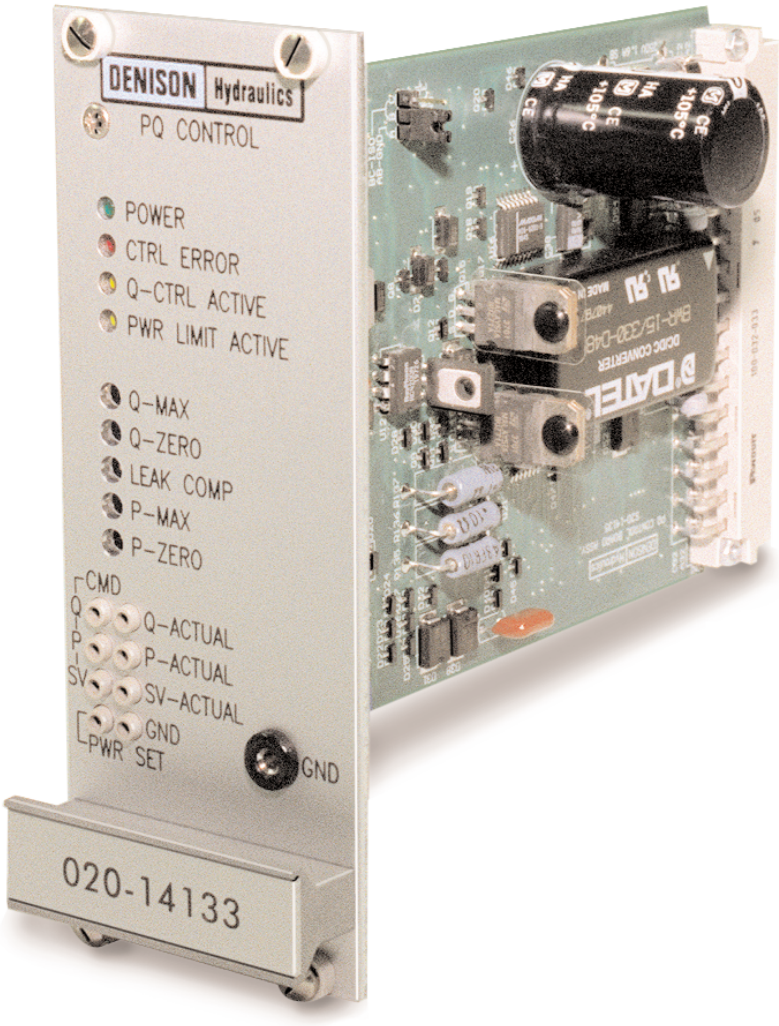
DENISON HYDRAULICS
P/Q Control Card
020-14133



LT2-00052-1

DENISON Hydraulics

Internet: http://www.denisonhydraulics.com
E-mail: denison@denisonhydraulics.com

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DECLARATION OF CONFORMITY
per EMC Directive 89/336/EEC and EN45014

MANUFACTURE'S NAME DENISON HYDRAULICS

MANUFACTURE'S ADDRESS 14249 Industrial Parkway
Marysville, Ohio 43040-9504, USA

declares that the product

PRODUCT NAME P/Q Control Card

PRODUCT PART NUMBER DHI 020-14133-0

conforms to the following product specifications

EMC: EN50081-1:March 1993 generic emissions for residential, commercial & light industry[1]
EN55011:7/1992 radiated or conducted EMI - 30-1000MHz

EN50082-2: 1995 generic immunity for heavy industry1

ENV50140:8/1993 - 10V/m, 80 - 1000MHz Performance Criteria B

EN61000-4-2, IEC801-2 electrostatic discharge (ESD)
8KV air discharge - Performance Criteria A
4KV contact discharge - Performance Criteria A

EN61000-4-4: 5/1995 fast transient rejection
2KV power supply wires - Performance Criteria B

Supplementary Information

The product was tested in an EMC TEST Laboratory and herewith complies with the EMC Directive 89/336 and the CE Marking requirements.

1 The product was tested in a typical system configuration with DENISON HYDRAULICS products or recommended second source products. The tested product was mounted in a NEMA 4 enclosure (or equivalent) and all cables exiting the enclosure were shielded (screened). Enclosure and cable shields were connected to earth ground (PE).

USA Contact

Office of Director of Quality
DENISON HYDRAULICS
14249 Industrial Parkway
Marysville, Ohio 43040

European Contact

DENISON HYDRAULICS Sales Office
or
Office of Quality Manger
DENISON HYDRAULICS GmbH
Auf dem Sand 14
D-40721 Hilden

See installation & Operation Guidelines under Procedures

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GENERAL DESCRIPTION

The P/Q Control Card, 020-14133, was designed in conjunction with a special Premier Series pump. The pump is fitted with a directional-proportional control valve, a cam position transducer and optional pressure sensor. These devices are utilized by the P/Q Controller to limit the pump output flow (Q) or limit the system pressure (P) to set values commanded by an external master machine controller, such as a programmable logic controller (PLC). The P/Q Controller automatically switches between Q-and P-control modes to assure that the set point limits for Q and P are not exceeded. A power limit can also be set externally for variable power levels or internally for fixed power limit.

SYSTEM FEATURES

- Designed to control the P/Q Premier Series Pump P16/P260
- EuroCard format
- Wide power supply input range 21.5 35VDC, 24V nominal
- Auxiliary power sources for transducers and command pots
- Power supply reverse polarity protection
- Self-regulating PWM frequency
- All outputs short-circuit protected
- Differential inputs for command signals
- 4-20mA current inputs from transducers
- Conditioned actual values for P & Q available externally
- Control Ready, Q-Ctrl mode & PWR Limit Ctrl signals externally available
- Selectable isolated ground for logic control signals
- Automatic P/Q mode selection
- Displacement control mode (Q)
- Pressure control mode (P)
- Trapped volume compensation adjustment, with external range switch
- Power limit control mode
- Valve spool position control
- LED control indicators, Front panel
- Diagnostic LED's on PC board
- Potentiometer adjustments
- Test points, Front panel
- CE Mark

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P/Q DRIVER CARD	DHI P/N S20-14133
POWER SUPPLY VOLTAGE U_B	24VDC nominal
--maximum U_{Bmax}	35VDC continuous
--minimum U_{Bmin}	21.5VDC continuous
Current Requirement @ $U_B$nom	660mA (1.5 Amps max momentary)
Fuse, onboard (serviceable)	1.6A T (slo blo) 5x20mm

INPUTS

--Q-Command (Flow Setpoint)	0 to +10VDC (differential input impedance 67K ohms)
--P-Command (Sys. PSI Setpoint)	0 to +10VDC (differential input impedance 67K ohms)
--Q-Actual (pump cam angle)	4-20mA into 100 ohm load
--P-Actual (System PSI)	4-20mA into 100 ohm load (differential input)
*--Power Command (P*Q Setpoint))*	0 to +10VDC (differential input impedance 50K ohms)
--Control Enable	15 to 35VDC (input impedance 10K ohms) isolated voltage option
--PSI Compensator RangeSwitch	15 to 35VDC (input impedance 10K ohms) isolated voltage option

