



ROHDE & SCHWARZ

SERVICE INSTRUCTIONS

1st Modulation Generator Module

802.5713.02

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5.1 Function Description

The module consists of two function units: AF synthesizer and modulation control unit.

5.1.1 AF Synthesizer

The AF synthesizer covers the frequency range from 20 Hz to 25 kHz. It does not contain an oscillator and is driven at input GENCP via a TTL signal whose frequency is 32 times the desired AF and whose High level is divided from 5 V down to 100 mV before it is applied to the input comparator N100 of the AF synthesizer which is set to a threshold voltage of 50 mV.

The TTL signal regenerated in this manner clocks the shift registers D2 and D3 connected as a sinewave generator so that a stepped sinewave with 32 steps per cycle is generated. The change in polarity after 16 steps is achieved by the frequency divider D1 which divides the input frequency by 32 and thus loads the shift chain with 16 Low levels and 16 High levels per AF cycle. The stepped sinewave is balanced-to-earth at the output of adder N1 and has an amplitude of 2.5 V.

Three parallel, active Butterworth lowpass filters with different cut-off frequencies are then connected to smoothen the stepped sinewave. The first filter is used for frequencies from 20 Hz to 300 Hz, the second from >300 Hz to 4 kHz and the third from >4 kHz to 25 kHz. This prevents the distortion from being increased to a non-permissible level at low frequencies. The automatically selected filter is connected via N6.

A signal generated in the same manner from the same frequency range and with the same level ($V_{rms} = 1.77$ V) can be added (double tone) at the summing input PILINT (N7).

The circuit then contains three digital level attenuators with which the output level can be finely adjusted. These attenuators are the D/A converter N8 for 256 steps, the fine range attenuator N10 with 8 steps and the coarse attenuator 1:10 following amplifier N11 with $V = 2.9$.

Switchover between the signal reduced 10 times and the connected signal takes place at output X3 of the AF synthesizer using a relay because of the high maximum possible level of $V_{rms} = 5.1$ V.

5.1.2 Modulation Control Unit

The second function unit on the module is the modulation controller where different internal and external signals are combined and drive the AM and FM modulators at two outputs.

An external signal whose level can be modified in 8 steps (Gain = 0.4 to 10), in order to achieve $V_{rms} = \text{approx. } 1 \text{ V}$, is applied to X4. The signal obtained can be routed to a peak-value meter by N16 (internal output MODMES). N17 is used to select between the external signal and the signal of the AF synthesizer which is available here with a constant level. The internal input EXTMOD (X1.B24) is not used.

The connection of the adder N20 is selected such that the two internally generated signals "Pilot tone" and "AF synthesizer" have a maximum level of $V_{rms} = 1 \text{ V}$ (AF synthesizer constant, pilot tone adjustable). These three signals can be distributed individually or combined to an AM path and an FM path via N21 (1st signal distribution) where the AM path is directly connected to the AM output and the following signal conditioning is possible with the FM path:

- A programmable level attenuator is used to adjust to various operating points on the FM modulator characteristic depending on the selected centre frequency.
- A second level divider is used to set the frequency deviation in 256 steps.

Optionally:

- Internal preemphasis for FM generation with 20 dB/decade (0 dB at 10 kHz, -20 dB at 1 kHz) or
- Direct output for FM.

5.2 Testing and Adjustment

5.2.1 Testing the Input Stage

X1.A22 (GENCP): $f = 32 \times f_{AF}$, i.e. $640 \text{ Hz} < f < 800 \text{ kHz}$, squarewave voltage ($V_{Low} = 0 \text{ V}$, $V_{High} = 100 \text{ mV}$) but distorted above $f > 100 \text{ kHz}$ by series-connected lowpass; V_{max} . remains at 100 mV .

P1: TTL signal with $f = 32 \times f_{AF}$

5.2.2 Testing the Sinewave Generator

D1/3: TTL signal with $f = f_{AF}$

P4: Stepped sinewave (32 steps/cycle) with $f = f_{AF}$,
 $v = 2.5 \text{ V} \pm 1\%$.

5.2.3 Testing the Reference Voltage

P3: DC voltage $V = +5 \text{ V} \pm 0.3\%$.

