



ROHDE & SCHWARZ

SERVICE INSTRUCTIONS

Output Stage

802.7616.02

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5.1 Function Description

The frequencies between 500 MHz and 1000 MHz generated by the RF oscillator module are converted to the frequency range from 0.1 to 1000 MHz by dividing and mixing on the output stage module and amplified to a maximum of +13 dBm. The RF carrier can be electronically attenuated and amplitude modulated.

5.1.1 RF Conditioning

Frequencies from 500 to 1000 MHz are applied via connector X410 to the module and amplified (V5). The input frequency can be divided in binary steps of 1:1, 1:2, 1:4, 1:8 and 1:16 using D35, D52 and D61. The dividing ratios 1:8 and 1:16 are achieved by cascading two dividers in each case. The required factor can be set using diode switches.

The output signal of the RF dividers is limited in the following amplifier (N70). It is then applied to the next amplifier stage (V83) and simultaneously decoupled via X406. The subsequent PIN modulator consists of six PIN diodes (V94, V95, V97, V98, V93 and V99). The RF level can be controlled via the input (R97, L97) (control element for level control, AM modulator).

The following two-stage RF amplifier (V112, V133) has a gain of 10 to 12 dB.

The signal is then applied via an attenuator to the harmonics filters which are divided into 10 frequency ranges and the mixer section. The 10 filter ranges are divided into groups of 2 x 4 filters and 1 x 2 filters which can be switched over using PIN diodes.

The mixer section is driven by frequencies between 100.1 and 131.25 MHz. These are amplified (V600) to max. 2 V. This level is required for the measuring point <8 MHz. The signal is then applied to the RF input of the mixer (U630) via attenuators. The 100-MHz LO signal is applied from connector X405 to the mixer via an amplifier (V670).

The IF signal of 0.1 to 31.25 MHz is amplified (V640, V641; gain adjustable using R641) and applied to the output amplifier.

The three-stage output amplifier (V380, V390, V400) amplifies the frequencies of 0.1 to 1000 MHz to a maximum output level of +13 dBm. Transistor V400 is screwed onto a heat sink because of the high power dissipation. The required output level with an impedance of 50 Ω is then available at the output connector X401.

The RF level is rectified using diode V442 and applied to a changeover switch (N461). At 8 MHz this switches between the high-frequency measuring point and the measuring point in the mixer section. The respective rectified voltage is then compared with the reference value.

The level control loop is connected via the PI controller (N470). This controls the RF level via the PIN modulator until the rectified RF value corresponds to the reference value.

5.1.2 Modulation Controller

This part of the circuit mainly comprises a modulation depth setting circuit and a level attenuator for the electronic level setting.

A DC voltage is applied from a reference voltage source (V515) via amplifier N510 to the 10-bit D/A converter D520 which divides the voltage into the required reference value (adjustable using R514).

The AM modulation frequency is applied via X1.A31 and amplified (N500). An 8-bit D/A converter divides the AF voltage into the required modulation depth. The modulation depth can be adjusted using R503. The AC voltage is added to the DC reference value at N510.

5.1.3 Control and Diagnostic Circuit

The module is controlled via a serial data bus. The data for the RF setting and the modulation control are read into a total of 5 latches. Two different strobes differentiate the data for the RF setting (X1.A6) and the modulation control (X1.A25).

Eight different diagnostic positions (DC values) can be applied to output X1.A23 via the multiplexer (D560).

The comparator N150 monitors the level control loop and switches the output X1.A3 from +5 V to 0 V if the level control has failed.

Input amplifier RF divider Limiting amplifier PIN modulator Intermediate amplifier Harmonics filter/mixer Output amplifier

