CROSS HYDRAULICS

Electronic Devices

Guideline

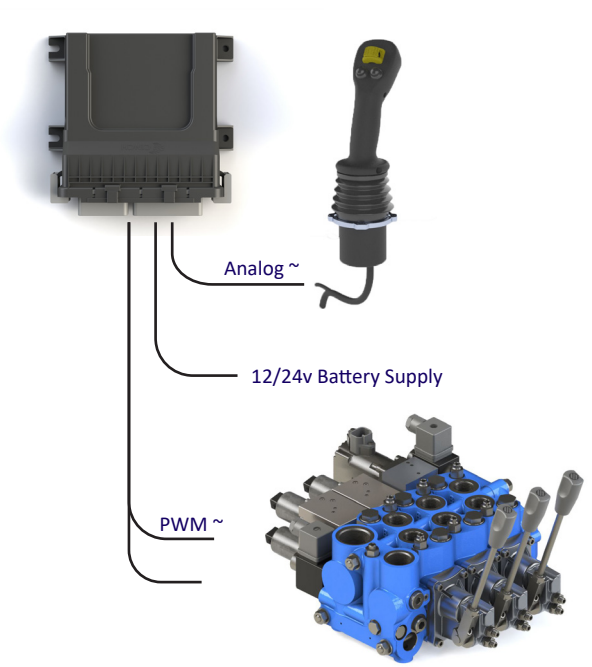
Table of Contents

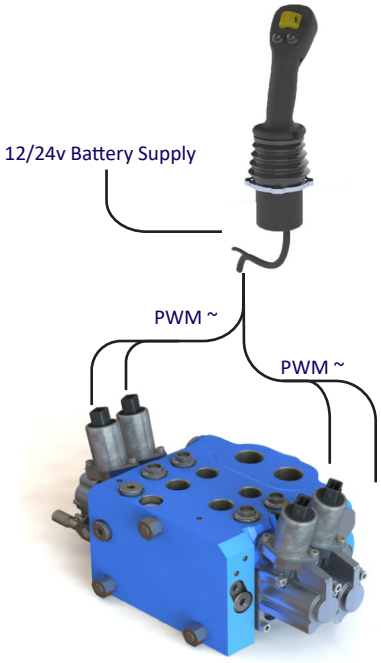
PWM - Pulse Width Modulation

In the past, electronic boards for the control of solenoid valves relied on linear current. However, this dissipates large power as heat, therefore being inefficient.

It also does not solve the problem of static friction and hysteresis in operation of solenoid valves.

Pulse Width Modulation (PWM) and Dither are now commonly used in all solenoid valve electronic control units.





PWM and Dither

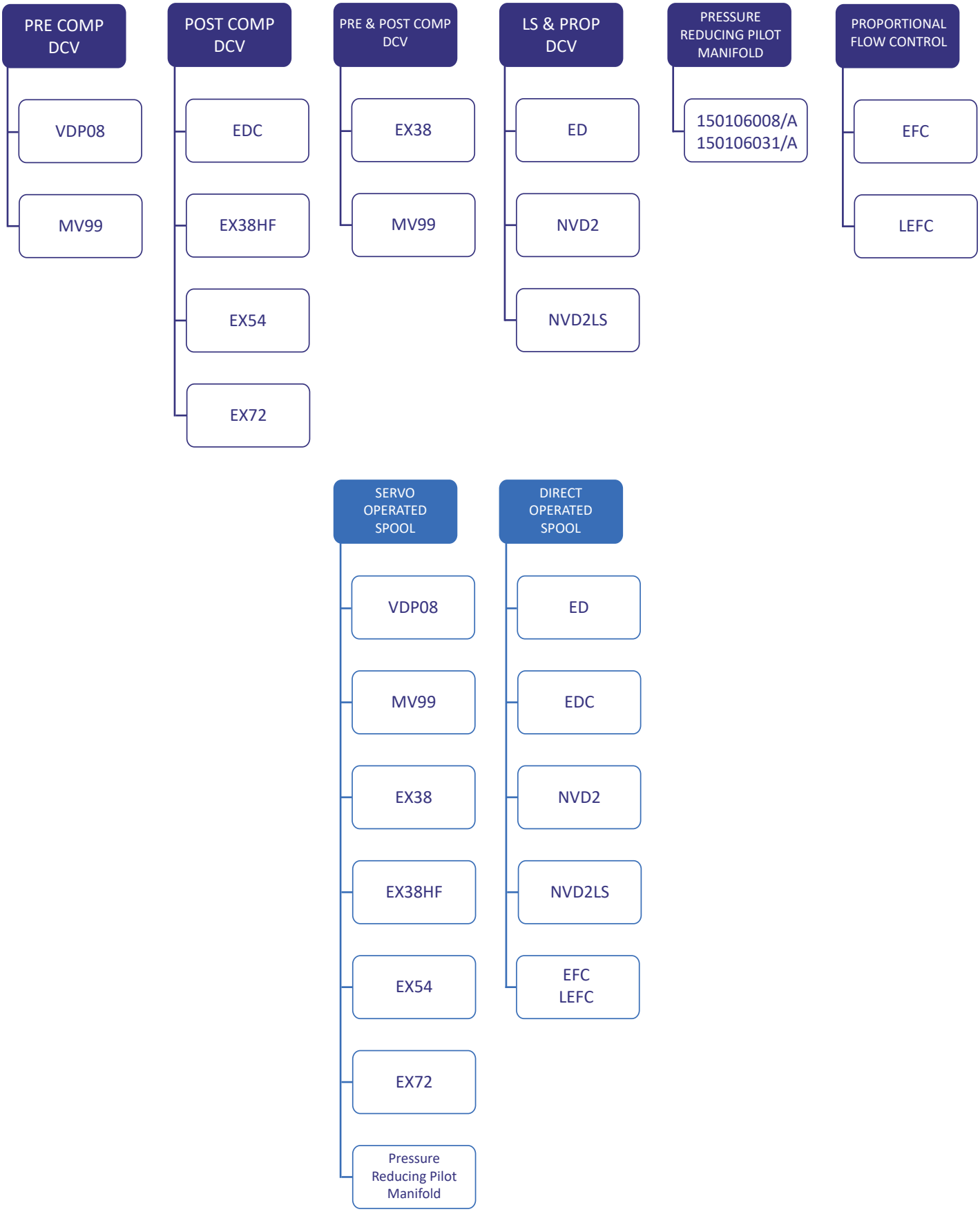
Pulse Width Modulation (PWM) produces constant current through the coil. A PWM signal itself is not constant. Rather, the signal is on for part of the time, and off for the rest of the time in a cyclic fashion. This pulsation rate can vary to the input signal and produces much more effective means to control the proportional valves.

Static friction (Stiction) and hysteresis can cause the control of a hydraulic valve to be erratic and unpredictable. Stiction can prevent the valve spool from moving when given small input changes. Hysteresis can cause the shift to be different depending on its applications from the same input signal. In order to counteract the effects of stiction and hysteresis, small vibrations (cyclic frequency) around the desired position are created in the spool. This constantly breaks the static friction ensuring that the spool will move even with small input changes, and the effects of hysteresis are averaged out.

Dither vs PWM

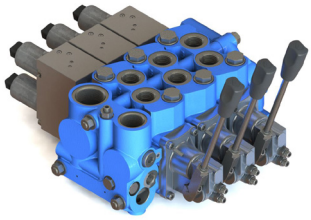
Dither is a small ripple frequency that is superimposed over the PWM signal to the solenoid current that causes the desired vibration which increases the linearity of the valve and improves valve response. Dither and PWM frequencies complement each other for improved spool control and are, in most amplifiers, adjustable independently. This allows the user to customise these signals to each individual application for optimum performance.

