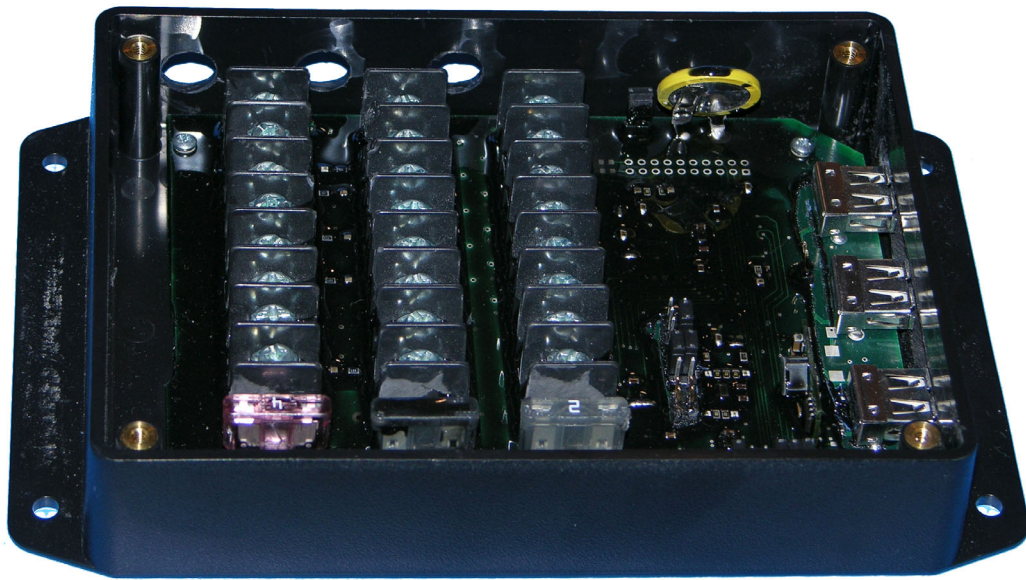

vGauge-Remote

User's Manual



Chetco Digital Instruments

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vGauge-Remote™ is a trademark of Chetco Digital Instruments, Inc.

vDash™ is a trademark of Chetco Digital Instruments, Inc.

WARNING!

USE THIS UNIT ONLY AS AN AID TO MONITORING ENGINE PERFORMANCE INFORMATION.

CAUTION

When showing sensor data, this unit will only show information based on the sender used and its installed position.

The operating and storage temperature for your unit is from -4 degrees to +167 degrees Fahrenheit (-20 to +75 degrees Celsius). Extended storage temperatures higher or lower than specified will cause the liquid crystal display to fail. Neither this type of failure nor its consequences are covered by the warranty. For more information, consult the factory customer service department.

All features and specifications subject to change without notice.

Chetco Digital Instruments may find it necessary to change or end our policies, regulations, and special offers at any time. We reserve the right to do so without notice.

All screens in this manual are simulated.

NOTICE!

Free software upgrades will be available on our website at [http:// www.chetcodigital.com](http://www.chetcodigital.com) as they are released. Please check our website periodically for these and other information as they become available.

Thank you for choosing Chetco Digital Instruments

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the factory customer service department for help.

SPECIFICATIONS

Dimensions:..... 6.76" W x 4.68" D x 1.3" H

Input Voltage:..... 10 - 15 vDC, 12-volt Nominal

Processor Frequency:..... 18.432 MHz

Maximum Current: 800 mA

Operating and Storage Temperature .. -4 to +167 degrees Fahrenheit
20 to +75 degrees Celsius

Analog Conversion Accuracy : 10 bits

Sender voltage range: 0 -3.3 volts

Sender voltage resolution: 0.0128 volts

Pulse Count resolution:..... 1 per second

Maximum Pulse Count: 250 per second

NMEA 2.0 Instrumentation Sentences \$IIXDR,A \$IIXDR,C \$IIXDR,D \$IIXDR,F
\$IIXDR,G \$IIXDR,I \$IIXDR,P \$IIXDR,R \$IIXDR,S \$IIXDR,T \$IIXDR,U \$IIXDR,V

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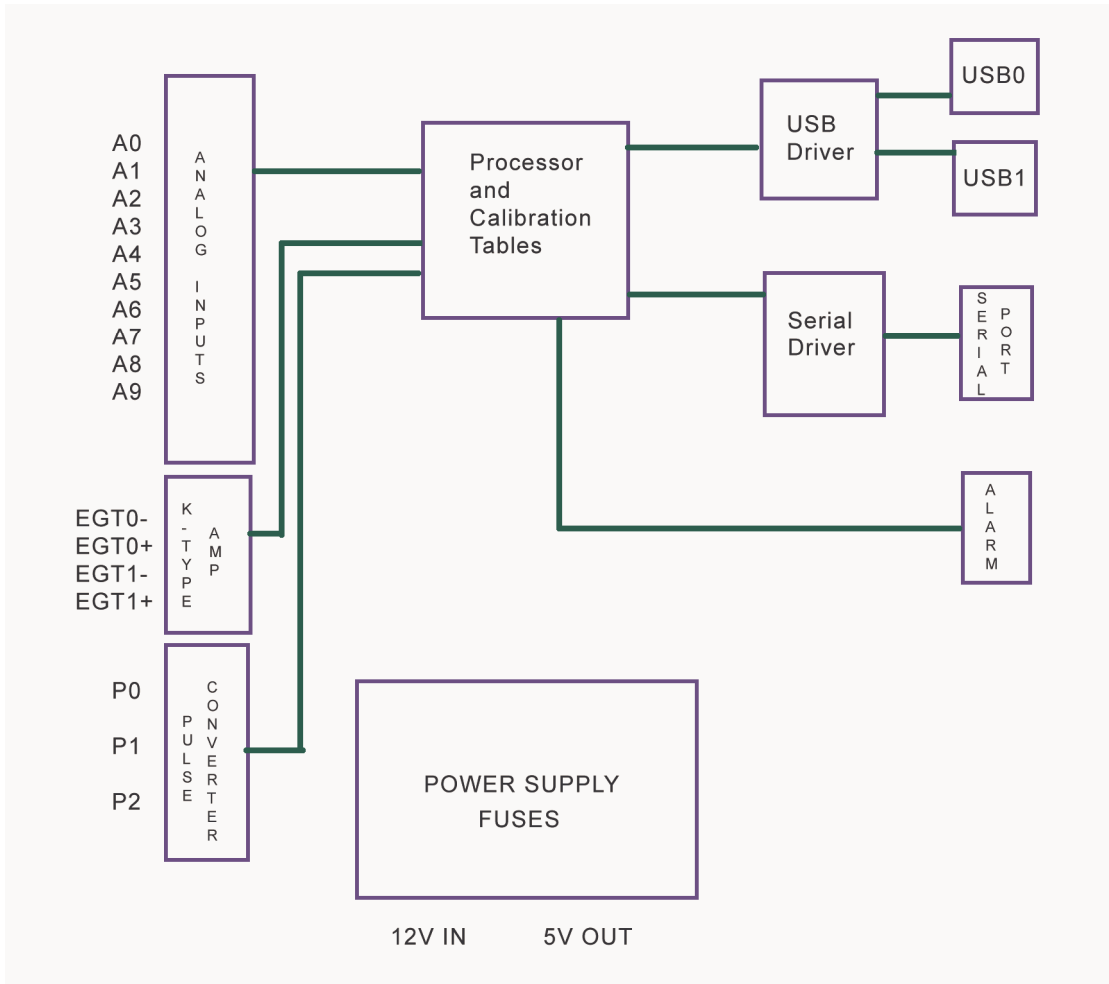
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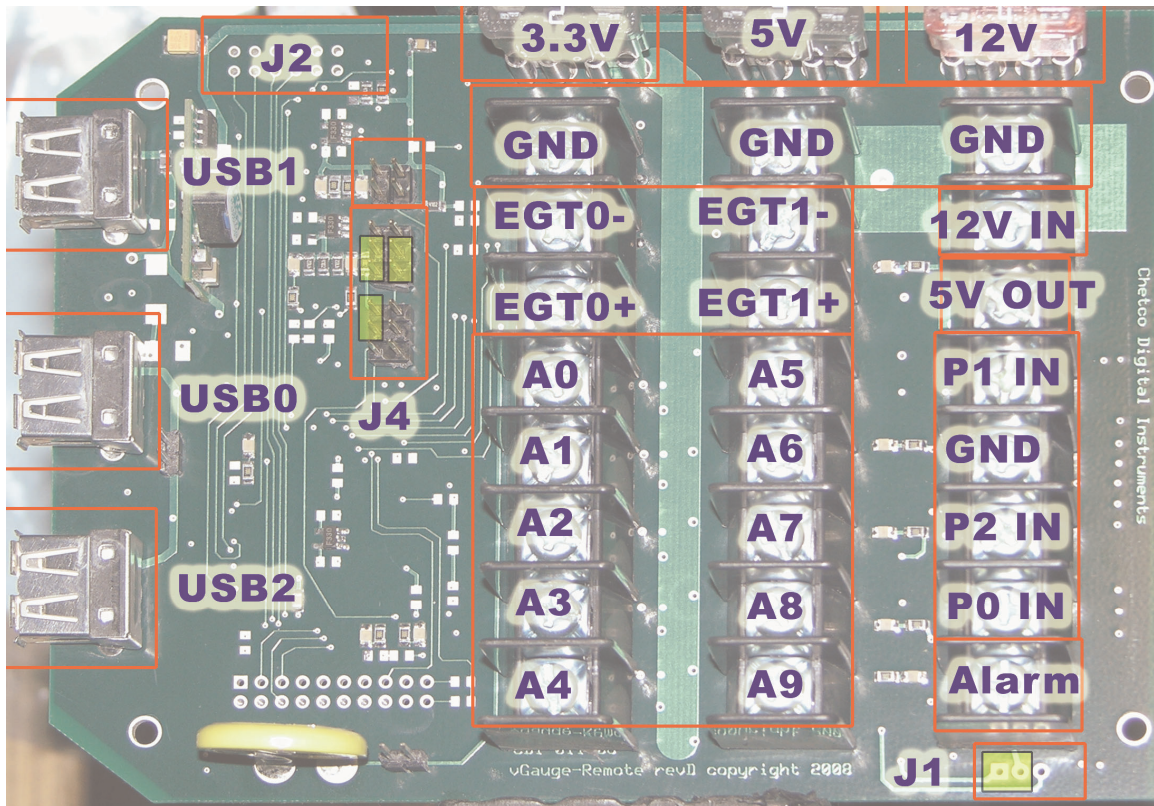
Introduction

Welcome

Thank you for purchasing a Chetco Digital Instruments product. vGauge-Remote™ provides custom instrumentation in a rugged compact design. Its user defined calibration tables and alarms allow it adapt to and monitor many different sensors from a single location.

vGauge-Remote™ will interface directly with a personal computer via serial or USB interfaces. Optional display heads provide real-time display of instrumentation in remote locations.





