

MR25 Service Manual

**Radio modem designed
to transmit data**

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1 Radio modem MR25

The MR25 is a radio modem designed to transmit data in the VHF and UHF bands with 25 kHz (12,5 kHz) channel spacing. The radio modem uses 4-level GMSK modulation which makes possible a maximum communication speed of 21.68 kbps (25kHz channel spacing). From the point of view of the data network's architecture, it is possible to consider the radio modem as an autonomous system; the operator has at his disposal three standard ports RS232 (it can be converted to RS422/485 by RACOM optocouplers OPI).



Identification of modems by frequency band

- 146 – 162,2 MHz – RACOM160S21L
- 162,2 – 180 MHz – RACOM160S21H
- 300 – 360 MHz – RACOM300S21
- 400 – 444 MHz – RACOM400S21L
- 444 – 493 MHz – RACOM400S21H

By means of the modem module, it is possible for the radio data transceiver to configure an arbitrary transmission and receiving frequency in the divided frequency span 3.2 MHz in the 25 kHz or 12.5 kHz channel grid. Input and output work frequencies are independent of each other and are derived from the frequency by the 4-phase lock-loop system programmed in the transceiver microcontroller. The channel setting is stored in EEPROM memory in the transceiver and in FLASH memory in the modem module, whose communication processor controls the performance of the transceiver microcontroller. The output power of the high frequency signal from the radio modem transmitter is digitally adjusted in 16-steps.

A description of the MR25 software controls and configuration is available in the publication *Morse Firmware – Documentation* in the chapter *Morse main menu*.

1.1 Description of functions

1.1.1 MR25 Radio Part

The architecture of the MR25 radio modem provides for a comfortable and reliable working station. Frequency synthesis makes possible multi-channel operation, with the synthesizer's dividing conditions being stored in EEPROM memory. The performance of the radio data transceiver module is controlled and diagnosed with the microcontroller.

The logic circuits, the switching stations between the receiving and transmitting modes, have high signal noise immunity and activate the relevant blocks gradually. This minimizes most of the transient parasitical conditions, and optimizes the bandwidth when switching over.

The receiver part of the modem works with two mixes. Centralized selectivity is divided between both interfrequency degrees. The first filter maintains the basic channel preselection until suppressed, ensuring linear functioning for the second mixer and the interfrequency amplifier. The second filter has suppression characteristics needed for channel selection in the 25kHz user's channel space.

1.1.2 MR25 Modem Part

The modem part is composed of three basic blocks:

1. the microcomputer controller
2. the convertor circuits for standards RS232
3. the modem data circuits.

The microcomputer has 512 kB of flash memory and 64 kB RAM memory available. Included among the circuits are a backup battery for power in real time, a detector for monitoring lost power, and a circuit watchdog.

During a power failure, a charge preserved in the electrolytic capacitor enables the exact time of the occurrence to be recorded into flash memory. So, the operator has the relevant information on-hand to determine the length, extent, and manner of the blackout.

The microprocessor activity is protected by a circuit watchdog. Protection is implemented by the processor chip and if needed, it carries out a 16 second reset.

Convertors RS232 can work with speed limitation 120 kbps. The convertors are protected against prestress by TRANSIL components.

Data conversion on the 4-level FSK modulation signal and back is made possible by a specially programmed circuit made by CML. The transmission speed of 21680 bps is derived from the crystal oscillator on the board of the radio part.

2 MORSE connectors

2.1 Antenna Connector

The cable for connecting the antenna is equipped with a MINI UHF type connector. The fitting for the connector corresponds to the type and impedance. For antenna leads, we recommend cable RG58 for lengths up to 10 m, and RG213 for longer lengths.

2.2 MR25 Data Connectors – DSUB37F

All inputs/outputs, three serial ports, and some parameters for service functions run through this connector. Signals shown in the table are functions depending on the version of the MR25 (more in the chapter 3). The old designation COM 1, 2, 3 is replaced by SCC 0, 1, 2 now.

