

Pycnometer Electronics Interface Technical Manual

April 2011

Overview

The board interfaces 36 digital and 18 analog input signals from the National Instruments 6224 PCI DAQ card to six pycnometer cells. The Ports listed in the PCI 0 and PCI 1 tables below are the only ones supported.

Figure 1. Pycnometer Interface Board.



The PCI 6224 low-level digital signals are converted to voltage pulses with sufficient amplitude and duration to drive the valve solenoids in the pycnometer cells. It also provides the 24V excitation to the pressure transducers and noise filtering to the transducer output signals. A temperature signal is derived from an RTD mounted on the pycnometer cell. Pressure and temperature signals are applied as analog input signals to the PCI 6224.

Features

The electronics will output a 12V/30 ms pulse, regardless of the time duration of the triggering pulse. The solenoid from micromeritics requires a 12V/30 ms pulse for optimal operation. Longer energizing times could cause magnetization of the plunger causing intermittent failure to latch. A 3 sec reset circuit inhibits random switching when power is first applied.

The triggering signals from the PCI 6224 are electrically isolated from the interface supply by means of optocoupler devices. Output is triggered by the leading edge of the input trigger. A series of LEDs indicate the presence of input trigger signals and output pulses. LEDs also indicate the presence of both 12V and 24V Power supplies and of the 12V supply to each cell. Removing the appropriate fuse can isolate the power supplies. Board power supplies are reverse polarity protected. Due to the low duty-cycle of solenoid “on” time, combined with 6000 uF of capacitance storage on board, a low output 12V power supply is sufficient.

Hardware and Interconnection

2 X SHC68-68-EPM cables, 0 and 1, provide the connectivity between the NI PCI 6224 and the Pycnometer interface board.

Connectivity from the interface board to the pycnometer cells is via two cables terminated into DB9 connectors, one for solenoid switching pulses and the second for the pressure and temperature analog signals. Their gender prevents them from being interchanged. Pycnometer cells are interchangeable.

The 36 digital outputs and 18 analog inputs are hardwired from PCI connectors J1 (PCI 0) and J2 (PCI 1) to the wire wrapping pins of J3. J4 wire wrapping pins are hardwired to the pycnometer cell functions. PCI 6224 ports are connected to pycnometer functions by wire wrapping between J3 and J4.

Interconnection Tables

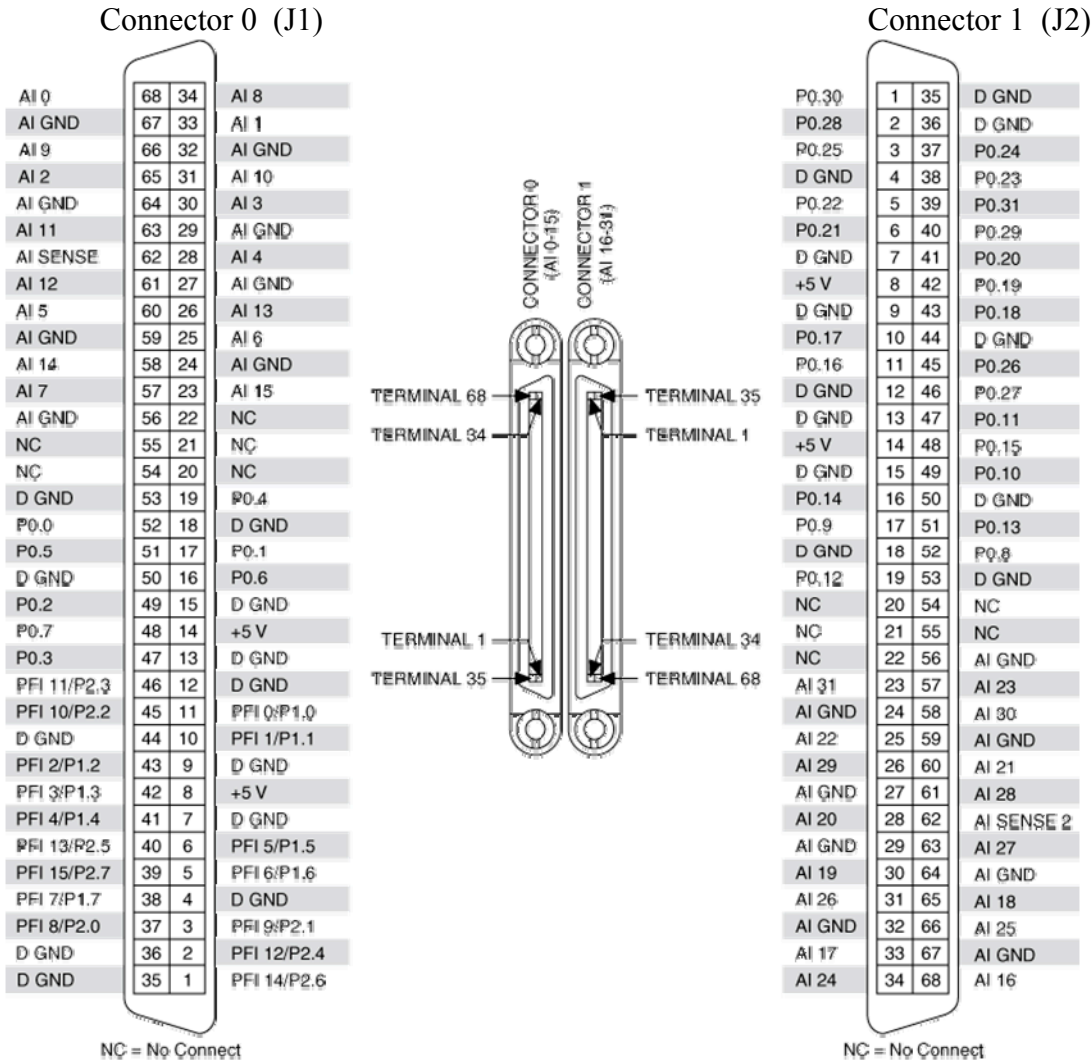
Table 1. PCI 0.

Port	J1 (PCI 0) PIN	J3 PIN	J4 PIN	FUNCTION/CELL	DB9 to Pyc.		CELL COLOR
					pin	COLOR	
P0.0	J1 52	18	43	INLET OPEN 1	J5/9	GREY	ORG
P0.1	J1 17	15	44	INLET CLOSE 1	J5/5	YEL	BRN
P0.2	J1 49	14	45	EXPAND OPEN 1	J5/4	ORG	ORG
P0.3	J1 47	12	46	EXPAND CLOSE 1	J5/3	RED	BRN
P0.4	J1 19	17	47	VENT OPEN 1	J5/2	BRN	ORG
P0.5	J1 51	16	48	VENT CLOSE 1	J5/1	BLK	BRN
AI 0	J1 68	27	60	PRESS SIGNAL pos 1	J6/8	VIOLET	GRN
AI 8	J1 34	26	59	PRESS SIGNAL neg 1	J6/9	GREY	WHT
AI 7	J1 57	19	58	TEMP 1	J6/1	BLK	WHT
P2.0	J1 37	3	13	INLET OPEN 2	J7/9	GREY	ORG
P2.1	J1 3	2	14	INLET CLOSE 2	J7/5	YEL	BRN
P2.2	J1 45	11	15	EXPAND OPEN 2	J7/4	ORG	ORG
P2.3	J1 46	13	16	EXPAND CLOSE 2	J7/3	RED	BRN
P2.4	J1 2	1	17	VENT OPEN 2	J7/2	BRN	ORG
P2.5	J1 40	5	18	VENT CLOSE 2	J7/1	BLK	BRN
AI 2	J1 65	25	2	PRESS SIGNAL pos 2	J8/8	VIOLET	GRN
AI 10	J1 31	24	1	PRESS SIGNAL neg 2	J8/9	GREY	WHT
AI 5	J1 60	20	3	TEMP 2	J8/1	BLK	WHT
P1.0	J1 11	10	25	INLET OPEN 6	J15/9	GREY	ORG
P1.1	J1 10	9	26	INLET CLOSE 6	J15/5	YEL	BRN
P1.2	J1 43	7	27	EXPAND OPEN 6	J15/4	ORG	ORG
P1.3	J1 42	8	28	EXPAND CLOSE 6	J15/3	RED	BRN
P1.4	J1 41	6	29	VENT OPEN 6	J15/2	BRN	ORG
P1.5	J1 6	4	30	VENT CLOSE 6	J15/1	BLK	BRN
AI 4	J1 28	23	10	PRESS SIGNAL pos 6	J16/8	VIOLET	GRN
AI 12	J1 61	22	9	PRESS SIGNAL neg 6	J16/9	GREY	WHT
AI 6	J1 25	21	11	TEMP 6	J16/1	BLK	WHT

Table 2. PCI 1.

Port	J2 (PCI 1) PIN	J3 PIN	J4 PIN	FUNCTION/CELL	DB9 to Pyc.		CELL COLOR
					pin	COLOR	
PO 12	J2 19	51	37	INLET OPEN 3	J9/9	GREY	ORG
PO 13	J2 51	49	38	INLET CLOSE 3	J9/5	YEL	BRN
PO 14	J2 16	50	39	EXPAND OPEN 3	J9/4	ORG	ORG
PO 15	J2 48	48	40	EXPAND CLOSE 3	J9/3	RED	BRN
PO 16	J2 11	44	41	VENT OPEN 3	J9/2	BRN	ORG
PO 17	J2 10	45	42	VENT CLOSE 3	J9/1	BLK	BRN
AI 16	J2 68	60	56	PRESS SIGNAL pos 3	J10/8	VIOLET	GRN
AI 24	J2 34	59	55	PRESS SIGNAL neg 3	J10/9	GREY	WHT
AI 21	J2 60	53	54	TEMP 3	J10/1	BLK	WHT
PO 18	J2 43	42	19	INLET OPEN 4	J11/9	GREY	ORG
PO 19	J2 42	40	20	INLET CLOSE 4	J11/5	YEL	BRN
PO 20	J2 41	43	21	EXPAND OPEN 4	J11/4	ORG	ORG
PO 21	J2 6	39	22	EXPAND CLOSE 4	J11/3	RED	BRN
PO 22	J2 5	38	23	VENT OPEN 4	J11/2	BRN	ORG
PO 23	J2 38	37	24	VENT CLOSE 4	J11/1	BLK	BRN
AI 18	J2 65	57	6	PRESS SIGNAL pos 4	J12/8	VIOLET	GRN
AI 26	J2 31	58	5	PRESS SIGNAL neg 4	J12/9	GREY	WHT
AI 22	J2 25	54	7	TEMP 4	J12/1	BLK	WHT
PO 24	J2 37	35	31	INLET OPEN 5	J13/9	GREY	ORG
PO 25	J2 3	36	32	INLET CLOSE 5	J13/5	YEL	BRN
PO 26	J2 45	46	33	EXPAND OPEN 5	J13/4	ORG	ORG
PO 27	J2 46	47	34	EXPAND CLOSE 5	J13/3	RED	BRN
PO 28	J2 2	34	35	VENT OPEN 5	J13/2	BRN	ORG
PO 29	J2 40	41	36	VENT CLOSE 5	J13/1	BLK	BRN
AI 20	J2 28	56	52	PRESS SIGNAL pos 5	J14/8	VIOLET	GRN
AI 28	J2 61	55	51	PRESS SIGNAL neg 5	J14/9	GREY	WHT
AI 23	J2 57	52	50	TEMP 5	J14/1	BLK	WHT

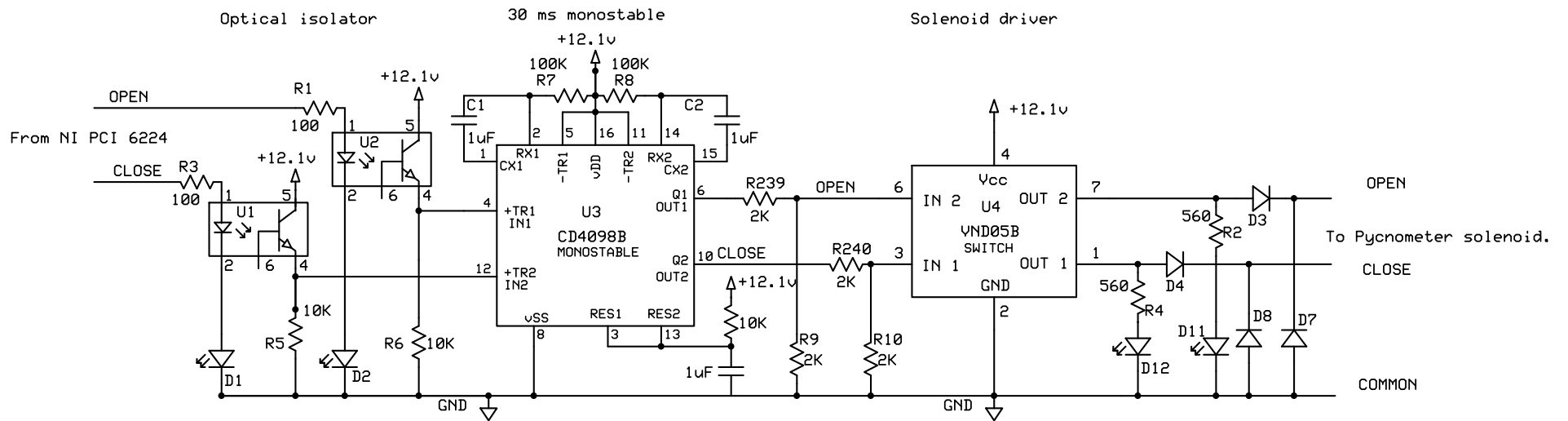
Figure 2. PCI CONNECTORS TO INTERFACE BOARD



Circuit Description

Refer to the 'Single solenoid schematic' on the following page.

