V-7 Z < 1 Ω AMPLIFIER

Refer to schematic in plate V-9.

This subassembly comprises an amplifier using complementary transistors which receives frequency F5 : 10 Hz/1 MHz from the Demodulator Amplifier. It provides a signal with 0 dBm/75 Ω to + 20 dBm/75 Ω electromotive force, depending on the level of the main output signal, at an impedance of less than 1 Ω.

V-8 PARALLEL BCD PROGRAMMING (OPTION 010)

Refer to schematic in plate V-12.

This option enables the logic signals from the manual controls of the synthesizer to be replaced by external parallel BCD signals applied to programming connectors (S03) and (S04) .

V-9 IEEE BUS PROGRAMMING (OPTION 020)

Refer to block diagram in figure V-11, and schematics in plates V-10 and V-11.

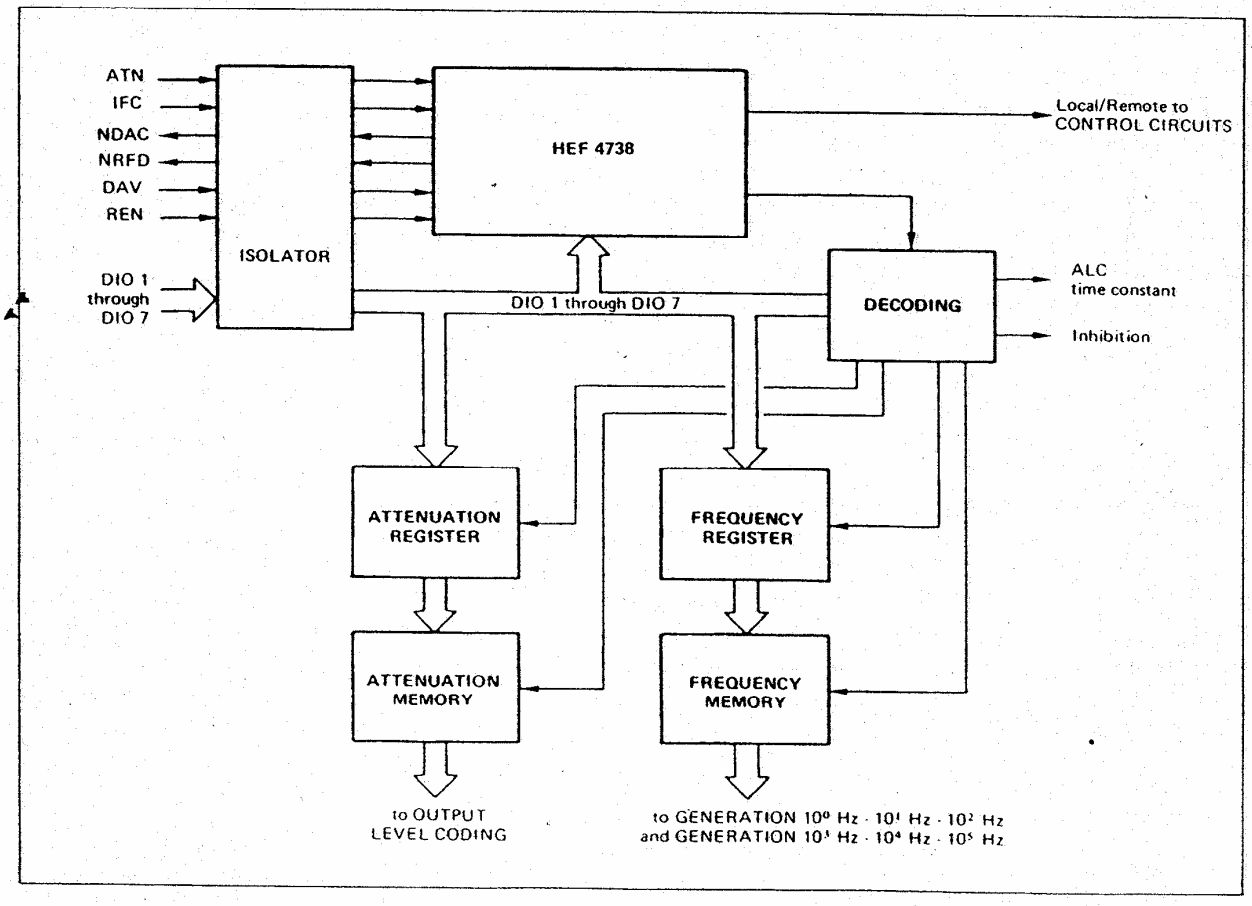


Figure V-11 IEEE BUS PROGRAMMING

This option, consisting of two subassemblies, converts the data supplied by the IEEE Bus into parallel BCD signals which are substituted in Programming mode for the logic signals from the manual synthesizer controls.

V-9-1 IEEE BUS ISOLATOR

This circuit comprises a series of Schmitt triggers (integrated circuits SN1 and SN2, plate V-10), followed by galvanic isolators (transformers T1, T2 and T3) which enable the ground of the IEEE bus to be isolated from that of the synthesizer. For this reason, the various circuits **upstream of the galvanic isolators are supplied by a +5 V floating voltage issued from the IEEE Bus** Registers subassembly.

The secondary winging of each transformer is connected in a feedback to a C-MOS gate (integrated circuits SN5, SN6 and SN7) which stores the transient pulse induced in the winding.

V-9-2 IEEE BUS REGISTERS

This circuit converts the data transmitted by the IEEE Bus Isolator subassembly into parallel BCD signals.

The handshake process with the IEEE bus is entirely controlled by the HEF 4738 integrated circuit, with the aid of a 4014 shift-register. These two integrated circuits provide for the recognition of the address selected by switches (K10) , for the Local/Remote control of the synthesizer, and for the control of the Decoding circuit. The HEF 4738 integrated circuit is controlled by a 2 MHz square-wave signal obtained by dividing by 2 the frequency generated by a 4 MHz oscillator (integrated circuit SN30).

The digits and the characters CR, A, ?, F, < and > are decoded by four decoders (integrated circuits SN4 and SN5 , plate V-11) followed by NOR gates (integrated circuits SN6 to SN9) and JK flip-flops (integrated circuits SN10 , SN11 and SN12) . The decoding circuit also controls transfer of data from lines DI01 to DI04 to the output registers, and supplies the Demodulator-Amplifier with the Inhibition and the ALC time constant programming signals.

The output level attenuation transmitted on lines DI01 to DI04 is transferred to the Attenuation Register consisting of 4 shift registers (integrated circuits SN14 and SN15) and to the Attenuation Memory consisting of 16 type D flip-flops (integrated circuits SN20 to SN23), which supplies this attenuation in parallel BCD code to the Output Level Coding subassembly.

