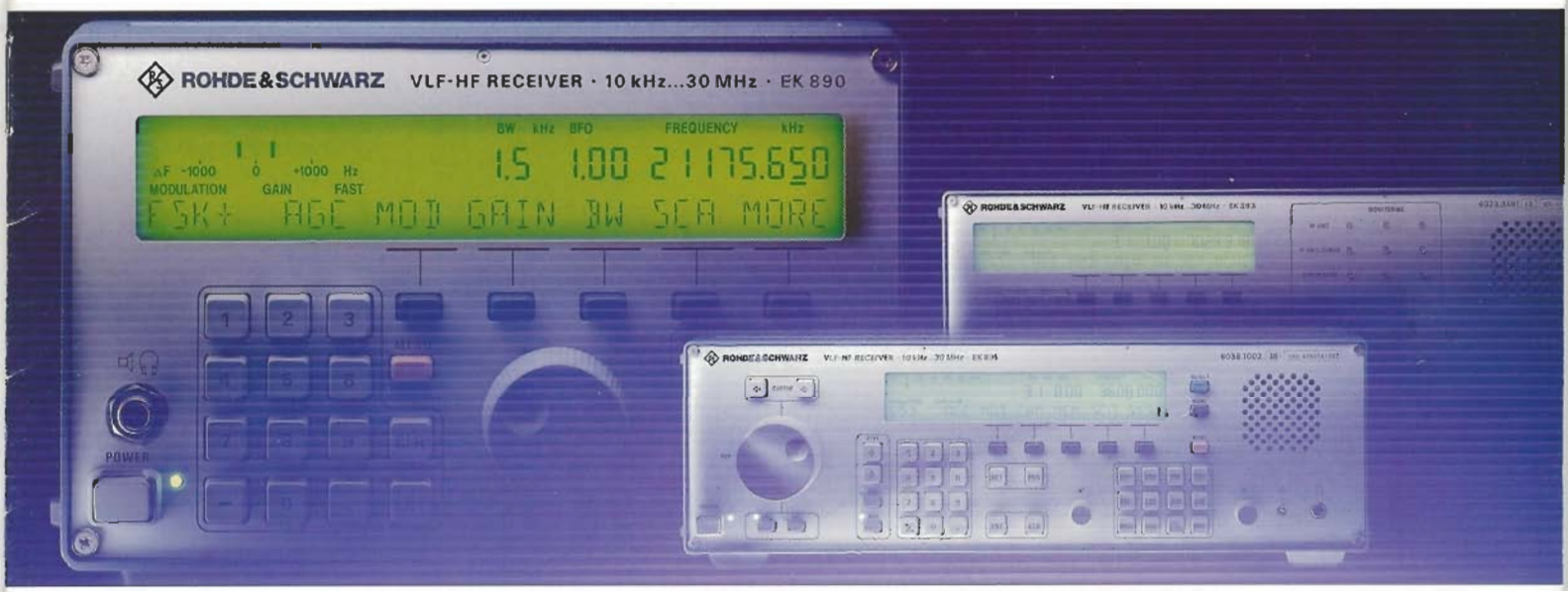


VLF-HF Receiver Family EK890

For all shortwave applications from 10 kHz to 30 MHz

- Compact receivers for
  - radiomonitoring and radio detection
  - radiocommunications
  - search operation, DF systems
  - as front-end for HF intelligence tasks
- 3 different models:
  - single receiver EK890
  - search receiver EK891
  - triple receiver EK893
- Real-time remote control or master-slave mode
- Digital signal processor (option)
- Well-proven system concept
- Excellent price/performance ratio

ROHDE&SCHWARZ

VLF-HF Receiver EK890 with Control Panel GB890 (option) for manual operation from front panel

VLF-HF Receiver Family EK890

Special features

- Excellent large-signal behaviour, very good intercept points
- High resolution of tuning frequency down to 1 Hz
- Fast and low-noise synthesizer
- Demodulators for AM, CW, FAX1, LSB and USB included in basic configuration
- Can be extended to up to six IF filter bandwidths
- Interface fully complying with international standards
- Low power consumption <25 VA (basic model EK890), therefore little self-heating
- Powerful microprocessor for bus interfacing, menus and user programs
- Dual and triple receiver as 19" bench model
- Free slots for retrofitting of options
- Integrated self-test down to module level with plain-language result display
- Available with operator front panel or remote-control-only front panel (EK890/893)
- Highly compact, width $^1/_2$19" (EK890) or 19" (EK891/EK893)

