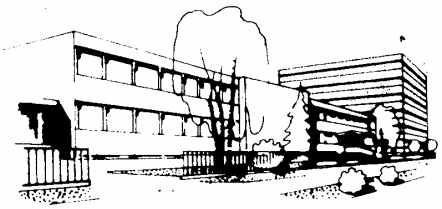
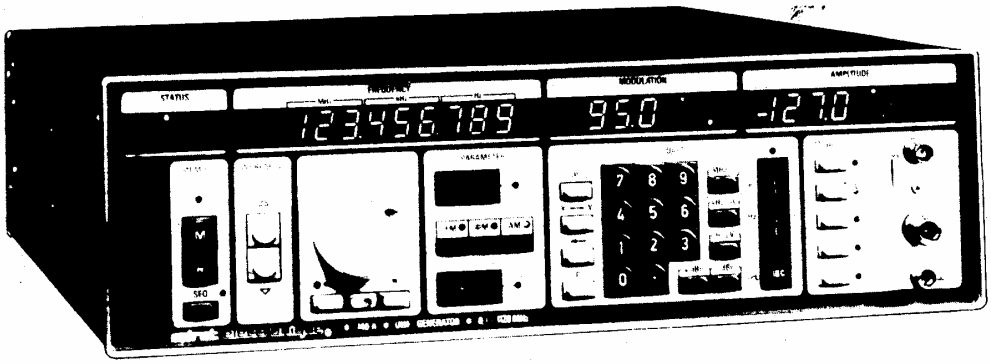
ADRET





VHF/UHF GENERATOR
0.1/1120 MHz

with AM, FM and ϕ M modulation facilities

OPERATING INSTRUCTIONS

740 A

ADRET
Schlumberger

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CONTENTS

CHAPTER I

INTRODUCTION

The 740 A synthetizer generator is a highly developed instrument in which advantage is taken of the lastest technological advances in frequency generation, synthesis and microprocessor control.

It has therefore been possible to produce a generator with such performance that most users'problems can be solved while providing them with an exceptional flexibility of application.

The RF frequency, covering the range 100 kHz to 1119.$\overline{9}$ MHz (with the doubler option above 560 MHz) is generated by a 10 Hz step frequency synthetizer referenced to a crystal controlled master oscillator which provides it with stability, precision and spectral purity.

Output and modulating circuits have been designed to meet the requirements of measurements in the field of frequency, amplitude and phase modulation radiocommunications. A precision output attenuator and electronic output circuit protection are provided. A pulse modulator is available as an option.

The wide flexibility in application is due to the microprocessor which manages the front panel controls and enables complete programming of all controls via the IEEE BUS.

A remarkable innovation in this type of equipement is the provision of an "EXECUTE" control which represents a major advantage in that it enables :

- Preparation of a new configuration without interfering with the program currently in progress.
- Testing a complete program before entering it into memory.
- Moving from one configuration to another with no intermediate or unwanted configurations occuring.

The 740 A has numerous other refinements :

- Entry of functional parameters by digital keyboard and by spin wheeel at user's choice.

- Storage in non-volatile memory of 99 complete configurations greatly simplifying test bench routines.

- Large dimension and very luminous display which can be easily read no matter what tha ambient light conditions are.

These features make the 740 A flexible and pleasant to use and make it a highly advanced instrument.

Finally, the large read-only memory capacity of the instrument has enabled certain additional or special functions to be incorporated which further extend the instruments capabilities. The large reserve capacity will enable the later introduction of new functions which will always keep the 740 A ahead of the competition.

Currently available options for the 740 A are :

- Option 03 : built in doubler to extend the frequency range to 1120 MHz

- Option 06 : pulse modulation

- High stability master oscillator option, $5.10^{-9}/24h$.

CHAPTER II

TECHNICAL SPECIFICATIONS

FREQUENCY RANGE

* Direct	:	100 kHz to 599.999 99 MHz
* With doubler	:	100 kHz to 1119.999 99 MHz

Below 2 MHz there is automatic switching of detection time constant. The AM bandwidth is thus reduced and the level acquisition time increased.

FREQUENCY RESOLUTION, CONTROL AND DISPLAY

* In direct range	:	10 Hz
* In doubled range	:	10 Hz

FREQUENCY STABILITY

* Standard . 1×10^{-7} per day after one hour of operation at constant temperature		
. Temperature coefficient	:	$< 5.10^{-8}$°C
* Option 01 . 5×10^{-9} per day after 1 month of operation		
* Reference output	:	10 MHz - 0.5 Vrms/50Ω
	:	approx.
* Locking		
- from external standard		
. frequency	:	All submultiples of
	:	10MHz up to 1MHz
. level	:	200mV to 1V RMS/50Ω
- by DC voltage from an external comparator	:	± 5 V for ± 5×10^{-7}
	:	10^{-7} pilot only

OUTPUT

* Main output	:	+13dBm to -129.9dBm/50 Ω
* Resolution	:	10 dB, 1dB and 0.1 dB
* Flatness (measured at 0 dBm)	:	± 1 dB
* Flatness	:	± 0.5 dB from 1.5 to 1119.$\overline{9}$MHz
	:	± 1 dB from 0.1 to 1.499 MHz
* Attenuation accuracy from + 13 to - 119.9 dBm	:	± 0.7 dB from 1 to 560 MHz
	:	± 1.4 dB from 1 to 1120 MHz
* Absolute accuracy of output level measured across a 50 ohms load with a SWR less than 1.05	:	± 1,2 dB for F = 1 to 599,$\overline{9}$ MHz
	:	± 2 dB for F > 560 MHz
* Calibration accuracy, at 0 dBm and 50 MHz	:	± 0.2 dB
* Display	:	Digital in Volts, mV, µV, dBm or dB/µV
* Output protection	:	Automatic up to 50 W
* S.W.R. - for amplitudes < - 3 dBm	:	< 1.3
- for amplitudes > - 3 dBm	:	< 2
* Auxiliary output (on the rear panel)	:	Variable between - 5 and
	:	- 15 dBm with reference
	:	to the main output level

SPECTRAL PURITY MEASURED AT 0 dBm, IN C.W.

* Harmonic components	f > 200 kHz	:	< - 30 dBc
	f < 200 kHz	:	< - 20 dBc
	f > 560 MHz	:	< - 25 dBc
* Sub-harmonic components		:	< - 30 dBc (typical - 40 dBc)
* Mains components		:	< - 50 dBc (1)
* Non-harmonic components, distance from carrier	< 300 Hz	:	< - 60 dBc (1)
	> 300 Hz	:	< - 65 dBc (1)
. Résidual AM, CCITT Standard 300 Hz to 3 kHz		:	< - 90 dB

(1) Value to be reduced by 6 dB for F >560 MHz

. Phase noise measured over 1 Hz band at 400 MHz (typical values)

* at 100 Hz from the carrier	:	- 90 dB
* at 1 kHz from the carrier	:	- 105 dB
* at 20 kHz	:	- 120 dB
* at 1 MHz	:	- 125 dB
* floor noise, beyond 3 MHz from the carrier	:	- 140 dB

The values in doubled range (560 to 1120 MHz should be derated by 6 dB).

* Residual FM, CCITT Standard 300 Hz to 3 kHz	:	< 1 Hz
. RF Leakage MIL STD461A, VDE0871 Standards	:	< 1 µV in front panel < 3 µV on the sides

MODULATION : Unless otherwise specified, all measurements are carried out with a 0 dBm output level, LF 1000 Hz.

AMPLITUDE MODULATION

* AM depth	:	0 to 99.9%
* Internal generator	:	400 Hz and 1000 kHz
* External signal input	:	0,5 V RMS/600Ω
* Bandwidth (refered to 1 kHz) - at ± 0.5 dB	:	20 Hz to 20 kHz (typical)
- at - 1.0 dB	:	20 Hz to 25 kHz
- at - 3.0 dB	:	10 Hz to 50 kHz

(For F < 2MHz, the bandwidth is limited to 5kHz at - 1dB and 10kHz at - 3dB)

* Calibration accuracy, F = 50 MHz . AM 10 at 90%	:	< 2% (typical 1%)
* AM distortion, F > 2 MHz . rate = 30 Hz at 20 kHz, AM 10 at 70%	:	≤ 1.2% (typical 0.7%)
. AM 70 at 90%	:	≤ 2% (typical 1%)
* Incidental phase modulation, at AM 30%	:	≤ 0.2 radian (F > 10 MHz)

FREQUENCY MODULATION

* Deviation		:	0 to 199,9 kHz
* Internal generator		:	400 Hz and 1 kHz
* External signal input		:	0.5 V RMS/600Ω
* Bandwidth (refered to 1 kHz)	- at ± 0.5 dB	:	30 Hz to 30 kHz (typical)
	- at _ 1.0 dB	:	30 Hz to 40 kHz
	- at ± 3.0 dB	:	20 Hz to 90 kHz (typical
		:	10 Hz to 100 kHz)
* Calibration accuracy F = 50 MHz, Δ F = 1 to 200 kHz		:	> 2% (typical 1%)
* FM distortion, ΔF = 75 kHz . 400/1000 Hz and 30Hz to 5 kHz EXT		:	< 1% (typical 0.5%)
. external input, rate = 30 Hz to 40 kHz		:	≤ 3% (typical 2%)
* Distortion + noise, ΔF = 2 kHz . filter = 300 kHz to 15 kHz, rate = 1 kHz to 5 kHz,			
	- F < 560 MHz	:	< 1% (typical)
	- F > 560 MHz	:	< 2% (typical)
* Signal to noise ratio, F = 470 MHz, ΔF = 2 kHz, rate = 1 kHz . CCITT filter 300/3000 Hz		:	≤ - 55 dB (typical)
* Residual FM, in FM mode, Δ F = 0 . F = 470 MHz,	filter 300/3000 Hz	:	4 Hz RMS (typical)
.	filter 50/3000 Hz	:	8 Hz RMS (typical)
* Frequency drift		:	< 1 Hz per hour

PHASE MODULATION

* Phase excursion display	:	0 to 19.99 rd peak
* Internal generator	:	400 Hz and 1000 Hz
* External signal input	:	0.5 V RMS/600Ω
* Bandwidth (1)	:	see FM modulation
* Calibration accuracy, at 1000 Hz	:	> 5%
* Total harmonic distortion	:	see FM modulation

(1). Within the limits of a FM deviation equalling ($\Delta F = \Delta \varphi$ x Fmod), for example : 10 radians for a rate = 20 kHz

INHIBITION

* RF amplitude	:	residual level approx. 10 nV
* Modulations	:	without modification of entered values

PULSE MODULATION (Optional)

* Minimum pulse duration		:	200 ns
* Recurrent frequency		:	100 Hz to 2 MHz
* Minimum rise time		:	30 ns
* Minimum fall time		:	30 ns
* Input thresholds	- for cut off	:	0 to 0.15 V
	- for etablishment	:	+ 3.5 to + 5 V

Between the thresholds, the HF signal amplitude is approximately proportional to the rise and fall times of the input signal.

* Protection (on/off)	- from 5 to 559.9MHz	:	- 35 dBc (typical value)
	- from 560 to 1119.9MHz	:	- 55 dBc (typical value)

NON VOLATILE MEMORY

* Number	:	99 complete configurations
* Memory access	:	manually or via BUS
* Memory safeguard	:	rechargeable battery giving safeguard for approx. 1 month

IEEE 488 BUS PROGRAMMING

Programmable parameters

* Frequency in 10 Hz steps			
. Frequency settling time		:	< 20 ms
* Level in 0.1 dB steps			
. Amplitude switching time		:	< 20 ms
* AM modulation depth		:	in 0.1% steps
* FM modulation	. up to 20kHz	:	in 10 Hz steps
	. from 20kHz to 200kHz	:	in 100 Hz steps
* Phase modulation		:	in 0.01 rd steps
* Modulating sources		:	400 Hz, 1 kHz or external

(1). According to the IEC norm so as to be at 10 Hz from the final frequency.