The output frequency transmitted on lines DI01 to DI04 is transferred to the Frequency Register consisting of 8 shift registers (integrated circuits SN16 to SN19) and to the Frequency Memory consisting of 24 type D flip-flops (integrated circuits SN24 to SN29), which supplies this frequency in parallel BCD code to the Generation 10^0 Hz - 10^1 Hz - 10^2 Hz and Generation 10^3 Hz - 10^4 Hz - 10^5 Hz subassemblies.

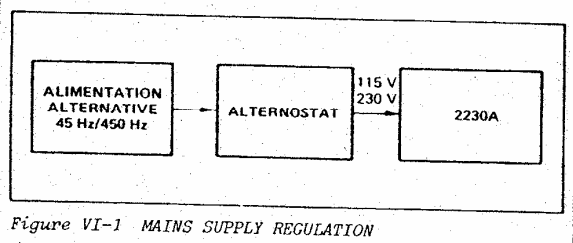
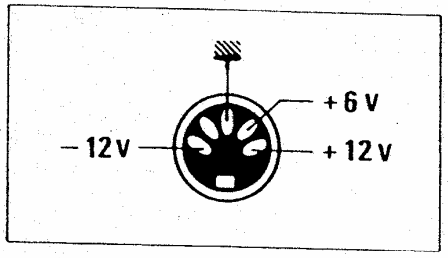
CHAPTER VI

MAINTENANCE

The tests described in the following pages are designed to enable the user to check that the instrument conforms to the technical characteristics set out in chapter II. These tests may be carried out as acceptance tests, as periodic performance checks, or as a control on the instrument characteristics following repairs.

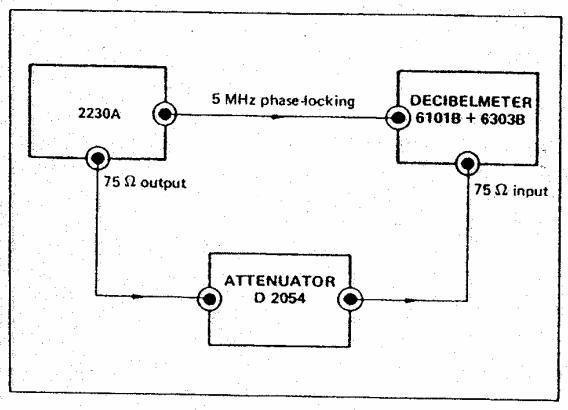
INSTRUMENTS REQUIRED FOR EXECUTING TESTS

TYPE OF INSTRUMENT	REFERENCE	CHARACTERISTICS
Alternostat		0 V to 260 V ; 200 W
Multimeter	FLUKE 8000 A	DC/AC ; accuracy $\pm$ 1%
Oscilloscope	H.P. 180C + 1808A + 1820C	75 MHz bandwidth
Frequencymeter	SCHLUMBERGER FH 2523	10 Hz to 500 MHz ; 9 digits
RF voltmeter	H.P. 3400 A	10 Hz to 10 MHz ; accuracy $\pm$ 1%
Milliwattmeter	WANDEL & GOLTERMANN EPM-1	10 kHz to 300 MHz ; accuracy $\pm$ 0.015 dB
Standard attenuator	SIEMENS D 2054	0 dB to 99.9 dB
Decibelmeter	ADRET 6101B + 6303B + 63032A + 63030B	DC to 11 MHz ; resolution 0.01 dB
Spectrum analyser	ADRET 6100B + 6303B + 6503A + 63032A	DC to 11 MHz ; dynamic range 120 dB
X-Y recorder	H.P. 7041A	Speed 76 cm/s
ECF 136	ADRET	Impedance transformer 75 Ω/150 Ω/600 Ω
ECF 141	ADRET	Asymmetry detector
Frequency difference multiplier	ADRET 4110A	Resolution 10^{-8} to 10^{-12}
Frequency standard	ADRET 3310A	300 Hz to 60 MHz ; stability $\pm$ 5.10^{-9}/24 h
DC source	ADRET 102	Accuracy $\pm$ 5.10^{-5}; output current 50 mA

N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
1	VISUAL CHECK Check the external appearance of the instrument and that protective fuse (F1) is of the correct rating (300 mA for 115V supply, 150 mA for 230 V supply).	
2 45 Hz to 450 Hz 115V - 230V power supply Alternostat Multimeter	MAINS SUPPLY REGULATION **Connect the instrument to a 45 Hz/450 Hz power supply** through an alternostat, as shown in figure VI-1.  *Figure VI-1 MAINS SUPPLY REGULATION* a) Vary the supply frequency between 45 Hz and 450 Hz for supply voltages of 115V and 230V. Measure the voltages present at connector (S01) of the rear panel : + 12V relative to ground. - 12V relative to ground. + 6V relative to ground.  *Figure VI-2 CONNECTOR (S01)* b) Repeat the above test using the alternostat to apply voltages of 115V ± 10% and 230V ± 10%. c) Use the multimeter to measure the current drawn by the instrument at both mains supply voltages. Calculate the apparent power consumption by means of the formula P = UI.	Accuracy : + 11.8 V to + 12.5 V - 11.8 V to - 12.5 V + 5.75 V to + 6.25 V The previously measured voltages must remain substantially identical. P < 20 VA

N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
3 Power supply Alternostat 250 Hz low-pass filter Oscilloscope	RESIDUAL LF RIPPLE With the instrument supplied at 50 Hz, use the 250 Hz low-pass filter and the oscilloscope to measure the LF ripple on the +12V, + 6V and -12V voltages available at connector (S01) .	Residual ripple < 5 mVp-p
4 Frequencymeter DC source	OUTPUT FREQUENCY a) Synthesizer mode : With the frequencymeter and the 2230A synthesizer connected to the same 5 MHz reference frequency, use the frequencymeter to check that the frequency at connector (J1) is the same as that set on switches (K2) . b) Generator mode : Set a frequency of 500 000 Hz on switches (K2) , set potentiometer (P1) to the 0.5 mark, and adjust the vernier of this potentiometer so as to obtain very slow flashing of indicator lights (DS3) . Then measure the output frequency at various positions of potentiometer (P1) , the vernier being left in its initial position. The maximum permissible error relative to the frequency indicated on the graduated dial is ± 50 kHz in all circumstances. If the error is greater than 50 kHz, the amplifier A12 of subassembly 02 7003 (Control Circuits, plate V-7) must be recalibrated as follows : - Set a frequency of 500 000 Hz on switches (K2) , release the three keys of keyboard (K3) , and set potentiometer P1 of subassembly 02 7003 so as to obtain very slow flashing of indicator lights (DS3) . - Depress the "GENER", key of keyboard (K3) , set potentiometer (P1) to 0.5, and adjust the vernier of this potentiometer so as to obtain a very slow flashing of indicator lights (DS3) . Then set potentiometer (P1) to 0.1 and adjust potentiometer P2 of subassembly 02 7003 to obtain an output frequency of 100 kHz. Then check the value of the output frequency when potentiometer (P1) is set to 1.	(P1) | Output frequency 0.1 | 100 ± 50 kHz 0.3 | 300 ± 50 kHz 0.5 | 500 kHz 0.7 | 700 ± 50 kHz 0.9 | 900 ± 50 kHz Output frequency : 1 MHz ± 50 kHz