Operational features

- Easy to operate via terminal, computer or front panel
- High rejection of strong interfering signals
- 1000 programmable channel memory locations
- Scan mode for programmable frequency ranges and any desired channel sequences
- Remote control of all settings – over any distance when using modems
- Ideal handoff receivers in stationary, mobile and remote receiving systems
- High availability thanks to long MTBF and short MTTR
- Easy to adapt to special requirements by means of optional plug-in modules and standardized interfaces

Overview

General characteristics of EK890

With the EK890 family, Rohde&Schwarz is presenting a powerful generation of VLF-HF receivers which are top-end products benefiting from many years of experience in this field. All members of this family are based on the basic model EK890. The compact design results from the use of large-scale-integration SMDs. Thanks to their full system compatibility, the receivers provide the basis for extremely economical customer-specific solutions.

Due to the excellent RF characteristics and the uncomplicated and full remote-control capability via standardized data interfaces, the EK890 family is suitable for all civil, administrative and military shortwave applications. These receivers are an ideal choice for receiving systems which have to fulfill extremely high reliability requirements, in particular under harsh environmental and EMC conditions.

Operation is possible via an ASCII terminal, a computer (PC) or via the front panel. Using line drivers, a master receiver can control up to 99 detached receivers in master-slave operation. The well-proven EK085 Receiver can also be used as a master receiver. On the EK890/891, two wired and bus-integrated slots for plug-in modules are provided for extensions, eg special digital demodulators, IF converters or input filters, whereas the EK893 has a free slot for retrofitting either the digital demodulator or the IF converter.

Uses

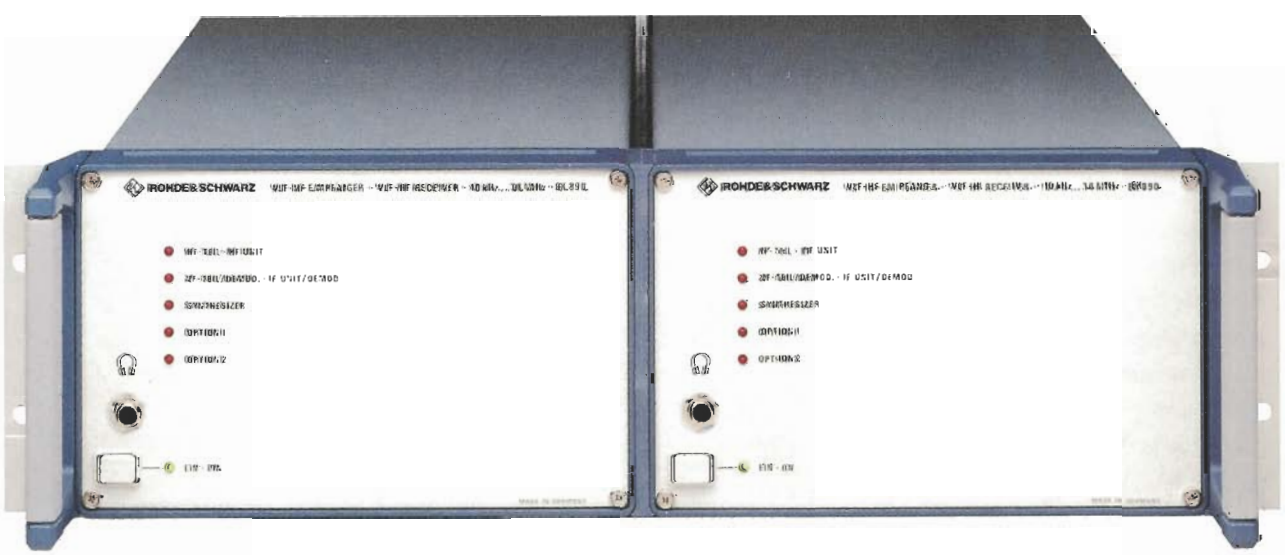
The comprehensive sequence control can be used for all demanding shortwave reception tasks. Due to flexible programming of the processor, the following operating modes are possible:

- manual operation
- remote control or master-slave operation
- channel scanning, sequential and programmable
- frequency scan
- channel reception
- password-protected channel reception

The EK890 family thus fulfills the requirements for versatile use in voice receiving and any kind of data communication systems as well as for all radiomonitoring, radio detection and radio intelligence (COMINT) applications. For application in DF systems an EK890 is used as the master (controlling synthesizer), its LOs being brought out for external amplification, distribution and phase-locked application to all other receivers.