* RF inhibition
* Modulations inhibition
* Entry and recall of stored configurations

POWER REQUIREMENTS

* Frequency	:	50 to 400 Hz
* Voltage	:	115V ± 15V and 230V ± 30V
* Power consumption	:	100 VA

MECHANICAL SPECIFICATIONS

* Height	:	128 mm
* Width	:	440 mm
* Depth	:	500 mm
* Net weight	:	16 kg approx.

ENVIRONMENT

* Operating temperature range	:	0°C to + 50°C
* Storage temperature	:	- 20°C to + 70°C

MASTER OSCILLATOR 629C (10^{-7})

ELECTRICAL CHARACTERISTICS

Frequency : 80 MHz (+ 10 MHz)

Stability : $\geqslant 1.10^{-6}$ after 10 mn of operation
$\geqslant 1.10^{-7}$/24 h after 1 h of ininterrupted operation

Temperature drift : $\leqslant 5.10^{-8}$/°C from + 10°C to 50°C

Range of electrical adjustment : $\geqslant 8.10^{-6}$ (centering of the range in relation to Fo - 4/5, + 1/5)

Phase-locking : $\geqslant \pm 3.10^{-6}$ for ± 5 V

Outputs	3	1 and 2
Frequency	80 MHz	2 x 10 MHz
Impedance	50 Ω	100 Ω
Level	+ 4 dBm ± 1	2 Vcc ± 100 mV

Note : The pins 8 - 4 and 9 - 5 can be connected 2 by 2 to obtain a single output of 10 dBm/50 Ω.

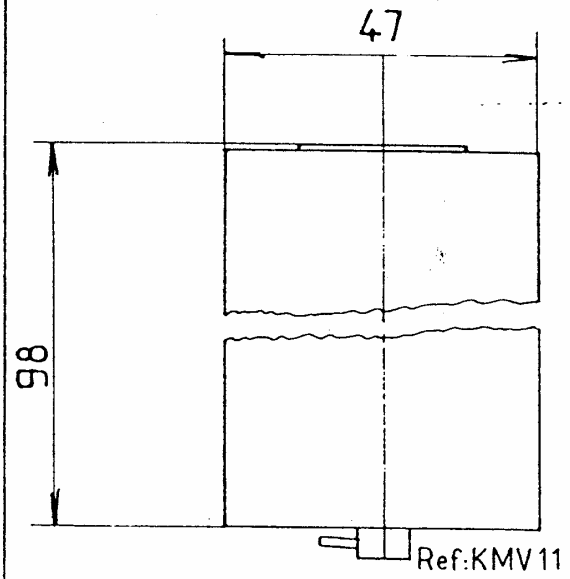
Harmonic distortion : $\leqslant$ - 45 dBc : $\leqslant$ 40 dBc

Spectral purity	Output 3	Outputs 1 and 2
typical	80 MHz	10 MHz
at 10 Hz from Fo	$\leqslant$ - 94 dBc/Hz	$\leqslant$ - 100 dBc/Hz
at 100 Hz from Fo	$\leqslant$ - 122 dBc/Hz	$\leqslant$ - 135 dBc/Hz
at 1 kHz from Fo	$\leqslant$ - 137 dBc/Hz	$\leqslant$ - 154 dBc/Hz
at 10 kHz from Fo	$\leqslant$ - 160 dBc/Hz	$\leqslant$ - 155 dBc/Hz

Power supply voltage : + 12 V to + 15 V

Power consumption

- at starting : $\leqslant$ 350 mA
- after 5mn of operation : $\leqslant$ 200 mA



CARACTERISTIQUES

CHARACTERISTICS

Masse : *Ground*

Connecteur : serie D_Sub. 9pr. *Connector*

Norme : MIL.C.24308 C *Norm*

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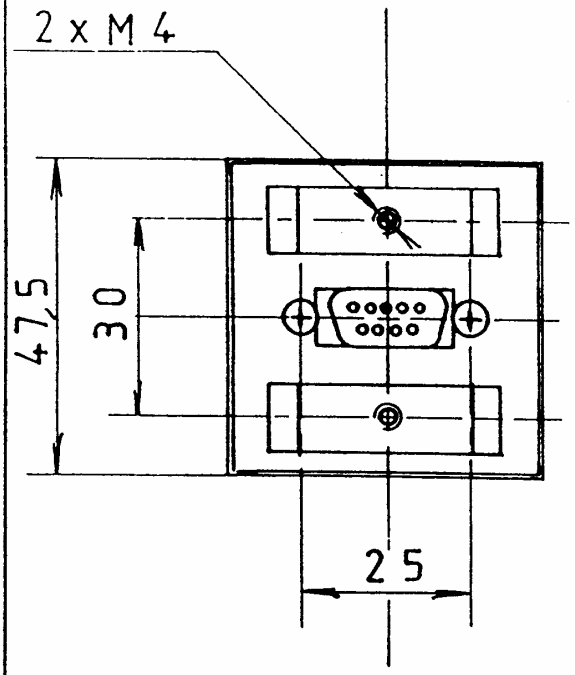
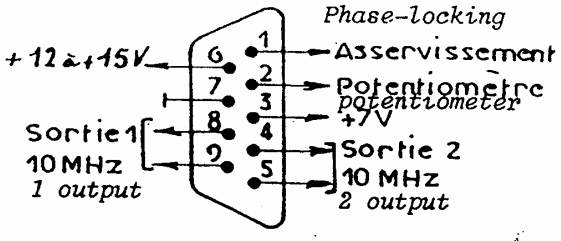
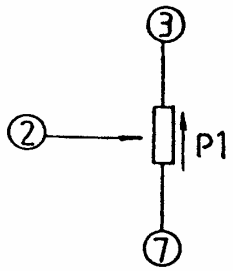
BRANCHEMENT ELECTRIQUE

ELECTRICAL CONNECTION







POTENTIOMETRE D'AJUSTEMENT
EXTERIEUR 10 KΩ 10 TOURS

MASTER OSCILLATOR 631C (10^{-9})

ELECTRICAL CHARACTERISTICS

Frequency : 80 MHz (+ 10 MHz)

Stability :
- $\geqslant 1.10^{-7}$ after 10 mn of operation
- $\geqslant 2.10^{-8}$/24 h after 72 h of ininterrupted operation
- $\geqslant 5.10^{-9}$/24 h after 1 month of ininterrupted operation
- $\geqslant 1.10^{-7}$/3 months after 3 months of ininterrupted operation

Temperature drift : $\leqslant 5.10^{-10}$/°C from + 10°C to 50°C

Range of electrical adjustment : $\geqslant 4.10^{-6}$ (centering of the range in relation to Fo - 2/3, + 1/3)

Phase-locking : $\pm 4.10^{-6}$ for ± 5 V

Outputs	3	1 and 2
Frequency	80 MHz	2 x 10 MHz
Impedance	50 Ω	100 Ω
Level	+ 4 dBm ± 1	2 Vcc ± 100 mV

Nota : The pins 8 - 4 and 9 - 5 can be connected 2 by 2 to obtain a single output of 10 dBm/50 Ω.

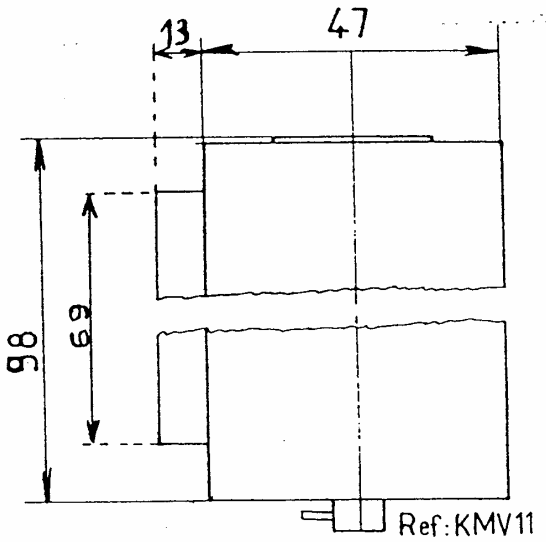
Harmonic distortion	$\leqslant$ - 45 dBc	$\leqslant$ - 40 dBc

Spectral purity	Output 3	Outputs 1 and 2
typical	80 MHz	10 MHz
at 10 Hz from Fo	$\leqslant$ - 103 dBc/Hz	$\leqslant$ - 108 dBc/Hz
at 100 Hz from Fo	$\leqslant$ - 120 dBc/Hz	$\leqslant$ - 138 dBc/Hz
at 1 kHz from Fo	$\leqslant$ - 136 dBc/Hz	$\leqslant$ - 158 dBc/Hz
at 10 kHz from Fo	$\leqslant$ - 160 dBc/Hz	$\leqslant$ - 160 dBc/Hz

Power supply voltage : + 12 V to + 15 V

Power consumption

- at starting : $\leqslant$ 600 mA/12 V at 15 V at 20° C
- after 5mn of operation : $\leqslant$ 280 mA/12 V at 15 V at 20° C



CARACTERISTIQUES

CHARACTERISTICS

Masse : *Ground*

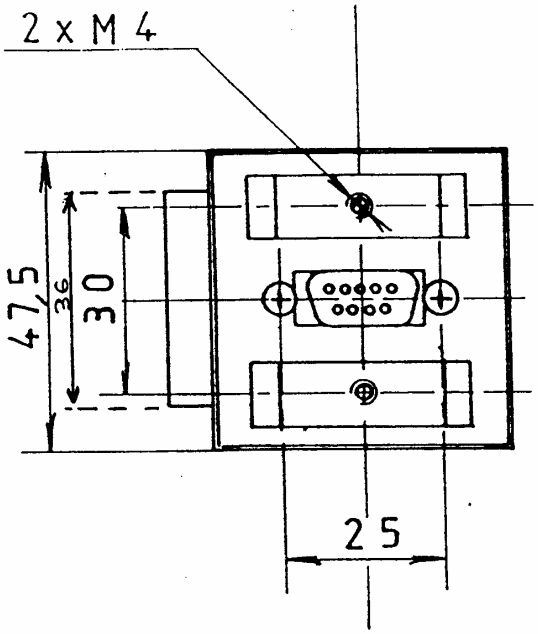
Connecteur : serie D_Sub. 9pts *Connector*

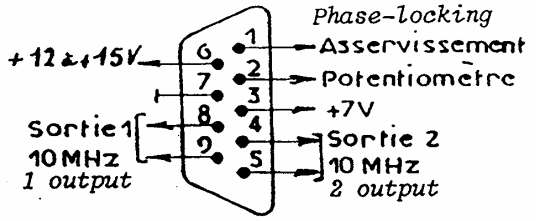
Norme : MIL.C.24308 C *Norm*

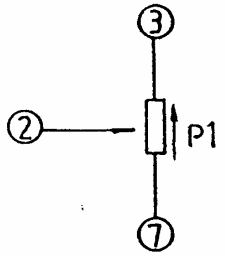
HE 501

BRANCHEMENT ELECTRIQUE

ELECTRICAL CONNECTION







POTENTIOMETRE D'AJUSTEMENT EXTERIEUR 10 KΩ 10 TOURS

CHAPTER III

OPERATING INSTRUCTIONS

III 1. PUTTING INTO SERVICE

DELIVERY OF EQUIPMENT

The instrument is delivered in a cardboard carton and is protected by an expanding polyurethane injection process. The package contains the instrument specified on the delivery note together with the power cord and the instrument manual.

The guarantee covers damage caused during delivery from ADRET ELECTRONIQUE. Check that the equipment has suffered no mechanical damage in transit.