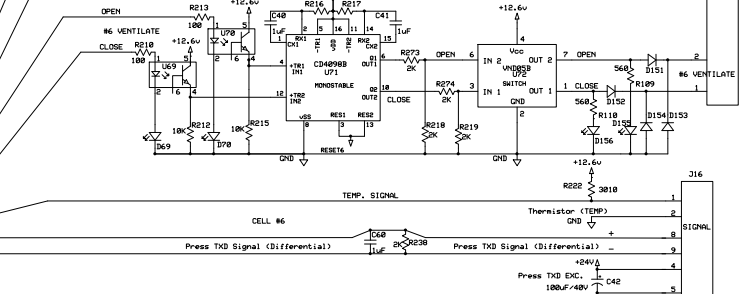
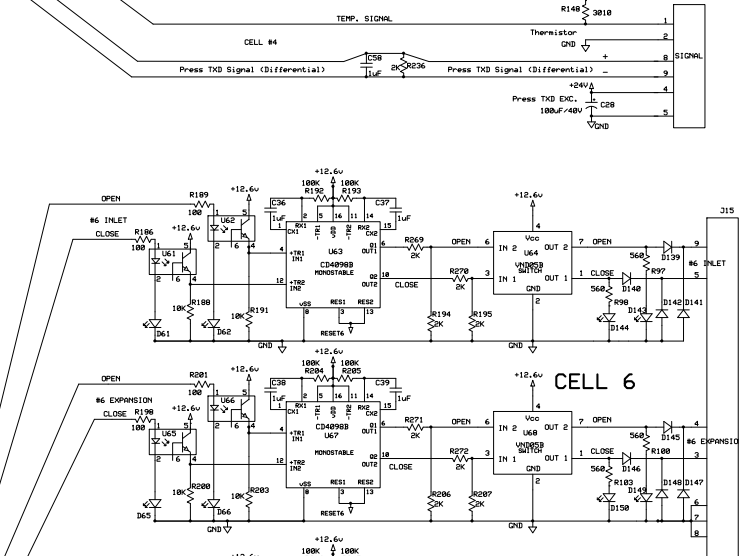
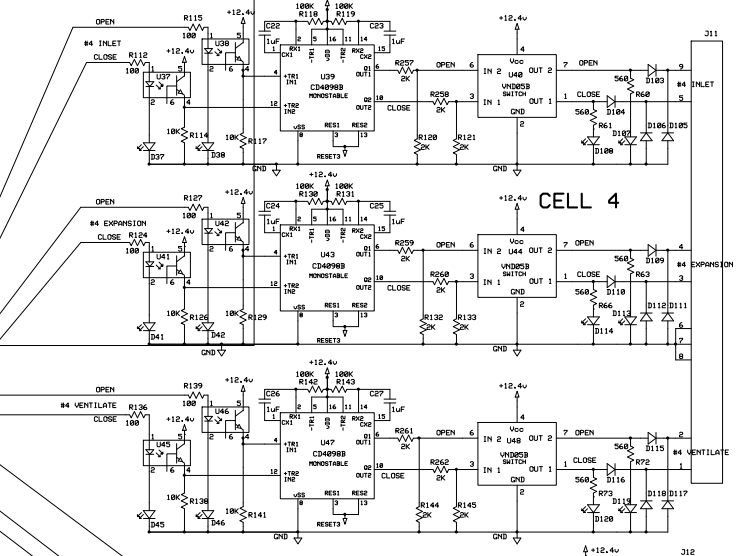
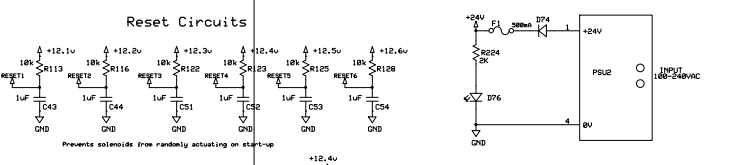
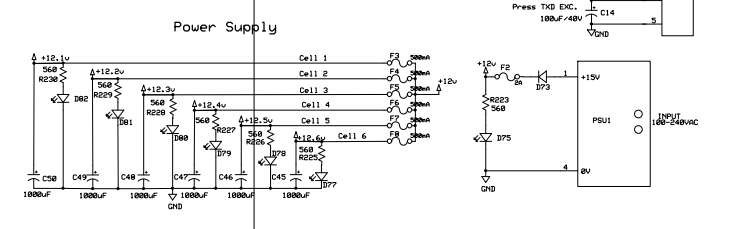
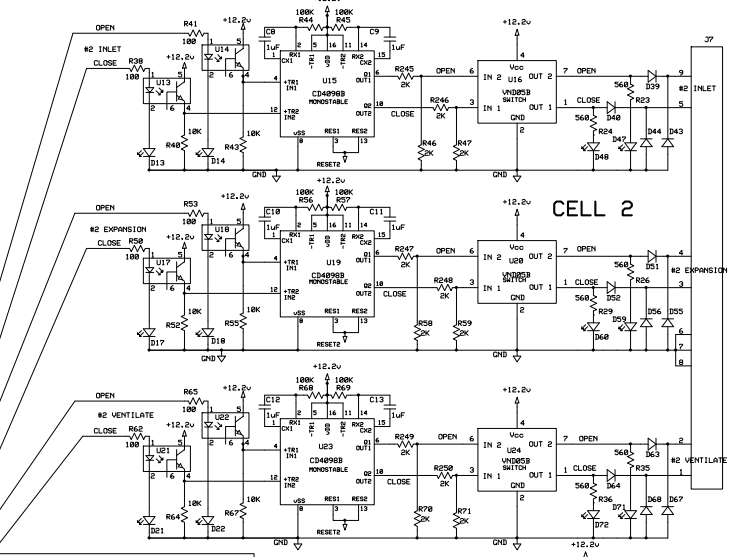
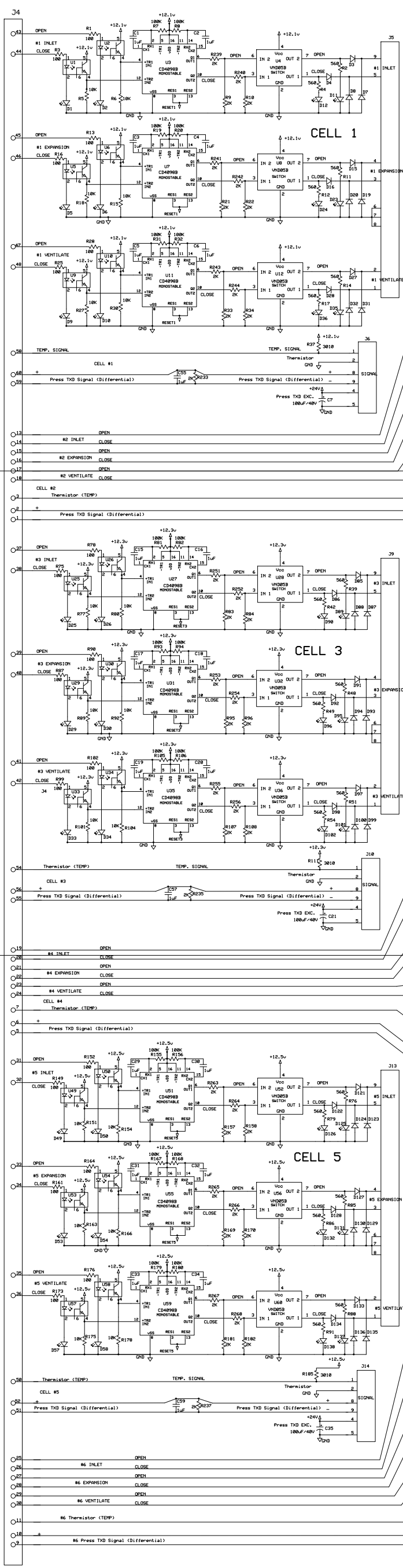
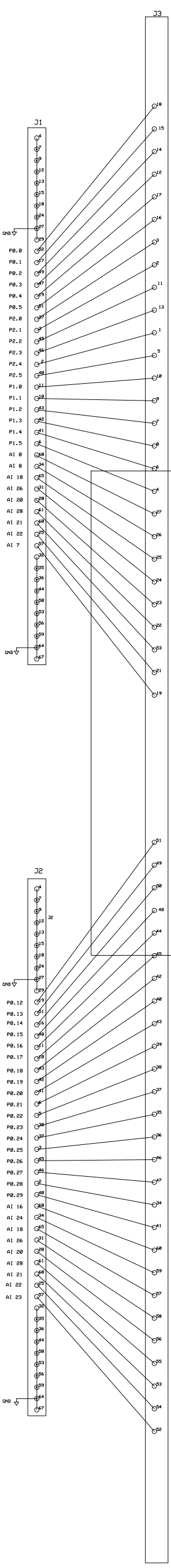
The 5V TTL switching signal from PCI 6224 will forward-bias U2 optocoupler LED. U2 pin 4 will trigger U3 Monostable Pin 4 and U3 output pin 6 will go and stay high for a period determined by R7 and C1. U3 pin 6 will force U4 Switch, pin 6 high. U4 pin2 will follow and source current to the solenoid for 30 ms. U3 reset pins (3, 13) are kept low for a period determined by R and C when power is first applied to the interface board. This action will inhibit random switching of solenoids on startup. D7 will dissipate the solenoid back-EMF energy.



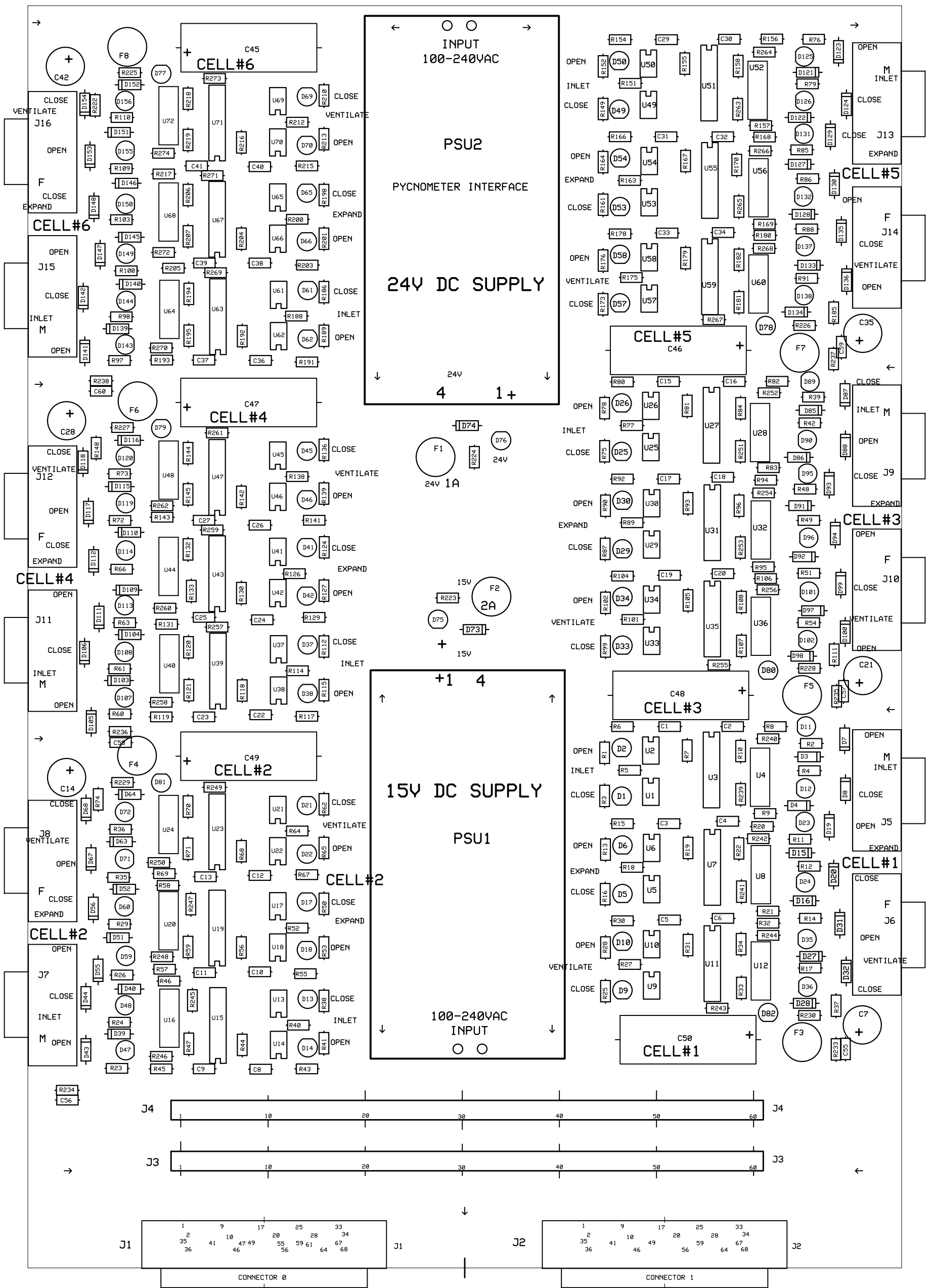
IODP
Pycnometer Interface

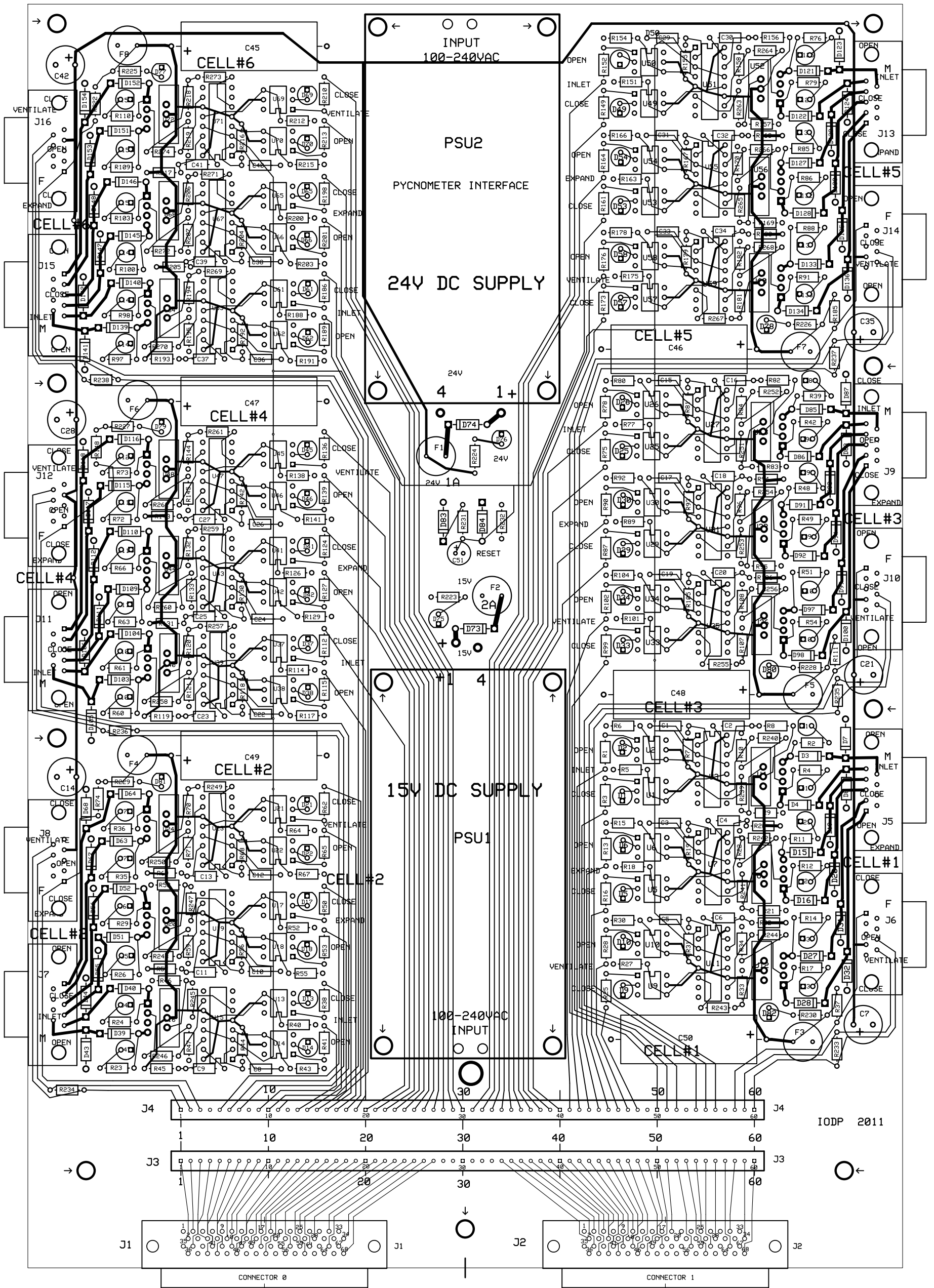
Rev 2.0
 Mike Meiring
 12/12/2010
 Page 1 of 1

Rev B 12/12/2010
 Rev C 02/15/2011 Provided individual RESET coils for each cell
 Rev D 04/20/2011 Add 1uf filter cap in press txd signal line.



SEE WIRE WRAP SCHEDULE







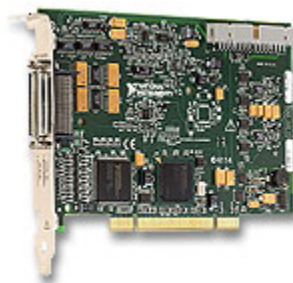
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NI PCI-6224

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48 digital I/O; 32-bit counters; digital triggering
NI-MCal calibration technology for increased measurement accuracy
NIST-traceable calibration certificate and more than 70 signal conditioning options
Correlated DIO (32 clocked lines, 1 MHz)
Select high-speed M Series for 5X faster sampling rates or high-accuracy M Series for 4X resolution.
NI-DAQmx driver software and NI LabVIEW SignalExpress interactive data-logging software



Overview

The National Instruments PCI-6224 is a low-cost multifunction M Series data acquisition (DAQ) board optimized for cost-sensitive applications. Also consider the high-speed M Series devices for 5X faster sampling rates or the high-accuracy M Series devices for 4X resolution and superior measurement accuracy.

Low-cost M Series devices incorporate advanced features such as the NI-STC 2 system controller, NI-PGIA 2 programmable amplifier, and NI-MCal calibration technology to increase performance and accuracy. To learn more about M Series technologies, device specifications, and information on recommended cables and accessories, please refer to the data sheet and specifications.

Driver Software

M Series devices work with multiple operating systems using three driver software options including NI-DAQmx, NI-DAQmx Base, and the Measurement Hardware DDK. Browse the information in the Resources tab to learn more about driver software or download a driver. M Series devices are not compatible with the Traditional NI-DAQ (Legacy) driver.

Application Software

Every M Series data acquisition device includes a copy of NI LabVIEW SignalExpress so you can quickly acquire, analyze, and present data without programming. In addition to LabVIEW SignalExpress, M Series data acquisition devices are compatible with the following versions (or later) of NI application software – LabVIEW 7.x, LabWindows™/CVI 7.x, or Measurement Studio 7.x; or LabVIEW with the LabVIEW Real-Time Module 7.1. M Series data acquisition devices are also compatible with Visual Studio .NET, C/C++, and Visual Basic 6.

