



# EC02 User Guide

HY28-2707-02/ELE/US August 2017



ENGINEERING YOUR SUCCESS.

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**Parker Hannifin Corporation**  
Hydraulic Pump and Power Systems Division  
United States

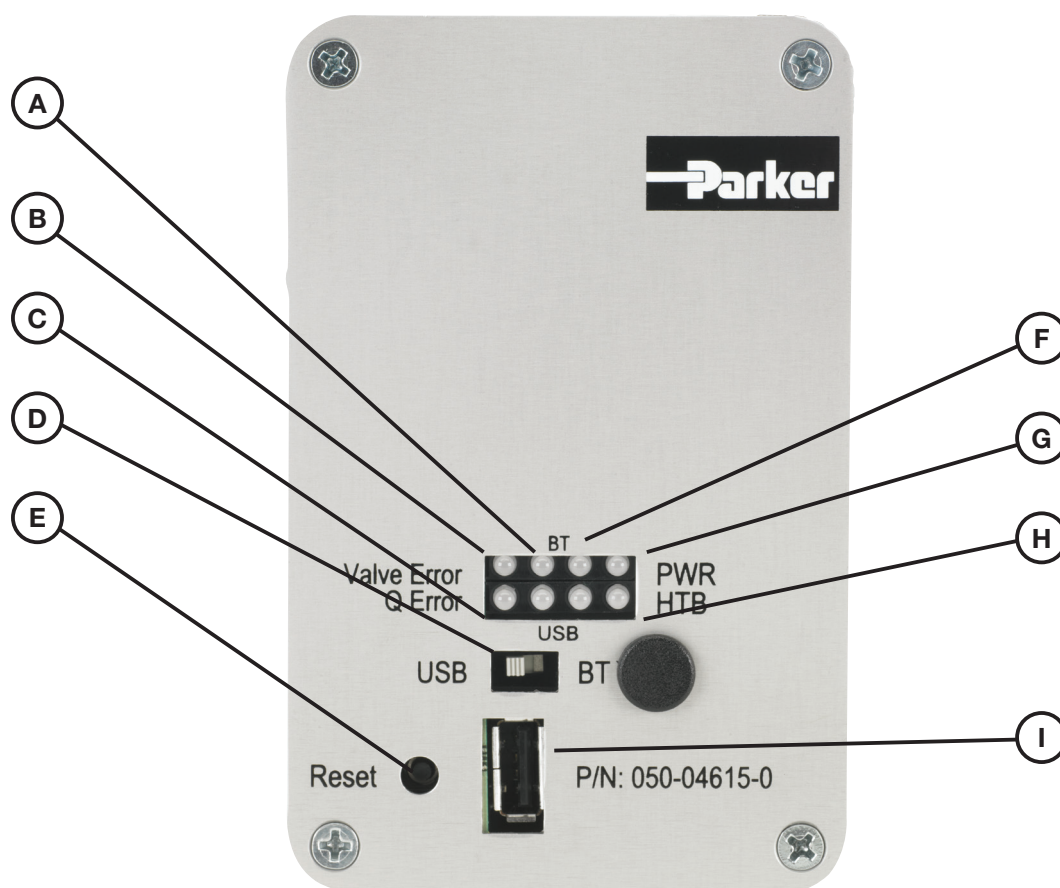
## Overview

This document describes the installation and operation of the EC02 Digital Electronic Control Module (part number 050-04615-0). Parker Hydraulic Pump and Power Systems Division's newest device is taking performance and reliability to the next level. Capable of performing in a wide range of operating temperatures, along with EMI/EMC and Environmental Certifications, this device is ideal for offshore environments and demanding industrial applications. Installation and service are easily accomplished with EC02's robust DIN rail mounting interface and quick connect terminal strips. This single device is easily configured to drive any GOLD CUP® Hi-IQ pump (with D1FP control valve), regardless of the pump displacement, rotation, control position or feedback device option. The closed loop control functions include Q (flow), P/Q (pressure & flow) and Master Slave P/Q (pressure & flow where secondary units follow a master pump).

RDEC\_EC02\_GUI is the software file used to control the EC02. This software is used for both Parker's Remote Digital Electronic Control (RDEC) and the EC02 Module, and will automatically recognize the controller to which it's connected. With a customizable Graphical User Interface (GUI), this advance digital control provides simplified setup, easy system commissioning and responsive troubleshooting. All in a compact pump control solution. The intuitive, user friendly GUI utilizes Windows-based programming to offer on-screen graphics, drop-down menus and help manual.

Item Description	Specification/Value
Power supply voltage (reverse polarity protection) – PIN A1/A2 (+), PIN A8 (-)	10 to 32VDC@ 36 watts for EC02 only. (See DF+ literature for valve power requirements)
Maximum supply voltage transients	SAE J1455 4.13.2.2.1, 4.13.2.2.2 & 4.13.2.2.3
User reference voltage (i.e. sensor power and command signals) – PIN C1 to C6	±15VDC (±5%) @ ±50mA (max)
	±10VDC (±5%) @ ±20mA (max)
	±5VDC (±5%) @ ±40mA (max)
Analog Inputs (9 channels) – PIN D1 to D10	
Potentiometer	10k ohms nominal, 5k ohms minimum
Input voltage range	±10VDC, ±5VDC, 0-5VDC, 0-10VDC
Input impedance	100K ohms, 470nF
Current loop input	±20mA, 12±8mA, 4-20mA Note: Q cmd 12+/-8mA, P cmd 4-20mA
Current loop input impedance	249 ohms, 470nF
Feedback scale: -100% to +100%	Feedback range can be software selected
Feedback inputs (4 channels) - PIN D1, D4, D5, & D9	
Horse power limiting and major loop	±10VDC, ±5VDC, 0-5VDC, 0-10VDC, 4-20ma
Ramps generator:	
Ramp up time Positive ramp( rising) range A	0.01 – 100 sec.
Positive ramp (rising) range B	0.01 – 100 sec.
Ramp down time Negative ramp (falling) range A	0.01 – 100 sec.
Negative ramp (falling) range B	0.01 – 100 sec.
Software command type select	±5v input, ±10v input, ±20mA, 12±8mA (4-20mA), CAN Bus J1939
Analog output (4 channels) - PIN D11-D14	
Output voltage range	±10VDC at ±5mA
Output impedance	1K ohms (pA & pB software scaled for 0 -10VDC)
Digital input (7 channels) PIN A5, B1 to B5, and B15	+12v ~ 24v @5mA
Digital output (9 channels) PIN B6 to B14	
External power supply	10v – 24v Max 10mA
Internal power supply	10, 15, or 24v (ref voltages)
Error indicator (digital output)	
Error	0 V indicate error
Normal operation	Supply voltage
Function generator (sine, square, triangle wave)	Frequency: 0.02Hz – 20Hz
	Offset: -100% – 100%
	Amplitude: -100% – 100%
	Offset + Amplitude: -100% – 100%
Log function	Data log to files on PC (via USB connection or Bluetooth). Hi-speed logging (4 channel, 1ms max, 5000 data points per channel). Low speed logging limited to USB cable transmission rate.
Security levels (software selectable)	To obtain security passwords, contact OEM
User – available to all	View ONLY
Technician	Change gains and configure drop down parameters
OEM engineer	Change gains and configure drop down parameters, plus set OEM defaults
Universal parameter setup for different size pump	Based on pump's model code (default setup)
Software calibrate	Cam feedback sensor fine tuning parameter
CE Mark	IEC 61000-6-2 (2005)
EMC	The tested product was mounted in a NEMA 4 enclosure (or equivalent) and all cables exiting the enclosure were shielded (screened). Enclosure and cable shields were connected to earth ground (PE).
CISPR 11	Radiated emissions
IEC 61000-4-2	Electrostatic discharge immunity
IEC 61000-4-3	Radiated electric field immunity
IEC 61000-4-4	Electric fast transient burst immunity
IEC 61000-4-5	Surge immunity
IEC 61000-4-6	RF common mode immunity
IEC 61000-4-8	Power frequency magnetic field immunity
EC generic immunity standard for industrial environments	
EN 61000-6-2:2005 / IEC 61000-6-2:2005	2kv power supply wires
Operating temperature	-40°F to +158°F (-40°C to +70°C)
Enclosure	Standard DIN rail mount. Dimension (mm): HxWxD 118.9 x 76.2 x 155.1 (w/o mounting clip)

## EC02 Enclosure Front View



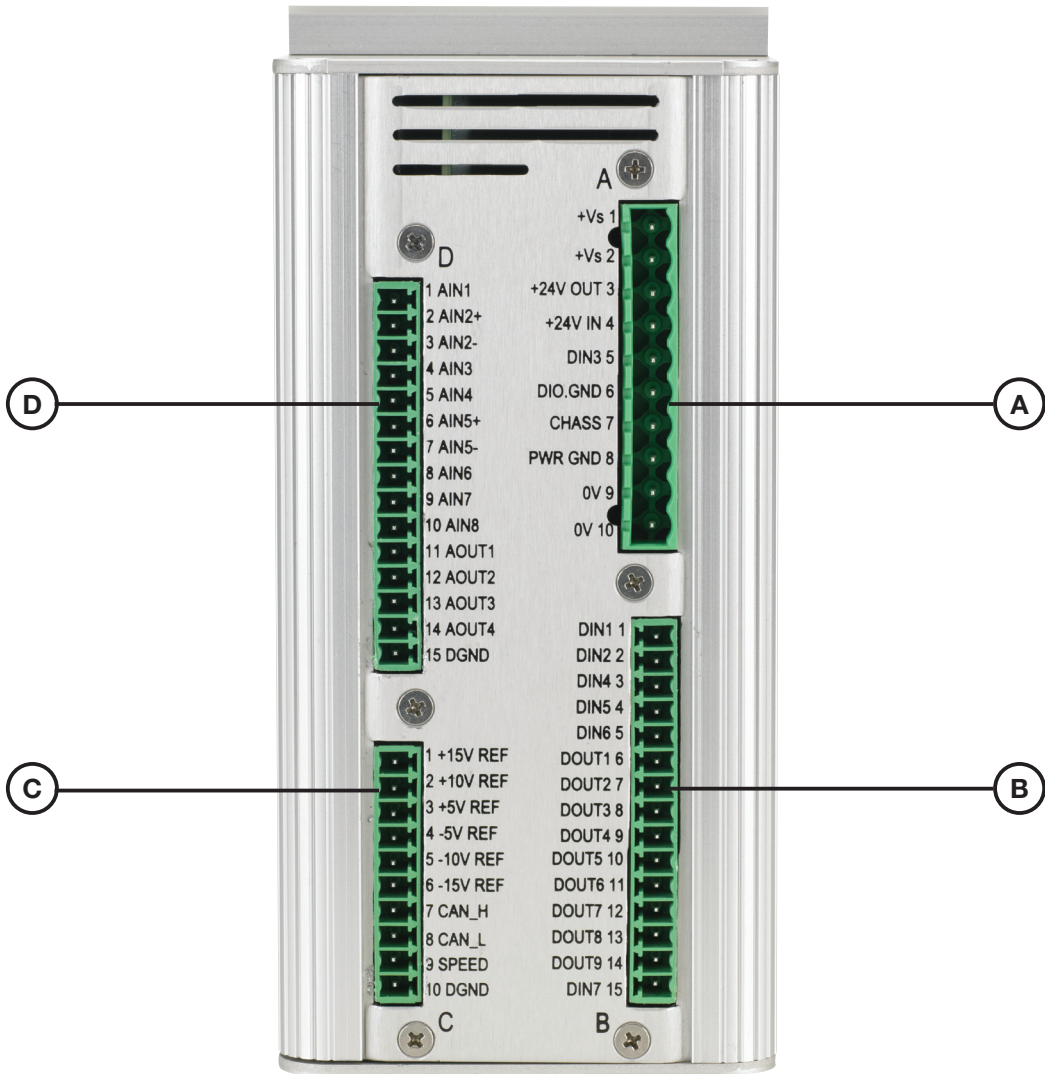
- A. USB Transmit/Receive LEDs:** LEDs will flicker when data is being transmitted or received via the USB communication cable.
- B. Error LED – Valve:** Visual error indicator if the valve command and feedback are not tracking within the user specified criteria.
- C. Error LED – Displacement:** Visual error indicator if the displacement command and feedback are not tracking within the user specified criteria.
- D. USB/Bluetooth Selector Switch:** Switch to define the communication type (USB cable or wireless with Bluetooth).
- E. Reset Button:** Push button to conduct software reset. This will reset all parameters to the information last saved to the RAM.
- F. Bluetooth Transmit/Receive LEDs:** LEDs will flicker when data is being transmitted or received via Bluetooth communication.
- G. Power LED:** Visual indicator that the power has been supplied to the module and is within operating range.
- H. Heartbeat LED:** Continuous blink of the LED indicates proper operation and health of the microprocessor board.
- I. USB Port:** Communication port used for software downloads, system setup, diagnostics, etc.

**Note:**

If not communicating via Bluetooth, a USB type 2.0 male to male cable will be required to connect the EC02 module to a computer. Do not use a USB “File Transfer Cable,” as these typically have built-in software that can interfere with the connection between the computer and EC02.



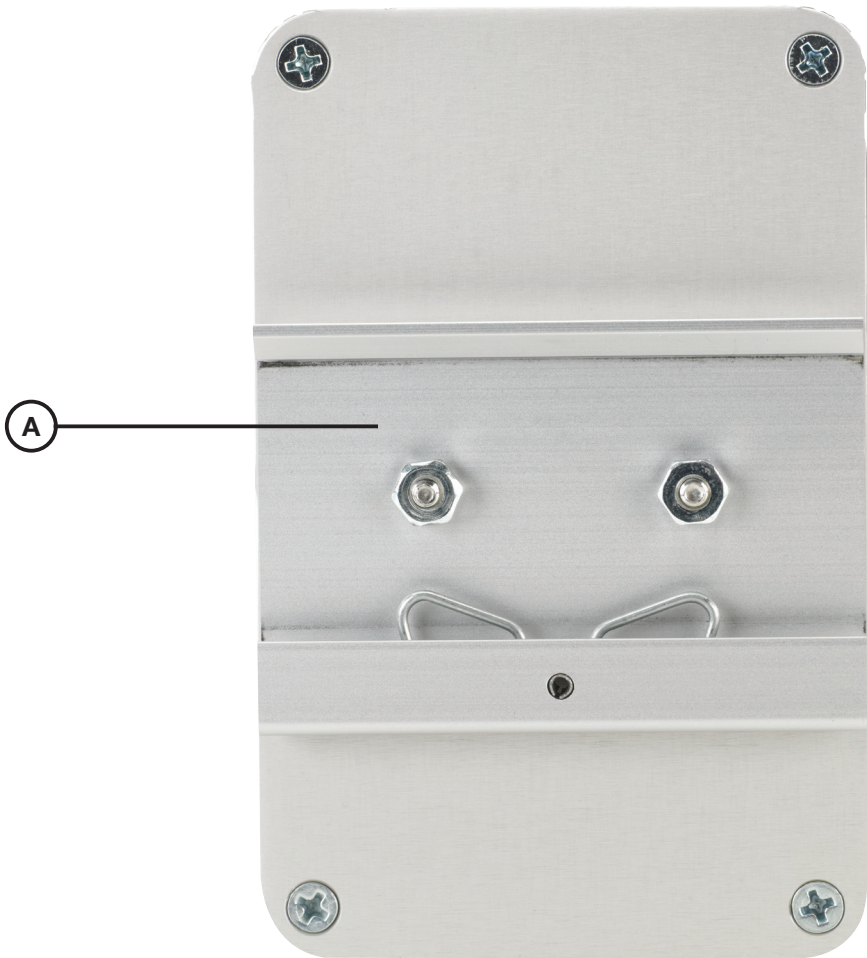
EC02 Enclosure Top View



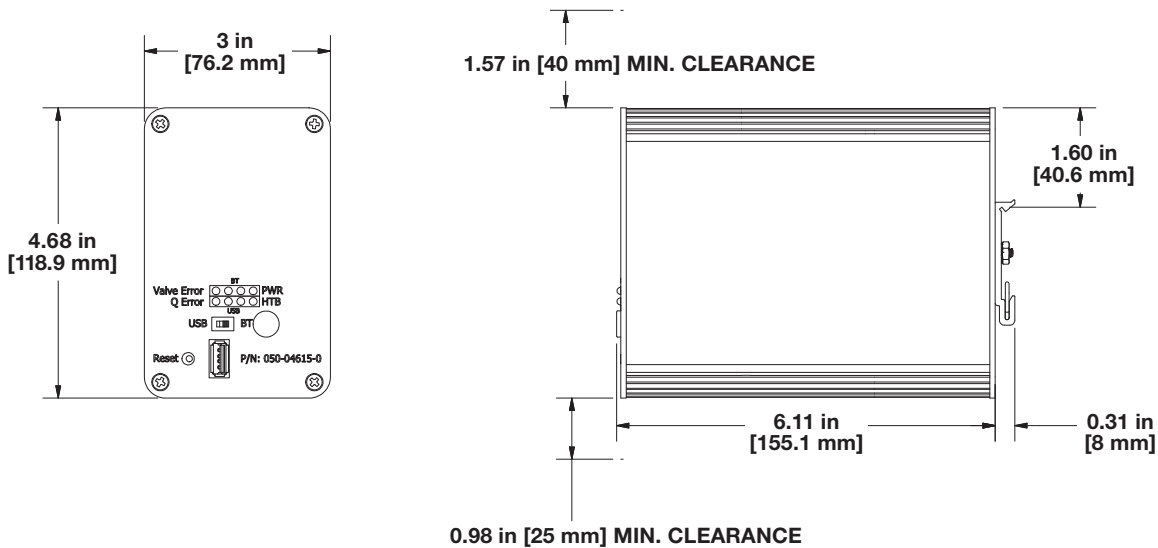
- A. Power Supply Connector:** 10 PIN connector for supply power and ground connections
- B. Digital I/O Connector:** 15 PIN connector.
- CAUTION:**  
The Analog I/O uses the same type connector, so be careful to plug into the correct connector.
- C. Reference Voltage/CAN Bus Connector:** 10 PIN connector.
- D. Analog I/O Connector:** 15 PIN connector.
- CAUTION:**  
The Digital I/O uses the same type connector, so be careful to plug into the correct connector.

Connector Description		
ID	Mating Connector (Cust. Supplied)	Allowable Wire Size
A	Phoenix Contact P/N: 1792605	12-16 AWG
B	Phoenix Contact P/N: 1803701	16-24 AWG
C	Phoenix Contact P/N: 1803659	16-24 AWG
D	Phoenix Contact P/N: 1803701	16-24 AWG

EC02 Enclosure Rear View



A. DIN Mounting Clip: Spring loaded clip for mounting to standard 35 mm DIN rail.



## EC02 Hardware Installation

The EC02 is furnished with a rear DIN mounting clip. Vertical mounting (connectors facing up) of the unit to a DIN rail located within a protected enclosure is recommended. As previously shown, the EC02 has four Phoenix Contact connectors (mating connectors and part numbers can be found in the wiring schematic drawings). The color coded Connector/PIN Identification chart (*Page 7*) provides an abbreviated description for each of the connector pins. Depending on the application requirements, all connectors may not be required.

