

# ADRET

VHF GENERATOR  
MODEL 730A



MAINTENANCE HANDBOOK  
PART ONE

C O N T E N T

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## CHAPTER VI

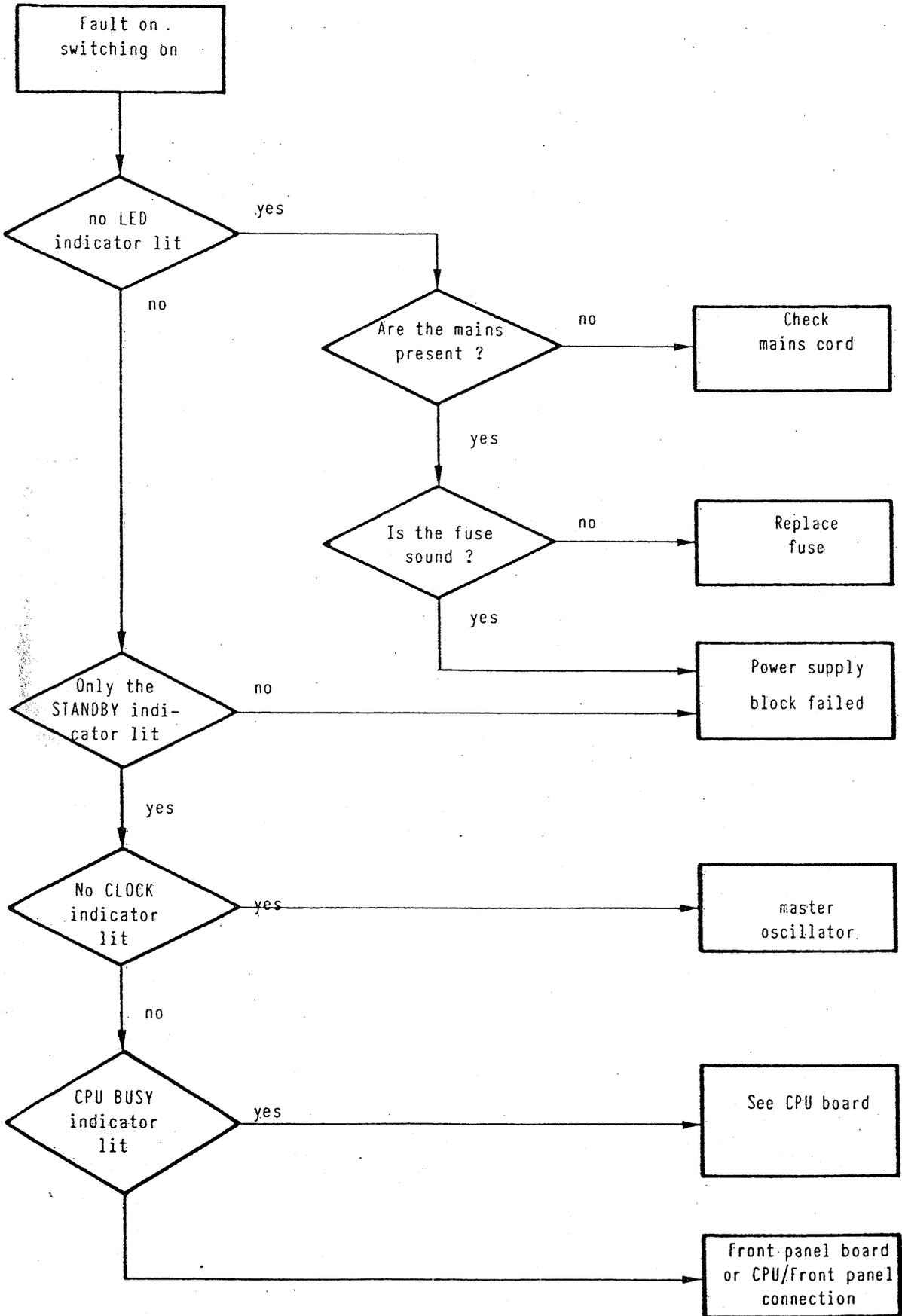
### MAINTENANCE

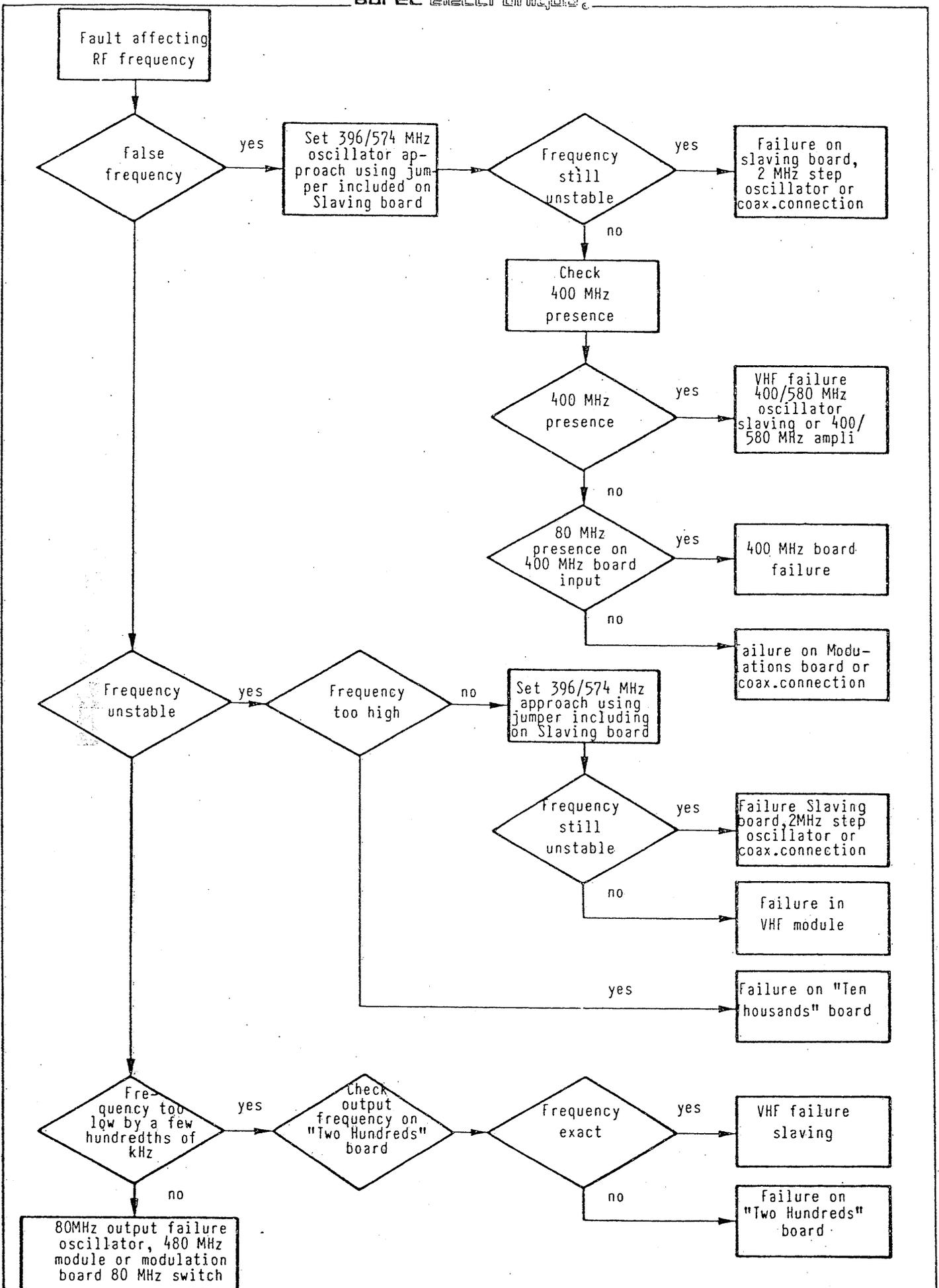
#### FAULT FLOWCHARTS

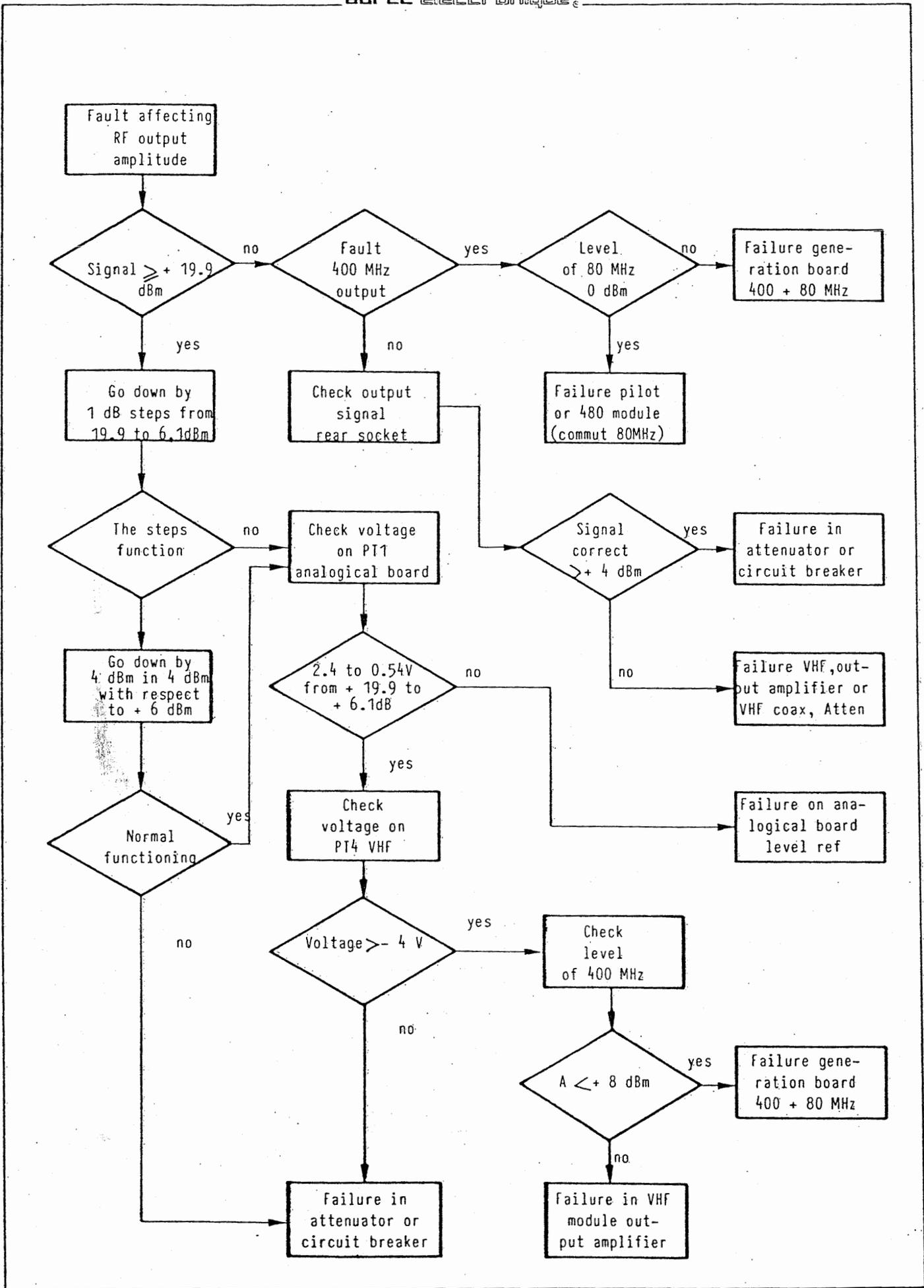
Fault flowcharts have been established for each instrument function showing the faults most likely to occur in order to facilitate the repair of the instrument.

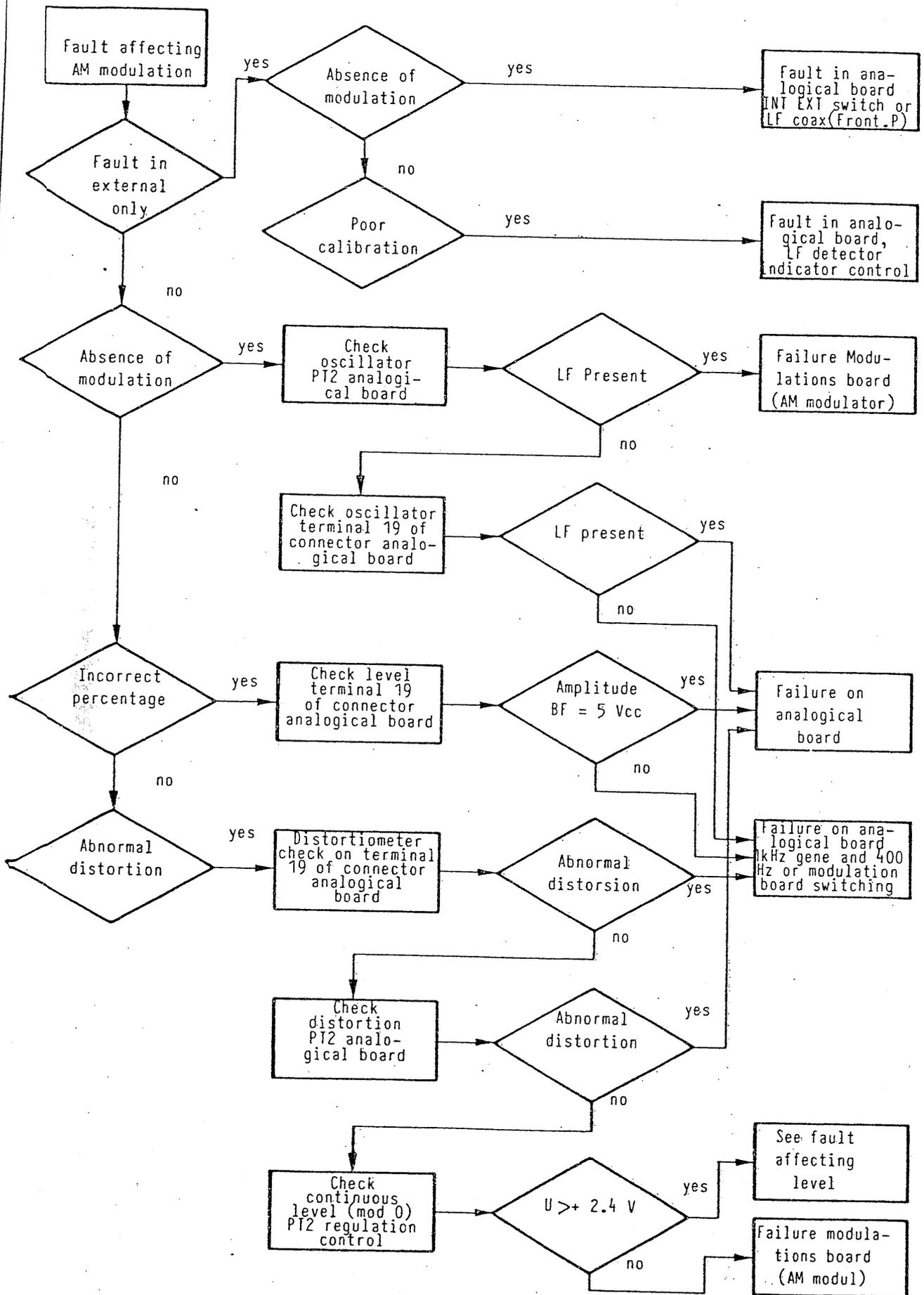
They indicate the checks to be made and localize faults to the suspect module, sub-assembly or connection.

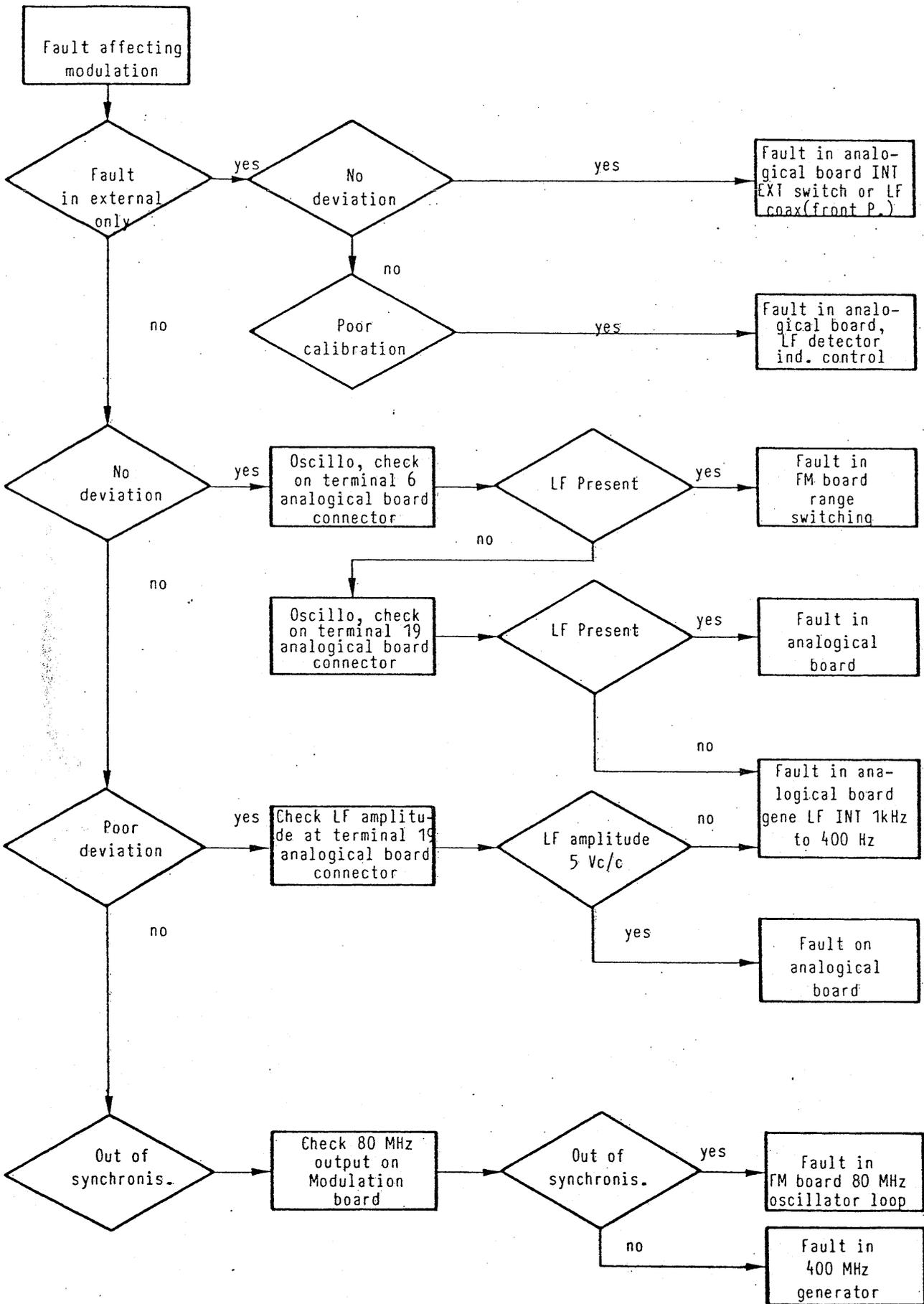
- 1) Faults affecting the display,
- 2) Faults affecting RF frequency,
- 3) Faults affecting RF output amplitude,
- 4) Faults affecting AM modulation,
- 5) Faults affecting FM and  $\phi$ M modulations.

