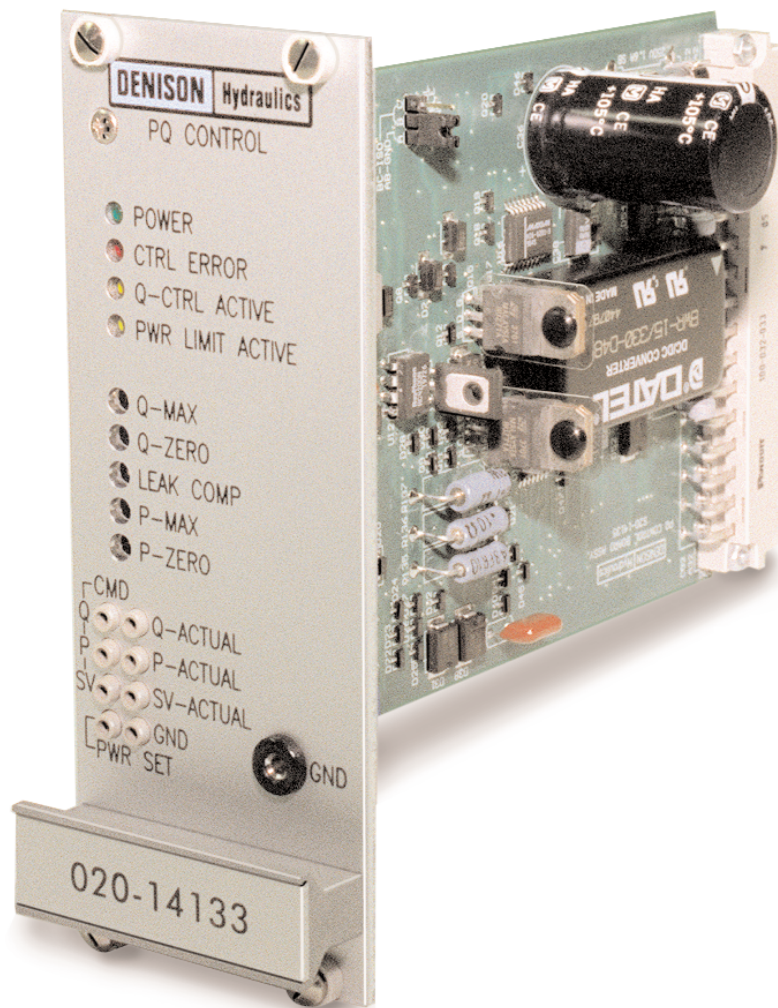


DENISON HYDRAULICS

PQ Control Card

020-14133



Publ. LT2-00052-1

DENISON Hydraulics

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

www.comoso.com

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 industry ¹ 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	<p>The product was tested in an EMC TEST Laboratory and herewith complies with the EMC Directive 89/336 and the CE Marking requirements.</p> <p>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).</p>
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 Manager DENISON HYDRAULICS GmbH Auf dem Sand 14 D-40721 Hilden

See installation & Operation Guidelines under Procedures

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

	PAGE
European EMC Directive 89/336/EEC Declaration of Conformity	i
features & general description	ii
table of contents	iii
technical specifications	1-2
block diagram	3
circuit description	4
installation drawings	5-12
locator for indicators and adjustments	5
power supply dimensional outline and installation drawing	6
cardholder, dimensional outline & installation	7
pc board assembly dimensional outline	8
connector Q-feedback outline and wiring	9
connector valve spool feedback outline and wiring	9
pressure transducer dimensional outline	10
connector pressure transducer wiring for ± 15 power source	10
connector pressure transducer wiring for power < 30VDC	11
connector pressure transducer wiring for isolated power supply	11
procedures	12-14
installation & operating guidelines	12
EMC installation guidelines	13
psi controller optimization	14
sales and service worldwide	16

P/Q DRIVER CARD

DHI P/N S20-14133

POWER SUPPLY VOLTAGE U_B

--maximum U_{Bmax}
 --minimum U_{Bmin}

24VDC nominal
 35VDC continuous
 21.5VDC continuous

Current Requirement @ U_{Bnom}
 Fuse, onboard (serviceable)

660mA (1.5 Amps max momentary)
 1.6A T (slo blo) 5x20mm

INPUTS

--Q-Command (Flow Setpoint)
 --P-Command (Sys. PSI Setpoint)
 --Q-Actual (pump cam angle)
 --P-Actual (System PSI)
 --Power Command (P*Q Setpoint))
 --Control Enable
 --PSI Compensator RangeSwitch

0 to +10VDC (differential input impedance 67K ohms)
 0 to +10VDC (differential input impedance 67K ohms)
 4-20mA into 100 ohm load
 4-20mA into 100 ohm load (differential input)
 0 to +10VDC (differential input impedance 50K ohms)
 15 to 35VDC (input impedance 10K ohms) isolated voltage option
 15 to 35VDC (input impedance 10K ohms) isolated voltage option

OUTPUTS

--Solenoids A & B currents I_{max}
 $I_{nom.}$

2.8 Amps (momentary)
 850 mA (@ steady state)

Solenoids A & B operate in differential current mode. When A-solenoid increases, B-solenoid decreases and vice versa.

