

INSTRUCTION MANUAL



61302V **Barometric Pressure Sensor**

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1. INTRODUCTION

MODEL 61302V Barometric Pressure Sensor is a versatile electronic barometer featuring high accuracy, low power, wide operating temperature range, and RS-232 serial data I/O or a calibrated voltage output.

Low power consumption and wide temperature range make the 61302V ideal for remote applications using battery or solar power. An accuracy of ± 0.3 hPa rms is maintained over the entire specified operating pressure and temperature range. Full scale voltage output (2.5V or 5V) may be set to span any portion of the 500 to 1100 hPa operating range. RS-232 serial I/O options include continuous or polled ASCII text output or NMEA marine output. The sensor is supplied with the following standard configuration:

- RS232 serial output (TTL levels)
- Polled mode, 9600 baud (8 bit/1 stop bit/no parity)
- Measurement range = 500 to 1100 hPa (10 samples averaged, Output when polled)

2. SPECIFICATIONS

| | |
|------------------|---|
| Pressure: | 500 to 1100 hPa standard range |
| Accuracy: | ± 0.2 hPa rms at 25°C, ± 0.3 hPa rms over -50 to +60°C (serial output) |
| Resolution: | 0.01 hPa (serial output) 0.15 full scale (Analog output) |
| Operating Range: | -50°C to +60°C (unit must remain dry) |
| Output Rate: | 1.8 Hz (max) to 1 per minute (software selectable) |
| Voltage Output: | 0 to 5000 mV (standard), optional 0 to 2500 mV 12-bit resolution (1 in 4000) Selectable pressure range - 500 to 1100 hPa (standard) Resolution is dependent on selected pressure range |

| | |
|-----------------|---|
| Serial Output: | Full duplex RS-232 (standard & TTL levels) 1200 to 38400 baud Continuous ASCII text, polled ASCII text, NMEA |
| Supply Voltage: | 7 to 30 VDC 2.8 mA with Vout 1.4 uA shutdown (Trig=0V) 7 mA with serial I/O (standard) |
| Case: | Fiber-reinforced thermoplastic |
| Weight: | Net 0.2 lb, Shipping 1 lb |

3. INSTALLATION

3.1. *Mounting*

The sensor must be protected from the elements either by being placed in a weather proof enclosure or indoors. The 61302V has two mounting holes that are spaced 1" on centre. The screws and grommets shipped with the sensor will aid in mounting the sensor inside one of Campbell Scientifics' white fibreglass enclosures. If the 61302V is to be installed in an enclosure a QDP HYDRO VENT should be used. Otherwise the included poly tube can be used to vent the sensor to the outdoors via the enclosure port. Vent this tube about 1" out the cable entry port and insert one of the white hydrophobic filters (provided) into the end of the tube.

3.2. *Wiring*

The recommended measurement method is using the serial "COM" channels available on a datalogger (CR3000, CR1000, CR800 series). When necessary the sensor can be reconfigured to output a voltage signal, which can be measured on the analog channels of a datalogger. This reconfiguration is addressed in Section 4.2 and Appendix B.

The recommended power supply for the sensor is the switched 12V channel. This will help conserve station power.

3.2.1. Serial Output Wiring

| Colour | Sensor Designation | Datalogger Terminal (CR800/850, CR1000, CR3000) |
|--------|--------------------|---|
| White | Tx | COMn* Rx |
| Blue | Rx | COMn* Tx |
| Green | Reference | G |
| Red | +PWR | SW12V (recommended) or 12V |
| Black | -PWR | G |
| Clear | Shield | G |

*The “n” indicates the COM port number

As shown in the above table, the serial wiring requires a crossover between the sensor transmit/receive and the datalogger transmit/receive.

3.2.2. Analog Output Wiring

| Colour | Sensor Designation | Datalogger Terminal (CR800/850, CR1000, CR3000, CR23X) | Datalogger Terminal (CR10X, CR510) |
|--------|--------------------|--|------------------------------------|
| White | Vout | Single Ended Channel | Single Ended Channel |
| Blue | Optional Trigger | No Connection or SW12V | No Connection or SW12V |
| Green | Reference | ⊥ | AG |
| Red | +PWR | SW12V or 12V | SW12V or 12V |
| | | | Jumper b/w Ctrl Port & SW12 CTRL |
| Black | -PWR | ⊥ | AG |
| Clear | Shield | ⊥ | G |

Single ended wiring is the only available analog measurement.

4. SENSOR OPERATION

The 61302V Barometric Pressure sensor offers a variety of serial and analog configurations, which are discussed in the following sections. Communication/Output connections are made with the 5-position terminal plug included with the sensor. Changes to the sensor configuration require changes to jumper and/or software settings. Access the jumpers by loosening the two screws in the sensor enclosure and removing the cover. See Appendix A for wiring details and jumper settings.