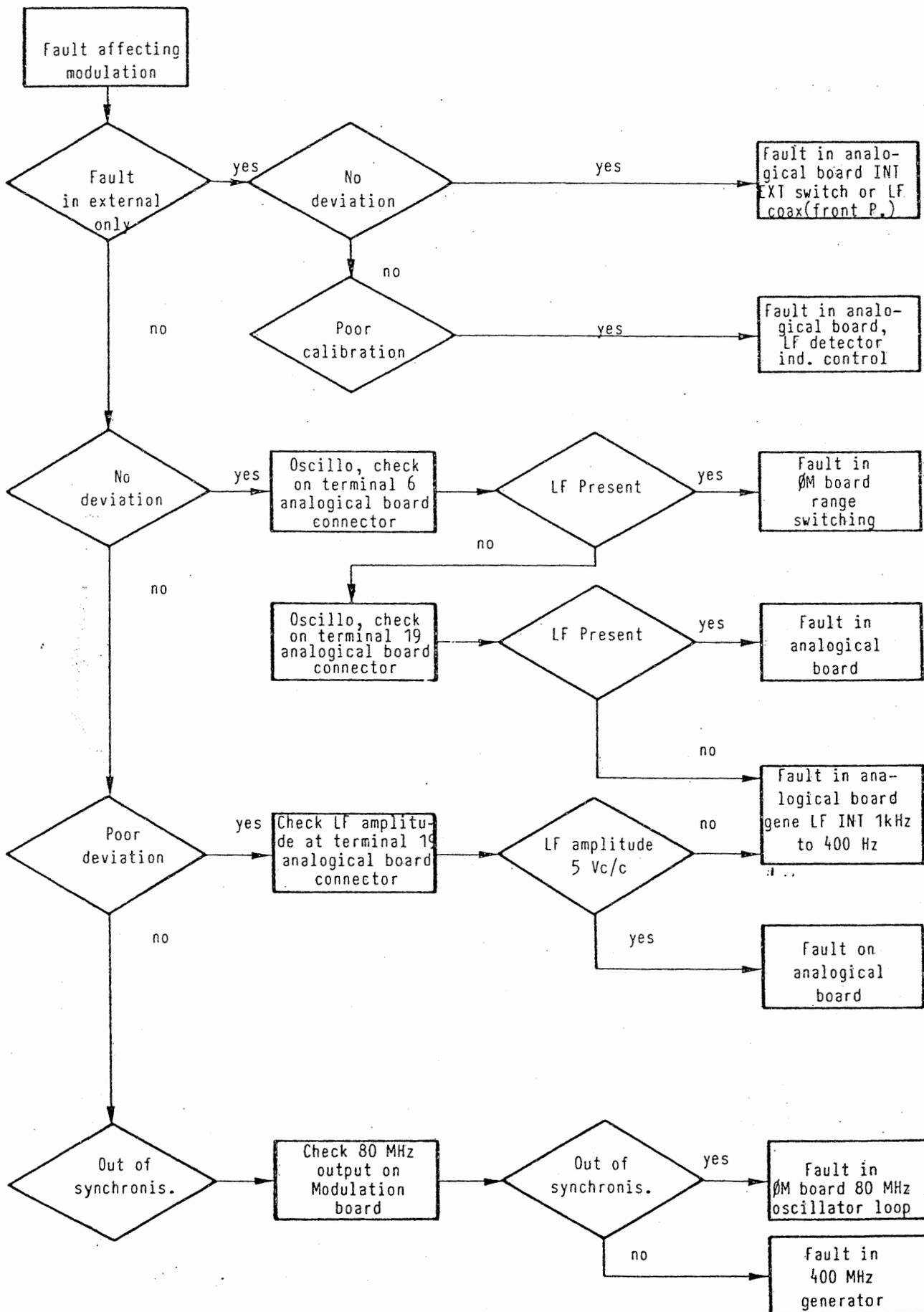












## CONTINUOUS FM BOARD

This board generates an 80 MHz FM frequency with bandwidth ranging from continuous to  $\pm 10$  kHz of  $F_0$ . It is substituted for an 80 MHz nonmodulated or AM signal, or for an 80 MHz FM or  $\Phi$ M signal.

Description

An 8 MHz quartz oscillator is frequency-modulated by a voltage applied on varicap BB 809 which modifies the capacity of the quartz oscillating circuit.

The signal is linearized by two operational amplifiers, A2 and A3, and a type AD534JH linearizing circuit which compensates for the varicap fault in linearity.

Amplifier A2 corrects the term in  $X^2$  by P2.  
Its gain is adjustable from + 1 to -1.

Amplifier A3 corrects the term in  $X^3$  by P3.  
Its gain is adjustable from + 4 to - 4.

The A3 output drives the current of one of the sections of a current block made up of transistors BC416 and BC414, designed to apply the corrective terms to amplifier A4 and shift the continuous audio-frequency signal ; this may take place with a correction cell link, if applicable.

Regulation of frequency deviation takes place on the modulation audio-frequency input by variation in the gain of amplifier A1, which may be adjusted by P1 (10 V DC maximum). This amplified audio-frequency signal is then applied to the linearizing circuit and shifting amplifier A4.

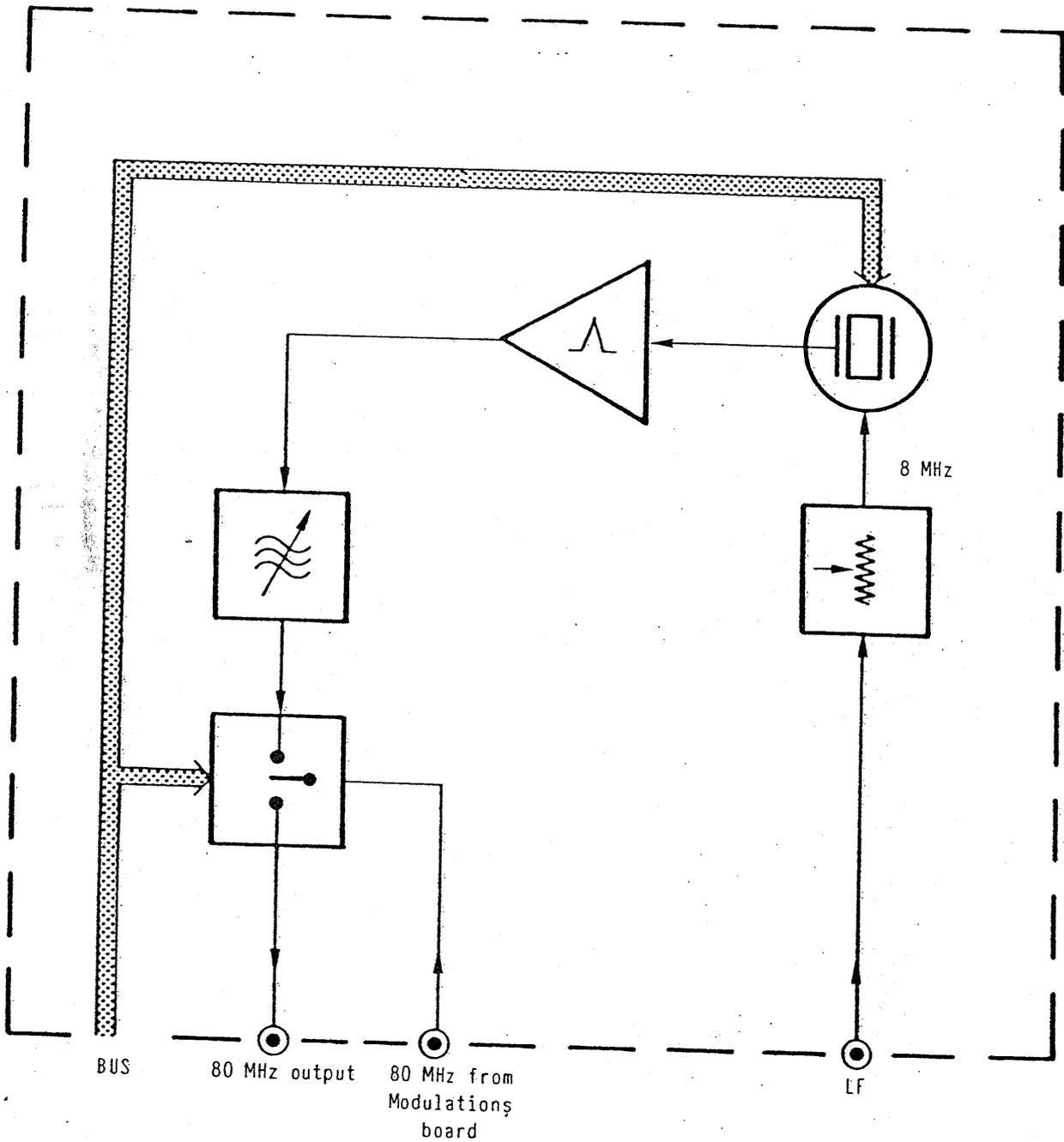
The role of amplifier A4 is to center the modulation audio-frequency signal around 6 V DC (adjusted by P4 on the current block) in order to use the most linear portion of the varicap slope.

The output of amplifier A4 applies the audio-frequency signal to the varicap by means of a series RL network which drives it under low impedance in order to limit audio-frequency signal noise while remaining at high impedance under 8 MHz.

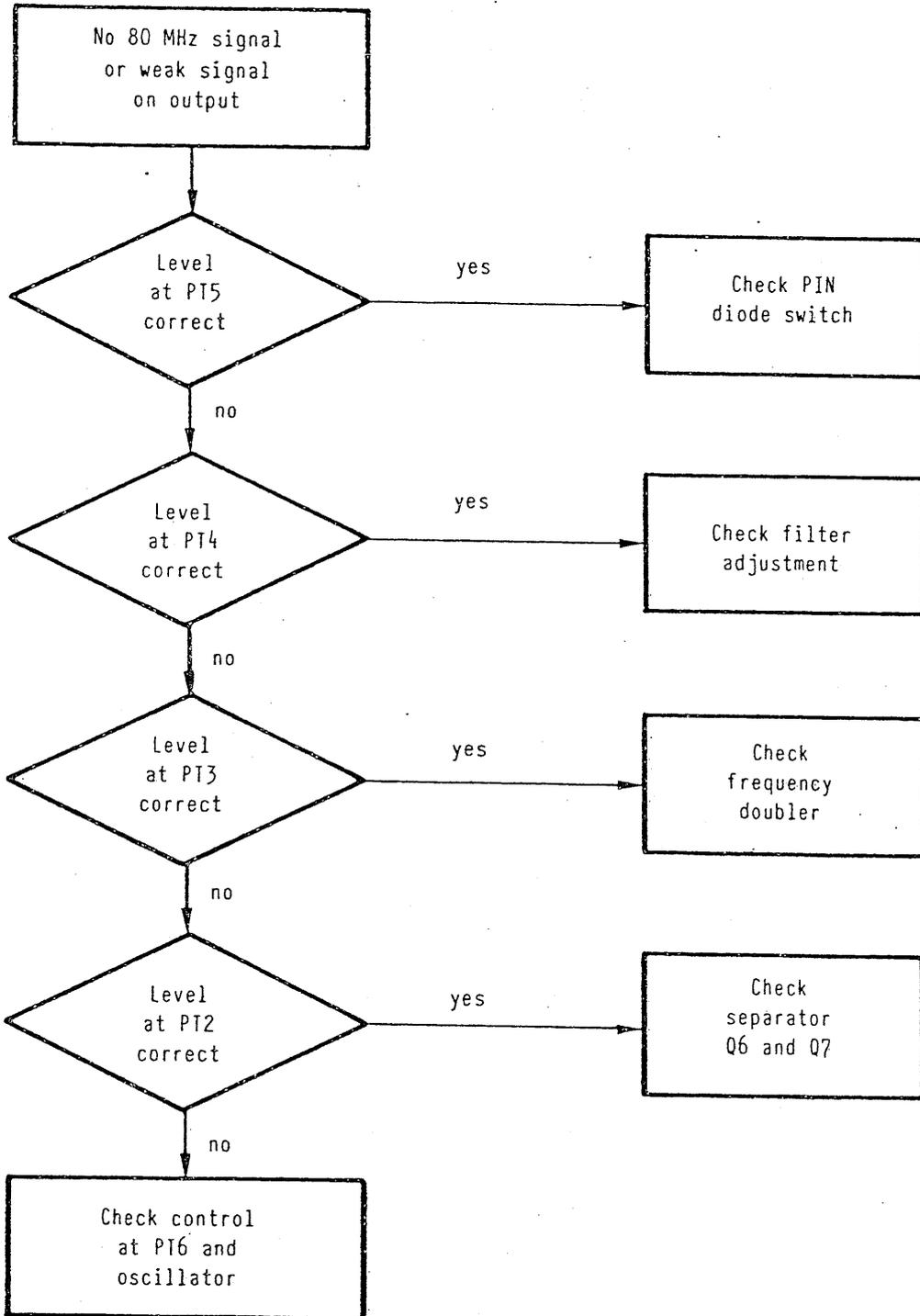
The 8 MHz quartz oscillator, which is thermostatically controlled in order to limit temperature drift, is multiplied by two (diode doubler) and applied to a class C amplifier in the collector ; a circuit in the collector tuned on harmonic 5 enables 80 MHz selection.

This 80 MHz signal is sent across a PIN diode switch after filtering which selects either it or the signal output by the Modulations board - or + polarization of the diodes by means of SN4. When the 80 MHz signal from the Modulations board is selected, the 8 MHz oscillator is cut off by non-conduction of Q5. The level of the 80 MHz signal is regulated by adjusting P5 on the class C amplifier.

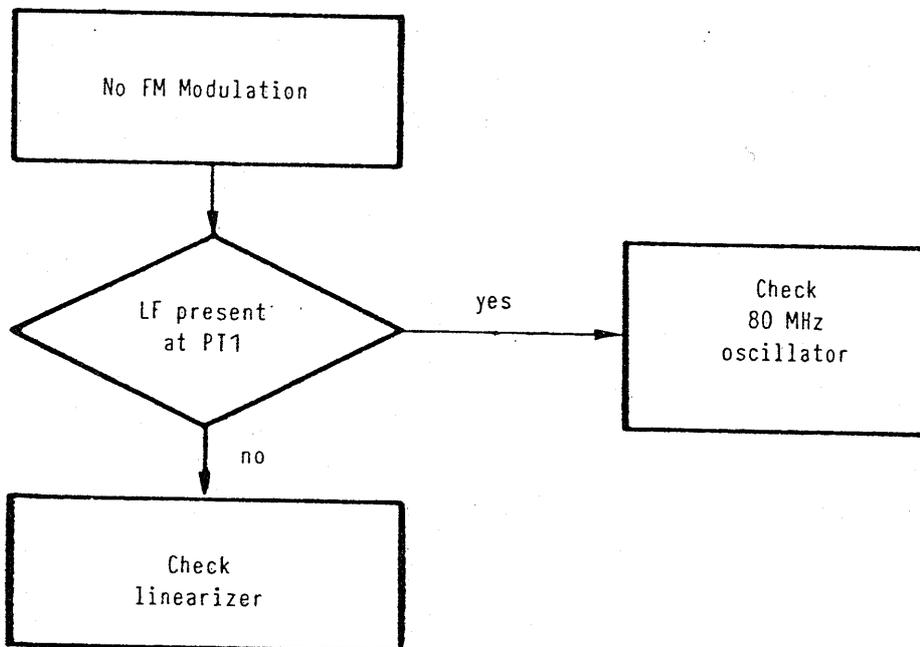
SYNOPTIQUE



Flowchart 1



Flowchart 2



## 10 000 STEPS BOARD

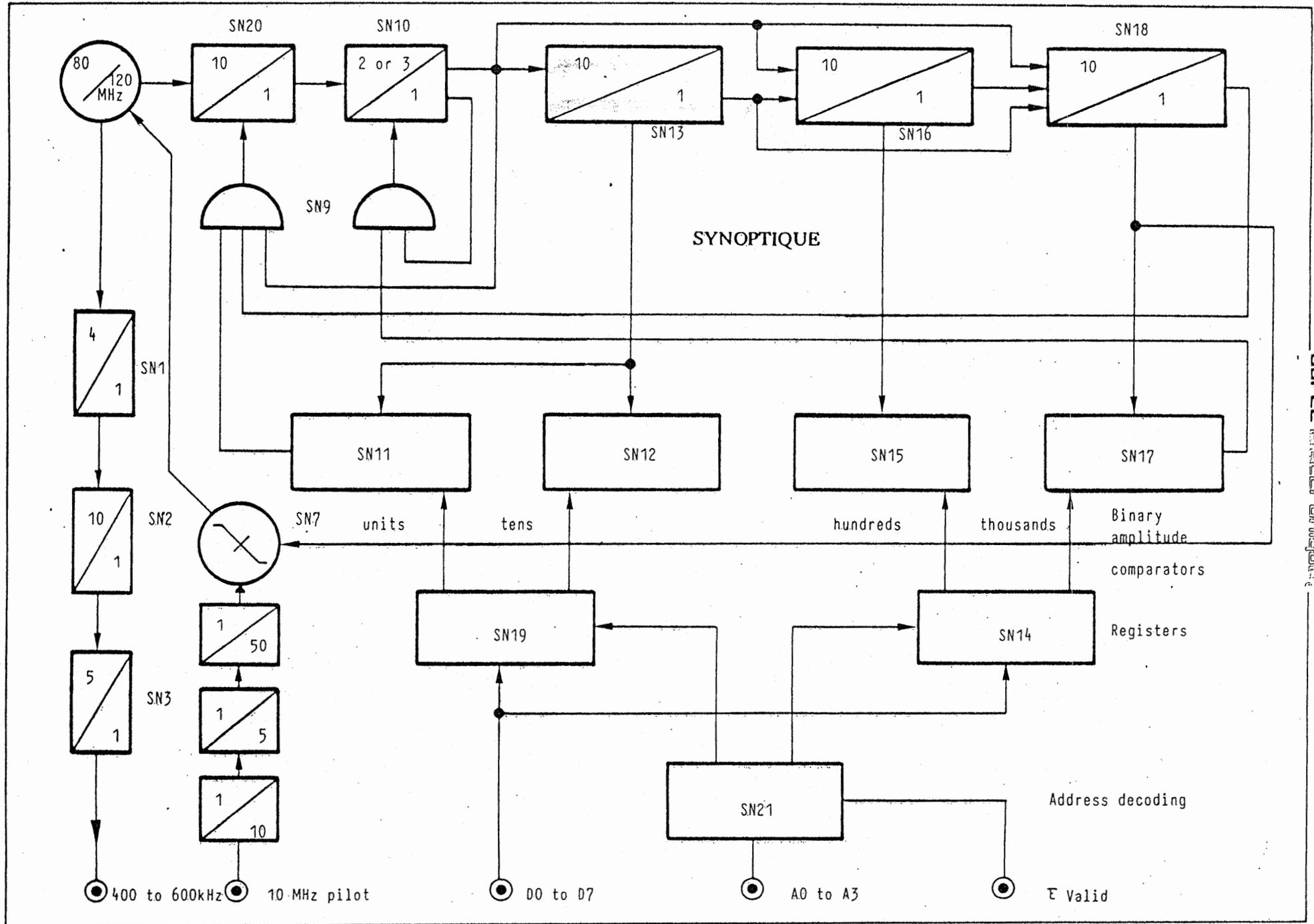
The "10 000" Steps board generates the increments from 1 Hz to 9.999 kHz, or 9999 steps. Frequency resolution of the 730 is 1 Hz.

An 80 to 120 MHz oscillator drives two separators. Q3 sends the signal to the 400 to 600 kHz output across a divider by 200 ( $4 \times 10 \times 5$ ); Q4 is used as an ECL - TTL adapter. Additionally, Q3 transmits the signal to the 20,000 to 29,999 programmed divider. Phase-lock oscillator on the CPF SN07 is brought about by comparison between the output of this divider and a 4 kHz reference frequency.

This latter is obtained from the input 10 MHz signal after division by 2500 ( $10 \times 5 \times 50$ ). Q09 is a TTL - MOS - 15 V adapter.

The programmed divider first uses an ECL SP 8647 circuit which divides by 10 or 11, followed by divider by 2 or 3 SN10, then three dividers by 10 in series, SN13, SN16 and SN18. Division ratio coding is sent to the 74LS85 comparators, SN12, SN15 and SN17, by means of registers SN19 and SN14. These receive signals from the data bus and are addressed by SN21 to which is connected the address bus; validation of this decoder is ensured by bit E.

