Naztec Operations Manual

For

Model NM512-E123

TS1 Conflict Monitor Enhanced 12 Channel Unit With LCD Display

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NAZTEC SERIES 500 MALFUNCTION MONITORS
MODEL NM512-E123 – Enhanced, 12 Channel Unit
With LCD Display

1.0   Advanced Features

The NM512-E123 is fully compliant with NEMA Standard TS-1, Section 6, for 12 Channel Conflict Monitors for use in traffic control systems. In addition, the monitor provides the following advanced features not addressed by TS-1:

➢ Multiple active indications on a channel

➢ Short Yellow interval - minimum is programmable per channel

➢ Sequencing of channels from Green to Red without intervening Yellow indication

➢ Short Green interval - minimum is programmable per channel

➢ AC Line Monitor - monitors incoming AC line for voltage dips, surges, and long-term over-voltage conditions and logs each instance detected

➢ Reset Input/Switch - a continuously active reset input or key-press is not recognized after a time-out of 30 seconds

➢ RS232 port for connection to printer, NEMA controller, or computer for transmitting report data and receiving report requests

➢ Unique access codes and security levels for up to 64 users

The NM512-E123 also generates the following reports and logs which can be uploaded in the field with a laptop or uploaded through the StreetWise ATMS through a controller interfaced with the monitor's RS-232 port.

➢ Fault history - up to 20 previous faults

➢ Power history - up to 30 previous power events. Power disturbances may be recorded as a programmable option.

➢ Trace - logs the 20 previous changes of the channel inputs and system inputs. Samples are time-stamped to 0.1 second resolution

➢ Reports are available for the above three logs and of all programmable settings

➢ Reports are initiated by keyboard command or communications port request

All features are easily programmable using the 20-key keypad and 16 column by 4 line LCD display. The same intuitive data entry methods are used to program the monitor as have been employed by Naztec controllers for years. If you are familiar with operating the Series 900 controller, programming a Series 500 monitor will seem quite natural.

2.0   Keypad Programmable Settings

The following parameters in the NM512-E123 may be programmed from the keyboard.

- ➢ Date and Time

- ➢ Minimum allowable Yellow interval, per channel

- ➢ Minimum allowable Green interval, per channel

- ➢ Initial flash time

- ➢ Red Fail Inhibit, per channel

- ➢ Enhanced feature enable, per channel--includes Sequence Monitoring and Multiple-indication monitoring

- ➢ Log and Latch enable of CVM, +24V and Program Card ajar monitoring. Failure conditions on these inputs may be programmed to be logged, to be logged and to latch the fault relay, or to operate in the standard NEMA manner of activating the fault relay only as long as the failure condition persists.

- ➢ Communication Baud Rate and station identifier

3.0 STATUS INDICATORS

3.1 LED Indicators

The LED indicators in the upper group, except the POWER LED, indicate that the monitor is in a faulted state which has not been reset or that still persists. The condition or conditions that caused the fault are identified by the indicators as follows.

INDICATOR	Condition
POWER	AC voltage and internal DC voltage is present
CONFLICT	Green, Walk or Yellow indications were detected on conflicting channels
RED FAIL	No inputs were active on at least one channel
INDICATION FAIL	Invalid combination of active inputs detected on a channel
MIN/SEQ FAIL	A yellow or green input was active for a shorter time than the programmed minimum; or else a channel has sequenced from green to red without a yellow indication in between
+24 Volt I	A voltage of less than 20 volts DC (nominal) is detected at the +24V I input.
+24 Volt II	A voltage of less than 20 volts DC (nominal) is detected at the +24V II input.
CVM	The CVM input is inactive (>12 volts DC nominal). If CVM faults are programmed to be latched, an illuminated LED may indicate a previous condition that has not been reset.
PRGM CARD	The program card is not installed or not fully seated in the monitor connector. If program card faults are programmed to be latched, an illuminated LED may indicate a previous condition that has not been reset.

4.0 OPERATION

The keyboard and display of the Series 500 Conflict Monitor operate almost identically as with the Series 900 Controllers. The differences are described in this section.