N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
	c) Sweeper mode : Set a frequency of 500 000 Hz on switches (K2), set potentiometer (P1) to 0.5, and adjust the vernier of the potentiometer so as to obtain very slow flashing of indicator lights (DS3). Apply -5V to connector (J7) and use the frequencymeter to check that the output frequency is **less than 100 kHz. Then apply +5V to connector** (J7) and chech that the output frequency is between 900 kHz and 1.1 MHz.	Linearity : ± 10%
5 Milliwattmeter Standard attenuator Decibelmeter ECF 136	OUTPUT LEVEL a) In Synthesizer mode, set a frequency of 10 kHz on switches (K2) and select an output impedance of 75 Ω by means of keyboard (K5). Using the milliwattmeter, measure the output level at connector (J1) when -0.00 dBm and +0.00 dBm are set on switches (K4). If necessary, adjust the level at -0.00 dBm using potentiometer P1 and then the level at + 0.00dBm by means of potentiometer P2 of the Demodulator-Amplifier subassembly (plate V-4).	Accuracy at 0 dBm : ± 0.2 dB
	b) In Synthesizer mode, set a frequency of 10 kHz on switches (K2) and select an impedance of 150 Ω on keyboard (K5). Set +3.01 dBm on switches (K4) and measure the output level with the milliwattmeter, matching the impedances by setting the ECF 136 to 150 Ω (insertion loss 3.01 dB). If necessary, adjust potentiometer P1 of the Output Module (plate V-6) for calibrating this level.	Measured level : 0 dBm ± 0.2 dB
	c) In Synthesizer mode, set a frequency of 10 kHz on switches (K2) and select an impedance of 600 Ω on keyboard (K5). Set 9.03 dBm on switches (K4) and measure the output level using the milliwattmeter, matching the impedances by switching the ECF 136 to 600 Ω (insertion loss 9.03 dB).	Measured level : 0 dBm ± 0.2 dB
	d) In Synthesizer mode, set a frequency of 10 kHz and an impedance of 75 Ω, and check the accuracy of the 0.01 dB and 0.1 dB steps of the output level using the milliwattmeter.	0.01 dB steps : ± 0.005 per step, max.error ± 0.01 dB.

N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
	Then set up the circuit shown in figure VI-3 using the Siemens D 2054 standard attenuator and the Adret selective decibelmeter 6101B + 6303B to check the accuracy of the 1 dB and 10 dB Steps in the output level.	0.1 dB steps : ± 0.01 dB per step, max.error ± 0.02 dB. 1 dB steps : ± 0.03 dB per step, max.error ± 0.05 dB. 10 dB steps : ± 0.1 dB per step, max.error ± 0.2 dB from 0 dBm to -60 dBm.
	 *Figure VI-3 MEASUREMENT OF 1 dB AND 10 dB STEPS*	
	The selective decibelmeter is tuned to the output frequency of the 2230A and its reference frequency is locked onto the 5 MHz signal obtained at connector (J6) on the synthesizer.	
6 Milliwattmeter ECF 136	OUTPUT LEVEL FLATNESS a) 75 Ω impedance : Set + 0.00 dBm on switches (K4), set switch (K9) to F < 10 kHz, and connect the milliwattmeter to output (J1). Vary the synthesized frequency from 50 Hz to 1 MHz, and measure the variation in the output level relative to the level at 10 kHz.	Level flatness : ± 0.05 dB from 50 Hz to 1 MHz.
	b) 150 Ω impedance : Set + 3.01 dBm on switches (K4), set switch (K9) to F < 10 kHz and connect the milliwattmeter to output (J2), matching the impedances by switching the ECF 136 to 150 Ω (insertion loss 3.01 dB). Vary the synthesized frequency from 200 Hz to 1 MHz and measure the output level variation.	Level flatness : ± 0.05 dB from 200 Hz to 200 kHz. ± 0.1 dB from 200 kHz to 620 kHz.
	c) 600 Ω impedance : Set + 9.03 dBm on switches (K4), set switch (K9)	

