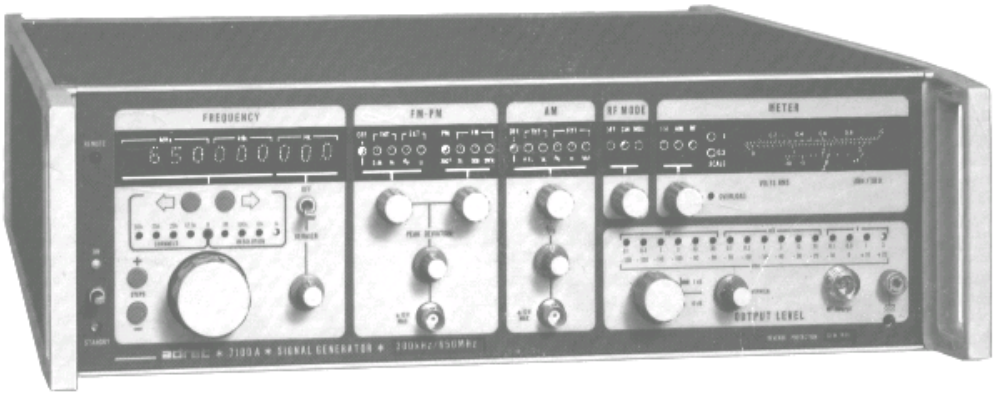
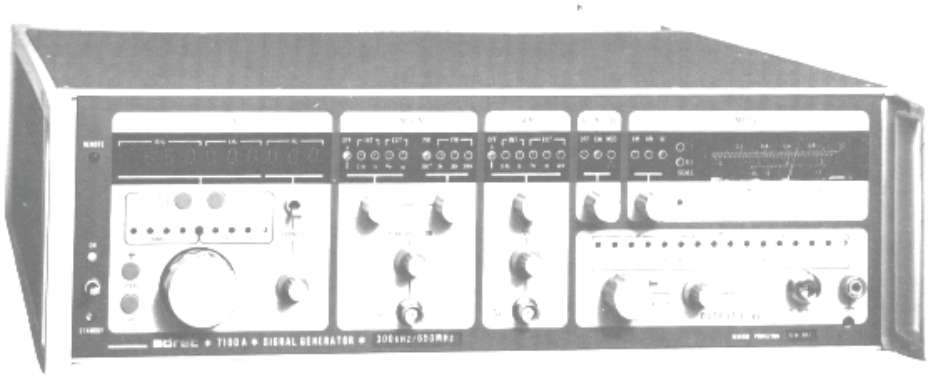
7100 A

AM | FM | PM GENERATOR



adret electronique

INSTRUCTION MANUAL



7100A

VHF_UHF GENERATOR

0.3 to 650 MHz

Instruction manual

1st édition. JANUARY 1979

WARRANTY AND ASSISTANCE

This ADRET ELECTRONIQUE product is guaranteed for one year from the date of delivery.

The warranty applies to equipment with mechanical damage caused on shipping from ADRET ELECTRONIQUE or found to comprise components or sub-assemblies, which, after a fault condition occuring, are found to be out of limits with regard to the technical specification. Specifically excluded from the terms of the warranty is damage caused by failure to observe the conditions set out in the technical specifications applicable to the instrument.

The warranty is rendered null and void by any attempt by the user to service the equipment during the warranty period. Return carriage on equipment sent to ADRET-ELECTRONIQUE for servicing will be paid by ADRET ELECTRONIQUE.

The company can provide a full range of back-up services beyond the guarantee period, at competitive prices.

For any further information, contact your local ADRET representative (refer to table on page 3).

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SUMMARY

LIST OF FIGURES

LIST OF PLATES

CHAPTER I

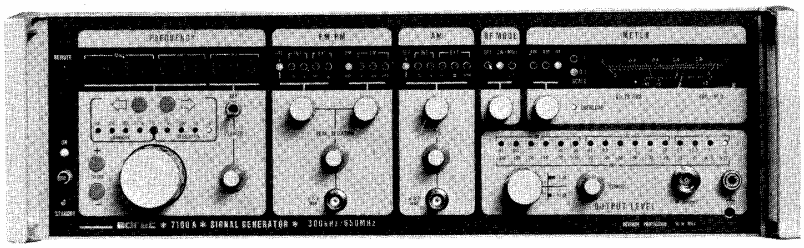
FUNCTIONAL DESCRIPTION

This chapter describes the functions of the 7100A signal generator and the available options. It also sets out the technical specifications of the equipment.

1.1 GENERAL DESCRIPTION

The 7100A signal generator is a high-performance instrument combining in one unit the basic features of the best free-running signal generators and frequency synthesizers.

The technology on which this instrument is based and its numerous facilities mean that the 7100A is the first of a new generation of signal generators characterised by the combination of frequency synthesis and the operating principles of free-running generators. The combination of these two techniques and the use of a built-in microprocessor taking care of control functions are key design factors of the 7100A (see figure 1-1).



- Wide frequency range
- 1 Hz resolution
- Quartz-controlled for stability and accuracy
- Maximum output level + 20 dBm/50 Ω
- Excellent spectral purity
- AM, FM, PM capability (+ combinations)
- Fully programmable

Figure 1-1 : 7100A SIGNAL GENERATOR AND PRINCIPAL DESIGN FEATURES

1.2 FREQUENCY RANGE

The instrument covers the frequency band from 300 kHz to 650 MHz in a single range, which can be extended to 1300 MHz by incorporating the internal frequency doubler option. The frequency is set by a spin-wheel driving an optical coding wheel, to a resolution of 1 kHz, 10 kHz, 100 kHz or 1 MHz, a vernier control being provided for resolution down to 1 Hz. The exact output frequency is displayed on a 9-digit LED display (10 digits when frequency doubler option included). The stability and accuracy of the frequency are determined by the internal quartz-controlled oscillator (5×10^{-9}/24 h).

To facilitate measurements on receivers, following calibration at a particular frequency, an internal timing circuit provides for incrementing the output frequency in discrete steps corresponding to the standard channel spacing (12.5 kHz, 20 kHz, 25 kHz, 50 kHz, and 100 kHz). The instrument can also carry out a frequency scanning function, with steps of 1 kHz, 10 kHz, 100 kHz or 1 MHz.

1.3 SPECTRAL PURITY

The signal/phase noise ratio has a characteristic curve at frequencies close to the carrier frequency which is similar to that obtained with frequency synthesizers. Above 20 kHz, the signal/noise ratio is comparable with that obtained from the best resonant cavity signal generators.

Figure 1-2 shows the phase noise characteristic in a 1 Hz band at 520 MHz in CW mode :

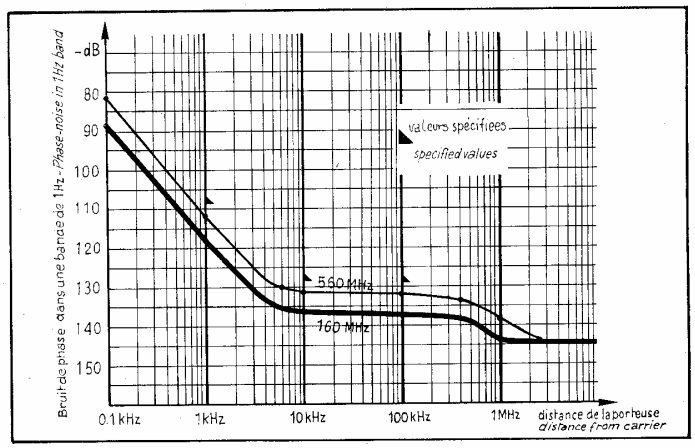


Figure 1-2 : SIGNAL/PHASE NOISE CHARACTERISTIC OF THE 7100A

This excellent performance depends on two key design factors :

- the small frequency steps are generated by a varicap diode tuned oscillator comparable with a free-running oscillator with a very large overvoltage coefficient ;
- the large frequency steps are generated by an oscillator controlled from an 80 MHz quartz crystal, with a phase noise at 10 kHz relative to the carrier of - 165 dB/1 Hz.

The frequency generator loops comprise low numbers of mixer circuits and arithmetic functions, the output oscillator reproducing with only slight noise degradation the output noise from the two

oscillators, the inharmonic and subharmonic components being more than 100 dB down relative to the carrier.

The 7100A is particularly suited to selectivity measurements on narrow-band VHF-UHF receivers.

1.4 OUTPUT LEVEL

The output level is variable from + 20 dBm to - 139 dBm, in steps of 1 dB in LOCAL mode, the single control knob also providing steps of 10 dB. This level is constant to within ± 0.5 dB over the full frequency range.

The maximum output level is + 10 dBm at frequencies above 650 MHz when the frequency doubler option is included, the resolution being 0.1 dB if the programming option is included.

A meter with automatic range switching capability displays signal levels in μV, mV, V or dBm/50 Ω. Leakage is better than 5 mV, and the output circuits are protected to enable the instrument to be used for measurements on receivers and transmitter-receivers.

1.5 AMPLITUDE MODULATION

The amplitude modulation (AM) level is variable from 0 to 100 %, with a passband of 150 kHz, the modulation level being constant to within ± 5 % up to 100 kHz.

The modulating signal may be internal (two fixed frequencies) or external, with DC or AC coupling. The input sensitivity for 100 % modulation is approximately 200 mVrms/600 Ω. When the 7100A is fitted with options 004 and 005, the AM level is programmable in steps of 1 %, the input signal in this case being set to 1 Vrms/600 Ω.

The modulation level is displayed on the front panel meter, the FSD automatically being switched to 30 % for improved accuracy.

1.6 VOR-ILS MODULATION

The 7100A has a "VOR" setting for testing short and medium-range aircraft navigation and instrument landing systems (VOR, ILS). This standard facility is obtained by increasing the time constant of the internal regulation loops so as to match the phase shift characteristics required for VOR-ILS operation (0.2^{o} at 30 Hz).

1.7 FREQUENCY MODULATION

The maximum peak frequency modulation (FM) deviation is ± 3 kHz, ± 30 kHz, or ± 300 kHz over the whole frequency range. The modulating signal may be internal (two fixed frequencies) or external, with DC or AC coupling for a passband extending up to 150 kHz and an input sensitivity of approximately 1 Vrms/600 Ω, corresponding to a peak deviation of ± 1 kHz, ± 10 kHz, or ± 100 kHz, depending on the selected range.

When options 004 and 005 are included, the FM deviation is programmable in steps of 10 Hz, 100 Hz or 1 kHz, respectively, for the ranges ± 3 kHz, ± 30 kHz or ± 300 kHz, the input signal being set to 3 Vrms/600 Ω.

The FM deviation is indicated on the front-panel meter.

The FM distortion for modulating frequencies of 400 Hz and 1 kHz is better than 3 %, spurious amplitude modulation being less than 1 % over the 1 MHz to 650 MHz band.

1.8 PHASE MODULATION

The peak deviation of phase modulation of the output signal is variable between 0° and 300°. The choice of modulating signal is identical to that for FM, although the passband in external mode is limited to 60 kHz. The input sensitivity for 100° deviation is approximately 1 Vrms/600 Ω. When options 004 and 005 are included, the deviation is programmable with a resolution of 1°, the input signal being set to 3 Vrms/600 Ω.

1.9 SELF TEST FACILITY

This facility considerably speeds up troubleshooting faults on the 7100A, providing rapid identification of faulty sub-assemblies. The modular design of the instrument means that it can be immediately returned to service by replacing the faulty module.

The self-test system is controlled by the built-in microprocessor, and checks the main internal signal levels in the instrument and the control loops of the generator circuitry. The state of each point tested can be displayed on the front panel or fed out to an external controller when the programming option is included. The fault detection system also advises the user when he is attempting to operate the instrument under out of limit conditions.

1.10 OPTIONS

Option 001 : PROTECTIVE FUSE

The internal cartridge fust protects the output circuitry of the instrument against re-injection of HF signals at power levels of up to 50 W.

Option 003 : FREQUENCY DOUBLER

The internal frequency doubler module expands the output frequency band of the instrument to 1300 MHz, with minimal degradation of the spectral purity characteristics and output level, all other specifications being met and the modulation and direct display calibrations being undisturbed.

Thus the AM accuracy and linearity characteristics are affected by the incorporation of the frequency doubler option, the maximum level being limited to + 10 dBm.

Options 004 and 005 : IEEE PROGRAMMING

The generator is designed for programming of all functions under IEEE standard IEE-488 (1975). Programming is facilitated by the use of unrestricted formats and "clear language", and is carried out using two additional options coupled to the instrument via the rear panel connectors. The local display remains active, providing a means of verifying the programs. An additional connector outputs 1 byte derived from the ASCII signal which may be used to control a peripheral device.

Option 004 covers programming of the output frequency and level, the operating mode and the AM, FM or PM modulating signal. The acquisition time is better than 100 ms.

Option 005 is complementary to option 004, providing 1 Hz frequency resolution. The 7100A then operates as a true frequency synthesizer, the output frequency being programmable in steps of 1 Hz and entirely referred to the quartz-controlled reference frequency. Option 005 also covers programming of the AM level and FM and PM deviations. Option 005 can only be used in conjunction with option 004.

Option 010 : FREQUENCY EXTENSION TO 100 kHz

With this option, the generator covers the 100 kHz to 650 MHz frequency range, or 100 kHz to 1.3 GHz if option 003 is also provided.

It must be noticed that all options are mutually compatible.

All options for the 7100A are mutually compatible.

1.11 TECHNICAL SPECIFICATIONS

FREQUENCY

RANGE :

0.3 MHz to 650 MHz in only one band

TUNING CONTROL :

- Main tuning by spin-wheel providing 100 steps variation per turn, with step value selectable between 1 kHz, 10 kHz, 100 kHz and 1 MHz.

Resolution	Δ F per turn
1 kHz	100 kHz
10 kHz	1 MHz
100 kHz	10 MHz
1 MHz	100 MHz

In this case, the 7100 A is a true frequency synthesizer with 1 kHz resolution.

- Fine tuning by vernier providing continuous frequency variation between 1 kHz steps.
- Fine tuning by external voltage :

± 3 kHz frequency variation for ± 3 V.

- Step-by-step variation by two pushbuttons providing frequency variation in 1 kHz - 10 kHz - 100 kHz 1 MHz steps and in 12.5 kHz - 20 kHz - 25 kHz - 50 kHz steps corresponding to standard channel spacing.

A constant pressure during 3 seconds on either of these pushbuttons provides an uninterrupted frequency change.

FREQUENCY DISPLAY :

The output frequency is permanently displayed with 1 kHz resolution on a 6 digits LED display unit (7 digits with Doubler option). When the fine-tuning vernier is used, 3 additional digits provide output frequency display with 1 Hz resolution.

DISPLAY ACCURACY :

Master Oscillator accuracy ± 1 Hz (with vernier).

FREQUENCY STABILITY :

Measured at 25° C ± 1°.

Factor	With vernier or DC coupled FM	Without vernier
Time	±1 Hz per 10 mn after 30 mn of operation with vernier	± 2.10^{-8} per day after 72 hours' continuous operation. ± 5.10^{-9} per day after 3 months' continuous operation.
Mains (± 10 %)	negligible	negligible
Temperature	± 0.2 Hz/°C	± 2.10^{-10}/°C
Output level	negligible	negligible
Output load	negligible	negligible

MASTER OSCILLATOR PHASE-LOCKING :

The crystal oscillator can be phase locked to an external standard through a built-in phase comparator.

Phase-locking display by two LEDS, Master Oscillator frequency adjustment by ten-turn potentiometer.

- Frequency : Any subharmonic of 10 MHz down to 1 MHz.
- Level : 0.2 Vrms to 1 Vrms/50 Ω.
- Master Oscillator output : 10 MHz, approximately 0.5 Vrms/50 Ω.

SPECTRAL PURITY

Measured in CW mode at + 13 dBm/50 Ω output level

HARMONIC SIGNALS :

$\leq$ 30 dBc (- 35 dBc typical).

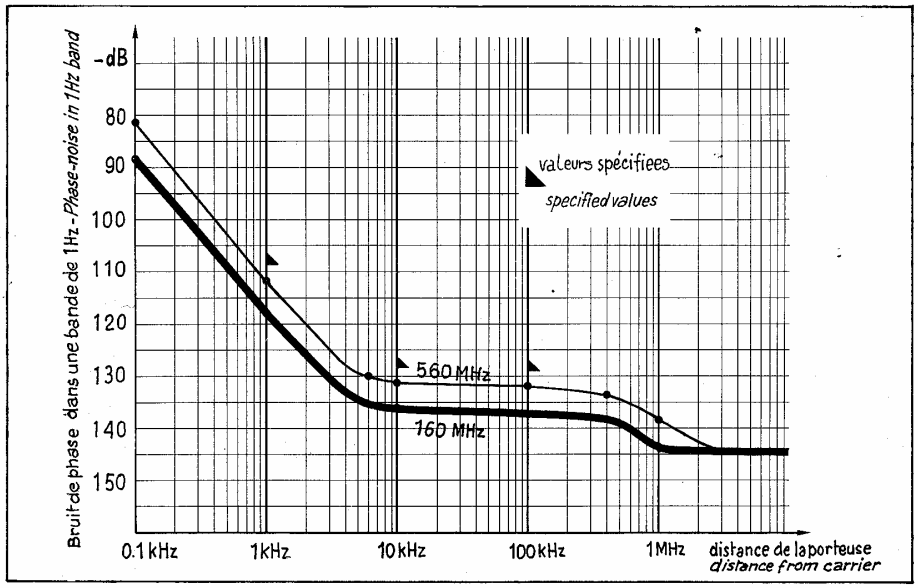
SUBHARMONIC SIGNALS : $\leq$ 100 dBc.

SPURIOUS SIGNALS :

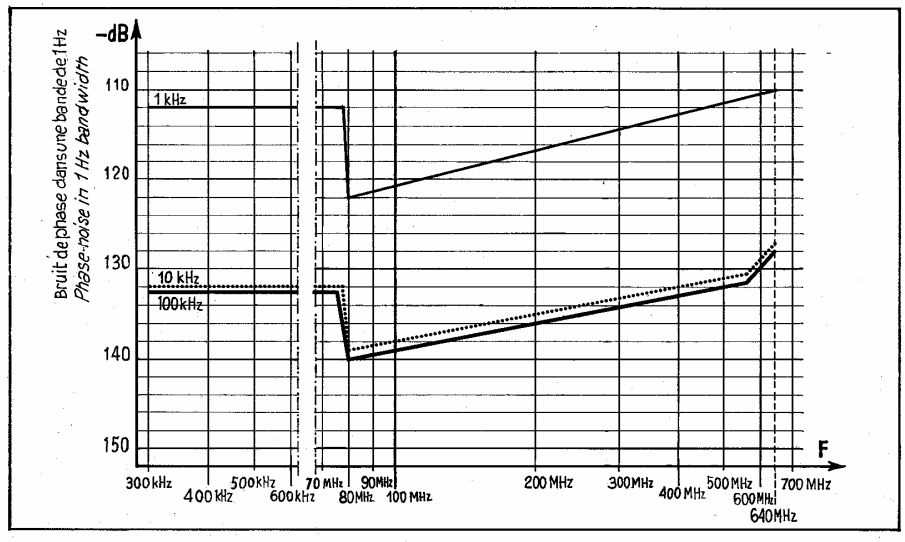
- Line related spurious :
  - $\leq$ 50 dBc at 50 Hz or 60 Hz
  - $\leq$ 60 dBc at 100 Hz or 120 Hz
  - $\leq$ 70 dBc at 1 kHz
- Other spurious for 300 kHz to 80 MHz frequency range :
  - $\leq$ 100 dBc between 15 kHz and 300 MHz from carrier
  - $\leq$ 80 dBc beyond 300 MHz from carrier
- Other spurious for 80 MHz to 650 MHz frequency range :
  - $\leq$ 100 dBc beyond 15 kHz from carrier.

PHASE NOISE :

- In a 1 Hz bandwidth for a 160 MHz and 560 MHz carrier.



- In a 1 Hz bandwidth at 1 kHz, 10 kHz and 100 kHz from carrier (typical).



RESIDUAL AM :

- < - 90 dBc in a 300 Hz to 3 kHz bandwidth (CCITT standard) over the entire frequency range.
- < - 80 dBc in a 20 Hz to 15 kHz bandwidth (CCIR standard) over the entire frequency range.

RESIDUAL FM :

- < 1 Hz in a 300 Hz to 3 kHz bandwidth (CCITT standard) over the entire frequency range.
- < 10 Hz in a 20 Hz to 15 kHz bandwidth (CCIR standard) over the entire frequency range.

LEAKAGE :

(with all the outputs terminated properly) :

Leakage limits are below those specified in MIL-I-6181 D. Furthermore, less than 3 µV is induced in a 2-turn, 1-inch diameter loop 1-inch away from any surface and measured into a 50 Ω receiver.

RF OUTPUT

OUTPUT LEVEL :

+ 20 dBm to - 140 dBm/50 Ω.

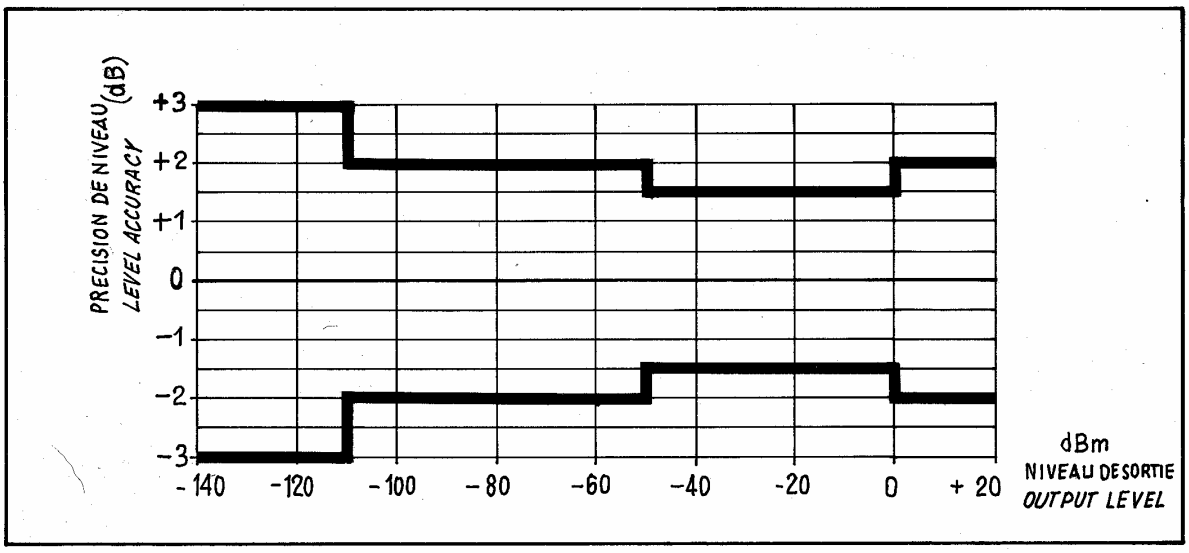
160 dB dynamic range : 10 dB and 1 dB steps by attenuator, - 1.2 dB to + 0.2 dB by vernier.

Output level display in volts and dBm/50 Ω by LED indicators and calibrated meter.

Overload indicator.

OUTPUT LEVEL ACCURACY (TYPICAL)

Including attenuator error and flatness.



- Output level accuracy at 0 dBm meter display :
  ± 0.2 dB for a 20 MHz frequency..

ATTENUATOR ACCURACY :

● 10 dB steps :

Output level	Accuracy
+ 20 to + 10 dBm	± 1.5 dB
0 to - 40 dBm	± 1 dB
- 50 to - 100 dBm	± 1.5 dB
- 110 to - 130 dBm	± 2.5 dB

● 1 dB steps :

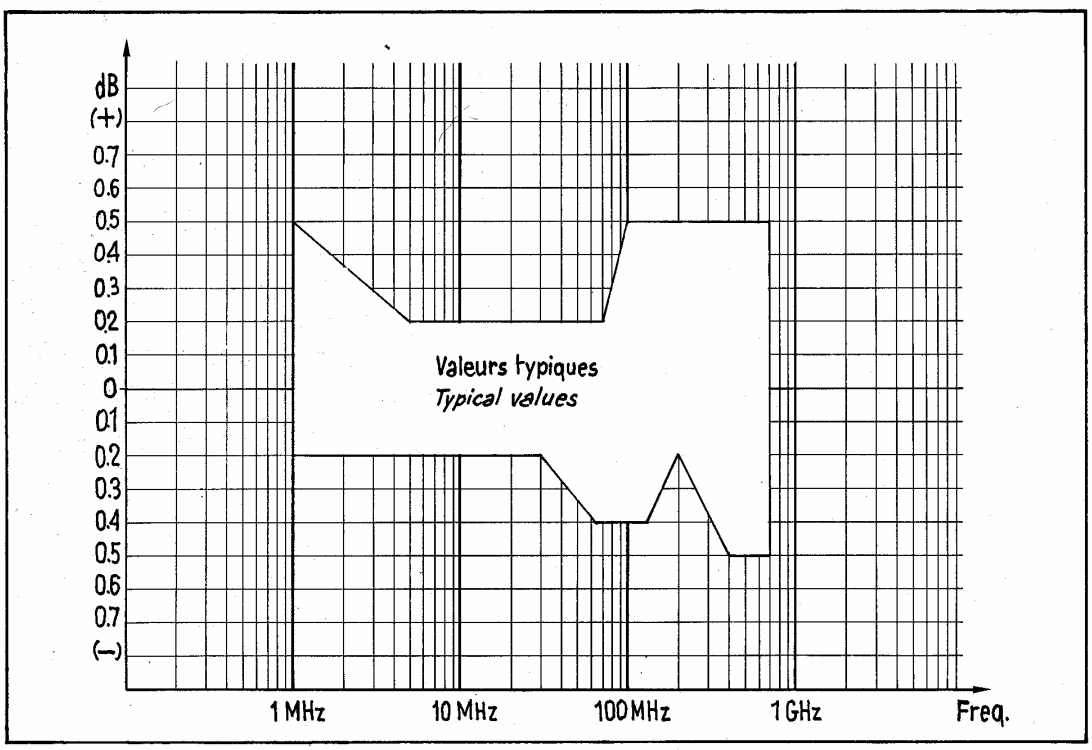
± 0.5 dB maximum error for ten 1 dB steps.

METER ACCURACY :

3 % of full scale

OUTPUT LEVEL FLATNESS :

± 0.5 dB from 1 MHz to 650 MHz (measured at 0 dBm, with respect to 20 MHz).



VSWR :
Measured with 50 Ω load impedance :

Output level	VSWR
+ 20 to + 1 dBm	2
0 to - 12 dBm	1.3
- 13 to - 140 dBm	1.2

AMPLITUDE MODULATION

MODULATION DEPTH :

- Adjustable from 0 % to 100 % for up to + 14 dBm/50 Ω output level. Above + 14 dBm average output level, overload indicator lights up if peak level exceeds + 20 dBm.
- AM depth adjustment by vernier, calibrated meter display with automatic scale switching.

ACCURACY up to 90 % modulation depth for 1 kHz internal modulating signals :
± 2 % of full scale
± 5 % of reading

INTERNAL MODULATING SIGNALS

- Frequency : 400 Hz or 1000 Hz (Master Oscillator stability)
- The internal modulating signals are available on a rear-panel connector with 2.5 Vrms/600 Ω output level.

EXTERNAL MODULATING SIGNALS

- AC or DC coupling
- Frequency :

Bandwidth	DC coupling	AC coupling
± 1 dB	0 Hz to 60 kHz	100 Hz to 60 kHz
- 3 dB	0 to 100 kHz	30 Hz to 100 kHz

- Input sensitivity :

Approximately 2 mVrms/600 Ω for 1 % modulation depth.

- Maximum input level : ± 10 V peak

AM DISTORTION

With 1 kHz internal modulating signal, from 1 MHz to 650 MHz.

1.2 % from 0 % to 30 %
2 % from 30 % to 50 %
3 % from 50 % to 80 %

INCIDENTAL PHASE MODULATION :
0.1 rd for 50 % modulation depth.

VOR-ILS MODULATION

- General characteristics identical to those of AM

ENVELOPPE PHASE-SHIFT :
0.2° for a 30 Hz modulating signal.

FREQUENCY MODULATION

FREQUENCY DEVIATION

- Up to 300 kHz deviation in 3 ranges
  Automatic scale switching of calibrated meter provides 3 subranges.

Range	Subrange
0 to ± 3 kHz	0 to ± 1 kHz
0 to ± 30 kHz	0 to ± 10 kHz
0 to ± 300 kHz	0 to ± 100 kHz

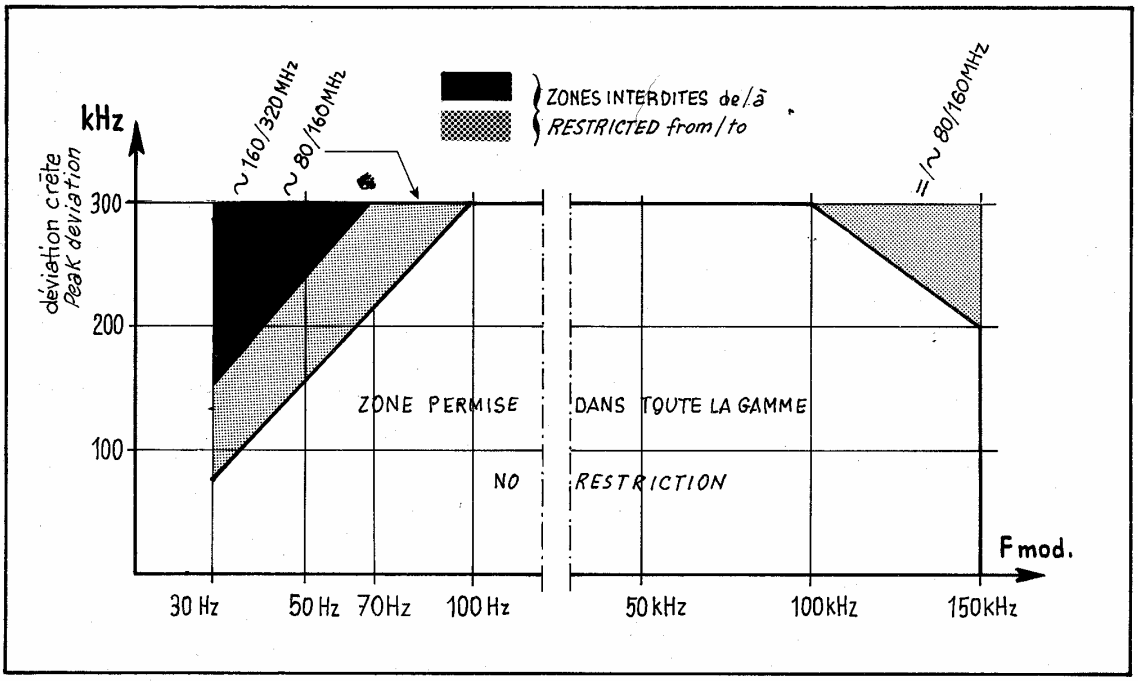
INTERNAL MODULATING SIGNALS

- Frequency : 400 Hz or 1000 Hz (Master Oscillator Stability)
- The internal modulating signals are available on a rear-panel connector with 2.5 Vrms/600 Ω output level.

EXTERNAL MODULATING SIGNALS

- AC or DC coupling
- 3 dB bandwidth
  DC coupling : DC to 150 kHz
  From 80 MHz to 160 MHz, the maximum FM deviation is reduced according to the figure below for modulating frequencies above 100 kHz.

  AC coupling : 30 Hz to 150 kHz
  From 80 MHz to 320 MHz, the maximum FM deviation is reduced according to the figure below for modulating frequencies below 100 Hz or above 100 kHz.



● Input sensitivity :

Approximately 1 Vrms/600 Ω for 1 kHz, 10 kHz or 100 kHz frequency deviation depending on the selected range.

● Maximum input level : ± 10 V peak

FREQUENCY DEVIATION CONTROL

Adjustment by vernier ; calibrated meter display with automatic range switching. In DC coupled external modulation, the center frequency shift can be read on the front-panel frequencymeter.

DISPLAY ACCURACY :

± 7 % of full scale

FM DISTORTION

With internal modulating signals

1 % up to 30 kHz frequency deviation

3 % up to 100 kHz frequency deviation

RESIDUAL AM

<1 % from 1 MHz to 650 MHz for a 1 kHz modulating signal with 75 kHz deviation.

PHASE MODULATION

PHASE DEVIATION

● Adjustable from 0° to 300° in two subranges.

- Adjustment by vernier calibrated meter display with automatic scale switching.

DISPLAY ACCURACY

± 10 % of full scale

INTERNAL MODULATING SIGNALS

- Frequency : 400 Hz or 1000 Hz (Master Oscillator stability)
- The internal modulating signals are available on a rear-panel connector with 2.5 Vrms/600 Ω output level.

EXTERNAL MODULATING SIGNALS

- AC or DC coupling
- 3 dB bandwidth :

  DC coupling : 0 to 50 kHz

  AC coupling : 30 Hz to 50 kHz
- Input sensitivity : approximately 1 Vrms/600 Ω for 100° phase deviation
- Maximum input level : ± 10 V peak

SIMULTANEOUS MODULATIONS

Simultaneous AM/FM or AM/PM capability with internal and external modulating signals.

POWER SUPPLY

Voltage : 115 V - 230 V ± 15 %

Frequency : 50 Hz to 400 Hz

Power : 100 W.

Mechanical characteristics :

Adaptable to 19" rack.

Height : 132 mm (3 U)

Width : 440 mm

Depth : 452 mm

Temperature range :

Operation : 0°C to + 50°C.

Storage : - 20°C to + 70°C.

Weight : 23 kg.

OPTIONS

001 REVERSE POWER PROTECTION

003 FREQUENCY DOUBLER

004 IEEE BUS PROGRAMMING

005 COMPLEMENTARY PROGRAMMING

010 EXTENSION TO 100 kHz

CHAPTER II

SETTING UP

2.1 INTRODUCTION

This chapter covers the electrical installation of the instrument, the environmental conditions applicable to the use of the instrument, and the mounting of the instrument in a 19" rack.

2.2 GOODS INWARD TESTING

The instrument is shipped in a cardboard box, protected by expanded polyurethane foam inserts. The carton contains the instrument indicated on the delivery note plus the appropriate mains power supply connection cable (EUROPAVIA type).

As the warranty covers damage occuring during transit from ADRET ELECTRONIQUE, check that the instrument has suffered no mechanical damage in transit.

2.3 CONNECTION OF MAINS SUPPLY

The 7100A signal generator is designed to operate from a mains supply at 115 or 230 Vrms $\pm$ 15 %, with a supply frequency of between 50 and 400 Hz. The maximum power consumption is 140 VA (100 W).

The instrument is set at the factory to operate from a supply of 230 Vrms, the input circuit protective fuse being rated at 1 A. The mains supply cable is plugged into the 3-pin connector on the "mains filter and voltage selector" unit on the rear panel, which also contains the mains fuse. Total safety is ensured in that access to these components is only available with the mains cord unplugged from the instrument.

When the instrument is not set up for the local mains voltage, proceed as outlined in figure 2.1.

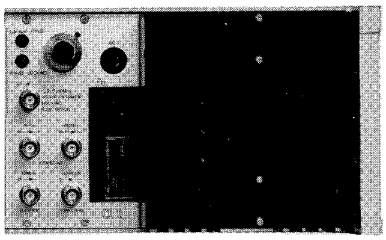
2.4 ENVIRONMENTAL CONDITIONS

The technical specifications for the instrument apply to an operating environment with a temperature of between 0 and + 50°C. The inside of the instrument is cooled by natural convection promoted by the careful arrangement of the internal modules. Air is drawn into the instrument through louvers in the rear and side panels. The modules are fabricated from light alloy, providing efficient dissipation of the heat generated by the internal circuitry.

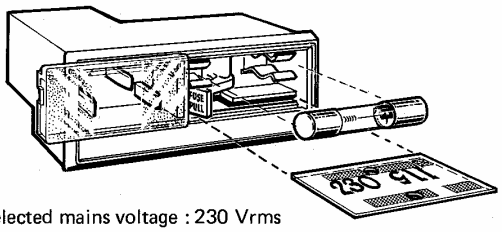
The instrument may be stored at temperatures of between - 20 and + 70°C, in a dry place.

POWER SUPPLY

1. Raise the transparent cover.
2. Raise the lever marked FUSE PULL and remove fuse from housing.
3. Withdraw voltage selector printed circuit from its housing and position as shown opposite so that the voltage of the local mains power supply is to the left.
4. Fit the fuse (1 A/230 V or 2 A/115 V) into the fuse-holder (the lever marked FUSE PULL should return to its initial position).
5. Replace the transparent cover. The supply voltage visible through the transparent cover should correspond to that of the local mains supply.



Rear view of 7100 A



Selected mains voltage : 230 Vrms

Figure 2-1 : SELECTION OF MAINS SUPPLY VOLTAGE

2.5 19" RACK MOUTING

Two adaptors (height 3U) are available to order, and enable the 7100A to be mounted in a standard 19" rack. The two metal brackets (ADRET reference 03800064) screw on to the side panels of the instrument (c.f. figure 2-2) using 4 countersunk screws.

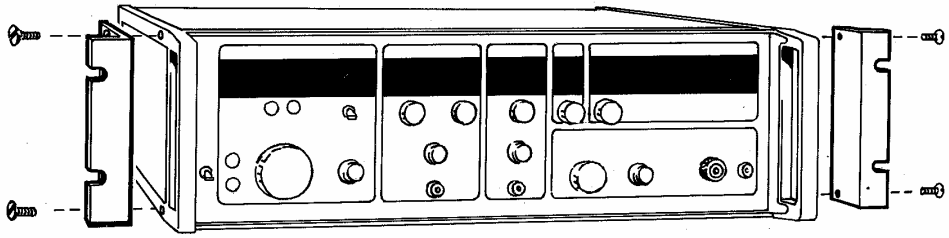


Figure 2-2 : 19" RACK MOUNTING OF THE 7100A

CHAPTER III

OPERATION

3.1 INTRODUCTION

This chapter describes the function of all the knobs, switches, indicator lamps, connectors and potentiometers on the FRONT and REAR panels of the 7100A-type generator. A description of a procedure for checking the principal controls, to verify the correct operation status of the instrument, is described before we go on to consider the determination of the output frequency and level and the selection of AM, FM or PM modulation. The manner in which the instrument is programmed is also described.

3.2 DESCRIPTION OF FRONT AND REAR PANELS

Figure 3.1 shows the controls, indicator lamps and connectors of the FRONT panel of the instrument. Figure 3.2 shows the connectors and other controls of the REAR panel. The programming facilities on the rear panel are described with reference to figure 3.3.

3.3 CHECKING THE CONTROLS

Checking the controls merely involves confirming that the adjustment and local selection controls are operating correctly. The check-out procedure is described below with reference to figure 3.4.

3.4 OPERATING MODES

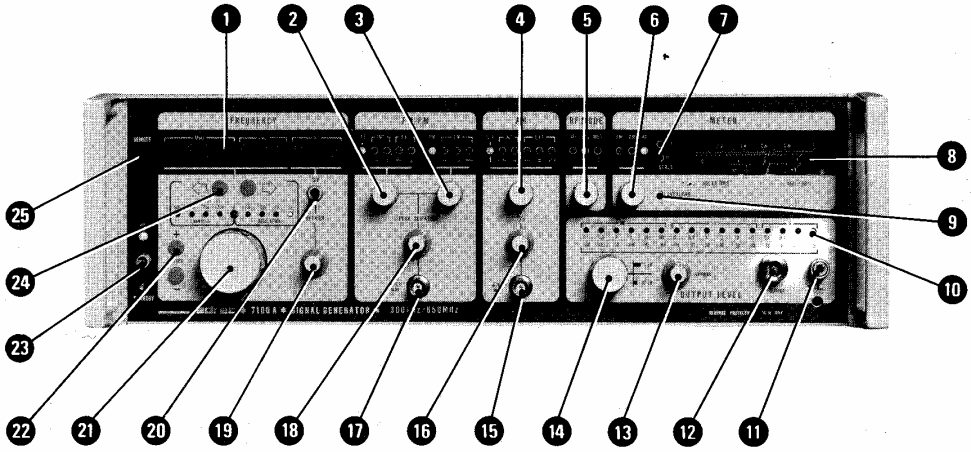
Figures 3.5 and 3.6 illustrate the procedure to be followed to set and display the frequency and the output level, and for adjustment of the AM, FM and PM modulation.

