Manual Code Number 982-783

SMG 40 Stereo Generator

RE TECHNOLOGY

Emdrupvej 26 · DK-2100 Copenhagen Ø · Denmark · Telephone 31 18 44 22 · Telefax 31 18 44 01 · Telex 9118770 reas dk

** N O T E **

The SMG 40/2 is identical to the SMG 40 (390 - 647) with the following exceptions:

Build in modulation sources in SMG 40/2

40 Hz	:	R301 = R302 = 1.15 M ohms
500 Hz	:	R303 = R304 = 100 k ohms
5 kHz	:	R305 = R306 = 9.09 k ohms
10 kHz	:	R307 = R308 = 4.53 k ohms
15 kHz	:	R309 = R310 = 3.01 k ohms

Modification Sheet for Operating and Servicing Manual

SMG40/OM & SM/9006 Page 1/1

Following drawings referred to in the text have been changed:

Previous No.:	Actual No.:
1829-A1	985-072
1830-A1	985-073
2712-A2	985-074
2713-A2	985-075

On page:

E31	C173	Tantalum 2uF -20+50% 35V		267-002
		changed to:		
		Solid Al-Capacitor u4 20%		265-000
E32	L101	coil		12233-A4
		changed to:		740-012
	L102	coil		12234-A4
		changed to:		740-013
	L103	coil		12235-A4
		changed to:		740-014
	L107	coil		12236-A4
		changed to:		740-015
	L108	coil		12237-A4
		changed to:		740-016
	QA108	LM318N		364-216
		changed to:		740-016

E36 and diagram

R311	resistor	1K2	106-412
	changed to:	1K	106-410
R312	NTC	4K7	160-054
	changed to:	8K2	160-006
R314	resistor	2K7	106-427
	changed to:	1K	106-410
R315	potm.	2K2	182-012
	changed to:	1K	182-001
R316	resistior	1K5	106-415
	changed to:	470E	106-347

R317	resistor	1K	106-410
	changed to:	3K3	106-433
R318	resistor	4K7	106-447
	changed to	1K8	106-418
R319	resistor	68E	106-368
	changed to	1K	106-410

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Section A ____ General Information

AI INTRODUCTION

The SMG40 Stereo Generator is a compact stereo generator which provides a time-multiplexed composite signal conforming to the FCC and EBU standards for stereo broadcasting.

The time-multiplex principle has been adopted in the SMG40 because of its advantages of which one of the most significant is the completely uniform handling of the left and right signals, which implies that minor amplitude- and phase-differences become less probable.

The composite signal can be used in testing high-quality multiplex stereo decoders and in driving FM signal generators to full 75 kHz deviation.

The SMG40 can be modulated either with the built-in, low-distortion oscillator offering a choice of five fixed frequences or from an external AF oscillator.

In addition, it is furnished with an SCA input and with outputs for pilot and modulation synchronization.

The SMG40 is provided with the following modes: L & R, L = R, L = -R, L, R.

The SMG40 has a preemphasis selector for 25 µs, 50 µs or 75 µs time constants.

The SMG40 can be used as a modulation source for the RE110 FM Carrier Unit and the RE101 Signal Generator.

AII EQUIPMENT and ACCESSORIES

The following items are included with the SMG40 STEREO GENERATOR as STANDARD ACCESSORIES:

1 Line Cord
2 Spare Fuses
1 Instruction Manual

The following item is available as an OPTIONAL ACCESSORY:

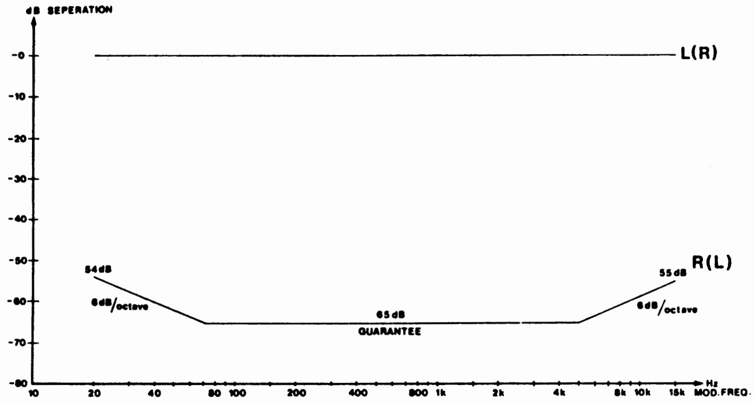
Rack Mounting Kit.

AIII SPECIFICATIONS:

COMPOSITE SIGNAL

Modes: L & R, L = R, L = −R, L, R.

Channel Separation:



80 Hz to 5 kHz: > 65 dB

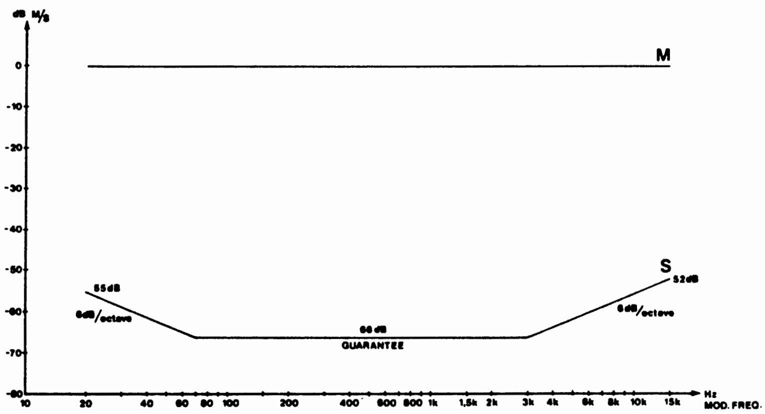
40 Hz to 8 kHz: > 60 dB

22 Hz to 15 kHz: > 55 dB

Note: The capacitive load of COMP. OUT and COMPOSITE must be less than 100 pF

M-S Separation:

Function: L = R (M)

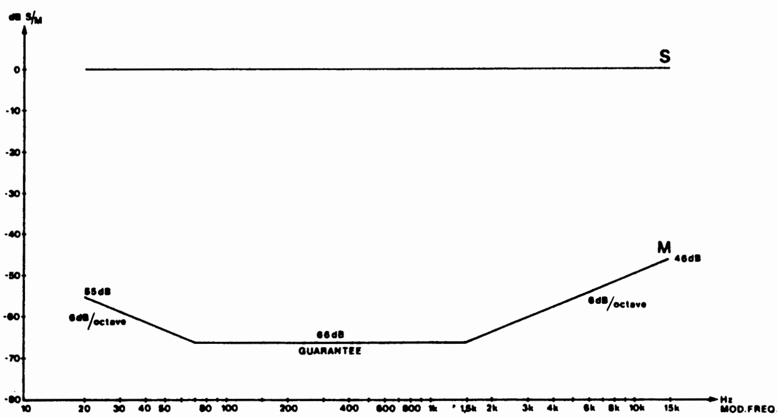


70 Hz to 3 kHz: > 66 dB

40 Hz to 5 kHz: > 61 dB

20 Hz to 10 kHz: > 55 dB

Function L = −R (S)



70 Hz to 1.5 kHz: > 66 dB

40 Hz to 3 kHz: > 61 dB

20 Hz to 5 kHz: > 55 dB

Distortion

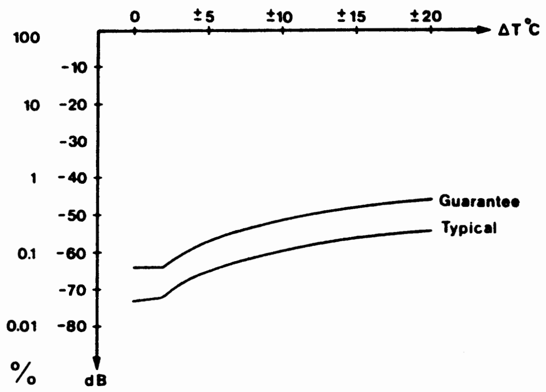
Content of harmonics of the modulation frequency at 100% composite signal level and a load   2 kΩ at COMP.OUT.

Internal mod. 80 Hz:	0.07% (-63 dB)
Other frequencies: 400 Hz	
1 kHz, 5 kHz, 10 kHz:	0.03% (-70 dB)
Intrinsic distortion:	0.02% (-74 dB)

Residual, 38 kHz

More than 64 dB below 100% composite signal.

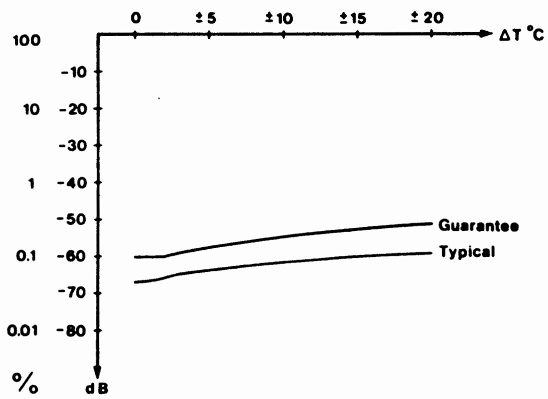
Note: The residual is a function of changes in the ambient temperature as shown in the adjacent figure. Factory-adjusted at approx. 25°C.



Spurious above 53 kHz

More than 60 dB below 100% composite signal.

Note: Spurious above 53 kHz are a function of changes in the ambient temperature as shown in the adjacent figure.
Factory-adjusted at approx. 25°C.



Hum and noise:

This specification is relative to 100% Composite Signal with 1 kHz as a reference frequency and applies to both mono and stereo.

At 15 kHz noise bandwidth:	-72 dB
Weighted according to CCIR, 468-1 filter	-66 dB
Weighted according to CCIR, 468-1 filter + deemphasis:	
75 μsec:	-74 dB
50 μsec:	-72 dB
25 μsec:	-69 dB

PILOT

Frequency:	19 kHz ± 1 Hz
Time difference between coincident zero passages for pilot and subcarrier:	< 0.06 μs (0.9 degr. in rel. to the subcarrier)
Level:	0 - 15%
Scale accuracy:	Better than 0.3% units at 8 - 10% Better than 0.6% units at 0 - 15%.

PRE-EMPHASIS

Time constants:	25, 50 and 75 μs
Accuracy:	Better than ± 3.5%
Deviation from standard at 15 kHz:	< ± 1 dB.

COMP. OUT:

Level:	Variable 0 - 5 Vp at 100% composite level.
Scale accuracy:	Better than ± 4% of f.s.
Source impedance:	90 - 700 Ω depending on level setting
DC offset:	0 to ± 15 mV depending on level setting

COMPOSITE

Level at 100%	795 mVp ± 2.5%
Source impedance:	600 Ω ±2%
DC offset:	0 to ± 2 mV

PILOT SYNC.

Frequency:	19 kHz ±1 Hz
Level:	Approx. 1 Vp.
Source impedance	Approx. 600 Ω

MODULATION OSCILLATOR

Frequencies:	80 Hz, 400 Hz, 1 kHz, 5 kHz, 10 kHz
Frequency accuracy:	Better than ± 3%
Frequency response:	<±2% (0.2 dB)
Level:	Var. 0 - 100% composite level in PREEMPH. OFF.
Distortion at: 80 Hz	< 0.07% (- 63 dB)
Distortion at: 400 Hz, 1 kHz, 5 kHz, 10 kHz	<0.025% (-72 dB).

MOD. SYNC.

Frequency:	As for Mod. Osc.
Level:	Approx. 1 Vp,
Source impedance	Approx. 600 Ω

COMPOSITE METER

Scale:	0 - 100%
Accuracy:	±3.5% of f.s.

EXT L and R INPUT

Frequency range:	20 Hz to 15 kHz
Frequency response:	< ± 1% (0.1 dB)
Level for 100%	Approx. 1 Vp (0.7 V_{RMS})
Input impedance:	Approx. 47 kΩ.

SCA INPUT

Frequency range:	10 - 100 kHz
Frequency response:	<±1% (0.1 dB)
Level for 10%	Approx. 1 Vp (0.7 V_{RMS})
Input impedance	Approx. 600 Ω.

RF UNIT

Composite level:		795 mVp at 100%, pin 3
Voltages:	+5 V	at pin 1
	-15 V	at pin 4
	+15 V	at pin 5
	0 V	at pin 2

POWER REQUIREMENTS

Line voltage:	95-130/190-260 Vac
Line frequency:	47.5 to 63 Hz
Consumption:	7 VA.

ENVIRONMENTAL REQUIREMENTS

Ambient temperature:	+5 to +40°C
Storage temperature:	-40 to +70°C
Relative humidity:	20 to 80%.

DIMENSIONS and WEIGHT

W x H x D:	300 x 78 x 250 mm
Weight:	3 kg.

Section B ______ Installation and Operation

BI INSTALLATION

INITIAL INSPECTION. When unpacking the instrument, the accessories and the packing material should be visually inspected for physical damage.

If the instrument is damaged, notify the carrier and your local Radiometer Electronics representative or the factory. The packing material should be saved for inspection by the carrier.

Electrical installation:

The SMG40 Stereo Generator will operate on either 115 volt ac or 220 volt ac line supplies. The proper line voltage is selected by a slide switch on the rear panel of the SMG40.

CAUTION: To prevent damage to the instrument, check that the line voltage selector is set to the correct line voltage and that the line fuse has the correct rating.

To change the line voltage, remove the lock plate by unscrewing the two screws holding it, set the slide switch to the proper line voltage and replace the lock plate. When changing the line voltage, the line fuse must be changed, too. The correct fuse rating is printed under the fuse holder.

In accordance with international safety standards, the SMG40 is supplied with a 3-wire line cord which, when connected to an appropriate ac power outlet, grounds the SMG40 cabinet.

If the SMG40 is to be connected to an ac power outlet without a ground connection, the ground jack ⏚ (16) on the rear panel can be used to ground the instrument.

Environmental requirements:

The SMG40 will operate within the specifications stated when the operating environment is within the following limitations:

Temperature:	between +5 and +40°C
Relative Humidity:	between 20% and 80%.

The SMG40 should be stored in an environment having a temperature between -40°C and +70°C and a relative humidity below 80%.

BII DESCRIPTION OF FRONT AND REAR PANELS

FRONT PANEL

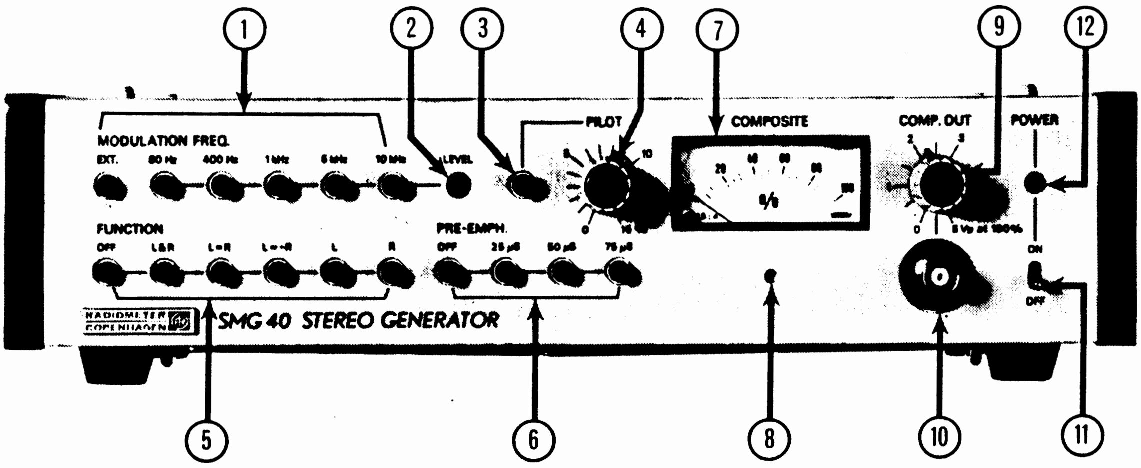


FIG. B1

(1) MODULATION FREQ. Selects between EXTernal modulation and the five fixed frequencies of the internal modulation oscillator.

(2) LEVEL. Adjusts the level of the internal modulation. The level is indicated in % on the COMPOSITE meter (7).

(3) PILOT (on/off). In its depressed position the pushbutton switches the PILOT signal on.

(4) PILOT (level). With this knob, the pilot level can be set between 0 and 15%.

(5) FUNCTION. Selects between the five operating modes, L & R, L = R, L = -R, L, R and function OFF.

(6) PREEMPH. Selects between the three preemphasis modes, 25 µs, 50 µs, 75 µs and preemphasis OFF.

(7) COMPOSITE. The meter indicates the sum of the modulation signal, the pilot signal and the SCA signal.

(8) Mechanical zeroing adjustment for the COMPOSITE meter.

(9) COMP. OUT (level). With this knob, the composite level can be set between 0 and 5 Vp for 100% deflection on the COMPOSITE meter (7).

(10) COMP. OUT (connector). Type BNC connector provides a connection for the composite output signal.

(11) POWER. Switch controlling ac power to the power supply.

(12) POWER lamp. Is illuminated when the instrument is ON.

REAR PANEL

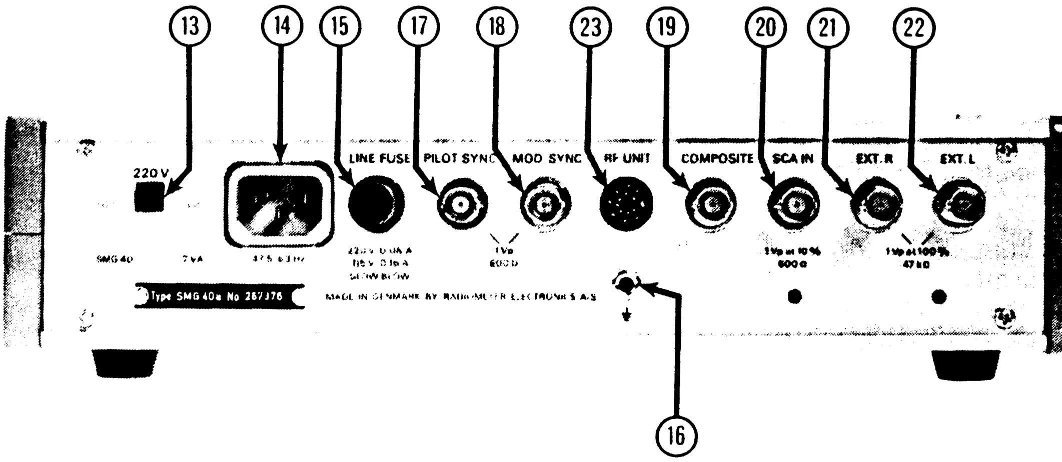


FIG. B 2

(13) Line voltage selector. Selects either 220 V or 115 V ac line voltage.

(14) Line cord receptacle (three-prong). Provides ac line voltage and ground connection when an appropriate line cord is used.

(15) LINE FUSE. 0.08 A for 220 V and 0.16 A for 115 V operation.

(16) ⏚ (ground jack) is used if grounding via the line cord is not possible.

(17) PILOT SYNC. The pilot signal is always available at this BNC connector. The level is approx. 1 V peak EMF (600 Ω).

(18) MOD. SYNC. The signal from the internal modulation oscillator is always available at this BNC connector with a frequency as selected by the MODULATION FREQ. (1) switch.

NOTE: In position EXT., the frequency will be 80 Hz. The level is approx. 1 V peak EMF (600 Ω).

(19) COMPOSITE. The composite signal is available at this BNC connector with a "fixed" level of 795 mV peak EMF (600 Ω) for 100% deflection on the COMPOSITE meter (7).

(20) SCA IN. An SCA signal can be connected to this BNC connector. A level of 1 V peak corresponds to 10% deflection on the COMPOSITE meter (7). The input impedance is 600 Ω.

