



ECQUE

**Quadrature Shaft Encoder with ECN Protocol Interface
including the Display option**

User Reference Manual

Firmware Revision #

Updated: January 17, 2002

<http://www.amassdata.com>

Clockwise rotation of the pulley represents rising water levels when the scale is positive, otherwise the scale must be set negative.

TABLE OF CONTENTS

1. <u>ECQUE SHAFT ENCODER</u>	3
1.1. <u>OPTIONS</u>	4
1.2. <u>QUADRATURE ENCODER -PRINCIPLE OF OPERATION</u>	4
2. <u>ECN PROTOCOL</u>	5
3. <u>ECN COMMANDS</u>	6
3.1. <u>ECN COMMAND SYMBOLS</u>	6
3.2. <u>RETRIEVE DATA COMMANDS</u>	6
3.2.1. <u>Send Shaft Position in Scaled Units</u>	6
3.2.2. <u>Start verification command</u>	7
3.2.3. <u>Read Value of Set-up Parameter</u>	7
3.3. <u>ECN SET COMMANDS</u>	8
3.3.1. <u>Set Encoder H2O Level</u>	8
3.3.2. <u>Set encoder scale (units per revolution)</u>	8
3.3.3. <u>Checksum Verification Mode</u>	9
3.3.4. <u>Set the CL ZERO (\4-20 Only)</u>	10
3.3.5. <u>Set the “CL SPAN” (\4-20 Only)</u>	10
3.4. <u>ECN NETWORK COMMANDS</u>	11
3.4.1. <u>Return identification string</u>	11
3.4.2. <u>Acknowledge active command</u>	11
3.4.3. <u>Change ECN device (node) address</u>	12
4. <u>DISPLAY OPERATION: \D OPTION</u>	13
4.1. <u>DISPLAYING THE FLUID LEVEL</u>	13
4.2. <u>ACCEPTING/CHANGING THE PASSWORD</u>	13
4.3. <u>SETTING THE FLUID LEVEL</u>	14
4.4. <u>SETTING THE ENCODER SCALE</u>	14
4.5. <u>SETTING THE “CL ZERO” (\4-20 ONLY)</u>	14
4.6. <u>SETTING THE “CL SPAN” (\4-20 ONLY)</u>	14
4.7. <u>SETTING THE CHECKSUM MODE</u>	15
4.8. <u>SETTING THE NODE ADDRESS</u>	15
5. <u>INSTALLATION</u>	16
5.1. <u>MECHANICAL</u>	16
5.2. <u>ELECTRICAL</u>	17
5.3. <u>CONNECTORS</u>	18
5.3.1. <u>Standard ECQUE</u>	18
5.3.2. <u>ECQUE\PMDM models</u>	18
5.3.3. <u>Option \4-20</u>	19
5.4. <u>CONNECTION OF 4-20 MA CURRENT LOOP (\4-20 ONLY)</u>	19
5.5. <u>CALIBRATION OF 4-20 CURRENT LOOP (\4-20 ONLY)</u>	20
5.6. <u>JUMPER CONFIGURATION</u>	20
6. <u>SPECIFICATIONS</u>	21
<u>APPENDIX A: ECN COMMAND SET FOR ECQUE: QUICK REFERENCE</u>	22
<u>APPENDIX B: DETERMINING “CL ZERO” AND “CL SPAN” (\4-20 OPTION)</u>	23
<u>APPENDIX C: ECQUE ERROR MESSAGES</u>	24