Port SCC0

pin	in / out	pin	in / out
2	RxD	3	TxD
21	RTS	22	CTS
4	DTR	20	DSR
1	CD	23	GND

Port SCC1

pin	in / out	pin	in / out
27	RxD	28	TxD
9	RTS	10	CTS
29	DTR	8	DSR
26	CD	11	GND

Port SCC2

pin	in / out	pin	in / out
32	RxD	33	TxD
14	RTS	15	CTS
13	CD	34	GND

2.2.1 Other pins

- pin no. 17 (ExtPTT) – input/output for station service transmission
- pin no. 36 (Ext AF) – audio frequency output for demodulator
- pin no. 37 (GND) – ground
- pin no. 7 (-10V) – auxiliary signal for SCC0
- pin no. 31 (-10V) – auxiliary signal for SCC1
- pin no. 19 (+12V) – this input is not for direct supplying of external devices! The using consult with producer.

2.3 Standard Connector Wiring for Interfaces RS232, V.24, DCE equipment

2.3.1 RS232 interface

▷ Cannon DSUB9F connector

pin	signif.	pin	signif.	pin	signif.
1	CD	4	DTR	7	RTS
2	RxD	5	GND	8	CTS
3	TxD	6	DSR	9	—

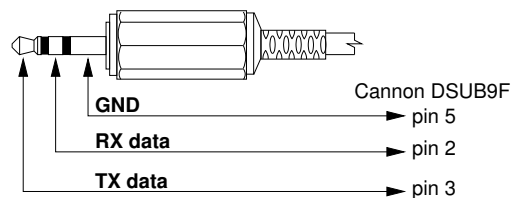
2.3.2 V.24 interface

▷ Cannon DSUB25F connector

pin	signif.	pin	signif.	pin	signif.	pin	signif.	pin	signif.
1	—	6	DSR	11	—	16	—	21	RDL
2	TxD	7	GND	12	—	17	RxC	22	—
3	RxD	8	CD	13	—	18	LAL	23	—
4	RTS	9	—	14	—	19	—	24	—
5	CTS	10	—	15	TxC	20	DTR	25	TI

2.4 Service Connector Wiring

Designated Service Cable DKR12. The wiring of DSUB9 connector corresponds to DTE devices.



2.5 MR25 Power Connector

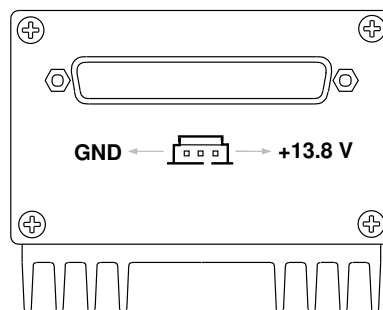
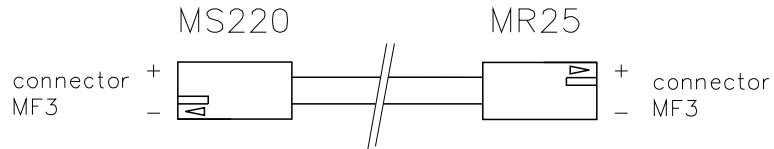


Figure 2.1: The wiring of power supply plug in MR25

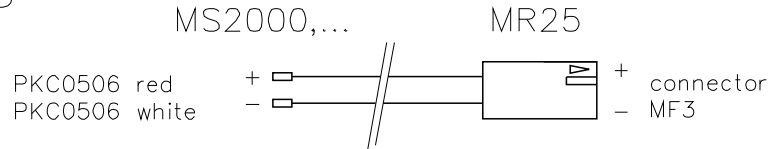
2.6 Power connector types

The type of power cord used is NKRx.