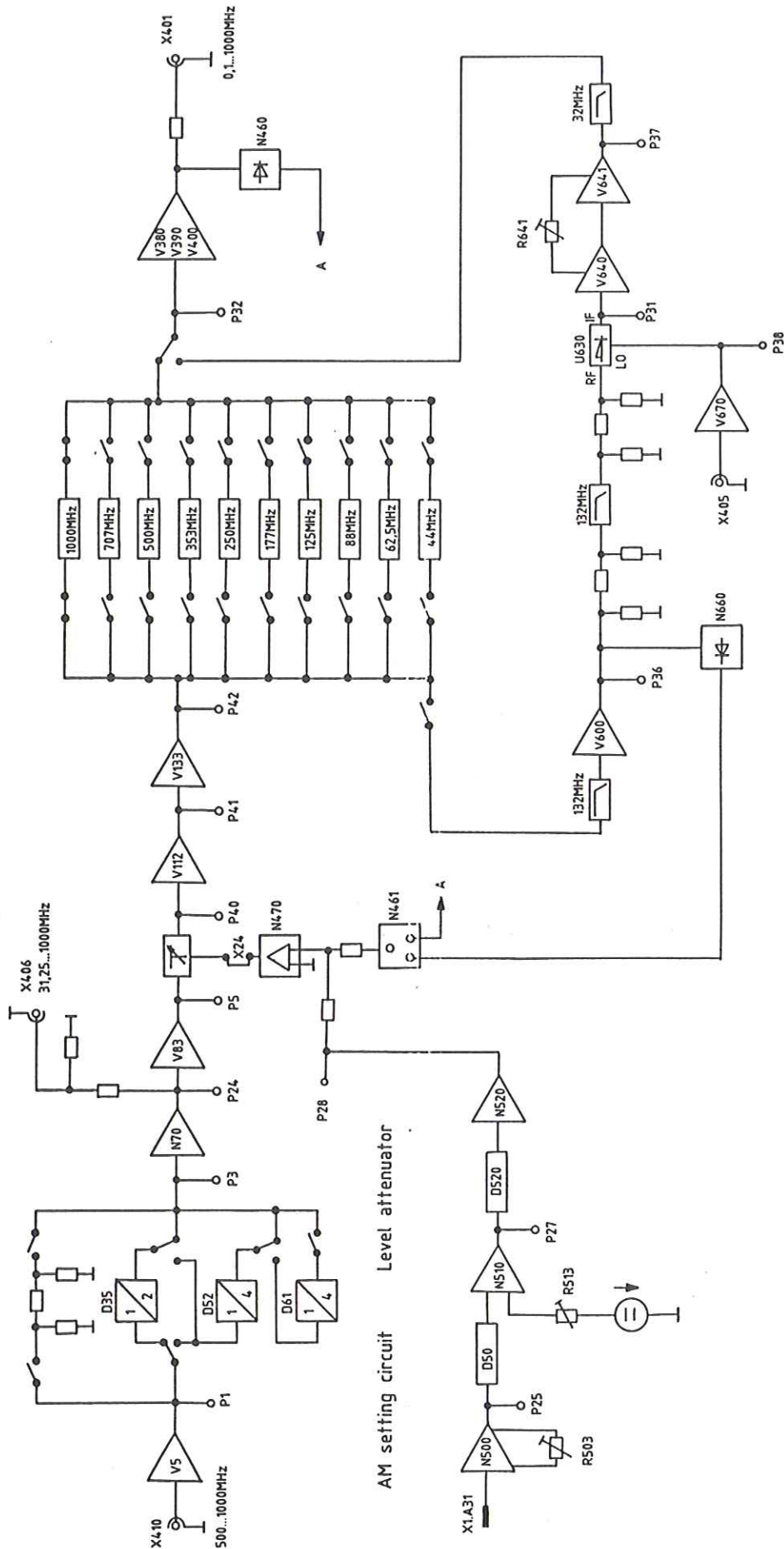


Fig. 5-1 Block diagram of the output stage

5.2 Testing and Adjustment

5.2.1 Level Adjustments

- Connect the module to the service adapter.
- Connect X410 or X405 to output X310 or X315 of the RF oscillator module via the Subminax cable.
- Connect the RF power meter to X401.
- Adjust the levels as in Table 5-1.

Table 5-1

Carrier frequency	Level setting	Trimmer	Tolerance	Remarks
100 MHz	+13 dBm	R514	±0.05 dB	RF level >8 MHz
100 MHz	-6.9 dBm	R452	±0.05 dB	Meas. point >8 MHz
7.9 MHz	+13 dBm	R641	±0.05 dB	RF level <8 MHz
7.9 MHz	-6.9 dBm	R663	±0.05 dB	Meas. point <8 MHz

Setting -6.9 dBm: Enter 13 dBm,
set 0% AM,
adjust in 0.1-dB steps to -6.9 dBm
using the fine level variation
(the mechanical attenuation set
must not be heard to switch)

5.2.2 Adjustment of Modulation Depth

- Set a carrier frequency of 100 MHz and a level of +7 dBm.
- Set the modulation depth to 80% with 1 kHz modulation frequency.
- Connect a modulation depth meter to X401 and adjust to 80% ±0.1% using R503.