The "PWM" Users

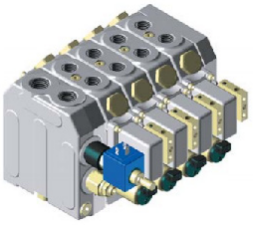


The "PWM" Users

VDP08

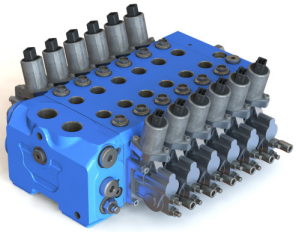


MV99



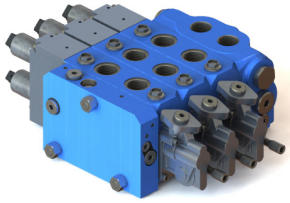
THOMAS
PPCD04-PPRV

EX38



TECNORD
IP-DAR-43C

EX38HF



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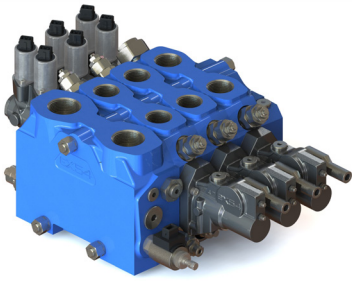
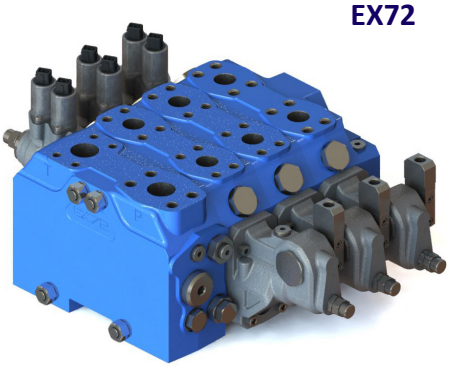
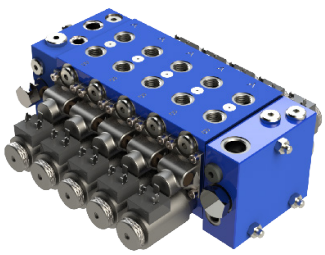


EX72



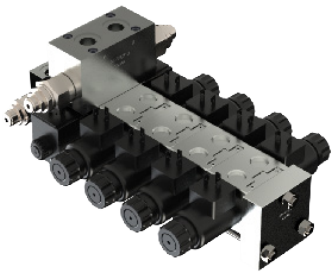
THOMAS
PPCD04-NGPPRV

NVD2
Proportional Direct Solenoid



EFC
Proportional Direct Solenoid

EDC / ED4
Proportional Direct Solenoid



Electronic Joysticks & Control Units

JHM Series

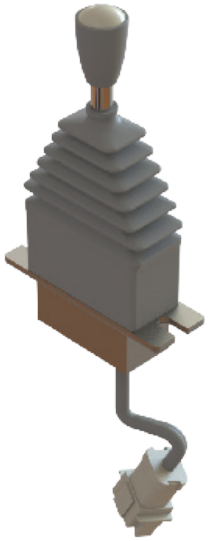
Single / Dual / Multi Axis Joystick
PWM Output

Code:
JHML2SPWM3 (Single Axis)
JHML4CPWM3 (Dual Axis)
JHML4DPWM3 (Multi Axis)

MAP2 Series

Single Axis Joystick
PWM Output

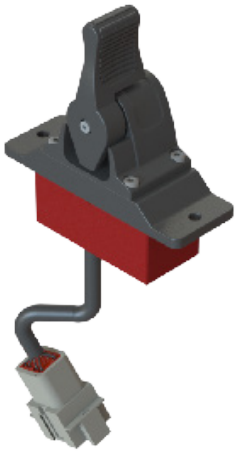
Code:
PMAP2SSAR (Single Axis)
PMAP2SSAF (Single Axis w/ Friction)



MAP3 Series (Marine Application)

Single Axis Joystick
PWM Output

Code:
PMAP3SSAF (Single Axis w/ Friction)
PMAPSSAR (Single Axis w/ Spring Return)



MAP2L Series

Single Axis Mini Joystick
PWM Output

Code:
MAP2SSLR (Single Axis)
MAP2SSLF (Single Axis w/ Friction)

Features:
All metallic parts - Stainless Steel
All alluminum parts - Deep Anodised
Fixing Plate - Nylon Compound
Preferably shaped to be compressed at the base of the rubber boot.
Fixing plate gasket - EPDM Rubber

Electronic Joysticks & Control Units

JLP Series

Single Axis
Fingertip Joystick
Analogue Output 80% VIN

Code:
JLPL2SQOIPD

FPR Series

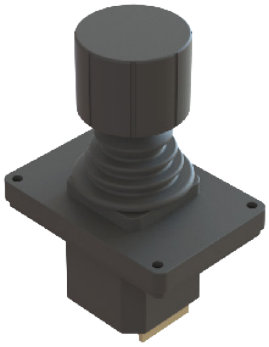
Thumb proportional roller
PWM & Analogue

Code:
200107093 (1 Channel Analogue)
200107095 (2 Channel Analogue)
230409160 (w/ PWM Driver)

MANP2 Series

Dual Axis
Mini Joystick
Analogue Output

Code: A1000380400



MANP3 Series

3 Axis
Mini Joystick
Analogue Output

Code: A1000380402

MANP4 Series

Dual Axis
Mini Joystick
Analogue Output

Code: A1000380602

JMT Series

Multi Axis
Thumb Joystick
Analogue Output

Code:
200107165A

Hand Grips

MS Grips to Suit JHM Series

Code:
MS######

*See MS Handgrips Catalogue

M, B, D Grips to Suit JHM and MAP2 Series

Code:
RCMAWA70 (Cylinderical Hand Grip)
RCMBWA70 (w/ Push Switch)
RCMDWA70 (/w Rocker Switch)

IE Grips to suit JHM Series

Code:
IE#########

EC-PWM-A*-MPC1-DT-CAN Smart PWM Driver

Microprocessor-based PWM electronic driver for the control of a single or double acting proportional function by means of CANbus or analogue voltage signal.

The EC-PWM-A*-MPC1-DT-CAN drives one or two solenoids with a PWM current proportional to the input signal provided by a CANbus ECU or a Joystick.

Features

- Robust thermoplastic enclosure, fully potted against harsh environmental conditions
- Microprocessor architecture with high diagnostics capability
- Protection against disturbances on power supply: overvoltages, reversed polarity and load dump
- Protection of inputs against short circuits to GND and power supply
- Protection of outputs against short circuits, overcurrent and overtemperature
- CANbus connection: ISO 11898-2
- CANbus communication protocol: SAE J1939 (standard), CANopen (on specific request)
- Driver's parameters adjustable through CANbus (min/max current, ramps, dither)
- Driver's firmware can be updated through CANbus using Tecnord's CANprogrammer tool
- Electro Magnetic Compatibility (EMC): EN 13309 (construction) - EN 14982 (Ag & forest) - EN 13766

Applications

- 12/24 Vdc proportional valve driver
- Control of single proportional valve (A1)
- Control of dual proportional valve (A2)
- Possibility of customized working cycle (e.g. clutch engagement cycle)

Code:

230409326 - Smart Driver (Single)

230409327 - Smart Driver (Double)

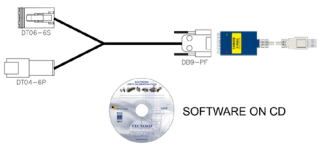
Suit IPDAR43CDT12L2500 and IPDAR43CDT24L2500

