QBridge

I2C, SPI, CAN Control Software User's Manual

Date: 11-2006
Rev 1.4

1. Introduction

1.1. What QBridge can do?

QBridge is a single board computer provides an efficient and economical way to connect I2C, SPI or CAN (optional feature) to the PC RS232 port. It quickly turns any PC into an I2C, SPI mater or CAN node.

1.2. Disclaimer

While every effort has been made to ensure that the information contained in this manual is accurate and complete, no liability can be accepted for any error and omission. Q-Proto system reserves the right to change the specification of the hardware and software described herein at any time prior notice.

Q-Proto System shall not be liable for direct, indirect, incidental, general or consequential damage from the use of the products from Q-Proto system. If you do not agree with these terms, do not buy the products.

1.3. Operational Format

All the QBridge operation is based on HEX format.

2. How to use QBridge

2.1. Power up the QBridge

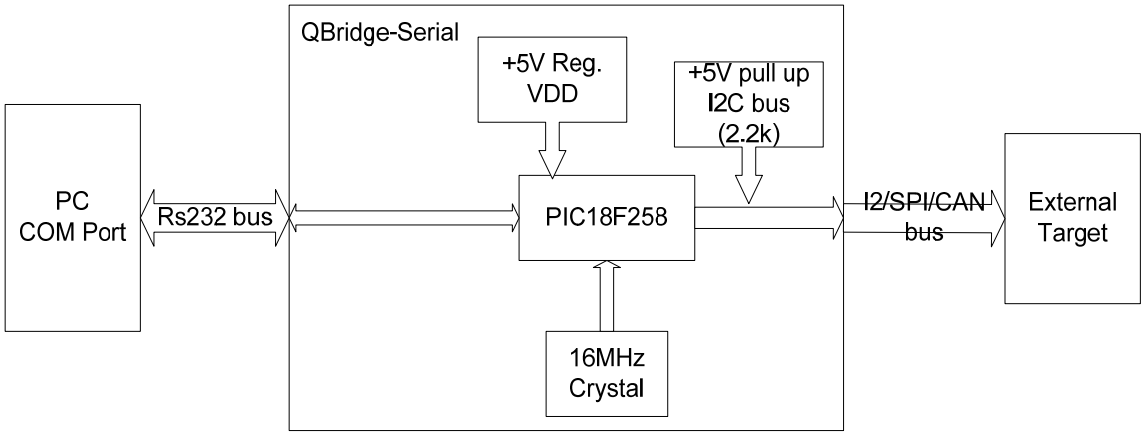
An external +9 V is needed to power the QBridge for its normal operation.

2.2. Pins layout

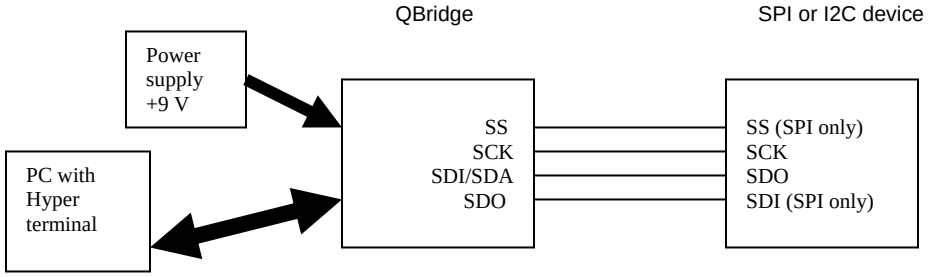
A female DB9 is for Host RS232 connection and a male DB9 connecter is used to connect external target. Pins layout for external target (male DB9) is shown below:

5: +9V	9: Boot
4: GND	8:SS
3:SCK	7: SDI/SDA
4:SDO	6:CANH
1: CANL	

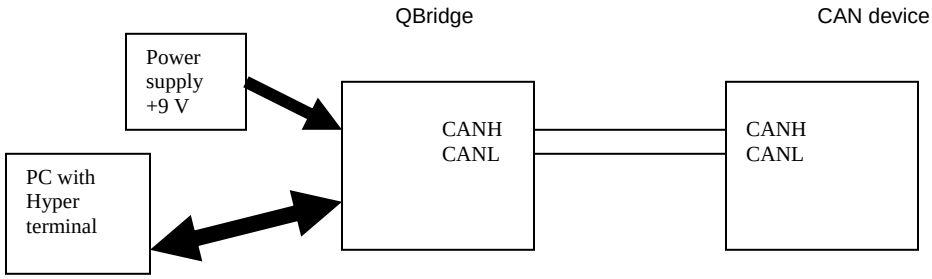
2.3. Basic hardware architecture



2.4. Diagram to connect to SPI or I2C device



2.5. Diagram to connect to CAN device



2.6. ASCII mode and Binary mode

QBridge V2 supports both ASCII and Binary mode. The ASCII mode allows user to utilize the Windows Hyper Terminal to control the device while the Binary mode allows user to write his own application to interface with QBridge.

The Mode selection can only be done once after the device is powered up. The Binary mode is automatically selected if there is no character (any character) sent to the device (via COM port) within five seconds after the power up. Character 'm' (indicates the current state is Main Menu) is sent out from QBridge to the Host once the Binary mode is entered. The ASCII mode is selected if there is any character sent to the QBridge from host within 5 seconds after the device is powered up. Traditional ASCII main menu will be shown once the ASCII mode is entered.

For software version 1.6 or later, a banner "QBridge by Q-Proto System" is always sent out from the device to the host when power up regardless of the mode.