--Q-Actual (I/V signal conditioned)
 --P-Actual (I/V signal conditioned)
 --Cam Control Active
 --Power Limit Active
 --Control Ready

-2 to +10VDC (5K min impedance)
 0 to +10VDC (5K min impedance)
 U_B -5V = Active (short-circuit protected)
 U_B -5V = Active (short-circuit protected)
 U_B -5V = Ready, 0 Volts = Control Error (min. load resistance 500 ohms, 60mA max, short-circuit protected)
 ± 15 VDC @ 100mA (for pressure transducer, etc. if needed)
 $+10$ VDC @ 10mA (for command pot excitation if needed)

--Auxillary Voltage Sources

INDICATORS, FRONT PANEL

-- Power
 -- CTRL Error
 -- Q-CTRL Active
 -- PWR Limit Active

LED Green
 LED Red
 LED Yellow
 LED Yellow

ADJUSTERS, FRONT PANEL

--Q-Max
 --Q-Zero
 --Leakage Compensator
 --P-Max
 --P-Zero

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

TEST POINTS, FRONT PANEL

--Q-Command
 --Q-Actual
 --P-Command
 --P-Actual
 --SV-Command
 --SV-Actual
 --Power Limit Set Command
 --Ground Reference
 --Ground Ref (for large test probe)

0 to -10VDC (reduced when PWR LMT is active) 1.8K output impedance
 -2 to +10VDC 1.8K output impedance
 0 to +10VDC (same as input) 1.8K output impedance
 0 to +10VDC 1.8K output impedance
 0V normal, ± 10 VDC momentary
 0V normal, ± 5 VDC momentary
 0 to +10VDC
 Signal ground, power ground, chassis ground
 Test receptacle grounded at Front Panel for ESD immunity.

CONNECTOR TYPE

32-Pin Male DIN 41612 Form D

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)

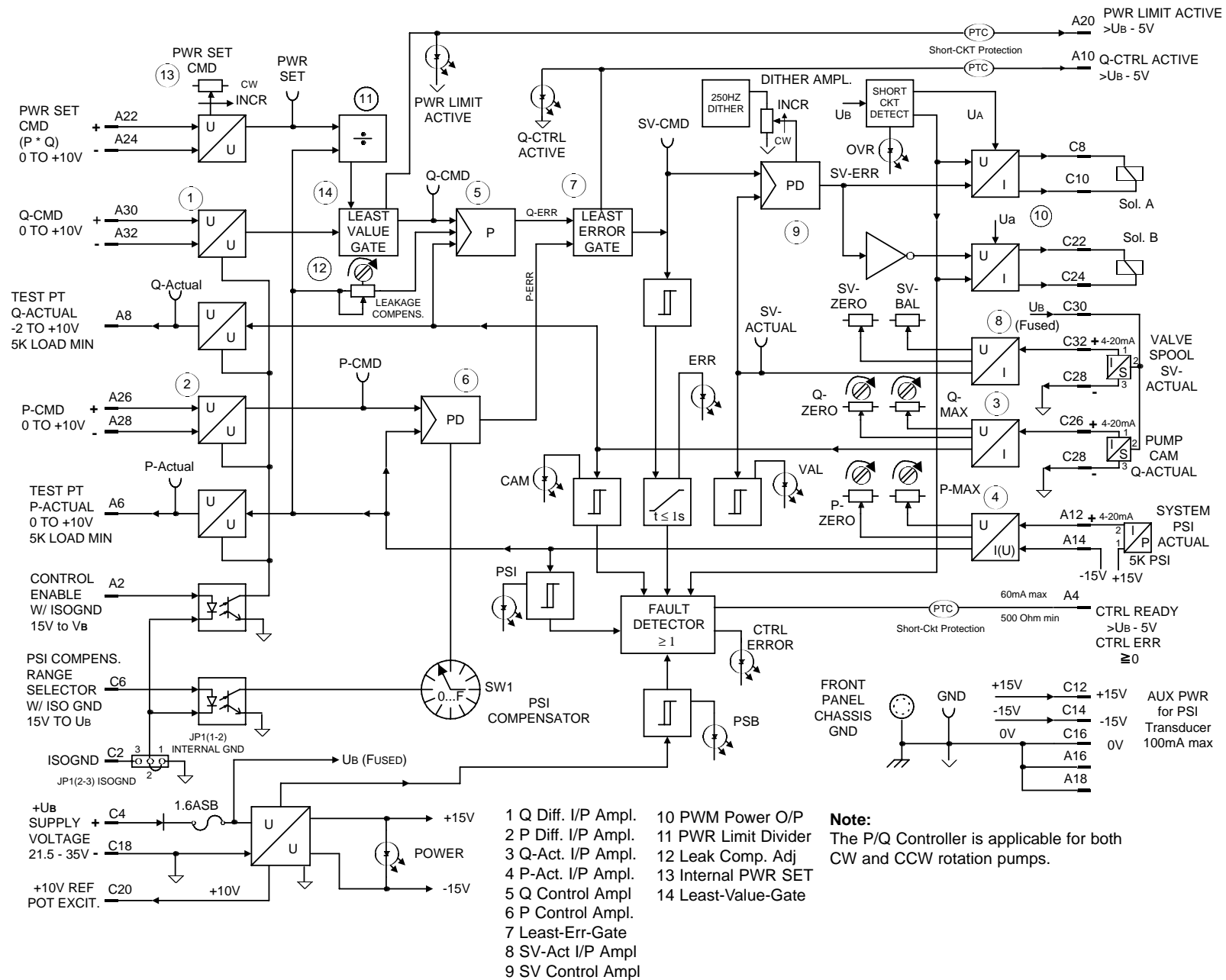
--Sensor type	Denison P/N 788-30012
--Linear range	Linear differential transformer
--Supply voltage	0.236" (±3mm)
--Supply current	18-36VDC (Reverse polarity protected)
--Output	50mA
--Linearity	4-20mA (Extended -3mm = 4mA; Retracted +3mm = 20mA)
--Sensitivity	±1.5%
--Offset	2.667mA/mm (factory set, do not change)
--Operating temperature	±1mm (user adjustable)
--Connector type	0 to 80°C
--Connector, Mating	Binder Series 713 5-Pin male M12x1 Threads
	Denison P/N 721-30108

