



RM9600 Radio Modem Series

Technical Information

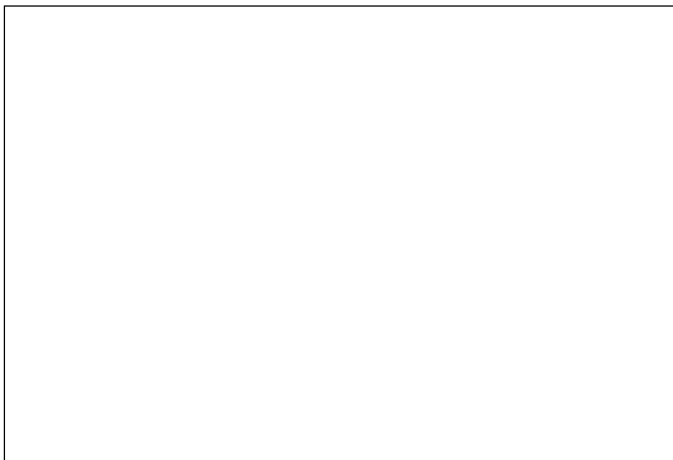
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Features

- UHF FM Synthesised Radio Transceiver
- Transparent 9600bps serial data transmission
- RS-232 & RS-485 Serial Data Interfaces
- 6 modes of operation including Asynchronous, Modem and Repeater
- User selectable RF channel, Address and Tx power level
- LED indicators for, radio functions, signal strength and serial line status
- Forward Error Correction (FEC)
- Automatic Repeat Request (ARQ)

Brief Description

The RM9600 Series of Radio Modems are a range of UHF multi-channel transceivers, incorporating a GMSK baseband modem and RS232/RS485 serial data interfaces.



As with all RDT Radio Modem products, the RM9600 provides fully transparent operation regardless of the serial data protocol. Over-air speeds up to 16Kbps are achievable and serial data can be input at various baud rates up to 19,200bps.

Access to all user configurable parameters is possible using the on-board switches and operational status is easily monitored using the standard LED indicators.

Models currently available include the RM9600 Modem Card for OEM customers, the RM9600B Aluminium housed model and the RM9600E & EX, IP67 housed units with integral power supplies.

A brief summary of features includes addressing capability, user selectable RF power level and frequency of operation, built-in repeater facility, Forward Error Correction (FEC), Automatic Repeat Request (ARQ) and MODBUS compatibility (ASCII & RTU).

The RM9600 utilises RDT's unique multi-channel UHF transceiver which is available as a separate module to OEM customers wishing to take advantage of the superior design, build quality and performance for which our products have a world-wide reputation.

Applications include Alarm Systems, Data acquisition, Remote Metering, Remote Control Systems, Warehousing and Despatch, SCADA, Security Systems, Video Surveillance Systems, Telemetry, Traffic Information and Control Systems etc.

The RM9600 products carry the CE mark and meet various UK, European and world-wide radio approval specifications including ETS 300 113, ETS 300 220 and MPT1329. Details are available upon request.

Primary Modes of Operation

Asynchronous Mode

In Asynchronous Mode data arrives through either the RS-232 or RS-485 serial port and is placed in the data buffer. As soon as data is detected in the buffer, the transceiver is switched to transmit mode. Once switched to transmit there will be a short delay (10mS), while the synthesiser locks and the transmitter reaches operating power. The data buffer is then inspected to determine the number of bytes available for transmission in this data packet. A small amount of header information (used internally by the receiving RM9600) and the data bytes are then transmitted along with a 16 bit CRC. After this packet has completed transmission the data buffer is re-inspected to see if more data has arrived. If more data is available then the transmission process is repeated. When no more data is available the transceiver is switched to receive mode.

When an RM9600 header block containing the appropriate modem address, size of data packet and valid CRC is received then the number of bytes specified in the header block will be read into the data buffer and then output to the RS-232 or RS-485 serial port.

Point to point, multidrop and repeater configurations are feasible in this mode.

Synchronous Mode

In Synchronous Mode timing constraints are imposed on the serial data. This mode is designed to be used in systems such as RTU MODBUS where the end of a message is determined by a gap in the serial data stream of 3.5 characters or more.