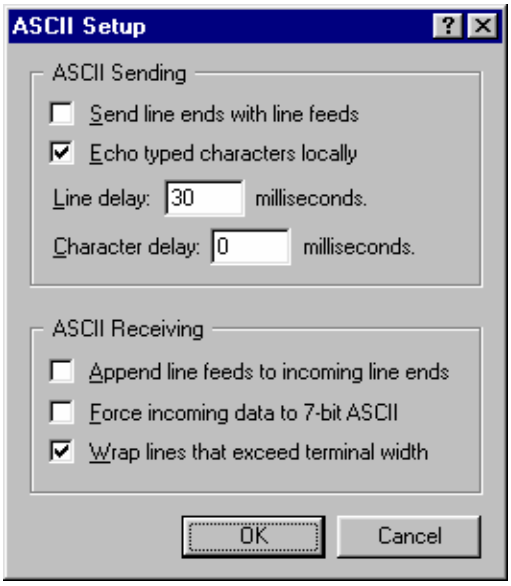
2.6.1. ASCII mode

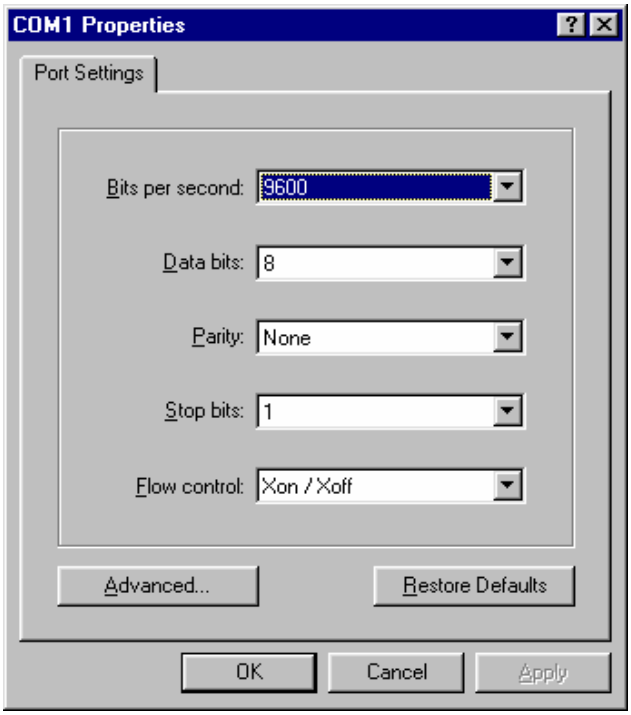
The ASCII mode is the legacy mode that QBridge supports. It uses the Windows Hyper Terminal to control the device.

- Connect to Hyper terminal

  QBridge connects to PC via RS232 port. It uses Windows Hyper Terminal program to send commands and receive data. The setting for Hyper Terminal is 9600-baud rate, 8 data bits, 1 stop bit, no parity bit, Xon/Xoff flow control, and also check 'echo typed character locally' and set '30 milliseconds' to line delay.

  Example setup is shown below:





2.6.2. Binary mode

The Binary mode extends the flexibility to allow user to develop his application. The Binary mode is only supported in QBridge V2 hardware with software version 1.5 or higher. Software version can be found from the main menu in the ASCII mode.

Xon/Xoff Flow control must be disabled for user application in Binary mode.

The application shall wait for character 'm' from QBridge to ensure Binary mode is entered when power up. No data shall be sent to the device within the five seconds after the power up, otherwise ASCII mode is selected.

- Connect to QBridge

The QBridge connects to the host application in the same way to Hyper Terminal. The default baud rate is 9600 bps.

- Command format from Host to QBridge

@	Command length	Command identifier	Data if any

All commands are lower case.

Example: Once the device is entering the Binary mode after the power up, user likes to send a command 'I' to enter the I2C application.

Packet 0x40 0x3 0x69 shall be sent to the device.

'@'	0x3	0x69 ('I')

- Response from QBridge to host

The reply from QBridge is the original command identifier followed by data, if any, when the operation succeeds. If an error is encountered, an error identifier 'e' followed by error code is returned to the host.

Example: navigate the QBridge from main menu to SPI application after the Binary mode is selected.

Packet: 0x40 0x3 0x73('s') is sent to the host

0x73 ('s') is returned to the host is SPI application is active
0x65 ('e') xx is returned to the host, where xx is the error code.

Error codes list for Binary mode

Error response	Description
0x01	Invalid parameter
0x03	Invalid command
0x50	Unknown SPI speed
0x51	SPI write timeout
0x52	Error when enable write command
0x53	SPI read timeout
0x54	SPI read status register timeout
0x55	SPI write status register timeout
0x30	I2C set speed error
0x31	I2C send data or START bit failure
0x32	I2C send STOP bit failure
0x33	I2C salve no ACK
0x34	I2C receiver buffer overflow
0x35	I2C read data timeout
0x36	I2C ACK slave time out
0x37	I2C bus collision
0x38	I2C send data error
0x3F	I2C unknown error
0x40	Unknown CAN operation mode
0x41	Invalid CAN register
0x42	Invalid frame bit
0x43	Invalid character
0x44	No CAN data
0x45	Invalid CAN data length
0x46	Invalid nibble count

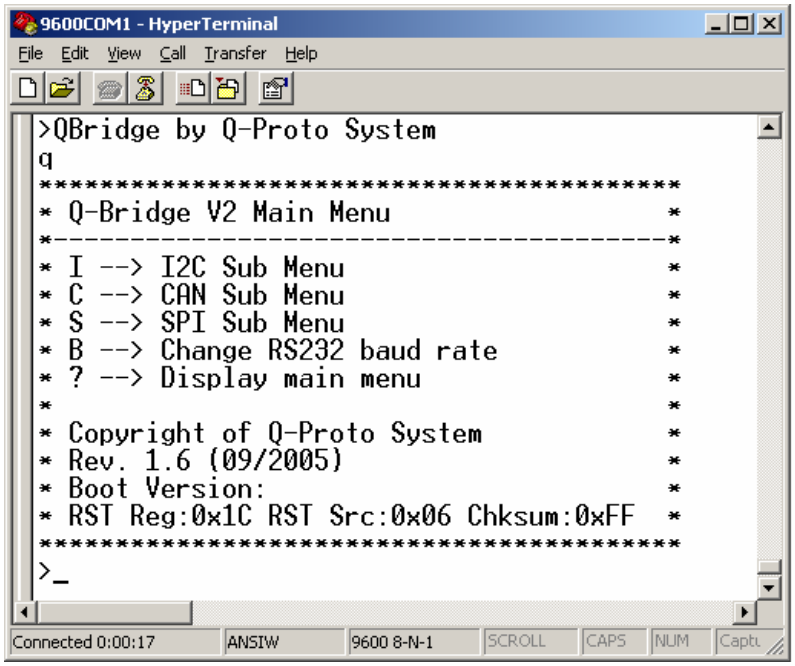
0x47	Invalid Baud rate
0x48	TX failure
0x49	Invalid TX buffer
0x4A	Initialization failure
0x4B	No CAN data
0x4D	Invalid Tx buffer length
0x4E	Unable to set CAN operation mode

3. Main Menu

3.1. Command I (if I2C feature is purchased)

I command will transfer the main menu to I2C sub menu.