Specifications	
Operating Voltage:	8 - 30 V DC
Max. current consumption:	< 50 mA (without load)
Operating Temperature:	-40 ~ +85°C
Degree of protection:	IP69K
Analogue voltage control (A2 version):	0.5 - 2.5 - 4.5 V DC
Analogue voltage control (A1 version):	0.5 - 4.5 V DC
Available options (A1 version):	0 - 10V, 0 - 20 mA
Current output range:	0 - 1600 mA
Adjustable parameters:	min. current, Max. current ramps, dither
CANbus lines:	1
CANbus interface:	ISO 11898
CANbus protocol:	SAE J1939 (default) CANopen
CANbus speed selectable:	125 - 250 (default) - 500 kbit/s

Adjustments

Adjustments can be effected via CANbus line to modify the following work parameters:

- Imin (minimum output current)
- Imax (maximum output current)
- Ramp-up time
- Ramp-down time
- Dither frequency
- non-linear characteristics
- CANbus communication parameters
- type of control signal (Can or analogue voltage)



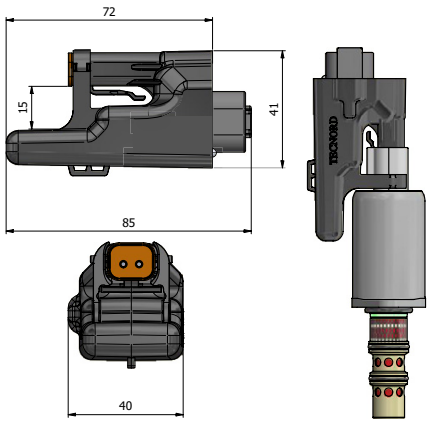
Calibration tool ordering code:

21.0801.075

CAN-USB converter ordering code:

21.0801.040

Dimensions



Connector Pinout - A1 (single coil) version

Mating connectors:

Deutsch DT04-2P (solenoid)

1 EV-A
2 FB (feedback)

Deutsch DT06-6S (harness)

1 +V (power)
2 CAN-H
3 ANALOG IN
4 do not connect
5 CAN-L
6 GND

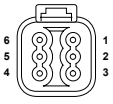
Connector Pinout - A2 (dual coil) version

Mating connectors:

Deutsch DT04-2P (solenoid)

1 EV-A
2 FB (feedback)

Deutsch DT06-6S (harness)



1 +V (power)
2 CAN-H/ANALOG IN
3 EV-B (solenoid)
4 FB (feedback)
5 CAN-L
6 GND

PVD200 Proportional Valve Driver

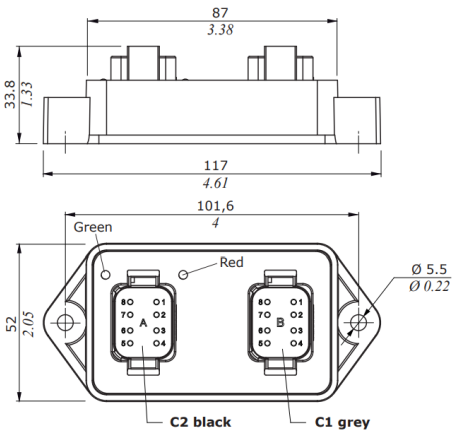
The PVD200 is a microprocessor-based PWM driver designed to control 4 proportional solenoid valves (2+2). Delivered in a potted enclosure, the PVD200 provides a flexible I/O configuration in a compact package, specifically designed to resist water, temperature, humidity and high vibrations typical of harsh environments.

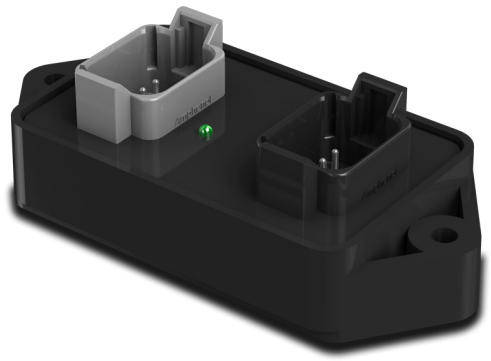
The PVD200 can manage input signals coming from switches, rollers, potentiometer and PLC's, both analogue and CAN bus. The working parameters (min/max currents, ramp times, dither) can be easily programmed with a PC and the WST interface).

Features

- Solenoid currents measurement (to compensate changes in coil resistance, temperature and supply voltage)
- Programmable Dither frequency (to reduce spool sticking)
- Protected power supply (against reversed polarity and load dump)
- Protected inputs (against short circuits to GND and to power supply)
- Protected outputs (against short circuits to GND and to power supply)

Specifications	
General Features	
Supply Voltage:	8 - 32 V DC
Current consumption (without external load):	< 50 mA (without load)
Max. current output	4A - 12 VDC
Operating Temperature:	-40 ~ +85°C
EMC Compatibility	ISO13766, ISO14982
Degree of protection:	IP67 - 69K with mating connector fitted
Output Connector:	0.5 - 2.5 - 4.5 V DC
Input Connector	0.5 - 4.5 V DC
Analogue Inputs	
Number:	Up to 4
Signal Type:	2 types F: 0.5 - 4.5V / 2 types P: 25% - 75% Vbb
Communication Port	
CANbus 2.0B Port	
Proportional Outputs	
Number	4 (2 pairs)
Type	4HSD + 2LSD*
Signal	PWM on HSD*
Dither Frequency	From 50Hz to 300Hz
Max. load per channel	2A
Other outputs	
2 led for status indication	
1 output	5V@50mA max.





Code: 183380008

LED Diagnostic			
	ON	OFF	BLINK
GREEN	Controller On	Controller Off	-
RED	-	Normal Working	Error State (see WST)

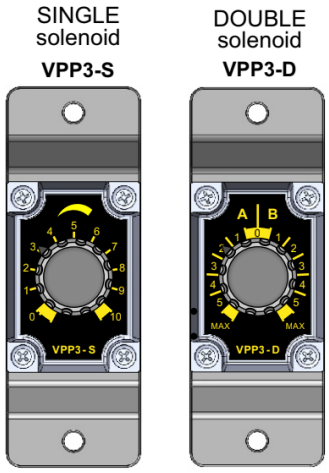
PIN-OUT Connector		
PIN	C1 Connector	C2 Connector
1	VB+	Controller Off
2	GND_2	AI-1 (0-5V analogue input/digital input)
3	GND_1	AI-2 (0-5V analogue input/digital input)
4	OUT_1	AI-3 (0-5V analogue input/digital input)
5	OUT_2	AI-4 (0-5V analogue input/digital input)
6	VB-	CAN_L
7	OUT_3	CAN_H
8	OUT_4	GND Sensor Supply

Mating Connectors:

C1: DT06-08SA Deutsch

C2: DT06-08SB Deutsch

Electronic Control Units



VPP3 Series

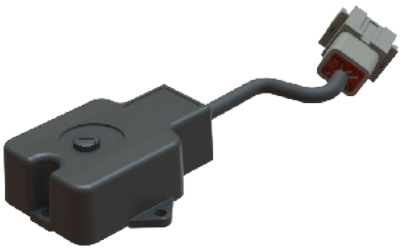
Rotary Proportional Controller
Single and Double solenoid valves
PWM Output Signal

Code:
PVPP3S1 (12V Single Solenoid)
PVPP3S2 (24V Single Solenoid)
PVPPD1 (12V Double Solenoid)
PVPPD2 (24V Double Solenoid)

VRG Series

Step Mode Controller and Ramp Generator
PWM/Analogue Output Signal
Panel Mount

Code:
PVRGPP (PWM)
PVRGPS (Analogue)



VRG Series

Step Mode Controller and Ramp Generator
PWM/Analogue Output Signal
Box Mount

Code:
PVRGSP (PWM)
PVRGSS (Analogue)

