NEMA TS2 Fully-Actuated Advanced Traffic Controller Software

This specification is fully met by the following Econolite model:

ASC/3-LX Software

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

Table of Contents

Introduction

This specification sets forth the minimum requirements for software that operates a two (2) through 16 (sixteen) phase, fully-actuated, digital, solid-state traffic controller. The controller shall meet, as a minimum, all applicable sections of the NEMA Standards Publications for TS2 and NTCIP 1202 and ATC standard 6.10. Where differences occur, these specifications shall govern. Controller versions shall be available to comply with NEMA TS2 Types 1 and 2. Type 2 versions of the controller shall be capable of operating as a Type 1 controller.

Displays

Dynamic Displays

2. Dynamic displays listed below shall be provided to show the operational status of the controller. Additional displays shall be offered for programming. It shall be possible to jump from a status screen to the appropriate programming screen and return after viewing is complete. When the cursor is moved to a dynamic location on the screen, an audible tone shall be provided when the display changes. When the cursor is moved around the status screen and the help key is pressed, a context sensitive help shall be displayed. The intersection, controller, coordination, preempt, and time-of-day (TOD) status displays shall contain a title line that displays the status being viewed, the controller status, the current date, and time.

2.1.1.1. The **INTERSECTION STATUS DISPLAY** shall indicate a summary of ring, phase, coordination, preemption, TSP, communications, logic processor flags, and time-based control status. It shall be possible to place vehicle, pedestrian, preemption, and TSP calls from the keyboard while displaying status information.

2.1.1.2. The **CONTROLLER STATUS DISPLAY** shall indicate current interval, pedestrian, density, maximum, and maximum extension timing by phase and ring. The status of vehicle, pedestrian, and overlap signal outputs shall be displayed in combination with vehicle and pedestrian calls. The display shall also show the split plan, timing plan, sequence, action plan, and day plan in effect. The display shall include the status of the first sixteen logic processor flags.

2.1.1.3. The **COORDINATOR STATUS DISPLAY** shall indicate the status of vehicle signal outputs in combination with vehicle and pedestrian calls. The display shall also show the split plan, timing plan, sequence, action plan and day plan in effect. Also displayed shall be, current coordination pattern information, local and system cycle count, time-based control status, hold, force-off, vehicle permissive, pedestrian permissive, split count down, split extension, and offset from ring 1.

2.1.1.4. The **PREEMPTOR STATUS DISPLAY** shall indicate the status of vehicle, pedestrian overlap and overlap signal outputs shall be displayed in combination with vehicle and pedestrian calls. Priority (railroad, fire, emergency) preemptors and bus preemptors with calls, preemptor active, inhibit, and delay status. When a preemptor is active, the display shall also indicate preemptor interval, timing, duration, and dwell status. A portion of the display shall indicate the controller status during preemption including current status, interval, and timing by phase and ring and the status of vehicle and pedestrian signals for each phase.

2.1.1.5. The **TIME BASE STATUS** display shall indicate the current time and date the source of pattern selection, the next day plan to be selected, the current schedule, day of the week, day plan number, day plan number, action plan number and the action plan start time. This status screen shall display a total of 30 TOD events.

2.1.1.6. The **COMMUNICATION STATUS** displays shall be communications status displays for Ethernet, Port 1 (SDLC), Port 2 (terminal) Port 3, and NTCIP.

a. An Ethernet status display shall indicate the line speed, the line status, the total number of transmits and receive counts and the number of transmit and receive error counts.

b. Port 1 (SDLC) status display shall indicate the frame responses from the MMU, the terminal and facilities BIUs and the detector BIUs.

c. Ports 2 and 3 status display shall indicate the interconnect format, transmit, valid data, data error, carrier detect and the last valid command.

d. An NTCIP status display shall indicate the total number of SNMP and STMP transmit and receive counts.

2.1.1.7. The **DETECTOR STATUS** display shall indicate activity for up to 64 detectors. The display shall show detector calls as they are processed by the controller. The display shall also show the extension and delay timers for the selected detector. In addition the failure status of the detector shall be displayed.

2.1.1.8. The **FLASH/MALFUNCTION MANAGEMENT UNIT (MMU**) status display shall indicate flash status plus MMU channel, conflict, and monitoring function status. A separate display shall indicate the results of the controller's comparison of its MMU programming to the programming in the controller.

2.1.1.9. The **INPUT AND OUTPUT STATUS** displays shall indicate the activity of all of the logic level inputs and outputs to the controller.

2.2. Programming Displays

2.2.1. Programming displays in the form of menus shall aid the operator in entering data from the front-panel keyboard.

2.2.2. A main menu shall allow the user to select a major function of the controller. A submenu shall then be displayed to allow the user to select a sub-function within the major function.

2.2.3. English language and traffic engineering terminology shall be used throughout to facilitate programming. The display organization shall allow traffic personnel to program the controller without using reference cards or manuals. All data entry and data screens shall be in logical order.

2.2.4. Four (4) arrow cursor key shall allow the user to scroll through all programmed data.

2.2.5. Programming entries shall consist of alpha-numerical values, YES/NO and ON/OFF entries. During program entry, the new data shall be displayed as it is entered. Warning and consistency checks shall be performed when ENTER or cursor key is pressed. On constrained data (entries that are constrained by other programmed data), entries shall only be stored when the consistency check is validated. On non-constrained data the entries shall be stored only when the new values are within valid value thresholds.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

2.2.5.1. An example of constrained data is the sequence of the phases within a ring. They need to be checked with the phase compatibility, phases in the ring and start phases among others.

2.2.5.2. An example of non-constrained data is the vehicular extension time entry.

2.2.6. The keyboard entry software shall include context sensitive help screens. Help information shall be accessed by placing the cursor on the data entry in question then pressing the HELP key. Help screens shall be provided for all keyboard-entered data and shall include at a minimum range, description, and functional operation information for the data entry.

Programing

Programming Methods

3. The methods listed below shall be available for controller configuration and timing entries. The manufacturer shall be able to provide as off-the-shelf items all of the firmware and software required to affect the listed methods and to implement network operation with system masters and host PC's.

3.1.1.1. Manual data entry via the front panel keyboard.

3.1.1.2. Downloading via telemetry from a system master connected to a host PC in a closed-loop system or a central server in an enterprise system.

3.1.1.3. Downloading from a portable PC-compatible computer via a serial or Ethernet cable.

3.1.1.4. Transfer from one controller to another, or restoring for a back-up copy, using a data key, USB thumb drive, or an SD card.

3.1.1.5. A PC web interface shall allow the operator to view the current status and programming for the controller. It shall be possible to change programming from a remote device like a PC and if the device is connected to the controller, the programming changes shall take effect the next time that interval or function is used.

3.2. Programming Security

3.2.1. A minimum of three access levels shall be available to provide programming security.

3.2.1.1. The highest or administrator level shall have access to all programming entries including setting access codes.

3.2.1.2. The second or data change level shall have read-write privileges for all programming entries except access codes and CRC enable/disable.

3.2.1.3. The third or data display level shall only have access to read programmed data and status screen.

3.2.2. User selectable, access codes shall be provided for the administrator and data change and read only access levels. Each user shall have a user name that is entered using from 6 to 15 characters. Access codes shall initially be set to provide unrestricted access.

