INJECTOR DRIVER BOX OPERATION (PN G01624-00)

Control I/O Connector:

PIN	FUNCTION
1	**Logic Supply (Optional)**
2	**+3.3V**
3	**N/A**
4	**N/A**
5	**Cyl #1 Select**
6	**Cyl #2 Select**
7	**Cyl #3 Select**
8	**N/A**
9	**Logic Signal Return**

Mating Connector: DB9-F

Rear Panel Connectors:

SOLENOID OUTPUTS	
PIN	FUNCTION
1	**Cyl 1+**
2	**Cyl 1- / RAMP mode inj-**
3	**Cyl 2+**
4	**Cyl 2-**
5	**Cyl 3+**
6	**Cyl 3-**
7	**RAMP mode inj+**

Mating Connector: AMP 206226-1

POWER INPUT	
PIN	FUNCTION
1	**VBOOST+**
2	**Ground**
3	**Ground**
4	**Ground**
5	**Ground**
6	**VBATT+**
7	**VBATT+**

Mating Connector: AMP 206136-1

I/O pin functions

Function	Description
VBATT+	External power input. Should be connected to +12 VDC (approx 15A) source.
VBOOST+	Boost voltage input. Should be connected to voltage source capable of supplying required pull-in voltage and current (example: Acopian PN A0100MX60; 0-100 VDC@600 mA)
Ground	Connect to VBATT and VBOOST supply returns
Cyl x+	Injector high side output (common between all injectors)
Cyl x-	Injector low side output
Chassis Ground	Connect to earth ground to prevent injury
Cyl x Select	Logic level signal (active high) which allows injector x to be fired according to the **Injection Event Control** signal. Only 1 **Cyl x Select** pin should be high at any given moment. Compatable with 5v and 3.3v logic levels.
Signal Return	Logic signal ground

Note: The current Monitor BNC output on front panel is used to monitor injector current draw. This output is calibrated to 100 mV/A.