Prior to making any connections, first determine the wiring diagram to use for the application by identifying if Q (Flow), P/Q (Pressure & Flow), or P/Q with Master-Slave will be used. Next determine if the system will use a voltage or current command. The title block for the diagram will describe the function and command type as mentioned above. The five most popular wiring diagrams are included within this document. However, if an alternative diagram is required, a request can be submitted to [pumptechsupport@parker.com](mailto:pumptechsupport@parker.com).

Once the proper wiring diagram has been selected, install the wiring and hardware as shown in the schematic. Ensure that the EC02 is secured to the DIN rail, wires are fully engaged and tightened within the connectors, and the connectors are fully inserted to the appropriate mating connector. Power should not be applied until all wiring has been reviewed for proper routing.

**Pressure Transducers:** For applications using PQ type control, pressure transducers must be purchased and installed to sense system pressure.

### NOTE:

The A port and B port transducers must be rated for the same pressure.

The basic requirements for the pressure transducer are as follows:

- 4-20 mA Output
- <1 msec response time
- Rated pressure >10% above expected max. pressure setting

**Enabling the EC02:** As shown in each of the control diagrams, +15 (or +24V) must be applied to PIN 5 of Connector A for the EC02 to function. Removing power from this PIN will send Q command to zero and P command to maximum. In such an event, ramps will be disabled, so the change in command signal to zero will be a step command change. Installing a switch to remove power from the enable pin is sometimes used to function as an E-Stop. Keep in mind that this does not stop the pump from rotating, but rather sends the command signal to zero.



## Connector/PIN Identification Chart

Pin #	
D1	AIN1, Q_FDBK
D2	AIN2, Q_Cmd+
D3	AIN2, Q_Cmd-
D4	AIN3, pA_Pressure_FDBK
D5	AIN4, pB_Pressure_FDBK
D6	AIN5, P_Cmd+
D7	AIN5, P_Cmd-
D8	AIN6, Q cmd (Slave)
D9	AIN7, Valve_FDBK
D10	AIN8, Spare
D11	AOUT1, Valve_Cmd
D12	AOUT2, Q_FDBK_Out (MS)
D13	AOUT3, pA FDBK Out (PQ, MS)
D14	AOUT4, pB FDBK Out (PQ, MS)
D15	GND

Pin #	
C1	15 + REF
C2	10v + REF
C3	5 v+ REF
C4	5 v- REF
C5	10 v - REF
C	15 v - REF
C7	CAN H
C8	CAN L
C9	Speed/Pulse
C10	GND

### Color Key

Pressure (P) Command & Feedback
Flow (Q) Command & Feedback
Valve Command & Feedback
Digital Inputs
Digital Output
Voltage Outputs (Red Text)

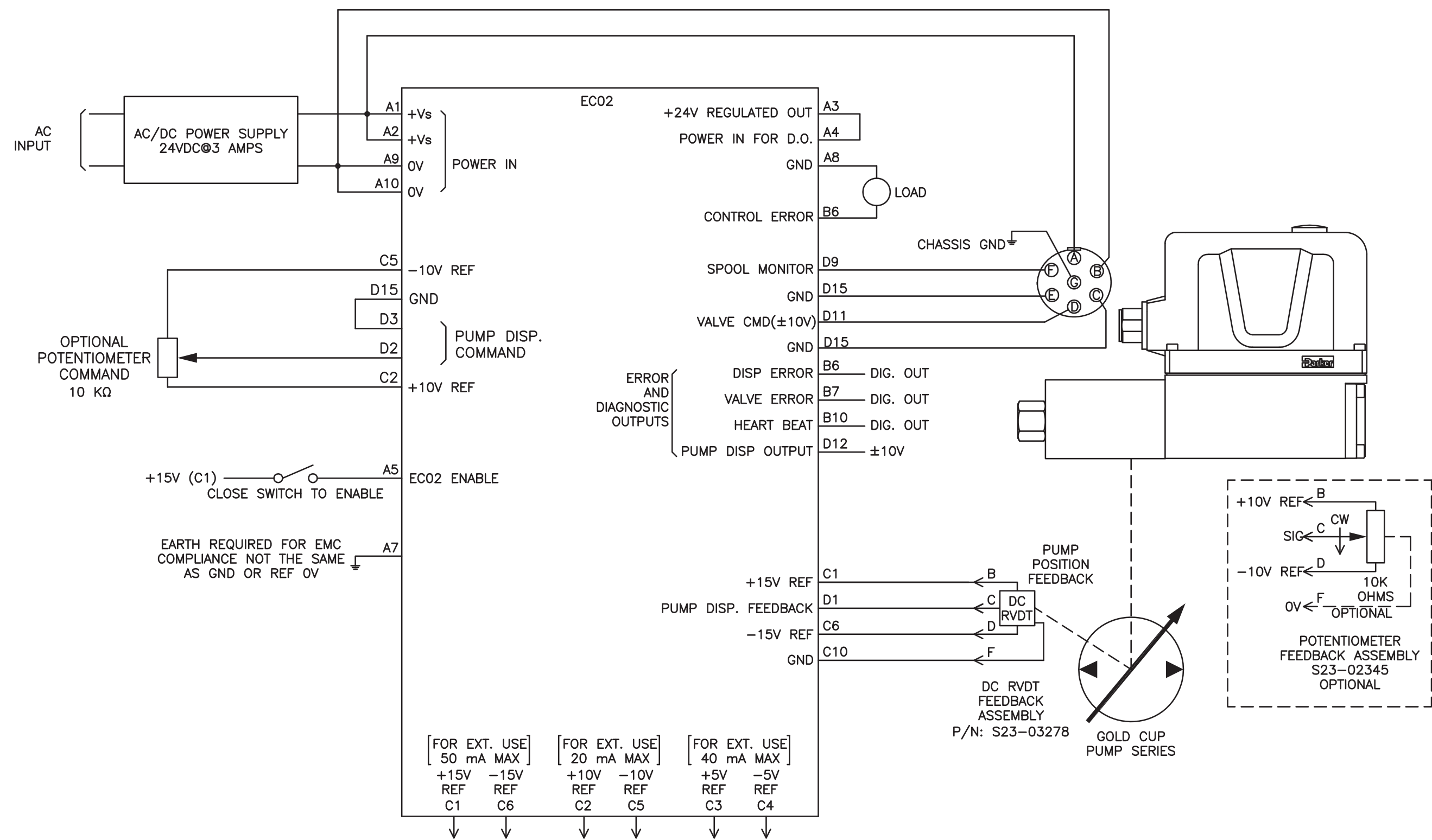
Pin #	
A1	Vsupply +
A2	Vsupply +
A3	24 v OUT
A4	DigIO_PWR_Supply
A5	Dig 3 IN, Pump_Enable (Hi)
A6	Dig IO GND
A7	Chass GND
A8	PWR_GND (Regulated Power GND for pin A3)
A9	Vsupply 0V (Power Supply GND for A1 & A2)
A10	Vsupply 0V (Power Supply GND for A1 & A2)

Pin #	
B1	Dig 1 IN, Hi-Speed-Data Log trigger
B2	Dig 2 IN, Q_Corn Polarity
B3	Dig 4 IN, PID_Gain_1
B4	Dig 5 IN, PID_Gain_2
B5	Dig 6 IN, Master (Low) /Slave (High)
B6	Dig.1 Out, Displacement Error
B7	Dig.2 Out, Valve Error
B8	Dig.3 Out, Pressure A Error
B9	Dig.4 Out, Pressure B Error
B10	Dig.5 Out, Heat Beat
B11	Dig.6 Out, Spare
B12	Dig.7 Out, Spare
B13	Dig.8 Out, Spare
B14	Dig.9 Out, Spare
B15	Dig 7 In, Spare

### GROUNDING NOTES:

1. Pin A6, A8, C10 and D15 are internally connected and separated for customer convenience. These are for analog input/output signal grounding.
2. Chass GND (Pin A7) should be connected to the Chassis Ground of power supply/source if EC02 is stand alone and not in grounded cabinet.
3. Pin A6 is internally connected to Pin A8. If an external PLC is used to provide digital input/output, then the PLC digital ground must be connected to A6.

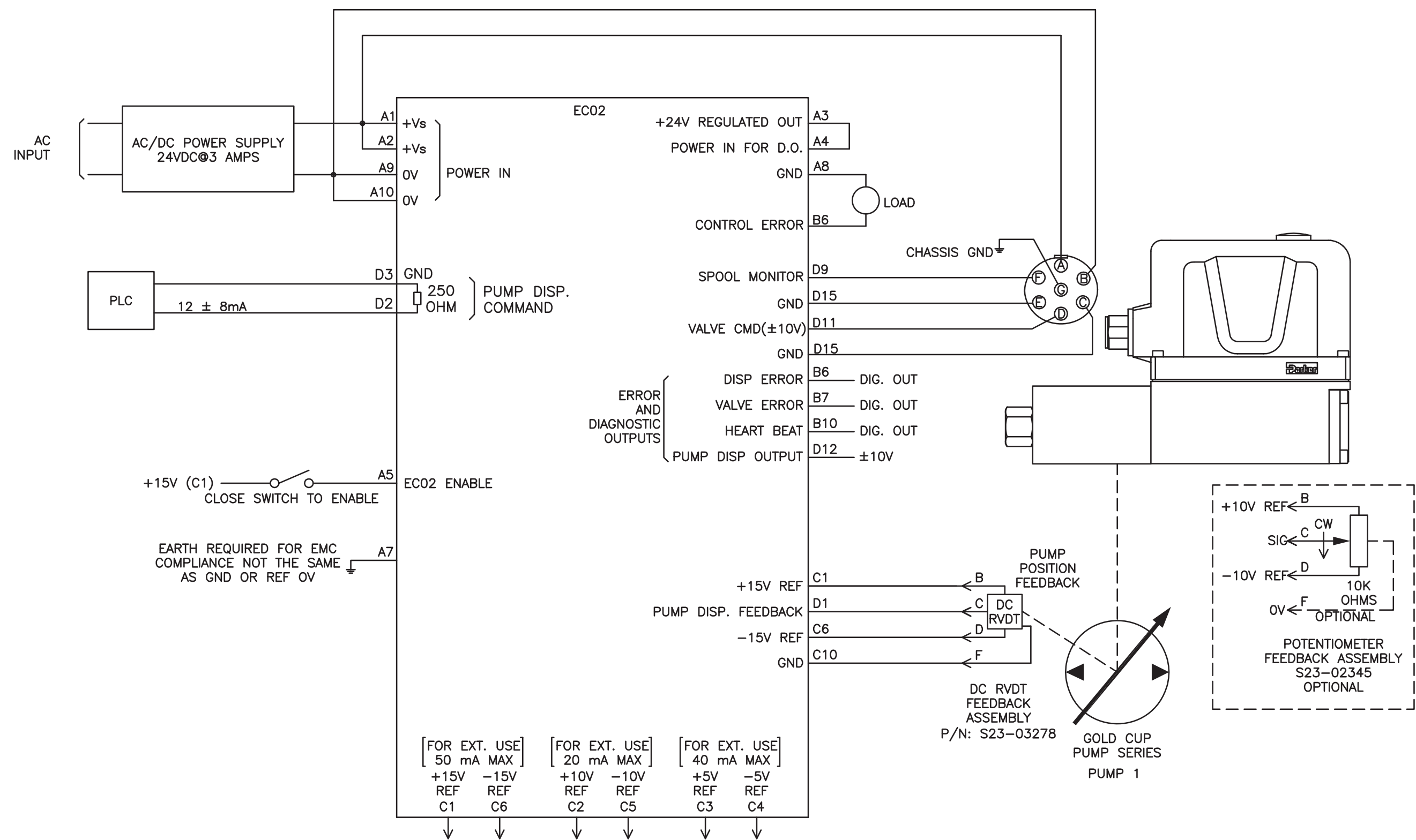
Q Control With Voltage Command – SK16127



**NOTE:**  
Pump setup, command type and feedback scaling are set using EC02 GUI program



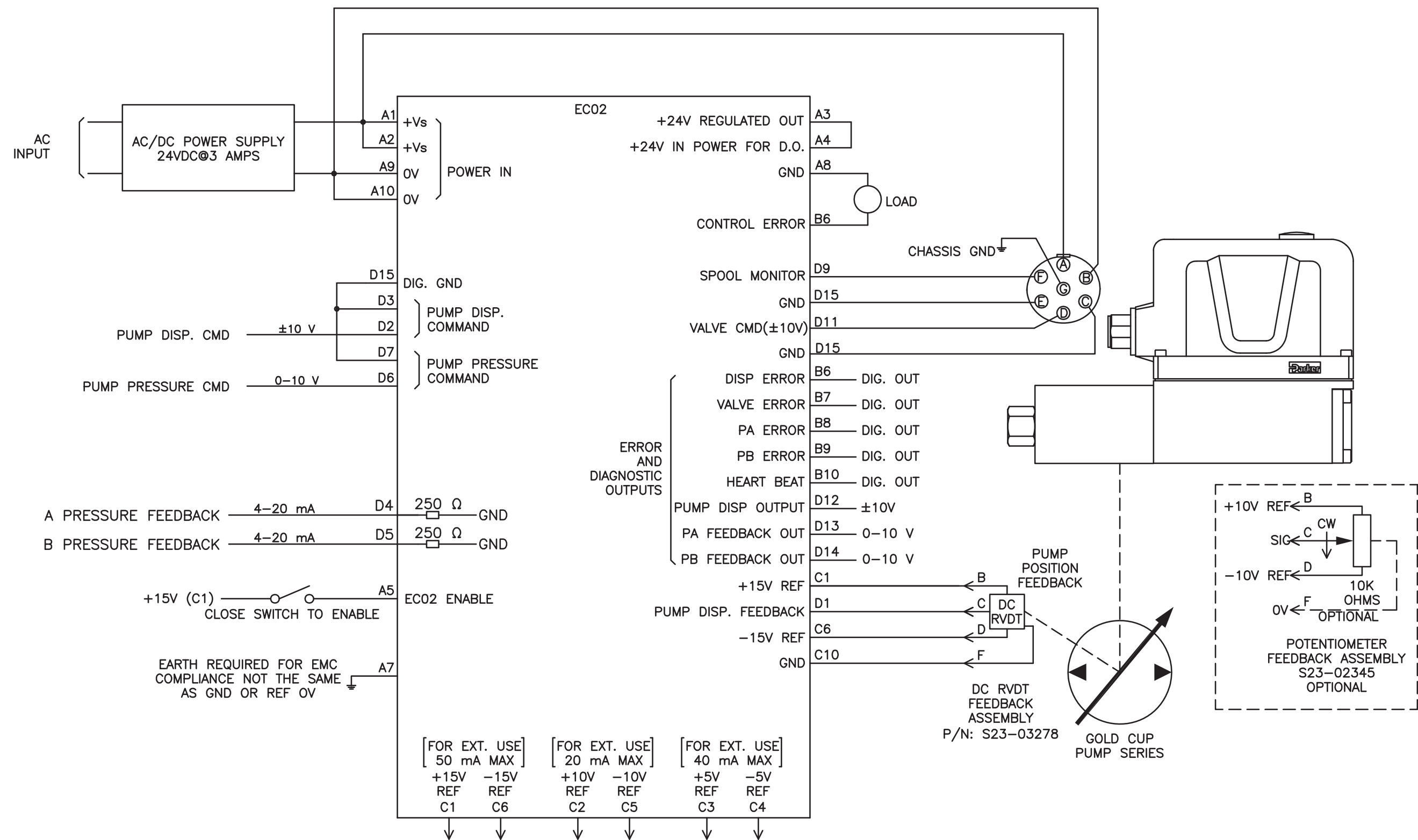
Q Control With Current Command – SK16128



**NOTE:**  
Pump setup, command type and feedback scaling are set using EC02 GUI program



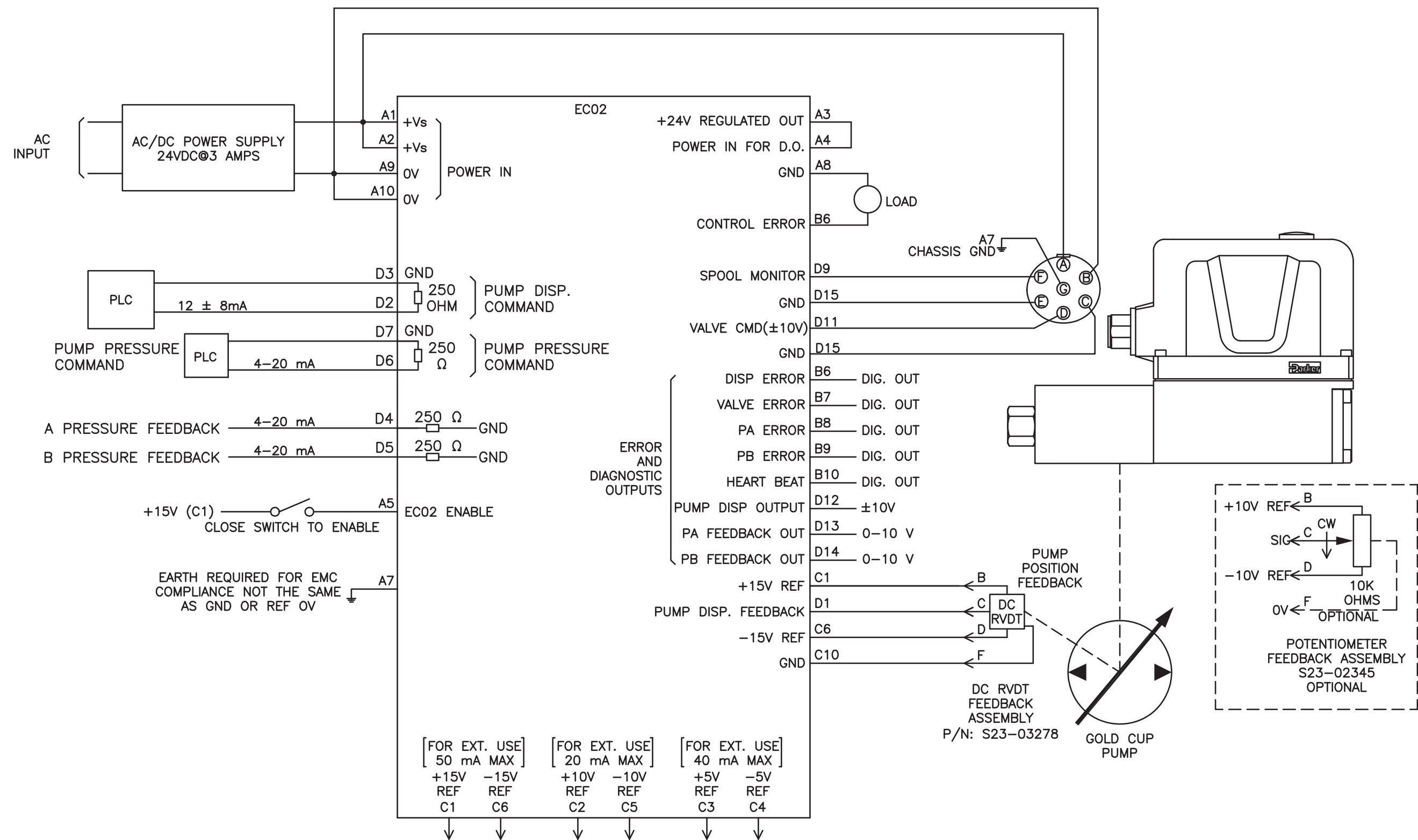
PQ Control With Voltage Command – SK16132