The built-in memory has capacity for nonvolatile storage of 1000 complete channel settings so that channel management and control by an external computer are not required but nevertheless additionally possible. Due to their excellent characteristics regarding dynamic range, low synthesizer noise and gain control range, the receivers are ideal high-performance front ends for subsequent signal processing.

Two independent EK890 Receivers with remote-control panel in a 19" rackmount adapter



Search Receiver EK891

The EK891 has been designed with a particular view to complex tasks of radio detection and search reception, its operating principle and configuration matching perfectly the relevant requirements. Basically it is fitted with panel controls and LCD displays for local and remote-control operation since with radiomonitoring manual optimization of receive parameters is practically always necessary. The receiver has 6 IF bandwidths and is designated as model .04 in its standard version. The five special IF bandwidth configurations provided for models .35 to .39 are also available for the rest of the EK890 family (see page 11). This affords optimum system operation with fully identical equipment.

dio detection tasks. Due to its outstanding characteristics, the EK891 is ideal for use as a stand-alone receiver. All EK890 options can be fitted.

Triple VLF-HF Receiver EK893

The EK893, a triple compact receiver, has been developed from the EK890. Whereas two EK890 units can be mounted in a 19" adapter to form a dual receiver, the EK893 combines in a 19" cabinet three complete receivers which are operated via a common processor and power supply. The receivers enable simultaneous reception of different classes of emission and use of different operating modes. The EK893 has the same RF characteristics and operational features as the EK890, and the storage capacity for 1000 channels per receiver is also the same. A free slot is provided in each of the three receivers so that an IF Signal Processor GM890 or an IF Converter UX890 can be inserted.

The advantages of the EK893 as against the use of single receivers are the extremely compact design, enhanced reliability (MTBF is better than that of three single receivers) as well as the economical and operational efficiency. With its excellent characteristics, the EK893 is the ideal receiver for use in remote-controlled receiving systems, where only the best in quality and reliability is acceptable. The EK893 is available as a triple handoff receiver without any panel controls and as a receiver with a control section. When used in systems, it is controlled via a serial multistandard interface which is also bus-compatible (RS-485) and, using additional line drivers, allows up to 99 receivers to be operated in master-slave mode.

Search Receiver EK891 with front panel for manual operation

Triple Receiver EK893 with panel controls to the left, as handoff receiver for remote control to the right

High-speed and reliable radiomonitoring is supported by temporary storage of a complete receiver setup and its transfer to or readout from the connected slave. The EK891 is the optimal operator's position in modern radiomonitoring systems. In the usual master-slave mode, a master receiver can control up to 99 slave receivers via additional line drivers to handle simultaneous radiomonitoring or specific ra-

Design

RF unit

The antenna signal is routed via a low-pass filter, which is provided for rejecting image frequencies and suppressing oscillator reradiation, and applied to the input mixer where it is converted into the first IF of 41.44 MHz by means of an oscillator variable in 1-Hz steps. The crystal filter that follows determines the maximum receiving bandwidth of 10 kHz and provides for rejection of the second image frequency. A fixed frequency of 40 MHz is used for conversion into the second IF of 1.44 MHz.

The high-performance mixer at the receiver input ensures excellent large-signal behaviour. The intercept points are typically +70 dBm (IP_2) and +35 dBm (IP_3); the crossmodulation transfer is 10% for an interfering signal of +21 dBm. In most cases, additional filters such as suboctave filters are therefore not required.