OUTPUTS

--Solenoids A & B currents I_{max}	2.8 Amps (momemtary)
$I_{nom.}$	850 mA (@ steady state)
	Solenoids A & B operate in differential current mode. When A-solenoid increases, B-solenoid decreases and vica versa.
--Q-Actual (I/V signal conditioned)	-2 to +10VDC (5K min impedance)
--P-Actual (I/V signal conditioned)	0 to +10VDC (5K min impedance)
--Cam Control Active	U_B -5V = Active (short-circuit protected)
--Power Limit Active	U_B -5V = Active (short-circuit protected
--Control Ready	U_B -5V = Ready, 0 Volts = Control Error (min. load resistance 500 ohms, 60mA max, short-circuit protected)
--Auxillary Voltage Sources	±15VDC @ 100mA (for pressure transducer, etc. if needed) +10VDC @ 10mA (for command pot excitation if needed)

INDICATORS, FRONT PANEL

-- Power	LED Green
-- CTRL Error	LED Red
-- Q-CTRL Active	LED Yellow
-- PWR Limit Active	LED Yellow

ADJUSTERS, FRONT PANEL

--Q-Max	Q-Max adjustment range 40% to 100% @ full Q-command signal
--Q-Zero	Q-Zero adjustment range +25% to -5%
--Leakage Compensator	Leakage compensate adjustment (Dependent on Q-Max & P-Max settings)
--P-Max	P-Max adjustment range 40%-to-104% of transducer rating.
--P-Zero	P-Zero adjustment range 0 to 15% of P-Max.

TEST POINTS, FRONT PANEL

--Q-Command	0 to -10VDC (reduced when PWR LMT is active) 1.8K output impedance
--Q-Actual	-2 to +10VDC 1.8K output impedance
--P-Command	0 to +10VDC (same as input) 1.8K output impedance
--P-Actual	0 to +10VDC 1.8K output impedance
--SV-Command	0V normal, ±10VDC momentary
--SV-Actual	0V normal, ±5VDC momentary
--Power Limit Set Command	0 to +10VDC
--Ground Reference	Signal ground, power ground, chassis ground
--Ground Ref (for large test probe)	Test receptacle grounded at Front Panel for ESD immunity.

CONNECTOR TYPE 32-Pin Male DIN 41612 Form D

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AMBIENT TEMPERATURES	
--OPERATING	0 TO 60°C
--STORAGE	-20 to 80°C
PHYSICAL DIMENSIONS	
--Card	Euro-card 3.94” x 6.30 (100 x 160mm)
--Front Panel	1.99” Wide x 5.05” High 10TE X 3HE (50.5mm x 128.4mm)
--Weight	0.5Lbs (0.23Kg)
Q TRANSDUCER (CAM ANGLE)	Denison P/N 788-30012
--Sensor type	Linear differential transformer
--Linear range	0.236” (±3mm)
--Supply voltage	18-36VDC (Reverse polarity protected)
--Supply current	50mA
--Output	4-20mA (Extended -3mm = 4mA; Retracted +3mm = 20mA)
--Linearity	±1.5%
--Sensitivity	2.667mA/mm (factory set, do not change)
--Offset	±1mm (user adjustable)
--Operating temperature	0 to 80°C
--Connector type	Binder Series 713 5-Pin male M12x1 Threads
--Connector, Mating	Denison P/N 721-30108
PRESSURE TRANSDUCER	Denison P/N 788-50035
--Supply voltage	10-30VDC or ±15VDC (Reverse polarity and overvoltage protected)
--Operating pressure	0 to 5000PSI (350 Bar)
--Overload pressure	200% Operating (will not destroy, but may shift calibration point)
--Burst pressure	450% Operating (will cause permanent damage or complete destruction)
--Output	4-20mA (2-Wire system)
--Linearity	0.5% of span
--Operating temperature	0 to 80°C
--Connector type	Compact appliance 4-Pole Male
--Connector, Mating	Compact 4-Pole Female Hirschmann Series G4W1F P/N 932 157-100
--Hydraulic connection	1/4 NPT male
--Environmental	NEMA 5 / IP65
VALVE SPOOL TRANSDUCER	Supplied as part of valve assembly
--Sensor type	Linear differential transformer
--Linear range	±0.8mm
--Supply voltage	18 to 35VDC (Reverse polarity proctected)
--Supply current	50mA
--Output	4-20mA (12mA near hydraulic null)
--Sensitivity	2.667mA/mm factory set not not adjust
--Offset	factory set do not adjust
--Operating temperature	0 to 80°C
--Connector type	Binder Series 713 4-Pin male M12x1 Threads
--Connectro, Mating	Denison P/N 167-01106-8

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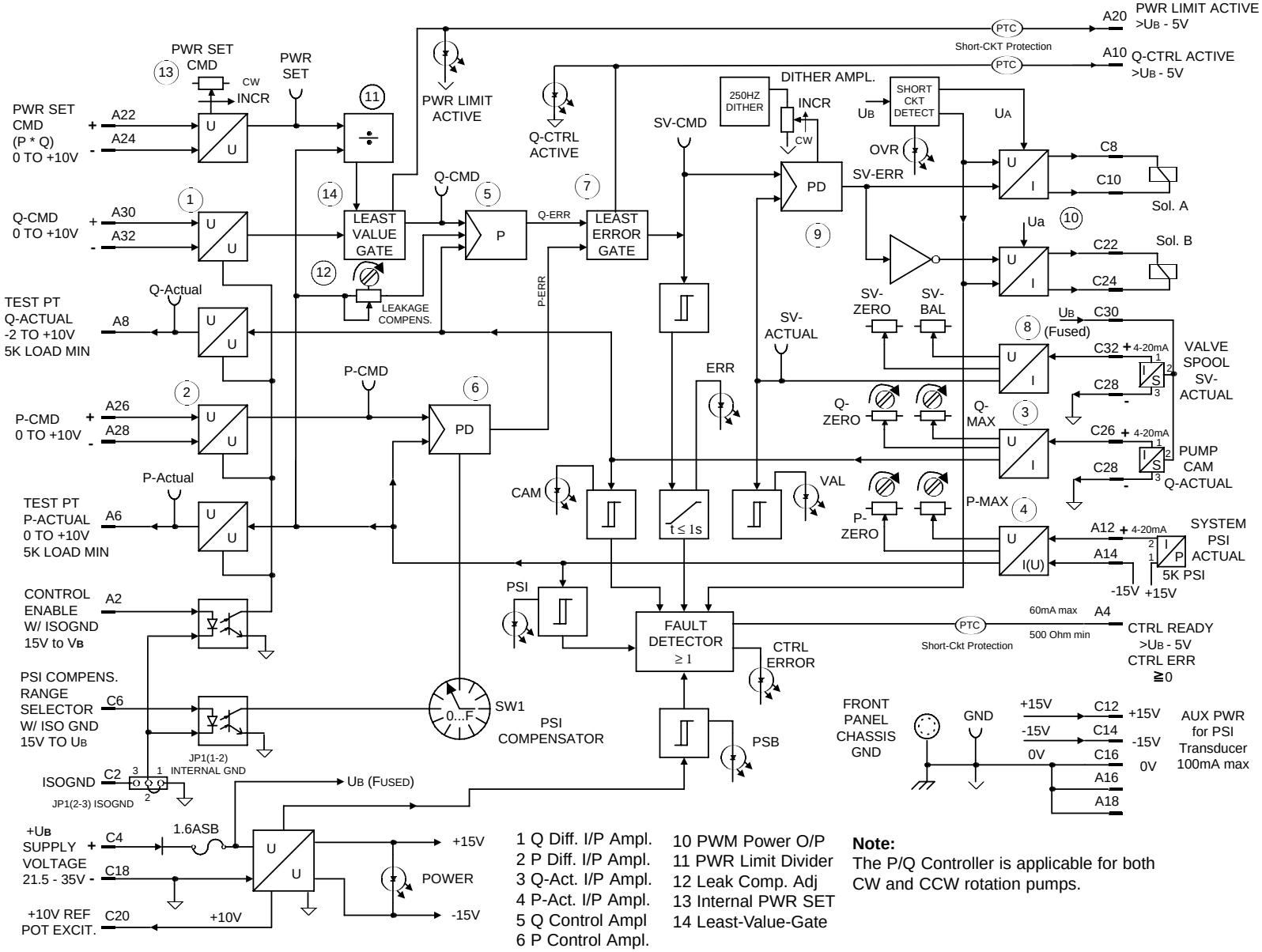