Data arrives through either the RS-232 or RS-485 serial port and is placed in the data buffer until a gap of 3½ characters is detected in the serial byte stream. At this point, no more serial data can be accepted until the stored data has been transmitted. The transceiver is then switched to transmit and the contents of the data buffer with a header block are sent as a single data packet. The transceiver is then switched to receive mode.

Following reception of a valid header block for synchronous mode, the data packet received is placed into the data buffer. When all the data is in the buffer it is output synchronously to the serial port to ensure no gaps appear in the serial data stream.

Point to point and multidrop configurations are feasible in Synchronous Mode.

Modem Mode

In Modem Mode the transceiver is controlled with the CTS/RTS control lines. To transmit, the CTS input must be taken high. When the synthesiser has locked and the transmitter reached operating power the modem will set RTS output high. This signals the user that the RM9600 is now available to accept serial data. Once RTS is raised, the RM9600 will operate in accordance with Asynchronous mode with the exception that the transceiver will stay in transmit until the user lowers CTS.

Repeater Modes

The RM9600 has three repeater modes, Standard, Repeat All and Automatic Repeat.

With the **Standard Repeater** mode selected, all RM9600 units within the system must be set to the same address. The base unit is configured as a standard unit, the repeater is set to 'Standard Repeater' and the remote units must be set to 'Repeater Remote' (see page 4 for switch settings).

The base unit transmits data with a standard header block. To avoid unnecessary interference and the possibility of the remote units interpreting the base station transmissions, the remote units will not accept messages with the standard header block.

When the repeater receives data from the base unit, the header block is changed prior to re-transmission so that the remote units will recognise the transmission. In the same manner, a remote unit can only transmit data back to the base station via the repeater which changes the header block to the standard acceptable by the base unit.

Repeat All mode is identical to the Standard Repeater mode with the exception that all messages are repeated regardless of their address.

Automatic Repeat mode allows a message to be automatically transmitted along an unlimited number of repeaters. A received message is repeated and output to the selected serial port at the same time.

Customers wishing to use this mode of operation should contact their distributor or RDT technical support for system planning assistance.

User Controls

Factory Settings

The RM9600 is shipped from the factory pre-programmed to operate with the following settings:-

General/Serial Port

Mode	Async, FEC On
Listen Before Tx	0 N
Serial Port	RS232
Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1