Electronic Control Units

One Proportional Coil

ECA1P Series

PWM Driver
Panel Mount
Push Pins Adjustment

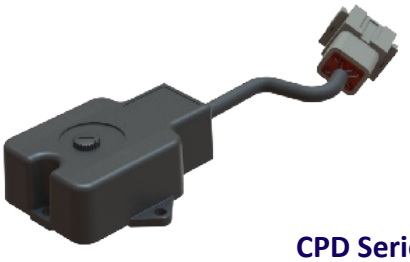
Code: 230409087

ECA1D Series

PWM Driver
DIN Plug
Push Pins Adjustment

Code: 230409077

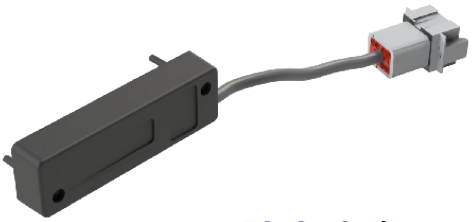
Two Proportional Coils



CPD Series

PWM Driver
PC Programmable

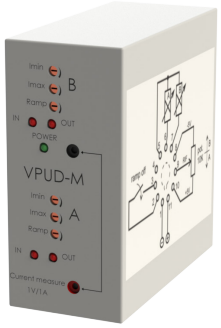
Code:
PCPDD1 (12V)
PCPDD2 (24V)



ECA2H Series

PWM Driver
Trimmer Adjustment

Code: 230409138



VPUDM Series

PWM Driver DIN RAIL Mount
Trimmer Adjustment

Code:
PVPUMA (-5/0/+5V)
PVPUMB (0-10V)

UNDECAL Connector

DIN RAIL Mount connector for proportional regulators

Code:
A2007700041

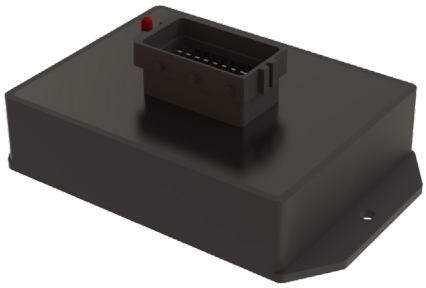
Electric Control Units

Four & Six Proportional Coils

MDE Series

PWM Electronic Control Unit
PC Programmable

Code: PSCH54PV3E2



ECP4 Series

PWM Electronic Control Unit
PC Programmable

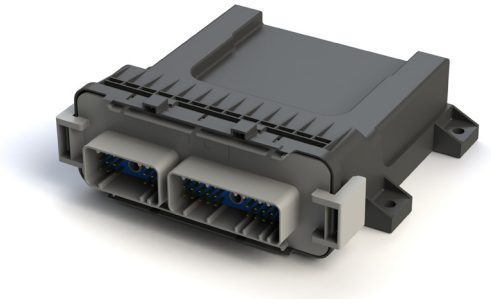
Code:
230409237 (1.5A)
230409238 (3A)

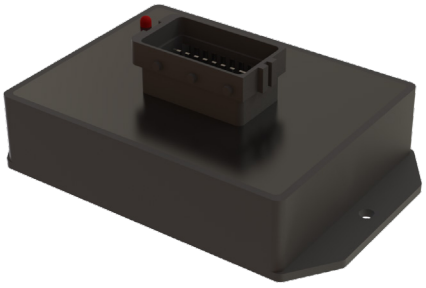
Eight & Sixteen Proportional Coils

ECS8 Series

PWM Electronic Control Unit
PC Programmable
Bluetooth Connection

Code: ECS8





ECP8 Series

PWM Electronic Control Unit
PC Programmable

Code:
230409081 (1.5A)
230409071 (3A)

Speed Controls

EC1202 Series

Electronic Panel
Mount Control
PWM Output Signal

Code: EC1202S

EC1206 Series

Potentiometer Control
Aluminum Box
PWM Output Signal

Code: EC1201L

EC20100 Series

Joystick Control
PWM Output Signal

Code: EC20100

EC20200 Series

Potentiometer
Control
PWM Output Signal

Code: EC20200

EC20300 Series

Potentiometer
Control
PWM Output Signal

Code: EC20300

EC20400 Series

Joystick Control
PWM Output Signal

Code: EC20400

Calibration Kits

PC Calibration Kit

AMP SEAL - DB9 connecting cable with calibration software
Suit ECP4 & ECP8 Series

Code:
201001026A

PC Calibration Kit

Deutsch - DB9 connecting cable with calibration software
Suit JHM PWM Joysticks

Code:
210801055A

RS232 - USB Converter

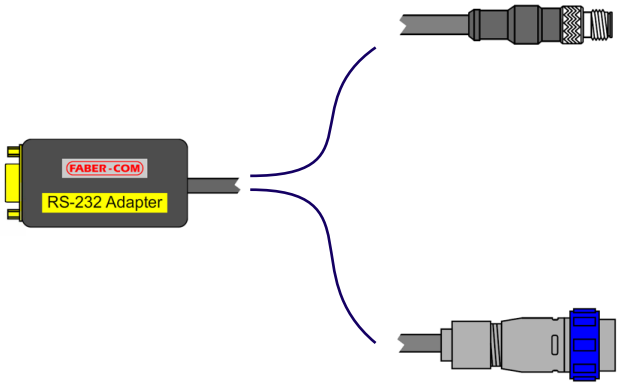
RS232 Serial port to USB cable to suit PISP Calibration Kit

Code:
502205227

RS232 - USB Converter

RS232 Serial port to USB cable to suit PISP Calibration Kit

Code:
502205227



Calibration Kit

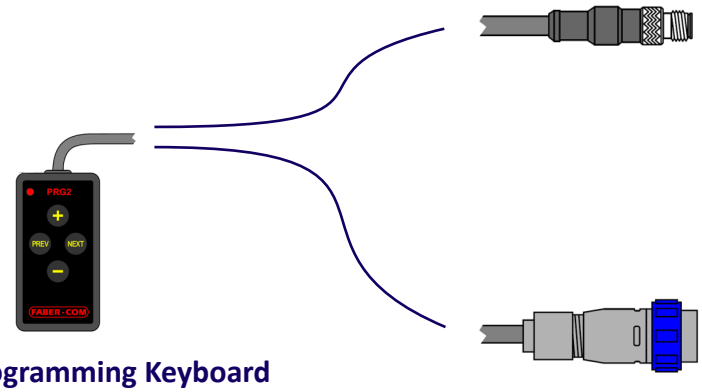
M8 Connector
Suit MAP2, MAP3, MAPL, VPP3, VRG, CPD Series

Code:PISPR

Calibration Kit

Bulgin Buccaneer Connector
Suit MDE Series

Code:PISPB



PRG2 Programming Keyboard

Allows working parameters fine tuning on the field

Calibration Kit

M8 Connector
Suit MAP2, MAP3, MAPL, VPP3, VRG, CPD Series

Code:PRG2R

Calibration Kit

Bulgin Buccaneer Connector
Suit MDE Series

Code:PRG2B

RCR Series

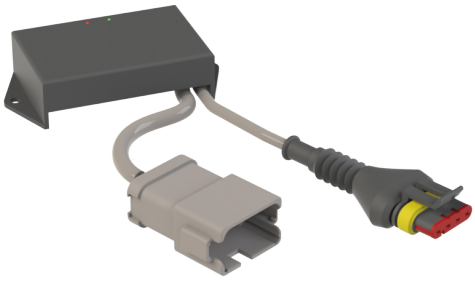
Radio Remote Control Receiver & Transmitter 433MHz
4 to 16 Channel ON-OFF

