

# **SERVO CAN VALVE DRIVER (0-300mA)**

**OPERATION AND INSTALLATION MANUAL**

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**DESCRIPTION:**

The CAN VALVE DRIVER is a state of the art microprocessor based system for controlling electro-hydraulic proportional valves.

There are 2 proportional outputs available, controlled by the levels present on 2 analog inputs. Each output is designed with short circuit and overload protection.

The CAN Valve Driver will also communicate with a host over CAN. Using CAN, the operator has the ability to control the on board outputs and configure the valve driver as needed. See CAN messages section below.

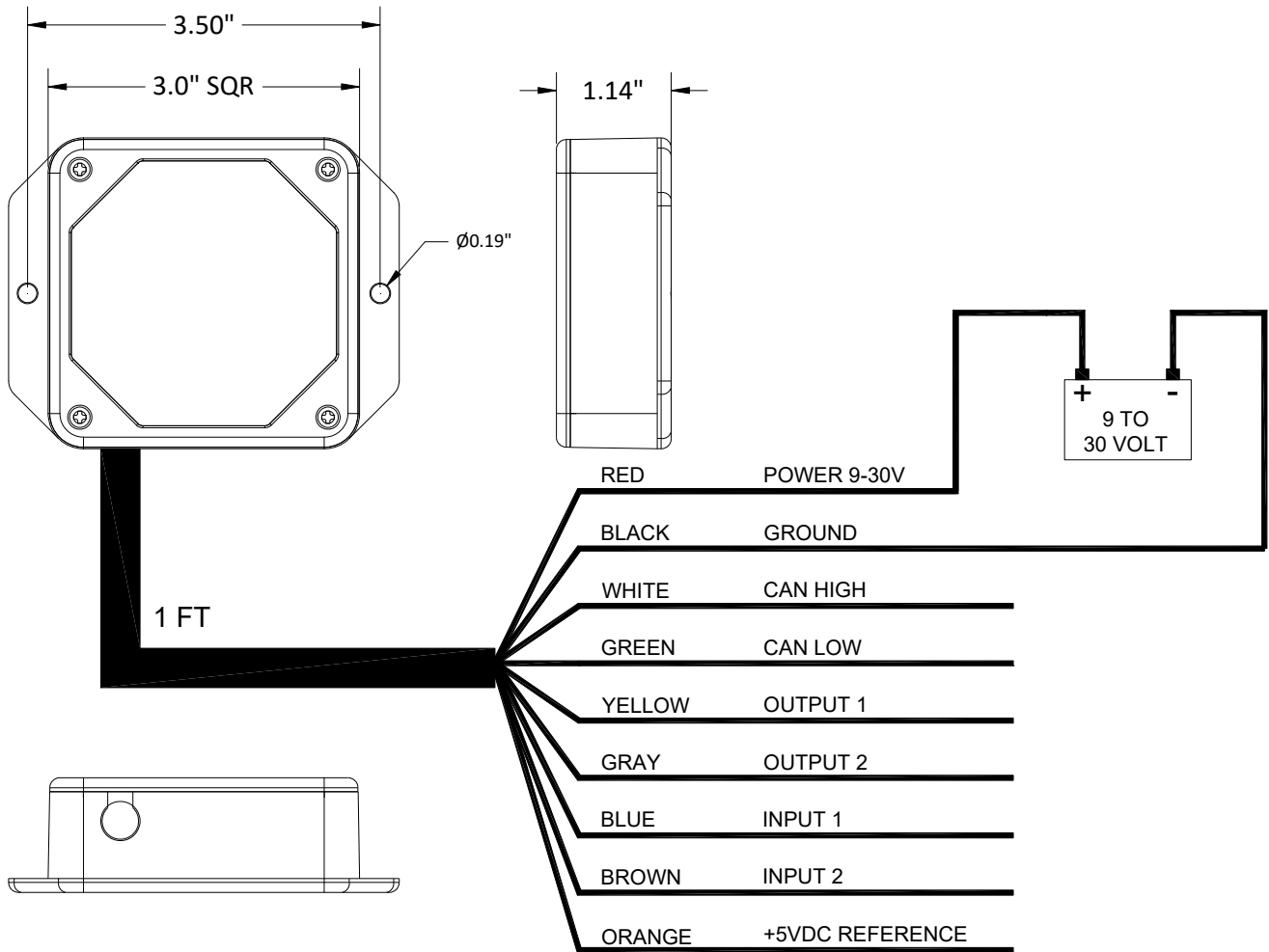
The CAN Valve Driver also has 2 LEDs displaying the system status. The green LED will blink when power to the system is applied and it will blink rapidly when CAN messages are received. The red LED will blink if there are any faults on any of the inputs or outputs. Each output is monitored for no-load or broken wire conditions. If a fault condition occurs, count the number of blinks of the red LED, and then refer to the ERROR CODE section in this manual for additional information.

**INSTALLATION:**

1. Refer to the WIRING CHART in this manual for wiring connections.
2. To install the CAN Valve Driver control, use the 2 mounting holes provided on the control enclosure. Please take extra caution not to damage internal components while installing the unit.
3. When installing the unit, the main power should run from the battery, through a 10 amp fast blow fuse. Use 18 gauge or heavier wire.
4. All connections must be properly insulated to protect against shorts.
5. If using CAN, make sure your CAN bus has the proper terminating resistors installed. These are two 150 ohm resistors across CANH and CANL, one at either end of the CAN bus.

**BEFORE APPLYING POWER:**

1. Check power and ground for correct polarity.
2. Check wiring harness for possible shorts before connecting control to output devices (i.e., valves, relays) by checking each mating pin terminal.
3. Read the rest of this manual.



CAN Valve Driver wiring diagram

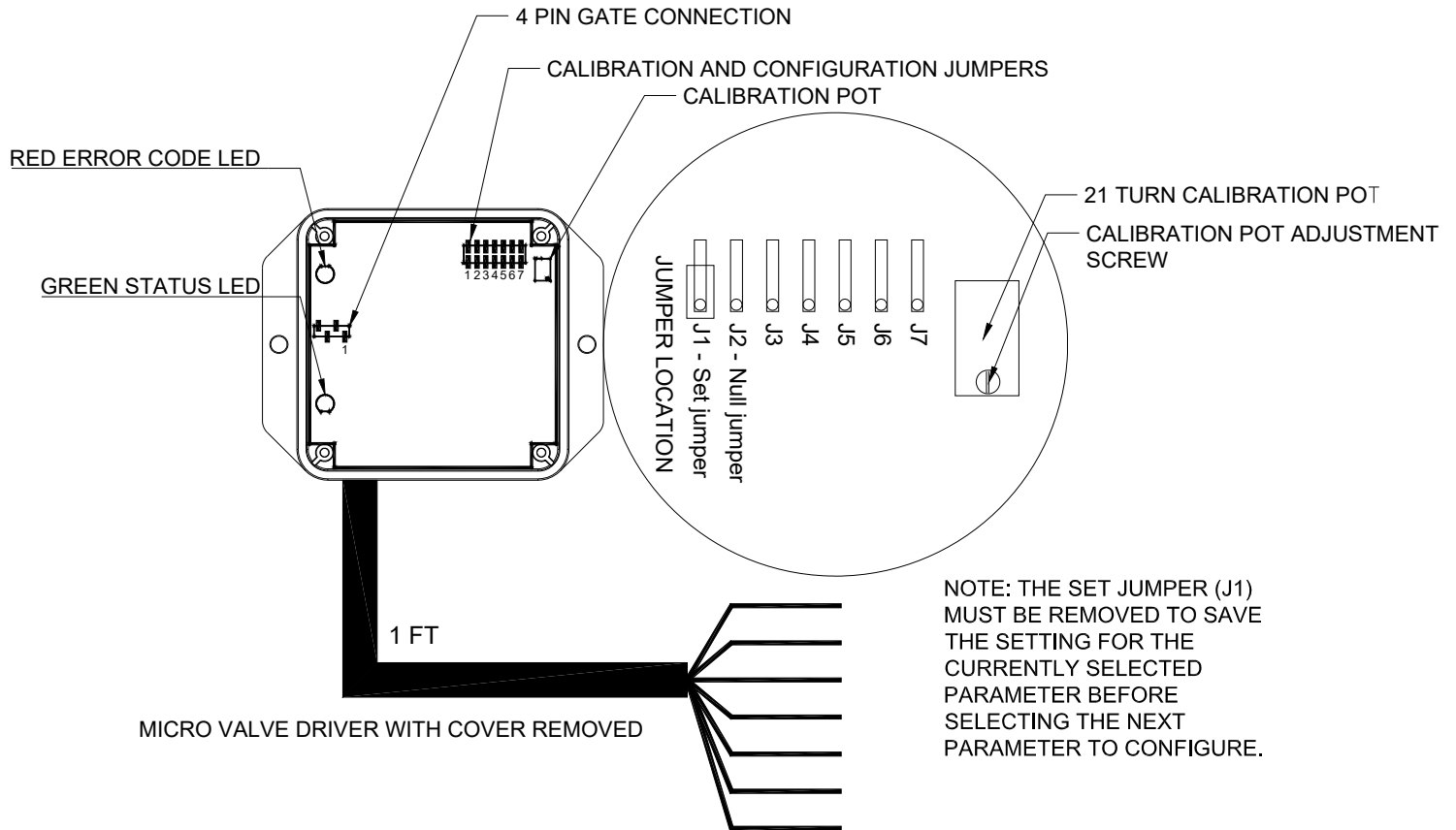
Table 1: Configuration Jumper Settings

Configuration Option	Jumpers to Install	Number of red LED blinks	Number of green LED blinks
1 Input / 1 Output	J1 and J3	1	1
1 Input / 2 Output	J1 and J4	1	2
2 Input / 2 Output	J1, J3, and J4	1	3
Soft start	J1 and J5	1	4
Bump Complementary Default Mode	J1, J3, and J5	1	5
Bump Complementary Step Down Mode	J1, J4, and J5	1	6
Bump Independent Mode	J1, J3, J4, and J5	1	7