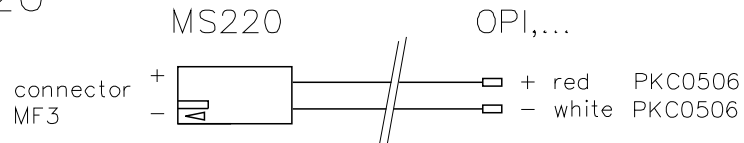
NKR3



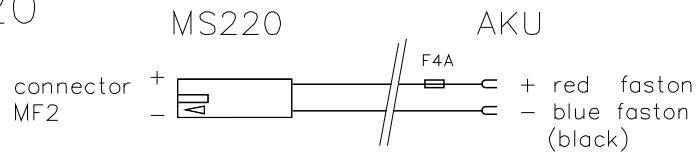
NKR9
for MR25



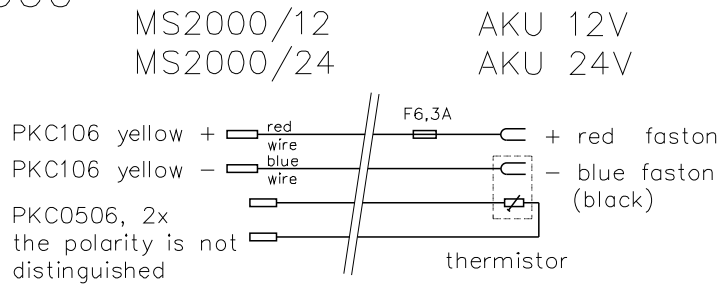
NKR9
for MS220



NKR4
for MS220



NKR4
for MS2000



3 Radio modem MR25 versions

The following chart shows the port assignement to individual versions of the MR25:

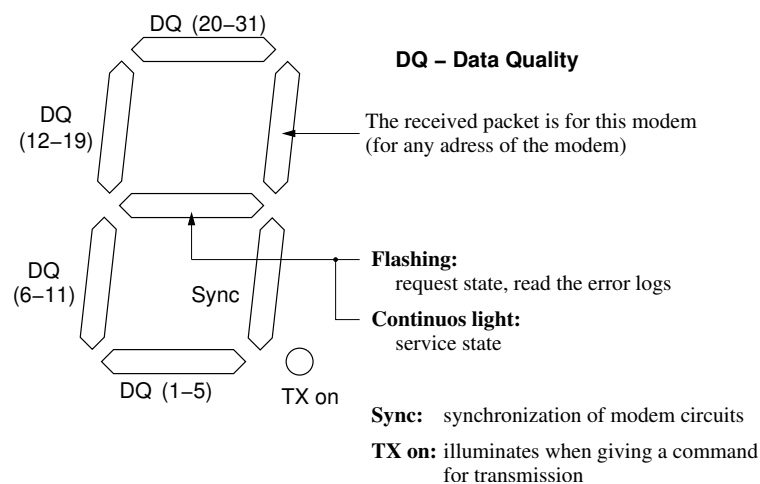
	RS232 simple	RS232	V.24	RJ45 Ethernet
MR25 type	TxD, RxD, RTS, CTS, DSR	TxD, RxD, RTS, CTS, DSR, CD	TxD, RxD, RTS, CTS, DSR, CD, TxC, RxC	
MR25X ver. ≤11 rzn subverze	*	*	*	
MR25X ver. 12		*		
MR25ET		*	*	*
MCM302ET		*		*

- MR25X hw version 11 and older was produced in more subversions labeled:
 - XS – with synchronous port V.24
 - X4 – ports configurable to RS485, RS422
 - XE – economy, with limited volume bytes/min
 - X – asynchronous port RS232 or RS232 simple which covers the majority of cases
- MR25X hw version 12 produced since 8/2001 has the RS232 port only
- MR25ET is equipped by synchronous port V.24 in context with faster medium Ethernet
- RS485 or RS422 signals can be connected by optocouplers OPI485 or OPI422
- The DSR signal is connected via resistance to +12V

4 LED Numerals in the MR25

4.1 Seven-segmented display in the MR25 modem part

Located on upper part of MR25, near of the RACOM logo.



4.1.1 Condition while active connected terminal

Condition while switching on the modem, a connector from an active connected terminal is inserted in the service connector:



- b indicated – the base loader module is launched, if Enter is pressed within the next 3 seconds, the modem stays in this module



- after quick changing a pair of characters the display remains dark for next 6 seconds -/- the *main module* is launched. If any ordered command is send from Setr on this time, then the whole menu goes to the default values in memory. If it doesn't happen, the program starts with the values set in flash memory.



- after finishing the start process a group of number leaded by letter r or c starts circulate. This number indicates the version of software. Modem is set in MORSE mode



- Modem is set in C92 mode

4.1.2 Condition without attached to service terminal

Condition while turning on the modem, the service connector is not attached to any active connected terminal:

- after quick changing a pair of characters the display remains dark for next 6 seconds – the *main module* is launched.
- after finishing the start process a group of number indicating the version of software starts circulate.