- **ASCII Mode:**



- **Binary Mode format:**

@	0x3	'i'

Response:
Success: 'I'
Failure: 'e' followed by an error code listed in Section 2.6.2

3.2. Command C (if CAN feature is purchased)

C command will transfer the main menu to CAN (controller area network) sub menu.

Binary Mode format:

@	0x3	'c'

Response:
Success: 'c'
Failure: 'e' followed by an error code listed in Section 2.6.2

3.3. Command S (if SPI feature is purchased)

S command will transfer the main menu to SPI sub menu.

Binary Mode format:

@	0x3	's'

Response:
Success: 's' is returned

Failure: ‘e’ followed by an error code listed in Section 2.6.2

3.4. Command B

ASCII mode:

B command will configure QBridge to different Baud rate.

- B0

Set Baud rate to 9600 bps. This is the default setting.

- B1

Set Baud rate to 19200 bps.

- B2

Set Baud rate to 57600 bps.

- B3

Set Baud rate to 125K bps.

Binary Mode format:

- Get Baud rate

@	0x3	‘b’

Response:
Success: ‘b’ is returned followed by the baud rate

@	3	‘b’	{0~3}

Failure: ‘e’ followed by an error code listed in Section 2.6.2

- Set Baud rate

@	0x4	‘b’	0~3 (same as ASCII mode)

Response:
Success: ‘b’ is returned
Failure: ‘e’ followed by an error code listed in Section 2.6.2

Note:

Power must be cycled in order for the new Baud rate to take effect.

3.5. Command ‘?’

Command ‘?’ will display the main menu again.

ASCII mode:

Format: >?

Binary mode format:

@	0x3	‘?’

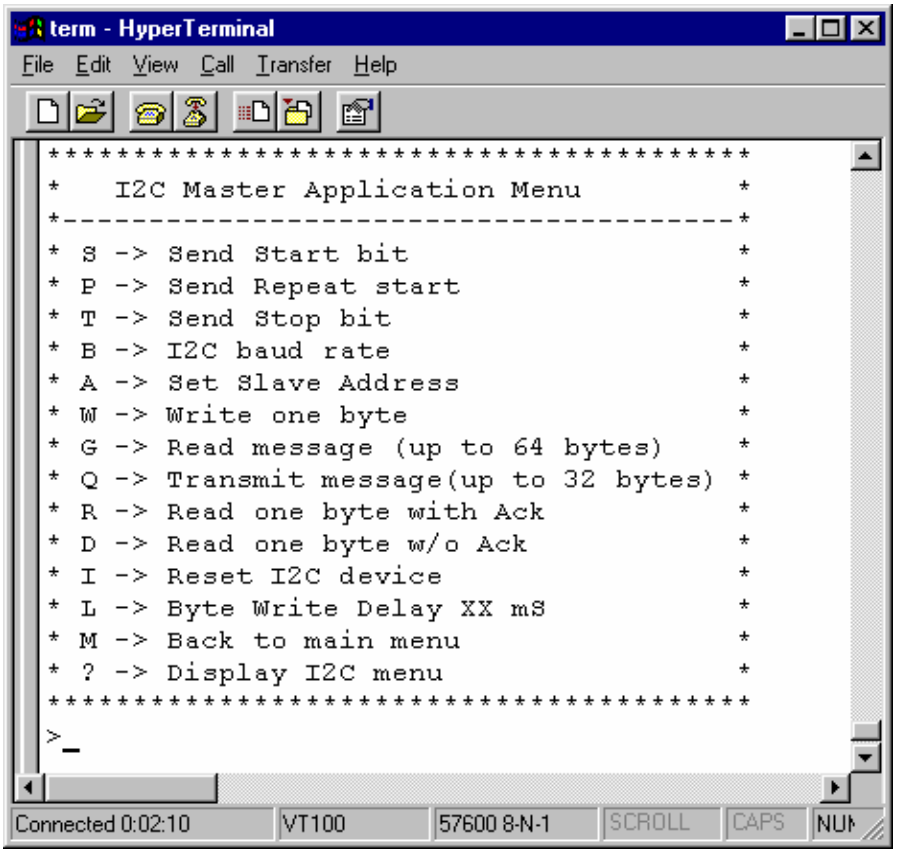
Response:
Success: ‘m’ is returned.
Failure: ‘e’ followed by an error code listed in Section 2.6.2.

3.6. Reset Status

At main menu, it will show the current status of the reset register value, reset source and the software checksum. The reset register and reset source values are only for debug purpose when report problem to Q-proto system.

4. I2C Application Menu

- **ASCII mode**:



- **Binary Mode:**

'i' is sent to the Host.

4.1. Command S

Command S will send the I2C start bit

Binary Mode format:

@	0x3	's'

Response:
Success: 's' is returned
Failure: 'e' followed by an error code listed in Section 2.6.2

4.2. Command P

Command P will send the I2C repeated start bit.

Binary Mode format:

@	0x3	'p'

Response:
Success: ‘p’ is returned
Failure: ‘e’ followed by an error code listed in Section 2.6.2

4.3. Command T

Command T will send the I2C Stop bit that terminates communication.

Binary Mode format:

@	0x3	‘t’

Response:
Success: ‘t’
Failure: ‘e’ followed by an error code listed in Section 2.6.2

4.4. Command B

Command B will set the I2C clock speed

ASCII Mode:

Format:

- B

Show the current I2C clock speed

- B0

Set I2C clock speed to 100K

- B1

Set I2C clock speed to 400K

Binary Mode format:

@	0x4	‘b’	{0,1}

Response:
Success: ‘b’ is returned
Failure: ‘e’ followed by an error code listed in Section 2.6.2

4.5. Command W

Command W writes one byte to the I2C bus. No Start will be sent in this command. User shall send Start bit (command S) if it is needed.

ASCII Mode:

Format:

- >W xx, where XX is the Hex format of data.

Example: W ef

If command is failed to send, error code can found in Section 4.14:

Binary Mode format:

@	0x4	‘w’	data

Response:
Success: ‘w’
Failure: ‘e’ followed by an error code listed in Section 2.6.2

4.6. Command G

Command G will read multiple bytes from I2C slave. Start bit is NOT used in this command due to varied device architecture. User shall send the Start bit and address bytes properly before this command is used. There is no ACK for the last read and Stop bit is sent at the end of this command.

ASCII Mode:

Format:

- >G xx Where xx is number of bytes to read. xx is in Hex format

Restriction:
This command allows only 64 bytes (hex 0x40) of data to read at a time

Example: >S <- Send Start bit
>W A0 <- Send Control byte with W bit set (Device address is 0 in this example)
>W 0 <- Word Address
>P <- Repeated Start
>W A1 <- Send Control byte with R bit set
>G 12 <- Get 0x12 byte of data from salve word address 0x0. Stop bit is inserted.

