Model 242L / 244L

DC Isolator Unit

Operations Manual

THIS MANUAL CONTAINS TECHNICAL INFORMATION FOR
THE MODEL 242L AND 244L SERIES DC ISOLATOR

REVISION: OCTOBER 2015
pn 888-2420-002

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THE MODEL 242L/244L SERIES IS DESIGNED AND MANUFACTURED IN THE USA BY
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AN ISO 9001:2015 REGISTERED COMPANY

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1.1 GLOSSARY

A - Ampere
°C - Celsius
Component - Any electrical or electronic device
DC - Direct Current
Firmware – Program code embedded into a microcontroller unit
Hz - Hertz
IC - Integrated Circuit
Jumper - A means of connecting/disconnecting two or more conductive by soldering/desoldering a conductive wire or by PCB post jumper
LED - Light Emitting Diode
LOGIC - Negative Logic Convention (Ground True) State
mA - milliAmpere
ms - millisecond
MCU - Micro Controller Unit or microcontroller unit
MOV - Metal Oxide Varistor
Opto-coupler – An integrated circuit that provides electrical isolation
PCB - Printed Circuit Board
RMS - Root-Mean-Square
s – second
Schmitt Circuit – a circuit that provides hysterisis in the threshold
SW – Switch
uF - microfarad
VAC - Voltage Alternating Current
VDC - Voltage Direct Current

1.2 GENERAL DESCRIPTION

The Model 242L is a dual channel DC Isolator unit designed to meet Caltrans specifications TEES 2009 including Errata #2 (December 2014). The Model 244L is a quad channel DC Isolator unit in a half-width form factor. These isolator units occupy one position of a 33X style standard input file. The isolator unit card incorporates a double-sided 44 pin edge connector for the connection of power, input, and output signals. Each channel has individual front panel controls for testing the operational mode, and high intensity front panel LEDs which are used to indicate the output state. Outputs are optically-isolated solid-state transistors. The Model 242L and 244L are powered from the 24VDC Cabinet Power Supply and do not require AC Line.

While the Model 244L is interchangeable with the Model 242L, note that the Model 244L can only be installed in the even numbered slots of a standard Input Assembly. The Model 244L half-width form factor is primarily intended for use in rack assemblies designed for double density (four channel half-width) detector/isolator units.

1.3 GENERAL CHARACTERISTICS

Each channel of the Model 242L/244L provides input hysterisis and digital filtering to qualify the input signal. An input signal must meet the minimum pulse requirements specified in section 1.7.4 in order to produce a valid output. The output pulse width for both channels can be set to 100 milliseconds minimum by installing jumper “100ms” (J4-A).

Both the input and output circuits have been designed for maximum protection from electrical transients. The inputs have been designed to withstand the discharge of a 10 uF capacitor charged to +/- 1000 Vdc directly across the input pins, and a discharge of a 10 uF capacitor charged to +/- 2000 Vdc applied through a source impedance of 5 ohms across the input pins or to Equipment Ground. The outputs are protected by a transient clamp diode.

The Model 242L/244L handle assembly is made of GE Lexan™ Type 121, which is a super durable polycarbonate resin. The design of this assembly strengthens and protects the whole PCB assembly much better than conventional metal face plates.

1.4 INSTALLATION AND ADJUSTMENTS

Installation of the unit consists of plugging into the appropriate slot of the Input File and connecting the assigned inputs to the proper cabinet terminals. The edge connector is keyed to prevent incorrect installation. Following power-up, a front panel LED test will illuminate both OUT indicators for two seconds.

1.4.1 MINIMUM OUTPUT PULSE

If desired, the output pulse width for both channels can be set to 100 milliseconds minimum by installing jumper “100ms” (J4-A).

1.4.2 INPUT POLARITY

The polarity of the input can be inverted such that a closed contact input is False and an open contact input is True. The input polarity of Channel 1 can be set to invert by installing a jumper into the “CH1 POL” (J4-B). The input polarity of Channel 2 can be set to invert by installing a jumper into the “CH2 POL” (J4-C). The input polarity of Channel 3 can be set to invert by installing a jumper into the “CH3 POL” (J4-C). The input polarity of Channel 4 can be set to invert by installing a jumper into the “CH4 POL” (J4-D).

