HYDRAULIC DIGITAL CONTROLLER – DIN 43650
Single or Dual Proportional Outputs
Handheld Programmer

Digital Proportional Controller

The digital controller supplies one or two proportional solenoid coils with current proportional to an input control. All calibration settings are managed by a microprocessor for accurate control of hydraulic and pneumatic proportional solenoid valves used in mobile construction equipment and industrial processes. An external handheld programming device calibrates the controller and remembers parameter settings for multiple drivers.

Features:
- Microprocessor based control
- Precise current control and regulator
- Accepts 0.5-4.5V/0-5 V/ Potentiometer/ 0-10 V/ +/-10V/ 4-20 mA command
- Single or dual output models
- Fully configurable current output (0-2 A)
- 9 to 32 VDC operating voltage
- Current sensing maintains output with supply voltage or coil resistance changes
- Modern technology utilizing high frequency switching output (15 kHz PWM)
- Energy efficient design (no heat sink)
- Electronic limiting circuit means no fuses
- Short circuit and reverse polarity protection
- Can disconnect load while powered
- IP65 protection rating

Handheld Programming Device

- Connection via a 2 meter unterminated, shielded cable
- Mates to a DIN 43650 plug on a cartridge or block style solenoid valve
- External handheld programming device provides parameter set up via a single wire
- Configures multiple valve drivers with the same settings held in the internal memory of the programming device
- Simple and accurate troubleshooting available by connecting the handheld device
- LED indicates power on
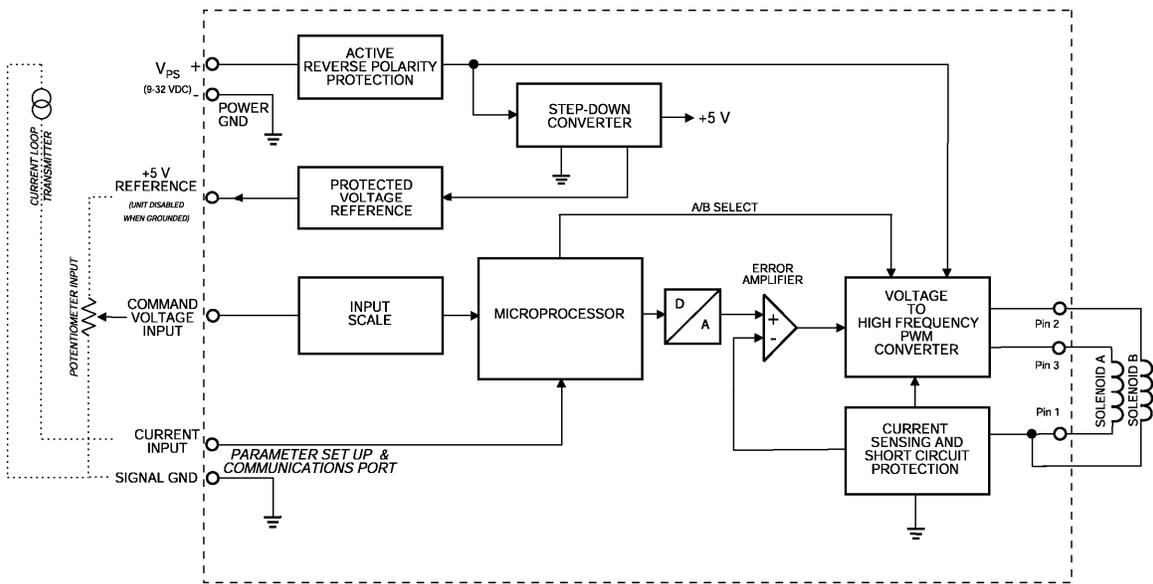
Ordering Part Numbers:

Single Output, max. 2A: DCAPV-H-1-2A **0-5-4.5V Input, Dual Output, max. 2A: DCAPV-H-2-2A-2** **0.5-4.5V Input, Dual Output, 2A, custom:** **DCAPV-H-2-2A-3 (default settings for OEM customer)**	**Handheld Programming Device:** **DCAPV-PRG**