4.1 Default Status Displays
Upon application of power, the monitor displays the current, real-time status of the monitor or of the channel inputs. During start delay, the sign-on screen is displayed. During the initial flash interval following the start delay, a message is displayed indicating that initial flash is underway. Following initial flash, real-time status of the channel inputs are continuously presented. If the controller is in the faulted state when powered-up, the type of fault is displayed along with the time it occurred and the channels causing the fault. When faults are detected during operation, the channel status is replaced with the fault status screen.

To activate the monitor console (keyboard and display) while the default status is displayed, press the MAIN/DISP key or any numeric key. The sign-on screen is displayed. Press the MAIN/DISP key or any numeric key again and the Main Menu is displayed. Select menu items by pressing the number key of the corresponding selection. Menu screens may be longer than the 4 lines of the display. Use the PAGE-DOWN and PAGE-UP keys to view additional lines. If no keys are pressed for a time that is user-programmable, the console will return to the default status mode.

4.2 Menus and Screens
The information presented or programmed on the various screens in the monitor is presented below. They are presented in the order that they appear on menus and submenus.

4.2.1 Status Menu

4.2.1.1 Fault Status

Displays information of the currently active or most recent fault. "CUR FLT" is displayed in the upper left corner of the display that identifies the screen as the Current Fault Status.

Three pages of information are available by using the PAGE-UP and PAGE-DOWN keys. The first page shows the type of fault, the date and time of occurrence, and the faulted channels.

The second page shows the status of the Red, Yellow, Green and Walk inputs for each channel at the time of the fault. The third page shows the date and time that the fault was reset or cleared. CUR FLT and the fault type are displayed again on the third page for user convenience.

4.2.1.2 Channel Status

This one-page display shows the current, real-time status of the 4 inputs of all 12 channels. The display is arranged in a matrix of 12 columns by 4 rows. Each channel occupies one column. Each input color is assigned to a row. Active inputs are indicated by displaying the first letter of the input color (R, Y, G or W) in the appropriate row and column location. A blank (space) indicates an inactive input.

4.2.1.3 System Status

This multi-page display shows the real-time status of non-channel inputs. The following table describes the information displayed.

Identifier	Values	Description
Red Enable	OFF	Input < 60 VAC
	ON	Input > 60 VAC
Red Mon Enb	OFF	Not used
CVM		Controller Voltage Monitor
	OFF	Input > 16 VDC
	ON	Input < 8 VDC
+24V MI		+24 Volt Monitor Inhibit
	OFF	Input > 16 VDC
	ON	Input < 8 VDC
+24V I		+24 Volt Monitor I
	0-30	Voltage at input in volts DC
+24V II		+24 Volt Monitor II
	0-30	Voltage at input in volts DC

4.2.1.4 Permissives

The Permissives screen shows the permissives map which was most recently read from the program card. These are the permissives that are used for determining conflict faults. The map is presented in the form of a matrix where each position represents a jumper location on the program card. Each "P" on the display indicates an installed jumper on the program card.

4.2.1.5 AC Line Status

The AC line status screen shows the real-time value of the line voltage in AC RMS volts. The range of voltage displayed is from 0 to 135 volts, although the monitor operates on voltages as high as 160 VAC.

Also presented is the number of momentary disturbances in AC line voltage detected by the monitor since the last time the monitor was powered up. "Momentary" disturbances include voltage dropouts, dips, surges, and over voltage conditions. These are described in the AC power logging section later in this document. A maximum of 30 disturbances are recorded.

4.2.2 HISTORY MENU

This three-page display shows the same information as the Current Fault Status screen but for previous faults. Up to 20 of the most recent previous faults are stored. The faults are numbered from most recent to oldest with the most recent being assigned number 1. As usual, the PAGE keys are used to move among the various pages of information for each fault. When the fault log is selected from the menu, fault #1 is displayed. To view other faults, two methods are available. The first is to use the ALT FCN, and PAGE keys as Follows:

ALT-FCN, PAGE-UP   Display the next more recent fault

ALT-FCN, PAGE-DOWN   Display the next older fault

Entering ALT-FCN, PAGE-UP while fault #1 is displayed will cause fault #20 to be displayed.