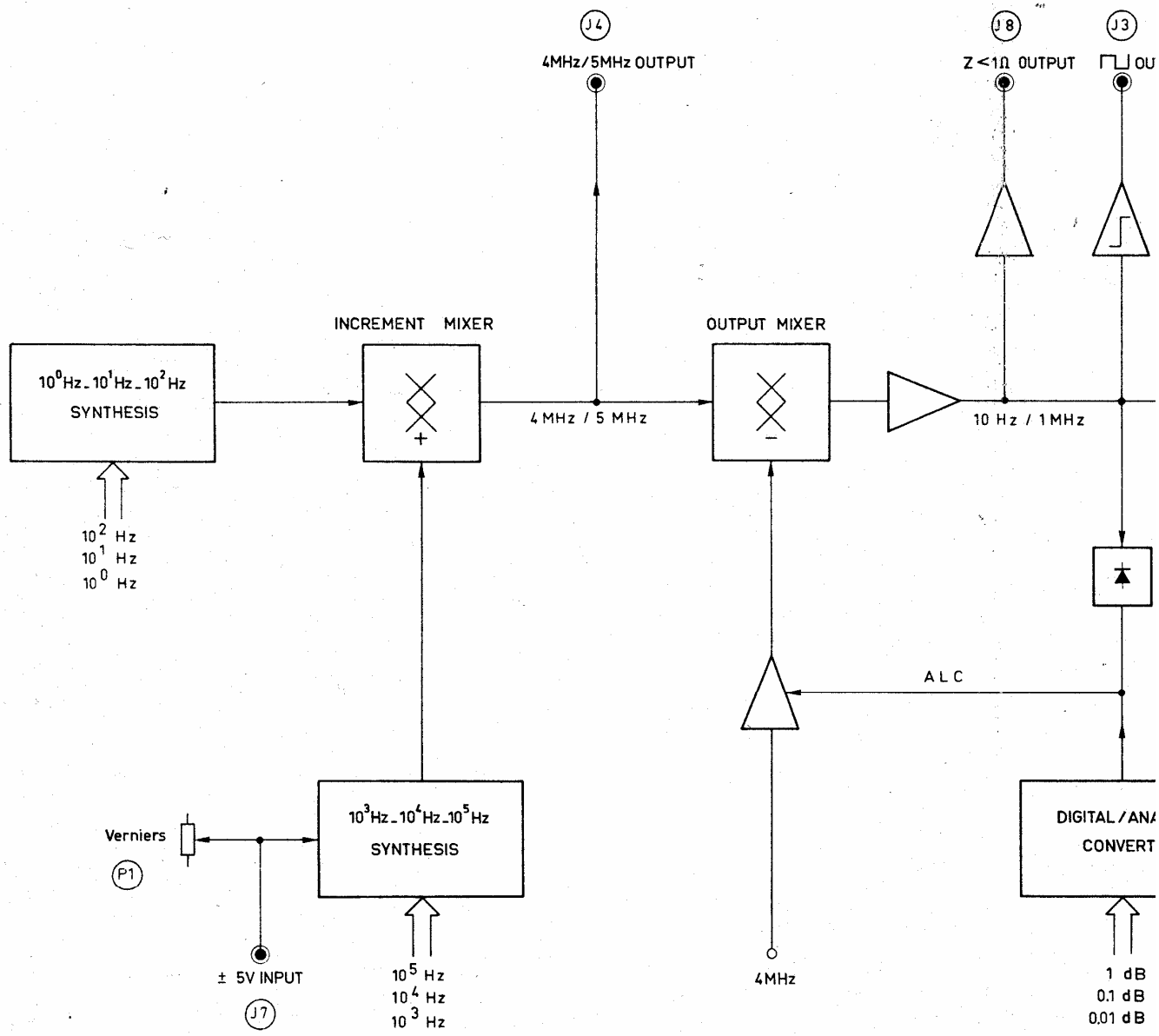
N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
	to F < 10 kHz and connect the milliwattmeter to output (J2), matching the impedances by switching the ECF 136 to 600 Ω (insertion loss 9.03 dB).	± 0.2 dB from 620 kHz to 1 MHz.
	Vary the synthesized frequency from 200 Hz to 300 kHz, and measure the output level variation.	Level flatness : ± 0.05 dB from 200 Hz to 110 kHz. ± 0.3 dB from 110 kHz to 300 kHz.
7 RF voltmeter ECF 141	SIGNAL UNBALANCE a) 150 Ω impedance : Set + 6.00 dBm on switches (K4), set switch (K9) to F < 10 kHz and connect the ECF 141 (switched to 150 Ω) to connector (J2). Connect the output of the ECF 141 to the RF voltmeter and measure the signal level relative to 0 dBm/600 Ω while varying the synthesized frequency from 200 Hz to 620 kHz.	Signal unbalance : - 50 dB
	b) 600 Ω impedance : Set + 0.00 dBm on switches (K4), set switch (K9) to F < 10 kHz and connect the ECF 141 (switched to 600 Ω) to connector (J2). Connect the output of the ECF 141 to the RF voltmeter and measure the signal level relative to 0 dBm/600 Ω while varying the synthesized frequency from 200 Hz to 110 kHz.	Signal unbalance : - 50 dB
8 Spectrum analyser X-Y recorder ECF 136	HARMONIC AND NONHARMONIC CONTENT a) 75 Ω impedance : Set + 10 dBm on switches (K4) and connect the spectrum analyser to output (J1), ensuring that the impedances are matched. Measure the relative levels of the harmonic and nonharmonic components at various frequencies between 50 Hz and 1 MHz, switch (K9) being set to F < 10 kHz for frequencies less than 10 kHz.	Harmonics at + 10 dBm : - 45 dB from 50 Hz to 300 Hz. - 55 dB from 300 Hz to 1 MHz.
	b) 150 Ω impedance : Set + 10 dBm on switches (K4) and connect the spectrum analyser to output (J2), ensuring that the impedances are matched by switching the ECF 136 to 150 Ω (insertion loss 3.01 dB). Measure the relative levels of the harmonic and nonharmonic components at various frequencies	Nonharmonics : - 60 dB Harmonics at + 10 dBm : - 50 dB

N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
	between 200 Hz and 1 MHz, switch (K9) being set to F < 10 kHz for frequencies less than 10 kHz. c) 600 Ω impedance : Set + 10 dBm on switches (K4) and connect the spectrum analyser to output (J2), ensuring that the impedances are matched by switching the ECF 136 to 600 Ω (insertion loss 9.03 dB).	Nonharmonics : - 60 dB
	Measure the relative levels of the harmonic and nonharmonic components at various frequencies between 200 Hz and 300 kHz, switch (K9) being set to F < 10 kHz for frequencies less than 10 kHz.	Harmonics at + 10 dBm : - 50 dB Nonharmonics : - 60 dB
9	PHASE-NOISE	
Spectrum analyser X-Y recorder ECF 136	Set + 10 dBm on switches (K4), select a 75 Ω impedance on keyboard (K5), and connect the spectrum analyser to output (J1). With switch (K9) set to F < 10 kHz, measure the phase-noise at 100 Hz, 1 kHz, 10 kHz and 100 kHz from carrier at various output frequencies. These measurements may also be carried out at the 150 Ω or 600 Ω output, using the ECF 136 adaptor.	Phase-noise in a 1 Hz band : - 85 dB at 100 Hz - 95 dB at 1 kHz - 110 dB at 10 kHz - 120 dB at 100kHz
10	SQUARE-WAVE OUTPUT	
Oscilloscope	Use the oscilloscope to measure the rise and fall times of the square-wave signals at connector (J3).	Rise time : 300 ns Fall time : 100 ns
11	TRACKING OUTPUT	
RF voltmeter Spectrum analyser X-Y recorder	a) Output level : Use the RF voltmeter to measure the level of the tracking signal available at connector (J4). b) Nonharmonic content : Use the spectrum analyser to measure the relative levels of nonharmonic components of the tracking signal.	Level : + 6 dBm/75 Ω ± 2 dB Nonharmonics : - 60 dB
12	AUXILIARY OUTPUT Z < 1 Ω	
Milliwattmeter Spectrum analyser X-Y recorder	a) Output level : Set a frequency of 10 kHz on switches (K2) at a level of +0.00 dBm on switches (K4). Use the milliwattmeter to measure the level of the signal at connector (J8) for a 75 Ω load.	Level : 0 dBm/75 Ω