IF unit/demodulator

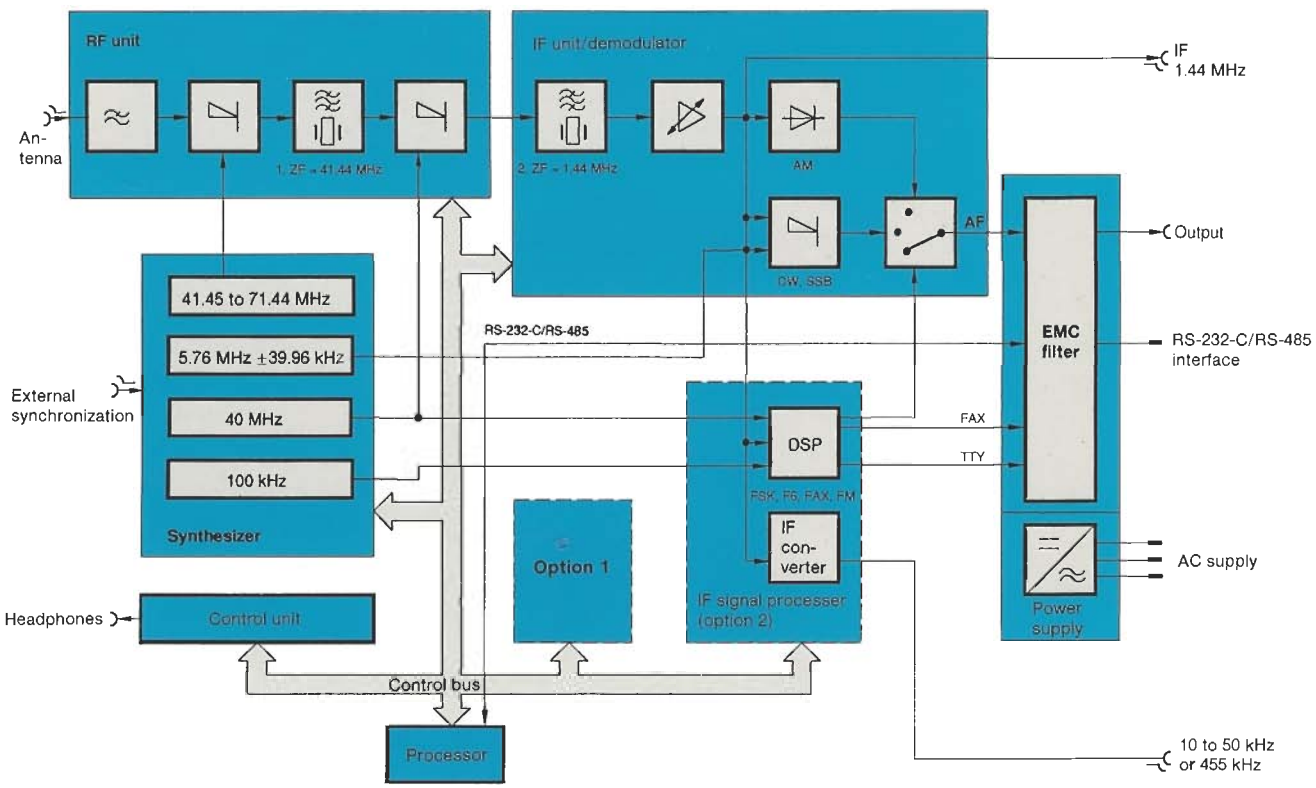
Six filter slots for crystal filters with bandwidths between 150 Hz and 10 kHz are available in the main filter section. All filters are employed in three different modes, ie as center-frequency filters and – in the USB and LSB modes – as sideband filters; the sideband filter characteristic is obtained by shifting the first conversion frequency and the BFO frequency. The filter section is followed by a multistage IF amplifier. Its gain control voltage, which is a measure of the signal voltage at the antenna, is indicated as the receive level in 5-dB steps between 0 and 120 dB. Gain control is possible automatically (AGC), remotely (DGC) or manually (MGC, via front panel). In the AM mode, the IF signal is converted into AF by means of an envelope detector, and in the CW and SSB modes by means of the BFO which is variable in 10-Hz steps.

Synthesizer

The synthesizer supplies all the conversion frequencies required for the RF and the IF demodulator units. Due to direct digital frequency synthesis, the first conversion oscillator can be varied in 1-Hz steps. The settling time of the oscillator is 5 ms for any frequency variation. Two phase-locked loops (PLLs) produce the 40-MHz fixed frequency and the BFO frequency. The operation of the total of four PLLs in the synthesizer is continuously monitored.

In the basic version, all the frequencies are derived from a temperature-compensated crystal oscillator. Higher accuracy requirements can be fulfilled by including a heated crystal oscillator (optional OCXO) or using an external frequency standard (1, 5 or 10 MHz).