(21) EXT. R. A signal connected to this BNC connector will provide the Right channel information when MODULATION FREQ. (1) is in EXT. and FUNCTION (5) is in L & R. A level of 1 V peak corresponds to 100% deflection on the COMPOSITE meter (7). The input impedance is 47 kΩ.

(22) EXT. L. A signal connected to this BNC connector will provide the Left channel information when MODULATION FREQ. (1) is in EXT. and FUNCTION (5) in L & R. Furthermore, a signal connected to this BNC connector will serve as modulation information when MODULATION FREQ. (1) is in EXT. and FUNCTION (5) is in either L = R, L = -R, L or R.

A level of 1 V peak corresponds to 100% deflection on the COMPOSITE meter (7). The input impedance is 47 kΩ.

(23) RF UNIT. Supplies power and composite signal for the RE110 FM Carrier Unit.

BIII OPERATING INSTRUCTIONS

The identification numbers in parentheses refer to the circled numbers in Figs. B1 and B2.

BEFORE USE

Before connecting the SMG40 to the line supply, check that the line voltage selector (13) is set in accordance with the local line voltage - if not, see section B1, Installation.

With the power off, check that the pointer of the COMPOSITE meter (7) is positioned directly over zero. If the pointer is not on zero, insert a screwdriver into the adjustment screw (8) and align the pointer with zero on the meter scale.

Plug the line cord into receptacle (14) and switch POWER (11) on. The green lamp (12) should light, indicating that power is on.

If the SMG40 cannot be grounded via the power cord, the ground jack ⏚ (16) on the rear panel must be used to ground the instrument.

BASIC OPERATIONS

MODULATION FREQUENCY

With the MODULATION FREQ. switches (1), select the desired internal modulation oscillator frequency (80 Hz - 400 Hz - 1 kHz - 5 kHz or 10 kHz) or connect an external oscillator to the EXT. L connector (22) on the rear panel. The level of the modulation signal can be read on the COMPOSITE meter (7) when PILOT and the SCA signal are off and the FUNCTION switch (5) is activated. LEVEL (2) sets the modulation level for internal modulation, while the level for external modulation must be set at the modulation source (1 Vp ~ 0.7 V_{RMS} corresponds to 100% on the COMPOSITE meter).

PREEMPHASIS

The modulation signal can be weighted by means of the PREEMPH. switch (6). The selected time constants conform to the international standards:

75 µs, American standard
50 µs, European standard
25 µs, FM-DOLBY

The frequency response in the individual PREEMPH. positions is shown in Fig.B3

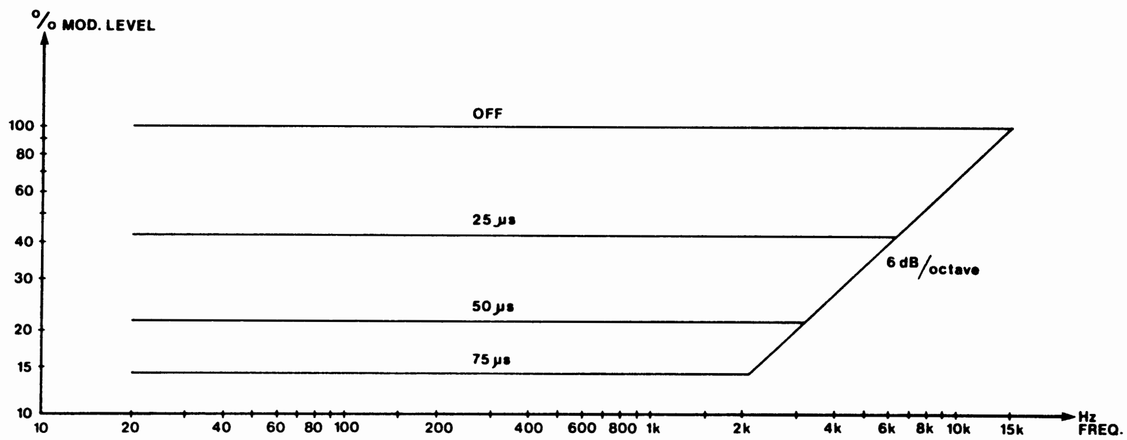


FIG. B 3

At 15 kHz, the MOD. LEVEL will be the same in all PREEMPH. positions.

FUNCTION

Select the desired operating mode with the FUNCTION switch (5).

Position OFF:

Both left and right channel will be switched off. The COMPOSITE meter (7) will show only the level of the pilot and/or the SCA signal.

Position L & R:

Different signals can be impressed on left and right channel.

Internal modulation

The internal modulation oscillator, whose frequency is set with the MODULATION FREQ. switch (1), will provide the signal for the right channel.

The left channel signal is obtained from an external LF generator connected to the EXT. L (22) connector on the rear panel.

To read the level of the right channel on the COMPOSITE meter (7), set MODULATION FREQ. to 80, 400, 1 kHz, 5 kHz or 10 kHz, and FUNCTION (5) to R.

To read the level of the left channel on the COMPOSITE meter (7), set MODULATION FREQ. (1) to EXT., and FUNCTION (5) to L.

External modulation

Set the MODULATION FREQ. switch (1) to position EXT. Connect the external generators to the EXT. L connector (22) and to the EXT. R connector (21) on the rear panel of SMG40.

Read the left channel level on the COMPOSITE meter (7) with the EXT. R generator switched off, and read the right channel level on the meter with the EXT. L generator switched off.

Position L = R:

The composite signal is a monophonic signal (M).

Position L = -R:

The composite signal is a stereophonic sub-channel signal (S).

Position L:

The composite signal is a left channel multiplex signal.

Position R:

The composite signal is a right channel multiplex signal.

As regards internal and external modulation in the positions L = R, L = -R, L and R, please refer to section Modulation Frequency.

PILOT

The 19 kHz pilot signal is switched on by depressing the PILOT on-off pushbutton (3). The pilot level, ranging from 0 to 15%, is set with the PILOT knob (4). The normalized level (8-10%) is marked on the scale.

SCA

An SCA sub-channel signal can be added to the composite signal by connecting an SCA generator to the SCA IN connector (20) on the rear panel. The carrier frequency should be 67 kHz and the amplitude approx. 10%. Read the level of the SCA signal on the COMPOSITE meter (7) with PILOT (3) and FUNCTION (5) switched off. 10% composite level is obtained with 1 Vp = 0.7 V_{RMS}.

COMPOSITE OUTPUT

The composite signal is available at two points:

1) At the COMP. OUT connector (10) on the front panel of the SMG40. The output level is set with the COMP. OUT level control (9) and is 0 to 5 Vp at 100% composite level.

2) At the COMPOSITE connector (19) on the rear panel with a "fixed" level of 795 mVp at 100% composite level (source impedance 600 Ω). For a load of 10 kΩ, the output level will be 750 mVp.

EXAMPLES OF USE

TESTING STEREO DECODERS

Stereo decoders can be connected directly to the COMP. OUT connector (10) on the front panel. Set the COMP. OUT level control (9) to the level corresponding to the decoder's 100% composite level. The pilot level can then be read directly on the pilot 0 to 15% scale (4).

MODULATING FM SIGNAL GENERATORS

When the SMG40 is needed to modulate an FM Signal Generator, both COMPOSITE outputs can be used.

a. At the COMPOSITE output (19) on the rear panel of the SMG40, the level is fixed. 100% on the COMPOSITE meter corresponds to an emf of 795 mVp. The source impedance is 600 Ω. A sensitivity of 1 Vp per 100 kHz deviation and an input impedance of 10 kΩ of the FM Generator's external FM input terminal will give a deviation of 75 kHz, and correct pilot level is obtained.

b. If a higher voltage is required, use the COMP. OUT connector (10) on the front panel of the SMG40. Set the SMG40's controls as follows:

   MODULATION FREQ. (1) at 1 kHz

   FUNCTION (5) at L = R

   Adjust with LEVEL (2) to 100% on the COMPOSITE meter.

   Adjust with COMP. OUT level control (9) to 75 kHz deviation on the FM Signal Generator's deviation meter, and the correct pilot level is obtained.

PRECAUTIONS

1. Distortion

   a. The composite level must not exceed 100%.

   b. Loading of the COMP. OUT connector (10) on the front panel must be > 2 kΩ.

2. Separation

   Linear distortion is caused by a non-flat amplitude response and a non-linear phase characteristic. These factors result in amplitude unbalance and phase distortion of the M and S signals, and will change the LR separation.

   As a guide, the following figures can be used:

   a. An amplitude unbalance of 0.1% (from the upper frequency limit) between the M and S signals, from, for example, 1 kHz to 39 kHz, will give an LR separation of 66 dB when the modulation frequency is 1 kHz.

b. A phase distortion of 0.05° (from the lower frequency limit) between the M and S signals, from, for example, 1 kHz to 39 kHz, will give an LR separation of 66 dB when the modulation frequency is 1 kHz.

c. To avoid essential influence on the separation data of the SMG40 at modulation frequencies from 20 Hz to 15 kHz, test jigs for stereo decoders and external FM inputs on FM signal generators ought to have a frequency response from at least 0.02 Hz to 1.5 MHz (3 dB points).

d. The capacitive load of the SMG40's composite outputs should not exceed 100 pF.

Section C ______ Technical Description

C1. PRINCIPLE OF OPERATION

A simplified block diagram of the SMG40 is shown in Fig. C1.

The multiplex stereo signal is generated by the 38 kHz modulator, which is an integrated, balanced switch modulator. The modulator itself suppresses the 38 kHz carrier, but it produces unwanted sidebands - odd harmonics of the 38 kHz carrier frequency, i.e., 114 kHz, 190 kHz, etc.. The sidebands in the vicinity of 190 kHz and upwards are removed by the composite filter, which is a lowpass filter with a 150 kHz cut-off frequency providing a phase-linear and flat amplitude response up to 53 kHz. The sidebands in the vicinity of 114 kHz are balanced out. by a signal from a 114 kHz modulator that is similar and phase-locked to the 38 kHz modulator.

The sinusoidal pilot signal is generated by integration of the 19 kHz square-wave. The harmonic components, 3 x 19 kHz and 5 x 19 kHz are compensated by means of a 57 kHz and 95 kHz square-wave. The 7th. harmonic component of the 19 kHz is eliminated by a 133 kHz trap, while the remaining higher harmonic components are attenuated by the composite filter.

A 4.56 MHz crystal controlled oscillator and its associated frequency divider networks, provide the various frequencies required for the modulators and the 19 kHz pilot integrator.

The two modulators can be modulated either by an internal LF oscillator, which is an NTZ-resistance, amplitude-regulated RC-oscillator, or from external LF sources. The modulation signals are passed via the PREEMPH. amplifiers and the FUNCTION switches to the modulators. At the amplifiers that feed the modulators, compensation is made for MS unbalance, which would otherwise result in LR cross-talk after decoding.

The level of the composite signal is measured with a linear peak detector which is connected to the composite output amplifier.

The power supply employs three integrated voltage regulators.

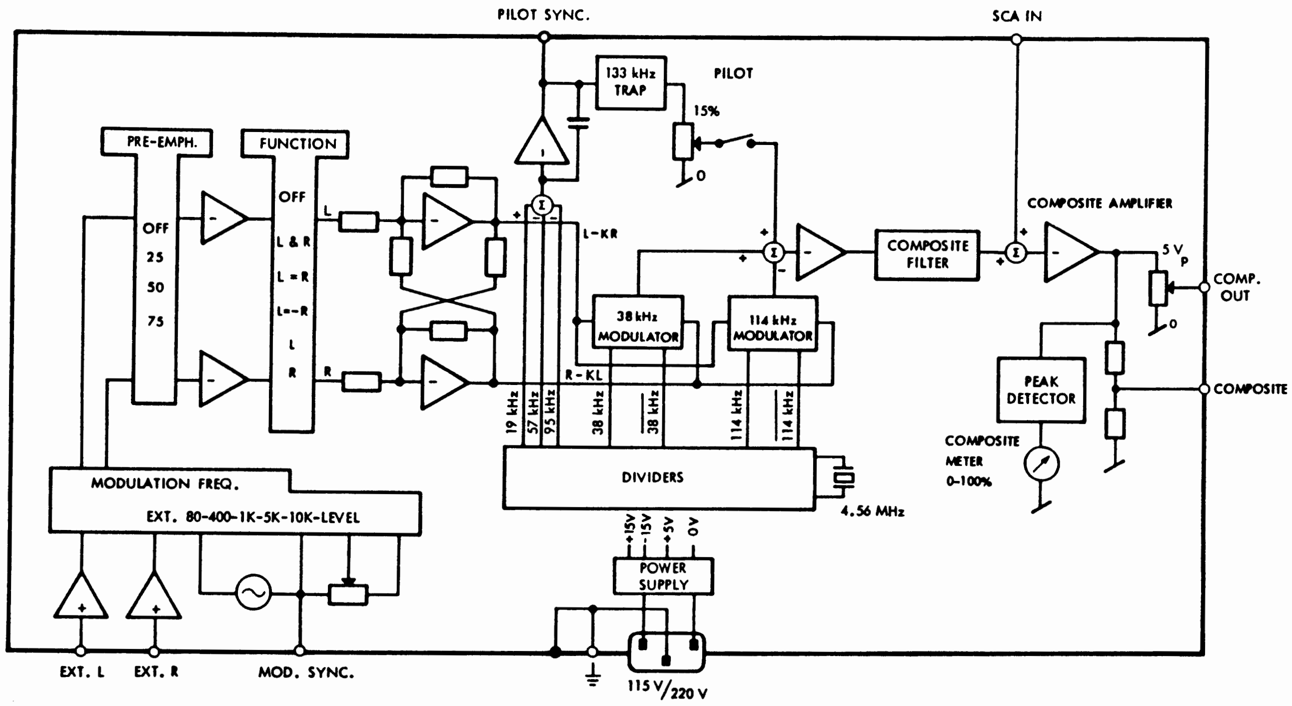


Fig. C1. Simplified Block Diagram of SMG 40.

CII. CIRCUIT DESCRIPTION

INTRODUCTION

This Section contains the following descriptions:

1. 38 kHz and 114 kHz Modulator.
2. Pilot.
3. Composite Filter.
4. Comp. Out Amplifier.
5. Peak Detector and Composite Meter.
6. L-KR and R-KL Amplifiers.
7. Preemphasis.
8. Ext. L and Ext. R Input Amplifiers.
9. Modulation Frequency Oscillator.
10. Digital Circuitry.
11. Power Supply.

The principle of operation, including a simplified block diagram of the SMG40 (Fig. C1), is described in Section C1.

1. 38 kHz and 114 kHz MODULATOR

Refer to drawing 1829-A1

The 38 kHz modulator generates the multiplex stereo signal. The 114 kHz modulator balances the unwanted sidebands in the vicinity of 114 kHz produced by the 38 kHz modulator.

Both circuits QA105 and QA106 consist of two dual-transistors supplied with individual current sources.

The L and R signals are connected to each half of the modulators. The current from each current source will alternately pass through the first and the second half of that dual-transistor to which it is connected, as the bases of the two dual-transistors are fed with complementary square wave voltages with an amplitude of approximately 500 mV.

Due to this, the current through R131 in the first half period of the 38 kHz equals the current of the current generator connected to the L-signal, while the current in the second half period of the 38 kHz equals the current from the current generator connected to the R-signal. As the dc current from the two current generators are equal - adjusted by R129 - the dc current through R131 will be constant, and then provide suppression of the 38 kHz signal from the modulator.

The 114 kHz signal from 114 kHz modulator is suppressed in a similar way, as described for the 38 kHz modulator. The currents from the two current generators are adjusted by R145.

The currents from the 38 kHz and the 114 kHz modulators are fed to the summing-amplifier QA108. Because the current from the 114 kHz modulator is 3 times less than the current from the 38 kHz modulator, the sidebands in the vicinity of 114 kHz will be compensated.

Adjustment of the L-signal current level is made by R151, and R-signal current by R142. C127 provides the correct phasing of the current from the 114 kHz modulator.

The pilot signal is also fed to the summing amplifier QA108. The output signal from QA108 will be the composite signal including unwanted signals from the modulators and the pilot generator, (see item 2, PILOT) such as: sidebands in the vicinity of 5 x 38 kHz, 7 x 38 kHz, 3 x 114 kHz, 5 x 114 kHz, etc., and harmonics of the 19 kHz, 11 x 19 kHz, etc..

To prevent transfer of noise and hum from the ±15 V supply to the composite signal, the modulators are isolated from the -15 V supply by means of the zenerdiodes CR105 and CR106, and from the +15 V supply by Q101 and Q105. As the currents from each of the current generators Q101 and Q105 are greater than the dc current in each of the current generators QA101 and QA106, the dc output of QA108 is forced to be lower than the voltage on the non-inverting input terminal of QA108. The output dc voltage will be 0-4 V ac depending on the component tolerances.

2. PILOT

See drawing 1829-A1

The pilot signal is generated by a square-wave from the digital circuitry, see item 10 and drawing 1830-A1. This square-wave is fed to the pilot integrator QA107 together with a 57 kHz and a 95 kHz square-wave also generated in the digital circuitry. The phase relationship and the current level are such that the 3rd. and 5th. harmonics of the 19 kHz are compensated, see Fig. C4. Only harmonic components of the 7th. and 9th. order and higher of the 19 kHz are present in the output signal of the pilot integrator. The 7th. harmonic, 133 kHz, is eliminated by a 133 kHz trap, which is a parallel resonance circuit. At resonance the 7th. harmonic of the 19 kHz is attenuated approximately 20 dB by the circuit together with R1.

The remaining harmonic components are eliminated by the composite filter (drawing 2712-A2). The resulting pilot signal at the COMP.OUT and the COMPOSITE connector will have a THD of approximately -48 dB.

The signal from the pilot integrator does not normally contain any even harmonics of the 19 kHz, because QA108 has a wide bandwidth, and, due to the emitter followers Q102, Q103 and Q104 (drawing 1830-A1), the generator resistance for the pilot integrator are the same in each half period of the square-wave voltages from the digital circuitry.

The phase of the pilot signal in relation to the sub-carrier is adjusted by changing the time constant of the pilot integrator by means of R200.

3. COMPOSITE FILTER

Refer to drawing 2712-A2.

The composite filter is a 6-link lowpass filter with the following characteristics:

a. linear phase characteristic up to 53 kHz

$$\Phi \simeq -90^{\circ}/16 \text{ kHz} \cdot f(\text{kHz})$$

b. flat amplitude response up to 15 kHz and max. attenuation of approx. 0.3% at 53 kHz.

c. abrupt cut-off.

The amplitude characteristics of the filter are shown in Fig. C2a. Fig. C2b shows the frequency spectrum and the residuals present in the stereo signal.

The filter coils are all adjusted to their nominal value ±1 % before mounting on the PC-board. The coil L107 is corrected for the input self-induction of QA109.