If command is failed to execute, error code can be one of the following:

Binary Mode format:

@	0x4	'g'	length

Response:
Success: 'g'
Failure: 'e' followed by an error code listed in Section 2.6.2

4.7. Command Q

Command Q writes multiple bytes (up to 32 bytes) to I2C slave. Both start bit and stop bit are used in this command. A preset interval will be inserted between each data byte. This interval may be set with command L. Most of the time, the first byte is control byte and the second or third byte is address byte followed by data bytes.

ASCII Mode:

Format:

- >Q xx, yy, zz. Start bit will be sent before xx,yy,zz are sent, and Stop bit is set at the end.

Restriction:
Only up to 32 bytes of data is allowed to write at a time.

Binary Mode format:

@	length	'q'	Data0	~	Data31

Length is depending on the number of data to write.

Example:

@	0x7	'q'	0x11	0x4d	0x57	0x68

Response:
Success: 'w' is returned
Failure: 'e' followed by an error code listed in Section 2.6.2

4.8. Command R

Command R reads one byte from slave with acknowledge bit at the end. User shall use command W to specify slave and word address if a particular location is accessed.

ASCII Mode:

Format: >R

Binary Mode format:

@	0x3	'r'

Response:

Success: 'r' followed by the read data.
Failure: 'e' followed by an error code listed in Section 2.6.2

4.9. Command D

Command D reads one byte from slave without acknowledge bit at the end. User shall use command W to specify slave and word address if a particular location is accessed.

ASCII mode:

Format: >D

Binary Mode format:

@	0x3	'd'

Response:
Success: 'd' followed by the read data.
Failure: 'e' followed by an error code listed in Section 2.6.2

4.10. Command I

Command I reset I2C controller to the known state.
I2C write delay is set to 0xA ms.
I2C clock speed will be first fetched from NVRAM or set to 100K if NVRAM value is corrupted.

ASCII mode:

>i

Binary Mode format:

@	0x3	'i'

Response:
Success: 'i'
Failure: 'e' followed by an error code listed in Section 2.6.2

4.11. Command L

Command L will set the interval between each data byte sent to salve. Because I2C is used often in EEPROM application, an internal write delay is needed for EEPROM programming.

ASCII mode:

Format:

> L show the current delay value

> L xx Set the delay, where xx is number of millisecond delay in hex format.

Example: L 10 Set write delay to 16 ms

Binary Mode format:

@	0x3 or0x 4 delay value is set	'l'	Delay if needed

Response:
Success: ‘I’
Failure: ‘e’ followed by an error code listed in Section 2.6.2

4.12. Command M

Command M will transfer the current I2C sub menu to main menu.

ASCII mode:

Format: >M

Binary Mode format:

@	0x3	‘m’

Response:
Success: ‘m’
Failure: ‘e’ followed by an error code listed in Section 2.6.2

4.13. Command ‘?’

Command ‘?’ will display the entire I2C sub menu again.

ASCII mode:

Format: >?

Binary mode format:

@	0x3	‘?’

Response:
Success: ‘i’ is returned.
Failure: ‘e’ followed by an error code listed in Section 2.6.2.

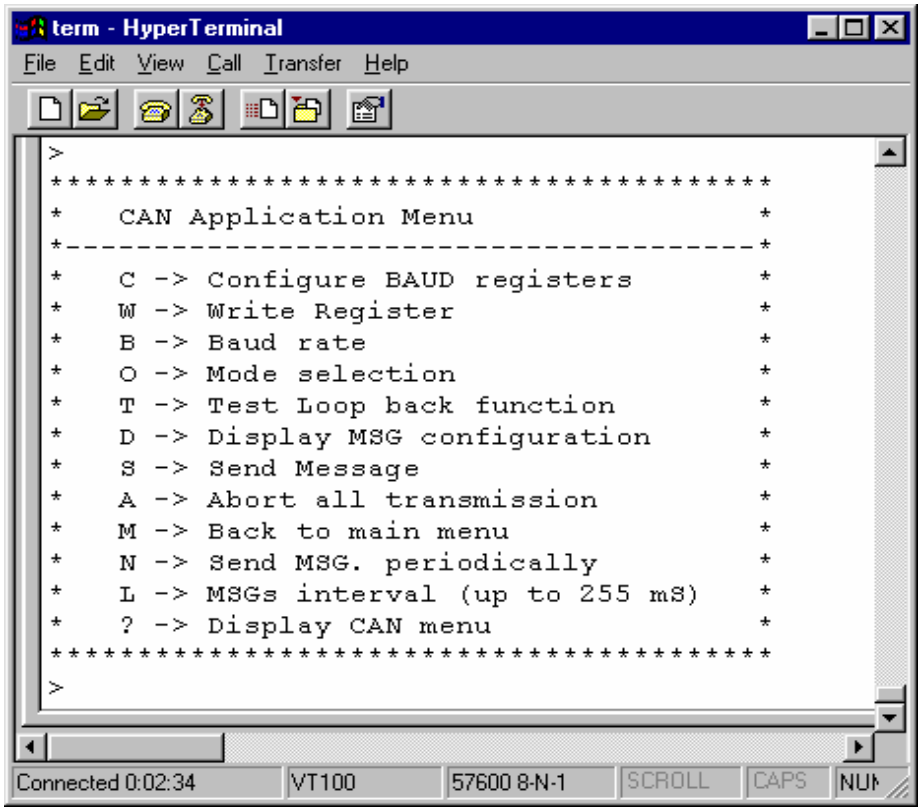
4.14. Error codes listing for ASCII mode

One of the following error codes will be returned if command is failed to execute.

Error code	Description
1	Time out when sending data or start bit
2	Timeout when sending STOP bit
4	No ACK from slave
8	Receive overflow
0x10	Timeout when reading data
0x20	Timeout when acking to slave (ACKDT)
0x40	Bus collision

5. CAN (controller area network) Application Menu

- **ASCII mode:**



- **Binary mode:**

A character ‘c’ is sent to the host.

5.1. Command C

Command C will let you configure the Baud rate registers for PIC18F258. Please refer to the PIC18F258 datasheet for details.

ASCII Mode:

Format:

- > C aa,bb,cc,dd,ee Set baud rate registers.
- > C show baud rate registers

C BRGCON1 BRGCON2 BRGCON3 will be echoed to host.

