Connect Tech Inc.
Industrial Strength Communications

ROADWARRIOR

User Manual

Connect Tech Inc.
42 Arrow Road
Guelph, Ontario
N1K 1S6

Tel: 519-836-1291
Toll: 800-426-8979 (North America only)
Fax: 519-836-4878
Email: sales@connecttech.com
support@connecttech.com
Web: www.connecttech.com

CTIM-000148 Revision 0.02 - August 20, 2012

Limited Lifetime Warranty

Connect Tech Inc. provides a lifetime warranty for all of our products. Should this product, in Connect Tech Inc.'s opinion, fail to be in good working order during the warranty period, Connect Tech Inc. will, at its option, repair or replace this product at no charge, provided that the product has not been subjected to abuse, misuse, accident, disaster or non Connect Tech Inc. authorized modification or repair.

You may obtain warranty service by delivering this product to an authorized Connect Tech Inc. business partner or directly to Connect Tech Inc. along with proof of purchase. Product returned to Connect Tech Inc. must be pre-authorized by Connect Tech Inc. with an RMA (Return Material Authorization) number marked on the outside of the package and sent prepaid, insured and packaged for safe shipment. Connect Tech Inc. will return this product by prepaid ground shipment service.

The Connect Tech Inc. lifetime warranty is defined as the serviceable life of the product. This is defined as the period during which all components are available. Should the product prove to be irreparable, Connect Tech Inc. reserves the right to substitute an equivalent product if available or to retract lifetime warranty if no replacement is available.

The above warranty is the only warranty authorized by Connect Tech Inc. Under no circumstances will Connect Tech Inc. be liable in any way for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, such product.

Copyright Notice

Trademark Acknowledgment

Connect Tech Inc. acknowledges all trademarks, registered trademarks and/or copyrights referred to in this document as the property of their respective owners.

Not listing all possible trademarks or copyright acknowledgments does not constitute a lack of acknowledgment to the rightful owners of the trademarks and copyrights mentioned in this document.

Table of Contents

Revision History

Revision	Date	Author(s)	Change(s)
0.00	01-03-2012	PD	Initial Manual Revision Created
0.01	02-28-2012	HJ	Firmware configuration and description added.
0.02	08-17-2012	PD	Added Dimensioned Drawings and Power Consumption Details

Customer Support Overview

If you experience difficulties after reading the manual and/or using the product, contact the Connect Tech Inc. reseller from which you purchased the product. In most cases the reseller can help you with product installation and difficulties.

In the event that the reseller is unable to resolve your problem, our highly qualified support staff can assist you. Our support section is available 24 hours a day, 7 days a week on our website at: www.connecttech.com/sub/support/support.asp. See the contact information section below for more information on how to contact us directly. Our technical support is always free.

Contact Information

We offer three ways for you to contact us:

Mail/Courier

You may contact us by letter at:

Connect Tech Inc.
Technical Support
42 Arrow Road, Guelph, ON
Canada N1K 1S6

Email/Internet

You may contact us through the Internet. Our email and URL addresses on the Internet are:
sales@connecttech.com
support@connecttech.com
www.connecttech.com

Note:
Please go to the **Download Zone** or the **Knowledge Database** in the **Support Center** on the Connect Tech Inc. website for product manuals, installation guides, device driver software and technical tips. Submit your technical support questions to our customer support engineers via the **Support Center** on the Connect Tech Inc. website.

Telephone/Facsimile

Technical Support representatives are ready to answer your call Monday through Friday, from 8:30 a.m. to 5:00 p.m. Eastern Standard Time. Our numbers for calls are:

Telephone:	800-426-8979 (North America only)
Telephone:	519-836-1291 (Live assistance available 8:30 a.m. to 5:00 p.m. EST, Monday to Friday)
Facsimile:	519-836-4878 (online 24 hours)

Introduction

Connect Tech's RoadWarrior enables remote monitoring, controlling and collecting of data from multiple I/O interfaces through a wireless cellular data link or Low Earth Orbit (LEO) satellite. RoadWarrior can be controlled from any Internet connected device. This product is designed for rugged mobile, mission-critical and industrial strength applications that require enhanced wireless M2M (machine-to-machine) connectivity. RoadWarrior can be configured to operate on any existing cellular network standard and frequency bands today, with drop-in replacement upgradeability to operate on future cellular networks. RoadWarrior also has the capability of operating on LEO satellite networks. With a wide range of interfaces including RS-232, RS-485, CAN, GPS, Bi-directional GPIO, High Voltage Isolated GPIO and ADC's, RoadWarrior is ideal for many remote or mobile application environments including transportation and military applications.