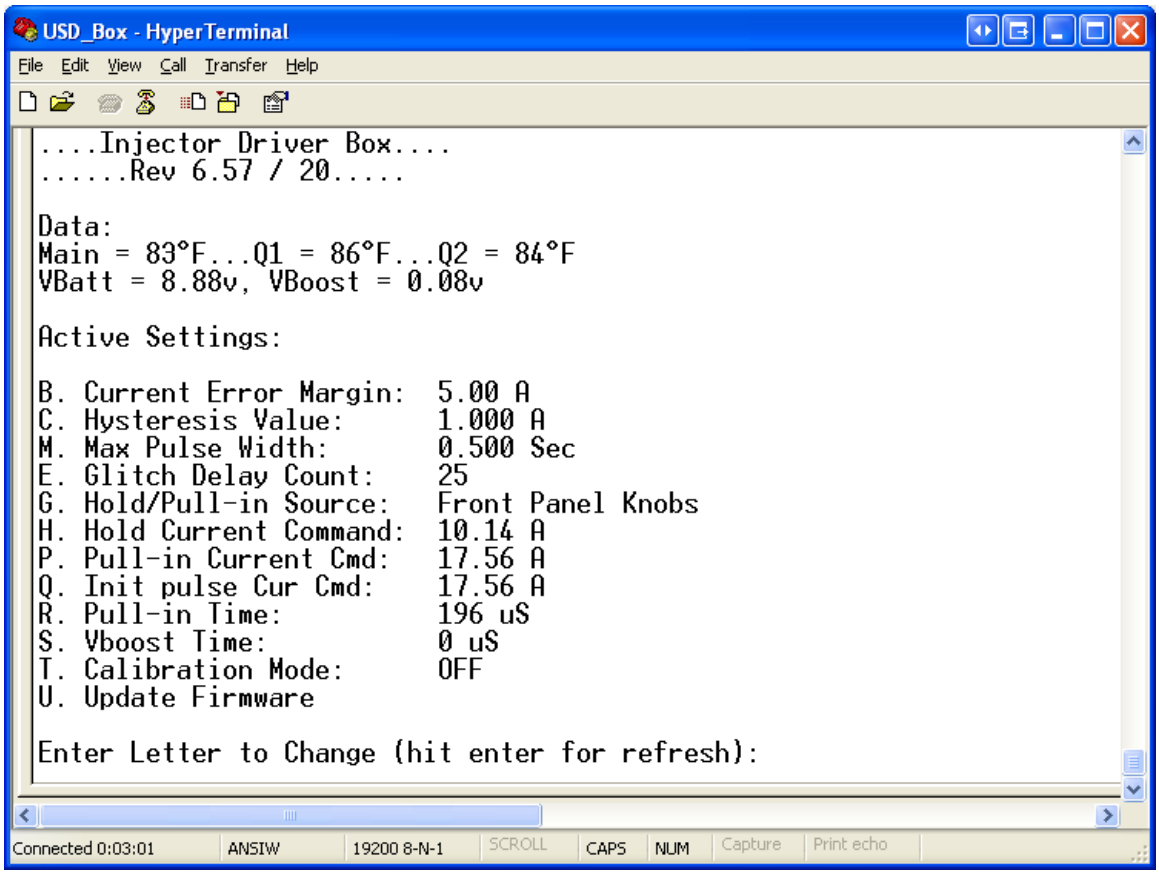
Electrical Characteristics

Parameter	Conditions	Min	Max	Units
VBOOST	Normal mode Ramp mode	0 N/A	200 N/A	Vdc
VBATT		10	35	Vdc
Output Current	Normal mode Ramp mode	0 0	29 19	A A
Cyl x Select	Logic level low Logic level hi	0 2.4	0.4 5.5	V V

RS232 Serial Interface

There are 2 serial interface modes provided: a menu based terminal interface for use with HyperTerminal, and a machine interface for automated control. The driver box automatically detects which interface is being used. In both cases, the settings are 19,200 bps, 8 bytes, No parity, 1 stop bit, and no flow control.

Terminal Interface



The main menu shows the current settings. Pressing <Enter> will refresh the display. All current command values must be entered in milliamps, and are displayed as Amps. Changes made to *Hysteresis Value*, *Current Error Margin*, and *Glitch Delay Count* are saved to FLASH.

Current Error Margin: If the difference between current command (+/- hysteresis) and measured current exceeds this value, the corresponding OVER or UNDER current fault lamp will be activated.

Hysteresis Value: Tolerance required for *Pull-in Current Cmd* and *Hold Current Command.*

Max Pulse Width: Maximum allowable injection pulse width time. Serves to prevent solenoid damage in the event of a faulty input signal.

Glitch Delay Count: This value is used in debouncing incoming logic level timing signals. Increasing the value results in longer debounce time.

Pulse Source: This should always be set to External. Internal mode is used for factory testing.
Hold/Pull-in Source: Used to determine if front panel knobs are to be used, or values received over the serial port (serial port refers to both terminal mode and machine mode).
Hold Current Command: Active hold current value.
Pull-in Current Command: Active pull-in current value.
Initial Pulse Current: Normally, this value is equal to *Pull-in Current Command*. In serial command mode, the user may set this value independently of pull-in current. This refers to the target current on the very first pull-in current pulse (VBOOST is normally used only during this initial pulse. At the beginning of an injection event, as soon as feedback current reaches this value, VBOOST is turned off until the beginning of the next injection event).
Vboost Time: This value is normally set to 0, indicating that VBOOST is only used during the initial current pulse. If greater than 0, this determines how long VBOOST is used during the pull-in time (values greater than *Pull-in Time* are not valid).
Calibration Mode: This mode is used for factory adjustment of current scaling and rear panel BNC outputs.
Update Firmware: Used to download new code to the microcontroller or FPGA.