Control of the operation of the 7100A in accordance with an external frequency reference and programming the various functions are described with reference to figures 3.7 and 3.8. The self-checking procedure is described with reference to figure 3.9.

3.5 FUSE REPLACEMENT

The fuse requires replacement if the AC supply voltage is changed or if the fuse blows. The mains supply input protection fuse is located in the connection module, close to the heatsink on the rear panel. To replace the fuse, disconnect the power cable from the 3-pin socket and push down the transparent cover. Press the lever marked FUSE PULL and replace the fuse (rating 1A or 2A for mains supply voltages of 230 V and 115 V, respectively).

DESCRIPTION OF FRONT PANEL



1 FREQUENCY STEP (10^0 to 10^8 Hz) DISPLAY AND SELECTOR

If the frequency-doubler option is included, the range of steps is 10^0 to 10^9.

The frequency is displayed on a 9-digit LED display (10-digit with frequency-doubler option), up to 650 MHz on the x 1 range or up to 1.3 GHz on the x 2 range.

The frequency resolution is 1 kHz, 10 kHz, 100 kHz or 1 MHz (without Vernier), or 1 Hz with Vernier (accuracy $\pm$ 1 digit).

NOTE : In FM mode with d.c. coupling, the carrier frequency shift due to the injected d.c. voltage is displayed.

Verification of the principal instrument levels on starting the self-checking routine is also obtained by displaying them on the three corresponding digits for steps 10^0 to 10^2 Hz :

- the two Right-hand digits (10^0 and 10^1 Hz) display a number from 1 to 10 representing the test point to be checked, and
- the third digit (10^2 Hz) indicates that the test is correct or incorrect.

2 FREQUENCY OR PHASE MODULATION (FM or PM) SELECTOR

The modulation is selected by means of a switch.

OFF : disable FM or PM modulation
INT : internal FM or PM modulation source
0.4 k : 400 Hz
1 k : 1 kHz
EXT : external FM or PM modulation source
∿ : a.c. coupling
= : d.c. coupling.

The selected source of modulation is indicated by the red LED.

Figure 3-1 : FRONT-PANEL DESCRIPTION (1/6)

DESCRIPTION OF FRONT PANEL

3 FM or PM DEVIATION SELECTOR

This switch selects the PM or FM deviation.

PM (300°) : Phase modulation with maximum peak deviation of 300°.

FM (3k, 30 k or 300 k) : Frequency modulation with maximum peak deviation of ± 3 kHz, ± 30 kHz or ± 300 kHz.

The selected PM or FM deviation is indicated by a red LED.

4 AM MODULATING SIGNAL SELECTOR

This switch selects the modulation source.

OFF : disable AM modulation
INT : internal AM modulation source
0.4 k : 400 Hz
1 k : 1 kHz
EXT : external AM modulation source
∿ : a.c. coupling
= : d.c. coupling
VOR : AM phase-shift < 0,2° for a 30 Hz modulating signal.

The selected source of modulation is indicated by the red LED.

5 OPERATING MODE SELECTOR

This switch selects the operating mode.

OFF : disable output signal (level < - 140 dBm)
CW : continuous pure output signal
MOD : output signal modulated in AM, FM, PM, AM-FM or AM-PM.

The selected operating mode is indicated by a red LED.

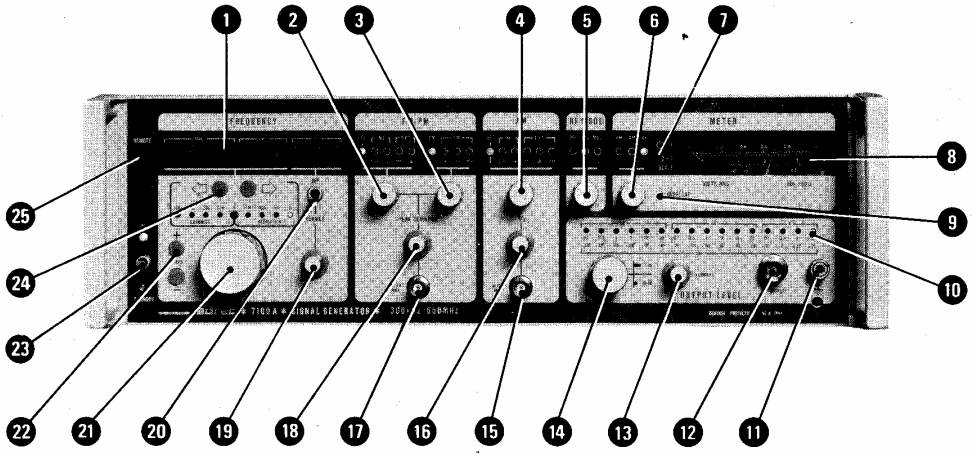
6 METER READOUT MODE SELECTOR

FM : FM or PM deviation
AM : AM modulation depth
RF : output level.

The selected meter readout mode is indicated by a red LED.

Figure 3-1 : FRONT-PANEL DESCRIPTION (2/6)

DESCRIPTION OF FRONT PANEL



7 LED READOUT SCALE INDICATOR

The meter is automatically switched between the top and centre scales :

1 : read upper scale (0 to 1.0)
0.3 : read centre scale (0 to 3).

The scale which is applicable is indicated by a red LED.

8 METER

The instrument includes a circuit which automatically switches between the top and centre scales on the meter.

2 scales, calibrated 0 to 1.0 and 0 to 3 provide for reading levels in µV, mV and V/50 Ω, depending on the selected range.

The bottom scale (- 10 to + 3) indicates the output level in dBm/50 Ω, as appropriate to the selected range.

AM : the modulation depth is displayed on the two upper scales, which is automatically switches at 30 %.

Scale 0 to 3 : AM depth 0 to 30 %.
Scale 0 to 1.0 : AM depth 30 to 100 %.

FM-PM : the frequency or phase shift is displayed on the two upper scales, automatic switchover occurring at 1/3 of the selected maximum peak deviation.

Scale 0 to 1 : deviation 0 to 1 kHz, 0 to 10 kHz, 0 to 100 kHz or 0 to 100° (PM)
Scale 0 to 3 : deviation 1 to 3 kHz, 10 to 30 kHz, 100 to 300 kHz or 100 to 300° (PM).

Figure 3-1 : FRONT-PANEL DESCRIPTION (3/6)

DESCRIPTION OF FRONT PANEL

9 LED OVERLOAD INDICATOR

This indicates that the permitted maximum peak power rating has been exceeded. This rating is :

- 20 dBm in CW mode,
- 14 dBm in AM mode for 100 % modulation,
- 10 dBm in CW mode above 650 MHz with frequency doubler option.

10 LED LEVEL RANGE INDICATORS

These indicate the range of levels selected by the control knob.

The various ranges are expressed in µV, mV and V, in steps of 1, 3 and 10, or in dBm in steps of 10 dB (0.1 µV to 3 V and - 130 to + 20 dBm).

11 GROUND SOCKET

This enables the instrument ground to be connected to an external ground.

12 RF OUTPUT

The RF output is obtained from a type N socket, at an output impedance of 50 Ω.

13 OUTPUT LEVEL VERNIER CONTROL

The Vernier is provided for fine adjustment of the output level.

14 OUTPUT LEVEL CONTROL

The output level is adjustable in steps of 1 dB or 10 dB, over the whole dynamic range.

The 10 dB steps control is enabled by axial pressure.

15 AM INPUT

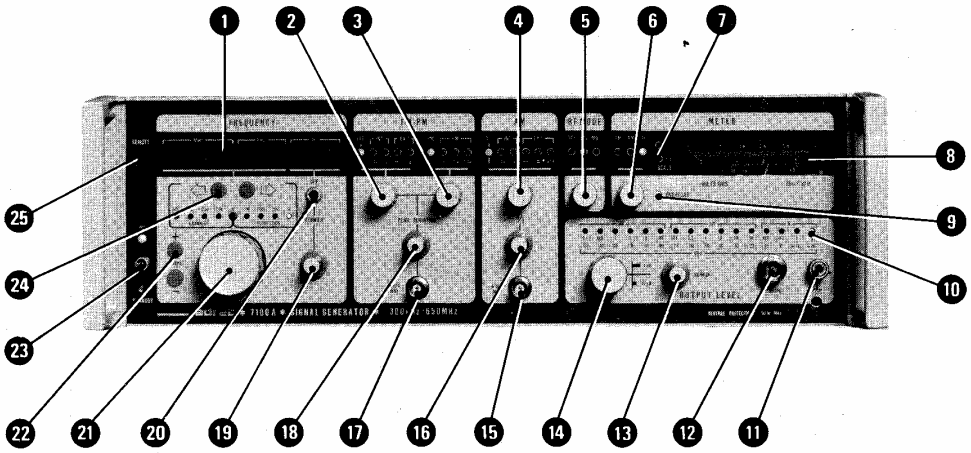
This socket is provided for the connection of an external modulating signal :

- 3 dB bandwidth :
  0 to 100 kHz with d.c. coupling
  ≃ 30 Hz to 100 kHz with a.c. coupling
- 1 dB bandwidth :
  0 to 60 kHz with d.c. coupling
  100 Hz to 60 kHz with a.c. coupling
- input impédance 600 Ω
- input level ≃ 200 mV rms for 100 % modulation
- maximum permitted input level ± 10 V.

16 AM MODULATION LEVEL CONTROL

Figure 3-1 : FRONT-PANEL DESCRIPTION (4/6)

DESCRIPTION OF FRONT PANEL



17 EXTERNAL FM or PM MODULATING SIGNAL INPUT

This socket is provided for the connection of an external modulating signal :

- 3 dB bandwidth
  0 to 150 kHz (FM) with d.c. coupling
  0 to 60 kHz (PM) with d.c. coupling
- 30 Hz to 150 kHz (FM) with a.c. coupling
- 30 Hz to 60 kHz (PM) with a.c. coupling
- input impedance 600 Ω
- 1 Vrms at 1 kHz, 10 kHz or 100 kHz depending on the selected maximum peak deviation (FM)
- 1 V rms at 100° (PM)
- Maximum permitted input level ± 10 V.

18 FM or PM DEVIATION CONTROL

19 OUTPUT FREQUENCY VERNIER CONTROL

The Vernier provides fine adjustment of frequency by approximately - 500 Hz to + 1500 Hz.

When using d.c. coupled FM on 30 kHz or 300 kHz range, this adjustement is respectively multiplied by 10 or 100.

20 VERNIER ENABLE SWITCH

OFF : Vernier disabled
VERNIER : Vernier enabled.

Figure 3-1 : FRONT-PANEL DESCRIPTION (5/6)

DESCRIPTION OF FRONT PANEL

21 OUTPUT FREQUENCY CONTROL

The frequency is selected by means of an optical coding wheel, providing increments (or decrements) of 100 steps per revolution, the size of the steps depending on the selected frequency resolution.

22 STEP MODE SELECTOR

This provides for stepwise adjustment of the frequency in steps equal to the 4 possible frequency resolutions or to the standard channel spacing.

\+ : output frequency incremented by selected step.

\- : output frequency decremented by selected step.

A continuous pressure on one of these keys provides digital frequency sweep at a rate of approximately 7 steps/second.

23 ON/STANDBY SWITCH

ON : instrument is ready for use

STANDBY : instrument functions on standby, with only pilot circuit powered up.

24 RESOLUTION/CHANNEL STEP SELECTORS

RESOLUTION : 1 kHz, 10 kHz, 100 kHz or 1 MHz

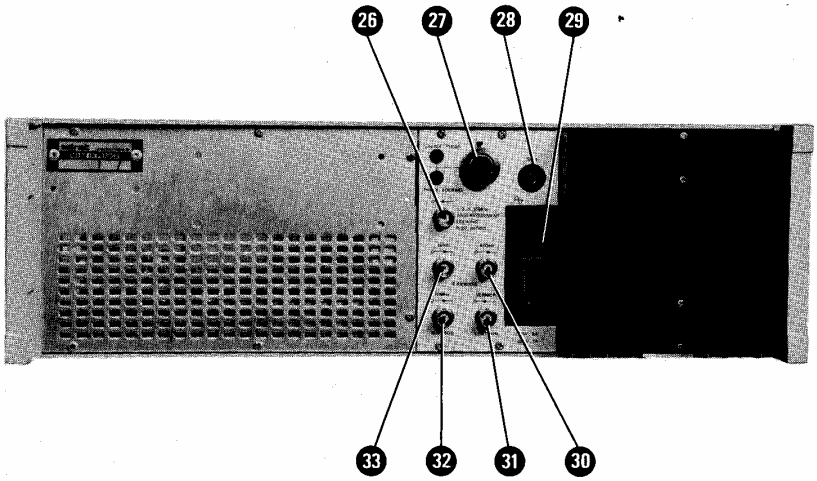
CHANNEL STEP : 12.5 kHz, 20 kHz, 25 kHz or 50 kHz.

NOTE : The centre 0 position disables the frequency tuning control knob.

25 PROGRAMMED MODE DISPLAY

Figure 3-1 : FRONT-PANEL DESCRIPTION (6/6)

DESCCRIPTION OF REAR PANEL



26 EXTERNAL FREQUENCY REFERENCE INPUT (1, 2, 5 or 10 MHz)

The internal pilot tone is locked on to an external reference at a level between 0.2 and 1 V rms across 50 Ω.

27 PHASE LOCKING CONTROL AND INDICATOR

This knob operates a 10-turn precision potentiometer for adjusting the lock-on point, which is displayed by indicator lamps.

28 POWER SUPPLY TO AUXILIARY EQUIPMENT

This 5-pin socket provides + 12 V, + 5 V and - 12 V supplies at approximately 50 mA.

29 MAINS INPUT CONNECTION MODULE

This incorporates the mains input protection fuse and the mains supply voltage selectors :

- input voltage : 115 or 230 V rms ± 15 %.
- frequency : 50 to 400 Hz.

30 400 Hz OUTPUT

This internal modulation signal is derived from the quartz-controlled pilot tone circuit. The output level is 2.5 V rms across 600 Ω.

31 ± 3 V/3 kHz INPUT

This socket provides for external analogue control of the output frequency.

Figure 3-2 : REAR-PANEL DESCRIPTION (1/2)

DESCRIPTION OF REAR PANEL

32 10 MHz OUTPUT

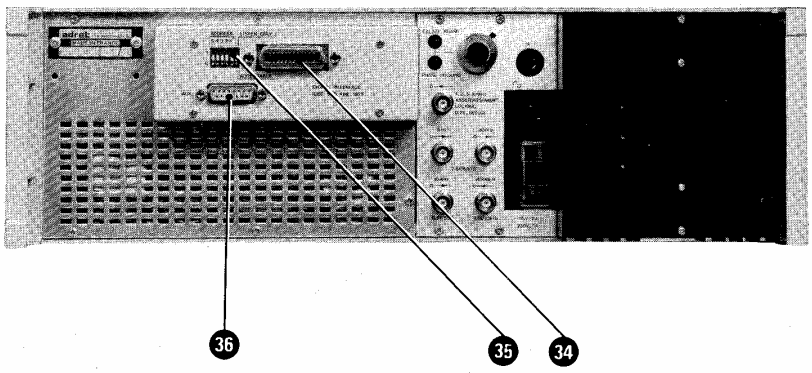
This is a reference frequency derived from the quartz-controlled pilot tone generator, supplied at a fixed level of 0.5 V rms across 50 Ω.

33 1 kHz OUTPUT

This internal modulation signal is derived from the quartz-controlled pilot tone circuit. The output level is 2.5 V rms across 600 Ω.

Figure 3-2 : REAR-PANEL DESCRIPTION (2/2)

DESCRIPTION OF REAR PANEL
PROGRAMMING OPTIONS
(004 AND 005)



34 IEEE BUS CONNECTOR

This connector provides the connection to the IEEE bus (IEEE Standard 488 of 1975).

35 ADDRESS SELECTOR

The 7100A is addressed by a number between 0 and 30 selected in binary code by a 5-decade switch (5-4-3-2-1). This identifying number is recognised when the 6th decade of the switch, marked LISTEN ONLY/ADDRESSABLE, is set to the "0" (down) position indicating ADDRESSABLE. In the LISTEN ONLY position ("1" or up), the 7100A receives all data sent out by the controller.

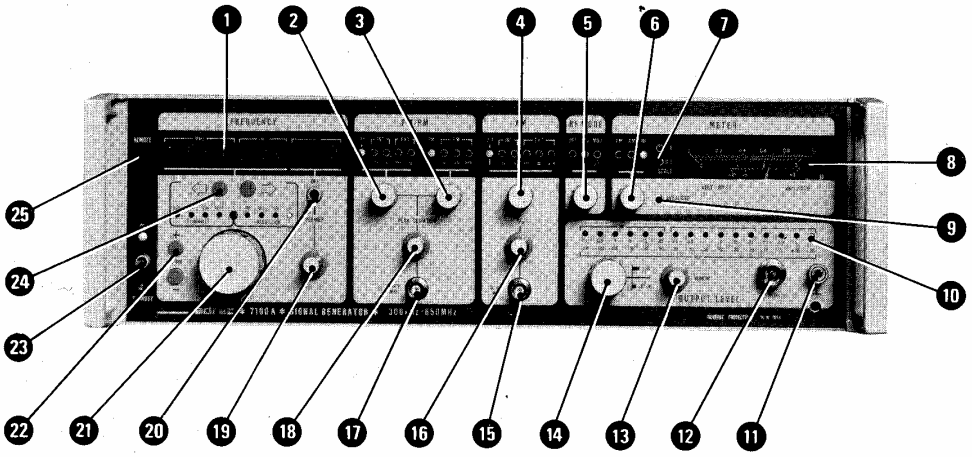
36 AUXILIARY CIRCUIT ENABLING SIGNAL CONNECTOR

This connector makes it possible to program ancillary equipment (peripherals). It outputs a byte corresponding to a programmed decimal number between 0 and 99.

Output levels :
"0" : 0.45 V maximum, maximum current drain + 8 mA ;
"1" : 2.4 V minimum, maximum current output - 2.6 mA.

Figure 3-3 : REAR-PANEL DESCRIPTION (programming options)

PRELIMINARY CONTROLS



a) Connect the instrument to the mains power supply. If switch (23) is in the lower position, the STANDBY indicator lights up while all the other displays are off.

SWITCHING ON

b) Set switch (23) to the ON position (indicator comes on). The display (1) indicates 300 MHz and indicator lamp (10) comes on to indicate the - 140 dBm range and a frequency resolution of 1 MHz ((24)).

c) Adjust the frequency using knob (22) and the level range by pushing in and rotating knob (14) . The resolution is adjusted by means of the pushbuttons (24).

FREQUENCY

d) Press the pushbuttons (24) and check that the indicator lamps come on in succession, corresponding to the successive frequency resolution steps and standard channel spacing.

e) Switch on the 1k indicator lamp and then press the right-hand pushbutton (24) . The centre 0 indicator lamp should come on. Repeat this operation with the 50 k indicator lamp and the left-hand pushbutton (24).

f) Check that the frequency indicated by the display (1) cannot go below 250 kHz or above 649.999 MHz (direct range) or 1299.999 MHz if the frequency-doubler option is included. This check is carried out using the pushbutton (24) and knob (21).

Figure 3-4 : PRELIMINARY CONTROLS (1/3)

PRELIMINARY CONTROLS

g) Select the 1 MHz resolution step (pushbuttons 24) and press pushbuttons 22 . The indicated frequency should vary in steps of 1 MHz, the indication varying continuously if the pushbutton is held down.

h) Set switch 20 to VERNIER and check that potentiometer 19 varies the frequency by - 500 Hz to + 1500 Hz.

OUTPUT LEVEL

i) Switch on the RF indicator lamp using switch 6.

j) Press in and rotate all switches 14 and check that :
- the indicator lamps 10 come on in succession ;
- the range of the meter 8 is automatically switched over (indicator lamp 7).

k) Check that operating the VERNIER 13 varies the level by + or - 1.5 dB. Set the Vernier to the extreme right-hand end of its travel.

l) Switch on the + 20 dBm indicator lamp 10 using switch 14 . Then set the pointer of meter 8 to the "0" graduation on the bottom scale by rotating knob 14.

m) Increase the output level by rotating knob 13 and check that indicator lamp 9 comes on.

AM MODULATION

n) Operate the switches 4 and check that the indicator lamps above the switches come on in succession. Check the "1 k" indicator lamp.

o) Switch on the "MOD" lamp by rotating knob 5 and the "AM" indicator lamp by rotating knob 6.

p) Set potentiometer 16 to the extreme left-hand end of its travel and then turn it slowly clockwise checking that the range switching (indicator lamp 7) for the meter 8 occurs at graduation "3" on the centre scale (allowing for hysterisis effects). In this case, the pointer is against graduation "0.3" on the upper scale.

q) Switch on the "RF" indicator lamp by rotating knob 6 and the "CW" indicator lamp by rotating knob 5.

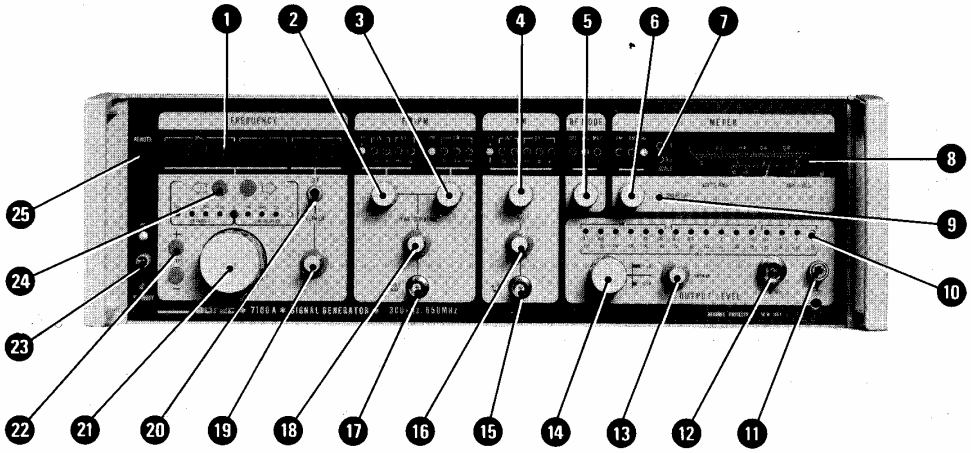
r) Switch on the "+ 20 dBm" indicator lamp 10 by pushing in and rotating knob 14 . Release the knob and rotate it to set the meter pointer to the "- 6" graduation on the lower scale. Use the VERNIER control knob 13 if necessary.

s) Switch on the "AM" indicator lamp by rotating knob 6 and the "MOD" indicator lamp by rotating knob 5. Using potentiometer 16 , set the meter pointer to the "1.0" graduation on the upper scale.

t) Rotate potentiometer 16 clockwise until indicator lamp 9 comes on.

Figure 3-4 : PRELIMINARY CONTROLS (2/3)

PRELIMINARY CONTROLS



FM or PM MODULATION

u) Operate switches (2) and (3) and check that the indicator lamps above them come on. Check the "1 k" and "30 k" indicator lamps.

v) Switch on the "MOD" indicator lamp by rotating knob (5) and the "FM" indicator lamp by rotating knob (6).

w) Operate potentiometer (18) and check that the automatic range switching for the meter (indicator lamp (7)) occurs on the "1.0" graduation on the upper scale (neglecting hysterisis effects). The pointer should be aligned with the "1" graduation on the centre scale.

Figure 3-4 : PRELIMINARY CONTROLS (3/3)

FREQUENCY AND OUTPUT LEVEL DISPLAY

FREQUENCY

a) Use the pushbuttons (24) to select frequency resolution steps of 1 kHz, 10 kHz, 100 kHz and 1 MHz, in direct and frequency-doubling mode (where applicable).

b) Rotate knob (21) until the required frequency is indicated on the display (1), remembering that this knob increments or decrements the frequency by 100 steps per revolution. The following table sets out, as a function of the selected resolution step, the number of rotations required to cover the whole frequency range of the instrument (with and without the frequency-doubler option).

Resolution step	Revolutions for full frequency range (without frequency doubler option)	Revolutions for full frequency range (with frequency doubler option)
1 kHz	6500	13000
10 kHz	650	1300
100 kHz	65	130
1 MHz	6.5	13

c) Set switch (20) to the VERNIER position and use potentiometer (19) to set and display the units, tens and hundreds digits for the frequency in Hertz on display (1).

NOTE : The Vernier varies the frequency by approximately - 500 Hz to + 1500 Hz, in direct and frequency-doubling modes.

d) The output frequency is modified as described above, using the pushbuttons (22) to vary the frequency in steps of a size determined by the pushbutton (24). The frequency step may be equal to one of the 4 resolution steps (1 kHz, 10 kHz, 100 kHz or 1 MHz) or to one of the 4 standard channel spacings (12.5 kHz, 20 kHz, 25 kHz or 50 kHz).

NOTE : Selecting one of the standard channel spacings automatically disables pushbutton (21). The 500 Hz of the 12.5 kHz spacing is displayed as the hundreds digit.

e) Hold down one of the pushbuttons (22) to produce continuous variation of the output frequency.

f) As soon as the working frequency is obtained, the knob (21) and the pushbuttons (22) may be disabled by using the pushbuttons (24) to switch on the central "0" indicator lamp.

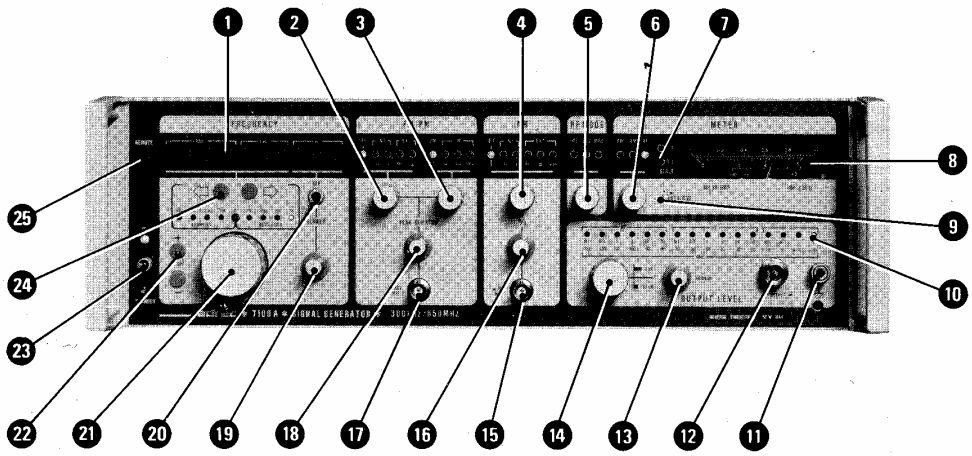
LEVEL

a) Switch on the "CW" indicator lamp by rotating knob (5).

b) Switch on the "RF" indicator lamp by rotating knob (6).

Figure 3-5 : FREQUENCY AND OUTPUT LEVEL DISPLAY (1/3)

FREQUENCY AND OUTPUT LEVEL DISPLAY



c) Press in and rotate knob 14 to switch on the indicator lamp 10 corresponding to the required level range (the ranges 1, 3 and 10 are indicated on the front panel in µV, mV, V and dBm).

NOTE : Pressing knob 14 varies the output level in steps of 10 dB.

d) Release and then rotate knob 14 to set the required level of the meter 8, the variation this time being in steps of 1 dB.

NOTE : Variation of the output level in steps of 1 dB is possible over the full 160 dB dynamic range of the instrument. For this reason, and to enable the threshold adjustments to be measured, the range switching (10) varies with the direction. After centring the VERNIER knob 13, the 1 dB steps causing the level to vary progressively by - 140 to + 20 dBm are indicated on the lower scale (- 6 to + 13) between successive changes of range. Where the level is attenuated by + 20 to - 140 dBm, the 1 dB steps vary by + 12 to - 7 on the lower scale between successive changes of range.

e) According to the selected range, read the level from the meter 8 in µV, mV or V, from the scale indicated by lamp 7, or in dBm on the lower scale.

f) Carry out the adjustment using the VERNIER knob 13 (1.5 dB). The output signal is obtained at the type N connector 12, across an impedance of 50 Ω.

g) The OVERLOAD indicator 9 comes on to indicate that the permitted peak power rating (+ 20 dBm) has been exceeded.

h) Switch on the OFF indicator lamp by rotating knob 5 to disable the output signal level (< - 140 dBm).

CENTRING THE LEVEL VERNIER

a) Set the VERNIER knob 13 to the extreme right-hand end of its travel.

b) Select the + 20 dBm range using knob 14 and then select the maximum level in steps of 1 dB.

Figure 3-5 : FREQUENCY AND OUTPUT LEVEL DISPLAY (2/3)

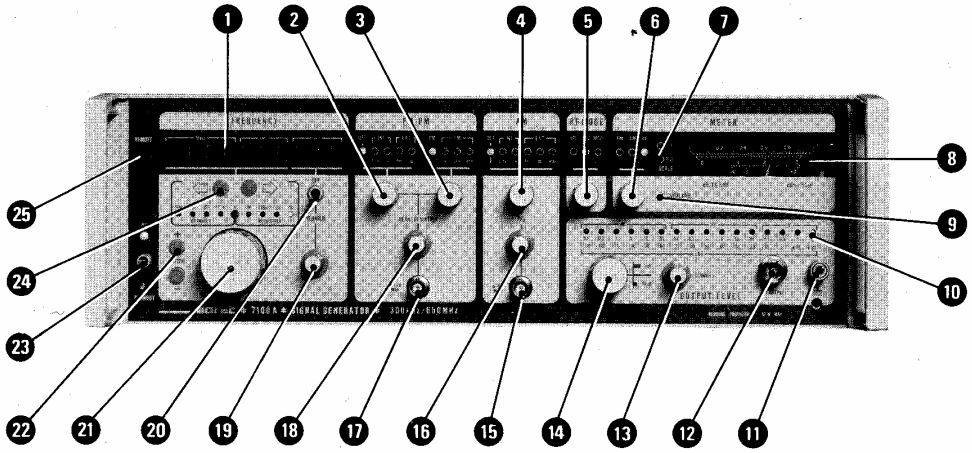
FREQUENCY AND OUTPUT LEVEL DISPLAY

c) Using the VERNIER knob (13), set the meter pointer to graduation "3" on the lower scale. The output level is thus + 23 dBm, corresponding to the maximum value obtained by operating knob (14) (10 dB and 1 dB steps).

d) Reduce the level to + 20 dBm and check that the VERNIER allows to set the level down to + 19 dBm.

Figure 3-5 : FREQUENCY AND OUTPUT LEVEL DISPLAY (3/3)

AM.FM.PM MODULATION



AMPLITUDE MODULATION

a) Switch on the red "MOD" indicator by rotating knob 5.

b) Switch on the "AM" indicator by rotating knob 6.

c) Select the source of modulation using switch 4.

d) When switched to INTERNAL, there are two fixed modulation frequencies of 400 Hz and 1 kHz, derived from the quartz-controlled pilot tone frequency.

NOTE : These frequencies of 400 Hz and 1 kHz are available at connectors 33 and 30 on the rear panel of the instrument. The source impedance is 600 Ω and the fixed output level is 2.5 V rms.

e) When switched to EXTERNAL, the modulating signal may be a.c. or d.c. coupled or specific to the requirements for testing radio-navigation systems (VOR - ILS).

f) Connect the modulating signal to the 600 Ω input impedance connector. 100 % modulation requires the application of the minimum level of 200 mV rms, the maximum input sensitivity being 2 mV rms per %.

NOTE : The indication "± 10 V max" adjacent the input connectors shows the maximum input voltage which can be tolerated without damaging the instrument.

g) Set the modulation level using potentiometer 16 and meter 8.

h) Take the meter reading from the scale indicated by lamp 7, the automatic switching action occurring at a value of 30 % (ignoring hysterisis).

i) Reduce the modulation level or output level as soon as the OVERLOAD indicator lamp 9 comes on. For 100 % modulation, the output level must not exceed + 14 dBm.

Figure 3-6 : AM-FM-PM MODULATION (1/2)

j) To cancel amplitude modulation, switch on the OFF indicator lamp using switch (4) or the "CW" indicator lamp using switch (5).

k) To disable the output signal, switch on indicator lamp OFF using switch (5).

FREQUENCY OR PHASE MODULATION

a) Switch on the red "MOD" indicator by rotating knob (5).

b) Switch on the "FM" indicator by rotating knob (6).

c) Select the source of modulation using switch (2).

d) When switched to INTERNAL, there are two fixed modulation frequencies of 400 Hz and 1 kHz, derived from the quartz-controlled pilot tone frequency.

NOTE : These frequencies of 400 Hz and 1 kHz are available at connectors (33) and (30) on the rear panel of the instrument. The source impedance is 600 Ω and the fixed output level is 2.5 V rms.

e) When switched to EXTERNAL, the frequency or phase modulation may be obtained by a.c. or d.c. coupling.

NOTE : In FM mode with d.c. coupling, the carrier shift resulting from the connection of a d.c. component to input (17) is allowed for in deriving the frequencymeter display :

- 1 Hz resolution for the ± 3 kHz range ;
- 10 Hz resolution for the ± 30 kHz range ;
- 100 Hz resolution for the ± 300 kHz range.

If the modulating frequency is greater than 30 Hz, the displayed value corresponds to the average value or fluctuates around the instantaneous value with a period of 0.25 second.

f) Select the maximum peak FM or PM deviation using switch (3) (± 3 kHz ; ± 30 kHz ; ± 300 kHz or 300°).

g) Connect the modulating signal to connector (17) (input impedance : 600Ω). The maximum peak FM deviation or full phase deviation requires a minimum input level of 3 V rms (approximately 4.29 V peak). The input sensitivity is 1 Vrms for a deviation of 1 kHz, 10 kHz, 100 kHz or 100°, depending on the range.

NOTE : The indication "± 10 V max" adjacent the input connectors shows the maximum input voltage which can be tolerated without damaging the instrument.

h) Set the frequency or phase deviation using potentiometer (18) and meter (8).

i) Take the meter reading from the scale indicated by lamp (7), the automatic switching occurring at 1 kHz, 10 kHz, 100 kHz or 100°.

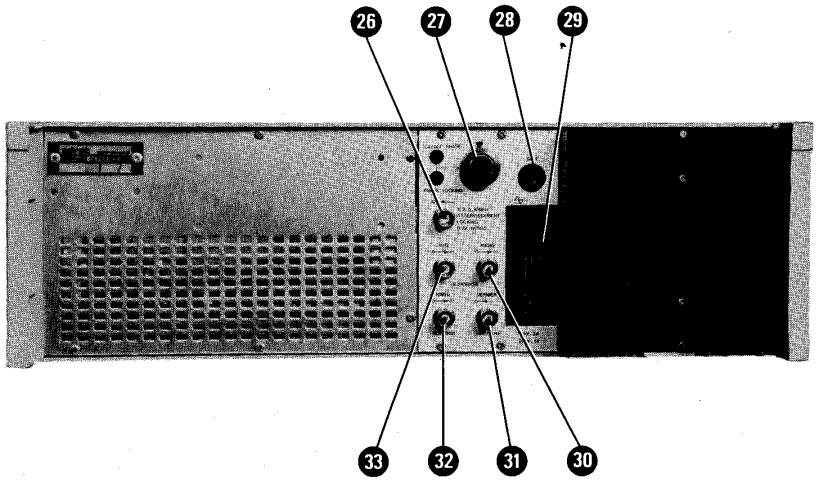
j) To cancel the frequency or phase modulation, switch on the OFF indicator lamp using switch (2) or the "CW" indicator lamp using switch (5).

COMBINED MODULATION MODES

The instrument provides for simultaneous AM + FM or AM + PM modulation, the procedure being as described above. The internal modulating frequency of 400 Hz and 1 kHz can be used for either type of modulation, or for both.

Figure 3-6 : AM-FM-PM MODULATION (2/2)

PILOT FREQUENCY LOCK-ON-



a) Connect the frequency reference signal (1, 2, 5 or 10 MHz) via connector 26. The permitted range of input levels is from 0.2 to 1 V rms across 50 Ω.

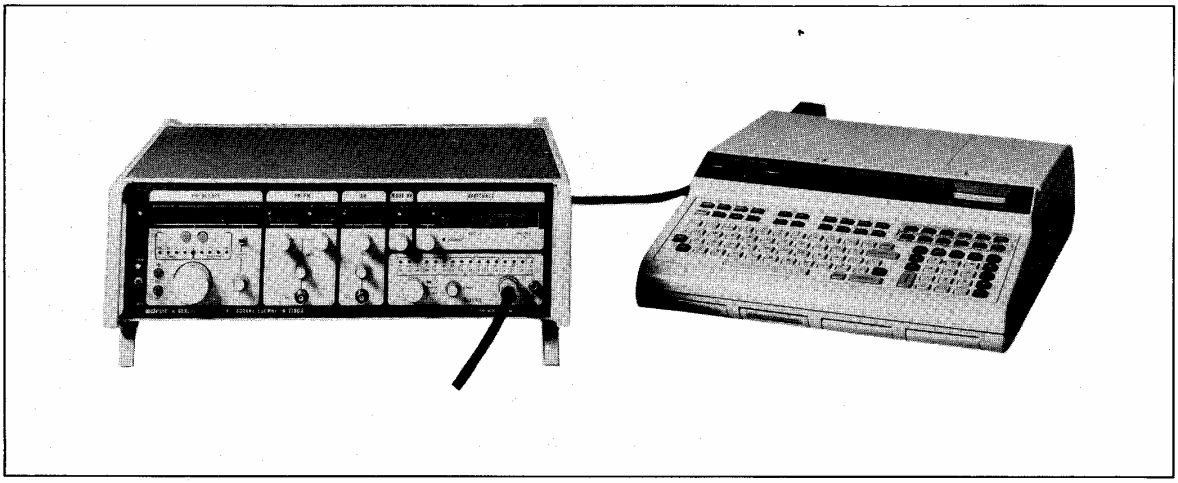
b) Release potentiometer 27 and rotate it until the indicator lamps to its left go out. This shows that the internal pilot frequency is phase-locked to the external frequency reference, so that the stability of the instrument is set by the stability of the external frequency standard.

c) Lock potentiometer 27.

NOTE : The internal pilot frequency is available at connector 32. It is supplied at a level of 0.5 Vrms across 50 Ω. The external reference accuracy must be better than $\pm 10^{-6}$. Otherwise, the internal pilot phase-locking could induce an instability of the output frequency, indicated by a flashing sign "-" at the left of the frequency display.

Figure 3-7 : PILOT FREQUENCY LOCK-ON.

FUNCTION PROGRAMMING



Programming via the IEEE bus is in conformity with IEEE Standard No. 488 (1975). Programming is a simple procedure because :

- it uses CLEAR LANGUAGE and a FREE FORMAT ;
- it uses a MNEMONIC PREFIX corresponding to each front panel function ;
- It uses a numerical code appended to each mnemonic prefix to indicate a frequency, output level or modulation level, or the selected AM, FM and PM modulation control (modulation source, coupling, range).

The instrument is programmed via the rear panel connectors, using programming options 004 and 005 (see figure below).

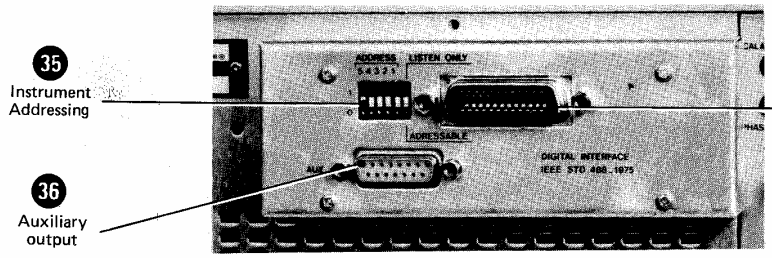
The front panel displays remain enabled in programmed mode, enabling the control data to be verified.

All instrument functions are programmable except the switching of the meter **8**, which is always obtained by switch **6**.

NOTE : Programming option 005 is only available in conjunction with programming option 004.