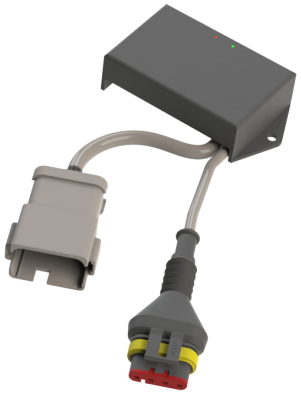
Receiver Specifications:	
Switch:	Output Switching - Relay
Battery:	12/24 Volts DC
Current (Amps):	Relay Rating 5 Amps Output Rating 8 Amps
Outputs:	4-16 Changeover relays
Frequency:	Operating 433.92MHz (other frequencies available on request, min 10 pcs)
Antenna:	Internal 433 Micro External optional
Wiring:	Optional multipin wiring loom
Enclosure:	ABS & PC Plastic with plastic hinge IP66 Box* Mounting 4 external lugs

Transmitter Specifications:	
Switch:	Tactile Dome Membrane
Battery:	9V Battery (Applied to battery clip)
Current (Amps):	Operating Max 35mA @ 8V DC
Frequency:	Operating 433.92MHz ModulationFM
Protection:	Reverse Polarity Protected IP Rating - 55 Code Combination - over 4 Billion
Performance:	Temp range -5 to 50C Range nominal 50m from Receiver
Antenna:	Built in loop antenna

RMR Series

Bluetooth low energy technology
2 to 8 Channel ON-OFF





Crew# Receiver

Bluetooth low energy technology
2-6 Channels

Transmitter Specifications:	
Model:	SPEEDY#ER
No. of Buttons:	2-6 + E-STOP
Battery:	3.7V
Frequency:	2.4GHz
Protection:	IP69K
Performance:	Up to 100m range -40C ~ +80C

Receiver Specifications:	
Model:	CREW#
No. of Buttons:	2-6 ON/OFF
Supply:	9-36V
Amps:	7A at 12V
Frequency:	2.4GHz
Protection:	IP69K
Performance:	Up to 100 [m] range -40[C] ~ +80[C]
Antenna:	Built in antenna

Speedy# Transmitter

Bluetooth low energy technology
2-8 Channels
E-STOP

Crew 8 Receiver

Bluetooth low energy technology
8 Channels
External CPU BLE Antenna

Transmitter Specifications:	
Model:	SPEEDY8ER
No. of Buttons:	8 + E-STOP
Battery:	3.7V
Frequency:	2.4GHz
Protection:	IP69K
Performance:	Up to 100m range -40C ~ +80C

Receiver Specifications:	
Model:	CREW8
No. of Buttons:	8 ON/OFF
Supply:	9-36V
Amps:	7A at 12V
Frequency:	2.4GHz
Protection:	IP69K
Performance:	Up to 100 [m] range -40[C] ~ +80[C]
Antenna:	External CPU BLE

Handy 10 Transmitter

Code:
PRMB016P (12V) - c/w G4 Receiver
PRMB026P (24V) - c/w G4 Receiver
PPR4P4 - HANDY Transmitter only

Handy 10 Transmitter Specifications	
Inputs:	10 pushbuttons
Features:	-Proportional and digital functionality -Dual operation modes duplicate the functionality of each button -Operational and battery status indication by LEDs and a LED display
Operator feedback by:	LEDs / Monochrome display 2.5" with 128 x 64 px / Colour display 4.3" with 380 x 272 px
Communication Protocol:	CANopen
Stop Function:	EN ISO 13849-1 cat. 3, PL e
Frequency bands:	433-434 or 902-928MHz (other frequencies available on request
Communication Type:	Two way
Cable control:	Standard 10 meters / ~33 ft.
Operating Range:	> 100m / >~330 ft.
Operational Temperature:	-20 °C to +70 °C
Protection:	IP65

Mini Transmitter

Mini Transmitter Specifications	
Inputs:	Various toggle switches, pushbuttons and rotary switches 1-6 linear levers or 1-3 joysticks
Features:	Operation
Operator feedback by:	LEDs / Monochrome display 2.5" with 128 x 64 px / Colour display 4.3" with 380 x 272 px
Stop Function:	EN ISO 13849-1 cat. 3, PL e
Frequency bands:	433-434 or 902-928MHz (other frequencies available on request
Communication Type:	Two way
Cable control:	Standard 10 meters / ~33 ft.
Operational time	20 hours on a single charge
Operating range:	> 100m / >~330 ft.
Operational remperature:	-20 °C to +70 °C
Protection:	IP65

G2B / G4 Receiver

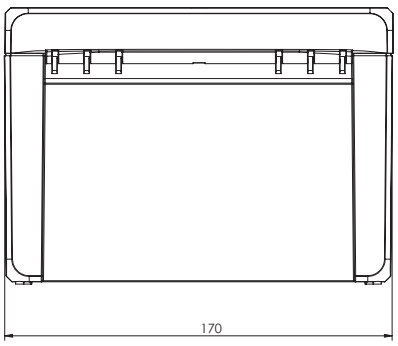
Specifications	G2B Receiver	G4 Receiver
Supply Voltage:	12/24 V DC	12/24 V DC
Outputs:	8 bi-directional proportional PWM outputs / 14 digital outpus (including dump valve)	6 bi-directional proportional PWM outputs / 7 digital outpus (including dump valve)
Inputs:	3 digital inputs + 1 configurable digital in or output	2 digital inputs for speed-setting management
Operator feedback by:	LEDs / Monochrome display 2.5" with 128 x 64 px / Colour display 4.3" with 380 x 272 px	LEDs / Monochrome display 2.5" with 128 x 64 px / Colour display 4.3" with 380 x 272 px
Communication Protocol:	CANopen Interface	CANopen Interface
Stop Function:	EN ISO 13849-1 cat. 3, PL e	EN ISO 13849-1 cat. 3, PL e
Frequency bands:	433-434 or 902-928MHz (other frequencies available on request	433-434 or 902-928MHz (other frequencies available on request
Communication Type:	Two way	Two way
Protection Category:	IP65	IP65
Operational Temperature:	-25°C to +70 °C	-25°C to +70 °C

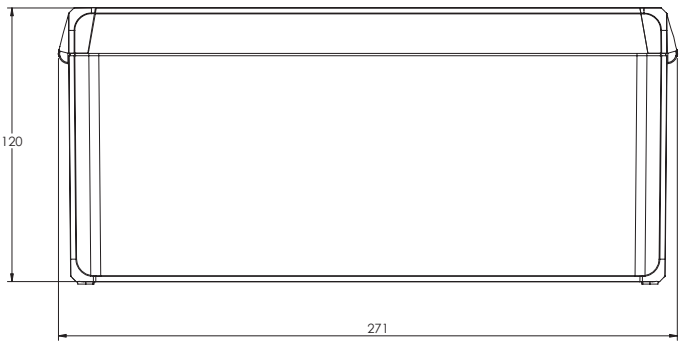
VPUDM Series and Enclosures

IP66/67 DIN EN60529
Up to 5 VPUDM Drivers DIN rail mounted

Code: VPUDM####

VPUDM Series Modular Control Box	
Input:	0-10V, -5/0/+5V selectable
Output:	4 to 10 PWM outputs
Switches:	LED Power Switch E-Stop
Calibration:	Trimmer adjustment
Cable:	300mm with 12pin Deutsch connector
Protection:	Polycarbonate with crystal clear lid IP65/IP67 DIN EN60529
Dimensions:	270 x 170 x 120 (mm)





Wired Remote Control Unit

CRC Series - Wired Remote Control Unit

2 or 3 proportional controllers (joystick/ rotary knob)

Code: CRCA#### (Up to 6 PWM proportional outputs)

