

**STATE OF CALIFORNIA
MODEL 242L**

**DC ISOLATOR UNIT
OPERATIONS MANUAL**

THE MODEL 242L DC ISOLATOR UNIT IS DESIGNED AND MANUFACTURED IN THE USA BY
EBERLE DESIGN INC., PHOENIX, ARIZONA, 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 hysteresis in the threshold

SW – Switch

uF - microfarad

VAC - Voltage Alternating Current

VDC - Voltage Direct Current

1.2 GENERAL DESCRIPTION

The Eberle Design Model 242L is a dual channel DC Isolator unit designed to meet Caltrans specifications TEES 2009 including Errata #2 (December 2014). The isolator unit occupies one position of a 170 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 is powered from the 24VDC Cabinet Power Supply and does not require AC Line.

1.3 GENERAL CHARACTERISTICS

Each channel of the Model 242L provides input hysteresis and digital filtering to qualify the input signal. An input signal must meet the minimum pulse requirements specified in section 1.7.5 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 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).

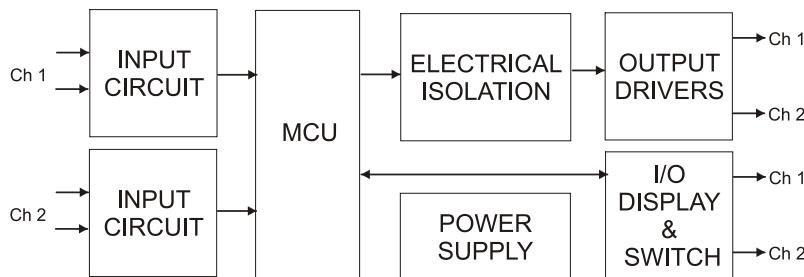
1.5 THEORY OF OPERATION

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 has two 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 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 requires no adjustments or preventive maintenance.

1.6.1 TROUBLE ANALYSIS

The following list should be used to trouble-shoot the Model 242L installation. If the Model 242L 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 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 1.7.4 or 1.7.5.

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 ± 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 ± 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), output transistor Q7 (Q8).

1.7 SPECIFICATIONS

1.7.1 CONSTRUCTION

Printed circuit boards are double sided copper with plated through holes. Circuit boards are coated for environmental protection.

1.7.2 MECHANICAL

Height	4.50 inches
Width	1.2 inches
Depth (excluding handle).....	6.875 inches

1.7.3 ENVIRONMENTAL

Storage Temperature Range	-45 to +85 °C
Operating Temperature Range.....	-34 to +74 °C
Humidity Range (non-condensing)	0 to 95% Relative