Table 2: Calibration Jumper Settings

Output Parameter	Calibration Jumpers to Install	Number of red LED blinks	Number of green LED blinks
Output 1 Minimum	J1 and J6	2	1
Output 1 Maximum	J1, J3, and J6	2	2
Output 1 Ramp Up Time	J1, J4, and J6	2	3
Output 1 Ramp Down Time	J1, J5, and J6	2	4
Current Regulated Output 1	J1, J3, J5, and J6	2	5
PWM Output 1	J1, J4, J5, and J6	2	6
Bump Step Output 1	J1, J3, J4, and J6	2	7
Bump Time Output 1	J1, J3, J4, J5, and J6	2	8
Output 2 Minimum	J1 and J7	3	1
Output 2 Maximum	J1, J3, and J7	3	2
Output 2 Ramp Up Time	J1, J4, and J7	3	3
Output 2 Ramp Down Time	J1, J5, and J7	3	4
Current Regulated Output 2	J1, J3, J5, and J7	3	5
PWM Output 2	J1, J4, J5, and J7	3	6
Bump Step Output 2	J1, J3, J4, and J7	3	7
Bump Time Output 2	J1, J3, J4, J5, and J7	3	8
Output Frequency	J1, J6, and J7	4	1
Reset to Factory Setting	J1, J3, J4, J5, J6, and J7	4	4

# SERVO CAN VALVE DRIVER



### Configuration & Calibration Using the Jumpers -

The CVD can be configured and calibrated using the on-board jumpers. Refer to the jumper detail drawing on page 3 and 4 for the location of these jumpers.

To configure the CVD, first apply power to module. The green LED will flash when the unit is on. Then install the jumpers for the desired configuration as shown in table 1 on page 3. The red and green LED should start to blink as described. Remove set jumper (J1) to save. The LEDs will stop blinking.

Changing the configuration jumper settings at any time immediately changes the CVD configuration. **Warning: when any of the input/output pairs are initially made active by installing any of the configuration jumpers, if an input voltage is present on the input(s) when the configuration jumper is installed, the corresponding output(s) will immediately come on. Ensure that the outputs are not connected to the equipment when performing CVD configuration.**

Note: when the 1 Input/ 2 Output configuration is chosen, the input voltage range for analog input 1 is divided into a high side and a low side corresponding to the high side and low side from the center voltage of a joystick . The high side input corresponds to proportional output 1 and the low

side corresponds to proportional output 2.

The individual output parameters can also be calibrated using the jumpers along with the 21 turn calibration pot. To set the individual parameters, install the jumper or jumpers to select the desired parameter as shown in table 2 on page 3. The red and green LED should start to blink as described. Then turn the adjustment screw on the calibration pot CW to increase or CCW to decrease the currently selected parameter. When the parameter has been adjusted to the desired level, **simply remove the set jumper (J1) and the new value will be saved.** The LEDs will stop blinking. Note: when calibrating CVD parameters using the calibration jumpers, the currently selected parameter will not change until the calibration pot adjustment screw has been turned one full turn in either the clockwise or counterclockwise direction.

To restore all of the CVD parameters to the default factory settings perform the following steps:

1. Install all six jumpers shown on table (Configuration and Calibration).
2. Red LED and green LED should both be blinking 4 times.
3. Remove set jumper (J1).
4. The LEDs will stop blinking.

At this point the CVD will power

up with the factory calibration settings. When any of the inputs and outputs is then made active by installing the configuration jumpers, the inputs and outputs will initially have these factory settings. The factory calibration settings for 1 Input/ 1 Output or 2 Input/ 2 Output configurations are:

Analog Inputs

Min. - 0.5V

Max. - 4.5V

Proportional Outputs

Min. - 40mA

Max. - 140mA

Ramp times - 0 Sec.

Freq. - 75Hz

The factory calibration settings for the 1 Input/ 2 Output configurations are:

Analog Input

Low Side - 0.5-2.25V

High Side - 2.75-4.5V

Proportional Outputs

Min. - 40mA

Max. - 140mA

Ramp times - 0 Sec.

Freq. - 75Hz

Note: When returning the CVD to factory settings, any calibration adjustments that had previously been made will be lost.



## SYSTEM TROUBLESHOOTING USING OPTIONAL GATE:

The Kar-Tech GATE connects to the controller thru the RS232 diagnostic port.

**Note:** To prevent electrical shorts and damage turn Controller power off. Plug gate to the controller then turn power on to the controller.

The GATE creates a Wi-Fi access point which allows you to connect to any device with Wi-Fi and web browser such as smart phones, pads or personal computers. It supports Google Chrome, Internet Explorer, Firefox and IOS Safari and allows user to configure, diagnose and troubleshoot the system.



*Gate Diagnostic Tool*

The GATE's POWER LED will start to blink if the battery is low. Charge the GATE as soon as possible after seeing low battery indicator using a Kar-Tech cable.

After being plugged in, the GATE will turn off after 1 minute if no CVD or Wi-Fi is connected. If the CVD or Wi-Fi is connected, the GATE will turn off after 5 minutes of no Wi-Fi and CVD connection otherwise it will stay on.

The Gate is a very useful tool for configuring and calibrating the control system. The CVD module application allows the user to configure the control as a 1 Input/ 1 Output control, a 1 Input/ 2 Output control, or as a 2 Input/ 2 Output control. The user can then also calibrate the parameters for the proportional outputs and analog inputs.

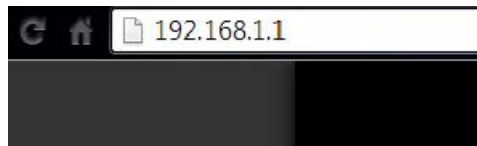
Connect the Gate interface to the 4-pin serial connector on the CVD control board; see the figure below for the location of the 4-pin serial connector. Place the ridge of the connector toward the top of the enclosure (side opposite of wires).



### ACCESSING THE CONTROL PANEL

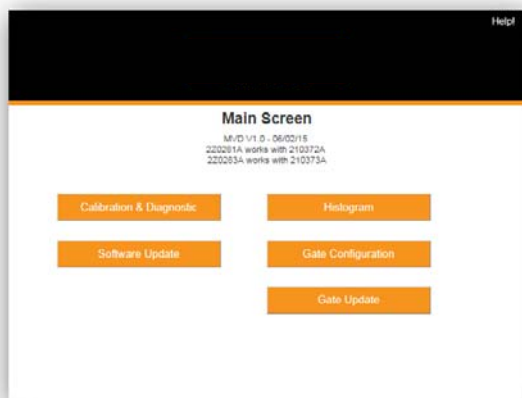
1. Turn off power to the CVD.
2. Plug in the GATE to the CVD.

3. Turn on the power to the CVD. The power LED on the GATE will turn on at this point
4. Use your device and look for the available WiFi networks. A network under the name of "KTMVD21037" should be available at this point. Connect to the network, the password is 210379A1.
5. Once the connection is established, open a web browser on your device. Kar-Tech recommends using Chrome browser.
6. Enter the address `http://192.168.1.1` in the address bar



*Address Bar*

7. The following options are available from the main screen.



*Main Screen*

### CALIBRATION & DIAGNOSTICS

To set inputs and outputs to match valves and joysticks, tap the CALIBRATION & DIAGNOSTICS button. A password is required to gain access to this section. The password is 1262.

After entering the password, the following screen will appear:



*Calibration & Diagnostic*

If the "Check Serial Link" message is flashing in the middle of the screen, check the connection to

the 4-pin serial connection of the CVD control board and the connection to the Gate.

The lower portion of the screen under Proportional Outputs label shows the three possible configuration choices for the CVD: 1 Input/ 1 Output (1-1), 1 Input/ 2 Output (1-2), or 2 Input/ 2 Output (2-2). Soft start, PWM mode for each output, and three Bump modes are also available. Select the desired configuration by tapping the box to the left of the desired choice then press SAVE. A checkmark will appear in the box to the left of the currently selected configuration.

Note: when the 1 Input/ 2 Output configuration is chosen, the input voltage range for analog input 1 is divided into a high side and a low side corresponding to the high side and low side from the center voltage of a joystick . The high side input corresponds to proportional output 1 and the low side corresponds to proportional output 2.

#### Soft Start

When Soft Start is checked the analog inputs will behave like digital inputs. That is when the voltage at the inputs is above 2.5V the corresponding output will turn on.

#### Bump Modes

When one of the three bump modes is selected the outputs are automatically set to PWM. The

modes are described below.

**Bump Complementary Default Mode.** When this mode is enabled, activating input 1 (>2.5V) will make output 1 increase bump step amount. Continuing to hit input 1 will keep making output 1 increase until max is reached. However if input 2 is activated (>2.5V) output 1 will turn off. Continuing to hit input 2 will increase output 2 bump step amount up to max. Then if input 1 is activated output 2 will turn off. Note: if it is desired to have 2 inputs control only one output, set the max for output 2 to 0%. Then input 1 and 2 will only control output 1.

