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RM96XX Modem Datasheet

- UHF FM synthesised radio transceiver
- Transparent up to 9600bps serial data transmission
- RS232 and RS485 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 RM96XX series of radio modems is a range of UHF multi-channel transceivers, incorporating a GMSK baseband modem and serial data interface.

As with all RDT modem products, the RM96XX provides fully transparent operation regardless of the serial data protocol. Over-air speeds of up to 16Kbps (RM9600, 8Kbps RM9634) are achievable and serial data can be input at baud rates up to 19200bps.

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

A brief summary of features includes forward 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

Applications include alarm systems, data acquisition, remote metering systems, warehousing and despatch, SCADA, security systems, video telemetry, traffic information and control systems.

The RM96XX series is R&TTE compliant and meets UK, European and some other radio approval specifications. Details are available on 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 (50mS), 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 RM96xx) and the data bytes are then transmitted along with a 16-bit CRC. After this packet has completed transmission the data buffer is 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 RM96xx 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 $3_{1}/_{2}$ 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.

Controlled Mode

In this mode the transceiver is controlled with the CTS/RTS control line. 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 RM96xx is now available to accept serial data. Once RTS is raised, the RM96xx will operate in accordance with Asynchronous mode with the exception that the transceiver will stay in transmit until the user lowers CTS.

Repeater Modes

From time to time it is necessary to include a repeater in a system for the following reasons:

- To extend range
- To circumvent obstacles
- Achieving a radio link where circumstances dictate the use of less efficient antennas.

A system using a repeater is inherently more complex than one without and it is recommended that first time users may wish to discuss the details of system operation with their modem supplier.

Repeater Modes

The RM96xx series modems have three repeater modes, Standard, Repeat All and Automatic Repeat. These are selected by the normal programming method with the rotary switch in position 3 and using DIL switches 4, 5, 6 and 7.

Standard Repeater
In the Standard Repeater mode all RM96xx 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'.
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.

Note that user equipment may be connected to the Serial I/O connection of the Standard Repeater (RS232 or RS485) allowing data to be routed back to the master.

Repeat All
Repeat All mode is similar to the Standard Repeater mode with the exception that all valid RM96xx messages are repeated regardless of their address. This permits the use of a base station operating under Serial Control and enables the master to communicate with a specific remote modem rather than broadcasting to all.

Chained Repeater
Automatic Repeat mode allows a message to be automatically transmitted along a ‘chain’ of up to 255 repeaters. Each repeater has its address set 1 above its predecessor in the chain. Each unit ‘listens’ for messages from units with addresses 1 below or 1 above their own. (For example unit 6 will listen for messages from 5 and 7). When it receives a message from the higher of lower address it will re-transmit it on its own address. Having transmitted it will disable its receiver for a short period to prevent reception of the onward transmission.

A received message is repeated and at the same time, output to the selected serial port. A message input at the serial port of any modem in the chain, will travel along the chain in both directions. It is possible to disable onward transmission, which allows the use of multiple units at the end of a chain.

User Controls

User Configuration

Settings are altered by following 3 simple steps:
1. Adjust Rotary switch (SW2) for desired function (see Table 1 on following page).
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 Table 1.

To ease configuration, LED indicators D10 to D17 display the current stored DIL switch settings, for each rotary switch function. Note that this does not apply in rotary switch positions '0' and '1', where the LED's are used as a bar graph to indicate received power. In positions '0' and '1' therefore the parameters are not stored, the DIL switches remain active and indicate the current settings.

Factory Settings

The RM96xx is shipped from the factory pre-programmed to the most common configuration. The default settings are shown in bold type in Table 1.
Note that for general use, the serial port is set to RS232 but for VideoWave customers (where the modem is used for PTZ control), the default is RS485.