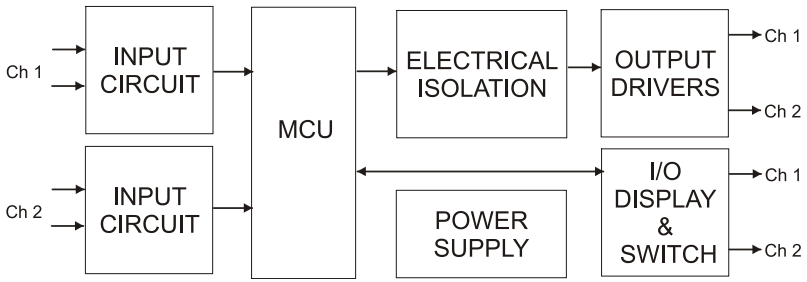
1.5 THEORY OF OPERATION

Reference designators shown are for Channel 1. Reference designators for Channel 2 are shown in parenthesis.

1.5.1 SYSTEM DESCRIPTION

The sensor circuitry can be broken down into seven major blocks. Each “Input Circuit” block contains the electrical transient devices and the input biasing circuit. Although the Model 242L (244L) has two (four) DC inputs, a single digital processing section is used to process both inputs.

The microcontroller unit “MCU” Block provides the input voltage threshold and input pulse width filtering function on both channel 1 and channel 2 DC input circuits.



The MCU then controls the OUTPUT and DISPLAY blocks appropriately. The TEST switches can be used to force the input to the True state. If the TEST switch is in the ON (locked) or MOM (momentary) position it will force the output to the asserted (True) state regardless of the input circuit state. The TEST switches are processed through the MCU for pulse width input and output requirements.

Valid output calls are made via optically isolated solid state transistors. Output calls are indicated on the front panel by means of red LEDs labeled “OUT”.

The Model 242L/244L operating voltage is generated by a high efficiency isolated switching power supply. The resulting bias voltage supplied to the Input circuits is electrically isolated from both 24VDC Logic Ground and AC Line Neutral. The VDD supply for the microcontroller and display elements results from a post regulated 5 Vdc.

1.5.2 INPUT CIRCUIT

Resistors R21, R7, R8, R25, and R19 (R22, R9, R3, R26, and R20) provide the input bias and voltage scaling circuit. The resulting voltage at U20.3 (U20.4) is then processed by the microcontroller U20. Gas tube CR2 (CR3) and diode CR 14 (CR16) provides input electrical transient protection.

1.5.3 MCU CIRCUIT

The microcontroller U20 processes the input voltages to perform the voltage threshold and pulse width filtering functions. All signal processing is performed in the digital domain and controlled by firmware embedded in the microcontroller. This unit does not rely on analog delay, pulse, or comparator circuits for processing the input signals.

1.5.4 OUTPUT CIRCUIT

The output driver Q7 (Q8) is isolated from both the AC Mains and the internal GND reference of the Model 242L by opto-couplers U8 (U9). CR9 (CR6) provides electrical transient protection for the output driver Q7 (Q8).

1.5.5 DISPLAY AND SWITCH CIRCUIT

The LED indicator DS1 (DS3) for the channel output is driven directly from the microcontroller U20. The input TEST switch SW1 (SW3) can be used to force the input state to the active status.

1.5.6 POWER SUPPLY CIRCUIT

The main power supply is a fully isolated switching design. The cabinet 24VDC input voltage is used to drive switching controller U18. The transformer T1 is used by controller U18 to generate the isolated and regulated 19 VDC input bias voltage VCC that drives the input circuits. The opto-coupler U21 and reference U25 provide the closed loop feedback to the power supply controller U18 for regulation.

A second regulator U26 generates the 5.0 Vdc internal supply voltage VDD used by the processor circuit from the 19 VDC bias. Inductor L2, C29, C31, and C24 filter the regulator U26 output to provide clean VDD to the processor.

1.6 MAINTENANCE

The Model 242L/244L requires no adjustments or preventive maintenance.