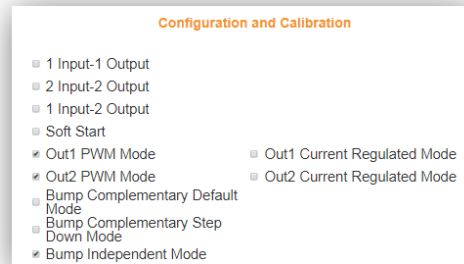
**Bump Complementary Step Down Mode.** When this mode is enabled, activating input 1 (>2.5V) will make output 1 increase bump step amount. Continuing to hit input 1 will keep making output 1 increase until max is reached. Activating input 2 (>2.5V) will then decrease output 1 by bump step amount. Continuing to hit input 2 will decrease output 1. Once output 1 is 0% then output 2 will increase with each activation of input 2 until max is reached. Then activating input 1 will decrease output 2. Hitting both inputs together will turn off both outputs. Note: if it is desired to have 2 inputs control only one output, set the max for output 2 to 0%. Then input 1 and 2 will only control output 1.

**Bump Independent Mode.** When this mode is enabled, hitting input 1 with >5.0V makes output 1 increase bump step amount. Continuing to hit input 1 at >5.0V will keep making output 1 increase until max is reached. Hitting input 1 between 2 & 3V makes output 1 decrease bump step amount until 0% is reached. Hitting input 2 with >5.0V makes output 2 increase bump step amount. Continuing to hit input 2 at >5.0V will keep making output 2 increase until max is reached. Hitting input 2 between 2 & 3V makes output 2 decrease bump step amount until 0% is reached.

Bump Step Value and Bump Time can then be adjusted for each output from second drop down box. Bump Step Value is the amount in percent that the output will increase or decrease when input is activated. Bump Step Time is the time in milliseconds that it takes the output to increase or decrease one step when input is held. To disable the output increasing or decreasing when input is held set this to 0.

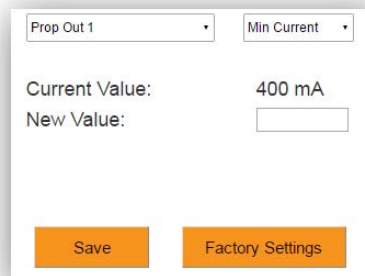
After Configuration is Selected

When one of the seven configuration options has been selected, the current status of the inputs and outputs that have been made active is displayed.



After configuring the number of inputs and outputs, the CALIBRATION section on the bottom of the screen can be used to calibrate the parameters for the active inputs and outputs.

There are two pull down lists to choose from in this section. The first (on the left) is a list of the currently inputs and outputs that can be calibrated. Tap on the down arrow to the right of "Prop Out 1" to expand the list as shown.



Choose which input or output to calibrate from this list. The currently selected input or output is then displayed next to the down arrow.

Next choose which parameter to calibrate for the currently selected input or output by expanding the pull down list next

to the second down arrow (to the immediate right of the first list), and selecting the desired parameter.

The currently selected parameter will be displayed below the two pull down lists. To change the currently selected parameter setting, enter the new value in box. After the new value has been entered, tap the SAVE button to save the new value. Tap the HOME button to exit the CALIBRATION & DIAGNOSTIC section.

Note: The Min and Max values for the Analog Inputs are entered in Volts. The Min and Max values for the Proportional Outputs are entered in Milliampere or percent (if PWM), the ramp times are entered in Seconds, and the frequency is entered in Hertz.

Tapping the Factory Settings button will restore the CVD to the default factory settings that it was shipped with. Any changes made using the Calibration procedure will be lost. The factory settings will disable both inputs and both outputs. When either of the Analog Inputs or Proportional Outputs is made active for the first time, they will be assigned the default factory parameters. **Warning: when any of the input/output pairs are initially made active, if an input voltage is present on the input(s) when the configuration box is checked, the corresponding output(s) will immediately come on. Ensure that the outputs are not connected to the equipment**

**when performing CVD configuration.**

The default factory parameters for 1 Input/ 1 Output or 2 Input/ 2 Output configurations are:

Analog Inputs

Min. - 0.5V

Max. - 4.5V

Proportional Outputs

Min. - 40mA

Max. - 140mA

Ramp times - 0 Sec.

Freq. - 75Hz

The default factory parameters for the 1 Input/ 2 Output configuration are:

Analog Input

Low Side - 0.5-2.25V

High Side - 2.75-4.5V

Proportional Outputs

Min. - 40mA

Max. - 140mA

Ramp times - 0 Sec.

Freq. - 75Hz

The default factory parameters for PWM outputs are:

Min. - 0%

Max. - 100%

Ramp times - 0 Sec.

Freq. - 75Hz

The default factory parameters for Soft Start are:

Proportional Outputs

Min. - 40mA

Max. - 140mA

Ramp times - 0 Sec.

Freq. - 75Hz

The default factory parameters for Bump Modes are:

Bump Step - 10%

Bump Time - 0 ms

The allowable limits for these

parameters are:

Analog Inputs:

Min. - 0V

Max. - 5V

Proportional Outputs

Min. - 0mA

Max. - 500mA

Ramp times - 0-30 Sec.

Freq. - 30-500Hz

PWM Outputs

Min - 0%

Max - 100%

Ramp times - 0-30 Sec.

Freq. - 30-500Hz

Bump Mode

Bump Step - 100%

Bump Time - 0-30 Sec.

Note that the Max. value for each proportional output must be at least 30mA greater than the Min. value to maintain stable output.

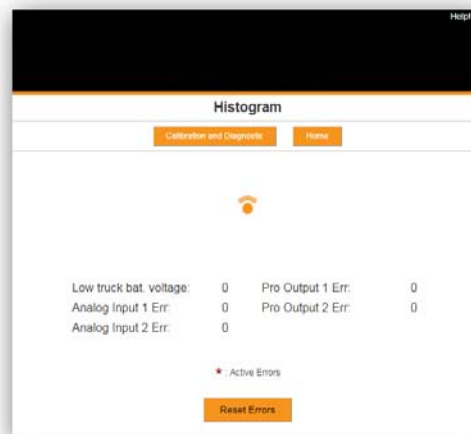
The CVD can also be configured to function as a ramp card. Simply configure the module for 1 Input/ 1 Output or 2 Input/ 2 Output operation. Then calibrate the minimum input voltage to 0V and the maximum input voltage to 5V, and calibrate the proportional output(s) minimum and maximum values and ramp times as desired. A switch input can then be used to switch between the min and max output values.

Note: The maximum input value that the CVD will recognize and that can be configured is 5V. The module can however accept voltages higher than 5V on the analog inputs. Any input higher than 5V will be read as an input of 5V.

Warning: when switching a voltage greater than 15V onto the analog inputs, a 5.1k or 4.7k ohm resistor **must** be installed in series between the switch and the input to avoid damaging the CVD.

### HISTOGRAM

Tap the HISTOGRAM icon on the MAIN screen. This will take the user to a screen that shows which error codes are active and how many times the specific error code has been active. This feature can be used to troubleshoot machine wiring and other problem areas. A star to the left of an error indicates that error is currently active. The number to the right of each error shows how many times that error has been active. Press the RESET button to reset all the error code counts to zero. This operation should be performed after installation of the system on the equipment. The password to reset is 1262. Press Home to return to main screen.



*Histogram Page*

## SOFTWARE UPDATE

The password to gain access to the software update page is 1262.

Use the Choose File button to select new software on your device with which to program the CVD. Kar-Tech will have provided software in the .kar format. Once the file is selected, press the SUBMIT button to upload the file. Note: This feature does not work on Apple mobile or tablet products.

Note: Do not turn the CVD or the GATE off during the upload process.

*Software Update Page*

*Gate Configuration Page*

## GATE CONFIGURATION

The password to gain access to the gate configuration page is 1262.

This page allows you to change the name (SSID) of the Wi-Fi network you are connecting to. Factory settings will rename the Wi-Fi to its original name.

If Broadcast SSID option is selected, the Wi-Fi name (SSID) is public and it will be visible to any other Wi-Fi devices. Otherwise, the Wi-Fi name (SSID) is hidden and it would require manual connection to the network.

If Enable Multiple Connections is selected, multiple connections up to 4 devices could be connected to the GATE. However, only one of the connected devices can use the GATE. If Single connection is enabled, only one device can be

connected to the GATE.

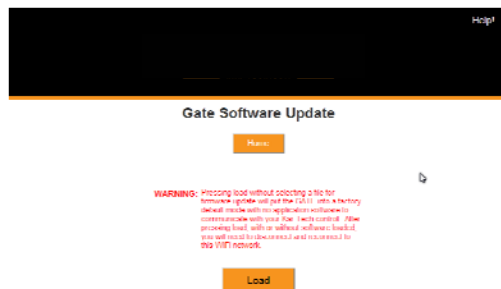
NOTE: A reconnect to the new Wi-Fi connection is needed after each change. It is advised to keep a note of the Wi-Fi name in case if Not Broadcast SSID option is selected. Forgetting the Wi-Fi name after selecting this option will require the GATE to be sent to KAR-TECH for RESET.

### GATE UPDATE

The password to gain access to the gate update page is 1262.

This page was designed to upload software that changes the product that the GATE interface works with.

Once the LOAD button is pressed the application on the GATE will be deleted.