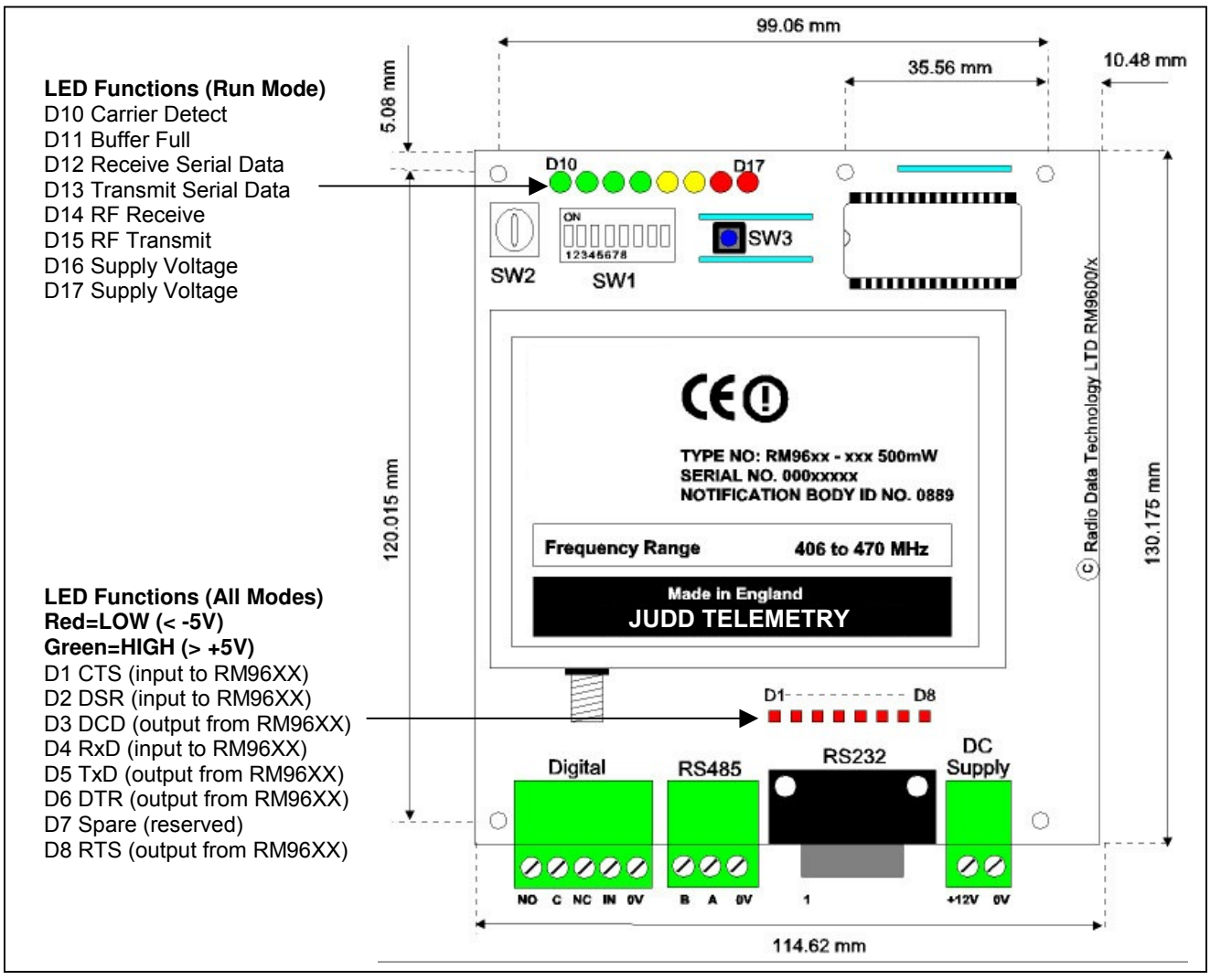

Table 1 – RM96XX User Configurable Settings

Rotary Switch **DIL Switch 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

Note: Address 255 is reserved for broadcasting a message in Serial Control Mode. Please refer to 'Global Addressing' section of User Manual.