If changed from the standard configuration to an analog output, please note that the software Vout Scale parameter must be set to agree with the hardware Voltage Output Scale jumper (P3) in order to achieve calibrated output.

4.1. **Serial Output**

Hardware jumper settings and software parameters determine the RS-232 serial communication format. The Appendix A Wiring Diagram shows jumper locations and function.

P1 A/B/C sets output format, baud rate, output rate, and averaging. The table below summarizes **P1** configurations.

P3 A/B sets the RS-232 hardware function. AUTO (AA) enables RS-232 hardware when valid standard RS-232 signals are present at RX and TX. When not present, the RS-232 hardware is disabled to save power. FIXED (AB) enables RS-232 hardware at all times so it can be used with TTL RS-232 signal levels.

P4 A/B configures the terminal connections for RS-232. Both jumpers must be in position A for RS-232 serial communication.

| Format | Description |
|------------------------------|--|
| Continuous ASCII Text | 9600 baud 10 sample average 1.8 Hz output |
| Polled ASCII Text (standard) | 9600 baud 10 sample average Output when polled |
| Marine NMEA 4800 baud | 10 sample average 1Hz output |
| Software | Output parameters determined by software settings |

Note that NMEA output is normally specified to work on RS-422 and RS-485 networks. The NMEA output here conforms to the standard data format but the electrical connection uses RS-232 signal levels.

In POLLED ASCII mode, the unit sends data only after receiving a poll command. The poll command is Ma! where 'a' is the sensor address value. The standard address is '0' (ASCII 48) for a poll command of M0! Please see Section 4.3 for details on changing the polling address. Standard baud rate is 9600 but any of several available baud rates between 1200 and 38400 may be used.

4.2. Analog Output

If the 61302V is to be used in a voltage output mode it is recommended that the output range of the sensor be remapped by changing the output range in the sensor software. This is important in maintaining the highest level of measurement accuracy. Hardware jumpers and software parameters determine voltage output operation. Appendix A shows jumper configurations, and Appendix B shows steps for software configuration. The jumper settings are also described below.

Both **P4** jumpers must be in position B for voltage output.

Jumper **P3** sets the Voltage Output Scale to either 0-5000 mV or 0-2500 mV.

Note - Jumper **P3** must agree with the software Vout Scale parameter in order to achieve calibrated output.

The voltage output scale may be mapped to any part of the 500 to 1100 hPa pressure range using the VOUT HI and VOUT LO software parameters. The standard setting maps 0 to 5000 mV with 500 to 1100 hPa.

For example:

$$\text{hPa} = 0.12 * \text{mV} + 500$$

Effective range is 600 hPa, Analog signal resolution is 12 bit (resolution = $600/2^{12}$)

Therefore the effective resolution is about 0.15 hPa

Better effective resolution may be achieved by mapping the voltage output to a narrower range of pressure with the VOUT HI and VOUT LO parameters. In most applications VOUT LO can be set to 950 hPa and VOUT HI can be set to 1050 hPa (VOUT Scale set to 0-5000 mV):

$$\text{hPa} = 0.02 * \text{mV} + 950$$

Effective range is 100 hPa, Analog signal resolution is 12 bit (resolution = $100/2^{12}$)

Effective resolution is about 0.025 hPa

Please see Section 4.3 and Appendix B for details on changing the VOUT HI and LO parameters.

With jumper P4 configured for voltage output, a special optional trigger (TRIG) input may be used to control barometer power. When TRIG=0V, all processes cease and power consumption is reduced to 1.4uA. When the voltage on TRIG > 1.8V (or left floating), normal operation resumes with a power up reset. The TRIG input connection is optional. It is recommended to connect

the TRIG to +PWR or left floating, as the datalogger program will control the sensor power.

4.3. **Software Commands**

Software commands sent via serial communication may be used to set operational parameters. The sensor must be configured for serial communication and connected to a PC or other compatible device using a program like HyperTerminal.

New settings are stored in temporary memory and must be burned to flash with command CMD420 to be retained.

Note that the **P1** jumper must be configured for SOFTWARE format to alter baud rate, sample average count, and output rate parameters. Although the sensor may receive commands at any time, measurement output may be caused by sending three ESC (ASCII 27) characters or CMD300 1. While paused, COMMAND mode is indicated by a ">" prompt. All commands must be terminated with a carriage return CR (ASCII 13).

Use "?" to list available commands as shown below.

>?