PRESSURE TRANSDUCER

--Supply voltage	Denison P/N 788-50035
--Operating pressure	10-30VDC or ±15VDC (Reverse polarity and overvoltage protected)
--Overload pressure	0 to 5000PSI (350 Bar)
--Burst pressure	200% Operating (will not destroy, but may shift calibration point)
--Output	450% Operating (will cause permanent damage or complete destruction)
--Linearity	4-20mA (2-Wire system)
--Operating temperature	0.5% of span
--Connector type	0 to 80°C
--Connector, Mating	Compact appliance 4-Pole Male
--Hydraulic connection	Compact 4-Pole Female Hirschmann Series G4W1F P/N 932 157-100
--Environmental	1/4 NPT male
	NEMA 5 / IP65

VALVE SPOOL TRANSDUCER

--Sensor type	Supplied as part of valve assembly
--Linear range	Linear differential transformer
--Supply voltage	±0.8mm
--Supply current	18 to 35VDC (Reverse polarity protected)
--Output	50mA
--Sensitivity	4-20mA (12mA near hydraulic null)
--Offset	2.667mA/mm factory set not not adjust
--Operating temperature	factory set do not adjust
--Connector type	0 to 80°C
--Connector, Mating	Binder Series 713 4-Pin male M12x1 Threads
	Denison P/N 167-01106-8



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 hysteresis.

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 ($P \times Q$) 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 UB and $\pm 15\text{VDC}$ 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 $\pm 15\text{VDC}$; ERR, excess-control error, SV-CMD, for >1 second; OVR, over-current or