The second method to cycle among the previous faults is to simply use the page keys. If the third page of a fault display is shown, pressing the PAGE-DOWN key will display the first page of the next older fault (next higher number). If the first page of a fault is displayed, the PAGE-UP key will display the next more recent (or lower number) fault.

Faults are identified as one of the following types:

Fault Type	Description
CONFLICT	Conflict
RED FAIL	Red Failure
IND FAIL	Indication Failure (multiple, invalid indications on a channel)
MIN YEL	Minimum Yellow
MIN GRN	Minimum Green
SEQ FAIL	Sequence Failure (yellow skipped)

24V I   +24 Volt DC Monitor #1
        24V II   +24 Volt DC Monitor #2
        CVM   Controller Voltage Monitor
        PRGM CARD Program Card has changed or is ajar

4.2.2.2 Power Log

Up to 30 previous power events relating to incoming AC line voltage are logged by the
monitor. A single page screen shows the event number (1 being most recent) and the
date and time the event occurred. The type of power event is displayed in the upper,
right-hand corner of the display. For momentary power events, or disturbances, the
length of the disturbance is recorded in number of 60 hz AC line cycles. The types of
power events that are logged are:

EVENT	DESCIPTION
PROC STRT	Processor Started from its internal hardware reset. This is the normal type of power-up, one from no voltage to full voltage occurring quickly, such as applying power by activating a switch or circuit breaker. An internal hardware reset is active until the processor +5 VDC power is stable. This event means that the AC line voltage was in normal range at the time the +5 VDC became stable.
BROWN-UP	Power-up from a brownout or low voltage condition. This may occur in two ways. First, if power is increased slowly, the processor may start before there is sufficient voltage to allow the cabinet to operate. In this case, there would be a PROC STRT event followed by a BROWN-UP. The second case is a return to operating voltage following a brown-out (but not a full power outage). In this case, the PWR-UP event follows a PWR-DOWN event without an intervening PROC STRT.
PWR-DOWN	A Power Down event indicates that AC line voltage fell below the brown-out threshold and remained so for longer than 475 ms. This could be due to a complete loss of AC or due to a brownout. If the event following a PWR-DOWN is a Processor Start, then there was a loss of AC. If the next event is a BROWN-UP, then there was not a complete loss of AC line voltage.
DROPOUT	A dropout is a loss of AC line voltage for less than 475 ms. The monitor does not go through a power-down/up cycle, but simply records the event.
DIP	A "dip" is a reduction in AC line voltage to below the brownout threshold for less than 475 ms. The only action taken by the monitor is to log the event.
SURGE	A surge is an increase in AC line voltage above 135 volts for less than one second. The only action taken is to log the event
DIP/SURGE	A momentary disturbance that is a combination of some low

	voltage cycles and some high voltage ones. The only action taken is to log the event.
OVERVOLTAGE	An over voltage condition is a line voltage above 135 volts for more than one second. The only action taken is to log the event.
NORMAL	The line voltage has returned to normal operating range after an Over voltage condition. The only action taken is to log the event.

Momentary disturbance logging may be turned on or off using the "Pwr Distrb" entry on the Latching screen. The latching screen is selected from the Configuration Menu.

4.2.2.3 Print Reports

This screen is used to print reports to an attached printer. There are four reports available that may be printed singly or in two combinations. The print selections that are available are as follows:

Selection	Report(s)	Description
CONFIG	Configuration	All operator programmable entry screens and program card permissives
HISTRY	History	Fault Log and Power Log
TRACE	Trace Log	
FAULT	Fault Log	
POWER	Power Log	
ALL	All Reports	Configuration, Fault, Power, Trace Reports

4.2.2.4 Clear Faults

The fault log may be cleared of all stored faults or
uninitialized data by using this screen.

4.2.2.5 Clear Power

The power log may be cleared of all stored power events or
uninitialized data by using this screen.

