Naztec Operations Manual

For

Model NM512E

TS1 Conflict Monitor
Enhanced 12 Channel Unit

June 2002

Published by

Naztec, Inc.
820 Park Two Dr.
Sugar Land, Texas 77478
Phone: (281) 2407233
Fax: (281) 240-7238

TABLE OF CONTENTS

NAZTEC SERIES 500 MALFUNCTION MONITORS
MODEL NM512E – Enhanced, 12 Channel Unit

1.0 OVERVIEW

1.1 Monitoring

The NM512E Conflict Monitor is fully compliant with NEMA Standard TS-1, Section 6, for 12 Channel Conflict Monitors for use in traffic control systems. When installed in a traffic control cabinet, this unit monitors the voltages applied to traffic signals to detect instances of conflicting channels being active at the same time. The NM512E also detects occurrences of "dark" channels or "red failure" due to there being no voltage applied to signal field terminals. In addition to signal monitoring, two 24 Volt DC inputs are checked for proper level and a logic signal, Controller Voltage Monitor, must be in the logic TRUE state (active low) for normal operation. Finally, as part of standard NEMA monitoring, the AC line voltage is monitored for being above brown-out level.

The NM512E provides enhanced monitoring features not addressed in the NEMA TS-1 standard. The first of these is monitoring for invalid combinations of multiple active outputs, or indications, on a channel; such as green and red being active at the same time. Another enhanced feature allows monitoring of the yellow output for being active for too short a time or for being skipped entirely in the sequence from green to yellow to red. Finally, the monitor may be set to "latch" +24Volt faults or CVM faults. Standard monitor operation is to transfer the output relay to the non-faulted state when either of these two fault conditions are sensed to be clear, ie. they are not "latched". If these faults are programmed to be latched, once they are detected the fault relay will not transfer out of the faulted state until the monitor is reset. All enhanced features may be easily enabled or disabled through front panel switch settings.

1.2 Relay Outputs

If any of the monitored items are outside of normal operating conditions, the monitor transfers its output relay to the "fault" state. This DPDT relay is normally wired in the controller assembly so that when it is in the fault state the signals are transferred to a flashing indication. In addition to fault conditions, the output relay is held in the "fault" or non-operating state for a short period after AC power is applied to the monitor. This period is called the minimum flash delay and it is operator-programmable.

A second relay, the Start Delay Relay, is provided which transfers to the normal operating state 2.5 seconds after power-up of the monitor. This relay transfers to the power-down state if AC line voltage drops below brown-out level for more than 500 milliseconds. The start delay relay is generally used to control the power-up sequence of equipment in the controller cabinet assembly.

1.3 Front Panel

All connections, operator settings and status indications are located on the front of the NM512E monitor. Conflict monitor input signals and relay output connections are made through two MS style connectors which mate with controller assembly harnesses.

Operating and fault status is provided by high-intensity LED indicators. Illuminated LEDs indicate active channels, operating power and the occurrence of specific faults.

Operator controls include a reset button, a switch to set the minimum flash time after power-up, a programming card, and pencil switches to enable and program the enhanced monitoring features. The programming card is used to identify channels (or phases) that are permitted to be active simultaneously without being considered a conflict.

Enhanced monitoring, which includes monitoring for multiple indications, short yellow and skipped yellow outputs may be enabled separately for each channel by use of the pencil switches. Short yellow monitoring may be disabled independently from the other enhanced features, and the minimum time allowed may be set from 2.7 to 18.2 seconds. Finally, latching of +24 Volt and CVM faults may be individually enabled. An AC line fuse is accessible from the front panel. No tools are required to inspect or replace the fuse.

1.4 Other Features

Reset Timeout	A continuously active reset input or key-press is not recognized after a time-out of 30 seconds. This feature provides an added margin of safety in the event of a malfunction or improper use of the reset function.
Zero Flash Time	The minimum flash interval may be set to zero seconds. When set to zero, the start delay time is also zero seconds.

2.0 OPERATION DESCRIPTION

2.1 MONITORING

2.1.1 Channel Inputs

Four AC inputs are monitored for each of the twelve channels: they are Red, Yellow, Green and Walk. A channel is active if the yellow, green or walk input is ON. These inputs are defined as ON if the voltage sensed is greater than 25 VAC (OFF if less than 15 VAC). A red signal is ON when the voltage sensed is greater than 60 +/-10 VAC.

2.1.2 Conflict

A conflict occurs when two channels which are not permitted to be active at the same time become so. Two channels that are permitted to be active simultaneously are called compatible or permissive. Channels not allowed together are termed conflicting. Permissive channels are programmed in pairs by installing jumpers in the programming card. If there are no jumpers installed, each channel conflicts with all others.

A conflict occurs when conflicting channels are active together for 450 milliseconds or longer. If the conflicting channels are active for shorter than 200 milliseconds, no conflict occurs.