RF Parameters

RF Channel	1
Power Level	5 0 0 mW
Address	0
RF Data Rate	16K

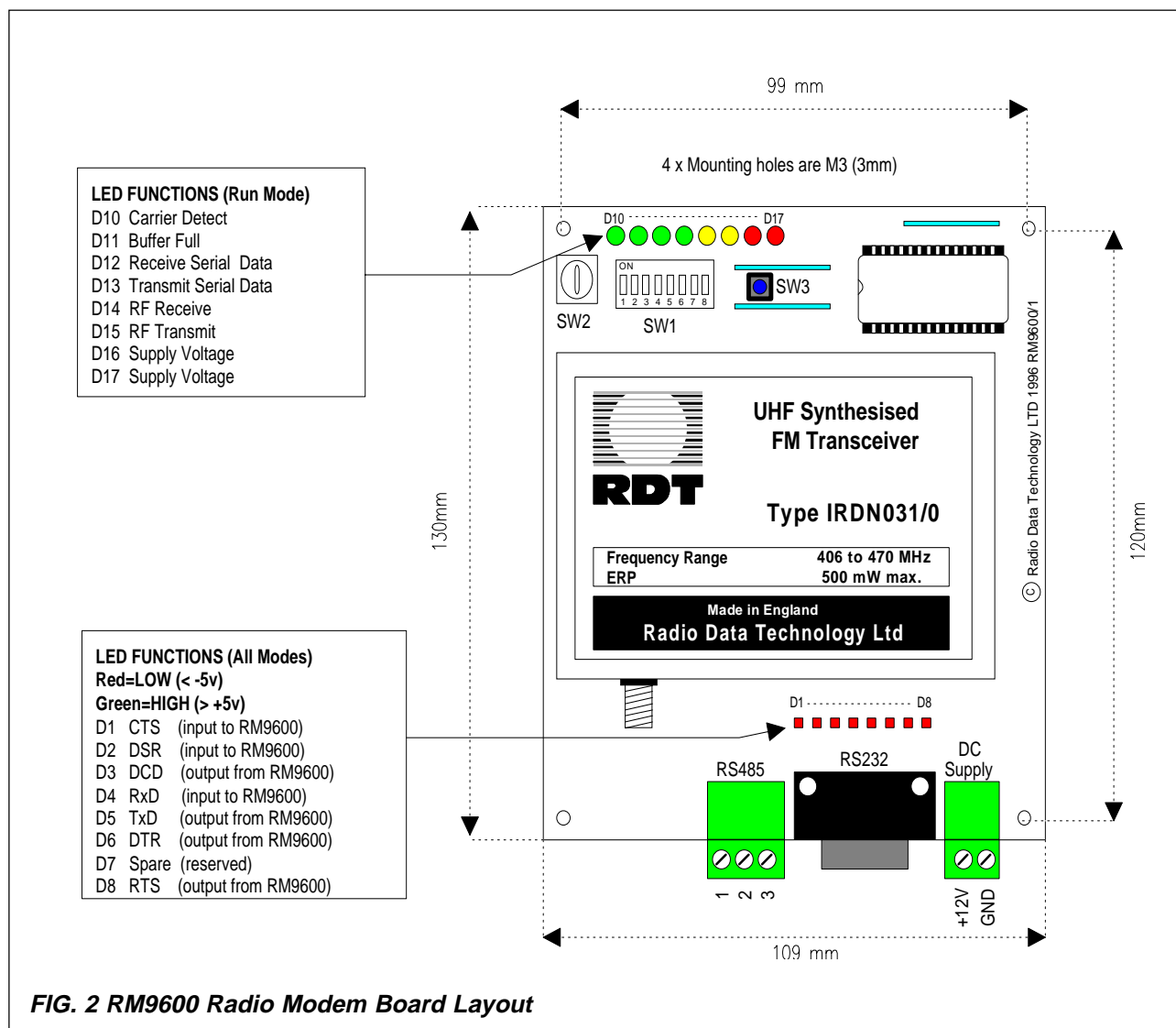
User Configuration

Settings are altered by following 3 simple steps:-

1. Adjust Rotary switch (SW2) for desired function (see table 1)
2. Select required parameters using DIL switch (SW1)
3. Press 'STORE' button (SW3)

The above steps may be repeated for each Rotary Switch function indicated in the table on page 4. (refer to notes for exceptions to this rule)

To ease configuration, LED indicators D10-D17 display the current stored DIL switch settings for each rotary switch function, excluding functions '0' and '1'.



RM9600 User Configurable Settings

ROTARY SWITCH = 0

RUN MODE

1	2	SWITCH SW1	3	4	5	6	7	8	
RF POWER			RF CHANNEL						
OFF	OFF	50mW	OFF	OFF	OFF	OFF	OFF	OFF	LOWEST FREQ
OFF	ON	100mW	OFF	OFF	OFF	OFF	OFF	ON	
ON	OFF	250mW	etc.	etc.	etc.	etc.	etc.	etc.	
ON	ON	500mW	ON	ON	ON	ON	ON	ON	HIGHEST FREQ

ROTARY SWITCH = 1

TEST

1	2	SWITCH SW1	3	4	5	6	7	8	
TEST MODE			RF CHANNEL						
OFF	-	Receive	OFF	OFF	OFF	OFF	OFF	OFF	LOWEST FREQ
ON	-	Transmit	OFF	OFF	OFF	OFF	OFF	ON	
			etc.	etc.	etc.	etc.	etc.	etc.	
			ON	ON	ON	ON	ON	ON	HIGHEST FREQ

ROTARY SWITCH = 2

ADDRESS

1	2	3	4	5	6	7	8	
UNIT ADDRESS								
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ADDRESS '0'
OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	
etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	
ON	ON	ON	ON	ON	ON	ON	ON	ADDRESS '255'