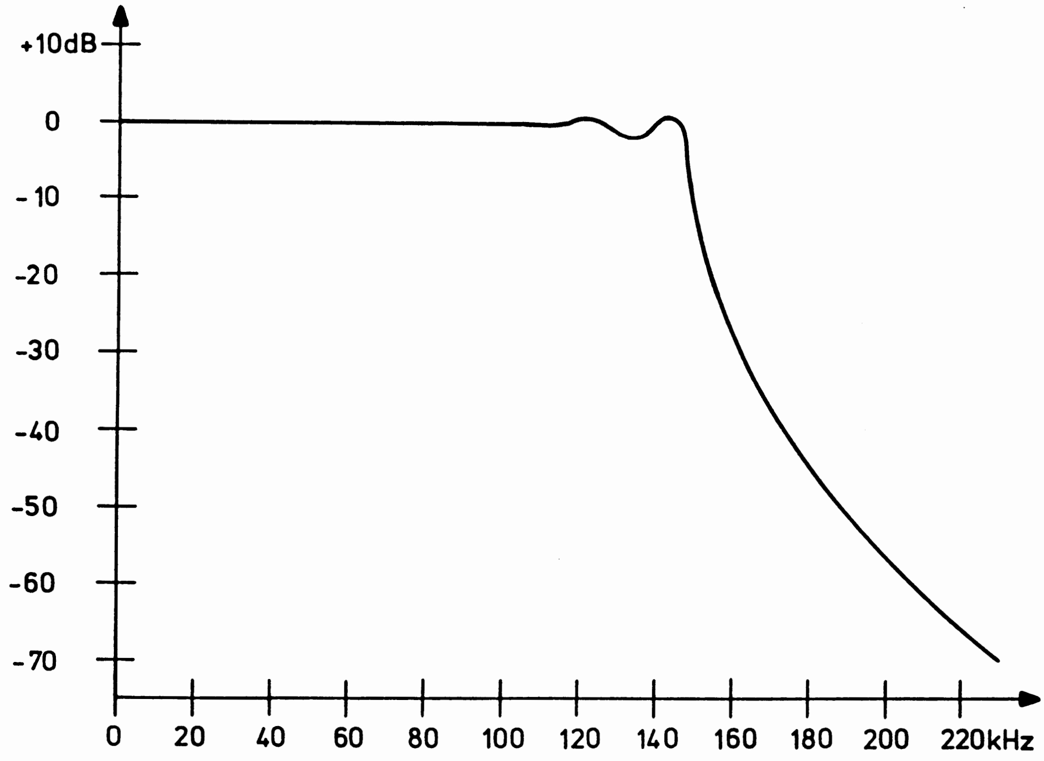


Fig. C2a Amplitude characteristic of the composite filter

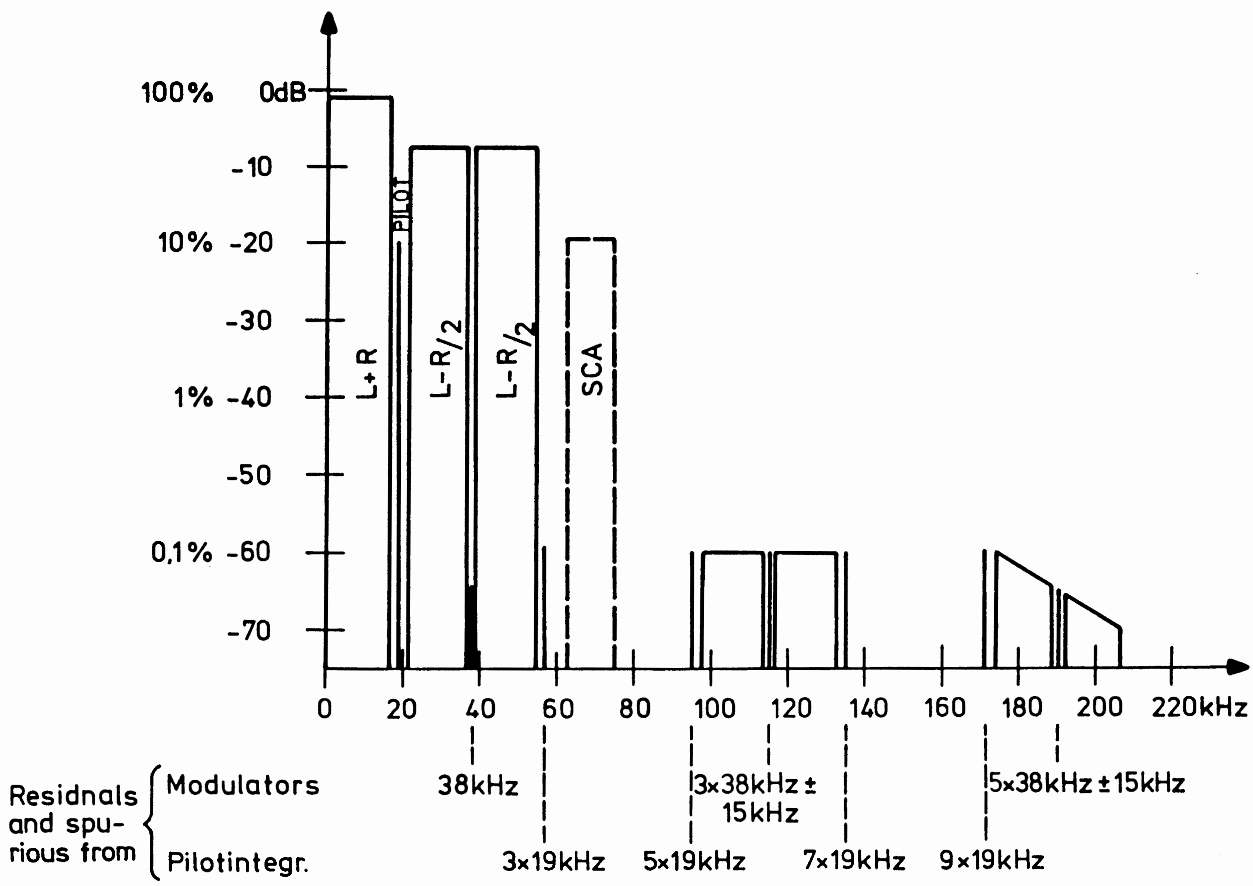


Fig. C2b Frequency spectrum of the composite output signal

4. COMP. OUT AMPLIFIER

Refer to drawing 2712-A2

The Comp. Out Amplifier QA109 adds together the composite and the SCA signal. The output signal from the amplifier will be 5Vp at a 100% composite level.

The level at the COMP. OUT connector is continuously adjustable by means of R2 from 0 V to 5 Vp at a 100 % coposite level.

The level at the COMPOSITE connector is 795 mVp at a load resistance of 10 kΩ, as the source impedance is 600 Ω.

The dc voltage at the two composite output connectors is adjusted to zero by means of R172.

5. PEAK DETECTOR and COMPOSITE METER

Refer to drawing 2712-A2.

The Peak Detector consists of the comparator QA110. The Comparator charges the capacitors C152 and C175 to a dc voltage equal to the peak value of the input signal to the comparator. At 100 % composite level the dc voltage will be 5 V.

The Peak Detector is extremely linear due to the large loop amplification of QA110. The frequency response is determined by the discharge current through R178. Within the frequency range 20 Hz to 53 kHz, the error will be approx. 1 %, and approx. 0.1 % within the range 200 Hz to 53 kHz.

The dc voltage from the detector is fed to the Composite Meter via QA111. The meter sensitivity is adjusted by means of R179.

6. L-KR and R-KL AMPLIFIERS

Refer to drawing 1829-A1.

The L-KR and R-KL Amplifiers (QA103 and QA104) feed the modulators.

The output signal from the L-KR amplifier is fed to the input terminal of the R-KL amplifier via R116 and R204, while the output signal from the R-KL amplifier is fed to the input of the L-KR amplifier via R123 and R203. This is done to compensate the LR cross-talk present in modulators of the switching type and the LR cross-talk caused by the composite filter's attenuation at 38 kHz.

The separation is set to maximum by R204 for the L-signal and by R203 for the R-signal. At L=R the sub-channel signal L-R is set to minimum by means of R119, while at L = -R the L+R signal is set to minimum by means of R118.

The output dc-voltage of the L-KR and R-KL amplifiers is displaced in a positive direction by means of R114 and R121 to provide a correct bias voltage for C115 and C116, independent of the off-set voltages of the amplifiers which feed the L-KR and R-KL amplifiers.

The output dc voltage will be 0-0.2 Vdc on the L-KR amplifier and 0-0.33 Vdc on the R-KL amplifier.

7. PRE-EMPHASIS

Refer to drawing 1829-A1

Pre-emphasis is obtained by changing the generator impedance for QA101 and QA102. The value of the generator impedance is such that the amplification of the PRE-EMPHASIS amplifiers at 15 kHz is the same whether the PRE-EMPHASIS is ON or OFF.

The amplitude characteristic of the PRE-EMPHASIS amplifiers is shown in Fig. C3.

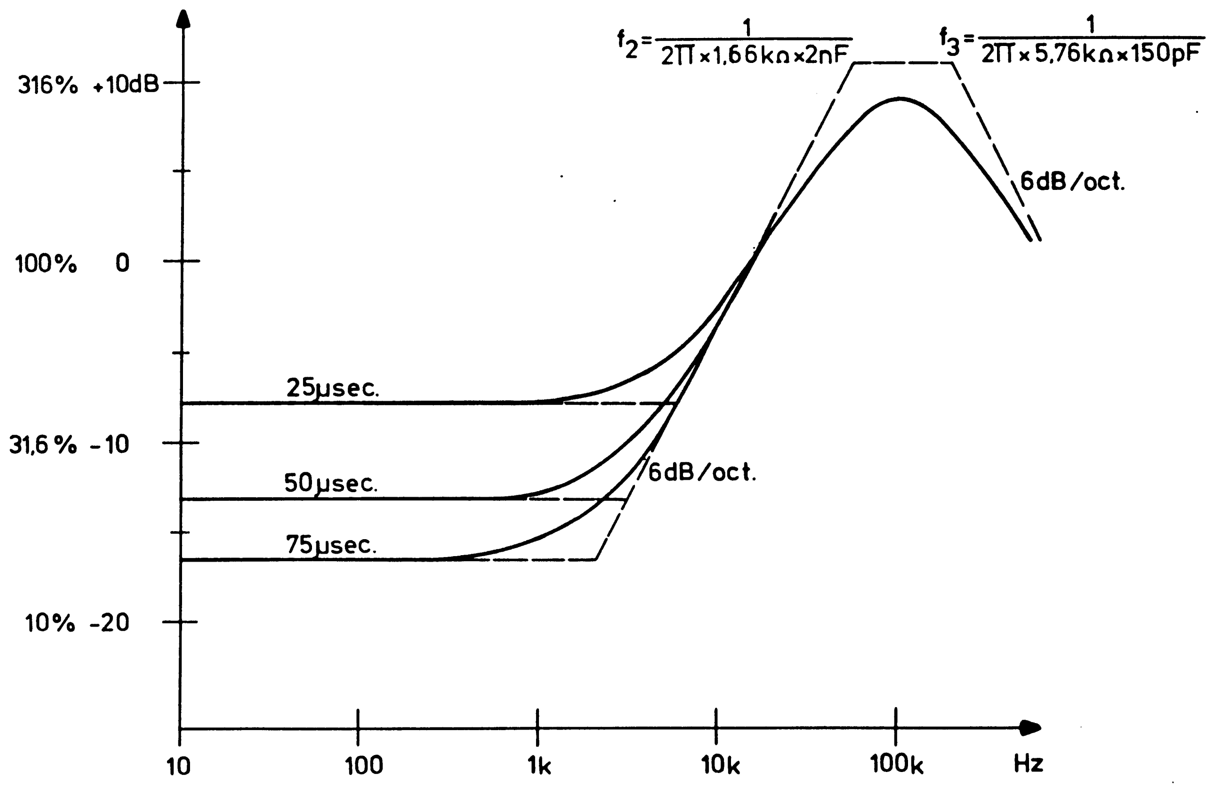


Fig. C3 Amplitude characteristic of the PRE-EMPH-Amplifier

8. EXT.L and R INPUT AMPLIFIERS

Refer to drawing 2713-A2.

Both the EXT L and EXT R input amplifiers have unity gain. The input resistance is determined only by R322 and R324 (47 kΩ), as QA302 and QA303 have FET-inputs.

The resistor R325 (301 ohm) at the output of the EXT. R amplifier corresponds to the mean value of the output resistance of the MOD. FREQ. OSCILLATOR, so that the generator impedance for the R-PRE-EMPH. amplifier is constant, whether the signal arrives from the MOD.FREQ.OSCILLATOR or from the EXT.R. input amplifier.

9. MODULATION FREQUENCY OSCILLATOR

Refer to drawing 2713-A2.

The MOD. FREQ. OSCILLATOR is an RC-oscillator. The lowest frequency (80 kHz) is determined by C301, C302, R301 and R302. The other frequencies are determined by the MOD.FREQ. switches.

The amplitude of the MOD. FREQ. OSCILLATOR is stabalized by means of the thermistors R312 and R313. Any resulting amplitude drift will be approximately -1 %/°C.

10. DIGITAL CIRCUITRY

Refer to drawing 1830-A1

The digital circuit consists of a crystal oscillator, dividers and a reset circuit.

The frequency of the crystal oscillator is 4.56 MHz, which is adjustable by means of C156. Frequency variation as a function of temperature is less than 20 ppm within a temperature change from 0 to 70°C.

The signals to the Modulator (38 kHz and 114 kHz) and the Pilot integrator (19 kHz, 57 kHz and 95 kHz) are provided by means of flip-flops and counters.

The emitter followers, Q102, Q103 and Q104, provide a low output resistance whether QD106 is low or high. The suppression of the 3rd. and 5th. harmonics in the Pilot integrator is exclusively determined by the R154, R155 and R156, on drawing 1829-A1.

The flip-flops and counters feeding the Modulators and the Pilot integrator are synchronized by the reset circuit which consists of flip-flop QD104/8-13 and nandgate QD107/11-13.

Each time QD105/9 goes high QD107/11 goes low and resets the flip-flops and counters. Resetting ceases when QD104/5 goes high as QD104/8 goes low by clocking the flip-flop. When QD105/9 goes low, QD104 is reset (QD104/8 goes high). The circuit is now ready to give a new reset pulse as soon as QD105/9 goes high.

The phase relationship between the signals to the Modulators, the Pilot integrator and the reset pulse is shown in Fig. C4.

11. POWER SUPPLY

Refer to drawing 1830-A1.

All used voltages, +15 V, -15 V and +5 V are derived from integrated voltage regulators, which are short-circuit protected. The diodes CR103 and CR104 provide correct up-start of the +15 V and -15 V supply.

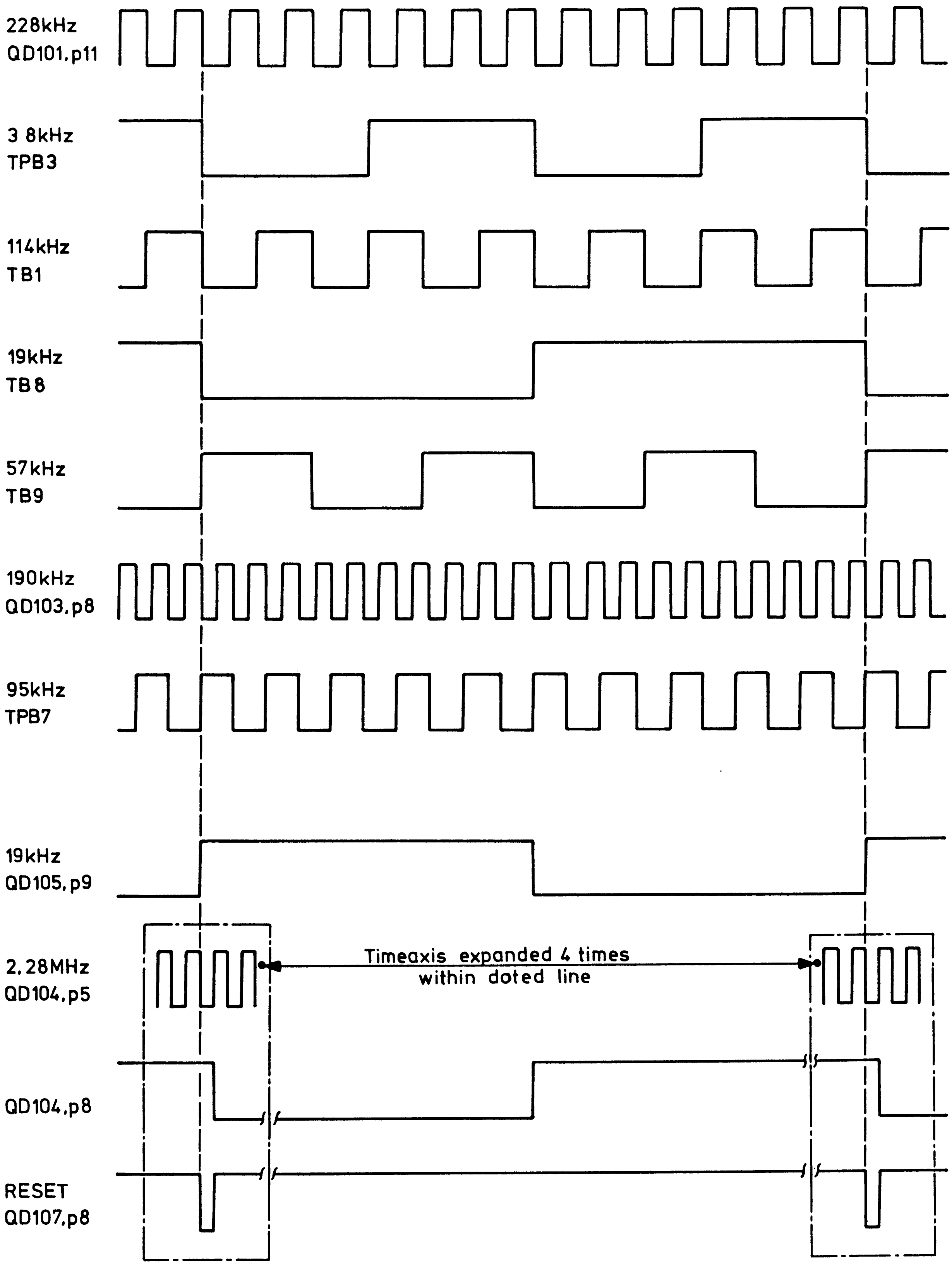


Fig. C4 Signals in the digital circuitry

Section D______Maintenance

D I PERFORMANCE TESTS

INTRODUCTION

The performance tests given in this section verify the operation of the SMG40. All performance tests can be performed without access to the interior of the SMG40.

If the tolerances given during the performance tests are not met, reference should be made to Section EIII, ADJUSTMENTS and TROUBLE SHOOTING which gives systematic checks and adjustments, and some troubleshooting hints.

The performance tests are divided into the following sections:

1. Pilot Frequency
2. Composite Output Level
   - A. dc offset check
   - B. Pilot Signal Level
   - C. Composite Level (front panel)
   - D. Composite Level (rear panel)
3. Separation
4. Pilot Phase
5. Residual and Noise
   - A. Using an Oscilloscope
   - B. Using the BKF10 Distortion Analyzer
   - C. Using the SMU401 Selective Measuring Unit in conjunction with the BKF10.
6. Distortion
7. Pre-emphasis

RECOMMENDED TEST EQUIPMENT

Instrument	Critical Specifications	Recommended
Oscilloscope	Able to be overdriven 40 dB without distortion of zero line. Flat amplitude and linear phase characteristics up to 53 kHz.	ADVANCE OS1000A

Instrument	Critical Specifications	Recommended
Digital Voltmeter	AC and DC. Sensitivity 0.1 mV Accuracy at 19 kHz: better than 1% of reading	Data Precision Model 1450
Frequency Counter	Gate time 10 sec.	Data Precision Model 5740
Distortion Meter	Fundamental freq.: 20 Hz to 20 kHz Harmonics and noise: 10 Hz to 150 kHz Distortion range: 0.02% to 10% Accuracy (0.1% to 10% distortion): ±1 dB	Radiometer BKF10 Distortion Analyzer
Harmonic content measuring unit	Fundamental freq.: 20 Hz to 20 kHz Harmonics: 2nd. to 5th. of fundamental freq. Line freq. harmonics: 1st. to 4th. Filter bandwidth: 3 Hz Accuracy (when THD $<$10%, and the harmonic content is $<$20 dB below THD): ±1 dB	Radiometer SMU401 Selective Measuring Unit in conjunction with a BKF10 Distortion Analyzer

Other equipment than that specified, which satisfies the specifications given in the table may be used.

