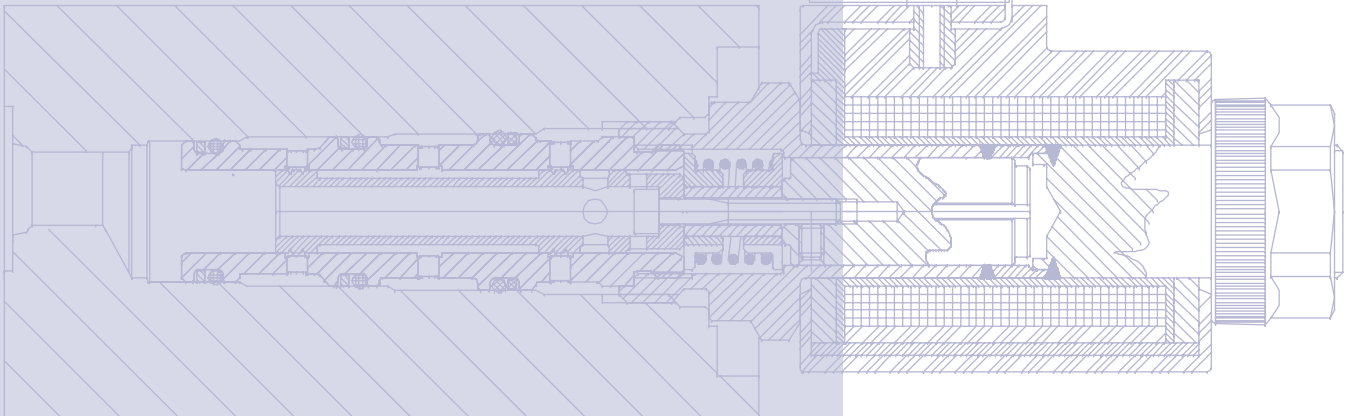




# Proportional Solenoid Valves

## Product Electrical Installation

### Tech Note





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# ditional Solenoid Valves Product Electrical Installation Tech Note Revisions

## Version

## Revisions

| Date         | Page | Changed | Rev. |
|--------------|------|---------|------|
| 10 Apr, 2007 |      |         | AA   |

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Front cover illustrations: 2427, 2399



# Proportional Solenoid Valves

## Product Electrical Installation Tech Note

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**References**

Refer to *Cartridge Valves Technical Information 520L0588* for complete product electrical and mechanical specifications.

Refer to *Cartridge Valves Function Block User Manual 11013500* for compliant function block set-up information.

Technical literature is available at: [www.sauer-danfoss.com](http://www.sauer-danfoss.com)

# Proportional Solenoid Valves

## Product Electrical Installation Tech Note

### Product Overview

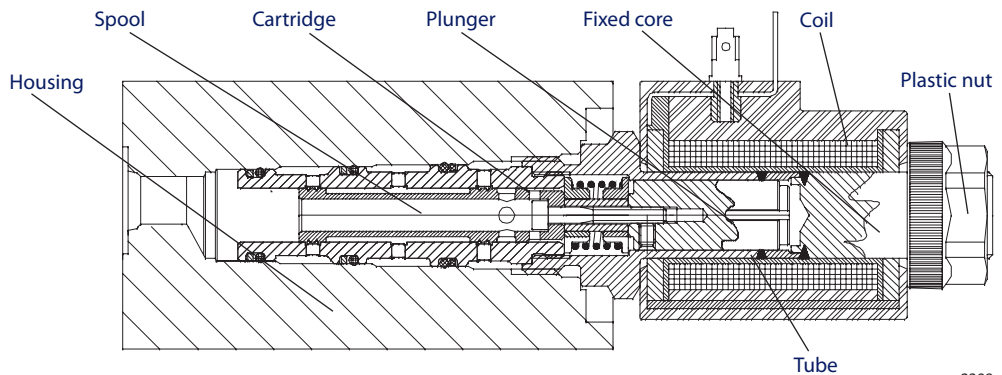
#### Product Image



#### Description/ Theory of Operation

A proportional solenoid valve provides infinitely variable control of flow, pressure, or direction in response to an electric input signal. The electric signal utilizes a current control feature in the driver and a pulse width modulation (PWM) output. It is necessary to utilize a current control driver because it outputs a constant current regardless of changes in system voltage, line losses or temperature. Generally, the PWM is a square wave from 80 to 500 Hz, however, a 100 to 200 Hz signal is recommended.

