DATA SHEET :DCI-82-242

Model 242 DC Isolator:

Description:

The PDC Model DCI-82 dual channel DC isolator is designed specifically to meet the California Department of Transportation , Model 242 specifications. Each channel of the DC isolator shall present a true signal (ground closure) at the output of its optical coupling device when a contact closure causes an input voltage of less than 8 VDC, for longer than 5 milliseconds. A transition from a true to a false signal at the output shall occur when the respective contact closure causes an input voltage of greater than 12 VDC.

All electronics are provided on a single sided P.C. board with an aluminum front panel. The P.C. board is provided with a solder mask, silk screen identifying all component locations and is conformally coated to resist adverse environmental conditions.

Installation:

The DC Isolator intermates with the model 332 cabinet input file. Connector pinouts are as shown in Fig. 1. The connector mates with a Cinch #250-22-30-xxx or equivalent.

Pin	Function	Pin	Function
A	DC ground	N	AC+
B	+24 VDC	P	NA
C	NA	R	NA
D	Input #1	S	NA
E	Input #1 common	T	NA
F	Output #1 (C)	U	NA
H	Output #1 (E)	V	NA
J	Input #2	W	Output #2 (C)
K	Input #2 common	X	Output #2 (E)
L	Chassis ground	Y	NA
M	AC-	Z	NA

FIG 1.

General Characteristics:

Model DCI-82-242
Input:
True State.....<8 VDC,>5 msec.
False State.....>12 VDC
Output:
Voltage.....30 VDC max.(open collector)
Current.....50 mamp sink(true state)
Power:
Voltage.....115 VAC
Current.....20 mamp AC max.
Isolation:
Voltage.....2500 VAC
Resistance.....1000 megohm.
Transient suppression:
Energy.....50 Joules

Mechanical Characteristics:

Length …… 7.00 IN.
Width…….. 1.12 IN.
Height……. 4.50 IN
Weight…… 0.70 LBS.

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Theory of Operation:

General:
DC Power Supply
A.C. line voltage is applied to the combination of an input surge suppressor and transformer primary winding. The voltage at the secondary winding is full wave rectified and applied to a series pass regulator to develop +20 VDC +/- 4 VDC. This voltage drives the remainder of the circuitry.

Isolation Circuit:
A contact closure is applied at the input of the isolation circuit. See Fig. 2. A transient suppression network across the input shall filter any high energy spikes. Assuming the contact closure is of greater than 5 millisecond duration, it shall pass through the spurious input filter and be presented to the threshold comparator.
A closure producing an input voltage of less than 8 VDC shall trigger the comparator output,setting the 100 msec. duration latch, and drive the output optical coupler, turning on the output transistor, producing a true output condition. If the contact closure produces an input voltage exceeding 12 VDC at any time after the expiration of the 100 msec. latch timer, then the output transistor shall be turned off, producing a false condition at the output.

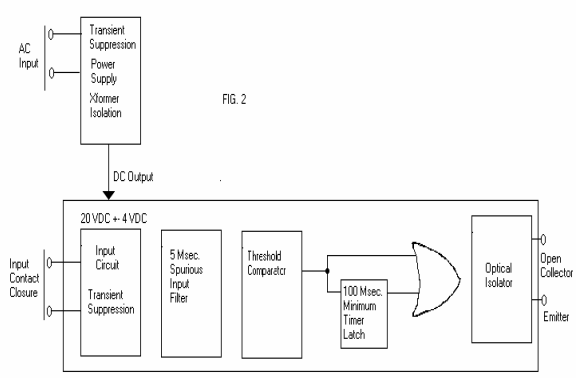

FIG. 2

D.C. Power Supply

Refer to circuit schematic, Fig. 3. 115 VAC is applied to the transient suppressor R1 and VR1 and primary of T1 from input connector pins M & N. The secondary of T1 develops 28 VAC peak which is full wave rectified bydiode bridge CR1, filtered by capacitor C1, and applied to the linear series pass darlington combination Q1 & Q2. Zener diode CR2 establishes the power supply output across C2 at 20 VDC minus diode voltage drops in Q1 & Q2, or approximately 19 VDC.

