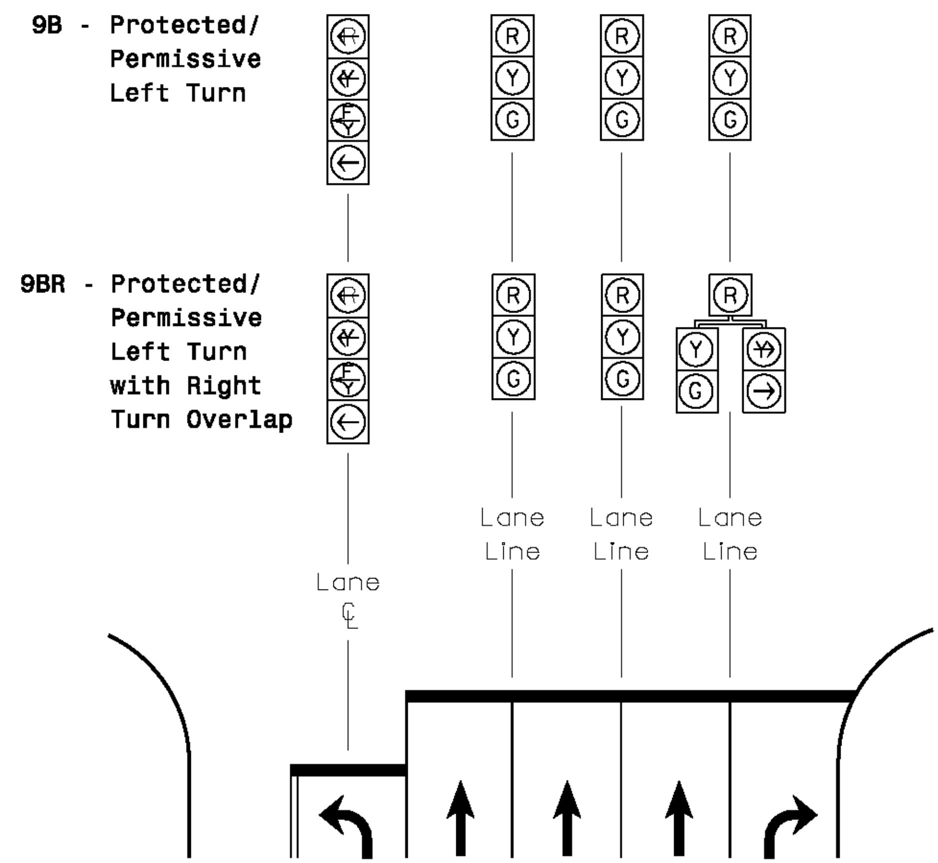
CASE 9 (1 OF 3)

Standard Main or Side Street Signal Head Configuration



CASE 9 (2 OF 3)

Standard Main or Side Street Signal Head Configuration



Signal Head Approach Displays and Alignment

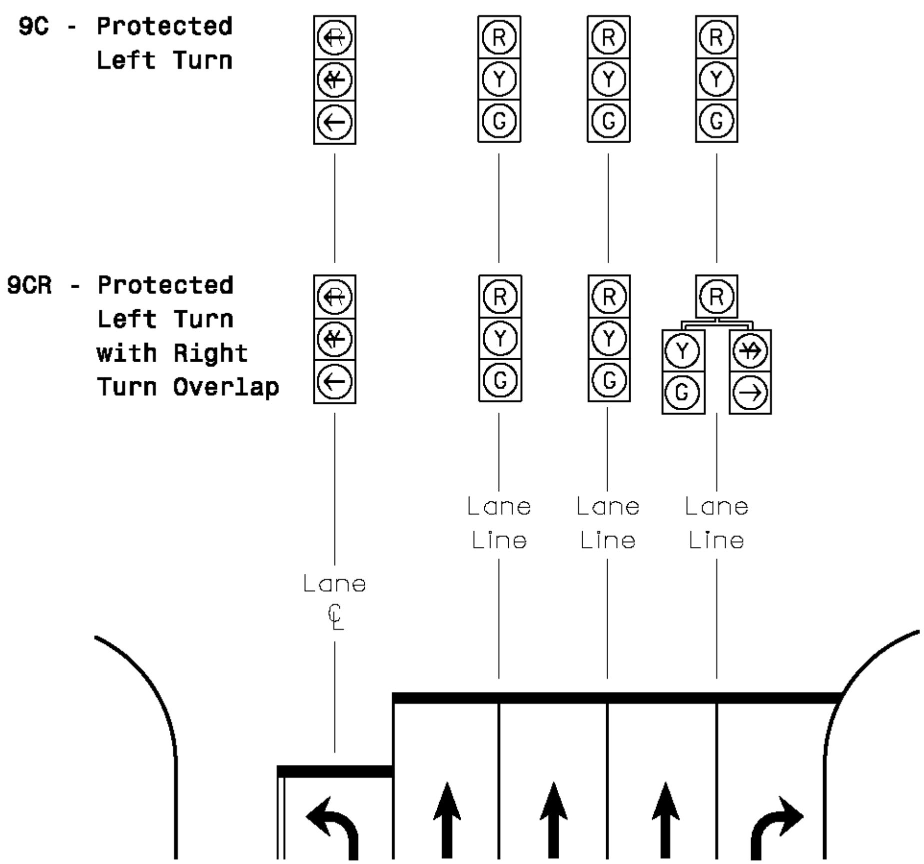
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO.	3.2
SHEET 8 OF 24	

CASE 9 (3 OF 3)

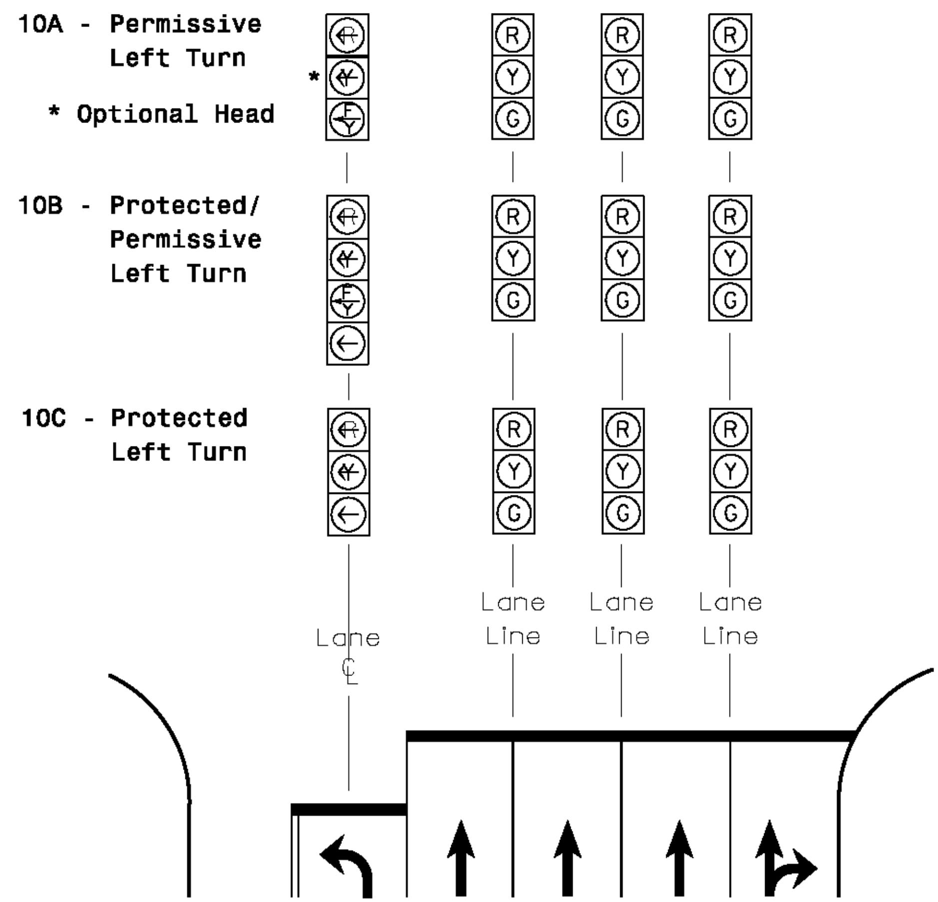
Standard Main or Side Street Signal Head Configuration



CASE 10 (1 OF 2)

(Speeds less than 45 MPH)

Standard Main or Side Street Signal Head Configuration



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION

TRANSPORTATION MOBILITY AND SAFETY DIVISION

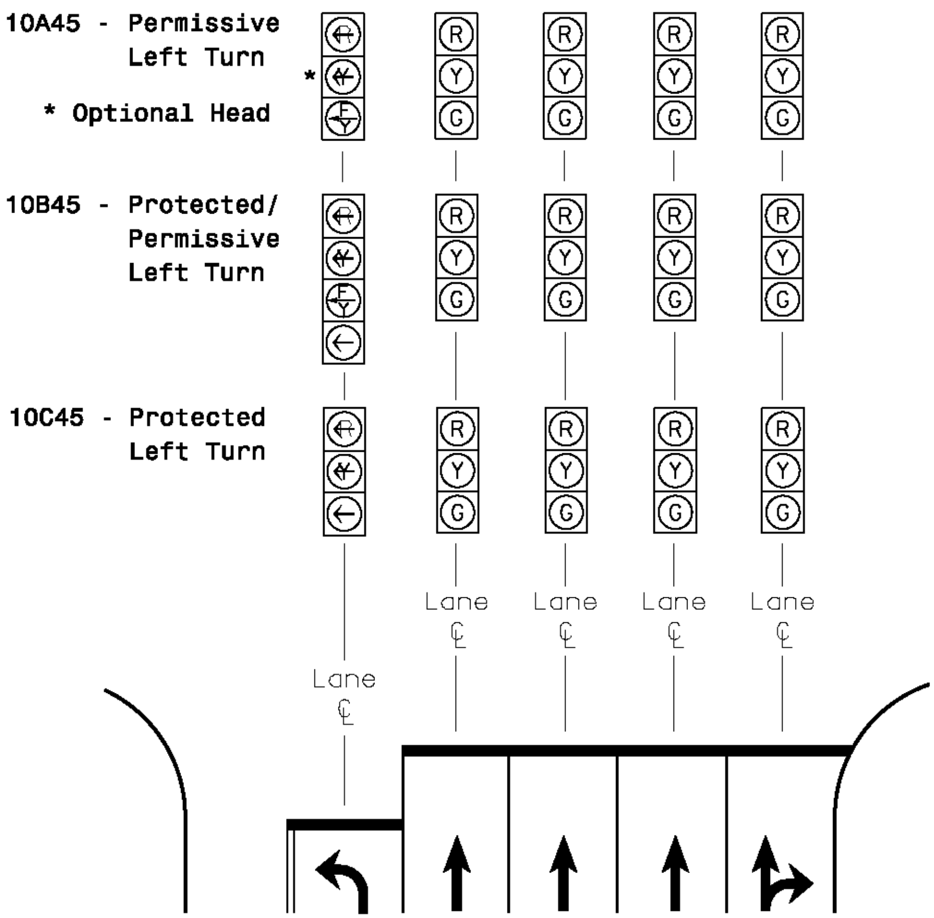
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO. 3.2

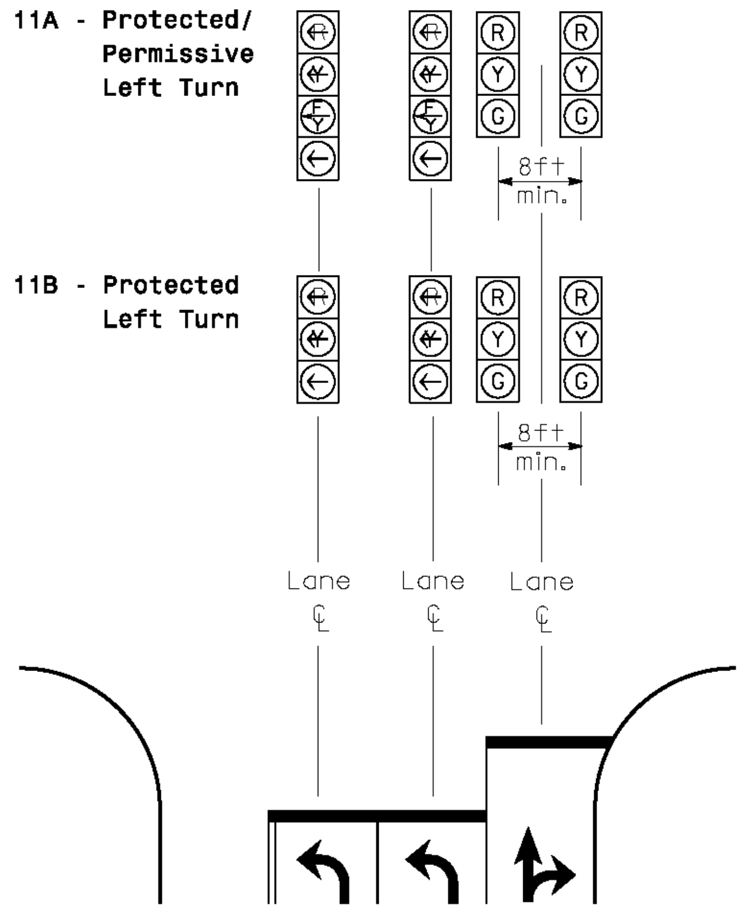
CASE 10 (2 OF 2)
(Speeds 45 MPH or above)

Standard Main or Side Street
Signal Head Configuration



CASE 11

Main or Side Street
Signal Head Configuration
for Dual Left Turn Movements

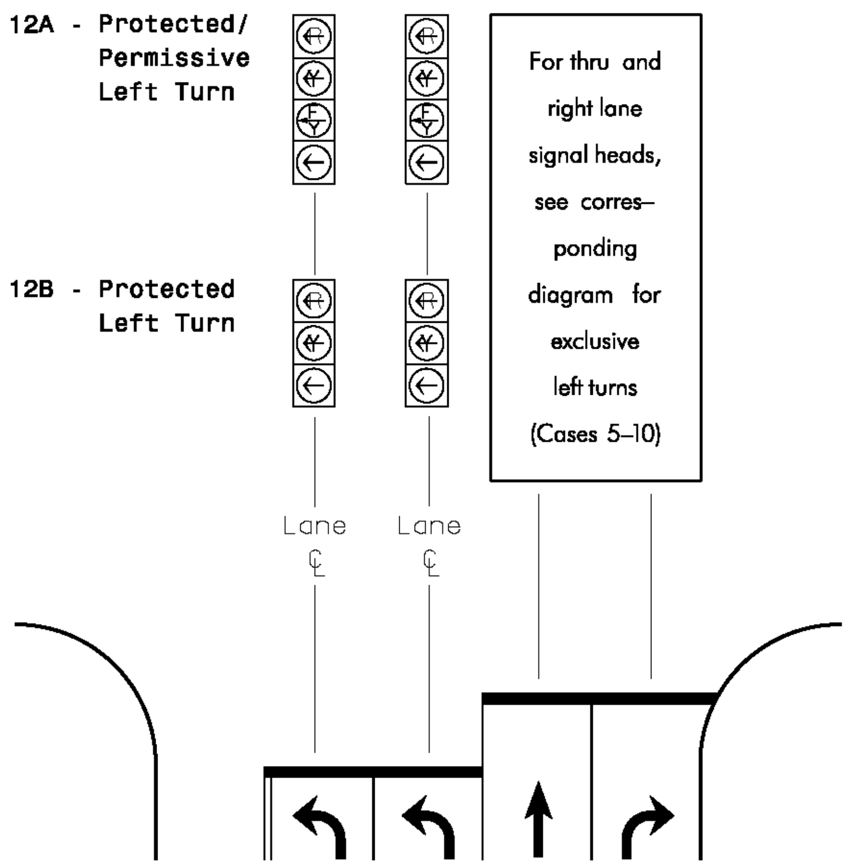


Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

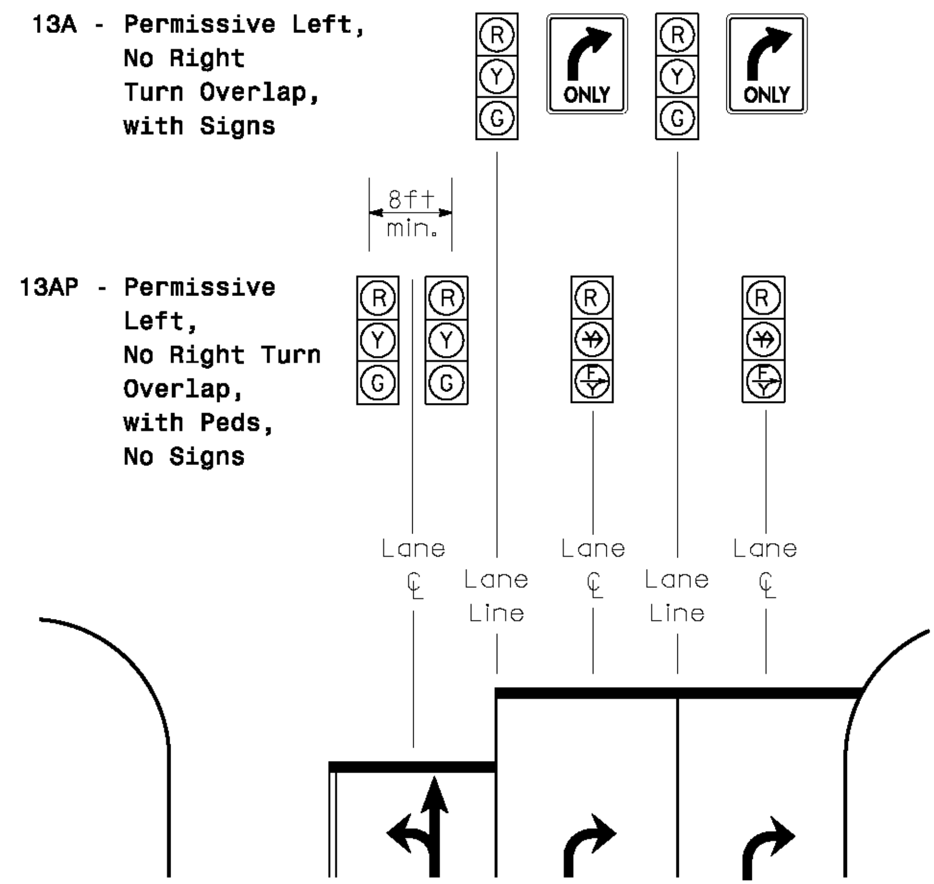
CASE 12

**Main or Side Street
Signal Head Configuration
for Dual Left Turn Movements**



CASE 13 (1 OF 2)

**Main or Side Street
Signal Head Configuration
for Dual Right Turn Movements**



Signal Head Approach Displays and Alignment

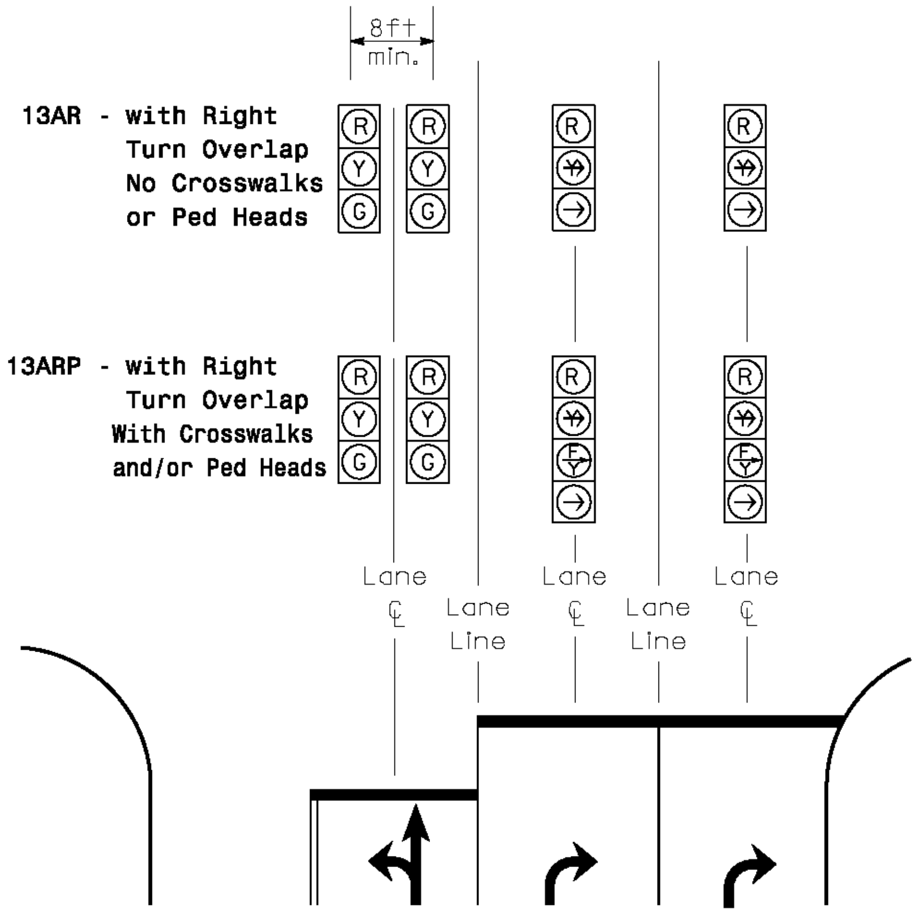
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.2

SHEET 11 OF 24

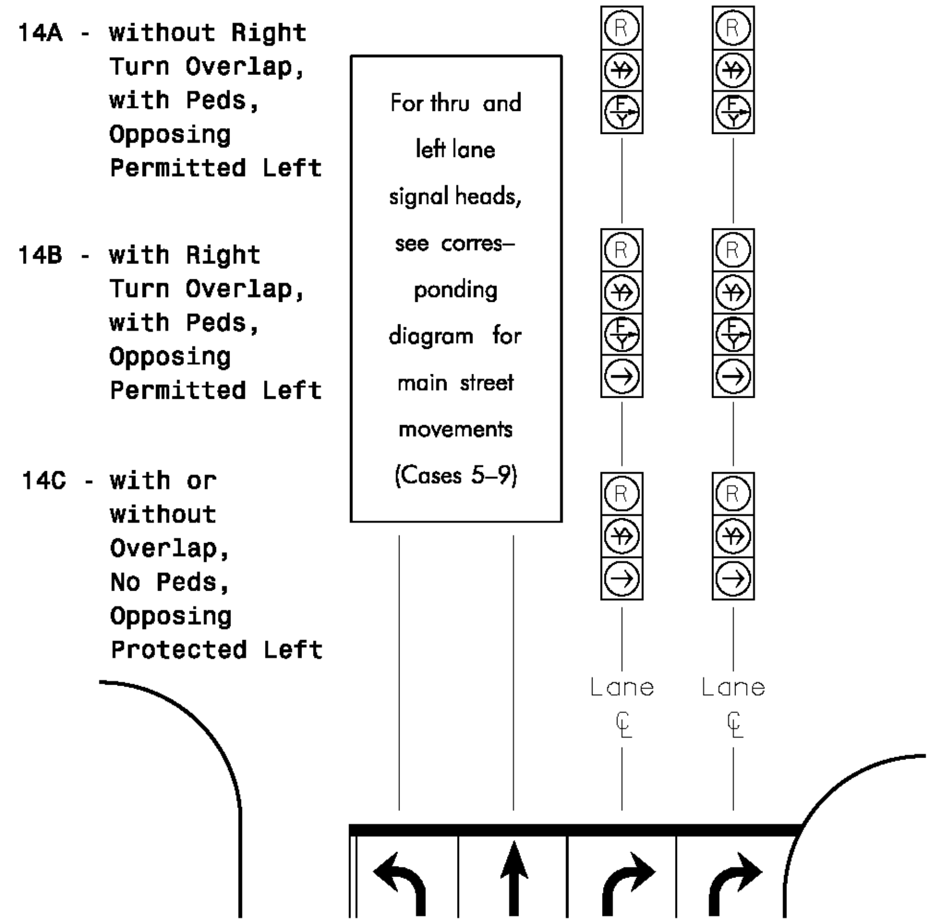
CASE 13 (2 of 2)

Main or Side Street
Signal Head Configuration
for Dual Right Turn Movements



CASE 14

Main or Side Street
Signal Head Configuration
for Dual Right Turn Movements



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.2

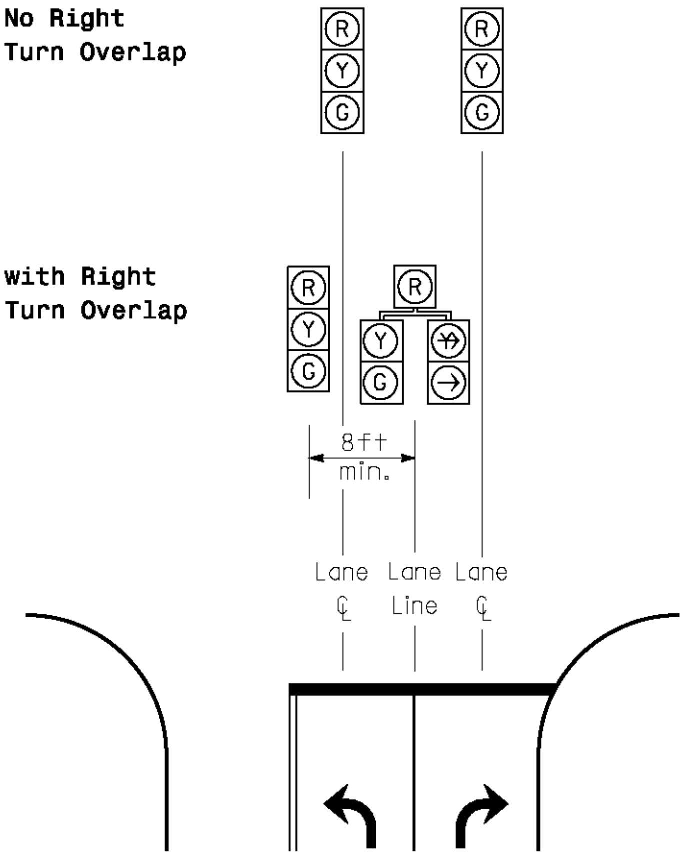
SHEET 12 OF 24

CASE 15

Stem of "Tee" Intersection or Ramp Terminal or One–Way Situation Signal Head Configuration

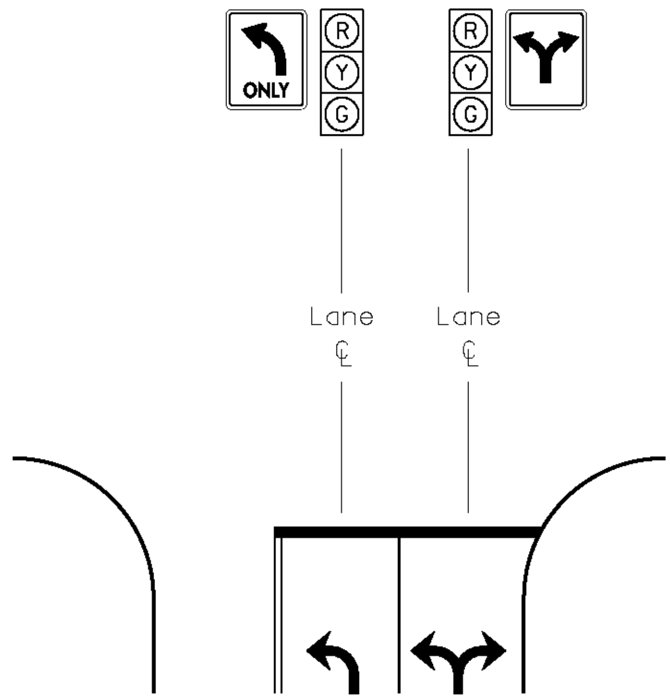
15A - No Right Turn Overlap

15AR - with Right Turn Overlap



CASE 16

Stem of "Tee" Intersection or Ramp Terminal or One–Way Situation Signal Head Configuration



Signal Head Approach Displays and Alignment

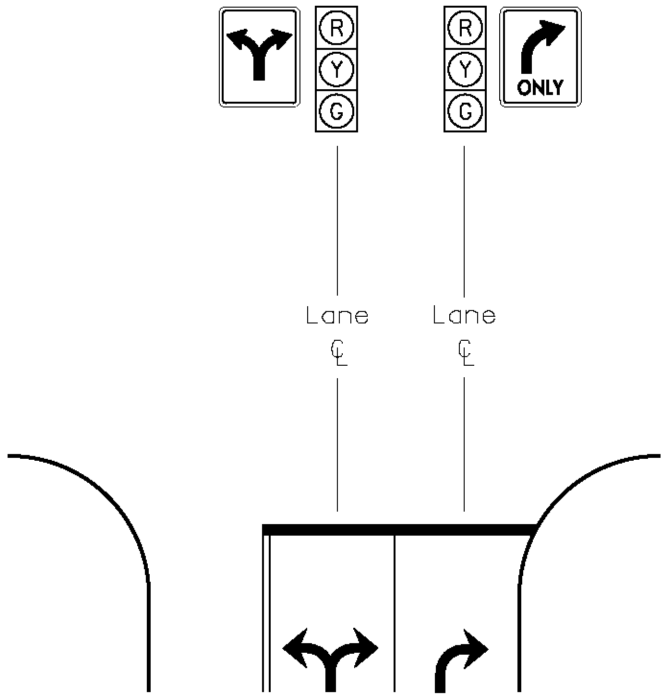
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.2

SHEET 13 OF 24

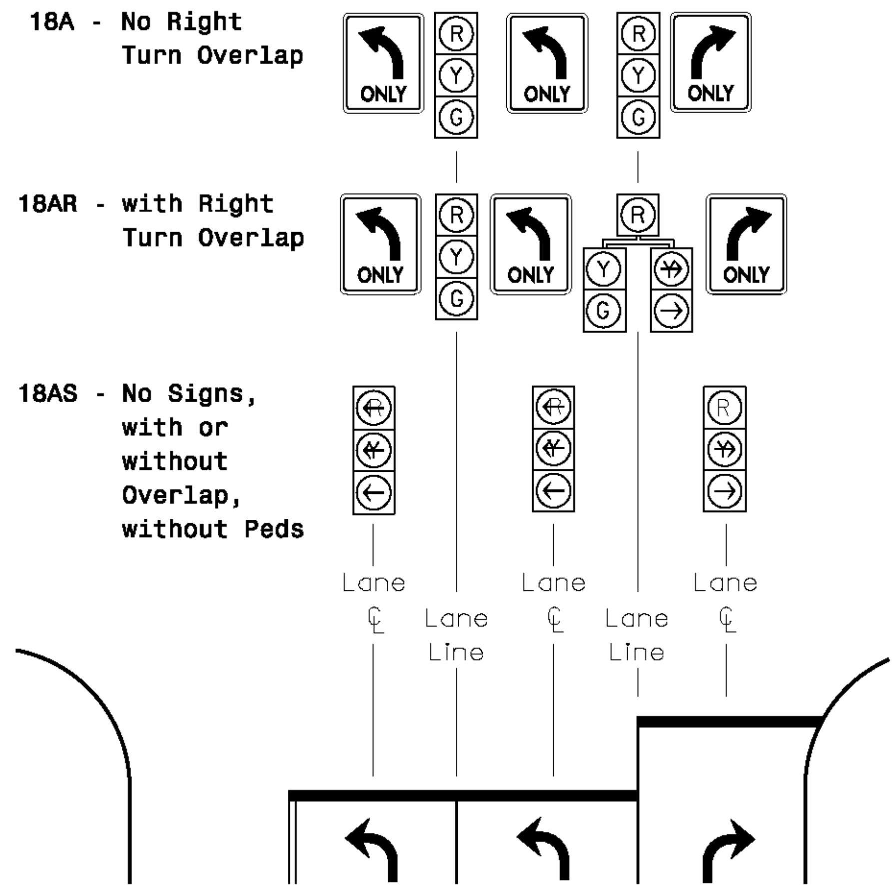
CASE 17

**Stem of "Tee" Intersection or
Ramp Terminal or
One–Way Situation
Signal Head Configuration**



CASE 18

**Stem of "Tee" Intersection or
Ramp Terminal or
One–Way Situation
Signal Head Configuration**



Signal Head Approach Displays and Alignment

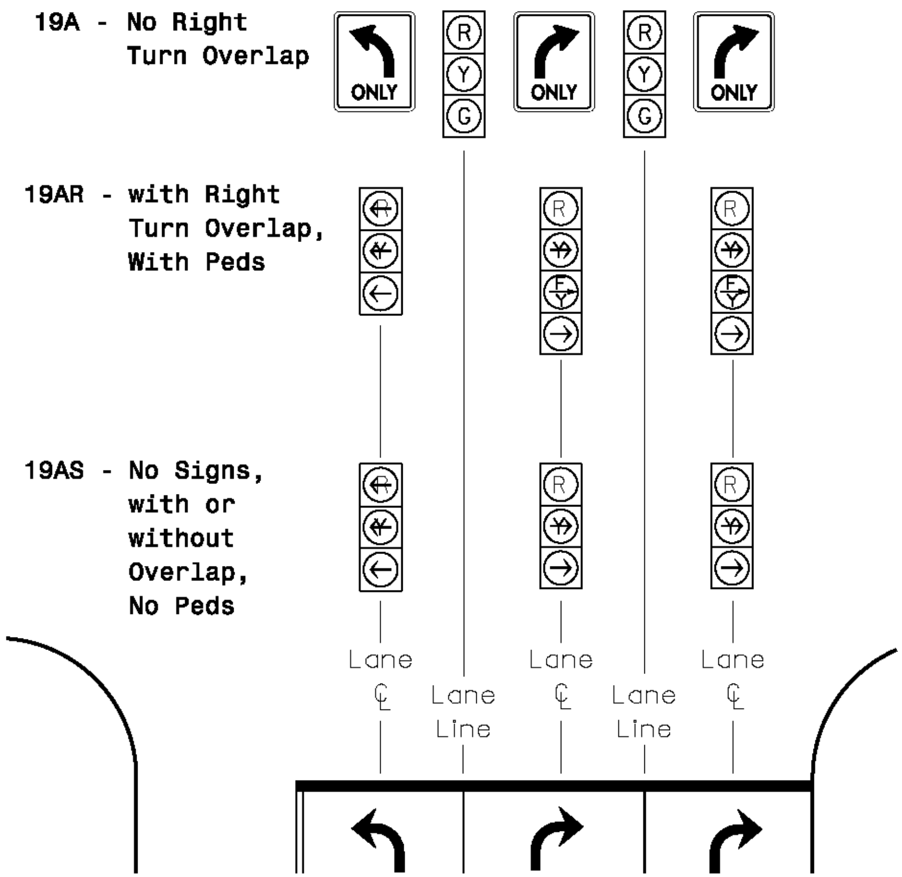
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO.
3.2
SHEET 14 OF 24

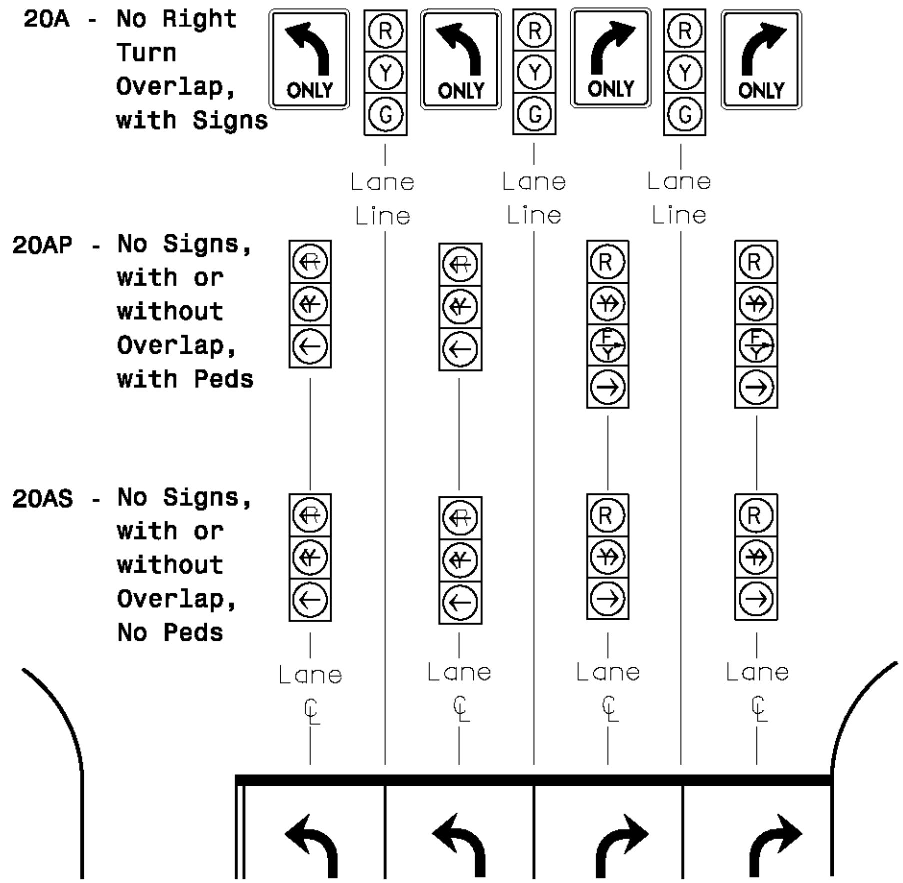
CASE 19

Stem of "Tee" Intersection or Ramp Terminal or One–Way Situation Signal Head Configuration



CASE 20

Stem of "Tee" Intersection or Ramp Terminal or One–Way Situation Signal Head Configuration



Signal Head Approach Displays and Alignment

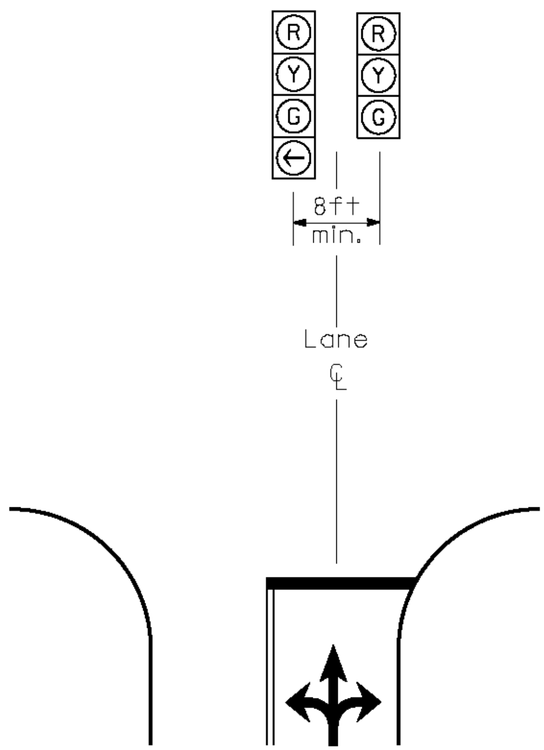
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO. 3.2

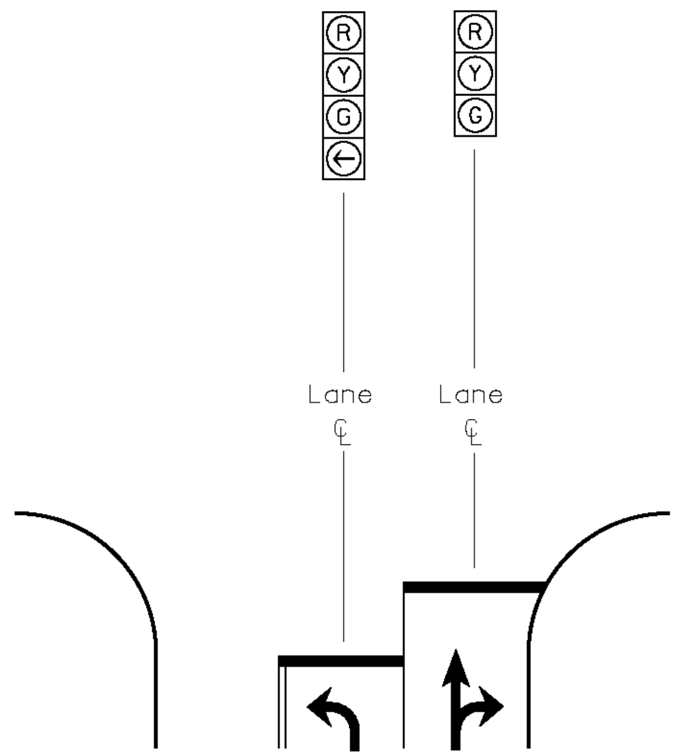
CASE 21

Split Phasing
Signal Head Configuration



CASE 22

Split Phasing
Signal Head Configuration



Signal Head Approach Displays and Alignment

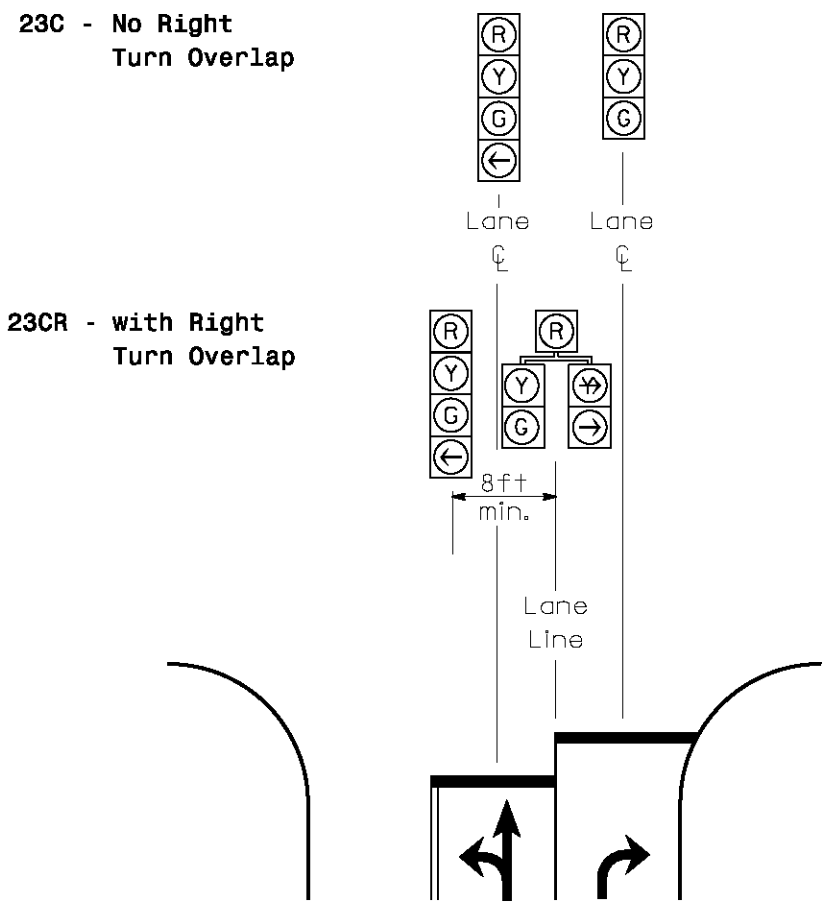
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO.
3.2

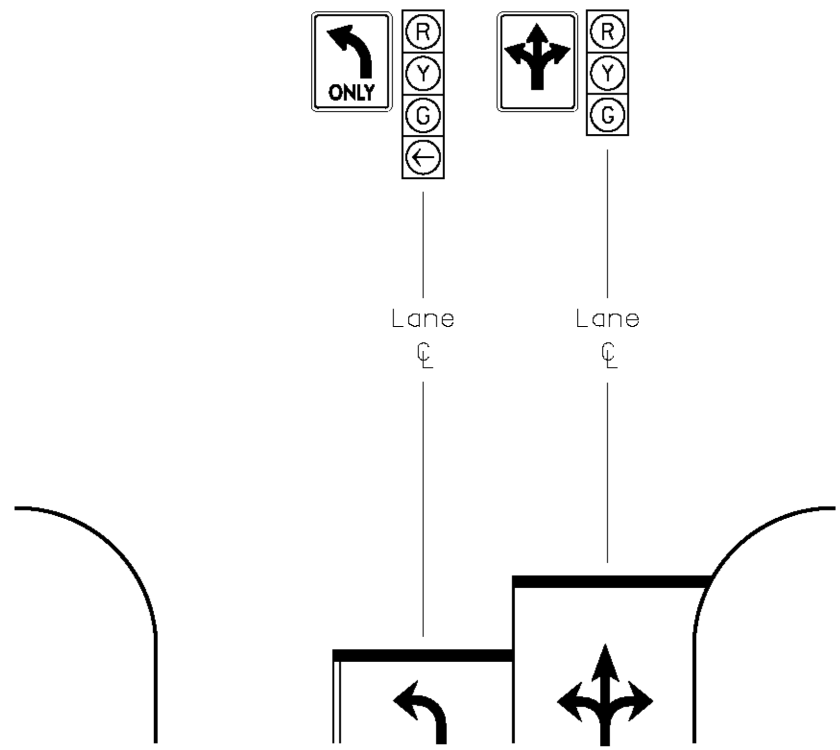
CASE 23

Split Phasing
Signal Head Configuration



CASE 24

Split Phasing
Signal Head Configuration



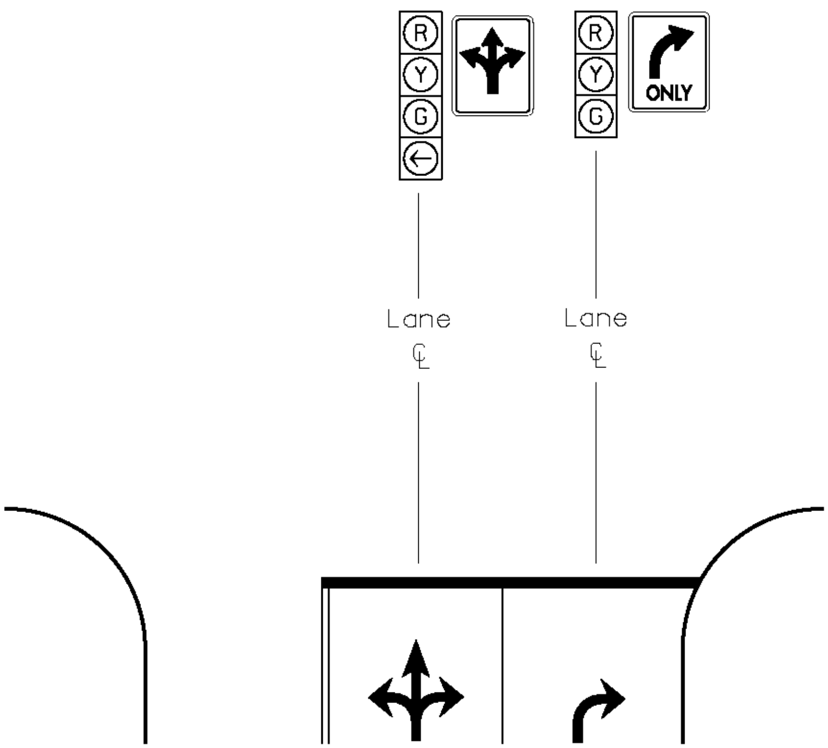
Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
3.2

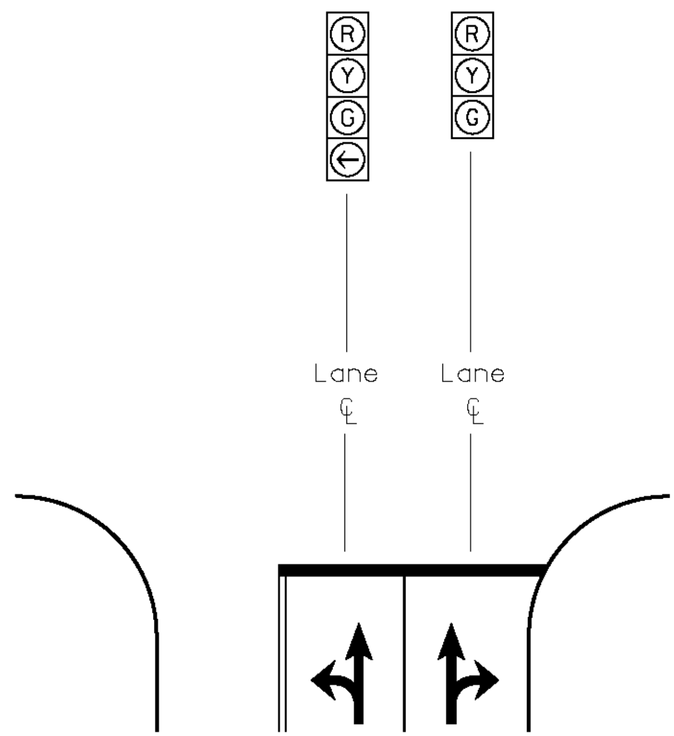
CASE 25

Split Phasing
Signal Head Configuration



CASE 26

Split Phasing
Signal Head Configuration



Signal Head Approach Displays and Alignment

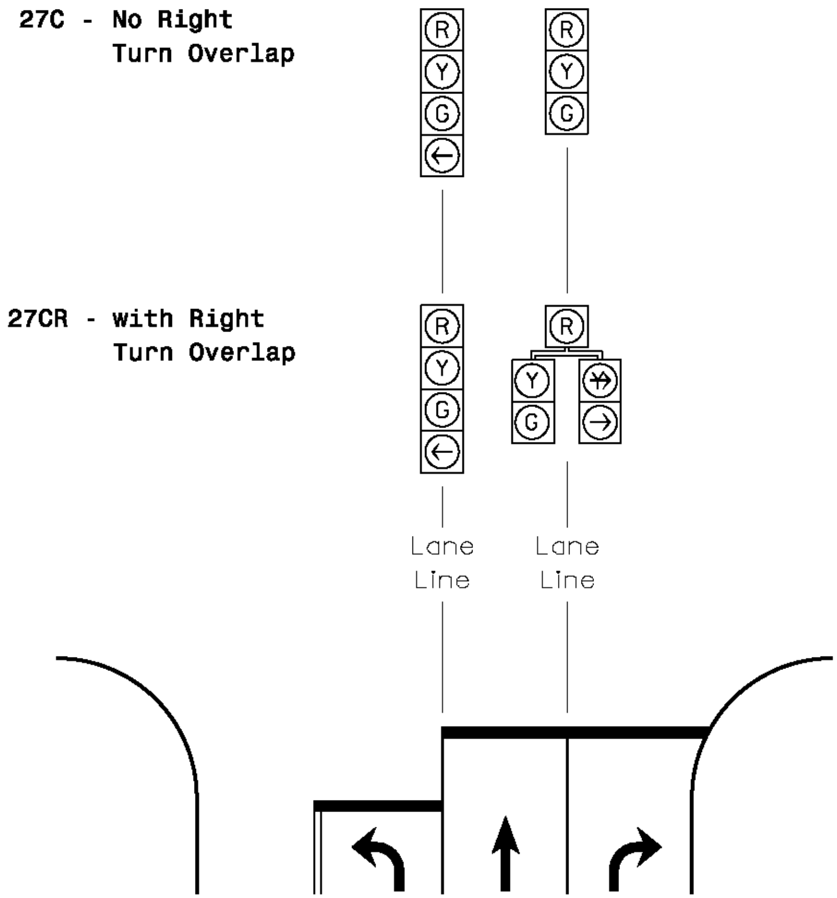
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO.
3.2

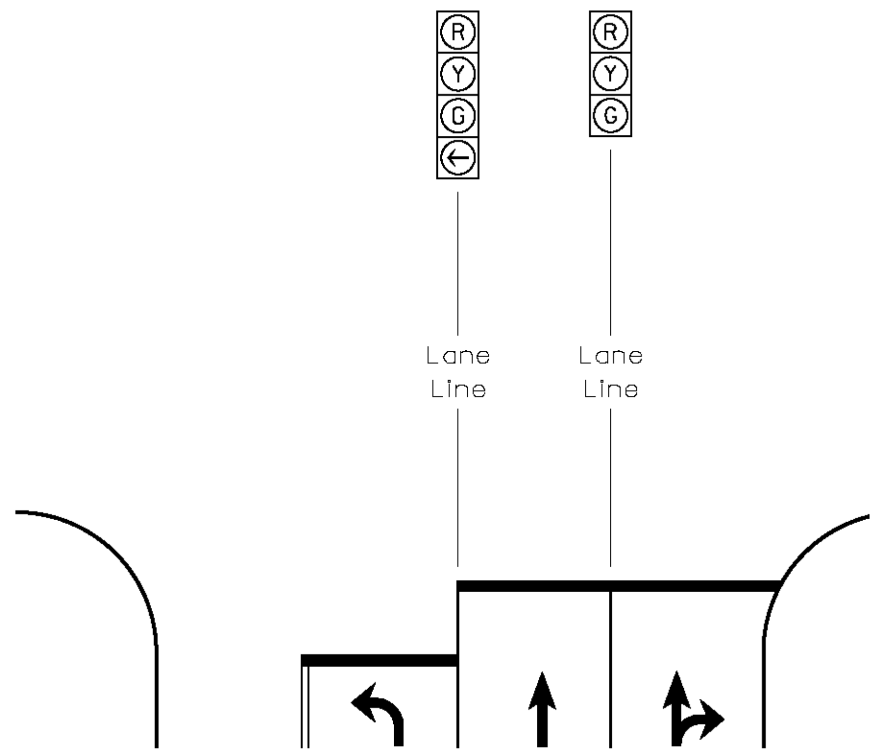
CASE 27

Split Phasing
Signal Head Configuration



CASE 28

Split Phasing
Signal Head Configuration



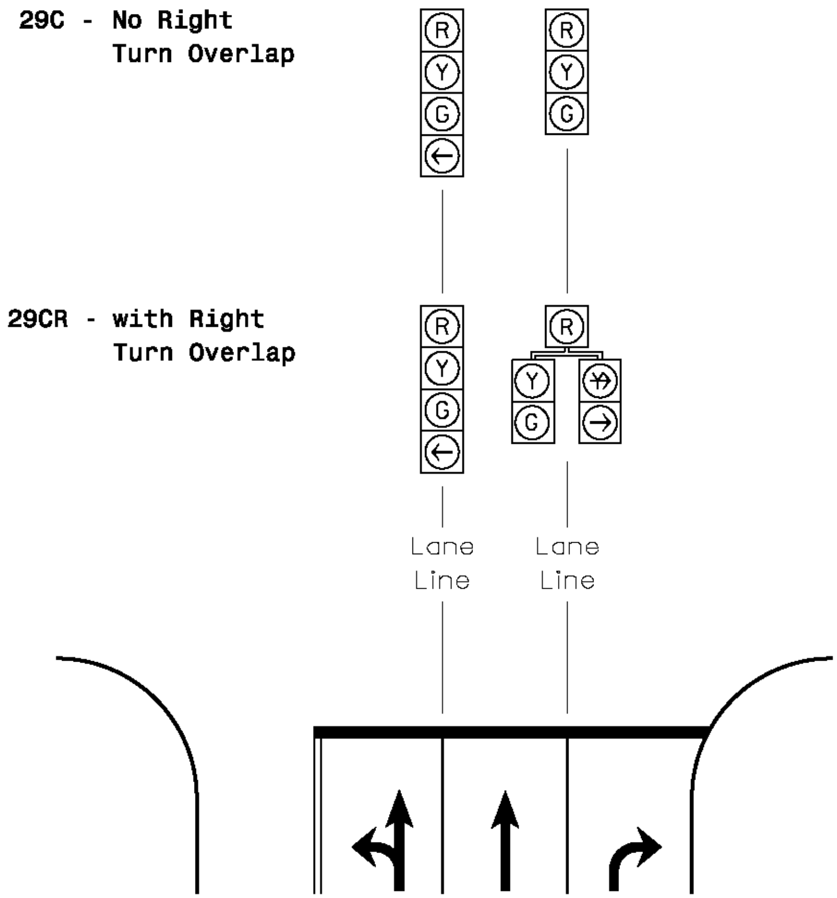
Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.2

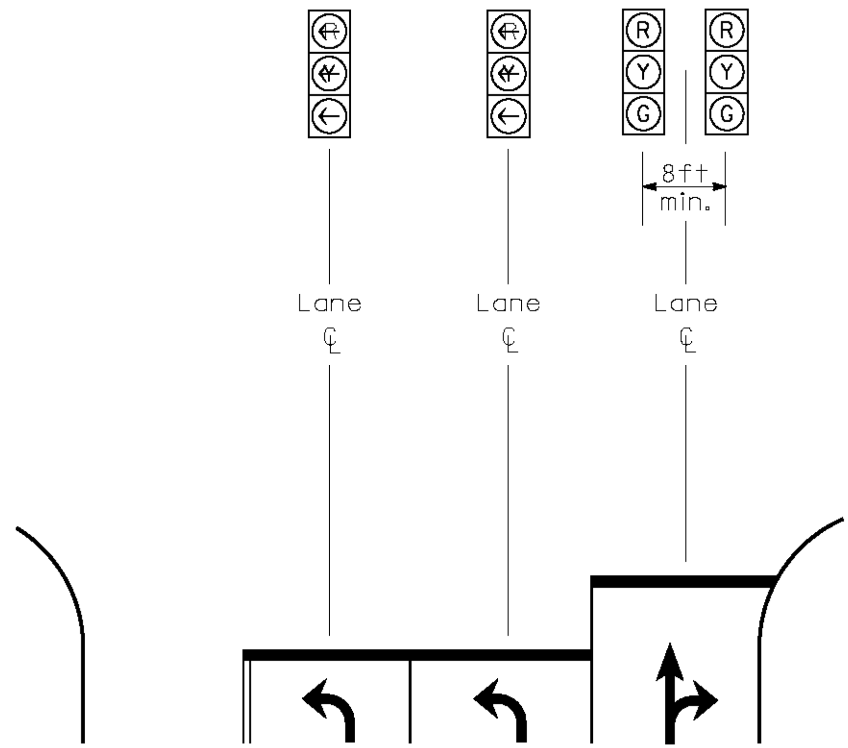
CASE 29

Split Phasing
Signal Head Configuration



CASE 30

Split Phasing
Signal Head Configuration



Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

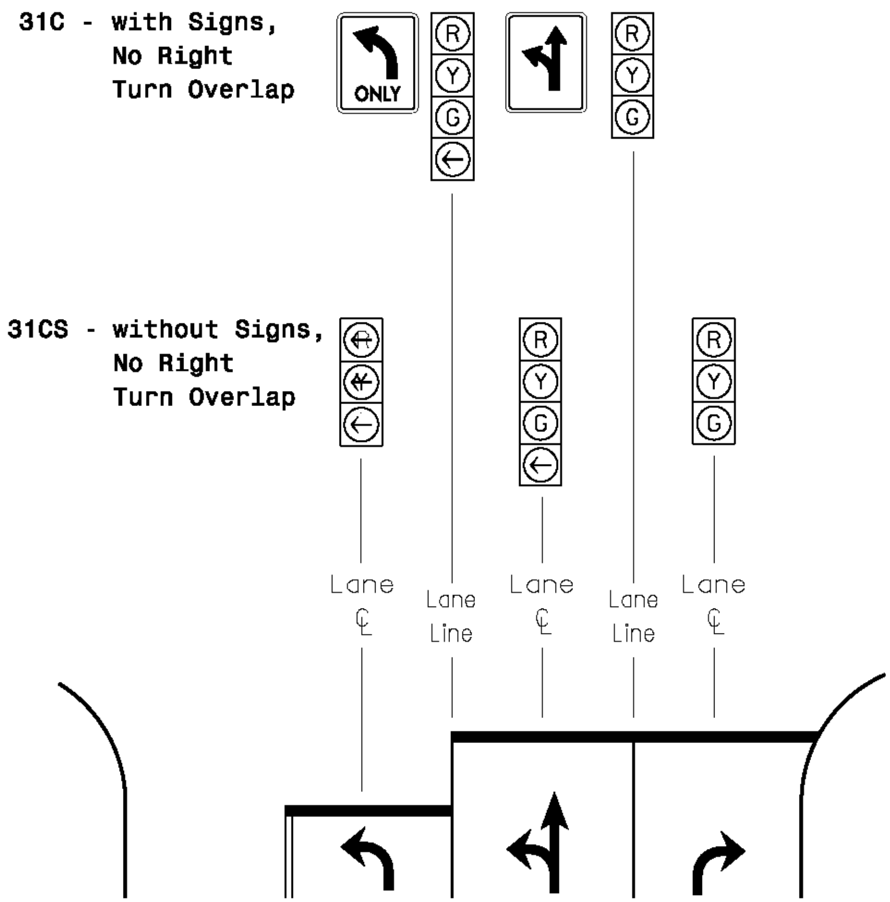
12-10

STD. NO. 3.2

SHEET 20 OF 24

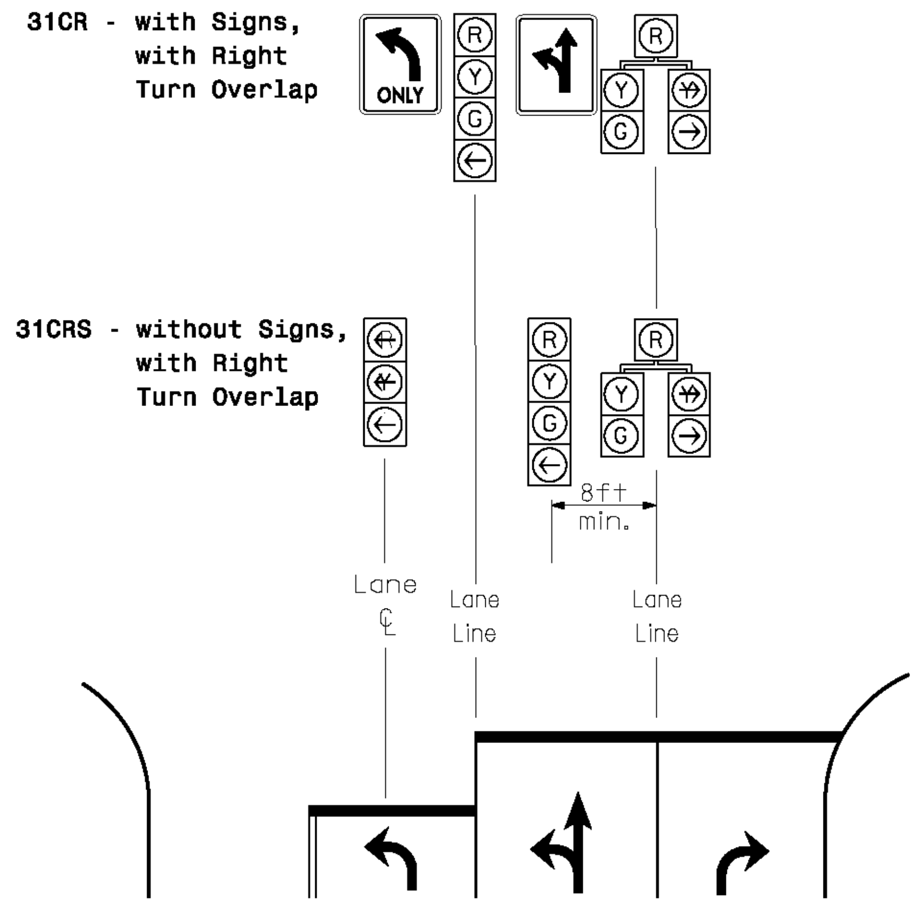
CASE 31 (1 OF 2)

Split Phasing
Signal Head Configuration



CASE 31 (2 OF 2)

Split Phasing
Signal Head Configuration



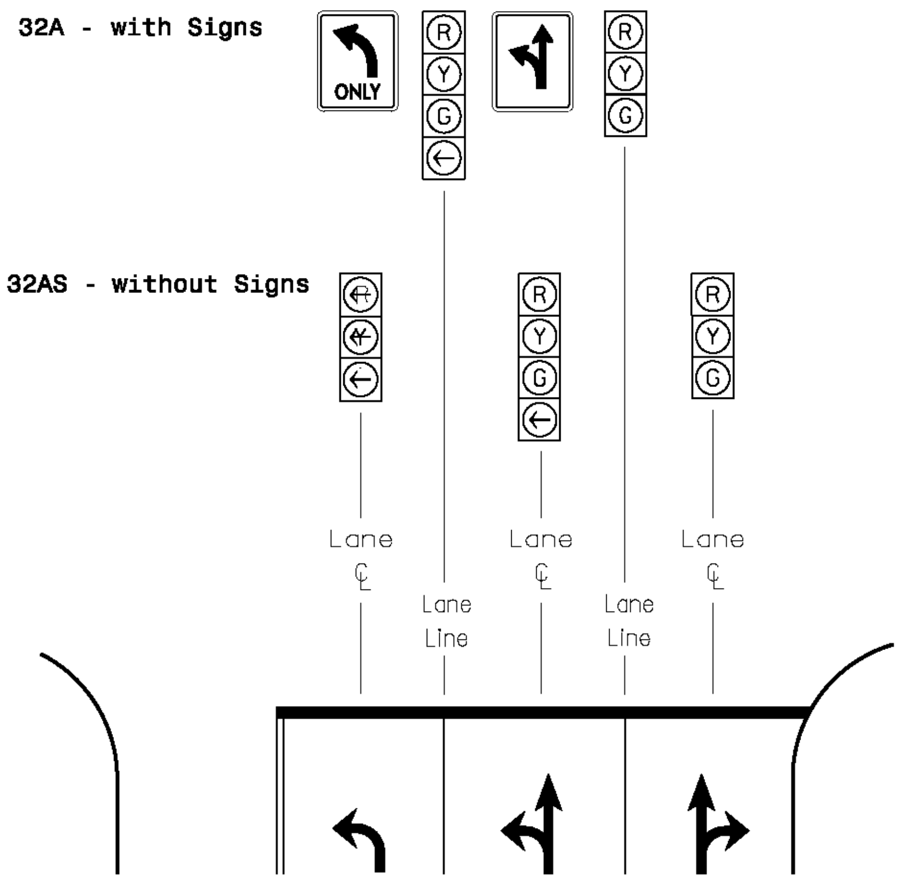
Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
3.2
SHEET 21 OF 24

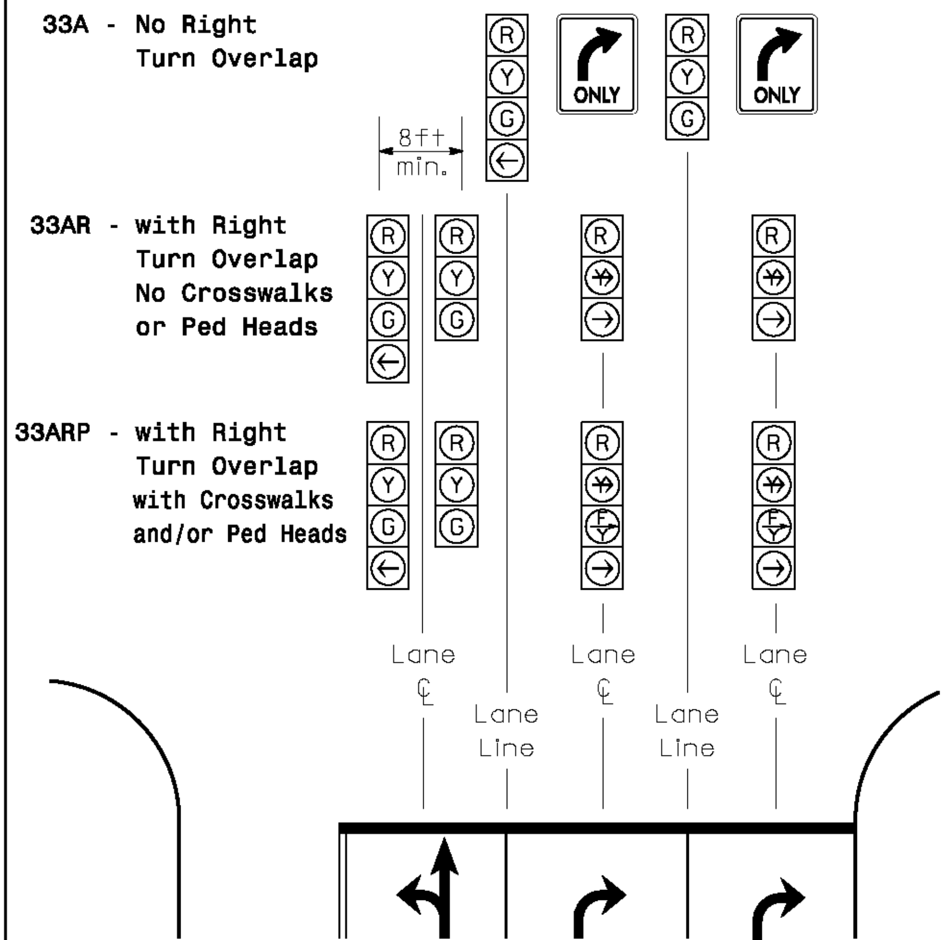
CASE 32

Split Phasing
Signal Head Configuration



CASE 33

Split Phasing
Signal Head Configuration
for Dual Right Turn Movements



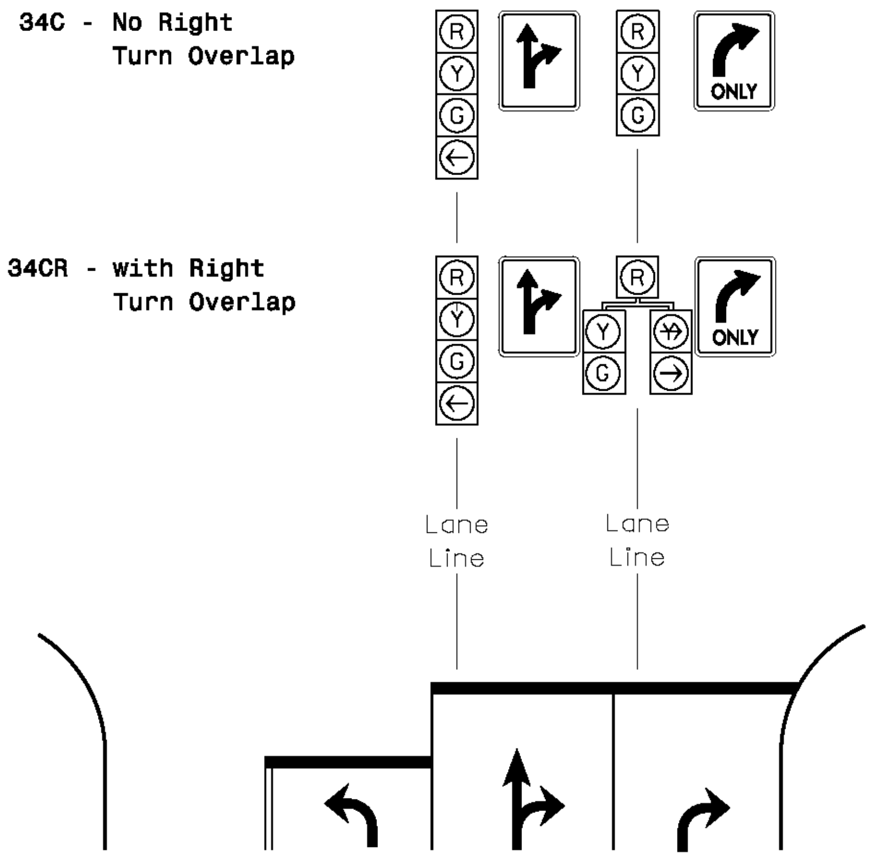
Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.2

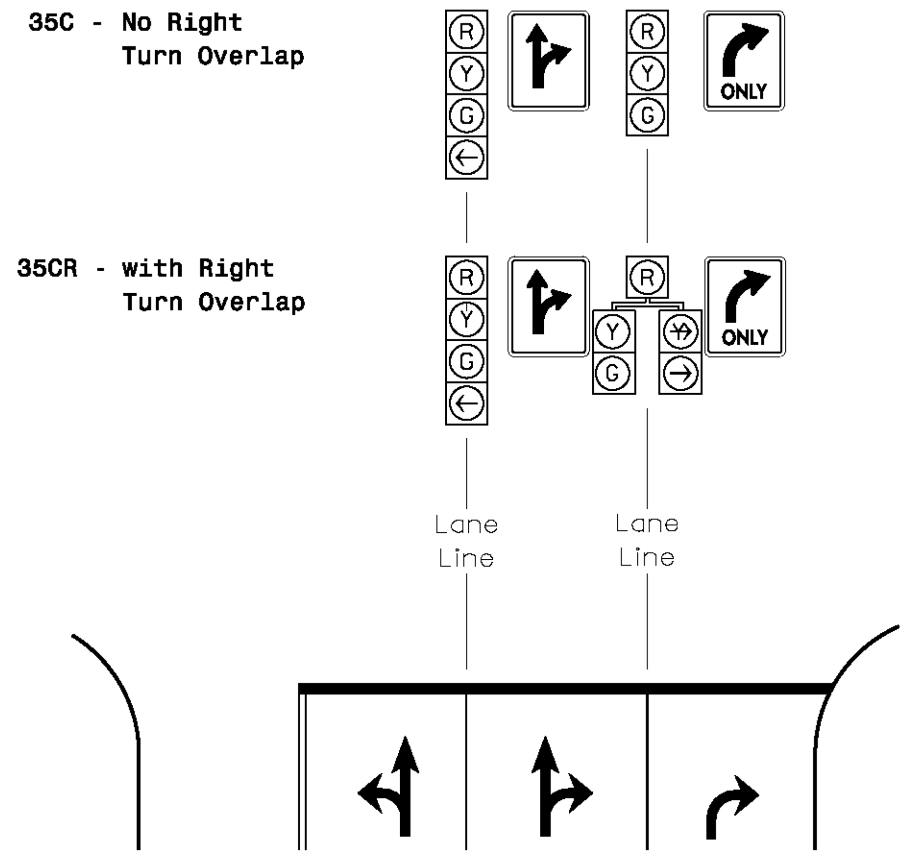
CASE 34

Split Phasing
Signal Head Configuration



CASE 35

Split Phasing
Signal Head Configuration



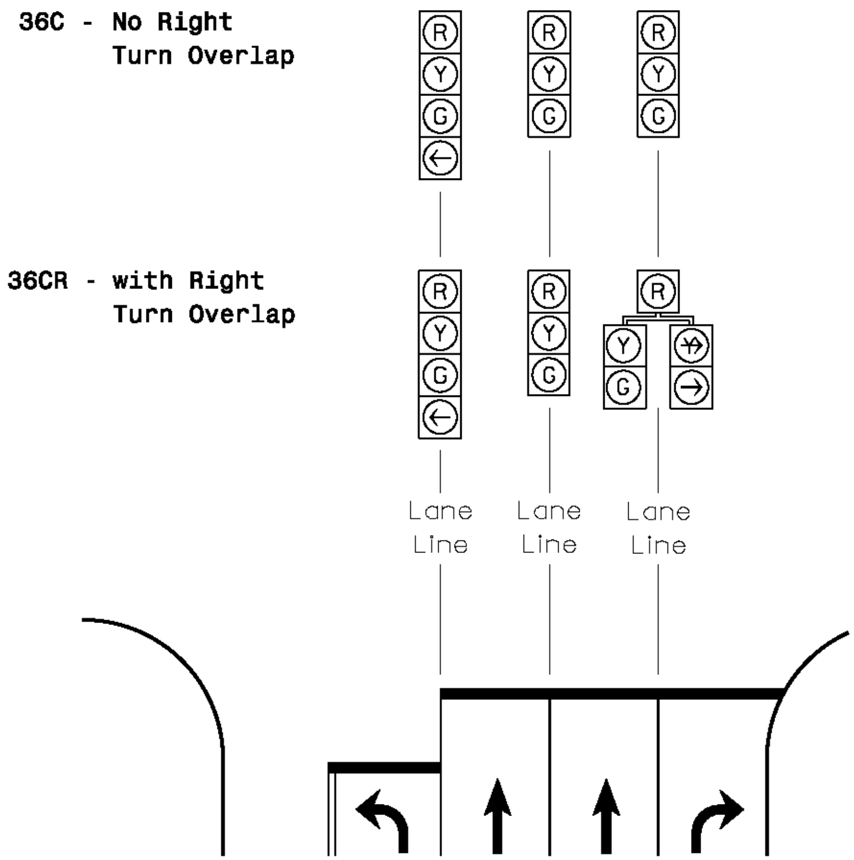
Signal Head Approach Displays and Alignment

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
3.2
SHEET 23 OF 24

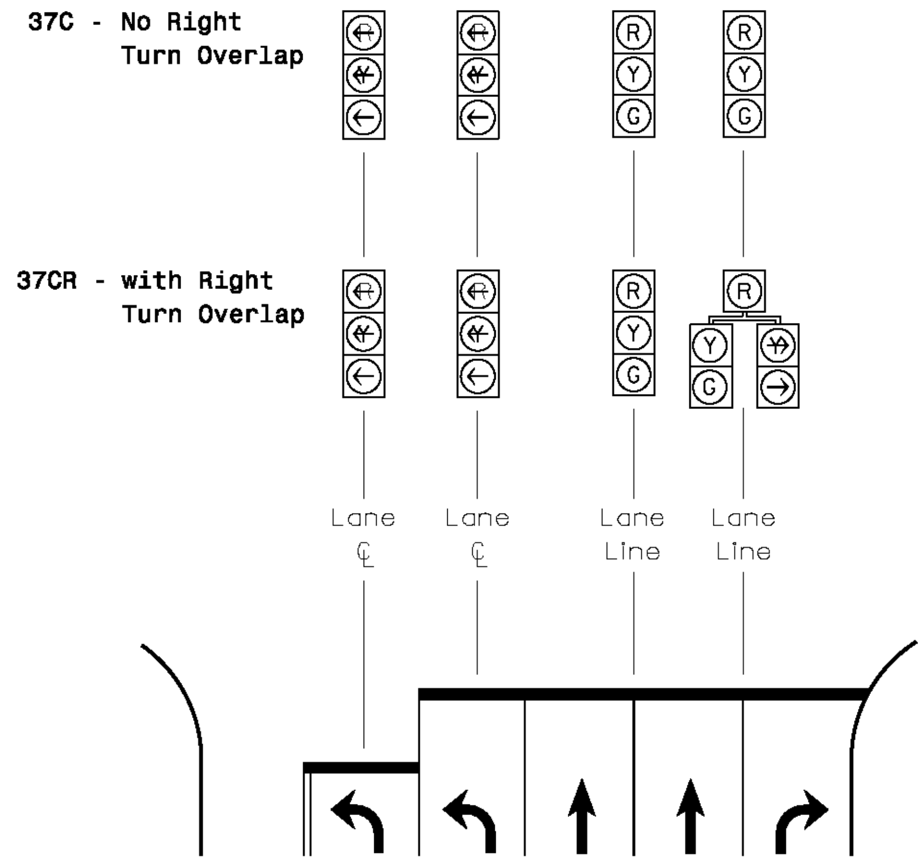
CASE 36

Split Phasing
Signal Head Configuration



CASE 37

Split Phasing
Signal Head Configuration



Signal Head Approach Displays and Alignment

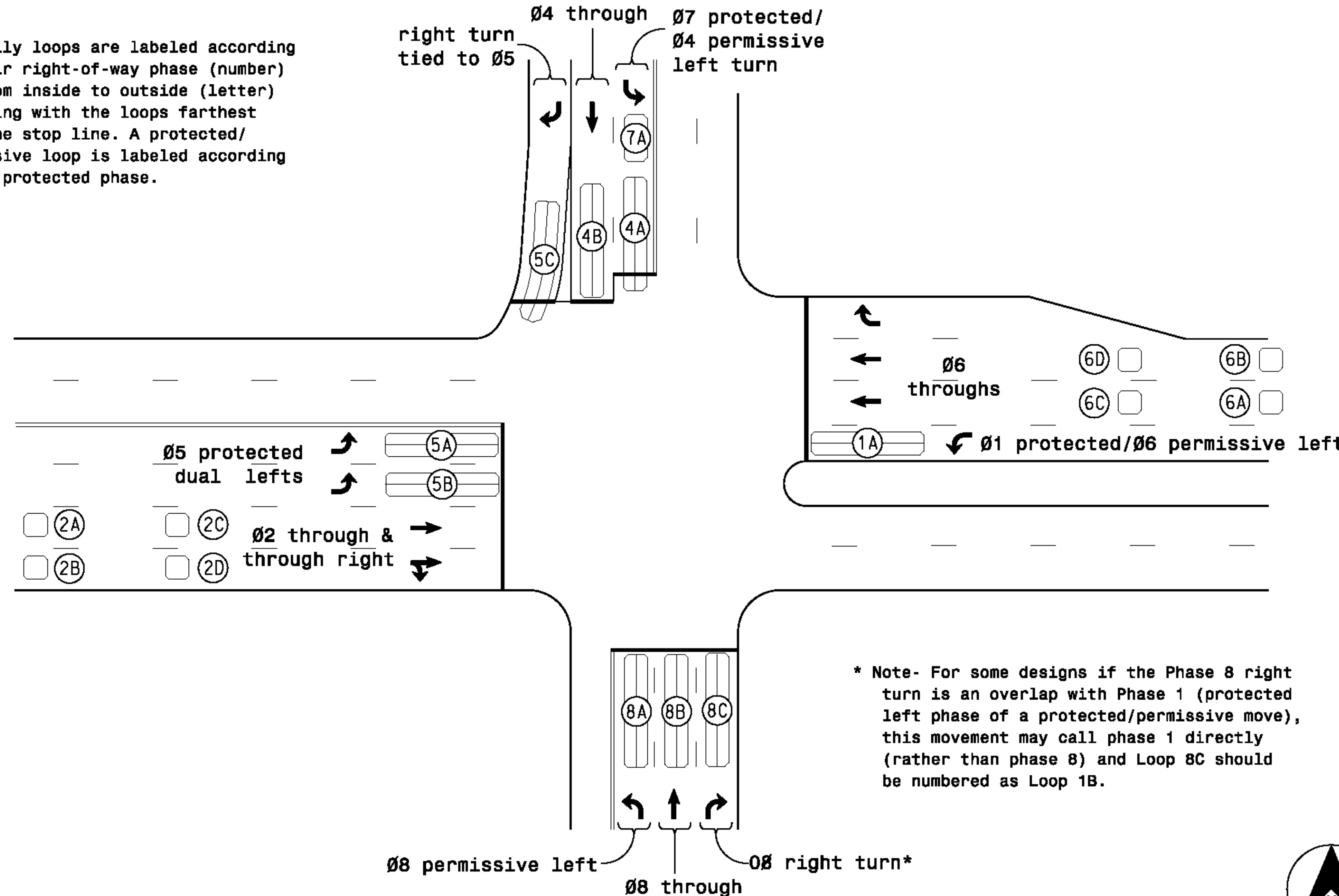
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

12-10

STD. NO. 3.2

SHEET 24 OF 24

Typically loops are labeled according to their right-of-way phase (number) and from inside to outside (letter) beginning with the loops farthest from the stop line. A protected/ permissive loop is labeled according to its protected phase.



* Note- For some designs if the Phase 8 right turn is an overlap with Phase 1 (protected left phase of a protected/permissive move), this movement may call phase 1 directly (rather than phase 8) and Loop 8C should be numbered as Loop 1B.

Typical Numbering of Loops/Detection Zones

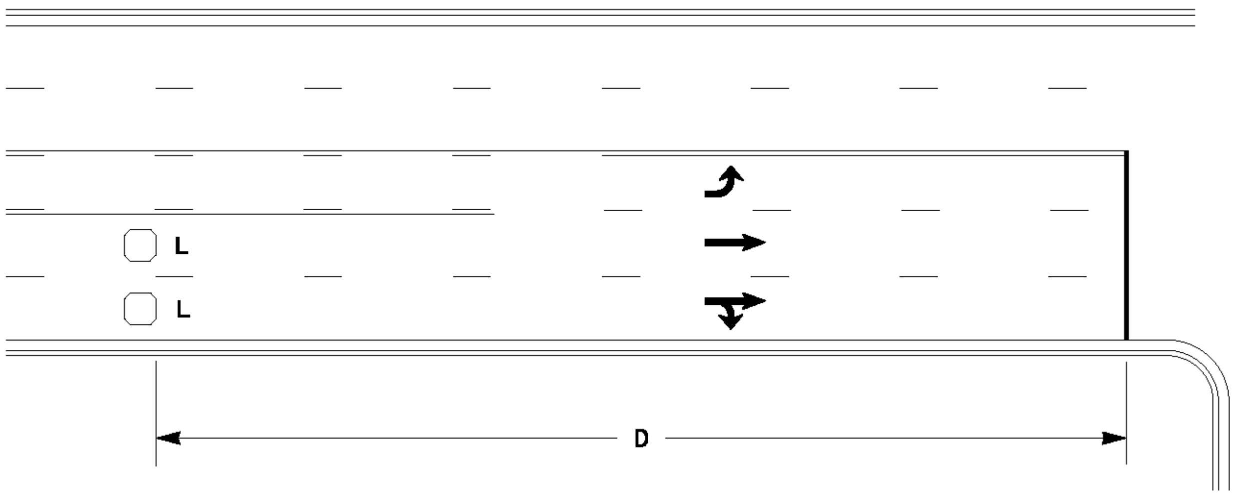
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO. 4.0

SHEET 1 OF 1

Volume Density Operation



L = 6ft X 6ft (1.8m X 1.8m)
Presence loop
Wired in series for TS1 Controllers
Wired to separate detectors/channels
for 170, TS2, and 2070 Controllers

Design Speed mph (km/hr)		D ft	(m)
40	(64)	250	(75)
45	(72)	300	(90)
50	(80)	355	(110)
55	(88)	420	(130)

Design Considerations:

- High speed [≥40 mph (64 km/hr)]
- Preferred option for cost and efficiency

Notes:

- Set vehicle call memory to "LOCK"
- Not appropriate for use with out-of-street detection
- Volume density loops can double as system detectors when wired separately.

Loop Placement for Main Street Through Movements

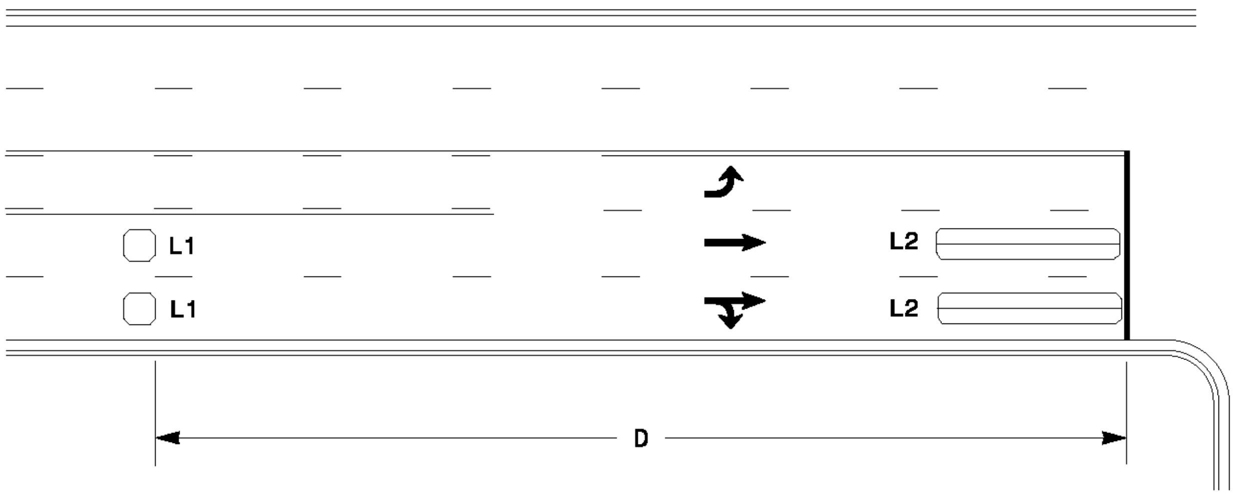
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

11-06

STD. NO. 4.1.1

Volume Density Operation with DC/EC

(Delayed Call/Extended Call)



L1 = 6ft X 6ft (1.8m X 1.8m)
Presence loop
Wired in series for TS1 Controllers
Wired to separate detectors/channels
for 170, TS2, and 2070 Controllers

L2 = 6ft X 40ft
(1.8m X 12.0m)
Quadrupole loop
Wired to separate
detectors/channels

Design Speed mph (km/hr)		D ft (m)		L2 Delay sec	L2 Extend sec
40	(64)	250	(75)	5.0	2.0
45	(72)	300	(90)	5.0	2.0
50	(80)	355	(110)	5.0	2.0
55	(88)	420	(130)	5.0	2.0

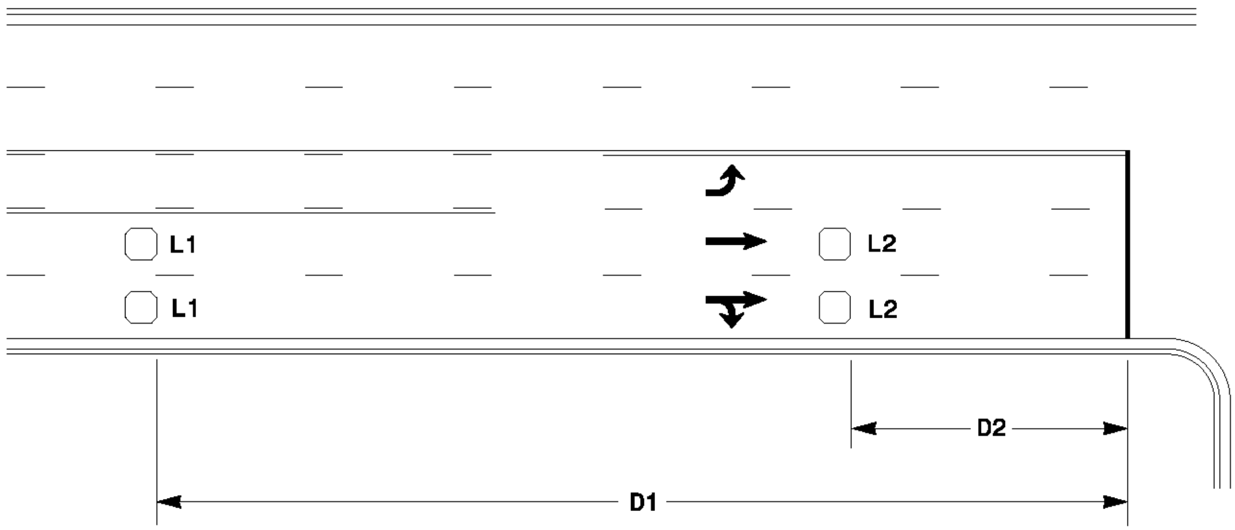
Design Considerations:

- High speed [≥40 mph (64 km/hr)]
- High volume driveways between L1 and L2
- Single lane approach with left turns
- High truck traffic with steep positive grades
- Out-of-street detection
- More efficient than standard "stretch" detection, but costlier to install and maintain

Notes:

- Do not program "ACTUATIONS B4 ADD" (not applicable for 2070 controllers), "SEC. PER ACTUATION" and "MAX. INITIAL"
- Delay on loops L2 must be FULL TIME delay
- Do not program "Vehicle Call Memory" for phases 2 & 6
- Loops L1 can double as system detectors when wired separately

Extend (Stretch) Detection



L1 = 6ft X 6ft
(1.8m X 1.8m)
Presence loop
Wired in series

L2 = 6ft X 6ft
(1.8m X 1.8m)
Presence loop
Wired in series

Design Speed mph (km/hr)		D1 ft	(m)	D2 ft	(m)	Extend sec
40	(64)	250	(75)	80	(25)	1.3
45	(72)	300	(90)	90	(27)	1.6
50	(80)	355	(110)	100	(30)	1.9
55	(88)	420	(130)	110	(35)	2.2

Design Considerations:

- High speed [≥40 mph (64 km/hr)]
- High volume driveways between L1 and L2

Notes:

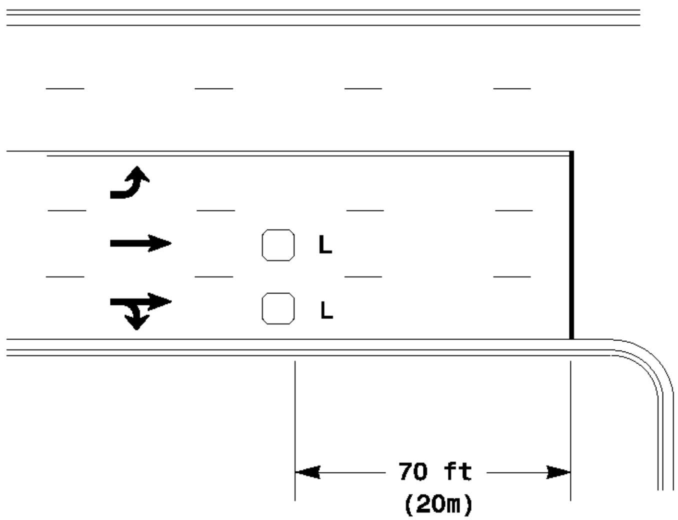
- Appropriate for use with out-of-street detection
- Loops L1 can double as system detectors, IF wired to separate detectors/ channels
- Gap time typically 2.0 seconds
- For TS-1 controllers, round Extend time up to nearest 0.25 seconds
- Loop placement may be varied due to design constraints such as bridges or poor pavement, or non-standard placement of existing loops. In such cases, recalculate Extend times for L1.

$$\text{Extend time (sec)} = \left(\frac{\text{(D1-D2) feet}}{\text{(Design Speed -5) mph}} \times \frac{\text{3600 sec/hr}}{\text{5280 ft/mi}} \right) - \text{Gap time}$$

Loop Placement for Main Street Through Movements

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

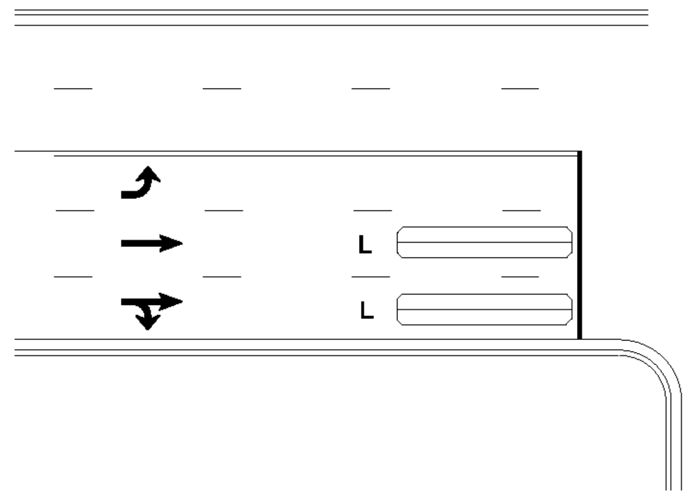
Low Speed Detection



L = 6ft X 6ft (1.8m X 1.8m)
Presence loop, wired in series

Design Considerations:

-Low speed [≤35 mph (56 km/hr)]
-Gap time typically 3.0 seconds
-Preferred option



L = 6ft X 40ft (1.8m X 12.0m)
Quadrupole loop, wired to
separate detectors/channels

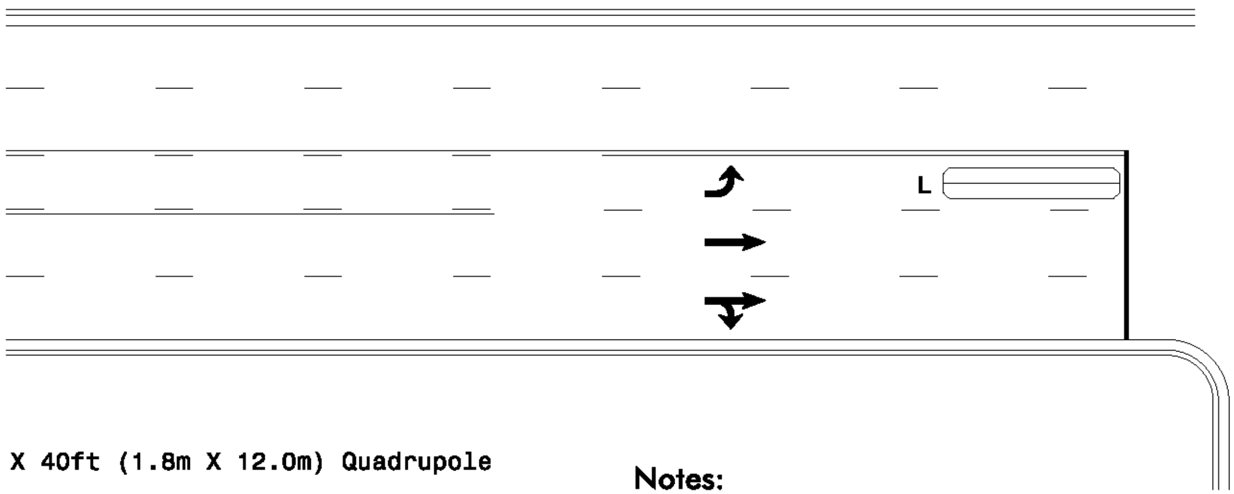
Design Considerations:

-Low speed [≤35 mph (56 km/hr)]
-Gap time typically 0-2 seconds
-Appropriate for use with soft recall

Loop Placement for Main Street Through Movements

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Presence Detector



L = 6ft X 40ft (1.8m X 12.0m) Quadrupole

or, if longer detection area is needed:

6ft X 50ft (1.8m X 15.0m) Quadrupole
or
6ft X 60ft (1.8m X 18.0m) Quadrupole

Notes:

- Loops may not be required for all main street permissive turns
- Option to use 6ft X 6ft (1.8m X 1.8m) loop to wire in series with 70′ through loops.

Loop Type	Delay time	Full Time Delay
Left Turn Loop on Main Street with Low Speed or Stretch Detection	0 sec	N/A
Left Turn Loop on Main Street with Volume Density Detection	3-5 sec	Yes
Left Turn Loop on Side Street	2-3 sec if "clipping" prevention is desired; 0 sec otherwise	No

Loop Placement for Permissive Left Turns

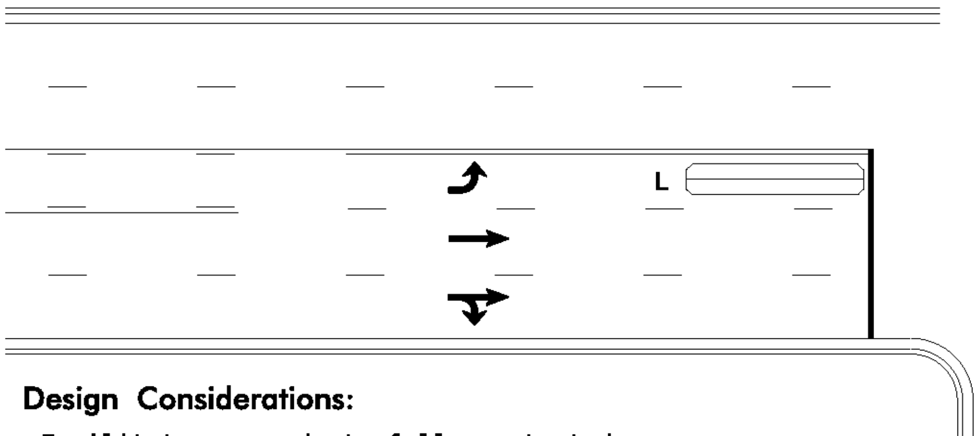
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

5-05

STD. NO. 4.1.2

SHEET 1 OF 1

Presence Loop with 2 Channel Detector



L = 6ft X 40ft (1.8m X 12.0m) Quadrupole loop

or, if longer detection area is needed:

6ft X 50ft (1.8m X 15.0m) Quadrupole loop
or
6ft X 60ft (1.8m X 18.0m) Quadrupole loop

Design Considerations:

- Facilitates upgrade to fully protected or downgrade from fully protected
- Calls up arrow when 1 or 2 cars waiting to turn
- Consider queue loop (Std. No. 4.1.3:2) for light left turn traffic or for light opposing through traffic

Note:

- Calling/extending the permissive phase may not be required for main street loops
- Gap time typically 1-3 seconds

Loop Type	Detector Channel	Phase	Delay Time	Full Time Delay
Left Turn Loop on Main Street with Low Speed or Stretch Detection	1	Protected Phase	10-30 sec	No
	2	Permissive Phase	0 sec	N/A
Left Turn Loop on Main Street with Volume Density Detection	1	Protected Phase	10-30 sec	No
	2	Permissive Phase	3-5 sec	Yes
Left Turn Loop on Side Street	1	Protected Phase	10-30 sec	No
	2	Permissive Phase	2-3 sec if "clipping" prevention is desired; 0 sec otherwise	No

Loop Placement for Protected/Permissive Left Turns

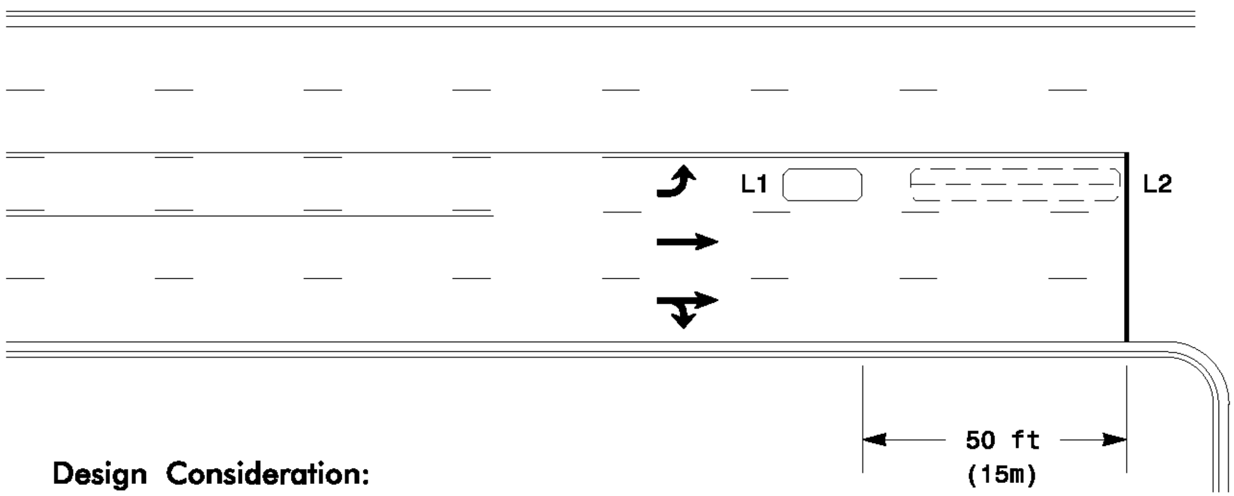
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

5-05

STD. NO. 4.1.3

SHEET 1 OF 2

Queue Detector Loop



L1 = 6ft X 15ft (1.8m X 4.5m)
Presence loop (Queue detector) with Call delay

L2 = 6ft X 40ft (1.8m X 12.0m)
Quadrupole loop

Notes:

- L2 is optional when permitted phase has minimum recall
- L1 min green typically 8 seconds
- L1 gap time typically 2-4 seconds
- L2 gap time typically 1-3 seconds

Design Consideration:

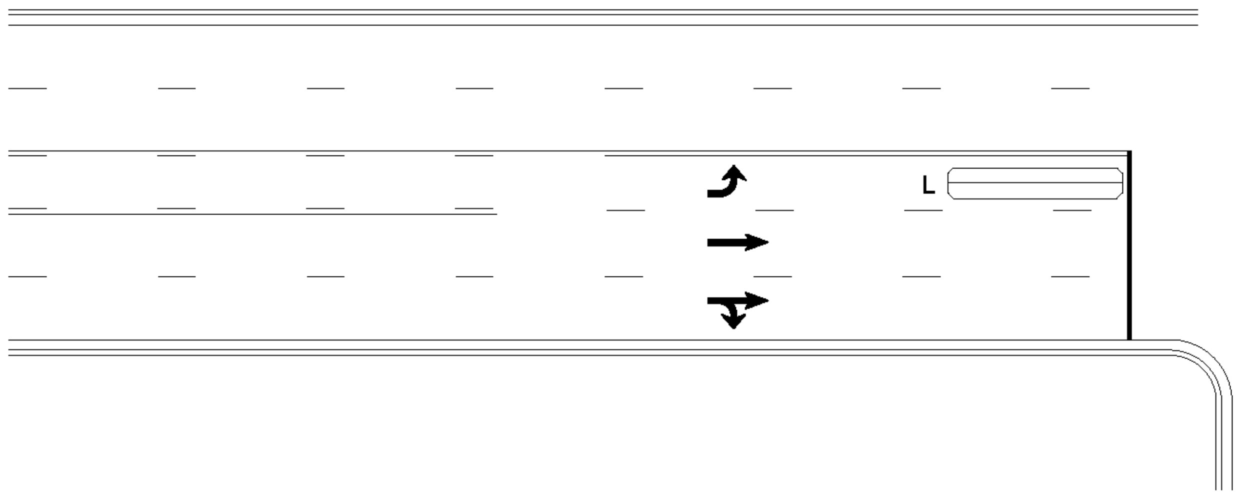
- Calls up arrow when 3 or more cars waiting to turn
- Consider for side street left turns

Loop Type	Phase	Delay Time	Full Delay Time
L1: Queue Detector	Protected Phase	5-15 sec	No
L2: Left Turn Loop on Main Street with Low Speed or Stretch Detection	Permissive Phase	0 sec	N/A
L2: Left Turn Loop on Main Street with Volume Density Detection	Permissive Phase	3-5 sec	Yes
L2: Left Turn Loop on Side Street	Permissive Phase	2-3 sec if "clipping" prevention is desired; 0 sec otherwise	No

Loop Placement for Protected/Permissive Left Turns

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Presence Detector



L = 6ft X 40ft (1.8m X 12.0m) Quadrupole

or, if longer detection area is needed:

6ft X 50ft (1.8m X 15.0m) Quadrupole
or
6ft X 60ft (1.8m X 18.0m) Quadrupole

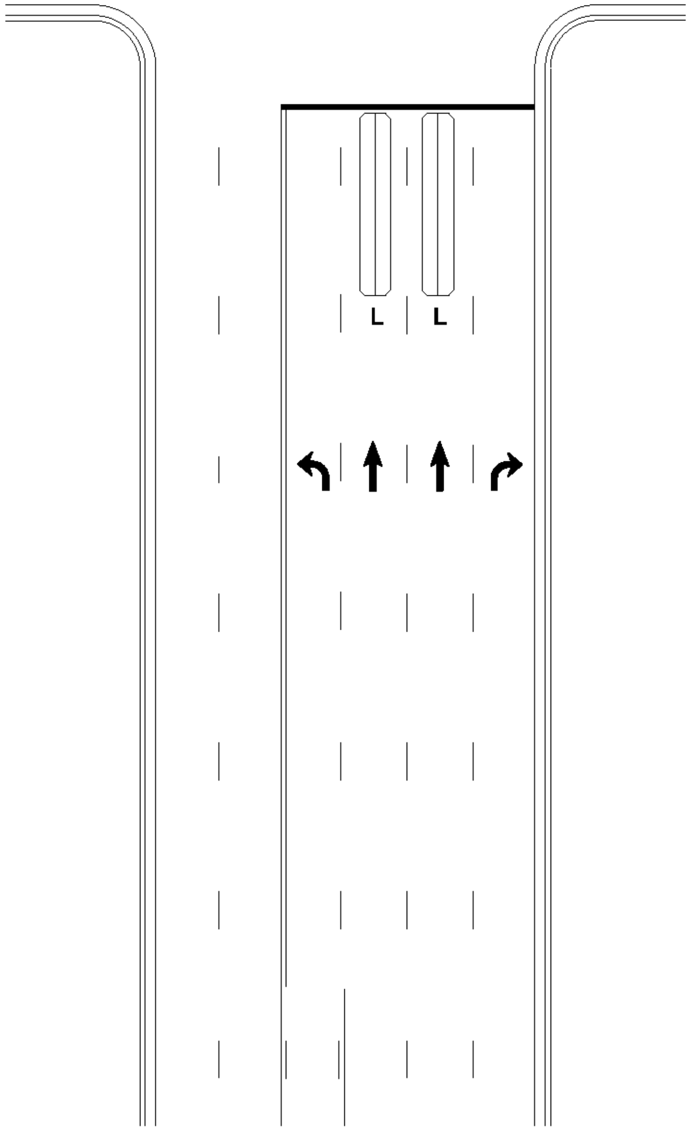
Notes:
- Gap time typically 1-3 seconds
- A short (2 or 3 sec) call delay may be used if turning vehicles are able to "clip" loop L
- If call delay is used, do not program full time delay

Loop Placement for Protected Left Turns

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

5-05

STD. NO. 4.1.4



Typical Presence Detection

L = 6ft X 40ft (1.8m X 12.0m)
Quadrupole loop
Wired to separate detectors/channels

or, if longer detection area is needed:

6ft X 50ft (1.8m X 15.0m) Quadrupole
or
6ft X 60ft (1.8m X 18.0m) Quadrupole

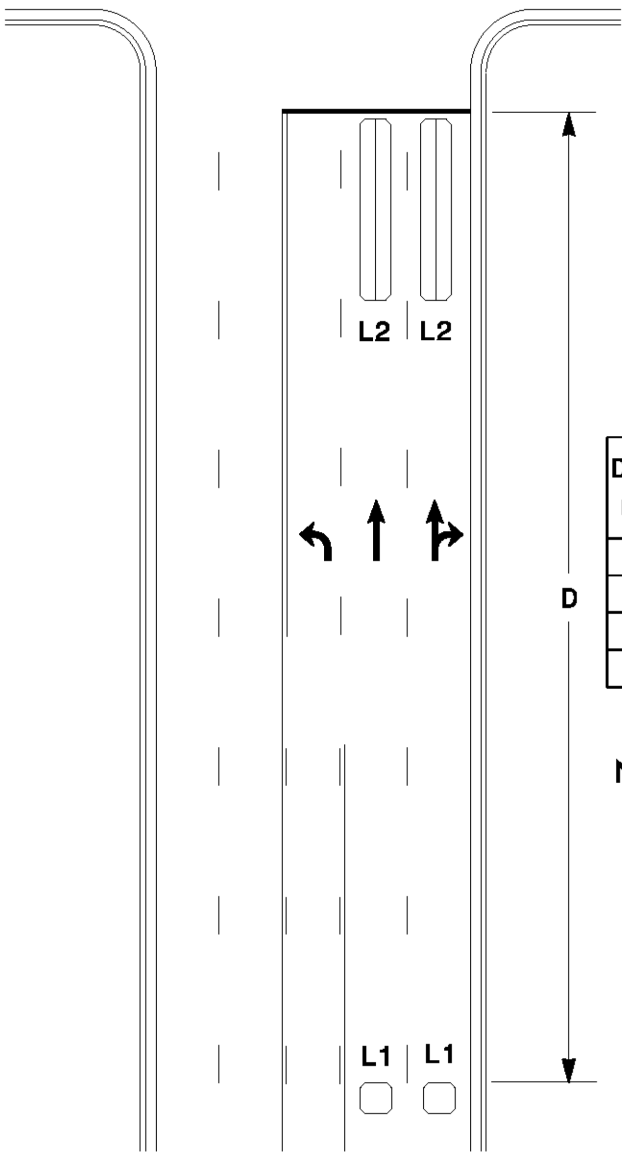
Notes:

- Consider delay (NOT full time) if through lane is shared with a right-turn move, except where right turn on red is prohibited
- Gap time typically 1-3 seconds
- Consider higher gap time or longer detection area under the following circumstances:
  - Steep positive approach grade
  - High truck volumes

Loop Placement for Side Street Through Movements

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Volume Density Operation with DC/EC
(Delayed Call/Extended Call



L1 = 6ft X 6ft (1.8m X 1.8m) Presence loop
Wired in series for TS1 Controllers
Wired to separate detectors/channels
for 170, TS2, and 2070 Controllers

L2 = 6ft X 40ft (1.8m X 12.0) Quadrupole loop
Wired to separate detectors/channels

Design Speed mph (km/hr)	D ft (m)	L2 Delay sec	L2 Extend sec
40 (64)	250 (75)	5.0	2.0
45 (72)	300 (90)	5.0	2.0
50 (80)	355 (110)	5.0	2.0
55 (88)	420 (130)	5.0	2.0

Design Considerations:

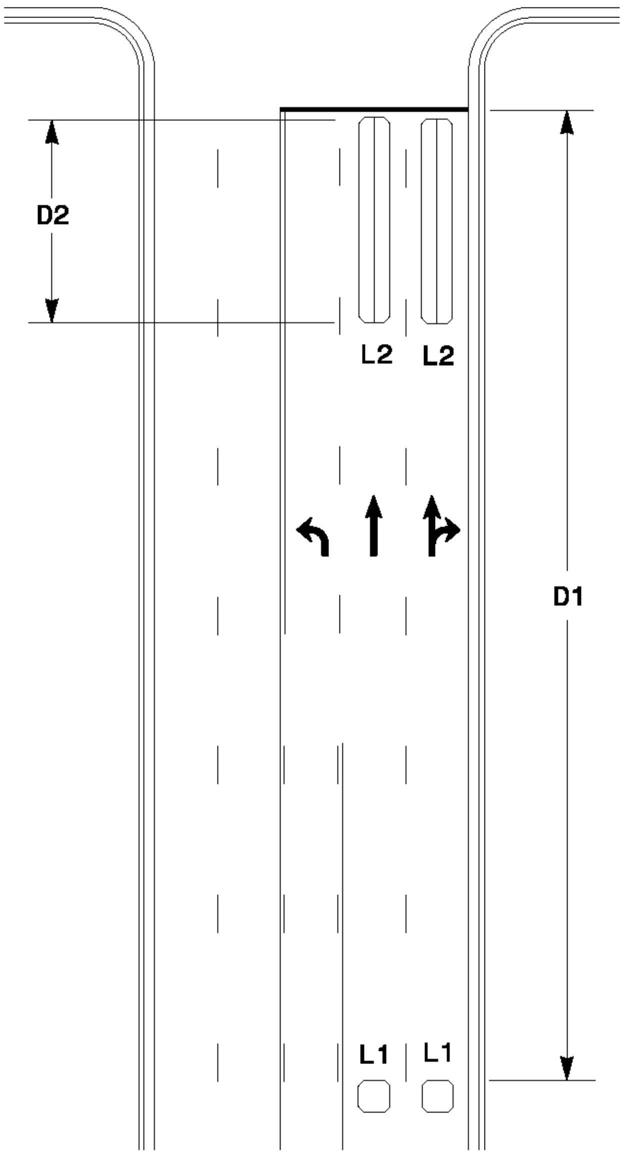
- Cross intersection AND
- High speed [≥40 mph (64 km/hr)] AND
- Good horizontal and vertical alignment
- In some cases can provide better efficiency than "stretch" detection

Notes:

- Do not program "ACTUATIONS B4 ADD" (not applicable for 2070 controllers), "SEC. PER ACTUATION" and "MAX. INITIAL."
- Delay on loops L2 must be FULL TIME delay
- Do not program "Vehicle Call Memory" for phases 4 & 8.
- Loops L1 should be programmed for "EXTENSION" but NOT "CALLING."
- For TS2 controllers, loops L1 must be programmed with 100 second delay (INHIBIT DELAY DURING GREEN = YES) to ensure that the loop acts to extend the phase only.
- Loops L1 can double as system detectors if wired separately.