GENERATOR REFERENCES

Manufacturing references for the instrument are given on a label rivetted to rear panel. In particular it gives the ADRET code number, the manufacturing series, the serial number and possibly the options fitted.

STORAGE

The equipment must be stored in a non-humid place where the temperature remains within the range - 20°C to + 70°C.

ENVIRONMENT

The technical specifications of the generator are valid when the equipment is used in an ambient temperature within the range 0°C to + 55°C.

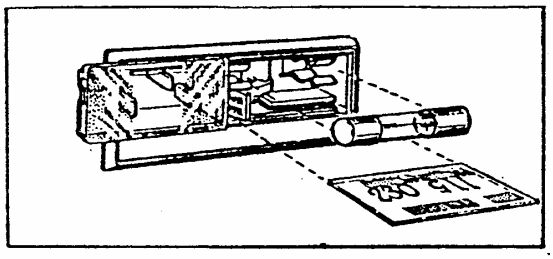
The forced air cooling must be able to operate normally : the air intakes and outlets must remain unobstructed.

MAIN CONNECTION

The 740 generator is designed to work on mains voltages of 115 V ± 15 V or 230 V ± 30 V.

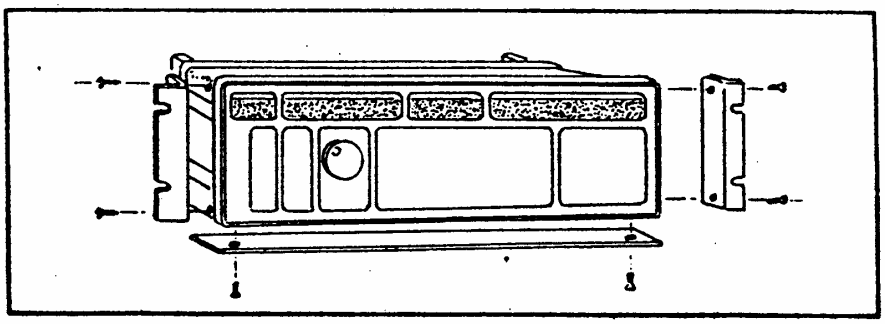
The equipment is delivered adjusted to operate on 230 V. When operation on 115 Volts mains is required, position the voltage selector so that the "115 Volts" indication is visible and legible with the selector in its correct position.

Replace the 1 A fuse with a 2 A fuse.



19-INCH RACK MOUNTING

The generator can be mounted in a 19 inch rack by means of a 3 U adapter kit, supplied on request.



III 2. DESCRIPTION (See page III-14)

The upper part of the front panel contains four D I S P L A Y blocks :

- Status
- Frequency
- Modulation
- Amplitude

The lower part of the front panel contains 6 F O N C T I O N A L blocks :

- Memory
- Increment
- Tuning
- Parameter
- Data
- Modulation

The on/off switch is located at the bottom left-hand corner of the panel and enables the generator to be put on standby, in which all power supplies are cut off apart from that of the thermostat controlled master oscillator.

* The **PARAMETER** block selects the parameter to be entered or modified.

* The **DATA** block enables the corresponding data to be entered.

The "**EXECUTE**" key causes execution of the new instruction(s). The instrument remains in its former configuration until this key is pressed..

The "**INCREMENT**" button enables the instruction to be entered incrementally.

* The **INCREMENT** block carries out the increment thus determined in + or - .

* The **TUNING** block enables any selected parameter to be varied by means of the code wheel.

* The **MODULATION** block contains the instrument's input and output sockets and also keys for validating the modulations, selecting their sources and inhibition of the RF signal.

The N type output socket has an impedance of 50 ohms and can tolerate a DC component of up to 50 V and an accidental RF overload of up to 50 W.

The BNC modulation socket is a modulating signal input of impedance 600 ohms having a fixed required input signal level of 0.5 Vrms.

In internal mode, the 1 kHz or 400 Hz signal is available at the same socket at the same amplitude.

* The **MEMORY** block commands the entering and recall of 99 stored instrument configurations. The "SEQ" button enables a sequence of N stored configurations to be organized.

The rear panel contains from right to left :

- The IEEE 488 programming socket,
- The auxiliary socket enabling the memories to be sequenced,
- The standardized mains connector, the mains selector and the fuse,
- The BNC socket for synchronizing input,
- The BNC socket for the 10 MHz, 0.5 Vrms/50 ohms reference output,
- An RF output socket delivering an amplitude of approximately - 15 dBm.

III 3. KEYBOARD OPERATON

OPERATING INSTRUCTIONS

The 740 A has a permanent memory and, as soon as power is applied, the instrument is set up as it was at the time it was switched off.

However, in order to prevent errors where there is a change of use, special functions are cleared each time operation in interrupted.

In order to make the operations as simple as possible, to enable corrections and to avoid mistakes or transients sometimes dangerous to the circuit under test, an "EXECUTE" key is provided.

The use of the keyboard is illustrated in the diagram on page III-5.

In particular, this arrangement enables :

- Passing from configuration A to configuration B with no unwanted intermediate configuration.
- Verification of all the entered data before execution.
- Recall and checking of memories before execution.

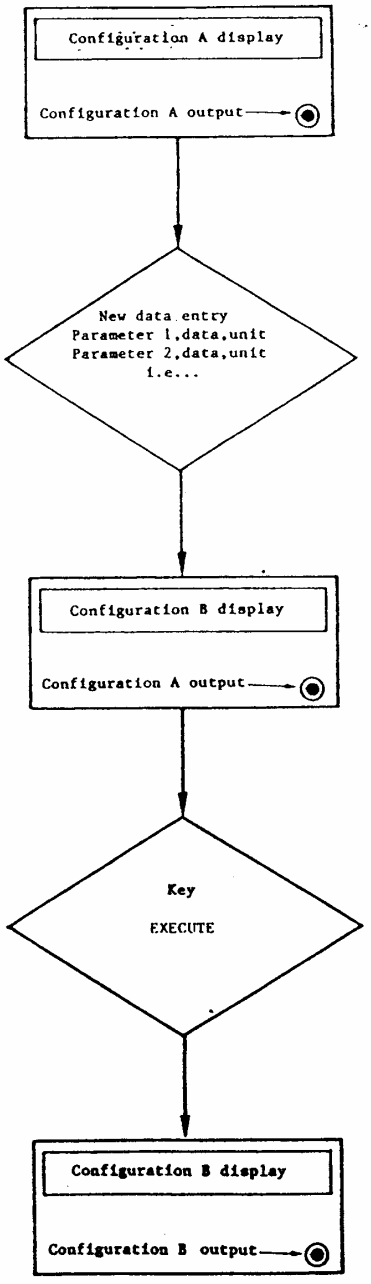
During the entry of new data, the "X←→Y" key produces a temporary display of the current configuration, i.e. the output configuration.

The indicator above the "EXECUTE" key lights after entry of the first figure of a piece of data and blinks after entering the units, thereby inviting the operator to execute.

If the second parameter must be entered or modified, the diode again lights continuously and again blinks after keying in the units, and so on for other parameters.

The lighting or blinking of the indicator draws the user's attention to the fact that the display refers to an entry in progress and not to the active output.

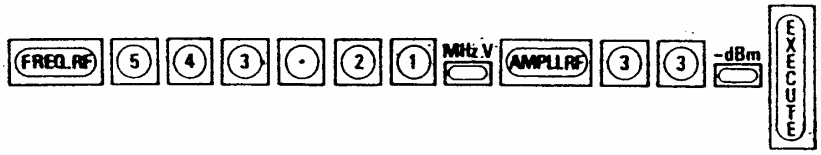
KEYBOARD OPERATION DIAGRAM



FREQUENCY AND AMPLITUDE PROGRAMMING

Examples :

* An RF frequency with an amplitude expressed in dBm, say 543.21 MHz, - 33 dBm.

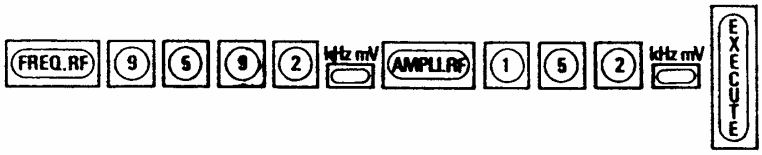


The "RF INHIB" indicator lights up if the RF signal is inhibited. Press the button beside this indicator to obtain the signal.

When the RF signal is inhibited, press the button "X Y" so as to obtain the temporarily display.

Note : There is no set order for entry of parameters and it is always possible to change any parameter without having to re-enter the others.

* An RF frequency with an amplitude expressed in volts : say 9592 kHz, 152 mV.



* Amplitude in dB/μV : say + 20 dB/μV.

Do as follows to return to normal :

PROGRAMMING THE MODULATIONS

* Selection of source :

The "EXT", "1 kHz" and "400 Hz" MODULATION buttons are used to select the source of modulation. The "0" button inhibits any modulation, no matter how it is set up.

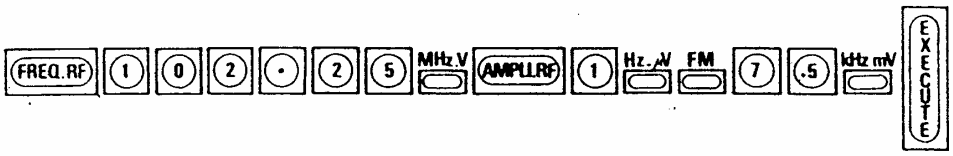
When the modulations are inhibited, press the button "X↔Y" so as to obtain the temporarily display.

In external mode, a 0.5 Vrms/600 ohms signal must be applied to the LF input. The ⌓ and ⌔ indicators enable the calibration to be checked or to adjust calibration by varying the input signal level.

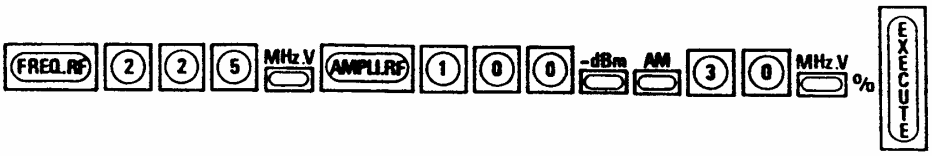
* Selection of Type of Modulation and Adjustment

Examples :

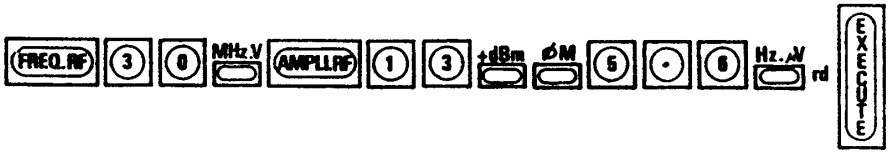
- An RF frequency, RF amplitude and FM deviation : say 102.25 MHz, 1 µV amplitude, 75 kHz deviation.



- An RF frequency, RF amplitude and AM modulation percentage : say 225 MHz, - 100 dBm amplitude and modulation percentage 30%.



- An RF frequency, RF amplitude and phase excursion : say 30 MHz, + 13 dBm amplitude and phase excursion of 5.6 rd.



INCREMENTATION

Each parameter can be entered incrementally after entering the data simply by pressing the "INC" button in the "DATA" block.

Incrementation is then carried out by means of the ▲ and ▼ buttons in the "INCREMENT" block.

Example : To increment an already enterred frequency by 12.5 kHz :

and pressing the ▲ or ▼ key as may times as there are increments to make.

Note : . An already enterred increment can be displayed by pressing the "INC" button. After entering an increment, it is possible (but not essential) to re-display the value of the parameter to be incremented by pushing in the corresponding key on the PARAMETER block ; "RF FREQ" in the example.
. In amplitude, an increment is expressed in dB only.