**NOTE:**  
Pump setup, command type and feedback scaling are set using EC02 GUI program



PQ Control With Current Command – SK16129

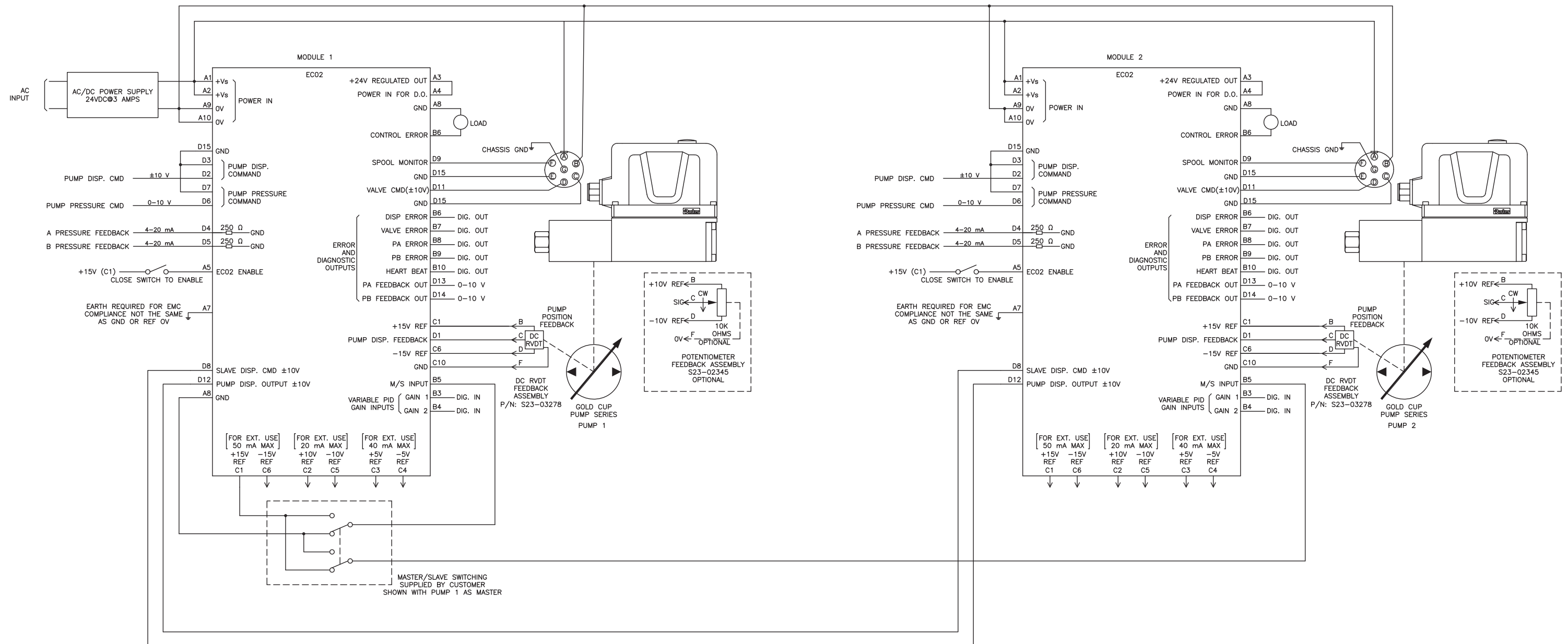


**NOTE:**  
Pump setup, command type and feedback scaling are set using EC02 GUI program





### M/S With Voltage Command – SK16130



**NOTE:**

Pump setup, command type and feedback scaling are set using EC02 GUI program

## GUI & USB Driver Installation

All installation software can be found on Parker's website at [www.parker.com/HPS/ECO2\\_for\\_Gold\\_Cup](http://www.parker.com/HPS/ECO2_for_Gold_Cup). All files located here should be copied to the hard drive of the computer you plan to use for EC02 operation.

These will include:

- USB Driver Installation Guide  
(example: Refer to AN\_119\_FTDI\_Drivers\_Installation\_Guide\_for\_Windows7.pdf)
- USB driver folders 32 or 64 bit
- EC02 GUI folder (installation files)

All software can be loaded without being connected to the EC02 controller.

### Loading the USB Driver Software







To determine if your computer is 32 or 64 bit, go to your computer "Properties" under System Type, and either 32 or 64 bit operating system should be specified. To select the correct driver, you will also want to know what type of operating system is running (ie: Windows 7, Windows XP). Open the appropriate driver folder (32 or 64 bit) and double click on the zip file (example: CDM \*\*.\*\*. WHQL Certified.zip). Next, extract the files and install the USB driver according to the instruction steps provided in the USB Driver Installation Guide. Computer Requirements: Desktop or laptop with Windows 98 NT/2000/XP/version7 operating system or later.

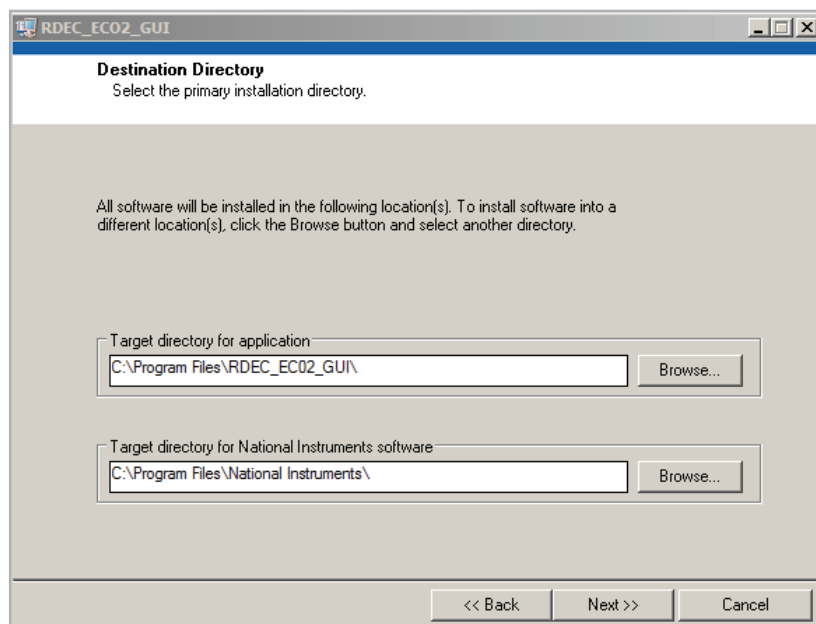
### Loading the GUI (Graphical User Interface) Software

Once the USB driver is installed, proceed with the installation of the Graphical User Interface software. Start by clicking on the software folder titled "EC02 GUI Folder".

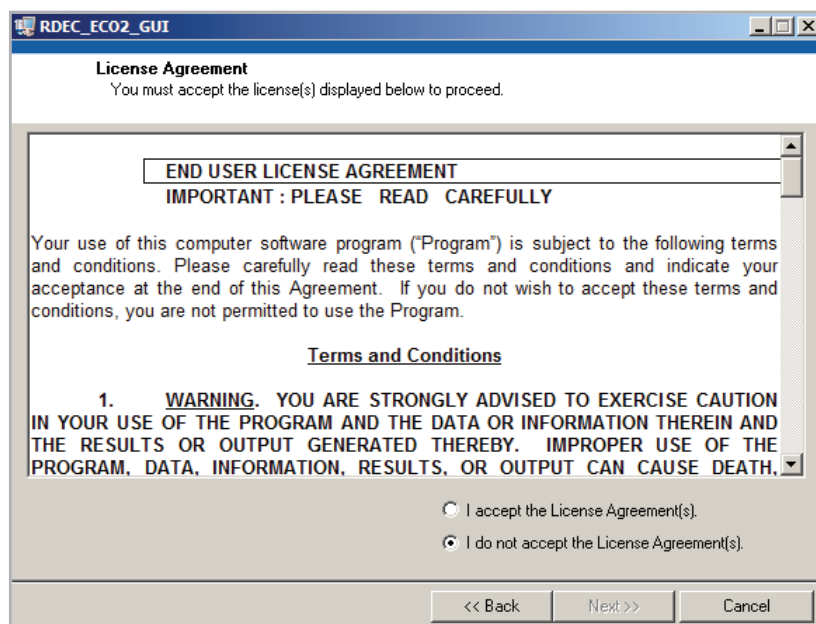
Click on the "Setup" file as highlighted below. This will have an application file type.

The software will automatically install files under "RDEC\_EC02\_GUI" within the program files unless otherwise directed. To accept, click "Next."

Name	Date modified	Type	Size
 bin	11/11/2016 2:01 PM	File folder	
 license	11/11/2016 2:01 PM	File folder	
 supportfiles	11/11/2016 2:01 PM	File folder	
 nidist.id	11/9/2016 4:55 PM	ID File	1 KB
 setup	1/23/2008 1:32 PM	Application	2,396 KB
 setup	11/9/2016 4:55 PM	Configuration sett...	2 KB



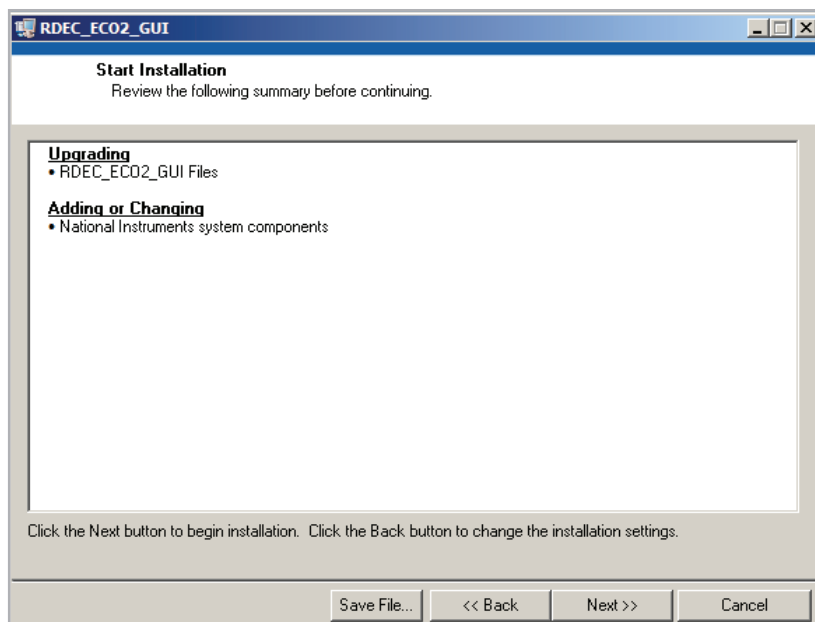
Prior to installing the software files, the user must agree to the “Terms and Conditions” as outlined. Click the “I Accept the License Agreement” to proceed with installation if you agree with the terms and conditions. Then click “Next.”



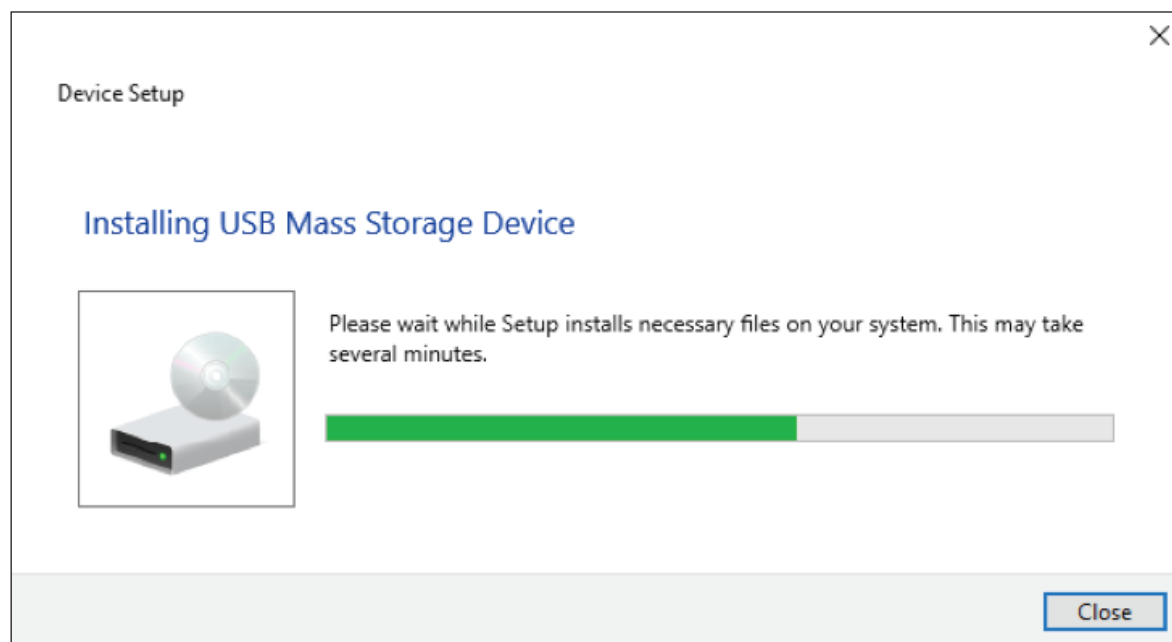
Start the installation by clicking “Next.”

#### NOTE:

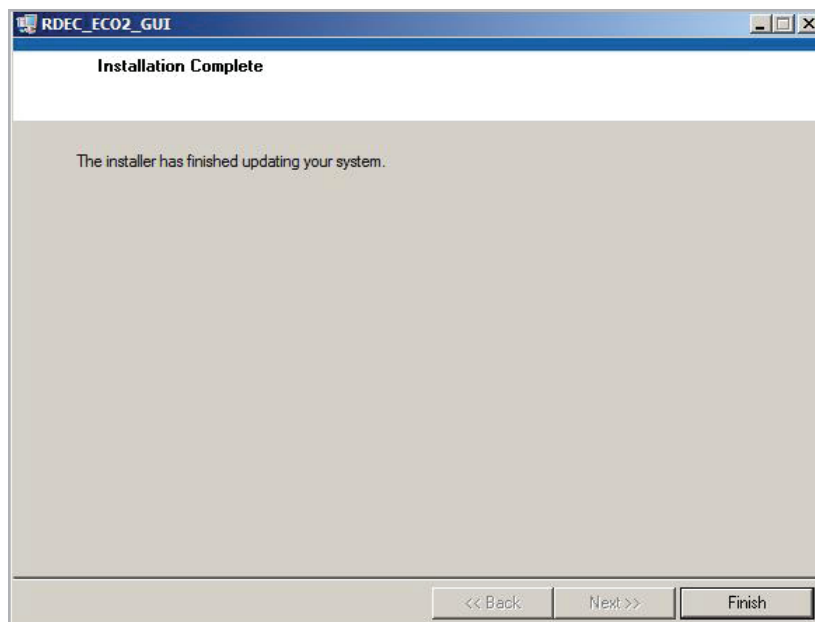
If an Installation Summary appears that states “No software will be installed or removed”, then the computer you are using already has this GUI software revision level installed.



As the software installation begins, the progress bars will provide a visual indication that the installation is in process.



Once the installation is complete, the screen below will appear. Click "Finish" to exit.



GUI short-cut icon

The GUI software is now successfully installed. A GUI short-cut icon (right) can now be found on your desktop. This icon will be used to open the GUI for set up, operation, and diagnostics/monitoring of the EC02 controller.

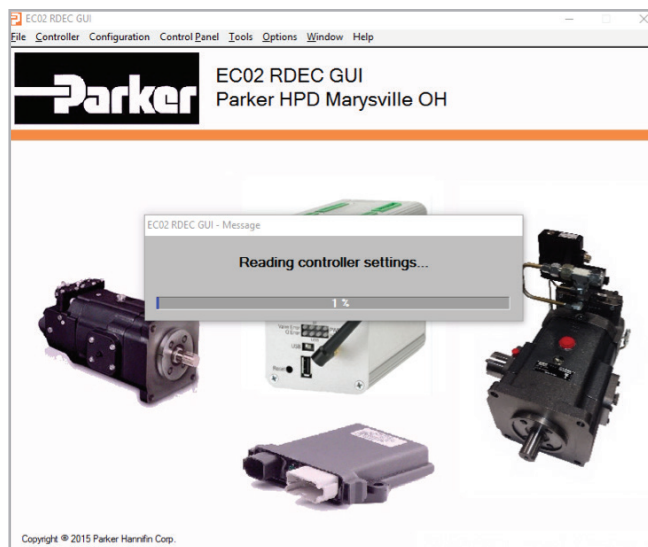
**NOTE:**

Setting the pump parameters according to the pump configuration and control mode is recommended before making any connections from the EC02 to a functioning pump control valve.



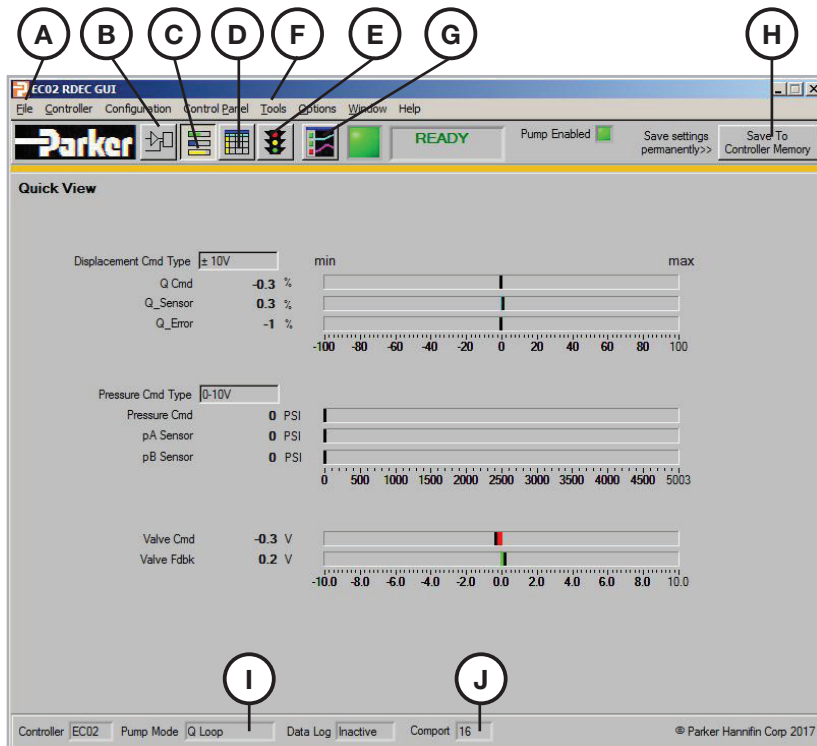
## How to Use the GUI (Graphical User Interface)

1. Plug in CONNECTOR A (10 PIN cable ) into the controller and plug the USB connector into the computer. The EC02 is equipped with a USB driver that will automatically install on the PC, once connected and powered up. Wait while this installs.
2. Make certain the pump electronics are powered with 24 VDC according to the “EC02 Hardware Installation & Wiring Diagrams” section.
3. Everything is connected correctly, Green LED indicates power is on, Green LED indicate heartbeat which means everything works OK.
4. Start the EC02\_GUI program.
  - If the status says “Online” the computer is communicating with the pump correctly.
  - If the computer isn’t communicating with the pump, turn the power to the electronics off, close down the GUI, check the USB connector and the 9 PIN connector to make certain there is a good connection.
  - Turn the power back on to the pump electronics, wait a couple of seconds and then start the GUI software.
  - If there is still a problem, make certain that the serial port is “enabled” in the BIOS setup.