YOUNG 61300 SERIES BAROMETER V2.03

```
-----  
CMD100 n OUTPUT PERIOD (0-60 sec)  
CMD105 n AVG SAMPLE COUNT (0-32)  
CMD110 n OUTPUT FORMAT (1=ASCII 2=POLLED 3=NMEA  
4=RAW 5=DIAG)  
CMD120 n MULTIPLIER (10000 = 1.0000)  
CMD125 n OFFSET (hPa x 100)  
CMD130 n SEA LEVEL CORRECTION (hPa x 100)  
CMD140 n VOUT RANGE HI (500-1100)  
CMD142 n VOUT RANGE LO (500-1100)  
CMD144 n VOUT SCALE (2=2.5V 5=5V)  
CMD150 c POLL ADDR CHAR  
CMD160 n BAUD RATE (38400,9600,4800,2400,1200)  
CMD300 n 1=STOP, 2=RUN  
CMD310 n FORCE VOUT (0-5000 FULL SCALE)  
CMD400 n 1=RPT TEXT, 2=RPT CODE ONLY  
CMD410 GET CAL TABLE  
CMD420 STORE SETUP PARAMETERS  
>
```

CMD100 n sets output period in seconds. When set to zero, the output rate is about 1.8 per second.

CMD105 n sets the average sample count. Higher sample count yields more stable readings but will lengthen the startup delay.

CMD110 n sets output format. RAW and DIAG settings are for factory use only.

CMD120 n sets the output multiplier. 10000 represents 1.0000

CMD125 n sets the output offset in hPa x 100

CMD130 n sets the sea level correction in hPa x 100

$$=[\text{Punadjust} * (\text{Mult} / 10000)] + [(\text{Offset} / 100) + (\text{Correction Sea Lvl} / 100)]$$

CMD140 n sets the Vout Pressure Range HI

CMD142 n sets the Vout Pressure Range LO Vout Pressure Range HI must be greater than Vout Pressure Range LO

CMD144 n sets the Vout Scale. 2 = 0 to 2500 mV. 5 = 0 to 5000 mV. This parameter setting must agree with the physical P3 jumper position to achieve calibrated voltage output.

CMD150 c sets the poll address character. Any ASCII character from '0' (ASCII 48) to 'z' (ASCII 122) may be used.

CMD160 n sets the baud rate. Acceptable values are 38400, 9600, 4800, 2400, and 1200. Note that the baud rate change occurs immediately after the command is received. Therefore, in order to continue communicating, the serial communication program that issued the command must also change to match.

CMD300 n causes the sensor to pause or resume measurement. 1 = Stop, 2 = Run.

CMD400 n causes the sensor to issue a report summarizing parameter settings.

1 = RPT text

2 = RPT code only

CMD410 retrieves the internal calibration table. This is for factory use only.

CMD420 burns new parameter settings to flash memory. This step must take place to retain changes otherwise parameters will revert to the previous values at the next power up.

5. PROGRAMMING

The 61302V draws upwards of 7mA of power when activated. Depending on your power supply it may be beneficial to conserve power. This can be achieved by powering the sensors on and off. This is done through the switched 12V port on the CR10X, CR23X, CR800, CR850, CR1000, and CR3000. This is used in the following program examples.

The default measurement units are Hectopascals (hPa). The units can be converted by adding programming which makes use of the following conversions.

Multipliers to convert the hPa reading to different units

| For | Multiply by |
|----------|-------------|
| kPa | 0.1 |
| Mm of Hg | 0.75006 |
| In of Hg | 0.02953 |
| mBar | 1.0 |
| PSI | 0.0145 |

The weather service and most airports correct the pressure reading at a particular station to what it would be if that station were located at sea level. This is done so that weather forecasters can obtain a clearer picture of what is happening in the atmosphere.

The following equation is used in the program examples to determine the pressure correction factor. This can then be added to the measured value. Because barometric pressure is greatly affected by elevation, the elevation of the site used in the equation should be as accurate as possible. Where Elevation is in meters above sea level.

$$P = 1013.25 [1 - (1 - \text{Elevation}/44307.69231) ^{5.253283}]$$

5.1. Serial Output Program Example

The program example illustrates the polling of a 61302V in its default configuration using a CR1000 datalogger. Communications will occur on serial port COM1. The sensor is powered for one minute before the top of each hour, at which time the sensor is polled for a measurement. The program also includes the option to correct for elevation. The measurement units in the example are hPa.

```

CR1000 Series Datalogger

' Jumper P1 will need to be set to Polled mode (jumpers B & C in place)
' Jumper P3 will need to be set to "Fixed" modes (as per Appendix A)
' Jumper P4 will need to be set to Serial mode (A position)
' Baud 9600, 8 bit, 1 stop, no parity.

'61302V Wiring

'Red - CR1000 SW12V (Unit can be powered continuously if power consumption is not an
issue)
'Black - CR1000 G
'Blue - CR1000 C1 (Tx)
'White - CR1000 C2 (Rx)
    
```

