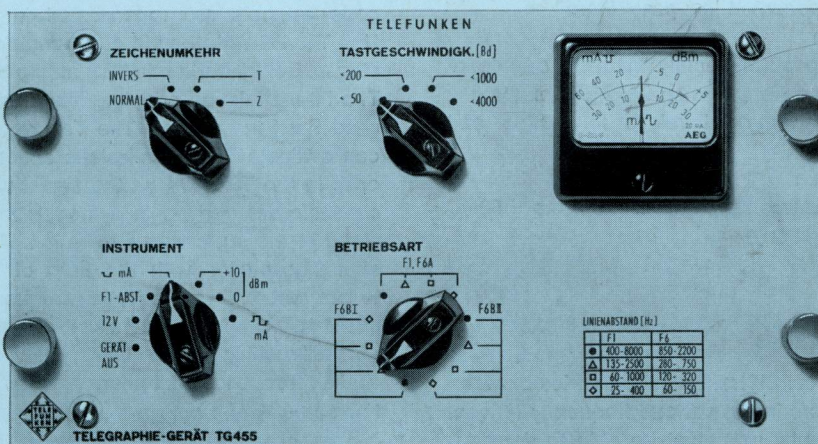


Telegraphy Unit TG 455

17. JUNI 1966



Diese Blätter sind
nicht für die Ablage in den
Sammelordnern bestimmt.



TELEFUNKEN

AKTIENGESELLSCHAFT

Fachbereich Anlagen Hochfrequenz

Applications

The Telegraphy Unit TG 455 is used for demodulating any type of frequency-keyed binary message (F1, F4, F6). It requires the IF voltage (525 kc/s) of a receiver as input signal. The unit can also be converted to accept intermediate frequencies between 250 kc/s and 1600 kc/s.

Facilities exist for direct connection of teletypewriters, facsimile recorders, other data processing units, as well as double-current and AF telecommunications lines.

Special Features

Fully transistorised, thus low current consumption, long life and small maintenance requirements

Professional transistors, tested in accordance with MIL specifications

Clearly arranged design employing plug-in circuit boards

F1 line spacings from 25 c/s to 8000 c/s

Simple tuning indication for F1 transmissions subject to little interference

F6 line spacings 100 c/s, 200 c/s, 400 c/s, 500 c/s, 1000 c/s according to CCIR Code 1 or 2 and intermediate values

Keying speeds up to 4000 bauds

Transit-time compensated low-pass filters

Signal restoration

Does not start-up automatically in the presence of interference during transmission keying intervals

Electronic constant-current relays for single and double-current

Tone keying device

Operating temperature range from -20°C to $+50^{\circ}\text{C}$

Humidity and vibration proof

Small dimensions and light weight

Technical Remarks

The line spacing of FSK transmissions varies between 25 c/s and 8000 c/s in the various frequency ranges. A modern telegraphy unit must be able to demodulate all such transmissions. Special measures have been applied in the Telegraphy Unit TG 455, which permit demodulation of both small and very large line spacings in a simple manner. The signal is derived from a high-stability demodulator on all service types. Normally correct tuning to an F1 transmission is performed with the aid of a CRT Receiver Tuning Indicator SG 455. However, the Telegraphy Unit TG 455 renders possible tuning to F1 transmissions which are subject to little interference, during operation with the aid of the incorporated instrument.

F1-morse code or facsimile transmissions are often registered by a recorder or facsimile transcriber. The signals are therefore made audible in the Telegraphy Unit TG 455 with the aid of a tone keying unit. The signals can be fed simultaneously into a communi-

cations line without interposition of a matching transformer.

Rational operating procedure makes it undesirable for complicated adjustments to be necessary when the line spacing is changed, or for reception to be discontinued completely if the incoming line spacing does not conform to some fixed agreed value. The Telegraphy Unit TG 455 thus employs an evaluation principle which functions within certain limits on any line spacing. Teletype transmissions are either typed-out directly at the receiving station, or passed-on to a central receiving station via a line connection. The Telegraphy Unit TG 455 can feed VF signals and double-current simultaneously onto a telecommunications line and, furthermore, single-current permits simultaneous reading at the receiving station.