Analog Inputs – vGauge-Remote will support up to 12 analog inputs for interface to most temperature, pressure, and voltage senders. Internal signal conditioning allows resistive senders and direct voltage inputs up to 36 volts on selected inputs. Most temperature and pressure senders use variable resistance to convert physical parameters into an analog voltage. vGauge-Remote provides a 3.3 volts reference and proper pull-up resistance to interface with these senders.

To accommodate more accurate measurements, vGauge-Remote also supplies +5 volt output to drive specified senders with require a regulated voltage source commonly found in high precision pressure senders.

EGT inputs – vGauge-Remote provides a built-in interface for up to two K-Type thermocouples commonly used for exhaust gas temperature (EGT) measurements. These probes output a very low level voltage (typically 0 – 0.5v) that need to be amplified and conditioned to obtain reliable results. vGauge-Remote provides the proper conditioning and calibration to attach K-Type EGT probes directly to the unit.

Pulse Inputs - vGauge-Remote can accept up to three pulse inputs from a variety of sources for measurement of revolution information such as tachometer and speedometer

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functions. vGauge-Remote conditions pulse inputs to allow direct interface to most tachometer signal generators. vGauge-Remote also provides pulse dividers up 256 ratio for interface to inductive pickup systems.

Alarm Output – vGauge-Remote can be configured to support high/low alarm conditions on each of the 12 analog inputs and 3 pulse inputs. User specified alarm settings are combined into a single output used to drive visual or audio indicators such as a buzzer or panel lamp.

USB interface – vGauge-Remote can optionally support two USB 2.0 interfaces for driving remote displays or data logging to flash memory disks. USB port 0 is used for attachment of compatible display head for real-time display of instrumentation data. USB port 1 is used for attachment of USB flash memory device for real-time data logging.

Serial Interface – a built-in RS232 serial port is provided for driving optional remote display head or attachment to PC serial port. Multiple display heads can be attached by using the optional serial port expander module. A Bluetooth module is also available for wireless interface to PC and PDA devices.

NOTE: Some newer models have a third USB port (USB2) instead of a built-in serial port. A USB-Serial port adapter is available if needed.

What You Get

Unit

vGauge-Remote unit with power and sensor input. Unit constantly monitors the sensor inputs and creates NMEA 0183 compatible sentences two times per second. A 10-bit analog converter samples sensor data and then performs a real-time average. The built-in microprocessor takes the averaged value for each sensor and looks up the display value from a 256 point table that is user modifiable. Once a sensor value is determined, it is paired with a corresponding text label and sent via built-in serial port in NMEA 0183 format. Sensor data is also compared with a user defined min/max alarm table and will trigger an alarm signal if any of the parameters are exceeded.

Cables

vGauge-Remote is supplied with terminal blocks for attaching sensor and power inputs to the unit. Standard USB and RS232 cables are used for attachment to remote PC or display heads..

Operation

vGauge-Remote is sealed and self-contained. All user control is performed via the built-in USB or RS232 port. The unit can be configured with the included vDash utility described in a separate manual or via text commands sent directly to the serial port.

When you receive your unit it has been programmed with default sensor calibration tables and labels. All alarms have been cleared. The unit can be reconfigured by modification of the tables using a text editor and reloading the unit.

To prevent any errors in programming – it is recommended to use the included vDash utility for reprogramming of the unit. While it is possible to manually reconfigure the tables using standard serial communications utilities – any errors could render the unit inoperable and require reprogramming of the entire unit using the separate flash programming port.

Sensor Inputs

The factory default inputs include 4 temperature, 4 pressure, 2 voltage, 2 EGT, and 3 pulse inputs. The following table describes the default sensor ranges and display labels

<i>Pin</i>	<i>Channel</i>	<i>Function</i>	<i>Min Value</i>	<i>Max Value</i>	<i>Min Alarm</i>	<i>Max Alarm</i>
A0	A0	TEMP1	-19 F	336 F	OFF	OFF
A1	A4	TEMP2	-19 F	336 F	OFF	OFF
A2	A6	TEMP3	-19 F	336 F	OFF	OFF
A3	A2	TEMP4	-19 F	336 F	OFF	OFF
A4	A10	VOLT1	0	36V	OFF	OFF
A5	A1	PSI1	0	150	OFF	OFF
A6	A5	PSI2	0	150	OFF	OFF
A7	A7	PSI3	0	150	OFF	OFF
A8	A3	PSI4	0	150	OFF	OFF
A9	A11	VOLT2	0	36	OFF	OFF
A10	A8	EGT0	42	1600F	OFF	OFF
A11	A9	EGT1	42	1600F	OFF	OFF
P0	P0	PULSE0	25	10000	OFF	OFF
P1	P1	PULSE1	25	10000	OFF	OFF
P2	P2	PULSE2	25	10000	OFF	OFF

Other sensors can be used by changing any of the 12 calibration tables and 16 display labels.

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Data Output format

After the unit is properly installed and powered up, it will automatically start transmitting data in NMEA 0183 format with an update rate of 2 per second for each of nine inputs (8 analog and 1 pulse). The following is an example of a typical sequence.

```
$PCDIS,VGAUGE-REMOTE,0001.100,*79
$IIXDR,G, 0 ,B,OIL **1*37
$IIXDR,G, 192 ,C,ENGINE**2*48
$IIXDR,G, 35 ,D,TRANS **3*26
$IIXDR,G, 8.2,E,VOLT ***4*45
$IIXDR,G, 60,F,AMPS ***5*4B
$IIXDR,G, 57 ,G,PORT ***6*5E
$IIXDR,G, 57 ,H,STRB ***7*5C
$IIXDR,G, 72,I,FUEL****8*47
$IIXDR,G, 00 ,A,RPM ****0*24
```

The \$IIXDR NMEA 0183 sentence contains 6 fields separated by commas with the following definitions:

- 1) \$IIXDR – Instrumentation data tag
- 2) Data type specifier – from NMEA tag lookup table
- 3) Data Values – from calibration lookup table
- 4) Unit of measure – from NMEA suffix lookup table
- 5) Instrument Label – from device label lookup table
- 6) Checksum

VGauge-Remote also adds a proprietary tag (\$PCDIS) that specifies status information. In this case it specifies the name of the unit and firmware revision number.

Display Label Table

The display labels are obtained from a lookup table. An example table is shown as follows:

```
1)      [TABLE] [6800] [8] [50]
2)      db 'OIL **' ; Display Label 00
3)      db 'ENGINE *' ; Display Label 01
4)      db 'TRANS **' ; Display Label 02
5)      db 'VOLT ***' ; Display Label 03
6)      db 'AMPS ***' ; Display Label 04
7)      db 'PORT ***' ; Display Label 05
8)      db 'STRB ***' ; Display Label 06
9)      db 'FUEL ***' ; Display Label 07
10)     db 'STRING9 ' ; Display Label 08
11)     db 'STRINGA ' ; Display Label 09
12)     db 'STRINGB ' ; Display Label 0A
13)     db 'STRINGC ' ; Display Label 0B
14)     db 'STRINGD ' ; Display Label 0C
15)     db 'STRINGE ' ; Display Label 0D
16)     db 'STRINGE ' ; Display Label 0E
17)     db 'RPM ****' ; Display Label 0F
18)     db 'ALARM ' ; Display Label 10
19)     db 'LIGHT ' ; Display Label 11
20)     db 'OPTIONS ' ; Display Label 12
21)     db 'ALARMS ' ; Display Label 13
22)     db 'DISPLAY ' ; Display Label 14
23)     db 'NMEA ' ; Display Label 15
24)     db 'GROUPS ' ; Display Label 16
25)     db 'POSITION' ; Display Label 17
26)     db 'CHANNEL ' ; Display Label 18
27)     db 'OFF ' ; Display Label 19
28)     db 'ON ' ; Display Label 1A
29)     db 'SERIAL ' ; Display Label 1B
30)     db 'BLUE ' ; Display Label 1C
31)     db 'SET ' ; Display Label 1D
32)     db '0001.077' ;1E revision number
33)     db 'VGAUGE-REMOTE' ;1F Product name
34)     db '$IIXDR,G' ; 0
35)     db '$IIXDR,G' ; 1
36)     db '$IIXDR,G' ; 2
37)     db '$IIXDR,G' ; 3
38)     db '$IIXDR,G' ; 4
39)     db '$IIXDR,G' ; 5
40)     db '$IIXDR,G' ; 6
41)     db '$IIXDR,G' ; 7
42)     db '$IIXDR,G' ; 8
43)     db '$IIXDR,G' ; 9
44)     db '$IIXDR,G' ; A
45)     db '$IIXDR,G' ; B
46)     db '$IIXDR,G' ; C
47)     db '$IIXDR,G' ; D
48)     db '$IIXDR,G' ; E
49)     db '$IIXDR,G' ; F
50)     db 'ABCDEFGH' ; F
51)     db 'IJKLMNOP' ; F
```

There are 51 rows in the table. Each row except for the first corresponds to a label attached to a sensor input and used to format the NMEA 0183 data output sentence.

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The first row identifies the file as a table specifier ([TABLE]) followed by the starting address in memory to load the table ([6800]), followed the length in characters contained on each row ([8]) followed by the number of rows ([50]). None of the values in the first row can be modified.

The following 16 rows contain the text labels used for each sensor. While there are 16 rows of labels, only the first 8 and the last row (2-9, and 17) are used. The remaining are reserved for future upgrades. Each text label must start with "db " and end with ";". This can not be modified. Each label must contain exactly 8 characters. If you wish to have shorter labels then use the "*" character as a placeholder but be sure there are exactly 8 characters per label. Anything after the ";" character is considered a comment and ignored.

Rows 18 – 33 are reserved and should not be modified.

Rows 34-49 are the NMEA 0183 prefix attached to each sensor on transmission. The NMEA standard allows an identifier to indicate the type of sensor. Only the last character in each row will need to be modified. Following is a listing of the acceptable data types:

- 1) \$IIXDR, A = Angular Displacement degrees
- 2) \$IIXDR, C = Temperature Degrees Celcius
- 3) \$IIXDR, D = Linear Displacement Meters
- 4) \$IIXDR, F = Frequency Hertz
- 5) \$IIXDR, G = Generic
- 6) \$IIXDR, H = Humidity Percent
- 7) \$IIXDR, I = Current Amperes
- 8) \$IIXDR, N = Force Newtons
- 9) \$IIXDR, P = Pressure Pascal or Bar
- 10) \$IIXDR, R = Flow Rate Liters/Second
- 11) \$IIXDR, S = Switch or Valve
- 12) \$IIXDR, T = Tachometer or RPM
- 13) \$IIXDR, U = Angular Voltage Volts
- 14) \$IIXDR, V = Volume Cubic Meters

The last two rows (50 and 51) contain the single character suffix added to each sensor to indicate the units of measure. Since there are currently only 8 sensor labels – row 51 is reserved and should not be modified.