61302V Barometric Pressure Sensor

```
'Green - CR1000 G
'Shield - CR1000 G

'Declare Public Variables
Public BP_Poll As String, CR As String
Public BP_raw As String
Public BP_string As String
Public Elevation_Correction
Public BP_61302V As Float 'Default units are hPa

'Declare Constants
Const Elevation = 0 'This value must be added in order to correct for elevation (meters).

'Define Data Tables
DataTable (Hourly,1,-1)
  DataInterval (0,1,Hr,10)
  Sample (1,BP_61302V,IEEE4)
EndTable

'Main Program
BeginProg

  *** 61302V Sensor Polling Variables ***
  BP_Poll = "M0!"
  CR = CHR(13)

  'Configure ComPort 1 for use with the 61302V
  SerialOpen (Com1,9600,0,0,1000)
  Scan (5,Sec,0,0)

  ' Switch 61302V Sensor On 1 minute before the top of the hour
  If TimeIntoInterval (59,60,Min) Then SW12 (1)

  ' Poll 61302V Sensor at the top of the hour
  If TimeIntoInterval (0,60,Min) Then

    SerialFlush (Com1) 'Clear buffer before polling for a new measurement
    SerialOut (Com1,BP_Poll,"",0,100) 'Send sensor poll command
    SerialIn (BP_raw,Com1,100,CR,100) 'Receive sensor response
    SplitStr (BP_string,BP_raw,"",1,0) 'Parse out BP value
    BP_61302V = BP_string 'Convert ASCII to numeric value

  ' Switch 61302V Sensor Off after polling
  SW12 (0)

  ' Correct Barometric Pressure value for elevation above sea level (elevation must be in
meters)
  Elevation_Correction = 1013.25 * (1 - (1 - Elevation/44307.69231)^5.253283)

  BP_61302V = BP_61302V + Elevation_Correction

EndIf

  CallTable Hourly
  NextScan
EndProg
```

5.2. Voltage Output Program Example

The program example illustrates the analog measurement of a 61302V in the configuration shown in Appendix A, using a CR1000 datalogger. The sensor is powered for one minute before the top of each hour, at which time the sensor is polled for a measurement. The program also includes the option to correct for elevation. The measurement units in the example are hPa.

```
'CR1000 Series Datalogger

'61302V will need to have the following configuration:
' Jumper P1 will need to be set to Continuous ASCII mode (jumpers A, B, & C in place)
' Jumper P3 will need to be set to "5VDC" mode (A position)
' Jumper P4 will need to be set to Voltage mode (B position)

'61302V Wiring
'Red - CR1000 12V (power continuously for testing)
'Black - CR1000 AG
'White - CR1000 SE1
'Blue - No Connection
'Green - CR1000 AG
'Shield - CR1000 AG

'Declare Public Variables
Public BP_61302V_Analog
Public Elevation_Correction

'Declare Constants
Const Elevation = 0 'This value must be added in order to correct for elevation (meters).

'Define Data Tables
DataTable (Hourly,1,-1)
  DataInterval (0,60,min,10)
  Sample (1,BP_61302V_Analog,IEEE4)
EndTable

'Main Program
BeginProg

  Scan (5,Sec,0,0)

  ' Switch 61302V Sensor On 1 minute before the top of the hour
  If TimeIntoInterval (59,60,Min) Then SW12 (1)

  ' Poll 61302V Sensor at the top of the hour
  If TimeIntoInterval (0,60,Min) Then

    *** Measure Analog 61302V ***
    VoltSe (BP_61302V_Analog,1,mV5000,1,1,0,_60Hz,0.12,500)
```