### *Gate Update Page*

1. Select LOAD
2. Disconnect then reconnect to "KTMVD21037" network
3. Press HOME button
4. Screen below should be shown:



5. Press Gate Software Update
6. Using Browse select proper .gat file
7. Press Submit
8. File will upload and say Success! When complete
9. Disconnect then reconnect to "KTMVD21037" network
10. Press HOME button
11. Update complete

Note: the GATE is not a precision measurement instrument. There may be some delays.



## CAN MESSAGES

### IDENTIFIERS (PGNs)

The valve driver uses 29bit CAN 2.0b identifiers.

There are both Command Identifiers and Report Identifiers. Command Identifiers are used to send commands to the valve driver. Report Identifiers are used by the valve driver to send messages to the host.

Each valve driver has default Command and Report Identifiers which cannot be changed. They can be enabled and disabled if desired. At power-up, the Default Command Identifier is always enabled.

To allow for multiple valve drivers to be used on the same CAN bus; each valve driver can have one User Defined Report Identifier, and up to four User Defined Command Identifiers. These are assigned using CAN messages.

The Report Identifier that the valve driver uses can be switched between the Default Report ID and the User Defined Report ID by clearing or setting the **RPSEL** bit in the **Report ID Reassignment** message.

All the assigned Command IDs are active at the same time. This can be helpful when setting up various groups of valve drivers. For example, each valve driver could have one of their User Defined Command IDs and their User Defined Report IDs set up as unique to each of them. Then perhaps the second User Defined Command IDs could be set to either a Chassis ID or a Turret ID. Then a command sent from the master to the Chassis ID will be obeyed by all the valve drivers with this ID assigned to it. Any replies could be unique, if the modules are set to use their User Defined Report IDs by setting **RPSEL** to '1'.

The Default Command ID can be enabled or disabled using the **DISDEF** bit in the **Command ID Reassignment** message.

The default Command Identifier is 0xFF0022.

The default Report Identifier is 0xFF0023.

NOTE: Identifiers 0xFFFFXX and 0xFF00XX are reserved and should not be used for Used Defined IDs.

## CAN COMMANDS

The following are the commands that can be sent to the CAN Valve Driver.

All messages use 29 bit identifiers and 8 data bytes. Byte 0 is used to specify the message's Type. Byte 1 is used to flag auto replies, confirmation requests, and to further specify the message (Data Type). Bytes 2-7 are used to hold the message's data.

Byte 1	
C	DATA TYPE

C - Confirmation Flag:

Set to 1, the valve driver will echo the same message to confirm it was received.

Set to 0, no confirmation will be sent back.

Bits 0-5 are used to specify the DATA TYPE of the message.

The Default Command Identifier is 0xFF0022.

Note that if the valve driver does not receive a command within 1 second; it turns off the outputs to go into a safe mode. It is suggested to refresh commands every 100ms or so.

Numbers in parentheses are as follows: (DECIMAL, HEX).

### Configure - Operation Mode, Output Type

Byte 0	Byte 1				Byte 2	Byte 3			Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=3	OPERATION MODE	000000	O2	O1	CONTRO L MODE	BUMP MODE		
0xF5	C	0	RB	DT=3	OPERATION MODE	000000	O2	O1	CONTRO L MODE	BUMP MODE		

Default: All inputs/outputs are disabled. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the type of operation (for example: one analog input controlling one output), output type, and control mode (CAN control or analog input control of outputs).

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (35, 0x23) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data Type must be set to 3 (3, 0x03)

Byte 2:

OPERATION MODE - this byte is used to indicate the operation mode.

- 00 (0, 0x00) = All inputs/outputs are disabled
- 01 (1, 0x01) = 1-1: 1 analog input and 1 output
- 10 (2, 0x02) = 2-2: 2 analog inputs and 2 outputs
- 100 (4, 0x04) = 1-2: 1 analog input and 2 outputs
- 1000 (8, 0x08) = soft start (analog inputs behave like digital inputs)

Byte 3:

O1 - (bit 0) Sets the type of output that output 1 is.

- 0 = Current Regulated
- 1 = PWM (or On/Off)

O2 - (bit 1) Sets the type of output that output 2 is.

- 0 = Current Regulated
- 1 = PWM (or On/Off)

00 (0, 0x00) = output 1 and 2 are both current regulated outputs

01 (1, 0x01) = output 1 is a PWM output and output 2 is a current regulated output

10 (2, 0x02) = output 2 is a PWM output and output 1 is a current regulated

11 (3, 0x03) = both outputs are PWM (or On/Off)

Byte 4:

CONTROL MODE - this byte is used to indicate whether the analog inputs will control the outputs or the outputs will be controlled by CAN using index 0x01.

00 (0, 0x00) = Outputs are controlled by analog inputs, CAN index 0x01 is ignored

01 (1, 0x01) = Outputs are controlled by CAN, analog inputs are ignored

Byte 5:

BUMP MODE - this byte is used to indicate whether or not bump mode should be activated. When one of the three bump modes is activated, the outputs will automatically be set to PWM. The three types of bump mode are described below:

00 (0, 0x00) = No bump mode

01 (1, 0x01) = Bump Complementary Default Mode. When this mode is enabled, activating input 1 (>2.5V) will make output 1 increase bump step amount. Continuing to hit input 1 will keep making output 1 increase until max is reached. However if input 2 is activated (>2.5V) output 1 will turn off. Continuing to hit input 2 will increase output 2 bump step amount up to max. Then if input 1 is activated output 2 will turn off. Note: if it is desired to have 2 inputs control only one output, set the max for output 2 to 0%. Then input 1 and 2 will only control output 1.

10 (2, 0x02) = Bump Complementary Step Down Mode. When this mode is enabled, activating input 1 (>2.5V) will make output 1 increase bump step amount. Continuing to hit input 1 will keep making output 1 increase until max is reached. Activating input 2 (>2.5V) will then decrease output 1 by bump step amount. Continuing to hit input 2 will decrease output 1. Once output 1 is 0% then output 2 will increase with each activation of input 2 until max is reached. Then activating input 1 will decrease output 2. Hitting both inputs together will turn off both outputs. Note: if it is desired to have 2 inputs control only one output, set the max for output 2 to 0%. Then input 1 and 2 will only control output 1.

100 (4, 0x04) = Bump Independent Mode. When this mode is enabled, hitting input 1 with >5.0V makes output 1 increase bump step amount. Continuing to hit input 1 at >5.0V will keep making output 1 increase until max is reached. Hitting input 1 between 2 & 3V makes output 1 decrease bump step amount until 0% is reached. Hitting input 2 with >5.0V makes output 2 increase bump step amount. Continuing to hit input 2 at >5.0V will keep making output 2 increase until max is reached. Hitting input 2 between 2 & 3V makes output 2 decrease bump step amount until 0% is reached.

Bytes 6, & 7:  
Reserved

Example:

(Decimal) 245 3 2 0 0 0 0 0  
(HEX) 0xF5 0x03 0x02 0x00 0 0 0 0

This sets the operation mode to 2 analog inputs and two outputs (0x02). This also sets the output type to both outputs being current regulated outputs (0x00) and outputs are controlled by analog inputs (0x00). No confirmation reply and no bump mode.

To read back the current settings:

(Decimal) 245 35 0 0 0 0 0 0  
(HEX) 0xF5 0x23 0 0 0 0 0 0

### Output Control for Output 1 & Output 2

Byte 0	Byte 1			Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
1	C	000	O2	O1	OUTPUT 1 VALUE	OUTPUT 2 VALUE		ERROR ENABLE	
0x01	C	000	O2	O1	OUTPUT 1 VALUE	OUTPUT 2 VALUE		ERROR ENABLE	

This message is used to send commands for Outputs 1 and 2. Make sure the set output type and output type selected below are the same.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

O1 - (bits 0 & 1) Selects the type of output that output 1 should be.

00 (0, 0x00) = Disabled  
01 (1, 0x01) = PWM (or On/Off)  
10 (2, 0x02) = Current Regulated PWM

O2 - (bits 2 & 3) Selects the type of output that output 2 should be.

00 (0, 0x00) = Disabled  
01 (4, 0x04) = PWM (or On/Off)  
10 (8, 0x08) = Current Regulated PWM

Bytes 2 & 3:

OUTPUT 1 VALUE - This is the value that Output 1 should be set to. Byte 2 is the least significant byte. Byte 3 is the most significant byte.

If O1 = 00 (0, 0x00), then this value does not matter.  
 If O1 = 01 (1, 0x01), then OUTPUT 1 VALUE is in 0.1% per bit. To use this as an On/Off output, use 0 for Off and 1000 for ON.  
 If O1 = 10 (2, 0x02), then OUTPUT 1 VALUE is in mA.

Bytes 4 & 5:

OUTPUT 2 VALUE - This is the value that Output 2 should be set to. Byte 4 is the least significant byte. Byte 5 is the most significant byte.

If O2 = 00 (0, 0x00), then this value does not matter.  
 If O2 = 01 (1, 0x01), then OUTPUT 2 VALUE is in 0.1% per bit. To use this as an On/Off output, use 0 for Off and 1000 for ON.  
 If O2 = 10 (2, 0x02), then OUTPUT 2 VALUE is in mA.

Byte 6:

ERROR ENABLE - This byte is used to enable the error flag for used outputs. The red LED will now blink if there is an error with the output and it will be shown on Histogram page of gate.