ECQUE

Quadrature Shaft Encoder with ECN Protocol Interface

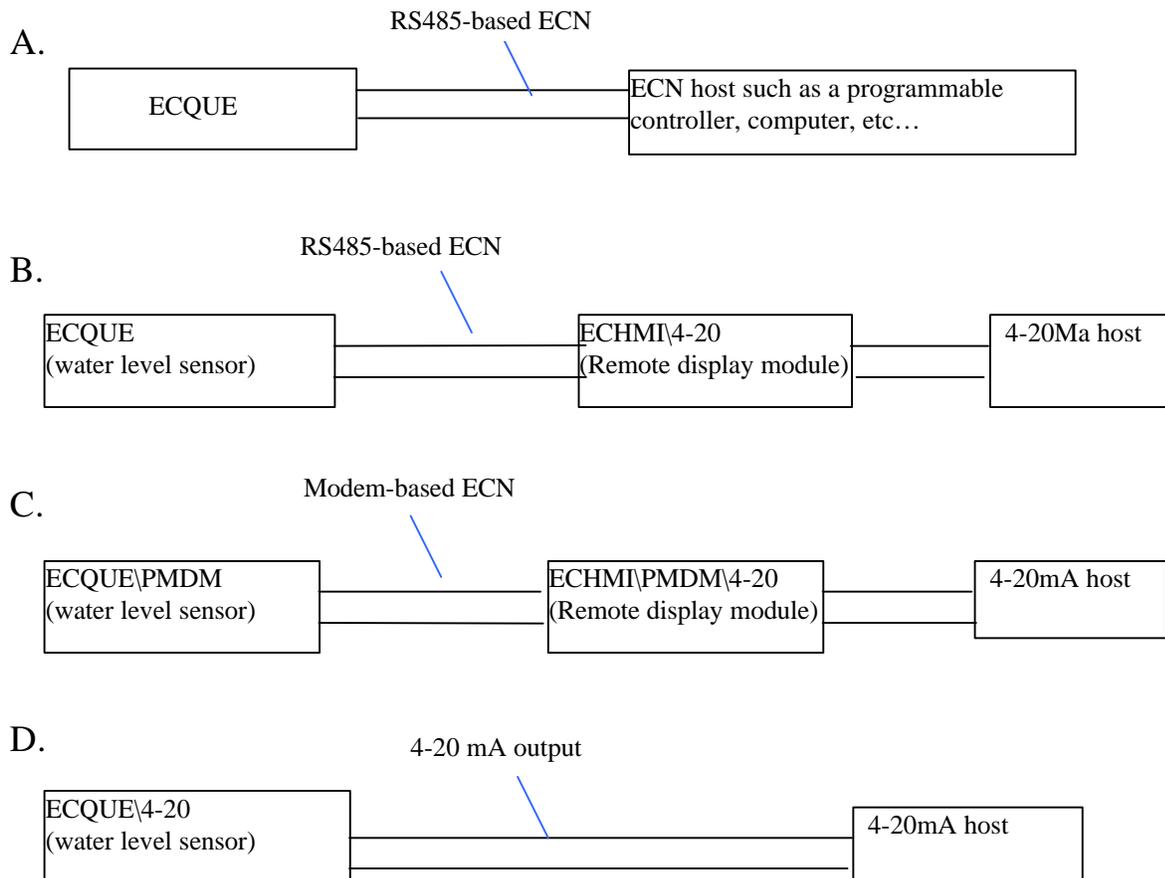
Pliant Technology Specialists

Pliant: readily yielding to influence

1. ECQUE Shaft Encoder

The ECQUE Incremental Shaft Encoder is an intelligent and reliable microprocessor-based incremental shaft encoder, which may be used with a pulley, tape, and float arrangement to measure stream stage or other fluid levels. The ECQUE accumulates position data at 2500 times per second to ensure accurate tracking of the shaft. A low power version (see section 1.1 Options) samples the shaft position adaptively as a function of its rotational speed.

The ECQUE provides its sensed data to the Data Collection Platform (DCP), ECHMI, personal computer, programmable controller or other host device by means of the AMASSER ECN Protocol (see datasheet on the ECN Protocol or visit www.amassdata.com). The standard ECQUE provides the ECN communications by means of an RS485 driver thus allowing support up to 4000 feet. A built-in modem (option \PMDM only) allows communication over any distance covered by a telephone line. Another possibility is to interface the ECQUE directly to a host requiring a 4-20mA input (option \4-20). These communication options are depicted below (refer to section 5.2 Electrical for proper connections):



The resolution of the encoder is 1/384th of a revolution (standard); when used with a stream stage pulley with a 375 mm circumference, the resolution of the system is 0.98 mm. When used with a 12.00 inch-circumference pulley, the resolution of the system is 0.03125 inches or 0.0026 feet. It is a two channel optical incremental encoder that contains a lensed LED source, integrated detectors, and a codewheel, which rotates between the emitter and the detector. The ECQUE firmware provides a pulsed LED driver and signal transition detector that provides the 4x quadrature decoder function.

Hardware is powered from a +10.5 to 15 V input for external battery, charger or power supply. A 256byte EEPROM provides non-volatile storage of the device address as well as the following set-up data: the encoder “SCALE” and “H2O LEVEL”, the “CL ZERO” and “cl SPAN” (\4-20 models only) as well as the “Checksum Verification Mode” (see 3.3.3 Checksum Verification Mode). A 9 V alkaline battery provides backup (a total of approximately 190 hours for \LP models) in the event of power supply interruption.

There are no mechanical contacts involved in the measurement process; the only contacting moving parts are the precision shaft bearings. The starting torque is low -- 0.65 inch-oz (47 cm-g) or less -- and the system is not sensitive to vibration. It is housed in a painted aluminium case, and may be installed in exposed locations. It is tested to operate from -40C to +55C, and up to 100% relative humidity.

1.1. Options

Here are the options of the ECQUE:

The \4-20 option: The ‘\4-20’ option is a 4-20 mA module which provides a standard current loop as a means of relaying the acquired data to the host in applications requiring an analog interface.

The \LP option: LP stands for Low Power. The \LP version of the ECQUE utilizes a sampling technique that is adaptive to the speed of the shaft encoder. This adaptive sampling technique reduces the current draw from about 30 mA down to about 5 mA (quiescent).

The \D option: This option provides an 8-digit display and two operator switches that allow the user to view data as well as set parameters (*H2O Level, Scale, CL Offset, CL Span ...*).

The \PMDM and \PMDM\V options: Built-in PMDM environmental modem (See PMDM user manual). The standard ECQUE uses an RS485 output for driving the ECN protocol. Alternatively, the \PMDM option provides modem communications whereas the \PMDM\V provides both modem and voice-modem communications.

1.2. Quadrature Encoder -Principle of Operation

The ECQUE is provided with an on-board 89S8252 microcontroller and firmware which follows the shaft rotation; each transition of either of the quadrature inputs adds or subtracts a count to a 16 bit stored value representing the position of the shaft and therefore the fluid level. A set-up parameter called *Scale* is provided to allow the application of a standard-circumference pulley and tape so that the accumulated count represents an accurate fluid level. If using a 1 ft-circumference pulley for instance, the accumulated count would directly indicate a fluid level in feet by setting the *scale* = 1.0. The ECN output from the microprocessor is the ASCII code representation calculated to three decimal places and is equal to the position value stored in the internal register divided by 384 (Model K encoder).