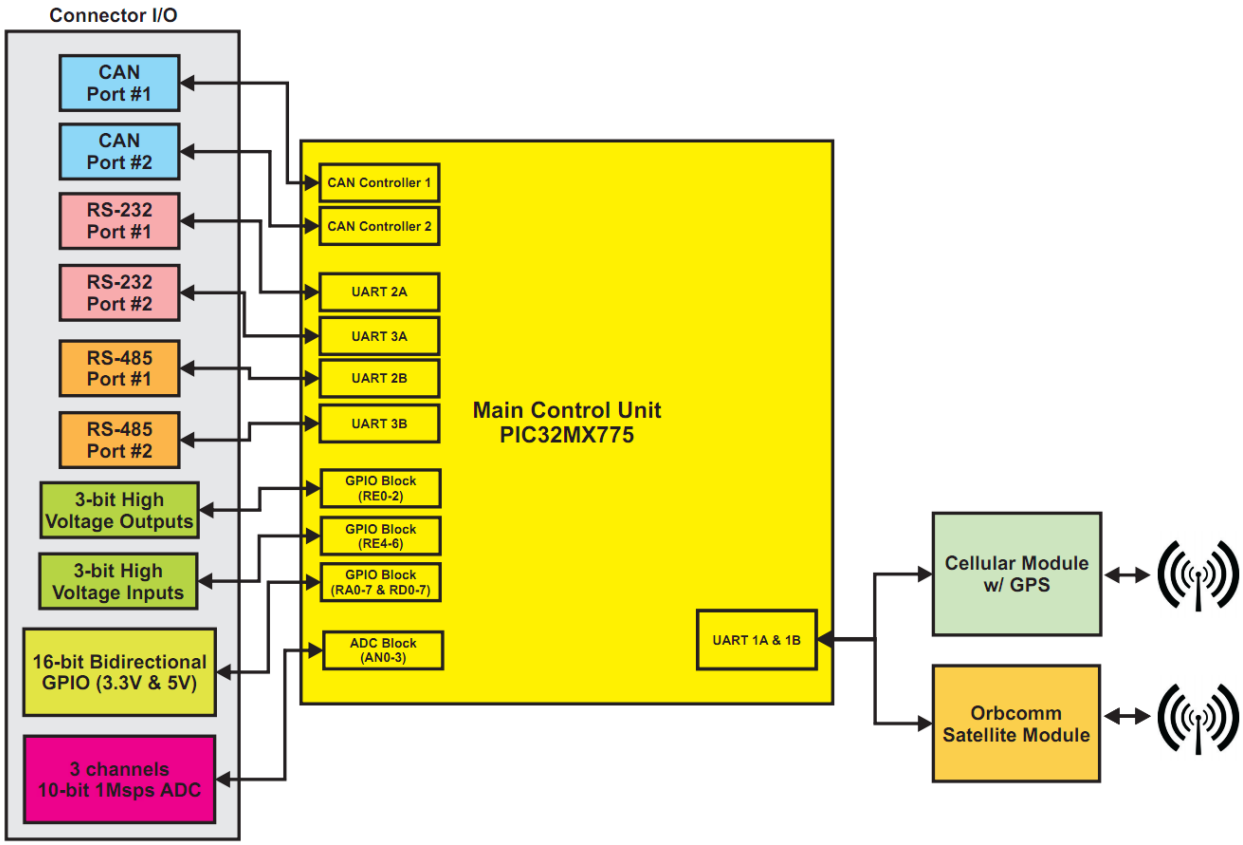
Product Features

Specification	Details

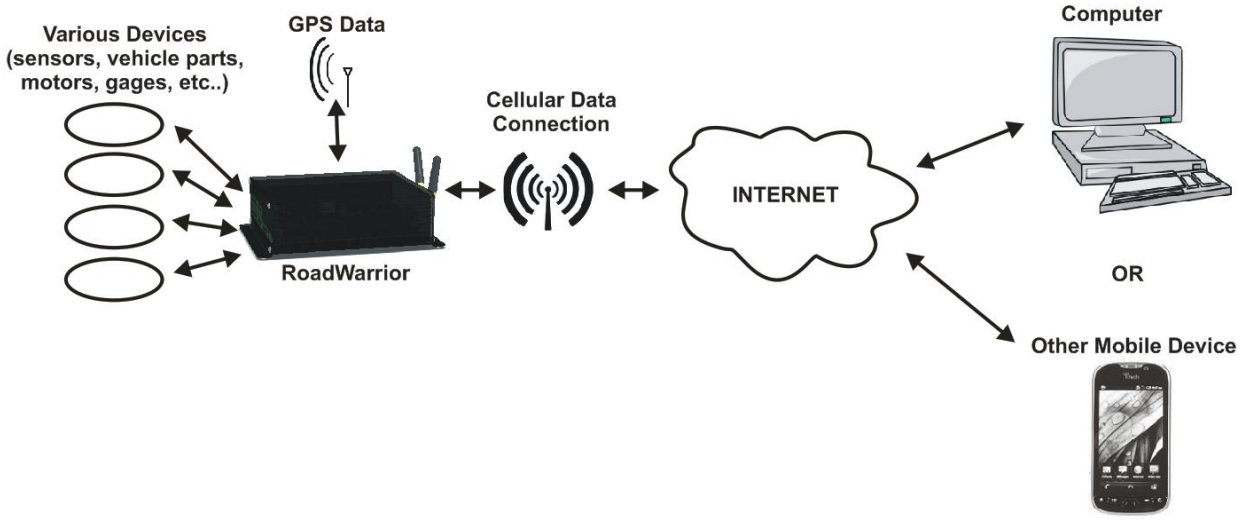
Cellular	• Cellular Networks:
	  ○ HSPA/EV-DO/UMTS/EDGE/GPRS/CDMA
	• Frequency Bands:
	  ○ 3G/3.5G: 850/1900/2100 MHz
	  ○ 2G/2.5G: 850/900/1800/1900 MHz
	  ○ Drop-in replacement for future mobile telephony
	  ○ standards, networks and frequency band