BLOCK DIAGRAM - SINGLE OUTPUT CONTROLLER
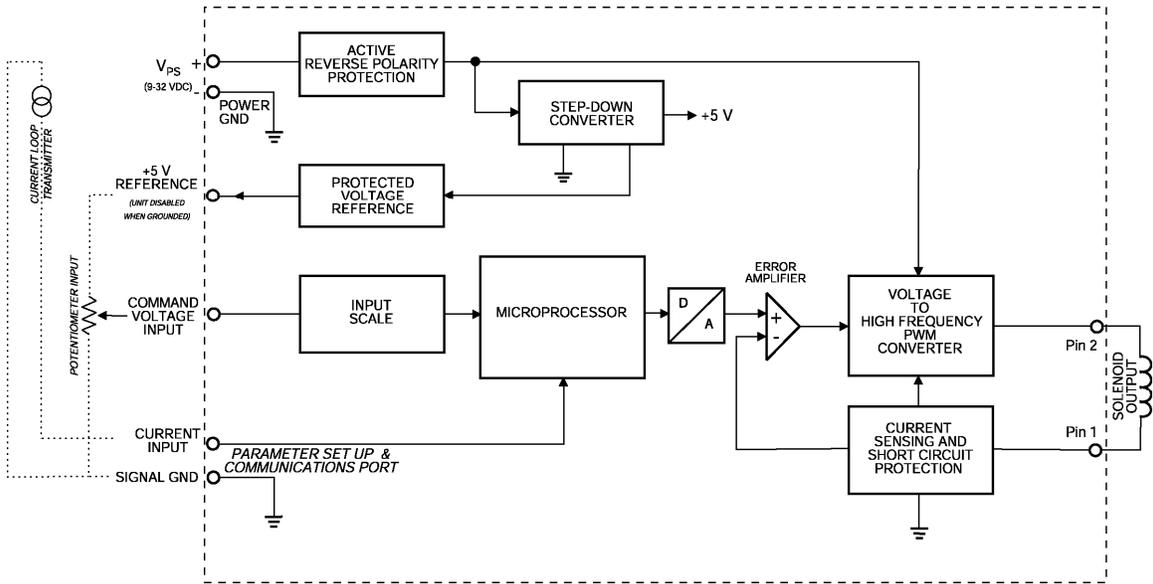
BLOCK DIAGRAM - DUAL OUTPUT CONTROLLER
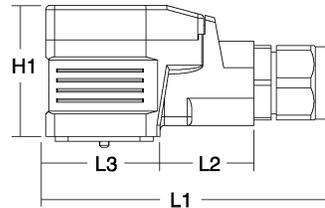
Technical Specifications – Digital Driver:

All specifications are typical at nominal input voltage and 25°C unless otherwise specified.

General Specifications

Microprocessor	PIC12F674SN 8-bit
Control Logic	Dual output version: supports single DIN 43650, dual coil solenoid Single output version: supports single DIN 43650, single proportional solenoid
Communications	Single wire serial communications between controller and handheld programming device.
Operating conditions	-40 to +85°C (-40 to 185°F) 0 to 85% relative humidity
Storage temperature	-50 to 125°C (-58 to 257°F)
LED Indicator	Green LED ON indicates unit is powered.
Electrical connection	DIN 43650 plug (Refer to parameter set up for pin out.) 2 metres unterminated, shielded, jacketed cable (2 power conductors 18 AWG, 4 conductors 24 AWG)
Protection class	IP65 with lid, washer, o-ring and base gasket
Weight	DCAPV: 0.50 lbs. (0.227 kg)

Dimensions in mm/inches (excluding cable)

Length L1	85.35mm	3.36"
L2	61.75mm	2.43"
L3	34.00mm	1.34"
Width = L3	34.00mm	1.34"
Height H1	38.00mm	1.49"