If ERROR ENABLE = 00 (0, 0x00), then the error flag remains disabled for outputs 1 and 2  
 If ERROR ENABLE = 01 (1, 0x01), then the error flag is enabled for output 1  
 If ERROR ENABLE = 10 (2, 0x02), then the error flag is enabled for output 2  
 If ERROR ENABLE = 11 (3, 0x03), then the error flag is enabled for both outputs 1 and 2.

Byte 7:

Reserved

Example:

(Decimal)    1     5     232   3     232   3     3     0  
 (HEX)        0x01 0x05 0xE8 0x03 0xE8 0x03 0x03 0

This sets both outputs 1 and 2 as ON/OFF outputs (0x05). It also turns both of the outputs ON (0x03E8) and enables the error flag for both outputs (0x03). No confirmation reply. NOTE: this will only work if control mode above is CAN control mode.

**Configure - Baud Rate**

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	DT=4	BAUD RATE					
0xF5	DT=4	BAUD RATE					

Default: 250kBit/second

This message is used to change the baud rate for CAN commanding and reporting. This rate will be stored in the valve driver and will not be lost when power is turned off.

Byte1:

DT - Data Type must be set to 4 (4, 0x04)

Byte 2:

BAUD RATE - this byte is used to indicate the baud rate.

00 (0, 0x00) = 250kBit/second

01 (1, 0x01) = 500kbit/second

10 (2, 0x02) = 1Mbit/second

Byte 3-7:

Reserved

Example:

(Decimal) 245 3 2 0 0 0 0 0

(HEX) 0xF5 0x04 0x02 0 0 0 0 0

This sets the baud rate to 1Mbit/second.

### Low Level Requests

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
127	C	DT=0		INPUTS				
0x7F	C	DT=0		INPUTS				

This message is used to request input data and request external input values.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

DT - Data Type must be set to 0 (0, 0x00).

Byte 2:

Reserved

Byte 3:

INPUTS - This byte is used to request the values of the inputs.

Bit 0 - Set this bit to 1 (1, 0x01) to get the values for the external inputs 1 & 2 and the Supply Voltage (VBAT). (See reply 128, 0x80)

Bit 1 - Set this bit to 1 (2, 0x02) to get the values for the calibration pot and the reference voltage (+5V VREF). (See reply 129, 0x81)

Bit 2 - Set this bit to 1 (4, 0x04) to get the values for Current 1, Current 2, and Supply Voltage (VBAT). (See reply 132, 0x84)

Bit 3 - Set this bit to 1 (8, 0x08) to get the jumper inputs and error pattern. (See reply 144, 0x90)

Bytes 4-7:

Reserved

Example:

(Decimal) 127 0 0 3 0 0 0 0

(HEX) 0x7F 0x00 0 0x03 0 0 0 0

This asks for Input Report #1 and #2. No confirmation reply.

### Configure Report Rates

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
240	C CLEAR	Report Index 1	Time 1 (ms)		Report Index 2	Time 2 (ms)	
0xF0	C CLEAR	Report Index 1	Time 1 (ms)		Report Index 2	Time 2 (ms)	

This message is used to set up scheduled reports.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

CLEAR - To assign Report Rates, clear this value. To erase all previously set report rates set this to 1 (1, 0x01).

Byte 2:

Report Index 1 - This is the index of the Report that you want sent every Time 1 ms.

Bytes 3 & 4:

Time 1 - This is the interval to send the report indicated by Report Index 1. The units are ms. Byte 3 is the least significant byte. Byte 4 is the most significant byte.

Byte 5:

Report Index 2 - This is the index of the Report that you want sent every Time 2 ms.



**Bytes 6 & 7:**

Time 2 - This is the interval to send the report indicated by Report Index 2. The units are ms. Byte 6 is the least significant byte. Byte 7 is the most significant byte.

**Example:**

(Decimal) 240 0 128 232 3 129 208 7  
 (HEX) 0xF0 0x00 0x80 0xE8 0x03 0x81 0xD0 0x07  
 This asks for Input Report #1 (0x80) every second (0x03E8) and Input Report #2 (0x81) every 2 seconds (0x07D0). No confirmation reply.

**Polling Reports**

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
241	C	DT=0	Report Index 1	Report Index 2	Report Index 3	Report Index 4	Report Index 5	Report Index 6
0xF1	C	DT=0	Report Index 1	Report Index 2	Report Index 3	Report Index 4	Report Index 5	Report Index 6

This message is used to ask for up to 6 reports at once.

**Byte1:**

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

DT - Data type must be set to 0 (0, 0x00).

**Bytes 2 thru 7:**

Each byte can be filled with a Report to be replied. Leave the byte 0 if no reply is needed.

**Example:**

(Decimal) 241 0 128 129 132 0 0 0  
 (HEX) 0xF1 0x00 0x80 0x81 0x84 0x00 0x00 0x00

This asks for Input Report #1-#3 (0x80, 0x81, 0x84) all at the same time. No confirmation reply

**Configure Outputs - Current**

Byte 0	Byte 1			Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=1	OUTPUT INDEX	0	MINIMUM CURRENT (mA)	MAXIMUM CURRENT (mA)	
0xF5	C	0	RB	DT=0x01	OUTPUT INDEX	0	MINIMUM CURRENT (mA)	MAXIMUM CURRENT (mA)	

Default: minimum current = 40 mA and maximum current = 140 mA.  
These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the minimum current and maximum current of the outputs if they are already set as current regulated.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (33, 0x21) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 1 (1, 0x01)

Byte 2:

OUTPUT INDEX - this byte is used to indicate which output is being configured: 1 or 2.

00 (0, 0x00) = Output 1

01 (1, 0x01) = Output 2

Byte 3:

Must be set to 0 (0, 0x00).

Bytes 4 & 5:

These bytes are used to set the minimum current to the valve. The value is in mA. Byte 4 is the least significant byte and byte 5 is the most significant byte.

Bytes 6 & 7:

These bytes are used to set the maximum current to the valve. The value is in mA. Byte 6 is the least significant byte. Byte 7 is the most significant byte.

Example:

(Decimal)	245	1	1	0	144	1	120	5
(HEX)	0xF5	0x01	0x01	0	0x90	0x01	0x78	0x05

This sets output 2's minimum current to 400mA (0x190) and maximum current to 1400mA (0x578) if already set as a current regulated output. No confirmation reply.

To read back the current settings for output 1:

(Decimal) 245 33 0 0 0 0 0 0  
 (HEX) 0xF5 0x21 0 0 0x00 0x00 0x00 0x00

### Configure Outputs - Ramp Times

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=1	OUTPUT INDEX	1	RAMP UP (ms)		RAMP DOWN (ms)	
0xF5	C	0	RB	DT=0x01	OUTPUT INDEX	0x01	RAMP UP (ms)		RAMP DOWN (ms)	

Default: ramp up = 0 ms and ramp down = 0 ms. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the ramp up and ramp down times of each output.

#### Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (33, 0x21) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 1 (1, 0x01)

#### Byte 2:

OUTPUT INDEX - this byte is used to indicate which output is being configured: 1 or 2.

00 (0, 0x00) = Output 1

01 (1, 0x01) = Output 2

#### Byte 3:

Must be set to 1 (1, 0x01).

#### Bytes 4 & 5:

These bytes are used to set Ramp Up: the time in milliseconds it takes the output to go from minimum current or % to maximum current or %. Byte 4 is the least significant byte and byte 5 is the most significant byte.

#### Bytes 6 & 7:

These bytes are used to set Ramp Down: the time in milliseconds it takes the output to go from maximum current or % to no current. Byte 6 is the least significant byte. Byte 7 is the most significant byte.

Example:

(Decimal) 245 1 0 1 232 3 244 1  
 (HEX) 0xF5 0x01 0x00 0x01 0xE8 0x03 0xF4 0x01

This sets ramp up to 1 second (0x3E8) and ramp down to 0.5 second (0x1F4) for output 1. No confirmation reply.

To read back the current settings:

(Decimal) 245 33 0 1 0 0 0 0  
 (HEX) 0xF5 0x21 0 0x01 0x00 0x00 0x00 0x00

### Configure Outputs - PWM %, FREQUENCY

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=1	OUTPUT INDEX	2	MIN %	MAX %	FREQUENCY (Hz)	
0xF5	C	0	RB	DT=0x01	OUTPUT INDEX	0x02	MIN %	MAX %	FREQUENCY (Hz)	

Default: min PWM % = 0%, max PWM % = 100%, and frequency = 75 Hz.

These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the minimum PWM % and maximum PWM % of the outputs if they are already set as PWM % outputs. It is also used to set the frequency of the outputs.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (33, 0x21) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT -Data type must be set to 1 (1, 0x01)

Byte 2:

OUTPUT INDEX - this byte is used to indicate which output is being configured: 1 or 2.

00 (0, 0x00) = Output 1

01 (1, 0x01) = Output 2

Byte 3:

Must be set to 2 (2, 0x02).

Bytes 4:

This byte is used to set the minimum PWM % (0-100%) to the valve.

Bytes 5:

This byte is used to set the maximum PWM % (0-100%) to the valve.

Bytes 6 & 7:

These bytes are used to set the frequency of the outputs. NOTE: This changes the frequency of both outputs 1 and 2. Byte 6 is the least significant byte. Byte 7 is the most significant byte.

Example:

(Decimal) 245 1 0 2 20 100 100 0  
 (HEX) 0xF5 0x01 0x00 0x02 0x14 0x64 0x64 0x00

This sets minimum % to 20% (0x14) and maximum % to 100% (0x64) for output 1 if it already set as a PWM output. It also sets the frequency of the outputs to 100 Hz (0x64). No confirmation reply.