GPS	• NMEA-0183 V3.01 compliant GPS message
Satellite	• Optional satellite communication capabilities via Low Earth Orbit (LEO) Satellites
Serial	• 2 x RS-232, 2 x RS-485
CAN	• 2 x CAN 2.0b
GPIO	• 16 bits +3.3V or +5V bi-direction GPIO • 3 bits optically isolated outputs (0 ~ +40V DC) • 3 bits optically isolated inputs (0 ~ +40V DC)
Connectors	• 2.5mm pitch terminal block header
Main Control Unit	• Microchip PIC32 Microcontroller (PIC32MX775) which can be optionally configured end-users application code
Enclosure	• Rugged extruded aluminum enclosure with mounting flanges. • 5.275" (width) x 2.000" (height) x 6.000" (length)
Input Power	• +9 to +30V DC (ability to handle standard vehicle power)
Operating Environment	• Industrial Temperature: -40ºC to 85ºC (-40ºF to 185ºF)

Block Diagram



Usage Diagram



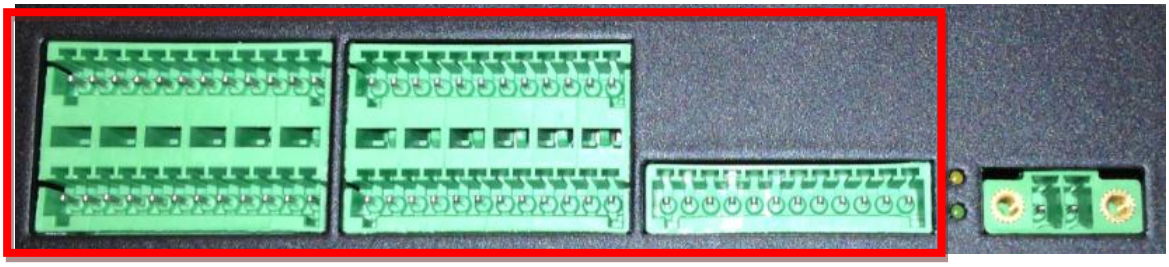
Part Number Information

Part Number	Features	Board Image
RDG001	GSM / GPRS Model	
RDG002	HSPA Model	
RDG003	EV-DO Model	
RDG004	CDMA Model	

To order any of these part numbers or to inquire about the other available ordering options please contact sales@connecttech.com for further information.

Connector Pinouts

I/O Connectors (P6, P7, P4)



P6 (Left Connector)

A1 GPIO0	A2 GPIO1	A3 GPIO2	A4 GPIO3	A5 GPIO4	A6 GPIO5	A7 GPIO6	A8 GPIO7	A9 GPIO8	A10 GPIO9	A11 GPIO10	A12 GND
B1 GPIO11	B2 GPIO12	B3 GPIO13	B4 GPIO14	B5 GPIO15	B6 GND	B7 ANALOG_CH0	B8 ANALOG_CH1	B9 ANALOG_CH2	B10 ANALOG_CH3	B11 ANALOG_VREF+	B12 ANALOG_VREF-

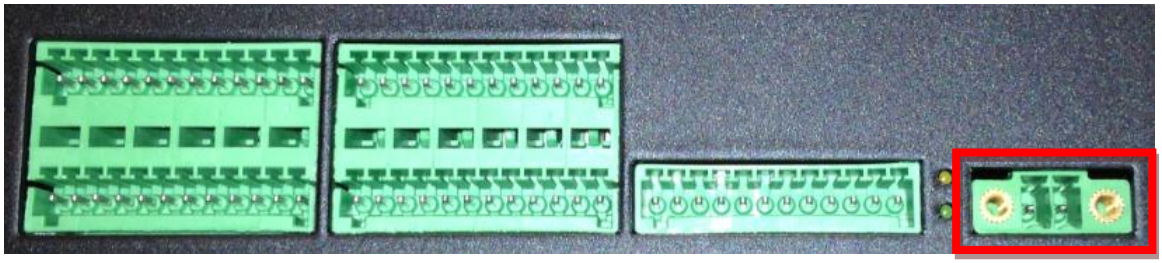
P7 (Middle Connector)