Figure 3-8 : FUNCTION PROGRAMMING (1/16)

FUNCTION PROGRAMMING

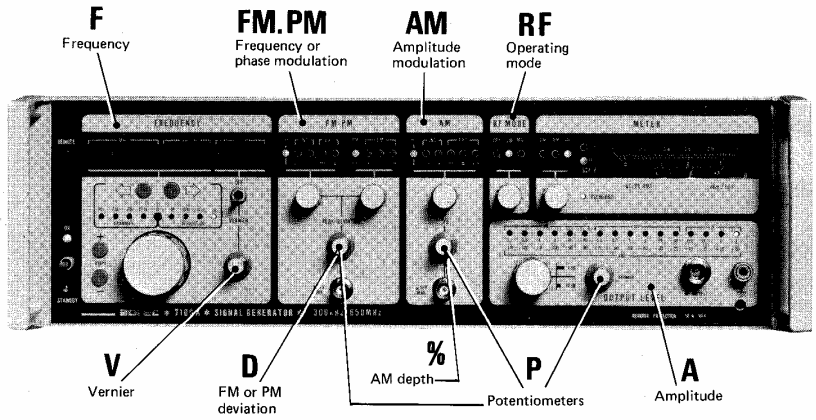


004 OPTION

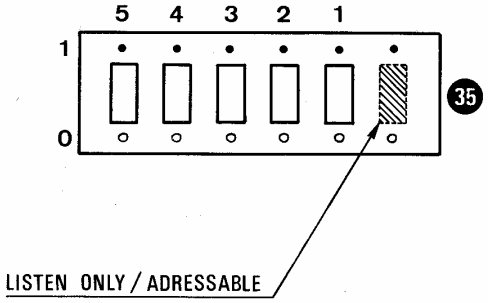
- Frequency : 125 Hz, 250 Hz or 500 Hz resolution depending on frequency range
- 1 kHz above 650 MHz
- Level : 0.1 dB resolution
- Operating mode : - CW/MOD/INHIB
  - AM-FM-PM modulating signal
  - FM deviation range

005 OPTION

- Frequency : 1 Hz resolution
- AM level : %
- FM deviation : 10 Hz, 100 Hz or 1 kHz resolution depending on the range
- PM deviation : per degre
- Enabling of AM, FM, PM and level potentiometers.



7100A ADDRESSING



a) Set the "LISTEN ONLY/ADDRESSABLE" switch decade 35 to "ADDRESSABLE".

NOTE : In the "LISTEN ONLY" position, the 7100A receives all data sent out by the controller.

Figure 3-8 : FUNCTION PROGRAMMING (2/16)

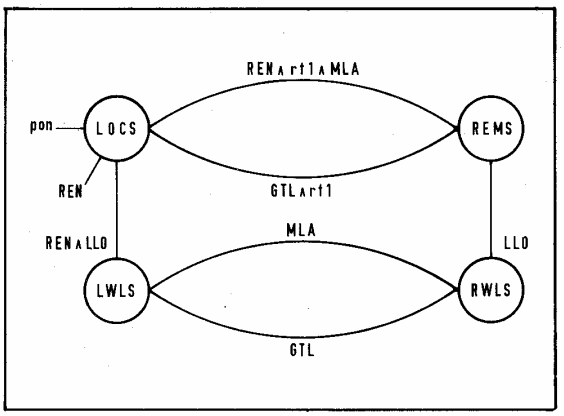
b) Set decades 1 to 5 of switch (35) to "1" or "0", in accordance with the binary digit corresponding to the selected decimal address (between 0 and 30).

c) Connect the controller to the instrument via the 24-pin connector (34).

LOCAL/REMOTE MODE

The 7100A meets conditions RL2 of IEEE Standard No. 488, which stipulates that the programmed mode may be LOCAL or REMOTE, with the facility for locking the operation of the instrument.

This RL2 function is represented schematically in the following diagram, which is accompanied by its mnemonic table.



CONTROL MESSAGES

pon : power on
rtl : return to local
REN : remote enable
LLO : local lockout
GTL : go to local
MLA : my listen address

MODES

LOCS : local state
LWLS : local with lockout state
REMS : remote state
RWLS : remote with lockout state.

NOTE : The message rtl is output by the transient position of the ON/STANDBY switch on the instrument.

When the controller is connected to the rear panel connector (34) and the IEEE bus is active (REN line at 0 V), the switch (23) can no longer be used to set the apparatus to STANDBY, whether in local or remote mode.

a) Switching to REMOTE mode :
The REMOTE mode is obtained on first selecting LISTEN ONLY addressing, provided that the REN line is active (REN = 0 V).

b) Return to LOCAL mode with or without lockout :
When the apparatus is in REMOTE mode (LISTEN ONLY addressing), the return to LOCAL mode is obtained by a command from the controller (GTL : Go To Local), or by manual operation of switch (23) of the 7100A. This manual control can be disabled by the controller, by sending out the command LLO (Local Lockout). After this, only the controller can order the return to LOCAL mode. The lockout condition is only interrupted if the bus returns to its idle state (REN - 1 V).

Figure 3-8 : FUNCTION PROGRAMMING (3/16)

Programming example

The following example is based on the use of a HP 9825 controller.

INITIAL OPERATING MODE \ PROGRAM OPERATING MODE	LOCAL STATE	REMOTE STATE	REMOTE WITH LOCKOUT STATE	LOCAL WITH LOCKOUT STATE
LOCAL STATE		wrt 7xx or rem 7xx	1107	✸
REMOTE STATE	lcl7 or lcl7xx or manual		✸	1107
LOCAL WITH LOCKOUT STATE	lcl7	✸		rem7xx or wrt7xx
REMOTE WITH LOCKOUT STATE	lcl7	✸	lcl7xx (but not manual)	

✸ impossible xx 7100A address

CONTROL STATUS ON SWITCHING TO REMOTE MODE

On switching on and first selecting REMOTE mode, the main instrument functions are in the following states :

- the displays of frequency (F), amplitude (A), operating mode (RF) and modulation (FM and AM) are the same as apply in LOCAL mode ;
- the frequency adjustment VERNIER is disabled (V0) or enabled (V2) ;
- the AM level, FM/PM deviation and level Vernier potentiometers are enabled (P1).

On return to LOCAL mode, the frequency and amplitude still correspond to the programmed values. The modulation (AM/FM), operating mode (RF) and frequency Vernier (V) correspond to the local control applicable befire switching to REMOTE mode.

Figure 3-8 : FUNCTION PROGRAMMING (4/16)

FUNCTION PROGRAMMING

FREQUENCY

a) Using program option 004, program the MNEMONIC PREFIX "F or f" followed, in free format, by the frequency in Hertz. The frequency resolution for each frequency range is indicated in the table below :

Frequency range	Option 004 resolution
0 - 81.25 MHz	500 Hz
80 - 162.5 MHz	125 Hz
160 - 325 MHz	250 Hz
320 - 650 MHz	500 Hz
640 - 1300* MHz	1 kHz

*Frequency doubler option.

For example, a frequency of 559.480 MHz may be programmed in various ways :
- "F 599480000"
- "F 599.48 e 6"
- "F 5.9948 e 8"

Note : A program frequency which is a multiple of one of the frequency resolution steps is rounded off where necessary.

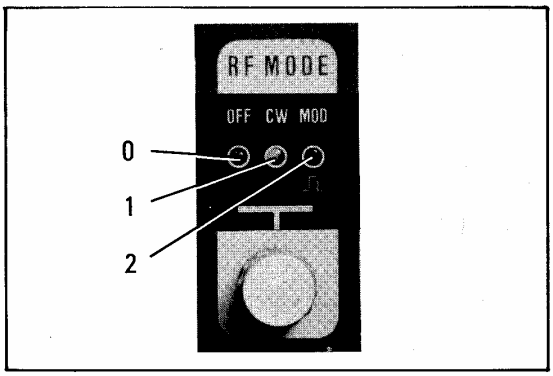
b) With programming options 004 and 005, the frequency resolution may be as low as 1 Hz if the frequency Vernier control is programmed (V1). Refer to the corresponding section below.

c) The display (1) indicates the output frequency corresponding to the programmed frequency (or to the rounded off frequency).

OPERATING MODE

a) Program the MNEMONIC PREFIX "RF" followed by the digit specifying the required mod (0 to 2) :

"RF0" : disable
"RF1" : CW
"RF2" : MOD



VERNIER

a) Program the MNEMONIC PREFIX "V or v" followed by a digit (0 to 2) indicating if the Vernier is disabled, remotely variable, or manually variable :

"V0" : Vernier disabled, frequency resolution is 125 Hz, 250 Hz, 500 Hz or 1 kHz depending on the frequency range selected.

"V1" (programming option 005 only): Vernier programmed to provide frequency resolution of 1 Hz for output frequency. This command is incompatible with FM command F41, F42 or F43.

"V2" : manual control of Vernier and rear panel analogue controls enables.

Figure 3-8 : FUNCTION PROGRAMMING (5/16)

FUNCTION PROGRAMMING

NOTE : For the "V2" situation, the output frequency can also be set by an analogue control voltage input via connector (31) on the rear panel. The range of frequency variation obtained by manual control of the Vernier, analogue control via the rear panel connector or frequency modulation with d.c. coupling must not exceed ± 3 kHz.

For the "V0" situation, the set frequency can only be varied by the frequency shift introduced in FM mode by injection of the d.c. component at the modulating signal input.

In the "V1" situation, the inadvertent programming of parameters "V1" and "FM41", "FM42", "FM43" modifies the output data, as shown in the table below. The output equivalence in fact depends on the order in which the two parameters are programmed.

Parameter programming order	Equivalent to
FM41 V1	FM31 V1
FM42 V1	FM32 V1
FM43 V1	FM33 V1
V1 FM41	V0 FM41
V1 FM42	V0 FM42
V1 FM43	V0 FM43

AMPLITUDE

a) Program the MNEMONIC PREFIX "A or a" followed by, in free format, the level expressed in dBm. For levels below 0 dBm (224 mV rms), the value indicating the level should be preceded by the symbol "-" :

"A18" = + 18 dBm
"a -135.8":-135.8 dBm
"A -4.63 e 1" : - 46.3 dBm

NOTE : The 0.1 dB resolution is obtained only if the potentiometers are disabled (refer to corresponding section on page III-25).

b) A level may be read off from meter (8) after switching on the "RF" indicator lamp using switch (6).

c) The OVERLOAD indicator lamp (5) comes on to indicate that the maximum permitted peak power rating has been exceeded :
+ 20 dBm in the direct range, or
+ 10 dBm in the frequency-doubling range.

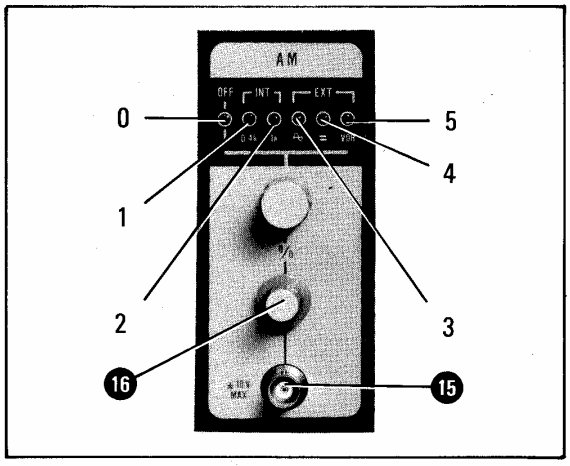
Figure 3-8 : FUNCTION PROGRAMMING (6/16)

AMPLITUDE MODULATION

a) Program the MNEMONIC PREFIX "AM or am" followed by a digit (0 to 5) corresponding to the required modulation mode :

"AM0" : function disabled
"AM1" : AM by internal 400 Hz signal
"AM2" : AM by internal 1 kHz signal
"AM3" : AM by external a.d.-coupled signal
"AM4" : AM by external d.c.-coupled signal
"AM5" : external VOR.

NOTE : In AM mode with d.c. coupling, the d.c. component modifies the level and therefore results in a discrepancy relative to the programmed value : the actual mean level is then indicated by the meter.



Ⓐ - AM from option 004

b) For AM modulation from the internal source, the modulation level is 100 % when potentiometer control is disabled (P0). Refer to corresponding section on page III-25.

c) The AM level is adjusted using potentiometer 16 and meter 8 when potentiometer control is enabled (P1).

d) When the source of modulation is external, connect the modulating signal to connector 15 . The AM level is adjustable using potentiometer 16 and meter 8 if potentiometer control is enabled (P1). If not, the AM level can only be adjusted by an externally programmable generator, with an input level of 200 mV rms for 100 % modulation.

e) The OVERLOAD indicator lamp 9 comes on to indicate that the permitted maximum peak output level has been exceeded. Decrease the modulation level or the output level until this lamp goes out.

Ⓑ - AM from option 004 and 005

a) The AM level is determined by programming the MNEMONIC PREFIX "%" followed by a number between 0 and 100 (resolution x 1 %). The input level of the modulating signal at socket 15 must be set to 1 V rms into 600 Ω.

NOTE : The AM level can only be programmed if potentiometer control is disabled (refer to corresponding section on page III-25). If not, the AM level is adjusted by potentiometer 16 , the input sensitivity being 200 mV rms for 100 % modulation.

b) The AM level may be read off from meter 8 , indicator lamp 9 indicating if the permitted maximum peak power rating is exceeded.

Figure 3-8 : FUNCTION PROGRAMMING (7/16)

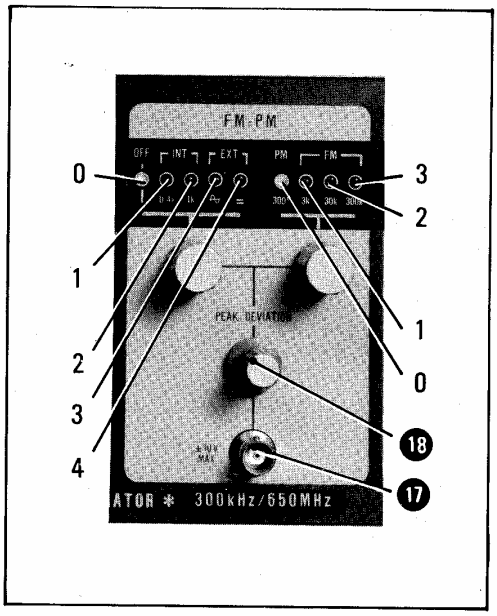
FUNCTION PROGRAMMING

FREQUENCY OR PHASE MODULATION

a) FREQUENCY MODULATION : Program the MNEMONIC PREFIX "FM or fm" followed by two digits specifying the required modulation and deviation :

"FM1x" : FM by internal 400 Hz signal
"FM2x" : FM by internal 1 kHz signal
"FM3x" : FM by a.c.-coupled external signal
"FM4x" : FM by d.c.-coupled external signal

(X) = 1 : deviation ± 3 kHz
2 : deviation ± 30 kHz
3 : deviation ± 300 kHz



NOTE : In FM mode with d.c. coupling, the frequency Vernier cannot be programmed (V1) and vice versa (refer to section on the VERNIER on page III-25).

b) PHASE MODULATION : Program the MNEMONIC PREFIX "PM or pm" followed by a digit (1 - 4) specifying the modulation mode :

- "PM1" : PM by internal 400 Hz signal
- "PM2" : PM by internal 1 kHz signal
- "PM3" : PM by a.c.-coupled external signal
- "PM4" : PM by d.c.-coupled external signal

NOTE : Phase modulation may also be obtained by programming the mnemonic prefix "FM or fm" followed by 2 digits, the second of which is always 0.

Ⓐ - FM or PM from option 004

a) When using the internal source of modulation, the FM or PM deviation is maximum when potentiometer control is disabled (P0). Refer to corresponding section on page III-25).

b) The FM or PM deviation is adjusted using potentiometer 18 and meter 8 when potentiometer control is enabled (P1).

c) Using an external source of modulation, input the modulating signal to connector 17. The FM or PM deviation is adjustable by potentiometer 18 and meter 8 when potentiometer control is enabled (P1). If not, the adjustment is obtained by means of an external programmable generator with an input level of ± 3 V rms for full FM or PM deviation.

NOTE :

In FM mode with d.c. coupling, the carrier shift resulting from the connection of a d.c. component via input 17 is taken into account in the frequencymeter display.

If the modulating frequency is greater than 30 Hz, the display corresponds to the average value or fluctuates around the instantaneous value with a period of 0.25 second.

Figure 3-8 : FUNCTION PROGRAMMING (8/16)

Ⓑ- FM or PM from options 004 and 005

a) The FM deviation is set by programming the MNEMONIC PREFIX "D" followed by the deviation sensibility as a multiple of the step corresponding to 1/300 of the programmed range (± 3 k, ± 30 k or ± 300 k).

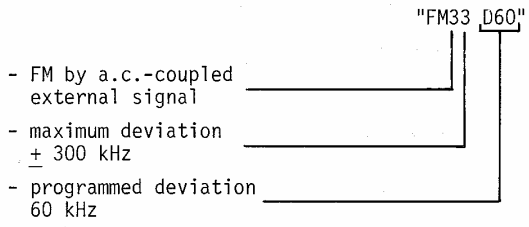
b) The PM deviation is set by programming the MNEMONIC PREFIX "D" followed by a number between 0 and 300 (resolution 1°).

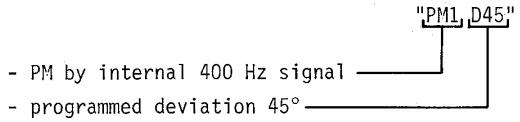
c) In both cases, the modulating signal at input (17) must be at a level of 3 V rms at an impedance of 600 Ω.

NOTE : The FM or PM deviation can only be programmed if potentiometer control is disabled (refer to corresponding section on page III-25).

d) The programmed FM or PM deviation is indicated on displays (7) and (8).

e) FM and PM programming examples :





POTENTIOMETER CONTROL ((18) , (16) and (13))

a) Program the MNEMONIC PREFIX "P" followed by digit 0 or 1 to disable or enable the 3 potentiometers :

- "P0" : the 3 potentiometers are disabled. For instrument with programming option 005, the FM, PM, AM and output levels are adjusted as follows :

  FM : sensitivity as a multiple of the step corresponding to 1/300 of the range (± 3 k, ± 30 k or ± 300 k)
  PM : resolution 1°
  AM : resolution 1 %
  Output level : 0.1 dB steps.

For instruments without programming option 005, the AM level and FM or PM deviation can only be programmed using an external programmable generator. The modulating input signal levels are as follows :

Figure 3-8 : FUNCTION PROGRAMMING (9/16)

AM : 200 mV rms for 100 % modulation
FM-PM : ± 3 V rms for deviation of ± 3 kHz, ± 30 kHz, ± 300 kHz or 300°.

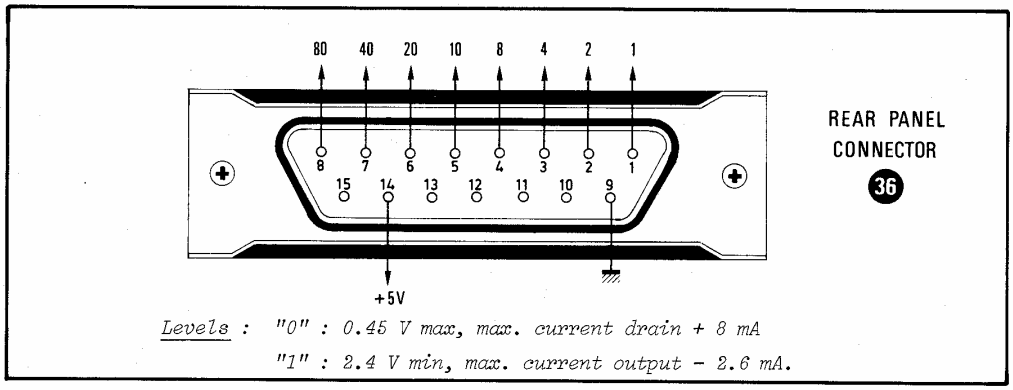
The output level resolution is 0.1 dB.

NOTE : In that case, auxiliary programming connector 36 provides BCD signals derived from the data sent on the IEEE bus. Which make it possible to control the modulating signal generator.

- "P1" : the 3 potentiometers are enabled. With the 005 programming option, the output level resolution is 1 dB and program control of the FM and PM deviation (D) and AM level (%) are disabled.

AUXILIARY OUTPUT

a) Program the MNEMONIC PREFIX "X or x" followed by a 2-digit number between 00 and 99. The corresponding BCD number is output to connector 36 on the rear panel. The diagram below shows the BCD weighting of the output signal at each connector pin.



Levels : "0" : 0.45 V max, max. current drain + 8 mA
"1" : 2.4 V min, max. current output - 2.6 mA.

TALKER FUNCTION

When programmed in LOCAL or in REMOTE mode, the instrument replies when addressed in TALKER mode, giving the value of the set frequency, allowing for variations due to the Vernier control, the analogue control via the rear panel connector, the FM modulation with d.c. coupling and the rounding off of the frequency (where applicable).

The response sent to the controller consists of a message comprising 13 ASCII characters, with the following format :

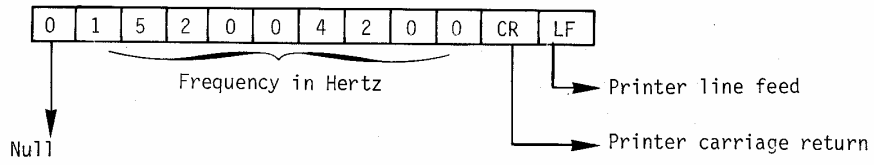
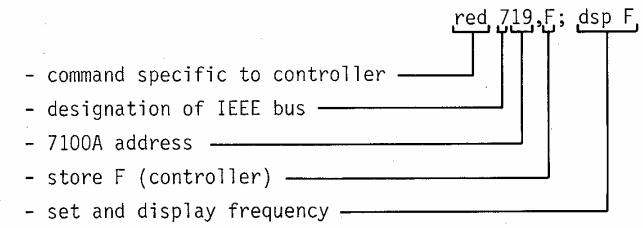


Figure 3-8 : FUNCTION PROGRAMMING (10/16)

FUNCTION PROGRAMMING

Programming the TALKER function from the HP 9825 controller uses the following addressing for examples:



PROGRAMMING EXAMPLES

The following examples show how external command instructions are programmed, without providing an exhaustive listing as far as programming order and selection of free format are concerned. These examples are included for the guidance of first-time users programming the instrument in external mode.

With a view to facilitating comprehension, all the following examples are bases on the use of the HP 9825 controller as the programming source. It should be understood, however, that the instrument can be programmed from other types of controller.

Ⓐ-OUTPUT OF A CONTINUOUS PURE WAVE (CW)

The parameters to be defined are :

- "F" for the frequency
- "V" for the frequency Vernier
- "RF" for the functioning mode
- "A" for the output level
- "P" for potentiometer control.

In this examples, the output signal frequency is 458.736273 MHz and the output signal level is - 28.3 dBm.

OPTION 004

a) Program :

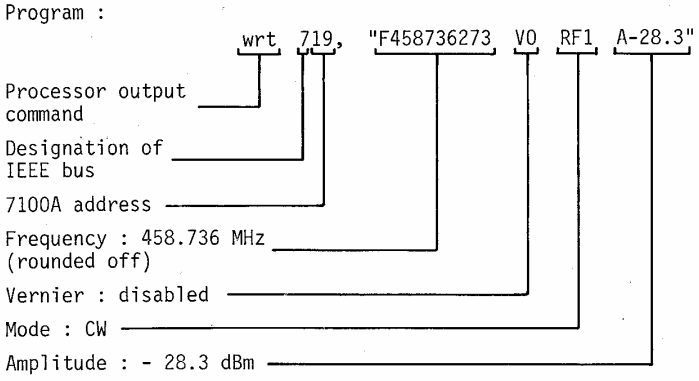
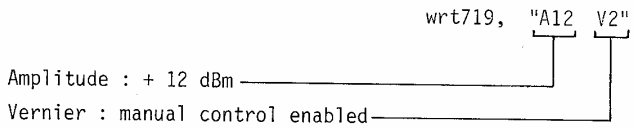


Figure 3-8 : FUNCTION PROGRAMMING (11/16)

FUNCTION PROGRAMMABLE

NOTE : The 7100A ignores digits following a comma or a space. As the frequency is not a multiple of a resolution (see page III-25), it is rounded off. As the potentiometer control mode is not programmed, it is taken as P0.

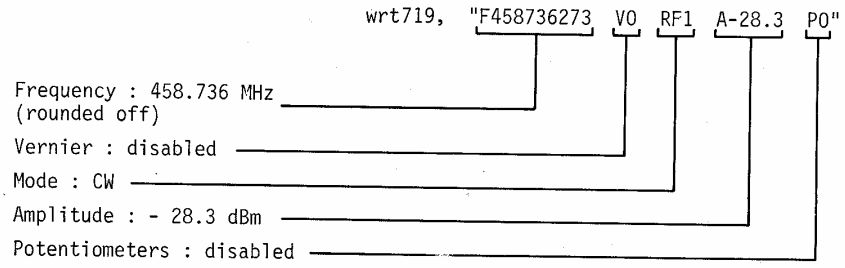
b) To modify parameters V and A, program :



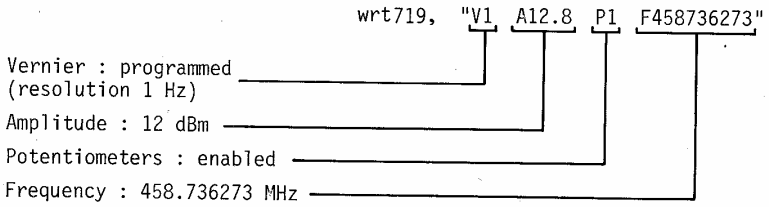
NOTE : By programming "V2", the output frequency may be defined by an external analogue control signal input to connector 31 on the rear panel.

OPTION 004 + 005

a) Program :



b) To modify the parameters V, P, A and F, programs :



NOTE : The output frequency corresponds to the programmed value, as the Vernier is used in programmed mode, providing 1 Hz resolution.

The output level is 12 dBm plus or minus the value corresponding to the setting of Vernier 13.

The enabling of potentiometer 13 cancels the programming of the 0.1 dB steps.

Figure 3-8 : FUNCTION PROGRAMMING (12/16)

(B) - OUTPUT OF MODULATED SIGNAL

The parameters to be determined are :

- "F" for the frequency
- "V" for the Vernier
- "FM" or PM" for frequency or phase modulation
- "AM" for amplitude modulation
- "RF" for operating mode
- "P" for potentiometers.

With the 005 option, the following parameters must also be programmed :

- "%" for the modulation depth
- "D" for the FM or PM deviation.

The example applies to the modulation of a signal at 350.245750 MHz at a level of 10.7 dBm.

OPTION 004 - AMPLITUDE MODULATION

Program :

```
wrt719, "F35024.5750 e4  V0  AM2  RF2  A10.7  P0"
```

Frequency : 350.245500 MHz (rounded off)
Vernier : disabled
Modulation : 1 kHz external signal
Mode : modulated
Level : 10.7 dBm
Potentiometers : disabled

NOTE :

The frequency is rounded off as it is not a multiple of the frequency resolution.
The 7100A ignores digits following a comma or a space.
The modulation depth is controlled by an external programmable generator.

Figure 3-8 : FUNCTION PROGRAMMING (13/16)

FUNCTION PROGRAMMING

OPTION 004 - FREQUENCY MODULATION

Program

wrt719, "F350.245750 e6 V2 FM42 AM0 RF2 A10.7 P0"

Frequency : 350.245500 MHz (rounded off)

Vernier : manual control enabled

Modulation : external d.c.-coupled signal, deviation ± 30 kHz

Internal modulation signal : disabled

Mode : modulated

Level : 10.7 dBm

Potentiometers : disabled

NOTE : The programmed frequency is rounded off as it is not a multiple of the frequency resolution.

By programming "V2", the output frequency may be defined by an external analogue control signal input to connector 31 on the rear panel.

Simultaneous AM and FM modulation can be applied by programming both parameters.

The FM deviation is controlled by an external programmable generator.

OPTION 004 - PHASE MODULATION

wrt719, "RF2 V0 PM3 F350245.750 e3 A10.7 P0"

Mode : modulated

Vernier : disabled

Modulation : external a.c.-coupled signal

Frequency : 350.250500 MHz (rounded off)

Level : + 10.7 dBm

Potentiometers : disabled

NOTE :

The PM deviation is controlled by an external programmable generator.

Simultaneous AM and PM modulation can be applied by programming both parameters.

The programmed frequency is rounded off as it is not a multiple of the frequency resolution.

Figure 3-8 : FUNCTION PROGRAMMING (14/16)

FUNCTION PROGRAMMING

OPTION 005 - AMPLITUDE MODULATION

Program :

wrt719, "F35024.5750e4 V1 AM3 RF2 A10.7 P0 %55"

Frequency : 350.245750 MHz
Vernier : programmed (resolution 1 Hz)
Modulation : external a.c.-coupled signal
Mode : modulated
Level : + 10.7 dBm
Potentiometers : disabled
AM level : 55 %

NOTE :

The output frequency corresponds to the programmed value, as the Vernier is used in programmed mode, providing 1 Hz resolution.

The AM level and the 0.1 dB output level resolution can be programmed as potentiometer control is disabled.

OPTION 005 - FREQUENCY MODULATION

Program :

wrt719, "V0 RF2 A10.7 FM33 P1 F3.50245750e8"

Vernier : disabled
Mode : modulated
Level : + 10 dBm
Modulation : external a.c.-coupled signal, deviation ± 300 kHz
Potentiometers : enabled
Frequency : 350.245500 MHz

NOTE :

As the potentiometers are enabled, the output level resolution must be 1 dB.

The output frequency is rounded off as it is not a multiple of the frequency resolution.

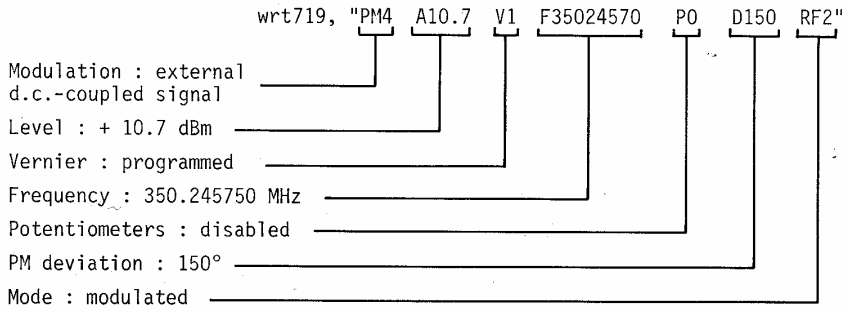
Simultaneous AM and FM modulation can be applied by programming both parameters.

Figure 3-8 : FUNCTION PROGRAMMING (15/16)

FUNCTION PROGRAMMING

OPTION 005 - PHASE MODULATION

Program :



Note : Simultaneous AM and PM modulation can be applied by programming both parameters.

Figure 3-8 : FUNCTION PROGRAMMING (16/16)

SELF_TESTING

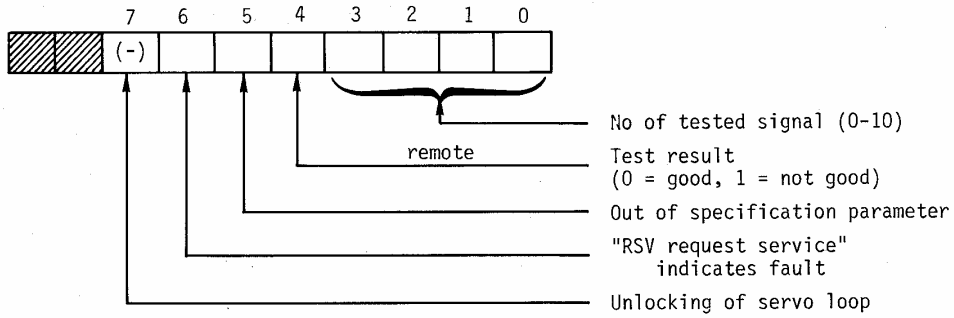
STATUS

The instrument provides function SR1 (IEEE standard 488).

It outputs the SRQ signal (service request) on the bus when either of the following 2 conditions occurs :

- out of specification parameter programmed (e.g. F1 e9 if the frequency-doubling option is not included) ;
- unlocking of synthesis loops, indicated by "-" flashing in display.

The controller can then request a status byte using the serial Polling proceeding. The status byte has the following format :



TEST

The 7100A signal generator includes a self-testing facility for easing maintenance operations and for preventing misoperations on the part of the user. To this end the self-testing facility tests the 3 servo loops and the principal internal signal levels :

- a steady "-" at the most significant end of the display in local mode indicates that the user is attempting to operate the instrument outside its specification (frequency < 300 kHz) ;
- a flashing "-" indicates an internal fault (unlocking of one of the 3 loops). The local or programmed test procedure must then be run.

Using this test facility requires the preliminary setting of output frequency, output level and functional mode to 79 MHz, + 13 dBm and CW.

Figure 3-9 : SELF TESTING

MANUAL (LOCAL) TEST

a) Remove the top panel of the instrument and set the TEST switch of the REGISTER board (See figure on page

b) The number of the test point being checked and the results are displayed on the 10^0 - 10^2 Hz bits of display (1)

c) Switch on the resolution indicator lamp "0" by operating pushbuttons (24), and then operate pushbutton (22) to increment or decrement the number of the tested signal (0 - 10).

d) The units and tens digit of the frequency display indicate the number of the signal under test, the result of the test being indicated by the third digit :

- off : signal correct
- on : signal degraded.

The test points are listed below, and are indicated on drawing IV-1 (7100A general block diagram).

00 : Input level of 2 MHz reference signal or 2 MHz $\pm$ ΔF from vernier control.

01 : Output level FP/40 (from 10 kHz step module).

02 : Output level of 10 MHz step module.

03 : Output level of VHF module.

04 : Output level of 20 - 25 MHz module.

05 : Output level FS/40 (VHF module).

06 : 400 MHz output level (10 MHz step module) : this signal is only enabled when the output frequency exceeds 80 MHz.

07 : Level of difference frequency (20/25 MHz) derived from 300/670 MHz and 320/650 MHz oscillators (VHF module).

08 : 1 kHz control frequency of 20/25 MHz oscillator.

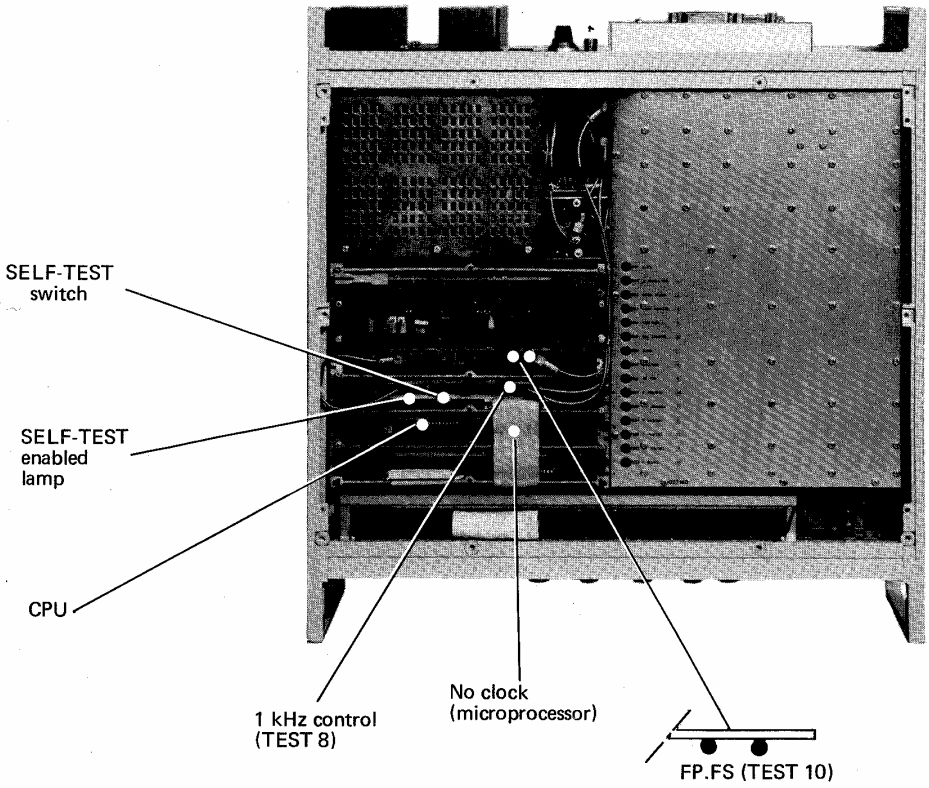
09 : Level of 4 MHz difference frequency (phase-frequency comparator board).

10 : FS and FP servo control (counter board).

For ease of maintenance and so as to offer improved efficiency, the instrument comprises internal indicator lamps which complement the self-testing facility by indicating the absence of the required level at certain test points, determining the faulty signal (FP or FS) for test 10 and indicating the operating state of the microprocessor.

Figure 3-9 : SELF-TESTING

The diagram below shows the positions of these test lamps and the "TEST" switch :



The "CPU" indicator lamp flashes during each intervention by the microprocessor, the scanning phase being triggered by any operation of the front panel control.

The "no clock" indicator lamp comes on if the clock signal of the controlling element is incorrect.

The "1 kHz control" indicator lamp comes on when test 8 gives a negative result.

When the result of test 10 is negative, the lamps "FP-FS" indicate the signal providing the locking of the loop. The FS lamp comes on when the signal obtained from the 320/650 MHz oscillator is incorrect. Both lamps come on to indicate a fault in the signal from the 300/670 MHz oscillator.

When the fault has been located, return the TEST switch to its initial position, in which case the test lamp should go out. Replace the rubber washers for the bottom panel fixing screws and replace the bottom panel. It is important that the same rubber washers are used, as their high conductivity ensures a good earth connection.

Figure 3-9 : SELF TESTING

PROGRAM (REMOTE) TEST

The instrument is interrogated via the controller, as follows :

a) Program the MNEMONIC PREFIX "T" followed by a number from 0 to 10.

b) The serial polling status is read off from bit 4 of the status byte, a "0" indicating no fault and a "1" indicating a fault at the level being tested.

Figure 3-9 : SELF TESTING

CHAPTER IV

OPERATING PRINCIPLES

4.1 INTRODUCTION

This chapter sets out a simplified description of the principal frequency generator circuits of the 7100A signal generator, indicating the points at which the AM, FM or PM modulation is applied and the output level regulation effected.

The chapter ends with a description of the structure and operation of the microprocessor.

The general block diagram of the 7100A and the circuit diagrams for the various modules and circuit cards are contained in drawings IV-1 and IV-21, respectively.

4.2 OPERATION PRINCIPLES

The 7100A signal generator provides a very high level of spectral purity comparable with that of an LC resonant circuit or cavity resonator with a high overvoltage coefficient or with that obtained using indirect frequency synthesis.

An oscillator with a high overvoltage coefficient (a precondition for a high level of spectral purity) generates the small frequency steps whereas a digital control loop provides the frequency programming function and is responsible for the accuracy and stability of the output frequency.

The larger frequency steps are generated in a circuit using frequency synthesiser techniques, based on new technology made possible by the relatively small number of steps to be generated, and built around very low noise circuits. This means that only low multiplication ratios are needed, in conjunction with a very pure reference source.

The 7100A signal generator therefore comprises a short-term free-running oscillator operating at 20 to 25 MHz, with long-term control from a quartz crystal oscillator, this section being followed by a frequency synthesizer offering high spectral purity which provides the larger frequency steps and extends the frequency range to 650 MHz without degrading the spectral quality of the 20 to 25 MHz oscillator. A simplified block diagram of the frequency generation system is given in figure IV-1.

The output frequency lies in one of 4 sub-ranges, the microprocessor providing an automatic range-switching function.

A wideband oscillator covers the frequency range from 320 to 650 MHz, which is divided down by 2 or 4 to generate the 160/320 MHz band and the 80/160 MHz band. The 0.3/80 MHz band is obtained by heterodyning the fixed frequency of 400 MHz and the oscillator frequency which, in this instance, is variable between 480 and 400 MHz.

The output oscillator is included in the frequency increment control loop, and is controlled through two mixers by a signal obtained by addition or subtraction of the frequencies obtained at the outputs of two other oscillators, the "20 to 25 MHz" oscillator and the "300 to 370 MHz" oscillator.