3.2.3. If there has been no keyboard activity the controller shall automatically logoff the user after 30 minutes.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

3.3. Programming Utility Functions

3.3.1. A copy function shall permit copying all timing data from one phase to another. It shall also permit copying all timing plans from one timing plan to another, one detector plan and detector options plan to another, all coordination pattern data from one pattern to another and one sequence to another. This feature will facilitate data entry when programming any two or more phases with the same timing values, or detectors with the same programming, and/or two or more coordination patterns with the same pattern data.

3.3.2. The controller unit shall contain a backup database with user specified values stored in non-volatile memory. A copy function shall permit transferring the backup database to the active database. The user shall be able to create their database and copy it to the default database.

3.3.3. A sign-on message shall allow the user to view the controller software version number. It shall also be possible to display the sign-on message by keyboard selection. The sign-on display shall allow a user-defined message of up to two lines with 38 characters per line.

3.3.4. The controller shall have the capability to output a memory image of the user programmed settings and intersection configuration data in binary format. This shall allow transferring the memory image data to a data key, USB thumb drive, or a SD card.

4. Actuated Control Functions

The controller software shall provide all actuated control functions and operations required by the NEMA TS2 Standard. In addition, it shall provide the features described in the following sub sections.

Phase Sequence

4.1.1. The phase sequence of the controller shall be programmable in any combination of sixteen phases, using up to 16 concurrent groups and four timing rings.

4.1.2. Up to 16 unique phase sequences shall be user configurable and used in the controller.

4.1.2.1. Four additional fixed sequences shall conform to the following TxDOT "Diamond" configurations:

a. 3-phase diamond
b. 4-phase diamond
c. NEMA 8-phase diamond
d. 2 intersection diamond control

4.1.3. Phase sequence information shall be changeable from the keyboard and stored in data memory.

4.1.4. The standard phase sequence of the controller shall also be capable of being altered by coordination, TOD or external alternate sequence command, by selection 1 of the 16 configurable sequences or 1 of the 4 "diamond" sequences.

4.1.5. An exclusive pedestrian phase feature shall be provided which will time and display the pedestrian indications with the vehicle movements remaining in all red.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

Timing Intervals

4.1.6. Timing intervals shall be programmable from 0-255 in one second increments or from 0-25.5 in one-tenth second increments, depending on the function.

4.1.7. Four independent timing plans shall be provided. Any plan shall be selectable on a TOD basis, by coordination pattern, or for one cycle following preemption.

4.1.8. Each timing plan shall contain the following interval timings:

Minimum Green	Maximum 3
Bike Green	Dynamic Maximum
Delay Green	Dynamic Maximum Step
Conditional Service Minimum Green	Yellow Clearance
Walk	Red Clearance
Walk 2	Red Maximum
Walk Maximum	Red Revert
Pedestrian Clearance	Actuations before Reduction
Pedestrian Clearance 2	Seconds per Actuation
Pedestrian Clearance Maximum	Maximum Initial
Pedestrian Carryover	Time before Reduction
Vehicle Extension	Cars Waiting
Vehicle Extension 2	Time to Reduce
Maximum 1	Min Gap
Maximum 2	Steps to Reduce

4.1.8.1. The bike green interval shall replace the phase minimum green if the interval time is larger than the min green time and if a detector input designated as a bike detector has been activated.

4.1.8.2. Two Walk and Pedestrian Clearance intervals shall be provided for each phase per timing plan. The second Walk and Pedestrian Clearance shall be activated by a time base action plan.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

4.1.8.3. Two vehicle extension intervals shall be provided for each phase per timing plan. The active vehicle extension interval shall be selected by a time base action plan.

4.1.8.4. If enabled, a Delay Green timer shall delay the vehicle phase from starting until the timer has expired. This shall provide an additional all red for the vehicles movement and allow the pedestrian indications to precede the vehicle movement.

4.1.8.5. The Pedestrian Walk interval shall extend from Walk to the smaller of the Walk Max time or the phase maximum in effect with a constant input from the "Walk Extension detector". The Pedestrian Clearance interval shall also extend Pedestrian Clearance to the smaller of the Pedestrian Clearance Max time or the phase maximum in effect with a constant input from the "Walk Extension detector."

4.1.8.6. Volume density intervals shall include actuations before adding to the initial green and the number of cars waiting while the phase is not green. Actuations before added shall provide a user-specified number of actuations that must occur before adding variable (added) initial time. Cars waiting shall record the number of cars recorded while the phase is not green, the start of gap reduction is initiated by the time before reduction or the cars waiting which ever reaches its programmed value first.

4.1.8.7. The controller shall be capable of dynamically extending the maximum green time for each phase based on vehicle demand. Three maximum green intervals shall be selectable per phase based on TOD, coordination pattern, or external input. The initial interval shall be selectable as Max 1, Max 2, or Max 3. If the phase terminates due to max-out for two successive cycles, then the maximum green time in effect shall automatically be extended by a dynamic max step interval on each successive cycle until it is equal to dynamic maximum. If the phase gaps out for two successive cycles, then the maximum green time shall be reduced by the dynamic max step time until it reaches to the original max value.

4.1.8.8. Each phase shall have a red maximum timing interval. An input (red extension) shall extend the all red period of the assigned phase as long as the detector input is true. This input must be true within the all red time of the assigned phase to be able to extend the all red period. If this detector fails then the all red extension feature shall be disabled.

4.1.9. Guaranteed minimum interval values shall be settable and shall not be overridden by the controller. Values shall be provided for the following intervals:

4.1.9.1. Minimum Green

4.1.9.2. Walk

4.1.9.3. Pedestrian Clearance

4.1.9.4. Yellow Clearance

4.1.9.5. Red Clearance

4.1.9.6. Overlap Green

Overlaps

4.1.10. The controller shall provide 16 (sixteen) internally-generated overlaps (A - P). All overlap functions shall be programmable from the controller keyboard.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

4.1.11. Overlaps shall be individually programmable as standard (normal), other (to include minus green/yellow, protected, pedestrian protected, and protected permissive flashing arrow), with lag overlap timing capabilities. The green, yellow, red and lag interval timings shall be individually programmable with respect to the activation or termination of the parent phase, respectively.

4.1.11.1. The standard overlap shall require only included phases to be configured.

4.1.11.2. A protected overlap shall operate according to the following rules:

a. Overlap shall be green, yellow, or red like a normal overlap except its outputs shall be blank when the protected phase is green, or the controller is transitioning to a non-included phase.

4.1.11.3. Minus green/yellow overlaps shall operate according to the following rules:

a. Overlap shall indicate green when any of the overlap phases are green or when in transition between overlapped phases and a modifier phase is not green.
b. The overlap shall be yellow when an overlapped phase is yellow and the modifier phase is not yellow and none of the overlapped phases are next.

4.1.11.4. A pedestrian protected overlap shall be green under the following conditions:

a. When an included phase is green and the protected pedestrian is NOT in walk or pedestrian clearance.
b. When the controller is in transition between included phases and a pedestrian protected phase is not next.
c. After servicing an included phase pedestrian demand if there is enough time before max out to service the overlap minimum green.

4.1.11.5. The controller shall provide an overlap selection for Protected/Permissive Left Turn (PPLT) Flashing Yellow Arrow FYA operation. PPLT/FYA shall allow selection of the protected phase, permissive phase, flash yellow output to either the overlap output, or a pedestrian clearance (yellow) output. The PPLT/FYA shall also allow the yellow arrow to continue flashing once the permissive through phase reaches yellow clearance. PPLT/FYA shall be enabled on a TOD basis.