61302V Barometric Pressure Sensor

```
' Switch 61302V Sensor Off after polling
SW12 (0)

' Correct Barometric Pressure value for elevation above sea level (elevation must be in
meters)
Elevation_Correction = 1013.25 * (1 - (1 - Elevation/44307.69231)^5.253283)

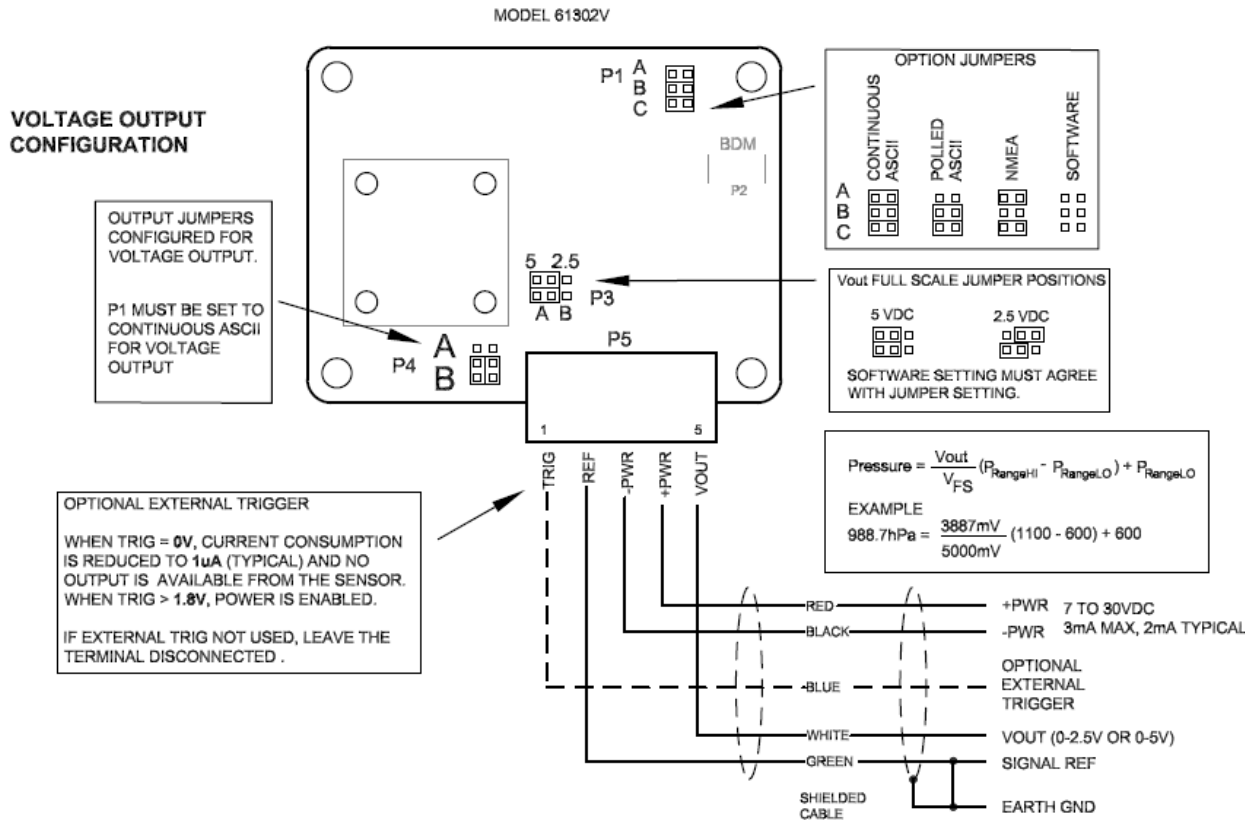
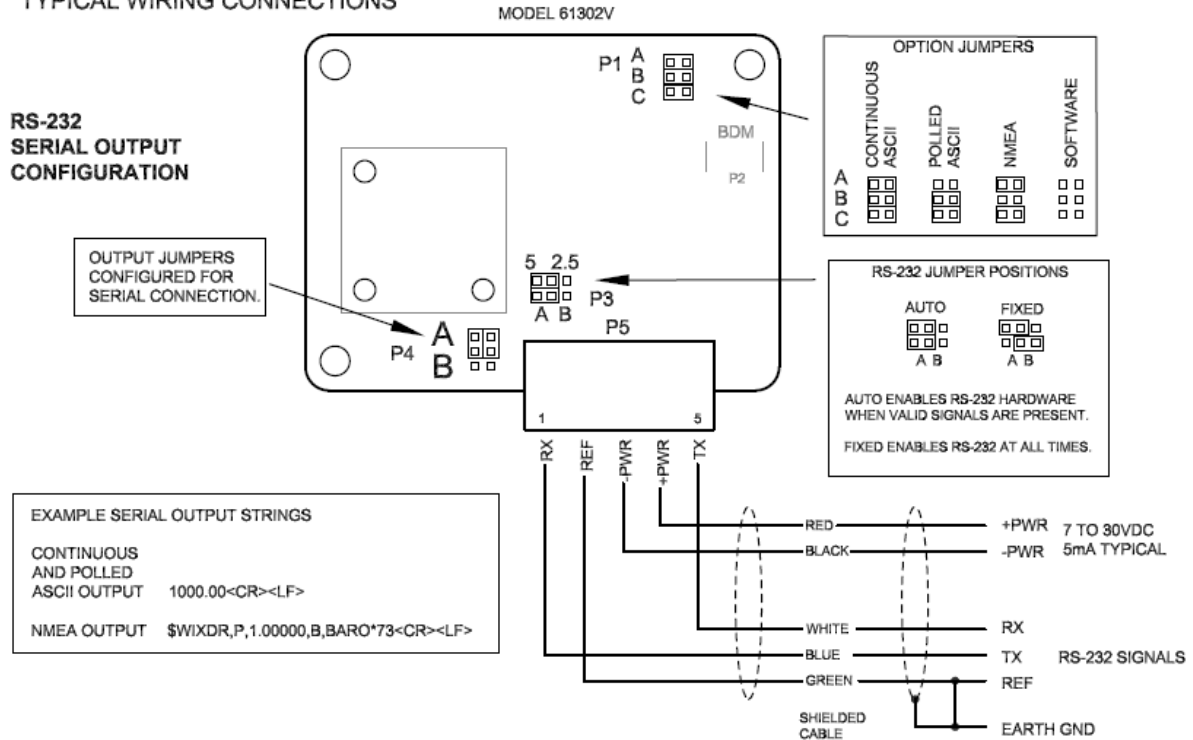
BP_61302V_Analog = BP_61302V_Analog + Elevation_Correction

EndIf

CallTable Hourly
NextScan
EndProg
```