Channels Table

The 12 sensor input are assigned to calibration tables via the Channels Table. This table allows mapping of analog inputs to desired lookup tables. Calibration tables are assigned in the same order as the Display Label Table entries. So for example – the OIL label is assigned to the first calibration table and the ENGINE the second and so on. The Channels table decides which analog input pin is actually the OIL input.

An example table is as follows:

1)	[TABLE][7800][1][32]	
2)	db %01; Display Label	0
3)	db %04; Display Label	1
4)	db %06; Display Label	2
5)	db %05; Display Label	3
6)	db %03; Display Label	4
7)	db %02; Display Label	5
8)	db %00; Display Label	6
9)	db %07; Display Label	7
10)	db %00; Display Label	8
11)	db %00; Display Label	9
12)	db %00; Display Label	10
13)	db %00; Display Label	11
14)	db %00; Display Label	12
15)	db %00; Display Label	13
16)	db %00; Display Label	14
17)	db %00; Display Label	15
18)	db %00; Display Position	16
19)	db %01; Display Position	17
20)	db %02; Display Position	18
21)	db %03; Display Position	19
22)	db %04; Display Position	20
23)	db %05; Display Position	21
24)	db %06; Display Position	22
25)	db %07; Display Position	23
26)	db %08; Display Position	24
27)	db %09; Display Position	25
28)	db %0A; Display Position	26
29)	db %0B; Display Position	27
30)	db %0C; Display Position	28
31)	db %0D; Display Position	29
32)	db %0E; Display Position	30
33)	db %0F; Display Position	31

The first row identifies the file as a table specifier ([TABLE]) followed by the starting address in memory to load the table ([7800]), followed the length in bytes contained on each row ([1]) followed by the number of rows ([32]). None of the values in the first row can be modified.

Only Rows 2-9 and 18-26 are used – the other rows are reserved.

Rows 2-9 contain two digit hexadecimal values corresponding to the analog channel assigned to the display label and calibration table. For example row 2 contains the value 01 HEX which corresponds to channel A1 which is pin 3 on the 9-pin data connector. Row 3 contains the value 04 HEX which is channel 4 and pin 5 on the connector and so on.

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Rows 18-26 are used to determine the position each display label will have when picked up and displayed by the vDash utility. Since the vDash utility can display up to 9 values on a single screen – these numbers determine which position (row) on the screen the sensor will occupy. The numbers entered in rows 18-26 are appended to the end of the Display Labels when constructing the NMEA sentence and then used by the vDash Utility to determine row position. Range of values is 00 HEX to 08 Hex.

Alarms Tables

The Alarms table is used to set min and max alarm thresholds for each of the 8 sensor inputs. After the analog conversion and digital averaging, the 10 bit vales are scaled to 8-bit values and used to perform a lookup of actual display values from the Calibration tables. 8-bit digital values have a range from 0 to 255. Every sensor input is scaled to this range. Min alarms are defined as being tripped when the scaled sensor value is below the min set point. Max alarms are defined as being tripped when the scaled sensor value is above the max set point.

```
1)      [TABLE] [7800] [1] [128]
2)      db %20,      ;"OIL      " ;0
3)      db %FF,
4)      db %00,      ;"ENGINE  " ;1
5)      db %E0,
6)      db %00,      ;"TRANS  " ;2
7)      db %FF,
8)      db %00,      ;"VOLT   " ;3
9)      db %FF,
10)     db %00,      ;"AMPS   " ;4
11)     db %FF,
12)     db %00,      ;"PORT   " ;5
13)     db %FF,
14)     db %00,      ;"STRB   " ;6
15)     db %FF,
16)     db %00,      ;"FUEL   " ;7
17)     db %FF,
18)     db %00,      ;"ALARM  " ;8
19)     db %FF,
20)     db %00,      ;"ALARM  " ;9
21)     db %FF,
22)     db %00,      ;"ALARM  " ;A
23)     db %FF,
24)     db %00,      ;"ALARM  " ;B
25)     db %FF,
26)     db %00,      ;"ALARM  " ;C
27)     db %FF,
28)     db %00,      ;"ALARM  " ;D
29)     db %FF,
30)     db %00,      ;"ALARM  " ;E
31)     db %FF,
32)     db %00,      ;"ALARM  " ;F
33)     db %FF,
```

The first row identifies the file as a table specifier ([TABLE]) followed by the starting address in memory to load the table ([7800]), followed the length in bytes contained on each row ([1]) followed by the number of rows ([128]). None of the values in the first row can be modified.

The following 16 rows contain the alarm value pairs used for each sensor. While there are 128 rows, only the first 16 rows (2-17) are used. The remaining rows are reserved for future upgrades. Each alarm value must start with “db ” and end with “;”. This can not be modified. Each label must contain exactly 1 hex byte starting with a “%” symbol and followed by two hexadecimal characters. In hexadecimal notation %FF is equal to 255 decimal. Anything after the “;” character is considered a comment and ignored.

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Alarm values are entered in pairs with the first value being the min alarm threshold and the second being the max threshold. If the min threshold is set to %00, then the min alarm is disabled since no sensor value can be less than 0. If the max threshold is set to %FF, then the max alarm is disabled since no sensor value can be greater than 255. In this way, various min and max alarms can be disabled.

In this example row 2 contains the hexadecimal value %20 which translates to 32 decimal. This value is associated with the 32ed row of the OIL pressure lookup table and indicates the min OIL pressure alarm will sound if the scaled sensor value drops below 32ed row. If the 32ed row in the OIL Pressure calibration table corresponds to the display value of 10 PSI then the alarm will sound when pressure drops below 10 PSI. Since the max alarm (row 3) is set to %FF (255 decimal) the max alarm is disabled. In other words, the values used in the Alarm Table are row indexes in the matching Calibration tables used to trigger alarm events.

Calibration Tables

The vGauge-Remote contains 12 calibration tables used to convert sensor input to display values. Sensor inputs are averaged, scaled, and converted to digital values with a range from 0 to 255 decimal. These values are then used to look up 8 character values from a 256 row calibration table. As a result, vGauge-Remote can be easily configured to adapt to virtually any type of sensor input and adjusted to precisely match sender profiles.

The calibration table must conform to a strict format to be loaded. The first row of the text file must start with “[TABLE] [Table Address] [Num of Characters per line = 8] [Number of lines = 256]” to indicate to the download program it is a text file. The remaining 256 lines are the display lookup values corresponding to each of 256 table indexes. No extra spaces or other symbols can be inserted as the file is parsed by position.

Following is an example of a partial table used to display battery voltage. The actual table has 256 indexed values.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	17
[	T	A	B	L	E	]	[	C	0	0	0	]	[	8	]	[	2	5	6]	
d	b	‘				0	.	0	#	0	0	‘	;	0	0	0					
d	b	‘				0	.	1	#	0	0	‘	;	0	0	1					
d	b	‘				0	.	1	#	0	0	‘	;	0	0	2					
d	b	‘				0	.	2	#	0	0	‘	;	0	0	3					
d	b	‘				0	.	3	#	0	1	‘	;	0	0	4					
d	b	‘				0	.	3	#	0	1	‘	;	0	0	5					
d	b	‘				0	.	4	#	0	1	‘	;	0	0	6					
d	b	‘				0	.	5	#	0	1	‘	;	0	0	7					
d	b	‘				0	.	5	#	0	2	‘	;	0	0	8					
d	b	‘				0	.	6	#	0	2	‘	;	0	0	9					
d	b	‘				0	.	7	#	0	2	‘	;	0	1	0					
d	b	‘				0	.	7	#	0	2	‘	;	0	1	1					
d	b	‘				0	.	8	#	0	3	‘	;	0	1	2					
d	b	‘				0	.	9	#	0	3	‘	;	0	1	3					
d	b	‘				0	.	9	#	0	3	‘	;	0	1	4					
d	b	‘				1	.	0	#	0	3	‘	;	0	1	5					
d	b	‘				1	.	1	#	0	4	‘	;	0	1	6					
d	b	‘				1	.	1	#	0	4	‘	;	0	1	7					

- Column 0-3 must be “db ” to indicate start of data field
- Column 4-9 is the 6 character display value associated with the table index
- Column 10-11 is two character (HEX) used for graphic display lookup
- Column 12-13 must be “;” to indicate end of display values
- Column 14 – is a comment and usually is the table row index number for reference

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The 6 character display value can be any alpha-numeric value but usually is a numeric sequence representing the desired readout for the given table index. The “#” character is reserved to skip the space when displaying the sequence. For example ‘1.3###04’ will only display the 4 character value “1.3”. Most display values will only be 4 characters long.

The 2 character HEX Graphic Display Lookup value is used to calibrate the graphic displays. The values range for 0x00 Hex to 0x3F Hex (63 decimal) where 0x3F represents the maximum range for the graphic display. Normally these values can increase in a linear fashion from 0x00 to 0x3F. However, they can be adjusted in a non-linear sequence to give graphic displays more resolution in a desired operating range. For example if it is desired to have more sensitivity at vehicle operating temperature of 180 F, these values can be adjusted so graphic displays ramp quickly and then level off.

Less sensitive graphic display	More sensitive graphic display
db '55F 20' ; 164	db '155F 31' ; 229
db '60F 20' ; 165	db '160F 32' ; 230
db '65F 20' ; 166	db '165F 33' ; 231
db '70F 20' ; 167	db '170F 34' ; 232
db '75F 21' ; 168	db '175F 35' ; 233
db '80F 21' ; 169	db '180F 36' ; 234
db '85F 21' ; 170	db '185F 37' ; 235
db '90F 21' ; 171	db '190F 38' ; 236
db '95F 22' ; 172	db '195F 39' ; 237
db '100F 22' ; 173	db '200F 3A' ; 238
db '105F 22' ; 174	db '205F 3B' ; 239
db '110F 22' ; 175	db '210F 3C' ; 240

Each table has 2048 characters to modify and there are 88 choices for each character for a total of over 18,000 character choices for each table. For this reason the tables are much too large to be modified directly from the Setup Mode. However table files can be obtained and downloaded to the unit to allow for modification of any table. All that is needed is a computer interface (RS232 or Bluetooth) and a communication program such as HyperTerminal or the vDash utility.

Contact Checto Digital Instruments or <http://www.chectodigital.com/vgauge/support.htm> for more information on obtaining additional table files to match particular senders/sensors.

