2018KCL Series

18 Channel RMS Signal Monitor with Datakey

Operations Manual

THIS MANUAL CONTAINS TECHNICAL INFORMATION FOR
THE **2018KCL** and **2018KCLip**, PCB Issue J
Firmware Version 0159, 0459

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MAINTENANCE NOTE

EBERLE DESIGN INC. SIGNAL MONITORS HAVE BEEN CAREFULLY INSPECTED AND TESTED TO ENSURE PROPER OPERATION. IT IS RECOMMENDED THAT THE SIGNAL MONITOR BE TESTED AT LEAST ANNUALLY TO ENSURE COMPLIANCE WITH THE PROPER SPECIFICATIONS.

SECTION 4.1.2, SPECIAL FUNCTION INPUTS

SPECIAL FUNCTION #2 HAS BEEN DISABLED TO PROVIDE COMPATIBILITY WITH THE MT-180 MONITOR TESTER. RESISTORS R245 AND R219 HAVE BEEN REMOVED TO DISABLE THIS CIRCUIT. IF SPECIAL FUNCTION #2 INPUT IS REQUIRED, R245 AND R219 (75K OHMS, 1/4W) SHOULD BE INSTALLED.

- WARNING -

THE P8 RED INTERFACE CABLE SHOULD ALWAYS BE UNPLUGGED BEFORE REMOVING THE UNIT FROM THE CABINET TO PREVENT POTENTIAL EXPOSURE TO ELECTRICAL SHOCK.

- WARNING -

PIN 27 OF THE MAIN CONNECTOR PROVIDES THE CLOSED CONTACT OF THE OUTPUT RELAY WHEN THE MONITOR IS IN THE NO-FAULT STATE. WHEN THE MONITOR IS IN THE NO-FAULT STATE AND THE AUTO/FLASH SWITCH IS IN THE FLASH POSITION, AC LINE VOLTAGE MAY BE PRESENT ON PIN 27.

THIS PIN WAS PREVIOUSLY DEFINED AS A "NO-CONNECT' PIN IN LEGACY EQUIPMENT. TO PREVENT POTENTIAL EXPOSURE TO ELECTRICAL SHOCK, BEFORE INSTALLING THIS MONITOR THE USER IS CAUTIONED TO CHECK THAT THE CABINET WIRING IS COMPATIBLE WITH THE USE OF THIS PIN AS A SOURCE OF AC LINE VOLTAGE.

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Section 1
BASIC FUNCTIONS

1.1 MODEL DESCRIPTION

The model 2018KCL unit is an eighteen channel version of the 2010ECL model, and is compatible with the requirements of both the 170 Controller Unit and the 2070 Advanced Traffic Controller. The need for diode based program cards and on-board DIP switches for configuration has been replaced with the interchangeable Datakey device. The default configuration meets the requirements of the industry 2010 specification. Where not specified otherwise, the information in this manual will apply to all models.

The 2018KCL is completely compatible with cabinets wired for conventional 16 channel monitor operation. All monitoring functions related to channels 17 and 18 may be disabled if necessary.

The model 2018KCL has a three color LED full intersection display and an EIA-232 serial port that gives the unit the capability to communicate with Controller Unit or PC based operational software for status and fault event data. The model 2018KCL also provides an enhanced event logging capability for full time stamped event reporting to the Controller Unit or PC based operational software. The model 2018KCLip provides an Ethernet port in place of the standard EIA-232 serial port.

1.2 BASIC FUNCTIONS

The 2018KCL Signal Monitor is a device used in a traffic controller assembly to monitor traffic signals at an intersection for conflicting proceed indications caused by malfunctions of the controller, load switches, field wiring and loads, or miss-wiring of the cabinet. The 2018KCL also provides error sensing of the cabinet 24VDC supply and monitors the controller Watchdog output. The 2018KCL is directly interchangeable with a standard model 210 Signal Monitor and complies with all applicable specifications outlined in Chapter 4 (Model 210 Monitor Specifications) of the *Caltrans Traffic Signal Control Equipment Specifications* (January 1989).

When triggered by the detection of a fault condition which exists longer than the minimum period, the 2018KCL will enter the fault mode transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller. The cabinet assembly should be wired such that the transfer of the Output relay contacts to the fault position will cause an automatic switching of the field signal outputs from normal operation to flashing operation. The 2018KCL will then display the appropriate fault indications and will remain in this fault mode until a reset command is issued. The loss of AC Line power will not reset the fault mode (except Diagnostic Fail). In the event of AC Line power loss the 2018KCL will retain the status of all fault and channel indicators and will display the correct fault and channel status upon restoration of AC Line power.

1.2.1 DATAKEY PARAMETER PROGRAMMING

The 2018KCL is configured using a removable nonvolatile memory device called a Datakey[tm] (Datakey is a trademark of Datakey Electronics, Inc.). The Datakey replaces the mechanical jumpers, DIP switches, and diode based program card used in conventional signal monitors and provides an interchangeable and electronic method of programming the unit. The Datakey contains a nonvolatile prom device that is read by the 2018KCL. The Datakey itself is programmed by a separate programming tool using a Personal Computer program such as the Eberle Design *MonitorKey*[®] product. See the Eberle Design **MonitorKey Operations Manual** for further details.

1.2.1.1 MONITORKEY CONFIGURATION SET-UP WIZARD

The Set-up Wizard in the *MonitorKey*® program can be used to automatically generate all the enhanced monitor programming data for the 2018KCL in most cases without the need for understanding complex and confusing monitor terminology. It configures the monitor enhanced-feature programming parameters using a simple series of intersection related questions.

1.2.2 CONFLICT MONITORING

The 2018KCL is capable of monitoring 18 channels. Each channel consists of a Green, Yellow, and Red field signal output at the field terminals. Programming is provided in the Datakey for assigning permissive (compatible) channels and inhibiting Yellow monitoring for required channels. The 2018KCL detects the presence of conflicting Green or Yellow signals on the AC field terminations between any two or more channels assigned to conflict. The monitoring circuitry is capable of detecting either full wave or positive and negative half-wave field signal outputs at the specified voltage levels. A Conflict fault places the 2018KCL into the fault mode illuminating the CONFLICT indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller.

1.2.3 24VDC MONITORING (VDC)

Sensing of the cabinet 24VDC supply is provided as specified in Section 4.2, Chapter 4 of the *Caltrans Traffic Signal Control Equipment Specifications*. When the 24VDC input falls below the specified voltage levels the 2018KCL will enter the fault mode illuminating the VDC indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller. See Section 8.1.3.

1.2.4 CONTROLLER WATCHDOG MONITORING (WDT)

Sensing of the controller Watchdog output is provided as specified in Section 4.3 of the *Caltrans Traffic Signal Control Equipment Specifications*. When a logic transition is not sensed for the specified period (see Section 8.1.4) the 2018KCL will enter the fault mode illuminating the WDT indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller.

1.2.4.1 WDT CLEAR ON PU OPTION

The WDT Clear on PU option (see section 4.2.3.7) determines whether this Watchdog (WDT) fault mode is latched through an AC Line brownout or not. If the WDT Clear on PU option is selected, an AC Line brownout condition will reset the Watchdog (WDT) fault mode when the AC Line is restored. The WDT indicator will remain illuminated until a Reset command is issued via the front panel RESET button or External Reset input. This indicates to the technician that a Watchdog (WDT) fault occurred but was cleared by an AC Line brownout. If the WDT Clear on PU option is not selected, the Watchdog (WDT) fault mode is maintained until a Reset command is applied.

Section 2
EXTENDED FEATURES

The following extended features are provided on the Signal Monitor to provide additional fault monitoring functions, to increase the reliability of the monitor operation, and enhance the diagnostic capabilities offered to the service technician.

2.1 HARDWARE FEATURES

The 2018KCL is a dual microprocessor based unit. All monitoring functions and features are firmware programmable that permits upgrades or modifications by simply reprogramming the Flash memory device containing the firmware with the upgraded version. Thus, most changes to the Signal Monitor specifications may be accommodated without modifying the hardware.

Since all critical timing functions are accomplished by the microprocessor, the quartz crystal based accuracy results in very precise and repeatable measurements. This accuracy is maintained on functions from timing fault conditions to implementing a unique firmware based digital sampling and filtering algorithm. This algorithm is applied to all AC field signals to help eliminate false detection in a "noisy" AC line environment.

Input voltages are measured using a true Root Mean Squared (RMS) technique. A dedicated microprocessor RMS- Engine controls the analog to digital (A/D) hardware which samples each AC input voltage 32 times per cycle. The RMS-Engine then calculates the true RMS voltage value producing accurate results which are very insensitive to changes in frequency, phase, wave shape, and distortion. Voltage references are temperature compensated for constant voltage levels within the operating temperature range.

A nonvolatile EEPROM device is utilized to retain fault status information and event logs in the event of an AC Line power interruption. The correct fault indications will be displayed upon restoration of AC Line power. This EEPROM device requires no battery back-up. The time of day in the model 2018KCL unit is stored in a battery-backed real time clock circuit. Should this battery fail, only current time of day and date information will be lost. No monitor configuration programming is stored under battery power.

2.2 RED FAILURE MONITORING

The 2018KCL is designed to adapt Red Failure Monitoring to a conventional controller cabinet assembly. The simultaneous absence of active Green, Yellow, and Red field signal voltages on a channel places the 2018KCL into the fault mode illuminating the RED FAIL indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller. Sixteen Red signal inputs, a Red Enable input, and two Special Function preemption inputs (SF1,2) are connected to the monitor via a front panel connector (P8) and ribbon cable assembly. Channel 17 and 18 Red signal inputs are connected to the monitor via the main connector (P1). Chassis Ground may also be connected to the unit through pin P8-4. Jumper E14 must then be inserted to complete the connection.

The Red Fail fault timing value is selected by the Red Fail Timing Short Option. See section 4.2.3.11.

The Red Failure monitoring function is enabled by applying AC+ to the Red Enable input (P8-20). Each channel is enabled for Red Failure monitoring via Red Fail Enable programming in the Datakey. Red Failure monitoring is disabled for all channels when the Red Enable input is not active, a Preemption input (SF1,2) is active, or the pin #EE input (MC Coil) is active.

2.2.1 RED INTERFACE CABLE FAULT

When inserted into the output file without the Red Interface cable assembly, the 2018KCL will operate as a standard 210 signal monitor, that is, the Red Fail, Dual Indication, and Clearance monitoring functions will be disabled. When the Red Cable Fault option is selected (see section 4.2.3.8), operating without the Red Interface cable will cause the 2018KCL to enter the fault mode illuminating the RED FAIL indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller. To indicate this fault mode the RED FAIL indicator will be illuminated with all channel indicators Off.

The cabinet should be wired such that the Red Enable input is only interrupted by the Load Switch bus being de-energized. Red Fail preemption control to the monitor should use the Special Function inputs #1 or #2.

2.3 GYR-DUAL INDICATION MONITORING

This monitoring function detects simultaneous indications of active Green and Yellow, Green and Red, or Yellow and Red field signal outputs on the same channel. A GYR-Dual Indication fault places the 2018KCL into the fault mode illuminating the DUAL indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller. GYR-Dual Indication Monitoring is enabled on a per channel basis using the GY Dual Enable, GR Dual Enable, and YR Dual Enable programming in the Datakey (see section 4.2.6) and requires the controller cabinet assembly to be adapted for Red Signal Monitoring. GYR-Dual Indication Monitoring is disabled for all channels when the Red Enable input is not active or the Pin #EE input (MC Coil) is active.

The Dual Indication fault timing value is selected by the Dual Indication Timing Long Option. See section 4.2.3.13.

An open or no load condition (i.e., burned-out bulb) may be detected as an active signal due to load switch leakage current and may cause a Dual Indication fault. Dual Indication Monitoring may also anticipate a possible Conflict in the event that a proceed signal on a channel is constantly detected as active.

2.4 CLEARANCE (SHORT OR ABSENT YELLOW) MONITORING

2.4.1 MINIMUM YELLOW CHANGE INTERVAL

The 2018KCL will verify that the Yellow Change interval is at least the Clearance Fail Fault time (section 8.1.4). The Yellow Change interval consists of the duration of time in which the Yellow field signal input is active in a sequence from Green to Yellow to Red. When this minimum interval is not satisfied the 2018KCL will enter the fault mode illuminating the CLEARANCE indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller.

Minimum Yellow Change monitoring is enabled on a per channel basis using the Minimum Yellow Change Enable programming in the Datakey (see section 4.2.7.1) and requires the controller cabinet assembly to be adapted for Red Signal Monitoring. Minimum Yellow Change monitoring is disabled for all channels when the Red Enable input is not active or the pin#EE input (MC Coil) is active.