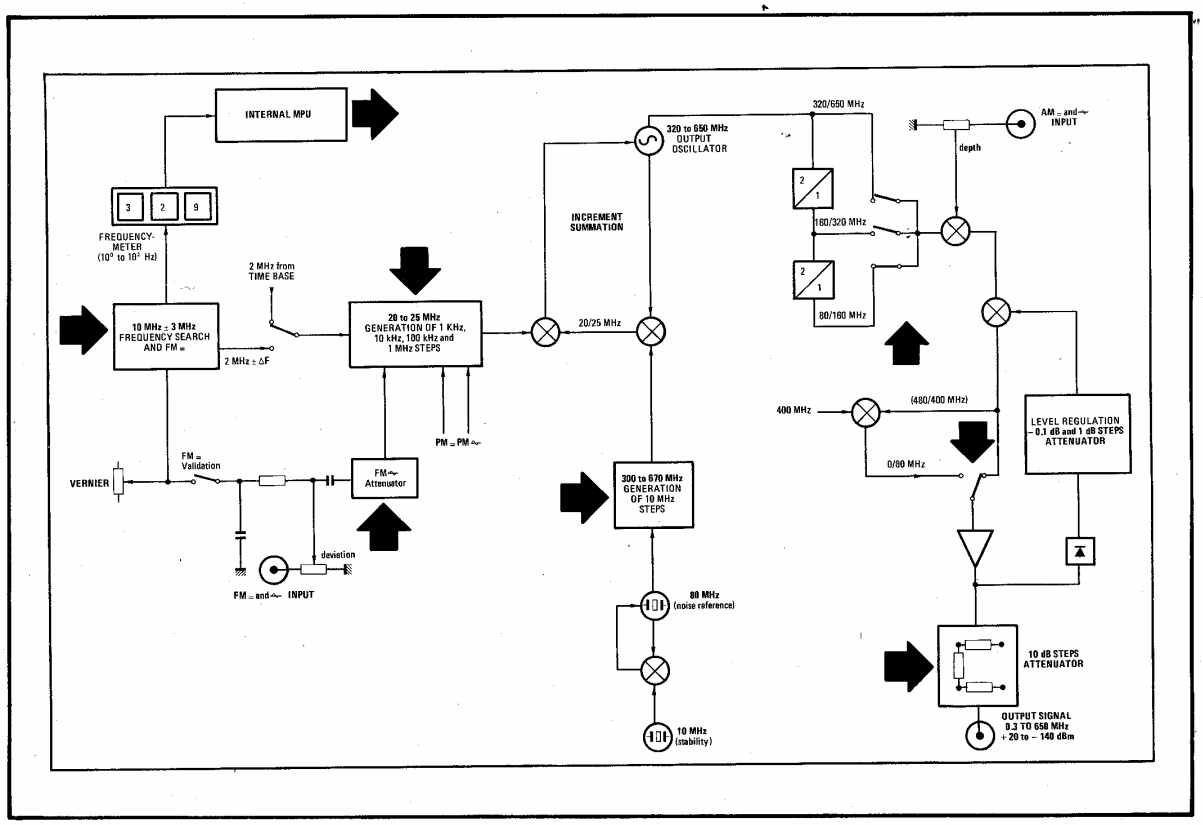


Figure 4-1 : 7100A SIGNAL GENERATOR BLOCK DIAGRAM

4.3 GENERATION OF SMALL FREQUENCY STEPS

The 20 to 25 MHz oscillator is in reality implemented as an 80/100 MHz oscillator operating in conjunction with a "divide by 4" circuit (refer to figure IV-1). This oscillator generates the small frequency steps (1 kHz, 10 kHz, 100 kHz and 1 MHz). The maximum resolution of the loop is in reality 500 Hz. In conjunction with the use of a microprocessor, this provides a frequency step of 12.5 kHz corresponding to the standard channel spacing and also means that the same output resolution is obtained in the direct output range (up to 650 MHz) and in the extended range when the frequency doubler option is included (up to 1300 MHz).

The 20 to 25 MHz circuit comprises two interleaved loops, the frequency steps being programmed by means of a counter with a high division ratio. The control loop for the 80/100 MHz oscillator (20 to 25 MHz) can therefore have a small passband (5 Hz), so that alternating FM modulation can be applied directly at the oscillator output. The deviation ranges $\pm$ 3 kHz, $\pm$ 30 kHz and $\pm$ 300 kHz obtained by analogue division are maintained constant throughout the frequency band (0.3 to 650 MHz) by means of correction circuits which are enabled by the microprocessor.

Phase modulation is also provided by this "20 to 25 MHz" circuit, operating on the 80/100 MHz oscillator with AC input coupling or on a phase comparator with DC coupling. The phase deviation is also constant across the whole of the frequency band.

The same comparator can be switched to receive the frequency 2 MHz $\pm$ ΔF from the interpolation circuit and to introduce into the frequency generation loop small discrete frequency variations produced by operating the vernier control on the front panel.

The maximum excursion (5 MHz) of the 20 to 25 MHz oscillator is insufficient for generation of all steps equal to or less than 10 MHz (i.e. maximum excursion of 9.999 999 MHz). This involves setting the latter in the direct spectrum from 20 to 25 MHz and then in the inverted spectrum from 25 to 20 MHz. This feature, in conjunction with automatic switching of the 10 MHz steps (obtained from the 300 to 670 MHz oscillator) and with the cutting out of the 320 to 650 MHz oscillator prevents the appearance of transient signals at the generator output during frequency changing. The setting in the inverted spectrum requires switching over certain circuits so as to maintain various parameters in the same deviation sense as the 20/25 MHz frequency. All these operations, indicated symbolically in figure IV-1 and on drawing IV-1 by bold arrows, are automatically carried out by the microprocessor each time the operating mode is changed (32/58 MHz oscillators, comparators, FM correctors, etc.).

4.4 GENERATION OF 10 MHz STEPS

The wideband 300 to 670 MHz oscillator generates the 10 MHz steps across the whole frequency band using a sample and hold comparator. This loop actually provides only fine control of the oscillator, an approximation of the operating frequency being obtained by a first loop which is enables by the microprocessor.

The sampling is obtained as shown in drawing IV-1, on the difference frequency between the 300 to 670 MHz output frequency of the oscillator and the frequency obtained at the output of the filter whose tuned frequency is switched by the microprocessor. The 10 MHz sampling frequency is obtained from the 80 MHz output frequency of the quartz-controlled oscillator used as the noise reference, the 10 MHz oscillator providing the medium and long-term stability characteristics of the instrument.

The microprocessor monitors the operation of this oscillator and the 10 MHz step generator, forcing it to take account of the operating mode of the 20/25 MHz oscillator (direct or inverse), to provide continuous frequency variation of the output oscillator frequency (320 to 650 MHz). This amounts to saying that the latter is sometimes controlled in accordance with an additive difference frequency and sometimes in accordance with a subtractive difference frequency.

The three oscillators therefore operate as follows, where :

- F_1 is the frequency : 20/25 MHz
- F_2 is the oscillator frequency : 300/670 MHz, and
- F_3 is the oscillator frequency : 320/650 MHz.

If the additional frequency F_2 is, for example, 320 MHz and F_1 varies from 20 to 25 MHz, the output oscillator frequency F_3 will increase from 340 to 345 MHz. In this instance, the control is based on the additive difference frequency between F_1 and F_2.

As soon as F_1 reaches 25 MHz, F_3 is locked at 345 MHz by the microprocessor, which simultaneously switches F_2 to 370 MHz. Control is thereafter based on the subtractive difference frequency between F_2 and F_1, so that F_3 varies from 345 to 350 MHz, continuously without generation of transience.

F_1 then operates in direct output again, from 20 to 25 MHz, F_3 being locked at 350 MHz and F_2 being switched to 330 MHz. The control of the output oscillator is based on the additive difference frequency between F_1 and F_2, F_3 varying from 350 to 355 MHz. This process is repeated across the whole frequency band of the signal generator.

Thus it will be seen that the output frequency of the 300/670 MHz oscillator switches to a value 50 MHz higher as soon as the small frequency step oscillator output reaches 25 MHz, subsequently switching to a value 40 MHz below the usual frequency when the output of this oscillator reaches 20 MHz. The frequency difference (10 MHz) between these 2 switching operations corresponds to the small frequency step increment (9.999 999 MHz).

4.5 FREQUENCY INTERPOLATION (VERNIER CONTROL)

Continuous variation of the frequency between the 1 kHz steps is obtained from a free-running oscillator operating at 10 MHz $\pm$ 3 MHz, the output frequency of which is divided down by a factor of 500, this division process reducing the instability of the oscillator by the same factor. The interpolation frequency is set on the basis of information sent to the microprocessor by a frequency meter, the microprocessor adding this to or subtracting it from the programmed small step value (20/25 MHz oscillator), knowing that the steps introduced by the interpolation circuit are between 0 and 1 kHz for the output range 320/650 MHz, 0 and 2 kHz for the range 160/320 MHz and 0 and 4 kHz for the range 80/160 MHz. For this reason, the maximum variation of the signal generator output frequency is, after all the various dividing down operations, approximately 2 kHz. When the instrument includes the frequency doubling option, the frequency variation introduced by the interpolation circuit is between 0 and 500 Hz for an output variation of 0 to 1 kHz.

This circuit also enables frequency modulation with transmission of the continuous component, the division ratio varying, as shown on drawing IV-1, as a function of the deviation range $\pm$ 3 kHz, $\pm$ 30 kHz and $\pm$ 300 kHz. The vernier is operative at all times for compensating the output frequency due to any carrier offset caused by re-injection of the continuous component, the frequency meter indicating the exact mean output frequency. Continuous frequency modulation is obtained by transmitting the modulating signal to the interpolation circuit (signal integrator) and to the 20/25 MHz oscillator (signal differentiator), the connection being perfect at 5 Hz.

4.6 OUTPUT CIRCUITS

The output frequency is in one of the ranges 320/650 MHz, 160/320 MHz and 80/160 MHz, and is selected by the microprocessor. It is applied directly to the inputs of the AM modulating circuits and to the input of a first regulator responsible for the insertion of the 0.1 dB and 1 dB program steps. An internal switch is used to select the 80/650 MHz or the 0.3/80 MHz range, the output frequency being obtained through the output amplifier and the 10 dB step attenuator.

4.7 MICROPROCESSOR AND ASSOCIATED LOGIC CIRCUITRY

The instrument is controlled by a microprocessor, figure IV-2 being a schematic representation of the internal control functions.

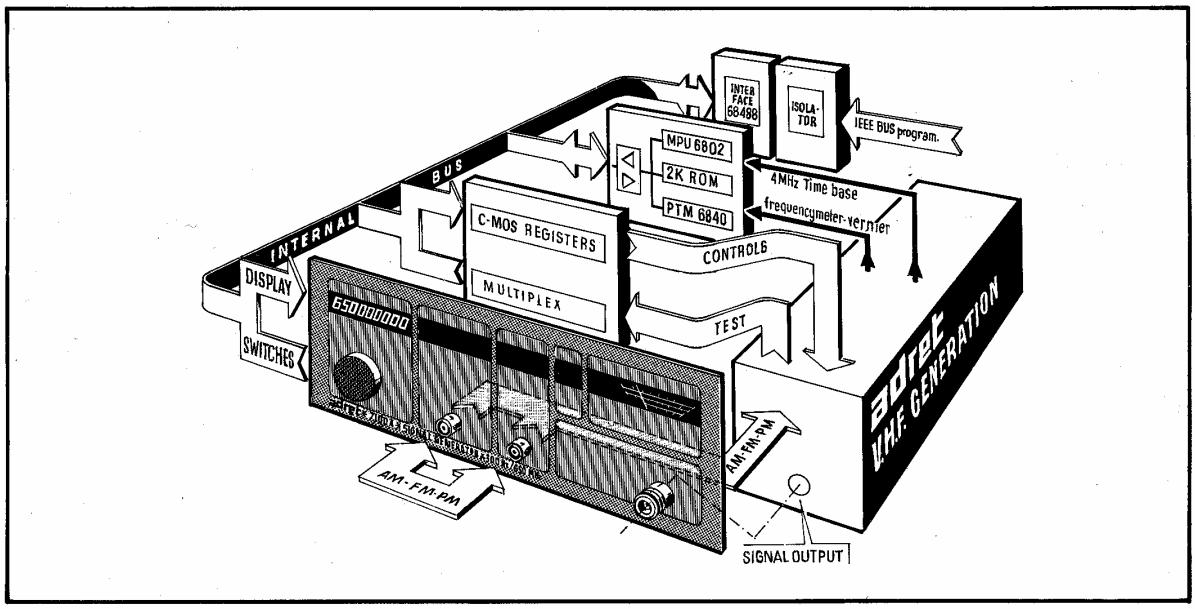


Figure 4-2 : MICROPROCESSOR-BASED INTERNAL CONTROL FUNCTIONS

DESCRIPTION OF THE HARDWARE STRUCTURE

The internal control system comprises 7 separate functions, implemented on 7 circuit cards :

a) The "PROCESSOR" card comprises the 6802 microprocessor with 128 bytes of RAM storing data representing all operating modes of the instrument (frequency, level, switch settings, etc.). The microprocessor programs are written into a 2708 ROM, occupying between 2 and 3 kilobytes, depending on the options included in the instrument. The program describes all the computations and other functions to be executed when a new command is received. A 684 programmable counter acts as a frequency meter for the interpolation frequency oscillator (10 MHz $\pm$ 3 MHz), the other associated circuits providing miscellaneous functions such as power down and power up detection. The logic circuitry external to this card is connected to the microprocessor via the internal bus of the instrument, through tristate gates.

b) The "FRONT PANEL SWITCHES AND DISPLAYS" card carries all the manually operated controls and associated displays (switches and optical coding wheel for frequency selection). An interrupt circuit informs the microprocessor of any change in the setting of any control.

c) The "REGISTER" card holds circuits storing the command bits for the HF and VHF subsystems and the tristate gates for entry of signals tested by the microprocessor.

d) The "COUNTER" card holds the two programmable counters for the frequency synthesizer function (32000 to 58000 and 30 to 67 counters). This card is connected to the CPF card for control of the various oscillators.

e) The "ANALOGUE FRONT PANEL" card carries the circuits for processing the AM and FM modulating signals, the level regulator and the vernier control circuit.

f) The"IEEE PROGRAMMING BUS" card enables the instrument to be programmed from a computer with an IEEEE 488 or IEC TC66 interface, and also provides galvanic isolation between the signal generator and computer earth circuits.

g) The "COMPLEMENTARY PROGRAMMING" card is used in conjunction with the "IEEE programming bus" card for programming the AM modulation level and the FM frequency deviation, using 2 digital-analogue converters, the 1 Hz step vernier being programmed through the programmable counter controlling the operation of the frequency interpolation circuit.

OPERATION

When the microprocessor has carried out all its tasks, it switches to a standby state which is interrupted only by a change in the setting of any of the external controls. It therefore has no function in terms of the generation of the output frequency.

However, as soon as a "stop" command is received, the microprocessor interrogates all interrupt sources to identify which one is active. It then processes the various operations to be carried out in accordance with received commands, and sends new states to the instrument and the display. A general block diagram of the various operations is set out in figures IV-3 and IV-4, the first showing the PRINCIPAL LEVEL at which the various computations and I/O operations are carried out, the second showing the INTERRUPT LEVEL used for identifying the cause of the interrupt which is simply listed by the setting of an indicator which is interrogated when the microprocessor has terminated the interrupted task.

GLOSSARY

BIT : Smallest unit of binary data (contraction of BInary digiT)

BYTE : A "word" comprising 8 "bits"

RAM : Random Access Memory

ROM : Read Only Memory

WORD : A set of binary digits which operate as a unit and which represent a number.

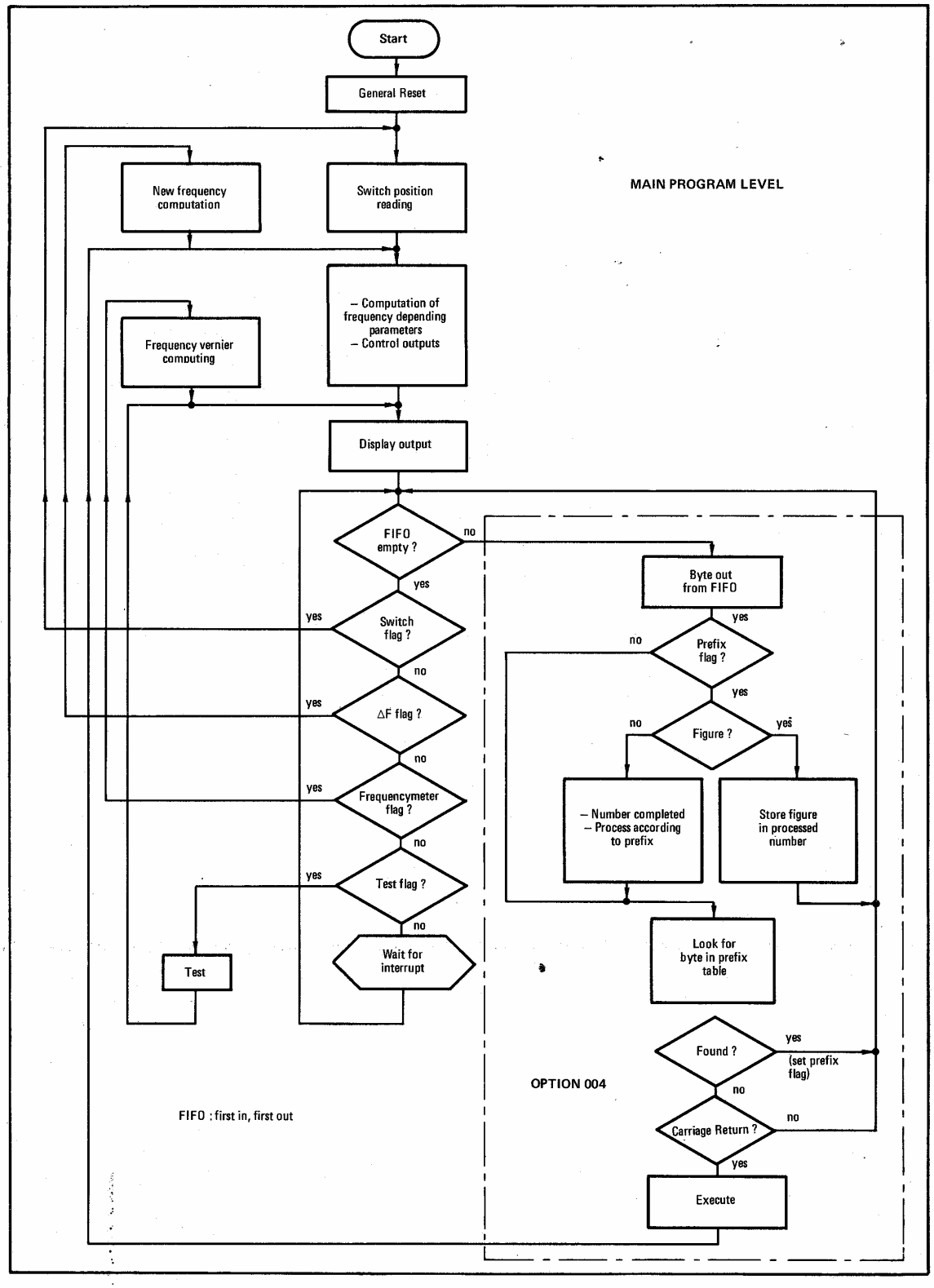


Figure 4-3 : MICROPROCESSOR FLOW CHART (MAIN PROGRAM LEVEL)

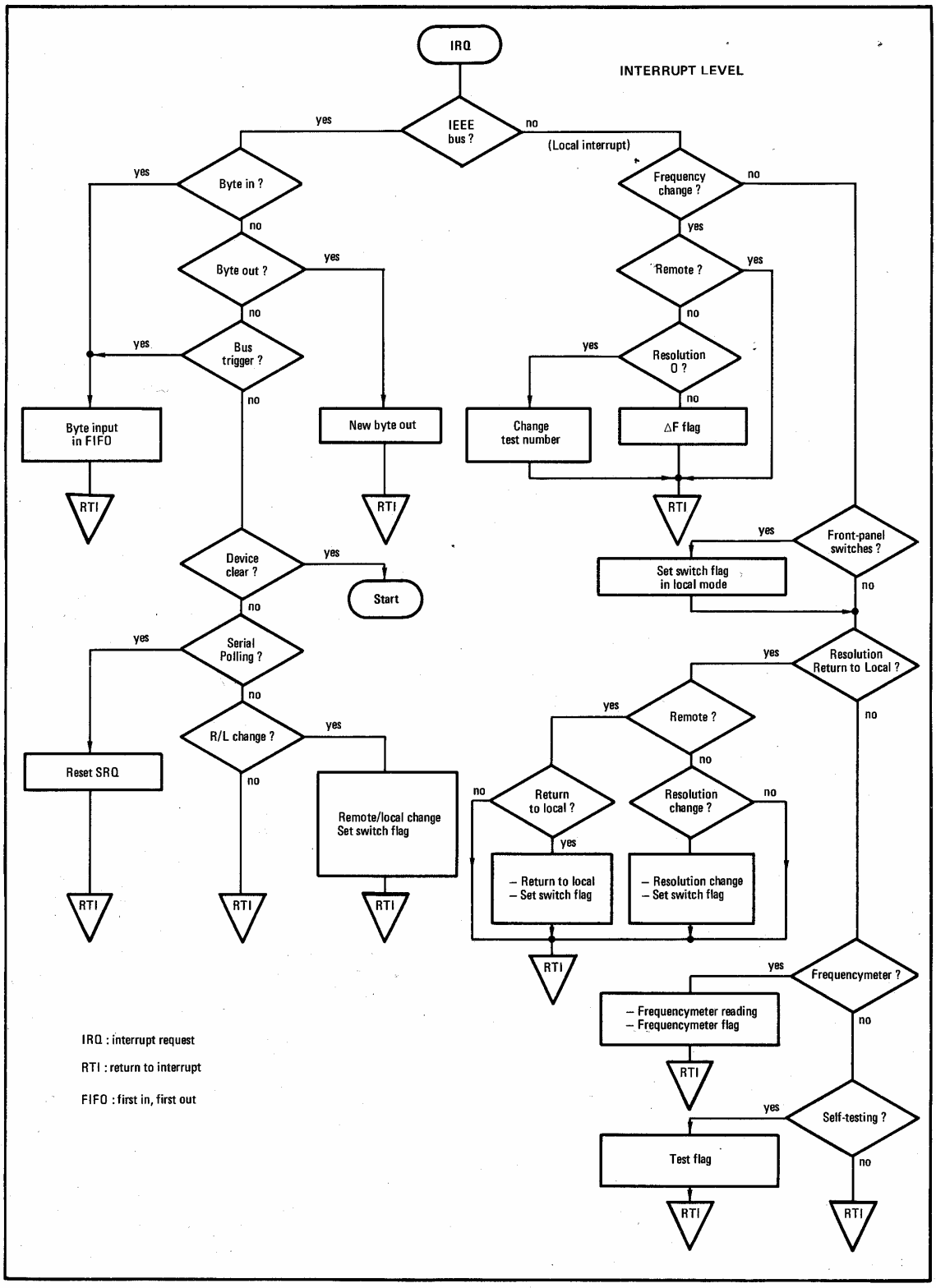
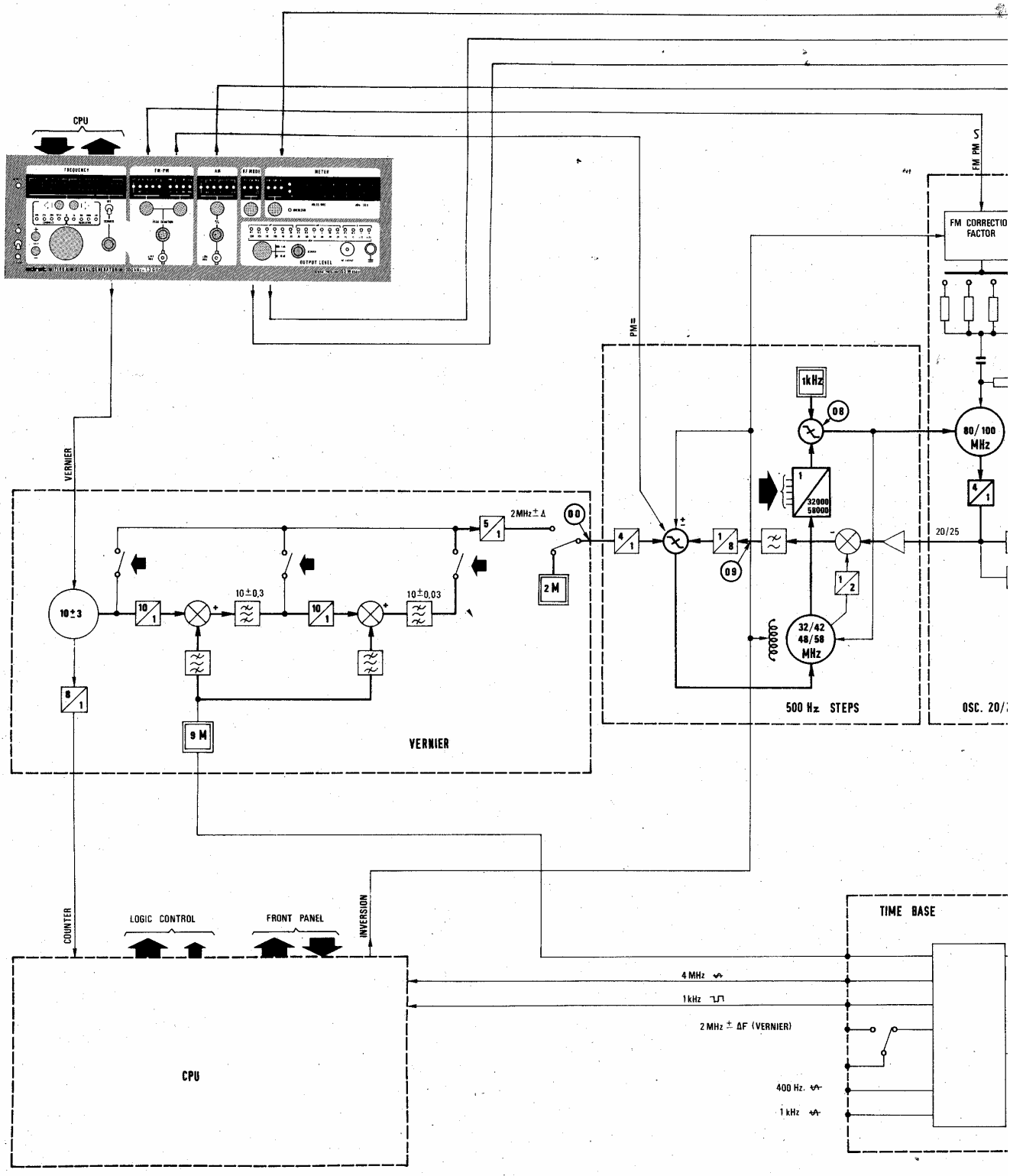


Figure 4-4 : MICROPROCESSOR FLOW CHART (INTERRUPT LEVEL)


CPU
FM PM
FM CORRECTIO
FACTOR
PM=
VERNIER
1kHz
08
80/100
MHz
1
32000
58000
4
1
2MHz± Δ
00
5
1
20/25
10±3
10
1
10±0,3
10±0,03
2M
1
8
09
1
2
32/42
48/58
MHz
8
1
9 M
VERNIER
500 Hz STEPS
OSC. 20/
COUNTER
LOGIC CONTROL
FRONT PANEL
INVERSION
TIME BASE
4 MHz
1kHz
2 MHz ± ΔF (VERNIER)
400 Hz.
1 kHz
CPU

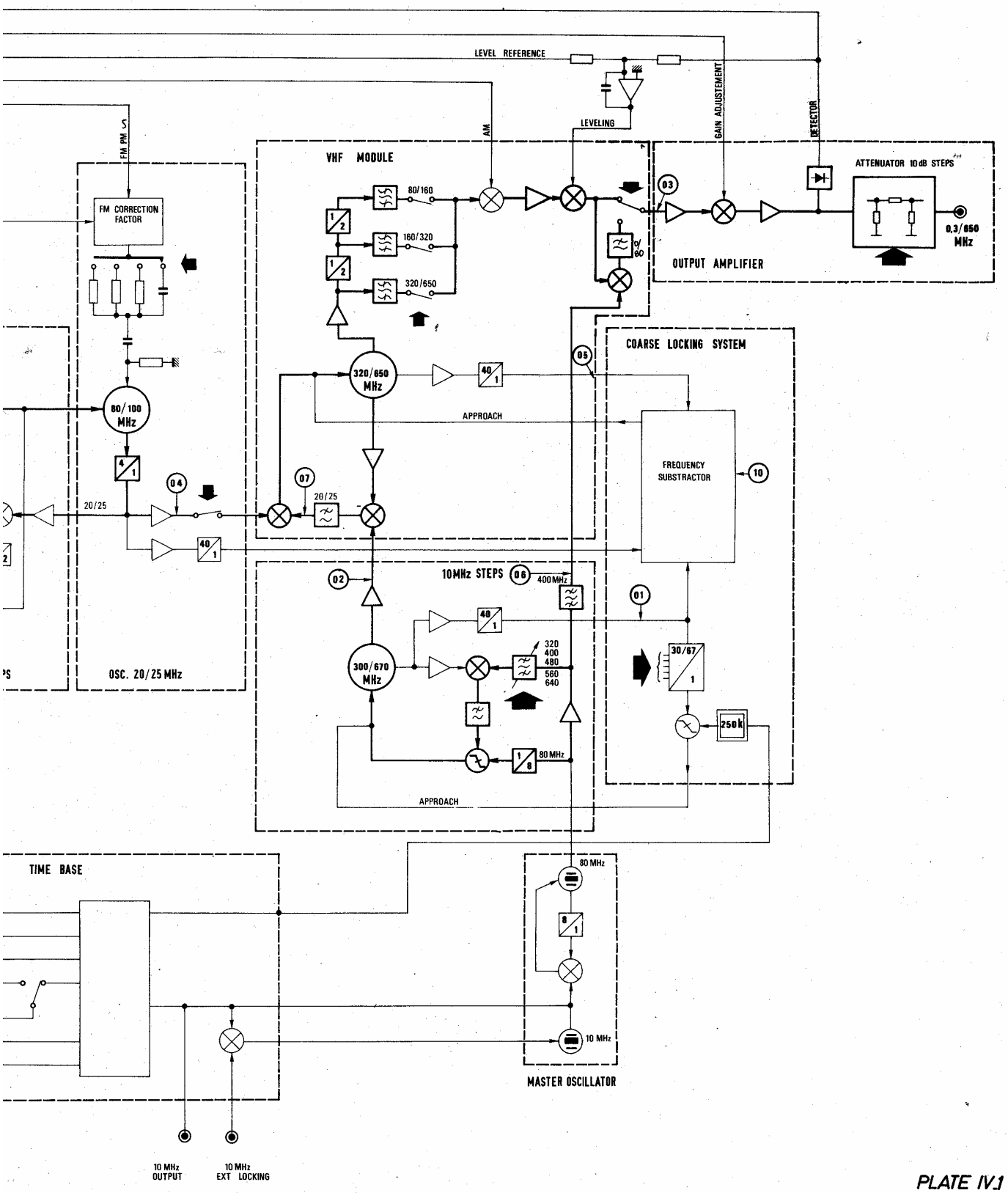


PLATE IV.1

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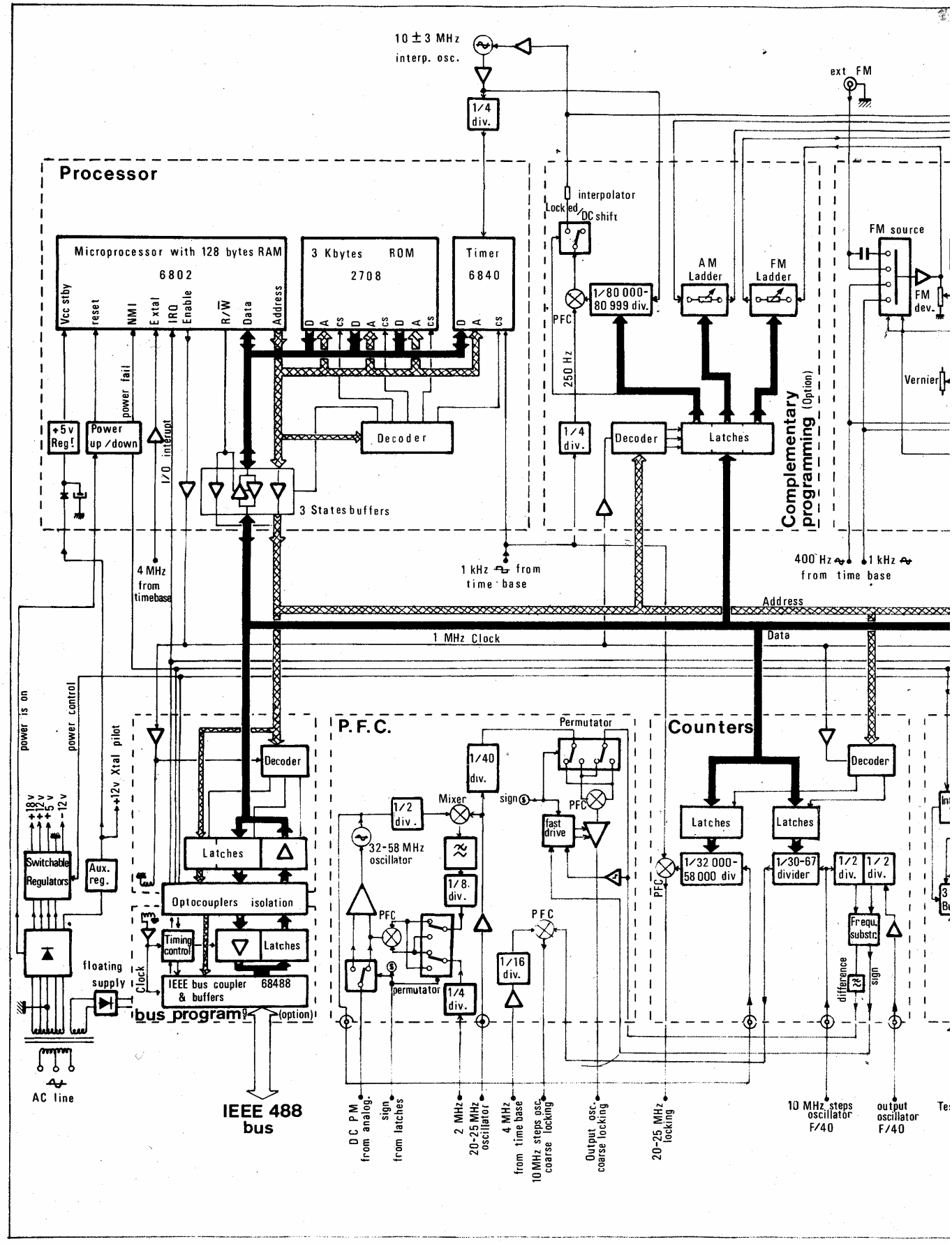
ETUDIE: DC - DESSINE: VERIFIE: JR	7100 BLOCK DIAGRAM	PAGE : /
		97 71 00 A


10 ± 3 MHz
interp. osc.
1/4 div.
ext FM
Processor
Microprocessor with 128 bytes RAM
6802
Vcc stby
reset
NMI
E xtal
IRQ
Enable
R/W
Data
Address
3 Kbytes ROM
2708
Timer
6840
interpolator
Locked/DC shift
1/80 000-80 999 div.
PFC
250 Hz
AM Ladder
FM Ladder
FM source
FM dev.
Vernier
Complementary programming (Option)
+5 v Reg!
Power up /down
power fail
I/O interrupt
Decoder
Latches
3 States buffers
4 MHz from timebase
1 kHz from time base
400 Hz
1 kHz from time base
Address
1 MHz Clock
Data
power is on
power control
+12v Xtal pilot
+8 v
+12 v
+5 v
-12 v
Switchable Regulators
Aux. reg.
floating supply
AC line
Optocouplers isolation
Timing control
IEEE bus coupler & buffers
68488
Clock
bus program
(option)
IEEE 488 bus
P.F.C.
Permutator
1/40 div.
Mixer
sign
1/2 div.
32-58 MHz oscillator
1/8. div.
fast drive
permutator
1/4 div.
1/16 div.
Counters
1/32 000-58 000 div
1/30-67 divider
1/2 div.
Frequ. substr.
difference
sign
DC PM from analog.
sign from latches
2 MHz
20-25 MHz oscillator
4 MHz from time base
10 MHz steps osc. coarse locking
Output osc. coarse locking
20-25 MHz locking
10 MHz steps oscillator F/40
output oscillator F/40