Electrical Specifications

Operating voltage	9 to 32 VDC Reverse polarity protection provided
Control input signal	Selectable with the handheld programmer Single output model (P/N: DCAPV-H-1-2A): 0-5 VDC, 0-10 VDC, +/- 10VDC 10K Potentiometer (accepts 1K to 50K pots) 4-20 mA Dual output model {P/N: DCAPV-H-2-2A-2 (3)}: 0.5-4.5VDC, 0-10 VDC, +/- 10VDC 10K Potentiometer (accepts 1K to 50K pots) 4-20 mA NB. For the dual output version, the A solenoid is activated by the lower half of the input range and the B solenoid is activated by the upper half of the signal range. For example with a 0-10VDC input signal, a 0-5V signal activates Solenoid A and a 5-10V signal activates Solenoid B. **Programming Codes for Input Range -** Use these codes to program the command input. {table below}

1	0-5V or 0.5 to 4.5V (depends on model ordered)
2	Not implemented
3	0 to +10V
4	-10 to +10V
5	4-20 mA

Input resistance	1 MOhm
Solenoid output(s)	Single proportional output or Dual proportional output (one output at a time)
Output current range	Single output models: 0 – 2 Amps Dual output model: 0 – 2 Amps Maximum and minimum current settings are fully configurable from 0 to 2 Amps. The user sets a desired value using the handheld programming device during installation. Short circuit protection provided
Solenoid resistance selection (nominal)	Nominal resistance of solenoid coil should comply with: Rcoil $\leq$ (Vpower supply - 1.5 V)/I-max.
Internal supply for setpoint potentiometer	+5 VDC

Note 1: For proper operation of the amplifier, match power supply voltage with rating of solenoid coil. Operating the amplifier with a supply voltage lower than the solenoid rated voltage may result in reduced maximum current output.
Note 2: The maximum current output of the amplifier should not exceed the current rating of the solenoid coil.

Adjustments – Defaults vary per model.
All adjustments are made through serial communications using a handheld programming device.

| Minimum output current range	0 to 2.0 A (in 10 mA increments) *P/N's DCAPV-H-1-2A, DCAPV-H-2-2A-2:* 0.25 A (factory default) *P/N DCAPV-H-2-2A-3:* For 12V, 500 mA (factory default) For 24V, 180 mA
Maximum output current range	0 to 2.0 A (in 10 mA increments) *P/N's DCAPV-H-1-2A, DCAPV-H-2-2A-2:* 1 A (factory default) *P/N DCAPV-H-2-2A-3:* For 12V, 1A (factory default) For 24V, 510 mA
Current ramp time	0 - 10 seconds range for ramp up or ramp down times *P/N's DCAPV-H-1-2A, DCAPV-H-2-2A-2, DCAPV-H-2-2A-3:* Ramp up time (0 to 2A) Ramp down time (2A to 0), Independently selectable 0 seconds (factory default)
Dither amplitude	5% (factory default) 0 to 20% of full scale current (2.0A)
Current dither frequency	50 to 400 Hz ($\pm$10%) in 5 Hz increments *P/N's DCAPV-H-1-2A, DCAPV-H-2-2A-2:* 200 Hz (factory default) *P/N DCAPV-H-2-2A-3:* 225 Hz (factory default)

Error Codes

The programming device displays error codes when there is a problem during communications between this device and the controller.

ERR1	Error in setting Imax and Imin (Imax $\leq$ Imin)
	Review settings and correct.
ERR2, ERR3, ERR4, ERR6, ERR7, ERR8	Communication errors.
	Check wiring connections.
	If problem persists, contact manufacturer and provide code.
ERR5	Version incompatibility between digital controller and handheld programming device.
ERR9	Error during writing settings to the controller's EEPROM has been detected.
	Digital controller requires repair or replacement. Contact manufacturer.