5.2.3 Function Test of Module

- Remove the spring-mounted cover on the component side and connect the module to the service adapter.
- Connect X410 or X405 to output X310 or X315 of the RF oscillator module via the Subminax cable.
- Terminate the output connector X401 with 50 Ω.

- Sweep through the complete frequency range (e.g. via the IEC bus) with an output level of +13 dBm, 0 dBm and +15 dBm and check the control voltage at jumper X24 according to Table 5-2.

Table 5-2

Frequency range	Check DC voltage at X24		
	At 0 dBm	At +13 dBm	At +15 dBm
0.1 to 500 MHz	-2.4 to -1.8 V	-1.2 to -1.8 V	-1.0 to +0.5 V
500 to 1000 MHz	-2.3 to -1.8 V	-2.2 to -1.8 V	-1.2 to +1.0 V

Setting +15 dBm: Apply a positive DC voltage of 1.41 V via AM EXT and adjust the modulation depth to 26% (AM DC).

- Set an RF level of +7 dBm and check the harmonics in the complete frequency range; they must be <-30 dBc.
- Connect an AM analyzer to X401.
- Check the distortion with an RF level of +7 dBm and 80% AM. The distortion should be <1% with a modulation frequency of 1 kHz. (See Section 5.3 Troubleshooting if the value is outside the tolerance.)

5.3 Troubleshooting

5.3.1 DC Operating Points of the RF Amplifier

- ✦ Unscrew the spring-mounted cover on the wiring side.
- ✦ Set 1000 MHz and terminate connector X410 with 50 Ω .
Check the DC voltages according to Table 5-3:

Table 5-3

Transistor	Collector voltage	Remarks
V5	-5.1 V	Input amplifier
V83	+5.0 V	Amp. before PIN modulator
V112	+4.2 V	Amp. after PIN modulator
V133	+5.3 V	Amp. after PIN modulator
V380	+12.2 V	Output amplifier
V390	+12.2 V	Output amplifier
V400	+15.8 V	Output amplifier
V600	+7.2 V	Mixer section: RF amplifier
V640	+8.9 V	Mixer section: IF amplifier
V641	+8.2 V	Mixer section: IF amplifier
V670	+6.3 V	Mixer section: LO amplifier

5.3.2 DC Switching Voltages for RF Adjustment

- ✦ Check that +1.8 V (± 0.2 V) is present at P29.
- ✦ Further tests according to Table 5-4.

Table 5-4

Carrier frequency (MHz)	Check DC voltage at test points (values in V, ± 1.5 V)																Anode V51
	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	
1000	-13	+12	+13	+13	+12	+12	-11	-14	-14	-15	-12	+12	-14	-15	-14	-15	+5
700	-13	+12	+13	+13	+12	-11	+12	-14	-14	-15	-12	+12	-14	-15	-14	-15	+5
350	+12	-14	+13	+13	-14	-11	-11	-14	-14	+12	+12	-9	-14	-15	-14	+8	+5
300	+12	-14	+13	+13	-14	-11	-11	-14	-14	+12	-9	+12	-14	-15	-14	+8	+5
200	+12	+12	+13	-14	+12	-11	-11	-14	-14	+12	+12	-9	-14	-15	+7	-15	0
150	+12	+12	+13	-14	+12	-11	-11	-14	-14	+12	-9	+12	-14	-15	+7	-15	0
100	+12	-14	+13	-14	+12	-11	-11	-14	+12	+12	+12	-9	-14	+7	-14	-15	0
70	+12	-14	+13	-14	+12	-11	-11	-14	+12	+12	-9	+12	-14	+7	-14	-15	0
50	+12	+12	-14	+12	+12	-11	-11	-14	+12	+12	+12	-9	+7	-15	-14	-15	0
40	+12	+12	-14	+12	+12	-11	-11	-14	+12	+12	-9	+12	+7	-15	-14	-15	0
30	+12	+12	-14	+12	-14	-11	-11	+12	+12	+12	+12	-9	-14	-15	+7	-15	0
10	+12	-14	+12	-14	+12	-11	-11	+12	+12	+12	+12	-9	-14	-15	+7	-15	0
1	+12	-14	+12	-14	+12	-11	-11	+12	+12	+12	+12	-9	-14	-15	+7	-15	0

5.3.3 RF Test

It is recommendable to use a high-impedance probe with e.g. a transmission loss of 20 dB for the test. The following level data are the values measured at 50 Ω + attenuation of the probe.

Check the RF levels at the test points according to Table 5-5 at +13 dBm with the module under level control.