Where aa is Baud rate prescaler bits, bb is Synchronized jump width bit, cc is propagation time select bits, dd is phase segment 1 bit, ee is phase segment 2 bit.

Binary Mode format:

Configure the all baud rate registers

@	0x8	‘c’	aa	bb	cc	dd	ee

Response:
Success: ‘c’ is returned
Failure: ‘e’ followed by an error code listed in Section 2.6.2

Read the Baud rate register

‘@’	0x3	‘c’

Response

Success:

‘c’	BRGCON1	BRGCON2	BRGCON3

Failure: ‘e’ followed by an error code listed in Section 2.6.2

5.2. Command W

Command W will allow you write value to CAN receive filter and mask registers. In the ASCII mode, the QBridge CAN receiver module is always active. Once a matched CAN message is received, it will be shown on terminal. In the Binary mode, the command ‘r’ shall be issued to retrieve data. Refer to section 5.13 for details.

ASCII mode:

Format:

>W r {m0, m1, f0, f1, f2}, nnnn,f{s,x,r,t}

Where r is register to write, nnnn is the value in hex format, f is the framing format bit.

Register r definition:

m0: receive buffer 0 mask register
m1: receive buffer 1 mask register
f0: receive buffer 0 filter 0 register
f1: receive buffer 0 filter 1 register
f2: receive buffer 1 filter 2 register
f3: receive buffer 1 filter 3 register
f4: receive buffer 1 filter 4 register
f5: receive buffer 1 filter 5 register

Framing bit definition:
S: Standard frame
X: Extended frame
R: Remote standard frame
T: Remote extended frame

Example: w m0, 34ef,x Configure mask 0 register to extended frame with value 0x34e.

Binary Mode format:

@	0xA	‘w’	{m,f}	{0~5}	Byte3	Byte2	Byte1	Byte0	{s,x,r,t}

Response
Success: ‘w’
Failure: ‘e’ followed by error code

5.3. Command B

Command B will configure the baud rate. Power on default is 125K

ASCII Mode:

Format:

- B

Display the current baud rate. Note that baud rate will not be shown properly if command C is used to set to customized baud rate prior.

- B 0

Set baud rate to 1M bits

- B 1

Set baud rate to 800 K bits

- B 2

Set baud rate to 500 K bits

- B 3

Set baud rate to 250 K bits

- B 4

Set baud rate to 125 K bits

- B 5

Set baud rate to 100 K bits

- B 6

Set baud rate to 50 K bits

Binary Mode format:

- Get current Baud rate

@	0x3	'b'

Response:

Success:

'b'	nn

nn=0 1MBits
nn=1 800KBits
nn=2 500KBits
nn=3 250KBits
nn=4 125KBits
nn=5 50KBits

- Set to predefined Baud rate

@	0x4	'b'	nn

Success: 'b' is returned
Failure: 'e' followed by an error code listed in Section 2.6.2

5.4. Command O

Command O will change the CAN operation mode

ASCII Mode:

Format: O n{0,1,2,3,4} Where n is the mode to change to

- O

Show the current CAN operation mode

- O 0

Set to configuration mode

- O 1

Set to disable mode

- O 2

Set to operation mode

- O 3

Set to listen mode

- O 4

Set to loop back mode

Binary Mode format:

- Get current operation mode

@	0x3	‘o’

Response:

Success:

‘o’	nn

nn=0 configuration mode
nn=1 CAN is disabled
nn=2 operation mode
nn=3 listen mode
nn=4 loopback mode-

- Set to predefined Baud rate

@	4	‘o’	nn

Success: ‘o’ is returned
Failure: ‘e’ followed by an error code listed in Section 2.6.2

5.5. Command T

Command T is loop back test mode.

ASCII mode:

Format: >T

Binary mode format:

‘@’	0x3	‘t’

Response:
Success: ‘t’
Failure: ‘e’ followed by an error code listed in Section 2.6.2

5.6. Command D

Command D will show CAN filter, mask, transmit and error register values.

ASCII mode:

Format: >D

Example:
>M0:X-0x1FFFFFFE S-0x000007FF F0:X-0x12345678 F1:S-0x00000678
>M1:X-0x1FFFFFFF S-0x000007FF
>F2:X-0x000001BC F3:S-0x000001BC F4:X-0x00000000 F5:X-0x00000000
>T0:S-0x00000678 FF EE DD 05 04 03 02 01
>T1:X-0x12345678 A5 34 31 88 77 99 EF 5A
>T2:XR-0x000001BC
>TxErr:00 RxErr:00 Invalid Msg. cntr:00 Bus Err. Cntr:00
>

Mask 0 is 0x1FFFFFFE for extended frame or 0x000007FF for standard frame
Filter 0 is extended frame 0x12345678
Filter 1 is standard frame 0x00000678
Mask 1 is 0x1FFFFFFE for extended frame or 0x000007FF for standard frame
Filter 2 is extended frame 0x000001BC
Filter 3 is extended frame 0x000001BC
Filter 4 and 5 are extended frame 0x00000000

Transmit buffer 0 is standard frame, id 0x00000678, data FF EE DD 05 04 03 02 01
Transmit buffer 1 is extended frame, id 0x12345678, data A5 34 31 88 77 99 EF 5A
Transmit buffer 3 is remote standard frame, id 0x000001BC

Note: CAN message framing format: X– standard frame, R- remote frame, S- standard frame.

Binary mode format:

'@'	0x3	'd'

Response:
Success:

'd'	'x'	Mx03	Mx02	Mx01	Mx00	's'	Ms03	Ms02	Ms01	Ms00	'x'	Mx13	Mx12
Mx11	Mx10	's'	Ms13	Ms12	Ms11	Ms10	{x,s}	F03	F02	F01	F00	{x,s}	F13
F12	F11	F10	[x,s]	F23	F22	F21	F20	{x,s}	F33	F32	F31	F30	{x,s}
F43	F42	F41	F40	{x,s}	F53	F52	F51	F50	TX0 ID 3	TX0 ID 2	TX0 ID 1	TX0 ID 0	{x,s,r,t}
TX0 length	Tx0 D0	Tx0 D1	Tx0 D2	Tx0 D3	Tx0 D4	Tx0 D5	Tx0 D6	Tx0 D7	TX1 ID 3	TX1 ID 2	TX1 ID 1	TX1 ID 0	{x,s,r,t}
TX1 length	Tx1 D0	Tx1 D1	Tx1 D2	Tx1 D3	Tx1 D4	Tx1 D5	Tx1 D6	Tx1 D7	TX2 ID 3	TX2 ID 2	TX2 ID 1	TX2 ID 0	{x,s,r,t}
TX2 length	Tx2 D0	Tx2 D1	Tx2 D2	Tx2 D3	Tx2 D4	Tx2 D5	Tx2 D6	Tx2 D7					