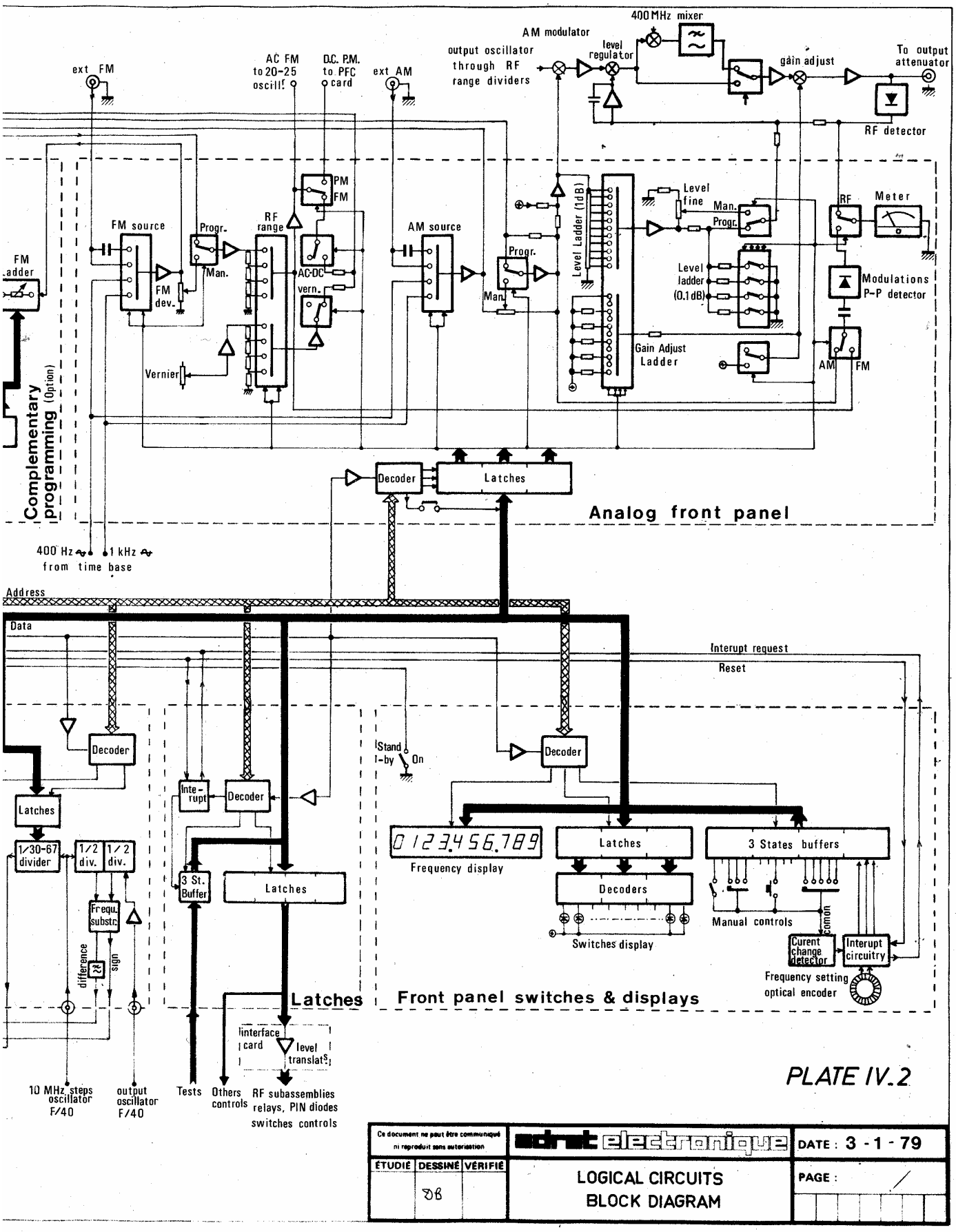


PLATE IV.2

ÉTUDIÉ	DESSINÉ	VÉRIFIÉ	
	DB		

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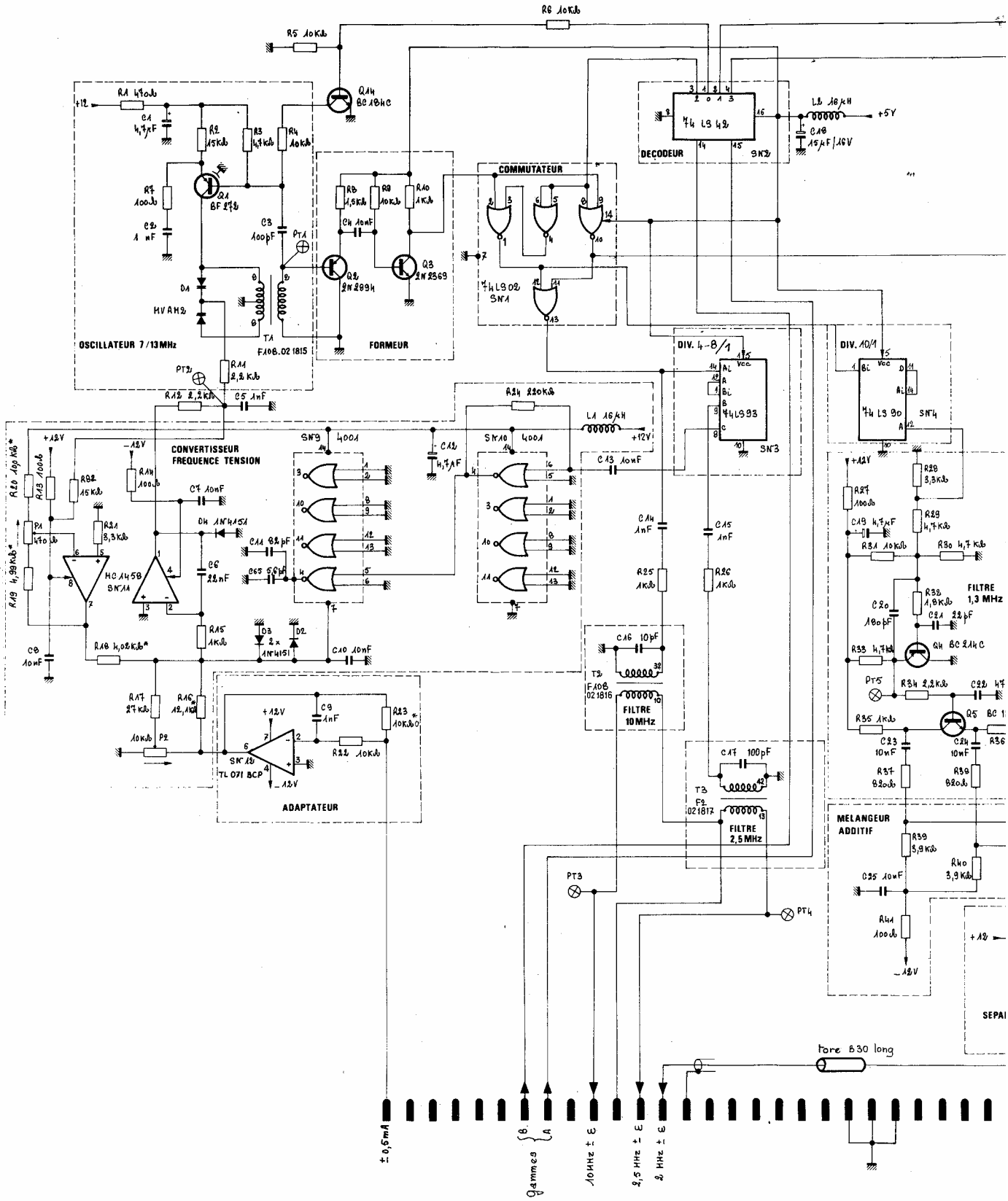
DATE : 3 - 1 - 79

LOGICAL CIRCUITS BLOCK DIAGRAM

PAGE :


OSCILLATEUR 7 /13MHz
FORMEUR
COMMUTATEUR
DECODEUR
CONVERTISSEUR FREQUENCE TENSION
ADAPTATEUR
DIV. 4-8/1
DIV. 10/1
FILTRE 10MHz
FILTRE 2,5MHz
FILTRE 1,3 MHz
MELANGEUR ADDITIF
74 LS 42
74 LS 90
74LS93
74LS02
HC 1458
TL 071 BCP
Fibre B30 long
±0,6mA
Gammes B A
10 MHz ± 3
8,5 MHz ± 3
8 MHz ± 3

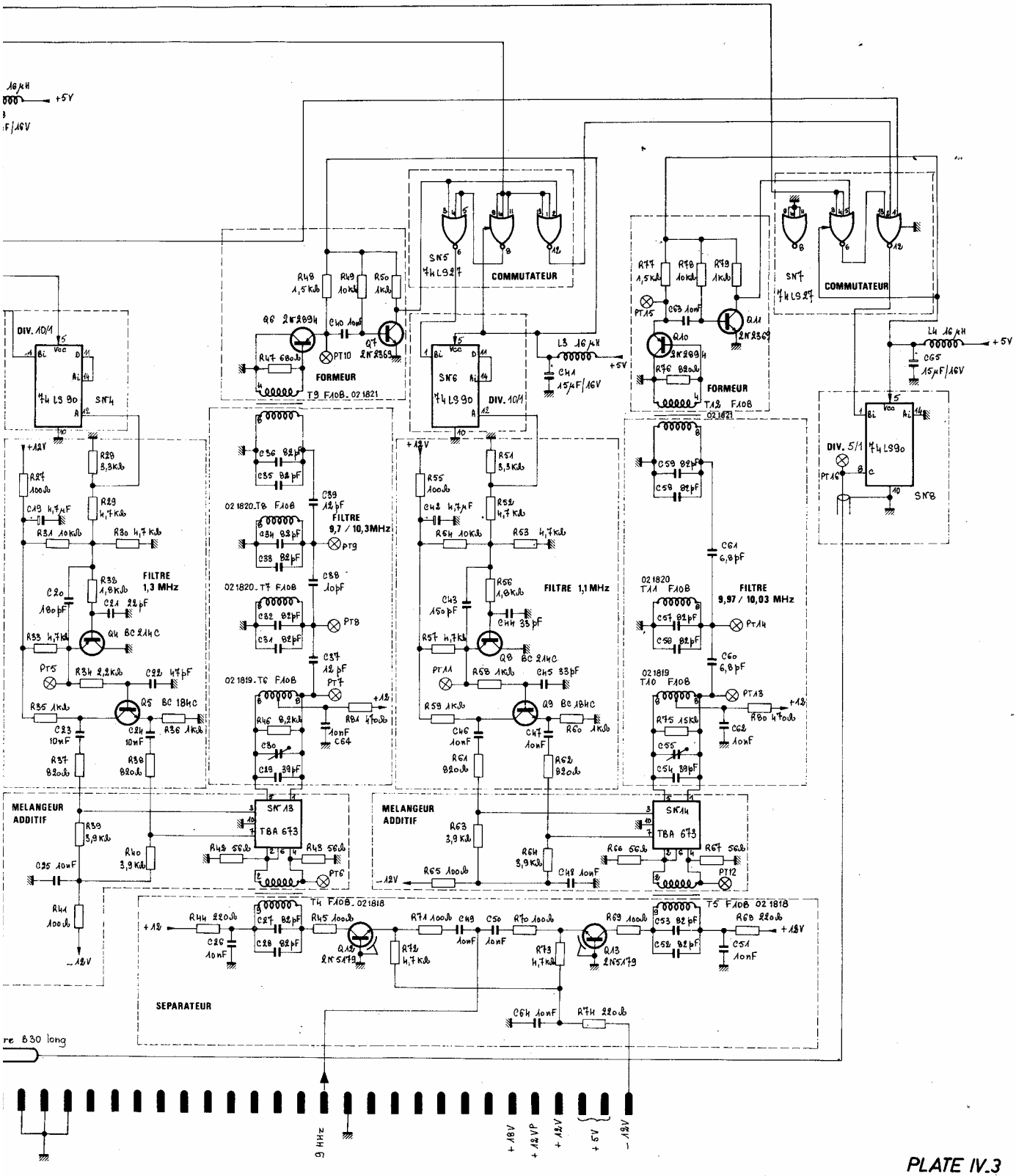


PLATE IV.3

PLANCHE IV.3

SEARCH FREQUENCY. DC COUPLED FM

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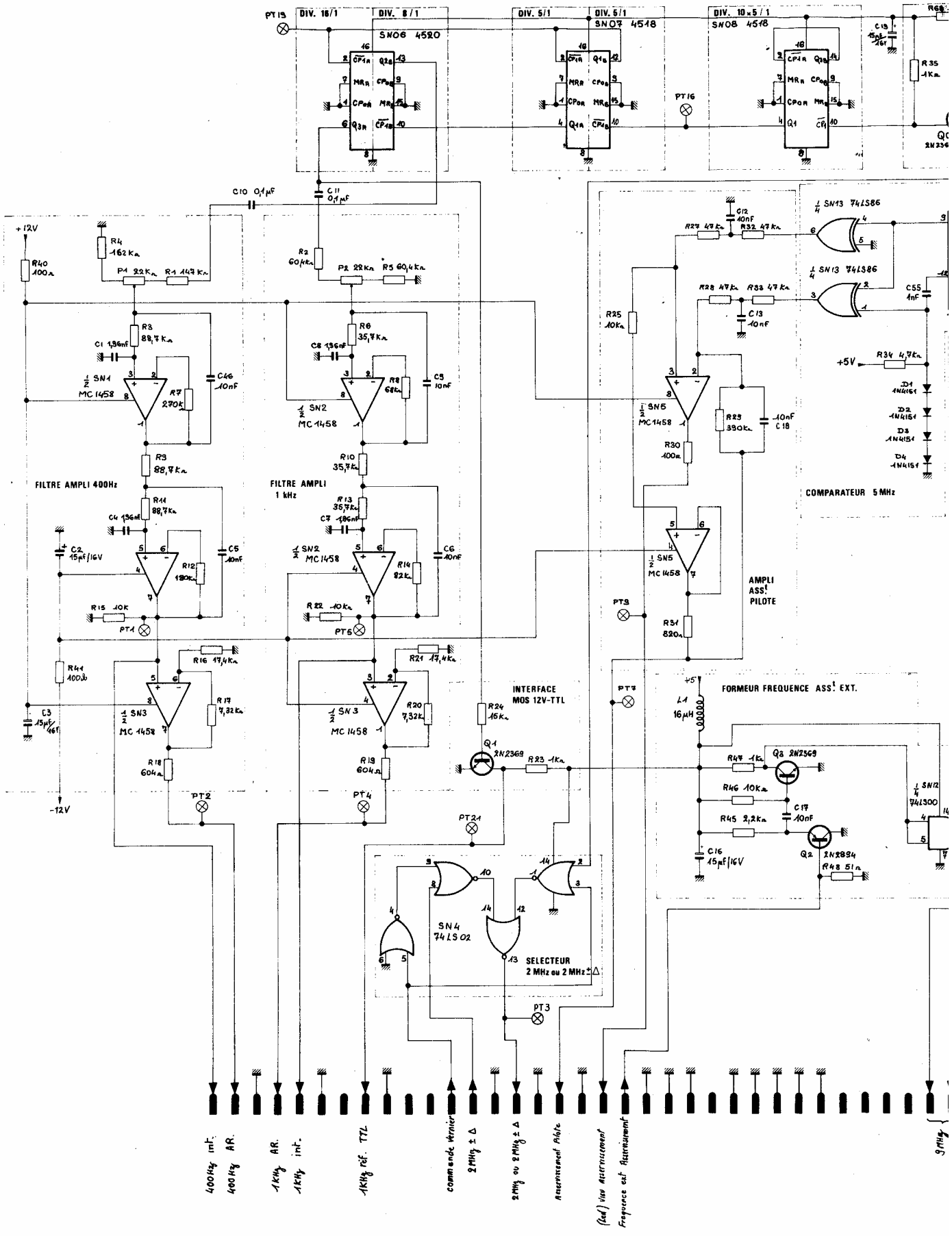
ÉTUDIE	DESSINÉ	VÉRIFIÉ	INTERPOLATEUR 7100A FM CONTINUE	PAGE : /
	DC -			97128A


DIV. 16/1
DIV. 8/1
SN06 4520
DIV. 5/1
DIV. 5/1
SN07 4518
DIV. 10×5/1
SN08 4518
PT15
PT16
+12V
-12V
FILTRE AMPLI 400Hz
FILTRE AMPLI 1 kHz
COMPARATEUR 5 MHz
AMPLI ASS! PILOTE
INTERFACE MOS 12V-TTL
FORMEUR FREQUENCE ASS! EXT.
SN4 74LS02
SELECTEUR 2 MHz ou 2 MHz ± Δ
400Hz int.
400Hz AR.
1kHz AR.
1kHz int.
1kHz réf. TTL
commande vernier
2 MHz ± Δ
2 MHz ou 2 MHz ± Δ
Asservissement Aléa
(ext.) vers Asservissement
Fréquence ext. Asservissement
9 MHz

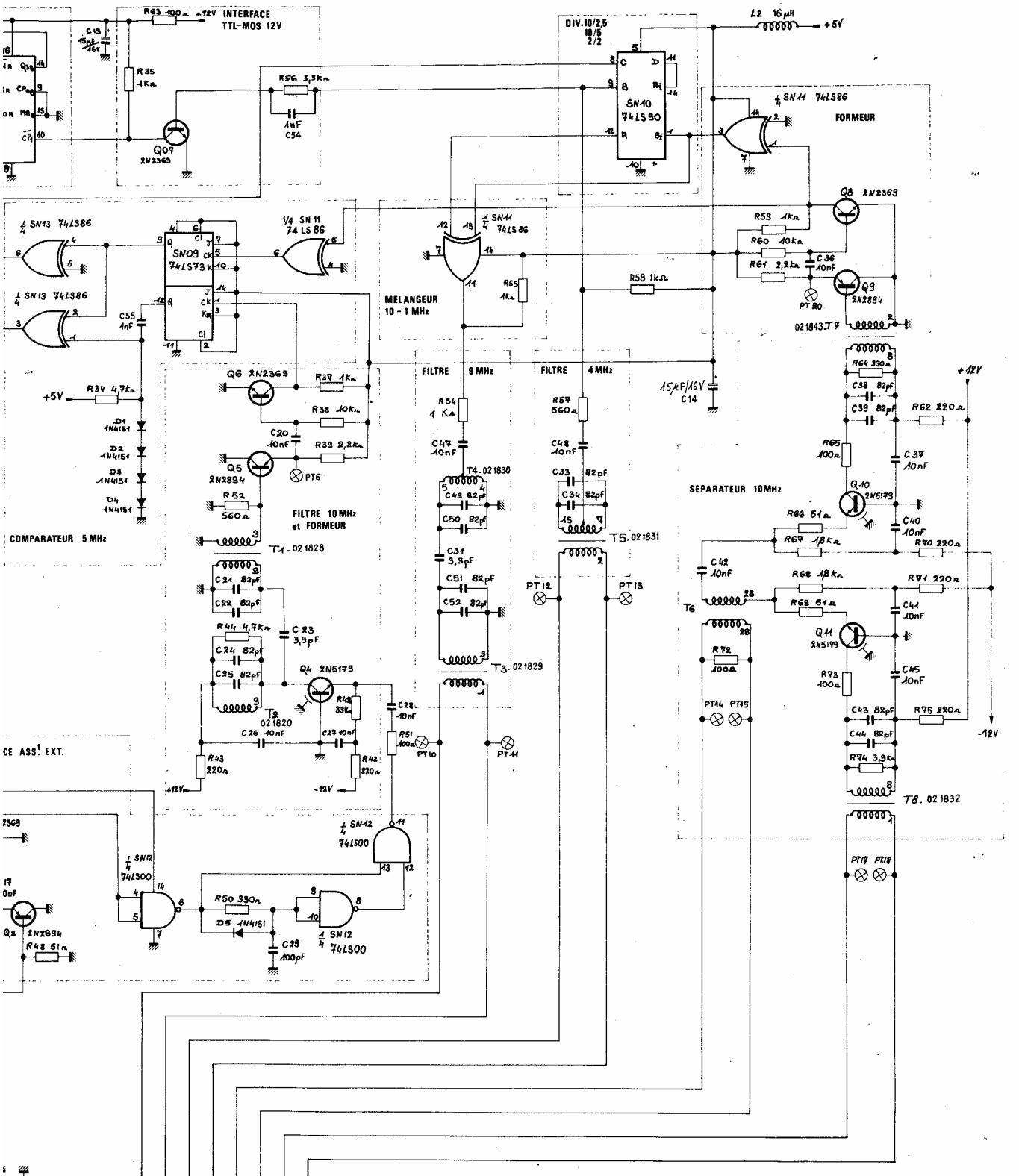


PLATE IV.4
PLANCHE IV.4

TIME BASE

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ETUDIÉ	DESSINÉ	VÉRIFIÉ	

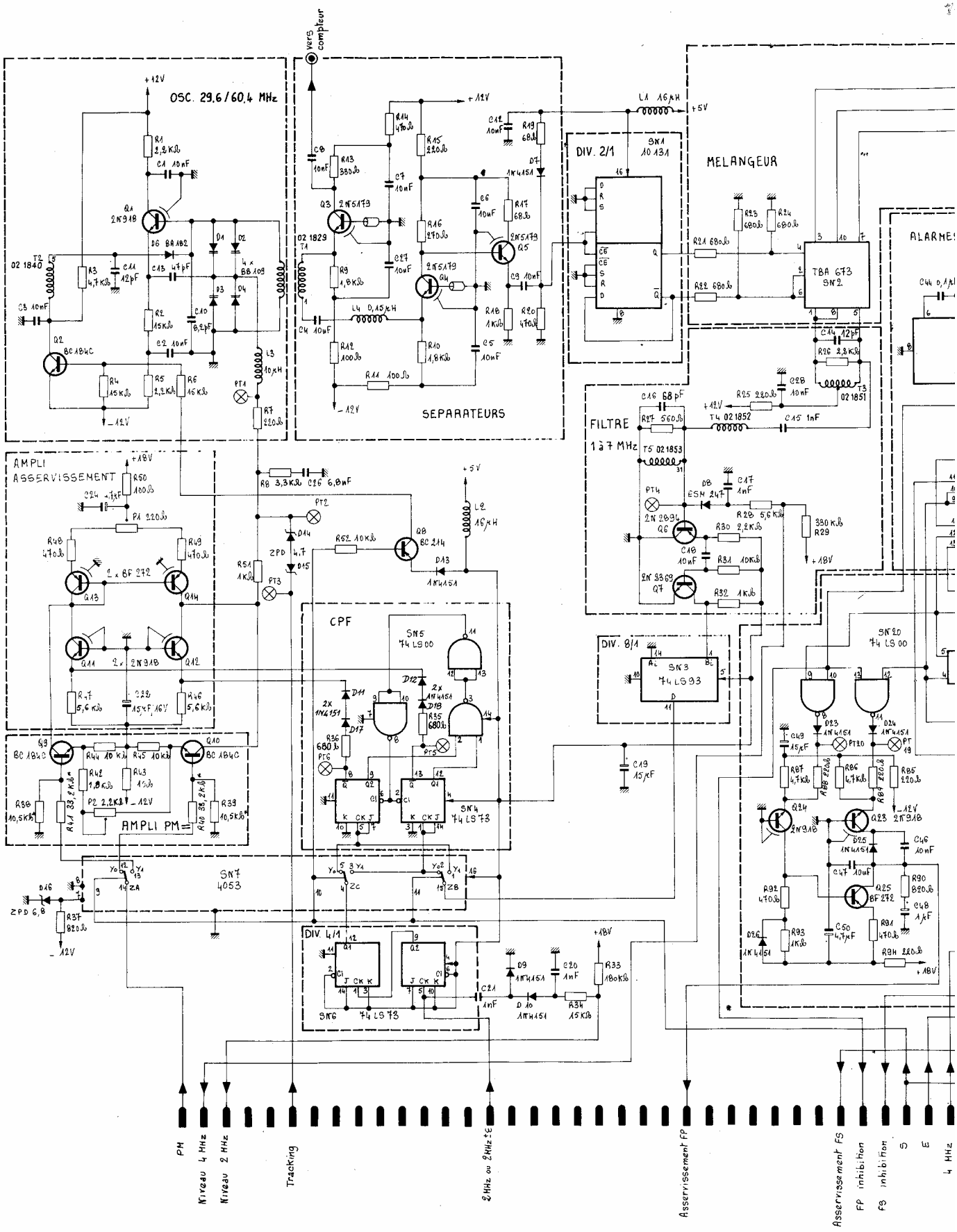
electronique

DATE : 06/07/78

BASE DE TEMPS 7100A

PAGE : /

97129A


OSC. 29,6 / 60,4 MHz
vers compteur
SEPARATEURS
DIV. 2/1
SN1 10 131
MELANGEUR
TBA 673 SN2
FILTRE 1 à 7 MHz
AMPLI ASSERVISSEMENT
AMPLI PM
CPF
SN5 74 LS00
SN4 74 LS73
SN3 74 LS93
SN7 4053
SN6 74 LS73
SN8 74 LS00
DIV. 8/1
DIV. 4/1
PM
Niveau 4 MHz
Niveau 2 MHz
Tracking
2 MHz ou 2 MHz÷2
Asservissement FP
Asservissement FS
FP inhibition
FS inhibition
S
E
4 MHz

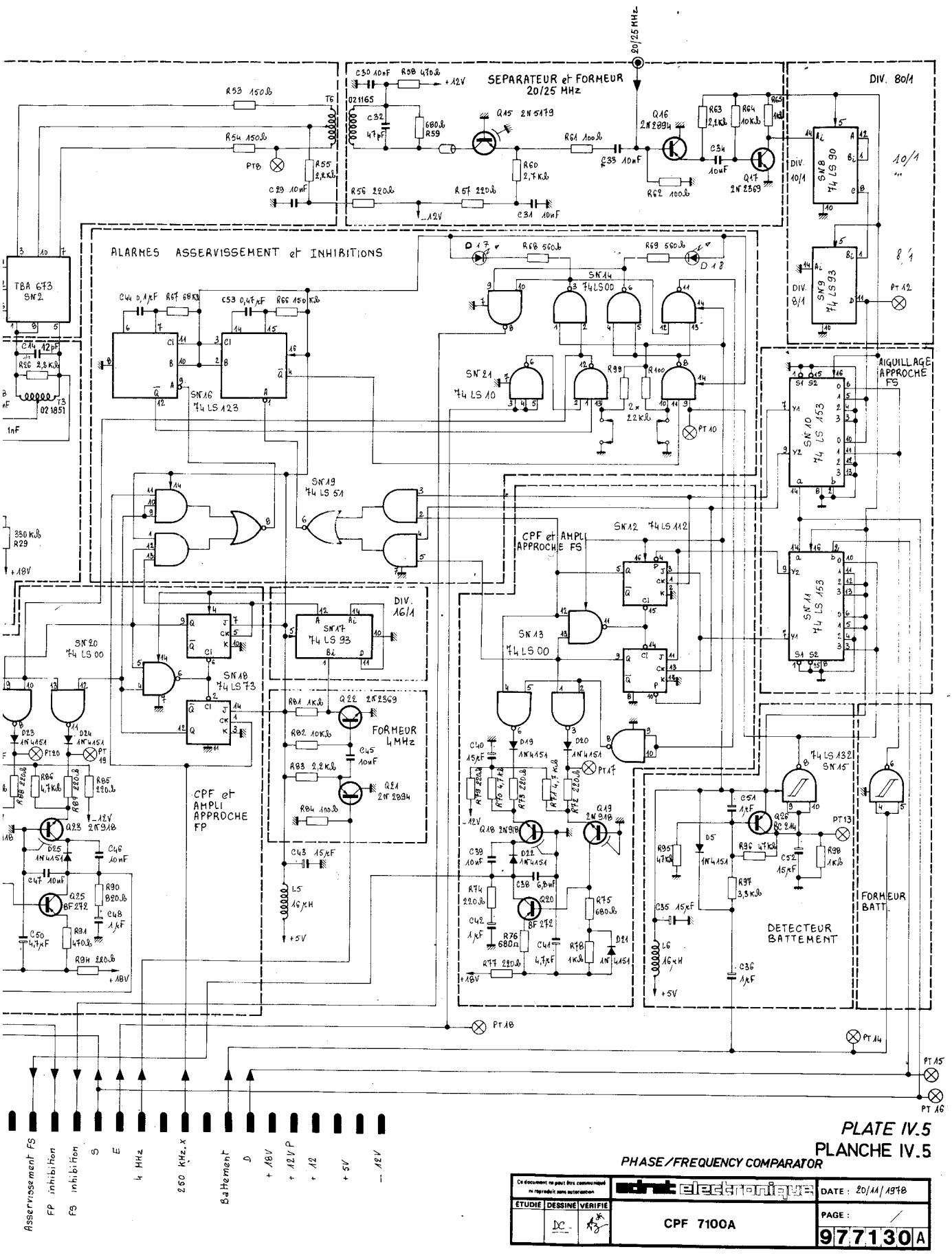


PLATE IV.5
PLANCHE IV.5

PHASE/FREQUENCY COMPARATOR

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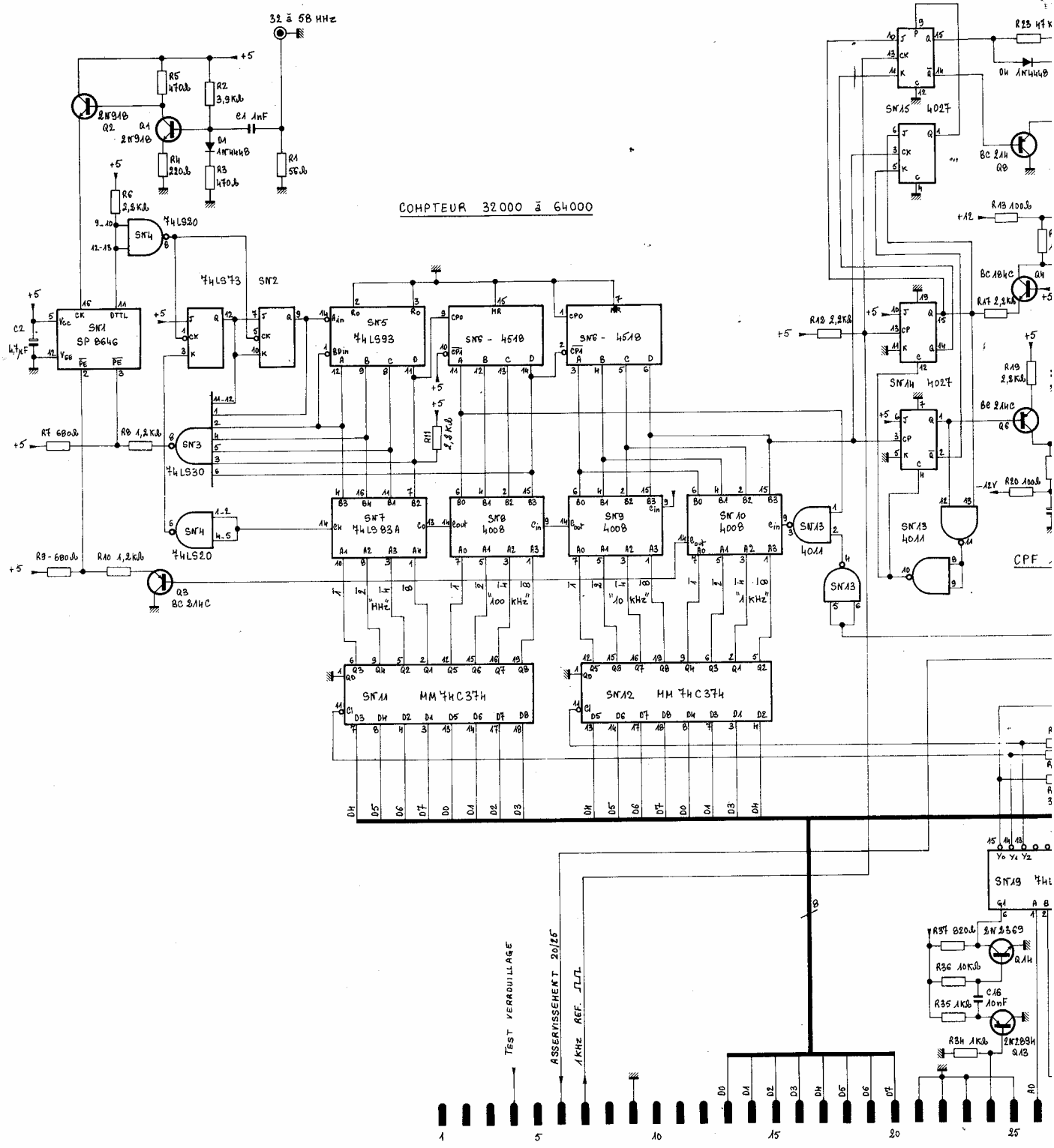
ETUDIE:	DESSINE: DC	VERIFIE:
	CPF 7100A	PAGE : /
		977130 A


32 à 58 MHz
COMPTEUR 32000 à 64000
SN1 SP 8646
SN2 74LS73
SN3 74LS30
SN4 74LS20
SN5 74LS93
SN6 - 4518
SN7 74LS83A
SN8 4008
SN9 4008
SN10 4008
SN11 MM74HC374
SN12 MM74HC374
SN13 4011
SN14 4027
SN15 4027
SN19 74L
2N918
BC 214C
BC 184C
2N2369
2N2894
TEST VERROUILLAGE
ASSERVISSEMENT 20/25
1KHz REF.
CPF

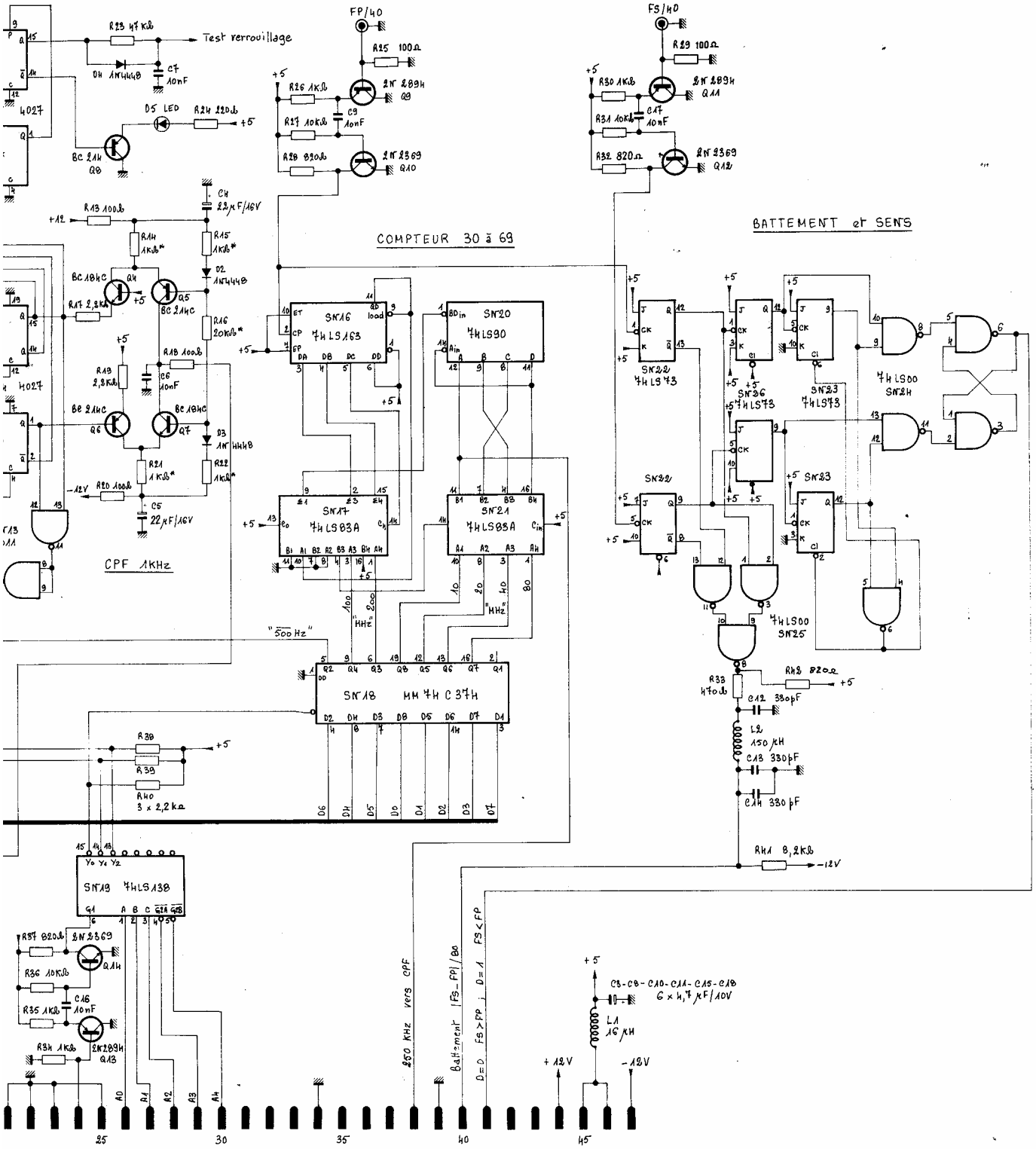


PLATE IV.6
PLANCHE IV.6

COUNTERS

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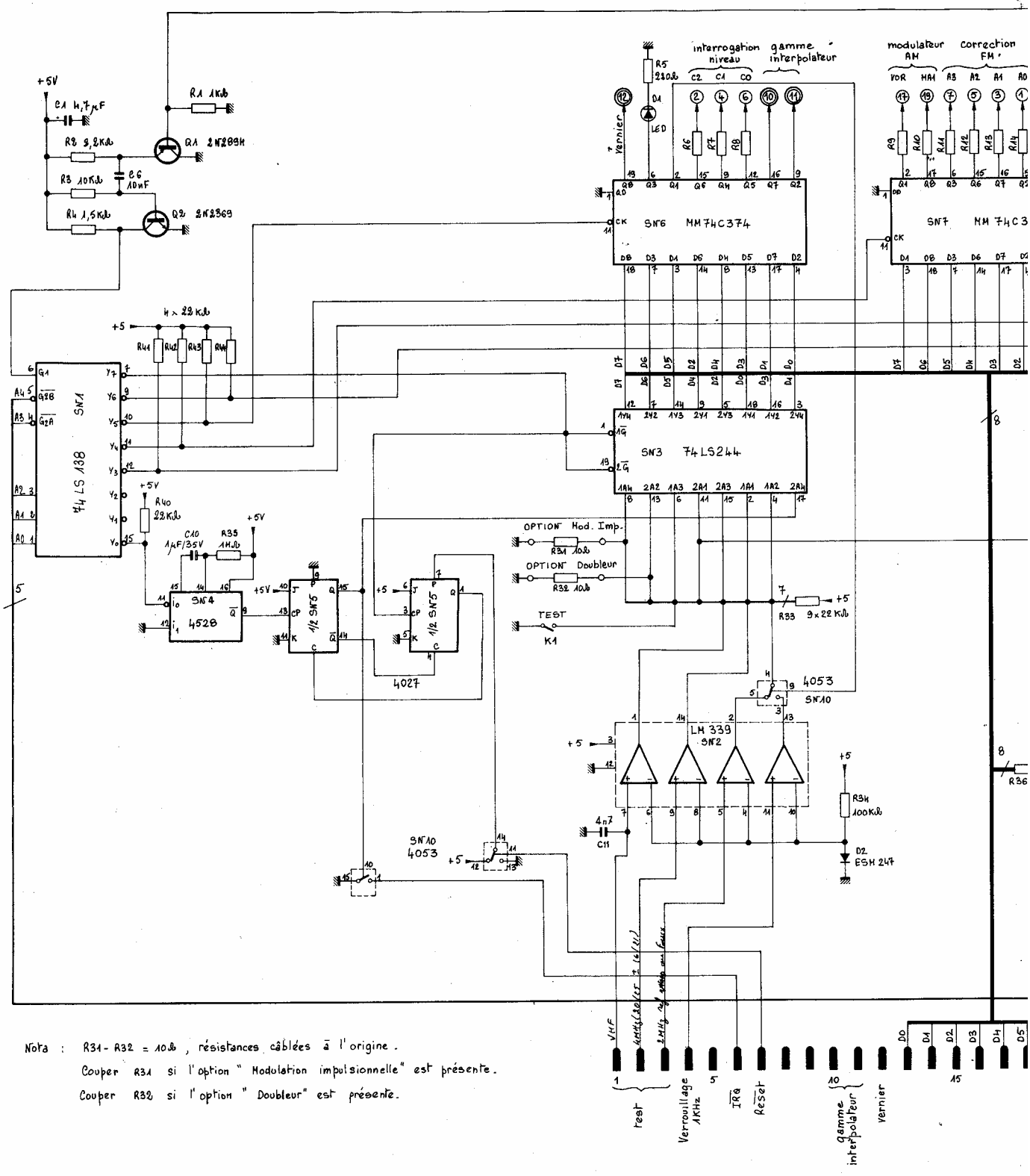
ETUDIE / DESSINE / VERIFIE	COMPTEURS 7100A	PAGE : /	
DC 17 x 78		97133A	


+5V
C1 4,7µF
R1 1Kb
R2 8,2Kb
Q1 2N2894
C6 10nF
R3 10Kb
R4 1,5Kb
Q2 2N2369
interrogation niveau
gamme interpolateur
modulateur AM
correction FM
R5 220b
D1 LED
Vernier
SN6 MM74HC374
SN7 MM 74C3
SN1 74 LS 138
SN3 74LS244
SN4 4528
SN5 1/2 SN5
4027
SN10 4053
SN2 LM 339
SN10 4053
R40 22Kb
C10 1µF/35V
R35 1MΩ
OPTION Mod. Imp.
R31 10Kb
OPTION Doubleur
R32 10Kb
TEST
K1
R33 9x22 Kb
R34 100Kb
C11 4n7
D2 ESH 247
R36
Nota : R31 - R32 = 10Kb , résistances câblées à l'origine.
Couper R31 si l'option " Modulation impulsionnelle" est présente.
Couper R32 si l'option " Doubleur" est présente.
Reset
Verrouillage 1KHz
gamme interpolateur
vernier