Loop Placement for Side Street Through Movements

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



Extend (Stretch) Detection

L1 = 6ft X 6ft (1.8m X 1.8m)
Presence loop, Wired in series

L2 = 6ft (1.8m) X D2 Quadrupole loop
Wired to separate detectors/channels

Design Speed mph (km/hr)	D1 ft (m)	D2 ft (m)	Gap Time sec	L1 Extend sec
40 (64)	250 (75)	40 (12)	2.0	2.1
		60 (18)	1.0	2.7
45 (72)	300 (90)	40 (12)	2.0	2.4
		60 (18)	1.0	3.1
50 (80)	355 (110)	40 (12)	2.0	2.8
		60 (18)	1.0	3.5
55 (88)	420 (130)	40 (12)	2.0	3.2
		60 (18)	1.0	3.9

Design Considerations:

- -Cross intersection AND
- -High speed [≥40 mph (64 km/hr)] AND
- -Good horizontal and vertical alignment

Notes:

- -Loops L1 should be programmed for "EXTENSION" but NOT "CALLING."
- -For TS-1 controllers, round Extend time up to nearest 0.25 seconds.
- -Loop placement may be varied due to design constraints such as bridges or poor pavement, or non-standard placement of existing loops. In such cases, recalculate Extend times for L1 (See Std. 4.1.1:3).
- -For TS2 controllers, in addition to appropriate extend time, loops L1 must be programmed with 100 second delay (INHIBIT DELAY DURING GREEN = YES) to ensure that the loop acts to only extend the phase.
- -Loops L1 can double as system detectors, if wired separately.

Loop Placement for Side Street Through Movements

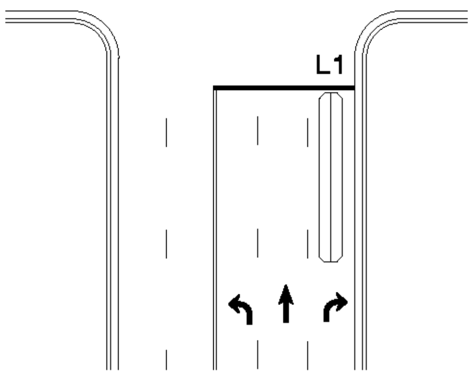
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 4.1.5

SHEET 3 OF 3

Typical Detector Layouts

Standard Turn

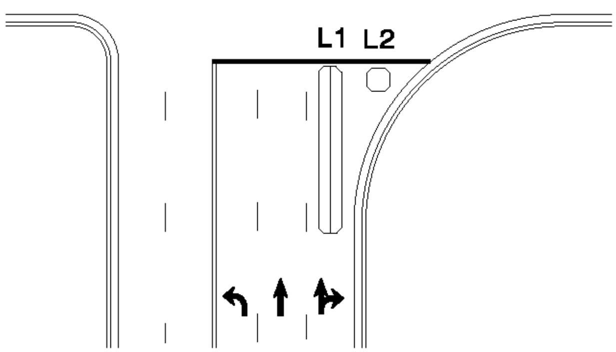


L1 = 6ft X 40ft (1.8m X 12.0m) Quadrupole loop
L2 = 6ft X 6ft (1.8m X 1.8m) [Minimum] Presence loop
Wired to separate detector/channel
L3 = 6ft X 30ft (1.8m X 9.0m) Quadrupole loop

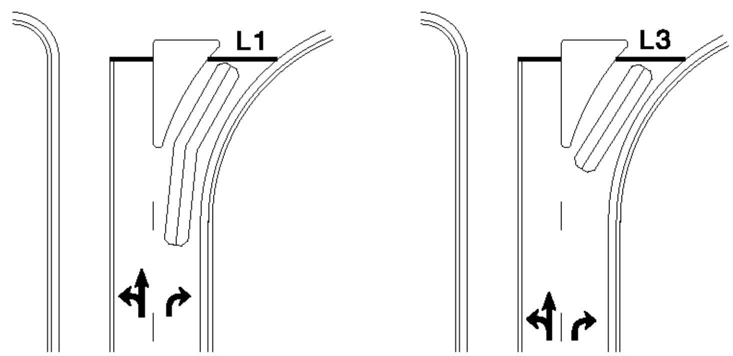
Notes:

- Call delay appropriate for right turn loops unless right turn on red is prohibited.
- Suggestions for delay:
  - Exclusive right turn lane: 15 sec
  - Right turn lane shared with through or through/ left movement: 10 sec or greater
- Do not program full time delay.

Wide Radius Turn



Channelized Turn



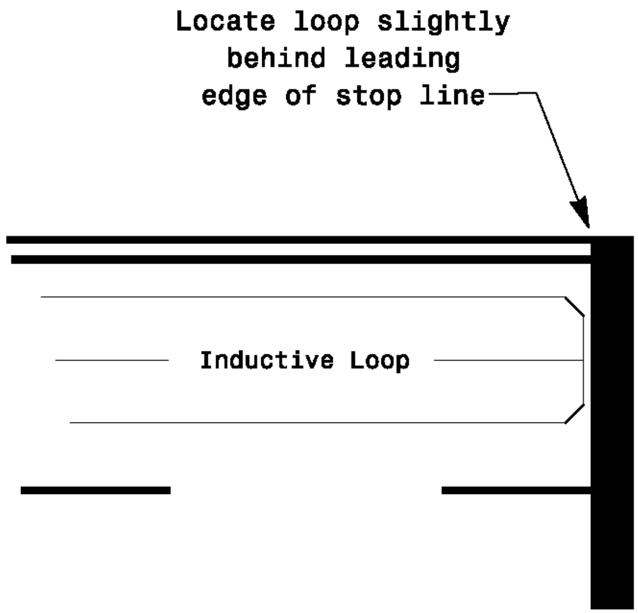
Delete detection for yield condition

Loop Placement for Side Street Right Turns

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

5-05

STD. NO.
4.1.6
SHEET 1 OF 1



Note:
Loop may be located in advance of stop line when stop line is greater than 15′ (4.5m) from edge of intersecting roadway; or, when loop detects a permissive or protected/permissive left turn.

Placement of Presence Loops

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
4.1.7
SHEET 1 OF 1

5-05

Loop Dimension ft (m)	Turns	Inductance µh	Loop Wire ft (m)	Sealant gal * (liter)	Sawcut ft (m)
6 X 6 (1.8 X 1.8)	3	72	72 (22)	0.8 (3)	24 (7)
	4	120	96 (30)		
	5	180	120 (37)		
	6	252	144 (44)		
6 X 15 (1.8 X 4.5)	2	63	84 (26)	1.3 (5)	42 (13)
	3	126	126 (39)		
	4	210	168 (52)		
6 X 25 (1.8 X 7.5)	2-4-2	218	224 (69)	2.7 (10)	87 (27)
6 X 30 (1.8 X 9.0)	2-4-2	258	264 (81)	3.1 (12)	102 (31)
6 X 40 (1.8 X 12.0)	2-4-2	338	344 (105)	4.0 (16)	132 (41)
6 X 50 (1.8 X 15.0)	2-4-2	418	424 (130)	5.0 (19)	162 (50)
6 X 60 (1.8 X 18.0)	2-4-2	498	504 (154)	5.9 (23)	192 (59)

* Amount of sealant is rounded up to nearest tenth of a gallon or liter

Amount of Inductance, Loop Wire, Sealant and Sawcut for Inductive Loops

Calculate additional loop wire or sawcut for loop wire tail section by measuring length of tail section from loop to edge of pavement.

OR

ENGLISH $L\ (ft) = 6 + (N-1)12$

METRIC $L\ (m) = 1.8 + (N-1)3.6$

Where: L = Length of loop wire or sawcut
N = Number of lanes crossed by tail section

To calculate additional sealant for loop wire tail section:

ENGLISH $S\ (gal) = L\ (ft)\ /\ 33$

METRIC $S\ (liters) = L\ (m)\ /\ 2.6$

Where: S = Amount of sealant
L = Length of sawcut required for tail section

Loop Wire and Lead–In Calculations

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

5-05

STD. NO. 4.2

Loop Inductance Notes

-Loop inductance should be equal to or greater than the lead-in inductance. A 2-to-1 ratio is preferable.

-Average lead-in cable inductance is .22µh/ft (.72µh/m)

-The minimum total inductance on a single digital detector (channel) is 50 uh, the maximum is 1000 µh.

-The maximum number of turns is 6.

-If the loop (excluding quadrupoles) will have more than 2" (50mm) of cover, add 1 turn to the loop over the normal calculated number of turns.

-Loops connected in series

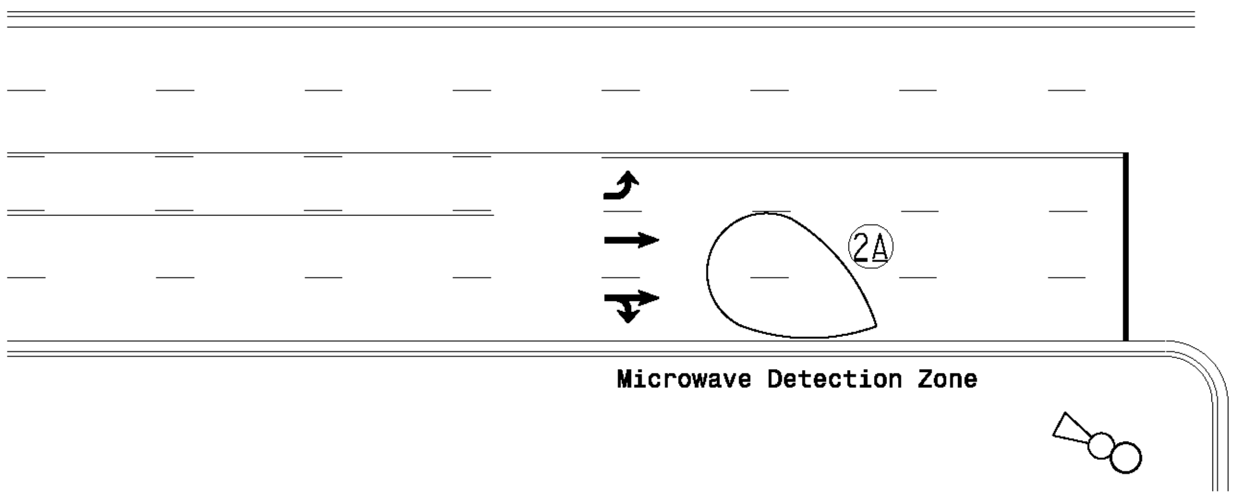
$L_{Total} = L_1 + L_2 + \ldots + L_N$

Where: N = Number of loops in series
L = Loop inductance (µh)

-Recommended number of turns for a single 6' X 6' (1.8m X 1.8m) loop:

Length of Lead-in ft (m)	Number of Turns
< 250 (75)	3
250-375 (75-115)	4
375-525 (115-160)	5
> 525 (160)	6

Microwave Vehicle Detector



Design Consideration:

- Loops are not feasible due to bridges, poor pavement or anywhere loop lead-in can not be reasonably maintained such as constructions zones, etc.
- Typically used for only one to two detection areas, or one approach of an intersection.

Notes:

- Requires one microwave detector unit per detection zone.
- Microwave detector needs to face traffic.
- Some microwave detectors have specific detection zone size parameters based on mounting height and distance from zone.
- Cannot be used for system detection or vehicle counting.

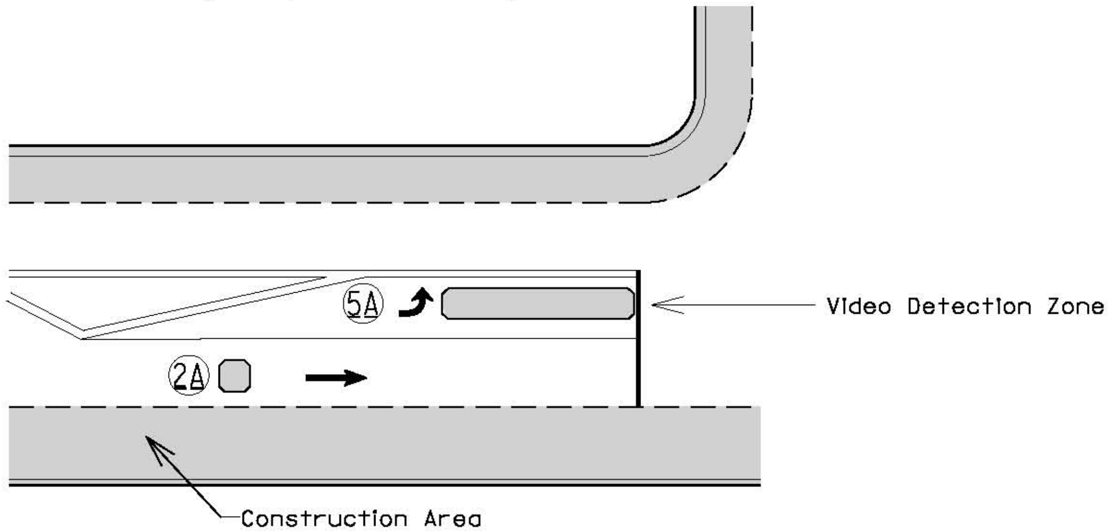
2070L LOOP & DETECTOR INSTALLATION

INDUCTIVE LOOPS					DETECTOR PROGRAMMING							
LOOP	SIZE (FT)	TURNS	DISTANCE FROM STOPBAR (FT)	NEW LOOP	PHASE	CALLING	EXTENSION	FULL TIME DELAY	SYSTEM LOOP	STRETCH TIME	DELAY TIME	NEW CARD
2A	*	*	70	Y	2	Y	Y	-	-	-	-	*

*Microwave Detection Zone

Out–of–Street Detection

Video Detection Systems
(Loop Emulator)



Design Consideration:

- Loops are not feasible due to bridges, poor pavement, or anywhere loop lead-in can not be reasonably maintained such as constructions zones, etc.
- Flexibility is desired in detection areas due to traffic shifts associated with constuction phasing
- All other detection options have been exhausted.

Notes:

- Cannot be used for vehicle counting.
- Cannot be used for system detection.

2070L LOOP & DETECTOR INSTALLATION													
INDUCTIVE LOOPS					DETECTOR PROGRAMMING								
LOOP	SIZE (FT)	TURNS	DISTANCE FROM STOPBAR (FT)	NEW LOOP	PHASE	CALLING	EXTENSION	FULL TIME DELAY	SYSTEM LOOP	STRETCH TIME	DELAY TIME	NEW CARD
2A	6X6	*	70	*	2	Y	Y	-	-	-	-	*
5A	6X40	*	0	*	5	Y	Y	-	-	-	-	*

*Video Detection Zone

Out–of–Street Detection

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

NOTES		WHEN TO USE	
L 01	Refer to "Roadway Standard Drawings NCDOT" dated July 2006 and "Standard Specifications for Roads and Structures" dated July 2006.	**H 01**	All Plans except Developer Plans
L 03	Refer to "Roadway Standard Drawings NCDOT" dated July 2006, "Standard Specifications for Roads and Structures" dated July 2006, and all applicable sections of the latest version of the generic Project Special Provisions. The PSP can be accessed at the following website: http://www.ncdot.org/doh/preconstruct/traffic/itss/	**H 03**	Developer Plans
L 04	Do not program signal for late night flashing operation unless otherwise directed by the Engineer.	**H 04**	For locations without railroad preemption
L 05	This location contains railroad preemption phasing. Do not program signal for late night flashing operation.	**H 05**	For locations with railroad preemption
L 10	Omit phase 1 during phase 2 on.	**H 10**	Phase omit note for TS1,TS2, and 2070 operation
L 11	Program phase 1 as protected/permissive.	**H 11**	Phase omit note for 170 operation
L 12	Omit phase 5 during phase 6 on.	**H 12**	Phase omit note for TS1,TS2, and 2070 operation
L 13	Program phase 5 as protected/permissive.	**H 13**	Phase omit note for 170 operation
L 14	Omit phase 3 during phase 4 on.	**H 14**	Phase omit note for TS1,TS2, and 2070 operation
L 15	Program phase 3 as protected/permissive.	**H 15**	Phase omit note for 170 operation
L 16	Omit phase 7 during phase 8 on.	**H 16**	Phase omit note for TS1,TS2, and 2070 operation
L 17	Program phase 7 as protected/permissive.	**H 17**	Phase omit note for 170 operation
L 18	Wire cabinet to allow the controller to clear from phase # to phase # by progressing through phase # (see Electrical Details for wiring).	**H 18**	Additional note for omit situations for TS1 operation
L 19	Program controller to clear from phase # to phase # by progressing through phase # (see Electrical Details).	**H 19**	Additional note for omit situations for TS2, 2070, and 170 operation
L 20	Enable Backup Protect for phase # to allow the controller to clear from phase # to phase # by progressing through an all red display.	**H 20**	Alternate to Phase Omits in 2070s. Used with Red Revert.
L 21	Disable Backup Protect for phase #.	**H 21**	Use for FYA plans with existing 2070 cabinets where backup protection is no longer needed.

NOTES		WHEN TO USE	
L 22	Phase 1 and/or phase 5 may be lagged.	**H 21**	Use for exclusive left turns and Flashing Yellow Arrows
L 23	Phase 3 and/or phase 7 may be lagged.	**H 22**	Use for exclusive left turns and Flashing Yellow Arrows
L 24	The order of phase 3 and phase 4 may be reversed.	**H 23**	Use for split side streets
L 25	Program phase 4 and phase 8 for dual entry.	**H 24**	For use with TS-1 or TS-2 equipment
L 30	Relocate existing signal heads numbered #.	**H 30**	Use when head is moved to new span
L 31	Reposition existing signal heads numbered #.	**H 31**	Use when head is "slid" on same span
L 32	Install backplates for signal heads numbered #.	**H 32**	As needed
L 33	Tether signal heads numbered #.	**H 33**	As needed
L 40	Run all lead-in cable overhead on existing utility poles where possible.	**H 40**	Urban projects with many driveways
L 41	Abandon existing loops #.	**H 41**	As needed, usually by contracts
L 42	Use controller input delay for phase #. Override channel # call delay during peak hours.	**H 42**	Add this note for variation on protected-permissive design.
L 43	Set all detector units to presence mode.	**H 43**	All Plans
L 44	In the event of loop replacement, refer to the current ITS and Signals Design Manual and submit a Plan of Record to the Signal Design Section.	**H 44**	Use when not replacing “old style” loops
L 50	Locate new cabinet so as not to obstruct sight distance of vehicles turning right on red.	**H 50**	All plans with new cabinets
L 51	The cabinet should be designed to include an Auxiliary Output File for future use.	**H 51**	Use on plans with new 2070 cabinets and no FYA
L 52	Program all timing information into phase banks 1, 2, and 3 unless otherwise noted.	**H 52**	Standard with 170 operation
L 53	Set phase bank 3 maximum limit to 250 seconds for phases used.	**H 52**	Signal system plans with 170s
L 60	Omit "WALK" and flashing "DON'T WALK" with no pedestrian calls.	**H 60**	Use for pedestrian-activated signals

	NOTES		WHEN TO USE
L 61	Program pedestrian heads to countdown the flashing "Don't Walk" time only.	**H 61**	Use with countdown peds
L 70	Flash beacon # continuously.	**H 70**	Actuated flasher plan
L 71	Flash beacons # when actuated by loop #.	**H 71**	Actuated flasher plan
L 80	Thirty days after implementation of the revised signal operation, signs # and/or orange flags may be removed at the discretion of the Regional Traffic Engineer.	**H 80**	Use on plans being revised from fully protected or split side street phasing to protected-permissive phasing
L 81	Remove existing "Left Turn Signal" sign(s)-(R10-10L) and/or existing "Right Turn Signal" sign(s)-(R10-10R).	**H 81**	As needed
L 82	Existing "Left Turn Yield on Green" ball sign(s)-(R10-12) may be removed at the discretion of the Regional Traffic Engineer.	**H 82**	As needed
L 90	Pavement markings are existing.	**H 90**	Signal upgrades
L 91	Repaint stopbars and/or crosswalks.	**H 91**	As needed
L 92	Install pavement markings to designate lane separations for **APPROACH**.	**H 92**	As needed
L 93	Revise pavement markings as shown. All pavement markings and raised reflective markings shown are a representation of actual placement criteria. Refer to NCDOT Roadway Standard Drawings actual placement.	**H 93**	Safety plan with proposed reflectorized markings
L 100	Install box span, if possible.	**H 100**	As needed
L 110	This is a proposed plan view only. Field adjust all drainage, superelevation, utility conflicts, and grade changes.	**H 110**	Geometric changes only.
L 120	Locate emergency vehicle preemption switch in **LOCATION**.	**H 120**	Emergency vehicle preemption (pushbutton actuated)
L 121	The Division Traffic Engineer will determine the Delay Time and Preempt Dwell Min Time for the emergency vehicle preemption timing.	**H 121**	Emergency vehicle preemption (pushbutton actuated)
L 122	This intersection features an optical preemption system. Shown locations of optical detectors are conceptual only.	**H 122**	Optical preemption

NOTES		WHEN TO USE	
L 123	Program signal heads numbered # to clear to all red before going into preempt.	**H 123**	Use in place of dummy phase for emergency vehicle preemption
L 124	Ensure flashing operation does not alter operation of blankout signs.	**H 124**	Standard with RR preemption with blank-out signs
L 125	Clear signal heads numbered # from flashing 8" yellow to steady 12" yellow during interval 1 and steady red during interval 2.	**H 125**	RR preemption plans with advance flashing heads (for non-standard clearance)
L 126	Program start vehicle call OFF for phase #.	**H 126**	RR preemption plans with preempt phase that does not have corresponding regular phase (170 controller)
L 127	Program parent phases for Overlap “P” for all phases used in normal operation.	**H 127**	Most signal plans with railroad preemption that have a Track Clearance phase.
L 128	Upon completion of Railroad (or Emergency Vehicle) Preemption, controller returns to normal operation based on vehicle demand.	**H 128**	RR or EV Preemption plan when an exit phase (first normal phase served after preemption) is not or cannot be designated
L 129	The Division Traffic Engineer will determine the hours of use for each phasing plan.	**H 129**	Flashing Yellow Arrow plans designed with multiple or time of day phasing options.
L 131	These loops serve as queue backup detectors. After # seconds of constant actuation, the detector unit places a call to the controller to preempt normal operation to clear out the storage lanes.	**H 131**	Backup queue detectors
L 132	Existing Yellow Change Interval for phase # may be decreased by # seconds per week until the required value is reached.	**H 132**	Major adjustments to clearance times
L 133	Maximum times shown in timing chart are for free-run operation only. Coordinated signal system timing values supersede these values.	**H 133**	Standard with coordination
L 134	Closed loop system data: Intersection Number #, Local telemetry address number #, Channel number #.	**H 134**	Closed loop signal system plans
L 135	Closed loop system data: Master Asset #, Controller Asset #.	**H 135**	2070 Closed loop signal system plans

	OASIS 2070L LOOP & DETECTOR INSTALLATION CHART													
	INDUCTIVE LOOPS					DETECTOR PROGRAMMING								
	LOOP	SIZE (FT)	DISTANCE FROM STOPBAR (FT)	TURNS	NEW LOOP	PHASE	CALLING	EXTENSION	FULL TIME DELAY	STRETCH TIME	DELAY TIME	SYSTEM LOOP	NEW CARD
Volume density loops combined w/system loops	2A/S1	6X6	420	5	Y	2	Y	Y	–	–	–	Y	Y
	2B/S2	6X6	420	5	Y	2	Y	Y	–	–	–	Y	Y
Queue Detector	3A	6X15	50	3	Y	3	Y	Y	–	–	15	–	Y
	8A	6X40	+5	2-4-2	Y	8	Y	Y	–	–	–	–	Y
Volume Density with DC/EC for sidestreet	4A	6X6	300	5	Y	4	–	Y	–	–	–	–	Y
	4B	6X40	0	2-4-2	Y	4	Y	Y	Y	2.0	5	–	Y
Left turn loop calling 2 phases (with volume density on phase 2)	5A	6X60	0	2-4-2	Y	5	Y	Y	–	–	15	–	Y
						2	Y	Y	Y	–	3	–	Y
Stretch loops	6A, 6B	6X6	300	EXISTING	–	6	Y	Y	–	1.6	–	–	Y
	6C, 6D	6X6	90	EXISTING	–	6	Y	Y	–	–	–	–	Y
System Loop	S3	6X6	+120	4	Y	–	–	–	–	–	–	Y	Y

Oasis 2070L Controller

Detector Programming Attributes

Calling - Select to place call during red. Selecting this attribute is similar to selecting ALL for NEMA's "Place Call During Phase." (Usually selected)

Extension - Select to extend the green time. Gap resets after each call. Must be selected whenever Vehicle Extension Time is entered in the timing chart. (Usually selected)

Full Time Delay - Select to delay during red, yellow, and green. If not selected, controller will time delay during red and yellow only. Selecting this attribute is equivalent to selecting NO for NEMA's "Inhibit Delay During Green." (Usually not selected)

Stretch Time - Enter times in intervals of .1 second

Loop Chart Typicals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO. 5.1

SE-PAC 2070: Use with Burlington, Hickory and Raleigh Signal Systems

SE-PAC 2070 LOOP & DETECTOR UNIT INSTALLATION CHART

	INDUCTIVE LOOPS						DETECTOR PROGRAMMING														
							ASSIGNED PHASE	TIMING		OPERATION MODE								SWITCH	SYSTEM LOOPS	STATUS	
										0	1	2	3	4	5	6	7				
	LOOP NO.	SIZE (ft)	TURNS	DIST. FROM STOPBAR (ft)	NEW	EXISTING		DELAY	EXTEND (STRETCH)	VEHICLE	PEDESTRIAN	1 CALL	STOP A	STOP B	PROT/PER LEFT	PROT/PER THROUGH	AND			NEW	EXISTING
VD loops combined w/system loops	2A/S1	6X6	5	300	X	–	2	– SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
	2B/S2	6X6	5	300	X	–	2	– SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
Volume Density with DC/EC for sidestreet	4A	6X6	5	300	X	–	4	100 SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
	4B	6X40	2-4-2	0	X	–	4	5 SEC.	2.0 SEC.	X	–	–	–	–	–	–	–	–	–	X	–
Left turn loop calling 2 phases	5A	6X40	2-4-2	0	X	–	5	15 SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
							2	– SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
Stretch loops	6A; 6B	6X6	5	300	X	–	6	– SEC.	1.6 SEC.	X	–	–	–	–	–	–	–	–	X	X	–
	6C; 6D	6X6	5	90	X	–	6	– SEC.	– SEC.	X	–	–	–	–	–	–	–	–	X	X	–
Protected Left Turn Loop	7A	6X40	2-4-2	0	X	–	7	3 SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
Sidestreet Loop	8A	6X40	2-4-2	0	X	–	8	10 SEC.	– SEC.	X	–	–	–	–	–	–	–	–	–	X	–
System Loop	S3	6X6	5	+125	X	–	–	– SEC.	– SEC.	–	–	–	–	–	–	–	–	–	X	X	–

Detector Programming Attributes

Vehicle- Vehicle detector operates as standard vehicle detector

Pedestrian - Vehicle detector operates as standard pedestrian detector (Not Used)

1 Call - Typically Not Used

Stop A - Typically Not Used

Stop B - Typically Not Used

Prot/Per Left - Typcially Not Used

Prot/Per Through - Typically Not Used

And - Typically Not Used

Switch - List an alternate phase that could be extended when green by loop detection while the assigned primary phase is red (Not Normally Used)

Extend (Stretch) - Enter times in intervals of .1 second

SE-PAC cannot be programmed for Full Time Delay

Loop Chart Typicals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 5.1

SHEET 2 OF 5

NAZTEC 2070: Use with Greensboro Signal System

LOOP & DETECTOR UNIT INSTALLATION CHART
NAZTEC APOGEE SOFTWARE 2070 CONTROLLER

	INDUCTIVE LOOPS					DETECTOR PROGRAMMING								
	LOOP	SIZE (FT)	DISTANCE FROM STOPBAR (FT)	TURNS	NEW LOOP	PHASE	SWITCH (PHASE)	DELAY TIME	STRETCH TIME	CALLING	EXTENSION	ADDED INIT.	SYSTEM LOOP	NEW CARD
P/P Left turn loop calling 2 phases	1A	6X40	0	2-4-2	X	1	6	15	-	X	X	-	-	X
VD loop combined w/system loop	2A/S1	6X6	300	5	X	2	-	-	-	X	X	X	X	X
	2B/S2	6X6	300	5	X	2	-	-	-	X	X	X	X	X
Stretch Detection for sidestreet	4A	6X6	300	5	X	4	-	-	3.4	-	X	-	-	X
	4B	6X40	0	2-4-2	X	4	-	10	-	X	X	-	-	X
P/P Left turn loop calling 2 phases	5A	6X40	0	2-4-2	X	5	2	15	-	X	X	-	-	X
Stretch loops	6A; 6B	6X6	300	5	X	6	-	-	1.6	X	X	-	-	X
	6C; 6D	6X6	90	4	X	6	-	-	-	X	X	-	-	X
Protected left turn phase loop	7A	6X40	0	2-4-2	X	7	-	3	-	X	X	-	-	X
Sidestreet loop	8A	6X40	0	2-4-2	X	8	-	10	-	X	X	-	-	X
System Loop	S3	6X6	+125	5	X	-	-	-	-	-	-	-	X	X

2070 Controller
w/Naztec Apogee
Software

Detector Programming Attributes

Switch (Phase) - Typically used for protected/permitted left turns to call and extend the (primary) protected phase after the side street is serviced and extend the (secondary) permitted time for the corresponding adjacent through phase.

Calling - Select to place call during red. Selecting this attribute is similar to selecting ALL for NEMA's "Place Call During Phase." (Usually selected)

Extension - Select to extend the green time. Gap resets after each call. Must be selected whenever Vehicle Extension Time is entered in the timing chart. (Usually selected)

Added Init. - Volume-density feature that extends the Minimum Green timer. Use if loop operates using volume-density detection

Stretch Time - Enter in intervals of .1 second

Naztec Apogee cannot be programmed for Full Time Delay

Loop Chart Typicals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO.
5.1

NEMA LOOP & DETECTOR INSTALLATION CHART
with TS-1 CABINET

	INDUCTIVE LOOPS						DETECTOR UNITS								
	LOOP	SIZE (ft)	DIST. FROM STOPBAR (ft)	TURNS	NEW	EXISTING	UNIT NO.	NEW	EXISTING	CHANNEL	NEMA PHASE	TIMING FEATURE	TIMING TIME	PLACE CALL DURING PHASE	INHIBIT DELAY DURING GREEN?
Volume density loop	2A	6X6	300	4	X		1		X	1	2	–	–	ALL	NO
Volume Density with DC/EC for sidestreet	4A	6X6	300	4	X		2		X	1	4	–	–	4	NO
	4B	6X40	0	2–4–2	X					2	4	DC/EC	5/2	ALL	NO
Left turn loop calling 2 phases (with volume density on phase 2)	5A	6X40	0	2–4–2	X		3	X		1	5	DELAY	15	ALL	YES
										2	2	DELAY	3	2	NO
Stretch Loops	6A, 6B	6X6	300	4	X		4		X	1	6	EXTEND	1.75	ALL	NO
	6C, 6D	6X6	90	4	X					2	6	–	–	ALL	NO
Sidestreet loop	8A	6X40	0	EXIST		X	1		X	2	8	–	–	ALL	NO
System Loop	SD1	6X6	+150	4	X		5	X		2	System Detector				

TS–1 Cabinet

Enter Stretch times in intervals of .25 second

Both of these charts are also used for Cary Signal System (2070N Equipment)

NEMA LOOP & DETECTOR INSTALLATION CHART
with TS-2 CABINET

	INDUCTIVE LOOPS						DETECTOR UNITS					
	LOOP	SIZE (ft)	DIST. FROM STOPBAR (ft)	TURNS	NEW	EXISTING	NEMA PHASE	NEW	EXISTING	TIMING FEATURE	TIMING TIME	INHIBIT DELAY DURING GREEN?
Volume density loop combined w/System Loop	2A/SD1	6X6	300	4	X		2	X		–	–	NO
							–	X		System Detector		
Volume Density with DC/EC for sidestreet	4A	6X6	300	4	X		4	X		DELAY	100	YES
	4B	6X40	0	2–4–2	X		4	X		DC/EC	5/2	NO
Left turn loop calling 2 phases (with volume density on phase 2)	5A	6X40	0	2–4–2	X		5	X		DELAY	15	YES
							2			DELAY	3	NO
Stretch loops	6A	6X6	300	4	X		6		X	EXTEND	1.6	NO
	6B	6X6	90	4	X		6			–	–	NO
Sidestreet loop	8A	6X40	0	EXIST		X	8	X		–	–	NO
System Loop	SD2	6X6	+150	4	X		–	X		System Detector		

TS–2 Cabinet

Enter Stretch times in intervals of .1 second

Loop Chart Typicals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO. 5.1

170 LOOP & DETECTOR INSTALLATION CHART

	INDUCTIVE LOOPS						DETECTOR PROGRAMMING													
							NEMA PHASE	TIMING		ATTRIBUTES							SYSTEM LOOPS	STATUS	
	LOOP	SIZE (ft)	DIST. FROM STOPBAR (ft)	TURNS	NEW	EXISTING		DELAY	CARRY (STRETCH)	1 FULL TIME DELAY	2 PEDESTRIAN CALL	3 RESERVED	4 COUNT	5 EXTENSION	6 TYPE 3	7 CALLING		NEW	EXISTING
Volume density loop	2A	6X6	300	4	X		2	– SEC.	– SEC.	–	–	–	X	X	–	X	–	–	X
Volume Density with DC/EC for sidestreet	4A	6X6	300	EXIST		X	4	– SEC.	– SEC.	–	–	–	–	X	–	–	–	–	X
	4B	6X40	0	2-4-2		X	4	5 SEC.	2.0 SEC.	X	–	–	–	X	–	X	–	–	X
Left turn loop calling 2 phases (with omit phase programmed)	5A	6X40	0	2-4-2	X		5	30 SEC.	– SEC.	–	–	–	–	X	–	X	–	X	–
							4	30 SEC.	– SEC.	–	–	–	–	–	–	X	–	X	–
							2	3 SEC.	– SEC.	X	–	–	–	X	–	X	–	X	–
Stretch loops	6A, 6B	6X6	300	4	X		6	– SEC.	1.6 SEC.	–	–	–	–	X	–	X	–	–	X
	6C, 6D	6X6	90	4	X		6	– SEC.	– SEC.	–	–	–	–	X	–	X	–	–	X
Sidestreet loop	8A	6X40	0	EXIST		X	8	– SEC.	– SEC.	–	–	–	–	X	–	X	–	–	X
Pedestrian pushbutton	P81, P82	N/A	N/A	N/A	X		8	– SEC.	– SEC.	–	X	–	–	–	–	–	–	–	–
System Loop	SD1	6X6	+150	3	X		–	– SEC.	– SEC.	–	–	–	–	–	–	–	X	X	–

170 Controller

(Use for Durham Signal System)

Detector Programming Attributes

Full Time Delay - Select to delay during green and red. If not selected, controller will time delay during red only. Selecting this attribute is equivalent to selecting NO for NEMA's "Inhibit Delay During Green." (Usually not selected)

Pedestrian Call - Select to assign as a pedestrian detector. Used with ped push-button.

Reserved - Currently not in use. (Not selected)

Count - Select to count vehicles. (Usually selected with volume density loops)

Extension - This allows the detector to extend the green time. Gap resets after each call. Must be selected whenever Vehicle Extension Time is entered in the timing chart. (Usually selected)

Type 3 - This attribute will place call during green until the call drops or the Type 3 Limit expires. Once the Type 3 detector drops off it will not be active until the next phase. This attribute is similar to NEMA's EC/DC operation except that the loop is disconnected after a set time instead of after a gap in traffic. (Usually not selected)

Calling - Select to place call during red. Selecting this attribute is similar to selecting ALL for NEMA's "Place Call During Phase." (Usually selected)

Carry (Stretch) - Enter times in intervals of .1 second

Loop Chart Typicals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 5.1

SHEET 5 OF 5

For All Plans

Oasis 2070L Timing Chart (Part 1)

- Main Street:
  55 mph (88 km/hr) - 14 sec
  50 mph (80 km/hr) - 14 sec
  45 mph (72 km/hr) - 12 sec
  40 mph (64 km/hr) - 12 sec
  ≤35 mph (56 km/hr) - 10 sec

  Side Streets, Lefts, and Main Street Stopbar Detection:
  Set to 4-8 sec, depending on size of detection area, grade, truck traffic, etc.
  Typically 7 sec.

- Main Street - Typically 2.0 sec for stretch detection, 3.0 sec for low speed detection. For volume density, amount of time required to get vehicle traveling 5 mph (8 kph) under the speed limit from upstream loop to stop line, generally 6.0 sec.
  Side Street - Typically 1.0-3.0 sec. Adjust for size of detection area, grade, truck traffic, etc.

- Maximum green times may be determined with the help of a software package. Alternately, a hand calculation may be suitable:

$$\text{Max Green} = 4 + 2\left(\frac{\text{Heaviest PHV per lane}}{\text{3600/est cycle length}}\right)$$

PHV = Peak hour volume

- See STD. NO. 5.2.2
- A type of Backup Protection. Typically set to 5.0 for phase(s) used, otherwise default is 2.0 sec. (See Std. 2.3)
- Typically 4-7 seconds
- See STD. NO. 6.0
- None, Min Recall, Max Recall, Soft Recall, Ped Recall or Ped Soft Recall
- None, Red, or Yellow (See Definitions)
- On or not selected (see Definitions)
- On or not selected, usually selected (see Definitions)

Note: For Pre-Timed Signal, set Extension 1 to 0.0 and Recall Position to Max Recall. Enter N/A for Vehicle Call Memory.

OASIS 2070L TIMING CHART

FEATURE	PHASE 2	PHASE 4	PHASE 5
• Min Green 1*	10	7	7
• Extension 1*	3.0	1.0	3.0
• Max Green 1*	45	20	25
• Yellow Clearance	3.6	3.7	3
• Red Clearance	1.9	2.1	
• Red Revert	5.0	2.0	
• Walk 1*	4	-	
• Don't Walk 1	12	-	
Seconds Per Actuation*	-	-	
Max Variable Initial*	-	-	
Time Before Reduction*	-	-	
Time To Reduce*	-	-	
Minimum Gap	-	-	
• Recall Mode	MIN RECALL	-	
• Vehicle Call Memory	YELLOW	-	
• Dual Entry	-	O	
• Simultaneous Gap	ON		

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

Oasis 2070L Timing Chart (Part 2)

For Volume Density Plans (See 5.2.3 Sheet 1)

Variable Initial Features (Time only during non-green portion of phase)

- Amount added to Variable Initial Time (starting at 0) for each actuation of detector loops. Typical values:
  - 2.5 secs for single through lane
  - 1.5-1.8 sec for two through lanes
  - 1.0-1.5 sec for three through lanes

  When traffic is more evenly distributed over multiple lanes, use lower number. Increase for high truck traffic.

- Time needed to service a queue reaching from detector loop to stop line. Calculated by:

$$\text{Maximum Variable Initial} = 4 + 2\left(\frac{\text{Distance to loop}}{\text{Std veh length} = 20' \text{ (6m)}}\right)$$

Gap Reduction Features (Time only during green portion of phase)

- Time that expires before gap reduction begins. Prevents premature transfer of green. Typically 15-30 secs, but never less than the minimum green. For sidestreet Volume Density, may use 0 or 5 sec.
- Amount of time over which gap time will reduce from initial value (Extension 1) to minimum value (Minimum Gap). Typically 30-60 secs. For sidestreet Volume Density, may use 15 or 20 sec.
- Set equal to lowest gap time that allows vehicle to clear dilemma zone. Typically 3.0 sec - 4.0 sec., but no lower than 3.4 sec. for 55 MPH

Notes:
-The sum of the Time Before Reduction and the Time to Reduce should not exceed the Max Green 1 time.
-The Extension 1 resets to the initial value if the serviceable conflicting call is removed (eg. Turns right on red).

OASIS 2070L TIMING CHART

FEATURE	PHASE 2	PHASE 4	PHASE 5
Min Green 1*	12	7	7
Extension 1*	6.0	6.0	2.0
Max Green 1*	90	30	25
Yellow Clearance	4.3	3.6	3.1
Red Clearance	1.4	2.1	2
Red Revert	5.0	2.0	
Walk 1*	4	–	
Don't Walk 1	12	–	
• Seconds Per Actuation*	1.5	–	
• Max Variable Initial*	34	–	
• Time Before Reduction*	15	0	
• Time To Reduce*	30	15	
• Minimum Gap	3.0	3.0	
Recall Mode	MIN RECALL	–	
Vehicle Call Memory	YELLOW	–	
Dual Entry	–	O	
Simultaneous Gap	ON		

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

SE–PAC 2070 Timing Chart
(Burlington, Hickory and Raleigh Signal Systems)

For All Plans
- See Sheet 1, Min Green 1
- See Sheet 1, Extension 1
- See Sheet 1, Max Green 1
- See STD. NO. 5.2.2
- See Sheet 1, Walk 1
- See Sheet 1, Don't Walk 1

For Volume Density Plans
- See Sheet 2, Seconds per Actuation
- See Sheet 2, Maximum Variable Initial
- See Sheet 2, Time Before Reduction
- See Sheet 2, Time to Reduce
- See Sheet 2, Minimum Gap

For All Plans
- None, Min Recall, Max Recall, Soft Recall, or Ped Recall
- Lock or Non-Lock (See Definitions)
- On or not selected (see Definitions)
- On or not selected, usually selected (see Definitions)

Note: For Pre-Timed Signal, set Extension 1 to 0.0 and Recall Position to Max Recall. Enter Non-Lock for Vehicle Call Memory.

Note: SE-PAC Software cannot use Red Revert for backup protection. Phase omits must be used.

SE-PAC 2070 TIMING CHART

FEATURE	2	4	5
• Min Green *	10	7	7
• Passage Gap *	3.0	2.0	2.0
• Maximum Green *	45	25	15
• Yellow Change	3.9	3.4	3.0
• Red Clear	1.8	2.1	2.2
• Walk *	–	–	–
• Pedestrian Clear	–	–	–
• Added Initial *	–	–	
• Maximum Initial *	–	–	
• Time Before Reduction *	–	–	
• Time To Reduce *	–	–	
• Minimum Gap	–	–	
• Recall Mode	MIN RECALL	–	
• Vehicle Call Memory	LOCK	NON–LOCK	
• Dual Entry	–	ON	
• Simultaneous Gap	ON	ON	

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

Signal Plan Timing Chart

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 5.2.1

SHEET 3 OF 6

Naztec Apogee 2070 Timing Chart
(Greensboro Signal System)

For All Plans
- See Sheet 1, Min Green 1
- See Sheet 1, Extension 1
- See Sheet 1, Max Green 1
- See STD. NO. 5.2.2
- See Sheet 1, Walk 1
- See Sheet 1, Don't Walk 1

For Volume Density Plans
- See Sheet 2, Seconds per Actuation
- See Sheet 2, Maximum Variable Initial
- See Sheet 2, Time Before Reduction
- See Sheet 2, Time to Reduce
- See Sheet 2, Minimum Gap

For All Plans
- None, Min Recall, Max Recall, Soft Recall, or Ped Recall
- Yes or No (See Definitions)
- On or not selected (see Definitions)
- On or not selected, usually selected (see Definitions)

Note: For Pre-Timed Signal, set Gap, Extension 1 to 0.0 and Recall Position to Max Recall. Enter No for Lock Calls.

Note: Naztec Apogee Software can not use Red Revert for backup protection. Phase omits must be used.

NAZTEC APOGEE 2070 TIMING CHART

FEATURE	PHASE 2	PHASE 4	PHASE 5
• Min Green *	12	7	7
• Gap, Extension *	6.0	2.0	2.0
• Maximum Green 1 *	90	30	20
• Maximum Green 2 *	110	25	25
• Yellow Clear	5.1	3.8	3.0
• Red Clear	1.2	1.9	2.1
• Walk *	4	–	–
• Pedestrian Clear	16	–	–
• Added Initial *	1.5	–	
• Maximum Initial *	34	–	
• Time Before Reduction *	15	–	
• Time To Reduce *	60	–	
• Minimum Gap	3.0	–	
• Recall Mode	MIN RECALL	–	
• Lock Calls	YES	NO	
• Dual Entry	–	ON	
• Simultaneous Gap	ON	ON	

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

NEMA Timing Chart (Also for Cary 2070N Signal System)

For All Plans

- See Sheet 1, Min Green 1
- See Sheet 1, Extension 1
- See STD. NO. 5.2.2
- See Sheet 1, Max Green 1
- None, Min Recall, Max Recall, Soft Recall or Ped Recall
- Lock or Nonlock
- See Sheet 1, Walk 1
- See Sheet 1, Don't Walk 1

For Volume Density Plans (See 5.2.3 Sheet 1)

Variable Initial Features (Active only during non–green portion of phase)

- Number of vehicles that arrive that will not count toward Maximum Initial value. For most controllers, this value is zero. If needed (such as Traconex TMP 390 and Minnesota Microtronics 800 controllers), the Actuation B4 Add may be calculated:

  $$\text{Actuation B4 Add} = \frac{\text{Min green - 4}}{2}$$

- Amount added to Variable Initial Time (starting at 0) for each actuation of detector loops. Typical values:
  - 2.5 secs for single through lane
  - 1.5-1.8 sec for two through lanes
  - 1.0-1.5 sec for three through lanes

  When traffic is more evenly distributed over multiple lanes, use lower number. Increase for high truck traffic. For the Traconex and Minnesota Microtronics controllers:
  - 2.0 secs for single through lane
  - 1.3-1.5 sec for two through lanes
  - 1.0-1.3 sec for three through lanes
- See Sheet 2, Maximum Variable Initial

Gap Reduction Features (see Sheet 2)

Notes:

- The sum of the Time Before Reduction and the Time to Reduce should not exceed the Max Green 1 time.
- The Passage/Gap resets to the initial value if the serviceable conflicting call is removed (eg. Turns right on red).

NEMA TIMING CHART

FEATURE	PHASE 2	PHASE 4	PHASE 6
• Minimum Green*	12	7	12
• Passage/Gap*	6.0	1.0	6.0
• Yellow Change Int	4.3	3.6	4.
• Red Clearance	1.4	2.1	1
• Maximum 1*	90	20	
• Recall Position	MIN RECALL	NONE	
• Vehicle Call Memory	LOCK	NONLOCK	
• Walk *	4	-	
• Flashing Don't Walk	12	-	
Volume Density	ON	OFF	
• Actuation B4 Add*	0	-	
• Sec Per Actuation*	2.5	-	
• Maximum Initial*	34	-	
• Time B4 Reduction*	15	-	
• Time To Reduce*	30		
• Minimum Gap	3.0		

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

Note: For Pre-Timed Signal, set Passage/Gap to 0.0 and Recall Position to Max Recall. Enter N/A for Vehicle Call Memory.

Note: NEMA Equipment cannot use Red Revert for backup protection. Phase omits must be used.

170 Timing Chart (Durham Signal System)

For All Plans

- See Sheet 1, Min Green 1
- See Sheet 1, Extension 1
- See STD. NO. 5.2.2
- See Sheet 1, Max Green 1
- None, Veh Recall, Ped Recall, Max Recall, Soft Recall
- None, Yellow Lock, Red Lock
  Yellow Lock begins locking call during yellow, Red Lock begins locking call during red. Typically None for stopbar detection and Yellow Lock for setback detection.
- On or Off
- See Sheet 1, Walk 1
- See Sheet 1, Don't Walk 1
- Used with Type 3 Limit Detector Attribute, See STD NO. 5.2:3

For Volume Density Plans (See 5.2.3 Sheet 2)

Variable Initial Features (Active only during non-green portion of phase)

- See Sheet 2, Seconds per Actuation
- See Sheet 2, Maximum Variable Initial

Gap Reduction Features (Time only during green portion of phase)

- The gap the controller starts reducing from. Unlike NEMA and 2070L controllers, the 170 starts reducing this gap immediately. Typically 6.8-8.0 secs. If Volume Density is not used, enter Vehicle Extension time, as a time must be entered.
- Maximum Gap reduces by 0.1 sec after this much time until it reduces to the Minimum Gap. Typically 1.0-2.4 secs.
- See Sheet 2, Minimum Gap. If Volume Density is not used, enter Vehicle Extension time, as a time must be entered.

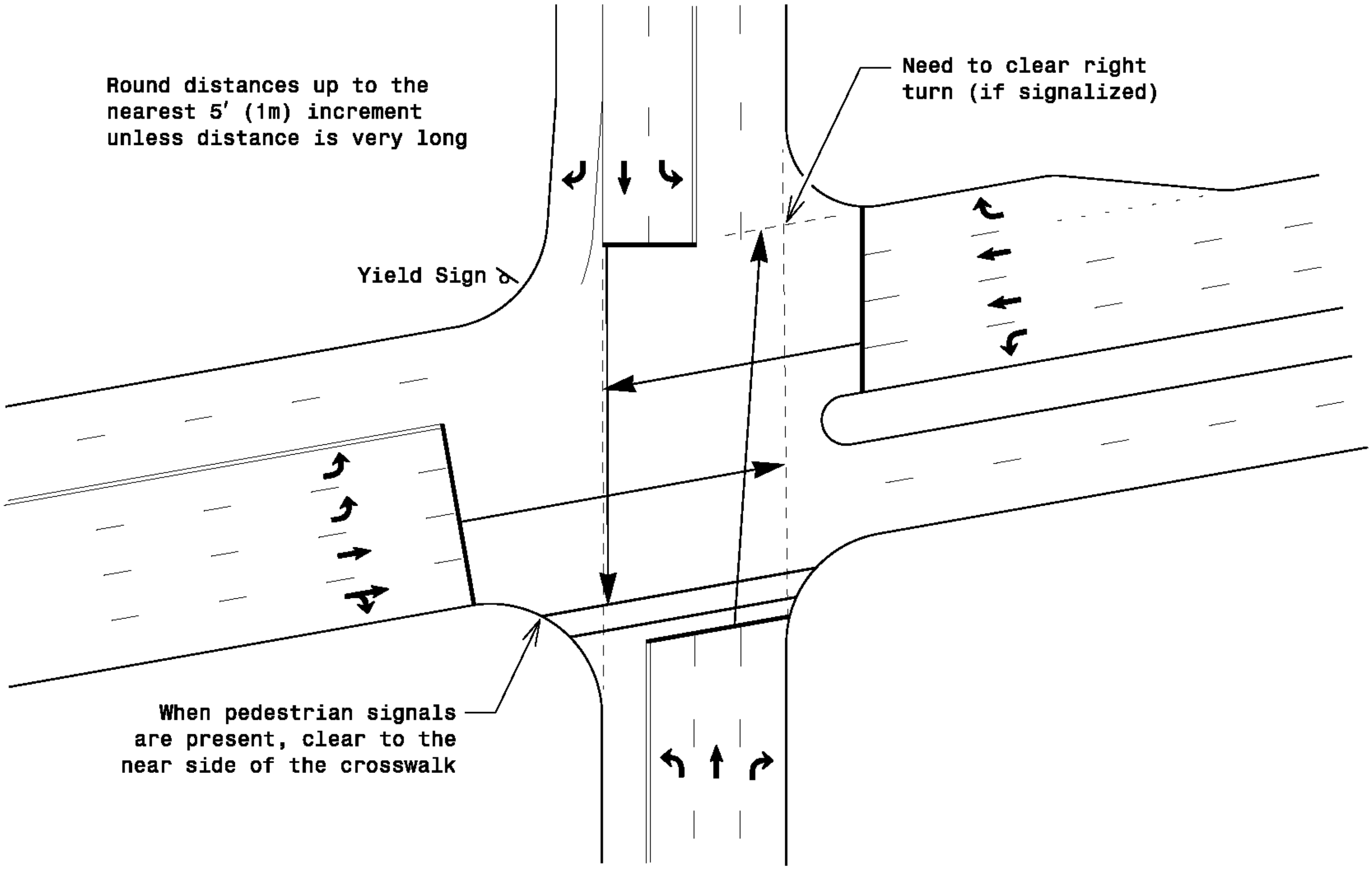
170 TIMING CHART

FEATURE	PHASE		
	2	4	6
• Minimum Initial*	12	7	12
• Vehicle Extension*	6.0	1.0	6.0
• Yellow Change Int	4.3	3.6	4.4
• Red Clearance	1.4	2.1	1.4
• Maximum Limit*	90	20	90
• Recall Position	VEH RECALL	NONE	VEH RE
• Vehicle Call Memory	YELLOW LOCK	NONE	YELLOW
• Double Entry	OFF	ON	O
• Walk*	4	-	
• Flashing Don't Walk	12	-	
• Type 3 Limit	–	-	
• Add Per Vehicle*	1.5	-	
• Maximum Initial*	34	-	
• Maximum Gap*	7.0	1.0	
• Reduce 0.1 Sec Every*	1.5	-	
• Minimum Gap	3.0	1.0	

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

Notes:
- For non-volume density operation, set Maximum Gap and Minimum Gap equal to Vehicle Extension.
- For Pre-Timed Signal, set Vehicle Extension to 0.0 and Recall Position to Max Recall. Enter none for Vehicle Call Memory.

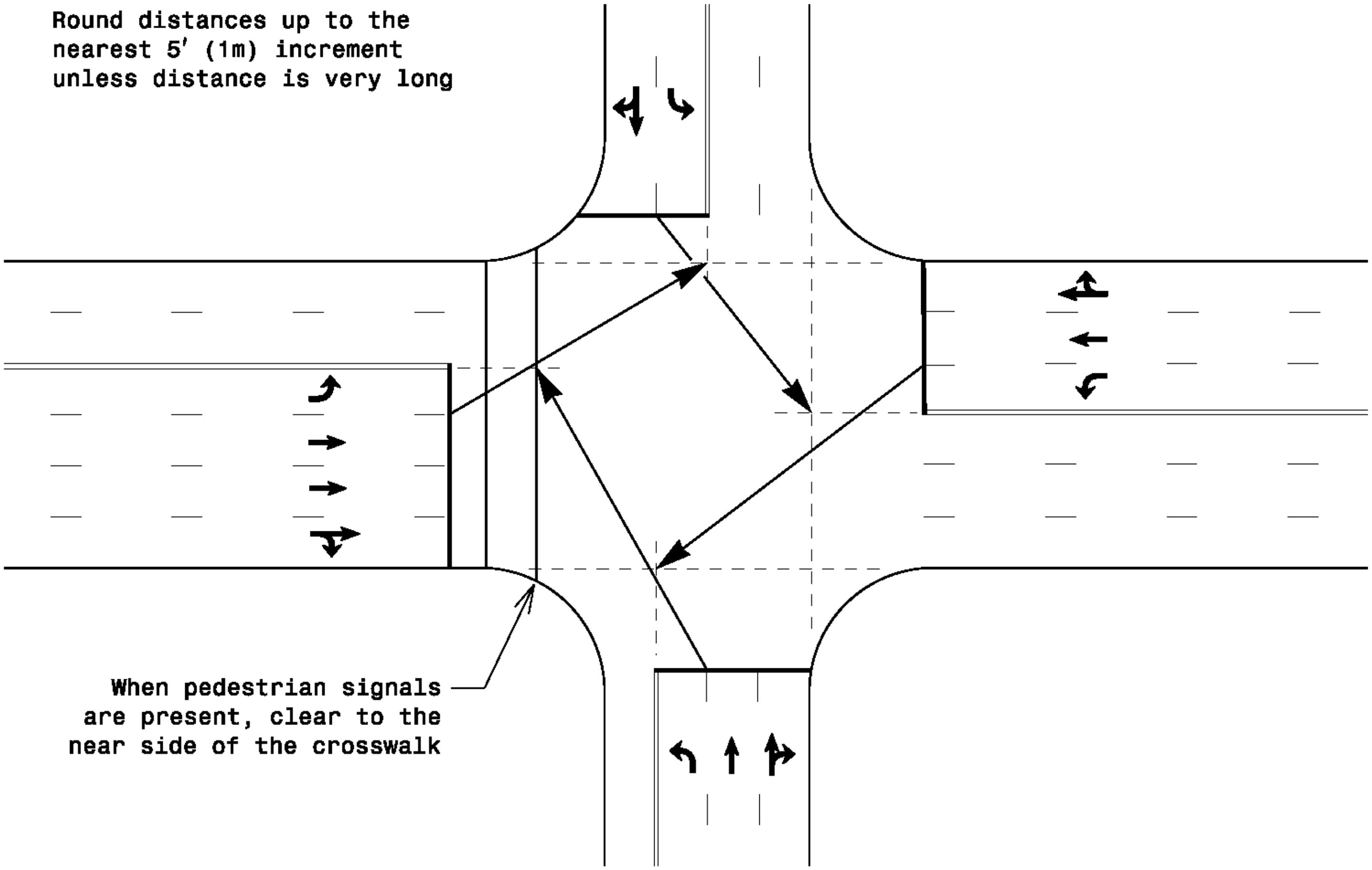
Through Movement Clearance Distances



Change and Clearance Intervals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

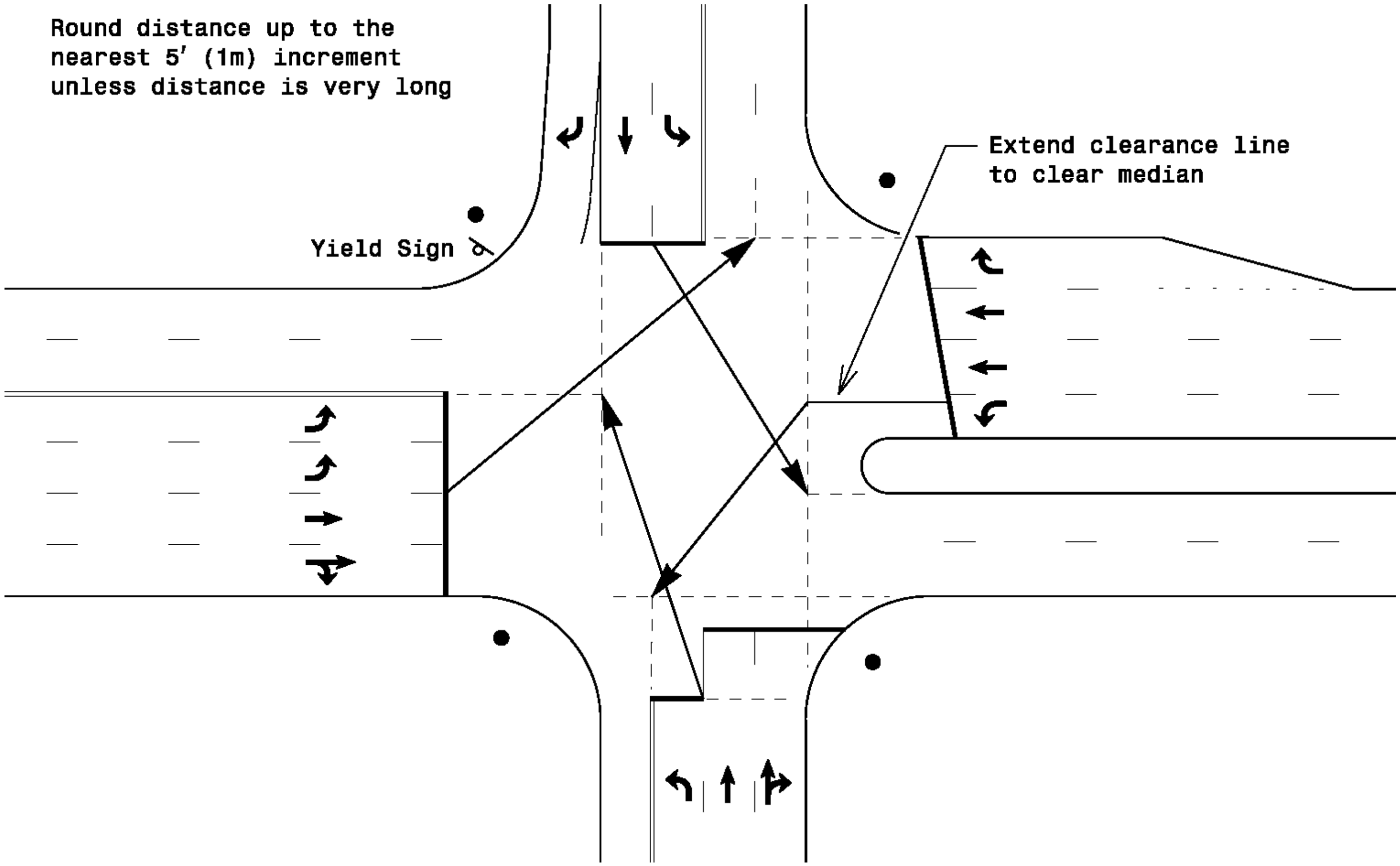
Standard Left Turn Movement Clearance Distances



Change and Clearance Intervals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Other Left Turn Movement Clearance Distances
Median, Dual Left, Setback



Change and Clearance Intervals

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
5.2.2
SHEET 3 OF 4

Determination of Yellow Change and Red Clearance Intervals

Yellow Change Interval

$$\text{Yellow interval} = t + \frac{v}{2a + 64.4g}$$

t = perception reaction time, typically 1.5 seconds
v = design speed*, in ft/sec
a = deceleration rate, typically 11.2 ft/sec^2
g = grade

Round up to nearest 0.1 second.

Minimum yellow change interval is 3.0 seconds.

Hold stakeholder discussion** when calculated yellow change interval is longer than 6.0 seconds.

Red Clearance Interval

$$\text{Red interval} = \frac{w}{v}$$

w = width of intersection, in feet
v = design speed*, in ft/sec

If the initial calculation results in an all red time longer than 3.0 seconds, recalculate the red time as follows:

$$\text{Recalculated red interval} = \frac{1}{2}\left(\frac{w}{v} - 3\right) + 3$$

Round up to nearest 0.1 second.

Red clearance interval should be between 1.0 and 6.0 sec.

Hold stakeholder discussion** when recalculated red clearance interval is longer than 4.0 seconds.

Notes

* Design speed is the speed limit unless a speed study determines that the 85th percentile speed is faster or intersection geometrics compel vehicles to traverse the intersection slower.

** The purpose of a stakeholder discussion is to provide advance notification and involvement to stakeholders and provide an opportunity to consider possible countermeasures.

For most left turn lanes, assume a speed of 20 mph (32 kph) to 30 mph (48 kph). For locations with unusual conditions a higher or lower speed may be appropriate.

For separate left turn phases, calculate yellow and red intervals.

For left turns without a separate phase, calculate yellow and red times for both the through movement and the left turn movement. Use the highest yellow and enough red to equal the highest total time.

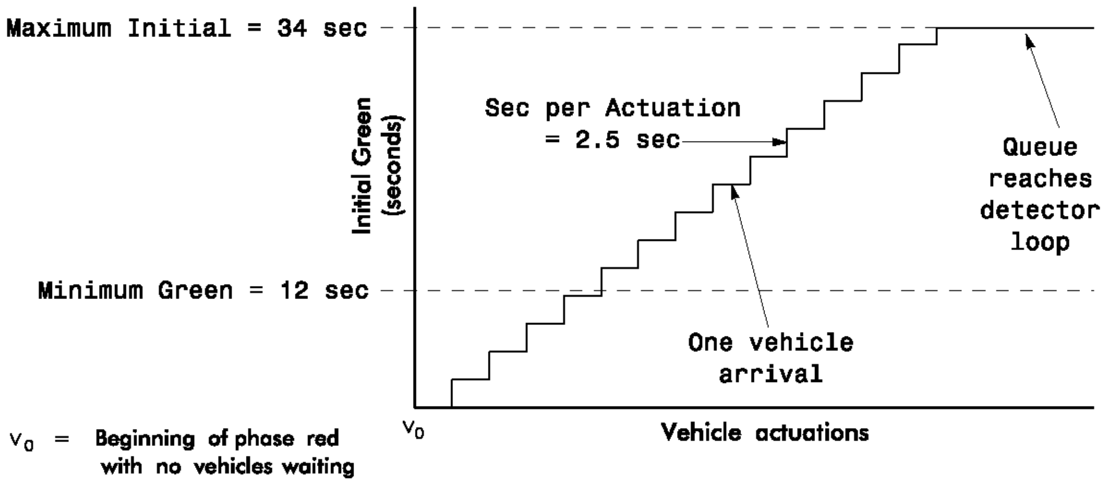
Where existing times are higher than calculated times, use the calculated values unless there is a documented history of the need for higher times. If approach is high speed and existing times are significantly higher than the calculated times, use the calculated values but consider adding a note to the plan to direct field forces to reduce the time incrementally. Include in the note how much and how often to reduce time until the final value is reached. (Ex. Existing Yellow Change Interval for phase 2 may be decreased by 0.2 seconds per week until the required value is reached.)

Where revising a location or adding a new signal along a corridor, consider comparing clearance times at adjacent intersections to new calculations to meet driver expectations.

Sources:
Traffic Engineering Handbook, Fifth Edition, Institute of Transportation Engineers, 1999.

A Policy on Geometric Design of Highways and Streets, Fourth Edition, American Association of State Highway and Transportation Officials, 2001.

Variable Initial Parameters

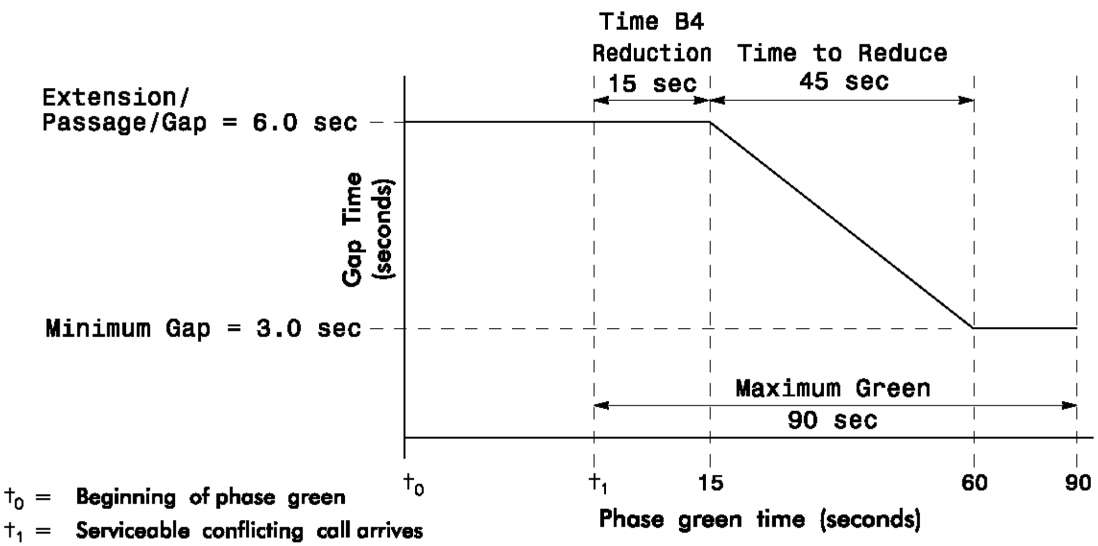


Variable initial operation increases the MIN Green interval in a manner dependent upon the number of vehicle actuations placed on the phase while it is in the Yellow or Red interval. The variable initial interval is calculated as a function of the vehicle actuations and the MIN Green, Seconds Per Actuation, and MAX Variable Initial settings. The following relationship calculates the variable initial interval:

Initial Interval = (# of Vehicle Actuations) X (Seconds Per Actuation Setting)

If the calculated initial interval is less than the MIN Green setting, the MIN Green time will be used as the initial interval. If the calculated initial interval is greater than the MAX Variable initial setting, the MAX Variable initial will be used as the initial interval.

Gap Reduction Parameters



Gap Reduction reduces the allowable gap between successive vehicle actuations by dynamically decreasing the extension time. The rate of reduction is based on the setting of the Extension, Minimum Gap, and Time to Reduce settings. Using this method, the gap will be reduced by the following relationship:

$$\text{Reduction} = \frac{\text{Extension} - \text{Minimum Gap}}{\text{TTR}} \times (\text{Current Green Interval Time} - \text{TBR})$$

This reduction begins when the Green interval has timed the Time Before Reduction (TBR) setting. Reduction of the allowable gap will continue until the gap reaches a value equal to or less than the Minimum Gap In the presence of continual vehicle actuations, the phase will not gap out, even if the gap has been reduced to zero.

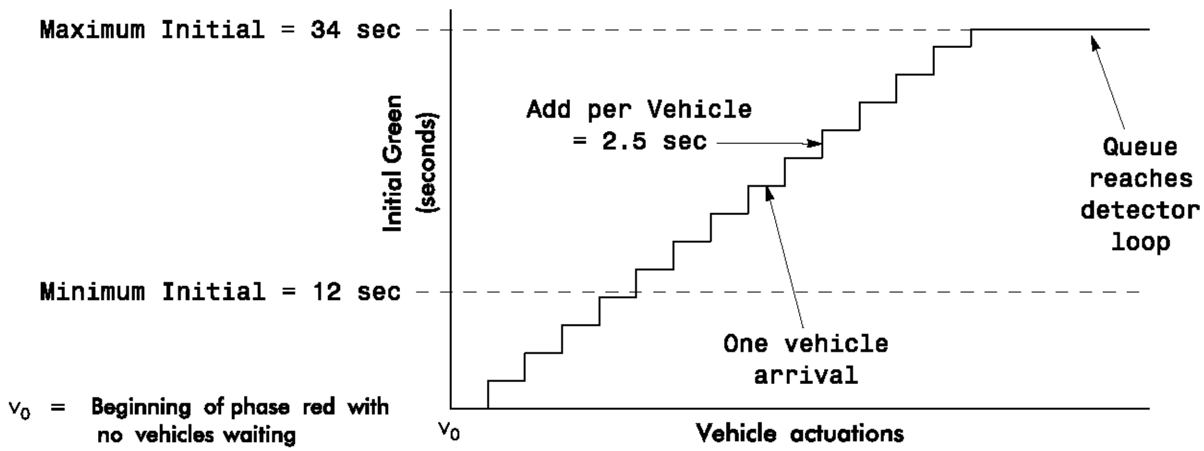
Volume Density Timing Example 2070L and NEMA Controllers

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

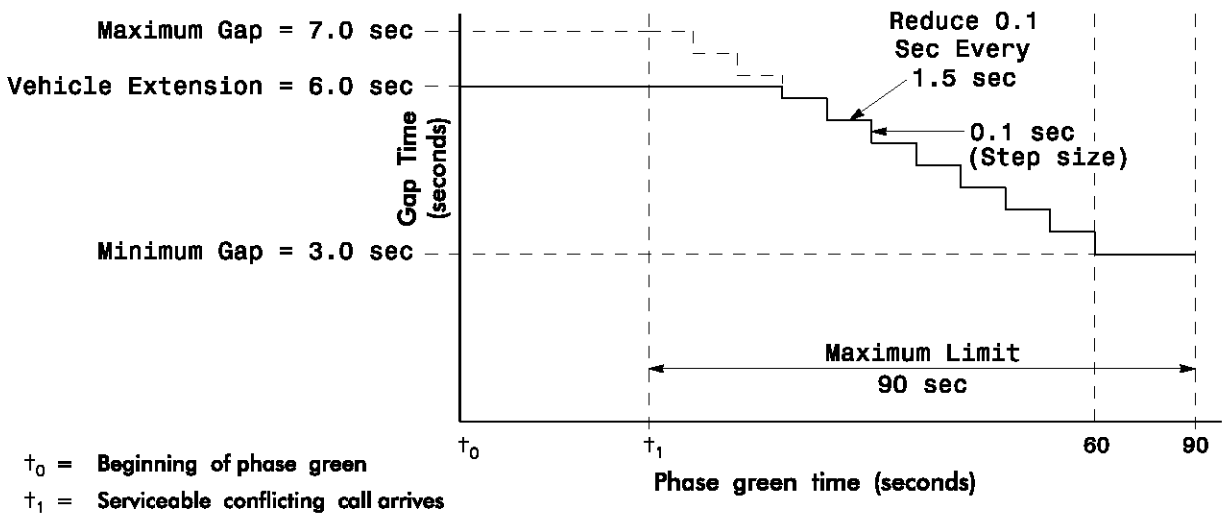
7-04

STD. NO.
5.2.3

Variable Initial Parameters



Gap Reduction Parameters



Note: The controller begins timing the gap reduction from the Maximum Gap (7.0 sec) when it gets a conflicting call; however, the 'real' maximum gap is the Vehicle Extension (6.0 sec). The Vehicle Extension time will never go above 6.0 seconds. The time the controller takes to reach the Vehicle Extension from the Maximum Gap is the 170's version of Time B4 Reduction.

Volume Density Timing Example – 170 Controller

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Standard Signal Plan Legend

LEGEND

PROPOSED		EXISTING
	Traffic Signal Head	
	Modified Signal Head	N/A
	Sign	
	Pedestrian Signal Head With Push Button & Sign	
	Signal Pole with Guy	
	Signal Pole with Sidewalk Guy	
	Inductive Loop Detector	
	Controller & Cabinet	
	Junction Box	
	2-in Underground Conduit	
N/A	Right of Way	
	Directional Arrow	

Note:

Symbols for utilities, hydrology, property lines, etc. should mirror standards set by NCDOT's Roadway Design Unit.

Other Common Symbols

PROPOSED		EXISTING
	Modified Pedestrian Head	N/A
	Metal Strain Pole	
	Metal Pole with Mastarm	
	Signal Pedestal	
DD	Directional Drill	N/A
	Out of Pavement Detector	
	Video Detection Area	
	Out of Pavement Detection Area	
M	Master Controller & Cabinet	M
N/A	Railroad Cantilever	
N/A	Railroad Gate and Flasher	
N/A	Railroad Tracks	
	Construction Zone Drums	
	Construction Zone	
	New Pavement	N/A
N/A	Wheelchair Ramp	WCR
N/A	Wheelchair Ramp	
A	Sign I.D.	A

Common Drawing Symbols

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

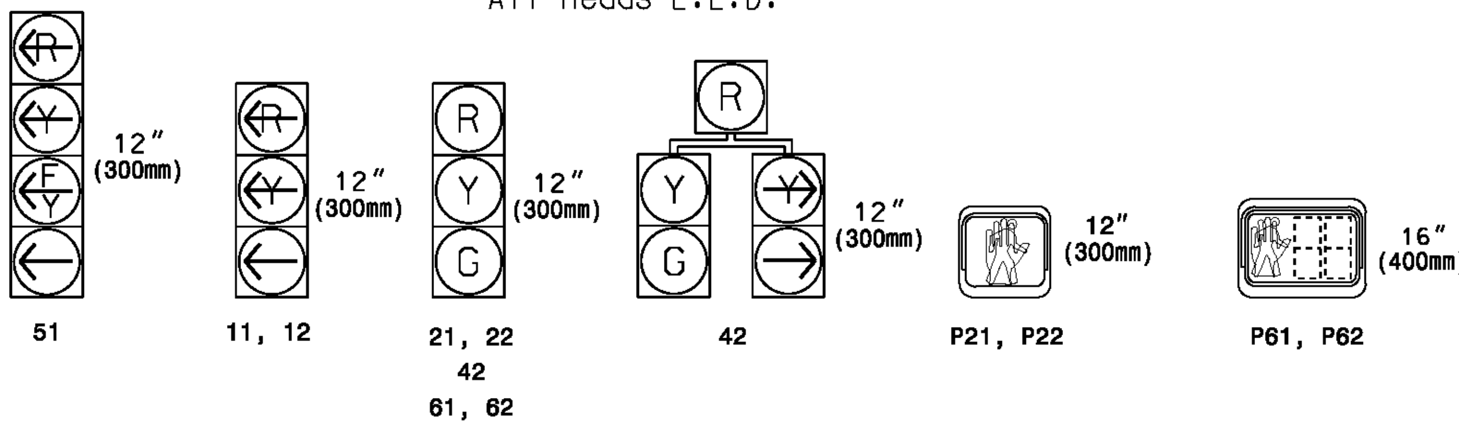
STD. NO. 5.3

SHEET 1 OF 1

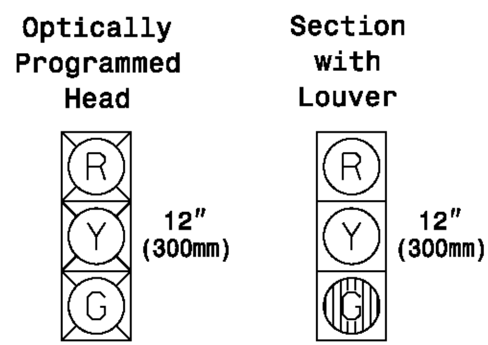
Typical Appearance of Signal Face I.D.

SIGNAL FACE I.D.

All Heads L.E.D.



Signal Faces/Heads with Special Characteristics



Signal Face I.D. Details

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 5.4

SHEET 1 OF 1

7-09

Project Type

Indicate whether 'New Installation,' 'Signal Upgrade,' or 'Temporary Signal.'

Graphic Scale

Include a graphic scale on all plans.

Plan Description

Description should include:

- # Phases
- Type of Actuation
- w/ Special Features (if any)
- Isolated or System (including type)

Text and Lettering

-Letter sizes should approximate the following:
Title block street names and title heads...3/16in (5mm)
All other lettering........................1/8in (3mm)

-List the routes in the title block using the word "at", not "and", as follows:

SR XXXX (Tree Avenue) at SR XXXX (Stump Drive)

-OR-

SR XXXX (Tree Avenue) at SR XXXX (Stump Drive)/NC 123 (Branch Street)

Metric Block

For metric plans, include the metric block in the upper righthand corner.

North Arrow

For Spot Safety projects, align the main street to run horizontally across the plan where possible. For Contract projects, align the plan in the same general direction as the roadway plans. For closed loop system projects, align signal plan sheets in the same general direction as the cable routing plans where possible.

Address

For plans developed in house, include the department logo with the Signals & Geometrics Section's address in the title block.

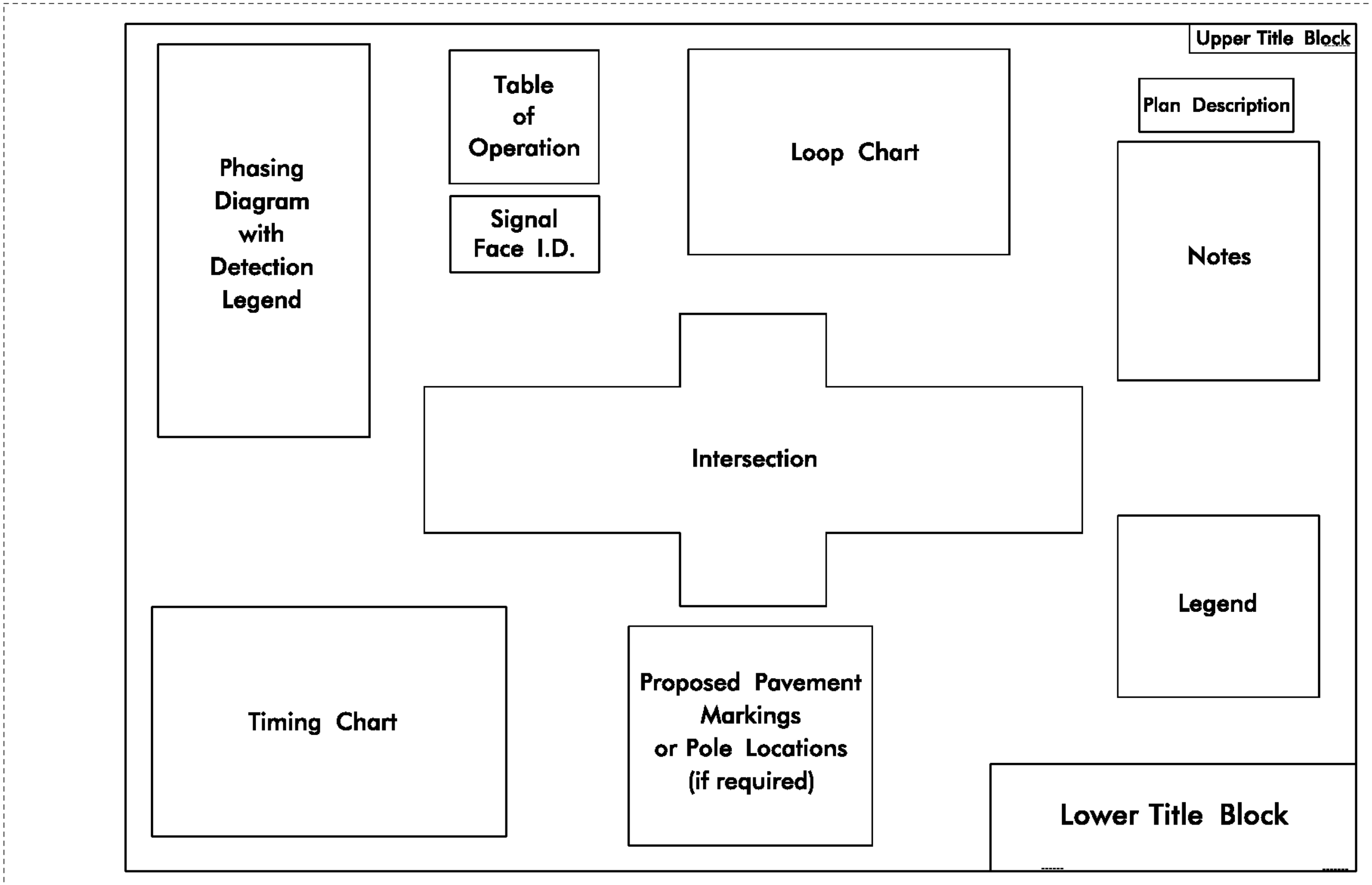
For plans developed by private engineering firms, include the department logo with the Signals & Geometrics Section's address in the title block and the firm's name with address on the plan sheet beside the title block.

For plans developed by municipalities, include the department logo with the Signals & Geometrics Section's address in the title block and the municipality's name with address on the plan sheet beside the title block.

For plans developed by private engineering firms for a municipality, include the department logo with the Signals & Geometrics Section's address in the title block and the firm's name with address on the plan sheet beside the title block.

Note: Private engineering firms and municipalities are responsible for placing their name with address on the plans. Company or municipal logos are permitted providing they do not detract from the plan.

Typical Signal Plan Layout



Miscellaneous Drawing Format Items

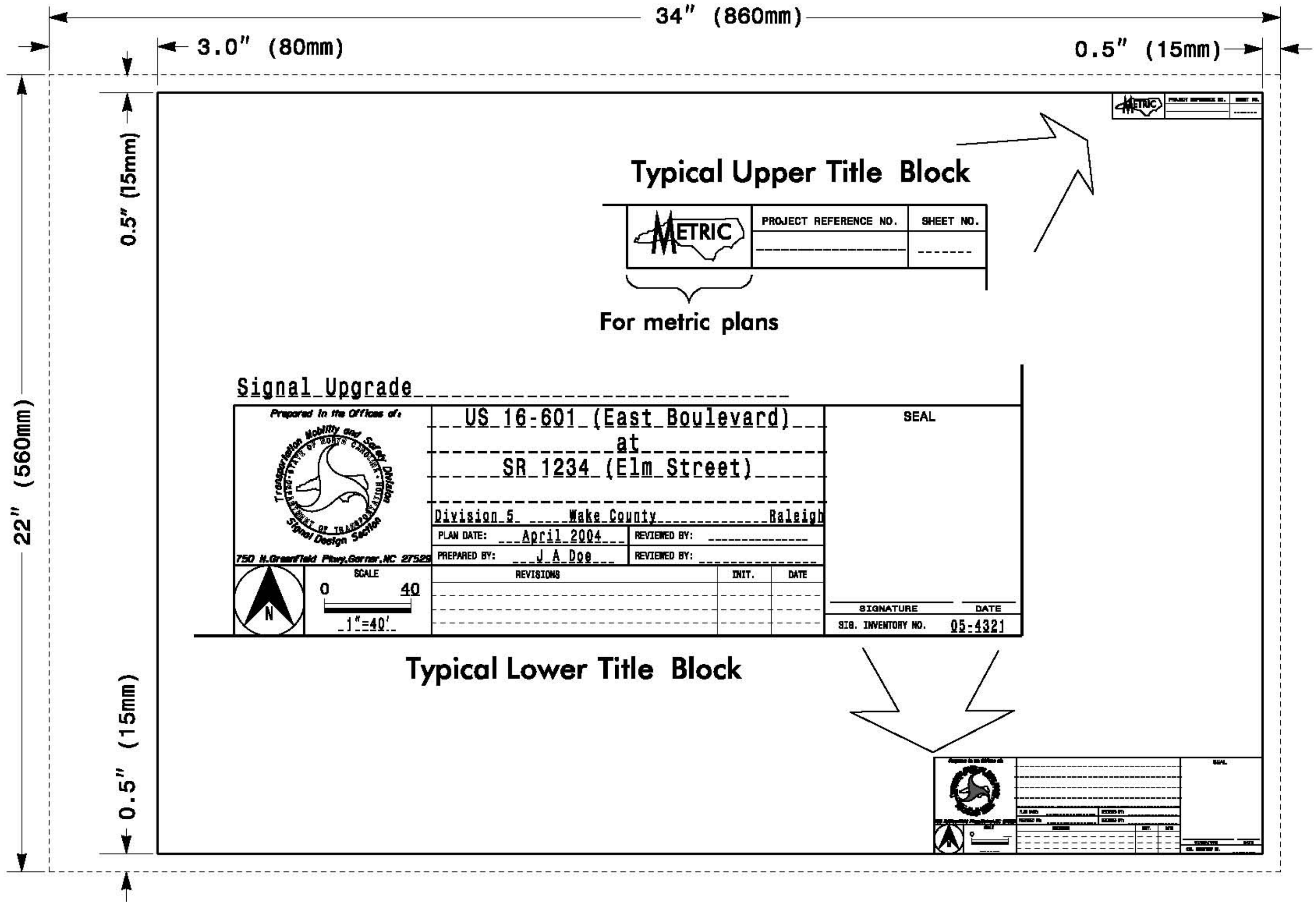
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

11-06

STD. NO. 5.5

SHEET 2 OF 4

Typical Border Sheet with Dimensions



Miscellaneous Drawing Format Items

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

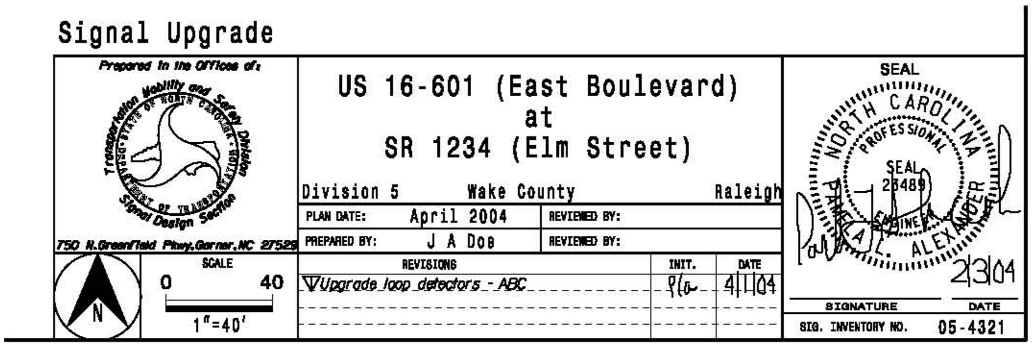
STD. NO. 5.5

SHEET 3 OF 4

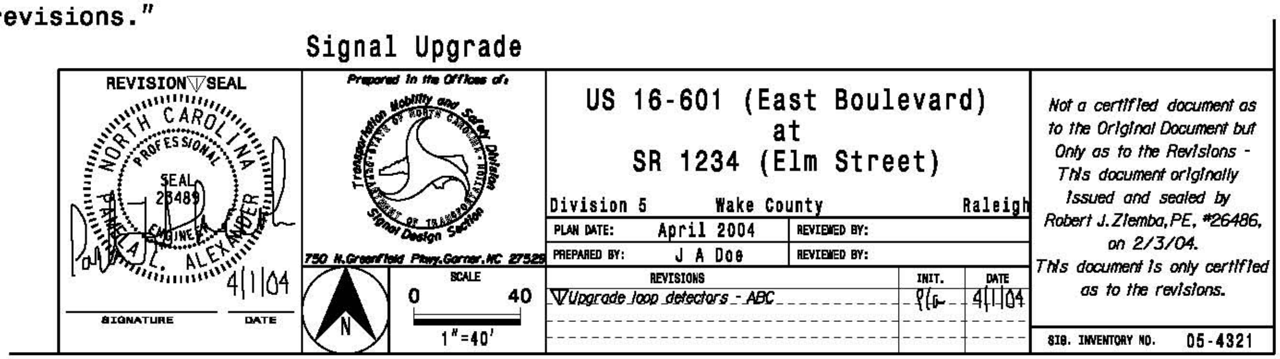
Revisions

When revising an existing traffic signal plan, include the revision number, date, and revision description. Additionally, enclose the revision number in a triangle and place the triangle on the plans near the affected area if needed for clarity.

When the PE making the revision is the same PE who sealed the original plan, the PE initials and dates the revision block and reseals the original plan with the original date.



When the PE making the revision is different than the PE who sealed the original plan, then a "Revision Seal" block needs to be added to the title block to the left (preferred) or just above the title block on the original plans. In addition, add the text "Not a certified document as to the Original Document but only as to the Revisions - This document originally issued and sealed by 'name,' 'PE number,' on 'date.' This document is only certified as to the revisions."



Signal Cable Calculations

Signal Cable

There is only one pay item for signal cable; combine measurements for 16-4 and 16-7 cable. Route cable to minimize the length of cable used. Add 3′ (1 m) extra in cabinets. Add 3′ (1 m) extra at each signal head. Assume 30′ (10 m) down poles. Note: Use 2 separate cable runs if there are more than 6 heads on a phase.

Example (See sheet 2)

Heads 61 & 62:
3′ (beside head) + 12′ + 3′ (beside head) + 270′ + 30′ (down pole) + 10′ (to cabinet) + 3′ (in cabinet) = 331′

Head 11
3′ (beside head) + 256′ + 30′ (down pole) + 10′ (to cabinet) + 3′ (in cabinet) = 302′

Heads 41 & 42:
3′ (beside head) + 15′ + 3′ (beside head) + 105′ + 30′ (down pole) + 10′ (to cabinet) + 3′ (in cabinet) = 169′

Head 43:
3′ (beside head) + 220′ + 30′ (down pole) + 10′ (to cabinet) + 3′ (in cabinet) = 266′

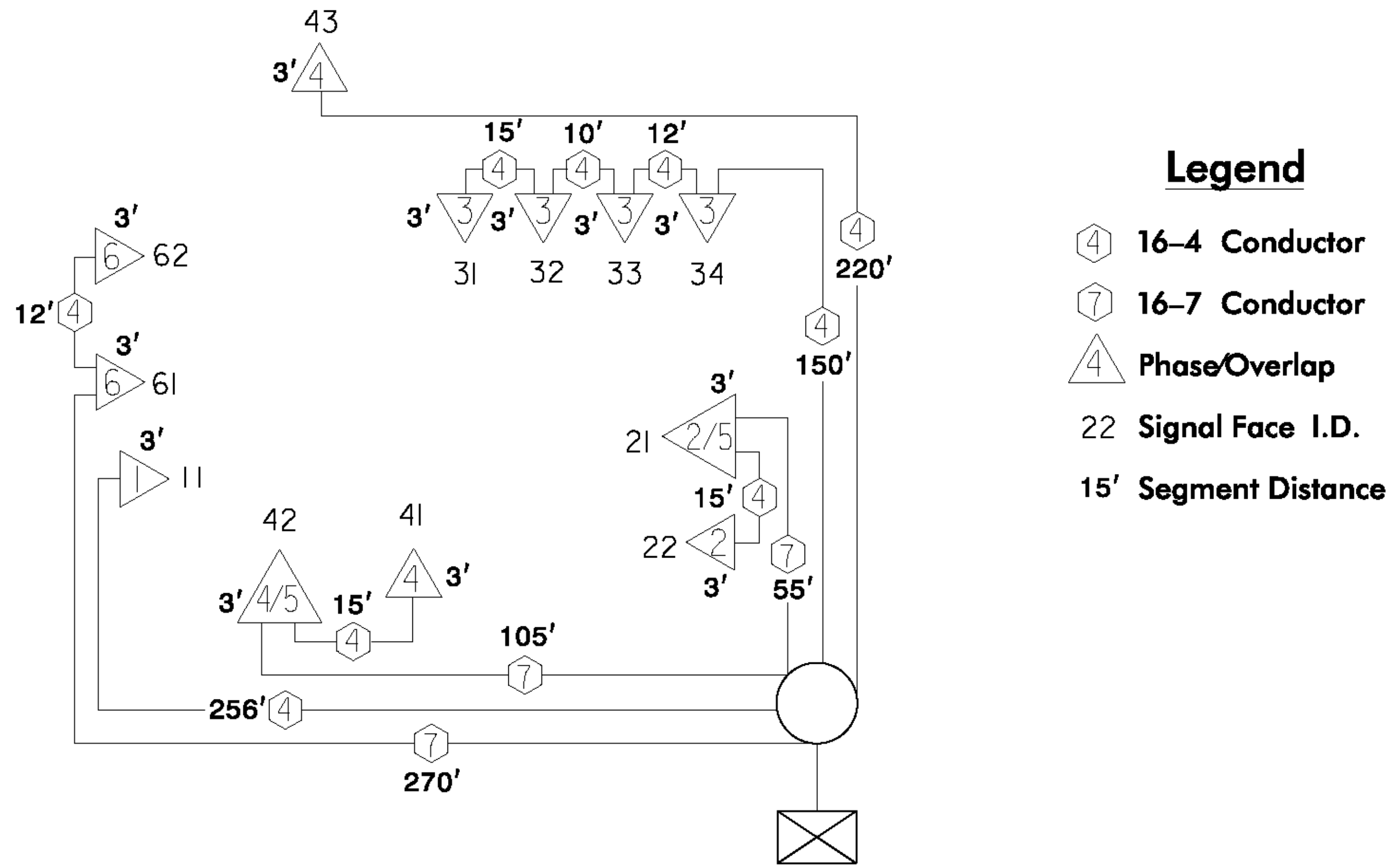
Heads 31, 32, 33 & 34:
3′ (beside head) + 15′ + 3′ (beside head) + 10′ + 3′ (beside head) + 12′ + 3′ (beside head) + 150′
+ 30′ (down pole) + 10′ (to cabinet) + 3′ (in cabinet) = 242′

Heads 21 & 22:
3′ (beside head) + 15′ + 3′ (beside head) + 55′ + 30′ (down pole) + 10′ (to cabinet) + 3′ (in cabinet) = 119′

Total: 331′ + 302′ + 169′ + 266′ + 242′ + 119′ = 1429′

Round up to nearest 10′ = 1430′

Signal Cable Example Diagram



Plan Quantity Calculations

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-09

STD. NO. 5.6

Messenger Cable & Loop Lead–In Calculations

Messenger Cable (Spanwire)

Example (See sheet 4)

Note: Do not add any length for guys as they are included as a pay item for guy assemblies.

145′ + 170′ + 110′ + 172′ = 597′

Round up to nearest 10′ = 600′

Loop Lead–In Cable

Each loop lead-in wire connects 1 loop to the cabinet if the is wired separately. Quadrupole and volume density (counting) loops need to be wired separately. If multiple loops are wired together, 1 lead-in connects the group to the cabinet. Low speed and extend (stretch) loops may be wired together. Include lead-in for pedestrian pushbuttons and microwave detectors. Assume 30′ (10 m) up or down poles.

Example (See sheet 4)

Loops 2A & 2B (together) and 5A (separate):
25′ + 30′ (up pole) + 172′ + 30′ (down pole) + 10′ (to cabinet)
= 267′ X 2 = 534′

Loop 6A and 6B (each separate):
250′ + 25′ + 30′ (up pole) + 110′ + 30′ (down pole) +10′ (to cabinet)
= 455′ X 2 = 910′

Loop 1A:
25′ + 30′ (up pole) + 110′ + 30′ (down pole) + 10′ (to cabinet)
= 205′

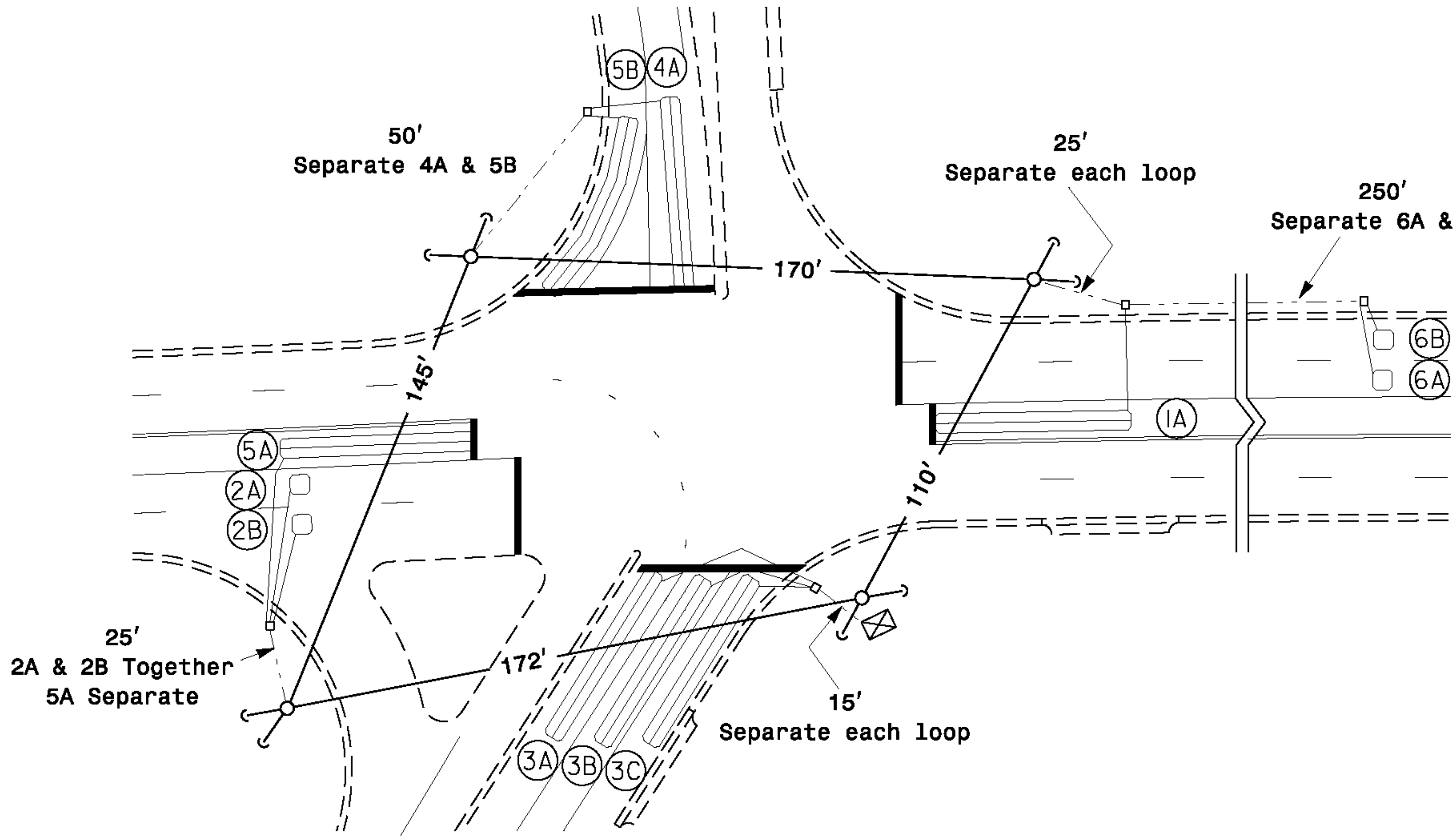
Loops 3A, 3B, and 3C (each separate): 15′
= 15′ X 3 = 45′

Loop 4A and 5B (each separate):
50′ + 30′ (up pole) + 170′ + 110′ + 30′ (down pole) +10′ (to cabinet)
= 400′ X 2 = 800′

Total: 534′ + 910′ + 205′ + 45′ + 800′ = 2494′

Round up to nearest 10′ = 2500′

Loop Lead–In & Messenger Cable Example Diagram

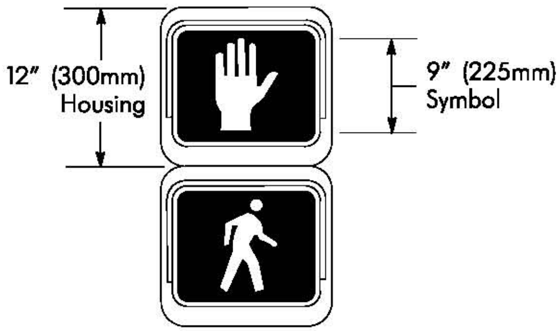


Plan Quantity Calculations

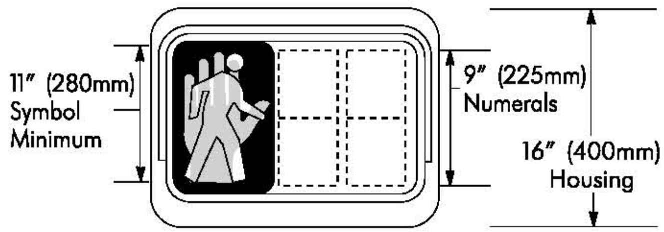
SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Typical Pedestrian Heads

Retrofit Installation



Standard – Countdown Pedestrian Head



Alt/Preemption Pedestrian Head

Pedestrian Head Guidelines

- With pretimed operation, use "Ped Recall" when push buttons are not used.
- Also with pretimed operation, "Max Time" should not be less than the total of "Walk" and "Flashing Don't Walk" times.
- Typically, do not use countdown pedestrian heads with railroad preemption (unless pretimed operation).
- Countdown heads may not be compatible with some forms of EV or Fire Preemption.
- Existing 9" (225 mm) Housing, 2 section pedestrian heads are allowed when distance to head is less than 100 feet (30m).
- For head numbering refer to Std. No. 3.0:1.