4.2.3   SET TIMES MENU

4.2.3.1 Date/Time

The date and time are set using this screen. When setting either of these values, leading zeros must be entered (this is the only screen where leading zeros must be entered). The Date is entered in a single, six-digit field (dashes are not entered). A four-digit field is provided to enter hours and minutes for setting the time.

The seconds field of the time is automatically set to 00 at the instant the ENTR key is pressed. This feature allows setting the time to within one second of the desired time by waiting until the "top of the minute" before pressing the ENTR key.

4.2.3.2 Min Yellow

The minimum yellow interval is programmable on a per- channel basis. Any full yellow interval that is shorter than the programmed minimum for the channel will cause a latched fault. A "full" interval is one that is preceded by a green interval on the channel. This feature prevents false minimum yellow faults from occurring on cabinets wired such that the controller continues to run when the signals are turned off.

Also required for minimum yellow interval monitoring to be enabled is that the Red Enable input be active. This feature provides a method to prevent minimum interval failures that might otherwise occur as a cabinet is manually placed on flash or the signal head power is turned off using cabinet controls.

Minimum yellow monitoring is disabled on a per-channel basis by setting the minimum yellow interval to zero.

4.2.3.3 Min Green

Minimum green monitoring operates the same for green intervals as the minimum yellow monitoring does for yellow intervals. Refer to the above section describing yellow monitoring for programming considerations.

4.2.3.4 Flash Delay

The flash delay is programmable from 0 to 10 seconds in 0.1 second increments. If the time programmed is less than 2.5 seconds, then the start-up delay is automatically set equal to the flash delay.

4.2.4 Configuration Menu

4.2.4.1 Red Mon Inh (Red Monitor Inhibit)

Red Fail Monitoring may be inhibited on a per channel basis through this screen. Setting this entry to ON prevents monitoring for Red Failure on a channel. For red monitoring to occur, this programmable inhibit must be set to OFF and the Red Enable input must be active.

4.2.4.2 Seq/Ind Enb (Sequence and Indication Monitoring Enable)

Monitoring for sequence failures or for invalid multiple-indications on channels is enabled or disabled on this screen. An entry is provided for each channel so that monitoring may be selected on a per-channel basis.

For sequence or multi-indication monitoring to occur, the Red Enable input must be active (AC voltage greater than 60 volts, nominal). By requiring the Red Enable to be active, a method is provided to prevent sequence failures that might otherwise occur as a cabinet is manually placed on flash or the signal head power is turned off using cabinet controls.

4.2.4.3 Latching

Standard treatment of system faults (CVM, +24V Monitors, Program Card Ajar) is for the monitor to activate the fault output relay only for the period that the fault exists; in other words, the fault is not "latched".

The NM512-E123 conflict monitor provides programmable options that allow system faults to be logged and to be latched. The Latching screen is used to enable these options. The entry fields and available selections are described below.

SELECTIONS

Selection	Description
OFF	Normal NEMA TS-1 operation, non-latched
LOG	Log faults only, do not latch
LATCH	Latch and Log faults (i.e. treat as channel faults)

ENTRY FIELDS

Field	Description and (selections)
CVM	Controller Voltage Monitor Input (OFF, LOG, LATCH)
24V Mon	24V I and 24V II Monitor Inputs (OFF, LOG, LATCH)
Prgm Card	Program Card Ajar or Change (OFF, LATCH)
Pwr Distrb	Power Disturbances (not including Processor Start, Brown-up, or Power- down) (OFF, LOG)

Program Card selections affect monitoring in the following way. If latching is OFF, then the program card is read continuously and conflict monitoring performed accordingly. If the card is removed or replaced during operation, then the new permissives are used for determining fault conditions. For the time that the card is removed, there are no permissives. The program ajar sensor is not monitored.

If program card latching is set to LATCH, then the program card is monitored for any change in its program after being read during power-up or following monitor Reset (either from the Reset pushbutton or NEMA input). If a change is detected or the card is removed, the monitor will latch a program card fault.