1 Q Diff. I/P Ampl.
2 P Diff. I/P Ampl.
3 Q-Act. I/P Ampl.
4 P-Act. I/P Ampl.
5 Q Control Ampl
6 P Control Ampl.
7 Least-Err-Gate
8 SV-Act I/P Ampl
9 SV Control Ampl
10 PWM Power O/P
11 PWR Limit Divider
12 Leak Comp. Adj
13 Internal PWR SET
14 Least-Value-Gate

Note:
The P/Q Controller is applicable for both CW and CCW rotation pumps.

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Refer to the block diagram to identify the circuit blocks referenced in the following discussion.

When the Control Enable signal is present, the P/Q Control Card accepts two primary control signals--flow (Q-CMD) and pressure (P-CMD) at their respective differential input amplifiers (1)&(2). The cam position transducer on the pump measures the pump displacement angle and provides actual flow information to the Q-Actual input. The pressure transducer monitors system pressure and provides the actual pressure information to the P-Actual input. The actual value signals are converted from current-to-volts, adjusted for zero point and scaled for maximum at amplifiers (3) & (4), before being compared to their respective command signals at control amplifiers (5) & (6). The control amplifiers produce signals (Q-ERR) & (P-ERR), representing the errors between the commanded values and the actual values. The Least-Error-Gate (7) output is the lesser of the two error signals and is also the command signal (SV-CMD) for the control-valve amplifier. In this fashion the pump operating point is controlled by the loop with the least error.

The control valve is regulated by the spool position loop. The SV-CMD (Least-Error-Gate output) is the command value. The spool position signal, SV-Actual, is provided by a position transducer that is part of the valve. The SV-Actual signal is converted from current-to-volts, zeroed and scaled for maximum by amplifier (8), before being compared to the command signal at amplifier (9). The spool position error, SV-ERR, is the command signal for the Pulse-Width-Modulated (PWM) power amplifier which modulates the coil currents to the control valve. An amplitude-adjustable dither signal is imposed at the PWM power amplifier to keep the valve spool in constant motion, and hence reduce hysterisis.

When in Q-Ctrl mode an adjustment is provided to compensate for pressure dependent system leakage. With proper adjustment of the Leakage Compensator adjuster (12), the Q-CMD signal is automatically corrected for system pressure changes.

The pressure control loop can be adjusted to compensate for trapped oil volume in actuators and hydraulic lines. The onboard PSI compensator switch, SW1, has 16 settings. The externally controlled PSI Compensator Range Selector activates a second range of compensator adjustments. The two ranges overlap and thus provide pairs of compensation points that can be switched on and off externally during a machine cycle to compensate for varying trapped volumes or pressure changes.

The P/Q control card can also provide power limiting. The power level (P * Q) can be set onboard with a potentiometer (13) for a constant power level or it can be set externally via the PWR SET CMD input (when using the external PWR SET CMD the internal setting must be at min). The PWR SET CMD signal is divided by system P-actual signal at block (11). The result is a power limited Q command signal which is compared with the existing Q-CMD input at the Least-Value-Gate(14). The lesser of the two signals is passed to the Q control amplifier (5).

Front panel LED's show system status. The green POWER LED indicates supply voltage U_B and ±15VDC is present. The yellow Q-CTRL ACTIVE LED is lit when the pump cam angle position (Q) loop is being controlled by the controller; when the LED is off the pump is in pressure limit mode. The PWR LIMIT ACTIVE LED is lit when the Q-CMD signal is reduced by the power limiter circuit (11)(14). The red CTRL ERROR LED is lit when any one of the following fault monitor circuits detect an error: CAM, broken wire from transducer or out-of-range signal; PSI, broken wire from transducer or out-of-range signal; VAL, broken wire or out-of-range signal; PSB, out of balance ±15VDC; ERR, excess-control error, SV-CMD, for >1 second; OVR, over-current or short-circuit at the PWM power amplifier (10). Any detected fault will lite the CTRL ERROR LED and force a high-to-low signal change at the CTRL Ready terminal, A4. The OVR fault monitor will also shut-off the PWM power amplifier to protect the electronic drivers. The P/Q Driver Card must be de-energized to reset the OVR monitor. All fault monitors have diagnostic LED's on the board to help isolate any fault condition.

Front panel adjustments of zero and max for Q & P and leakage compensation permit easy setup of system parameters.

Eight front panel test points are provided for easy access for monitoring key points in the circuit during setup or fault analysis. The front panel test point labels are descriptive and correspond with the labels on the block diagram. The Q-CMD test point value is the polarity-inverted Q-CMD input modified by the PWR limiter circuit when the PWR LIMIT ACTIVE LED is the lit. The P-CMD testpoint value is the same magnitude and polarity as the P-CMD input. The SV-CMD test point represents the system deviation from the commanded value. The polarity can be either positive or negative, the value is normally small during steady-state conditions; large values are momentary when the control card makes corrections in responds to command changes or system conditions. The PWR SET test point value is either the internal or external PWR SET CMD. Q-Actual, P-Actual and SV-Actual test point values are the conditioned signals from their respective sensors. Two front panel GND test points are provided to accommodate different size test lead probes.

The status indicators Q-CTRL ACTIVE, PWR LIMIT ACTIVE and CTRL READY are also available at the the card I/O connector. The Q-Actual and P-Actual values are also available at the I/O connector. The above signals may be conntected to a system control PLC for information purposes.

The CTRL ENABLE & PSI COMPENS. RANGE SELECTOR signals are optically coupled to provide isolation if required. Jumper J1 is factory jumpered to 1-2 for internal ground. Set jumper to 2-3 for isolated ground.