N° d'ESSAI TEST NUMBER	CONDITIONS	SANCTIONS RESULTS
	If necessary, adjust this level by means of potentiometer P2 of the Z < 1 Ω Amplifier subassembly (plate V-9). b) Output level flatness : Set + 0.00 dBm on switches (K4), set switch (K9) to F < 10 kHz, and connect the milliwattmeter to connector (J8). Vary the synthesized frequency from 50 Hz to 1 MHz and measure the output level variation relative to 0 dBm. c) Harmonic and nonharmonic content : Set + 10 dBm on switches (K4) and connect the spectrum analyser to output (J8). Measure the relative levels of the harmonic and nonharmonic components at various frequencies between 50 Hz and 1 MHz, with switch (K9) set to F < 10 kHz for frequencies less than 10 kHz.	Level flatness : ± 0.5 dB from 50 Hz to 200 Hz. ± 0.3 dB from 200 Hz to 1 MHz. Harmonics at + 10 dBm : - 40 dB from 50 Hz to 300 Hz. - 50 dB from 300 Hz to 1 MHz. Nonharmonics : - 60 dB
13 RF voltmeter	1 MHz REFERENCE OUTPUT Use the RF voltmeter to measure the level of the 1 MHz reference output at connector (J6) for a load of 50 Ω.	Level : 550 mVrms/50 Ω ± 10 %
14 Frequency difference multiplier Frequency standard	MASTER OSCILLATOR STABILITY Use the frequency difference multiplier to measure the relative difference ΔF/F between the 5 MHz frequency available at connector (J6) and the 5 MHz signal from the frequency standard. Leave the synthesizer switched on, and measure the difference ΔF'/F between the two frequencies 24 hours later. If necessary, recalibrate the internal Master Oscillator by means of capacitor C13 located on the Generation 10^0 Hz - 10^1 Hz - 10^2 Hz subassembly.	$\left\lvert \frac{\Delta F'}{F} - \frac{\Delta F}{F} \right\rvert < 3.10^{-6}$ after 24 hours of continuous operation.
15 Oscilloscope Frequency standard	EXTERNAL REFERENCE FREQUENCY Connect the 5 MHz reference frequency from the frequency standard to connector (J5) on the synthesizer and to channel 1 on the oscilloscope. Connect output (J6) of the synthesizer to channel 2 of the oscilloscope, and check that the two signals appearing on the screen are stationary relative to one another as the level of the 5 MHz reference frequency applied to connector (J5) is varied from 220 mVrms/50 Ω to 1 Vrms/50 Ω.	

CHAPTER VII

PLATES, SCHEMATICS, PARTS LIST


J4
4MHz/5MHz OUTPUT
J8
Z<1Ω OUTPUT
J3
INCREMENT MIXER
OUTPUT MIXER
10^0Hz_10^1Hz_10^2Hz
SYNTHESIS
4 MHz / 5 MHz
10 Hz / 1 MHz
10^2 Hz
10^1 Hz
10^0 Hz
ALC
Verniers
P1
10^3Hz_10^4Hz_10^5Hz
SYNTHESIS
DIGITAL/ANA
CONVERT
± 5V INPUT
J7
10^5 Hz
10^4 Hz
10^3 Hz
4MHz
1 dB
0.1 dB
0.01 dB

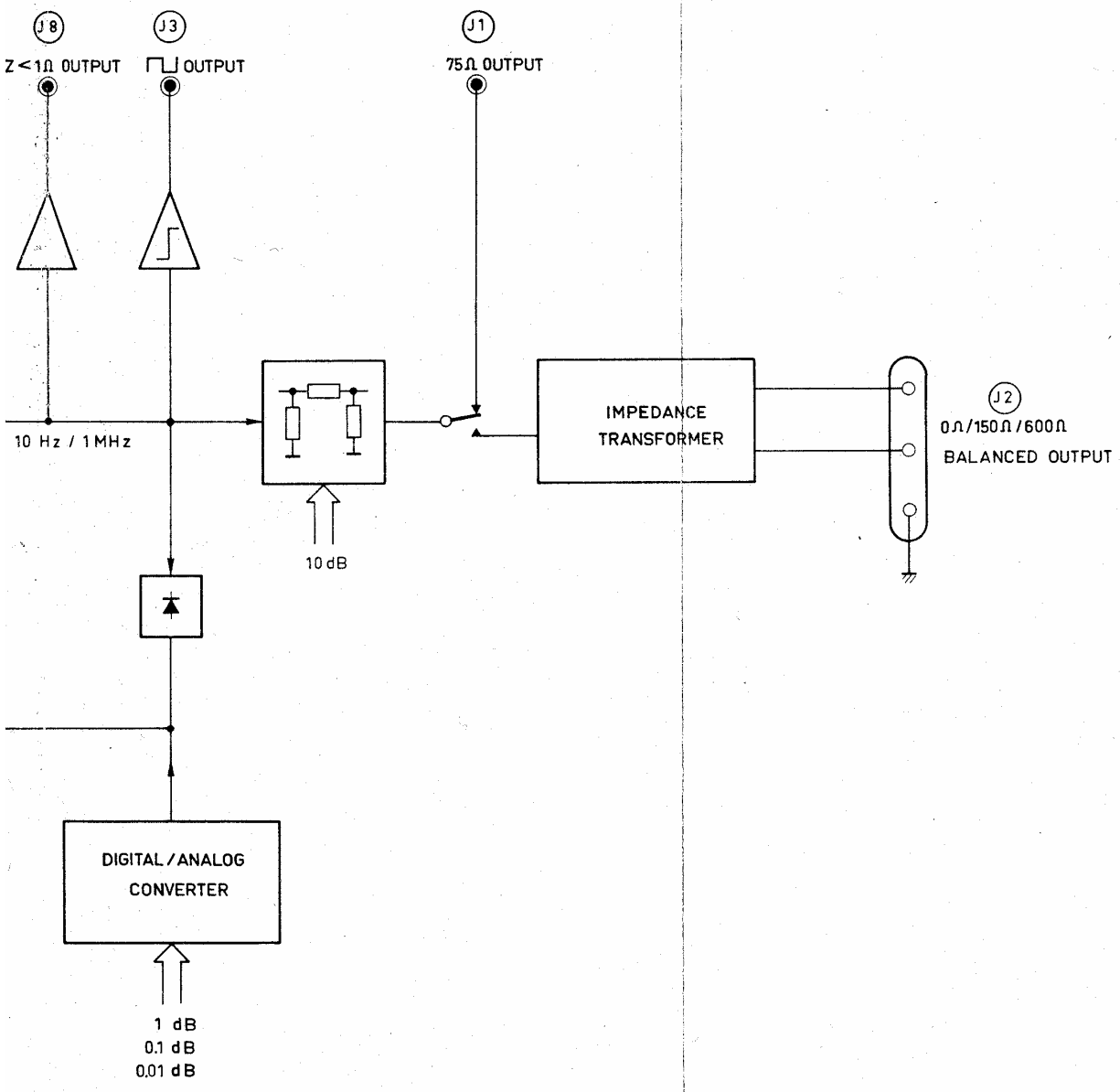


PLATE III_1

2230A_PRINCIPLE OF OPERATION

Lever/indicator switches for digital frequency setting.