2.4.2 MINIMUM YELLOW PLUS RED INTERVAL

The 2018KCL will verify that the Yellow Change plus Red Clearance interval between the end of an active Green (Walk) signal and the beginning of the next conflicting Green (Walk) signal is at least the Clearance Fail Fault time (see section 8.1.4). This ensures a minimum clearance interval for channels without a true yellow signal such as pedestrian channels. When this minimum interval is not satisfied the 2018KCL will enter the fault mode

illuminating the CLEARANCE indicator, transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller.

Minimum Yellow Plus Red Clearance monitoring is enabled on a per channel basis using the Minimum Yellow Plus Red Clearance Enable programming in the Datakey (see section 4.2.7.2) and requires the controller cabinet assembly to be adapted for Red Signal Monitoring. Minimum Yellow Plus Red Clearance monitoring is disabled for all channels when the Red Enable input is not active or the pin#EE input (MC Coil) is active.

2.4.2.1 MINIMUM YELLOW PLUS RED CLEARANCE DISABLE

The **MUTCD Section 4D.10 Yellow Change and Red Clearance Intervals** requirement states, "A yellow signal indication shall be displayed following every CIRCULAR GREEN or GREEN ARROW signal indication". In some legacy intersection cases this requirement is not met due to the lack of a Yellow signal head on an overlap phase (channel), and signal timing that precludes what would normally be the overlap clearance interval. In this case the Minimum Yellow Plus Red Clearance monitoring function can be disabled for that channel. It should be noted that the Minimum Yellow Plus Red Clearance monitoring function is only intended to be disabled under these special conditions.

2.5 AC LINE BROWN-OUT DETECTION

When the AC Line voltage is below the "drop-out" level the 2018KCL will suspend all fault monitoring functions, transfer the Output relay contacts to the fault position, and enable the Stop-Time output to the controller. The AC PWR indicator on the front panel will flash at a rate of 2Hz to indicate the brown-out status. When the AC Line voltage returns above the "restore" level the monitor will resume normal operation and the AC PWR indicator on the front panel will remain illuminated.

The AC Brownout dropout and restore voltage levels are selected by the 92Vrms Brownout option in the Datakey. See section 4.2.3.14.

AC Line Brown-out Detection is provided to prevent a dark intersection in the event a brown-out causes the cabinet controller to release control of the intersection. If this occurs and the intersection is not placed into flash, the monitor will detect a Red Failure (absence of signal) or WDT and will require a manual reset. **The "low AC Line Voltage" level on the Controller Unit should be set at least 5 volts below the monitor drop-out level.**

2.5.1 MINIMUM FLASH TIME

A Minimum Flash time option can be selected (see section 4.2.3.1.1) which provides a flash interval of at least 4 seconds and at most 16 seconds in duration following a power-up, an AC Line interruption, or a brownout restore. During this interval the unit will suspend all fault monitoring functions and transfer the Output relay contacts to the fault position. The AC PWR indicator on the front panel will flash at a rate of 4Hz.

The minimum flash interval will be terminated after the selected minimum flash time value if the Watchdog input has made five transitions between the True and False state and the AC Line voltage is greater than the restore level.

2.6 *LEDGUARD*® LED FIELD SIGNAL SENSING

The Signal Monitor can be configured to use a technique called *LEDguard*® that is designed to better monitor the characteristics of LED based signal loads. Each field signal input is measured and compared to both a high threshold and a low threshold value to determine On / Off status. This differs from conventional operation where the active threshold is picked according to the color of the field signal. Once the high and low On / Off thresholds (Section 8.1.2) have been determined using the input RMS voltage, the individual fault monitor functions use the appropriate threshold to determine if a fault condition exists.

LEDguard®	Green/Walk	Yellow	Red/Dont Walk
Conflict	Low	Low	---
Red Fail	High	High	High
Dual Indication	Low	Low	Low
Clearance	Low	Low	High

The *LEDguard®* mode is enabled by an option in the Datakey. See section 4.2.3.12. The 2018KCL will meet the requirements of automatic monitor testers with this option selected.

2.7 RECURRENT PULSE DETECTION

This error detection function supplements the normal Conflict, Dual Indication, and Red Fail monitoring algorithms for sensing faults that are intermittent or pulsing in nature. The RMS-Engine is designed to filter out short term transients commonly found on the electrical service and provide noise immunity against false signal detections. The Recurrent Pulse detection function is designed to respond to fault conditions which are intermittent in nature and do not meet the continuous timing requirements of the normal detection algorithms, yet may still produce improper signal displays. These input conditions are differentiated by their longer time constant and fault response times.

The figure below shows a simple example of a recurrent Conflict fault. Channel 2 Green is detected active due to a malfunction of the load switch that caused the output to ≡flicker≡ On for 100 ms approximately every 200 ms. Since normal Conflict detection requires a continuous fault of at least 350 ms duration, this event could go undetected. The Recurrent Pulse detection algorithm will combine these pulses into one event and trigger a Conflict fault once the longer recurrent timing threshold is exceeded.
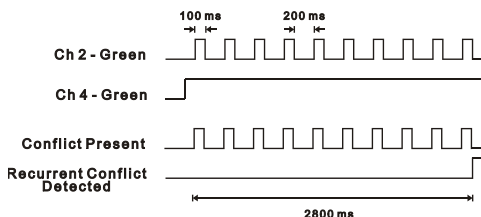
When triggered by a recurrent fault condition, the Signal Monitor will enter the fault mode, transfer the Output relay contacts to the Fault position, enable the Stop-Time output to the controller, and illuminate the appropriate CONFLICT, DUAL, or RED FAIL indicator along with the RP DETECT indicator. The unit will remain in the fault mode until reset by the Reset button or the External Reset input. Fault response times will vary depending on the pulse width and frequency of the recurrent inputs, but will range from 1000 ms minimum to 10.4 seconds maximum. Recurrent Pulse detection can be disabled with the Recurrent Pulse Disable option in the Datakey, see section 4.2.3.9.

2.8 EXIT FLASH

When the 2018KCL series exits the flash state (Output relay de-energized) as a result of a Reset command or AC Line brownout restore, the Stop Time output will go to the inactive state 250 ± 50 ms before the Output relay transfers to the energized state. This transition will provide an early indication to the 2070 Controller Unit that the cabinet will transfer from flash to signal operation.

2.9 NON-VOLATILE FAULT MEMORY

The Signal Monitor stores the fault and channel indicator status at the time the fault occurs into a non-volatile EEPROM device. Should an AC Line power interruption occur while the monitor is in the fault mode, then upon restoration of AC Line power, the Output relay and

Stop-Time output will remain in the fault mode and the correct fault and channel indicators will be displayed.

The 2018KCL use a lifetime lithium battery to maintain the time of day clock. Should this battery fail, only current time and date functions will be lost. No monitor configuration parameters or event log data is stored under battery power.

2.10 KEY (DATAKEY ABSENT) INDICATION

If the Datakey is absent or not seated properly in the receptacle, the 2018KCL will enter the fault mode transferring the Output relay contacts to the fault position and enabling the Stop-Time output to the controller. The KEY indicator will illuminate to indicate this condition. A manual or external Reset is required after the Datakey is properly seated.

2.10.1 DATAKEY MEMORY DIAGNOSTIC

This test will verify whether the non-volatile Datakey contains valid data. The routine will perform a check on each nonvolatile memory element and make a comparison with a 16 bit Frame Check Sequence (FCS) procedure defined in clause 4.6.2 of ISO/IEC 3309. Invalid data may result from corrupted Datakey contents, an invalid FCS calculation, invalid parameter values, or a Datakey Protocol Version incompatibility. The KEY indicator will illuminate to indicate this condition.

2.11 CONFIGURATION CHANGE MONITORING

The 2018KCL maintains an internally calculated CRC value of the current Datakey configuration settings. On power-up, reset, and periodically during operation, the unit will compare the current configuration settings with the previously stored value. If the settings have changed, the 2018KCL will automatically log the new setting.

When the Configuration Change Fault select option is enabled by an option in the Datakey (see Section 4.2.3.16), any change in the configuration parameters will cause the 2018KCL to enter the fault mode causing the Output relay contacts to close and enabling the Stop-Time output to the controller. To indicate this fault mode the KEY indicator will flash at a 4 Hz rate. The Channel Status indicators will display the hex value of the Configuration Check Value for the Datakey inserted. Depressing the Reset button for three seconds will clear this fault and log the new configuration parameters.

If the Configuration Change Fault select option is not selected, the unit will not set the fault mode but will still log the configuration change.

2.12 INTERNAL MPU WATCHDOG

The Signal Monitor generates an internal watchdog pulse from its microprocessor. This occurs at least once per line cycle. If the internal hardware does not detect a watchdog pulse within approximately 325 milliseconds, the Signal Monitor will enter the fault mode causing the Output relay contacts to close and enabling the Stop-Time output to the controller. The DIAGNOSTIC indicator on the front panel will illuminate to indicate a monitor hardware and/or firmware failure.

This type of failure is configured as latching. With latching operation, only a loss of AC Line will restore operation. If the microprocessor resumes operation the unit will not return to normal operation. If non-latching operation is desired, jumper E13 (Latching MPU Fault) may be removed.

2.13 RESET INPUT DETECTION

A reset command from either the front panel Reset button or External Reset input will cause a one-time reset command to the monitor. If the reset command is maintained longer

than 500 milliseconds, the monitor will resume monitoring functions and the Reset command will then provide input to the Diagnostic Display mode (see Section 2.18).

2.14 LED TEST

The monitor will illuminate all front panel indicators for 500 milliseconds when a Reset command is issued by the front panel Reset button or External Reset Input. This function provides a means to verify the operation of all front panel indicators.

2.15 MEMORY TEST

The Signal Monitor verifies the proper operation of the memory devices (RAM, EPROM, & EEPROM) required to operate the monitor. This test is performed when AC Line power is applied, a Reset Command is issued to the monitor, and periodically during operation. If a memory error is detected, the Signal Monitor will attempt to update the front panel display and then execute a STOP instruction. This will cause the Output relay contacts to close and enable the Stop-Time output to the controller. The DIAGNOSTIC indicator on the front panel will illuminate to indicate a monitor hardware and/or firmware failure. Due to the nature of these hardware or firmware failures, other fault indicators that may be concurrently illuminated may not be valid for trouble shooting purposes.

2.16 WATCHDOG MONITORING DISABLED INDICATOR

When the AC Line voltage is below the Watchdog disable level and the 92Vrms Brownout option is set, the 2018KCL will flash the WDT indicator on the front panel once every 2 seconds. This function informs the service technician that the cabinet Controller Watchdog monitoring function is disabled.

2.17 RED FAILURE MONITOR DISABLED INDICATOR

When the Red Fail Monitoring function is disabled because the Red Enable input is not active or the EE input (MC Coil) is active or a Special Function input is active, the Signal Monitor will flash the RED FAIL indicator on the front panel once every 2 seconds. This function informs the service technician that Red Fail Monitoring function is disabled.

2.18 DIAGNOSTIC DISPLAY MODE

The 2018KCL model provides two means of displaying the individual Green, Yellow, and Red field status. The No Fault Diagnostic Display mode shows the real time individual colors while the monitor is not in the fault mode (intersection operating) using the three color LED full intersection display. The Fault Diagnostic Display mode shows the individual colors which were active at the time the monitor triggered to the fault mode (intersection in flash) as well as the channel(s) which were involved in the fault. The Fault Diagnostic Display mode also provides a review of previous fault events.

2.18.1 NO FAULT DIAGNOSTIC DISPLAY

When the 2018KCL model is not in the fault state, the unit will continuously display the active Green, Yellow, and Red field status simultaneously on a three color LED full intersection display.

2.18.2 FAULT DIAGNOSTIC DISPLAY

Once the 2018KCL model has been triggered by a fault the channel status display will alternate between the field signals active at the time of the fault for 6 seconds, and the channels which were involved in the fault (fault status) for 2 seconds. The channels involved in the fault will flash their respective Green, Yellow, and Red indicators simultaneously at a 4 Hz rate for the 2 second fault status interval. If the fault displayed is a Recurrent Pulse Conflict, Recurrent Pulse Dual Indication, or a Recurrent Pulse Red Fail,

the RP DETECT indicator will then flash simultaneously at a 4 Hz rate with the input(s) that had Recurrent Pulse status for an additional 2 seconds following the fault channel display.