4.1.12. The controller shall provide the capability of sixteen pedestrian overlaps. These shall be capable of overlapping the pedestrian displays of any combination of phases with a pedestrian movement.

Conditional Service

4.1.13. The controller shall provide a programmable conditional service feature. When selected, the controller shall service an odd-numbered phase once normal service to that phase has been completed and enough time for additional service exists on the concurrent even phase.

4.1.14. A conditional service minimum green time shall be programmable for each phase. This interval shall ensure a minimum green if the phase is conditionally served.

4.1.15. It shall be possible to program the controller to re-service the even phase after conditionally serving an odd phase. Once an even phase has been conditionally re-serviced, the odd phase shall not be conditionally served again until returning to the concurrent group that is timing.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

Additional Features

4.1.16. The following features shall be programmable for each phase in each of four separate timing plans:

4.1.16.1. Locking/non-locking detector memory

4.1.16.2. Vehicle Recall
4.1.16.3. Pedestrian Recall
4.1.16.4. Maximum Recall
4.1.16.5. Soft Recall
4.1.16.6. No-Rest Phase
4.1.16.7. Enable Added Initial

4.1.17. Also programmed by phase shall be:

d. Phase in Use
b. Exclusive Pedestrian Phase

4.1.18. Soft recall shall return the controller to the programmed phase in the absence of other calls.

4.1.19. If a phase is designated as a no-rest phase the controller shall not rest in the phase, and proceed to the next phase with serviceable demand, or if no demand is present the next soft recalled phase.

4.1.20. The controller shall permit power start and external start to be programmed by phase and interval. Start intervals shall be green, yellow red, or yellow with overlaps forced yellow.

4.1.21. During a power start condition, the controller shall be capable of timing an all-red or flash interval before the power start phase(s) and interval(s) are displayed. The controller shall support the MUTCD 2009 that requires a minimum of 6 seconds of all red following red/red flash.

4.1.22. The controller shall provide guaranteed passage operation on a per phase basis. When selected, this feature shall provide a full passage (vehicle extension) interval when a phase gaps out with a gap in effect less than the vehicle extension interval (preset gap).

4.1.23. The controller shall provide both single and dual entry operation. When selected, dual entry shall cause the controller to ensure that one phase is timing in each ring.

4.1.24. It shall be possible via keyboard selection to inhibit the service of a phase with other phase(s) within the same concurrent group.

4.1.25. The controller shall provide the following additional selectable pedestrian functions:

4.1.25.1. Actuated phase rest in WALK

4.1.25.2. Flashing WALK output

4.1.25.3. Pedestrian clearance protection during manual control

4.1.25.4. Pedestrian clearance through yellow

4.1.25.5. Pedestrian timing shall be capable of being carried over from one phase to another

4.1.26. Programming shall be provided to inhibit re-service of odd phases (left turns) within the same concurrent group. Also, programming shall be provided to place a demand on a phase in another concurrent group to cause the controller to leave the concurrent group prior to servicing the odd phases in the same concurrent group.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

4.1.27. The controller shall provide a programmable simultaneous gap termination feature. When programmed, phases in both rings shall gap out together in order to terminate the green interval and cross the barrier.

4.1.28. The controller shall provide automatic flash selection per the requirements of the MUTCD. Both the flash entrance and exit phases shall be programmable through the keyboard, and flashing shall be controlled by either setting the fault/voltage monitor output to be FALSE or by flashing through the load switch driver outputs. If flash desired through the load switches, both the phase and overlap outputs shall be flashed either yellow or red as selected by the operator. Automatic flash shall be selectable by external input, system command, or TOD action plan.

4.1.29. The controller shall provide dimming for selectable load switch outputs. Dimming shall be accomplished by inhibiting the selected outputs for alternate half cycles of the 120 VAC line. Dimming shall be controllable by TOD and an external input; both functions must be TRUE for dimming to occur. Programming shall permit individual dimming of the Green/Walk, Yellow/Ped Clear, Red/Don't Walk outputs for each load switch. Based upon controller programming the controller shall automatically compute the MMU channel compatibility. The compatibility computed shall be based on phases-in-use, phase concurrency, valid pedestrian movements, vehicle and pedestrian overlaps, and pedestrian carryover.

5. Coordination

Coordination functions to control intersection cycle lengths, system offset relationships, and phase split percentages shall be provided as a standard feature, with no need for additional modules or software.

Coordination Patterns

5.1.1. A minimum of 120 coordination patterns shall be provided. Each pattern shall allow selection of an independent cycle length, offset value, and split pattern. The coordination patterns shall be selected using telemetry (system), hardwire, or non-interconnected (time-base) coordination commands. Offset and Split values shall be entered in either seconds or percentages.

5.1.2. The coordination patterns shall be selected by the coordination command using the following formats:

e. Pattern - This format shall allow selecting the coordination patterns directly, that is, commanding Plan 1 selects Pattern 1. Pattern command shall include 1-120 patterns, pattern 254 shall select free, and pattern 255 shall select flash.
f. Standard - This format shall allow selecting the coordination patterns using a pattern number derived from a cycle offset-split command. Each pattern shall be assignable to a specific cycle-offset-split combination. The coordination pattern shall be selected programmed by the user to each pattern used.
g. TS2 - This format shall allow selecting the coordination patterns as a function of Timing Plan and one of three offsets. With this format a minimum of 20 Timing Plans shall be available for selection of one of sixty coordination patterns.

5.1.3. The following functions shall be programmable in each coordination pattern:

a. Cycle length
b. Split pattern number
c. Offset value

d. Dwell/add time
e. Actuated coordination
f. Timing plan
g. Actuated walk rest
h. Phase sequence
i. Phase re-service
j. Action plan
k. Maximum select
l. Fixed/Floating force off
m. Split timing per phase in seconds of percentage
n. Directed split preferences
o. Coordinated phase split extension
p. Crossing artery pattern
q. Permissive timing
r. Ring extension
s. Split demand pattern
t. Ring displacement
u. Coordinated phase
v. Split value by phase
w. Omit by phase
x. Min recall by phase
y. Max recall by phase
z. Pedestrian recall by phase
aa. Special function outputs

5.1.4. The following functions shall be programmable for each of the 120 Split patterns:

h. Coordinated phase
i. Split value by phase
j. Omit by phase
k. Min recall by phase
l. Max recall by phase
m. Pedestrian recall by phase
n. Max and Pedestrian recall by phase

Cycle Length

5.1.5. One cycle length shall be provided for each coordination pattern. The cycle shall be adjustable over a range of 30-999 seconds in 1-second increments.

5.1.6. The cycle length shall serve as the reference time for all coordination timing.

Synchronization

5.1.7. For systems with a single system sync pulse, coordination timing shall be synchronized to the leading edge of that pulse, which shall serve as the master zero reference for all offset timing.

5.1.8. For hardwire systems with multiple sync pulses, the coordinator shall lock onto the correct sync by trying different syncs and checking for reoccurrence during successive cycles.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

5.1.9. After a valid system sync pulse has been received the coordinator shall check for the proper occurrence of the system sync pulse during each subsequent cycle. If a sync pulse does not occur, the coordinator shall self-sync and continue to operate with the last set of coordination commands for a programmable number of cycles from 0-255. If a sync pulse does not occur within the programmed period (or until the first sync pulse is received), the coordinator shall revert to the non-interconnected coordination mode.