A telegraphy unit must operate satisfactorily even under conditions of poor signal-to-noise ratio. A transit-time compensated low-pass filter is therefore connected following the demodulator in the Telegraphy Unit TG 455. The cut-off frequency of this filter can be matched optimally to the telegraphy keying speed, so that the received code symbols are free from interference to the greatest possible extent. A telegraphy unit should produce the smallest possible distortion itself, i.e. the form of the received code symbols in relation to time (pulse waveform) should not be changed. To meet this requirement, the code symbols are regenerated in the Telegraphy Unit TG 455 with the aid of symmetrical pulse-shaper stages. Self-distortion is thus negligibly small.

The F6 modulation principle has increasingly established itself in practice. The Telegraphy Unit TG 455 can evaluate F6 transmissions according to Code 1 or 2. In the TG 455 Unit the signal voltages for both channels are derived in a modulation converter, instead of the customary separation of the 4 transmission frequencies with the help of filters. Contrary to conventional methods, the frequency deviation of such two-channel transmissions may be chosen arbitrarily within certain limits, thanks to the suitably chosen frequency multiplier.

For some time, some radio teletypewriter links have been operated with three-frequency changeover keying. The centre frequency corresponds to the interval current and the two outer, alternately transmitted frequencies correspond to the code-symbol current. The Telegraphy Unit TG 455 can be used for this type of modulation too.

The motor of the teletypewriter must not start-up during a keying break, since otherwise incorrect symbols are printed. The pulse-shaper stages in the Telegraphy Unit TG 455 are consequently DC-coupled to the demodulator.

When the transmitter is switched off in simplex teletype operation the own teletypewriter must not respond to noise and interfering pulses. By means of an external short-circuit contact the TG 455 allows the adjustment of the pulse-shaper stages into the spacing current position.



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Fig. 2: Telegraphy Unit TG 455, view showing the plug-in circuit boards

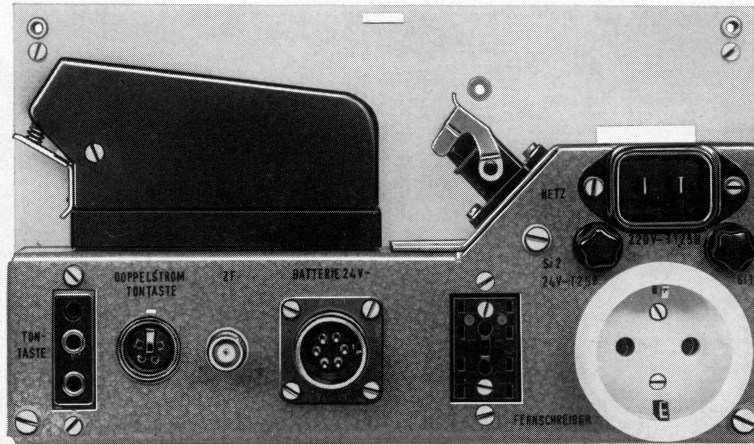
Method of Operation

(see block circuit diagram)

The IF signal voltage delivered by a receiver is fed via a wideband IF amplifier to a ring modulator. The transposition of the F1/F4/F6 communications signal into an IF of 25 kc/s is carried out with the help of a crystal-controlled oscillator whose crystals are exchangeable. An accessory unit can be connected subsequent to the modulator to improve the selectivity of the employed receiver. The vertical deflection amplifier of the CRT Receiver Tuning Indicator SG 455 is fed via a buffer amplifier. The signal is freed from amplitude variations in a multi-stage wideband limiting amplifier. Transmissions with a line spacing of at least 400 c/s are fed directly to a bandpass filter via the service selector switch. The horizontal deflection amplifier of the CRT Receiver Tuning Indicator SG 455 (see Brief Description KB 028) can be con-

nected subsequent to the bandpass filter via a buffer amplifier.