APPENDIX A

61302V BAROMETER
TYPICAL WIRING CONNECTIONS



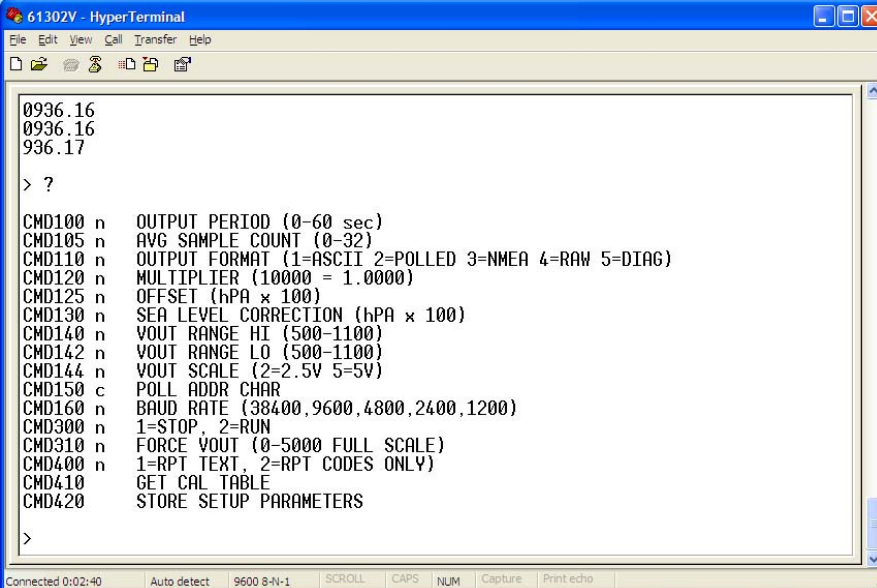
Appendix B

Software Configuration for Voltage Output

Listed below are the steps to remap the measurement range of the 61302V.

NOTES:

- Before making any jumper changes be sure that power is disconnected and that you and your work area are free of static discharge potential.
 - The following example assumes that the 0-5V output range will be used. If you require the 0-2.5V output range you will need to change this software configuration as well. This can be done with CMD144.
 - All commands must be completed with hitting the ENTER key.
1. Connect the 61302V to the PC. Please note in order to make the connection to the PC you will require either an interface board (i.e. DB9M-TERM), or a 9-pin cable with connections for Tx, Rx, and Ground. The sensor must have **P1** configured for SOFTWARE mode (no jumpers), and **P4** must have both jumpers in position A.
 2. Start a HyperTerminal session with the following port settings of 9600 baud, 8 bit, 1 stop bit, no parity.
 3. Power the sensor up. The sensor should start outputting measurements. Interrupt the output by pressing the Esc key three times, which will give you command prompt (>). Entering a question mark will give you a list of the available commands. Please note that the syntax is case sensitive, and any typing error will require that you reenter the command.



