

Optimizing Protected-Permissive Left Turn Detection in the Controller Unit

By Gregory D. Bremser, Traffic Signal Technician II, New Jersey Section

Vehicle detection is an integral part of our traffic signal systems. As Traffic Signal Technicians, it is our job to ensure that intersections are operating at their peak performance. Some detection issues at intersections are not field problems or even cabinet wiring issues but are overlooked controller programming details that can make a large impact. These programming issues are especially important with protected-permissive left turns.

To give a brief definition, Protected-Permissive left turns are where traffic turning left has a protected phase of the signal sequence with a left turn arrow, and is allowed to also proceed during the adjacent through phase. It is typically characterized by a 5-section signal head, but also exists in other variations depending on the state or locality. Protected Only left turns are where traffic turning left can only proceed on a green left turn arrow. A 3-section signal head is typically used for this application.



Protected-only left turn signal head

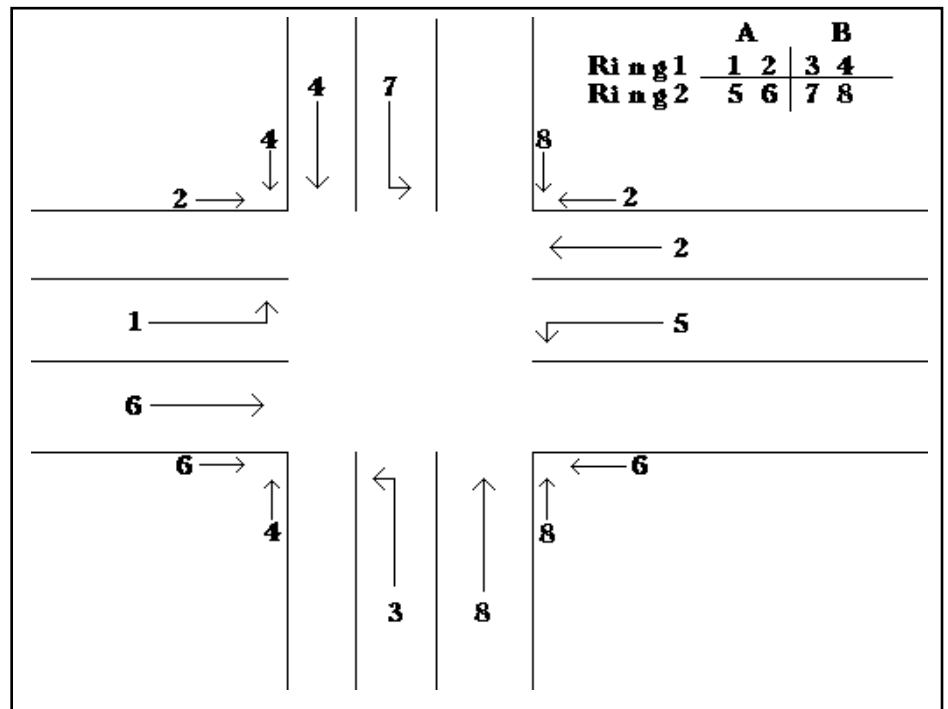


Typical Protected-Permissive left turn signal head

Detail of detector programming on intersection, permits and plans will vary between state and/or locality. While some may go into great detail on detector operation, many only specify the basics, such as phasing and detector locations. This leaves the details up to the signal technician and it is our responsibility to implement controller programming details that best serve the traffic patterns at a particular intersection.

I will examine two common situations where controller programming has a significant effect on intersection efficiency. The following examples of detector programming will be extremely beneficial for some intersections, but not necessarily appropriate for every intersection. Reevaluation of changing field conditions may be necessary during preventive maintenance.

In this article I will refer to NEMA dual ring or NEMA standard 8 phase in regards to intersection configuration, since this an extremely common set up in the field today. Generally, phases 1 and 5 are main street left turns, phases 2 and 6 are main street through phases, phases 3 and 7 are side street left turns and 4 and 8 are side street through phases.



Layout of a typical NEMA dual ring 8 phase intersection, with vehicle and pedestrian phases shown. Graphic courtesy of William L. Smith, Republic ITS.

Detector Cross Switching

One of the most common problems that I encounter is caused by the absence of detector cross-switching in the controller. This occurs most often at an 8 phase fully actuated intersection with leading protected/permissive left turns, but also can occur at other types of intersections. Timing at intersections with protected/permissive left turns is generally calculated with the notion that if some left turning traffic does not make it through during the protected portion that sufficient time and gaps in opposing traffic should exist to allow progress during the permissive portion.

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An intersection similar to this one, fully actuated with a high volume of left turns will benefit from cross switching.

Taking the 8 phase NEMA example, during phase 2 and 6 green, vehicles queuing in turn lanes will trip the loops that call phases 1 and 5. If an excess of turning traffic exists but no through traffic, conventional detector programming will not extend phases 2 and 6 and gap out will occur before all vehicles can clear the intersection.