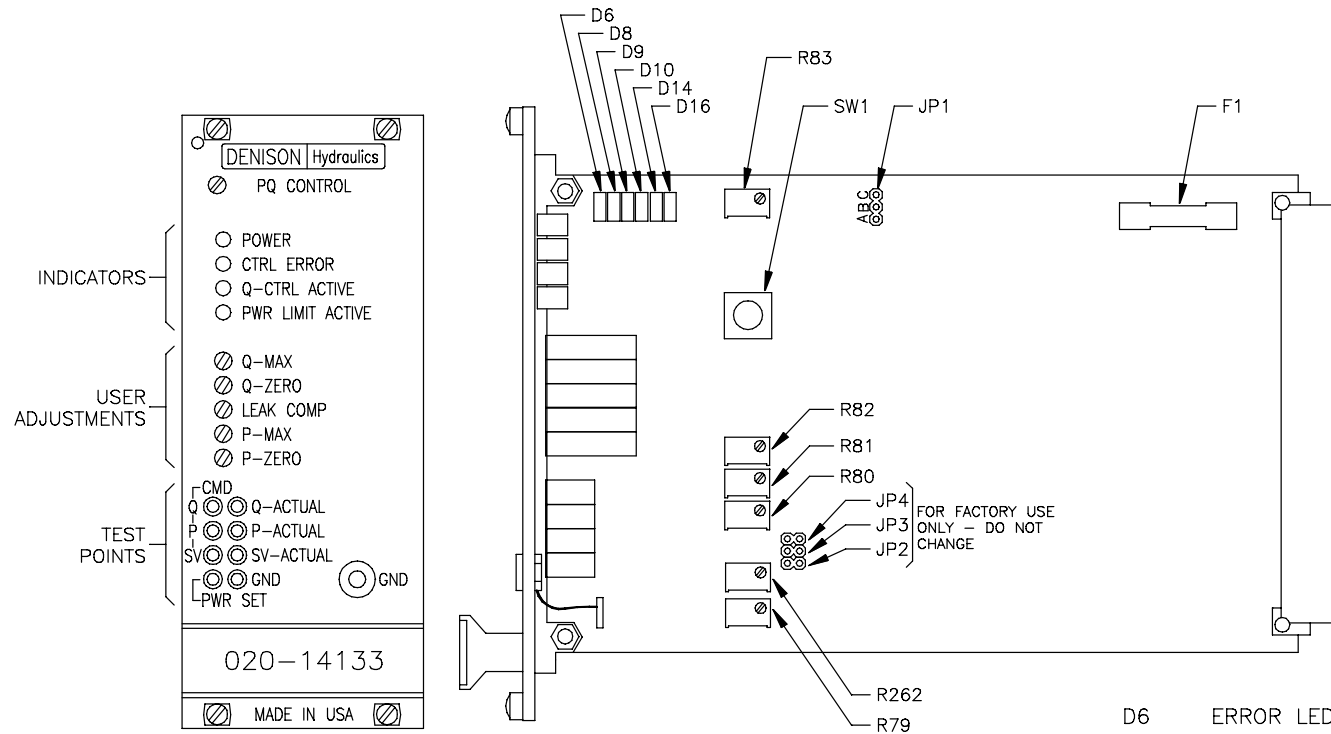
short-circuit at the PWM power amplifier (10). Any detected fault will lite the CTRL ERROR LED and force a high-to-low signal change at the CTRL Ready terminal, A4. The OVR fault monitor will also shut-off the PWM power amplifier to protect the electronic drivers. The P/Q Driver Card must be de-energized 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 connected 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.



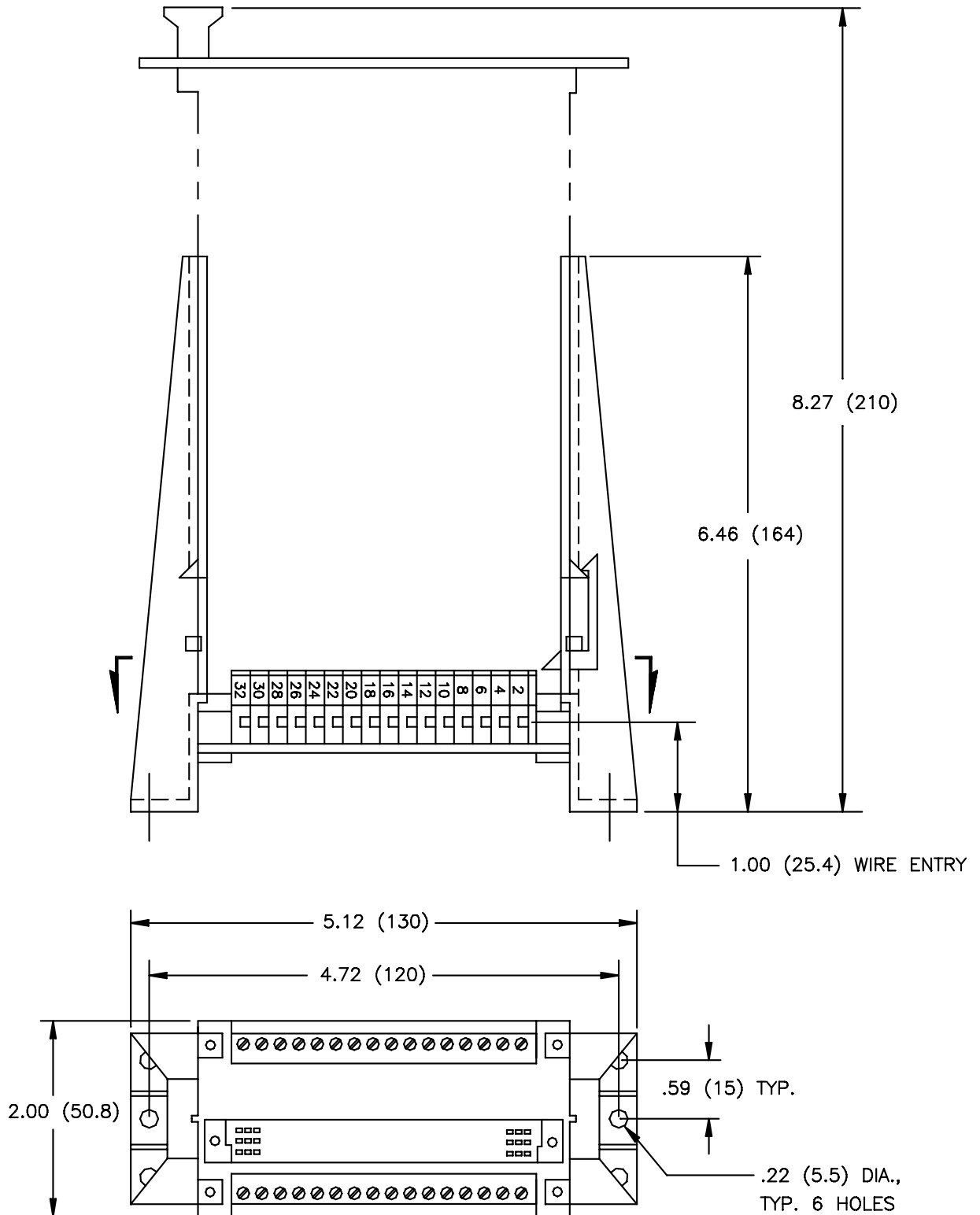
ITEM	DESCRIPTION	ITEM	DESCRIPTION
D1	POWER LIMIT ACTIVE LED	R11	Q-MAX POT
D2	Q-CTRL ACTIVE LED	R79	SV-BIAS
D3	CTRL ERROR LED	R80	SV-BAL
D4	POWER LED	R81	SV-ZERO
F1	FUSE 1.6A SB	R82	PWR SET
JP1	A-B:INTERNAL GND B-C:ISOLATED GND	R83	PSI P-GAIN
JP2	FACTORY USE ONLY-DO NOT CHANGE	R262	DITHER AMPLITUDE
JP3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