#### Basic Components of a Solenoid and Proportional Valve



**Coil** is a winding of enamelled copper wire, able to withstand high temperatures and then encapsulated in melted plastic or resin. There could be two wires that exit this plastic covering so that they can be connected externally.

**Tube** is made up of a **plunger** and a **fixed core**. When electricity passes through the coil it creates a magnetic field that causes them to attract.



## Proportional Solenoid Valves

### Product Electrical Installation Tech Note

### Product Overview

#### Electrical Specifications

#### Coil Specifications

|  | D08        |            | D10 - 30 Watt |            | D14E       |            |
|--|------------|------------|---------------|------------|------------|------------|
| <b>Voltage (V)</b>                               | 12 Vdc     | 24 Vdc     | 12 Vdc        | 24 Vdc     | 12 Vdc     | 24 Vdc     |
| <b>Rated Current at 20°C [68°F]</b>              | 1330 mA    | 665 mA     | 2500 mA       | 1300 mA    | 2500 mA    | 1300 mA    |
| <b>Rated Power</b>                               | 16 W       | 16 W       | 30 W          | 30 W       | 30 W       | 30 W       |
| <b>Coil Resistance at 20°C [68°F]</b>            | 9 Ω        | 36 Ω       | 4.8 Ω         | 19 Ω       | 4.8 Ω      | 19 Ω       |
| <b>Coil Resistance at 60°C [140°F]</b>           | 12.4 Ω     | 49.7 Ω     | 6.6 Ω         | 26.2 Ω     | 6.6 Ω      | 26.2 Ω     |
| <b>PWM Frequency Range</b>                       | 100-200 Hz | 100-200 Hz | 100-200 Hz    | 100-200 Hz | 100-200 Hz | 100-200 Hz |
| <b>Recommended PWM Frequency (see not below)</b> | 125 Hz     | 125 Hz     | 125 Hz        | 125 Hz     | 125 Hz     | 125 Hz     |

|  | M13        |            | M16        |            | M19P       |            |
|--|------------|------------|------------|------------|------------|------------|
| <b>Voltage (V)</b>                               | 12 Vdc     | 24 Vdc     | 12 Vdc     | 24 Vdc     | 12 Vdc     | 24 Vdc     |
| <b>Rated Current at 20°C [68°F]</b>              | 1700 mA    | 850 mA     | 2100 mA    | 1050 mA    | 2700 mA    | 1350 mA    |
| <b>Rated Power</b>                               | 20 W       | 20 W       | 26 W       | 26 W       | 33 W       | 33 W       |
| <b>Coil Resistance at 20°C [68°F]</b>            | 7.2 Ω      | 29 Ω       | 5.6 Ω      | 22 Ω       | 4.4 Ω      | 17 Ω       |
| <b>Coil Resistance at 40°C [140°F]</b>           | 8.7 Ω      | 35.2 Ω     | 6.8 Ω      | 26.7 Ω     | 5.3 Ω      | 20.7 Ω     |
| <b>PWM Frequency Range</b>                       | 100-200 Hz | 100-200 Hz | 100-200 Hz | 100-200 Hz | 100-200 Hz | 100-200 Hz |
| <b>Recommended PWM Frequency (see not below)</b> | 125 Hz     | 125 Hz     | 125 Hz     | 125 Hz     | 125 Hz     | 125 Hz     |