The two previous faults may be also be displayed individually. This status is not reset by an AC Line power interruption. To enter this display mode remove the Datakey. The sequence is as follows:

Reset	Event	KEY LED	Fault Status LEDs
---	#1	Single flash	Current Fault Status (newest)
#1	#2	Double flash	Event #2 Fault Status
#2	#3	Triple flash	Event #3 Fault Status (oldest)
...			(repeats back to top)

To enter this display mode remove the Datakey. The channel status display will alternate between the channels which were involved in the fault (fault status) for 2 seconds, and the field signals active at the time of the fault for 6 seconds. The channels involved in the fault will flash their Green, Yellow, and Red indicators simultaneously at a 4 Hz rate for the 2 second interval. The KEY LED will pulse once per second to indicate the current fault (#1, newest).

Depressing the Reset button advances the display mode from the current fault (#1) to the fault display mode for fault #2. The KEY LED will pulse twice per second to indicate the previous fault (#2).

Depressing the Reset button again advances the display mode from fault #2 to the fault display mode for fault #3. The KEY LED will pulse three times per second to indicate the previous fault (#3).

Depressing the Reset button again returns the display mode from fault #3 to the fault display mode for fault #1.

To exit this display mode, replace the Datakey. If the Datakey is removed while the model 2018KCL unit has **not** been triggered by a fault, the fault status display mode will show the Green, Yellow, and Red channels active when the Datakey was removed. If a KEY fault is displayed during the review, the KEY LED will not flash during the Fault Status display step to indicate the fault number.

2.19 FLASHING YELLOW ARROW (FYA) OVERVIEW

This unit is designed to monitor an intersection with up to four approaches using the four section FYA movement outlined by the NCHRP Research Project 3-54 and NEMA TS-2 Amendment #4-2012 on Protected/Permissive signal displays with Flashing Yellow Arrows. For monitoring purposes an FYA approach is defined as a four input "logical channel" consisting of the solid Red Arrow, solid Yellow Arrow, flashing Yellow Arrow (permissive), and solid Green Arrow (protected). The Signal Monitor combines two physical channels to monitor each "logical" FYA approach.

Three cabinet configurations are supported depending on the number of load switches provided and the capabilities of the Controller Unit. A Flashing Yellow Arrow approach is actually monitored using two physical channels of the Signal Monitor. In the basic FYA mode of the unit, one additional load switch is required for each FYA approach to be monitored. Thus a cabinet providing four vehicle phases, four pedestrian phases, and four FYA approaches would require sixteen load switches (Aux Assembly). See Section 2.20.1 for FYA Mode programming.

The compact FYAC mode requires the Controller Unit to remap the Yellow outputs of the pedestrian load switches to drive the protected Green Arrow signals of the FYA approaches. In this mode the cabinet can provide the four FYA approaches with the existing twelve position output assembly. See Section 4.4.8 for FYAC Mode programming.

The compact FYAC Mode-H requires the Controller Unit to remap the Yellow outputs of the pedestrian load switches to drive the permissive flashing Yellow Arrow signals of the FYA approaches. In this mode the cabinet can provide the four FYA approaches with the existing twelve position output assembly and support an Aux Assembly to provide four additional load switches for channels 9-12. See Section 2.20.3 for FYAC Mode-H programming.

2.19.1 FYA MODE

In the FYA mode (see Table 2-1), the cabinet must be wired such that for each 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 associates channel 1 with 9, channel 3 with 10, channel 5 with 11, and channel 7 with 12, when FYA monitoring is enabled for that respective approach. See Section 4.2.9 for FYA Mode programming.

Table 2-1
FYA Mode Channel Configurations

FYA Mode	Protected Turn Channels (Ga)	Opposing Through Channels	Permissive Turn Channels (Ra, Ya, fYa)	Green Arrow Signal Driver Source
	1	2	9	1 Green
	3	4	10	3 Green
	5	6	11	5 Green
	7	8	12	7 Green

2.19.1.1 FYA MONITORING FUNCTIONS

If a FYA channel pair is enabled for FYA operation, the Signal Monitor will monitor the FYA logical channel pair for the following fault conditions:

2.19.1.1.1 CONFLICT

Channel conflicts are detected based on the Permissive programming jumpers on the Program Card for each channel. This operation remains unchanged from normal operation except for the solid Yellow arrow (FYA clearance) signal.

2.19.1.1.1.1 PROTECTED YELLOW CHANGE INTERVAL CONFLICT

The Signal Monitor will verify during the Yellow change interval of the Protected Turn channel (Green arrow; channels 1,3,5,7) that no conflicting channels to the solid Yellow arrow channel (clearance) are active. The conflicting channels are determined by the Program Card compatibility programming of the Protected Turn channel (Green arrow; channels 1,3,5,7) of the pair.

2.19.1.1.1.2 PERMISSIVE YELLOW CHANGE INTERVAL CONFLICT

During all other times the Signal Monitor will verify that no conflicting channels to the solid Yellow arrow channel (clearance) are active as determined by the Program Card compatibility programming of the Permissive Turn channel (flashing Yellow arrow; Channels 9, 10,11, 12).

2.19.1.1.2 FLASH RATE DETECTION

When the FLASHRATE FAULT option is not disabled (see Section 4.2.9.1), the Signal Monitor will monitor a flashing yellow arrow output for a lack of flashing operation. If any of the enabled flashing yellow arrow signals on channels 9,10,11,12 remain active for more than the FYA Flash Rate Fault time (Section 8.1.4), the Signal Monitor will enter the fault mode, transfer the OUTPUT relay contacts to the Fault position, and display status. The Signal Monitor will remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input.

2.19.1.1.3 RED FAIL

A Red Fail fault will occur if the solid Red Arrow AND solid Yellow Arrow AND flashing Yellow Arrow AND solid Green Arrow all remain inactive for the Red Fail fault response time. The fault channel status will be indicated for both channels of the pair. The Red and Yellow inputs for channels 1, 3, 5, and 7 do not affect the Red Fail condition for the FYA channels 9, 10, 11, and 12.

2.19.1.1.4 DUAL INDICATION

A Dual Indication fault will occur if any two or more of the solid Red Arrow, solid Yellow Arrow, flashing Yellow Arrow, or solid Green Arrow signal combinations are active simultaneously for the Dual Indication fault response time. The fault channel status will be indicated for the Overlap channel (9, 10, 11, 12). The fault channel status will also be indicated for the solid Green Arrow channel (1, 3, 5, 7) IF the solid Green Arrow was active.

If the GY Dual Enable, GR Dual Enable, or YR Dual Enable is On for the solid Green Arrow channels (1, 3, 5, 7) then a Dual Indication fault will occur if any two or more of the Red, Yellow, or solid Green Arrow inputs (1, 3, 5, 7) are active simultaneously for the Dual Indication fault response time.

2.19.1.1.5 CLEARANCE

A Clearance fault will be detected if the FYA channel sequences from the solid Green Arrow (1, 3, 5, 7) to the solid Red Arrow (9, 10, 11, 12) without a minimum clearance time on the solid Yellow Arrow (9, 10, 11, 12), when SSM switch 9, 10, 11, 12 is On. The fault channel status will be indicated for the Overlap channel (9, 10, 11, 12).

A Clearance fault will be detected if the FYA channel sequences from the flashing Yellow Arrow (9, 10, 11, 12) to the solid Red Arrow (9, 10, 11, 12) without a minimum clearance time on the solid Yellow Arrow (9, 10, 11, 12), when SSM switch 9, 10, 11, 12 is On. The fault channel status will be indicated for the Overlap channel (9, 10, 11, 12).

A Clearance fault will be detected if the protected channel sequences from the solid Green Arrow (1, 3, 5, 7) to the solid Red Arrow (1, 3, 5, 7) without a minimum clearance time on the solid Yellow Arrow (1, 3, 5, 7). SSM switch 1, 3, 5, 7 is On. The fault channel status will be indicated for the solid Green Arrow channel (1, 3, 5, 7).

2.19.1.2 FYA INSTALLATION

The cabinet must be wired such that for each 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 associates channel 1 with 9, channel 3 with 10, channel 5 with 11, and channel 7 with 12 when FYA monitoring is enabled for that respective approach.

To enable channel pair for FYA operation, select that Datakey Unit Options checkbox labeled "FYA x-y" (where "x-y" is 1-9, 3-10, 5-11, or 7-12). When the Datakey Unit Options checkbox labeled "FYA x-y" is in the unchecked mode, both channel x and y operate in standard fashion.

> **- WARNING -**
>
> **IF THE PERMISSIVE FLASHING YELLOW ARROW AND PROTECTED GREEN ARROW CHANNEL ASSIGNMENTS ARE SWAPPED SUCH THAT THE FYA INPUT IS MONITORED ON CHANNELS 1,3,5, AND 7:**
>
> 1) The Flashrate Fault function monitors the enabled flashing Yellow Arrow input of channels 9,10,11, and 12. The Flashrate Fault function must be disabled. See 4.2.9.1
>
> 2) Exit Flash into Start-up in all Yellow signals is not permitted.
>
> 3) Time of Day flash in all Yellow signals is not permitted.

This Permissive Programming (Conflict Matrix) assignment example assumes standard channel assignments for an eight phase quad intersection. The Permissive programming for channels 1, 3, 5, and 7 (solid Green Arrow) are unchanged from conventional programming for a protected left turn phase, with the addition of the jumpers for the associated FYA overlap channels. The Permissive programming for overlap channels 9, 10, 11, and 12 (solid Yellow and flashing Yellow Arrow) must be set with similar programming to the associated through phase. For example:

Primary Channel	Permissive With:
1	5, 6, 11
2	5, 6, 9, 11
3	7, 8, 12
4	7, 8, 10, 12
5	9
6	9, 11
7	10
8	10, 12
9	11
10	12
11	--
12	--

Note: This example is for illustrative purposes ONLY. Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming.

2.19.1.3 RIGHT TURN OVERLAPS

Because the FYA operation uses channels 9 through 12 normally assigned to overlap phases, a sixteen channel monitor does not provide enough channels for an eight phase intersection with four pedestrian channels, four right turn overlaps, and four FYA approaches. Right turn overlaps can still be implemented by driving the right turn signal heads with the corresponding protected left turn load switch. In this case, the right turn overlap will not be controlled independently. Consideration should be given for the SSM switch being On for the channel 1, 3, 5, and 7 if used in this manner.

For right turn overlaps with no Yellow Arrow, consideration should be given to driving the Green Arrow load switch input with the Phase On control.

2.19.2 FYAC (COMPACT) MODE

For each FYAC approach (see Table 2-2), each solid Green protected Arrow signal is monitored on channels 9, 10, 11, and 12 (Green). The associated solid Red Arrow, solid

Yellow Arrow, and flashing Yellow Arrow is monitored on channels 1, 3, 5, and 7 respectively. The Signal Monitor associates channel 1 with 9, channel 3 with 10, channel 5 with 11, and channel 7 with 12, when FYAC monitoring is enabled for that respective approach. See Section 4.2.9 for FYAC Mode programming.

In the FYAC mode the Signal Monitor requires that the protected Green arrow signals be driven by the unused Ped Yellow load switch outputs. This relies on a Caltrans cabinet wiring requirement of connecting the Ped Yellow load switch outputs to monitor channels 9 and 10 as described in section 2.19.2.2. Using this scheme allows a standard twelve position Output File to provide the necessary signals without the addition of an Auxiliary File.

Table 2-2
FYAC Channel Configurations

FYAC Mode	Protected Turn Channels (Ga)	Opposing Through Channels	Permissive Turn Channels (Ra, Ya, fYa)	Green Arrow Signal Driver Source
	9	2	1	13 Yellow
	10	4	3	14 Yellow
	11	6	5	15 Yellow
	12	8	7	16 Yellow

2.19.2.1 FYAC MONITORING FUNCTIONS

If a FYA channel pair is enabled for FYAC operation, the Signal Monitor will monitor the FYAC logical channel pair for the following fault conditions. If a channel pair is NOT enabled for FYAC operation then the protected Green input (9-12) will be disabled (no load resistor required).

2.19.2.1.1 CONFLICT

Channel conflicts are detected based on the Permissive programming jumpers on the Program Card for each channel. This operation remains unchanged from normal operation except for the solid Yellow arrow (FYA clearance) signal.

2.19.2.1.1.1 PROTECTED YELLOW CHANGE INTERVAL CONFLICT

The Signal Monitor will verify during the Yellow change interval of the Protected Turn channel (Green arrow; channels 9,10,11,12) that no conflicting channels to the solid Yellow arrow channel (clearance) are active. The conflicting channels are determined by the Program Card compatibility programming of the Protected Turn channel (Green arrow; channels 9,10,11,12) of the pair.