Offset

5.1.10. Offset shall normally be defined as the time period from the system sync pulse to the beginning of the leading coordinated phase green (local zero). The coordinator shall also be capable of referencing the offset to the beginning of the lagging coordinated phase green, coordinated phase yield, start of yellow point or the start of the ring 1 coordinated phase

5.1.11. Offsets shall be programmable using both percent and seconds. The range shall be from 0-99% of the cycle length in 1% increments or 0-255 seconds in 1-second increments.

5.1.12. Offset changes shall be achieved by adding or subtracting cycle time over a maximum of three cycle periods to allow a smooth transition to the new offset. Other offset change methods shall be adding 20% or a user-selectable value to each cycle or to snap to the sync point once the permissive period are complete and the coordinated phases are green. Offset correction using dwell shall also be selectable.

Split

5.1.13. Each split shall provide a split interval for each of sixteen phases. The split interval shall be programmable using percent or seconds. The range shall be from 0-99% of the cycle length in 1% increments or 0-255 seconds in 1-second increments.

5.1.14. Split interval settings shall determine the maximum time, including vehicle clearance (yellow and red), for a non-coordinated phase, or the minimum time for a coordinated phase. Phase termination shall be controlled by establishing a force-off point for each phase within the cycle. Except for the coordinated phases the force-off point shall be selectable to be a fixed point within the cycle or allowed to float. If floating force-offs are selected each phase shall time no more than its own split interval.

5.1.15. During coordination, it shall be possible to operate a coordinated phase as actuated or non-actuated. If a coordinated phase is actuated, vehicle detections shall permit the coordinator to extend a phase beyond the normal yield point. Extended coordinated phase green shall be selectable using the same range as split interval settings (percent or seconds). If actuated coordinated phases are used they shall be able to have actuated or non-actuated (walk rest) pedestrian movements.

Permissive Periods

5.1.16. Permissive periods shall be provided to control the time period during which coordinated phases are released to service calls on non-coordinated phases.

5.1.17. All permissive timing shall begin at the lead coordinated phase yield point. A yield point shall be automatically computed for the coordinated phase in each ring. The coordinated phase yield points shall allow the coordinated phases to yield independent of each other. The yield point shall be the

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

point at which the coordinated phase is released to allow the controller to service calls on non-coordinated phases. The computation shall take into account the coordinated phase split interval plus pedestrian and vehicle clearance times.

5.1.18. Automatic permissive period operation shall be provided by automatically calculating a permissive period for each non-coordinated phase. The permissive period shall consist of a separate vehicle and pedestrian period computed from the phase split interval and the vehicle/pedestrian minimum time. The controller shall answer a call only during the associated phase permissive period. However, once the controller has been released to answer a call, all remaining phases shall be served in normal sequence.

5.1.19. Single permissive period operation shall be provided by defining a single time period per cycle beginning with the yield point during which the controller is allowed to answer phase calls for any phase. The duration of this period shall be selectable in each coordination pattern.

5.1.20. Dual-permissive period operation shall also be provided. During the first permissive period, the controller shall answer only vehicle or pedestrian calls on the phases following the coordinated phase. If the controller yields to a call during this period, calls on the remaining phases are served in normal rotation. During the second permissive period, the controller shall answer calls on all remaining phases except the first permissive phase. The duration of the two permissive periods, and the time at which to start the second permissive period (displacement), shall be selectable in each coordination pattern.

Phase Re-service

5.1.21. If actuated coordinated phases are in use it shall be possible to re-service non-coordinated phases within the same cycle if sufficient time remains. A phase shall be re-serviced only if the permissive period for the phase indicates there is sufficient time remaining in the cycle to service the phase.

5.1.22. Phase re-service shall be capable of being enabled/ disabled in each coordination pattern.

Transition Cycles

5.1.23. It shall be possible to program the controller to ignore the pedestrian timing when calculating the minimum cycle length for offset correction.

5.1.24. The controller shall provide a smooth and orderly transition when changing from free operation to coordinated operation and from one coordination command to another.

5.1.25. During a free-to-coordinated transition, the controller shall initiate a pick-up cycle beginning upon receipt of a sync pulse and a valid coordination command. The controller shall then enter coordination mode upon crossing a barrier or if resting in the coordinated phases.

5.1.26. Each coordination command shall select a pattern. A command change shall be implemented concurrent with a sync pulse. Cycle, offset, and split changes shall not take effect until local zero.

Crossing Artery Control

5.1.27. The coordinator shall be capable of implementing dual coordination at an intersection where two arterials are under control of separate masters.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

5.1.28. An external input shall enable dual coordination. Once enabled, the coordinator shall place a continuous call on the crossing artery phases so as to ensure that these remain green for their full split interval.

5.1.29. The coordinator shall output a crossing artery sync signal to indicate the beginning of the crossing artery phase split interval.

5.1.30. Dual coordination shall force a selectable crossing artery split plan to be used so as to allow a particular split to be optimized for dual coordination in each coordination pattern.

Local Split Demand

5.1.31. The coordinator shall provide a minimum of two split demand detector inputs, which shall allow the selection of a preferred split plan based on intersection demand.

5.1.32. If the split demand detector indicates continuous vehicle presence during a programmed monitoring period beginning with the onset of a selected phase green, the coordinator shall force a selectable split plan to be in effect during the next cycle. This split plan shall remain in effect for a selected number of cycles from 0-255. A specific split plan shall be capable of being selected in each coordination pattern.

Adaptive Split Demand

5.1.33. The coordinator shall provide a method to select the split using measurement of each phase's green utilization. From the measurement the coordinator shall determine which phase or phases had excess time that was not used during the last measurement period. Then the excess time shall be added to the first set of preferential phases. If the first set of preferential phases gapped out during the last measurement period, then the excess time will be added to a second set of preferential phases. If both sets of preferential phases gapped out during the last measurement period then the time shall be added to the beginning of the coordinated phases.

Free Mode

5.1.34. The coordinator shall provide a free mode of operation, where all coordination control is removed.

5.1.35. Free mode operation shall be selectable by coordination commands, by external input or by keyboard entry.

5.1.36. The coordinator shall revert to the free mode when active controller inputs or functions would interfere with coordination. Such inputs or functions shall include the following:

o. Manual control enable
p. Stop time
q. Automatic flash
r. Preemption

5.1.37. The coordinator shall provide an active free mode, where coordination control is removed but the coordinator continues to monitor system sync so as to keep its timing in step with the system master or time of day if operating under TOD or central system control.

Manual Control

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

5.1.38. The controller shall allow manual override of the current coordination command from the keyboard. The manual command shall allow selection of any coordination pattern to be in effect.

Interconnect Modes

5.1.39. The coordinator shall be capable of operating with any of the following interconnect types:

s. Non-interconnected coordination (time-based)
t. Telemetry
u. Hardwired

5.1.40. The coordinator shall be compatible with fixed-time interconnect, which provides the sync pulse superimposed on the offset lines. It shall also operate within an interconnected system using a separate sync line. The non-interconnected coordination mode shall serve as a backup when using telemetry or hardwired interconnect.

6. Preemption

The controller shall provide a minimum of ten preemption sequences that can be programmed as either railroad-fire-emergency or bus vehicle preemption sequences. Preemption capability shall be standard and shall not require additional modules or software.

