2 CMT Operation in the Frequency Range 1 to 2 GHz

The general information on operation of the CMT given in sections 2.1 to 2.3.2 of the CMT operating manual is also valid for operation over 1 GHz. The numbers in bold print and italics refer to the figure in the appendix of the CMT operating manual.

2.1 Frequencies

The frequency is set using the key (f) ***5*** in the receiver test and (SET f) ***6*** in the transmitter test. These keys are the main controls for setting the operating modes of the CMT to the frequency ranges greater or smaller than 1 GHz.

2.1.1 Setting the Frequency (Receiver Test)

For setting the RF frequency of the CMT to frequencies >1 GHz proceed as with 1 GHz. The frequency is indicated in the frequency display ***1*** with a resolution of 200 Hz.

e.g. operating mode

RF ≤1 GHz:	[1] [MHz] [SET f]
RF >1 GHz:	[2000] [MHz] [SET f]

2.1.2 Setting the Operating Frequency (Transmitter Test)

The operating frequency of the CMT for the transmitter test is set using the key (SET f) ***6***. It is indicated in the frequency display ***1***.

This sequence of operation produces two effects:

a) The receive frequency on the CMT is set to the expected transmit frequency.

b) The value entered is used to determine the operating mode of the RF counter. A frequency ≤1 GHz activates the direct RF counter specified in the frequency range up to 1 GHz inclusive. A frequency >1 GHz activates the IF counter which is capable of determining the RF frequency in the frequency range >1 GHz by means of internal search routines. If only the operating mode of the counter is selected, it will be sufficient to enter any frequencies of the appropriate range.

2.1.3 Setting the Operating Mode of the Counter

By setting the operating frequency in the transmitter test, the operating mode of the counter is determined at the same time (see 2.1.2).

The two counter modes overlap with respect to their efficiency in the vicinity of 1 GHz (approx. 50 MHz).

The counter mode f >1 GHz shows the following special feature:

If the frequency counter is in the operating mode RF >1 GHz, pressing of the key (COUNT f) ***5*** activates a search routine which is able to determine frequencies in the range between 1 and 2 GHz. This frequency is continuously monitored and displayed for demodulation. Small frequency jumps (<100 kHz) are handled by the counter and demodulator without the need for repeated pressing of the key (COUNT f) ***5***. If random frequency jumps occur in the range between 1 and 2 GHz, the search routine must be reactivated by pressing the key ***5*** again.

2.2 Modulation and Demodulation

Die FM modulation and demodulation capabilities of the 2-GHz CMT models exceed those of the basic models.

As far as modulation is concerned, the modulation frequency for external signals has been extended; as for demodulation, a wideband demodulator has been added. The modulation is performed as with the basic CMT model.

2.2.1 Demodulation

For demodulation, either preset the frequency of the transmit signal fed in by means of the key (SET f) ***6*** (thus the operating mode of the counter is selected automatically) or, if the transmitter frequency is not known, press the key (COUNT f) ***5*** first. The CMT is automatically matched to the level of the transmitter when using the input (RF IN/OUT) ***77***.

For special applications, the CMT can also be adapted directly to the level of the transmitter. In this case, automatic level control has to be switched off before by means of 19 SPEC when using the socket RF IN/OUT ***77***. (18 SPEC: switch automatic level control on again). The entries to be made on the CMT for this purpose (SPEC functions) depend on the input level and are summarized in the following table.

Type of mod.	**at RF IN/OUT 77**	**at INPUT 2 79**	**Atten-uation**	**Operation**
AM	<0.22 W >0.22 W >2 W >18 W	<33 mV >33 mV >100 mV >300 mV	0 dB 10 dB 20 dB 30 dB	171 SPEC 21 SPEC 170 SPEC 21 SPEC 171 SPEC 20 SPEC 170 SPEC 20 SPEC
FM/ ΦM	<12.5 W >12.5 W	<250 mV >250 mV	0 dB 10 dB	171 SPEC 21 SPEC 170 SPEC 21 SPEC

2.2.2 FM Wideband Demodulation

The wideband demodulator incorporated in the CMT models 53 and 55 can be used for FM demodulation in the frequency range 40 MHz $< f < 2$ GHz.
Switching on/off is performed as follows:

	FM wideband demodulator	**Dev. meter of basic model**	**Relationship deviation - voltage at output DEMOD *81***
172 SPEC	on (max. 130 kHz)	off	100 kHz $\hat{=}$ 5 V_p
173 SPEC	on (max. 260 kHz)	off	100 kHz $\hat{=}$ 2.5 V_p
174 SPEC	on (max. 520 kHz)	off	100 kHz $\hat{=}$ 1.25 V_p
175 SPEC	off	on	100 kHz $\hat{=}$ 5 V_p

Prerequisites for switching on and operation of the wideband demodulator:

- FM demodulation
- fc >40 MHz
- Adjacent-channel power measurement (ACP) off

Otherwise, the error message "NOT POSSIBLE" is output or the deviation meter of the basic model is automatically selected.

Remarks on wideband demodulator:

- For wideband demodulation, peak weighting is intended to be used exclusively. This type of weighting is switched on using 36 SPEC. Automatic switching to rms weighting at a deviation of 100 Hz (35 SPEC) or exclusive use of rms weighting (37 SPEC) is to be avoided with wideband demodulation.

- Switching-on of the IF narrow-band filter only affects the deviation meter of the basic model.

2.2.3 Power Measurement

Operation of the power meter in the frequency range f >1 GHz is the same as in the frequency range f <1 GHz. As the power is displayed with a frequency-dependent correction factor, a correct power measurement requires a frequency measurement to be performed before. In the operating mode f <1 GHz (see 2.1.2) this takes place automatically. A power measurement in the frequency range f >1 GHz performed at a frequency other than that of the previous measurement requires the RF counter to be activated before. (Key COUNT f *5* with manual operation. Likewise, be careful to activate the counter to ensure an accurate power measurement when programming the autorun control (CM-B5) and the IEC bus (CM-B4)).

2.2.4 Special Features in the 2-GHz Frequency Range

Depending on the probe used, the frequency range of the RF millivoltmeter (CM-B8) covers up to 2 GHz.

The use of the wideband demodulator in the frequency range 40 MHz to 1 GHz requires the CMT to be set to the expected transmitter frequency using the key (SET f) *6*.

When using the 300-Hz highpass filter (key HP) *27* in conjunction with the wideband demodulator, it is to be noted that weighting of the demodulated signal is only specified up to 20 kHz.

2.2.5 Special Functions

18 SPEC — The level applied to RF IN/OUT *77* causes automatic level matching in the CMT.

19 SPEC — Automatic level control according to 18 SPEC is switched off. The control elements can be set by means of special functions (20, 21 SPEC) instead.

20 SPEC — The RF input signal is reduced by 20 dB.
- at INPUT 2 *79* unconditional
- an RF IN/OUT *77* conditional (18, 19 SPEC)

21 SPEC — The RF input signal is not reduced.
- at INPUT 2 *79* unconditional
- at RF IN/OUT *77* conditional (18, 19 SPEC)

35 SPEC, 36 SPEC, 37 SPEC — Though these special functions are freely selectable during operation of the wideband demodulator, it is recommended to use 36 SPEC: modulation measurement with peak weighting.

70 SPEC — Demodulator control: squelch on

71 SPEC — Demodulator control: Switch off output signal

72 SPEC — Demodulator control: Connect output signal through

170 SPEC — A 10-dB attenuator in the path of the RF input signal is switched on. (equivalent 20 SPEC)
- at INPUT 2 *79* unconditional
- at RF IN/OUT *77* conditional (18, 19 SPEC)

171 SPEC — A 10-dB attenuator in the path of the RF input signal is switched off. (equivalent 21 SPEC)
- at INPUT 2 *79* unconditional
- at RF IN/OUT *77* conditional (18, 19 SPEC)

172 SPEC — Switch on wideband demodulator with maximum deviation 130 kHz.

173 SPEC — Switch on wideband demodulator with maximum deviation 260 kHz.

174 SPEC — Switch on wideband demodulator with maximum deviation 520 kHz.

175 SPEC — Switch on deviation meter of basic model (switch off wideband demodulator at the same time).

C10, C11, C12, C13 SPEC and C20, C21 SPEC — Increasing the measuring time when counting in the frequency range >1 GHz does not increase the accuracy. It is independent of the selection of the special functions ± 100 Hz. This applies both to the BEAT function using the AF counter (special functions C10 to C13) and to the RF counter (special functions C20 and C21).

3 Maintenance

3.1 Required Measuring Equipment and Accessories

Item	Instrument type Required specifications	Type	Order No.	Application Section
1	RF spectrum analyzer 1 to 4000 MHz			3.2.1 3.2.2 3.2.5
2	Modulation analyzer 1 to 2000 MHz			3.2.3 3.2.7 3.2.8
3	Power meter 1 to 2000 MHz			3.2.4 3.2.6
4	Precision attenuator set 0 to 2000 MHz	DPVP	214.8017.52	3.2.5
5	AF generator 1 to 130 kHz	SPN	336.3019.02	3.2.7 3.2.12
6	Power amplifier 1 to 2 GHz 50 watts			3.2.9
7	Signal generator 0 to 2000 MHz modulation capability AM, FM	SMPD	376.8011.52	3.2.9 3.2.10 3.2.11 3.2.12 3.2.13
8	Vector analyzer	ZPV	291.4012.93	3.2.9
9	VSWR bridge	ZRB2	373.9017.52	3.2.9

3.2 Checking the Rated Specifications

3.2.1 Checking the Harmonics and Subharmonics

Setting (receiver test)

Output voltage 100 mV:

[1] [0] [0] [mV] [V_0]

Switch off modulation:

[OFF]

Test setup

Connect spectrum analyzer to socket RF IN/OUT *77* of the CMT.

Test

Frequency setting on CMT	Frequencies to be analyzed		
	Subharmonics		Harmonics
	$^1/_2$ f	$^3/_2$ f	2 f
1001 MHz	500.5 MHz	1501.5 MHz	2002 MHz
1115 MHz	557.5 MHz	1672.5 MHz	2230 MHz
1500 MHz	750 MHz	2250 MHz	3000 MHz
2000 MHz	1000 MHz	3000 MHz	4000 MHz

The typical ratio to the set CMT frequency is 20 dB for all frequencies to be analyzed. It must not fall below 12 dB (internal tolerance).

This measurement checks correct functioning of the frequency doubler. If the basic model works properly, this ensures a correct frequency setting and correct FM and ϕM modulation at the same time.

3.2.2 Checking the Nonharmonics

Setting (receiver test)

Output voltage 100 mV:
[1] [0] [0] [mV] [V_0]

Switch off modulation (measurement a):
[0] [kHz] [INT1]

Switch on modulation (measurement b):
[1] [0] [0] [Hz] [INT1]

Frequency 1600.005 MHz:
[1] [6] [0] [0] [.] [0] [0] [5] [MHz]

Test

Search for nonharmonics at the following frequencies:

1600 MHz, 1600.055 MHz und 159.9955 MHz (measurement a),

1600.0175 MHz and 159.99925 MHz (measurement b),

1200.00375 MHz and 1400.004375 MHz

The ratio must always be >54 dB.

3.2.3 Spurious FM

Setting (receiver test)

Switch off modulation:
[0] [kHz] [INT1]

Level 0 dBm:
[0] [dBm] [V_0]

Frequency 1360 MHz:
[1] [3] [6] [0] [MHz] [f]

Further significant frequencies:
1001/1600/1800/1900/2000 MHz

Test setup

Connect modulation meter to RF IN/OUT ***77***.

Test

Measure the spurious FM by connecting the CCITT filter and switching on rms weighting on the modulation meter. It must be <24 Hz.

Rms weighting:
Bandwidth 30 Hz to 20 kHz:
Spurious FM <64 Hz, internal tolerance

3.2.4 Setting Errors and Frequency Response of RF Output Level

Setting (receiver test)

Switch off spurious FM:
[0] [kHz] [INT1]

Output voltage 10 dBm:
[1] [0] [dBm] [V_0]

Switch off amplitude modulation:
[0] [%] [INT1]

Output voltage -20 dBm:
[-] [2] [0] [dBm] [V_0]

Test setup

Connect power meter to RF IN/OUT *77*.

Test

Set frequencies between 1000 and 2000 MHz, preferably 1115 MHz.
The deviation from the nominal value must be less than ± 1.2 dB.

3.2.5 RF Divider

Setting (receiver test)

Frequency 1800 MHz:

[1] [8] [0] [0] [MHz] [f]

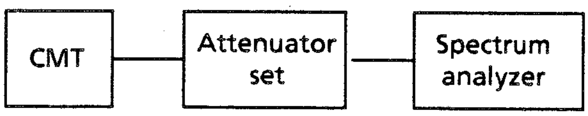
Initial level 10 dBm:

[1] [0] [dBm] [V_0]

Switch off modulation:

[0] [kHz] [INT1]

Test setup



Test

Set the analyzer to 1 dB/div and reference level approx. 3 µV with a bandwidth of 15 kHz .

Carry out the following settings on the CMT and the attenuator set:

CMT level (dBm)	Attenuation of attenu-ator set (dB)	Tested RF attenuator (dB)	Permissible deviation (dB)
10	110	Reference	Reference
5	105	5	±0.2
0	100	10	±0.3
-5	95	5 with 10	±0.35
-10	90	20	±0.4
-30	70	2 x 20	±0.8
-50	50	40 with 20	±0.8
-90	10	2 x 40 with20	±0.8

The analyzer indicates the same value for all settings with the deviations specified in the table referred to the 10-dBm setting.

3.2.6 Fine Adjustment of Level

Setting (receiver test)

Frequency 1115 MHz:

[1] [1] [1] [5] [MHz] [f]

Switch off modulation:

[0] [kHz] [INT1]

Output level 5.1 dBm:

[5] [.] [1] [dBm] [V_0]

Test setup

Connect power meter to RF IN/OUT *77*.

Test

Once the level setting has been applied to the VAR spinwheel (takes place automatically when the last setting of the output level is made), reduce the level without interruptions in two hundred 0.1-dB steps by rotating the spinwheel counterclockwise. Check the level jumps on the power meter. The reductions must be monotonous.

The deviation from the nominal value is ≤ ± 1 dB at -4.9 dBm and ≤ ± 2.0 dB at -14.8 dBm.

If the lowest value of the fine variation range is dropped below by mistake, key in the output level of 5.1 dBm again and then rotate the VAR spinweel counterclockwise again.

3.2.7 AF Frequency Response of FM Modulation

If the doubler works properly, proper functioning of FM and ΦM modulation is ensured. This measurement only checks the extended modulation frequency range.

Setting (receiver test)

Modulation deviation 100 kHz with 1 V_{RMS}:
[1] [0] [0] [kHz] [EXT] [1V_{RMS} EXT]

RF frequency:
[1] [3] [6] [0] [MHz] [f]

Level 0 dBm:
[0] [dBm] [V_0]

Apply the following frequencies via the socket MOD EXT ***82***: 1, 10, 20, 50, 100, 130 kHz

Test setup

Set the modulation analyzer to a large enough AF bandwidth (200 kHz) and connect to RF IN/OUT ***77***. A modulation generator connected to MOD EXT ***82*** is used for modulation.

Test

The AF frequency response may be 3 % (< ± 1.5 %) for AF frequencies stated before.

3.2.8 AM Modulation

3.2.8.1 Frequency Response of Modulation Depth

Setting (receiver test)

Frequency 1115 MHz:
[1] [1] [1] [5] [MHz] [f]

Modulation depth 80 %:
[8] [0] [%] [INT1]

Level 0.1 dBm:
[0] [.] [1] [dBm] [V_0]

Set the following AF frequencies:
50 Hz
[5] [0] [Hz] [AF INT1]

300 Hz 1 kHz
4 kHz
25 kHz

Test setup

Set the modulation analyzer to a large enough AF bandwidth and connect to RF IN/OUT ***77***.

Test

The AF frequency response of the measured modulation depth may be 6 % (± 3 %). It cannot be adjusted (internal tolerance).

3.2.8.2 AM Error

Setting (receiver test)

Frequency 1115 MHz:
[1] [1] [1] [5] [MHz] [f]

Level 0.1 dBm:
[0] [.] [1] [dBm] [V_0]

AF frequency 1 kHz:
[1] [kHz] [AF INT1]

Set the following modulation depths:
5 %

[5] [%] [INT1]

10 %, 30 %, 80 %

Test setup

Adjust the modulation analyzer to an AF bandwidth of 300 Hz to 3 kHz and connect to RF IN/OUT ***77***.

Test

The deviation of the set modulation depth must not exceed 10 % of the set value ±0.5 % additional modulation depth error (resolution), taking into account the frequency response determined in section 3.2.8.1 (internal tolerance).

3.2.8.3 AM Distortion

Setting (receiver test)

Frequency 1115 MHz:

[1] [1] [1] [5] [MHz] [f]

Level 0.1 dBm:

[0] [.] [1] [dBm] [V_0]

AF 1 kHz:

[1] [kHz] [AF INT1]

Modulation depth 80 %:

[8] [0] [%] [INT1]

Test setup

Connect modulation analyzer to RF IN/OUT ***77***.

Test

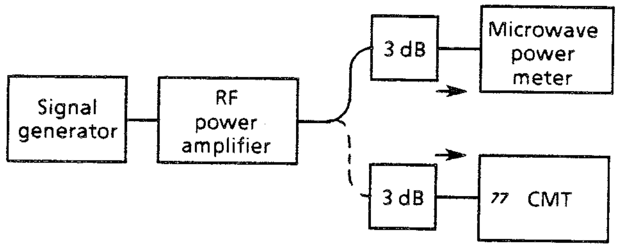
The distortion is <3 % (internal tolerance)

3.2.9 Power Meter

Setting (transmitter test)

The power measurement is selected by pressing the POWER key.

Test setup



To achieve the accuracy guaranteed in the data sheet, make sure that the coaxial 50-Ω resistor is connected to the socket RF-30 dB ***111*** on the rear of the instrument and that each power measurement with a frequency deviating from the previous measurement must be preceded by a frequency measurement. The correct impedance of the connection from the output of the power amplifier to the CMT and to the microwave power meter is of great importance to the power measurement. An attenuator at the end of the cable near to the CMT or the microwave power meter improves the impedance conditions. A low-distortion RF signal is required for the test (use a lowpass if applicable) since the CMT power test is based on a peak-value measurement.

Test

Power	Frequency			
	1200 MHz	1500 MHz	1800 MHz	2000 MHz
5 mW	±2 dB*	±2 dB*	±2 dB*	±2 dB*
100 mW	±1 dB +1 digit	±1 dB +1 digit	±1 dB +1 digit	±1 dB +1 digit
50 W	±1 dB +1 digit	±1 dB +1 digit	±1 dB +1 digit	±1 dB +1 digit

* internal tolerances

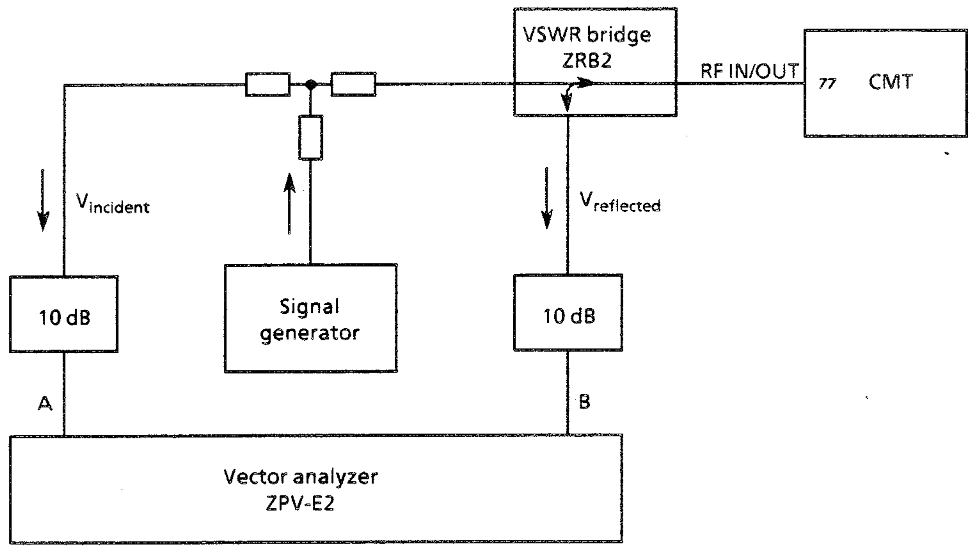
Record the test parameters listed in the table on the microwave power meter for an unmodulated test signal and compare with the results on the CMT. The table lists the maximum deviation from the nominal value determined on the microwave power meter.

3.2.9.1 VSWR of Power Meter

Setting

As in section 3.2.9, but additionally press the key V_0 OFF (RF level off).

Test setup



Test:

Measure the standing wave ratio $(V_{refl}/V_{inc})^2$ between 1000 and 2000 MHz. It must be <1.5. For frequencies between 1 and 1000 MHz it is <1.3.

3.2.10 RF Counter

3.2.10.1 Counter Accuracy and Sensitivity at Socket RF IN/OUT *77*

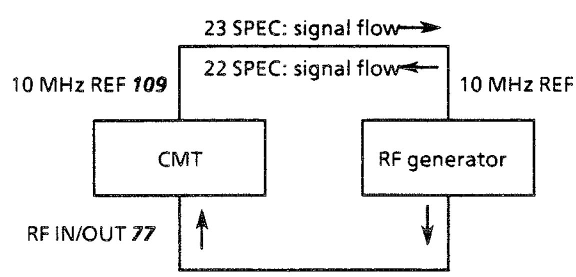
Setting (transmitter test FM)

Set the counter to 2-GHz mode:

[2] [0] [0] [0] [MHz] [SET f]

Select RF counting by pressing the key COUNT f. Select the socket RF IN/OUT *77* by pressing the key INPUT SELECT.

Test setup



Feed in unmodulated signals between 1 and 2 GHz.

Test

The counter must work properly (± 100 Hz deviation from RF generator) at levels >20 mW.

3.2.10.2 Counter Frequency Accuracy at Socket INPUT 2

As opposed to the measurement in section 3.2.10.1, the INPUT SELECT ***78*** key activates the socket INPUT 2 ***79*** in this case.

The counter sensitivity lies at voltages ≥ 10 mV.

3.2.11 Checking the AM Meter

Setting (transmitter test)

Presetting of CMT to AM:

[%] [MAX PK]

Preset the RF frequency via the key SET f, e.g. 2000 MHz:

[2] [0] [0] [0] [MHz] [SET f]

Test setup

Feed 80 % amplitude-modulated signal with 100 mV into socket INPUT 2 ***79***.

Test

The same AM demodulator is used as in the frequency range < 1 GHz.

The AM demodulation in the frequency range >1 GHz includes one more RF converter stage which is checked in a sample test at RF = 2000 MHz, AF = 1 kHz and AM = 80 %. The error may be max. 6 % (internal tolerance).

Checking the spurious AM

Set the signal generator to "unmodulated". The residual AM may be max. 0.06 % (with CCITT filter).

3.2.12 Checking the Wideband Demodulator

Setting (transmitter test)

Using the key SET f, the following frequencies are set:
600 MHz, 1001 MHz, 1500 MHz, 2000 MHz.

The wideband demodulator is selected using

172 SPEC	(130 kHz deviation)
173 SPEC	(260 kHz deviation)
174 SPEC	(520 kHz deviation)

Test setup

A frequency-modulated signal is fed into the socket RF IN/OUT ***77*** with 1 V. Connect an AF voltmeter to the DEMOD output ***81***.

Checking the AF frequency response

The check is carried out at 2000 MHz, 25 kHz deviation, type of weighting PK +-/2, 172 SPEC and is made both on the display and on the output DEMOD ***81***. The AF frequencies cover the range from 1 kHz (reference for DEMOD output) to 130 kHz.

Frequency response:	up to 20 kHz:	<2 %
	up to 100 kHz:	<4 %
	up to 130 kHz:	<7 %

Checking the linearity

The check is carried out at 2000 MHz, 1 kHz AF, type of weighting PK +-/2, 172 SPEC and is made both on the display and on the DEMOD output ***81***. The deviations cover the range from 0 to 130 kHz (reference for DEMOD output: 6.5 V_p).

The linearity error (from Δf >10 kHz) and the frequency response determined before must not exceed the following values:

up to 20 kHz:	<3 %
up to 100 kHz:	<5 %
up to 130 kHz:	<8 %

Checking the spurious FM

The check is carried out at the RF frequencies stated above, with the 3 limit values of the measurement range (172 to 174 SPEC) and with or without CCITT filter.

The check is performed using an AF voltmeter connected to output DEMOD ***81***. Rms weighting in the range from 20 Hz to approx. 130 kHz is used.

The scaling referred to the DEMOD output is as follows:
3.54 V_{rms} for 100 kHz deviation (172 SPEC)
1.77 V_{rms} for 100 kHz deviation (173 SPEC)
0.88 V_{rms} for 100 kHz deviation (174 SPEC)

The measurement on the display is performed using 37 SPEC (rms weighting).

The maximum spurious FM values can be obtained from the following table:

	with CCITT		without CCITT			
			DEMOD		Readout	
	f = 600 MHz	f > 1 GHz	f = 600 MHz	f > 1 GHz	f = 600 MHz*	f > 1 GHz*
172 SPEC	< 12 Hz	< 24 Hz	< 120 Hz	< 200 Hz	< 150 Hz*	< 300 Hz*
173 SPEC	< 12 Hz	< 24 Hz	< 150 Hz	< 250 Hz	< 200 Hz*	< 400 Hz*
174 SPEC	< 12 Hz	< 24 Hz	< 200 Hz	< 300 Hz	< 250 Hz*	< 500 Hz*

* internal tolerance

3.2.13 Checking the Deviation Meter of the Basic Model

Checking of the deviation meter of the basic model (175 SPEC) is described in section 3.2.22 of the CMT operating manual. This measurement is intended as a sample check of the deviation meter, taking into account the additional RF converter stage.

Setting (Transmitter test)

Switch on deviation meter of basic model:
[1] [7] [5] [SPEC]

Transmitter frequency 2000 MHz:
[2] [0] [0] [0] [MHz] [SET f]

Select deviation measurement:
[MAX PK]

Rms measurement with deviation < 100 Hz:
[3] [5] [SPEC]

Switch off CCITT filter.

Test setup

Feed an RF signal of 13 dBm that is frequency-modulated with 1 kHz AF and with 25 kHz deviation (or an unmodulated RF signal) into socket RF IN/OUT ***77***.

Test

Measurement of spurious FM (RF signal unmodulated)

The spurious FM is < 64 Hz (rms).

Deviation measurement (RF signal with1 kHz AF, 25 kHz deviation)

The error is < 3 %.

3.3 Performance Test Report

Rohde & Schwarz
RADIOCOMMUNICATION TESTER CMT

Date ....
Name ....

Order No. 802.2020.55
Serial No. ....

Item	Characteristic	Measurement in Section	Min.	Actual value	Max.	Unit
1	*Harmonics*	3.2.1				
	2002 MHz		12	----	—	dB
	2230 MHz		12	----	—	dB
	3000 MHz		12	----	—	dB
	4000 MHz		12	----	—	dB
	Subharmonics 1/2 f					
	500.5 MHz		12	----	—	dB
	557.5 MHz		12	----	—	dB
	750 MHz		12	----	—	dB
	1000 MHz		12	----	—	dB
	Subharmonics $^3/_2$ f					
	1501.5 MHz		12	----	—	dB
	1672.5 MHz		12	----	—	dB
	2250 MHz		12	----	—	dB
	3000 MHz		12	----	—	dB
2	*Nonharmonics*	3.2.2				
	1600 MHz		54	----	—	dB
	1600,055 MHz		54	----	—	dB
	1599,955 MHz		54	----	—	dB
	1600,0175 MHz		54	----	—	dB
	1599,9925 MHz		54	----	—	dB
	1200,00375 MHz		54	----	—	dB
	1400,004375 MHz		54	----	—	dB
3	*Spurious FM (CCITT)*	3.2.3				
	1360 MHz		—	----	24	Hz
	1001 MHz		—	----	24	Hz
	1600 MHz		—	----	24	Hz
	1800 MHz		—	----	24	Hz
	1900 MHz		—	----	24	Hz
	2000 MHz		—	----	24	Hz
	without CCITT					
	1360 MHz		—	----	64	Hz
	1001 MHz		—	----	64	Hz
	1600 MHz		—	----	64	Hz
	1800 MHz		—	----	64	Hz
	1900 MHz		—	----	64	Hz
	2000 MHz		—	----	64	Hz
4	*RF output level 10 dBm*	3.2.4				
	1001 MHz		8.8	----	11.2	dBm
	1115 MHz		8.8	----	11.2	dBm
	1500 MHz		8.8	----	11.2	dBm
	1800 MHz		8.8	----	11.2	dBm
	2000 MHz		8.8	----	11.2	dBm

Item	Characteristic	Measure-ment in Section	Min.	Actual	Max.	Unit
4	*RF output level -20 dBm*	3.2.4				
	1001 MHz		-21.2	----	-18.8	dBm
	1115 MHz		-21.2	----	-18.8	dBm
	1500 MHz		-21.2	----	-18.8	dBm
	1800 MHz		-21.2	----	-18.8	dBm
	2000 MHz		-21.2	----	-18.8	dBm
5	*RF divider*	3.2.5				
	Deviation from nominal CMT level					
	10 dBm			Reference		
	5 dBm		-0.2	----	0.2	dB
	0 dBm		-0.3	----	0.3	dB
	-5 dBm		-0.35	----	0.35	dB
	-10 dBm		-0.4	----	0.4	dB
	-30 dBm		-0.8	----	0.8	dB
	-50 dBm		-0.8	----	0.8	dB
	-90 dBm		-0.8	----	0.8	dB
6	*Fine adjustment of level*	3.2.6				
	-4.9 dB		-1	----	+1	dB
	-14.8 dB		-1	----	+1	dB
7	*AF frequency response of FM modulation*	3.2.7				
	AF 1 kHz		96.5	Reference	103.5	kHz
	10 kHz		-1.5	----	1.5	%
	20 kHz		-1.5	----	1.5	%
	50 kHz		-1.5	----	1.5	%
	100 kHz		-1.5	----	1.5	%
	130 kHz		-1.5	----	1.5	%
8	*AM modulation*	3.2.8.1				
	Frequency response					
	50 Hz		-3	----	3	%
	300 Hz		-3	----	3	%
	1 kHz		76.8	Reference	83.2	%
	4 kHz		-3	----	3	%
	25 kHz		-3	----	3	%
				----		%
9	*AM error*	3.2.8.2				
	5 %		-10	----	10	%
	10 %		-10	----	10	%
	30 %		-10	----	10	%
	80 %		-10	----	10	%
10	*AM distortion*	3.2.8.3	----	----	3	%
11	*Power measurement*	3.2.9				
	5 mW					
	1200 MHz		-2	----	2	dB
	1500 MHz		-2	----	2	dB
	1800 MHz		-2	----	2	dB
	2000 MHz		-2	----	2	dB
	100 mW					
	1200 MHz		-1.1	----	1.1	dB
	1500 MHz		-1.1	----	1.1	dB
	1800 MHz		-1.1	----	1.1	dB
	2000 MHz		-1.1	----	1.1	dB
	50 W					
	1200 MHz		-1.1	----	1.1	dB
	1500 MHz		-1.1	----	1.1	dB
	1800 MHz		-1.1	----	1.1	dB
	2000 MHz		-1.1	----	1.1	dB

Item	Characteristic	Measure-ment in Section	Min.	Actual value	Max.	Unit
12	*VSWR 1 to 1000 MHz*	3.2.9.1	—	----	1.3	—
	1000 to 2000 MHz		—	----	1.5	—
13	*RF measurement*	3.2.10.1				
	1000 MHz		20	----	—	mW
	1500 MHz		20	----	—	mW
	1800 MHz		20	----	—	mW
	2000 MHz		20	----	—	mW
	RF measurement	3.2.10.2				
	1000 MHz		10	----	—	mV
	1500 MHz		10	----	—	mV
	1800 MHz		10	----	—	mV
	2000 MHz		10	----	—	mV
	AM meter	3.2.11				
	spurious AM (CCITT)		75.2	----	84.6	% AM
			—	----	0.06	% AM
14	*Wideband demodulator*	3.2.12				
	AF frequency response					
	1 kHz		-2	----	2	%
	10 kHz		-2	----	2	%
	20 kHz		-2	----	2	%
	50 kHz		-4	----	4	%
	100 kHz		-4	----	4	%
	130 kHz		-7	----	7	%
	Linearity					
	10 kHz deviation		----	----	----	kHz
	20 kHz deviation		----	----	----	kHz
	50 kHz deviation		----	----	----	kHz
	100 kHz deviation		----	----	----	kHz
	130 kHz deviation		----	----	----	kHz
	Frequency response with linearity error at AF					
	<20 kHz		-3	----	3	%
	<100 kHz		-5	----	5	%
	≤130 kHz		-8	----	8	%
15	*Spurious FM*	3.2.12	**172 SPEC**	**173 SPEC**	**174 SPEC**	**Unit**
	with CCITT					
	600 MHz		<12	<12	<12	Hz
	1001 MHz		<24	<24	<24	Hz
	1500 MHz		<24	<24	<24	Hz
	2000 MHz		<24	<24	<24	Hz
	without CCITT (DEMOD)					
	600 MHz		<120	<150	<200	Hz
	1001 MHz		<200	<250	<300	Hz
	1500 MHz		<200	<250	<300	Hz
	2000 MHz		<200	<250	<300	Hz
	without CCITT (readout)					
	600 MHz		<150	<200	<250	Hz
	1001 MHz		<300	<400	<500	Hz
	1500 MHz		<300	<400	<500	Hz
	2000 MHz		<300	<400	<500	Hz
16	*Deviation meter of basic model*	3.2.13				
	Deviation measurement		24.25	----	25.75	kHz
	Spurious FM		—	----	64	Hz

4 Service Manual for Complete Instrument

(see circuit diagram 802.2020 S, sheet 2)

Refer to the CMT service manual except for the modified module "Output stage 2 GHz" and the two newly added modules "Output amplifier" and "2-GHz wideband demodulator".