The amplitude-limited 25 kc/s signal proceeds to the demodulator. The most important section of this demodulator is the modulation converter. This consists of a reactive multipole which converts frequency deviations with respect to one or three predetermined reference frequencies into corresponding phase shifts. This modulation converter permits demodulation in a simple manner for F1 transmissions and also F6 transmissions according to Code 1 and 2 in both channels. No special alignment is required for this purpose, it is sufficient to select the appropriate output voltages of the multipole converter by means of the service selector switch. Subsequent conversion of the abrupt phase changes into corresponding jumps of DC voltage level is undertaken in a phase detector. In order to improve the signal-to-noise ratio the resulting balanced communications signal is then compressed to within an optimum frequency spectrum, with the aid of transit-time compensated low-pass filters matched to the keying speed.



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Fig.3 The Telegraphy Unit TG 455, rear side

The code-symbol reversal switch permits selection of the correct output signal polarity and also enables the line outputs to be disconnected from the radio terminal. The filtered communications signal is restored in pulse-shaper stages to reconstitute the original form. The drive signal for the electronic single-current relay is taken from these stages.

The Telegraphy Unit TG 455 is fitted with a frequency multiplier for demodulating transmissions with small line spacings (≥ 25 c/s on F1 service and ≥ 60 c/s on F6 service). The harmonic frequencies generated in the limiting amplifier are selected from the output signal thereof, using three bandpass filters which can be selected with the service selector switch. The selected harmonic frequencies are then again transposed to the 25 kc/s band in a ring modulator with

the aid of a crystal-controlled auxiliary frequency. The resulting IF signal is fed to the demodulator.

The incorporation of an electronic double-current relay and a VF keying device is provided for connecting lengthy telecommunications lines. The double-current relay consists of a bridge circuit employing switch transistors. A constant-current source permits changes in the load resistance presented to the bridge without significant change in the preset fixed value of the current.

An LC oscillator is used to generate the audio frequency for operating the VF keying device. The audio frequency thereof is switched in conjunction with the keying speed. The keyed VF signal is amplified to line feed level in a 600 ohms line amplifier.

Technical Data

Types of Service:

F1; 2-frequency keying (teletype, multiplex)
 F1; 3-frequency keying (data transmission)
 F4; 2-frequency keying (facsimile, weather charts)
 F6; 4-frequency keying (2 teletype channels, Code 1 and Code 2)

Inputs

Input Signal Voltage: Nominal: 50 mV rms
 Minimum: 20 mV rms
 Maximum: 300 mV rms

Input Impedance: ≥ 600 ohms

Intermediate Frequency: 525 kc/s, normal version
 (by replacing two crystals, any other value from 250 kc/s to 1600 kc/s)

Outputs

25 kc/s, unlimited
 (band-pass filter)

Output Signal Voltage: 100 mV rms $\pm 20\%$
 Load Resistance: 1000 ohms $\pm 20\%$

25 kc/s, unlimited
(cathode-ray display unit vertical
deflection input 1)

Output Signal Voltage: 100 mV rms $\pm 20\%$
Output Impedance: < 100 ohms
Load Resistance: > 1000 ohms

25 kc/s, limited
(cathode-ray display unit horizontal
input 1, vertical 2)

Output Signal Voltage, sine-wave: 300 mV rms $\pm 20\%$
Output Impedance: < 100 ohms
Load Resistance: > 1000 ohms

Limiting Factor: > 45 dB, relative to minimum value of input signal voltage

Tone Keying

(floating output via transformer with screen winding)

Output Impedance: 600 ohms
Reflection Factor: $< 10\%$
Tone Keying Frequency: 1500 c/s up to 200 bauds
5000 c/s above 200 bauds
switched over with keying-speed switch
Frequency Drift: $< 5 \times 10^{-2}$
Output Signal Level
across 600 ohms: -6 dBm to $+15$ dBm
(0.38 V rms to 4.3 V rms),
adjustable with control on front panel
Stop-band Attenuation: > 40 dB across 600 ohms with blocked tone keying modulator and
previous adjustment of tone keying level to 0 dBm
Maximum Line Length: 150 km,
for a telecommunications cable with light inductive loading coils, with
1.4 mm conductor diameter (0.15 dB/km at 1500 c/s) and VF Reconverter
Unit USR 726 as receiving unit (see Brief Description KB 012)
Mark or Space Current: can be selected with switch-in unit