1.6.1 TROUBLE ANALYSIS

The following list should be used to trouble-shoot the Model 242L/244L installation. If the Model 242L/244L unit itself is suspect, see Section 1.6.2 for a complete internal testing sequence.

a. Neither channel responds to DC inputs
    a. Power supply fault

        The Model 242L/244L requires a nominal 24 Vdc input voltage. The unit will operate at voltages as low as 10.8 Vdc, however, an input voltage below this may result in the unit entering a reset state. In this case, the unit will appear to be non-functional.

b. Channel does not detect all inputs

a. Input voltage or pulse width does not meet the requirements of section 1.7.3 or 1.7.4.

   Verify that the DC input voltage level is less than the DC Inputs True specification. Verify that the DC input pulse width is greater than the Input Pulse Width Accept specification.

1.6.2 TROUBLE SHOOTING SEQUENCE

Apply 24 Vdc nominal power to DC POWER pin J1-B referenced to LOGIC GROUND pin J1-A. Connect a jumper circuit to the DC inputs J1-D (J1-J) and J1-E (J1-K) to simulate the closure of the input contacts. The following signal measurements are referenced to test point CH1 (CH2).

NOTE: internal test point “GND” is isolated from Logic Ground. Care should be exercised in probing internal test points.

a. Input Bias Power Supply VCC

   Voltage at test point VCC should be 19 $\pm$ 1 Vdc with respect to GND.

   Possible component faults are: controller U18, CR12, R14, transformer T1, CR30, reference U25, or opto-coupler U21.

b. Regulated Power Supply VDD

   Voltage at test point VDD should be 5 $\pm$ 0.2 Vdc with respect to GND.

   Possible component faults are: voltage regulator U26, inductor L2, diode CR29.

c. Microcontroller

   Possible components at fault are: microcontroller U20.

d. Output Circuit

   Output signals are processed by the microcontroller U20 and appear at U20.10 (U20.9) and on the display LEDs but are not appearing at the output pins.

   Possible components at fault are: opto-coupler U8 (U9), transistor Q7 (Q8).

1.7 SPECIFICATIONS

1.7.1 MECHANICAL

Height	4.50 inches
Width (242L)	1.2 inches
Width (244L)	1.2 inches
Depth (excluding handle)	6.875 inches

1.7.2 ENVIRONMENTAL

Storage Temperature Range	-45 to +85 ^{o}C
Operating Temperature Range	-34 to +74 ^{o}C
Humidity Range (non-condensing)	0 to 95% Relative

1.7.3 ELECTRICAL

DC Supply Voltage Minimum	10.8 Vdc
DC Supply Voltage Maximum	28.0 Vdc
DC Supply Power Maximum	2.0 Watts
DC Inputs	
True (low)	less than 8 Vdc
False (high)	greater than 12 Vdc
Optically Isolated Solid State Outputs	
True (low, 50 mA)	less than 1.5 Vdc
False (high)	greater than 16 Vdc
Maximum Leakage Current (high)	less than 1 uA
Maximum Current	50 mA
Collector Voltage Maximum	50 Vdc

1.7.4 TIMING

Input Pulse Width Reject ..... less than 5 ms
Input Pulse Width Accept..... greater than 10 ms

1.7.5 242L CONNECTIONS

Edge Connector mates with connector type Cinch 50-44A-30

PIN	FUNCTION
A	Logic Ground
B	DC Supply
D	Input CH 1
E	Input CH 1 Common
F	CH 1 Output Collector
H	CH 1 Output Emitter
J	Input CH 2
K	Input CH 2 Common
L	Equipment Ground
W	CH 2 Output Collector
X	CH 2 Output Emitter

1.7.6 244L CONNECTIONS

Edge Connector mates with connector type Cinch 50-44A-30

PIN	FUNCTION
A	Logic Ground
B	DC Supply
D	Input CH 1
E	Input CH 1 Common
F	CH 1 Output Collector
H	CH 1 Output Emitter
J	Input CH 2
K	Input CH 2 Common
L	Equipment Ground
P	Input CH 3
R	Input CH 3 Common
S	CH 3 Output Collector
T	CH 3 Output Emitter
U	Input CH 4
V	Input CH 4 Common
W	CH 2 Output Collector
X	CH 2 Output Emitter
Y	CH 4 Output Collector
Z	CH 4 Output Emitter