R&S®M3AR MR6000A
Software Defined Radios
Specifications

Secure Communications

Data Sheet | 05.00

ROHDE&SCHWARZ

CONTENTS

Technical specifications **3**

Built-in interfaces 3

General technical information 3

General performance data 4

Transmitter characteristics 6

Carrier-related *6*

Modulation-related (voice) *7*

Modulation-related (wideband) *8*

Modulation-related (data) *8*

Sidetone *8*

Receiver characteristics 9

Antenna port *9*

Main receiver *9*

Guard receiver *12*

Main receiver, AF-related (voice) *13*

Main receiver, AF-related (wideband) *13*

LINK 11 output *14*

Guard receiver (40.5/121.5/156.8/243 MHz) audio output *14*

DSC guard receiver 156.525 MHz interface *14*

Environmental data 15

General environment *15*

Mechanical environment *15*

Electromagnetic compatibility (EMC) *16*

Electrical network characteristics *16*

Related standards 17

Compatibility with fixed frequency radio standards *17*

Guidelines *17*

Precedence of standards *17*

Referenced standards *18*

Ordering information **19**

Data without tolerance limits is not binding.

Technical specifications

Built-in interfaces

MIL-STD-1553B data bus	for interaction with the aircraft's avionic bus system	dual redundant
Serial interface	for remote control, e.g. via R&S®GB6500	RS-485
	for data in SATURN mode	RS-422, up to 16 kbit/s
	for service purposes	RS-232
RF connector for antenna	common for tactical VHF, VHF and UHF	TNC type
Interface for logic converter unit	for active antenna	Manchester-coded frequency word
AF interfaces	for voice and user data	narrowband and wideband (baseband/diphase), PTT line
Timing system	for TOD loading	input in line with ICD-GPS-060
Fill interface	for use with e.g. R&S®KDD, KYK-13, DTD and AN/CYZ-10	RS-232/DS-102/DS-101 – depending on available waveforms and embedded cryptology processor
External crypto devices	KY-58, KY-100, ELCRODAT 4-2; others on request	wideband interface, delayed PTT, etc.
DSC data interface	for use with external GMDSS device	RS-485
Sonobuoy interface	for use with external sonobuoy device	specific broadband input (38 kHz)
ADF broadband interface	for use with external ADF device	broadband output
LINK 11 interface	for use with external LINK 11 DTS	narrowband lines and PTT
Miscellaneous interfaces		e.g. TX/RX inhibit, squelch, emergency clear, switched DC for external devices

General technical information

Power supply		
Nominal supply voltage		+28 V DC
DC supply range	negative terminal connected to chassis	+24 V to +30 V DC
Emergency mode		+16 V to +32 V DC
DC power consumption	in transmit mode, +28 V DC, 50 Ω	≤ 300 W
	in transmit mode under extreme voltage and/or VSWR conditions	≤ 380 W
	in receive mode	≤ 35 W
	in switched-off state	≤ 0.15 W
Built-in test	local and functional error identification down to module level; error messages reported via MIL-STD-1553B data bus and serial interface, to be stored in nonvolatile memory at unit level	
	PBIT	automatic initialization of BIT at power-on of radio
	CBIT	continuous monitoring during operation
	IBIT	initialization of BIT upon command received via MIL-STD-1553B data bus or serial interface
Cooling interface		aircraft interface in line with ARINC 600, with standard locking
Weight		≤ 6.9 kg (≤ 15.2 lb)
Dimensions	with the exception of height in line with ARINC 600, with standard locking (typical values shown; see mechanical interface description for exact values)	3 MCU, length: 320 mm (12.6 in), height: 161 mm (6.3 in)
Color		TLA – 003, edition 3a, RAL 9005
Temperature		
Operating temperature range		–40 °C to +71 °C
Storage temperature range		–55 °C to +90 °C
MTBF	in line with MIL-HDBK-217F, notice 2	
EPM hardware included	ARW, +25 °C	> 3000 h
	AUF, +25 °C	> 3000 h
	AUC, +25 °C	> 4900 h
	GF, +25 °C	> 11000 h
RF connector	common for tactical VHF, VHF and UHF	TNC type
Impedance	nominal	Z = 50 Ω

General performance data

All data is valid for plain fixed frequency mode, unless otherwise stated.

Operating frequency ranges	depending on option	
Tactical VHF	30 MHz to 87.975 MHz	FM (F3E, F1D) in line with STANAG 4204
VHF	108 MHz to 117.975 MHz	AM (A3E, A1D), receive only
	118 MHz to 155.975 MHz	AM (A3E, A1D)
	136 MHz to 173.975 MHz	FM (F3E, F1D)
	156 MHz to 173.975 MHz	FM (G3E)/maritime PM in line with ITU-R M.489-2, chapter 1.1.1
UHF	225 MHz to 399.975 MHz	AM (A3E, A1D) in line with STANAG 4205
		FM (F1D) in line with STANAG 4205
		FM (F3E)
		MSK/FSK (SATURN) in line with STANAG 4372
		MSK/FSK (R&S®SECOS)
		AM (HAVE QUICK) in line with STANAG 4246
		FM (LINK 11) in line with STANAG 5511 and MIL-STD-188-203-1A
Frequency accuracy	from –40 °C to +55 °C	≤ ±0.5 ppm
	from +55 °C to +71 °C	≤ ±5.0 ppm
	aging/1st year	≤ ±1.0 ppm
	aging/following years	≤ ±0.5 ppm

Channel spacing and presets	in all frequency ranges	25 kHz
	in the ATC VHF frequency range (118.000 MHz to 136.975 MHz)	25 kHz and 8.33 kHz in line with EUROCAE ED-23B
Number of preset channels		2 sets of 100 each + 2 guard channels + 1 GMDSS
EPM (ECCM) mode (depending on option)	in UHF band (225 MHz to 399.975 MHz)	HAVE QUICK I/II in line with STANAG 4246, SATURN in line with STANAG 4372, R&S®SECOS
Changeover times	specified for 20 W RF carrier power and 1 mV receive signal	
Transmitter attack/release		
Transmitter attack time		≤ 25 ms in line with STANAG 4204 and STANAG 4205
Transmitter release time		≤ 10 ms in line with STANAG 4204 and STANAG 4205 [1]
Transmitter attack time in LINK 11 mode		≤ 7 ms in line with STANAG 5511, Annex B, chapter 7.3.e
Transmitter attack/release time in semi-duplex mode (maritime channels)		≤ 50 ms
Transmit-to-receive recovery		
Transmit-to-receive switchover	fixed frequency voice mode	≤ 50 ms
	EPM (ECCM) modes	in line with STANAG 4246 (HAVE QUICK), STANAG 4372 (SATURN)
	in LINK 11 mode	≤ 23 ms in line with MIL-STD-188-203-1A, chapters 5.3.1.3 and 5.1.7
Channel changing time	fixed frequency mode	≤ 50 ms

[1] In wideband mode (cipher text), the transmitter release time is approx. 120 ms to ensure transmission of the EOM message of the external cipher unit.