Once a conflict is detected and the output relay transfers, the fault condition is maintained (or "latched") until the NM512E is reset. A fault may be reset manually by pressing the reset button; it may be reset electrically by cycling the Reset input. A conflict fault is latched; therefore, it is NOT cleared by cycling power. Only a reset will clear a conflict fault.

2.1.3 Red Failure and Red Enable Input

The NM512E is capable of monitoring channels for the absence of voltage on all four inputs of a channel. This feature is enabled by AC voltage being present on the RED ENABLE input. If there are no active inputs on any channel for 1000 milliseconds and the RED ENABLE input is active, the monitor recognizes a red failure fault. Red failure is a latched fault; it causes the output relay to transfer and must be reset to restore normal monitoring.

2.1.4 +24 Volt DC I & II Inputs

Two +24 volt DC inputs are monitored for ensuring adequate supply voltage in the controller assembly. If the voltage at either input falls below 18 volts DC, the output relay transfers to the fault state for the duration of the low voltage condition. 24 Volt I & II faults are normally not latched; therefore, when the voltage at both inputs returns to the nominal value, the output relay returns to the non-fault state. A reset is NOT required to return to normal monitoring for a non-latched fault.

As a programmable option, 24 Volt I & II faults may be latched. If this option is enabled by a front panel pencil switch setting, then any 24 Volt faults will be latched and an operator or remote reset is required to clear the fault.

+24 Volt DC monitoring may be disabled by placing a logic true voltage at the 24 Volt Monitor Inhibit input. A logic true voltage is a level less than 8 VDC. A voltage of greater than 16 VDC at the 24 Volt Monitor Inhibit input, or if the input is left unconnected, enables monitoring at the +24 VDC I and II inputs.

2.1.5 Controller Voltage Monitor Input

The NM512E monitors an input called the controller voltage monitor input for an active "true" logic level of less than 8 VDC. If a low level is not detected, a "CVM" fault is recognized and the output relay is transferred to the fault state. Normally, CVM is a non-latched fault and the monitor returns to normal operation when a low level is sensed at the CVM input. In this case, a reset is not required to restore normal monitoring. The CVM input is intended to be connected to a traffic signal controller and provides a means for the controller to indicate that it is ready to operate the signals.

As a programmable option, CVM faults may be latched. If this option is enabled by a front panel pencil switch setting, then any CVM faults will be latched and an operator or remote reset is required to clear the fault.

2.1.6 AC Line Voltage

AC line voltage is continuously monitored for being present at an adequate level to allow proper operation of the controller assembly. If line voltage is too low for a long enough time, the NM512E transfers the output and start delay relays in response to a power-down condition. The NM512E recognizes "brownout" at about 92 VAC. Hysteresis of 8 VAC is used to prevent the NM512E from cycling in and out of brownout when the line voltage is near the brownout threshold. Therefore, return to monitoring from power interruption occurs when line voltage reaches 100 volts.

Note that the NM512E operates internally at much lower line voltages than the power interruption thresholds described in the previous paragraph.

2.2 Enhanced Monitoring

The enhanced monitoring features are discussed in this section. These features may be enabled for each channel separately by using the switches on the front panel. If the enable switch for a channel is set to the OFF position, none of the following monitoring will occur for that channel.

2.2.1 Indication Failure

An indication failure is one in which an invalid combination of signal voltages is present on a channel. Each channel has a red, yellow, green and walk input corresponding to standard traffic signal indications. Invalid combinations are any that include more than one of the red, yellow or green inputs being active at the same time. Also, only the walk input being active is an indication failure. All other combinations are considered valid and will not trigger a fault.

An Indication failure condition must persist between 700 and 1000 milliseconds to be recognized as a fault. If the condition occurs for shorter than 700 milliseconds, it does not cause a fault.

2.2.2 Skip Yellow Failure

Skip yellow monitoring checks for the omission of the yellow clearance interval in the cycling of the indications of a channel. If the active inputs of a channel move from green to red without an intervening yellow, then a skip yellow failure is declared and the monitor faults.

To avoid false triggers due to transients, green and red inputs must be active for approximately 330 milliseconds before being considered ON for the purposes of declaring a skipped yellow. Please note that the timing for this feature has no affect on other monitoring such as for conflict or red failure.

2.2.3 Minimum Yellow Failure

Minimum yellow monitoring checks for yellow intervals that are shorter than a programmed minimum time. Once a yellow input is active for more than about 330 milliseconds, it must remain active for at least the length of time programmed on the front panel pencil switches. If the interval is too short, the monitor will declare the failure and transfer the fault relay.

Minimum yellow monitoring is enabled or disabled overall with a single pencil switch; however, it is also enabled on a per-channel basis along with indication failure and skip yellow monitoring with the channel enable switches as described in section 2.2. Therefore, for minimum yellow monitoring to be enabled for specific channels, the overall minimum yellow enable must be set to ON, AND the enhanced monitoring enable switch for the specific channel or channels must also be ON.

2.3 Power-up Sequencing

Upon restoration of AC line voltage following an interruption of 475 milliseconds, the NM512E operates the relays in the following manner.