Communication with an external controller or computer is according to the ECN protocol. The output will be a decimal value in the range +/-999,999 units. The encoder's *Scale* and *H2O Level* are set using ECN commands. As mentioned, the value of *Scale* must be equal to the circumference of the wheel whereas *H2O Level* is set equal to the initial fluid level. For instance, if you want the ECQUE to track the stage in meters above sea level, you would measure your stage at set-up time and enter it in metres above sea level. If you measure it as being 101.225, you would simply enter 101.225 as your *H2O Level* and the unit would now track your stage in meters above sea level.

3. ECN Commands

The ECQUE is a device that uses the ECN Protocol as an interface to your DCP or host and as such follows the guidelines set out in that protocol.

3.1. ECN Command Symbols

a : address byte

<cr> : The carriage return character which is represented as '\0d' in the ASCII string.

<cksum>: A one-byte checksum which is the one's complement of the sum of all the bytes in the message including the carriage return byte, but **not including** the one-byte checksum itself. Examples of checksums are shown in the sections that follow.

Command bytes : one or two byte ASCII character command. Ex.: M0

Identification String : "AMASSDATA ECQUExxx" where xxx = firmware revision level

3.2. Retrieve Data Commands

3.2.1. Send Shaft Position in Scaled Units

- Command: aR0<cr><cksum>
- Response: a<shaft position in scaled units><cr><cksum>

This command instructs the ECQUE unit to measure the current shaft encoder position. The ECN format for the response to this command is as shown above.

Note that the value returned for the shaft position is to be interpreted with the same engineering units used to define the *Scale* and *H2O Level*.

Example:

The ECQUE is set to address 0 and you wish to obtain the current encoder position.

Command: 0R0<cr>@

Response: 0+13.232<cr>n

This response indicates that the current shaft position is +13.232. This value is to be interpreted with the same engineering units as used to define the *Scale* and *H2O Level*. Therefore if the *Scale* was set in metres (see section 3.3.2) and the *H2O Level* to metres above sea level, the current level would be interpreted as 13.232 m above sea level.

3.2.2. Start verification command

- command: aV<cr><cksum> or aV0<cr><cksum>
- response: a+<EEPROM status>+<Power interruption>+<Checksum mode><cr><cksum>

This command is used to monitor the memory operational status, the *Checksum Verification Mode* of the unit as well as to determine if the power supply has been interrupted. The data buffers are defined as follows:

Data Buffer 1 EEPROM	Data Buffer 2 Power Supply interruption	Data Buffer 3 Checksum Mode
1 (Operational) or 0 (Failure)	1 (Operational, no interruption) or 0 (Interruption)	0 or 1

Example:

The current host address is 0 and you want the power supply status as well as determine if the checksum verification is enabled.

Command: 0V<cr>l

Response: 0+1+1+0<cr>\af

This would indicate that the power systems did not fail since the last verification and that incoming checksums are currently ignored. To learn the significance of the *Checksum Verification Mode* refer to section 3.3.3.

3.2.3. Read Value of Set-up Parameter

1. Command: aS0?<cr><cksum> Or aS1?<cr><cksum>, etc...
2. Response: a<data buffer><cr><cksum>

This command enables the user to read the current value of any given set-up parameter. Its use is simple. Simply send the command normally used for setting the parameter in question but substitute the data value with the character ‘?’.

Examples:

1. The current sensor address is 3 and you wish to determine the current value of the shaft encoder “scale”.

Command: ‘3S1?<cr>\fc’

Response: ‘3+0.375<cr>\97’

The current value of the shaft encoder scale is therefore “+0.375”. Recall that the value for the parameter “scale” represents the engineering units equal to one revolution of the shaft and is equal to the circumference of the pulley mounted on the shaft. Therefore “+0.375” might represent 0.375 meters per revolution. Also recall that a positive value for “scale” represents a clockwise rotation of the shaft for rising water levels. Refer to 3.3.2.

3.3. ECN Set Commands

3.3.1. Set Encoder H2O Level

- command: aS0<H2O Level><cr><cksum>
- response: a<cr><cksum>

This command is for setting the initial fluid level. The ECQUE uses a 16-bit value to represent the shaft position, therefore, the range of the sensor is +/-32 meters from the initial level (with 384 counts per rev and assuming a *Scale* of 0.375m/rev).

Example:

The current address of the ECQUE is 5 and you wish to set the encoder to measure the elevation of the water level above sea level. You would measure your stage at set-up time and enter the *H2O Level* accordingly. For instance, if the stage level were measured as 101.225 meters above sea level you would enter 101.225. You would then interpret all values returned by the ECQUE as meters above sea level.

Command: 5S0+101.225<cr>\bb
Response: 5<cr>\ed

3.3.2. Set encoder scale (units per revolution)

- Command: aS1<scale><cr><cksum>
- Response: a<cr><cksum>

This command sets the encoder scale according to the size of pulley in use and the direction of shaft rotation. Note that the *H2O Level* and *Scale* must be set with consistent engineering units, usually ft or m. In addition, when initializing the *Scale* the user must be aware of the direction of shaft rotation with respect to water levels.

Clockwise rotation of the pulley represents rising water levels when the *Scale* is positive, otherwise the scale must be set negative.

Example:

The current ECQUE address is 4 and you wish to initialize the encoder scale. The pulley is 375 mm in circumference and the shaft turns counter-clockwise with rising water levels.

Command: 4S1-0.375<cr>\de
Response: 4<cr>\ee

Note that the scale is entered in meters because the water levels will be measured in meters (not mm). Also note that the scale is entered as a negative value because in this instance the shaft turns counter-clockwise when the water level is rising.