TUNING WHEEL

To obtain a pseudo-analogue variation of any parameter, all that is necessary is to call up that parameter (parameter indicator lit) and to turn the tuning wheel after validating it ("VALID").

Whenever the instrument is switched on, the preset initial resolutions are as follows :

- RF frequency : 1 MHz
- RF Amplitude : 0.1 dB
- FM Deviation : . from 0 to 20 kHz ⟶ 10 Hz
  . from 20 to 200 kHz ⟶ 0.1 kHz
- ØM Excursion : 0.01 rd
- AM Percentage : 0.1%

This resolution is indicated by a blinking of the corresponding figure for 2 seconds after validating the tuning knob ("VALID"). It can be modified in decimal ratios by means of the "x10" and ":10" buttons.
In FM and ØM the tuning wheel is only active after a start value has been entered on the keyboard.

The tuning wheel can be inhibited for all parameters by pressing the "VALID" button again.

MEMORIES AND SEQUENCE

* Entry

When a complete instrument configuration must be protected, it can be entered into memory number 24 by the following simple operation :

or, to enter it into memory n°8 :

The memory location is temporarily shown in the frequency display in the form P08, representing Memory Position 08

Note : It is essential to enter 2 figures to designate a memory.

* Output

To recall a stored configuration, say n°13, do as follows :

The memory number is displayed for 2 seconds and then the stored configuration appears and the "EXECUTE" indicator blinks, while the instrument remains in the most recently executed configuration.

Operate as follows to execute the last recalled configuration :

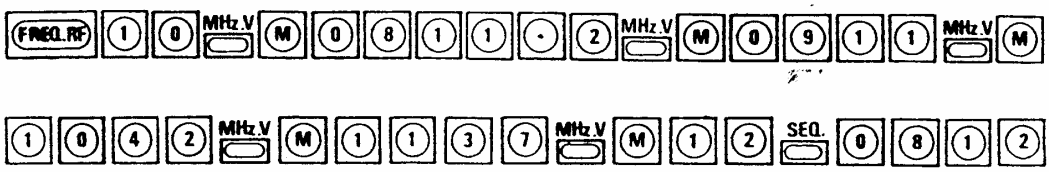
If a stored configuration is recalled in order to check it without wishing to execute it, the initially executed configuration can be recalled to the display simply by pressing the "X⟷Y" button in the "DATA" block.

* Sequence : It is possible to organize a certain number of memory positions into a sequence which can be exploited by means of a 9 pin connector at the rear of the instrument.

Semi-automatic use of the instrument can then be achieved by sequencing through the configurations under the control of a foot pedal, a timer or the increment buttons.

To do this, first enter the configurations into memory in their number order and then define the limits.

Example : Sequence of 5 frequencies :



The "SEQ" indicator lights while this key is being pressed. Enter the limits quickly as soon as "SEQ" is pressed ; the delay must not exceed 2 seconds.

Execution is under the control to the external pedal or the ▲ and ▼ keys.

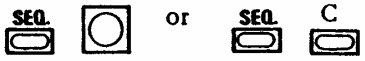
This action permits to increment the memories and to return to the start of the sequence.

The ▲ key increments the memories and the ▼ key commands the return to the start of the sequence.

The ▼ key permits the return to the start of the sequence, do :

To come back to the normal mode, do

To inhibit the system, all that is required, is to select any parameter and to suppress it, to do as follows :



Once a sequence is organized, pressing the "SEQ" key produces a 2 second display of the sequence start and stop numbers in the RF frequency display, for example : 08-12, but the "SEQ" indicator is lit, except when the instrument is switched off, as long as the function has not been inhibited or suppressed.

As long as the "SEQ" indicator is lit, the INCREMENT ▲ and ▼ buttons or a foot switch* connected to the "AUX" socket can control the stepping through of the memories in the sequence. Execution is carried out at each step.

* Pin connections are shown on the CPU board diagram.

* Searching for a memory position :

In order to search either for a free memory or for a configuration whose number has been forgotten by the user, press "R", give a start number and use the ⌃ and ⌄ keys on the **INCREMENT** block to sequence through the memories in one direction or the other.

After each press, the memory position number appears in place of the frequency, but after about 2 seconds the complete configuration is displayed on the front panel. This is not a self executing mode and any selected configuration has to be executed ("EXECUTE" indicator blinking).

An indicator above the "M" button shows, is the same way for the PARAMETER buttons, that this button is in the active state and, consequently, the ⌃ and ⌄ INCREMENT keys are also active.

PULSE MODULATION (Optional)

This mode is only possible when the pulse modulation option is fitted and it prohibits FM and ØM. To select this mode, do as follows :

SPL 6 4

The display then shows :

P - - -

The 3 figures remain available for a possible AM modulation.

The following operation is all that is required to suppress pulse modulation :

SPL 6 0

or it can be suppressed by selecting another modulation parameter other than AM.

The pulse modulation position is forgotten when the instrument is initialized.

SPECIAL KEYBOARD CHARACTERISTICS

The C Button : erases the data in progress, the increments and the sequence function.

The ← Button : enables correction of the selected parameter starting from the last entered figure. A blinking indicates the figure that can be corrected.

The X ⟷ Y Button : produces a 2 second display of the active instrument configuration while a new keyboard entry is in progress and enables the active configuration to be re-displayed during the recall of a memory not being executed.

The SPL Button : This key, in conjunction with the keybard, enables special requirements to be met. For example : pulse modulation ; amplitude expressed in dB/µV.
It also enables the front panel to be initialized to 300 MHz and - 129.9 dBm ; "SPL 98".

SPECIAL FUNCTIONS

01 Test RAM number 1
40 Return to normal operation
* 44 Reference level offset
60 Return to normal operation
64 Pulse modulation
84 Return to start of sequence
98 Initialization generator

* Level display in dBµV.

STATUS

This block contains four indicators and a push button :

* REM ◯ Indicator : (Remote) indicates that the instrument is in external IEEE 488 programming mode.

* RTL ◯ Push Button : two functions :

  - In "Remote" mode this commands a return to "Local" except when the controller has the "Local Lock Out" instruction.

  - In "Local" mode, it causes a reading of the instrument address to appear in the frequency display. This address can be modified by means of a switch inside the instrument.
    The display is in the form A03, for example.

* Indicators ◯ Normal : Everything is normal.

  ◯ Overload : Operation is autorized but is in overload condition and specifications are not guaranteed or are reduced.

  ◯ Error : Incorrect command.

Overload

- The overload indicator lights below 2 MHz to indicate a modification in the specifications in AM modulation.

- The overload indicator also lights as soon as an AM modulation is programmed if the output level is equal to or greater than + 7 dBm (risk of AM distorsion).

Incorrect Entry

The error indicator lights whenever an out-of-range data entry is made and an error code appears in the frequency display for about 2 seconds. After this delay, the instrument returns to its previous value.

The meanings of the error codes are given in the following table :

RF frequency too high	E-21
RF frequency too low	E-22
RF amplitude too high	E-41
RF amplitude too small	E-42
Increment expressed in volts	E-47
AM modulation percentage too high	E-61
AM modulation percentage < 0	E-62
Pulse modulation option not present	E-64
FM - ØM excursion too large	E-71
FM - ØM excursion < 0	E-72
FM or ØM in pulse modulation	E-74
Exceeding sequence stop	E-89
IEEE Bus overflow	E-91
Units inconsistent in FM and ØM	E-77

When an empty memory is called up, the error indicator lights and the frequency display shows "E" beside the called memory number.

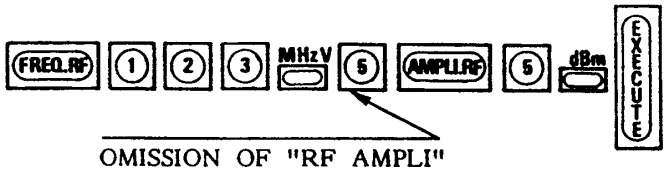
Omission of units or units inconsistent

If the units are omitted, the ERROR indicator lights and the instrument returns to the previous value.

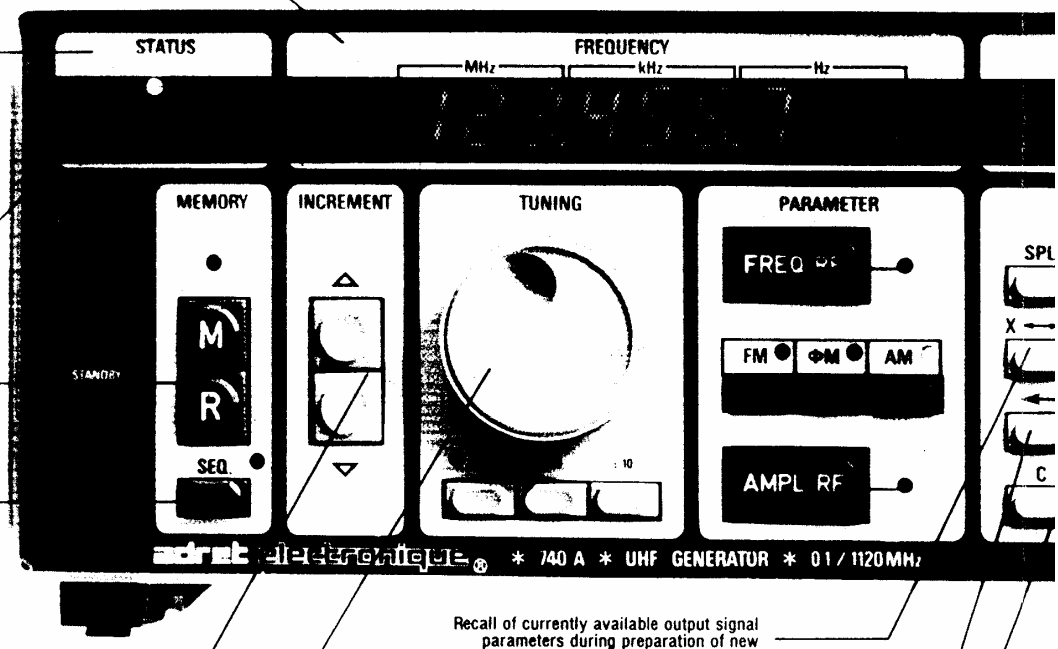
Forgetting to select a new parameter

This often happens when a complete configuration is being entered. In this case, in order not to lose the value entered for the initial parameter after entering the units, the keyboard is no longer active until a parameter has been selected or the configuration has been executed.

Example :



The output frequency is effecively 123 MHz, the first "5", which was keyed in without being preceded by "RF AMPLI", is disregarded.



Large luminous numerical display of frequency, memory address, bus address and error codes

Additional information indicating the mode of operation, data entry and parameters setting errors

Return to local operation (except in the case of Local Lock Out) in programmed mode. Display of instrument adress in local mode

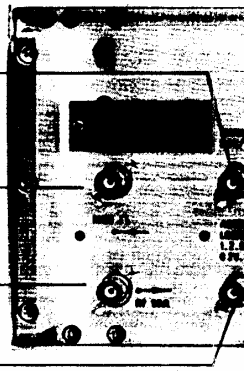
Entry of 40 complete configurations into memory. Configurations can be called up separately or by sequence

increment/ Decrement of selected parameter data, the EXECUTE function being provided automatically

Spin wheel will operate for any parameter. It has variable resolution in decade steps and can be used in conjunction with keyboard entry. The EXECUTE function is carried out automatically

Recall of currently available output signal parameters during preparation of new configuration by displaying them temporarily (2 seconds)

Editing/correcting of entered values, digit by digit or complete entry.