CRC Series Wired Remote Control Unit	
Controllers:	2 or 3 proportional controllers (joystick/rotary knob)
Output:	Solenoid Unloading Valve output Fault diagnostic output
Switches:	LED Power Switch E-Stop
Calibration:	PC Programmable
Cable:	300mm with 12pin Deutsch connector
Enclosure:	Die-cast aluminum enclosure yellow RAL1003 Ergonomic aluminum handles
Dimensions:	235 x 119 x 143 (mm)

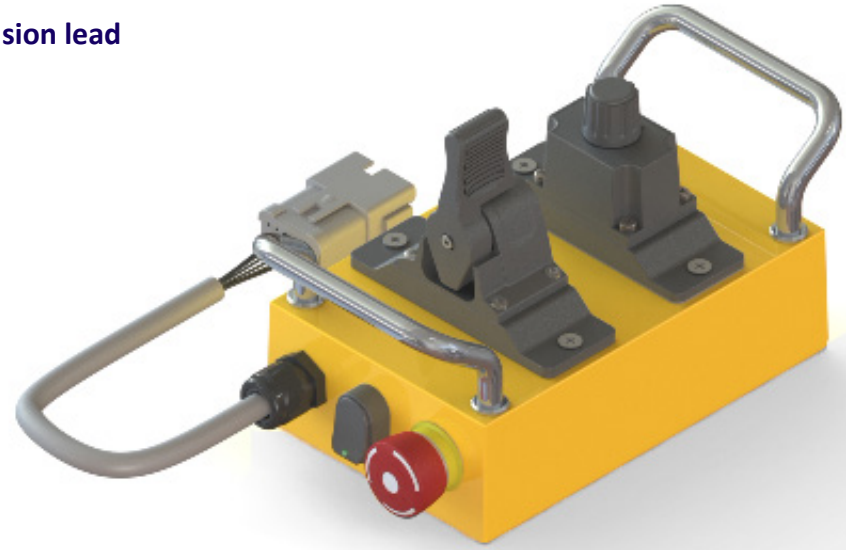
Wire loom valve end

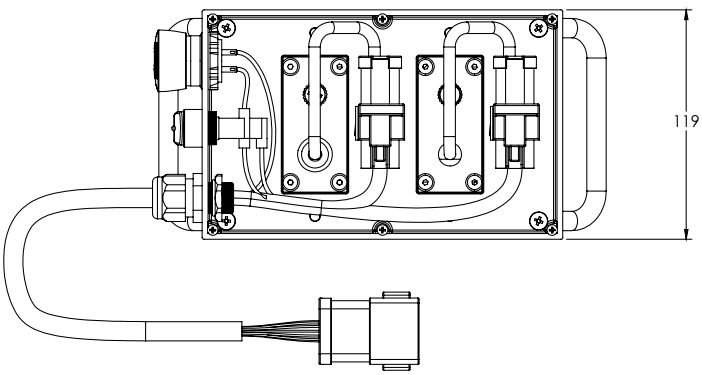
12 Pin male Deutsch to 4 X AMP Junior

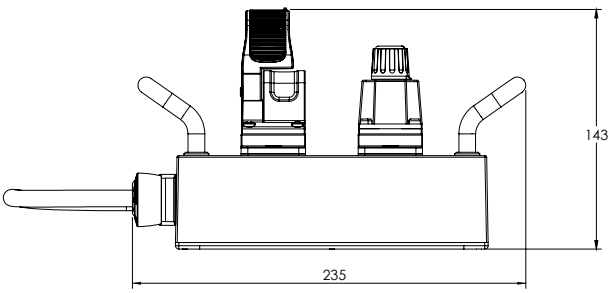
Code: RCL12DM4JNR002

2000mm 12 pin Deutsch extension lead

Code: RCL12DM12DF2000







Control Signals

As mobile equipment becomes more technologically sophisticated, there is an increasing need for electronic control of hydraulic systems. Electronic components have become more reliable and rugged. They can now withstand the harsh environmental conditions required for mobile equipment applications. Amplification of the control signal is usually required to actuate solenoid-operated hydraulic valves. Electronic controllers that are designed for hydraulic applications will normally include the required amplification functions.

Why Pulse Width Modulation (PWM)?
When voltage is applied to a valve coil, the current flowing through it creates a magnetic field which provides the force to shift the spool or poppet of the valve. The input voltage divided by the resistance of the coil equals the current draw. This is very straightforward when used with on/off valves, but proportional valves are only useful if the spool position can be precisely controlled by varying the input current.

A simple potentiometer can be used to vary the resistance, which then varies the input current. This is an inefficient method of control, and is not practical when high currents are required. Also, when an infinitely variable DC signal is used to operate a proportional valve solenoid , the output transistor of the amplifier functions like a variable resistor. It drops the power supply voltage down to the level required by the solenoid coil at a particular time. The full coil current, which may be several amps, needs to pass through this output transistor. The result is that the transistor builds up heat which requires a large sink to dissipate.

PWM is a control technique which can overcome the problems described above. With PWM, the output transistor is used as on/off switch, feeding the solenoid coil with a series of on/off pulses at a constant voltage. The pulses are set at a constant frequency. The signal level is determined by varying the duration of “on” pulses relative to “off” pulses.

The advantage of this technique is that during the “off” pulse, the output transistor is not passing any current, and during the “on” pulse, there is virtually no voltage drop across the transistor and therefore very little heat is created. However, the amount of heat is much smaller than would be produced by a conventional DC output signal.

PWM has become the standard for all valve amplifiers in order to reduce amplifier size and power waste. No modifications are required to the valve solenoid in order to use this technique. PWM is an efficient way to control current to a proportional valve coil. It allows the use of electronics for current regulation, dither, ramping, short circuit protection, and the elimination of dead-band.

How PWM works.

A PWM signal is not constant, it is on for a period of time and off for a period of time (see Fig.1).

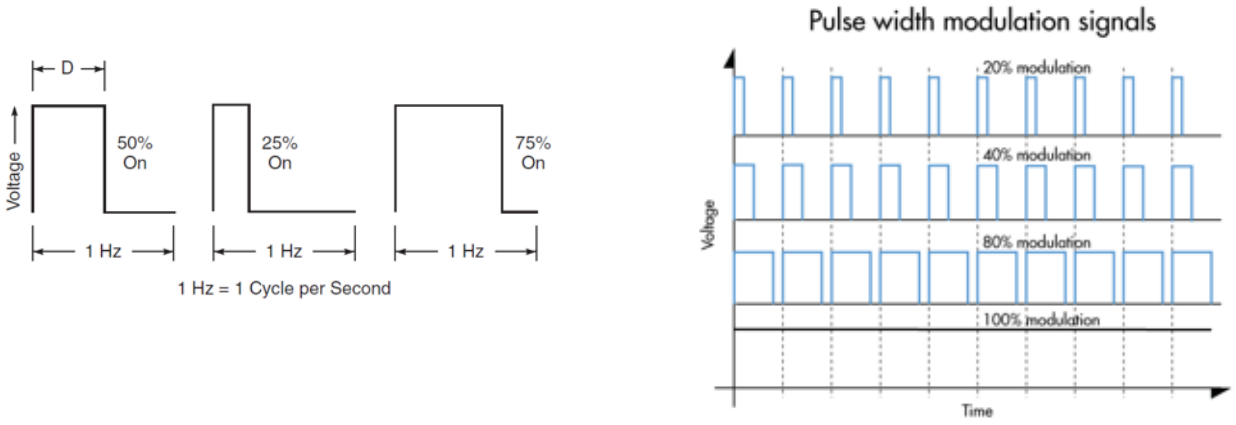


Figure 1.

The duty cycle “D” refers to the “on” portion of the cycle. The duty cycle can be anywhere from 0 (signal always off) to 1 (signal always on). A 50% “D” results in a perfect square wave.
Higher the PWM frequency more constant is the ripple-free amperage output.