Railroad-Fire-Emergency Vehicle Preemption

6.1.1. The ten railroad-fire-emergency vehicle preemptors shall be selectable as a priority or non-priority type. Priority preemptor calls shall override non-priority preemptor calls. Low-numbered priority preemptors shall override higher-numbered priority preemptor calls. Non-priority preemptor calls shall be serviced in the order received.

6.1.2. Each preemptor shall provide a locking and non-locking memory feature for preemptor calls. If a preemptor is in the non-locking mode and a call is received and dropped during the delay time, the preemptor shall not be serviced.

6.1.3. Preemptor timing intervals shall be programmable from 0-255 in one-second increments or 0-25.5 in one-tenth second increments, depending on function. Delay, max presence, and duration timing intervals shall be programmed from 0 – 65535 seconds in one-second increments.

6.1.4. A programmable delay time interval shall be provided to inhibit the start of the preemption sequence. This interval shall begin timing upon receipt of a preemption call. This time shall be programmable from 0-65535 seconds in one-second increments.

6.1.5. An inhibit time shall be provided as the last portion of the delay time interval. During this time, phases that are not part of the preempt sequence shall be inhibited from service. This time shall be programmable from 0-255 seconds in one-second increments.

6.1.6. A programming option shall be available that allows termination of all phases prior to entering preemption.

6.1.7. A programmable extend input shall cause the preemptor to remain in the dwell interval following the removal of the preempt call. If a preempt call is reapplied during this time, the preemptor shall revert to start of dwell interval. This time shall be programmable from 0-25.5 seconds in one-tenth second increments.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

6.1.8. A programmable duration time shall be provided to control the minimum time that a preemptor remains active. This time shall be programmable from 0-65535 seconds in one-second increments.

6.1.9. A programmable maximum presence time shall be provided to control the maximum time that a preemptor input remains active and still be recognized by the controller. Once failed, the input must return to inactive state to be recognized again. This time shall be programmable from 0-65535 seconds in one-second increments.

6.1.10. Phases timing at the beginning of a preemption sequence shall remain in effect for a minimum time before the controller advances to the next sequential interval. If the phase has been timing for longer than the programmed preemptor minimum time, the controller shall immediately advance to the next sequential interval. Minimum times shall be programmable for the following intervals:

v. Green/walk/pedestrian clearance
w. Yellow
x. Red

6.1.11. A phase shall advance immediately to pedestrian clearance if it has been timing a WALK interval at the beginning of a preemption sequence. It shall be possible to time the minimum pedestrian clearance through the yellow interval, or alternately to advance immediately to yellow. During preemption, pedestrian indicators shall be selectable as being a solid DONT WALK, OFF (blank), or fully operational.

6.1.12. If an overlap is in effect when the preemption sequence begins, it shall be possible to terminate the overlap so that it remains red for the remainder of the preemption sequence. Overlaps terminating or forced to terminate shall time the preemptor minimum yellow and red clearance times.

6.1.13. Each preemptor shall provide user-programmable green, yellow, and red track clearance intervals. These shall begin timing immediately after the preemptor minimum red interval.

6.1.14. Each preemptor shall provide a user-programmable gate down extension and gate down max green. The gate down extension shall extend the track clearance green time after the gate down input in received. The gate down max green is the maximum the track clearance green time will be extended. If the gate down max green is exceeded the intersection shall be forced to flash.

6.1.14.1. The forced flash shall be programmable to be either hard or soft. If hard flash is enabled then exiting flash to normal operation shall require either pressing the clear key or the MMU reset. A programmed soft flash shall automatically return to normal once the fault condition no longer exits. For gate down fault this shall be once preemption is deactivated.

6.1.15. Up to four permissive phases shall be selectable as track clearance phases. During the track clearance period, the selected phases shall time the track clearance green, yellow and red intervals once, and then advance to the hold interval. If track clearance phases are not selected the track clearance interval shall be omitted from the preempt sequence. Controller interval timing shall be used if track clearance interval times have been programmed as zero.

6.1.16. The preemption hold interval shall begin immediately after track clearance. It shall remain in effect until the preemptor duration time and minimum hold times have elapsed and the preemptor call has been removed or the preemptor maximum time has been exceeded. During the preemption hold interval, any one of the following conditions shall be selectable:

y. Hold phase green
z. Limited phase service

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

aa. All red
bb. Flash

6.1.17. Any valid phase, except a track clearance phase, shall be selectable as a hold phase. If hold phases are not selected, the controller shall remain in all red during the hold interval. If flash is selected for the hold interval, up to two permissive phases shall be selectable to flash yellow, and the remaining phases shall flash red. Overlaps associated with the phases flashing yellow shall also flash yellow unless they have been forced to terminate, in which case they shall remain red.

6.1.18. The preemptor shall immediately cause flashing operation if the preemption input and the track interlock input are not in opposite states and the track interlock function is enabled.

6.1.19. Each preemptor shall provide a user-programmable green, yellow, and red dwell interval, during which the dwell phase(s) shall operate normally, except that the minimum green interval time shall equal the hold green time. At the completion of the dwell green interval, the controller shall time the dwell yellow and red clearance intervals prior to transfer to the exit phases.

6.1.20. Up to four permissive exit phases shall be selectable to time after the preemption sequence has been completed. These shall serve as transition phases to return the controller to normal operation. It shall also be possible to place calls on selected phases upon exiting preemption. The option shall be provided to cause the preemptor to exit preemption to the correct phase to maintain coordination.

6.1.21. Each preemptor shall provide a user-selectable exit timing plan. Upon exiting the preemption sequence, this timing plan shall serve as the phase times in effect for one controller cycle for all phases.

6.1.22. Preemptor linking shall permit preemption sequences, where lower-priority preemptors may call the higher-priority preemptors from their preemption sequence.

6.1.23. Each preemptor shall allow programming of an inhibit extension timer. This timer shall be the length of time the max call inhibit can be extended.

6.1.24. Preemptor active outputs shall be provided for each of the preemptors. The output shall be set to ON when the preemption sequence begins and shall remain ON for the duration of the sequence. It shall also be possible to program preempt active outputs to be ON only during preempt hold intervals. Additionally, it shall be possible to program the non-active, non-priority preemptor outputs to flash while another preemptor is active.

6.1.25. Preemptors shall normally override automatic flash. It shall be possible to inhibit this feature for each preemptor.

6.1.26. Each preemptor shall provide the ability to delay the preempt input based on vehicle and pedestrian service request in relation to the coordinated cycle. The preemptor will compare the preempt delay time to the minimum time required to service a phase or pedestrian and then skip the phase or pedestrian movement if there is not enough time left in the delay to service the movement.

6.1.27. Each preemptor shall allow pedestrian movements which were interrupted by a preempt call to be dynamically selected as that Preemptor's exit phases.

6.1.28. Each preemptor shall allow vehicle phases which have been interrupted by a preempt call to be dynamically selected as that Preemptor's exit phases. The preemptor shall calculate the percentage of green time served of phases interrupted by a preempt call. If the amount serviced does not meet the limits defined by the Priority Return % data entries then the preemptor run shall select those interrupted movements as exit phases.

6.1.29. Each preemptor shall allow phases that have been waiting the longest to be serviced or which have the most cars waiting to be dynamically selected as that Preemptor's exit phases.

6.1.30. The conditional delay, interrupted pedestrian, interrupted vehicle and queue delay functions shall be programmed for enable, disable or time of day selection.