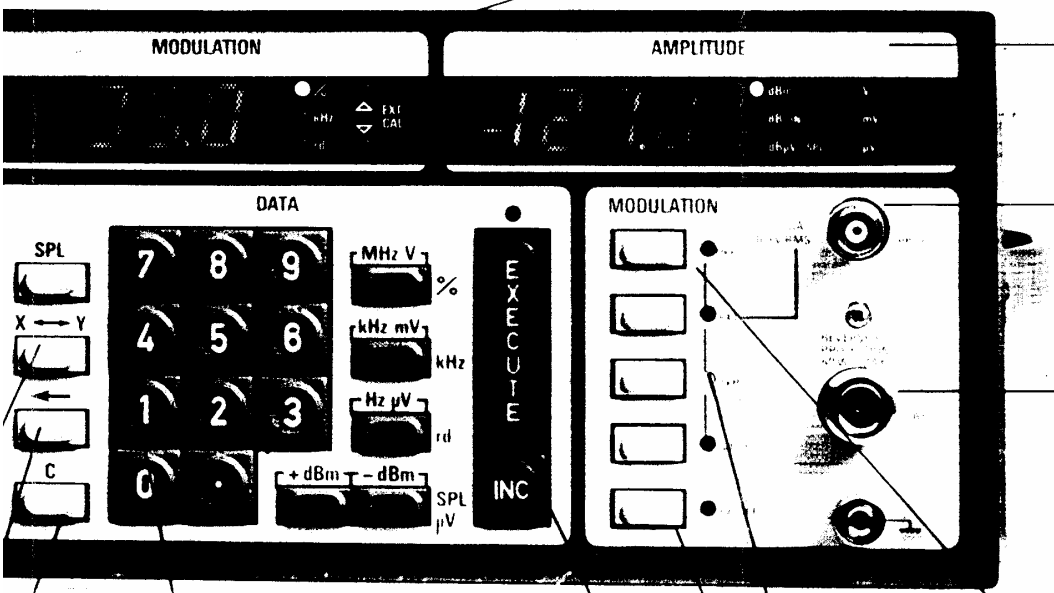
Reference Output for phase locking of external devices.

LF pulse modulation input (option)

Auxiliary RF output for synchronization of external selective receiver devices, volt/vector-meter etc. (approx.: - 15 dBm/50 ohms)

Phase locking input, 1, 2, 5, 10 MHz or DC ± 5V

Phase locking adjustment



Direct high resolution display (10 Hz FM — 0.1% AM - 0.01 rd ØM) of percentages and deviations. Extremely accurate calibration of external modulating signal.

Direct display of output levels in dBm or in any other reference system V, mV, µV or dB/µV

External modulating signal input with visual indication of accurate calibration. Internal AF output.

RF Output, protected up to 50 W by automatic reset electronic contact breaker. Output level — 129.9 to + 13 dBm/50 ohms

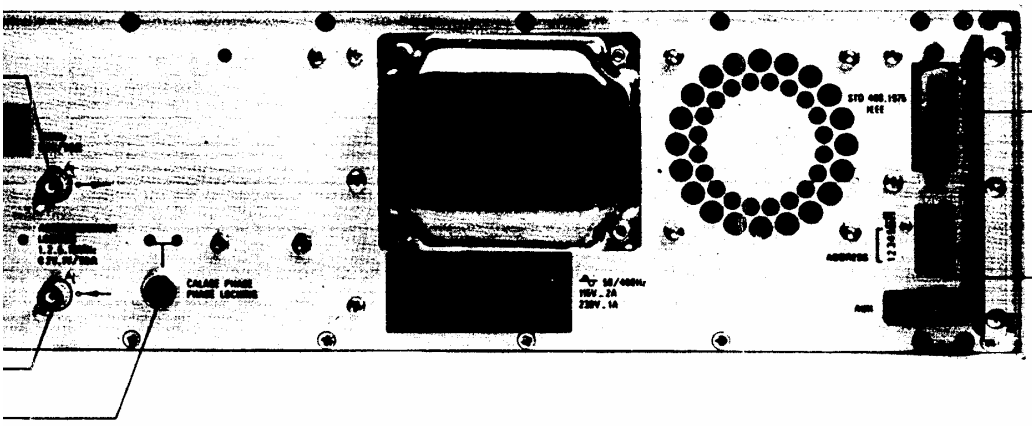
Modulation off (cw mode)

Selection of internal or external modulation

RF signal on/off

Call up of special functions to the keyboard, such as :
- Pulse modulation
- dB/µV
- Total or partial erasure of registers, memories, etc...

Definition by the user of the incremental steps for each parameter enabling the "up and down" function to be controlled by means of the continuous INCREMENT/DECREMENT buttons, the EXECUTE function being provided automatically.



IEEE 488 BUS input

Auxiliary socket for external control of memory sequence facility

III 4. MAKING MEASUREMENTS

RF OUTPUT

* **Inhibition**

The RF signal is inhibited by lighting the "RF INHIB" indicator by means of the button beside it.

* **Protection**

The output amplifier and attenuator are protected against reinsertion of an RF signal on the output socket of greater than about 100 mV amplitude. Protection is provided against reinserted frequencies within the range of the instrument and powers up to 50 W. The contact breaker automatically resets as soon as the reinsertion disappears.

* **Very low level measurements**

A certain number of precautions must be taken when making measurements with output levels lower than 10 mV. First of all, the connecting cable must be made in a Faraday cage or on an Earth Plane connected to the earth terminal under the N-type socket by means of a wide braid.

The 50 ohms plug must always remain fitted to the rear auxiliary output.

* **Auxiliary RF Output**

This output is intended for use with a volt-vectormeter and can be used whenever a synchronizing signal is required.

This socket outputs an amplitude in the order of - 15 dBm which is not affected by the action of the 5 dB step attenuator but does, however, depend on the configuration of 0.1 and 1 dB steps. The level therefore varies by about 5 dB. When the main RF output is of amplitude lower than - 100 dBm, it is essential to use a double braid cable for the auxiliary output.

MODULATIONS

* **Switching of Sources**

The "0" button in the **MODULATION** block inhibits the modulations irrespective of the programmed percentages or deviations (CW mode).

Selecting the 400 Hz or 1 kHz sources gives a calibrated modulation corresponding to the displayed value. When an external source is selected, a 0.5 Vrms/600 ohms signal must be applied to the input socket.

* **Calibration**

The ▲ and ▼ indicators located to the right of the modulation display enable the input level to be adjusted to obtain perfect calibration. Calibration is carried out in the "EXT" or the "0" position.

The ▲ and ▼ indicators are both out when adjustment is correct. The ▼ indicator light when the level is too low and the ▲ indicator lights when the level is too high.

The calibration system also works for rectangular waveform signals with a peak-to-peak amplitude of 1.4 V and remains active during the non-executed display of a memory configuration.

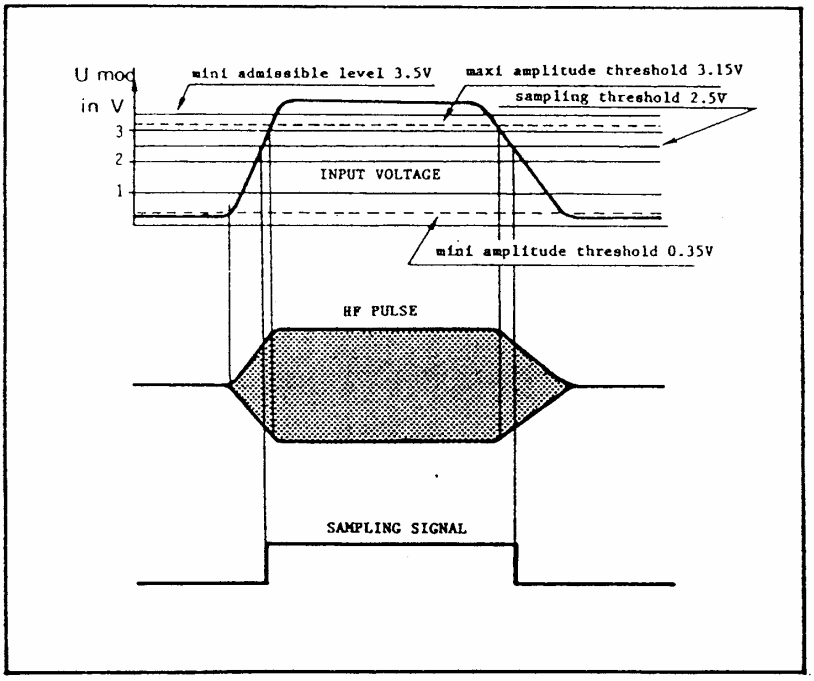
* **Pulse modulation** (optional)

When this type of modulation is programmed (see Page III-12), output level adjustment is only made when a suitable modulating signal is applied to the pulse modulation input on the rear panel of the 740.

The modulating signal is a positive pulse of amplitude from 3.5 V to 5 V, of minimum duration 200 ns and repetition frequency within the range 100 Hz to 2 MHz.

- Below 0.35 V the RF signal is minimum.
- Between 0.35 V and 3.15 V, the RF signal increases with the input signal.
- Above 3.15 V, the RF signal is fully established, but a minimum level of 3.5 V is recommended.

The relationship between the HF signal and the input pulse is shown in the following figure :



The sampling threshold of the calibration loop is 2.5 V. This level must therefore be achieved in order to obtain correct functioning of the calibration circuit.

SYNCHRONIZING THE MASTER OSCILLATOR

The rear panel contains a 10 MHz reference output socket, providing a signal of 0.5 Vrms/50 ohms intended for synchronizing another instrument.

It also contains an input socket for synchronizing the generator to a stable and accurate external source.

The function is provided for frequency sub-multiples of 10 MHz and for amplitudes in the range 0.2 to 1 Vrms/50 ohms.

Adjustment is made by means of the split spindle potentiometer and the 2 LED diode indicator. Do not make the adjustment until the master oscillator has been warming up for one hour, i.e. one hour after connecting to the mains with the master oscillator being supplied while the switch is in either the "on" or "standby" position.

Note : It is possible to apply a DC voltage of ± 5 V directly to the synchronizing input to control the quartz oscillator frequency. This enables an external phase comparator to be used.

III 5. USE OF THE IEEE 488 BUS

PRINCIPLE

The instrument is programmed according to the 1975 IEEE-48 standards and uses a CLEAR LANGUAGE and a FREE FORMAT.

All the instrument functions can be programmed by means of MNEMONIC PREFIXES allocated to each of the front panel controls.

These prefixes are associated with one or several figures to select a command or to define an input value according to the procedure explained in the following pages.

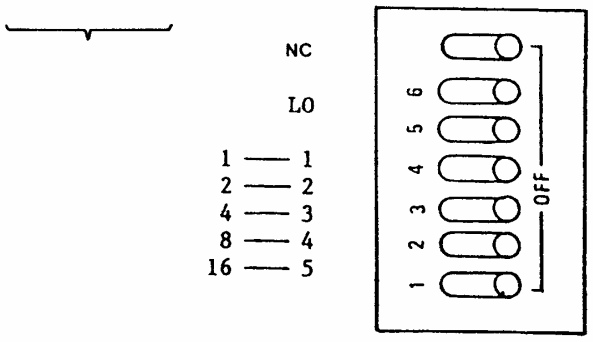
The instrument display remains validated in programmed mode to enable verification of the configuration entered and executed by the controller.

CONNECTION TO THE BUS, ADDRESSING

The standardized connector is located on the rear panel of the instrument and must be connected to the controller by means of a standard IEEE 488 interface cable.

The address selected on the 740 can be read by pressing the "address (rtl)" button. The address is displayed in clear on the front panel in place of RF frequency.

The address can be changed by means of the switch on the rear panel.



- Set the LO (Listener Only) switch to the "0" (addressable) position.

  In the opposite position (LO = "1") the instrument is permanently addressed.