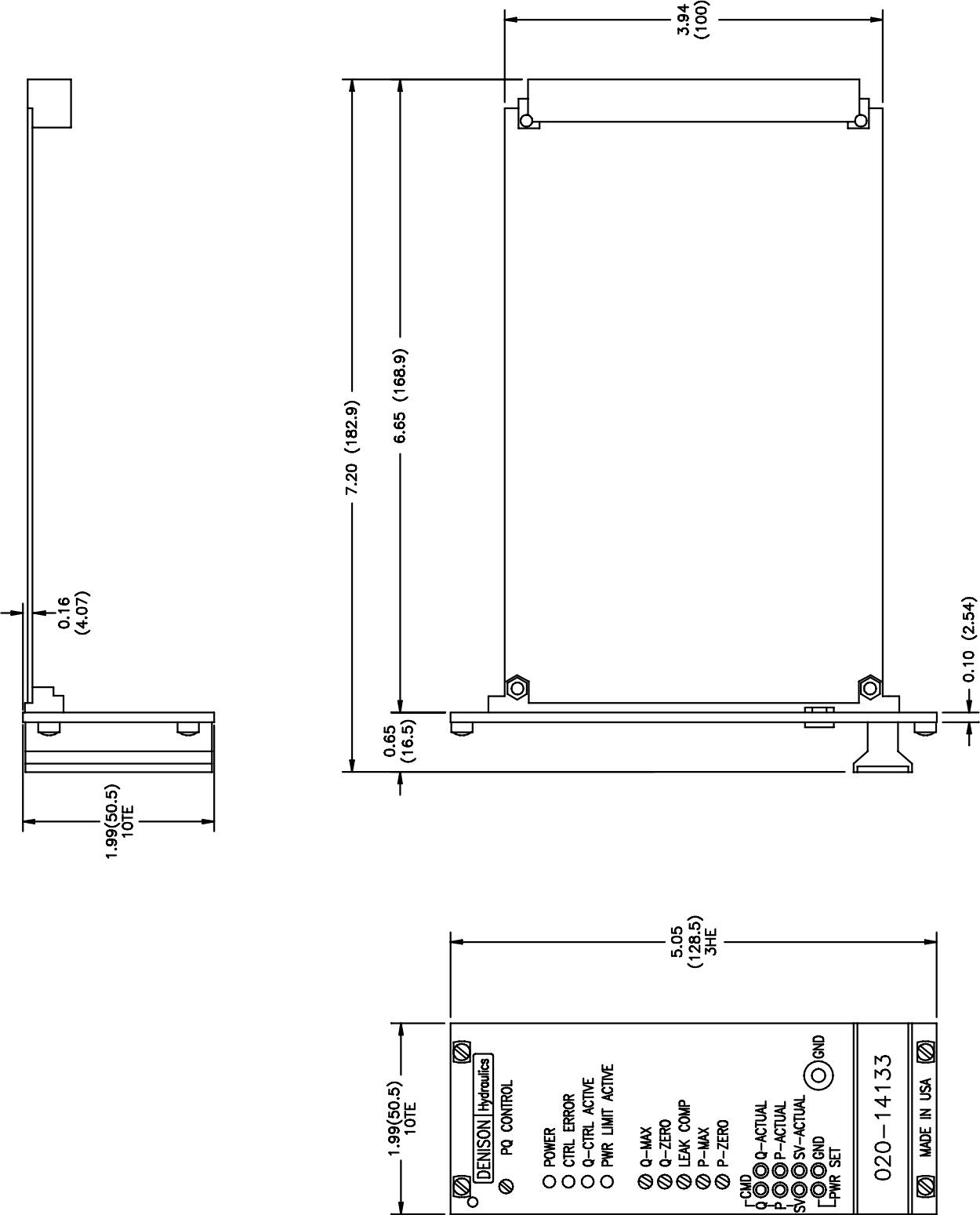


762-40015 24VDC POWER SUPPLY MOUNTING HOLES
DIMENSIONS IN INCHES (MILLIMETERS)