Duty cycle	transmit/receive	
High-power mode (with cooling in line with ARINC 600 [2])	from –40 °C to +55 °C	1 min transmit, 2 min receive
	from +55 °C to +71 °C	1 min transmit, 5 min receive
LINK 11 data mode (with enhanced cooling [3])	enhanced cooling system required for continuous operation with data mode equipment	100 % in line with MIL-STD-188-203-1A, chapter 5.3.1.7
Overtemperature		reduction of RF power to not less than 3 W in case of excessive temperature, insufficient cooling air flux, or duty cycle or VSWR out of specified limits
Maximum input level without damage	in transmit/receive mode, maximum input level at antenna connector	≤ +36 dBm for f = 30 MHz to 400 MHz
Power interruptions, frequency and power-on time		
Transparency time without restart		≤ 3 ms
Restart/warm start in case of power interruptions of less than 5 s	After a restart the radio continues normal operation with the same settings as before.	≤ 5 s in fixed frequency modes
		≤ 10 s in EPM modes
ADF	ADF control output for ADF antenna relay open collector	≤ +28 V DC, I ≤ 50 mA

[2] The typical air flow in line with chapter 3.5.4.3 is 18 kg/h at an inlet temperature of max. +55° C. The pressure drop in line with chapter 3.5.4.5 is approx. 60 Pa.

[3] Enhanced cooling (higher than specified in ARINC 600) required for continuous operation. Cooling air flux of 70 kg/h at an inlet temperature of max. +55 °C. The typical air flow needed is 55 kg/h with a pressure drop of 620 Pa.

Transmitter characteristics

Specified for +28 V DC supply and nonreactive 50 Ω termination, unless otherwise stated.

Carrier-related

Carrier power measured at a supply voltage from 24 V DC to 30 V DC.

Output power		
High-power mode	fixed frequency AM/HAVE QUICK I/II mode	20 W to 28 W (≥ 15 W at +24 V DC)
	fixed frequency FM/MSK mode	30 W to 42 W (≥ 23 W at +24 V DC)
Medium-power mode	fixed frequency AM/HAVE QUICK I/II mode	2 W to 4 W
	fixed frequency FM/MSK mode	3 W to 6 W
Low-power mode	fixed frequency AM/HAVE QUICK I/II mode	0.2 W to 0.4 W
	fixed frequency FM/MSK mode	0.3 W to 0.6 W
Low-power mode (optional on request)	fixed frequency AM/HAVE QUICK I/II mode [4]	0.02 W to 0.2 W
	fixed frequency FM/MSK mode	0.02 W to 0.2 W
RF carrier power degradation (relevant only in high-power mode)	at VSWR = 2, all phases	≤ 1 dB
	at VSWR = 3, all phases	≤ 2 dB
	for VSWR > 3, all phases	The transmitter stays operational with degraded performance > 3 W; no damage occurs due to mismatch of the antenna circuitry.
Emergency operation	DC supply voltage	≥ +16 V DC
	RF carrier power	≥ 3 W in high-power mode
	modulation distortion	≤ 15 %
	modulation depth	≥ 60 %
Phase noise/wideband noise	Δf ≥ ±100 kHz	≤ –83 dBm (1 Hz)
	Δf ≥ ±1 MHz	≤ –100 dBm (1 Hz)
	Δf ≥ ±5 MHz in tactical VHF range, Δf ≥ ±10 MHz in VHF/UHF range	≤ –120 dBm (1 Hz)
	f ≥ 225 MHz	≤ –145 dBm (1 Hz) in tactical VHF and VHF mode
	108 MHz ≤ f ≤ 173.975 MHz	≤ –135 dBm (1 Hz) in UHF mode
	f ≥ 450 MHz	≤ –145 dBm (1 Hz) in UHF mode
Spectral containment/occupied spectrum	for A3E, F3E voice modes and for A1D, F1D wideband baseband 16 kbit/s modes	≥ 99 % of transmitted energy within selected 25 kHz channel in line with STANAG 4204 and STANAG 4205
	transmitter spectral mask in 8.33 kHz mode	in line with EUROCAE ED-23B, chapters 3.2.7.2 and 3.2.11
Harmonic radiation For fixed frequency mode, measured in FM 30 W or AM 20 W carrier-unmodulated (CW) mode	30 MHz to 87.975 MHz tactical VHF	≤ –60 dBc
	118 MHz to 173.975 MHz VHF	≤ –70 dBc for 2nd and 3rd order ≤ –80 dBc for higher order
	225 MHz to 399.975 MHz UHF	≤ –70 dBc for 2nd order ≤ –80 dBc for higher order
Spurious radiation For fixed frequency mode, offset from carrier	±25 kHz ≤ Δf ≤ ±50 kHz	≤ –15 dBm (≤ –60 dBc at FM 30 W in line with STANAG 4204)
	±50 kHz ≤ Δf ≤ ±200 kHz	≤ –28 dBm (≤ –71 dBc at AM 20 W/ ≤ –73 dBc at FM 30 W)
	200 kHz ≤ Δf ≤ 10 %	≤ –38 dBm (≤ –81 dBc at AM 20 W/ ≤ –83 dBc at FM 30 W)
	Δf > 10 %	≤ –58 dBm (≤ –101 dBc at AM 20 W/ ≤ –103 dBc at FM 30 W)
	max. 10 spurious between –38 dBm and –58 dBm in frequency range from 1.5 MHz to 1 GHz	

[4] AM distortion, sidetone level not specified.