Pedestrian Timing

- "Walk Time": Minimum 4 to 7 seconds, depending on pedestrian volume and characteristics.
- "Flashing Don't Walk Time" (FDW): Enough time to get from curb or shoulder to farside of the farthest traveled lane (D). Assume 4 feet (1.2m) per second (S), minus the concurrent yellow change interval (YC). Use slower travel speed where a high percentage of slower moving pedestrian traffic can be expected.

$$FDW = \frac{D}{S} - YC$$

Pedestrians Heads & Timing

SIGNAL DESIGN SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

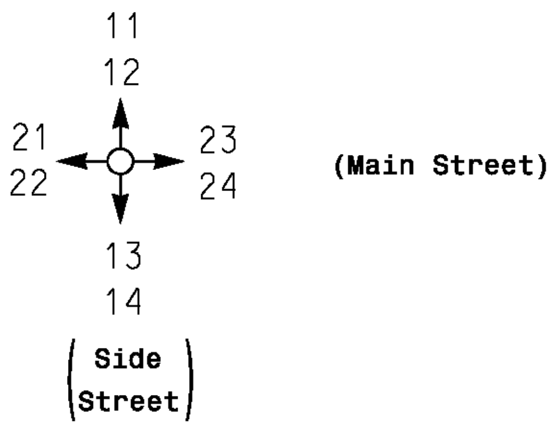
7-09

STD. NO. 6.0

SHEET 1 OF 1

Typical Numbering for Flashers	Table of Operation for Flashers

Typical Numbering for Flashers



SIGNAL FACE I.D.

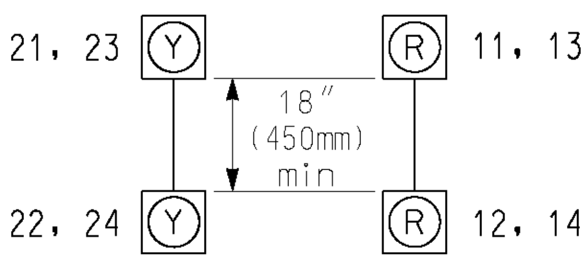


Table of Operation for Flashers

TABLE OF OPERATION

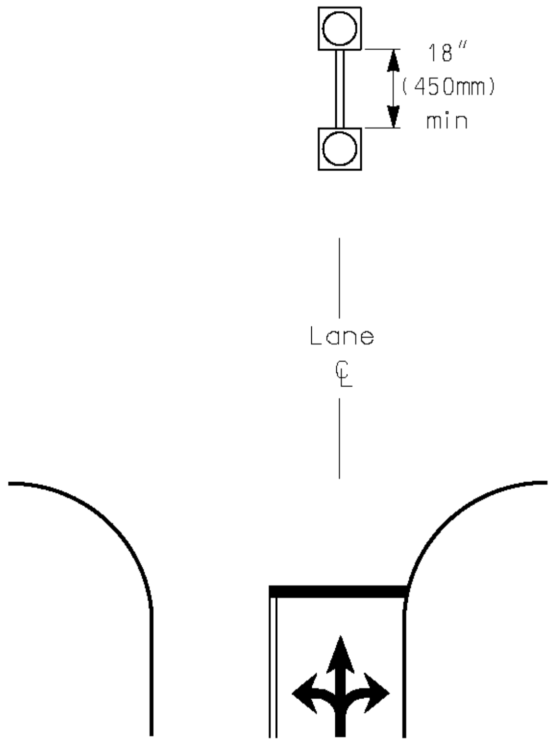
SIGNAL FACE	INTERVAL 1	INTERVAL 2
	ON	OFF
	OFF	ON
	ON	OFF
	OFF	ON

Flashers

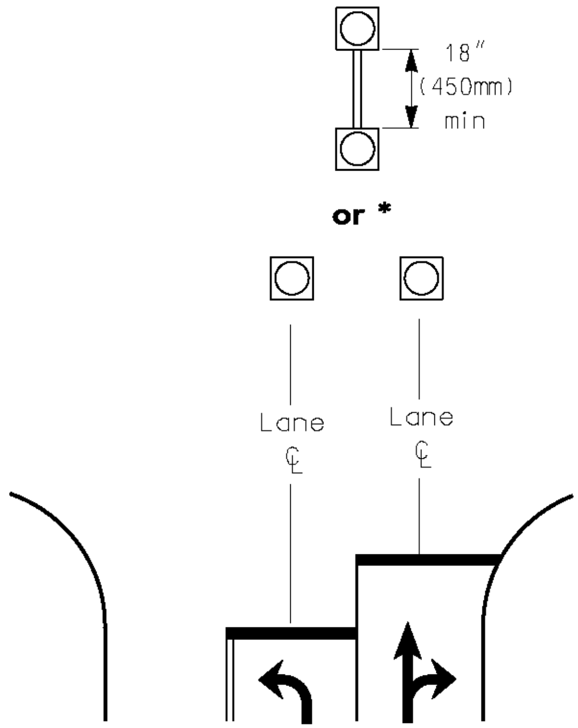
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Signal Head Approach Display and Alignment

Single Lane Approach

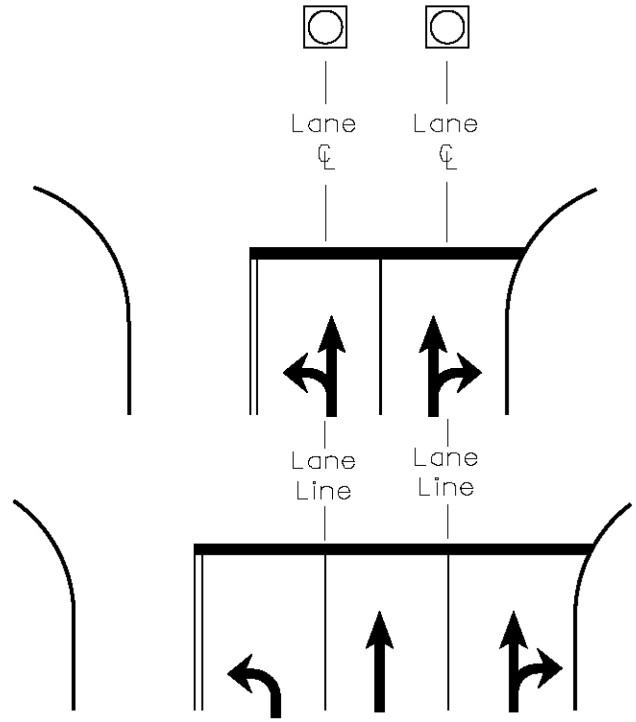


Single Lane Approach with Turning Bay



* Engineer to determine based on site specific characteristics

Multilane Approach

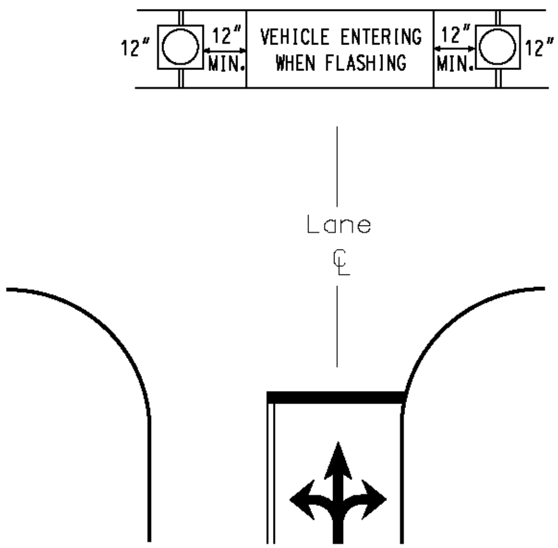


General Guidelines

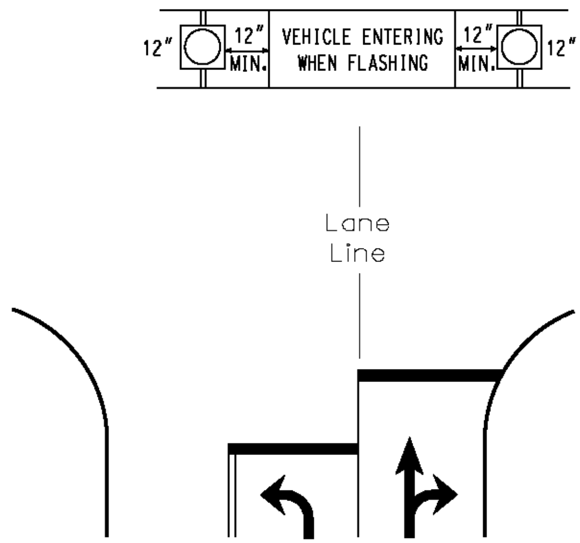
- Flash vertically mounted heads alternatively
- Flash horizontally mounted heads concurrently

Actuated Flasher with Overhead Sign

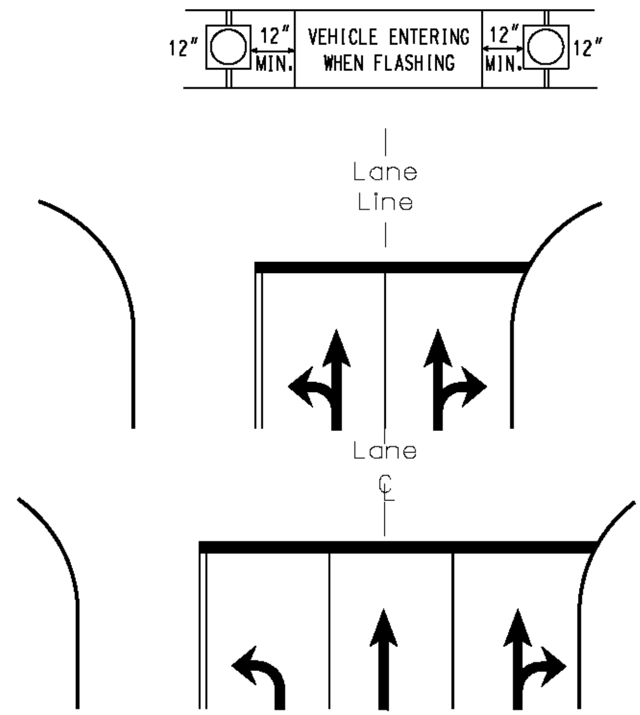
Single Lane Approach



Single Lane Approach with Turning Bay



Multilane Approaches



General Guidelines

–Sign may be installed at intersection or in advance of intersection, at engineer's discretion

–Typical sign size: 114"x36"

–Lettering size: 8"D

–See drawing notes (Std. No. 5.0) for notes specific to actuated flashers

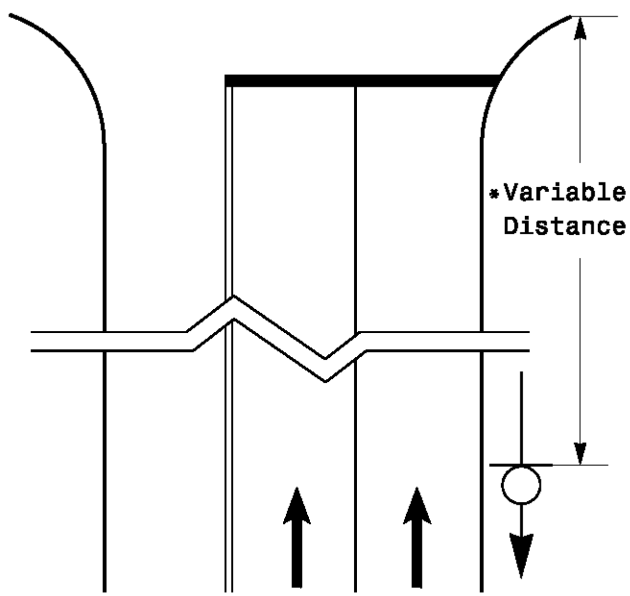
Flashers

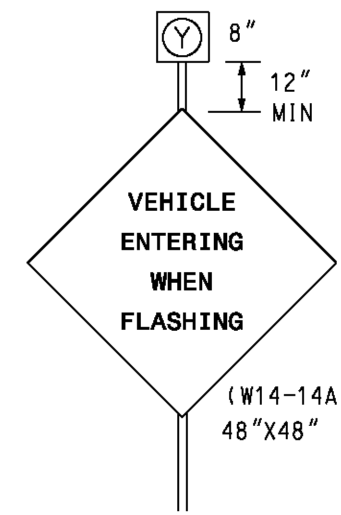
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 7.0

Actuated Flasher with Ground–Mounted Sign

Single or Multi Lane Approaches





GROUND MOUNTED
SIGN DETAIL

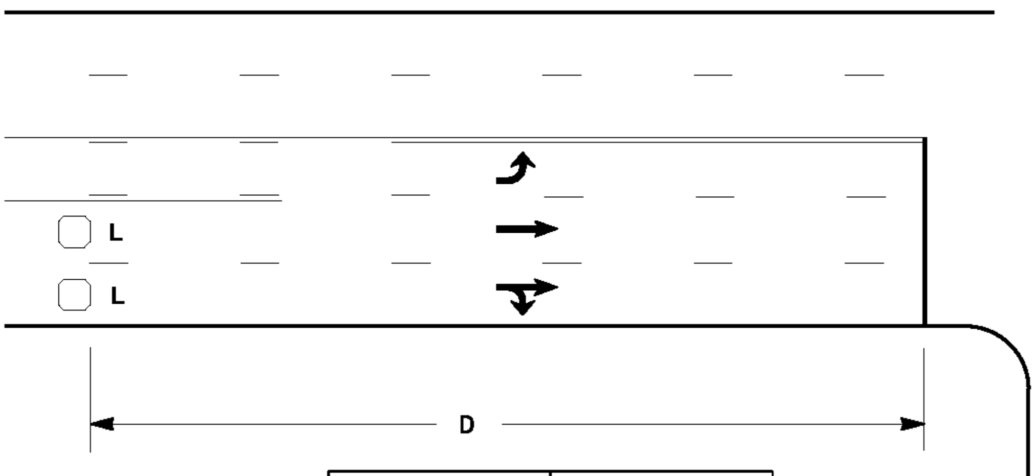
General Guidelines

- For multilane divided roadways with medians dual ground mounted signs may be installed
- See drawing notes (Std. No. 5.0) for notes specific to actuated flashers

* Refer to MUTCD Table 2C–4 for advance placement of signs

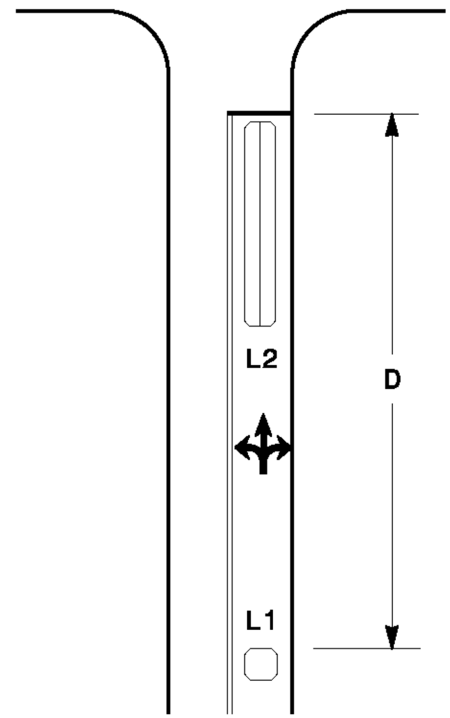
Loop Placement for Actuated Flashers

Main Street Loop Placement
(Single or Multilane)



Design Speed mph	(km/hr)	D ft	(m)
40	(64)	250	(75)
45	(72)	300	(90)
50	(80)	355	(110)
55	(88)	420	(130)

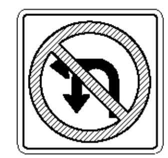
Side Street Loop Placement



L = 6ft X 6ft (1.8m X 1.8m), Presence loop

L1 = 6ft X 6ft (1.8m X 1.8m), Presence loop (Loop L1 is optional)

L2 = 6ft X 40ft To 60ft (1.8m X 12.0) Quadruple loop

Sign No.	Description	Graphic
R1-1	"STOP" Sign	
R1-2	"YIELD" Sign	
R3-1 R3-2	No Right Turn Sign No Left Turn Sign	
R3-3	"NO TURNS" Sign	
R3-4	No U Turn Sign	
R3-5a	Through Arrow "ONLY" Sign	
R3-5L R3-5R	Left Arrow "ONLY" Sign Right Arrow "ONLY" Sign	
R3-6L R3-6R	Combined Through and Left Arrow Sign Combined Through and Right Arrow Sign	
R3-18	No U-Turn/No Left Turn Sign	
R8-8	"DO NOT STOP ON TRACKS" Sign	

Commonly Used Signs

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

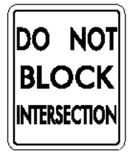
7-04

STD. NO. 8.0

Sign No. | **Description** | **Graphic**

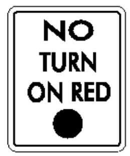
R10-6 "STOP HERE ON RED" Sign

R10-7 "DO NOT BLOCK INTERSECTION" Sign



R10-10L "LEFT TURN SIGNAL" Sign
R10-10R "RIGHT TURN SIGNAL" Sign

R10-11 "NO TURN ON RED" ● Sign
R10-11a "NO TURN ON RED" Sign



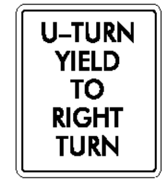
R10-12 "LEFT TURN YIELD ON GREEN" ● Sign

R10-13 "EMERGENCY SIGNAL" Sign

Sign No. | **Description** | **Graphic**

R10-15 "TURNING TRAFFIC MUST YIELD TO PEDESTRIANS" Sign

R10-16 "U-TURN YIELD TO RIGHT TURN" Sign
For usage, see MUTCD Sect. 2B.45, Page 2B-43



R10-21 "LEFT TURN SIGNAL YIELD ON GREEN" ● Sign

Dual Turn Arrows Sign

Dual Turn and Through Arrows Sign

W25-2 "ONCOMING TRAFIC MAY HAVE EXTENDED GREEN" Sign
For usage, see MUTCD Sect. 2C.39, Page 2C-20

Commonly Used Signs

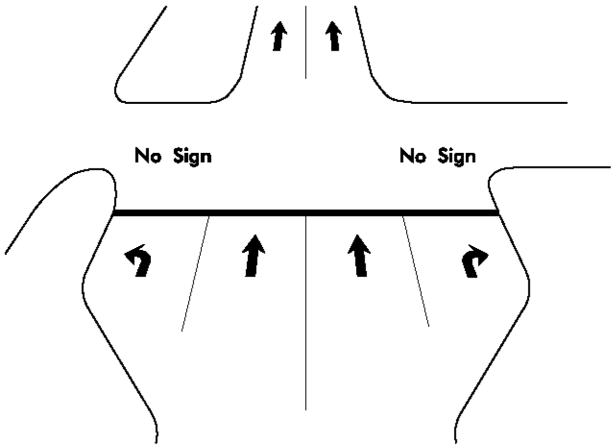
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

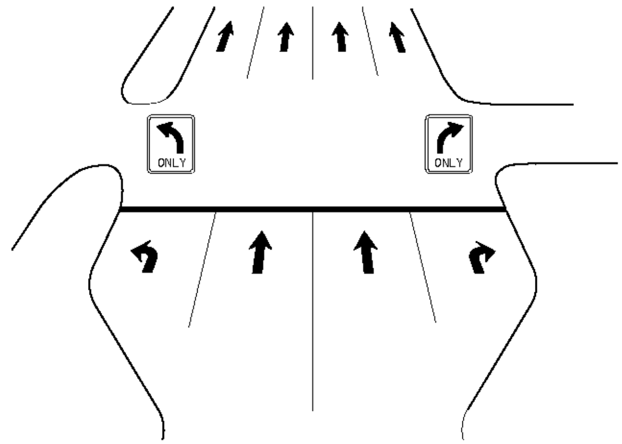
STD. NO. 8.0

1) In general, lane-use control signs are not required when a vehicle must shift into a turning bay to make a turning movement (Example 1).

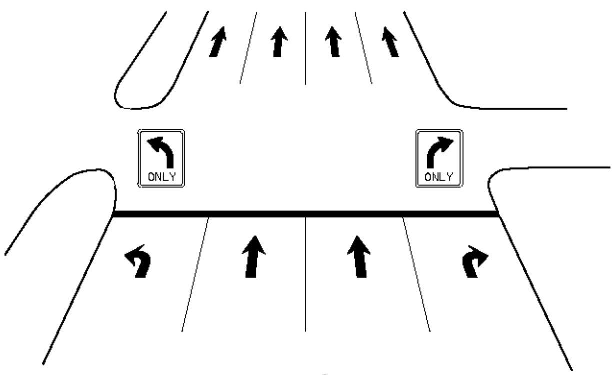
2) In general, lane-use control signs should be used when:
   A) Lane geometrics allow a through movement, but a mandatory turn is required (Examples 2 and 3).
   B) A lane without a turn bay ends abruptly (Example 4).



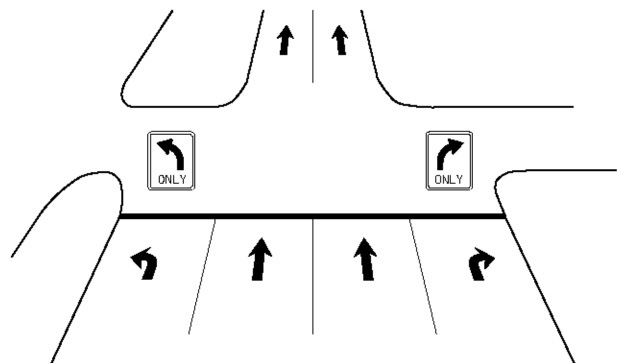
Example 1



Example 2



Example 3



Example 4

Application of Lane–Use Control Signs

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

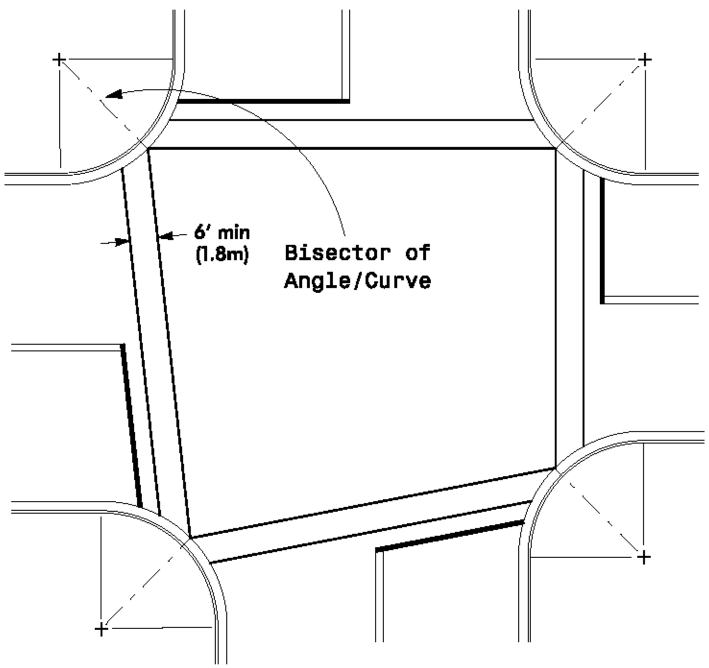
7-04

STD. NO. 8.1

SHEET 1 OF 1

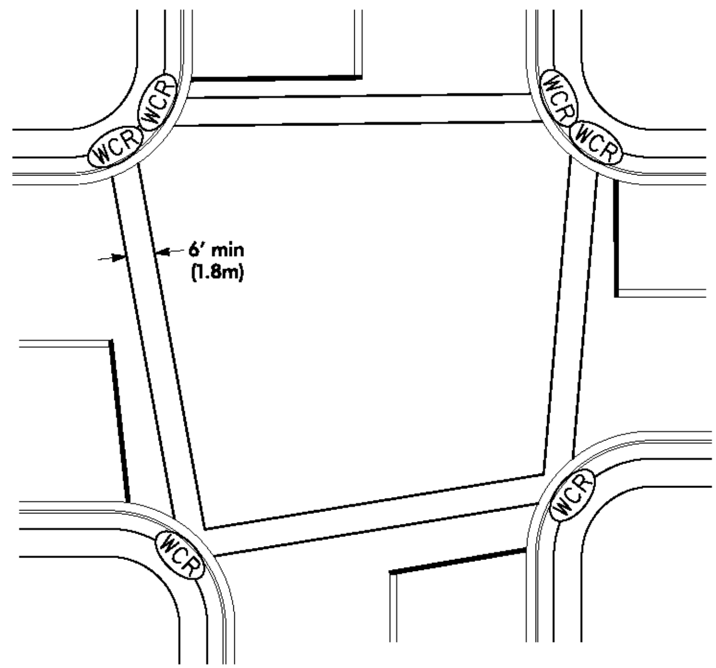
CASE 1

Locate Crosswalks from Center of Curve



CASE 2

Connect Wheelchair Ramps



Reference: Roadway Standard Drawing 1205.07

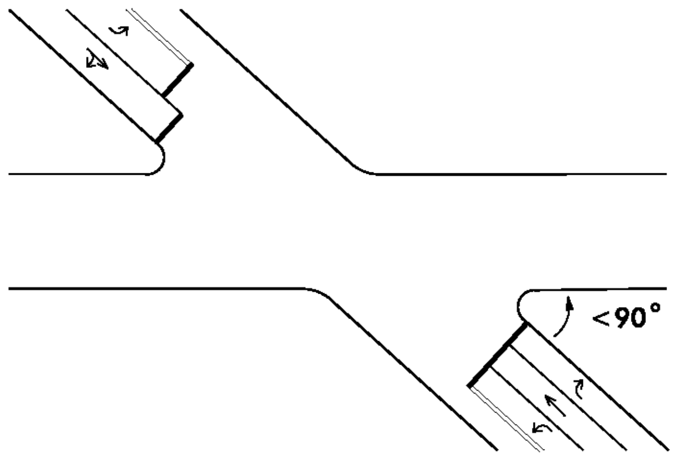
Crosswalks

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

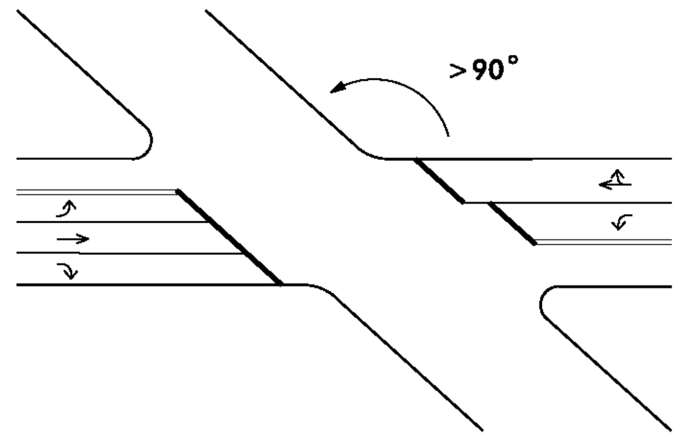
STD. NO.
9.0
SHEET 1 OF 1

CASE 1



For approaches with intersection angles less than 90 degrees, place stop lines perpendicular to the centerline of the approach.

CASE 2



For approaches with intersection angles greater than 90 degrees, place stop lines parallel to the edge of the intersecting roadway.

Notes

-"Intersection angle" is defined as the angle between the approach in question and the intersection roadway to the right.
-Typically, place stop lines no more than 30 feet (9.1m) nor less than 4 feet (1.2m) from the nearest edge of the intersecting travel way.
-For stop line locations at crosswalks, locate stop line 4 feet (1.2m) behind and parallel to the nearest crosswalk line, but not within the area of a wheelchair ramp.

Reference: Roadway Standard Drawings 1205.04 and 1205.07

Stop Lines

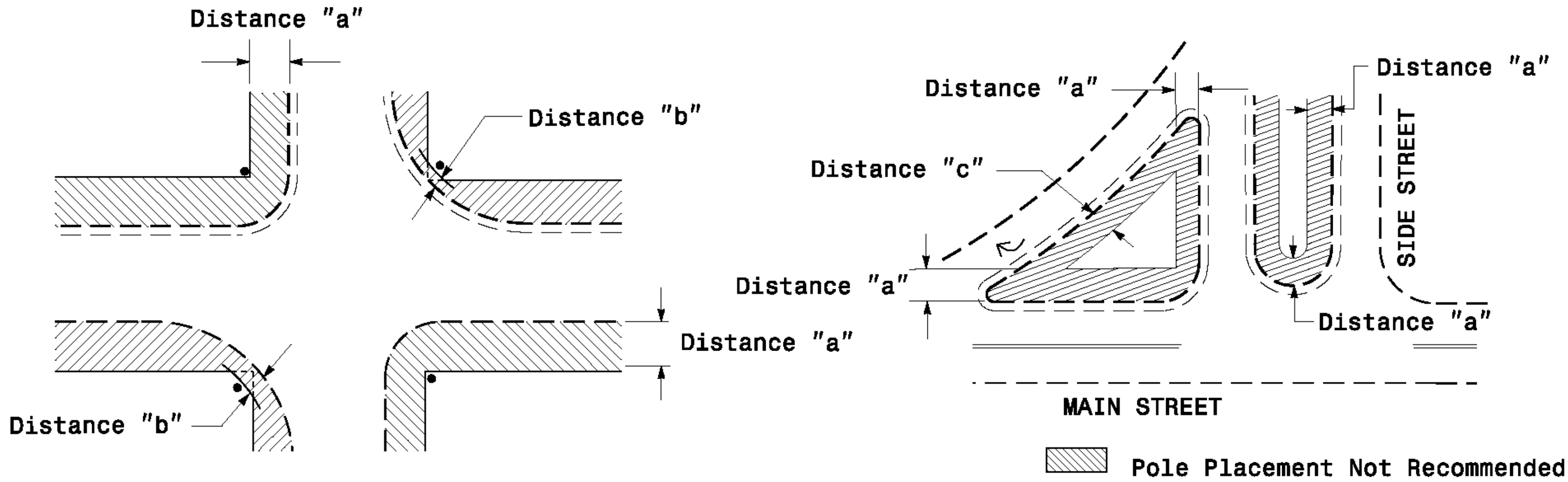
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 9.1

SHEET 1 OF 1

Clear Zone Distances for Pole Placement



Design Speed MPH (km/h)	Distance "a": Distance from Face of Curb ft (m)	Distance "a": Distance from EOP ft (m)	Distance "b": Face of Curb ft (m)	Distance "b": EOP ft (m)	Distance "c": Side St. Speed MPH	Distance "c": Distance from Face of Curb ft (m)	Distance "c": Distance from EOP ft (m)
≤40 (64)	12 (3.5)	14 (4.0)	7 (2.0)	10 (3.0)	≤40	7 (2.0)	7 (2.0)
					45-50	7 (2.0)	7 (2.0)
					≥55	10 (3.0)	12 (3.0)
45-50 (72-80)	16 (5.0)	18 (5.5)			≤40	7 (2.0)	7 (2.0)
					45-50	10 (3.0)	12 (3.5)
					≥55	12 (4.5)	14 (4.5)
≥55 (88)	22 (6.5)	22 (6.5)			≤40	7 (2.0)	7 (2.0)
					45-50	10 (3.0)	12 (3.5)
					≥55	12 (3.5)	14 (4.5)

Note 1: When traffic signals are installed on high-speed facilities, the signal supports should be placed as far away from the roadway as practical.

Note 2: Painted islands should not be used for pole locations unless a method of protection is provided (such as a guardrail).

Distances are the desired minimum from the face of pole

Reference: "Roadside Design Guide" 2002 AASHTO

Standard Pole Placement

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

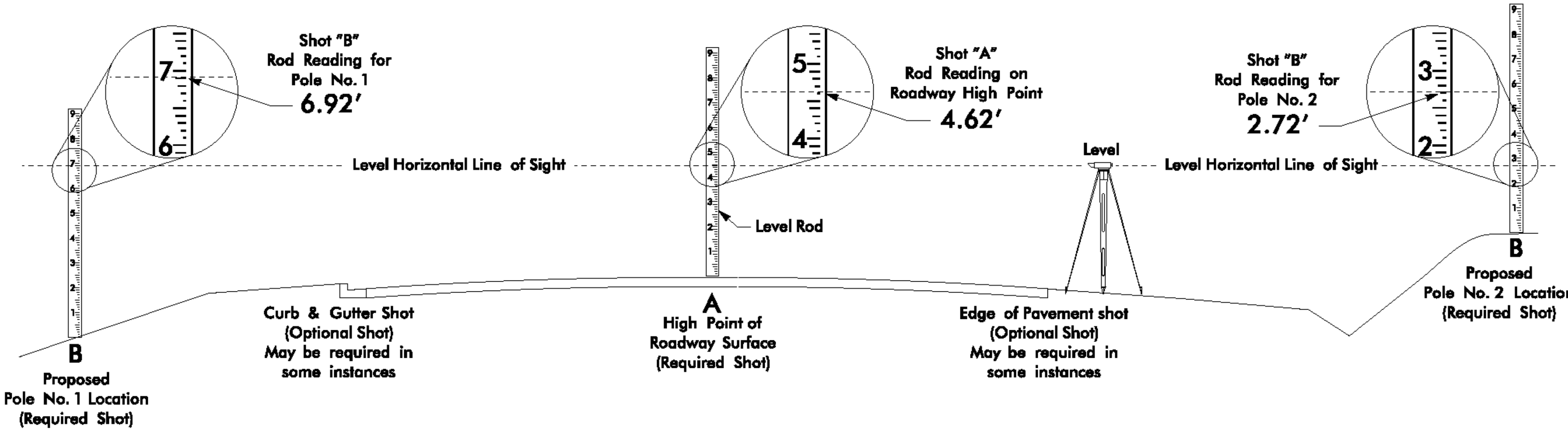
STD. NO. 10.0

SHEET 1 OF 1

Survey Level With Rod Method

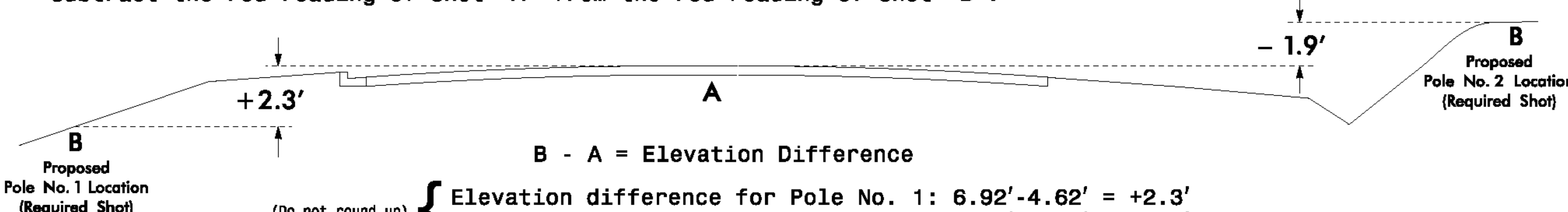
Step 1: Using a standard Survey Level and Level Rod:

– Take elevation shots on high point of roadway (shot "A") and at proposed pole foundation centerline (Shot "B").



Find the elevation difference between the proposed foundation and the high point of the roadway

– Subtract the rod reading of Shot "A" from the rod reading of shot "B".



B - A = Elevation Difference

(Do not round up) Elevation difference for Pole No. 1: 6.92′-4.62′ = +2.3′
Elevation difference for Pole No. 2: 2.72′-4.62′ = -1.9′

Determining Elevation Difference for Metal Poles

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

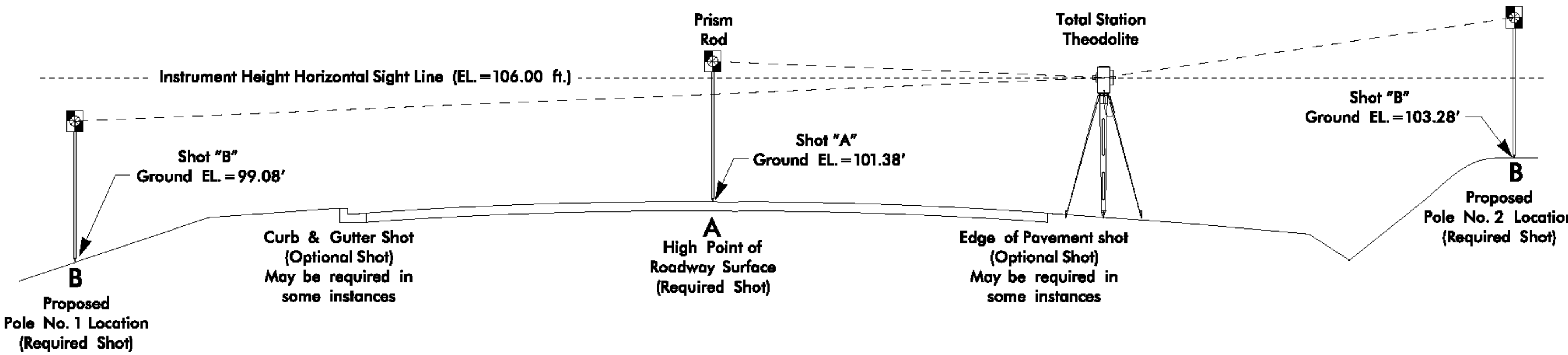
STD. NO. 10.1.1

SHEET 1 OF 2

Total Station And Data Collector With Prism Rod Method

Step 1: Using a Total Station and Data collector with Prism Rod:

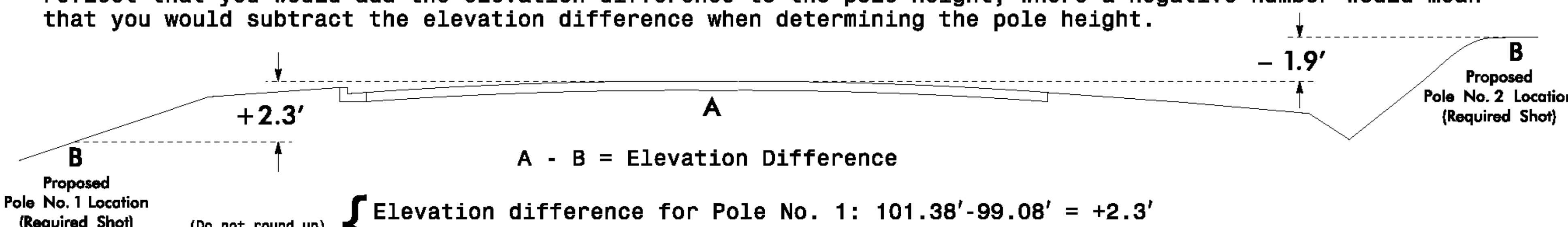
– Take elevation shots on high point of roadway (shot "A") and at proposed pole foundation centerline (Shot "B").



Step 2: Find the elevation difference between Shot "A" and Shot "B"

– Subtract the ground elevation of Shot "B" from the roadway elevation of shot "A".

Notice the difference in the equation when different survey methods are used. A positive number should reflect that you would add the elevation difference to the pole height, where a negative number would mean that you would subtract the elevation difference when determining the pole height.



A - B = Elevation Difference

(Do not round up) { Elevation difference for Pole No. 1: 101.38'-99.08' = +2.3'
Elevation difference for Pole No. 2: 101.38'-103.28' = -1.9' }

Determining Elevation Difference for Metal Poles

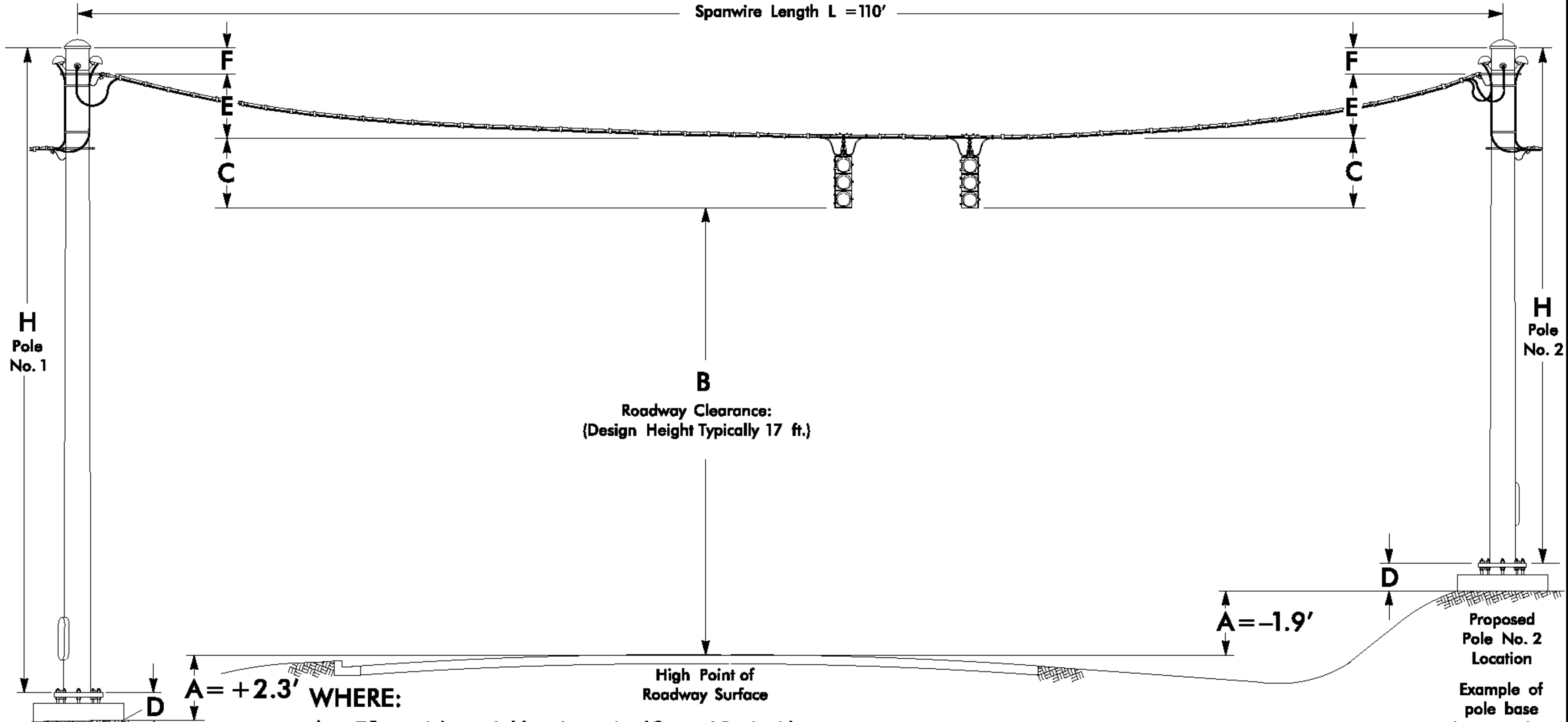
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 10.1.1

SHEET 2 OF 2

MINIMUM STRAIN POLE HEIGHT (H) = A + B + C − D + E + F



WHERE:

- **A** Elevation Adjustment (See 10.1.1)
- **B** Roadway Clearance Distance (Design Height typically 17′)
- **C** Signal Head Height for Spanwire Mounting (See 10.1.3)
- **D** Top of pole base above ground = 0.75′
- **E** Spanwire Sag = 4% of total Spanwire Length "L"
- **F** Spanwire Attachment Point (Minimum) = 1.5′ Below Top of Pole

Calculating H
(Round up to .5 ft.)

Pole height for pole No. 1 (H): +2.3′+17′+4.25′-.75′+4.4′+1.5′ = 28.7′ => 29.0 ft.
Pole height for pole No. 2 (H): -1.9′+17′+4.25′-.75′+4.4′+1.5′ = 24.5′ => 24.5 ft.

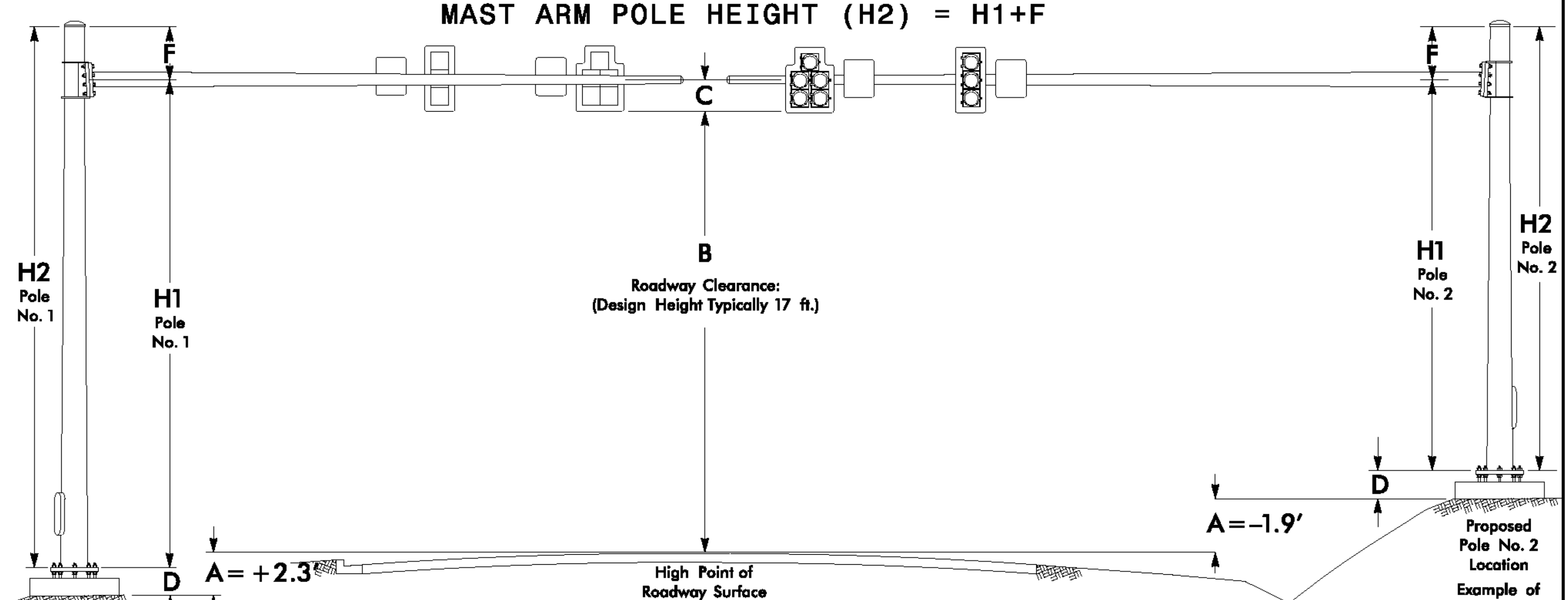
Pole Height Determination – Strain Poles

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 10.1.2

MAST ARM ATTACHMENT HEIGHT (H1) =A+B+C-D
MAST ARM POLE HEIGHT (H2) = H1+F



WHERE:

- **A** Elevation Adjustment - (See 10.1.1)
- **B** Roadway Clearance Distance (Design Height typically 17′)
- **C** ½ Signal Head Height for Mast Arm Mounting (See 10.1.3)
- **D** Top of Pole base above ground = 0.75′
- **F** ℄ Arm Attachment Point to Top of Pole = 2′

EXAMPLES:

Calculating H1 (Round up to .1 ft.)
- Mast Arm attachment height for pole No. 1 (H1): +2.3′+17′+(4.67′/2)-.75′ = 20.885′ => 20.9 ft.
- Mast Arm attachment height for pole No. 2 (H1): -1.9′+17′+(4.67′/2)-.75′ = 16.685′ => 16.7 ft.

Calculating H2 (Round up to .5 ft.)
- Pole height for pole No. 1 (H2): 20.9′+2′ = 22.9′ => 23.0 ft.
- Pole height for pole No. 2 (H2): 16.7′+2′ = 18.7′ => 19.0 ft.

Pole Height Determination – Straight Mast Arms

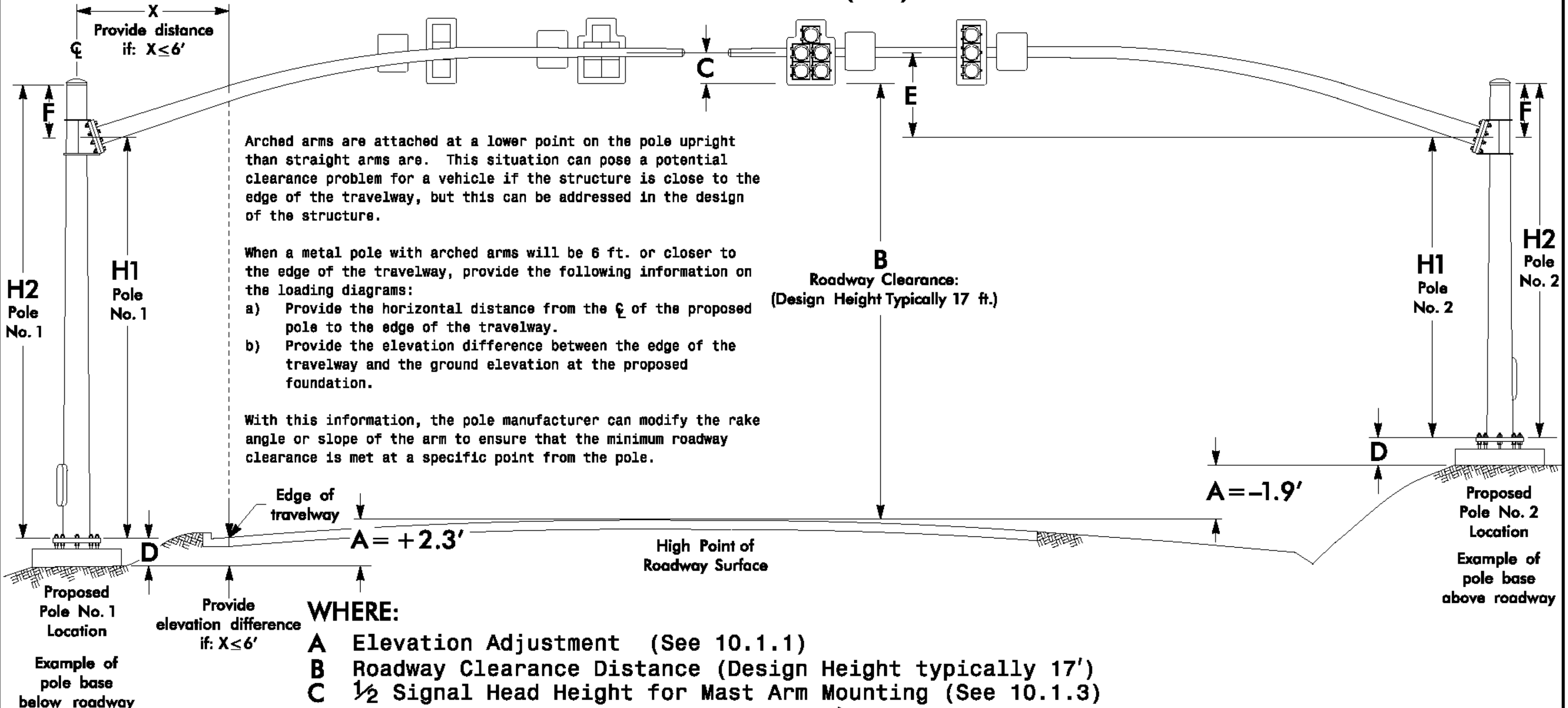
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 10.1.2

SHEET 2 OF 3

MAST ARM ATTACHMENT HEIGHT (H1) =A+B+C-D-E
MAST ARM POLE HEIGHT (H2) = H1+F



Arched arms are attached at a lower point on the pole upright than straight arms are. This situation can pose a potential clearance problem for a vehicle if the structure is close to the edge of the travelway, but this can be addressed in the design of the structure.

When a metal pole with arched arms will be 6 ft. or closer to the edge of the travelway, provide the following information on the loading diagrams:

a) Provide the horizontal distance from the ℄ of the proposed pole to the edge of the travelway.
b) Provide the elevation difference between the edge of the travelway and the ground elevation at the proposed foundation.

With this information, the pole manufacturer can modify the rake angle or slope of the arm to ensure that the minimum roadway clearance is met at a specific point from the pole.

WHERE:

- A Elevation Adjustment (See 10.1.1)
- B Roadway Clearance Distance (Design Height typically 17′)
- C ½ Signal Head Height for Mast Arm Mounting (See 10.1.3)
- D Top of pole base above ground = 0.75′
- E Nominal Rise in Mast Arm = 5′
- F ℄ Arm Attachment Point to Top of Pole = 2′

EXAMPLES:

Calculating H1 (Round up to .1 ft.)
- Mast Arm attachment height for pole No. 1 (H1): +2.3′+17′+(4.67′/2)-.75′-5.0′ = 15.885′ => 15.9 ft.
- Mast Arm attachment height for pole No. 2 (H1): -1.9′+17′+(4.67′/2)-.75′-5.0′ = 11.685′ => 11.7 ft.

Calculating H2 (Round up to .5 ft.)
- Pole height for pole No. 1 (H2): 15.9′+2′ = 17.9′ => 18.0 ft.
- Pole height for pole No. 2 (H2): 11.7′+2′ = 13.7′ => 14.0 ft.

Pole Height Determination – Curved /Arched Mast Arms

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 10.1.2

LOADING SCHEDULE FOR STRAIN POLES

DESCRIPTION	AREA	SIZE	WEIGHT
SIGNAL HEAD 12"-3 SECTION-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	9.2 S.F.	25.5" W x 52.0" L	56 LBS
SIGNAL HEAD 12"-4 SECTION (T-TYPE)-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	16.3 S.F.	42.0" W x 56.0" L	73 LBS
SIGNAL HEAD 12"-4 SECTION (VERTICAL)-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	11.6 S.F.	25.5" W x 65.5" L	69 LBS
SIGNAL HEAD 12"-5 SECTION-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	16.3 S.F.	42.0" W x 56.0" L	89 LBS
SIGNAL HEAD 8"-3 SECTION-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	6.3 S.F.	22.0" W x 41.5" L	41 LBS
SIGNAL HEAD 8"-4 SECTION (VERTICAL)-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	7.9 S.F.	22.0" W x 51.5" L	49 LBS
SIGNAL HEAD 8"-5 SECTION-WITH BACKPLATE, HANGER, AND BALANCE ADJUSTER	10.6 S.F.	35.0" W x 43.5" L	62 LBS
SIGN WITH HANGER	5.0 S.F.	24.0" W x 30.0" L	11 LBS
SIGN WITH HANGER	7.5 S.F.	30.0" W x 36.0" L	14 LBS
SIGN, LED BLANKOUT WITH HANGER	6.0 S.F.	24.0" W x 36.0" L	110 LBS

LOADING SCHEDULE FOR MAST ARM POLES

DESCRIPTION	AREA	SIZE	WEIGHT
SIGNAL HEAD 12"-3 SECTION-WITH BACKPLATE AND ASTRO-BRAC	9.3 S.F.	25.5" W x 52.5" L	60 LBS
SIGNAL HEAD 12"-4 SECTION (T-TYPE)-WITH BACKPLATE AND ASTRO-BRAC	16.3 S.F.	42.0" W x 56.0" L	90 LBS
SIGNAL HEAD 12"-4 SECTION (VERTICAL)-WITH BACKPLATE AND ASTRO-BRAC	11.7 S.F.	25.5" W x 66.0" L	74 LBS
SIGNAL HEAD 12"-5 SECTION-WITH BACKPLATE AND ASTRO-BRAC	16.3 S.F.	42.0" W x 56.0" L	103 LBS
SIGNAL HEAD 8"-3 SECTION-WITH BACKPLATE AND ASTRO-BRAC	6.4 S.F.	22.0" W x 42.0" L	43 LBS
SIGNAL HEAD 8"-4 SECTION (VERTICAL)-WITH BACKPLATE AND ASTRO-BRAC	7.9 S.F.	22.0" W x 52.0" L	53.5 LBS
SIGNAL HEAD 8"-5 SECTION-WITH BACKPLATE AND ASTRO-BRAC	10.6 S.F.	35.0" W x 43.5" L	75 LBS
SIGN RIGID MOUNTED WITH ASTRO-SIGN-BRAC	5.0 S.F.	24.0" W x 30.0" L	11 LBS
SIGN RIGID MOUNTED WITH ASTRO-SIGN-BRAC	7.5 S.F.	30.0" W x 36.0" L	14 LBS
SIGN, LED BLANKOUT WITH HANGER	6.0 S.F.	24.0" W x 36.0" L	110 LBS

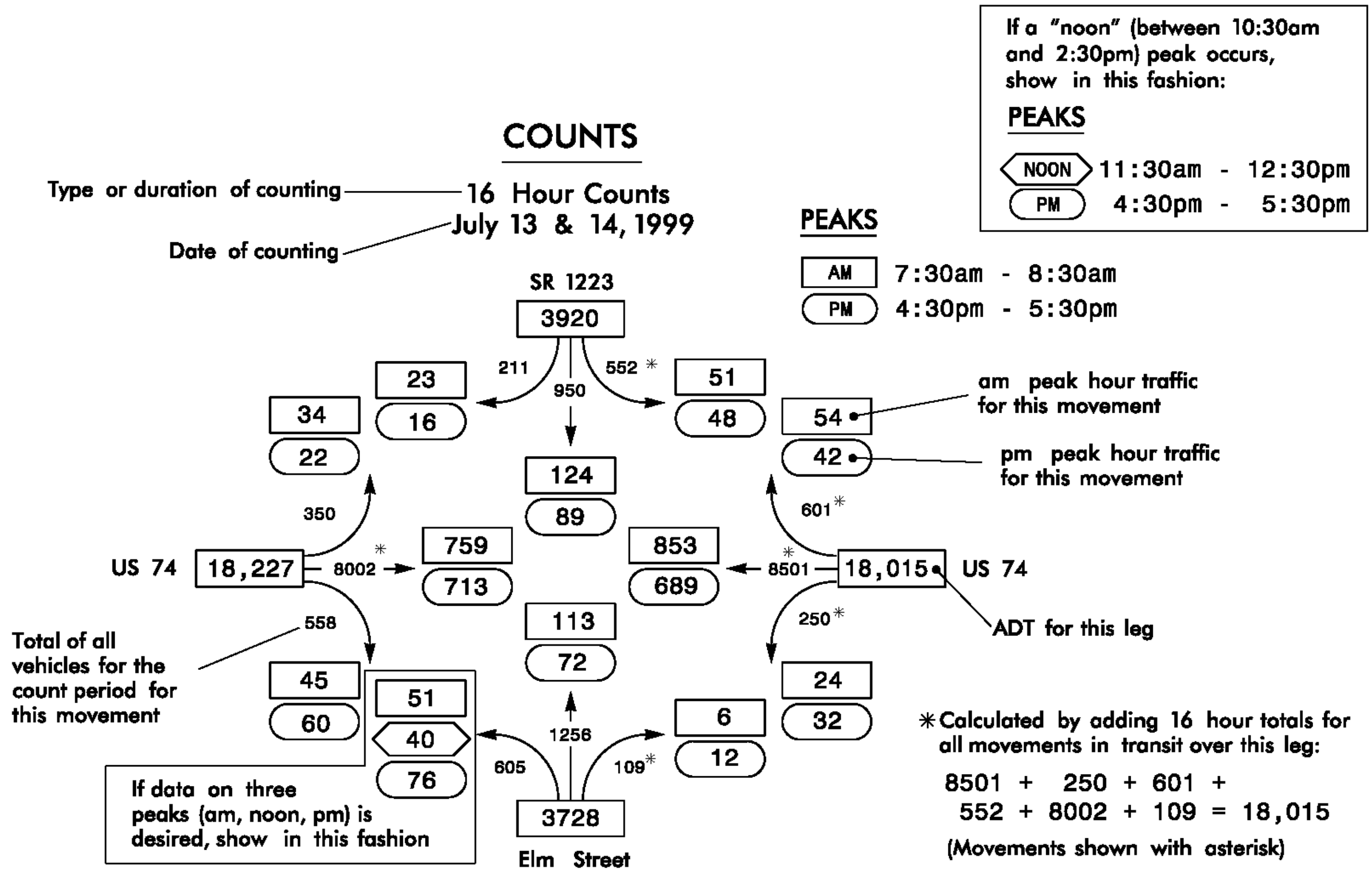
Loading Schedules For Metal Poles

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
10.1.3
SHEET 1 OF 1

Typical Count Diagram
Complete Traffic Counts

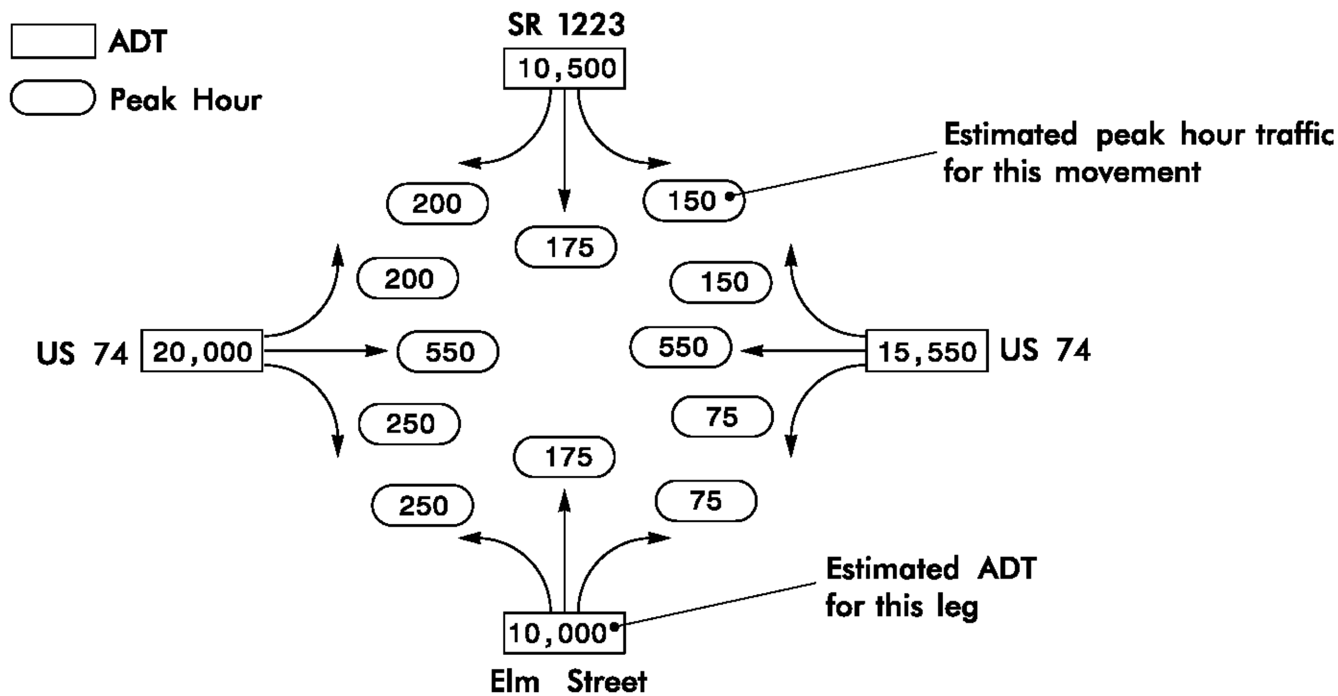


Traffic Counts

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

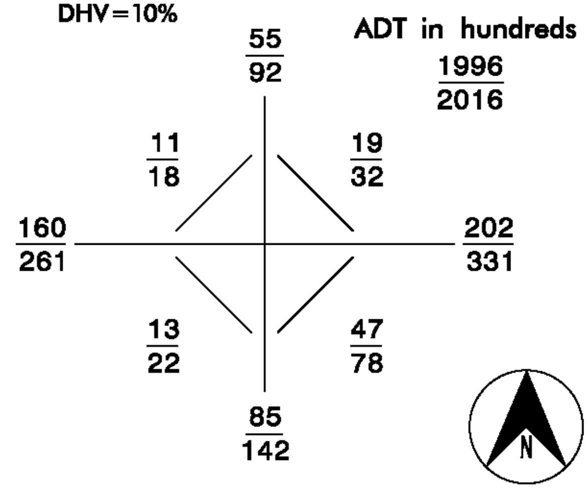
Typical Count Diagram
Estimated Traffic Counts

Year 2020 Projected Volumes



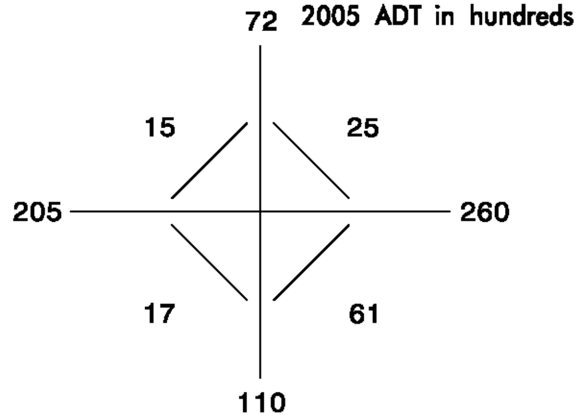
Conversion from Estimated ADT to Estimated DDHV – Example

GIVEN Project Letting Date=2000
Design Year=Letting Date+5 years=2005
D=60%
DHV=10%



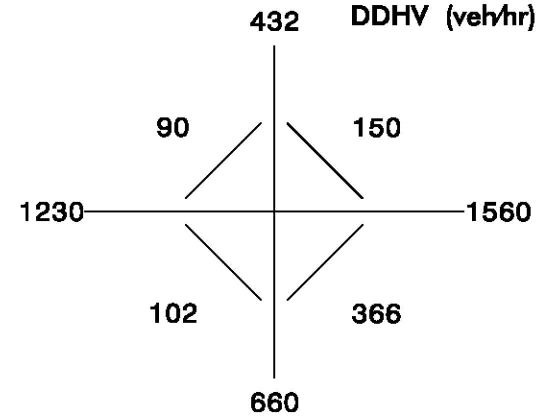
STEP 1 Interpolate to find 2005 ADT.

For the north leg, 55 + (92-55)(9/20) = 72



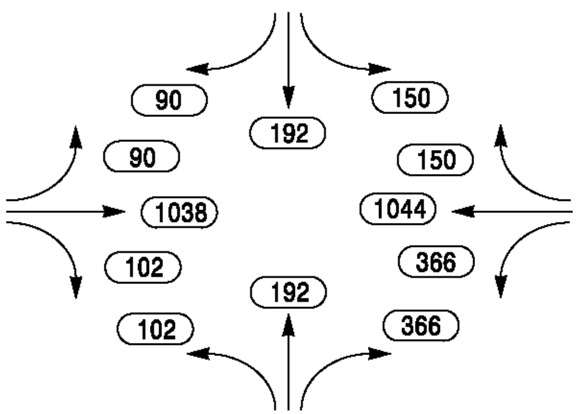
STEP 2 Convert to DDHV: (ADT)(DHV)(D) = DDHV.

For the north leg, (7200)(.10)(.60) = 432

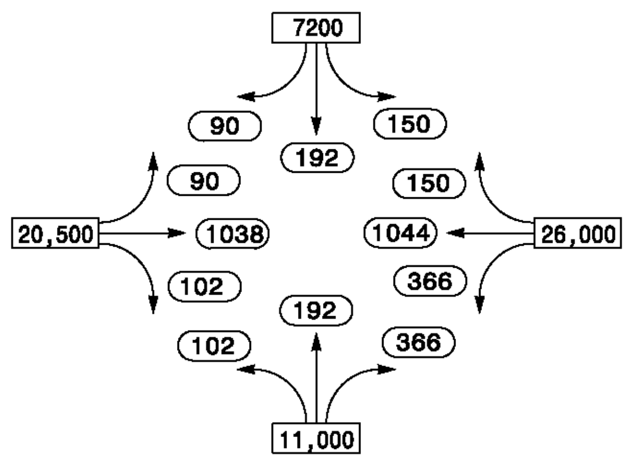


STEP 3 Determine through volumes by subtracting turning volume from total volume.

For the north leg, 432 - 90 - 150 = 192



STEP 4 Complete count diagram.

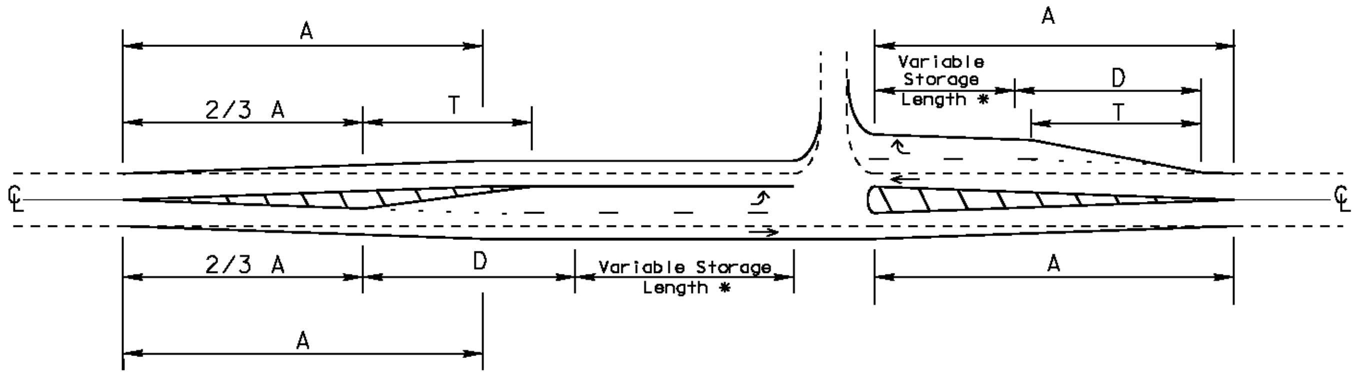


NOTES

- -ADT = Average Daily Traffic
- -DHV = Design Hour Volume
- -DDHV = Directional Design Hour Volume
- -D = Directional Split
- -Use the highest directional split for each movement. Do not attempt to determine the direction of the peak flow for both the morning and afternoon peak hours.
- -Because of the uncertainty of the data, a peak hour factor of 1.0 should be used when these peak hour volumes are used for analysis.

Recommended Treatment for Turn Lanes

Symmetrical Widening



Design Speed (mph)	Posted Speed (mph)	Minimum Deceleration Length (D)	Desirable Deceleration Length (D)	Bay Taper Length (T)	Approach / Departure Taper (A)
30	≤ 25	100′	150′	75′	$A = WS^2/60$ (IF $S \leq 40$ MPH)
35	30	100′	150′	75′	$A = WS$ (IF $S > 40$ MPH)
40	35	150′	200′	100′	S = Design Speed
45	40	150′	250′	100′	W = Width of Lateral Shift
50	45	150′	300′	100′	* Storage length for waiting vehicles should be calculated based on the latest version of the Highway Capacity Manual or Policy on Street and Driveway Access to North Carolina Highways.
55	50	200′	500′	150′	
60	55	250′	575′	200′	

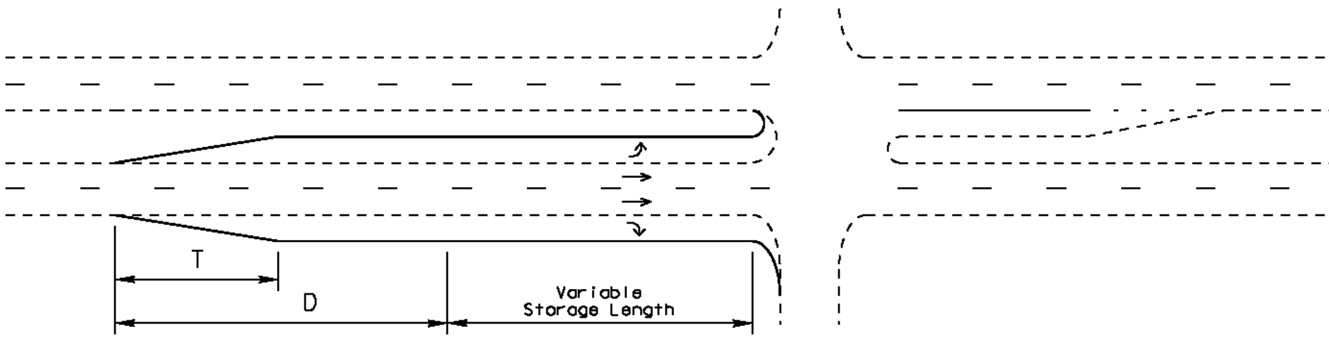
From *Policy on Street and Driveway Access to North Carolina Highways*

Geometrics – Turn Lanes

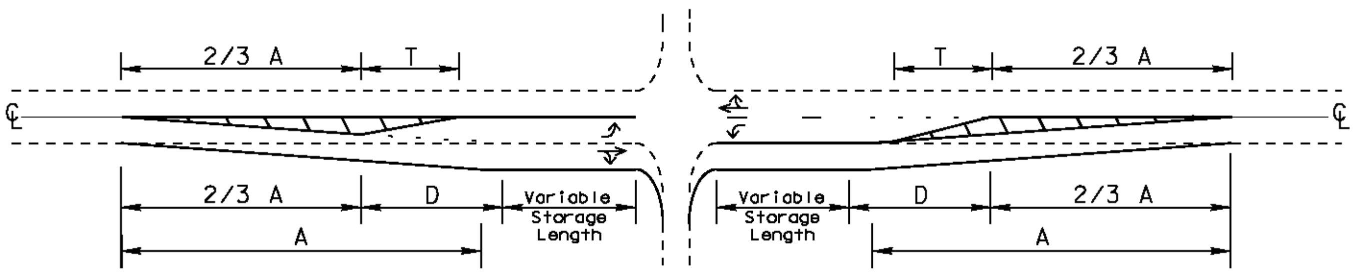
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Recommended Treatment for Turn Lanes

Pocket Lanes



Near Side Widening



All values to be determined using the table on the previous page.

From *Policy on Street and Driveway Access to North Carolina Highways*

Geometrics – Turn Lanes

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 12.0

2070L Preemption Chart

Used to designate this interval as the preemption dwell interval. This interval will use Dwell Min. Time below. Selecting 255 sec. green indicates dwell (hold) phase.

Clearance times for dwell (hold) phase. Using 0.0 sec. for each will allow controller to use times set in normal operation.

Amount of time signal is in exit phase before preemption ends. Select 0 for controller to return to normal operation after preemption. Select 1 to designate an exit phase.

Clearance time not used when Interval 5 is exit interval.

Delay time after preempt call is received before going to preempt phase. Usually 0.0 sec. for Opticom systems; may need delay for pushbutton locations.

Minimum green time assured for current phase before transitioning into preempt phase. Usually 1 sec., so as to begin preemption sequence immediately (0 sec. will default to normal minimum green time).

Time provided to display Flashing "DON'T WALK" for pedestrians to clear intersection before beginning preemption sequence.

Clearance times provided to clear current phase before transitioning into preemption. Using 0.0 sec. for each will allow controller to use times set in normal operation.

Minimum time preemption dwell phase will run. Opticom systems typically use the same time as the phase in normal operation. Minimum time for pushbutton locations needs to be based on trial runs (typically by the Division).

Select yes to clear to all red before going into preemption to prevent yellow trap.

"Y" (for Yes) will time the "Ped Clear Before Pre" and "Yellow Clear Before Pre" simultaneously, thereby reducing overall clearance time needed before preemption. Select "N" to time "FDW" and then yellow clear and red clear before going into preeempt.

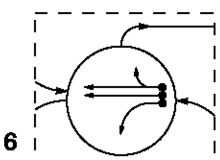
Time to extend preempt dwell phase after call is dropped (usually 2 sec.) Prevents the call from being dropped accidentally. Typically used for Opticom systems.

2070L EV PREEMPTION

FUNCTION	PRE 3	PRE 4	PRE 5	PRE 6
Interval 1 – Dwell Green	255	255	255	255
Interval 1 – Dwell Yellow	0.0*	0.0*	0.0*	0.0*
Interval 1 – Dwell Red	0.0*	0.0*	0.0*	0.0*
Interval 5 – Exit Green	1	1	1	1
Interval 5 – Yellow	0.0	0.0	0.0	0.0
Interval 5 – Red	0.0	0.0	0.0	0.0
Delay Time	0.0	0.0	0.0	0.0
Min Green Before Pre	1	1	1	1
Ped Clear Before Pre	0	0	0	0
Yellow Clear Before Pre	0.0*	0.0*	0.0*	0.0*
Red Clear Before Pre	0.0*	0.0*	0.0*	0.0*
Dwell Min Time	10	7	10	7
Enable Backup Protection	Y/N	Y/N	Y/N	Y/N
Ped Clear Through Yellow	Y/N	Y/N	Y/N	Y/N
Preempt Extend **	2	2	2	2

* Time defaults to time used for phase during normal operation
** Program Timing on Optical Detection Unit

Notes:
1) For pushbutton operation, use EV PRE 2.
2) For Opticom type operation:
For 1 preempt, use EV PRE 3
For 2 preempts, use EV PRE 3 and 5
For 3 preempts, use EV PRE 3, 4, and 5
For 4 preempts, use EV PRE 3, 4, 5, and 6
3) Include corresponding regular phases in phasing diagram



EV PRE 3
(Ø1+6)

Emergency Vehicle Preemption

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-05

STD. NO. 13.0

NEMA Preemption Chart

Delay time after preempt call is received before going to preempt phase. Usually 0 sec. for Opticom systems. May need delay for pushbutton locations, typically Division will determine delay needed.

Time provided to display Flashing "DON'T WALK" for pedestrian to clear intersection before beginning preempt sequence. This time may be reduced if necessary.

Minimum green time assured for current phase before transitioning into preempt phase. Usually 1 sec., so as to begin preemption sequence immediately (0 sec. will default to normal minimum green time).

Highest yellow and highest red clear times needed to clear normal operation phases (may come from different phases).

Minimum time preemption dwell phase will run. Opticom systems typically use the same time as the phase in normal operation. Minimum time for pushbutton locations needs to be based on trial runs (typically by the Division).

Clearance times for dwell (hold) phase. Use clearance times from corresponding normal phase (See Std. 5.2.2, Sheet 4).

Some NEMA controllers allow Ped Clear time and Yellow Clear time Before Preempt to time simultaneously, while other brands do not. If in doubt about type of equipment being used, select "N."

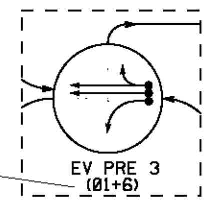
Time to extend preempt dwell phase after call is dropped (usually 2 sec.) Prevents the call from being dropped accidentally. Typically used for Opticom systems.

NEMA EV PREEMPTION

FUNCTION	PRE 3	PRE 4	PRE 5	PRE 6
Delay Before Preempt	0	0	0	0
Ped Clear Before Preempt	–	–	–	–
Min. Green Before Preempt	1	1	1	1
Yellow Clear Before Preempt	4.0	4.0	4.0	4.0
Red Clear Before Preempt	1.0	1.0	1.0	1.0
Preempt Dwell Min. Green	10	7	10	7
Yellow Clr After Preempt	4.0	4.0	4.0	4.0
Red Clear After Preempt	1.0	1.0	1.0	1.0
Ped Clear Through Yellow	Y/N	Y/N	Y/N	Y/N
Preempt Extend **	2.0	2.0	2.0	2.0

** Program Timing on Optical Detection Unit

Notes:
1) For pushbutton operation, use EV PRE 2.
2) For Opticom type operation:
   For 1 preempt, use EV PRE 3
   For 2 preempts, use EV PRE 3 and 5
   For 3 preempts, use EV PRE 3, 4, and 5
   For 4 preempts, use EV PRE 3, 4, 5, and 6
3) Include corresponding regular phases in phasing diagram



170 Preemption Chart

(See Above)

Time needed for pedestrians to clear intersection before going into preempt phase.

(See Above)

Preemption dwell phase minimum green (times after call is released).

(See Above)

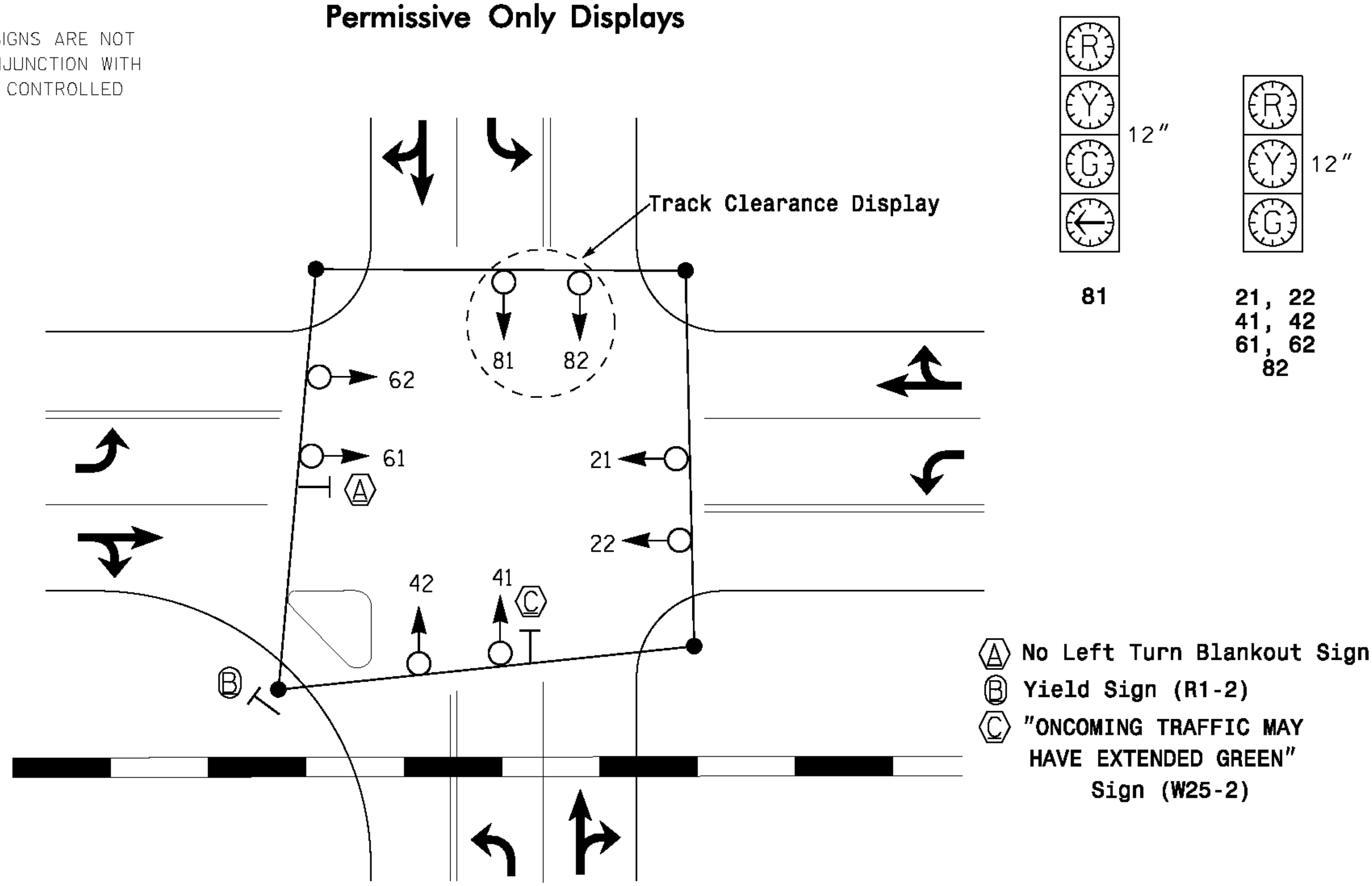
170 EV PREEMPTION

FUNCTION	EVA	EVB	EVC	EVD
Delay Before Preempt	0	0	0	0
Ped. Clear Before Preempt	–	–	–	–
Min. Green Before Preempt	1.0	1.0	1.0	1.0
Clearance Time	7	7	7	7
Preempt Extend **	2.0	2.0	2.0	2.0

** Program Timing on Optical Detection Unit

Use of Signal Heads and Blankout Signs
Permissive Only Displays

NOTE: BLANKOUT SIGNS ARE NOT USED IN CONJUNCTION WITH "YIELD" SIGN CONTROLLED MOVEMENTS

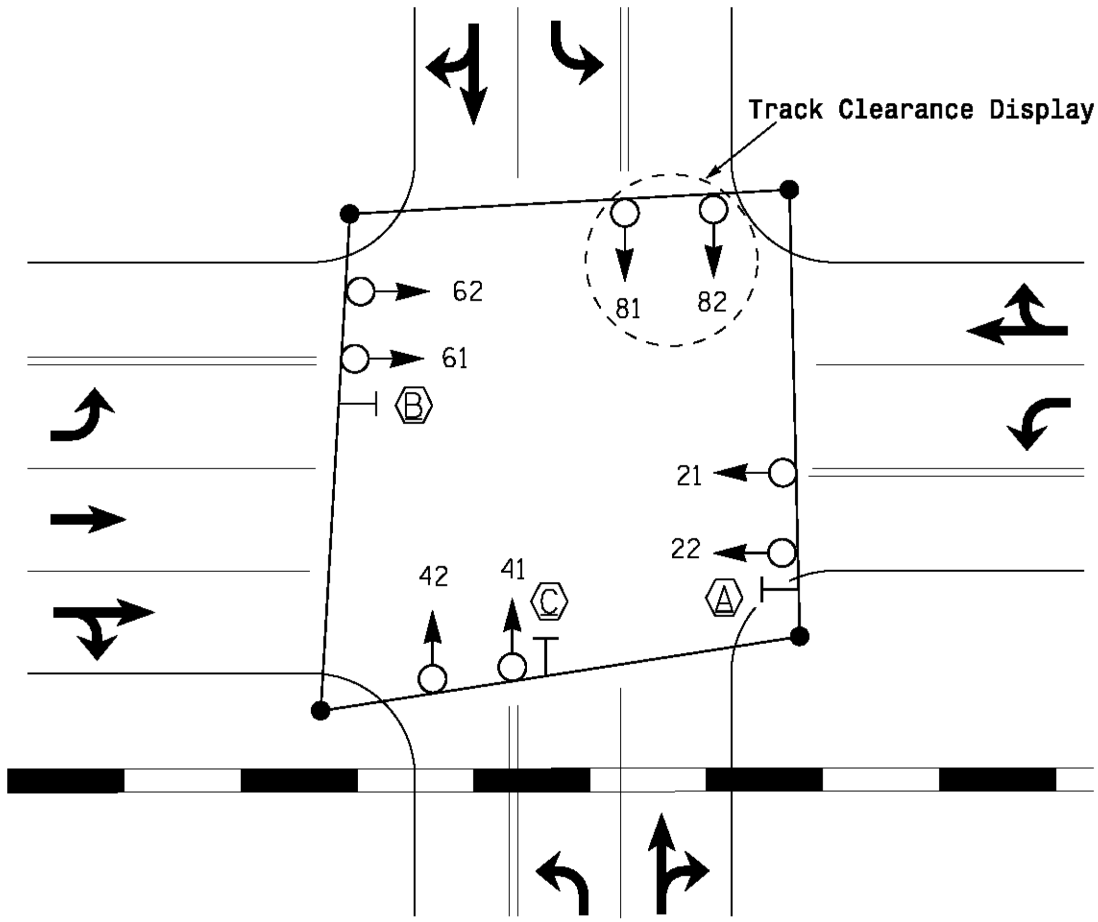


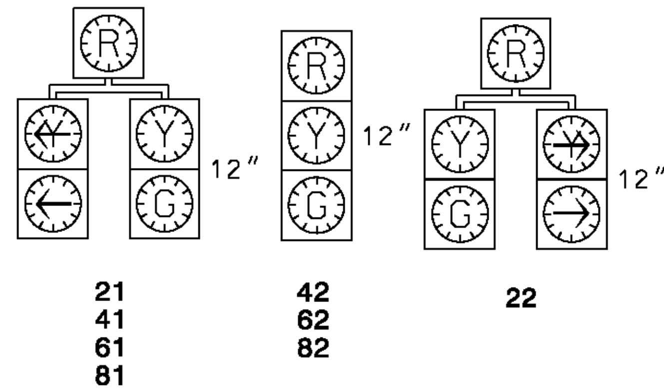
Ⓐ No Left Turn Blankout Sign

Ⓑ Yield Sign (R1-2)

Ⓒ "ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN" Sign (W25-2)

Use of Signal Heads and Blankout Signs
Protected /Permissive Displays





(A) No Right Turn Blankout Sign
(B) No Left Turn Blankout Sign
(C) "ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN" Sign (W25-2)

Railroad Preemption

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

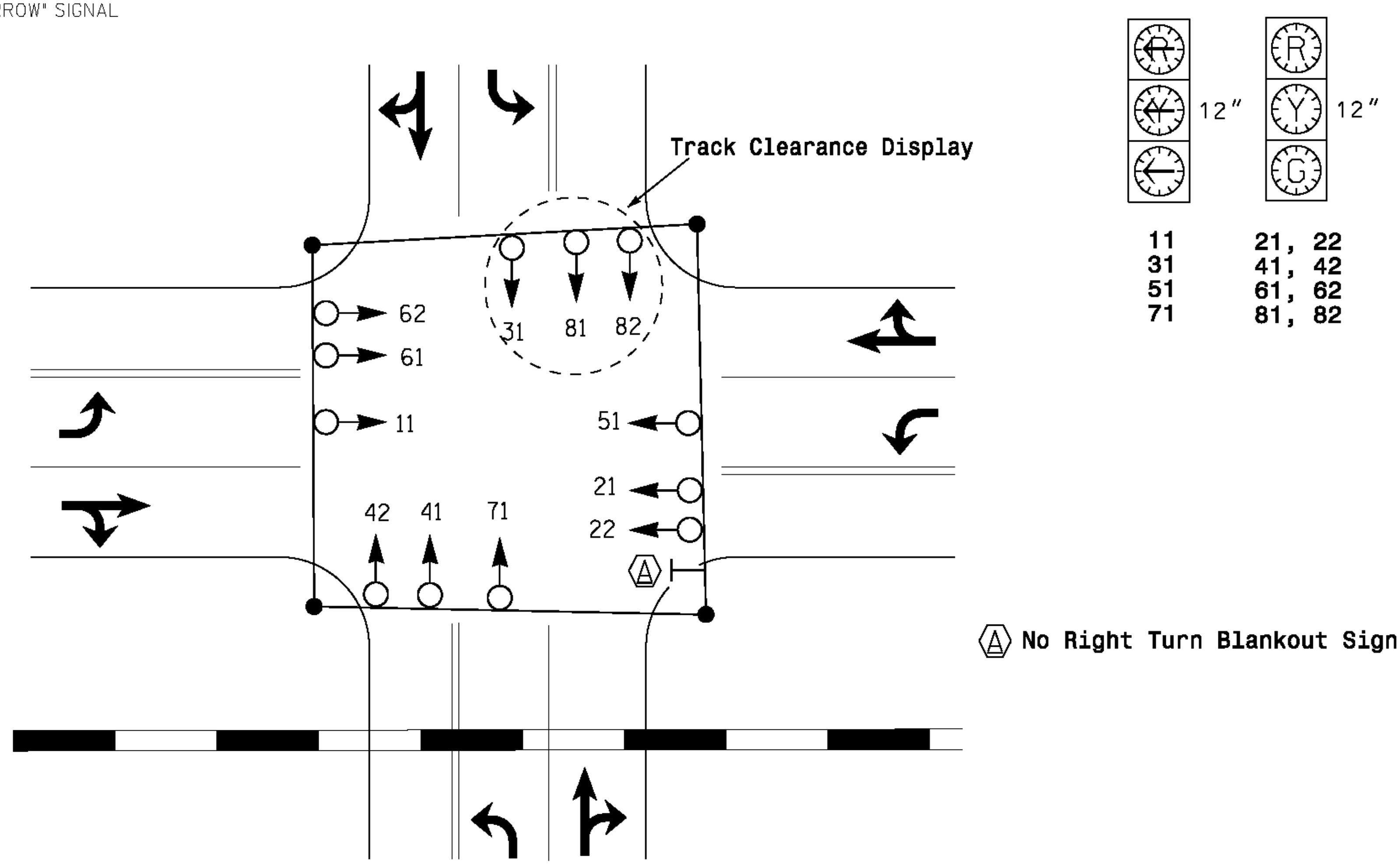
7-04

STD. NO. 13.1

SHEET 2 OF10

NOTE: BLANKOUT SIGNS ARE NOT USED IN CONJUNCTION WITH "RED ARROW" SIGNAL DISPLAYS

Use of Signal Heads and Blankout Signs
Protected Only Displays



Railroad Preemption

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 13.1

SHEET 3 OF 10

Use of Signal Heads and Blankout Signs
Advance Signal Heads
(With Adequate Storage)

Design Consideration:

When active crossing warning devices consists only of flashers (no gates present) and there is room to store vehicles between the tracks and the intersection.

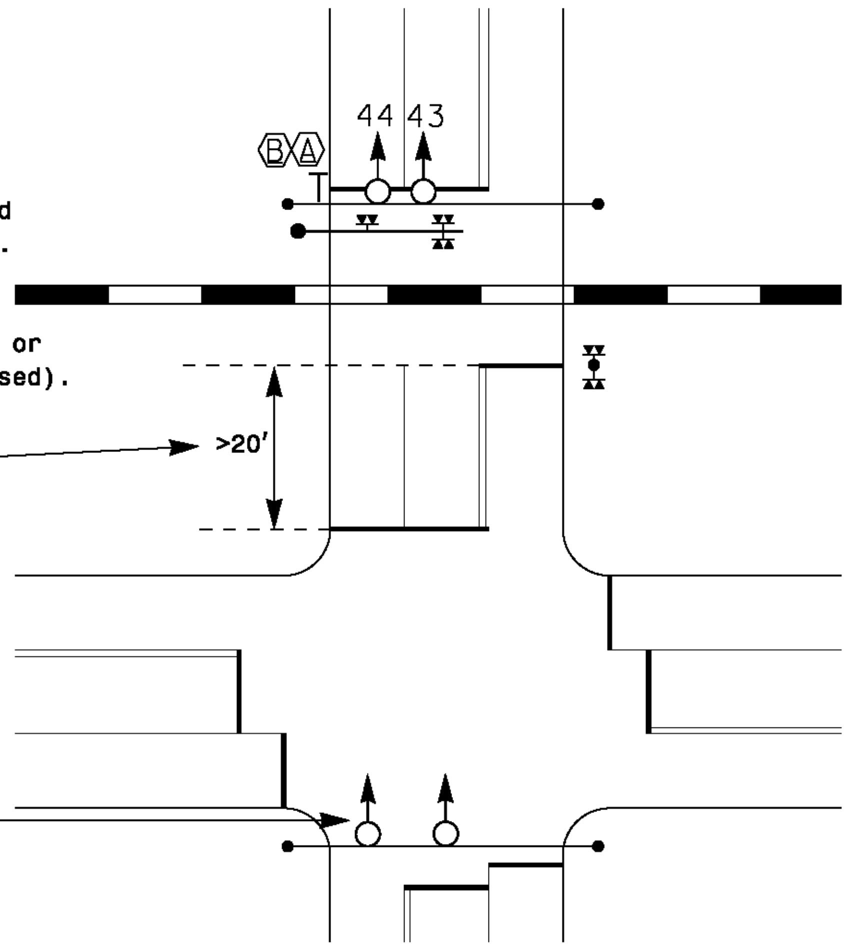
Advance signal faces should be located as near as practical to the stop line.

Advance signal heads should not block or obstruct flashers on cantilever (if used).

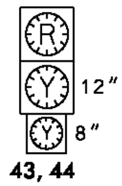
Adequate storage space to hold at least one design vehicle (typically assumed to be 20′).

NOTE: Based on engineering judgement, advance signal heads may be placed downstream (across) of the railroad tracks.

NOTE: When advance heads are used, consider visibly limiting the signal heads for the approach from the railroad at the intersection.



SIGNAL FACE I.D.



SIGN I.D.

(A) "STOP HERE ON RED" Sign (R10-6)
(B) "DO NOT STOP ON TRACKS" Sign (R8-8)

TABLE OF OPERATION					
SIGNAL FACE	PHASE				
	Ø2+6	Ø4+8	RR CLR	RR PRE	FLASH
43, 44	FY	FY	R	R	R

FY = 8" Flashing Yellow
(See Note 125 in Section 5.0)

Use of Signal Heads and Blankout Signs
Advance Signal Heads
(Without Adequate Storage)

Design Consideration:

When there is no room to store vehicles between the tracks and the intersection.

A Track Clearance Phase is generally not used in this situation.

A supplemental signal head should be used due to the potential for a train to block the signal heads.

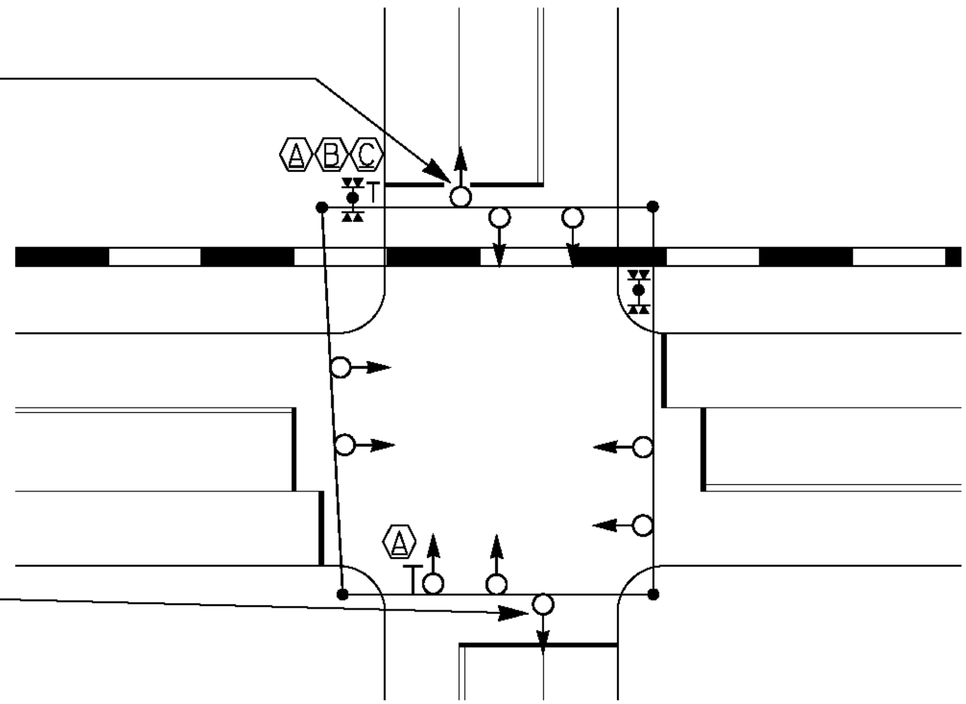
Traffic must stop at stopbar prior to railroad track for signal. A "NO TURN ON RED" sign should be used.

Advance signal heads should not block or obstruct flashers on cantilever (if used).

A supplemental signal head may be needed due to the potential for a train to block the signal heads.

SIGN I.D.

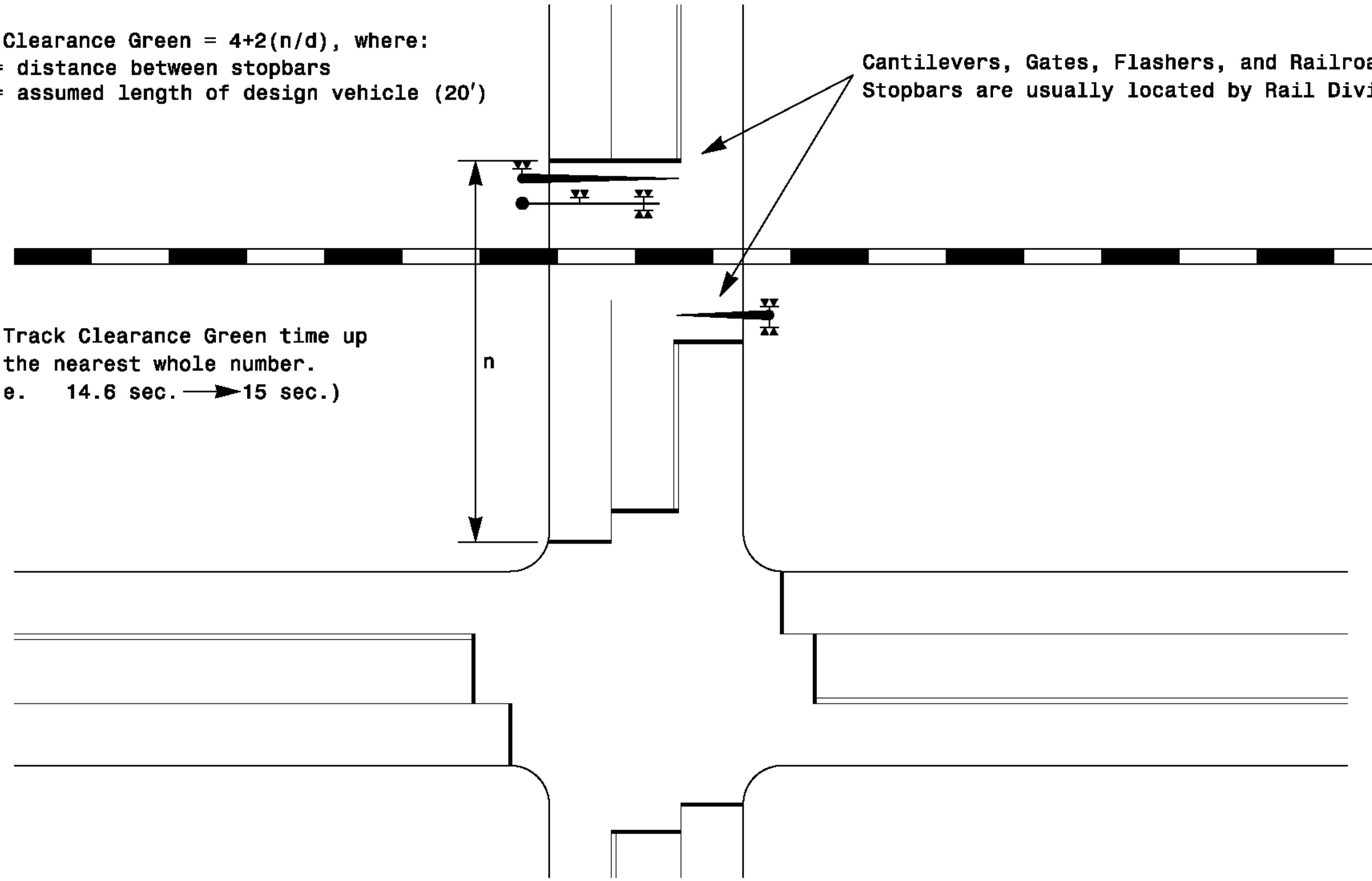
(A) "NO TURN ON RED" Sign (R10-11)
(B) "STOP HERE ON RED" Sign (R10-6)
(C) "DO NOT STOP ON TRACKS" Sign (R8-8)



Track Clearance Phase Times

Greenshield's Formula:

Track Clearance Green = 4+2(n/d), where:
n = distance between stopbars
d = assumed length of design vehicle (20')



Round Track Clearance Green time up to the nearest whole number.
(i.e. 14.6 sec. ⟶ 15 sec.)

2070L Preemption Chart

Based on Greenshield's Formula (see Sheet 6).
Typically minimum is 10 seconds.

Times for track clearance phase. Should be the same times as if the phase were used in normal operation.

Used to designate this interval as the preemption dwell interval. This interval will use Dwell Min. Time below. Selecting 255 sec. green indicates dwell (hold) phase.

Clearance times for dwell (hold) phase. Using 0.0 sec. for each will allow controller to use times set in normal operation.

Amount of time signal is in exit phase before preemption ends. Select 0 for controller to return to normal operation after preemption. Select 1 to designate an exit phase.

Clearance time not used when Interval 5 is exit interval.

Delay time after preempt call is received before going to preemption sequence. Typically use 0 sec.

Minimum green time assured for current phase before transitioning into preempt phase. Usually 1 sec., so as to begin preemption sequence immediately (0 sec. will default to normal minimum green time).

Time provided to display Flashing "DON'T WALK" for pedestrians to clear intersection before beginning preemption sequence. This time may be reduced if necessary.

Clearance times provided to clear current phase before transitioning into preemption. Using 0.0 sec. for each will allow controller to use times set in normal operation.

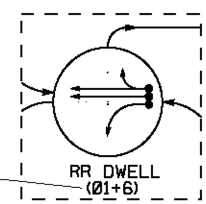
Minimum Green Time for Dwell (hold) phase. Typically, same as time used in normal operation.

"Y" (for Yes) will time the "Ped Clear Before Pre" and "Yellow Clear Before Pre" simultaneously, thereby reducing overall clearance time needed before preemption. Select "N" to time "FDW" and then yellow clear and red clear before going into preeempt.

2070L RR PREEMPTION 1	
Interval 1 – Track Clearance Green	12
Interval 1 – Track Clearance Yellow	3.7
Interval 1 – Track Clearance Red	1.8
Interval 2 – Dwell Green	255
Interval 2 – Dwell Yellow	0.0*
Interval 2 – Dwell Red	0.0*
Interval 5 – Exit Green	1
Interval 5 – Yellow	0.0
Interval 5 – Red	0.0
Delay Time	0
Min Green Before Pre	1
Ped Clear Before Pre	0
Yellow Clear Before Pre	0.0*
Red Clear Before Pre	0.0*
Dwell Min Time	7
Ped Clear Through Yellow	Y/N

* Time defaults to time used for phase during normal operation

Notes:
1) Use Preemption 1
2) Include corresponding regular phases in phasing diagram



Railroad Preemption

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-05

STD. NO. 13.1

NEMA (TS–1 and TS–2) Preemption Chart

Delay time after preempt call is received before going into preempt sequence: Typically use 0 sec.

Time provided to display Flashing "DON'T WALK" for pedestrian to clear intersection before beginning preempt sequence. This time may be reduced if necessary.

Minimum green time assured for current phase before transitioning into preempt phase. Usually 1 sec., so as to begin preemption sequence immediately (0 sec. will default to normal minimum green time).

Highest yellow and highest red clearance times needed to clear normal operation phases (may come from different phases).

Based on Greenshield's Formula (see Sheet 6).

Times for Track Clearance phase. Should be the same times as if the phase were used in normal operation (See Std. 5.2.2, Sheet 4).