## Graphic User Interface

The GUI software main window



**A. Main Menu Control Bar:** This main menu bar provides access to common commands and operations. Drop down menus will appear for multi-level options. However, short-cut icons are also available for quick navigation.

File Controller Configuration Control Panel Tools Options Window Help

**B. Control Loop:** Click this icon to open the control loop window. The current "Control Loop" diagram selected will appear.



**C. Quick View:** Click this icon to show the "Quick View" window.



**D. Data Log:** Click this icon to open "Data Log" window. This window is used to select the type of data logging (standard or hi-speed), parameters to be logged, and log settings.



**E. Diagnostic:** Click this button to pop up "Diagnostic" window.



**F. Tools:** Only used by manufacturer for testing process.

**G. Graphic:** Click this button to pop up "Graphic" window.



**H. Save to NOVRAM:** Click this button to save all the setting to controller internal NOVRAM.



**I. Control Mode:** This window will show the current mode of operation in real time. For PQ control, you will see it toggle between Q Loop and P Loop as it switches control modes.

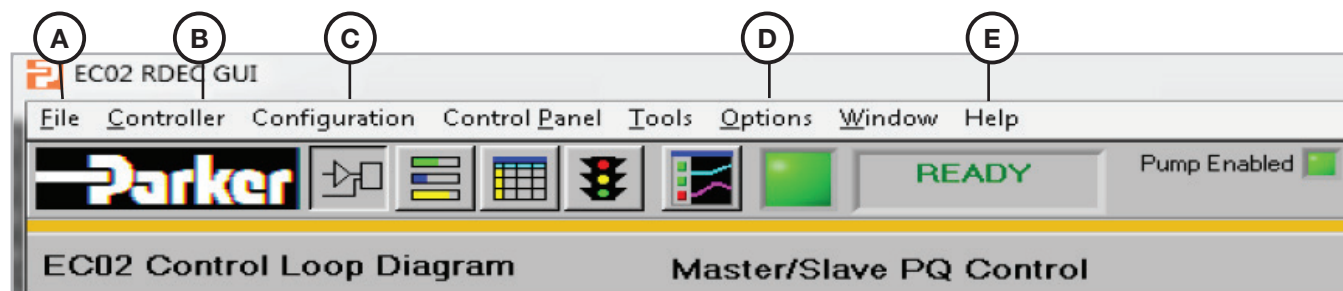


**J. Comport:** Indicates the serial communication port number.



## Main

The application menu provides access to common commands and operations.



- A. File Menu:** The file menu allows user to save parameter to controller NOVRAM, or save all the parameters setting to PC File, or download PC parameters to controller.

File

- B. Controller:** The controller can update the new firmware to controller.

Controller

- C. Configuration:** The configuration allows user to set up the pump.

Configuration

- D. Options:** The menu allows user to set up password and set up to English or metric unit.

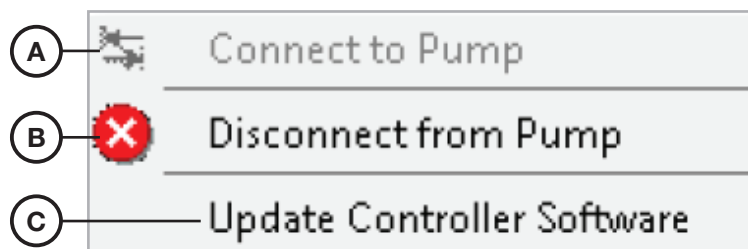
Options

- E. Help:** The “Help” menu consists of links to help and support resources.

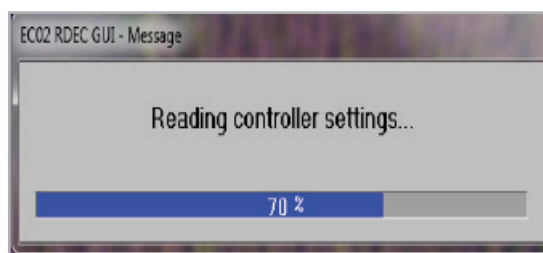
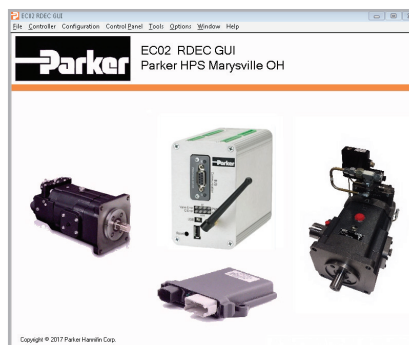
Help

## Communication

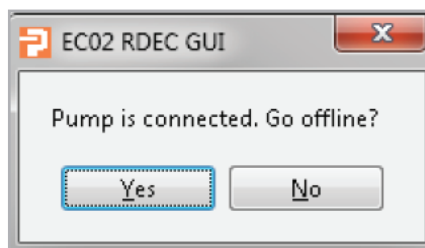
The “Edit” sub-menu consist of object editing commands.



- A. Connect to Pump:** Connect PC GUI to controller with COM port if PC GUI is lost communicate to the controller.



- B. Disconnect to Pump:** Click “Yes, Disconnect Communication.”



- C. Update Controller Software:** Update controller firmware.

## Update Firmware

EC02 RDEC GUI - UPDATE PUMP CONTROLLER SOFTWARE

Latest hex file is selected  
Press BEGIN DOWNLOAD to update pump controller

Controller version: FirmwareRev\_A. 08/16/2016

File: C:\Program Files (x86)\RDEC\_EC02\_GUI\hexfiles\EC02.hex # lines in file 3418

Status:

Sent 8193, DSP sends back:

Line of hex file: Line # 0 Byte val hex 00 dec 00 write status 0

wrong errors 0 Last wrong inbuf bytes 0

unknown errors 0 Last unknown inbuf bytes 0

outQ delays>max 0 outq loop active outQ len 0 outQ delay max 0.005

End of line - DSP sends back:

time/line 0.000 remain time 0.000 remain min 0 min

EXIT

SELECT FILE

BEGIN DOWNLOAD

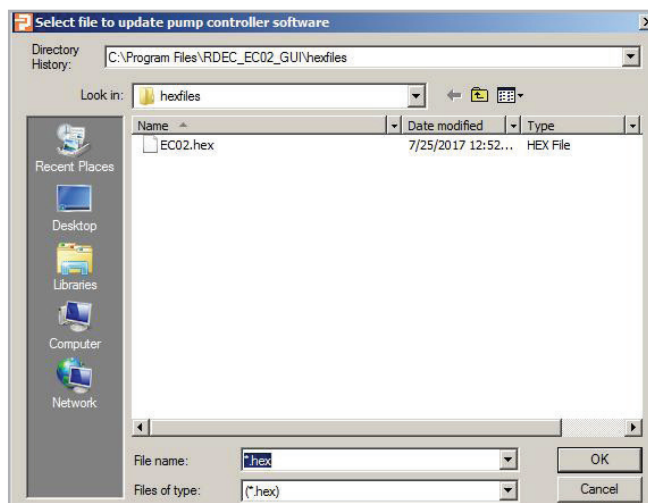
A

B

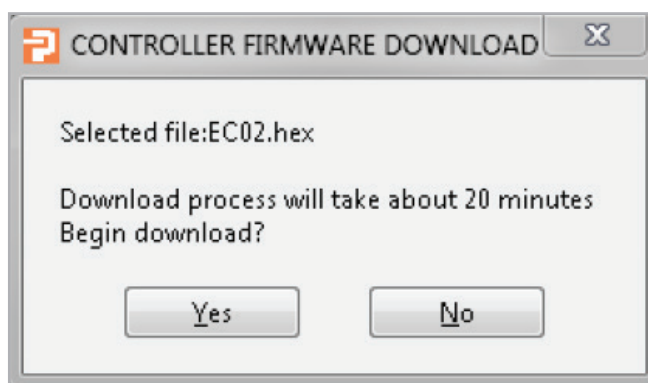
C



**A. Select:** Select latest \*.hex file.



**B. Begin Download:** Begin download firmware to controller. The download usually needs about 20 minutes. It has to keep power on during this process. Click “Yes” to start download firmware. Click “No” to quit download process.

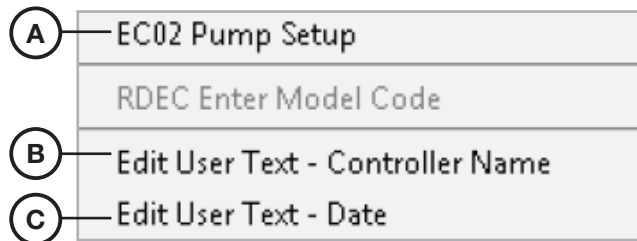


**C. Exit:** Press this button to close the dialog.



## Configuration

The “View” submenu allows user to set up the application interface layout.

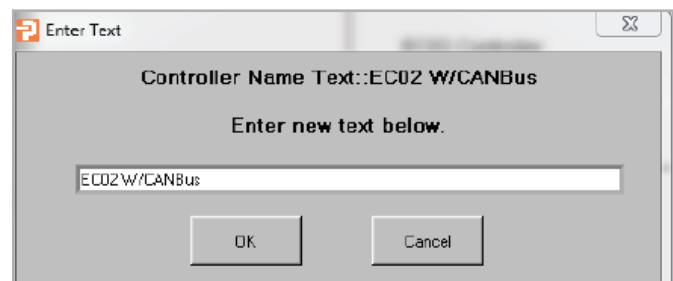


**A. EC02 Pump Setup:** Opens Pump Setup dialog.

EC02 Pump Setup

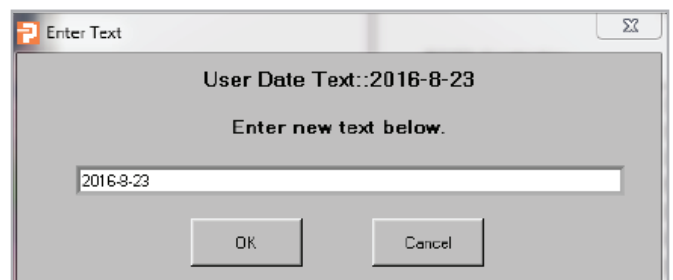
**B. User Controller Name:** User can set up controller name.

Edit User Text - Controller Name

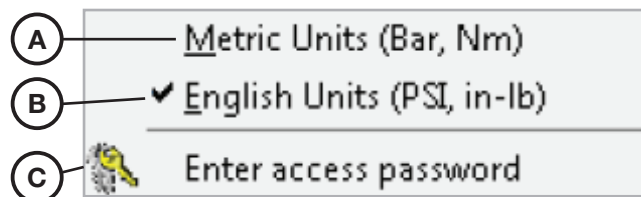


**C. Edit User Date:** User can set up date.

Edit User Text - Date



## Option



**A. Metric:** Select metric units.

Metric Units (Bar, Nm)

**B. English:** Select English units.

✓ English Units (PSI, in-lb)

**C. Enter Access Password:** Enter password.

Enter access password

### 3-Level Password:

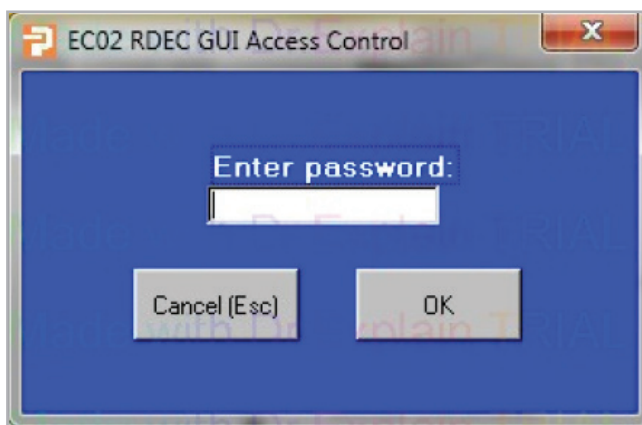
#### NOTE:

Once software is installed, the GUI will default to the Basic User level. For OEM level passwords, contact OEM.

1. **OEM engineer level** will provide access to change pump types, control types, ramps and scale feedback devices. This level will also allow OEM default gains to be entered for viewing.
2. **OEM technician/advanced user level** will provide access to change pump types, control types, ramps and scale feedback devices. It will show only Parker default gains.
3. **Basic user** can view settings, graphs, quick view screens, etc., but can't make any changes.

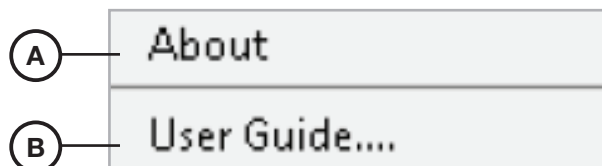
Click "Cancel" if password has not changed.

Click "OK" to exit this panel.

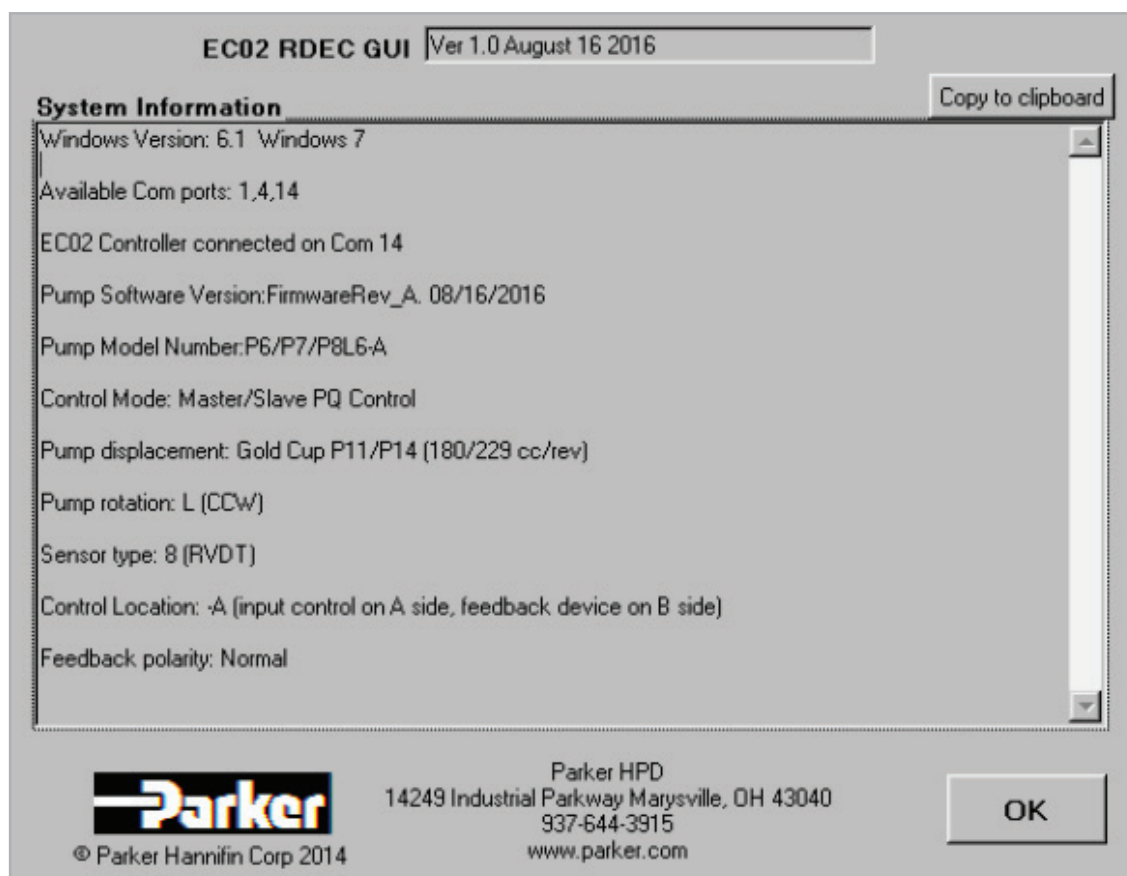


## Help

The “Help” submenu consists of links to help files and support resources.



### A. About:

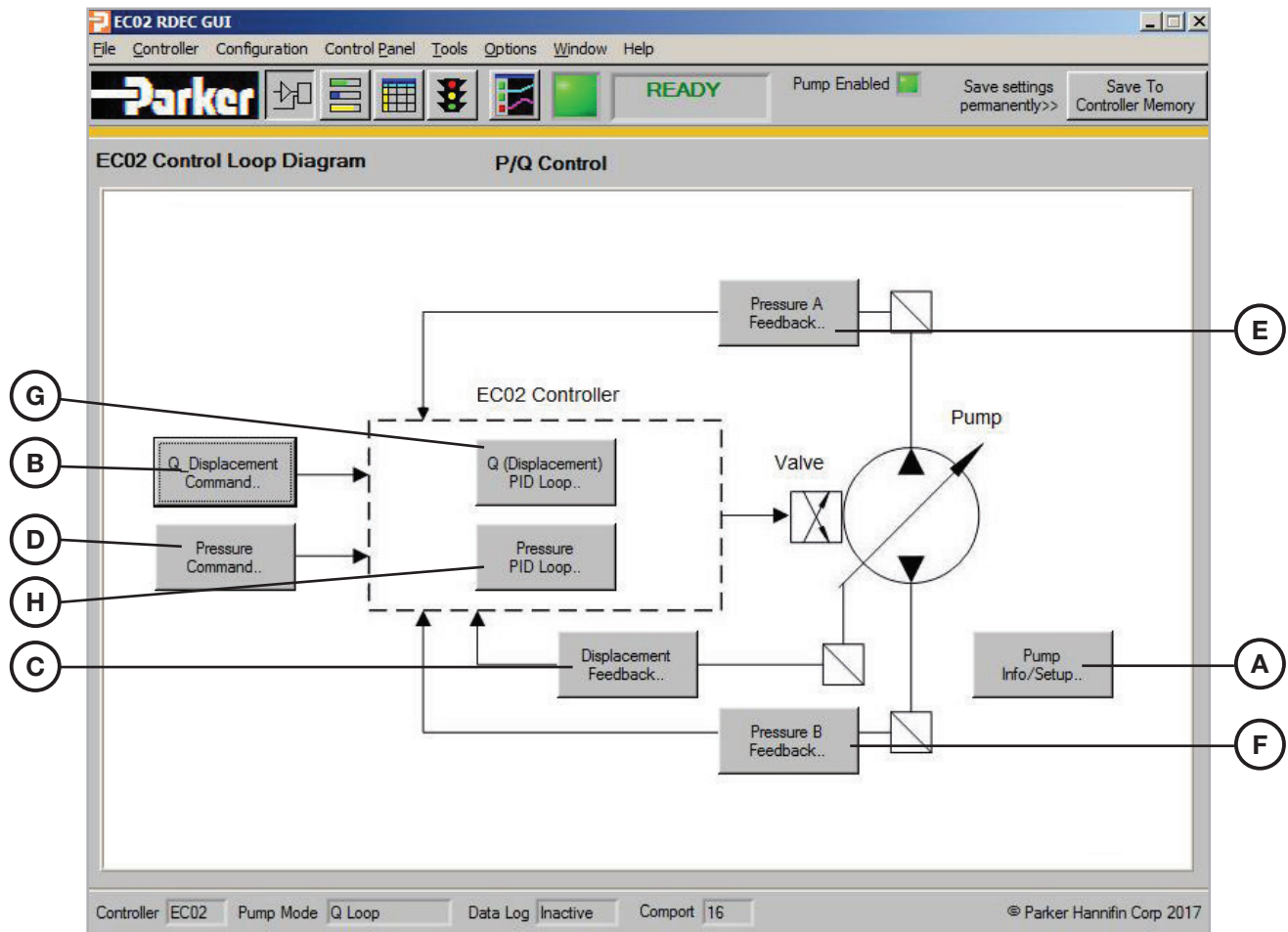


### B. User Manual: The EC02 manual is here.

## Control Loop

The control loop diagram icon provides a schematic representation of the control type selected during the pump configuration setup. In other words, what function you want the pump to perform during machine operation (displacement control, pressure and displacement control, master/slave, etc.). Prior to pump information being entered, the control loop diagram will default to the “Displacement Command” schematic.