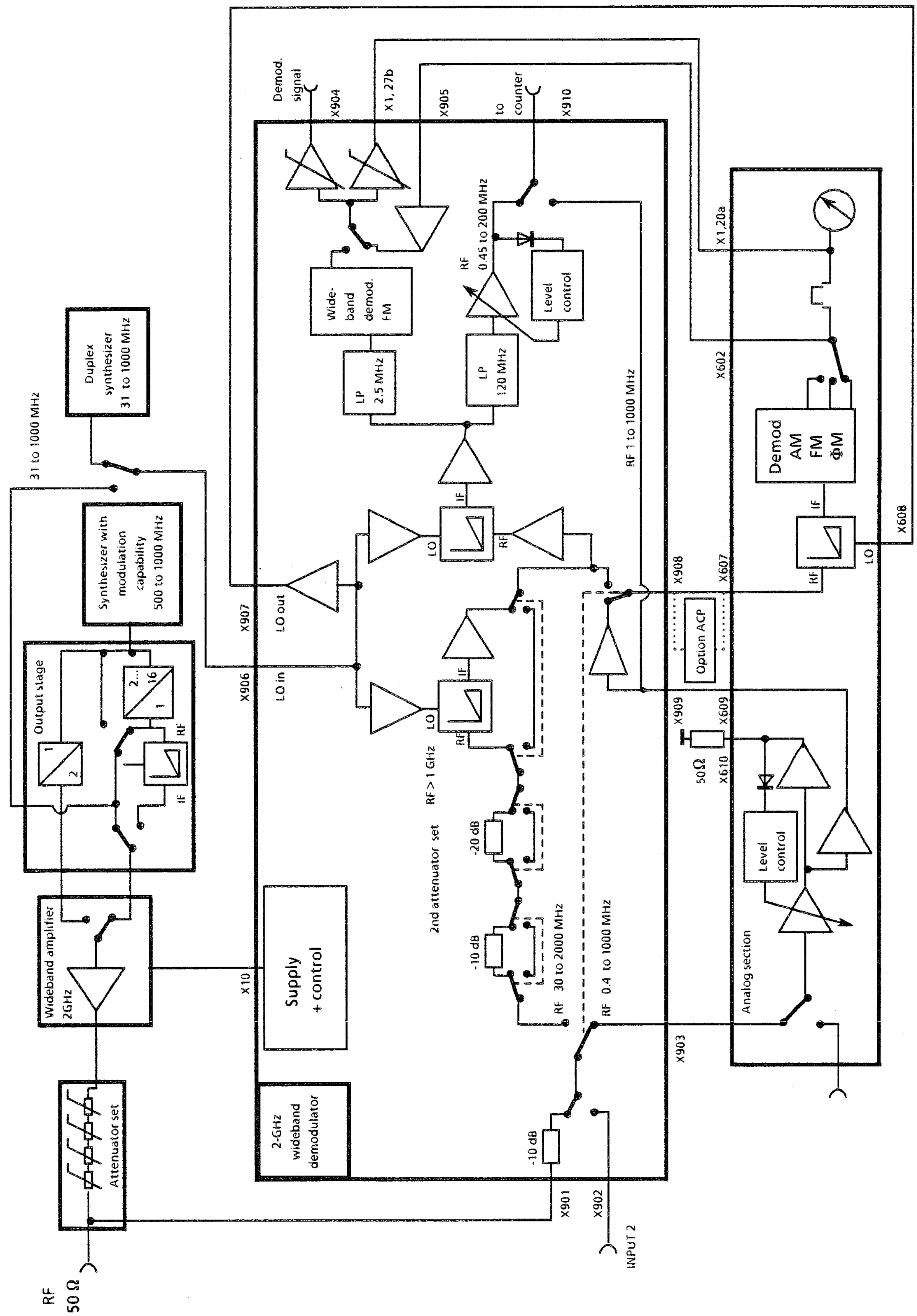
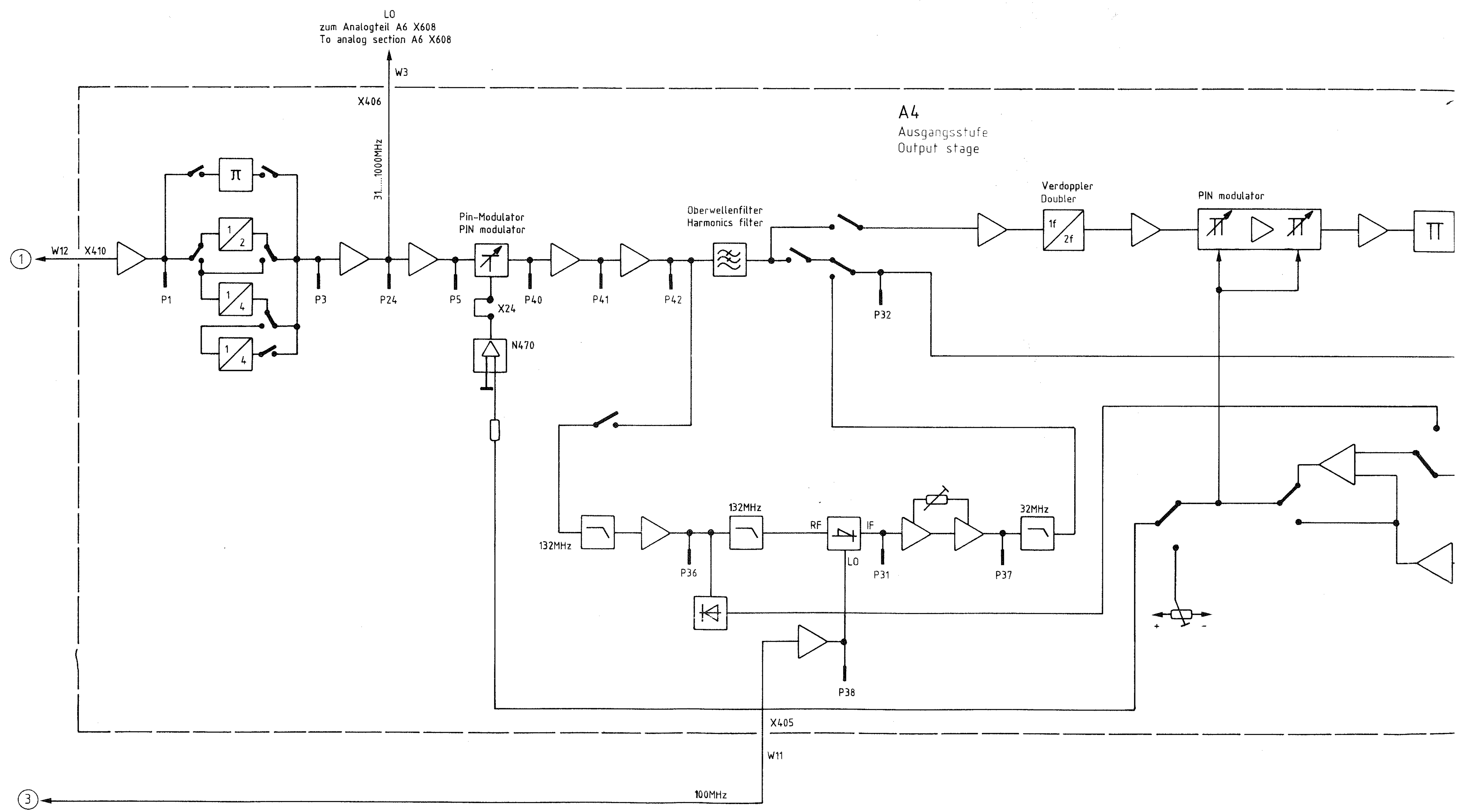


Fig.4-1 Block diagram of 2-GHz functional units



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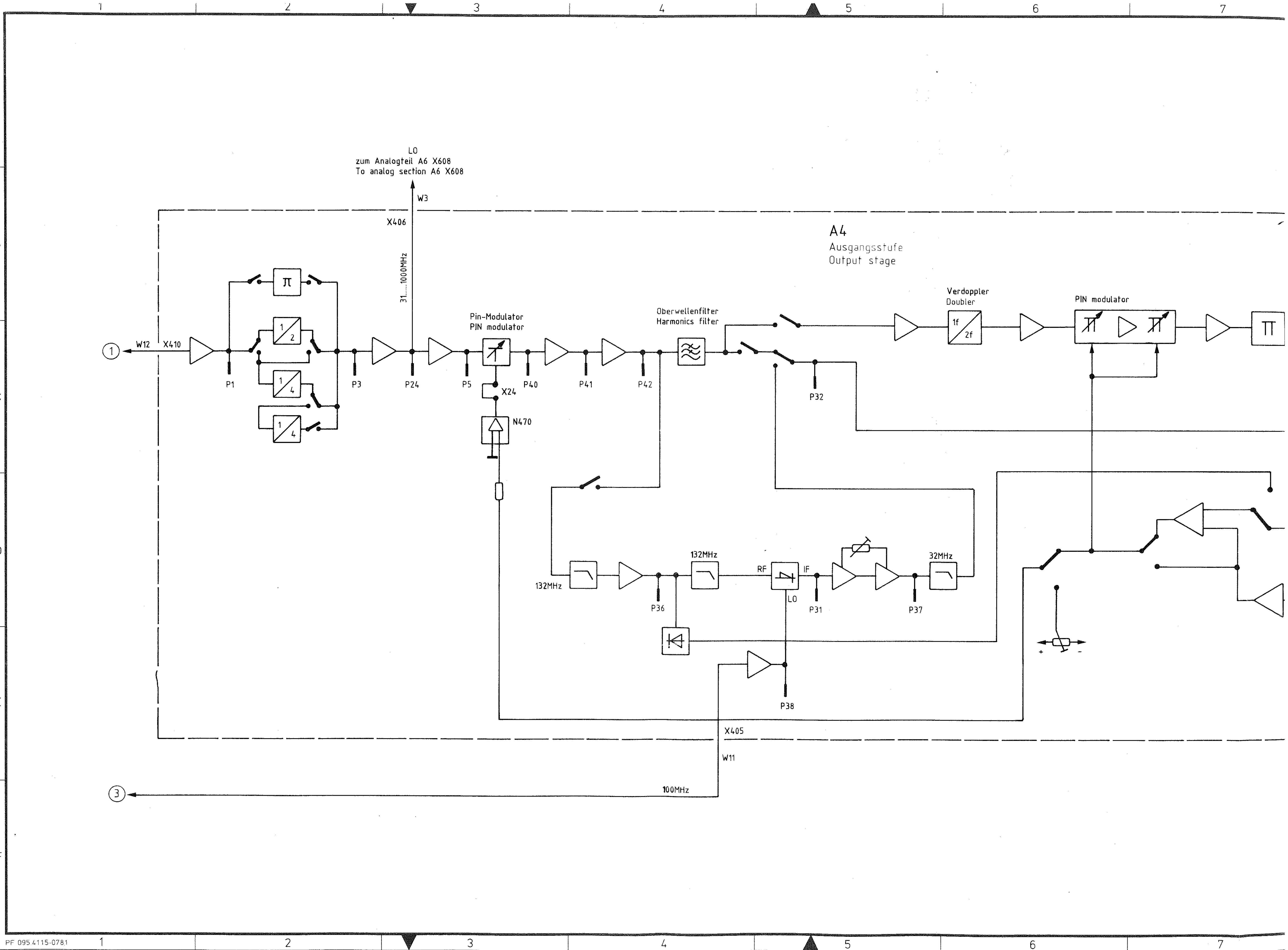
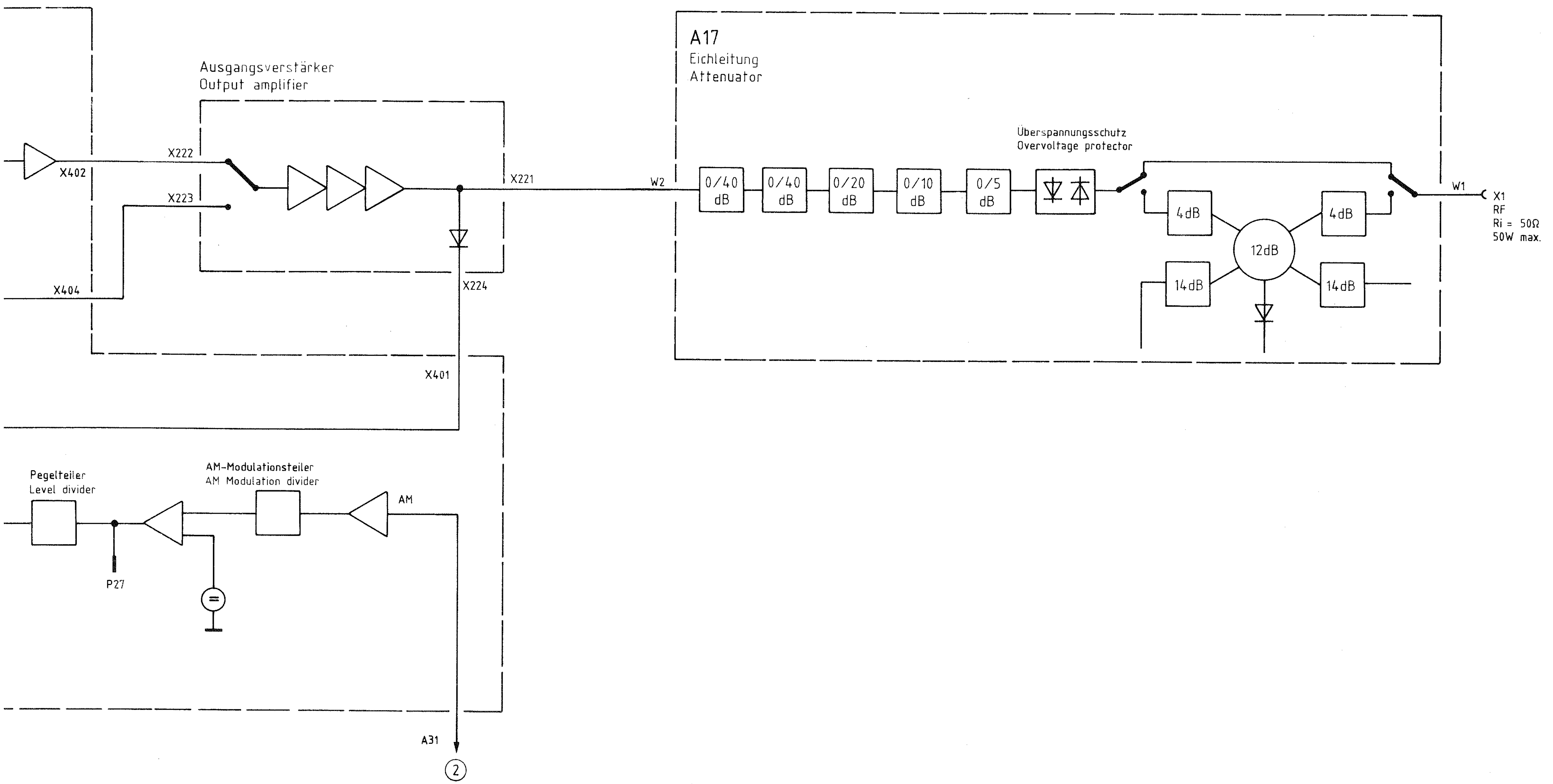
Zeichn.-Nr. 802.2020 FS Bl.5



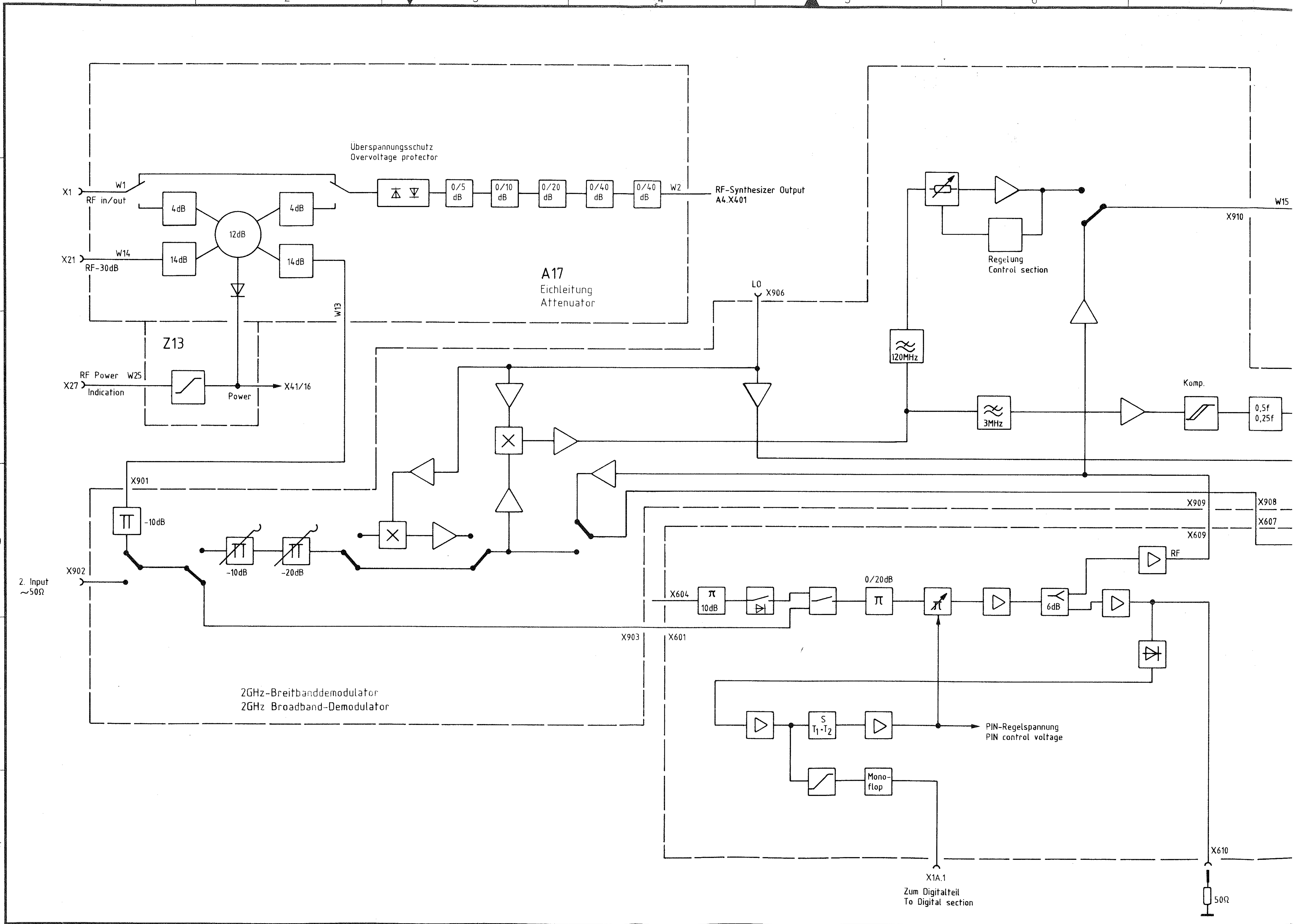
Zeichn.-Nr. 802.2020 FS Bl.5

PF 095.4115-0781

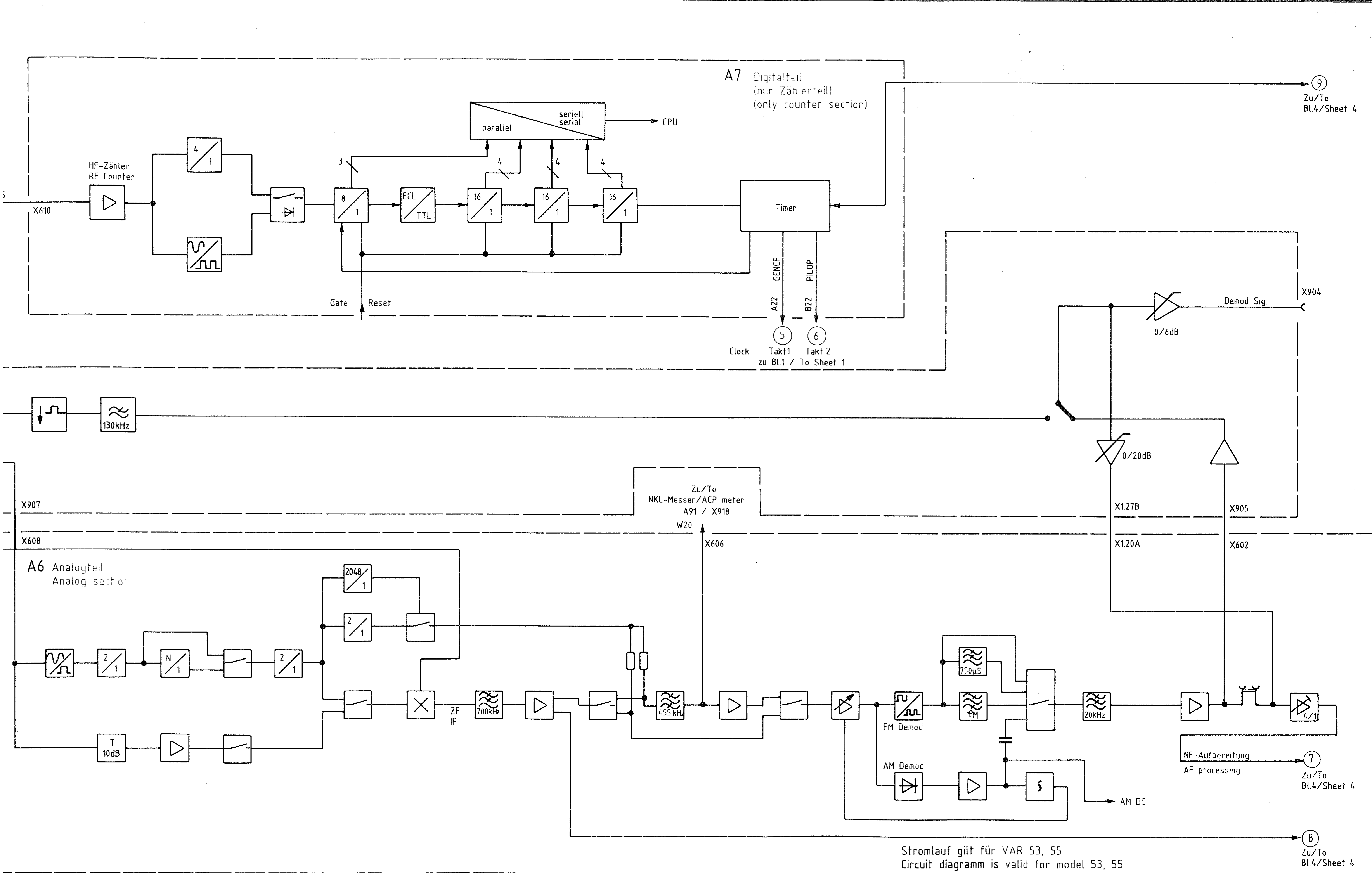


Stromlauf gilt für VAR 53, 55
Circuit diagramm is valid for model 53, 55

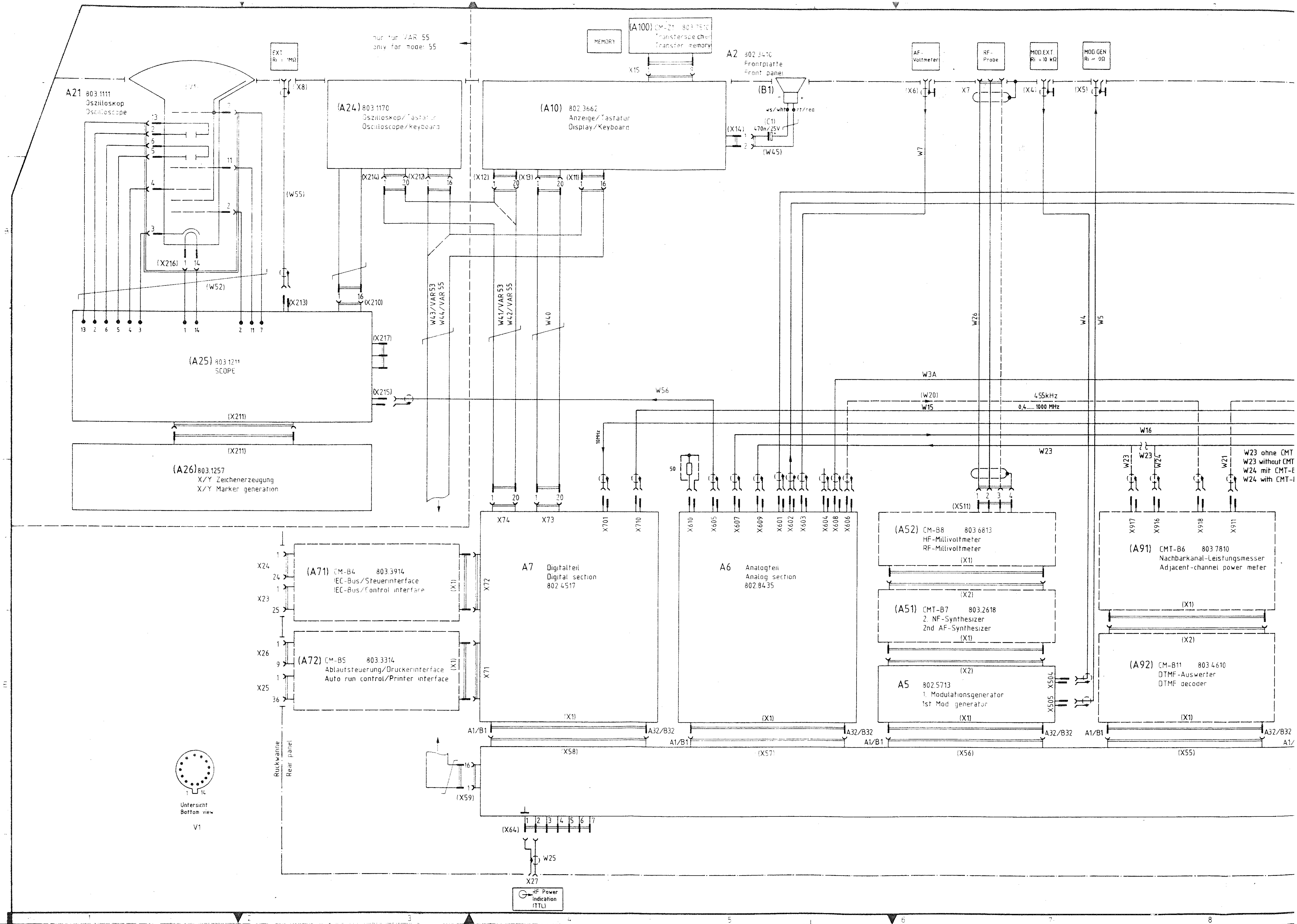
ROHDE&SCHWARZ	1KSA	Tag	Name	Benennung	Z	Zeichn.-Nr.	Blatt-Nr.
	Bearb.	10.87	CO	Radiocommunication Tester		802.2020 FS	5
	Gepr.						v. Bl.
Änd. Zust. / Änderungs-Mitteilung / Datum / Name	Norm			zu Gerät: CMT		reg. i. V. 802.2020 V	erste Z.