3.3.3. Checksum Verification Mode

1. Command: aS2+<checksum verification mode><cr><cksum>
2. Response: a<cr><cksum>

This command is used to set the ECQUE to either verify or ignore the checksums of incoming messages. This capability is useful when troubleshooting code for the ECN host. The modes are as follows:

Checksum verification enabled	Checksums ignored
Mode 1	Mode 0

Example:

The current address is 3 and you wish to set the ECQUE to ignore the checksums of incoming messages. Therefore the following command must be sent:

Command: 3S2+0<cr>\df

Response: 3<cr>\c2

This response confirms that the “checksum verification mode” has been successfully set. The checksums of messages from the host will henceforth be ignored by the ECQUE. Therefore, valid commands with incorrect checksums will be accepted and processed appropriately. Note that the “checksum verification mode” is stored in the EEPROM and is thus non-volatile.

NOTE: The host must always send a checksum byte following the <CR> character regardless of the “checksum verification mode”.

Sections 3.3.4, 3.3.5 are applicable to models with the \4-20 option.

3.3.4. Set the CL ZERO (4-20 Only)

1. Command: aS7<CL ZERO><cr><cksum>
2. Response: a<cr><cksum>

This command is for setting the CL ZERO, that is, the water level for which 4mA will be generated in the current loop. Naturally, the CL ZERO is equivalent to the lowest anticipated water level.

Example:

The current sensor address is 2 and the lowest anticipated water level is 12.121 meters. You would therefore set the CL ZERO to 12.121 as follows:

Command: 2S7+12.121<cr>\e6
Response: 2<cr>\c0

3.3.5. Set the “CL SPAN” (4-20 Only)

1. Command: aS8<“CL SPAN”><cr><cksum>
2. Response: a<cr><cksum>

This command is to set the 4-20mA SPAN. The “CL SPAN” must be set to the maximum anticipated range in the water level.

Example:

The lowest anticipated water level is 10.000m and the maximum is 20.000m. Therefore the “CL SPAN” must be set to 10.000. Note that the accuracy of the current loop is a function of the “CL SPAN”. Given that the \4-20 module uses a 16-bit A/D the resolution of a 10-meter SPAN is approximately 0.00015m! (The resolution of the shaft encoder is 0.00098m). Assume the sensor address B:

Command: BS8+10.000<cr><cksum>\db
Response: B<cr>\b0

3.4. ECN Network Commands

3.4.1. Return identification string

- Command: aI<cr><cksum>
- Response: a<identification string><cr><cksum>

This command instructs the ECQUE to return its identification string.

Example:

The current ECQUE address is 0 and you wish to obtain its identification string.

Command: 0I<cr>y

Response: 0 AMASSDATA ECQUE070<cr><cksum>

Therefore the sensor is manufactured by AMASS Data Technologies and the firmware version is 070.

3.4.2. Acknowledge active command

- command: a!<cr><cksum>
- response: a<cr><cksum>

This command allows the user to confirm that the current host address is active.

Example:

The current host address is 3 and you would like confirmation that it is active.

Command: 3!<cr>\9e

Response: 3<cr>\bf

This response is confirmation that host address 3 is active.

3.4.3. Change ECN device (node) address

- Command: aA<new address><cr><cksum>
- Response: <new address><cr><cksum>

This command changes the node address of the ECQUE. In order to communicate with a particular ECQUE on the ECN bus, the host and node (ECQUE) addresses must be the same. Therefore it is necessary to update the host address following a change of node address.

Example:

The current host (and node) address is 4 and you wish to change the node address to 6.

Command: '4A6<cr>G'

Response: '6<cr>\bc'

This response confirms that the new node address is 6. The host address must now be updated to 6 in order to communicate with the ECQUE. The user can then confirm that the new host address is active by sending the *acknowledge active* command.

4. Display Operation: \D Option

The \D option provides an 8-digit display and two double-position switches that control the display and setup of parameters. The setup parameters are only accessible however, once the correct password has been entered. The front of the unit appears as in Fig.1.

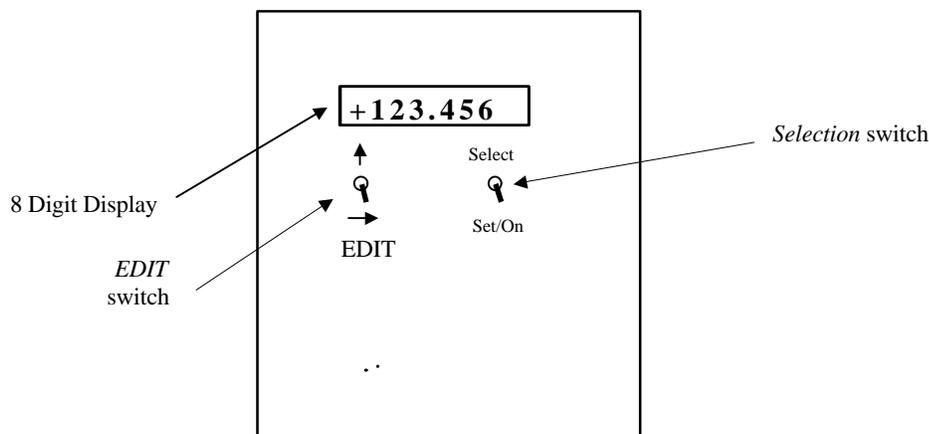


Figure 1 Front view of the ECQUE\D.

The four switch positions allow the user to display the current fluid level as well as setup the following parameters: the encoder *H2O Level and Scale*, the *CL ZERO* and “*CL SPAN*” (\4-20 models), the node address for ECN communications and the *Checksum Verification Mode*.