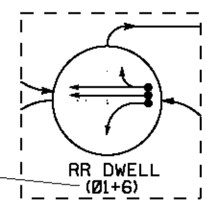
Min Green Time for Dwell (hold) phase. Typically same as time used in normal operation.

Yellow and Red Times of Dwell (hold) phase. Use highest yellow and red times if more than 1 Dwell phase is used.

Some NEMA controllers allow Ped Clear time and Yellow Clear time Before Preempt to time simultaneously, while other brands do not. If in doubt about type of equipment being used, select "N."

NEMA RR PREEMPTION 1	
Delay Before Preempt	0
Ped. Clear Before Preempt	–
Min. Green Before Preempt	1
Yellow Clear Before Preempt	–
Red Clear Before Preempt	–
Track Clearance Green	–
Track Clearance Yellow	–
Track Clearance Red	–
Preempt Dwell Min. Green	–
Yellow Clear After Preempt	–
Red Clear After Preempt	–
Ped Clear Through Yellow	Y/N

Notes:
1) Use Preemption 1
2) Include corresponding regular phases in phasing diagram



Railroad Preemption

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
13.1

170 Preemption Chart

Delay time after preempt call is received before going into preempt sequence: Typically use 0 sec.

Based on Greenshield's Formula (see Sheet 6).

170 RAILROAD PREEMPTION	
Delay Before Preempt	0
Track Clearance Green	–

NOTE: The Railroad preemption calls are immediate with 170 equipment. 170 Bi-Trans Software does not clear pedestrian times before entering Railroad Preemption. Ped displays go directly from a solid WALK to a solid DON'T WALK display and does not provide any clearance time (flashing DON'T WALK display).

Elements on a Signal Plan with Railroad Preemption

- -AAR DOT Crossing Number on Plan.
- -Name of Railroad(s) operating on tracks.
- -Show all gates, flashers, and cantilevers on signal plan.
- -Railroad Preemption Timing Chart.
- -Be sure all phases (including any timed overlaps) lead directly to a Track Clearance phase.
- -Railroad Preemption should have priority over Emergency Vehicle Preemption.
- -"NO RIGHT (LEFT) TURN" Blankout signs as needed.
- -Show blankout signs in Table of Operation. Illuminate blankout signs during track clearance and all preempt hold phases.
- -Include blankout sign operation during flash mode in the Notes.
- -When entering the preemption sequence, yellow traps are permitted if necessary to provide immediate and proper track clearance. Use an "ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN" sign (W25-2) on the approach(es) subjected to a yellow trap.
- -Use a "DO NOT STOP ON TRACKS" sign (R8-8) on approach crossing tracks leading to signal (add any other time there is potential for traffic to queue across tracks).
- -Use a "STOP HERE ON RED" sign (R10-6) if traffic is to stop prior to tracks and there is little or no storage room between tracks and the intersection.
- -When possible, the street crossing the tracks should flash YELLOW in flashing operation, even if it is not the main phase (2+6). If the side street flashes yellow, then the main street flashes red. An all red flashing indication may also be used at some locations.
- -2070 and most NEMA equipment can designate an exit phase upon leaving Railroad Preemption. Typically, exit to the primary phase that was unable to move due to the presence of a train.

Elements for Calculating Minimum Advance Warning Time

Delay Before Preempt
* Ped Clear Before Preempt
Min Green Before Preempt
* Yellow Clear Before Preempt
Red Clear Before Preempt
Track Clear Green
** Track Clear Yellow
** Track Clear Red
** Time for Exit Gates
Safety Equipment Reaction Time
(Usually 5 Seconds)

Add the above to find the Advance Warning Time needed to clear signal for preemption and request this time from Rail Division.

* These values may clear simultaneously with some types of signal equipment.

** If 4 quadrant (exit) gates are used, do not include Track Clear Yellow and Track Clear Red times in this equation. Instead add:
12 Seconds for exit gates to descend to horizontal position.
5 seconds (exit gates should be horizontal 5 seconds prior to train arrival).

Design Considerations

The purpose of system detectors is to provide volume and occupancy information for dynamic traffic control.

More advanced equipment allows for independent control of multiple zones in the same system, so each system must be evaluated to determine its logical segments. (a.k.a. zones)

Subject to the noted limits, enough system detectors should be included to provide redundant detection of main and side street traffic in each zone of the system:

- . Main street detection should be provided in each direction at multiple intersections in each zone.
- . Side street detection should be provided at critical intersections in each zone and at additional locations when combined loops are possible and system detector limits are not compromised.

Design Engineer should consult with system timing group to determine ultimate system detector locations.

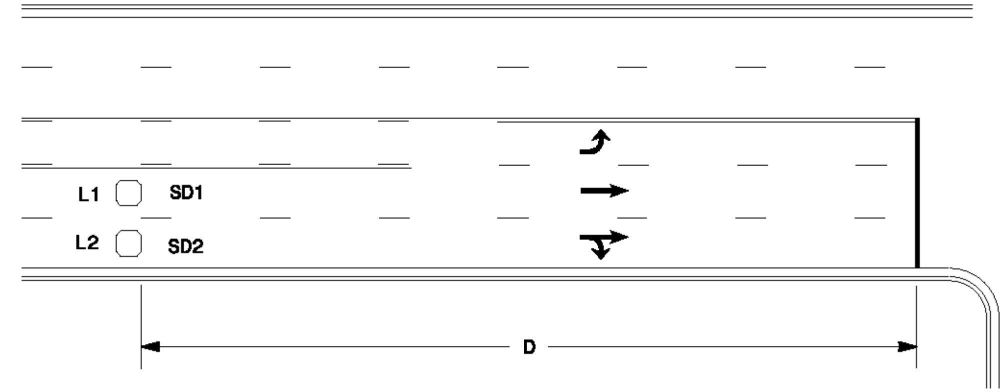
System Detector Limits

- 2070 Systems:
  - . Each master controller is limited to 64 system detectors.
  - . Each local controller is limited to 16 system detectors.
- NEMA TS-1 and TS-2 Systems:
  - . Each master controller is limited to 32 system detectors.
  - . Each local controller is limited to 8 system detectors.
- Other Considerations:
  - . Pole-mounted cabinets frequently have limited rack space for detectors, which may limit the number of system detectors.
  - . Keep some system detectors in reserve for future signal addition and/or addition of system detectors based on field experience.

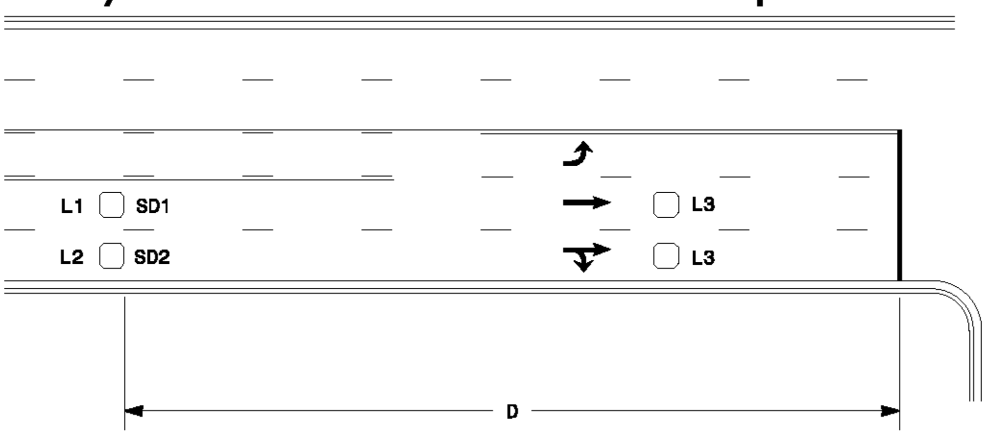
Closed Loop Signal Systems – General information

Combined System and Main Street Detectors

System Detectors with Volume–Density Operation



System Detectors with Stretch Operation

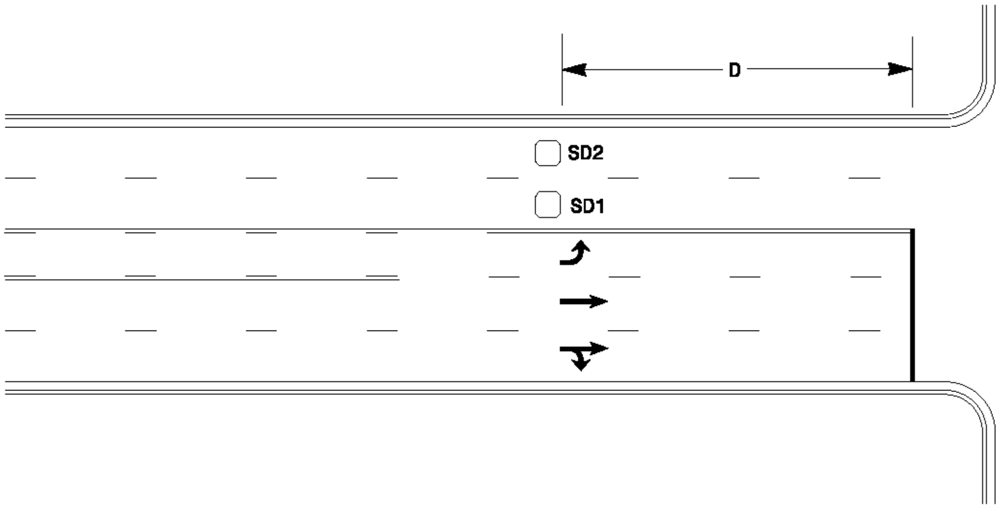


Design Considerations:

- Preferred treatment for new 2070 system installations.
- Typically for use with D>=300′ (90m).
- Loop size, turns, and location based on Main Street detection.
- Set detectors to presence mode.
- Any delay or stretch (carry) times must be programmed in the controller, not on the detector unit (may not be possible in older controllers, especially NEMA TS-1).
- Combined loops must be wired to separate detectors/channels.
- With Volume-Density operation, combined loops can be used with or without DC/EC.
- Not for use with low speed detection.

Downstream Main Street System Detectors

Downstream System Detector Placement



-SD = 6ft X 6ft,(1.8m X 1.8m)
Wired to separate channels

-D=50-250′ (15m-75m) beyond intersection

Design Considerations:

-Preferred for consistency at signals in existing systems with downstream system detectors, especially older NEMA systems.

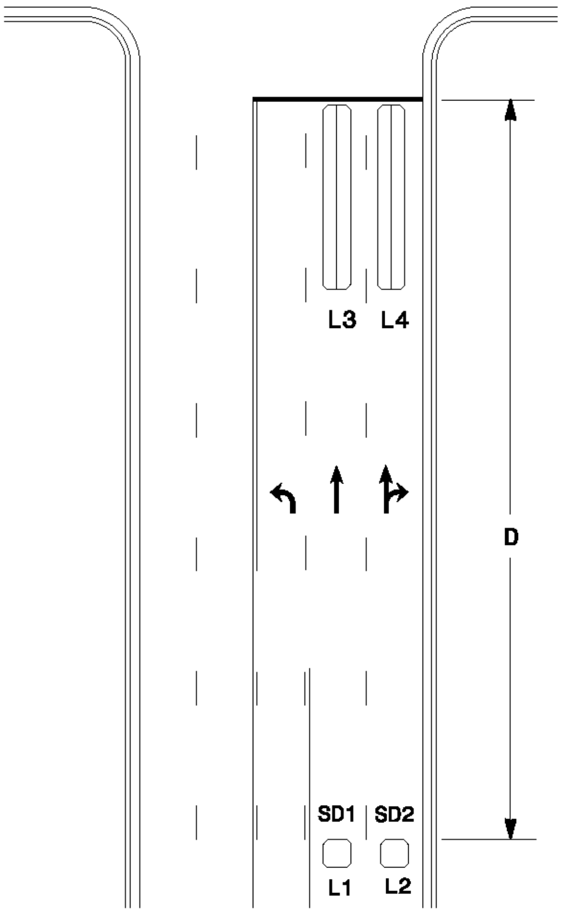
-May also be appropriate in new systems at locations with heavy undetected turns from the side street to the main street (where side street system detectors are not appropriate).

-Set detectors to presence mode.

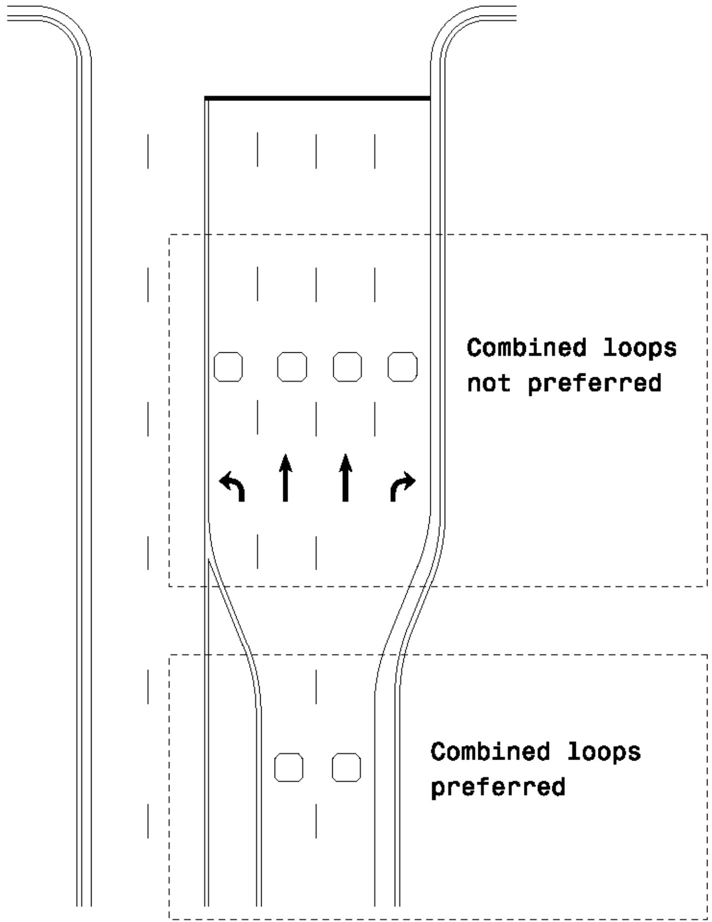
-Locate downstream system detectors past the point where traffic has selected a lane while also avoiding driveways.

Combined System and Side Street Detectors

SDs with Volume–Density or Stretch Operation



When to use combined loops



Design Considerations:

- Side street system detectors should be provided when combination loops are possible, provided system detector limits are not compromised.
- Combined system detectors are NOT preferred when loop placement is past the entrance to the left or right turn lane (when combined system detectors will miss traffic turning onto the main street -see figure).
- Typically for use with D>=300′ (90m).
- Loop size, turns, and location based on side street detection.
- Set detection to presence mode.
- May not be possible in older controllers, especially NEMA TS-1.
- Combined loops must be wired to separate detectors/channels.

Closed Loop Signal Systems – Side Street Detection

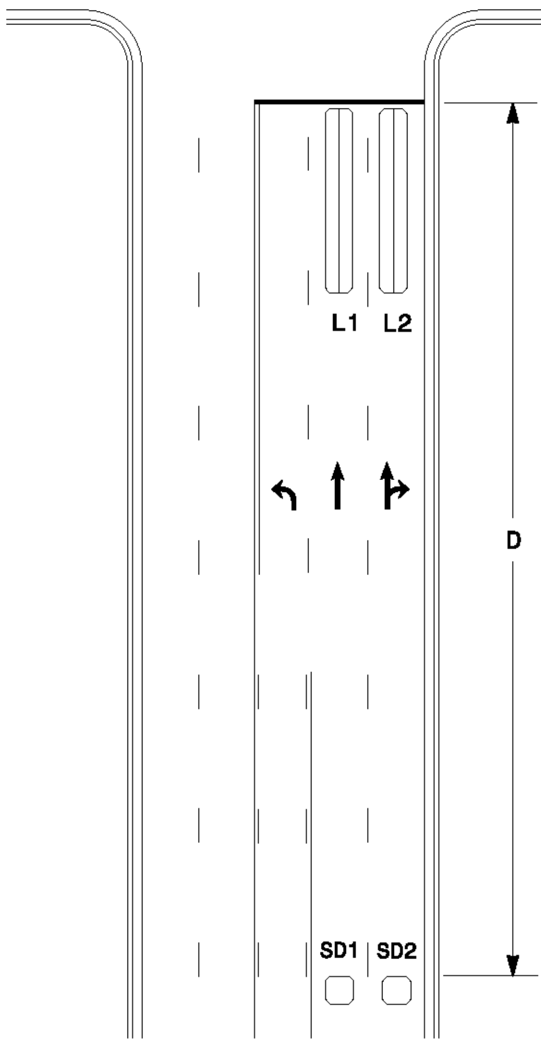
SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 14.2

SHEET 1 OF 2

Upstream Side Street – System Detectors



-SD = 6ft X 6ft,(1.8m X 1.8m)
Wired to separate channels

-D = 300′-500′, (90m-150m)

Design Considerations:

- When combination loops are not possible or not preferred, this treatment may be used at the critical intersection in each zone of new system installation.
- Set detectors to presence mode.
- D should be chosen to ensure all volume is counted before entering left or right turn lanes.
- If turn lane consideration makes D unreasonably large, consider placing a system detector in the turn lane (preferred) or using downstream main street system detectors at this location (less preferred)

Closed Loop Signal Systems – Side Street Detection

SIGNALS & GEOMETRICS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
14.2
SHEET 2 OF 2

Design Manual

Signals Management Section

Transportation Mobility and Safety Division

State of North Carolina

Department of Transportation

Signals Management Section

Part 2

(This page is intentionally left blank)

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.

Table of Contents

(This page is intentionally left blank)

THIS ELECTRICAL DETAIL IS FOR
THE SIGNAL DESIGN: 11-1001
DESIGNED: 07-2003
SEALED: 08-15-03
REVISED: N/A

THIS ELECTRICAL DETAIL IS FOR
THE SIGNAL DESIGN: 02-1234T,
AND: 02-1234
DESIGNED: 03-2000
SEALED: 03-22-00
1 REVISED: 09-09-03

Signal Plan I.D. Box

Every electrical detail must have a Signal Plan I.D. Box. The purpose of this box is to positively identify the signal plan that the electrical detail is designed to implement. The box has four data fields:

Signal Inventory Number - An inventory number is assigned to each signalized intersection. That number is found in the bottom right corner of the signal plan and should be entered in the first data field. Some plans have one or more temporary designs and a final design. If some or all of these designs can be combined on a single electrical detail, the different versions can be shown as on the lower example.

Design Date - This date is found on the signal plan in the area labeled 'Plan Date'. It should be duplicated in the second data field.

Seal Date - The third data field should contain the date that the signal plan was sealed on.

Revision Date - If a signal plan has been revised, the date of the revision is shown in the bottom data field. If a plan has been revised more than once, all revision dates should be shown. If the plan has no revisions, the data field should be designated as 'N/A'.

(This page is intentionally left blank)

EQUIPMENT INFORMATION

CONTROLLER..............2070
CABINET 336
SOFTWARE ....ECONOLITE OASIS
CABINET MOUNT...........POLE
OUTPUT FILE POSITIONS...12
LOAD SWITCHES USED......S1,S2,S3,S4,S5,S8,S9
PHASES USED.............1,2,2PED,3,4,6,6PED
OVERLAPS................NONE

EQUIPMENT INFORMATION

CONTROLLER..............2070
CABINET ....332 W/ AUX
SOFTWARE ....ECONOLITE OASIS v3.03.32E
(OR LATEST APPROVED VERSION)
CABINET MOUNT...........BASE
OUTPUT FILE POSITIONS...18 WITH AUX. OUTPUT FILE
LOAD SWITCHES USED......S1,S2,S4,S5,S7,S8,AUX S1,AUX S2
PHASES USED.............1,2,3,4,5,6
OVERLAP A...............1+4
OVERLAP B...............3+6
OVERLAP C...............NOT USED
OVERLAP D...............NOT USED

Equipment Information

Controller - Gives the controller model.

Cabinet - Gives the cabinet model (332 for a base mount cabinet, or 336 for a pole mount cabinet).

Software - Gives the local software package to be used at a particular location. If the signal design includes railroad preemption, the specific version of the software will be listed.

Cabinet Mount - Specifies whether the traffic signal cabinet is a base mount or pole mount design.

Output File Positions - Lists the number of load switch sockets available in the output file. Also specifies, if applicable, the presence of an auxiliary output file.

Load Switches Used - Indicates which load switches are to be used on the design.

Phases Used - Lists the phases used by the controller, including any phases used for timing only that have no field display.

Overlaps - Lists the parent phases for any overlaps being used.

(This page is intentionally left blank)

SIGNAL HEAD HOOK-UP CHART

LOAD SWITCH NO.	S1		S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	Ⓐ
CMU CHANNEL NO.	1		2	13	3	4	14	5	6	15	7	8	16	Ⓑ
PHASE	1		2	2 PED	3	4	4 PED	5	6	6 PED	7	8	8 PED	Ⓒ
SIGNAL HEAD NO.	11	82	21,22 23	P21, P22	NU	41,42	NU	51	61,62 63	P61, P62	NU	81,82	NU	Ⓓ
RED			128			101			134			107		Ⓔ
YELLOW			129			102			135			108		
GREEN			130			103			136			109		
RED ARROW	125							131						Ⓕ
YELLOW ARROW	126	126						132						
GREEN ARROW	127	127						133						
				113						119				Ⓖ
				115						121				

NU = NOT USED Ⓗ

Ⓗ Extra column - if more than one type of signal head is attached to the same load switch, a second column is added to the chart as shown above. In this example, both a 3-section all left arrow head and the arrow portion of a 5-section head are to run on phase 1.

2070 Signal Head Hook-Up Chart

The chart shown at left appears on all 2070 electrical details. Its purpose is to provide a user-friendly reference on connecting the signal heads to the cabinet field terminals.

Features:

Ⓐ Load Switch No. - Displays the load switch designation.

Ⓑ CMU Channel No. - Displays the conflict monitor unit channel number for each corresponding load switch position.

Ⓒ Phase - Lists the function of the load switch. The load switch function can be reassigned in the controller programming. The default settings are shown at left.

Ⓓ Signal Head No. - Lists the signal heads that should have connections made to the field terminals for this load switch. Note that a 4- or 5- section head may appear in two different columns because the red, yellow, and green balls are controlled by one load switch while the arrow indications are controlled by another.

Ⓔ Red, Yellow, Green - Lists the field terminal number to which the red, yellow, and green ball indications for the signal heads listed in the row above should be tied.

Ⓕ Red, Yellow, and Green arrows - Red, yellow, and green arrow indications for the signal heads should be tied to the field terminals that appear in these rows.

Ⓖ Pedestrian Signal Indications - The 'Hand' and the 'Man' indications of the pedestrian signal heads should be connected to the field terminals indicated. If no pedestrian signals are used, these two rows may be removed from the drawing.

(continued on next page)

Features (cont.):

I Load Resistor note - If there is not a field indication for each of the three outputs on a given load switch, a note referring to the load resistor installation detail should appear below the field hook-up chart. An asterisk is to be placed in the chart to show where a load resistor needs to be installed. If only the green and yellow indications of the load switch are used (common with 5-section heads on protected/permissive left turns), an asterisk referring to the note should be placed in the 'red' row. If only the green arrow indication is used, the asterisk should appear in the 'yellow' row. This scenario can occur when a 4-section head is used to display a left turn that is only used during a preemption. See STD. NO. 4.0 for more information.

J Auxiliary Output file - If overlaps are used, an auxiliary output file is installed providing additional load switch capacity for up to six overlaps. The default load switch to function relationships for the auxiliary output file are as follows:

AUX S1 ——— OVERLAP A
AUX S2 ——— OVERLAP B
AUX S3 ——— SPARE (OVERLAP E)
AUX S4 ——— OVERLAP C
AUX S5 ——— OVERLAP D
AUX S6 ——— SPARE (OVERLAP F)

SIGNAL HEAD HOOK-UP CHART

LOAD SWITCH NO.	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	AUX S1	AUX S2	AUX S3	AUX S4	AUX S5	AUX S6
CMU CHANNEL NO.	1	2	13	3	4	14	5	6	15	7	8	16	9	10	17	11	12	18
PHASE	1	2	2 PED	3	4	4 PED	5	6	6 PED	7	8	8 PED	OLA	OLB	SPARE	OLC	OLD	SPARE
SIGNAL HEAD NO.	61	21,22	NU	NU	41,42	NU	21	61,62	NU	41	81,82	NU	23,24	63,64	NU	43,44	NU	NU
RED	*	128			101		*	134			107		A121	A124		A114		
YELLOW		129			102			135		*	108		A122	A125		A115		
GREEN		130			103			136			109		A123	A126		A116		
RED ARROW																		
YELLOW ARROW	126						132											
GREEN ARROW	127						133			124								

NU = NOT USED

* Denotes install load resistor. See load resistor installation detail this page.

I J

2070 Signal Head Hook–Up Chart

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.0

SHEET 2 OF 2

SIGNAL HEAD HOOK-UP CHART FOR 4-SECTION FYA PPLT SIGNAL HEADS USED IN A 332 BASE MOUNTED CABINET

SIGNAL HEAD HOOK-UP CHART

LOAD SWITCH NO.	S1		S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	AUX S1	AUX S2	AUX S3	AUX S4	AUX S5	AUX S6
CMU CHANNEL NO.	1		2	13	3	4	14	5	6	15	7	8	16	9	10	17	11	12	18
PHASE	1		2	2 PED	3	4	4 PED	5	6	6 PED	7	8	8 PED	OLA	OLB	SPARE	OLC	OLD	SPARE
SIGNAL HEAD NO.	11 ★	82	21,22	NU	31 ★	41,42	NU	51 ★	61,62	NU	71 ★	81,82	NU	11 ★	31 ★	NU	51 ★	71 ★	NU
RED		✳	128			101			134			107							
YELLOW			129		✳	102		✳	135		✳	108							
GREEN			130			103			136			109							
RED ARROW														A121	A124		A114	A101	
YELLOW ARROW		126												A122	A125		A115	A102	
FLASHING YELLOW ARROW														A123	A126		A116	A103	
GREEN ARROW	127	127			118			133			124								

NU = NOT USED

✳ Denotes install load resistor. See load resistor installation detail this page.

★ See pictorial of head wiring in detail below.

2070 Signal Head Hook-Up Chart

The chart shown at left appears on all 2070 electrical details. Its purpose is to provide a user friendly reference on connecting the signal heads to the cabinet field terminals.

Features:

Ⓐ Auxiliary Output file - The cabinet must be wired such that for each Flashing Yellow Arrow (FYA) approach, the solid green protected arrow is driven by a load switch monitored on channels 1, 3, 5, and 7. The associated solid red arrow, solid yellow arrow, and flashing yellow arrow (overlap phase) must be driven by a load switch monitored on channels 9, 10, 11, and 12 respectively. The signal monitor makes the following associations when FYA monitoring is enabled for each approach:

Channel 1 with 9
Channel 3 with 10
Channel 5 with 11
Channel 7 with 12

Overlaps are used to drive the solid red arrow, solid yellow arrow, and flashing yellow arrow. The display sequence is further controlled by logic statements programmed in the controller.

Ⓑ Any load switch that only drives the solid green arrow on a 4-section FYA head will have a load resistor installed on its associated yellow field terminal on the output file. Additionally, the SSM switch for that channel will remain in the OFF position on the conflict monitor.

Ⓒ In addition to the hook-up information shown in this chart, every electrical plan utilizing FYA heads will have a FYA signal wiring detail showing a pictorial relationship of the signal head to output file wiring.

(continued on next page)

SIGNAL HEAD HOOK-UP CHART FOR 4-SECTION FYA PPLT SIGNAL HEADS USED IN A CABINET OPERATING IN COMPACT MODE

SIGNAL HEAD HOOK-UP CHART

LOAD SWITCH NO.	S1	S2	S3		S4	S5	S6	S7	S8	S9		S10	S11	S12	
CMU CHANNEL NO.	1	2	9	13	3	4	14	5	6	11	15	7	8	12	16
PHASE	OLA	2	1 GRN	2 PED	3	4	4 PED	OLC	6	5 GRN	6 PED	OLD	8	7 GRN	8 PED
SIGNAL HEAD NO.	11★	21,22	11★	P21, P22	NU	41,42	P41, P42	51★	61,62	51★	NU	71★	81,82	71★	NU
RED		128				101			134				107		
YELLOW		129				102			135				108		
GREEN		130				103			136				109		
RED ARROW	125							131				122			
YELLOW ARROW	126							132				123			
FLASHING YELLOW ARROW	127							133				124			
✋				113			104								
PED YELLOW							✳								
GREEN ARROW			114							120				111	
🚶				115			106				✳				✳

✳ Denotes install load resistor. See load resistor installation detail this sheet.

★ See pictorial of head wiring in detail below.

NOTE: Load switches S1, S3, S7, S9, S10, and S12 require output remapping. See sheets x through y for details.

Features (cont.):

Ⓓ Load switch outputs that drive the solid red arrow, solid yellow arrow, and flashing yellow arrow will have to be remapped to function as vehicle overlaps.

Unused ped yellow load switch outputs will have to be remapped to drive the left turn green arrows.

Ⓔ FYA operation when using a cabinet in compact mode. The FYA compact mode switch on the conflict monitor must be set to the ON position. Further details are found in STD. NO. 7.0. The cabinet must be wired such that the (unused) ped yellow load switch outputs are wired to the conflict monitor as follows:

2-PY to Channel 9 Green (CMU pin 13, logical Channel 9)
4-PY to Channel 9 Yellow (CMU pin 16, logical Channel 10)
6-PY to Channel 10 Green (CMU pin R, logical Channel 11)
8-PY to Channel 10 Yellow (CMU pin U, logical Channel 12)

For all cabinets, this is accomplished through a keyed plug connection found on the inside panel of the output file. Plug together the two connectors labeled as shown below:

1-2PY	1-CMU-13
2-4PY	2-CMU-16
3-6PY	3-CMU-R
4-8PY	4-CMU-U

Ⓕ Connecting the keyed ped yellow connector in 'E' above will make it appear to the conflict monitor that the Walk and Ped Yellow indications are "ON" at the same time for unused ped movements which will result in a conflict. To remedy this, terminate all unused ped 'Walk' load switch outputs with a load resistor.

2070 Signal Head Hook–Up Chart For FYA

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

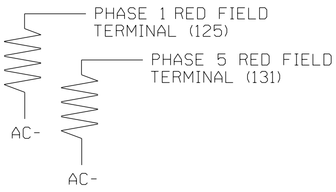
STD. NO. 3.1

Load Resistor Installation Detail

LOAD RESISTOR INSTALLATION DETAIL
(install resistors as shown below)

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)

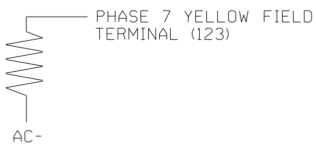


NOTE: The purpose of these resistors is to load the channel red monitor inputs in order for the Signal Sequence Monitor to use the full signal sequence monitoring capability on channels that do not use the red display in the field.

LOAD RESISTOR INSTALLATION DETAIL
(install resistor as shown below)

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)



In all traffic signal installations, the signal head displays are switched 'ON' and 'OFF' by solid state load switches. These load switches take a logic level input from the controller and switch AC power to the signal heads through a triac device. The triac is protected from transient voltages by a snubber circuit. In the 'OFF' condition there is a small leakage current through the snubber circuit. As long as there is a load across the circuit, such as a bulb or LED module, this leakage current goes unnoticed. If there is no load, however, the conflict monitor will see an 'OFF' condition as an active signal, resulting in either a false conflict or a dual indication fault.

If there is not a field indication for each of the three outputs on a given load switch, a load resistor needs to be installed. The load resistor takes the place of a bulb or LED indication and provides a load for the channel red or yellow monitor input preventing the problems with unwarranted faults.

If only the green and yellow indications of the load switch are used (common with 5-section heads on protected/permissive left turns), a resistor needs to be installed on the red field terminal as shown above left.

If only the green arrow indication is used, the resistor should be installed on the yellow field terminal as shown lower left. This situation can occur when a 4-section head is used to display a left turn that is only used during a preemption, or when a 4-section flashing yellow arrow head is used to display a protected left turn. In either case, no resistor is needed on the red terminal as the signal sequence monitoring capability is not used. See STDS. NO. 3.0 and 7.0 for more information.

(This page is intentionally left blank)

(OPTION #1)

DYNAMIC BACKUP CONTROL PROGRAMMING

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE DYNAMIC/BACKUP CONTROL FUNCTIONS 1 AND 2. — A

2. FROM PHASE CONTROL FUNCTIONS MENU PRESS '2' (DYNAMIC/BACKUP CONTROL FUNCTIONS).

```
 DYNAMIC/BACKUP CONTROL FUNCTION #01
             OVERLAPS:¦ABCDEFGHIJKLMNOP
IF OVERLAPS ARE ACTIVE ¦
OR       PHASES:¦12345678910111213141516
IF PHASES ARE ON¦ X                          B
OMIT PHASES     ¦X                           C
CALL PHASES     ¦   X                        D
```

PRESS 'NEXT'

```
 DYNAMIC/BACKUP CONTROL FUNCTION #02         E
             OVERLAPS:¦ABCDEFGHIJKLMNOP
IF OVERLAPS ARE ACTIVE ¦
OR       PHASES:¦12345678910111213141516
IF PHASES ARE ON¦     X
OMIT PHASES     ¦    X
CALL PHASES     ¦   X
```

BACKUP PROTECTION PROGRAMMING COMPLETE

(OPTION #2)

BACKUP PROTECTION NOTE

(program controller as shown below)

From Main Menu press '2' (Phase Control), then '1' (Phase Control Functions). Program phase 2 for 'Backup Protect'. Make sure the Red Revert times shown on the Signal Design Plans are programmed in the 'Phase Timing' menu.

Oasis Backup Protection Programming Details

When a signal design requires the use of backup protection to eliminate a yellow trap situation, two options are available.

Option #1 uses the Dynamic Backup function. The upper left image is an exact duplication of the dynamic backup programming display found on a 2070 controller running Oasis control software.

The controller accomplishes dynamic backup protection by omitting the left turn phase while the opposite through movement is "ON". Phase "ON" is a controller function that is active during the phase green, yellow change, and red clearance intervals.

Below is a brief explanation of dynamic backup protection features and functionality:

A Activation note - This note directs the installer to the phase control page of the controller programming. At the bottom of this page there is a parameter listed called "Dynamic/Backup". The installer is directed to flag the Dynamic/Backup functions that will be in use, otherwise the backup programming will not function. See function number below in note E.

B Phases On row - Phases selected here determine when an omit is placed during the signal sequence.

C Omit Phases row - Phases selected here determine where an omit is placed during the selected phase "ON".

D Call Phases row - Phases selected here determine the phase that the omitted phase detectors will call while that phase is omitted. The call placed is a special dynamic call that will be released when the selected phase switches to green. This dynamic call produces a minimum recall type operation (dynamic call will not max out a phase).

E Function number - The controller is capable of up to sixteen dynamic functions. For normal backup protection, one function should be used for each left turn that is being omitted. The example shown to the left shows phases 1 and 5 being omitted by phases 2 and 6 respectively. The phase calls will cycle the controller through the side street through movements before serving phases 1 and/or 5. Please note that each left turn omit is accomplished in a separate function.

Option #2 uses the Backup Protect function. This function puts the through phases in All Red before serving the left turns. This function is typically used in conjunction with increased Red Revert times on the concurrent through phase.

2070 OASIS Backup Protection Programming

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 5.0

SHEET 1 OF 1

ECONOLITE ASC/3-2070 BACKUP PROTECTION ENABLE PROGRAMMING

(program controller as shown)

1. From Main Menu select `1. CONFIGURATION`
2. From CONFIGURATION Submenu select `1. CONTROLLER SEQ`
3. From CONTROLLER SEQUENCE Submenu select `3. BACKUP PREVENT PHASES`

Follow programming as shown below. On the 'ENABLE BACKUP PREVENT' screen move cursor to the appropriate field and press 'YES/NO' on the controller keypad to toggle field value between 'X' ,'B', 'C' and 'OFF'.

ENABLE BACKUP PREVENT

	TMG/BKUP	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6
	1		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
C	2	B		.	.	.	.	.	.	.	.	.	.	.	.	.	.
	3	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
D	4	.	.	X		.	.	.	.	.	.	.	.	.	.	.	.
	5	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.
E	6	.	.	.	C	B		.	.	.	.	.	.	.	.	.	.
	7	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.
F	8	.	.	.	.	.	.	X		.	.	.	.	.	.	.	.
	9	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.
	10	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
	11	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
	12	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.
	13	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.
	14	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.
	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.
	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

B

END PROGRAMMING

A

NOTES

1. 'B' without a 'C' programmed for the 'TIMING' (row) phase inhibits the controller from servicing the 'BACKUP' (column) phase when the 'TIMING' (row) phase is active, or next, until the controller goes through Red Revert and Red Clear. Make sure the proper Red Revert and Red Clear times shown on the Signal Design plan are programmed in the controller phase timing.

2. 'B' with a 'C' programmed for the 'TIMING' (row) phase places a demand on that 'BACKUP' (column) phase. The controller will then service the called phase and proceed normally.

3. 'X' inhibits the controller from servicing the 'BACKUP' (column) phase when the 'TIMING' (row) phase is active or next.

Econolite ASC/3-2070 Backup Protection Programming Details

When a signal design requires the use of backup protection to eliminate a yellow trap situation, a dynamic approach as well as a red revert approach are both available from one programming screen as shown to the left.

Use the notes shown beneath the screen shot to interpret the backup protection requirements that may be shown on a signal design plan.

A TMG Row - Determines the phase when an omit is placed during the signal sequence.

B BKUP Column - Determines the phase where an omit is placed while the TMG row phase is "ON". Also used to determine the phase that will be called while the TMG row phase is "ON" and the programmed omit phase has a call.

C Example 1: The controller will back up from phase 2 to phase 1 after first going to all Red and timing the Red Revert times programmed in the controller. See Note 1.

D Example 2: Omits phase 3 when phase 4 is "ON" (the controller will not back up directly from phase 4 to phase 3). See Note 3.

E Example 3: When phase 6 is "ON" and the controller receives a call on phase 5, the controller will omit the phase 5 call and call phase 4. Phase 5 will be served when the controller recrosses the barrier after phase 4 clears. The controller will not back up directly from phase 6 to phase 5. See Note 2.

F Example 4: Omits phase 7 when phase 8 is "ON" (the controller will not back up directly from phase 8 to phase 7). See Note 3.

ASC/3-2070 Backup Protection Programming

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 5.1

SHEET 1 OF 1

SE-PAC2070 BACK-UP PROTECTION PROGRAMMING DETAIL

(program controller as shown below)

From Main Menu, press '3' (Phase Data)

```
EPAC PHASE DATA           PRESS # DESIRED

 1-VEHICLE TIMES         5-V & P RECALLS
 2-DENSITY TIMES         6-N.LOCK & MISC
 3-PEDEST. TIMES         7-SPEC. SEQUENCE
 4-INITIALIZE &          8-SPEC. DETECTOR
   N.A. RESPONSE         9-PHASE COPY

                              F-PRIOR MENU
```

```
        D              E
A  PHASE......1...2...3...4...5...6...7...8
B    OMIT     2   0   0   0   6   0   0   0
     -YEL     0   0   0   0   0   0   0   0
C    OCAL     0   0   0   0   4   0   0   0

     OMIT:## PHS ON OMITS THIS PHASE
      -YEL:## PHS YEL OMITS THIS PHS YEL
      OCAL: WHEN OMIT, DETS CALL## PHS

A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

Special Sequence programming complete.

SE-PAC2070 Backup Protection Programming Details

When a signal design requires the use of backup protection to eliminate a yellow trap situation, dynamic backup protect is available as shown to the left.

A PHASE row - Determines the phase where an omit is placed while the programmed OMIT phase is "ON".

B OMIT row - Phases programmed here determine when an omit is placed during the signal sequence.

C OCAL row - Phases programmed here determine the phase that will be called while the programmed OMIT phase is "ON" and the phase in the PHASE row has a call.

D Example 1: Omits phase 1 when phase 2 is "ON" (the controller will not back up directly from phase 2 to phase 1).

E Example 2: When phase 6 is "ON" and the controller receives a call on phase 5, the controller will omit the phase 5 call and call phase 4. Phase 5 will be served when the controller recrosses the barrier after phase 4 clears. The controller will not back up directly from phase 6 to phase 5.

SE–PAC2070 Backup Protection Programming

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. **5.2**

SHEET 1 OF 1

NAZTEC APOGEE CALL, INHIBIT, REDIRECT PROGRAMMING DETAIL

(USED FOR BACK-UP PROTECTION)

(program controller as shown below)

From Main Menu press '1' (Controller), then '1' (Phases), then '5' (Call, Inh, Redirect).

```
                         Inhibit Ps 1111111     >
 P    ..Call.Ps..   12345678 90123456          — B
 1     0  0  0  0   ........ ........
 2     0  0  0  0   X....... ........
 3     0  0  0  0   ........ ........          — D
 4     0  0  0  0   ........ ........
 5     0  0  0  0   ........ ........
 6     0  0  0  0   ....X... ........
 7     0  0  0  0   ........ ........
 8     0  0  0  0   ........ ........
```

SCROLL TO THE RIGHT TO ACCESS "REDIRECT P CALLS" SCREEN BELOW

```
     <   Redirect P Calls (from P to P)
 P    From-To  From-To  From-To  From-To
 1       0  0     0  0     0  0     0  0
 2       0  0     0  0     0  0     0  0
 3       0  0     0  0     0  0     0  0      — E
 4       0  0     0  0     0  0     0  0
 5       0  0     0  0     0  0     0  0
 6       5  4     0  0     0  0     0  0
 7       0  0     0  0     0  0     0  0
 8       0  0     0  0     0  0     0  0
 A       C
```

OPERATIONAL NOTE

This programming will omit phase 1 when phase 2 is "ON" and omit phase 5 when phase 6 is "ON". Also, calls will be redirected from phase 5 to phase 4 during phase 6.

Naztec Apogee Backup Protection Programming Details

When a signal design requires the use of backup protection to eliminate a yellow trap situation, dynamic backup protect is available as shown to the left.

(A) Phase column - Determines the phase when an inhibit (omit) is placed during the signal sequence.

(B) Inhibit Phase row - Determines the phase where an inhibit (omit) is placed while the phase in the 'Phase' column is "ON".

(C) From-To column - Phase programmed in the 'From' column will have calls redirected to the phase programmed in the 'To' column while the phase in the 'Phase' column is "ON".

(D) Example 1: Call Inhibits - This programming will inhibit (omit) phase 1 when phase 2 is "ON" and will inhibit (omit) phase 5 when phase 6 is "ON". The controller will not back up directly from phase 2 to phase 1 or from phase 6 to phase 5.

(E) Example 2: Call Redirects - A call redirect can work in conjunction with a call inhibit. When phase 6 is on and the controller receives a call on phase 5, the controller will inhibit (omit) the phase 5 call as per Example 1. To serve phase 5, the controller will first redirect phase 5 calls to phase 4 and phase 5 will be served when the controller recrosses the barrier after phase 4 clears. The controller will not back up directly from phase 6 to phase 5.

NOTES

1. To prevent "flash-conflict" problems, insert red flash program blocks for all unused vehicle load switches in the output file. The installer shall verify that signal heads flash in accordance with the signal plans. — A

2. Program phases 4 and 8 for Dual Entry. — B

3. Enable Simultaneous Gap-Out for all phases. — C

4. Program phases 2 and 6 for Variable Initial and Gap Reduction — D

5. Program phases 2 and 6 for Startup In Green. — E

6. Program phases 2, 4, 6 and 8 for Startup Ped Call. — F

7. Program phases 2 and 6 for Yellow Flash, and overlaps 1 and 2 as Wag Overlaps. — G

8. The cabinet and controller are part of the (insert) System. — H

Notes

All electrical details have a section of notes. A typical set for an Oasis 2070 design is shown above. Unneeded notes should be removed. Additionally, if there is a need to highlight an unusual setting or feature about the signal design that is not covered elsewhere on the electrical detail, a custom note can be added to this space.

2070 Oasis Notes

A Flash setup note - The first sentence, concerning flash color setup on unused load switches, may be omitted if all load switches are used. The second sentence is always used.

B Dual Entry note - Directs that the indicated phases be programmed for Dual Entry. The '2070 Timing Chart' on the signal plan will specify which phases require this feature.

C Simultaneous Gap-Out note - Directs that all phases be programmed for Simultaneous Gap-Out. This note always appears and never requires modification.

D Variable Initial and Gap Reduction note - Directs that the indicated phases be programmed for these timing features. If the '2070 Timing Chart' on the signal plan has timing values for 'Seconds Per Actuation' and 'Max Variable Initial', that phase should be programmed for Variable Initial. If values are shown for 'Time Before Reduction', 'Time To Reduce', and 'Minimum Gap', the phase should be programmed for Gap Reduction.

E Controller Start Up note - In general, the controller should be programmed to start up in the phase or phases that flash yellow. If no phases flash yellow, the controller needs to be programmed to start up in a red clearance interval. If this is the case, consult the signal plan designer to see if there is a preference about what phase(s) should be served first.

F Startup Ped Call note - Any ped phases that will be in use during normal operation should be listed here.

G Yellow Flash note - This ensures phases 2 and 6 flash yellow during controller flash. Wag overlap programming flashes overlap 1 (OLA) and overlap 2 (OLB) concurrently with phases 1 and 3 (typically for FYA applications).

H System note - If the signal is part of a closed loop or urban traffic control system, the system type and/or name (if available) is listed here.

NOTES

1. To prevent "flash-conflict" problems, insert red flash program blocks for all unused vehicle load switches in the output file. The installer shall verify that signal heads flash in accordance with the Signal Plans. (A)
2. Program phases 4 and 8 for Dual Entry. (B)
3. Enable Simultaneous Gap-Out for all Phases. (C)
4. Program phases 2 and 6 for volume density operation. (D)
5. Program controller to start up in phase 2 Green and 6 Green. (E)
6. The cabinet and controller are part of the (insert) System. (F)

ASC/3-2070 Notes

(A) Flash setup note - The first sentence, concerning flash color setup on unused load switches, may be omitted if all load switches are used. The second sentence is always used.

(B) Dual Entry note - Directs that the indicated phases be programmed for Dual Entry. The 'ASC/3-2070 Timing Chart' on the signal plan will specify which phases require this feature.

(C) Simultaneous Gap-Out note - Directs that all phases be programmed for Simultaneous Gap-Out. This note always appears and never requires modification.

(D) Volume Density Operation note - Directs that the indicated phases be programmed for the following timing features if indicated on the 'ASC/3-2070 Timing Chart' on the signal plan: 'Actuations B4 Add', 'Seconds/Actuation', 'Max Initial', Time Before Reduction', 'Time To Reduce', and 'Minimum Gap'.

(E) Controller Start Up note - In general, the controller should be programmed to start up in the phase or phases that flash yellow. If no phases flash yellow, the controller needs to be programmed to start up in a red clearance interval. If this is the case, consult the signal plan designer to see if there is a preference about what phase(s) should be served first. If the the startup phase also has a ped movement, it should be programmed to start in 'Walk' instead of 'Green'.

(F) System note - If the signal is part of a closed loop or urban traffic control system, the system type and/or name (if available) is listed here.

ASC/3–2070 Notes

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.1

SHEET 1 OF 1

NOTES

1. To prevent "flash-conflict" problems, insert red flash program blocks for all unused vehicle load switches in the output file. The installer shall verify that signal heads flash in accordance with the Signal Plans. — A

2. Program controller to start up in phases 2 and 6 green. — B

3. Enable simultaneous gap-out feature, on controller unit, for all phases. — C

4. Program phases 4 and 8, on controller unit, for dual entry. — D

5. Program phases 2 and 6, on controller unit, for volume density operation. — E

6. The cabinet and controller are part of the (insert) System. — F

SE-PAC 2070 Notes

A Flash setup note - The first sentence, concerning flash color setup on unused load switches, may be omitted if all load switches are used. The second sentence is always used.

B Controller Start Up note - In general, the controller should be programmed to start up in the phase or phases that flash yellow. If no phases flash yellow, the controller needs to be programmed to start up in a red clearance interval. If this is the case, consult the signal plan designer to see if there is a preference about what phase(s) should be served first.

C Simultaneous Gap-Out note - Directs that all phases be programmed for Simultaneous Gap-Out. This note always appears and never requires modification.

D Dual Entry note - Directs that the indicated phases be programmed for Dual Entry. The 'SE-PAC 2070 Timing Chart' on the signal plan will specify which phases require this feature.

E Volume Density Operation note - Directs that the indicated phases be programmed for the following timing features if indicated on the 'SE-PAC 2070 Timing Chart' on the signal plan: 'Added Initial', 'Maximum Initial', 'Time Before Reduction', 'Time To Reduce', 'Minimum Gap'.

F System note - If the signal is part of a closed loop or urban traffic control system, the system type and/or name (if available) is listed here.

SE–PAC 2070 Notes

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.	6.2
SHEET 1 OF 1	

NOTES

1. To prevent "flash-conflict" problems, insert red flash program blocks for all unused vehicle load switches in the output file. The installer shall verify that signal heads flash in accordance with the Signal Plans. — A
2. Initialize database in Naztec 2070 local software (Apogee) as FULL-CALTRANS. This initialization should be done prior to programming controller. — B
3. Initialize I/O "C1-C11-ABC IO Mode" to USER (MM 1-8-6). Then set "Init 2A" to MODE 5 (MM 1-8-9-3). — C
4. Program phases 2 and 6 for Start Up In Green (Walk if 2 and/or 6 Peds are used). — D
5. Program "Start Up Flash" for 0 sec. The conflict monitor will govern start-up flash time. — E
6. Ensure "Local Flash Start" feature is set to "ON". — F
7. Program controller to provide a 1 second delay on the Flash Sense/Local Flash input. Use the following logic statement to provide this functionality: — G

FROM MAIN MENU->1->8->7 (I/O LOGIC)

Result	Src.Fcn	TimeOp	Time
I208 =	OI208	DLY	1

8. Program phases 4 and 8 for Dual Entry. — H
9. The cabinet and controller are part of the (insert) System. — I

Apogee Notes

A Flash setup note - The first sentence, concerning flash color setup on unused load switches, may be omitted if all load switches are used. The second sentence is always used.

B Initialize Database note - loads controller with defaults required to run standard eight phase with CALTRANS I/O mapping.

C Initialize I/O - Loads the I/O map with the NCDOT I/O mapping that might not be identical to CALTRANS I/O mapping.

D Controller Start Up note - In general, the controller should be programmed to start up in the phase or phases that flash yellow. If no phases flash yellow, the controller needs to be programmed to start up in a red clearance interval. If this is the case, consult the signal plan designer to see if there is a preference about what phase(s) should be served first. If the the startup phase also has a ped movement, it should be programmed to start in 'Walk' instead of 'Green'.

E Start Up Flash - Determines how long a controller will remain in flash following a power interruption.

F Local Flash Start - Allows the programmed Local Flash Start feature to initiate whenever any of the four controller flash signals toggle.

G Flash Sense Delay - Allow a 1 second delay on this input to prevent possible controller restarts due to noise or false signals present.

H Dual Entry note - Directs that the indicated phases be programmed for Dual Entry. The Controller Timing Chart on the signal plan will specify which phases require this feature.

I System note - If the signal is part of a closed loop or urban traffic control system, the system type and/or name (if available) is listed here.

Naztec Apogee Notes

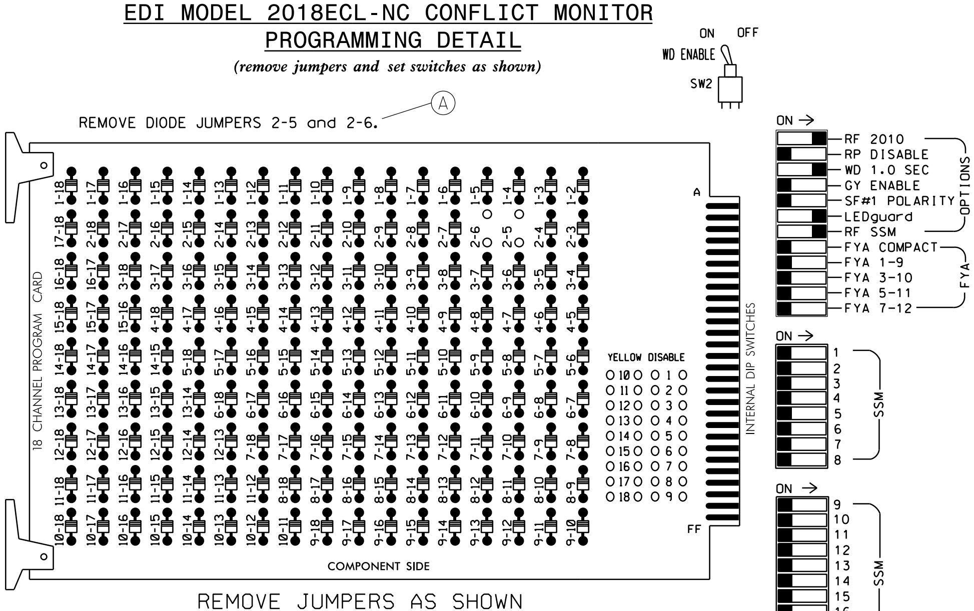
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.3

SHEET 1 OF 1

EDI MODEL 2018ECL-NC CONFLICT MONITOR
PROGRAMMING DETAIL

(remove jumpers and set switches as shown)



■ = DENOTES POSITION OF SWITCH

NOTES:

1. Card is provided with all diode jumpers in place. Removal of any jumper allows its channels to run concurrently.
2. Ensure jumpers SEL2-SEL5 and SEL9 are present on the monitor board.
3. Ensure that Red Enable is active at all times during normal operation.
4. Connect serial cable from conflict monitor to comm. port 1 of 2070 controller. Ensure conflict monitor communicates with 2070.

2018 Conflict Monitor Programming

The conflict monitor typically used in all NCDOT 2070 installations is the EDI model 2018ECL-NC. (See note I on sheet 2) The representation at the left is found in the top left corner on all the 2070 start drawings.

The 2018ECL-NC has 18 monitor channels. The default channel to load switch to function relationships are as follows:

Channel 1	S1	Phase 1
Channel 2	S2	Phase 2
Channel 3	S4	Phase 3
Channel 4	S5	Phase 4
Channel 5	S7	Phase 5
Channel 6	S8	Phase 6
Channel 7	S10	Phase 7
Channel 8	S11	Phase 8
Channel 9	AUX S1	Overlap A
Channel 10	AUX S2	Overlap B
Channel 11	AUX S4	Overlap C
Channel 12	AUX S5	Overlap D
Channel 13	S3	Phase 2 PED
Channel 14	S6	Phase 4 PED
Channel 15	S9	Phase 6 PED
Channel 16	S12	Phase 8 PED
Channel 17	AUX S3	Spare (Overlap E)
Channel 18	AUX S6	Spare (Overlap F)

The channel to load switch relationship is fixed in the cabinet hardware. The load switch function can be changed in the controller software. Load switches AUX S1-AUX S6 are on the auxiliary output file.

Features:

A Remove diode jumper note - For any two movements to be allowed to run concurrently, the corresponding diode jumper must be removed on the monitor card. This includes not only phases that can run concurrently, but also any ped or overlap that can run concurrently. Any permissible combination that does not have the corresponding jumper removed will result in an unwarranted conflict fault and place the intersection in flash. Conversely, removing a jumper representing a movement that should not be allowed creates a dangerous scenario where a true conflict can go undetected. This note lists the jumpers that should be removed on the monitor card.

2018 Conflict Monitor Programming

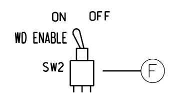
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

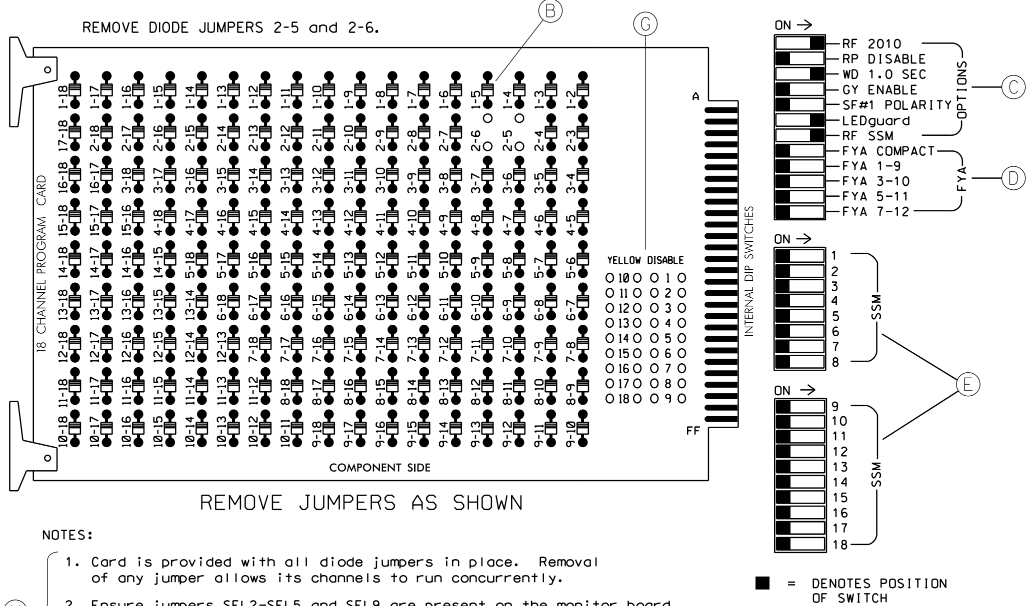
STD. NO. 7.0

SHEET 1 OF 2

EDI MODEL 2018ECL-NC CONFLICT MONITOR PROGRAMMING DETAIL

(remove jumpers and set switches as shown)





NOTES:

H
1. Card is provided with all diode jumpers in place. Removal of any jumper allows its channels to run concurrently.
2. Ensure jumpers SEL2-SEL5 and SEL9 are present on the monitor board.
3. Ensure that Red Enable is active at all times during normal operation.
4. Connect serial cable from conflict monitor to comm. port 1 of 2070 controller. Ensure conflict monitor communicates with 2070.

(Option 2)

I — 4. Integrate monitor with Ethernet network in cabinet.

I For signal systems using Ethernet communications, use Note 4 (Option 2) and change the monitor model to "2018ECLip-NC".

Features (cont.):

B Monitor card programming - The electrical detail provides a graphic representation of the monitor card after the appropriate diode jumpers have been removed as described above. This drawing should always match the remove diode jumper note directly above.

C Option switches - These dip switches control a variety of optional settings for the 2018ECL-NC monitor. The settings shown at left should be used for all electrical details. For more information on these options, refer to the manufacturer's operations manual.

D FYA switches - These switches are used to enable flashing yellow arrow monitoring for 3-section and 4-section FYA's using overlaps. Refer to the manufacturer's operations manual for more information on these switches.

E SSM switches - These switches are used to enable dual indication, red fail, and minimum yellow clearance monitoring on individual monitor channels. In general, any channel that has both a green and a yellow indication in the field should have its SSM switch set to the 'ON' position. Channels used to monitor pedestrian movements, or the green arrow exclusively for a four-section head or four-section FYA head, should be set to the 'OFF' position.

F Watchdog enable - Enables the controller watchdog monitoring feature. If the monitor fails to sense the logic level signal being toggled by the controller, a 'WDT Error' fault will be triggered. Should always be shown in the 'ON' position.

G Yellow disable jumpers - This feature allows the minimum yellow change monitoring to be disabled for a channel being used for a pedestrian movement. Since NCDOT also does not monitor dual indication for peds, the SSM switches for those channels should be set to 'OFF', making the use of the yellow disable jumpers unnecessary.

H Notes - These notes should appear with the conflict monitor programming detail on all 2070 electrical details. For more information on these options and conflict monitor functionality, refer to the manufacturer's operations manual.

2018 Conflict Monitor Programming

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
7.0
SHEET 2 OF 2

INPUT FILE POSITION LAYOUT

(front view)

FILE		1	2	3	4	5	6	7	8	9	10	11	12	13	14
"I"	U	Ø 1 1A	Ø 2 2A	Ø 2 2C	Ø 2 2E	Ø 3 3A	Ø 4 4A	Ø 4 4C	Ø 4 4E	SYS. DET. S1	SLOT EMPTY	SLOT EMPTY	Ø2 PED DC ISOLATOR	Ø6 PED DC ISOLATOR	FS DC ISOLATOR
"I"	L	NOT USED	Ø 2 2B	Ø 2 2D	NOT USED	NOT USED	Ø 4 4B	Ø 4 4D	NOT USED	SYS. DET. S2			Ø4 PED DC ISOLATOR	Ø8 PED DC ISOLATOR	ST DC ISOLATOR
"J"	U	Ø 5 5A	Ø 6 6A	Ø 6 6C	Ø 6 6E	Ø 7 7A	Ø 8 8A	Ø 8 8C	Ø 8 8E	SYS. DET. S3	SLOT EMPTY	SLOT EMPTY	PRE3 DC ISOLATOR	PRE4 DC ISOLATOR	PRE1 AC ISOLATOR
"J"	L	NOT USED	Ø 6 6B	Ø 6 6D	NOT USED	NOT USED	Ø 8 8B	Ø 8 8D	NOT USED	SYS. DET. S4			PRE5 DC ISOLATOR	PRE6 DC ISOLATOR	PRE2 AC ISOLATOR

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME
PRE = PREEMPT

INPUT FILE POSITION LAYOUT

(front view)

A

FILE		1	2	3	4	5	6	7	8	9	10	11	12	13	14
"I"	U	Ø 1 1A	Ø 2 2A	Ø 2 2C	SLOT EMPTY	Ø 3 3A	Ø 4 4A	Ø 4 4C	SLOT EMPTY	SYS. DET. S1	SLOT EMPTY	SLOT EMPTY	Ø2 PED DC ISOLATOR	Ø6 PED DC ISOLATOR	FS DC ISOLATOR
"I"	L	NOT USED	Ø 2 2B	Ø 2 2D		NOT USED	Ø 4 4B	NOT USED		SYS. DET. S2			NOT USED	NOT USED	ST DC ISOLATOR
"J"	U	Ø 5 5A	Ø 6 6A	Ø6/SYS 6C/S3	SLOT EMPTY	Ø 7 7A	Ø 8 8A	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	PRE1 AC ISOLATOR
"J"	L	Ø 5 5B	Ø 6 6B	Ø6/SYS 6D/S4		NOT USED	Ø 8 8B								NOT USED

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME
PRE = PREEMPT

2070 Input File Layout (332)

NCDOT uses 2070 controllers in type 170 cabinets. The base mounted 332 cabinet has two input files labeled 'I' and 'J' that accept inputs for traffic detection, pedestrian push buttons, preempt calls or other functions deemed necessary.

Each input file has 14 slots. Each slot can hold a 2-channel inductive loop detector, AC isolator or DC isolator. Each slot has two input terminals, but not every input terminal is independently connected to the controller. Slots 1, 4, 5 and 8 have the two input pins jumpered together and wired to a single controller harness pin. Neither of the input pins for slot 10 are connected to the controller.

Two examples of the input file layout for the base mounted 332 cabinet are shown left. The upper example shows how the rack is represented on the start drawings. The functions shown for slots 1-8 and 12-14 correspond to the default input assignments in the Econolite Oasis software. The controller detectors for slot 9 are assigned as local detectors by default but NCDOT reserves them for system detectors instead. Slot 10 is not wired to the controller and is therefore unused. The upper and lower channels of slot 11 in the I-File are assigned to Manual Advance and Manual Control Enable, respectively. The upper channel of slot 11 in the J-File is a spare and the lower slot is the Door Ajar input to the controller.

Features:

(A) Inductive Loop Detectors - Input file slots 1-9 are set up for inductive loop detector cards. Each card has two channels. Each channel is represented on the electrical detail by a block in the layouts shown on the left. For each channel, the function of the loop is shown in the upper half of the block while the loop name is shown in the lower half. A channel can be assigned to a local detector, a system detector, or both. While the default phase settings should be followed as much as practical, controller detectors can be easily reassigned as needed.

(continued on next page)

INPUT FILE POSITION LAYOUT

(front view)

File		1	2	3	4	5	6	7	8	9	10	11	12	13	14
FILE "I"	U	Ø 1 1A	Ø 2 2A	Ø 2 2C	SLOT EMPTY	Ø 3 3A	Ø 4 4A	Ø 4 4C	SLOT EMPTY	SYS. DET. S1	SLOT EMPTY	SLOT EMPTY	Ø2 PED DC ISOLATOR	Ø6 PED DC ISOLATOR	FS DC ISOLATOR
	L	NOT USED	Ø 2 2B	Ø 2 2D		NOT USED	Ø 4 4B	NOT USED		SYS. DET. S2			NOT USED	NOT USED	ST DC ISOLATOR
FILE "J"	U	Ø 5 5A	Ø 6 6A	Ø6/SYS 6C/S3	WIRED INPUT ⊗	Ø 7 7A	Ø 8 8A	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	PRE1 AC ISOLATOR
	L	Ø 5 5B	Ø 6 6B	Ø6/SYS 6D/S4		NOT USED	Ø 8 8B								NOT USED

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME
PRE = PREEMPT

⊗ Wired Input - Do not populate slot with detector card

(H) Detector Test Switches - There are eight detector test switches in the cabinet labeled 1-8 that can be used to test eight different phase approaches. They are wired, in order, to the controller C1 pin for slots 1,4,5, and 8 of the "I" file and the "J" file. When any of the aforementioned slots are used for detector inputs, it is recommended that the assigned phase match the default phase of the slot so a test switch activation will place a call to the correct phase.

Features (cont.):

(B) Slots 1, 4, 5 and 8 have only one controller input pin. The lower channel is normally unused. However, the lower channel of these slots may be used if neither the loop on the upper channel nor the loop proposed for use on the lower channel have any associated delay timing and all other settings for both loops are identical. The controller will view the two loops as if they are one.

(C) Loops That Call Two Phases - Sometimes a left turn loop will call both the left turn phase and the adjacent through movement with different timings or attributes for each. In this case, two detector channels are needed for the single loop. Utilize the default programmed detector settings. Populate the turn phase detector slot with a detector card. Then jumper the turn phase controller input pin to the through movement controller input pin that is associated with slot(s) 4 or 8. The through movement slot is not populated with a detector card as shown in the example at left.

(D) System Detectors - Detector cards for system loops are normally placed in slots I9 and J9. If more than four dedicated system loops are needed, an unused channel from slots 1-8 may be used. A detector may also serve as both a local and a system detector, as shown in slot J3 in the example at left.

(E) Ped Detectors - Pedestrian push buttons interface to the controller through DC isolator cards in slots I12 and I13.

(F) Preempt Inputs - The default setup can accommodate six preempt inputs. Preempts 1 and 2 interface the controller through an AC isolator card in slot J14. Preempt 1 is normally reserved for railroad preemption, while preempt 2 can be used for a second railroad preempt or (more commonly) for push button style emergency vehicle preemption. Preempts 3-6 are normally reserved for vehicle initiated EV preemptions and interface the controller through DC isolator cards. For more information on preemption see STD. No. 9.0.

(G) Slot I14 is reserved for flash sense and stop time. This DC isolator card is equipped from the factory and this slot always appears on electrical details without modification.

* Using any of these slots for purposes other than those shown here may require reassignment of inputs in the controller software and/or modification of the surge protection on the cabinet input panel.

2070 Input File Layout – 332

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. **8.0**

SHEET 2 OF 2

INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	INPUT ASSIGNMENT NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND	FULL TIME DELAY	STRETCH TIME	DELAY TIME
1A[1]	TB2-1,2	I1U	56	18	1	1	Y	Y			15
	-	J4U	48	10	26	6	Y	Y	Y		3
2A	TB2-5,6	I2U	39	1	2	2	Y	Y			
2B	TB2-7,8	I2L	43	5	12	2	Y	Y			
2C	TB2-9,10	I3U	63	25	32	2	Y	Y			
2D	TB2-11,12	I3L	76	38	42	2	Y	Y			
3A	TB4-5,6	I5U	58	20	3	3	Y	Y			3
4A	TB4-9,10	I6U	41	3	4	4		Y		2.8	
4B	TB4-11,12	I6L	45	7	14	4	Y	Y			15
4C	TB6-1,2	I7U	65	27	34	4	Y	Y			15
* S1	TB6-9,10	I9U	60	22	11	SYS					
* S2	TB6-11,12	I9L	62	24	13	SYS					
5A	TB3-1,2	J1U	55	17	5	5	Y	Y			
5B	TB3-3,4	J1L	55	17	5	5	Y	Y			
6A	TB3-5,6	J2U	40	2	6	6	Y	Y			
6B	TB3-7,8	J2L	44	6	16	6	Y	Y			
6C/S3	TB3-9,10	J3U	64	26	36	6/SYS	Y	Y			
6D/S4	TB3-11,12	J3L	77	39	46	6/SYS	Y	Y			
7A	TB5-5,6	J5U	57	19	7	7	Y	Y			3
8A	TB5-9,10	J6U	42	4	8	8	Y	Y			
8B	TB5-11,12	J6L	46	8	18	8	Y	Y			
PED PUSH BUTTONS											
P21,P22	TB8-4,6	I12U	67	29	PED 2	2 PED					
P61,P62	TB8-7,9	I13U	68	30	PED 6	6 PED					

NOTE:
INSTALL DC ISOLATORS IN INPUT FILE SLOTS I12 AND I13.

A

[1] ADD JUMPER FROM I1-W TO J4-W, ON REAR OF INPUT FILE. — B

* SYSTEM DETECTOR ONLY. REMOVE THE VEHICLE PHASE ASSIGNED TO THIS DETECTOR IN THE DEFAULT PROGRAMMING.

C

INPUT FILE POSITION LEGEND: J2L

FILE J
SLOT 2
LOWER

Full jumper list if all wired inputs are used:

[1] ADD JUMPER FROM I1-W TO J4-W, ON REAR OF INPUT FILE.
[2] ADD JUMPER FROM I5-W TO J8-W, ON REAR OF INPUT FILE.
[3] ADD JUMPER FROM J1-W TO I4-W, ON REAR OF INPUT FILE.
[4] ADD JUMPER FROM J5-W TO I8-W, ON REAR OF INPUT FILE.

2070 Input File Connection & Programming Chart (332)

The purpose of the Input File Connection & Programming Chart is to provide the installer with a convenient reference for connecting inductive loops and pedestrian push buttons to the cabinet as well as for programming controller detectors. The example shown at left is set up to match the example shown in the 2070 Input File Layout section (STD. No. 8.0 sheet 2, feature "C").

The key value to each row is the input file position (third column from the left). The first six values in the row should be considered attributes of the input file position. The relationship of the input file position with a specific inductive loop (first column) is decided during the preparation of the input file layout. Also, once the input file layout is established, all rows corresponding to unused input file positions can be deleted.

The relationship of the input file position with the loop terminal and pin numbers is fixed in the cabinet hardware. Changing these values entails rewiring the cabinet and should be avoided. The relationship of the input file position with the input assignment and controller detector numbers is set in the controller software. The values shown on the start drawings are the controller defaults. Changing them is only necessary if the detector is to be reassigned to another function.

The remaining (right-most) six columns contain attributes that apply to the specific loop associated with the input file position in question. These values can be found in the '2070 Loop Detector and Installation' chart on the signal plan and should be duplicated in this chart.

Additional Features:

A Pedestrian Push buttons - If the design utilizes pedestrian push buttons, an extension is added to the Input File Connection & Programming Chart that contains the appropriate values for those detector channels. The values in the last five columns of the main chart do not apply to pedestrian detectors. The CADD cell containing the pedestrian detectors also includes a note reminding the installer to equip the appropriate slots with a DC isolator.

B Jumper Note - If a single loop requires two controller detector inputs (see STD. NO. 8.0 sheet 2), a note is placed below the chart detailing which controller input pins should be jumpered together.

C System Detector Note - If a detector channel is to serve as a system detector only, this note is included to remind the installer to remove the vehicle phase assigned to that detector in the default programming.

2070 Input File Connection & Programming Chart – 332

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 8.1

SHEET 1 OF 1

INPUT FILE POSITION LAYOUT

(front view)

FILE "I"

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
U	Ø 1 1A	Ø 2 2A	Ø 3 3A	Ø 4 4A	Ø 5 5A	Ø 6 6A	Ø 7 7A	Ø 8 8A	PRE1 AC ISOLATOR	PRE3 DC ISOLATOR	PRE4 DC ISOLATOR	Ø2 PED DC ISOLATOR	Ø6 PED DC ISOLATOR	FS DC ISOLATOR
L	Ø 2 2C	Ø 2 2B	Ø 4 4C	Ø 4 4B	Ø 6 6C	Ø 6 6B	Ø 8 8C	Ø 8 8B	PRE2 AC ISOLATOR	PRE5 DC ISOLATOR	PRE6 DC ISOLATOR	Ø4 PED DC ISOLATOR	Ø8 PED DC ISOLATOR	ST DC ISOLATOR

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME
PRE = PREEMPT

INPUT FILE POSITION LAYOUT

(front view)

Ⓐ

FILE "I"

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
U	Ø 1 1A	Ø2/SYS 2A/S3	Ø 3 3A	Ø 4 4A	Ø 5 5A	Ø 6 6A	Ø 7 7A	Ø 8 8A	PRE1 AC ISOLATOR	SLOT EMPTY	SLOT EMPTY	Ø2 PED DC ISOLATOR	Ø6 PED DC ISOLATOR	FS DC ISOLATOR
L	⊗ WIRED INPUT	Ø2/SYS 2B/S4	NOT USED	Ø 4 4B	NOT USED	Ø 6 6B	NOT USED	SYS. DET. S1	NOT USED			NOT USED	NOT USED	ST DC ISOLATOR

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME
PRE = PREEMPT

2070 Input File Layout (336)

NCDOT uses 2070 controllers in type 170 cabinets. The pole mounted 336 cabinet has one input file labeled 'I' that accepts inputs for traffic detection, pedestrian push buttons, preempt calls or other functions deemed necessary.

The input file has 14 slots. Each slot can hold a 2-channel inductive loop detector, AC isolator or DC isolator. Each slot has three input terminals, 'F', 'W', and 'SP' that are independently connected to the controller by way of a C1 pin.

Two examples of the input file layout for the pole mounted 336 cabinet are shown left. The upper example shows how the rack is represented on the start drawings. The functions shown for slots 1-14 correspond to the default input assignments in the Econolite Oasis software. The 'SP' pin in slot I9 is the Door Ajar input to the controller, and the 'SP' pin in slot I14 is the Manual Advance input to the controller.

Features:

Ⓐ Inductive Loop Detectors - Input file slots 1-8 are set up for inductive loop detector cards. Each card has two channels. Each channel is represented on the electrical detail by a block in the layouts shown on the left. For each channel, the function of the loop is shown in the upper half of the block while the loop name is shown in the lower half. A channel can be assigned to a local detector, a system detector, or both. While the default phase settings should be followed as much as practical, controller detectors can be easily reassigned as needed.

(continued on next page)

INPUT FILE POSITION LAYOUT

(front view)

FILE "I"

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
U	Ø 1 1A	Ø2/SYS 2A/S3	Ø 3 3A	Ø 4 4A	Ø 5 5A	Ø 6 6A	Ø 7 7A	Ø 8 8A	PRE1 AC ISOLATOR	SLOT EMPTY	SLOT EMPTY	Ø2 PED DC ISOLATOR	Ø6 PED DC ISOLATOR	FS DC ISOLATOR
L	⊗ WIRED INPUT	Ø2/SYS 2B/S4	NOT USED	Ø 4 4B	NOT USED	Ø 6 6B	NOT USED	SYS. DET. S1	NOT USED			NOT USED	NOT USED	ST DC ISOLATOR

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME
PRE = PREEMPT

⊗ Wired Input - turn off Channel 2.
(2006 Spec. cabinet only)

G Detector Test Switches - There are eight detector test switches in the cabinet labeled 1-8 that can be used to test eight different phase approaches. They are wired, in order, to the controller C1 pin for slots 1-8 of the "I" file to the upper channel. When any of the aforementioned slots are used for detector inputs, it is recommended that the assigned phase match the default phase of the slot in the upper channel so a test switch activation will place a call to the correct phase.

Features (cont) :

B System Detectors - Detector cards for dedicated system loops may be placed in any unused detector slot. If space in the I-File runs out and additional system detectors are called for, a detector may also serve as both a local and a system detector as shown in slot I2 in the example at left.

C Preempt Inputs - The default setup can accommodate six preempt inputs. Preempts 1 and 2 interface the controller through an AC isolator card in slot J9. Preempt 1 is normally reserved for railroad preemption, while preempt 2 can be used for a second railroad preempt or (more commonly) for push button style emergency vehicle preemption. Preempts 3-6 are normally reserved for vehicle initiated EV preemptions and interface the controller through DC isolator cards. For more information on preemption see STD. No. 9.0.

D Ped Detectors - Pedestrian push buttons interface to the controller through DC isolator cards in slots I12 and I13.

E Slot I14 is reserved for flash sense and stop time. This DC isolator card is equipped from the factory and this slot always appears on electrical details without modification.

F Loops That Call Two Phases (2006 Spec. cabinets) - Loops that call two phases in a 336 pole mounted cabinet require special wiring. A jumper must be added from the controller input pin of the first phase to the controller input pin of the second phase in the same slot that the loop detector is installed. Also, the second channel for the loop detector plugged into the slot must be turned OFF so that the detector can not inadvertantly place a call to the controller on the second channel.

Loops That Call Two Phases (2012 Spec. cabinets) - Loops that call two phases in a 336 pole mounted cabinet require special wiring. Typically a jumper is added from the controller input pin of the first phase to a spare controller input pin of the second phase located in the same slot that the loop detector is installed.

✳ Using any of these slots for purposes other than those shown here may require reassignment of inputs in the controller software and/or modification of the surge protection on the cabinet input panel.

2070 Input File Layout – 336

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 8.2

INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	INPUT ASSIGNMENT NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND	FULL TIME DELAY	STRETCH TIME	DELAY TIME
1A[1]	TB21-1,2	I1U	56	18	1	1	Y	Y			15
	-	-	59	21	15	6	Y	Y	Y		3
2A/S3	TB21-3,4	I2U	39	1	2	2/SYS	Y	Y			
2B/S4	TB23-3,4	I2L	43	5	12	2/SYS	Y	Y			
3A	TB21-5,6	I3U	58	20	3	3	Y	Y			
4A	TB21-7,8	I4U	41	3	4	4		Y		2.8	
4B	TB23-7,8	I4L	45	7	14	4	Y	Y			15
5A	TB21-9,10	I5U	55	17	5	5	Y	Y			
6A	TB21-11,12	I6U	40	2	6	6	Y	Y			
6B	TB23-11,12	I6L	44	6	16	6	Y	Y			
7A	TB21-13,14	I7U	57	19	7	7	Y	Y			3
8A	TB22-1,2	I8U	42	4	8	8	Y	Y			
* S1	TB24-1,2	I8L	46	8	18	SYS					
PED PUSH BUTTONS											
P21,P22	TB22-9,10	I12U	67	29	PED 2	2 PED					
P61,P62	TB22-11,12	I13U	68	30	PED 6	6 PED					

NOTE:
INSTALL DC ISOLATORS IN INPUT FILE SLOTS I12 AND I13.

Ⓐ

[1] Add jumper from I1-F to I1-SP, on rear of input file. Ⓑ

* SYSTEM DETECTOR ONLY. REMOVE THE VEHICLE PHASE ASIGNED TO THIS DETECTOR IN THE DEFAULT PROGRAMMING.

Ⓒ

INPUT FILE POSITION LEGEND: I2L

FILE I
SLOT 2
LOWER

Ⓑ

For 2006 Spec. cabinet:

[1] Add jumper from I1-F to I1-W, on rear of input file.
[2] Add jumper from I3-F to I3-W, on rear of input file.
[3] Add jumper from I5-F to I5-W, on rear of input file.
[4] Add jumper from I7-F to I7-W, on rear of input file.
(Include 'Wired Input' reference for Channel 2 slots where required)

For 2012 Spec. cabinet:

[1] Add jumper from I1-F to I1-SP, on rear of input file.
[2] Add jumper from I3-F to I3-SP, on rear of input file.
[3] Add jumper from I5-F to I5-SP, on rear of input file.
[4] Add jumper from I7-F to I7-SP, on rear of input file.

2070 Input File Connection & Programming Chart (336)

The purpose of the Input File Connection & Programming Chart is to provide the installer with a convenient reference for connecting inductive loops and pedestrian push buttons to the cabinet as well as for programming controller detectors. The example shown at left is set up to match the example shown in the 2070 Input File Layout section (STD. No. 8.2 sheet 2, feature "F", 2012 Spec. cabinet).

The key value to each row is the input file position (third column from the left). The first six values in the row should be considered attributes of the input file position. The relationship of the input file position with a specific inductive loop (first column) is decided during the preparation of the input file layout. Also, once the input file layout is established, all rows corresponding to unused input file positions can be deleted.

The relationship of the input file position with the loop terminal and pin numbers is fixed in the cabinet hardware. Changing these values entails rewiring the cabinet and should be avoided. The relationship of the input file position with the input assignment and controller detector numbers is set in the controller software. The values shown on the start drawings are the controller defaults. Changing them is only necessary if the detector is to be reassigned to another function.

The remaining (right-most) six columns contain attributes that apply to the specific loop associated with the input file position in question. These values can be found in the '2070 Loop Detector and Installation' chart on the signal plan and should be duplicated in this chart.

Additional Features:

Ⓐ Pedestrian Push buttons - If the design utilizes pedestrian push buttons, an extension is added to the Input File Connection & Programming Chart that contains the appropriate values for those detector channels. The values in the last five columns of the main chart do not apply to pedestrian detectors. The CADD cell containing the pedestrian detectors also includes a note reminding the installer to equip the appropriate slots with a DC isolator.

Ⓑ Jumper Note - If a single loop requires two controller detector inputs (see STD. NO. 8.2 sheet 2, a note is placed below the chart detailing which controller input pins should be jumpered together.

Ⓒ System Detector Note - If a detector channel is to serve as a system detector only, this note is included to remind the installer to remove the vehicle phase assigned to that detector in the default programming.

2070 Input File Connection & Programming Chart – 336

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

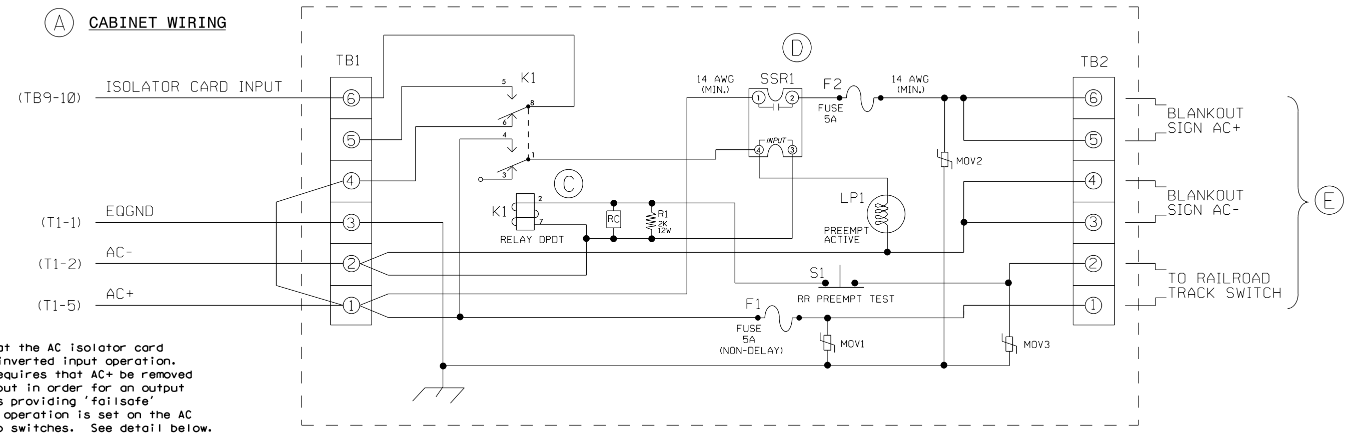
STD. NO. 8.3

SHEET 1 OF 1

(B) NOTES

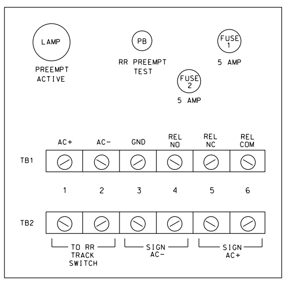
1. Relay K1 is shown in the energized (Preempt not active) normal operation state.
2. Relay K1 is an enclosed DPDT general purpose relay with a 120VAC coil, 10A contacts, and octal style plug.
3. Relay SSR1 is a SPST (normally open) Solid State Relay with AC input and AC (25 amp) output.
4. AC Isolator Card shall activate preemption upon removal of AC+ from the input (as shown above). To accomplish this set invert dip switch on AC Isolator Card.

5. IMPORTANT!! A jumper must be added between input file terminals J14-E and J14-K if not already present. Also, terminal TB9-12 (on input panel) shall be connected to AC neutral (jumper may have to be added).



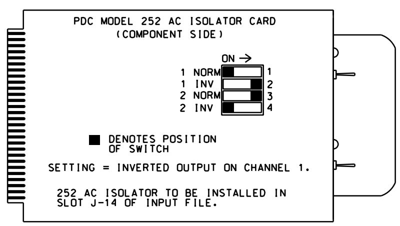
Note #4 indicates that the AC isolator card is to be set-up for inverted input operation. Inverted operation requires that AC+ be removed from the isolator input in order for an output to be generated, thus providing 'failsafe' operation. Inverted operation is set on the AC isolator card via dip switches. See detail below.

FRONT VIEW



PREEMPT 1 AC ISOLATOR (MODEL 252) OUTPUT PROGRAMMING DETAIL

(set DIP switches as shown below)



NOTE: IF ANOTHER MANUFACTURER TYPE OF AC ISOLATOR IS USED, OUTPUT PROGRAMMING IS LIKELY NOT TO EQUATE TO THAT SHOWN ABOVE.

2070 RR Preemption and Blankout Sign Control Box

The 2070 Preemption and Blankout Sign Control Assembly/Box provides the following functionality:

1. Provides the interface between the railroad crossing signal equipment and the traffic signal equipment, which includes, termination points for the interconnect cable, surge protection, and termination points for blankout signs.
2. Provides an output which directs the controller to begin the preemption sequence. A test switch is present to manually test this output.
3. Provides the control circuitry for the operation of any blankout signs required by the preemption sequence. This circuitry allows the blankout signs to operate normally, even when cabinet is in the flash mode.

Explanation of major components:

(A) Cabinet wiring termination points - Tells the installer where to make the connections in order to interface the box with the cabinet. These connections supply AC power to the box, as well as tie the preempt relay output to an AC isolator.

(B) Notes section - Describes the component types and part numbers used in the box. Any special wiring instructional notes are placed here.

(C) Preempt relay - The coil of this relay (K1) is tied to the RR cabinet contacts which, when opened, indicate the presence of a train. When the RR contacts open, this relay de-energizes and removes AC+ from the isolator card, thus causing a preempt input to be placed to the controller. The other set of contacts on this relay cause AC+ to be applied to the input of SSR1 which illuminates any blankout signs being used.

(D) Blankout sign relay - This relay is a SPST solid state relay which controls the illumination of the blankout signs. When this relay is activated by the preempt relay (K1), the signs will be switched "ON".

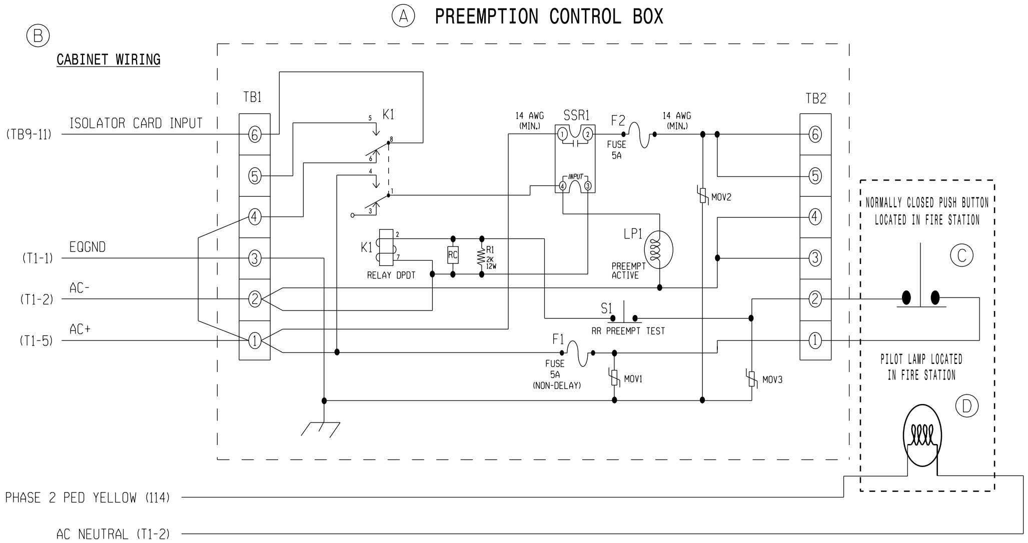
(E) Field wiring termination points - Tells the installer where the connections are made in order to interface the preempt box with the RR crossing signal equipment. Terminations for blankout sign AC+ and AC- are included here as well.

2070 RR and EV Preemption and Blankout Sign Control Box

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 9.0

SHEET 1 OF 1



Emergency Vehicle Preemption Push Button And Indicator Lamp Wiring Detail

This wiring detail gives the installer the information needed to interface the controller/cabinet assembly with a firehouse push button. The function of this button is to generate a controller input to initiate the EV preemption sequence.

Usually, there is also an indicator (pilot) lamp to be installed in the firehouse. The purpose of this lamp is to give the user positive feedback from the controller that the traffic signal has been preempted. The wiring for the indicator lamp is also shown on this detail.

Major components:

(A) Preemption Control Box - This box essentially serves the same purpose in fire preemption applications as it does in railroad preemption applications. See STD. NO. 9.0 sheet 1 for a detailed description of the preempt control box.

(B) Cabinet wiring termination points - Tells the installer where to make the connections in order to interface the box with the cabinet. These connectons supply AC power to the box, as well as tie the preempt relay output to an AC isolator.

(C) Firehouse Push Button - This is a momentary, normally closed, push button switch. The contacts of this switch are opened when the button is pressed, causing preempt to be activated.

(D) Indicator Lamp - The function of this lamp is described above. This lamp is normally controlled by the yellow circuit of a pedestrian load switch. The function of the C1-pin associated with this ped yellow will have to be changed to operate this lamp correctly. A load resistor is normally tied in parallel with the lamp to drain off any induced voltage. Special programming notes are necessary to alert the installer of these changes. If delay before preempt interval is used, special logic processor programming is necessary for proper operation.

(E) When the push button in the fire station is pressed, the preempt relay in the preempt control box de-energizes and removes AC+ from the AC isolator card. As such, the AC isolator card needs to have its switches set to the inverted position for Channel 2.

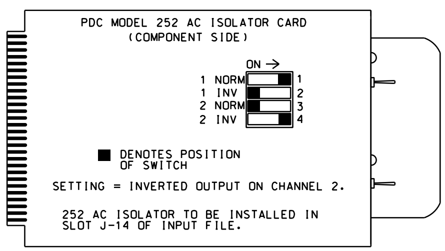
NOTES

If the ped movement associated with the load switch being used to operate the lamp is not used, a load resistor will have to be placed on the ped walk field terminal to drain off load switch leakage current. This resistor is shown in the load resistor installation detail.

1. Relay K1 is shown in the energized (Preempt not active) normal operation state.
2. Relay 'K1' is an enclosed DPDT general purpose relay with a 120VAC coil, 10A contacts, and octal-style plug.
3. Relay SSR1 is a SPST (normally open) Solid State Relay with AC input and AC (25 amp) output.
4. AC Isolator Card shall activate preemption upon removal of AC+ from the input (as shown above). To accomplish this, set invert dip switch on AC Isolator Card.
5. IMPORTANT!! Terminal TB9-12 (on input panel) shall be connected to AC neutral (jumper may have to be added).

PREEMPT 2 AC ISOLATOR (MODEL 252) OUTPUT PROGRAMMING DETAIL

(set DIP switches as shown below)



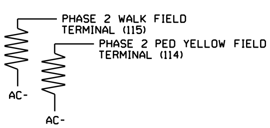
NOTE: IF ANOTHER MANUFACTURER TYPE OF AC ISOLATOR IS USED, OUTPUT PROGRAMMING IS LIKELY NOT TO EQUATE TO THAT SHOWN ABOVE.

LOAD RESISTOR INSTALLATION DETAIL

(install resistors as shown below)

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)



Emergency Vehicle Preemption (Push Button Style) Wiring Detail

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.	9.1
SHEET 1 OF 1	

PREEMPTION PROGRAMMING DETAIL

(program controller as shown below)

FROM MAIN MENU PRESS 'A' (PREEMPTION), THEN '1' (STANDARD PREEMPTION).

```
   PREEMPTION  #1  SETTINGS (NEXT:1-10)
INTERVAL/TIMING ¦  CLEAR/DWELL PHASES
  GRN YEL  RED  ¦12345678910111213141516
1  12  4.0  3.5 ¦  XX                         Ⓐ
2 255  0.0  0.0 ¦ X   X
3   0  0.0  0.0 ¦
4   0  0.0  0.0 ¦
5   1  0.0  0.0 ¦   X   X
EXIT CALLS      ¦
             OPTIONS
PRIORITY (Y/N TO SELECT) ............HIGH  —— Ⓑ
DELAY TIMER (0-255 SEC) .............0
MIN GREEN BEFORE PRE (0= DEFAULT)....1
PED CLEAR BEFORE PRE (0= DEFAULT)....0
YELLOW CLEAR BEFORE PRE (0= DEFAULT).4.0
RED CLEAR BEFORE PRE (0= DEFAULT)....3.5
DWELL MIN TIMER (0-255 SEC) .........7
DWELL MAX TIMER (0=OFF,1-255MIN) ....0
DWELL HOLD-OVER TIMER (0-255) .......0 —— Ⓒ
LATCH CALL? .........................N —— Ⓓ
LINK TO NEXT PREEMPT? ...............N
ENABLE BACKUP PROTECTION? ...........N
HOLD CLEAR 1 PHASES DURING DELAY? ...N —— Ⓔ
FAST GREEN FLASH DWELL PHASES? ......N
PED CLEARANCE THROUGH YELLOW? .......N
INHIBIT OVERLAP GREEN EXTENSION? ....N
SERVICE DURING SOFTWARE FLASH? ......N
REST IN RED DURING DWELL INTERVAL? ..N
FLASH DWELL INTERVAL? ...............N
ALLOW PEDS IN DWELL INTERVAL? .......N
RE-TIME DWELL INTERVAL? .............N
OVERLAPS:                  ¦ ABCDEFGHIJKLMNOP
DWELL INT FLASH YELLOW     ¦
OMIT OVERLAPS:             ¦
```

2070 Oasis Preemption Programming Detail

The image to the left is an exact duplication of the preempt programming display found on a 2070 controller running Oasis control software.

When a signal plan requires Railroad or Emergency Vehicle preemption, this detail is to be used on the electrical detail to instruct the installer on setting the different operational parameters required to operate the preempt sequence per the signal design plans.

Below is a brief description of the most commonly used features:

Ⓐ Interval programming - This is the section in which interval phase selection and timing are programmed. Each interval consists of green, yellow clear, and red clear times. A section where phases are selected for each interval are positioned to the right of each set of timings. An interval time of 255 sec. is a special flag to the controller instructing it to use that interval as the "dwell" interval. The exit interval is designated when a 1 sec. green is selected following the dwell interval. Always use interval 5 as the exit interval.

Dwell interval - The dwell interval is the interval that the controller will rest in until the following two events occur:
1. The dwell minimum timer has expired, and
2. The preempt call is removed.

Ⓑ Priority settings - There are four priority settings:
1. OFF - indicates the preemptor is not used.
2. LOW - use for low priority preempts such as transit vehicle preempts.
3. MED - use for emergency vehicle preempts.
4. HIGH - use for railroad preempts.

Railroad preempt should always be set to be the highest priority. If multiple preempts are set to the same priority, preempts will be served on a first come, first served basis.

Ⓒ Dwell hold-over timer - This timer begins to time after the preempt call is removed. If this timer expires, the dwell interval will be released. If this timer does not expire before a second preempt call is received, the dwell interval will be retimed. Normally used with vehicle initiated EV preemption systems.

Ⓓ Latch call - Used in conjunction with the delay timer. The application for this feature is normally the fire house push button style of preempt. These types of preempts normally have a delay interval. This feature will allow the preempt call to latch and not release until the preempt is served.

Ⓔ Hold clear 1 phases during delay - This feature is used in conjunction with the delay interval. If clear 1 phases are used in normal operation, and those phases just happen to be served during the delay interval, this feature will apply a hold on the clear 1 phases during the remainder of the delay interval.

(continued on next page)

PREEMPTION PROGRAMMING DETAIL

(program controller as shown below)

FROM MAIN MENU PRESS 'A' (PREEMPTION), THEN '1' (STANDARD PREEMPTION).

```
   PREEMPTION  #1  SETTINGS (NEXT:1-10)
INTERVAL/TIMING ¦  CLEAR/DWELL PHASES
  GRN YEL  RED  ¦12345678910111213141516
1  12  4.0  3.5 ¦  XX
2 255  0.0  0.0 ¦ X   X
3   0  0.0  0.0 ¦
4   0  0.0  0.0 ¦
5   1  0.0  0.0 ¦   X   X
EXIT CALLS      ¦
              OPTIONS
PRIORITY (Y/N TO SELECT) ............HIGH
DELAY TIMER (0-255 SEC) .............0
MIN GREEN BEFORE PRE (0= DEFAULT)....1
PED CLEAR BEFORE PRE (0= DEFAULT)....0
YELLOW CLEAR BEFORE PRE (0= DEFAULT).4.0
RED CLEAR BEFORE PRE (0= DEFAULT)....3.5
DWELL MIN TIMER (0-255 SEC) .........7
DWELL MAX TIMER (0=OFF,1-255MIN) ....0
DWELL HOLD-OVER TIMER (0-255) .......0
LATCH CALL? .........................N
LINK TO NEXT PREEMPT? ...............N
ENABLE BACKUP PROTECTION? ...........N
HOLD CLEAR 1 PHASES DURING DELAY? ...N
FAST GREEN FLASH DWELL PHASES? ......N
PED CLEARANCE THROUGH YELLOW? .......N
INHIBIT OVERLAP GREEN EXTENSION? ....N ---- F
SERVICE DURING SOFTWARE FLASH? ......N ---- G
REST IN RED DURING DWELL INTERVAL? ..N ---- H
FLASH DWELL INTERVAL? ...............N
ALLOW PEDS IN DWELL INTERVAL? .......N
RE-TIME DWELL INTERVAL? .............N ---- I
OVERLAPS:                   ¦ ABCDEFGHIJKLMNOP
DWELL INT FLASH YELLOW      ¦
OMIT OVERLAPS: -----------------------------  J
```

PREEMPT ONLY PHASE OMIT NOTE — K

(program controller as shown below)

From Main Menu press '2' (Phase Control). Then '1' (Phase Control Functions). Program Phase 3 for 'Omit Phase' and Phases 2, 4, 6, and 8 for 'Startup Calls'. This is to prevent Phase 3 from being served when not in Preempt.

2070 Oasis Preemption Programming Detail

F Inhibit overlap green extension - Affects how green extension overlaps (a.k.a. timed overlaps) transition into preemption. If a green extension overlap will not be used in the preemption, this setting is typically "YES". This will inhibit the overlap green extension from timing and allow transition to preemption to be accomplished in the quickest possible time. This is most important in RR preemption applications. If the overlap is used in the first interval of the preempt, the setting should be programmed as "NO".

G Service during software flash - This allows the controller to come out of software flash in order to serve the EV preempt.

H Rest in red during dwell interval - If the signal plan calls for the preempt dwell to be an all red rest state, this feature should be enabled. In addition, do not select any phases for the dwell interval.

I Re-time dwell interval - Used in conjunction with dwell hold-over timer. Allows the controller to re-time the dwell interval if a second preempt call is received before the hold-over timer times out. Normally used with EV preemption. Do not use this feature with railroad preemption unless there are special circumstances.

J Omit overlaps - This feature allows overlaps to be omitted during preemption when the overlap parents are active during preempt, but the overlap is not desired. Overlaps will return during exit interval 5.

> Note: Description of features is not complete. This section is intended to address applicational use. Consult the Signal Design Section of this design manual and/or the Econolite Oasis manual for more details.

K In designs with a phase that is only run during preemption, e.g. a four section head with a protected left turn arrow that is only served during the preempt track clearance interval, use the note and the programming shown to the left to omit the protected turn at controller startup.

2070 OASIS Preemption Programming Detail

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 9.2

SHEET 2 OF 3

2070 Oasis Firestation Pilot Lamp Logic Programming Detail

LOGICAL I/O PROCESSOR PROGRAMMING DETAIL FOR PILOT LAMP CONTROL

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMANDS 1 AND 2.
2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

A

```
  LOGICAL I/O COMMAND #1  (+/-COMMAND#)
IF  INPUT   ASSIGNMENT #14 IS ON
OR  ACTIVE PREEPTION   #2  IS ON

          SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #33 ON
```

NOTE: FIRE HOUSE PILOT LAMP LOGIC.

PRESS '+'

B

```
  LOGICAL I/O COMMAND #2  (+/-COMMAND#)
IF  INPUT   ASSIGNMENT #14 IS OFF
AND ACTIVE PREEMPTION  #2  IS OFF

          SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #33 OFF
```

NOTE: FIRE HOUSE PILOT LAMP LOGIC.

END OF PROGRAMMING

OUTPUT REFERENCE SCHEDULE

USE TO INTERPRET LOGIC PROCESSOR

INPUT 14 = Preempt 2 (Firestation push button)
OUTPUT 33 = Phase 2 PED Yellow (Pilot lamp)

For firestation preemption designs that utilize a push button inside the firestation with a pilot lamp, use the logic processor to turn the lamp "ON" when the button is pressed and "OFF" at the end of the preempt sequence. The example shown to the left uses PRE2 for the fire preempt and the PED 2 Yellow output to light the pilot lamp. Make sure to install load resistors as described in STD. NO. 9.1 sheet 1.

A Firestation preempts are usually always latched calls because the push button is a momentary input and there may be delay time programmed. When the firestation push button is pressed, the preempt call is latched and both statements of command #1 will evaluate TRUE in the order they are shown. This turns on the load switch that drives the pilot lamp in the firestation.

B When the Dwell and/or Cycle intervals end, the actual preempt input (the push button) is already FALSE so both statements will evaluate FALSE, at which point the pilot lamp will turn off.

ECONOLITE ASC/3-2070 RAILROAD PREEMPT PROGRAMMING DETAIL

(program controller as shown)

1. From Main Menu select 4. PREEMPTOR/TSP
2. From PREEMPTOR/TSP/SCP Submenu select 1. PREEMPT PLAN 1-10

Place cursor in [ ] next to Preempt Plan and press 1. Then press the right cursor arrow and toggle the controller to YES. Next cursor down. This will select Railroad Preempt #1.

```
PREEMPT PLAN [  1]    ENABLE....YES                A
 VEH/PED 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
 OVERLAP A B C D E F G H I J K L M N O P
TRKCLR V . . . . . . . . . . . . . . . .
TRKCLR O . . . . . . . . . . . . . . . .
ENA TRL  . . . . . . . . . . . . . . . .
DWEL VEH . . . . . . . . . . . . . . . .
DWEL PED . . . . . . . . . . . . . . . .
DWEL OLP . . . . . . . . . . . . . . . .
CYC VEH  . . . . . . . . . . . . . . . .           B
CYC PED  . . . . . . . . . . . . . . . .
CYC OLP  . . . . . . . . . . . . . . . .
EXIT PH  . . . . . . . . . . . . . . . .
EXIT CAL . . . . . . . . . . . . . . . .
SP FUNC  . . . . . . . . . . . . . . . .

ENABLE... YES|PMT OVRIDE.X|INTERLOCK. NO           C
DET LOCK... X|DELAY..    0|INHIBIT...  0           D
OVERIDE FL. .|DURATION   0|CLR-GRN... NO           E
TERM OLP.  NO|PC>YEL    NO|TERM PH    NO
PED DARK.. NO|TC RESRV YES|DWELL FL  OFF
LINK PMT....0|X FLCOLR RED|EXIT OPT. OFF
X TMG PLN...0|RE-SERV..  0|FLT TYPE.HARD
FREE DUR PMT|R1  NO|R2  NO|R3  NO|R4  NO
--TIMING-----WALK|PED CL|MN GR| YEL| RED
ENTRANCE TM.  255|   255|    1|25.5|25.5
-----------MIN GR|EXT GR|MX GR| YEL| RED
TRACK CLEAR     0|     0|    0|25.5|25.5
-----------MIN DL|PMTEXT|MX TM| YEL| RED
DWL/CYC-EXIT    7|   0.0|    0|25.5|25.5
PMT ACTIVE OUT..ON   PMT ACT DWELL...NO
OTHER - PRI PMT.OFF  NON-PRI PMT.....OFF
INH EXT TIME... 0.0  PED PR RETURN...OFF
PRIORITY RETURN.OFF  QUEUE DELAY.... OFF
COND DELAY......OFF
PHASES     1   2   3   4   5   6   7   8
PR RTN%    0   0   0   0   0   0   0   0
PHASES     9  10  11  12  13  14  15  16
PR RTN%    0   0   0   0   0   0   0   0
```

ASC/3-2070 Preemption Programming Detail

The image to the left is an exact duplication of the preempt programming display found on a 2070 controller running Econolite ASC/3-2070 software.

When a signal plan requires Railroad or Emergency Vehicle preemption, this detail is to be used on the electrical detail to instruct the installer on setting the different operational parameters required to operate the preempt sequence per the signal design plans.

Below is a brief description of the most commonly used features:

A Preempt Plan - this setting is used to select the preemptor plan as well as establish preempt priority. Preemptor 1 is the highest priority preemptor and should always be used for railroad preemption.

B Interval programming - these settings describe which phases run when the controller transitions into preemption, dwells, and exits. All entrance, dwell, and exit timing is shown in another section of the programming display.

- -TRKCLR V/O are vehicle phases and overlaps that run during the track clearance interval of the preemption sequence.
- -ENA TRL enables or disables the trailing G/Y/R overlap timing during preemption (often referred to as a timed overlap)
- -DWEL VEH/PED/OLP are the vehicle, pedestrian, and overlaps that are first served following the TRKCLR interval of the preemption sequence.
- -CYC VEH/PED/OLP are the vehicle, pedestrian, and overlaps that are served during the preemption sequence after the DWELL phases.
- -EXIT PH selects the phases that the controller will exit to at the end of the DWELL and/or CYCLE intervals. The preemption sequence terminates when all exit phases are timing.

C PMT OVRIDE - When enabled allows this preemptor to override all higher numbered preemptors.

D DELAY - The time between receipt of the preemptor call and initialization of preemption. Delay is typically used in firestation preempt applications where a push button in the firestation initiates the preemptor call a set DELAY time after the press of the button.

DET LOCK - A preemptor call is non latched when this setting is not programmed and is latched when it is programmed. When DELAY is used and a preemptor call is dropped during the DELAY period and DET LOCK is programmed, the preempt will be latched and will be serviced. This setting is typically used in tandem with DELAY in firestation preemption applications.

E OVERIDE FL - Allows the preemptor to override automatic flash and time the preemptor sequence, after which the controller returns to automatic flash.

(continued on next page)

ECONOLITE ASC/3-2070 RAILROAD PREEMPT PROGRAMMING DETAIL

(program controller as shown)

1. From Main Menu select `4. PREEMPTOR/TSP`
2. From PREEMPTOR/TSP/SCP Submenu select `1. PREEMPT PLAN 1-10`

Place cursor in [ ] next to Preempt Plan and press 1. Then press the right cursor arrow and toggle the controller to YES. Next cursor down. This will select Railroad Preempt #1.