A1 485_UART1_TX+	A2 485_UART1_TX-	A3 485_UART1_RX+	A4 485_UART1_RX-	A5 GND	A6 485_UART2_TX+	A7 485_UART2_TX-	A8 485_UART2_RX+	A9 485_UART2_RX-	A10 HV_OUT0	A11 HV_OUT0_V+	A12 HV_OUT0_V-
B1 HV_OUT1	B2 HV_OUT1_V+	B3 HV_OUT1_V-	B4 HV_OUT2	B5 HV_OUT2_V+	B6 HV_OUT2_V-	B7 HV_IN0+	B8 HV_IN0-	B9 HV_IN1+	B10 HV_IN1-	B11 HV_IN2+	B12 HV_IN2-

P4 (Right Connector)

A1 232_UART1_RX	A2 232_UART1_TX	A3 GND	A4 232_UART2_RX	A5 232_UART2_TX	A6 GND	A7 CAN1_LOW	A8 CAN1_HIGH	A9 CAN1_GND	A10 CAN2_LOW	A11 CAN2_HIGH	A12 CAN2_GND

Power Connector (P3)



Pin 1 (Left Side Pin) = Positive Terminal (+9 to +30V)
Pin 2 (Right Side Pin) = Negative Terminal (GND)

Custom Firmware Development and Programming

Development

All of the firmware code can be developed using MicroChips's free MPLAB IDE in conjunction with their Full-featured ANSI-compliant C compiler for PIC32 microcontrollers. Information on the development tools can be found below.

MPLAB IDE:
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en019469

MPLAB C Compiler:
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2615&dDocName=en532454

Programming

Programming and configuration will can done using any of MicroChip's PIC32 Debugging and emulation tools. These include the MPLAB ICD3 device or the MPLAB REAL ICE device, information on these products can be found below. With PIC devices the main programming interface is done through MicroChip's own propretary two wire interface. The programming tools will connect via an RJ 6-Pin connector on the RoadWarrior labeled "ICD Programming" at location P1.

MPLAB ICD3 (Recommended)

Device List Price: ~$200
Website Link:
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en537580

MPLAB REAL ICE

Device List Price: ~$500
Website Link:
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en028120

Microcontroller Mappings

Below is a complete listing of all of the peripheral interconnect to the microcontroller.

PIC32 Name	Signal Name	Notes
(+3.3V or +5V) GPIO		
PORTA0	GPIO0	0 = Low | 1 = High
PORTA1	GPIO1	0 = Low | 1 = High
PORTA2	GPIO2	0 = Low | 1 = High
PORTA3	GPIO3	0 = Low | 1 = High
PORTA4	GPIO4	0 = Low | 1 = High
PORTA5	GPIO5	0 = Low | 1 = High
PORTA6	GPIO6	0 = Low | 1 = High
PORTA7	GPIO7	0 = Low | 1 = High
PORTD0	GPIO8	0 = Low | 1 = High
PORTD1	GPIO9	0 = Low | 1 = High
PORTD2	GPIO10	0 = Low | 1 = High
PORTD3	GPIO11	0 = Low | 1 = High
PORTD4	GPIO12	0 = Low | 1 = High
PORTD5	GPIO13	0 = Low | 1 = High
PORTD6	GPIO14	0 = Low | 1 = High
PORTD7	GPIO15	0 = Low | 1 = High
PORTB8	GPIO0-7 Direction	0 = sets GPIO Pins 0-7 as INPUTS | 1 = sets GPIO Pins 0-7 as OUTPUTS
PORTB9	GPIO8-15 Direction	0 = sets GPIO Pins 8-15 as INPUTS | 1 = sets GPIO Pins 8-15 as OUTPUTS
USER LEDs		
PORTD8	USER_LED0	Located at front at edge of board
PORTD9	USER_LED1	Located at front at edge of board
PORTD10	USER_LED2	Located on PCB
PORTD11	USER_LED3	Located on PCB
PORTD12	USER_LED4	Located on PCB
PORTD13	USER_LED5	Located on PCB
Isolated GPIO		
PORTE0	HV_OUT0	Isolated GPIO Output Bit-0
PORTE1	HV_OUT1	Isolated GPIO Output Bit-1
PORTE2	HV_OUT2	Isolated GPIO Output Bit-2
PORTE4	HV_IN0	Isolated GPIO Input Bit-0
PORTE5	HV_IN1	Isolated GPIO Input Bit-1
PORTE6	HV_IN2	Isolated GPIO Input Bit-2
UARTs		
UART1A	USM_UART	This UART is connected to the cellular modem (TX, RX, RTS, CTS)
UART2A	232_UART1	RS-232 Port #1 (TX, RX only)
UART3A	232_UART2	RS-232 Port #2 (TX, RX only)
UART3B	485_UART1	RS-485 Port #1 (TX, RX only)
UART2B	485_UART2	RS-485 Port #2 (TX, RX only)
CAN		
CAN1	CAN1	CAN Controller #1
CAN2	CAN2	CAN Controller #2
ADC		
AN0	ANALOG_CH0	ADC Input
AN1	ANALOG_CH1	ADC Input
AN2	ANALOG_CH2	ADC Input
AN3	ANALOG_CH3	ADC Input
VREF-	ANALOG_VREF-	ADC VREF-
VREF+	ANALOG_VREF+	ADC VREF+
MISC		
PORTC1	USM_RESET#	Cellular Modem Reset Signal

Preloaded Firmware in RoadWarrior

Target Audience

The RoadWarrior User Manual assumes that the reader is familiar with programming using the C language, and the hardware platform. It is also assumes that the reader is familiar with the target operating system and related C development tools such as Borland, Visual Studio, or the GCC compiler.

