CalSense

"RRE"   RF MODEM
User Manual

Version A2

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CALSENSE

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Overview

This RF MODEM is a 2 watt VHF data modem in module form, suitable for integration in OEM products. It is completely self-contained, self-regulated, and shielded. It contains a receiver, a transmitter, base-band circuits, and a microprocessor. The user interface to it is ASYNC data in and out. Modem operation is transparent to the user, although the configuration of the MODEM is via the user serial port.

FCC Information

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

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

This product complies with FCC Part 95 for operation on the MURS radio service.

Features

- *Built-in VHF band transceiver with integrated modem*
- *Unlicensed MURS band operation*
- *Small size*
- *Very low cost narrow-band radio modem*
- *2 watts of RF output*
- *Full spec –30 to +60 degrees C*
- *Easily configured using "AT" commands*
- *User interface is asynchronous serial data for TX, RX, and configuration.*
- *TTL level inputs and outputs*
- *Low receive and standby current consumption*

Specifications

General

All measurements made per TIA-603-B

Vpwr input Voltage.. 5.0V DC

Average current draw, /SLEEP asserted (low) .... <20mA

Average current draw, ENABLE negated (low)....................................... <200uA

Current draw when receiving data.. <90mA

Current draw when transmitting data..<2.5A

Power supply ripple and noise limit .... <100mV RMS

Frequency Stability .... better than ±5ppm

User selectable channels: ....Five, see frequencies below
        1.. 151.820 MHz
        2.. 151.880 MHz
        3.. 151.940 MHz
        4.. 154.570 MHz
        5.. 154.600 MHz

Serial Port Baud Rates 300, 1200, 2400, 4800, 9600, 19200, 57600

Operating temperature range...-30ºC to +60ºC

Maximum over-the-air data rate 4800bps

Storage temperature range...-30ºC to +80ºC

TX-RX and RX-TX turn-around time .... <50mS

Wake-up time from /SLEEP.. <60mS

Power on (or ENABLE asserted) time to operational .... <250mS

Transmitter

Maximum RF Power output .... 2.0 watts

Maximum Duty Cycle 10%

Maximum Transmit frequency deviation .... ± 2.25kHz

TX Spurious outputs .... < -70dBc

Occupied Bandwidth mask:
        (i) On any frequency from the center of the authorized bandwidth f(o) to 5.625
        kHz removed from f(o): Zero dB. (ii) On any frequency removed from the center

of the authorized bandwidth by a displacement frequency (f(d) in kHz) of more than 5.625 kHz but no more than 12.5kHz: at least 7.27(f(d) -2.88 kHz) dB. (iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f(d)in kHz) of more than 12.5 kHz: at least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

Receiver

RX sensitivity (1% BER) ....-110dBm

RX selectivity... -60dB

RX intermodulation rejection... -65dB at 2400bps

User Input and Output Signals

Voltage Levels..3.3V HCMOS levels

RX and TX data.. Async data

Modem handshake signals ....RTS, CTS, DTR, DSR, CD

RF I/O   ....50 ohm SMA

Power   ....B+ input and Ground

HCMOS Input and Output Specifications

Digital out, low .... <.6V at 6mA

Digital out, high.. >2.7V at 3mA

Digital In, low threshold 0.9V

Digital in, high threshold 1.5V

Input leakage current .... < 50nA

User I/O Connector

The User I/O is via a 20-pin header connector, 2mm pin spacing. The following pin are defined.