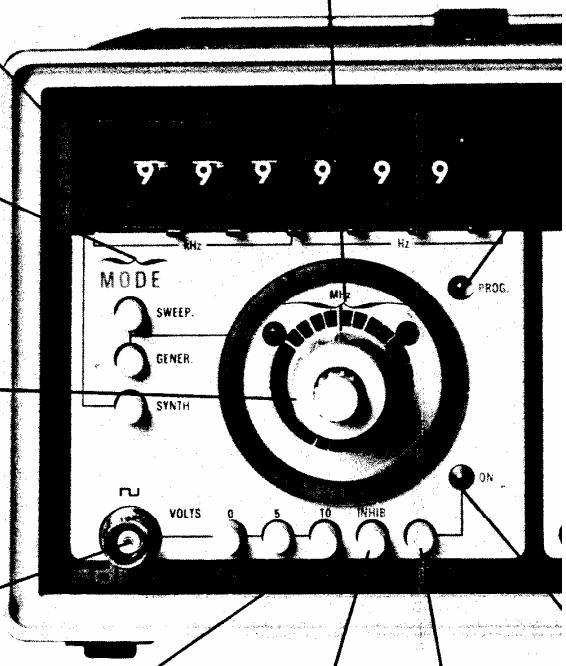
Indicator lights permitting to compare the output frequency in Generator or Sweeper mode with the digital display of switches **K2.**

K2

DS3

Mode selection of output frequency setting :
- Key **SYNTH.** pressed : digital setting by switches **K2.**
- Key **GENER.** pressed : analogical setting by verniers **P1.**
- Key **SWEEP.** pressed : analogical setting by verniers **P1** and sweep by external signal applied to connector **J7.**

K3



Analogical setting of output frequency in Generator or Sweeper mode.

P1

J3

Square-wave output.
0V, 5V or 10V amplitude selected by keyboard **K7.**

K7

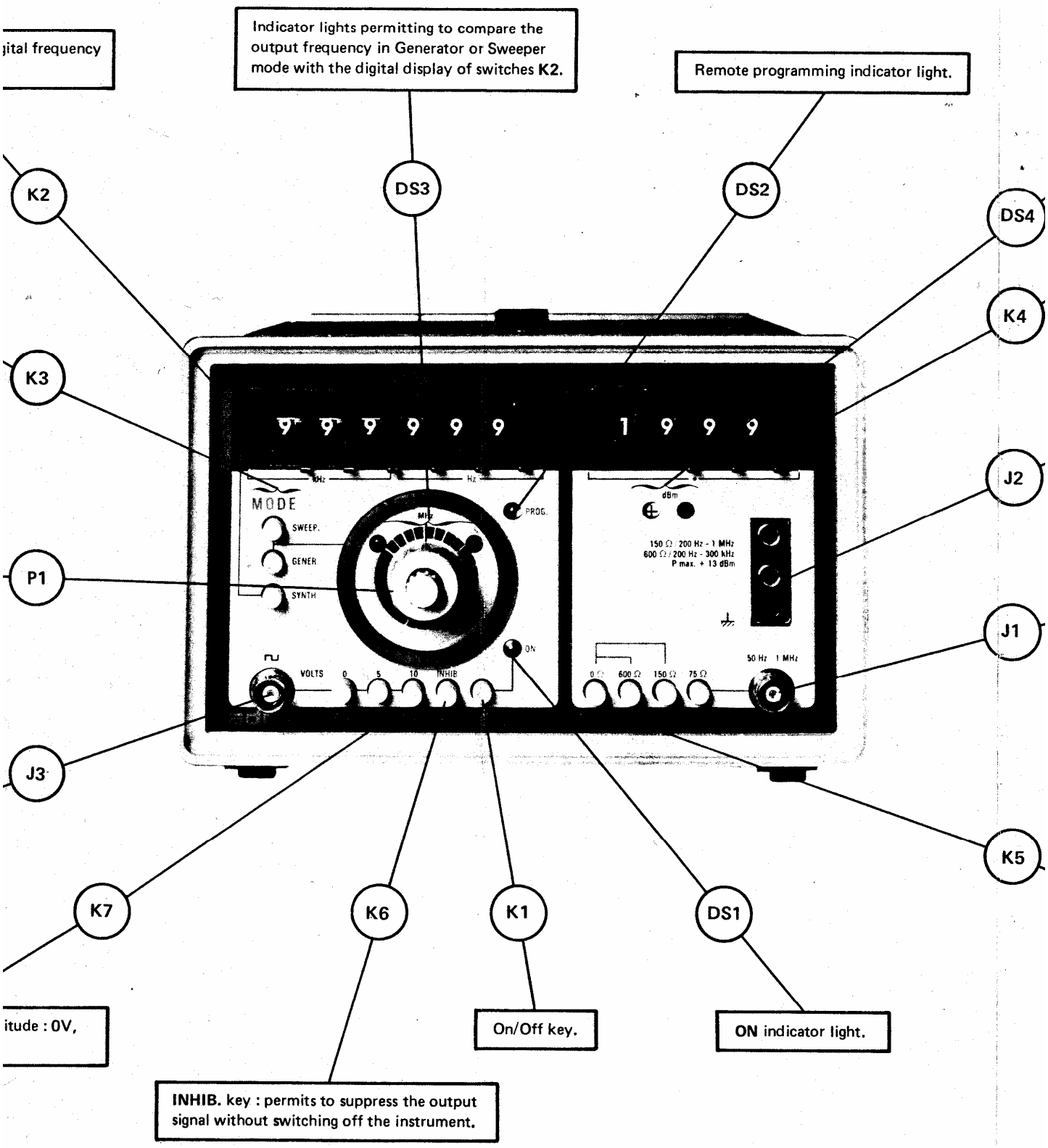
K6

K1

Selection of square-wave amplitude : 0V, 5V or 10V.

On/Off key.