The control loop components (gray shaded boxes) have been developed to allow quick setup and changes to your system. These components typically consist of an input signal, sensor feedback and closed loop gain tuning. Prior to setting up these individual system components, let’s start by defining the pump configuration and specifying the control loop. To do this, click on “Pump Info/Setup” (Item A).





- A. Pump Setup:** Use this tab control to configure the EC02 default values according to the pump model configuration.

Pump  
Info/Setup..

- B. Q Command:** Use this tab control to access the “Q\_Command” window for setup of the displacement command parameters.

Displacement  
Command..

- C. Q Sensor:** Click this button to set up the parameters of the displacement feedback device.

Displacement  
Feedback..

- D. P Command:** Use this tab to access the “P\_Command” window for setup of the pressure command parameters.

Pressure  
Command..

- E. pA Transducer:** Pressure sensor setup and check.

Pressure A  
Feedback..

- F. pB Transducer:** Pressure sensor setup and check.

Pressure B  
Feedback..

- G. Q PID Parameters:** Click this to access the gain turning parameters for Displacement “Q Control Loop” Kp, Ki, Ki\_s.

Q (Displacement)  
PID Loop..

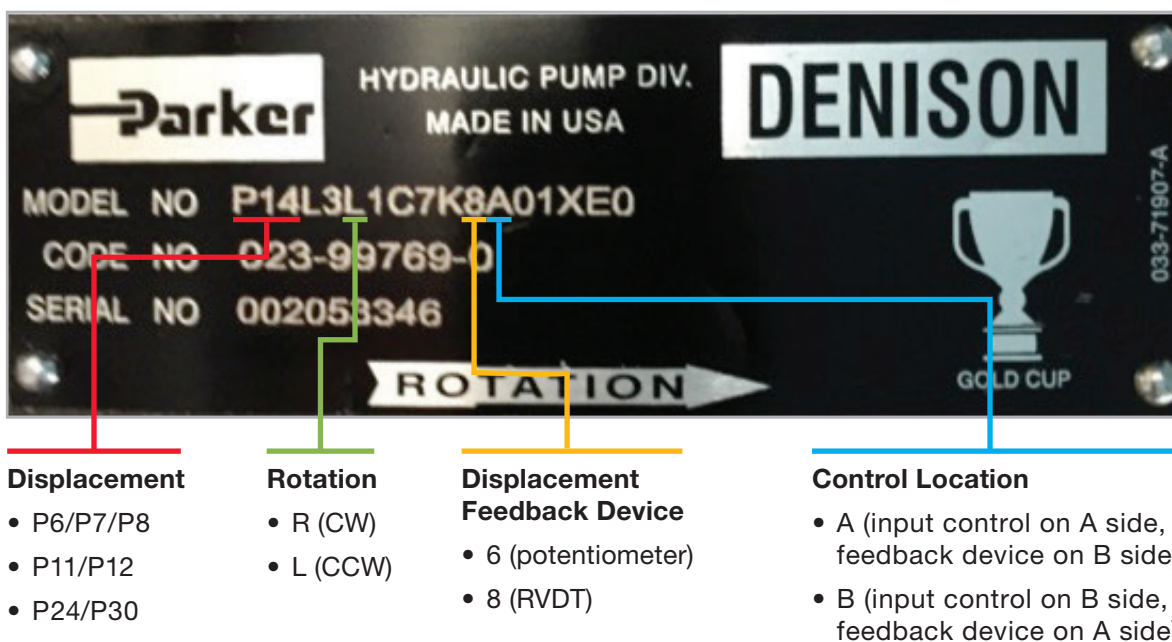
- H. P PID Parameters:** Click this to access the gain tuning parameters for Pressure “P Control Loop” Kp, Ki and Kd.

Pressure  
PID Loop..

## Pump Setup

The EC02 Pump Setup screen is used to configure the EC02 with all of the initial default values and hardware programming, according to the specific pump model configuration. The pump name plate will provide the information needed to ensure the EC02 parameters

are set correctly for the pump. The diagram below explains the four model code designators used for this pump setup procedure. Use the drop down menus and select the appropriate choice according to the pump name tag data.



**EC02 Pump Setup**

Select Pump Options

**(A)** Pump Size: Gold Cup P11/P14 (180/229 cc/rev)

**(B)** Rotation: L (CCW)

**(C)** Sensor Type: 8 (RVDT)

**(D)** Control Location: -A (input control on A side, feedback device on B side)

**(E)** Q\_Sensor Polarity: Normal

Select pump control mode

**(F)** Control Mode: Master/Slave PQ Control

Send to Pump    Cancel

- A. Pump Size:** Use drop down button to select pump size.

Pump Size Gold Cup P11/P14 (180/229 cc/rev)

- ✓ Gold Cup P6/7/8 (98/119/131 cc/rev)
- Gold Cup P11/P14 (180/229 cc/rev)
- Gold Cup P24/P30 (403/501 cc/rev)

- B. Rotation** Use drop down button to select the pump rotation.

Rotation L (CCW)

- R (CW)
- ✓ L (CCW)

- C. Sensor Type:** Use drop down button to select the displacement feedback sensor type.

Sensor Type 8 (RVDT)

- 6 (potentiometer)
- ✓ 8 (RVDT)

- D. Control Location:** Use drop down button to select the input control location.

Control Location -A (input control on A side, feedback device on B side)

- ✓ -A (input control on A side, feedback device on B side)
- B (input control on B side, feedback device on A side)

- E. Q Sensor Polarity:** This text box indicates the polarity setting (Normal or Inverted) of the feedback sensor. If there is a need to change the polarity, it can be changed in the Q\_Sensor menu.

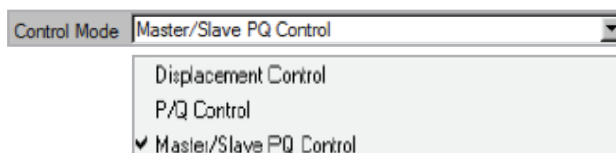
Q\_Sensor Polarity Normal

- F. **Control Mode:** Use drop down button to set control mode type.

**Displacement (Q) Control:** Input command signal controls the swashplate angle of the pump (proportionally varying pump displacement) to obtain the output flow (Q) required.

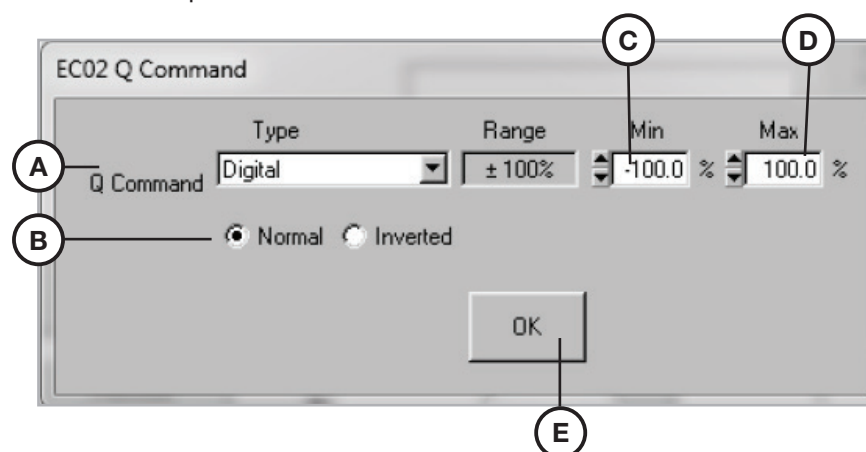
**P/Q Control:** Allows individual input commands for both displacement (as described above) and a maximum pressure setpoint (P). In P/Q mode, the pump will react to provide the flow as requested by the Q input command, until the system pressure reaches the P (pressure) setpoint. When the P setpoint is met, the swashplate control will react accordingly to limit pressure to the P setting.

**Master/Slave PQ Control:** Always use this control when operating in a P/Q mode with multiple pumps. The master/Slave mode operates the same as P/Q mode, except the input commands are only sent to the controller designated as the Master. All other controller will obtain their command from the displacement feedback of the Master Pump, and will essentially be operating in Displacement (Q) mode as described above.

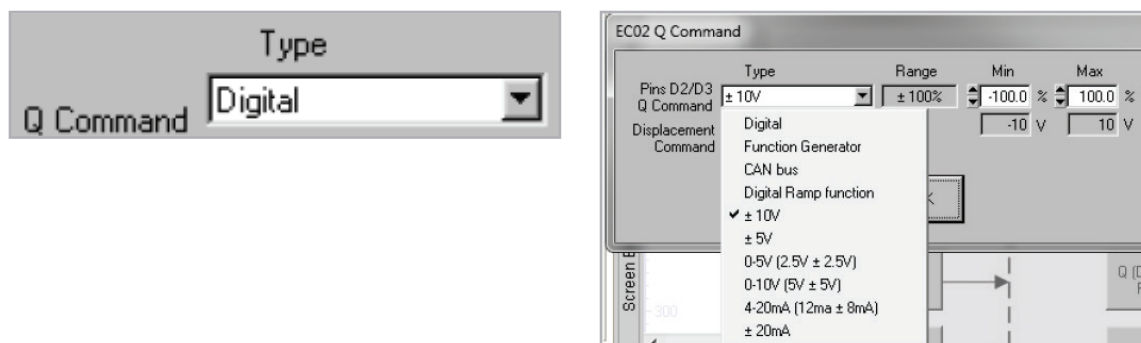


## Q\_Command

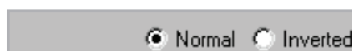
This dialogue box is used to set up the displacement “Q Command” parameters.



- A. Type:** Use the drop down button to select different command types.



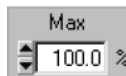
- B. Polarity:** Use radio buttons for command polarity change.



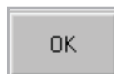
- C. Minimum:** This value will set the highest displacement % for a negative input command. For example with Command type +/-10V and a value of -80%, the controller will scale the -10V command to be -80% pump stroke.



- D. Maximum:** This value will set the highest displacement % for a positive input command. For example with Command type +/-10V and a value of 50%, the controller will scale the +10V command to be 50% pump stroke.

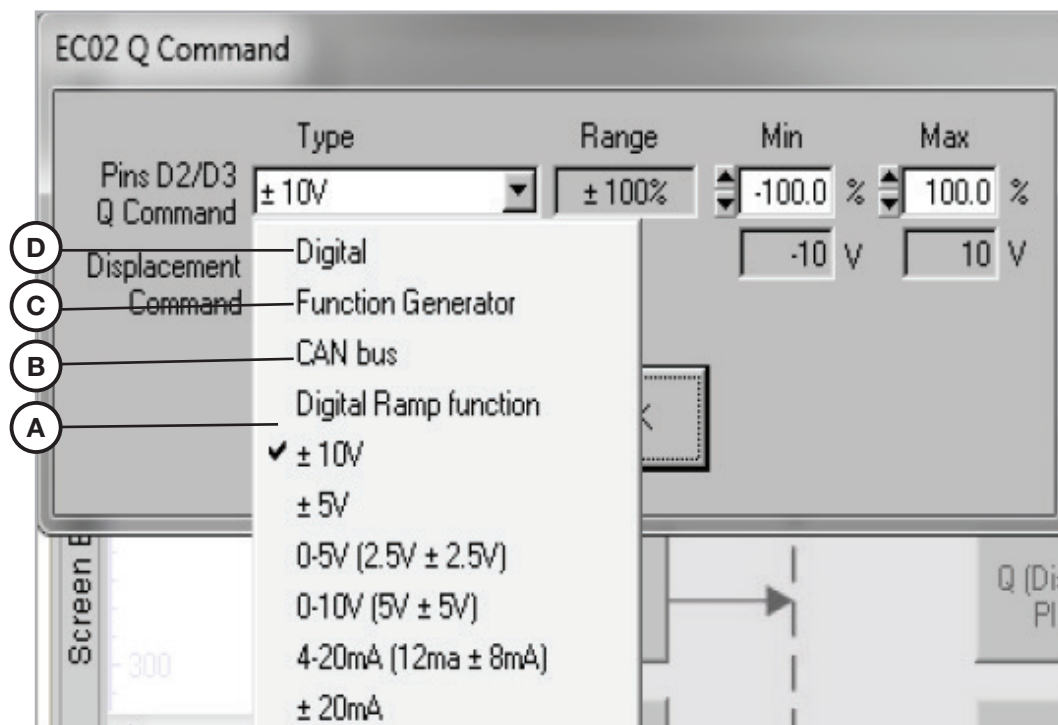


- E. OK:** Press this button to save the changes and to close the dialog.



## Type

Use this section to specify “Q Command” type settings.



### A. Analog Voltage and Current Commands:

Any one of six analog input commands can be selected for external control. Each have a range capable of -100% to +100%, but can be scaled (see Minimum and Maximum drop downs) as required by the application.

- ✓ ±10V
- ±5V
- 0-5V (2.5V ± 2.5V)
- 0-10V (5V ± 5V)
- 4-20mA (12ma ± 8mA)
- ±20mA

### B. CAN Bus: Used for two-wire command with J1939 CAN communication.

CAN bus

### C. Function Generator: This command type generates a digital sine, square, or triangle waveform. The waveform parameters (amplitude, frequency, and off-set) can also be adjusted using the drop down menus.

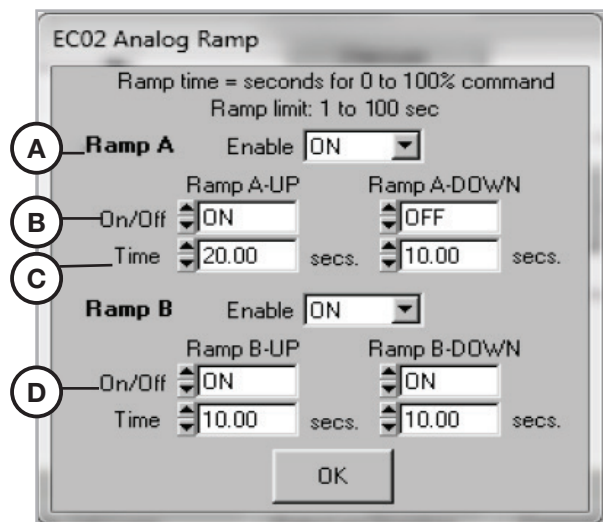
Function Generator

### D. Digital: Input command is controlled via. settings assigned in the Quick View screen of the GUI. This feature overrides all external command signals. As you select Digital command mode, you will be given the option of defaulting the digital commands to the current external command values, or setting them to zero.

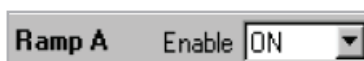
Digital

## Digital Ramp

This command type acts the same as the square wave function generator, however, allows ramp rates to be set for increasing or decreasing step commands. The ramp settings defined here will be applied to analog input command changes.



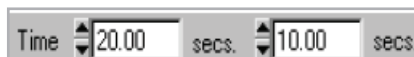
**A. Enable:** The enable is an On/Off switch for the ramp function (one switch for each side of center, A & B). When switched to the OFF position, any ramp times selected will be disabled. The command will have zero ramp time.



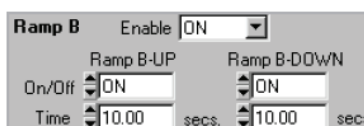
**B. On/Off:** These On/Off switches allow you to individually enable and disable the ramp of an increasing or decreasing command on one side of center (in this example: A side).



**C. Time:** The ramp times can be individually specified for increasing and decreasing command on one side of center. Note that the time selected represents the ramp time over the entire range. For example: A 20 second Ramp A-UP means 0 to 100% stroke in 20 seconds. If the pump is already at 25% stroke and you enter a step command to 50%, then it will ramp to this displacement in 5 seconds.



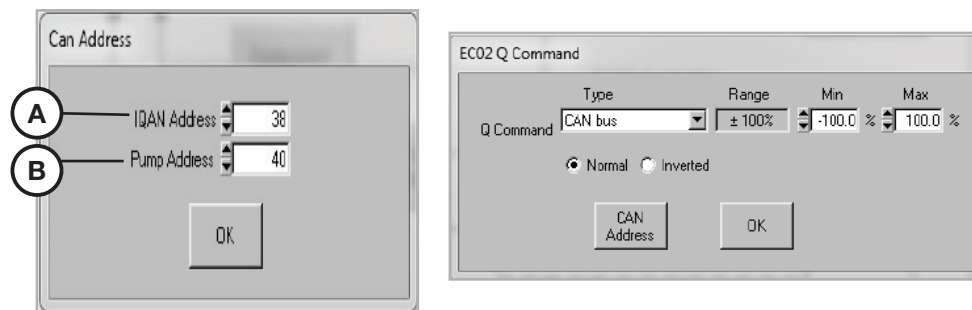
**D. B Side:** All functions described above are duplicate for the other side of center (in this example: B side).





## CAN Bus

Use this section to specify “CAN Bus” address settings.



- A. Master ECU CAN Bus Address:** Set up master ECU CAN Bus address (Like IQAN).

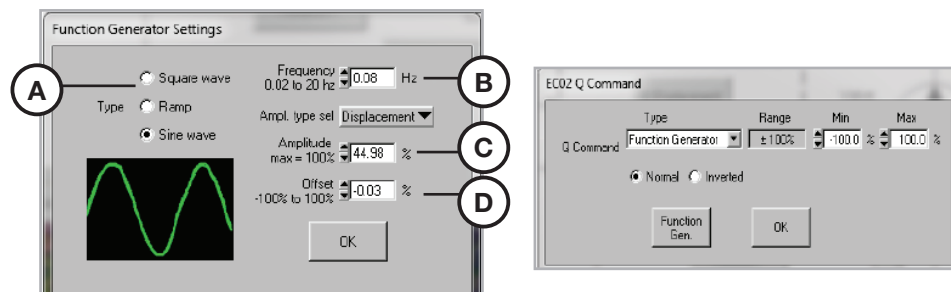
IQAN Address

- B. EC02 CAN Bus Address:** Set up EC02 pump address.