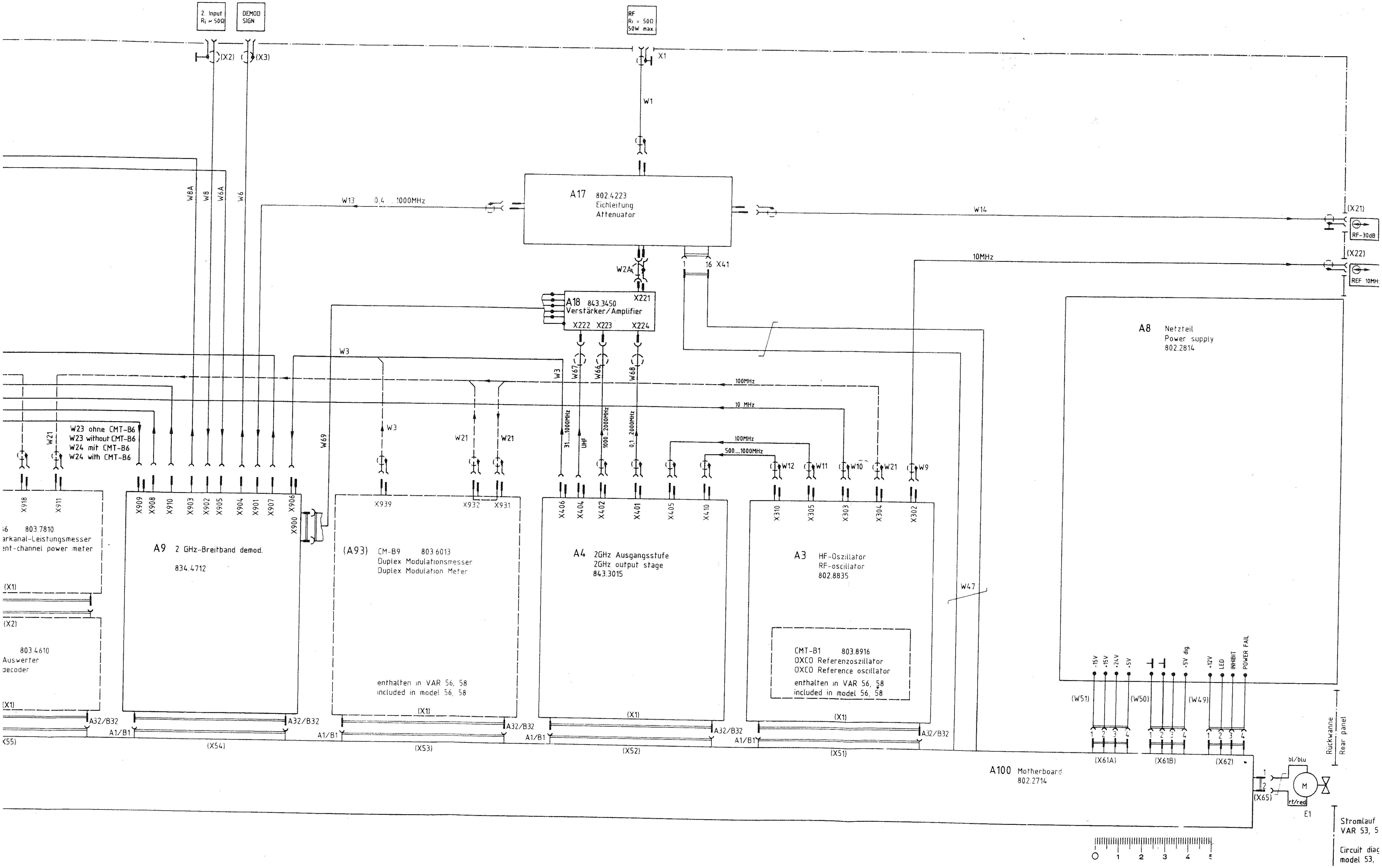


Überspannungsschutz
Overvoltage protector
X1
W1
RF in/out
4dB
12dB
4dB
0/5 dB
0/10 dB
0/20 dB
0/40 dB
0/40 dB
W2
RF-Synthesizer Output
A4.X401
X21
W14
RF-30dB
14dB
14dB
A17
Eichleitung
Attenuator
W13
LO
X906
Z13
RF Power W25
X27
Indication
Power
X41/16
X901
-10dB
-10dB
-20dB
X902
2. Input
~50Ω
X903
X601
X604
10dB
0/20dB
6dB
RF
2GHz-Breitbanddemodulator
2GHz Broadband-Demodulator
S
T_1-T_2
Mono-flop
PIN-Regelspannung
PIN control voltage
X1A.1
Zum Digitalteil
To Digital section
X610
50Ω
Regelung
Control section
120MHz
3MHz
Komp.
0,5f
0,25f
W15
X910
X909
X908
X607
X609



ROHDE & SCHWARZ					1KSA	Tag	Name	Benennung		Zeichn.-Nr.	Blatt-Nr.
					Bearb.	10.87	CO	Radiocommunication Tester	Z	802.2020 FS	6
					Gepr.						v. Bl.
	Änd Zust	Änderungs-Mitteilung	Datum	Name	Norm			zu Gerät: CMT		reg. i. V. 802.2020 V	erste Z.


nur für VAR 55
only for model 55
EXT
Ri = 1MΩ
MEMORY
(A100) CM-Z1 803.7510
Transferspeicher
Transfer memory
A2 802.3410
Frontplatte
Front panel
AF-Voltmeter
RF-Probe
MOD.EXT. Ri = 10 kΩ
MOD.GEN Ri ≈ 0Ω
A21 803.1111
Oszilloskop
Oscilloscope
(X8)
(A24) 803.1170
Oszilloskop/Tastatur
Oscilloscope/Keyboard
(A10) 802.3662
Anzeige/Tastatur
Display/Keyboard
(X15)
(B1)
ws/wht
rt/red
(C1)
470n/25V
(X14)
(W45)
(X6)
X7
(X4)
(X5)
W7
(W55)
(X214)
(X212)
(X12)
(X13)
(X11)
(X216)
(W52)
(X213)
(X210)
W43/VAR 53
W44/VAR 55
W41/VAR 53
W42/VAR 55
W40
W26
W4
W5
(A25) 803.1211
SCOPE
(X217)
(X215)
W56
(X211)
(A26) 803.1257
X/Y Zeichenerzeugung
X/Y Marker generation
W3A
(W20)
455kHz
W15
0,4...... 1000 MHz
W16
W23
10MHz
50
W23 ohne CMT
W23 without CMT
W24 mit CMT-
W24 with CMT-
W21
W24
(X511)
X74
X73
X701
X710
X610
X605
X607
X609
X601
X602
X603
X604
X608
X606
X917
X916
X918
X911
X24
X23
X26
X25
(A71) CM-B4 803.3914
IEC-Bus/Steuerinterface
IEC-Bus/Control interface
(A72) CM-B5 803.3314
Ablaufsteuerung/Druckerinterface
Auto run control/Printer interface
A7 Digitalteil
Digital section
802.4517
X72
X71
A6 Analogteil
Analog section
802.8435
(A52) CM-B8 803.6813
HF-Millivoltmeter
RF-Millivoltmeter
(A51) CMT-B7 803.2618
2. NF-Synthesizer
2nd AF-Synthesizer
A5 802.5713
1. Modulationsgenerator
1st Mod generator
X504
X505
(A91) CMT-B6 803.7810
Nachbarkanal-Leistungsmesser
Adjacent-channel power meter
(A92) CM-B11 803.4610
DTMF-Auswerter
DTMF decoder
(X1)
(X2)
A1/B1
A32/B32
(X58)
(X57)
(X56)
(X55)
(X59)
Rückwanne
Rear panel
Untersicht
Bottom view
V1
(X64)
W25
X27
RF Power Indication (TTL)
1
2
3
4
5
6
7
8



Stromlauf VAR 53, 5...

Circuit diag... model 53, ...

VERKLEINERUNG

A	38951	9.87	Co	
B	38951	10.87	IB	
C	38989	5.88	CO	
Änd.	Änderungs-Mitteilung	Datum	Name	

	Tag	Name
1KSA		
Bearb.	4.87	CO
Gepr.		
Norm		

ROHDE&SCHWARZ

Benennung: Radiocommunication Tester

Z

Zeichn. Nr. 802.2020 S...

zu Gerät: CMT

reg. i. V. 802.2020 V

Klebekante für Druckerzeugnis, durch diese Zone möglichst nur Leitungen führen

ROHDE&SCHWARZ

Service Documents

Wideband Demodulator

834.4712.02

Contents

5 Service Manual "2-GHz Wideband Demodulator"

(See circuit diagram 834.4712 S)

5.1 Circuit Description

5.1.1 Switching the RF Input (K1 to K7)

The input signals for this functional unit cover the frequency range between 0.4 MHz and 2000 MHz with a dynamic level range of approx. 40 dB for each input.

The 10-dB input attenuator at X901 serves to correct the offset in the dynamic input range so that, after the first relay, the dynamic range covers 5 to 500 mV for quantitative measurements.

The signal can be switched over for the following purposes:

Frequency	0.4 to 32 MHz	32 to 1000 MHz	1000 to 2000 MHz
Narrowband FM	to X903	to X903	to K3
Wideband FM	not possible	to K3	to K3
ΦM or AM	to X903	to X903	to K3

Signal processing via X903:
See analog unit.

Signal processing via K3:

The controller in the test assembly cuts in or out the 10-dB attenuator (K3 and K4) and the 20-dB attenuator (K5 and K7) so that 30 dB of the total dynamic range of 40 dB are absorbed. The controller obtains information on the level either from the user via special functions or from the power meter.

5.1.2 Converter Stage (K7 to K8)

Frequencies below 1 GHz are not converted in the first converter stage. The converter stage is bypassed by means of K7 and K8.

Frequencies above 1 GHz are converted to the IF by converting *twice* with the *same* LO frequency. The first of the two conversions is performed with U100.

Example:

Input frequency: 1500 MHz
IF to be obtained: 0.455 MHz

1st conversion:

1500 MHz - 749.7725 MHz = 750.2275 MHz
(RF in) (LO) (1st IF)

2nd conversion:

750.2275 MHz - 749.7725 MHz = 0.455 MHz
(1st IF) (LO) (2nd IF)

Equation of formation:

$f_w = (f_{in} - f_{IF}) : 2$

The 2nd IF to be obtained is 455 kHz for narrowband FM and wideband FM (130 kHz deviation).

The 2nd IF is 910 kHz for wideband FM (260 kHz deviation) and 1820 kHz for wideband FM (520 kHz deviation).

In the case of narrowband FM, the second conversion is performed on the analog unit. In the case of wideband FM, it is performed on the very same module.

5.1.3 2nd Converter Stage (K9, N210, U110, N130)

The 1st IF generated in the 1st converter stage is either taken via K9 and X908 to the analog unit (relay position 14: narrowband FM for RF >1 GHz, relay position 8: narrowband FM for RF < 1 GHz) or converted to the 2nd IF with U110.

The 2nd IF is divided up between the wideband demodulator path (LP 2.5 MHz, L103 ...) and the IF counter path (LP 120 MHz, L107...).

5.1.4 Counter Conditioning

The counter obtains the signal either from the 2nd converter stage or via X909 and N250, N240 from the analog unit. In the latter case, the signal is already controlled to a constant level.

The signal coming from the second converter stage passes the signal path V250, V251, N220, N230 and is taken via K10 to the counter which is connected to X910.

The signal path from V250 to N230 includes a level control ensuring a constant counter level.

Test point: V207/I

Controller: N200, 210

Control element: V250 and V251
(Dual-gate MOS FET with gain setting at G2)

5.1.5 Wideband Demodulator

The 2nd IF is amplified in V600 and V601, limited to TTL level in N600 and, in D620 and D630, taken through a divide-by-4 (for IF 1820 kHz), divide-by-2 (for IF 910 kHz) or divide-by-1 circuit (for IF 455 kHz). The subsequent monoflop 8T20 (D635) constitutes the FM demodulator (function description of the analog unit also applies analogously).

The preamplifier stages, the TTL delimiter and the demodulator can be switched off by means of D600.

Part of the IF signal is decoupled in V601 and taken to an auxiliary demodulator (V750, D730, D740, D750). This demodulator delivers a TTL 1 signal at its output D750, pin 5 when the IF level exceeds a minimum level. This signal switches off the output signal of the test demodulator (D635 to N710) in case no sufficient IF level is present. The two monoflops D740 cause a rising IF level to connect the AF path through after a delay of approx. 200 µs and a falling IF level to switch off the AF path immediately. This prevents the noise of the FM demodulator from getting to the test points without input signal (squelch). This squelsh function can be switched off at D750.

5.1.6 Demodulated Signal

D720 is used to switch between the demodulated signal (X905) originating from the basic model and the demodulated signal of the wideband deviation meter. The signal is taken via the motherboard plug B27 to the analog unit to be weighted at the test points. The demodulated signal is taken to the front panel via X904.

Depending on the deviation meter selected, the ratio of the applied voltage to the deviation varies.

Narrowband demodulator:
$5V_p$ for 100 kHz deviation

Wideband demodulator 130 kHz deviation:
5 V_p for 100 kHz deviation

Wideband demodulator 260 kHz deviation:
2.5 V_p for 100 kHz deviation.

Wideband demodulator 520 kHz deviation:
1.25 V_p for 100 kHz deviation

5.1.7 LO Paths

Depending on the options installed in the test assembly, the LO signal obtained via X906 originates either from the RF synthesizer or from the duplex synthesizer and has a level of approx. 0 dBm. It is distributed to 3 destinations with the correct impedance:

- The LO of the basic model is taken via X907 to the analog unit with approx. 0 dBm.
- The LO for the 1st converter stage is taken via N302 and N303 to the 1st converter stage U100 with 10 dBm.
- The LO for the 2nd converter stage is taken via N301 to U110 with 7 dBm.

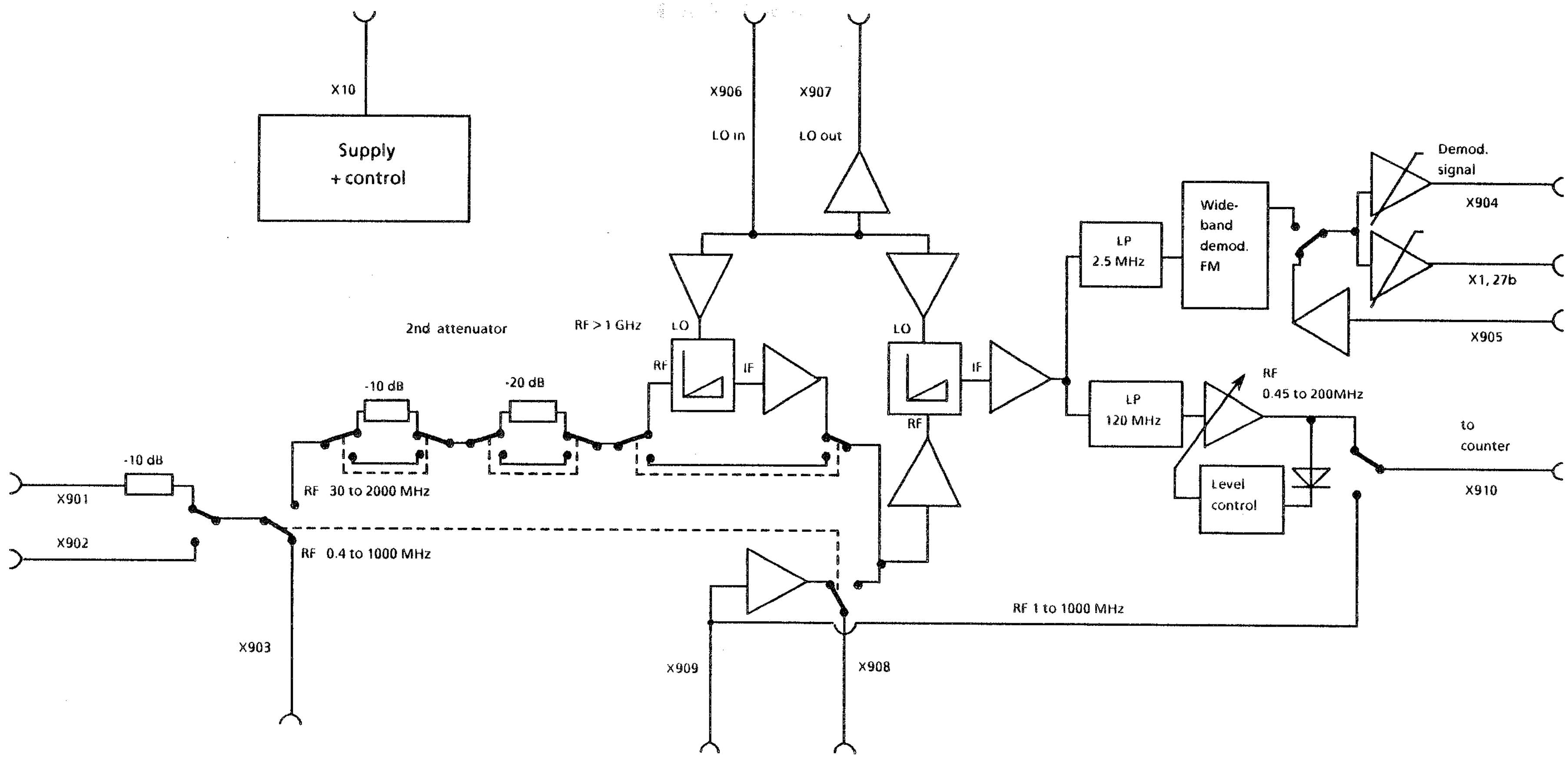


Fig. 5-1 Block diagram of 2-GHz wideband demodulator

5.2 Checking and Adjustment

Required equipment:

2 power supplies (+ 5/ ± 15/ + 24 V)	e.g. NGT 35
2 signal generators 0.1 to 1000 MHz	e.g. SMPD
AF generator	e.g. SPN
Spectrum analyzer 0 to 1000 MHz	e.g. FSA
Power meter	
Oscilloscope	e.g. BOL
RF voltmeter	e.g. URV5
AC/DC voltmeter	e.g. UDL44

5.2.1 Checking DC Voltages and Currents

Purpose	Test parameters	Test point	Measurement result
Derived DC voltages	Apply supply and 10 V_{ref}	MP10 MP5 MP1	- 5V ± 0.3 V - 5V ± 0.1 V + 5V. ± 0.1 V
Supply currents	Set bit 23 = 1, do not connect wideband amplifier	X1, 13ab (+ 5 V) X1, 17ab (+ 15 V) X1, 19ab (-15 V) X1, 15ab (+ 24 V) X1, 25ab (+ 10 V)	10 mA ± 2 mA 600 mA ± 40 mA 90 mA ± 10 mA 7 mA ± 2 mA 0 mA ± 0.1 mA
Operating voltage for separate wideband amplifier	Set bit 3 = 0 [1]	X10, 2b and X1, 23b X10, 1a and X1, 22b X10, 3a and X1, 28a	- 15 V ±0.2 V [-15 V ±0.2 V] + 15 V ±0.2 V [0V] + 24 V ±0.2 V [0V]
Switching voltage for wideband amplifier	Set bit 1 = 0 [1]	X10, 2a and X1, 24b X10, 3b and X1, 25b	- 15 V ±1 V [+ 15 V ±1 V] + 15 V ±1 V [- 15 V ±1 V]
Poll of options	Set bit 4 = 0 [1]	X1, 21b	0 V ±0.5 V [+ 5 V ±1 V]

5.2.2 Checking RF Signal Paths without Frequency Conversion

Input	Output	Test Parameters	Measurement result
Signal generator in X901 (+10 dBm)	Power meter at X903	---	Frequency response in 100-MHz steps -10 dB ± 1 dB
X902	X903	---	+0 dB ± 1 dB
X901	X908	Attenuation 2nd attenuator 0 dB 10 dB 20 dB 30 dB	Frequency response in 20-MHz steps -16 dB ± 2 dB -26 dB ± 2 dB -36 dB ± 2 dB -46 dB ± 2 dB
X909 (-12 dBm)	X910	---	Frequency response in 50-MHz steps +6 dB ± 3 dB
X906 (-3 dBm)	X907	---	0 dB ± 2 dB
X909 (-13 dBm)	X908	---	0 dB ± 3 dB
Signal generator (5 mV) in X652 (unmodulated)	Voltmeter at MP4	Remove jumper from X652/653 and X650/651. Bit 19 = 1	f = 100 kHz: V_{MP4}/V_{X652} >35 dB 500 kHz: >35 dB 1000 kHz: >35 dB 3000 kHz: >35 dB

5.2.3 Checking RF Signal Paths with Frequency Conversion

Input	Test parameters	Output	Test parameters	Measurement	Measurement result
Signal generator (f_{RF}) in X901 (-17 dBm)	Signal generator (f_{LO}) in X906 frequency: $f_{LO} = f_{RF}/2 - 3$ MHz	Analyzer Span 0 to 12 MHz X908	Setting 2nd attenuator 0 dB 10 dB 20 dB 30 dB	Frequency response 1000 to 2000 MHz in RF steps of 20 MHz	 -16 dB ±3 dB -26 dB ±3 dB -36 dB ±3 dB -46 dB ±3 dB
in X902 (-27 dBm)	"	"	30 dB	"	-36 dB ±3 dB
in X902 (-13 dBm, 800 MHz)	LO = 799.9 MHz 799.5 MHz 799 MHz 790 MHz 780 MHz 750 MHz 700 MHz 680 MHz 685 MHz 600 MHz 500 MHz	Analyzer Span 0 to 300 MHz at X210	0 dB, set 1-GHz path plug in jumper X610	IF = 0.1 MHz 0.5 MHz 1 MHz 10 MHz 20 MHz 50 MHz 100 MHz 120 MHz 125 MHz 200 MHz 300 MHz	+ 1 dB ±3 dB +3 dB ±3 dB +3 dB ±3 dB +3dB ±3 dB +2 dB ±3 dB +2 dB ±3 dB +2 dB ±3 dB +2 dB ±3 dB -2 dB ±4 dB -34 dB ±8 dB >-55 dB
	LO = 799.9 MHz 799.5 MHz 799 MHz 798.5 MHz 798 MHz 797.5 MHz 797 MHz 795 MHz 790 MHz	Analyzer at X653 Span 0 to 10 MHz	0 dB 1-GHz path jumper on test plug X151/150	IF = 0.1 MHz 0.5 MHz 1 MHz 1.5 MHz 2 MHz 2.5 MHz 3 MHz 5 MHz 10 MHz	+ 2 dB ±3 dB +3 dB ±3 dB +3 dB ±3 dB +3 dB ±3 dB +3 dB ±3 dB +2 dB ±3 dB +1 dB ±3 dB -27 dB ±3 dB >-55 dB ±3 dB

5.2.4 Checking and Adjustment of FM Demodulator

Measurement target	Input	Test parameters	Output	Adjustment/measurement
Comparator (N600) Multiplexer (D630) Monoflop (D635)	Connect signal generator to X652 (10 mV, 455 kHz)	Bit 17 18 19 24 0 0 1 0	Voltmeter at X650 Scope at X650	Adjust for V_{DC} = 0 V ±50 mV using R624, AC component: ±5V ±0.1 V square wave Frequency = 2 x input frequency (910 kHz) Pulse duty factor: approx. 1:1
Signal path X651 → X904	AF generator in X651 ($V = 1 V_{rms}$, $R_i \leq 10\Omega$, f = 1 kHz)	Bit 19 20 21 24 1 1 0 0	AC voltmeter at X904 and X1, 27b	f = 1 kHz : 0 dB (reference) 10 kHz : 0 dB ± 0.1 dB 20 kHz : 0 dB ± 0.1 dB 50 kHz : 0 dB ± 0.2 dB 80 kHz : 0 dB ± 0.2 dB 100 kHz : 0 dB ± 0.2 dB 130 kHz : 0 dB ± 0.4 dB 175 kHz : -6 dB ± 2 dB 455 kHz : >-70 dB
	$V = 100 mV_{rms}$	19 20 21 24 1 1 1 0	"	"
Overall function of wideband demodulator	Sig. gen. in X652 20 mV, f_{mod} = 1 kHz, dev. = 130 kHz, f = 455 kHz	Bit 17 18 19 20 21 24 0 0 1 1 0 0	AC/DC voltmeter at X904	AC adjustment with R711 : 4.6 V ± 10 mV DC adjustment with R624 : 0 V ± 5 mV
	f[kHz] dev. [kHz] 455 130 910 260 1820 520 455 0 910 0 1820 0	Bit 17 18 0 0 1 0 1 1 0 0 1 0 1 1	AC voltmeter at X904	V_{AC} distortion $4.6 V_{rms}$ ± 0.04 V < 0.3% $2.3 V_{rms}$ ± 0.02 V < 0.3% $1.15 V_{rms}$ ± 0.01 V <2.8 mV *) <1.5 mV *) <1.2 mV *) *) spurious FM measurement (bandwidth < 200 kHz, > 100 kHz)
Squelch D730, 740, 750)	f = 455 kHz dev. = 130 kHz f_{mod} = 1 kHz V = 2 mV	Bit 17 18 19 20 21 24 0 0 1 1 0 1	AC voltmeter at X904	Set squelch response threshold to this limit, ie $4.6 V_{rms}$ or < 1 mV

5.2.5 Checking and Adjustment of Counter Path

Input	Test parameters	Output	Measurement / adjustment
Sig. gen in X150 V = 100 mV, f = 1 MHz	Bit 11 12 Remove 1 0 jumper X150/151	RF voltmeter (Ri = 50Ω) at X910	Adjust for 100 mV ± 20 mV using R250
		DC voltmeter at MP11/12	V_{DC} = 100 mV ± 20 mV
V = 3 mV or 200 mV	"	RF voltmeter at X910	
f = 0.4 MHz			V_{RF} = 100 mV ± 40 mV
1 MHz			100 mV ± 40 mV
10 MHz			100 mV ± 40 mV
60 MHz			100 mV ± 40 mV
120 MHz			100 mV ± 40 mV
f = 50 MHz	Bit 2 11 12 22	DC voltmeter at X1, 26a	Indication of over/undervoltage
V = 5 mV	0 1 0 1		V_{DC} = 5 V ± 1 V
V = 1 mV	0 1 0 1		V_{DC} = 0 V ± 1 V
V = 300 mV	0 1 0 0		V_{DC} = 5 V ± 1 V
V = 30 mV	0 1 0 0		V_{DC} = 0 V ± 1 V

5.3 Troubleshooting

In the event that faults occur, they can be traced by checking according to section 5.2.

5.4 Interface Data

5.4.1 Hardware Interface

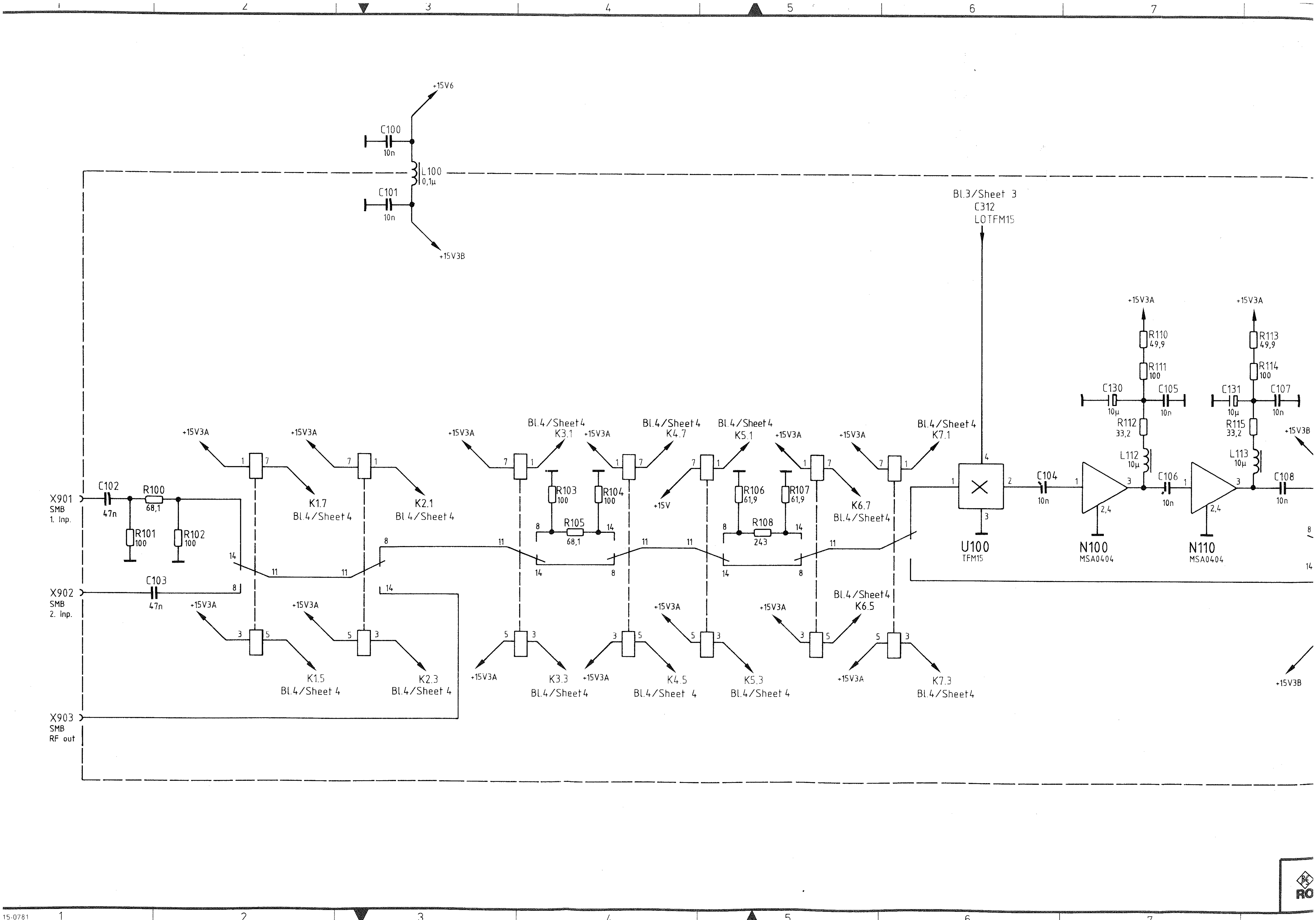
Plug	I:input O:output	Meaning	Data	Remark
X1, 13ab 17ab 19ab 15ab	I I I I	Supply Supply Supply Supply	+ 5 V ± 0.5 V, < 110 mA + 15 V ± 0.5 V, < 650 mA - 15 V ± 0.5 V, < 50 mA + 24 V ± 0.5 V, < 300 mA	
X1, 8a 10ab 6a 21b 26a	I I I O O	Data Clock Strobe Opt. poll DIANG	TTL TTL TTL TTL TTL	 Wired Or Counter level, Wired Or
X1, 25a	I	10 V reference	10 V ± 1 mV	
X1, 27b	O	Demod out	Analog -5 V_p to + 5 Vp f = 0 to 130 kHz	
X1, 24b with X10, 2a X1, 25b with X10,3b	O O	PU1 PU2	+ 15 V ± 1 V or -15 V ± 1 V, <50 mA -15 V ± 1 V or + 15 V ± 1 V, <50 mA	inverse signs
X1,23b with X10,2b X1, 22b with X10, 1a X1, 28b with X10,3a	O O O	external supply switched external supply switched external supply	-15 V ±0.5 V, < 10 mA + 15 V ±0.5 V, < 250 mA + 24 V ± 5 V, < 150 mA	

Plug	I:Input O:Output	Meaning	Data
X905	I	Demod	analog: ±5 Vp f = 0 to 20 kHz
X904	O	Demod	analog: ±6.5 Vp f = 0 to 130 kHz
X910	O	Count.	V ≈ 100 mV (< 150 mV) f = 0.4 to 1000 MHz
X906	I	LO	Ri ≈ 50 Ω V: -6 to 0 dBm f = 31.25 to 1000 MHz
X907	O	LO	Ri ≈ 75Ω V: -6 to 0 dBm f = 31.25 to 1000 MHz
X909	I	RF	Ri ≈ 50 Ω V: < 60 mV f = 0.1 to 1000 MHz
X908	O	RF/IF	Ri ≈ 50 Ω V: < 60 mV f = 0.1 to 1000 MHz
X901	I	1st input	Ri ≈ 50 Ω V: < 1.5 V f = 0.1 to 2000 MHz
X902	I	2d input	Ri ≈ 50 Ω V: < 0.5 V f = 0.1 to 2000 MHz
X903	O	RF	Ri ≈ 50 Ω V: < 0.5 V f = 0.1 to 1000 MHz