To read back the current settings:

(Decimal) 245 33 0 2 0 0 0 0  
 (HEX) 0xF5 0x21 0 0x02 0x00 0x00 0x00 0x00

**Configure Outputs - KP, KI**

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=1	0	3	KP		KI	
0xF5	C	0	RB	DT=0x01	0	3	KP		KI	

Default: KP = 0.003, KI = 0.15. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the closed loop gain parameters KP and KI. These are used on all outputs, assuming the same valves/loads are used on all outputs.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (33, 0x21) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 1 (1, 0x01)

Byte 2:  
Must be set to 0 (0, 0x00).

Byte 3:  
Must be set to 3 (3, 0x03).

Bytes 4 & 5:  
KP is the value of the proportional closed loop gain.  
Byte 4 is the least significant byte. Byte 5 is the most significant byte. Values are in 0.0001 per bit.

Bytes 6 & 7:  
KI is the value of the integral closed loop gain.  
Byte 6 is the least significant byte. Byte 7 is the most significant byte. Values are in 0.0001 per bit.

Example:  
(Decimal) 245 1 0 3 40 0 88 2  
(HEX) 0xF5 0x01 0 0x03 0x28 0x00 0x58 0x02  
This sets KP equal to 0.004 (0x28) and KI equal to 0.06 (0x0258).  
No confirmation reply.

To read back the current settings:  
(Decimal) 245 33 0 3 0 0 0 0  
(HEX) 0xF5 0x21 0 0x03 0x00 0x00 0x00 0x00

**Configure Outputs - KD FREQ**

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=1	0	4	KD		CL FREQ	
0xF5	C	0	RB	DT=0x01	0	4	KD		CL FREQ	

Default: KD = 0.0001, CL FREQ = 55. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the closed loop gain parameters KD and the Closed Loop correction Frequency. These are used on all outputs, assuming the same valves/loads are used on all outputs.

Byte1:  
C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (33, 0x21) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 1 (1, 0x01)

Byte 2:

Must be set to 0 (0, 0x00).

Byte 3:

Must be set to 4 (4, 0x04).

Bytes 4 & 5:

KD is the value of the differential closed loop gain.

Byte 4 is the least significant byte. Byte 5 is the most significant byte. Values are in 0.0001 per bit.

Byte 6 & 7:

CL FREQ is the frequency of the closed loop corrections. Adjusting this can adjust the response speed and help control oscillations.

Byte 6 is the least significant byte. Byte 7 is the most significant byte.

Example:

(Decimal) 245 1 0 4 2 0 50 0

(HEX) 0xF5 0x01 0x00 0x04 0x02 0x00 0x32 0

This sets KD equal to 0.0002 (0x02) and closed loop correction frequency equal to 50 (0x32). No confirmation reply.

To read back the current settings:

(Decimal) 245 33 0 4 0 0 0 0

(HEX) 0xF5 0x21 0x00 0x04 0x00 0x00 0x00 0x00

### Configure Bump Step and Bump Time

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=1	OUTPUT INDEX	5	BUMP STEP VALUE (%)		BUMP STEP TIME (ms)	
0xF5	C	0	RB	DT=0x01	OUTPUT INDEX	0x05	BUMP STEP VALUE (%)		BUMP STEP TIME (ms)	

Default: Bump Step = 10%, Bump Step Time = 0 ms. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set Bump Step Value and Bump Step Time if one of the three bump modes is enabled.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (33, 0x21) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 1 (1, 0x01)

Byte 2:

OUTPUT INDEX - this byte is used to indicate which output is being configured: 1 or 2.

00 (0, 0x00) = Output 1

01 (1, 0x01) = Output 2

Byte 3:

Must be set to 5 (5, 0x05).

Bytes 4 & 5:

These bytes are used to set the Bump Step Value. That is the amount in percent that the output will increase or decrease when input is activated. Byte 4 is the least significant byte. Byte 5 is the most significant byte.

Bytes 6 & 7:

These bytes are used to set the Bump Step Time. That is the time in milliseconds that it takes the output to increase or decrease one step when input is held. To disable the output increasing or decreasing when input is held set this to 0. Byte 6 is the least significant byte. Byte 7 is the most significant byte.

Example:

(Decimal) 245 1 0 5 5 0 232 3  
 (HEX) 0xF5 0x01 0x00 0x05 0x05 0x00 0xE8 0x03  
 This sets Bump Step and Bump Time for output 1 to 5% (0x05) and 1000ms (0x03E8). No confirmation reply.

To read back the current settings:

(Decimal) 245 33 0 5 0 0 0 0  
 (HEX) 0xF5 0x21 0x00 0x05 0x00 0x00 0x00 0x00

### Configure Analog Input 1

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=2	0	0	MIN VOLTAGE (mV)		MAX VOLTAGE (mV)	
0xF5	C	0	RB	DT=0x02	0	0	MIN VOLTAGE (mV)		MAX VOLTAGE (mV)	



Default: min voltage = 500 mV and max voltage = 4500 mV. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the minimum voltage and maximum voltage for analog input 1 if 1-1 or 2-2 operation is selected.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (34, 0x22) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 2 (2, 0x02)

Byte 2:

Must be set to 0 0 (0x00)

Byte 3:

Must be set to 0 0 (0x00)

Bytes 4 & 5:

These bytes are used to set the minimum voltage for analog input 1. Byte 4 is the least significant byte. Byte 5 is the most significant byte

Bytes 6 & 7:

These bytes are used to set the minimum voltage for analog input 1. Byte 6 is the least significant byte. Byte 7 is the most significant byte

Example:

(Decimal)	245	2	0	0	232	3	160	15
(HEX)	0xF5	0x02	0x00	0x00	0xE8	0x03	0xA0	0x0F

This sets minimum voltage to 1000mV (0x03E8) and maximum voltage to 4000mV (0x0FA0) for analog input 1. No confirmation reply.

To read back the current settings:

(Decimal)	245	34	0	0	0	0	0	0
(HEX)	0xF5	0x22	0	0x00	0x00	0x00	0x00	0x00

**Configure Analog Input 2**

Byte 0	Byte 1			Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=2	0	1	MIN VOLTAGE (mV)	MAX VOLTAGE (mV)	
0xF5	C	0	RB	DT=0x02	0	1	MIN VOLTAGE (mV)	MAX VOLTAGE (mV)	

Default: min voltage = 500 mV and max voltage = 4500 mV. These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the minimum voltage and maximum voltage for analog input 2 if 1-1 or 2-2 operation is selected.

**Byte1:**

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (34, 0x22) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 2 (2, 0x02)

**Byte 2:**

Must be set to 0 (0, 0x00)

**Byte 3:**

Must be set to 1 (1, 0x01)

**Bytes 4 & 5:**

These bytes are used to set the minimum voltage for analog input 1. Byte 4 is the least significant byte. Byte 5 is the most significant byte

**Bytes 6 & 7:**

These bytes are used to set the minimum voltage for analog input 1. Byte 6 is the least significant byte. Byte 7 is the most significant byte

**Example:**

(Decimal) 245 2 0 1 232 3 160 15  
 (HEX) 0xF5 0x02 0x00 0x01 0xE8 0x03 0xA0 0x0F  
 This sets minimum voltage to 1000mV (0x03E8) and maximum voltage to 4000mV (0x0FA0) for analog input 2. No confirmation reply.

To read back the current settings:

(Decimal)	245	34	0	1	0	0	0	0
(HEX)	0xF5	0x22	0	0x01	0x00	0x00	0x00	0x00

### Configure Joystick High Side

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=2	0	2	JOYSTICK CENTER HIGH (mV)		JOYSTICK MAX (mV)	
0xF5	C	0	RB	DT = 0x02	0	2	JOYSTICK CENTER HIGH (mV)		JOYSTICK MAX (mV)	

Default: joystick center high = 2750 mV and joystick max = 4500 mV.  
These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the joystick center high side voltage and max voltage for a joystick if 1-2 operation is selected.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (34, 0x22) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 2 (2, 0x02)

Byte 2:

Must be set to 0 (0x00)

Byte 3:

Must be set to 2 (2, 0x02)

Bytes 4 & 5:

These bytes are used to set the joystick center high voltage. Byte 4 is the least significant byte. Byte 5 is the most significant byte

Bytes 6 & 7:

These bytes are used to set the joystick voltage maximum. Byte 6 is the least significant byte. Byte 7 is the most significant byte

Example:

(Decimal)	245	2	0	2	184	11	192	18
(HEX)	0xF5	0x02	0x00	0x02	0xB8	0x0B	0xC0	0x12

This sets joystick center high voltage to 3000mV (0x0BB8) and

maximum joystick voltage to 4800mV (0x12C0). No confirmation reply.

To read back the current settings:

(Decimal)	245	34	0	2	0	0	0	0
(HEX)	0xF5	0x22	0	0x02	0x00	0x00	0x00	0x00

### Configure Joystick Low Side

Byte 0	Byte 1				Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
245	C	0	RB	DT=2	0	3	JOYSTICK MIN (mV)		JOYSTICK CENTER LOW (mV)	
0xF5	C	0	RB	DT=0x02	0	3	JOYSTICK MIN (mV)		JOYSTICK CENTER LOW (mV)	

Default: joystick min = 500 mV and joystick center low = 2250 mV.

These values are stored in the valve driver and will not be lost when power is turned off.