1. Start delay relay is transferred 2.5 seconds after power is restored. If the minimum flash time is set to zero, the relay is transferred immediately upon sensing adequate line and internal voltages.

2. Output relay is held in the de-energized (or fault) state for the minimum flash time. If there are no latched faults and all non-latched inputs are at satisfactory levels, the output relay is transferred to the non-fault state; otherwise, the output relay stays in the fault position. If the minimum flash time is set to zero and there is no cause for remaining in the fault state, the output relay is energized immediately to the non-fault state.

3.0 STATUS INDICATORS

3.1 Monitor Status

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	Invalid combination of active inputs detected on a channel
MIN/SKIP	A clearance interval was not detected between the green and red intervals, or it was shorter than the programmed minimum time.
+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).

3.2 Phase Status

Phase status (or channel status) LEDs illuminate when the corresponding channel is active (ie. when the yellow, green or walk input of the channel is ON). If the monitor has faulted, these LEDs display the channels that were active at the time of the fault.

4.0 SETUP AND USE

Setup of the NM512E conflict monitor consists of installing jumpers in the programming card, setting the minimum flash time, programming the enhanced features, and resetting a latched fault if necessary.

4.1 Programming Card

Program permissive channels by installing soldered wire jumpers into the appropriate positions on the programming card. One jumper position is provided for each pair of channels. There are a total of 66 jumper locations. Each jumper location is marked with its corresponding pair of channels. The programming card complies with the NEMA TS 1-1989 standard for Traffic Signal Conflict Monitors and is therefore interchangeable with compliant cards of other manufacturers.

4.2 Minimum Flash Time

A rotary switch is provided for setting the minimum flash time. Settings for 0 seconds and 4 through 12 seconds are available. The action of the minimum flash time is discussed in section 2.2 above.

4.3 Reset Pushbutton

Twelve pencil switches are provided--one for each channel--which activate enhanced monitoring for their respective channels. Setting a switch to the "ON" position activates enhanced monitoring. Setting it to "OFF" disables all enhanced monitoring. Monitoring for indication failures and skipped yellow intervals is enabled and disabled solely by these switches. Monitoring for minimum yellow failures is controlled by these switches and by the short yellow enable switch which is described below.

4.4 Minimum (Short) Yellow Monitoring

Minimum yellow (also referred to as short yellow) interval monitoring is programmed by the upper six switches in the right-most switch group. The top switch enables or disables short yellow monitoring. This is an overall enable control for this feature; it applies to all twelve channels. For short yellow monitoring to be active for a channel, both this switch and the individual channel enable switch for enhanced monitoring must be set to their ON positions.

The remaining five switches (#2-6) in the short yellow group are used to set the minimum allowed yellow interval. To the right of each of these switches is a number which indicates "additional seconds" to be added to the minimum yellow time. The total minimum yellow interval is determined by adding the times for each switch set to the ON position to the base value of 2.7 seconds. For example, to program a minimum interval of 5.2 seconds, you would turn to ON the switches corresponding to the addition of 0.5 seconds and 2.0 seconds.

The total time would be calculated as:

Minimum Yellow = switch 0.5 + switch 2.0 + base time
= 0.5 + 2.0 + 2.7
= 5.2 seconds

3.7 seconds would be programmed by setting only the 1.0 seconds additional time switch to ON.

Minimum Yellow = 1.0 + 2.7 = 3.7 seconds

4.5 Latch 24V Faults

To enable the enhanced feature of latching +24V I & II faults, set the switch labelled "LATCH 24V" to ON. If this switch is set to OFF, +24V I and II faults operate in the standard non-latched manner. Non-latched faults clear automatically when the fault condition ends. It is not required to press the reset switch or cycle the reset input to clear a non-latched fault.

4.6 Latch CVM Faults

To enable the enhanced feature of latching Controller Voltage Monitor (CVM) faults, set the switch labelled "LATCH CVM" to ON. If this switch is set to OFF, CVM faults operate in the standard non-latched manner. Non- latched faults clear automatically when the fault condition ends. It is not required to press the reset switch or cycle the reset input to clear a non-latched fault.

4.7 Reset Pushbutton

Latched faults are manually reset by pressing the reset button on the front panel. A fault condition may be overridden for a short time by holding down the reset button; however, after 30 seconds, a continuous reset is no longer recognized. To reactivate the reset, the button must be released and pressed again. This reset time-out feature is provided to protect against malfunction or misuse of the monitor reset.

APPENDIX A

CONNECTOR PINOUTS

Type 12 - 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 (closes when fault occurs)	g	Channel 5 Yellow
		h	Channel 3 Yellow
C	Output Relay 2 Closed (opens when fault occurs)	i	Channel 3 Walk
		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 (opens when fault occurs)
H	Channel 8 Green		
J	Channel 7 Green	q	Output Relay 2 Open (closes when fault occurs)
K	Channel 6 Green		
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		

Type 12 - 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

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
Minimum Yellow	Programmable from 2.7 seconds to18.2 seconds
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

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