2.19.2.1.1.2 PERMISSIVE YELLOW CHANGE INTERVAL CONFLICT

During all other times the Signal Monitor will verify that no conflicting channels to the solid Yellow arrow channel (clearance) are active as determined by the Program Card compatibility programming of the Permissive Turn channel (flashing Yellow arrow; Channels 1,3,5,7).

2.19.2.1.2 FLASH RATE DETECTION

When the FLASHRATE FAULT option is not disabled (see Section 4.2.9.1), the Signal Monitor will monitor a flashing yellow arrow output for a lack of flashing operation. If any of the enabled flashing yellow arrow signals on channels 1,3,5,7 remain active for more than the FYA Flash Rate Fault time (Section 8.1.4), the Signal Monitor will enter the fault mode, transfer the OUTPUT relay contacts to the Fault position, and display status. The Signal Monitor will remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input.

2.19.2.1.3 RED FAIL

A Red Fail fault will occur if the solid Red Arrow AND solid Yellow Arrow AND flashing Yellow Arrow AND solid Green Arrow all remain inactive for the Red Fail fault response time. The fault channel status will be indicated for both channels of the pair. The Red and Yellow inputs (typically unused) for channels 9, 10, 11, and 12 do not affect the Red Fail condition for the FYA channels 1, 3, 5, and 7.

2.19.2.1.4 DUAL INDICATION

A Dual Indication fault will occur if any two or more of the solid Red Arrow, solid Yellow Arrow, flashing Yellow Arrow, or solid Green Arrow signal combinations are active simultaneously for the Dual Indication fault response time. The fault channel status will be indicated for the FYAC channel (1, 3, 5, 7). The fault channel status will also be indicated for the solid Green Arrow channel (9, 10, 11, 12) IF the solid Green Arrow was active.

2.19.2.1.5 CLEARANCE

A Clearance fault will be detected if the FYAC channel sequences from the solid Green Arrow (9, 10, 11, 12) to the solid Red Arrow (1, 3, 5, 7) without a minimum clearance time on the solid Yellow Arrow (1, 3, 5, 7), when the Minimum Yellow Change Enable programming for channels 1, 3, 5, 7 is On. The fault channel status will be indicated for the FYAC channel (1, 3, 5, 7).

A Clearance fault will be detected if the FYAC channel sequences from the flashing Yellow Arrow (1, 3, 5, 7) to the solid Red Arrow (1, 3, 5, 7) without a minimum clearance time on the solid Yellow Arrow (1, 3, 5, 7), when the Minimum Yellow Change Enable programming for channels 1, 3, 5, 7 is On. The fault channel status will be indicated for the FYAC channel (1, 3, 5, 7).

2.19.2.2 FYAC INSTALLATION

The cabinet must be wired such that the (unused) Ped Yellow load switch outputs are wired to the Signal Monitor inputs as follows:

Phase	Load Switch #	Monitor Physical Input
Ped 2 Yellow	3	Ch 9 Green (pin 13)
Ped 4 Yellow	6	Ch 9 Yellow (pin 16)
Ped 6 Yellow	9	Ch 10 Green (pin R)
Ped 8 Yellow	12	Ch 10 Yellow (pin U)

The Controller unit must be configured to drive the protected Green arrow signals from the Ped Yellow load switch outputs. If ANY channel pairs are enabled for FYAC operation, the Signal Monitor will internally remap monitor Channel 9 and 10 physical inputs such that the protected Green arrow signals will be monitored as Channels 9, 10, 11, and 12 as follows:

Monitor Physical Input	Monitor Logical Channel	Associated FYA Channel
Ch 9 Green	Ch 9 Green	Ch 1
Ch 9 Yellow	Ch 10 Green	Ch 3

Monitor Physical Input	Monitor Logical Channel	Associated FYA Channel
Ch 10 Green	Ch 11 Green	Ch 5
Ch 10 Yellow	Ch 12 Green	Ch 7

The associated solid Red Arrow, solid Yellow Arrow, and flashing Yellow Arrow phases must be driven by a load switch monitored on channels 1, 3, 5, and 7 respectively. The Signal Monitor associates channel 1 with 9, channel 3 with 10, channel 5 with 11, and channel 7 with 12 when FYA monitoring is enabled for that respective approach.

- WARNING -

IF THE PERMISSIVE FLASHING YELLOW ARROW AND PROTECTED GREEN ARROW CHANNEL ASSIGNMENTS ARE SWAPPED SUCH THAT THE FYA INPUT IS MONITORED ON CHANNELS 1,3,5, AND 7:

1) The Flashrate Fault function monitors the enabled flashing Yellow Arrow input of channels 9,10,11, and 12. The Flashrate Fault function must be disabled. See 4.2.9.1.

2) Exit Flash into Start-up in all Yellow signals is not permitted.

3) Time of Day flash in all Yellow signals is not permitted.

To enable channel pair for FYAC operation, select that Datakey Unit Options checkbox labeled "FYA x-y" (where "x-y" is 1-9, 3-10, 5-11, or 7-12). When the Datakey Unit Options checkbox labeled "FYA x-y" is in the unchecked mode, both channel x and y operate in standard fashion. If all four "FYA x-y" Datakey Unit Options checkboxes are in the unchecked mode, channels 9, 10, 11, and 12 all operate in standard fashion and the remapping of Channel 9 and 10 Green and Yellow described above is not done.

Because of the remapping of the inputs to channels 9, 10, 11, and 12 Green, the functionality of the Yellow and Red inputs of channels 9, 10, 11, and 12 is not provided for when FYAC operation is enabled. The Dual Enable and Clearance Enable checkboxes for these four channels should be placed in the unchecked mode.

This Permissive Programming (Conflict Matrix) assignment example assumes standard channel assignments for an eight phase quad intersection. The Permissive programming for channels 9, 10, 11, and 12 (solid Green Arrow) are unchanged from conventional programming for a protected left turn phase, with the addition of the jumpers for the associated FYAC channels. The Permissive programming for FYAC channels 1, 3, 5, and 7 (solid Yellow and flashing Yellow Arrow) must be set with similar programming to the associated through phase. For example:

Primary Channel	Permissive With
1	2, 5, 6, 11
2	5, 6, 11
3	4, 7, 8, 12
4	7, 8, 12
5	6, 9
6	9
7	8, 10
8	10
9	11
10	12
11	--
12	--

NOTE: This example is for illustrative purposes ONLY. Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming.

2.19.3 FYAC (COMPACT) MODE-H

For each FYAC Mode-H approach (see Table 2-3), each flashing Yellow permissive Arrow signal is monitored on channels 13, 14, 15, and 16 Yellow. The associated solid Red Arrow, solid Yellow Arrow, and protected Green Arrow is monitored on channels 1, 3, 5, and 7 respectively. The Signal Monitor associates channel 1 with 13, channel 3 with 14, channel 5 with 15, and channel 7 with 16, when FYAC Mode-H monitoring is enabled for that respective approach.

In the FYAC Mode-H the Signal Monitor requires that the permissive flashing Yellow arrow signals be driven by the unused Ped Yellow load switch outputs. The cabinet must be wired such that the Ped Yellow load switch outputs are monitored on channel 13-16 Yellow inputs of the monitor. FYAC Mode-H is a useful mode only when an Aux Assembly is installed such that channels 9-12 can be used for other movements such as overlaps.

FYAC Mode-H has three requirements for use:

1. The permissive flashing Yellow arrow phase must have the same Conflict permissive programming as the associated pedestrian phase.
2. Exit Flash into Start-up in all Yellow signals is not permitted.
3. Time of Day flash in all Yellow signals is not permitted.

Table 2-3

FYAC Mode-H Channel Configurations

FYAC Mode H	Protected Turn Channels (Ra, Ya, Ga)	Opposing Through Channels	Permissive Turn Channels (fYa)	Flashing Yellow Arrow Signal Driver Source
	1	2	13 Yellow (Ped)	13 Yellow (Ped)
	3	4	14 Yellow (Ped)	14 Yellow (Ped)
	5	6	15 Yellow (Ped)	15 Yellow (Ped)
	7	8	16 Yellow (Ped)	16 Yellow (Ped)

2.19.3.1 FYAC MODE-H MONITORING FUNCTIONS

If a FYA channel pair is enabled for FYAC Mode-H operation, the Signal Monitor will monitor the logical channel pair for the following fault conditions:

2.19.3.1.1 CONFLICT

Channel conflicts are detected based on the Permissive programming of the Program Card for each channel. This operation remains unchanged from normal operation except for the solid Yellow arrow (FYA clearance) signal.

2.19.3.1.1.1 PERMISSIVE YELLOW CHANGE INTERVAL CONFLICT

The Signal Monitor will verify during the Yellow change interval of the Permissive Turn channel (flashing Yellow arrow; channels 13,14,15,16) that no conflicting channels to the flashing Yellow arrow channel (clearance) are active. The conflicting channels are determined by the Program Card compatibility programming of the Permissive Turn channel (flashing Yellow arrow; channels 13,14,15,16) of the pair.

2.19.3.1.1.2 PROTECTED YELLOW CHANGE INTERVAL CONFLICT

During all other times the Signal Monitor will verify that no conflicting channels to the solid Yellow arrow channel (clearance) are active as determined by the Program Card compatibility programming of the Protected Turn channel (Green arrow; Channels 1,3,5,7).

2.19.3.1.2 FLASH RATE DETECTION

When the FLASHRATE FAULT option is not disabled (see Section 4.2.9.1), the Signal Monitor will monitor a flashing yellow arrow output for a lack of flashing operation. If any of the enabled flashing yellow arrow signals on channels 13,14,15,16 remain active for more than the FYA Flash Rate Fault time (Section 8.1.4), the Signal Monitor will enter the fault mode, transfer the OUTPUT relay contacts to the Fault position, and display status. The Signal Monitor will remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input.

2.19.3.1.3 RED FAIL

A Red Fail fault will occur if the solid Red Arrow AND solid Yellow Arrow AND flashing Yellow Arrow AND solid Green Arrow all remain inactive for the Red Fail fault response time. The fault channel status will be indicated for both channels of the pair. The Red (Don't Walk) and Green (Walk) inputs for channels 13,14,15, and 16 do not affect the Red Fail condition for the FYA channels 1, 3, 5, and 7.

2.19.3.1.4 DUAL INDICATION

A Dual Indication fault will occur if any two or more of the solid Red Arrow, solid Yellow Arrow, flashing Yellow Arrow, or solid Green Arrow signal combinations are active simultaneously for the Dual Indication fault response time. The fault channel status will be indicated for the FYAC channel (1, 3, 5, 7). The fault channel status will also be indicated for the flashing Yellow Arrow channel (13,14,15,16) IF the solid Green Arrow was active.

2.19.3.1.5 CLEARANCE

A Clearance fault will be detected if the FYAC channel sequences from the solid Green Arrow (1, 3, 5, 7) to the solid Red Arrow (1, 3, 5, 7) without a minimum clearance time on the solid Yellow Arrow (1, 3, 5, 7), when SSM switch 1, 3, 5, 7 is On. The fault channel status will be indicated for the FYAC channel (1, 3, 5, 7).

A Clearance fault will be detected if the FYAC channel sequences from the flashing Yellow Arrow (13,14,15,16) to the solid Red Arrow (1, 3, 5, 7) without a minimum clearance time on the solid Yellow Arrow (1, 3, 5, 7), when SSM switch 1, 3, 5, 7 is On. The fault channel status will be indicated for the FYAC channel (1, 3, 5, 7).

2.19.3.2 FYAC MODE-H INSTALLATION

The cabinet must be wired such that the (unused) Ped Yellow load switch outputs are wired to the Signal Monitor inputs as follows:

Table 2-4 Type 332 Cabinet Load Switch Map		
Phase	Load Switch #	Monitor Physical Input
Ped 2 Yellow	3	Ch 13 Yellow (pin 8)
Ped 4 Yellow	6	Ch 14 Yellow (pin 11)
Ped 6 Yellow	9	Ch 15 Green (pin K)
Ped 8 Yellow	12	Ch 16 Yellow (pin N)

Table 2-5
Type 330 Cabinet Load Switch Map

Phase	Load Switch #	Monitor Physical Input
Ped 2 Yellow	13	Ch 13 Yellow (pin 8)
Ped 4 Yellow	14	Ch 14 Yellow (pin 11)
Ped 6 Yellow	15	Ch 15 Green (pin K)
Ped 8 Yellow	16	Ch 16 Yellow (pin N)

The Controller unit must be configured to drive the permissive flashing Yellow arrow signals from the Ped Yellow load switch outputs. The associated solid Red Arrow, solid Yellow Arrow, and protected Green Arrow phases must be driven by a load switch monitored on channels 1, 3, 5, and 7 respectively. The Signal Monitor associates channel 1 with 13, channel 3 with 14, channel 5 with 15, and channel 7 with 16 when FYA monitoring is enabled for that respective approach.