Pin #	Name	Dir	Function	Level / Specification
1	Vird	I	DC power for IrDA	
2	Vcc	I/O	Power Input	DC input to the radio module. See specification section for DC input requirements.
3				
4	Vcc	I/O	Power Input	DC input to the radio module. See specification section for DC input requirements.
5	/SLEEP	I	Tells RF Module to enter sleep mode.	Active low. <.7V = sleep. 2-3.3V = power OK. Must tie to Vcc if unused. Also may be used as power-fail input. Zin > 1M.
6	TxD	I	Transmit Data	Transmits bytes out of user device and into modem. 3.3V HCMOS level.
7	RxD	O	Receive Data	Receives bytes into user device. RF modem sends data out if this pin. 3.3V HCMOS level.
8	RTS	I	Request To Send	RTS/CTS flow control. RTS Signal into modem. 3.3V HCMOS level.
9	CTS	O	Clear To Send	RTS/CTS flow control. Active low CTS signal from modem into user device. Will be negated (set to 1) if serial port RX buffer is full. 3.3V HCMOS level.
10	GND			
11	GND			
12	DCD	O	Data Carrier Detect	Modem connected to another modem or channel is busy. 3.3V HCMOS level.
13	NC			
14	RESET	I	Modem reset	Active low. Causes CPU within the modem to do a cold-reset. Clears RTC and re-initializes modem to parameters stored in flash.
15	RXAUD	O	RX audio	Test signal. Audio from demodulator of radio. Zout = TBD.
16	RSSI	O	Receiver Signal Strength	Test signal. eal-time analog representation of RSSI. Zout = TBD. Vout = TBD.
17	/CONFIG	I	Config mode select	Active low, with 10K internal pull-up. When pulled low, the modem will enter the configuration mode. OK to leave open-circuit.
18	ENABLE	I	Power on/off	Pull low to turn the unit completely off. High (>2V) to turn the RF modem on.
19	IR_TX	I	TX to IR transceiver	Pass-through to IR transceiver
20	IR_RX	O	RX to IR transceiver	Pass-through to IR transceiver

Note: With ENABLE low, the DC circuits in the modem are off, so I/O pins to and from the radio modem must all be low or open circuit. These are pins 5, 6, 7, 8, 9, 12, 14, and 17.

Serial Port Data and Handshaking

In computer terminology, the RF modem is considered a "Data Communications Equipment" device, or DCE. The user's hardware that the modem is connected to is considered "Data Terminal Equipment", or DTE. Here is a description of how data and control is communicated over the various serial port signals between the modem (DCE) and another device (DTE) that the modem's I/O port is connected to.

TxD (INPUT)

This line is used to transmit data from the DTE to the DCE. It is maintained at a logical 1 state when nothing is transmitted. If Hardware Flow Control is enabled in the modem, the terminal will start to transmit data to the modem when a logical 1 is present on all of the following lines:

- Clear To Send (output from modem)
- Request to Send (output from the DTE)

RxD (OUTPUT)

This circuit is used to receive data from the DCE to the DTE. The modem will start to transmit data to the DTE when a logical 1 is present on all of the following lines:

- Data Terminal Ready (reply that it is OK to send)
- Data Set Ready (asserted by the modem)

RTS

On this line, the DTE will send a signal when it wants to receive data from the modem (DCE). The modem will not output data unless this pin is low, or "Flow Control" has been disabled in the modem set-up. When a DTE (such as a PC or microcontroller) wants to stop the flow into it, it negates RTS. Negated "Request To Send" (+3.3V) means "request NOT to send to me" (stop sending). When the DTE is ready for more bytes it asserts RTS (0 volts) and the flow of bytes to it resumes. DCE equipment works the same way but sends the stop signal out the CTS pin. Thus it's RTS/CTS flow control using 2 lines.

CTS

Here the modem (DCE) will send a signal (0 volts) when it's ready to receive data from the DTE. When negated (3.3 volts), the remote DTE device should stop sending data.

CD

On this line the modem indicates to the DTE that it has established a carrier with a remote device. It will assert this signal any time there is a carrier detected. The modem may be configured to assert this when an RF carrier is detected (any on-

channel RF, voice or data), or assert it only when another RF modem signal is detected.

User Serial Port Commands

Overview

The asynchronous serial port on the RF modem is used to send and receive data over the air, as well as to configure the RF modem. In normal operation, the user sends data into the TxD pin of the user port, an this data will be sent over the air. Receive data from another RF modem is output to the user via the RxD pin of the user port. This is the default operating condition of the RF modem.

There also is a configuration mode, where in the RF modem accepts commands via the TxD pin. The commands can be used to change certain internal parameters of the radio modem.

Configuration Mode

The RF modem may be put into a "config mode", by entering a sequence of characters (+++) or by pulling the hardware /CONFIG pin low.