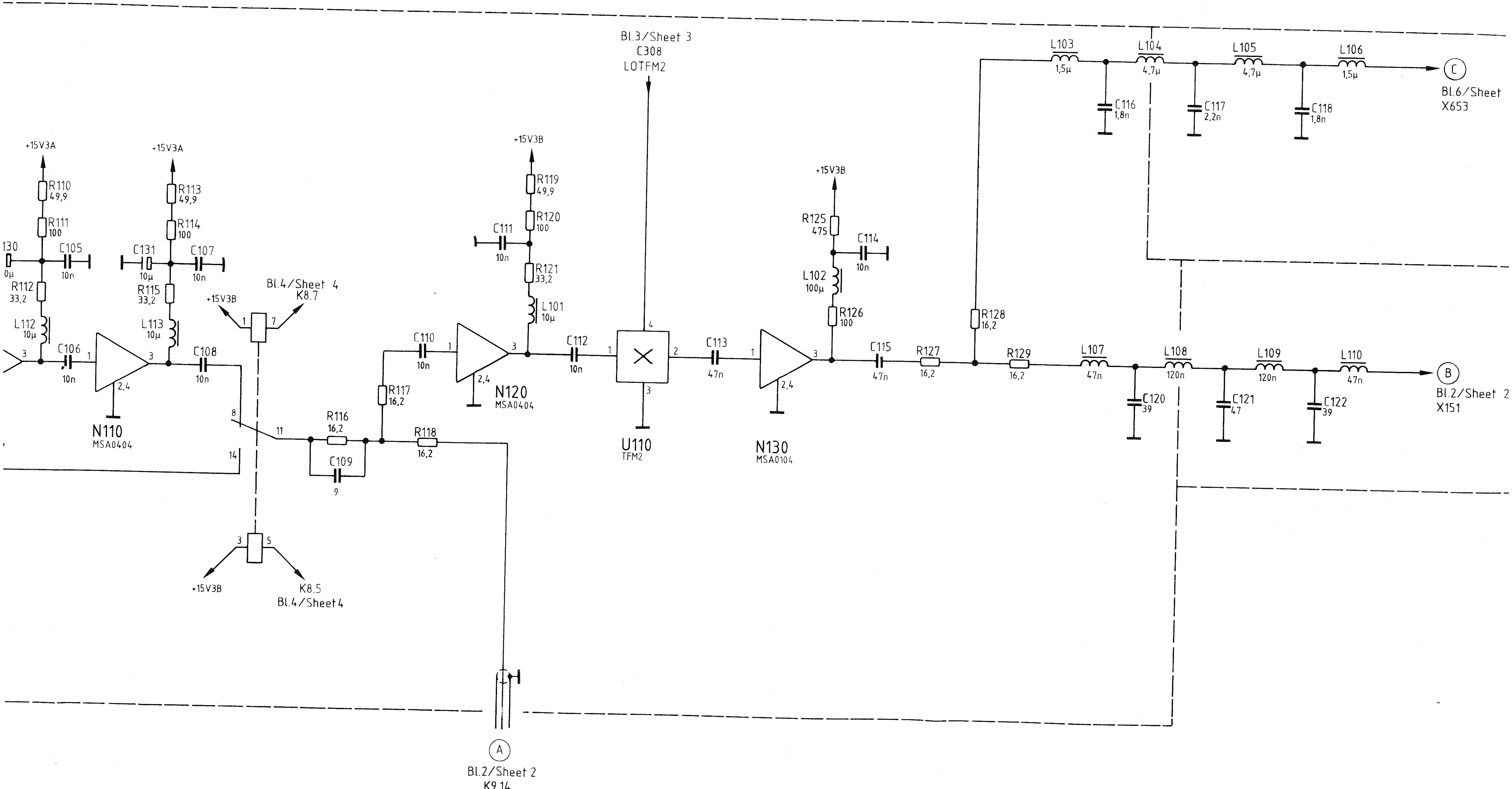
5.4.2 Software Interface

Bit	Designation	Function	Data
1	1-2 GHz	Switchover from 1 to 2 GHz of (external) wideband amplifier	0: 1 GHz PU1 = -15 V / PU2 = +15 V 1: 2 GHz PU1 = +15 V / PU2 = -15 V
2	DIANG	Switching on/off of counter message	0: Signal line on 1: Signal line off
3	Output. off	Switching on/off of operating voltage for the (separate) wideband amplifier	0: On 1: Off
4	Opt. poll	Bit for detection of module n.c.	
5	---	n.c.	
6	---	n.c.	
7	---	n.c.	
8	---		
9 10	K 9.5 K 9.7	Switch RF/IF	Bit 9 10 0 0 idle state 1 0 signal path X909 → X908 0 1 RF or IF → X908 1 1 not permitted
11 12	K 10.5 K 10.7	Switch Count.	Bit 11 12 0 0 idle state 0 1 signal path X909 → X910 1 0 internal counter path → X910 1 1 not permitted
13	---	n.c.	
14	---	n.c.	
15	---	n.c.	
16	---	n.c.	
17 18	Deviation 0 Deviation 1	Programmable divider (1:1 / 2/4) of IF ahead of wideband demodulator	Bit 17 18 0 0 130 kHz deviation 0 1 no function 1 0 260 kHz deviation 1 1 520 kHz deviation
19	Demod on	On/off switch for wideband demodulator	0:off 1:on
20	Demod wideband	Switchover from narrowband (analog section) to wideband demodulation	0:narrowband 1:wideband
21	20 dB on	On/off switch of 20-dB amplifier for DEMOD signal	0:20 dB amplification 1:no amplification
22	Count. H/L detect.	Selector switch for over/undervoltage detector	0:overvoltage detector 1:undervoltage detector
23	LO	On/off switch for LO	0:off 1:on
24	Squelch	On/off switch for squelch	0:squelch off 1:squelch active

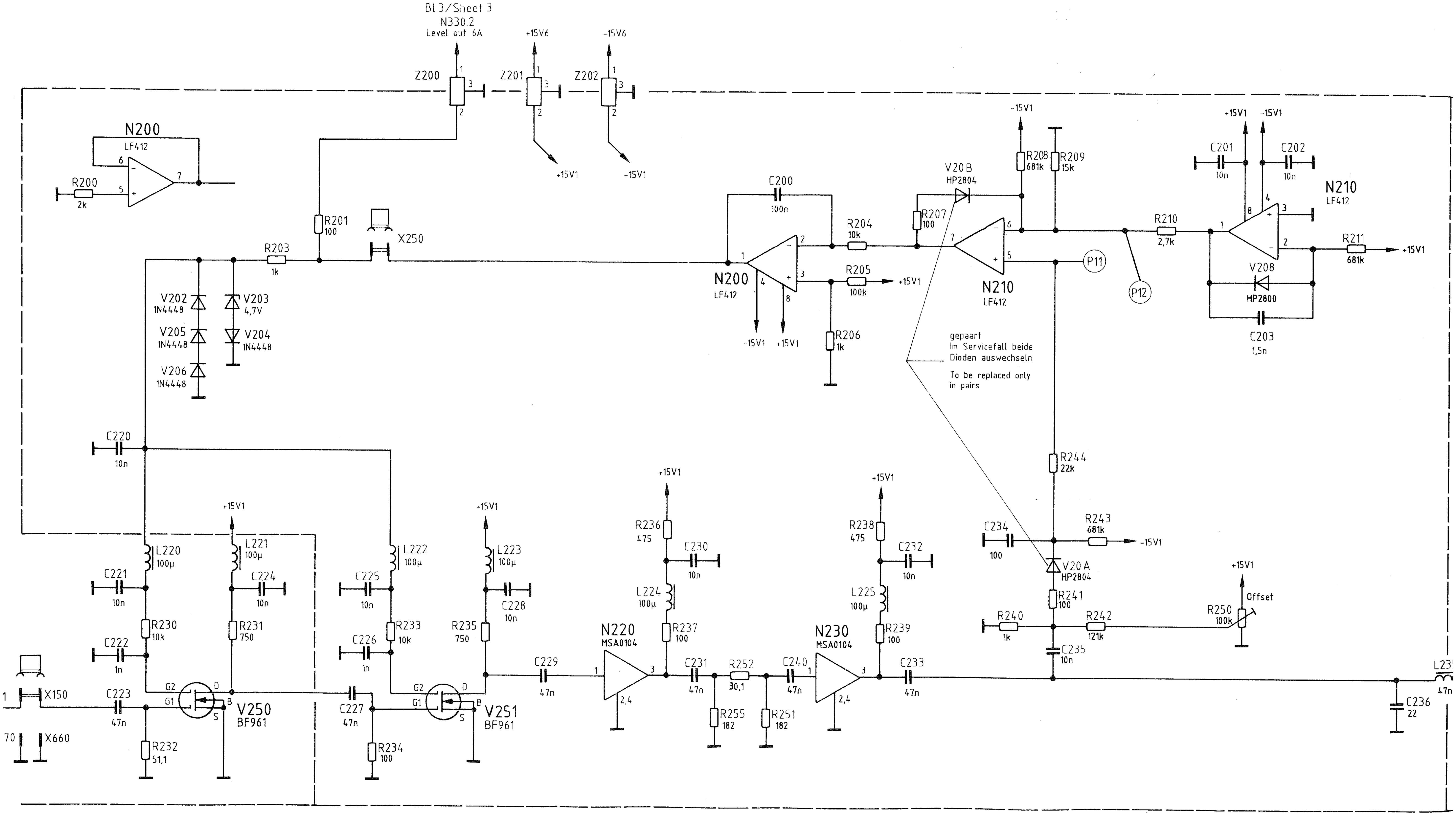
Bit	Designation	Function	Data
25 26	K1.7	Input selector switch	Bit 25 26 0 0 idle state 1 0 input X901 0 1 input X902 1 1 not permitted
27 28	K2.1 K2.3	Switch: signal to 2nd attenuator or to X903	Bit 27 28 0 0 idle state 0 1 signal X901/2 → X903 1 0 signal X901/2 → 2nd att. 1 1 not permitted
29 30 31 32	K 3.1 K 3.3 K 4.7 K 4.5	10-dB attenuator	Bit 29 30 31 32 0 0 0 0 idle state 0 1 0 1 0 dB 1 0 1 0 -10 dB All other combinations are not permitted
33 34 35 36	K 5.1 K 5.3 K 6.5 K 6.7	20-dB attenuator	Bit 33 34 35 36 0 0 0 0 idle state 0 1 1 0 0 dB 1 0 0 1 -20 dB all other combinations are not permitted
37 38 39 40	K 7.1 K 7.3 K 8.5 K 8.7	Demodulation RF < 1 GHz or RF > 1 GHz	Bit 37 38 39 40 0 0 0 0 idle state 1 0 0 1 RF < 1 GHz 0 1 1 0 RF > 1 GHz All other combinations are not permitted



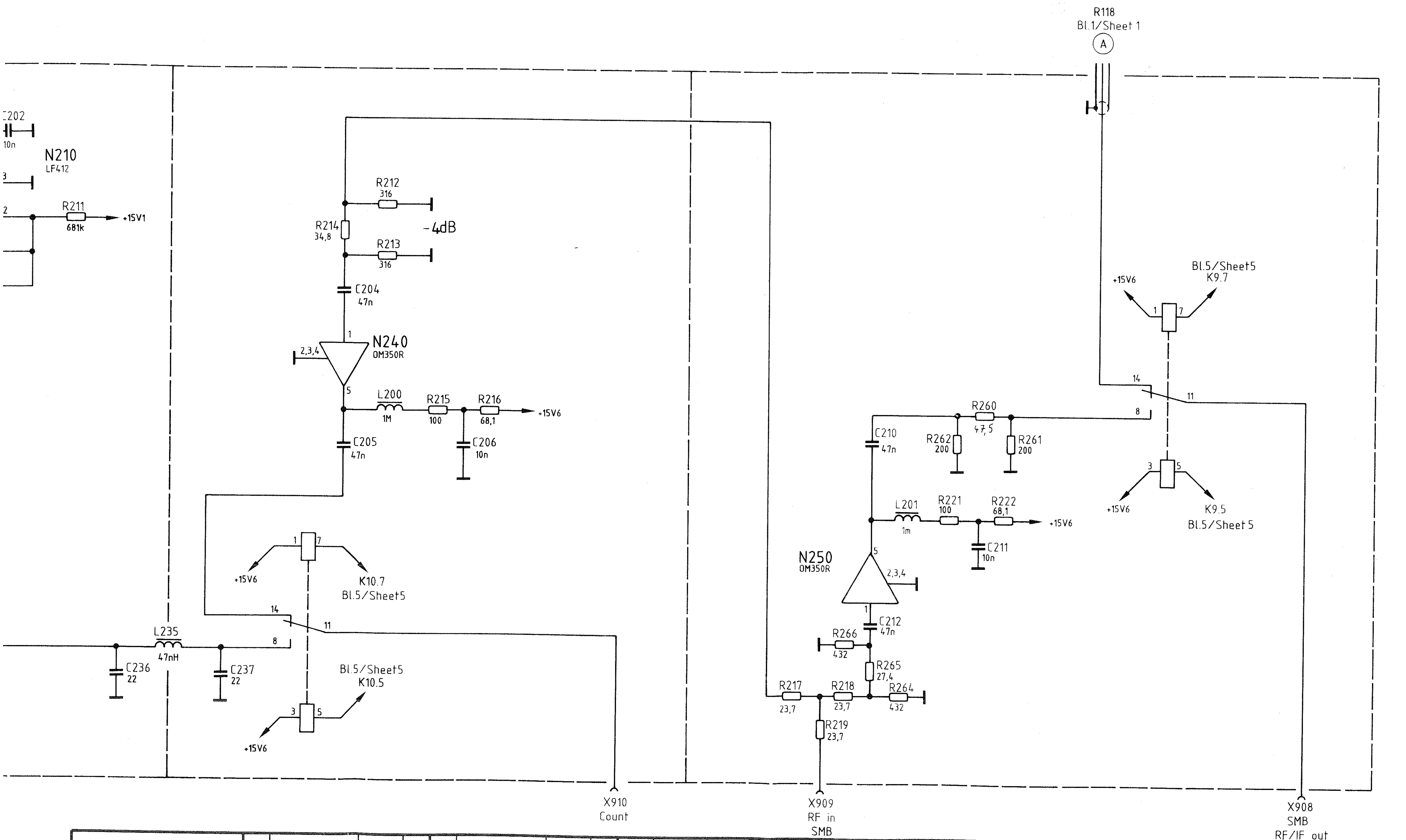
+15V6
C100
10n
L100
0,1µ
C101
10n
+15V3B
Bl.3/Sheet 3
C312
LOTFM15
X901
SMB
1. Inp.
C102
47n
R100
68,1
R101
100
R102
100
X902
SMB
2. Inp.
C103
47n
X903
SMB
RF out
+15V3A
K1.7
Bl.4/Sheet 4
K2.1
Bl.4/Sheet 4
K1.5
Bl.4/Sheet 4
K2.3
Bl.4/Sheet 4
Bl.4/Sheet 4
K3.1
R103
100
R104
100
R105
68,1
K3.3
Bl.4/Sheet 4
Bl.4/Sheet 4
K4.7
K4.5
Bl.4/Sheet 4
Bl.4/Sheet 4
K5.1
+15V
R106
61,9
R107
61,9
R108
243
K5.3
Bl.4/Sheet 4
K6.7
Bl.4/Sheet 4
Bl.4/Sheet 4
K6.5
Bl.4/Sheet 4
K7.1
K7.3
Bl.4/Sheet 4
U100
TFM15
C104
10n
N100
MSA0404
R110
49,9
R111
100
C130
10µ
C105
10n
R112
33,2
L112
10µ
C106
10n
N110
MSA0404
R113
49,9
R114
100
C131
10µ
C107
10n
R115
33,2
L113
10µ
C108
10n



ROHDE&SCHWARZ		1KSA	Tag	Name	Benennung		Zeichn.-Nr.
Änd. Zust. / Änderungs-Mitteilung / Datum / Name	Änd. Zust. / Änderungs-Mitteilung / Datum / Name	Bearb.	4.87	HO	2GHz Breitbanddemodulator 2GHz Broadband demodulator	Z	834.4712 S
		Gepr.					
		Norm			zu Gerät:		reg. i. V. 834.0000 V

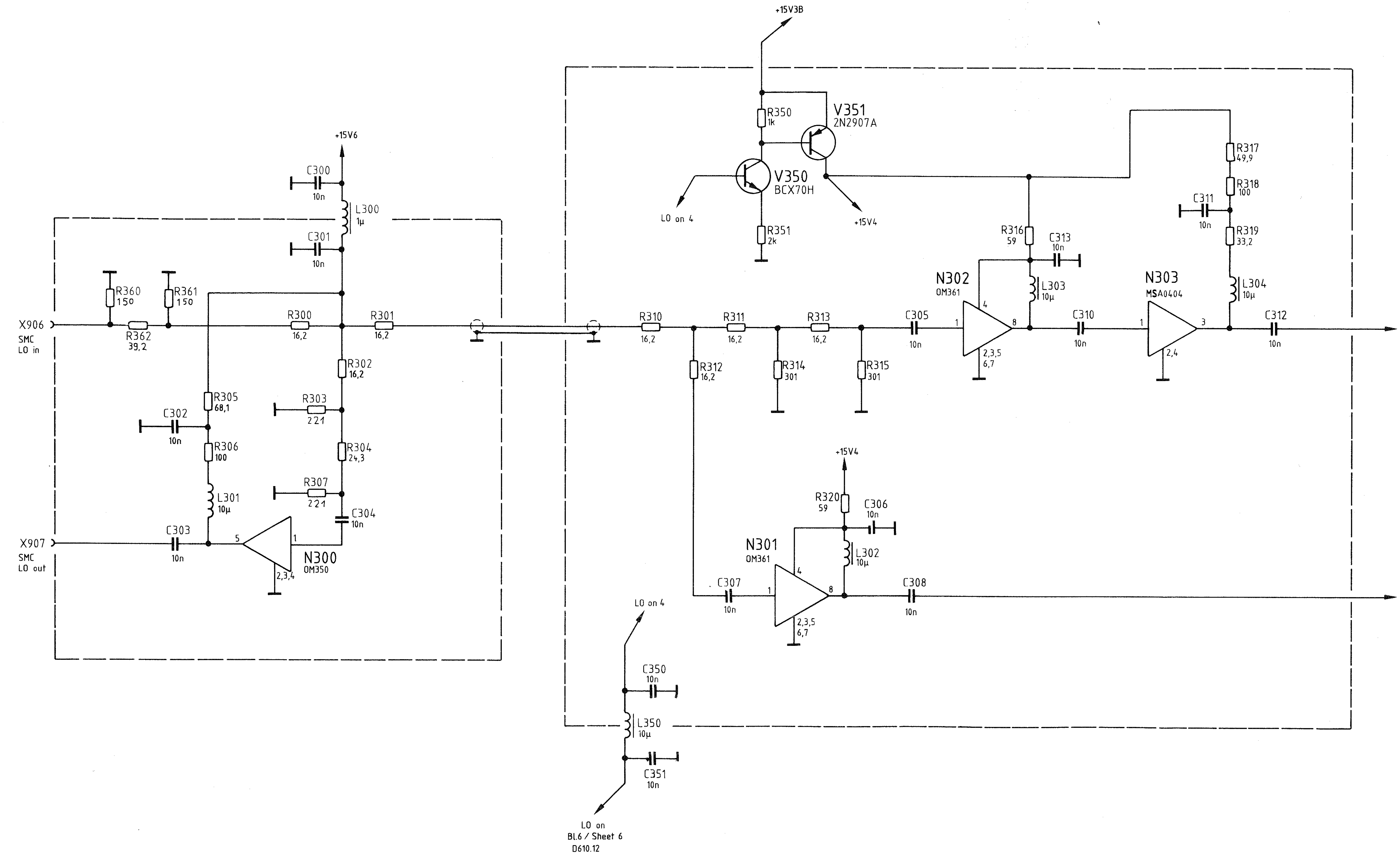


Bl.3/Sheet 3
N330.2
Level out 6A
+15V6
-15V6
Z200
Z201
Z202
+15V1
-15V1
N200
LF412
R200
2k
R201
100
R203
1k
X250
V202
1N4448
V203
4,7V
V205
1N4448
V204
1N4448
V206
1N4448
C200
100n
R204
10k
R205
100k
R206
1k
V20B
HP2804
R207
100
R208
681k
R209
15k
N210
LF412
P11
P12
R210
2,7k
C201
10n
C202
10n
R211
681k
V208
HP2800
C203
1,5n
gepaart
Im Servicefall beide
Dioden auswechseln
To be replaced only
in pairs
C220
10n
R244
22k
C234
100
R243
681k
V20A
HP2804
R241
100
R240
1k
R242
121k
R250
100k
Offset
C235
10n
L220
100µ
L221
100µ
L222
100µ
L223
100µ
C221
10n
C224
10n
C225
10n
C228
10n
R230
10k
R231
750
R233
10k
R235
750
C222
1n
C226
1n
X150
C223
47n
C227
47n
V250
BF961
V251
BF961
R232
51,1
R234
100
X660
C229
47n
N220
MSA0104
R236
475
C230
10n
L224
100µ
R237
100
C231
47n
R252
30,1
R255
182
R251
182
C240
47n
N230
MSA0104
R238
475
C232
10n
L225
100µ
R239
100
C233
47n
C236
22

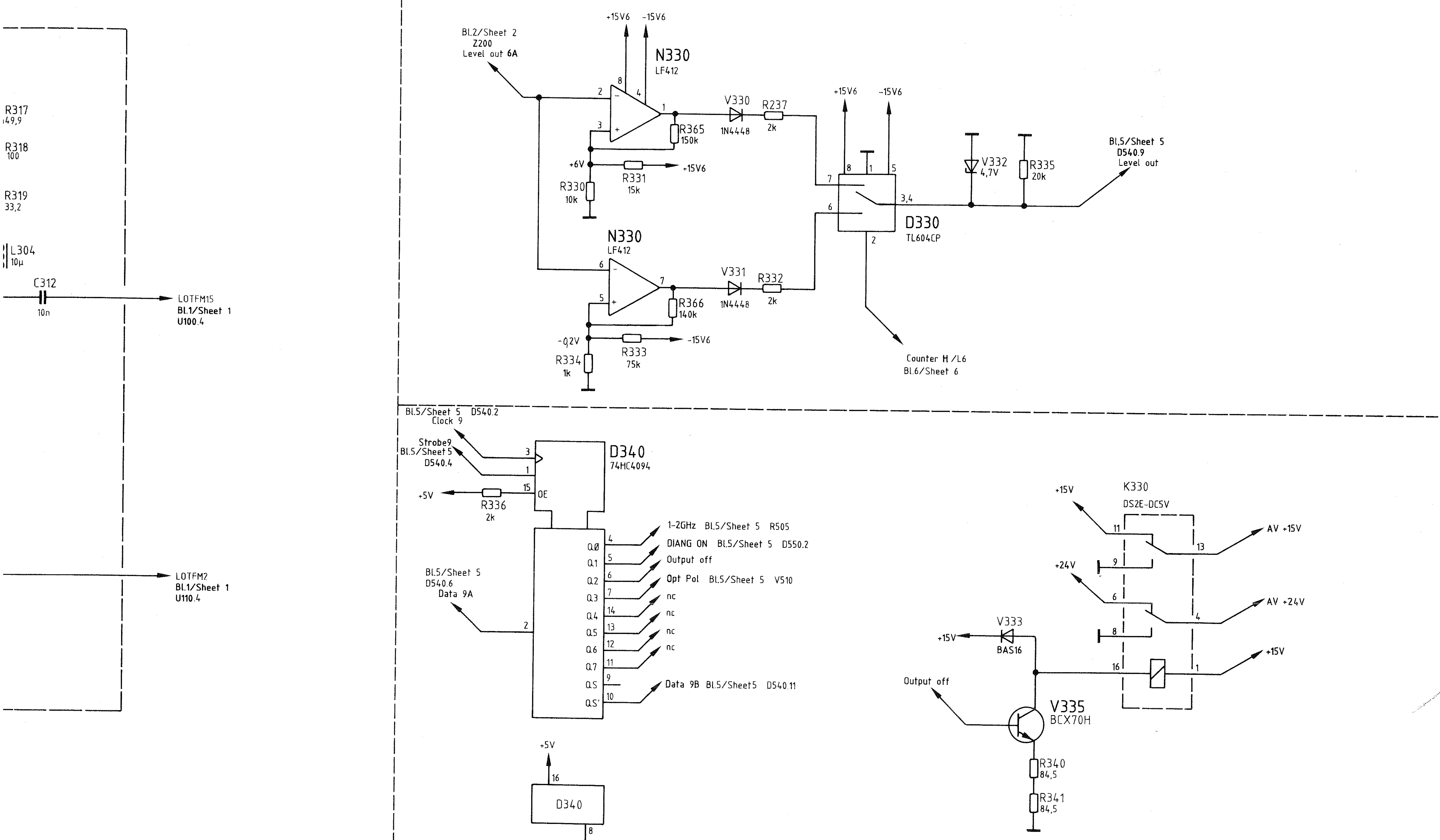


ROHDE&SCHWARZ						1KSA	Tag	Name	Benennung		Zeichn.-Nr.	Blatt-Nr.
						Bearb.	5.87	HO	2GHz Breitbanddemodulator 2GHz Broadband demodulator	Z	834.4712 S	2
						Gepr.						v. 7 Bl.
Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name	Norm	zu Gerät		reg. i. V. 834.0000 V	erste Z.

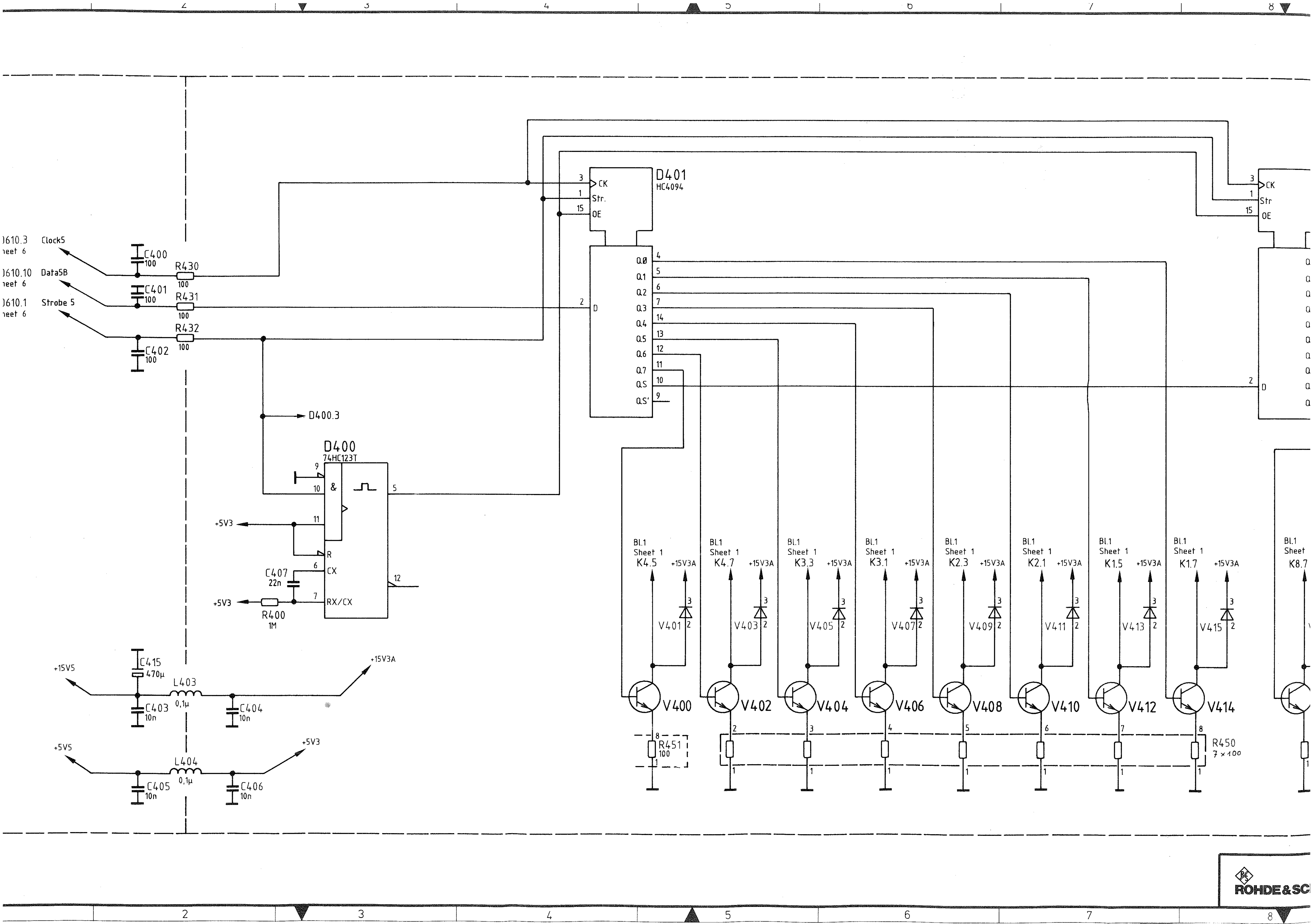
8 9 10 11 12 13 14


+15V3B
V351
2N2907A
R350
1k
V350
BCX70H
LO on 4
+15V4
R351
2k
R317
49,9
R318
100
C311
10n
R319
33,2
R316
59
C313
10n
N302
OM361
L303
10µ
N303
MSA0404
L304
10µ
+15V6
C300
10n
L300
1µ
C301
10n
R360
150
R361
150
X906
SMC
LO in
R362
39,2
R300
16,2
R301
16,2
R310
16,2
R311
16,2
R313
16,2
C305
10n
C310
10n
C312
10n
R302
16,2
R312
16,2
R314
301
R315
301
R305
68,1
R303
221
C302
10n
R306
100
R304
24,3
R307
221
L301
10µ
C304
10n
+15V4
R320
59
C306
10n
X907
SMC
LO out
C303
10n
N300
OM350
N301
OM361
L302
10µ
C307
10n
C308
10n
LO on 4
C350
10n
L350
10µ
C351
10n
LO on
BL6 / Sheet 6
D610.12

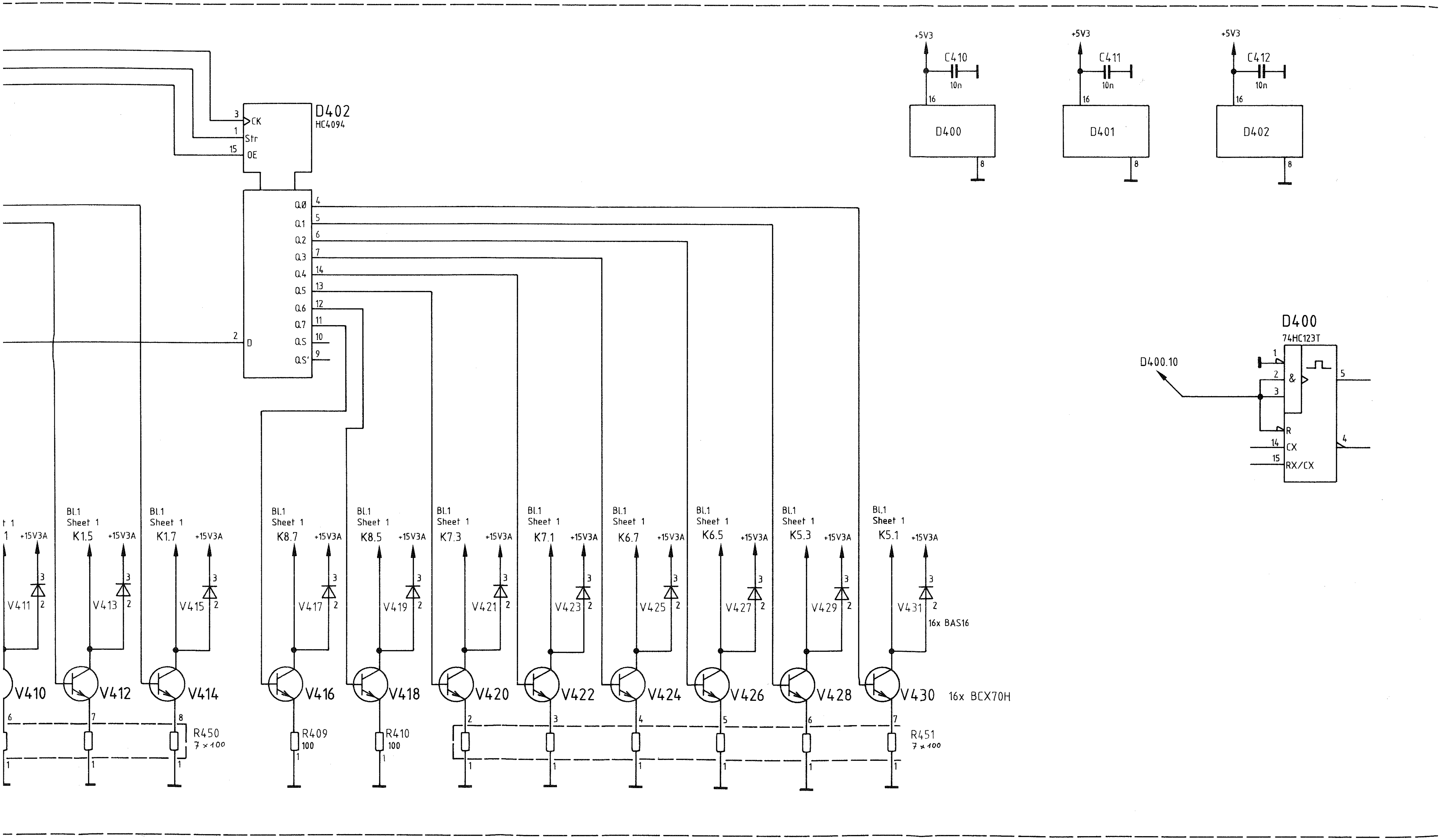
ROHDE&SC



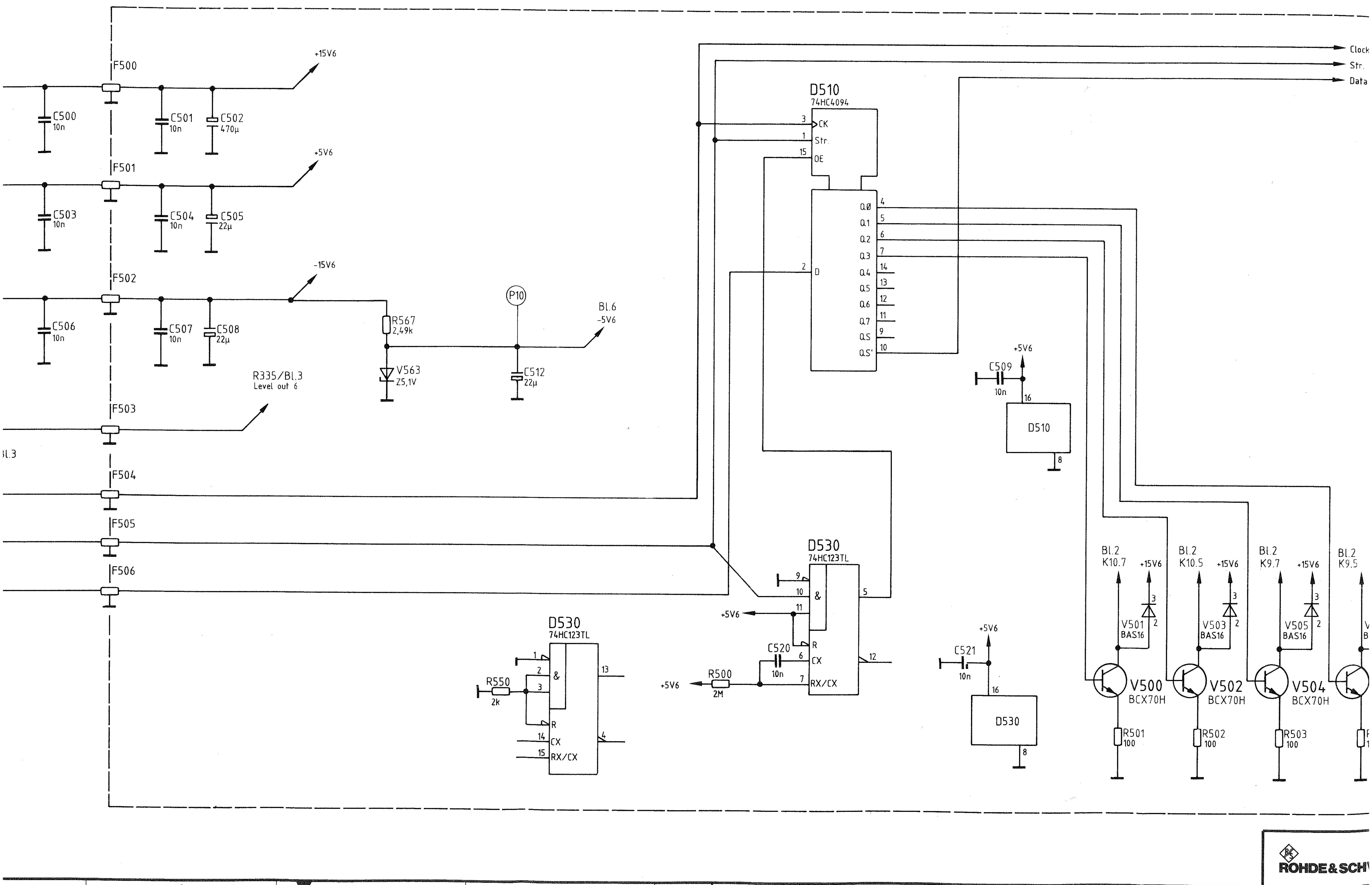
ROHDE&SCHWARZ	Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name	1KSA	Tag	Name	Benennung		Zeichn.-Nr.	Blatt-Nr.
									Bearb.	4.87	HO	2GHz Breitbanddemodulator / 2GHz Broadband demodulator	Z	834.4712 S	3 v. 7 Bl.
									Gepr.						
									Norm			zu Gerät:		reg. i. V. 834.0000 V	erste Z