Table 5-5

Carrier frequency (MHz)	RF level at test points (values in dBm, ± 2.5 dB)								Remarks
	P1	P3	X406	P5	P40	P41	P42	P32	
1000	+8.5	+2	-5	+8.5	-1	+1	+6	0	Basic range
500	+8.5	+1	-5	+8.5	-3	+5	+5	-1	Division 1:2
250	+8.5	+1	-3	+8.5	-3	+5	+7	+1	Division 1:4
125	+8.5	0	-3	+8.5	-3	+5	+8	+1	Division 1:8
62	+8.5	0	-5	+8.5	-3	+5	+8	+1	Division 1:16
31	+8.5	+2	-5	+8.5	-3	+5	+8	+1	Mixer section
1	+8.5	+1	-5	+8.5	-3	+5	+8	+1	Mixer section

5.4 Interfaces

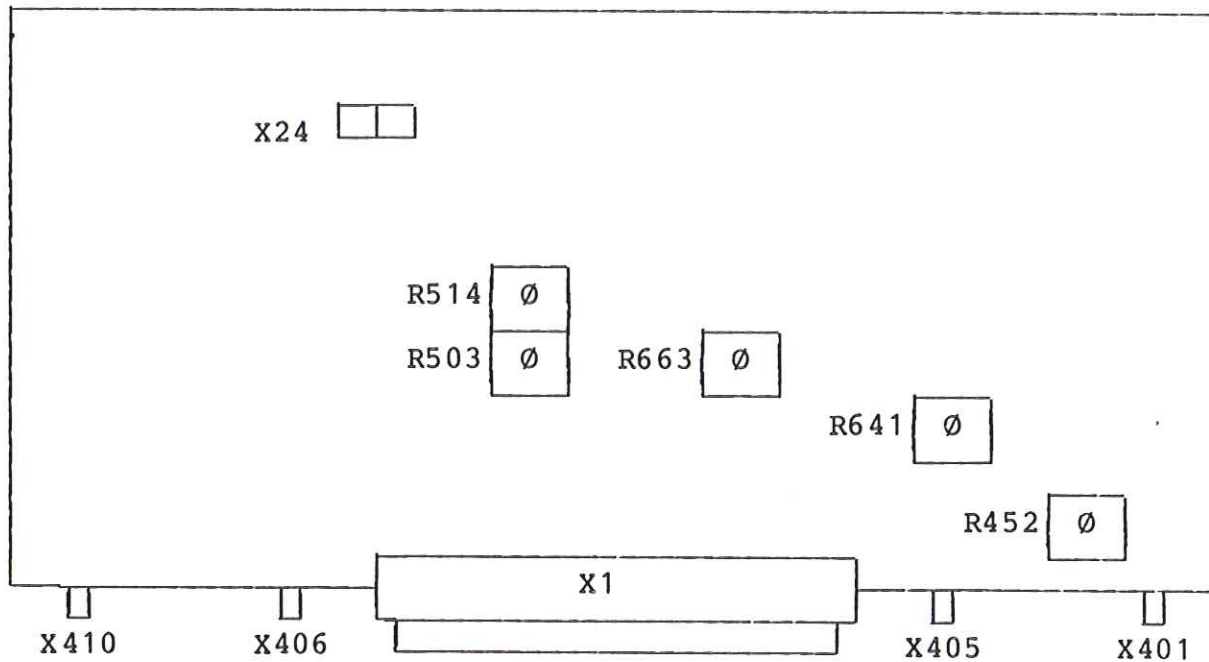


Fig. 5-2 Locations of the inputs/outputs and trimmers

Analog interfaces

Designation	Function	Frequency	Level
X410	RF input	500 to 1000 MHz	0 dBm
X406	RF output	31.25 to 1000 MH	-3 dBm
X405	RF input	150 MHz	0 dBm
X401	RF output	0.1 to 1000 MHz	+13 dBm(max.)
X1.A29	RF measuring point (input/output)	DC	0 to 2.8 V
X1.A23	Diagnostic output	DC	0 to +4 V
X1.A31	Modulation input	DC to 50 kHz	1 V

Digital interfaces (C-MOS)

Designation	Function	Remarks
X1.A8	Data input	Serial
X1.A10	Clock	
X1.A6	Strobe	For RF setting
X1.A25	Strobe	For modulation controller/diagnosis
X1.A3	Loop control	For level control

Supply voltages

Designation	Voltage
X1.A12,A13	+5 V
X1.A15	+24 V
X1.A17	+15 V
X1.A19	-15 V
X1.A2,A7,A11,A14,A16, A18,A20,A30,A32	Ground