Configuration of Cell Modem

To configure cell modem, connect UART1 to a serial port; use hyperterminal, putty, etc. for Windows and Minicom for Linux to communicate with the cell modem. Power on the cell modem. The firmware will emit the character '*' for 30 seconds through UART1 while the firmware scans for a 'password' as login authentication. Once the password is entered from the application, (hyperterminal, putty etc.) the login prompt '>' will appear.

From this point forward, any character entered will be sent to the cell modem, and any character received from cell modem will sent to the application by UART1.

To configure the cell, use 'AT' commands.

Please refer to the following three documents to configure the modem:

1. Universal_IP_Ref_Guide_S000457I.pdf
2. HSPA_AT_Command_Ref_Guide_S000483A.pdf
3. GPRS_AT_Command_Ref_Guide_S000463C.pdf

For the latest manuals, please visit www.multitech.com.

Once the configuration is complete, enter:

'Ctrl-q' (0x11)

This command will exit the cell modem configuration mode and the normal firmware booting will continue.

TCP Socket Configuration

You will need to assign IP address for the modem that you get from the carrier service provider and a valid TCP port. Use #TCPSERV for setting IP address and #TCPPORT for setting TCP port. See 'Chapter 5 – TCP Commands for All Universal IP Devices' of Universal_IP_Ref_Guide_S000457I.pdf.
Once the modem is configured for TCP server, the socket application can connect to the modem and send commands to the firmware to perform various operations on GPIO, ADC, RS-232/485 UARTs, CAN and GPS.

Packet and Command Response

All command packet will have to be terminated by '<' character and all response packets will be terminated by the same character followed by '\r\n\>'.

The general command format is as follows:

- If the command has no configuration data then the following command format will apply:
  Command<
- If the command has configuration data then the following command format will apply:
  Command:'configuration data'<
- If the response has no data then the following response format will apply:
  Command:'status'<
  Where status is 'DONE' or 'FAIL'
- If the response has data then the following response format will apply:
  Command:'data'<

GPIO - Non-Isolated GPIO

PORTA0 to PORTA7 are configured as output and PORTD0 to PORTD7 are configured as input.

The following commands will read input from PORTD0 to PORTD7:

GPIOA1R<	read PORTD0
GPIOA2R<	read PORTD1
GPIOA3R<	read PORTD2
GPIOA4R<	read PORTD3
GPIOA5R<	read PORTD4
GPIOA6R<	read PORTD5
GPIOA7R<	read PORTD6
GPIOA8R<	read PORTD7

The response will be one byte '0' for low and '1' for high.
For example, "GPIOA2R:1<" means PORTD1 is high.

The following commands will set output low from PORTA0 to PORTA7:

GPIOB1W0<	set low PORTA0
GPIOB2W0<	set low PORTA1
GPIOB3W0<	set low PORTA2
GPIOB4W0<	set low PORTA3
GPIOB5W0<	set low PORTA4
GPIOB6W0<	set low PORTA5
GPIOB7W0<	set low PORTA6
GPIOB8W0<	set low PORTA7

The following commands will set output high from PORTA0 to PORTA7:

GPIOB1W1<	set high PORTA0
GPIOB2W1<	set high PORTA1
GPIOB3W1<	set high PORTA2
GPIOB4W1<	set high PORTA3
GPIOB5W1<	set high PORTA4
GPIOB6W1<	set high PORTA5
GPIOB7W1<	set high PORTA6
GPIOB8W1<	set high PORTA7

Isolated GPIO

PORTE0 to PORTE2 are configured as output and PORTE4 to PORTE6 are configured as input.

The following commands will read input from PORTE4 to PORTE6:

GPIOC1R<	read PORTE4
GPIOC2R<	read PORTE5
GPIOC3R<	read PORTE6

The following commands will set output low from PORTE0 to PORTE2:

GPIOD1W0<	set low PORTE0
GPIOD2W0<	set low PORTE1
GPIOD3W0<	set low PORTE2

The following commands will set output high from PORTE0 to PORTE2:

GPIOD1W1<	set high PORTE0
GPIOD2W1<	set high PORTE1
GPIOD3W1<	set high PORTE2

ADC

The following command will read values from ADC1, ADC2 ADC3 and ADC4.

ADC1R<
ADC2R<
ADC3R<
ADC4R<

The response is 4 bytes, returned as integer. Though ADC is 10 bit but 32 bits are returned; therefore the application will ignore the remaining bits. Following is a response:

ADC1R:0a000000<

Therefore, the ADC1 reads 0xa; the value will have to be multiplied with the proper voltage multiplier to get the voltage reading.