Machine Interface serial mode
Commands should be sent using the following protocol:
0x02D:_____0x03

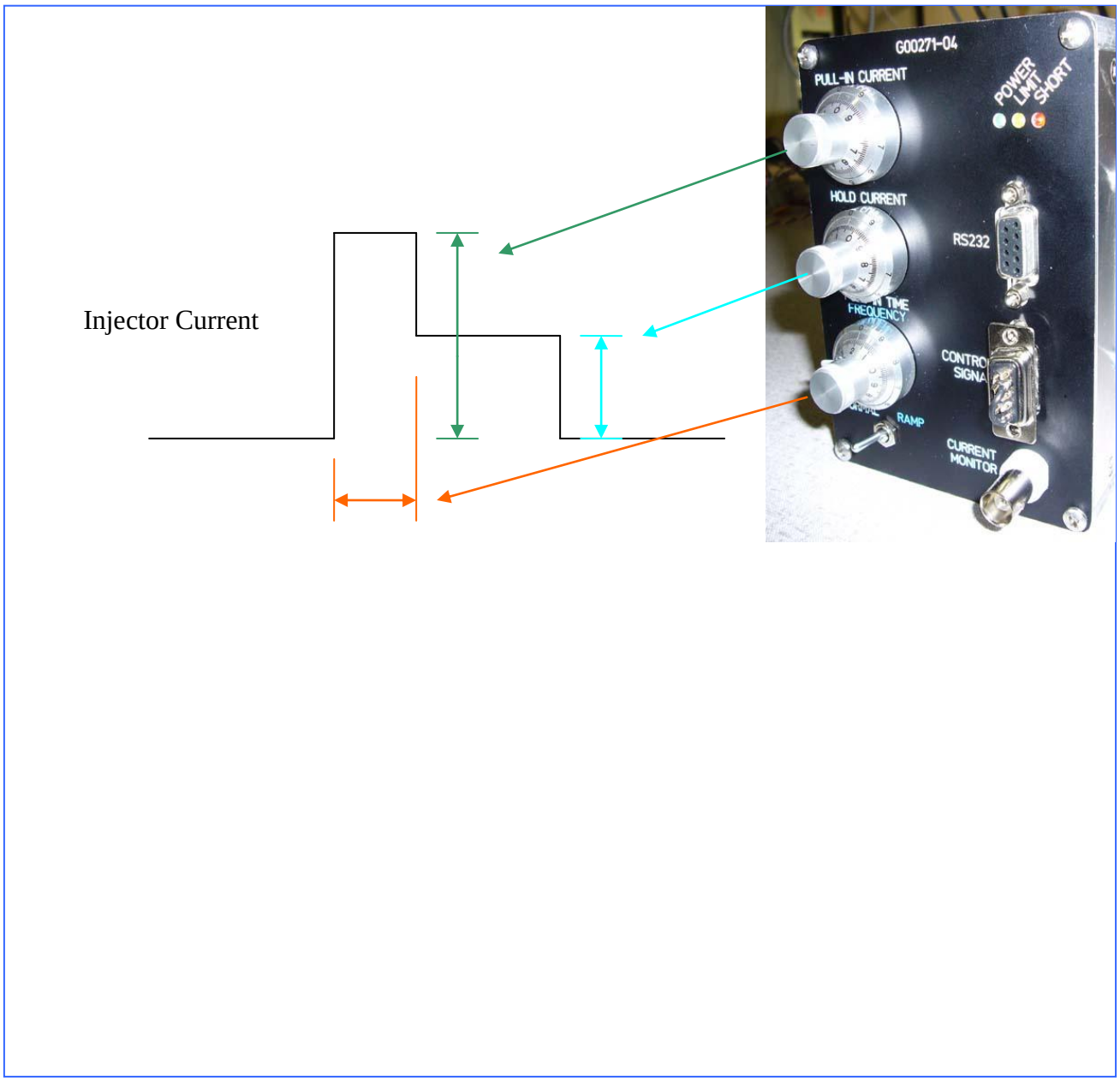
Where 0x02 = start character
D: = 2 character command designator
____ = numerical value (in ASCII)
0x03 = end character

The driver box response is in the following format:
0x02eD:____0x03

Where 0x02 = start character
e = error byte (in ASCII)
0 = no error
1 = value out of range
2 = invalid command
3 = read only parameter
D: = 2 character command designator
____ = numerical value (in ASCII)
0x03 = end character