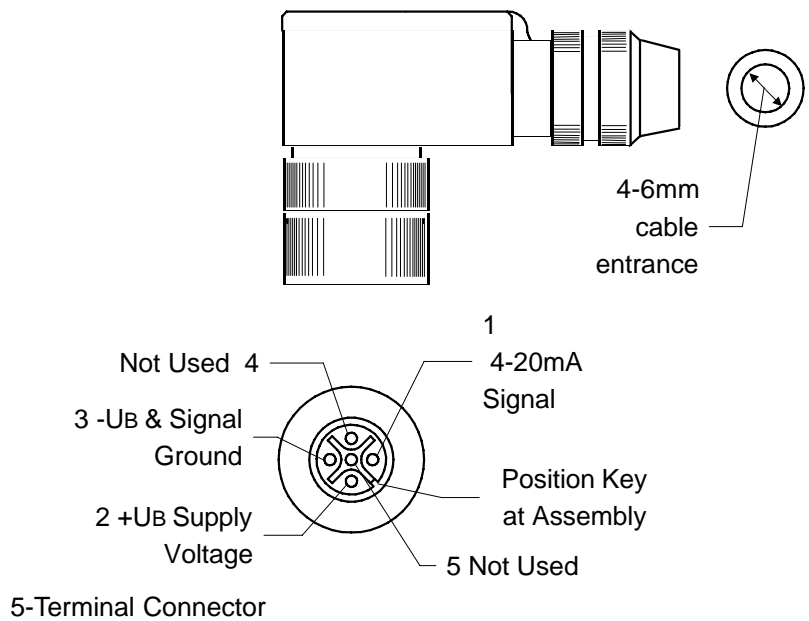
OUTPUT: 24VDC @ 4.5 A
INPUT: 85 – 265VAC
50/60 HZ