Incidental FM in AM mode		
UHF	with AM modulation, m = 0.6 and f_{mod} = 1 kHz	≤ 200 Hz
VHF	with AM modulation, m = 0.9 and f_{mod} = 1 kHz	≤ 300 Hz in line with ARINC 716, chapter 3.3
Incidental AM in FM mode	with FM modulation, Δf = ±6.4 kHz, f_{mod} = 1 kHz	≤ 1 %
Backdoor intermodulation, 3rd order	with +43 dBm wanted signal and +23 dBm unwanted signal	≤ +10 dBm
Residual radiation in TX nontransmit state Emissions at the selected frequency are limited as follows:		
Conducted spurious emissions	in VHF ATC range	≤ –107 dBm (0.02 pW) at antenna port in 118 MHz to 137 MHz frequency range in line with EUROCAE ED-23B, chapter 3.2.2
Adjacent channel power in 8.33 kHz mode		
±8.33 kHz adjacent channel power in VHF ATC range	under all conditions, test modulation constantly 300 Hz to 800 Hz, attenuated by 10 dB/octave for audio frequencies above 800 Hz	≤ –45 dBc with 7 kHz channel bandwidth in line with ICAO Annex 10, Vol. III, Part II, chapter 2.3.1.3

Modulation-related (voice)

AF narrowband input impedance	alternative balanced inputs	600 Ω ± 60 Ω or 150 Ω ± 15 Ω
AF narrowband input sensitivity	for m ≥ 0.8 and for Δf = ±(6.4 kHz ± 0.8 kHz) for Δf ≥ 3 kHz at 1 kHz AF, maritime mode in the tactical VHF range, this includes 1.6 kHz ± 350 Hz FM deviation for 150 Hz squelch tone in line with STANAG 4204	adjustable from –6 dBm to +14 dBm into 150 Ω/600 Ω input via MIL-STD-1553B data bus/serial interface
	maximum AM modulation depth	≥ 85 % in line with STANAG 4205, limited, less than 99 % to prevent overmodulation in line with EUROCAE ED-23B, chapter 3.2.3
	automatic audio level gain control	> ±10 dB, switchable via MIL-STD-1553B data bus/serial interface
AF narrowband frequency response	25 kHz channel spacing	300 Hz to 3400 Hz, ±2 dB relative to 1 kHz in line with STANAG 4204 and STANAG 4205
		≤ –12 dB at 200 Hz
		≤ –20 dB at 6 kHz
	8.33 kHz channel spacing	300 Hz to 2500 Hz, ±3 dB relative to 1 kHz in line with ARINC 716, chapter 4.4.2.3
		≤ –12 dB at 200 Hz
		≤ –50 dB at 3.2 kHz in line with ARINC 716, chapter 4.4.2.3
	maritime VHF range from 156.000 MHz to 173.975 MHz	preemphasis 6 dB/octave, in 300 Hz to 3400 Hz frequency range, in line with ITU-R M.489-2, chapter 1.1.3
AF narrowband modulation distortion	m = 0.8 or Δf = ±6.4 kHz, f_{mod} = 1 kHz	≤ 10 %
Signal-to-noise ratio	m = 0.8 or Δf = ±6.4 kHz, f_{mod} = 1 kHz	≥ 40 dB, measured in 3 kHz bandwidth
150 Hz squelch tone for voice transmission in tactical VHF range		
Tone frequency	nominal	150 Hz
Peak FM modulation		1600 Hz ± 350 Hz in line with STANAG 4204
1020 Hz calling tone		
Tone frequency		1020 Hz ± 20 Hz
AM/FM modulation		m ≥ 0.8 or Δf = ±6.4 kHz

Modulation-related (wideband)

AF wideband input impedance		
Balanced input		600 Ω ± 60 Ω
AF wideband input sensitivity	for m ≥ 0.8	1.4 V (V_{pp}) or 12 V (V_{pp}) into 600 Ω input (configurable via software)
	for Δf = ±(5.0 kHz ± 1.0 kHz) in tactical VHF range in line with STANAG 4204	
	for Δf = ±(5.5 kHz ± 1.0 kHz) in VHF/UHF range in line with STANAG 4205	
AF wideband frequency response		
Baseband	frequency response cutoff required in order to fulfill occupied spectrum requirements	20 Hz to 11 kHz, flat within ±3 dB relative to 1 kHz in line with STANAG 4204 and STANAG 4205
		≤ –20 dB at 30 kHz
Diphase		20 Hz to 22 kHz, flat within ±3 dB relative to 1 kHz
		≤ –20 dB at 50 kHz

Modulation-related (data)

Digital selective calling (DSC) modulation (not available on equipment with 156.8 MHz guard receiver)		
Frequency modulation		with preemphasis 6 dB/octave with frequency shift of modulating subcarrier
Frequency shift		between 1300 Hz and 2100 Hz/± 10 Hz
Modulation rate		1200 baud
Index of modulation		2.0 ± 10 %
Data input (LINK 11)		
Impedance	balanced input	600 Ω ± 90 Ω
Audio level		+10 dBm (for Δf = ±20 kHz ± 2.0 kHz) in line with STANAG 5511, Annex B, chapter 7.3.c
Frequency response		300 Hz to 3500 Hz, flat within 3 dB in line with STANAG 5511, Annex B, chapter 7.3.b
Sonobuoy control input		
Impedance	balanced input	100 Ω ± 10 Ω
Audio level (for m ≥ 0.8)		0.5 V (RMS)
Frequency range		1 kHz to 38 kHz, flat within 4 dB

Sidetone

Audio sidetone		
Audio level		adjustable from 0 dB down to –21 dB relative to main receiver audio level with tolerance of ±2 dB; can be switched off
Frequency range [5]		300 Hz to 3400 Hz, flat within 6 dB
		≤ –12 dB at 200 Hz
		≤ –20 dB at 6 kHz
Signal-to-noise ratio		≥ 40 dB at m = 0.8, f_{mod} = 1 kHz, high power
Data sidetone (LINK 11)	in line with MIL-STD-188-203-1A, chapter 5.3.1.5	
Audio level for Δf = ±20 kHz		+10 dBm ± 1.5 dB into 600 Ω load
Frequency response		300 Hz to 3500 Hz, flat within 3 dB

[5] In tactical VHF operation: suppression of 150 Hz squelch tone in line with STANAG 4204.