TYPICAL PARAMETER SET UP

DIGITAL CONTROLLER - DCAPV SERIES - WIRING DIAGRAM

HANDHELD PROGRAMMING DEVICE
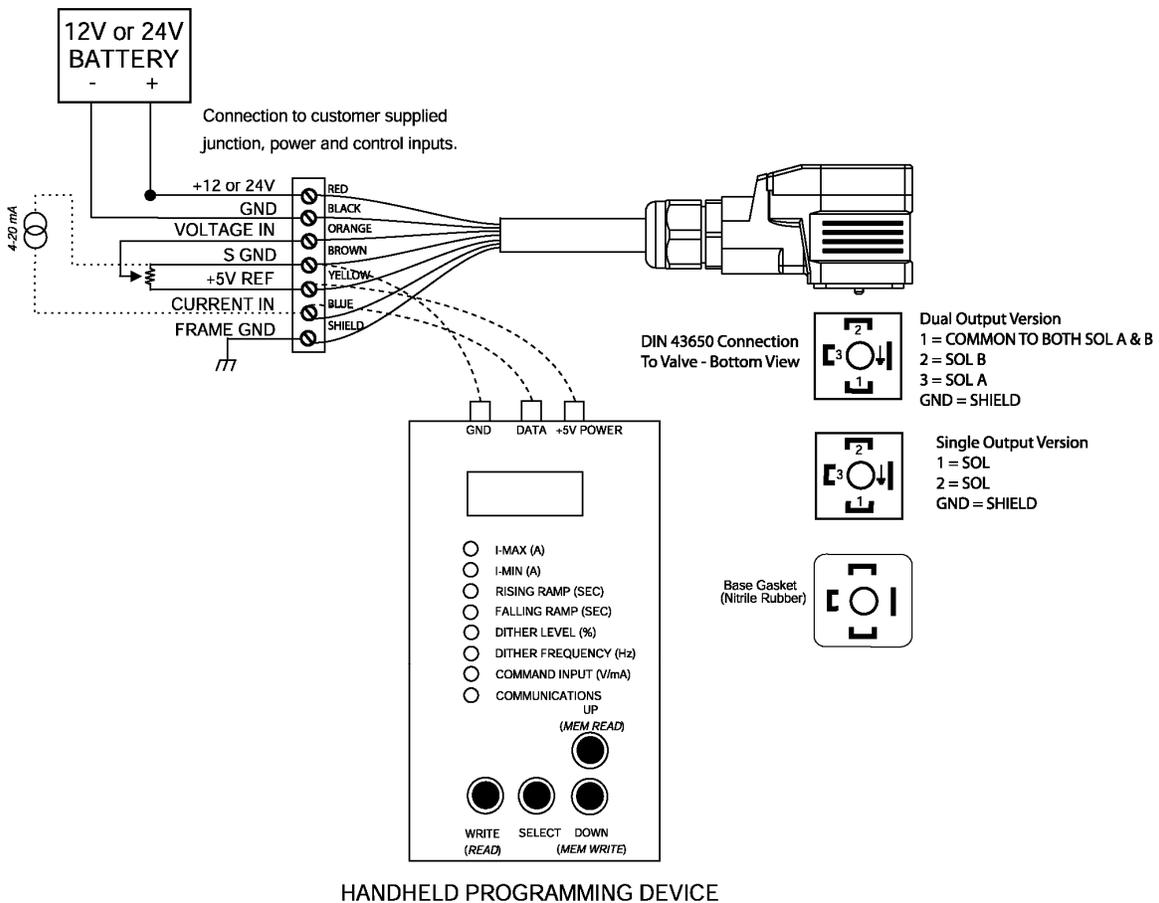
General Specifications – Handheld Programming Device
- Simple and accurate parameter set up and troubleshooting of the digital controller (DCAPV Series)
- A 3 digit 7-segment LED display clearly shows settings.
- Power is provided by the digital controller's (DCAPV)+5V reference voltage. WARNING: It is NOT powered by supply voltage. In the case power supply voltage is applied in error, the device is protected against damage for up to +/-40V continuous. Reverse polarity protection is also provided.
- Internal memory for programming multiple digital controllers and diagnostics.
- Weight 0.40 lbs. (0.181 kg)

Installation
- Wire the handheld programmer's 3-conductor cable (for serial communications between the handheld device and the DCAPV) to the current input, signal GND and +5V reference connections at the customer-supplied interface (junction box or other).
- Disconnect the external command input (current signal) from the DCAPV, as it will interfere with data transmission. A voltage command input can remain connected.
- Connect the DCAPV (digital controller) to a power source. You are ready to program.