To enable a channel pair for FYAC operation, select that Datakey Unit Options checkbox labeled "FYA x-y" (where "x-y" is 1-13, 3-14, 5-15, or 7-16). When the Datakey Unit Options checkbox labeled "FYA x-y" is in the unchecked mode, both channel x and y operate in standard fashion. If all four "FYA x-y" Datakey Unit Options checkboxes are in the unchecked mode, channels 13, 14, 15, 16 all operate in standard fashion.

This Permissive Programming (Conflict Matrix) assignment example assumes standard channel assignments for an eight phase quad intersection. The Permissive programming for channels 1, 3, 5, and 7 (solid Green Arrow) are unchanged from conventional programming for a protected left turn phase. The Permissive programming for FYAC Mode-H channels 13, 14, 15, and 16 (flashing Yellow Arrow) share the programming of the associated Ped channel. For example:

Primary Channel	Permissive With
1	5, 6, 15
2	5, 6, 13, 15
3	7, 8, 16
4	7, 8, 14, 16
5	13
6	13, 15
7	14
8	14, 16
9	--
10	--
11	--
12	--
13	15
14	16
15	--

NOTE: This example is for illustrative purposes ONLY. Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming.

Section 3
EVENT LOGGING FEATURES

3.1 BASIC FRONT PANEL FAULT EVENT DISPLAY

The Signal Monitor retains three fault events in nonvolatile memory that can be reviewed via the front panel display. The contents of the log and the procedure for review is described in Section 2.18.

3.2 STATUS AND EVENT REPORTING

The model 2018KCL uses the EIA-232 port to communicate status to a Controller Unit operational software and event data logs to a Personal Computer (PC). The model 2018KCLip uses an Ethernet port to communicate status to a Controller Unit operational software and event data logs to a Personal Computer (PC).

3.2.1 BI TRAN SYSTEMS 233 PROGRAM MONITOR STATUS

The 2018KCL status message format and time/date message format is compatible with BI Tran Systems Model 223 Software when used with channels 1 through 16 only. On request from the operational software, the model 2018KCL provides the current field status if no fault has triggered the monitor. If the monitor is in the fault mode, the current fault status and field input status at the time of the fault is reported. The operational software will also periodically synchronize the model 2018KCL time clock. The BI Tran Systems Model 223 Software manual should be consulted for details of operation.

3.2.2 EDI *ECCOM* MONITOR REPORT

The EDI *ECcom* software package (Version 3.6.4 or greater is required) interfaces a Computer to the model 2018KCL. The *ECcom* program will display the Status (S), Previous Fault (PF) event log, AC Line (AC) event log, Manual Reset (MR) event log, Configuration (CF) event log, and Fault Trace log. All events are time stamped with the time and date of the event. Operation of the *ECcom* software package is described in "***EDI ECcom Software Operations Manual***" and will not be covered in this manual. The following data is available:

> General Data
> > a) Monitor ID#: an eight digit (0-99999999) ID number may be assigned to the monitor.
> > b) Time and Date: each event is marked with the time and date of occurrence.
> > c) Event Number: identifies the record number in the log. Event #1 is the most recent event.
>
> Current Status (S)
> > a) Fault Type: the fault type description.
> > b) Field Status: the current or latched GYR field status and RMS voltages.
> > c) Cabinet Temperature: the current or latched temperature if the monitor.
> > d) AC Line Voltage: the current or latched AC Line voltage.
> > e) Control Input Status: the current or latched state and RMS voltages of the Red Enable input, EE input, Special Function #1 and #2 inputs, and the WDT monitor.
>
> Previous Fault (PF) Event Log (25)
> > a) Fault Type: the fault type description.
> > b) Field Status: the latched field status, RMS voltages, and fault channel status at the time of the fault.

c) <u>Cabinet Temperature</u>: the latched temperature at the time of the fault.
d) <u>AC Line Voltage</u>: the AC Line voltage at the time of the fault.
e) <u>Control Input Status</u>: the latched state and RMS voltages of the Red Enable input, EE input, Special Function #1 and #2 inputs, and the WDT monitor.

AC Line (AC) Event Log (40)

a) <u>Event Type</u>: describes the type of AC Line event that occurred.
    Power-up - AC on, monitor performed a cold start
    Brown-out   - AC Line < drop-out level
    Restore   - AC restored from AC brown-out or AC interruption, no cold start
b) <u>AC Line Voltage</u>: the AC Line voltage at the time of the event.

Manual Reset (MR) Event Log (25)

a) The monitor was reset from a fault by the front panel Reset button or External Reset input.

Configuration (CF) Event Log (10)

a) <u>Conflict Matrix</u>: the permissive programming for each channel.
b) <u>Yellow Disable</u>: the Yellow Disable programming for each channel.
c) <u>Red Fail</u>: the Red Fail programming for each channel.
d) <u>Dual Indication</u>: the Dual Indication (GY, GR, YR) programming for each channel.
d) <u>Clearance</u>: the Clearance programming for each channel.
e) <u>Unit Options</u>: 1 Second WDT Timing, WDT Clear on PU, Red Cable Fault Enable, Recurrent Pulse Disable, Special Function #1 Invert, LEDguard Thresholds, Dual Indication Timing Long, 92Vrms Brownout, MC Coil Invert.
f) <u>Watchdog Programming</u>: Watchdog timing.
g) <u>Configuration Check Value</u>: the value of the 16 bit Check Value for the reported configuration.

3.2.3 EDI *ECCOM* MONITOR EVENT LOG EXAMPLES

An example of each type of record is shown below:

1) <u>Previous Fault (PF) Event Log</u>

```
>> Previous Fail Event Log
>> Monitor ID #73
>> EDI Model 2018KCL, Firmware Type 01, Firmware V5.0, Comm V3.6
>> RMS-Engine Firmware Type 01, RMS-Engine Firmware V2.3
>> ECcom Version 3.6.4
>> Downloaded at 10:23:35 AM  Friday, September 22, 2006
>> Number of events = 25

PREVIOUS FAIL EVENT #1 at:
   12:12:59 PM  Monday, October 2, 2006
   Fault = Red Fail Fault

   Channel Status:
    Ch: 1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
        *
        R   .   .   R   R   .   R   R   R   R   R   R   R   R   R   R
        .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
        .   .   .   .   .   G   .   .   .   .   .   .   .   .   .   .

   Channel RMS Voltages:
    R: 120   1   0 122 122   1 122 121 121 122 122 122 122 122 121 122
    Y:   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
    G:   0   0   0   0   0 121   0   0   0   0   0   0   0   0   0   0

            AC Line = 122 Vrms @ 60Hz
            Temperature = 80 F
       Red Enable = Active (122 Vrms)
       MC Coil (EE) = Off    (0 Vrms)
       Special Function #1 = Off    (1 Vrms)
       Special Function #2 = Off    (0 Vrms)
       WDT Monitor = Active
```

2) <u>AC Line (AC) Event Log</u>
```
>> AC Line Event Log
>> Monitor ID #73
>> EDI Model 2018KCL, Firmware Type 01, Firmware V5.0, Comm V3.6
>> RMS-Engine Firmware Type 01, RMS-Engine Firmware V2.3
>> ECcom Version 3.6.4
>> Downloaded at 10:21:27 AM  Friday, September 22, 2006
>> Number of events = 2

AC Event #1 at:
   2:41:30 PM  Tuesday, January 02, 1996
     Restore AC & WDT
     AC Line Voltage = 119 Vrms @60 Hz

AC Event #2 at:
   2:41:25 PM  Tuesday, January 02, 1996
     Brownout AC & WDT
     AC Line Voltage = 85 Vrms @60 Hz
```

4) <u>Manual Reset (MR) Event Log</u>
```
>> Monitor Reset Event Log
>> Monitor ID #73
>> EDI Model 2018KCL, Firmware Type 01, Firmware V5.0, Comm V3.6
>> RMS-Engine Firmware Type 01, RMS-Engine Firmware V2.3
>> ECcom Version 3.6.4
>> Downloaded at 10:23:31 AM  Friday, September 22, 2006
>> Number of events = 2

Monitor Reset Event #1 at:
   9:50:08 PM  Friday, January 26, 1996

Monitor Reset Event #2 at:
   2:33:39 PM  Wednesday, January 24, 1996
```

5) <u>Configuration (CF) Event Log</u>
```
>> Configuration Log
>> Monitor ID #73
>> EDI Model 2018KCL, Firmware Type 01, Firmware V5.0, Comm V3.6
>> RMS-Engine Firmware Type 01, RMS-Engine Firmware V2.3
>> ECcom Version 3.6.4
>> Downloaded at 10:13:48 AM  Friday, September 22, 2006
>> Number of events = 10
>> (A '*>' symbol indicates that parameter has changed)

-----------------------------------------------------------------------

CONFIGURATION CHANGE #1 at:
   4:33:39 PM  Monday, February 7, 2005

   Permissive Programming:
   Ch 1  with: 5  6
   Ch 2  with: 5  6  13 15
   Ch 3  with: 7  8
   Ch 4  with: 7  8  14 16
   Ch 5  with: no channels
   Ch 6  with: 13 15
   Ch 7  with: no channels
   Ch 8  with: 14 16
   Ch 9  with: no channels
   Ch 10 with: no channels
   Ch 11 with: no channels
   Ch 12 with: no channels
   Ch 13 with: 15
   Ch 14 with: 16
   Ch 15 with: no channels
   Ch 16 with: no channels
   Ch 17 with: no channels

   Red Fail Enable (X=Enable):
       Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
            X  X  X  X  X  X  X  X  X  X  X  X  X  X  .  .  .  .

   Dual Indication Enables (X=Enable):
    Green-Yellow Dual Enable:
       Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
            X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  .  X
    Yellow-Red Dual Enable:
       Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
            X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  .  X
    Green-Red Dual Enable:
       Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
            X  X  X  X  X  X  X  X  X  X  X  X  .  .  .  .  .  X

   Clearance Enables (X=Enable):
    Minimum Yellow Clearance Enable:
       Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
            X  X  X  X  X  X  X  .  .  .  .  .  .  .  .  .  .  .
```

```
    Minimum Yellow Plus Red Clearance Enable:
        Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
             X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  .  .

  Yellow Disable (X=Disable):
        Ch:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
             .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .

  Unit Data:
    Minimum Flash = 6 seconds
    Watchdog Timing = 1 second
    Watchdog Clear on PU = DISABLED
    Red Cable Fault = ENABLED
    Recurrent Pulse = ENABLED
    SF#1 Polarity = NORMAL
    Red Fail Fault Timing = 1200-1500 ms
    LEDguard Thresholds = ENABLED
    Dual Indication Fault Timing = 350-500 ms
    AC Line Brownout = 98 +/- 2 Vrms
    Pin EE Polarity = NORMAL
    Config Change Fault = ENABLED
     Flashing Yellow Arrows = <none>
    Configuration Check Value = 5355 (0x14EB)
```

3.3 SIGNAL SEQUENCE EVENT LOG

The Signal Sequence event log graphically displays all signal states and Red Enable state for up 30 seconds prior to the 2018KCL fault trigger for the most recent five (5) Previous Fault (PF) events.
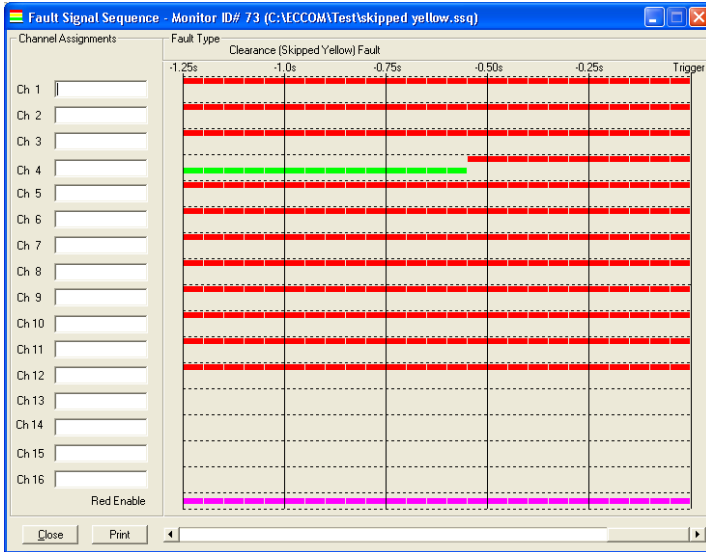
Section 4
INSTALLATION

The 2018KCL is a plug-in module for the Type 170/179 output file. When inserted into the output file without the Red Interface cable assembly, it will operate as a standard 210 signal monitor.