Single-Current

(floating with respect to ground, but galvanically connected to double-current output)

EMF of Internal Voltage Source: 80 V $\pm 20\%$
Dynamic Internal Impedance: > 10 kohms
Maximum Teletype Current
which can be set: 60 mA
Permissible Loop Resistance: 0 to 1000 ohms, at 40 mA,
0 to 500 ohms, at 60 mA
Change of Set Current (40 mA)
for Change of Loop Resistance: $< 10\%$

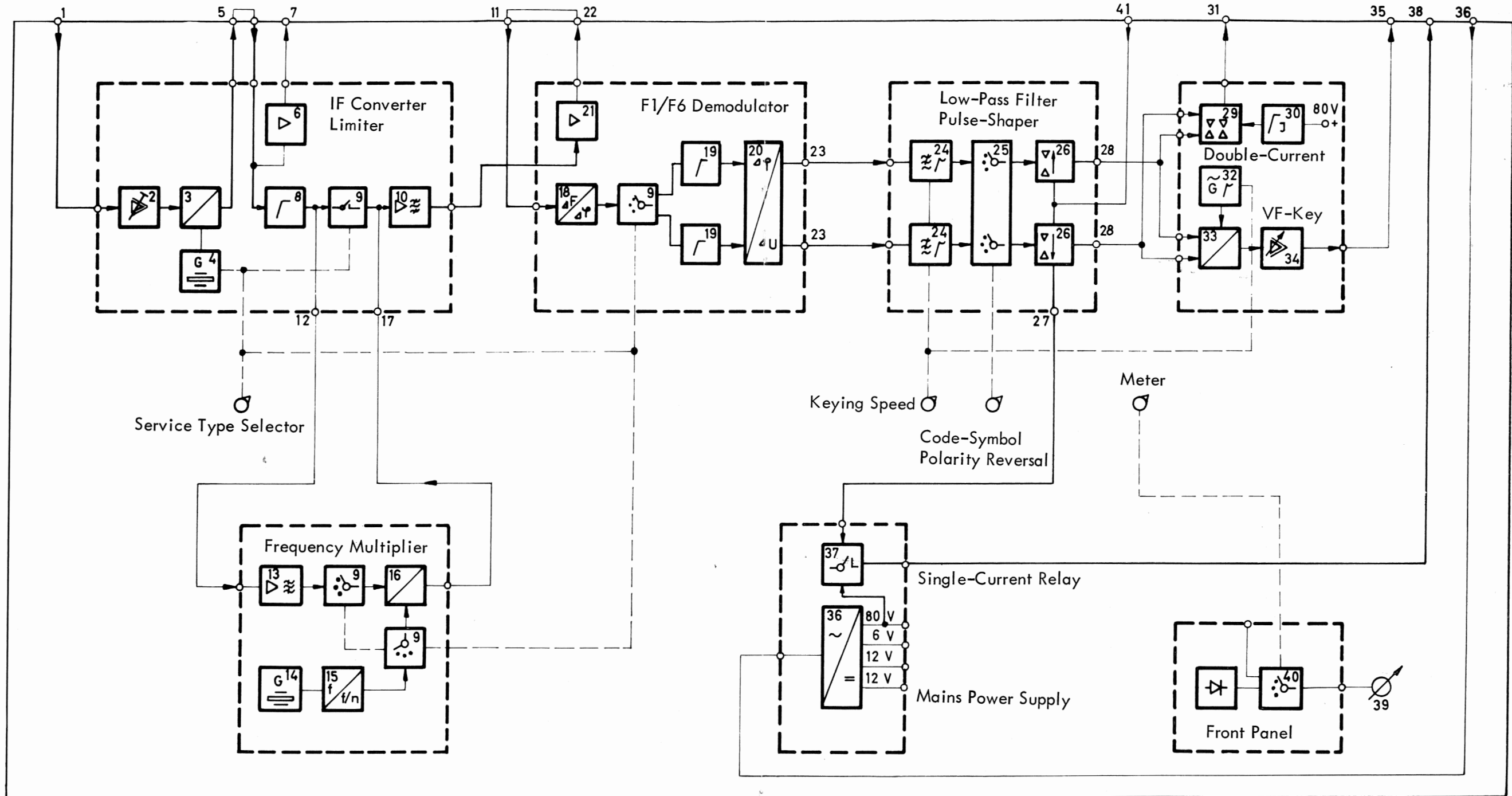


Fig. 3: Block Circuit Diagram of the Telegraphy Unit TG 455

- | | | | |
|---|--|--|--|
| <ul style="list-style-type: none"> 1 IF input 2 IF preamplifier 3 Ring modulator 4 Crystal oscillator 5 Socket for Bandpass Filter BP 455 6 Buffer amplifier 7 to vertical deflection input 1 of CRT Receiver Tuning Indicator SG 455 8 Limiting amplifier 9 Service selector switch 10 Bandpass filter | <ul style="list-style-type: none"> 11 to Receiver Diversity Unit ED 455 12 Limiting amplifier output 13 Bandpass filter 14 Crystal oscillator 15 Frequency divider 16 Ring modulator 17 Frequency multiplier output 18 Modulation converter 19 Auxiliary limiting amplifier 20 Phase detector 21 Buffer amplifier | <ul style="list-style-type: none"> 22 to horizontal deflection input 1 of CRT Receiver Tuning Indicator SG 455 23 Phase detector output 24 Low-pass filter 25 Code-symbol polarity reversing switch 26 Pulse-shaper stage 27 Drive voltage single-current 28 Drive voltage double-current/VF key 29 Double-current relay 30 Constant-current source 31 Double-current output | <ul style="list-style-type: none"> 32 VF oscillator 33 VF keying modulator 34 Line amplifier 35 VF keying output 36 Mains power supply unit 37 Single-current relay 38 Single-current output and mains connection for teleprinter 39 Operating meter 40 Mains switch, test point switch 41 Socket for telegraphy squelch |
|---|--|--|--|