Where
Mx03~Mx00: Mask 0 in extended frame format
Ms03~Ms00: Mask 0 in standard frame format
Mx13~Mx10: Mask 1 in extended frame format
Ms13~Ms10: Mask 1 in standard frame format
F03~F00: Filter 0. The {x,s} preceding to this data is the frame bit
F13~F10: Filter 1. The {x,s} preceding to this data is the frame bit
F23~F20: Filter 2. The {x,s} preceding to this data is the frame bit
F33~F30: Filter 3. The {x,s} preceding to this data is the frame bit
F43~F40: Filter 4. The {x,s} preceding to this data is the frame bit
F53~F50: Filter 5. The {x,s} preceding to this data is the frame bit

Tx0 ID3~ID0: Tx buufer0 CAN ID
{x,s,r,t}: x is extended frame, s is standard frame, r is remote standard frame, r is remote extended frame.
TX0 length: Length of Tx buffer0
Tx0 D0~D8: Tx buffer 0 data

Tx1 ID3~ID0: Tx buufer1 CAN ID
{x,s,r,t}: x is extended frame, s is standard frame, r is remote standard frame, r is remote extended frame.
TX1 length: Length of Tx buffer 1
Tx1 D0~D8: Tx buffer 1 data

Tx2 ID3~ID0: Tx buufer 2 CAN ID
{x,s,r,t}: x is extended frame, s is standard frame, r is remote standard frame, r is remote extended frame.
TX2 length: Length of Tx buffer 2
Tx2 D0~D8: Tx buffer 2 data

All values shown above are already adjusted according to the frame bit.

Failure: 'e' followed by an error code listed in Section 2.6.2

5.7. Command S

Command S will transmit the CAN message to a specified buffer.

ASCII mode:

Format:
S x{0,1,2}, nnnn, f{x, s, r, t}, aa, bb, cc, dd

Where x is the buffer number, nnnn is the CAN id in hex format, f is the CAN message format bit, aa – dd are CAN data up to 8 bytes

Message format: {x, s, r, t} where x is extended frame, s is standard frame, r is remote standard frame, t is extended frame. Note that when remote frame is sent, user should still send dummy data byte even receiver ignores it , because some CAN application will expect remote frame data length is the same as returned data length.

Example:
S 0, 1234edf, x, 11,22, 3e, 4d
Sending extended frame 0x1234edf with data packet 11,22,3e,4d to transmit buffer 0.

S1, 3ef, t, 00,00,00
Sending extended remote frame, id: 0x3ef, data length is 3.

Binary mode format:

'@'	Length	's'	{0,1,2}	CAN ID byte 3	CAN ID byte 2	CAN ID byte 1	CAN ID byte 0
{x,s,r,t}	Byte 0	Byte 1	Byte2	Byte3	Byte4	Byte5	Byte6
Byte7							

Where 'Length' varies with size of the data

Example:
Send CAN message ID 0x2345, extended frame, data 0x1, 0x2, 0x3, 0x4 to TX buffer 1

'@'	0xD	's'	1	00	00	23	45	'x'	0x1
0x2	0x3	0x4							

5.8. Command A

Command A aborts all current transmission actives.

ASCII mode:

Format: >a

Binary mode format:

'@'	0x3	'a'

Response:
Success: 'a'
Failure: 'e' followed by an error code listed in Section 2.6.2

5.9. Command M

Command M transfers from CAN application to Main menu.

ASCII mode:

Format: >m

Binary mode format:

'@'	0x3	'm'

Response:
Success: 'm'
Failure: 'e' followed by an error code listed in Section 2.6.2

5.10. Command N

Command N will continuously send a preset CAN message for a specified number of times. A delay is also inserted between messages sent and delay can be set with command L.

ASCII Mode:

Format: N x, nn
Where x is the CAN transmit buffer number between 0 and 2, nn is number of times to repeat this message, which is up to 255 times.

Example: N 2, 20 send TX buffer 2 for 32 (hex 0x20) times.

Binary mode format:

'@'	5	'n'	Buffer number {0,1,2}	Number of times to send

Response:
Success: 'n'
Failure: 'e' followed by an error code listed in Section 2.6.2

5.11. Command L

Command L will set the interval between each sent message when messages are sent with command N. Power on default value is 0xA ms.

ASCII mode:

Format: > L 20 Set interval to 32 (0x20) milliseconds.

Binary mode format:

- Get current delay

@	0x3	'l'

Response:

Success:

'l'	nn

Where nn is the delay in milliseconds

- Set delay

@	0x4	'l'	nn

Success: 'l' is returned
Failure: 'e' followed by an error code listed in Section 2.6.2

5.12. Command '?'

ASCII mode:

Command '?' will display the entire CAN application menu again.

Binary mode format:

@	0x3	'?'

Response:
Success: 'c' is returned.
Failure: 'e' followed by an error code listed in Section 2.6.2.

5.13. CAN message receiving

ASCII mode:

Once CAN application is entered, CAN message receiver module is automatically enabled. Whenever a matched message is received, it will be displayed on the console. Message is shown in the following format:

<ID>-<Type>-<Filter> <Data0~Data8> <Timestamp> <Dropped packet counter>

- ID is the CAN message ID in hex format
- Type is the CAN message type. R is remote frame, X is extended frame, S is standard frame.
- Filter is the received hit filter ranges from 0-5
- Data0~Data8 is the CAN data packet
- Timestamp is the received CAN message timestamp in 2 microsecond resolution.

Note: The total of bits for standard CAN message is calculated as of following:
SOF+11bit ID+RTR+6 Control bits + number of data*8 =16 bits CRC + 2 ACK + 7 EOF bits. Extended frame will have 29 bits ID instead of 11 bits.

- Dropped packet counter is the counter for all the dropped packets when received buffers are overrun.

Example1:
>Recv:12345678-X-F00 A5 34 31 88 77 99 EF 5A T:131F D:00

Received message: ID is 0x12345678, X is extended frame, from filter 0, packet is A5 34 31 88 77 99 EF 5A, timestamp is 0x131F, dropped packet counter is 0.