```
PREEMPT PLAN [  1]    ENABLE....YES
 VEH/PED 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
 OVERLAP A B C D E F G H I J K L M N O P
TRKCLR V . . . . . . . . . . . . . . . .
TRKCLR O . . . . . . . . . . . . . . . .
ENA TRL  . . . . . . . . . . . . . . . .
DWEL VEH . . . . . . . . . . . . . . . .
DWEL PED . . . . . . . . . . . . . . . .
DWEL OLP . . . . . . . . . . . . . . . .
CYC VEH  . . . . . . . . . . . . . . . .
CYC PED  . . . . . . . . . . . . . . . .
CYC OLP  . . . . . . . . . . . . . . . .
EXIT PH  . . . . . . . . . . . . . . . .
EXIT CAL . . . . . . . . . . . . . . . .
SP FUNC  . . . . . . . . . . . . . . . .

ENABLE... YES|PMT OVRIDE.X|INTERLOCK. NO
DET LOCK... X|DELAY..    0|INHIBIT...  0
OVERIDE FL. .|DURATION   0|CLR-GRN... NO
TERM OLP.  NO|PC>YEL    NO|TERM PH    NO
PED DARK.. NO|TC RESRV YES|DWELL FL  OFF
LINK PMT....0|X FLCOLR RED|EXIT OPT. OFF
X TMG PLN...0|RE-SERV..  0|FLT TYPE.HARD
FREE DUR PMT|R1  NO|R2  NO|R3  NO|R4  NO
--TIMING-----WALK|PED CL|MN GR| YEL| RED
ENTRANCE TM.  255|   255|    1|25.5|25.5
-----------MIN GR|EXT GR|MX GR| YEL| RED
TRACK CLEAR     0|     0|    0|25.5|25.5
-----------MIN DL|PMTEXT|MX TM| YEL| RED
DWL/CYC-EXIT    7|   0.0|    0|25.5|25.5
PMT ACTIVE OUT..ON   PMT ACT DWELL...NO
OTHER - PRI PMT.OFF  NON-PRI PMT.....OFF
INH EXT TIME... 0.0  PED PR RETURN...OFF
PRIORITY RETURN.OFF  QUEUE DELAY.... OFF
COND DELAY......OFF
PHASES     1   2   3   4   5   6   7   8
PR RTN%    0   0   0   0   0   0   0   0
PHASES     9  10  11  12  13  14  15  16
PR RTN%    0   0   0   0   0   0   0   0
```

ASC/3-2070 Preemption Programming Detail (continued)

(F) TERM OLP (ASAP) - Forces overlaps to terminate immediately with their included phases and ignore any existing Lagging Overlap programming.

PC>YEL - Allows the Yellow Change indication to time with the completion of Pedestrian Clearance interval.

TERM PH - Terminate all timing phases and force an All Red condition before starting the activated preempt. Phases will NOT be terminated if the current Green phases exactly match the preempt's entry phase(s) and a yellow trap will not be caused for conflicting PPLT overlap programming.

(G) TC RESRV - Allows the preemptor to reservice the track clearance phases when the preemption call goes away and returns before the preemption sequences terminate. When enabled, the PREEMPTION EXTEND option is disabled.

(H) Timing Parameters - these settings describe the controller operation as it transitions from normal operation into preemption, dwells, and then exits from preemption back to normal operation.

- ENTRANCE TM. describes the minimum green, pedestrian walk and clear, and yellow and red clearance times for the phases currently timing when the preemptor receives a call and transitions from normal operation into preemption. The values 25.5 and 255 are special values used by the controller that allow the phase minimum times of the phases currently running to be timed by the controller. There is no way for the phase indication time to be larger than their programming when entering preemption any time these values are used.
- TRACK CLEAR times are used for the track clearance phases and time after the entrance timing. Programming clearance times to 25.5 allows the phase minimum times to be used.
- DWL/CYC-EXIT times determine the minimum dwell, preempt extend, max preempt time, and preempt exit clear times. The controller will serve any programmed dwell phases before serving cycle phases. Programming clearance times to 25.5 allows the phase minimum times to be used. Preemption advances to the exit sequence when the preempt input is removed and the preempt sequence is no longer active once all exit phases are timing.

ASC/3-2070 Preemption Programming Detail

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 9.3

ECONOLITE ASC/3-2070 LOGIC PROCESSOR PROGRAMMING DETAIL FOR PREEMPT ONLY PHASE OMIT

(program controller as shown)

1. From Main Menu select `1. CONFIGURATION`
2. From CONFIGURATION Submenu select `8. LOGIC PROCESSOR`

3. From the LOGIC PROCESSOR Submenu select `2. LOGIC STATEMENTS`

ENTER A "1" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   1  COPY FROM:   1  ACTIVE:  M   (T/F)
IF    PMT PREEMPT ACTIVE    1      IS  OFF

THEN  CTR OMIT PHASE        3          ON


ELSE
```

LOGIC FOR OMITTING PHASE 3 AT STARTUP AND/OR WHEN NOT IN PREEMPT

4. From the LOGIC PROCESSOR Submenu select `1. LOGIC STATEMENT CONTROL`

ENABLE LOGIC PROCESSOR STATEMENT 1 BY POSITIONING THE CURSOR OVER THE FIELDS SHOWN BELOW AND USING THE TOGGLE KEY TO ENABLE IT.

```
LOGIC STATEMENT CONTROL
          1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6
LP 1-15   E  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 16-30  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 31-45  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 46-60  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 61-75  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 76-90  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

END PROGRAMMING

ASC/3-2070 Preempt Only Phase Omit Programming Detail

In designs with a phase that is only run during preemption, e.g. a four section head with a protected left turn arrow that is only served during the preempt track clearance interval, ASC/3-2070 uses the logic processor to suppress the omitted phase. Use the programming detail shown to the left to omit the desired phases as necessary when the controller starts up or is not in preemption.

ASC/3–2070 Preempt Only Phase Omit Programming Detail

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 9.3

SHEET 3 OF 4

ECONOLITE ASC/3-2070 LOGIC PROCESSOR
PROGRAMMING DETAIL FOR PILOT LAMP CONTROL

(program controller as shown)

1. From Main Menu select **1. CONFIGURATION**
2. From CONFIGURATION Submenu select **8. LOGIC PROCESSOR**
3. From the LOGIC PROCESSOR Submenu select **2. LOGIC STATEMENTS**

ENTER A "1" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   1  COPY FROM:   1  ACTIVE:  M   (T/F)
IF    PMT INPUT            2     IS  ON
OR    PMT PREEMPT ACTIVE   2     IS  ON

THEN  SIG SET PH PED CLR   2        ON


ELSE
```

NOTE: FIRE HOUSE PILOT LAMP LOGIC

ENTER A "2" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   2  COPY FROM:   2  ACTIVE:  M   (T/F)
IF    PMT INPUT            2     IS  OFF
AND   PMT PREEMPT ACTIVE   2     IS  OFF

THEN  SIG SET PH PED CLR   2        OFF


ELSE
```

NOTE: FIRE HOUSE PILOT LAMP LOGIC

4. From the LOGIC PROCESSOR Submenu select **1. LOGIC STATEMENT CONTROL**

ENABLE LOGIC PROCESSOR STATEMENTS 1 AND 2 BY POSITIONING THE CURSOR OVER THE FIELDS SHOWN BELOW AND USING THE TOGGLE KEY TO ENABLE THEM.

```
LOGIC STATEMENT CONTROL
          1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
LP 1-15   E E . . . . . . . . . . . . . .
LP 16-30  . . . . . . . . . . . . . . . .
LP 31-45  . . . . . . . . . . . . . . . .
LP 46-60  . . . . . . . . . . . . . . . .
LP 61-75  . . . . . . . . . . . . . . . .
LP 76-90  . . . . . . . . . . . . . . . .
```

END PROGRAMMING

ASC/3-2070 Pilot Lamp Logic Programming Detail

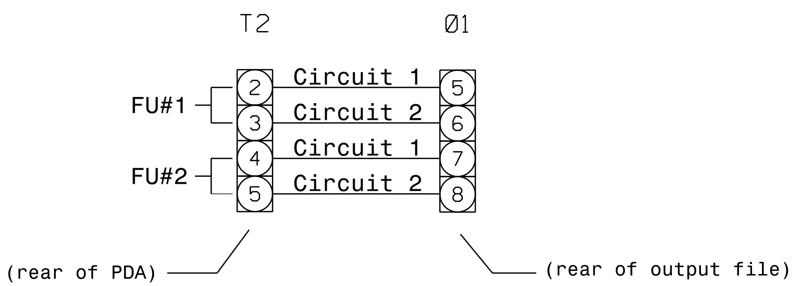
For firestation preemption designs that utilize a push button inside the firestation with a pilot lamp, use the logic processor to turn the lamp "ON" when the button is pressed and "OFF" at the end of the preempt sequence. The example shown to the left uses PRE2 for the fire preempt and the PED 2 Yellow output to light the pilot lamp. Make sure to install load resistors as described in STD. NO. 9.1 sheet 1.

ASC/3-2070 Pilot Lamp Logic Programming Detail

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

(This page is intentionally left blank)

CABINET FLASHER OUTPUTS — Ⓐ



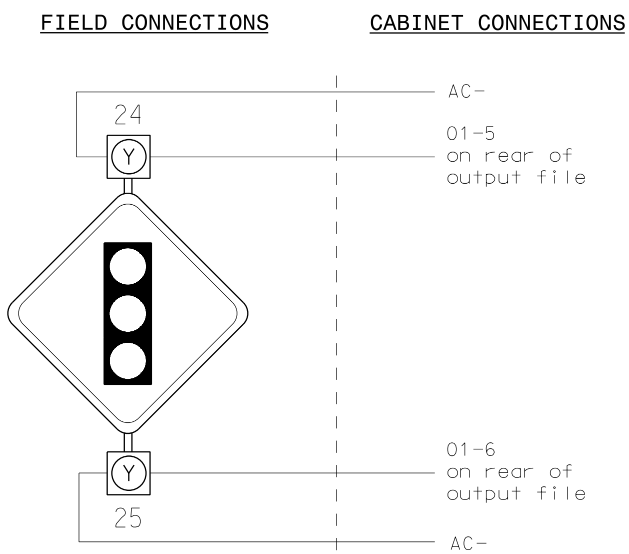
Advance Beacons - Continuous Flash

ADVANCE BEACONS that flash continuously can be wired directly to the flasher unit outputs in the cabinet. Flasher outputs are wired from the power distribution assembly to the output file. Each flasher unit has two circuits, each of which flashes 180 degrees out of phase with the other. Single flashing beacons, side by side, or WIG WAG type beacons can all be wired directly to the cabinet flasher outputs. This type of ADVANCE BEACONS will continue to flash even when the cabinet is in flash.

Ⓐ Cabinet flasher terminal block output reference.

Ⓑ WIG WAG ADVANCE BEACON - This diagram illustrates a beacon that has two heads that flash out of phase with each other. One head flashes with flasher unit #1 circuit #1, and the other head flashes with flasher unit #1 circuit #2. To maintain proper phasing, it is important that a WIG WAG flasher use the outputs of the same flasher unit.

WIG WAG ADVANCE BEACON — Ⓑ



Advance Beacons – Continuous Flash

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 10.0

SHEET 1 OF 1

ADVANCE BEACON OUTPUT ASSIGNMENT PROGRAMMING DETAIL

(A)

(program controller as shown below)

FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '1' (OUTPUT ASSIGNMENTS). PRESS '+' UNTIL OUTPUT #33 (PIN 35) IS REACHED.

```
PAGE:1  C1 PIN:35  NOT ENABLED
OUTPUT ASSIGNMENT #.................33
FREQUENCY (0=DEFAULT) (0-25.5 HZ)...1.0
DUTY CYCLE (0=DEFAULT) (0 - 100%)...50
MODE (0=SOLID,1=FLASH)..............1
SELECT ASSIGNMENT:
NOT ENABLED.........................Y
VEHICLE PHASE.......................
PEDESTRIAN PHASE....................
VEHICLE OVERLAP.....................
PEDESTRIAN OVERLAP..................
WATCHDOG............................
DETECTOR RESET......................
ADVANCE BEACON......................Y
OUT OF PHASE FLASHER................
CONTROLLER FLASH....................
RUN FREE............................
RESERVED............................
PREEMPT.............................
SOFT PREEMPT........................
ANY PREEMPT.........................
COORDINATION PLAN...................
OFFSET..............................
PHASE CHECK.........................
PHASE ON............................
PHASE NEXT..........................
```

(A)

THE FIRST THREE PROGRAMMING ROWS DEFINE THE OUTPUT TO FLASH, ALONG WITH THE RATE AT WHICH IT WILL FLASH.

THE NOT ENABLED 'Y' WILL REMAIN UNTIL THE FUNCTION OF THIS OUTPUT IS CHANGED. DO NOT ENTER AN 'N'.

```
PAGE:1  C1 PIN:35  NOT ENABLED
SELECT BEACON INDEX (1-4)...........1
```

WHEN A 'Y' IS ENTERED FOR 'ADVANCE BEACON' THE SCREEN SHOWN ABOVE WILL APPEAR. ENTER DATA AS SHOWN.

PRESS THE 'ENT' KEY AFTER INPUTTING DATA, THEN 'ESC'.

DISPLAY WILL NOW SHOW THE SPECIFIED OUTPUT ASSIGNED AS 'ADVANCE BEACON' AS SHOWN BELOW.

```
PAGE:1  C1 PIN:35  ADVANCE BEACON
OUTPUT ASSIGNMENT #.................33
FREQUENCY (0=DEFAULT) (0-25.5 HZ)...1.0
DUTY CYCLE (0=DEFAULT) (0 - 100%)...50
MODE (0=SOLID,1=FLASH)..............1
SELECT ASSIGNMENT:
NOT ENABLED.........................
VEHICLE PHASE.......................
PEDESTRIAN PHASE....................
VEHICLE OVERLAP.....................
PEDESTRIAN OVERLAP..................
WATCHDOG............................
DETECTOR RESET......................
ADVANCE BEACON......................Y
OUT OF PHASE FLASHER................
CONTROLLER FLASH....................
RUN FREE............................
RESERVED............................
PREEMPT.............................
SOFT PREEMPT........................
ANY PREEMPT.........................
COORDINATION PLAN...................
OFFSET..............................
PHASE CHECK.........................
PHASE ON............................
PHASE NEXT..........................
```

Oasis Single Programmable/Actuated Advance Beacons

Any output may be programmed as an ADVANCE BEACON and programmed to flash at variable frequencies and duty cycles when turned on. The unused ped yellow load switch outputs are typically chosen for advance beacon outputs and most often turned on and off by the logic processor.

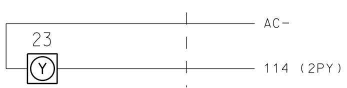
(A) ADVANCE BEACON OUTPUT PROGRAMMING - The four normally unused ped yellow outputs are typically chosen first for ADVANCE BEACON outputs. Their outputs are set up to flash at 1Hz with a 50% duty cycle when turned on. The ADVANCE BEACON is assigned a unique index number from 1-4 as shown.

TYPICAL ADVANCE BEACON WIRING DETAIL (FOR PHASE 2 APPROACH)

(B)

(wire flasher as shown below)

FIELD CONNECTIONS | CABINET CONNECTIONS



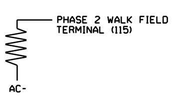
IMPORTANT

1. REMOVE, TAPE AND LABEL CONFLICT MONITOR WIRE ATTACHED TO THE REAR OF TERMINAL 114 (2PY).
2. INSTALL LOAD SWITCH IN OUTPUT FILE SLOT S3.
3. MAKE SURE LOAD RESISTOR IS IN PLACE AS SHOWN IN LOAD RESISTOR INSTALLATION DETAIL ON THIS SHEET.
4. TO ACTIVATE ADVANCE BEACON OPERATION AS INDICATED ON THE SIGNAL PLAN, REASSIGN OUTPUT 33 AS SHOWN ON THIS SHEET.

LOAD RESISTOR INSTALLATION DETAIL

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)



ADVANCE BEACON PROGRAMMING DETAIL

(C)

(program controller as shown below)

1. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '2' (OUTPUT BEACON SETTINGS).

```
           OUTPUT BEACON SETTINGS
TRIGGER PHASES: |12345678910111213141516
BEACON #1 OFF   | X
BEACON #2 OFF   |
BEACON #3 OFF   |
BEACON #4 OFF   |
                BEACON |  1   2   3   4
OFF DELAY TIME (0-255)|   0   0   0   0
ON DELAY TIME  (0-255)|   0   0   0   0
STOP-TIME HOLD (0-255)|   0   0   0   0
-----------------------------------------
   ADVANCE BEACON PROGRAMMING COMPLETE
```

SCROLL DOWN TO VIEW ALL DATA

NOTE: AN OUTPUT HAS TO BE ASSIGNED AS AN ADVANCE BEACON IN ORDER FOR PROPER OPERATION TO OCCUR. SEE OUTPUT ASSIGNMENT DETAIL ON SHEET X.

(B) ADVANCE BEACON WIRING - When using a ped yellow load switch output to drive a beacon, a load resistor must be used on the ped green output to prevent a conflict on the monitor. The wire that connects the yellow signal to the conflict monitor must also be disconnected.

(C) ADVANCE BEACON PROGRAMMING - A typical Advance Beacon is controller by a trigger phase. The beacon will be "OFF" whenever the trigger phase is not in its green interval.

Oasis Advance Beacons – Single Programmable /Actuated

ADVANCE BEACON OUTPUT ASSIGNMENT PROGRAMMING DETAIL

Ⓐ

(program controller as shown below)

FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '1' (OUTPUT ASSIGNMENTS). PRESS '+' UNTIL OUTPUT #33 (PIN 35) IS REACHED.

Ⓐ

```
PAGE:1  C1 PIN:35  NOT ENABLED
OUTPUT ASSIGNMENT #.................33
FREQUENCY (O=DEFAULT) (O-25.5 HZ)...1.0
DUTY CYCLE (O=DEFAULT) (O - 100%)...50
MODE (O=SOLID,1=FLASH)..............1
SELECT ASSIGNMENT:
NOT ENABLED.........................Y
VEHICLE PHASE.......................-
PEDESTRIAN PHASE....................-
VEHICLE OVERLAP.....................-
PEDESTRIAN OVERLAP..................-
WATCHDOG............................-
DETECTOR RESET......................-
ADVANCE BEACON......................Y
OUT OF PHASE FLASHER................-
CONTROLLER FLASH....................-
RUN FREE............................-
RESERVED............................-
PREEMPT.............................-
SOFT PREEMPT........................-
ANY PREEMPT.........................-
COORDINATION PLAN...................-
OFFSET..............................-
PHASE CHECK.........................-
PHASE ON............................-
PHASE NEXT..........................-
```

THE FIRST THREE PROGRAMMING ROWS DEFINE THE OUTPUT TO FLASH, ALONG WITH THE RATE AT WHICH IT WILL FLASH.

THE NOT ENABLED 'Y' WILL REMAIN UNTIL THE FUNCTION OF THIS OUTPUT IS CHANGED. DO NOT ENTER AN 'N'.

```
PAGE:1  C1 PIN:35  NOT ENABLED
SELECT BEACON INDEX (1-4)...........1
```

WHEN A 'Y' IS ENTERED FOR 'ADVANCE BEACON' THE SCREEN SHOWN ABOVE WILL APPEAR. ENTER DATA AS SHOWN.

PRESS THE 'ENT' KEY AFTER INPUTTING DATA, THEN 'ESC'.

DISPLAY WILL NOW SHOW THE SPECIFIED OUTPUT ASSIGNED AS 'ADVANCE BEACON' AS SHOWN BELOW.

```
PAGE:1  C1 PIN:35  ADVANCE BEACON
OUTPUT ASSIGNMENT #.................33
FREQUENCY (O=DEFAULT) (O-25.5 HZ)...1.0
DUTY CYCLE (O=DEFAULT) (O - 100%)...50
MODE (O=SOLID,1=FLASH)..............1
SELECT ASSIGNMENT:
NOT ENABLED.........................-
VEHICLE PHASE.......................-
PEDESTRIAN PHASE....................-
VEHICLE OVERLAP.....................-
PEDESTRIAN OVERLAP..................-
WATCHDOG............................-
DETECTOR RESET......................-
ADVANCE BEACON......................Y
OUT OF PHASE FLASHER................-
CONTROLLER FLASH....................-
RUN FREE............................-
RESERVED............................-
PREEMPT.............................-
SOFT PREEMPT........................-
ANY PREEMPT.........................-
COORDINATION PLAN...................-
OFFSET..............................-
PHASE CHECK.........................-
PHASE ON............................-
PHASE NEXT..........................-
```

FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '1' (OUTPUT ASSIGNMENTS). PRESS '+' UNTIL OUTPUT #34 (PIN 36) IS REACHED.

Ⓑ

```
PAGE:1  C1 PIN:36  NOT ENABLED
OUTPUT ASSIGNMENT #.................34
FREQUENCY (O=DEFAULT) (O-25.5 HZ)...0.0
DUTY CYCLE (O=DEFAULT) (O - 100%)...0
MODE (O=SOLID,1=FLASH)..............0
SELECT ASSIGNMENT:
NOT ENABLED.........................Y
VEHICLE PHASE.......................-
PEDESTRIAN PHASE....................-
VEHICLE OVERLAP.....................-
PEDESTRIAN OVERLAP..................-
WATCHDOG............................-
DETECTOR RESET......................-
ADVANCE BEACON......................-
OUT OF PHASE FLASHER................Y
CONTROLLER FLASH....................-
RUN FREE............................-
RESERVED............................-
PREEMPT.............................-
SOFT PREEMPT........................-
ANY PREEMPT.........................-
COORDINATION PLAN...................-
OFFSET..............................-
PHASE CHECK.........................-
PHASE ON............................-
PHASE NEXT..........................-
```

THE NOT ENABLED 'Y' WILL REMAIN UNTIL THE FUNCTION OF THIS OUTPUT IS CHANGED. DO NOT ENTER AN 'N'.

Ⓑ

```
PAGE:1  C1 PIN:36  NOT ENABLED
SELECT OUTPUT ASSIGNMENT (1-64).......33
```

WHEN A 'Y' IS ENTERED FOR 'OUT OF PHASE FLASHER' THE SCREEN SHOWN ABOVE WILL APPEAR. ENTER DATA AS SHOWN.

PRESS THE 'ENT' KEY AFTER INPUTTING DATA, THEN 'ESC'.

DISPLAY WILL NOW SHOW THE SPECIFIED OUTPUT ASSIGNED AS 'OUT OF PHASE FLASHER' AS SHOWN BELOW.

```
PAGE:1  C1 PIN:36  OUT OF PHASE FLASHER
OUTPUT ASSIGNMENT #.................34
FREQUENCY (O=DEFAULT) (O-25.5 HZ)...0.0
DUTY CYCLE (O=DEFAULT) (O - 100%)...0
MODE (O=SOLID,1=FLASH)..............0
SELECT ASSIGNMENT:
NOT ENABLED.........................-
VEHICLE PHASE.......................-
PEDESTRIAN PHASE....................-
VEHICLE OVERLAP.....................-
PEDESTRIAN OVERLAP..................-
WATCHDOG............................-
DETECTOR RESET......................-
ADVANCE BEACON......................-
OUT OF PHASE FLASHER................Y
CONTROLLER FLASH....................-
RUN FREE............................-
RESERVED............................-
PREEMPT.............................-
SOFT PREEMPT........................-
ANY PREEMPT.........................-
COORDINATION PLAN...................-
OFFSET..............................-
PHASE CHECK.........................-
PHASE ON............................-
PHASE NEXT..........................-
```

Oasis Wig Wag Programmable/Actuated Advance Beacons

Any output may be programmed as an ADVANCE BEACON and programmed to flash at variable frequencies and duty cycles when turned on. Any output may be programmed as an OUT OF PHASE FLASHER and programmed to flash 180 degrees out of phase with an ADVANCE BEACON. Unused ped yellow load switch outputs are typically used for this application and WIG WAG beacons that are actuated by pavements loops and ancillary equipment are the most common application.

Ⓐ ADVANCE BEACON OUTPUT PROGRAMMING - The four normally unused ped yellow outputs are typically chosen first for ADVANCE BEACON outputs. Their outputs are set up to flash at 1Hz with a 50% duty cycle when turned on.

Ⓑ OUT OF PHASE FLASHER - An output may be programmed to flash 180 degrees out of phase with an existing output that has has already been programmed to flash its output. Typically the OUT OF PHASE FLASHER will be paired with an ADVANCE BEACON. The actual output that the OUT OF PHASE FLASHER is to be paired with must be specified in the programming. Unused ped yellow load switch outputs are typically used for OUT OF PHASE FLASHER outputs.

(continued on next page)

Oasis Advance Beacons – Wig Wag (Out Of Phase) Programmable /Actuated

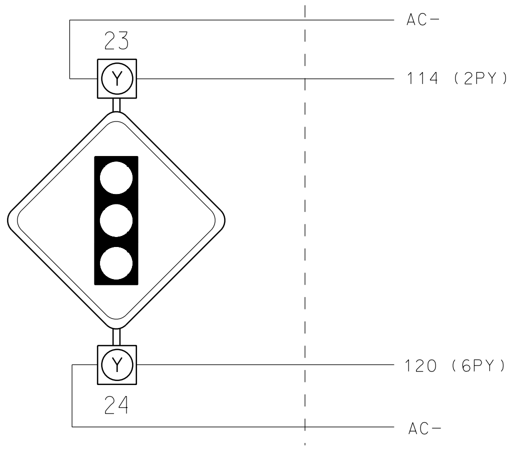
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 10.1

SHEET 2 OF 5

ADVANCE BEACON WIRING DETAIL
(FOR PHASE 2 APPROACH)
(wire flashers as shown below) — Ⓒ

FIELD CONNECTIONS CABINET CONNECTIONS



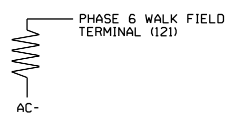
IMPORTANT

1. REMOVE, TAPE AND LABEL CONFLICT MONITOR WIRE ATTACHED TO THE REAR OF TERMINAL 114 (2PY) AND TERMINAL 120 (6PY).
2. INSTALL LOAD SWITCHES IN OUTPUT FILE SLOTS S3 AND S9.
3. MAKE SURE LOAD RESISTORS ARE IN PLACE AS SHOWN IN LOAD RESISTOR INSTALLATION DETAIL ON THIS SHEET.
4. TO ACTIVATE ADVANCE BEACON OPERATION AS INDICATED ON THE SIGNAL PLAN, REASSIGN OUTPUTS 33 AND 34 AS SHOWN ON THIS SHEET.

LOAD RESISTOR
INSTALLATION DETAIL

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)



Oasis Wig Wag Programmable/Actuated Advance Beacons

Ⓒ ADVANCE BEACON WIRING - For a typical WIG WAG ADVANCE BEACON application, two unused ped yellow load switch outputs are used to drive the beacons. One beacon is programmed as an ADVANCE BEACON while the other is set up to flash as an OUT OF PHASE FLASHER. To prevent conflicts, load resistors and wiring modifications must be made in the cabinet as shown to the left.

Ⓓ HOOK-UP CHART WITH ADVANCE BEACON - For any location where an ADVANCE BEACON is deployed, the signal head hook-up chart will show which load switches drive the beacon signal heads and other pertinent installation requirements.

Ⓓ

SIGNAL HEAD HOOK-UP CHART

LOAD SWITCH NO.	S1	S2	S3		S4	S5	S6	S7	S8	S9		S10	S11	S12
CMU CHANNEL NO.	1	2	13		3	4	14	5	6	15		7	8	16
PHASE	1	2	2 PED	ADVANCE BEACON	3	4	4 PED	5	6	6 PED	ADVANCE BEACON	7	8	8 PED
SIGNAL HEAD NO.	NU	21,22	P21, P22	23	NU	41,42	P41, P42	NU	61,62	NU	24	NU	81,82	NU
RED		128				101			134				107	
YELLOW		129				102			135				108	
GREEN		130				103			136				109	
RED ARROW														
YELLOW ARROW														
GREEN ARROW														
✋			113				104							
PED YELLOW				** 114							** 120			
🚶			115				106			*				

NU = Not Used
* Denotes install load resistor. See load resistor installation detail on sheet x.
** Special advance beacons will be wired to S3-Y and S9-Y. See wiring and programming details on sheets x and y of this electrical detail.

Oasis Advance Beacons – Wig Wag (Out Of Phase) Programmable /Actuated

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
10.1

SHEET 3 OF 5

ADVANCE BEACON PROGRAMMING DETAIL FOR STOP TIME HOLD

A

(program controller as shown below)

1. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '2' (OUTPUT BEACON SETTINGS).

```
              OUTPUT BEACON SETTINGS
TRIGGER PHASES: |12345678910111213141516
BEACON #1 OFF   | X
BEACON #2 OFF   |     X                      B
BEACON #3 OFF   |
BEACON #4 OFF   |
                  BEACON |   1    2    3    4
OFF DELAY TIME (0-255)|     0    0    0    0
ON DELAY TIME  (0-255)|     0    0    0    0
STOP-TIME HOLD (0-255)|     2    2    0    0
```

SCROLL DOWN TO VIEW ALL DATA

ADVANCE BEACON PROGRAMMING COMPLETE

NOTICE STOP TIME HOLD SETTINGS FOR BEACONS #1 AND #2.

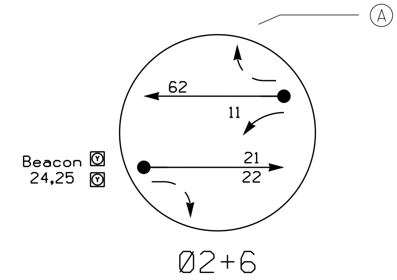
NOTE: AN OUTPUT HAS TO BE ASSIGNED AS AN ADVANCE BEACON IN ORDER FOR PROPER OPERATION TO OCCUR. SEE OUTPUT ASSIGNMENT DETAIL ON SHEET X.

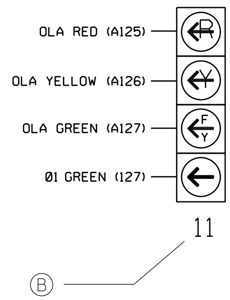
Oasis Wig Wag Advance Beacons With Stop Time Hold

A STOP TIME HOLD - ADVANCE BEACONS are typically programmed to turn "ON" and "OFF" using trigger phases. The beacon will be "OFF" when the trigger phase is green. Some signal designs also specify that the beacon turn "ON" a specified amount of time prior to the end of green on a specified phase. The STOP-TIME HOLD setting specifies the interval that the beacon will turn back "ON" prior to the trigger phase turning yellow. The interval is served as additional green time given to the trigger phase beyond the gap or max termination point. In the illustration to the left, the beacon will turn "ON" two seconds prior to the end of phase 2 green and will flash until the time at which phase 2 turns green again.

B STOP TIME HOLD FOR DUMMY BEACON - In a situation where there are opposing approaches and one is equipped with an ADVANCE BEACON that is programmed with STOP-TIME HOLD and the other does not have a beacon, it is necessary to create a dummy ADVANCE BEACON with the same amount of STOP-TIME HOLD on the approach with no beacon. Without the dummy beacon, the approach would clear while the opposing move would be held green for the duration of STOP-TIME HOLD which could create a yellow trap. The dummy programming ensures the two approaches clear simultaneously.

(continued on next page)





ADVANCE BEACON PROGRAMMING DETAIL FOR STOP TIME HOLD (C)

(program controller as shown below)

1. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '2' (OUTPUT BEACON SETTINGS).

```
          OUTPUT BEACON SETTINGS
TRIGGER PHASES: ¦12345678910111213141516
BEACON #1 OFF   ¦ X
BEACON #2 OFF   ¦
BEACON #3 OFF   ¦
BEACON #4 OFF   ¦
               BEACON ¦   1   2   3   4
OFF DELAY TIME (0-255)¦   0   0   0   0
ON DELAY TIME  (0-255)¦   0   0   0   0
STOP-TIME HOLD (0-255)¦   2   0   0   0
```

SCROLL DOWN TO VIEW ALL DATA

NOTICE STOP TIME HOLD SETTINGS FOR BEACON #1.

ADVANCE BEACON PROGRAMMING COMPLETE

NOTE: AN OUTPUT HAS TO BE ASSIGNED AS AN ADVANCE BEACON IN ORDER FOR PROPER OPERATION TO OCCUR. SEE OUTPUT ASSIGNMENT DETAIL ON SHEET X.

OVERLAP PROGRAMMING DETAIL (D)

(program controller as shown below)

FROM MAIN MENU PRESS '8' (OVERLAPS), THEN '1' (VEHICLE OVERLAP SETTINGS).

```
 PAGE 1: VEHICLE OVERLAP 'A' SETTINGS
 PHASE:          ¦12345678910111213141516
VEH OVL PARENTS:¦XX
VEH OVL NOT VEH:¦
VEH OVL NOT PED:¦
VEH OVL GRN EXT:¦
STARTUP COLOR: _ RED  _ YELLOW  _ GREEN
FLASH COLORS:  _ RED  _ YELLOW  X GREEN
SELECT VEHICLE OVERLAP OPTIONS:   (Y/N)
FLASH YELLOW IN CONTROLLER FLASH?...Y
GREEN EXTENSION (0-255 SEC).........2
YELLOW CLEAR (0=PARENT,3-25.5 SEC)..0.0
RED CLEAR (0=PARENT,0.1-25.5 SEC)...0.0
OUTPUT AS PHASE # (0=NONE, 1-16)....0
```

NOTICE GREEN FLASH

NOTICE GREEN EXTEND

OVERLAP PROGRAMMING COMPLETE

Oasis Wig Wag Advance Beacons With Stop Time Hold and FYAs

Special consideration must be taken into account when a three or four section flashing yellow arrow opposes a beacon that has stop time hold programmed. Because the flashing yellow arrow has the opposing through movement as a parent, it will clear at the end of the opposing green while the controller turns on the beacon and times the stop time hold. This means the flashing yellow arrow clears while the opposing through movement stays green. To eliminate this, green extension time equal to the stop time hold time has to be added to the flashing yellow arrow overlap programming to hold the flashing yellow arrow on for the same duration as its parent.

(A) Signal design example showing an ADVANCE BEACON with two WIG WAG heads on one approach where the opposing approach has a four section flashing yellow arrow.

(B) Four section flashing yellow arrow with typical overlap and protected turn output assignments.

(C) ADVANCE BEACON programming detail with a phase 2 trigger phase and two seconds of stop time hold programmed.

(D) Overlap programming showing the green extension time for overlap A equal to the stop time hold specified for beacon #1. This means at the end of green when the controller starts flashing the beacon and extends the green time of the trigger phase, the overlap will begin timing its green extension which keeps the flashing yellow arrow flashing for the same amount of time before clearing.

Oasis Advance Beacons – Wig Wag (Out Of Phase) With Stop Time Hold & FYAs

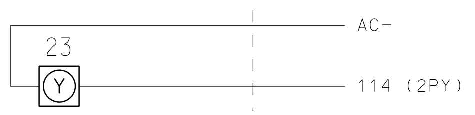
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

TYPICAL ADVANCE BEACON WIRING DETAIL
(FOR PHASE 2 APPROACH)

(wire flasher as shown below)

Ⓐ

FIELD CONNECTIONS   CABINET CONNECTIONS



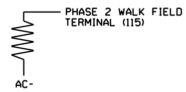
IMPORTANT

1. REMOVE, TAPE AND LABEL CONFLICT MONITOR WIRE ATTACHED TO THE REAR OF TERMINAL 114 (2PY).
2. INSTALL LOAD SWITCH IN OUTPUT FILE SLOT S3.
3. MAKE SURE LOAD RESISTOR IS IN PLACE AS SHOWN IN LOAD RESISTOR INSTALLATION DETAIL ON THIS SHEET.

LOAD RESISTOR
INSTALLATION DETAIL

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)



ASC/3-2070 Single Programmable/Actuated Advance Beacons

Any output may be used to drive an ADVANCE BEACON. The unused ped yellow load switch outputs are typically chosen for ADVANCE BEACON outputs and are most often turned on and off by the logic processor. The example illustrated on this page turns ADVANCE BEACON 23 "ON" whenever phase 2 is not green.

ECONOLITE ASC/3-2070 LOGIC PROCESSOR PROGRAMMING TO TURN ON ADVANCE BEACON

Ⓑ

(program controller as shown)

1. From Main Menu select **1. CONFIGURATION**
2. From CONFIGURATION Submenu select **8. LOGIC PROCESSOR**
3. From the LOGIC PROCESSOR Submenu select **2. LOGIC STATEMENTS**

ENTER A "1" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   1  COPY FROM:   1  ACTIVE:  M   (T/F)
IF     VEH GREEN ON PH       2      IS  OFF
AND    LP COB CODE ON                   546
AND    LP COB CODE OFF                  544

THEN   SIG SET PH PED CLR    2         ON

ELSE
```

FLASHED ADVANCE BEACON 23 AS LONG AS PHASE 2 GREEN IS OFF AND THE CONTROLLER IS NOT IN FLASH.

COB CODE 544 = Automatic (Remote) Flash
COB CODE 546 = Flashing Logic 1Hz

4. From the LOGIC PROCESSOR Submenu select **1. LOGIC STATEMENT CONTROL**

ENABLE LOGIC PROCESSOR STATEMENT 1 BY POSITIONING THE CURSOR OVER THE FIELDS SHOWN BELOW AND USING THE TOGGLE KEY TO ENABLE IT.

```
LOGIC STATEMENT CONTROL
          1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6
LP 1-15   E  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 16-30  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 31-45  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 46-60  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 61-75  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 76-90  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

END PROGRAMMING

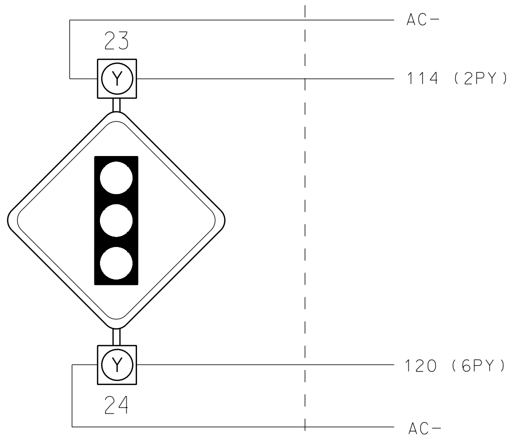
Ⓐ ADVANCE BEACON WIRING - When using a ped yellow load switch output to drive a beacon, a load resistor must be used on the ped green output to prevent a conflict on the monitor. The wire that connects the yellow signal to the monitor must also be disconnected.

Ⓑ LOGIC PROCESSOR PROGRAMMING - The controller tests to see that phase 2 is not green and the controller is not in flash. When these two statements are true, the beacon will begin to flash on and off at 1Hz with a 50% duty cycle.

ADVANCE BEACON WIRING DETAIL
(FOR PHASE 2 APPROACH) — A

(wire flashers as shown below)

FIELD CONNECTIONS   CABINET CONNECTIONS



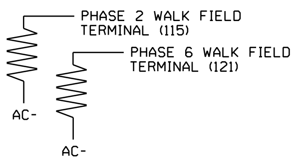
IMPORTANT

1. REMOVE, TAPE AND LABEL CONFLICT MONITOR WIRE ATTACHED TO THE REAR OF TERMINAL 114 (2PY) AND TERMINAL 120 (6PY).
2. INSTALL LOAD SWITCHES IN OUTPUT FILE SLOTS S3 AND S9.
3. MAKE SURE LOAD RESISTORS ARE IN PLACE AS SHOWN IN LOAD RESISTOR INSTALLATION DETAIL ON THIS SHEET.

LOAD RESISTOR
INSTALLATION DETAIL

ACCEPTABLE VALUES

VALUE (ohms)	WATTAGE
1.5K - 1.9K	25W (min)
2.0K - 3.0K	10W (min)



ASC/3-2070 Wig Wag Programmable/Actuated Advance Beacons

Any output may be used to drive an ADVANCE BEACON. The unused ped yellow load switch outputs are typically chosen for ADVANCE BEACON outputs and are most often turned on and off by the logic processor. The example illustrated on this page turns on ADVANCE BEACONS 23 and 24 in a WIG WAG pattern whenever phase 2 is not green by driving them with two different ped yellow load switch outputs.

A ADVANCE BEACON WIRING - When using a ped yellow load switch output to drive a beacon, a load resistor must be used on the ped green output to prevent a conflict on the monitor. The wire that connects the yellow signal to the monitor must also be disconnected.

(continued on next page)

ECONOLITE ASC/3-2070 LOGIC PROCESSOR PROGRAMMING TO TURN ON ADVANCE BEACON —— Ⓑ

(program controller as shown)

1. From Main Menu select `1. CONFIGURATION`
2. From CONFIGURATION Submenu select `8. LOGIC PROCESSOR`
3. From the LOGIC PROCESSOR Submenu select `2. LOGIC STATEMENTS`

ENTER A "1" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   1  COPY FROM:   1  ACTIVE:  M   (T/F)
IF     VEH GREEN ON PH       2     IS  OFF
AND    LP COB CODE ON                   546
AND    LP COB CODE OFF                  544

THEN   SIG SET PH PED CLR    2        ON

ELSE
```

FLASHES ADVANCE BEACON 23 AS LONG AS PHASE 2 GREEN IS OFF AND THE CONTROLLER IS NOT IN FLASH.

COB CODE 544 = Automatic (Remote) Flash
COB CODE 546 = Flashing Logic 1Hz

ENTER A "2" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   2  COPY FROM:   2  ACTIVE:  M   (T/F)
IF     VEH GREEN ON PH       2     IS  OFF
AND    LP COB CODE OFF                  546
AND    LP COB CODE OFF                  544

THEN   SIG SET PH PED CLR    6        ON

ELSE
```

FLASHES ADVANCE BEACON 24 AS LONG AS PHASE 2 GREEN IS OFF AND THE CONTROLLER IS NOT IN FLASH.

4. From the LOGIC PROCESSOR Submenu select `1. LOGIC STATEMENT CONTROL`

ENABLE LOGIC PROCESSOR STATEMENTS 1 AND 2 BY POSITIONING THE CURSOR OVER THE FIELDS SHOWN BELOW AND USING THE TOGGLE KEY TO ENABLE THEM.

```
LOGIC STATEMENT CONTROL
          1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6
LP 1-15   E  E  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 16-30  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 31-45  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 46-60  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 61-75  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 76-90  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

END PROGRAMMING

ASC/3-2070 Wig Wag Programmable/Actuated Advance Beacons

Ⓑ LOGIC PROCESSOR PROGRAMMING - The controller tests to see that phase 2 is not green and the controller is not in flash. When these two statements are true, the beacons will begin to flash on and off at 1Hz with a 50% duty cycle in a WIG WAG pattern.

ASC/3–2070 Beacons – Wig Wag Programmable /Actuated

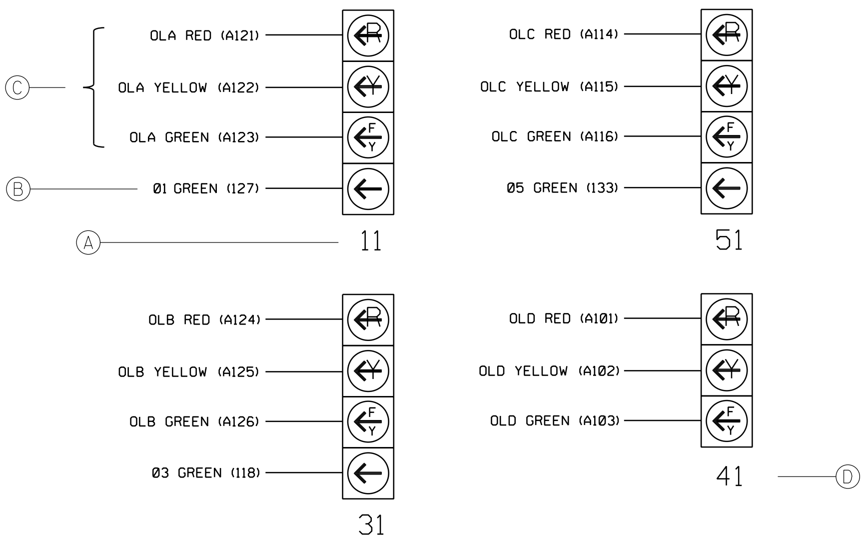
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
10.2

(This page is intentionally left blank)

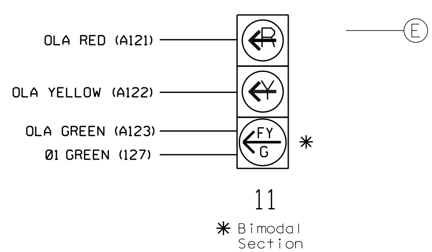
FYA SIGNAL WIRING DETAIL FOR 332 BASE MOUNTED CABINET

(wire signal heads as shown)



NOTE

The sequence display for signal heads 11, 31, and 51 requires special logic programming. See sheet 2 for programming instructions.



NOTE

The sequence display for signal head 11 requires special logic programming. See sheet 2 for programming instructions.

2070 FYA 332 Signal Head Wiring

Flashing Yellow Arrow signals may consist of 4-section heads where there is both a protected and permitted vehicle movement, or they may be 3-section heads that are permitted movements only. Each type has unique wiring requirements that vary depending on whether the cabinet type being used is a 332 base type or a 336 pole type.

(A) Four section FYA signal - Equipped with four signal faces required to implement the protected/permitted flashing yellow arrow vehicle movement.

(B) Green signal face used for the protected turn and is typically wired to the load switch associated with the protected turn phase.

(C) Flashing yellow, solid yellow, and red arrows that comprise the permitted turn portion of the protected/permitted FYA signal sequence. These signal faces are driven by overlaps.

(D) Three section FYA signal - Equipped with three signal faces required to implement a permitted only flashing yellow movement. This signal head has no protected turn associated with it but does require a correctly configured overlap with a parent to run correctly.

(E) Bi-Modal FYA signal - Serves the same purpose as a four section FYA signal head. The bi-modal signal face has wiring for both the protected green turn and the flashing yellow arrow and will display either of those two signals in the correct color when they are active.

2070 FYA for 332 Base Mounted Cabinets – Signal Head Wiring

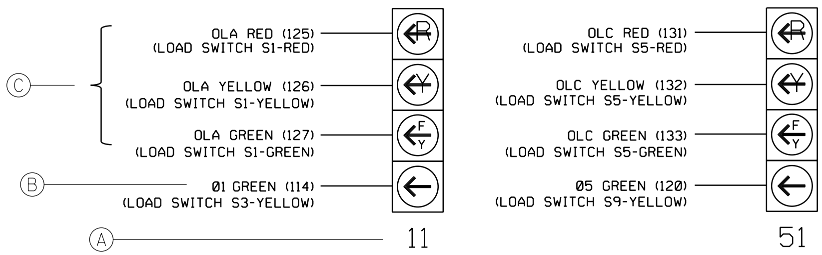
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. **11.0**

SHEET 1 OF 2

FYA SIGNAL WIRING DETAIL FOR 336 POLE MOUNTED CABINET

(wire signal heads as shown)



NOTE

The sequence display for signal heads 11 and 51 requires special logic and output remapping. See sheet 2 for programming instructions.

2070 FYA 336 Signal Head Wiring

Flashing Yellow Arrow signals may consist of 4-section heads where there is both a protected and permitted vehicle movement, or they may be 3-section heads that are permitted movements only. Each type has unique wiring requirements that vary depending on whether the cabinet type being used is a 332 base type or a 336 pole type.

(A) Four section FYA signal - Equipped with four signal faces required to implement the protected/permitted flashing yellow arrow vehicle movement.

(B) The green signal face used for the protected turn when using a 336 cabinet must be connected to the PED yellow output of a PED load switch. This is because there are a limited number of load switches due to the fact there is no auxiliary output file in the cabinet. To use this output as a vehicle phase it must first be remapped as a vehicle phase and assigned the appropriate phase.

(C) Flashing yellow, solid yellow, and red arrows that comprise the permitted turn portion of the protected/permitted FYA signal sequence. These signal faces are driven by overlaps Before being used as an overlap, the load switch in use must first be remapped as the appropriate vehicle overlap.

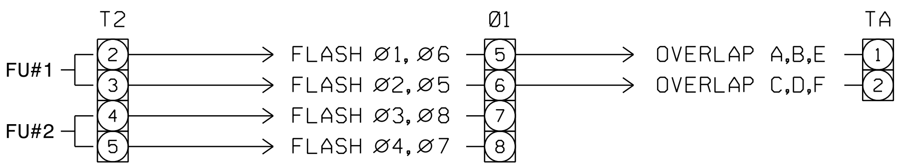
2070 FYA for 336 Pole Mounted Cabinets – Signal Head Wiring

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
11.0
SHEET 2 OF 2

2070 FYA Flasher Circuit Modification

FLASHERS (rear of PDA) | **OUTPUT FILE** (rear view) | **AUX FILE** (rear view)



A

B

The 170 type signal cabinets, both base and pole mount styles, are equipped with two flasher units that are designed to flash signal heads on the various spans of a design per the signal design plan. All signal heads on a span shall flash in unison, but when dealing with flashing yellow arrow designs the default flasher wiring found in the cabinet does not always readily facilitate this requirement. When faced with heads that do not flash in unison with default cabinet flasher wiring, it becomes necessary to modify the cabinet flasher wiring to ensure all heads on their respective spans will flash in unison. The chart shown to the left illustrates where the flasher circuits originate, where they terminate, and which phases and overlaps they are associated with.

Ⓐ This diagram shows where the flasher circuits originate and terminate in the cabinets and which phases and overlaps are associated with each flasher circuit. Each flasher unit has two flasher circuits that flash 180 degrees out of phase with each other at a 1Hz 50% duty cycle rate. Each flasher unit operates independently. This diagram can be used to compare which signal heads on a span are being driven by which flasher unit in an effort to determine whether they flash in unison.

Ⓑ FLASHER CIRCUIT MODIFICATION - Often times when FYAs are used on a signal design, the heads on a span will not flash in unison. This happens more often than not on side streets where an overlap flashes out of phase with a through move phase on the same span. When this is the case and flashing all heads on a single flasher unit will remedy the problem, put the note shown to the left on the electrical detail.

FLASHER CIRCUIT MODIFICATION DETAIL

IN ORDER TO ENSURE THAT SIGNALS FLASH CONCURRENTLY ON THE SAME APPROACH, MAKE THE FOLLOWING FLASHER CIRCUIT CHANGES:

1. ON REAR OF PDA - REMOVE WIRE FROM TERM. T2-4 AND TERMINATE ON T2-2.
2. ON REAR OF PDA - REMOVE WIRE FROM TERM. T2-5 AND TERMINATE ON T2-3.
3. REMOVE FLASHER UNIT 2.

THE CHANGES LISTED ABOVE TIES ALL PHASES AND OVERLAPS TO FLASHER UNIT 1.

2070 FYA for 332 and 336 Cabinets – Flasher Circuit Modification

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.1

SHEET 1 OF 1

OVERLAP PROGRAMMING DETAIL

(program controller as shown below)

FROM MAIN MENU PRESS '8' (OVERLAPS), THEN '1' (VEHICLE OVERLAP SETTINGS).

```
PAGE 1: VEHICLE OVERLAP 'A' SETTINGS
PHASE:          |12345678910111213141516
VEH OVL PARENTS:|XX
VEH OVL NOT VEH:|
VEH OVL NOT PED:|
VEH OVL GRN EXT:|
STARTUP COLOR: _ RED   _ YELLOW   _ GREEN
FLASH COLORS:  _ RED   _ YELLOW   X GREEN
SELECT VEHICLE OVERLAP OPTIONS:   (Y/N)
FLASH YELLOW IN CONTROLLER FLASH?...Y
GREEN EXTENSION (0-255 SEC).........0
YELLOW CLEAR (0=PARENT,3-25.5 SEC)..0.0
RED CLEAR (0=PARENT,0.1-25.5 SEC)...0.0
OUTPUT AS PHASE # (0=NONE, 1-16)....0
```

A — VEH OVL PARENTS

B — FLASH COLORS

C — FLASH YELLOW IN CONTROLLER FLASH

NOTICE GREEN FLASH

PRESS '+' TWICE

```
PAGE 1: VEHICLE OVERLAP 'C' SETTINGS
PHASE:          |12345678910111213141516
VEH OVL PARENTS:|    XX
VEH OVL NOT VEH:|
VEH OVL NOT PED:|
VEH OVL GRN EXT:|
STARTUP COLOR: _ RED   _ YELLOW   _ GREEN
FLASH COLORS:  _ RED   _ YELLOW   X GREEN
SELECT VEHICLE OVERLAP OPTIONS:   (Y/N)
FLASH YELLOW IN CONTROLLER FLASH?...Y
GREEN EXTENSION (0-255 SEC).........0
YELLOW CLEAR (0=PARENT,3-25.5 SEC)..0.0
RED CLEAR (0=PARENT,0.1-25.5 SEC)...0.0
OUTPUT AS PHASE # (0=NONE, 1-16)....0
```

NOTICE GREEN FLASH

OVERLAP PROGRAMMING COMPLETE

2070 Oasis FYA Overlap Programming

Flashing Yellow Arrow designs utilizing three and four section heads to run protected/permitted sequences require overlaps to properly run the protected and the permitted movements. The protected turn is assigned a parent phase that is associated with the usual turning phase. The permitted move is assigned a parent phase that is the opposing through movement of the protected turn. In cases where FYA designs are permitted turns only (three section heads), there is only one parent for the overlap and it is normally the opposing through move phase.

A VEH OVL PARENTS: - Overlaps will be allowed to run when any of the phases selected in this row are active. Most times the odd phases are the turning phases and the even phases are the opposing through phases.

B FLASH COLORS: - When selected, the controller will flash the selected color at 1Hz with a 50% duty cycle when it is timing. For FYAs, the flashing yellow arrow is wired to the overlap load switch green output so flashing the green is what produces the flashing yellow arrow.

C FLASH YELLOW IN CONTROLLER FLASH - When programmed with a 'Y', the controller will flash the overlap yellow output if the controller goes into controller flash.

2070 Oasis FYA 332 Base and 336 Pole Mounted Cabinets – Overlaps

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.2

SHEET 1 OF 1

LOGICAL I/O PROCESSOR PROGRAMMING DETAIL TO PRODUCE SPECIAL FYA-PPLT SIGNAL SEQUENCE

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMANDS 1, 2, 3, 4, 5 AND 6.

2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

```
  LOGICAL I/O COMMAND #1   (+/-COMMAND#)
IF  ACTIVE PHASE        #1  IS ON
AND RED CLEAR ON PHASE #1   IS ON

SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #50 ON
SET OUTPUT  ASSIGNMENT #51 OFF
```

NOTE: LOGIC FOR PHASE 1 RED CLEAR WHEN TRANSITIONING FROM PHASE 1 TO PHASE 2 (HEAD 11).

PRESS '+'

```
  LOGICAL I/O COMMAND #2   (+/-COMMAND#)
IF  ACTIVE PHASE        #1  IS ON

SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #52 OFF
```

NOTE: LOGIC FOR SWITCHING FLASHING YELLOW ARROW OFF DURING PHASE 1 (HEAD 11).

PRESS '+'

```
  LOGICAL I/O COMMAND #3   (+/-COMMAND#)
IF  YELLOW ON PHASE     #1  IS ON

SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #51 ON
```

NOTE: LOGIC FOR YELLOW ARROW CLEARANCE FROM PHASE 1 (HEAD 11).

PRESS '+'

C

```
  LOGICAL I/O COMMAND #4   (+/-COMMAND#)
IF  ACTIVE PHASE        #5  IS ON
AND RED CLEAR ON PHASE #5   IS ON

SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #42 ON
SET OUTPUT  ASSIGNMENT #43 OFF
```

NOTE: LOGIC FOR PHASE 5 RED CLEAR WHEN TRANSITIONING FROM PHASE 5 TO PHASE 6 (HEAD 51).

PRESS '+'

A

```
  LOGICAL I/O COMMAND #5   (+/-COMMAND#)
IF  ACTIVE PHASE        #5  IS ON

SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #44 OFF
```

NOTE: LOGIC FOR SWITCHING FLASHING YELLOW ARROW OFF DURING PHASE 5 (HEAD 51).

PRESS '+'

B

```
  LOGICAL I/O COMMAND #6   (+/-COMMAND#)
IF  YELLOW ON PHASE     #5  IS ON

SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #43 ON
```

NOTE: LOGIC FOR YELLOW ARROW CLEARANCE FROM PHASE 5 (HEAD 51).

LOGIC I/O PROCESSOR PROGRAMMING COMPLETE

D

OUTPUT REFERENCE SCHEDULE

OUTPUT 42 = Overlap C Red
OUTPUT 43 = Overlap C Yellow
OUTPUT 44 = Overlap C Green
OUTPUT 50 = Overlap A Red
OUTPUT 51 = Overlap A Yellow
OUTPUT 52 = Overlap A Green

2070 Oasis FYA 332 Logic Processor Programming

The Logic Processor contained in the Oasis software is required to produce the proper protected/permitted vehicle sequence when running FYAs that use four section heads.

A When the protected turn phase is being serviced, this logic forces the flashing yellow arrow section of the FYA "OFF".

B When the protected turn phase is transitioning through yellow clear, this logic forces the four section FYA to display a solid yellow indication.

C When the protected turn phase is transitioning through red clear, this logic forces the four section FYA to display a solid red indication while ensuring the solid yellow indication is "OFF".

D Reference Schedule that defines the controller output assignment to overlap/signal face relationship.

2070 Oasis FYA 332 Base Mounted Cabinets – Logic Processor

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
11.3
SHEET 1 OF 2

LOGICAL I/O PROCESSOR PROGRAMMING DETAIL
TO PRODUCE SPECIAL FYA-PPLT SIGNAL SEQUENCE

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMANDS 1, 2, 3, 4, 5, and 6.
2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

```
  LOGICAL I/O COMMAND #1  (+/-COMMAND#)
IF  ACTIVE PHASE         #1  IS ON
AND RED CLEAR ON PHASE #1  IS ON
                SCROLL DOWN
THEN:
SET OUTPUT  ASSIGNMENT #14 ON
SET OUTPUT  ASSIGNMENT #15 OFF
```

NOTE: LOGIC FOR PHASE 1 RED CLEAR WHEN TRANSITIONING FROM PHASE 1 TO PHASE 2 (HEAD 11).

PRESS '+'

```
  LOGICAL I/O COMMAND #2  (+/-COMMAND#)
IF  ACTIVE PHASE         #1  IS ON
                SCROLL DOWN
THEN:
SET OUTPUT  ASSIGNMENT #16 OFF
```

NOTE: LOGIC FOR SWITCHING FLASHING YELLOW ARROW OFF DURING PHASE 1 (HEAD 11).

PRESS '+'

```
  LOGICAL I/O COMMAND #3  (+/-COMMAND#)
IF  YELLOW ON PHASE    #1  IS ON
                SCROLL DOWN
THEN:
SET OUTPUT  ASSIGNMENT #15 ON
```

NOTE: LOGIC FOR YELLOW ARROW CLEARANCE FROM PHASE 1 (HEAD 11).

PRESS '+'

```
  LOGICAL I/O COMMAND #4  (+/-COMMAND#)
IF  ACTIVE PHASE         #5  IS ON
AND RED CLEAR ON PHASE #5  IS ON
                SCROLL DOWN
THEN:
SET OUTPUT  ASSIGNMENT #30 ON
SET OUTPUT  ASSIGNMENT #31 OFF
```

C

NOTE: LOGIC FOR PHASE 5 RED CLEAR WHEN TRANSITIONING FROM PHASE 5 TO PHASE 6 (HEAD 51).

PRESS '+'

```
  LOGICAL I/O COMMAND #5  (+/-COMMAND#)
IF  ACTIVE PHASE         #5  IS ON
                SCROLL DOWN
THEN:
SET OUTPUT  ASSIGNMENT #32 OFF
```

A

NOTE: LOGIC FOR SWITCHING FLASHING YELLOW ARROW OFF DURING PHASE 5 (HEAD 51).

PRESS '+'

```
  LOGICAL I/O COMMAND #6  (+/-COMMAND#)
IF  YELLOW ON PHASE    #5  IS ON
                SCROLL DOWN
THEN:
SET OUTPUT  ASSIGNMENT #31 ON
```

B

NOTE: LOGIC FOR YELLOW ARROW CLEARANCE FROM PHASE 5 (HEAD 51).

LOGIC I/O PROCESSOR PROGRAMMING COMPLETE

D

OUTPUT REFERENCE SCHEDULE

OUTPUT 14 = Overlap A Red
OUTPUT 15 = Overlap A Yellow
OUTPUT 16 = Overlap A Green
OUTPUT 30 = Overlap C Red
OUTPUT 31 = Overlap C Yellow
OUTPUT 32 = Overlap C Green

Note: All outputs shown above have been remapped. See sheets 3 and 4 of this electrical detail.

2070 Oasis FYA 336 Logic Processor Programming

The Logic Processor contained in the Oasis software is required to produce the proper protected/permitted vehicle sequence when running FYAs that use four section heads.

A When the protected turn phase is being serviced, this logic forces the flashing yellow arrow section of the FYA "OFF".

B When the protected turn phase is transitioning through yellow clear, this logic forces the four section FYA to display a solid yellow indication.

C When the protected turn phase is transitioning through red clear, this logic forces the four section FYA to display a solid red indication while ensuring the solid yellow indication is "OFF".

D Reference Schedule that defines the controller output assignment to overlap/signal face relationship.

2070 Oasis FYA for 336 Pole Mounted Cabinets – Logic Processor

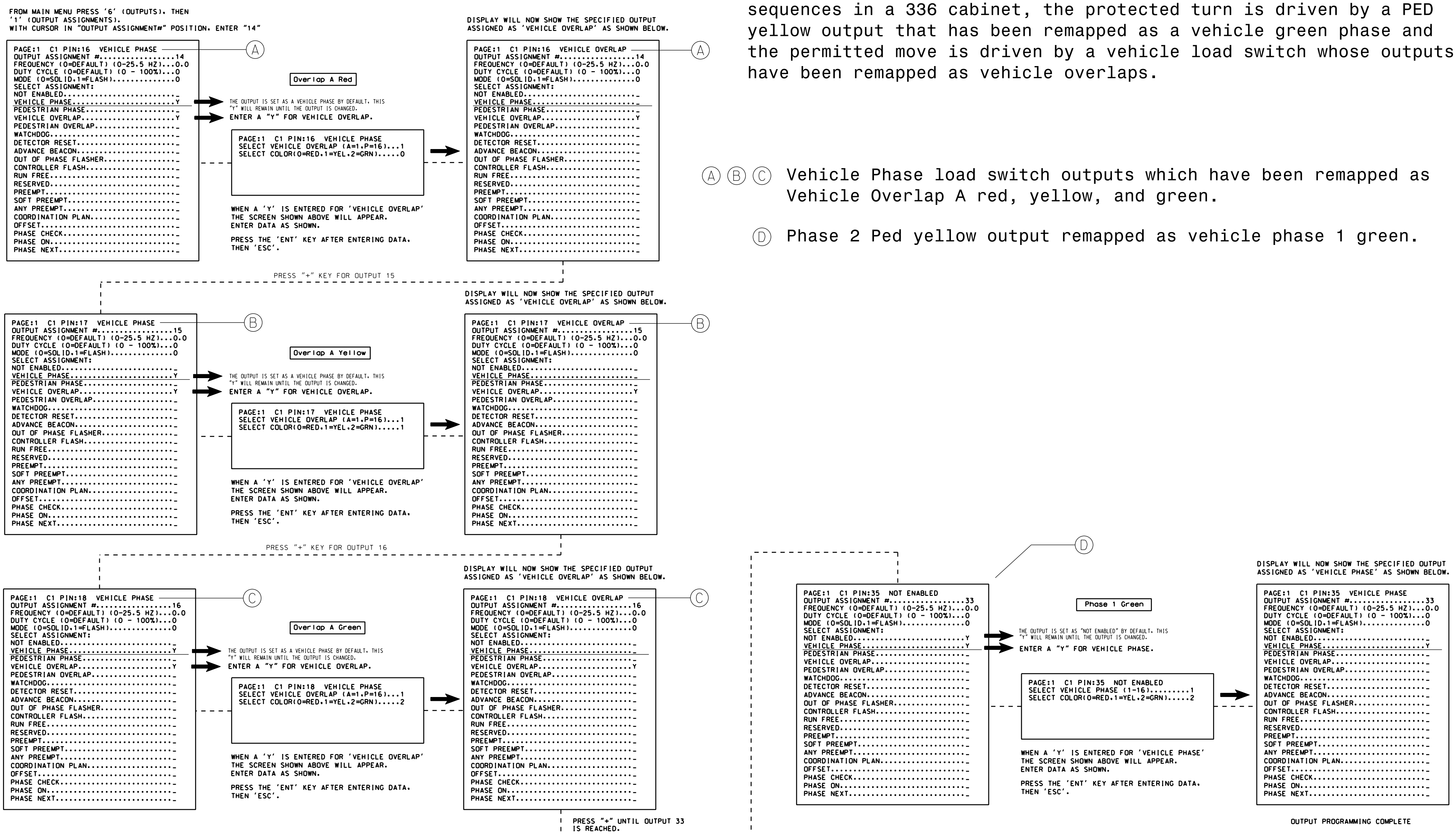
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.3

SHEET 2 OF 2

FYA SIGNAL OUTPUT REMAPPING ASSIGNMENT PROGRAMMING DETAIL
FOR LOADSWITCHES S1 & S3 (SIGNAL HEAD 11)

(program controller as shown below)



2070 Oasis FYA 336 Output Remapping

When using four section heads to implement protected/permitted FYA sequences in a 336 cabinet, the protected turn is driven by a PED yellow output that has been remapped as a vehicle green phase and the permitted move is driven by a vehicle load switch whose outputs have been remapped as vehicle overlaps.

(A) (B) (C) Vehicle Phase load switch outputs which have been remapped as Vehicle Overlap A red, yellow, and green.

(D) Phase 2 Ped yellow output remapped as vehicle phase 1 green.

2070 Oasis FYA for 336 Pole Mounted Cabinets – Output Remapping

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.4

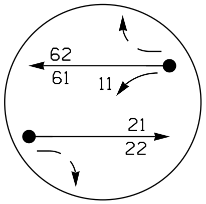
SHEET 1 OF 1

2070 Oasis 4-Section FYA Alternate Phasing

Often times a signal plan will call for alternate phasing where the protected and permitted turning movements of a four section flashing yellow arrow signal are run as the default phasing but the protected only movement is run during an alternate phasing period. This section illustrates the steps needed to run the protected and permitted turning movements of a four section flashing yellow arrow signal during default phasing and only the protected turn during the alternate phasing. Also shown are loop detector programming changes that are implemented during the alternate phasing period.

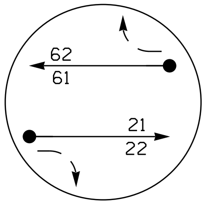
A

Default

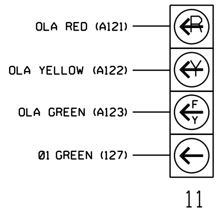


Ø2+6

Alternate



Ø2+6



B

INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	INPUT ASSIGNMENT NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND	FULL TIME DELAY	STRETCH TIME	DELAY TIME
1A[1]	TB2-1,2	I1U	56	18	1	1	Y	Y			15
	-	J4U	48	10★	26	6	Y	Y	Y		3
	-	I1U	56	18★	51	1	Y	Y			

★ See Input Page Assignment programming details on sheets 3 and 4. — B

C

OVERLAP PROGRAMMING DETAIL FOR DEFAULT PHASING

(program controller as shown below)

FROM MAIN MENU PRESS '8' (OVERLAPS), THEN '1' (VEHICLE OVERLAP SETTINGS).

```
 PAGE 1: VEHICLE OVERLAP 'A' SETTINGS
 PHASE:           ¦12345678910111213141516
VEH OVL PARENTS:¦XX
VEH OVL NOT VEH:¦
VEH OVL NOT PED:¦
VEH OVL GRN EXT:¦
STARTUP COLOR: _ RED   _ YELLOW   _ GREEN
FLASH COLORS:  _ RED   _ YELLOW   X GREEN
------------------------------------------
SELECT VEHICLE OVERLAP OPTIONS:    (Y/N)
FLASH YELLOW IN CONTROLLER FLASH?...Y
GREEN EXTENSION (0-255 SEC).........0
YELLOW CLEAR (0=PARENT,3-25.5 SEC)..0.0
RED CLEAR (0=PARENT,0.1-25.5 SEC)...0.0
OUTPUT AS PHASE # (0=NONE, 1-16)....0
```

NOTICE GREEN FLASH

OVERLAP PROGRAMMING COMPLETE

NOTICE PAGE 2

OVERLAP PROGRAMMING DETAIL FOR ALTERNATE PHASING

(program controller as shown below)

FROM MAIN MENU PRESS '8' (OVERLAPS), THEN '1' (VEHICLE OVERLAP SETTINGS). PRESS 'NEXT' TO ADVANCE TO PAGE 2.

```
 PAGE 2: VEHICLE OVERLAP 'A' SETTINGS
 PHASE:           ¦12345678910111213141516
VEH OVL PARENTS:¦X
VEH OVL NOT VEH:¦
VEH OVL NOT PED:¦
VEH OVL GRN EXT:¦
STARTUP COLOR: _ RED   _ YELLOW   _ GREEN
FLASH COLORS:  _ RED   _ YELLOW   _ GREEN
------------------------------------------
SELECT VEHICLE OVERLAP OPTIONS:    (Y/N)
FLASH YELLOW IN CONTROLLER FLASH?...Y
GREEN EXTENSION (0-255 SEC).........0
YELLOW CLEAR (0=PARENT,3-25.5 SEC)..0.0
RED CLEAR (0=PARENT,0.1-25.5 SEC)...0.0
OUTPUT AS PHASE # (0=NONE, 1-16)....0
```

OVERLAP PROGRAMMING COMPLETE

(A) Default and Alternate phasing diagrams from the signal plan showing that the permitted turn on flashing yellow arrow signal head 11 does not run during alternate phasing 2+6.

(B) Input File Chart - Information contained here is taken directly from the signal plan. The detector call to phase 6 on loop 1A is turned off during the alternate phasing period and the delay time on loop 1A is reduced. Programming required to implement this is found on subsequent sheets of the electrical detail as shown in the footnote.

(C) Overlap Programming - To ensure the permitted flashing yellow arrow signal face does not run during the alternate phasing, its parent overlap must be omitted and it should not be programmed to flash green. This is programmed on overlap "PAGE 2" for use during alternate phasing.

(continued on next page)

2070 Oasis 4-Section FYA Alternate Phasing

INPUT PAGE 2 ASSIGNMENT PROGRAMMING DETAIL FOR ALTERNATE PHASING - LOOP 1A — Ⓓ

(program controller as shown below)

NOTES: 1. THIS PROGRAMMING APPLIES FOR INPUT PAGE 2 ONLY. INPUT PAGE 1 WILL USE STANDARD DEFAULT SETTINGS. THIS PROGRAMMING IS NECESSARY FOR PROPER DETECTOR OPERATION DURING ALTERNATE PHASING OPERATION.

2. THE FIRST TASK THIS PROGRAMMING ACCOMPLISHES IS THE DISABLING OF INPUT #10 (DETECTOR 26) SO THAT A VEHICLE CALL WILL NOT BE PLACED TO PHASE 6 DURING ALTERNATE PHASING OPERATION. THE SECOND TASK THIS PROGRAMMING ACCOMPLISHES IS THAT IT REASSIGNS DETECTOR 51 TO INPUT #18 SO THAT THE DELAY ON LOOP 1A CAN BE REDUCED FROM 15 SECONDS TO 0 SECONDS.

FROM MAIN MENU PRESS '5' (INPUTS), THEN PRESS 'NEXT' TO GET TO INPUT PAGE '2'. PRESS THE '+' KEY UNTIL INPUT 10 IS REACHED.

```
PAGE: 2 C1 PIN:48  VEHICLE DETECTOR
INPUT ASSIGNMENT #..................10
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED (Y/N)...................Y
VEHICLE DETECTOR (1-64).............26
PEDESTRIAN DETECTOR (1-16).........._
ALTERNATE PED DETECTOR (1-16)......._
PREEMPT (1-10)......................._
INVERTED PREEMPT (1-10)............._
STOP TIME (Y/N)....................._
FLASH SENSE (Y/N)..................._
DOOR OPEN (Y/N)....................._
MANUAL CONTROL ENABLE (Y/N)........._
MANUAL CONTROL ADVANCE (Y/N)........_
SPECIAL FUNCTION ALARM (1-8)........_
TOD HOUR SYCHRONIZATION (0-23)......_
FORCE OFF RING (1-4)................_
HOLD PHASES (1-16).................._
PLAN (65=FLSH,66=FREE)..._  OFFSET#.._
CHANGE PHASE SEQUENCE PAGE (1-12)..._
CHANGE PHASE TIMING PAGE (1-4)......_
CHANGE PHASE CONTROL PAGE (1-4)....._
CHANGE OVERLAP CONTROL PAGE (1-4)..._
CHANGE INPUT PAGE (1-4)............._
CHANGE OUTPUT PAGE (1-4)............_
OVERRIDE PHASE CONTROL FUNCTION (Y)._
```

ENTER A 'Y' FOR NOT ENABLED

DEFAULT DETECTOR NUMBER WILL REMAIN UNTIL 'NOT ENABLED' IS ENTERED.

(LOOP 1A - PHASE 6)

```
PAGE: 2 C1 PIN:48  NOT ENABLED
INPUT ASSIGNMENT #..................10
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED (Y/N)...................Y
VEHICLE DETECTOR (1-64)............._
PEDESTRIAN DETECTOR (1-16).........._
ALTERNATE PED DETECTOR (1-16)......._
PREEMPT (1-10)......................._
INVERTED PREEMPT (1-10)............._
STOP TIME (Y/N)....................._
FLASH SENSE (Y/N)..................._
DOOR OPEN (Y/N)....................._
MANUAL CONTROL ENABLE (Y/N)........._
MANUAL CONTROL ADVANCE (Y/N)........_
SPECIAL FUNCTION ALARM (1-8)........_
TOD HOUR SYCHRONIZATION (0-23)......_
FORCE OFF RING (1-4)................_
HOLD PHASES (1-16).................._
PLAN (65=FLSH,66=FREE)..._  OFFSET#.._
CHANGE PHASE SEQUENCE PAGE (1-12)..._
CHANGE PHASE TIMING PAGE (1-4)......_
CHANGE PHASE CONTROL PAGE (1-4)....._
CHANGE OVERLAP CONTROL PAGE (1-4)..._
CHANGE INPUT PAGE (1-4)............._
CHANGE OUTPUT PAGE (1-4)............_
OVERRIDE PHASE CONTROL FUNCTION (Y)._
```

PRESS '+' TO ADVANCE TO INPUT 18

```
PAGE: 2 C1 PIN:56  VEHICLE DETECTOR
INPUT ASSIGNMENT #..................18
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED (Y/N)..................._
VEHICLE DETECTOR (1-64).............1
PEDESTRIAN DETECTOR (1-16).........._
ALTERNATE PED DETECTOR (1-16)......._
PREEMPT (1-10)......................._
INVERTED PREEMPT (1-10)............._
STOP TIME (Y/N)....................._
FLASH SENSE (Y/N)..................._
DOOR OPEN (Y/N)....................._
MANUAL CONTROL ENABLE (Y/N)........._
MANUAL CONTROL ADVANCE (Y/N)........_
SPECIAL FUNCTION ALARM (1-8)........_
TOD HOUR SYCHRONIZATION (0-23)......_
FORCE OFF RING (1-4)................_
HOLD PHASES (1-16).................._
PLAN (65=FLSH,66=FREE)..._  OFFSET#.._
CHANGE PHASE SEQUENCE PAGE (1-12)..._
CHANGE PHASE TIMING PAGE (1-4)......_
CHANGE PHASE CONTROL PAGE (1-4)....._
CHANGE OVERLAP CONTROL PAGE (1-4)..._
CHANGE INPUT PAGE (1-4)............._
CHANGE OUTPUT PAGE (1-4)............_
OVERRIDE PHASE CONTROL FUNCTION (Y)._
```

ENTER '51' TO REASSIGN THE VEHICLE DETECTOR FOR THIS INPUT

(LOOP 1A - PHASE 1)

```
PAGE: 2 C1 PIN:56  VEHICLE DETECTOR
INPUT ASSIGNMENT #..................18
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED (Y/N)..................._
VEHICLE DETECTOR (1-64).............51
PEDESTRIAN DETECTOR (1-16).........._
ALTERNATE PED DETECTOR (1-16)......._
PREEMPT (1-10)......................._
INVERTED PREEMPT (1-10)............._
STOP TIME (Y/N)....................._
FLASH SENSE (Y/N)..................._
DOOR OPEN (Y/N)....................._
MANUAL CONTROL ENABLE (Y/N)........._
MANUAL CONTROL ADVANCE (Y/N)........_
SPECIAL FUNCTION ALARM (1-8)........_
TOD HOUR SYCHRONIZATION (0-23)......_
FORCE OFF RING (1-4)................_
HOLD PHASES (1-16).................._
PLAN (65=FLSH,66=FREE)..._  OFFSET#.._
CHANGE PHASE SEQUENCE PAGE (1-12)..._
CHANGE PHASE TIMING PAGE (1-4)......_
CHANGE PHASE CONTROL PAGE (1-4)....._
CHANGE OVERLAP CONTROL PAGE (1-4)..._
CHANGE INPUT PAGE (1-4)............._
CHANGE OUTPUT PAGE (1-4)............_
OVERRIDE PHASE CONTROL FUNCTION (Y)._
```

PROGRAMMING COMPLETE

SPECIAL DETECTOR PROGRAMMING DETAIL - LOOP 1A (ALT.)

(program controller as shown below)

FROM MAIN MENU PRESS '7' (DETECTORS), THEN PRESS '1' FOR VEHICLE DETECTORS. PRESS THE '-' KEY TO GET TO VEHICLE DETECTOR #51.

```
VEHICLE DETECTOR #51  SETTINGS (+-,1-64)
SETTING:                           (Y/N)
ENABLE DETECTOR.....................N
ENABLE LOGGING......................N
ENABLE DIAGNOSTICS..................N
SPEED TRAP..........................N
CALL DETECTOR.......................Y
EXTENSION DETECTOR..................Y
MODE 2 STOP BAR.....................N
SWITCHING DETECTOR..................N
DUPLICATING DETECTOR................N
ENABLE FULL TIME DELAY..............N
IF FAILED, SET MIN RECALL?..........N
IF FAILED, SET MAX1 RECALL?.........N
IF FAILED, SET MAX2 RECALL?.........N
PHASE#          ¦12345678910111213141516
PHASES ASSIGNED ¦
SWITCH/DUPLICATE¦
LOOP SIZE (0-255 FT)................6
SPEED TRAP DISTANCE (0-255 FT)......0
STOP BAR TIME (0-255 SEC)...........0
STRETCH (0-25.5 SEC)................0.0
DELAY (0-255 SEC)...................0
MAX CALLS/MIN (0-255)...............255
MIN CALLS/DIAGNOSTIC PERIOD (0-255).0
MAX OCCUPANCY (0-100%)..............100
EXTENSION DISABLE TIME (0-255 SEC)..0
QUEUE MAX OCCUPANCY TIME (0-255)....0
QUEUE GAP RESET TIME (0-25.5).......0.0
PREEMPTION INDEX FOR QUEUE (0-10)...0
```

ENTER 'Y' FOR ENABLE DETECTOR

ENTER '1' FOR PHASES ASSIGNED

ENSURE DELAY IS '0'

```
VEHICLE DETECTOR #51  SETTINGS (+-,1-64)
SETTING:                           (Y/N)
ENABLE DETECTOR.....................Y
ENABLE LOGGING......................N
ENABLE DIAGNOSTICS..................N
SPEED TRAP..........................N
CALL DETECTOR.......................Y
EXTENSION DETECTOR..................Y
MODE 2 STOP BAR.....................N
SWITCHING DETECTOR..................N
DUPLICATING DETECTOR................N
ENABLE FULL TIME DELAY..............N
IF FAILED, SET MIN RECALL?..........N
IF FAILED, SET MAX1 RECALL?.........N
IF FAILED, SET MAX2 RECALL?.........N
PHASE#          ¦12345678910111213141516
PHASES ASSIGNED ¦X
SWITCH/DUPLICATE¦
LOOP SIZE (0-255 FT)................6
SPEED TRAP DISTANCE (0-255 FT)......0
STOP BAR TIME (0-255 SEC)...........0
STRETCH (0-25.5 SEC)................0.0
DELAY (0-255 SEC)...................0
MAX CALLS/MIN (0-255)...............255
MIN CALLS/DIAGNOSTIC PERIOD (0-255).0
MAX OCCUPANCY (0-100%)..............100
EXTENSION DISABLE TIME (0-255 SEC)..0
QUEUE MAX OCCUPANCY TIME (0-255)....0
QUEUE GAP RESET TIME (0-25.5).......0.0
PREEMPTION INDEX FOR QUEUE (0-10)...0
```

DETECTOR PROGRAMMING COMPLETE

Ⓓ Input Assignment and Detector programming provides the programming steps necessary to disable a phase 6 call on loop 1A, reassign the detector number assigned to loop 1A's input, and reduce the delay. This is all programmed on input "PAGE 2" for use during alternate phasing.

NOTE: DETECTOR IS PROGRAMMED PER THE INPUT FILE CONNECTION AND PROGRAMMING CHART SHOWN ON SHEET 1.

(continued on next page)

2070 Oasis 4–Section FYA Alternate Phasing

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

ALTERNATE PHASING ACTIVATION DETAIL

(E)

TO RUN ALT. PHASING DURING COORDINATION - SELECT ALL PAGE CHANGES (AS SHOWN BELOW) WITHIN COORDINATION PLAN PROGRAMMING.

TO RUN ALT. PHASING DURING FREE RUN - PROGRAM PAGE CHANGES (SHOWN BELOW) IN SEPARATE TIME OF DAY EVENTS. IF PAGE 1 IS USED, NO EVENT PROGRAMMING IS NECESSARY FOR THAT PARTICULAR PAGE.

PHASING	INPUTS PAGE	OVERLAPS PAGE
ACTIVE PAGES REQUIRED TO RUN DEFAULT PHASING	1	1
ACTIVE PAGES REQUIRED TO RUN ALTERNATE PHASING	2	2

NOTE: PAGES NOT SHOWN (i.e. sequence, phase control, etc.) SHOULD REMAIN AS '1', OR AS DEFINED BY TIMING ENGINEER.

IMPORTANT: IF ALT. PHASING IS USED DURING FREE RUN AND COORDINATION, DO NOT OPERATE TIME OF DAY PAGE CHANGE EVENTS CONCURRENTLY WITH COORDINATION PLAN EVENTS IN THE EVENT SCHEDULER. (EX. FREE RUN PAGE CHANGE EVENT SHOULD END BEFORE COORDINATION PLAN EVENT STARTS AND VICE-VERSA).

(F)

ALTERNATE PHASING PAGE CHANGE SUMMARY

THE FOLLOWING IS A SUMMARY OF WHAT TAKES PLACE WHEN THESE OVERLAP/INPUT PAGE CHANGES ACTIVATE TO CALL THE "ALTERNATE PHASING":

OVERLAPS PAGE 2: Modifies overlap parent phases for heads 11 to run protected turns only.

INPUTS PAGE 2: Disables phase 6 call on loop 1A and reduces delay time for phase 1 call on loop 1A to 0 seconds.

(E) Alternate Phasing Activation Detail is a legend that outlines which inputs, overlaps, and other relevant pages are required to run during normal operation or during alternate phasing operation.

(F) Alternate Phasing Page Change Summary - This area is used to describe in detail how the programming changes made to the different controller programming pages affect the phasing operation during the alternate phasing period. The loop delay reduction time of "0" seconds shown in this example is taken from the signal design plan, and that value may vary.

PED YELLOW CONFLICT MONITOR WIRING DETAIL Ⓐ

(make cabinet wiring changes as shown below)

In order to use FYA COMPACT mode with the 2018ECL-NC Monitor, the cabinet must be wired such that the (unused) Ped Yellow load switch outputs are wired to the conflict monitor as follows: From 2 PY (field term. 114) to chan. 9 green (monitor pin 13), from 4 PY (field term. 105) to chan. 9 yellow (monitor pin 16), from 6 PY (field term. 120) to chan. 10 green (monitor pin R), and from 8 PY (field term. 111) to chan. 10 yellow (monitor pin U).

Follow the instructions below to make the appropriate connections:

STEP 1: Fold down rear panel of output file.

STEP 2: Find unused wiring harness from conflict monitor card edge connector (which should be tied and bundled together).

STEP 3: Find the conductors that correspond to the following conflict monitor card edge pins and solder wire to the appropriate terminal on the rear of the output file as shown below:

CMU-13	2PY (term. 114)
CMU-16	4PY (term. 105)
CMU-R	6PY (term. 120)
CMU-U	8PY (term. 111)

NOTE: Some cabinet manufacturers use keyed connectors to accomplish this wiring configuration. If connectors are used, fold down the rear panel of the output file and find the set of 3 keyed connectors and connect them as shown below:

1-2PY	1-CMU-13
2-4PY	2-CMU-16
3-6PY	3-CMU-R
4-8PY	4-CMU-U

2070 Oasis FYA 336 Conflict Monitor Wiring Detail

When using four section heads to implement protected/permitted FYA sequences in a 336 cabinet, the protected turn is driven by a PED yellow output that has been remapped as a vehicle green phase and the permitted move is driven by a vehicle load switch whose outputs have been remapped as overlaps. For the monitor to be able to see the protected turn indication on the rempped PED yellow output, special wiring must be made between the output file and the conflict monitor.

Ⓐ PED Yellow Conflict Monitor Wiring Detail giving the monitor visibility of the protected turn that is output on the remapped PED yellow load switch output.

2070 Oasis FYA for 336 Pole Mounted Cabinets – Conflict Monitor Wiring Detail

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.6

SHEET 1 OF 1

ECONOLITE ASC/3-2070 OVERLAP PROGRAMMING DETAIL

(program controller as shown)

1. From Main Menu select 2. CONTROLLER
2. From CONTROLLER Submenu select 2. VEHICLE OVERLAPS

OVERLAP A

Select TMG VEH OVLP [A] and 'PPLT FYA'

```
TMG VEH OVLP...[A] TYPE: .....PPLT FYA   (A)

PROTECTED LEFT TURN....   PHASE    1     (B)
OPPOSING THROUGH.......   PHASE    2     (C)

FLASHING ARROW OUTPUT.....CH9  ISOLATE   (D)

DELAY START OF: FYA..0.0 CLEARANCE..0.0
ACTION PLAN SF BIT DISABLE.......... 0
```

END PROGRAMMING

ECONOLITE ASC/3-2070 OVERLAP PROGRAMMING DETAIL

(program controller as shown)

1. From Main Menu select 2. CONTROLLER
2. From CONTROLLER Submenu select 2. VEHICLE OVERLAPS

OVERLAP A

Select TMG VEH OVLP [A] and 'PPLT FYA'

```
TMG VEH OVLP...[A] TYPE: .....PPLT FYA   (A)

PROTECTED LEFT TURN....   PHASE    1     (B)
OPPOSING THROUGH.......   PHASE    2     (C)

FLASHING ARROW OUTPUT.....CH13 YEL PED   (E)

DELAY START OF: FYA..0.0 CLEARANCE..0.0
ACTION PLAN SF BIT DISABLE.......... 0
```

END PROGRAMMING

ASC/3-2070 4-Section FYA Overlap Programming

Flashing Yellow Arrow designs utilizing four section heads to run protected/permitted sequences require overlaps to properly run the protected and the permitted movements. ASC/3-2070 has an overlap mode designed specifically for protected/permitted FYA applications that takes care of sequencing the signal face outputs on the four section FYA signal heads.

(A) Toggle through the overlap selections in the overlap programming and select PPLT FYA when using four section FYA signal heads. A compliant conflict monitor is required to monitor FYA/s when using this type of overlap.

(B) PROTECTED LEFT TURN - Represents the protected turning movement of the protected/permitted FYA sequence.

(C) OPPOSING THROUGH - Represents the opposing through movement during which the left turn movement is permitted for the protected/permitted FYA sequence.

When using a 332 base mounted cabinet...

(D) FLASHING ARROW OUTPUT - Toggle through the selections to select ISOLATE, which refers to the isolated green indication of the protected turn channel. The appropriate output channel for the assigned protected and permitted phases will be displayed as shown in a read only field.

When using a 336 pole mounted cabinet...

(E) FLASHING ARROW OUTPUT - Toggle through the selections to select YEL PED in order to assign the permitted turn channel to a PED yellow output channel. The appropriate PED channel for the assigned protected and permitted phases will be displayed as shown in a read only field. Output remapping is required to satisfy the conflict monitor FYA channel monitoring requirements. Refer to STD 11.8, sheet 1 of 2 for remapping details.

ECONOLITE ASC/3-2070 OVERLAP PROGRAMMING DETAIL

(program controller as shown)

1. From Main Menu select 2. CONTROLLER
2. From CONTROLLER Submenu select 2. VEHICLE OVERLAPS

OVERLAP A

Select TMG VEH OVLP [A] and 'OTHER/ECONOLITE'

```
    TMG VEH OVLP...[A] TYPE:OTHER/ECONOLITE  A
      PHASES 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
B   INCLUDED . X . . . . . . . . . . . . . .
    PROTECT  . . . . . . . . . . . . . . . .
    PED PRTC . . . . . . . . . . . . . . . .
    NOT OVLP . . . . . . . . . . . . . . . .
C   FLSH GRN . 1 . . . . . . . . . . . . . .
    LAG X PH . . . . . . . . . . . . . . . .
    LAG 2 PH . . . . . . . . . . . . . . . .

    LAG GRN 0.0 YEL 0.0 RED 0.0 ADV GRN 0.0
```

Toggle TWICE

OVERLAP C

Select TMG VEH OVLP [C] and 'OTHER/ECONOLITE'

```
    TMG VEH OVLP...[C] TYPE:OTHER/ECONOLITE
      PHASES 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
B   INCLUDED . . . . . X . . . . . . . . . .
    PROTECT  . . . . . . . . . . . . . . . .
    PED PRTC . . . . . . . . . . . . . . . .
    NOT OVLP . . . . . . . . . . . . . . . .
C   FLSH GRN . . . . . 1 . . . . . . . . . .
    LAG X PH . . . . . . . . . . . . . . . .
    LAG 2 PH . . . . . . . . . . . . . . . .

    LAG GRN 0.0 YEL 0.0 RED 0.0 ADV GRN 0.0
```

END PROGRAMMING

ASC/3-2070 3-Section FYA Overlap Programming

Flashing Yellow Arrow designs utilizing three section heads to run permitted only sequences require overlaps to properly run the permitted movements. ASC/3-2070 has an overlap mode that will flash the flashing yellow arrow signal face during the permitted phase movement.

A Toggle through the overlap selections in the overlap programming and select OTHER/ECONOLITE when using three section FYA signal heads. A compliant conflict monitor is required when using this type of overlap to monitor the FYA's.

B INCLUDED - Select the phases in which the the permitted move is allowed to run for the permitted FYA sequence.

C FLASH GRN - Defines the rate at which the overlap will flash during the green interval of each included phase. Toggle this setting to '1' to flash the flashing yellow arrow signal face at a 1Hz 50% duty cycle rate.

ECONOLITE ASC/3-2070 I/O PIN REMAPPING

The ASC/3 Configurator utility program must be used to remap the I/O pins as shown below. Consult the ASC/3 Configurator User Guide for specific instructions on software use.

1. Run the Configurator utility. Load a file as the Current DB.
2. Choose the C1-out tab to change the I/O mapping as needed. Use the drop down list within the program to select the assigned function for the pins shown below.
3. Save the database file and download it to the controller.

C1 PIN # / DEFAULT FUNCTION	ASSIGNED FUNCTION (A)	
PIN 18-PHASE 1 GREEN	PHASE 2 PED CLEAR	NOTE: FOR FYA 1-9 COMPACT MODE
PIN 35-PED 2 YELLOW	PHASE 1 GREEN	
PIN 9-PHASE 3 GREEN	PHASE 4 PED CLEAR	NOTE: FOR FYA 3-10 COMPACT MODE
PIN 37-PED 4 YELLOW	PHASE 3 GREEN	
PIN 34-PHASE 5 GREEN	PHASE 6 PED CLEAR	NOTE: FOR FYA 5-11 COMPACT MODE
PIN 36-PED 6 YELLOW	PHASE 5 GREEN	
PIN 26-PHASE 7 GREEN	PHASE 8 PED CLEAR	NOTE: FOR FYA 7-12 COMPACT MODE
PIN 38-PED 8 YELLOW	PHASE 7 GREEN	

NOTE: The steps below can be used to view changes to I/O pins within the controller. Any I/O pins that have been remapped will display and show their default function in addition to the current assigned function.

1. From Main Menu select 7. STATUS DISPLAY
2. From STATUS DISPLAY Submenu select 8. INPUTS/OUTPUTS
3. From INPUT/OUTPUT Submenu select 9. I/O DIFFERENCES

ASC/3-2070 4-Section FYA Output Remapping

By default, when "YEL PED" is selected as the flashing arrow output during overlap programming, the ASC/3-2070 software outputs the flashing yellow arrow on a PED yellow channel and the protected turn on the green load switch channel of the protected turn phase. This arrangement places the protected turn and the flashing yellow arrow on the wrong conflict monitor input channels and as such these two outputs must be swapped with each other to satisfy the conflict monitor requirements. The ASC/3-2070 Configurator is used to remap these two outputs.

(A) By selecting the C1 pin associated with the phase 1 green output and changing its function to "PHASE 2 PED CLEAR" from the drop down menu, and by selecting the C1 pin associated with the Ped 2 yellow output and changing its function to "PHASE 1 GREEN", the flashing yellow arrow will now be output on the overlap A green output and the solid green arrow will be output on the Ped 2 yellow output. These same actions are repeated as needed for any four section FYA in use.

ASC/3–2070 4–SECTION FYA for 336 Pole Mounted Cabinets – Output Remapping

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.8

SHEET 1 OF 1

ECONOLITE ASC/3-2070
LOAD SWITCH ASSIGNMENT DETAIL

(program controller as shown)

To assign load switches S1 and S5 as OLA and OLC, program LD SWITCH 1 as OVLP '1' TYPE 'O' and LD SWITCH 5 as OVLP '3' TYPE 'O' as shown below.

1. From Main Menu select `1. CONFIGURATION`
2. From CONFIGURATION Submenu select `3. LOAD SW ASSIGN`

LD SWITCH ASSIGN

Ⓐ	Ⓒ PHASE /OVLP	Ⓑ TYPE	DIMMING R	Y	G	D	---FLASH--- PWR	Ⓓ AUT	TGR
1	1	O	.	.	.	+	A	Y	X
2	2	V	.	.	.	+	A	Y	.
3	3	V	.	.	.	+	A	R	X
4	4	V	.	.	.	+	A	R	.
5	3	O	.	.	.	-	A	Y	.
6	6	V	.	.	.	-	A	Y	X
7	7	V	.	.	.	-	A	R	.
8	8	V	.	.	.	-	A	R	X
9	1	O	.	.	.	+	A	R	X
10	2	O	.	.	.	+	A	R	X
11	3	O	.	.	.	-	A	R	.
12	4	O	.	.	.	-	A	R	.
13	2	P	.	.	.	+	A	.	.
14	4	P	.	.	.	-	A	.	.
15	6	P	.	.	.	+	A	.	.
16	8	P	.	.	.	-	A	.	.

ASC/3-2070 FYA Load Switch Reassignment

The function of a load switch can be reassigned using ASC/3-2070 software. To implement permitted turn movements using three section FYA signal heads, vehicle load switches must be reassigned as vehicle overlaps. This is accomplished by reassigning the required load switches using the programming screen shown to the left.

Ⓐ LD SWITCH ASSIGN - This column represents 16 load switches that are typically found in a 170 type cabinet. Numbers 1-8 are vehicle load switches, 9-12 are overlap load switches located in an auxiliary output file if the cabinet were so equipped, and 13-16 are pedestrian load switches. This is a read only field.

Ⓑ TYPE - This column defines the output type of the load switch. The four assignment types can be toggled between Vehicle, Overlap, Pedestrian, or the load switch can be turned OFF with no selection being shown in this column.

Ⓒ PHASE/OVLP - This column defines the Vehicle or Pedestrian phase number assigned to type "V" and type "P" load switches. For load switches reassigned as type "O", the OVLP numbers range from 1-16 which represents overlaps A-P. In the screen shown to the left, load switches 1 and 5 have been reassigned as overlaps "A" and "C" respectively.

Ⓓ AUT - This column defines the load switch Automatic Flash color, which can be set to Red, Yellow, or dark. In the screen shown to the left, overlap A and overlap C will flash yellow when the controller goes into automatic flash.

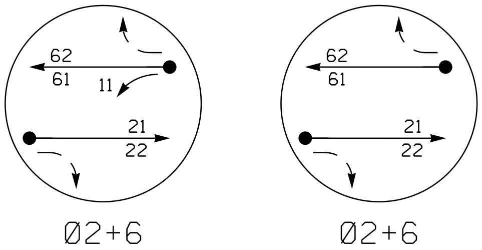
ASC/3-2070 3-SECTION FYA for 336 Cabinets - Load Switch Assignment

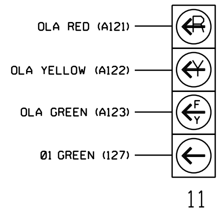
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.9

SHEET 1 OF 1

Default Alternate





ASC/3-2070 4-Section FYA Alternate Phasing

Occasionally a signal plan will call for alternate phasing where the protected and permitted turning movements of a four section flashing yellow arrow signal are run as the default phasing but the protected only movement is run during an alternate phasing period. This section illustrates the steps needed to run the protected and permitted turning movements of a four section flashing yellow arrow signal during default phasing and only the protected turn during the alternate phasing. Also shown are loop detector programming changes that are implemented in the alternate phasing period.

INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND TIME	DELAY TIME	DETECTOR TYPE
1A [1]	TB2-1,2	I1U	56	1 ★	1	YES		15	S
	-	J4U	48	26 ★	6	YES		3	G

★ See Input Page Assignment programming details on sheet 3.

ECONOLITE ASC/3-2070 OVERLAP PROGRAMMING DETAIL

(program controller as shown)

1. From Main Menu select 2. CONTROLLER
2. From CONTROLLER Submenu select 2. VEHICLE OVERLAPS

OVERLAP A

Select TMG VEH OVLP [A] and 'PPLT FYA'

```
TMG VEH OVLP...[A] TYPE: .....PPLT FYA

PROTECTED LEFT TURN....   PHASE    1
OPPOSING THROUGH.......   PHASE    2

FLASHING ARROW OUTPUT.....CH9  ISOLATE

DELAY START OF: FYA..0.0 CLEARANCE..0.0
ACTION PLAN SF BIT DISABLE........... 1
```

NOTICE ACTION PLAN SF BIT "1"

END PROGRAMMING

Ⓐ Default and Alternate phasing diagrams from the signal plan showing that the permitted turn on flashing yellow arrow signal head 11 does not run during alternate phasing 2+6.

Ⓑ Input File Chart - Information contained here is taken directly from the signal plan. The detector call to phase 6 on loop 1A is turned off during the alternate phasing period and the delay time on loop 1A is reduced. Programming required to implement this is found on subsequent sheets of the electrical detail as shown in the footnote.

Ⓒ Overlap Programming - ASC/3-2070 has special function bits that can be entered in the overlap programming and be used to disable the permitted left turn of a four section flashing yellow arrow during alternate phasing. Enable the selected special function bit to disable the permitted turn during alternate phasing.

(continued on next page)

ASC/3-2070 4-Section FYA - Alternate Phasing

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 11.10

ECONOLITE ASC/3-2070 VEHICLE DETECTOR SETUP PROGRAMMING DETAIL FOR ALTERNATE PHASING LOOP 1A

Ⓓ

(program controller as shown)

IMPORTANT!

Program detectors per the input file connection and programming chart shown on sheet 1 before proceeding.

1. From Main Menu select `8. UTILITIES`
2. From UTILITIES Submenu select `1. COPY/CLEAR`
3. Copy from DETECTOR PLAN "1" to DETECTOR PLAN "2".

```
COPY / CLEAR UTILITY
       FROM              TO
PHASE TIMING.... . > PHASE TIMING.... .
TIMING PLAN..... . > TIMING PLAN..... .
PH DET OPT PLAN. . > PH DET OPT PLAN. .
DETECTOR PLAN... 1 > DETECTOR PLAN... 2
  TOGGLE TO SELECT A "FROM" AND A "TO"
            THEN PRESS ENTER
```

4. From Main Menu select `6. DETECTORS`
5. From DETECTOR Submenu select `2. VEHICLE DETECTOR SETUP`
6. Place cursor in VEH DET PLAN [ ] position and enter "2".

- Place cursor in VEH DETECTOR [ ] position and enter "1".
- Set delay time to "0".

```
VEH DETECTOR [ 1]   VEH DET PLAN [ 2]      ← NOTICE VEH DET PLAN 2
TYPE: S-STANDARD
TS2 DETECTOR..... . ECPI LOG.......   NO
DET PH - 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
 1  1    . . . . . . . . . . . . . . . .
EXTEND TIME...  0.0 DELAY TIME...    0.0   ← ENSURE DELAY IS SET TO '0'
USE ADDED INITIAL . CROSS SWITCH PH..  0
LOCK IN....... NONE NTCIP VOL . OR OCC .
PMT QUEUE DELAY. NO
```

- Place cursor in VEH DETECTOR [ ] position and enter "26".
- Set assigned phase to "0".

```
                        VEH DETECTOR [26]   VEH DET PLAN [ 2]      ← NOTICE VEH DET PLAN 2
                        TYPE: G-GREEN EXTENSION/DELAY
                        TS2 DETECTOR..... . ECPI LOG.......   NO
                        DET PH - 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
ENSURE PHASE            
IS SET TO "0"  →         26 0    . . . . . . . . . . . . . . . .
                        EXTEND TIME...  0.0 DELAY TIME...    3.0
                        USE ADDED INITIAL . CROSS SWITCH PH..  0
                        LOCK IN....... NONE NTCIP VOL . OR OCC .
                        PMT QUEUE DELAY. NO
```

END PROGRAMMING

ASC/3-2070 4-Section FYA Alternate Phasing

Ⓓ Vehicle Detector Setup provides the programming steps necessary to disable a phase 6 call on loop 1A and reduce the delay. This is all programmed on vehicle detector plan 2 for use by an action plan during alternate phasing operation.

(continued on next page)

ECONOLITE ASC/3-2070 ACTION PLAN PROGRAMMING DETAIL

(E)

1. From Main Menu select 5. TIME BASE

2. From TIME BASE Submenu select 2. ACTION PLAN

```
ACTION PLAN...[  1]
PATTERN..........AUTO   SYS OVERRIDE.... NO
TIMING PLAN........ 0   SEQUENCE........  0
VEH DETECTOR PLAN.. 2   DET LOG........NONE
FLASH...........   --   RED REST........ NO
VEH DET DIAG PLN... 0   PED DET DIAG PLN..0
DIMMING ENABLE..   NO   PRIORITY RETURN. NO
PED PR RETURN..    NO   QUEUE DELAY..... NO
PMT COND DELAY     NO
  PHASE   1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6
PED RCL   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
WALK 2    .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
VEX 2     .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
VEH RCL   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
MAX RCL   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
MAX 2     .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
  PHASE   1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6
MAX 3     .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
CS INH    .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
OMIT      .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
SPC FCT   X  .  .  .  .  .  .  .  (1-8)
AUX FCT   .  .  .  (1-3)
          1  2  3  4  5  6  7  8  9  0  1  2  3  4  5
LP 1-15   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 16-30  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 31-45  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 46-60  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 61-75  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 76-90  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
LP 91-100 .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

ASC/3-2070 4-Section FYA Alternate Phasing

(E) The Action Plan programming detail shows that vehicle detector plan 2 and special function bit 1 will be enabled in action plan 1, both of which are required to run protected only turns during alternate phasing operation. Action plan 1 typically runs during a scheduled day plan or during coordination.

(continued on next page)

ALTERNATE PHASING ACTIVATION DETAIL

TO RUN ALT. PHASING DURING FREE RUN - PROGRAM CHANGES (SHOWN BELOW) IN A TIME BASED ACTION PLAN. SCHEDULE A DAY PLAN THAT INCLUDES THE ACTION PLAN PROGRAMMED TO SELECT VEH DET PLAN 2 AND ENABLE SF BIT 1

TO RUN ALT. PHASING DURING COORDINATION - SELECT THE TIME BASED ACTION PLAN THAT IS PROGRAMMED TO SELECT VEH DET PLAN 2 AND ENABLE SF BIT 1

PHASING	VEH DET PLAN	SF BITS ENABLED
ACTIONS REQUIRED TO RUN DEFAULT PHASING	1	NONE
ACTIONS REQUIRED TO RUN ALTERNATE PHASING	2	1

IMPORTANT: IF ALT. PHASING IS USED DURING FREE RUN AND COORDINATION, DO NOT OPERATE TIME OF DAY EVENTS CONCURRENTLY WITH COORDINATION PLAN EVENTS IN THE EVENT SCHEDULER. (EX. FREE RUN EVENT SHOULD END BEFORE COORDINATION PLAN EVENT STARTS AND VICE-VERSA).

F

G

ALTERNATE PHASING CHANGE SUMMARY

THE FOLLOWING IS A SUMMARY OF WHAT TAKES PLACE WHEN SF BIT 1 AND VEH DET PLAN 2 ACTIVATE TO CALL THE "ALTERNATE PHASING":

SF BIT 1: Modifies overlap parent phases for head 11 to run protected turns only.

VEH DET PLAN 2: Disables phase 6 call on loop 1A and reduces delay time for phase 1 call on loop 1A to 0 seconds.

ASC/3-2070 4-Section FYA Alternate Phasing

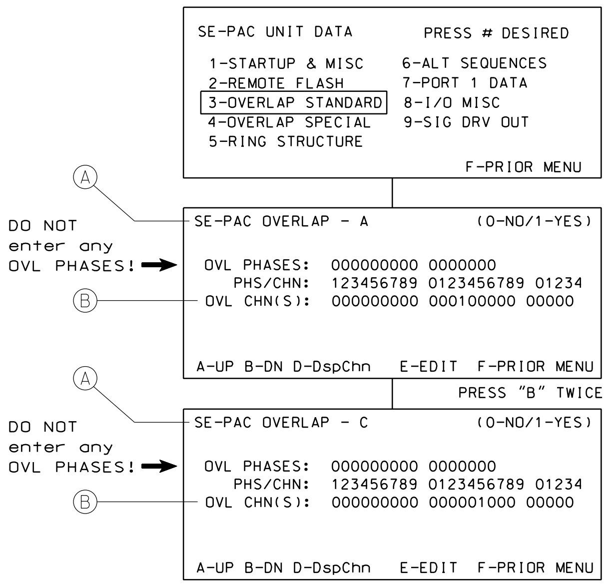
F Alternate Phasing Activation Detail is a legend that outlines which vehicle detector plan, special function bits, and other relevant programming is required to run during normal operation or during alternate phasing operation.

G Alternate Phasing Page Change Summary - This area is used to describe in detail how the programming changes made to the different controller programming pages affect the phasing operation during the alternate phasing period. The loop delay reduction time of "0" seconds shown in this example is taken from the signal design plan, and that value may vary.

SE-PAC2070 FYA PROTECTED/PERMISSIVE SEQUENCE FOR OVERLAPS A & C

(program controller as shown below)

FROM MAIN MENU PRESS 4 (UNIT DATA)



OVERLAP PROGRAMMING COMPLETE
PRESS 'F' TO RETURN TO UNIT DATA

SE-PAC2070 FYA Overlap Programming

Flashing Yellow Arrow designs utilizing three and four section heads to run protected/permitted sequences typically require overlaps to properly run the protected and the permitted movements. When using SE-PAC2070 software, the protected/permitted overlap phase relationship is programmed in a special overlap portion of the software so care must be taken to ensure no standard overlaps are programmed for overlaps that are to be used for the protected/permitted sequence.

(A) SE-PAC OVERLAP - Overlap being used for the protected/permitted or permitted only flashing yellow arrow movement.

(B) OVL CHN(S) - This represents the signal driver output for the designated overlap. Make sure this channel is correct for the SE-PAC OVERLAP, e.g. OVL CHN 13 = SE-PAC OVERLAP A, and ensure no overlap phases are assigned.

PROTECTED AND PERMISSIVE PHASES FOR FLASHING YELLOW ARROW

(program controller as shown below)

FROM MAIN MENU PRESS 4 (UNIT DATA)

```
SE-PAC UNIT DATA          PRESS # DESIRED

 1-STARTUP & MISC      6-ALT SEQUENCES
 2-REMOTE FLASH        7-PORT 1 DATA
 3-OVERLAP STANDARD    8-I/O MISC
 4-OVERLAP SPECIAL     9-SIG DRV OUT
 5-RING STRUCTURE

                               F-PRIOR MENU
```

```
                    SE-PAC OVLP.A...B...C...D...E...F...G...H.
                       TR GRN   0   0   0   0   0   0   0   0
                       YEL/10  40  40  40  40  40  40  40  40
                       RED/10  20  20  20  20  20  20  20  20
PROTECTED PHASES  -->  -G/Y     1   0   5   0   0   0   0   0
PERMISSIVE PHASES -->  +GRN     2   0   6   0   0   0   0   0
                     (-) #-PH G/Y KILLS OVLP= (+) #-PH G STRT
                     A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

NOTE: THIS PROGRAMMING IS REQUIRED FOR SIGNAL HEADS 11 AND 51 SO THAT THE SOLID GREEN ARROWS TURN ON EXCLUSIVELY DURING PROTECTED GREEN PHASES 1 AND 5. AND THE FLASHING YELLOW ARROWS TURN ON EXCLUSIVELY DURING PERMITTED GREEN PHASES 2 & 6.