|  | R13        |            | R16        |            |
|--|------------|------------|------------|------------|
| <b>Voltage (V)</b>                               | 12 Vdc     | 24 Vdc     | 12 Vdc     | 24 Vdc     |
| <b>Rated Current at 20°C [68°F]</b>              | 1340 mA    | 670 mA     | 1740 mA    | 870 mA     |
| <b>Rated Power</b>                               | 16 W       | 16 W       | 20 W       | 20 W       |
| <b>Coil Resistance at 20°C [68°F]</b>            | 9 Ω        | 36 Ω       | 6.9 Ω      | 28 Ω       |
| <b>Coil Resistance at 40°C [140°F]</b>           | 10.9 Ω     | 43.7 Ω     | 8.4 Ω      | 34 Ω       |
| <b>PWM Frequency Range</b>                       | 100-200 Hz | 100-200 Hz | 100-200 Hz | 100-200 Hz |
| <b>Recommended PWM Frequency (see not below)</b> | 125 Hz     | 125 Hz     | 125 Hz     | 125 Hz     |



## Proportional Solenoid Valves

### Product Electrical Installation Tech Note

### Product Overview

#### Electrical Specifications (continued)

#### Coil Specifications (continued)

|  | PD03       |            | PD05       |            |
|--|------------|------------|------------|------------|
|  | 12 Vdc     | 24 Vdc     | 12 Vdc     | 24 Vdc     |
| <b>Voltage (V)</b>                               | 12 Vdc     | 24 Vdc     | 12 Vdc     | 24 Vdc     |
| <b>Rated Current at 20°C [68°F]</b>              | 2700 mA    | 1350 mA    | 2500 mA    | 1250 mA    |
| <b>Rated Power</b>                               | 40 W       | 40 W       | 30 W       | 30 W       |
| <b>Coil Resistance at 20°C [68°F]</b>            | 4.4 Ω      | 18.6 Ω     | 2.3 Ω      | 13 Ω       |
| <b>Coil Resistance at 50°C [140°F]</b>           | 6.8 Ω      | 28.7 Ω     | 3 Ω        | 16.9 Ω     |
| <b>PWM Frequency Range</b>                       | 100-200 Hz | 100-200 Hz | 100-200 Hz | 100-200 Hz |
| <b>Recommended PWM Frequency (see not below)</b> | 125 Hz     | 125 Hz     | 125 Hz     | 125 Hz     |

Refer to *Cartridge Valves Technical Information 520L0588* for all the other coil specifications. The valve chosen will determine the coil specifications.

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Verify the PWM Frequency is set correctly in the PLUS+1™ controller. The default is set at 4000 Hz which will significantly reduce the proportional valve performance.

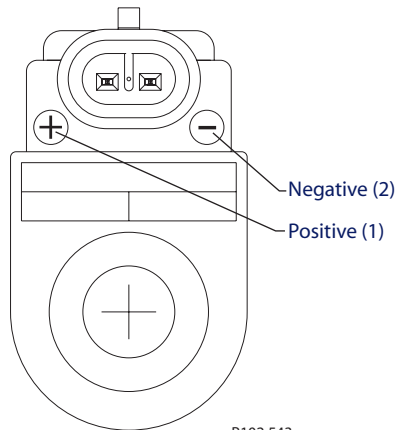
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roportional Solenoid Valves  
 Product Electrical Installation Tech Note  
 Electrical Installation

**Pinout**

*Connection Arrangement*



All coils are clearly marked to identify the connection arrangement. The figure shows one method of identification. Another method identifies the connection arrangement with the number one as positive and the number two as negative. If the coil uses lead wires they will be color coded red as positive and black as negative. If both wires are black then the connection arrangement does not matter.