Isolation Circuit:

Refer to circuit schematic Fig 3. We shall consider channel 1 only, with input on pins D & E and output on pins H & F. Assume a contact closure, creating a voltage of less than 8 VDC, is applied to the input. Current is supplied through R5 from the DC supply to the contact closure to establish the input voltage level. Once the closure is applied, capacitor C3 discharges through resistor R7. If the closure remains for a period of time greater than 5 milliseconds then C3 will discharge sufficiently such that the voltage at IC1-4 becomes less positive than the reference voltage

at IC1-5, causing a high transition at IC1-2. If the closure is not of sufficient duration, then capacitor C3 will be quickly charged through diode CR3. When IC1-2 goes through a high state, transistor Q3 is turned on, allowing current to flow from the D.C. supply through R19, indicator I1 and the primary of optical coupler IC2, producing a true condition at the output of IC2 and Q5 darlington pair. The collecof Q3 also clamps IC1-4 low through capacitor C5 and diode CR7 for a period of time necessary to charge C5 through resistor R15. This period is in excess of 100 msec..
If the input closure is now removed or altered such as to produce a voltage greater than 12 VDC at the input, capacitor C3 will charge, producing a voltage at IC1-4 more positive than the reference voltage at IC1-5 creating a low transition at IC1-2. This condition will turn off Q3, allowing no current to flow in the primary of IC2 which will produce a false condition at the output of IC2 and Q5 darlington pair.

Troubleshooting:

Should improper operation of the isolator module be observed, the technician should first become thoughly familiar with the theory of operation before attempting to troubleshoot. Refer to isolation schematic, Fig. 3 and Fig. 4, for component location.

Preliminary Checks:

1) Check that the cabinets AC+ at pin N is >95 VAC
2) Check contact closures at pins D & E and J & K to verify proper input voltages are developed.
3) Check ouput connections proper loading, and presence of a pullup voltage at pins F & W.

If the preliminary checks 1 through 3 are normal, then the problem must be within the DC Isolator Module. Check the +20 VDC power supply as in problem 1. If the power supply is good then proceed to either problem 2 or 3 depending on the symtoms. The fault isolation procedures ahown assume channel 1 of the module to be faulty.

Problem 1.
Either no voltage or incorrect voltage (not +20 +/-4 VDC) from power supply at the emitter of Q2.
1.A Disconnect emitter of Q2. If voltage at emitter of Q2 = 19 VDC then go to 5.A.
B.Measure voltage at collector of Q2. If voltage is >22 VDC unregulated, then go to 8.
2.Disconnect one lead of C1. If voltage is >22 VDC unregulated at the collector of Q2, then install a new C1 and repeat procedure.
3.A. Reconnect C1 and desolder diode bridge CR1. If >44 VAC peak to peak measured at the secondary of T1, then install new CR1 and repeat procedure.
B. If >95 VAC at measured primary of T1, then install new T1 and repeat procedure.
4. Remove one lead of VR1. Use VOM to check if VR1 shorted. If VR1 is shorted then install a new VR1 and R1, otherwise install new R1 and repeat procedure.
5.A. Disconnect emitter of Q1. If 19.5 VDC measured at emitter of Q1, then install new Q2, reconnect all leads and repeat procedure.
B. If 20 VDC not measured at base of Q1then go to 6. Otherwise install new Q1, reconnect all leads and repeat procedure.
6. Remove one lead of R2. Measure resistance of R2 if R2=24K ohm then go to 7. Otherwiseinstall new R2, , reconnect all leads and repeat procedure.
7. Install new CR2, , reconnect all leads and repeat procedure.
8. Disconnect one lead of C2 and reconnect emitter of Q2. If 19 VDC is measured at the emitter of Q2, then install new C2, , reconnect all leads and repeat procedure, otherwise locate and remedy shorted IC1 or trace on the circuit board.

Problem 2.
With contact closure at the input, producing <8 VDC, the output does not go true (saturated N-P-N transistor, pins H & F).