- Set switches 1 to 5 to "0" or "1" to form the binary number equivalent to the decimal address selected from within the range 0 to 31.

PROGRAMMING OF LOCAL/REMOTE MODES

The 740 meets the RL2 conditions of the IEEE 488 standards which stipulate that programmed mode can be LOCAL or REMOTE with the ability to lock out the instrument functions. The RL2 function is represented by the following simplified diagram together with its mnemonic table.

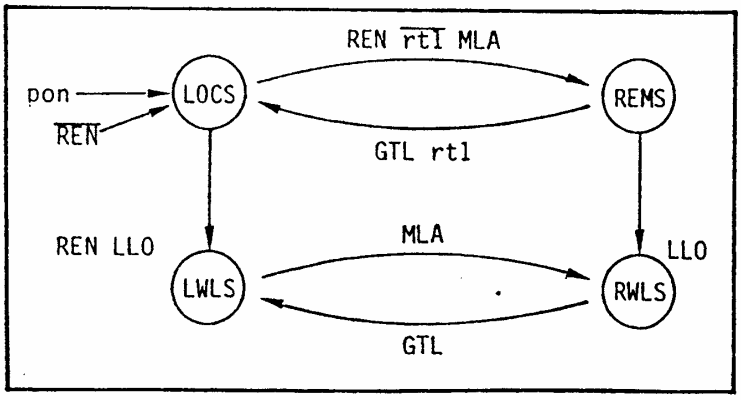
INSTRUCTIONS

pon = power on
rtl = return to local
REN = remote enable
LLO = local lock out
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.

As soon as the controller is connected to the REAR panel connector and when the IEEE interface is active (REN line at 0 Volts), the ON/STANDBY switch can no longer put the instrument on STANDBY whether the instrument is in local or remote mode.



Going into Remote Mode

The instrument goes into remote mode as soon as it is addressed in LISTENER mode, provided that the REN line is active (REN = 0 V).

MESSAGE FORMAT

The different parameters are always programmed in ASCII code which are acted upon by the generator on receipt of an execution character which takes the part of the "EXECUTE" key in local mode.

The following characters are considered as execution characters : the command "Group Execute Trigger", "Carriage Return" (CR) or the Line Feed (LF) which are generally sent automatically.

The sending of an exclamation mark will delay execution until another execution character is received. It is therefore always possible to record and display a configuration without executing it immediately.

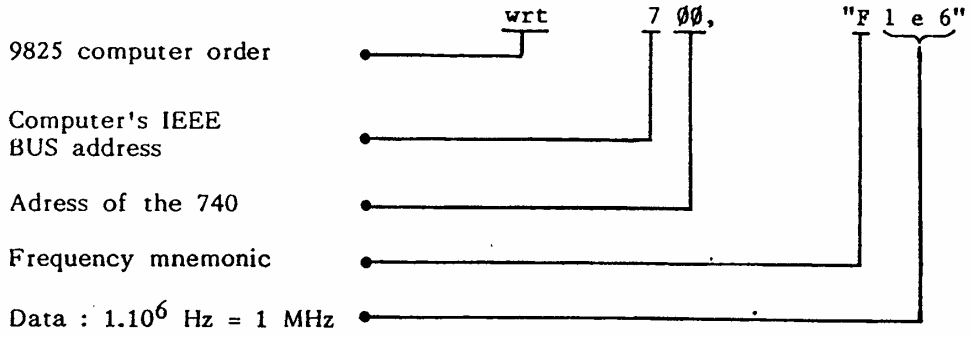
Programming examples, corresponding with the use of an HP9825 controller are given to complete the description and facilitate understanding. However the use of this controller is by no means essential as the generator can be programmed from other models.

The mnemonic programming prefixes can be written in either upper case or lower case characters.

PROGRAMMING THE RF FREQUENCY

Program the mnemonic "F" followed, in free format, by the frequency expressed in Hz. Any frequency requiring a resolution better than 10 Hz is rounded down by default to the nearest whole number of tens of Hz :

Example :



PROGRAMMING THE OUTPUT AMPLITUDE

Program the mnemonic "A" (amplitude) followed by the amplitude in dBm, the resolution being 0.1 dB.

Amplitude must be programmed in dBm.

Example 1 : say, - 45.2 dB
wrt 700, "A - 45.2"

Example 2 : Programming frequency and amplitude, say 118 MHz and - 117 dBm
WRT 700, "F 118 e 6 A - 117"

PROGRAMMING THE MODULATIONS

Amplitude Modulation

Program the mnemonic "AM" followed by a figure between 0 and 3 to select the mode according to the following table :

AM 0	Inhibition of the modulation (CW)
AM 1	External source
AM 2	1 kHz internal source
AM 3	400 Hz internal source

Program the prefix "%" followed by a number representing the modulation percentage with a resolution of 0.1%.

Example : 1 kHz internal source and 50.5% modulation rate.
W 700, "AM 2% 50.5"

Frequency Modulation

Program the mnemonic "FM" followed by a figure between 0 and 3 to select the mode according to the following table :

FM 0	Inhibition of the modulation (CW)
FM 1	External source
FM 2	1 kHz internal source
FM 3	400 Hz internal source

Program the mnemonic "D" (deviation) followed by a number representing the frequency deviation expressed in kHz, knowing that the available resolution is :

10 Hz from 0 to 19.99 kHz
100 Hz from 20 to 199.9 kHz

Example : 400 Hz internal source and 75 kHz deviation.
wrt 700 "FM3 D 75"

Phase Modulation

Program the mnemonic "PM" followed by a figure between 0 and 3 to select the mode according to the following table :

PM 0	Inhibition of the modulation (CW)
PM 1	External source
PM 2	1 kHz internal source
PM 3	400 Hz internal source

Program the prefix "P" followed by a figure expressing the deviation in radians with a resolution of 0.01 rd.

Example : External source and deviation of ± 3.14 rd
wrt 700 "PM 1 3.14"

Pulse Modulation

Program the mnemonic prefix "SP 64" (special 64) to validate the mode.

Suppression of pulse modulation mode : "SP 60".

PROGRAMMING THE MEMORIES

Enter the configuration into a memory by programming the mnemonic prefix "M" followed by the selected memory order number from 01 to 99.

Recall a stored configuration by means of the mnemonic "RM" (recall memory) followed by the memory number.

PROGRAMMING SEQUENCES

Program the mnemonic "SQ" followed by 4 figures determining the limits of the sequence.
Example : wrt 7ØØ, "SQ 05 23"

The sequence thus determined contains the memories numbered 05 to 23 and subsequent operation of the foot switch or of the and buttons in the **INCREMENT** block will enable the sequence to be used after return to local.

To suppress the sequence, program : "SQØ"

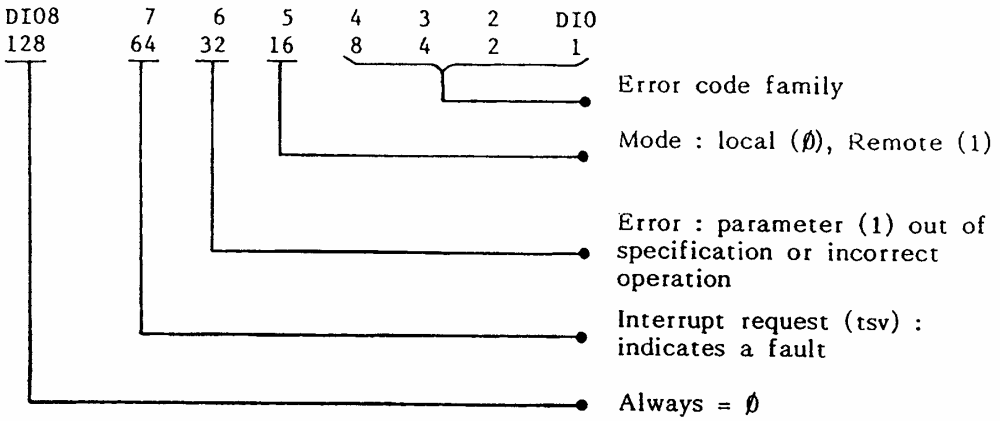
ERROR PROCESSING

Status

The instrument performs the SR1 function of the IEEE-488 standard by sending the SRQ (service request) signal over the bus following an attempt to exceed the input specifications.

The controller can then request a status byte according to the serial polling procedure. The format of the byte is as follows :

Validation of bit 32 indicates an operational error. The error code family corresponding to the fault committed is indicated by the BCD bits 1-2-4-8 (0 to 9), the exact code being shown on the generator display (ØØ to 91).



Interface Function

The 740 conforms to the IEEE-488 1975 standard and to the CEI 625-1 standard with the exception of the connector which is the IEEE standard connector. A CEI connector adaptation is possible on request. The 740 fulfils the following functions :

AH1 - SH1 - T2 - TEØ - L1 - LEØ - RL1 - PPØ - DC1 - DT1 - CØ.

READING BY THE BUS

At an attemp of addressing in Talker mode, the 740 A answers :

space CR LF

CHAPTER IV

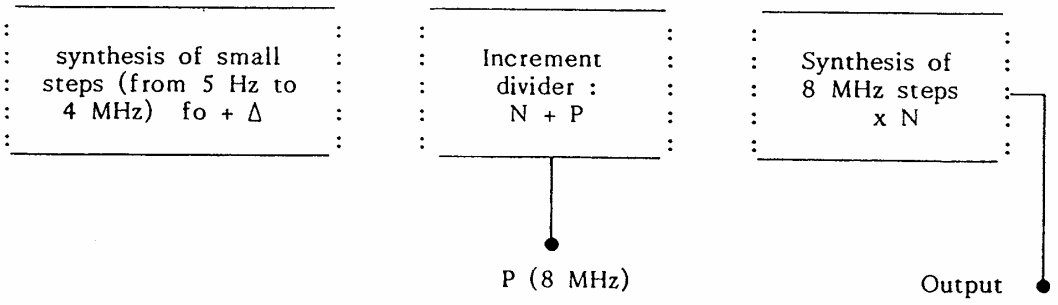
PRINCIPLE OF OPERATION

GENERAL PRINCIPLE

The 740 frequency synthesizer generator makes use of a new and original process which provides an excellent spectral purity while considerably reducing the number of elements necessary to produce the parts operating in VHF.

The new process, patented in France (N° 80 27 872) and abroad, concerns the synthesis of the largest step, which for the 740 means steps of 8 MHz.

The principle of the 740 can be represented, in a very simplified way, as follows :



The three blocks successively represent the small steps synthetsizer, of traditional design, generating a frequency containing a fixed part fo and a variable part Δ being the sum of the small steps.

Then comes an increment divider which performs the following operation :

$$\frac{fo + \Delta}{N} + P$$

The output frequency of the divider is remultiplied by N in the large steps synthesizer to obtain :

$$\left(\frac{fo + \Delta}{N} + P \right) \times N = fo + \Delta + NP$$

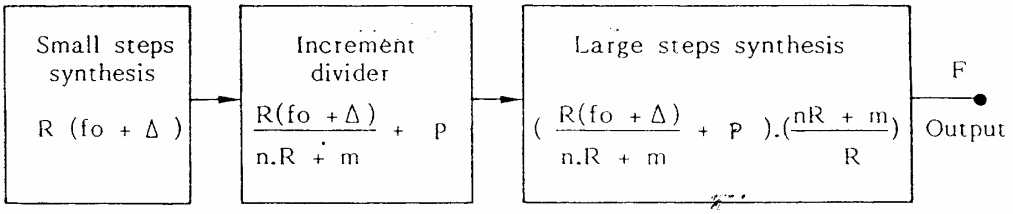
In the case where fo is a multiple of P it is easy to see that the output frequency is the sum of the small steps frequency and a number of large steps, N.