Block diagram of VLF-HF Receiver EK890



Control functions

Processor and software
The modern 16-bit microprocessor using power-saving CMOS technology is what makes the high-performance, compact, reliable and user-friendly concept of the EK890 possible. The microprocessor is not only responsible for setting and managing the module functions, it also communicates with the outside world via the panel controls and the data interface, executes the internal programs and ensures the high operational reliability through various routines:

- nonvolatile storage of all settings
- continuous testing of CPU, RAM and PROM functions
- continuous monitoring (CM) of synthesizer
- BIT (built-in test) for module testing

The simple and logical ASCII command syntax for controlling the receiver via the serial interface includes control commands for

basic settings
- frequency
- BFO
- bandwidth
- demodulation modes
- gain control mode
- digital threshold
- passband tuning

search operations
- frequency scanning
- channel scanning
- hold time
- dwell time
- stop criterion

test operations
- read CM status
- BIT start
- BIT readout

system operations
readout of
- software version
- options
- error messages
- signal level
- deviation
- filters inserted

channel operations
- store channel
- erase channel
- select channel
- read out channel

special operations
- master-slave operation
- operation with EK085
- complete erasure of channel memory

In addition, the following functions can be selected on the front panel:
- display of interface configuration
- fast channel storage
- channel buffer storage
- default settings on/off
- password for channel service
- local/remote mode
- knob increments

Various configurations

Receivers with remote-control panel
In the standard version, the receivers are remote-controlled by ASCII command sequences via a multistandard interface (RS-232-C, RS-485, RS-422/423, 2-/4-wire). In the simplest case, a terminal can be used as the control unit. For more convenience a computer can be used to handle complex tasks and to create special user interfaces. A demo program for generating a virtual front panel is available if desired.

Receivers with control panel
The EK890/893 models are optionally available with an operator front panel, which can also be retrofitted. This front panel permits also manual control and display of all functions while full remote-control capability is maintained. This version is particularly suitable for use as a master receiver in receiving systems or as a stand-alone unit (standard with EK891).

The operator interface provides for a combination of hardkey and softkey entries. Parameters that are frequently handled, ie receive frequency, channel, BFO frequency and passband tuning (PBT), can be entered directly via a separate keypad. All current receiver settings are continuously indicated in large high-contrast characters on a backlit LCD. An additional bargraph indicator allows indication of either the receive level (0 to 120 dBµV, in 5-dB steps), the DGC or MGC settings or the frequency offset (as a tuning aid and deviation indication if the optional IF signal processor is installed).

Remote Control Unit GB 899 (option)
This option is an EK890 reduced to control functions plus a Control Panel GB890. It is used for real-time remote control of handoff receiving equipment, over long distances preferably via additional modems.

IF filter configuration
The EK890/893 is available in three standard models with 2, 3 or 6 fixed IF filter bandwidths. Models .35 to .39 of EK890, EK891 and EK893 are available with 6 bandwidths (see page 11). Special bandwidths are available on request.

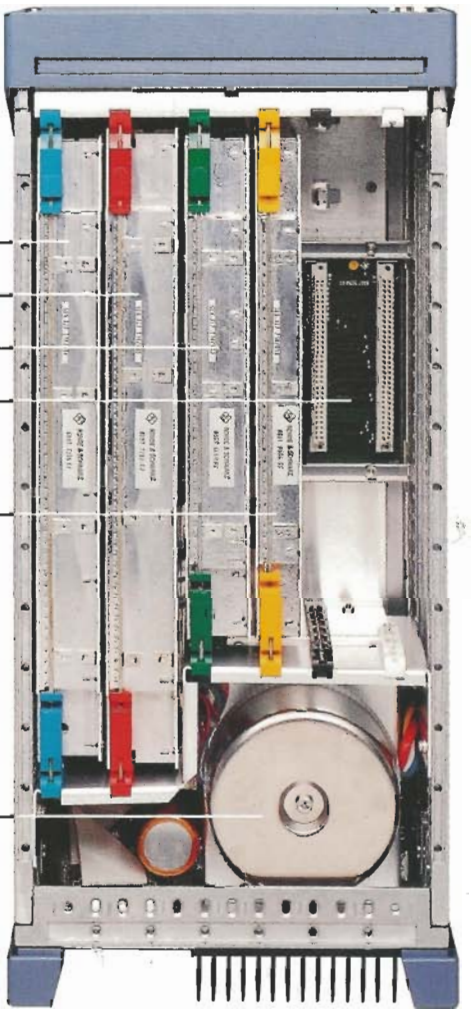
IF Signal Processor GM890 (optional)
In the IF signal processor, the second IF is down-converted, digitized by a 12-bit A/D converter and applied to a single-chip processor for demodulation and digital signal processing (DSP). The basic version of this module is designed for TTY operation (FSK, AFSK) and can optionally be extended for the following functions:

– voice/NBFM (F3E)
– TTY 2-channel (F7B)
– FAX (F3C) with grey levels
– IF conversion to 10 to 50 kHz or 455 kHz (available also separately as **IF Converter UX890**)

Input Filter Unit FK890H1 (option)
The input filter module comprises a lowpass filter, a bandpass filter and eight suboctave filters which are automatically selected with the receive frequency.

BCD Interface GC890 (option)
A plug-in BCD interface is available for controlling frequency-dependent add-on units with parallel interfaces, eg a selective antenna.

TTY Line Current Source GH890 (option)
For the operation of older teletype units which require line current (single/double current), a TTY line current source requiring no extra slot can be accommodated in addition to the IF Signal Processor GM890.



Main menu: MOD GAIN BW SCA MORE ↓		Indication at 2nd menu level
MOD	**Demodulation modes** MORE, if options are inserted	AM CW LSB USB MORE
GAIN	**Control modes** Auto, manual, auto+manual, auto+digital MORE: fast or slow control	AGC MGC A+M A+D MORE
BW	**Bandwidth**	BW ↓ BW ↑
SCA	**Scan mode** Frequency sweep, channel sweep (any sequence), channel sweep (incremental), stop or continue sweep, program sweep	FRQ CHP CHS S/C PRO
MORE: M/S SYS SPEC CHM MEM ↓		
M/S	**Master-slave operation** Address slave (indicate slave address, eg 62), read out or vary slave settings	ADR62 GET PUT
SYS	**Systemstatus** Read out firmware version, built-in options, error messages; start self-test; MORE: total reset	VERS OPT CM BIT MORE
SPEC	**Special functions** Rotary knob: step size on/off; level setting for threshold-controlled external switching signal; indicate seriol interface setting; switch to remote control; default settings on/off	KNOB LEV SER REM DEF
CHM	**Channel memory parameters** Channel memory indication and channel-specific parameter variation without interrupting reception	MOD GAIN BW THLD
MEM	**Channel memory operations** Clear all memory, clear certain memory, store to certain memory, use next free memory	CLA CLCH STCH STO

Setting possibilities of EK 890 down to second menu level

Operating concept

The EK890 family has a suitable operating mode for every application (see opposite page). The remote-control interface is configured to the RS-485 standard and is bus-compatible for system operation. Users who want to control their radiomonitoring system from the receiver front panel instead from a computer can use the receivers of the EK890 family as a master receiver or install the Remote Control Unit GB899.

The softkey-menu operator interface provides the ergonomical advantage of clean front panel layout as well as access to a large number of setting parameters. When you insert extension modules, they are automatically detected and incorporated in the software and the menu system. The clear operating concept of the EK890 family has 5 menu levels which allow 50 logically structured operating routines to be called up by softkeys. In spite of the multitude of functions, the operating convenience is high, eg each type of modulation is assigned a default setting with all relevant parameters.

The table to the left shows all setting possibilities down to the second menu level.

For fast access to the setting parameters the EK891 has 12 additional hardkeys, eg for standard types of modulation, bandwidth variation, etc.

Remote control

Local control

... via PC or ASCII terminal

EK890 with control panel as a stand-alone unit or as a master receiver in systems

EK890 with front panel for remote control

Search Receiver EK891

... via Remote Control Unit GB899 and modem

Triple VLF-HF Receiver EK893 with control unit

Slave receivers (99 max.)