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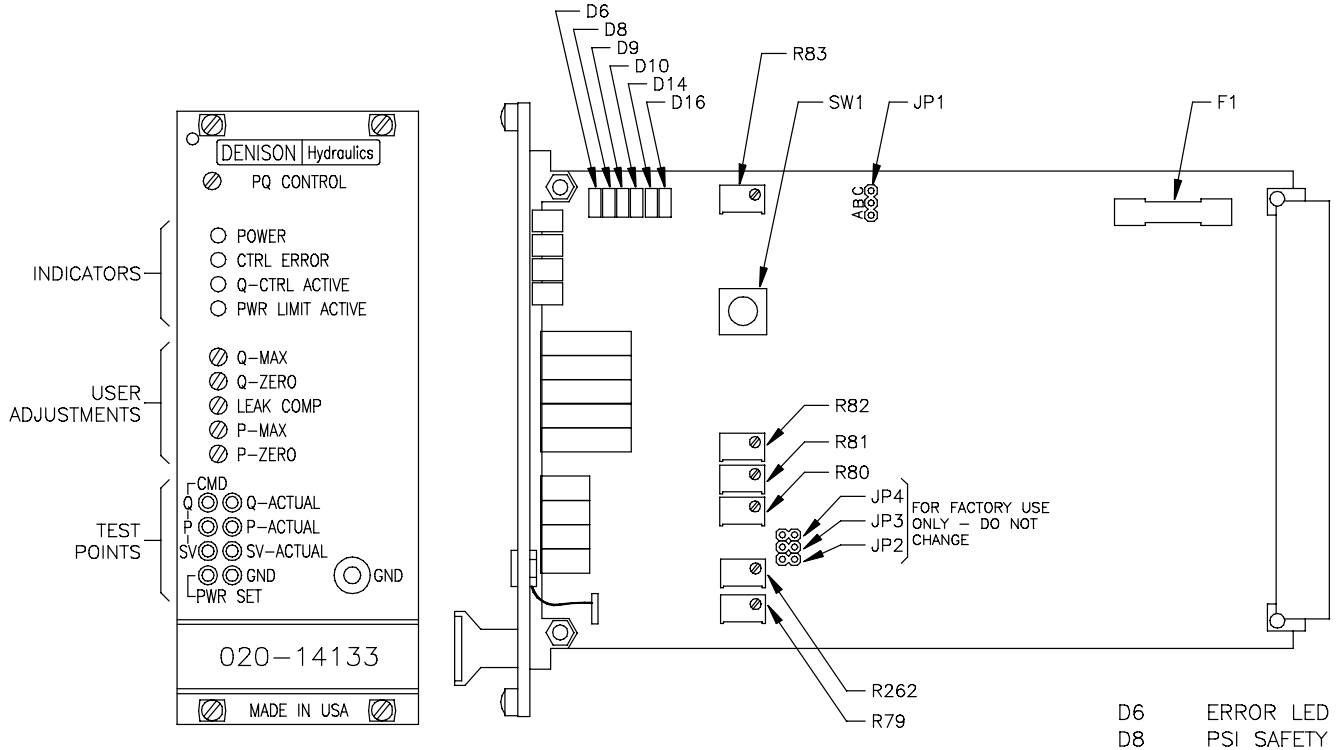

ITEM	DESCRIPTION	ITEM	DESCRIPTION
D1	POWER LIMIT ACTIVE LED	R11	Q-MAX POT
D2	Q-CTRL ACTIVE LED	R79	SV-BIAS
D3	CTRL ERROR LED	R80	SV-BAL
D4	POWER LED	R81	SV-ZERO
F1	FUSE 1.6A SB	R82	PWR SET
JP1	A-B:INTERNAL GND B-C:ISOLATED GND	R83	PSI P-GAIN
JP2	FACTORY USE ONLY-DO NOT CHANGE	R262	DITHER AMPLITUDE
JP3	FACTORY USE ONLY-DO NOT CHANGE	SW1	PSI D-GAIN
JP4	FACTORY USE ONLY-DO NOT CHANGE		

D6	ERROR LED	
D8	PSI SAFETY LED	
D9	CAM SAFETY LED	
D10	VALVE SAFETY LED	
D14	POWER SUPPLY BAL LED	
D16	OVERCURRENT LED	
R7	P-ZERO POT	
R8	P-MAX POT	
R9	LEAK COMP POT	
R10	Q-ZERO POT	
TP1A	PWR SET TEST POINT	+10V ≈ 100%
TP1B	GND TEST POINT	0V
TP2A	SV-CMD TEST POINT	±10V momentary
TP2B	SV ACTUAL TEST POINT	±5V momentary
TP3A	P-CMD TEST POINT	+10V ≈ 100%
TP3B	P-ACTUAL TEST POINT	+10V ≈ 100%
TP4A	Q-CMD TEST POINT	+10V ≈ 100%
TP4B	Q-ACTUAL TEST POINT	-2 to +10V ≈ -20 to 100%
GC1	GND TEST POINT	0V

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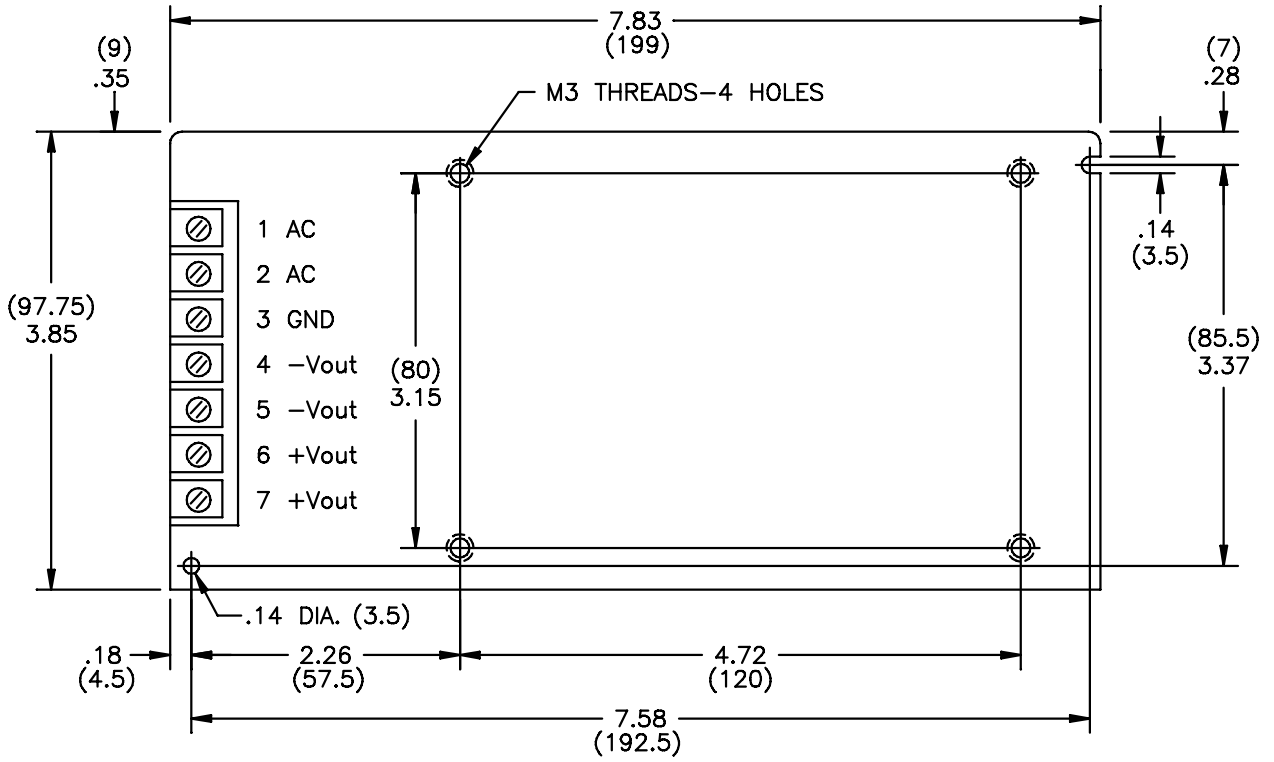
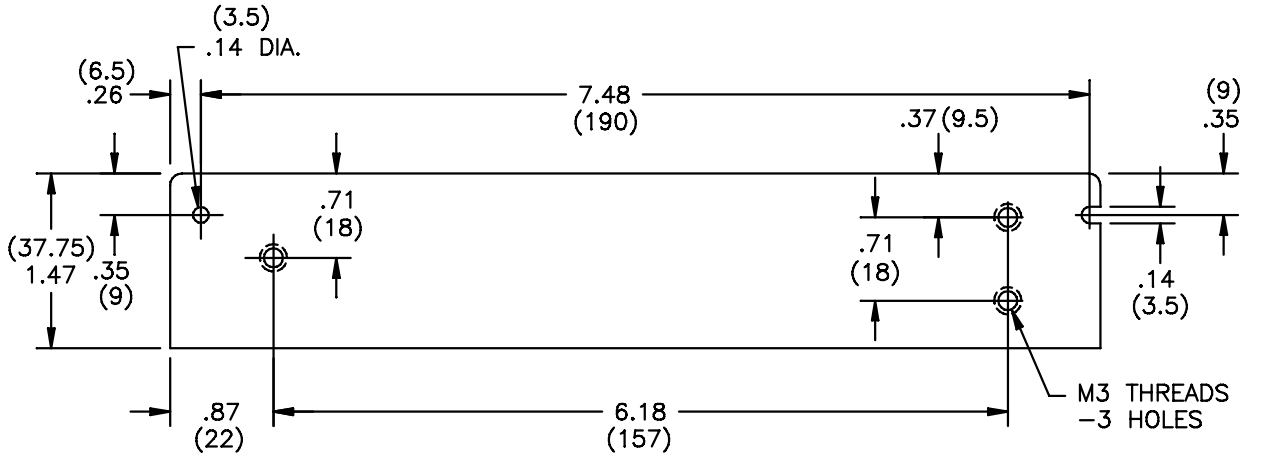