Receiver characteristics

Antenna port

Input impedance VSWR		
Tactical VHF, VHF and UHF frequency ranges (except VHF ATC)		≤ 2.5
VHF ATC range	118.000 MHz to 136.975 MHz	≤ 3.5
Maximum RF level without damage	continuous, without switching off	14 V (RMS) receiver remains functional, but audio might be distorted
Oscillator reradiation	in frequency range from 0 Hz to 3 GHz	≤ –100 dBm, valid for all spurious components in general

Main receiver

Sensitivity [6]	specified for 10 dB (S+N)/N ratio unweighted, f_{mod} = 1 kHz	
	30 MHz to 87.975 MHz, Δf = ±2.4 kHz	≤ –113 dBm
	108 MHz to 155.975 MHz, m = 0.30	≤ –105 dBm
	136 MHz to 173.975 MHz, Δf = ±2.4 kHz	≤ –113 dBm
	225 MHz to 399.975 MHz, m = 0.30	≤ –105 dBm
	225 MHz to 399.975 MHz, Δf = ±2.4 kHz	≤ –113 dBm
Internal spurious/self-reception	channels impacted by internal spurious or limited mixer harmonic suppression test method in line with ITOP 6-2-242, chapter 4.1.4f	
Total number of channels with reduced sensitivity (more than 3 dB)		less than 10
Identified channels [7]	in tactical VHF range	48.000 MHz
	in UHF range	240.000 MHz, 280.000 MHz, 288.000 MHz, 320.000 MHz, 336.000 MHz, 352.000 MHz, 360.000 MHz, 368.000 MHz, 384.000 MHz
Blocked channels	with 50 Ω matched receiver input and squelch SNR of 10 dB	
Number of blocked channels	in tactical VHF range	none
	in VHF range	none
	in UHF range	none
Selectivity (IF bandwidth)	clear voice, 8.33 kHz, in line with EUROCAE ED-23B class E and ICAO Annex 10, Vol. III, Part II, chapters 2.3.2.4 and 2.3.2.5	
	passband bandwidth at 6 dB	≥ 7 kHz
	stopband attenuation at 50 dB	≤ 11.2 kHz
	stopband attenuation at 60 dB	≤ 14.7 kHz
	clear voice, 25 kHz, in line with STANAG 4204, STANAG 4205 and EUROCAE ED-23B, class C	
	passband bandwidth at 6 dB	≥ 22 kHz
	stopband attenuation at 50 dB	≤ 34 kHz
	stopband attenuation at 60 dB	≤ 50 kHz
	stopband attenuation at 100 dB	≤ 2 MHz
	wideband mode (baseband/diphase) and LINK 11 in line with MIL-STD-188-203-1A, chapter 5.3.3.1.3	
	passband bandwidth at 6 dB	> 50 kHz
	stopband attenuation at 60 dB	< 100 kHz

[6] Specified for temperature range from –40 °C to +55 °C, ≤ 2 dB derating in temperature range from +55 °C to +71 °C.

[7] The listed UHF frequencies have been observed only on a few test items. In most cases, the spurious reception is slightly audible but the specified limits are fulfilled.

Spurious response rejection	test method in line with ITOP 6-2-242, chapter 4.4	
Rejection of input signals at $f_{RX}/2$		≥ 80 dB
IF rejection		≥ 100 dB
Image rejection		≥ 100 dB
Spurious response rejection in general for Δf ≥ 50 kHz	Due to limited mixer harmonic suppression, a few discrete responses with suppression of less than 100 dB can occur.	≥ 100 dB
Remarks on spurious response rejection		
Formula for prediction of spurious response in tactical VHF range	$\lvert fs\rvert = \frac{[n \times frx + 21.4 \times (n-1)]}{m}$ or $\lvert fs\rvert = \frac{[n \times frx + 21.4 \times (n+1)]}{m}$	
Formula for prediction of spurious response in VHF/UHF range	$\lvert fs\rvert = \frac{[n \times frx + 35.25 \times (n-1)]}{m}$ or $\lvert fs\rvert = \frac{[n \times frx + 35.25 \times (n+1)]}{m}$	
Exceptions in range	39 MHz to 47 MHz	≥ 75 dB for mixer harmonics order n = 1, m = 2
	38 MHz to 50 MHz	≥ 90 dB for mixer harmonics order n = 3, m = 5
	36 MHz to 52 MHz	≥ 90 dB for mixer harmonics order n = 3, m = 4
	108 MHz to 120 MHz	≥ 85 dB for mixer harmonics order n = 2, m = 3 ≥ 90 dB for mixer harmonics order n = 4, m = 5
	122 MHz to 170 MHz	≥ 90 dB for mixer harmonics order n = 3, m = 4
	300 MHz to 399.975 MHz	≥ 90 dB for mixer harmonics order n = 2, m = 2 [8]
Desensitization		
Test method in line with ITOP 6-2-242, chapter 4.3	maximum degradation of SINAD by 3 dB by interfering RF signals, defined as unmodulated carrier from 50 Ω source; wanted signal with specified sensitivity level of –105 dBm (AM) and –113 dBm (FM)	
	for Δf ≥ 200 kHz	≥ 75 dB
	for Δf ≥ 1 MHz	≥ 90 dB
	for Δf ≥ 2 %, in VHF and UHF range	≥ 100 dB
	for Δf ≥ 2 MHz, in tactical VHF range	≥ 100 dB
HF immunity to interferers ≤ 30 MHz	for operating frequencies from 118 MHz to 399.975 MHz	≥ 120 dB
Desensitization FM immunity to broadcast signals in range from 87.5 MHz to 107.9 MHz		≥ –5 dBm in line with EUROCAE ED-23B, chapter 3.1.11
Desensitization in adjacent channels ±8.33/25 kHz		≥ –33 dBm in line with EUROCAE ED-23B, chapter 3.1.11
Adjacent channel rejection ±8.33 kHz		
Test method in line with EUROCAE ED-23B, chapter 3.1.15, class E	±8.33 kHz, unwanted signal modulated by 400 Hz, 60 %	≥ 45 dB
Crossmodulation		
Test method in line with ITOP 6-2-242, chapter 4.8	specified values relative to maximum sensitivity level which produces 10 dB (S+N)/N; interfering carrier AM-modulated with m = 0.30, f_{mod} = 400 Hz; the unwanted crossmodulation product is down by at least 20 dB (10 %) relative to the audio output	
	for Δf ≥ 200 kHz	≥ 90 dB
	for Δf ≥ 1 MHz	≥ 95 dB
	for Δf ≥ 2 %	≥ 100 dB [9]

[8] Valid for temperatures > 0 °C, ≥ 80 dB for temperatures ≤ 0 °C.

[9] Valid for temperatures > 0°C, ≥ 97 dB for temperatures ≤ 0 °C.