Coil Inductance

Inductance is the characteristic of a circuit that opposes the starting, stopping or changing of current flow. Inductance in an electrical system is similar to inertia in a mechanical system. Its effect is to introduce a time lag into the duty cycle wave form. In theory the wave form is perfectly rectangular, rising immediately when current is applied, and falling immediately when current is withdrawn. Because of the effects of inductance, the actual wave form rises and falls more gradually (see Fig.2).

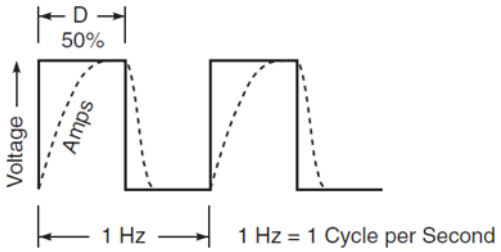


Figure 2.

Dither (Current Ripple)

Stiction and hysteresis can make the behavior of a hydraulic proportional valve seem erratic and unpredictable. Stiction keeps the valve spool from moving when input signal changes are small. When the signal finally becomes large enough to initiate movement, the spool will tend to overshoot the position required for accurate control.

Hysteresis is the tendency for the spool shift to be different depending on whether the change is increasing or decreasing, even when the control signal input value is identical.
Dither is a rapid, small movement of the spool around the desired position. It is intended to keep the spool moving to avoid Stiction and average-out hysteresis. Dither amplitude must be large enough and the frequency slow enough for the spool to respond, and yet small and fast enough to avoid creating a noticeable pulsation in the hydraulic output of the valve.
Dither is caused by coil current “ripples” – current variations around the desired control signal value. Due to inertia, the valve spool will follow low frequency ripples better than it will follow high frequency ripples. The amplitude of the ripples determines if, or how far, the spool will move at a given frequency.

Low Frequency PWM

Low Frequency PWM, typically less than 400Hz, generates dither (current ripple) as a by-product of the PWM process (see Fig.3).The PWM frequency is low enough so that the current has time to decay before the next rise begins. The amount of dither (ripple) changes as the average coil current changes. Dither is maximum at 50% “D”. Dither decreases to zero at 0% and 100% “D”. This can result in too much dither at some current levels and not enough at others.
The dither current amplitude at a given average current is a function of coil inductance and PWM frequency. The inductance of a coil is largely a function of its rated voltage and wattage.
A low wattage coil will usually have more inductance – thus less by-product dither for a given PWM frequency – than a high wattage coil.
Different valve designs will have different responses to the same dither frequency and amplitude. Changing the PWM frequency will allow adjusting the dither, but the amplitude and frequency of the dither cannot be set independently as may be required by various valve designs.

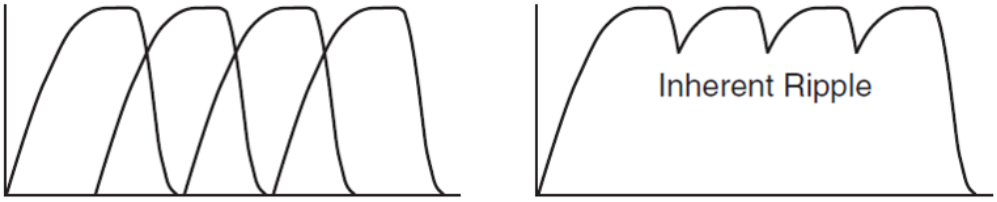


Figure 3.

High Frequency PWM

The advantage of using high frequency PWM is that dither can be generated separately and then superimposed on top of the output current (see Fig.4).

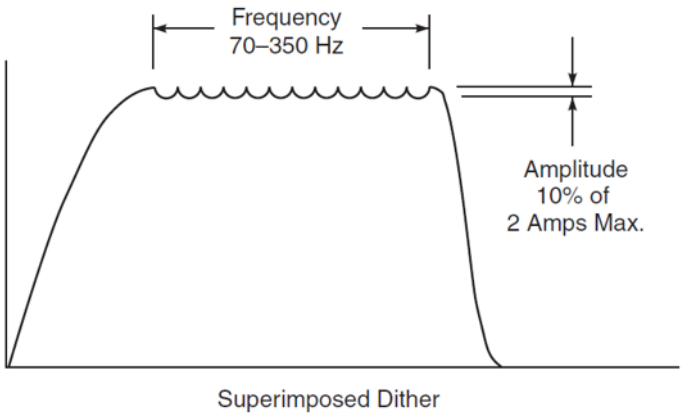


Figure 4.

Ramps

Ramps are used to slow down the response of the valve driver to a changing command input. This results in a smooth transition when an abrupt change of the command input signal occurs. Ramps have no effect if the input signal change is slower than the ramp setting.

Ramps can be symmetrical or independent, and single or dual. Ramps are usually adjustable and operate in the zero to few seconds range. Single-side ramps are usually used in slow-shift controls where only acceleration is a concern.

Symmetrical ramps (see Fig.5) are controlled by a single device that adjusts the increasing or decreasing ramps identically.

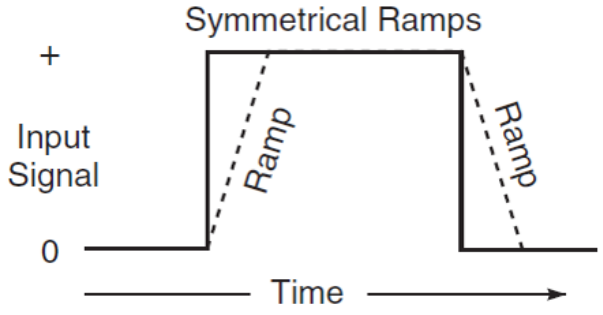


Figure 5.

Independent ramps (Fig.6) have separate devices for the increasing and decreasing sides, allowing acceleration and deceleration to be set independently of one another.

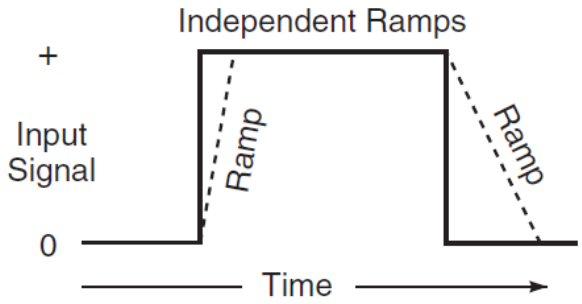


Figure 6.

Multi-coil drivers offer two independent ramps per coil (see Fig.7).

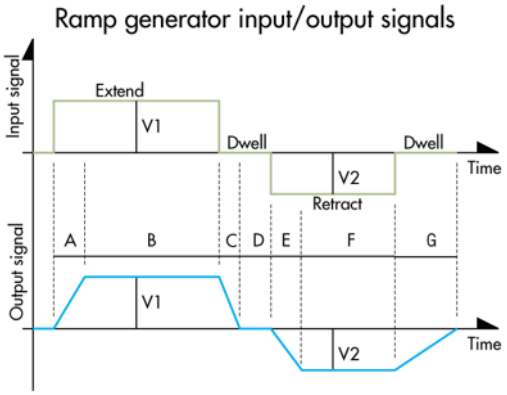


Figure 7.

Gain or I-Max.
The gain of an amplifier is the ratio of its large output signal (to the valve) to its small control input signal.
Gain = Output Signal : Input Signal
The gain is usually adjusted by a device on the amplifier. This adjustment is usually called “I-Max”. Adjusting the I-Max adjusts the amplifier gain. This can be used to adjust the maximum output of the amplifier (which controls the valve setting) for full input signal.