1. PILOT FREQUENCY

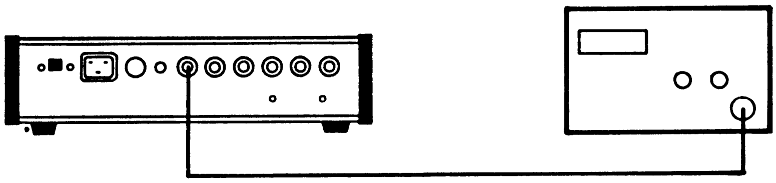


Fig. D1. Pilot Frequency Test Setup.

1. Connect the Frequency Counter to the PILOT SYNC connector on the rear panel of the SMG40.

2. Set the Frequency Counter to the 10 sec. position.

3. Check that the pilot frequency is 19000.0 Hz ±1.0 Hz.

If out of tolerance: See Section EIII ADJUSTMENT and TROUBLE SHOOTING, item 2.

2. COMPOSITE OUTPUT LEVEL

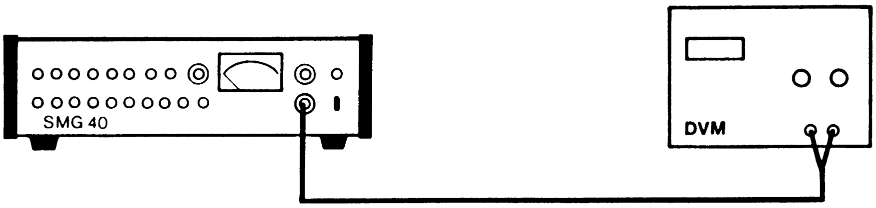


Fig. D2. Composite Output Level Setup (front panel).

A. dc offset check

1. Connect a DVM to the COMP. OUT connector on the front panel of SMG40.
2. Set the controls on the SMG40 as follows:
   COMP. OUT Level Control fully clockwise.
   FUNCTION to OFF
   PILOT to OFF
3. Read the dc voltage - it should be less than ±15 mV ±DVM accuracy.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, item 12.1.

B. Pilot Signal Level

1. Connect a DVM to the COMP. OUT connector on the front panel of SMG40.
2. Set the DVM to ac mode.
3. Set the controls on the SMG40 as follows:
   COMP. OUT Level Control fully clockwise.
   FUNCTION to OFF
   PILOT to ON
   PILOT Level at 10%
4. Read the ac voltage - it should be between 343 mV_{RMS} and 363 mV_{RMS} ±DVM accuracy.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, item 15.2.

C. Composite Level (front panel)

1. Connect the DVM to the COMP. OUT connector on the front panel of the SMG40.

2. Set the DVM to ac mode

3. Set the controls on the SMG40 as follows:

   COMP.OUT Level Control fully clockwise.
   PILOT to OFF.
   MODULATION FREQ. at 1 kHz.
   FUNCTION to L=R.
   Adjust with LEVEL to 100% on COMPOSITE Meter.

4. Read the ac voltage - it should be between 3.445 V_{RMS} and 3.625 V_{RMS} ±DVM accuracy.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, items 12.2 and 13.

D. Composite Level (rear panel)

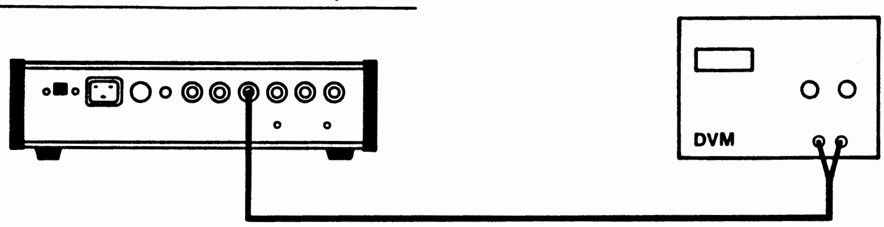


Fig. D3. Composite Level Setup (rear panel).

1. Connect the DVM to the COMPOSITE connector on the rear panel of the SMG40.

2. Set the DVM to ac mode.

3. Set the SMG40 controls as in item C.3. above.

4. Read the ac voltage - it should be between 548 mV_{RMS} and 576 mV_{RMS} ±DVM accuracy.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, items 12.3 and 13.

3. SEPARATION

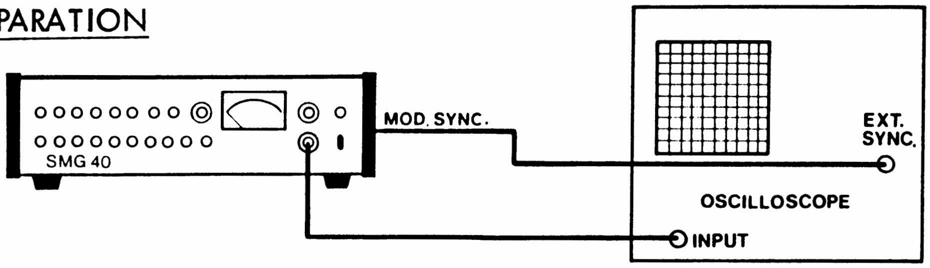


Fig. D4. Separation, Pilot Phase, Residual and Noise Test Setup.

1. Set the controls on the SMG40 as follows:
   COMP. OUT Level Control at 4 Vp.
   PILOT to OFF.
   MODULATION FREQ. at 1 kHz.
   FUNCTION to L.
   Adjust with LEVEL to 100% on COMPOSITE meter.
2. Set the oscilloscope in dc mode.
3. Set the oscilloscope sensitivity to 10 mV/cm.
4. Connect the input of the oscilloscope to the COMP. OUT connector on the front panel of the SMG40.
5. Connect the EXT. SYNC. of the oscilloscope to the MOD. SYNC. connector on the rear panel of the SMG40.

   NOTE: Do not use a probe, as this will cause amplitude and phase distortion if not adjusted very carefully.
   Max. capacitive load 100 pF (refer to Section B, page 10).
6. Check that V_1 (See Fig. D5.) is less than 4 mVpp.

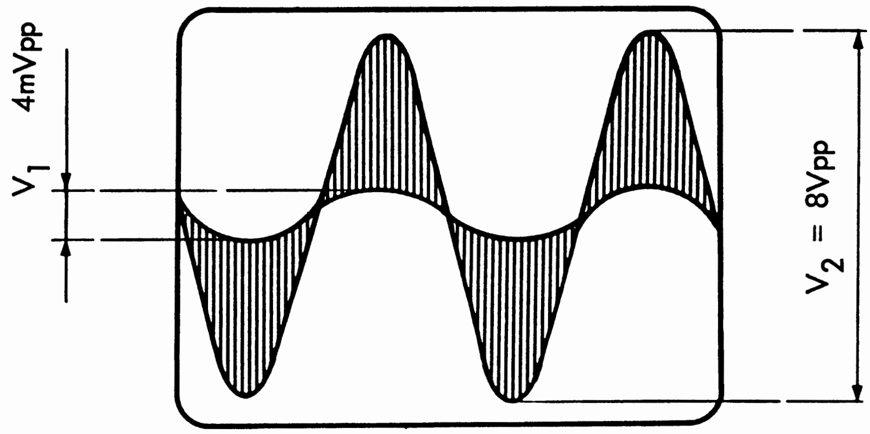


Fig. D5. Check of Separation.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, item 8.

4. PILOT PHASE

Use the same measuring setup as in SEPARATION, see Fig. D4.

1. Set the controls on the SMG40 as follows:
   PILOT to ON
   PILOT Level at 15%
   MODULATION FREQ. at 1 kHz
   FUNCTION to L = -R
   Adjust with LEVEL the total composite level to 20%.
2. Check that the difference between the zero passages is max. 8 mV (See Fig. D6.).

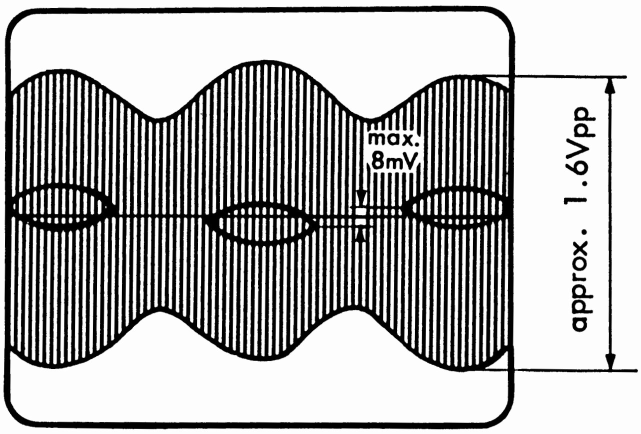


Fig. D6. Check of Pilot Phase.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, item 15.3.

5. RESIDUAL and NOISE

The residuals and noise can be measured in three ways: A. with an oscilloscope, B. with the BKF10, and C. with the BKF10 in conjunction with the SMU401 from which the residuals of the harmonic components are obtained.

NOTE: Due to the temperature dependence of the levels of the 38 kHz Residual and the Spurious above 53 kHz (see Specifications, Section A), it is necessary to perform the tests in this sub-section (5.Residual and Noise, A, B and C), at 25°C ± 2°C.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, items 5, 6, 15.1, 16 and 17.

A. Using an oscilloscope

1. Same measuring setup as in SEPARATION (see Fig. D4.).
2. Set the SMG40 controls as follows:
   PILOT to OFF.
   FUNCTION to OFF.
3. Check that the amplitude of residuals and noise is max. 16 mVpp.

B. Using the BKF10 Distortion Analyzer

1. Connect the INPUT of the BKF10 to the COMP. OUT connector on the front panel of the SMG40.
2. Set MAX. INPUT of BKF10 to 3V.
3. Set the controls on the SMG40 as follows:
   FUNCTION to OFF.
   PILOT to ON.
   PILOT Level at 15%.
   COMP. OUT level control at 4 Vp.
4. Read the distortion factor of the 19 kHz directly on the Distortion Meter (tolerance: -40 dB).

C. Using the SMU401 Selective Measuring Unit in conjunction with the BKF10

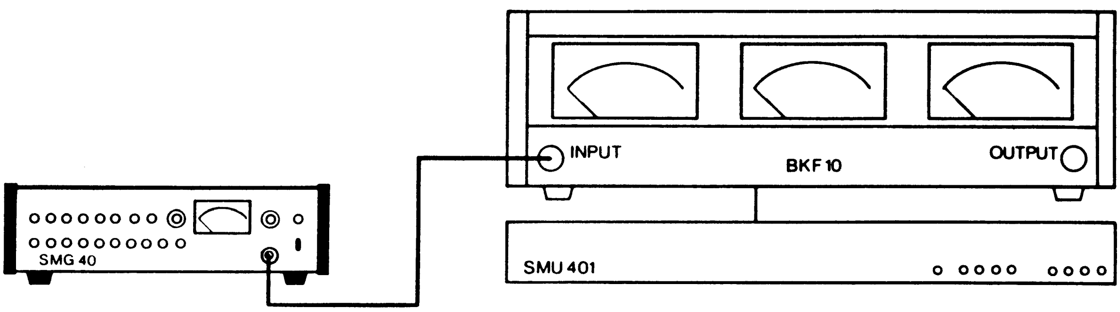


Fig. D7. Residuals and Noise Test Setup.

1. Connect the INPUT of BKF10 to the COMP. OUT connector on the front panel of SMG40.

2. Set MAX.INPUT of BKF10 to 3 V.

3. Set the SMG40 controls as described in B above.

4. Total harmonic distortion (THD) of the 19 kHz Pilot is obtained by depressing the THD button on the SMU401, and reading the Distortion Meter on the BKF10.

5. Furthermore, the residuals of the 2nd. harmonic (38 kHz), the 3rd. harmonic (57 kHz), the 4th. harmonic (76 kHz) and 5th. harmonic (95 kHz) are obtained directly by depressing the FUNDAMENTAL HARM. buttons on the SMU401.

6. The hum components are obtained by depressing the LINE FREQ. HARM. buttons on the SMU401.

7. Tolerances:
   THD: < -40 dB.
   38 kHz residual: < -47 dB.
   57 kHz, 76 kHz and 95 kHz residuals: < -43 dB.
   Hum: < -63 dB.

6. DISTORTION

Use the BKF10 in conjunction with the SMU401 (See Fig. D7).

1. Connect the INPUT of the BKF10 to the COMP.OUT connector on the front panel of the SMG40.

2. Set the MAX.INPUT of BKF10 to 3 V.

3. Set the controls on the SMG40 as follows:
   COMP.OUT Level control at 4 Vp.
   PILOT to OFF.
   MODULATION FREQ. at 1 kHz.
   FUNCTION to L=R.
   Adjust with LEVEL to 100% on the COMPOSITE meter.

4. Check that the 2nd. and the 3rd. harmonics of the 1 kHz are:
   2nd. harmonic < -74 dB.
   3rd. harmonic < -72.5 dB.

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, item 16.

7. PRE-EMPHASIS

1. Connect the DVM to the COMP.OUT connector on the front panel of SMG40, and set the DVM to ac mode.

2. Set the controls on the SMG40 as follows:
   FUNCTION to L=R.
   PILOT to OFF.
   PRE-EMPHASIS to OFF.
   MODULATION FREQ. to 1 kHz.
   Adjust with LEVEL to 100% on COMPOSITE meter.

3. Adjust, using the COMP.OUT Level control, the voltage on the COMP. OUT connector to 2 V_{RMS} ± 10 mV_{RMS}.

4. With the pre-emphasises below, the voltage should be:
   at PRE-EMPHASIS 25 μs: 785–875 mV_{RMS}
   at PRE-EMPHASIS 50 μs: 430–480 mV_{RMS}
   at PRE-EMPHASIS 75 μs: 305–345 mV_{RMS}

If out of tolerance: See Section EIII. ADJUSTMENT and TROUBLE SHOOTING, item 4.

Section E ——— Repair

EI. INTRODUCTION

Section EII. DISMANTLING gives disassembly information when it is necessary to gain access to the interior of the SMG40.

Section EIII. ADJUSTMENT and TROUBLE SHOOTING provides systematic tests and adjustments to ensure peak operating conditions. The Trouble Shooting information is provided in the form of hints and suggestions.

Section EIII. ADJUSTMENT and TROUBLE SHOOTING is divided into the following items:

1. Power Supply
2. Digital Circuitry
3. Modulation Frequency Oscillator
4. EXT.L and R Input Amplifiers, Pre-emphasis and L-KR and R-KL Amplifiers.
5. 38 kHz Residual
6. 114 kHz Residual
7. 114 kHz Sidebands
8. Separation:
   - 8.1 Adjustment of Separation at 1 kHz
   - 8.2 Check of Separation
9. Monophonic Channel Output: L=R
   - 9.1 Adjustment of L=R
   - 9.2 Check of L=R
10. Stereophonic Sub-channel Output: L= -R
    - 10.1 Adjustment of L= -R
    - 10.2 Check of L= -R
11. Composite filter
12. Composite Output
    - 12.1 Adjustment of dc offset
    - 12.2 Adjustment of COMP. OUT Level and COMP. OUT Scale
    - 12.3 Check of voltage on COMPOSITE connector
13. Peak Detector and Composite Meter
14. SCA input

15. Pilot
    - 15.1 Adjustment of Distortion
    - 15.2 Adjustment of Pilot Level and Pilot Scale
    - 15.3 Adjustment of Pilot Phase
16. Distortion and Hum
17. Noise

Section EIV contains the PARTS LIST

The schematic drawings are placed at the end of this Section.

EII. DISMANTLING

TOP PLATE

Remove the two upper screws at each corner of the rear panel, and the top plate can now be removed.

BOTTOM PLATE

Remove the screws at each corner of the bottom plate, and the bottom plate can now be removed.

REMOVAL OF MOD. FREQ. OSCILLATOR and EXT.L & R ON PC-board. (970-767).

Remove the two screws securing the PC-board to the Main PC-board.
Remove the two screws securing the angle bracket to the front panel.
The PC-board can now be removed.

CAUTION - with the removal of the PC-board the pushbuttons are now loose, but spring loaded - take care.

ACCESS TO THE FRONT PANEL COMPONENTS

Remove the four blind plugs in each side plate. Remove the screws which are now exposed through holes.
Remove the side plates.

Remove the four screws securing the front panel.

CAUTION - with the removal of the front panel the pushbuttons are now loose, but spring loaded - take care.

EIII. ADJUSTMENT and TROUBLE SHOOTING

RECOMMENDED EQUIPMENT

For the adjustment of the SMG40 the same instruments as given in Table D1 (see Section D1 PERFORMANCE TESTS.) are recommended. Additional equipment required is listed in Table E1, below:

TABLE E1.

Instrument	Critical Specifications	Recommended
Wave Analyzer Spectrum Analyzer	Frequency range: at least 50 kHz-180 kHz Min. bandwidth: $\leq$ 10 Hz Sensitivity: $>$ 100 dB below 3.5 V_{RMS}	HP8556A/8552B
AF Oscillator	Frequency range: 20 Hz to 20 kHz Output voltage (EMF): 1 mV to 1 V Harmonic distortion: $<$0.01%	Radiometer BKF10 Distortion Analyzer

1. POWER SUPPLY

Refer to drawing 1830-A1.

The Power Supply voltages are measured at the test point TPA using a DVM.

Tolerances:

TPA pins	Vol.Rig.	dc voltage	ac voltage	dc voltage variation with specified line voltage variation
1	+5 V	4.8 to 5.2 V	$<$0.3 mV_{RMS}	$<\pm$50 mV
3	+15 V	14.4 to 15.6 V	$<$5 mV_{RMS}	$<\pm$200 mV
4	0V			
5	-15V	-14.4 to -15.6V	$<$2 mV_{RMS}	$<\pm$200 mV

The Power Supply can be disconnected from the remaining circuits by removing the solder junction pads on the component side of the PC-board. (See the component placement drawing).

WARNING When replacing the voltage regulators they must be orientated in the correct position before they are soldered to the PC-board connections.

2. DIGITAL CIRCUITRY

Refer to drawing 1830-A1

Equipment Required:

Frequency Counter: Data Precision Model 5740

Distortion Meter and harmonic content measuring unit: Radiometer BKF10 Distortion Analyzer in conjunction with SMU401 Selective Measuring Unit.

A. Frequencies

1. Set the Frequency Counter to position 1 sec.
2. Connect the Frequency Counter to test point, TPB, terminals 1-9, and check the frequencies of the signals to the Modulators and the Pilot-integrator.
3. Tolerances:

TPB	Frequency	Tolerance
1	114 kHz	±1 Hz
2	114 kHz	±1 Hz
3	38 kHz	±1 Hz
4	38 kHz	±1 Hz
5	0 V	
7	95 kHz	±1 Hz
8	19 kHz	±1 Hz
9	57 kHz	±1 Hz

4. If necessary, adjust C156 to give 114 kHz ±1 Hz at TPB1.

B. Phase relationships

The phase relationships of the signals are checked by measuring the distortion of the pilot signal at the PILOT SYNC. connector, as the suppression of the 3rd. and 5th. harmonics of the 19 kHz is dependent upon the phase between the digital signals.

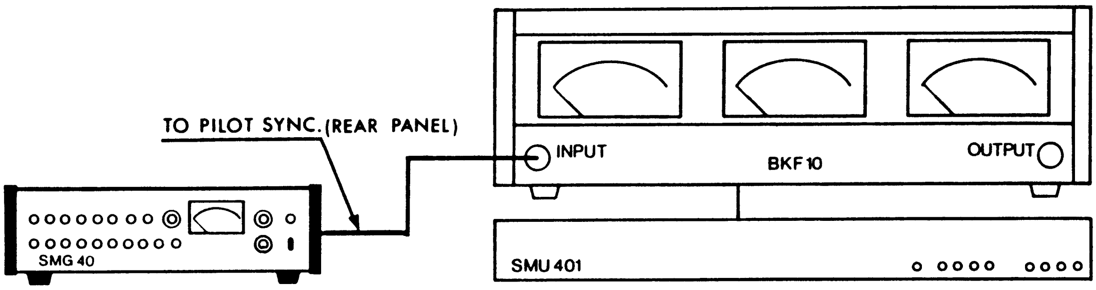


Fig. E1. Phase Relationship Measuring Setup.