Available Commands

Command	Example	Response
A <Request all values> Range: N/A	Set to 4: *Hex:* 02 41 3A 03 *ASCII:* STX A : ETX	Current values returned, no error *Hex:* 02 30 41 3A 0D 42 3A 36 2E 35 37 0D 43 3A 31 2E 36 30 30 0D 45 3A 32 35 0D 46 3A 30 0D 47 3A 30 0D 48 3A 37 2E 39 31 39 0D 50 3A 31 34 2E 33 30 31 0D 51 3A 31 34 2E 33 30 31 0D 52 3A 39 36 31 0D 53 3A 30 0D 56 3A 30 2E 31 35 0D 57 3A 31 32 2E 31 34 0D 6D 3A 35 30 30 0D 03 *ASCII:* STX 0 A: CR B:6.57 CR C:1.600 CR … … m:500 CR ETX
B <Request SW version> Range: N/A	Set to 4: *Hex:* 02 42 3A 03 *ASCII:* STX B : ETX	Value returned, no error *Hex:* 02 30 42 3A 35 2E 33 03 *ASCII:* STX 0 B : 5 . 3 ETX
C <Hysteresis value> Range: 0-5,000 mA	Set Hysteresis to 500 mA: *Hex:* 02 43 3A 35 30 30 03 *ASCII:* STX C : 5 0 0 ETX	Value accepted, no error *No return*
E <Glitch Delay Count> Range: 0-1000	No value given: *Hex:* 02 45 3A 03 *ASCII:* STX E : ETX	Value accepted, no error *No return*
F <Pulse Source> Range: 0 = External 1 = Internal	No value given: *Hex:* 02 46 3A 03 *ASCII:* STX F : ETX	Value accepted, no error *No return*
G <Hold/Pull-in Source> Range: 0 = Front panel 1 = Serial cmd	Turn on serial mode: *Hex:* 02 47 3A 31 03 *ASCII:* STX G : 1 ETX	Value accepted, no error *No return*
H <Hold Current Cmd> Range: 0-25000 mA	Set to 8 amps (serial mode ON): *Hex:* 02 48 3A 38 30 30 30 03 *ASCII:* STX H : 8 0 0 0 ETX Set to 8 amps (serial mode OFF): *Hex:* 02 48 3A 38 30 30 30 03 *ASCII:* STX H : 8 0 0 0 ETX	Value accepted, no error *No return* ERROR, Value NOT accepted No Return. Use Request All to verify
P <Pull-in Current Cmd> Range: 0-25000 mA	Set to 15 amps (serial mode ON): *Hex:* 02 50 3A 31 35 30 30 30 03 *ASCII:*STX P : 1 5 0 0 0 ETX	Value accepted, no error *No return*
Q <Initial pulse Current > Range: 0-25000 mA	Set to 15 amps (serial mode ON): *Hex:* 02 51 3A 31 35 30 30 30 03 *ASCII:*STX Q : 1 5 0 0 0 ETX	Value accepted, no error *No return*
R <Pull-in Time> Range: 0-5000 us	Set to 180 us (serial mode ON): *Hex:* 02 52 3A 31 38 30 03 *ASCII:* STX R : 1 8 0 ETX	Value accepted, no error *No return*
S <Vboost Time> Range: 0-5000 us	Set to 0: *Hex:* 02 53 3A 30 03 *ASCII:* STX S : 0 ETX	Value accepted, no error *No return*
m <Max solenoid ON time> Range: 1-429000 mS	Set to 2 seconds (serial mode ON): *Hex:* 02 02 6D 3A 32 30 30 30 03 *ASCII:*STX m : 2 0 0 0 ETX	Value accepted, no error *No return*



Sample I/O traces (Normal Mode)

OPERATION MODES

Normal Mode

In this mode, up to 3 injectors may be driven. Pull-in current, Pull-in time, and Hold current may be adjusted using the front panel knobs or through serial commands. Serial control may be accomplished by using the built in menu system and Hyperterminal, or by directly sending serial commands from within a PC or embedded control system. The serial interface should be set up for 19200 bps, 8-N-1, no flow control.

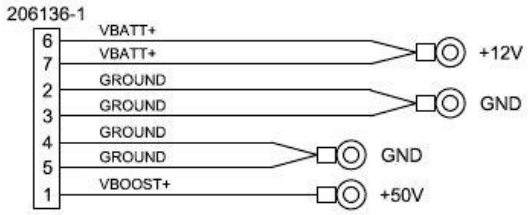
Operation in Normal mode requires a **Boost voltage supply** (typically 50 VDC). Use the Pull-in Time knob and/or serial command to adjust the pull-in time.