6.1.31. Each preemptor shall, if free one cycle is enabled, allow the preemptor to exit to free for one cycle before returning to coordination.

6.1.32. Each preemptor shall, if exit phase once is enabled, allow the preemptor to exit to specific phases in free mode (for a special minimum green time as defined in a new timing plan) before returning to coordination.

Bus Preemption

6.1.33. Ten bus preemptors shall provide control for bus or other low-priority vehicles. Bus preemptors shall have low priority and shall be overridden by railroad-fire-emergency vehicle preemptor calls.

6.1.34. The preemptor shall be programmed to accept either a 6.25 pulse-per-second signal with a 50% duty cycle or a solid input to identify a bus preemptor call. Bus preemptor calls shall be capable of preemptor call memory and shall be served in the order received.

6.1.35. Bus preemptor timing intervals shall be programmable from 0-255 in one-second increments or 0-25.5 in one-tenth second increments depending on the function.

6.1.36. A re-service time shall be provided to avoid excessive utilization of the same bus preemptor. If a call is received before the re-service time has elapsed, the bus preemptor shall not be re-serviced. If re-service time has not been entered then all phases with a call when leaving the bus preemption sequence shall be serviced before the bus preemptor may be served again.

6.1.37. Bus preemptors shall provide delay, inhibit, and maximum time functions similar to those for railroad-fire-emergency vehicle preemptors described above.

6.1.38. Bus preemptors shall provide the following entrance intervals:

6.1.38.1. Green/walk/pedestrian clearance

6.1.38.2. Yellow

6.1.38.3. Red

6.1.39. At the completion of the entrance red clearance, the bus preemptor shall advance to the hold green interval. During this interval, up to four (4) permissive phases shall be selectable to remain green until the minimum hold time has elapsed and the bus preemptor call has been removed or the preemptor maximum time has been exceeded.

6.1.40. It shall be possible to program the controller to allow concurrent phases to be serviced for a bus preemptor with only one phase selected as the hold interval phase.

Preemption Safeguards

6.1.41. If a preemptor call is active when power is restored to a controller, the fault/voltage monitor output shall be set to FALSE, placing the intersection in flash. Similarly, if external start is applied during a

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

preemption sequence, the intersection shall be set to flash. Intersection flash shall remain in effect until the preemptor call has been removed and the preemptor duration time has elapsed.

6.1.42. An input shall be provided to stop timing of the current active preemptor under control of the MMU/CMU.

6.1.43. A preemptor safety interlock shall be provided to cause the intersection to go into flash whenever the controller has been replaced and/or has not been programmed for preemption. This shall be achieved with an appropriate signal to the MMU/CMU.

Optional Transit Signal Priority (TSP)

6.1.44. The controller shall include a transit signal priority algorithm that provides for transit vehicle movement through the intersection, while not interrupting coordination or skipping phases.

6.1.45. A check-in detector input shall be provided that senses the arrival of the transit vehicle. When active this input shall initiate TSP.

6.1.46. A TSP delay shall delay the beginning of TSP operation until a set interval after check-in.

6.1.47. A check-out detector input shall determine the departure of the transit vehicle.

6.1.48. Assignment of a single pulse from the check-in detector and check-out detector to the controller inputs shall be programmable to any controller input.

6.1.49. When under coordination the TSP sequence shall use adjusted split times to accommodate transit vehicles while maintaining coordination.

6.1.50. When under free operation the TSP sequence shall use adjusted maximum times to accommodate transit vehicle while not skipping phase.

7. Time-Based Control (Non-Interconnected) Coordination

The controller shall include time-based control. This capability shall be a standard feature and shall not require additional modules or software.

Clock/Calendar Functions

7.1.1. The controller shall provide a TOD clock, which shall be used for all time-based control functions. The only required clock settings shall be the current time (hour, minute, and second) and date (month, day, and year). Day of week and week of year shall be automatically computed from the date setting. It shall also be possible to set the number of hours that the local standard time is ahead or behind Greenwich Mean Time.

7.1.2. During normal operation, the TOD clock shall use the power line frequency as its time base. When power is removed, the time shall be maintained by a crystal oscillator for up to 30 days. The oscillator shall have a timing accuracy of +/- 0.005% over the entire NEMA temperature range as compared to the Universal Coordinated Time Standard.

7.1.3. In addition to entering time and date via the keyboard, it shall be possible to download the information from a central computer or a system master.

7.1.4. The controller shall include a time reset input. This feature shall reset the TOD clock to 03:30 whenever the time reset input is TRUE.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

7.1.5. The controller shall provide support for a serial input from a GPS clock that supports NEMA protocol to set the time and date of the controller.

7.1.6. The TOD clock shall automatically compensate for leap year and shall be programmable to automatically switch to daylight savings time.

Time-Based Control

7.1.7. Time-based control shall utilize a day plan program format. The month program shall consist of 200 programmable schedules, each assignable to one of 16 (sixteen) day programs. Each day program shall consist of from 1 to 50 program steps, which define a program for the entire day. Each program step shall be programmed with a starting time and an action plan number. The day plans shall also be assigned to days of the week and days of the month.

7.1.8. Time based control shall use action plans to assign:

cc. Coordination pattern number
dd. Vehicle detector plan number
ee. Controller sequence
ff. Timing plan
gg. Vehicle detector diagnostic plan
hh. Pedestrian detector diagnostic plan

7.1.9. Time based control shall also use action plans to enable:

ii. Automatic flash
jj. System override
kk. Detector log
ll. Dimming
mm. Special functions
nn. PPLT/FYA
oo. Priority return
pp. Ped priority return
qq. Queue Delay
rr. Conditional delay
ss. Auxiliary functions
tt. Logic Processor statements
uu. By-Phase functions
- Pedestrian recall
- Walk 2 enable
- Vehicle extension 2 enable
- Vehicle recall
- Vehicle max recall
- Max 2 enable
- Max 3 enable
- Conditional service inhibit
- Phase omit

7.1.10. There shall be a minimum of 36 holiday or exception day programs, which override the normal day program. Holiday programs shall be capable of being set as floating (occurs on a specific day and

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

week of the month) or fixed (occurs on a specific day of the year). It shall be possible to program a fixed holiday so that it automatically repeats in the following year.

7.1.11. It shall be possible to manually force any of the action plans to override the current action plan. The forced plan shall be entered from the keyboard and shall remain in effect until removed.

Time-Based Coordination

7.1.12. A minimum of 200 time-based schedule programs shall be available for the day-programs. There shall be up to 16-day plans with up to 50 events per day plan. These shall not have to be entered in any special sequence. It shall be possible to add and delete steps from a day-program without affecting any other day-program. Each of the program steps shall permit selection of the following functions:

vv. Day program assignment
ww. Start time
xx. Action plan

7.1.13. Selection of system override in an action plan shall allow the coordination pattern selected by the action plan to override the current telemetry or hardwire system commanded coordination pattern.

7.1.14. When operating in the time-based coordination mode the synchronization point for all cycles shall be referenced to a user selected reference time (sync reference), last event, or last sync as selected from the keyboard. The sync reference time is that time at which all cycles shall be reset to zero.

7.1.15. If the sync reference time is selected, the synchronization point for the cycle selected by the current program step shall be computed using the present time, sync reference time, and cycle length. The synchronization point shall occur whenever the present time is such that an even number of cycle length periods has occurred since the sync reference time.