4.2.4.4 Config Comm (Configure Communications Port)

Four entries are provided on the Configure Communications screen. These are:

Prompt	Entries/Selections	Description
Baud:	300, 600, 1200, 2400, 4800, 9600	Determines the Async Baud Rate of the serial port
Xon/Xoff:	OFF, ON	Enables or disables the use of X-ON and X-OFF characters for flow control. [Note: X-ON,X-OFF is the only protocol provided at this time. This setting should be ON].
Stn ID:	0 to 9999	Station Identification Number that is printed on reports
Timout:	15 to 255	Number of seconds to wait before aborting a transmission; usually due to an X-OFF or disconnected comm cable.

To communicate with the monitor, the async parameters of the device being communicated with should be set to:

```
Data Characters:        8
Start Bits:             1
Stop Bits:              1, 1.5, 2
Parity:                 None
```

4.2.4.5 Init EEPROM

The default settings of all configuration parameters that are stored in non-volatile
memory (EEPROM) may be restored to their factory settings using this screen.

The default values are:

```
Parameter                    Default Setting
---------------------------  ---------------------------------------

Min Yellow                   2.7 seconds, all channels

Min Green                    0.0 seconds (disabled), all channels

Initial Flash                4.0 seconds

Red Monitor                  OFF, all channels Inhibit

Sequence/ Indication         ON, all channels
Monitoring

System Fault Latching        LOG for CVM, 24V I & II; OFF for Program Card

Power Disturbance Logging    OFF

Comm Baud                    2400
Xon/Xoff                     On
Station ID                   0
Timeout                      30 Seconds

Security Codes               None entered
Access Levels                None, all users
```

4.2.5 DIAGNOSTICS

4.2.5.1 RAM Memory

The RAM diagnostic verifies that all RAM locations may be written and read with a variety of data patterns.

4.2.5.2 ROM Memory

The ROM diagnostic calculates a checksum of the entire program memory. The result is compared to the checksum calculated at the factory that is also stored in the ROM. The result of the comparison is displayed as PASSED or FAILED. The calculated checksum is also displayed.

4.2.5.3 Program Card

This factory diagnostic uses an external test fixture to verify that each input of the program card slot is functioning and that there are no short circuits between any of them. It is a production-time diagnostic. The "Permissives" screen is provided for field or depot level maintenance personnel to verify operation of the program card slot and circuitry.

4.2.5.4 Permissives

The Permissives screen shows the permissives map which was most recently read from the program card. These are the permissives used for determining conflict faults.

This screen may also be used with multiple program cards to verify that the program card slot is functioning properly. When used in this way, four or more cards should be used, each with a different set of program jumpers installed. The jumpers on any card should be equally spaced; for example, every fourth jumper if four cards are used, or every fifth if there are five cards.

If all cards are read properly, it is unlikely that the program card circuitry is malfunctioning. The more cards that are used (with fewer jumpers installed per card), the less likely it will be that an error goes undetected.

4.2.5.5 Communications Port

Use this screen and a "loopback" connector to execute the internal self-test of the communication port. The loopback connector should be wired as follows:
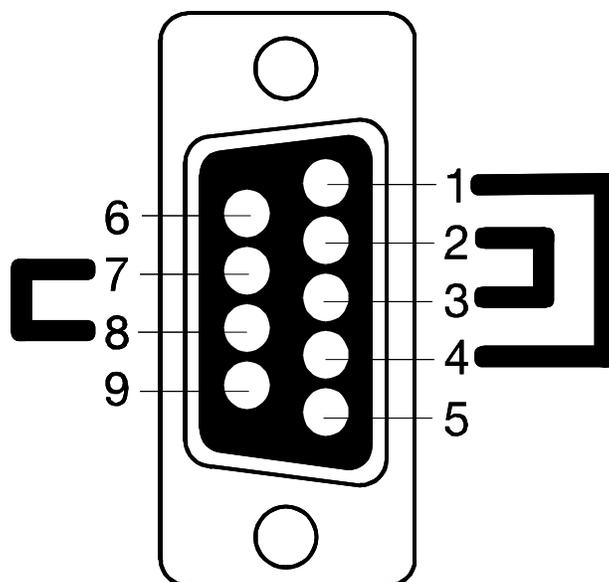
Rear View
DE-9S "RS232" Loopback Connector