3rd order intermodulation rejection	specified values relative to RF input level for 10 dB SINAD	
Test method in line with ITOP 6-2-242, chapter 4.5	for spacing 2/4 to 40/80 channels from wanted channel	≥ 76 dB [10]
FM immunity, 3rd order intermodulation rejection	FM broadcast signals in range from 87.5 MHz to 107.9 MHz	≥ –5 dBm in line with EUROCAE ED-23B, chapter 3.1.10
AGC characteristic		
Input level range Test method in line with ITOP 6-2-242, chapter 4.1	RF carrier modulated, m = 0.30, less than ±3 dB audio variation	≥ 120 dB
Recovery time		≤ 250 ms in line with EUROCAE ED-23B, chapter 3.1.2b
Attack/release time		≤ 40 ms/≤ 60 ms in line with STANAG 4204 and STANAG 4205
Attack time in LINK 11 mode		≤ 12 ms in line with STANAG 5511, Annex B, chapter 7.4.a
S/N squelch	adjustable via MIL-STD-1553B data bus/serial interface, defined for 30 % AM modulation or 2.4 kHz FM deviation, 1 kHz audio frequency	
Adjustable setting range		6 dB to 15.5 dB (S+N)/N
Accuracy of opening threshold		≤ ±2 dB [11]
Squelch hysteresis		1 dB to 6 dB
Squelch opening threshold depending on A3E modulation depth from 20 % to 95 %		< ±1 dB for 25 kHz channels
		< ±2 dB for 8.33 kHz channels, tested with 1 kHz AF, 10 dB squelch setting
Squelch opening threshold depending on F3E deviation from 1 kHz to 5 kHz		< –1/+2 dB, tested with 1 kHz AF, 10 dB squelch setting
Squelch opening threshold depending on audio frequency	tested with 10 dB squelch setting, 30 % A3E modulation depth or 2.4 kHz F3E deviation	< ±1dB for 25 kHz channels with AF from 300 Hz to 3400 Hz
		< ±2 dB for 8.33 kHz channels with AF from 350 Hz to 2500 Hz
Squelch muting		≥ 40 dB
Squelch attack time (open squelch)		≤ 50 ms in line with STANAG 4205, Annex B, chapter 9d
Time to mute		≤ 150 ms
Squelch signalization/indication		via MIL-STD-1553B data bus and hardware contact
Carrier override/RSSI squelch	adjustable via MIL-STD-1553B data bus/serial interface, defined for two CW signals	
Test method using two-carrier signal with ±5 kHz offset (±2.5 kHz offset for 8.33 kHz channels)	In order to confuse the S/N algorithm, the second carrier is 10 dB to 20 dB below the first carrier signal.	
Squelch override function		available in voice modes (25/8.33 kHz) and in wideband modes (baseband/diphase)
Adjustable squelch setting range	–87 dBm default value in line with EUROCAE ED-23B, chapter 3.1.14	adjustable from –93 dBm to –81 dBm in steps of 1 dB
Accuracy of opening threshold		≤ ±3 dB [12] specified for voice operation modes
Hysteresis		1 dB to 6 dB for A3E, F3E voice modes
Test method in line with EUROCAE ED-23B, chapters 3.1.14 and 5.2.1.14 using two-carrier offset signal; 1st carrier signal spaced +8 kHz from nominal receiving frequency, input level: –93 dBm; 2nd carrier signal spaced between –8 kHz and +4 kHz, input level: –85 dBm		
Squelch opening/nonclosure	for 25 kHz channels in VHF ATC frequency range from 118 MHz to 136.975 MHz	≤ –85 dBm in line with EUROCAE ED-23B, chapter 3.1.14

[10] Max. 2 dB derating for temperatures ≤ 0 °C in UHF frequency range.

[11] Degradation for extreme temperatures –40 °C/+55 °C/+71 °C: accuracy of opening threshold for FM modes within ±3 dB.

[12] Degradation for extreme temperatures –40 °C/+55 °C/+71 °C: accuracy of opening threshold within ±4 dB.

Guard receiver

The guard receiver shares the RF antenna input with the main receiver, and both the main receiver and the guard receiver are able to receive RF signals simultaneously. The R&S®MR6000A radio contains two independent guard receivers (GRX1 and GRX2).

Supported guard frequencies with GRX1 guard receiver	tactical VHF	40.5 MHz
	VHF	121.5 MHz
	UHF	243 MHz
Supported maritime guard frequencies with GRX2 guard receiver	VHF maritime	156.525 MHz, (GMDSS channel 70) or 156.8 MHz depending on radio model, see ordering information
Sensitivity Modulation frequency f_{mod} = 1 kHz	40.5 MHz	
	for 10 dB (S+N)/N ratio unweighted, Δf = ±2.4 kHz	≤ –105 dBm
	121.5 MHz, 243.0 MHz	
	for 10 dB (S+N)/N ratio unweighted, m = 30 %	≤ –99 dBm
	for 26 dB (S+N)/N ratio unweighted, m = 30 %	≤ –83 dBm
	156.525 MHz digital selective calling (DSC) receiver, with phase modulation of 2 rad	
	digital detection of subcarrier shift 1300 Hz (mark) and 2100 Hz (space)	≤ –105 dBm
	156.8 MHz	
	for 10 dB (S+N)/N ratio unweighted, Δf = 1.5 kHz	≤ –105 dBm
GRX1 selectivity (IF bandwidth) 6 dB bandwidth ≥ 28 kHz in line with STANAG 4205 in order to accept AM-DSB receive signal with up to ±12 kHz inaccuracy	40.5 MHz	
	passband bandwidth at 6 dB	≥ 28 kHz
	stopband attenuation at 60 dB/100 dB	≤ 100 kHz/≤ 250 kHz
	121.5 MHz, 243 MHz	
	passband bandwidth at 6 dB	≥ 28 kHz
	stopband attenuation at 60 dB/100 dB	≤ 100 kHz/≤ 250 kHz
GRX2 selectivity (IF bandwidth)	156.525 MHz	
	passband bandwidth at 6 dB	≥ 28 kHz
	stopband attenuation at 60 dB/100 dB	≤ 100 kHz/≤ 250 kHz
	156.8 MHz	
	passband bandwidth at 6 dB	≥ 18 kHz
	stopband attenuation at 60 dB/100 dB	≤ 100 kHz/≤ 250 kHz
Spurious response rejection/signal rejection		
IF rejection		≥ 100 dB
Image rejection		≥ 100 dB
Signal rejection for Δf ≥ ±250 kHz	no unwanted squelch opening for 10 dB squelch setting	≥ 100 dB
Crossmodulation	specified values relative to maximum sensitivity level of –99 dBm; interfering carrier AM-modulated with m = 0.30, f_{mod} = 400 Hz; the unwanted crossmodulation product is down by at least 20 dB (10 %) relative to the audio output	
	for Δf ≥ ±1 %	≥ 90 dB
AGC characteristic		
Input level range Test method in line with ITOP 6-2-242, chapter 4.1	RF carrier with 30 % AM modulation, less than ±3 dB audio variation	≥ 114 dB
S/N squelch	adjustable via MIL-STD-1553B data bus/serial interface, defined for 30 % AM modulation or 2.4 kHz FM deviation, 1 kHz audio frequency	
Adjustable setting range		8 dB to 15.5 dB (S+N)/N
Accuracy of opening threshold	for GRX1 40.5 MHz, 121.5 MHz and 243 MHz	≤ ±3 dB [13]
	for GRX2 156.8 MHz specified for nominal setting of 10 dB	≤ –4 dB/+2 dB
Squelch hysteresis		1 dB to 6 dB
Squelch opening threshold depending on AM modulation depth from 20 % to 95 %		< ±1 dB, tested with 1 kHz AF, 10 dB squelch setting
Squelch opening threshold depending on FM deviation from 1 kHz to 5 kHz	for GRX1 40.5 MHz	< ±1 dB, tested with 1 kHz AF, 10 dB squelch setting

