SIEMENS

Communication Receiver E 401
10 kHz to 30 MHz

S 42044–E 401–A1

Special Features

- Large frequency range: 10 kHz to 30 MHz
- Synthesizer with high frequency stability and high-stability filters
- Digital frequency control in 100-Hz steps – frequency indication with Nixie tubes, resulting in rapid and accurate setting of any desired frequency
- Reception of all commonly used classes-of-emission in LF, MF and HF communications
- Interference-free reception by mechanical filters with high selectivity, high image rejection (high first IF with IF crystal-filter) and good suppression of intermodulation. by high-grade mixer stages
- Blocking for simplex operation
- High reliability and lifetime by exclusive use of silicon semiconductors
- Application of system building blocks and plug-in modules
- IF filters may be changed according to operating conditions
- Power supply from ac mains or battery

The Communication Receiver Type E 401, a common product of ROHDE & SCHWARZ and SIEMENS AKTIENGESELLSCHAFT, can be applied for all kinds of reception of telegraphy and telephony transmissions in the entire frequency range between 10 kHz and 30 MHz. It can be utilized for all the usual classes-of-emission, eventually with attachments. With a suitable adapter duplex operation will be possible also when operating near HF-transmitters.

The fields of application comprise, for example, radio links of PTT administrations and radio companies, news services and security services, embassy networks, marine and coastal services, as well as meteorological and time signal services. The receiver may be equally used for fixed and mobile applications.

By utilizing a synthesizer for frequency processing and with the aid of high-stability filters an accuracy of frequency is obtained as never before with such type of equipment. The receiving frequency can be set by six decade switches in 100-Hz steps and directly read off indicator tubes. Continuous tuning between the 100-Hz steps is also possible.

The receiver is exclusively equipped with silicon transistors. It is largely independent of temperature changes. Its sturdy and compact style which employs plug-in modules, makes it suitable also for rough conditions of service. The receiver may be operated on all the usual ac voltages or from a 24-V or 28-V battery.

The unit has been laid out for the reception of telephony and telegraphy transmissions in the following classes-of-emission:

A1 unmodulated telegraphy (keyed unmodulated carrier)
A2 modulated telegraphy (keying the tone-modulated carrier or keying the tone modulation)
6A3 double-sideband telephony
3A3H single-sideband telephony with carrier
3A3A single-sideband telephony with reduced carrier
3A3J single-sideband telephony with suppressed carrier
6A3B telephony with two independent sidebands when correspondingly equipped

When FSE 401 is added:

F1 frequency-shift keying for single-channel data and teleprinter transmission
F4 frequency-shift keying for facsimile transmission
F6 frequency-shift keying for double-channel data and teleprinter transmission

The high frequency stability and netting accuracy of the equipment also permit the reception of small-shift signals.

An attachment for frequency-shift keying operation is the Telegraphy Demodulator FSE 401 which was especially designed for application with Radio Receiver E401. Uniform construction and equal base size in both units permit a space-saving organic layout of the radio teleprinter receiving station.