1. Connect the INPUT of the BKF10 to the PILOT SYNC. connector on the rear panel of the SMG40.
2. Set MAX INPUT of BKF10 to 3 V.
3. The THD of the 19 kHz is obtained by depressing the THD button on the SMU401 and reading the Distortion Meter on the BKF10.
4. The 3rd. and the 5th. harmonics are obtained by depressing the FUNDAMENTAL HARM. 3. and 5. buttons on the SMU401.
5. Tolerances:

THD:	<-29 dB
3rd. harmonic:	<-46 dB
5th. harmonic:	<-48 dB

Troubleshooting

If the phase relationships are incorrect the 3rd. harmonic will be approx. -13 dB and the 5th. harmonic approx. -22 dB.

Even if the phase relationships are correct the distortion can be greater than the tolerances given above because of a defect at R154, R155 and R156 or QD106.

3. MODULATION FREQUENCY OSCILLATOR

Refer to drawing 2713-A2.

Equipment Required:

DVM:	Data Precision Model 1450
Frequency Counter:	Data Precision Model 5740
Distortion Meter:	Radiometer BKF10 Distortion Analyzer

A. Oscillator Voltage

1. Set the controls on the SMG40 as follows:
   MODULATION FREQ. at 1 kHz.
   LEVEL to maximum
2. Using the DVM, check that the voltage across R320 is 1 V_{RMS}. If not, adjust R315.

B. Remaining data

The remaining data, Frequency, Response 1 kHz Ref., Distortion (THD) and dc voltage are measured on the MOD.SYNC. connector on the rear panel of the SMG40.

The ac level on this connector is between 470 and 1000 mV_{RMS}.

Check the data in accordance with the table below:

MOD.FREQ. POSITION	FREQUENCY	RESPONSE 1 kHz REF.	DISTORTION THD	dc-VOLTAGE
80 Hz	77.8-82.2 Hz	±2 %	-64 dB	+10 to -150 mV
400 Hz	387-411 Hz	±2 %	-72 dB	+10 to -40 mV
1 kHz	0.972-1.028 kHz	0 %	-73 dB	+10 to -20 mV
5 kHz	4.860-5.140 kHz	±2 %	-73 dB	+10 to -15 mV
10 kHz	9.720-10.280 kHz	±2 %	-73 dB	+10 to -10 mV
Equipment	Counter	DVM	Distortion Meter	DVM

Troubleshooting

If the distortion at 80 Hz is too great, it is due to the thermistor R312 which causes 3rd. harmonic distortion.

If the distortion is too great at higher frequencies it can be due to QA301 and/or R312.

WARNING: If the top plate of the SMG40 is removed, the thermistor R312 will pick up any hum present from other equipment, which will increase the THD reading. The SMG40 should always be grounded during these measurements.

4. EXT.L and L INPUT AMPLIFIERS, PRE-EMPHASIS and L-KR and R-KL AMPLIFIERS

Refer to drawing 2713-A2 and 1829-A1.

Equipment Required:

AF-oscillator:	Radiometer BKF10 Distortion Analyzer
Distortion Meter:	Radiometer BKF10 Distortion Analyzer. For use of the AF-oscillator of the BKF10, please refer to the Operating Instructions for the BKF10.
DVM:	Data Precision, Model 1450.

The signals from the L and the R channel are measured at Testpoint TPC.

TPC1: L-KR amplifier
TPC3: R-KL amplifier
TPC4: 0 V.

1. Connect the output of the AF-oscillator (e.g. BKF10) both to the EXT.L and the EXT.R connector on the rear panel of the SMG40.
2. Set the AF-oscillator voltage to 1 V_{RMS} ±10 mV_{RMS} and the frequency to 1 kHz ± 1 %.
3. Set the controls on the SMG40 as follows:
   MODULATION FREQ. to EXT.
   FUNCTION to L & R.
   PRE-EMPH. to OFF
4. Check with the DVM that the ac voltage at TPC1 is 1.80 to 2.15 V_{RMS}.

5. Check that the voltage at TPC3 can be adjusted with R119 to the same level as above.
6. Set the AF-oscillator voltage so that the voltage at TPC1 is 1.99 to 2.01 V_{RMS}.
7. Check the voltages at TPC1 at the following positions of the PRE-EMPH. switch:

   25 µs: 795 to 865 mV_{RMS}
   50 µs: 435 to 475 mV_{RMS}
   75 µs: 310 to 340 mV_{RMS}
8. Repeat step 6 and 7 at TPC3.
9. Set PRE-EMPH. to OFF.
10. Set the AF-oscillator frequency to 15 kHz ±1 %.
11. Set the AF-oscillator voltage so that the voltage at TPC1 is 1.99 to 2.01 V_{RMS}.
12. Check that the voltage at TPC1 is 1.90 to 2.11 V_{RMS} at all positions of the PRE-EMPH. switch.
13. Repeat steps 9 to 12 at TPC3.
14. Set the PRE-EMPH. to OFF.
15. Connect the INPUT of the BKF10 to TPC1, and set MAX INPUT of the BKF10 to 3 V.
16. Check that the THD of the 15 kHz is more than 77 dB down.
17. Repeat steps 15 and 16 at TPC3.
18. Check with a DVM the dc voltages at TPC1 and TPC3 in the following modes of the SMG40:

   A) MODULATION FREQ.: EXT.
      PRE-EMPH.: OFF
      FUNCTION: L & R

   B) MODULATION FREQ.: 80 Hz
      PRE-EMPH.: OFF
      FUNCTION: L = -R

   The dc voltage should be: TPC1: 0 to 0.2 V
   TPC3: 0 to 0.33 V

Trouble shooting:

If the voltages in step 18.A are out of tolerance it is due to too large off-set voltages or base current in the amplifiers, or a defect R114 or R121. In step

18.B it will be due to a defect C311 in the Modulation Frequency Oscillator.

5. 38 kHz RESIDUAL

Refer to drawing 1829-A1.

Equipment Required: A or B

Distortion Meter:	A	Radiometer BKF10 Distortion Analyzer
Harmonic Content Measuring Unit:	A	Radiometer SMU401 Selective Measuring Unit
Wave Analyzer:	B	HP8556A/5852B

The adjustment of the 38 kHz can be performed in two ways.

A. Using the SMU401 Selective Measuring Unit in conjunction with the BKF10 Distortion Analyzer.

The measuring setup is shown in Fig. D7, page D7.

1. Connect the INPUT of the BKF10 to the COMP.OUT connector on the front panel of the SMG40.
2. Set MAX.INPUT of the BKF10 to 3 V.
3. Set the controls on the SMG40 as follows:
   COMP.OUT level control fully clockwise.
   PILOT to ON.
   PILOT level fully clockwise.
   FUNCTION to OFF.
4. Depress the FUNDAMENTAL HARM. 2. button on the SMU401.
5. Adjust the 38 kHz residual to at least -57 dB with R129.

B. Using the Wave Analyzer.

1. Connect the wave analyzer to the COMP.OUT connector on the front panel of the SMG40.
2. Set the controls on the SMG40 as follows:
   COMP.OUT level control fully clockwise.
   FUNCTION to OFF.
   PILOT to OFF.

3. Set the wave analyzer so that it shows the 38 kHz residual, and adjust the residual with R129 to at least 74 dB below the 100 % Composite level of 5 Vp.

Trouble shooting

If the 38 kHz residual cannot be adjusted to below the tolerances given, the trouble will probably be a defect QA105.

IMPORTANT The final adjustment of the 38 kHz residual should not be performed before the SMG40 has been allowed to warm up for at least 2 hours, due to the temperature dependence of the 38 kHz residual (refer to the curve shown in the specifications).

If the SMG40 is used at environmental temperatures essentially different from 25°C, the 38 kHz residual should be adjusted at the temperature in question.

6. 114 kHz - RESIDUAL

Refer to drawing 1829-A1.

IMPORTANT Point 5. 38 kHz Residual must be performed before this adjustment is made.

Equipment Required:	A or B	
Distortion Meter:	A	Radiometer BKF10 Distortion Analyzer
Wave Analyzer:	B	HP8556A/8552B

The 114 kHz adjustment can be performed in two ways.

A. Using the BKF10.

1. Connect the INPUT of the BKF10 to the COMP.OUT connector on the front panel of the SMG40.
2. Set MAX. INPUT of the BKF10 to 3 V.
3. Set the SMG40 controls as follows:
   COMP. OUT level control fully clockwise.
   PILOT to ON.
   PILOT level fully clockwise.
   FUNCTION to OFF.

4. Adjust the THD of the pilot to minimum with R145.

NOTE: As the THD of the 19 kHz is also dependent on the adjustment of the 133 kHz trap (see item 15.1), the adjustment of the 114 kHz - and 133 kHz - residual should be performed at the same time.

At correct adjustment of the 38 kHz, 114 kHz and 133 kHz residuals the THD of the pilot should be more than 45 dB down.

B. Using a Wave Analyzer

1. Connect the Wave Analyzer to the COMP.OUT connector on the front panel of the SMG40.
2. Set the SMG40 controls as follows:
   COMP.OUT level control fully clockwise.
   PILOT to OFF.
   FUNCTION to OFF.
3. Adjust the Wave Analyzer until it shows the 114 kHz residual.
4. Adjust to minimum with R145.
   The 114 kHz residual must be at least 68 dB below the 100 % composite level of 5 Vp.

Trouble shooting

If the 114 kHz residual cannot be adjusted to below the tolerances given, the trouble may be a defect QA105 or a too large leakage current in C125.

IMPORTANT: The final adjustment of the 114 kHz residual should not be performed before the SMG40 has been allowed to warm up for at least 2 hours, due to the temperature dependence of the 114 kHz residual.
Refer to the curve shown in the specifications.

If the SMG40 is used at an enviromental temperature essentially different from 25°C, the 114 kHz residual should be adjusted at the temperature in question.

7. 114 kHz - SIDEBANDS

Refer to drawing 1829-A1.

IMPORTANT: Item 6. 114 kHz Residual must be performed before this adjustment is made.

Equipment Required:

Wave Analyzer:	HP8556A/8552B

1. Connect the Wave Analyzer to the COMP.OUT connector on the front panel of the SMG40.
2. Set the controls on the SMG40 as follows:
   COMP.OUT level control fully clockwise.
   PILOT to OFF.
   PRE-EMPH. to OFF.
   MODULATION FREQ. at 10 kHz.
   FUNCTION to L.
   Adjust with LEVEL to 100 % on COMPOSITE meter.
3. Adjust the Wave Analyzer until it shows either the 104 kHz or the 124 kHz sideband.
4. Adjust the sideband to minimum with R151.
5. Set FUNCTION to R and adjust the same sideband to minimum with R142.
   Tolerance: In both cases, steps 4 and 5, the sideband should be adjusted to at least 72 dB below the 100 % composite level of 5 Vp.

Trouble shooting

If it is not possible to meet the tolerance given the trouble may be a defect C127, on condition that R151 and R142 are not turned against stop.

8. SEPARATION

Refer to drawing 1829-A1.

Equipment Required:

Oscilloscope:	ADVANCE OS1000A
Digital Voltmeter:	Data Precision, Model 1450

Before performing the check and adjustment of the separation, check the following dc voltages with the DVM:

1. Check that the voltage at TPD2 is 0-4 Vdc.
2. Check that the dc voltage at the COMP.OUT connector is 5 mV, if not adjust with R172, see item 12.1.

NOTE: Do not use a probe when checking and adjusting the separation, as this will cause amplitude and phase distortion if it is not adjusted very carefully.

The capacitive load of the COMP.OUT connector will also change the separation. The total capacitive load - coaxial cable between oscilloscope and SMG40 plus the input capacity of the oscilloscope - should not exceed 100 pF.

8.1 ADJUSTMENT of SEPARATION at 1 kHz.

IMPORTANT: Items 5, 6 and 7 must be performed before this adjustment is made.

The measuring setup is shown in Fig. D4.

1. Connect the input of the oscilloscope to the COMP.OUT connector on the front panel of the SMG40.
2. Connect EXT.SYNC. of the oscilloscope to the MOD.SYNC. connector on the rear panel of the SMG40.
3. Set the oscilloscope to dc mode.
4. Set the SMG40 controls as follows:
   PILOT to OFF.
   PRE-EMPH. to OFF
   COMP.OUT level control at 4 Vp.
   MODULATION FREQ. at 1 kHz.
   FUNCTION to L.
   Adjust with LEVEL to 100 % on COMPOSITE meter.
5. Check with the oscilloscope that the peak value of the composite signal is approx. 8 V.
6. Set the oscilloscope sensitivity to 10 mV/cm.
7. Adjust with R204 until the symmetry of the 1 kHz signal in respect of the composite signal zero line is within $\leq$ 2 mVpp. The 1 kHz signal must be either in phase or 180° out of phase with the envelope of the composite

signal, see Fig. E2a and b.

8. Set FUNCTION to R and repeat item 7 above. Adjust with R203.

Trouble shooting

If you are not able to adjust the symmetry of the peak value of the 1 kHz signal in respect to the composite signal zero line to within $\leq$ 2 mV, or if the phase differs from that given in Fig. E2a and b, the following may help to determine the reason.

A. The 1 kHz is in phase with the envelope of the composite signal (see Fig. E2a).

Accepted that the L-KR and R-KL circuits are in order, the trouble may be:

a) The bandwidth of QA108 and/or QA109 has become too small.
b) Losses to large in the Composite filter at 38 kHz due to a defect capacitor or coil.
c) The capacative load of the COMP. OUT connector on the front panel of the SMG40 is greater than specified.

In instruments with Serial Numbers between 255681 and 255703, the trouble may also be due to too small variation range of R203 and R204, as R116 and R123 = 137 kΩ and R203 and R204 = 10 kΩ.

R116 and R123 can be shunted with up to a max. of 2.2 MΩ.

B. The 1 kHz is 180° out of phase with the envelope of the composite signal (see Fig. E2b).

The trouble will probably be found in the L-KR and R-KL circuits, but might also be a defect capacitor or coil in the Composite filter.

C. The 1 kHz is 90° out of phase with the envelope of the composite signal (see Fig. E3a and b).

The trouble will probably be due to:

a) The capacitor C144 between the Composite filter and the COMP. OUT amplifier is defect, or the value too small.
See Fig. E3a.

b) Defect capacitor or coil in the Composite filter. See Figs. E3a and b.

c) The oscilloscope is in ac mode. See Fig. E3a.

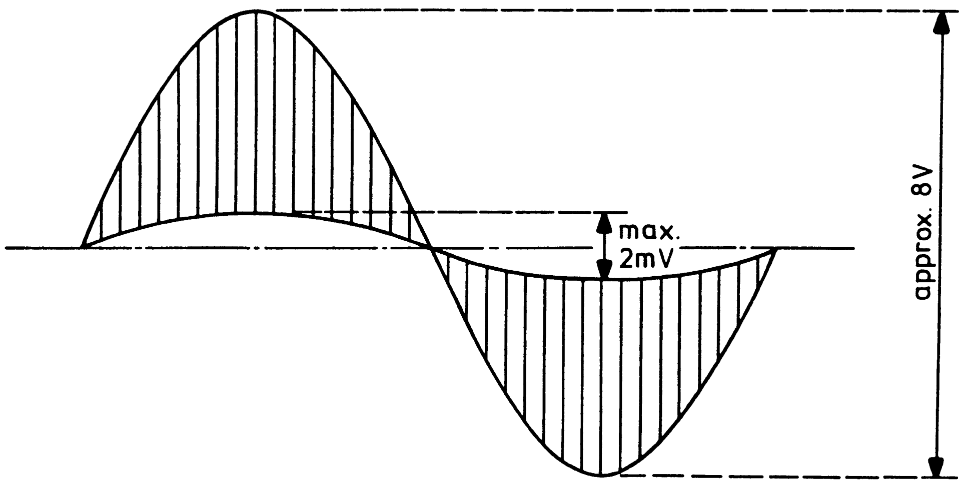


Fig. E2a Separation
0 degr. between the 1 kHz-signal and the envelope of the composite signal

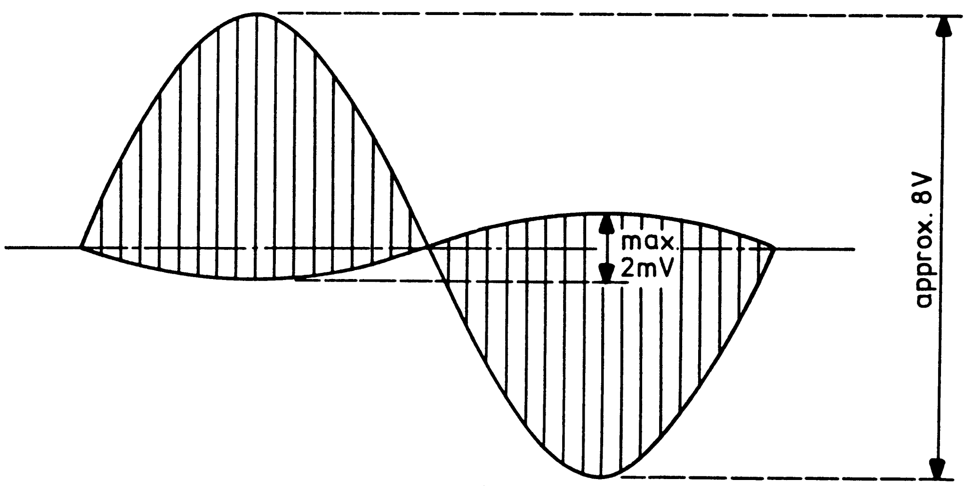


Fig. E2b Separation
180 degr. between the 1 kHz-signal and the envelope of the composite signal

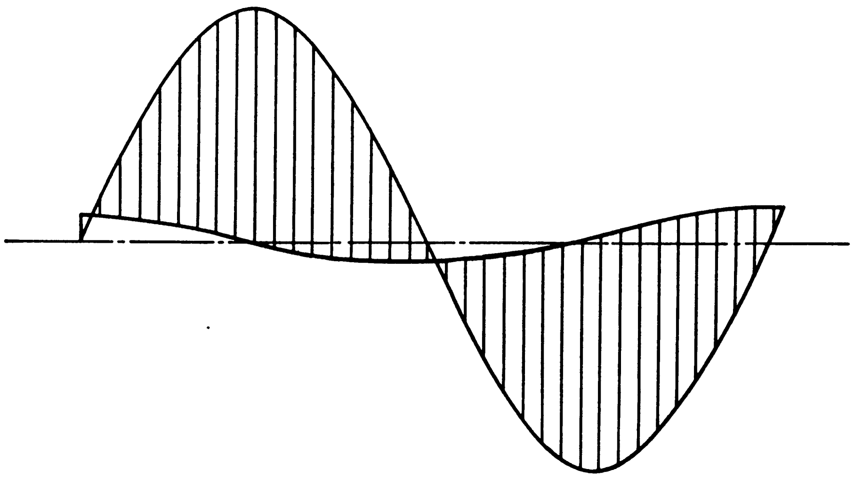


Fig. E3a Separation
-90 degr. between the 1 kHz-signal and the envelope of the composite signal

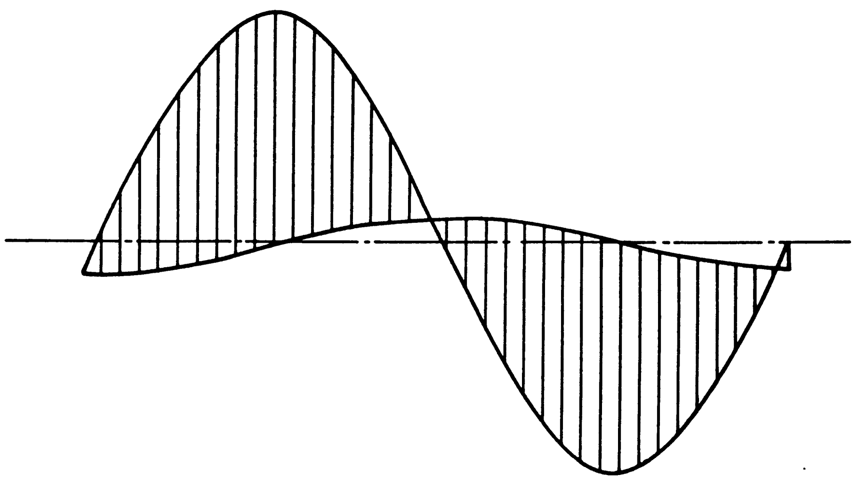


Fig. E3b Separation
+90 degr. between the 1 kHz-signal and the envelope of the composite signal

8.2 CHECK OF SEPARATION

The separation is checked with the MODULATION FREQ. in position 80 Hz and 10 kHz, both with FUNCTION in positions L and in R.