The right switch is used to *select* the parameter to be displayed and/or altered. It is also used as an enter key to *set* the new values of setup parameters, and as an *on* switch for the display. The left switch allows the user to *EDIT* the value displayed at the screen. The lower position of this switch is labeled with a right-arrow and is used to select the digit that is to be edited; the “active” digit is the one flashing on the screen. The upper position, which is labelled with an up-arrow, edits the active digit by scrolling through the available options: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ., +, -.

In short, the value of a parameter is displayed and entered using *set/on*. If the value that is displayed is correct it may be left unaltered by simply reentering it using *set/on*. On the other hand, any changes made to a value that has not yet been saved may be disregarded by using *select*.

4.1. Displaying the Fluid Level

To use the display to view the current fluid level simply turn it on with *set/On*. The current fluid level appears.

4.2. Accepting/Changing the Password

Set-up of the ECQUE\D using the display is password-protected (setup can also be done using the ECN commands described in section 3). Begin by switching it on with *set/On*. The current encoder position, i.e. water level, is displayed. Now use *select* until “PASSWORD” appears, then use *set/On* (“+000” appears). The default password of “+000” can now be edited to your own using the *EDIT* switch if you desire password-protection. When entering the four-character password the following characters are valid: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ., +, -, <space>. The password can only be viewed or altered from the display and must be entered correctly to view the

remaining setup parameters. **To set the password equal to the characters displayed on the screen press the *set* switch**, otherwise press *Select*.

Note that the correct password that was entered to gain entry to the setup parameters can be viewed as long as the display has not switched off with the auto power-off feature (see below). If the display does shut off however, and is turned back on “PASSWORD” will display the default value, namely “+000”, which must be edited once again to obtain access. Never forget your password otherwise you will not be able to change the setup parameters from the display at a later date. In the event that it is forgotten contact AMASS Data Technologies Inc at amassinf@amassdata.com.

4.3. Setting the Fluid Level

Begin by accepting the password as described above. Use *select* until the word *H2O Level* appears. Press the *set/On* switch. Use the *Edit* switch to set the display to the current fluid level (see 3.3.1) then use *set/On* to enter this value.

NOTE that when entering values for the *H2O Level* and *Scale* the decimal point must be entered as these parameters are floating point variables. The “+” or “-“ sign must also be entered for these parameters. For instance, a *Scale* of +1.000 may be entered as “+1.” but not as “+1”, “1.” or “1”. Use *set/on* repetitively to review the list of parameters and their respective values.

4.4. Setting the Encoder Scale

As explained in section 3.3.2, the parameter *scale* must be set equal to the circumference of the pulley mounted on the shaft encoder. Most standard pulleys are either 0.375metres or 1 ft in circumference.

Begin by accepting the password as described above. Use *select* until the word *scale* appears. Press the *set/On* switch. Use the *Edit* switch to set the display equal to the circumference of the pulley mounted on the shaft then use *set/On* to enter this value.

4.5. Setting the “cl Zero” (/4-20 only)

As explained in APPENDIX B, the parameter “**cl Zero**” (‘cl’ stands for current loop) must be set equal to the minimum anticipated water level, that is, the level for which the ECQUE/4-20 will output 4mA.

Begin by accepting the password as described above. Use *select* until the word “**cl Zero**” appears. Press the *set/On* switch. Use the *Edit* switch to set the display to the proper value as described in APPENDIX B, then use *set/On* to enter this value.

NOTE that when entering values for the “**cl Zero**” the decimal point must be present as these parameters are floating point variables. The “+” or “-“ sign must also be entered for these parameters. For instance, a value of +1.000 may be entered as “+1.” but not as “+1”, “1.” or “1”. Use *set/on* repetitively to review the list of parameters and their respective values.

4.6. Setting the “cl SPAN” (/4-20 only)

As explained in APPENDIX B, the parameter “**cl SPAN**” (‘cl’ stands for current loop) must be set equal to the maximum anticipated range in the water level, that is, the “cl Zero” + “cl SPAN” equals the level for which the ECQUE/D will output 20 mA.

Begin by accepting the password as described above. Use *select* until the word “**cl SPAN**” appears. Press the *set/On* switch. Use the *Edit* switch to set the display equal to the proper value as described in APPENDIX B, then use *set/On* to enter this value.

NOTE that when entering values for the “**cl SPAN**” the decimal point must be present as these parameters are floating point variables. The “+” or “-“ sign must also be entered for these parameters. For instance, a scale of

+1.000 may be entered as “+1.” but not as “+1”, “1.” or “1”. Use *set/on* repetitively to review the list of parameters and their respective values.

4.7. Setting the Checksum Mode

As explained in section 3.3.3 Checksum Verification Mode, the ECQUE can be configured to either verify or ignore the checksums of incoming messages from the host. This configuration can be accomplished from the display as follows:

Begin by accepting the password as described above. Use *select* until the word *Ev-scale* appears. Press the *set/On* switch. Use the *Edit* switch to set the display to the desired value then use *set/On* to enter it.

4.8. Setting the Node Address

The ECQUE\D is an ECN device. ECN is a multi-drop protocol, that is, it allows up to 32 units on the same bus by using a node addressing scheme. The node address by which ECN communication takes place is among the parameters that may be set on the display. This is done in the same manner as with the other parameters: *select* the parameter to be edited, i.e. “Node Adr”, use *set/on* to view its current value, use the *EDIT* switch as required, then enter the value using *set/on*. Given that 32 ECN devices may be supported on a given bus, the node addresses are numbered from 0 to 9 and from A to V.