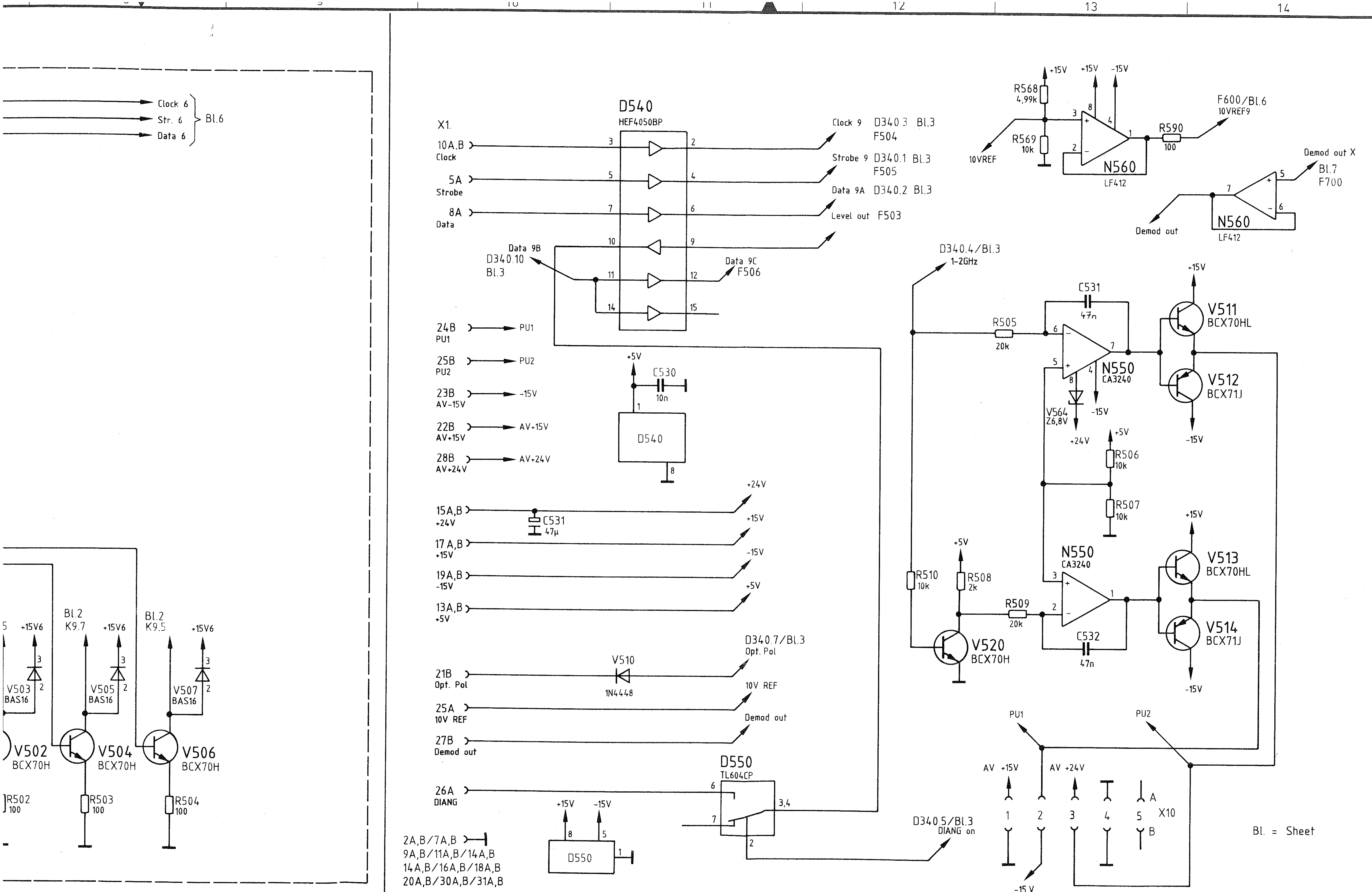


D401
HC4094
CK
Str.
OE
D
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
QS
QS'
Clock5
Data5B
Strobe 5
C400
100
C401
100
C402
100
R430
100
R431
100
R432
100
D400.3
D400
74HC123T
+5V3
C407
22n
R400
1M
CX
RX/CX
R
+15V5
C415
470µ
L403
0,1µ
C403
10n
C404
10n
+15V3A
+5V5
L404
0,1µ
C405
10n
C406
10n
Bl.1
Sheet 1
K4.5
K4.7
K3.3
K3.1
K2.3
K2.1
K1.5
K1.7
K8.7
V401
V403
V405
V407
V409
V411
V413
V415
V400
V402
V404
V406
V408
V410
V412
V414
R451
R450
7 × 100
ROHDE&SC

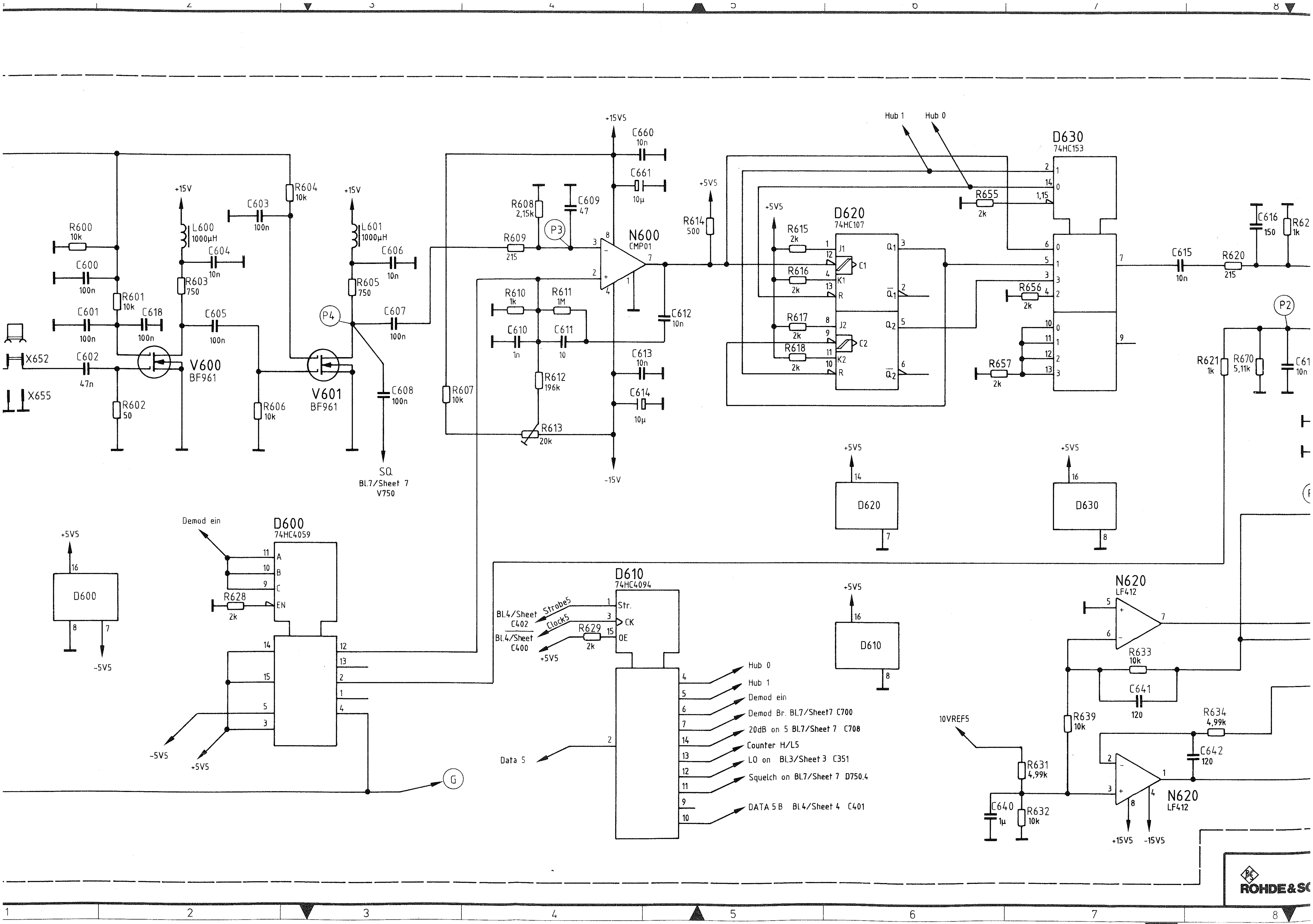


ROHDE&SCHWARZ	1KSA	Tag	Name	Benennung	Zeichn.-Nr.
	Bearb.	6.87	HO	2GHz Breitbanddemodulator / 2GHz Broadband demodulator Z	834.4712 S
	Gepr.				
Änd. Zust. / Änderungs-Mitteilung / Datum / Name	Norm			zu Gerät:	reg. i. V. 834.0000 V — erste Z.

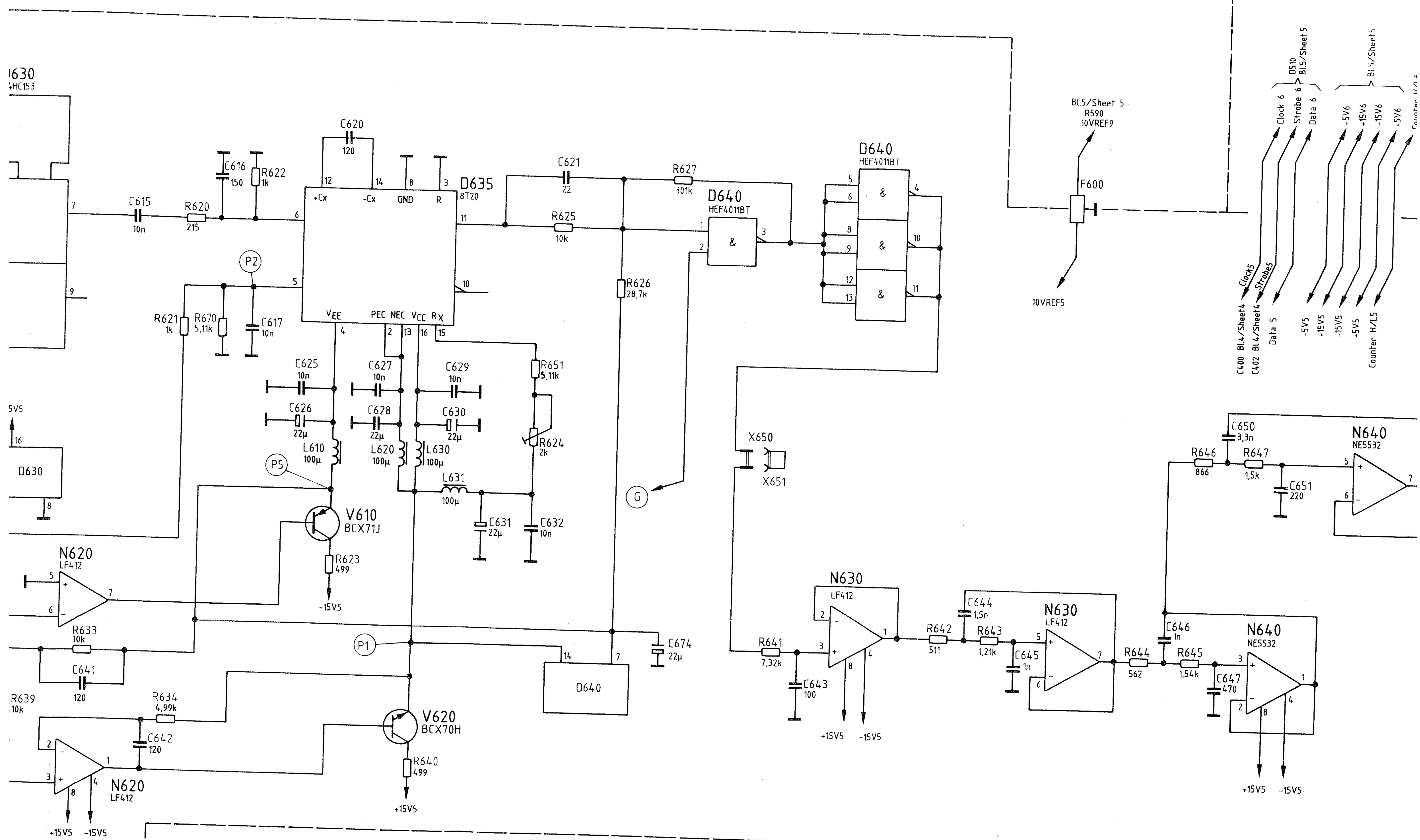

F500
+15V6
C500 10n
C501 10n
C502 470µ
F501
+5V6
C503 10n
C504 10n
C505 22µ
F502
-15V6
C506 10n
C507 10n
C508 22µ
R567 2,49k
V563 Z5,1V
P10
C512 22µ
Bl.6 -5V6
R335/Bl.3 Level out 6
F503
Bl.3
F504
F505
F506
D510 74HC4094
CK
Str.
OE
D
Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7 QS QS'
Clock
Str.
Data
C509 10n
+5V6
D510
D530 74HC123TL
&
R
CX
RX/CX
+5V6
C520 10n
R500 2M
R550 2k
C521 10n
D530
Bl.2 K10.7
Bl.2 K10.5
Bl.2 K9.7
Bl.2 K9.5
+15V6
V501 BAS16
V503 BAS16
V505 BAS16
V500 BCX70H
V502 BCX70H
V504 BCX70H
R501 100
R502 100
R503 100
ROHDE&SCH



ROHDE&SCHWARZ	Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name	1KSA	Tag	Name	Benennung	Z	Zeichn.-Nr.	Blatt-Nr.
									Bearb.	4.87	HO	2GHz Breitbanddemodulator 2GHz Broadband demodulator		834.4712 S	5 v. 7 Bl.
									Gepr.			zu Gerät:		reg. i. V. 834.0000 V	erste Z
									Norm						



X652
X655
R600 10k
C600 100n
C601 100n
C602 47n
R601 10k
C618 100n
R602 50
V600 BF961
+15V
L600 1000µH
C604 10n
R603 750
C605 100n
C603 100n
R604 10k
R606 10k
V601 BF961
L601 1000µH
C606 10n
R605 750
P4
C607 100n
C608 100n
SQ
Bl.7/Sheet 7
V750
+15V5
C660 10n
C661 10µ
R608 2,15k
C609 47
P3
R609 215
N600
CMP01
R610 1k
R611 1M
C610 1n
C611 10
R612 196k
R613 20k
R607 10k
C612 10n
C613 10n
C614 10µ
-15V
+5V5
R614 500
Hub 1
Hub 0
D620
74HC107
R615 2k
R616 2k
R617 2k
R618 2k
J1
C1
K1
R
J2
C2
K2
Q1
Q2
D630
74HC153
R655 2k
R656 2k
R657 2k
C615 10n
R620 215
C616 150
R62 1k
P2
R621 1k
R670 5,11k
C61 10n
D620
D630
D600
-5V5
Demod ein
D600
74HC4059
A
B
C
EN
R628 2k
G
D610
74HC4094
Str.
CK
OE
Bl.4/Sheet C402
Strobe5
Clock5
Bl.4/Sheet C400
R629 2k
Data 5
Hub 0
Hub 1
Demod ein
Demod Br. Bl.7/Sheet7 C700
20dB on 5 Bl.7/Sheet 7 C708
Counter H/L5
LO on Bl.3/Sheet 3 C351
Squelch on Bl.7/Sheet 7 D750.4
DATA 5 B Bl.4/Sheet 4 C401
D610
N620
LF412
R633 10k
C641 120
R639 10k
10VREF5
R631 4,99k
R632 10k
C640 1µ
R634 4,99k
C642 120
+15V5
-15V5
ROHDE&SC



ROHDE&SCHWARZ	A	38987	4.88	CO					1KSA	Tag	Name
	Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name	Bearb.	5.87	HO
									Gepr.		
									Norm		

Benennung: 2GHz Breitbanddemodulator / 2GHz Broadband demodulator

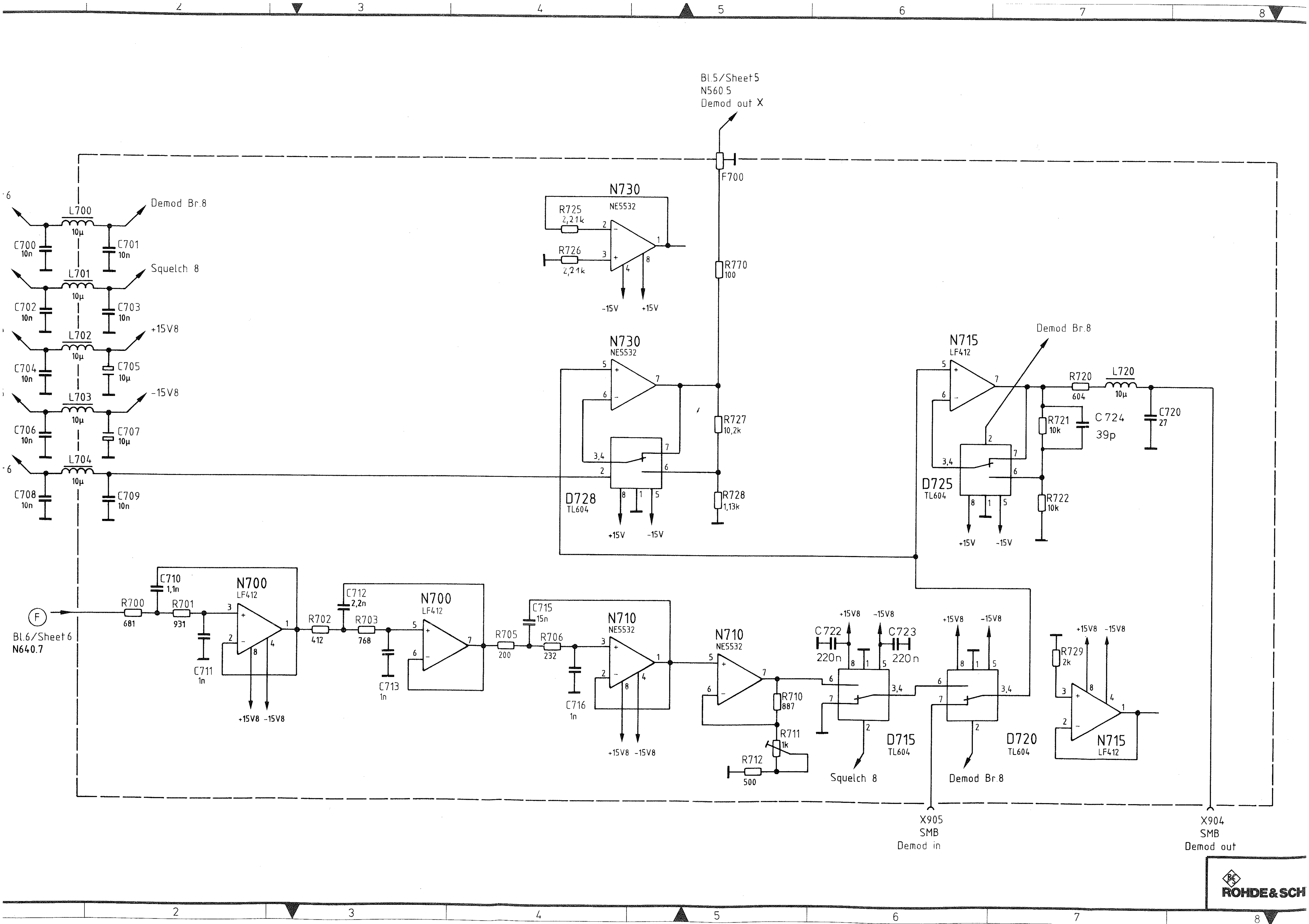
Z

Zeichn.-Nr. 834.4712 S

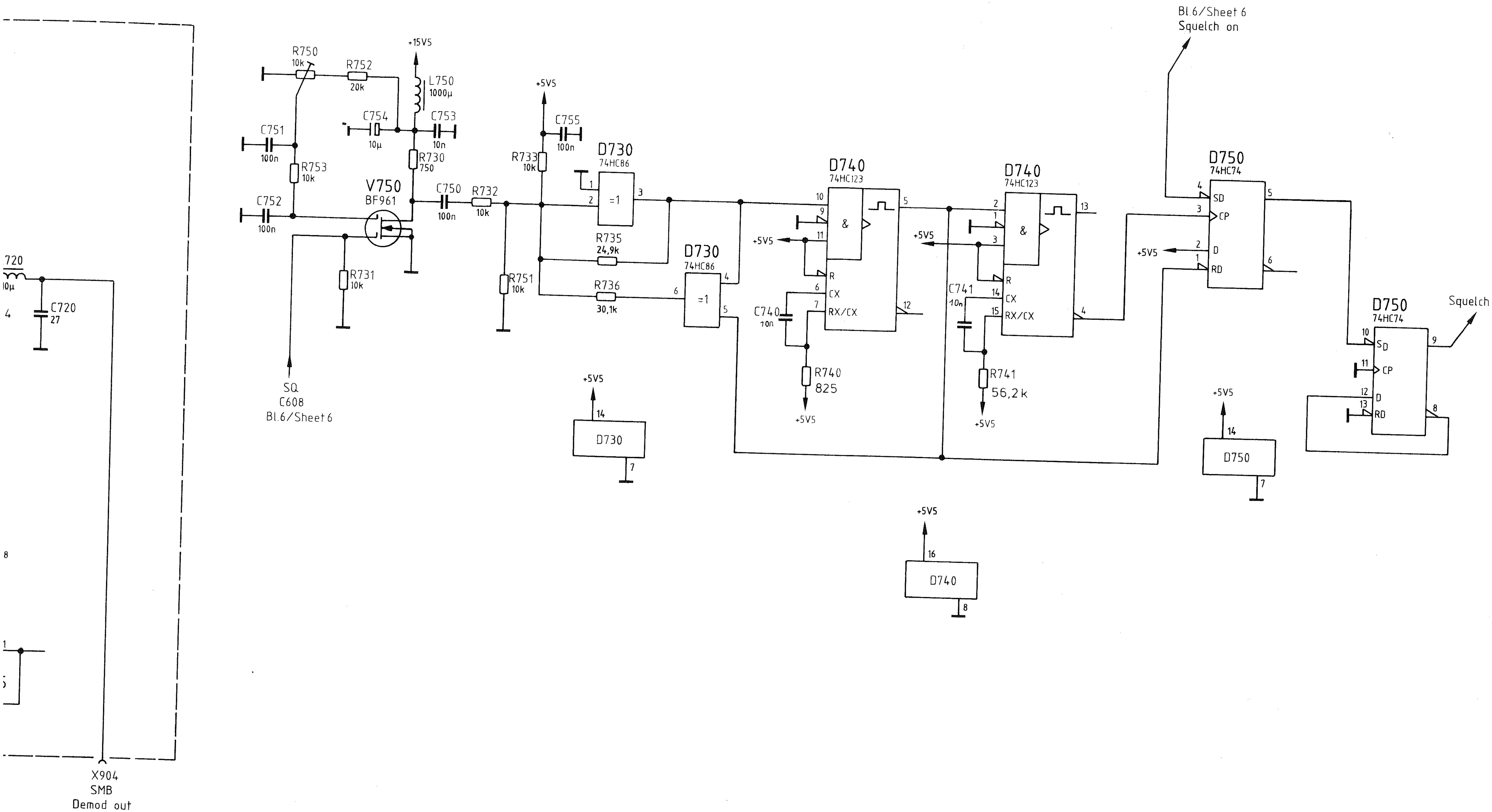
zu Gerät

reg. i. V. 834.0000 V

erste Z.



Bl.5/Sheet 5
N560.5
Demod out X
F700
N730
NE5532
R725
2,21k
R726
2,21k
-15V
+15V
R770
100
Demod Br.8
L700
10µ
C700
10n
C701
10n
Squelch 8
L701
C702
C703
+15V8
L702
C704
C705
-15V8
L703
C706
C707
L704
C708
C709
R727
10,2k
D728
TL604
R728
1,13k
N715
LF412
Demod Br.8
R720
604
L720
10µ
R721
10k
C 724
39p
C720
27
D725
TL604
R722
10k
C710
1,1n
N700
LF412
R700
681
R701
931
C711
1n
Bl.6/Sheet 6
N640.7
+15V8 -15V8
C712
2,2n
R702
412
R703
768
C713
1n
C715
15n
R705
200
R706
232
C716
1n
N710
NE5532
R710
887
R711
1k
R712
500
C722
220n
C723
220n
D715
TL604
Squelch 8
D720
TL604
Demod Br.8
R729
2k
X905
SMB
Demod in
X904
SMB
Demod out
ROHDE&SCH



ROHDE & SCHWARZ

Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name	1KSA	Tag	Name
								Bearb.	5.87	HO
								Gepr.		
								Norm		

Benennung: 2GHz Breitbanddemodulator
2GHz Broadband demodulator

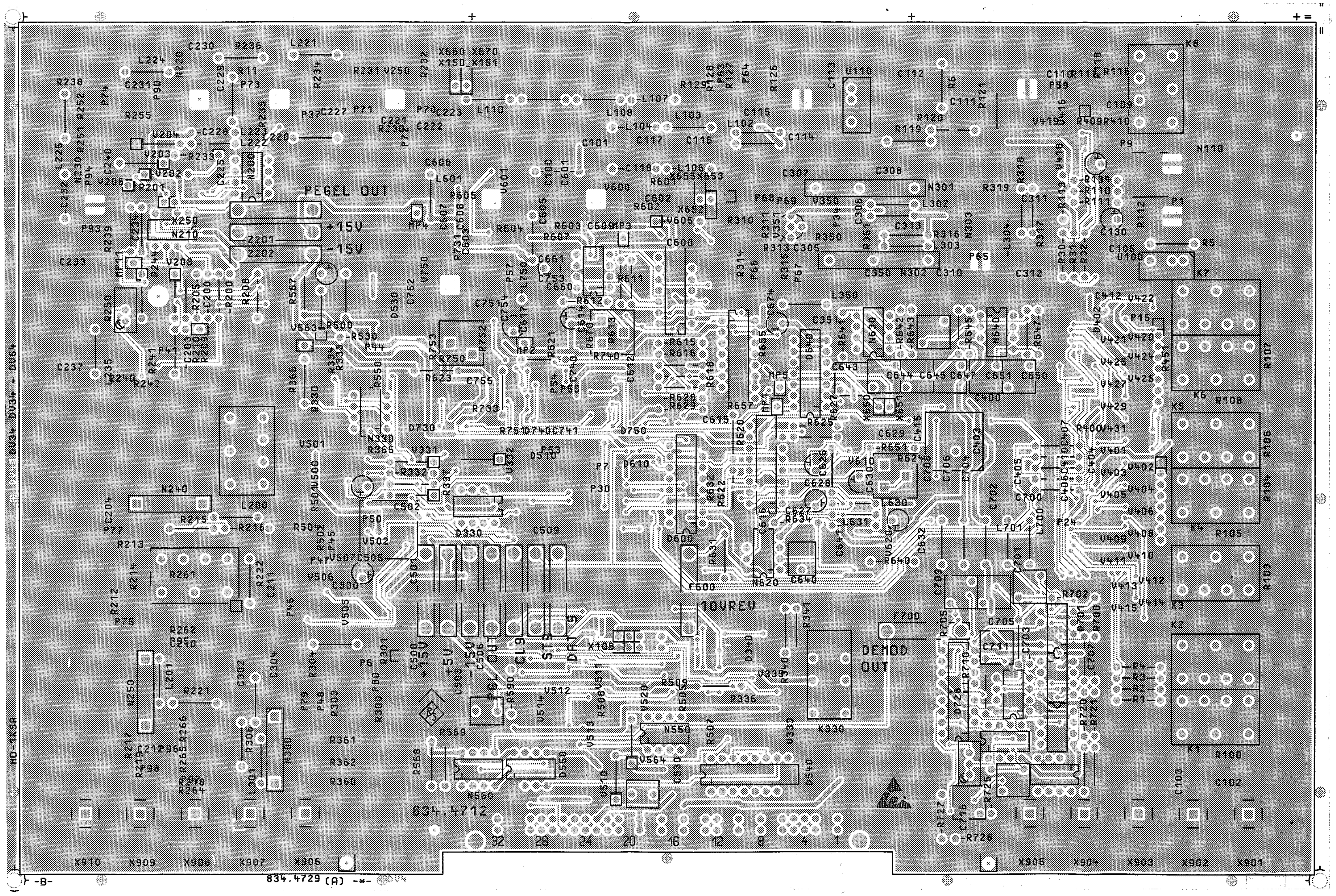
Z

Zeichn.-Nr. 834.4712 S

Blatt-Nr. 7 v. 7 Bl.

zu Gerät: reg. i. V. 834.0000 V

erste Z.



Ansicht und Leitungsführung Bauteilseite
View of tracks on component side

VARIANTENERKLÄRUNG / VERSION
VAR 02 – GRUNDAUSFÜHRUNG / BASIC MODEL

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(hierzu HVC 250)

ACHTUNG: EGB!
Elektrostatisch gefährdete Bauelemente erfordern eine besondere Handhabung.
ATTENTION ESD!
Electrostatic sensitive devices require a special handling.