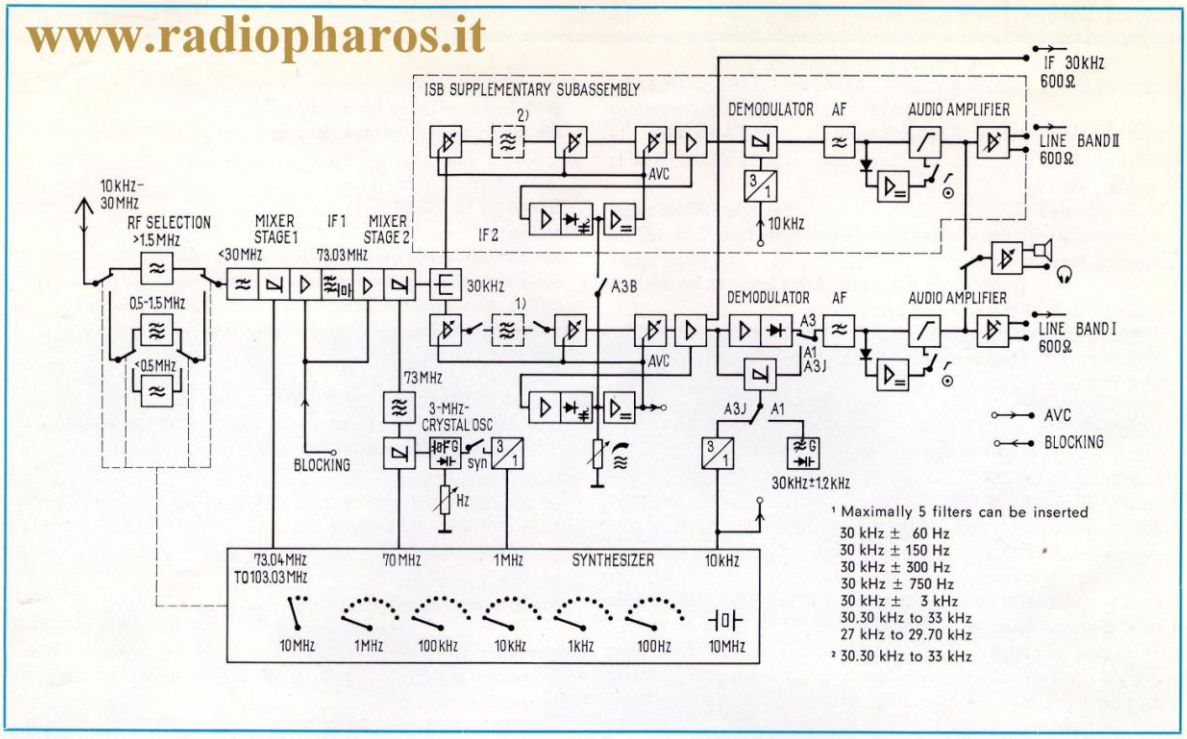
A *diversity subassembly* for *space diversity* or *frequency diversity* operation with two E401 receivers or an automatic *antenna-selecting subassembly* for one receiver may be optionally inserted in the Telegraphy Demodulator FSE 401.

Layout

The receiver is constructed in a light-metal framework as a table unit, 20 cm high, and covered at the sides as well as on top and below with easily detachable metal sheets. On the front panel all operating and indicating elements are accommodated which have to remain accessible during operation. The greater part of the equipment circuitry is incorporated in plug-in modules. The fuses and all electrical terminals with the exception of the earphone jacks have been arranged at the rear of the unit.

The frequency-decade rotary switches are fitted with detents for facilitating an unequivocal setting and for preventing unintentional detuning. The receiving frequency can be read off six Nixie tubes.

Radio teleprinter receiving station



Functioning

RF and IF1 Stages, Frequency Conversion

The receiving signal initially passes an input filter corresponding to the receiving frequency range; switching of the input filters takes place automatically during frequency selection. The signal reaches the *first mixer stage* via a 30-MHz low-pass filter and is there converted to the IF1 frequency (73.03 MHz). The *synthesizer* supplies the required oscillator voltage in the 73.04-MHz to 103.3-MHz range in 100-Hz steps, all waves derived from a 10-MHz crystal.

The IF1 signal reaches the *second mixer stage* via a crystal filter (± 12 kHz bandwidth) placed between two amplifier stages, where it is converted with the aid of a second oscillator voltage to the IF2 frequency (30 kHz). This auxiliary wave results from mixing the 70-MHz output of the synthesizer with the output of a *3-MHz crystal oscillator*. This crystal oscillator is synchronized by the synthesizer, when operation in 100-Hz steps has been selected. The 3-MHz oscillator can be continuously detuned by 120 Hz with the aid of varactors to provide for receiving frequencies between the 100-Hz steps.

IF2 Stages

A hybrid for branching the IF2 signal to two channels for the upper and the lower sideband with 6A3B operation is situated at the output of the second mixer.

From the hybrid the IF2 signal reaches in each case a *demodulator* via a regulated multi-stage *IF amplifier*. The one amplifier chain incorporates up to five 30-kHz filters of different bandwidths which may be switched in according to the operating mode. The filter equipping pattern depends on the application of the receiver. Gain control is either automatic or by hand. The AVC voltage is indicated by the built-in measuring instrument as a measure for the RF input voltage. Simultaneously it is accessible on the rear via a jack.