To Enter the Config mode when using AT Commands -

Using serial communications software, send the 3-character command sequence "+++" while observing times of silence before [BT (Silence Before Sequence) Command] and after [AT (Silence After Sequence) Command] the command character.

The default sequence for entering into AT Command Mode:
1. *No characters sent for 1 second.*
2. *Input three (3) plus characters ("+++") within one (1) second.*
3. *No characters sent for one (1) second.*

Reading a Parameter

To read the value of a particular setting, issue the command, with no parameter. The modem will return the value followed by an "OK". The modem response is:

The value in ASCII decimal format.

A <CR> <LF> sequence (ASCII 0D, ASCII 0A).

An "O", "K", <CR>, and <LF> sequence.

Configuration Mode Commands

AT Command	Command Description	Parameters	Factory Default
AT	**Silence AFTER Sequence** - Sets period of silence after the command sequence character in mS.	Range:0 – 1000 (mS)	0x0A (DEC "10")
BD	**Baud Rate** – Sets serial com port baud rate (bps). Over-the-air (throughput) baud rate is factory-set only. If a PC's serial baud rate is set higher than the fixed over-the-air baud rate of the module, may need to be implemented.	Range: 0 – 6 0 = 1200 bps 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600	Set to equal module's fixed over-the-air Baud rate.
BT	**Silence BEFORE Sequence** – Sets period of silence before the command sequence character in mS.	Range: 0-1000 mS	0x0A (DEC "10")
CN	**Exit AT Command Mode** – Exits module from AT Command Mode and returns it to Idle Mode. Parameters are not saved in EEPROM.	none	none
CT	**Time Out from AT Command Mode** – If no valid commands have been received within this time period, module returns to Idle Mode from AT Command Mode.	Range: 0x00 - 0xFFFF (tenths of a second)	0xC8 (DEC "200")
DT	**Module Address** – Sets module address. Only modules with same address can communicate with each other.	Range:	0
E0 , E1	**Echo – Set Echo on (E1) or off (E0)**	Range: 0 , 1	0
ER	**Receive Error Count** – Number of RF packets detected but not sent out the module due to bit errors	Range:	0
GD	**Receive Good Count** – Number of RF packets received successfully.	Range:	0
G0	**Serial Port time out** – Number of uS of no activity before transmitting.	Range: 0 - 5000000	20000
HP	**Channel Number** – Select separate channels to minimize interference between multiple sets of modules operating in the same vicinity.	Range: 0 - 4	0
MK	**Address Mask** – Configures local and global address space.	Range: 0x00 - 0xFFFF	0xFFFF (DEC "65535")

Command	Description	Range/Values	Default
NB v 4.27B*	**Parity** – Selects parity format. Settings 0-4 transfer 8-bits over antenna port and generate the parity bit on the RF receiving side. NB=5 actually transfers 9-bits over antenna port.	Range: 0 – 5 0 = none 1 = Even 2 = Odd 3 = Mark 4 = Space	0
PE	**Packet Error Display –** Shows statistics to compute packet-error rate, assuming a test packet every 500mS.	None (display PER) 1 = reset counters 2 = Stop PER display	none
RS v 4.22*	**RSSI** (Receive Signal Strength Indicator) – Returns the signal level of last received packet.	none Range: -120dBm to -40dBm	none
SL v 4.27C*	**Serial Number** – Reads and returns Low 16 bits of unique module serial number.	Read Only	none
SH	**Show –** Display the configuration of the modem. This will return a page of ASCII characters, showing the main configuration parameters.	none	none
SV	**Save –** Save all the parameters to EEPROM. This command must be used if changed parameters are to be stored in non-volatile memory, and used next time the modem is powered up. Modem exits configuration mode after this command is executed.	none	none
TT	**Max Packet Size –** Set the maximum number of bytes in an over-the-air packet.	1 - 512	240
VR	**Firmware Version** – Returns firmware version currently loaded on the module.	Read Only, 3 characters	none
&F	**Restore Factory** – Restore the factory default values. This command will not erase the calibration values in the flash unless the parameter is the three-digit string "123". After this command executes, the modem will still be in the CONFIG mode.	None to maintain calibration, "123" to erase everything.	none

** indicates values that are calibrated in the factory and are unit-specific.