1.7.4 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

1.7.5 TIMING

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

1.7.6 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

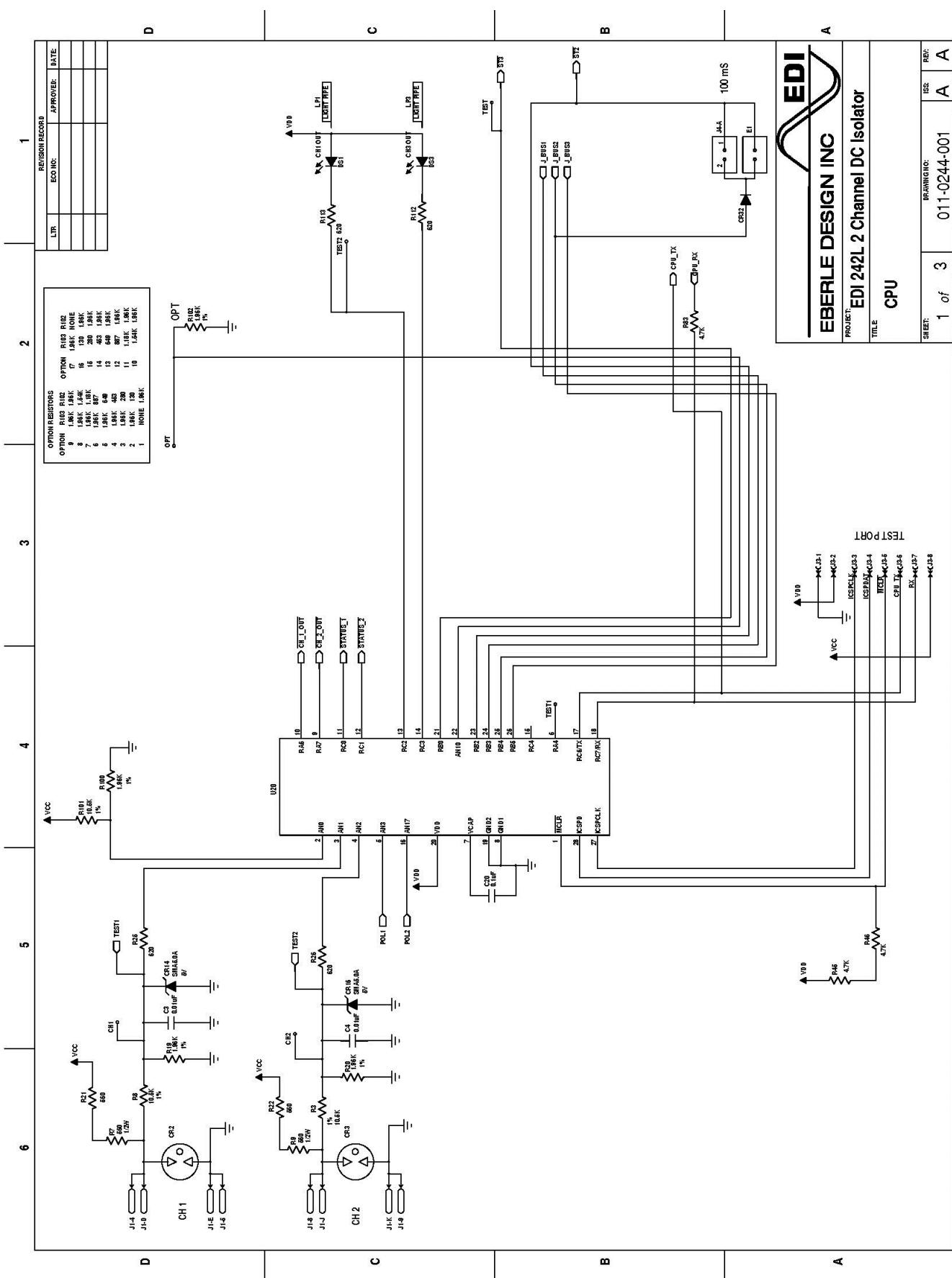
1.8 PARTS LIST AND SCHEMATIC

Item	EDI Part Number	Qty	Description	Reference	Manufacturer
1		1	(NO COMPONENT)	J1	
2		1	(no component)	J3	
3		10	(NO COMPONENT)	CH1-2 GND GND_1 OPT TEST TEST1-2 VCC VDD	
4		1	(NO COMPONENT)	E1	
5		2		M1-2	
6	215-0033-S	2	RESISTOR, 1/2W, 0.33 OHMS, 5%, 2010 surface mount	R74 R99	
7	215-0180-S	1	RESISTOR, 1/2W, 1.8 OHMS, 5%, 2010 surface mount	R14	
8	215-3310-S	1	Resistor, 330 OHM, 1/2W, 5%, 2010 surf. mnt.	R117	
9	215-5610-S	4	Resistor, 560 OHMS, 1/2W, 5%, 2010 surf. mnt.	R7 R9 R21-22	
10	215-5620-S	1	Resistor, 5.6K OHMS, 1/2W, 5%, 2010 surf. mnt.	R82	
11	251-1052-S	3	RESISTOR, 1/8W, 10.5K, 1%, 1206 surface mount	R3 R8 R101	
12	251-1211-S	3	RESISTOR, 1/8W, 1.21K, 1%, 1206 surface mount	R70 R78 R92	
13	251-1961-S	7	RESISTOR, 1/8W, 1.96K, 1%, 1206 surface mount	R19-20 R95 R100 R102 R109-110	
14	251-5901-S	1	RESISTOR, 1/8W, 5.90K, 1%, 1206 surface mount	R94	