Main Functions
Reading setpoints from DCAPV: The function is performed automatically upon connection to the DCAPV. It can be done manually at any time by pressing the SELECT and then WRITE/(*READ*) buttons. Upon completing the reading operation, the setpoints are shown on the display of the Programming Device. The user can scroll through the setpoints to see individual settings using the SELECT and UP, DOWN buttons.

Writing setpoints to DCAPV: To write currently displayed setpoints to the connected DCAPV the user should press the WRITE/(*READ*) button. The Programming Device transfers the setpoints to the DCAPV and then verifies them showing an error if the setpoints of the DCAPV and the Programming Device do not match.

Storing setpoints in internal memory of Programming Device: To store currently displayed setpoints the user should press the SELECT and then DOWN/(*MEM WRITE*) buttons. The setpoints are then transferred into the nonvolatile memory of the Programming Device and can be retrieved at any time if necessary.

Reading setpoints from internal memory of Programming Device: Setpoints stored in the nonvolatile memory can be read by pressing the SELECT and then UP/(*MEM READ*) buttons. After reading, the setpoints shown on the display can be used to program the connected DCAPV. If no setpoints were stored, the factory programmed default set of setpoints is displayed.

Programming for one digital controller (DCAPV)
The user can read, edit and reprogram setpoints in an individual DCAPV using the Programming Device. To perform these functions the following sequence of operations is required:
1. Connect the DCAPV to the Programming Device.
2. After power-up, look through the DCAPV setpoints and change them as necessary. Use the SELECT, UP, and DOWN buttons to scroll through the setpoints and individually edit them.
3. Write the setpoints to the DCAPV by pressing the WRITE/(*READ*) button.
4. Remove the programming device.
5. For users with a 4-20 mA input only, reconnect the external command input wiring.
6. You are ready to operate the digital controller.

Programming for multiple digital controllers (DCAPV's) with the same settings

For quick programming of multiple DCAPV's with the same set of setpoints, the memory functions of the Programming Device are used. The user should perform the following operations:
1. Connect a DCAPV to the Programming Device. Power up.
2. Edit the setpoints and write them to the DCAPV by pressing the WRITE/(*READ*) button.
3. To transfer and store the setpoints into the internal nonvolatile memory of the Programming Device, press the SELECT and then DOWN/(*MEM WRITE*) buttons.
4. Shut down power and disconnect the DCAPV.
5. Connect a new DCAPV to the Programming Device. Power up.
6. Retrieve the setpoints from the internal memory. Press the SELECT and then UP/(*MEM READ*) buttons. The Programming Device will display the previously stored setpoints.
7. Write the setpoints to the DCAPV by pressing the WRITE/(*READ*) button.
8. Shut down the power and disconnect the DCAPV.
9. Repeat steps 5-8 as necessary.

NOTE: If the internal memory of the programming device is blank or an error occurs, a default set of setpoints is set in the programmer memory (Imax=1A, Imin=0.25A, RampUp=0sec, RampDown=0sec, DitherAmp=5%, DithFrequency=200Hz, ControlInput=0-5V).

Specifications are indicative and subject to change. Actual performance will vary depending on the application and operating conditions. Users should satisfy themselves that the product is suitable for use in the intended application. All our products carry a limited warranty against defects in material and workmanship. Please refer to our Warranty, Application Approvals/Limitations and Return Materials Process as described on www.axiomatic.com/service.html.

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