*Pinout*

| Pin | Description |
|-----|-------------|
| 1   | PWM signal  |
| 2   | Ground      |

**Pin Compatibility**

*PLUS+1 Module Pin Type/ Cartridge Valve Pin Compatibility*

| PLUS+1 Module Pin Type | Acceptable Use: Device Pin Number |
|------------------------|-----------------------------------|
| PWMOUT/DOUT/PVGOUT     | 1                                 |
| Power ground -         | 2                                 |



## Proportional Solenoid Valves

### Product Electrical Installation Tech Note

### Electrical Installation

#### Pin Compatibility (continued)

#### Valve Model and Coil Specifications

This table will assist in determining which function block to be used with the valve selected and it provides the correct inputs for the deadband that needs to be entered in the function block.

#### Valve Model versus Coil Matrix

| Model Number | Coil    | Threshold (mA) | Function Block |
|--------------|---------|----------------|----------------|
| CP518-PNO    | M19P    | 200            | Proportional   |
| XQ2 06/NA    | M19P    | 200            | Proportional   |
| CP518-PNC    | M19P    | 800            | Proportional   |
| XQ2 06/NC    | M19P    | 400            | Proportional   |
| XQ2 12/NC    | M19P    | 600            | Proportional   |
| CP550-38     | D14E    | 500            | Proportional   |
| CP551-38     | D14E    | 500            | Proportional   |
| XQ2 06/C5    | M19P    | 500            | Proportional   |
| XQ2 06/NA    | M19P    | 100            | Proportional   |
| XQC2 12/NA   | M19P    | 200            | Proportional   |
| XQC2 06/NC   | M19P    | 100            | Proportional   |
| XQC2 12/NC   | M19P    | 600            | Proportional   |
| XQC3 06/NA   | M19P    | 100            | Proportional   |
| XQC3 12/NA   | M19P    | 200            | Proportional   |
| XQC3 06/NC   | M19P    | 400            | Proportional   |
| XQC3 12/NC   | M19P    | 400            | Proportional   |
| XMD 04       | M19P    | 200            | Proportional   |
| CP558-20     | D10 30W | 200            | Proportional   |
| XMP 06       | M19P    | 200            | Proportional   |
| PRV 10       | M19P    | 200            | Proportional   |
| PRV 12       | M19P    | 200            | Proportional   |
| XRP 06       | M19P    | 200            | Proportional   |
| CP558-24     | D08     | 200            | Proportional   |
| XRP 044      | M13     | 150            | Proportional   |
| PSV10-34-02  | M16     | 500            | Proportional   |
| P-DCV03-3Z11 | PD03    | 600            | Proportional   |
| P-DCV05-3Z11 | PD05    | 500            | Proportional   |
| PSV10-34-05  | M16     | 300            | Proportional   |
| P-DCV03-3Y11 | PD03    | 600            | Proportional   |
| P-DCV05-3Y11 | PD05    | 500            | Proportional   |
| CP550-32     | D14E    | 500            | Proportional   |
| CP551-32     | D14E    | 500            | Proportional   |
| CP550-33     | D14E    | 500            | Proportional   |
| CP551-33     | D14E    | 500            | Proportional   |
| CP550-34     | D14E    | 500            | Proportional   |
| CP551-34     | D14E    | 500            | Proportional   |

All coils are not polarity sensitive unless they have an internal diode. When connecting a coil without a diode there are two connections to make, a positive and negative. When utilizing a diode the positive leg must be connected to pin 1. Pin 1 is identified by a 1 or + molded in the coil. If you are using lead wires they are generally red and black.