Specifications

Specifications Documents

Specifications
Data Sheet

Specifications Summary

General

Product Name	PCI-6224
Product Family	Multifunction Data Acquisition
Form Factor	PCI
Operating System/Target	Windows , Real-Time , Linux , Mac OS
LabVIEW RT Support	Yes
DAQ Product Family	M Series
Measurement Type	Digital , Frequency , Quadrature encoder , Voltage
RoHS Compliant	Yes
Analog Input	
Channels	32 , 16
Single-Ended Channels	32
Differential Channels	16
Resolution	16 bits
Sample Rate	250 kS/s
Max Voltage	10 V
Maximum Voltage Range	-10 V , 10 V
Maximum Voltage Range Accuracy	3100 μ V
Maximum Voltage Range Sensitivity	97.6 μ V
Minimum Voltage Range	-200 mV , 200 mV
Minimum Voltage Range Accuracy	112 μ V
Minimum Voltage Range Sensitivity	5.2 μ V
Number of Ranges	4
Simultaneous Sampling	No
On-Board Memory	4095 samples
Analog Output	
Channels	0
Current Drive Single	5 mA
Digital I/O	
Bidirectional Channels	48
Input-Only Channels	0
Output-Only Channels	0
Number of Channels	48 , 0 , 0
Timing	Hardware , Software

	1 MHz
Logic Levels	TTL
Input Current Flow	Sinking , Sourcing
Output Current Flow	Sinking , Sourcing
Programmable Input Filters	Yes
Supports Programmable Power-Up States?	Yes
Current Drive Single	24 mA
Current Drive All	1 A
Watchdog Timer	No
Supports Handshaking I/O?	No
Supports Pattern I/O?	Yes
Maximum Input Range	0 V , 5 V
Maximum Output Range	0 V , 5 V
Counter/Timers	
Counters	2
Number of DMA Channels	2
Buffered Operations	Yes
Debouncing/Glitch Removal	Yes
GPS Synchronization	No
Maximum Range	0 V , 5 V
Max Source Frequency	80 MHz
Minimum Input Pulse Width	12.5 ns
Pulse Generation	Yes
Resolution	32 bits
Timebase Stability	50 ppm
Logic Levels	TTL
Physical Specifications	
Length	15.5 cm
Width	9.7 cm
I/O Connector	68-pin VHDCI female
Timing/Triggering/Synchronization	
Triggering	Digital
Synchronization Bus (RTSI)	Yes

Pricing

NI PCI-6224 Complete Package

Each NI PCI-6224 requires:



2 Connector Block



2 Cable



NI PCI-6224

NI PCI-6224 and Accessories

Hardware Subtotal: \$ 1,535

NI PCI-6224 - 779067-01

Qty \$ 679 each

Connector Block - Screw Terminal

SCB-68 - 776844-01

Qty \$ 299 each

Cable - Shielded

SHC68-68-EPM Cable (2m) - 192061-02

Qty \$ 129 each

Change Accessories

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Additional Product Information


Manuals (6)

Dimensional Drawings

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CMOS Dual Monostable Multivibrator

High-Voltage Types (20-Volt Rating)

■ CD4098B dual monostable multivibrator provides stable retriggerable/resettable one-shot operation for any fixed-voltage timing application.

An external resistor (R_X) and an external capacitor (C_X) control the timing for the circuit. Adjustment of R_X and C_X provides a wide range of output pulse widths from the Q and \bar{Q} terminals. The time delay from trigger input to output transition (trigger propagation delay) and the time delay from reset input to output transition (reset propagation delay) are independent of R_X and C_X .

Leading-edge-triggering (+TR) and trailing-edge-triggering (-TR) inputs are provided for triggering from either edge of an input pulse. An unused +TR input should be tied to V_{SS} . An unused -TR input should be tied to V_{DD} . A RESET (on low level) is provided for immediate termination of the output pulse or to prevent output pulses when power is turned on. An unused RESET input should be tied to V_{DD} . However, if an entire section of the CD4098B is not used, its RESET should be tied to V_{SS} . See Table I.

In normal operation the circuit triggers (extends the output pulse one period) on the application of each new trigger pulse. For operation in the non-retriggerable mode, \bar{Q} is connected to -TR when leading-edge triggering (+TR) is used or Q is connected to +TR when trailing-edge triggering (-TR) is used.

The time period (T) for this multivibrator can be approximated by: $T_X = \frac{1}{2} R_X C_X$ for $C_X \geq 0.01 \mu\text{F}$. Time periods as a function of R_X for values of C_X and V_{DD} are given in Fig. 8. Values of T vary from unit to unit and as a function of voltage, temperature, and $R_X C_X$.

The minimum value of external resistance, R_X , is 5 k Ω . The maximum value of external capacitance, C_X , is 100 μF . Fig. 9 shows time periods as a function of C_X for values of R_X and V_{DD} .

The output pulse width has variations of $\pm 2.5\%$ typically, over the temperature range of -55°C to 125°C for $C_X = 1000 \text{ pF}$ and $R_X = 100 \text{ k}\Omega$.

For power supply variations of $\pm 5\%$, the output pulse width has variations of $\pm 0.5\%$ typically, for $V_{DD} = 10 \text{ V}$ and 15 V and $\pm 1\%$ typically, for $V_{DD} = 5 \text{ V}$ at $C_X = 1000 \text{ pF}$ and $R_X = 5 \text{ k}\Omega$.

These types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, and MT suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

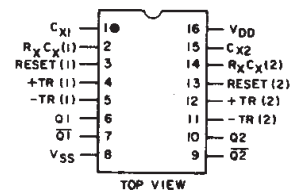
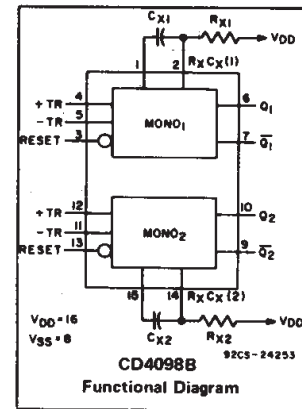
The CD4098B is similar to type MC14528.

Features:

- Retriggerable/resettable capability
- Trigger and reset propagation delays independent of R_X , C_X
- Triggering from leading or trailing edge
- Q and \bar{Q} buffered outputs available
- Separate resets
- Wide range of output-pulse widths
- 100% tested for maximum quiescent current at 20 V
- Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (full package-temperature range):
 - 1 V at $V_{DD} = 5 \text{ V}$
 - 2 V at $V_{DD} = 10 \text{ V}$
 - 2.5 V at $V_{DD} = 15 \text{ V}$
- 5-V, 10-V, and 15-V parametric ratings
- Standardized, symmetrical output characteristics
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices."

Applications:

- Pulse delay and timing
- Pulse shaping
- Astable multivibrator



TERMINALS 1, 8, 15 ARE
ELECTRICALLY CONNECTED
INTERNALLY

92CS-24848R1

TERMINAL ASSIGNMENT

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

Voltages referenced to V_{SS} Terminal) -0.5 V to $+20 \text{ V}$

INPUT VOLTAGE RANGE, ALL INPUTS -0.5 V to $V_{DD} + 0.5 \text{ V}$

DC INPUT CURRENT, ANY ONE INPUT $\pm 10 \text{ mA}$

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ 500mW

For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ Derate Linearly at $12 \text{ mW}/^\circ\text{C}$ to 200mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

For $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$ 100mW

OPERATING-TEMPERATURE RANGE (T_A) -55°C to $+125^\circ\text{C}$

STORAGE TEMPERATURE RANGE (T_{stg}) -85°C to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ inch ($1.59 \pm 0.79 \text{ mm}$) from case for 10s max $+265^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V_{DD} V	LIMITS		UNITS
		MIN.	MAX.	
Supply-Voltage Range (For $T_A =$ Full Package-Temperature Range)	—	3	18	V
Trigger Pulse Width $t_W(\text{TR})$	5	140	—	ns
	10	60	—	
	15	40	—	
Reset Pulse Width $t_W(\text{R})$ (This is a function of C_X)	—	See Dynamic Char. Chart and Fig. 10		—
Trigger Rise or Fall Time $t_r(\text{TR}), t_f(\text{TR})$	5 - 15	—	100	μs

CD4098B Types

TABLE I
CD4098B FUNCTIONAL TERMINAL CONNECTIONS

FUNCTION	V _{DD} TO TERM. NO.		V _{SS} TO TERM. NO.		INPUT PULSE TO TERM. NO.		OTHER CONNECTIONS	
	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂
Leading-Edge Trigger/Retriggerable	3, 5	11, 13			4	12		
Leading-Edge Trigger/Non-retriggerable	3	13			4	12	5-7	11-9
Trailing-Edge Trigger/Retriggerable	3	13	4	12	5	11		
Trailing-Edge Trigger/Non-retriggerable	3	13			5	11	4-6	12-10
Unused Section	5	11	3, 4	12, 13				

NOTES:

1. A RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS AN OUTPUT PULSE WIDTH WHICH IS EXTENDED ONE FULL TIME PERIOD (T_X) AFTER APPLICATION OF THE LAST TRIGGER PULSE.

The minimum time between retriggering edges (or trigger and retrigger edges) is 40 per cent of (T_X).

2. A NON-RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS A TIME PERIOD T_X REFERENCED FROM THE APPLICATION OF THE FIRST TRIGGER PULSE.

INPUT PULSE TRAIN

RETRIGGERABLE MODE PULSE WIDTH (+TR MODE)

NON-RETRIGGERABLE MODE PULSE WIDTH (+TR MODE)

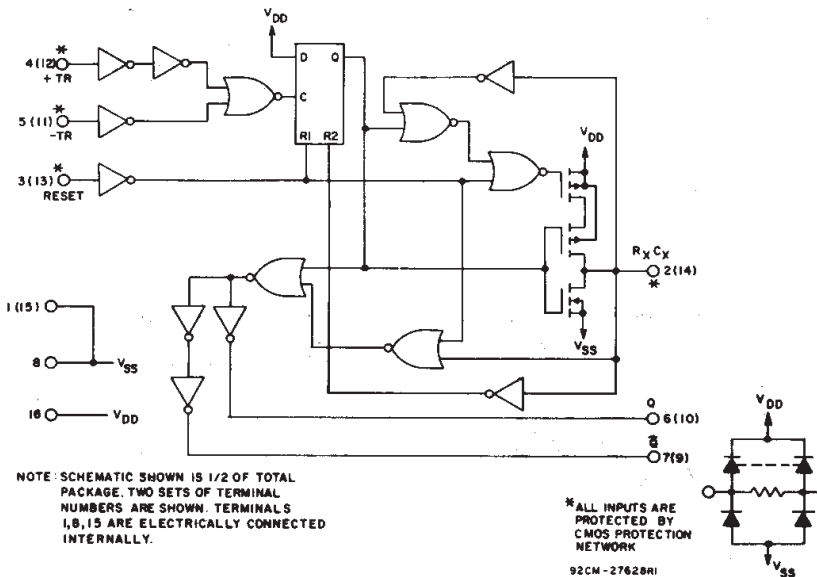
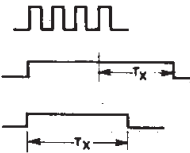


Fig. 4 - CD4098B logic diagram.

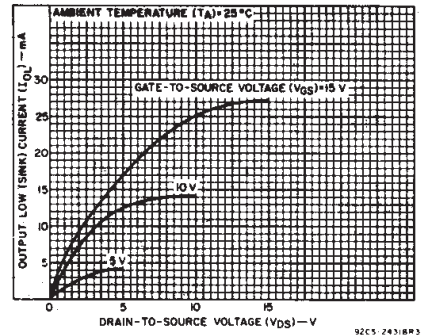


Fig. 1 - Typical output low (sink) current characteristics.

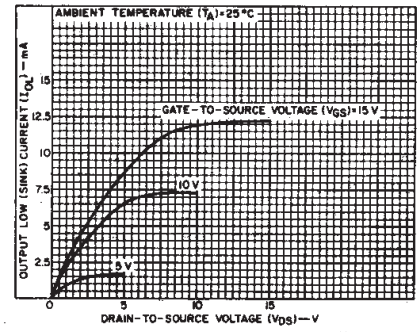


Fig. 2 - Minimum output low (sink) current characteristics.

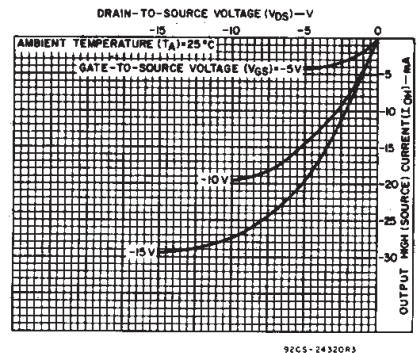


Fig. 3 - Typical output high (source) current characteristics.

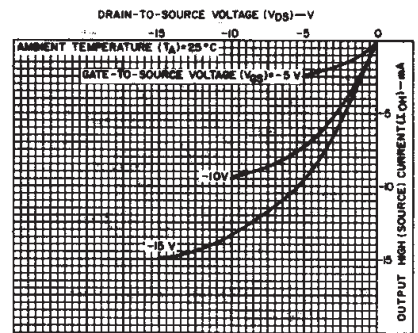


Fig. 5 - Minimum output high (source) current characteristics.

3
COMMERCIAL CMOS HIGH VOLTAGE ICs

CD4098B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55	-40	+85	+125	+25			
								Min.	Typ.	Max.	
Quiescent Device Current	—	0.5	5	1	1	30	30	—	0.02	1	μA
Current I _{DD} Max.	—	0.10	10	2	2	60	60	—	0.02	2	
	—	0.15	15	4	4	120	120	—	0.02	4	
Output Low (Sink) Current, I _{OL} Min.	0.4	0.5	5	0.64	0.61	0.42	0.36	0.51	1	—	mA
	0.5	0.10	10	1.6	1.5	1.1	0.9	1.3	2.6	—	
	1.5	0.15	15	4.2	4	2.8	2.4	3.4	6.8	—	
Output High (Source) Current, I _{OH} Min.	4.6	0.5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	mA
	2.5	0.5	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	—	
	9.5	0.10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
Output Voltage: Low-Level, V _{OL} Max.	—	0.5	5							0.05	V
	—	0.10	10							0.05	
	—	0.15	15							0.05	
Output Voltage: High-Level, V _{OH} Min.	—	0.5	5							4.95	V
	—	0.10	10							9.95	
	—	0.15	15							14.95	
Input Low Voltage, V _{IL} Max.	0.5, 4.5	—	5							1.5	V
	1.9	—	10							3	
	1.5, 13.5	—	15							4	
Input High Voltage, V _{IH} Min.	0.5, 4.5	—	5							3.5	V
	1.9	—	10							7	
	1.5, 13.5	—	15							11	
Input Current, I _{IN} Max.	—	0.18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA

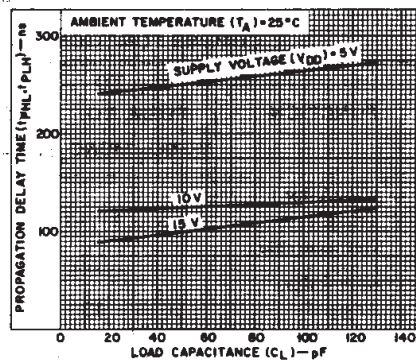


Fig. 6 - Typical propagation delay time vs. load capacitance, trigger into Q out. (All values of C_X and R_X).

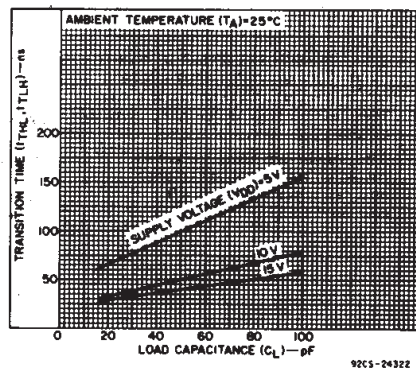


Fig. 7 - Transition time vs. load capacitance for R_X = 5 kΩ-10000 kΩ and C_X = 15 pF-10000 pF.

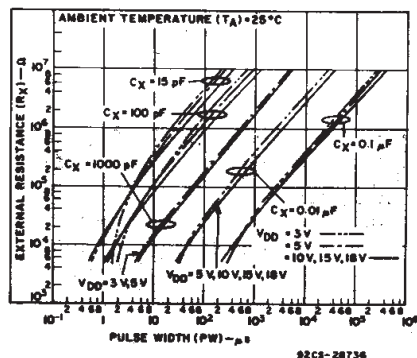


Fig. 8 - Typical external resistance vs. pulse width.

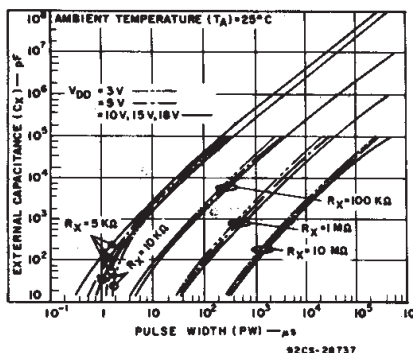


Fig. 9 - Typical external capacitance vs. pulse width.

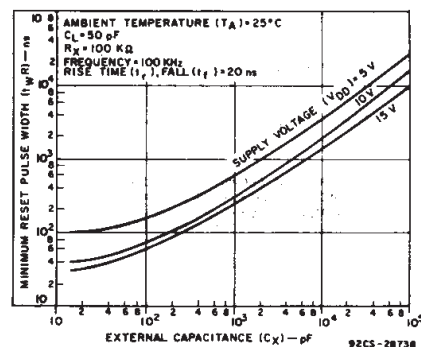


Fig. 10 - Typical minimum reset pulse width vs. external capacitance.