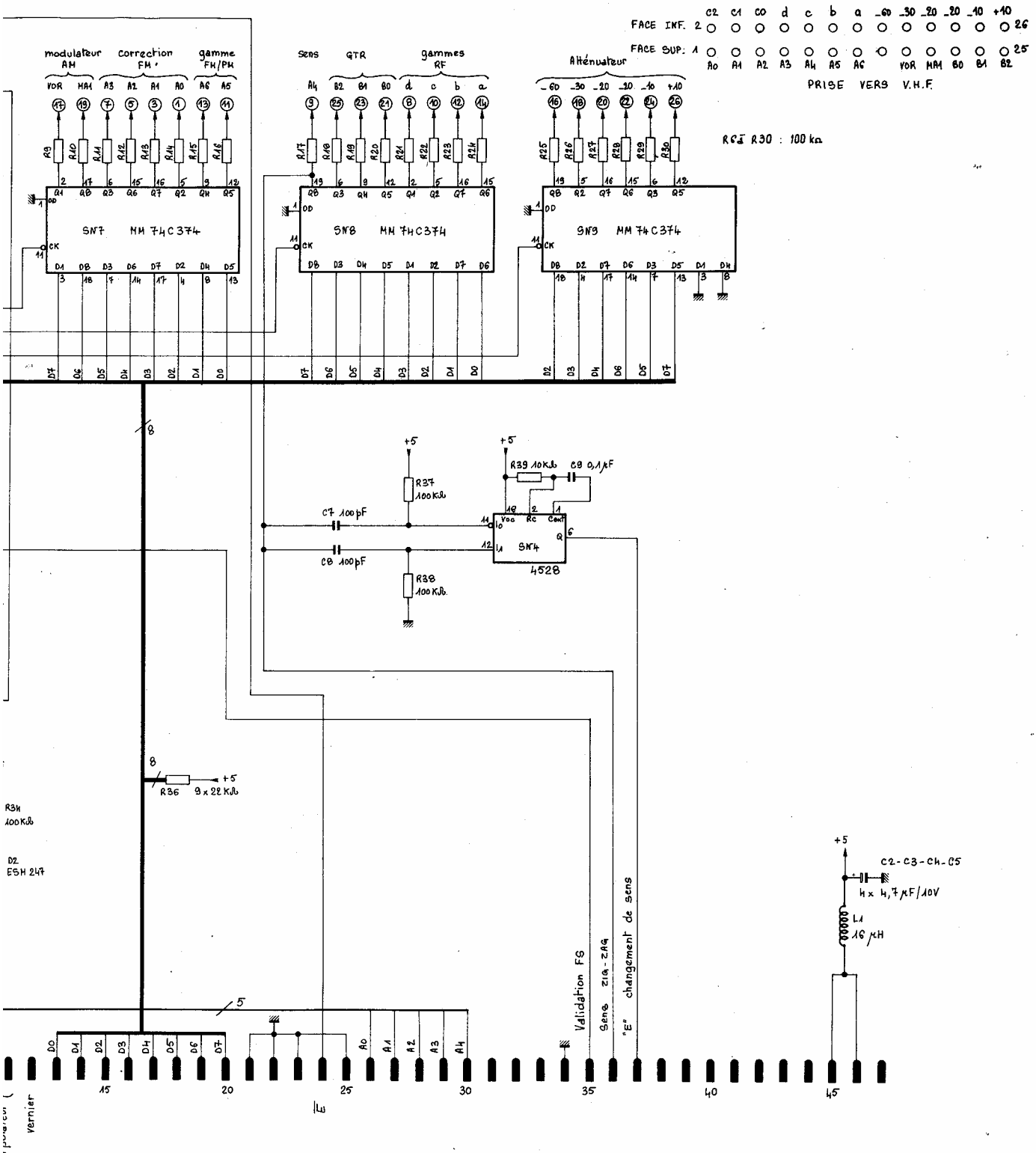


PLATE IV.7
PLANCHE IV.7

REGISTERS

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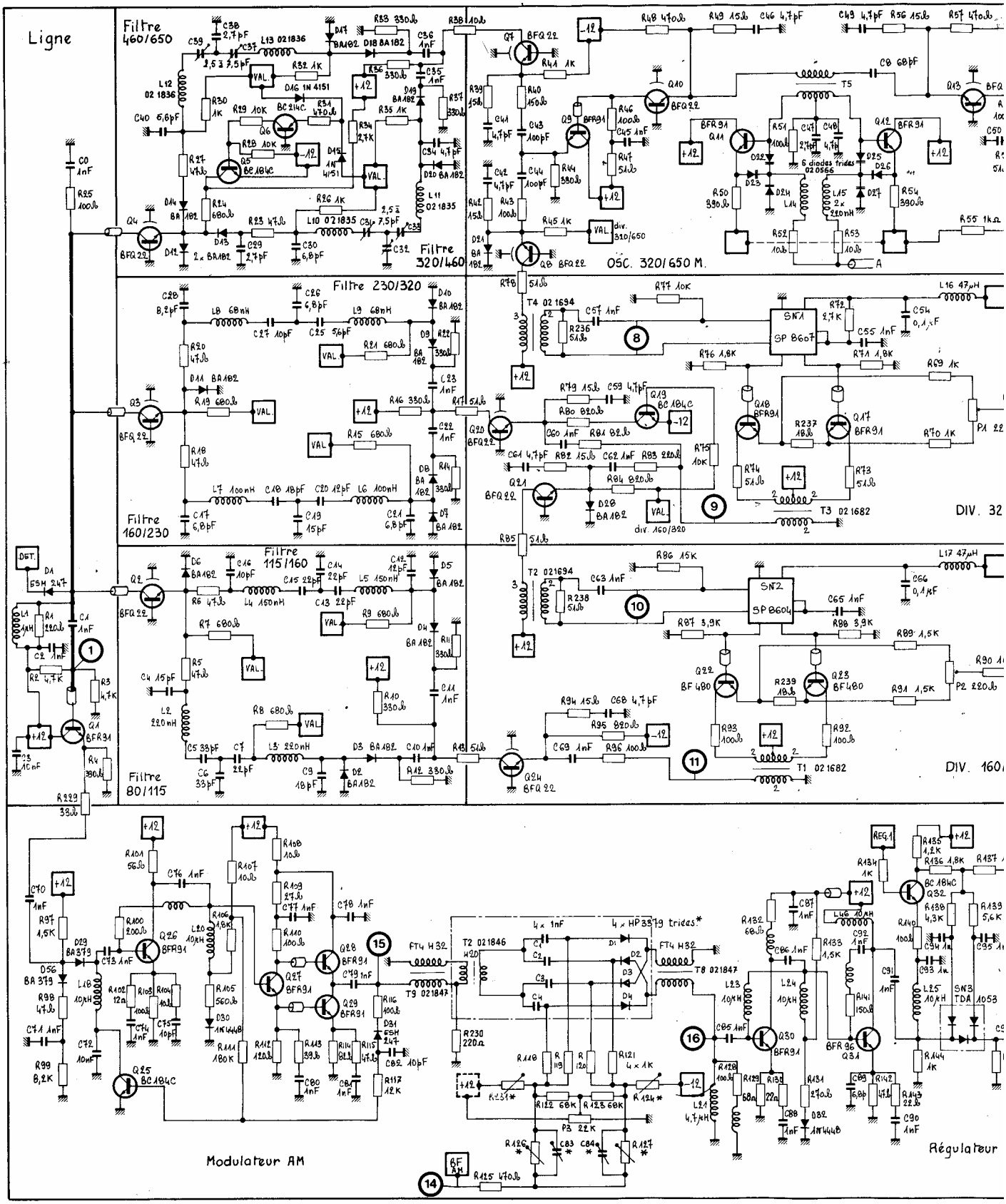
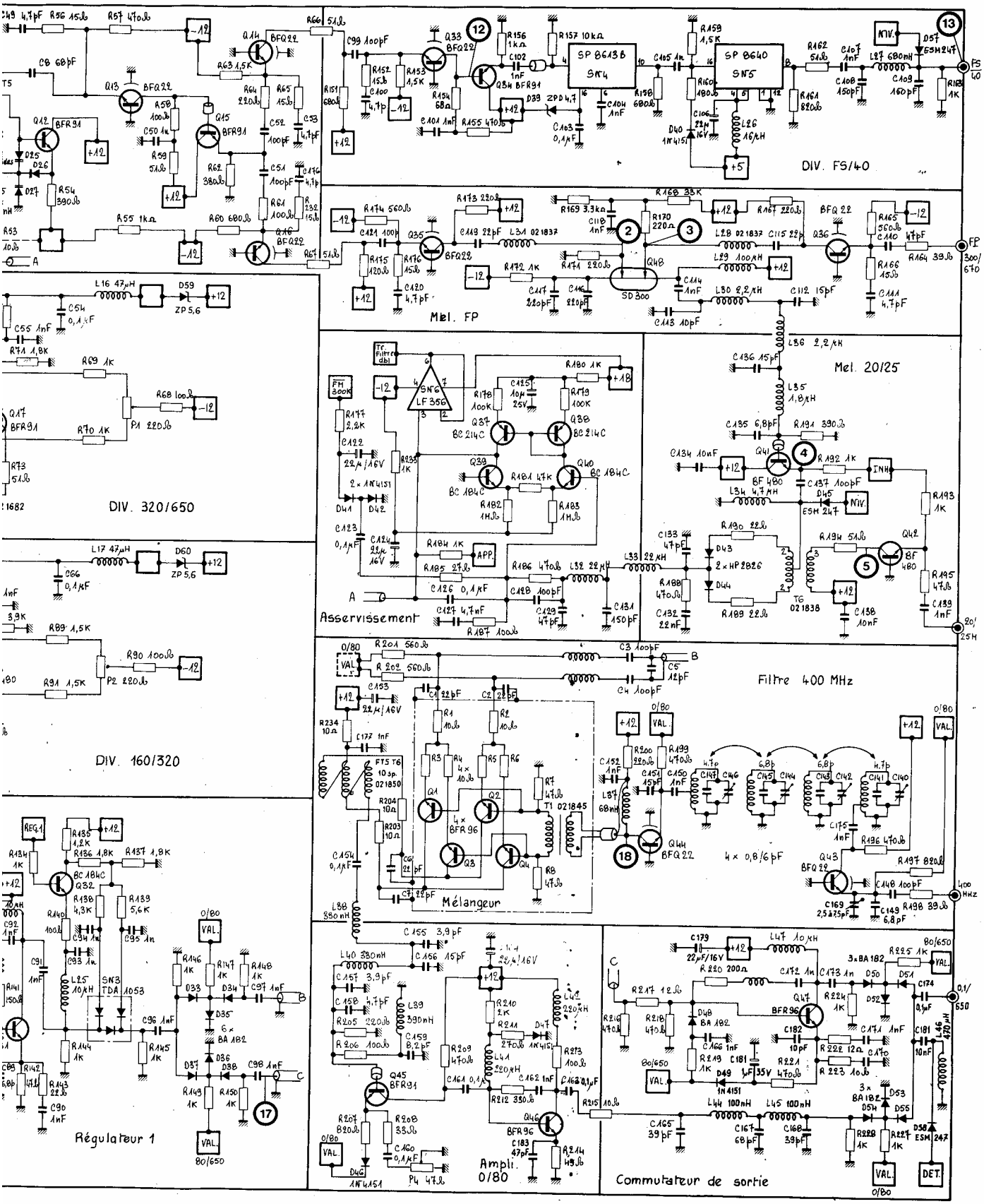
ETUDE	DESSINE	VERIFIE	PAGE :
	DC		9 7 7 1 3 5 A

REGISTRES 7100A


Ligne
Filtre 460/650
Filtre 320/460
Filtre 230/320
Filtre 160/230
Filtre 115/160
Filtre 80/115
OSC. 320/650 M.
DIV. 32
DIV. 160
Modulateur AM
Régulateur
6 diodes trides 020566
4 x HP3379 trides*
SN1 SP8607
SN2 SP8604
SN3 TDA 1053
80/115
115/160
160/230
230/320
320/460
460/650
FM 300KHz
80/650
O/80
Ctrl. 1
Ctrl. 2
Ctrl. 3
- 12
+ 12
+ 12
+ 5
- 12
- 12
d. 320/650
Cde Reg 1
d. 160/320
U. Track.
Inhib.
+ 18
U. Appl.



VHF MODULE

PLATE IV.8
PLANCHE IV.8

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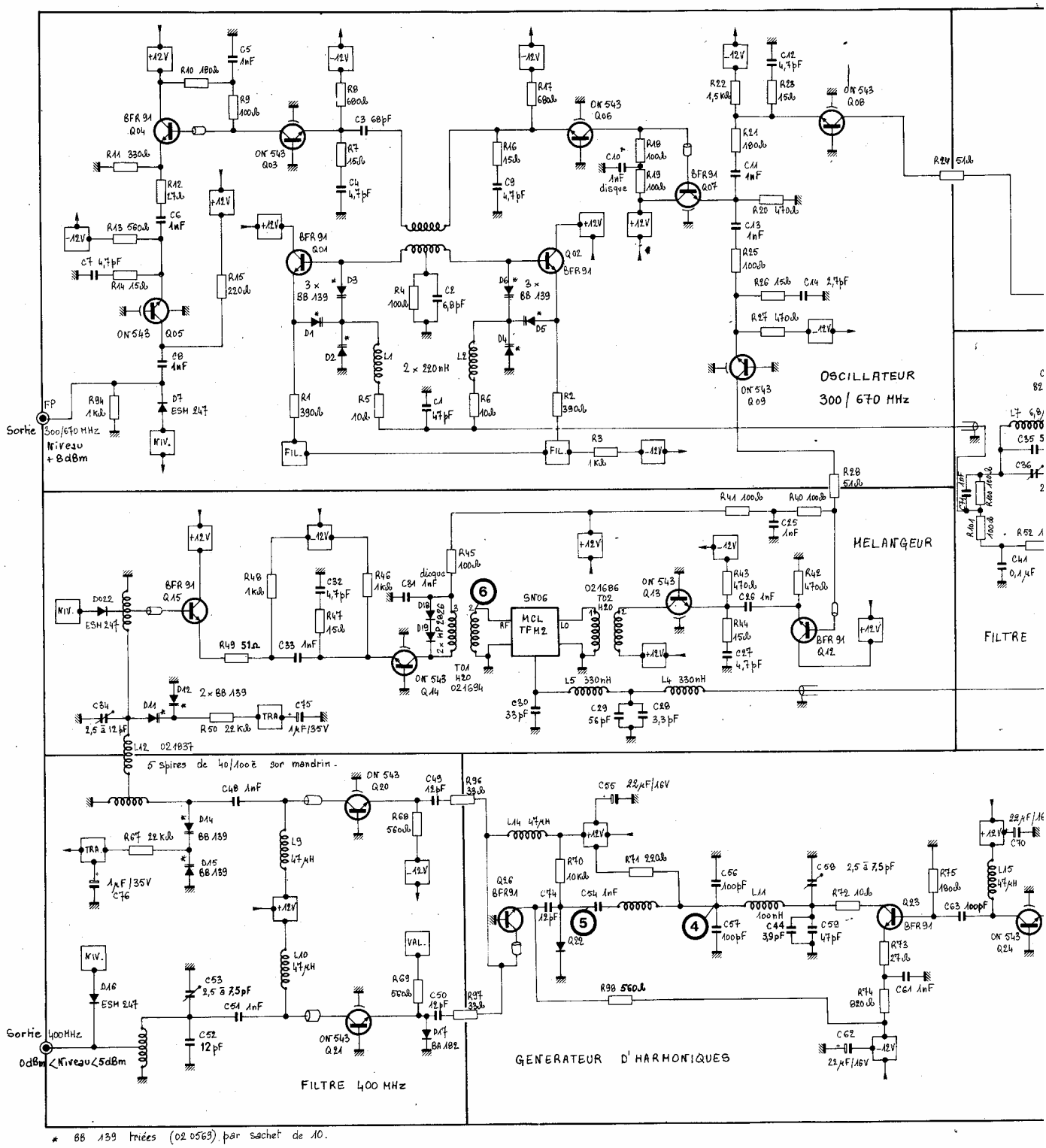
ETUDIE : DE / DESSINE : / VERIFIE : JM	MODULE VHF 7100A	PAGE : /
		97140 A



* BB 139 triées (02 0563) par sachet de 10.

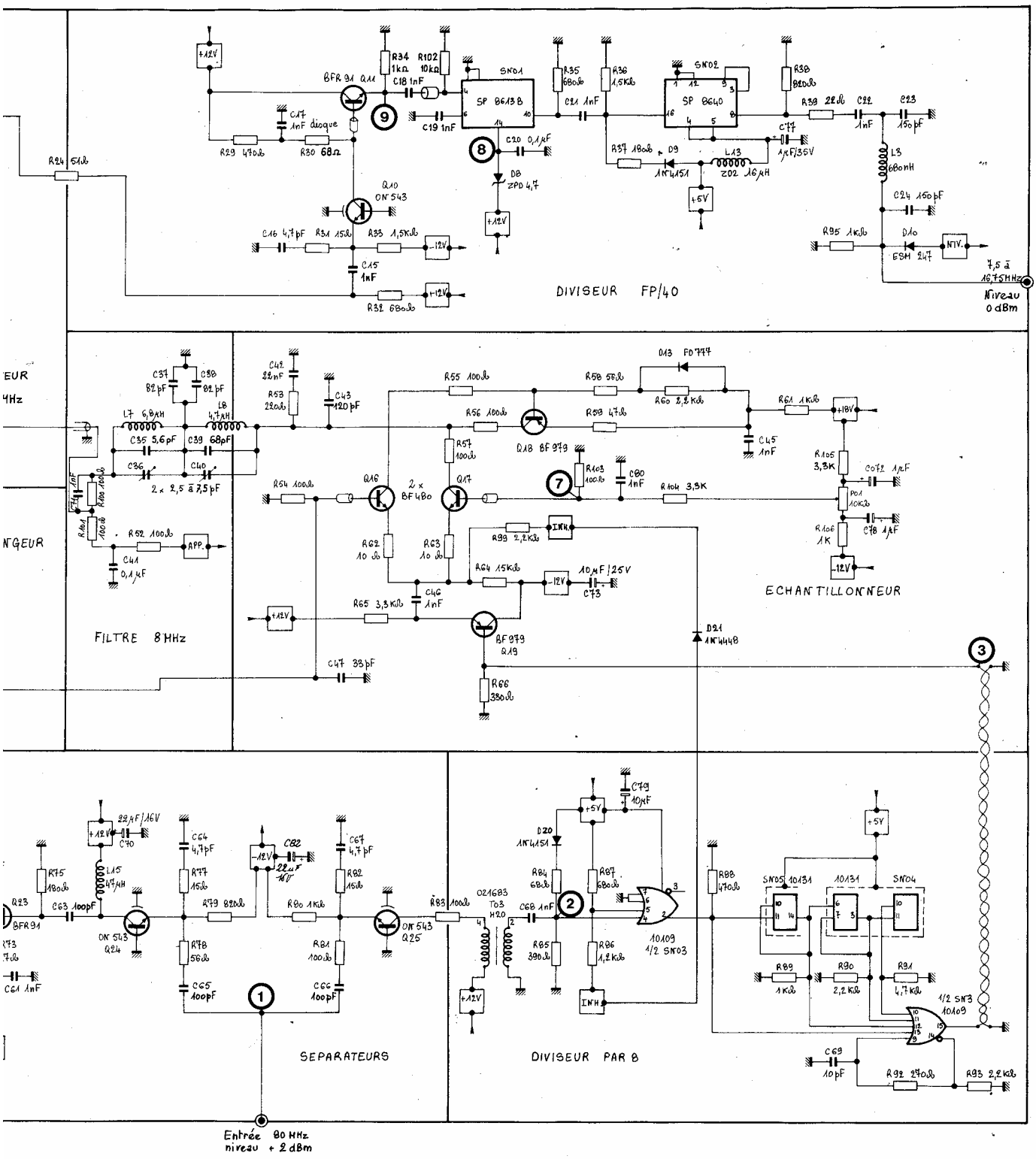


PLATE IV.9
PLANCHE IV.9

10Mhz STEPS MODULE

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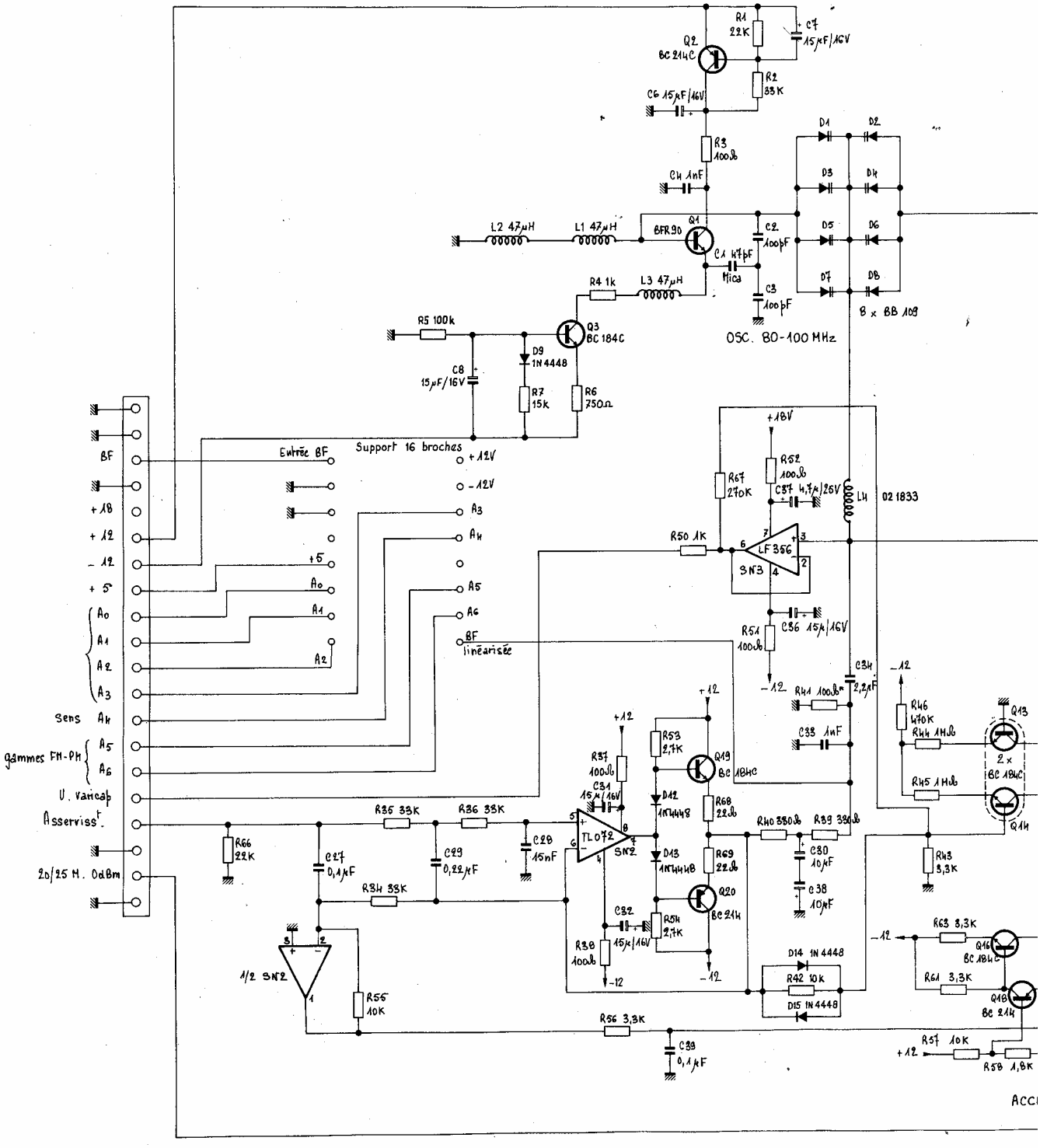
ETUDE	DESSINE	VERIFIE	PAS DE 10 MHz 7100A	PAGE : /
	DC.	JR		9771 41 A


Q2 BC 214C
R1 22K
C7 15µF/16V
R2 33K
C6 15µF/16V
R3 100Ω
C4 1nF
L2 47µH
L1 47µH
BFR 90
Q1
C2 100pF
C1 47pF
C3 100pF
D1 D2 D3 D4 D5 D6 D7 D8
8 x BB 109
OSC. 80-100 MHz
R4 1k
L3 47µH
R5 100k
Q3 BC 184C
D9 1N 4448
C8 15µF/16V
R7 15K
R6 750Ω
Support 16 broches
Entrée BF
+12V
-12V
A3
A4
A5
A6
BF linéarisée
+5
A0
A1
A2
BF
+18
+12
-12
+5
A0
A1
A2
A3
Sens A4
Gammes FM-PM A5 A6
U. varicap
Asservissᵗ.
20/25 M. 0dBm
+18V
R67 270K
R52 100Ω
C37 4,7µ/25V
L4
02 1833
R50 1K
LF 356
SN3
R51 100Ω
C36 15µ/16V
C34 2,2nF
R41 100Ω
C33 1nF
R53 2,7K
Q19 BC 184C
D12 1N4448
R68 22Ω
R37 100Ω
C31 15µ/16V
R40 330Ω
R39 330Ω
C30 10µF
C38 10µF
R43 3,3K
R46 470K
R44 1MΩ
R45 1MΩ
Q13
2 x BC 184C
Q14
R35 33K
R36 33K
C28 15nF
TL072
SN2
D13 1N4448
R69 22Ω
Q20 BC 214
C32 15µ/16V
R54 2,7K
R38 100Ω
R66 22K
C27 0,1µF
C29 0,22µF
R34 33K
1/2 SN2
R55 10K
D14 1N 4448
R42 10K
D15 1N 4448
R63 3,3K
Q16 BC 184C
R61 3,3K
Q18 BC 214
R56 3,3K
C39 0,1µF
R57 10K
R58 1,8K

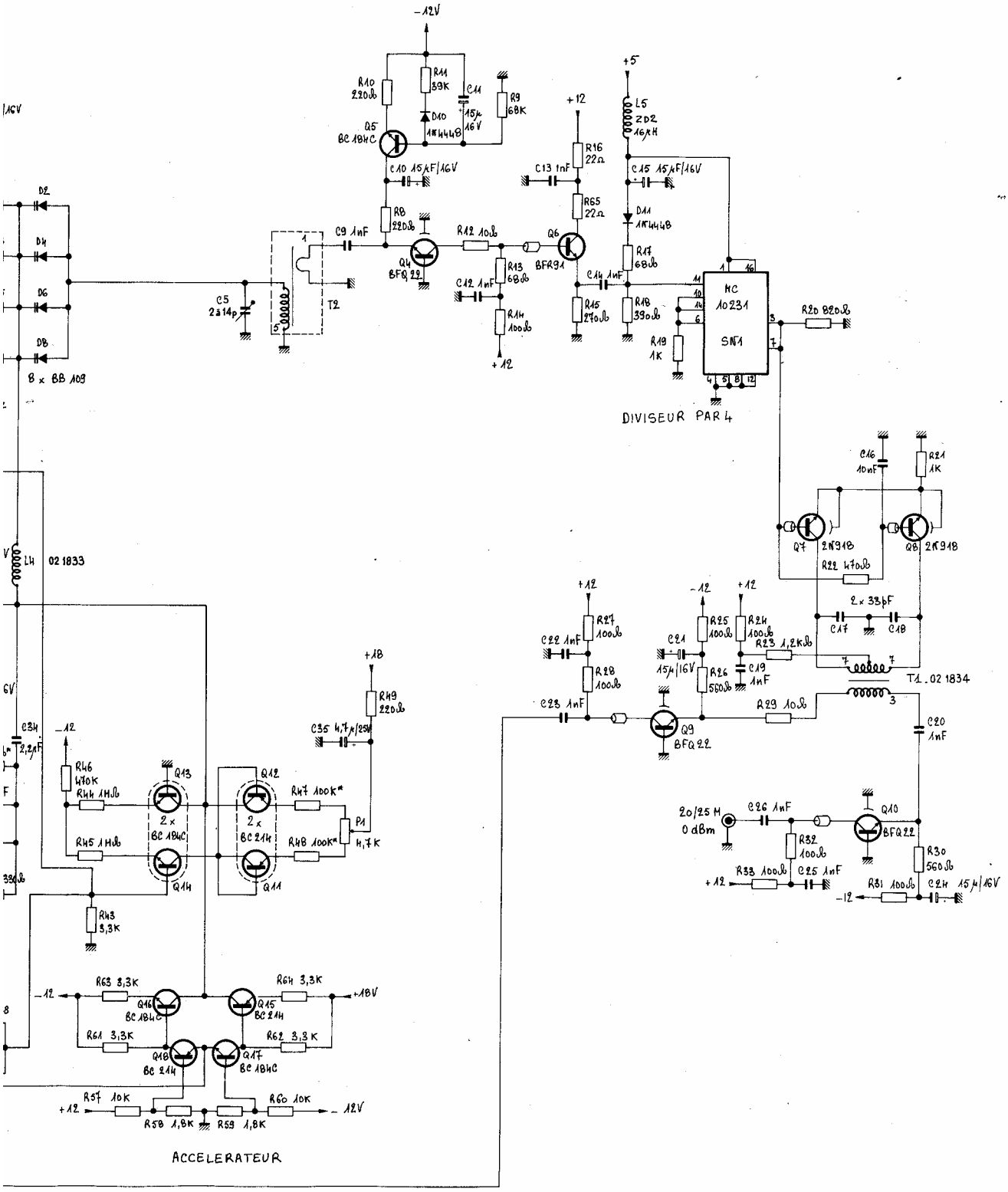


PLATE IV.10
PLANCHE IV.10

20 TO 25 MHz OSCILLATOR

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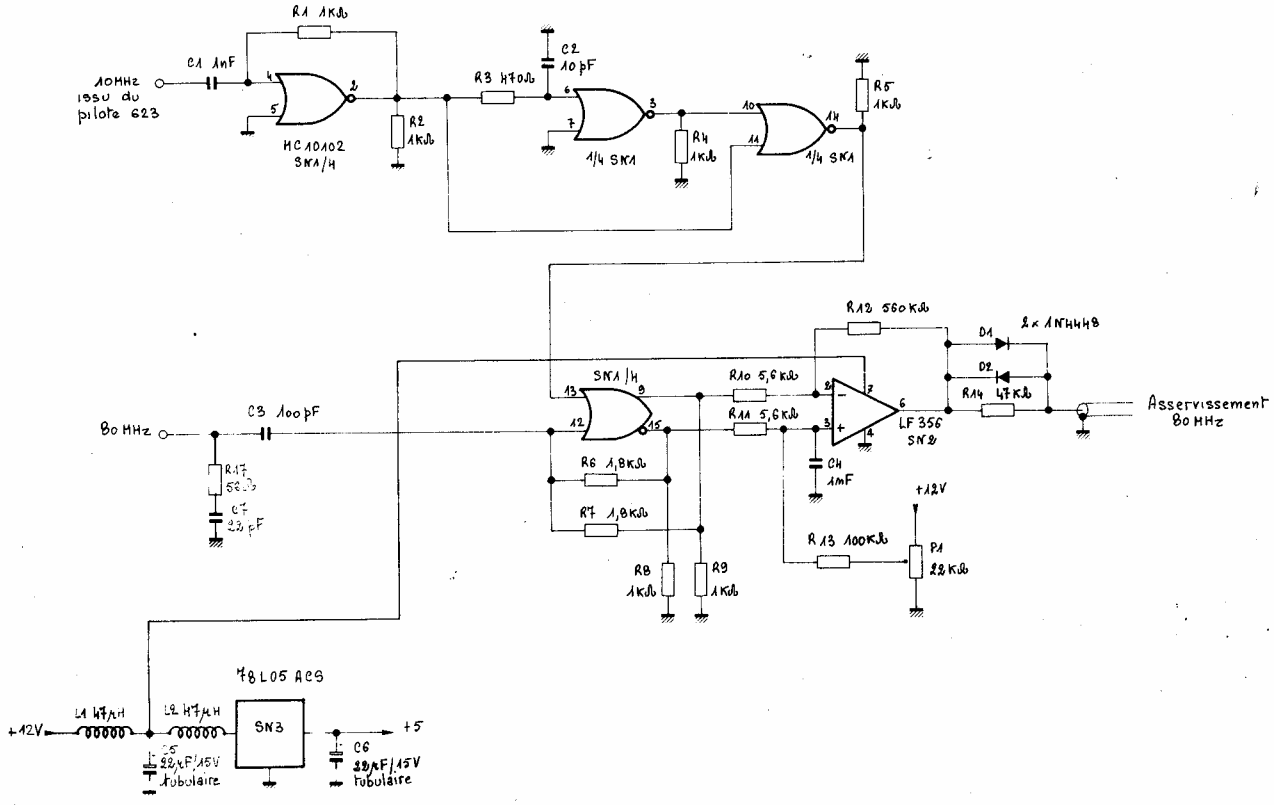
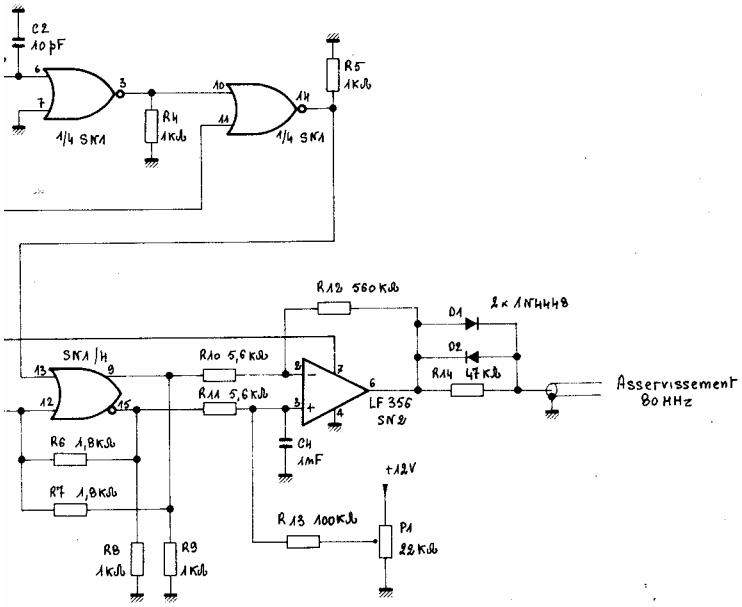
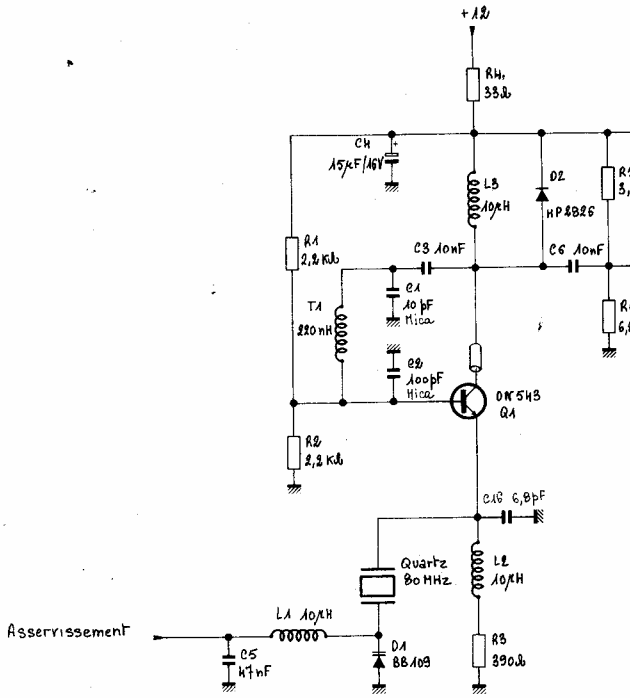
ÉTUDIE / DESSINÉ / VÉRIFIÉ	OSCILLATEUR 20/25 MHz 7100A	PAGE : /
		97146 A



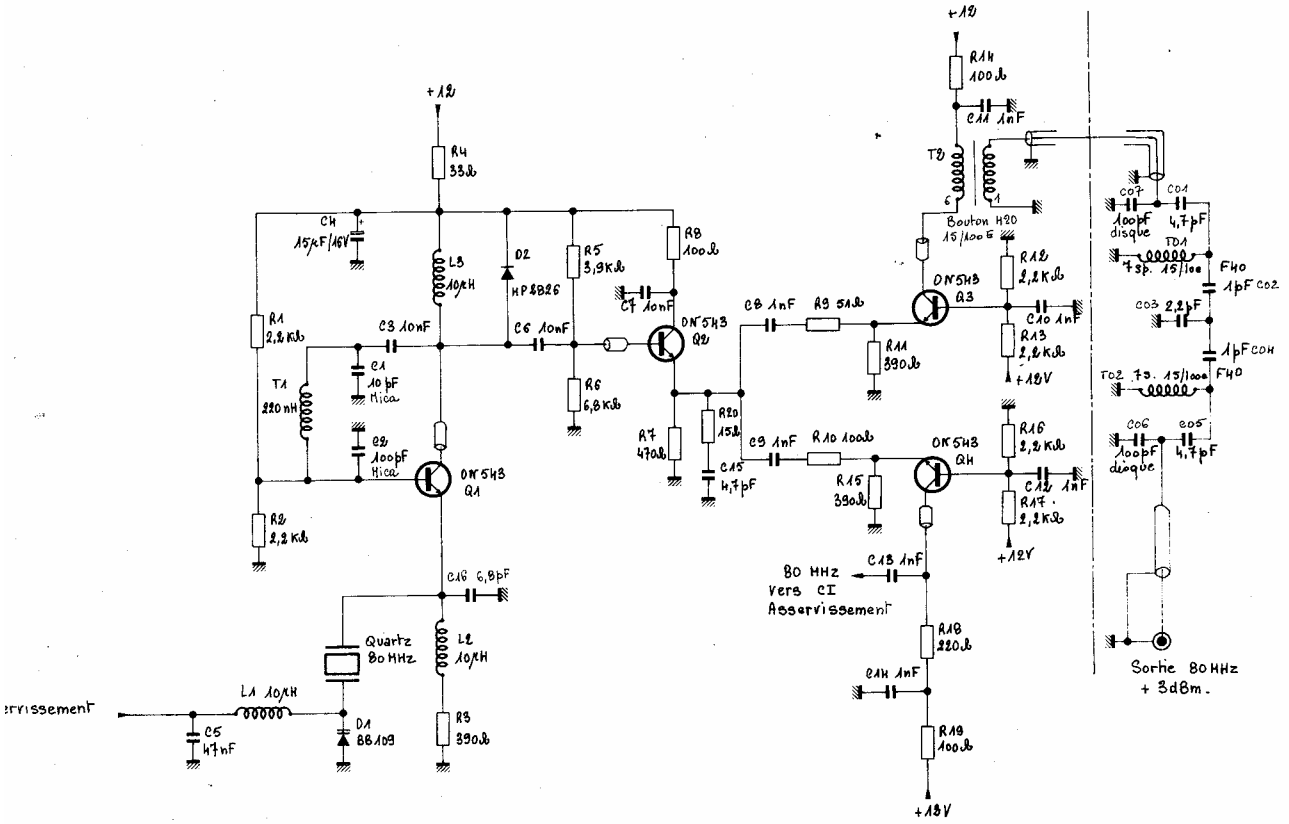
ASSERVISSEMENT 80 MHz



ASSERVISSEMENT 80 MHz



OSCILLATEUR 8



OSCILLATEUR 80 MHz

PLATE IV.11
PLANCHE IV.11

80MHz CRYSTAL OSCILLATOR

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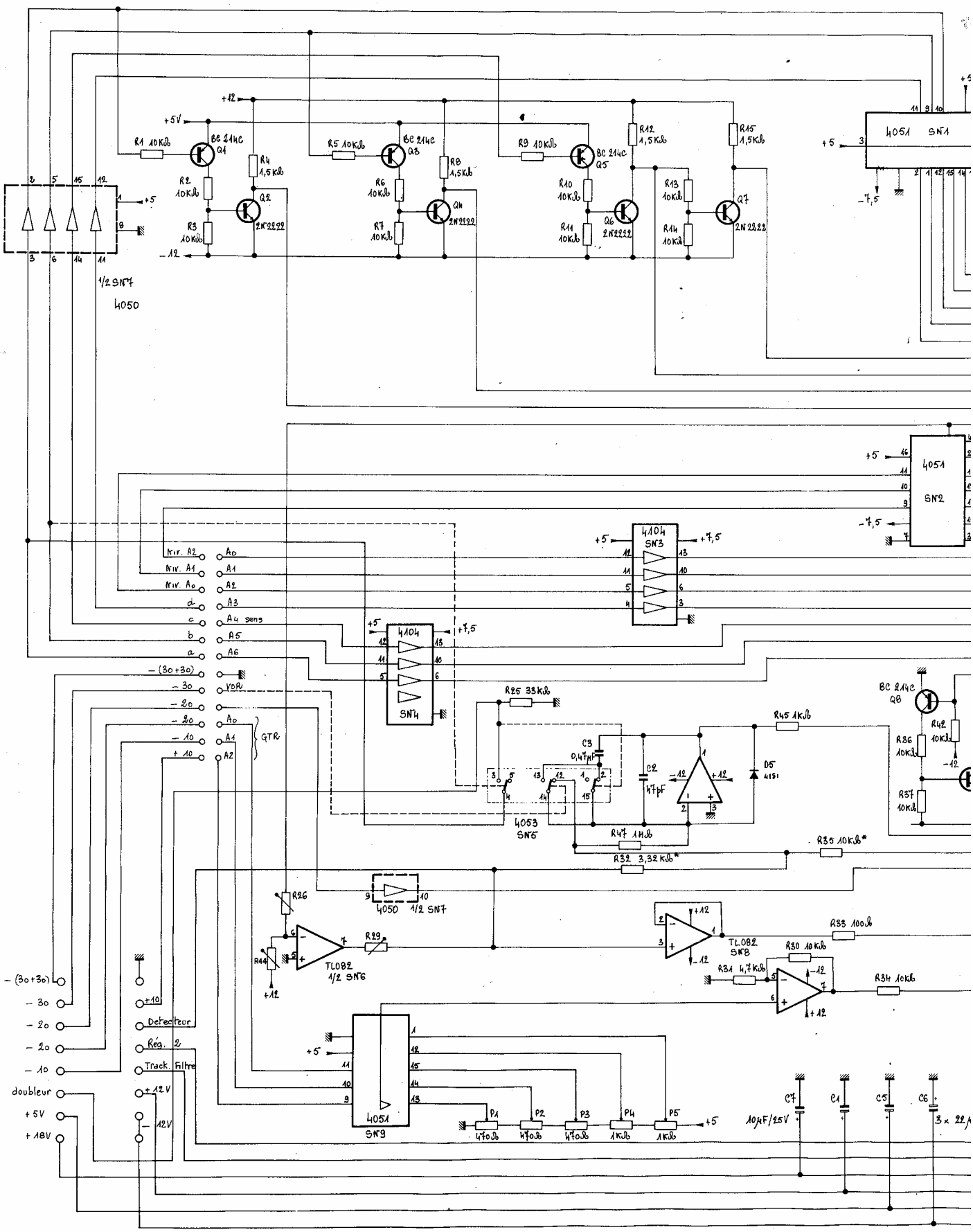
ÉTUDIÉ	DESSINÉ	VÉRIFIÉ	7100A PILOTE 80MHz	PAGE : /
	DC	JR		977147A