Keying Speed: max. 75 bauds
 Keying Distortion at 50 bauds: < 5 %
 Max. Line Length: 10 km,
 for a local cable with 0.8 mm conductor diameter
 ($R_0 < 75$ ohms/km loop, $C_0 < 38$ nF/km, $I = 40$ mA)

Double-Current

(floating with respect to ground, but galvanically connected to single-current output)

EMF of Internal Voltage Source: 80 V ± 20 %

Dynamic Internal Impedance: > 10 kohms

Maximum Teletype Current which can be set: ± 30 mA

Permissible Loop Resistance: 0 to 2000 ohms, at ± 20 mA,
 0 to 1500 ohms, at ± 30 mA

Change of Set Current (± 20 mA) for Change of Loop Resistance: < 10 %

Keying Speed: max. 4000 bauds

Max. Line Length: 75 km,
 for a telecommunications cable with 1.4 mm conductor diameter
 ($R_0 < 25$ ohms/km loop, $C_0 < 36$ nF/km, $I = \pm 20$ mA)

Self-Distortion: For an F1-signal with 800 c/s line spacing and nominal IF signal level at a signal-to-noise ratio ≥ 40 dB, measured at the double-current output:

Pulse Form	50 bauds	200 bauds	4000 bauds
1:1	≤ 2 %	≤ 4 %	≤ 20 %
1:6	≤ 2 %	≤ 4 %	≤ 20 %

Text Distortion: (a) For an F1-Signal with 800 c/s line spacing and nominal IF signal level for the CCIT Test Code, measured at the double-current output with a time probability of 10^{-3} :

Signal-to-noise ratio	Text distortion
≥ 10 dB	≤ 2 %
≥ 4 dB	≤ 20 %

(b) For an F6-signal with 400 c/s line separation according to Code 2 and nominal IF signal level for the CCIT Test Code, measured in channel B with synchronous keying at the double-current output with a time probability of 10^{-3} :

Signal-to-noise ratio	Text distortion
≥ 20 dB	≤ 2 %
≥ 12 dB	≤ 20 %

Code Symbol Reversal: Reversal of signal polarity for inverse keying of transmitter

Detuning:

Detuning of the F1-signal by 0.75 of half the line spacing does not affect the operational reliability of the demodulation.