A. MODULATION FREQ. 80 Hz.

At a 100 % composite level of approx. 8 Vpp, the 80 Hz signal symmetry in respect to the composite signal zero line should be within 4 mVpp. If the signal is greater than 4 mVpp, the trouble may be:

a) C144 between the Composite filter and the Comp.Out Amplifier is defect - the value too small, as in the curve form shown in Fig. E2a.

b) The oscilloscope is in the ac mode. See the curve form shown in Fig. E2a.

B. MODULATION FREQ. 10 kHz.

At a 100 % composite level of approx. 8 Vpp, the 10 kHz signal symmetry in respect to the composite signal zero line, should be within 8 mVpp. The signal will be 90^{o} out of phase to the envelope of the composite signal. See Fig. E3b.

If the signal is greater than 8 mVpp, it is probably due to a defect capacitor or coil in the composite filter.

9. MONOPHONIC CHANNEL OUTPUT: L=R

Equipment Required:

Wave Analyzer: HP8556A/8552B

Connect the wave analyzer to the COMP.OUT connector on the front panel of the SMG40.

Adjust the wave analyzer to read one of the sub-channel sidebands, i.e., 38 kHz ± an impressed modulation frequency.

Set the SMG40 controls as follows:
COMP.OUT level control fully clockwise.

PILOT to OFF.
PRE-EMPH. to OFF.
FUNCTION to L=R.

9.1 ADJUSTMENT of L=R.

Refer to drawing 1829-A1.

IMPORTANT: Item 8.1 must be performed before this adjustment is made.

1. Set MODULATION FREQ. at 1 kHz.
   Adjust with LEVEL to 100 % on COMPOSITE meter.
2. Adjust with R119 until one of the sidebands, 37 kHz or 39 kHz, is at least 75 dB below the 100 % composite level of 5 Vp.

Trouble shooting

If the sidebands cannot be adjusted below the tolerance given, the trouble will probably be found in the L-KR and R-KL circuits.

9.2 CHECK OF L=R

The suppression of the S-signal is checked with the MODULATION FREQ. in positions 80 Hz and 10 kHz.

A. MODULATION FREQ. 80 Hz.

   The sidebands 37.920 kHz and 38.080 kHz must be at least 73 dB below the 100 % composite level of 5 Vp.

   Trouble shooting

   If the level is higher, it is propably due to a defective C115 or C116, which can cause a large difference between the time constants C115/R117 and C116/R124.

B. MODULATION FREQ. 10 kHz.

   The sidebands 28 and 48 kHz should be at least 63 dB below the 100 % composite level of 5 Vp.

Trouble shooting

If not, the trouble is probably due to too little bandwidth in QA103 or QA104, or a defective C111 or C114.

10. STEREOPHONIC SUB-CHANNEL OUTPUT: L=-R

Equipment Required:

Wave Analyzer: HP8556A/8552B

Connect the wave analyzer to the COMP.OUT connector on the front panel of the SMG40. Adjust the wave analyzer to read the modulation frequency in question.

Set the SMG40 controls as follows:
COMP.OUT level control fully clockwise.
PILOT to OFF.
PRE-EMPH. to OFF.
FUNCTION to L=R.

10.1 ADJUSTMENT OF L=-R

Refer to drawing 1829-A1.

IMPORTANT: Item 9.1 must be performed before this adjustment is made.

1. Set the MODULATION FREQ. at 1 kHz.
   Adjust with LEVEL to 100 % on COMPOSITE meter.
2. Adjust with R118 until the 1 kHz signal is at least 69 dB below the 100 % composite level of 5 Vp.

   Trouble shooting

   If the 1 kHz signal cannot be adjusted to below the tolerance given, look for the trouble in the L-KR or R-KL circuits.

10.2 CHECK OF L= -R

The suppression of the M-signal is checked at the MODULATION FREQ. 80 Hz and 10 kHz.

A. MODULATION FREQ. 80 Hz.

The 80 Hz signal on the COMP. OUT connector must be 67 dB below the 100 % composite level of 5 Vp.

Trouble shooting

If the level is greater, it is probably due to a defective C115 or C116, as this will cause a large difference between the time constants C115·R117 and C116·R124.

B. MODULATION FREQ. 10 kHz.

The 10 kHz signal on the COMP. OUT connector must be 51 dB below the 100 % composite level of 5 Vp.

Trouble shooting.

If the level is higher, the trouble may be too little bandwidth in QA104 or a defect C114.

11. COMPOSITE FILTER

If it is found that insufficient separation (see item 8) is due to trouble in the composite filter, it is recommended to send the SMG40 for service at your local Radiometer Electronics representative or to Radiometer Electronics.

12. COMPOSITE OUTPUT

Refer to drawing 2712-A2.

Equipment Requtred:

Digital Voltmeter:	Data Precision, Model 1450

12.1 ADJUSTMENT OF DC-OFFSET

1. Set the SMG40 controls as follows:
   FUNCTION to OFF.
   PILOT to OFF.
   COMP. OUT level control fully clockwise.

2. Check with a DVM that the dc voltage at TPD2 is 0-4 V.
3. Connect the DVM to the COMP.OUT connector and adjust the dc voltage with R172 to less than ± 5mV.

Trouble shooting.

If the dc voltage cannot be adjusted to the tolerance given it is due to large leakage currents in C144 or a defective QA109.

12.2 ADJUSTMENT OF THE COMP.OUT LEVEL AND COMP.OUT SCALE.

1. Set the SMG40 controls as follows:
   FUNCTION to L=R.
   MODULATION FREQ. at 1 kHz.
   COMP.OUT level control fully clockwise.
2. Connect a DVM to the COMP.OUT connector on the front panel of the SMG40.
3. Adjust the ac voltage LEVEL until the COMP.OUT connector is 3535 mV_{RMS} ± 10 mV_{RMS}.
4. Adjust the COMP.OUT level control until the DVM reads 1768 mV_{RMS}.
5. This represents 2.5 Vp which is the orientation point of the COMP.OUT level knob. If not, loosen the knob and reset to correct position.
   The accuracy of the ac voltage on the COMP.OUT connector after the orientation should be between 1740 to 1795 mV_{RMS} at 2.5 Vp.
6. Check the ac voltage in position 1 Vp and 4 Vp.
   1 Vp: 575 to 839 mV_{RMS}
   4 Vp: 2690 to 2960 mV_{RMS}

12.3 CHECK OF COMPOSITE VOLTAGE (rear panel)

1. Set the COMP.OUT level control fully clockwise, equal to 3535 mV_{RMS} ± 10 mV_{RMS} on the COMP.OUT connector.
2. Connect DVM to the COMPOSITE connector on the rear panel of SMG40.
3. The ac voltage should be:
   unloaded: 549 to 575 mV_{RMS}
   loaded with 10 kΩ ± 1 %: 518 to 542 mV_{RMS}.

13. PEAK DETECTOR AND COMPOSITE METER.

Refer to drawing 2712-A2.

IMPORTANT: Items 5, 6, 12.1 and 12.2 must be performed before this adjustment is made.

Equipment Required:

Digital Voltmeter:	Data Precision. Model 1450

1. Set FUNCTION and PILOT to OFF.
2. Check the dc voltage in TPE2. The voltage should be between -30 and +40 mV due to offset in QA111 and detected residuals.
3. Adjust the pointer of the COMPOSITE Meter to zero, using the mechanical zeroing adjustment screw.
4. Connect the DVM to the COMP.OUT connector.
5. Set the SMG40 controls as follows:
   FUNCTION to L=R.
   MODULATION FREQ. at 1 kHz.
   COMP.OUT level control fully clockwise.
   Adjust with LEVEL until the DVM reads 3535 mV_{RMS} ± 10 mV_{RMS} (ac).
6. Adjust the reading of the COMPOSITE Meter to 100 % with R179.
7. Check that the dc voltage at TPE2 is 4.96 to 5.05 Vdc.
8. The accuracy of the adjustment is the equivalent of a ac voltage on the COMP.OUT connector of 3510 to 3560 mV_{RMS} at 100%.
9. Adjust with LEVEL to 1768 mV_{RMS} ± 10 mV_{RMS} on the COMP.OUT connector, and check that the COMPOSITE Meter reads 47 to 53 %.

14. SCA INPUT

Refer to drawing 2712-A2.

Equipment Required:

AF-oscillator:	Radiometer, BKF10 Distortion Analyzer
Digital Voltmeter:	Data Precision, Model 1450.

1. Connect the OUTPUT of the BKF10 to the SCA IN connector on the rear panel of the SMG40.

2. Adjust the frequency of the BKF10 to 20 kHz and the voltage to 707 mV_{RMS} ± 5 mV_{RMS} (check with DVM).
3. Set the SMG40 controls as follows:
   FUNCTION to OFF.
   PILOT to OFF.
   COMP. OUT level control fully clockwise.
4. Check with DVM for 340 to 365 mV_{RMS} on the COMP. OUT connector, and that the COMPOSITE meter reads 7 to 13 %.

15. PILOT.

Refer to drawing 1829-A1.

Distortion, level and phase of the pilot signal is adjusted in this item.

Equipment Required:	A or B and C	
Distortion Meter:	A	Radiometer, BKF10 Distortion Analyzer
Wave Analyzer:	B	HP8556A/8552B
Oscilloscope:	C	ADVANCE 1000A
Digital Voltmeter:	C	Data Precision, Model 1450

15.1 ADJUSTMENT OF DISTORTION

It is the 7th. harmonic (133 kHz) of 19 kHz which is adjusted. The adjustment can be performed in two ways.

A. Using the BKF10

1. Connect the INPUT of the BKF10 to the COMP. OUT connector on the front panel of the SMG40, and set MAX. INPUT of the BKF10 to 3 V.
2. Set the controls of the SMG40 as follows:
   COMP. OUT level control fully clockwise.
   PILOT to ON.
   PILOT level fully clockwise.
   FUNCTION to OFF.
3. Adjust with L108 to minimum THD of the pilot.

NOTE: The THD of the pilot is dependent upon the 38 kHz and the 114 kHz residuals. These must be adjusted to minimum before this adjustment procedure of the 133 kHz can be used, see items 5A and 6A.

At correct adjustment of the residuals the THD of the pilot should be more than 45 dB down.

B. Using a Wave Analyzer

1. Connect the Wave Analyzer to the COMP.OUT connector on the front panel of the SMG40.
2. Set the SMG40 controls as follows:
   COMP.OUT level control fully clockwise.
   PILOT to ON.
   PILOT level fully clockwise.
   FUNCTION to OFF.
3. Adjust the Wave Analyzer to read the 133 kHz residual.
4. Adjust the residual with L108 to at least 73 dB below the 100% composite level of 5 Vp.

Trouble shooting

If not possible to meet the tolerances given above, look for the trouble at the 133 kHz trap. The value of L108 without a trimmer core should be 108 μH ± 4.5 % and dc resistance $< 0.7\ \Omega$.

15.2 ADJUSTMENT OF PILOT LEVEL and PILOT SCALE.

1. Connect a DVM to the COMP.OUT connector.
2. Set the SMG40 controls as follows:
   COMP.OUT level control fully clockwise.
   FUNCTION to OFF.
   PILOT to ON.
   PILOT level fully clockwise.
3. Adjust with R160 until the DVM reads 530, 3 mV_{RMS} ± 1 mV_{RMS}.
4. Adjust with PILOT level to 353.6 mV_{RMS} on DVM. This is equivalent to 10 %, which is the orientation point of the PILOT level knob.
5. If not correct, loosen the PILOT level knob and orientate it correctly. The accuracy of the orientation corresponds to 345 to 363 mV_{RMS} on the COMP.OUT connector at 10 % pilot level.
6. Check the 5 % point. The voltage on the COMP.OUT connector should be 159 to 195 mV_{RMS}

15.3 ADJUSTMENT OF PILOT PHASE

IMPORTANT: Item 10.1 must be performed before this adjustment is made.

The measuring setup is shown in Fig. D4.

1. Connect the input of the oscilloscope to the COMP.OUT connector on the front panel of SMG40.
2. Connect EXT.SYNC. of the oscilloscope to the MOD.SYNC. connector on the rear panel of SMG40.
3. Set the oscilloscope to dc mode.
4. Set the SMG40 controls as follows:
   COMP.OUT level control to 4 Vp.
   PILOT to ON.
   PILOT level fully clockwise.
   FUNCTION to OFF.
5. Check on the oscilloscope that the peak to peak voltage of the pilot signal is approx. 1.2 V.
6. Set FUNCTION to L = -R .
   MODULATION FREQ. at 1 kHz.
   Set the sensitivity of the oscilloscope to 10 mV/cm.
7. Adjust with LEVEL until curves showing the symmetry around the zeroline, just appear as shown in Fig. E4. The total composite level should be approximately 20 %.
8. Adjust the difference between the zero point symmetry levels to less than 3 mV with R200, as shown in Fig. E4 below.

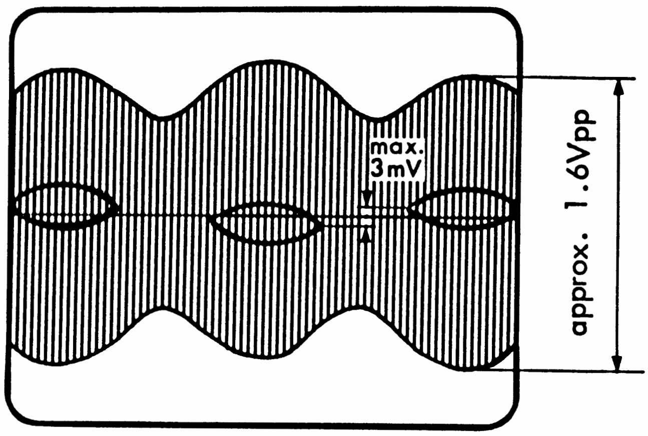


Fig. E4. Pilot phase.

16. DISTORTION AND HUM

Equipment Required:

Distortion Meter:	Radiometer, BKF10 Distortion Analyzer
Harmonic content measuring unit:	Radiometer, SMU401, in conjunction with the BKF10.

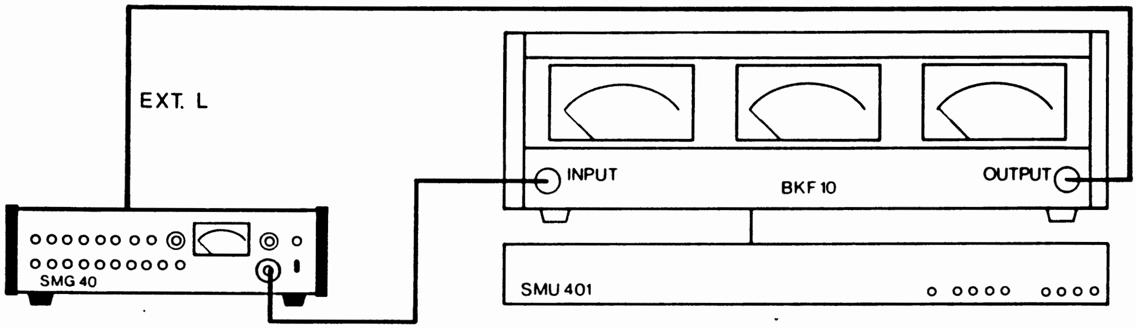


Fig. E5. Distortion and Hum Setup.

1. Check that the SMG40 is properly grounded.
2. Connect the INPUT of BKF10 to the COMP. OUT connector on the SMG40.
3. Connect the OUTPUT of BKF10 to the EXT. L connector on the rear panel of SMG40.
4. Set MAX. INPUT of BKF10 to 3 V.
5. Set the controls on the SMG40 as follows:
   COMP. OUT level control at 4 Vp.
   PILOT to OFF.
   FUNCTION to L=R.
   PRE-EMPH. to OFF.
   MODULATION FREQ. at EXT.
6. Set the BKF10 controls as follows:
   MAX INPUT to 3 V.
   FILTER to FLAT.
   OUTPUT FREQ. to 15 kHz.
   LEVEL at OUTPUT to 0.3 V.
   Adjust the LEVEL CONTROL VERNIER to give 100 % on the COMPOSITE meter of the SMG40.

7. Using the SMU401, determine the harmonic components of the 15 kHz and the line frequency.

   2nd. harmonic of 15 kHz (30 kHz):
   3rd. harmonic of 15 kHz (45 kHz): The tolerances are shown in Fig. E6.
   Fundamental of line freq. (50/60 Hz): more than 80 dB down
   2nd. harmonic of line freq. (100/120 Hz): more than 80 db down

8. Set MODULATION FREQ. at 1 kHz and check the harmonics of 1 kHz and line frequency at 100 % composite level.
   Tolerances:

2nd. harmonic of 1 kHz (2 kHz):	< -74.5 dB
3rd. harmonic of 1 kHz (3 kHz):	< -73 dB
Fundamental of line freq. (50/60 Hz):	< -80 dB
2nd. harmonic of line freq. (100/120 Hz):	< -80 dB

9. Set the controls on the SMG40 as follows:
   FUNCTION to OFF.
   PILOT to ON.
   PILOT level at 15 %.

10. Determine the harmonics of the line frequency.
    Tolerances:

Fundamental of line freq. (50/60 Hz)	< -64 dB
2nd. harmonic of line freq. (100/120 Hz)	< -68 dB

Trouble shooting

If the fundamental of the line frequency is too great, it can be due to improper grounding of the SMG40.

In the two first measurements (items 7 and 8) the 2nd. harmonic of line frequency is due to the +15 V and -15 V voltage regulators (QA112 and QA113). In the last measurement of line frequency (item 10) it is due to the +5 V voltage regulator (QA114).

If the distortion is too great, it is probably because of to little slew rate of the amplifiers QA108 and QA109. This only applies under the conditions that the distortion in items 3 and 4 is within the tolerances given.

The 2nd. harmonic distortion from the 38 kHz and 114 kHz modulators will be approx. -80 dB. If items 5, 6, 7 and 8 are in order, the modulators will probably not cause too much distortion of the composite signal.

