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PS/RF/Note 88-6
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AC RF H=6 TUNING CONTROL MODULE

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1. DESCRIPTION

The Bunch Rotation Cavities CBR 2506 and CBR 2706 require two different tuning conditions depending on the AAC machine operation mode

A) Detune

The cavities are detuned as strongly as possible ($\Delta f \geq 7$ KHz).

B) On Tune

The cavities resonant frequency is kept as close as possible to the working frequency.

Two main blocks perform the needed tasks.

1.1 Detune

This tuning condition is selected either locally (Detune push-button) or by remote control (5)* (See circuit diagram).

The detuning piston on the cavity is activated by shorting pin 4 on connector 13 to ground.

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*) Numbers in brackets indicate the connector number.

The status of the detuning piston is checked by a switch (O.C = Detuned, S.C. = On Tune) linked to the module (2).*

When the cavity is detuned the interlock status line (3) is opened. This prevents from switching the interlock level 2 'ON' or stops it if already 'ON'.*

1.2 On Tune

In this tuning mode the purpose is to keep the cavity resonant frequency f_c as close as possible to the working frequency f_o.

The measurement of the error voltage V_{in} (8), coming from the phase discriminator module, has to be done during the flat-top time (see Figure 1).*

*The measurement is meaningful only if the 2 signals ACTive 1 and ACTive 2, coming from the AVC amplifiers, are high (6,7)**

The tuning correction is done after the end of the present RF program only if the 'On tune' mode is selected.

The tuning correction is not proportional to the tuning error voltage V_{in}.

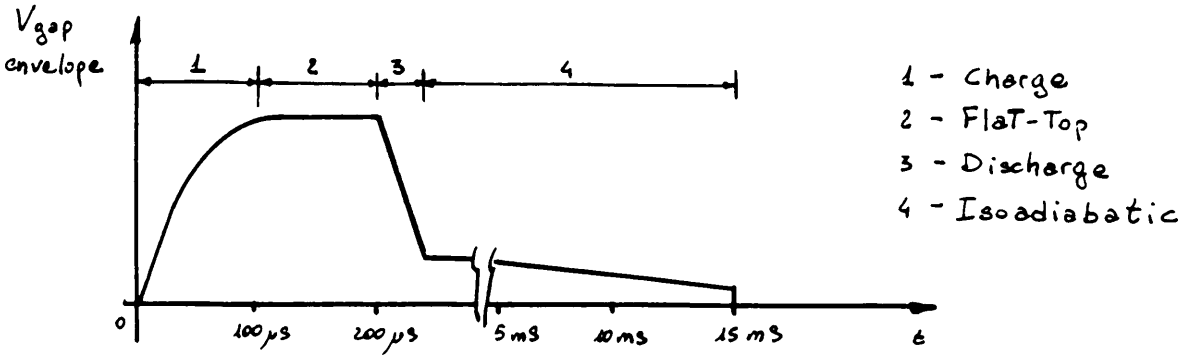
Upper and lower tuning range limits can be selected by means of two switches installed on the cavity. Whenever the upper or lower range limit is reached the RF is shut-off and the tuning motor is positioned at the range center.

The circuit is divided into the following blocks :

a) Timing and enable
b) Correction selector
c) Motor controller
d) Range limit controller

**) See footnote on page 1.*

RF PROGRAM Fig. 1



1.2.1 Timing and enable block

This block provides the synchronisation signal for measure and enables the eventual tuning correction after the end of the RF program.

The RF program is started by the "charge" pulse (+24 V 1µs 9). The same pulse triggers the two monostables 'move delay' and 'measure delay'. The 'measure window' is opened during the 'flat-top' and the 'move enable' command after the end of the RF program.*

To create the 'measure enable' command, the 'measure window' is logically 'anded' with ACT1 (6), ACT2 (7*) and the 'On Tune' signal.*

1.2.2 Correction selector

This block is composed of an electronic switch controlled by the 'measure enable' command, two error limit comparators and two temporary memories.

When the 'measure enable' command is low the error voltage V_{in} (8) is transferred to the error limit comparators that detect whether V_{in} is higher, lower or within the two limits '- lim' and '+ lim'. The result is stored into the two temporary memories during 50 ms.*

**) See footnote on page 1.*

Transfer of the memories status to the 'motor controller' is synchronised by the 'move enable' command.

1.2.3 Motor controller

The motor controller block allows either manual or automatic operation. It also provides the interface between the tuning motor and the 'range limit' controller.

Two one-shots, triggered by the memories status (auto) or by the UP/DOWN push-buttons (manual) provide a constant time movement of the tuning motor in the desired direction or continous movement when driven by the 'range limit' controller.

Two relays provide low to high voltage level shifting and prevent from activating both UP and DOWN command lines (13 pin 3 and 2 respectively).*

Note that :

UP means towards higher frequency
DOWN " " lower "

1.2.4 Range limit controller

Three switches mounted on the cavity check for 3 positions within the tuning range :

- *End Up Limit (12*)*
- *End Down Limit (10*)*
- *Center (11*)*

Whenever the tuning motor reaches one of the two limits the corresponding switch is opened. This forces one of the 'error limit flip-flops' to memorise the fault ($\overline{Q}$ = 0V).