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 Operation

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 Mode	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-ON	=Automatic Repeater		ON	ON= RS485
ON	ON	N/U		ON-ON-OFF	=Repeat ALL			

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	DSP/DTR Handshake	ARQ Timeout
OFF	OFF	4k	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	OFF= Std
OFF	**ON**	8k						
ON	**OFF**	16k	ON	ON	ON	ON	ON	ON= Extended
ON	ON	N/U						

RM9634 Factory Default
RM9600 Factory Default

Rotary Switch=5 Serial Interface

1	2	3		4	5		6	7		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	OFF	9 Bits		
OFF	ON	ON	1200								
ON	OFF	OFF	2400								
ON	OFF	ON	4800								
ON	**ON**	**OFF**	9600								
ON	ON	ON	19200								

Rotary Switch=7 Serial Control

1	2	3	4	5	6	7	8
Spare	Spare	Serial Control Guard Time		ARQ Retries	Global Addresses	Sensitivity	Power Save
		OFF OFF = None OFF ON = 200 mS ON OFF = 500mS ON ON = 1 second		ON = 20 **OFF = Inf**	ON **OFF**	ON = Low **OFF = Normal**	ON = Save **OFF = Normal**

Rotary Switch=8 Hayes Mode

1	2	3	4	5	6	7	8
Hayes	RS232 Activity Timer	Spare	Compatibility	Bench Test	Disable Onward TX	I/O	Serial Port
ON **OFF**	ON =RS232 Inactivity Timer Disabled **OFF =RS232 Inactivity Timer Enabled**		ON =Compat. **OFF =Normal**	ON =Bench **OFF =Normal**	ON =Disable **OFF =Normal**	ON =Enabled **OFF =Disabled**	ON =RX Only **OFF=Normal**

Rotary switch positions '9' to 'E' are not used. **Bold items denote factory defaults.**

Summary of Features

Run Mode
Note that in ‘Run Mode’ the power and frequency are set by the current position of switch 1 and not stored in memory using switch 3.

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

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.

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

Operating Mode
Various operating modes can be selected. Please refer to the detailed description of each mode on page 4 of the User Manual before selecting.

Serial Control
This mode of operation permits the user to alter various RM96xx parameters via the serial port instead of using the on-board switches. A detailed description can be found on page 10 of the User Manual.

Repeater
Please refer to the detailed description of Repeater operation on pages 5-6 of the User Manual.

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 RM96xx 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 RM96xx 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 to16k (4800bps and 8k data rate for 12.5kHz channel spacing).

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 of the User Manual 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 20 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 RM96xx 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 RM96xx requires the CTS line to be controlled by the user equipment. The RTS line will be lowered when there is only 256 bytes of space left within the transmit buffer and raised once again when the buffer is empty. Lowering the CTS line causes the RM96xx to buffer any data received over the RF link. Raising the CTS line forces the RM96xx to output the serial data.

DSR/DTR
This feature can be used as a means of switching +/- 12V over the RF link. Raising DSR (+12v) on one RM96xx unit will cause DTR on the receiving unit to also be raised. Lowering DSR (-12v) will cause DTR on the receiving unit to be lowered. The effects of raising/lowering the DSR line are immediate and independent of any serial data activity. Note that this feature is not available if using two digital I/O.

RF Receive Sensitivity Control
The Receiver ‘carrier detect/data acquisition’ sensitivity threshold can be selected between two levels, Normal and Low. The ‘Low’ sensitivity setting decreases the sensitivity by 6dB. This reduces the chance of the carrier detect being activated in noisy environments.

Power Saving
To save power, the LED’s can be switched off in Run Mode, using Rotary switch 7, DIL switch 8. Note that D17 remains on as a Power ‘ON’ indication.

Serial Port Input Disable
The serial port input can be disabled so that the modem operates as receive only and will accept no data into the RS232 or RS485 ports. Rotary switch 8, DIL switch 8.

Disable Onward Transmission
In Auto-Repeater Mode, onward transmission can be disabled so that a number of units can be used at the end of a chain. If the onward transmission is not disabled, they would all receive each others transmissions. Rotary switch 8, DIL switch 6.