15	251-8061-S	1	RESISTOR, 1/8W, 8.06K, 1%, 1206 surface mount	R91	
16	255-0000-S	6	RESISTOR, 1/8W, 0 OHMS, 5%, 1206 surface mount	E3-4 R42-43 R52 R55	
17	255-1020-S	3	RESISTOR, 1/8W, 1K, 5%, 1206 surface mount	R61-62 R88	
18	255-4310-S	1	RESISTOR, 1/8W, 430 Ohm, 5%, 1206 surface mount	R87	
19	255-4720-S	9	RESISTOR, 1/8W, 4.7K, 5%, 1206 surface mount	R45-46 R54 R56 R72 R77 R79 R83 R86	
20	255-6210-S	4	RESISTOR, 1/8W, 620 Ohm, 5%, 1206 surface mount	R25-26 R112-113	
21	261-1200-S	1	RESISTOR, PULSE RATED, 3/4W, 12 OHMS, 5%, 2010 smt	R97 SEI	
22	300-3370-035S	4	CAPACITOR, ELECTROLYTIC, 330uF, 35V, LOW ESR, 20%, SMT	C14 C19 C31 C36 337AXZ035MD10	ILLINOIS
23	320-1010-100S	2	CAPACITOR, CER.MULT, 100pF, 100V, 5%, NPO,1206 CHIP	C32 C34 CL31C101JCCNFNC	Samsung
24	320-1020-050S	2	CAPACITOR, CER.MULT, 0.001uF, 50V, 10%, 1206 CHIP	C18 C30	
25	320-1030-100S	2	CAPACITOR, CER.MULT, 0.01uF, 100V, 10%, 1206 CHIP	C3-4	
26	320-1040-050S	9	CAPACITOR, CER.MULT, 0.1uF, 50V, 10%, 1206 CHIP	C9 C20 C22-25 C35 C37-38	
27	320-1060-025S	1	CAPACITOR, CER.MULT, 10uF, 25V, 10%, 1206 CHIP	C29 Samsung	