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1.A. Does indicator I1 iluminate? If not then go to 2.A.
B. Check pull up voltage at pin F. Measure voltage at base of Q5. If >0.7 VDC replace Q5, otherwise replace IC2 and recheck output.
2.A. Is voltage at IC1-4 less than at IC1-5? If no go to 3.
B. Does IC1-2 go to 0.7 VDC with input true? If yes go to 2.C. if no replace IC1 and recheck output. Note that problem may also be base-emitter shorted on Q3.
C. Short collector of Q3 to ground. If I1 illuminates replace Q3 and recheck output.
D. Short cathode of I1 to ground If I1 illuminates replace IC2 and recheck output.
E. Replace I1 and recheck output.
3. Is voltage at IC1-5 +10 +/-1 VDC ? If yes go to 4. If no change resistive divider R11 & R13 and recheck output.
4. Disconnect one lead of CR7. If output does not change, then reconnect and go to 5. If no install new CR7 and recheck output.
5. Measure voltage at the common point of R3 & R7. If voltage >8 VDC, then replace R3 and recheck output.

If at this point the problem is not solved, check visually for problems and then repeat the test procedure.

Problem 3.

With contact closure at the input, producing >12 VDC, the output does not go false.

1.A. Does indicator I1 illuminate? If yes then go to 2.A.
B. Measure voltage at base of Q5. If 0.7 VDC replace IC2, otherwise replace Q5 and recheck output.
2.A. Is voltage at IC1-4 greater than at IC1-5? If no go to 3.
B. Does IC1-2 go to) VDC with input false? If yes go to 2.C. If no replace IC1 and recheck output.
C. Replace Q3 and recheck output.
3. Disconnect one lead of C3. If output is unchanged, reconnect lead and go to 4., otherwise install new C3 and recheck output.
4. If voltage at common point of R3 and R5 is <8 VDC, then replace VR2 and recheck output. Note that problem could also be a shorted S1.

If at this point the problem is not solved, check visually for problems and then repeat the test procedure.

Item	QTY	PDC P/N	Description	MFG	MFG P/N	SCHEMATICREF.
1	1	00128	P.C. Board Fab.	Power Distribution & Control	00128	
2	1	00118-2	Front Panel	Power Distribution & Control	00118-2	
3	1	00333-2	Handle	H.H. Smith	1642	
4	2	00445	Angle Bracket	G&C	6263	
5	2	S0002	Switch SPDT	C&K	7107SD9ABE	
6	2	LD0004	L.E.D., Clear , Red	Monsanto	MV5020	I1,2
7	4	C0008	Cap., 0.1mf, 50V,10%	Sprague		C3,4,5,6
8	1	C0005	Cap. ,22 mf,35V,20%	Sprague		C2
9	1	C0014	Cap., 470 mf,50V,20%	Sprague		C1
10	2	CR0001	Diode, 1N4004	Diodes Inc.	1N4004	CR3,4
11	1	CR0004	Diode Bridge,1A,400V	G.I.	WL04M	CR1
12	4	CR0007	Diode,Signal,1N914	Fairchild	1N914	CR5,6,7,8
13	1	CR0009	Diode,Zener,20V,1N968B	Fairchild	1N968B	CR2
14	2	IC0031	I.C. Opto Isolator	G.E.	4N36	IC2,3
15	1	IC0004	I.C. 3302,Quad Comparator	Motorola	MC3302P	IC1
16	5	Q0001	Transistor, 2N5172	G.E.	2N5172	Q1,3,4,5,6
17	1	Q0003	Transistor, Tip 47	Teccor	TIP47	Q2
18	1	T0002	Transformer, 6VA	Signal	LP20-300	T1
19	1	VR0001	Varistor 20 Joules	G.E.	V150LA10	VR1
20	2	VR0003	Varistor, 3 joules	Panasonic	ERZ-C10DK330	VR2,3
21	3	R0028	Res., 5 ohm, 1/2W	Dale	PW-10	R1,3,4
22	2	R0025	Res., 680 ohm, 1/2W	Dale		R19,20
23	2	R0007	Res., 24K ohm, 1/4W	Dale		R5,6
24	3	R0030	Res., 91K ohm, 1/4W	Dale		R2,17,18
25	2	R0019	Res., 150K ohm, 1/4W	Dale		R7,8
26	6	R0020	Res., 390K ohm, 1/4W	Dale		R11,12,13,14,23,24
27	2	R0022	Res., 390K ohm, 1/4W	Dale		R21,22
28	2	R0044	Res., 2.4M ohm, 1/4W	Dale		R15,16
29	2	R0031	Res., 6.2M ohm,1/4W	Dale		R9,10
30	2		Screw, PH Pan HD 4-40 x 5/16			
31	2		Screw, PH pan HD 4-40 X 7/16			
32	2		Washer, Flat, #4			
33	2		Washer, Split Lock, #4			
34	2		Nut, Keps, 4-40			