4.1 ADAPTING RED MONITORING

A Red Interface Adapter PCB and an Interconnecting cable are used to adapt Red Signal Monitoring to the controller cabinet assembly. The interconnecting cable is terminated at each end with identically polarized 20 pin plugs. To connect the 2018KCL with the adapter PCB, insert the Interconnecting cable plug into the Red Interface connector (P8) until the two ejector latches "snap" into place over the cable plugs.

```
- WARNING -
THE P8 RED INTERFACE CABLE SHOULD ALWAYS BE UNPLUGGED BEFORE
REMOVING THE UNIT FROM THE CABINET TO PREVENT POTENTIAL
EXPOSURE TO ELECTRICAL SHOCK.
```

4.1.1 RED FIELD INPUTS

The pins numbered 1,2,3,5,7, and 9 through 19 of the Red Interface connector P8 correspond to Red channel 1:16 inputs on the 2018KCL. Channel 17 and 18 Red inputs are provided on the main connector (P1). Pin #20 of P8 is the Red Enable input and must be active to enable Red Failure Monitoring, GYR-Dual Indication Monitoring, and Clearance Monitoring. The Red Enable input is normally connected to the load switch AC+ buss in order to disable Red Failure Monitoring, GYR-Dual Indication Monitoring, and Clearance Monitoring when the intersection is in hardware flash.

4.1.2 SPECIAL FUNCTION PREEMPT INPUTS (SF1,2)

The pins numbered 8 and 6 of Red Interface connector P8 are Special Function (SF) inputs #1 and #2 respectively. These inputs require an AC+ input to disable the Red Failure monitoring function during preemption. An active signal on **either** input will disable Red Failure monitoring. The RED FAIL indicator will then flash once every two seconds to indicate that Red Failure monitoring is disabled.

The Special Function #1 Invert option may be used to change the polarity of the Special Function input #1 (see section 4.2.3.10). When the option is not selected, the Special Function input #1 will be active when AC+ is present. AC+ present on **either** input will disable Red Failure monitoring. An unused preemption input may be left OPEN (no connection) if the option is not selected. When the Special Function #1 Invert option is selected, the Special Function input #1 will be active when AC+ is NOT present. Lack of AC+ on Special Function #1 input will then disable Red Failure monitoring.

Special Function #1 Invert option	SF Input #1	SF Input #2	Red Fail Monitoring
Off	Not Active	Not Active	Enabled
Off	Not Active	Active	Disabled - Preempt
Off	Active	Not Active	Disabled - Preempt
Off	Active	Active	Disabled - Preempt

Special Function #1 Invert option	SF Input #1	SF Input #2	Red Fail Monitoring
On	Not Active	Not Active	Disabled - Preempt
On	Not Active	Active	Disabled - Preempt
On	Active	Not Active	Enabled
On	Active	Active	Disabled – Preempt

4.2 DATAKEY PARAMETERS

4.2.1 DATAKEY PARAMETER PROGRAMMING

The 2018KCL is configured using a removable nonvolatile memory device called a Datakey[tm] (Datakey is a trademark of Datakey Electronics, Inc.). The Datakey replaces the mechanical jumpers, DIP switches, and diode based program card used in conventional signal monitors and provides an interchangeable and electronic method of programming the unit. The Datakey itself is programmed by a separate programming tool using a Personal Computer program such as the Eberle Design *MonitorKey*® product. See the Eberle Design ***MonitorKey® Operations Manual*** for further details.

4.2.2 MONITORKEY CONFIGURATION SET-UP WIZARD

The Set-up Wizard in the *MonitorKey*® program can be used to automatically generate all the enhanced monitor programming data for the 2018KCL in most cases without the need for understanding complex and confusing monitor terminology. It configures the monitor enhanced-feature programming parameters using a simple series of intersection related questions.

4.2.3 UNIT DATA PARAMETERS

4.2.3.1 EIA-232 COMM PORT SETTINGS (2018KCL)

The baud rate and parity settings for the EIA-232 port are set in the Datakey. The DTR Enable function is not supported in the 2018KCL model. These settings can be temporarily overridden by the *ECcom* program. If the 2018KCL is reset or powered up, the Datakey settings will be restored.

4.2.3.1.1 EIA-232 CABLE

A typical cable assembly for a DB-9 connector on the PC would be a straight through connection see Section 9.4.

4.2.3.2 ETHERNET COMM PORT SETTINGS (2018KCLIP)

The Ethernet port must be configured with specific network parameters such as an IP address. The network port parameters are set or changed using the EDI *ECcom* Signal Monitor Communications software. See the "***EDI ECcom Software Operations Manual***" for details on the SETUP / COMM PORT / SETTINGS / **Search** function.

The factory default network settings are: IP Address = 192.168.1.100 and Subnet Mask = 255.255.255.0

4.2.3.2.1 ETHERNET LAN CABLE

The LAN cable required is a typical Cat-5 network cable using the 8 pin RJ-45 connector. If the connection is from the monitor to a switch or hub, a standard LAN cable is needed. If the connection is from the monitor directly to a network adaptor (PC), a cross-over or patch cable is needed.

4.2.3.3 MINIMUM FLASH INTERVAL

The minimum flash interval is set to None, or a value from 4 seconds to a maximum of 10 seconds. See section 2.5.1.

4.2.3.4 MONITOR ID NUMBER

A monitor ID number can be set in the range of 0 to 99999999. This ID number is used when retrieving event logs from the 2018KCL.

4.2.3.5 MONITOR ID NAME

A forty character monitor ID name can be set. This ID name is used when retrieving event logs from the 2018KCL.

4.2.3.6 ONE SECOND WDT TIMING

If this option is selected, the WDT fault time is set to 1000 ms. See section 1.2.4.

4.2.3.7 WDT CLEAR ON PU

If this option is selected, either a Reset OR a power-up will clear a WDT fault (Caltrans mode). The WDT fault is set to the latched mode by default. See section 1.2.4.1.

4.2.3.8 RED CABLE FAULT ENABLE

If this option is selected, the 2018KCL will enter the fault mode if the Red Interface cable is not connected. See section 2.2.1.

4.2.3.9 RECURRENT PULSE DISABLE

The Recurrent Pulse Detection function is **DISABLED** by setting this option. See section 2.7.

4.2.3.10 SPECIAL FUNCTION #1 INVERT

This option will invert the polarity of the Special Function input #1. See section 4.1.2.

4.2.3.11 RED FAIL TIMING SHORT

Selecting this option will extend the Red Fail fault timing to the 700-1000 ms value. 2.2

4.2.3.12 LEDGUARD® THRESHOLDS

Selecting this option will enable the LEDguard® thresholds. See section 2.6.

4.2.3.13 DUAL INDICATION TIMING LONG

Selecting this option will extend the Dual Indication fault timing to the 700-1000 ms value. See section 2.3.

4.2.3.14 92VRMS BROWNOUT

Selecting this option will set the AC Line dropout and restore voltage and timing values to the low (210E) settings in section 8.1.4. This option is intended for downward compatibility with 210 monitor specifications. See section 2.5.

4.2.3.15 MC COIL INVERT

Setting this option will invert the polarity of the pin #EE (MC Coil) input. For a cabinet that operates with the Flash Transfer relays de-energized for tri-color signal operation (Caltrans), this option should <u>not</u> be selected. For a cabinet that operates with the Flash Transfer relays energized for tri-color signal operation (Nema), this option should be selected.

4.2.3.16 CONFIGURATION CHANGE FAULT

Selecting this option will enable the Configuration Change Fault mode. See section 2.11.

4.2.4 PERMISSIVE CHANNEL PAIR PARAMETERS

These parameters define the conflict matrix. For each primary channel from 1 to 17, the check boxes select which channels are permitted to be active concurrently with the primary channel (compatible). Thus a checked box is equivalent to removing a diode on a standard 210 diode card. See section 1.2.1.1.

4.2.5 RED FAIL ENABLE PARAMETERS

Each channel is individually enabled for Red Fail monitoring. A checked box ENABLES the channel for the Red Fail function. If an unused channel does not have a load switch installed, unchecking this box will eliminate the need to tie the Red input to AC Line. See section 2.2.

4.2.6 DUAL INDICATION ENABLE PARAMETERS

Each channel is individually enabled for Green-Yellow, Green-Red, and Yellow-Red Dual Indication monitoring. A checked box ENABLES the channel for the respective function. See section 2.3.

4.2.7 CLEARANCE ENABLE PARAMETERS

4.2.7.1 MINIMUM YELLOW CHANGE

Each channel is individually enabled for Yellow Change Clearance monitoring. A checked box ENABLES the channel for the Minimum Yellow Change monitoring. See section 2.4.1.

4.2.7.2 MINIMUM YELLOW PLUS RED CLEARANCE

Each channel is individually enabled for Yellow Plus Red Clearance monitoring. A checked box ENABLES the channel for the Minimum Yellow Plus Red Clearance monitoring. See section 2.4.2.1.

4.2.8 YELLOW DISABLE PARAMETERS

The Yellow input for each channel can be disabled. When a checked box DISABLES a Yellow input, the 2018KCL considers the input to have 0 Vrms applied regardless of the actual voltage at the monitor input.

4.2.9 FLASHING YELLOW ARROW (FYA / FYAC) PARAMETERS

The selector labeled "Green Arrow Group" selects the FYA, FYAC, or FYAC Mode-H mode. If no "FYA Channel Enables x-y" are selected then the FYA or FYAC operation is disabled and all channels work in a standard fashion.

To enable channel pair for FYA (section 2.19.1) or FYAC (section 2.19.2) operation, select that Datakey Unit Options checkbox labeled "FYA Channel Enables x-y" (where "x-y" is 1-9, 3-10, 5-11, or 7-12). When the Datakey Unit Options checkbox labeled "FYA Channel Enables x-y" is in the unchecked mode, both channel x and y operate in standard fashion.

4.2.9.1 FYA FLASHRATE MONITOR DISABLE

The Signal Monitor will respond to an enabled flashing Yellow Arrow signal that is not flashing at a minimum rate (see Section 2.19.1.1.2, 2.19.2.1.2). To DISABLE this monitoring function check the "Flash Rate Fault Disable" checkbox.

Section 5
FRONT PANEL DESCRIPTION

5.1 INDICATORS

5.1.1 AC PWR INDICATOR

The AC PWR indicator will illuminate when the AC Line voltage level is above the brown-out "restore" level. The indicator will flash at a rate of 2Hz when the AC Line voltage is below the "drop-out" level. The indicator will extinguish when the AC Line voltage is less than 75 $\pm$2 Vac. During the minimum flash interval the indicator will flash at a rate of 4Hz. See Section 2.5.1.

5.1.2 VDC INDICATOR

The VDC indicator will illuminate when a 24VDC fault condition is detected. This indicator remains extinguished if the monitor has not been triggered by a 24VDC fault.

5.1.3 WDT INDICATOR

The WDT indicator will illuminate when a controller Watchdog fault is detected. If the AC Line voltage is below the Watchdog disable level, the WDT indicator will flash ON once every 2 seconds.

5.1.4 CONFLICT INDICATOR

The CONFLICT indicator will illuminate when a conflicting proceed signal fault is detected.

5.1.5 RED FAIL INDICATOR

The RED FAIL indicator will illuminate when an absence of signal is detected on a channel(s). If the Red Enable input is not active, or a Special Function input is active, or the pin #EE input (MC Coil) is active the RED FAIL indicator will flash once every two seconds to indicate that Red Fail Monitoring functions are disabled.

5.1.6 DUAL IND INDICATOR

The DUAL IND indicator will illuminate when a GY-Dual or GYR-Dual Indication fault is detected on a channel(s).

5.1.7 CLEARANCE INDICATOR

The CLEARANCE indicator will illuminate when the minimum Yellow Clearance time or Minimum Yellow Plus Red Clearance time has not been met on a channel(s).

5.1.8 KEY INDICATOR

The KEY indicator will illuminate if the Datakey is absent or not properly seated in the receptacle. A manual Reset is required after the Datakey is properly inserted. The KEY indicator will also illuminate if the Datakey contains invalid data resulting from corrupted Datakey contents, an invalid FCS calculation, invalid parameter values, or a Datakey Protocol Version incompatibility.