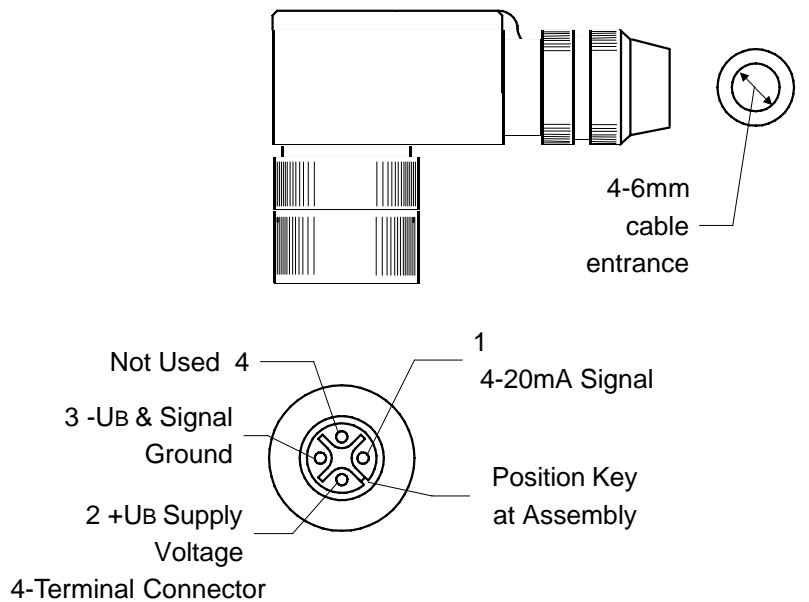
EUROCARD HOLDER
701-00007-8



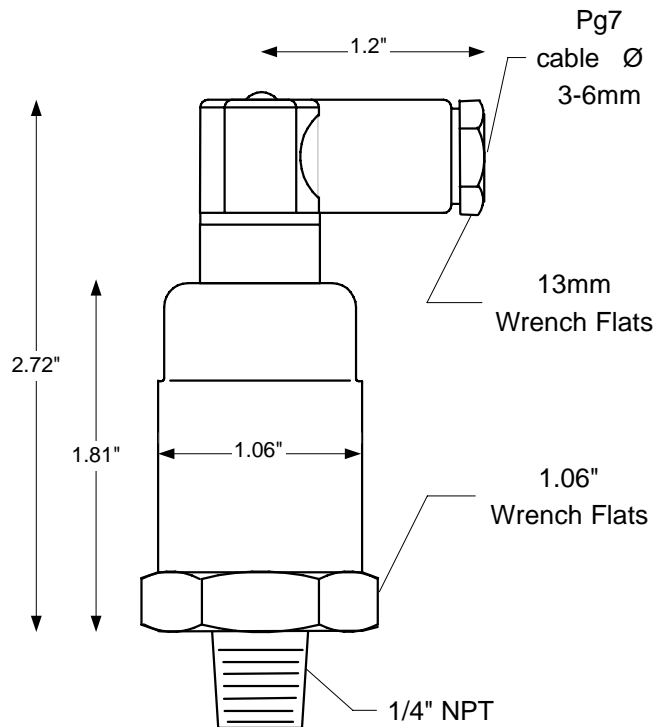
721-30108-0 Mating Connector for Cam Position (Q) Transducer



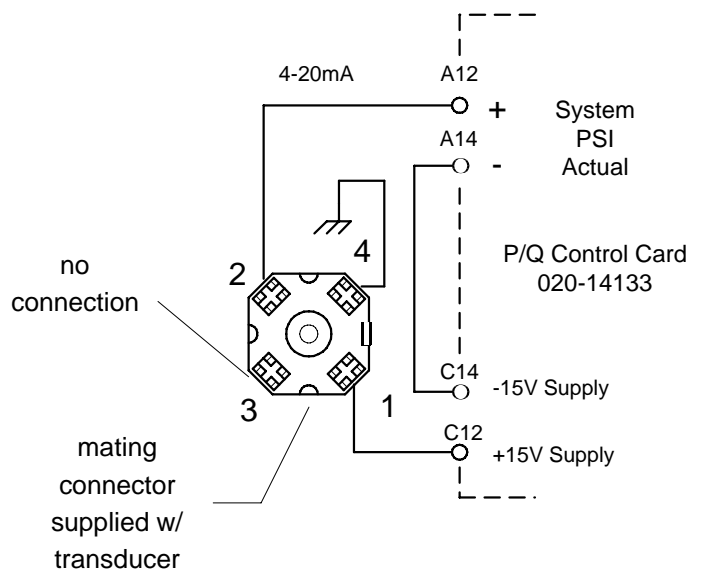
167-011106-8 Mating Connector for Valve-Spool Position Transducer



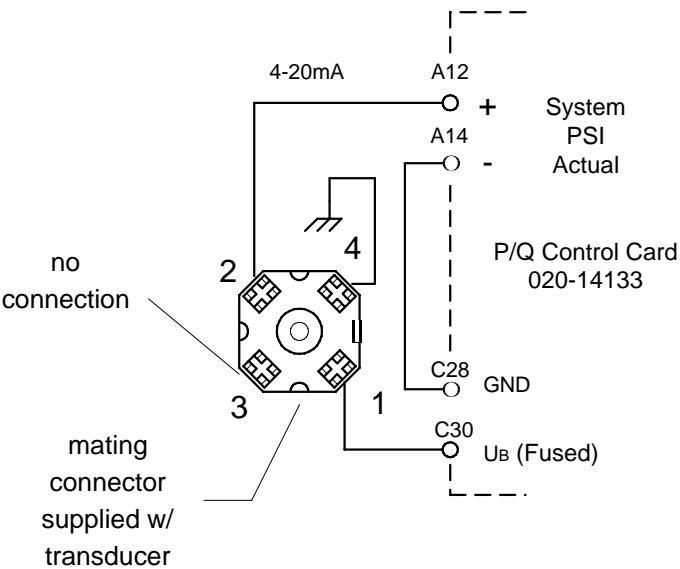
Note: During initial wiring take care not to interchange the above connectors. They appear identical, but one is a 4-Terminal and one is a 5-Terminal. The different terminal count for each connector will prevent accidental interchange of the transducers cables during routine system maintenance. The 5-Terminal 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.



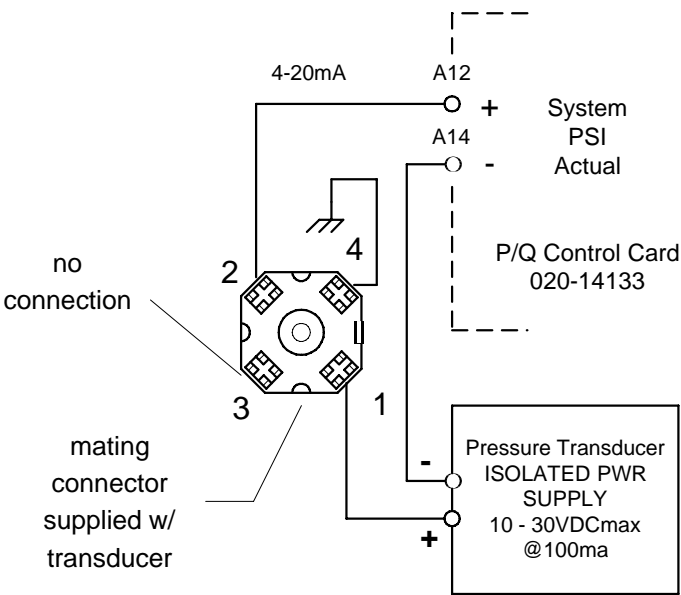
Wiring diagram for 2-Wire pressure transducer, 788-50035, using $\pm 15\text{VDC}$ power supply.