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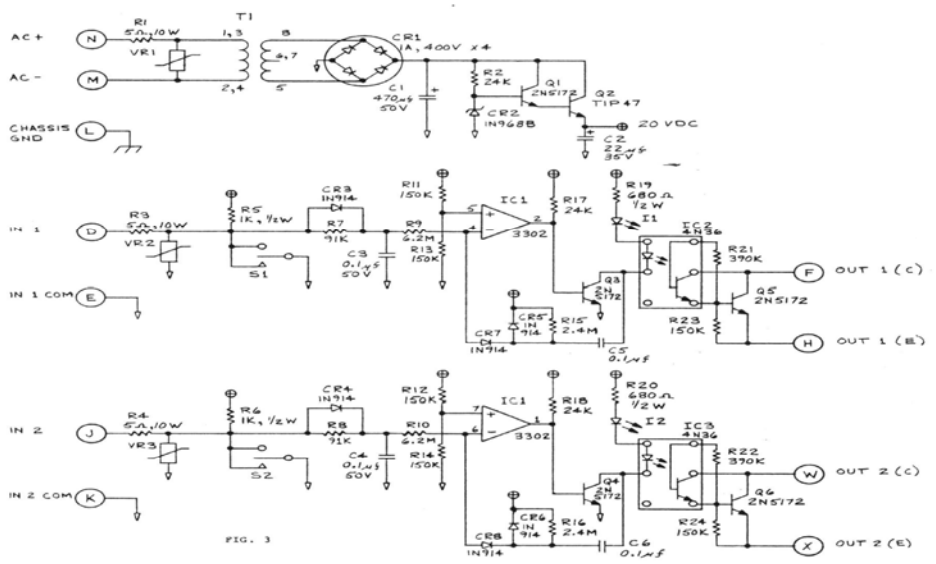

FIG. 3

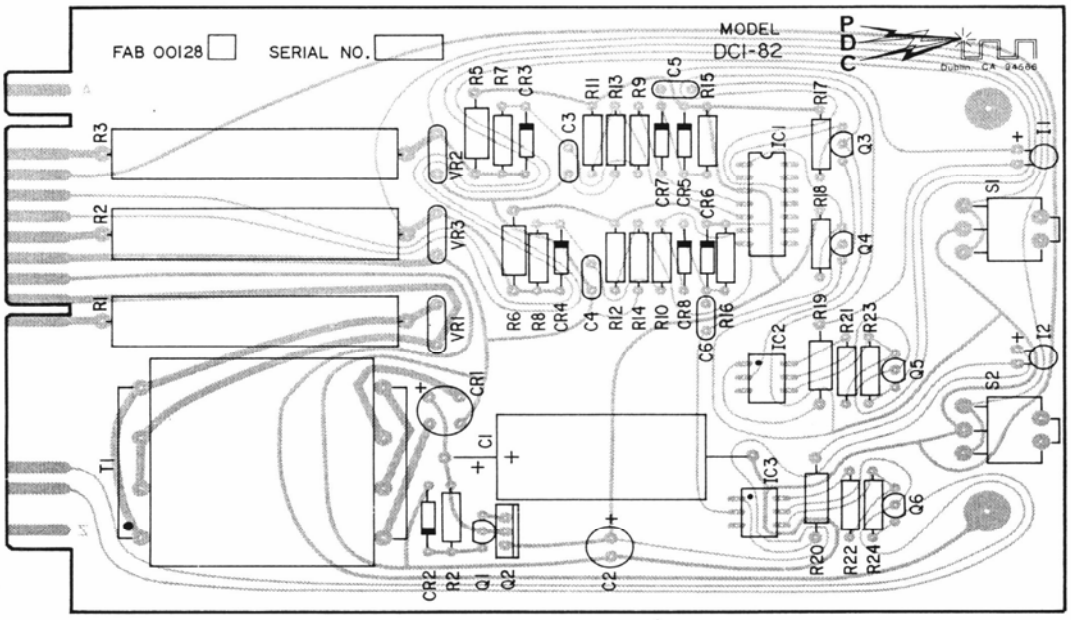

FIG. 4

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