BOTTOM VIEW



SIDE VIEW

762–40015 24VDC POWER SUPPLY MOUNTING HOLES

DIMENSIONS IN INCHES (MILLIMETERS)

OUTPUT: 24VDC @ 4.5 A
INPUT: 85 – 265VAC
50/60 HZ

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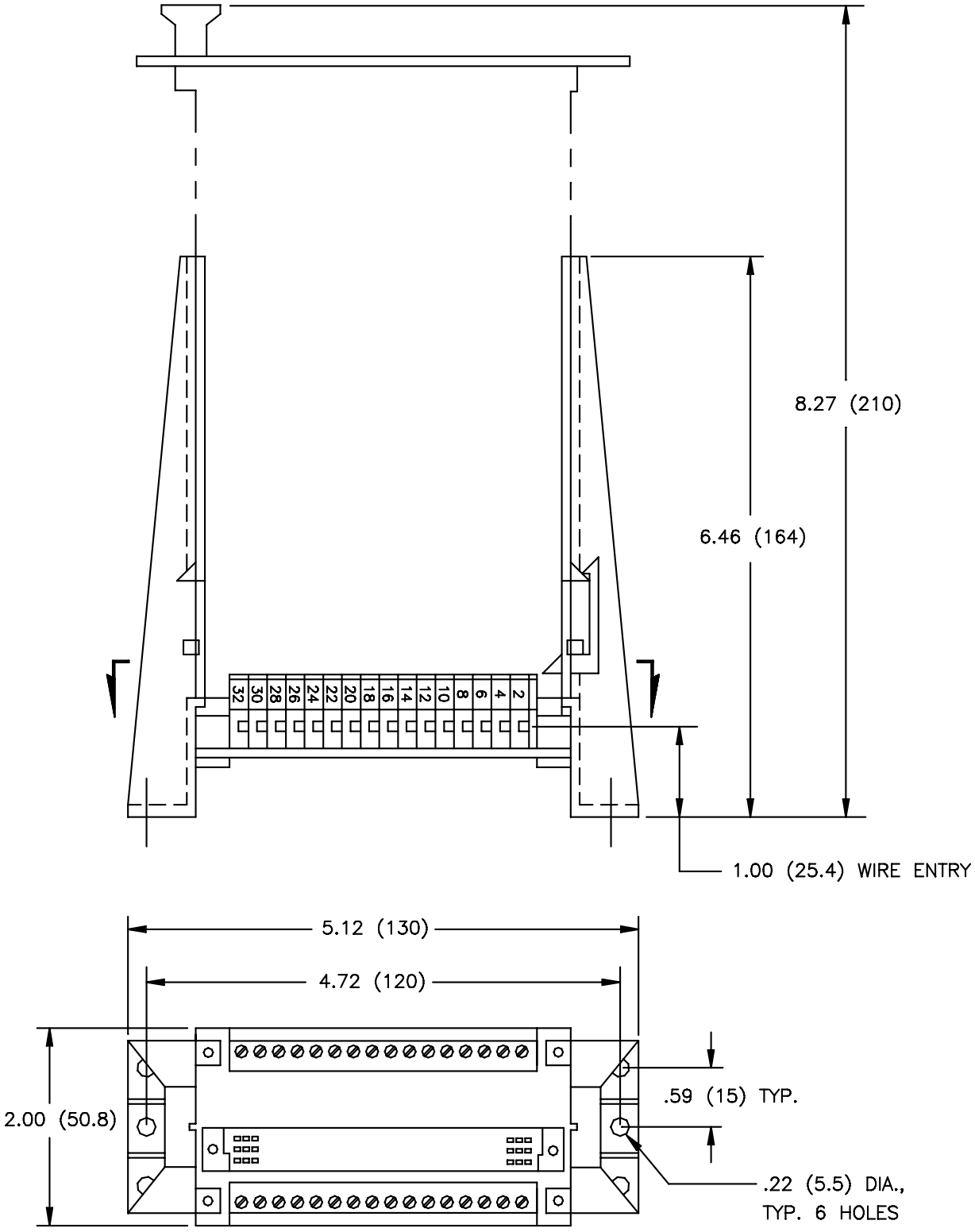