PPLT DEFINITION PROGRAMMING COMPLETE

PRESS 'F' TO RETURN TO UNIT DATA

SE-PAC2070 FYA Protected/Permissive Phases

Flashing Yellow Arrow designs utilizing three and four section heads to run protected/permitted sequences typically require overlaps to properly run the protected and the permitted movements. When using SE-PAC2070 software, the protected/permitted overlap phase relationship is programmed in a special overlap portion of the software shown to the left. The -G/Y entry defines the protected move and the +GRN entry defines the permissive move. Both of the phases must be in the same ring for the software to consider them valid entries.

When three section flashing yellow arrow signal heads are used to run permitted only movements, there is no protected phase. In spite of this, the protected phase that would normally be associated with the permissive must still be entered in the -G/Y field to make the signal head function correctly. This protected phase is turned "OFF" in the INIT & N.A RESPONSE programming.

SE–PAC2070 FYA 332 Base Mounted Cabinets – Protected/Permissive Phases

INIT & N.A. RESP PROGRAMMING DETAIL

(program controller as shown below)

From Main Menu, press '3' (Phase Data)

```
SE-PAC PHASE DATA        PRESS # DESIRED

 1-VEHICLE TIMES       6-N.LOCK & MISC
 2-DENSITY TIMES       7-SPEC. SEQUENCE
 3-PEDEST. TIMES       8-SPEC. DETECTOR
 4-INIT & N.A. RESP    9-PHASE COPY
 5-V & P RECALLS       0-MISC PED OPTIONS

                             F-PRIOR MENU
```

Phases 1,5 NOT used!

```
PHASE......1...2...3...4...5...6...7...8...9
 INITIAL   0   4   1   1   0   4   1   1   1   (A)
 NA RESP   0   1   0   2   0   1   0   0   0

CODES.......0....1....2....3....4....5
 INITIAL   NONE INACT RED  YEL  GRN  DRK
 NA RESP   NONE  NA1  NA2 BOTH  ---  ---
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

INIT & N.A. RESP programming complete.

SE-PAC2070 FYA Init & N.A Response Programming

When using SE-PAC2070 software to implement a permitted only flashing yellow arrow movement using a three section signal head, care must be taken to ensure that the protected phase programmed in the PROTECTED AND PERMISSIVE PHASES FOR FYA is not an enabled phase in the Init & N.A. Resp Programming.

(A) INITIAL - Entering a "0" will turn the load switch outputs "OFF" for the selected phase. This is required for the protected phase that is programmed in the protected/permissive programming when using a three section flashing yellow arrow signal head that has no protected turn move.

SE–PAC2070 FYA 332 Base Mounted Cabinets – Init & N.A. Resp Programming

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-17

STD. NO. 11.13

SHEET 1 OF 1

OASIS 2070 TIMING CHART

FEATURE	PHASE 1	2	3	4	6
Min Green 1 *	7	12	7	7	12
Extension 1 *	3.0	6.0	1.0	1.0	6.0
Max Green 1 *	40	90	25	25	90
Yellow Clearance	3.0	4.6	3.7	4.3	4.6
Red Clearance	2.1	1.6	2.7	2.7	1.6
Walk 1 *	-	-	-	-	7
Don't Walk 1	-	-	-	-	12
Walk Advance Time *	-	-	-	-	5
Seconds Per Actuation *	-	-	-	-	-
Max Variable Initial *	-	-	-	-	-
Time Before Reduction *	-	-	-	-	-
Time To Reduce *	-	-	-	-	-
Minimum Gap	-	-	-	-	-
Recall Mode	-	MIN RECALL	-	-	MIN RECALL
Vehicle Call Memory	-	YELLOW	-	-	YELLOW
Dual Entry	-	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

A

ADVANCED WALK NOTE

B

(program controller as shown below)

From Main Menu press '2' (Phase Control), then '1' (Phase Control Functions). Program phase 6 for 'Advanced Walk'. Make sure the Walk Advance Time shown on the Signal Design plans are programmed in the 'Phase Timing' menu.

TIMING CHART
ASC/3-2070 CONTROLLER

PHASE	Ø2	Ø4	Ø5	Ø6	Ø8
MINIMUM GREEN *	12 SEC.	7 SEC.	7 SEC.	12 SEC.	7 SEC.
VEHICLE EXT. *	6.0 SEC.	2.0 SEC.	1.0 SEC.	6.0 SEC.	– SEC.
GUAR MIN OVL GREEN	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
YELLOW CHANGE INT.	4.7 SEC.	3.0 SEC.	3.0 SEC.	4.7 SEC.	3.0 SEC.
RED CLEARANCE	1.9 SEC.	3.2 SEC.	3.4 SEC.	1.9 SEC.	3.2 SEC.
MAX. 1 *	100 SEC.	60 SEC.	30 SEC.	100 SEC.	35 SEC.
RECALL POSITION	MIN. RECALL	NONE	NONE	MIN. RECALL	NONE
LOCK DET.	ON	OFF	OFF	ON	OFF
DELAYED GREEN	– SEC.	– SEC.	– SEC.	5 SEC.	– SEC.
WALK *	– SEC.	– SEC.	– SEC.	7 SEC.	– SEC.
PED. CLEAR	– SEC.	– SEC.	– SEC.	12 SEC.	– SEC.
VOLUME DENSITY	ON	OFF	OFF	ON	OFF
ACTUATION B4 ADD *	– VEH.	– VEH.	– VEH.	– VEH.	– VEH.
SEC. PER ACTUATION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MAX. INITIAL *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME B4 REDUCTION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME TO REDUCE *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MINIMUM GAP	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
DUAL ENTRY	OFF	ON	OFF	OFF	OFF
SIMULTANEOUS GAP	ON	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

C

Leading Pedestrian Interval

Some signal designs call for a pedestrian movement that precedes its associated vehicle movement in the phase interval, i.e. the pedestrian move leads the phase interval in question. The controller will serve the pedestrian walk for a designated time while at the same time holding the associated vehicle move red, thus giving the pedestrian a "head start" into the crosswalk.

There are potential vehicle/pedestrian conflicts that may arise, depending on the exact signal design, that remove the "protection" the leading pedestrian interval is designed to offer a pedestrian. These conflicts are remedied in different ways depending on the exact configuration of the signal design and signal heads used, and the software being used in the controller.

(A) Oasis Advanced Walk - Oasis software refers to the leading pedestrian interval as Advanced Walk. The absolute total pedestrian walk time is shown in the timing chart as the Walk 1 entry. The Walk Advance Time is the amount of walk time that will display on the ped head while its associated vehicle movement is being held in red. After the walk advance time has expired, the controller will display the remaining balance of Walk 1 on the ped head before timing the don't walk time. The Advance Walk Time should never be greater than Walk 1.

(B) Oasis Advanced Walk Note - Include this note on the electrical detail for any design utilizing Oasis software that has leading pedestrian intervals.

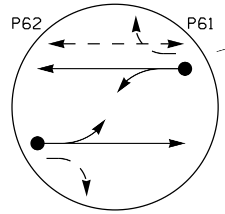
(C) ASC/3-2070 Delayed Green - ASC/3-2070 software refers to the leading pedestrian interval as Delayed Green. The absolute total pedestrian walk time is shown in the timing chart as the Walk entry. The Delayed Green time is the amount of walk time that will display on the ped head while its associated vehicle movement is being held in red. After the delayed green time has expired, the controller will display the remaining balance of Walk on the ped head before timing the ped clear time. The Delayed Green time should never be greater than Walk.

Leading Pedestrian Interval

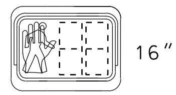
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. **12.0**

SHEET 1 OF 1



Ø2+6



P61,62
(actuated)

Leading Pedestrian Interval - No Startup Ped Call With Actuated Peds

Oasis software provides a phase control option that allows pedestrian movements to be called for service one time at controller startup even when no demand may exist. This applies to pedestrian moves that are push button actuated as opposed to those that may be programmed for ped recall. Specific programming instructions are found in the 'NOTES' section of the electrical detail and specify which phases should be served at startup, if any.

Pedestrian phases that have advance walk time and are specified as the startup in green phases should NOT be programmed for startup ped calls. The reason for this is that when the controller is powered on and is coming out of flash, or if the controller is running in controller flash and is coming out of controller flash, a leading pedestrian interval on the startup phase will cause the startup phase to transition from a flashing yellow indication to a solid red indication as the leading ped interval is being timed. This transition from flashing yellow to solid red is in violation of the MUTCD and is avoided by not programming the pedestrian movement for a startup ped call.

Ⓑ

NOTES

5. Program phase 6 for Startup Ped Call.

DO NOT USE THIS NOTE FOR THIS APPLICATION!

OASIS 2070 TIMING CHART

FEATURE	PHASE 2	PHASE 4	PHASE 6	PHASE 8
Min Green 1 *	12	7	12	7
Extension 1 *	6.0	1.0	6.0	1.0
Max Green 1 *	90	25	90	25
Yellow Clearance	4.6	4.3	4.6	4.3
Red Clearance	1.6	2.7	1.6	2.7
Walk 1 *	-	-	7	-
Don't Walk 1	-	-	12	-
Walk Advance Time *	-	-	5	-
Seconds Per Actuation *	-	-	-	-
Max Variable Initial *	-	-	-	-
Time Before Reduction *	-	-	-	-
Time To Reduce *	-	-	-	-
Minimum Gap	-	-	-	-
Recall Mode	MIN RECALL	-	MIN RECALL	-
Vehicle Call Memory	YELLOW	-	YELLOW	-
Dual Entry	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

Ⓐ Phase diagram from the signal plan illustrating the pedestrian movement on one of the main street phases, phase 6 in this example.

Ⓑ One of the notes in the standard notes section specifies all of the phases that should be programmed for a ped call at controller startup. In order to prevent the MUTCD flash to right of way violation, this is where startup phases with ped movements that have leading pedestrian intervals should have no startup calls specified. If there is more than one pedestrian phase in use, only the phases causing a violation should be deleted from the note.

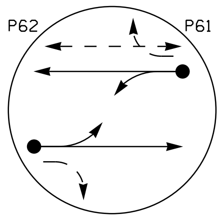
Ⓒ Oasis timing chart from the signal chart showing that the pedestrian phase should be programmed for advance walk.

2070 Oasis Leading Pedestrian Interval Exceptions – No Startup Ped Call

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

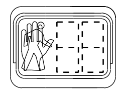
STD. NO. 12.1

SHEET 1 OF 1



Ⓐ

Ø2+6



P61,62
(non actuated)

Leading Pedestrian Interval - No Startup Ped Call With Pretimed Peds

Pretimed systems with non actuated ped movements are programmed to serve the pedestrian movement during every interval with a ped recall, and the ped movements are also served at startup. For startup ped phases with leading pedestrian intervals, the only way to omit the startup ped call is through a special phase override function and a series of logic processor statements.

Ⓐ Phase diagram from the signal plan illustrating the pedestrian movement on one of the main street phases, phase 6 in this example.

Ⓑ Oasis timing chart from the signal chart showing that the pedestrian phase should be programmed for advance walk and ped recall.

OASIS 2070 TIMING CHART

FEATURE	PHASE			
	2	4	6	8
Min Green 1 *	12	7	12	7
Extension 1 *	6.0	1.0	6.0	1.0
Max Green 1 *	90	25	90	25
Yellow Clearance	4.6	4.3	4.6	4.3
Red Clearance	1.6	2.7	1.6	2.7
Walk 1 *	-	-	7	-
Don't Walk 1	-	-	12	-
Walk Advance Time *	-	-	5	-
Seconds Per Actuation *	-	-	-	-
Max Variable Initial *	-	-	-	-
Time Before Reduction *	-	-	-	-
Time To Reduce *	-	-	-	-
Minimum Gap	-	-	-	-
Recall Mode	MAX RECALL	-	MAX/PED RECALL	-
Vehicle Call Memory	YELLOW	-	YELLOW	-
Dual Entry	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON

Ⓑ Ⓑ

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

(continued on next page)

PROGRAMMING TO OMIT PHASE 6 PEDESTRIAN OPERATION AT "STARTUP" — Ⓒ

INPUT ASSIGNMENT PROGRAMMING DETAIL

(program controller as shown below)

1. FROM MAIN MENU PRESS '5' (INPUTS).
2. WITH CURSOR IN "INPUT ASSIGNMENT #" FIELD, USE "-" KEY TO FIND THE INPUT ASSIGNMENT NUMBER 64, AS SHOWN BELOW.
3. PROGRAM CONTROLLER AS SHOWN:

STEP 1

```
PAGE:1  C1 PIN: 0  NOT ENABLED
INPUT ASSIGNMENT #..................64        Ⓓ
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC)............ 0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED.........................Y   ->  EXISTING DEFAULT PROGRAMMING
                                            (IGNORE FOR NOW)
VEHICLE DETECTOR (1-64).............
PEDESTRIAN DETECTOR (1-16)..........
ALTERNATE PED DETECTOR (1-16).......
PREEMPT (1-10)......................
INVERTED PREEMPT (1-10).............
STOP TIME (Y/N).....................
FLASH SENSE (Y/N)...................
DOOR OPEN (Y/N).....................
MANUAL CONTROL ENABLE (Y/N).........
MANUAL CONTROL ADVANCE (Y/N)........
SPECIAL FUNCTION ALARM (1-8)........
TOD HOUR SYNCHRONIZATION (0-23).....
FORCE OFF RING (1-4)................
HOLD PHASES (1-16)..................
PLAN (65=FLSH,66=FREE)..._  OFFSET#..
CHANGE PHASE SEQUENCE PAGE (1-12)...
CHANGE PHASE TIMING PAGE (1-4)......    SELECT "Y" FOR      Ⓔ
CHANGE PHASE CONTROL PAGE (1-4).....    OVERRIDE PHASE
CHANGE OVERLAP CONTROL PAGE (1-4)...    CONTROL FUNCTION
CHANGE INPUT PAGE (1-4).............
CHANGE OUTPUT PAGE (1-4)............
OVERRIDE PHASE CONTROL FUNCTION (Y).Y  <-
```

SCROLL DOWN TO VIEW ALL DATA

STEP 2 — Ⓔ

AFTER SELECTION IS MADE, THE PHASE CONTROL FUNCTIONS TABLE APPEARS. SCROLL DOWN ON THIS TABLE AND FIND "OMIT PEDESTRIAN", THEN SELECT PHASE 6 FOR "OMIT PEDESTRIAN".

AFTER SELECTION IS MADE PRESS "ESC". SCREEN NOW APPEARS AS SHOWN BELOW.

STEP 3

```
PAGE:1  C1 PIN: 0  OVERRIDE PHASE CONTRO     Ⓕ
INPUT ASSIGNMENT #..................64
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED.........................
VEHICLE DETECTOR (1-64).............
PEDESTRIAN DETECTOR (1-16)..........
ALTERNATE PED DETECTOR (1-16).......
PREEMPT (1-10)......................
INVERTED PREEMPT (1-10).............
STOP TIME (Y/N).....................
FLASH SENSE (Y/N)...................
DOOR OPEN (Y/N).....................
MANUAL CONTROL ENABLE (Y/N).........
MANUAL CONTROL ADVANCE (Y/N)........
SPECIAL FUNCTION ALARM (1-8)........
TOD HOUR SYNCHRONIZATION (0-23).....
FORCE OFF RING (1-4)................
HOLD PHASES (1-16)..................
PLAN (65=FLSH,66=FREE)..._  OFFSET#..
CHANGE PHASE SEQUENCE PAGE (1-12)...
CHANGE PHASE TIMING PAGE (1-4)......
CHANGE PHASE CONTROL PAGE (1-4).....
CHANGE OVERLAP CONTROL PAGE (1-4)...
CHANGE INPUT PAGE (1-4).............
CHANGE OUTPUT PAGE (1-4)............
OVERRIDE PHASE CONTROL FUNCTION (Y).Y        Ⓕ
```

PROGRAMMING COMPLETE

Leading Pedestrian Interval - No Startup Ped Call With Pretimed Peds (cont.)

Ⓒ OMIT PHASE AT "STARTUP" Detail - The programming detail illustrates the steps required to override the ped 6 pedestrian movement at controller startup.

Ⓓ Input Assignment - This is any controller input that is not in use that can be assigned as a 'phase override' that will be used by the logic processor to omit the ped 6 movement at controller startup.

Ⓔ OVERRIDE PHASE CONTROL FUNCTION - When this selection is made, the phase control screen will appear. The diagram below represents a portion of that screen where the 'OMIT PEDESTRIAN' entry is made for the desired phase.

```
 PHASE CONTROL SET: PAGE1 (NEXT: PAGES)
PHASE#          |12345678910111213141516
PERMITTED       | X X X X
.               |
.               |
.               |
VARIABLE INITIAL|
GAP REDUCTION   |
OMIT PEDESTRIAN |     X
TIME WALK 2     |
TIME FDWALK 2   |
.               |
.               |
.               |
```

Ⓕ After the omit pedestrian programming phase has been entered, the programming may be verified by observing that the input function displays "OVERRIDE PHASE CONTROL" and that the "OVERRIDE PHASE CONTROL FUNCTION" has a 'Y' entered.

(continued on next page)

LOGICAL I/O PROCESSOR PROGRAMMING DETAIL TO OMIT PED 6 AT STARTUP

(G)

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMANDS 1, 2, AND 3.

2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

```
LOGICAL I/O COMMAND #1  (+/-COMMAND#)
IF INPUT    ASSIGNMENT #43  IS ON
OR OUTPUT   ASSIGNMENT #54  IS ON

        SCROLL DOWN

THEN:
   DELAY FOR    1.0 SECONDS
SET LOGIC FLAG         #1  ON
```

FLASH SENSE OR CONTROLLER FLASH DETECTED SO DELAY AND THEN SET LOGIC FLAG TRUE.

PRESS '+'

```
LOGICAL I/O COMMAND #2  (+/-COMMAND#)
IF  LOGIC FLAG         #1   IS ON

        SCROLL DOWN

THEN:
SET INPUT   ASSIGNMENT #64 ON
```

LOGIC FLAG IS TRUE SO TURN ON INPUT 64 TO OMIT PED 6.

PRESS '+'

```
LOGICAL I/O COMMAND #3  (+/-COMMAND#)
IF  INPUT   ASSIGNMENT #43  IS OFF
AND OUTPUT  ASSIGNMENT #54  IS OFF

        SCROLL DOWN

THEN:
   DELAY FOR    3.0 SECONDS
SET LOGIC FLAG         #1  OFF
```

BOTH FLASH SENSE AND CONTROLLER FLASH ARE NO LONGER DETECTED SO SET THE LOGIC FLAG FALSE. THIS HOLDS INPUT 64 "ON" FOR 3 ADDITIONAL SEC, ENSURING PED 6 IS OMITTED AS THE CONTROLLER STARTS UP.

LOGIC I/O PROCESSOR PROGRAMMING COMPLETE

OUTPUT REFERENCE SCHEDULE

USE TO INTERPRET LOGIC PROCESSOR

OUTPUT 54 = Controller Flash
INPUT 43 = Flash Sense
INPUT 64 = Omit Ped 6

Note: See sheet x for Input 64 Input Assignment details.

Leading Pedestrian Interval - No Startup Ped Call With Pretimed Peds (cont.)

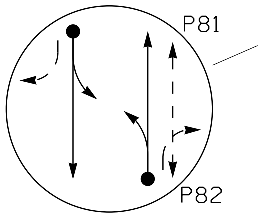
(G) In order to implement the phase control override that was programmed to omit the pedestrian movement at startup, a series of logic processor steps must be programmed. The controller will check to see if flash sense is "ON" (cabinet flash) or controller flash is "ON", and if so the controller will turn input 64 "ON" so that the desired pedestrian movement will be omitted when the controller comes out of flash and starts running. A delay is built in to hold input 64 "ON" for three seconds after the controller starts to prevent the controller from possibly skipping the ped omit due to a controller internal race condition.

2070 Oasis Leading Pedestrian Interval Exceptions – No Startup Ped Call

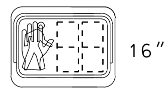
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 12.2

SHEET 3 OF 3



Ø4+8



P81,82
(actuated)

Leading Pedestrian Interval - Opposing Dummy Ped Phase

When an adjacent through vehicle movement is being held red during a leading ped interval, care must be taken to ensure that no other vehicle movement could encroach upon a pedestrian in the crosswalk. In the phase diagram shown to the left, phase 8 vehicles will be held in red during the advanced walk period but a phase 4 vehicle would not be held in red. This means a phase 4 vehicle could potentially make a permitted left turn into the crosswalk during the advance walk period.

The remedy for this situation is to create a dummy ped movement for phase 4. All phase 4 ped times will be identical to those of phase 8, including the walk advance time. There will be no actual ped signal heads for phase 4. The ped push buttons for ped 8 will have to be programmed to call ped 4 and ped 8 when pressed. What this does is hold vehicle phase 4 red for the same walk advance time as phase 8 giving the pedestrian a leading ped interval without the possibility of vehicle interference. The vehicle phase 4 heads will turn green at the end of the walk advance time just like the phase 8 vehicle heads.

OASIS 2070 TIMING CHART

FEATURE	PHASE			
	2	4	6	8
Min Green 1 *	12	7	12	7
Extension 1 *	6.0	1.0	6.0	1.0
Max Green 1 *	90	25	90	25
Yellow Clearance	4.6	4.3	4.6	4.3
Red Clearance	1.6	2.7	1.6	2.7
Walk 1 *	-	7	-	7
Don't Walk 1	-	12	-	12
Walk Advance Time *	-	5	-	5
Seconds Per Actuation *	1.5	-	1.5	-
Max Variable Initial *	34	-	34	-
Time Before Reduction *	15	-	15	-
Time To Reduce *	45	-	45	-
Minimum Gap	3.0	-	3.0	-
Recall Mode	MIN RECALL	-	MIN RECALL	-
Vehicle Call Memory	YELLOW	-	YELLOW	-
Dual Entry	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON

B C

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

PEDESTRIAN DETECTOR ASSIGNMENT PROGRAMMING DETAIL — D

(program controller as shown below)

FROM MAIN MENU PRESS '7' (DETECTORS), THEN '2' (PEDESTRIAN DETECTOR ASSIGNMENTS). PRESS '+' UNTIL PED DETECTOR # 8 IS REACHED.

D

```
PED DETECTOR #8  SETTINGS   (+/- DET)
PHASE#          ¦12345678910111213141516
PHASES ASSIGNED ¦   X   X
SETTING:                          (Y/N)
ENABLE DETECTOR.....................Y
ENABLE LOGGING......................N
ENABLE DIAGNOSTICS..................N
RECALL IF FAILED....................N
MAX CALLS/MINUTE (0-255)............255
MAX CALLS/DIAG PERIOD (0-255).......0
MAX OCCUPANCY % (0-100%)............100
```

Ⓐ Phase diagram from the signal plan illustrating the pedestrian movement on phase 8 on the side street, and the opposing vehicle move phase 4 with a permitted left turn and no ped movement.

Ⓑ Oasis timing chart from the signal chart showing that the pedestrian phase should be programmed for advance walk.

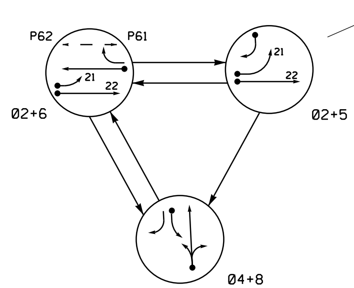
Ⓒ Dummy ped times assigned to phase 4, identical to those for phase 8.

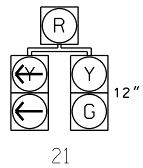
Ⓓ Pedestrian Detector Assignment Programming Detail - This programming screen assigns the specific ped phases that will be called by the ped detector buttons. For ped detector 8, be sure to include ped phase 4 to run the dummy ped phase.

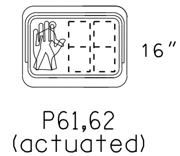
2070 Oasis Leading Pedestrian Interval Exceptions – Opposing Dummy Ped Phase

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 12.3







Leading Pedestrian Interval - Five Section Heads

When an adjacent through vehicle movement is being held red during a leading ped interval, care must be taken to ensure that no other vehicle movement could encroach upon a pedestrian in the crosswalk. In the phase diagram shown to the left, phase 6 vehicles will be held in red during the advanced walk period but a phase 2 vehicle would not be held in red. This means a phase 2 vehicle could potentially make a permitted left turn into the crosswalk during the advance walk period.

The remedy for this situation is to create a dummy ped movement for phase 2. All phase 2 ped times will be identical to those of phase 6, including the walk advance time. There will be no actual ped signal heads for phase 2. Logic is used to place a call to ped 2 when there is a call on ped 6.

In this phasing arrangement, phase 5 must always lag and all red backup protect for phase 2 must be programmed. This ensures that the leading pedestrian interval will run correctly.

OASIS 2070 TIMING CHART

FEATURE	PHASE 2	4	5	6	8
Min Green 1 *	12	7	7	12	7
Extension 1 *	6.0	1.0	1.0	6.0	1.0
Max Green 1 *	90	25	25	90	25
Yellow Clearance	4.6	4.3	4.3	4.6	4.3
Red Clearance	1.6	2.7	2.7	1.6	2.7
Walk 1 *	7	-	-	7	-
Don't Walk 1	12	-	-	12	-
Walk Advance Time *	5	-	-	5	-
Seconds Per Actuation *	1.5	-	-	1.5	-
Max Variable Initial *	34	-	-	34	-
Time Before Reduction *	15	-	-	15	-
Time To Reduce *	45	-	-	45	-
Minimum Gap	3.0	-	-	3.0	-
Recall Mode	MIN RECALL	-	-	MIN RECALL	-
Vehicle Call Memory	YELLOW	-	-	YELLOW	-
Dual Entry	-	-	-	-	-
Simultaneous Gap	ON	ON	ON	ON	ON

B

C

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

BACKUP PROTECTION NOTE

D

(program controller as shown below)

From Main Menu press '2' (Phase Control), then '1' (Phase Control Functions). Program phase 2 for 'Backup Protect'. Make sure the Red Revert times shown on the Signal Design Plans are programmed in the 'Phase Timing' menu.

A Phase diagram from the signal plan illustrating the pedestrian movement on phase 6 on the main street, and the opposing vehicle move phase 2 with five section protected and permitted left turn head and no pedestrian movement.

B Oasis timing chart from the signal chart showing that the pedestrian phase should be programmed for advance walk.

C Dummy ped times assigned to phase 2, identical to those for phase 6.

D Backup Protection Note - Make sure this note is on the electrical detail when five section heads are used in this type of leading pedestrian interval application.

(continued on next page)

2070 Oasis Leading Pedestrian Interval Exceptions – Five Section Heads

LOGICAL I/O PROCESSOR PROGRAMMING TO CALL PHASE 2 DUMMY PED WHEN PHASE 6 PED IS CALLED — (E)

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMAND 1.

2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

```
  LOGICAL I/O COMMAND #1   (+/-COMMAND#)
IF  PED CALL ON PHASE  #6   IS ON
AND NEXT PHASE         #6   IS ON

           SCROLL DOWN

THEN:
SET INPUT   ASSIGNMENT #29 ON
```

NOTE: IF EXISTING CALL ON PHASE 6 PED THEN CALL PHASE 2 PED.

LOGIC I/O PROCESSOR PROGRAMMING COMPLETE

OUTPUT REFERENCE SCHEDULE

INPUT 29 = Phase 2 PED Call

Leading Pedestrian Interval - Five Section Heads

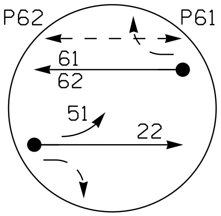
(E) Logic processor programming to call the phase 2 dummy ped. This logic ensures the dummy ped call on phase 2 is served at the appropriate time. Without this logic, the dummy ped call on phase 2 could be served before the ped call on phase 6.

2070 Oasis Leading Pedestrian Interval Exceptions – Five Section Heads

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

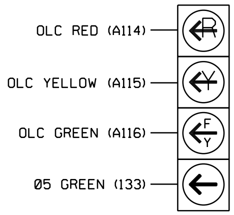
STD. NO. 12.4

SHEET 2 OF 2



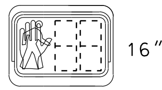
Ø2+6

Ⓐ



51

Ⓑ



P61,62
(actuated)

Leading Pedestrian Interval - Flashing Yellow Arrows

When an adjacent through vehicle movement is being held red during a leading ped interval, care must be taken to ensure that no other vehicle movement could encroach upon a pedestrian in the crosswalk. When flashing yellow arrows are being used for the vehicle approach that opposes the ped move, care must be taken to suppress the flashing yellow arrow output, which is the permitted movement, during the leading ped interval. The logic processor is used to accomplish this as shown on this sheet. The same logic is applied to main street and side street three section permitted only flashing yellow arrows. The phase diagram shown to the left is used for the explanation.

Ⓐ Phase diagram from a signal plan illustrating the pedestrian movement on phase 6 on the main street, and the opposing vehicle move phase 2 with no ped and a protected/permitted left turn via the flashing yellow arrow. Note that the ped 6 movement can be omitted at startup by omitting it as a startup ped call, thus avoiding the MUTCD startup violation.

Ⓑ Signal head 51 is a protected and permitted flashing yellow arrow that has overlap parent phases of 5+6 (phase 6 is the opposing through move).

Ⓒ To suppress the signal head 51 flashing yellow arrow during the leading pedestrian interval, the logic processor is required. When ped 6 is timing the advance walk, the phase 6 vehicle move is held red. When the logic processor sees that the ped 6 movement is "ON" and the phase 6 vehicle move is "OFF", it prevents the flashing yellow arrow from turning on by holding the overlap red (head 51) while at the same time allowing the phase 2 through movement (head 22) to be served. After the walk advance time has expired, the logic statement is no longer TRUE and the phase 6 vehicle movement will turn "ON", at which time the flashing yellow arrow signal face will also turn "ON" and begin to flash.

This logic is used whenever a flashing yellow signal head opposes a pedestrian movement that has a leading pedestrian interval whether it happens to be a three section permitted only or a four section protected and permitted head.

LOGICAL I/O PROCESSOR PROGRAMMING FOR FYA SUPPRESSION DURING THE ADVANCE WALK PERIOD

Ⓒ

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMAND 1.

2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

```
 LOGICAL I/O COMMAND #1  (+/-COMMAND#)
IF  OUTPUT ASSIGNMENT  #26  IS ON
AND OUTPUT ASSIGNMENT  #29  IS OFF

            SCROLL DOWN

THEN:
SET OUTPUT  ASSIGNMENT #44 OFF
SET OUTPUT  ASSIGNMENT #43 OFF
SET OUTPUT  ASSIGNMENT #42 ON
```

LOGIC STATEMENT FOR ADVANCE WALK WITH FYA's. TURN FYA HEAD 51 OFF DURING PED 6 ADVANCE WALK.

LOGIC I/O PROCESSOR PROGRAMMING COMPLETE

OUTPUT REFERENCE SCHEDULE

OUTPUT 26 = 6 PED Walk
OUTPUT 29 = Vehicle 6 Green
OUTPUT 42 = Overlap C Red
OUTPUT 43 = Overlap C Yellow
OUTPUT 44 = Overlap C Green

2070 Oasis Leading Pedestrian Interval Exceptions – Flashing Yellow Arrows

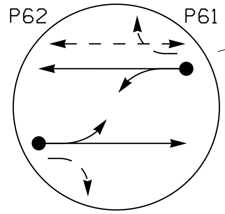
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
12.5
SHEET 1 OF 1

Leading Pedestrian Interval - Startup in Green With Actuated Peds

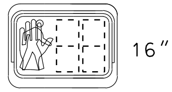
ASC/3-2070 software provides a startup option that allows the controller to start in the specified phases either in Green or Walk if there are associated ped movements. This applies to pedestrian moves that are push button actuated as opposed to those that may be programmed for ped recall. Specific programming instructions are found in the 'NOTES' section of the electrical detail and specify which phases should start in Green, if any.

Controllers running ASC/3-2070 software will serve pedestrian movements on the second interval instead of the first interval even for phases programmed to start in walk. This virtually eliminates the possibility of a MUTCD startup violation when coming out of flash at startup, but in spite of this, startup phases with ped movements should be programmed to start in Green and not in Walk.



Ø2+6

Ⓐ



P61,62
(actuated)

Ⓑ

NOTES

5. Program controller to start up in phase 2 Green and 6 Green.

NOTE THAT PHASE 6 DOES NOT START IN WALK!

TIMING CHART
ASC/3-2070 CONTROLLER

PHASE	Ø2	Ø4	Ø5	Ø6	Ø8
MINIMUM GREEN *	12 SEC.	7 SEC.	7 SEC.	12 SEC.	7 SEC.
VEHICLE EXT. *	6.0 SEC.	2.0 SEC.	1.0 SEC.	6.0 SEC.	– SEC.
GUAR MIN OVL GREEN	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
YELLOW CHANGE INT.	4.7 SEC.	3.0 SEC.	3.0 SEC.	4.7 SEC.	3.0 SEC.
RED CLEARANCE	1.9 SEC.	3.2 SEC.	3.4 SEC.	1.9 SEC.	3.2 SEC.
MAX. 1 *	100 SEC.	60 SEC.	30 SEC.	100 SEC.	35 SEC.
RECALL POSITION	MIN. RECALL	NONE	NONE	MIN. RECALL	NONE
LOCK DET.	ON	OFF	OFF	ON	OFF
DELAYED GREEN	– SEC.	– SEC.	– SEC.	5 SEC.	– SEC.
WALK *	– SEC.	– SEC.	– SEC.	7 SEC.	– SEC.
PED. CLEAR	– SEC.	– SEC.	– SEC.	12 SEC.	– SEC.
VOLUME DENSITY	ON	OFF	OFF	ON	OFF
ACTUATION B4 ADD *	– VEH.	– VEH.	– VEH.	– VEH.	– VEH.
SEC. PER ACTUATION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MAX. INITIAL *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME B4 REDUCTION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME TO REDUCE *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MINIMUM GAP	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
DUAL ENTRY	OFF	ON	OFF	OFF	OFF
SIMULTANEOUS GAP	ON	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

Ⓒ

Ⓐ Phase diagram from the signal plan illustrating the pedestrian movement on one of the main street phases, phase 6 in this example.

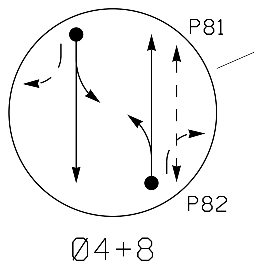
Ⓑ One of the notes in the standard notes section specifies how the startup phases should be programmed. In order to prevent the MUTCD flash to right of way violation, this is where startup phases with ped movements that have leading pedestrian intervals should be programmed to start in Green and not in Walk. If there is more than one pedestrian phase in use, only the phases causing violation should be specified to start in Green. Do this for both actuated and pretimed locations.

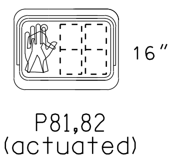
Ⓒ ASC/3-2070 timing chart from the signal chart showing that the phase 6 should be programmed for delayed green.

ASC/3–2070 Leading Pedestrian Interval Exceptions – Startup in Green

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
12.6
SHEET 1 OF 1





Leading Pedestrian Interval - Opposing Dummy Ped Phase

When an adjacent through vehicle movement is being held red during a leading ped interval, care must be taken to ensure that no other vehicle movement could encroach upon a pedestrian in the crosswalk. In the phase diagram shown to the left, phase 8 vehicles will be held in red during the delayed green period but a phase 4 vehicle would not be held in red. This means a phase 4 vehicle could potentially make a permitted left turn into the crosswalk during the delayed green period.

The remedy for this situation is to create a dummy ped movement for phase 4. All phase 4 ped times will be identical to those of phase 8, including the delayed green time. There will be no actual ped signal heads for phase 4. The ped push buttons for ped 8 will have to be programmed to call ped 4 and ped 8 when pressed. What this does is hold vehicle phase 4 red for the same delayed green time as phase 8 giving the pedestrian a leading ped interval without the possibility of vehicle interference. The vehicle phase 4 heads will turn green at the end of the delayed green time just like the phase 8 vehicle heads.

TIMING CHART
ASC/3-2070 CONTROLLER

PHASE	Ø2	Ø4	Ø5	Ø6	Ø8
MINIMUM GREEN *	12 SEC.	7 SEC.	7 SEC.	12 SEC.	7 SEC.
VEHICLE EXT. *	6.0 SEC.	2.0 SEC.	1.0 SEC.	6.0 SEC.	– SEC.
GUAR MIN OVL GREEN	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
YELLOW CHANGE INT.	4.7 SEC.	3.0 SEC.	3.0 SEC.	4.7 SEC.	3.0 SEC.
RED CLEARANCE	1.9 SEC.	3.2 SEC.	3.4 SEC.	1.9 SEC.	3.2 SEC.
MAX. 1 *	100 SEC.	60 SEC.	30 SEC.	100 SEC.	35 SEC.
RECALL POSITION	MIN. RECALL	NONE	NONE	MIN. RECALL	NONE
LOCK DET.	ON	OFF	OFF	ON	OFF
DELAYED GREEN	– SEC.	5 SEC.	– SEC.	– SEC.	5 SEC.
WALK *	– SEC.	7 SEC.	– SEC.	– SEC.	7 SEC.
PED. CLEAR	– SEC.	12 SEC.	– SEC.	– SEC.	12 SEC.
VOLUME DENSITY	ON	OFF	OFF	ON	OFF
ACTUATION B4 ADD *	– VEH.	– VEH.	– VEH.	– VEH.	– VEH.
SEC. PER ACTUATION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MAX. INITIAL *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME B4 REDUCTION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME TO REDUCE *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MINIMUM GAP	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
DUAL ENTRY	OFF	ON	OFF	OFF	OFF
SIMULTANEOUS GAP	ON	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

B

C

ECONOLITE ASC/3-2070 — D

PED 8 PROGRAMMING ASSIGNMENT DETAIL

(program controller as shown)

1. From Main Menu select 6. DETECTORS
2. From DETECTOR Submenu select 3. PED DETECTOR INPUT ASSIGNMENT

PED DET PHASE ASSIGNMENT MODE: NTCIP

PHASE	1	2	3	4	5	6	7	8
DETECTOR	0	2	0	8	0	6	0	8

PHASE	9	10	11	12	13	14	15	16
DETECTOR	0	0	0	0	0	0	0	0

D

NOTICE PED DETECTOR 8 ASSIGNED TO PHASES 4 & 8

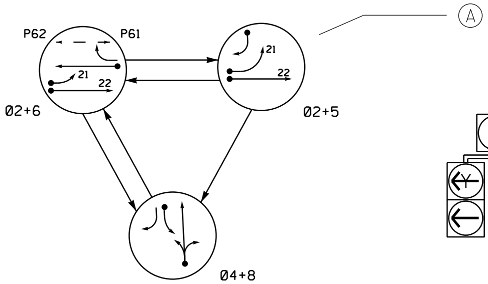
Ⓐ Phase diagram from the signal plan illustrating the pedestrian movement on phase 8 on the side street, and the opposing vehicle move phase 4 with a permitted left turn and no ped movement.

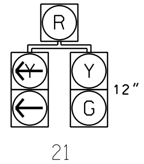
Ⓑ ASC/3-2070 timing chart from the signal chart showing that the pedestrian phase should be programmed for delayed green.

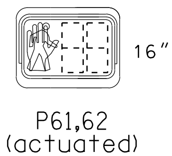
Ⓒ Dummy ped times assigned to phase 4, identical to those for phase 8.

Ⓓ Pedestrian Detector Assignment Programming Detail - This programming screen assigns the specific ped phases that will be called by the ped detector buttons. For ped detector 8, be sure to include ped phase 4 to run the dummy ped phases.

ASC/3–2070 Leading Pedestrian Interval Exceptions – Opposing Dummy Ped Phase







Leading Pedestrian Interval - Five Section Heads

When an adjacent through vehicle movement is being held red during a leading ped interval, care must be taken to ensure that no other vehicle movement could encroach upon a pedestrian in the crosswalk. In the phase diagram shown to the left, phase 6 vehicles will be held in red during the delayed green period but a phase 2 vehicle would not be held in red. This means a phase 2 vehicle could potentially make a permitted left turn into the crosswalk during the delayed green period.

The remedy for this situation is to create a dummy ped movement for phase 2. All phase 2 ped times will be identical to those of phase 6, including the delayed green time. There will be no actual ped signal heads for phase 2. Logic is used to place a call to ped 2 when there is a call on ped 6.

In this phasing arrangement, phase 5 must always lag and all red backup protect for phase 2 must be programmed. This ensures that the leading pedestrian interval will run correctly.

TIMING CHART
ASC/3-2070 CONTROLLER

PHASE	Ø2	Ø4	Ø5	Ø6	Ø8
MINIMUM GREEN *	12 SEC.	7 SEC.	7 SEC.	12 SEC.	7 SEC.
VEHICLE EXT. *	6.0 SEC.	2.0 SEC.	1.0 SEC.	6.0 SEC.	– SEC.
GUAR MIN OVL GREEN	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
YELLOW CHANGE INT.	4.7 SEC.	3.0 SEC.	3.0 SEC.	4.7 SEC.	3.0 SEC.
RED CLEARANCE	1.9 SEC.	3.2 SEC.	3.4 SEC.	1.9 SEC.	3.2 SEC.
MAX. 1 *	100 SEC.	60 SEC.	30 SEC.	100 SEC.	35 SEC.
RECALL POSITION	MIN. RECALL	NONE	NONE	MIN. RECALL	NONE
LOCK DET.	ON	OFF	OFF	ON	OFF
DELAYED GREEN	5 SEC.	– SEC.	– SEC.	5 SEC.	– SEC.
WALK *	7 SEC.	– SEC.	– SEC.	7 SEC.	– SEC.
PED. CLEAR	12 SEC.	– SEC.	– SEC.	12 SEC.	– SEC.
VOLUME DENSITY	ON	OFF	OFF	ON	OFF
ACTUATION B4 ADD *	– VEH.	– VEH.	– VEH.	– VEH.	– VEH.
SEC. PER ACTUATION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MAX. INITIAL *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME B4 REDUCTION *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
TIME TO REDUCE *	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
MINIMUM GAP	– SEC.	– SEC.	– SEC.	– SEC.	– SEC.
DUAL ENTRY	OFF	ON	OFF	OFF	OFF
SIMULTANEOUS GAP	ON	ON	ON	ON	ON

* These values may be field adjusted. Do not adjust Min Green and Extension times for phases 2 and 6 lower than what is shown. Min Green for all other phases should not be lower than 4 seconds.

B

C

(A) Phase diagram from the signal plan illustrating the pedestrian movement on phase 6 on the main street, and the opposing vehicle move phase 2 with five section protected and permitted left turn head and no pedestrian movement.

(B) ASC/3-2070 timing chart from the signal chart showing that the pedestrian phase should be programmed for advance walk.

(C) Dummy ped times assigned to phase 2, identical to those for phase 6.

(continued on next page)

ECONOLITE ASC/3-2070 BACKUP PROTECTION ENABLE PROGRAMMING

(program controller as shown)

Ⓓ

1. From Main Menu select [1. CONFIGURATION]
2. From CONFIGURATION Submenu select [1. CONTROLLER SEQ]
3. From CONTROLLER SEQUENCE Submenu select [3. BACKUP PREVENT PHASES]

Follow programming as shown below. On the 'ENABLE BACKUP PREVENT' screen move cursor to the appropriate field and press 'YES/NO' on the controller keypad to toggle field value between 'X' ,'B', 'C' and 'OFF'.

```
ENABLE BACKUP PREVENT
TMG/BKUP 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
       1   . . . . . . . . . . . . . . .
       2 .   . . . . . . . . . . . . . .
       3 . .   . . . . . . . . . . . . .
       4 . . .   . . . . . . . . . . . .
       5 . . . .   B . . . . . . . . . .
       6 . . . . .   . . . . . . . . . .
       7 . . . . . .   . . . . . . . . .
       8 . . . . . . .   . . . . . . . .
       9 . . . . . . . .   . . . . . . .
      10 . . . . . . . . .   . . . . . .
      11 . . . . . . . . . .   . . . . .
      12 . . . . . . . . . . .   . . . .
      13 . . . . . . . . . . . .   . . .
      14 . . . . . . . . . . . . .   . .
      15 . . . . . . . . . . . . . .   .
      16 . . . . . . . . . . . . . . .
```

END PROGRAMMING

ECONOLITE ASC/3-2070 LOGIC PROCESSOR PROGRAMMING TO CALL PHASE 2 DUMMY PED WHEN PHASE 6 PED IS CALLED

(program controller as shown)

Ⓔ

1. From Main Menu select [1. CONFIGURATION]
2. From CONFIGURATION Submenu select [8. LOGIC PROCESSOR]
3. From LOGIC PROCESSOR Submenu select [2. LOGIC STATEMENTS]

ENTER A "1" IN THE LP# FIELD, PRESS 'ENTER', AND PROGRAM AS SHOWN.

```
LP#:   1  COPY FROM:   1  ACTIVE:  M   (T/F)
IF     VEH RED ON PHASE       5   IS  ON
AND    CTR PHASE TIMING       5   IS  ON
OR     CTR PH NEXT ON PHS     6   IS  ON
AND    CTR PED CALL ON PH     6   IS  ON

THEN   DET SET PED            2      ON

ELSE
```

NOTE: IF CONTROLLER IS IN 2+5 GOING TO 2+6, OR IN 4+8 GOING TO 2+6, AND A PED CALL EXISTS ON PHASE 6, PUT DUMMY PED CALL ON PHASE 2.

4. From LOGIC PROCESSOR Submenu select [1. LOGIC STATEMENT CONTROL]

ENABLE LOGIC PROCESSOR STATEMENT 1 BY POSITIONING THE CURSOR OVER THE FIELDS SHOWN BELOW AND USING THE TOGGLE KEY TO ENABLE IT.

```
LOGIC STATEMENT CONTROL
          1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
LP 1-15   E . . . . . . . . . . . . . .
LP 16-30  . . . . . . . . . . . . . . .
LP 31-45  . . . . . . . . . . . . . . .
LP 46-60  . . . . . . . . . . . . . . .
LP 61-75  . . . . . . . . . . . . . . .
LP 76-90  . . . . . . . . . . . . . . .
```

END PROGRAMMING

Leading Pedestrian Interval - Five Section Heads

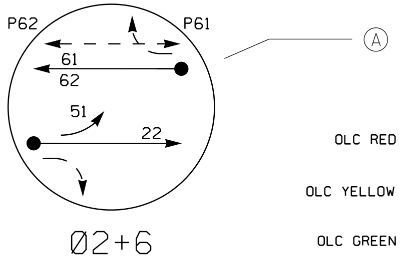
Ⓓ Backup Protection Note - This programming will ensure that the controller will not progress from 2+5 to 2+6 without first going to all red.

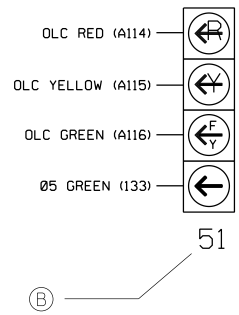
Ⓔ Logic processor programming to call the phase 2 dummy ped. This logic ensures the dummy ped call on phase 2 is served at the appropriate time.

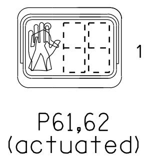
ASC/3-2070 Leading Pedestrian Interval Exceptions - Five Section Heads

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 12.8







Leading Pedestrian Interval - Flashing Yellow Arrows

When an adjacent through vehicle movement is being held red during a leading ped interval, care must be taken to ensure that no other vehicle movement could encroach upon a pedestrian in the crosswalk. When flashing yellow arrows are being used for the vehicle approach that opposes the ped move, care must be taken to suppress the flashing yellow arrow output, which is the permitted movement, during the leading ped interval. The logic processor is used to accomplish this as shown on this sheet. The same logic is applied to main street and side street three section permitted only flashing yellow arrows. The phase diagram shown to the left is used for the explanation.

Ⓐ Phase diagram from a signal plan illustrating the pedestrian movement on phase 6 on the main street, and the opposing vehicle move phase 2 with no ped and a protected/permitted left turn via the flashing yellow arrow. Ped 6 is not served at startup and no MUTCD startup violation will occur because phase 6 is programmed to start in green. Refer to STD 12.6 sheet 1.

Ⓑ Signal head 51 is a protected and permitted flashing yellow arrow that has overlap parent phases of 5+6 (phase 6 is the opposing through move).

Ⓒ To suppress the signal head 51 flashing yellow arrow during the leading pedestrian interval, the logic processor is required. When ped 6 is timing the delayed green, the phase 6 vehicle move is held red. When the logic processor sees that the ped 6 movement is "ON" and the phase 6 vehicle move is "OFF", it prevents the flashing yellow arrow from turning on by holding the overlap red (head 51) while at the same time allowing the phase 2 through movement (head 22) to be served. After the delayed green time has expired, the logic statements are no longer TRUE and the phase 6 vehicle movement will turn "ON", at which time the flashing yellow arrow signal face will also turn "ON" and begin to flash.

This logic is used whenever a flashing yellow signal head opposes a pedestrian movement that has a leading pedestrian interval whether it happens to be a three section permitted only or a four section protected and permitted head.

ECONOLITE ASC/3-2070 LOGIC PROCESSOR PROGRAMMING FOR FYA SUPPRESSION DURING THE DELAYED GREEN PERIOD — Ⓒ

(program controller as shown)

1. From Main Menu select `1. CONFIGURATION`
2. From CONFIGURATION Submenu select `8. LOGIC PROCESSOR`
3. From the LOGIC PROCESSOR Submenu select `2. LOGIC STATEMENTS`

ENTER A "1" IN THE LP# FIELD. PRESS 'ENTER'. AND PROGRAM AS SHOWN.

```
LP#:   1  COPY FROM:   1  ACTIVE:  M   (T/F)
IF     PED ON PH WALK       6      IS   ON
AND    VEH GREEN ON PH      6      IS   OFF

THEN   SIG SET OLP RED      3           ON
       SIG SET OLP YELLOW   3           OFF
       SIG SET OVLP GREEN   3           OFF

ELSE
```

← LOGIC STATEMENT FOR ADVANCE WALK WITH FYA's. TURN FYA HEAD 51 OFF DURING PED 6 ADVANCE WALK.

4. From the LOGIC PROCESSOR Submenu select `1. LOGIC STATEMENT CONTROL`

ENABLE LOGIC PROCESSOR STATEMENT 1 BY POSITIONING THE CURSOR OVER THE FIELDS SHOWN BELOW AND USING THE TOGGLE KEY TO ENABLE IT .

```
LOGIC STATEMENT CONTROL
          1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
LP 1-15   E . . . . . . . . . . . . . . .
LP 16-30  . . . . . . . . . . . . . . . .
LP 31-45  . . . . . . . . . . . . . . . .
LP 46-60  . . . . . . . . . . . . . . . .
LP 61-75  . . . . . . . . . . . . . . . .
LP 76-90  . . . . . . . . . . . . . . . .
```

END PROGRAMMING

ASC/3–2070 Leading Pedestrian Interval Exceptions – Flashing Yellow Arrows

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

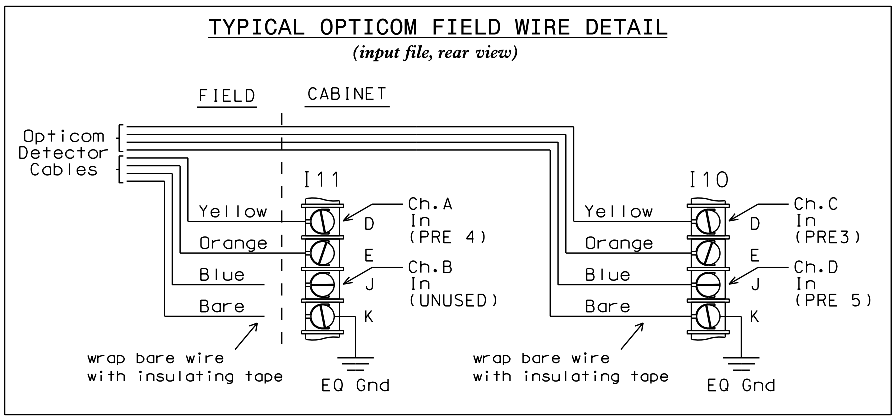
STD. NO. 12.9

SHEET 1 OF 1

Optical Emergency Vehicle Detection (Opticom)

Opticom optical detection systems are typically used for emergency vehicle detection. The detector cards plug into the "I" file and "J" file of the 336 pole mounted and 332 base mounted 170 cabinets respectively. Cards are available in both two channel and four channel configurations. The two channel cards can be used in either of the designated emergency vehicle preemption slots of the 332 or 336 cabinets but are normally used in the leftmost slot. The four channel cards come equipped with a doublewide faceplate and must plugged into the rightmost preempt slot. See STD. NO. 8.0 sheets 1 and 2 to see the preempt slot locations in the input files for the 332 and 336 cabinets.

336 Pole Mounted Cabinet (uses ("I file")

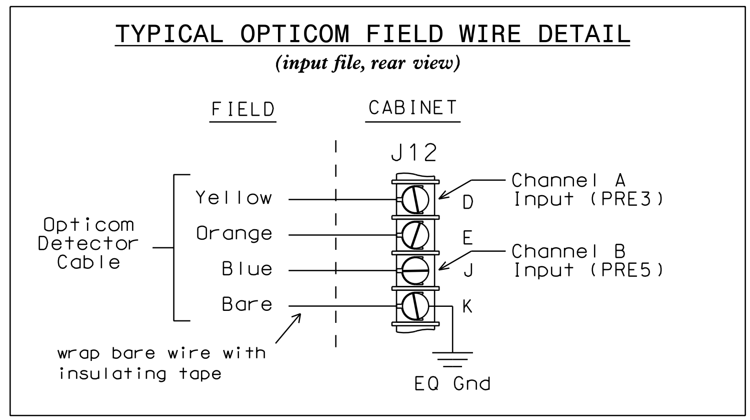


I10	I11
CH. C PRE 3	CH. A PRE 4
CH. D PRE 5	CH. B UNUSED

4 CHANNEL OPTICOM CARD
INSERT CARD INTO SLOT I11
FOR USE WITH PRE3, 4, 5

(input file, front view)

332 Base Mounted Cabinet (uses "J File")



J12
CH. A PRE 3
CH. B PRE 5

2 CHANNEL OPTICOM CARD
INSERT CARD INTO SLOT J12
FOR USE WITH PRE3 & PRE5

(input file, front view)

Detection – Typical Optical Emergency Vehicle (Opticom)

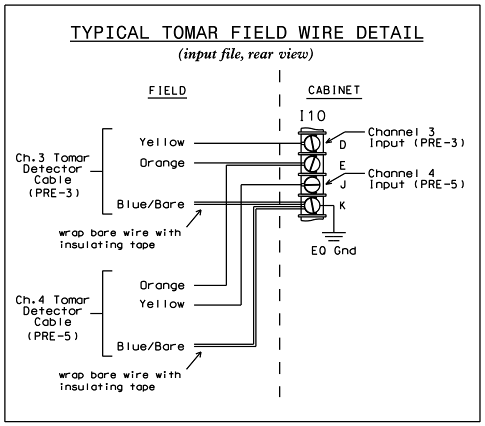
SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. **13.0**

Optical Emergency Vehicle Detection (Tomar)

Tomar optical detection systems are typically used for emergency vehicle detection. The detector cards plug into the "I" file and "J" file of the 336 pole mounted and 332 base mounted 170 cabinets respectively. Cards are equipped with four preemption inputs and have a doublewide faceplate for use with 170 cabinets. As such, the card should always be plugged into the rightmost preemption slot whether it is used in a 332 or a 336 cabinet. See STD. NO. 8.0 sheets 1 and 2 to see the preempt slot locations in the input file for the 332 base mounted cabinet and 336 pole mounted cabinet.

336 Pole Mounted Cabinet (uses ("I file")

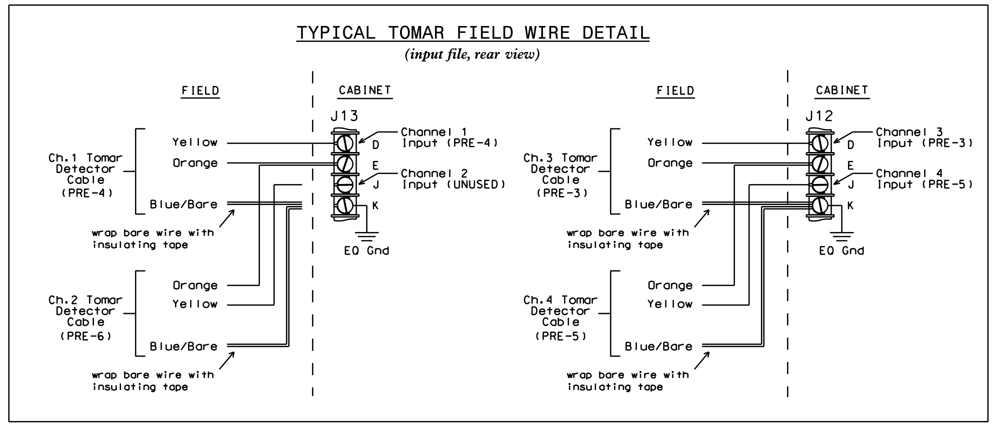


I10	I11
CH. 3 PRE 3	CH. 1 UNUSED
CH. 4 PRE 5	CH. 2 UNUSED

4 CHANNEL TOMAR CARD
INSERT CARD INTO SLOT I11
FOR USE WITH PRE3 & PRE5

(input file, front view)

332 Base Mounted Cabinet (uses "J File")



J12	J13
CH. 3 PRE 3	CH. 1 PRE 4
CH. 4 PRE 5	CH. 2 UNUSED

4 CHANNEL TOMAR CARD
INSERT CARD INTO SLOT J13
FOR USE WITH PRE3, 4, 5

(input file, front view)

Microwave Pulse Detection

Microwave motion detectors can be used for vehicle pulse detection. When a vehicle enters the detection zone defined by the microwave head, the equipment will trigger a single momentary input to a DC Isolator located in the input file and register a true input to the controller. Based on the requirements of the signal design, the controller might use the input to lock a vehicle call, extend a phase, register a system count, or similar. The following sheets illustrate a typical pulse detection application.

INPUT FILE POSITION LAYOUT

(front view)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
FILE "I"	U	SLOT EMPTY	Ø 1 1A	Ø 2 2A,2B	SLOT EMPTY	SLOT EMPTY	Ø 4 4A	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	FS DC ISOLATOR
	L		Ø 1 1B	Ø 2 2C,2D			Ø 4 4B								ST DC ISOLATOR
FILE "J"	U	SLOT EMPTY	Ø 6 6A DC ISOLATOR	Ø 6 6B,6C	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY
	L		NOT USED	NOT USED											

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME

! Note: Install a model 242 DC isolator in slot J2 for use with microwave detector. See the Microwave Detector Wiring Details on sheet 2.

! IMPORTANT: For proper operation of the microwave detector, remove surge protection from TB3-5 and TB3-6, and from TB3-7 and TB3-8.

Ⓐ INPUT FILE LAYOUT - In this example the DC isolator used with the pulse detector is located in slot J2-U and is used for loop 6A.

INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	INPUT ASSIGNMENT NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND	FULL TIME DELAY	STRETCH TIME	DELAY TIME
1A	TB2-5,6	I2U	39	1	2	1	Y	Y			
1B	TB2-7,8	I2L	43	5	12	1	Y	Y			
2A,2B	TB2-9,10	I3U	63	25	32	2	Y	Y		1.8	
2C,2D	TB2-11,12	I3L	76	38	42	2	Y	Y			
4A	TB4-9,10	I6U	41	3	4	4	Y	Y			
4B	TB4-11,12	I6L	45	7	14	4	Y	Y			15
★ 6A	TB3-5,6	J2U	40	2	6	6	Y	Y		1.2	
6B,6C	TB3-9,10	J3U	64	26	36	6	Y	Y			

★ Microwave pulse detector. See wiring and programming detail on sheet 2.

INPUT FILE POSITION LEGEND: J2L
FILE J
SLOT 2
LOWER

Ⓑ INPUT FILE CONNECTION - Details for loop 6A are found in this chart. When a vehicle enters the microwave zone, a phase 6 call is placed, phase 6 is extended if it is timing, and stretch detection is implemented.

(continued on next page)

LOGICAL I/O PROCESSOR PROGRAMMING DETAIL FOR MICROWAVE DETECTOR INPUT PROCESSING

(program controller as shown below)

1. FROM MAIN MENU PRESS '2' (PHASE CONTROL), THEN '1' (PHASE CONTROL FUNCTIONS). SCROLL TO THE BOTTOM OF THE MENU AND ENABLE ACT LOGIC COMMANDS 1 AND 2.
2. FROM MAIN MENU PRESS '6' (OUTPUTS), THEN '3' (LOGICAL I/O PROCESSOR).

```
 LOGICAL I/O COMMAND #1  (+/-COMMAND#)
IF  INPUT   ASSIGNMENT #2 IS ON

              SCROLL DOWN

THEN:
SET INPUT   ASSIGNMENT #64 OFF
```

NOTE: DETECTOR CONTACTS ARE CLOSED, SO NO CALL IS 'DETECTED'.

PRESS '+'

```
 LOGICAL I/O COMMAND #2  (+/-COMMAND#)
IF  INPUT   ASSIGNMENT #2 IS OFF

              SCROLL DOWN

THEN:
SET INPUT   ASSIGNMENT #64 ON
```

NOTE: DETECTOR CONTACTS ARE OPEN, SO A CALL IS 'DETECTED'.

LOGIC I/O PROCESSOR PROGRAMMING COMPLETE

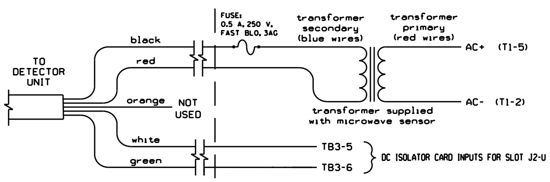
OUTPUT REFERENCE SCHEDULE

INPUT 2 = Detector Physical Input (Not Enabled)
INPUT 64 = Dummy Detector Input (Detector 6)

Microwave Pulse Detection

TYPICAL MICROWAVE PULSE DETECTOR WIRING DETAIL

(wire as shown)



MICROWAVE DETECTOR WIRE LIST

COLOR	FUNCTION
black	12V to 24V AC/DC (no polarity)
red	12V to 24V AC/DC (no polarity)
orange	Output Relay Normally Open
white	Output Relay Normally Closed
green	Output Relay Common

NOTES:

1. Sensor is a microwave motion detector mounted on poles as indicated on the Signal Design Plans.
2. Microwave wiring shown above will cause a permanent call unless the Input Assignment Programming and Logical I/O Processor Programming details are entered as shown on this sheet. These programming details will cause a call to be placed upon opening the Normally Closed contact on the microwave detector.
3. DC Isolator's LED will be ON when no call is present and will be OFF when a call is present.
4. Important: For proper operation of the microwave detector, remove surge protection from TB3-5, TB3-6, TB3-7, and TB3-8 and insert 242 DC Isolator in slot J2.

INPUT ASSIGNMENT PROGRAMMING DETAIL FOR MICROWAVE DETECTOR INPUT

(program controller as shown below)

FROM MAIN MENU PRESS '5' (INPUTS), THEN '+' UNTIL INPUT 2 (PIN 40) IS REACHED. MODIFY DEFAULT CONDITIONS AS INDICATED BY ARROWS.

```
PAGE: 1 C1 PIN:40  NOT ENABLED
INPUT ASSIGNMENT #..................2
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED (Y/N)...................Y
VEHICLE DETECTOR (1-64).............._
PEDESTRIAN DETECTOR (1-16)..........._
ALTERNATE PED DETECTOR (1-16)........_
PREEMPT (1-10)......................._
INVERTED PREEMPT (1-10).............._
STOP TIME (Y/N)......................_
FLASH SENSE (Y/N)...................._
DOOR OPEN (Y/N)......................_
MANUAL CONTROL ENABLE (Y/N).........._
MANUAL CONTROL ADVANCE (Y/N)........._
SPECIAL FUNCTION ALARM (1-8)........._
TOD HOUR SYCHRONIZATION (0-23)......._
FORCE OFF RING (1-4)................._
HOLD PHASES (1-16)..................._
PLAN (65=FLSH,66=FREE)..._  OFFSET#.._
CHANGE PHASE SEQUENCE PAGE (1-12)...._
CHANGE PHASE TIMING PAGE (1-4)......._
CHANGE PHASE CONTROL PAGE (1-4)......_
CHANGE OVERLAP CONTROL PAGE (1-4)...._
CHANGE INPUT PAGE (1-4)..............._
CHANGE OUTPUT PAGE (1-4)............._
OVERRIDE PHASE CONTROL FUNCTION (Y).._
```

ENTER 'YES' for Not Enabled

PRESS '-' until Input Assignment #64 is reached