NOTE: The display does not allow the user to enter addresses from A to V. This can only be done using the ‘aA<new address><cr><checksum>’ command (see section 3.4.3)

The display comprises an auto power-off feature. It switches the display off following an inactive period of approximately 5 minutes in order to save energy. Note that the ECQUE\D consumes about 90 mA when the display is on.

5. Installation

5.1. Mechanical

All AMASS Data Incremental Shaft Encoders may be attached to a flat surface using #10 bolts or screws through the six holes located in the mounting brackets on the ECQUE housing as shown in Fig.2. When installed to measure water level, it may be attached to a horizontal or vertical surface in a gauge house, with the shaft extending horizontally over the stilling well. A pulley is mounted to the unit by means of the aluminium clamping assembly, which is threaded to the shaft. The clamping assembly accepts standard L&S or F&P pulleys. Any model may be used to indicate the position of any shaft, which can be coupled or geared to the encoder shaft. With suitable mechanical coupling, linear positions may also be measured. For more information on the physical characteristics of the ECQUE refer to *Specifications*.

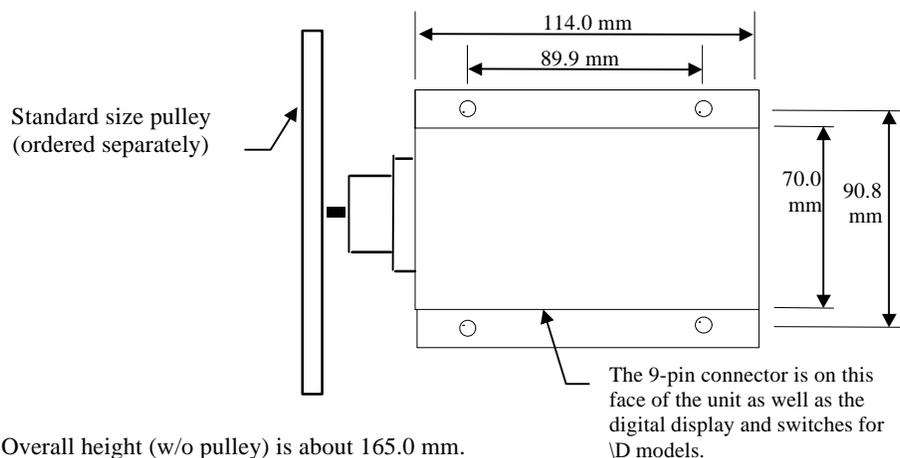


Figure 2. Top view of ECQUE(D) with mounting brackets installed.

The sensor may be installed in any orientation that a particular application may require. Weights or other mechanical loads at right angles to the shaft centre line should not exceed 10 lb (4.5 kg). Larger loads will distort the bearings, increase the starting torque, and decrease the bearing life.

5.2. Electrical

The Encoder is internally protected against transient voltages and lightning surges on the signal input lines.

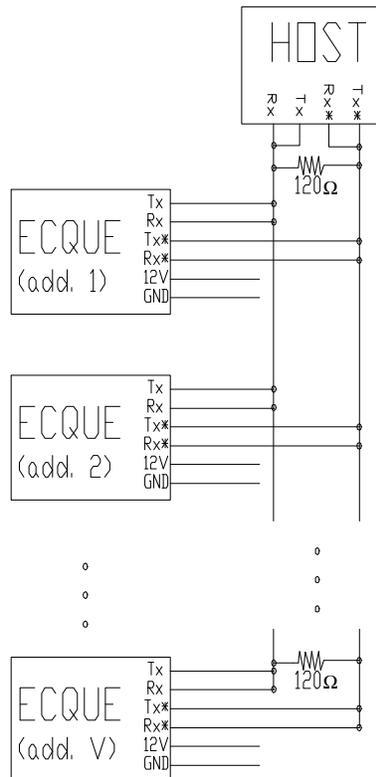
However,

IT IS ESSENTIAL TO PROVIDE PRIMARY EXTERNAL LIGHTNING PROTECTION.

The 9 V battery backup is only enabled when the 9 pin connector is secured to the unit. Therefore if the connector remains mounted to the unit the 9V battery will provide backup if the power supply fails or becomes disconnected (at the power supply, not the ECQUE). If the connector is removed at the ECQUE, however, the current shaft position is lost and the unit must be reinitialized using the “SET” commands or the display and switches. This is because the connector closes the backup circuit through pins 7 and 9 (see *Connectors*), therefore, the 9V battery-backup facility becomes disabled if the cable is not mounted the unit. Note that the backup is provided regardless of whether the cable is connected to a source or not, as long as the connector is mounted to the ECQUE. The open circuit that results when the connector is not mounted means that the ECQUE can be stored without depleting the 9 V battery.

The ECQUE communications is via ECN protocol (see 2 ECN Protocol). The hardware interface is thus RS485. The ECQUE may only be connected in half-duplex mode.

HALF-DUPLEX



Up to 32 devices on the ECN bus.
Addresses: 0 to 9, A to V

5.3. Connectors

5.3.1. Standard ECQUE

1 9 pin AMP CPC Connector

Connections are as follows:

PIN	SIGNAL	Cable Color
1	+ 12 Vin	Red
2	none	Blue
3	Ground	Black
4	DATA*	White
5	Event Counter	Green
6	Ground	none
7	Ground	Jumper across 7 and 9
8	DATA	Brown
9	Neg. terminal of +9V battery	Jumper across 7 and 9

5.3.2. ECQUE\PMDM models

1 RJ11 Connector for telephone line
1 DB15P Connector

DB15P Pin Assignments (connected internally)

PIN	SIGNAL
1	Ground to ECQUE
6	TxB Out to ECQUE from PMDM
7	+5V to ECQUE
8	Ground from power supply
12	RxB In from ECQUE to PMDM
15	+12V input from power supply

All other pins unassigned.