ROTARY SWITCH = 3

OPERATING MODE

1	2	3	4	5	6	7	8
PRIMARY MODE OF OPERATION		SERIAL CONTROL	REPEATER ON/OFF	REPEAT ALL ON/OFF	AUTO REPEAT ON/OFF	REPEATER REMOTE	RS232/RS485
OFF	OFF	ASYNC	OFF-X-X = REPEATER OFF				OFF=RS232
OFF	ON	SYNC	OFF ON-OFF-OFF = STANDARD REPEATER			OFF	
ON	OFF	MODEM	ON ON-OFF-OFF = AUTOMATIC REPEATER			ON	ON=
ON	ON	N/U	ON-ON-OFF = REPEAT ALL				RS485

ROTARY SWITCH = 4

RF PARAMETERS

1	2	3	4	5	6	7	8
RF BAUD RATE		LISTEN BEFORE Tx	FEC ON/OFF	ARQ ON/OFF	RTS/CTS HANDSHAKE	DSR/DTR H'SHAKE	ARQ TIMEOUT
OFF	OFF	4K	OFF	OFF	OFF	OFF	OFF=Std
OFF	ON	8K					
ON	OFF	16K					
ON	ON	N/U	ON	ON	ON	ON	ON=Extended

ROTARY SWITCH = 5

SERIAL INTERFACE CONFIGURATION

123						45						67						8				
SERIAL PORT BAUD RATE								PARITY							CHARACTER LENGTH						STOP BITS	
OFF	OFF	OFF	150					OFF	OFF	NONE					OFF	OFF	7 BITS	OFF			1	
OFF	OFF	ON	300					ON	OFF	EVEN					OFF	ON	8 BITS	ON			2	
OFF	ON	OFF	600					ON	ON	ODD					ON	ON	9 BITS					
OFF	ON	ON	1200																			
ON	OFF	OFF	2400																			
ON	OFF	ON	4800																			
ON	ON	OFF	9600																			
ON	ON	ON	19200																			

ROTARY SWITCH = 6 UPDATE EEROM (See notes page 5)

ROTARY SWITCH = F FACTORY SETTINGS (See notes page 5)

ROTARY SWITCH POSITIONS '7' TO 'E' ARE NOT USED

BOLD ITEMS DENOTE FACTORY DEFAULTS

Summary of Features

RF Channel

Binary coded RF Channel number. Refer to the frequency list supplied with each unit for corresponding frequency of operation

Address

Binary coded unit Address (0-255). Only units with the same address will communicate.

Test Mode

Receive LED's D10-D17 act as a received signal strength indicator in the form of a bar-graph. Yellow LED's indicate minimum acceptable signal, green LED's indicate excellent signal strength.

Transmit Unit transmits continuous modulated carrier.

These features can be used to ascertain the link quality between two units.

Operating Mode

Various operating modes can be selected. Please refer to the detailed description of each mode on page 2 before selecting.

Serial Control

This mode of operation permits the user to alter various RM9600 parameters via the serial port instead of using the on-board switches. A separate data sheet is available which describes this feature fully.

Repeater

Please refer to the detailed description of Repeater operation on page 2.

RS232/485

The RM9600 has two serial ports, a 9-Way 'D' Type connector (RS232) and a two part Phoenix connector (RS485). Connections are as follows:-

RS232 9-Way 'D'	Description
Pin 1	DCD Data Carrier Detect
Pin 2	RxD Receive Data
Pin 3	TxD Transmit Data
Pin 4	DTR Data Terminal Ready
Pin 5	GND Ground
Pin 6	DSR Data Set Ready
Pin 7	RTS Request To Send
Pin 8	CTS Clear To Send
Pin 9	Reserved

RS485 2-Part	Description
Pin 1	B
Pin 2	A
Pin 3	'GND'

RF Data Rate

The RF data rate can be adjusted to improve range/data integrity for applications that do not require high data rates. A low RF Data Rate will improve range a high RF data rate will reduce it.

Listen before Tx

With this feature 'OFF', the RM9600 will transmit serial data regardless of RF channel activity. If switched 'ON', the unit will only transmit when the RF channel activity is below that of the RSSI threshold. Otherwise data is buffered until the channel becomes free.