```
PAGE: 1 C1 PIN:0  VEHICLE DETECTOR
INPUT ASSIGNMENT #..................64
DEBOUNCE TIME (0-25.5 SEC)..........0.5
DELAY TIME (0-25.5 SEC).............0.0
HOLD-OVER TIME (0-25.5 SEC).........0.0
ASSIGNMENT SELECTION:
NOT ENABLED (Y/N)...................._
VEHICLE DETECTOR (1-64).............6
PEDESTRIAN DETECTOR (1-16)..........._
ALTERNATE PED DETECTOR (1-16)........_
PREEMPT (1-10)......................._
INVERTED PREEMPT (1-10).............._
STOP TIME (Y/N)......................_
FLASH SENSE (Y/N)...................._
DOOR OPEN (Y/N)......................_
MANUAL CONTROL ENABLE (Y/N).........._
MANUAL CONTROL ADVANCE (Y/N)........._
SPECIAL FUNCTION ALARM (1-8)........._
TOD HOUR SYCHRONIZATION (0-23)......._
FORCE OFF RING (1-4)................._
HOLD PHASES (1-16)..................._
PLAN (65=FLSH,66=FREE)..65 OFFSET#..._
CHANGE PHASE SEQUENCE PAGE (1-12)...._
CHANGE PHASE TIMING PAGE (1-4)......._
CHANGE PHASE CONTROL PAGE (1-4)......_
CHANGE OVERLAP CONTROL PAGE (1-4)...._
CHANGE INPUT PAGE (1-4)..............._
CHANGE OUTPUT PAGE (1-4)............._
OVERRIDE PHASE CONTROL FUNCTION (Y).._
```

ENTER '6' for Vehicle Detector

PROGRAMMING COMPLETE

NOTE:

This remapping removes the default detector from the microwave's physical input and reassigns it to unused INPUT 64. The Logical I/O Processor Programming Detail on this sheet will invert the disabled input and control INPUT 64 and the reassigned detector.

Detection – Microwave Pulse

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 13.2

SHEET 2 OF 2

Microwave Presence Detection

Microwave (radar) motion detectors can be used for vehicle presence detection. When a vehicle enters the detection zone defined by the microwave head, the equipment will send a presence signal to the detection equipment located in the input file and register a true input to the controller for as long as the vehicle remains in the detection zone. Based on the requirements of the signal design, the controller might use the input to lock a vehicle call, extend a phase, register a system count, or similar. The following illustrates a typical presence detection application.

INPUT FILE POSITION LAYOUT

(front view)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
FILE "I"	U	SLOT EMPTY	RADAR DETECTOR 1	Ø 2 2C	SLOT EMPTY	SLOT EMPTY	Ø 4 4A	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	FS DC ISOLATOR
	L			NOT USED			Ø 4 4B								ST DC ISOLATOR
FILE "J"	U	SLOT EMPTY	RADAR DETECTOR 2	Ø 6 6C	SLOT EMPTY	SLOT EMPTY	Ø 8 8A	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY	SLOT EMPTY
	L			NOT USED			Ø 8 8B								

EX.: 1A, 2A, ETC. = LOOP NO.'S

FS = FLASH SENSE
ST = STOP TIME

(A) INPUT FILE LAYOUT - In this example the radar detection cards are located in input file slots I2 and J2.

INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	INPUT ASSIGNMENT NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND	FULL TIME DELAY	STRETCH TIME	DELAY TIME
2C	TB2-9,10	I3U	63	25	32	2	Y	Y	Y		3
4A	TB4-9,10	I6U	41	3	4	4	Y	Y			5
4B	TB4-11,12	I6L	45	7	14	4	Y	Y			15
6C	TB3-9,10	J3U	64	26	36	6	Y	Y	Y		3
8A	TB5-9,10	J6U	42	4	8	8	Y	Y			5
8B	TB5-11,12	J6L	46	8	18	8	Y	Y			15

INPUT FILE POSITION LEGEND: J2L

FILE J
SLOT 2
LOWER

(B) INPUT FILE CONNECTION - Details for the radar detection system setup are found on the signal plan and not on the electrical detail. Installation and setup is left to field personnel, the manufacturer, and the manufacturer's representative.

SPECIAL DETECTOR NOTE

Install a radar detection system for vehicle detection. Perform installation according to manufacturer's directions and NCDOT engineer-approved mounting locations to accomplish the detection schemes shown on the Signal Design Plans.

Detection – Microwave Presence

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 13.3

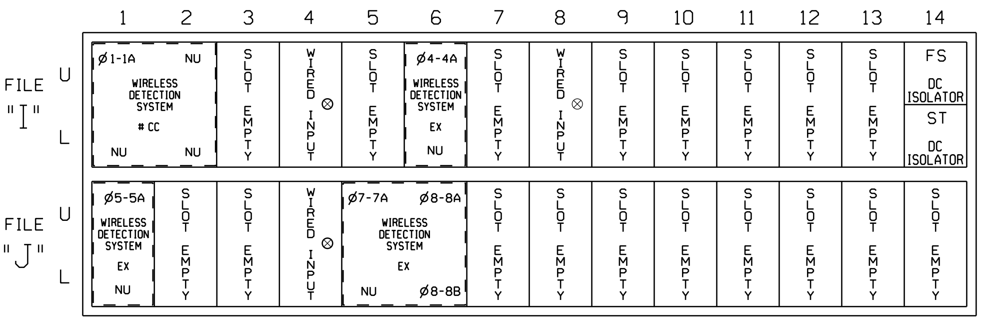
SHEET 1 OF 1

In Pavement Wireless Detection

In pavement wireless detection systems make use of wireless sensors, repeaters, an access point, and special contact closure cards to implement a vehicle detection system. Wireless sensors are installed beneath the pavement surface and transmit detector information to repeaters that communicate the information to the cabinet via an access point mounted on a pole in the intersection. Each system must have one master CC contact closure card in the input file. Expansion contact closure cards (EX) are available in two and four channel configurations. The details shown below illustrate how a typical in pavement wireless detection system would be represented on an electrical detail.

INPUT FILE POSITION LAYOUT

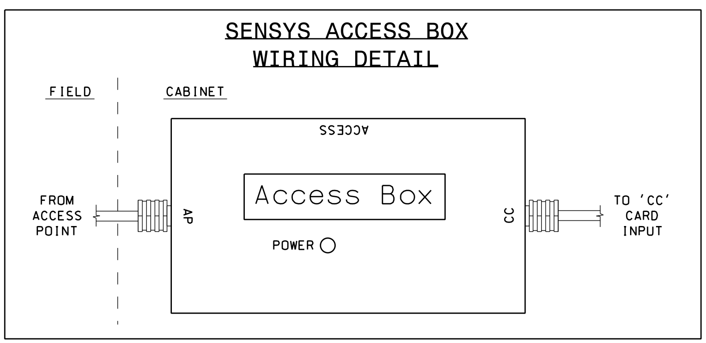
(front view)



EX.: 1A, 2A, ETC. = LOOP NO.'S
NU = CHANNEL NOT USED

⊗ Wired Input - Do not populate slot with detector card
See Sensys Access Box Wiring Detail below.

FS = FLASH SENSE
ST = STOP TIME



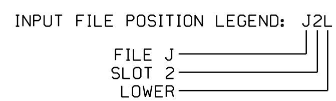
INPUT FILE CONNECTION & PROGRAMMING CHART

LOOP NO.	LOOP TERMINAL	INPUT FILE POS.	PIN NO.	INPUT ASSIGNMENT NO.	DETECTOR NO.	NEMA PHASE	CALL	EXTEND	FULL TIME DELAY	STRETCH TIME	DELAY TIME
✱ 1A	-	I1U	56	18	1	1	Y	Y	Y		15
✱ 4A	-	I6U	41	3	4	4	Y	Y			3
✱ 5A	-	J1U	55	17	5	5	Y	Y	Y		15
✱ 7A	-	J5U	57	19	7	7	Y	Y			15
✱ 8A	-	J6U	42	4	8	8	Y	Y			3
✱ 8B	-	J6L	46	8	18	8	Y	Y			15

✱ WIRELESS DETECTION SYSTEM

1. Install a Wireless Vehicle Detection System for vehicle detection. Perform installation according to manufacturer's directions and NCDOT Engineer-approved mounting locations to accomplish the detection schemes shown on the signal design plans.

2. Ensure that the Wireless Vehicle Detection System is fully compatible with equipment manufactured in accordance with the specifications for the type 2070 controller.



Detection – In Pavement Wireless

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

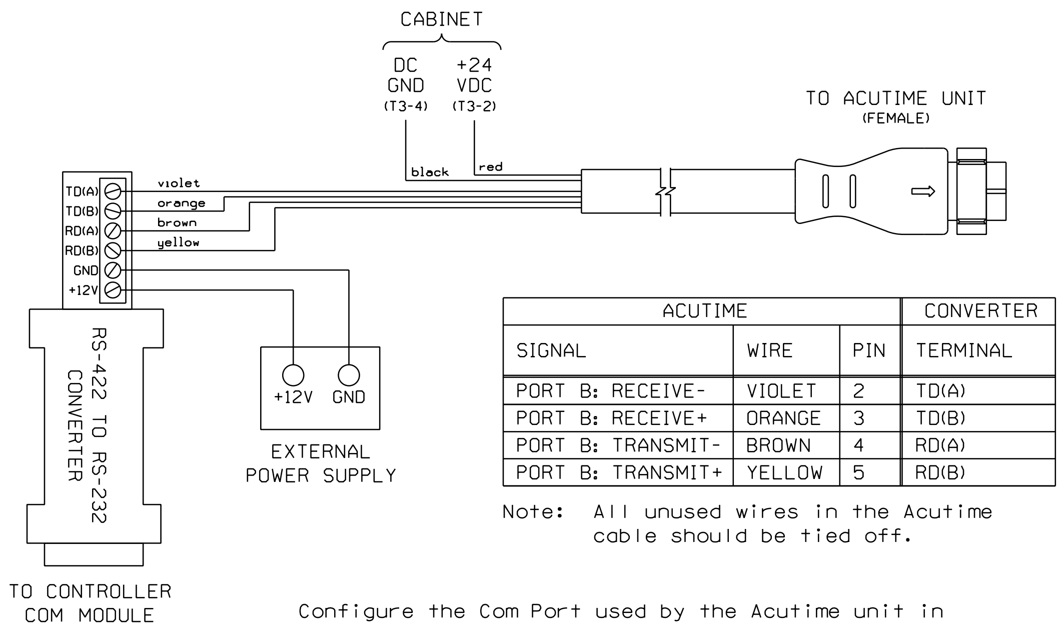
STD. NO. 13.4

Detection - GPS Clock Reference

Some systems must derive a clock reference from a satellite by using a GPS antenna. A typical GPS antenna wiring reference that would be shown on an electrical detail is shown below.

CONNECTOR WIRING DETAIL FOR ACUTIME GPS ANTENNA WITH RS-422 INTERFACE

(make connections as shown)



ACUTIME			CONVERTER
SIGNAL	WIRE	PIN	TERMINAL
PORT B: RECEIVE-	VIOLET	2	TD(A)
PORT B: RECEIVE+	ORANGE	3	TD(B)
PORT B: TRANSMIT-	BROWN	4	RD(A)
PORT B: TRANSMIT+	YELLOW	5	RD(B)

Note: All unused wires in the Acutime cable should be tied off.

Configure the Com Port used by the Acutime unit in the Oasis software using the settings below:

* 9600 Baud
* 8 Data Bits
* 1 Stop Bit
* Odd Parity
* Trimble TSIP GPS Protocol

Be sure to enable the "GET TIME FROM GPS" option under D-1 (Set Clock) menu.

Detection – GPS Clock Reference

SIGNALS MANAGEMENT SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 13.5

SHEET 1 OF 1

(This page is intentionally left blank)

Design Manual

Intelligent Transportation Systems (ITS) Section

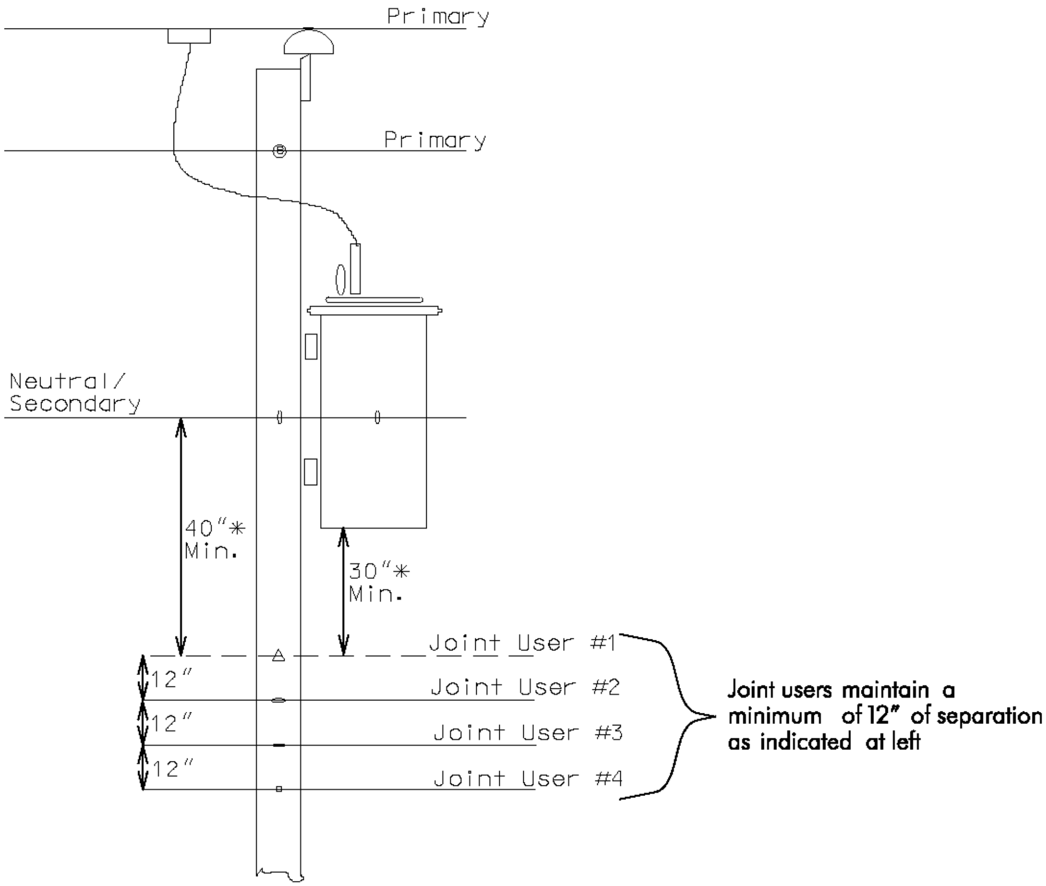
Part 3

Table of Contents

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.

Minimum Utility Clearance Requirements



NCDOT Minimum Attachment Clearances
From Other Joint Users at the Pole

Clearance From	Min. Distance
Neutral / Secondary	40"
Power Service Drop	40"
Power Service Drip Loop[1]	40"
Top of Power Riser	40"
Bottom of Transformer	30"
Guy Attachment	12"

If the power service drip loop supplies power to an <u>effectively grounded</u> streetlight the minimum clearance requirement is reduced to 12"

<u>Notes</u>

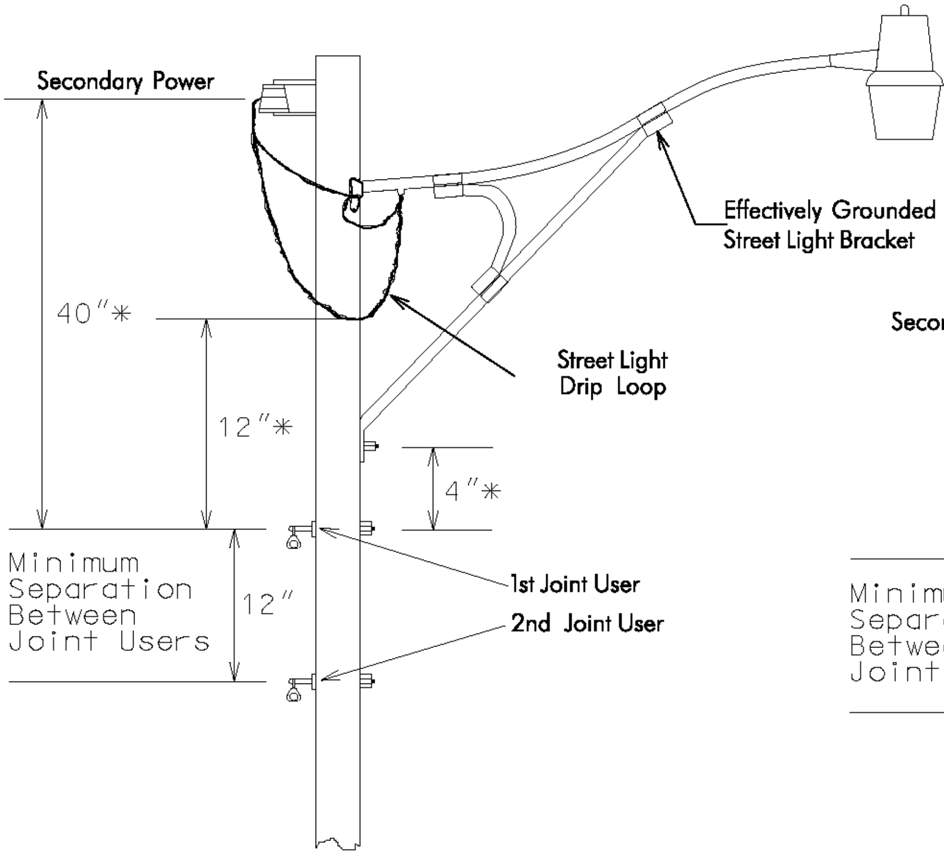
The attachment point for joint user #1 must maintain a minimum of 40" below power and/or a minimum of 30" below bottom of transformer (whichever is greater)

"Joint User" refers to the power company CATV companies, NCDOT, phone company, cities, and others

NESC Clearance Requirements – Utilities

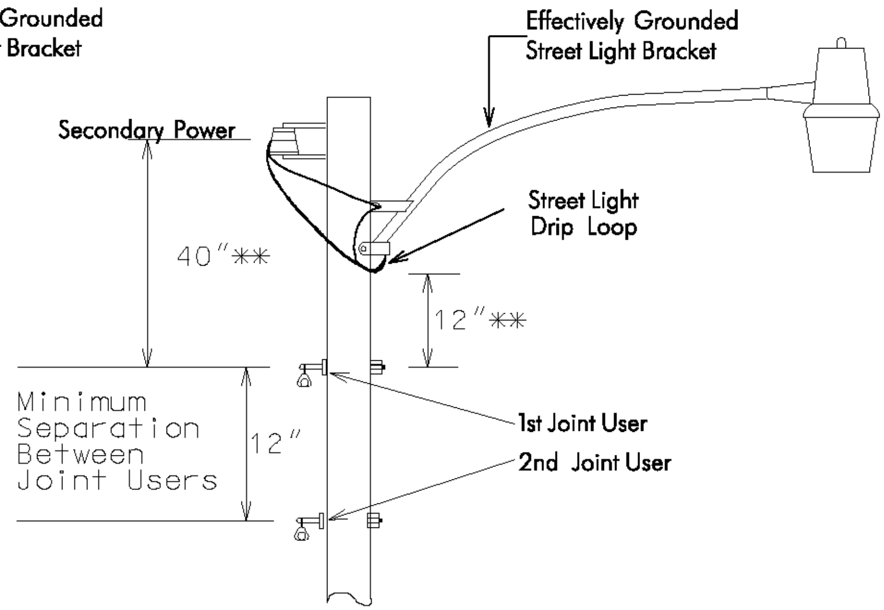
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Street Light Clearances



* All three of these minimum clearance requirements for effectively grounded street lights must be met

"Joint User" refers to the power company CATV companies, NCDOT, phone company, cities, and others



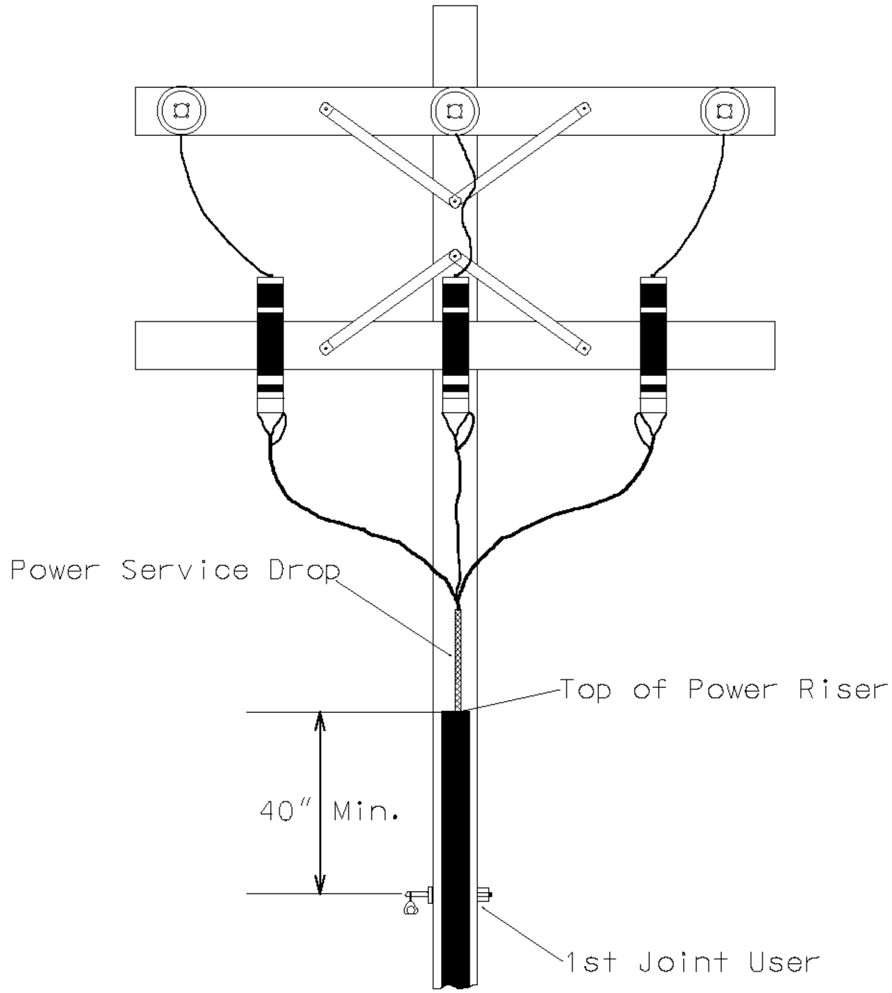
**Both of these minimum clearance requirements for effectively grounded street lights must be met

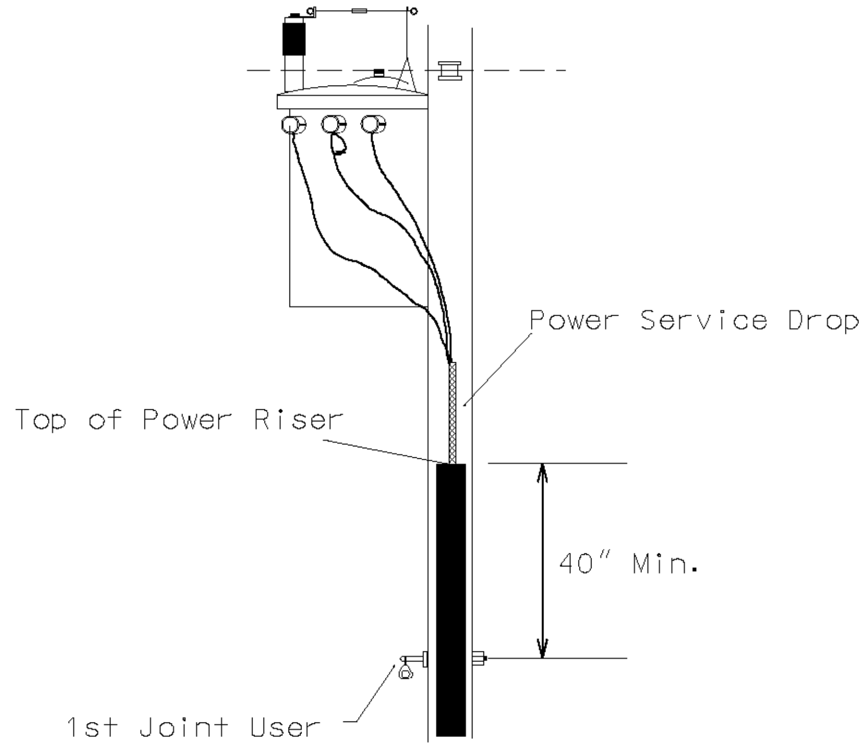
IF THE STREET LIGHT /STREET LIGHT BRACKET IS NOT EFFECTIVELY GROUNDED, THEN THE MINIMUM CLEARANCE REQUIREMENT IS INCREASED TO 40" BELOW DRIP LOOP

NESC Clearance Requirements – Streetlights

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 1.0





"Joint User" refers to the power company CATV companies, NCDOT, phone company, cities, and others

NESC Clearance Requirements – Power Risers

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 1.0

SHEET 3 OF 4

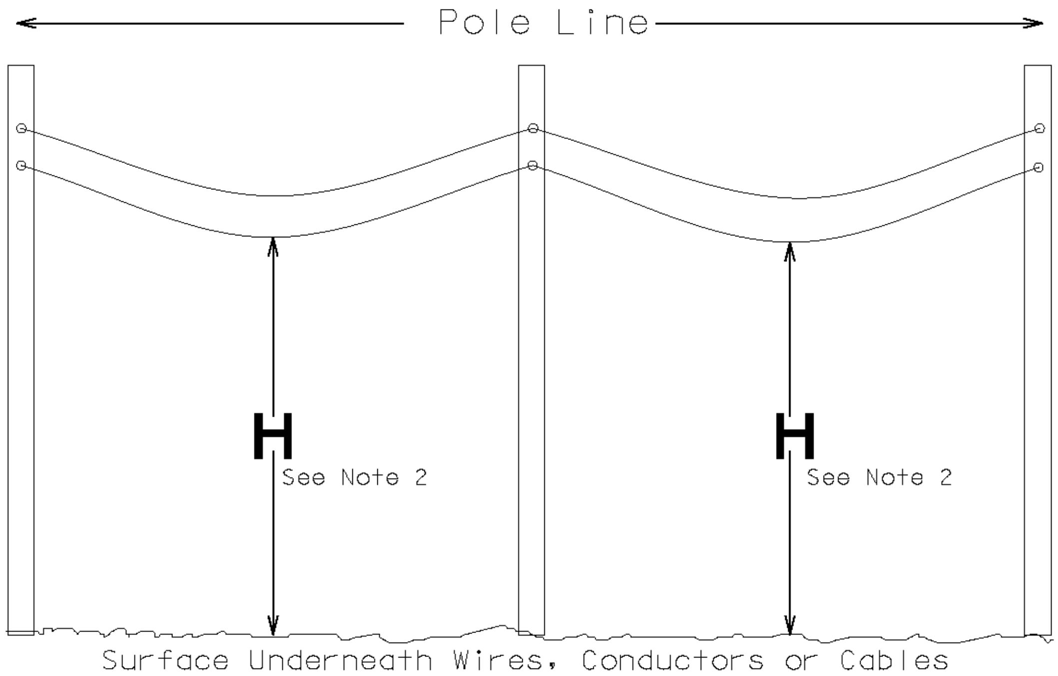


Table 1

Nature of Surface Underneath Wires Conductors or Cables	Minimum Clearance (H)*
1. Track rails of railroad except electrified railroads using overhead trolley conductors	30 FT
2. Roads, streets and other areas subject to truck traffic	18 FT
3. Driveways, parking lots, and alleys	18 FT
4. Other land traversed by vehicles such as cultivated, grazing, forest orchards, etc.	18 FT
5. Spaces and travel ways subject to pedestrian or restricted traffic only	15.5 FT

* These values have been adopted by NCDOT (as well as various utility companies) and exceed the specifications as set forth in the National Electrical Safety Code (NESC).

Notes:

1. See table 1 for acceptable minimum clearance values (H) over varying surfaces
2. "H" is defined as the vertical distance (Height) as measured from the lowest point (Typically Midspan) of the wires, conductors or cables to the surface below
3. Sag between poles should match the sag of existing utility lines

NESC Clearance Requirements – Height Over Grade

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

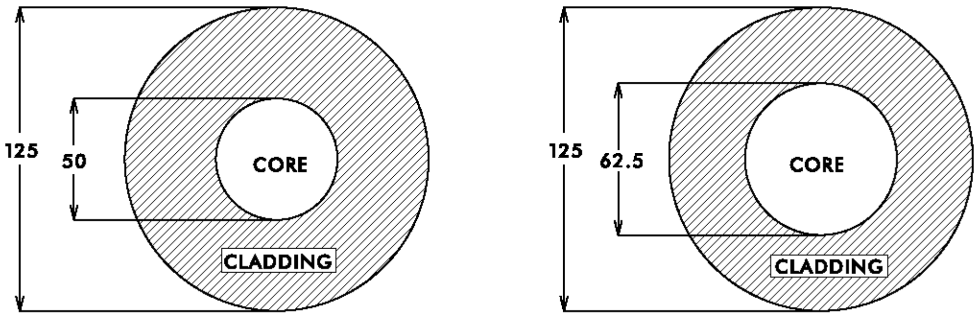
STD. NO. 1.0

SHEET 4 OF 4

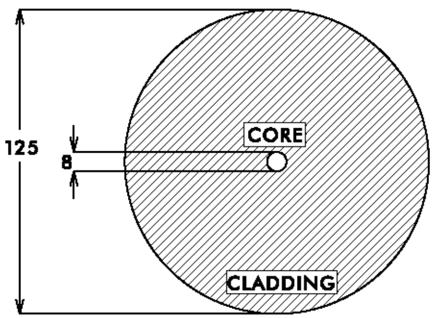
Fiber Optic Cross Section

All dimensions in micrometers (microns)

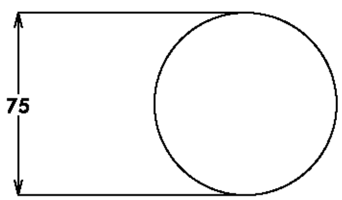
1,000,000 Microns = 1 Meter



Typical Dimension of Multimode Fiber



Typical Dimensions of Single Mode Fiber



Typical Dimension of Human Hair

Typical Signal Wavelengths

Fiber Type	Signal Wavelength	Typical Losses
Multimode	850 nm	3.5 dB /km
	1300 nm	1.5 dB /km
Single Mode	1310 nm	0.35 dB /km
	1550 nm	0.25 dB /km

Fiber Color Code

Number	Color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua

	Number	Color
Blue Buffer Tube	1	Blue
	2	Orange
	3	Green
	4	Brown
	5	Slate
	6	White
Orange Buffer Tube	1	Blue
	2	Orange
	3	Green
	4	Brown
	5	Slate
	6	White

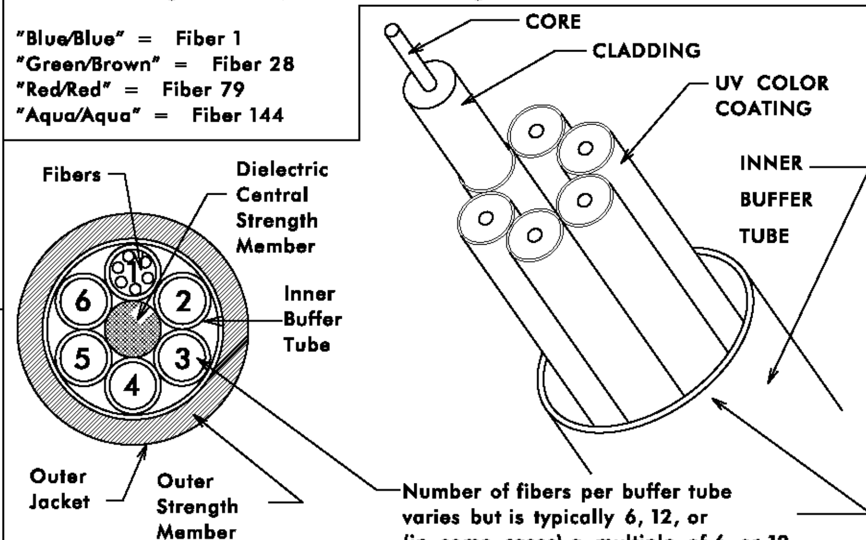
Individual fibers can be identified by number and by color

When specifying by color it is customary to refer to the buffer tube color followed by the fiber color

"Orange/Green" is the green fiber in the orange buffer tube

If a cable contained 144 fibers arranged with 12 buffer tubes each containing 12 fibers, then the following would be true

"Blue/Blue" = Fiber 1
"Green/Brown" = Fiber 28
"Red/Red" = Fiber 79
"Aqua/Aqua" = Fiber 144



Number of fibers per buffer tube varies but is typically 6, 12, or (in some cases) a multiple of 6 or 12

FIBER OPTIC CABLE

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

8-04

STD. NO. 2.0

SHEET 1 OF 1

COMMON DRAWING SYMBOLS

	EXISTING SIGNAL POLE
	NEW SIGNAL POLE
	EXISTING METAL POLE
	NEW METAL POLE
	EXISTING METAL POLE WITH MAST ARM
	NEW METAL POLE WITH MAST ARM
SP	SIGNAL POLE
	NEW JUNCTION BOX
	EXISTING JUNCTION BOX
	NEW CCTV CAMERA
	EXISTING CCTV CAMERA
	CABLE STORAGE RACK (SNOW SHOES)
S	NEW SPLICE CABINET
S	EXISTING SPLICE CABINET
S	AERIAL SPLICE ENCLOSURE
	EXISTING SIGNAL CABINET
M	MASTER CONTROLLER CABINET

	NEW DOWN GUY
	NEW SIDEWALK GUY
	NEW MICROWAVE VEHICLE DETECTION
	EXISTING MICROWAVE VEHICLE DETECTION
DMS	NEW DYNAMIC MESSAGE SIGN
DMS	EXISTING DYNAMIC MESSAGE SIGN
FO	NEW FIBER OPTIC COMMUNICATIONS CABLE
TWIST PR	NEW TWISTED PAIR COMMUNICATIONS CABLE
EXI	EXISTING COMMUNICATIONS CABLE
REM	EXISTING COMMUNICATIONS CABLE TO BE REMOVED
	NEW AERIAL GUY ASSEMBLY
	NEW CONDUIT
	EXISTING CONDUIT
DD	NEW DIRECTIONAL DRILLED CONDUIT
B&J	NEW BORED AND JACKED CONDUIT
	YAGI ANTENNA (DOUBLE) FOR REPEATER OPERATION
	YAGI ANTENNA (SINGLE)
	OMNI ATENNA
XX-XXXX	SIGNAL INVENTORY NUMBER

NOTE:
DRAWING SYMBOLS SHOULD BE AT THE SAME SCALE AS THE PLAN SHEET
FOR INFORMATION ON SCALING LINE STYLES SEE "STANDARD SYMBOLOGY TABLES" SECTION 9.0

Drawing Format Items – Symbology

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 3.0

SHEET 1 OF 1

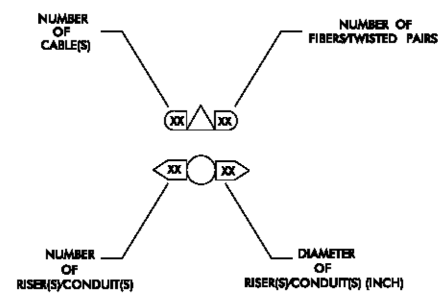
1. INSTALL REA, PE – 22, SHIELDED, TWISTED PAIR COMMUNICATIONS CABLE
2. INSTALL REA, PE – 38, (FIGURE 8) SHIELDED, TWISTED PAIR COMMUNICATIONS CABLE
3. INSTALL REA, PE – 39, (UNDERGROUND) SHIELDED, TWISTED PAIR COMMUNICATIONS CABLE
4. INSTALL SMFO CABLE
5. INSTALL MMFO CABLE
6. INSTALL FIBER OPTIC DROP CABLE
7. INSTALL TRACER WIRE
8. TRENCH OR PLOW
9. INSTALL PVC CONDUIT
10. INSTALL RIGID, GALVANIZED STEEL CONDUIT
11. INSTALL RIGID, GALVANIZED STEEL RISER WITH WEATHERHEAD
12. INSTALL RIGID, GALVANIZED STEEL RISER WITH HEAT SHRINK TUBING
13. INSTALL OUTER-DUCT POLYETHYLENE CONDUIT
14. INSTALL POLYETHYLENE CONDUIT
15. DIRECTIONAL DRILL CONDUIT
16. BORE AND JACK CONDUIT
17. INSTALL CABLE(S) IN EXISTING CONDUIT
18. INSTALL CABLE(S) IN NEW CONDUIT
19. INSTALL CABLE(S) IN EXISTING RISER
20. INSTALL CABLE(S) IN NEW RISER
21. INSTALL CABLE(S) IN EXISTING CONDUIT STUB-OUTS
22. INSTALL NEW CONDUIT INTO EXISTING CABINET BASE (USE EXISTING CONDUIT STUB-OUTS WHEN AVAILABLE)
23. INSTALL NEW RISER INTO EXISTING CABINET BASE (USE EXISTING CONDUIT STUB-OUTS WHEN AVAILABLE)
24. INSTALL NEW CONDUIT INTO EXISTING POLE MOUNTED CABINET
25. INSTALL NEW RISER INTO EXISTING POLE MOUNTED CABINET
26. TERMINATE COMMUNICATIONS CABLE ON EXISTING TELEMETRY INTERFACE PANEL IN TRAFFIC SIGNAL CONTROLLER CABINET
27. INSTALL NEW TELEMETRY INTERFACE PANEL IN TRAFFIC SIGNAL CONTROLLER CABINET
28. INSTALL INTERCONNECT CENTER, PATCH PANEL, JUMPERS AND FUSION SPLICE CABLE IN CABINET
29. INSTALL UNDERGROUND SPLICE ENCLOSURE
30. INSTALL AERIAL SPLICE ENCLOSURE
31. INSTALL POLE MOUNTED SPLICE CABINET
32. INSTALL BASE MOUNTED SPLICE CABINET
33. REMOVE EXISTING SPLICE CABINET
34. INSTALL CABINET FOUNDATION
35. REMOVE EXISTING CABINET FOUNDATION
36. INSTALL CCTV CAMERA ASSEMBLY
37. INSTALL CCTV CAMERA WOOD POLE
38. INSTALL CCTV CAMERA METAL POLE AND FOUNDATION
39. INSTALL JUNCTION BOX
40. INSTALL OVERSIZED JUNCTION BOX
41. REMOVE EXISTING JUNCTION BOX
42. INSTALL WOOD POLE
43. REMOVE EXISTING WOOD POLE
44. INSTALL AERIAL GUY ASSEMBLY
45. INSTALL STANDARD GUY ASSEMBLY
46. INSTALL SIDEWALK GUY ASSEMBLY
47. INSTALL MESSENGER CABLE
48. REMOVE EXISTING COMMUNICATIONS AND MESSENGER CABLE
49. REMOVE EXISTING MESSENGER CABLE
50. INSTALL TELEPHONE SERVICE
51. INSTALL CABLE STORAGE RACKS (SNOW SHOES) AND STORE 100 FEET OF CABLE
52. INSTALL DELINEATOR MARKER
53. STORE 20 FEET OF COMMUNICATIONS CABLE
54. LASH CABLE(S) TO EXISTING SIGNAL/COMMUNICATIONS CABLE
55. LASH CABLE(S) TO EXISTING MESSENGER CABLE
56. LASH CABLE(S) TO NEW MESSENGER CABLE
57. MODIFY EXISTING ELECTRICAL SERVICE
58. INSTALL NEW ELECTRICAL SERVICE

LEGEND

FO	NEW FIBER OPTIC COMMUNICATIONS CABLE
TWIST PR	NEW TWISTED PAIR COMMUNICATIONS CABLE
EXI	EXISTING COMMUNICATIONS CABLE
REM	EXISTING COMMUNICATIONS CABLE TO BE REMOVED
	NEW AERIAL GUY ASSEMBLY
	NEW CONDUIT
	EXISTING CONDUIT
DD	NEW DIRECTIONAL DRILLED CONDUIT
B&J	NEW BORED AND JACKED CONDUIT
	NEW JUNCTION BOX
	EXISTING JUNCTION BOX
	NEW WOOD POLE
	EXISTING WOOD POLE
S	AERIAL SPLICE ENCLOSURE
	NEW METAL POLE
	EXISTING METAL POLE
	NEW CCTV ASSEMBLY
	EXISTING CCTV ASSEMBLY
DMS	NEW DYNAMIC MESSAGE SIGN
DMS	EXISTING DYNAMIC MESSAGE SIGN
	NEW MICROWAVE VEHICLE DETECTION
	EXISTING MICROWAVE VEHICLE DETECTION
	NEW STANDARD GUY ASSEMBLY
	NEW SIDEWALK GUY ASSEMBLY
	NEW CABLE STORAGE RACKS (SNOW SHOES)
	EXISTING CONTROLLER AND CABINET
S	EXISTING SPLICE CABINET
S	NEW SPLICE CABINET
SP	SIGNAL POLE
XX-XXXX	SIGNAL INVENTORY NUMBER
CCTV-XX	CCTV IDENTIFICATION NUMBER

CONSTRUCTION NOTE SYMBOLOGY KEY

XX	INDICATES NUMBER OF CABLES, LOOPS, ETC.
XX	INDICATES NUMBER OF FIBERS PER CABLE, TWISTED PAIRS PER CABLE, ETC.
XX	INDICATES NUMBER OF RISER(S)/CONDUIT(S)
XX	INDICATES DIAMETER OF RISER(S)/CONDUIT(S) (INCH)



Drawing Format Items – Construction Notes

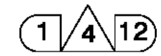
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 3.1

SHEET 1 OF 2

Understanding Construction Notes



Install one 12–fiber single mode fiber optic cable

Install two 6–fiber multi–mode fiber optic cables

Install one 2" diameter polyethylene conduit

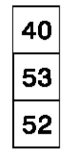
Install one 1" diameter rigid, galvanized steel riser with weatherhead

Construction Note Conventions

Place notes in numerical order

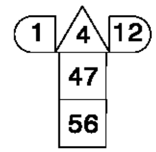
correct

incorrect

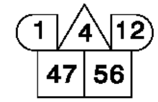


Orient vertically

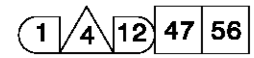
correct



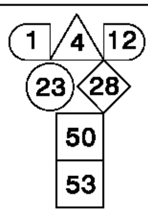
correct



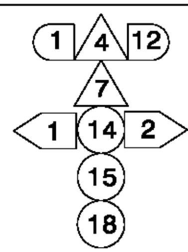
incorrect



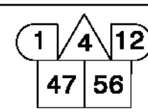
Some Common Construction Notes



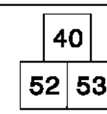
base mounted cabinet (master location)



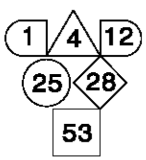
directional drilled conduit



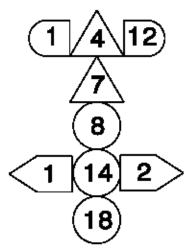
new fiber optic and messenger cable



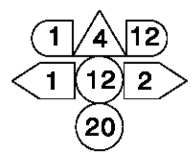
new oversized junction box



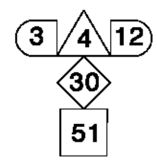
pole mounted cabinet



trenched or plowed conduit



new riser



aerial splice enclosure

For more information on construction notes, see sections 4–7 of this manual

Drawing Format Items – Construction Notes

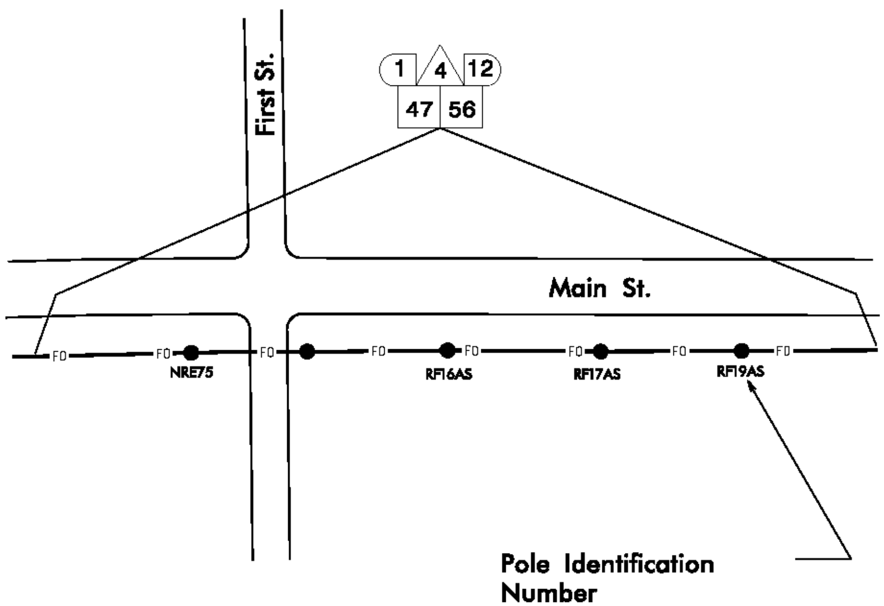
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 3.1

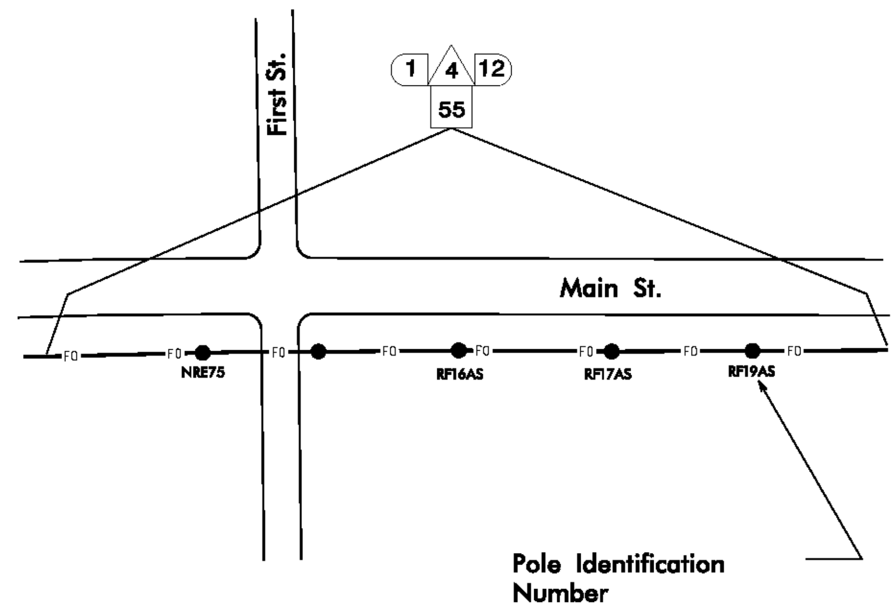
Case 1

New communications cable lashed to new messenger cable



Case 2

New communications cable lashed to existing messenger cable



Construction Notes for Aerial Cable Run

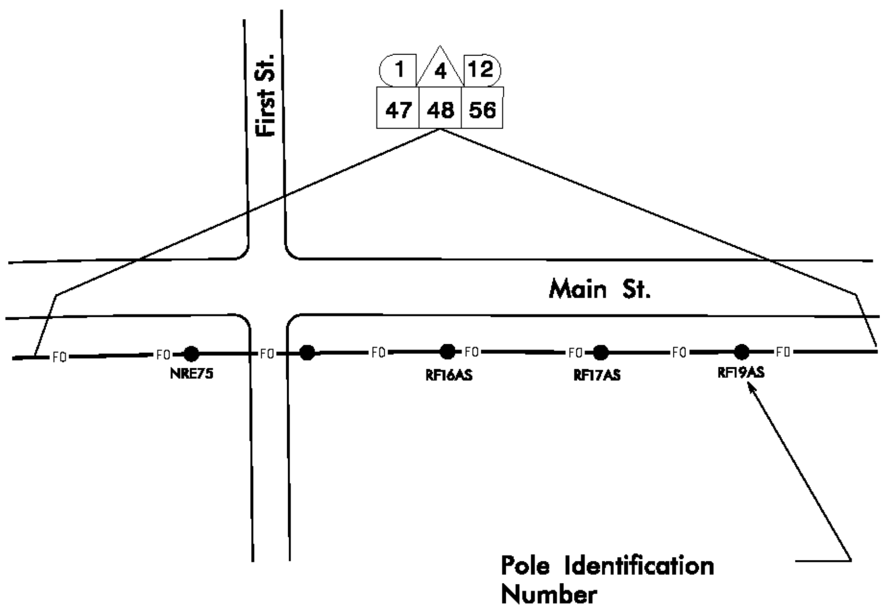
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
4.0

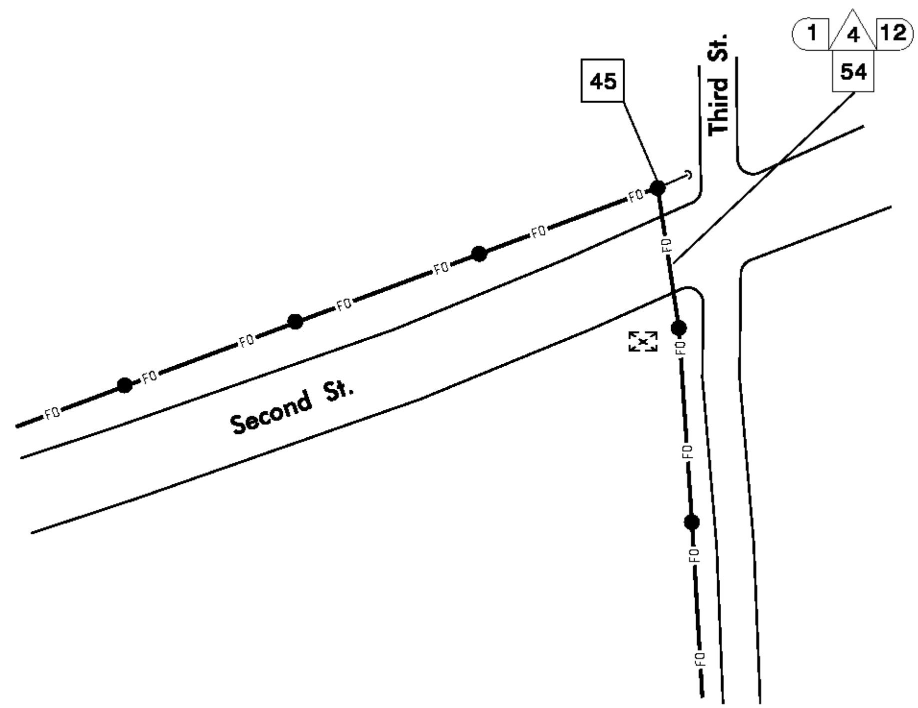
Case 3

Existing communications cable and messenger cable are to be removed new communications cable lashed to new messenger cable



Case 4

New communications cable lashed to existing signal/communications cable



Construction Notes for Aerial Cable Run

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

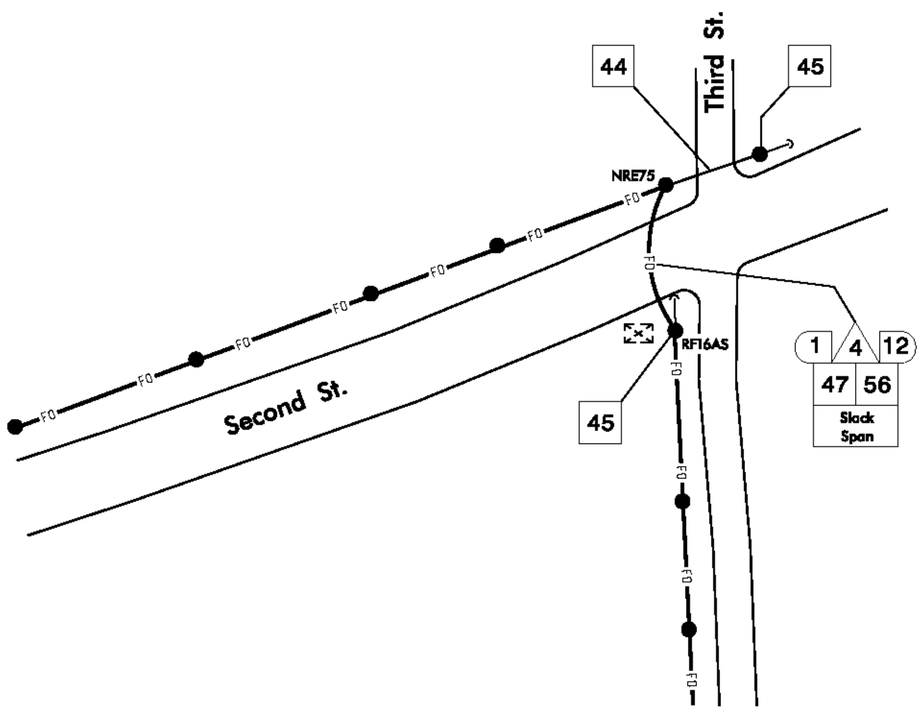
7-04

STD. NO. 4.0

SHEET 2 OF 3

Case 5

New communications cable lashed to new messenger cable and slack spanned



NOTE: Slack spanning should be used as a last resort. In this case, a guy could not be placed on pole NRE75 to counteract the tension of the aerial installation along Third Street. Therefore, slack span to pole RF16AS and place down guy at that pole.

Reserved for future use

Construction Notes for Aerial Cable Run

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

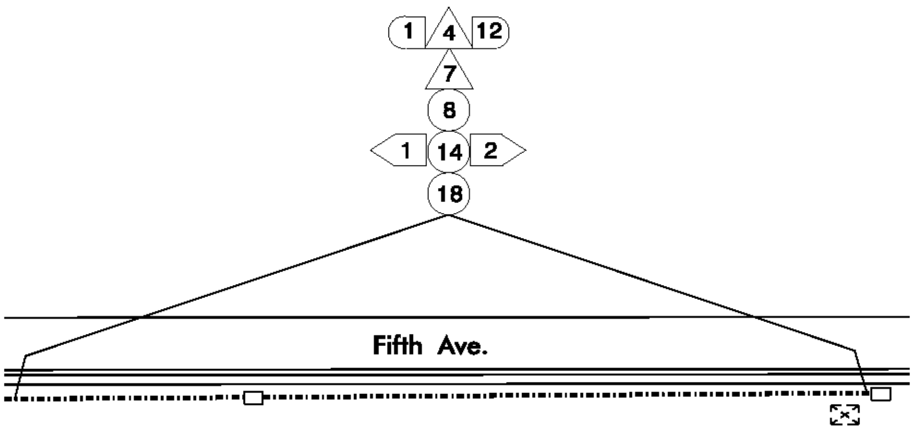
7-04

STD. NO. 4.0

SHEET 3 OF 3

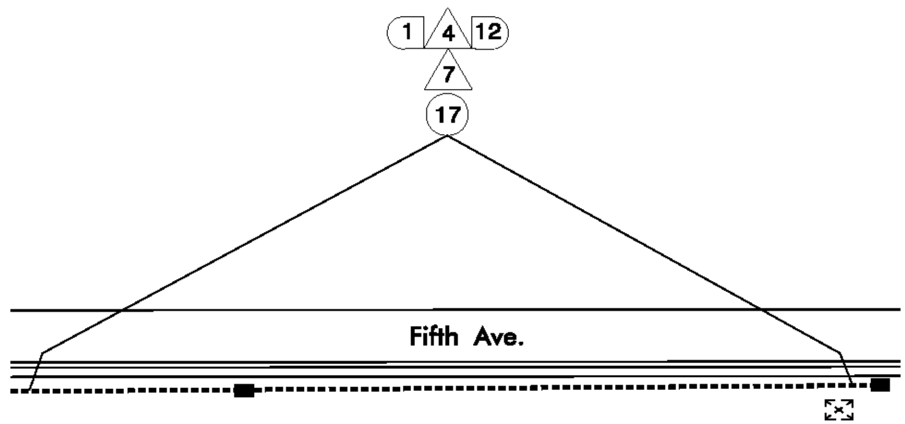
Case 1

Underground communications cable run installed in new conduit trenched or plowed



Case 2

Underground communications cable run installed in existing conduit



Construction Notes for Trenched or Plowed Conduit

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

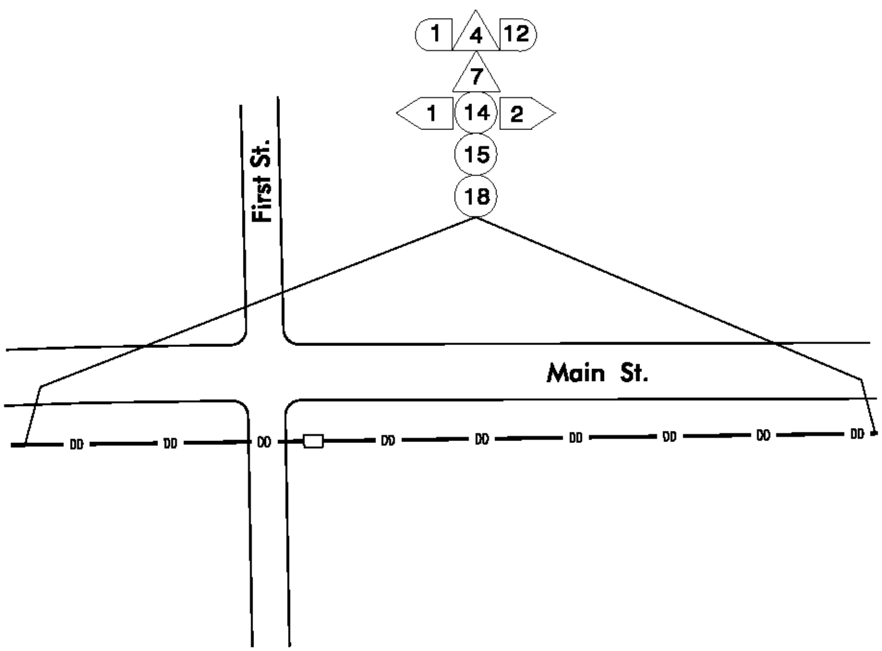
STD. NO.

4.1

SHEET 1 OF 3

Case 3

Underground communications cable run installed in new conduit directionally drilled



Case 4

Reserved for future use

Construction Notes for Directional Drilled Conduit

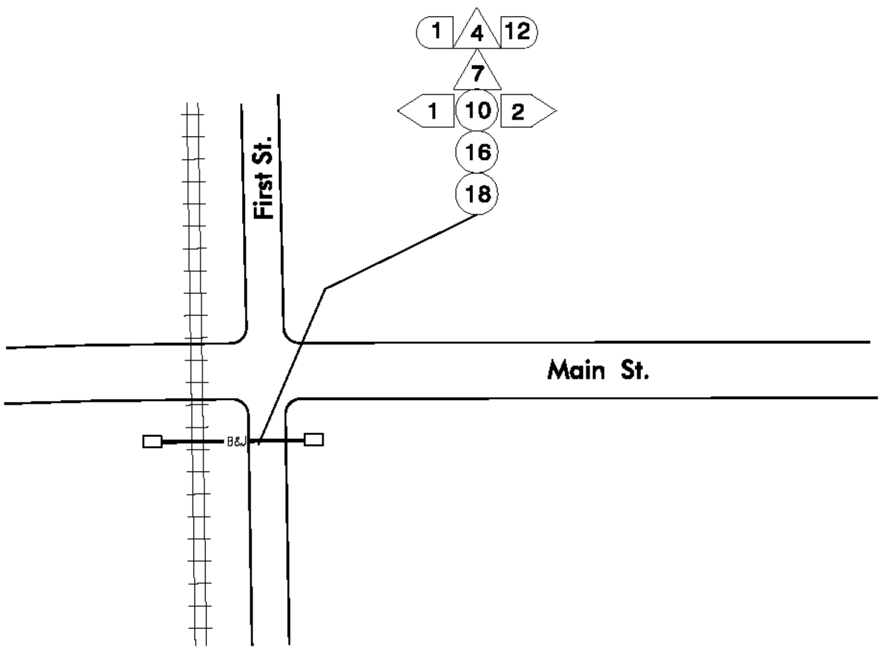
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 4.1

Case 5

Underground communications cable run
installed in new galvanized steel conduit



NOTE: This method is typically used for crossing under railroad tracks. However, it can be used for other applications requiring galvanized steel conduit.

Case 6

Reserved for future use

Construction Notes for Bored and Jacked Conduit

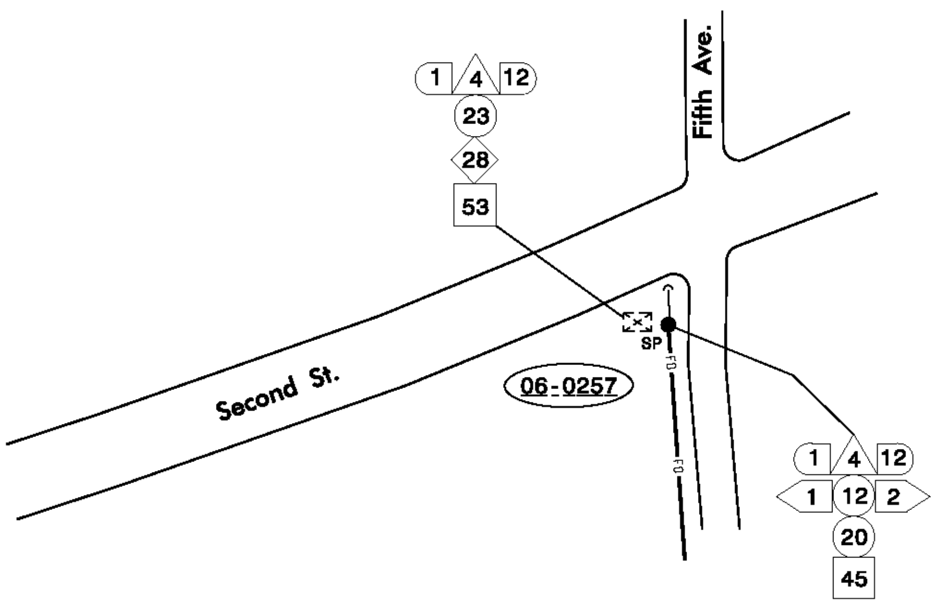
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

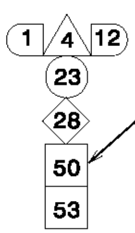
7-04

STD. NO. 4.1

Case 1

Fiber routed from a pole riser to a base mounted signal cabinet at the end of a run with standard guy assembly

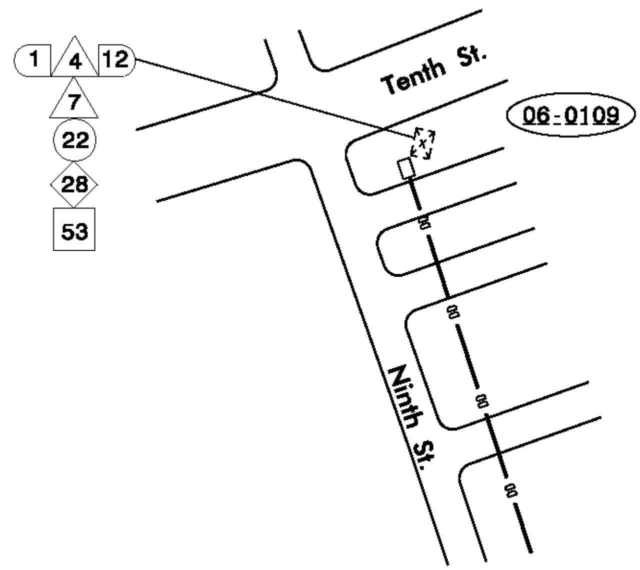


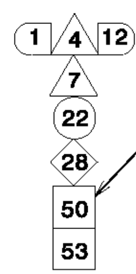


NOTE:If this is the master controller, add construction note #50.

Case 2

Fiber routed from a junction box to a base mounted signal cabinet at the end of a run (underground installation - no riser required)





NOTE:If this is the master controller, add construction note #50.

Construction Notes for Signal Cabinets and Risers

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

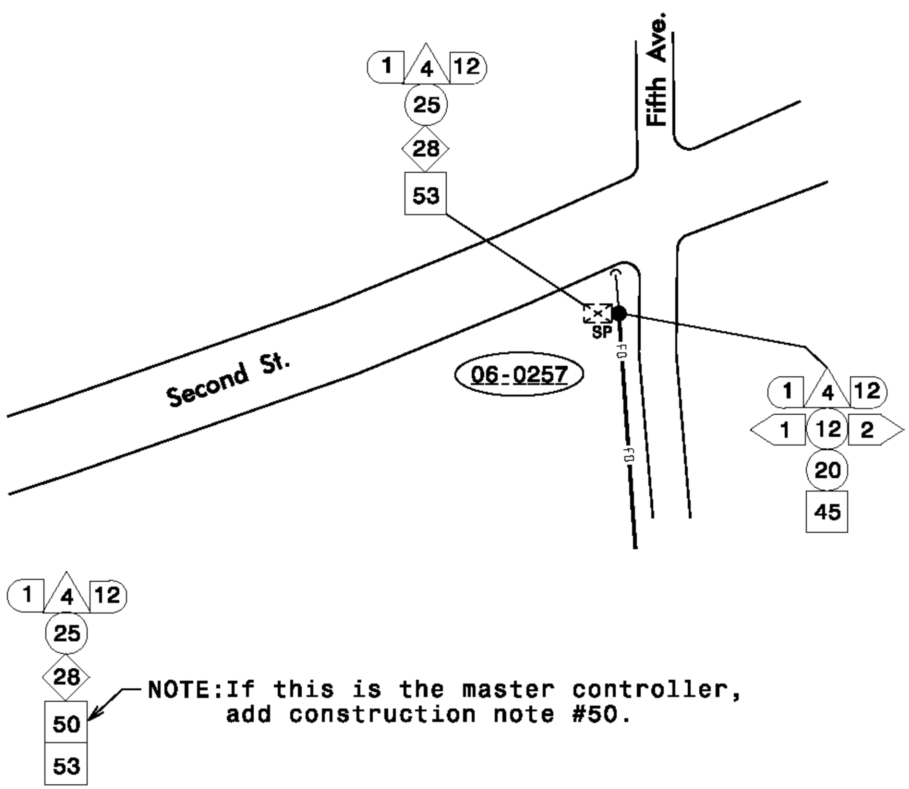
7-04

STD. NO. 4.2

SHEET 1 OF 4

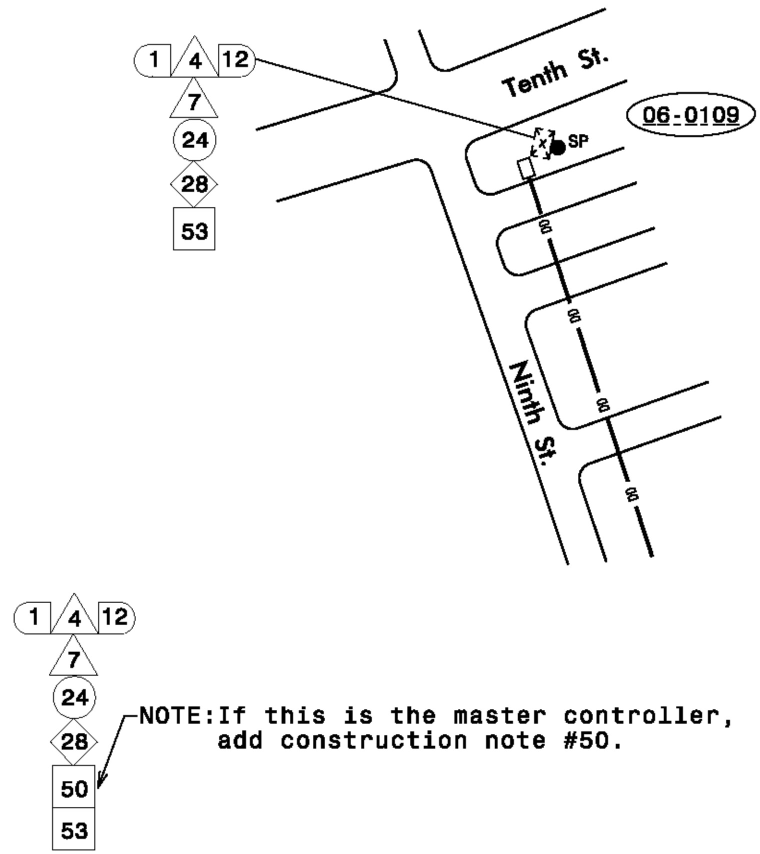
Case 3

Fiber routed from a pole riser to a pole
mounted signal cabinet at the end of a run
with standard guy assembly



Case 4

Fiber routed from a junction box to a pole
mounted signal cabinet at the end of a run
(underground installation - no riser required)



Construction Notes for Signal Cabinets and Risers

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

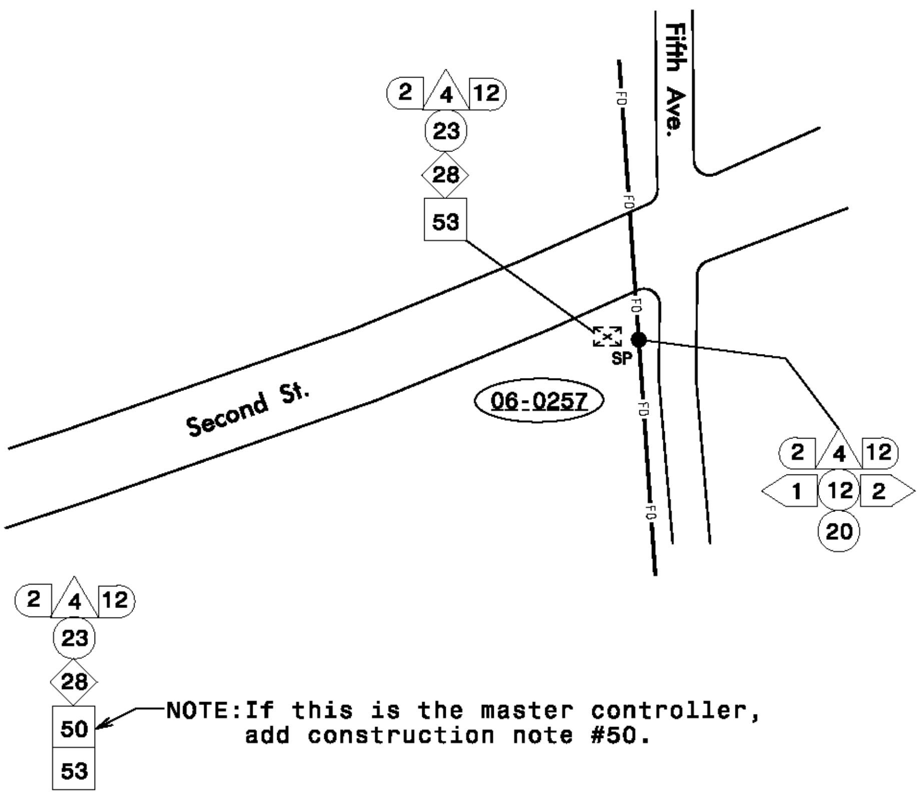
7-04

STD. NO. 4.2

SHEET 2 OF 4

Case 5

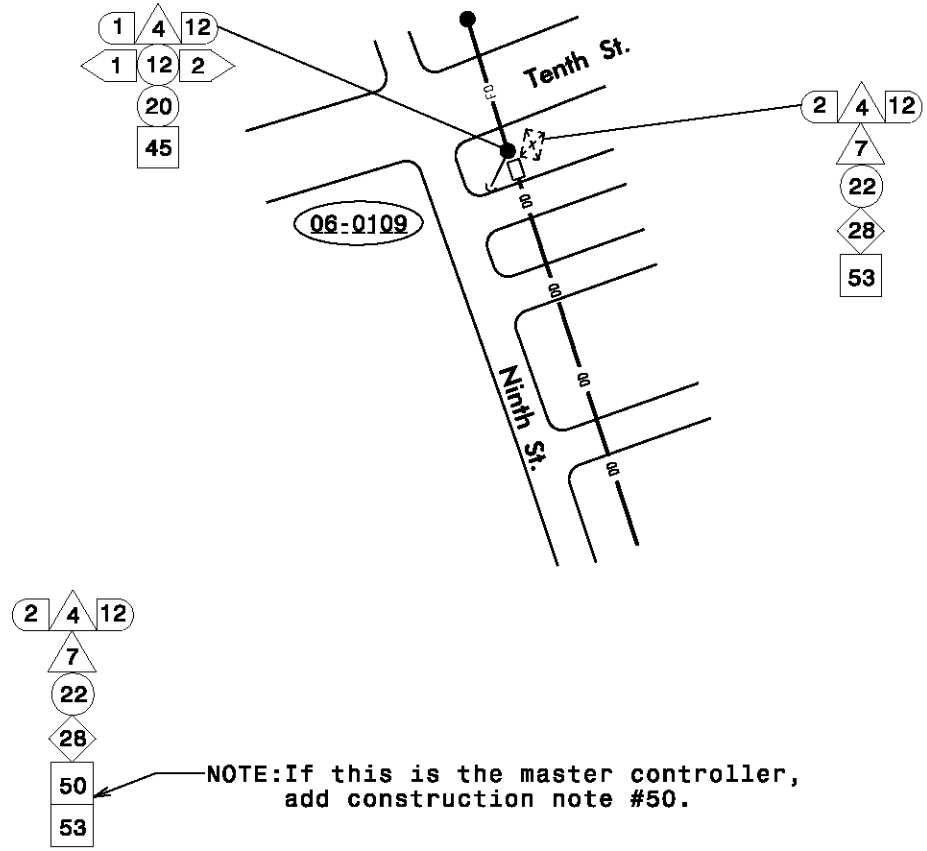
Fiber routed from a pole riser to a base mounted signal cabinet and back up through riser to continue to next location



NOTE: If this is the master controller, add construction note #50.

CASE 6

Fiber routed from a junction box to a base mounted signal cabinet then up the pole riser to continue to next location (transition from underground to aerial - riser and guy required)



NOTE: If this is the master controller, add construction note #50.

Construction Notes for Signal Cabinets and Risers

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

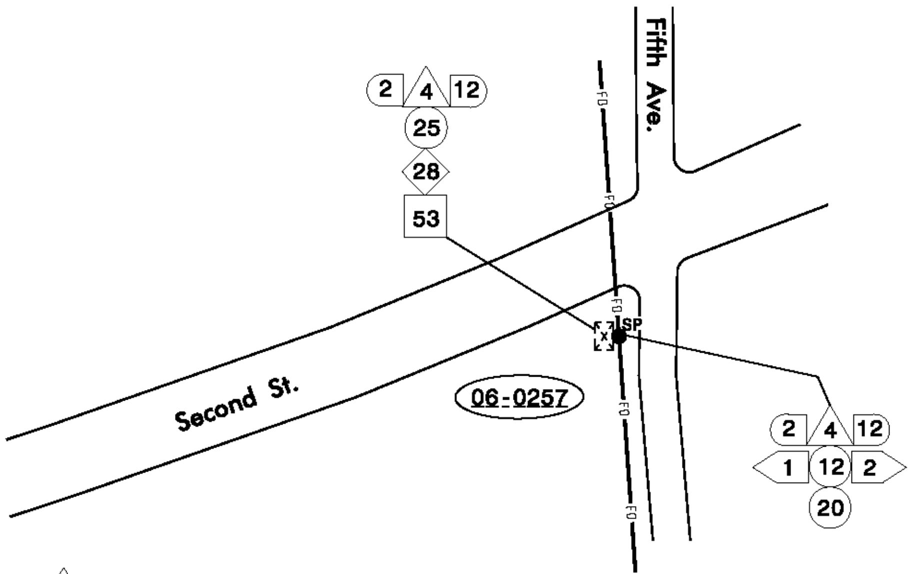
7-04

STD. NO. 4.2

SHEET 3 OF 4

Case 7

Fiber routed from a pole riser to a pole mounted signal cabinet and back up through riser to continue to next location

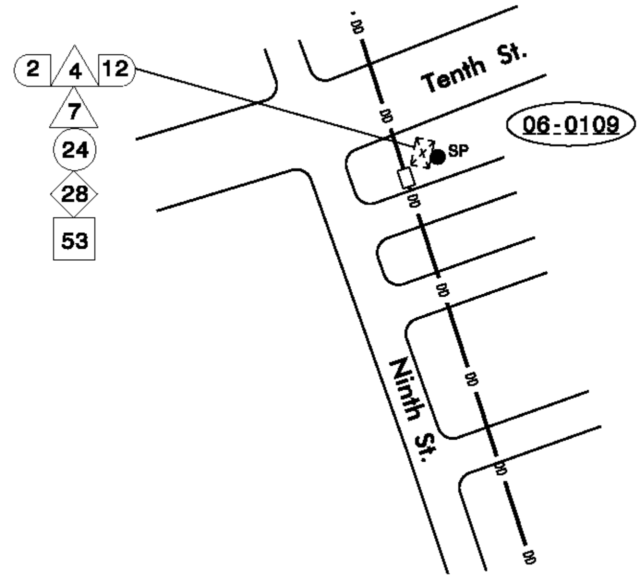


2 4 12
25
28
50
53

NOTE:If this is the master controller, add construction note #50.

Case 8

Fiber routed from a junction box to a base mounted signal cabinet and back to the junction to continue to next location (underground installation - no riser required)



2 4 12
7
24
28
50
53

NOTE:If this is the master controller, add construction note #50.

Construction Notes for Signal Cabinets

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 4.2

SHEET 4 OF 4

Case 1

Depicts installation of oversized junction box and delineator marker, ample storage on snow shoe nearby eliminates the need for extra cable storage.

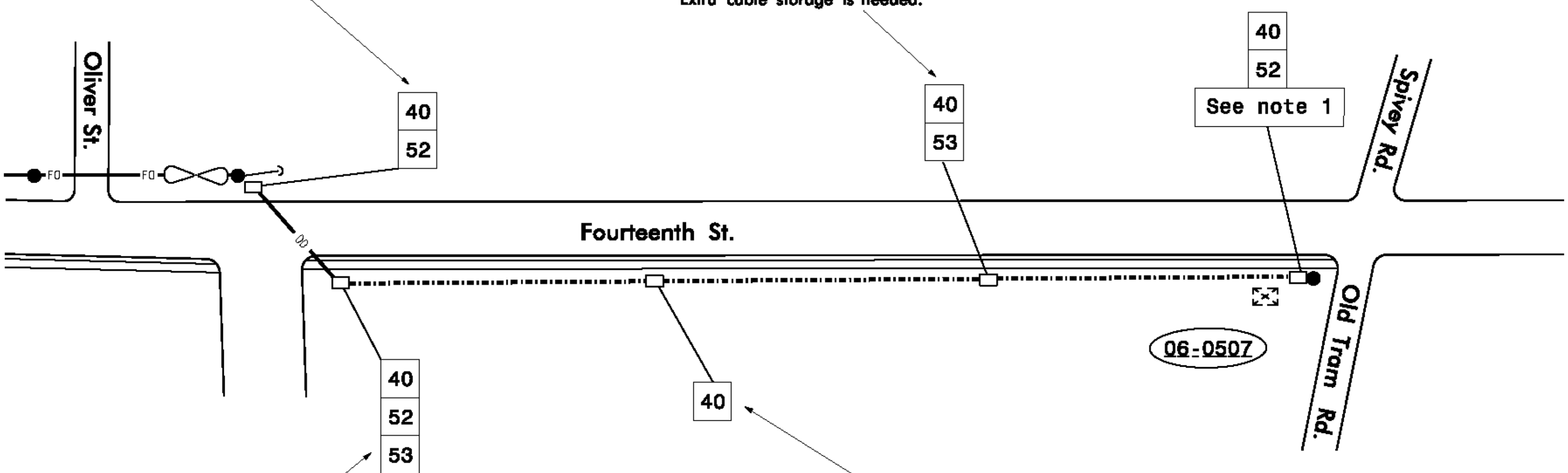
Case 2

Depicts installation of oversized junction box without delineator marker.
Line of sight, aesthetics, underground utilities are all factors in determining the need for markers.
Extra cable storage is needed.

Case 3

Depicts installation of oversized junction box and delineator marker, more than the standard 20 feet of extra cable storage is needed.

Note 1 should read: Store XXX feet of communications cable in junction box.



Case 4

Depicts installation of oversized junction box and delineator marker. Extra cable storage needed.

Case 5

Depicts installation of oversized junction box without delineator marker.
Line of sight, aesthetics, underground utilities are all factors in determining the need for markers.
Extra cable storage not needed.

Note: Distance between junction boxes may vary.

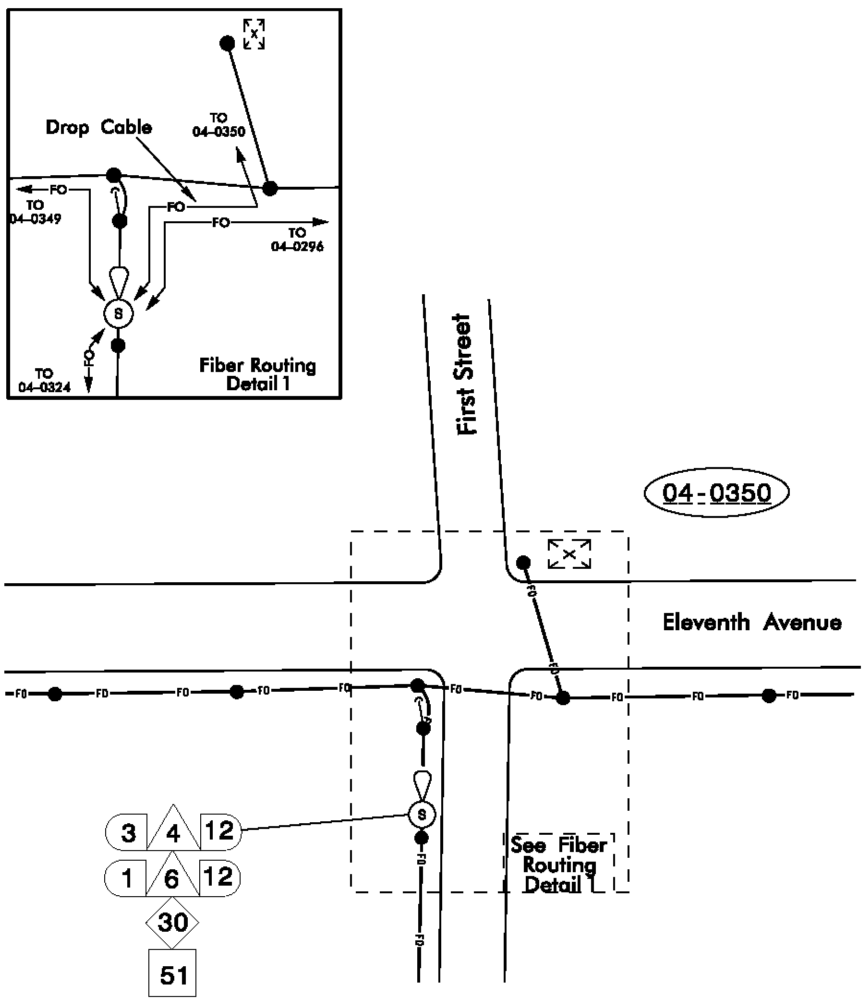
Construction Notes for Oversized Junction Box

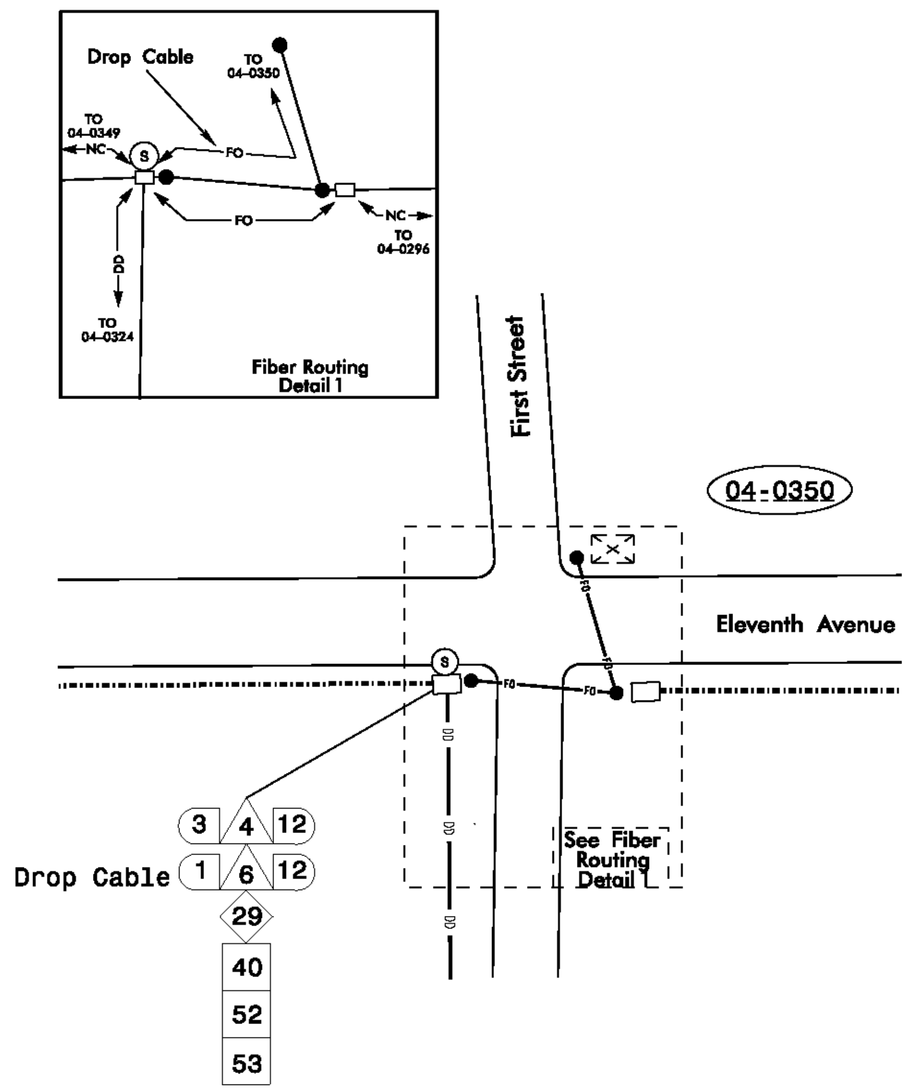
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 4.3

SHEET 1 OF 1





Fiber Routing Detail Drawing for Splice Enclosures

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

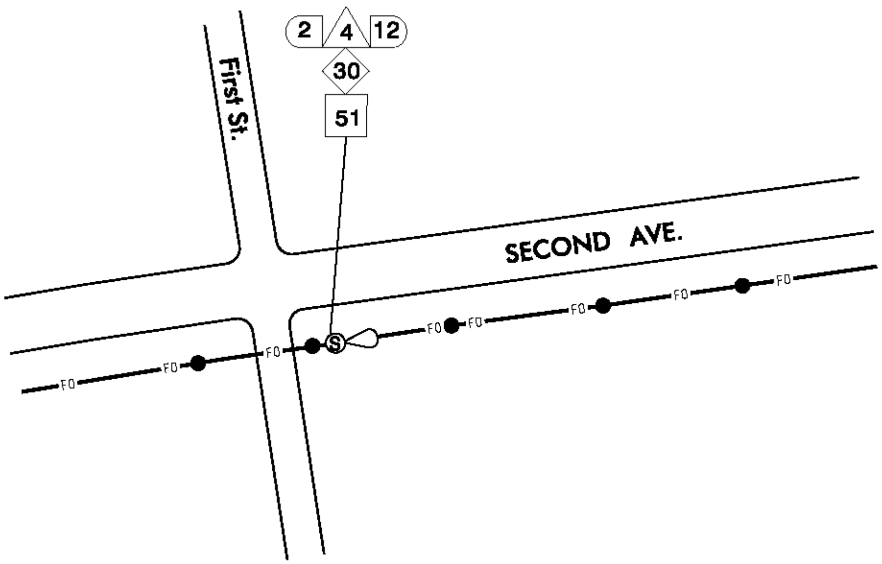
7-04

STD. NO.
4.4

SHEET 1 OF 4

Case 1

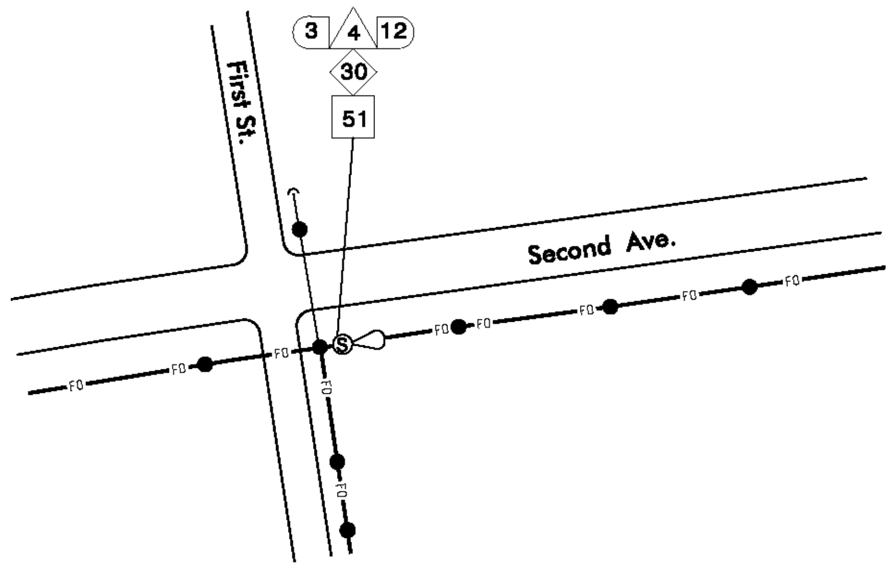
Cable routed to an aerial splice enclosure with one cable in and one cable out



NOTE: In this case, the splice enclosure would be for a future traffic signal, camera, or dynamic message sign. This is also the method used for tying into an existing cable left terminated at the pole.

Case 2

Cable routed to an aerial splice enclosure with one cable in and two cables out



Construction Notes for Splice Enclosures

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

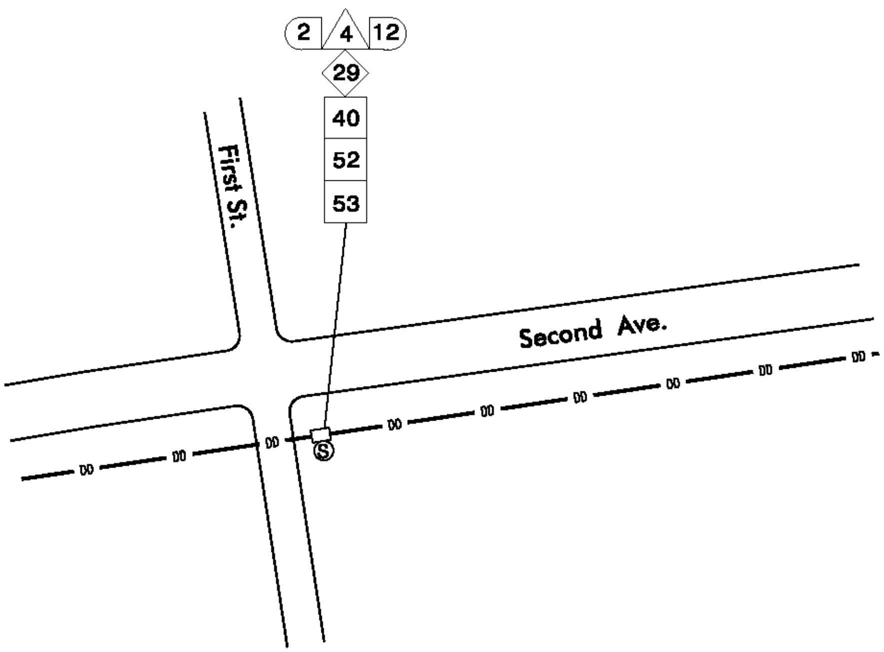
7-04

STD. NO. 4.4

SHEET 2 OF 4

Case 3

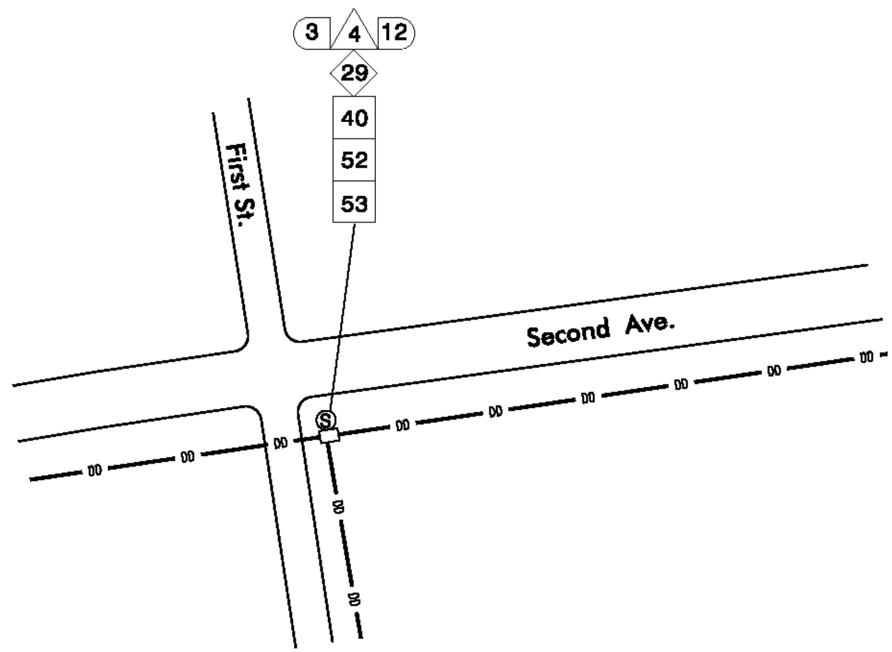
Cable routed to an underground splice enclosure
with one cable in and one cable out



NOTE: In this case, the splice enclosure would be for a future traffic signal, camera, or dynamic message sign. This is also the method used for tying into an existing cable left terminated at the junction box.

Case 4

Cable routed to an underground splice enclosure
with one cable in and two cables out



Construction Notes for Splice Enclosures

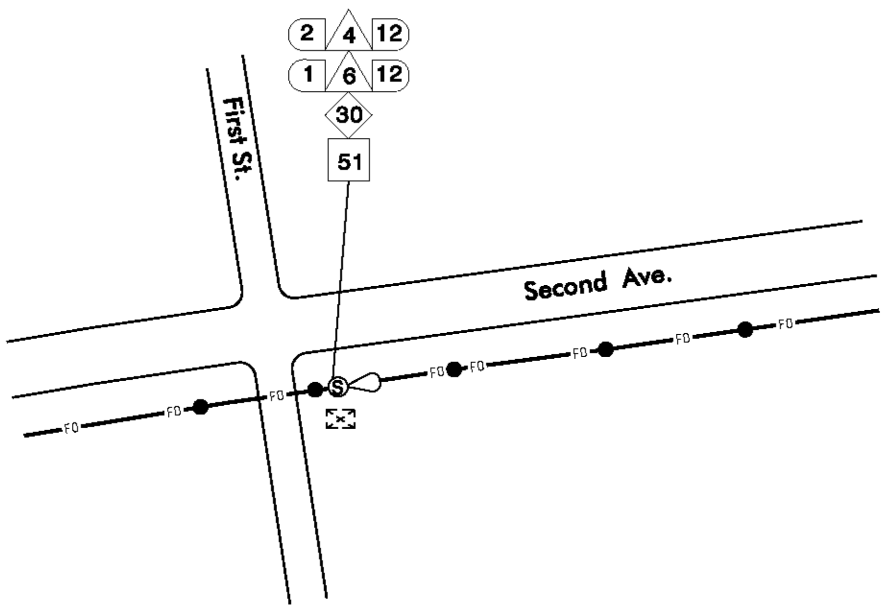
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
4.4
SHEET 3 OF 4

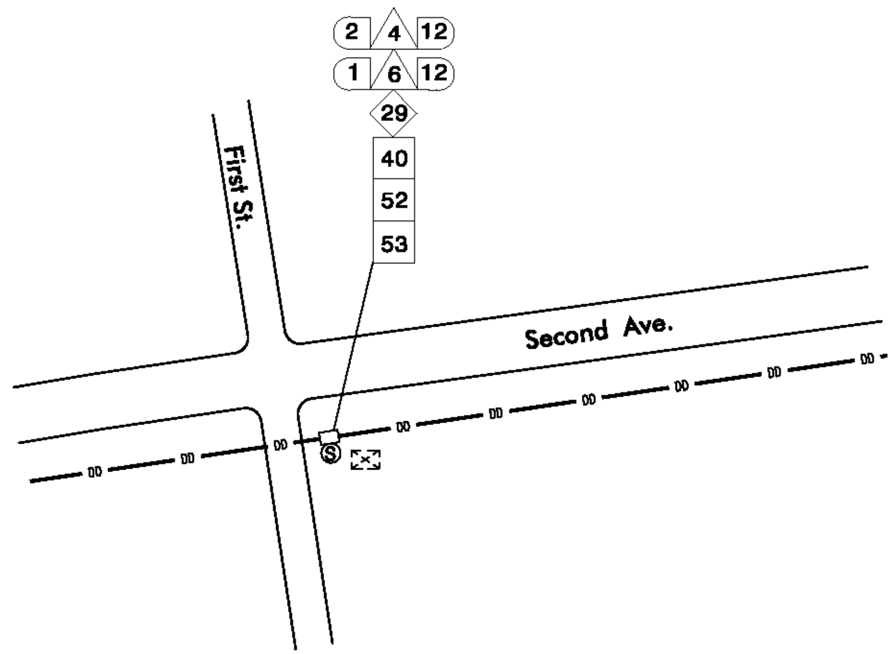
Case 5

Cable routed to an aerial splice enclosure with one trunk cable in, one trunk cable out and a drop cable routed to a cabinet



Case 6

Cable routed to an underground splice enclosure with one trunk cable in, one trunk cable out and a drop cable routed to a cabinet

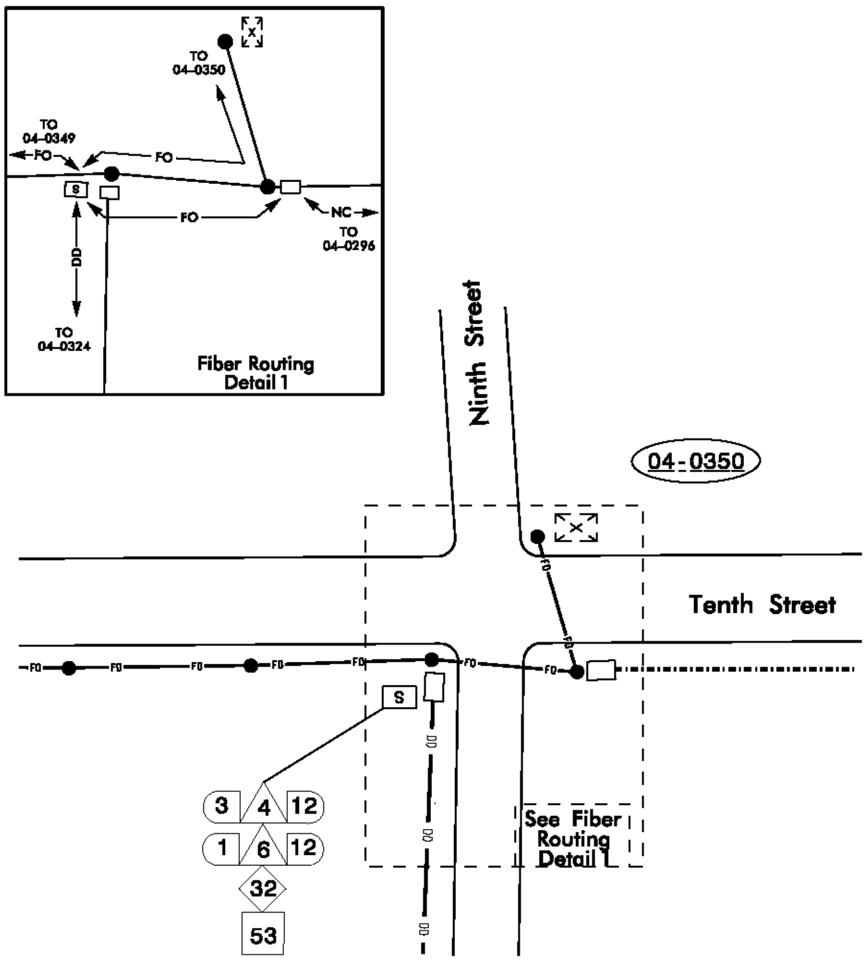


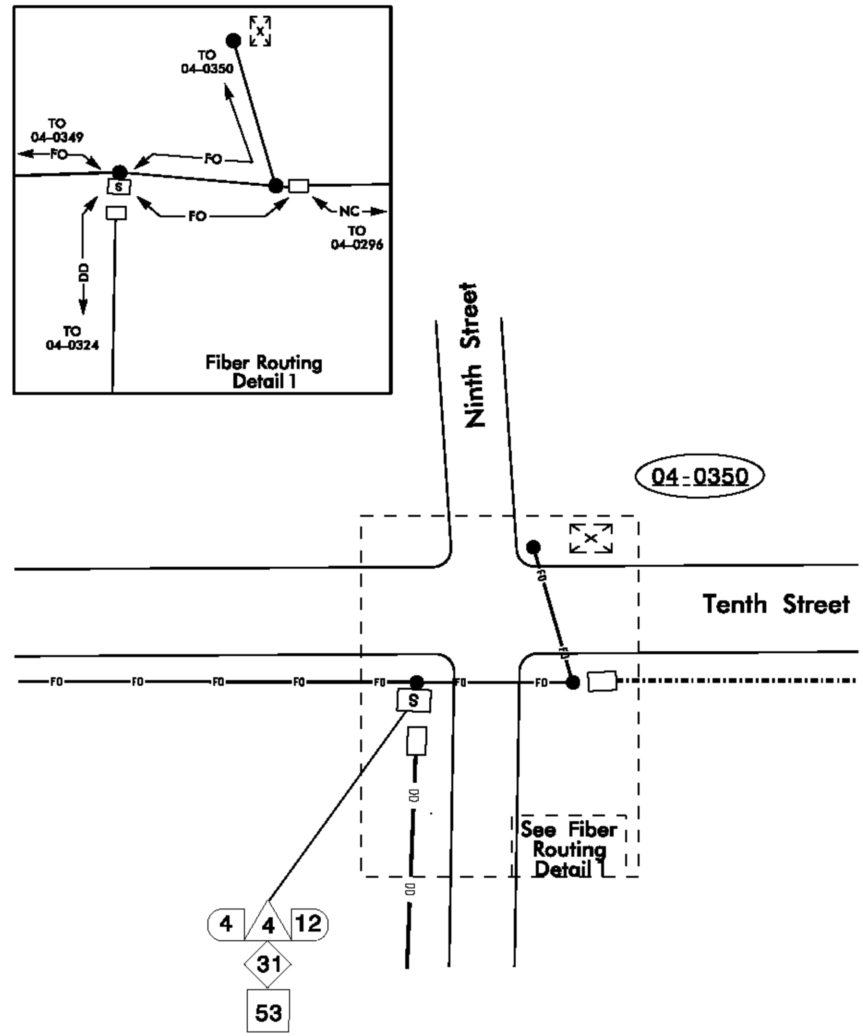
Construction Notes for Splice Enclosures

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 4.4





Fiber Routing Detail Drawing for Splice Cabinets

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

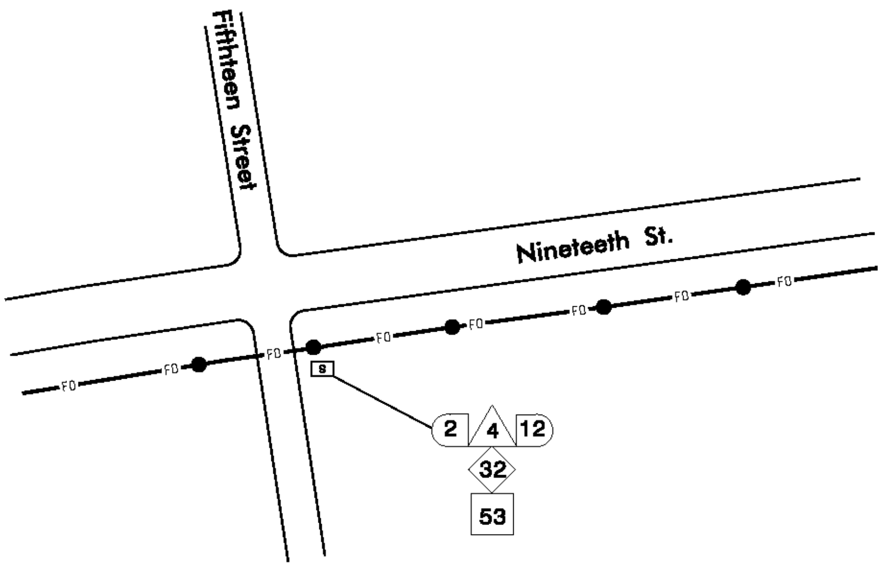
7-04

STD. NO. 4.5

SHEET 1 OF 5

Case 1

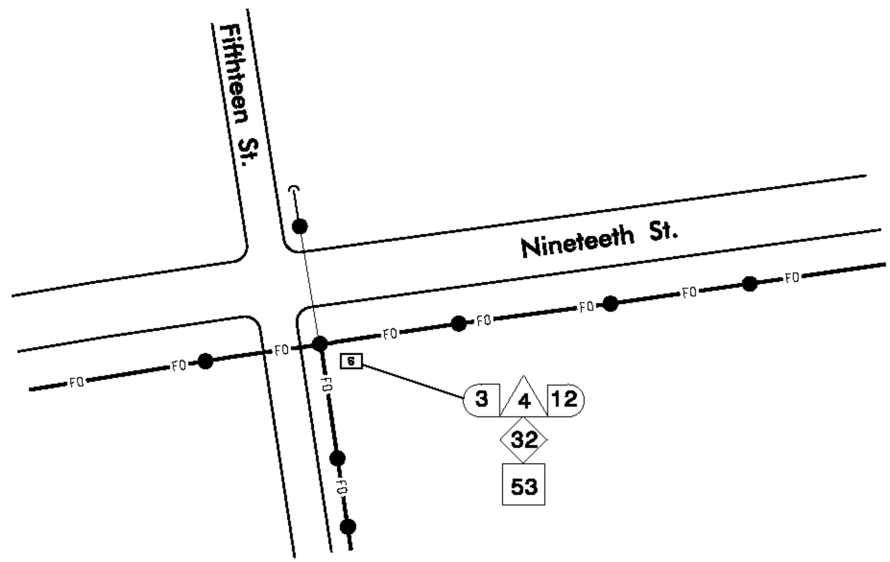
Aerial cable run routed through a riser
to a base mounted splice cabinet
with one in and one cable out



NOTE: In this case, the splice cabinet would be for a future traffic signal, camera, or dynamic message sign. This is also the method used for tying into an existing cable left terminated at the pole.

Case 2

Aerial cable run routed through a riser
to a base mounted splice cabinet
with one cable in and two cables out



Construction Notes for Splice Cabinets

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

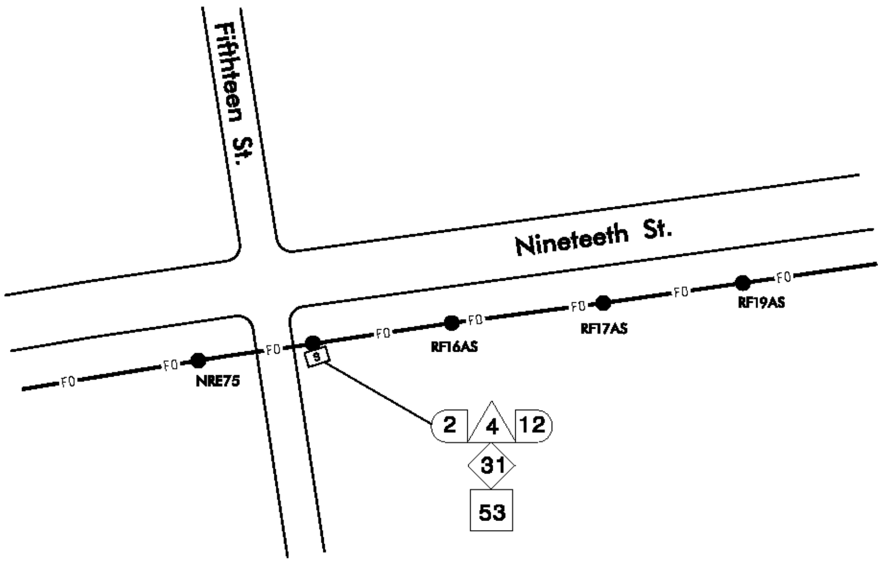
7-04

STD. NO. **4.5**

SHEET 2 OF 5

Case 3

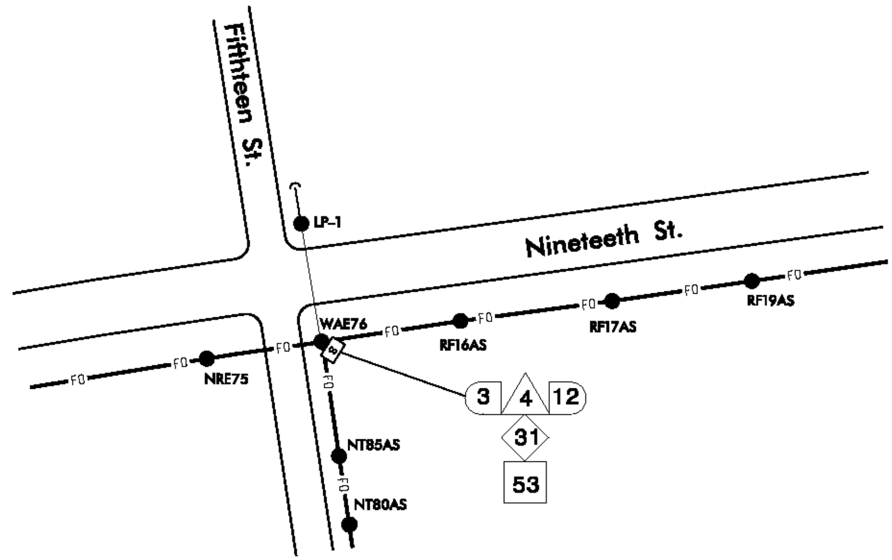
Aerial cable run routed through a riser
to a pole mounted splice cabinet
with one cable in and one cable out



NOTE: In this case, the splice cabinet would be for a future traffic signal, camera, or dynamic message sign. This is also the method used for tying into an existing cable left terminated at the pole.

Case 4

AERIAL CABLE RUN ROUTED THROUGH A RISER
TO A POLE MOUNTED SPLICE CABINET
WITH ONE CABLE IN AND TWO CABLES OUT



Construction Notes for Splice Cabinets

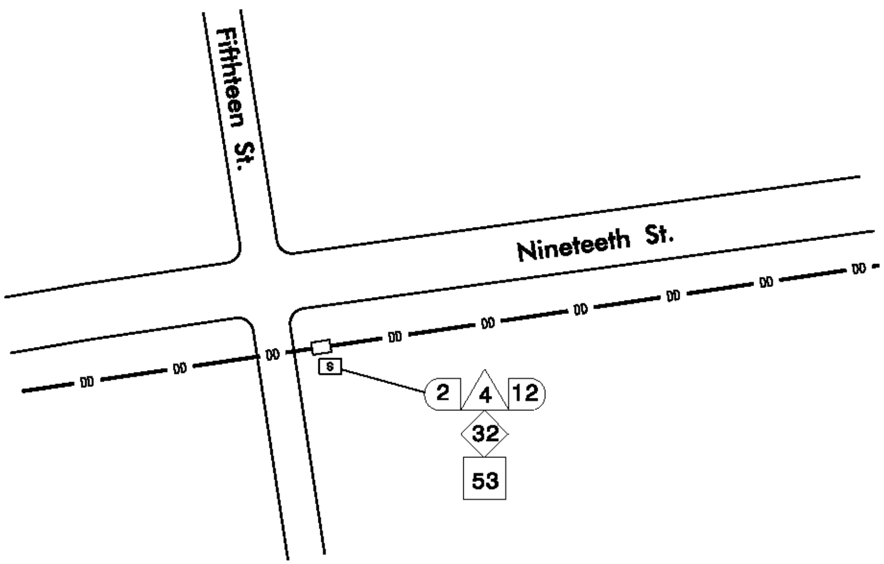
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 4.5

Case 5

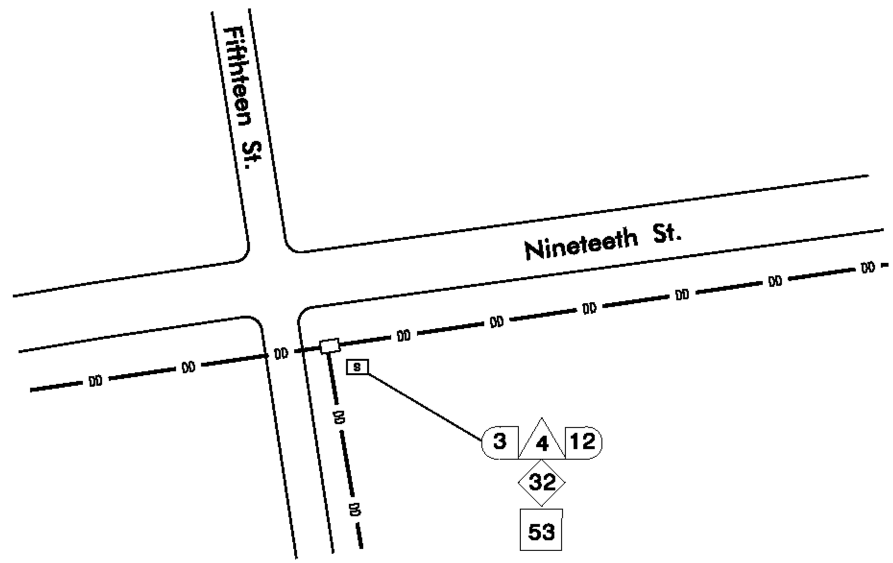
Underground cable run routed through a junction box
to a base mounted splice cabinet
with one cable in and one cable out



NOTE: In this case, the splice cabinet would be for a future traffic signal, camera, or dynamic message sign. This is also the method used for tying into an existing cable left terminated at the junction box.

Case 6

Underground cable run through a junction box
to a base mounted splice cabinet
with one cable in and two cables out



Construction Notes for Splice Cabinets

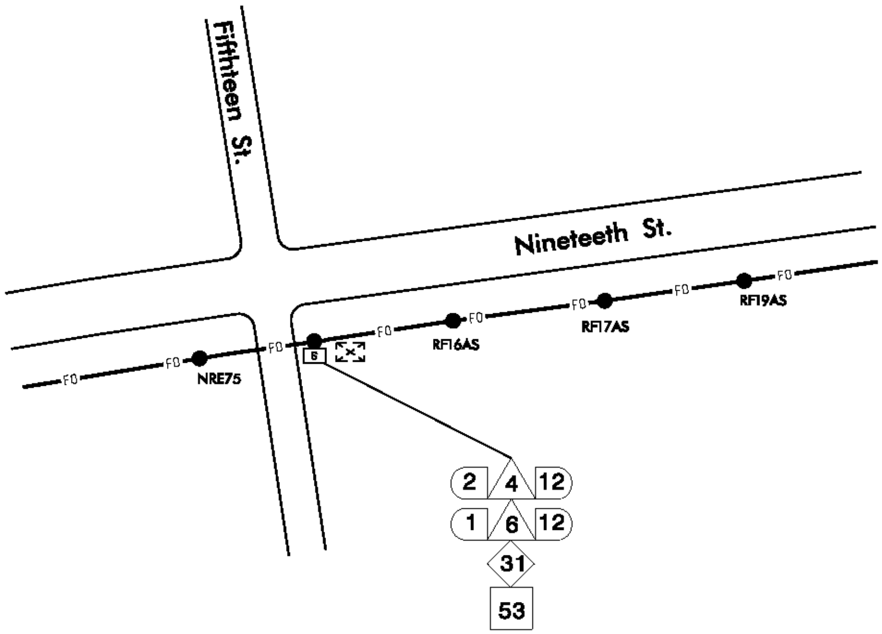
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 4.5

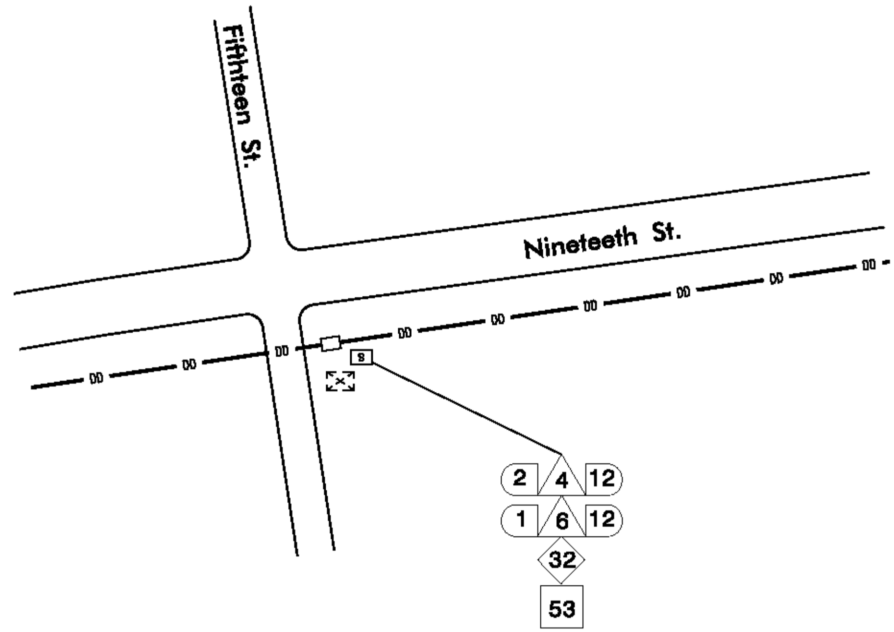
Case 7

Cable routed to a pole splice cabinet
with one trunk cable in, one trunk cable out
and a drop cable routed to a cabinet



Case 8

Cable routed to a base mounted splice cabinet
with one trunk cable in, one trunk cable out
and a drop cable routed to a cabinet



Construction Notes for Splice Cabinets

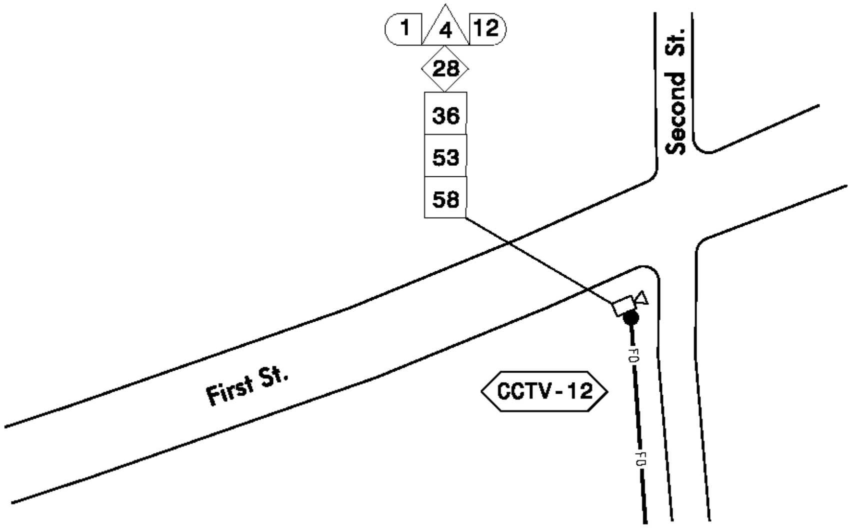
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
4.5
SHEET 5 OF 5

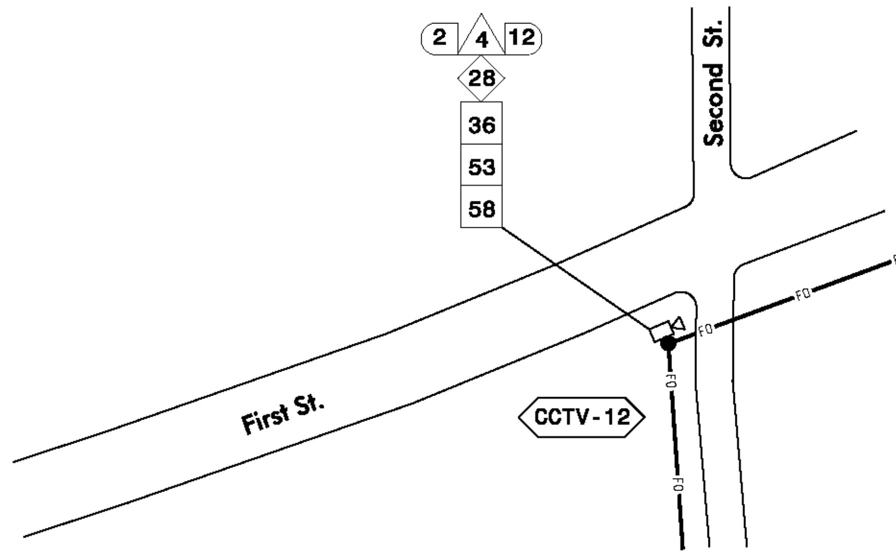
Case 1

CCTV assembly mounted on an existing pole
at the end of a run



Case 2

CCTV assembly on an existing pole
in the middle of a run



Construction Notes for CCTV Camera Assemblies

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

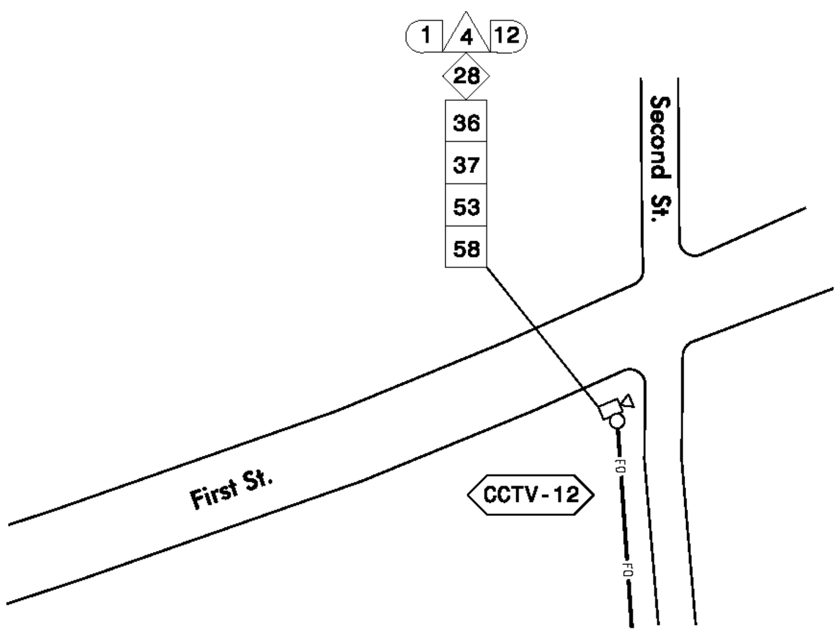
7-04

STD. NO. 5.0

SHEET 1 OF 3

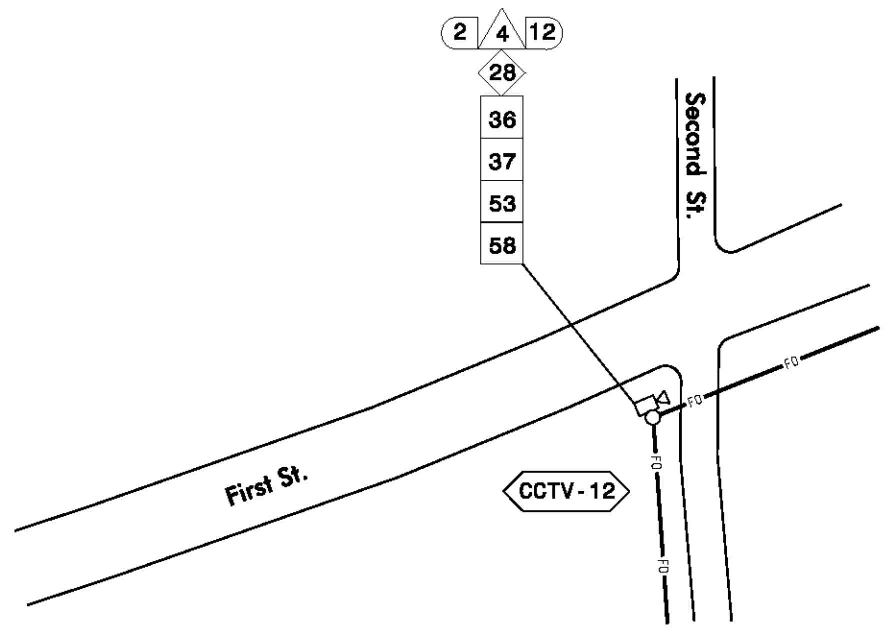
Case 3

CCTV assembly mounted on a new wood pole
at the end of a run



Case 4

CCTV assembly mounted on a new wood pole
in the middle of a run



Construction Notes for CCTV Camera Assemblies

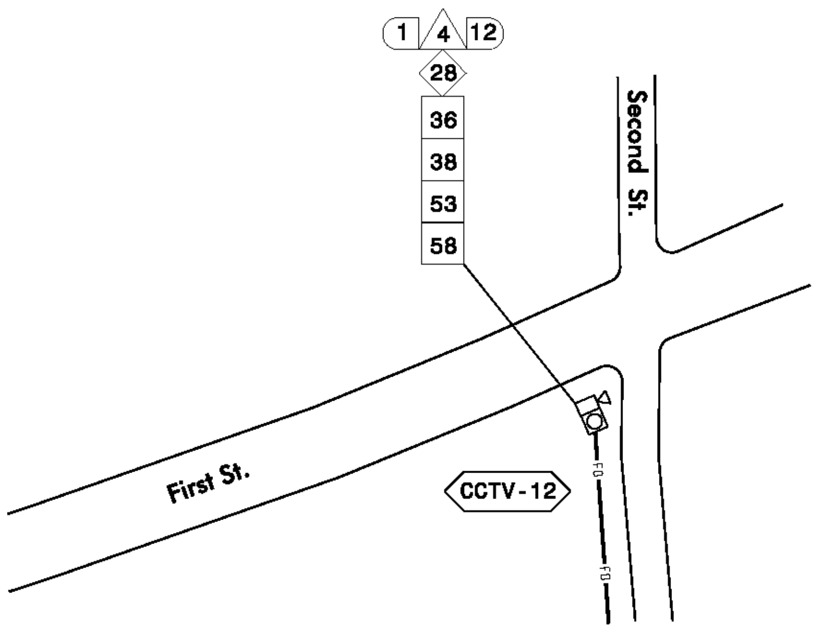
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 5.0

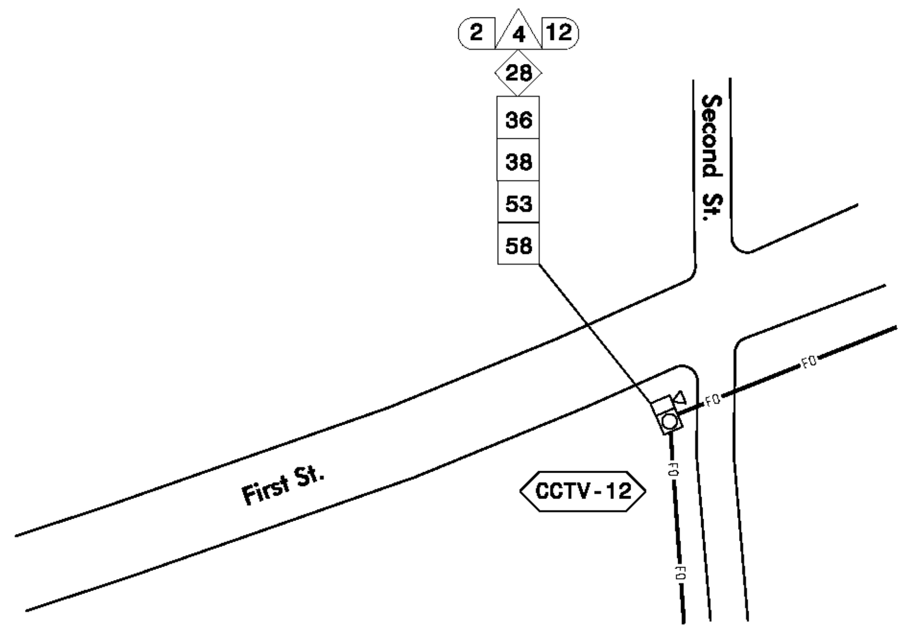
Case 5

CCTV assembly mounted on a new metal pole
at the end of a run



Case 6

CCTV assembly mounted on a new metal pole
in the middle of a run

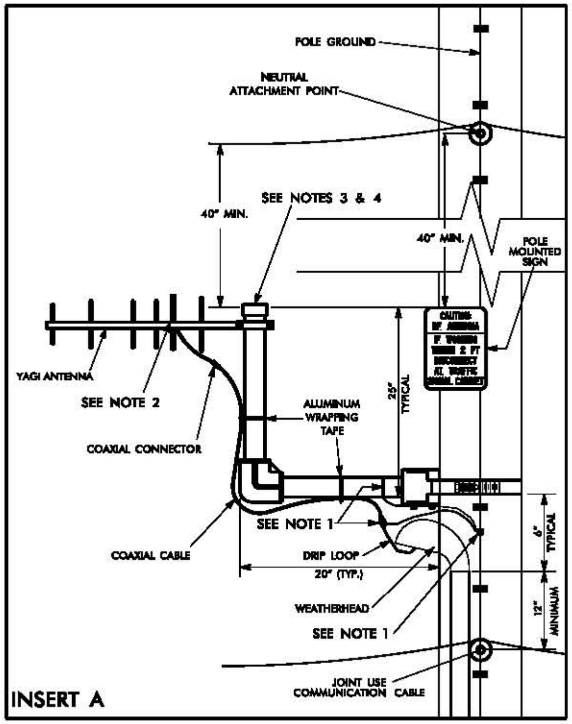


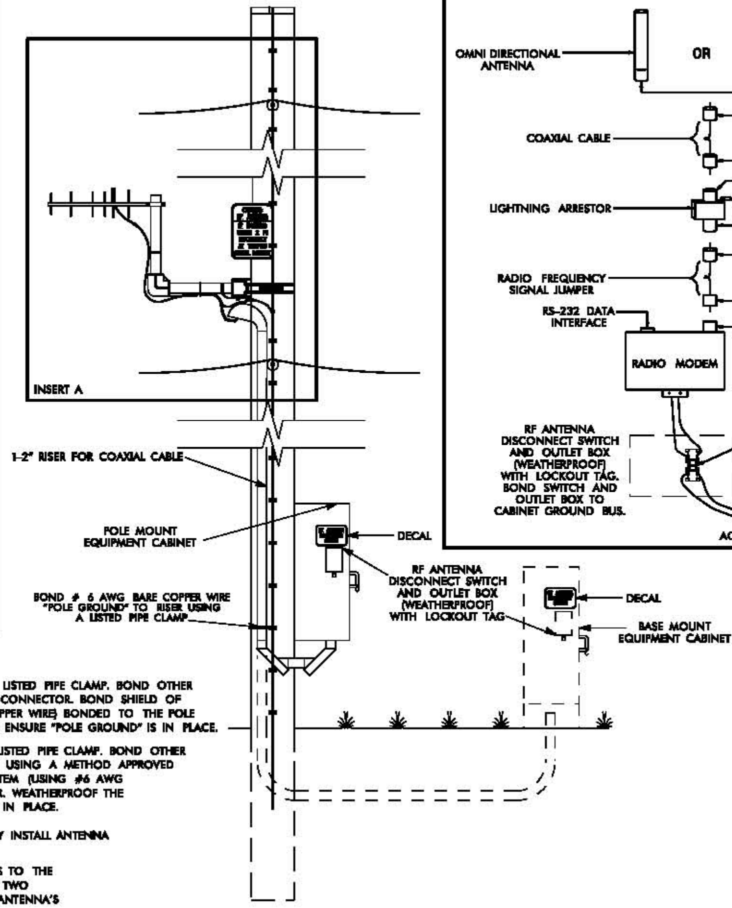
Construction Notes for CCTV Camera Assemblies

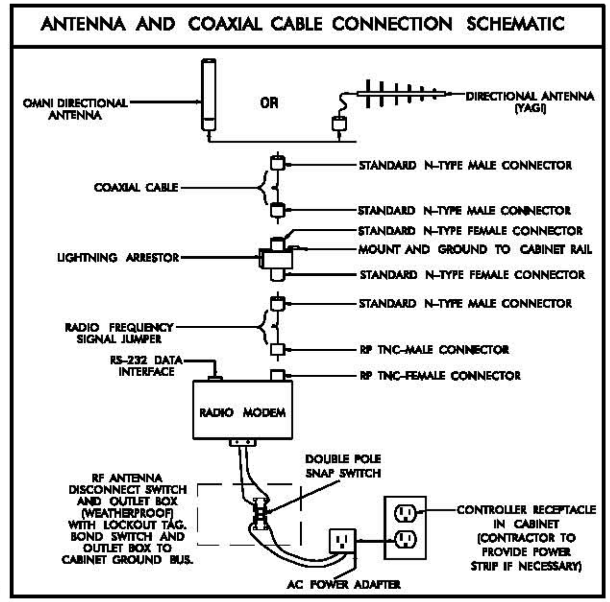
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 5.0







NOTES

1. WOOD POLE — BOND # 6 AWG SOLID BARE COPPER WIRE TO ANTENNA SUPPORT USING LISTED PIPE CLAMP. BOND OTHER END OF # 6 AWG SOLID BARE COPPER WIRE TO THE POLE GROUND USING A SPLIT BOLT CONNECTOR. BOND SHIELD OF COAXIAL CABLE WITH AN APPROVED GROUNDING SYSTEM (USING #6 AWG STRANDED COPPER WIRE) BONDED TO THE POLE GROUND. WEATHERPROOF THE CONNECTION ONCE THE GROUNDING SYSTEM IS INSTALLED. ENSURE "POLE GROUND" IS IN PLACE.

   METAL POLE — BOND # 6 AWG SOLID BARE COPPER WIRE TO ANTENNA SUPPORT USING LISTED PIPE CLAMP. BOND OTHER END OF # 6 AWG SOLID BARE COPPER WIRE TO THE POLE OR EXISTING SYSTEM GROUND USING A METHOD APPROVED BY THE ENGINEER. BOND SHIELD OF COAXIAL CABLE WITH AN APPROVED GROUNDING SYSTEM (USING #6 AWG STRANDED COPPER WIRE) BONDED TO THE POLE BY A METHOD APPROVED BY THE ENGINEER. WEATHERPROOF THE CONNECTION ONCE THE GROUNDING SYSTEM IS INSTALLED. ENSURE "SYSTEM GROUND" IS IN PLACE.

2. YAGI ANTENNA SHOWN IN VERTICAL POLARIZATION POSITION FOR CLARIFICATION. TYPICALLY INSTALL ANTENNA IN HORIZONTAL POLARIZATION POSITION.

3. TO CONSERVE VERTICAL SPACING ON THE POLE (JOINT-USE OR SIGNAL POLE) WITH REGARDS TO THE SURROUNDING UTILITIES, INSTALL THE ANTENNA MOUNTING HARDWARE USING ONE OF THE TWO METHODS LISTED BELOW: (ENSURE THAT THE MOUNTING METHOD DOES NOT DEGRADE THE ANTENNA'S SIGNAL INTEGRITY)

   A) ROTATE THE VERTICAL SUPPORT ARM 90 DEGREES SUCH THAT THE ANTENNA IS AT THE SAME HEIGHT AS THE HORIZONTAL SUPPORT ARM.

   B) ELIMINATE THE VERTICAL SUPPORT ARM AND MOUNT THE ANTENNA TO THE HORIZONTAL SUPPORT ARM.

   C) ANTENNA, ANTENNA SUPPORT ARM, AND SIGN TO MAINTAIN A 40" SEPARATION FROM NEUTRAL/POWER AND 12" FROM OTHER UTILITIES.

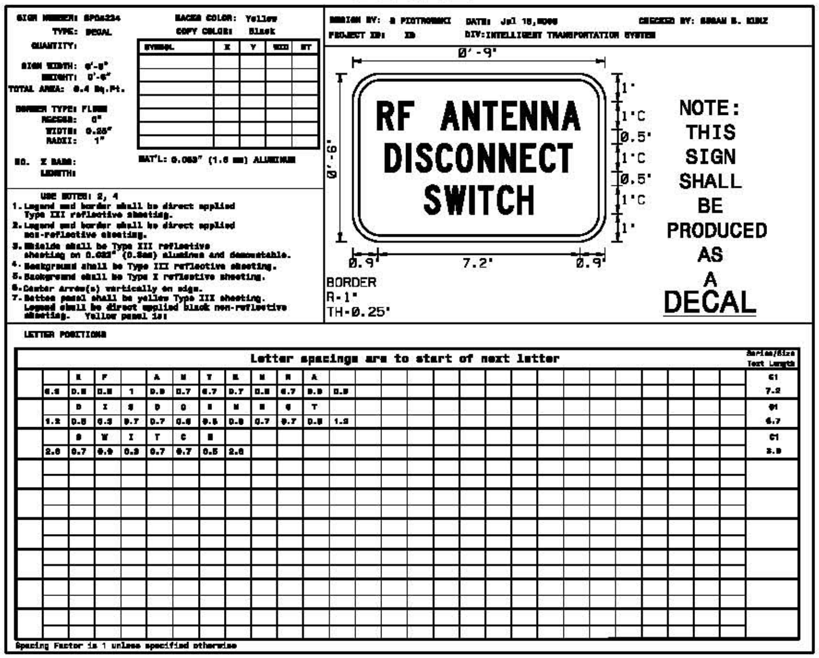
4. INSTALL AN END CAP TO SEAL THE EXPOSED END OF THE MOUNTING PIPE.

Wireless Communications – Typical Detail

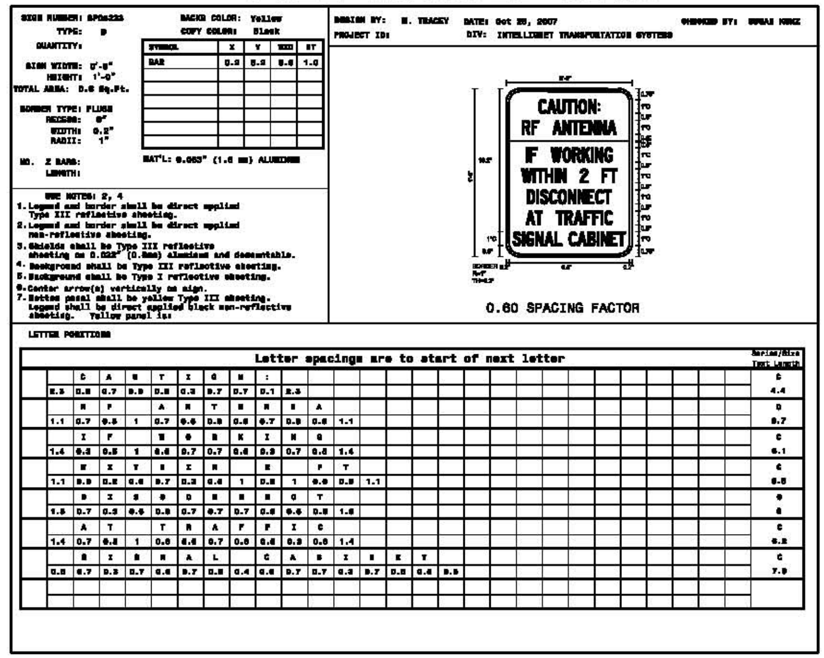
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO.
6.0
SHEET 1 OF 2

DECAL



POLE MOUNTED SIGN



Wireless Communications – Typical Detail

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.0

SHEET 2 OF 2

LEGEND

	YAGI ANTENNA (DOUBLE) FOR REPEATER OPERATION
	YAGI ANTENNA (SINGLE)
	OMNI ANTENNA
	EXISTING CONTROLLER AND CABINET
M	EXISTING MASTER CONTROLLER AND CABINET
XX-XXXX	SIGNAL INVENTORY NUMBER
	EXISTING METAL POLE W/MAST ARM
	EXISTING WOOD POLE
	NEW METAL POLE
SP	SIGNAL POLE
	EXISTING METAL POLE
	NEW OVERSIZED JUNCTION BOX
	EXISTING OVERSIZED JUNCTION BOX
	EXISTING CONDUIT
EXI	EXISTING COMMUNICATIONS CABLE

NOTES FOR WIRELESS COMMUNICATIONS:

1. INSTALL COAXIAL CABLE:
   A. ON WOOD POLES, REQUIRING A NEW RIGID GALVANIZED STEEL RISER, INSTALL A 2" RISER WITH WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   B. ON METAL POLES WITH MAST ARMS, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE MAST ARM; FIELD DRILL A 1/2" HOLE UP THROUGH THE BOTTOM OF MAST ARM FOR INSTALLATION OF THE COAXIAL CABLE TO THE ANTENNA.
   C. ON METAL STRAIN POLES, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   D. BETWEEN THE POINT OF EXITING THE RISER, METAL POLE OR MAST ARM AND THE ANTENNA, SECURE THE COAXIAL CABLE TO THE STRUCTURE USING 3/4" STAINLESS STEEL STRAPS EVERY 12".
2. IF AN EXISTING 2" SPARE RIGID GALVANIZED STEEL RISER IS AVAILABLE, INSTALL THE COAXIAL CABLE IN THE SPARE RISER.
3. INSTALL WIRELESS ANTENNA ON POLE WITH RF WARNING SIGN.
   (NOTE: RF WARNING SIGN NOT REQUIRED WHEN ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
4. MAINTAIN PROPER CLEARANCE FROM ALL UTILITIES PER THE NATIONAL ELECTRICAL SAFETY CODE.
5. INSTALL WIRELESS SERIAL RADIO MODEM WITH EXTERIOR DISCONNECT SWITCH LOCATED ON CABINET.
   (NOTE: RF ANTENNA DISCONNECT SWITCH AND DECAL ARE NOT REQUIRED WHEN THE ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
6. REFERENCE "WIRELESS RADIO ANTENNA TYPICAL DETAILS."

Wireless Communications – Typical Plan Sheet Notes & Legend

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.1

SHEET 1 OF 1

WIRELESS – STANDARD CONSTRUCTION NOTES

YAGI VERTICALLY POLARIZED

INSTALL 8.5 DB GAIN YAGI ANTENNA VERTICALLY POLARIZED

INSTALL 13 DB GAIN YAGI ANTENNA VERTICALLY POLARIZED

YAGI HORIZONTALLY POLARIZED

INSTALL 8.5 DB GAIN YAGI ANTENNA HORIZONTALLY POLARIZED

INSTALL 13 DB GAIN YAGI ANTENNA HORIZONTALLY POLARIZED

OMNI VERTICALLY POLARIZED

INSTALL 3 DB GAIN OMNI ANTENNA VERTICALLY POLARIZED

INSTALL 6 DB GAIN OMNI ANTENNA VERTICALLY POLARIZED

ATTACHMENT NOTES

ATTACH ANTENNA 12" ABOVE SIGNAL CABLE

ATTACH ANTENNA 6" ABOVE SIGNAL CABLE

ATTACH ANTENNA 12" ABOVE SIGNAL CABLE WEATHERHEAD

ATTACH ANTENNA 6" ABOVE SIGNAL CABLE WEATHERHEAD

ATTACH ANTENNA 12" BELOW SIGNAL CABLE

ATTACH ANTENNA 6" BELOW SIGNAL CABLE

ATTACH ANTENNA 12" BELOW SIGNAL CABLE WEATHERHEAD

ATTACH ANTENNA 6" BELOW SIGNAL CABLE WEATHERHEAD

ATTACH ANTENNA 40" BELOW POWER

ATTACH ANTENNA ALONG MAST ARM A MINIMUM OF 6 FEET AWAY FROM THE VERTICAL SHAFT MEMBER

NOTE: ATTACHMENT NOTES FOR THE ANTENNA CAN ALSO BE CHANGED TO REFERENCE OTHER UTILITIES (I.E., PHONE, CABLE, ETC.)
NOTE: FOR UNDERGROUND CONDUIT INSTALLATIONS INCLUDE THE FOLLOWING NOTE — "PROVIDE COAXIAL CABLE SUITABLE FOR WET LOCATIONS"

OTHER COMMONLY USED NOTES

MASTER NOTE

INSTALL TELEPHONE SERVICE

JOINT USE POLE NOTE

JOINT USE POLE
INCLUDE DISCONNECT SWITCH, WARNING SIGN AND DECAL

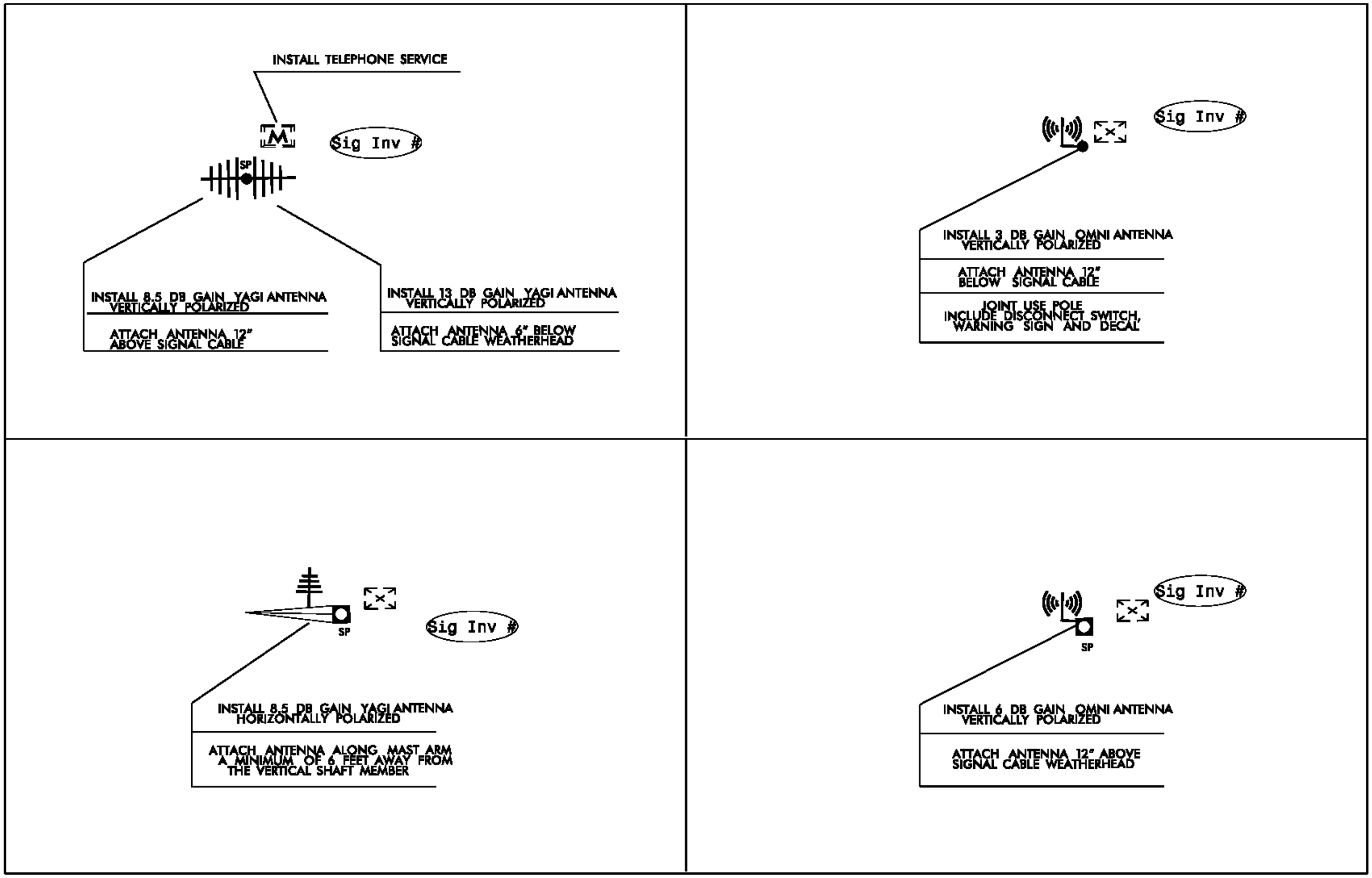
Wireless Communications – Sample of Wireless Notes

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.2

SHEET 1 OF 1

SAMPLES



Wireless Communications – Sample Intersection with Wireless Notes

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.3

SHEET 1 OF 1

ANTENNA DESIGN NOTES

OMNI ANTENNAS ARE ALWAYS INSTALLED VERTICALLY POLARIZED.

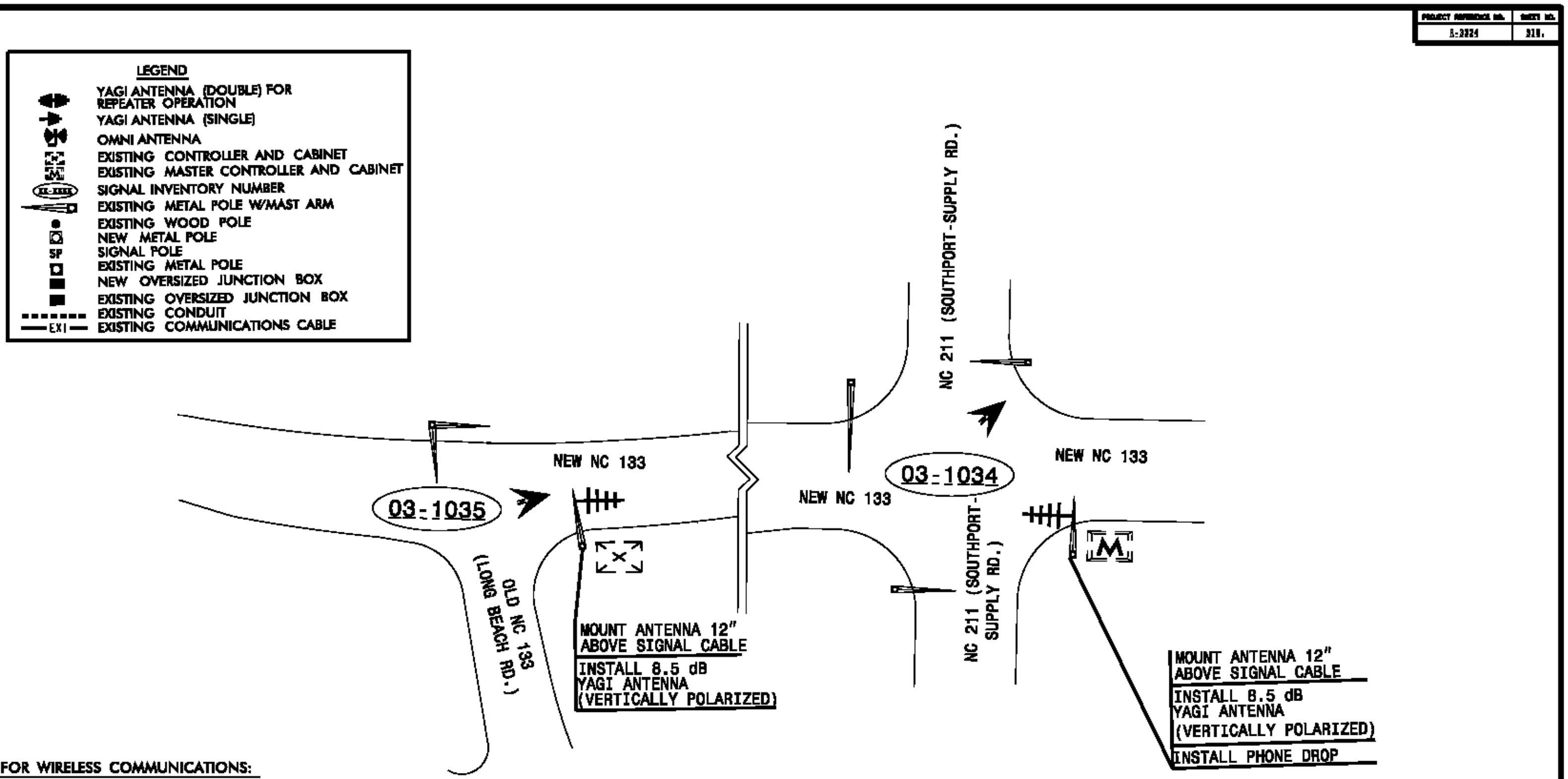
YAGI ANTENNAS CAN BE INSTALLED EITHER VERTICALLY POLARIZED OR HORIZONTALLY POLARIZED.

OMNI ANTENNAS CAN COMMUNICATE WITH BOTH OMNI ANTENNAS AND YAGI ANTENNAS. HOWEVER, IF COMMUNICATIONS IS DESIRED BETWEEN AN OMNI ANTENNA AND A YAGI ANTENNA, THEN THE YAGI ANTENNA MUST BE INSTALLED IN THE VERTICALLY POLARIZED POSITION.

YAGI ANTENNAS INSTALLED IN THE VERTICALLY POLARIZED POSITION CAN ONLY COMMUNICATE WITH OTHER YAGI ANTENNAS THAT ARE ALSO VERTICALLY POLARIZED.

YAGI ANTENNAS INSTALLED IN THE HORIZONTALLY POLARIZED POSITION CAN ONLY COMMUNICATE WITH OTHER YAGI ANTENNAS THAT ARE ALSO HORIZONTALLY POLARIZED.

WHEN DEALING WITH A DUAL ANTENNA DESIGN (REPEATING OPERATION) THE ANTENNAS CAN BOTH BE INSTALLED HORIZONTALLY POLARIZED OR VERTICALLY POLARIZED. ADDITIONALLY, ONE ANTENNA CAN BE INSTALLED HORIZONTALLY POLARIZED AND THE SECOND ANTENNA CAN BE INSTALLED VERTICALLY POLARIZED.



NOTES FOR WIRELESS COMMUNICATIONS:

1. INSTALL COAXIAL CABLE:
   A. ON WOOD POLES, REQUIRING A NEW RIGID GALVANIZED STEEL RISER, INSTALL A 2" RISER WITH WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   B. ON METAL POLES WITH MAST ARMS, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE MAST ARM; FIELD DRILL A 1/2" HOLE UP THROUGH THE BOTTOM OF MAST ARM FOR INSTALLATION OF THE COAXIAL CABLE TO THE ANTENNA.
   C. ON METAL STRAIN POLES, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   D. BETWEEN THE POINT OF EXITING THE RISER, METAL POLE OR MAST ARM AND THE ANTENNA, SECURE THE COAXIAL CABLE TO THE STRUCTURE USING 3/4" STAINLESS STEEL STRAPS EVERY 12".
2. IF AN EXISTING 2" SPARE RIGID GALVANIZED STEEL RISER IS AVAILABLE, INSTALL THE COAXIAL CABLE IN THE SPARE RISER.
3. INSTALL WIRELESS ANTENNA ON POLE WITH RF WARNING SIGN. (NOTE: RF WARNING SIGN NOT REQUIRED WHEN ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
4. MAINTAIN PROPER CLEARANCE FROM ALL UTILITIES PER THE NATIONAL ELECTRICAL SAFETY CODE.
5. INSTALL WIRELESS SERIAL RADIO MODEM WITH EXTERIOR DISCONNECT SWITCH LOCATED ON CABINET. (NOTE: RF ANTENNA DISCONNECT SWITCH AND DECAL ARE NOT REQUIRED WHEN THE ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
6. REFERENCE "WIRELESS RADIO ANTENNA TYPICAL DETAILS."

SOUTHPORT
NC 211/NC 133/NEW NC 133

Wireless Communications – Sample Plan – Wireless Communications Plan (Stand Alone)

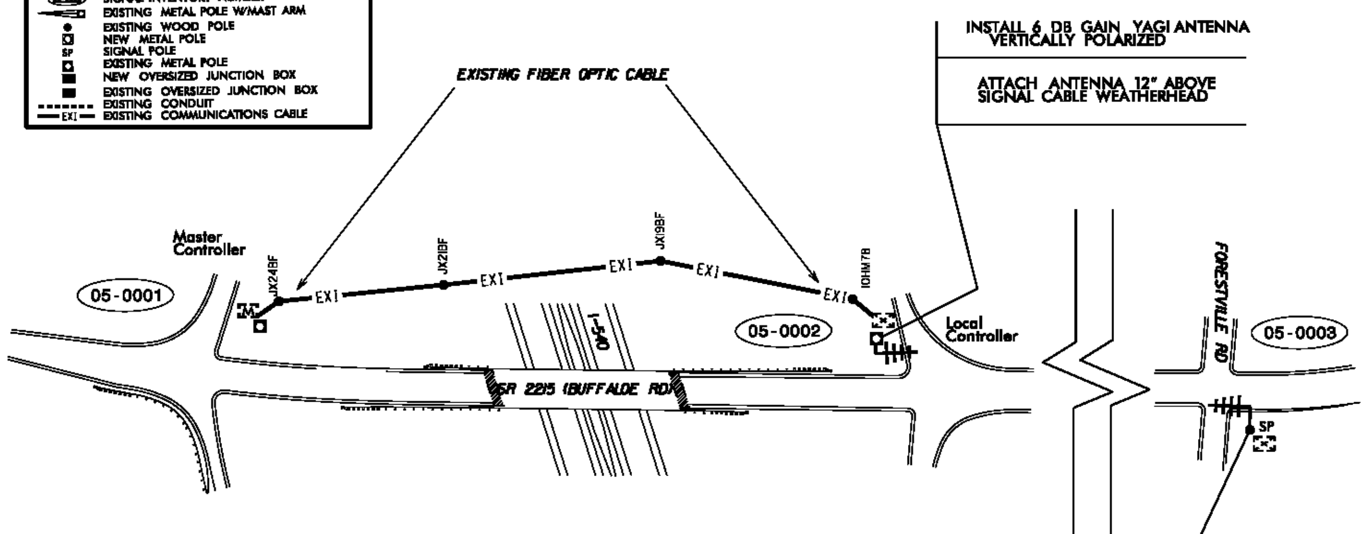
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.5

SHEET 1 OF 5

LEGEND

- YAGI ANTENNA (DOUBLE) FOR REPEATER OPERATION
- YAGI ANTENNA (SINGLE)
- OMNI ANTENNA
- EXISTING CONTROLLER AND CABINET
- EXISTING MASTER CONTROLLER AND CABINET
- SIGNAL INVENTORY NUMBER
- EXISTING METAL POLE W/MAST ARM
- EXISTING WOOD POLE
- NEW METAL POLE
- SP SIGNAL POLE
- EXISTING METAL POLE
- NEW OVERSIZED JUNCTION BOX
- EXISTING OVERSIZED JUNCTION BOX
- EXISTING CONDUIT
- EXI EXISTING COMMUNICATIONS CABLE



INSTALL 6 DB GAIN YAGI ANTENNA VERTICALLY POLARIZED

ATTACH ANTENNA 12" ABOVE SIGNAL CABLE WEATHERHEAD

NOTES FOR WIRELESS COMMUNICATIONS:

1. INSTALL COAXIAL CABLE:
   A. ON WOOD POLES, REQUIRING A NEW RIGID GALVANIZED STEEL RISER, INSTALL A 2" RISER WITH WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   B. ON METAL POLES WITH MAST ARMS, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE MAST ARM; FIELD DRILL A 1/2" HOLE UP THROUGH THE BOTTOM OF MAST ARM FOR INSTALLATION OF THE COAXIAL CABLE TO THE ANTENNA.
   C. ON METAL STRAIN POLES, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   D. BETWEEN THE POINT OF EXITING THE RISER, METAL POLE OR MAST ARM AND THE ANTENNA, SECURE THE COAXIAL CABLE TO THE STRUCTURE USING 3/4" STAINLESS STEEL STRAPS EVERY 12".
2. IF AN EXISTING 2" SPARE RIGID GALVANIZED STEEL RISER IS AVAILABLE, INSTALL THE COAXIAL CABLE IN THE SPARE RISER.
3. INSTALL WIRELESS ANTENNA ON POLE WITH RF WARNING SIGN. (NOTE: RF WARNING SIGN NOT REQUIRED WHEN ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
4. MAINTAIN PROPER CLEARANCE FROM ALL UTILITIES PER THE NATIONAL ELECTRICAL SAFETY CODE.
5. INSTALL WIRELESS SERIAL RADIO MODEM WITH EXTERIOR DISCONNECT SWITCH LOCATED ON CABINET. (NOTE: RF ANTENNA DISCONNECT SWITCH AND DECAL ARE NOT REQUIRED WHEN THE ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
6. REFERENCE "WIRELESS RADIO ANTENNA TYPICAL DETAILS."

SR 2215 (BUFFALOE RD)
AT FORESTVILLE RD.
WIRELESS COMMUNICATIONS PLANS

DIVISION 05 WAKE COUNTY RALEIGH

PREPARED BY: P. C. LOUDER

REVIEWED BY: I. B. AVERY

SCALE 10 0 20 1:1000

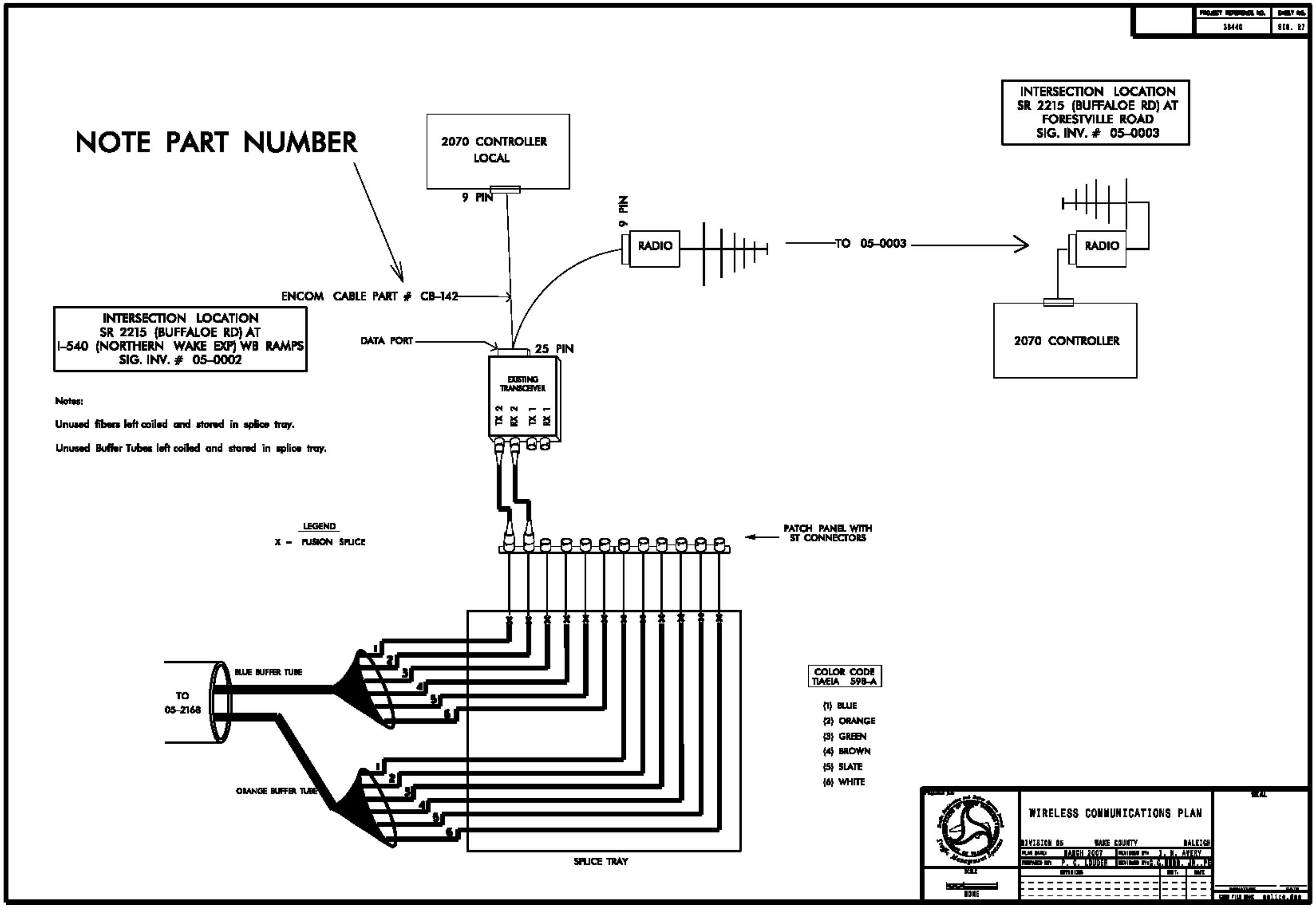
SEAL

Wireless Communications – Sample Plans – Fiber (Local Intersection) to Wireless Intersection

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.5

SHEET 2 OF 5

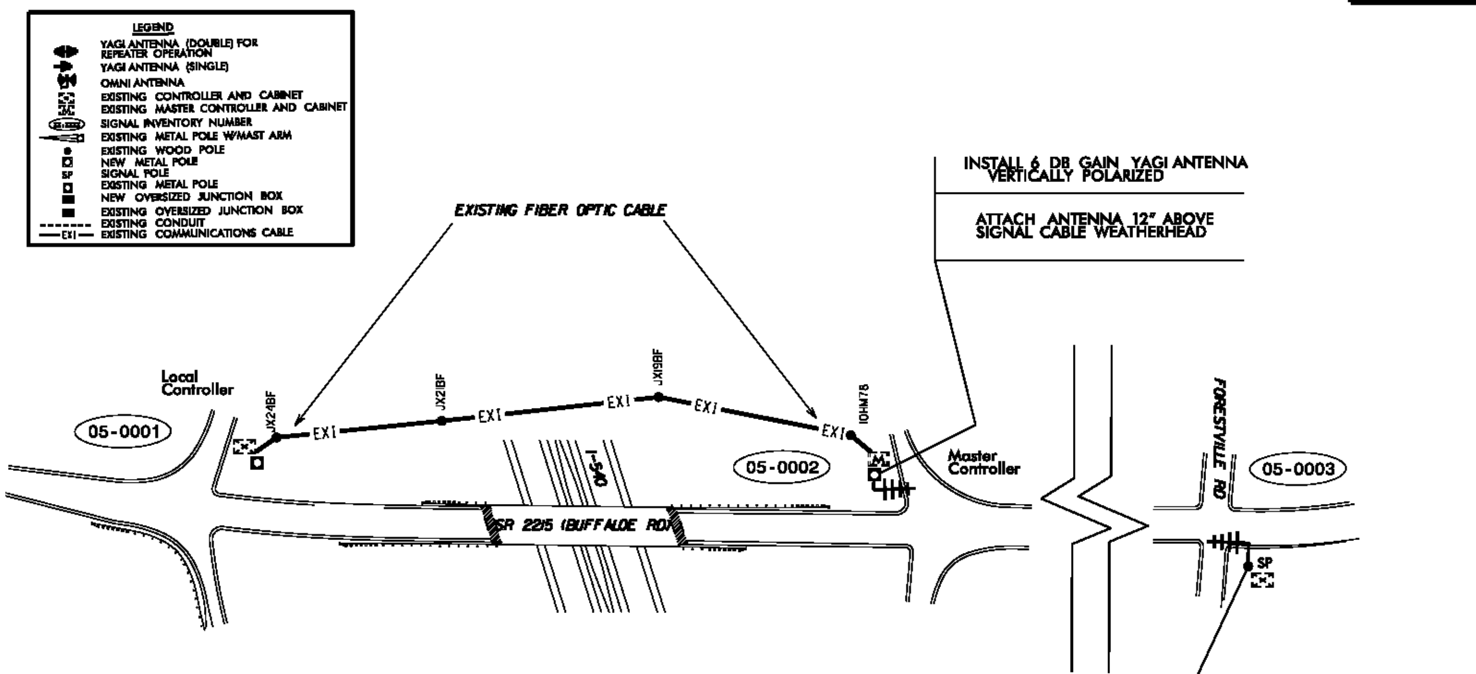


Wireless Communications – Sample Plans – Fiber Splicing (Local Intersction) to Wireless Intersection

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.5

SHEET 3 OF 5



NOTES FOR WIRELESS COMMUNICATIONS:

1. INSTALL COAXIAL CABLE:
   A. ON WOOD POLES, REQUIRING A NEW RIGID GALVANIZED STEEL RISER, INSTALL A 2" RISER WITH WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   B. ON METAL POLES WITH MAST ARMS, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE MAST ARM; FIELD DRILL A 1/2" HOLE UP THROUGH THE BOTTOM OF MAST ARM FOR INSTALLATION OF THE COAXIAL CABLE TO THE ANTENNA.
   C. ON METAL STRAIN POLES, RUN COAXIAL CABLE UP THROUGH THE POLE AND OUT THE WEATHERHEAD AND ROUTE THE COAXIAL CABLE TO THE ANTENNA.
   D. BETWEEN THE POINT OF EXITING THE RISER, METAL POLE OR MAST ARM AND THE ANTENNA, SECURE THE COAXIAL CABLE TO THE STRUCTURE USING 3/4" STAINLESS STEEL STRAPS EVERY 12".
2. IF AN EXISTING 2" SPARE RIGID GALVANIZED STEEL RISER IS AVAILABLE, INSTALL THE COAXIAL CABLE IN THE SPARE RISER.
3. INSTALL WIRELESS ANTENNA ON POLE WITH RF WARNING SIGN. (NOTE: RF WARNING SIGN NOT REQUIRED WHEN ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
4. MAINTAIN PROPER CLEARANCE FROM ALL UTILITIES PER THE NATIONAL ELECTRICAL SAFETY CODE.
5. INSTALL WIRELESS SERIAL RADIO MODEM WITH EXTERIOR DISCONNECT SWITCH LOCATED ON CABINET. (NOTE: RF ANTENNA DISCONNECT SWITCH AND DECAL ARE NOT REQUIRED WHEN THE ANTENNA IS INSTALLED ON AN NCDOT-OWNED POLE.)
6. REFERENCE "WIRELESS RADIO ANTENNA TYPICAL DETAILS."

INSTALL 6 DB GAIN YAGI ANTENNA VERTICALLY POLARIZED

ATTACH ANTENNA 12" ABOVE SIGNAL CABLE WEATHERHEAD

SR 2215 (BUFFALOE RD)
AT FORESTVILLE RD.
WIRELESS COMMUNICATIONS PLANS

DIVISION 05 WAKE COUNTY RALEIGH

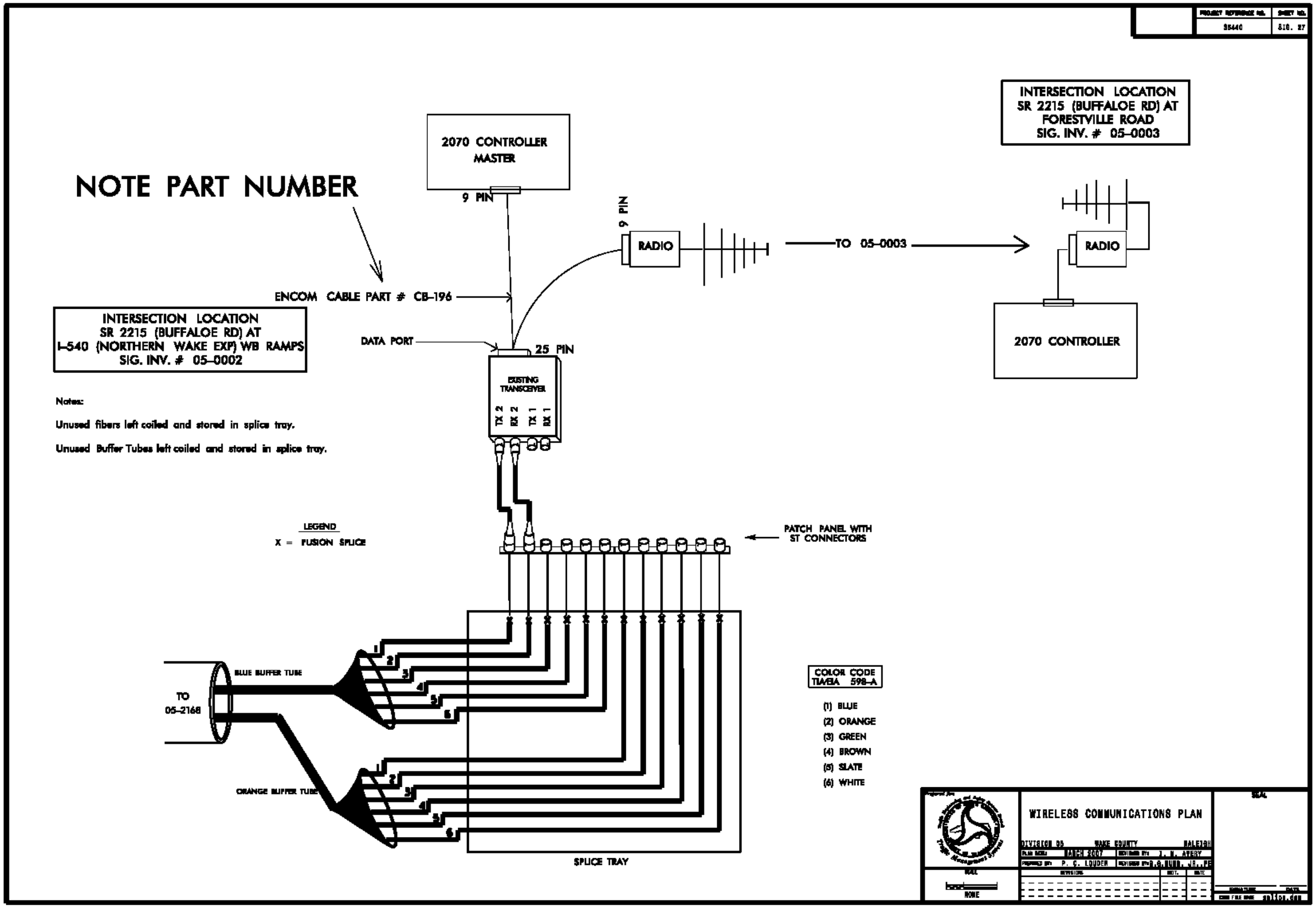
MARCH 2007 I. N. AVENT

SCALE 1:1000

Wireless Communications – Sample Plans – Fiber (Local Intersection) to Wireless Intersection

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.5



Wireless Communications – Sample Plans – Fiber Splicing (Master Intersction) to Wireless Intersection

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRANSPORTATION MOBILITY AND SAFETY DIVISION
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STD. NO. 6.5

SHEET 5 OF 5

DMS Site Selection and Design Process

- Obtain recommended locations from Congestion Management Section
- Identify points of interest:
  - Alternate route(s)
  - Venues (Stadiums, Motor Speedways, Sports /Concert Arenas)
- Set up a field investigation event with the following people:
  - Division Incident Management Engineer
  - Regional ITS Engineer
  - Regional Traffic Engineer
  - Signing Project Design Engineer
- Select a location that meets the following criteria:
  - Select location that is 2–4 miles in advance of the point of interest
  - Insure that display has at least 1200′ of unobstructed sight distance
  - Avoid placement in curves
  - Select location where shoulder is widest to avoid future lane closure
  - Ensure an ideal location at least 50 feet in advance of the display can be selected for the controller cabinet
  - Consider phone and power service availability
  - For 1–2 lanes (each direction) consider pedestal type assembly
  - For 3 or more lanes (each direction) consider full span assembly
  - Ensure all parties agree on the selected location
- Confirm the location by sending emails to all parties involved
  - Reference the location from the nearest mile marker
  - If no mile marker exists, use bridge or intersection as reference