INHIB. key : permits to suppress the output signal without switching off the instrument.


ital frequency
Indicator lights permitting to compare the output frequency in Generator or Sweeper mode with the digital display of switches K2.
Remote programming indicator light.
K2
DS3
DS2
DS4
K4
K3
J2
P1
J1
J3
K5
K7
K6
K1
DS1
itude : 0V,
On/Off key.
ON indicator light.
INHIB. key : permits to suppress the output signal without switching off the instrument.
MODE
SWEEP.
GENER
SYNTH
PROG.
VOLTS
INHIB
50 Hz 1 MHz

2230A

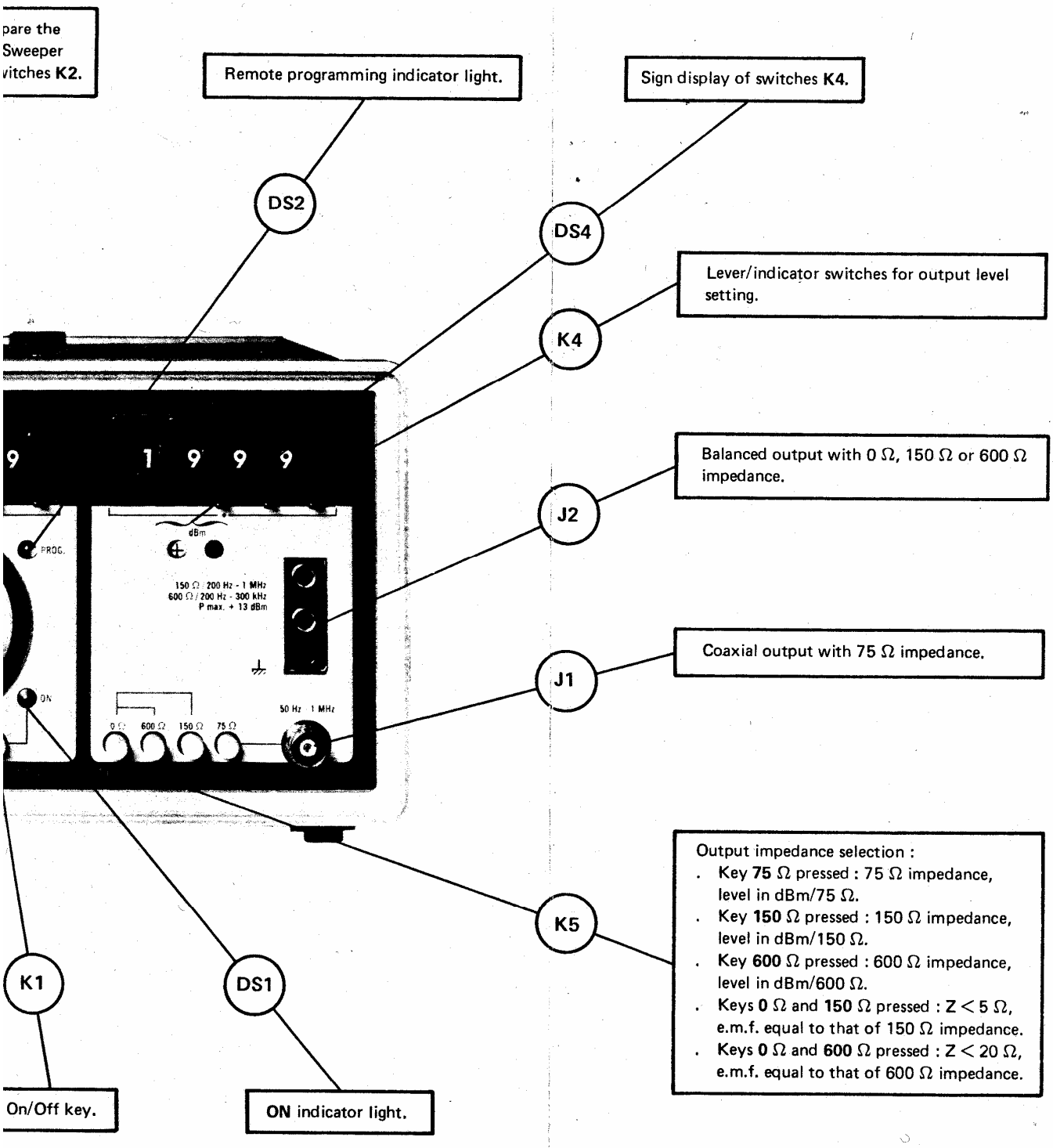
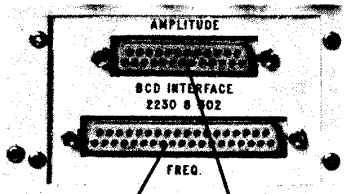


PLATE IV-1

2230A - FRONT-PANEL DESCRIPTION

PARALLEL BCD PROGRAMMING
(Option 010)



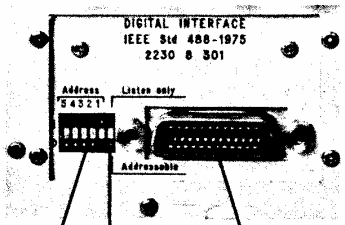
S04

S03

Output level programming connector

Output frequency programming connector

IEEE BUS PROGRAMMING
(Option 020)