B		06.87	HO
Änd. Zust.	Änderungs-Mitteilung	Tag	Name

Maße ohne Toleranzangabe

1KSA	Tag	Name
Bearb.	06.87	HO
Gepr.		
Norm		

ROHDE&SCHWARZ

zu Gerät: CMTA

Maßstab: 1 : 1

Halbzeug, Werkstoff

Benennung: 2GHz-Breitbanddemodul. / 2GHz-Broadband-Demodul.

Z

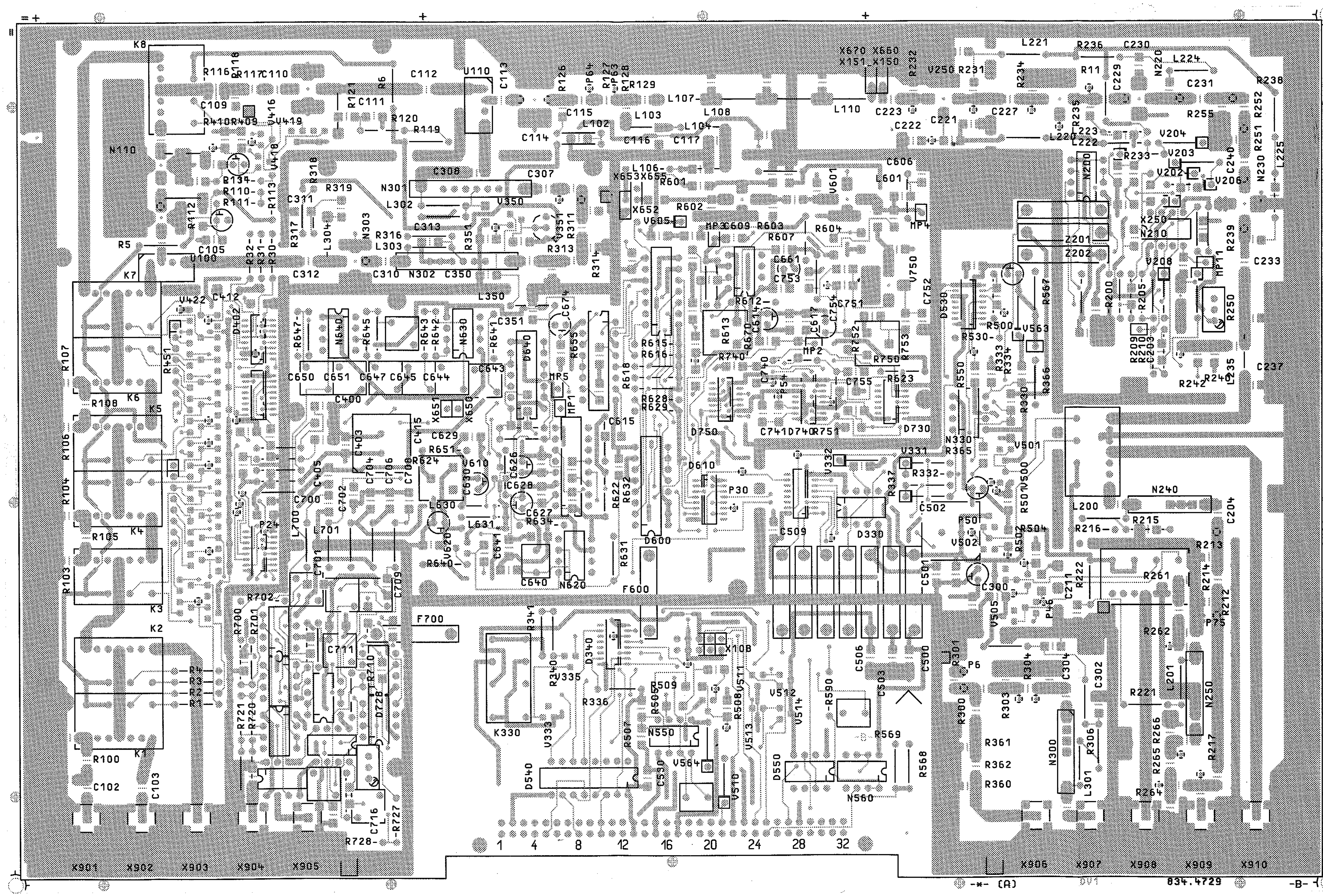
Zeichn.-Nr.: 834.4712.01 EE

Blatt-Nr. 2 v. Bl.

reg. i. V. 834.0000 V

erste Z.

ISO-Projektion Methode E



Ansicht und Leitungsführung Lötseite
View of tracks on solder side

VARIANTENERKLÄRUNG / VERSION
VAR 02 – GRUNDAUSFÜHRUNG / BASIC MODEL

B		06.87	HO	Maße ohne Toleranzangabe	Maßstab 1 : 1
					Halbzeug, Werkstoff
				1KSA / Tag / Name	Benennung
				Bearb. 06.87 HO	2GHz-Breitbanddemodul.
				Gepr.	2GHz-Broadband-Demodul.
				Norm	Z
				ROHDE & SCHWARZ	Zeichn.-Nr. 834.4712.01 EE — Blatt-Nr. 3 v. Bl.
Änd. Zust.	Änderungs-Mitteilung	Tag	Name	zu Gerät CMTA	reg. i. V. 834.0000 V — erste Z.

ACHTUNG: EGB!
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ISO-Projektion Methode E

PF 095.2493-0781 — 07 6001 81

ROHDE&SCHWARZ

Service Documents

Output Stage Module 2 GHz

843.3015.06

Contents

5.1 Circuit Description

(See circuit diagram 843.3015 S and Fig. 5-1)

The frequencies between 500 MHz and 1000 MHz generated by the RF oscillator module are converted on the output stage module into the frequency range 0.1 to 2000 MHz by doubling, dividing and mixing. The RF carrier can be electronically attenuated and amplitude modulated.

5.1.1 RF Conditioning

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

The output signal from the RF divider is limited in the amplifier N70. It is then taken to the next amplifier stage (V83) and is simultaneously decoupled via X406. The following 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 of level controller, AM modulator).

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

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

The mixer is controlled by frequencies between 100.1 and 131.25 MHz. These are amplified by V606 to a maximum of 2.82 V. This level is required for the channel <8 MHz. The signal is then applied to the RF input of the mixer (U630) via attenuators. The 150 MHz LO signal is applied from connector X405 via an amplifier stage (V670) to the mixer.

The IF signal of 0.1 to 31.25 MHz is amplified (V640, V641; gain adjustable using R641) and applied to output X404.

The doubler, consisting of T812 and the diodes V813 to V816, is driven by amplifier V810 with the fundamental octave 500 to 1000 MHz. The doubled signal (1000 to 2000 MHz) is amplified in amplifier N820 and applied to the pin modulator. The pin modulator (V824, V827, V828, V829, V834, V837, V838, V839) is used as control element of the level controller. The subsequent amplifiers N860 and N870 amplify the signal to the necessary output level.

For frequencies <8 MHz, the RF level is rectified using diode V616 and applied to changeover switch N461. At 8 MHz, this switch switches between the high-frequency channel leading to input X401 and the channel in the mixer. The respective rectified voltage is then compared with the reference value. The control amplifier N470 controls the RF level via the pin modulator such that the rectified RF value corresponds to the reference value. The control loop can be opened up using the changeover switch and the RF level can then be controlled via the modulation controller. Using changeover switch N890, the low-frequency pin modulator is operated with a fixed bias voltage in doubler mode.

5.1.2 Modulation Control

This part of the circuit basically consists of a modulation depth divider for amplitude modulation and a level divider for the electronic level setting.

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

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

5.1.3 Control and Diagnostic Circuit

The subassembly is triggered 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.A5).

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

The level control loop is monitored by comparator N150. This switches the output X1.A3 from +5 V to 0 V if the level control has failed.

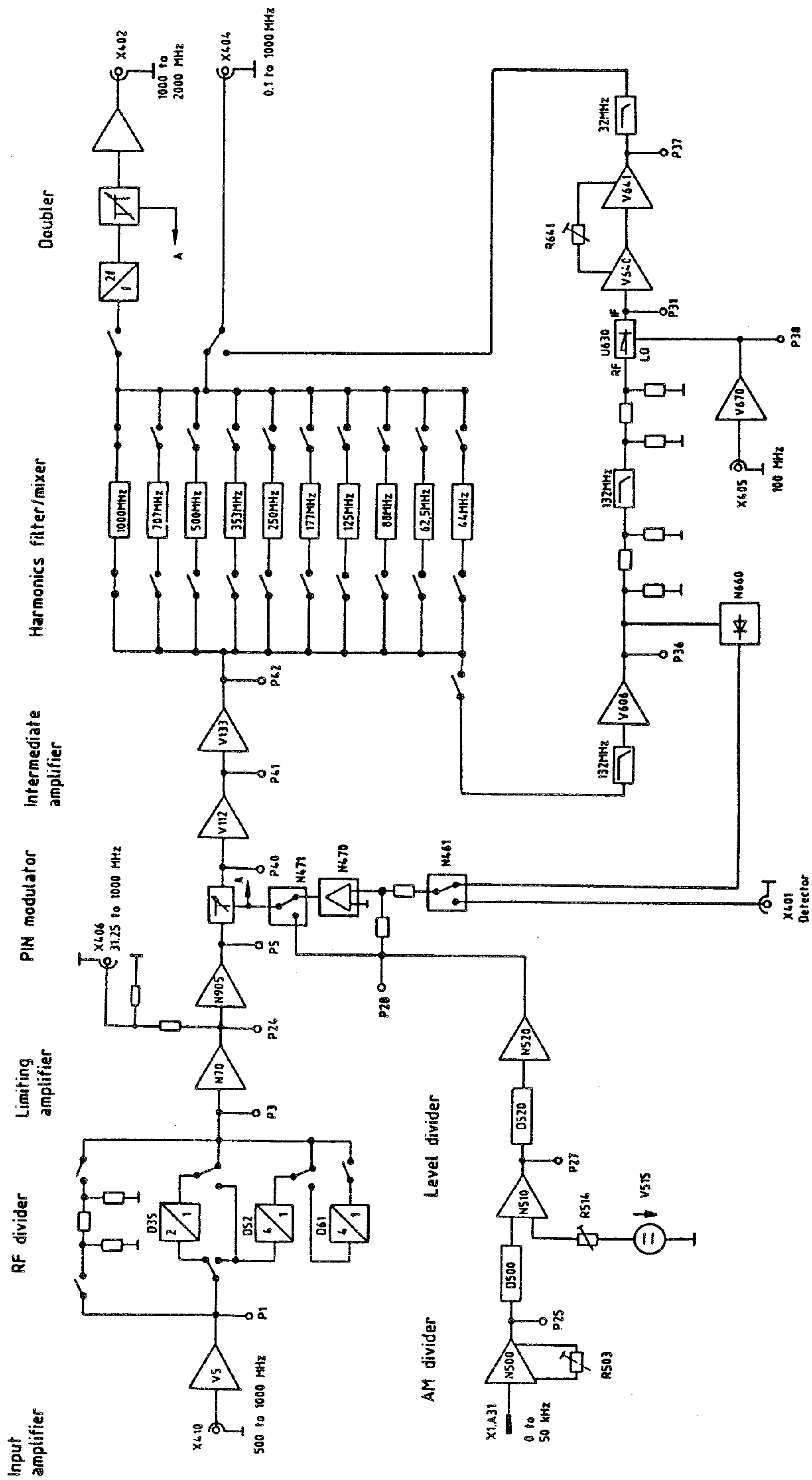


Fig. 5-1 Block diagram of output stage

5.2 Checking and Adjustments

→ Connect the module to the service adapter.

→ Connect an RF power meter to the RF socket.

5.2.1 Level Adjustments

a) Level adjustment for RF >8 MHz

→ Instrument setting : RF = 100 MHz, level = 0 dBm

→ Adjust the level to 0 dBm ±0.1 dB using trimmer R514.

b) Offset adjustment for RF <8 MHz

→ Instrument setting: RF = 7.9 MHz, level = 13 dBm

→ Note the level (P_{ref})

→ Set the level to -6.9 dBm in 0.1-dB steps by means of fine variation (switching of the mechanical attenuator must not be audible)

→ Use trimmer R663 to adjust to the level
$P_{nom} = (P_{ref} - 19.9\ dB) \pm 0.5\ dB$

c) Level adjustment for RF < 8 MHz

→ Instrument setting: level = 0 dBm

→ Measure level at RF = 8 MHz and adjust to the same value (±0.1 dB) at 7.999 MHz using R641.

5.2.2 Adjustment of Modulation Depth

→ Set carrier frequency of 100 MHz and a level of 0 dBm.

→ Set modulation depth to 80% with a modulation frequency of 1 kHz.

→ Connect a modulation depth analyzer to the RF socket and adjust to 80% ±0.1% using R503.

5.2.3 Function Test of Module

→ Sweep through the complete frequency range (e.g. via IEC bus) with an output level of -7 dBm and -17 dBm (-17 dBm with 10 dB fine variation) and check the respective control voltage (measured at X24) according to Table 5-2.

Table 5-2

Frequency range	Control voltage of level controller	
	At -7 dBm	At -17 dBm
0.1 to 999 MHz 1000 to 2000 MHz	-2.2 to -0.5 V -1.5 to -0.3 V	-3.0 to -1.5 V -1.8 to -0.9 V

→ Set an RF level of +13 dBm and check the harmonics in the complete frequency range; they must be <-30 dBc.

→ Connect an AM analyzer to the RF socket.

→ Check the distortion with an RF level of +7 dBm and 80 % AM. The distortion should be ≤2% at 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 Working Points of RF Amplifier

→ Unscrew the spring cover from the printed side and connect the module via the service adapter cable.

→ Set 1000 MHz and terminate connectors X410 and X405 with 50 Ω. Check the DC voltages according to Table 5-3:

Table 5-3

Transistor	Collector voltage	Remarks
V5	+5.3 V ±0.5 V	Input amplifier
N905	+5.1 V ±0.5 V	Ampl. before PIN modulator
V112	+4.4 V ±0.5 V	Ampl. after PIN modulator
V133	+5.5 V ±0.5 V	Ampl. after PIN modulator
V810	+6.7 V ±0.5 V	Ampl. before doubler
N820	+4.5 V ±0.5 V	Ampl. after doubler
N830	+4.5 V ±0.5 V	Ampl. after doubler
N860	+4.5 V ±0.5 V	Ampl. after doubler
N870	+4.5 V ±0.5 V	Ampl. after doubler
V606	+5.7 V ±0.5 V	Mixer section: RF amplifier
V640	+9.4 V ±0.5 V	Mixer section: IF amplifier
V641	+8.7 V ±0.5 V	Mixer section: IF amplifier
V670	+9.3 V ±0.5 V	Mixer section: LO amplifier

5.3.2 DC Switching Voltages for RF Setting

→ Check whether +1.8 V (±0.2 V) is present at P29.

→ Further tests as in 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	+13	-14	-15	-12	+12	-14	-15	-14	-15	+5
700	-13	+12	+13	+13	+12	-11	+12	+13	-14	-15	-12	+12	-14	-15	-14	-15	+5
350	+12	-14	+13	+13	-14	-11	-11	+13	-14	+12	+12	-9	-14	-15	-14	+8	+5
300	+12	-14	+13	+13	-14	-11	-11	+13	-14	+12	-9	+12	-14	-15	-14	+8	+5
200	+12	+12	+13	-14	+12	-11	-11	+13	-14	+12	+12	-9	-14	-15	+7	-15	0
150	+12	+12	+13	-14	+12	-11	-11	+13	-14	+12	-9	+12	-14	-15	+7	-15	0
100	+12	-14	+13	-14	+12	-11	-11	+13	+12	+12	+12	-9	-14	+7	-14	-15	0
70	+12	-14	+13	-14	+12	-11	-11	+13	+12	+12	-9	+12	-14	+7	-14	-15	0
50	+12	+12	-14	+12	+12	-11	-11	+13	+12	+12	+12	-9	+7	-15	-14	-15	0
40	+12	+12	-14	+12	+12	-11	-11	+13	+12	+12	-9	+12	+7	-15	-14	-15	0
30	+12	+12	+12	-14	+12	-11	-11	-14	+12	+12	+12	-9	-14	-15	+7	-15	0
1	+12	+12	+12	-14	+12	-11	-11	-14	+12	+12	+12	-9	-14	-15	+7	-15	0

5.3.3 RF Test

The RF connections to the module must be made using subminax cables. It is recommendable to use a high-impedance probe to test e.g. which has an insertion loss of 20 dB. The following levels are the values measured at 50 Ω plus attenuation of probe.

The RF levels should be tested at the test points according to Table 5-5 at -7 dBm with the module under ALC.

Table 5-5

Carrier frequency (MHz)	Check RF level at test points (values in dBm, ±3 dB)											Remarks
	P1	P3	P24	P5	P40	P41	P42	P36	P31	P37	P38	
1500	+6	0	+4	+10	+1	+11	+14	-	-	-	-	Doubler
999	+6	0	+5	+11	-1	+10	+12	-	-	-	-	Basic range
499	+6	-4	+3	+9	-6	+6	+10	-	-	-	-	Divider 1:2
249	+6	-4	+2	+10	-9	+1	+5	-	-	-	-	Divider 1:4
124	+6	-3	+1	+11	-9	+1	+5	-	-	-	-	Divider 1:8
62	+6	-3	+5	+11	-8	+1	+6	-	-	-	-	Divider 1:16
31	+6	-3	+1	+11	-4	+5	+10	+20	-10	0	+8	Mixer section

5.4 Interfaces

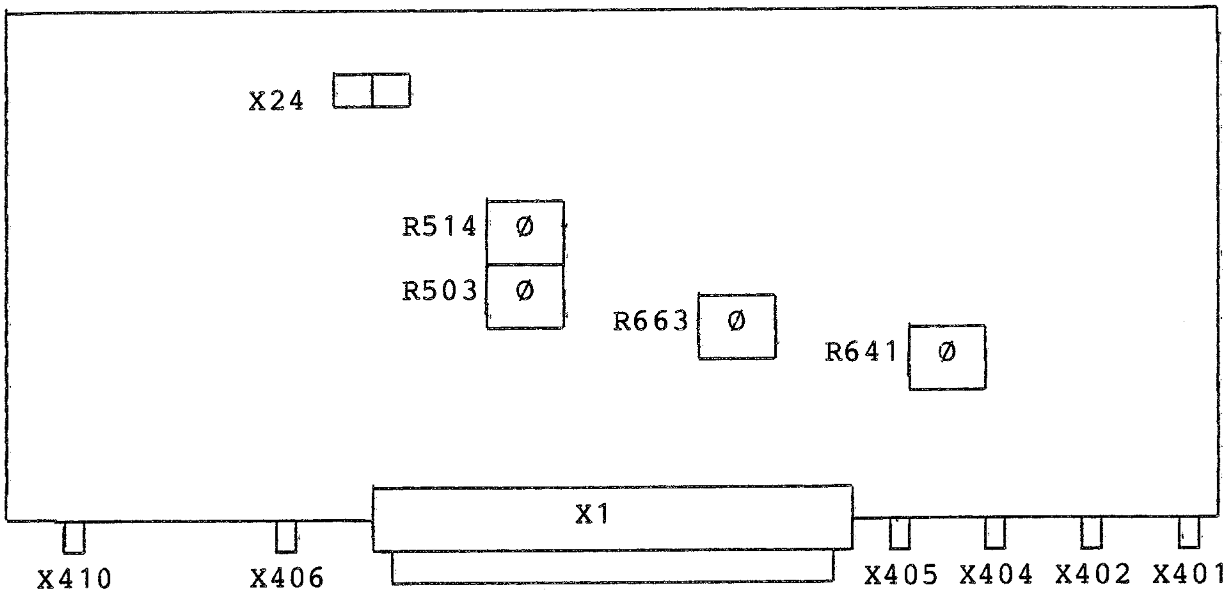


Fig. 5-2 Layout of inputs/outputs and adjusting elements

Analog interfaces

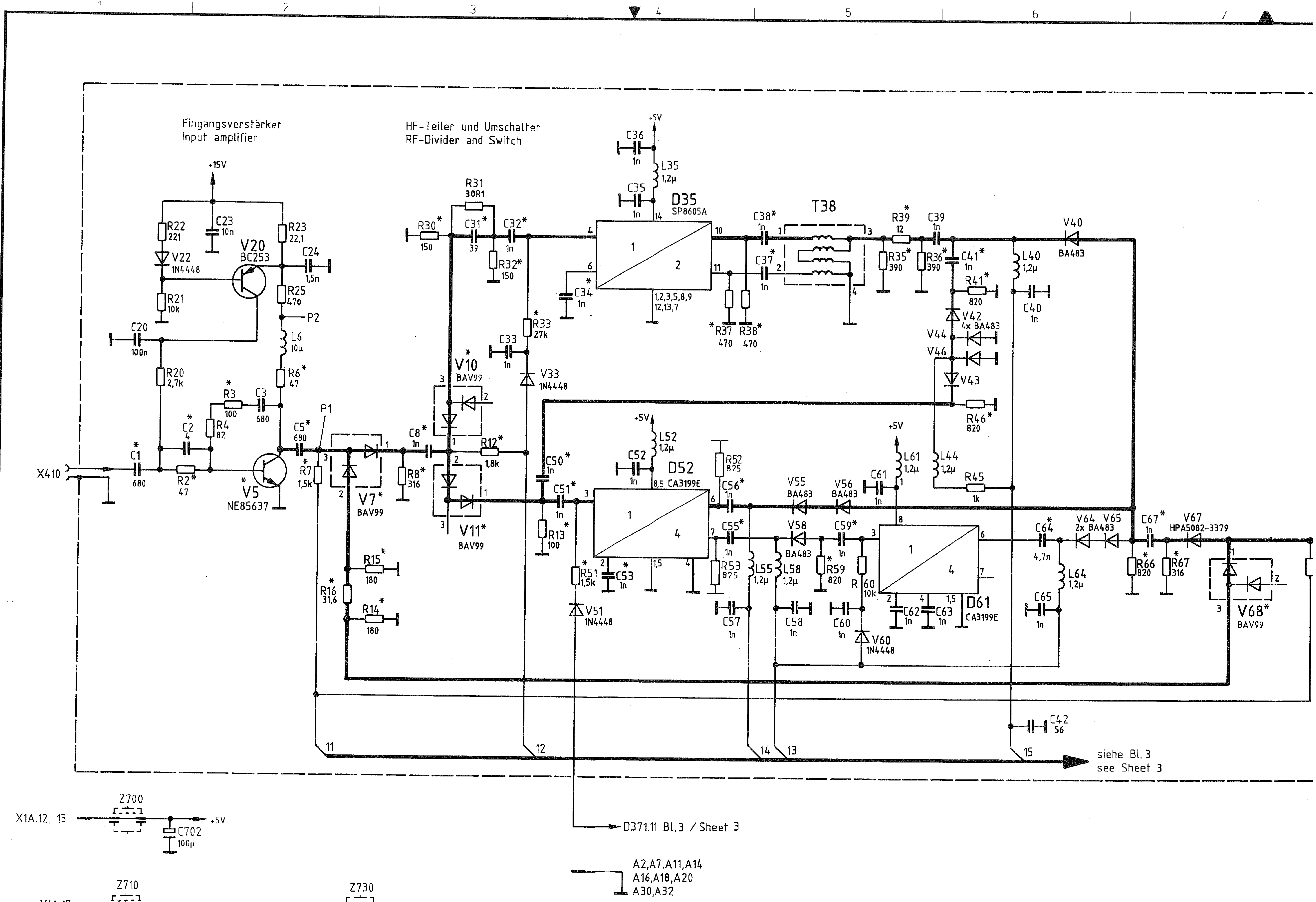
Designation	Function	Frequency	Level
X410	RF input	500 to 1000 MHz	0 dBm
X406	RF output	31.25 to 1000 MHz	-3 dBm
X405	RF input	150 MHz	0 dBm
X404	RF output	0.1 to 1000 MHz	+2 dBm
X402	RF output	1000 to 2000 MHz	+5 dBm
X401	RF channel	DC	0 to 4 V
X1.A23	Diagnostic output	DC	0 to 4 V
X1.A31	Modulation input	DC up to 50 kHz	1 V

Digital interfaces (CMOS)

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



ROHDE&SCHWARZ

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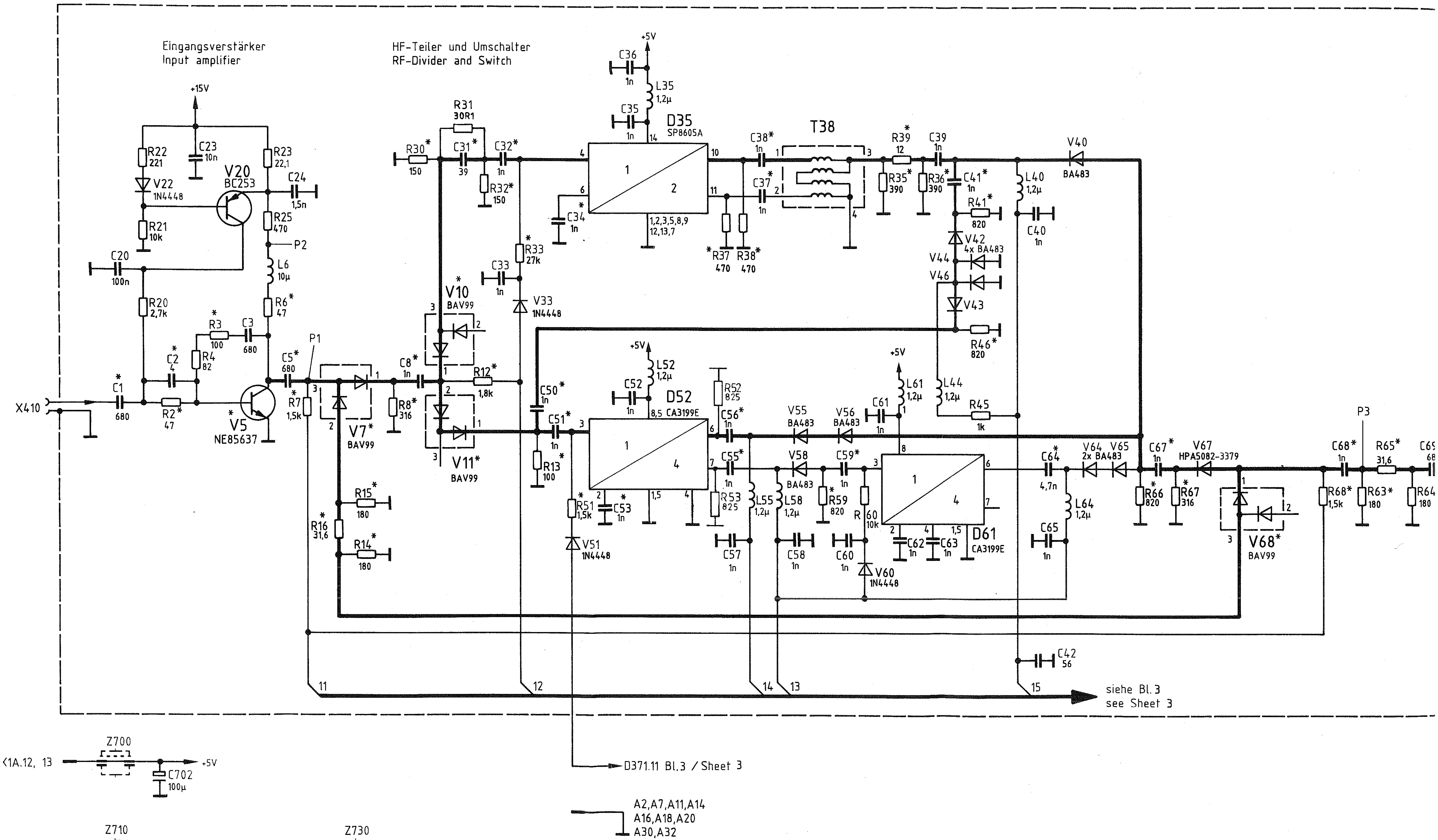
A	35567	6.87	CO					Bearb.	4.87	CO	
B	41810	1.89	JN					Gepr.			
C	41810	3.89	JN					Norm			

Zeichn.-Nr. 843.3015 S Bl.1

PE 095.4109.0781

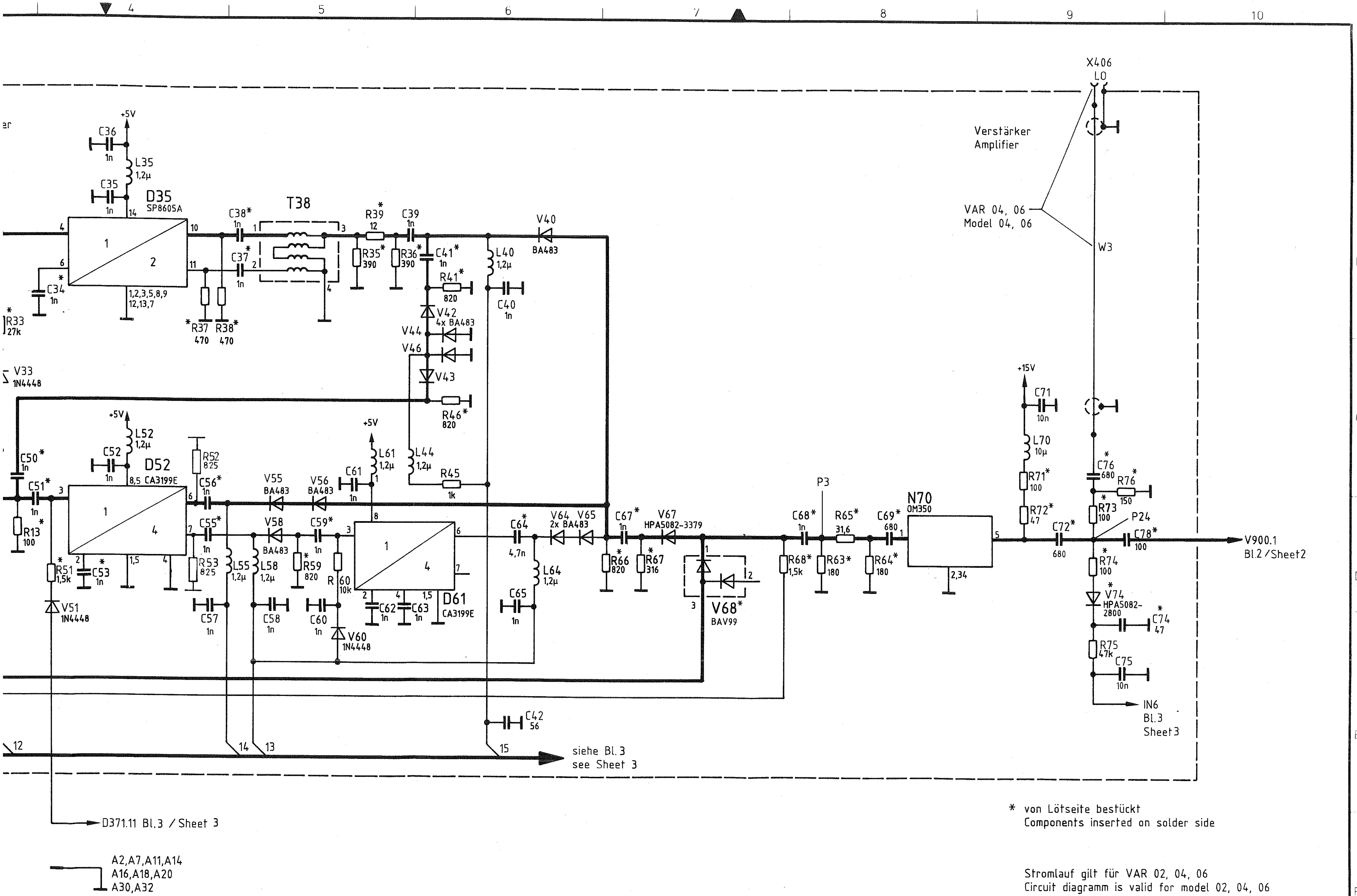


ROHDE&SCHWARZ

Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name
A	35567	6.87	CO				
B	41810	1.89	JN				
C	41810	3.89	JN				

1KSA	Tag	Name
Bearb.	4.87	CO
Gepr		
Norm		

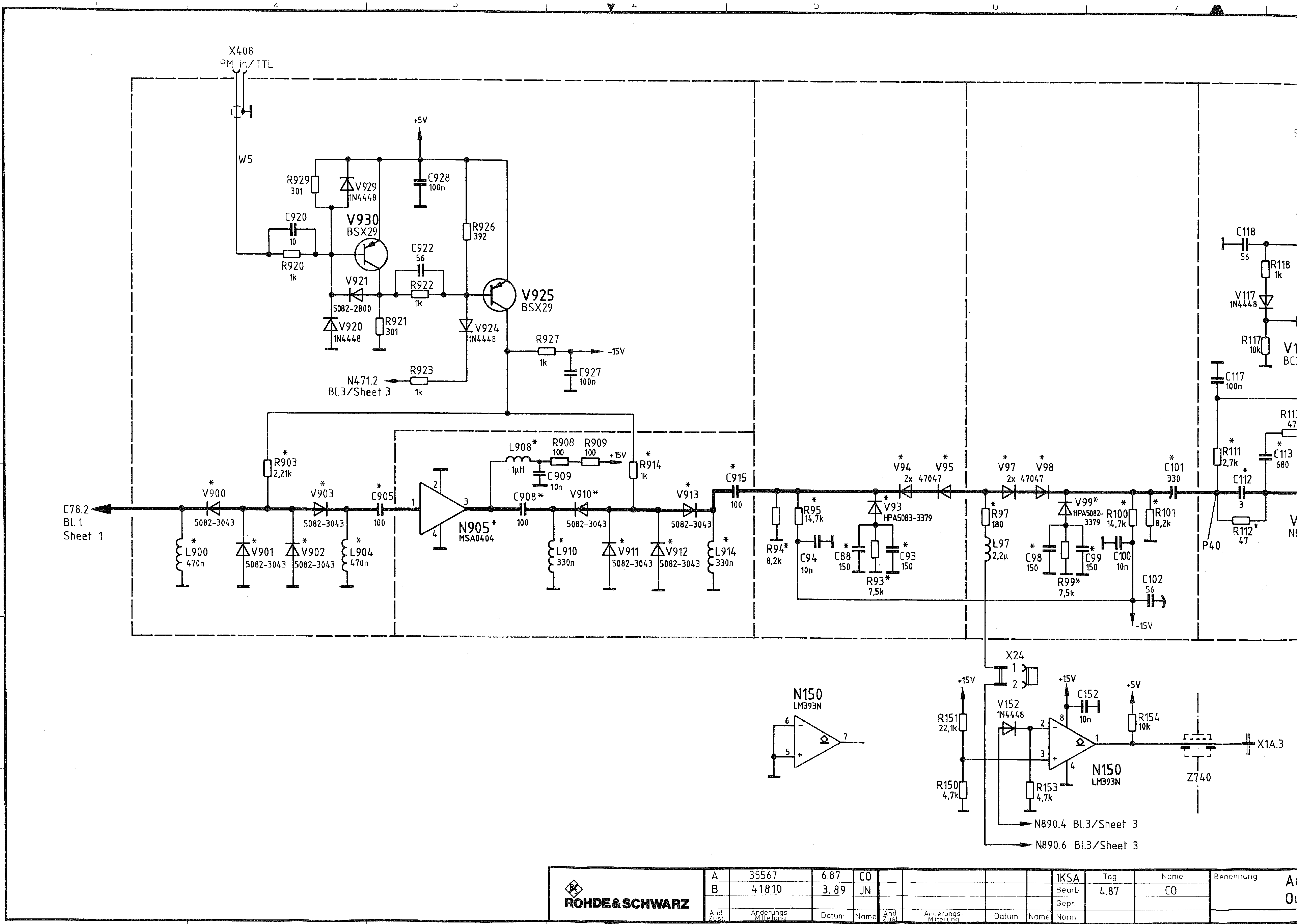
Benennung
Ausgangsst[...]
Output stag[...]