Demodulation ceases to be faultless if the detuning exceeds 0.75 of half the line separation of the F1-signal.

Demodulatable Line Spacings

Setting of the Service Selector Switch		F1 50 bauds	F4 4000 bauds	F6 50 bauds	F6 200 bauds
Switch Setting	Line Spacing				
●	min.	400 c/s	400 c/s	850 c/s	950 c/s
	max.	8000 c/s	4000 c/s	2200 c/s	2000 c/s
△	min.	135 c/s	135 c/s	280 c/s	320 c/s
	max.	2500 c/s	2000 c/s	750 c/s	640 c/s
□	min.	60 c/s		120 c/s	140 c/s
	max.	1000 c/s		320 c/s	280 c/s
◇	min.	25 c/s		60 c/s	
	max.	400 c/s		150 c/s	

Only the switch setting ● is possible for units without frequency multiplier circuit board.

Keying Speed:

< 50 Bd, < 200 Bd, < 1000 Bd and < 4000 Bd

F1 Tuning Indication:

taking the mean in respect of time with reference to zero point meter whilst transmitter is being keyed

Correct tuning:

±0 to 5 mA of double-current scale

Incorrect tuning:

±5 to 20 mA of double-current scale

Telegraphy Squelch:

by means of external short-circuit contact (load < 12 V, < 15 mA)

Operational Check:

Meter for checking the 12 V main supply voltage, F1 tuning, single-current, tone keying level and double-current

Supply Voltages

Mains:

110, 220 V ±10 %, 45 to 480 c/s

Battery:

24 V (21.5 to 30 V), negative grounded

Power Consumption

Mains:

max. 25 VA

Battery:

approx. 12 VA

Temperature Range:

+10 °C to +40 °C, full guarantee of specifications

—20 °C to +50 °C, may be operated

—40 °C to +70 °C, may be stored

Humidity Tolerance:

Operation for 96 hours at a relative humidity of 90 % and a temperature of +40 °C is permissible.

Vibration Tolerance:

No damage is incurred if the switched-on unit is subjected to a vibration amplitude of +0.5 mm at 10 to 30 c/s, or to an acceleration of 2 g in the range from 30 c/s to 70 c/s.

Jolts with an acceleration of 10 g and 10 ms duration are also permissible.

Dimensions and Weight

	Height mm	Width mm	Depth mm	Weight approx. kg
Without cabinet, as drawer unit:	134	256	324	6
Desk model with cabinet:	162	274	370	7

In order to meet numerous customer requests, four different versions of the Telegraphy Unit TG 455 are available. A letter index identifies the versions which differ from the basic unit.

Additional Modules of the Basic Unit

- A Tone key
- B Double-current relay
- C Line spacing multiplier

In case of simultaneous F6 operation on channel A and B, an additional unit TG 455 TW is required. For vehicle operation, a battery supply unit can be supplied on request (not for double-current operation).

Editions supplied

	TG 455	TG 455/AB	TG 455/C	TG 455/ABC
F1 line spacing \geq 400 c/s	×	×	×	×
F1 line spacing \geq 25 c/s			×	×
F6 line spacing \geq 850 c/s	×	×	×	×
F6 line spacing \geq 60 c/s			×	×
Single-current	×	×	×	×
Double-current		×		×
Tone keying		×		×

Extras supplied with each unit:

- 1 Set spare fuses comprising:
 - 4 fuses T 1.25 B; 5 N 4811.076-01
 - 2 fuses T 0.25 B; 5 N 4811.069-01
 - 2 fuses T 0.1 B; 5 N 4811.065-01
- 1 Mains power cable 5 Lv 4941.001-37
- 1 Manual

TELEFUNKEN

AKTIENGESELLSCHAFT

**Geschäftsbereich Anlagen
Export**

**79 Ulm/Donau
Elisabethenstrasse 3**