5.3.3. Option /SW

The “/SW” option provides a switch closure for controlling an external relay as shown below. This switch closure is rated up to 2 A.

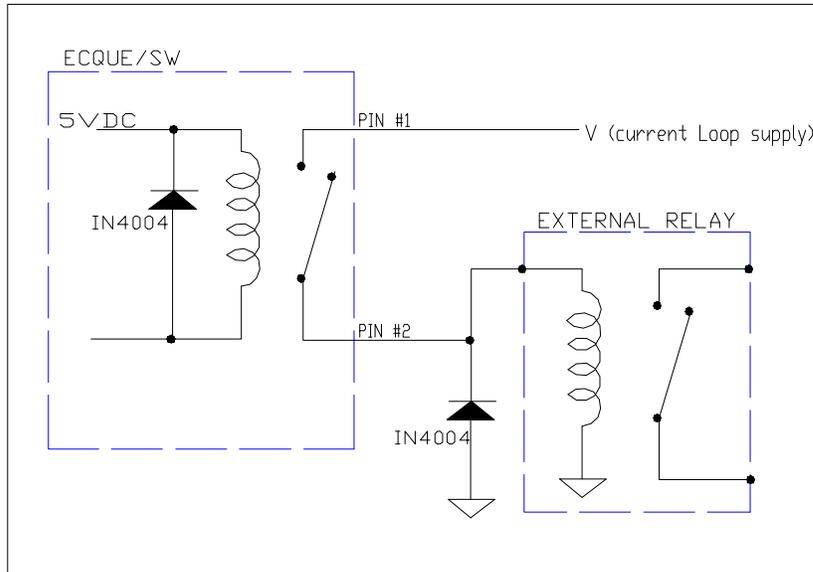


Figure 3. Relay configuration for ECQUE with "/SW" option.

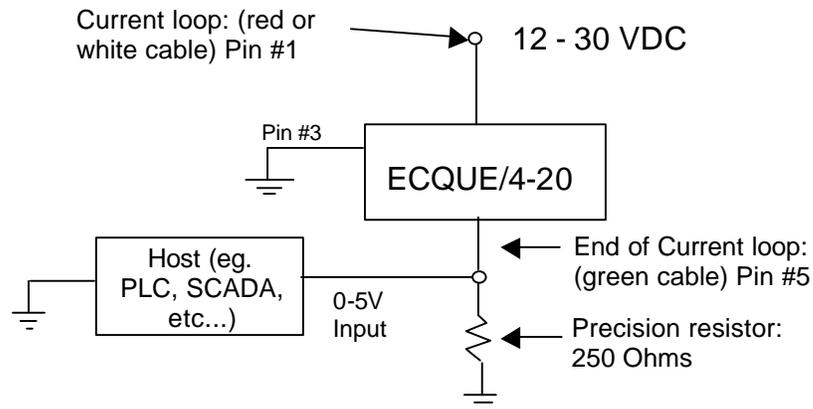
5.3.4. Option \4-20

1 9 pin AMP CPC connector		
PIN	SIGNAL	Cable Color
1	Current Loop	Red (or white)
5	End of Current loop	Green

Note that pin 5 is for an event counter in our standard models as shown in section 5.3.1 above. All other pins are assigned as in section 5.3.1.

5.4. Connection of 4-20 mA Current Loop (/4-20 only)

Connect the two wires of the current loop (see section 5.3.4) as shown below:



5.5. Calibration of 4-20 Current Loop (/4-20 only)

Once the ECQUE/4-20 is connected as shown above it must be calibrated. This is easily done with accurate results as follows:

1. Use the *Select* and *Set/on* switch positions until “**4mA out**” is displayed on the screen.
2. Using a voltmeter, measure the voltage across the precision 250-Ohm resistor. There should be exactly 1 V across the resistor. If it is not, remove the ECQUE panel from the enclosure and adjust the variable resistor labelled “**VR1**” until a 1 V reading is obtained.
3. Use the *Select* and *Set/on* switch positions until “**20mA out**” is displayed on the screen.
4. Using a voltmeter, measure the voltage across the precision 250-Ohm resistor. There should be exactly 5 V across the resistor. Adjust the variable resistor labelled “**VR2**” until a 5 V reading is obtained.
5. The calibration is done.

5.6. Jumper Configuration

In order to operate the ECQUE the user must ensure that proper jumper configuration is made as per the RED ARROW in Figure 3 below. Note that the jumper must be installed for “485”, not “HC”. The “HC” setting is when using the SDI-12 protocol.

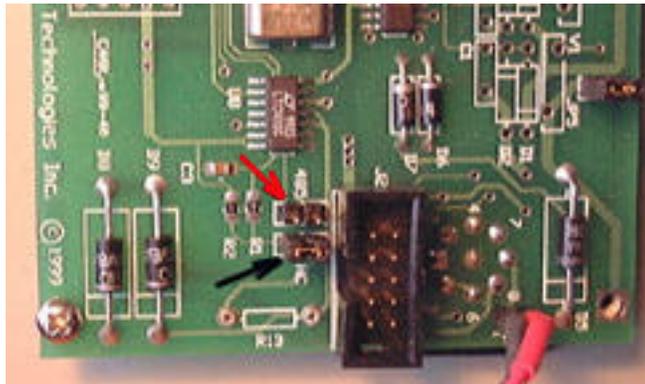


Figure 4. Location of 'HCMOS' and 'RS485' jumper blocks. Select “485” for RS485 operation.