CD4098B Types

DYNAMIC ELECTRICAL CHARACTERISTICS

At $T_A = 25^\circ\text{C}$; Input $t_r, t_f = 20\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}\Omega$

CHARACTERISTIC	TEST CONDITIONS			LIMITS		UNITS
	R_X (k Ω)	C_X (pF)	V_{DD} (V)	Typ.	Max.	
Trigger Propagation Delay Time +TR, -TR to Q, \bar{Q} t_{PHL} , t_{PLH}	5 to 10,000	≥ 15	5 10 15	250 125 100	500 250 200	ns
Minimum Trigger Pulse Width, t_{WH} , t_{WL}	5 to 10,000	≥ 15	5 10 15	70 30 20	140 60 40	ns
Transition Time, t_{TLH}	5 to 10,000	≥ 15	5 10 15	100 50 40	200 100 80	ns
t_{THL}	5 to 10,000	15 to 10,000	5 10 15	100 50 40	200 100 80	
	5 to 10,000	0.01 μF to 0.1 μF	5 10 15	150 75 65	300 150 130	
	5 to 10,000	0.1 μF to 1 μF	5 10 15	250 150 80	500 300 160	
Reset Propagation Delay Time, T_{PHL} , T_{PLH}	5 to 10,000	≥ 15	5 10 15	225 125 75	450 250 150	ns
Minimum Reset Pulse Width, t_{WR}	100	15	5	100	200	ns
			10	40	80	
			15	30	60	
		0.1 μF	5	25	50	μs
			10	15	30	
			15	10	20	
Trigger Rise or Fall Time t_r (TR), t_f (TR)	—	—	5 to 15	—	100	μs
Pulse Width Match Between Circuits in Same Package	10	10,000	5 10 15	5 7.5 7.5	10 15 15	%
Input Capacitance, C_{iN}	Any Input			5	7.5	pF

TEST CIRCUITS

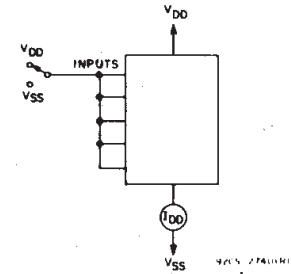


Fig. 12 - Quiescent-device-current test circuits.

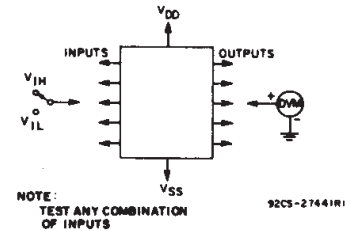


Fig. 13 - Input-voltage test circuit.

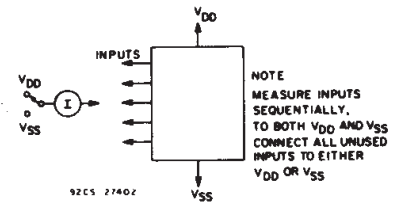


Fig. 14 - Input leakage current test circuit.

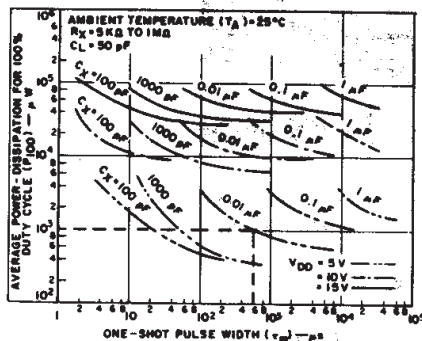
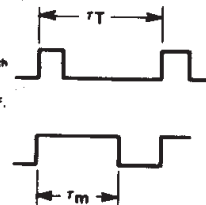


Fig. 11 - Average power dissipation vs. one-shot pulse width.

To calculate average power dissipation (P) for less than 100% duty cycle:
 P_{100} = average power for 100% duty cycle
 $P = \left(\frac{t_m}{T_T}\right) P_{100}$ where t_m = one-shot pulse width
 T_T = trigger pulse period
 e.g. For $t_m = 800\ \mu\text{s}$, $T_T = 1000\ \mu\text{s}$, $C_X = 0.01\ \mu\text{F}$,
 $V_{DD} = 5\text{ V}$
 $P = \left(\frac{800}{1000}\right) 10^3\ \mu\text{W} = 800\ \mu\text{W}$ (see dotted line on graph)



92CM-28739

3
COMMERCIAL CMOS
HIGH VOLTAGE ICs

CD4098B Types

APPLICATIONS

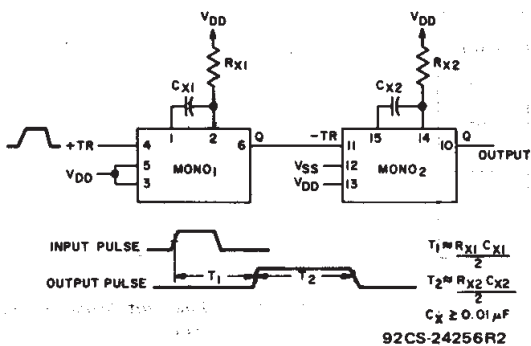


Fig. 15 - Pulse delay.

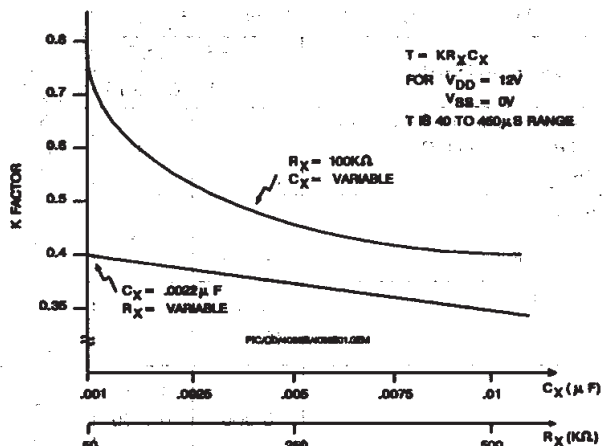


Fig. 17 - K-Factor for $V_{DD} = 12\text{V}$.

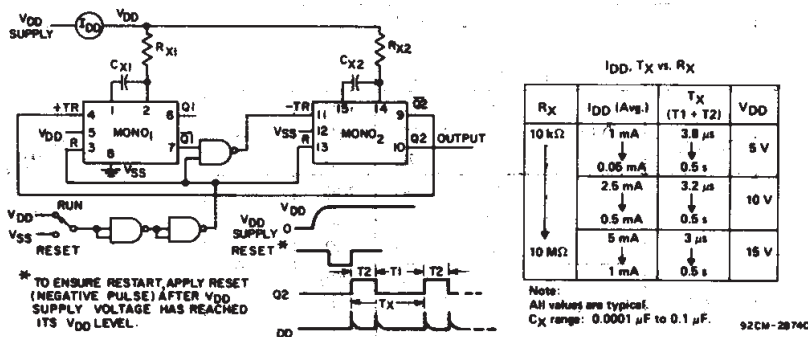
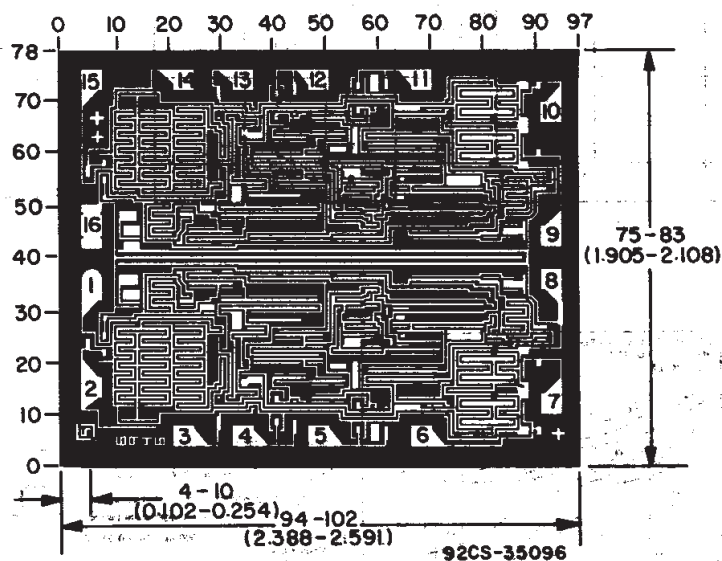


Fig. 16 - Astable multivibrator with restart after reset capability.



Dimensions and Pad Layout for CD4098BH
 Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
CD4098BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4098BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4098BF	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
CD4098BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
CD4098BFB	ACTIVE	CDIP	J	16	1	TBD	Call TI	Call TI
CD4098BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BM96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BMG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BMTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BMTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4098BPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
JM38510/17504BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSELETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements

for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

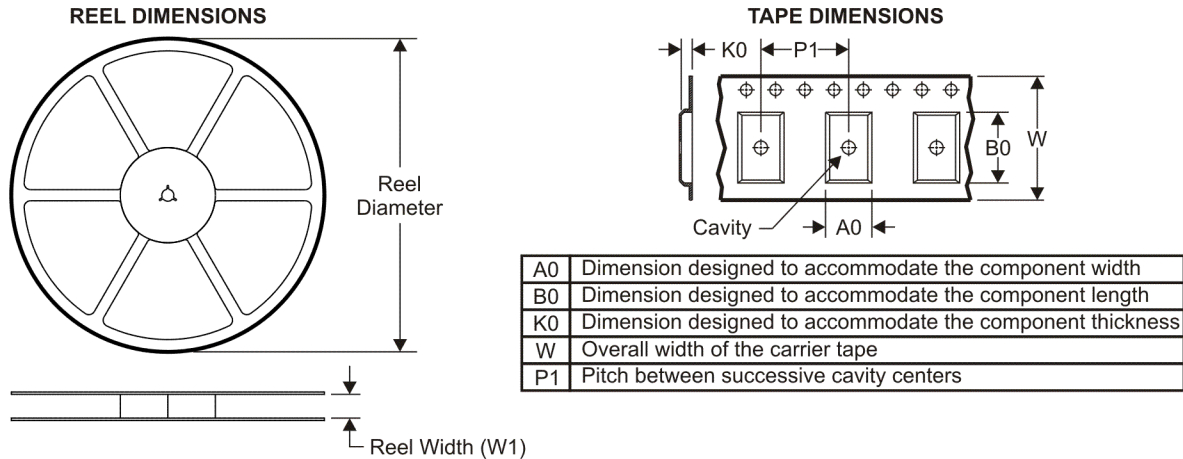
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4098BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4098BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4098BM96	SOIC	D	16	2500	333.2	345.9	28.6
CD4098BPWR	TSSOP	PW	16	2000	346.0	346.0	29.0

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

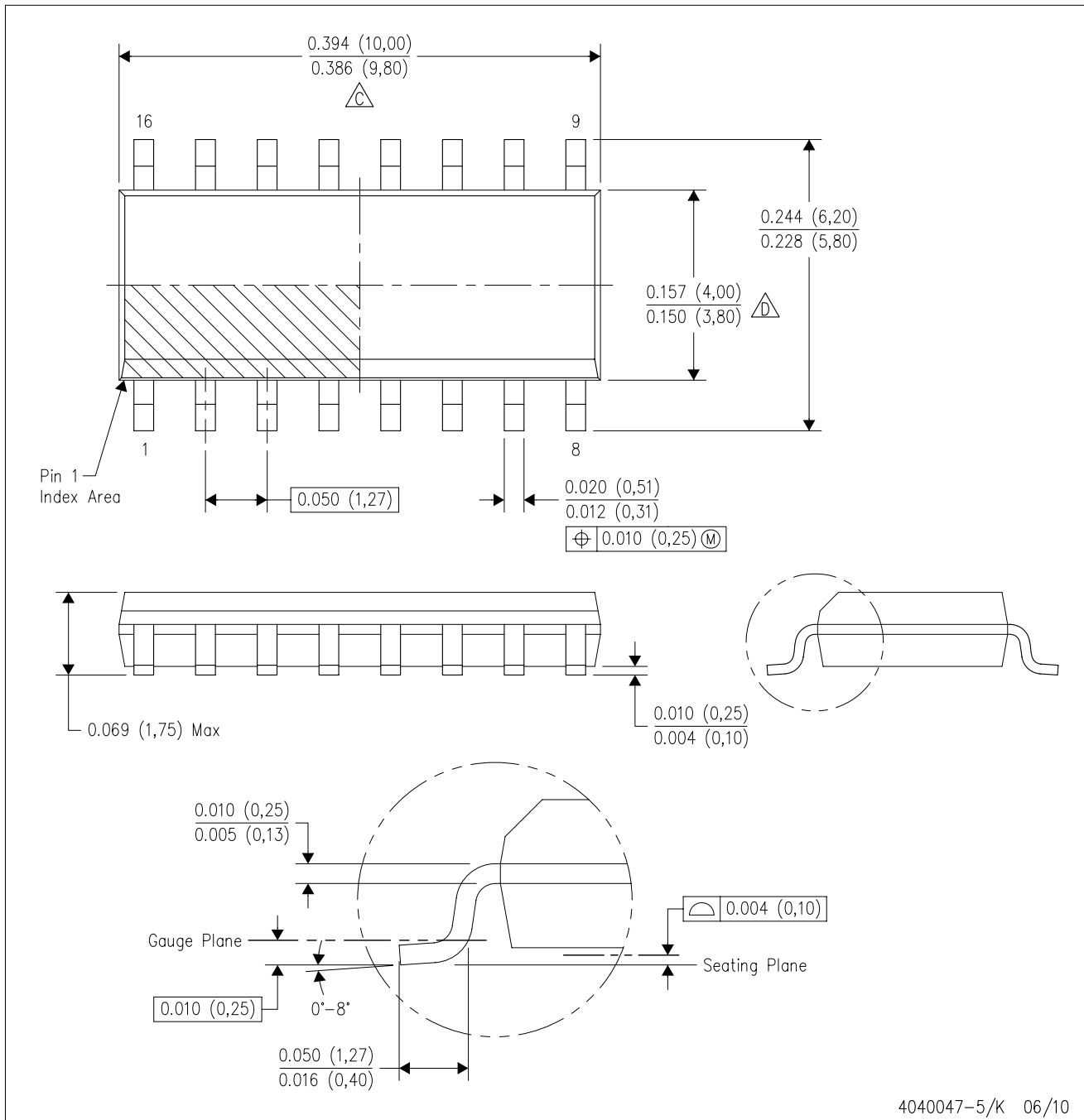
16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

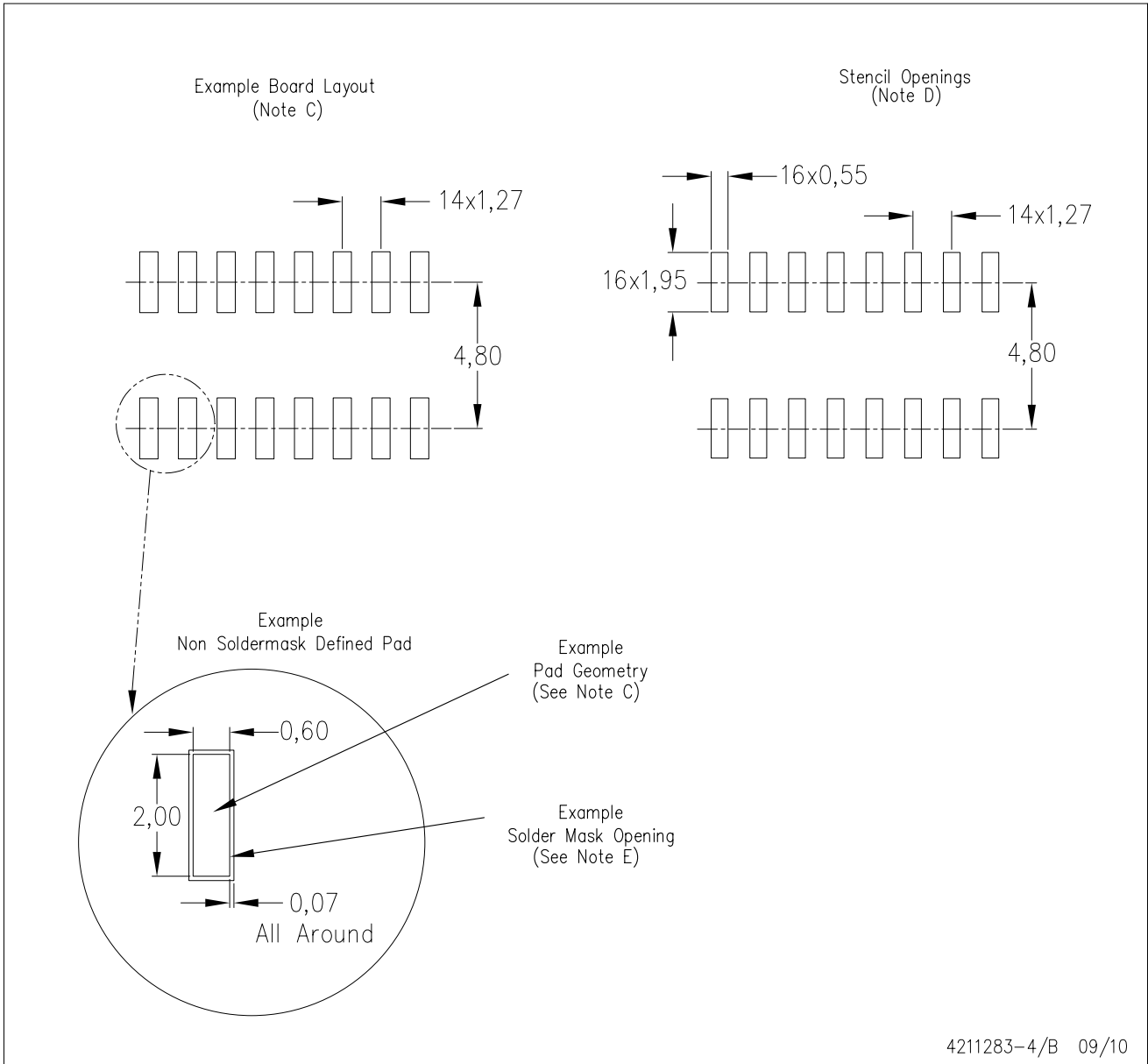
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN

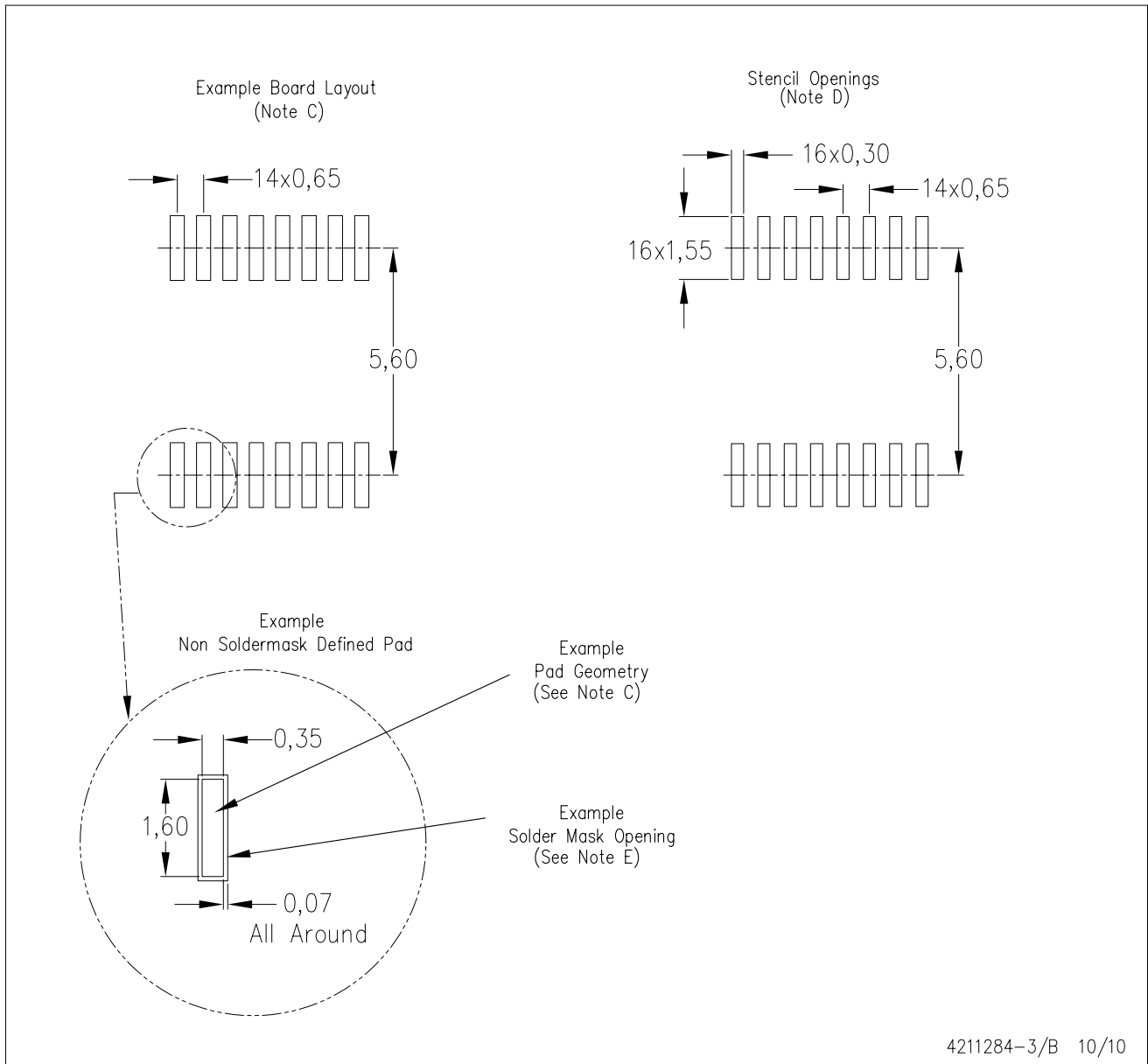


4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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VND05B VND05B (011Y) / VND05B (012Y)

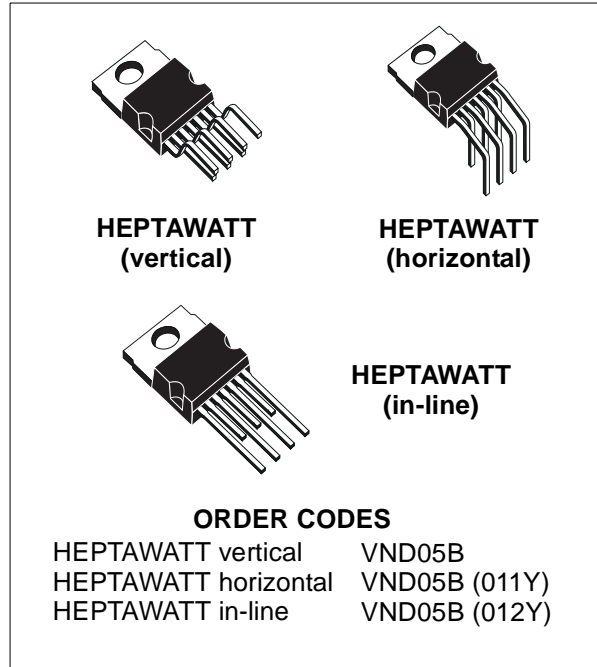
DOUBLE CHANNEL HIGH SIDE SMART POWER SOLID STATE RELAY

TYPE	V _{DSS}	R _{DS(on)}	I _n (*)	V _{CC}
VND05B	40V	200mΩ	1.6A	26 V
VND05B (011Y)				
VND05B (012Y)				

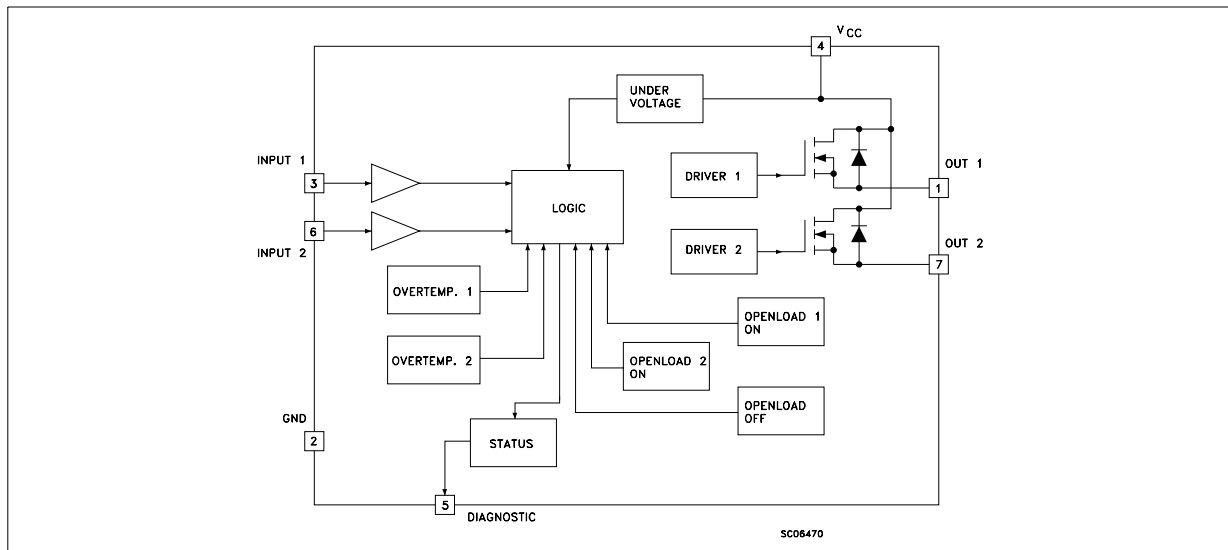
- OUTPUT CURRENT (CONTINUOUS): 9A AT T_c=85°C PER CHANNEL
- 5V LOGIC LEVEL COMPATIBLE INPUT
- THERMAL SHUT-DOWN
- UNDERVOLTAGE PROTECTION
- OPEN DRAIN DIAGNOSTIC OUTPUT
- INDUCTIVE LOAD FAST DEMAGNETIZATION
- VERY LOW STAND-BY POWER DISSIPATION

DESCRIPTION

The VND05B, VND05B (011Y), VND05B (012Y) is a monolithic device designed in STMicroelectronics VIPower technology, intended for driving resistive or inductive loads with one side connected to ground. This device has two channels, and a common diagnostic. Built-in thermal shutdown protects the chip from overtemperature and short circuit. The status output provides an indication of open load in on state, open load in off state, overtemperature conditions and stuck-on to V_{CC}.



BLOCK DIAGRAM

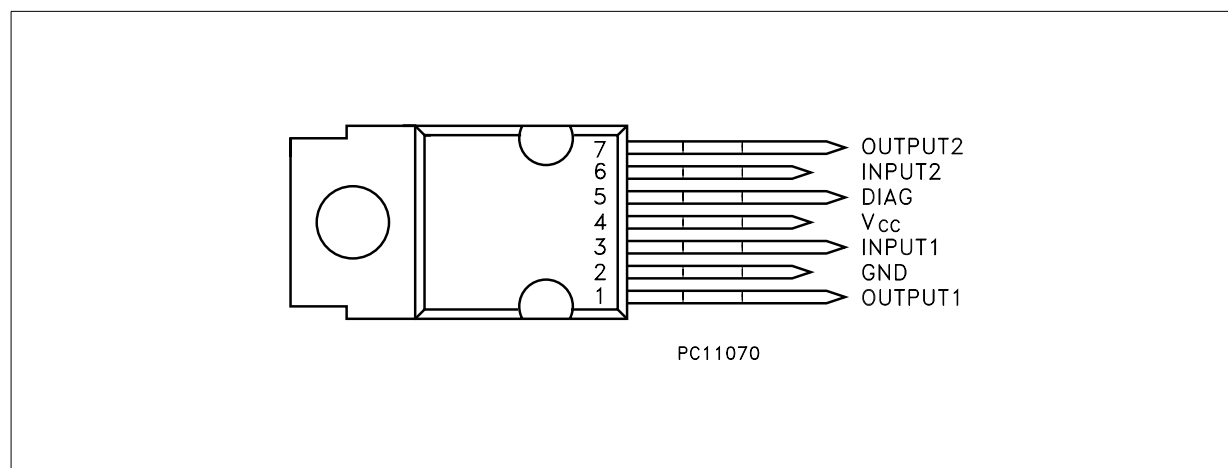


(*) I_n= Nominal current according to ISO definition for high side automotive switch (see note 1)

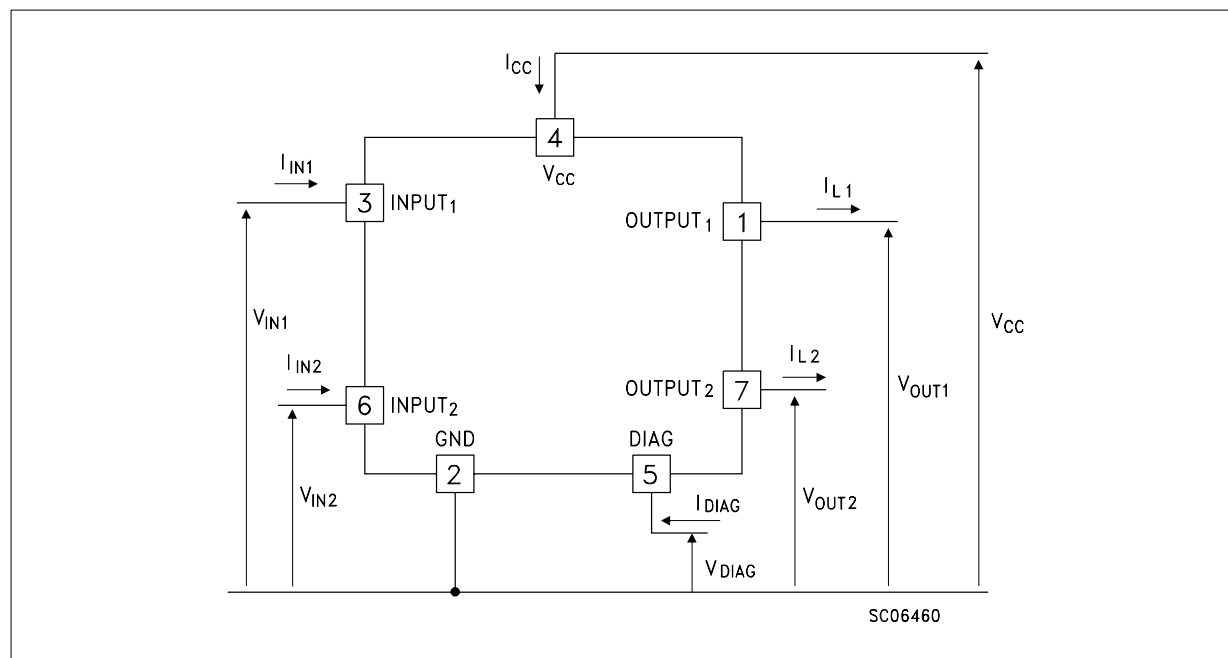
ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-Source breakdown voltage	40	V
I_{OUT}	Output current (continuous) at $T_c=85^\circ\text{C}$	9	A
$I_{OUT(RMS)}$	RMS Output current at $T_c=85^\circ\text{C}$ and $f > 1\text{Hz}$	9	A
I_R	Reverse output current at $T_c=85^\circ\text{C}$	-9	A
I_{IN}	Input current	+/- 10	mA
$-V_{CC}$	Reverse supply voltage	-4	V
I_{STAT}	Status current	+/- 10	mA
V_{ESD}	Electrostatic discharge ($R=1.5\text{k}\Omega$, $C=100\text{pF}$)	2000	V
P_{TOT}	Power dissipation at $T_c=25^\circ\text{C}$	59	W
T_j	Junction operating temperature	-40 to 150	$^\circ\text{C}$
T_{STG}	Storage temperature	-55 to 150	$^\circ\text{C}$

CONNECTION DIAGRAM TOP VIEW



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

Symbol	Parameter	Value	Unit
R _{thj-case}	Thermal resistance junction-case (MAX)	2.1	°C/W
R _{thj-amb}	Thermal resistance junction-ambient (MAX)	60	°C/W

ELECTRICAL CHARACTERISTICS (8V < V_{CC} < 16V; -40°C ≤ T_j ≤ 125°C; unless otherwise specified)**POWER**

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V _{CC}	Supply voltage		6	13	26	V
I _n (*)	Nominal current	T _c =85°C; V _{DS(on)} ≤ 0.5V; V _{CC} =13V	1.6		2.6	A
R _{ON}	On state resistance	I _{OUT} =I _n ; V _{CC} =13V; T _j =25°C	0.13		0.2	Ω
I _S	Supply current	Off state; T _j =25°C; V _{CC} =13V		35	100	μA
V _{DS(MAX)}	Maximum voltage Drop	I _{OUT} =7.5A; T _j =85°C; V _{CC} =13V	1.44		2.3	V
R _i	Output to GND internal impedance	T _j =25°C	5	10	20	KΩ

SWITCHING

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
t _{d(on)} (^)	Turn-on delay time of output current	R _{OUT} =5.4Ω	5	25	200	μs
t _r (^)	Rise time of output current	R _{OUT} =5.4Ω	10	50	180	μs
t _{d(off)} (^)	Turn-off delay time of output current	R _{OUT} =5.4Ω	10	75	250	μs
t _f (^)	Fall time of output current	R _{OUT} =5.4Ω	10	35	180	μs
(di/dt) _{on}	Turn-on current slope	R _{OUT} =5.4Ω	0.003		0.1	A/μs
(di/dt) _{off}	Turn-off current slope	R _{OUT} =5.4Ω	0.005		0.1	A/μs

LOGIC INPUT

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V _{IL}	Input low level voltage				1.5	V
V _{IH}	Input high level voltage		3.5		(•)	V
V _{I(hyst)}	Input hysteresis voltage		0.2	0.9	1.5	V
I _{IN}	Input current	V _{IN} =5V; T _j =25°C		30	100	μA
V _{ICL}	Input clamp voltage	I _{IN} =10mA I _{IN} =-10mA	5	6 -0.7	7	V

ELECTRICAL CHARACTERISTICS (continued)
PROTECTIONS AND DIAGNOSTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{STAT}	Low output voltage status	$I_{STAT}=1.6\text{mA}$			0.4	V
V_{USD}	Undervoltage shut-down		3.5	4.5	6	V
V_{SCL}	Status clamp voltage	$I_{STAT}= 10\text{mA}$	5	6	7	V
		$I_{STAT}= -10\text{mA}$		-0.7		V
T_{TSD}	Thermal shut-down temperature		140	160	180	°C
$T_{TSD(hyst)}$	Thermal shutdown hysteresis temperature				50	°C
T_R	Reset temperature		125			°C
V_{OL}	Open voltage level	Off state (note 2)	2.5	4	5	V
I_{OL}	Open load current level	On state	5		180	mA
t_{povi}	Overtemperature Status delay	(note 3)		5	10	μs
t_{pol}	Open Load Status delay	(note 3)	50	500	2500	μs

(*) I_n =Nominal current according to ISO definition for high side automotive switch (see note 1)

(^) See switching time waveform

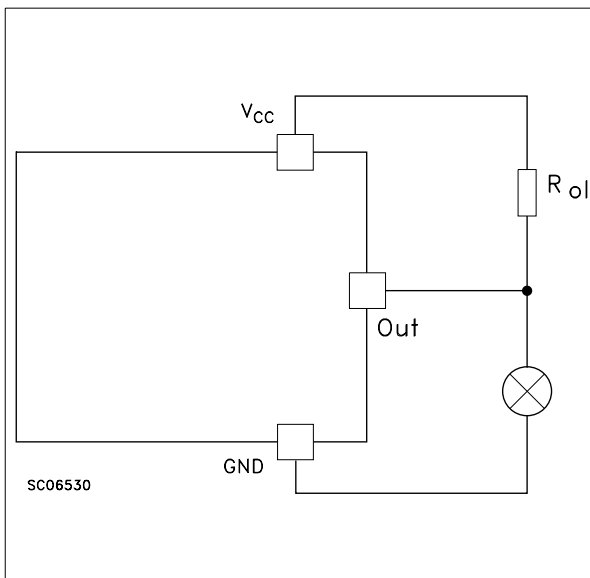
(•) The V_{IH} is internally clamped at 6V about. It is possible to connect this pin to an higher voltage via an external resistor calculated to not exceed 10 mA at the input pin.