EK085 as an alternative master receiver

RS-485 bus

Master-slave operation

Triple slave receivers (max. 33)

Specifications

Frequency range	10 kHz to 30 MHz	
Resolution	1 Hz	
Frequency drift	**–10 to +45°C**	**aging/year**
Frequency standard	5×10^{-7}	1×10^{-6}
Oven-controlled frequency standard	1×10^{-7}	1×10^{-7}
External frequency standard	1/5/10 MHz, 0.2 to 1 V_{rms}	
Antenna input	BNC connector, 50 Ω	
VSWR	<3	
Max. input voltage (≤30 MHz)	15 V EMF	
Oscillator reradiation into 50-Ω termination	≤10 µV	
Demodulation modes	CW/MCW (A1A, A1B, A2A, A2B) FAX1 (F1C) AM/AME (A3E, H2A, H2B, H2E) USB/LSB (R2A, R3E, J2A, J3E) optional: FSK/AFSK (F1A, F1B) F6 (F7B) FAX (F3C) FM (F3E)	

IF bandwidth (standard values)	**–3 dB**	**–60 dB**
	(±100 Hz	±250 Hz)
	(±300 Hz	±750 Hz)
	(±750 Hz	±1875 Hz)
	±1550 Hz	±2150 Hz
	(±3 kHz	±7.5 kHz)
	±5 kHz	±30 kHz
	(±4 kHz	±10 kHz)
	+0.3 to +3.4 kHz	–0.3 to +4 kHz
	–0.3 to –3.4 kHz	+0.3 to –4 kHz

(values in parantheses are optional depending on receiver model)

Sensitivity
(for (S+N)/N=10 dB; 0.1 to 30 MHz)

CW (bandwidth 200 Hz)	<0.3 µV EMF (–124 dBm)
USB/LSB (bandwidth 3.1 kHz)	<1 µV EMF (–113 dBm)
AM (bandwidth 6 kHz, f=1 kHz, m=0.6)	<2.5 µV EMF (–105 dBm)

Immunity to interference, non-linearities
Intermodulation (1.5 to 30 MHz; Δf ≥30 kHz; interfering signal 0 dBm)

IP_2	>60 dBm (typ. 70 dBm)
IP_3	>30 dBm (typ. 35 dBm)

Crossmodulation (0.1 to 30 MHz, interfering signal 5 V EMF (+21 dBm); Δf ≥30 kHz; m=0.3; f=1 kHz; signal level 10 mV EMF (–33 dBm)) ≤10% modulation transfer

Blocking (0.1 to 30 MHz; interfering signal 6.3 V EMF (+23 dBm); Δf ≥30 kHz; signal level 1 mV EMF (–53 dBm); m=0.3; f=1 kHz) ≥1 dB signal attenuation

Desensitization (interfering signal 300 mV EMF; Δf ≥30 kHz; signal level 30 µV EMF; bandwidth 3.1 kHz) ≥20 dB SINAD

Inherent spurious signals (f >100 kHz)	<–113 dBm (nominal –124 dBm)
Image frequency rejection	>90 dB
IF rejection	>90 dB
Weighted S/N ratio for 1 mV EMF	>46 dB SINAD
Gain control	automatic (AGC), manual (MGC) or remote (DGC)
AGC error	≤0.5 dB (1 µV to 1 V EMF)
Time response constants	
Attack time	approx. 10 ms
Decay time	0.3/3.5 s (fast/slow, switch-selected)
DGC range	0 to 120 dBµV EMF in 5-dB steps
BFO	–9.99 to +9.99 kHz
Resolution	10 Hz
Channel memory	for 1000 channels, nonvolatile, storage of complete receiver setup for each channel
Data interface	RS-232-C, RS-485 (bus-compatible)
Transfer rate	50 to 38,400 baud
Outputs	
IF output	1.44 MHz, 50 mV into 50 Ω
AF output	0.3 to 3.4 kHz; floating; Z_{out}=600 Ω
Setting range	–10 to +10 dBm
FAX1 (F1C)	1.9 kHz ±150 Hz in VLF range (f <500 kHz) 1.9 kHz ±400 Hz in HF range (f ≥500 kHz)
Monitoring output	500 mV, Z_{out}=332 Ω
FM video output (optional)	1 V/kHz, Z_{out}=1 kΩ