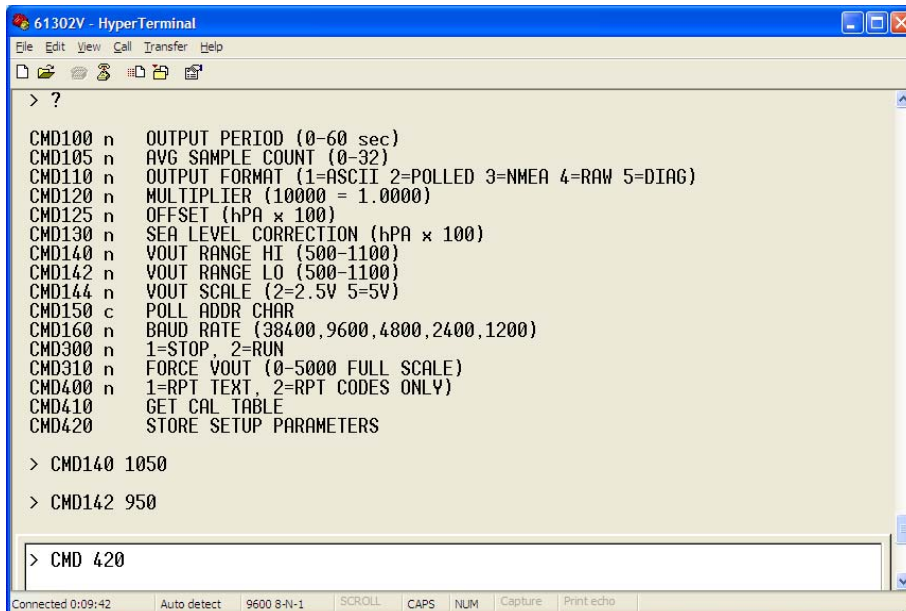
The screenshot shows a HyperTerminal window titled "61302V - HyperTerminal". The window displays the following text:

```
0936.16
0936.16
936.17
> ?
CMD100 n OUTPUT PERIOD (0-60 sec)
CMD105 n AVG SAMPLE COUNT (0-32)
CMD110 n OUTPUT FORMAT (1=ASCII 2=POLLED 3=NMEA 4=RAW 5=DIAG)
CMD120 n MULTIPLIER (10000 = 1.0000)
CMD125 n OFFSET (hPa x 100)
CMD130 n SEA LEVEL CORRECTION (hPa x 100)
CMD140 n VOUT RANGE HI (500-1100)
CMD142 n VOUT RANGE LO (500-1100)
CMD144 n VOUT SCALE (2=2.5V 5=5V)
CMD150 c POLL ADDR CHAR
CMD160 n BAUD RATE (38400, 9600, 4800, 2400, 1200)
CMD300 n 1=STOP, 2=RUN
CMD310 n FORCE VOUT (0-5000 FULL SCALE)
CMD400 n 1=RPT TEXT, 2=RPT CODES ONLY)
CMD410 GET CAL TABLE
CMD420 STORE SETUP PARAMETERS
>
```

The status bar at the bottom of the window shows "Connected 0:02:40", "Auto detect", "9600 8-N-1", "SCROLL", "CAPS", "NUM", "Capture", and "Print echo".