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Parameters Table

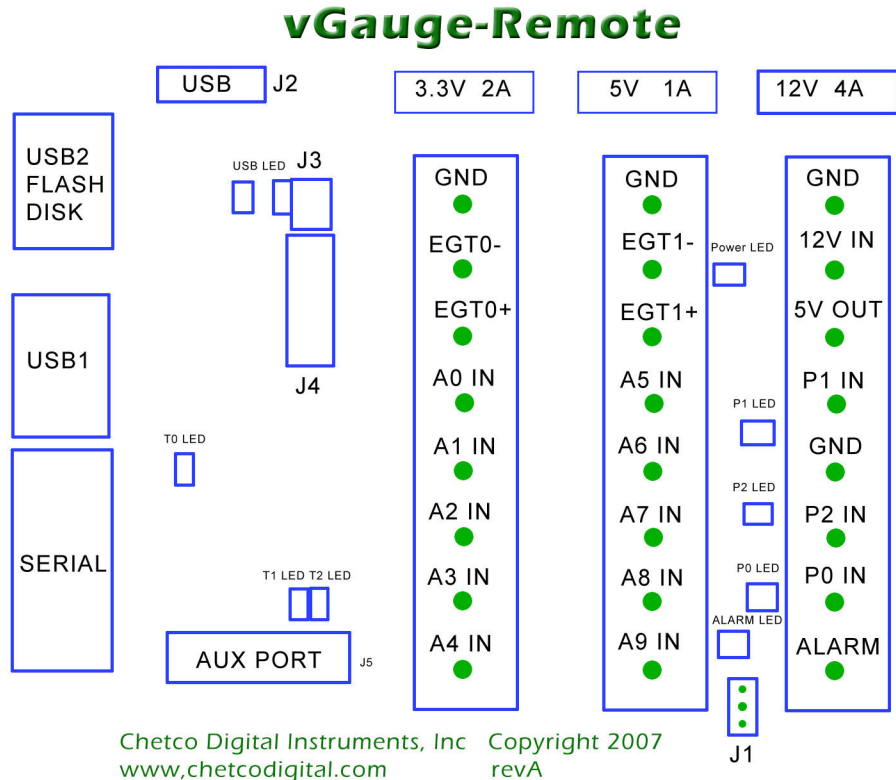
vGauge-Remote has many functions which are configured via the PARAMETERS table. All operating parameters can be modified using the vDash utility and are provided here only for informational purposes. Please consult the vDash users manual for more detail on user modification.

Connectors

The vGauge-Remote unit has three terminal blocks for attachment of power and sensor inputs. Each terminal provides a screw down attachment to 0.25" spade or lug termination for reliable connection.

The USB ports use standard A-type male cables. USB specification limits cable length to no more than 16 feet without a repeater.

Serial ports are either female DB9 to RJ45 jack depending on the model. The serial port can drive a remote display or PC up to 150 feet without a repeater. For long cable runs, an adaptor may be provided to allow use of common CAT5 Ethernet cable wired for serial data transmission. **IMPORTANT – RJ45 JACK IS WIRED FOR SERIAL AND WILL NOT WORK IN AN ETHERNET ENVIRONMENT.**



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System Power

System power is supplied via the 8-pin terminal block. The block also provides the reference voltage used for some sensors and the alarm signal

<i>POWER (T0)</i>				
<i>Pin</i>	FUSE	Function	Direction	Volt
<i>P0</i>	-	Ground	IN	0
<i>P1</i>	4 AMP	12 Volt Input power	IN	12
<i>P2</i>	1 AMP	5 Volt Output	OUT	0-5
<i>P3</i>	-	P1 IN	IN	0-12
<i>P4</i>	-	Ground	IN	0
<i>P5</i>	-	P2 IN	IN	0-12
<i>P6</i>	-	P0 IN	IN	0-12
<i>P7</i>	-	Alarm Out	OUT	3.3 or 5

The Power wire is connected to battery (+12 volts) via a switched 3 Amp fuse circuit. Never connect directly without providing a fused circuit. Circuit should be powered when key is on and power removed when key is off.

The ground wire should be connected to a solid ground bus located near the unit. The case is grounded and can be connected to system ground. Be sure to connect the ground wire from the cable and never rely on the case for ground.

The alarm signal provides the ground for a 2-wire pizo-electric alarm or buzzer. The hot lead of the alarm is connected via fuse to power source and ground connected directly to alarm signal. The alarm should draw no more then 25 mA. Never connect the alarm without a fuse.

The reference voltage is used to supply senders that require a regulated 5 volt source. Some senders like pressure, position, and fuel level may require fixed reference voltage. Never connect the reference without a 1 Amp fuse. Maximum current supplied by the reference is 500 mAmps.

The Pulse signal is used for RPM or other rotational senders that output a pulse stream of 12 volts maximum. The circuit is normally connected to the tach output of the ignition system to calculate RPM but can be used for other senders.

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Sensors

The sensor terminal blocks are used to interface with various senders to provide information to the unit. The information supplied in the following table is typical but may be different dependent on your application.

There are two basic classes of senders – those that provide a resistive load to ground and those that provide a voltage.

Senders that provide a resistance to ground (temperature/pressure) are easily interfaced by using a pull-up resistance. This resistance should be set to the mid-range resistance of the selected sender.

Senders that produce a voltage need to limit the full range voltage to no more than 3.3 volts. These senders will require a voltage divider (series/pull-down) to scale the range down to 3.3 volt max. For example – to support a voltage reading of 0-20 volts requires a scale down of $3.3/20 = 0.165$. Using the voltage divider calculation of $V_{out} = V_{in} (R_{pd}/(R_{pd} + R_s))$ if we set R_{pd} to 1000 and R_s to 5000, the resulting divider is $1/6 = 0.166$.

The standard vGauge-Remote configuration is to provide four temperature sender inputs, two voltage inputs and four pressure inputs.

- **Temperature Inputs** – These inputs are designed to be used with standard coolant senders with a resistance of 1000 ohms at 70 degrees F. Most VDO and GM style senders fit into this range.
- **Voltage Inputs** – These inputs use a voltage divider ratio of 1/6 and can accept input voltages up to 19.8 volts. Do not connect to a voltage source greater than 20 volts or damage to the unit will result.
- **Pressure Inputs** – These inputs are designed to be used with standard oil pressure senders of 0-45 PSI and an resistance range of 0 – 200 ohms. Most VDO and GM style senders fit into this range.
- **EGT Inputs** – These inputs are designed to be used with K-Type thermocouples with a range from 45F to 1650F. If using ungrounded probes, strap the EGT-terminal to ground.

The vGauge-Remote can be ordered with any combination of R_{pu} , R_{pd} , and R_s for each of the eight sensor inputs that match your application. Contact Chetco Digital Instruments for your custom application.

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<i>SIGNAL (T1)</i>									
<i>Pin</i>	<i>Color</i>	<i>Channel</i>	<i>Function</i>		<i>Pull-Up Ω</i>		<i>Pull-Down Ω</i>		<i>Series Ω</i>
<i>P0</i>	Black	-	GROUND	-	-	-	-	-	-
<i>P1</i>	Yellow	-	EGT1-	-	-	-	-	-	-
<i>P2</i>	Red	A9	EGT1+	R34	-	R24	5000	R14	10000
<i>P3</i>	-	A1	PSI1	R33	50	R23	-	R13	-
<i>P4</i>	-	A5	PSI2	R32	50	R22	-	R12	-
<i>P5</i>	-	A7	PSI3	R31	50	R21	-	R11	-
<i>P6</i>	-	A3	PSI4	R30	50	R20	-	R10	-
<i>P7</i>	-	A11	VOLT2	R37	-	R27	1000	R17	10000

<i>SIGNAL (T2)</i>									
<i>Pin</i>	<i>Color</i>	<i>Channel</i>	<i>Function</i>		<i>Pull-Up Ω</i>		<i>Pull-Down Ω</i>		<i>Series Ω</i>
<i>P0</i>	Black	-	GROUND	-	-	-	-	-	-
<i>P1</i>	Yellow	-	EGT0-	-	-	-	-	-	-
<i>P2</i>	Red	A8	EGT0+	R34	-	R24	5000	R14	10000
<i>P3</i>	-	A0	TEMP1	R33	300	R23	-	R13	-
<i>P4</i>	-	A4	TEMP2	R32	300	R22	-	R12	-
<i>P5</i>	-	A6	TEMP3	R31	300	R21	-	R11	-
<i>P6</i>	-	A2	TEMP4	R30	300	R20	-	R10	-
<i>P7</i>	-	A10	VOLT1	R37	-	R27	1000	R17	10000

NOTE – WHEN USING UNGROUNDED EGT PROBES, BE SURE TO STRAP EGT- TO GROUND

Ports

The serial port connector provides the interface to a computer RS232 interface for command and status control of the unit. The unit can be remotely controlled via this interface using ASCII command sequences or the optional software utilities. Status information is transmitted out this interface using NMEA 0185 \$IIXDR sentences. Status information includes current gauge readings and display labels.

Cables are supplied for connection to this interface and there should be no need to interface directly. A serial interface cable is normally used to remotely control the unit or to collect status information in NMEA 0185 format. Internal jumpers can be set if reprogramming is necessary and uses the same serial port and cables

Default baud rate is 9600, 8 bits, no parity, 1 stop bit, no flow control

<i>SERIAL DB9 (P3)</i>				
<i>Pin</i>	<i>Color</i>	<i>Function</i>	<i>Direction</i>	<i>Volt</i>
<i>1</i>	-	-	-	-
<i>2</i>	-	Serial TX	OUT	-5 - + 5
<i>3</i>	-	Serial RX	IN	-5 - + 5
<i>4</i>	-	-	-	-
<i>5</i>	-	Ground	IN	0
<i>6</i>	-	-	-	-
<i>7</i>	-	-	-	-
<i>8</i>	-	-	-	-
<i>9</i>	-	5 Volts	OUT	0-5

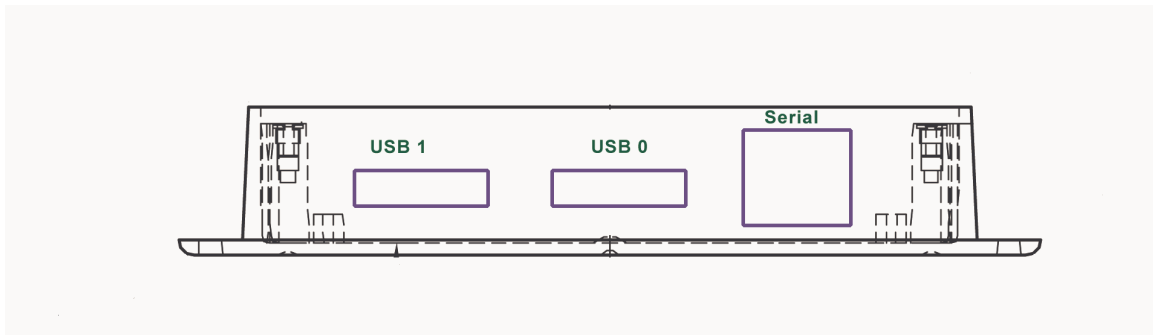
<i>SERIAL RJ45 (P3)</i>				
<i>Pin</i>	<i>Color</i>	<i>Function</i>	<i>Direction</i>	<i>Volt</i>
<i>1</i>	Blue/White	-	-	-
<i>2</i>	Blue	-	-	-
<i>3</i>	Green/White	Serial TX	OUT	-5 - + 5
<i>4</i>	Green	Serial Ground	IN	0
<i>5</i>	Orange	Serial Ground	IN	0
<i>6</i>	Orange/White	Serial RX	IN	-5 + 5
<i>7</i>	Brown/White	-	-	-
<i>8</i>	Brown	-	OUT	5V