Note 1: The Nominal Current is the current at $T_c=85^\circ\text{C}$ for battery voltage of 13V which produces a voltage drop of 0.5V

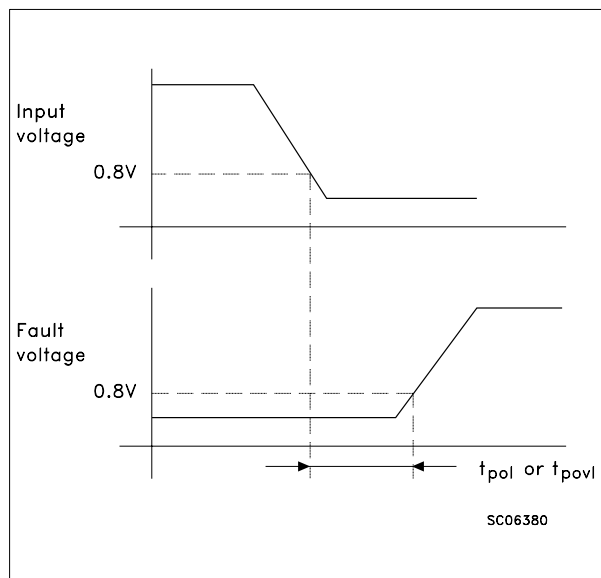
Note 2: $I_{OL(off)} = (V_{CC}-V_{OL})/R_{OL}$

Note 3: t_{povi} t_{pol} : ISO definition

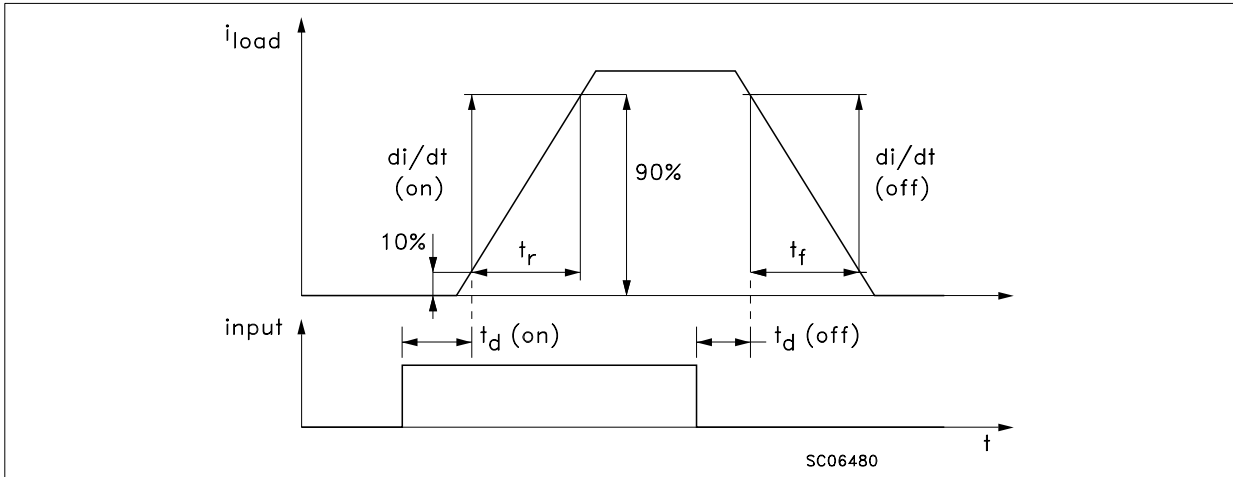
Note 2 Relevant Figure



Note 3 Relevant Figure



Switching Time Waveforms



FUNCTIONAL DESCRIPTION

The device has a common diagnostic output for both channels which indicates open load in on-state, open load in off-state, overtemperature conditions and stuck-on to V_{CC} .

From the falling edge of the input signal, the status output, initially low to signal a fault condition (overtemperature or open load on-state), will go back to a high state with a different delay in case of overtemperature (t_{povl}) and in case of open load (t_{pol}) respectively. This feature allows to discriminate the nature of the detected fault. To protect the device against short-circuit and overcurrent condition, the thermal protection turns the integrated PowerMOS off at a minimum junction temperature of 140°C. When this temperature returns to 125°C the switch is automatically turned in again. In short-circuit the protection reacts with virtually no delay, the sensor (one for each channel) being located inside each of the two PowerMOS areas. This positioning allows the device to operate with one channel in automatic thermal cycling and the other one on a normal load. An internal function of the devices ensures the fast demagnetization of inductive loads with a typical voltage (V_{demag}) of -18V. This function allows to greatly reduce the power dissipation according to the formula:

$$P_{dem} = 0.5 \cdot L_{load} \cdot (I_{load})^2 \cdot [(V_{CC} + V_{demag}) / V_{demag}] \cdot f$$

where f = switching frequency and

V_{demag} = demagnetization voltage.

The maximum inductance which causes the chip temperature to reach the shutdown temperature in a specified thermal environment is a function of the load current for a fixed V_{CC} , V_{demag} and f according to the above formula. In this device if the GND pin is disconnected, with V_{CC} not exceeding 16V, both channels will switch off.

PROTECTING THE DEVICE AGAINST REVERSE BATTERY

The simplest way to protect the device against a continuous reverse battery voltage (-26V) is to insert a Schottky diode between pin 2 (GND) and ground, as shown in the typical application circuit (fig. 2).

The consequences of the voltage drop across this diode are as follows:

- If the input is pulled to power GND, a negative voltage of $-V_f$ is seen by the device. (V_{il} , V_{ih} thresholds and V_{STAT} are increased by V_f with respect to power GND).
- The undervoltage shutdown level is increased by V_f .

If there is no need for the control unit to handle external analog signals referred to the power GND, the best approach is to connect the reference potential of the control unit to the device ground (see application circuit in fig. 3), which becomes the common signal GND for the whole control board avoiding shift on V_{il} , V_{ih} and V_{STAT} . This solution allows the use of a standard diode.

THRUTH TABLE

		INPUT 1	INPUT 2	OUTPUT 1	OUTPUT 2	DIAGNOSTIC
Normal operation		L	L	L	L	H
		H	H	H	H	H
		L	H	L	H	H
		H	L	H	L	H
Undervoltage		X	X	L	L	H
Thermal shutdown	Channel 1	H	X	L	X	L
	Channel 2	X	H	X	L	L
Openload	Channel 1	H	X	H	X	L
		L	L	L	L	L
	Channel 2	X	H	X	H	L
		L	L	L	L	L
Output shorted to V _{CC}	Channel 1	H	X	H	X	L
		L	L	H	L	L
	Channel 2	X	H	X	H	L
		L	L	L	H	L

Figure 1: Waveforms

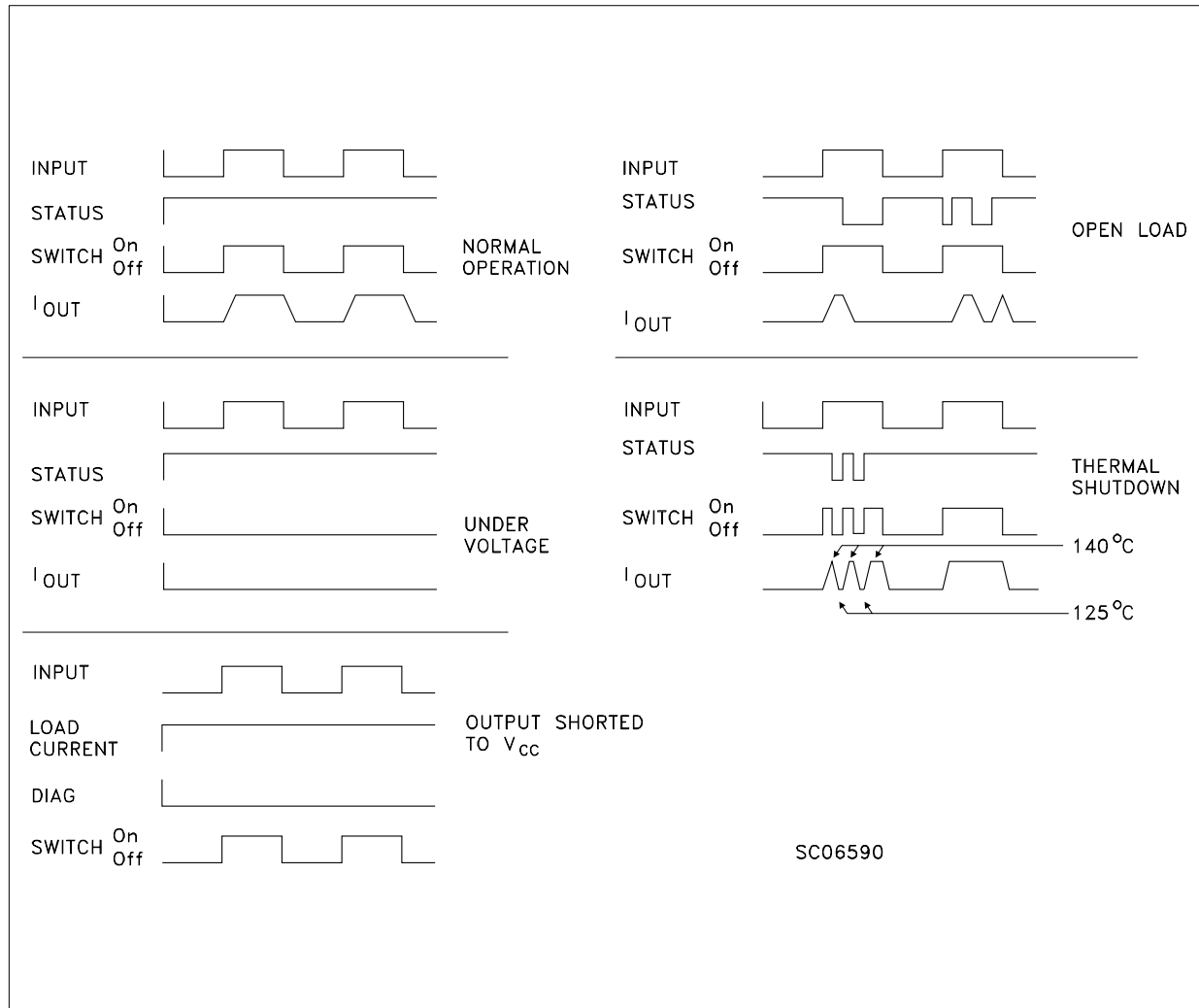


Figure 2: Typical application circuit with a Schottky diode for reverse supply protection

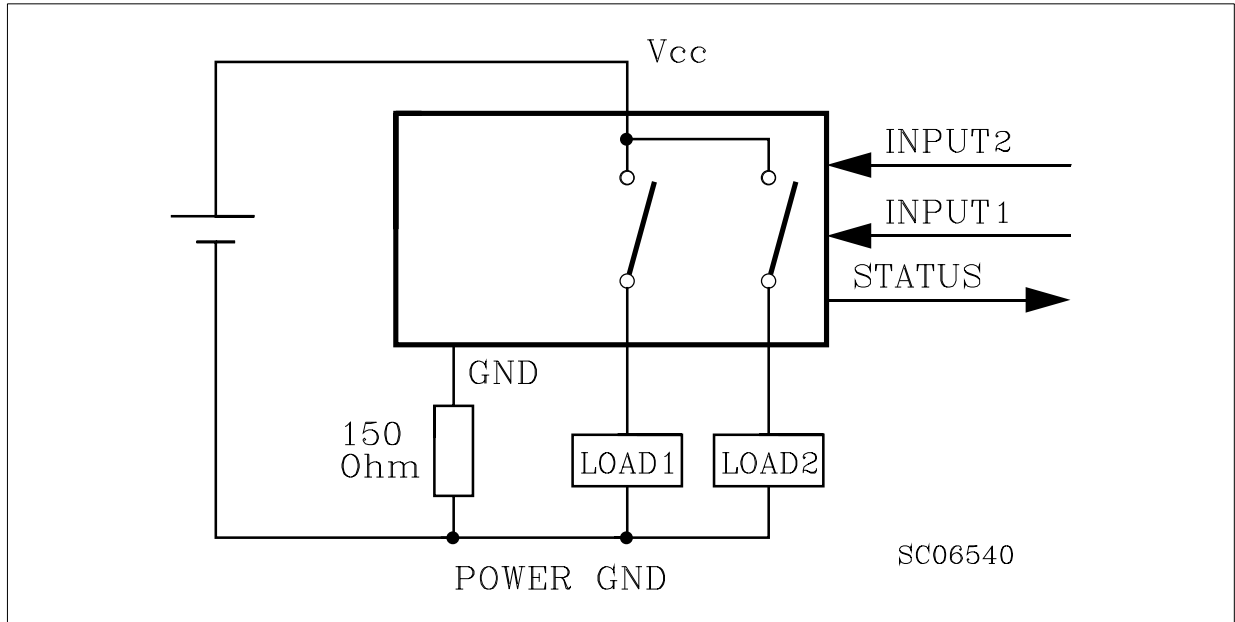
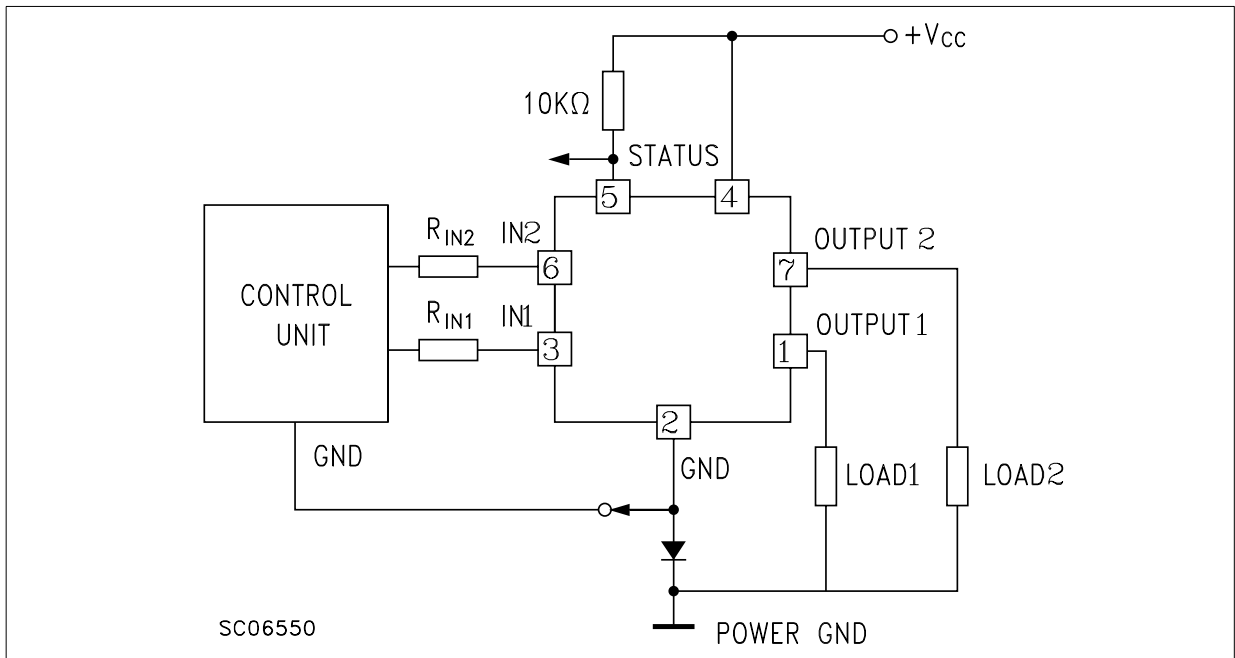
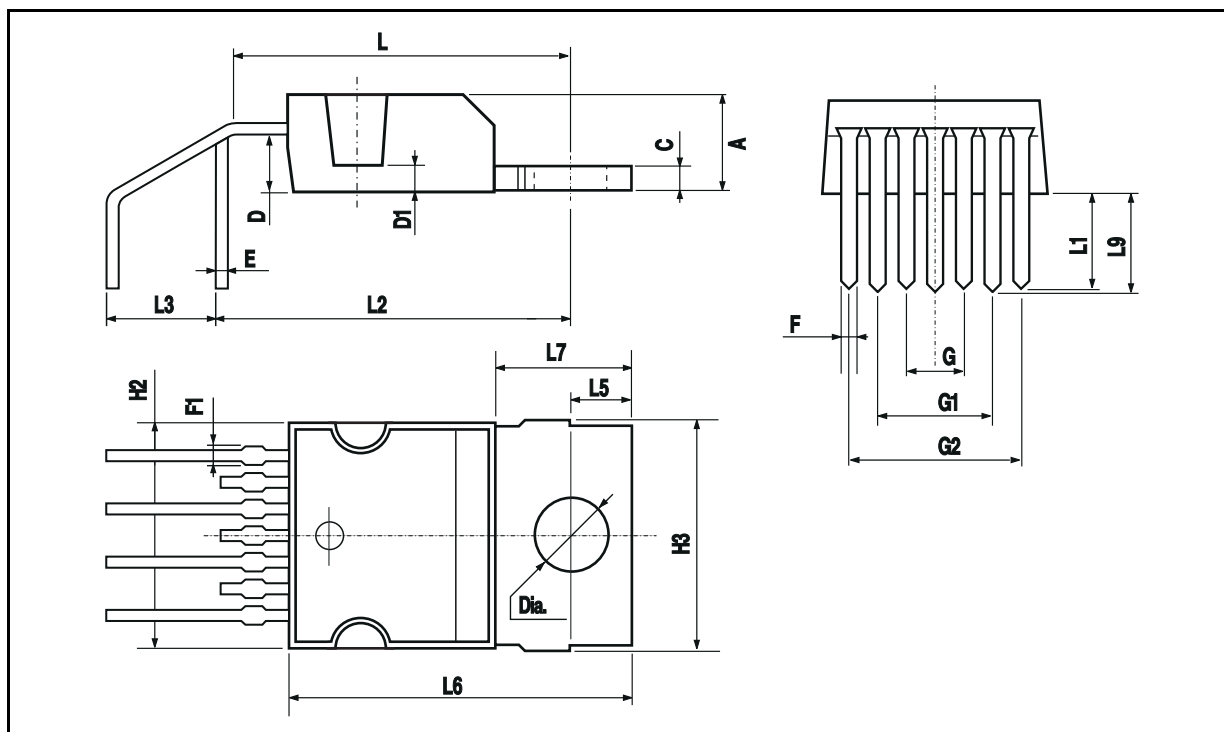