Pump Address

## Function Generator

Use this section to specify “Function Generator” settings.



- A. Type:** Click the radio buttons to select different wave form type.

☐ Square wave  
Type ☐ Ramp  
☒ Sine wave

- B. Frequency:** Frequency range setup is 0.02 Hz to 20 Hz.

Frequency  Hz

- C. Amplitude:** Amplitude range is from 0 to 100%.

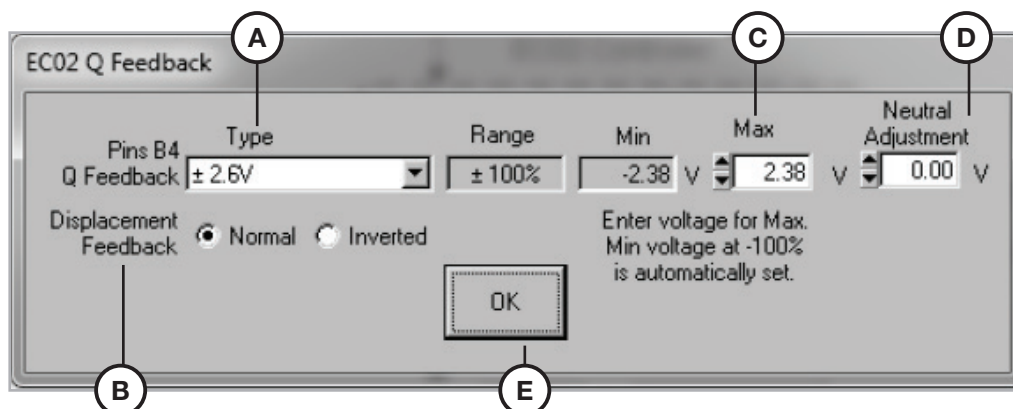
Amplitude  %

- D. Offset:** Wave form offset range is from -100 to 100%

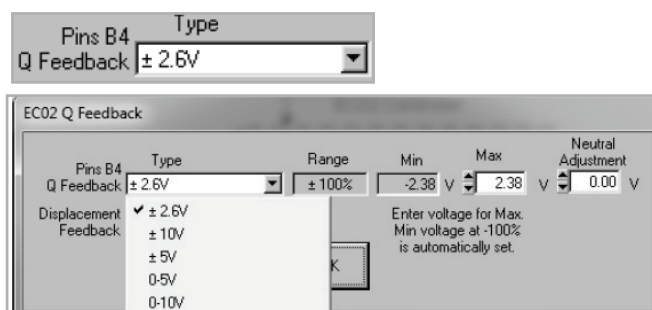
Offset  %

## Q Sensor

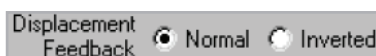
Use this section to set up “Q Sensor.”



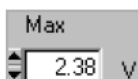
- A. Type:** Use drop down button to select different Q sensor type. The default Q feedback type for GOLD CUP® displacement is +/-2.6 V.



- B. Polarity:** Use radio buttons for sensor polarity change.



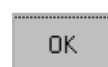
- C. Max:** Set up maximum voltage to match sensor. Enter the feedback sensor output for full pump displacement. For example, the standard GOLD CUP® RVD T outputs 2.38 V at full stroke, so enter 2.38 V.



- D. Offset:** Adjust 0 flow sensor feedback. This adjustment can be used to electrically fine-tune the zero displacement setting of the feedback device. It is common to have a small value in this field to obtain zero displacement at zero command. If this number is larger than 0.2, mechanically adjust the feedback device to obtain an accurate zero setting.

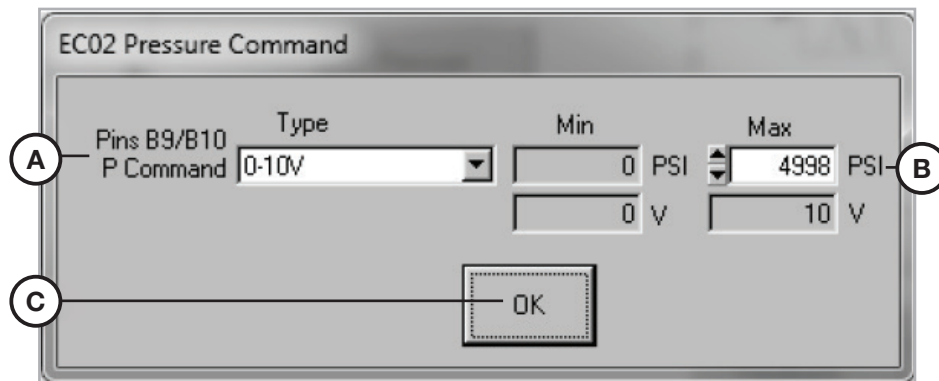


- E. OK:** Press this button to save the changes and close the dialog.

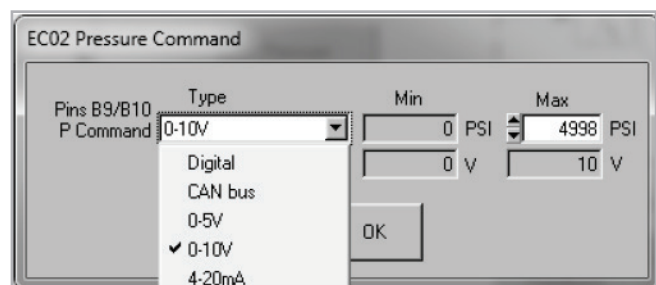
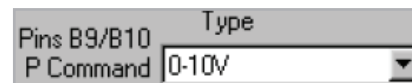


## P Command

Use this section to set up “P Command.”



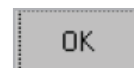
- A. Type:** Use this field to select different command input types.



- B. Max:** Set up maximum pressure command. This value will set the highest pressure setting for a full scale input command. For example with Command type 0-10V and a value of 3000 PSI (210 bar), the controller will scale the +10V command to be 3000 PSI (210 bar).

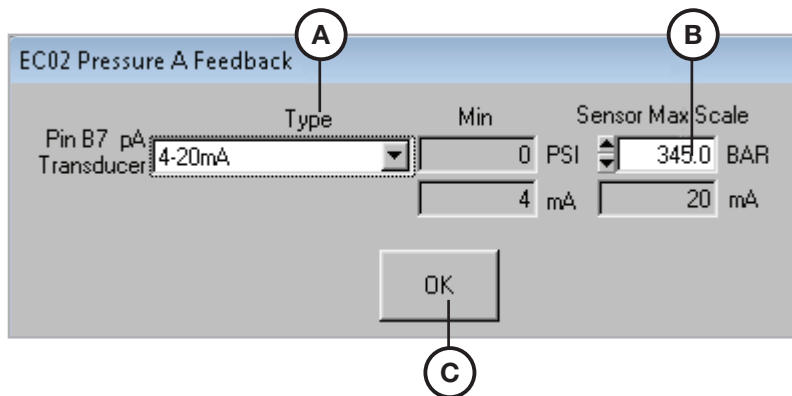


- C. OK:** Press this button to save the changes and close the dialog.

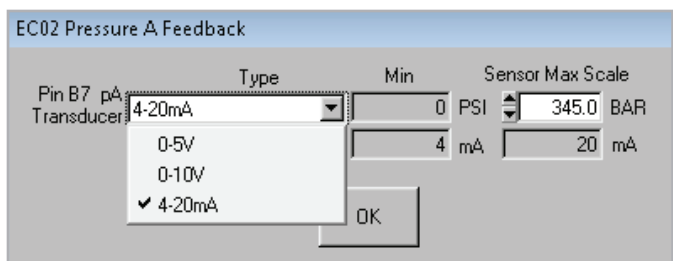
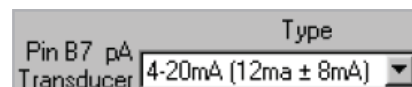


## pA Transducer

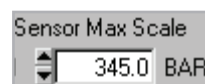
Use this section to set up “pA Transducer.”



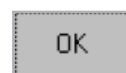
- A. Type:** Use drop down button to setup different types.



- B. Max:** Scale the maximum to match transducer scaling. For example: Enter 7500 PSI (or 520 bar) for a transducer that outputs 20mA at 7500 PSI (520 bar). Changes made to either transducer will be applied to both.

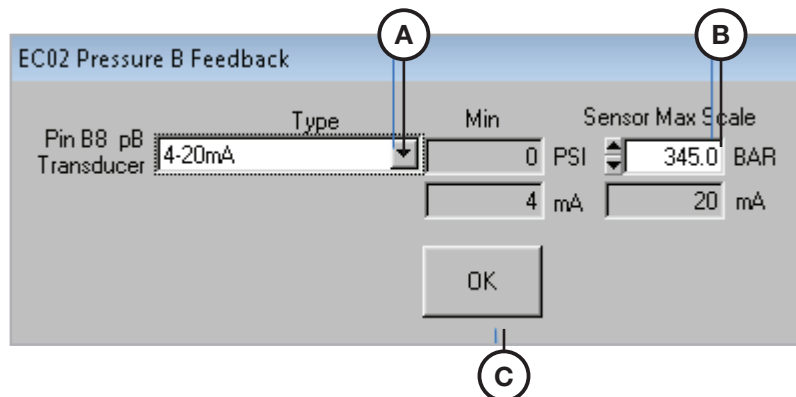


- C. OK:** Press this button to save the changes and close the dialog.

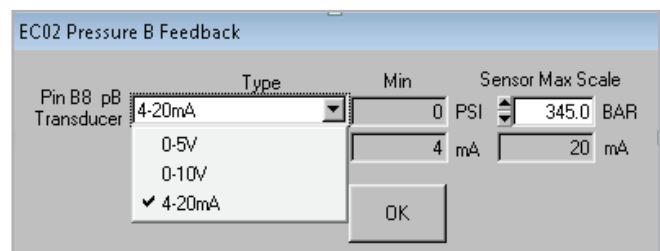
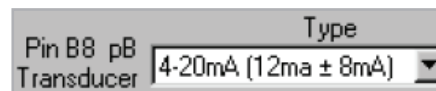


## pB Transducer

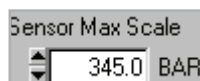
Use this section to set up “pB Transducer.”



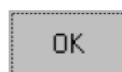
- A. Type:** Use drop down button to setup different types.



- B. Max Scaling:** Transducer scaling. For example: Enter 7500 PSI (or 520 bar) for a transducer that outputs 20mA at 7500 PSI (520 bar). Changes made to either transducer will be applied to both.



- C. OK:** Press this button to save the changes and close the dialog.



Q PID Parameter

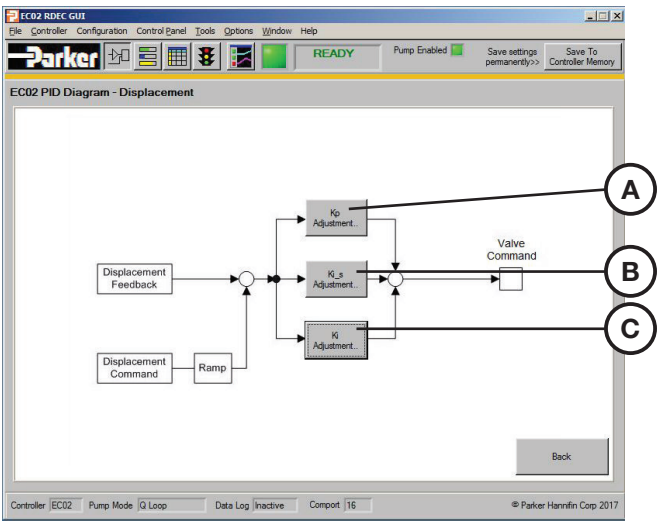
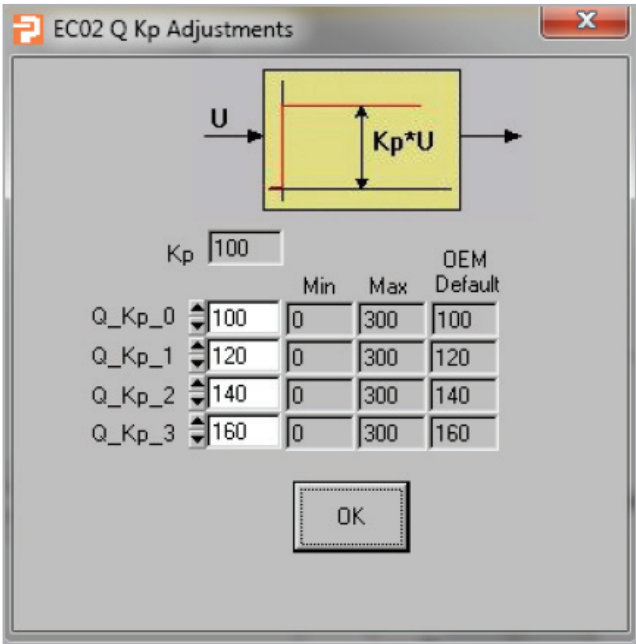
**WARNING:**  
Changes to the PID parameters can only be made by users with OEM Password access. This can result in drastic changes to machine operation. Always be certain that the machine is in a safe operating condition before adjusting these values.

The EC02 is equipped with four unique and selectable sets of gain tuning values. This feature allows optimum tuning of systems with multiple operating modes. The table below shows how the different gains can be selected with binary logic of Pins B2 and B3.

Each pop-up Gain Adjustment window will consist of five columns of information:

- Column 1 – Actual gain value set point
- Column 2 & 3 – Lower and upper limit for gain value
- Column 4 – Factory default values defined by the pump configuration entered
- Column 5 – OEM default values as established by machined type

A. **Q Kp:** Set up Kp parameters. Set digital input B2 and B3 high or low to select Kp. Default is Kp\_0.



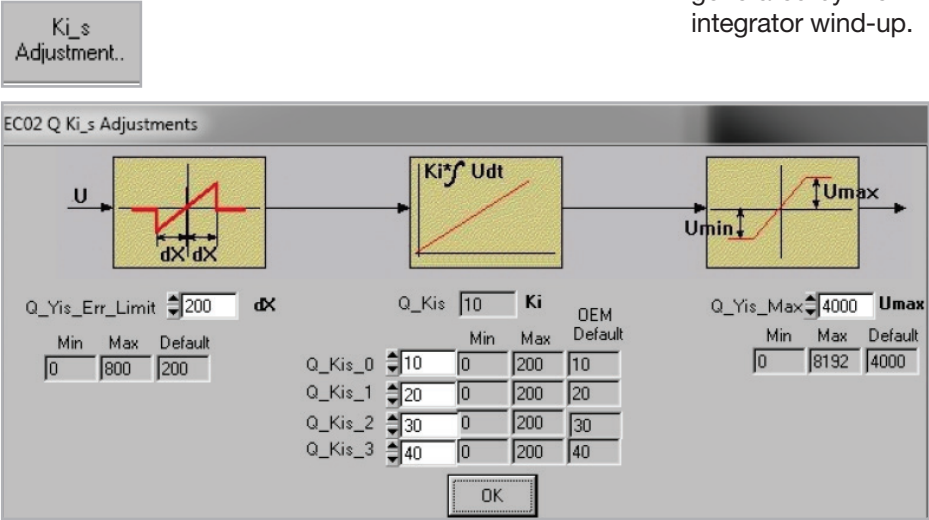
B3	B2	Kp	Kis	Ki
0	0	Kp_0	Kis_0	Ki_0
0	1	Kp_1	Kis_1	Ki_1
1	0	Kp_2	Kis_2	Ki_2
1	1	Kp_3	Kis_3	Ki_3

**B. Q Kis:** Set up Kis\_small.

This is the integral gain that will be active when Q error is less than the Q\_Yis\_Err\_Limit setting.

If error (command minus feedback) is greater than the Q\_Yis\_Err\_limit, then Kis factor is by-passed.

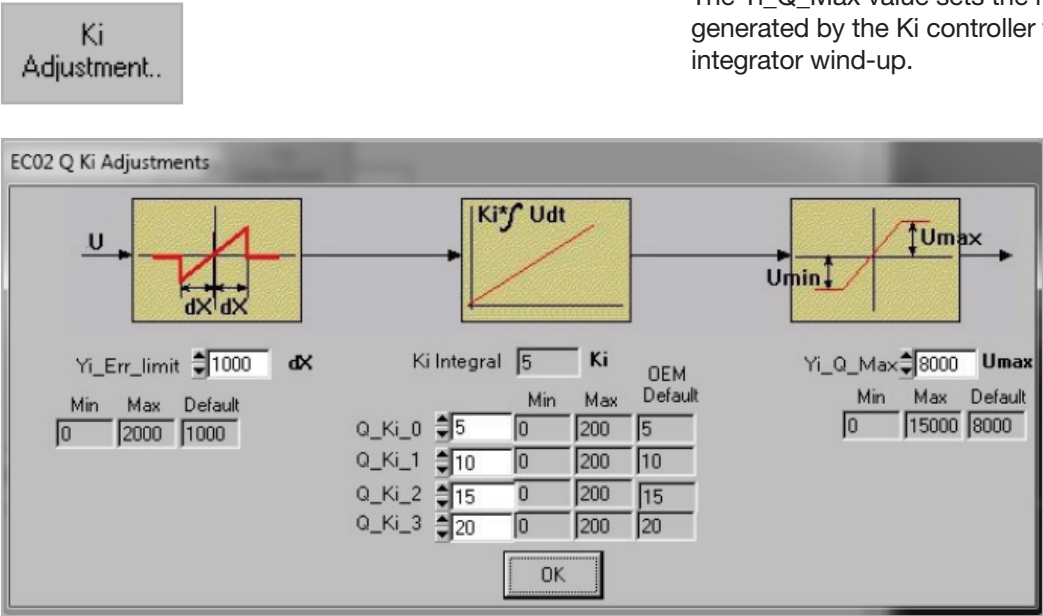
The Yi\_Q\_Max value sets the maximum output generated by the Ki controller term. This prevents integrator wind-up.