The **Cyl x Select** pins are used to control which injector output is turned on. Only one Cyl Select pin may be active per injection event (can not drive more than 1 injector simultaneously).

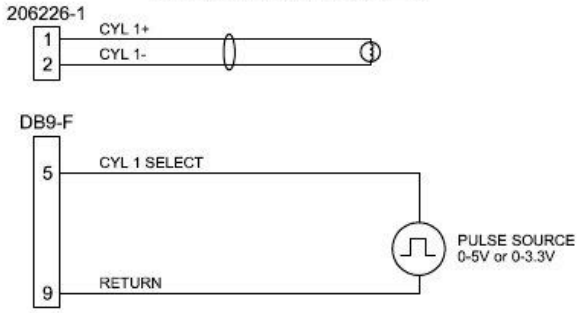
Ramp Mode

In this mode, only 1 injector may be driven, connected to the **RAMP mode inj+** pin and the **Cyl 1- / RAMP mode inj-** pin. In this mode, the injector current is ramped up at a rate of 10 ms / Amp until the injector plunger opening is detected. After the plunger movement is detected, current is ramped down and the plunger closing current is detected. After each cycle, the 2 rear panel BNC outputs are set to a voltage level that represents the measured opening current and closing current (0.500V / A). The detected values can also be seen on the RS232 output if connected to a terminal. Note that the Ramp Control BNC input on the rear panel is used to turn the RAMP function on by shorting the BNC contacts together. Also, it is necessary to calibrate the BNC outputs (Serial option 'T') under normal system load.

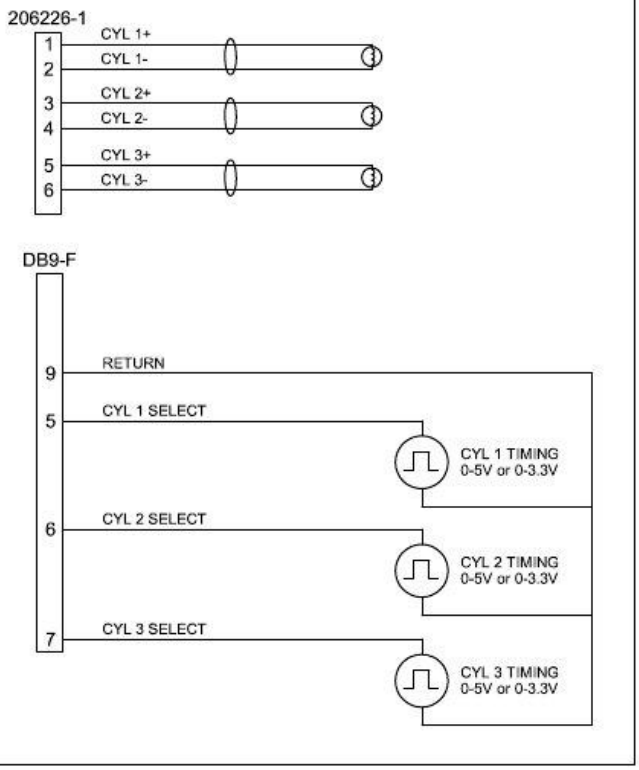
NORMAL MODE



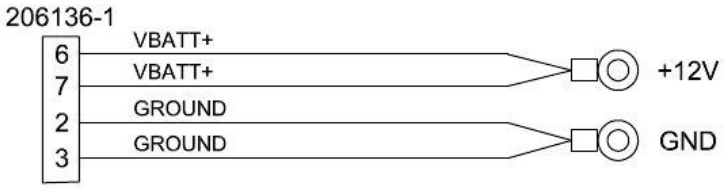
SINGLE CYLINDER

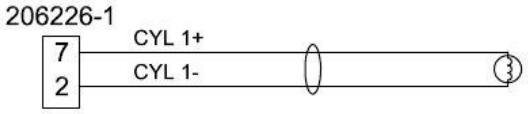


THREE CYLINDER



RAMP MODE





SHORT "RAMP CONTROL" BNC CONTACTS TO ENABLE CURRENT RAMP