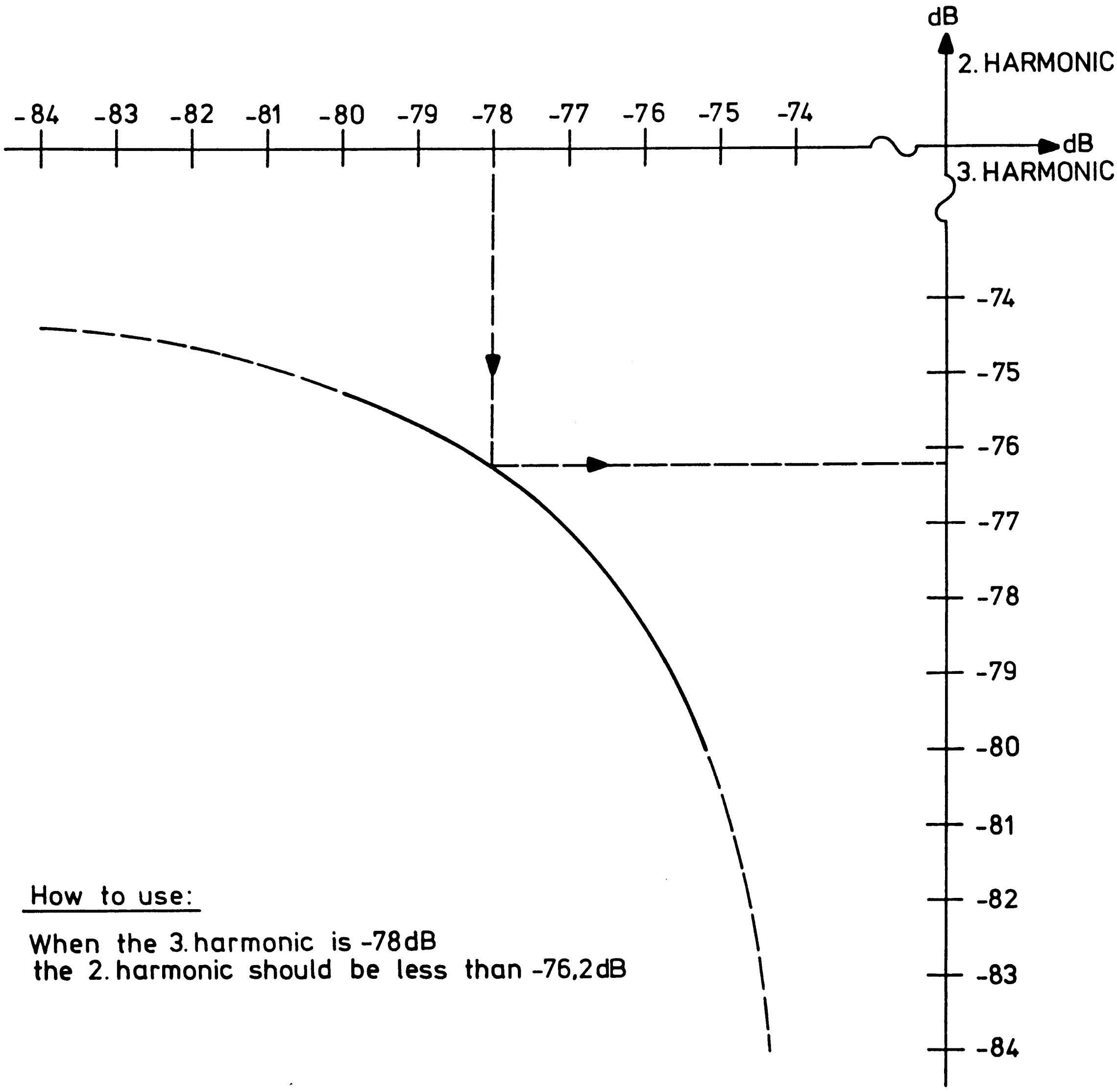


Fig. E6. SMG40 - Intrinsic Distortion.

17. NOISE

Equipment Required:

Wave Analyzer: HP8556A/8552B

The noise of the composite signal is measured in narrow frequency bands due to the content of residuals, and is then calculated for the actual bandwidth as given below.

1. Short circuit both the EXT.L and the EXT.R connectors on the rear panel of the SMG40 to 0 V.
2. Set the controls on the SMG40 as follows:
   MODULATION FREQ. at EXT.
   FUNCTION to L & R.
   PILOT to OFF.
   PRE-EMPH. to OFF.
   COMP.OUT level control fully clockwise.
3. Connect the wave analyzer to the COMP.OUT connector on the front panel of the SMG40, and perform the noise measurement at 10 kHz.
4. The noise is calculated for a 15 kHz noise bandwidth in the following way:
   BW(in Hz) = the noise bandwidth of the wave analyzer.
   AdB = the measured noise level below the 100 % composite level of 5 Vp at 10 kHz.

   The noise at bandwidth of 15 kHz will be:

   $$B = A - 10 \log \frac{15000}{BW} \text{ dB below the 100 \% composite level}$$

   of 5Vp.

   The value B should be greater than 76 dB.

EIV. REPLACEABLE PARTS

INTRODUCTION

All electronic components and the most important mechanical parts are included in the parts list. Parts marked with an x are manufactured by Radiometer. Measurements of mechanical components are given in millimeters unless otherwise specified.

As we are continually improving our instrument, it is important, when ordering spare parts, that you include the following information:

The code number and description of the part.
The circuit reference from the circuit diagram.
The complete type designation of your instrument.
The serial number of your instrument.

PRE-EMPH., MODULATOR, CRYSTAL OSC., COMPOSITE FILTER, PEAK DETECTOR and POWER SUPPLY

CAPACITORS

Designation	Description	Code No.
C101, 104, 138 139, 140, 141, 142, 143	Polystyrol 2nF 1% 63V	243-106
C102, 105	Ceramic 150pF 2% 100V N750	213-212
C103, 106, 107, 108, 109, 110, 112, 113, 126, 130, 131, 133, 135, 136, 146, 147, 149, 150, 165, 166	Ceramic 0. 1μF -20 + 80% 30V	213-009
C111, 114, 174	Ceramic 2.7pF ±0.25pF 100V NPO	213-201
C115, 116	Electrolytic 220μF 16V	261-075
C117, 124, 125 128, 151	Tantalum 10μF -20+80% 15V	267-000
C118, 119	Ceramic 47pF 2% 100V NPO	213-209
C120, 121, 122, 123	Tantalum 1μF -20+50% 25V	267-006
C127	Ceramic 10pF 2% 100V NPO Note: can be replaced by 8.2 pF, Code No. 213-224 or 12pF, Code No. 213-227 if necessary.	213-205

Designation	Description	Code No.
C129	Polystyrol 4.198nF 63V 1%	243-165
C132	Polystyrol 12 nF 2% 63V	243-017
C134	Tantalum 2µF -20+50% 25V	267-007
C137, 148	Ceramic 10pF 2% 100V NPO	213-205
C144, 171	Electrlytic 1000µF 16V	261-006
C145, 154	Ceramic 10nF -20+100% 40V	213-020
C152, 175	Tantalum 22µF 20% 15V	267-019
C153, 158	Ceramic 33pF 2% 100V NPO	213-208
C155	Ceramic 0pF 2% 100V NPO	?
C156	Ceramic plate trimmer for print 10/60pF N1500	268-007
C157	Ceramic 180pF 2% 100V N750	213-228
C159	Ceramic 220pF 2% 100V N750	213-218
C160	Ceramic 330pF 2% 100V N750	213-214
C161, 162, 163, 164	Ceramic 0.1µF -20+80% 12V	213-017
C167, 168	Electrolytic 470 µF 35V	261-050
C169, 170	Electrolytic 100 µF 25V	261-073
C172	Electrolytic 10µF 25V	260-012
C173	Tantalum 2µF -20+50% 35V	267-002
C176	Electrolytic 470µF 6V	261-060

DIODES

Designation	Description	Code No.
CR1	LED CQY94	350-051
CR101, 102	Rectifier BY164	340-208
CR103, 104	Diode 1N4002	350-409
CR105, 106	Zenerdiode C6V2-0.4	350-604
CR107, 108	Zenerdiode C7V5-0.4	350-621

FUSES

Designation	Description	Code No.
F1	80 mA slow blow, 220V	450-009
F2	160mA slow blow, 115V	450-112

CONNECTORS

Designation	Description	Code No.
J1 to J7	Coaxial connector BNC	800-108
J8	Line cord receptacle, 3 pole CSA	802-212
J9	Telephone jack	803-241
J101	Socket for 14-pin DIL	816-131

COILS

Designation	Description	Code No.
x L101	Coil	12233-A4
x L102	Coil	12234-A4
x L103 to L106	Coil	12235-A4
x L107	Coil	12236-A4
x L108	Coil	12237-A4

METER

Designation	Description	Code No.
M1	Composite meter 1mA 75Ω kl.-2.5	480-292

TRANSISTORS

Designation	Description	Code No.
Q101, 105, 107	BC557B	360-160
Q102, 103, 104, 106	BC547B	360-159

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA101, 102	LF356H	364-203
QA103, 104, 107, 108, 109	LM318H	364-216
QA105, 106	CA3054	364-070
QA110	LM311H	364-024
QA111	LM301AN	364-016

Designation	Description	Code No.
QA112	LM340T-15	364-210
QA113	LM320T-15	364-211
QA114	78MOSUC	364-180
QD101	SN74LS90N	364-187
QD102, 103	SN74LS92N	364-215
QD104, 105	SN74LS74N	364-185
QD106	SN74LS05N	364-214
QD107	SN74LS00N	364-213
QD108	SN7404N	364-033

RESISTORS

Designation	Description	Code No.
R1	Wirewound potentiometer 1kΩ 10%, lin. 1%	191-201
R2	Wirewound potentiometer 2kΩ 10%, lin. 1%	191-203
R101, 104	Metal film 4.12kΩ 1% 0.1 W TK100	140-894
R102	Metal film 1.37kΩ 1% 0.1 W TK100	140-607
R103, 106	Metal film 5.76kΩ 1% 0.1 W TK100	140-893
R105	Metal film 1.65kΩ 1% 0.1 W TK100	140-892
R107, 108	Metal film 12.4kΩ 1% 0.1 W TK100	140-729
R109, 110, 156	Metal film 24.9kΩ 1% 0.1 W TK100	140-635
R111, 112	Metal film 37.4kΩ 1% 0.1 W TK100	140-714
R113, 117	Metal film 1.58kΩ 1% 0.1 W TK50	140-891
R114	Carbon film 470kΩ 5% 0.2 W	106-647
R115, 122	Metal film 3.2kΩ 0.5% 0.1 W TK50	140-890
R116, 123	Metal film 130kΩ 1% 0.1 W TK100	140-923
R118, 119	Potentiometer 220Ω 20% 0.5 W	182-006
R120	Metal film 1.5kΩ 1% 0.1 W TK50	140-886
R121	Carbon film 220kΩ 5% 0.2 W	106-622
R124, 127	Carbon film 6.8kΩ 5% 0.2 W	106-468
R125, 126, 147	Metal film 10kΩ 0.25% 1/8 W TK25	140-394
R128, 157, 173, 178	Carbon film 1MΩ 5% 0.2 W	106-710
R129, 145, 172	Potentiometer 100kΩ 20% 0.5 W	182-009

Designation	Description	Code No.
R130, 163	Carbon film 1.5kΩ 5% 0.2 W	106-415
R131	Carbon film 680Ω 5% 0.2 W	106-368
R132, 133, 140, 141	Carbon film 1.2kΩ 5% 0.2 W	106-412
R134, 135, 138, 139, 194	Carbon film 150Ω 5% 0.2 W	106-315
R136, 137, 177, 196, 205	Carbon film 100Ω 5% 0.2 W	106-310
R142	Potentiometer 47kΩ 20% 0.5 W	182-010
R143	Metal film 60.4kΩ 1% 0.1 W TK100	140-649
R144	Metal film 10.7kΩ 5% 0.1 W TK25	140-840
R146	Carbon film 680kΩ 5% 0.2 W	106-668
R148	Metal film 215kΩ 1% 0.1 W TK100	140-666
R149	Metal film 1kΩ 1% 0.1 W TK50	140-887
R150, 161, 171	Carbon film 1.8kΩ 5% 0.2 W	106-418
R151, 160, 200	Potentiometer 10kΩ 20% 0.5 W	182-008
R152	Metal film 16.9kΩ 1% 0.1 W TK100	140-868
R153	Metal film 2.1kΩ 1% 0.1 W TK50	140-888
R154	Metal film 4.99kΩ 1% 0.1 W TK100	140-422
R155	Metal film 15kΩ 1% 0.1 W TK100	140-575
R158	Metal film 604Ω 1% 0.1 W TK100	140-885
R159	Metal film 21kΩ 1% 0.1 W TK100	140-813
R162	Carbon film 3.3kΩ 5% 0.2 W	106-433
R164, 201	Carbon film 2.2kΩ 5% 0.2 W	106-422
R165	Metal film 3.74kΩ 1% 0.1 W TK100	140-572
R166, 167	Metal film 1.3kΩ 0.5% 0.1 W TK100	140-883
R168	Metal film 26.1 kΩ 1% 0.1 W TK100	140-815
R169	Metal film 619Ω 1% 0.1 W TK100	140-541
R170	Metal film 13kΩ 1% 0.1 W TK100	140-837
R174	Metal film 3.79kΩ 0.5% 0.1 W TK100	140-882
R175	Metal film 715Ω 0.5% 0.1 W TK100	140-881
R176, 182, 183, 184, 185, 186, 187, 188, 190, 192	Carbon film 1kΩ 5% 0.2 W	106-410

Designation	Description	Code No.
R179	Potentiometer 4.7kΩ 20% 0.5 W	182-002
R180	Metal film 5.23kΩ 1% 0.1 W TK100	140-884
R181	Metal film 42.2kΩ 1% 0.1 W TK100	140-801
R189, 191, 193	Carbon film 2.7kΩ 5% 0.2 W	106-427
R195	Carbon film 12kΩ 5% 0.2 W	106-512
R197, 198	Carbon film 4.7kΩ 5% 0.2 W	106-447
R199	Carbon film 47kΩ 5% 0.2 W	106-547
R202	Carbon film 560Ω 5% 0.2 W	106-356
R203, 204	Mini potentiometer 20kΩ 20% 0.3 W	182-303

SWITCHES

Designation	Description	Code No.
S1	Pilot on/off push button	551-114
S2	Power switch 2-pole, 3A, 250Vac	500-201
S3	Slide switch, line CSA	500-111
S101	Function/Pre-emph. switch	551-115

TRANSFORMER

Designation	Description	Code No.
T101	Power transformer	770-656

CRYSTAL

Designation	Description	Code No.
Y101	Crystal 4.56 MHz	910-105

MISCELLANEOUS

Type	Code No.
Bayonet head for fuse holder, 220V	460-006
Bayonet head for fuse holder, 115V	460-008
Fuse holder base	460-007
PC-board	970-766

MOD. FREQ. OSC. and EXT. L & R IN (900-972)

CAPACITORS

Designation	Description	Code No.
C301, 302	Polystyrol 3.48nF 1% 63V	243-164
C303, 304, 305, 306	Ceramic 0.1μF -20+80% 30V	213-009
C307, 308	Electrolytic 100μF -10+50% 25V	261-073
C309, 310	Polyester 2.2μF 10% 63V	241-031
C311	Electrolytic 10μF 35V	260-012

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA301	LM318H	364-216
QA302, 303	LF356H	364-203

RESISTORS

Designation	Description	Code No.
R301, 302	Metal film 576kΩ 1% 0.25 W TK100	140-880
R303, 304	Metal film 143kΩ 1% 0.1 W TK100	140-859
R305, 306	Metal film 49.9kΩ 1% 0.1 W TK100	140-645
R307, 308	Metal film 9.31kΩ 1% 0.1 W TK100	140-878
R309, 310	Metal film 4.64kΩ 1% 0.1 W TK100	140-879
R311	Carbon film 1.2kΩ 0.2 W	106-412
R312	NTC 4.7kΩ 25°C 20%	160-054
R313	NTC 1kΩ 25°C 20%	160-001
R314	Carbon film 2k7 0.2 W	106-427
R315	Potentiometer 2.2kΩ 20% 0.5 W	182-012
R316	Carbon film 1.5kΩ 0.2 W	106-415
R317	Carbon film 1kΩ 0.2 W	106-410
R318	Carbon film 4.7kΩ 0.2 W	106-447
R319	Carbon film 680Ω 0.2 W	106-368
R320	Potentiometer 1kΩ 20% 0.125 W Lin.	180-004
R321, 323	Carbon film 33Ω 0.2 W	106-233
R322, 324	Carbon film 47kΩ 0.2 W	106-547

Designation	Description	Code No.
R325	Metal film 301Ω 1% 0.1 W TK100	140-806
R326	NTC 1k Ω 25°C 20%	160-001

SWITCH

Designation	Description	Code No.
S301	MODULATION FREQ. switch	551-116

CABLE

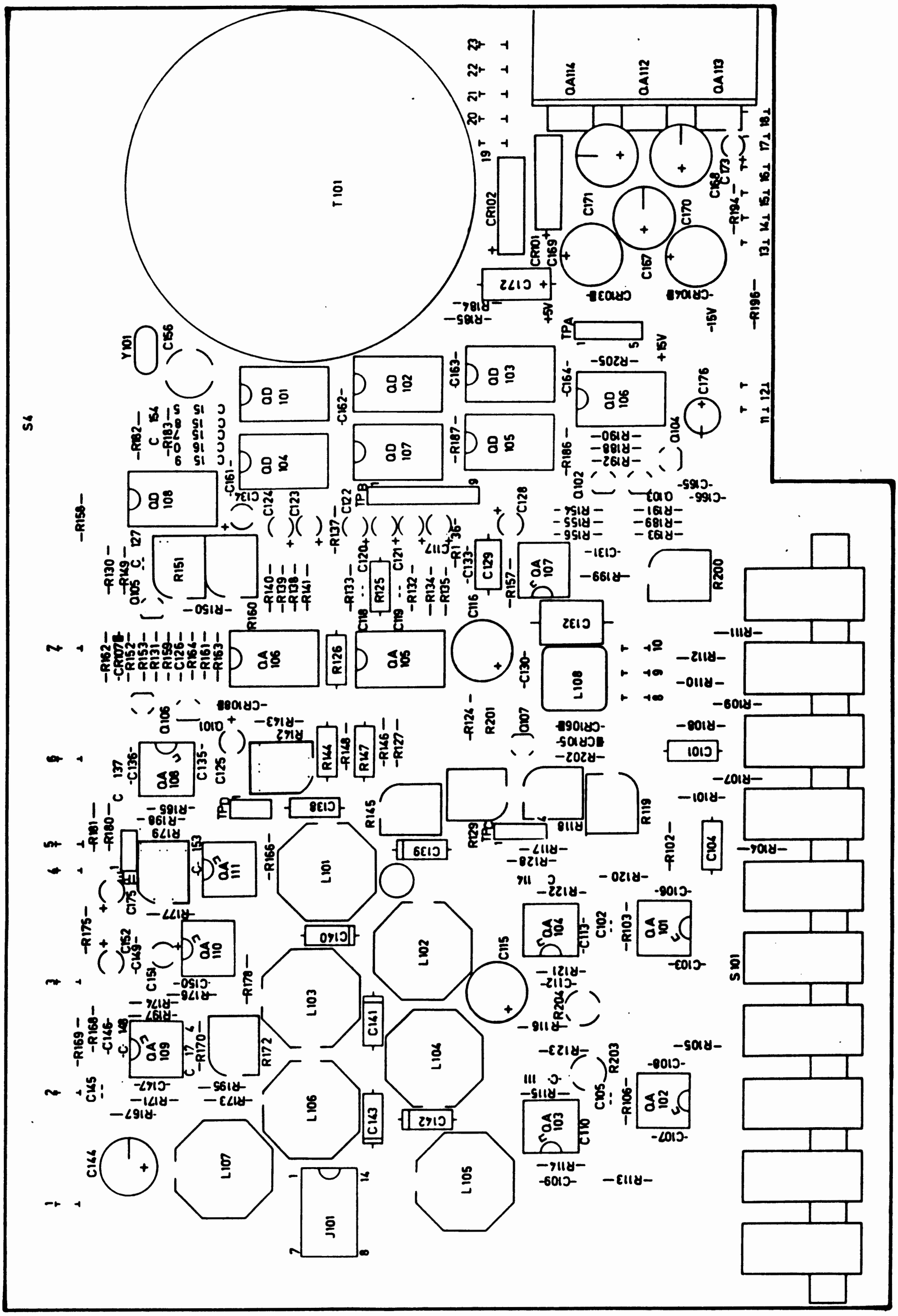
Designation	Description	Code No.
x W301	Flat cable w. dipplug connector	12238-A4