8. Detectors

Detector Functions

8.1.1. The controller shall provide a minimum of 64 vehicle detector inputs. Each input shall be assignable to one or more phases and be configured with optional detector functions.

8.1.1.1. Extend and delay timing shall be provided for each detector.

8.1.1.2. Each detector shall be capable of operating in a lock or non-lock mode.

8.1.2. The controller shall also be capable of providing 16 pedestrian detector inputs. Each pedestrian detector shall be assignable to one or more phases.

Detector Cross Switching

8.1.3. The controller shall provide detector cross switching, permitting a vehicle detector to alternately place calls on assigned phases and assigned cross switch phases.

8.1.3.1. If the assigned phase is not green and the cross-switch phase is green, the detector shall place calls on the cross switch phase.

8.1.3.2. If the assigned phase is omitted for any reason, the detector shall place calls on the cross switch phase.

Detector Types

Each vehicle detector shall be user-programmable to operate as one of the following 8 detector types:

8.1.3.3. **Type N (NTCIP):** Supports all NTCIP detector functionality.

8.1.3.4. **Type S (Standard):** Supports all standard detector functionality except the call and extend options will always be enabled.

8.1.3.5. **Type D (Disconnect queue/stop bar):** This detector will disconnect from extending the phase during green if either there is a gap in the detector input OR the detectors disconnect time times out. The detector's input must be active before the phase turns green for this detector to operate.

8.1.3.6. **Type P (Passage queue/stop bar):** If the detector input is active when the phase turns green the detector passage time is reset as long as the input is active. When the detector input becomes inactive the detector passage timer begins running. If addition calls are received before the detector passage timer expires, the detector passage timer shall be reset until the input becomes inactive. Once the detector passage timer times out the detector is disconnected for the balance of the phase green.

8.1.3.7. **Type C (Calling):** This detector shall place calls on the phase only when the phase is NOT green.

8.1.3.8. **Type R: (Red Extend):** Actuation on a red extend detector during the red clearance of the assigned phase shall extend the red up to the red max phase time.

8.1.3.9. **Type G (Green Delay/Extend):** When the phase is red the detector input becoming active to the controller shall be delayed by the amount of time programmed in the delay time. When the phase is green, the detector input shall be extended after removed by the amount of time programmed in the detector extension timer.

8.1.3.10. **Type B (Bike):** Activation shall cause the phase to use the Bike minimum green in place of the minimum green.

System Detectors

8.1.4. Each detector input shall be capable of functioning as one of 16 system detectors.

8.1.5. Vehicle detectors shall be capable of being assigned to a minimum of 16 speed detectors. Speed shall be detected using both one and two detector configurations. Speed shall be computed using a keyboard entered average vehicle length and loop length for a one-detector configuration. When using two detectors, speed shall be calculated using a keyboard-entered distance between detectors and travel time between detectors.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

9. Logic Processor Commands

Standard Logic Commands

9.1.1. One Hundred (100) logic processor commands shall be assessable from the front panel of the controller or through remote database management software.

9.1.2. Each logic command shall be allowed to be enabled or disabled by TOD control.

9.1.3. Each logic command shall consist of 10 “IF” statements, 5 “THEN” statements and 5 “ELSE” statements. At least 1 “IF” statement and 1 “THEN” statement are required to create a valid command.

9.1.3.1. “IF” statements shall be logically grouped using Boolean gating including:

- AND
- OR
- XOR
- NAND
- NOR

9.1.3.2. When combined “IF” statements create one single “TRUE” result, the “THEN” statements shall be implemented.

9.1.3.3. When combined “IF” statements create one single “FALSE” result, the “ELSE” statements shall be implemented.

9.1.3.4. The “IF” statements shall monitor controller functions and timer including, but not limited to the following:

Phase/Overlap Green	Phase Calls
Phase/Overlap Yellow	Phase Omits
Phase/Overlap Red	Phase Force Offs
Phase/Overlap Active	Detector Fails
Detector Plan Number	Ring Timers
Detector Activity	Preemption Activity
Detector Volume	Preemption Dwell
Detector Occupancy	Preemption Exit
Coordination Timers	Stop Time
Coordination Holds	Manual Control
Phase Holds	Overlap timers (lagging/leading grn)

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

Phase Walks	Active Coordination Plan Number
Phase Don't Walks	TBC parameter
Phase Next	Input / Output Bits
Phase Checks	Logic Flags

9.1.3.5. The "THEN" and "ELSE" statements shall be used to control functions and events (on/off) in the controller, including, but not limited to, the following:

Set Logic Flags	Set Phase/OVL Greens
Set Phase calls	Set Phase/OVL Yellows
Set Input or Output Bits	Set Phase/OVL Reds
Set Delays	Set Walk / Ped Clear / Don't Walk
Set Load Switch circuits (R/Y/G)	Set Pedestrian Detectors
Set Vehicle Detectors	Set Holds
Omit Phase / Peds	Set Force-offs
Change Max Timers (max1, max 2)	Set Red Rest
Set Stop Time	Set Flash
Set Alarms	Set External Start
Set Recalls, CNA1, CNA2, etc	Set Manual Control Enable
Set Coordination Plan	Set Manual Advance
Set Free	Call Preempt
Call TSP	Call Phase
Set Action Plan	Set Timing Plan

Extended Options Logic commands

9.1.4. An additional 100 logic commands (101-200) shall be available in the controller, but hidden from front panel access.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

9.1.4.1. These commands shall be stored and used for easy implementation of common logic required at multiple intersections.

9.1.4.2. These commands shall only be assessable through computer software and shall be uploaded and downloaded to the controller using the same computer software.

9.1.5. Once downloaded to the controller, the logic shall be activated using an extended options file.

9.1.5.1. This file shall be downloaded to the controller and used to initialize the logic statements.

9.1.5.2. This file shall be used to create a custom menu on the controller. From this menu the user shall be able to enable or disable any of the extended options hidden in the upper one hundred logic commands.

10. System Communications

On-Street Master Communications

10.1.1. The controller shall be capable of communicating with an on-street system master. This capability shall be provided by a separate telemetry module, which shall be included in the controller when required by the plans and specifications.

10.1.2. The telemetry module shall receive system master commands and data transmissions. In addition, it shall transmit the controller status, database and system detector information to the system master.

10.1.3. If required by the plans and specifications, an external fiber optic modem or external radio or other means of communications connected by serial or Ethernet shall be provided instead of the telemetry module.

System Commands

10.1.4. The telemetry module shall allow the controller to receive, as a minimum, the following commands:

yy. Cycle, offset, and split (coordination pattern)
zz. System sync
aaa. Special function commands (minimum of four)
bbb. Free and flash mode commands
ccc. Time and date
ddd. Request for local status
eee. Recall to Max

10.1.5. All commands must occur more than once in any three-second period in order to be recognized.

10.1.6. All mode and special function commands shall be cleared after 20 minutes of loss of communication between controller and system master or central system.