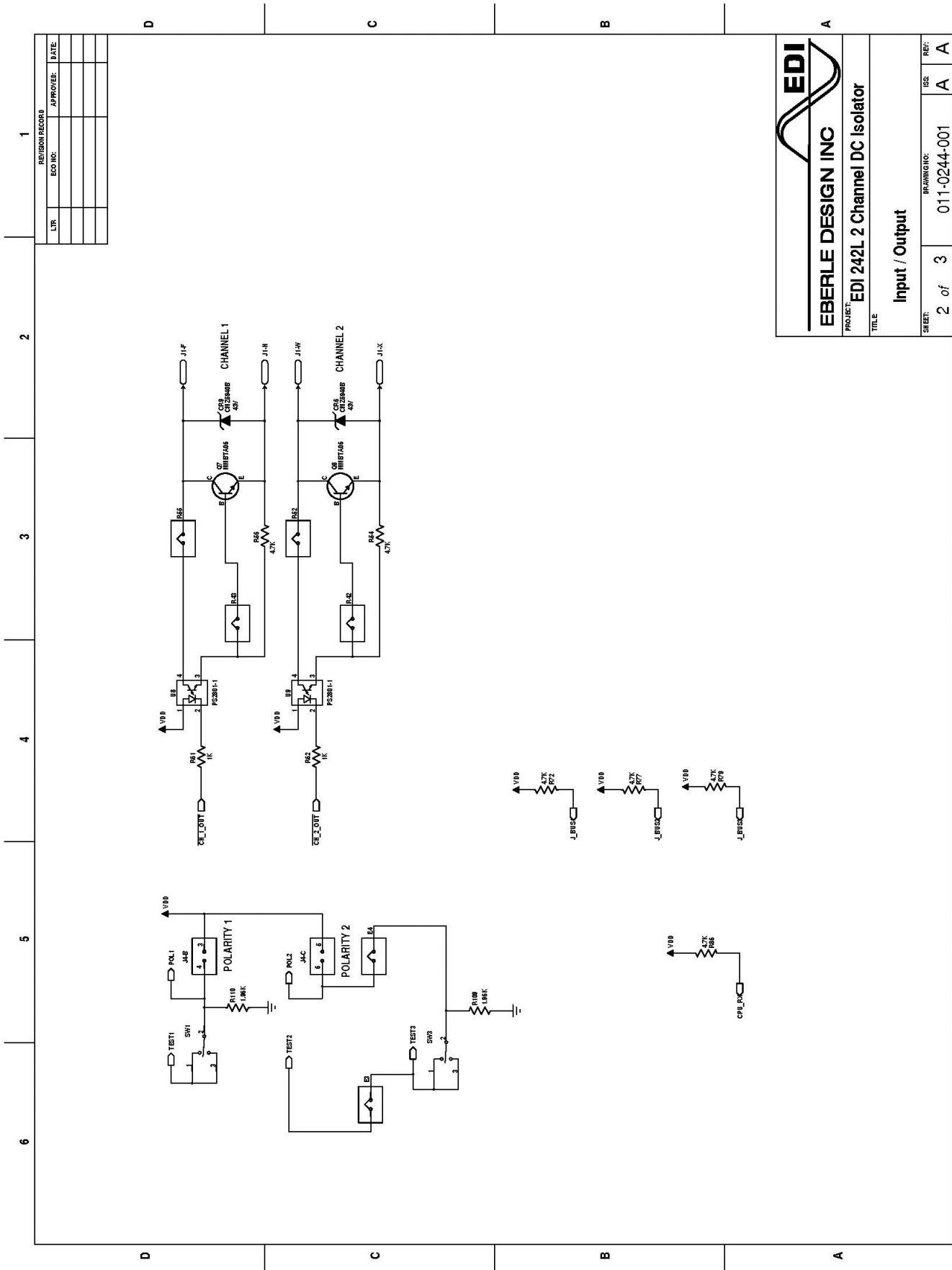
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28	320-2210-050S	1	CAPACITOR, CER.MULT, 220pF, 50V, 10%, 1206 CHIP	C17		CL31A106KAHNNNE	
29	410-0053-S	2	DIODE, TRANS. SUPR., SMA5.0A, 5V, SMA	CR14 CR16		MOTOROLA	
30	410-0110-S	2	DIODE, ULTRAFAST, MURA110T3, 100V, 1A, SMA	CR27 CR30		ON SEMI	
31	410-0141-S	1	DIODE, SCHOTTKY, MBRX140, 40V, 1A, SOD123	CR29		MMC MBRX140-TP	
32	410-1526-S	1	TRANSORB, SMCJ26A, 26V, 1500W	CR31		DIODES, INC.	
33	410-4005-S	1	DIODE, S1K, 800 PIV, 1A	CR12			
34	410-4148-S	1	DIODE, 1N4148WS, SMT SOD323	CR32		DIODES INC.	
35	410-4755-S	2	DIODE, ZENER, CMZ5941B, 1.0W, 5%, 43V, SMA	CR6 CR9			
36	420-2811-S	3	OPTOCOUPLER, PS2801-1, 4 PIN SOP	U8-9 U21		NEC PS2801-1	
37	425-0150-RS	2	LED, RED, WC LENS, 1206, FLAT, SMT	DS1 DS3		LITEON	
						LTST-C150KRKT	
38	430-0006-S	2	TRANSISTOR, MMBTA06LT1, NPN, 80V, 500 mA, SOT-23	Q7-8			