EUROCARD HOLDER

701–00007–8

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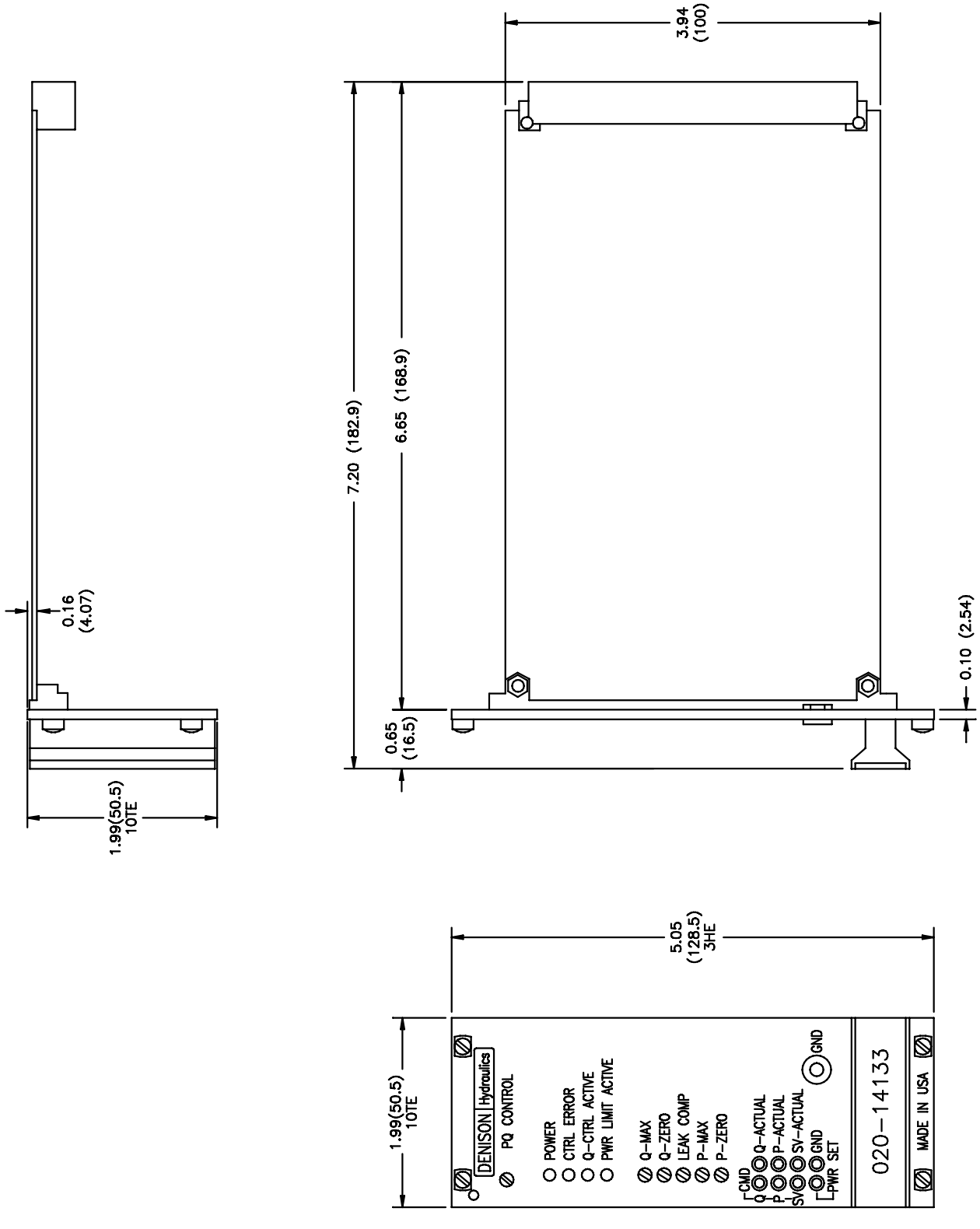

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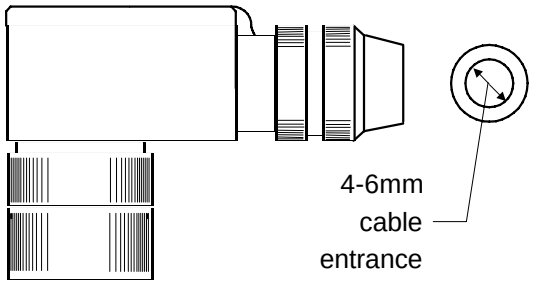
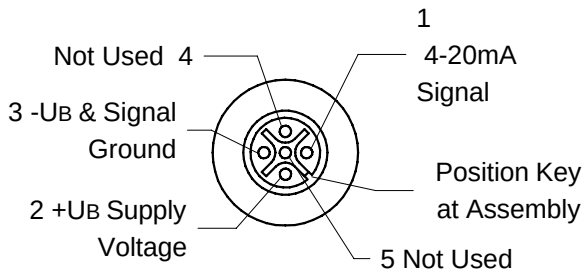
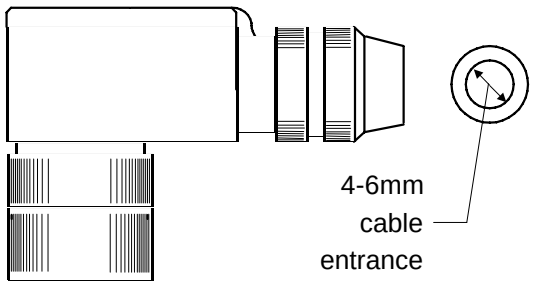
721-30108-0 Mating Connector for Cam Position (Q) Transducer

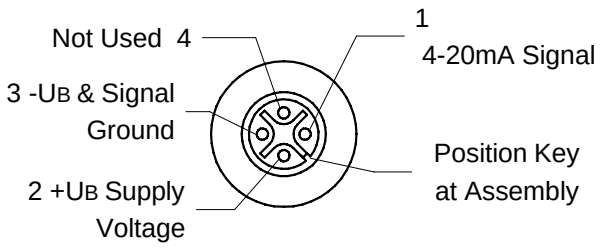




5-Terminal Connector

167-011106-8 Mating Connector for Valve-Spool Position Transducer





4-Terminal Connector

Note: During initial wiring take care not to interchange the above connectors They appear identical, but one is a 4-Terminal and one is a 5-Terminal. The different terminal count for each connector will prevent accidental interchange of the transducers cables during routine system maintenance. The 5-Terminal will fit on the 4-Terminal but not visa versa. The wiring is identical for the two connectors, hence no damage will occur if the 5-Terminal is accidentally plugged into the 4-Terminal transducer.

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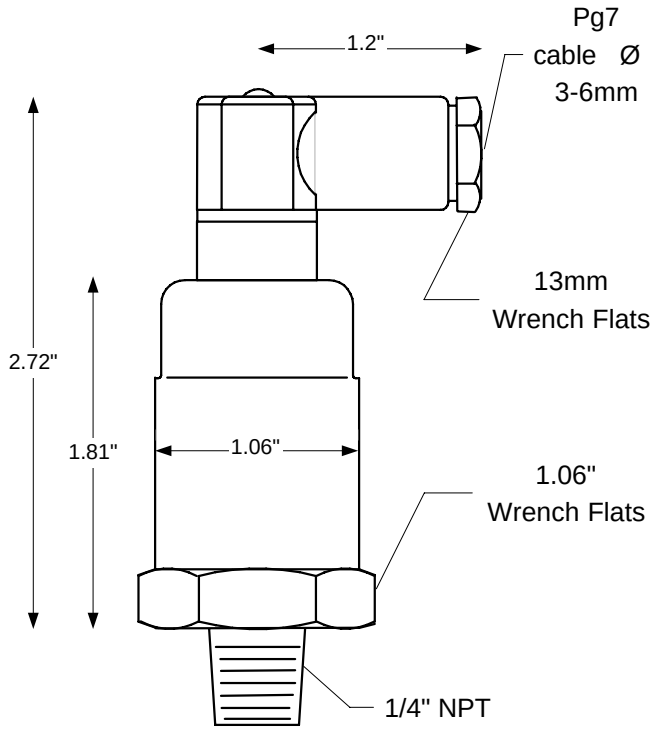
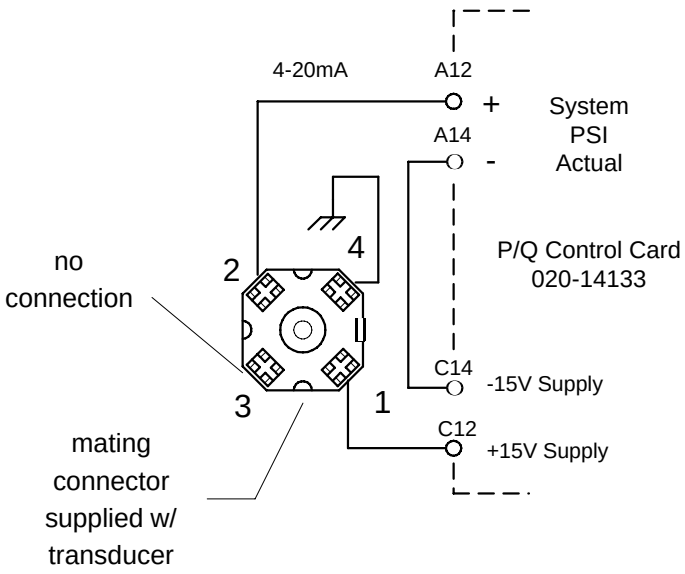


Wiring diagram for 2-Wire pressure transducer, 788-50035, using ±15VDC power supply.