Demodulator, Audio Stages

The demodulator which has been provided for modulated telegraphy (A2) and double-sideband telephony (A3), passes on the audio signal to the *audio final stages* via a disconnectable noise limiter. A 600-Ω output has been provided for the connection of telephone lines.

When receiving unmodulated telegraphy (A1) a pushpull converter translates the IF2 signal into tone signals with a continuously variable heterodyning carrier (30 kHz ± 1.2 kHz).

With single-sideband reception (3A3H, 3A3A, 3A3J) a 30-kHz heterodyning carrier is applied to the same converter, the former being supplied by the synthesizer via a frequency tripler. A following low-pass filter suppresses the carrier leakage in both cases.

For the simultaneous reproduction of two independent sidebands (6A3B) an ISB supplementary subassembly with an individual 600–Ω audio output is utilized, the input of which is connected to the hybrid of the second mixer. This supplementary subassembly contains the same communications path as the first channel at 3A3J, but only incorporates one filter for the required sideband; it can easily be inserted subsequently into the receiver.

For monitoring a final stage for the built-in monitoring loudspeaker, a supplementary loudspeaker or headphones may be connected optionally to the upper or the lower sideband channel.

With the reception of teleprinter services (F1, F6), the information passes via a special IF output to the telegraphy demodulator (FSE 401), and from there to the teleprinter.

The operating voltages are obtained from the power supply section which is fed either from the ac mains or a 24-V battery.

Electrical Data

Reception in the receiving modes A1, A2, 6A3, 3A3J, 3A3A, 3A3H (6A3B with supplementary module)
with supplementary unit, additionally ..... F1, F4, F6; diversity
Receiving range ..... 10 kHz to 30 MHz
Frequency setting
in six decades ..... down to 100-Hz steps
additionally with the interpolator continuously from 0 to 120 Hz
Frequency reading ..... by Nixie tubes (position of the interpolator knob to be added)
Frequency drift of the warmed-up receiver
with decade frequency setting
at stable room temperature and operating voltage
Long-time drift ..... $\leqq 5 \times 10^{-8}$ per month
Short-time drift ..... $\leqq 3 \times 10^{-8}$ per day
additionally
with a variation of the ambient temperature
from +15 °C to +35 °C ..... $\leqq 3 \times 10^{-8}$
from –20 °C to +50 °C ..... $\leqq 3 \times 10^{-7}$
with a variation of mains voltage by +10% –15% $\leqq \pm 1 \times 10^{-8}$
Frequency drift of the interpolator
with a stable operating voltage ..... 1 Hz/°C
with a variation of mains voltage by +10% –15% ..... 3 Hz
Intermediate frequencies
IF1 ..... 73.03 MHz
IF2 ..... 30 kHz
IF rejection (IF1 and IF2) ..... $\geqq$ 80 dB
Image frequency rejection ..... $\geqq$ 80 dB
Pulling range of the A1 oscillator ..... ± 1.2 kHz
Bandwidths with a 3-dB drop
(with corresponding equipping of plug-in IF filters)
double-sideband filter ± 60 Hz, ± 130 Hz (≙ ± 150 Hz with 6 dB)
± 300 Hz, ± 750 Hz, ± 3000 Hz
single-sideband filter, upper or lower sideband 300 Hz to 3000 Hz
Other types of filters may be inserted
Antenna input ..... approx. 50 Ω, unbalanced
Noise figure ..... approx. 10 dB