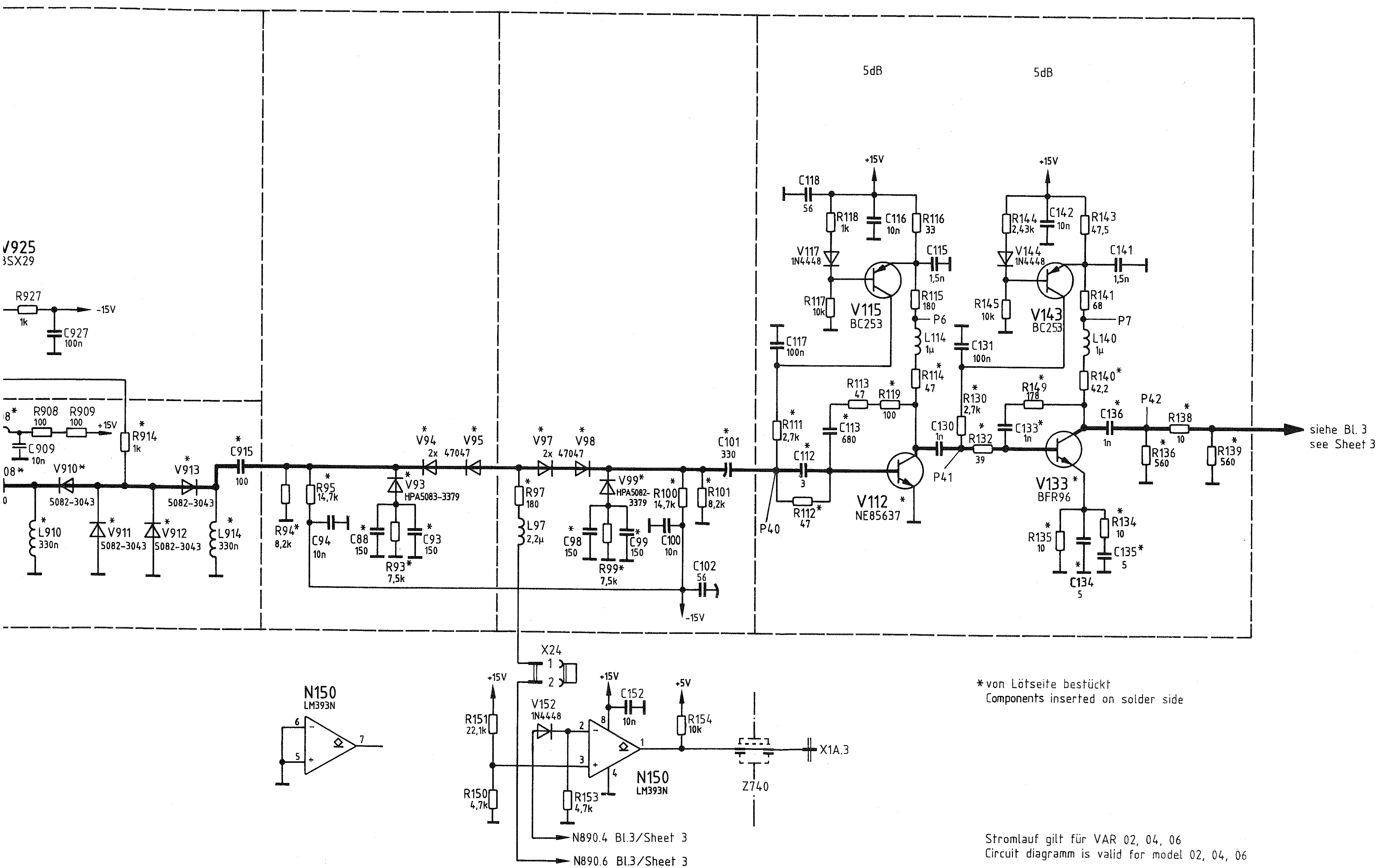
* von Lötseite bestückt
Components inserted on solder side

Stromlauf gilt für VAR 02, 04, 06
Circuit diagramm is valid for model 02, 04, 06

ROHDE&SCHWARZ												
	A	35567	6.87	CO	1KSA	Tag	Name	Benennung	Ausgangsstufe 2GHz / Output stage 2GHz	Z	Zeichn.-Nr. 843.3015 S	Blatt-Nr. 1 v. 5 Bl.
	B	41810	1.89	JN	Bearb.	4.87	CO					
	C	41810	3.89	JN	Gepr.							
	Änd. Zust.	Änderungs-Mitteilung	Datum	Name	Norm			zu Gerät: SMH			reg. i. V. 843.3009 V	erste Z. 843.3009 V



Zeichn.-Nr. 843.3015 S Bl.2



*von Lötseite bestückt
Components inserted on solder side

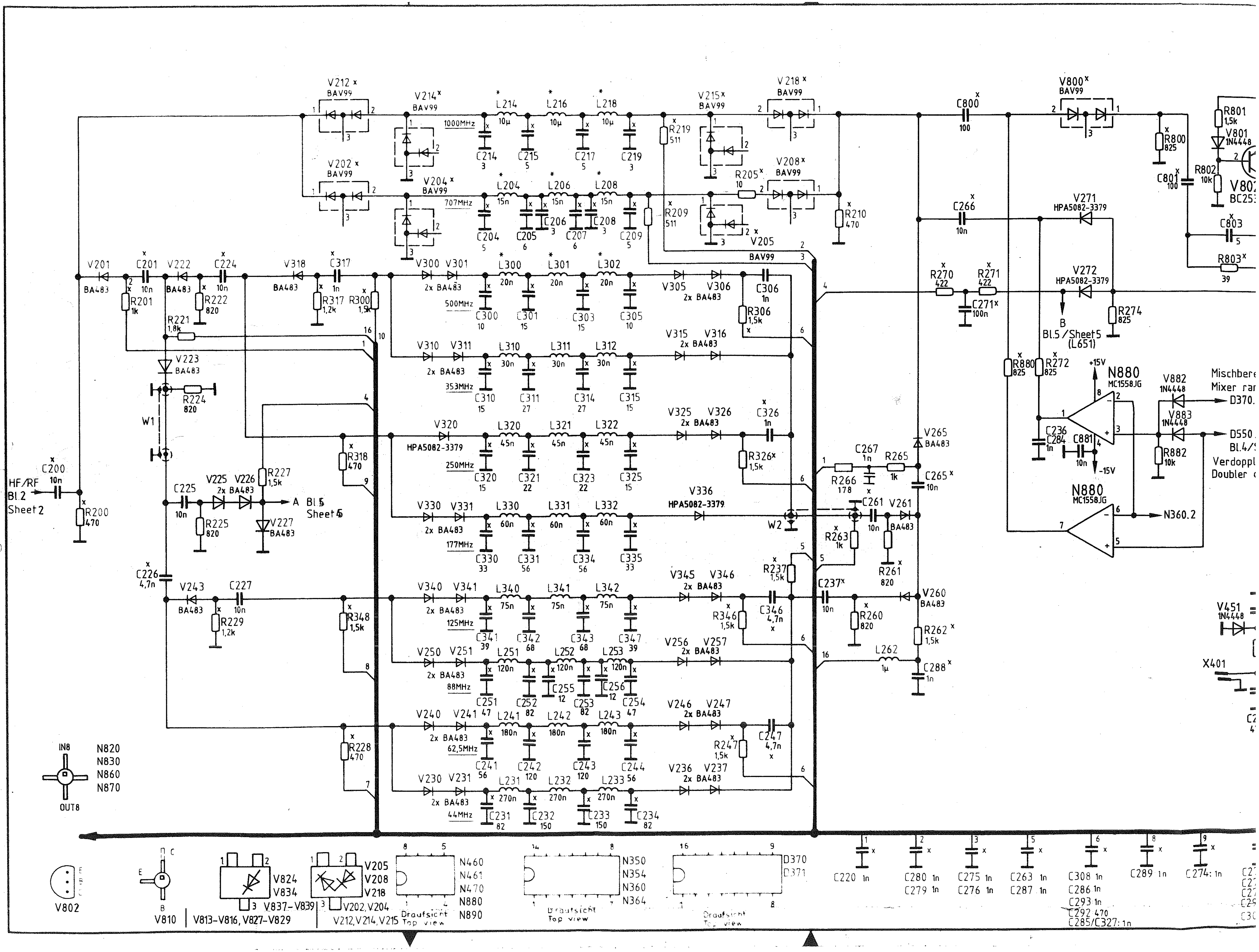
Stromlauf gilt für VAR 02, 04, 06
Circuit diagramm is valid for model 02, 04, 06

ROHDE&SCHWARZ	A	35567	6.87	CO					1KSA	Tag	Name	Benennung: Ausgangsstufe 2GHz / Output stage 2GHz
	B	41810	3.89	JN					Bearb.	4.87	CO	Z
	Änd. Zust.	Änderungs-Mitteilung	Datum	Name	Änd. Zust.	Änderungs-Mitteilung	Datum	Name	Gepr. / Norm			zu Gerät: SMH

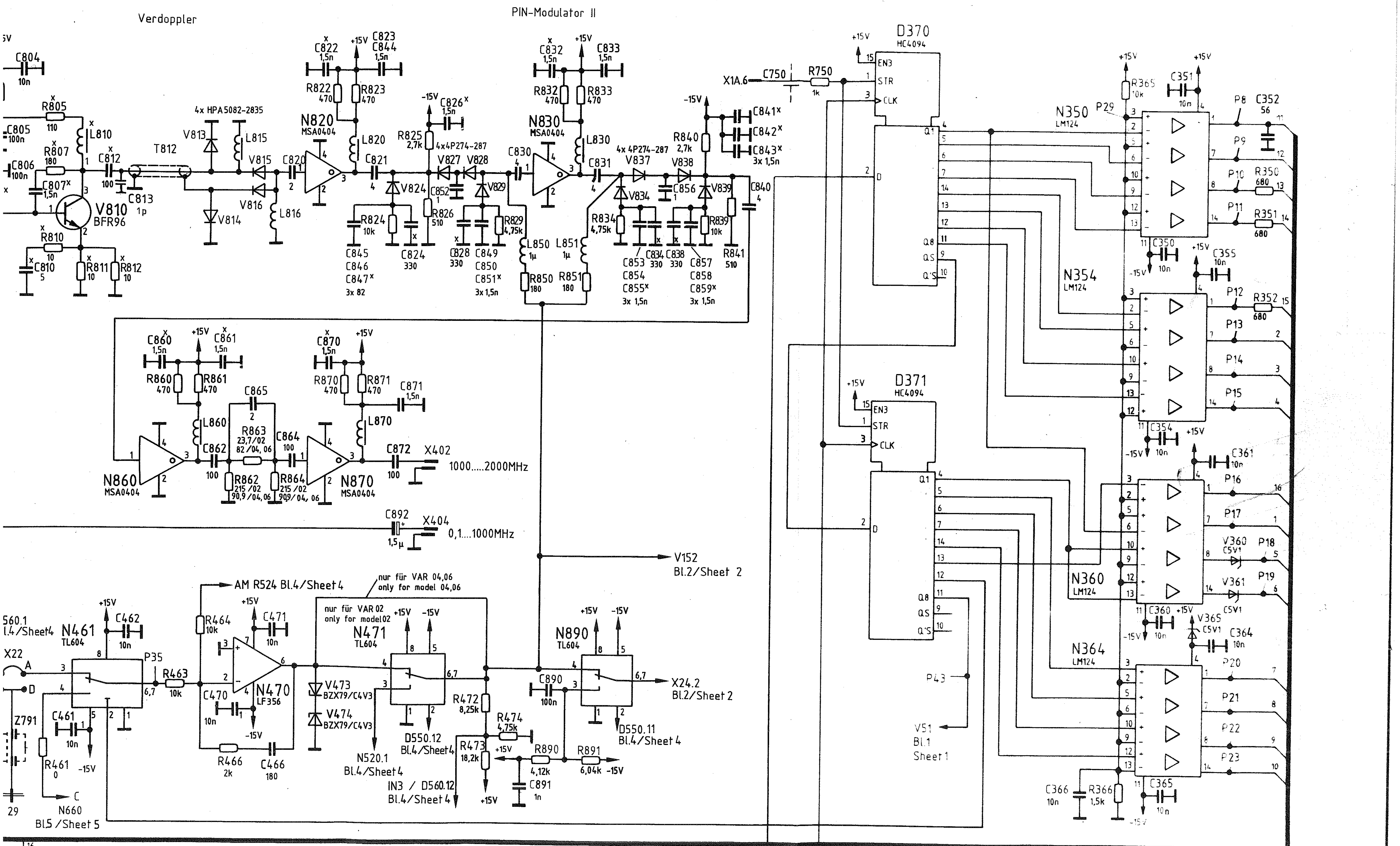
Zeichn.-Nr. 843.3015 S

Blatt Nr. 2 v. 5 Bl.

reg. i. V. 843.3009 V — erste Z. 843.3009



843.3015 S Bl.3



x von Lötseite bestückt / Components inserted on solder side

* gedrucktes Bauteil / printed component

C294 470

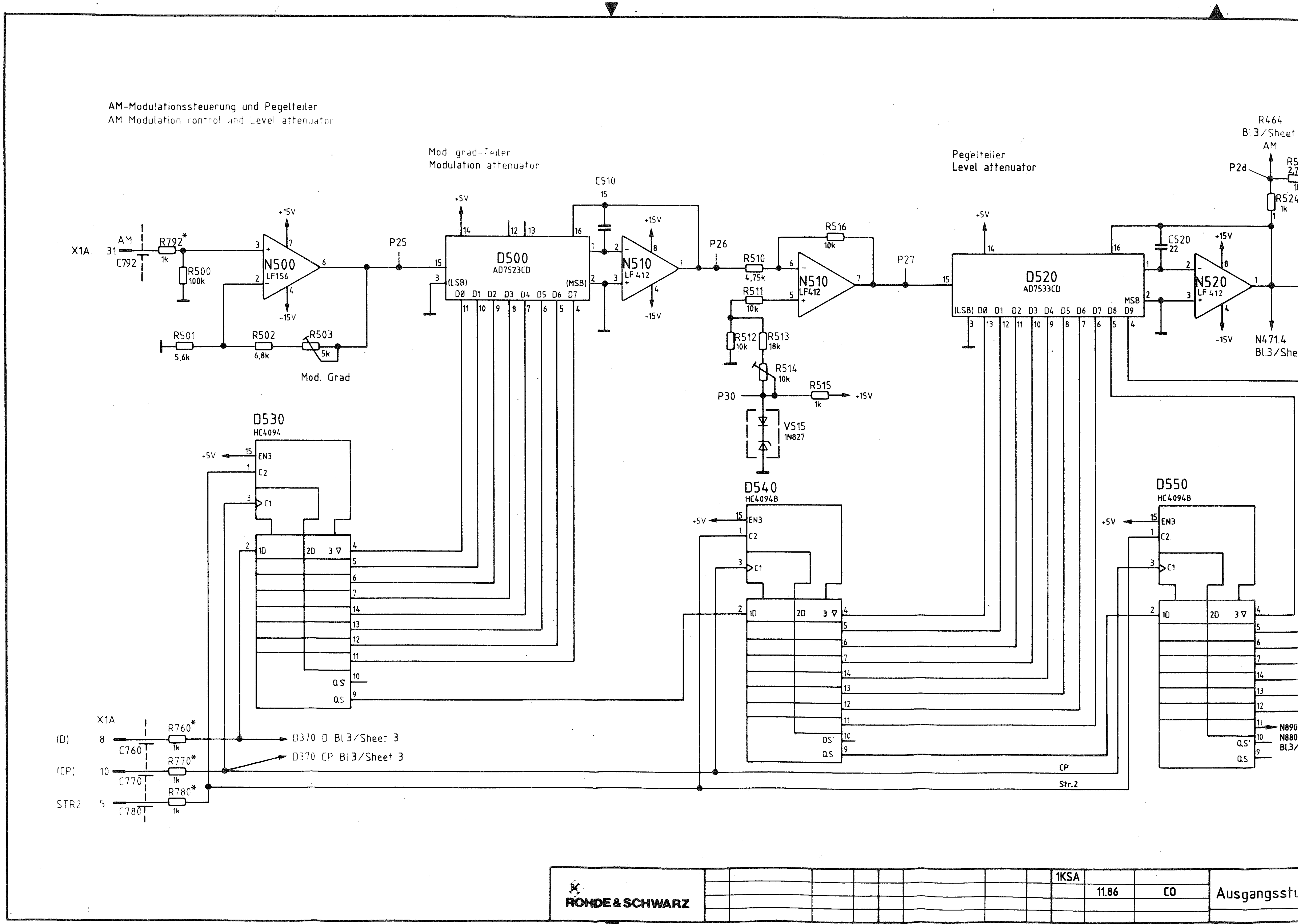
C278 1n

ROHDE&SCHWARZ

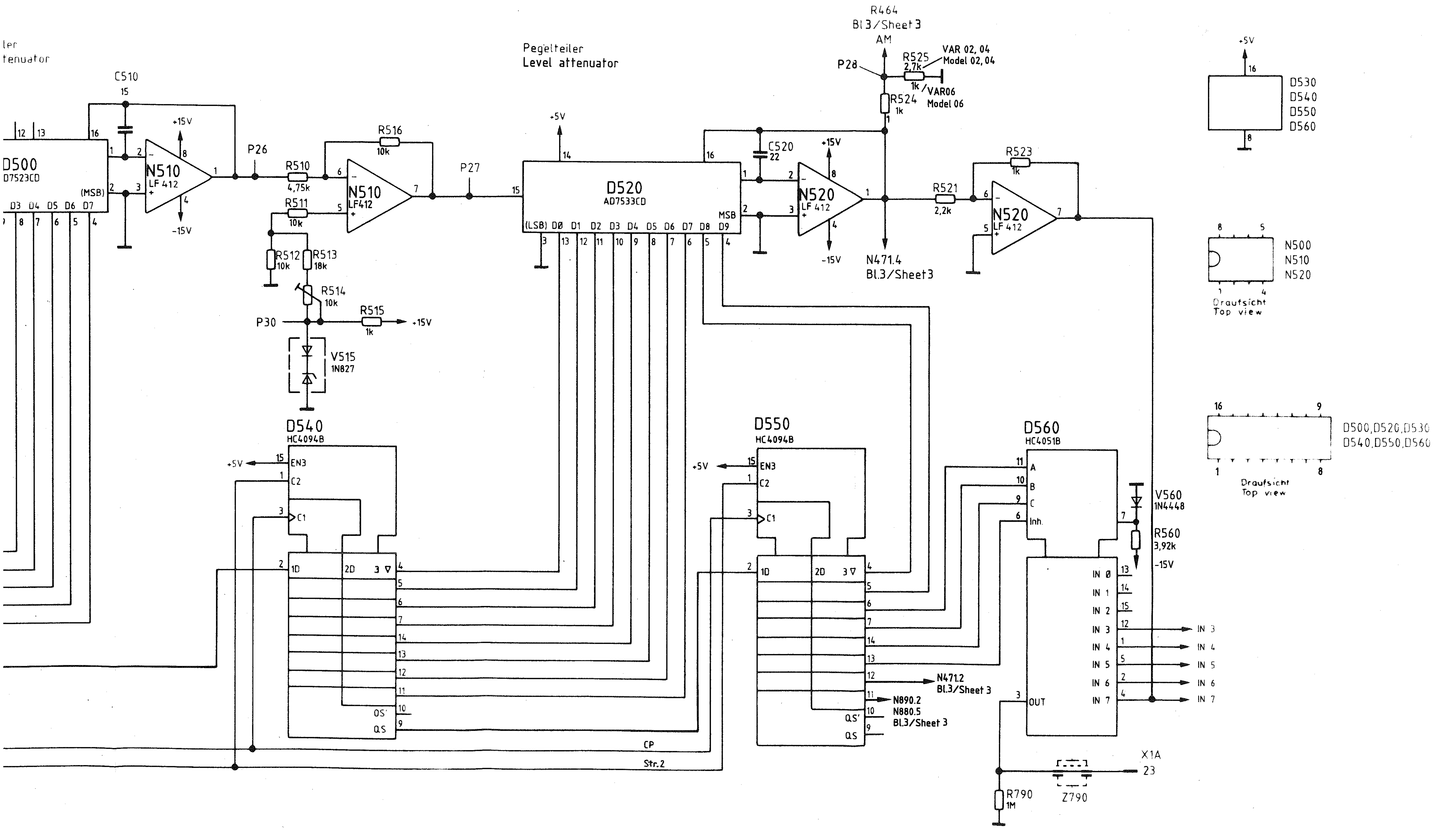
A	35567	6.87	CO	1KSA		
B	38970	11.87	CO		11.86	GU
C	41810	12.88	JN		11.86	CO

Ausgangsstufe 2GHz / Output stage 2GHz — Z — 843.3015 S — 3/5

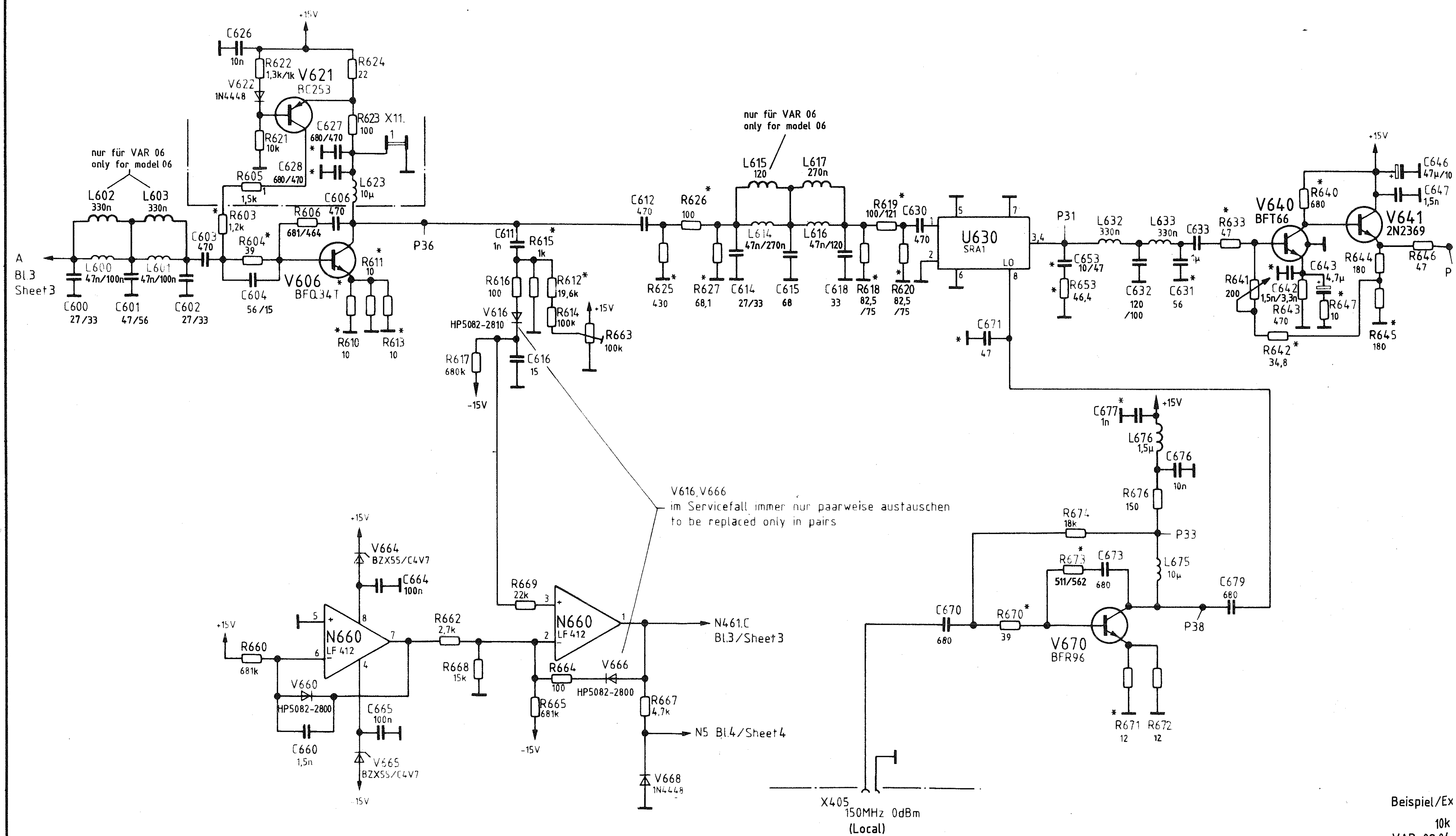
SMH — 843.3009 V — 843.3009



AM-Modulationssteuerung und Pegelteiler
AM Modulation control and Level attenuator
Mod grad-Teiler
Modulation attenuator
Pegelteiler
Level attenuator
D500 AD7523CD
N500 LF156
N510 LF 412
N510 LF412
D520 AD7533CD
N520 LF 412
D530 HC4094
D540 HC4094B
D550 HC4094B
V515 1N827
R464 Bl3/Sheet
N471.4 Bl.3/She
Mod. Grad
D370 D Bl3/Sheet 3
D370 CP Bl3/Sheet 3
X1A
(D)
(CP)
STR2
CP
Str.2
ROHDE&SCHWARZ
1KSA
11.86
CO
Ausgangsst



ROHDE & SCHWARZ	1KSA 11.86 CO	Ausgangsstufe 2GHz / Output stage 2GHz	Z
843.3015 S	4/5	SMH	843.3009 V / 843.3009



Beispiel/Ex
10k
VAR 02,04

* von Lötseite bestückt
Components inserted on solder side

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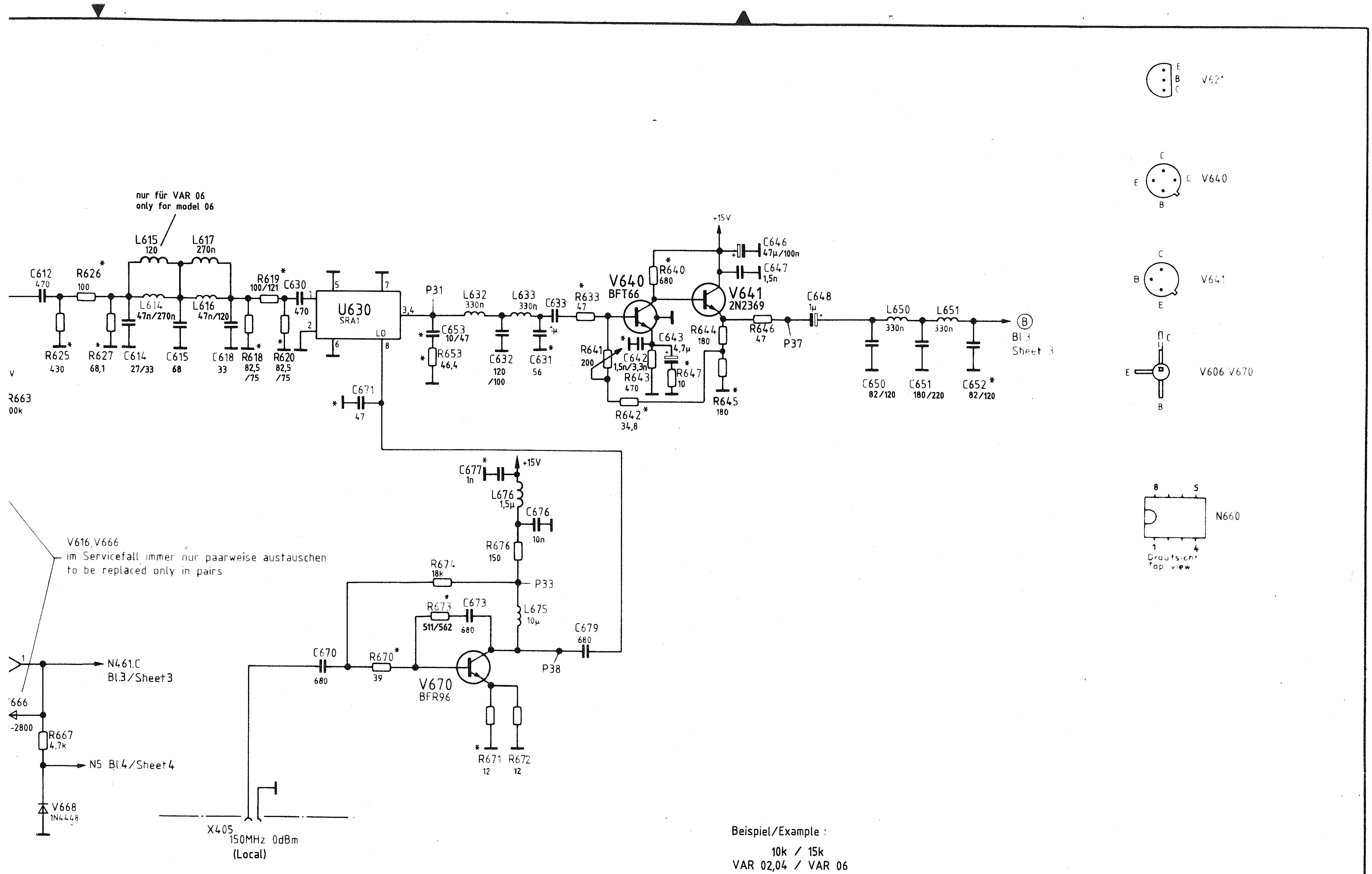
	B	38970	11.87	CO	11.86 CO	