This message is used to set the joystick center low side voltage and min voltage for a joystick if 1-2 operation is selected.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

RB - Read Back Flag (bit 5). Set this to 1 (34, 0x22) to read back the current stored settings for this parameter. When reading back, the settings will not be changed. RB must be set to 0 to change the settings.

DT - Data type must be set to 2 (2, 0x02)

Byte 2:

Must be set to 0 (0x00)

Byte 3:

Must be set to 3 (3, 0x03)

Bytes 4 & 5:

These bytes are used to set the joystick voltage minimum. Byte 4 is the least significant byte. Byte 5 is the most significant byte

Bytes 6 & 7:

These bytes are used to set the joystick center low voltage. Byte 6 is the least significant byte. Byte 7 is the most significant byte

Example:

(Decimal)	245	2	0	3	188	2	208	7
-----------	-----	---	---	---	-----	---	-----	---

(HEX)        0xF5 0x02 0x00 0x03 0xBC 0x02 0xD0 0x07  
 This sets joystick min voltage to 700mV (0x0BB8) and joystick center low voltage to 2000mV (0x12C0). No confirmation reply.

To read back the current settings:

(Decimal)    245   34   0   3   0   0   0   0  
 (HEX)        0xF5 0x22 0   0x03 0x00 0x00 0x00 0x00

**Report ID Reassignment**

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
247	C	DT=0	USER DEFINED REPORT ID			RPSEL	
0XF7	C	DT=0	USER DEFINED REPORT ID			RPSEL	

Default: Report ID = 0xFF0023. Report ID is stored in the valve driver and will not be lost when power is turned off.

This message is used to configure the User Defined Report CAN ID, and to switch between the user defined one and the default report ID. **If multiple valve drivers are used together, make sure to assign each one a unique USER DEFINED REPORT ID so you can tell the reports apart.**

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

DT - Data type must be set to 0 (0, 0x00).

Bytes 2 thru 5:

USER DEFINED REPORT ID - This value is the User defined ID that the Valve Drive can use when sending Reports. Byte 2 is the Least Significant Byte. Byte 5 is the Most Significant Byte.

Byte 6:

RPSEL - This parameter lets you select between either the Default Report ID or the User Defined Report ID. Set RPSEL to 1 (1, 0x01) to use the User Defined Report ID. Clear RPSEL to use the Default Report ID.

NOTE: Identifiers 0xFFFFEXX and 0xFF00XX are reserved and should not be used for User Defined IDs.

NOTE: To not change the stored USER DEFINED REPORT ID, enter 0xFFFFFFFF into bytes 2-5. This lets you change RPSEL without affecting the ID.

Byte 7:

Reserved

Example:

(Decimal) 247 0 4 1 255 24 1 0  
 (HEX) 0xF7 0x00 0x04 0x01 0xFF 0x18 0x01 0x00  
 This sets the USER DEFINED REPORT ID to 0x18FF0104x, and selects the USER DEFINED REPORT ID as the active Report ID (0x01). No confirmation reply.

### Command ID Reassignment

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
247	C	FILT	USER DEFINED COMMAND ID					DISDEF
0xF7	C	FILT	USER DEFINED COMMAND ID					DISDEF

Default: Command ID = 0xFF0022. Command ID is stored in the valve driver and will not be lost when power is turned off.

This message is used to assign User Defined Command IDs. The valve driver can have up to 4 of these. Multiple command IDs makes it possible to have some commands for certain groups of valve drivers. For example, turning off all the "left side" valve drivers' Output #1, all at once can be done with one CAN message if all the "left side" valve drivers have a common User Defined Command ID.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

FILT - This is the index of the User Defined Command ID. The value can be between 1 (1, 0x01) and 4 (4, 0x04).

Bytes 2 thru 5:

USER DEFINED COMMAND ID - This value is the User defined ID that the Valve Drive can respond to. Since there can be up to 4 of these, and the default ID, the Valve Driver can respond to up to 5 different sets of commands. Byte 2 is the Least Significant Byte. Byte 5 is the Most Significant Byte.

NOTE: Identifiers 0xFFFFEXX and 0xFF00XX are reserved and should not be used for User Defined IDs.

NOTE: To not change the stored USER DEFINED COMMAND ID, enter 0xFFFFFFFF into bytes 2-5. This lets you change DISDEF without affecting the stored IDs.

Byte 6:

Reserved

**Byte 7:**

DISDEF. Setting this value to 1 (1, 0x01) disables the Default Command ID. Clearing DISDEF enables the Default Command ID.

Note: Disabling Default Command IDs can be helpful when assigning IDs to multiple valve drivers.

DISDEF is always cleared when the valve driver is powered up, so the valve driver will respond to Default Command IDs. If multiple valve drivers are used, keep this in mind!

**Example:**

(Decimal) 247 1 5 1 255 8 0 1  
 (HEX) 0xF7 0x01 0x05 0x01 0xFF 0x08 0x00 0x01

This sets the 1<sup>st</sup> USER DEFINED COMMAND ID to 0x08FF0105x, and disables the DEFAULT Command ID. Until power is cycled, this valve driver will ignore commands set to the default Command ID.

No confirmation reply.

**Reset**

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
249	C DT=0	RESET TYPE		RESET TYPE EXTENSION 1			
0xF9	C DT=0	RESET TYPE		RESET TYPE EXTENSION 1			

This message is used to reset various parts of the Valve Driver.

**Byte1:**

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

DT- Data type must be set to 0 (0, 0x00).

**Bytes 2 thru 3:**

RESET TYPE - This value determines which type of reset is to be done.

Bit 0: 1, 0x0001 = reserved

Bit 1: 2, 0x0002 = Reset User Defined IDs.

Bit 2: 4, 0x0004 = Reset Report Rates.

Bit 3: 8, 0x0008 = reserved

Bit 4: 16, 0x0010 = Reset User Configurations (MIN, MAX, FREQ...).

Bits 0-15: 65535, 0xFFFF = Reset everything.

Byte 2 is the Least Significant Byte. Byte 3 is the Most Significant Byte.

Bytes 4 & 5:

RESET TYPE EXTENTION 1 – This parameter further defines some resets. Setting the bit to 1, activates the specific Reset. Clearing the bit leaves that parameter untouched.

Bit 0: 1, 0x0001 = Reset User Defined Report ID

Bit 1: 2, 0x0002 = Reset User Defined Command ID #1

Bit 2: 4, 0x0004 = Reset User Defined Command ID #2

Bit 3: 8, 0x0008 = Reset User Defined Command ID #3

Bit 4: 16, 0x0010 = Reset User Defined Command ID #4

Bit 13: 8192, 0x2000 = Reset RPSEL and activate default Report ID.

Bit 14: 16384, 0x4000 = Reset DISDEF and activate default Command ID.

Byte 4 is the Least Significant Byte. Byte 5 is the Most Significant Byte.

Bytes 4, 5, 6, & 7:

Reserved

Example:

(Decimal) 249 0 16 0 0 0 0 0

(HEX) 0xF9 0x00 0x10 0x00 0x00 0x00 0x00 0 0

This resets the user configurations (16, 0x0010). No confirmation reply.

### Priority Configuration

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
250	C	HANDSHAKE	AUTORPT	SCHEDULED	POLLED	ROC	0
0xFA	C	HANDSHAKE	AUTORPT	SCHEDULED	POLLED	ROC	0

The priorities of the different types of reports can be set, depending on your needs. The lower the number is the higher the priority.

Byte1:

C - Confirmation Flag - bit 7 (128, 0x80). (See above)

Reserved

Byte 2:

HANDSHAKE - These are the messages that are sent in reply to a Confirmation Flag being set.

Byte 3:



AUTORPT - These are the messages that are sent in reply to an Auto Reply Flag being set.

Byte 4:

SCHEDULED - These are the messages that have been set up to be sent automatically at a periodic rate.

Byte 5:

POLLED - These are the messages that are sent in response to a specific request.

Byte 6:

ROC - These are the messages that have been set up to be sent automatically if its data has changed.

Byte 7:

Reserved

Example:

(Decimal)	250	0	1	0	2	0	0	0
(HEX)	0xFA	0x00	0x01	0x00	0x02	0x00	0x00	0

This gives handshake messages first priority and scheduled messages second priority. No confirmation reply.

## CAN REPORTS

The following are the report messages that the CAN Valve Driver can send back to the host. These can either be sent using the Default Report Identifier, or to the User Report Identifier, depending on which is selected (see RPSEL in Report ID Reassignment).

### Input Report #1

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
128	DT=0	EXTERNAL INPUT 1	EXTERNAL INPUT 2	EXTERNAL INPUT 1	EXTERNAL INPUT 2	SUPPLY VOLTAGE	
0x80	DT=0	EXTERNAL INPUT 1	EXTERNAL INPUT 2	EXTERNAL INPUT 1	EXTERNAL INPUT 2	SUPPLY VOLTAGE	

This Report is used to send the values of the External Inputs 1 & 2, along with the Supply Voltage.

Byte1:

DT- Data type will be set to 0 (0, 0x00).

Bytes 2 & 3:

EXTERNAL INPUT 1 - This is the value of External Input #1.

The value is in mV. Byte 2 is the Least Significant Byte. Byte 3 is the Most Significant Byte.

Bytes 4 & 5:

EXTERNAL INPUT 2 - This is the value of External Input #2.  
The value is in mV. Byte 4 is the Least Significant Byte.  
Byte 5 is the Most Significant Byte.