**C. Q Ki:** Set up Q\_Ki.

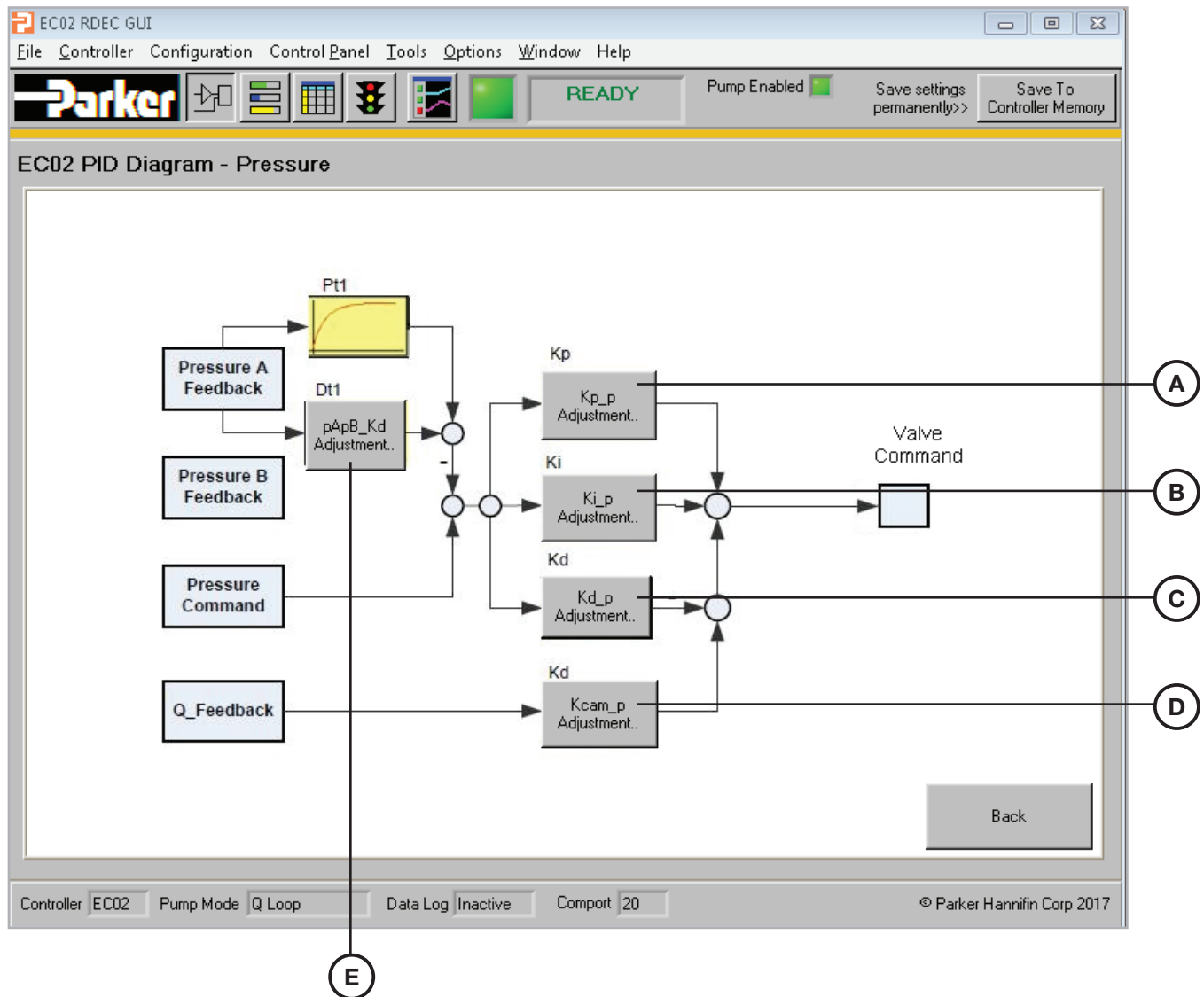
This is the integral gain that will be active when Q error is less than the Yi\_Err\_Limit setting. If error (command minus feedback) is greater than the Yi\_Err\_limit, then Ki factor is by-passed.

The Yi\_Q\_Max value sets the maximum output generated by the Ki controller term. This prevents integrator wind-up.



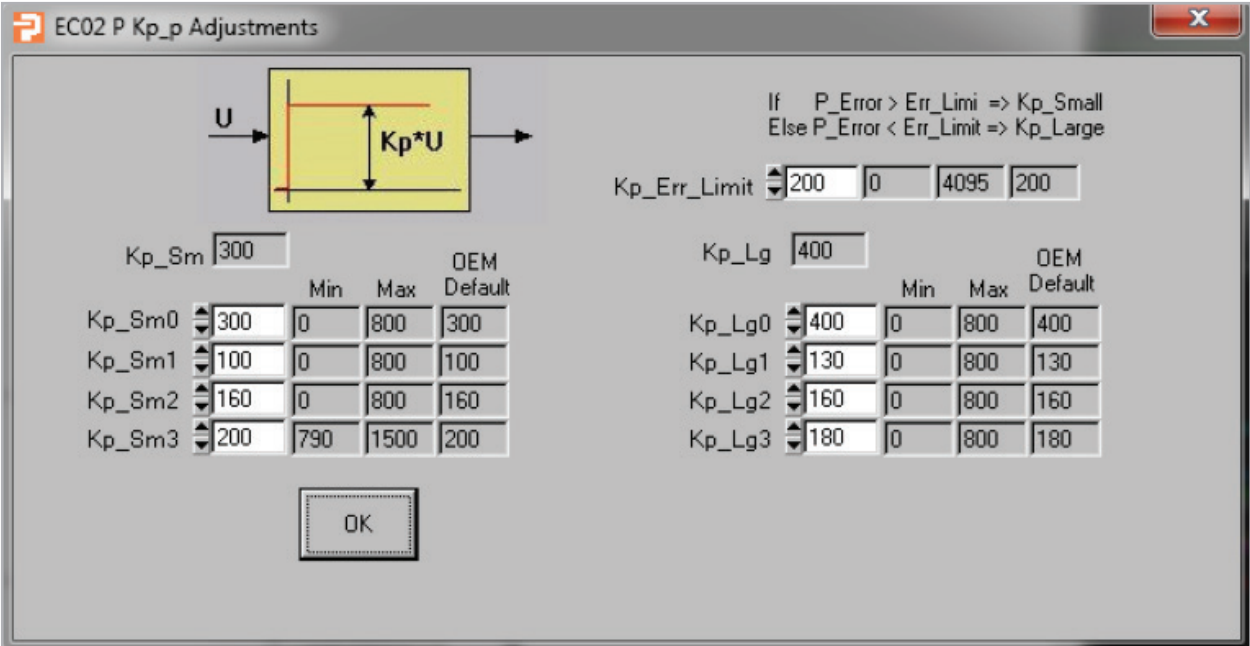


## P PID Parameter



- A. **P Kp:** Set up Kp parameters. Set digital input B2 and B3 high or low to select Kp. Default is Kp\_0.

Kp\_p  
Adjustment..



B3	B2	Kp_Sm	Kp_Lg	Ki_Sm	Ki_Lg	Kd_p	Kcam_Kd
0	0	Kp_Sm0	Kp_Lg0	Ki_Sm0	Ki_Lg0	Kd_p0	Kcam_Kd0
0	1	Kp_Sm1	Kp_Lg1	Ki_Sm1	Ki_Lg1	Kd_p1	Kcam_Kd1
1	0	Kp_Sm2	Kp_Lg2	Ki_Sm2	Ki_Lg2	Kd_p2	Kcam_Kd2
1	1	Kp_Sm3	Kp_Lg3	Ki_Sm3	Ki_Lg3	Kd_p3	Kcam_Kd3

B. Ki p: Set up Ki p

Ki\_p Adjustment..

EC02 P Ki\_p Adjustments

$U$   $dX/dX$   $Ki_p \int U dt$   $U_{min}$   $U_{max}$

$Ki_p$

If  $P\_Error > Err\_Limit \Rightarrow Ki\_p\_Small$   
Else  $P\_Error < Err\_Limit \Rightarrow Ki\_p\_Large$

$Ki\_error\_limit$

	Min	Max	OEM Default
$Ki\_Small$ <input type="text" value="100"/>			
$Ki\_Sm0$ <input type="text" value="100"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="100"/>
$Ki\_Sm1$ <input type="text" value="120"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="120"/>
$Ki\_Sm2$ <input type="text" value="200"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="200"/>
$Ki\_Sm3$ <input type="text" value="230"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="230"/>

	Min	Max	OEM Default
$Ki\_Large$ <input type="text" value="150"/>			
$Ki\_Lg0$ <input type="text" value="150"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="150"/>
$Ki\_Lg1$ <input type="text" value="180"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="180"/>
$Ki\_Lg2$ <input type="text" value="200"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="200"/>
$Ki\_Lg3$ <input type="text" value="300"/>	<input type="text" value="0"/>	<input type="text" value="1000"/>	<input type="text" value="300"/>

OK

C. Kd p: Set up Kd p, default is Kd\_p0.

Kd\_p Adjustment..

EC02 P Kd Adjustments

$U$   $Kd * U$

$Kd\_pA$

	Min	Max	OEM Default
$Kd\_p0$ <input type="text" value="500"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="500"/>
$Kd\_p1$ <input type="text" value="520"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="520"/>
$Kd\_p2$ <input type="text" value="560"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="560"/>
$Kd\_p3$ <input type="text" value="580"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="580"/>

OK

D. Kcam kd: Set up Kcam\_Kd, default is Kcam\_Kd0.

Kcam\_p Adjustment..

EC02 P Kcam\_p Adjustments

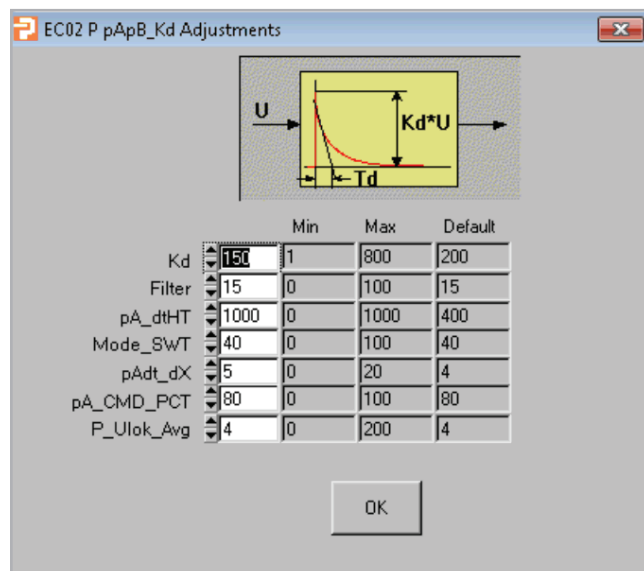
$U$   $Kd * U$

$Kcam\_Kd$

	Min	Max	OEM Default
$Kcam\_Kd0$ <input type="text" value="100"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="100"/>
$Kcam\_Kd1$ <input type="text" value="110"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="110"/>
$Kcam\_Kd2$ <input type="text" value="120"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="120"/>
$Kcam\_Kd3$ <input type="text" value="130"/>	<input type="text" value="0"/>	<input type="text" value="1200"/>	<input type="text" value="130"/>

OK

## E. pApB Feedback Derivative

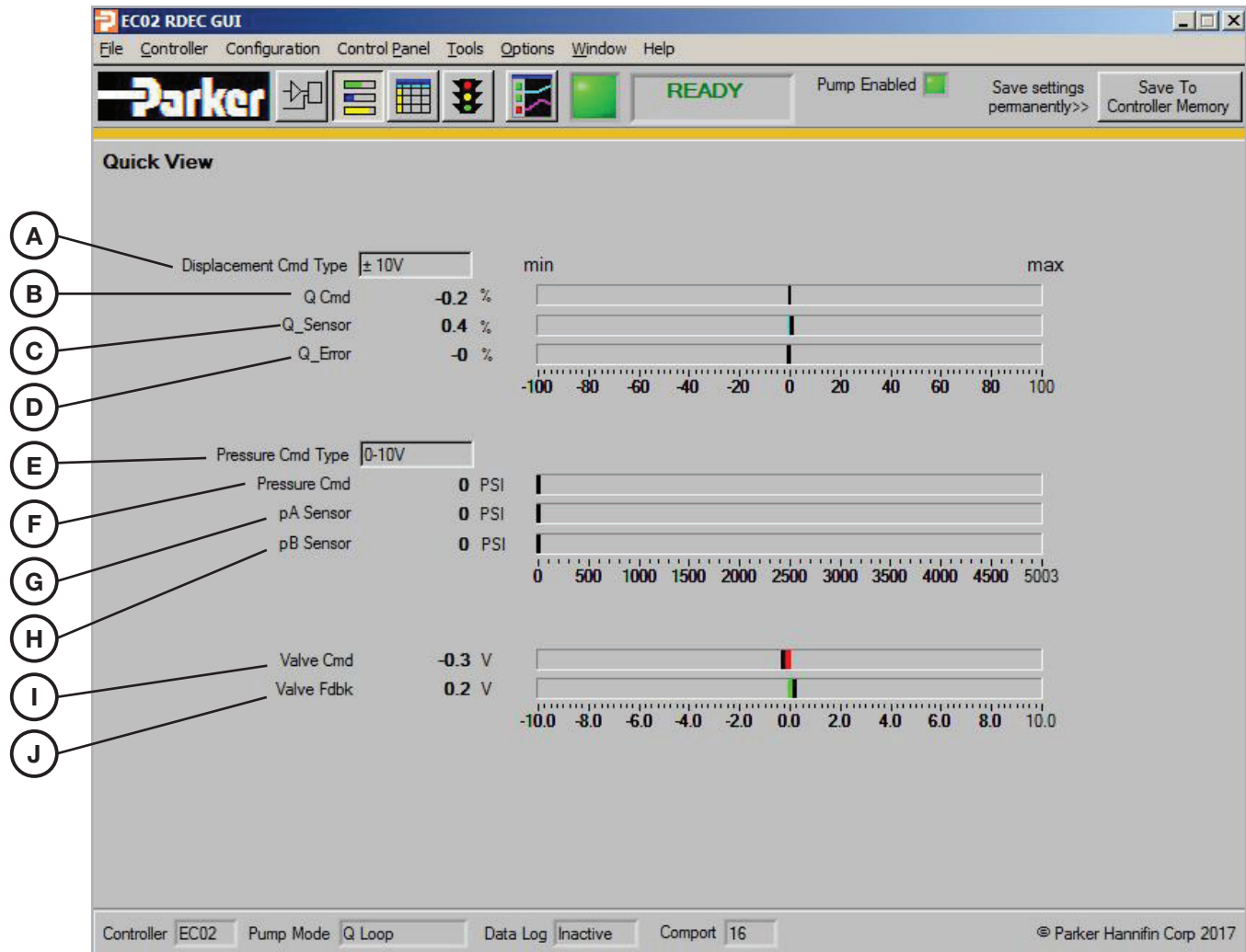


- Kd: gain of the pA difference (pA\_K2-pA\_K3)
- Filter: pA filter, pA\_k2 => pA feedback is averaged by this setting, pA\_K3 => is pA feedback averaged this setting plus 4.
- pA\_dtHT: pA derivation result limit
- Mode\_SWT: P\_Q mode switch time
- pAdt\_dX: pA difference limit setting. pA deviation result is 0 if pA difference is less than this setting.
- pA\_CMD\_PCT: stays in Q control mode until pA or pB are greater than P\_command multiplied by this percentage.  
*Example:*  
 P\_command = 4,000 psi  
 pA\_CMD\_PCT = 80%  
 $4,000 * .8 = 3,200$  psi.  
 Stays in Q mode until pA or pB are greater than 3,200 psi.
- P\_Ulok\_Avg: pA derivation result average

## Quick View

The “Quick View” screen is typically used to monitor the system in real time, but has the capability to override any PLC or Potentiometer command signals when set to the “Digital” mode (see *item 1 or 5*). In “Digital” mode, the screen will include an active slider bar where the command setting can be adjusted, simply by clicking and dragging the arrow to the desired value.

In addition to the visual bar read-out, the real time values are displayed along with their unit of measure. This particular screen can be very useful during the initial startup or commissioning of a new machine. The ability to manually make incremental adjustments to the command signal, while monitoring how other parameters behave, is invaluable to validating machine performance and improving setup times.



**A. Q Command Type**

Displacement Cmd Type  $\pm 10V$

**B. Q Command:** Real time Q Command.

Displacement Cmd **5.8** %

**C. Q Sensor:** Real time Q Sensor feedback.

Displacement Fdbk **1.2** %

**D. Q Error:** Real time Q Command –  
Q Sensor feedback.

Displacement Error **5** %

**E. P Command Type**

Pressure Cmd Type  $0-10V$

**F. P Command:** Real time pressure command.

Pressure Cmd **536** PSI

**G. pA Transducer:** Real time A-side pressure  
transducer feedback.

Pressure A Fdbk **0** PSI

**H. Pb Transducer:** Real time B-side pressure  
transducer feedback.

Pressure B Fdbk **0** PSI

**I. Valve Command:** Real time valve  
command +,-10v.

Valve Command **1.7** V

**J. Valve Feedback:** Real time valve feedback +,-10v.

Valve Fdbk **-0.9** V

## Data Log

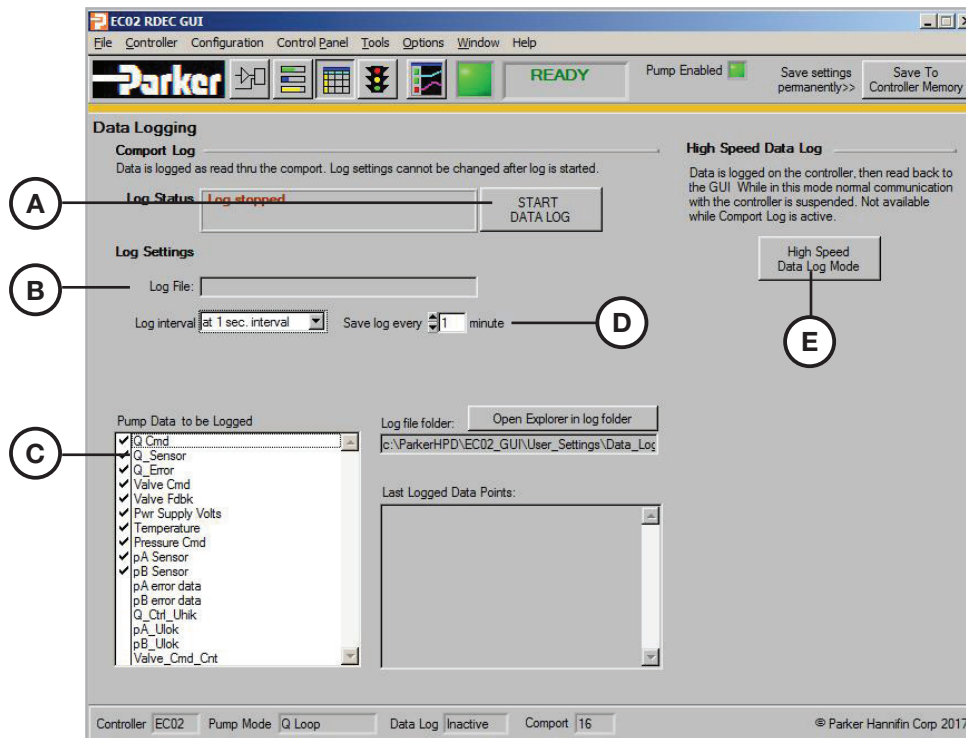
The “Data Logging” screen is used for set up of the logging attributes such as the data you want to record and the sample rate. Although the logging function of the EC02 does have the ability to sample at high rates for limited time, this should not be considered a substitute for data acquisition equipment.

There are two ways to log data:

**USB Cable:** This method will transfer data to an external memory source via a hard line USB cable.

The amount of data collected and stored is only limited by the external storage capacity. This is often used with a slower sample rate for monitoring operating parameters and analyzing trends.

**Internal Memory:** This method will transfer data directly to the EC02’s built-in memory and is identified as “High Speed Data Log Mode.” The controller memory capacity can hold up to 4 channels of data and has the ability to capture 3000 data points per channel. This data logging method can be used in conjunction with the “Triggered Start” feature to capture and analyze events at a sample rate down to every 1ms.