## Proportional Solenoid Valves

### Product Electrical Installation Tech Note

### Electrical Installation

#### Mating Connector

#### Coil Termination Specifications

| Code       | Termination  | Specifications   |
|------------|--|--|
| A          | DOM 43650  | DIN 43650A/ISO 4400 standard electrical connector  |
| AJ         | AMP® Junior  | Integral to coil   |
| AMJ        | AMP Junior   | Integral to coil   |
| AMS        | AMP Super Seal 1.5 (also conforms to Delphi® Metri-Pack™ 150 Type 1) | Integral to coil; mating connector is Delphi/Packard Part Number 12052641  |
| AS         | AMP Super Seal 1.5 (also conforms to Delphi Metri-Pack 150 Type 1)   | Integral to coil; mating connector is Delphi/Packard Part Number 12052641  |
| C          | Conduit  | Two 18 AWG wires, 457 mm [18 in] long with 1/2-14 NPT internal thread for conduit  |
| DE         | Deutsch®   | Integral to coil; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S   |
| DED        | Deutsch with diode   | Integral to coil; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S   |
| DN         | DIN 43650  | DIN 43650A / ISO 4400 standard electrical connector  |
| DP         | Dual Post  | Two No. 8-32UNC screw terminals 9.5 mm [0.375 in] long   |
| DT04       | Deutsch  | Integral to coil; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S   |
| E1         | DIN 43650  | DIN 43650A / ISO 4400 standard electrical connector  |
| E2         | DIN 43650 with diode   | DIN 43650A / ISO 4400 standard electrical connector  |
| E3         | AMP Junior   | Integral to coil   |
| E4         | AMP Junior with diode  | Integral to coil   |
| E5         | DIN 43650 with rectifier   | DIN 43650A / ISO 4400 standard electrical connector  |
| E8         | Lead wires   | Two 18 AWG wires, 457 mm [18 in] long  |
| E9         | Lead wires with diode  | Two 18 AWG wires, 457 mm [18 in] long  |
| E10        | Deutsch (on leads)   | On two 18 AWG lead wires, 203 mm [8 in] long with protective braid; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S |
| E11        | Deutsch (on leads) with diode  | On two 18 AWG lead wires, 203 mm [8 in] long with protective braid; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S |
| E12        | Deutsch  | Integral to coil; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S   |
| E13        | Deutsch with diode   | Integral to coil; mating connector is Deutsch IPD (Industrial Products Division) Part Number DT06-2S   |
| FL & FL600 | Flying leads   | Two 18 AWG wires, 600 mm [24 in] long  |
| FLD        | Flying leads with diode  | Two 18 AWG wires, 600 mm [24 in] long  |
| H          | DIN 43650  | DIN 43650A / ISO 4400 standard electrical connector  |
| L          | Lead Wires   | Two 18 AWG wires, 457 mm [18 in] long  |
| M2         | Delphi Metri-Pack 150 Type 1 (also conforms to AMP Super Seal 1.5)   | Integral to coil; mating connector is Delphi/Packard Part Number 12052641  |
| M3         | Delphi Metri-Pack 150 Type 2   | Integral to coil; mating connector is Delphi/Packard Part Number 12040753  |
| S          | Dual Spade   | Two 6.35 mm [0.25 in] wide Type 1B spade terminals per SAE J858A   |
| S1         | Single Spade   | One 6.35 mm [0.25 in] wide Type 1B spade terminal per SAE J858A with internal ground   |
| SP         | Dual Spade (M13 & M16 coils)   | Two 6.35 mm [0.25 in] wide Type 1B spade terminals per SAE J858A   |
|            | Single Post (D08 & D10 coils)  | One No. 8-32UNC Screw Terminals 9.5 mm [0.375 in] long with internal ground  |
| WPF        | Delphi® Weather-Pack™ Female   | On 150 mm [6 in] lead wires; mating connector is Delphi/Packard Part Number 12010973   |
| WPM        | Delphi Weather-Pack Male   | On 150 mm [6 in] lead wires; mating connector is Delphi/Packard Part Number 12015792   |
| WPMD       | Delphi Weather-Pack Male with diode                                  | On 150 mm [6 in] lead wires; mating connector is Delphi/Packard Part Number 12015792   |