This synthesis process has already been used in the production of the 6315 frequency synthesizer, using a value of P equal to 40 MHz.

The special feature of the 740, which is the subject of the patent, is the fact that it has been possible to reduce the value of P to 8 MHz, thus obtaining a very large number of steps and simplifying the synthesis of small steps, without however requiring too large a multiplication factor which would lead to a mediocre spectral purity.

The basic idea is to make the small steps synthesizer work at an R times higher frequency and introducing a term m at the frequency division level in the increment divider and also at the remultiplication level near the output.

This leads to the following simplified block diagram :



Carrying out this sequence provides :

$$\text{Output } F = fo + \Delta + nP + m\frac{P}{R}$$

It is therefore clear that, in comparison with the 6315 principle, a term m.P/R has been added and that by careful selection of R it is possible to obtain R times more steps for the same multiplication factor n.

In the 740, the values are as follows :

fo = 18 MHz

Δ = 0 to 8 MHz

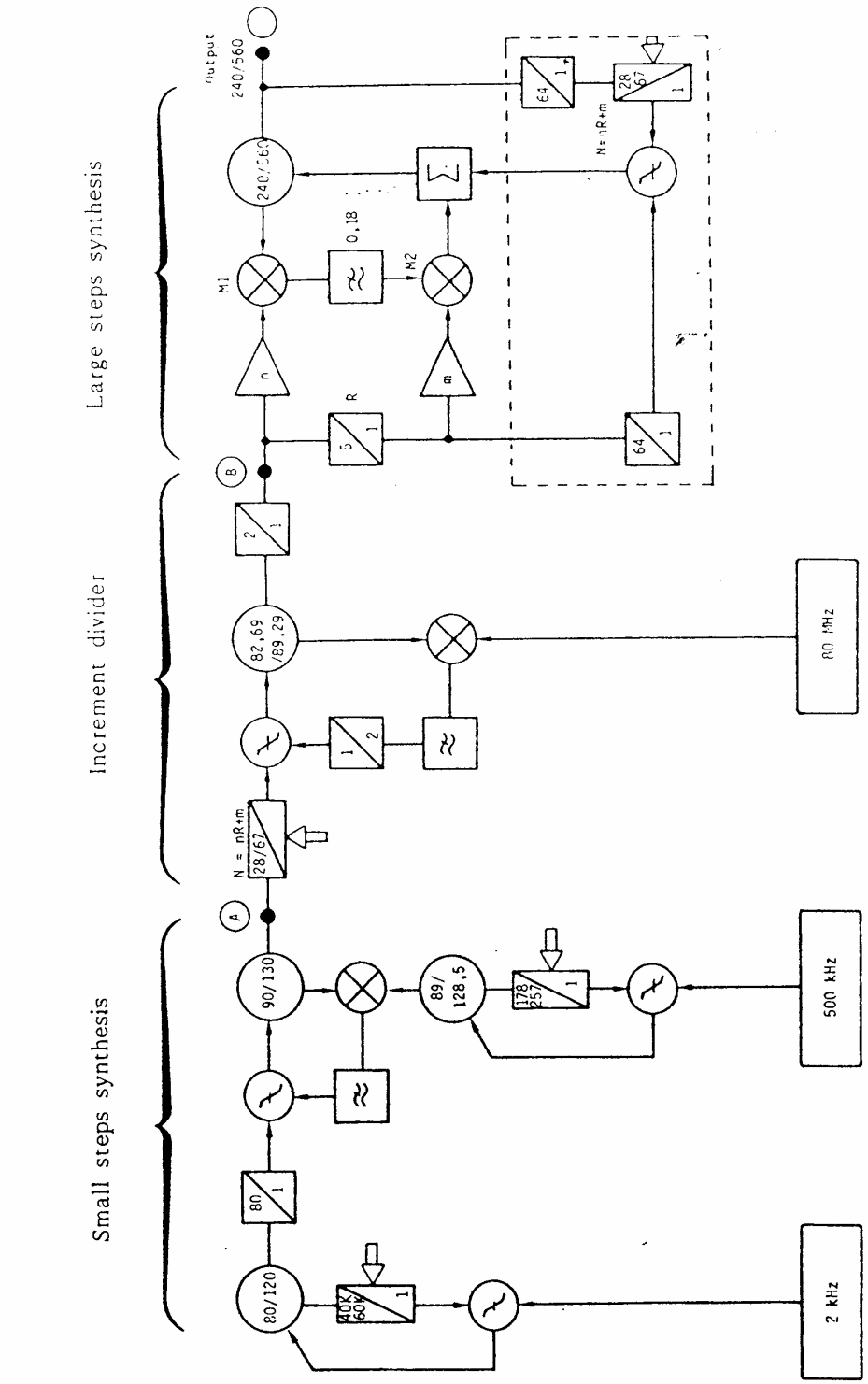
P = 40 MHz

R = 5, from which $\frac{P}{R}$ = 8 MHz

The block diagram on Page IV-4 which shows the main circuits and gives a more accurate idea of how the 740 synthesis works to obtain, from an 80 MHz quartz controlled oscillator, a direct frequency range of 240 MHz to 560 MHz and a range of 100 kHz to 560 MHz with the addition of a divider and a mixer to obtain the heterodyned range.

Small step synthesis is achieved in the traditional way by means of three phase locked loops.

BLOCK DIAGRAM OF THE 740 SYNTHESIS



The first loop contains an 80 to 120 MHz oscillator and a 40,000 to 60,000 programmable divider and synthesizes 20,000 steps of 2 kHz. After a fixed division by 80 which reduces the frequency range to 1 to 1.5 MHz and the step to 25 Hz, a second loop sums this frequency with a frequency from 89 to 128.5 MHz which is itself obtained from the third loop which, by means of an oscillator and a 178 to 257 programmable divider, generates 80 steps of 500 kHz. The summed frequency at point A therefore goes from 90 to 130 MHz with a resolution of 25 Hz and it will be seen later that the step value and the noise and possible spurious components are divided by 5 near the output C.

The output frequency of small steps synthesis is then divided by N, where N = nR + m and in practice varies from 28 to 67.

A loop comprising the 82.69 to 89.29 oscillator, a mixing with the 80 MHz reference frequency, a division by 2 and a phase-frequency comparator enables 80 MHz to be added to twice the frequency output from the 28 to 67 divider. After division by 2, a frequency is obtained at point B which is equal to the frequency at A divided by N, plus 40 MHz.

The large steps synthesizing loop multiplies the frequency at B by N/R, 5.6 to 13.4, which produces a fractional multiplication factor.

This fractional multiplication is carried out in a special way in order to prevent deterioration in the signal to noise ratio.

The frequency available at B is transformed into a frequency comb and mixed with the output oscillator frequency.

A tuning loop contains two fixed "by 64" dividers and a variable "by N = nR + m" divider and sets the oscillator to the correct frequency and all that is now required is the fine tuning that will produce spectral purity.

The mixer M1 therefore receives the frequency comb from B and the oscillator frequency. Two cases can occur :

1) N/R is whole : a spectral component is equal to the oscillator frequency. A zero beat frequency is applied to mixer M2 and after sampling at B/5, controls the oscillator.

2) N/R is not whole and a beat frequency appears which is equal to the difference between the oscillator and the nearest comb line. This beat is equal to B/5 or 2B/5, positive or negative, depending on whether the oscillator frequency is higher or lower than the comb line.

It is easy to see five synchronising conditions are possible on beats equal to 2B/5, B/5, 0, -B/5, -2B/5. Five steps are therefore made between each 40 MHz step giving a resolution of 8 MHz with a maximum multiplication factor of 14 with respect to frequency B.

Numeral Example :

This example shows the method of calculation of factors carried out by the CPU and the corresponding frequencies at the various points.

The CPU determines the value of the division factor of the N = nR + m divider by taking the whole part of the quotient of the required output frequency minus fo, or 18 MHz.

$$N = INT \left(\frac{Fs - 18}{8} \right)$$

Example : take a frequency of 543.21 MHz

$$N = INT \left(\frac{543.21 - 18}{8} \right) = 65$$

The remainder of this division is 5.21 MHz and corresponds to Δ . The frequency output from the small steps synthesis will therefore be :

$$A = R (fo + \Delta) = 5(18 + 5.21) = 116.05 \text{ MHz}$$

After the increment divider :

$$B = \frac{A}{N} + 40 = \frac{116.05}{65} + 40 = 41.785384 \text{ MHz}$$

This frequency is divided by 5 and then by 64 and then compared by the tuning loop with the oscillator output frequency divided by 64. This gives a synchronizing frequency for this loop of :

$$\frac{41.785385}{5 \times 64} + 0.130579 \text{ MHz}$$

The tuning loop counter divides by 65 and therefore gives an oscillator frequency of :

$$0.130579 \times 65 \times 64 = 543.21$$

Let us now examine the operation of the fine tuning loop. The frequency comb derived from the frequency of 41.785385 MHz includes, in particular, a line at :

$$41.785385 = 543.21 \text{ MHz}$$

A zero beat therefore appears at the output of mixer M1 and the sampling type mixer. M2, therefore merely copies the DC component which directly controls the oscillator. This is the simplest case, where the multiplication factor is a whole number.

Let us now take another example in which a fractional multiplication factor will appear :

Take 401 MHz :

$$N = \text{INT}\left(\frac{401 - 18}{8}\right) = 47, \text{ remainder } 7 \text{ MHz}$$

$$A = 5\,(\,18 + 7\,) = 125 \text{ MHz}$$

$$B = \frac{A}{N} + 40 = \frac{125}{47} + 40 = 42.65957$$

The tuning loop sets the oscillator to 401 MHz. The spectrum derived from B gives a line at :

$$42.65957 \times 9 = 383.9361$$

The mixer M1 produces a beat between this and the oscillator frequency of :

$$401 - 483.9361 = -\,17.0638 \text{ MHz}$$

This beat is sampled in M2 at B/5 :

giving : $\dfrac{42.6595}{5} = 2$

Now : $\dfrac{17.0638}{8.5319} = 2$

Synchronization is therefore carried out on harmonic 2 of frequency $\frac{B}{5}$.

EXPLANATION OF BLOCK DIAGRAM

Small steps synthesis makes use of two boards, the first produces 20000 steps and the second produces 80.

The "20,000" board includes an 80 to 120 MHz oscillator synchronized at 2 kHz across a 40000 to 60000 divider.

A fixed output divider brings the frequency to 1 to 1.5 MHz and the step value to 25 Hz, which is five times that requires for the output.

The "80" board contains two oscillators, the first, of 89 MHz to 128.5 MHz, synthesizes the 80 steps of 500 kHz by means of the 178 to 257 counter and synchronization at 500 kHz.

The 1 to 1.5 MHz frequency, including the small steps, is added to it by means of a second oscillator and a synchronizing loop. The output frequency of 90 to 130 MHz represents the synthesis of small steps and will be divided by five towards the output.

The synthesis of large steps was described at length in the previous paragraph and includes the increment divider which divides the small steps by N and the 82.69 to 89.29 oscillator providing twice the frequency at B which is then remultiplied to provide the output frequency.

Two output oscillators are used in such a way that each only covers a reasonable frequency range and the heterodyned range can be generated, bringing the output range down to 100 kHz.

The use of two oscillators, 01 and 02, a certain number of HF switches and a divide-by-two frequency divider produces a continuous frequency range from 100 kHz to 560 MHz, as shown in the table.

Output frequency (MHz)	Oscillator	Range	Oscillator frequency (MHz)
368 - 560	01	direct	368 - 560
280 - 367,9	02	direct	280 - 367,9
184 - 279,9	01	: 2	368 - 559,8
122 - 183,9	02	: 2	244 - 367,8
0,1 - 121,9	01	heterodyned	400 - 521,9
	02		400

The oscillator used for the direct and divided ranges is always synchronized by the fractional multiplication device which operates on the output of the 82 to 89 MHz oscillator.