MISCELLANEOUS

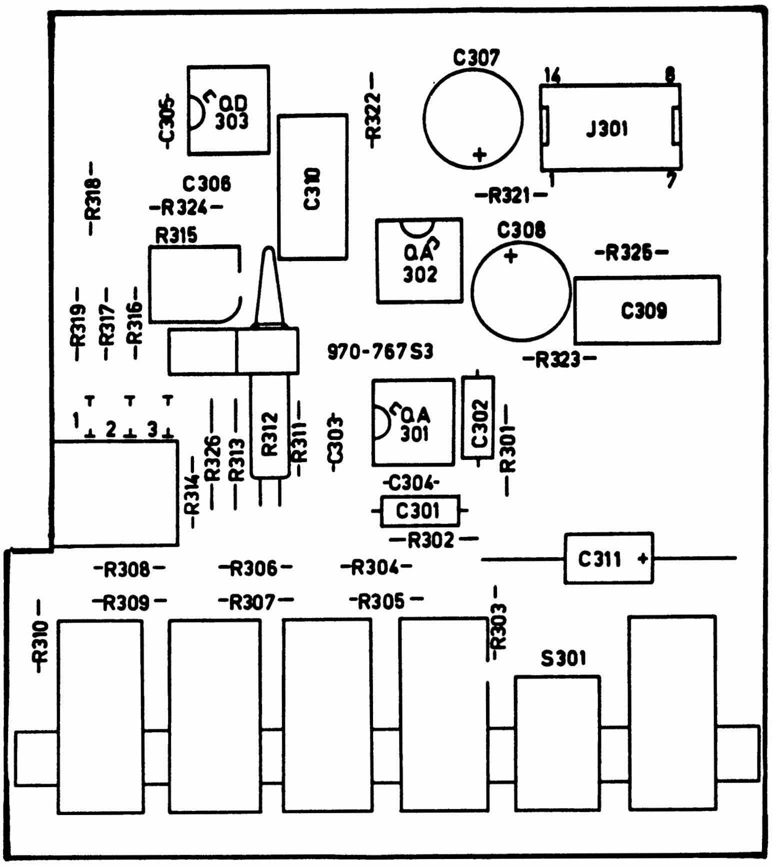
Type	Code No.
PC-board	970-767

DRAWINGS

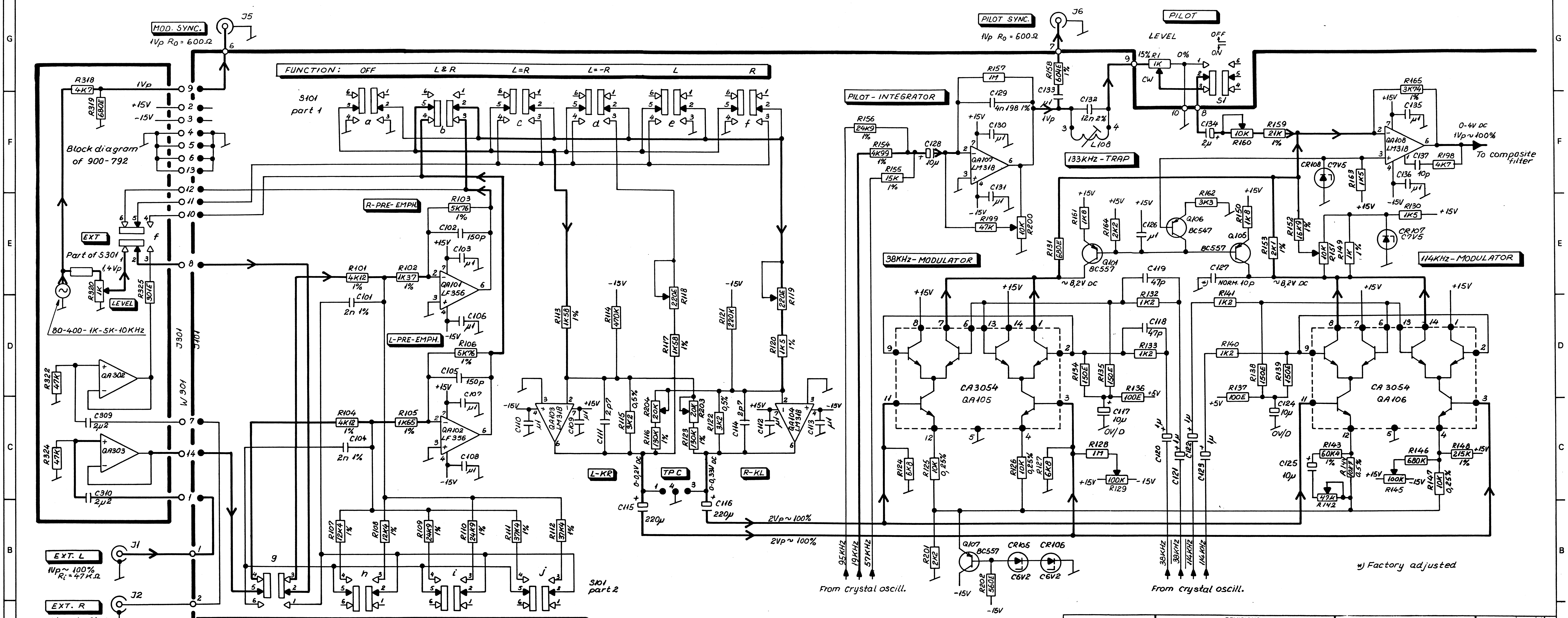
PRE-EMPH. and MODULATOR	1829-A1
POWER SUPPLY and CRYSTAL OSC.	1830-A1
COMPOSITE FILTER and PEAK DETECTOR	2712-A2
MOD.FREQ. OSCILLATOR and EXT. L & R IN	2713-A2



Component placement for Pre-Emph., Modulator, Crystal Osc., Composite Filter, Peak Detector and Power Supply.



Component placement for Mod. Freq. Osc. and
Ext. L & R IN.



The heavier lines indicate the signal path, when the switches are set as follow:

MODULATION FREQ: 1kHz, FUNCTION: L&R, PRE EMPH: OFF and PILOT: ON

REVISIONS

ISSUE	ÆM	DATE	DRAWN BY	CHECKED BY	APPR. BY
2	001075	83.05.18	PE		
2		7.11.77	MMV	EF	EF
1	267445	16.6.77	OH	EF	EF

RE INSTRUMENTS AS
26 Emdrupvej DK-2100 København Ø. Denmark Telf. (01) 184422

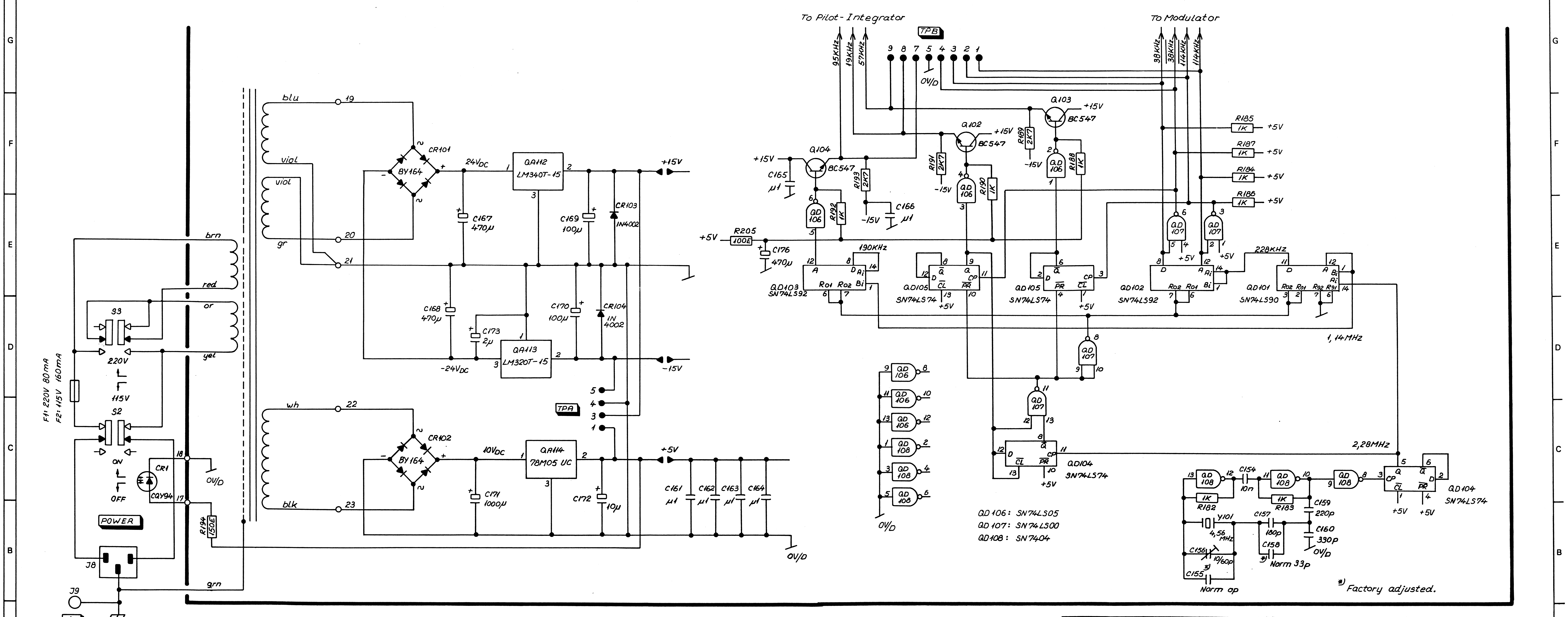
PRE-EMPH. AND MODULATOR

TYPE SMG40

FROM NO. TO NO.

DRAWN BY ÆH 11/10-76
CHECKED BY EF 14/10-76
APPR. BY EF 14/10-76

~~1829-A1~~
985-072



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REVISIONS

ISSUE	ÆM	DATE	DRAWN BY	CHECKED BY	APPR. BY
1	001075	83.05.19	PE		
1	267445	16.6.77	OH	EF	EF

RE INSTRUMENTS AS
26 Emdrupvej DK-2100 København Ø.
Denmark Telf. (01) 184422

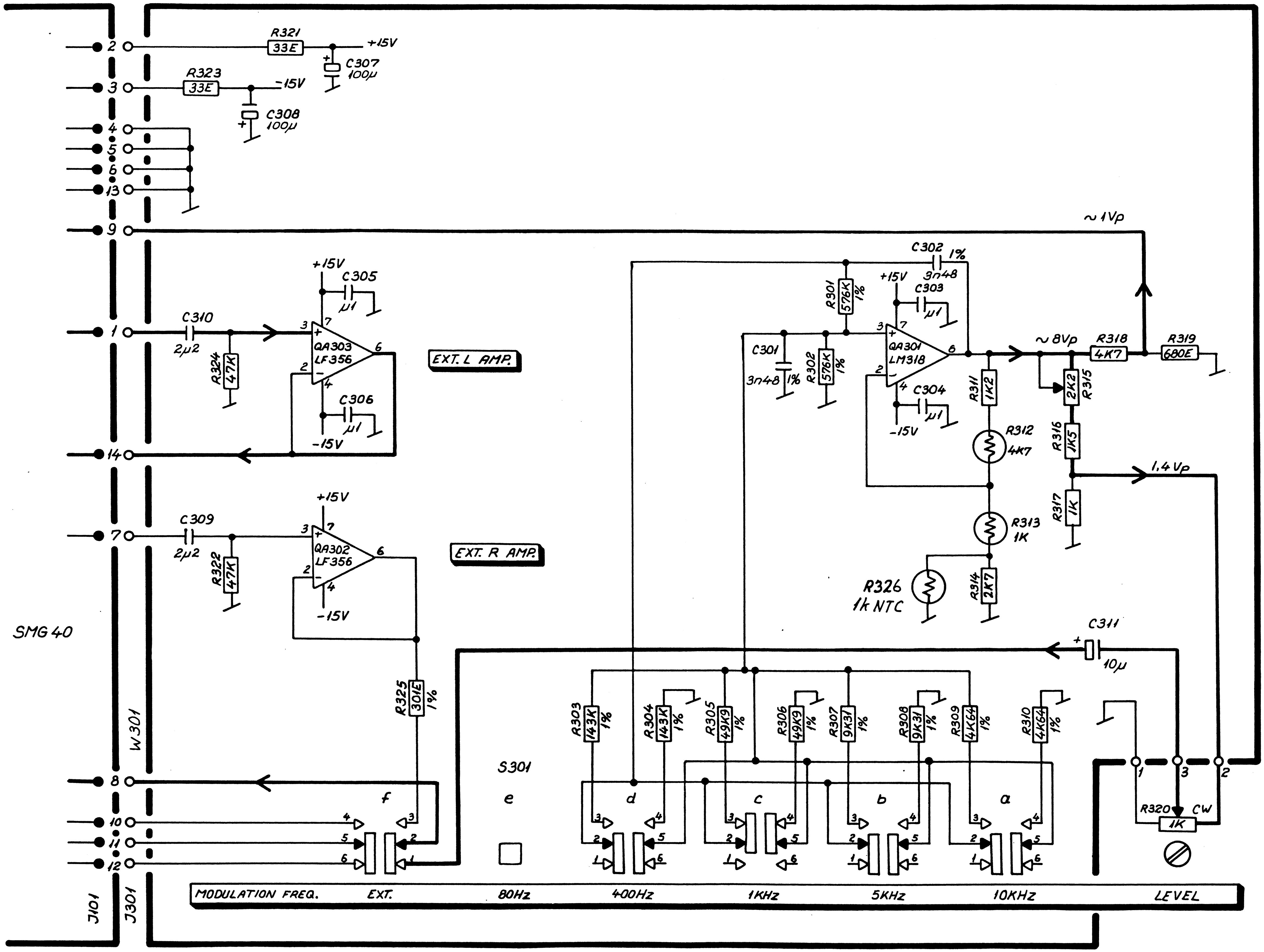
DRAWN BY	AEH	7/10-76
CHECKED BY	EF	13/10-76
APPR. BY	EF	14/10-76

POWER SUPPLY AND CRYSTAL OSCILLATOR.

TYPE SMG40

FROM NO. TO NO.

~~1830-A1~~
985-073



The heavier lines indicate the signal path, when the switches are set as follow :

MODULATION FREQ : 1kHz , FUNCTION : L&R

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REVISIONS					
2	001076	83.05.19	PE		
2		3.11.81	UGP		
1		7.11.77	MMV	EF	EF
ISSUE	ÆM	DATE	DRAWN BY	CHECKED BY	APPR. BY

MOD. FREQ. OSCILLATOR AND EXT. L & R IN

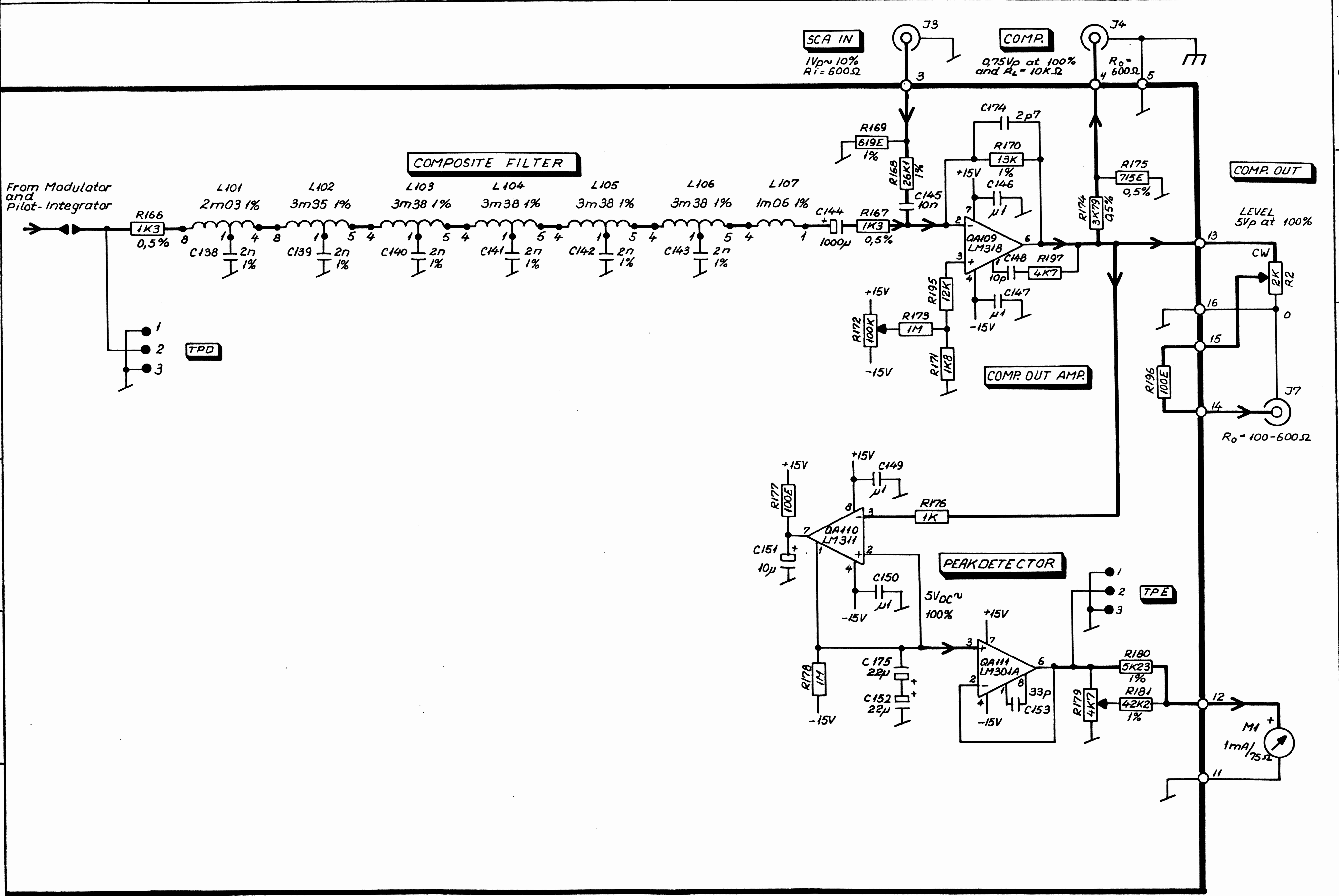
TYPE 900-792

FROM NO. TO NO.

DRAWN BY	AEH	6/10-76
CHECKED BY	EF	12/10-76
APPR. BY	EF	12/10-76

~~2713-A2~~

985-075



The heavier lines indicate the signal path.

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REVISIONS					
ISSUE	ÆM	DATE	DRAWN BY	CHECKED BY	APPR. BY
2	001075	83.05.19	PE		
2		7.11.77	MMV	EF	EF.
1	267445	16.6.76	OH	EF	EF

DRAWN BY	AEH	6/10-76
CHECKED BY	EF	12/10-76
APPR. BY	EF	12/10-76

COMPOSITE FILTER AND PEAK DETECTOR

TYPE SMG 40

FROM NO. TO NO.

~~2712-A2~~

985-074