K10

K11

S05

Address selection switches

IEEE bus connector

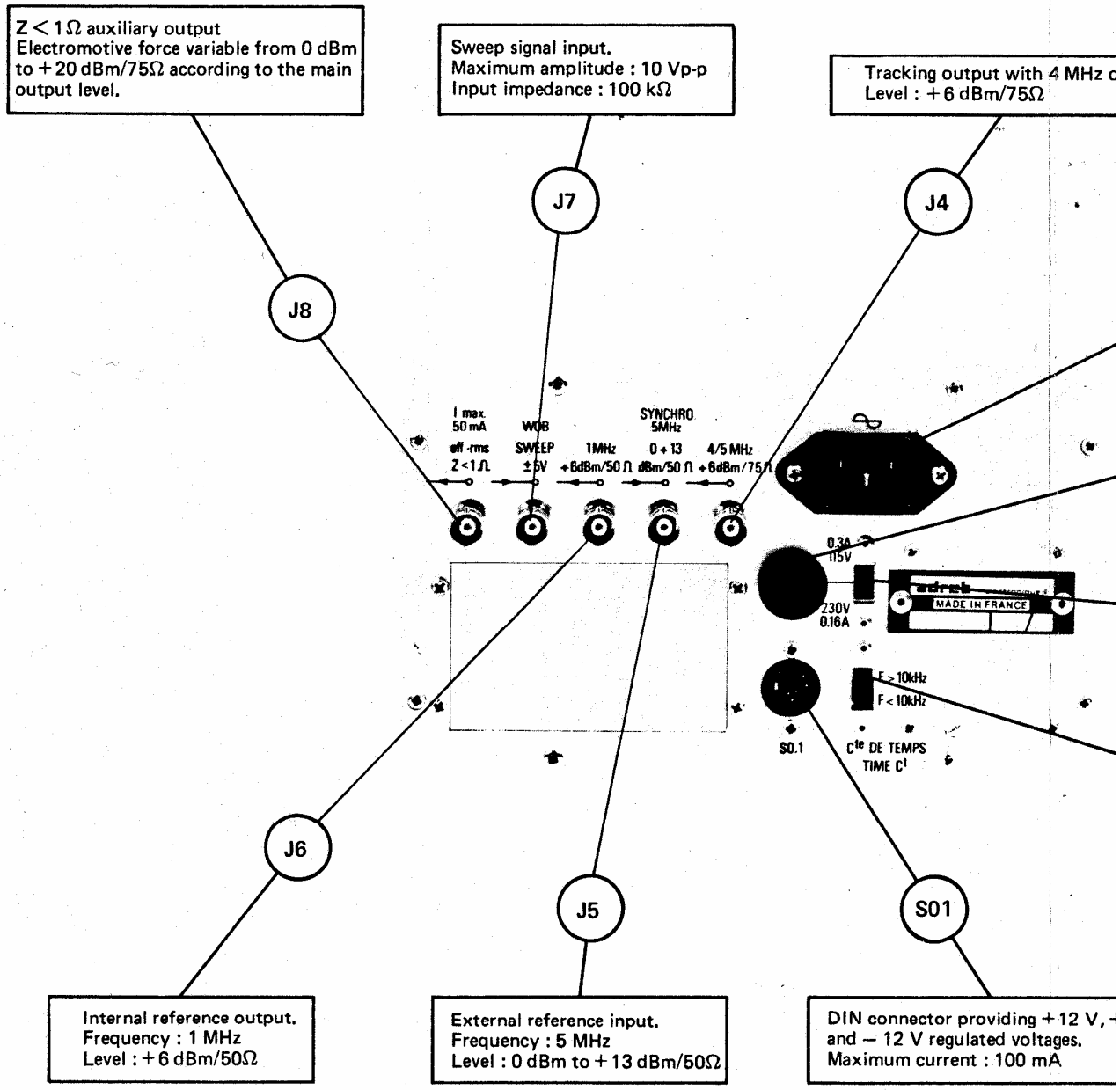
Address enable switch

$Z < 1\Omega$ auxiliary output
Electromotive force variable from 0 dBm to +20 dBm/75Ω according to the main output level.

J8

J6

Internal reference output.
Frequency : 1 MHz
Level : +6 dBm/50Ω


Z < 1Ω auxiliary output
Electromotive force variable from 0 dBm to +20 dBm/75Ω according to the main output level.
Sweep signal input.
Maximum amplitude : 10 Vp-p
Input impedance : 100 kΩ
Tracking output with 4 MHz o
Level : +6 dBm/75Ω
J8
J7
J4
I max. 50 mA
WOB
SYNCHRO 5MHz
eff -rms
SWEEP
1MHz
0 + 13
4/5 MHz
Z<1Ω
±5V
+8dBm/50Ω
dBm/50Ω
+6dBm/75Ω
0.3A
115V
230V
0.16A
MADE IN FRANCE
F>10kHz
F<10kHz
S0.1
Cte DE TEMPS
TIME C1
J6
J5
S01
Internal reference output.
Frequency : 1 MHz
Level : +6 dBm/50Ω
External reference input.
Frequency : 5 MHz
Level : 0 dBm to +13 dBm/50Ω
DIN connector providing +12 V, +
and − 12 V regulated voltages.
Maximum current : 100 mA

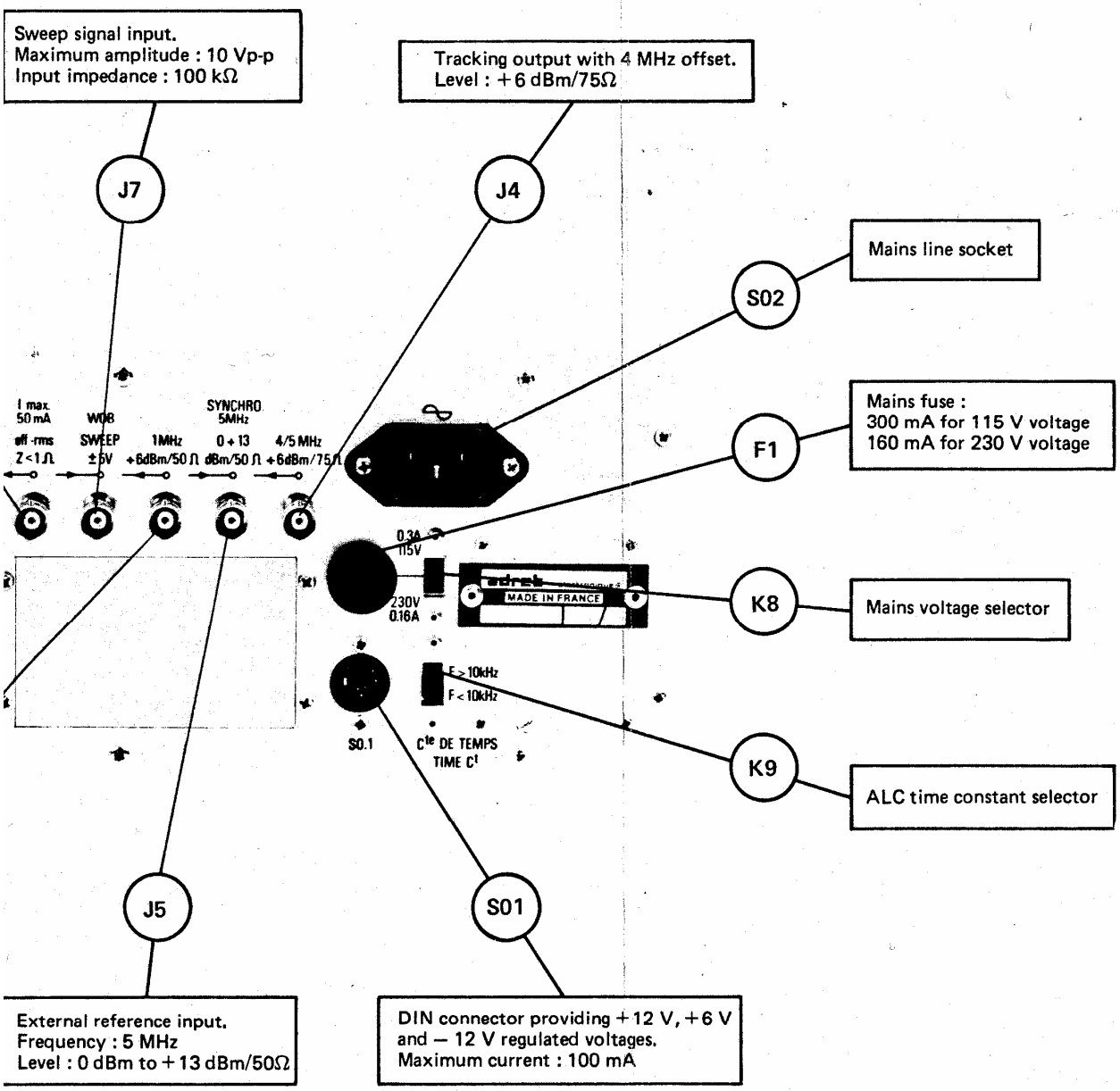


PLATE IV-2

2230A - REAR-PANEL DESCRIPTION