FEC (Forward Error Correction)

When selected, this feature will correct small data errors at the receiving RM9600 without having to re-transmit the data.

It should be noted that this feature will require an overhead to operate. Therefore, to achieve 9600bps transparently the RF data rate must be set to 16k.

Automatic Repeat Request (ARQ)

This feature can be enabled with any of the primary modes of operation with the exception of Modem Mode. When using ARQ, the primary mode operates in the same way as described on page 2 but each transmission is acknowledged by the receiving unit. If no acknowledgement is received within 500ms or a repeat request is received, the transmitter sends the data again up to a maximum of 5 times before moving to the next block of data.

ARQ can only be used in a point-to-point system or in a Serial Control system where all remote units have a different address.

RTS/CTS Handshake

This feature should be turned 'OFF' when the RM9600 is being used with a standard 3-wire connection to the user equipment (Tx, Rx, GND). This type of connection is the most common.

When switched 'ON', the RM9600 requires the RTS/CTS lines to be controlled by the user equipment otherwise the unit will not operate.

USER CONFIGURATION NOTES

Rotary Switch position 6 (Update EEPROM)

In this position it is possible for the contents of the EEPROM within the radio to be modified. This is an engineering function and should only be performed with the appropriate software and technical support from RDT.

Rotary Switch position F (Factory Defaults)

Pressing the STORE button (SW3) with the rotary switch in this position will cause all current settings to be returned to the factory defaults listed on page 3.