If the unit is in the Configuration Change Fault mode, the KEY indicator will flash at a 4 Hz rate. The Channel Status indicators will display the hex value of the Configuration Check Value for the Datakey inserted. See Section 2.11.

If the unit is in the Diagnostic Display mode, the KEY indicator will flash ON (once, twice, or three times) to indicate the fault event number being displayed. See Section 2.18.2.

5.1.9 DIAGNOSTIC INDICATOR

The DIAGNOSTIC indicator will illuminate when an internal hardware or firmware test function has failed. This indicator is intended to inform the service technician of a monitor hardware or firmware failure. Due to the nature of these hardware or firmware failures, other fault indicators that may be concurrently illuminated may not be valid for trouble shooting purposes.

5.1.10 RP DETECT INDICATOR

The RP DETECT indicator will illuminate when the Recurrent Pulse detection function has triggered a Conflict, Dual Indication, or Red Fail fault. See Section 2.7.

5.1.11 COMM INDICATOR

The COMM indicator will illuminate for a period of 50 ms when a valid ECcom frame is received on the EIA-232 port or Ethernet port. The COMM indicator will flash at a 4 Hz rate if the port is disabled due to the DTR signal in the false state while a frame is in the transmit queue.

5.1.12 CHANNEL STATUS INDICATORS

During normal operation the 2018KCL model Channel Status indicators will display all active signals (Green, Yellow, and Red).

In the fault mode the Channel Status indicators will display all signals active at the time of a fault. In the event of a Conflict, Red Failure, Dual Indication, or Clearance fault the channels on which the fault occurred will be displayed alternately (see Section 2.18) with the field status.

5.2 FRONT PANEL CONTROLS

5.2.1 RESET BUTTON

Depressing the Reset button resets the 2018KCL after it has been triggered by a fault. The monitor will remain in the reset mode only if the fault condition has been restored to normal. In the event of a monitor hardware or firmware fault (DIAGNOSTIC) the Reset button may not reset the monitor. A power-up restart may be required.

The Reset button also provides control of the Diagnostic Display mode. For a complete description of Diagnostic Display operation see Section 2.18.

5.3 RED INTERFACE CONNECTOR (P8)

This connector provides the required inputs for the 2018KCL to monitor the Red Field Signal outputs. It is polarized to insure proper mating with the adapter cable. Ejector latches are included to facilitate removal and prevents the cable from inadvertently disconnecting. **The 2018KCL will function as a standard 210 Signal Monitor when the cable is disconnected.**

Section 6
CIRCUIT OPERATION

6.1 INTRODUCTION

The Signal Monitor uses a dual microprocessor architecture consisting of an 68HC11D0 main microprocessor unit (MPU) and a Microchip PIC17F242 based RMS-Engine. The RMS-Engine is a dedicated single-chip high speed microcontroller used to sample the AC field inputs and calculate the true Root Mean Squared (RMS) voltage. This true RMS voltage information is then transmitted to the main microprocessor for fault processing.

The 68HC11D0 main microprocessor uses a high speed synchronous serial I/O system called the Serial Peripheral Interface (SPI) to exchange data with the peripheral circuit blocks. It controls all functions of the unit except for those of the RMS-Engine.

6.2 MAIN MPU LOGIC

The 68HC11D0 main microprocessor (U13) operates in the Expanded Multiplexed mode which allows for external memory devices. The program firmware is contained in the 29F010B CMOS Flash device (U11) and program data storage is contained in the SRM2264 8Kx8 static RAM (U16). The expanded address and data buss is used to link the memory devices with the microprocessor. A 74HC137 (U14) selector also resides on the buss to generate chip select signals for the SPI devices.

6.3 SERIAL PERIPHERAL INTERFACE (SPI)

The Serial Peripheral Interface (SPI) is a high speed synchronous serial I/O system used to interconnect the main microprocessor to the following circuit blocks: EEprom (U21), Real Time Clock (U29), 24Vdc Logic Processor (U41), Display Multiplexer (U1), and the RMS-Engine (U37).

Data is clocked out of the main microprocessor on the MOSI pin (U13.18) while data is clocked in on the MISO pin (U13.17). The SCLK signal (U13.20) provides the synchronous clock. A peripheral device must be selected by U18 before SPI transfers may take place.

6.4 INTERNAL MPU WATCHDOG

Circuit U4A and U4B comprise the internal MPU Watchdog circuit. If this circuit does receive an input from the main microprocessor for at least 325 ms, the circuit will trigger and force the Output relay to the fault mode, enable the Stop-Time output, and illuminate the DIAGNOSTIC indicator. This indicates that the microprocessor has failed to operate its program loop. Under normal conditions the microprocessor will clock this circuit every 20 ms. If jumper E13 is installed this fault mode will only be reset by a power down cycle.

6.5 EEPROM MEMORY

The 25C640 Serial EEprom (U21) device provides 8192 bytes of nonvolatile memory. It is interfaced to the main microprocessor through the SPI port. No battery is required to maintain the data in this device.

6.6 24VDC LOGIC INPUTS

The Cabinet 24VDC input, CU Watchdog input, and External/Manual Reset inputs are processed by a PIC16F687 microprocessor U41. Opto-couplers U28, U31, U36, and U38 provide electrical isolation between Logic Ground and Neutral.

6.7 REAL TIME CLOCK

The DS1305 Real Time Clock (U29) provides the timekeeping function. It transfers data to the main MPU using the serial SPI interface. During normal operation the RTC is synchronized to the 60 Hz AC Line for long term accuracy. The lifetime lithium battery (BATT1) provides power to the RTC when AC Line voltage is not present. Should the battery fail, no data will be lost other than the time and date should the AC Line voltage drop out.

6.8 DISPLAY

The front panel LED display is multiplexed by the row driver U3 and the column driver U1. The scan rate is approximately 60 Hz. Display data is shifted into U3 while individual columns are selected by U1 using the SPI interface.

6.9 RMS-ENGINE

The RMS-Engine is a Microchip PIC18F242 (U37) single-chip high performance RISC microcomputer executing proprietary firmware that calculates true RMS voltages for each input channel. The resulting data is transferred to the main MPU via the SPI interface. The analog to digital converter (U39) provides the voltage measurement data for the RMS-Engine approximately every 6 microseconds. Analog multiplexers (74HC4051N) select the appropriate channel for sampling. Op amp circuits U40 provide a buffer circuit.

6.10 POWER SUPPLY

The switching power supply is based on a MIC38C43 (U20) fixed frequency current-mode PWM controller. The AC Line is full wave rectified and charges capacitor C78 to approximately 170 Vdc. The PWM controller switches current from C78 through the transformer T1 using transistor Q4 at approximately 200 KHz. The transformer couples this energy to the secondaries and provides the following output voltages: VDD=+5 Vdc, VCC=+8 Vdc, VGG=-8 Vdc, VEE=-5 Vdc, VCCL=+16 Vdc, and VDDS=+5 Vdc. Opto-coupler U26 provides feedback to the controller for regulation.

6.11 EIA-232 COMMUNICATIONS PORT

The EIA-232 communications port is isolated from the main circuitry of the monitor through opto-couplers U7 and U12. The MAX202 interface circuit U2 provides a level translation from EIA-232 voltage levels.

6.12 ETHERNET COMMUNICATIONS PORT

The Ethernet communications port (J2) is isolated from the main circuitry of the monitor through opto-couplers U7 and U12.

Section 7
TROUBLE SHOOTING

SYMPTOMS:

>   Will not power on

CAUSES:
- A) Blown fuse
- B) Internal power supply is low
- C) No AC input to the monitor

SOLUTIONS:
- A) Remove the fuse and verify with an Ohm meter. Replace if necessary with a fuse with the same current rating.
- B) Check the unregulated voltage across filter capacitor C78 with an oscilloscope or volt meter. It should read approximately 170 Vdc when the AC Line is equal to or greater than 110 Vrms. If the regulated supply (VDD) is less than 4.5 Vdc the internal power supply monitoring circuit (U17) will hold the MPU in reset and the DIAGNOSTIC indicator on the front panel should illuminate. Measure the regulated voltage across capacitor C28. If it measures lower than 5 $\pm$0.5 Vdc the regulated supply may be overloaded or shorted to ground.
- C) If the fuse is not blown then the monitor may not be getting AC Line or Neutral to the edge connector of the monitor.

SYMPTOMS:

>   Faults when AC power is applied

CAUSES:
- A) Datakey is absent or not inserted properly
- B) AC Line level is low
- C) Memory device fault (Diagnostic)
- D) No internal watchdog pulses

SOLUTIONS:
- A) The KEY indicator on the front panel will illuminate. Re-insert the Datakey into the locking position and depress the RESET switch.
- B) Measure the AC Line voltage level with a volt meter. If it is below the required "drop-out" level, the monitor will transfer the Output relay contacts to the fault position and enable the STOP TIME output to the controller. The AC PWR indicator on the front panel will flash at a rate of 2 Hz to indicate the "brown-out" condition.
- C) The memory devices are verified when AC Line power is applied or a Reset command is issued. **If a memory fault is detected the MPU executes a STOP instruction.** This causes all MPU activity to cease. Refer to Section 2.15.
- D) Absence of internal watchdog pulses may be due to the following conditions: the MPU is not executing or completing the program loop or the hardware to detect the internal watchdog pulses is not functioning. Place an oscilloscope probe on U4.2. If there are no pulses, depress the front panel reset switch to re-start the MPU. If the watchdog pulses are now present on U4.2 then trace the remaining pulse detection hardware for the required waveforms.

SYMPTOMS:

>   Required channels will not conflict

CAUSES:

Permissive Channel pair programming in the Datakey is not correct.

SOLUTIONS:

Review the programming with the cabinet channel assignment for correctness and consistency.

Section 8
SPECIFICATIONS

8.1 ELECTRICAL

8.1.1 POWER REQUIREMENTS
Operating Line Voltage.. 75 to 135 Vrms
Operating Line Frequency .... 60 $\pm$3Hz
Power Consumption .... 5W (nominal)

8.1.2 AC VOLTAGE MONITORS

Green Signal Inputs	(no detect)...	less than 15 Vrms
	(detect)	greater than 25 Vrms
Yellow signal Inputs	(no detect)...	less than 15 Vrms
	(detect)	greater than 25 Vrms
Red Signal Inputs	(no detect)...	less than 50 Vrms
	(detect)	greater than 70 Vrms
Red Enable Input	(no detect)...	less than 50 Vrms
	(detect)	greater than 70 Vrms
Special Function Inputs	(no detect)...	less than 50 Vrms
	(detect)	greater than 70 Vrms
Watchdog Enable (AC level)	(enable)	greater than 103 $\pm$2 Vrms
	(disable).......................................	less than 98 $\pm$2 Vrms

LEDguard® Low Threshold Signal Inputs

	(no detect)...	less than 15 Vrms
	(detect)	greater than 25 Vrms

LEDguard® High Threshold Signal Inputs

	(no detect)...	less than 50 Vrms
	(detect)	greater than 70 Vrms

AC Line 2010 Brown-out	(drop-out)..	98 $\pm$2 Vrms
AC Line 2010 Brown-out	(restore)	103 $\pm$2 Vrms
AC Line 210E Brown-out	(drop-out)..	92 $\pm$2 Vrms
AC Line 210E Brown-out	(restore)	98 $\pm$2 Vrms

8.1.3 DC VOLTAGE MONITORS

+24VDC Input	(fault)	less than +18 Vdc
	(no fault)...	greater than +22 Vdc
External Reset Input	(true)...	less than 3.5 Vdc
	(False)	greater than 8.5 Vdc
Watchdog Input	(true)...	less than 3.5 Vdc
	(false)...	greater than 8.5 Vdc