Modern NEMA traffic signal controllers provide the capability for “detector switching” which allows the calls from one phase to be switched to an alternate phase when the alternate phase is green and the original phase is not. So then, we can program the phase 1 detector to be switched to the phase 6 detector. When phase 6 is green the calls from phase 1 will be switched to phase 6. During this time, the phase 1 detector will not receive any of those calls, but when phase 6 is no longer green the phase 1 detector will resume placing calls to phase 1.

The programming manual for each individual manufacturer and controller model should be consulted for specific programming parameters. Code driven, thumbwheel or dipswitch controllers in older TS-1 cabinets may not have any capability for this kind of detector programming. If cross switching operation is desired and procurement of a newer controller is not possible, hardwire connection on the backpanel with a diode could be substituted.

A major intersection with detector cross switching programmed should be monitored closely during preventive maintenance for detectors failures. One slight drawback with this otherwise beneficial setup is that when left turn detector fails, the controller will see a constant call for not only the left turn phase, but also the adjacent through phase when that is green. Then, a left turn and adjacent through phase will both time their max. If an intersection has high max times or a long cycle length, temporary changes to operation may need to be made if the detection cannot be repaired right away. Newer controllers offer user programmable “detector fail monitoring” that could also be used to mitigate this situation.

Where to Program Detector Switching:
The location of the programming screen in major NEMA controllers

Eagle EPAC 300 - Main Menu >3>8>1

Econolite ASC-2/2S – Main Menu >6>4

Econolite ASC-3 – Main Menu >6>2

Multisonics 820A – Free Parameters>3>1>Cursor Down to “Switching”

Naztec 980 – Main Menu>5>1

Peek 3000E – Main Menu>3>1>4>6

TCT/Peek LMD 8000 – Main Menu>2>2>6>6

Phase On - Phase Omit

Often, it is desired to keep a protected permissive left turn from being served when the opposing through phase has reached a gap out or green rest state. This is where it is appropriate to use “Phase On – Phase Omit” programming, sometimes referred to “Backup Protection” or “Anti-backup”.

Many intersections with protected permissive left turns have periods of light volume when the signal will needlessly cycle to a green arrow. Sometimes in observing an intersection a technician will also see a left turning car “beat out” a car pulling up on the side street and trip the arrow. The vehicle on the side street will then may have to wait a whole cycle for a green.

I have used this programming at semi-actuated intersections, either where the main street is pre-timed or coordinated. However, use of Phase On – Phase Omit must be evaluated independently for each intersection. Intersections where making left turns is difficult would usually not warrant this type of treatment. Intersection plans may provide specific operational notes such as “Phase 2 must be followed by phase 4”.

A novice technician will want to check with their supervisor before making any changes to controller programming. Extreme care must be taken in properly programming Phase On – Phase Omit. In a NEMA dual ring example, correct programming would be “Phase 2 On – Phase 1 Omit”.

With newer menu driven NEMA controllers, there is often ability to program Phase On – Phase Omit parameters within the controller unit. If a controller is not capable of this, it could be hard wired on the back panel by constructing a jumper wire between the desired phases. For instance, connect the “Phase 6 On” terminal to the “Phase 5 Omit” terminal. This will produce the same result as being programmed in a controller.

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Phase Omit programming has been beneficial at this T intersection. During periods of light volume, cycling to a protected/permissive left turn phase can create needless vehicle stops.

Where to program Phase On – Phase Omit: The location of the programming screen in major NEMA controllers

Eagle EPAC 300 – Main Menu>3>7

Econolite ASC 2/2S – Referred to as “Backup Protection”
Main Menu >2>9>2nd page

Econolite ASC 3 – Referred to as “Backup Prevent” Main
Menu>1>1>4

Multisonics 820A – Referred to as “Anti-Backup” Set
Up>1>Cursor down to Anti-backup

Naztec 980 – Referred to as “Inhibit” Main Menu>1>1>5

PEEK 3000E – Main Menu>3>1>9>1

TCT/Peek LMD 8000 – Main
Menu>2>2>6>4

Conclusion

These controller programming treatments can create noticeable improvements at many intersections. The beneficial effects will most likely not be noticeable during saturated rush hour conditions, but during off peak hours. I encourage technicians and engineers to discuss detection issues such as this at section meetings and in the IMSA online forum.

Working with controller programming and fine tuning intersection operation takes time and effort. Improvement in intersection efficiency, reduction of complaints and creating a better quality of life in the communities that we serve is well worth the effort.

Biography

Greg Bremser is a certified Level II Traffic Signal Field Technician. His first article “On Pedestrian Push Buttons: Small Equipment, Large Impact” appeared in the November/December 2007 issue of the IMSA Journal. Mr. Bremser is grateful to all those who gave him feedback and assistance in writing this article. He is employed in the greater Philadelphia area as a field technician and is an active member of the IMSA New Jersey section.



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