61302V Barometric Pressure Sensor

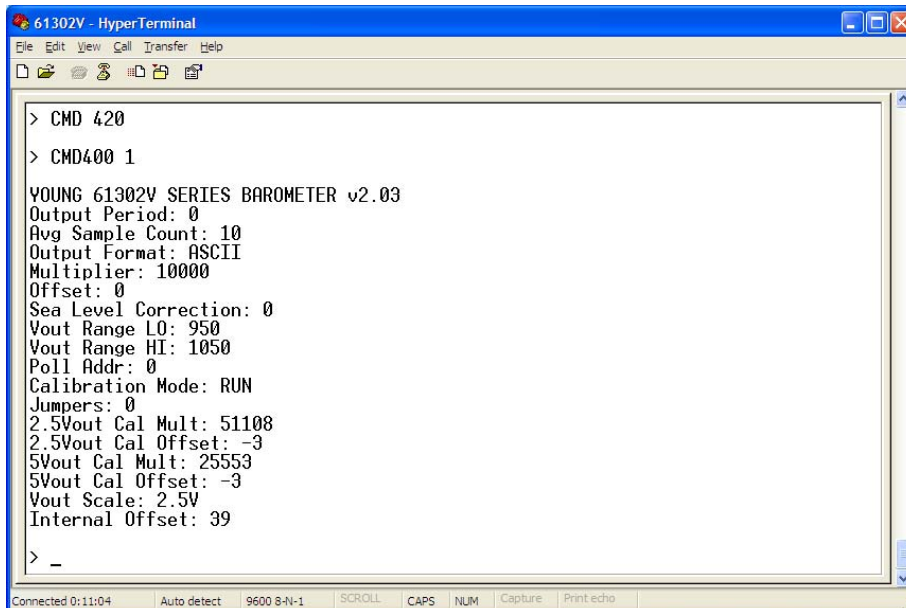
- Use CMD140 to set the upper measurement limit to 1050. Use CMD 142 to set the lower measurement limit to 950. These changes must be saved to flash memory, which is done by entering CMD420.



```
61302V - HyperTerminal
File Edit View Call Transfer Help
> ?
CMD100 n OUTPUT PERIOD (0-60 sec)
CMD105 n AVG SAMPLE COUNT (0-32)
CMD110 n OUTPUT FORMAT (1=ASCII 2=POLLED 3=NMEA 4=RAW 5=DIAG)
CMD120 n MULTIPLIER (10000 = 1.0000)
CMD125 n OFFSET (hPA x 100)
CMD130 n SEA LEVEL CORRECTION (hPA x 100)
CMD140 n VOUT RANGE HI (500-1100)
CMD142 n VOUT RANGE LO (500-1100)
CMD144 n VOUT SCALE (2=2.5V 5=5V)
CMD150 c POLL ADDR CHAR
CMD160 n BAUD RATE (38400,9600,4800,2400,1200)
CMD300 n 1=STOP, 2=RUN
CMD310 n FORCE VOUT (0-5000 FULL SCALE)
CMD400 n 1=RPT TEXT, 2=RPT CODES ONLY)
CMD410 GET CAL TABLE
CMD420 STORE SETUP PARAMETERS

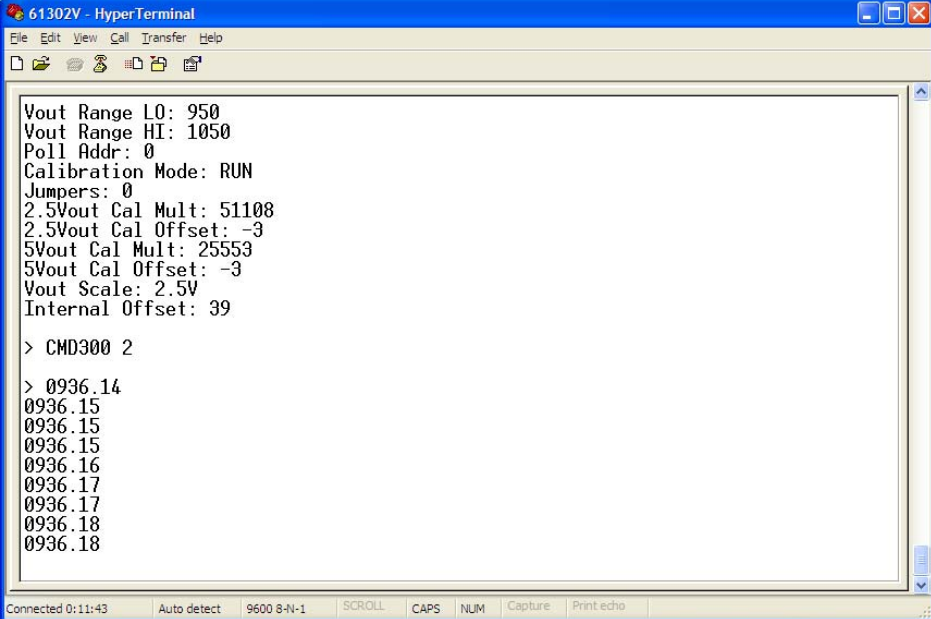
> CMD140 1050
> CMD142 950
> CMD 420
```

- Confirm that the changes have been saved to memory by entering CMD400 1. This will provide a list of all parameters in flash memory.



```
61302V - HyperTerminal
File Edit View Call Transfer Help
> CMD 420
> CMD400 1
YOUNG 61302V SERIES BAROMETER v2.03
Output Period: 0
Avg Sample Count: 10
Output Format: ASCII
Multiplier: 10000
Offset: 0
Sea Level Correction: 0
Vout Range LO: 950
Vout Range HI: 1050
Poll Addr: 0
Calibration Mode: RUN
Jumpers: 0
2.5Vout Cal Mult: 51108
2.5Vout Cal Offset: -3
5Vout Cal Mult: 25553
5Vout Cal Offset: -3
Vout Scale: 2.5V
Internal Offset: 39
> _
```

- Restart the measurement process with CMD300 2.



The screenshot shows a HyperTerminal window titled "61302V - HyperTerminal". The window displays the following configuration and measurement data:

```
Vout Range LO: 950
Vout Range HI: 1050
Poll Addr: 0
Calibration Mode: RUN
Jumpers: 0
2.5Vout Cal Mult: 51108
2.5Vout Cal Offset: -3
5Vout Cal Mult: 25553
5Vout Cal Offset: -3
Vout Scale: 2.5V
Internal Offset: 39

> CMD300 2

> 0936.14
0936.15
0936.15
0936.15
0936.16
0936.17
0936.17
0936.18
0936.18
```

The status bar at the bottom of the window indicates "Connected 0:11:43", "Auto detect", "9600 8-N-1", and various keyboard shortcuts like SCROLL, CAPS, NUM, Capture, and Print echo.

- Once the configuration is complete you can power the sensor down and replace all jumpers required for your specific application.