8.1.4 TIMING FUNCTIONS

Conflict	(no fault)......................................	less than 200 milliseconds
	(fault)	greater than 500 milliseconds
	(typical)	350 milliseconds
VDC Failed	(no fault)......................................	less than 200 milliseconds
	(fault)	greater than 500 milliseconds
	(typical)	400 milliseconds
Watchdog 1.0 second	(no fault)......................................	less than 900 milliseconds
	(fault)	greater than 1100 milliseconds
	(typical)	1000 milliseconds
Watchdog 1.5 second	(no fault)...................................	less than 1400 milliseconds
	(fault)	greater than 1600 milliseconds
	(typical)	1500 milliseconds
Red Fail	(no fault)...................................	less than 700 milliseconds
	(fault)	greater than 1000 milliseconds
	(typical)	850 milliseconds
Red Fail (2010)	(no fault)...................................	less than 1200 milliseconds
	(fault)	greater than 1500 milliseconds
	(typical)	1350 milliseconds
Dual Indication	(no fault)......................................	less than 200 milliseconds
	(fault)	greater than 500 milliseconds
	(typical)	400 milliseconds
Dual Indication Long	(no fault)......................................	less than 700 milliseconds
	(fault)	greater than 1000 milliseconds
	(typical)	850 milliseconds
Clearance	(no fault)..	greater than 2.8 seconds
	(fault)	less than 2.6 seconds
AC Line 2010 Brown-out	(drop-out)..	400 $\pm$50 milliseconds
AC Line 2010 Brown-out	(restore)	400 $\pm$50 milliseconds
AC Line 210E Brown-out	(drop-out)...	80 $\pm$17 milliseconds
AC Line 210E Brown-out	(restore)	80 $\pm$17 milliseconds
Minimum flash after restore	....	6.0 $\pm$0.5 seconds
Maximum flash after restore	....	10.0 $\pm$0.5 seconds
Watchdog (2010)	(disable)...	400 $\pm$50 milliseconds
Watchdog (2010)	(enable)	400 $\pm$50 milliseconds
Watchdog (210E)	(disable)...	80 $\pm$17 milliseconds
Watchdog (210E)	(enable)	80 $\pm$17 milliseconds
FYA Flash Rate	no fault..	less than 1400 msec
	fault..	greater than 1600 msec

8.2 MECHANICAL

Height...	9.3 inches
Width..	1.38 inches
Depth	10.17 inches

8.3 ENVIRONMENTAL

Storage Temperature Range	-55 to +90 ^{o}C
Operating Temperature Range..	-37 to +74 ^{o}C
Humidity Range...	0 to 95% Relative

Section 9
WIRING ASSIGNMENTS

9.1 MONITOR UNIT CONNECTOR (P1)

- WARNING -

PIN 27 OF THE MAIN CONNECTOR (P1) PROVIDES THE CLOSED CONTACT OF
THE OUTPUT RELAY WHEN THE MONITOR IS IN THE NO-FAULT STATE. WHEN
THE MONITOR IS IN THE NO-FAULT STATE AND THE AUTO/FLASH SWITCH IS
IN THE FLASH POSITION, AC LINE VOLTAGE MAY BE PRESENT ON PIN 27.

THIS PIN WAS PREVIOUSLY DEFINED AS A "NO-CONNECT" PIN IN LEGACY
EQUIPMENT. TO PREVENT POTENTIAL EXPOSURE TO ELECTRICAL SHOCK,
BEFORE INSTALLING THIS MONITOR THE USER IS CAUTIONED TO CHECK
THAT THE CABINET WIRING IS COMPATIBLE WITH THE USE OF THIS PIN AS A
SOURCE OF AC LINE VOLTAGE.

Pin #	Function	Pin #	Function
1	CHANNEL 2 GREEN	A	CHANNEL 2 YELLOW
2	CHANNEL 13 GREEN	B	CHANNEL 6 GREEN
3	CHANNEL 6 YELLOW	C	CHANNEL 15 GREEN
4	CHANNEL 4 GREEN	D	CHANNEL 4 YELLOW
5	CHANNEL 14 GREEN	E	CHANNEL 8 GREEN
6	CHANNEL 8 YELLOW	F	CHANNEL 16 GREEN
7	CHANNEL 5 GREEN	H	CHANNEL 5 YELLOW
8	CHANNEL 13 YELLOW	J	CHANNEL 1 GREEN
9	CHANNEL 1 YELLOW	K	CHANNEL 15 YELLOW
10	CHANNEL 7 GREEN	L	CHANNEL 7 YELLOW
11	CHANNEL 14 YELLOW	M	CHANNEL 3 GREEN
12	CHANNEL 3 YELLOW	N	CHANNEL 16 YELLOW
13	CHANNEL 9 GREEN	P	CHANNEL 17 YELLOW
14	CHANNEL 17 GREEN	R	CHANNEL 10 GREEN
15	CHANNEL 11 YELLOW	S	CHANNEL 11 GREEN
16	CHANNEL 9 YELLOW	T	CHANNEL 18 YELLOW
17	CHANNEL 18 GREEN	U	CHANNEL 10 YELLOW
18	CHANNEL 12 YELLOW	V	CHANNEL 12 GREEN
19	CHANNEL 17 RED	W	CHANNEL 18 RED
20	CHASSIS GROUND	X	UNASSIGNED
21	AC-	Y	DC GROUND
22	WATCHDOG TIMER	Z	EXTERNAL RESET
23	+24VDC	AA	+24VDC
24	[PINS 24 & 25	BB	STOP TIME
25	ARE TIED TOGETHER]	CC	UNASSIGNED
26	UNASSIGNED	DD	UNASSIGNED
27	OUTPUT SW, SIDE #3	EE	OUTPUT SW, SIDE #2 (MC Coil)
28	OUTPUT SW, SIDE #1	FF	AC+ LINE

NOTE: Pins 23 and AA are shorted together. Maximum current rating is 500 milliamps.
Pins 24 and 25 are shorted together. The Monitor circuit and the Program
Card mate with a 28/56 pin double sided edge-card connector having
0.156" centers.

OUTPUT SW, SIDE #1 closes in the fault mode. OUTPUT SW, SIDE #3 opens in the fault mode.

9.2 PROGRAM CARD CONNECTOR

Pin #	Function	Pin #	Function
1	CHANNEL 2 GREEN	A	CHANNEL 1 GREEN
2	CHANNEL 3 GREEN	B	CHANNEL 2 GREEN
3	CHANNEL 4 GREEN	C	CHANNEL 3 GREEN
4	CHANNEL 5 GREEN	D	CHANNEL 4 GREEN
5	CHANNEL 6 GREEN	E	CHANNEL 5 GREEN
6	CHANNEL 7 GREEN	F	CHANNEL 6 GREEN
7	CHANNEL 8 GREEN	H	CHANNEL 7 GREEN
8	CHANNEL 9 GREEN	J	CHANNEL 8 GREEN
9	CHANNEL 10 GREEN	K	CHANNEL 9 GREEN
10	CHANNEL 11 GREEN	L	CHANNEL 10 GREEN
11	CHANNEL 12 GREEN	M	CHANNEL 11 GREEN
12	CHANNEL 13 GREEN	N	CHANNEL 12 GREEN
13	CHANNEL 14 GREEN	P	CHANNEL 13 GREEN
14	CHANNEL 15 GREEN	R	CHANNEL 14 GREEN
15	CHANNEL 16 GREEN	S	CHANNEL 15 GREEN
16	RESERVED	T	DC GROUND
17	CHANNEL 1 YELLOW	U	CHANNEL 9 YELLOW
18	CHANNEL 2 YELLOW	V	CHANNEL 10 YELLOW
19	CHANNEL 3 YELLOW	W	CHANNEL 11 YELLOW
20	CHANNEL 4 YELLOW	X	CHANNEL 12 YELLOW
21	CHANNEL 5 YELLOW	Y	CHANNEL 13 YELLOW
22	CHANNEL 6 YELLOW	Z	CHANNEL 14 YELLOW
23	CHANNEL 7 YELLOW	AA	CHANNEL 15 YELLOW
24	CHANNEL 8 YELLOW	BB	CHANNEL 16 YELLOW
25	CHANNEL 17 GREEN	CC	CHANNEL 17 YELLOW
26	CHANNEL 18 GREEN	DD	CHANNEL 18 YELLOW
27	CHANNEL 16 GREEN	EE	PROGRAM CARD
28	YELLOW INHIBIT COMMON	FF	CHANNEL 17 GREEN

=== Mating connector shall be keyed between pins 24 and 25 and also BB and CC. The Monitor circuit and the Program Card mate with a 28/56 pin double sided edge-card connector having 0.156" centers.

9.3 RED INTERFACE CONNECTOR (P8)

Pin #	Function	Pin #	Function
1	CHANNEL 15 RED	11	CHANNEL 9 RED
2	CHANNEL 16 RED	12	CHANNEL 8 RED
3	CHANNEL 14 RED	13	CHANNEL 7 RED
4	CHASSIS GROUND**	14	CHANNEL 6 RED
5	CHANNEL 13 RED	15	CHANNEL 5 RED
6	SPECIAL FUNCTION #2	16	CHANNEL 4 RED
7	CHANNEL 12 RED	17	CHANNEL 3 RED
8	SPECIAL FUNCTION #1	18	CHANNEL 2 RED
9	CHANNEL 10 RED	19	CHANNEL 1 RED
10	CHANNEL 11 RED	20	RED ENABLE

Note: Pin #4 may be used to connect the monitor chassis to the cabinet CHASSIS GROUND. To complete this connection, a soldered wire jumper must be placed in location E14. Monitor CHASSIS GROUND is also connected through the edge connector P1. The additional connection through the Red Interface cable can provide the CHASSIS GROUND connection to the monitor if the unit is removed from the cabinet with the Red Interface cable attached. The cabinet assembly must also be wired to connect the other end of the Red Interface cable to CHASSIS GROUND.

- WARNING -

IF JUMPER E14 IS USED BE SURE THAT ANY CABINET WIRING OR MONITOR TEST EQUIPMENT DOES NOT DRIVE PIN #4 WITH AN ACTIVE SIGNAL. USE OF THIS CHASSIS GROUND CONNECTION MAY MAKE THE UNIT INCOMPATIBLE WITH SOME SIGNAL MONITOR TESTERS.

THE P8 RED INTERFACE CONNECTOR SHOULD ALWAYS BE UNPLUGGED BEFORE REMOVING THE UNIT FROM THE CABINET TO PREVENT POTENTIAL EXPOSURE TO ELECTRICAL SHOCK.

9.4 EIA-232 CONNECTOR (J5)

Pin #	Function	I/O
1	DCD	-
2	Tx DATA	O
3	Rx DATA	I
4	DTR	-
5	GROUND	-
6	DSR	-
7	CTS	-
8	RTS	O
9	NC	-

RTS is provided for compatibility with Data Terminal Equipment (DTE device) control signals.

9.4.1 EIA-232 CABLE TO A PC

A typical cable assembly for a DB-9 connector on the PC would be a straight through connection as follows:

PC DB-9		Monitor DB-9
RX pin 2	connect to	TX pin 2
TX pin 3	connect to	RX pin 3
GND pin 5	connect to	GND pin 5

A typical cable assembly for a DB-25 connector on the PC would be as follows:

PC DB-25		Monitor DB-9
RX pin 3	connect to	TX pin 2
TX pin 2	connect to	RX pin 3
GND pin 7	connect to	GND pin 5

9.4.2 EIA-232 CABLE TO A 170 CONTROLLER UNIT

A typical cable assembly for a 170 CU connector would be as follows:

170	Monitor DB-9

RX pin L	connect to	TX pin 2
TX pin K	connect to	RX pin 3
GND pin N	connect to	GND pin 5

DCD pin H should be connected to +5 pin D on the Controller Unit connector.
CTS pin M should be connected to RTS pin J on the Controller Unit connector.

9.5 ETHERNET LAN PORT

The Ethernet port must be configured with specific network parameters such as an IP address. The network port parameters are set or changed using the EDI *ECcom* Signal Monitor Communications software. See the "***EDI ECcom Software Operations Manual***" for details on the SETUP / COMM PORT / SETTINGS / **Search** function.

The network port parameters can also be configured in the Datakey. See the ***EDI ECcom Operation Manual*** (pn 888-1000-001) and ***MonitorKey Operations Manual*** (pn 888-1212-001) for details.
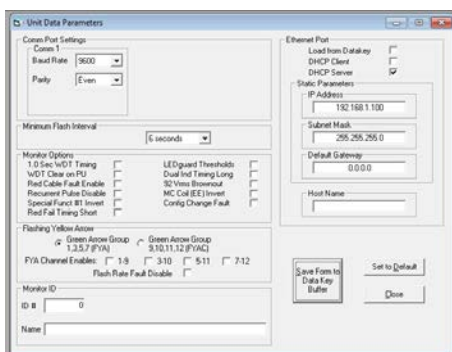
The default network settings are:

IP Address	192.168.1.100
Subnet Mask	255.255.255.0
Gateway	none

9.5.1 ETHERNET LAN CABLE

The LAN cable required is a typical Cat-5 network cable using the 8 pin RJ-45 connector. If the connection is from the monitor to a switch or hub, a standard LAN cable is needed. If the connection is from the monitor directly to a network adaptor (PC), a cross-over or patch cable is needed.