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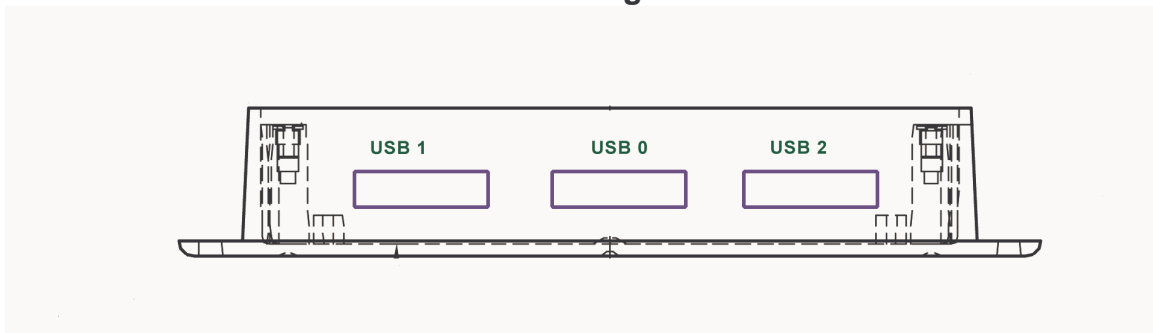
There are two models of vGauge-Remote with different combinations of interface ports. Both models are the same with the exception of substitution of a third USB port in place of the Serial port. Models with a third USB port can still support applications requiring a serial port with an optional USB-to-Serial adapter.

The recommended maximum cable length for a USB port without a repeater is 16 feet (3 meters) while a Serial port can drive up 150 feet (50 meters).

Attachment of a USB device more than 16 feet (3 meters) will require a repeater or and USB-to-Serial adapter



Port locations vGaugeRemote-001



Port locations vGaugeRemote-002

Two USB ports (USB0 or USB1) are provided for attachment to remote display heads or USB flash memory devices. A third port (SERIAL or USB2) is used to interface to host PC or Laptops.

USB Port 0 is used for attaching a remote display head. Only vGauge Remote Display heads will work with this port. USB Port 0 is not intended for attachment to remote PC USB as this is a USB Host port and drives the USB slave display heads. USB specifications prohibit two USB Host devices from driving the same port. **DO NOT ATTACH TO PC USB PORT UNLESS FIRMWARE HAS BEEN MODIFIED TO SUPPORT THIS MODE.**

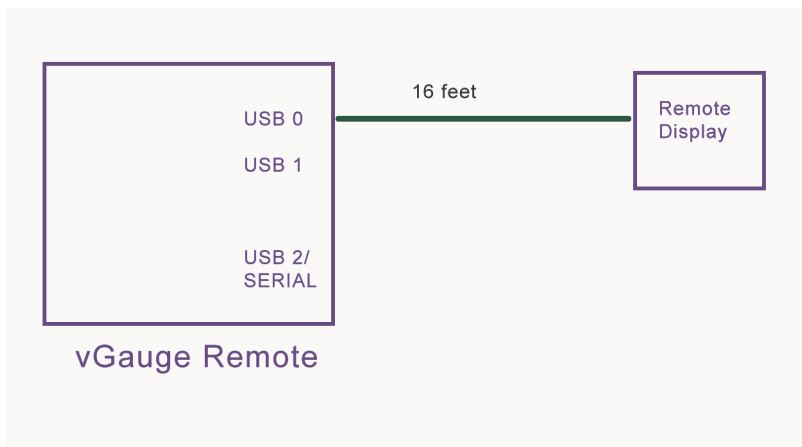
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USB Port 1 is used for data logging to flash memory device or attaching an additional remote display head. The default mode is to disable logging on this port. Logging must be enabled using the vDash program.

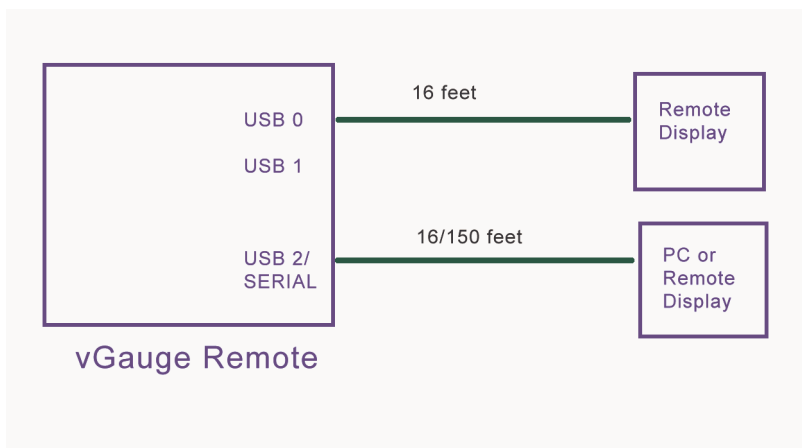
USB Port 2 is used for interfacing to a PC or laptop computer USB port. This is slave port and can not be used to drive a remote display head. When attached to a host PC, the supplied drivers will automatically create a virtual COM port which is used by application software such as vDash to real-time display and device configuration.

Serial Port is used for interfacing to a PC or laptop computer COM port. If the PC does not have a COM port, an optional serial-to-USB adapter can be used. When attached to a host PC, the supplied drivers will automatically create a virtual COM port which is used by application software such as vDash to real-time display and device configuration. If not using this port for configuration, it can be used to drive a remote display head set up for Serial Data Mode using the supplied adapter cable. The default configuration 9600 baud.

The following diagrams show supported modes of operation.

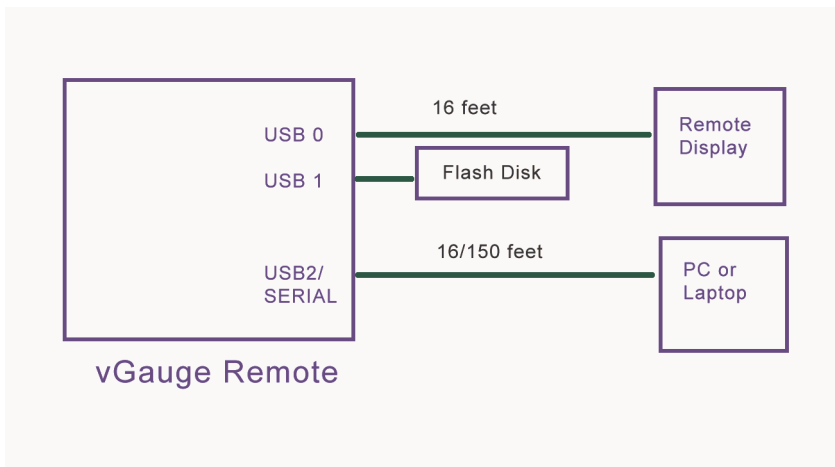


Single USB Display head

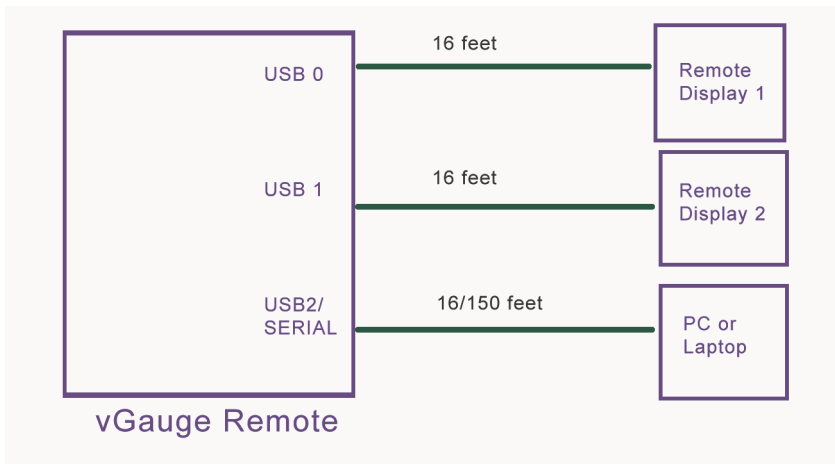


USB Display head and remote PC or another Serial Display Head

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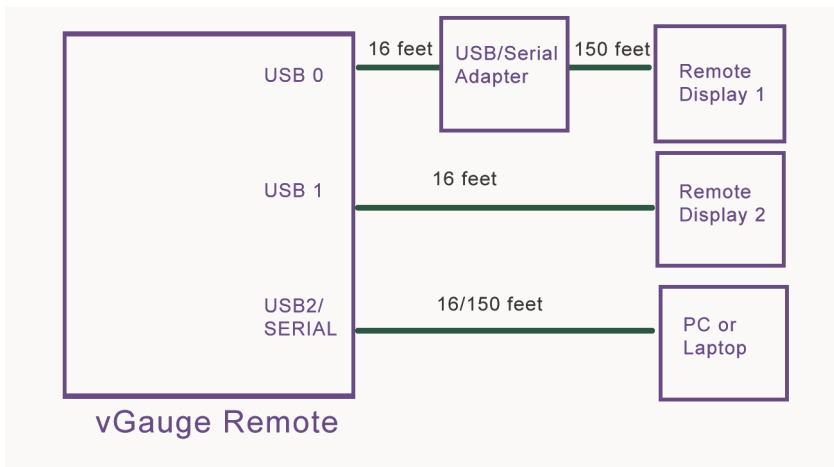


USB Display Head and USB Flash disk with Remote PC via USB/serial port

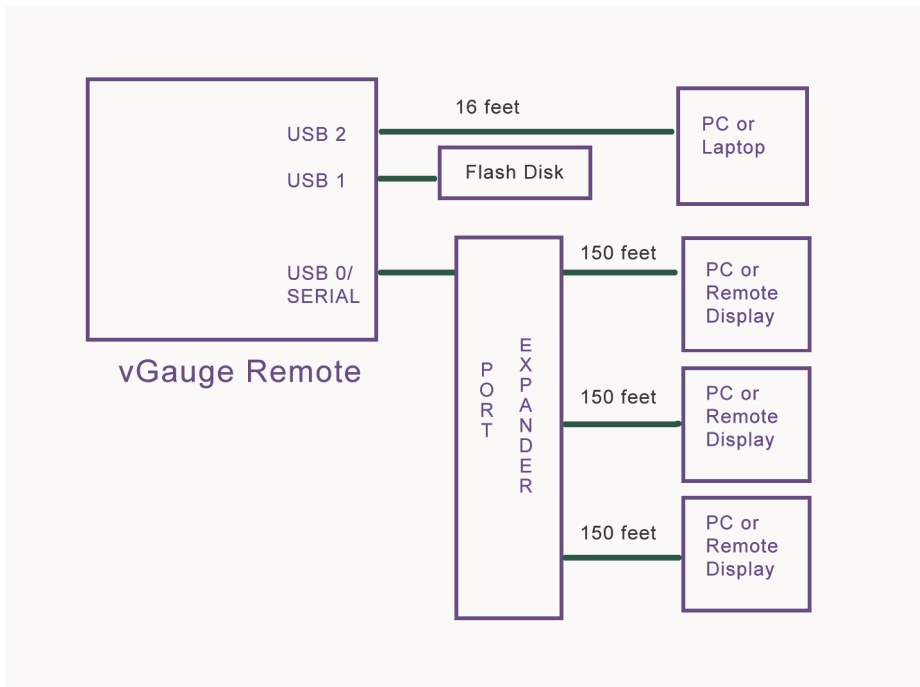


Two USB Display heads and PC/Laptop via third USB port or Serial Port. Only USB 2 can be used for direct connection to host PC/Laptop USB port.