Timing Diagrams

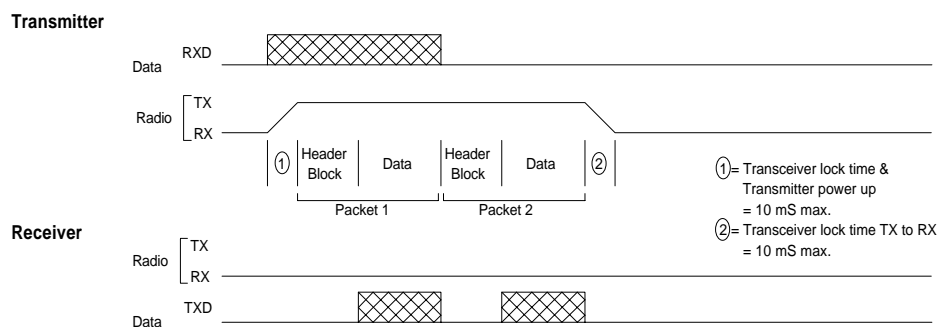


Fig. 3 Asynchronous Mode Transmit/Receive Timing Diagram

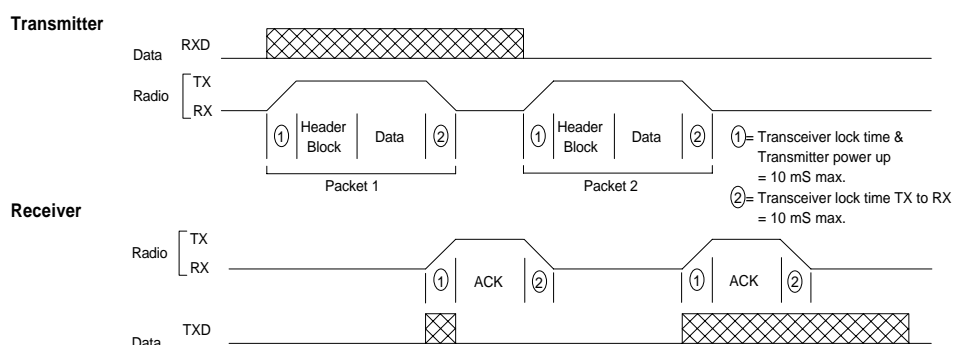


Fig. 4 Asynchronous ARQ Mode Transmit/Receive Timing Diagram

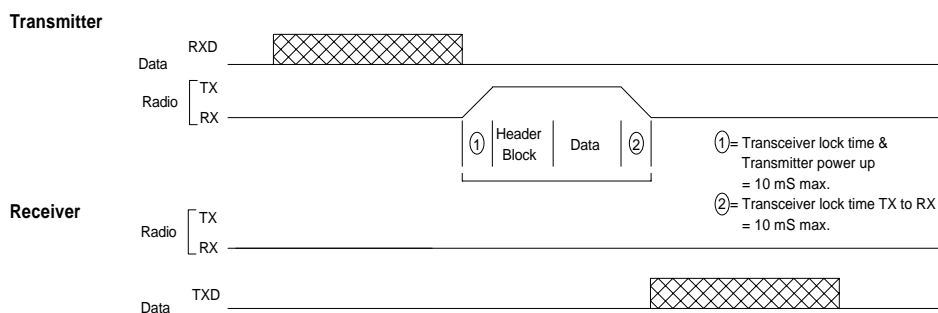


Fig. 5 Synchronous Mode Transmit/Receive Timing Diagram

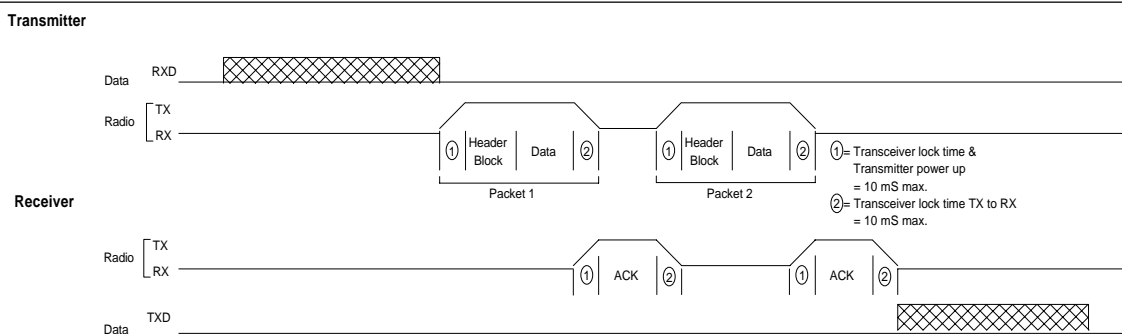


Fig. 6 Synchronous ARQ Mode Transmit/Receive Timing Diagram

....Timing Diagrams

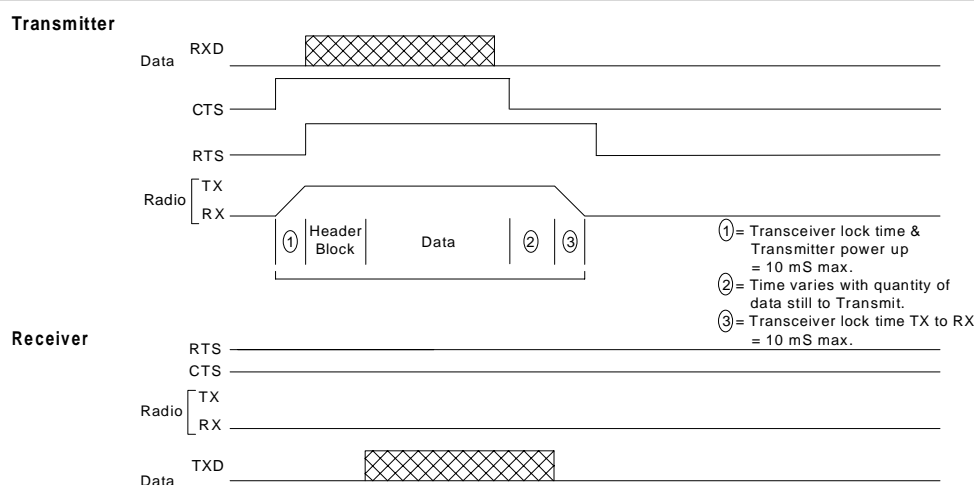


Fig. 7 Modem Mode Transmit/Receive Timing Diagram

Specifications - Specific Models

RM9600

General

Frequency Range 10MHz band in the range 406 - 470 MHz

Channel Spacing 10, 12.5, 20 or 25kHz

Transmitter

RF Power Output 50 - 500mW (in 4 steps)
 Adj. Channel Power -37dBm
 Freq. Tolerance ± 3 ppm
 FM Deviation ± 3.5 kHz