From the previous information, it can be gathered that the ideal conditions (high DQ, packet received for this modem, modem circuits synchronized, etc.) are indicated by a 0 (zero) when receiving.

Error states:

- Center segment flashing – check and analyze the error logs.
- Zero is not indicated – relatively low DQ, the modem did not synchronize or the packet is not destined for this modem
- Sync is not indicated – the modem is not able to synchronize with any packets on the RF channel. Sync should be indicated for the duration of receiving.
- Nothing is indicated – some unknown operation for the modem is on the RF channel, eg. packets are transmitted with another polarity (menu FMe), there is interference on the RF channel.

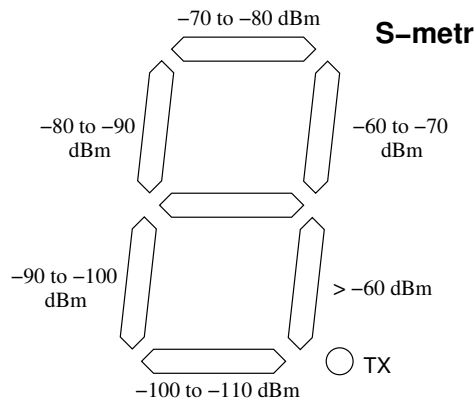
4.1.3 Writing into flash memory

When writing into flash memory by the service terminal SETR (commands w – write and I – Init) the display signalize shortly:



4.2 Seven-segmented display in the radio part MR25

Located near of the antenna connector.



TX on: illuminates during transmission

If the station is in a quiet state, a cyclical letter notice `rid 3o2` is displayed, or if need be another number of the software version.

While receiving, the station evaluates the signal level (*S-meter*). If the level is less than 110 dBm, the notice `rid 3o2` appears. The maximum level is indicated by 0 (zero).

When **Error** message is running on the display, it is a grand error condition, when at least one PLL in station is not locked.

5 MR25 Technical Specifications

Frequency ranges	146 – 162,2, 162,2 – 180 MHz 300 – 360 MHz 400 – 444, 444 – 493 MHz
Channel spacing	25 kHz (12.5 kHz)
Number of channels in working band	128 (256)
Method of setting up working frequency	software
Switching time transmit / receive	< 2 ms
Temp. range for guaranteed parameters:	–25 to +55 °C
Temp. range for guaranteed functionality:	–30 to +55 °C
Atmospheric pressure	700 – 1200 hPa
Relative humidity	10 – 90 %
Supply voltage	13.8 V
Current consumption	0.5 A
transmission 1W	1.1 A
max. output	2.0 A
Dimensions MR25 only	84×190×52 mm
Dimensions MR25 with heat sink and holders	84×190×71 mm
Dimensions MR25ET with heat sink and holders	84×190×97 mm
Weight MR25 only	890 g
Weight MR25 with heat sink and holders	1 150 g
Weight MR25ET with heat sink and holders	1 360 g
Antenna connector	mini UHF
Receiver sensitivity for BER 10^{-3}	better than –107 dBm
Frequency stability	according to ETS300113
Receiver intermodulation response	> 70 dB
Adjacent channel sensitivity 12.5 kHz	60dB
Adjacent channel sensitivity 25.0 kHz	70dB
Spurious response rejection	> 70 dB
Spurious receiver radiations	< 2 nW
Receiver spurious response rejection	> 70 dB
Receiver desensitisation	84 dB
Transmitter power	0.1 – 5 W
Transmitter output impedance	50 Ω
Spurious transmitter emissions	< –36 dBm
Transmitter power in adjacent channels 12.5 kHz	< 60 dBc
Transmitter power in adjacent channels 25.0 kHz	< 70 dBc
Max. modulation transmission speed 12.5 kHz	10.84 kbps
Max. modulation transmission speed 25.0 kHz	21.68 kbps
Standard interfaces in modem part	3× V.24 (without synchronization)
Max. speed on user channels	115 Kbps async.
Memory	64 kB SRAM 512 kB FLASH EEPROM
Software diagnostics through the network:	
• measuring receiver signal strength	yes
• adjusting output power	yes
• monitoring	yes
Remote config. possibilities: all necessary parameters	yes
Software modification through the network	yes

6 MR25 Mechanical Specifications