6. Specifications

Processor : Atmel 89S8252 @ 3.6864 MHz.
Word Size : 8 bit data - 8 bit instruction
Memory : 89S8252, 256 bytes RAM
EEPROM 2 kbytes

Shaft Encoder

K-Model

Sensor type - two channel optical incremental encoder 96 x 4 counts per revolution
Resolution - 384 counts per revolution;
software conversion to engineering units provided in firmware. (Units per revolution)

Range

+/- 32.0 m with .375 m circumference pulley
+/- 85.3 ft with 1.00 ft circumference pulley

Max. Response Speed

2.5 rev/sec.

Output

ASCII accumulated level using

- Slave ECN protocol driver: Response Messages transmitted upon request via RS485 (standard) or modem (**PMDM** option)

OR

- 4-20 mA current loop for host interface (**/4-20** option)

Physical Characteristics

Height : 165.0 mm. (6.5 in.)

Width : 114.0 mm. (4.5 in.)

Depth : 70.0 mm. (2.75 in.)

Weight : 1.35 Kg (3.0 lb.)

Mounting : Mounting brackets use four #10 bolts or screws.

The above information is believed to be true at the time of printing. AMASS Data Technologies Inc. reserves the right to modify specifications without notice. All trademarks are owned by their respective companies.

AMASS Data Technologies Inc.
812 Proctor Ave., Box 707
Ogdensburg, New York
13669
TEL: 315 393-3793 FAX 315 393-9017

AMASS Data Technologies Inc.
34 Chemin Helene, Val des Monts, QUEBEC J8N 2L7
TEL: 819 457-4926 FAX 819 457-9802
Email: amassinf@amassdata.com

Connector

9 pin DB9 Connector

Power Supply

+10.5 to 15 VDC input for external battery, charger or power supply

Power Consumption

Standard model: 30 mA with display off (2500 samples/sec)

Low Power model: < 5 mA quiescent current for a sample rate of once per second.
maximum current : < 30 mA (with display off)

Battery Backup

9 V 565 mAHr alkaline battery backup
(Only if connector is mounted)

Mechanical Interface

Threaded shaft

1/4 x 32 thread plus clamp assembly
#303 stainless

Maximum safe load

10 lb 4.5 kg.

Starting Torque

inch-oz (47 cm-g) max.

Environmental Characteristics

Operating : -40 to +55 C

Storage : -60 to +100C

Humidity : <= 100% non-condensing

APPENDIX A: ECN Command Set for ECQUE: Quick Reference

ECN Retrieve Data Commands

1. Send Shaft Position in scaled Units
 - command: aR0<cr><cksum>
 - response: a<shaft position><cr><cksum>
2. Start verification command
 - command: aV0<cr><cksum>
 - response: a+<EEPROM status>+<Processor Power status>+<Checksum Ver. Mode><cr><cksum>
3. Read Value of Set-up Parameter
 - command: aS0?<cr><cksum> or aS1?<cr><cksum>, etc...
 - response: a<cr><cksum>

ECN Set Commands

1. Set encoder Initial Level
 - command: aS0<initial level><cr><cksum>
 - Response: a<cr><cksum>
2. Set encoder scale (units per revolution)
 - command: aS1<scale><cr><cksum>
 - Response: a<cr><cksum>
3. Set the “CL ZERO” (\4-20 option only)
 - command: aS7<“CL ZERO”><cr><cksum>
 - response: a<cr><cksum>
4. Set the “CL SPAN” (\4-20 option only)
 - command: aS8<CL SPAN><cr><cksum>
 - response: a<cr><cksum>
5. Checksum Verification Mode
 - command: aS2+<Checksum Verification Mode><cr><cksum>
 - response: a<cr><cksum>

ECN Network Commands

1. Change Node Address Command A
 - command: aAb<cr><cksum> where b = new node address
 - response: b<cr><cksum>
2. Send ECN Identification String I
 - command: aI<cr><cksum>
 - response: a<identification string><cr><cksum>
3. Send acknowledgment !
 - command: a!<cr><cksum>
 - response: a<cr><cksum>

APPENDIX B: Determining “CL ZERO” and “CL SPAN” (/4-20 option)

In order for the ECQUE to properly convert the data to a 4-20 mA output (option “/4-20” only) it is necessary to define the values “CL ZERO” (see 3.3.4 and 4.5) and “CL SPAN” (see 3.3.5 and 4.6). The parameter “CL ZERO” must be set equal to the minimum anticipated value in the water level. The parameter “CL SPAN” must be set equal to the maximum anticipated range in this data.

Example:

Assume the lowest possible water level is 130.000 and that the highest is 140.000. You must enter a value of 130.000 for the “CL ZERO” and 10.000 for the “CL SPAN” using the display and switches (D option only) or proper ECN command. Therefore, a value of 132.500 would be generate 8mA in the current loop as such

$$[(\text{Sensor data}) - \text{“CL ZERO”}] \times 16 / \text{“CL SPAN”} + 4 = \text{current output}$$

$$[(132.500) - 130.000] \times 16 / 10.000 + 4 = 8\text{mA}$$

APPENDIX C: ECQUE ERROR MESSAGES

The following error codes may be transmitted by the ECQUE:

Error Code	Meaning
Er1	Invalid transmission length
Er3	Incorrect checksum
Er4	Tx buffer overflow
Er5	Invalid command (if checksum is correct, otherwise 'Er3' is returned)