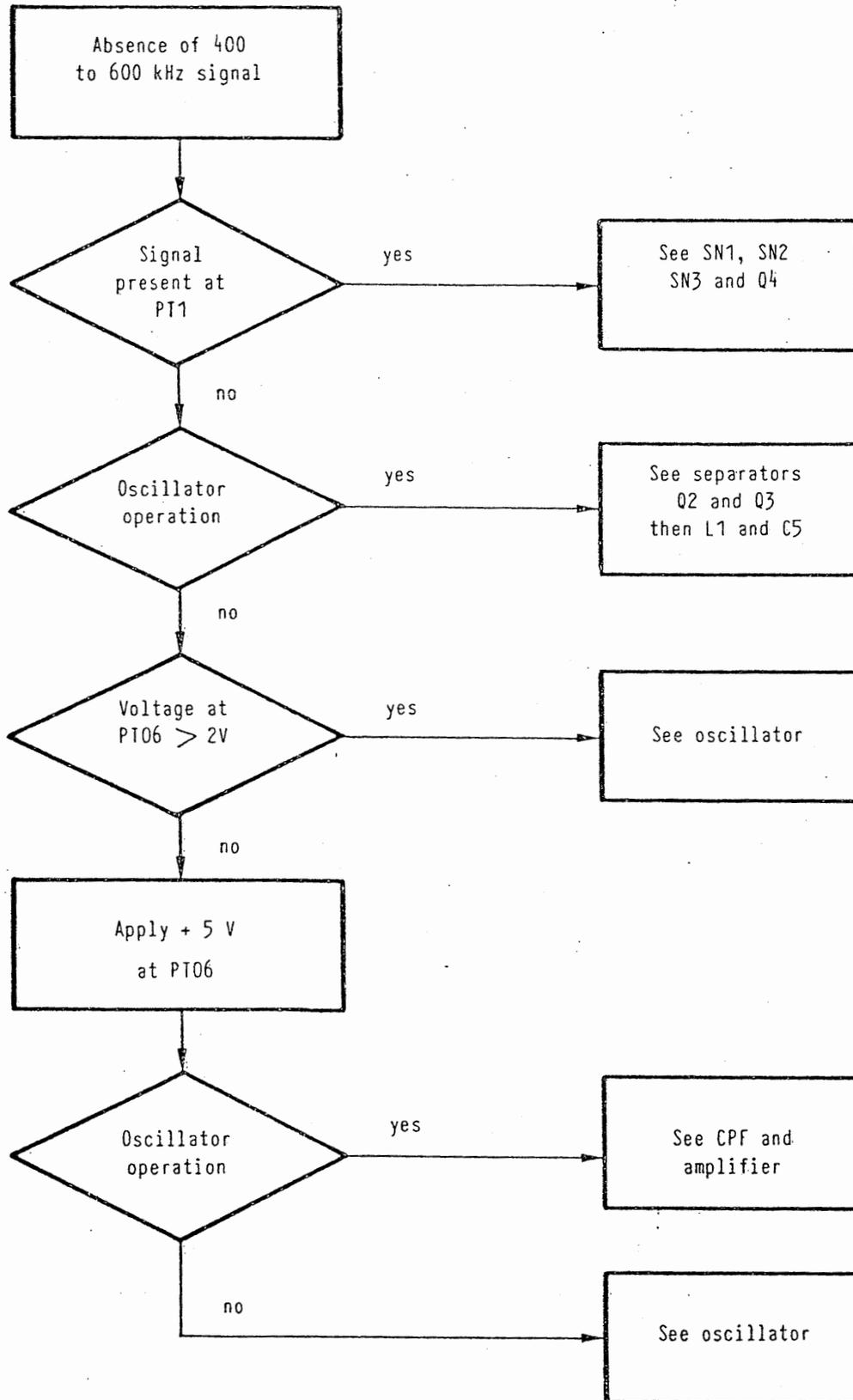
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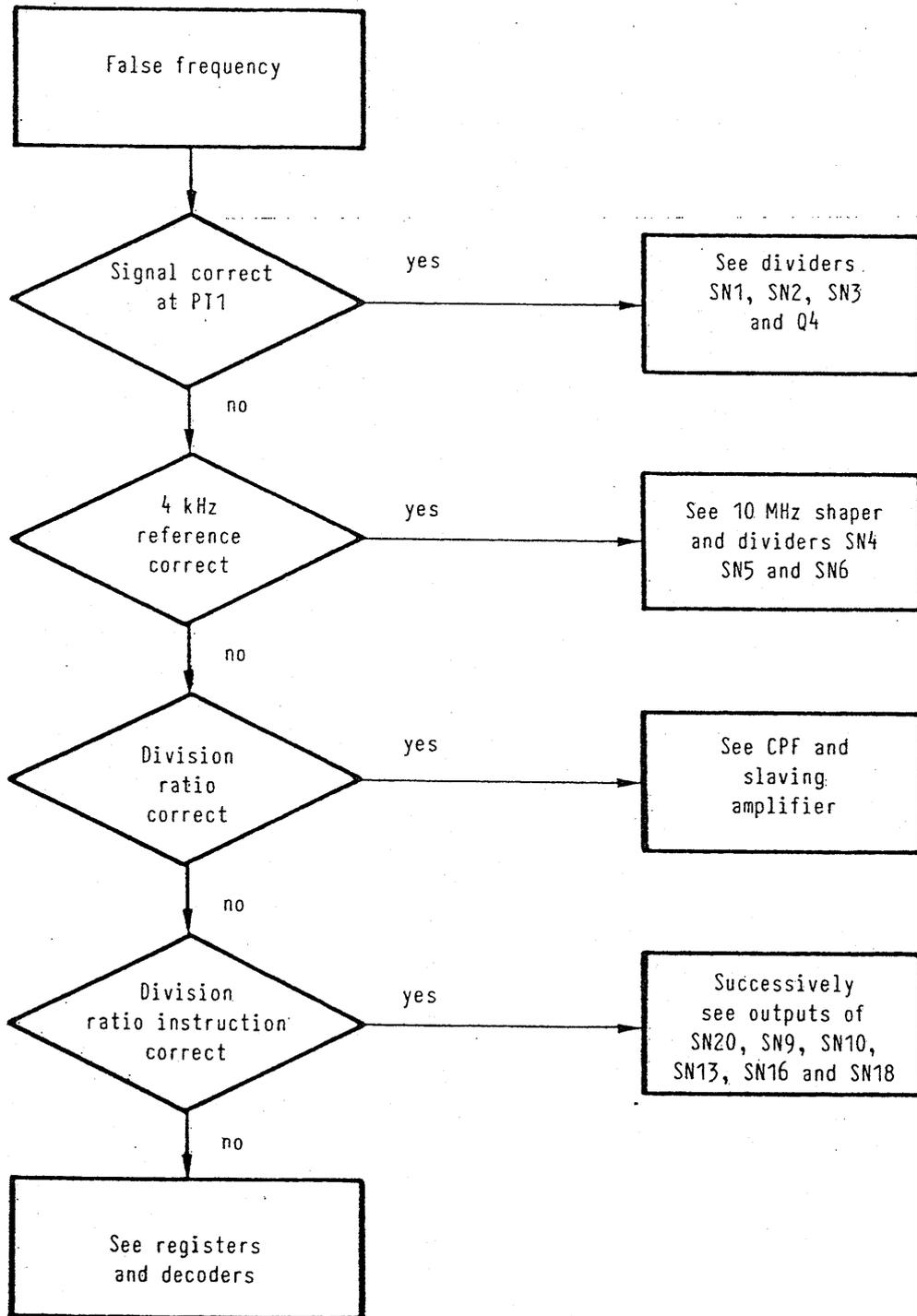
10 000 STEPS BOARD

adret

Flowchart 1



Flowchart 2



## 200 STEPS BOARD

Operation

The "200" Steps board generates increments from 10 kHz to 1.99 MHz, or 199 steps. To this, it adds the increment made on the "10 000" Steps board, or 9.999 kHz maximum. It features two oscillators.

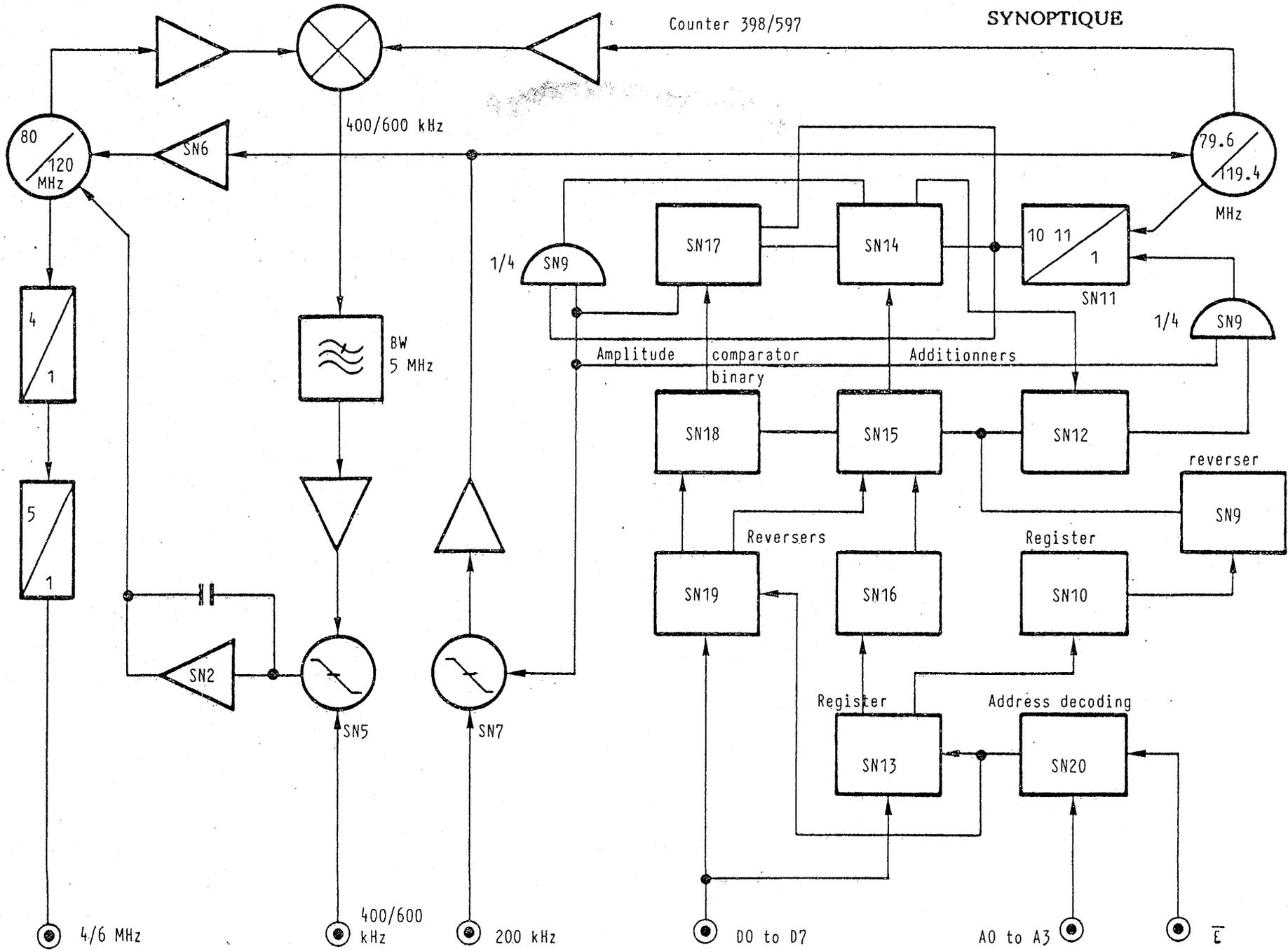
The first oscillator, covering the 79.6 to 119.4 MHz range, has its own independent phase-loop. Its frequency, after division by 398 to 597 in a programmed counter, is compared to a 200 kHz reference in CPF SN7. The downstream current block delivers the oscillator phase-locking voltage, which is also used for approach of the 80 to 120 MHz oscillator by means of follower amplifier SN6.

The second, 80 to 120 MHz oscillator represents the sum of the 400 to 600 kHz frequency output from the "10 000" Steps board and the 79.6 to 119.4 MHz oscillator. The difference in frequency between the two oscillators, made in the diodes mixer, is compared in CPF SN5 to the 400 to 600 kHz frequency output from the "10 000" Steps board. The CPF output locks the 80 to 120 MHz oscillator across integrator amplifier SN2.

Circuit SN20 is an address decoder. It changes the data in register SN13, which represent the instruction of the programmed divider.

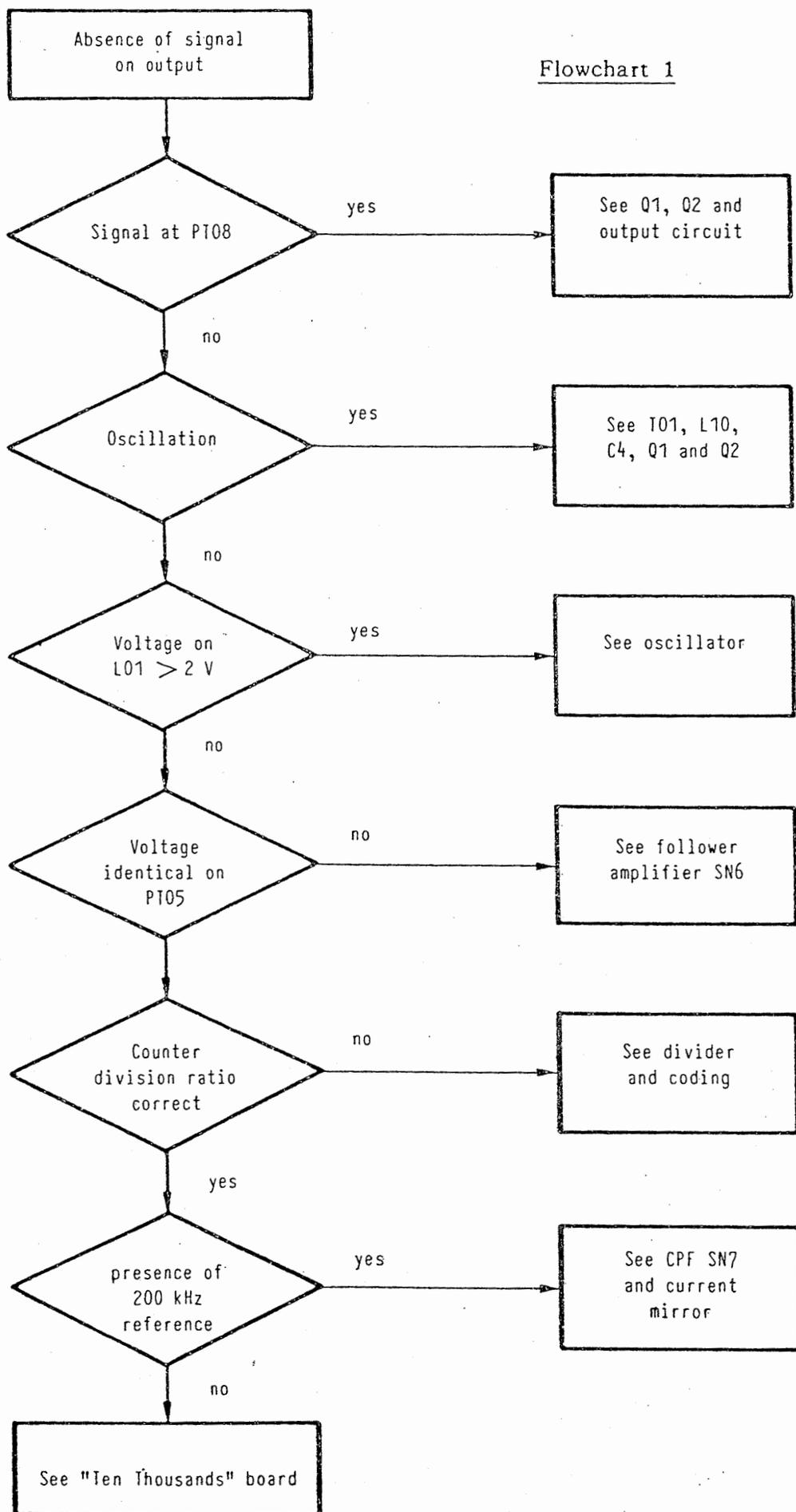
SYNOPTIQUE

Counter 398/597

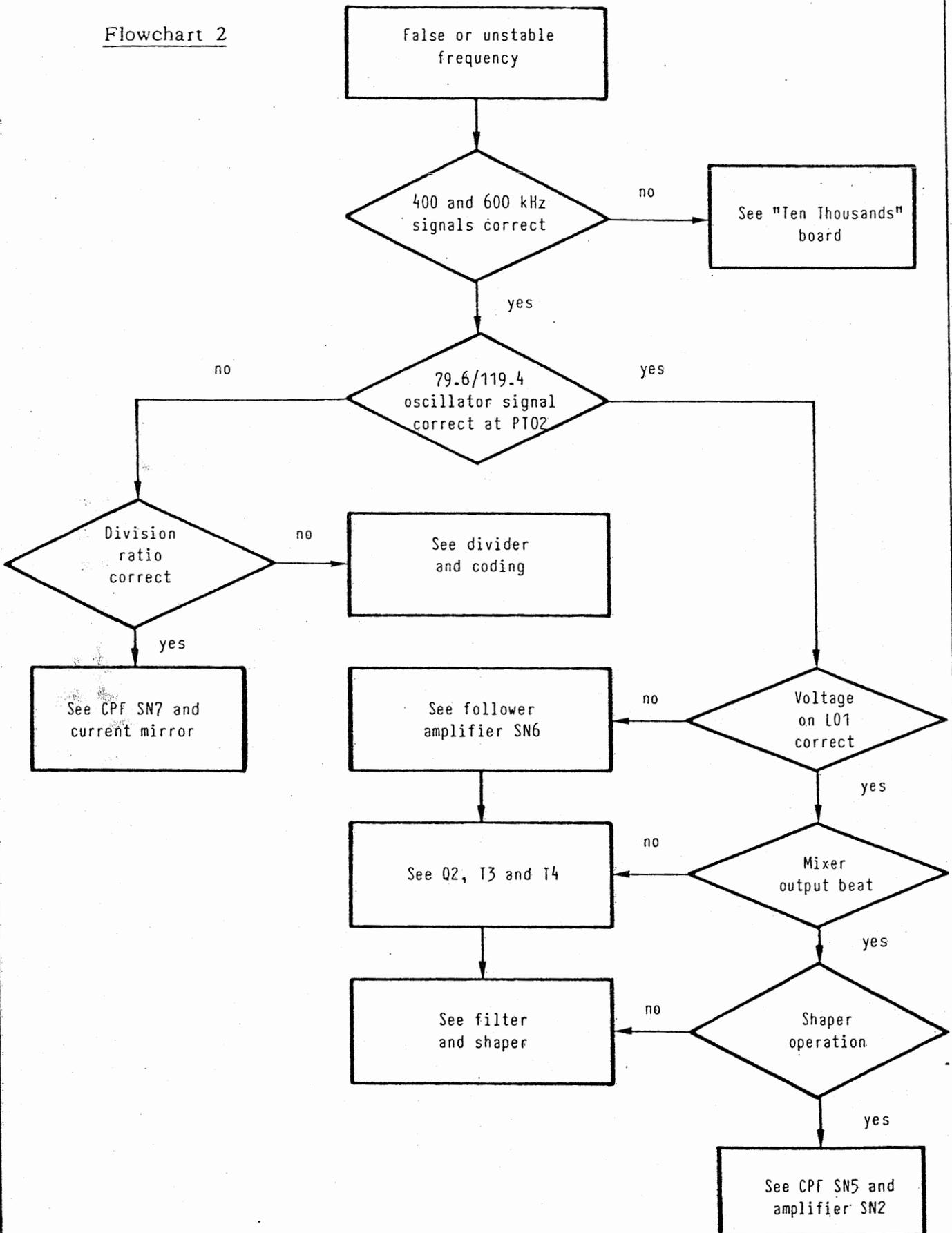


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Flowchart 1



Flowchart 2



## PHASE-LOCK OSCILLATOR

The Phase-lock oscillator board performs the following :

- \* approach of the 396/574 MHz oscillator, and
- \* approach of the final 400 to 500 MHz oscillator, as well as frequency tracking of both oscillators.