+12
+5V
R1 10KΩ
BC 214C Q1
R4 1,5KΩ
R2 10KΩ
Q2 2N2222
R3 10KΩ
-12
1/2 SN7 4050
R5 10KΩ
BC 214C Q3
R8 1,5KΩ
R6 10KΩ
Q4 2N2222
R7 10KΩ
R9 10KΩ
BC 214C Q5
R12 1,5KΩ
R10 10KΩ
Q6 2N2222
R11 10KΩ
R15 1,5KΩ
R13 10KΩ
Q7 2N2222
R14 10KΩ
4051 SN1
4051 SN2
4104 SN3
4104 SN4
Niv. A2
Niv. A1
Niv. A0
a
c
b
a
-(30+30)
-30
-20
-20
-10
+10
A0
A1
A2
A3
A4 sens
A5
A6
VDR
GTR
R25 33KΩ
C3 0,47nF
C2 47pF
R45 1KΩ
D5 4151
4053 SN5
R47 1KΩ
R32 3,32KΩ*
R35 10KΩ*
BC 214C Q8
R42 10KΩ
R36 10KΩ
R37 10KΩ
R26
R29
R44
TL082 1/2 SN6
4050 1/2 SN7
TL082 SN8
R33 100Ω
R30 10KΩ
R31 4,7KΩ
R34 10KΩ
-(30+30)
-30
-20
-20
-10
doubleur
+5V
+18V
+10
Detecteur
Rég. 2
Track. filtre
+12V
-12V
4051 SN9
P1
P2
P3
P4
P5
470Ω
470Ω
470Ω
1KΩ
1KΩ
C7 10µF/25V
C1
C5
C6 3 x 22µ

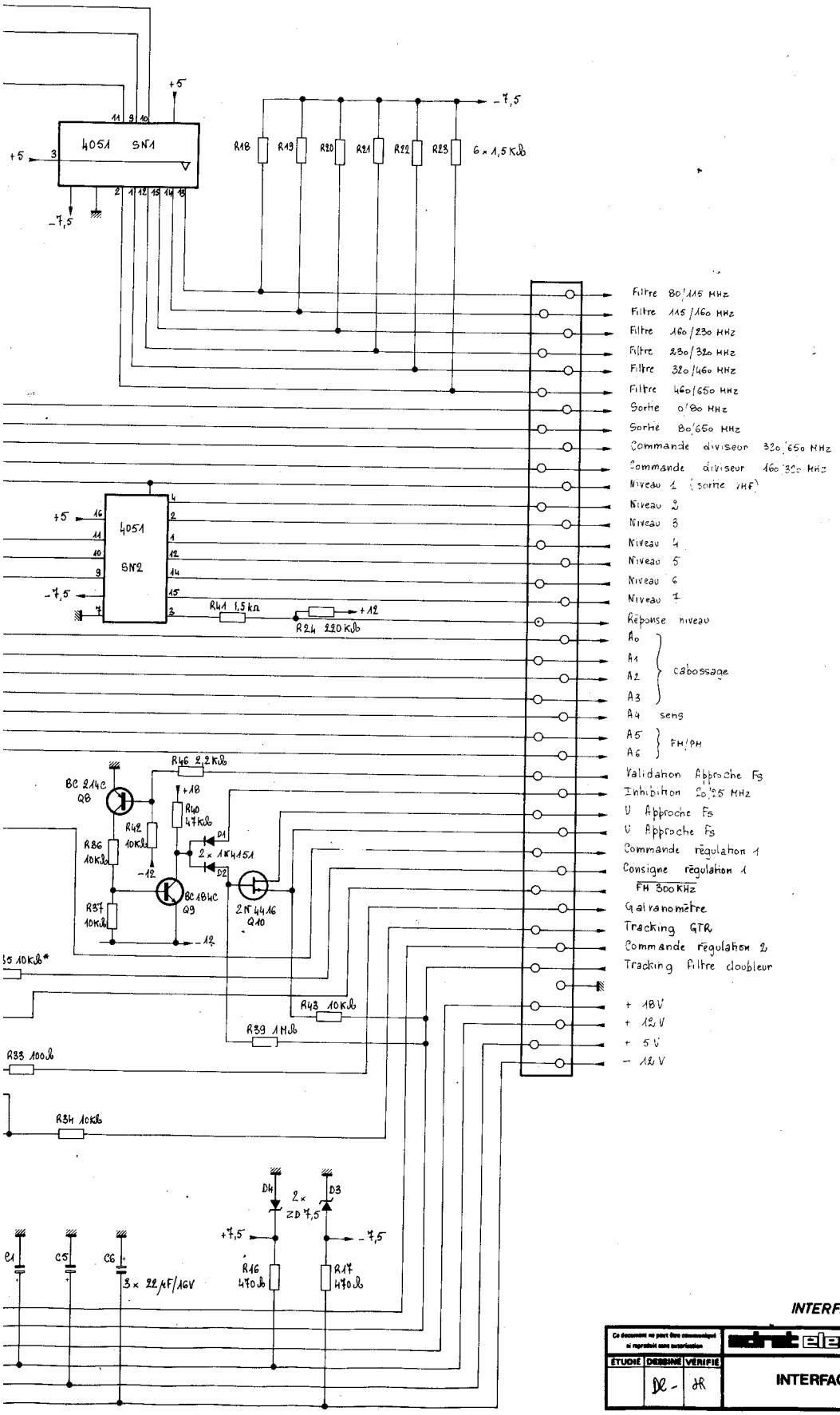


PLATE IV.12
PLANCHE IV.12

INTERFACE

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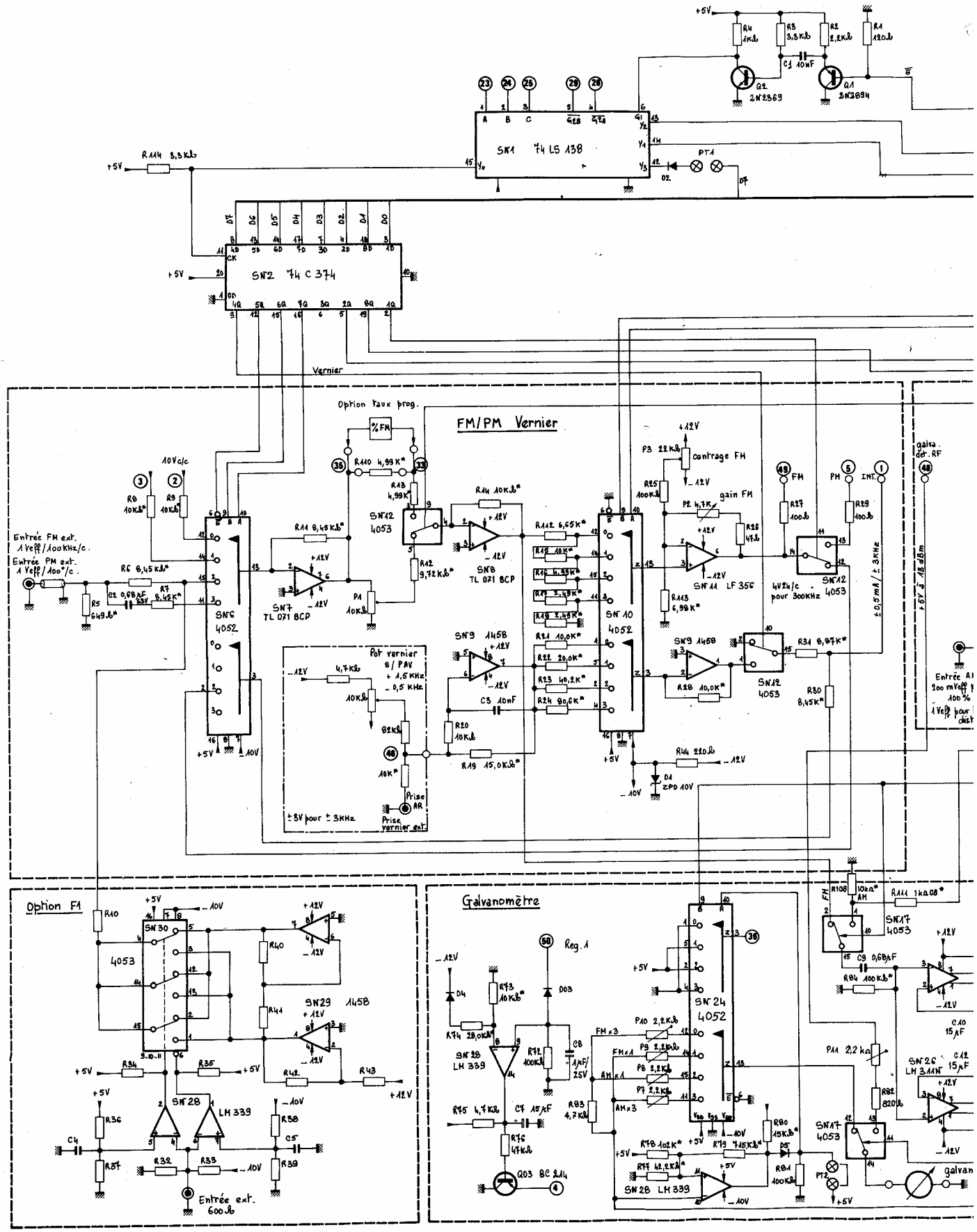
ÉTUDIÉ	DESSINÉ	VÉRIFIÉ	INTERFACE 7100A	PAGE : /
	DL -	JR		97148 A


FM/PM Vernier
Option Faux prog.
%FM
Vernier
Entrée FM ext.
1 Veff/100KHz/c.
Entrée PM ext.
1 Veff/100°/c.
10Vc/c
SN1 74 LS 138
SN2 74 C 374
SN6 4052
SN7 TL 071 BCP
SN8 TL 071 BCP
SN9 1458
SN10 4052
SN11 LF 356
SN12 4053
SN 24 4052
Por vernier s/ PAV
+ 1,5 KHz
- 0,5 KHz
± 5V pour ± 3KHz
Prise AR
Prise vernier ext
Option F1
SN30 4053
SN29 1458
SN28 LH 339
Entrée ext. 600Ω
Galvanomètre
Reg. 1
Q03 BC 214
SN 28 LH 339
SN17 4053
SN20 LH 3111N
galvan.

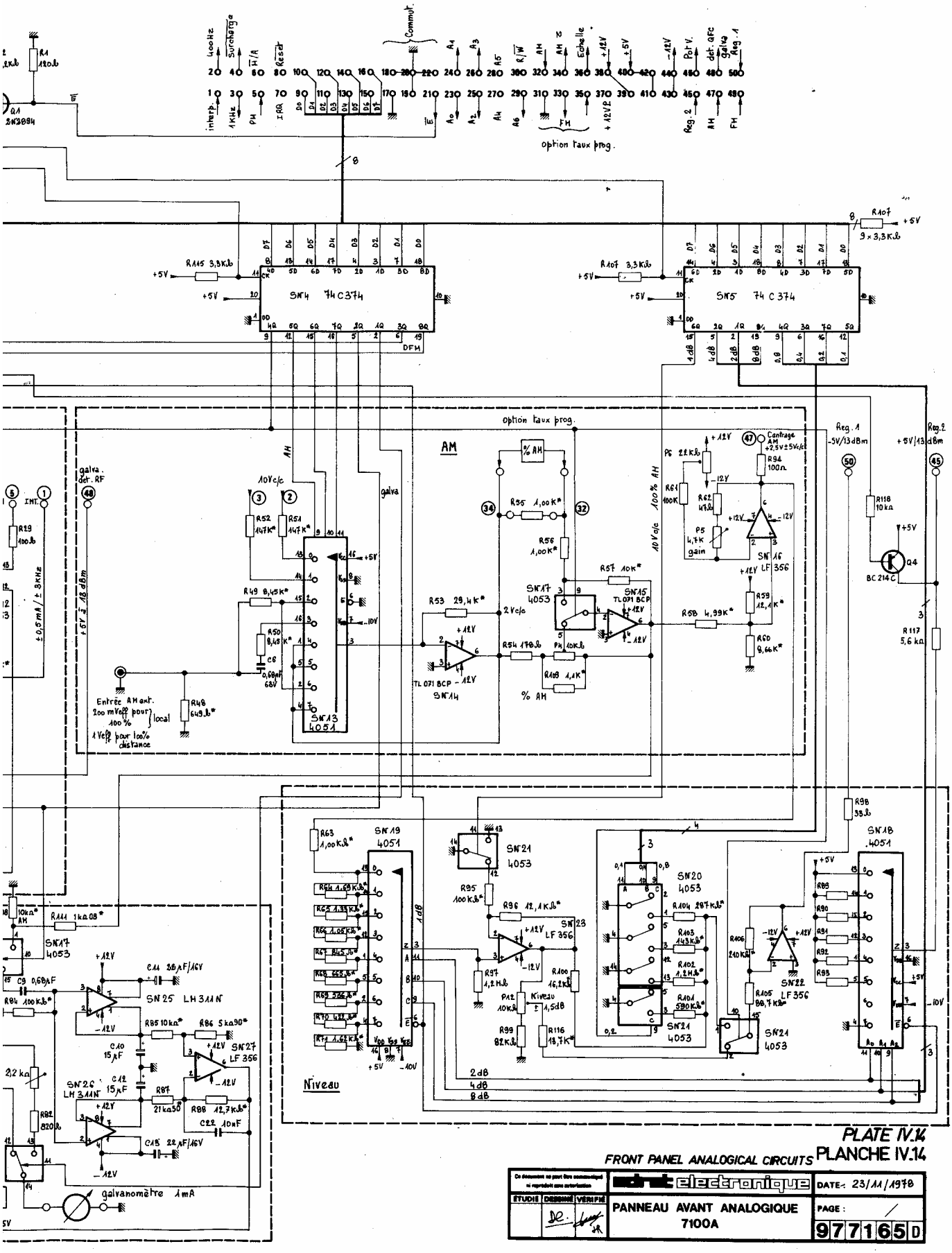


PLATE IV.14

FRONT PANEL ANALOGICAL CIRCUITS PLANCHE IV.14

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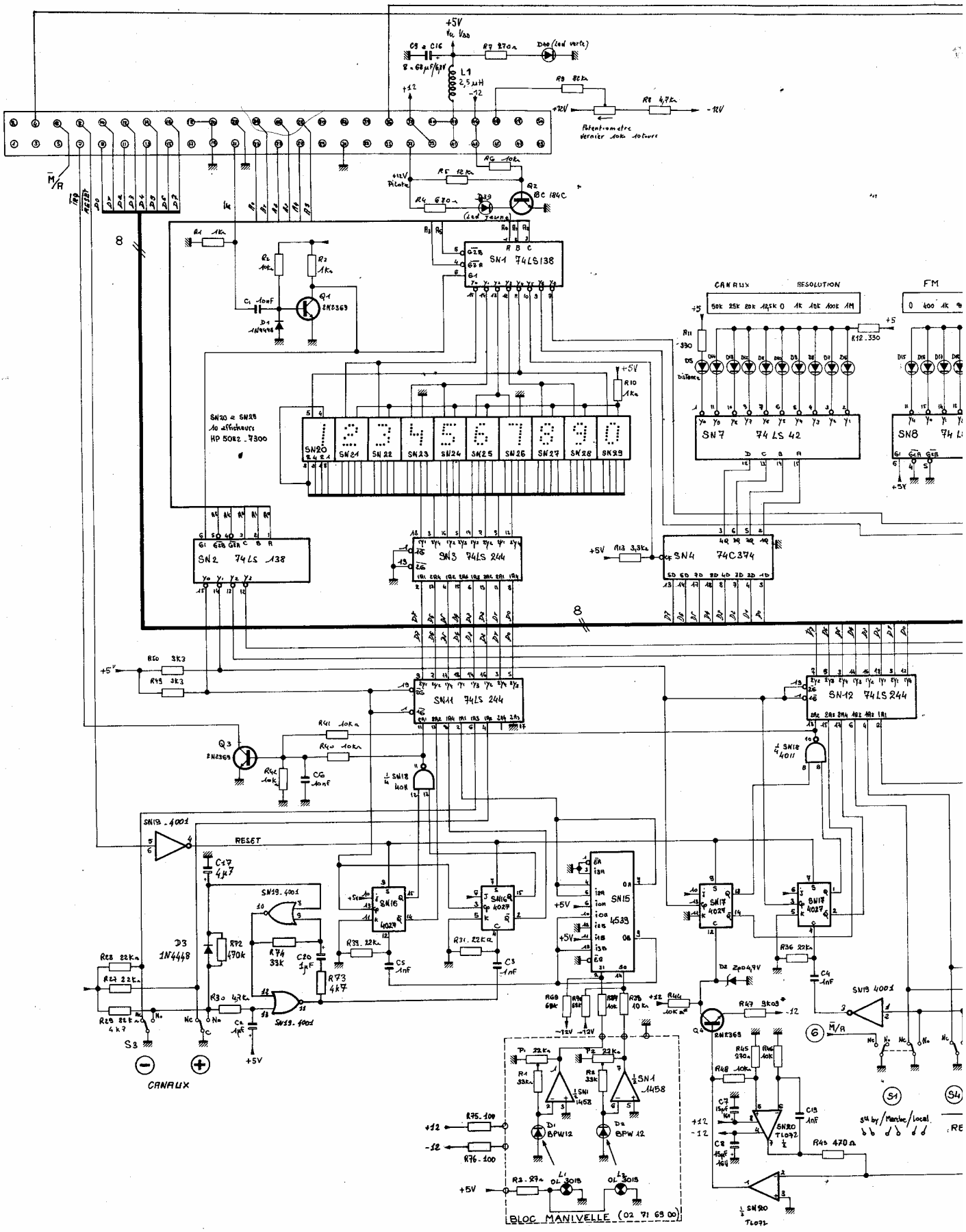
ETUDE	DESSINE	VERIFIE	PANNEAU AVANT ANALOGIQUE 7100A	PAGE: /
	DC.			97165 D


+5V
L1 2,5 µH
+12
-12
R9 82Ω
R8 4,7k
+12V
-12V
Potentiomètre vernier 10k 10 tours
+12V Pilote
R5 12k
R6 10k
R4 680Ω
Q2 BC 184C
R1 1k
R2 1k
C1 10nF
Q1 2N2369
D1 1N4448
SN1 74LS138
SN20 à SN28
10 afficheurs
HP 5082-7300
SN2 74LS 138
SN3 74LS 244
SN4 74C374
CANAUX
RESOLUTION
FM
SN7 74 LS 42
SN8 74 LS
R10 1k
R11 330
R12 330
R13 3,3k
SN11 74LS 244
SN12 74LS 244
R40 3k3
R39 3k3
Q3 2N2369
R41 10k
R42 10k
C6 10nF
SN18 4011
SN19 4001
RESET
C17 4µ7
R72 470k
R74 33k
C20 1µF
R73 4k7
D3 1N4448
R28 22k
R27 22k
R29 22k
4k7
S3
CANAUX
SN16 4029
SN17 4029
SN15 4539
R39 22k
R31 22kΩ
C5 1nF
C3 1nF
R36 22k
C4 1nF
D2 Zpd 4,7V
R47 9k09
Q4 2N2369
R45 220Ω
R46 10k
R48 10k
C7 15nF
C8 15nF
C18 1nF
SN20 TL072
R45 470Ω
R69 68k
R70 68k
R71 10k
R44 10k
P1 22k
P2 22k
R1 33k
R2 33k
½ SN1 1458
D1 BPW12
D2 BPW 12
R75 100
R76 100
R3 270
L1 OL 3018
L2 OL 3018
BLOC MANIVELLE (02 71 69 00)
M/A
S1
S4
S4 by/Marche/Local
RE

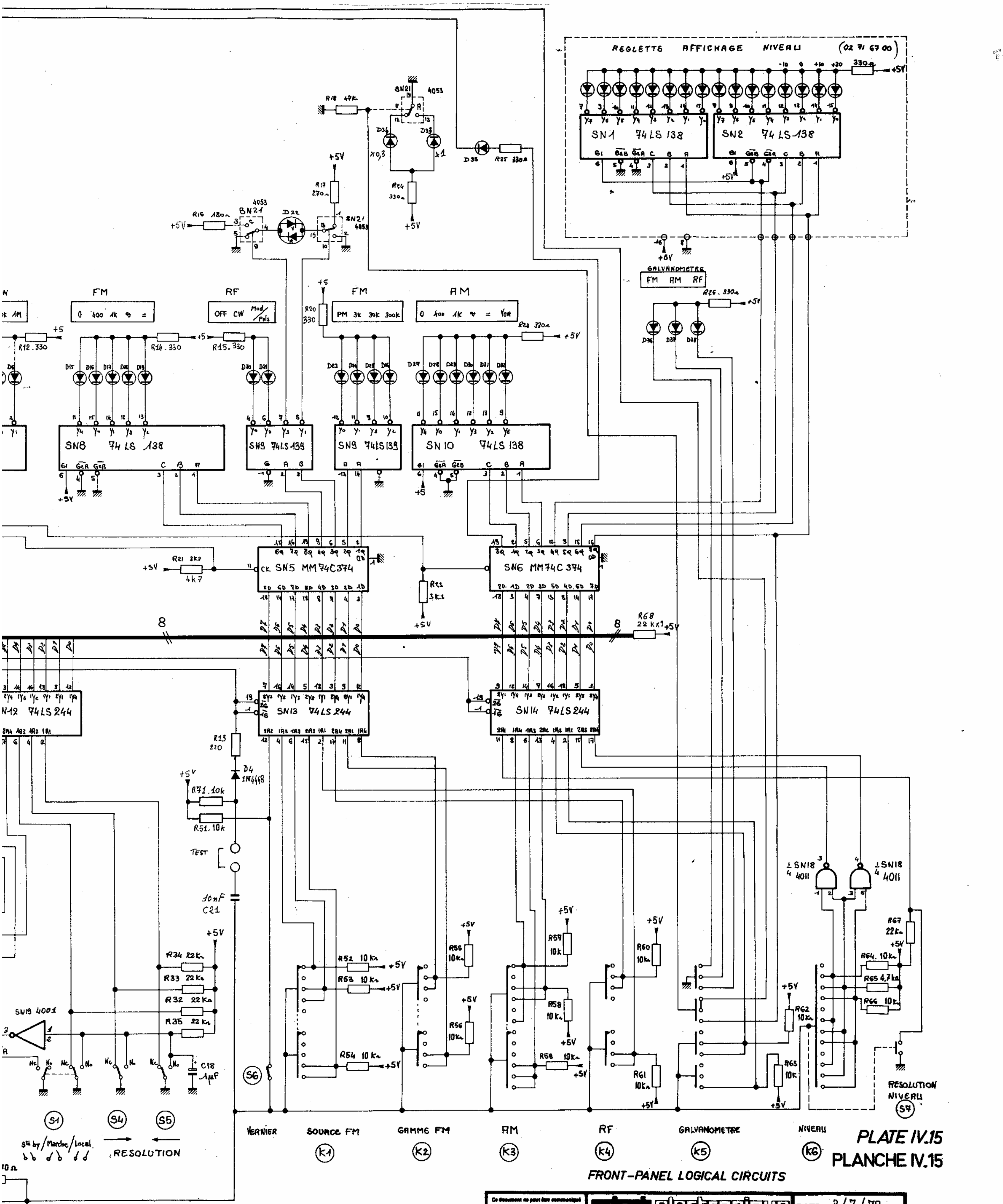
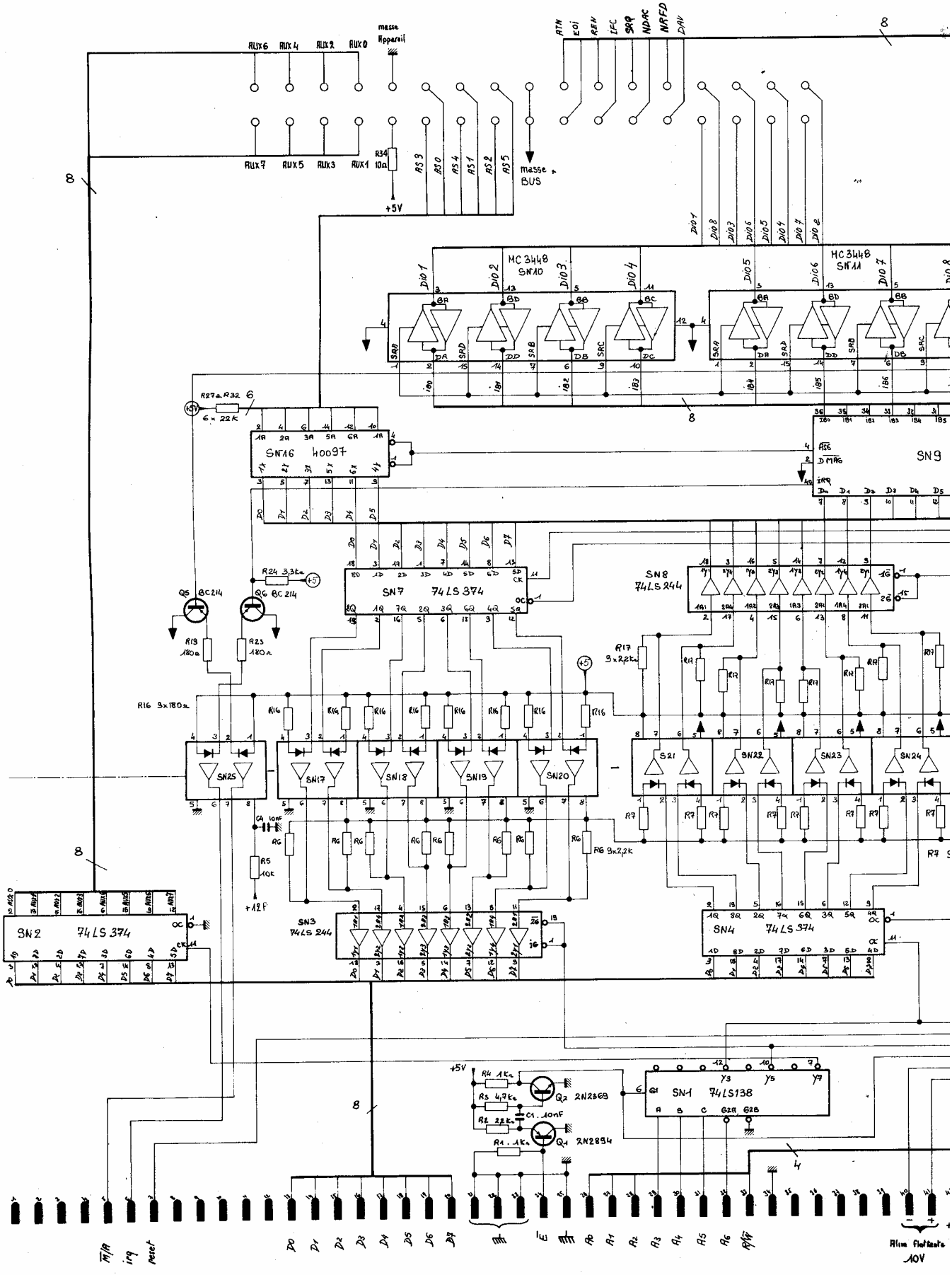


PLATE IV.15

PLANCHE IV.15

FRONT-PANEL LOGICAL CIRCUITS

adret electronique	DATE : 3/7/78
COMMUTATEURS 7100A	PAGE : 1
	977166A


AUX6 AUX4 AUX2 AUX0
masse Appareil
AUX7 AUX5 AUX3 AUX1
R34 10Ω
+5V
AS3 AS0 AS4 AS1 AS2 AS5
masse BUS
ATN EOI REN IFC SRQ NDAC NRFD DAV
DIO1 DIO8 DIO3 DIO6 DIO5 DIO4 DIO7 DIO2
MC3448 SN10
MC3448 SN11
SN16 40097
SN9
SN7 74LS374
SN8 74LS244
R24 3,3kΩ
Q5 BC214
Q6 BC214
R19 180Ω
R23 180Ω
R17 9x2,2kΩ
R16 9x180Ω
SN25
SN17
SN18
SN19
SN20
S21
SN22
SN23
SN24
C4 10nF
R5 10K
+12F
R6 9x2,2K
SN2 74LS374
SN3 74LS244
SN4 74LS374
R4 1kΩ
R3 4,9kΩ
R2 22kΩ
R1 1kΩ
C1 10nF
Q2 2N2369
Q1 2N2894
SN1 74LS138
D0 D1 D2 D3 D4 D5 D6 D7
IE
A0 A1 A2 A3 A4 A5 A6 R/W
M/R
irq
reset
Alim Flottante 10V

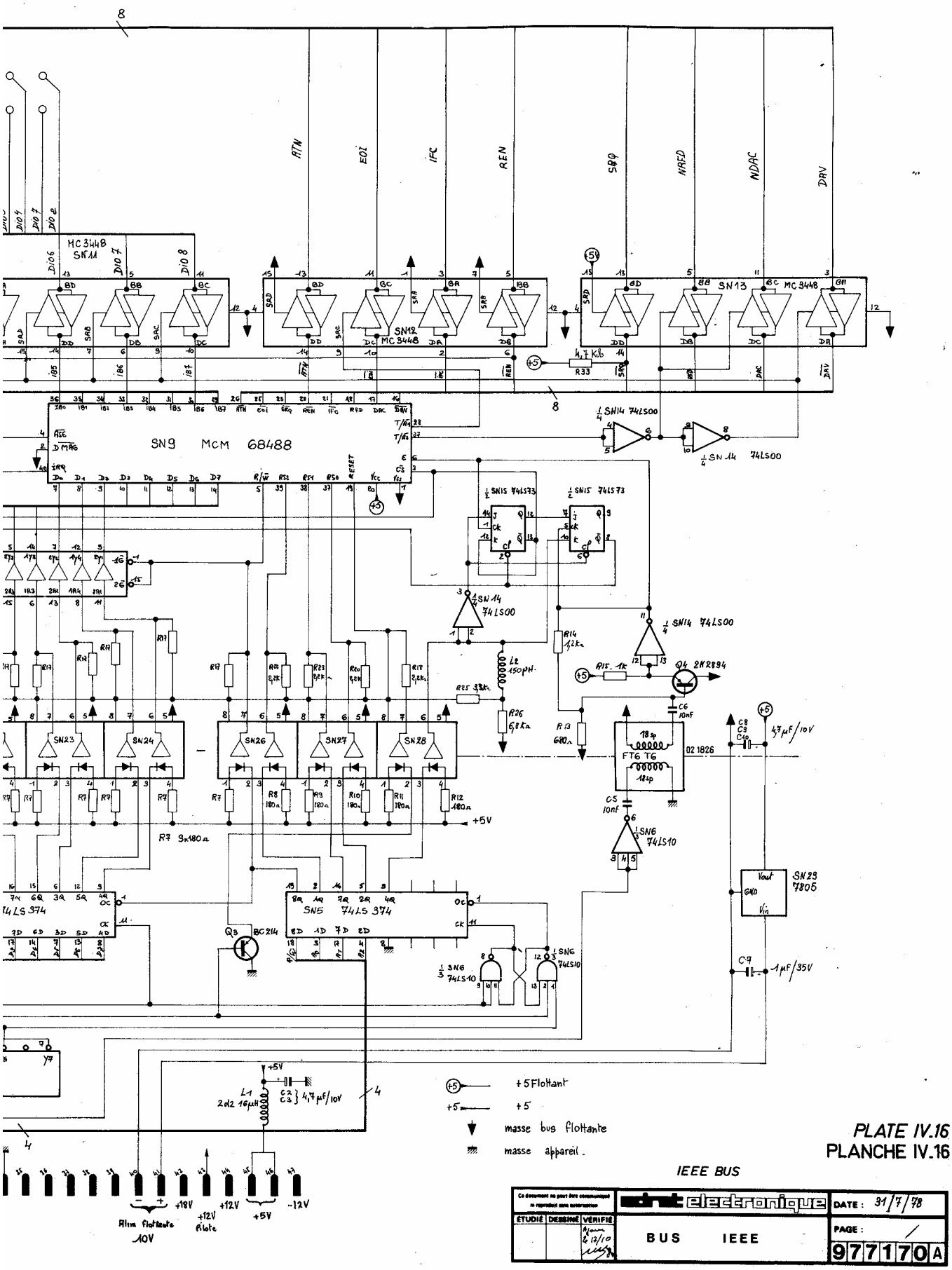


PLATE IV.16
PLANCHE IV.16

IEEE BUS

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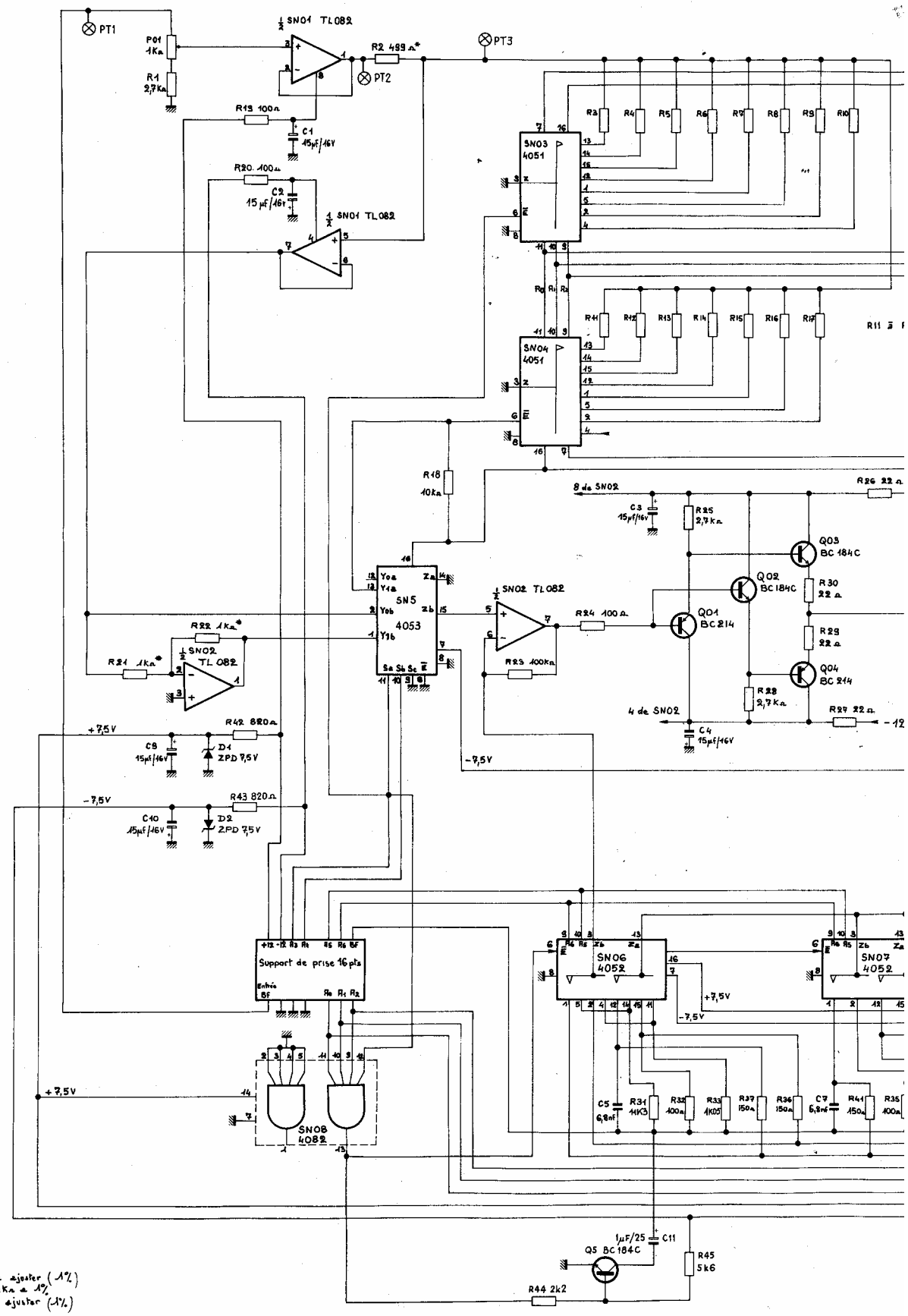
ÉTUDIÉ / DESSINÉ / VÉRIFIÉ	BUS IEEE		PAGE : 97717 0 A



R3 a R17 Resistances a ajuster (1%)
R21 et R22 " " 1Ka a 1%
R33 et R34 Resistances a ajuster (1%)