843015 S Bl.5



Beispiel/Example :

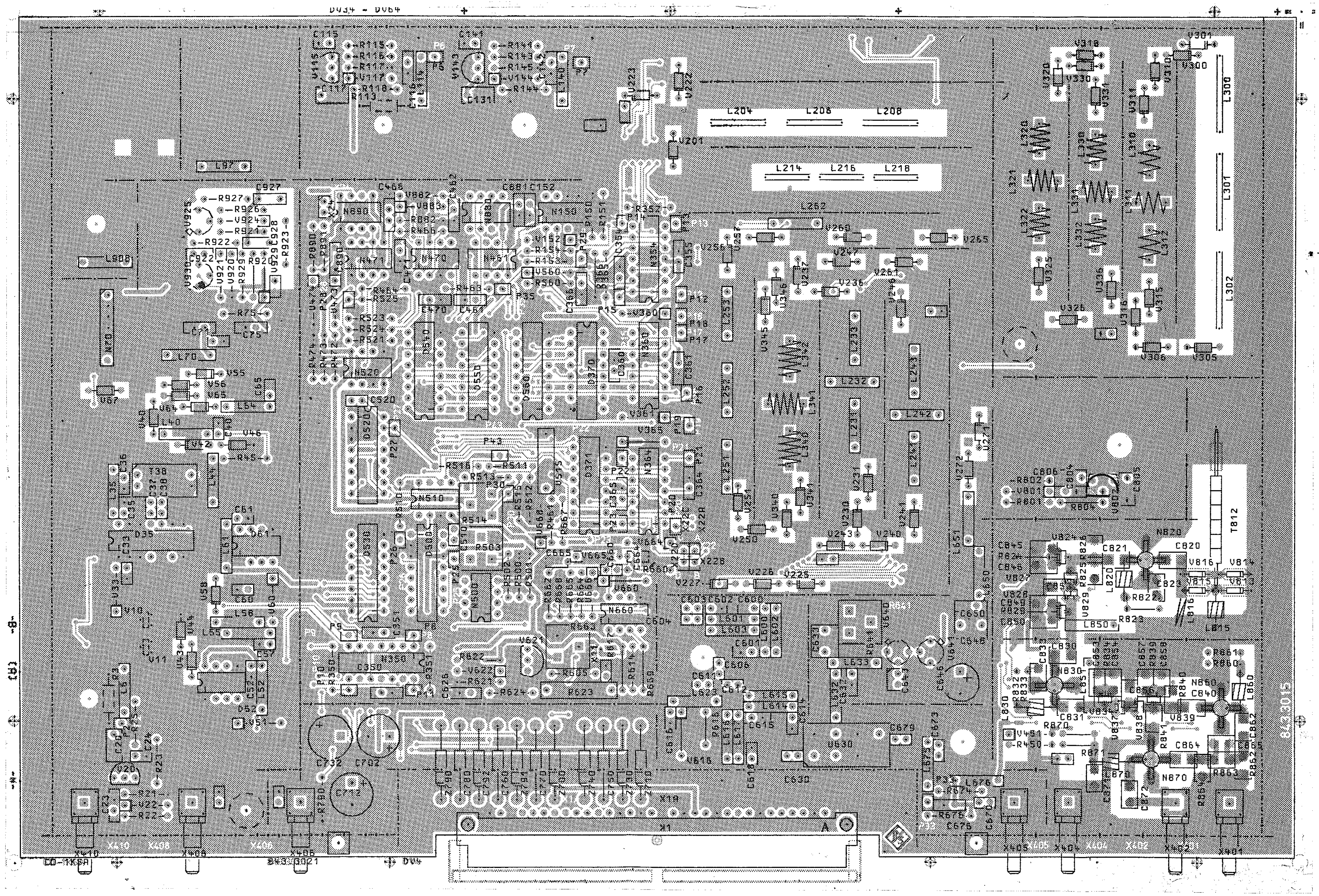
10k / 15k
VAR 02,04 / VAR 06

ROHDE & SCHWARZ	A	35567	6.87	CO	1KSA		
	B	38970	11.87	CO	11.86	CO	

Ausgangsstufe 2GHz/Output stage 2GHz Z 843.3015 S

SMH 843.3009 V 843.3009

5 / 5



Ansicht und Leitungsführung Bauteilseite
View of tracks on component side

VARIANTENERKLÄRUNG/VERSION
VAR 02 - GRUNDAUSFÜHRUNG/BASIC MODEL

B	35567	08.87	COS	Maße ohne Toleranzangabe	Maßstab 1 : 1
					Halbzeug, Werkstoff
				1KSA / Tag / Name	Benennung
				Bearb. 08.87 COS	AUSGANGSSTUFE 2GHZ / OUTPUT STAGE 2GHZ — Z
				Gepr.	
				Norm	
				ROHDE&SCHWARZ	Zeichn.-Nr. 843.3015.01 EE — Blatt-Nr. 3 v. Bl.
Änd. Zust.	Änderungs-Mitteilung	Tag	Name	zu Gerät SMH	reg. i. V. 843.3009 V — erste Z.

ACHTUNG: EGB!
Elektrostatisch gefährdete Bauelemente erfordern eine besondere Handhabung.
ATTENTION ESD!
Electrostatic sensitive devices require a special handling.

(hierzu HVC 250)

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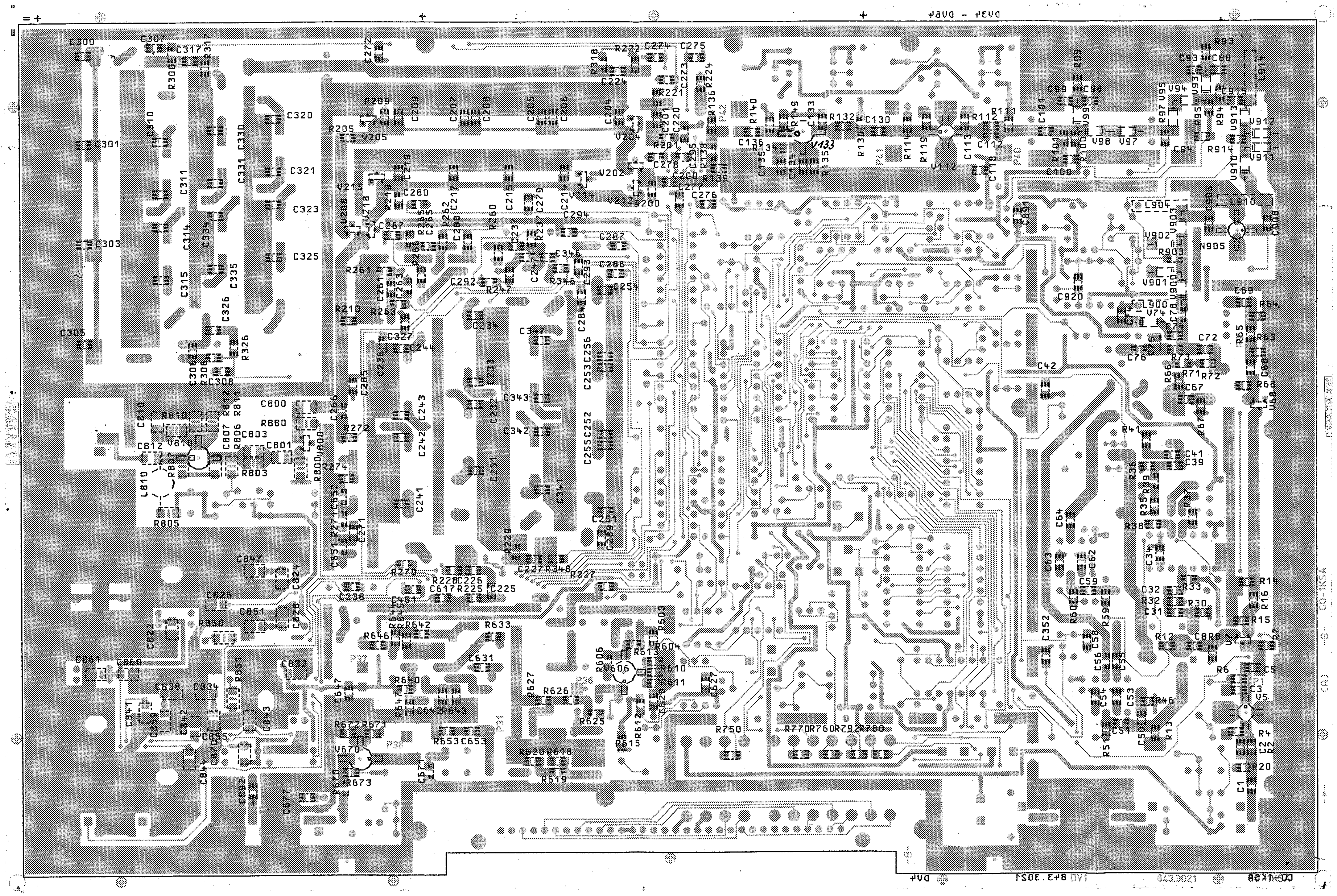
0-Projektion
Methode E

PF 095.2493-0781

07 6001 81



Ansicht und Leitungsführung Lötseite
View of tracks on solder side

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VARIANTENERKLÄRUNG / VERSION
VAR 02 – GRUNDAUSFÜHRUNG / BASIC MODEL

(hierzu HVC 250)

ACHTUNG: EGB!
Elektrostatisch gefährdete Bauelemente erfordern eine besondere Handhabung.
ATTENTION ESD!
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B	35567	08.87	COS	Maße ohne Toleranzangabe
Änd. Zust.	Änderungs-Mitteilung	Tag	Name	

1KSA	Tag	Name
Bearb.	08.87	COS
Gepr.		
Norm		

ROHDE & SCHWARZ
zu Gerät SMH

Maßstab 1 : 1

Halbzeug, Werkstoff

Benennung
AUSGANGSSTUFE 2GHZ
OUTPUT STAGE 2GHZ

Z

Zeichn.-Nr. 843.3015.01 EE

Blatt-Nr. 4 v. Bl.

reg. i. V. 843.3009 V

erste Z.

ISO-Projektion Methode E

PF 095.2493-0781

07 6001 81

ROHDE&SCHWARZ

SERVICE DOCUMENTS

Output Amplifier

843.3450.03

Contents

5 Service Manual "Output Amplifier"

(See circuit diagram 843.3450S)

5.1 Circuit Description

The output stage delivers RF signals between 0.1 and 1000 MHz as well as RF signals obtained by doubling between 1000 and 2000 MHz. These RF signals are switched over and amplified on the output amplifier. For level control and amplitude modulation, the level of the output signal is detected and the control voltage made available at the output socket.

The output amplifier contains 6 thin-film modules A242 to A246, A249 and the PCB A248.

The inputs X222 and X223 are connected to the preamplifier stage A243 via PIN switch A242. The input signal is further amplified in driver stage A244 and final stage A245 and taken to detector module A246. There, the RF signal is rectified with V502. The RF voltage is available at output socket X221 with an internal resistance of 50 Ω. The PIN diode V500 protects the final stage and the detector from positive voltage peaks which enter the amplifier from the RF output X221.

The "operating point control" board contains 3 current sources V5, V15, V25 for impressing the collector current of the RF transistors in preamplifier, driver and final stage, as well as V1, V10, V20 for controlling the respective collector voltages.

The rectified voltage coming from the detector module is applied to output X224 via N41.

The thin-film module A249 contains 2 diodes for temperature compensation and linearization of the rectified voltage.

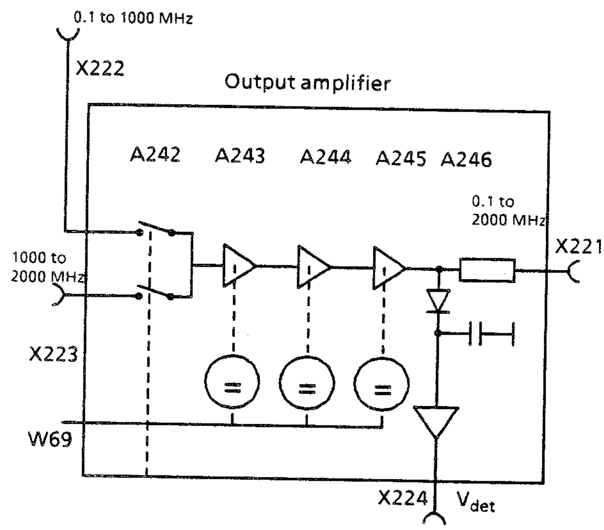


Fig. 5-1 Block diagram of output amplifier

Checking and Adjustment

5.2.1 Level Adjustment

Using potentiometer R30 in the output amplifier, the minimum level is set in the frequency range f >8 MHz with electronic level reduction:

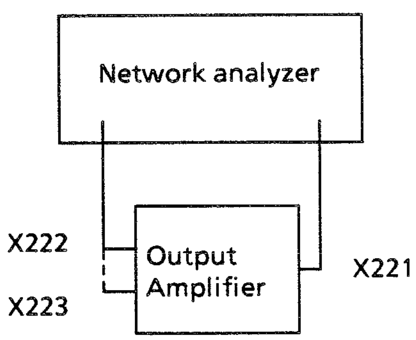
- Set frequency to 500 MHz
- Connect power meter to RF socket
- Enter 13 dBm, set 0 % AM, use level fine variation to set the level to -6.9 dBm in 0.1-dB steps (switching of the mechanical attenuator must not be audible)
- Using R30, adjust to -6.9 dBm ± 0.5 dB on the power meter.

5.2.2 Checking the Output Amplifier

5.2.2.1 Checking the Frequency Response

- Set a frequency <1 GHz.
- Connect network analyzer to amplifier input X222 and output X221.
- Check |S21| and |S11| according to Figs. 5-2 and 5-3.
- Set a frequency >1 GHz.
- Repeat the measurement for input X223.

Test setup:



Unscrew cables W13 from X222, W16 from X223, W15 from X221 and W12 from X224. In order to loosen cable W16, the output amplifier must be unscrewed from the mounting plate.

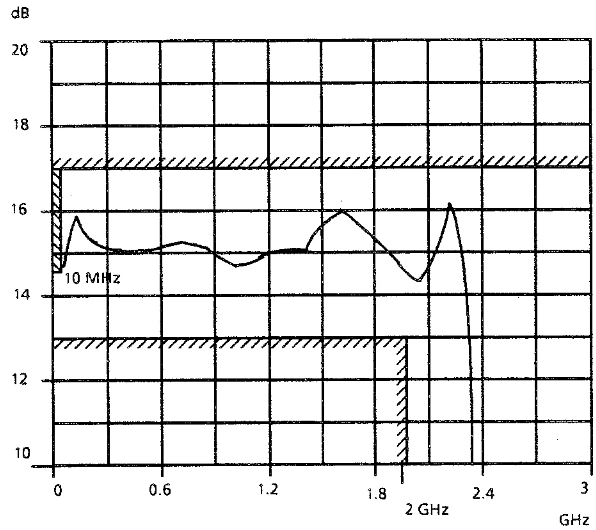


Fig. 5-2 |S21| Typical curve and tolerance field

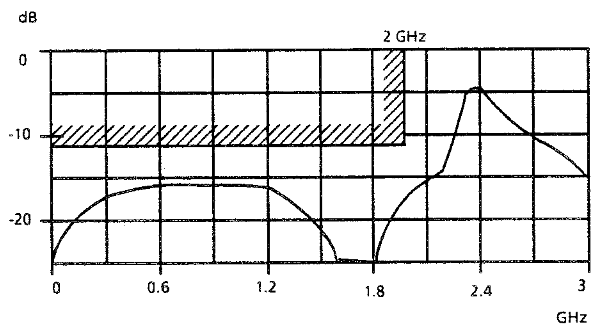


Fig. 5-3 |S11| Typical curve and tolerance field

5.2.2.2 Checking the Harmonic Suppression

- Connect spectrum analyzer to RF socket. Set level to + 13 dBm.
- Check level of fundamental. The harmonics d2 and d3 must be spaced >30 dBc apart in the frequency range $0.1\ \text{MHz} \leq f \leq 2\ \text{GHz}$.

5.2.2.3 Checking the Rectifier Linearity

Note: *If the AM control loop is open, e.g. after unscrewing the cable from output X224, an RF level of up to +23 dBm may occur at amplifier output X221!*

- Attach test adapter, e.g. T-piece, to output X244. Reconnect the cable, connect DC voltmeter to test adapter.
- Set frequency to 10 MHz.
- Set level to + 13 dBm, use level fine variation to set the level values in 0.1-dB steps according to Table 5-1 (switching of the mechanical attenuator must not be audible).
- Check the values of the rectified voltage.

Table 5-1

Level setting	Level setting at X224
+ 13 dBm	$3.0\ V \leq V_{13} \leq 3.4\ V$
+ 7 dBm	$0.49*V_{13} \leq V \leq 0.51*V_{13}$
- 6.9 dBm	$0.09*V_{13} \leq V \leq 0.11*U_{V3}$

5.2.2.4 Checking the Rectifier Frequency Response

- Connect RF power meter to RF socket.
- Set frequency to 100 MHz and level to + 13.0 dBm.
- The level measured using the power meter must not deviate by more than ± 0.5 dB from + 13 dBm.

5.3 Troubleshooting

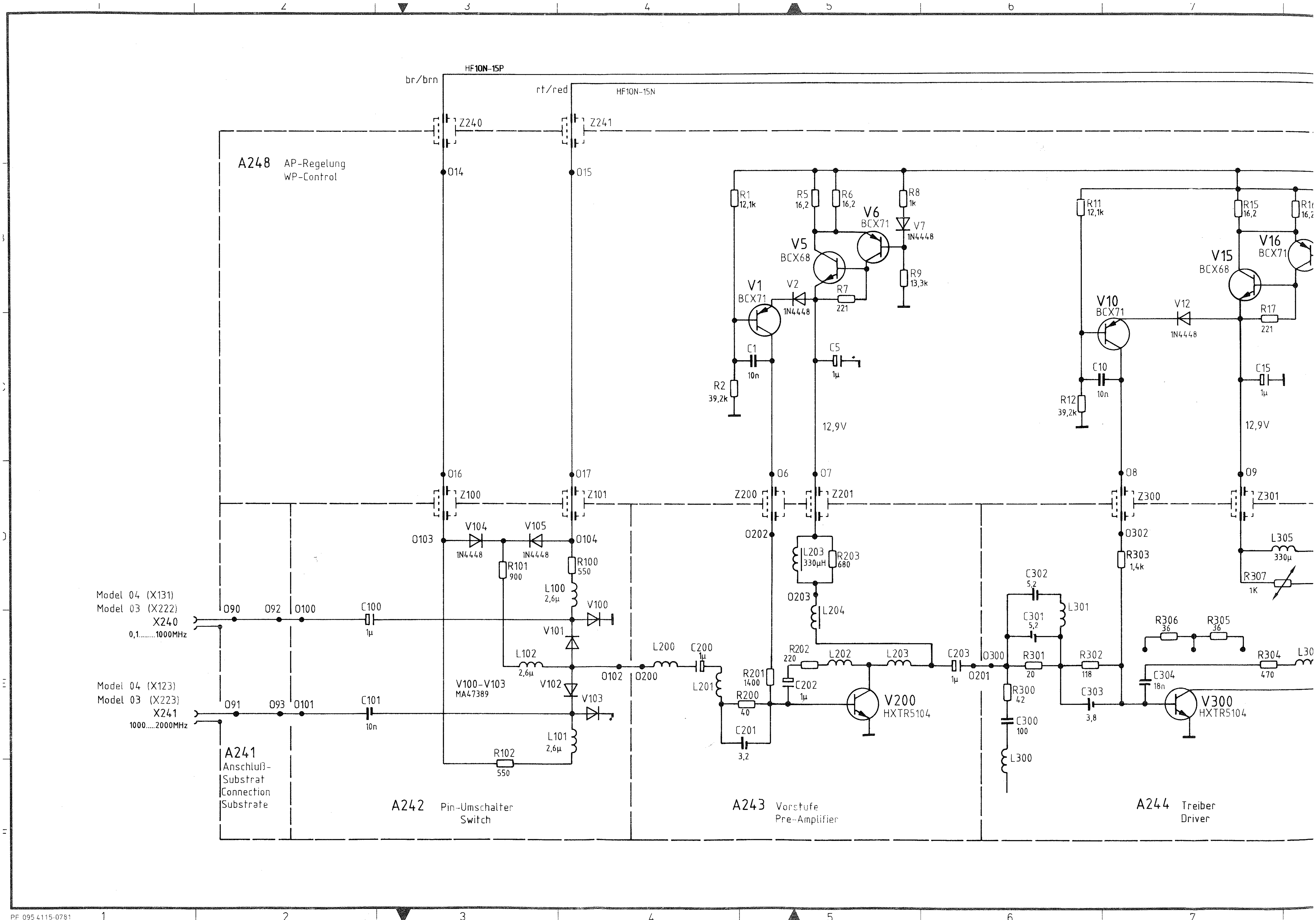
Set the frequency to 100 kHz, terminate input X222 with 50 Ω, unscrew the cover, check the voltages at the lead-through filters:

06, 08, 010:	3 V	≤ V ≤	8 V
07, 09:	12.7 V	≤ V ≤	13.1 V
011:	19 V	≤ V ≤	20 V
012:	-30 mV	≤ V ≤	150 mV
013	-250 mV	≤ V ≤	-50 mV
016:	12 V	≤ V ≤	15.2 V
017	-15.2 V	≤ V ≤	-12 V

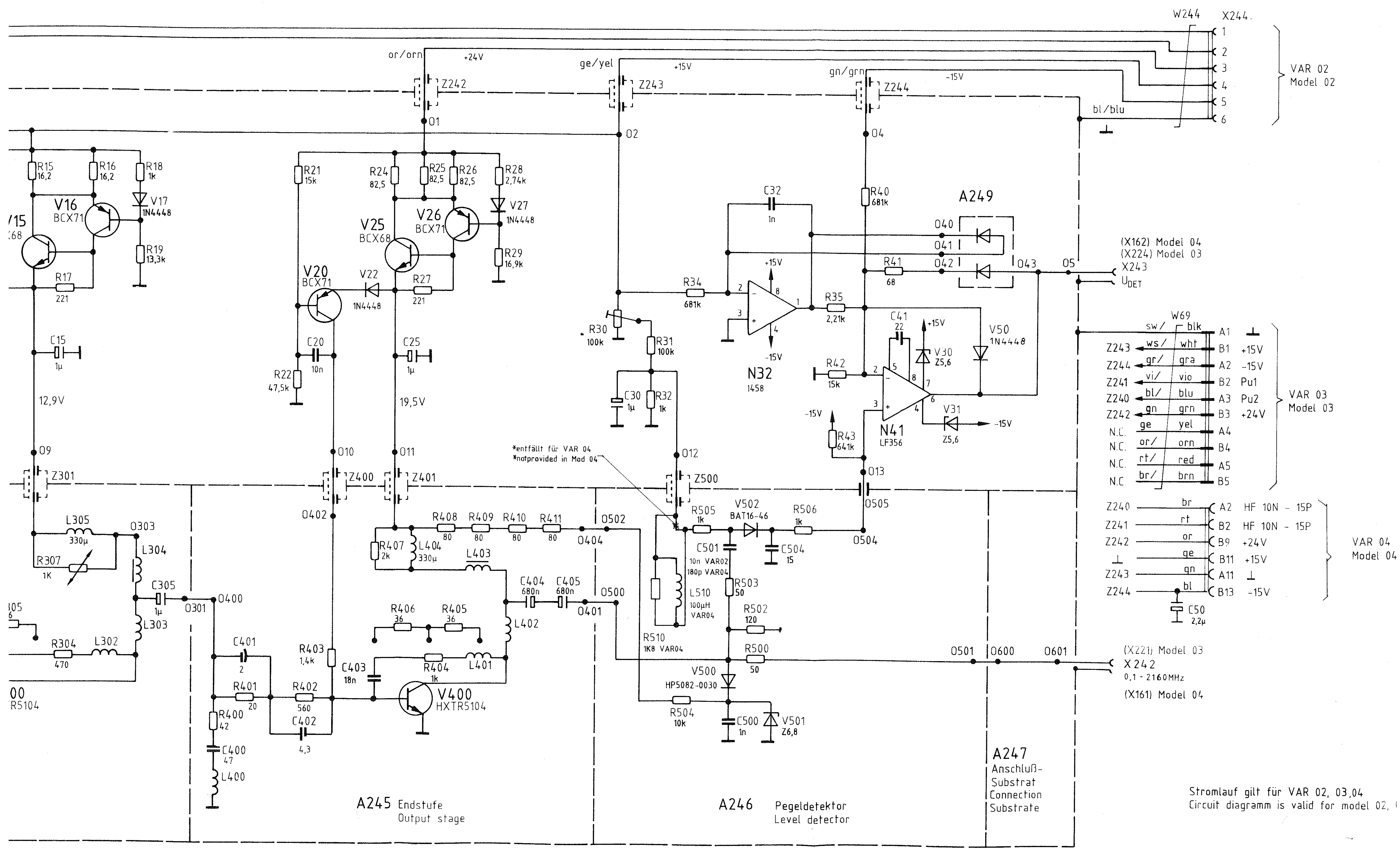
The voltage at the connection between pin switch and preamplifier stage is -4V ≤ V ≤ -3.5 V, independent of the switch position.

The transmission path from X223 to X224 can be checked e.g. using an RF voltmeter or an oscilloscope.
If X224 is terminated with 50 Ω, the operating voltage gains of the individual stages at f = 100 kHz are as follows:

PIN switch:	g = 0.8
Preamplifier stage:	g = 4
Driver stage:	g = 3
Final stage:	g = 1
Detector:	g = 0.5



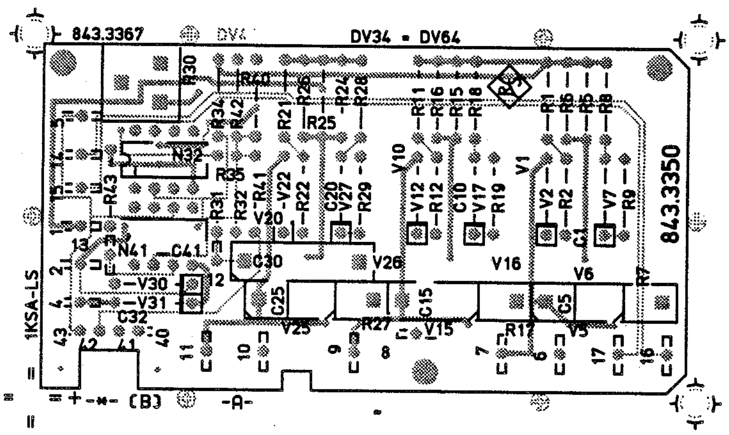
HF10N-15P
br/brn
rt/red
HF10N-15N
Z240
Z241
A248 AP-Regelung
WP-Control
014
015
R1 12,1k
R5 16,2
R6 16,2
R8 1k
V6 BCX71
V7 1N4448
V5 BCX68
R9 13,3k
V1 BCX71
V2 1N4448
R7 221
C1 10n
C5 1µ
R2 39,2k
12,9V
R11 12,1k
R15 16,2
V16 BCX71
V15 BCX68
V10 BCX71
V12 1N4448
R17 221
C10 10n
C15 1µ
R12 39,2k
12,9V
016
017
06
07
08
09
Z100
Z101
Z200
Z201
Z300
Z301
0103
V104 1N4448
V105 1N4448
0104
0202
0302
R101 900
R100 550
L203 330µH
R203 680
R303 1,4k
L305 330µ
R307 1K
L100 2,6µ
0203
L204
C302 5,2
L301
C301 5,2
Model 04 (X131)
Model 03 (X222)
X240
0,1.........1000MHz
090
092
0100
C100 1µ
V100
V101
R306 36
R305 36
L102 2,6µ
L200
C200 1µ
R202 220
L202
L203
C203 1µ
0300
R301 20
R302 118
R304 470
0102
0200
R201 1400
L201
C202 1µ
0201
Model 04 (X123)
Model 03 (X223)
X241
1000.....2000MHz
091
093
0101
C101 10n
V100-V103 MA47389
V102
V103
R200 40
V200 HXTR5104
R300 42
C303 3,8
C304 18n
V300 HXTR5104
C300 100
L101 2,6µ
C201 3,2
R102 550
L300
A241 Anschluß-Substrat Connection Substrate
A242 Pin-Umschalter Switch
A243 Vorstufe Pre-Amplifier
A244 Treiber Driver



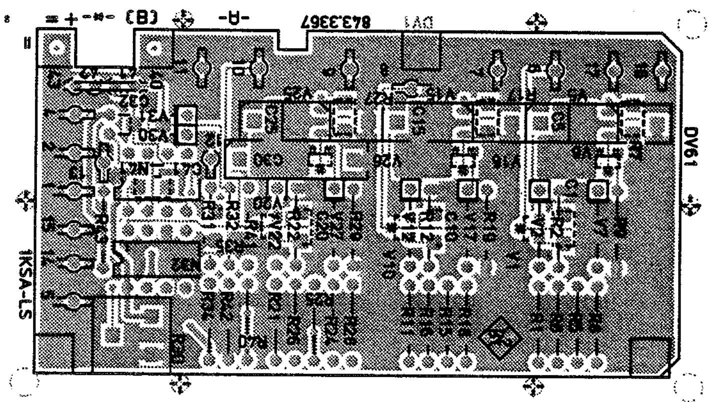
ROHDE&SCHWARZ	A	35567	08.87	LS	D	38970	10.88	CO	1KSA	Tag	Name	Benennung: Ausgangsverstärker Output amplifier	Z	Zeichn.-Nr. 843.3450 S
	B	38970	12.87	CO	E	41810	11.88	HO	Bearb.	5.87	LS			
	C	38970	3.88	HO					Gepr.					
	Änd Zust	Änderungs-Mitteilung	Datum	Name	Änd Zust	Änderungs-Mitteilung	Datum	Name	Norm			zu Gerät:		reg. i. V. 843.3009 V / erste Z.

8 9 10 11 12 13 14

Ansicht und Leitungsführung Bauteilseite
View of tracks on component side



Ansicht und Leitungsführung Lötseite
View of tracks on solder side



(hierzu HVC 250)

ACHTUNG: EGB!
Elektrostatisch gefährdete Bauelemente erfordern eine besondere Handhabung.

ATTENTION ESD!
Electrostatic sensitive devices require a special handling.

VARIANTENERKLÄRUNG/VERSION
VAR 02 – GRUNDAUSFÜHRUNG/BASIC MODEL

Maße ohne Toleranzangabe		Maßstab 1 : 1	
		Halbzeug, Werkstoff	
1KSA	Tag	Name	Benennung
Bearb.	07.87	LS	AP - REGELUNG
Gepr.			OPERATING POINT CTRL
Norm			Z
ROHDE&SCHWARZ		Zeichn.-Nr 843.3350.01 ED	Blatt-Nr 3
zu Gerät	SMH	reg. i. V. 843.3009 V	erste Z

Änd. Zust.	Änderungs-Mitteilung	Tag	Name

PF 095 2506-0781

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