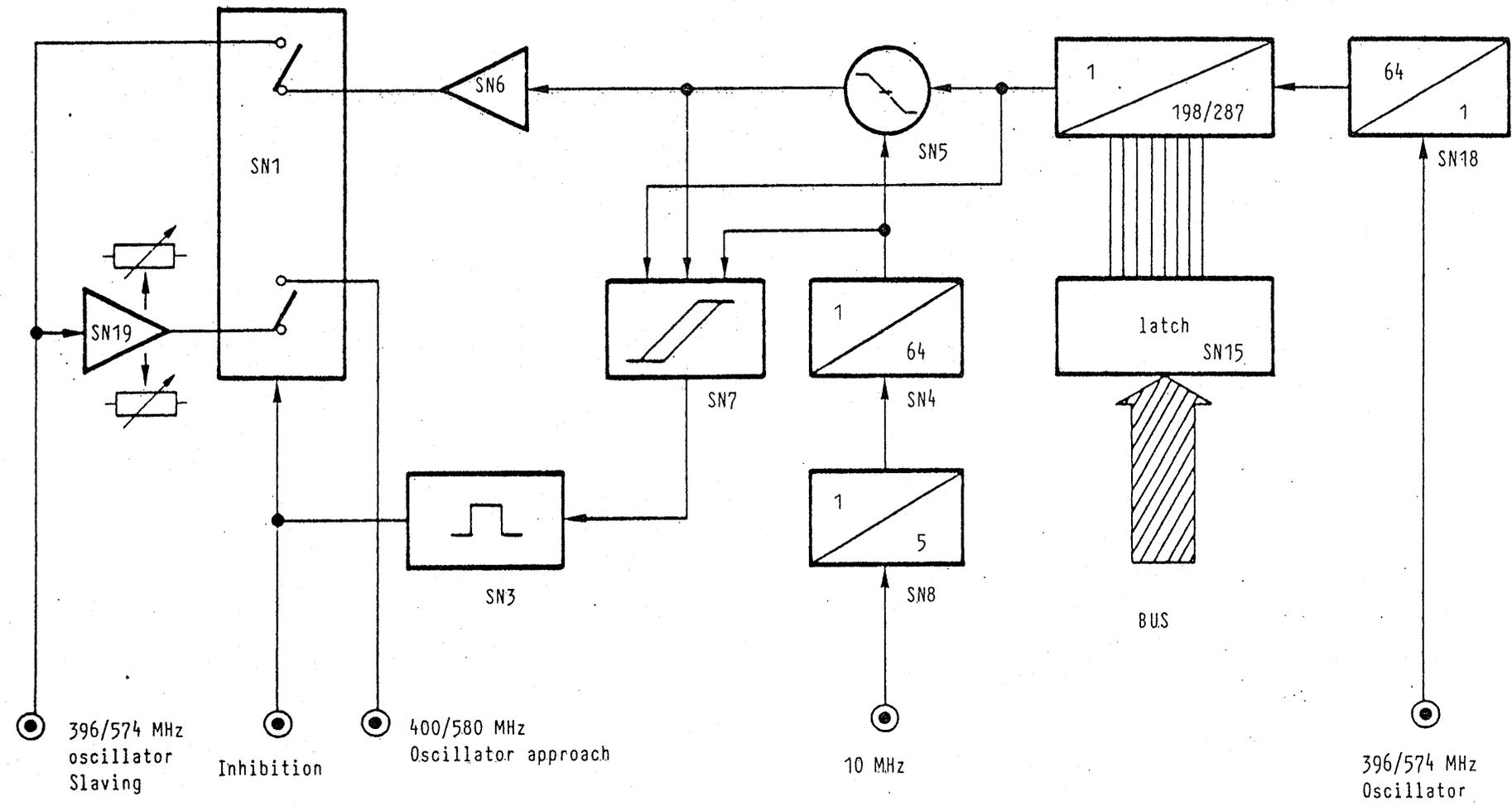
A frequency comparison device is activated with each frequency change made on the front panel keyboard and prepositions the 396/574 MHz and 400 to 580 MHz oscillators on their new value. This device operates only in a transient manner (approximately 2 ms).

The frequency output by the 396/574 MHz oscillator is divided by 64 in SN18 and by 198 to 297 in the programmed divider controlled by SN15. The frequency is 31.25 kHz at output and is compared in comparator SN5 to the reference frequency obtained after division by 320 in dividers SN8 and SN4. The comparator operates constantly but coincidence circuit SN7 triggers monostable SN3 with each new counter data bit ; for approximately 2 ms, this monostable closes switch SN1. This switch validates the approach of the 396/574 MHz oscillator and the 400/580 MHz oscillator.

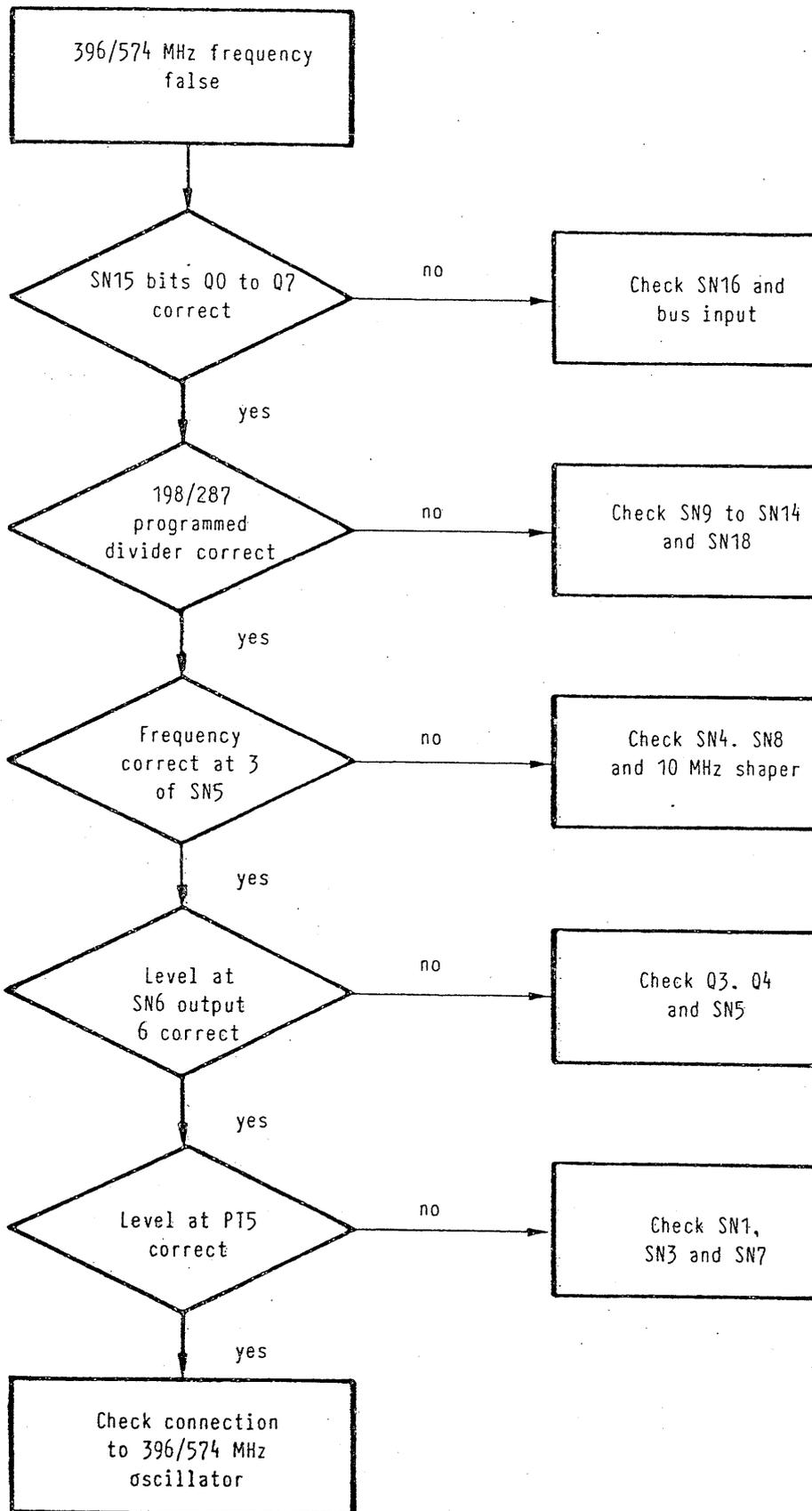
In order to result in correct tracking between the two oscillators, an amplifier with adjustable shift, SN19, is inserted into the output to the 400/580 MHz approach ; adjustments are made at 1 and 179 MHz.

SYNOPTIQUE

0274770000-2



Flowchart



## 2 MHz STEPS BOARD

The 2 MHz Steps board performs the following :

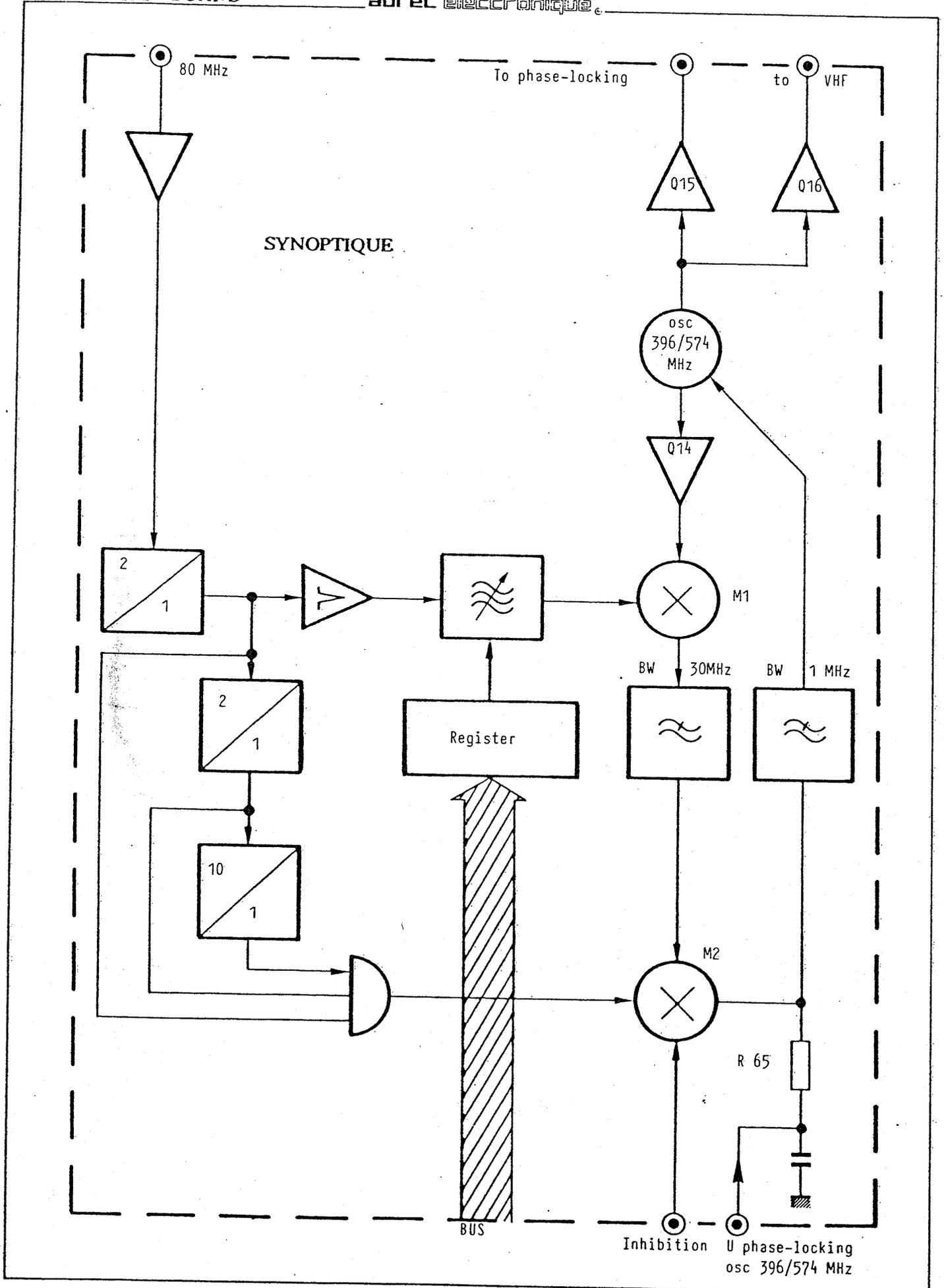
- \* generation of 90 steps of 2 MHz between 396 MHz and 574 MHz, and
- \* positioning of the final 400 to 580 MHz oscillator on a multiple of 2 MHz, selected in function of frequency coding.

A frequency comparison device continuously checks the equality between the frequency displayed and the frequency of the 396 to 574 MHz oscillator. This device is made up of a double sampler.

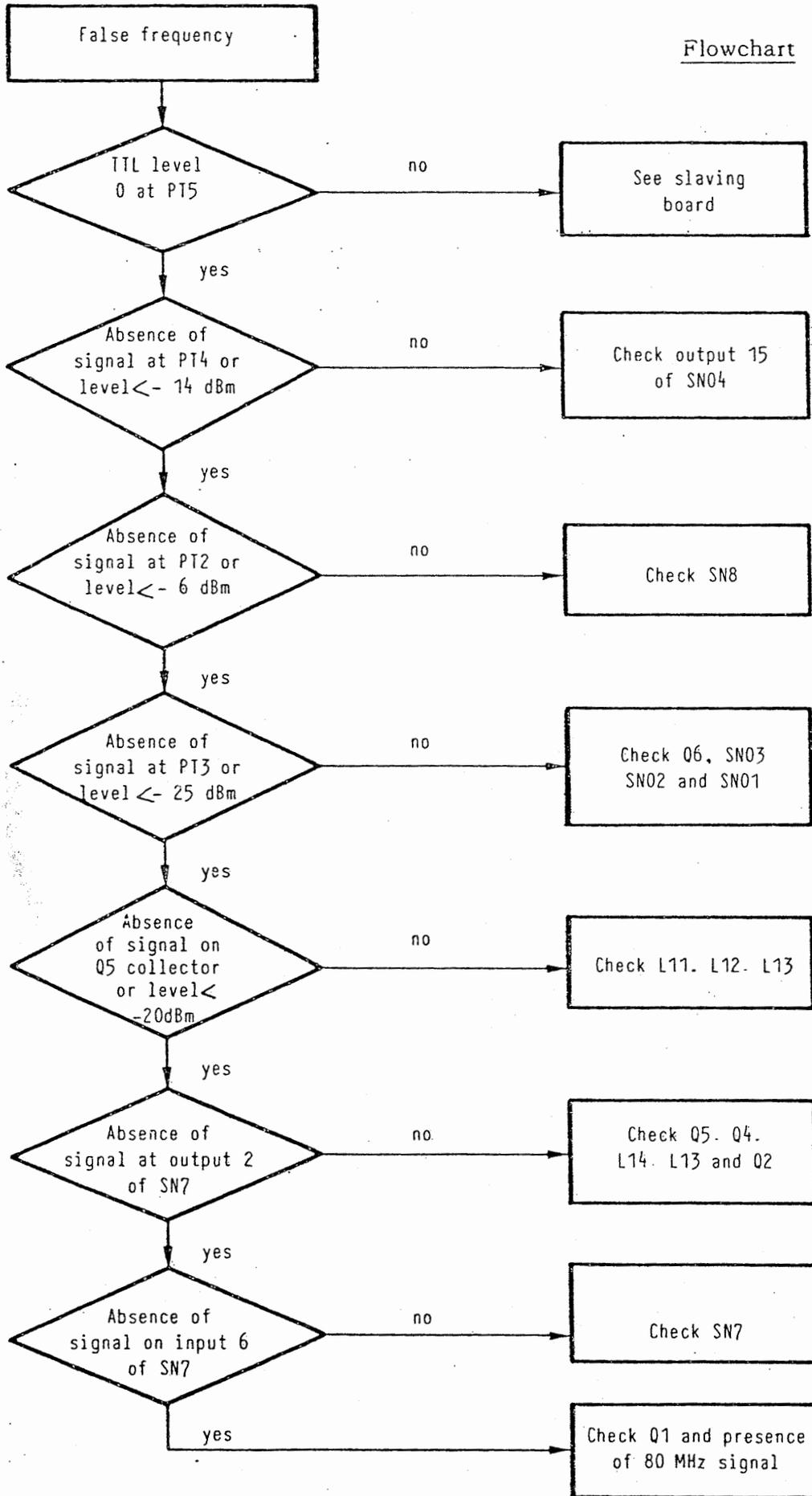
For the first sampler a comb of five discreet frequencies (400, 440, 480, 520 and 560 MHz) is generated from an 80 MHz reference signal. These five frequencies are automatically selected by a register in function of output frequency coding and are mixed in M1 with the frequency from the 396 to 574 MHz oscillator in order to always result in an output multiple of 2 MHz for this latter (which may range up to 10 times 2 MHz).

The frequency thus generated is then compared in a second sampler, M2, to a 2 MHz pulse obtained by dividing the 80 MHz reference signal by 40. A DC voltage is generated on the output of this sampler ; this voltage is proportional to the phase difference between these two frequencies, enabling finely tuned phase-locking of the 396 to 574 MHz oscillator. If a new code change occurs, this voltage is temporarily blocked for 2 ms and a phase-locking voltage output by the phase-lock oscillator board prepositions the oscillator via R65.

At the end of this period, this voltage is blocked and the "fine" phase-loop is switched in. The frequency is delivered to the outside of the board by two separator stages, Q15 and Q16, in order to drive the phase-lock oscillator board and the VHF Module, and to the outside via Q14 to drive modulator M1.



Flowchart



## MODULATIONS BOARD

This board generates the modulation functions used in the 730.

In FM and  $\phi$ M modes, an 80 MHz oscillator slaved with a low bandwidth is substituted for the 80 MHz master oscillator. FM and  $\phi$ M modulation is carried out on this oscillator. Operation of the 80 MHz oscillator is enabled by bits  $\overline{FM}$ ,  $\overline{FM}/10$  and  $\overline{\phi M}$ , which additionally ensure inhibition of 80 MHz master oscillator amplifier A1.

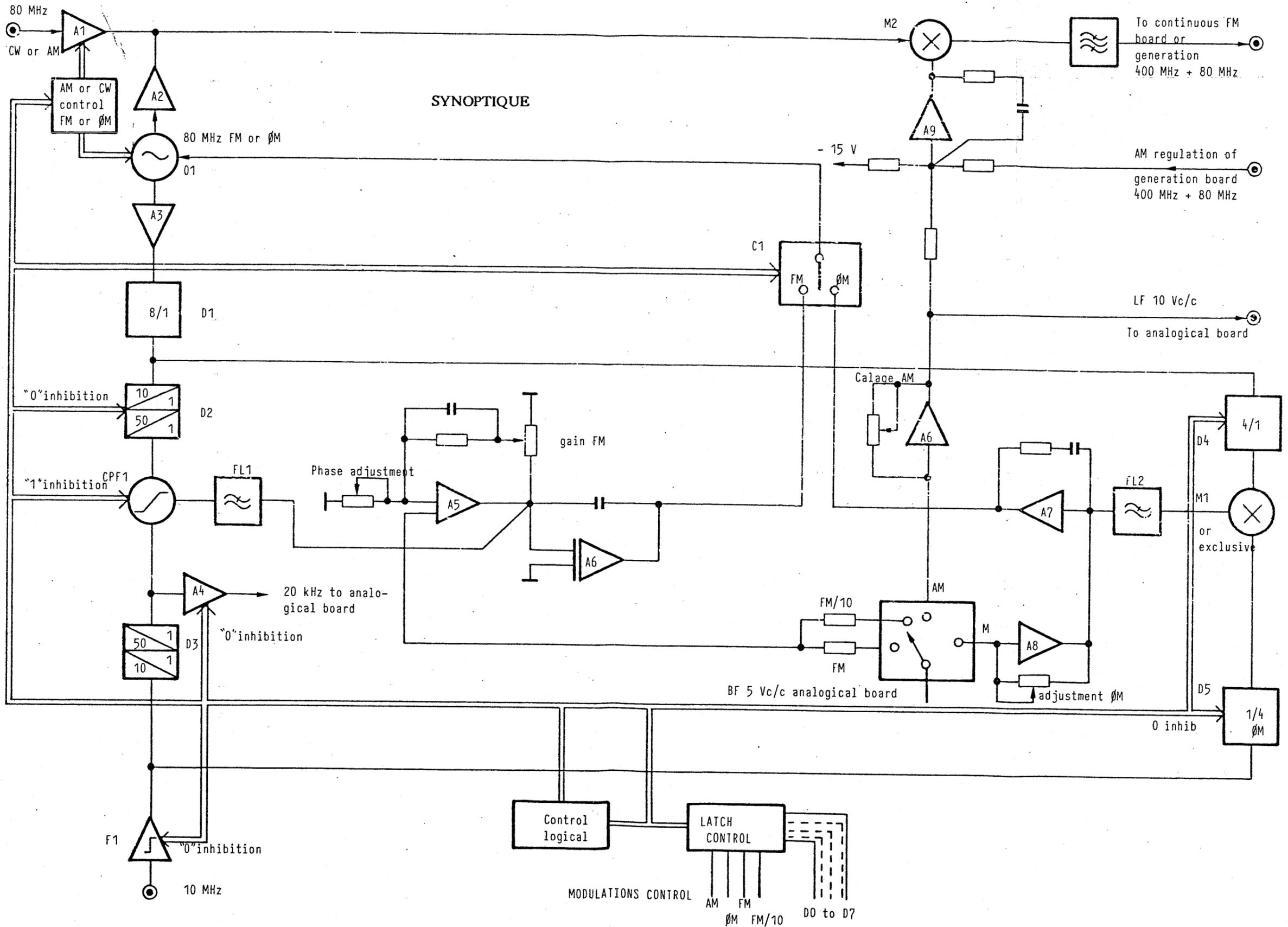
In FM mode, the 80 MHz frequency is divided by 8 in D1 (SN11) and then by 500 in D2 (SN12 and SN13) in order to be compared to the 20 kHz reference signal resulting from division of the 10 MHz master oscillator frequency by 500 in D3 (SN4 and SN6). There is a DC voltage proportional to the variation in 80 MHz oscillator frequency on the output of CPF1 (SN14 and SN15) and FL1 (1/2 SN10). Amplifier A5 (1/2 SN10) incorporates the audio-frequency signal in the slaving loop and, additionally, enables regulation of gain and sets the phase to 40 Hz. Current amplifier A6 slaves the oscillator via switch C1 (SN8), whose control is linked to the control of CPF1.