Example2:
>Recv:000001BC-RX-F02 T:17A2 D:00
Received message: remote extended frame, ID is 0x1BC, timestamp is 0x17A2, no dropped packet.

Binary Mode format:

In Binary mode, message receiving is not automatic as in ASCII mode. A command 'r' must be issued to get the messages in the buffer. One message can be retrieved at a time. Application shall continue issue 'r' command until an error code 0x4B is returned.

Command:

@	0x3	'r'

Response:

Success

'r'	CAN ID byte 3	CAN ID byte 2	CAN ID byte 1	CAN ID byte 0	Flag
length	Data 0	Data 1	Data 3	Data 4	Data 5
Data 6	Data 7	Timestamp high	Timestamp low	Counter of dropped packets	RX error counter
TX error counter					

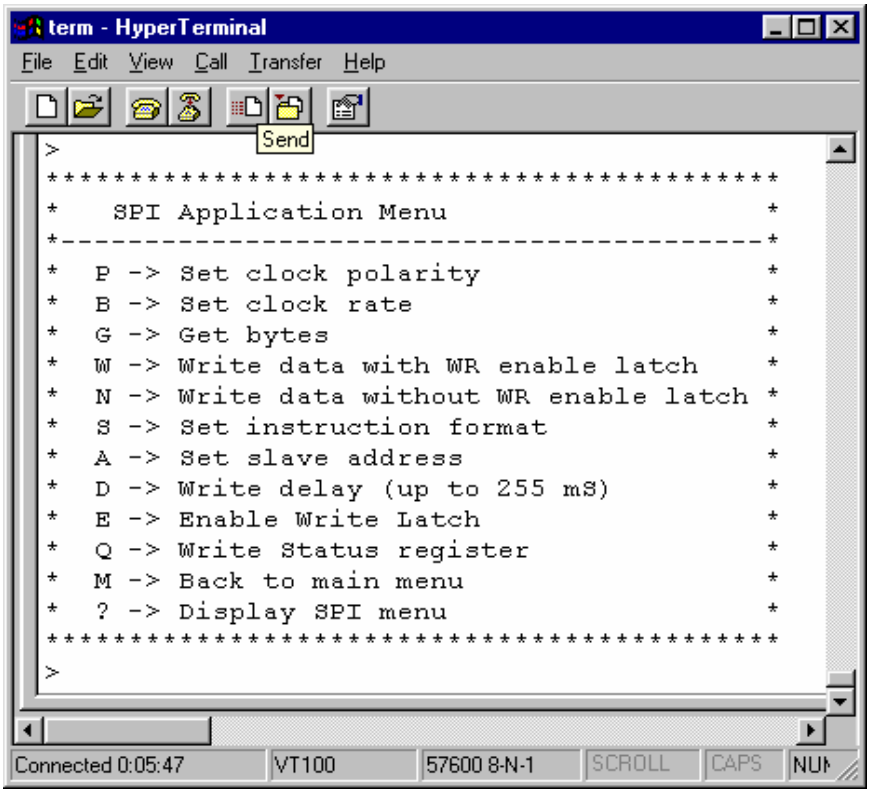
Where Flag is define as flowing:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Received Double buffer	Remote frame	Extended frame	Invalid message	RX overflow	RX filter number 000: filer 0 001: filter 1 010: filter 2 and so on.		

Failure: 'e' followed by an error code listed in Section 2.6.2

6. SPI application menu

- **ASCII mode:**



- **Binary mode:**

's' is returned

6.1. Command P

Command P sets SPI clock edge and polarity.

ASCII Mode:

Format:

- P

gets the current SPI clock edge and polarity.

- P0

SPI clock edge is idle low, data transmitted in falling edge.

- P1

SPI clock edge is idle low, data transmitted in rising edge. This setting is power on default.

- P2

SPI clock edge is idle high, data transmitted in rising edge.

- P3

SPI clock edge is idle high, data transmitted in falling edge.

Binary Mode format:

- Get current operation mode

@	0x3	‘p’

Response:

Success:

‘p’	nn

nn=0 SPI clock edge is idle low, data transmitted in falling edge.
nn=1 SPI clock edge is idle low, data transmitted in rising edge.
nn=2 SPI clock edge is idle high, data transmitted in rising edge.
nn=3 SPI clock edge is idle high, data transmitted in falling edge.

- Set to predefined Baud rate

@	0x4	‘p’	nn

Success: ‘p’
Failure: ‘e’ followed by an error code listed in Section 2.6.2

6.2. Command B

Command B sets the SPI clock speed rate.

ASCII mode:

Format:

- B

Show the current speed. Power on default is 250 K

- B0

Set clock speed to 4 MHz

- B1

Set clock speed to 1 MHz

- B2

Set clock speed to 250 KHz

Binary Mode format:

- Get current operation mode

@	0x3	‘b’

Response:

Success:

‘b’	nn

nn=0 4Mhz.
nn=1 1Mhz.
nn=2 250Khz.

Failure: ‘e’ followed by an error code listed in Section 2.6.2

6.3. Command G

Command G gets numbers of data from SPI slave device. Default address may be set using command A.

ASCII mode:

Format: > g 10 gets 16 (0x10) bytes from device

Binary mode format:

@	0x3	‘g’	Number of bytes (up to 32 bytes)

Response:

‘g’	Address mode	Address high	Address low	Data (up to 32 bytes)

Where address mode is 16 bits when value is 0xff or 8 bits when value is 0x0

Failure: ‘e’ followed by an error code listed in Section 2.6.2

6.4. Command W

Command W writes user input data to SPI slave device. This command will automatically enable the Write Enable Latch before each write to slave. An interval will be inserted between write cycles, which can be set with command D. Default address may be set with command A. Slave Address will be incremented after this operation.

ASCII mode:

Format: > w 12,34,56
If slave address is 0x0 before the operation, it will be set to 0x3 after the operation.

Binary mode format:

‘w’	length	Data0	…	Data n

Where length depends on the size of the packet

Response:
Success:

‘w’	Address mode: 16 bits when value is 0xff; 8 bits mode when value is 0	Address high	Address low

Failure: ‘e’ followed by an error code listed in Section 2.6.2

6.5. Command N

Command N is similar to command W except it won’t issue the Enable Write Latch command between write cycles.

ASCII mode:

Format: > n 12,34,56
If slave address is 0x0 before the operation, it will be set to 0x3 after the operation.