[13] Degradation for extremely low temperatures –40°C: accuracy of opening threshold for tactical VHF 40.5 MHz (FM) within ±4 dB.

Squelch opening threshold depending on audio frequency	for GRX1 40.5 MHz, 121.5 MHz, 243 MHz, 30 % AM modulation depth or 2.4 kHz FM deviation	< ±1 dB with AF from 300 Hz to 3400 Hz, tested with 10 dB squelch setting
Squelch muting		≥ 40 dB
Squelch attack time (open squelch)		≤ 50 ms, in line with STANAG 4205, Annex B, chapter 9d
Time to mute		≤ 150 ms
Squelch signalization/indication		via MIL-STD-1553B data bus and hardware contact
Carrier override function	RSSI-based squelch	additional carrier override squelch based on signal power

Main receiver, AF-related (voice)

Unless otherwise stated, the following data is valid at an RF input level of 1 mV (–47 dBm) into 50 Ω.

Output impedance		
Balanced outputs		isolated from ground, short-circuit-capable
Output impedance	for audio frequencies from 100 Hz to 6000 Hz	≤ 50 Ω for 150 Ω radios, ≤ 200 Ω for 600 Ω radios
Audio level	for m = 0.8 (AM) or Δf = ±6.4 kHz (FM)	adjustable from 2.2 mW to 400 mW ± 2 dB into 150 Ω or 600 Ω, set via MIL-STD-1553B data bus or serial configuration command
	for Δf = ±3.3 kHz at 1 kHz AF, maritime mode	
Audio frequency response	in tactical VHF, VHF (FM only) and UHF frequency ranges	300 Hz to 3400 Hz, ±2 dB relative to 1 kHz in line with STANAG 4204 and STANAG 4205, ≤ –12 dB at 200 Hz, ≤ –20 dB at 6 kHz
	suppression of 150 Hz squelch tone in tactical VHF frequency range	in line with STANAG 4204
	in ATC VHF frequency range from 108 MHz to 155.975 MHz, AM modulation, 8.33 kHz and 25 kHz channel spacing	350 Hz to 2500 Hz, ±3 dB
		≤ –20 dB at 3750 Hz relative to 1 kHz in line with ARINC 716, chapter 3.6.5.5
		≤ –35 dB at 4000 Hz relative to 1 kHz in line with EUROCAE ED-23B and EUROCAE ED-23C, chapter 3.1.1
	in maritime VHF range from 156 MHz to 173.975 MHz	deemphasis 6 dB/octave in frequency range from 300 Hz to 3400 Hz in line with ITU-R M.489-2, chapter 1.1.3
Audio distortion	m = 0.80 or Δf = ±6.4 kHz, f_{mod} = 300 Hz to 3400 Hz	≤ 5 % for RF input levels up to +7 dBm and audio output levels ≤ 200 mW
Audio signal-to-noise ratio	m = 0.30, f_{mod} = 1 kHz or Δf = ±2.4 kHz, f_{mod} = 1 kHz	≥ 40 dB for audio output levels ≥ 2.5 mW

Main receiver, AF-related (wideband)

Unless otherwise stated, the following data is valid at an RF input level of 1 mV (–47 dBm) into 50 Ω.

Wideband output level	for m = 0.8 (AM) or Δf = ±6.4 kHz (FM)	
	into 600 Ω	1.0 V to 1.8 V (V_{pp})
	into 20 kΩ	7.0 V to 11.0 V (V_{pp})
Wideband output frequency response		
Baseband/diphase		20 Hz to 22 kHz, flat within ±3 dB relative to 1 kHz in line with STANAG 4204 and STANAG 4205
		≤ –20 dB at 50 kHz
Wideband output audio distortion	for m = 0.9 or Δf = ±7.2 kHz, f_{mod} = 1 kHz	≤ 10 %
Bit error rate (BER)	digital baseband signal of 16 kbit/s, m = 0.8, RF level into 50 Ω	
	for RF level of –101 dBm	≤ 4×10^{-3}
	for RF level from –95 dBm to +7 dBm	≤ 1×10^{-5}

LINK 11 output

Audio output level with FM peak deviation, Δf = ±20 kHz		+10 dBm ± 1.5 dBm into 600 Ω load, in line with STANAG 5511, Annex B, chapter 7.4.c
Frequency response		300 Hz to 3500 Hz, flat within 3 dB, in line with STANAG 5511, Annex B, chapter 7.4.b

Guard receiver (40.5/121.5/156.8/243 MHz) audio output

Maritime VHF GRX2 guard receiver with 156.8 MHz depending on radio model, see ordering information.