In  $\phi$ M mode, the 80 MHz frequency is divided by 8 in D1 and by 4 in D4 (SN1) in order to be compared to the 2.5 MHz reference signal resulting from division of the 10 MHz master oscillator frequency by 4 (SN3). There is a DC voltage proportional to the variation in 80 MHz oscillator phase on the output of M1 and FL2. Amplifier A8 (SN5) incorporates the audio-frequency signal into the slaving loop and, additionally, enables regulation of  $\phi$ M gain. Semi-integrator amplifier A7 enables oscillator slaving via switch C1.

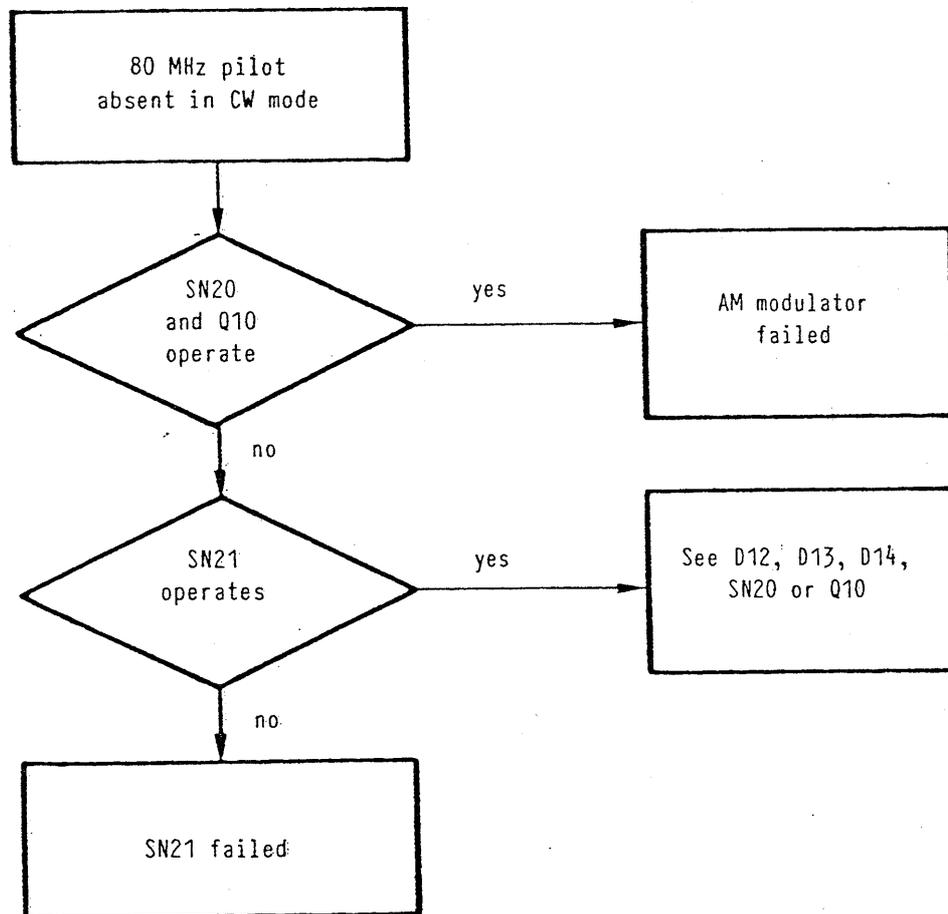
In AM mode, dividers D2, D4 and D5 are blocked, as well as CPF1 and O1. Mode switch CM1 (SN16 and SN17) switches the audio-frequency signal to amplifier A6 (1/2 SN19) which ensures regulation of AM gain. Downstream from this amplifier a comparison circuit continuously compares the audio-frequency signal with a reference voltage and the audio-frequency signal output from a detector located on the "400 MHz + 80 MHz" board. The result of this comparison modulates the transmitter current of modulator M2 by means of semi-integrator amplifier A9. There is an 80 MHz frequency, which is amplitude-modulated to the rhythm of the audio-frequency signal, available on the output of M2.

A control circuit (SN24 and SN21), which receives this data by a bus from the CPU, ensures all of the various board functions and inhibitions in combination with the control logic from SN22 and SN23.

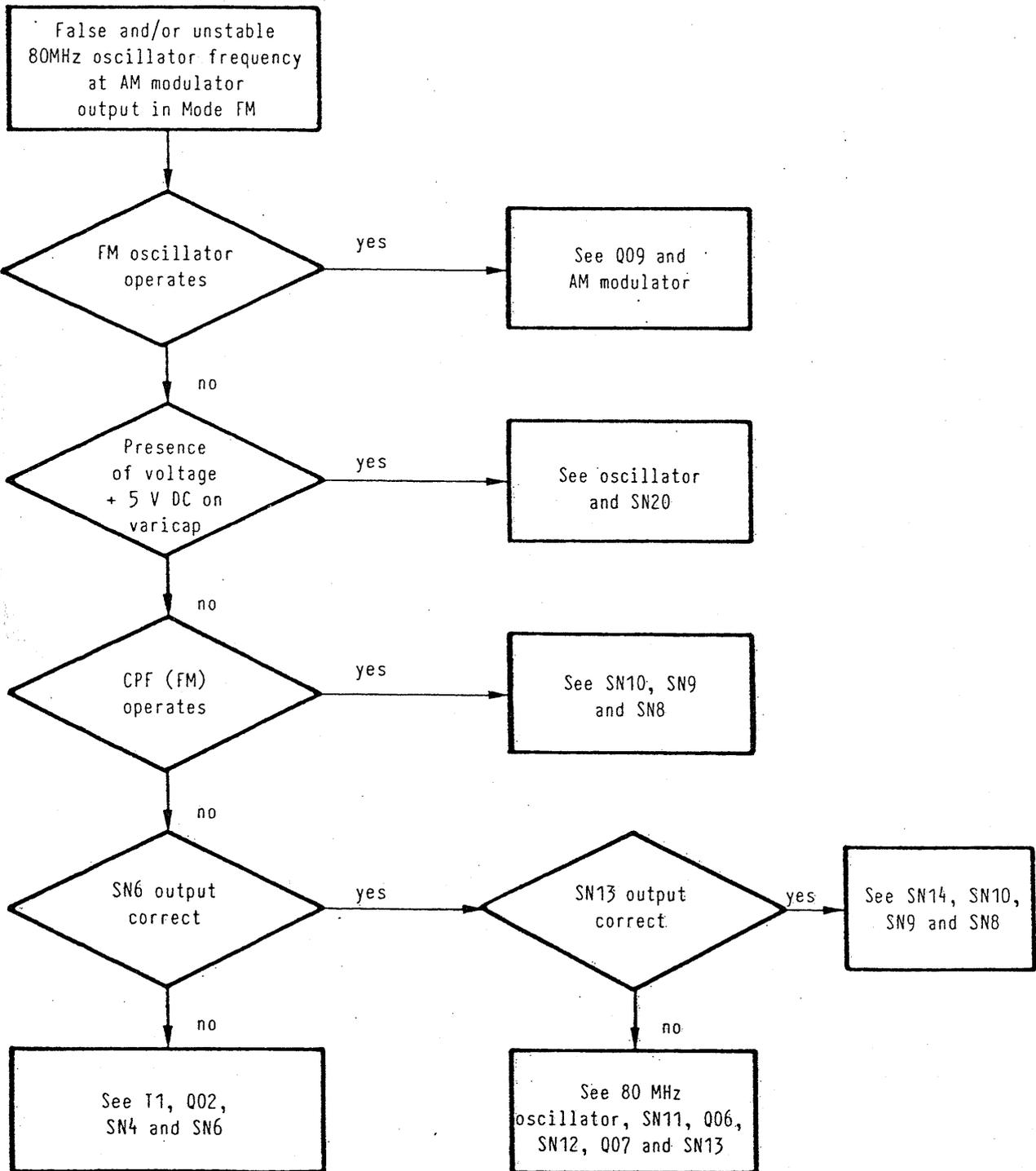
Finally, in CW mode, all modulation functions are blocked. The 80 MHz master oscillator signal transits only by amplifier A1 and modulator M2. The modulation current from this latter is fixed at a mean value of that existing to have 100% AM. In addition, input of the 10 MHz reference signal is blocked in F1, which cancels out the 20 kHz frequency necessary to the internal audio-frequency signal. This frequency is thus blocked in external audio-frequency operation.



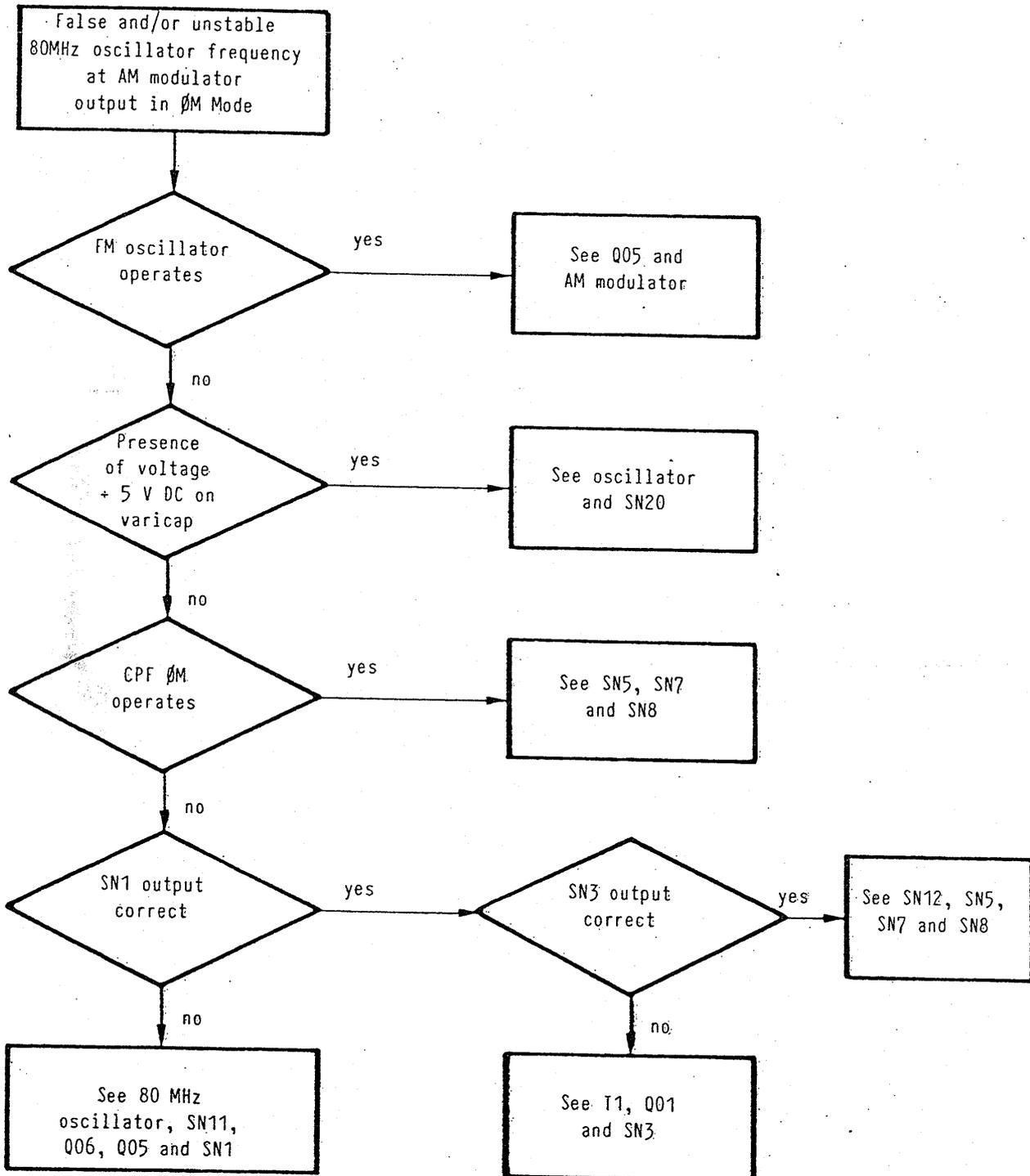
CW Mode



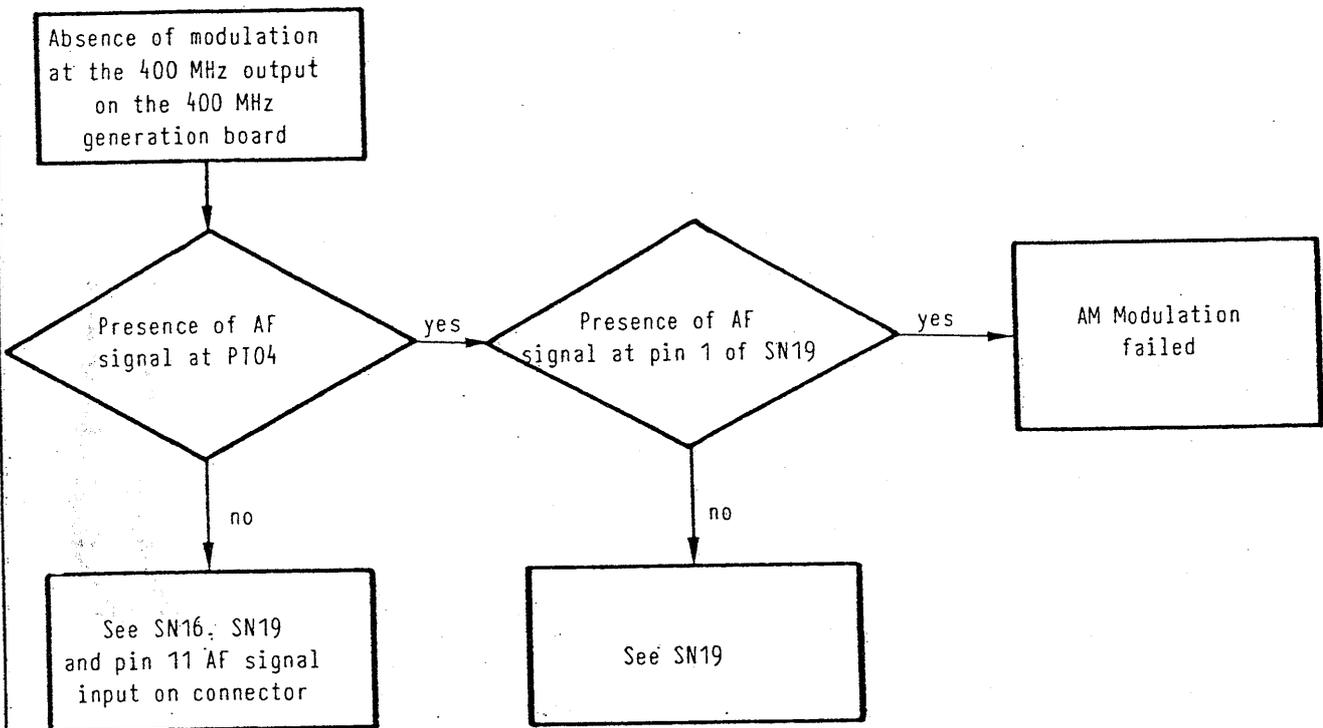
FM Mode



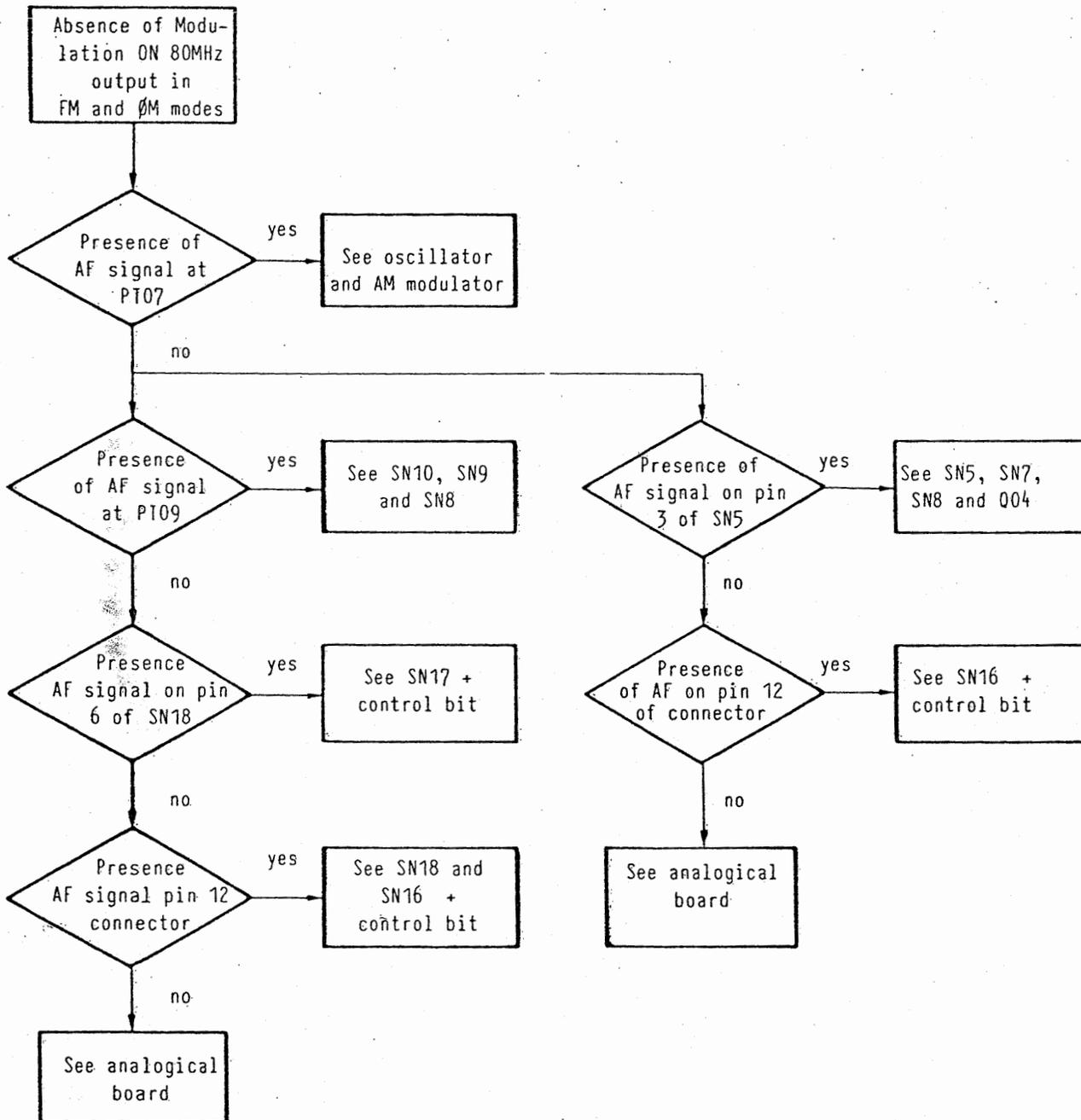
ØM Mode



AM Mode



Step from LF  
in FM and ØM Mode



## ANALOG BOARD

The analog board performs three independent functions :

- \* control of the output damper,
- \* control of analog damping,
- \* generation of two internal audio-frequency signals and control of modulation rates.