Bytes 6 & 7:

SUPPLY VOLTAGE - This is the value of Supply powering the Valve Driver.  
The value is in mV. Byte 6 is the Least Significant Byte.  
Byte 7 is the Most Significant Byte.

Example:

(Decimal) 128 0 146 19 149 19 243 54  
(HEX) 0x80 0x00 0x92 0x13 0x95 0x13 0xF3 0x36  
This reports that external input 1 is at 5.010 V (0x1392), external input 2 is at 5.013 V (0x1395), and the supply voltage is at 14.067V (0x36F3). Not a confirmation reply.

**Input Report #2**

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
129	DT=0	CALIBRATION POT				REFERENCE VOLTAGE	
0x81	DT=0	CALIBRATION POT				REFERENCE VOLTAGE	

This Report is used to send the value of the calibration potentiometer, along with the Reference Voltage.

Byte1:

DT- Data type will be set to 0 (0, 0x00).

Bytes 2 & 3:

CALIBRATION POT - This is the value of the Calibration Pot.  
The value is in mV. Byte 2 is the Least Significant Byte.  
Byte 3 is the Most Significant Byte.

Bytes 4 & 5:

Reserved

Bytes 6 & 7:

REFERENCE VOLTAGE - This is the value of Reference Voltage supplied by the Valve Driver to power Sensors.

The value is in mV. Byte 6 is the Least Significant Byte.  
Byte 7 is the Most Significant Byte.

Example:

(Decimal) 129 0 218 11 0 0 109 19  
(HEX) 0x81 0x00 0xDA 0x0B 0 0 0x6D 0x13

This reports that the calibration pot is at 3.034 V (0x0BDA) and the reference voltage is at 4.973 V (0x136D). Not a confirmation reply.

### Input Report #3

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
132	DT=0	OUTPUT1 CURRENT OR %	OUTPUT2 CURRENT OR %	OUTPUT2 CURRENT OR %	SUPPLY VOLTAGE		
0x84	DT=0	OUTPUT1 CURRENT OR %	OUTPUT2 CURRENT OR %	OUTPUT2 CURRENT OR %	SUPPLY VOLTAGE		

This Report is used to send the values of the current flowing from Outputs 1 & 2, along with the Supply Voltage.

Byte1:

DT- Data type will be set to 0 (0, 0x00).

Bytes 2 & 3:

OUTPUT 1 CURRENT - This is the value of current measurement of Output 1.

The value is in mA or % depending on what type of output it is. Byte 2 is the Least Significant Byte. Byte 3 is the Most Significant Byte.

Bytes 4 & 5:

OUTPUT 2 CURRENT - This is the value of current measurement of Output 2.

The value is in mA or % depending on what type of output it is. Byte 4 is the Least Significant Byte. Byte 5 is the Most Significant Byte.

Bytes 6 & 7:

SUPPLY VOLTAGE - This is the value of Supply powering the Valve Driver.

The value is in mV. Byte 6 is the Least Significant Byte.  
Byte 7 is the Most Significant Byte.

Example:

(Decimal) 132 0 85 5 29 5 243 54  
(HEX) 0x84 0x00 0x55 0x05 0x1D 0x05 0xF3 0x36

This reports that output 1 current is at 1.365 A (0x0555), output 2 current is at 1.309 A (0x051D), and the supply voltage is at 14.067V (0x36F3). Not a confirmation reply.

### Error and Jumper Report

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
144	DT=0	JUMPER INPUTS		ERROR CODE			
0x90	DT=0	JUMPER INPUTS		ERROR CODE			

This Report is used to send the values of the current Error Flags. Error flag must be enabled under outputs to receive error flags.

Byte1:

DT- Data type will be set to 0 (0, 0x00).

Bytes 2 & 3:

Bit 0 (1, 0x01): Jumper 1  
 Bit 1 (2, 0x02): Jumper 2  
 Bit 2 (4, 0x04): Jumper 3  
 Bit 3 (8, 0x08): Jumper 4  
 Bit 4 (16, 0x10): Jumper 5  
 Bit 5 (32, 0x20): Jumper 6  
 Bit 6 (64, 0x40): Jumper 7

Bytes 4 & 5:

Bit 0 (1, 0x01): Low Battery  
 Bit 1 (2, 0x02): Analog input 1 Error  
 Bit 2 (4, 0x04): Analog input 2 Error  
 Bit 3 (8, 0x08): Proportional Output 1 Error  
 Bit 4 (16, 0x10): Proportional Output 2 Error

Bytes 6 & 7: Reserved

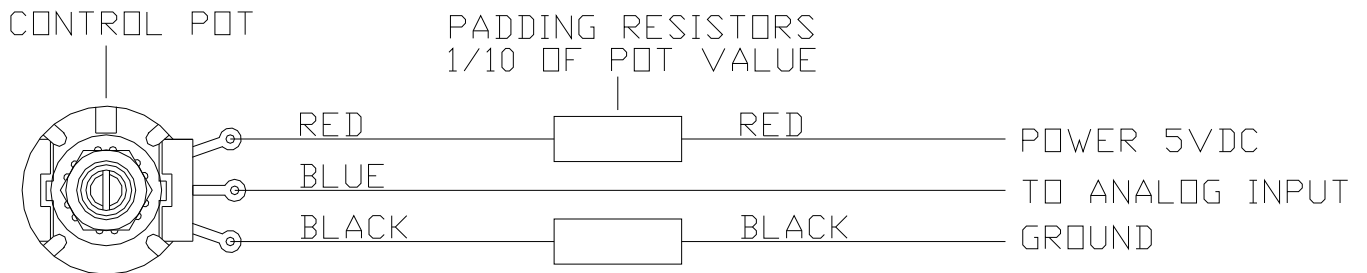
Example:

(Decimal) 144 0 0 0 48 0 0 0  
 (HEX) 0x90 0x00 0x00 0x00 0x30 0x00 0x00 0x00

This reports that outputs 1 and 2 both have an error (0x30) and that no jumpers are present. Not a confirmation reply.

WIRING CHART

<u>WIRE COLOR</u>	<u>FUNCTION</u>
RED	POWER (9 to 30 VDC)
BLACK	GROUND
WHITE	CAN HIGH
GREEN	CAN LOW
BLUE	ANALOG INPUT 1
BROWN	ANALOG INPUT 2
YELLOW	PROPORTIONAL OUTPUT 1
GRAY	PROPORTIONAL OUTPUT 2
ORANGE	+5VDC REFERENCE

WIRING ANALOG INPUTS

**ROUTINE MAINTENANCE:**

1. Inspect electrical wiring for wear points or other damage. Repair as required.
2. Inspect all connections for looseness or corrosion. Tighten and/or "seal" as necessary.

**MAINTENANCE PRECAUTIONS:**

When performing any inspection or maintenance work on the CAN VALVE DRIVER system, always exercise care to prevent injury to yourself and others or damage to the equipment. The following are general precautions that should be closely followed in carrying out any maintenance work.

1. Do not have hydraulic power available to the valves when performing electrical tests.
2. Never operate or test any function if any person is in an area where they could be hurt, hit or squeezed by the hydraulic equipment.
3. Turn power off before connecting or disconnecting valve coils or other electrical loads.

**TROUBLESHOOTING:**

This section provides basic operator level troubleshooting for the CAN VALVE DRIVER system. If, after following these instructions, the system still does not function, check the hydraulic system, and then contact your KAR-TECH representative for further instructions or servicing.

***TROUBLESHOOTING CHART***

<b>PROBLEM</b>	<b>SOLUTION</b>
1. No functions work	<ol style="list-style-type: none"><li>1. Check that control power is on.</li><li>2. Check vehicle wiring for power into the system.</li><li>3. Check status and error code LEDs for system status.</li><li>4. Check for proper grounding of vehicle's electrical circuit.</li><li>5. Check vehicle's hydraulic system.</li></ol>
2. Certain functions do not work	<ol style="list-style-type: none"><li>1. Check the wiring connection from the system to the valve coil or the output function that does not work.</li><li>2. Check status and error code LEDs for system status.</li><li>3. Check vehicle's hydraulic system.</li><li>4. Check vehicle's electrical system.</li></ol>
3. Function operates intermittently	<ol style="list-style-type: none"><li>1. Check for loose connections.</li><li>2. Check status and error code LEDs for system status.</li><li>3. Check vehicle's hydraulic system.</li></ol>

*ERROR CODE CHART*

Count the number of blinks of the red LED on the CVD control module.

<u><i>ERROR CODE</i></u>	<u><i>PROBABLE CAUSE</i></u>
1	Low Battery
2	Analog Input 1 Problem
3	Analog Input 2 Problem
4	Faulty Circuit to Proportional Output 1
5	Faulty Circuit to Proportional Output 2



PARTS LIST

<u>PART NUMBER</u>	<u>DESCRIPTION</u>
210375A	CAN VALVE DRIVER MODULE
020-510-2326	USB TO 4 PIN SERIAL CONNECTION CABLE
210379A	OPTIONAL GATE DIAGNOSTIC TOOL
055-038-0021	CONNECTOR, JUMPER WITH HANDLE

Note: For operation with negative ground vehicles only.

**SPECIFICATIONS**

Power supply voltage .....	9V to 30V
Operating temperature.....	-20°C to +70°C
Storage temperature.....	-40°C to +85°C
Analog Inputs.....	0.5V to 4.5VDC
Proportional outputs.....	0.5 Amp. MAX (Protected)
Vibration .....	3G to 200Hz
Shock .....	100G
Baud Rate.....	250K