To execute the self-test, install the loopback connector on the port to be tested. Then select the port and test to be run below the prompt "Sel Test:". The status will be displayed during the test and the results when it is complete. If "PORT 1 CONT" is selected, the test will be run continuously. In this case, a successful test is one that continues to display a status of "RUNNING". If the "ONCE" test is selected, a successful test displays "TEST COMPLETE". An unsuccessful test will result in one of the following messages: TRANSMIT ERROR, RECEIVE ERROR, TIMEOUT ERROR or MESSAGE ERROR.

4.2.6 SECURITY

Access to data entry screens may be limited through the use of access codes. Each user may be assigned one of five access levels. Up to 64 users, each assigned a unique access code and level, are maintained by the monitor. Since operation of the security system in Series 500 monitors is the same as that of Series 900 NEMA Traffic Controllers, only one set of access codes and levels is required for both pieces of equipment.

4.2.6.1 Enter Code

If security is setup in the monitor, this screen allows a user to enter his/her user number and access code.

4.2.6.2 Set Code

This screen is used to set access codes and levels for users. SECUR(e) is the maximum level of access and is required to gain access to this screen once any users are established. Therefore, the security administrator must be setup first with an access level of SECUR to be able to regain access to this screen.

4.3   REMOTE ACCESS VIA COMMUNICATIONS

The Series 500 Conflict Monitor supports remote requests for transmitting reports. These requests are received by the monitor through the RS232 port (if the comm option is installed). Reports are transmitted in ASCII, and include Carriage Return and Line Feed characters at the end of each line. Two characters are transmitted at the end of a report to signify the end of transmission. The following table identifies the various codes recognized and transmitted by the conflict monitor.

Code (hex/ascii)	TX/RX	Description
31, ' 1 '	RX	Configuration Report Request
32, ' 2 '	RX	History Report Request (Fault and Power Log Reports)
33, ' 3 '	RX	Trace (Analyzer) Report Request
34, ' 4 '	RX	Fault Report Request
35, ' 5 '	RX	Power Report Request
36, ' 6 '	RX	All Reports Request
49, ' I '	RX	Trace Report Request (alternate for ' 3 ')
52, ' R '	RX	History Report Request (alternate for ' 2 ')
11, DC1	RX	X-ON character (flow control)
13, DC3	RX	X-OFF character (flow control)
0D, CR	TX	Carriage Return
0A, LF	TX	Line Feed
12, DC2	TX	End of Report
04, EOT	TX	End of Transmission

APPENDIX A

CONNECTOR PINOUTS

Connector A

Pin	Signal	Pin	Signal
A	AC Line (AC+I)(jumpered internally to AC+II)	f	Channel 6 Yellow
B	Output Relay 1 Open	g	Channel 5 Yellow
	(closes when fault occurs)	h	Channel 3 Yellow
C	Output Relay 2 Closed	i	Channel 3 Walk
	(opens when fault occurs)	j	Channel 2 Yellow
D	Channel 12 Green	k	Channel 1 Yellow
E	Channel 11 Green	m	Controller Voltage Monitor
F	Channel 10 Green	n	+24 V Monitor Inhibit
G	Channel 9 Green	p	Output Relay 1 Closed
H	Channel 8 Green		(opens when fault occurs)
J	Channel 7 Green	q	Output Relay 2 Open
K	Channel 6 Green		(closes when fault occurs)
L	Channel 5 Green	r	Channel 12 Walk (Type 12 only)
M	Channel 4 Green	s	Channel 11 Walk (Type 12 only)
N	Channel 3 Green	t	Channel 9 Walk (Type 12 only)
P	Channel 2 Green	u	Channel 8 Walk
R	Channel 1 Green	v	Channel 7 Walk
S	+24 V Monitor I	w	Channel 5 Walk
T	Logic Ground	x	Channel 4 Yellow
U	Chassis (Earth) Ground	y	Channel 2 Walk
V	AC Neutral (AC-)	z	Channel 1 Walk
W	Output Relay 1 Common		
X	Output Relay 2 Common	AA	Spare 1
Y	Channel 12 Yellow	BB	Reset
Z	Channel 11 Yellow	CC	Cabinet Interlock A
		DD	Cabinet Interlock B
a	Channel 10 Walk (Type 12 only)	EE	Channel 6 Walk
b	Channel 10 Yellow	FF	Channel 4 Walk
c	Channel 9 Yellow	GG	Spare 2
d	Channel 8 Yellow	HH	spare 3
e	Channel 7 Yellow		