The output damper is controlled as described in this paragraph. A command from the CPU board is transferred by a bus to register SN3 which delivers a logic state of "1" on its output when the relays corresponding to the desired damping level are to be excited. This "1" logic state blocks the first PNP transistor, resulting in saturation of the second PNP transistor, and applies approximately - 14 V to the coil of the corresponding relay. Control is obtained in such a way that damping is freed when the relay is excited in order to always have maximum damping if no control is present.

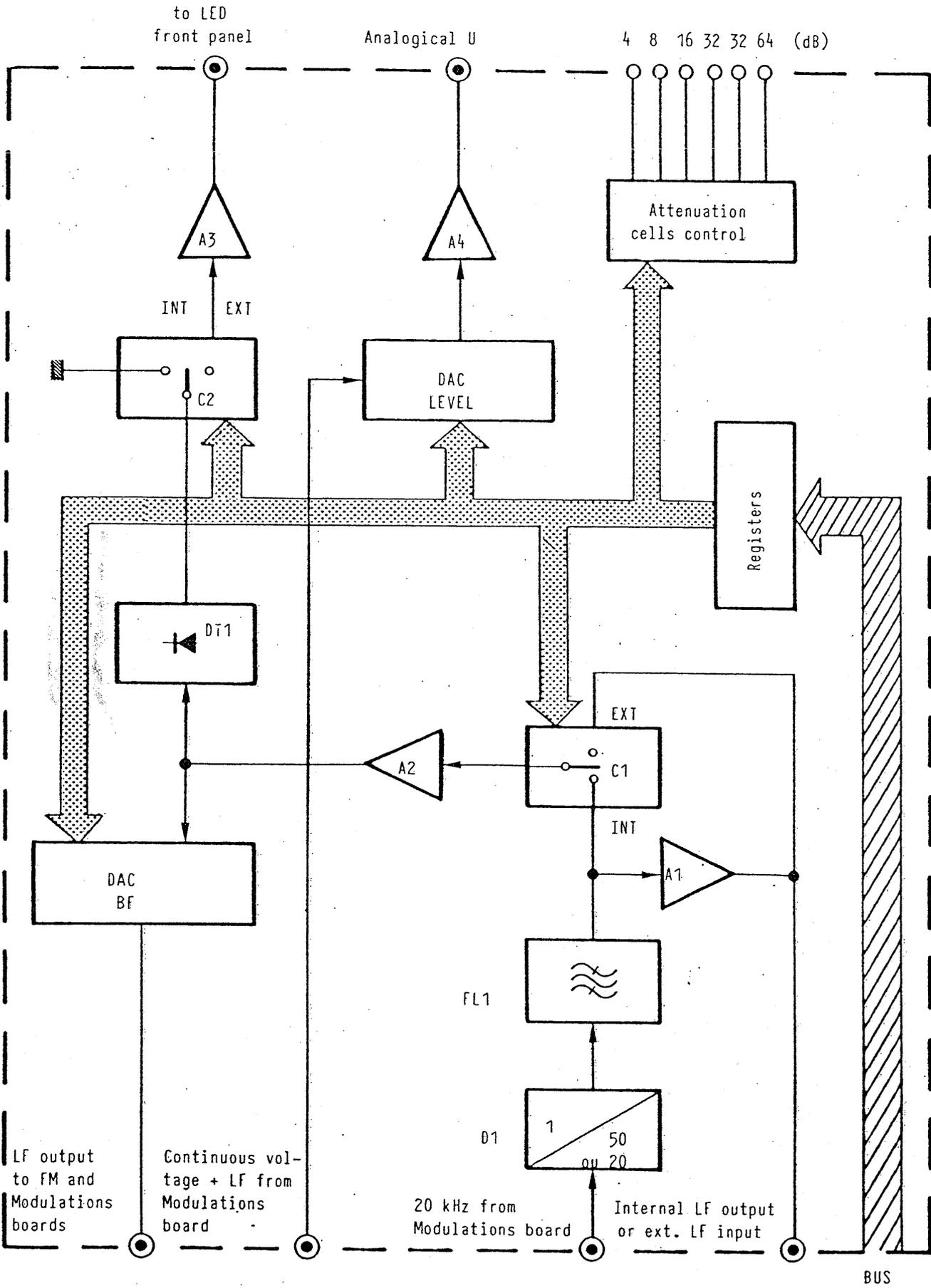
Analog damping is controlled as described in this paragraph. A command from the CPU board is transferred by a bus to a DAC Log  $2^{\frac{1}{2}}$  Digits, SN4, which features on its output a DC voltage proportional to the input coding ; this DC voltage also has a superimposed audio-frequency signal in the case of AM modulation. Analog variation extends over a dynamic of 14 dB for an output signal of between + 19.9 dBm and + 6.1 dBm. Following, the analog dynamic is not greater than 4 dB and ranges from 6.1 dB to + 10 dB, with the remainder effected by the output damper.

The two internal audio-frequency signals are generated as follows :

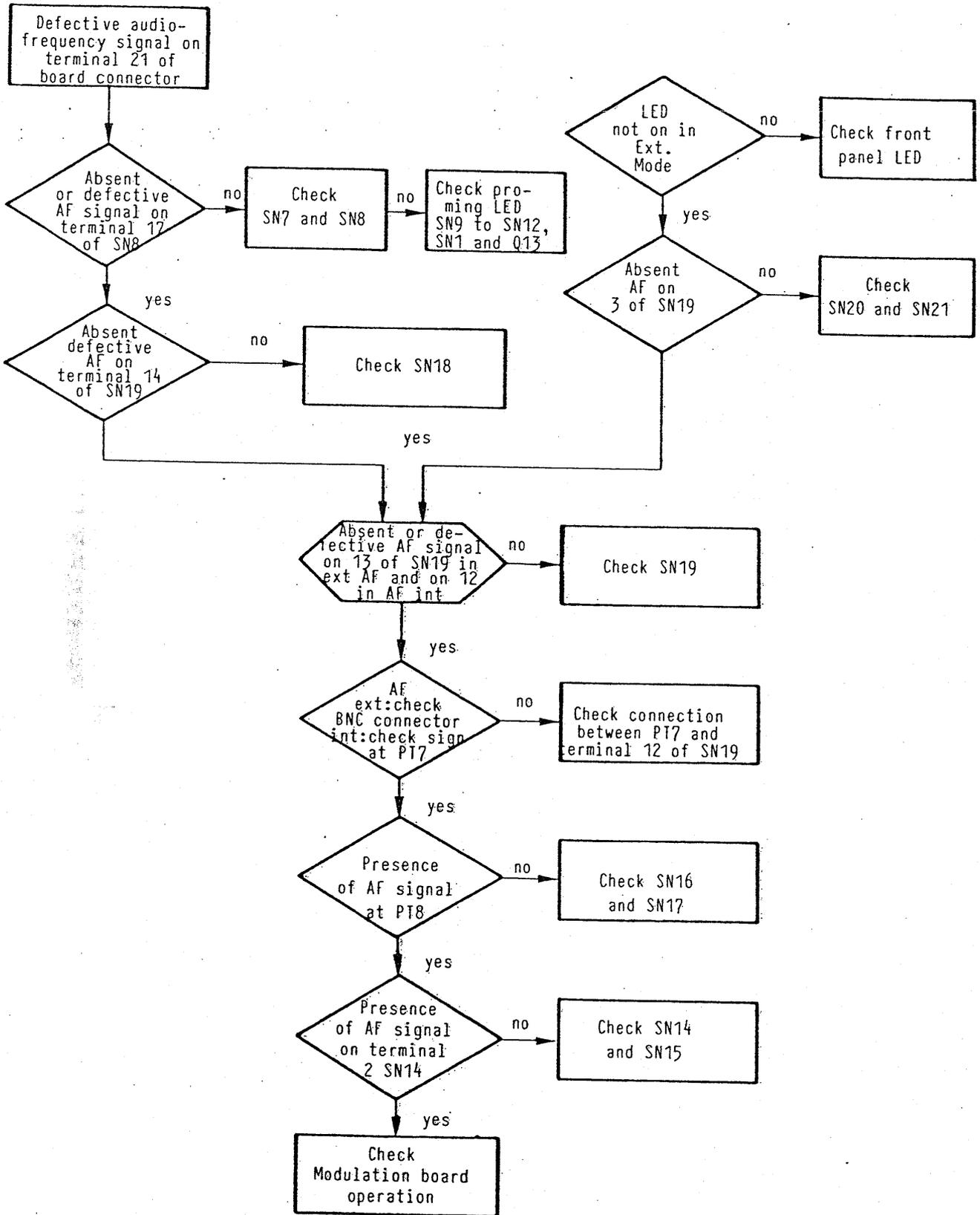
- \* A 20 kHz audio-frequency signal with TTL level output by the Modulations board is divided either by 20 or 50 by D1 to result in an output frequency of 1 kHz or 400 Hz. This frequency is then filtered by active filter FL1.
- \* During internal operation the audio-frequency signal thus generated is output via A1 over the BNC connector and by means of switch C1, and is sent to amplifier A2 which switches it through detector D1 and over the audio-frequency DAC. Upon output from the DAC the level of the audio-frequency signal is a function of programming of the rate or of the deviation in the various modulation modes.

In external audio-frequency operation, divider D1 and filter FL1 are blocked. The audio-frequency signal is injected on the BNC and is input directly to C1 either in a capacitive link, or in a direct link according to the mode selected. Next, the signal is processed the same as for internal audio-frequency operation with the following exception : instead of being switched to ground, the signal output from DT1 is sent to amplifier A3 which displays the excess or lack of amplitude in this external audio-frequency signal by means of two LED's located on the P.A.

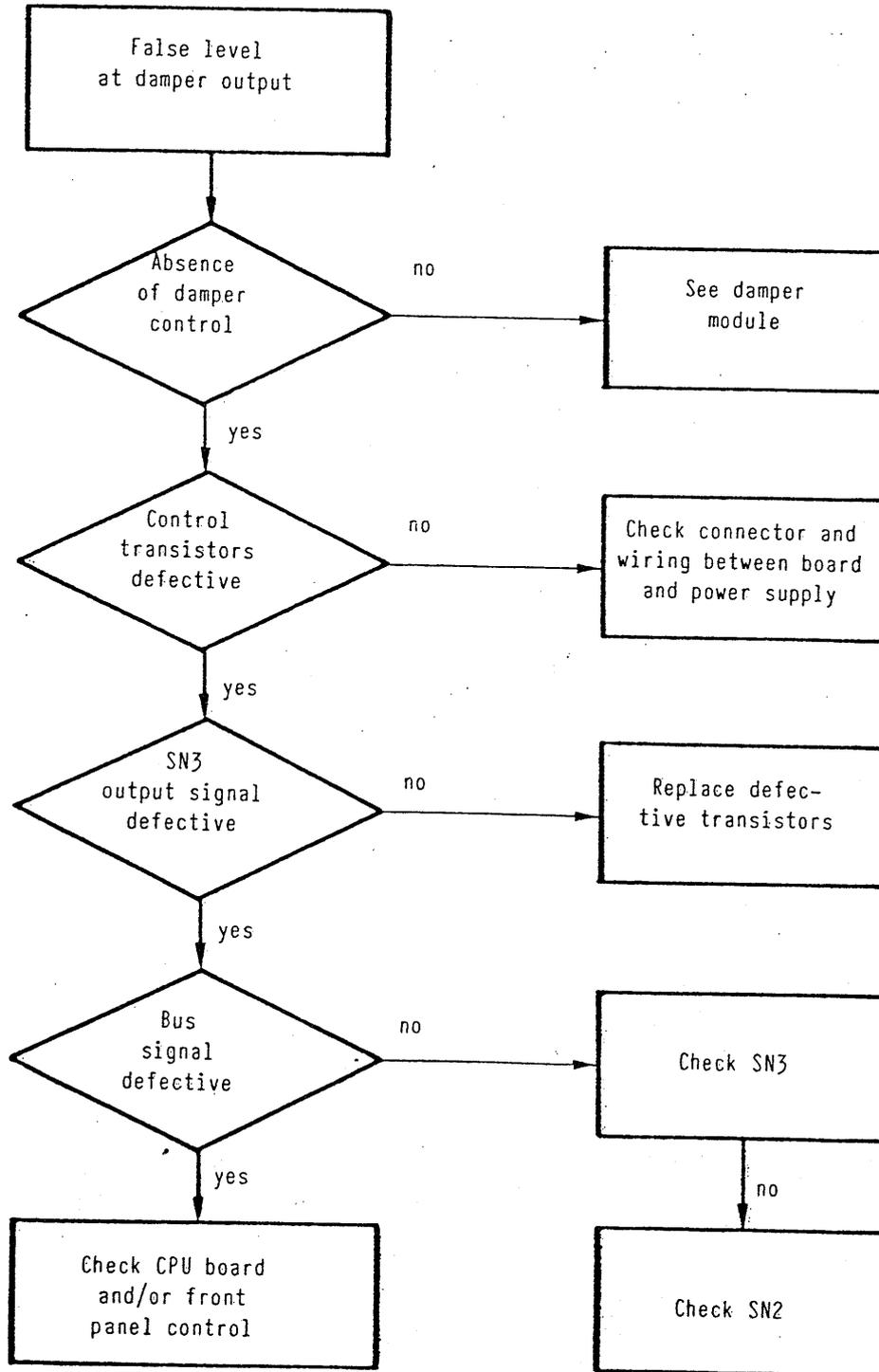
SYNOPTIQUE



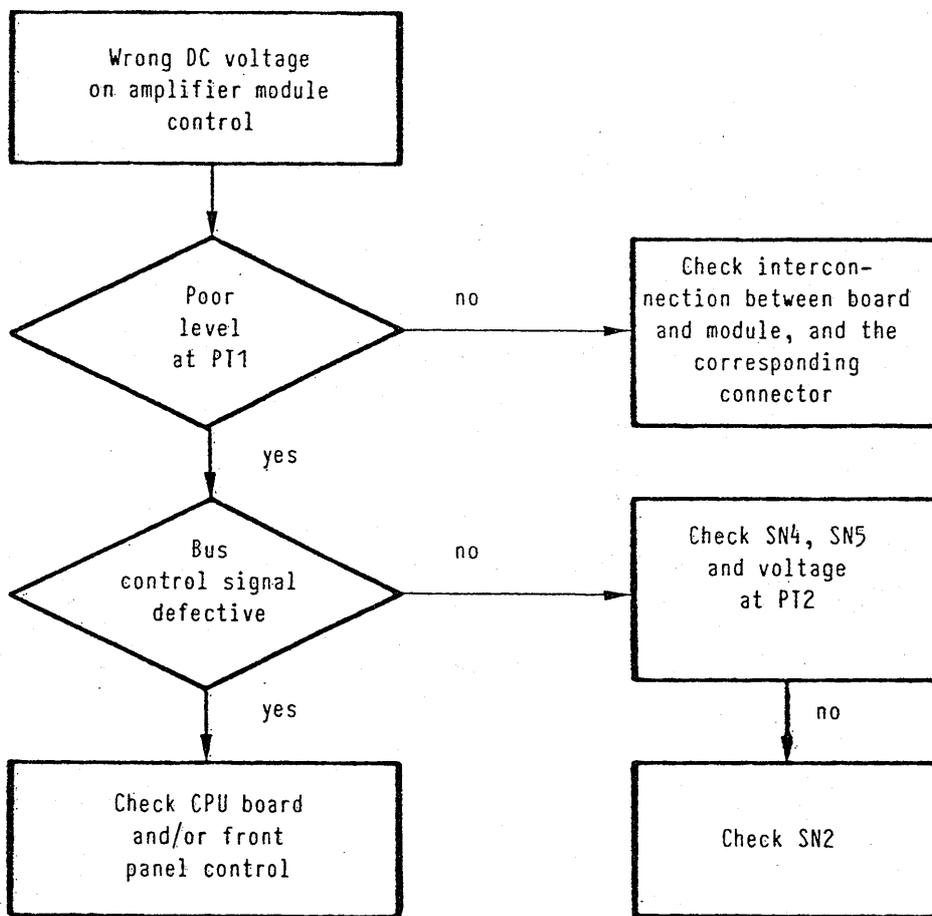
Modulations control flowchart



Flowchart in level operating  
Attenuator control



Flowchart in level operating  
Analogical control



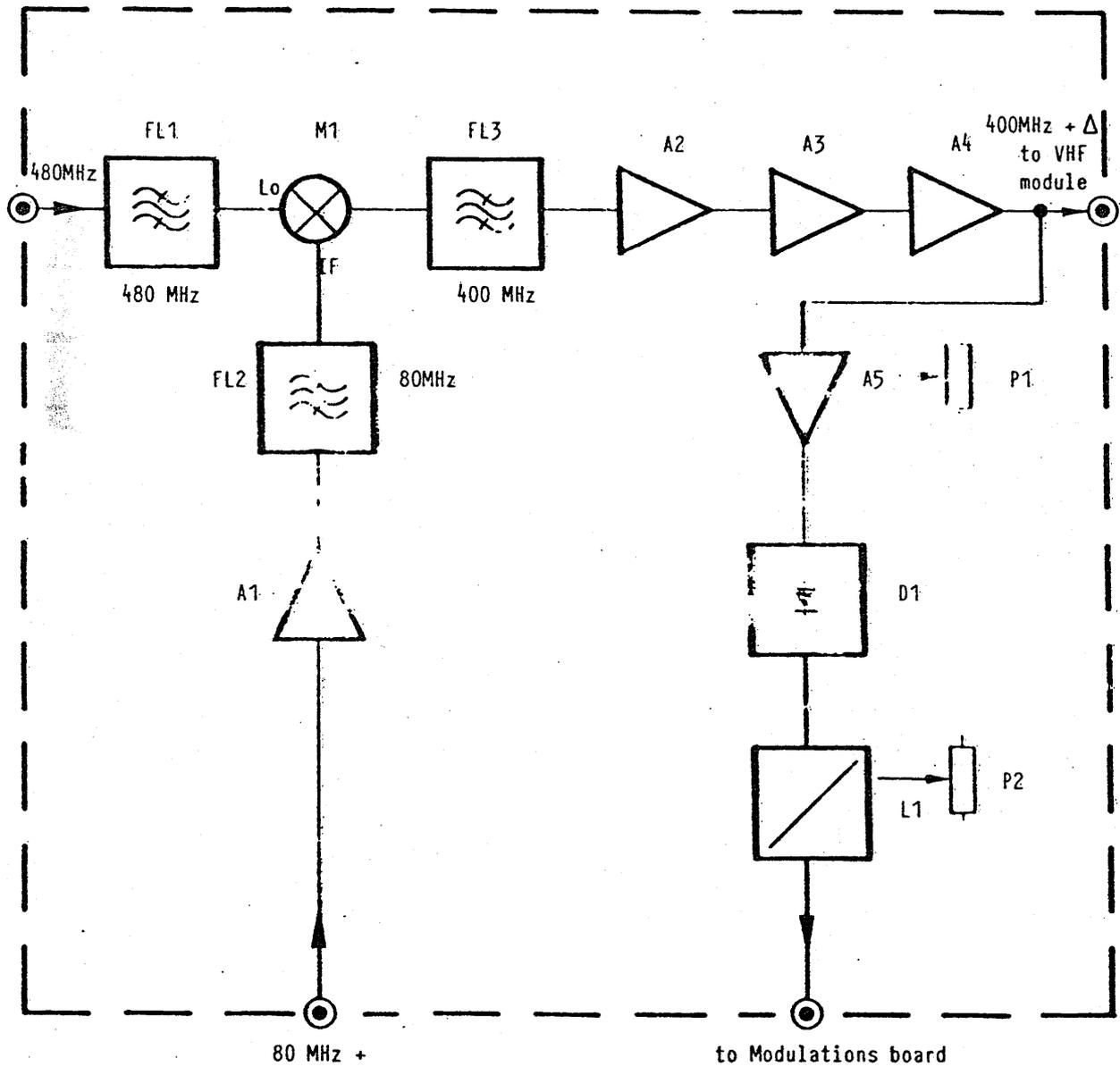
### 400 MHz GENERATION BOARD

This board generates the 400 MHz frequency necessary for heterodyning in the VHF module in order to obtain the output frequency for the 730 and detect and linearize AM modulation.