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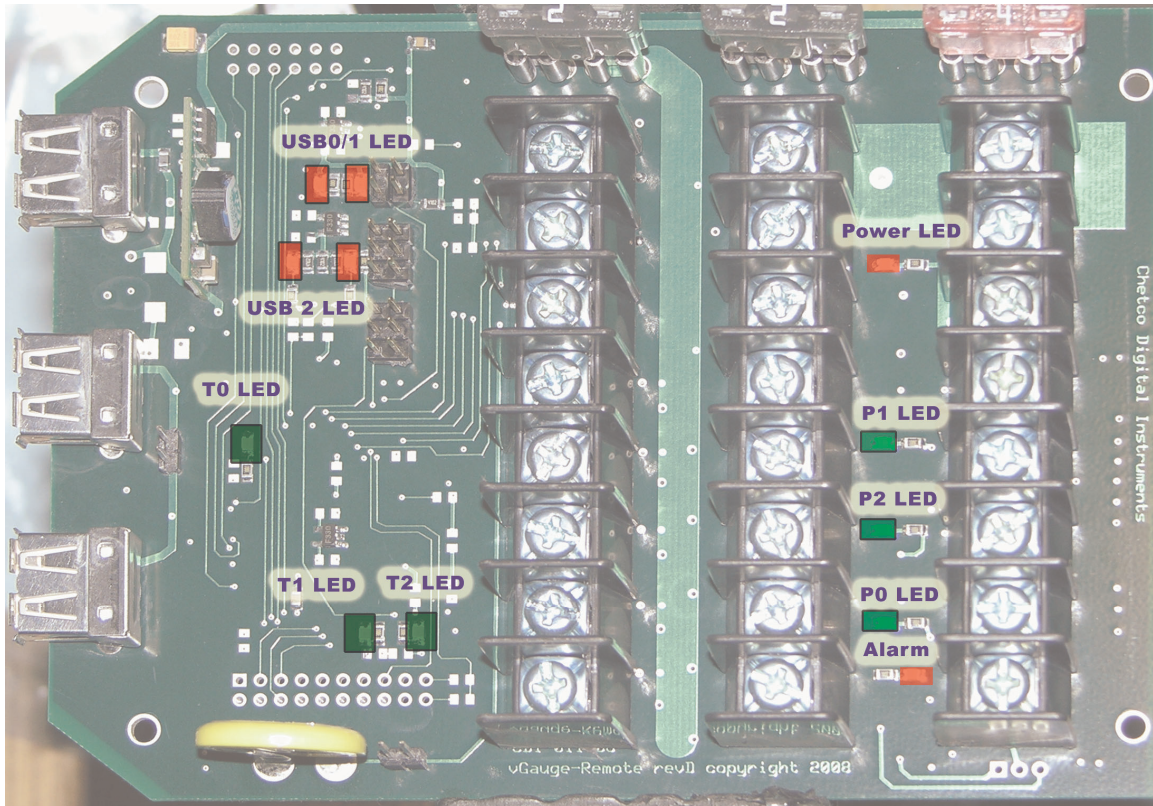
Remote Display head more the 16 feet (3 meters) can be supported by using optional USB-to-Serial adapter and standard CAT5 network cable up to 150 feet (50 meters). Serial port can directly drive a remote display head up 150 feet (50 meters)



Multiple remote display heads can be driven off of one port using optional Port Expander module. Up to three displays can be driven from one port.

LED INDICATORS

vGauge-Remote has several LED's to indicate operational status of the unit. The following diagram shows the locations.



LED Functions

ID	LED	Function	COLOR	STATE
P0	POWER	System Regulated 5 Volts	RED	ON NORMAL
P1	P0	Pulse 0 Input	GREEN	FLASH WITH PULSE
P2	P1	Pulse 1 Input	GREEN	FLASH WITH PULSE
P3	P2	Pulse 2 Input	GREEN	FLASH WITH PULSE
P4	ALARM	Active Alarm condition	RED	ON ALARM
P5	T0	Pulse 0 Divider Out	GREEN	FLASH WITH PULSE
P6	T1	Pulse 1 Divider Out	GREEN	FLASH WITH PULSE
P7	T2	Pulse 2 Divider Out	GREEN	FLASH WITH PULSE
P8	USB0	USB Data TX	GREEN	FLASH WITH TX
P9	USB1	USB Connected	GREEN	ON

Board Jumpers

Several special mode options can be configured via on-board jumpers. Normal operation will not require any modification of the jumpers.

The Alarm jumper block (J1) is used to configure the output drive for alarms. Normal operation (3 & 2) is active high drive of Pizo buzzer or LED. If it is desired to drive a relay or high current lamp, configure jumper for 1 & 2 for active low alarm drive of 100 mA.

<i>J1 ALARM</i>				
<i>ID</i>	<i>Pin</i>	<i>Function</i>		<i>STATE</i>
<i>J1-0</i>	1	Relay Drive	1&2	Active Low Alarm
<i>J1-1</i>	2	Alarm Out	-	-
<i>J1-2</i>	3	LED Drive	3&2	Active High Alarm

The USB jumper block (J2) connects the USB controller to on-board microprocessor. It is used for factory programming of firmware an should not be altered

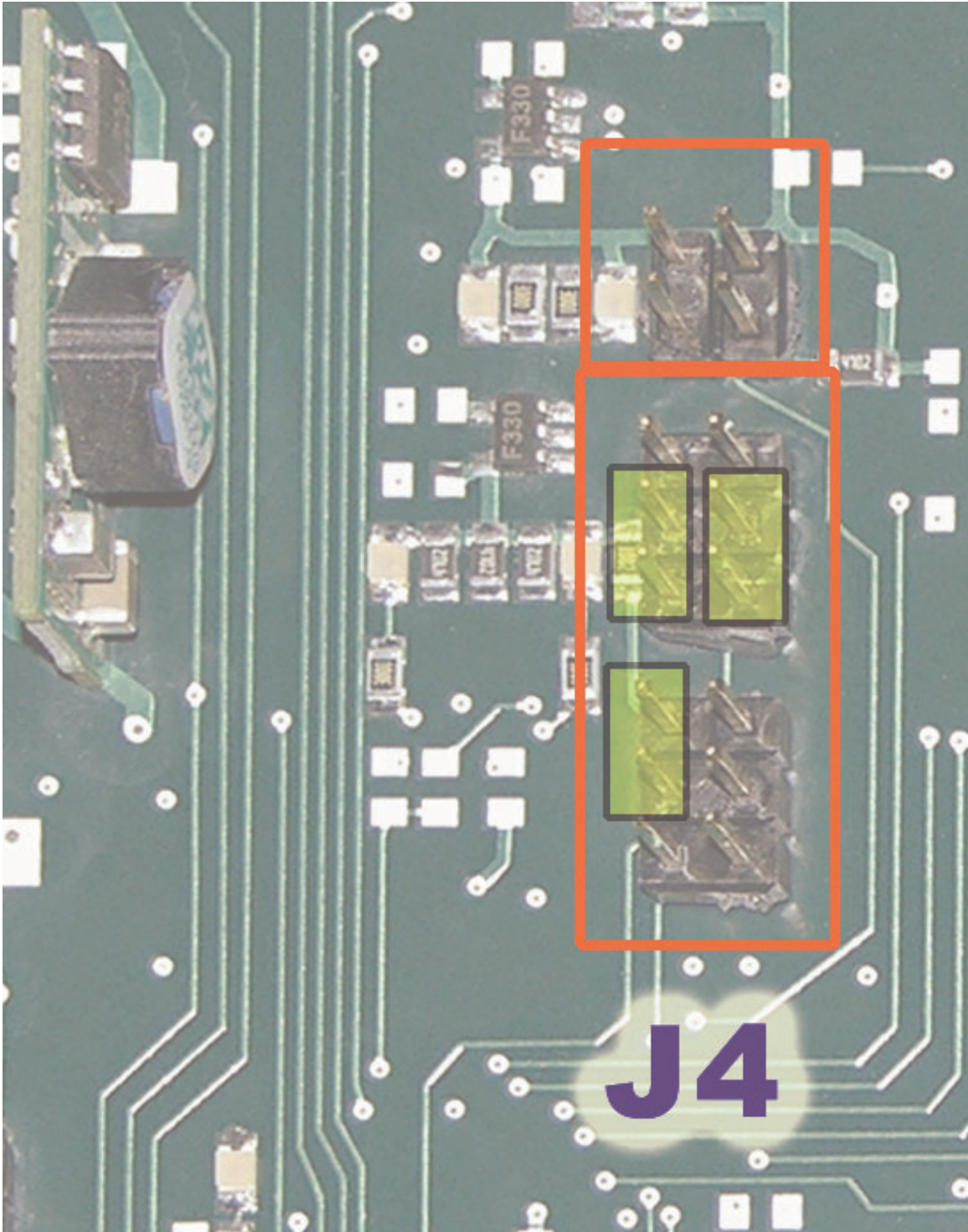
<i>J2 USB Controller</i>				
<i>Pin</i>	<i>Function</i>	<i>Pin</i>	<i>Function</i>	<i>STATE</i>
<i>1</i>	uP RX	7	USB TX	1&7 Normal
<i>2</i>	uP XX	8	USB RX	2&8 Normal
<i>3</i>	uP CTS	9	USB RTS	3&9 Normal
<i>4</i>	uP RTS	10	USB CTS	4&10 Normal
<i>5</i>	GND	11	-	
<i>6</i>	5V	12	-	