UART RS-232 and RS-485

All UARTs are configured with 8 data bits, 1 stop bit and no parity. The default baudrate of the firmware is 115200. The baudrate is settable and the command to set the baudrate to 9600 is as following

Baudrate = 0x25800000 (4 bytes)

UART1C:baudrate <	it will set baudrate for UART1
UART2C:baudrate <	it will set baudrate for UART2
UART3C:baudrate <	it will set baudrate for UART3
UART4C:baudrate <	it will set baudrate for UART4

The maximum packet length for UART read/write is 128 bytes. The following command will write data to UART:

Data[5] = {“abcde”};

UART1W:Data[5]<	it sends data ‘abcde’ to UART1
UART2W:Data[5]<	it sends data ‘abcde’ to UART2
UART3W:Data[5]<	it sends data ‘abcde’ to UART3
UART4W:Data[5]<	it sends data ‘abcde’ to UART4

The following command will request data from UART:

UART1R:<	read data from UART1
UART2R:<	read data from UART2
UART3R:<	read data from UART3
UART4R:<	read data from UART4

If there is any data, the response will be as following for UART1:

UART1R:ABCDE<	returned data is ABCDE

If there is no data then the response will be as following UART1:

UART1R:FAIL<

CAN

The following structure describes configuration structure:

```
#pragma pack(1)
typedef struct _can_cfg {
        unsigned long speed;  //baudrate
        unsigned char extended; //extended/standard frame
        unsigned long code; // 11-bit or 29-bit acceptance code
        unsigned long mask; // 11-bit or 29-bit acceptance mask
}can_config;
#pragma pack()
can_config cfg = {250000, 0, 0, 0};
```

The following commands will configure a CAN port:

CAN1C:cfg<	it will configure CAN1 port
CAN2C:cfg<	it will configure CAN2 port

The successful completion of the command will provide the following response:

CAN1C:DONE<

The CAN transmission packet has the following structure:

```
typedef struct
{
    // CAN TX Message Standard ID. This value should
    // be between 0x0 - 0x7FF.
        unsigned SID:11;
        unsigned :21;
}CAN_TX_MSG_SID;

typedef struct
{
    // Data Length Control. Specifies the size of the
    // data payload section of the CAN packet. Valid
    // values are 0x0 - 0x8.
        unsigned DLC:4;

    // Reserved bit. Should be always 0.
        unsigned RB0:1;
        unsigned :3;

    // Reserved bit. Should be always 0.
        unsigned RB1:1;

    // Remote Transmit Request bit. Should be set for
    // RTR messages, clear otherwise.
        unsigned RTR:1;

    // CAN TX and RX Extended ID field. Valid values
    // are in range 0x0 - 0x3FFFF.
        unsigned EID:18;

    // Identifier bit. If 0 means that message is SID.
    // If 1 means that message is EID type.
        unsigned IDE:1;

    // Susbtitute Remote request bit. This bit should
    // always be clear for an EID message. It is ignored
    // for an SID message.
        unsigned SRR:1;
        unsigned :2;

}CAN_MSG_EID;

typedef union {

        struct
        {
        // This is SID portion of the CAN TX message.
                CAN_TX_MSG_SID msgSID;

        // This is EID portion of the CAN TX message.
                CAN_MSG_EID msgEID;

        // This is the data portion of the CAN TX message.
                BYTE data[8];
        };

    // This is CAN TX message organized as a set of 32 bit
    // words.
        UINT32 messageWord[4];

}CANTxMessageBuffer;
```

The following sequence will send a CAN packet:

```
CANTxMessageBuffer tx_message;
//Initialize the structure
tx_message.messageWord[0] = 0;
tx_message.messageWord[1] = 0;
tx_message.messageWord[2] = 0;
tx_message.messageWord[3] = 0;

tx_message.msgSID.SID    = 0x202; // ID code
tx_message.msgEID.IDE    = 0;    // standard ID
tx_message.msgEID.DLC    = 1;    // data length
tx_message.data[0]        = 0x55; // data
```

The following command will send the CAN packets

CAN1W:tx_message<	tx_message will be sent by CAN1
CAN2W:tx_message<	tx_message will be sent by CAN2

The successful completion of the command will provide the following response:

CAN1W:DONE<
CAN2W:DONE<

The CAN reception packet has the following structure:

```
typedef struct
{
    // SID of the Received CAN Message.
        unsigned SID:11;

    unsigned :21;

}CAN_RX_MSG_SID;

typedef union {

        struct
        {
        // This is SID portion of the CAN RX message.
                CAN_RX_MSG_SID msgSID;

        // This is EID portion of the CAN RX message
                CAN_MSG_EID msgEID;

        // This is the data payload section of the
        // received message.
                BYTE data[8];
        };

    // This is CAN RX message organized as a set of 32 bit
    // words.
        UINT32 messageWord[4];

}CANRxMessageBuffer;
```

The following command will receive the CAN packets:

CAN1R<	receive packet from CAN1
CAN2R<	receive packet from CAN2

If there are CAN packets available then the following response will be delivered:

CAN1R:CANRxMessageBuffer< CANRxMessageBuffer received from CAN1
CAN2R:CANRxMessageBuffer< CANRxMessageBuffer received from CAN2

If there is no CAN packet available then the following response will be delivered:

CAN1R:FAIL<	no packet available for CAN1
CAN2R:FAIL<	no packet available for CAN2

GPS

The following command will provide the GPS information:

#GPSGETMESSAGE<

The GPS information returned as:

#GPSGETMESSAGE:GPS data<

GPS Data

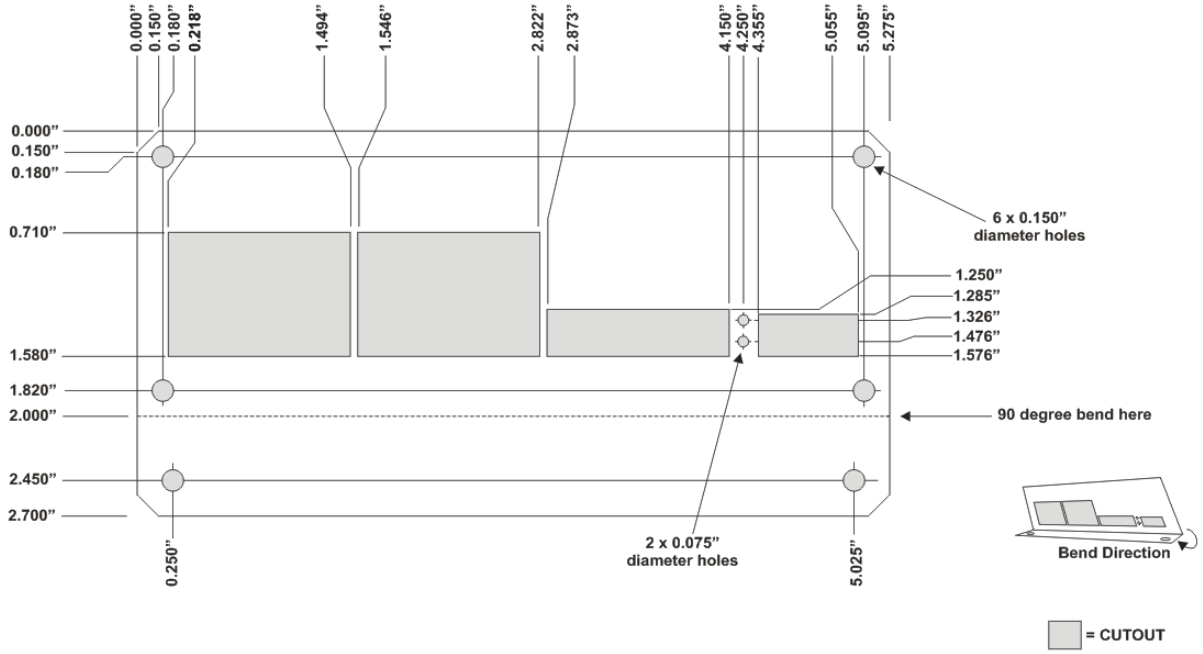
The format of the message is described in Universal_IP_Ref_Guide_S000457I.pdf, Part 6 - GPS Message Syntax.

The GPS data may not be latest; it is gathered when the socket connection is closed or during the boot of the firmware. To get the latest GPS data, connect to the modem and disconnect and connect again and issue GPS command. If this is not acceptable, then the modem has to be configured to have a GPS client where the server IP address and TCP port will have to be entered. Then the modem GPS client will connect the server and respond to GPS command.

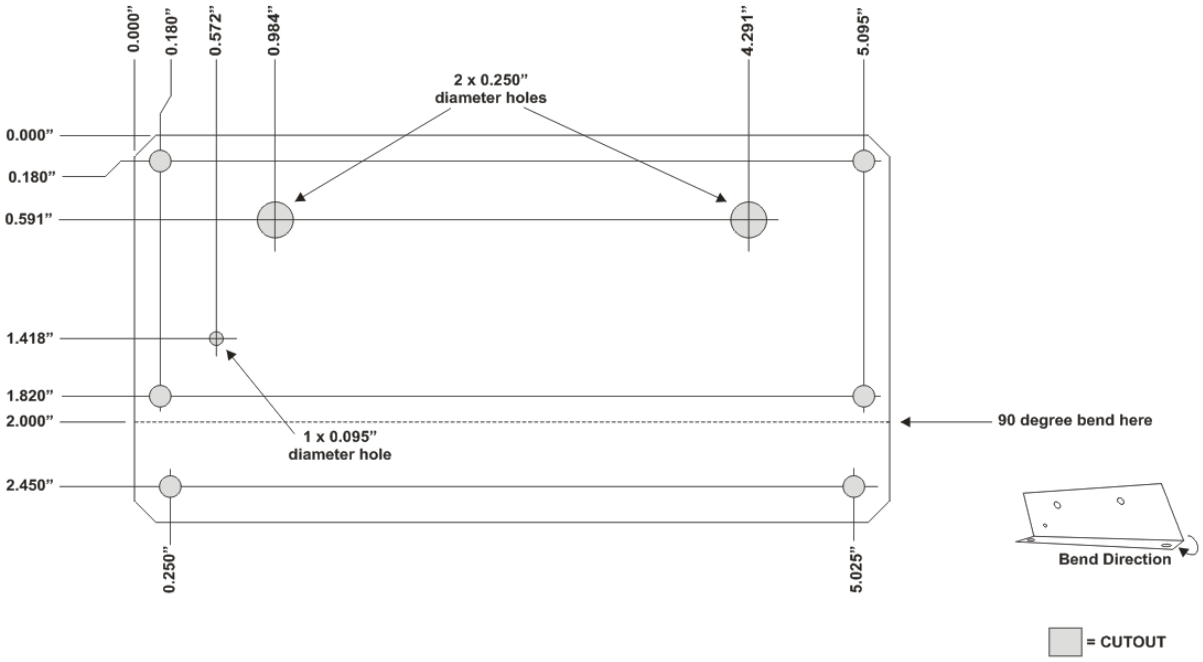
For more information consult ‘Chapter 16 – Commands for GPS-Enable Products’ of Universal_IP_Ref_Guide_S000457I.pdf.