Options

Control Panel GB890	with controls and indicators for complete receiver setup; connector for loudspeaker or headphones (max. 1 W into 8 Ω)
Remote Control Unit GB899	Control Panel GB890 plus EK890 reduced to control functions, with distances beyond about 100 m modem operation via RS-232-C with a transfer rate of 50 to 19,200 baud
IF Signal Processor GM890	
with AFSK/FSK demodulator	transfer rate (50 to 1200 baud) and deviation range (±42.5 to ±425 Hz) adjustable; V.28 interface and audible tone circuit
and optionally	
Diplex telegraphy demodulator (F7B)	2 x V.28 interface
FM demodulator (F3E)	NBFM (3-dB bandwidth: ±3 kHz)
Fax demodulator F3C	1.9 kHz modulated (at AF output)
IF Converter UX890	10 to 50 kHz in 250-Hz steps, 0 dBm into 600 Ω; or 455 kHz, 0 dBm into 50 Ω
Line Current Source GH890	single current: 40 mA/60 V double current: ±20 mA/±30 V
BCD Interface GC890	frequency information, 22 bit parallel (CMOS, 5 V)
Input Filter Unit FK890	lowpass filter 0 to 0.5 MHz bandpass filter 0.5 to 1.5 MHz 8 subactave filters 1.5 to 30 MHz
ZF filter	see ordering information; special bandwidths between 150 Hz and 10 kHz on request
Oven-controlled frequency standard	aging/day ≤1 x 10^{-9} (on request)

General data

Environmental conditions	to MIL-STD-810 D
Rated temperature range	–10 to +45°C
Operating temperature range	–25 to +55°C
Storage temperature range	–40 to +80°C
Humidity (non-condensing)	max. 95% at +40°C
Vibration test	10 to 55 Hz; 0.4 mm double amplitude
Shock test	30 g, 11 ms
EMC	to MIL-STD-461/462
MTBF	>14 000 h
Power supply	100/120/220/240 V –15/+10%, 47 to 420 Hz (approx. 25 bis 75 VA, depending on model)
Dimensions (W x H x D), weight	
EK890	211 mm x 132 mm x 460 mm, approx. 8 kg
EK891/893	426 mm x 132 mm x 460 mm, <10 kg (EK891), <20 kg (EK893)

Ordering information

EK890 with front panel for remote control, EK890 with Control Panel GB890	Order No.	6007.3003 .XX
EK893 with front panel for remote control, EK893 with Control Panel GB890	Order No.	6023.3491 .XX

	for remote control	local/remote control
	.XX	.XX
with 2 IF filter bandwidths 10 and 3.1 kHz	02	.12
with 3 IF filter bandwidths 10/3.1 kHz/600 Hz	.03	.13
with 6 IF filter bandwidths 10/6/3.1/1.5 kHz/600/200 Hz	.04 (depending on receiver, for master-slave operation special models .35 to .39 (see below) are available)	.14
EK890 os DF model with bondwidths of 10/3.1 kHz/600 Hz	.43	.53

EK891 (6 IF filter bandwidths)	Order No.	6038.1002.YY

IF filter bandwidths						
Standard						
10/6/3.1/1.5 kHz/600/200 Hz						.04
Special						
10 kHz	3.4 kHz	2.4 kHz	1.8 kHz	600 Hz	300 Hz	.35
10 kHz	3.4 kHz	2.4 kHz	1.5 kHz	600 Hz	300 Hz	.36
10 kHz	2.4 kHz	1.5 kHz	600 Hz	300 Hz	150 Hz	.37
10 kHz	3.4 kHz	1.5 kHz	600 Hz	300 Hz	150 Hz	.38
10 kHz	2.4 kHz	1.5 kHz	1.0 kHz	600 Hz	300 Hz	.39

Accessories supplied	manual	
Recommended extras		
Control Panel	GB890	6007.7709.02
Remote Control Unit	GB899	6037.3501.02
19" Adapter Kit	ZZA-98	0827.4533.00
19" Adapter Kit for 2 EK 890	KA890 L1	6014.6699.XX
Service manual		
EK890		6012.0709.62
EK891		6045.3965.62
EK893		6012.1428.62
Line Current Source	GH890	6007.6054.02
Plug-in modules		
Input Filter Unit	FK890H1	6007.7750.02
BCD Interface	GC890	6007.7809.02
IF Converter	UX890	6007.7850.02
Instead of standard synthesizer: synthesizer with OCXO reference oscillator		
IF Signal Processor	GM890	6007.6654.ZZ

.ZZ	.02	.03	.04	.05	.12	.13	.14	.15
FSK/AFSK	•	•	•	•	•	•	•	•
F3E			•	•			•	•
F7B		•		•		•		•
F3C			•	•			•	•
IF converter					•	•	•	•

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