The USB Programming jumper block (J3) is used for factory programming of firmware an should not be altered

<i>J3 USB Controller</i>				
<i>Pin</i>	<i>Function</i>	<i>Pin</i>	<i>Function</i>	<i>STATE</i>
<i>1</i>	RESET	3	GND	OPEN Normal
<i>2</i>	PROGRAM	4	GND	OPEN Normal

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The SIO jumper block (J4) is used for firmware modification of the on-board microcontroller and should be used only for firmware upgrades



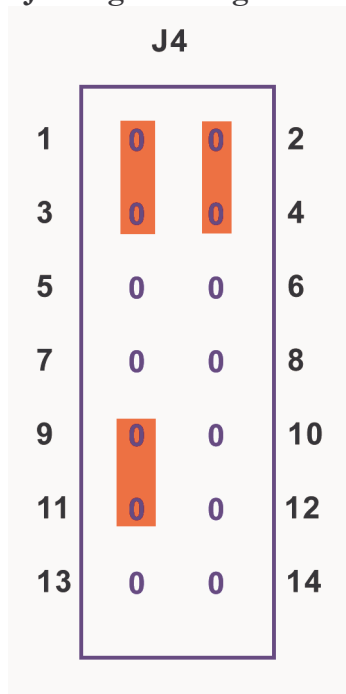
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J4 Flash Controller

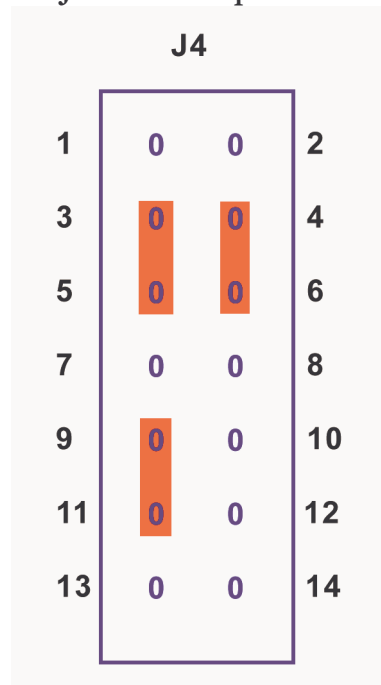
<i>Pin</i>	Function	Pin	Function	STATE
1	uP TX	2	uP RX	1&3 2& 4 Normal
3	Serial TX	4	Serial RX	1&3 2& 4 Normal
5	Flash TX	6	Flash RX	
7	5V	8	-	-
9	DBG0	10	GND	9&11 Normal
11	DBG	12	GND	-
13	RESET	14	3.3V	-

Dasdd

J4 Programming Mode



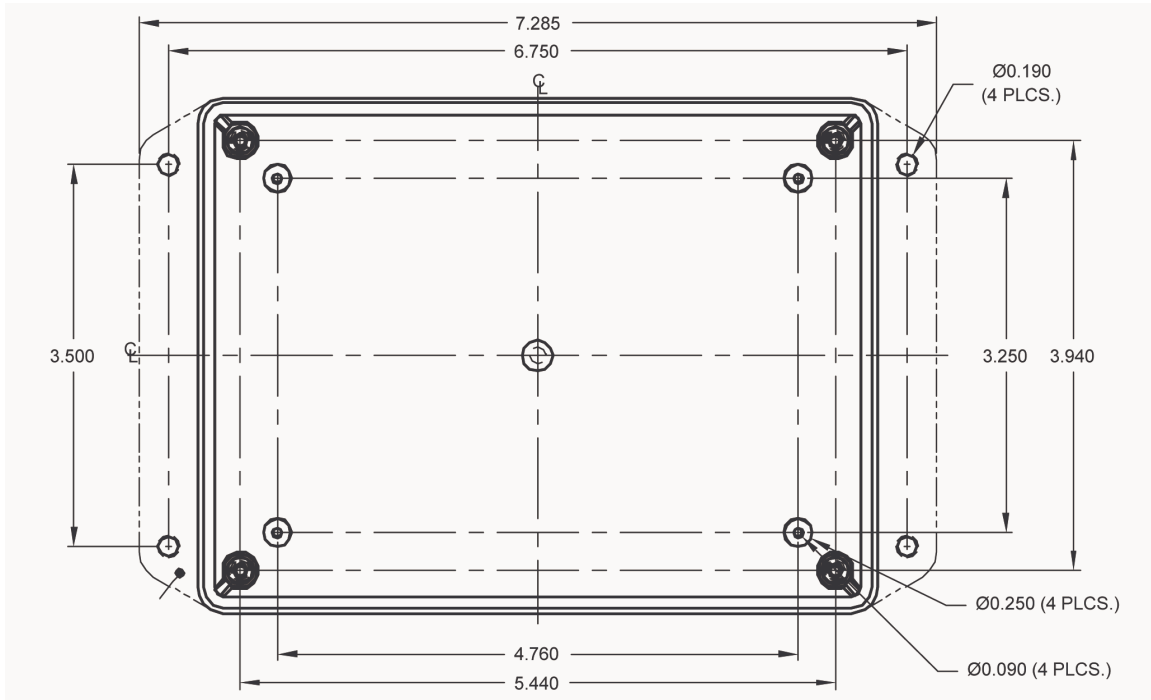
J4 Normal Operation



Installation

Mount

vGauge-Remote can be mounted by securing the four mounting holes with sheet metal screws in a suitable location. When choosing a location, be sure to include room for sensor and power cable entry as well as USB and serial cables. .



It is recommended to secure all sensor and power cables to chassis to avoid wires from moving around and breaking loose. USB and Serial cable should also be secured..

Power

Power is supplied from the accessory bus via a 3 amp fuse. Never attempt to connect power without providing a fused input or serious damage may result. Unit should have power applied when key is in the accessory or run position and power removed when key is off.

Be sure to attach ground lead to a solid ground bus for proper operation. All sensor/sender grounds should be attached to the same ground buss.

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Alarm

The alarm signal can be attached directly to a 3-12 volt pizo buzzer. The ground lead of the pizo buzzer should be attached to the ground buss. Be sure the set the vGauge-Remote alarm function be active HIGH when driving a pizo buzzer directly.

An alternate configuration is required for applications where alarms require more then 25 mA or more then 3.3 volts to operate. In this case the unit can be set to active LOW and provide the ground to a relay circuit to drive a high power alarm. The relay should not require more then 25 mA to close but can be hooked to a 12 volt source. When an alarm occurs the unit will ground the relay which is used to drive the alarm

Pulse input

The unit can detect and count voltage pulses. This is typically used for RPM or MPH calculations. Signals feed into the pulse input should be 5 – 12 volts referenced to ground and not exceed 14 volts. This input is normally attached to the tachometer signal and can be run in parallel with existing gauges. Be careful that the supplied signal does not contain large voltage transients or permanent damage may result. Use caution when connecting directly to the negative terminal of the ignition coil as large voltage spikes may occur if not properly filtered.

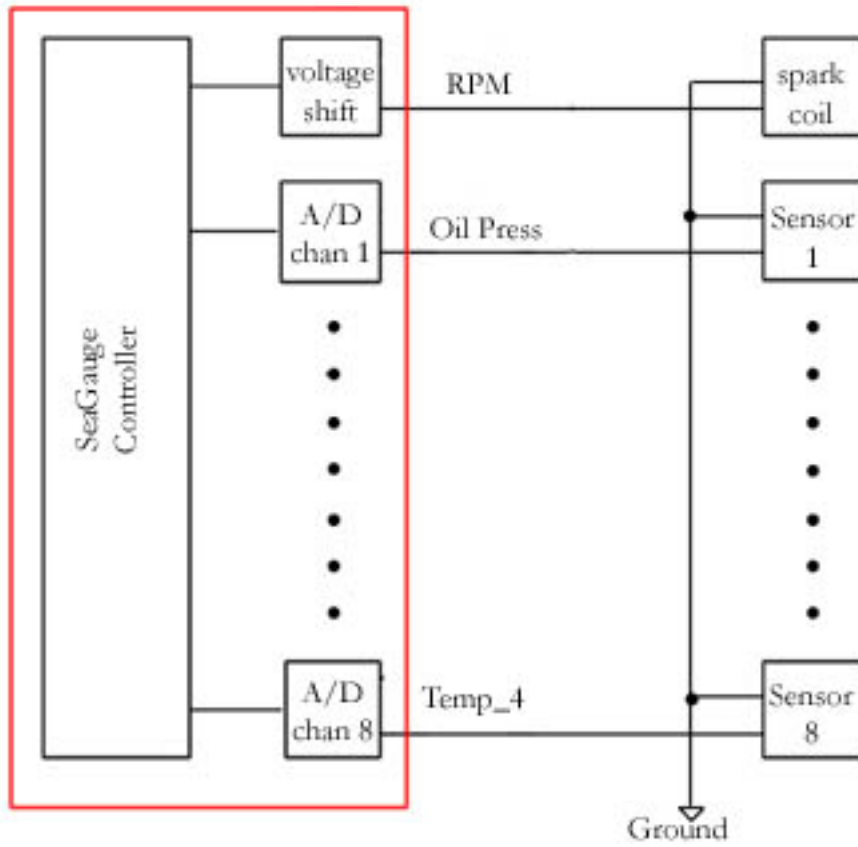
Reference Voltage

The reference voltage output can be used with senders which require a 3.3 volt or 5 volt source such as many pressure senders. This is a low current output not to exceed 500 mA and must be fused to avoid damage to the unit. A built-in 1 Amp fuse is provided to protect the circuit

Signals

The unit supports up to 15 sensor inputs (12 analog and 3 pulse). Refer to the connector diagrams for the proper connection for each type of sender. Any unused sensors should be connected to ground to avoid unwanted noise. Never connect any resistive sensor input (temperature/pressure) directly to a voltage source or damage to the unit may result.

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Calibration Tables

vGauge-Remote utilizes twelve modifiable calibration tables to convert sensor data into user readable display information. The internal Analog-to-Digital converter converts sensor voltages to 10-bit values. The converter can resolve voltages to $3.3/1024 = 3$ mVolts. These values are averaged and then used to lookup 8 character values form a 256 point lookup table. The use of a lookup table allows for accurate readings from non-linear sensors like temperature senders. The lookup table also allows for easy modification of display values to suit individual preferences and senders.

Following is an example of a partial table used to display battery voltage. The actual table has 256 indexed values. The measured voltage has a range from 0 to 3.3 volts. In this example it is desired to measure battery voltage from 0 to 18 volts so the input voltage from the battery is scaled down using a voltage divider ratio of $3.3/18 = 0.1833$. The scaled down voltage is converted to an averaged digital value and then used as an index lookup in the table. For example an Input voltage of 1.178 volts becomes index value 18 in the table which corresponds to the 8 character display value of 1.1 vdc. Using this method allows the VGauge-Remote to display just about any range of values form a large variety of sensors/senders.