Dimensions

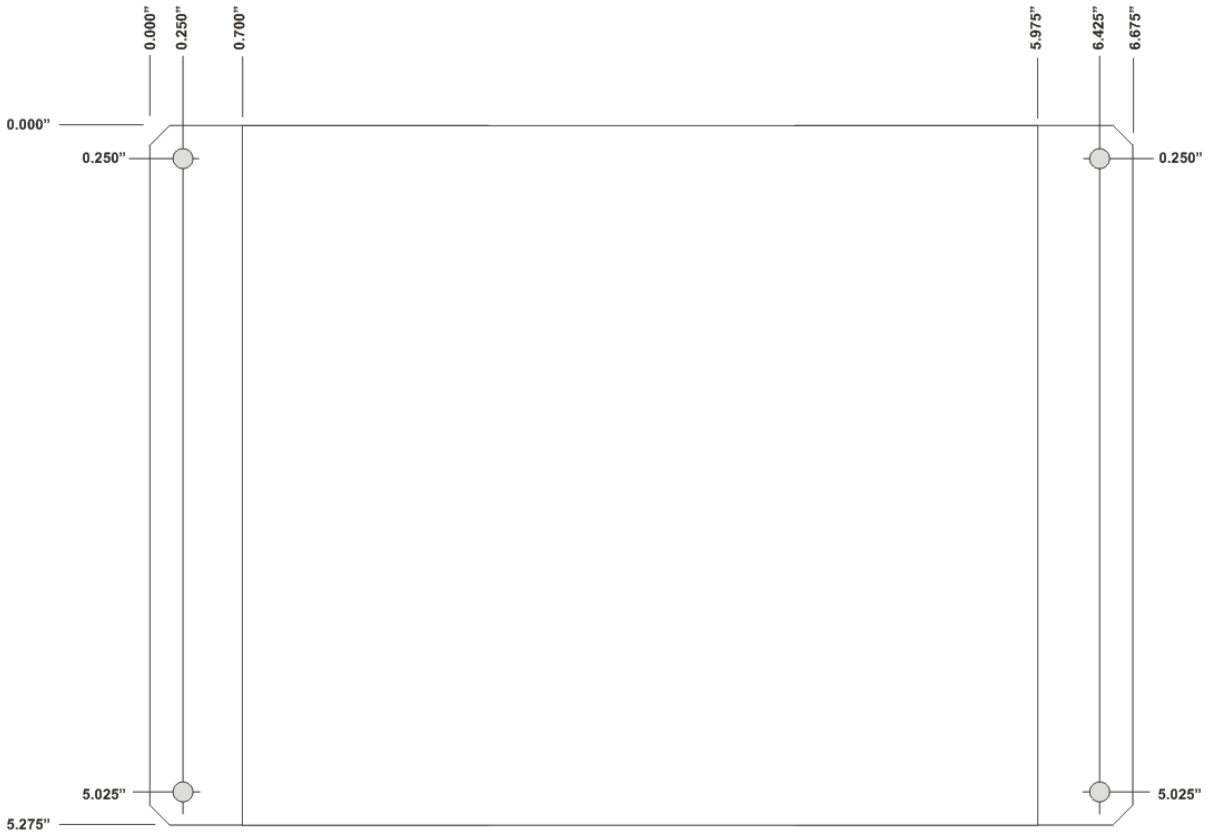
Front I/O Panel



Rear Antenna Panel



Top View



Power Consumption

Input Power
+9 to +30V DC

Power Consumption Details
The following was measured using a standard +12V nominal voltage source

Standby Mode
Description: Power ON, device is connected to cellular network but not actively transmitting or receiving data
Current Consumption: 180mA
Power: 2.16W

Transmitting Mode
Description: Power ON, device is connected to cellular network and is actively transmitting or receiving data
Current Consumption: 500mA (max)
Power: 6W