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



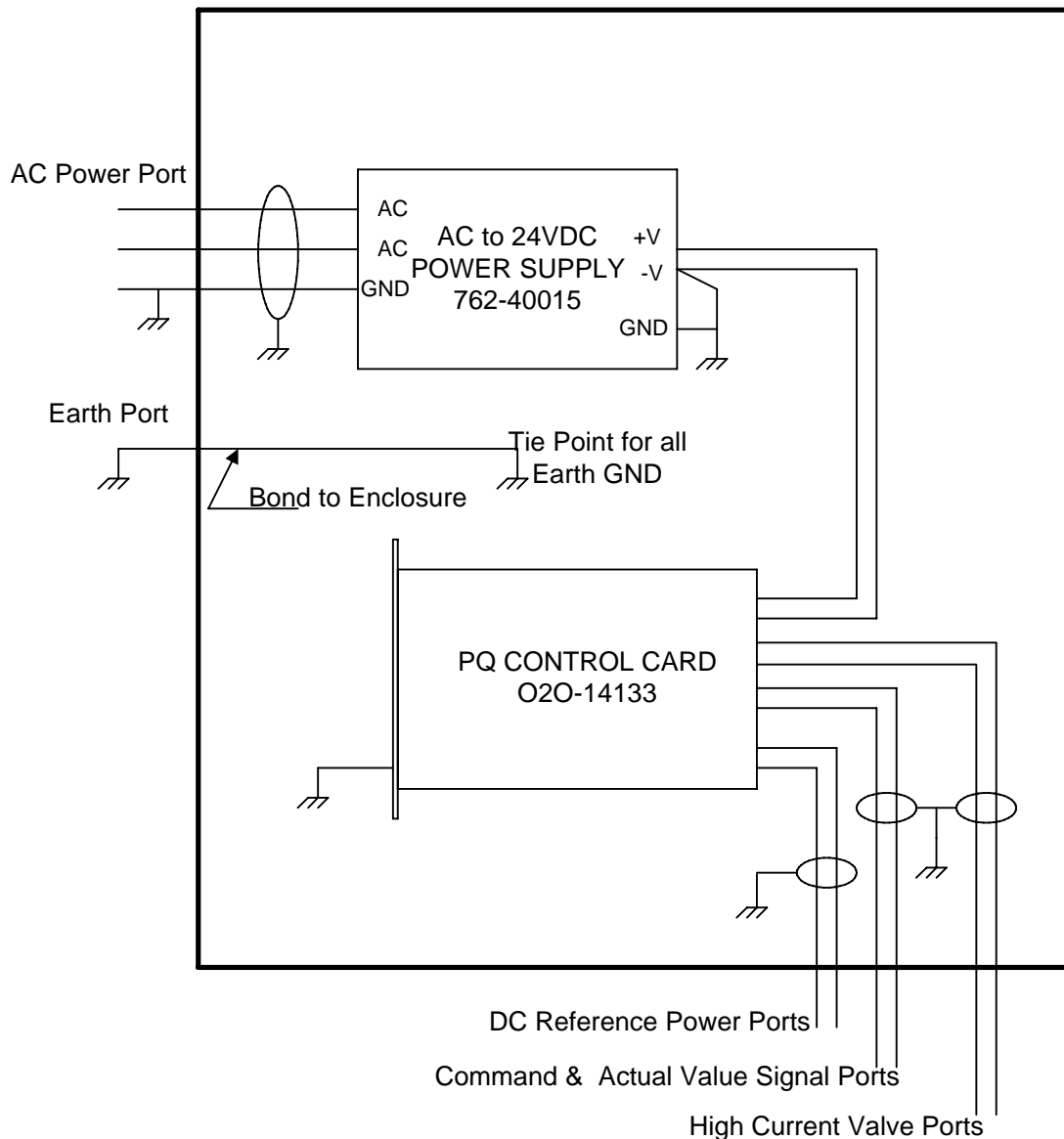
Wiring Diagram for 2-Wire pressure transducer, 788-50035, when using an isolated power supply.



**INSTALLATION & OPERATION
GUIDELINES**

- For EMC compatibility see section entitled EMC Installation Guidelines.
- Use Denison Hydraulics recommended power supply P/N 762-40015.
- Use shielded wire on all command and transducer 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.

NEMA 4 ELECTRICALLY CONDUCTIVE ENCLOSURE



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.

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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