Audio level		
Output 1, mixed with main receiver (see narrowband audio level)	for m = 0.8 (AM) or Δf = ±6.4 kHz (FM), for Δf = 3.3 kHz at 1 kHz AF, maritime mode	adjustable relative to main receiver level from 0 dB to –21 dB (default setting: 0 dB) via MIL-STD-1553B data bus or serial configuration command
Output 2, separate output, fixed level	for m = 0.8 (AM) or Δf = ±6.4 kHz (FM), for Δf = 3.3 kHz at 1 kHz AF, maritime mode	≥ 2 V (V_{pp}) into 600 Ω load
Audio frequency response	300 Hz to 3400 Hz, ±2 dB relative to 1 kHz	
	at 200 Hz	≤ –12 dB
	at 6 kHz	≤ –20 dB
Audio distortion	m = 0.8 or Δf = ±6.4 kHz, f_{mod} = 300 Hz to 3400 Hz	≤ 5 %, for RF input levels from –84 dBm to +7 dBm and audio output levels ≤ 200 mW
Audio signal-to-noise ratio	m = 0.3 or Δf =±2.4 kHz, f_{mod} = 300 Hz to 3400 Hz	≥ 40 dB for audio output levels ≥ 2.5 mW

DSC guard receiver 156.525 MHz interface

GRX2 DSC guard receiver with 156.625 MHz depending on radio model, see ordering information.

Digital data output RS-485	separate digital output for VHF FM guard channel 70 (GMDSS) available	
Output signal level		RS-485
Data protocol		in line with ITU-R Rec. 493/541
Logic levels	nominal	1300 Hz (mark) and 2100 Hz (space)
DSC demodulation threshold 1700 Hz		
Threshold for changing polarity		carrier subtone frequency between 1590 Hz and 1810 Hz at –105 dBm RF input level, 2 rad phase modulation

Environmental data

General environment

Temperature		
Forced air cooling intake condition	–40°C to +55 °C at MSL	
Low operating temperature	–40 °C ambient	MIL-STD-810E, method 502.3, proc. II
High operating temperature	+71 °C ambient	MIL-STD-810E, method 501.3, proc. II
	+80 °C for 15 min	MIL-STD-810E, method 501.3, proc. II
	+85 °C for 5 min	MIL-STD-810E, method 501.3, proc. II
Low storage temperature	–55 °C ambient	MIL-STD-810E, method 502.3, proc. I
High storage temperature	+90 °C ambient	MIL-STD-810E, method 501.3, proc. I
Temperature variation and shock	–40 °C to +71 °C	MIL-STD-810E, method 503.3
Pressure		
Low pressure (altitude)	55 000 ft within –40 °C to +5 °C, operating	MIL-STD-810E, method 500.3, proc. II
	55 000 ft within –40 °C to +5 °C, storage	MIL-STD-810E, method 500.3, proc. I
Salt fog		MIL-STD-810E, method 509.3, proc. I
Humidity		MIL-STD-810E, method 507.3, proc. I, cycle type 3
Rain		
Drip	radio in operating mode	MIL-STD-810E, method 506.3, proc. II
Sand and dust		
Settling dust		MIL-STD-810F, method 510.4, proc. III
Fungus resistance		MIL-STD-810E, method 508.4

Mechanical environment

Vibration		
Helicopter	0.002 g²/Hz to 0.020 g²/Hz	MIL-STD-810E, method 514.4, proc. I, category 6
Jet	curve J	MIL-STD-810B, method 514, proc. I, category B
Gunfire vibration		
Gun on helicopter platform	gun/aircraft combination-specific values tested	MIL-STD-810E, method 519.4
Shock		
Normal landing shock	±4.0 g in all directions, in operating mode, shock peak values for a half-period sine wave of 100 ms duration	MIL-STD-810E, method 516.4, proc. I
Hard landing shock	±6.0 g in all directions, in operating mode, shock peak values for a half-period sine wave of 100 ms duration	MIL-STD-810E, method 516.4, proc. I
Crash hazard	in nonoperating mode, ±20 g in all directions, shock peak values for a half-period sine wave of 100 ms duration	MIL-STD-810E, method 516.4, proc. V
Acceleration	all axes 13.5 g, duration 1 min	MIL-STD-810E, method 513.4, proc. I
	all axes, 9.0 g, duration 1 min	MIL-STD-810E, method 513.4, proc. II

Electromagnetic compatibility (EMC)

Conducted emission		
Power and interconnecting leads	30 Hz to 15 kHz, figure 2-1: limits for narrowband emissions; in TX SATURN operating mode the limit is relaxed by 10 dB from 10 kHz to 15 kHz	MIL-STD-461C, method CE01, MIL-STD-462, method CE01/CE02
	15 kHz to 50 MHz, figure 2-2: limit for narrowband emissions, figure 2-3, curve 2: limits for broadband emissions; in TX SATURN operating mode the limit is relaxed by 10 dB from 15 kHz to 100 kHz	MIL-STD-461C, method CE03, MIL-STD-462, method CE03/CE04
Antenna terminal	10 kHz to 12.4 GHz	MIL-STD-461C/MIL-STD-462, method CE06
Conducted susceptibility		
Power leads	30 Hz to 50 kHz, limits in line with figure 4-7	MIL-STD-461C/MIL-STD-462, method CS01
Power leads	50 kHz to 400 MHz, limits have been modified	MIL-STD-461C/MIL-STD-462, method CS02
Power leads, spikes	±600 V peak voltage	MIL-STD-461C/MIL-STD-462, method CS06
Antenna terminal	category W (specific, up to 13 W)	RTCA/DO-160E, Section 20
Bulk cable injection test	50 kHz to 400 MHz	MIL-STD-461D, CS114
Radiated emission		
Electric field	14 kHz to 10 GHz for narrowband, 14 kHz to 1 GHz for broadband, limits have been modified	MIL-STD-461C/MIL-STD-462, method RE02
Static magnetic interference		RTCA/DO-160D, Section 15, class A
Radiated susceptibility		
Magnetic field	30 Hz to 50 kHz, limits have been modified	MIL-STD-461C/MIL-STD-462, method RS01
Magnetic induction field	200 V (V_p), spike no. 2	MIL-STD-461C/MIL-STD-462, method RS02
Electric field	100 V/m to 614 V/m, 14 kHz to 18 GHz	MIL-STD-461C/MIL-STD-462, method RS03
Lightning		
Lightning induced transient susceptibility (LEMP)	category ZZZZZ (levels have been modified)	RTCA/DO-160D, Section 22