<i>Index</i>	<i>Input Voltage</i>	<i>Measured Voltage</i>	<i>Display value</i>
1	0.065	0.012968	0 vdc
2	0.131	0.025936	0.1 vdc
3	0.196	0.038904	0.1 vdc
4	0.262	0.051872	0.2 vdc
5	0.327	0.06484	0.3 vdc
6	0.393	0.077808	0.3 vdc
7	0.458	0.090776	0.4 vdc
8	0.523	0.103744	0.5 vdc
9	0.589	0.116712	0.5 vdc
10	0.654	0.12968	0.6 vdc
11	0.720	0.142649	0.7 vdc
12	0.785	0.155617	0.7 vdc
13	0.851	0.168585	0.8 vdc
14	0.916	0.181553	0.9 vdc
15	0.981	0.194521	0.9 vdc
16	1.047	0.207489	1.0 vdc
17	1.112	0.220457	1.1 vdc
18	1.178	0.233425	1.1 vdc
19	1.243	0.246393	1.2 vdc
20	1.309	0.259361	1.3 vdc
21	1.374	0.272329	1.3 vdc
22	1.439	0.285297	1.4 vdc
23	1.505	0.298265	1.5 vdc
24	1.570	0.311233	1.5 vdc
25	1.636	0.324201	1.6 vdc
26	1.701	0.337169	1.7 vdc

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27	1.767	0.350137	1.7 vdc
28	1.832	0.363105	1.8 vdc
29	1.897	0.376073	1.8 vdc
30	1.963	0.389041	1.9 vdc

Each table has 2048 characters to modify and there are 88 choices for each character for a total of over 18,000 character choices for each table. For this reason the tables are much too large to be modified directly from the Setup Mode. However table files can be obtained and downloaded to the unit to allow for modification of any table. All that is needed is a computer interface (RS232 or Bluetooth) and a communication program such as HyperTerminal or the vDash utility. Contact Checto Digital Instruments for more information on obtaining additional table files to match particular senders/sensors.

Serial Port Protocols

The serial port interface of the VGauge-Remote unit can be used for real-time status and reprogramming. The status information is sent in NMEA 0183 format using the \$IIXDR sentence format. Custom NMEA control sentences are used to control the unit via the serial port interface.

To access the serial port information – connect the supplied cable to computer RS232 port. Set the baud rate of the computer interface to match the baud rate of the unit (4800 or 9600). Use the standard 8 bits, no parity, and 1 stop bit (8-N-1). Start a serial interface program such as HyperTerminal with these settings then power up the unit. If the connection is correct you will status message from the unit –

VGauge-Remote Version 1.02. This indicates the settings are correct.

NMEA 0183 support custom message formats for command and control of propriety equipment. VGauge-Remote uses the sentence structures:

\$PCDIC,X - for control were X is the control command

- **N** = Next menu. Same as pressing the top button
- **S** = Set function. Same as pressing the bottom button
- **G** = Start dumping NMEA \$IIXDR sentences in real-time at two updates per second
- **P** = Initiate programming the unit
- **B** = Initialize the Bluetooth module.

\$PCDIS,YYYYYY – for status where YYYYYY is the returned status information

- \$PCDIS,VGAUGE-REMOTE,0001.100,*,79 = Model Name and Firmware revision

Instrumentation data is returned using the standard NMEA \$IIXDR sentence structure:

\$IIXDR,X,DATA,U,LABEL,CHECKSUM

- **X** = sensor type (G,P,C,..)
- **DATA** = 8 character sensor data value returned from the lookup table
- **U** = unit of measurement specifier
- **LABEL** = 8 character sensor label and a 1 character number representing the channel
- **CHECKSUM** = NEMA check sum calculation on the string

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NEXT MENU

The **\$PCDIC,N** command is used to command the unit to display the next menu or group. It functions exactly the same as pressing the top button on the unit

SET Function

The **\$PCDIC,S** command is used to enter Set-up mode or increment a setting. It operates the same as pressing the bottom button on the unit.

Real-time data

The **\$PCDIC,G** command is used to view real-time instrumentation from the serial port. When the unit is first powered up it will start listening to the default serial port (RS232 or Bluetooth) for commands. It will not dump data until it receives the **\$PCDIC,G** command. To view real-time data type this command in HyperTerminal after you see the prompt. Data for each of the sensors will immediately begin to be displayed in NMEA 0183 \$IIXDR sentence format. The unit will dump data for all 8 sensors every 0.5 seconds.

HyperTerminal allows capture of real-time data to a text file. First enable the Capture Text command under the Transfer menu. Select the file name and location to capture to. Next enter the **\$PCDIC,G** command string to start dumping data to the specified file.

Program Mode

The **\$PCDIC,P** command is used to put the unit into reprogramming mode. Once in this mode a programming file can be sent to the unit to update Lookup Tables, Sensor labels, Display Groups, Label positions, or channel assignments.

Use caution when using this command as improper use will erase the unit and it will have to be sent back for reprogramming.

Programming files can be obtained from Chetco Digital Instruments for use in this mode. These are in a special propriety format and can not be constructed or edited in the field. Contact Chetco Digital Instruments for more information on this option.

Download of new table information requires three steps:

- Enter program mode
- Erase existing table
- Load new table

Program mode is entered by using the **\$PCDIC,P** command from HyperTerminal. If this command is successful the unit will display:

- **READY->**

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At this point the unit will wait to receive the starting and ending pages to erase. Page numbers are 512 bytes and can be calculated by dividing the starting page memory location by 512. The following table will help you determine the table page numbers.

<i>Table</i>	<i>Bytes /line</i>	<i>Address</i>	<i>Start Page</i>	<i>End Page</i>	<i>Erase Command</i>
Sensor Labels	8	6800	34	37	*3438
Groups	1	7000	38	3B	*383C
Label Positions	1	7000	38	3B	*383C
Alarms	1	7800	3C	3F	*3C40
Channels	1	7800	3C	3F	*3C40
Parameters	1	7800	3C	3F	*3C40
Lookup Table 0	8	0800	04	07	*0408
Lookup Table 1	8	1000	08	07	*080C
Lookup Table 2	8	1800	0C	0B	*0C10
Lookup Table 3	8	2000	10	13	*1014
Lookup Table 4	8	2800	14	17	*1418
Lookup Table 5	8	3000	18	1B	*181C
Lookup Table 6	8	3800	1C	1F	*1C20
Lookup Table 7	8	4000	20	23	*2024
Lookup Table 8	8	4800	24	27	*2428
Lookup Table 9	8	5000	28	2B	*282C
Lookup Table 10	8	5800	2C	2F	*2C30
Lookup Table 11	8	6000	30	33	*3034

To erase the memory you must enter a “*” symbol followed by the start and end page values with no spaces. For example to erase the Alarms table enter:

- ***3C40**

To erase Lookup Table 3 enter:

- ***1014**

Once you have entered the 5 characters the unit will erase the memory and respond with

- **ERASED->**

At this point the unit will wait to receive the data to reprogram the unit. Use the HyperTerminal Send Text File function to transfer the appropriate file to reprogram the memory. As the file is transferring data the unit will display the memory address for each update. The display should increment till it reaches the end of file and then reset if no errors occur.

One Year Warranty

“We”, “our”, or “us” refers to **Chetco Digital Instruments**, the manufacturer of this product. “You” or “your” refers to the first person who purchases this product as a consumer item for personal, family, or household use.

We warrant this product against defects or malfunctions in materials and workmanship, and against failure to conform to this product's written specifications, all for one year (1) from the date of original purchase by you. **WE MAKE NO OTHER EXPRESS WARRANTY OR REPRESENTATION OF ANY KIND WHATSOEVER CONCERNING THIS PRODUCT.** Your remedies under this warranty will be available so long as you can show in a reasonable manner that any defect or malfunction in materials or workmanship, or any nonconformity with the product's written specifications, occurred within one year from the date of your original purchase, which must be substantiated by a dated sales receipt or sales slip. Any such defect, malfunction, or non-conformity which occurs within one year from your original purchase date will either be repaired without charge or be replaced with a new product identical or reasonably equivalent to this product, at our option, within a reasonable time after our receipt of the product. If such defect, malfunction, or non-conformity remains after a reasonable number of attempts to repair by us, you may elect to obtain without charge a replacement of the product or a refund for the product. **THIS REPAIR, REPLACEMENT, OR REFUND (AS JUST DESCRIBED) IS THE EXCLUSIVE REMEDY AVAILABLE TO YOU AGAINST US FOR ANY DEFECT, MALFUNCTION, OR NON-CONFORMITY CONCERNING THE PRODUCT OR FOR ANY LOSS OR DAMAGE RESULTING FROM ANY OTHER CAUSE WHATSOEVER. WE WILL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO ANYONE FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, OR OTHER INDIRECT DAMAGE OF ANY KIND.**

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This warranty does NOT apply in the following circumstances: (1) when the product has been serviced or repaired by anyone other than us, (2) when the product has been connected, installed, combined, altered, adjusted, or handled in a manner other than according to the instructions furnished with the product, (3) when any serial number has been effaced, altered, or removed, or (4) when any defect, problem, loss, or damage has resulted from any accident, misuse, negligence, or carelessness, or from any failure to provide reasonable and necessary maintenance in accordance with the instructions of the owner's manual for the product.

We reserve the right to make changes or improvements in our products from time to time without incurring the obligation to install such improvements or changes on equipment or items previously manufactured.

This warranty gives you specific legal rights and you may also have other rights which may vary from state to state.

REMINDER: You must retain the sales slip or sales receipt proving the date of your original purchase in case warranty service is ever required.

**Chetco Digital Instruments, INC.
14377 Highway 101 South Unit C
Harbor, OREGON 97415
541-661-2051**

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How to Obtain Service

We back your investment in quality products with quick, expert service and genuine replacement parts. If you're in the United States and you have questions, please contact the Factory Customer Service Department using our number listed below. You must send the unit to the factory for warranty service or repair. Please call the factory before sending the unit. You will be asked for your unit's serial number (shown above). Use the following number:

541-661-2051

U.S.A. only. Monday through Friday, except holidays.

Your unit is covered by a full one-year warranty. (See inside for complete warranty details.) If your unit fails and the failure is not covered by the original warranty, Chetco Digital Instruments has a flat-rate repair policy that covers your unit and accessories packed with the unit at the factory. There is a 180-day warranty on all non-warranty repairs from the factory, which is similar to the original warranty, but is for 180 days rather than one year. For further details, please call us at the above number.

Remember, non-warranty repairs are subject to Chetco Digital Instruments published flat rate charges and 180-day warranty.

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