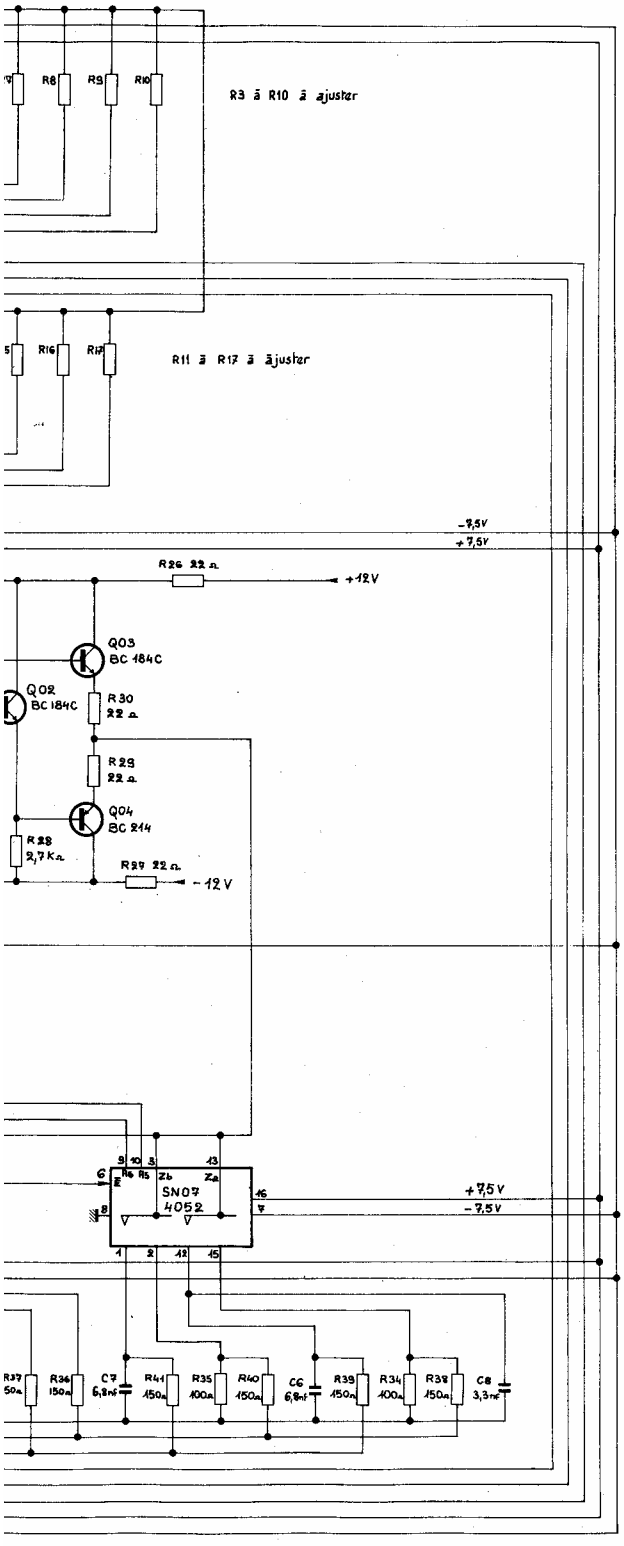


PLATE IV.17
PLANCHE IV.17

LINEARIZER

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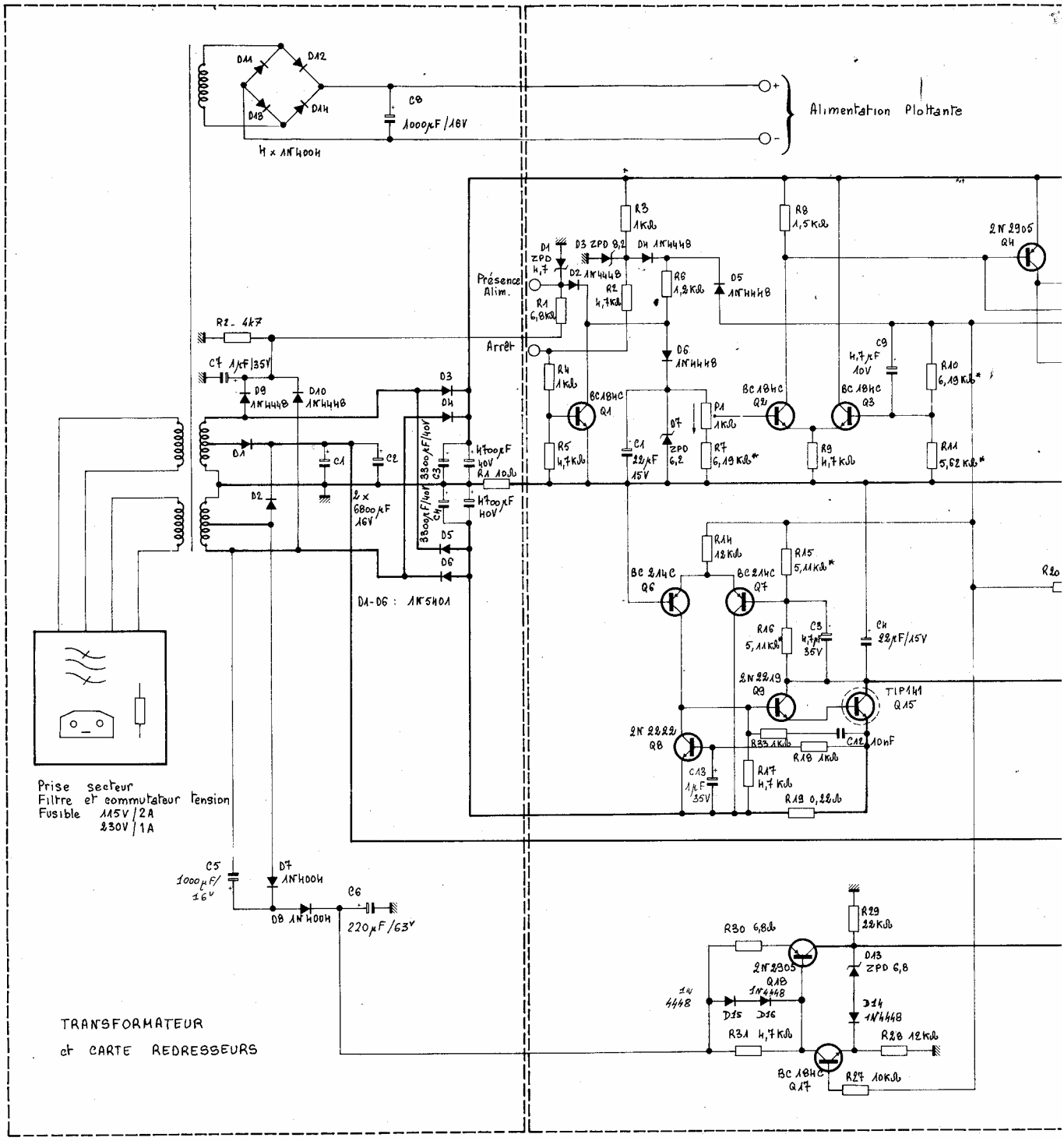
ÉTUDIE / DESSINÉ / VERIFIÉ : DC / JR	LINEARISATEUR 7100A	PAGE : . / 977172 A


D11
D12
D13
D14
C8
1000µF/16V
4 x 1N4004
Alimentation Flottante
+
-
R3
1Kob
R8
1,5Kob
2N2905
Q4
D1
ZPD
4,7
D3 ZPD 8,2
D4 1N4448
D2 1N4448
R6
1,2Kob
D5
1N4448
Présence
Alim.
R1
6,8Kob
R2
4,7Kob
R2 - 4k7
Arrêt
C7 1µF/35V
D6
1N4448
C9
4,7µF
10V
R10
6,19Kob*
R4
1Kob
BC 184C
Q1
BC 184C
Q2
BC 184C
Q3
P1
1Kob
D7
ZPD
6,2
R5
4,7Kob
C1
22µF
15V
R7
6,19Kob*
R9
4,7Kob
R11
5,62Kob*
D9
1N4448
D10
1N4448
D3
D4
D1
D2
C1
C2
4700µF
40V
R1 10ob
C3
330nF/160V
C4
330nF/160V
2 x
6800µF
16V
D5
D6
D1-D6 : 1N5404
R14
12Kob
R15
5,11Kob*
BC 214C
Q6
BC 214C
Q7
R16
5,11Kob*
C3
4,7µF
35V
C4
22µF/15V
2N2219
Q9
TIP141
Q15
2N2222
Q8
R33 1Kob
C12 10nF
R18 1Kob
C13
1µF
35V
R17
4,7 Kob
R19 0,22ob
Prise secteur
Filtre et commutateur tension
Fusible 115V/2A
230V/1A
C5
1000µF/
16V
D7
1N4004
D8 1N4004
C6
220µF/63V
R30 6,8ob
R29
22Kob
2N2905
Q18
D13
ZPD 6,8
1N
4448
1N4448
D15
D16
D14
1N4448
R31 4,7Kob
R28 12Kob
BC 184C
Q17
R27 10Kob
TRANSFORMATEUR
et CARTE REDRESSEURS

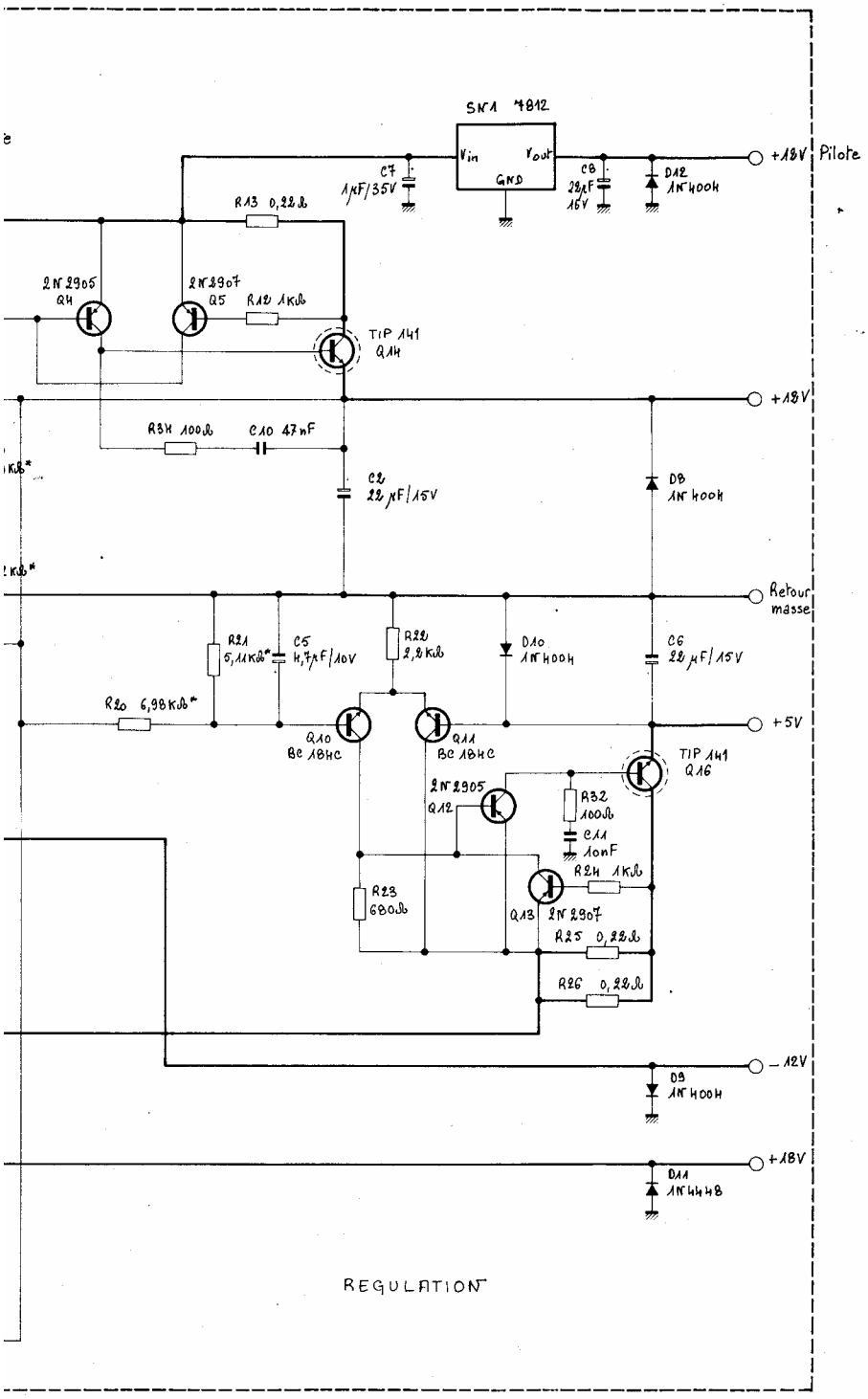


PLATE IV.18
PLANCHE IV.18

POWER SUPPLY

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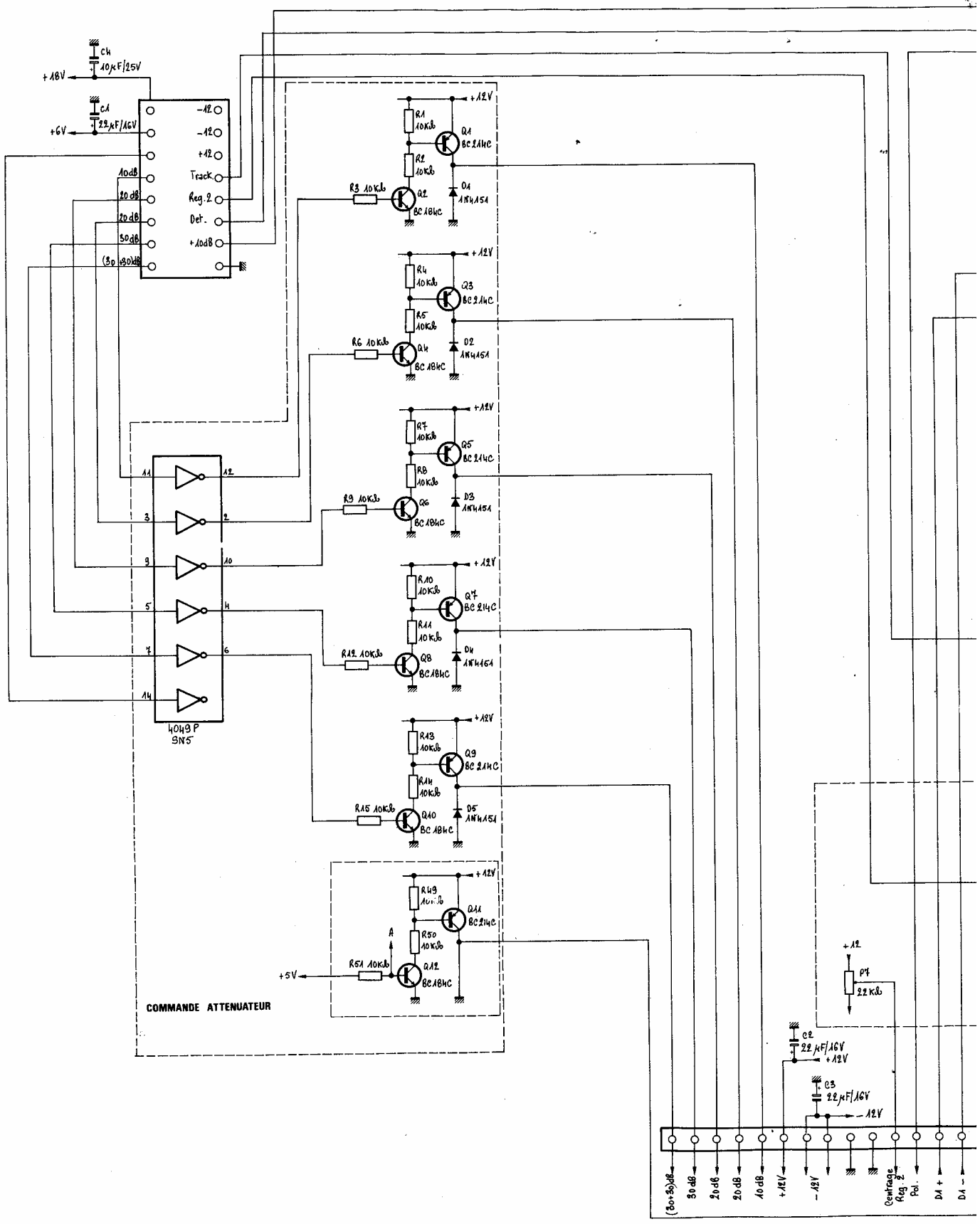
	De-	JR		97176A


C4
10µF/25V
+18V
C1
22µF/16V
+6V
-12
-12
+12
Track
Reg.2
Det.
+10dB
10dB
20 dB
20 dB
30dB
(30+30)dB
+12V
R1 10KΩ
Q1 BC214C
R2 10KΩ
R3 10KΩ
Q2 BC184C
D1 1N4151
R4 10KΩ
Q3 BC214C
R5 10KΩ
R6 10KΩ
Q4 BC184C
D2 1N4151
R7 10KΩ
Q5 BC214C
R8 10KΩ
R9 10KΩ
Q6 BC184C
D3 1N4151
R10 10KΩ
Q7 BC214C
R11 10KΩ
R12 10KΩ
Q8 BC184C
D4 1N4151
R13 10KΩ
Q9 BC214C
R14 10KΩ
R15 10KΩ
Q10 BC184C
D5 1N4151
R49 10KΩ
Q11 BC214C
R50 10KΩ
R51 10KΩ
Q12 BC184C
A
+5V
11
12
3
2
9
10
5
4
7
6
14
4049 P
SN5
COMMANDE ATTENUATEUR
+12
P1
2.2 KΩ
C2
22µF/16V
+12V
C3
22µF/16V
-12V
(30+30)dB
30 dB
20 dB
20 dB
10 dB
+12V
-12V
Centrage
Reg. 2
Pol.
D1 +
D1 -

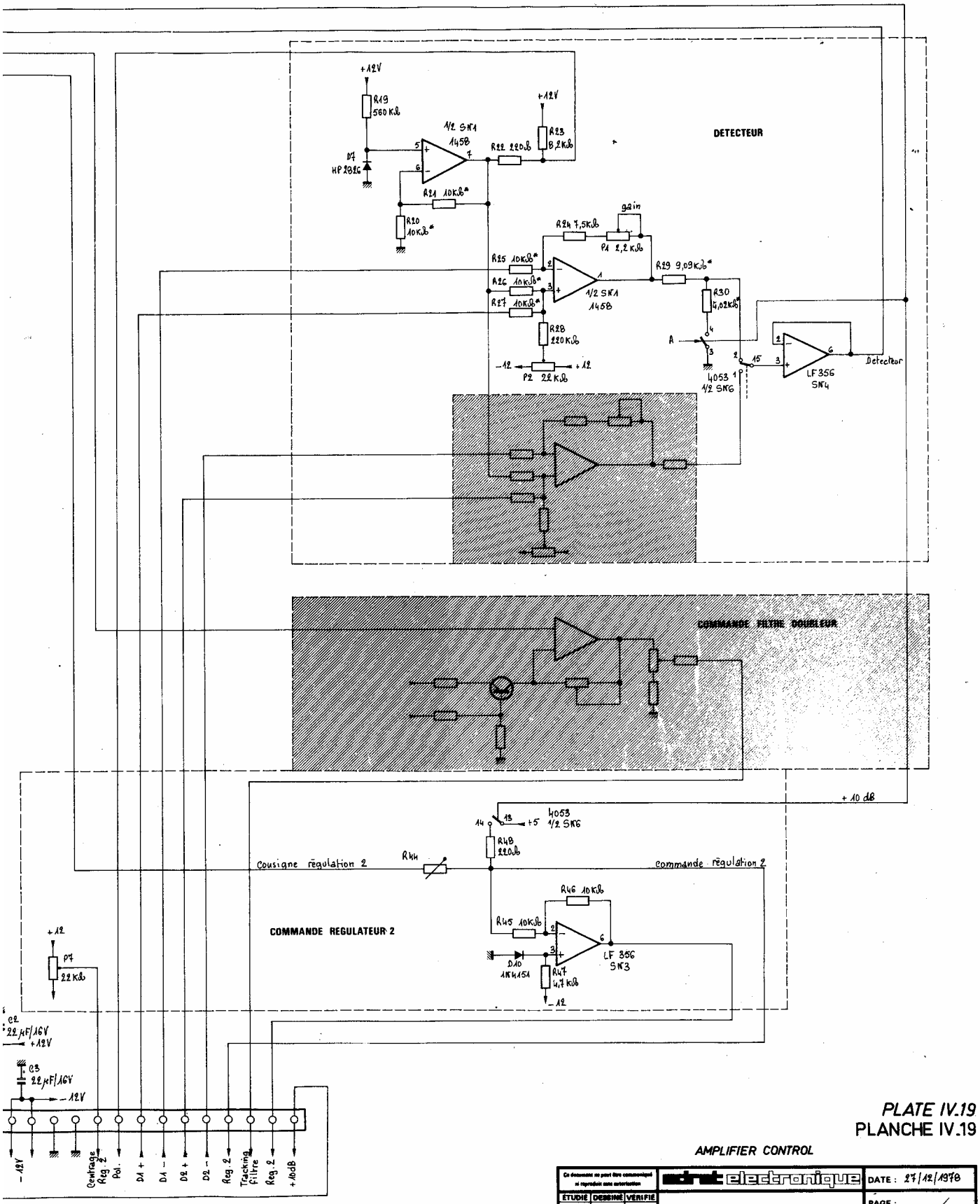


PLATE IV.19
PLANCHE IV.19

AMPLIFIER CONTROL

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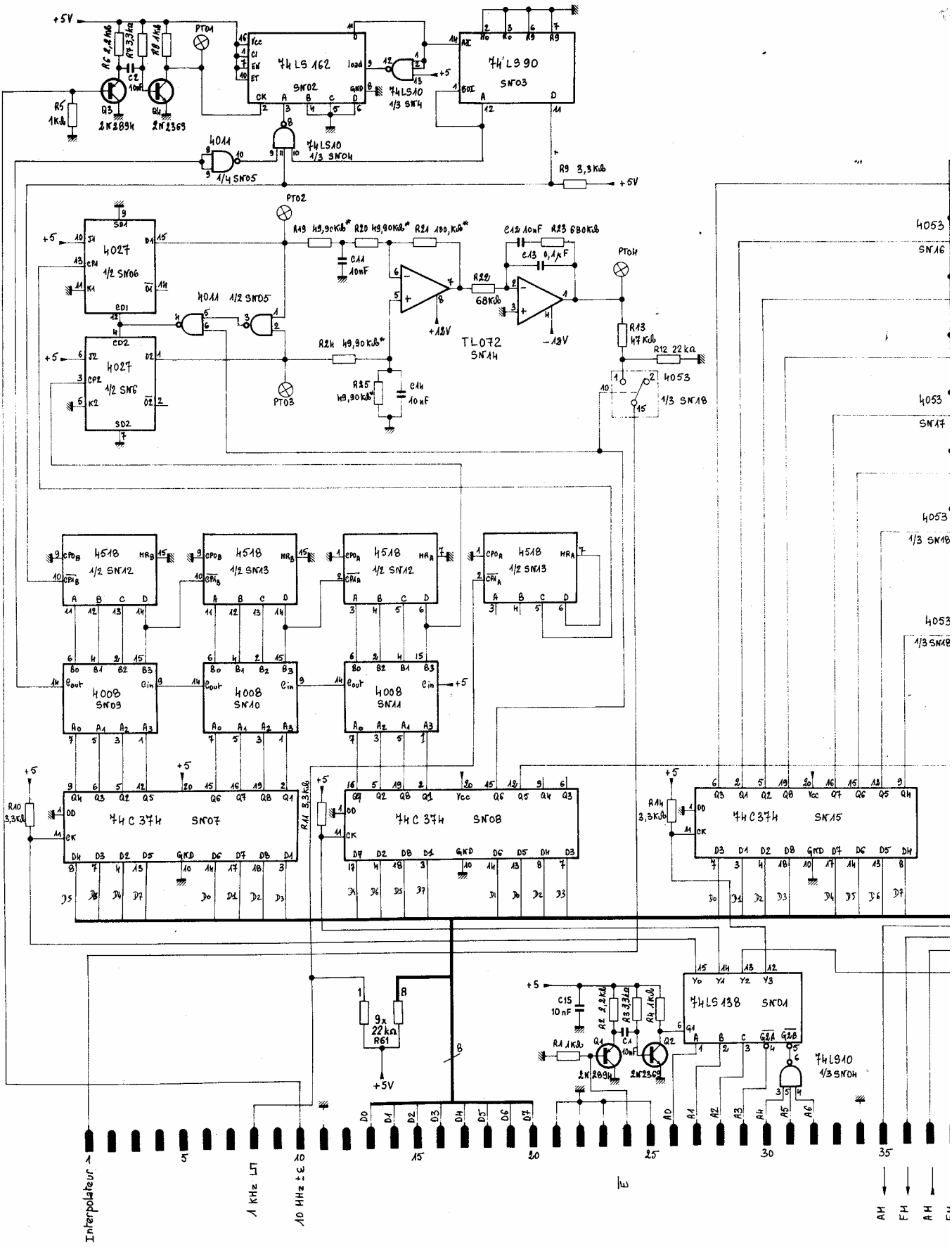
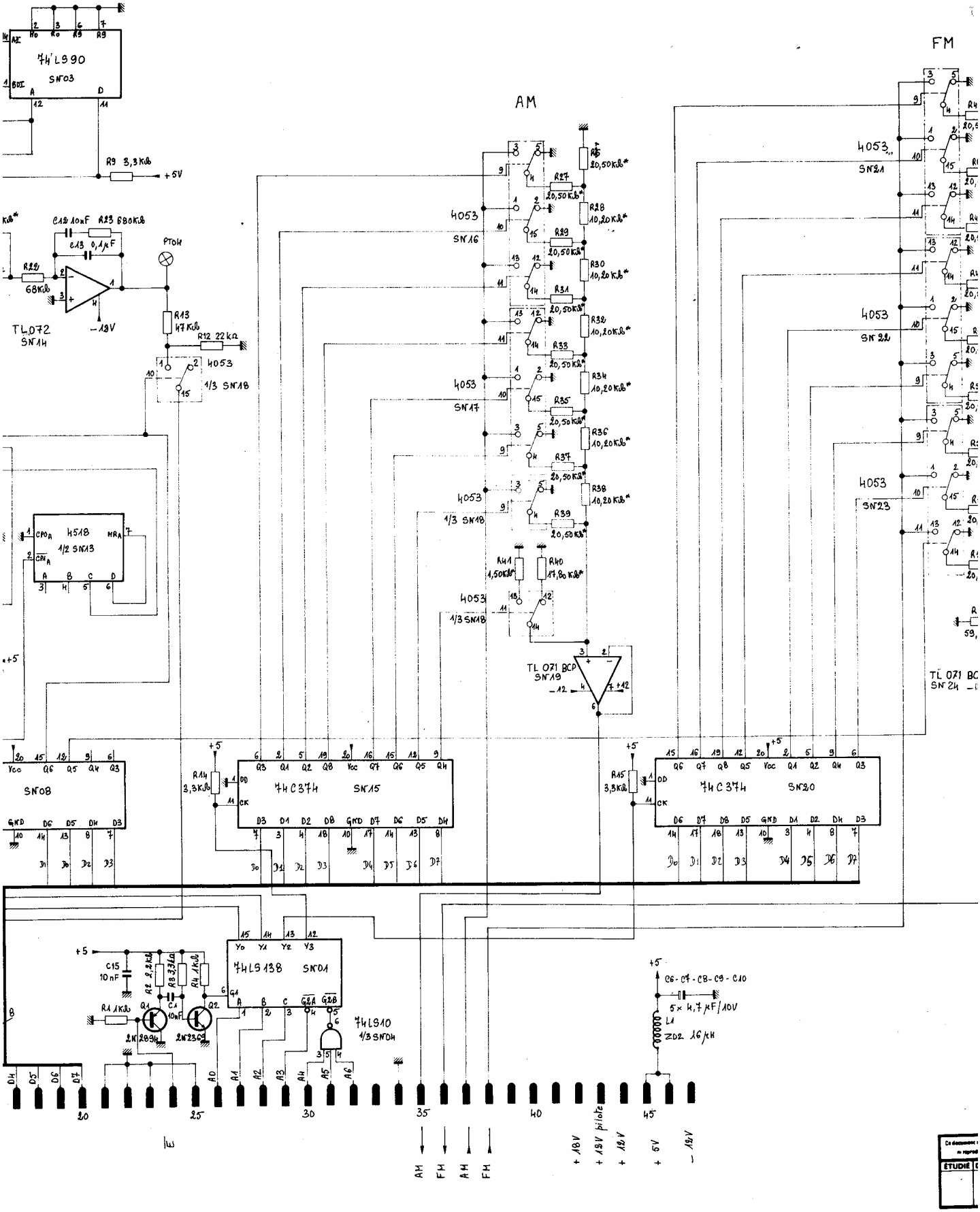

+5V
PTOM
74LS162
SN02
74'L90
SN03
74LS10
1/3 SN04
4011
1/4 SN05
R9 3,3Kω
PTO2
4027
1/2 SN06
4011 1/2 SN05
TL072
SN14
PTO3
PTOH
4053
SN16
SN17
1/3 SN18
4518
1/2 SN12
1/2 SN13
4008
SN09
SN10
SN11
74C374
SN07
SN08
SN15
74LS138
SN01
9x 22kΩ R61
+5V
Interpolateur
1 KHz LT
10 MHz ± ε
AM
FM


AM
FM
74'L990
SN03
R9 3,3KΩ
+5V
C12 10nF R23 680KΩ
C13 0,1µF
R22
68KΩ
PTOH
TL072
SN14
-18V
R13
47KΩ
R12 22kΩ
4053
1/3 SN18
4053
SN16
4053
SN17
4053
1/3 SN18
4053
1/3 SN18
R27 20,50KΩ*
R28 10,20KΩ*
R29 20,50KΩ*
R30 10,20KΩ*
R31 20,50KΩ*
R32 10,20KΩ*
R33 20,50KΩ*
R34 10,20KΩ*
R35 20,50KΩ*
R36 10,20KΩ*
R37 20,50KΩ*
R38 10,20KΩ*
R39 20,50KΩ*
R41 1,50KΩ*
R40 11,80 KΩ*
TL 071 BCP
SN19
4053
SN21
4053
SN22
4053
SN23
TL 071 BC
SN 24
4518
1/2 SN13
SN08
74C374
SN15
74C374
SN20
R14 3,3KΩ
R15 3,3KΩ
74LS138
SN01
74LS10
1/3 SN04
C15 10nF
R2 2,2KΩ
R3 3,3KΩ
R4 1KΩ
R1 1KΩ
C4 10nF
Q1 2N2369A
Q2 2N2369A
C6 - C7 - C8 - C9 - C10
5 x 4,7µF/10V
L1
ZD2 16µH
AM
FM
AM
FM
+18V
+18V pilote
+18V
+5V
-18V

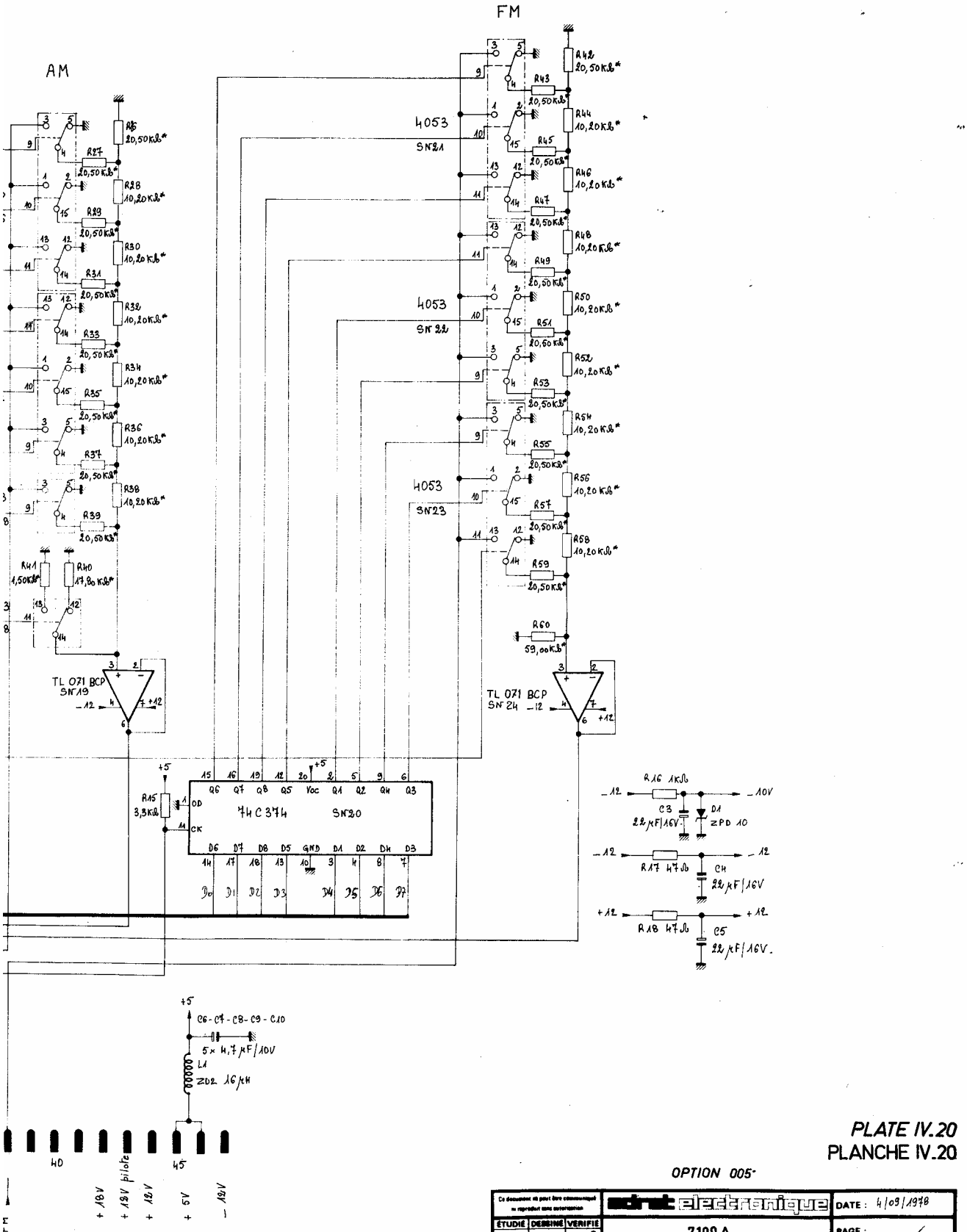


PLATE IV.20
PLANCHE IV.20

OPTION 005

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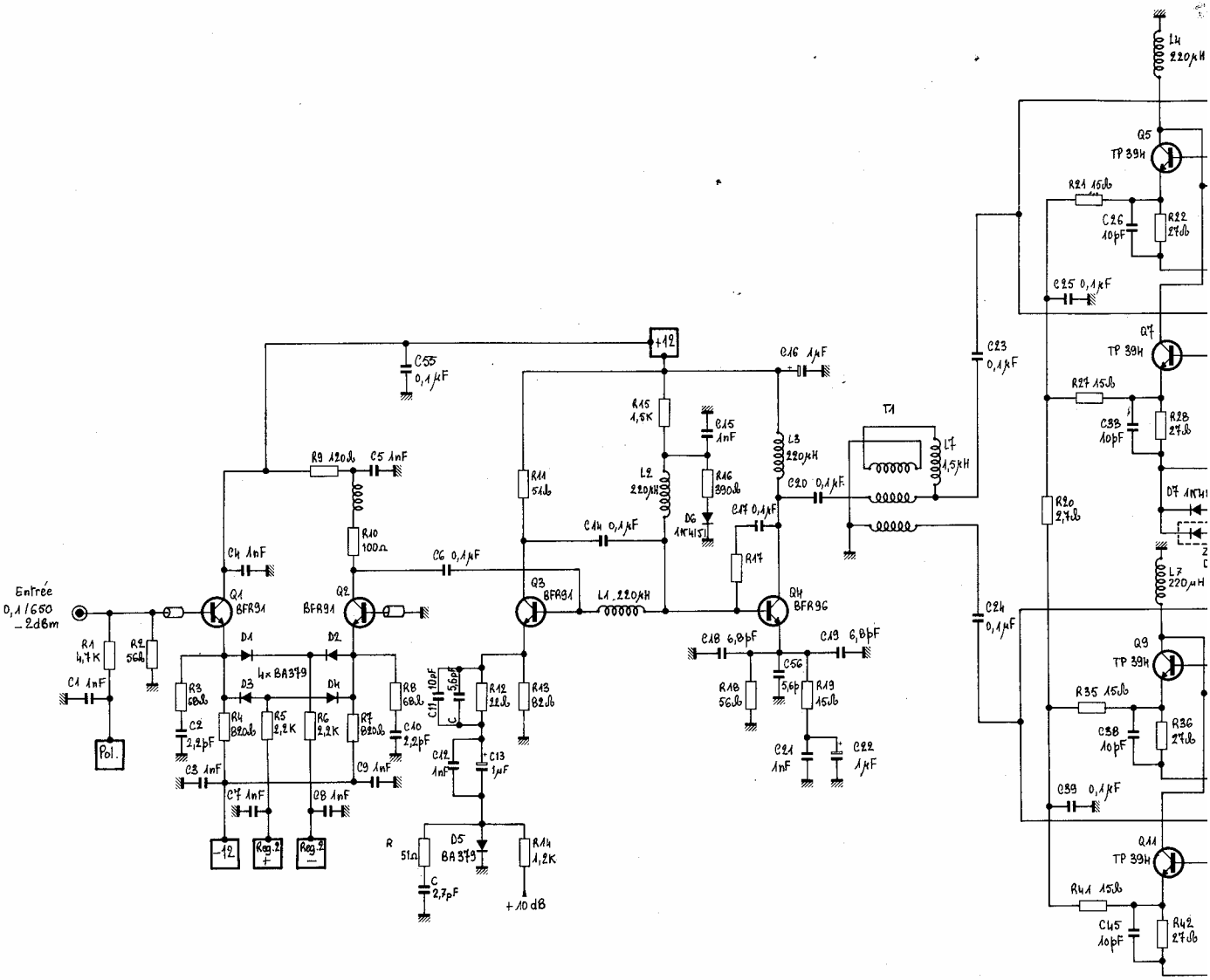
Entrée
0,1 / 50Ω
-2dBm
Pol.
Q1 BFR91
Q2 BFR91
Q3 BFR91
Q4 BFR96
4x BA379
D5 BA379
D6 1N4151
D7 1N41
T1
L1 220µH
L2 220µH
L3 220µH
L4 220µH
L7 1,5µH
L7 220µH
+12
-12
Reg.2 +
Reg.2 -
+10 dB
Q5 TP 39H
Q7 TP 39H
Q9 TP 39H
Q11 TP 39H

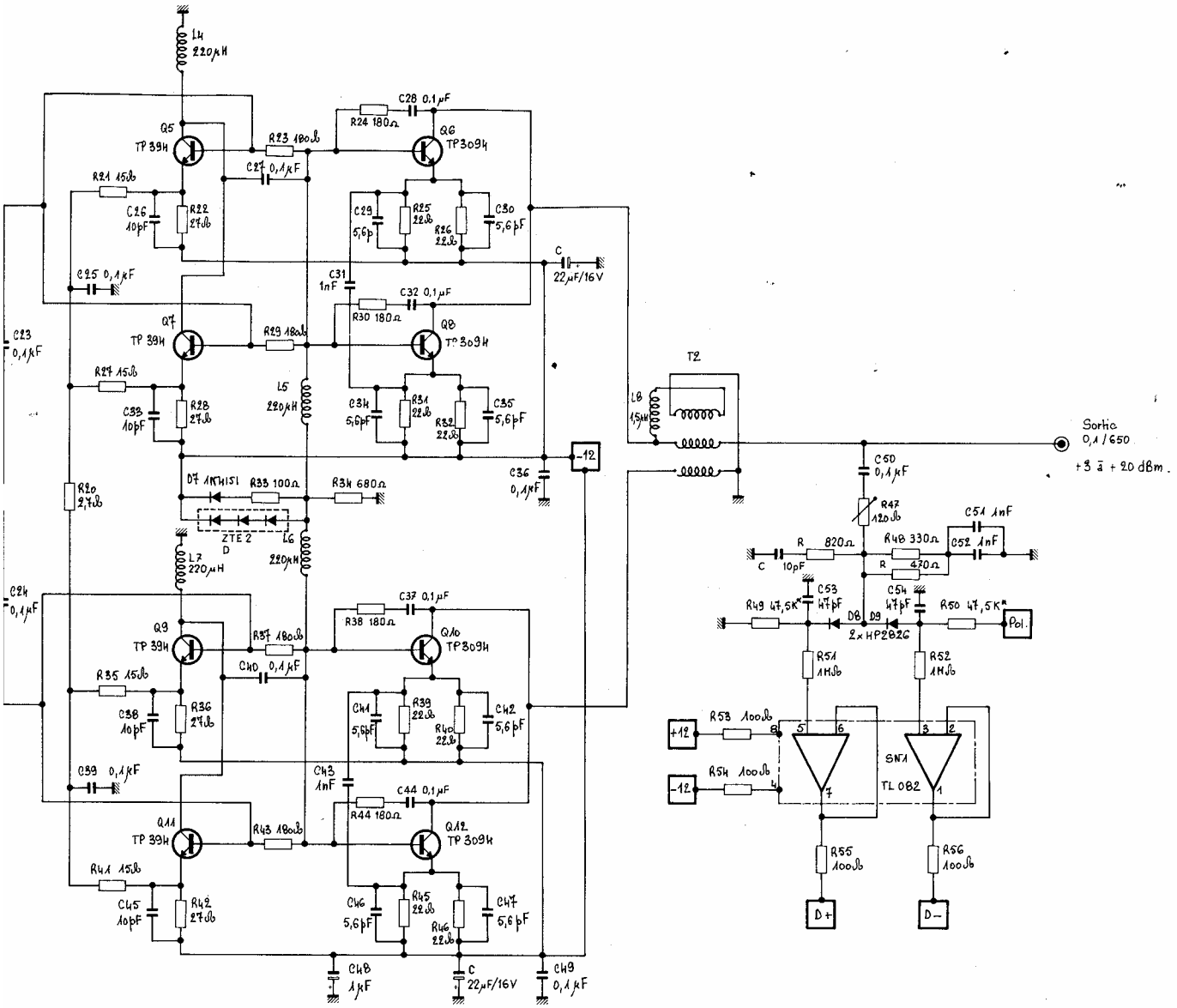

PLATE IV.21
PLANCHE IV.21

STANDARD AMPLIFIER

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