For the heterodyned range, oscillator 02 is synchronized in the same way, but 02 is synchronized at 400 MHz, directly from the 80 MHz master oscillator by an independent circuit also containing a tuning loop. The output frequency is obtained from the beating of the output frequencies of the two oscillators.

The AM modulator is positioned so that it is in the signal path in all appropriate cases and, in the case of the heterodyned range, it affects the linear channel of the mixer.

An HF switch preceeds the AM modulator to provide pulse modulation.

The Frequency Modulation function is provided on the "FM" board by means of an 80 MHz oscillator, synchronized with a 5 Hz bandwidth by means of a tuning loop which receives the FM modulation signal or its derivative divider instead of the 80 MHz reference signal in FM or ØM mode.

The divider and filter circuits generating the 400 Hz and 1 kHz modulating frequencies are located on the same board.

An analogue board supplies the AM, FM and ØM signals by means of a BCD DAC*, while a second DAC provides the variable multiplication factor compensation N, between the increment divider and the output.

The analogue board also provides the RF reference level that enables the generation of 0.1 and 1 dB steps between the 5 dB steps produced by the attenuator by means of a weighted network switched by a CMOS switch.

The tuning board contains the tuning loops 01 and 02 with a variable divider of factor 28 to 67 and the tuning loop for the fixed 400 MHz tuning loop for oscillator 02. This board also includes the register and control circuits for the VHF module and the attenuator.

The quartz controlled master oscillator provides a very pure 80 MHz signal and includes a divide by 8 circuit to obtain a 10 MHz reference signal. The logical part of the 740 is contained on two sub-assemblies, a CPU board and the front panel board.

* DAC : Digital Analogue Converter

The CPU board is organized in a special way with respect to isolation of the buses. Three different buses in the instrument are distinguished :

- the microprocessor bus which connects the microprocessor to its peripherals and controls the instrument bus via registers.
- the IEEE bus connected to the microprocessor via an interface circuit 68488, but not galvanically isolated from the microprocessor bus.
- the instrument bus which controls the various modules of the 740 and has galvanic isolation by photocouplers.

Thus the whole logic section is floating and isolated at the instrument bus level. The front panel, containing the keyboard and displays, is connected to the microprocessor via a PIA.

CHAPTER V

CALIBRATION

This chapter describes the calibration procedure for an instrument in working order and which the user wishes to recalibrate after a long period of use.

Only the adjustments to output and modulation calibration circuits will therefore be considered.

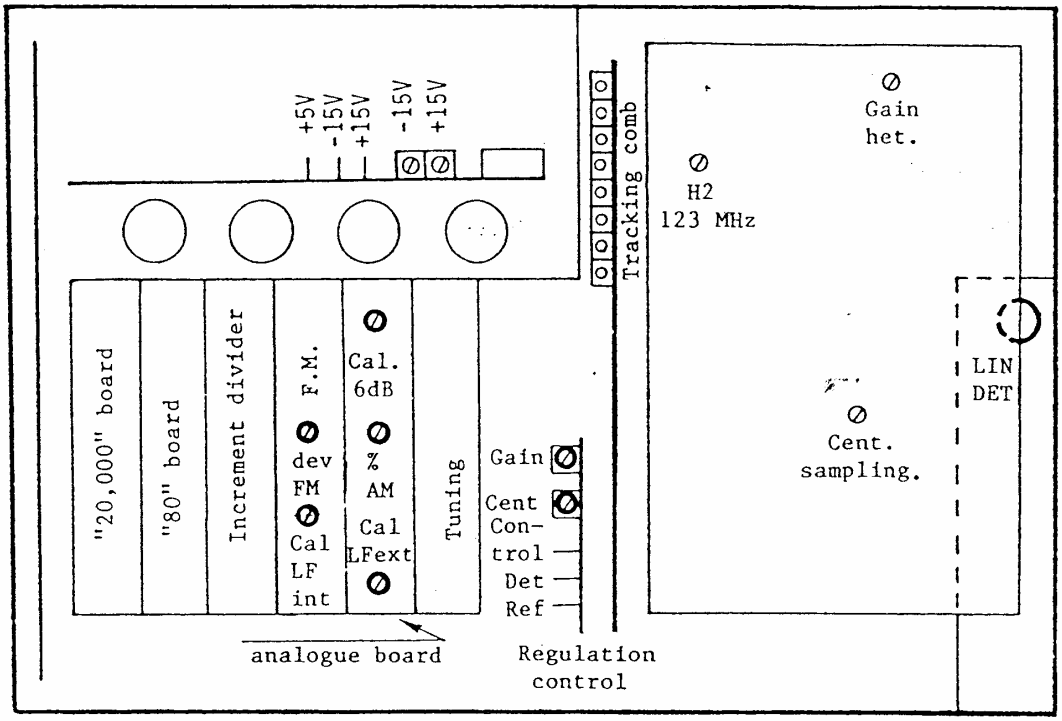
The diagram on Page V-2 shows where adjustments are made. Locations are indicated by heavy outlines.

The other adjustments are identified but most only be carried out during the complete instrument adjustment procedure.

Adjustment of the quartz controlled master oscillator is described in Chapter III 4.

NECESSARY EQUIPMENT

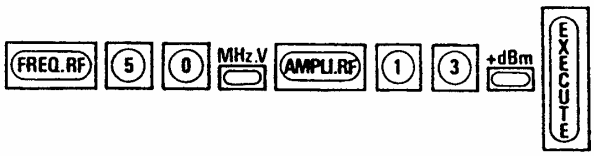
- 1 accurate milliwattmeter,
- 1 multimeter,
- 1 AM and FM Modulation meter,
- 1 Low Frequency Distorsion Meter,
- 1 Low Frequency low Distortion Generator.



Location of adjustment points

AMPLITUDE CALIBRATION

- Connect the milliwattmeter to the instrument output.
- Connect the multimeter to the "ref" test point on the regulation control board.
- Put the 740A into the following configuration :



- Measure the continuous voltage on PT "ref" regulation control board. Note this value U.
- Display + 7 dBm.
- Adjust the potentiometer Cal 6 dB on the analogue board to obtain U/2 on PT "ref".

- Display + 2.1 dBm.

- Adjust the potentiometer on the regulation control board (marked "Centrage"-Centring) to obtain + 2.1 dBm.

- Display + 7 dBm.

- Adjust the "gain" potentiometer to obtain + 7 dBm.

- Repeat the last two operations, + 2.1 dBm and + 7 dBm, until the adjustment is perfect.

- Display 0 dBm.

- Trim P1 on the regulation control board (gain) to obtain 0 dBm.

CALIBRATION OF EXTERNAL LF

- Switch to external modulation.

- Connect a low distortion (<0.5%) LF generator to the external LF input, 0.5 Vrms on 600 ohms exactly.

- Adjust P2 on the analogue board (marked cal LF ext) until the two "ext cal" indicators go out.

CALIBRATION OF INTERNAL LF

- Connect a modulation meter to the RF output.

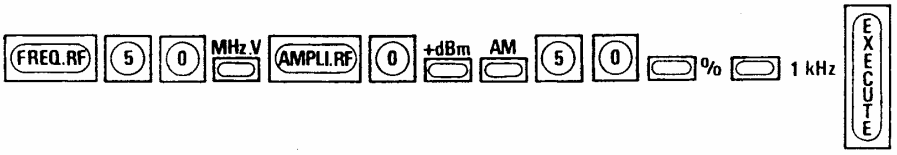
- Switch to external calibrated "AM" and display an AM modulation percentage of 50%.

- Adjust "taux AM (AM%)" potentiometer on the analogue board to obtain exactly a percentage of 50%.

- Switch to internal 1 kHz and adjust the potentiometer "Cal LF int" to obtain exactly a percentage of 50%.

CALIBRATION OF AM MODULATION

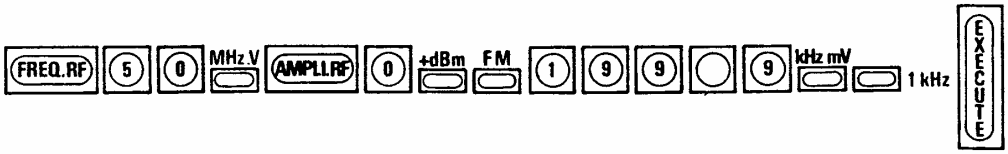
- Connect an AM modulation meter to the output of the 740, followed by a distortionmeter.
- Put the 740 into the following configuration :



- Display a modulation percentage of 95%.
- Adjust the "Lin Det" potentiometer on the attenuator block to obtain the minimum distorsion on the distorsion meter which must correspond with the modulation percentage of 95%.
- Re-check the 50% and 80% modulation percentages and if necessary trim P3 to make fine adjustments.

CALIBRATION OF FM AND ØM MODULATIONS

- Put the 740 into the following configuration :



- Adjust P1 on the FM board (marked dev FM) to obtain 199.9 kHz deviation on the modulation meter.
- Check that the deviation is accurate for 50, 100 and 150 kHz.

Calibrating FM modulation also calibrates Phase Modulation.

CALIBRATION FORM 740

Description	instruction	tolérance	measure
Measures at 50 MHz :			
Output level	+ 13 dBm	± 0,5 dB	
	+ 12 dBm	± 0,5 dB	
	+ 11 dBm	± 0,5 dB	
	+ 10 dBm	± 0,5 dB	
	+ 9 dBm	± 0,5 dB	
	+ 8 dBm	± 0,5 dB	
	+ 7 dBm	± 0,5 dB	
	+ 6 dBm	± 0,5 dB	
	+ 5 dBm	± 0,5 dB	
	+ 4 dBm	± 0,5 dB	
	+ 3 dBm	± 0,5 dB	
	+ 0 dBm	± 0,1 dB	
LF level 1KHz ext			
to go out indicators	0,5 Veff	± 0,5 %	
AM modulation % . 1 KHz ext	50 %	± 0,5 %	
400 Hz ext	80 %	± 1 %	
AM modulation %. 1 KHz int	50 %	± 1 %	
400 Hz int	50 %	± 1 %	
FM déviation. 1 KHz int	199,9 KHz	± 1 %	

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Ce produit SCHLUMBERGER est garanti pour une durée d'un an à compter de la date de livraison.

La garantie s'applique aux appareils ayant subi des dommages mécaniques causés lors de l'expédition en partance de TRAPPES ou présentant, à la suite de défaillance d'un élément ou d'un sous-ensemble, des caractéristiques non conformes aux spécifications techniques. Sont toutefois exclus de la garantie les dommages occasionnés par une utilisation anormale de l'instrument.

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Passé le délai de garantie, la Société reste bien entendu au service de ses clients en leur offrant son concours pour toutes éventuelles opérations de maintenance.

Pour tous renseignements complémentaires, veuillez contacter votre représentant SCHLUMBERGER le plus proche, les coordonnées de nos principaux agents étant données dans le tableau ci-dessous.

The SCHLUMBERGER product is guaranteed for a period of one year from the date of delivery.

The waranty applies to equipment with mechanical damage sustained during shipping from SCHLUMBERGER, or failing to conform to the technical specification due to faulty components of sub-assemblies.
The warranty does not cover damage caused by incorrect use of the instrument.

The client for his part undertakes not to interfere with the equipment during the warranty period, failing which the warranty is rendered void. One half of the cost of returning and re-shipping the equipment for maintenance under warranty will be met by SCHLUMBERGER.

After expiry of the warranty period, the Company will of course remain at the service of its customers and will offer its help to them for any maintenance work that may be necessary.

For any further information, please contact your nearest SCHLUMBERGER representative. The addresses of our main agents are given in the table below.

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