- Confirm availability of utilities by coordinating with Division personnel and Utility agents
- Develop Project Special Provisions
  - Determine if a particular brand is to be specified
    - Ensure integration section and pay item is included
    - Ensure that a bench test unit is not required
    - Determine if training is required
    - Determine if UPS, Modem, and Modem Reset devices are needed
  - Determine if desktop /laptop computers are needed
  - Determine if software upgrade is required
  - Determine if Fiber Optic Communication is to be used
    - Determine if dial–up backup system is not required
      - Ensure that dial up modems and related devices are not required
- Follow up with the Signing Section on the development of Structure line drawings, Traffic Control, and Roadway Plans
- If assembling the package for submission to Design Services, obtain plans from Traffic Control and Roadway and confirm quantities
- Ensure DMS Grounding Detail is inserted into the ITS Plans
- Ensure DMS Project Special Provisions are included with ITS Package

I. Cabinets

A. Note cabinet location

B. Note signal inventory number
(usually marked on cabinet)
Example: 01-0459

C. Note cabinet type
(base mount/pole mount)

D. Check inside cabinet for space conduit
(signal technician must be present before doing this)

II. Poles

A. Note pole type
(wood,metal,metal with mast arm)

B. Note pole number
(if applicable)
Use "SP" for signal pole

C. Determine NCDOT attachment height

D. Note any clearance problems or
adjustments required in order to
assume the desired attachment height

E. See section 1.0 for NESC clearance requirements

F. Record distances between poles
using laser range finder or measuring wheel

G. When evaluating adjustment options, be mindful
of 'height over grade' clearances

H. If adjustments are required on a pole,
record the attachment heights of all
existing utilities using the laser range finder

I. Determine vertical clearance over road as needed.
Use the laser range finder.
Measure from the roadway to the lowest
point on the span.

III. Roads and Structures

A. Record all road names and
state road (SR) numbers if applicable

B. Note any bridges (grade separations)

C. Record any landmarks, buildings, or
other structures for reference purposes
as needed

IV. Railroads

A. When the cable route crosses over
or under a railroad, special wire-line
agreements must be made.

B. The following information is needed
for wire line agreements:

1. Crossing number (if available)
usually found on cross arm mechanism
or crossing controller cabinet

2. Distance from center line of track to the
nearest pole on each side of the track
(for aerial installation)

3. Vertical clearance from the top of the rail
to the lowest existing overhead utility
(aerial installation)

4. Distance from crossing to the nearest
railway mile marker.
This information may be obtained through
NCDOT Railway Division, Railroad Company
Right of Way, or NCDOT Right of Way.

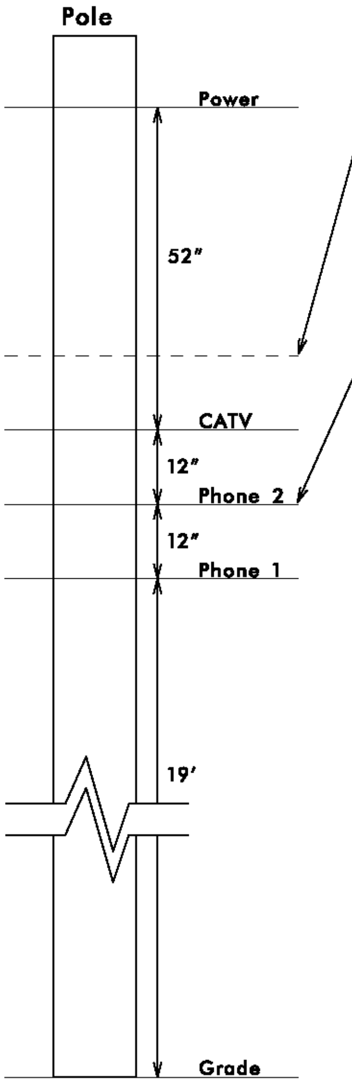
Utility Make Ready – Field Investigation Checklist

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
8.0

Case 1



A. If proposed NCDOT communications cable attachment height is 40" below power

Typical Adjustment Notes

no adjustment required

there is adequate clearance

B. If proposed NCDOT communications cable attachment height is 12" below CATV

Typical Adjustment Notes

CATV raise to 40" below power

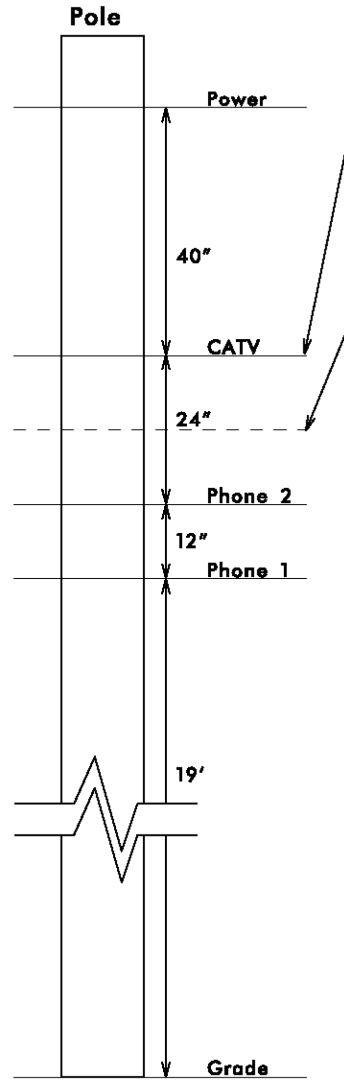
or

phone 2 lower to 24" below CATV
phone 1 lower to 12" below phone 2

Typical Utility Tree

25' -04"	Power	
21' -00"	CATV	52"
20' -00"	Phone 2	12"
19' -00"	Phone 1	12"

Case 2



A. If proposed NCDOT communications cable attachment height is 40" below power

Typical Adjustment Notes

CATV lower to 52" below power

B. If proposed NCDOT communications cable attachment height is 12" below CATV

Typical Adjustment Notes

no adjustment note required

there is adequate clearance

Typical Utility Tree

25' -04"	Power	
22' -00"	CATV	40"
20' -00"	Phone 2	24"
19' -00"	Phone 1	12"

Utility Make Ready – Common Adjustment Notes

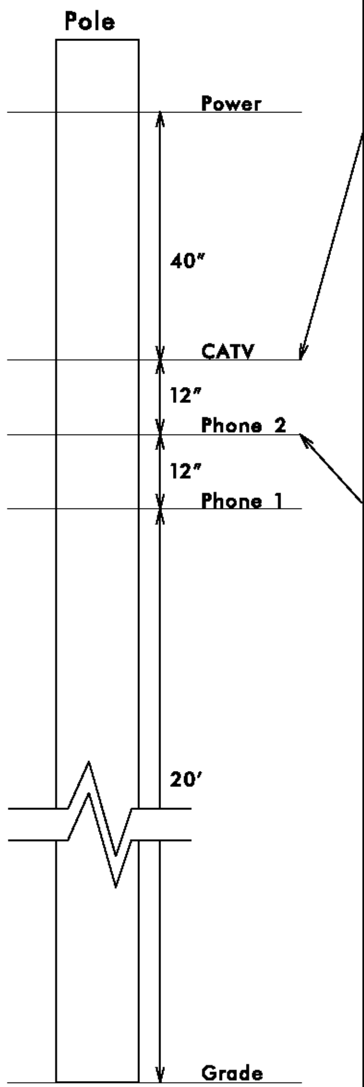
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 8.1

SHEET 1 OF 2

Case 3



A.

If proposed NCDOT communications cable attachment height is 40" below power

Typical Adjustment Notes

All utilities to lower 12"

or

CATV lower to 52" below power
Phone 2 lower to 64" below power
Phone 1 lower to 76" below power

or

CATV lower to 52" below power
Phone 2 lower to 12" below CATV
Phone 1 lower to 12" below Phone 2

B.

If proposed NCDOT communications cable attachment height is 12" below CATV

Typical Adjustment Notes

Phone 1 and Phone 2 lower 12"

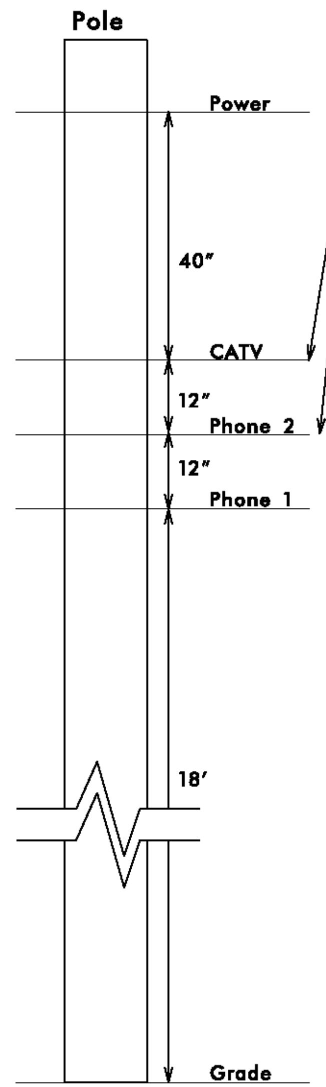
or

Phone 2 lower to 24" below CATV
Phone 1 lower to 12" below Phone 2

Typical Utility Tree

25' -04"	Power	
22' -00"	CATV	40"
21' -00"	Phone 2	12"
20' -00"	Phone 1	12"

Case 4



If proposed NCDOT communications cable attachment height is
40" below power
or
12" below CATV

Required adjustments would put lowest utility (phone 1) below 18' above grade

Therefore the existing pole must be replaced with a taller pole

Typical Adjustment Notes

General

Change out pole

Specific

Replace existing power pole (pole #) with class 2 – 55' wood pole

Typical Utility Tree

23' -04"	Power	
20' -00"	CATV	40"
19' -00"	Phone 2	12"
18' -00"	Phone 1	12"

Utility Make Ready – Common Adjustment Notes

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 8.1

SHEET 2 OF 2

Standard Design Elements Feature Description	Level	Color	Line Wt.	Line Style
Existing Roads EOP	58150	4	4	0
Existing Roads Match Line	58151	3	4	0
Proposed Aerial Guy	58152	6	1	0
Existing Bridge	58153	6	3	0
Existing Sidewalk	58154	19	1	0
Proposed Construction Note Leader Line	58155	3	1	0
Proposed Attachment Note Leader Line	58156	3	1	0
Proposed Utility Adjustment Leader Line	58157	3	1	0

Text Feature Description	Level	Color	Line Wt.	Line Style	Font	Size (English) 30:1	40:1	50:1	60:1	70:1	80:1	90:1	100:1
Existing Road Text	58200	3	4	0	11	8	10	12	14	16	18	20	22
Existing Road Match Line Text	58201	13	4	0	11	8	10	12	14	16	18	20	22
Existing Sidewalk Text	58202	19	1	0	11	4	5	7	9	11	13	15	17
Proposed Slack Span Text	58203	3	1	0	11	4	5	7	9	11	13	15	17
Proposed Attachment Text	58204	3	1	0	11	6	8	10	12	14	16	18	20
Proposed Utility Adjustment Text	58205	3	1	0	11	8	10	12	14	16	18	20	22
Existing Railroad Text	58206	7	1	0	11	8	10	12	14	16	18	20	22
Existing Right of Way Text	58207	5	1	0	11	8	10	12	14	16	18	20	22
Existing Pole Text	58208	3	1	0	11	4	5	7	9	11	13	15	17
Proposed General Note Text	58209	3	1	0	11	8	10	12	14	16	18	20	22

Group	Custom Line Styles Feature Description	Level	Color	Line Wt.	Line Style	Font	Scale 30:1	40:1	50:1	60:1	70:1	80:1	90:1	100:1
TMS Custom	Proposed Aerial Fiber Optic Cable	58000	3	0	Sig Com Cab FO		70	80	90	100	120	140	160	180
TMS Custom	Proposed Twisted Pair Cable	58001	4	0	Sig Com Cab Twi Pr Exi		70	80	90	100	120	140	160	180
TMS Custom	Existing Communications Cable	58002	1	0	Sig Com Cab Exi		70	80	90	100	120	140	160	180
TMS Custom	Remove Existing Communications Cable	58003	2	0	Sig Com Cab Rmv		70	80	90	100	120	140	160	180
TMS Custom	Proposed Conduit	58004	0	0	Sig Com Cab Nw Cond		70	80	90	100	120	140	160	180
TMS Custom	Existing Conduit	58005	6	0	Sig Com Cab Exi Cond		70	80	90	100	120	140	160	180
TMS Custom	Proposed Directional Drilled Conduit	58006	1	0	Sig Com Cab Dr Dri		70	80	90	100	120	140	160	180
TMS Custom	Proposed Jack and Bore Conduit	58007	120	0	Sig Com Cab Jac Bor		70	80	90	100	120	140	160	180
Other Custom	Existing Railroad Track	58008	7	2	(0) ncmap RR Gau Std		70	80	90	100	120	140	160	180
Other Custom	Existing Railroad Track (Title Sheet)	58009	0	1	(0) Sig Geo RR		1	1.5	2	2	2.5	2.5	3	3
Other Custom	Existing Railroad Gate	58010	3	1	(0) Sig Geo RR Gat		1	1.5	2	2	2.5	2.5	3	3
Other Custom	Existing Railroad Cantilever	58011	3	1	(0) Sig Geo RR Can		1	1.5	2	2	2.5	2.5	3	3
Other Custom	Existing Railroad Lights	58012	3	1	(0) Sig Geo RR Lit		1	1.5	2	2	2.5	2.5	3	3
Other Custom	Existing Right of Way	58013	5	1	(0) ncmap ROW Exi		30	40	50	60	70	80	90	100
Other Custom	Existing Guard Rail	58014	6	4	(0) Rdy GR Prop		30	40	50	60	70	80	90	100
Other Custom	Existing Fence Line	58015	0	1	(0) ncmap Fen		30	40	50	60	70	80	90	100
Other Custom	Existing Hedge Row	58016	153	1	(0) ncmap Hdg		30	40	50	60	70	80	90	100
Other Custom	Existing Woods	58017	153	1	(0) ncmap Wds		30	40	50	60	70	80	90	100
Other Custom	Existing Streams and Rivers	58018	99	1	2-5-2		1	1	1	1	1	1	1	1

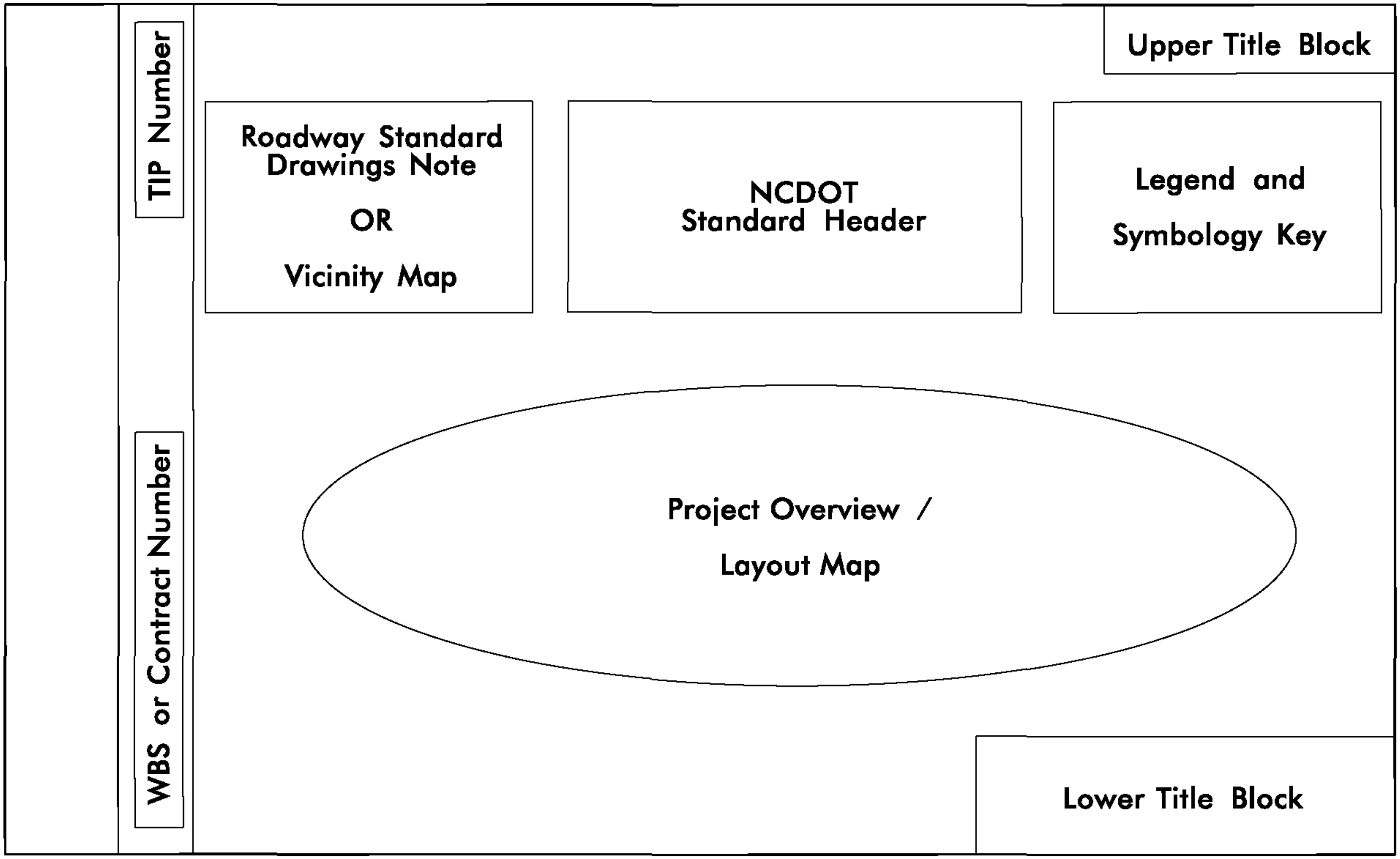
Standard Sheet Layout – TMS Standard CADD Symbology

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. **9.0**

SHEET 1 OF 1



Standard Sheet Layout – UMR Title Sheet

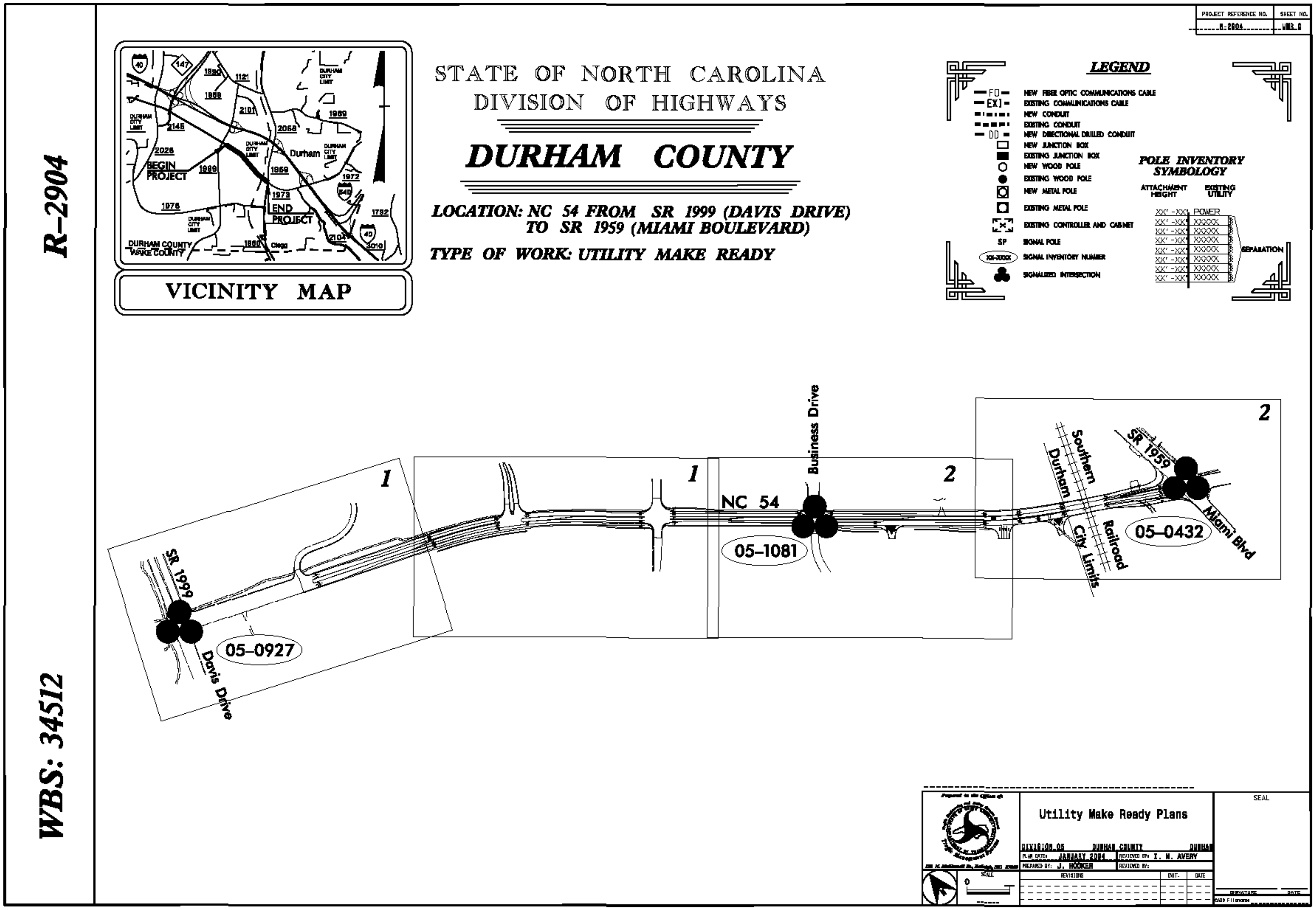
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.

9.1

SHEET 1 OF 5



Standard Sheet Layout – Sample UMR Title Sheet

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

Notes

Number UMR plan sheets in the
upper title block

Utility Make Ready plans are
not sealed by a professional engineer
do not include seal in lower block

PROJECT REFERENCE NO.	SHEET NO.
R-2904	UMR 0

Typical Upper Title Block

Typical Lower Title Block

Prepared in the Offices of:

Traffic Engineering and Safety Systems Branch
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
Traffic Management Systems

122 N. McDowell St., Raleigh, NC 27603

Utility Make Ready Plans

DIVISION 05 DURHAM COUNTY DURHAM

PLAN DATE: JANUARY 2004	REVIEWED BY: I. N. AVERY
PREPARED BY: J. HOOKER	REVIEWED BY:

SCALE

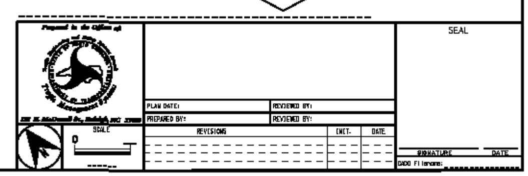
0

REVISIONS	INIT.	DATE

SEAL

SIGNATURE DATE

CADD Filename:



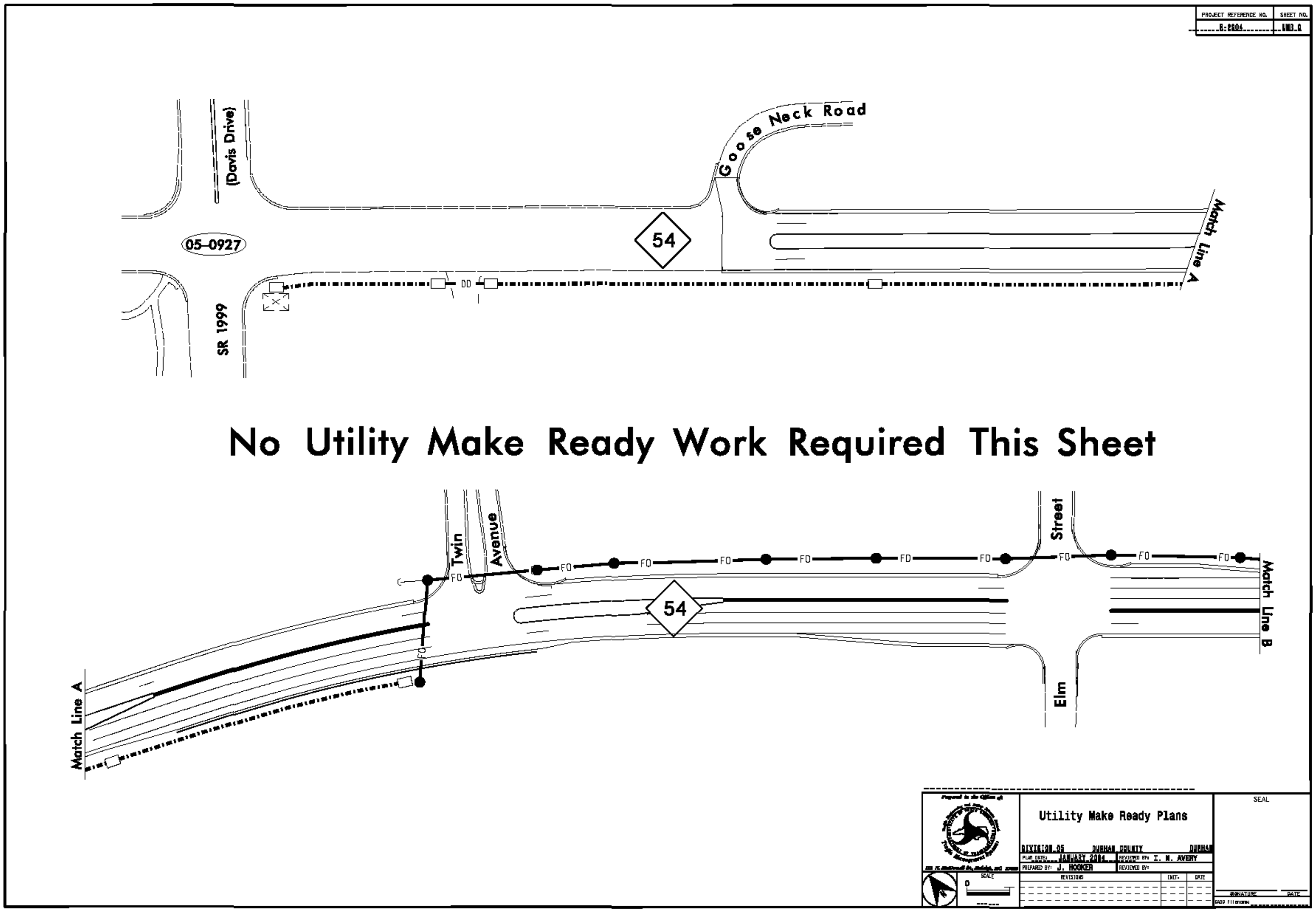
Standard Sheet Layout – Title Blocks – UMR

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 9.1

SHEET 3 OF 5

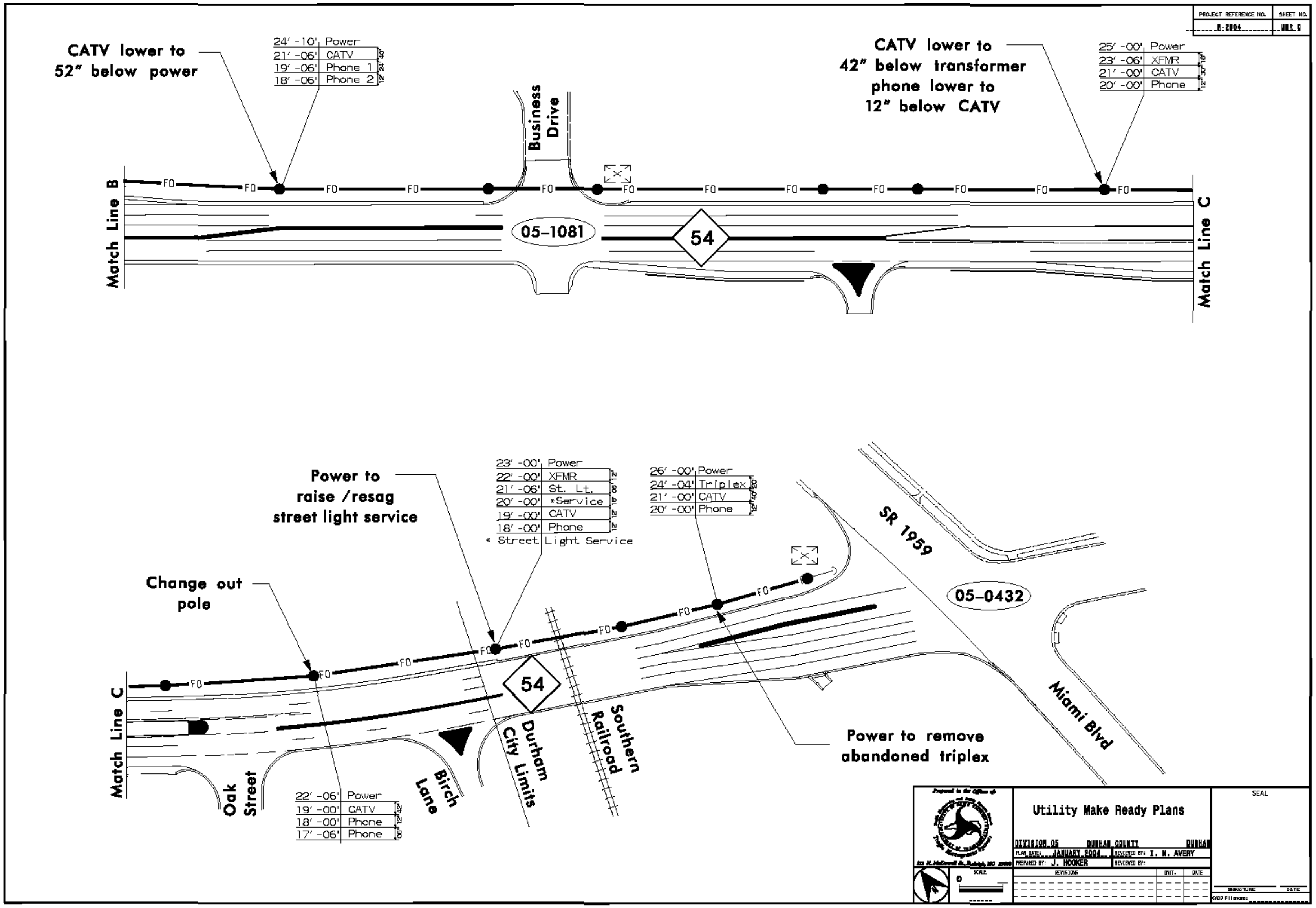


Standard Sheet Layout – Sample UMR Plan Sheet

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

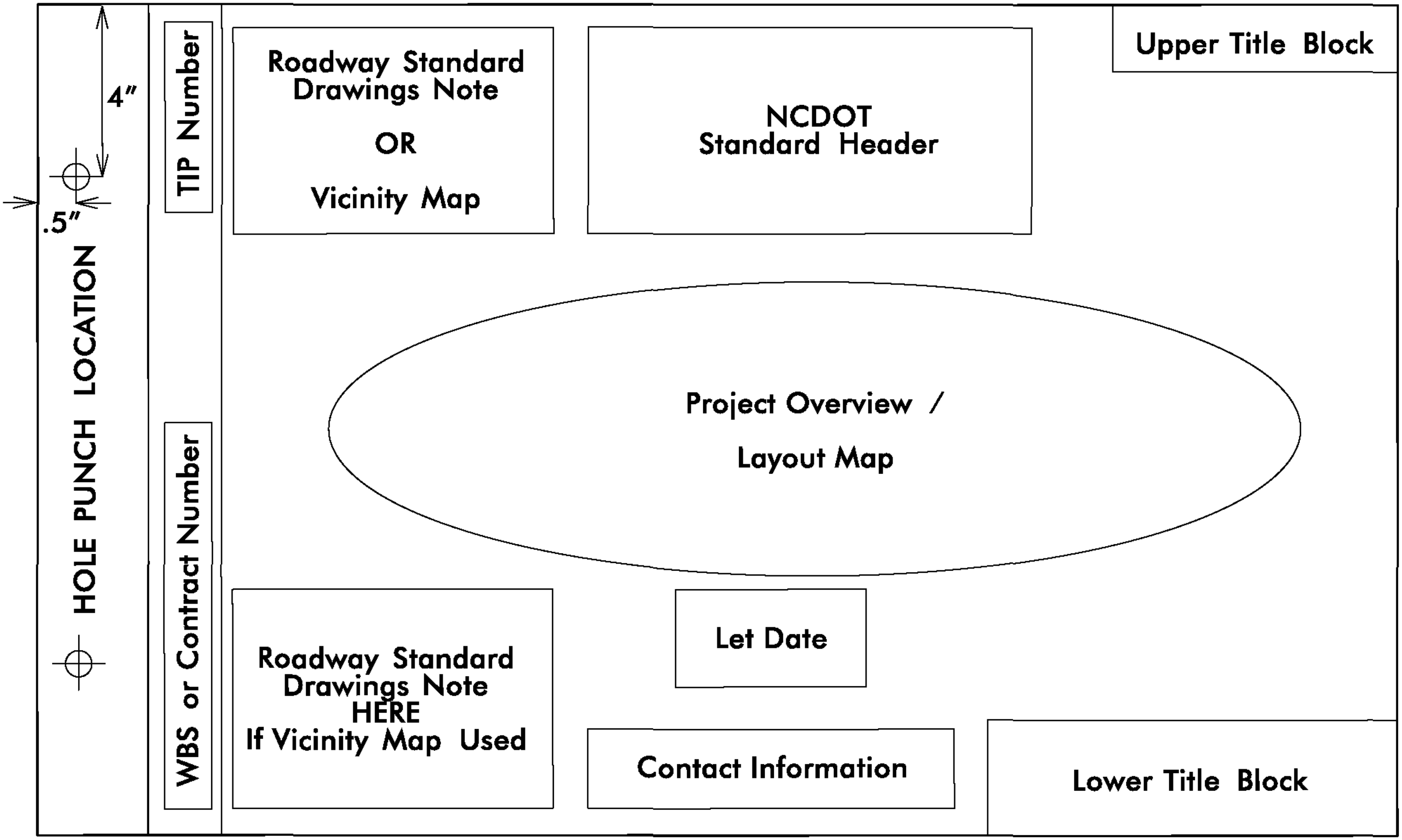
STD. NO.
9.1
SHEET 4 OF 5

7-04



Standard Sheet Layout – Sample UMR Plan Sheet

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



Standard Sheet Layout – Cable Routing Title Sheet

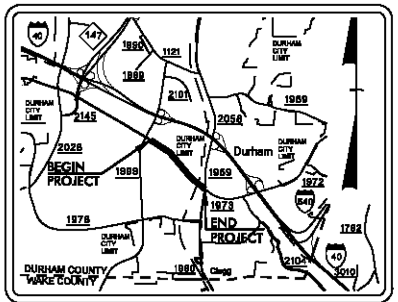
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
9.2
SHEET 1 OF 5

R-2904

WBS: 34512



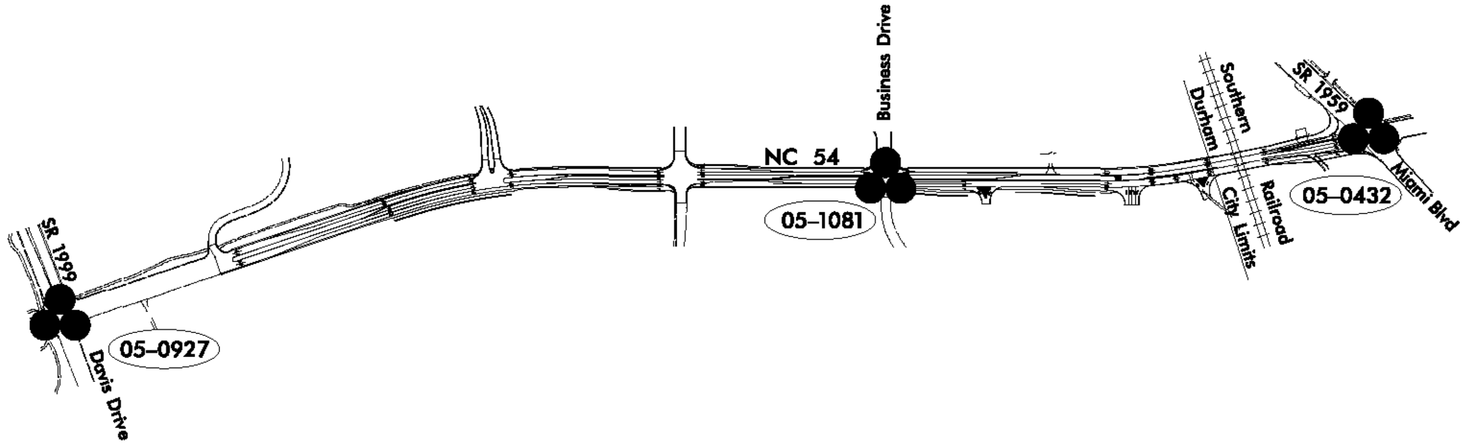
VICINITY MAP

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

DURHAM COUNTY

LOCATION: NC 54 FROM SR 1999 (DAVIS DRIVE) TO SR 1959 (MIAMI BOULEVARD)

TYPE OF WORK: COMMUNICATIONS CABLE AND CONDUIT ROUTING



ROADWAY STANDARD DRAWINGS

THE FOLLOWING ROADWAY STANDARDS AS APPEAR IN "ROADWAY STANDARD DRAWINGS", ROADWAY DESIGN UNIT – N.C. DEPARTMENT OF TRANSPORTATION – RALEIGH, N.C., DATED JANUARY 2002 ARE APPLICABLE TO THIS PROJECT AND BY REFERENCE HEREBY ARE CONSIDERED A PART OF THESE PLANS:

STD. NO.	TITLE
1715.01	UNDERGROUND CONDUIT
1716.01	JUNCTION BOXES
1720.01	WOOD POLES
1721.01	GUY ASSEMBLIES
1730.01	FIBER OPTIC CABLE – SPARE CABLE STORAGE
1730.02	FIBER OPTIC CABLE – CONDUIT INSTALLATION
1733.01	DELINEATOR MARKERS
1740.01	METAL POLES

Let Date: 12/14/04

NCDOT CONTACT:

TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
G.G. MURR, JR., PE – TRAFFIC MANAGEMENT SYSTEMS ENGINEER

Communications Cable and Conduit Routing Plans

DIVISION 05 DURHAM COUNTY DURHAM
PLAN DATE: JANUARY 2004 REVIEWED BY: I. M. AVERY
PREPARED BY: J. HOOKER REVIEWED BY: J.Q. ENGINEER

Standard Sheet Layout – Sample Cable Routing Title Sheet

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

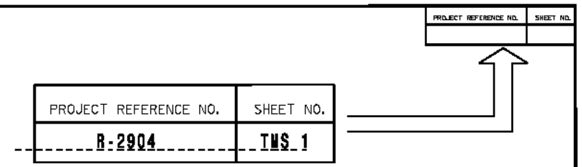
7-04

STD. NO. 9.2

Notes

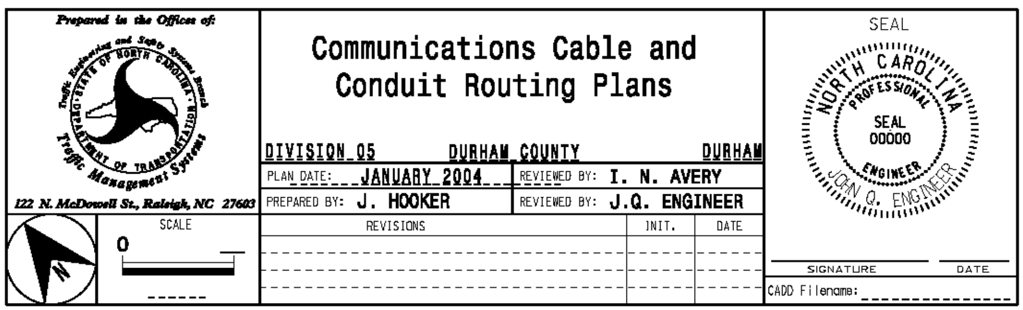
Number Cable Routing plan sheets in the upper title block

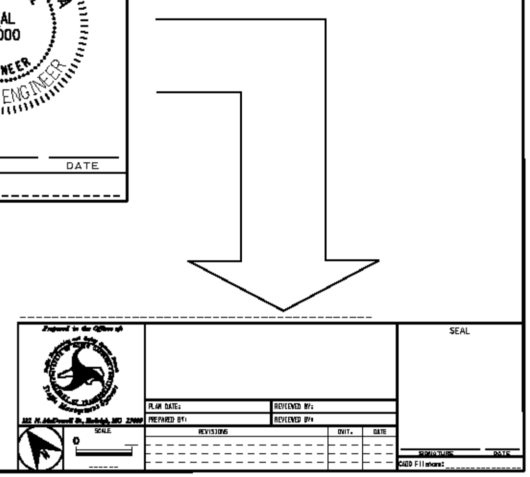
For Closed Loop System projects do not number the sheets. They are numbered later as part of a larger plan package.



Typical Upper Title Block

Typical Lower Title Block



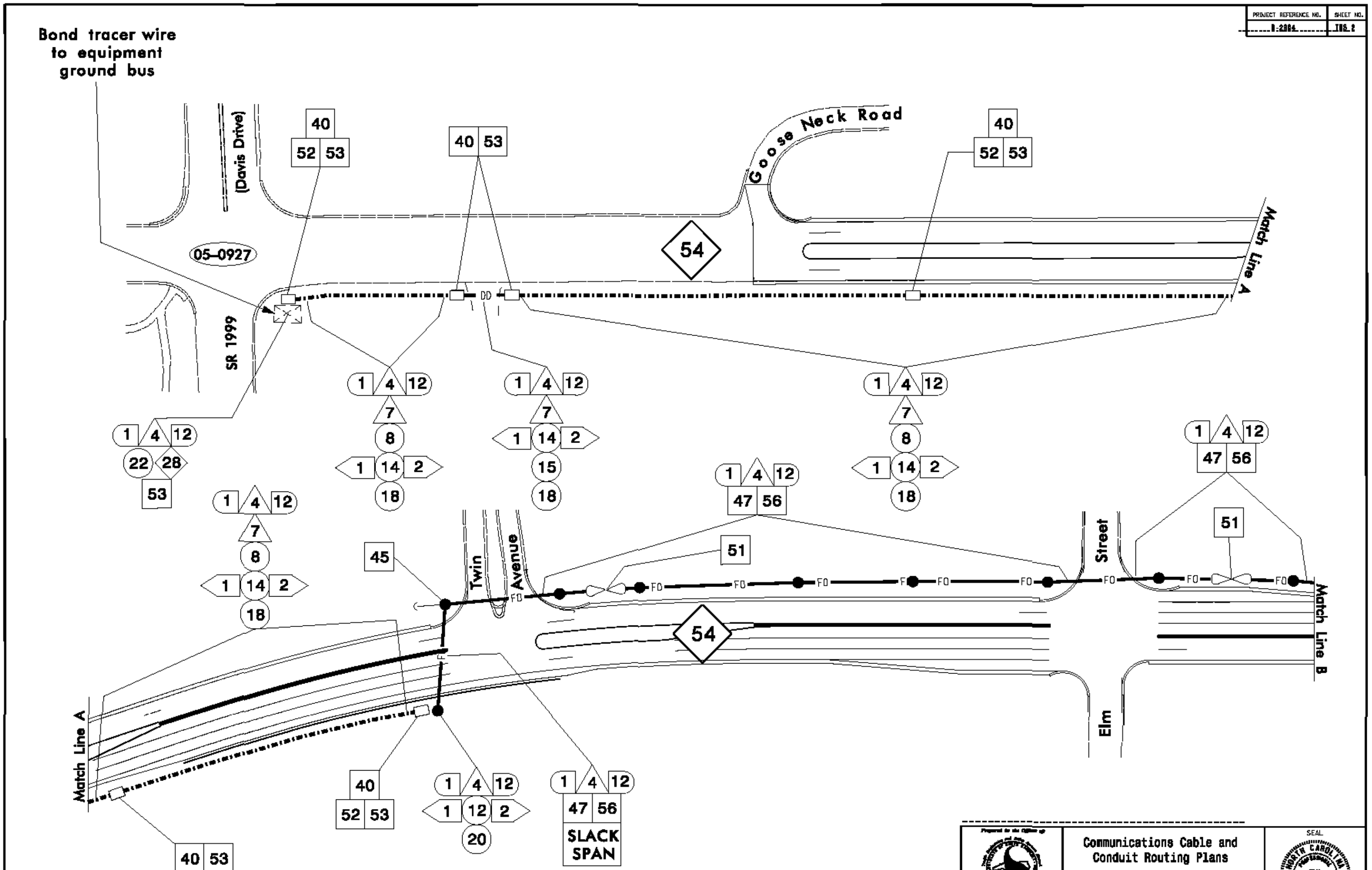


Standard Sheet Layout – Title Blocks – Cable Routing

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.
9.2
SHEET 3 OF 5



Unless otherwise note, all NCDOT attachment points are 40" below power, front side of pole
Over-sized junction boxes to be placed approximately 400 feet apart unless otherwise noted
Seal conduit ends with mechanical sealing devices at all junction box /cabinet entrances

Communications Cable and Conduit Routing Plans

SEAL

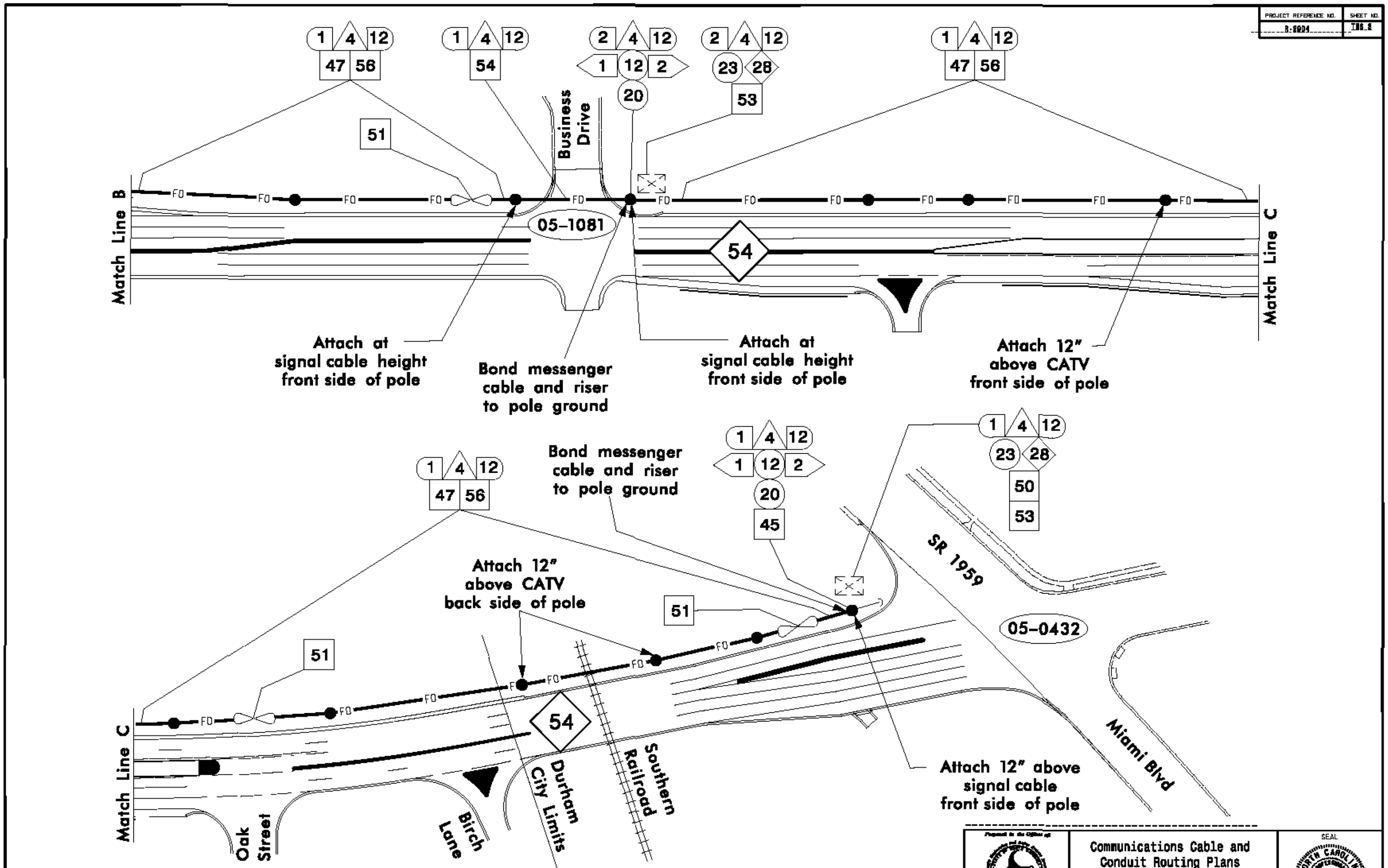
Standard Sheet Layout – Sample Cable Routing Plan Sheet

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO.

9.2



Unless otherwise noted, all NCDOT attachment points are 40" below power, front side of pole
Over-sized junction boxes to be placed approximately 400 feet apart unless otherwise noted
Seal conduit ends with mechanical sealing devices at all junction box/cabinet entrances

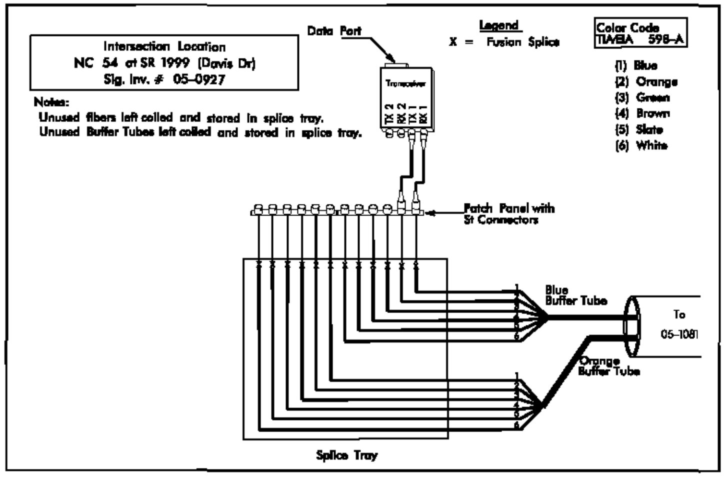
Standard Sheet Layout – Sample Cable Routing Plan Sheet

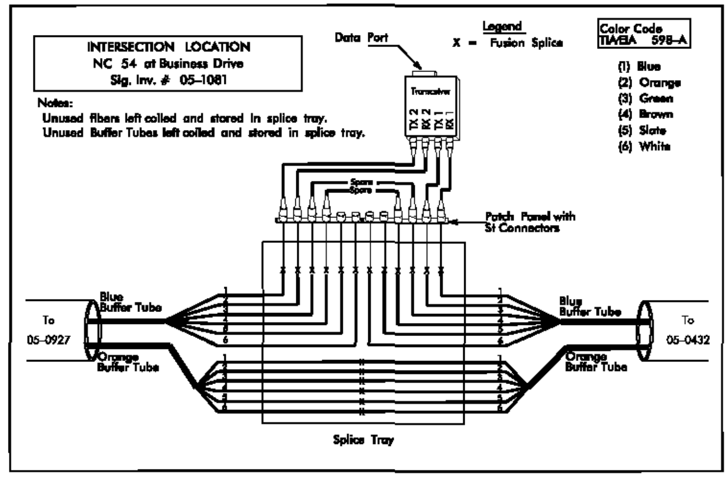
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

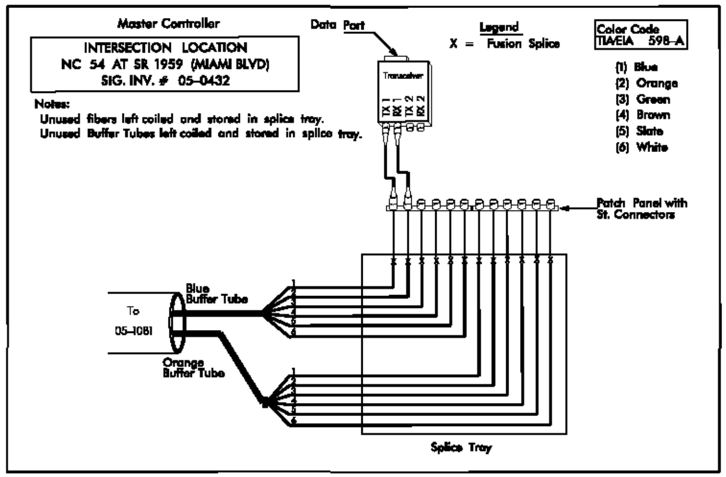
7-04

STD. NO. 9.2

Fiber Optic Cable







Transceiver termination configurations are generic. Contractor is responsible for determining \ ensuring proper terminations

Splice Detail

DIVISION 06 DURHAM COUNTY DURHAM

PLAN DATE: JANUARY 2004 | REVIEWED BY: I. N. AVERY

PREPARED BY: J. HOOKER | REVIEWED BY: J.Q. ENGINEER

Standard Sheet Layout – Splice Plan

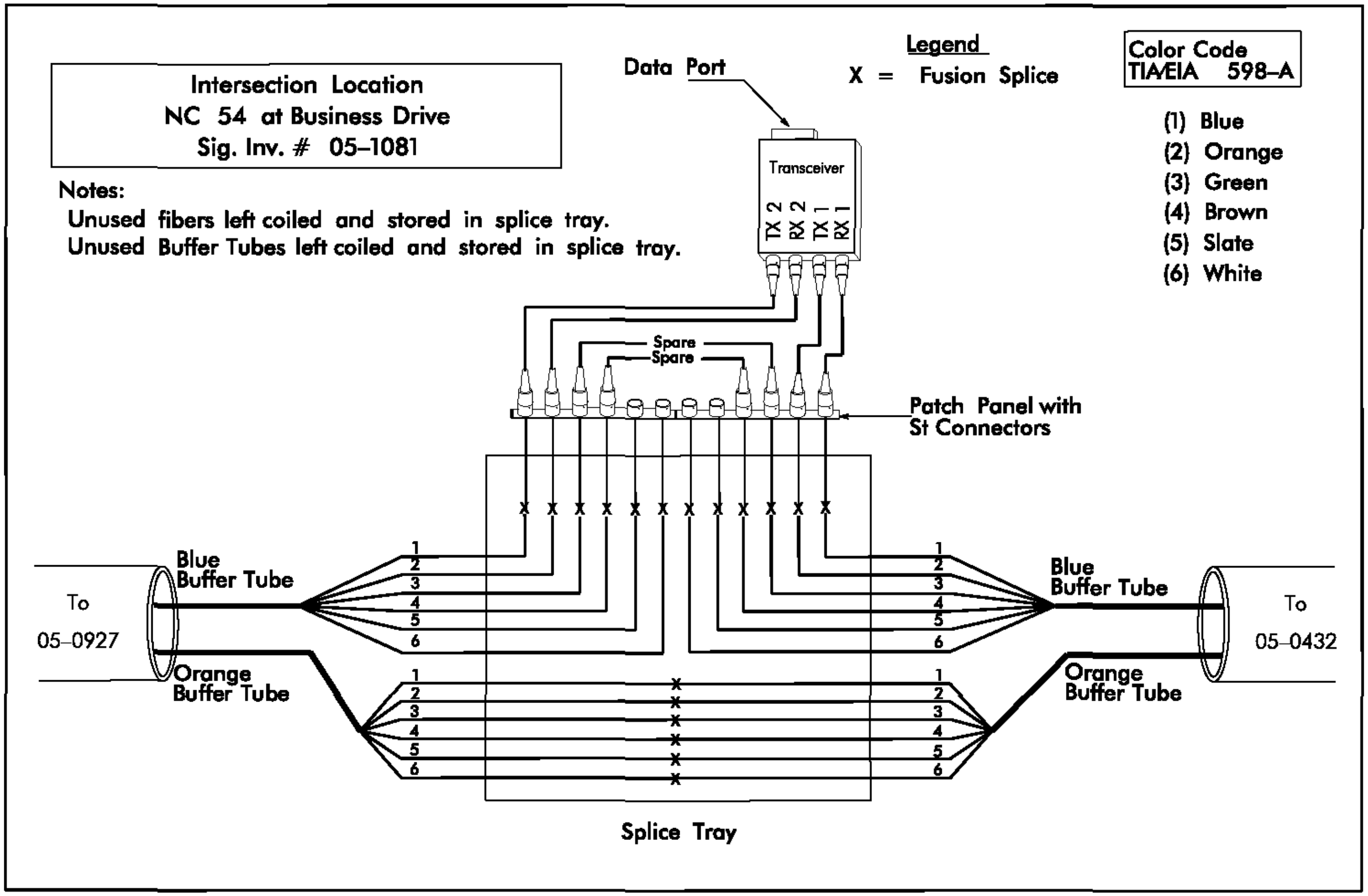
INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 9.3

SHEET 1 OF 2

Fiber Optic Cable



Transceiver termination configurations are generic. Contractor is responsible for determining \ ensuring proper terminations

Splice Detail

Standard Sheet Layout – Splice Plan – Exploded View

INTELLIGENT TRANSPORTATION SYSTEMS SECTION
TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

7-04

STD. NO. 9.3

Design Manual

Definitions

Traffic Engineering and Safety Systems Branch
State of North Carolina
Department of Transportation
Traffic Management & Signal Systems Unit

Part 4

-A-

AASHTO - American Association of State Highway and Transportation Officials.

Actuated Operation - A traffic signal operation that responds to information from vehicle or pedestrian detectors and provides signal operation and phase timing accordingly.

Actuation - A registration of demand for right-of-way by traffic to the controller unit.

ANSI - American National Standards Institute

Average Daily Traffic (ADT) - The average two-way volume of traffic at a given location during a 24-hour day, measured over some period of time less than a year.

AWG - American Wire Gauge. Standard measurement of wire based upon the circular mil system. One mil equals 0.001 inch (or approximately 0.0254mm).

-B-

Back Panel - A panel that is mounted on the back of the inside of a cabinet and on which terminals are mounted. The back panel may also include the sidewalls of the cabinet.

Back Plate - A black metal plate attached to a signal head used to increase the target value of the signal face (used when signal face is not readily visible to motorist due to competing background lighting such as commercial signs and lights, sunlight, etc).

Barrier - A reference point in the designated sequence of a dual ring controller. The barrier interlocks the two rings, and assures that conflicting phases will not be selected and/or timed concurrently. Both rings cross the barrier simultaneously to select and time phases on the other side.

Blank-out Sign - A sign that is typically used to control turning movements by time-of-day operation or in a preemption sequence. Sign is blank until message is needed.

Bore & Jack - An installation method for underground conduit.

Buffer Tubes - Extruded cylindrical tubes used for protection and isolation encasing optical fibers.

-C-

Call - see Actuation

Call Delay - For a detector unit, the ability to delay its output to the controller for a predetermined length of time after a vehicle enters the detection zone. For a controller, the ability to disregard a call from a detector unit for a predetermined length of time.

Card-Rack Mounted Detectors - see Rack Mounted Detectors

Channel - A specified band for the transmission and reception of fiber optic data and/or images.

CIM - Cable Identification Marker

Cladding - The material surrounding the core of an optic fiber. The cladding keeps the light in the fiber core.

Clearance Interval - The time from the end of the right of way of one phase to the beginning of the right of way of a conflicting phase. See also Yellow Change Interval and Red Clearance Interval.

Closed Circuit Camera (CCTV) – A television transmission circuit with a limited number of reception stations and no broadcast facilities.

Closed Loop System (CLS) - A signal system in which signals are connected to a master controller. The master controller selects timing patterns for the system that may be traffic-responsive or time-of-day. The master is connected to a computer in a central office. The computer can be used to monitor the system, make timing changes, and receive reports of signal malfunctions.

Communication Cable - Also called interconnect cable. The cable that is used to transmit and receive data between field devices and/or a central facility.

Communications Hub - Enclosure used to house a central computer network. It can be controlled from a remote location.

Conditional Re-service - A feature that allows reservice of an even phase (through phase) after an odd phase is conditionally serviced. Once the odd phase is allowed conditional service, the even phase (same ring) may begin timing again but times only minimum green.

Conditional Service - A feature that allows an odd phase to time again after normal service to that phase. Requirements for conditional service are: 1) A call is placed on odd phase while even phases are timing, 2) an even phase (same ring as odd phase) gaps or maxes out, and 3) vehicle clearance time of gapped/maxed out phase, plus conditional service minimum green time is less than or equal to the time remaining on the max timer of the even phase still timing.

Conduit - A polyethylene, PVC, or metal pipe used to protect wires or cables.

Conflict Monitor - A device located inside the cabinet (usually separate from controller) that continually checks for the presence of conflicting signal indications. Upon detection of conflicting indications, the conflict monitor will cause the signal to go into flash.

Controller (Signal Controller) - A device that determines the sequence and duration of indications displayed by traffic signals. See also Type 2070L Controller, NEMA Controller, and Type 170 Controller.

Controller Asset Number - A controller communication address number used in interconnected traffic signal systems. It is usually designated as the signal inventory number.

Coordination - A timing relationship between adjacent signals that allows traffic to progress smoothly along a corridor.

Cycle Length - The time period required for one complete sequence of signal indications. In an actuated traffic signal controller, a complete cycle is dependent on the presence of calls on all phases. In a pre-timed traffic signal, it is the complete sequence of signal indications.

-D-

Delineator Marker - A vertically anchored plastic dome post used to mark the path of underground conduit.

Design Hour Volume (DHV or K Factor) - The percentage of the 24-hour volume that occurs during the peak hour (usually on the Roadway Design Cover Sheet; if not, 10% is a good assumption).

Design Speed - The speed used for the design of the detection zone placement/controller timing.

Design Year - Usually five years after the project letting date.

Detection Zone - The area of the roadway where a vehicle will cause actuation.

Dielectric - A dielectric cable contains no metallic components and is, therefore, non-conductive. Glass fibers are dielectric.

Directional Drill - A method of installing underground conduit.

Digital Detector Unit (Detector) - A digital device used in a vehicle detection system which produces a signal when a vehicle passes through or remains within the detection zone of a sensing element.

Directional Split (D) - The highest percentage of the two-way traffic going in one direction at any time (usually on the Roadway Design Cover Sheet; if not, 60% is a good assumption).

Direction Design Hour Volumes (DDHV) - Estimated design year counts derived from ADT counts.

Drop Cable - A communications cable that is spliced into a trunk cable to service a traffic signal, CCTV, or DMS.

Dual Entry - An operating mode programmed on the controller that causes compatible phases on different rings to be served together even when only one of the phases has a call. Ex: For a location with phase 4 + 7 and 4 + 8 for side street phases, select dual entry for phase 4 so phase 4 comes on with phase 7 and phase 8.

Dual-Quad Phasing - Standard NEMA phasing sequence using two interlocking rings separated by a barrier.

Dual-Ring Controller - A controller unit containing two interlocking rings which are arranged to time in a preferred sequence and to allow concurrent timing of compatible phases in both rings, subject to the restraint of the barrier. Each of the compatible phase groups must cross the barrier simultaneously to select and time phases in the phase group on the other side.

Dummy Phase - A phase that times as a normal phase but for which there are no directly connected on-street signal indications. This is typically used as an all-red phase.

Dynamic Maximum Function - A 2070L feature that causes the maximum timing interval to be adjusted based on demand. Appropriate where demand is occasionally higher than normal max times (such as at a school).

Dynamic Message Sign (DMS) – A message board located over or near a road to alert travelers to possible traffic related problems. The message can be updated from a remote location. Formerly known as Changeable Message Sign and Variable Message Sign.

-E-

EIA - Electronic Industries Association

EIA-232 - A common interface standard for data communications equipment. It specifies signal voltages, signal timing, signal function, a protocol for information exchange, and mechanical connectors. Formerly known as RS-232.

Electrical Disconnect - Refers to the box where electrical connections are made. The box also houses the breaker controlling service to the cabinet.

Electrical Service - Includes the conduit, power meter, disconnect box, and triplex cable that provides power for any cabinet.

Emergency Vehicle Preemption - A type of preemption in which the normal signal sequence is interrupted, giving right of way to emergency vehicles.

Exclusive Mode – see Protected Mode

Exclusive Pedestrian Phase - A phase that serves only pedestrians. No vehicles are served.

Exclusive/ Permissive Mode – see Protected/Permissive Mode

Extend - For a detector unit, the ability of a detector to continue its output for a predetermined length of time following an actuation; i.e., after the vehicle leaves the detection zone. For a controller, the ability to hold a vehicle call for a predetermined length of time following an actuation (see also Stretch Detection).

-F-

Fiber - A thin filament of glass. An optical waveguide consisting of a core and a cladding that is capable of carrying information in the form of light.

Fiber Optic Jumper - Optical fiber cable that has connectors installed on both ends. Note: Industry standard utilizes a yellow jacket for SMFO jumper and an orange jacket for MMFO jumper.

Fiber Optic Pigtail - Optical fiber cable that has a connector installed on one end. Note: Industry standard utilizes a yellow jacket for SMFO pigtail and an orange jacket for MMFO pigtail.

Fiber Optic Receiver - An electronic device that converts optical signals to electrical signals.

Fiber Optic Splice - An interconnection method for joining the end of one bare fiber to another fiber.

Fiber Optic Splice Enclosure - An enclosure used to house a cable run splice point, and organize and protect splice trays.

Fiber Optic Splice Tray - A container used to secure, organize, and protect spliced fibers.

Fiber Optic Transceiver - An electronic device that converts optical signals to electrical signals and converts an electrical information-carrying signal to a corresponding optical signal for transmission by fiber. A transceiver is one device consisting of a transmitter and a receiver.

Fiber Optic Transmitter - An electronic device used to convert an electrical information-carrying signal to a corresponding optical signal for transmission by fiber. The transmitter is usually a Light Emitting Diode (LED).

Flashing Operation - A mode of operation in which traffic signal indications are turned on and off at a repetitive rate.

Free-Run Operation - A mode of operation for a traffic signal where the signal is not currently coordinated with adjacent traffic signals in the system.

Fully-Actuated Coordination - A traffic signal coordination feature in which at some point in the cycle, the coordinated phase loops become activated. This allows the coordinated phases the opportunity to gap out so that the traffic signal can service the minor phases without sacrificing system progression

Fully-Actuated Operation - A type of traffic signal operation in which all traffic movements are detected (actuated) and timing intervals vary with demand.

Fusion Splice - A permanent joint produced by the application of localized heat sufficient to fuse the ends of the optical fiber, forming a continuous light signal path.

-G-

Gap - Elapsed time between the end of one vehicle actuation and the beginning of the next actuation.

Gap-Out - Termination of a green interval due to an excessive time interval between the actuations of vehicles arriving on the green phase.

Gap Time - The time interval that extends the right of way portion of a phase. This interval is reset with each vehicle actuation. The phase is subject to the limit of the maximum green interval.

-H-

Heat Shrink Tubing - Used to seal the opening of a conduit or riser where fiber optic cable exits.

-I-

Inductive Loop - A loop of electrical wire placed in the roadway for vehicle detection.

Interconnect Cable - See Communications Cable

Interconnect Center - Refers to the housing compartment of the splice tray and patch panel.

Interval - Any of several divisions of the signal cycle during which signal indications do not change.

Isolated Signal - A signal which operates independently of any other signal.

-J-

Jumpers - See Fiber Optic Jumpers

Junction Box (Pull Box) - An enclosure usually placed underground with a removable top flush with ground level. It is used for splicing and storing cable. There are three types used for traffic purposes. 1) Regular sized junction boxes are used for loop lead-in or signal cable. 2) Oversized junction boxes are used primarily for communications cable. 3) Oversized heavy-duty junction boxes are used when the box may come in contact with vehicular traffic.

-L-

Lagging Left - A green arrow indication for a left turn that follows the green indication for the opposing through movement.

Lamp - The light bulb of a traffic signal section or an illuminated sign.

Lead-In Cable - The electrical cable that serves to connect the loop wire to the detector unit in the controller cabinet.

Leading Left - A green arrow indication for a left turn that precedes the green indication for the opposing through movement.

Lead/Lag Operation - A type of operation where a leading protected left is provided in one direction, followed by the through movements, and ending with a protected left in the opposite direction. Typically, the non-conflicting through movement is being served with the protected lefts.

Link - A telecommunications circuit between any two telecommunications devices.

Load Bay - The section of the back panel where load switches are installed.

Load Switch - An electrical device activated by the controller that turns power on or off for the traffic signal indications.

Locking Memory - A vehicle call for demand is remembered or held by the controller until the call has been satisfied by the appropriate green indication, even if the vehicle has left the detection zone.

Loop - see Inductive Loop

Loop Emulator Detection System - The system detects vehicles by processing images obtained through video cameras located at an intersection and providing outputs to the signal controller. The loop emulator detection system may be used when lead-in cable is difficult to maintain during lengthy time frames or when flexibility to move detection areas is needed such as for temporary signal configurations during numerous construction phases.

Loop Setback - The distance between the stop line and the loop.

Loop Wire - The electrical wire running from the lead-in cable to the inductive loop, forming the loop, and continuing back to the lead-in cable.

Louvers - A series of slats that are installed in a signal visor to limit a signal's visibility from an undesired direction.

-M-

Mast Arm - A structural support extending over the roadway from a pole, for the purpose of supporting traffic control devices.

Master Asset Number - A controller communication address number for the master controller that is used to communicate with the central computer.

Master Controller - A controller that supervises interconnected local controllers.

Maximum Green Interval - The maximum green time for a phase after an actuation by a conflicting phase.

Maximum Recall - An operating mode in which the right of way reverts to a particular phase. The controller serves this phase each cycle, regardless of vehicle demand.

Max-Out - Termination of a green phase resulting from the expiration of the maximum green interval.

Messenger Cable - see Span Wire

Microwave Vehicle Detector - A detector that uses a microwave beam to detect the motion of a vehicle. Microwave vehicle detectors are used where it may be impractical or cost prohibitive to use an inductive loop, such as on a bridge deck.

Minimum Green Interval (Initial Interval) - Minimum green indication time for a phase.

Minimum Recall - An operating mode in which the right of way reverts to a particular phase in the absence of conflicting vehicle calls. The controller serves this phase each time through the cycle for at least the minimum green interval, regardless of vehicle demand.

Modem - A device located in the master controller cabinet for transmitting digital data over telephone wires by modulating the data into an audio signal to send it and demodulating an audio signal into data to receive it.

Multi-Channel Detector - A detector unit that is capable of monitoring two or more detection zones.

MUTCD - Manual on Uniform Traffic Control Devices

-N-

National Electrical Safety Code (NESC) - Governs utility separations and clearances.

NEMA - National Electrical Manufacturer's Association

NEMA Controller - A type of controller in widespread use. The specifications for these controllers were developed by NEMA to provide compatibility and interchangeability. NEMA controllers are distinguished by standardized functions and input/output formats, and internal programming.

Nonlocking Memory - A controller feature in which a waiting call is dropped or forgotten by the controller after the vehicle leaves the detection zone.

-O-

OASIS - A traffic signal controller software developed by Econolite for implementation in an Advanced Transportation Controller (ATC) Type 2070 controller.

Occupancy - The proportion of time that a detection zone is occupied.

Offset - A time relationship, expressed in seconds or percent of cycle length, determined by the difference between the coordinated green phase and a system reference point.

Optically Programmed Head - A signal head containing optical units projecting an indication which is selectively masked so as to be visible only within desired viewing boundaries.

Option Zone - As a driver approaches a signal this is the area where, after seeing the signal head turn yellow, the driver is uncertain whether to decelerate and stop the vehicle, or continue and pass through the intersection.

Overlap - A green indication that allows traffic to move while a different phase is being timed.

-P-

Passage Time - see Gap Time

Patch Panel - A collection of connector panels in a common housing.

Peak Hour Factor (PHF) - The ratio of the total hourly flow to the maximum 15-minute rate of flow within the hour. A high PHF indicates uniform traffic throughout the hour and a low PHF indicates "spikes" of traffic within the hour.

Pedestrian Change Interval - The time that the flashing "Don't Walk" indication is displayed following the "Walk" interval.

Pedestrian Clearance Interval - The time interval that includes the pedestrian change interval, the yellow interval, and the all-red interval.

Pedestrian Push-button - A pedestrian detector that uses a pedestrian-operated button to place actuations.

Pedestrian Recall - An operating mode in which the controller serves a particular pedestrian phase for the walk time each time through the cycle, regardless of actuation.

Pedestrian Signal Head - Signal assembly advising pedestrians by word or symbols to "Walk" or "Don't Walk."

Pedestrian Soft Recall - An operating mode in which the controller serves a particular pedestrian phase for the walk time each time that the corresponding vehicle phase is served.

Permanent Call - A continuous call usually resulting from loop or detector unit malfunction.

Permissive Mode - A mode in which turning traffic is allowed to move but must yield to other traffic.

Phase - The right-of-way assignment of one or more traffic or pedestrian movements within the signal cycle.

Phase Omit - A feature that prohibits the controller from allowing a particular phase. Logic circuitry or controller programming may sometimes initiate the operation of this feature.

Phase Rotation - A programming option on some controllers that temporarily rearranges (rotates) the sequential order of phases to be served, depending on time-of-day or vehicle demand input. For example, a three-phase signal in which the left turn normally operates as a leading left, but operates as a lagging left during peak hours.

Phase Sequencing - A feature in which the traffic signal phases are sequenced differently than the NEMA standard dual ring configuration.

Pig Tail - See Fiber Optic Pigtail

Preemption - Transfer of the normal control of a signal to a special signal control due to a special situation such as passage of a train or granting of right of way to an emergency vehicle.

Presence Detection - The operating mode of a detector unit that sends a call to the controller as long as the vehicle remains within the detection zone.

Pretimed Operation - Traffic signal operation with predetermined fixed cycle length(s), fixed interval durations and interval sequence(s).

Protected Mode - A mode in which turning traffic is given right of way without having to yield to other traffic.

Protected/Permissive Mode - A mode in which turning traffic is given right of way during one portion of the cycle, but has to yield to other traffic during other portions of the cycle.

Pull Box - see Junction Box

Push-button - see Pedestrian Push-button

-Q-

Quadrupole Loop - An inductive loop design with a longitudinal saw slot along the center of a rectangular loop so that the loop wire can be installed in a figure-eight pattern. These loops are especially useful in the detection of small vehicles.

Queue Detector - A detector set back from the stop line so as not to place a call until a certain number of vehicles line up in the lane.

-R-

Rack-Mounted Detectors - Detector units that are not enclosed in a case and, therefore, must be inserted into a wired receptacle or "rack" in the cabinet.

Railroad Preemption - A type of preemption in which the normal signal sequence is interrupted when a train is approaching. Railroad tracks are cleared of vehicles and right of way is granted to vehicle movements that do not conflict with the train movement.

Recall, Maximum - see Maximum Recall

Recall, Minimum - see Minimum Recall

Recall, Pedestrian - see Pedestrian Recall

Recall, Soft - see Soft Recall

Red Clearance Interval - A clearance interval following the yellow change interval in which both the terminating phase and the next right of way phase display a red indication.

Red Detector Lock - A detector call is locked on a phase when that phase is in its red interval. The lock ensures service to the phase even if the detector input terminates prior to serving the phase.

Red Rest - An operating mode in which the signal will "rest" in red for all approaches, and will give a green indication to the first approach that is actuated.

Red Revert - Minimum red time before immediate phase reservice. Red revert times concurrently with the red clearance interval. This feature is typically used in lieu of a dummy phase.

Riser - A galvanized steel conduit that is used to protect wires and cables transitioning from underground to aerial.

RS-232 - See EIA-232

-S-

Sawcut - The groove cut into pavement to install inductive loops.

Sealant - The material used in the saw slot of an inductive loop to encapsulate the wire and environmentally seal the slot.

Self Healing Transceiver - A fiber optic transceiver that has the ability to transmit and receive a signal in a reverse direction should one of it’s two channels become disabled or damaged.

Semi-Actuated Operation - A type of traffic signal operation in which some, but not all traffic movements are detected.

Sequential Phasing - Standard NEMA phasing sequence in which the cycle progresses through the individual phases in a predetermined order with no concurrent phases.

Shelf-Mounted Detectors - Detector units that are enclosed in a case and are placed on a shelf inside the cabinet.

Signal Face - That part of a signal head that controls one or more traffic movements in a single direction and contains one or more signal sections.

Signal Head - An assembly of one or more signal faces together with the associated signal housings.

Signal Section -The assembly of a housing, lens, and light source with necessary components and supporting hardware to be used for providing one signal indication.

Signal System - Two or more signal installations operating in coordination.

Simultaneous Gap-Out - An operating mode programmed on the controller in which two phases must concurrently satisfy their respective gap times in order to cross the barrier.

Single-Mode Fiber (SMFO) - A type of optical fiber in which the signal travels in one mode. The fiber has a small core diameter of approximately 8 microns. Used primarily for communications in transportation applications that may cover longer distances.

Snow Shoe - A cable storage rack used for storing extra cable on an aerial run.

Soft Recall - An operating mode in which the right of way reverts to a particular phase in the absence of conflicting vehicle calls. The controller is able to skip this phase in the cycle if there are no calls for it.

Span Wire (Messenger Cable) - A cable used to support traffic signal heads, signal cable, communications cable and/or signs.

Splice Cabinet - A cabinet used to provide a housing for cable splices.

Splice Enclosure - See Fiber Optic Splice Enclosure

Splice Tray - See Fiber Optic Splice Tray

Split - The portion of cycle length, in seconds or percent, allocated to green, yellow and all red for a particular signal phase.

Split Phasing - An operating mode in which two facing approaches are serviced with separate phases.

Standard Signal Face Clearances - A standard chart that shows how each signal clears from each phase.

Stop Line (Stopbar) - A pavement marking line indicating where vehicles should stop when directed by a traffic control device.

Strain Pole - Typically a metal pole that has sufficient strength to support a span wire without the use of guys.

Stretch Detection - A detection scheme which uses the extend feature of the detector unit and passage time on the controller to extend the green interval of a phase (see also Extend).

System Detectors - Detectors used to provide information to a master controller (or a central control computer). This information is used to select appropriate coordination patterns to meet the traffic demands.

-T-

Time Based System (TBS) - A system that changes timing plans on an internal time basis. This type of system does not require interconnection of the traffic signals.

Time-of-Day Patterns - Signal timing plans that are implemented according to the time of day.

Time-Space Diagram - A pictorial representation of the operation of a signal system.

Tracer Wire - A number 14 copper wire in a jacket that is pulled through non-metallic conduit along with fiber optic cable to provide a means for locating the conduit after it is installed.

Traffic-Actuated Controller - see Actuated Controller

Traffic-Adaptive System (TAS) - A system in which a master controller (or a central control computer) can adapt cycle length, splits and offsets based on vehicle demand.

Traffic-Responsive System (TRS) - A system in which a master controller (or a central control computer) specifies cycle, splits and offsets based on the real-time demands of traffic as sensed by vehicle detectors.

Traffic Signal - Any power-operated traffic control device that alternately assigns right of way.

Transceiver - See Fiber Optic Transceiver

Trenching - An excavation method to install a conduit system underground.

Triplex - An electrical service cable consisting of three twisted cables, two current carrying conductors, and one neutral. All three are housed in an outer jacket.

Trunk - A transmission link joining two points which is distinguished by its large information carrying capacity and that all signals go from point to point without branching off to any separate drops except at the end points.

Type 170 Controller - A type of controller in widespread use. In a Type 170 controller, processor hardware is standardized with the actual control being provided by specialized, externally-loaded software.

Type 2070L Controller - One of the three primary types of controllers in widespread use. In a Type 2070L controller, hardware is standardized at the module level to aid in compatibility between manufacturers' equipment. Currently, manufacturer specific drivers are embedded in the firmware to allow customer-supplied application programs, such as OASIS, to run in an OS-9 operating system.

-V-

Vehicle Call Memory – See Red Detector Lock and Yellow Detector Lock

Volume-Density - A type of signal control with a variable passage time and a variable minimum green time. It reduces the probability of vehicles being caught in the option zone.

-W-

Weatherhead - The entrance into the top of a riser used for electrical cables.

-Y-

Yellow Change Interval - The display of a yellow indication following the right of way interval which warns drivers of the termination of right of way.

Yellow Detector Lock - A detector call is locked on a phase whenever the phase is not in its green interval. The lock ensures service to the phase even if the detector input terminates prior to serving the phase.