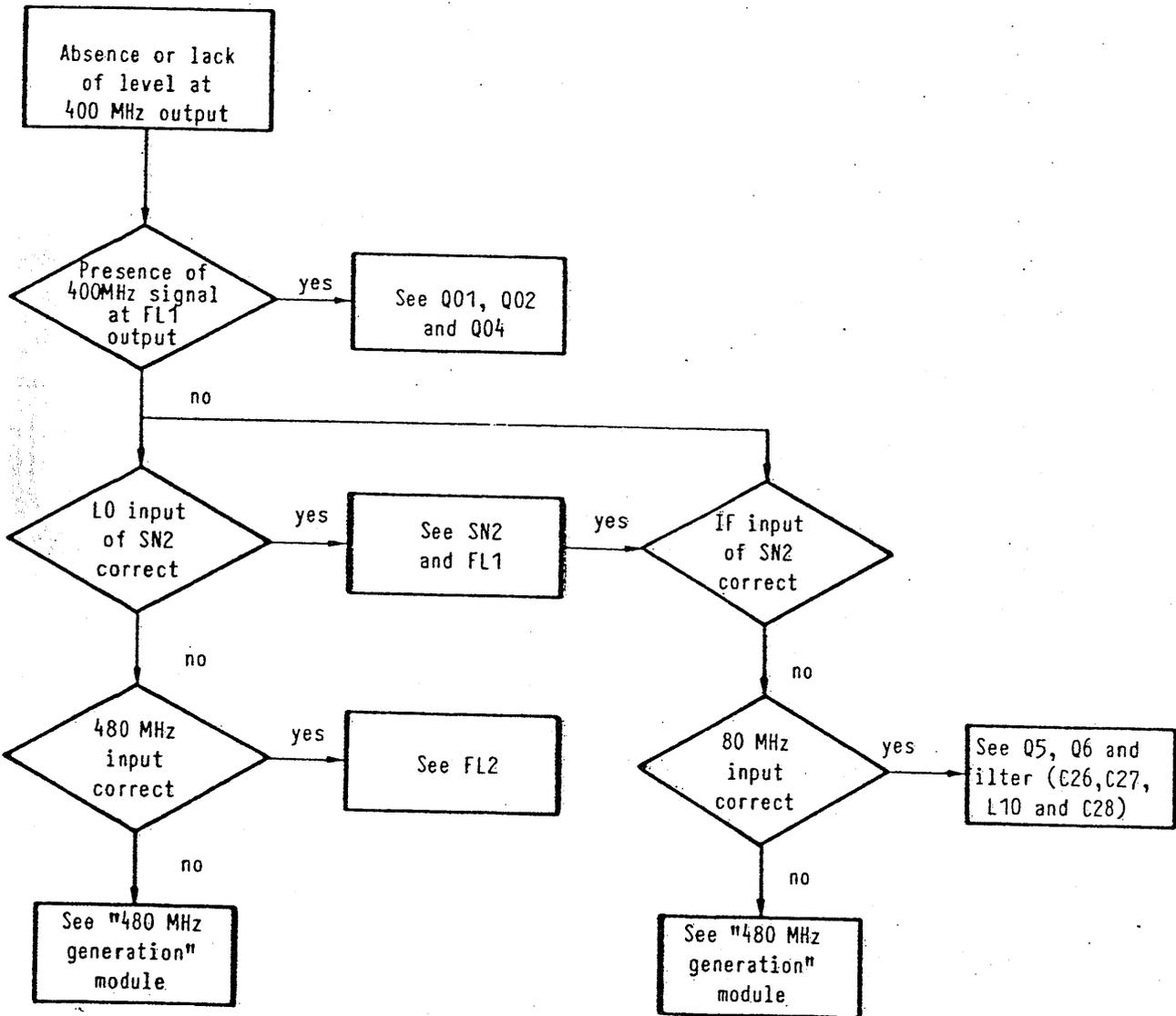
Filter FL1, whose design is the same as that used in the 480 MHz rack, filters the 480 MHz frequency with two additional poles in order that this signal may be applied over the switched M1 channel with a minimum of 400 MHz and 560 MHz components. The 80 MHz frequency is input over the linear channel ; this frequency features two modulations, and is amplified in A1 and filtered by FL2 in order to have a minimum of harmonic distortion on the input of M1.

Mixer M1 works as a subtractor in order to select the 400 MHz frequency. This latter is filtered by FL3 and amplified by amplifiers A2, A3 and A4 ; each amplifier supplies gain of approximately 9 to 10 dB. The output level of the 400 MHz signal is between + 9 and + 12 dBm into 50 ohms. The AM loop which is offset from the 400 MHz output includes an gain amplifier 1 with linearity regulation, a detector and a linearizing circuit featuring adjustment P2 used to reduce the distortion rate for high AM modulation rates. A signal of approximately 0.9 V DC is available on the output of L1 in the absence of AM modulation.

SYNOPTIQUE



Flowchart



## VHF MODULE

This module generates the output frequency of the 730 by heterodyning and controls output level.

It is made up of five sections :

- \* Mixing of small increments and slaving of the 400 to 580 MHz oscillator,
- \* A 400 to 580 MHz oscillator,
- \* Level control and filtering of the 400 MHz heterodyning frequency,
- \* Amplification of the 400 to 580 MHz frequency and an output mixer,
- \* Final amplification and detection.

The 400 to 580 MHz oscillator features design identical to that located on the 2 MHz step board, with frequency coverage from 396 MHz to 574 MHz so that the two oscillators may follow each other with a few MHz maximum of offset, a condition necessary to operation. This oscillator features three outputs represented by three separators, S1, S2 and S3.

Separator S2 switches the frequency towards amplifier A7 which yields a level of approximately + 10 dBm on the linear channel of the switched channel of mixer M1. Separator S3 inputs the 396/574 MHz frequency with a level of approximately 0 dBm.

The M1 output is filtered in FL1, a low-pass filter of approximately 40 MHz. The output frequency of this filter varies from 4 to 6 MHz and is compared in frequency phase comparator CPF1 to the 4 to 6 MHz frequency available on the output of the "Two Hundreds" board and featuring two million steps to Hz resolution.

On the output of A1 there is available a DC voltage proportional to this frequency variable from 4 to 6 MHz, which is selected on the front panel by the first six digits. This voltage "finely" slaves the 400 MHz to 580 MHz oscillator which also receives an approach voltage on the same point enabling it to be prepositioned on the value of the 2 MHz steps also selected on the equipment front panel.

Filter F5 rejects slaving signals exceeding - 70 dB on the output of CPF1. Separator S1 makes available a 400 to 580 MHz frequency on the equipment rear panel.

Separator S3 delivers the frequency to amplifier A2, whose gain is approximately 20 dB, a level necessary to drive the switched channel of heterodyning mixer M2. This mixer receives a fixed frequency of 400 MHz over its linear channel ; this frequency includes the modulations. The level of this fixed frequency is variable within a range of 14 dB, with a maximum of approximately 0 dB for a maximum output level on the 730 of + 19.9 dBm.

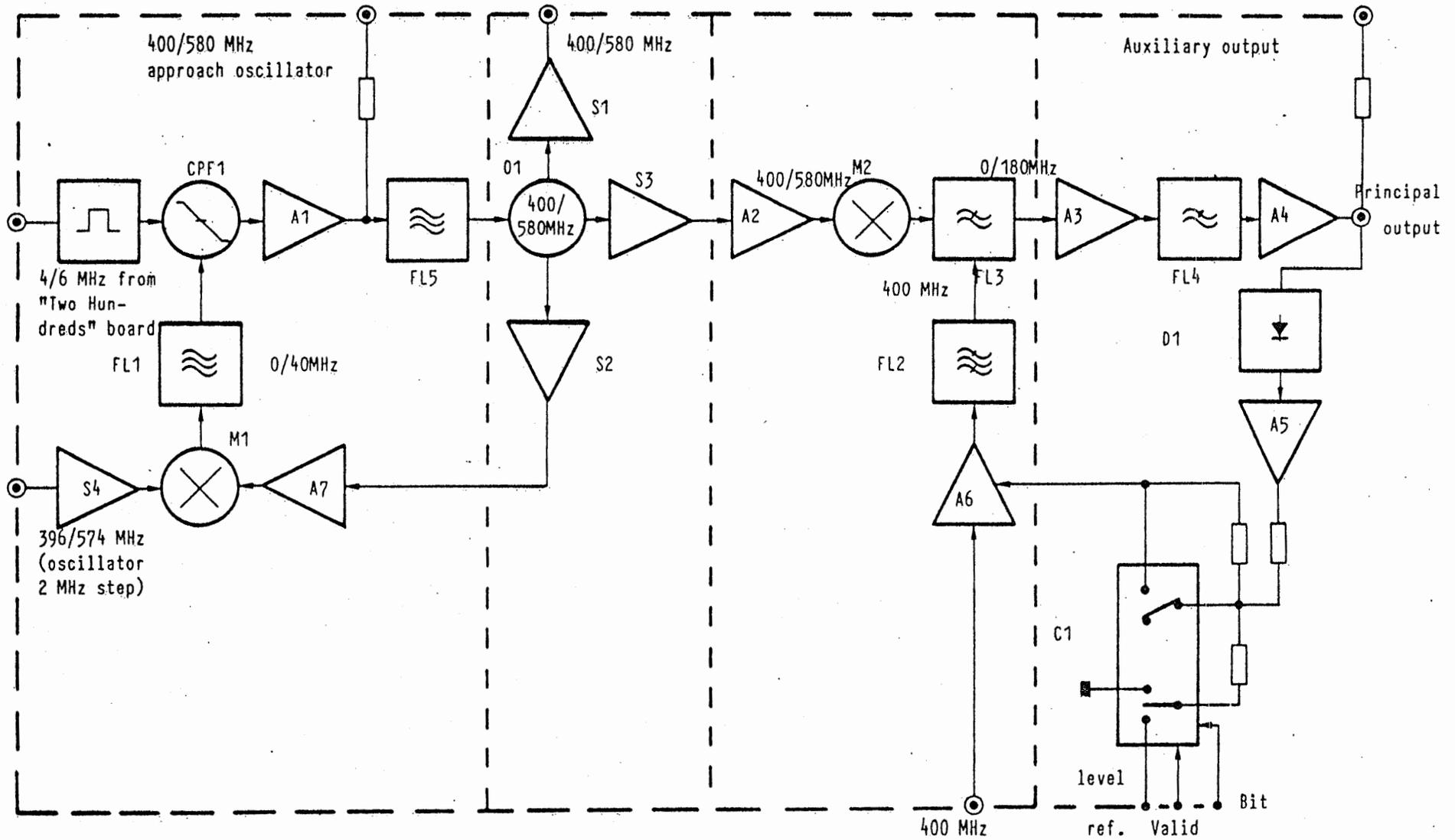
Filter FL2, which is very narrow, rejects frequencies other than the 400 MHz signal beyond - 70 dB.

On the output of M2, filter FL3 makes an initial cutoff of intermodulation outside the band. This filter is followed by preamplifier A3 whose low frequency is less than 300 Hz, filter FL4 which dynamically eliminates all undesirable frequencies above 190 MHz, and power amplifier A4. This latter features totally symmetrical design in order to obtain the best possible distortion rate.

Principal level at output may reach +19.9 dBm into a matched 50 ohms load. An auxiliary output makes available the frequency on the equipment rear panel with variable level up to 0 dBm into a high-impedance load.

Finally, detector D1 maintains output level as constant as possible in function of the frequency by means of A5 and C1. Output signal amplitude varies in a dynamic of 14 dB under the output + 19.9 dBm in function of the instructed value provided by the level reference. This variation occurs in A6 (variation by PIN diodes) on the input level of the 400 MHz frequency.

# SYNOPTIQUE

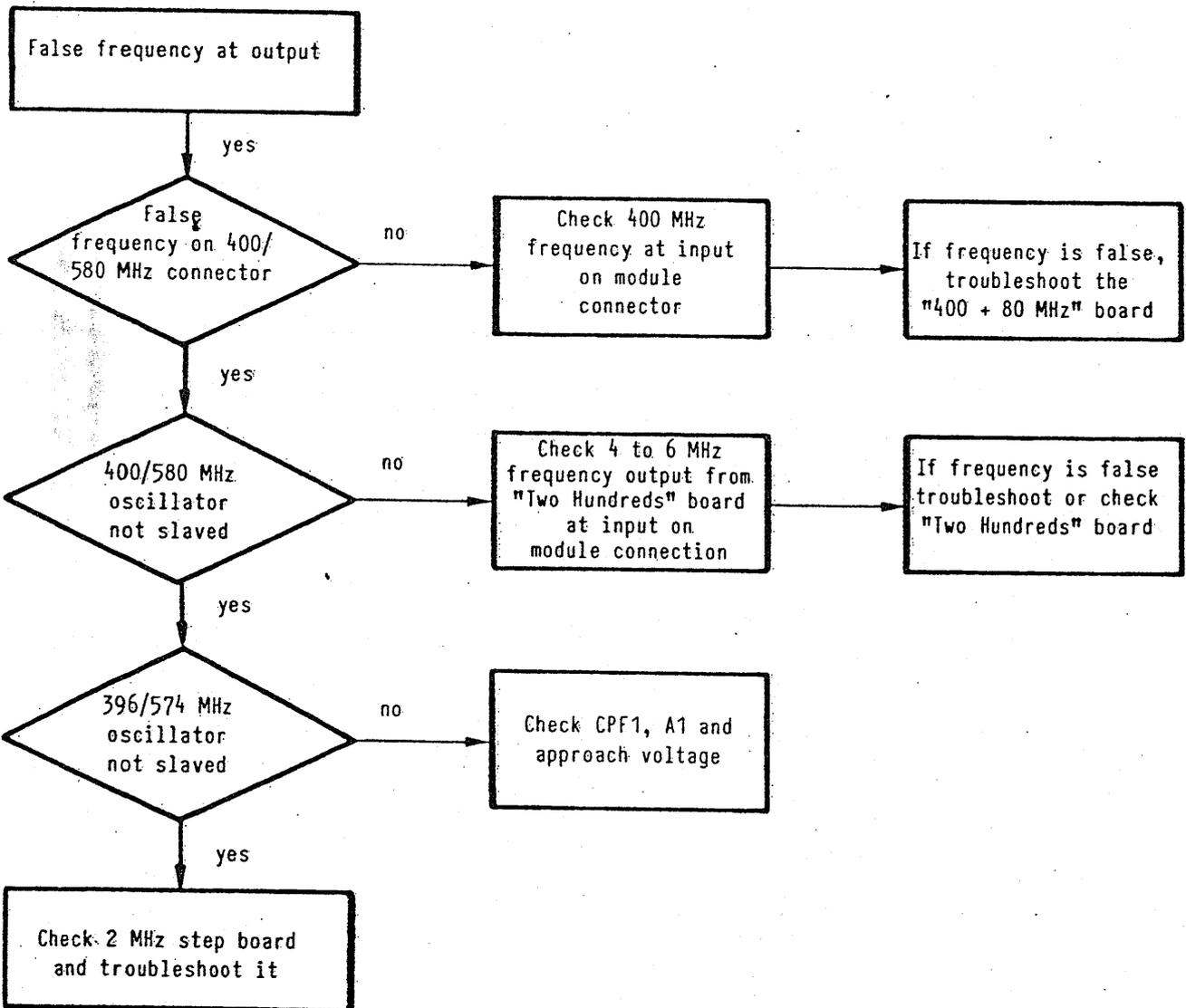


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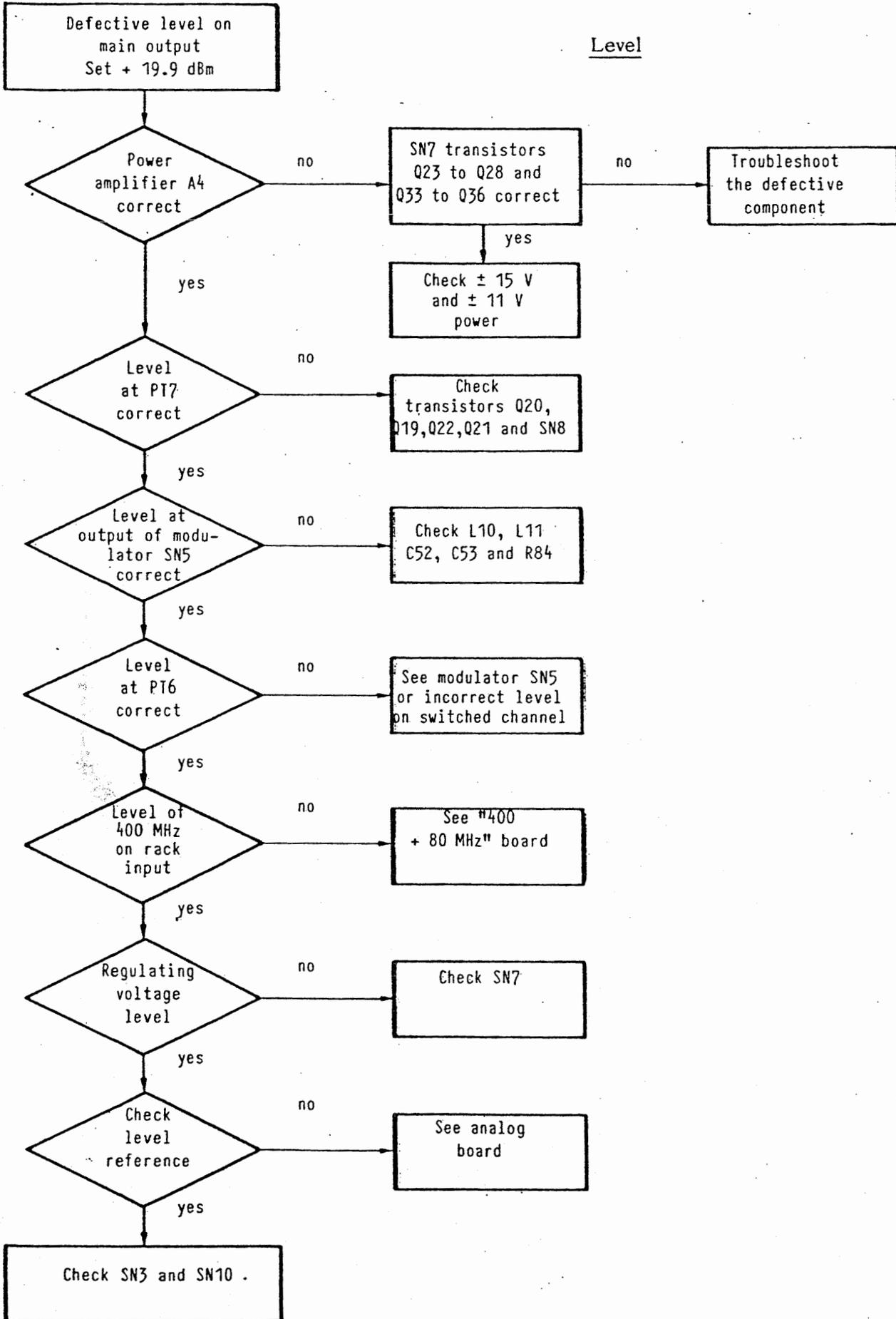
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VHF MODULE

Frequency



Level



**ATTENUATOR ASSEMBLY**

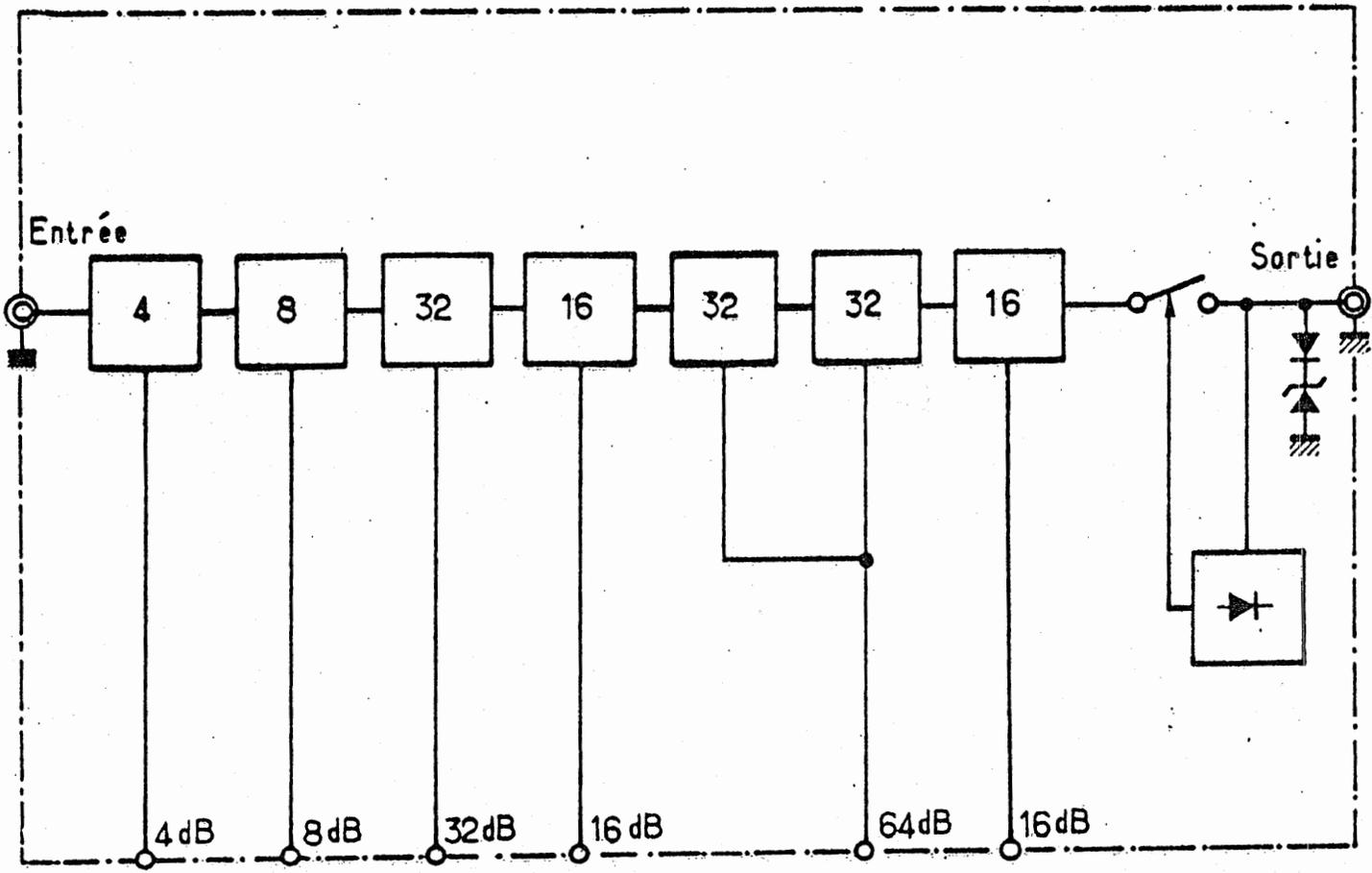
The damper module features seven damping cells controlled by 15 V power.