Figure 3: Typical application circuit with separate signal ground



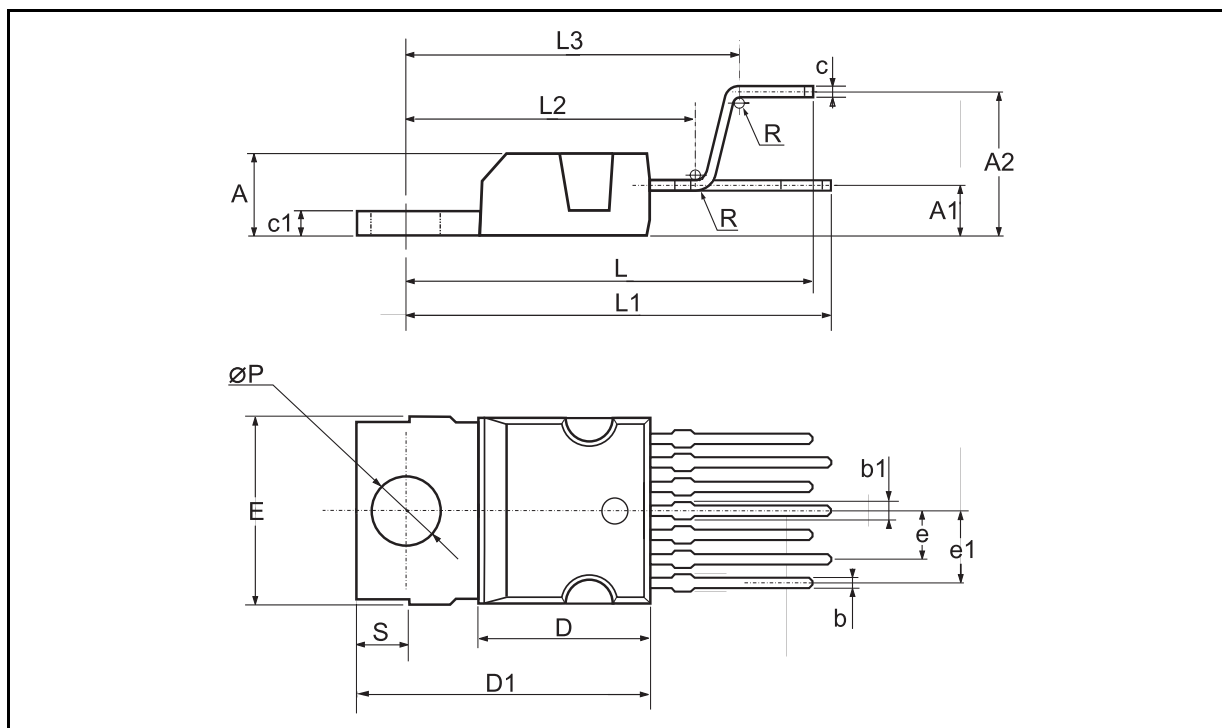
HEPTAWATT (horizontal) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.6		0.8	0.024		0.031
F1			0.9			0.035
G	2.41	2.54	2.67	0.095	0.100	0.105
G1	4.91	5.08	5.21	0.193	0.200	0.205
G2	7.49	7.62	7.8	0.295	0.300	0.307
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L		14.2			0.559	
L1		4.4			0.173	
L2		15.8			0.622	
L3		5.1			0.201	
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
L9		4.44			0.175	
Dia	3.65		3.85	0.144		0.152



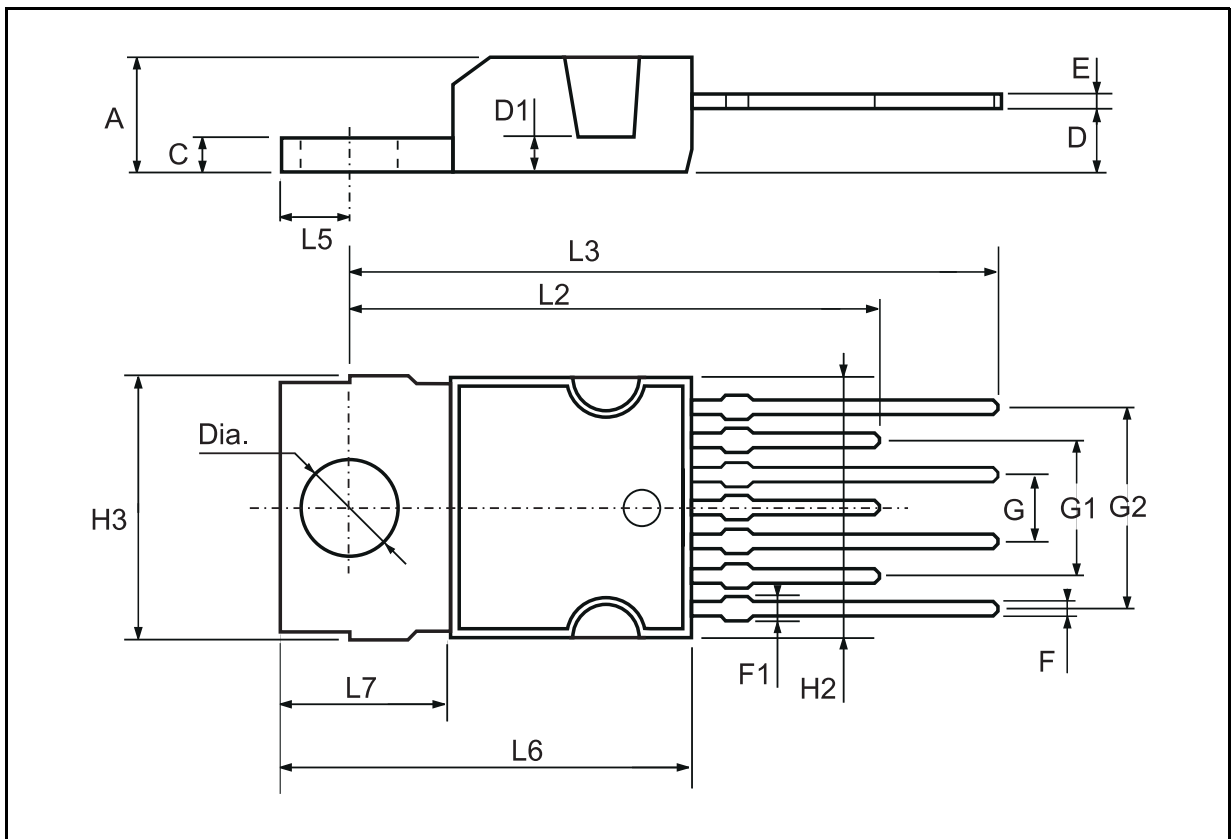
HEPTAWATT (vertical) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.6		0.8	0.024		0.031
F1			0.9			0.035
G	2.41	2.54	2.67	0.095	0.100	0.105
G1	4.91	5.08	5.21	0.193	0.200	0.205
G2	7.49	7.62	7.8	0.295	0.300	0.307
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L		16.97			0.668	
L1		14.92			0.587	
L2		21.54			0.848	
L3		22.62			0.891	
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
M		2.8			0.110	
M1		5.08			0.200	



HEPTAWATT (in-line) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.6		0.8	0.024		0.031
F1			0.9			0.035
G	2.41	2.54	2.67	0.095	0.100	0.105
G1	4.91	5.08	5.21	0.193	0.200	0.205
G2	7.49	7.62	7.8	0.295	0.300	0.307
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L2	22.4		22.9	0.882		0.902
L3	25.4		26	1.000		1.024
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
Dia.	3.65		3.85	0.144		0.152



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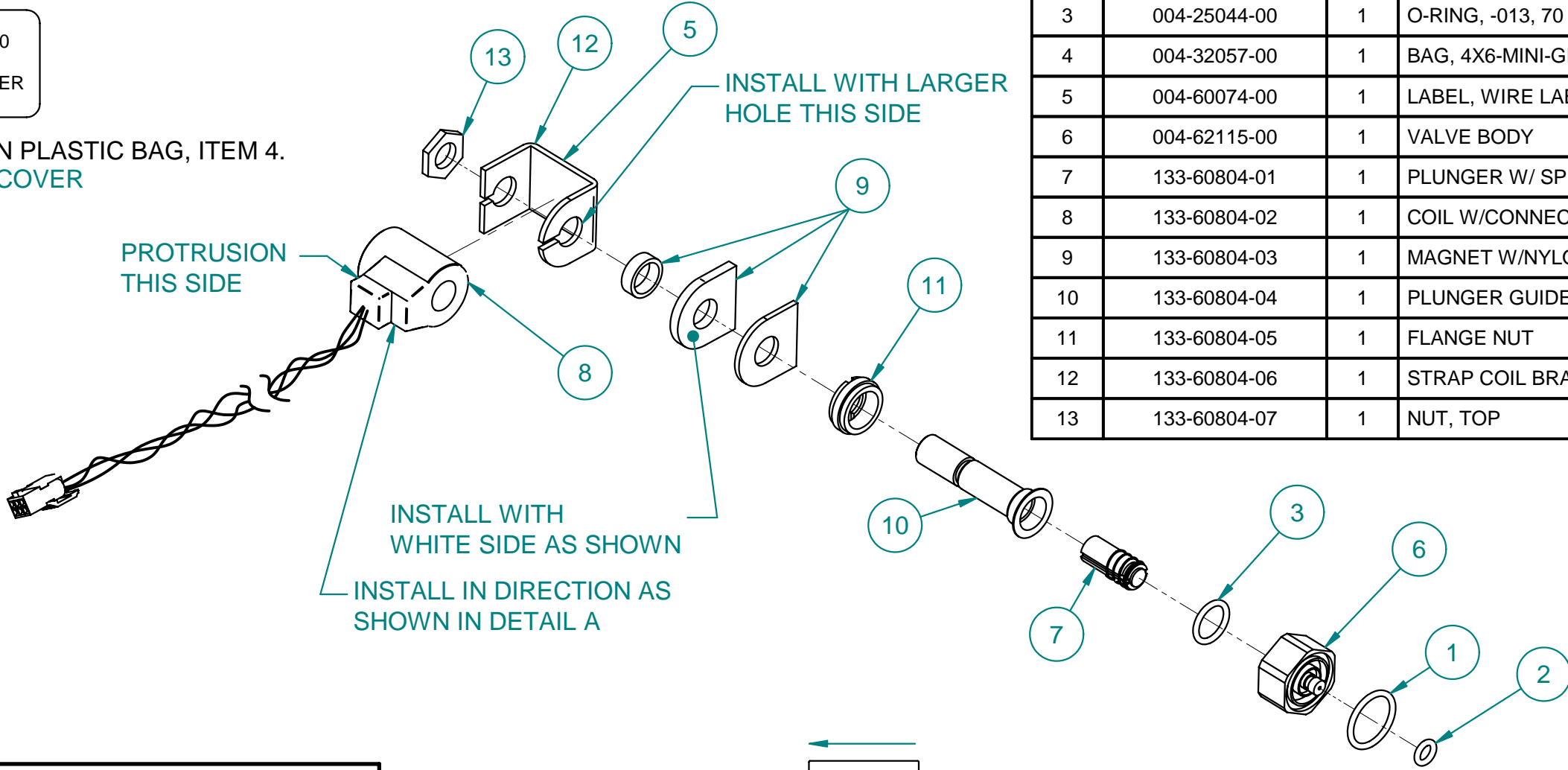
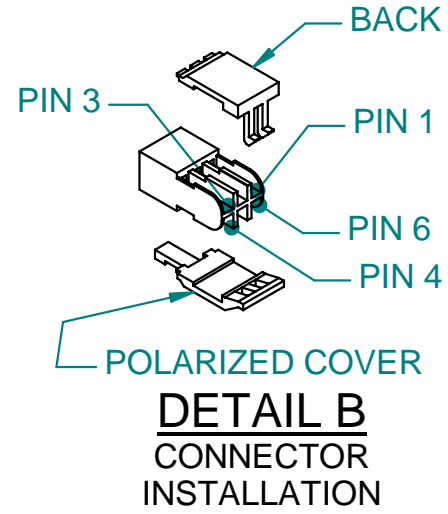
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NOTES:

- 1. CLEAN PER WORK INSTRUCTIONS FOR CLEANING ROOM SECTION D.
- 2. PRINT AND INSTALL LABEL AS SHOWN. TRIM TO FIT.

133-60804-00
REVISION
WORK ORDER

2. PLACE FINISHED VALVE IN PLASTIC BAG, ITEM 4.

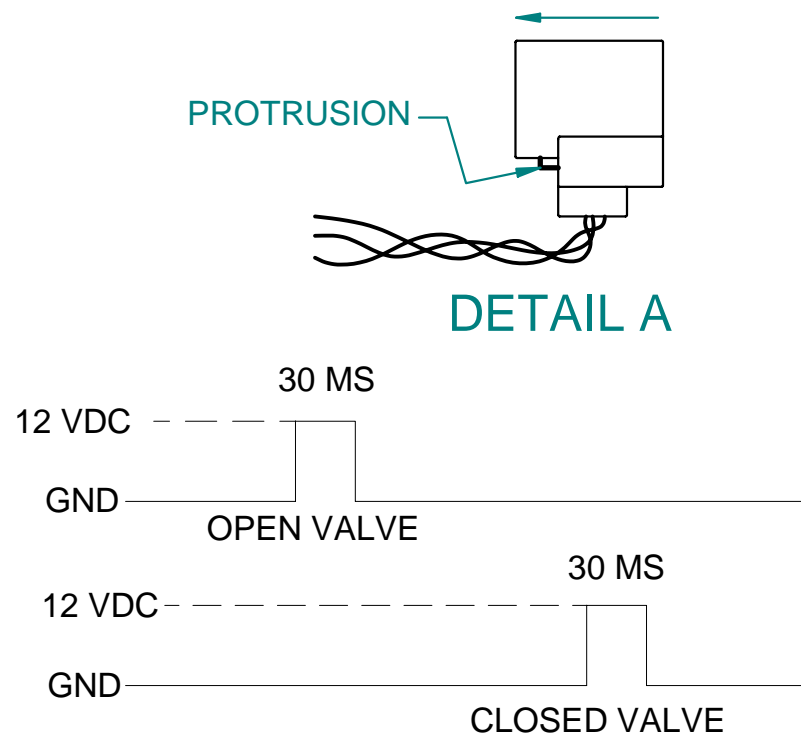


TORQUE SPECIFICATIONS:

- 1. FLANGE NUT TO BODY: 35-45 in-lbs.
- 2. HEX NUT ON TOP OF COIL: 15-25 in-lbs.
- 3. MANIFOLD MOUNT BODY TO MAINFOLD-FINGERTIGHT.