39	440-0431-S	1	REGULATOR, TL431AID, VOLTAGE REF., 1%, SO8	U25		MOTOROLA	
40	440-1002-S	2	GAS DISCHARGE TUBE	CR2-3		LITTLEFUSE	
						SL1002A090SM	
41	445-3463-S	2	IC, AZ34063U, PWR. SUPPLY CNTLR	U18 U26		DIODES INC	
						AZ34063UMTR-G1	
42	485-1512-S	1	IC, PIC16F1512-I/SO, RISC MPU	U20		MICROCHIP	
						PIC16F1512T-I/SO	
43	520-0206-P	1	Connector, Header, 6 Pin	J4		SAMTEC	
						TSM-103-01-L-DV-A	
						SMT HEADER	
44	610-0055	2	SWITCH, SPDT, ON-OFF-MOM, RIGHT ANGLE, GOLD	SW1 SW3		C&K 7101MD9ABE	
			CONTACTS				
45	725-0300-R	2	LIGHT PIPE, .300 HT	LP1 LP3		BIVAR	
						SLP3-300-100-R	
46	780-0080	1	242L FACEPLATE AND ENCLOSURE	CVR1		AZP & Associates	
47	800-0230-S	1	TRANSFORMER, DC TO DC, SMT, 2.5W	T1		Signal H-1520	
48	850-0151-S	1	INDUCTOR, 150uH, 0.46A, SHIELDED, SMT	L2		SIGNAL SCRH74-151	
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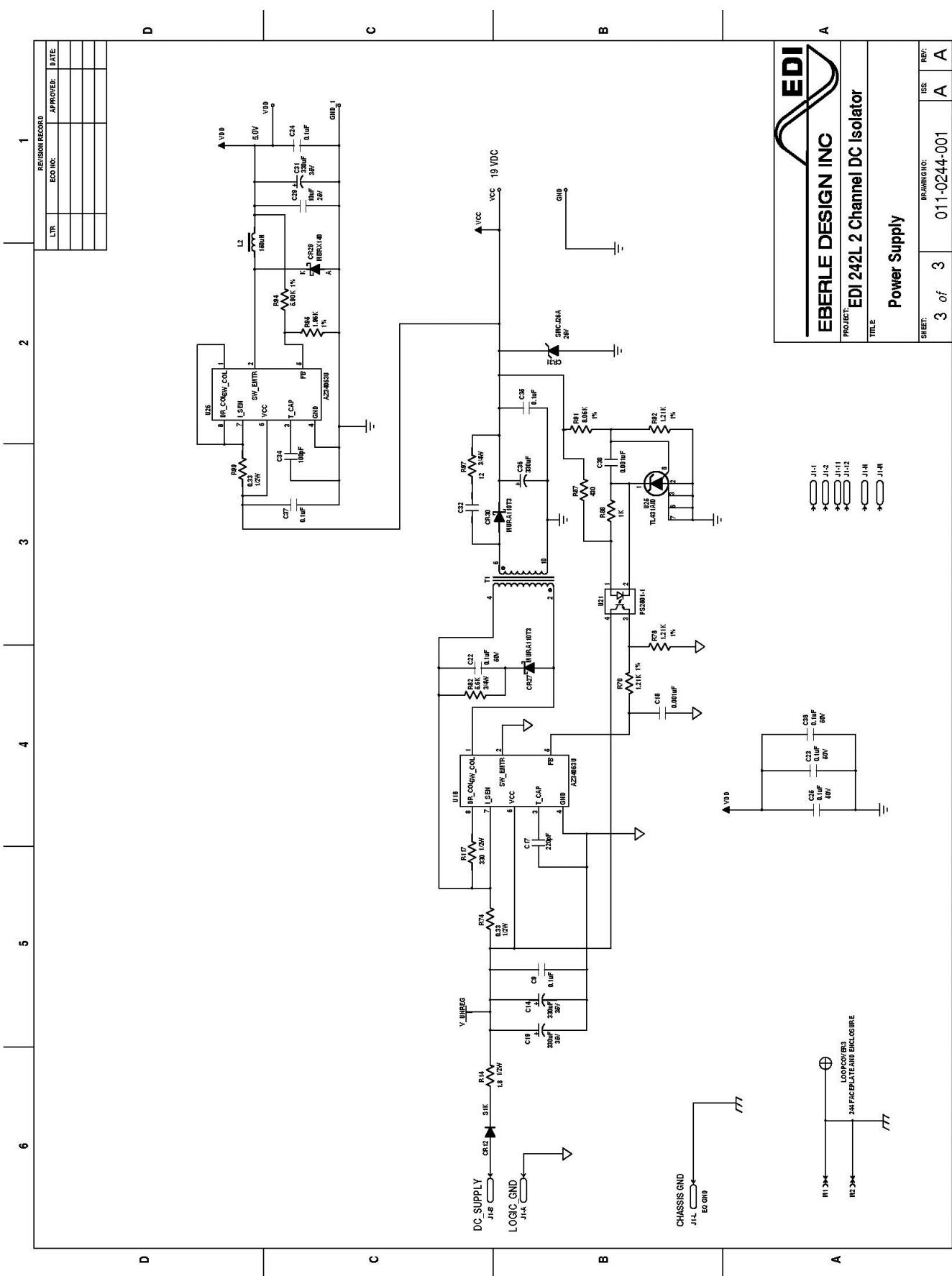
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