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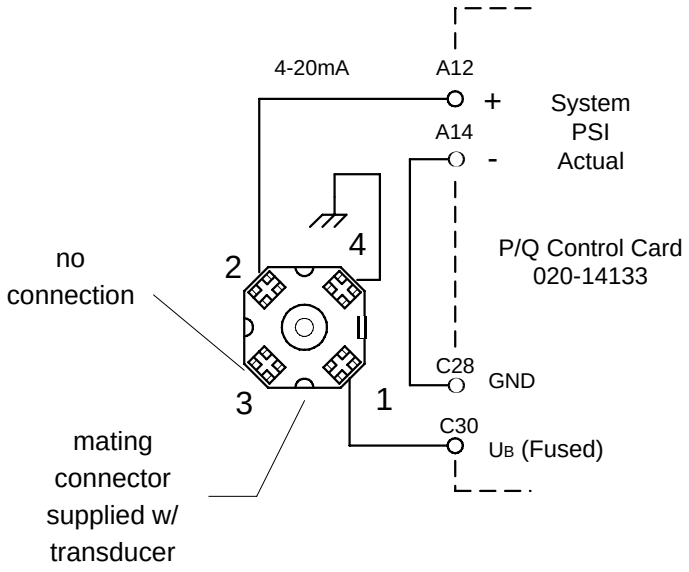
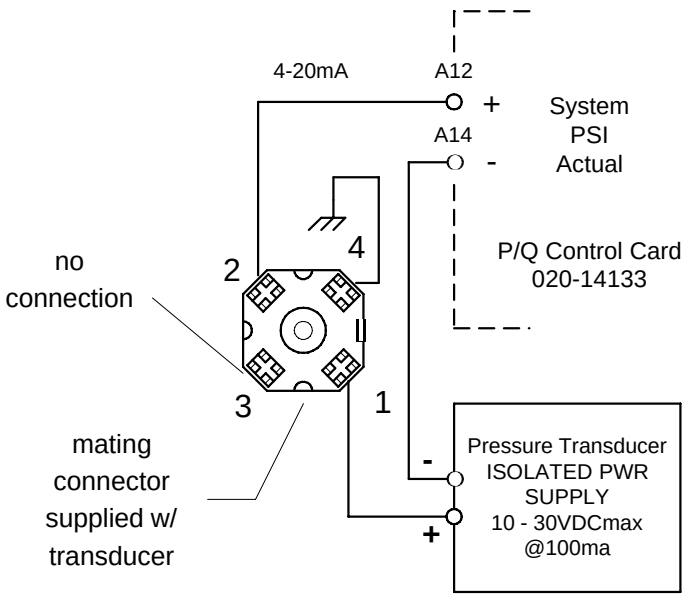
Wiring diagram for 2-Wire pressure transducer, 788-50035, when supply voltage U_B does not exceed 30 volts.



Wiring Diagram for 2-Wire pressure transducer, 788-50035, when using an isolated power supply.



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INSTALLATION & OPERATION GUIDELINES

- For EMC compatiblity see section entitled EMC Installation Guidelines.
- Use Denison Hydraulics recommended power supply P/N 762-40015.
- Use shielded wire on all command and transucer signals. Tie card end of shield to earth ground. Leave other end of shield open.
- Maximum cable length 1000ft with 16AWG wire.
- For safety always turn of power to electronics and hydraulics before removing or inserting PQ Driver Card.
- Monitor test points with high impedance test equipment->100K ohms.

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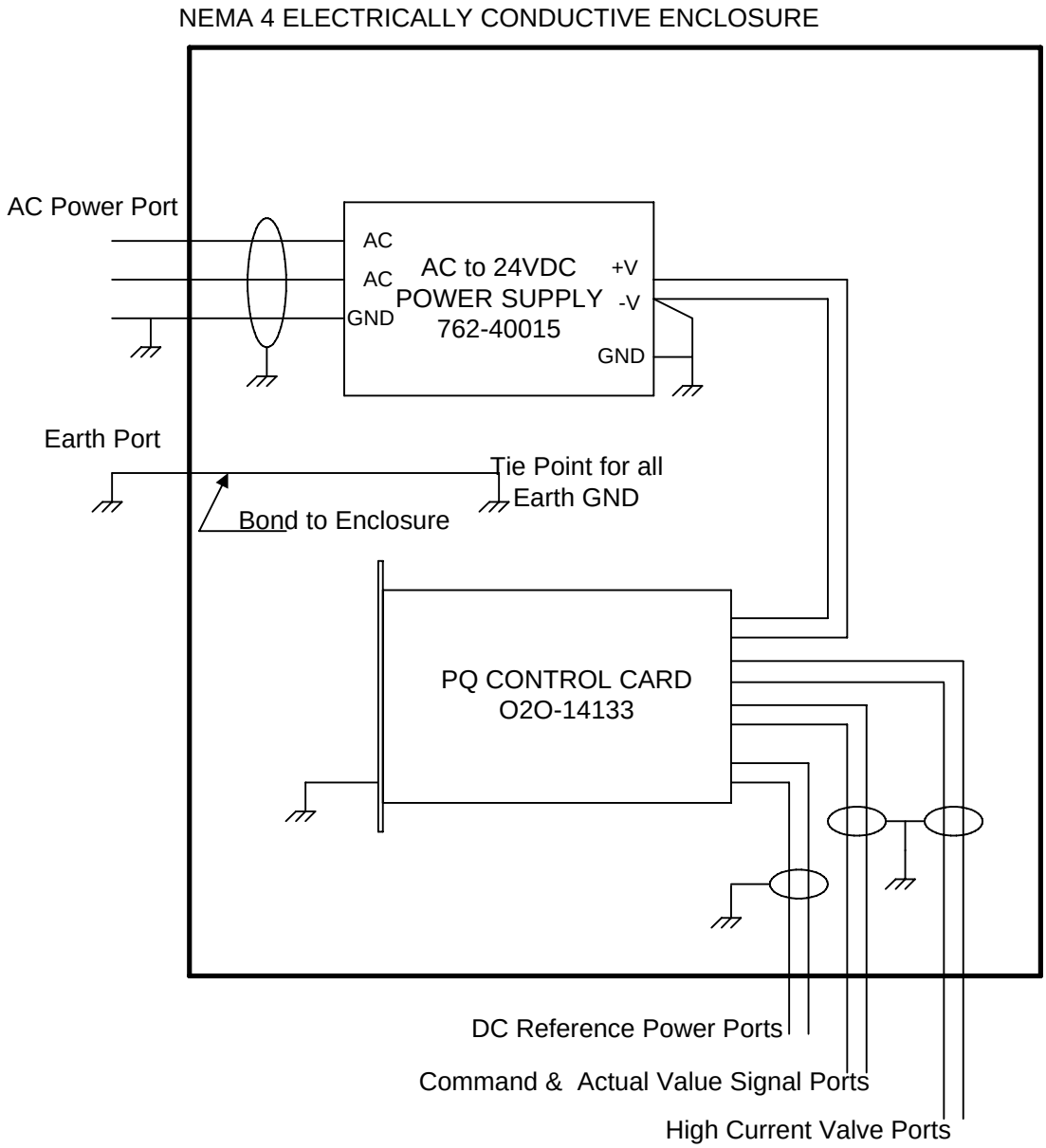

To comply with European EMC Directive 89/336 PQ Driver Card must be installed in NEMA4 enclosure or equivalent.