10.1.7. The status of each of the following functions shall be transmitted to the system master or central system in response to a local status request:

fff. Green and yellow status for all phases and overlaps
ggg. Walk and pedestrian clearance status for all phases
hhh. Vehicle and pedestrian detector status

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

iii. Phase termination status
jjj. Local time
kkk. Coordination status
lll. Command source
mmm. Sync or transitioning status of coordinator
nnn. Conflict flash status
ooo. Local flash status
ppp. Preempt activity and calls
qqq. Volume and occupancy data from a minimum of 16 system detectors
rrr. Speed data from a minimum of two speed detectors
sss. Maintenance required (cabinet door open) status
ttt. Status of two user-defined alarms

10.1.8. The status of each of the following parameters shall be calculated on a per-cycle basis and transmitted to the system master or central system for Split Monitor Reporting:

uuu. Actual time spent in each phase
vvv. Time of day at end of cycle
www. Phases forced off during cycle
xxx. Type of coordination operation
yyy. Whether transitioning to new offset
zzz. Cycle, offset, and split in effect during last cycle
aaaa. Flash status if operation is Free

10.1.9. Upload/Download Capability – The controller shall provide the capability to upload/download the entire intersection database. Phase assignments for overlaps and preemptors shall not be downloaded to preclude unsafe controller operation. Data transfer shall not require the intersection to be in flash.

Telemetry

Telemetry shall utilize TDM/FSK data transmission from 1200 baud to 9600 baud over two pairs of wires. These may be leased lines Type 3002, voice grade, unconditioned or dedicated cable. Optional external fiber optic or wireless communications capability shall also be available.

10.1.10. The nominal transmitter output level shall be 0 dbm into a 600-ohm load. The receiver sensitivity shall be -34 dbm and shall be adjustable from -40 to +6 dbm.

10.1.11. Parity and error checking shall be employed to assure transmission and reception of valid data. Indicators shall be provided on the telemetry module to show telemetry activity as follows: transmit, receive carrier, and valid data.

10.1.12. In the event of a telemetry failure, the controller shall revert to the non-interconnected coordination mode after it has self-synchronized for a number of cycles, which shall be selectable from 1-254. If the number of cycles is set to 255, the controller will self-synchronize until a synchronizations pulse is detected.

Communications Protocols

10.1.13. The controller shall have the capability of supporting communications with traffic management systems using industry standard protocols with the installation of appropriate optional software.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

10.1.14. At a minimum the controller shall have optional software to support the following protocols:

bbbb. Caltrans AB3418
cccc. ECPIP
dddd. NTCIP Level 2 as defined by Section 3.3.6 of NEMA TS2- 2003. NTCIP v02.06 capabilities shall include all NTCIP mandatory and optional objects. The controller vendor shall provide access to all controller data via vendor specific objects. These and all other objects supported by the controller shall be defined in a standard MIB file.

Ethernet Communications

10.1.15. The controller shall have the capability of supporting Ethernet communications, using TCP/IP communications protocols.

10.1.16. This communications protocol shall utilize the controller's built-in switches and shall not require Ethernet-to-Serial converters.

External Clock

10.1.17. The controller shall have the capability of communicating with an external clock like a GPS or WWV clock for setting its internal time of day clock.

10.1.18. The controller shall include a time reset input. This feature shall reset the TOD clock to 03:30 whenever the time reset input from the GPS of WWV clock is TRUE.

11. Diagnostics

General Diagnostics Features

11.1.1. The controller shall include both automatic and operator-initiated diagnostics. This capability shall be a standard feature and shall not require additional modules or software.

11.1.2. Automatic diagnostics shall verify memory and microprocessor operation each time power is reapplied to the controller. After power has been applied, diagnostics shall continually verify the operation of essential elements of the controller including communications.

Detector Diagnostics

11.1.3. TOD controlled detectors diagnostics shall be provided that allow testing vehicle and pedestrian detectors for no activity, maximum presence, and erratic output.

11.1.4. A minimum of four detector diagnostic plans shall be provided. These plans shall be selectable on a TOD basis. This shall allow varying the detector diagnostic intervals to correspond with changes in detector activity.

11.1.5. If a detector is diagnosed as failed, the associated phase shall be placed in one of the following keyboard selectable modes:

eeee. Detector fail recall from 1 to 255 seconds
ffff. Disable the detector from calling or extending.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116

11.1.6. Diagnostics for NEMA TS2 detectors connected to the controller using a Bus Interface Unit (BIU) shall also include detection of watchdog, open and shorted loop, and excessive inductance change failures.

12. Logging

The controller shall be capable of logging and reporting detector activity, detector failures, and the occurrence of selected events or alarms. Logs shall be capable of being printed or displayed on the front of the controller.

Detector Logging

12.1.1. The controller shall include a detector log buffer capable of logging volume, occupancy and average speed for selected vehicle and speed detectors.

12.1.2. The detector-logging interval shall be keyboard selectable as 5, 15, 30, or 60 minutes.

12.1.3. Detector logging shall be capable of being enabled or disabled by TOD.

Detector Failure Logging

12.1.4. The controller shall include a detector failure log buffer capable of storing a minimum of 100 time and date-stamped detector failure events. Once logged, detector failure events shall remain in the log until cleared or the log buffer capacity is exceeded at which time the oldest detector failure events shall be overwritten.

12.1.5. All detector diagnostic failures shall be recorded in the detector failure log including: no activity, maximum presence, erratic output, watchdog failure, open loop, shorted loop, and excessive inductance change. If a detector recovers after a diagnostic failure, a detector on-line event shall be stored in the detector failure log.

12.1.6. Detector failure logging shall be capable of being disabled.

Event Logging

12.1.7. The controller shall include an event log buffer capable of storing a minimum of 200 time and date-stamped events or alarms. Once logged, events shall remain in the buffer until cleared or the log buffer capacity is exceeded at which time the oldest events shall be overwritten.

12.1.8. At a minimum, the following events shall be logged: communication failures, coordination faults, MMU and local flash status, preempt, power ON/OFF, low battery, and status of a minimum of two alarm inputs. An on-line event shall be logged when an event or alarm returns to normal status.

12.1.9. If security is enabled, an event shall be logged when a user enters a data change. This event shall include the user's ID. It is necessary to log the first change only and not every change. Also an entry shall be recorded when a user logs in and out of the controller.

12.1.10. Event logging shall be capable of being enabled or disabled for each category of event or alarm.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

13. Optional Software Modules

The optional software modules shall not be considered as base features of the controller. These features shall be enabled through a special function data key, which when inserted in the controller shall unlock the software features and allow the controller to activate the functionality.

Transit Signal Priority (TSP)

13.1.1. Six (6) TSP plans shall be available to allow priority control of identified transit vehicles.

13.1.2. The transit vehicles shall be identified through special inputs into the controller. The inputs shall be of the following types:

a. Check-In and Check-Out – These shall be two momentary inputs providing a service request for the transit vehicle. TSP shall be given to the vehicle from the time the Check-In signal is received to the moment the Check-Out signal is received, or the max TSP timer expires, whichever comes first.

b. Constant Call – This shall be one continuous input providing a service request for the transit vehicle. TSP shall be given to the vehicle from the time the signal is received to the moment the call is terminated, or the max TSP timer expires, whichever comes first.

13.1.3. The TSP algorithm shall provide priority service to the transit vehicle without terminating coordination plans or skipping phases.

Centracs Adaptive Interface

13.2.1 The controller shall provide an interface to the *Centracs Adaptive* control software. The controller shall provide both NTCIP and *Centracs Adaptive* objects to provide detector and phase data. The controller shall accept new splits and offsets from the *Centracs Adaptive* software.

3360 E La Palma Avenue, Anaheim, CA 92806 · 714-630-3700 · sales@econolite.com · www.econolite.com

#683-10526-1116