Receiver

RF Sensitivity - 110dBm for 10^{-4} BER
 Intermodulation -70dB
 Adj. Channel Rejection -70dB

RM9634

General

Frequency Range 10MHz band in the range 406 - 470 MHz

Channel Spacing 12.5, 20 or 25kHz

Transmitter

RF Power Output 50 - 500mW (in 4 steps)
 Adj. Channel Power -37dBm
 Freq. Tolerance ± 1 kHz
 FM Deviation ± 2 kHz
 Intermod Attenuation >40dB
 Spurious Emissions <-36dBm 0-1 GHz
 <-30dBm 1-4 GHz

Receiver

RF Sensitivity - 110dBm for 10^{-4} BER
 Co-channel Rejection >-12dB
 Adj. Channel Selectivity >60dB
 Spurious Response Rejection >70dB
 Intermod Response Rejection >70dB
 Blocking >84dB for any signal >50kHz from the tune frequency

Spurious Emissions <-57 dBm 0-1 GHz
 <-47dBm 1-4 GHz

Specifications - All Models

RSSI Threshold Level -105dBm at 16K
 -110dBm at 8K/4K
 Max. Bit Rate 16kbps (25KHz)
 8kbps (10/12.5/20KHz)
 Modulation GMSK

Interface Baud Rate 150 -19.2 Kbaud, adjustable
 Parity Odd, Even or None
 Data Buffer 4 Kbytes Tx, 2 Kbytes Rx
 Stop Bits 1 or 2
 Data Bits 7, 8 or 9

.....Specifications Continued

Mechanical & Environmental

Size

RM9600	130 x 109 x 32mm
RM9600B	142 x 150 x 47mm
RM9600E/EX	280 x 190 x 130mm

Weight

RM9600	400 g
RM9600B	900 g
RM9600E/EX	3.6 kg

Operating temperature -25 to +60°C

Operating humidity 20% to 75% RH

Power Supply

RM9600 & RM9600B

Power Supply	10.5 - 15.5V d.c.
Supply Current	Tx 550mA (500mW)
	Tx 420mA (50mW)
	Rx 260mA

RM9600E/EX

Power Supply	220-260V a.c. 50Hz
Supply Current	250mA max.a.c.

Additional Information

Power Supply

The RM9600 board requires a 12V d.c. power supply which should be well filtered and regulated. On-board voltage regulator circuits will maintain a constant supply of voltage to the radio and logic circuits, however, excessive noise, fluctuations and interference on the d.c. supply may cause loss of data.

Antenna Selection

The antenna should be designed for use at the operating frequency in the 406-470MHz UHF frequency band. The radio range achieved will be dictated by the land topography between the nodes. Ranges quoted below are for guidance only, distances vary according to terrain and obstructions. In many situations increasing antenna height can greatly improve signal strength, and the RSSI test mode can be used for signal strength

indication. Yellow LEDs indicate minimum acceptable signal, green LEDs indicate excellent signal strength.

Coaxial feeder cable is available in many forms, 50 ohm impedance cable with low loss should always be used, note that 3dB of feeder loss will reduce radiated power by half. In some applications where maximum range is required, directional antennae with gain can compensate for feeder loss provided that the maximum radiated power limit is not exceeded (in most countries this is 500mW). When low loss RG213/U or UR67 coaxial cables are employed N-type RF connectors should be fitted in conjunction with the Antenna Bulkhead Cable Kit (ENC/007) to convert from the SMA socket on the radio module to N-type RF connectors on the coaxial cable.

Antenna Type	Range	Coverage	Gain	Mounting	Applications
½-Wave Whip	1 km	Omnidirectional	-3dB	Enclosure Mounted	Short range general use
End-fed Dipole	10 km	Omnidirectional	0dB	Pole Mounted	Medium range general use
8 Element Yagi	20 km	Directional (40°)	10dB	Pole Mounted	Long range, directional

Antenna Types

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