All cables entering the enclosure must be shielded. Shields to be grounded on one end only at PQ Driver Card 0 volt potential. Other end of shield to be left open.

Use separate cables, as shown, for command signals, DC Reference voltages, high-current solenoid valves and AC power mains.

Separate low-voltage cables from AC power cables.

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SETUP

PSI CONTROLLER OPTIMIZATION				
RANGE SELECTOR	OFF		ON	
SW1 POS.	$T_{95\%}$(msec)	VOL (CU IN)	$T_{95\%}$(msec)	VOL (CU IN)
0	54	416	90	693
1	74	573	110	850
2	90	693	126	970
3	110	850	146	1127
4	135	1040	171	1317
5	155	1197	191	1474
6	171	1317	207	1594
7	191	1474	227	1751
8	54	416	126	970
9	74	573	146	1127
A	90	693	162	1247
B	110	850	182	1404
C	135	1040	207	1594
D	155	1197	227	1751
E	171	1317	243	1871
F	191	1474	263	2028

For larger trapped volumes consult factory.

The above table is a guide for optimizing the pressure control loop. The pressure control loop is dependent on system trapped oil volume--hydraulic lines, actuators and pump. In combination with 16 SW1 settings and the 'ON/OFF' remotely operated range selector switch a broad selection of volumes to match the system is available--54cu in (1/4Gal) to 2028cu in (9 Gals). If the trapped volume changes during the machine cycle due to valve opening and closing, the remote range selector switch can be operated concurrently to switch between two levels of volume. For example, SW1-A with Range Selector OFF is 693 cu in, with Range Selector ON it is 1247 cu in.

Other factors such as operating pressure and the stiffness of the hydraulic system affect the settings. The above table is based on system pressure of 5000 PSI and bulk modulus of 100,000 PSI.

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Australia
DENISON HYDRAULICS Pty. Ltd.
41-43 St. Hillers Road
P.O. Box 192
Auburn, N.S.W. 2144
Tel. (612) 9646 5200
Fax (612) 9643 1305
Other sales offices:
Queensland
South Wantirna Victoria
Western Australia

Austria
DENISON HYDRAULIK GmbH
Zweigniederlassung Linz
Haidbachstraße 69
A-4061 Pasching
Tel. (43) 7229 4887
Fax (43) 7229 63092

Benelux
DENISON HYDRAULICS
BENELUX B. V.
Pascalstraat 100
3316 Dordrecht
Holland
Tel. (31) 786179 900
Fax (31) 786175 755

Canada
DENISON HYDRAULICS
CANADA Inc.
2320 Bristol Circle, Unit 1
Oakville, ON L6H 5S2
Tel. (905) 829 5800
Fax (905) 829 5805
Other sales offices:
Montreal, QC
Calgary, AB

China, P.R.
DENISON HYDRAULICS Ltd.
3F, No. 1, Mao Jia Zhai, Bai Lian Jing
Pudong New Area
Shanghai 200126,
Tel. (86) 21 5886 8991
Fax (86) 21 5886 1978

Denmark
DENISON HYDRAULIK
DENMARK A/S
Industrikrogen 2
DK-2635 Ishöj
Tel. (45) 4371 15 00
Fax (45) 4371 15 16

Finland
DENISON HYDRAULICS
P.O. Box 36
FIN-08101 Lohja
Tel. (358) 208 33 045
Fax (358) 207 33 045

France
DENISON HYDRAULICS
FRANCE SA
14, route du Bois Blanc
BP 539
18105 Vierzon
Tel. (33) 2 48 53 01 20
Fax (33) 2 48 75 02 91
Other sales offices:
Bordeaux
Lyon
Paris

Germany
DENISON HYDRAULIK GmbH
Herderstrasse 26
D-40721 Hilden
Tel. (49) 2103 940-6
Fax (49) 2103 940-880
Other sales offices:
Dresden
Hanover
Stuttgart

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DENISON HYDRAULICS U.K.
Ltd.
Kenmore Road
Wakefield 41, Industrial Estate
Wakefield, WF20XE
West Yorkshire
England
Tel. (44) 19 24 826 021
Fax (44) 19 24 826 146
Other sales offices:
Burgess Hill

Hong Kong, N. T.
DENISON HYDRAULICS Ltd.
Unit 3, 25/F Wharf Cable Tower
9 Hoi Shing Road
Tsuen Wan
Tel. (852) 24988381
Fax (852) 24991522

Italy
DENISON HYDRAULICS S.r.l.
Viale Europa 68
20090 Cusago
Tel. (39) 2 90 33 01
Fax (39) 2 90 39 06 94

Japan
DENISON JAPAN Inc.
4-2-1 Tsujido-Shinmachi
Fujisawa 251,
Tel. (81) 466 35 3257
Fax (81) 466 35 2029
Other sales office:
Osaka

Mexico, Central America, South America and Caribbean Countries Contact
DENISON HYDRAULICS Inc.
6167 NW 181 Terrace Circle North
Miami, FL 33015, USA
Tel. (305) 362 2246
Fax (305) 362 6220

Other European, Middle East and African Countries Contact
DENISON HYDRAULICS
FRANCE SA
14, route du Bois Blanc
BP 539
18105 Vierzon Cedex
France
Tel. (33) 2 48 53 01 45
Fax (33) 2 48 53 01 46

Singapore
DENISON HYDRAULICS S.E.A.
Pte. Ltd.
No. 11 Lorong Tukang Dua
2261 Singapore
Tel. (65) 2687840
Fax (65) 2687847

Spain
DENISON HYDRAULICS, S.A.
Gomis, 1
08023 Barcelona
Tel. (34) 3418 46 87
Fax (34) 3211 65 07
Other sales offices:
San Sebastian

Sweden
DENISON HYDRAULICS
SVENSKA AB
Sporregatan 13
213 77 - Malmö
Tel. (46) 40 21 04 40
Fax (46) 40 21 47 26
Other sales offices:
Spånga

Taiwan, R.O.C.
DENISON HYDRAULICS Ltd.
6F-10, No. 79, Sec. 2, Roosevelt Road
Taipei,
Tel. (886) 2 3645101 / 3645102
Fax (886) 2 3639025

USA
DENISON HYDRAULICS Inc.
14249 Industrial Parkway
Marysville, OH 43040
Tel. 937 644 3915
Fax 937 642 3738
For nearest Distributor:
Call toll free 1 800 551 5956
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Internet: http://www.denisonhydraulics.com
E-mail: denison@denisonhydraulics.com