5.2.4 Testing the Filter

P5: Sinewave signal with $f = f_{AF}$ and $V_{rms} = 1.768 \text{ V} \pm 1\%$

5.2.5 Testing and Adjustment of the Level Attenuator (Input Attenuator)

Set the following AF levels on the instrument with $f = 1$ kHz.
Set 5.10 V AF level. Using R51 adjust voltage at X505 to
 $5.10 V_{rms} \pm 5$ mV.

Measure the voltages at P6.

AF level [V]	V_{rms} [V] at P6
2.54	0.877
2.56	0.884
3.84	$1.326 \pm 2\%$
4.48	$1.547 \pm 2\%$
4.80	$1.657 \pm 2\%$
4.96	$1.713 \pm 2\%$
5.04	$1.740 \pm 2\%$
5.08	$1.754 \pm 2\%$
5.10	$1.761 \pm 2\%$

5.2.6 Testing the Fine Attenuator

Set the following AF levels on the instrument with $f = 1$ kHz.

Measure the voltages at P7.

AF level [V]	V_{rms} [V] at P7
4.00	$4.00 \pm 2\%$
2.00	$2.00 \pm 2\%$
1.00	$1.00 \pm 2\%$
0.40	$0.40 \pm 2\%$
0.20	$0.20 \pm 2\%$
0.10	$0.10 \pm 2\%$

5.2.7 Testing the Coarse Attenuator

Set the following AF levels on the instrument with $f = 1$ kHz.

Measure the voltages at X505.

AF level [mV]	V_{rms} [mV] at X505
50.0	$50.0 \pm 2\%$
50.5	$50.5 \pm 2\%$

5.2.8 Testing the Amplifier for External Modulation

Apply the following AF levels to X504 with $f = 1$ kHz.

Measure the voltages at P8.

V_{rms} [mV] at X504	V_{rms} [mV] at P8
2500	1000 Tolerance: $\pm 1.5\%$
1560	1000
1000	1000
625	1000
385	1000
250	1000
156	1000
100	1000

5.2.9 Testing the Signal Selection

Apply a sinewave signal with $f = 1$ kHz and $V_{rms} = 1$ V to X504.

Setting	Key sequence (receiver test)	Monitoring using oscilloscope	
		At N18/7	At N20/6
two-tone AM via EXT and INT1 (3 kHz)	50% EXT 3 kHz AF INT1 50% INT1	—	EXT signal (1 kHz) AF synth. signal (3 kHz)
AM via INT1	OFF 50% INT1	—	AF synth. signal (3 kHz)
Double modulation: AM via INT1 (3 kHz) FM via EXT	50% INT1 2 kHz EXT	EXT signal (1 kHz)	AF synth. signal (3 kHz)
AM via EXT	OFF 50% EXT	EXT signal (1 kHz)	—

5.2.10 Testing the 1st Signal Distribution

Apply a sinewave signal with $f = 1 \text{ kHz}$ and $V_{\text{rms}} = 1 \text{ V}$ to X504.

Setting	Key sequence (receiver test)	Monitoring using oscilloscope	
		At N22/6	At N23/7 = P9
Double modulation: AM via EXT (1 kHz) FM via INT1 (3 kHz)	50% EXT 2 kHz INT1	EXT signal (1 kHz)	INT1 signal (3 kHz)
Double modulation: AM via INT1 (3 kHz) FM via EXT	50% INT1 2 kHz EXT	INT1 signal (3 kHz)	EXT signal (1 kHz)
FM via INT1	OFF 2 kHz INT1	————	INT1 signal (3 kHz)

5.2.11 Testing the FM Characteristic Correction

- Set 25 kHz FM modulation.
- Vary the carrier frequency in the range 1 MHz to 1 GHz.

The measured deviation may deviate by $\pm 2\%$.

5.2.12 Testing the FM Deviation Setting

- Set FM modulation; carrier frequency 500 MHz.
- Vary the deviation in the range 100 Hz to 100 kHz; $f_{\text{AF}} = 1 \text{ kHz}$.

The error may be $\pm 1.5 \%$.

5.2.13 Testing the Preemphasis

- Set phase modulation, fixed centre frequency, fixed phase deviation.

When varying f_{AF} , the voltage at X1.B31 must change in the same direction and proportional to f_{AF} .

5.2.14 Testing the 2nd Signal Distribution

- Set any FM modulation. The voltage at X1.B31 must remain constant when varying f_{AF} .
- Set any phase modulation. The voltage at X1.B31 must change proportionally to f_{AF} when the latter is changed.