Bench Test
When carrying out a bench test with two units in close proximity, this feature reduces the sensitivity to avoid overloading the input. Rotary switch 8, DIL switch 5.

Compatibility Mode
Recently, a new synthesiser chip has been used, requiring updated software. Because of timing changes there may be problems using new modems with old versions. Switching to compatibility mode may help. Rotary switch 8, DIL switch 4.

USER CONFIGURATION NOTES

Rotary Switch position 6 (Update EEROM)
In this position it is possible for the contents of the EEROM within the radio to be modified. This is an engineering function and should only be performed with the appropriate software and technical support from Judd Telemetry.

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 14 of the User Manual.

Digital Input & Output Option
As a specified option, the RM96xx can be fitted with either 1 (RM96xxD1) or 2 (RM96xxD2) digital inputs (volt free) and outputs (single pole changeover relay). The status of the digital input is initially transmitted on power-up. Once powered, the RM96xx will transmit the status of the input when it changes state. If this change is during a normal RS232 data transmission, it will be sent immediately as the information is contained within the header. This feature can be enabled with Rotary switch 8, DIL switch 7. Default is normally off so that input is not transmitted on power up. Note that the second digital channel uses the DSR/DTR function for switching, so this function is not available if using two digital I/O.

RS232/RS485 Serial Port Connections

RS232/485
The RM96XX has two serial ports; a 9-way 'D' type connector (RS232) and a two-part Phoenix connector (RS485). Connections are as follows:

RS485 2-part	Description
Pin 1	'B' (-)
Pin 2	'A' (+)
Pin 3	'GND'

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	Rx Buffer Indicator

Pin 9 is the Ring Indicator (RI) when used in Hayes Mode (see page 9 of user manual).

Digital Input/Output	Description
Pin 1	NO – Relay normally open
Pin 2	C – Relay common
Pin 3	NC – Relay normally closed
Pin 4	IN – Digital input
Pin 5	OV - Earth

Additional Information

Power Supply
The RM96xx board requires a 12V D.C. power supply (24V d.c. version available) 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.

When low loss RG213/U or UR67 coaxial cables are employed N-type RF connectors should be fitted in conjunction with one of the Antenna Bulkhead Cable. Kits to convert from the SMA or BNC socket on the radio module to N-type RF connectors on the coaxial cable.

Note:
Modems are supplied with the following antenna connectors:
RM96xx SMA

Antenna Type

	Coverage	Gain	Mounting	Part Number
½ Wave whip	Omnidirectional	-3dB	Enclosure Mounted	ANT0006A
End-fed dipole	Omnidirectional	0dB	Pole Mounted	ANT0008-CAB
2 element Yagi	Directional (40°)	3dB	Pole Mounted	ANT0009-2
8 element Yagi	Directional (20°)	10dB	Pole Mounted	ANT0009-8

Technical Specifications

RM9600	
General	
Frequency Range	10MHz band in the range 406-470MHz
Channel Spacing	10, 12.5, 20 or 25KHz
Transmitter	
RF Power Output	50 – 500mW (in 4 steps)
Adj. Channel Power	-37dBm
Freq. Tolerance	± 1KHz
FM Deviation	± 3.5KHz
Receiver	
RF Sensitivity	-110dBm for 10^{-4} BER
Intermodulation	170dB
Adj. Channel Rejection	-70dB

RM9634	
General	
Frequency Range	10MHz band in the range 406-470MHz
Channel Spacing	12.5, 20 or 25KHz
Transmitter	
RF Power Output	50-500mW *
Adj. Channel Power	-37dB
Freq. Tolerance	± 1KHz
FM Deviation	± 2KHz
Intermod Attenuation	>40dB
Spurious Emissions	<-36dBm 0-1GHz <-30dBm 1-4GHz
Receiver	
RF Sensitivity	-115dBm 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	<-57dBm 0-1GHz <-47dBm 1-4GHz

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