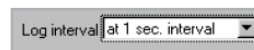
**A. Start Data Log:** Click “Start Data Log” to give a file name and start to log data.



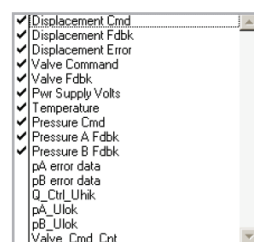
**D. Log Data:** Set save log data time.



**B. Log Interval:** Data log time.



**C. Data Select:** Select data to be logged.



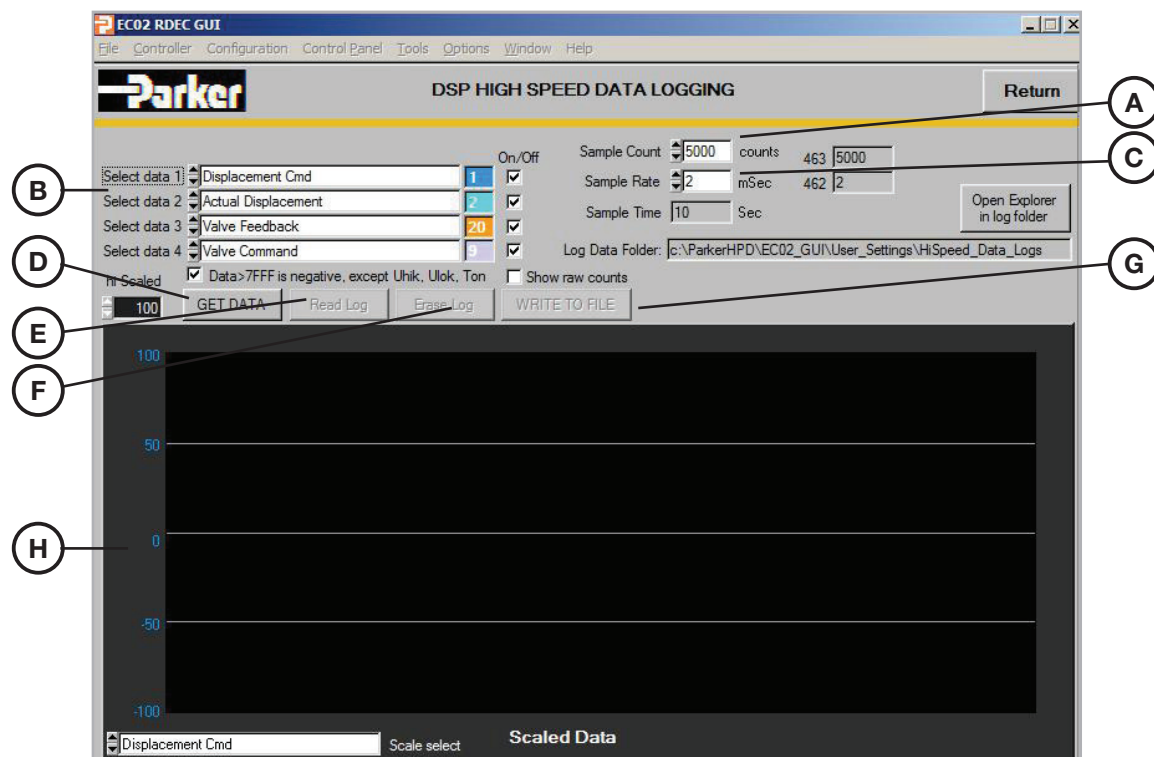
**E. High Speed Data Log:** Click this tab to pop out high speed data log window.





## High Speed Log

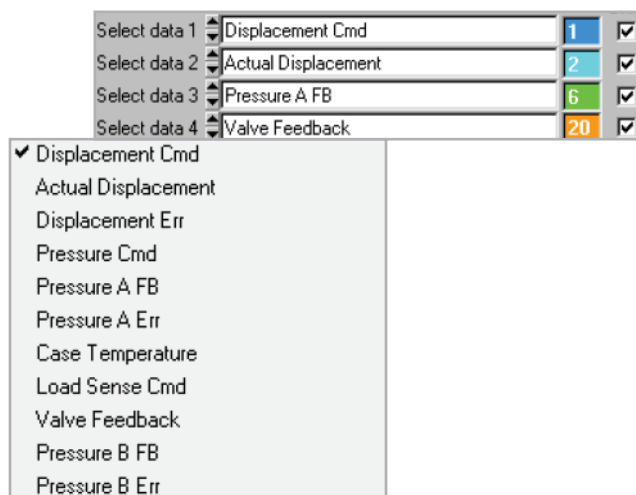
Use this section to do hi-speed data log.



- A. Data Counts:** Set up data counts to be logged, minimum is 2000, maximum is 5000.

Sample Count  counts

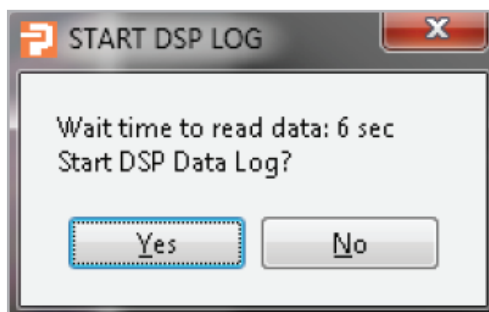
- B. Select Data:** Select data to be logged.



- C. **Log Rate:** Log data/ 2ms. Log rate can be from 1 ms to 50ms.



- D. **Start Log:** Click “Yes” to start log.



- E. **Read Log:** Reads data from temporary file on PC.



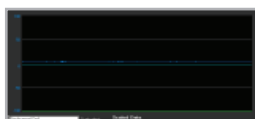
- F. **Erase Log:** Removes data from temporary file on PC.



- G. **Write to File:** The log file is saved as \*.csv format.



- H. **Graphic:** Graphic panel.

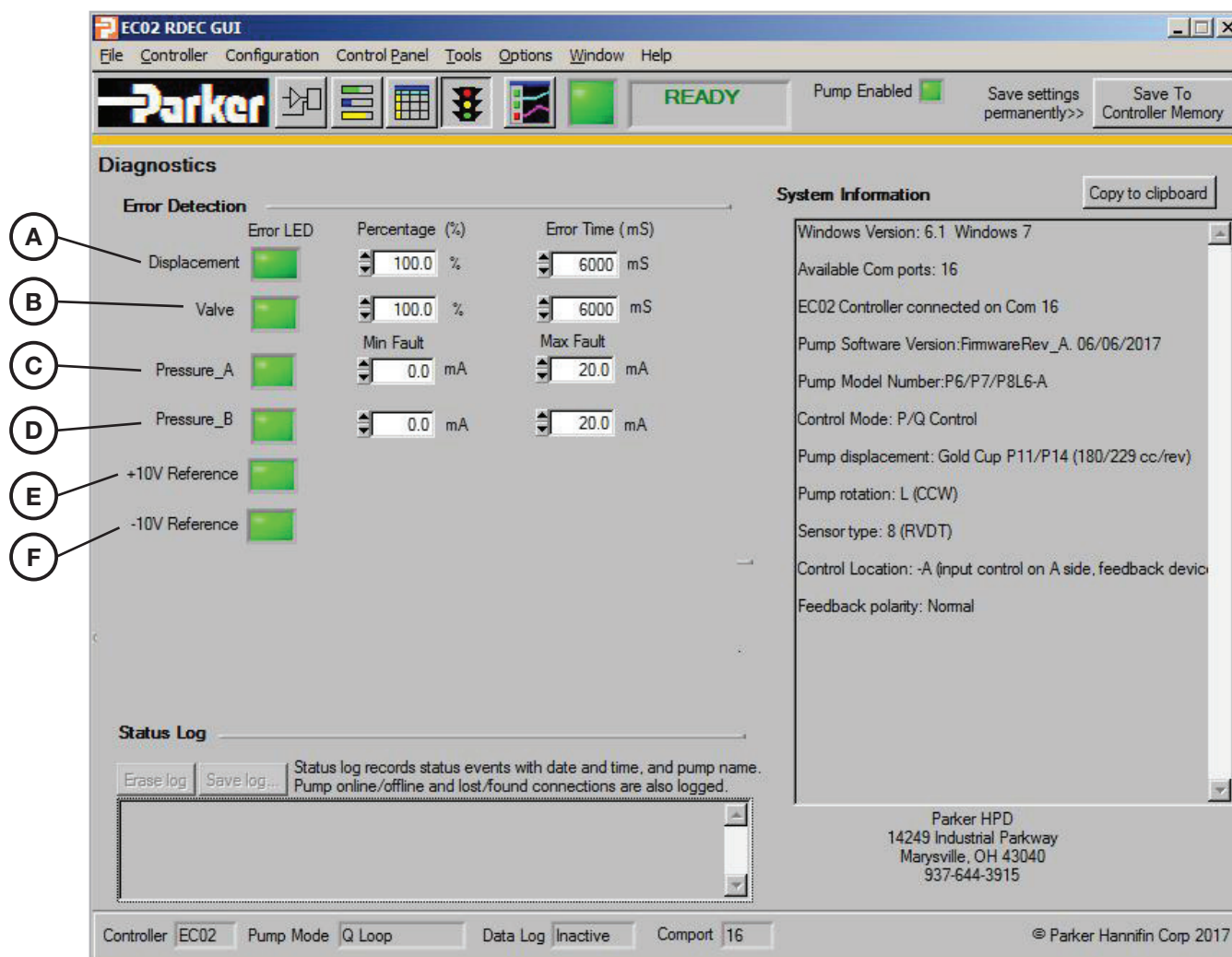


## Diagnostic

The “Diagnostics and System Information” screen includes information on error detection, error status log and system information. The error detection feature provides a visual (green/red) real time status of an operating parameter and allows the user to define when the error should occur based on the percentage and time that the attribute is out of range. While the visual indicator will go back to green when the parameter is operating within its set criteria, we are still able to identify the number of times an error was detected

using the status log. The status log will record when a parameter error is detected with a date and time stamp.

In addition to the error status and log information, this screen also includes the system information, which identifies your Windows OS, Com ports used, Software revision levels and pump configuration. This information is often useful to communicate while trouble shooting a system. For this reason, a “Copy to Clipboard” button has been provided for convenience of e-mailing this data.



- A. Q Control:** Set up error 0 - 100%, time from 800 ms to 60000 ms. LED green is OK, gray is error.



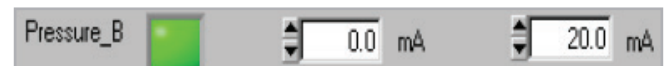
- B. Valve Control:** Set up error 0 - 100%, time from 800 ms to 60000 ms. LED green is OK, gray is error.



- C. pA Transducer:** Set minimum current 0 to 5 mA, maximum 18 to 21mA. LED green is OK, gray is error.



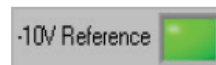
- D. pB Transducer:** Set minimum current 0 to 5 mA, maximum 18 to 21 mA. LED green is OK, gray is error.



- E. +10 v:** Green indicates +10v reference is OK, gray is error.

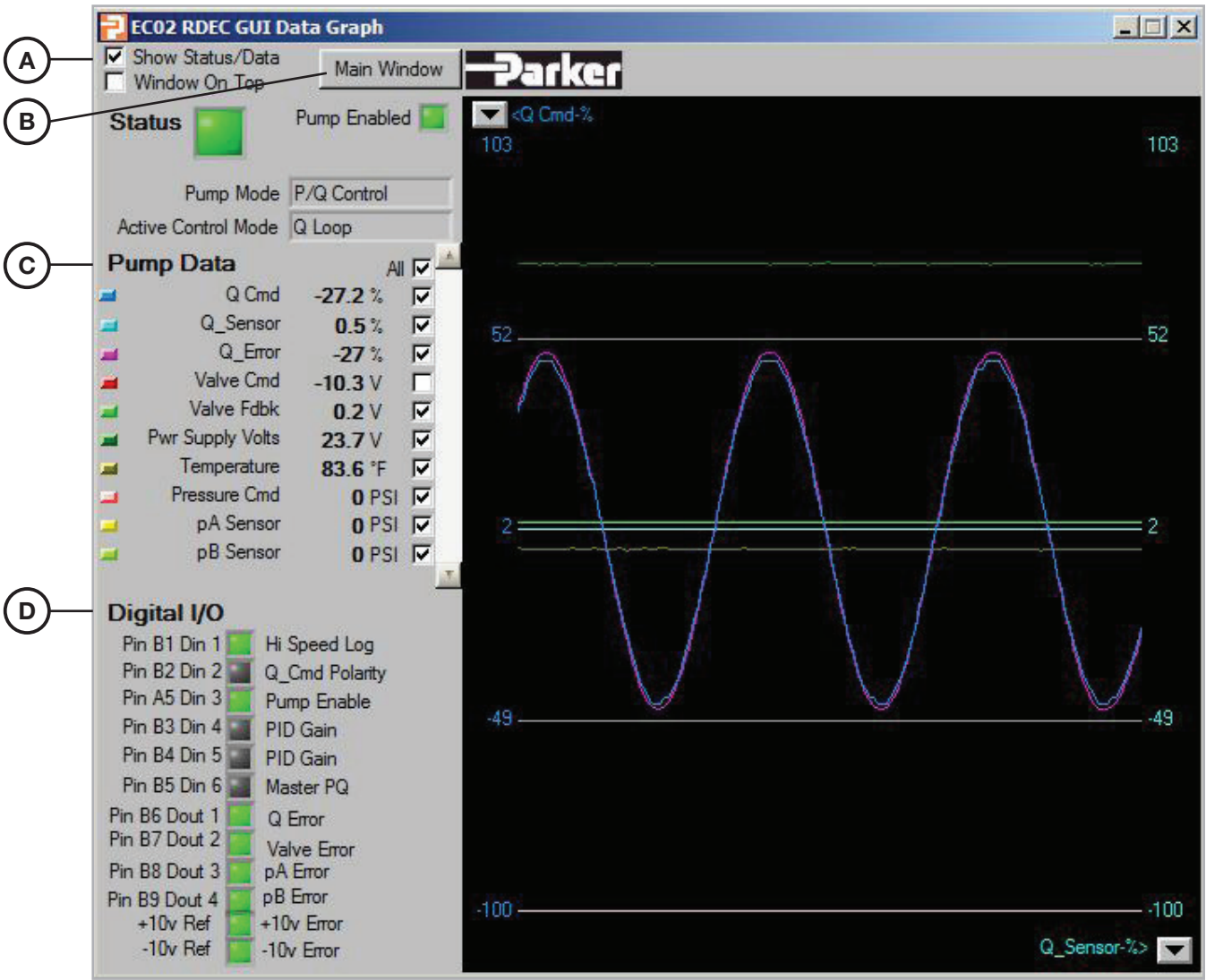


- F. -10 v:** Green indicates +10v reference is OK, gray is error.

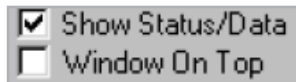


Graphic

The “Data Graphing” screen is a real time monitoring screen that can be resized and positioned for viewing at the same time as any of the other screens. You may find this screen to be very useful in a test mode where you are wanting to understand the effects of changes being made, or for simply monitoring a machine during normal operation. To simplify the screen, the traces can be easily turned on or off to show only those of interest. The scale for up to two traces can be defined and will appear at the right and left side of the display.



- A. Show Data:** Mark “Show Status/Data” to pop up the “Pump Data and Digital I/O” panel. Mark “Window On Top,” this data graph window is locked on top.



- B. Main Window:** Click this tab to pop up the “Control Loop” window.



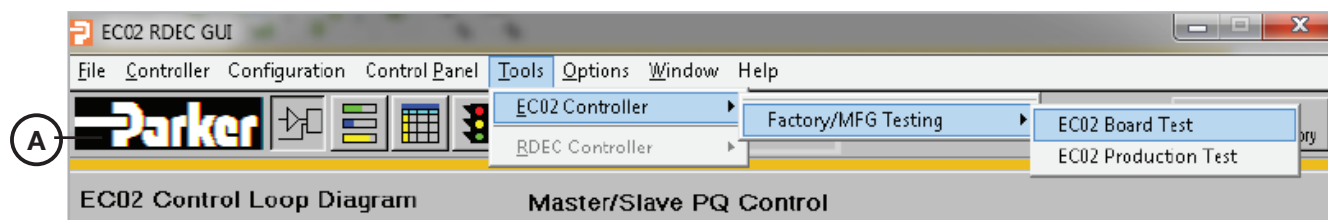
- C. Pump Data:** Mark the data to show up on the “Graphic” window.

Pump Data			All <input checked="" type="checkbox"/>
	Displacement Cmd	5.1 %	<input checked="" type="checkbox"/>
	Displacement Fdbk	1.2 %	<input checked="" type="checkbox"/>
	Displacement Error	4 %	<input checked="" type="checkbox"/>
	Valve Command	1.7 V	<input checked="" type="checkbox"/>
	Valve Fdbk	-0.9 V	<input checked="" type="checkbox"/>
	Pwr Supply Volts	27.6 V	<input checked="" type="checkbox"/>
	Temperature	98 °F	<input checked="" type="checkbox"/>
	Pressure Cmd	536 PSI	<input checked="" type="checkbox"/>
	Pressure A Fdbk	0 PSI	<input checked="" type="checkbox"/>
	Pressure B Fdbk	0 PSI	<input checked="" type="checkbox"/>
	pA error data	48 %	<input type="checkbox"/>
	pB error data	-49 %	<input type="checkbox"/>
	Q Ctrl Uhik	7502 cnts	<input type="checkbox"/>

- D. Digital I/O:** Digital I/O status, LED green is high, gray is low.

Digital I/O		
Pin B1 Din 1		Hi Speed Log
Pin B2 Din 2		Q_Cmd Polarity
Pin A5 Din 3		Pump Enable
Pin B3 Din 4		PID Gain
Pin B4 Din 5		PID Gain
Pin B5 Din 6		Master PQ
Pin B6 Dout 1		Q Error
Pin B7 Dout 2		Valve Error
Pin B8 Dout 3		pA Error
Pin B9 Dout 4		pB Error
+10v Ref		+10v Error
-10v Ref		-10v Error

## Tools



- A. Factory use only. Advanced password required.



## System Requirements

- Desktop computer or laptop with Microsoft Windows XP/ or higher operating system. Not compatible with Mac.
- True Color Display
- Minimum screen resolution of computer 1024x768 or higher
- USB port
- USB 2.0 type A male to male cable.
- 1 GHz processor
- 1 GB RAM
- 100 MB free hard drive space
- OWE-25013-E.00A.exe GUI software install
- CDM v2.08.30 WHQL Certified.exe driver install.
- Power supply 24 VDC, 1.5Amp for EC02 module and 3 Amp for DFplus valve
- Four plug phoenix connector needed:
  - 1 pc - 1792605 TERM BLOCK PLUG 10POS STR 5MM
  - 2 pc - 1803701 TERM BLOCK PLUG 15POS STR 3.81MM
  - 1 pc - 1803659 TERM BLOCK PLUG 10POS STR 3.81MM
- Fully operational EC02 module



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