Automatic gain control (can be disconnected)
With input voltages from 1 µV to 100 mV
the audio output voltage rises by ..... $\leqq$ 5 dB
Regulating time
from 100 µV to 0 µV ..... $\geqq$ 0.1 s or $\geqq$ 5 s
from 1 µV to 100 µV ..... $\leqq$ 20 ms
Blocking
An unmodulated interfering signal, stronger by 90 dB and superimposed on the modulated useful signal (V_e = 1 µV) with a separation of 30 kHz decreases the useful output voltage by 3 dB.
Cross modulation
A modulated interfering signal (m = 30 %; f_{mod} = 1 kHz) with V_e = 100 mV results in an audio cross-talk 20 dB below useful output when separated 30 kHz from the unmodulated useful signal of V_e = 100 µV (cross modulation = 10 %).
Intermodulation at the line output with two interfering signals (Δf = 2 kHz) of V_e = 5 mV
each at the receiver input ..... $\geqq$ 50 dB
IF output (30 kHz) ..... 0.7 V ± 1 dB across 600 Ω with V_e = 1 µV
Line output
Audio output level, continuously variable +3 dB max. across 600 Ω
Harmonic distortion at 0 dB ..... $\leqq$ 1 %
Unweighted signal-to-noise ratio for V_e = 1mV .....$\geqq$ 40 dB
Loudspeaker output ..... 5 Ω/2 W
Harmonic distortion at 2 W ..... $\leqq$ 5 %
Earphone output ..... 100 Ω
Power Supply
Mains operation ..... 110/125/220/240 V +10 %, –15 %; 45 to 60 Hz; 84 VA
Battery operation ..... 24/28 V (reconnectable); +20 %, –15 %; 3.2 A at 24 V
Permissible ambient temperature range
in storage ..... between –40 and +70 °C
operational ..... between –25 and +55 °C
technical data adhered to ..... between 0 and +55 °C

Available IF2-Filters

Bandwidth and type	Attenuation ratio	Bandwidth ratio	Applications
30 kHz ± 60 Hz S42045–E50–A1[1]	60 dB / 3 dB	3.8[2] / 1	A1, F1 ± 40 Hz shift/100 Bd
30 kHz ± 150 Hz S42045–E84–A1	60 dB / 6 dB	3.6[3] / 1	A1, F1 ± 100 Hz shift/200 Bd
30 kHz ± 300 Hz S42045–E54–A1	50 dB / 3 dB	2 / 1	F1 ± 200 Hz shift/200 Bd
30 kHz ± 750 Hz S42045–E55–A1	50 dB / 3 dB	2.8 / 1	F1 ± 400 Hz shift/200 Bd F6 ± 200/600 Hz shift/200 Bd
30 kHz ± 3 kHz S42045–E53–A1[1]	50 dB / 3 dB	2 / 1	6A3
27.0 kHz to 29.7 kHz S42045–E51–A1[1]	60 dB / 3 dB	1.4[4] / 1	3A3A, 3A3J, 3A3H telephony or VFT upper sideband
30.3 kHz to 33.0 kHz S42045–E63–A1	60 dB / 3 dB	1.4[4] / 1	3A3A, 3A3J, 3A3H telephony or VFT lower side band

[1] included in scope of delivery of the receiver; other or additional filter equipping patterns according to agreement. Further filters are under preparation.
[2] $\frac{50\text{ dB}}{3\text{ dB}} / \frac{3.2}{1}$ [3] $\frac{50\text{ dB}}{3\text{ dB}} / \frac{3.85}{1}$ [4] $\frac{50\text{ dB}}{3\text{ dB}} / \frac{1.35}{1}$ [5] depth with handles

Types, Dimensions and Weights

Description	Type
Receiver 10 kHz to 30 MHz ..... 440 mm × 442 mm[5] × 195 mm, 30 kg with 3 filters for ± 60 Hz, ± 3 kHz, upper sideband[1]	S42044–E401–A1
Power cord, 1600 mm	V45594–F4–A222
Line jack for battery connection	C42334–Z3–C76
Antenna plug	BNC plug (50 Ω)
Optionally	
Plug for extension speaker, 6-pole	T3400/1 Fa. Tuchel
Plug for audio line output, 600 Ω, 3-pole	T3260/1 Fa. Tuchel
Plug for receiver blocking during transmitting keying, 2-pole	T3200/1 Fa. Tuchel
Plug for AVC connection with diversity operation	T3200/1 Fa. Tuchel
Telegraphy demodulator 440 mm × 442 mm[5] × 88 mm, 20 kg	FSE 401
ISB supplementary with filter for the lower sideband	S42045–E87–A1
Power inverter 24/28 V for operation with battery	S42045–E61–A1

Postal address: D-8000 München 25, Postfach 704

SIEMENS AKTIENGESELLSCHAFT

Order No. 2-4210-016-101
Printed in West Germany
6692. (0055)