Binary mode format:

Command:

‘n’	length	Data0	…	Data n

Response:

Success:

‘n’	Address mode	Address high	Address low	Data (up to 32 bytes)

Where address mode is 16 bits when value is 0xff or 8 bits when value is 0x0

Failure: ‘e’ followed by an error code listed in Section 2.6.2

6.6. Command S

Command S sets the control command format.

ASCII mode:

Format:

- S

This command gets the current control commands.

Power on default value:

Read command	0x3
Write command	0x2
Write disable command	0x4
Write enable command	0x6
Read status register command	0x5
Write status register command	0x1

Example:
>s
>RD:34 WR:02 WRDI:04 WREN:06
>RDSR:05 WRSR:01
RD is read command, WR is write command, WREN is write enable command, RDSR is read status register command and WRSR is write status register command.

- SR nn

Sets the read command, where nn is the data in hex format.
Example: > SR 34 Sets read command to 0x34.

- SW nn

Sets the write command, where nn is the data in hex format

- SS nn

Sets the read status register command, where nn is the data in hex format.

- ST nn

Sets the write status register command, where nn is the data in hex format.

- SE nn

Sets the enable write command, where nn is the data in hex format.

- SD nn

Sets the disable write command, where nn is the data in hex format.

Binary mode format:

- Get the current control commands

@	0x3	's'

Response:
Success:

's'	Read command	Write command	Write disable command	Write enable command	Read status register command	Write status register command

Failure: 'e' followed by an error code listed in Section 2.6.2

- Set the command register

@	0x5	's'	{r,w,s,d,e,t}	value

Where r is read command, w is write command, s is read status register command, t is write status register command, e is enable write command and d is disable write command.

Response:
Success: 's' is returned.
Failure: 'e' followed by an error code listed in Section 2.6.2.

6.7. Command A

Command A sets the SPI slave address. Power on default is 0x0

ASCII mode:

Format:

- A

Shows the current slave address

- AH nn

Sets the high byte of the slave address, where nn is the high address in hex format.

- AL nn

Sets the low byte of the slave address, where nn is the low address in hex format.

Example:
>a
>Slave Address: 0x0003
>ah 12
>al 4f
>a
>Slave Address: 0x124F

Binary mode format:

- Gets the current address

@	0x3	'a'

Response:
Success: 'a' is returned followed by address high and address low

'a'	Address high	Address low

Failure: 'e' followed by an error code listed in Section 2.6.2.

- Sets address

@	0x5	'a'	{h,l}	Address value

Response:
Success: 'a' is returned.
Failure: 'e' followed by an error code listed in Section 2.6.2.

6.8. Command D

Command D sets an interval that is inserted between write cycles when command W or N is issued.

ASCII mode:

Format:

- D

Show current interval.

- D nn

Sets the interval to nn, where nn is in hex format.

Example:
>d
>SPI write-delay: 0x0A
>d 34
>d
>SPI write-delay: 0x34

Binary mode format:

- Gets the current delay

@	0x3	'd'

Response:
Success: 'a' is returned followed by delay value

'd'	delay

Failure: ‘e’ followed by an error code listed in Section 2.6.2.

- Sets delay

@	4	‘d’	New delay

Response:
Success: ‘d’ is returned.
Failure: ‘e’ followed by an error code listed in Section 2.6.2.

6.9. Command T

Command E enables the SPI write latch.

ASCII mode:

Format: > t

Binary mode format:

@	0x3	‘t’

Response:
Success: ‘t’ is returned.
Failure: ‘e’ followed by an error code listed in Section 2.6.2.

6.10. Command Q

Command Q writes to the status register if any.

ASCII mode:

Format:
Q nn, where nn is the new status register value, which is in hex format.

Binary mode format:

@	0x4	‘q’	value

Response:
Success: ‘q’ is returned.
Failure: ‘e’ followed by an error code listed in Section 2.6.2.

6.11. Command M

Command M transfers the SPI application menu to Main menu.

ASCII mode:

Format: > m

Binary mode format:

@	0x3	‘m’

Response:
Success: ‘m’ is returned.
Failure: ‘e’ followed by an error code listed in Section 2.6.2.

6.12. Command L

Command L toggles the address mode between 16 bits and 8 bits. This setting determines whether 16-bits address or 8-bits address is used when write and get date from SPI device. Please read your SPI device datasheet to decide which mode should be used. 16-bit address mode is used by default.

Note: Even in 16-bits address mode, the higher 8 bits address and lower 8 bits address are still clocked out at 8 clock pulses respectively instead of 16 clock pulses once.

ASCII mode:

Format: >L

Binary mode format:

- Gets the current address mode

@	0x3	'l'

Response:
Success: 'l' is returned followed by address mode

'd'	value

Where
Address mode is 16 bits when value is 0xff
8 bits when value is 0x0

Failure: 'e' followed by an error code listed in Section 2.6.2.

- Sets address mode

@	0x4	'l'	value

Value = 0xff, set to 16 bits mode
Value = 0x0, set to 8 bits mode

Response:
Success: 'l' is returned.
Failure: 'e' followed by an error code listed in Section 2.6.2.

6.13. Command '?'

Command '?' will display the entire SPI application menu.

ASCII mode format:

Format: > ?

Binary mode format:

@	0x3	'?'

Response:
Success: 's' is returned.
Failure: 'e' followed by an error code listed in Section 2.6.2.

6.14. Command X

Command x writes all user input data to the SPI salve. There is NO Write enable latch command inserted between data.

Address bytes are not affected by this command.

ASCII mode:

Format: > x 12, 4d

Hex data 0x12 and 0x4d will be sent to SPI bus.

Binary mode format:

Command:

'x'	length	Data0	…	Data n

Where length depends on the size of the packet

Response:
Success: ‘x’ is returned
Failure: ‘e’ followed by an error code listed in Section 2.6.2

7. Revision History

Revision	Software Version	Date	Description
1.0		3-2004	Initial release
1.1		5-2005	Added description for new pins layout to external target Removed command A in the I2C menu and add the list for the error codes. Added command x in the SPI menu for raw data write.
1.2	1.5	7-2005	Update the manual to support QBridgeV2 Command ‘e’ (enable write latch) of the SPI commands is changed to ‘t’ to support Binary mode. Add section for Binary mode. Add command ‘r’ for Binary mode
1.3	1.6	9-2005	Default baud rate is 9600 bps instead of 57Kbps.
1.4	1.8	11-2006	Added basic hardware diagram. Xon/Xoff must be disabled in Binary mode for user applications. Removed documentation for older version of the QBridge.