Connector B

Pin   Signal

A   AC Line (AC+II)
.B   Start Delay Relay Common
C   Start Delay Relay Open
      (closes during start delay period)
D   Channel 12 Red
E   Channel 11 Red
F   Channel 9 Red
G   Channel 8 Red
H   Channel 7 Red
J   Channel 6 Red
K   Channel 5 Red
L   Channel 4 Red
M   Channel 2 Red
N   Channel 1 Red
P   Spare 1
R   +24 V Monitor II
S   Spare 2
T   Spare 3
U   Start Delay Relay Closed   (open during start delay period)
V   Channel 10 Red
W   Spare 4
X   Spare 5
Y   Spare 6
Z   Channel 3 Red

a   Red Enable
b   Spare 7
c   Spare 8

Connector COMM A

Pin   Signal

1   DCD
2   Rx Data Input
3   Tx Data Output
4   DTR
5   Logic Ground
6
7   RTS
8   CTS
9

APPENDIX B - SPECIFICATIONS

1. ELECTRICAL

A. POWER

Line Voltage	75 to 160 Volts AC, RMS
Line Frequency	57 to 63 Hz., 60 Hz nominal
Power Consumption	9 Watts, typical
Fuse	1.0 Amp

AC Line Monitoring Voltage:

Pickup	100 ± 2.5 Volts AC, RMS
Dropout	92.5 ± 2.5 Volts AC, RMS
Hysteresis	7.5 ± 1.0 Volts AC, RMS

B. AC INPUTS

Green, Yellow and Walk Channel	OFF	0 to 15 Volts AC, RMS
	ON	greater than 25 Volts AC, RMS
Red Channel	OFF	0 to 50 Volts AC, RMS
	ON	greater than 70 Volts AC, RMS
Red Enable	OFF	0 to 50 Volts AC, RMS
	ON	greater than 70 Volts AC, RMS

Both positive and negative half cycles are measured for Green, Yellow, Red and Walk Channel inputs.

C. DC INPUTS

+24 Volt I & II	OFF	less than +18 Volts DC
	ON	Greater than +22 Volts DC

Controller Voltage Monitor (CVM), +24 Volt Monitor Inhibit, External Reset:

	True	less than +8 Volts DC
	False	greater than +16 Volts DC

D. RELAY OUTPUTS

Fault   Two sets of isolated Form C contacts,
                          rated 3 Amps maximum at 135 VAC

Start Delay   One set of Form C contacts, rated
                          3 Amps maximum at 135 VAC

2. TIMING FUNCTIONS

Conflict
    No Fault   less than 200 milliSeconds
    Fault   greater than 450 milliSeconds

Red Failure
    No Fault   less than 700 milliSeconds
    Fault   greater than 1000 milliSeconds

Power Interruption
    No response   less than 450 milliSeconds
    Respond   greater than 500 milliSeconds

Start Delay 2.5 ± 0.5 Seconds

Power-up Flash   0 to 20 seconds

3. CONNECTORS

Connector A   Mates with MS 3116 22-55 SZ
Connector B   Mates with MS 3116 16-26 S
Connector COMM A   Mates with DE-9S

4. SIZE
Height   10.5 inches
Width   4.5 inches
Depth   10.9 inches (add 2.5 inches for
                          connector harness assembly)

5. ENVIRONMENTAL
Operating Temperature Range   -34°C to +74°C
Storage Temperature Range   -45°C to +93°C
Relative Humidity   less than 95% non-condensing
                               to +43°C