## ditional Solenoid Valves

### Product Electrical Installation Tech Note

### Electrical Installation

#### Mating Connector (continued)

##### Coil Mating Connector Parts List

| Amp Junior         |                 |                                      |
|--------------------|-----------------|--------------------------------------|
| <b>Code</b>        | AJ AMJ E3 E4    |                                      |
| <b>Description</b> | <b>Quantity</b> | <b>Tyco Electronics® Part Number</b> |
| <b>Housing</b>     | 1               | 282190-1                             |
| <b>Terminal</b>    | 2               | 929940-3                             |
| <b>Seal</b>        | 2               | 828904-1                             |

| Amp SuperSeal        |                 |                            |
|----------------------|-----------------|----------------------------|
| <b>Code</b>          | AMS AS          |                            |
| <b>Description</b>   | <b>Quantity</b> | <b>Packard Part Number</b> |
| <b>TPA (Housing)</b> | 1               | 12052634                   |
| <b>Connector</b>     | 2               | 12162000                   |
| <b>Terminal</b>      | 2               | 12045773                   |
| <b>Seal</b>          | 2               | 12048074                   |

| Deutsch              |                             |                            |
|----------------------|-----------------------------|----------------------------|
| <b>Code</b>          | DE DED DT04 E10 E11 E12 E13 |                            |
| <b>Description</b>   | <b>Quantity</b>             | <b>Packard Part Number</b> |
| <b>Contact</b>       | 2                           | 0462-201-16141             |
| <b>Locking Wedge</b> | 1                           | W25                        |
| <b>Plug</b>          | 1                           | DT06-25                    |

| ISO 4400 (DIN 43650)*   |                 |                                  |
|-------------------------|-----------------|----------------------------------|
| <b>Code</b>             | A DN H E1 E2 E5 |                                  |
| <b>Description</b>      | <b>Quantity</b> | <b>Sauer-Danfoss Part Number</b> |
| <b>Type A Connector</b> | 1               | 088010080                        |
| <b>Type C Connector</b> | 1               | 088010060                        |
| <b>Type E Connector</b> | 1               | 088010410                        |

\* Refer to section 10.18 of *Cartridge Valves Technical Information 520L0588*

| Lead Wires                |                        |
|---------------------------|------------------------|
| <b>Code</b>               | C E8 E9 FL FL600 FLD L |
| All lead wires are 18 AWG |                        |

| MetriPak 150 Type 1 |                 |                            |
|---------------------|-----------------|----------------------------|
| <b>Code</b>         | M2              |                            |
| <b>Description</b>  | <b>Quantity</b> | <b>Packard Part Number</b> |
| <b>TPA</b>          | 1               | 12052634                   |
| <b>Connector</b>    | 2               | 12162000                   |
| <b>Terminal</b>     | 2               | 12045773                   |
| <b>Seal</b>         | 2               | 12048074                   |

| MetriPak 150, Type 2 |                 |                            |
|----------------------|-----------------|----------------------------|
| <b>Code</b>          | M3              |                            |
| <b>Description</b>   | <b>Quantity</b> | <b>Packard Part Number</b> |
| <b>TPA</b>           | 1               | 12052634                   |
| <b>Connector</b>     | 2               | 12052644                   |
| <b>Terminal</b>      | 2               | 12048074                   |
| <b>Seal</b>          | 2               | 12048806                   |

| Spade                 |         |
|-----------------------|---------|
| <b>Code</b>           | SP S S1 |
| 6.35 mm [.25 in] wide |         |

| Weatherpack (female)    |                 |                            |
|-------------------------|-----------------|----------------------------|
| <b>Code</b>             | WPF             |                            |
| <b>Description</b>      | <b>Quantity</b> | <b>Packard Part Number</b> |
| <b>Terminal (male)</b>  | 1               | 12089040                   |
| <b>Seal</b>             | 2               | 12015323                   |
| <b>Connector (male)</b> | 2               | 12010973                   |

| Weatherpack (male)        |                 |                            |
|---------------------------|-----------------|----------------------------|
| <b>Code</b>               | WPM WPM D       |                            |
| <b>Description</b>        | <b>Quantity</b> | <b>Packard Part Number</b> |
| <b>Terminal (female)</b>  | 1               | 12015792                   |
| <b>Seal</b>               | 2               | 12015323                   |
| <b>Connector (female)</b> | 2               | 12089188                   |



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