Dead-band/I-Min.
Spool-type proportional valves will normally have a certain amount of spool overlap which produces dead-band. For pressure and flow control this dead-band will occur at the start of spool movement. For directional valves the dead-band will occur around the center position. Spool overlap reduces leakage in the null position and also provides a greater degree of safety in power failure or emergency stop situations. The effect of spool overlap requires that a certain minimum signal level has to be present at the solenoid coil before any noticeable result occurs in the system.

If this characteristic is undesirable, dead-band can be eliminated or reduced by setting a minimum current (I-Min.) on the driver. When I-Min is adjusted above the zero point, the valve spool will immediately jump to this setting when power is applied, eliminating the dead-band. Please note that the I-Min adjustment will affect the I-Max setting, so it should always be set first.

Enable/Disable

Most of the drivers incorporate an “Enable” function. This is a safety feature. Enable can be used for “dead-man” trigger, close center unloading valve or other safety interlock device.

When a current passes through a solenoid coil, heat is generated. This heat increases the resistance of the coil. For example, a coil may have a resistance of 7 ohms at 20˚C, and a resistance of 9 ohms at 100˚C. This increased resistance causes a reduction in coil power which results in a lower valve setting.
To compensate for temperature induced changes, most of the drivers have a function known as ‘Current Feed-Back’. A current feedback resistor is added to the circuit in series with the solenoid coil. This allows the solenoid current to be proportional to the input signal voltage , and independent of the solenoid resistance. Power supply voltage must be sufficient to overcome the increased resistance.

What kind of remote control can drive our proportional valves?
Any type of electronic device that has a PWM output signal can operate our proportional valves. For example: joysticks and potentiometers with built-in PWM electronic board, radio remote controls, PLC.

Often our customers ask for electronic controls only after purchasing the proportional valve. During the offering process, what is the best time to talk about this topic?
Unless the proportional valve will be driven by a PLC, immediately is always the best time.
The configuration of the proportional valve often depends on the accessories that the customer requires in the electronic control devices.
Common questions are: how many and what types of control do you want to have in your hand, how many functions do you want to control with a single control device, does your equipment require cab-mounted or portable control devices?

Are our electronic joysticks compatible with Danfoss PVG proportional valves?
Normally the answer is no.
PVG valves are actuated by a PVE. PVE is not just a coil. It's a closed loop electro-hydraulic module with micro-controller built in.
The input signal required is a percentage in voltage of the power supply, 0.25*UDC to 0.75*UDC = 0.25*12 to 0.75*12 = from 3 to 9V.
We don't have these types of Joysticks in our range. All our joystick provide an output signal in mA.

Are our electronic joysticks compatible with Rexroth M4 proportional valves?
Normally the answer is yes. Rexroth M4 Series is equipped with pressure reducing proportional valves that require a PWM current signal.

My client wants to buy miniaturized electronic joysticks. What can we offer?
Typically mini joysticks are divided into two classes:
Finger tip joysticks, like JLP,MAP2L,MANP2,MANP3,MANP4 Series.
Thumb rollers and joysticks, like FPR and JMT Series.
Most of the time, unless specified, they supply an analogue output signal, therefore they need to be connected to a PWM driver.

Is it possible to convert a Joystick type JHML4C to a type JHML4D?
From a mechanical point of view it would also be possible. From an electronic point of view, it's impossible. The joystick type is recognized at the firmware level for the purpose of the calibration process.

What is a driver?
A driver is a controller/amplifier that convert low power analogue and digital input signals into more powerful PWM current output signals. Drivers can be integrated into electronic control devices to provide a PWM output signal directly, or installed within electronic control units. They can be calibrated mechanically using adjustment trimmers, or calibrated and programmed via software from a PC. In the second case the connection with the personal computer can be via cable or with Bluetooth connectivity.

What is a 5V or 12V auxiliary output?
Most of analogue devices, such as FPR proportional roller and JMT thumb joystick, require a clean 5V supply and have a 0.5-4.5V output signal. They are not supported by adequate electronics to manage battery voltage fluctuations, therefore you have to use a driver with the 5V or 12V auxiliary output.
Only in this way you can guarantee a stable voltage supply because it is internally generated by a linear dc/dc converter.

Some of our electronic cards have Bluetooth connectivity. What's the benefit of Bluetooth?
Bluetooth allows to connect the driver to a PC without a cable. More than for the desktop calibration/programming it is useful for on field fine tuning.
When you use drivers with Bluetooth connectivity make sure your PC is supported by the minimum configuration required.
The minimum configuration for Bluetooth connectivity is “BT 2.1 + EDR”.
The TPLINK UB400 is certified to works correctly, you can source if from: https://www.kogan.com/au/buy/bluetooth-40-nano-usb-adapter-nano-size-usb-20-tp-link/

My client is confused about the kind of calibration required by the joysticks we have offered. Can we provide calibrated joysticks? Is it sufficient to match the characteristics of the proportional valves when we calibrate a joystick or other electronic devices?
We can certainly calibrate joystick or electronic components if they are part of a supply package including proportional valve.
If only the joystick or an electronic component is supplied, we can calibrate it using the instructions provided by the customer. The minimum data required are: PWM frequency, IMIN, IMAX, RAMP UP, RAMP DOWN.
Laboratory calibration is not always optimal for field use. A final field calibration (fine tuning) is often required to optimize parameters such as: nonlinear curves, ramps, reduction or elimination of the spool dead-band. In this case it is recommended to purchase the appropriate calibration kit. In any case, the final calibration of the electronic device remains the sole responsibility of the customer.

My client wants to buy a radio remote control. Do we have in our product range a radio remote control that can drive proportional valves?
The only proportional radio remote control available in the product range is the Handy Series.

My client wants to buy a radio remote control with an emergency button (E-Stop). What can we offer?
The Speedy transmitter has the emergency button option (E-Stop).
When you press E-Stop:
SPEEDY transmitter will be immediately turned off.
CREW receiver will stop all the connected functions in about 2 seconds.
For the immediate stop of operating functions is recommended to install an in line mounted E-Stop in parallel with the receiver.

My client bought a pilot supply manifold code 150106031A a few years ago. He wants to use a potentiometer with the following characteristics:
2.19v - Neutral
3.80v - Full Travel in one Direction
0.92v - Full Travel in Opposite Direction
Now he wants us to provide the electronic card. What can we offer?
Potentially the ECA2H Series code 230409138 could have been the right choice. But after a thorough analysis the card turns out to be incompatible with the client's potentiometer.
Potentiometer output is 2.19V – Neutral. The driver dead-band is 2.23-2.77V, it means that the system will be always powered on with the potentiometer in neutral.
In this case the alternative could have been PVPP3DD2, a fully integrated double coil rotary potentiometer PWM output.

Notes

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CROSS HYDRAULICS

VICTORIA
P.O. Box 1345
CLAYTON SOUTH. VIC. 3169
7 TREFOREST DRIVE,
CLAYTON VIC. 3168
*Phone **(03) 9544 5155***
Fax (03) 9544 2511

QUEENSLAND
P.O. Box 5083
22 PINACLE STREET,
BRENDALE QLD. 4500
*Phone **(07) 3205 3655***
Fax (07) 3881 1592

NEW SOUTH WALES
47 SAMMUT STREET,
SMITHFIELD, N.S.W. 2164
*Phone **(02) 9757 3866***
Fax (02) 9575 3877

SOUTH AUSTRALIA
1/1 LINDFIELD AVENUE,
EDWARDSTOWN, S.A. 5039
*Phone **(08) 8371 3822***
Fax (08) 8371 3844

WESTERN AUSTRALIA
6 MELIADOR WAY,
MIDVALE W.A. 6056
*Phone **(08) 9250 8155***
Fax (08) 9250 8166

NEW ZEALAND
AUCKLAND
6/23 SPRINGS ROAD
EAST TAMAKI, 2013
*Phone **+64 9273 5470***
Fax +64 9273 5471

www.crosshydraulics.com.au