0 V	=	Damping
- 15 V	=	Direct throughput

The output breaker operates in two stages :

- 1) It provides instant protection by limiting (diode and zener).
- 2) Cutoff by a relay controlled by a threshold detector.

SYNOPTIQUE



0275710000-2

**480 MHz GENERATION MODULE**

This module generates certain time-base frequencies necessary to 730 operation.

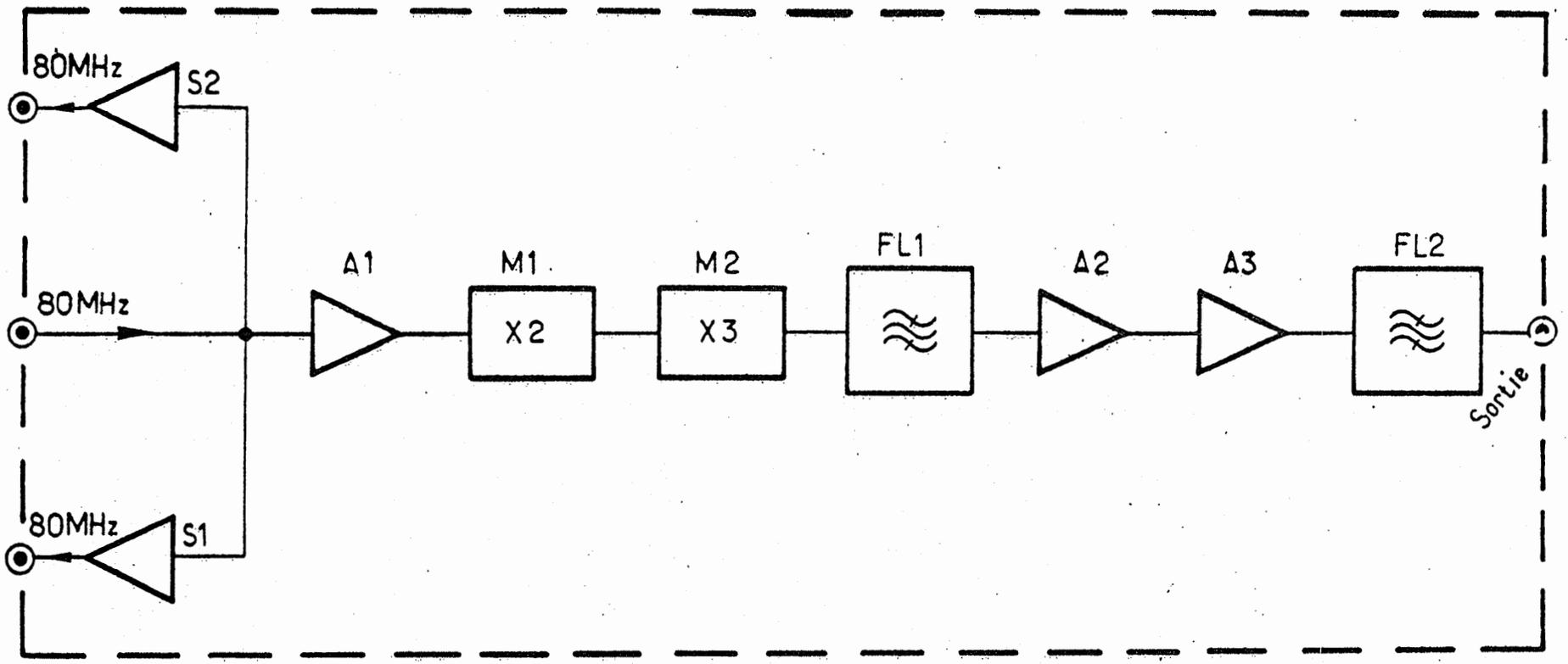
These frequencies are the following :

- \* 80 MHz, used in the Modulations board,
- \* 80 MHz, used in the 2 MHz Steps board,
- \* 480 MHz, used in the "400 MHz + 80 MHz" board.

The 80 MHz frequencies result from separation in an 80 MHz transformer output by the quartz oscillator.

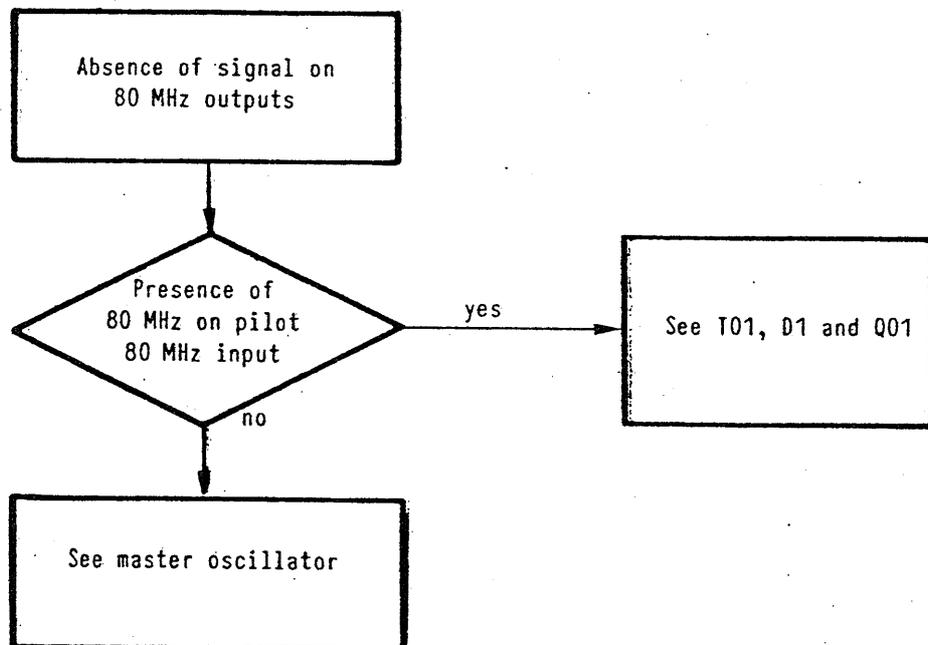
The 480 MHz frequency results from multiplication by 2 in M1 and multiplication by 3 in M2. This latter circuit is composed of a transistor operating in class C with a circuit tuned to 480 MHz in its collector. This circuit is followed by a filter which damps the 400 MHz frequency by 30 dB. Two cascade amplifiers, A2 and A3, supply gain of approximately 19 dB. Filter FL2 eliminates the 400 MHz signal at approximately - 70 dB at the module output.

SYNOPTIQUE

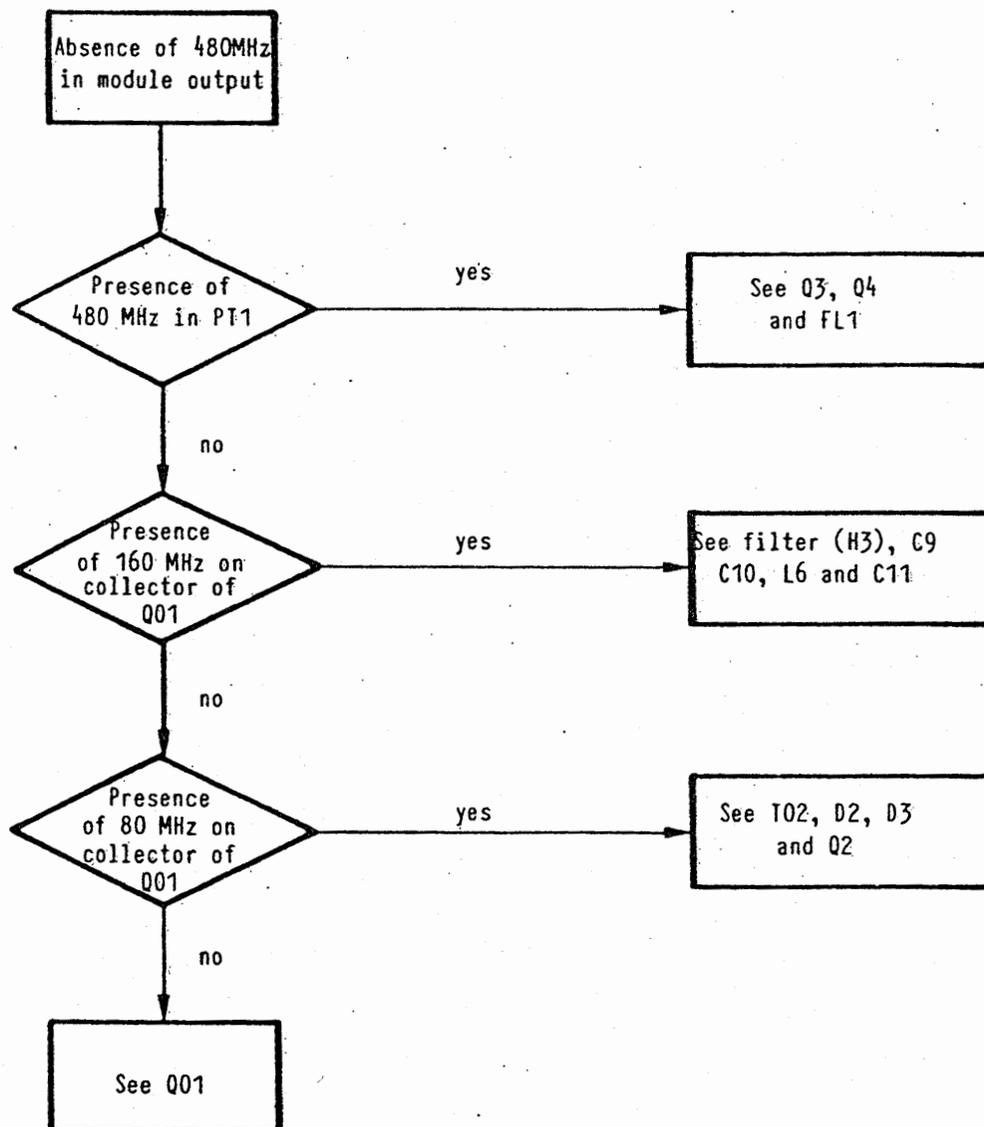


0276450000-2

Flowchart 1



Flowchart 2



## Garantie et Assistance - Warranty and Assistance

Ce produit ADRET ELECTRONIQUE 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 ADRET ELECTRONIQUE 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.

Le client s'engage, pour sa part, à ne pas intervenir sur le produit pendant la période de garantie sous peine de la perdre définitivement. Le retour et la réexpédition de l'appareil lors d'une opération de maintenance sous garantie sont pris en charge pour moitié par ADRET ELECTRONIQUE.

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 ADRET le plus proche, les coordonnées de nos principaux agents étant données dans le tableau ci-dessous.

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

The warranty applies to equipment with mechanical damage sustained during shipping from ADRET ELECTRONIQUE, 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 ADRET ELECTRONIQUE.

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 ADRET representative. The addresses of our main agents are given in the table below.

## Réseau commercial ADRET - ADRET commercial network

### FRANCE

**Société BASCOUL ELECTRONIQUE**  
31200 TOULOUSE - 35, rue du lucher  
Tél : 61 48 99 29 - Télex : 521 508  
33600 BORDEAUX PESSAC - 76 Avenue Pasteur  
Tél : 56 45 01 90 - Télex : 541 720

**Société DIMEL** Immeuble "Le Marino"  
83000 TOULON - Avenue Claude Farrère  
Tél : 94 41 49 63 - Télex 430 093

**JCF ELECTRONIQUE**  
74019 ANNECY CEDEX - Ancey le Vieux - BP 964  
Tél : 50 23 63 64 - Télex : 385 417

**Société SOREDIA**  
"Les Guittais" - Charillon sur Seiche  
35015 RENNES CEDEX - BP 1413  
Tél : 99 50 50 29 - Télex : 950 359

### AFRIQUE DU SUD - SOUTH AFRICA

**K.B.A. INSTRUMENTATION PTY**  
P O BOX 41062 - Avenue Sandton 2199  
CRAIGHALL TRANSVAAL 2024  
Tél : (11) 788 1700/05 - Télex : 422 033

### ALLEMAGNE - GERMANY

**S.P.E.A. GmBh** - Schützenweg 62  
D 6305 GROSSEN BUSECK  
Tél : (64) 08 2081 Code 299 - Télex : 484 296

### ARGENTINE - ARGENTINA

**RAYO ELECTRONICA**  
1092 BUENOS AIRES - Belgrano 990  
Tél : (01) 381779 - Télex : 22153

AUSTRALIE - AUSTRALIA

**VICOM INTERNATIONAL PTY**  
57 City Road - South Melbourne  
VICTORIA 3205  
Tél : (03) 626 931 - Téléc : 36935  
Telefax : (61) 3622325

AUTRICHE et EUROPE DE L'EST - EAST EUROPE

**S.P.E.A. GES.m.b.H.** Stiftgasse 27  
A 1100 WIEN - Tél : (222) 62 61 41  
Telex : 116 084

BELGIQUE et LUXEMBOURG - Belgium and Luxembourg

**SAIT ELECTRONICS**  
B 1190 BRUXELLES - 66 Chaussée de Ruisbroek  
Tél : (02) 376 20 30 Code 280 - Téléc : 61807

BRESIL - BRAZIL

**GRADIENTE ELECTRONICA LTDA**  
Staub Agency Division - Rua Sorocaba 316  
CEP 22271 BOFAFOGO - RIO DE JANEIRO  
Tél : (21) 286 8722 - Téléc : 21 21131

CANADA

**AIM ELECTRONICS INC**  
376 Churchill Avenue - Suite 108  
OTTAWA - ONTARIO K1Z 5C3  
Tél : (613) 7228286 Code 284  
(514) 3322762 (Montréal) - Téléc : 534862

DANEMARK - DENMARK

**METRIC A.S.**  
Skodsborgvej 305 - D. K. 2850 - NAERUM  
Tél : (02) 80 4200 Code 285 - Téléc : 37163

ESPAGNE - SPAIN

**TELCO**  
Gravina 27 - MADRID  
Tél : (01) 231 71 01 Code 279 - Téléc : 27348

ETATS-UNIS - UNITED STATES

**COMSTRON CORP**  
10 Hub Drive - MELVILLE - NEW YORK 11747  
Tél : (516) 756 1100  
Téléc : 4973525  
Telefax : (516) 756 1167

FINLANDE - FINLAND

**ORBIS OY**  
Sorolantie 16 - P O BOX 15 - 00421 HELSINKI 42  
Tél : (358) 05664066 Code 283 - Téléc : 123134

GRANDE-BRETAGNE - GREAT BRITAIN

**RACAL DANA**  
Duke Street - WINDSOR BERKS SL4 1SB  
Tél : (75) 38 68 101 Code 274 - Téléc : 847013

GRECE - GREECE

**SCIENTIFIC ENTERPRISES C.O.**  
45, Agion Saranta St - 18 346 ATHENES  
Tél : (1) 482 34 21 - Téléc : 221770

HONG KONG

**I N F A**  
19 Austin Road - TSIMSHATSUI, KOWLOON - HONG KONG  
Tél : (852) 5 7211151 - Téléc : 54016

INDE - INDIA

**HINDUSTAN INSTRUMENTS LTD**  
603 Vishal Bhavan - 95 Nehru Place  
NEW DELHI 110 019  
Tél : (11) 6410529 - Téléc : 31 61209

ITALIE

**I.P. INSTRUMENTS**  
Paolo Pallia 5 - 20139 MILANO  
Tél : (02) 5392440 Code 277 - Téléc : 315085

KOWEIT - MOYEN ORIENT

**ABDUL AZIZ YOUSUF ESSA et CO WLL**  
P O BOX 3562 - SAFAT  
Téléc : 23576

NORVEGE - NORWAY

**TERCO A.S.**  
P O BOX 98 - N 1540 VESTBY  
Tél : (02) 951000 Code 287 - Téléc : 74464

NOUVELLE ZELANDE - NEW ZEALAND

**NEECO**  
17 Adelaide Road - P O BOX 9749  
NEWTOWN WELLINGTON  
Tel : (64) 4858689 - Telex : NX 3582  
Telefax : (64) 4850510

PAYS-BAS - NETHERLAND

**CN ROOD BV**  
11.13. Cort V.D Lindenstraat - P O BOX 42  
2280 RIJSWIJK  
Tél : (70) 996 360 Code 281 - Téléc 31238

PORTUGAL

**RUALDO LDA**  
9 - 15 Rua de San Jose - 1198 LISBOA CODEX  
Tél : (01) 373461 Code 286 - Téléc : 16447

REP. POPULAIRE DE CHINE - CHINA

**COMPAGNIE OLIVIER**  
Peking Hôtel - Gui Bin Shi n°3 - BEIJING  
Téléc : 22375

SINGAPOUR - SINGAPORE

**COSMOTEC ENTERPRISES LTD**  
70 Bendemeer Road - Hiap Huat House 05-04  
SINGAPOUR 1233  
Tél : (65) 2967766 - Téléc 36992

SUEDE - SWEDEN

**SAVEN AB**  
Nytorspsvagen 30 - P O BOX 504 - S 18325 TABY  
Tél : 87921100 Code 282 - Téléc : 12986

SUISSE - SWITZERLAND

**AMOTEC ELECTRONIC AG**  
Roftluhstraße 38 - 8702 ZOLLIKON  
Tél : (01) 3915630 - Téléc : 816906  
Telefax : (01) 3915633

TAIWAN

**CATHAY ENTERPRISE CO Ltd**  
P O BOX 1778 - 102 Thun hua Road - TAITAI  
Tél : (886) 7310558 - Téléc : 22392  
Telefax : (886) 7732227