NOTES FOR REFERENCE ONLY:
OPERATIONAL COIL VOLTAGE: 11 TO 13 VDC PULSED
30MS ± 2MS.

CONNECTION TABLE			
CONN	WIRE	SIGNAL	RESISTANCE
1	BROWN	CLOSED	25 OHM
2	BLACK	COMMON	
3	ORANGE	OPEN	112 OHM
4	KEY	KEY	



Item	Part Number	Qty.	Description
1	004-25023-00	1	O-RING, -016 70 DURO BUNA-N
2	004-25034-00	1	O-RING, -008 70 DURO BUNA-N
3	004-25044-00	1	O-RING, -013, 70 DURO BUNA-N
4	004-32057-00	1	BAG, 4X6-MINI-GRIP
5	004-60074-00	1	LABEL, WIRE LABEL, 1 x 1.5 in.
6	004-62115-00	1	VALVE BODY
7	133-60804-01	1	PLUNGER W/ SPRING
8	133-60804-02	1	COIL W/CONNECTOR
9	133-60804-03	1	MAGNET W/NYLON TUBE & WASHER
10	133-60804-04	1	PLUNGER GUIDE
11	133-60804-05	1	FLANGE NUT
12	133-60804-06	1	STRAP COIL BRACKET
13	133-60804-07	1	NUT, TOP

N	WAS PURCHASED, NOW MADE AT MIC	do	10-25 2006	-	060387E
LTR	REVISION	CHG BY	DATE	CHK	REL. NO.
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UNLESS NOTED OTHERWISE DIMENSIONS IN INCHES	ENGR J. T.	 INSTRUMENT CORPORATION ONE MICROMERITICS DR. NORCROSS, GA 30093-1877 U.S.A.			
TOLERANCES ARE: .X ±.1 .XX ±.01 .XXX ±.005 .XXXX ±.0005 ANGLES ±.5°	DWN GAM				
INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5	ENGR CHK J. T.	TITLE VALVE, MINI MAGLATCH 12 VDC			
THIRD ANGLE PROJECTION	DOC CTRL CHK S. P. B.	MFG ENGR/OTHER USER CHK			
	QC CHK A. NOLAN	SCALE 3:4	SIZE B	NUMBER 133-60804-00	SHEET 1 / 1

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1



OPERATING INSTRUCTIONS
 MODEL 205-2 PRESSURE TRANSDUCER
 FOUR-WIRE, VOLTAGE OUTPUT

GENERAL INFORMATION

Your Setra transducer has been carefully calibrated before shipment to you, and it should be handled with the same care given any precision instrument. Pressure ranges and dimensions are reported on the specification bulletin for the transducer.

INSTALLATION

Do not use in ambient conditions corrosive to polyvinyl chloride (cable) or stainless steel, submerged in liquids, subject to spray or drip, or in a high vibration environment. The 205-2 Series is very slightly sensitive to acceleration in the pressure fitting axis, less than 0.05 psi/g typical. Factory calibrated in the vertical position, with pressure port downward, this position often minimizes damage from dripping of pressure system piping.

Installation of pressure fitting:

For very high pressure use of sealant such as Loctite hydraulic sealant is suggested.

For other pressure ranges, standard sealants such as Teflon tape generally are satisfactory.

For the most sensitive pressure ranges, excessive high torquing of a metal pressure fitting may cause a slight zero shift which may be trimmed out using the zero adjustment. Use of plastic fittings often shows no noticeable zero shift. The torquing effect does not appreciably affect linearity or sensitivity. Use the wrench flats on the 205-2 when attaching to fittings.

Installation with FM approved Explosionproof/Weatherproof enclosure:

1. Conduit seals shall be placed no more than 18" from the enclosure.
2. Cables with gas/vapor tight continuous sheath, capable of transmitting gas or vapor through the cable core, shall be sealed per National Electric Code (NEC) for Class 1, Division 1 (most current revision).
3. Caution: Do Not open cover while circuits are live.

ATMOSPHERIC REFERENCE (*Gage pressure transducers only*)

Lower range units are subject to excessive thermal zero shift unless vented to atmosphere. The electrical cable provides this equalization vent.

ELECTRICAL CONNECTIONS:

<u>CABLE LEAD</u>	<u>FUNCTION</u>
Red	positive excitation
Green	positive output
White	negative output
Black	negative excitation
Shield	case

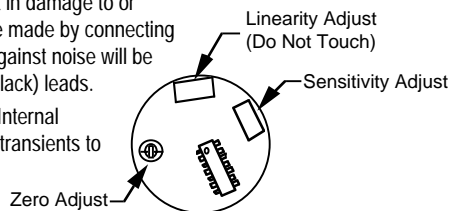
ELECTRICAL

The electrical circuit is equivalent to a 4 terminal network, which can be grounded at only one point, either at the negative excitation or the negative output lead, but must not be commoned or grounded at more than one point. The negative output lead is approximately 1.66 VDC above the negative excitation lead. The positive output lead is at this same 1.66 VDC common mode voltage plus the output signal from applied pressure (thus goes from approximately 1.66 VDC up to 6.66 VDC above the negative excitation).

The pressure transducer must be operated with the case connected either to the negative excitation terminal or to the negative output terminal. Failure to do this may result in damage to or unsatisfactory operation of the unit. This connection may be made by connecting the shield to white or shield to black leads. Best shielding against noise will be obtained by connecting the shield and negative excitation (black) leads.

Circuit is reversed voltage protected for at least 5 minutes. Internal transient suppression network is provided for short duration transients to 150 volts.

In some instances, use of long cables (several hundred feet length) may introduce enough cable capacitance into the



output circuit to cause output oscillation. If encountered, this oscillation may be eliminated by connecting a 100 ohm resistor (1/8 watt or larger) in series in each of the output leads at the end of the 2 foot transducer cable. These series resistors, of course, add to the output resistance.

CAUTION: Excitation power, or voltage in excess of 15 VDC, inadvertently applied to the output leads may damage the electrical circuit. Care must be taken when installing this transducer that the excitation voltage is not applied to the output leads by mistake. Shielding or other precaution should be provided to assure that transient voltages in excess of 15 VDC are not applied to the output leads.

ADJUSTMENTS (with cover removed)

CAUTION: TURN OFF EXCITATION POWER DURING COVER REMOVAL OR REPLACEMENT.

ZERO PRESSURE OUTPUT

Unit factory adjusted to within ± 50 mV. Can be adjusted by the air trim capacitor as shown in the diagram. Any adjustments will begin to change sensitivity.

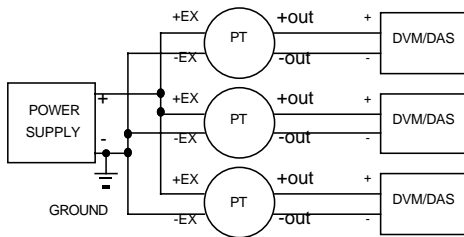
SENSITIVITY

Can be adjusted by potentiometer as shown on diagram. Unit factory adjusted to order specifications.

OTHER ADJUSTMENT

Adjusted at factory. Touching any adjustments other than zero output or sensitivity may necessitate recalibration. Do not touch.

INSTALLATION INSTRUCTIONS FOR MULTIPLE HOOK UP OF A 4-WIRE SETRA PRESSURE TRANSDUCER



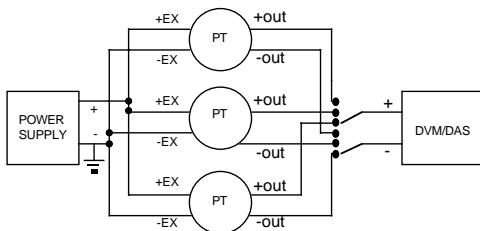
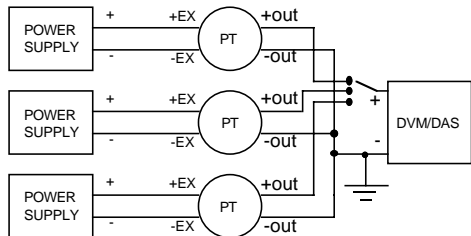
Option #1

Uses a single, ground referenced power supply for excitation and separate, isolated, (not ground referenced), readout or "differential input" to a data acquisition system for each pressure transducer output.

Option#2

Uses a separate, isolated power supply for each pressure transducer's excitation and a single, ground referenced readout or "single-ended input" to a data acquisition system for all of the outputs.

PS - Power Supply (Nominal 24 VDC)
 PT - Pressure Transducer (4 Wire Circuit)
 DVM/DAS - Digital Volt Meter or Data Acquisition System



Option #3

Uses a single, ground referenced power supply for excitation and either a single, isolated readout with a bipolar switch that "breaks before makes" both the + output and - output of each pressure transducer, or a single data acquisition system with a multiplexer (MUX).

NOTE: The shield is internally commoned to the case and pressure port of the transducer. When the shield is connected to ground, the case and pressure port of the transducer will also be commoned to that ground.

CALIBRATION SERVICES

Setra maintains a complete calibration facility that is traceable to the National Institute of Standards & Technology (NIST). If you would like to recalibrate or recertify your Setra pressure transducers please call our Repair Department at 1-800-257-3872 (978-263-1400) for scheduling, cost and turnaround estimates.

RETURNING PRODUCTS FOR REPAIR

Please contact Setra (1-800-257-3872 or 978-263-1400) before returning unit for repair to review information relative to your application. Many times, only minor field adjustments may be necessary.

When returning a product to Setra, the material should be carefully packaged and shipped prepaid to:

Setra Systems, Inc.
159 Swanson Road
Boxborough, MA 01719
Attn: Repair Department

To assure prompt handling, please supply the following information and include it inside the package of returned material:

1. Name and phone number of person to contact.
2. Shipping and billing instructions.
3. Full description of the malfunction.
4. Identify any hazardous material used with product.

Notes: Please remove any pressure fittings and plumbing that you have installed and enclose any required mating electrical connectors and wiring diagrams.

Allow approximately 3 weeks after receipt at Setra for the repair and return of the unit.

Non-warranty repairs will not be made without customer approval and a purchase order to cover repair charges.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

SETRA warrants its products to be free from defects in materials and workmanship, subject to the following terms and conditions: Without charge, SETRA will repair or replace products found to be defective in materials or workmanship within the warranty period; provided that:

- a) the product has not been subjected to abuse, neglect, accident, incorrect wiring not our own, improper installation or servicing, or use in violation of instructions furnished by SETRA;
- b) the product has not been repaired or altered by anyone except SETRA or its authorized service agencies;
- c) the serial number or date code has not been removed, defaced, or otherwise changed; and
- d) examination discloses, in the judgment of SETRA, the defect in materials or workmanship developed under normal installation, use and service;
- e) SETRA is notified in advance of and the product is returned to SETRA transportation prepaid.

Unless otherwise specified in a manual or warranty card, or agreed to in writing and signed by a SETRA officer, SETRA pressure and acceleration products shall be warranted for one year from date of sale.

The foregoing warranty is in lieu of all warranties, express, implied or statutory, including but not limited to, any implied warranty of merchantability for a particular purpose.


SETRA's liability for breach of warranty is limited to repair or replacement, or if the goods cannot be repaired or replaced, to a refund of the purchase price. SETRA's liability for all other breaches is limited to a refund of the purchase price. In no instance shall SETRA be liable for incidental or consequential damages arising from a breach of warranty, or from the use or installation of its products.

No representative or person is authorized to give any warranty other than as set out above or to assume for SETRA any other liability in connection with the sale of its products.

Setra Systems, Inc.

Product Line Summary

Pressure Transducers/Transmitters/Gages & Accelerometers

Model	Applications	Type of Pressure Measurement	Pressure Ranges	Accuracy (RSS Method) ± % FS	Thermal Effect ± % FS/100°F (± % FS/100°C)	Media Compatibility	Output
204/204D	Hazardous Environments R & D Laboratories Vacuum Systems	Absolute Gage Vacuum	25 to 5000 psia 25 to 10000 psig 0-14.7 psiv	0.11 .073 (opt.)	0.4 (1.72) max Zero 0.3 (5.4) max Span	Gas or liquid compatible with stainless steel	204 0-5 VDC C-204 4-20 mA
205-2	High Accuracy General Purpose R & D Test & Measurement Vacuum Systems Dynamometers Engine Test Cells	Absolute Gage	25 to 5000 psia 25 to 5000 psig	0.11	0.02 (3.6) max Zero 1.5 (2.7) max Span	Gas or liquid compatible with stainless steel	0-5 VDC
206/207	Equipment Automation Compressor Control Chillers Paper Converting Machines Hydraulics & Pneumatics	Gage	25 to 5000 psig M206 Avail. in 1.6 to 400 bar	0.13	1.0 (1.8) max Zero 1.5 (2.7) max Span	Gas or liquid compatible with stainless steel	206/207 0.1-5.1 VDC C-206C-207 4-20 mA
209	Off Road Equipment Hydraulic Equipment Compressor Control HVAC/R Equipment Industrial Engines	Gage	50 to 5000 psig Common bar ranges	0.25	2.0 (3.6) max Zero 1.5 (2.7) max Span	Gas or liquid compatible with stainless steel	1.0-6.0 VDC 0.2-5.2 VDC 0.5-4.5 VDC 1.0-5.0 VDC 4-20 mA
212 212FT	Specialty Gas Handling Semiconductor Process Gas Bottle Filling Equipment Pharmaceutical & Biotechnology Process High Press. Liquid Chromatography	Gage Compound Absolute (212)	-14.7 - 3000 psig 100 - 3000 psig 100 - 3000 psia	0.14 (212FT) 0.22 (212)	1.5 (2.7) max Zero 1.0 (1.8) max Span	Corrosive liquids or gases (Ultra-High Purity Gas & Liquid Compatible)	212/212FT 0.2-5.2 VDC C212/C212FT 4-20 mA
280E 280E-XP 	Process Instrument Signals Explosionproof/Weatherproof Natural Gas Lines Chemical Processing Off-Shore Drilling	Gage Absolute Compound PI	15 - 10000 psig 25 - 5000 psia -14.7 to 100 psig 3 - 15 psig	0.11	0.75 (1.4) Zero 1.5 (2.7)Span (Typ.) 2.0 (3.6) max Zero 2.0 (3.6) max Span	Gas or liquid compatible with stainless steel	280E 0-5 VDC C280E 4-20 mA
270	Weather Data Systems Laser Interferometers Altimeter Settling Indicators Transfer Pressure Standard	Barometric Gage Absolute	600-1100 mbars 800-1100 mbars 10 to 100 psia 5 to 100 psig	0.05 Option .03	0.1 (.18) max Zero (0.2 (.36) Baro.) 0.1 (.18) max Span	Wet or Dry Air	0-5 VDC
C290	Sanitary Pressure Lines Food & Beverage Processing Tank Level Measurement Pharmaceutical Processing Sanitary Filtration Systems	Gage	1 to 1000 psig	0.20	2.0 (3.6) max Zero 2.0 (3.6) max Span	Gas or liquid compatible with stainless steel	4-20 mA
228-1	Process Control Filter Condition Monitoring Refrigeration Equipment Pump Speed Control HVAC Equipment	Differential (can be wet both sides)	1 to 100 psid ±0.5 to ±50 psid	Low Ranges 0.15 High Ranges 0.21	2.0 (3.6) max Zero 2.0 (3.6) max Span	Gas or liquid compatible with stainless steel (both pressure & reference sides)	228-1 0-5 VDC Bidirectional ±2.5 VDC C228-1 4-20 mA
239	HVAC Control Leak Detection Environmental Testing R & D Scientific Fume Hood Control	Differential	0.5" to 30" WC ±0.25" to ±15" WC 5 to 10 psid ±2.5 to ±5 psid	0.14 Option .073	1.0 (1.8) max Zero 1.0 (1.8) max Span	High Pressure Port Gas or liquid compatible with SS, aluminum & Buna-N Low Pressure Port Clean dry air or inert gas	239 0-5 VDC Bidirectional ±2.5 VDC C-239 4-20 mA
264	HVAC and VAV Control Energy Management Systems Clean Room Control Medical Instrumentation Filter Condition Monitoring	Very low Differential	0.1" to 25" WC ±0.1" to ±5" WC (Pa, mbar & mmWC ranges available)	1.00 Option 0.25 & 0.4	3.3 (5.9) Zero & Span combined	Air or Inert gases	264 0-5 VDC C-264 4-20 mA
370 470	Altimeter Certification Pressure Transfer Standard Laser Interferometers Min/Max Tracking Hi/Lo Alarming Automatic Weather Systems High Accuracy Altimeter Weather Data Buoy Hydrological (SDI-12) option	Absolute Barometric	600-1100 mbar 800-1100 mbar 0 to 10, 20, 50, 100 psia	±0.02	0.2 max Zero 0.1 max Span	Air or Inert gases	RS-232
Accelerometer 141	Transportation Equipment Position Sensing Robotics Shock & Vibration Testing	G Ranges (Full Scale Ranges ±G)	±2, ±4, ±8, ±15, ±30, ±60, ±150, ±600g Response: DC to 3000 Hz	1.00	2.0 (3.6) max Zero 2.0 (3.6) Max Span	N/A	141A ±500mv (nom.) 141B ±1000mv (nom.)