Electrical network characteristics

Normal operating conditions		
Momentary power interruptions		RTCA/DO-160D, Section 16, chapter 16.5.2.3
Abnormal operating conditions		
Voltage steady state (DC)		RTCA/DO-160D, Section 16, chapter 16.5.4.1
Momentary undervoltage operation (DC)		RTCA/DO-160D, Section 16, chapter 16.5.4.3
Abnormal surge voltage (DC)	limits in line with EN 2282 (figure 7, curves 3 and 4)	RTCA/DO-160D Section 16, chapter 16.5.4.4

Related standards

Compatibility with fixed frequency radio standards

Standard	Edition, applicable chapters and date	Title
STANAG 4204	Edition 2, Annex B, May 1988	Technical standard for single channel VHF radio equipment
STANAG 4205	Edition 2, Annex B, May 1988	Technical standard for single channel UHF radio equipment
STANAG 5511	Edition 5, Annex B, chapters 7.3 to 7.5, October 2002	Tactical data exchange – LINK 11/LINK 11B
MIL-STD-188-203-1A	chapters 5.3.1 and 5.3.3, January 1988	Interoperability and performance standards for tactical digital information link
EUROCAE ED-23B	chapter 3, March 1995, with amendments 1 to 3, November 1997, equipment classes C, E, 3 and 5	Minimum operational performance specification for airborne VHF receiver-transmitter operating in the frequency range 117.975 MHz to 137.000 MHz
ICAO Annex 10	Volume III, Part II, chapter 2, July 1995; with amendments 71 to 76, dated November 1, 2001	Aeronautical voice communications systems

Notes regarding MIL-STD188-203-1A, chapters 5.3.1 and 5.3.3:

- Use unbalanced-to-ground method in line with chapter 5.2.8.1.5.2.a or b
- UHF receiver output level definition of +8.25 dBm in line with MIL-STD-188-203-1A, chapter 5.3.3.2.8 is contradictory to STANAG 5511, Annex B, chapter 7.4.c and is therefore not fulfilled
- –3 dB to +3 dB adjustment capability of UHF receiver output level in line with MIL-STD-188-203-1A, chapter 5.3.3.2.8 is not required by STANAG 5511, Annex B, chapter 7.4.c and is therefore not fulfilled
- UHF transmitter input level definition of +8.25 dBm in line with MIL-STD-188-203-1A, chapter 5.3.3.3.4 is contradictory to STANAG 5511, Annex B, chapter 7.3.c and is therefore not fulfilled

Guidelines

The following standards have been used as guidelines:		
Standard	**Edition, applicable chapters and date**	**Title**
Recommendation ITU-R M.489-2	1974/1978/1995	Technical characteristics of VHF radiotelephone equipment operating in the maritime mobile service in channels spaced by 25 kHz
ARINC 716-11	chapters 3 and 4, June 2003	Airborne VHF communications transceiver
	Please note the following limitations: • SELCAL is not supported • Microphone input is not available • Remote control via ARINC 429 is not supported	

Precedence of standards

In case of conflicts and technical contradictions, the standards have to be used in the following order of precedence:

This document
STANAG 4205
STANAG 4204
EUROCAE ED-23B
ICAO Annex 10, Vol. III, Part II, chapter 2
STANAG 5511
MIL-STD-188-203-1A
ARINC 716-11
Recommendation ITU-R M.489-2

Referenced standards

Standard	Edition and date	Title
STANAG 4372	Edition 3, April 1999	SATURN – a fast frequency hopping EPM mode for UHF radio
STANAG 4246	Edition 3, September 2006	HAVE QUICK UHF EPM communications equipment
MIL-STD-461	MIL-STD-461C/D, August 1986/January 1993	Electromagnetic emission and susceptibility requirements for the control of electromagnetic interference
MIL-STD-462	MIL-STD-462/462D, July 1967/January 1993	Measurement of electromagnetic interference characteristics
MIL-STD-810	MIL-STD-810B/E/F, June 1967/July 1989/January 2000	Environmental test methods and engineering guidelines
MIL-STD-1553	MIL-STD-1553B, April 1975	Digital time division command/response multiplex data bus
MIL-HDBK-217	MIL-HDBK-217F, Notice 2, February 1995	Reliability prediction of electronic equipment
RTCA/DO-160	RTCA/DO-160D, Change 3 December 2002	Environmental conditions and test procedures for airborne equipment
DS-101	October 1991	Interface protocols for electronically keyable INFOSEC equipment/system
DS-102	September 1987	Common fill device interface
ICD-GPS-060	Revision B, February 2002	Interface control document for the precise time and time interval (PTTI) interface
EUROCAE ED-23	EUROCAE ED-23C, June 2009	Minimum operational performance specification for airborne VHF receiver-transmitter operating in the frequency range 117.975 MHz to 137.000 MHz
ITOP 6-2-242	October 1993	Analog communications transmitter and receiver test procedures
ARINC 600	ARINC specification 600-12, November 1998	Air transport avionics equipment interfaces

Ordering information

Designation	Type	Order No.
R&S®MR6000A (extract of available equipment) ARINC 600 housing – remote control		
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): fixed frequency; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 600 Ω; with GRX2 guard receiver 156.525 MHz	R&S®XM6023	6134.6400.62
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 600 Ω; with GRX2 guard receiver 156.525 MHz	R&S®XM6123	6163.0007.67
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 600 Ω; with GRX2 guard receiver 156.8 MHz	R&S®XM6523D	6134.7207.62
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): SATURN (enhanced functionality – with additional STANAG 4372 options), HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 600 Ω; with GRX2 guard receiver 156.525 MHz	R&S®XM6923	6134.8803.67
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): SATURN, HAVE QUICK I/II; COMSEC: embedded NATO; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 150 Ω or 600 Ω; with GRX2 guard receiver 156.525 MHz	R&S®XM6923L	customer-specific
Accessories		
Mating connector sets (R&S®M3AR)		
Mating Connector Set for R&S®MR6000A	R&S®ZR6000A	6113.8033.02
Tray (R&S®M3AR)		
Mounting Tray for R&S®MR6000A	R&S®KR6000A	6133.8345.03
Service and maintenance tools (R&S®M3AR)		
Maintenance Connection Box for R&S®MR6000A	R&S®ZK6000A	6131.3698.03
Radio Commander	R&S®CP6000	6026.9026.22
PC Maintenance Tool Software	R&S®ZS6001	6026.9078.02

The system delivered has the configuration as confirmed in the order.

For product brochure, see PD 0758.1970.12 and www.rohde-schwarz.com

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