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*) See footnote on page 1.

This signal is used for opening the system interlock line (3). The system interlock will shut the RF "OFF".*

The same signal is also used for driving the 'motor controller' and move the tuning motor towards the range center.

When the 'center' switch is activated the 'error limit' flip-flops are reset and the system interlock line is shorted again.

Note : For the system interlock a short circuit means OK.

2. ADJUSTMENT

2.1 Measure equipment

1 Digital memory scope.
1 Standard pulse generator (24 ÷ 30 V 1 µs)
1 ±1 V variable supply.
4 Lemo 0 plugs with shorted pins.
1 +6 V supply.

2.2 Detune block

2.2.1 Insert a 100Ω 10 W resistor between pin 4 and 5 on connector 13 (R.P.).

a) Select 'Detune' (push-button) :

Voltage on pin is ≤ 3 V.

b) Select 'On tune' (push-button) :
Voltage on pin 4 is ≥ 22 V.

Repeat a) and b) but select inserting a 50Ω load in connectors 5 and 4.

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*) See footnote on page 1.

2.2.2 Leave connector 2 open circuit and verify that :

a) LED 'ILT' is 'OFF'.

b) Between pins 1 and 2 on connector 3 there is an open-circuit.

c) Connector 1 is shorted to ground.

d) Led 'Detune ST' is 'ON'.

2.2.3 Insert short circuit plugs in connectors 2, 10, 12.

Insert short circuit plug in connector 11.

Verify that conditions defined in paragraph 2.2.2 are now inversed.

2.3 Timing and enable

2.3.1 Apply a standard pulse on connector 9 (rep. rate ~ 1.5 secs).

Adjust :

Move delay	=	30 ms
Move enable	=	1 sec.
Measure delay	=	120 µs
Measure window	=	70 µs

2.3.2 Apply +6 V to connectors 6 and 7.

a) Select 'On tune':

Verify that the measure window pulse is present on chip 5, pin 2.

b) Verify that without +6 V on connectors 6 or 7 no pulse is present on Chip 5 pin 2 (it is always high +6 V).

c) Verify that on selecting 'Detune' no pulse is present on chip 5 pin 2.

2.3.3 Verify that 'move enable' command is present on chip 3 pins 9 and 12.

2.4 Correction selector block

2.4.1 Adjust '-lim.' and '+ lim' potentiometers to -.5V and +.5V respectively (this corresponds to $\pm 10^0$ dephasing between final cathode and final anode voltage).

2.4.2 Apply alternatively +1 V and -1 V to connector 8.

a) Verify that with +1 V pin 7 of chip 7 goes high (>5 V) during the 'measure enable' command time.

b) Verify that with -1 V pin 7 of chip 6 goes high (>5 V) during the 'measure enable' command time.

c) Adjust the temporary memories monostables to 50 ms.

d) Verify that on pin 10 or 11 of chip 3 a pulse of ~ 20 ms is present. It starts when 'move enable' starts and ends when the memory pulse ends.

Pin 10 of chip 3 goes high when -1 V is present on connector 8 while pin 11 of chip 3 goes high when +1 V is present on connector 8.

Verify that for $-.5 < V_{in} < .5$ none of the memories is setted.

2.5 Motor controller block

2.5.1 Position switch on 'AUTO'

Apply - standard pulse 24 to 30 V, 1 µs, 1.5 sec Rep. rate on connector 9.
- +6 V on connectors 6 and 7.
- +1 V on connctor 8.

a) Adjust monostable 'move up time' to get a 30 ms pulse on pin 9 chip 9 ($\overline{Q}$).

b) Reverse polarity on connector 8.

Adjust monostable 'move down time' to get a 30 ms pulse on pin 7 chip 9 ($\overline{Q}$).

c) Position switch on 'Manual' and verify that pressing 'UP' and 'Down' push-buttons the respective monostable is triggered.

2.6 Range limit controller

2.6.1 Same conditions as in paragraph 2.5.1

Insert short circuit plugs in connector 2, 10, 12.

Insert a short circuit plug in connector 11.

- With +1 V on connector 8 RL2 should be actioned as well as led 'UP'.

- With -1 V on connector 8 RL1 should be actioned as well as led 'DOWN'.

2.6.2 Same conditions as in paragraph 2.6.1.

a) Remove short circuit plug from connector 10.

Verify : ILT led goes 'OFF'.
UP led goes 'ON'.
Relay RL2 is actioned.

- Insert short circuit plug in connector 10.
- Remove short circuit plug from connector 11.

Verify : ILT Led goes 'ON'.
UP Led goes 'OFF'.
Relay RL2 goes 'OFF'.

b) Repeat operation 2.6.2 a changing connector 10 with connector 12, Up led with Down Led and RL2 with RL1.

Distribution :

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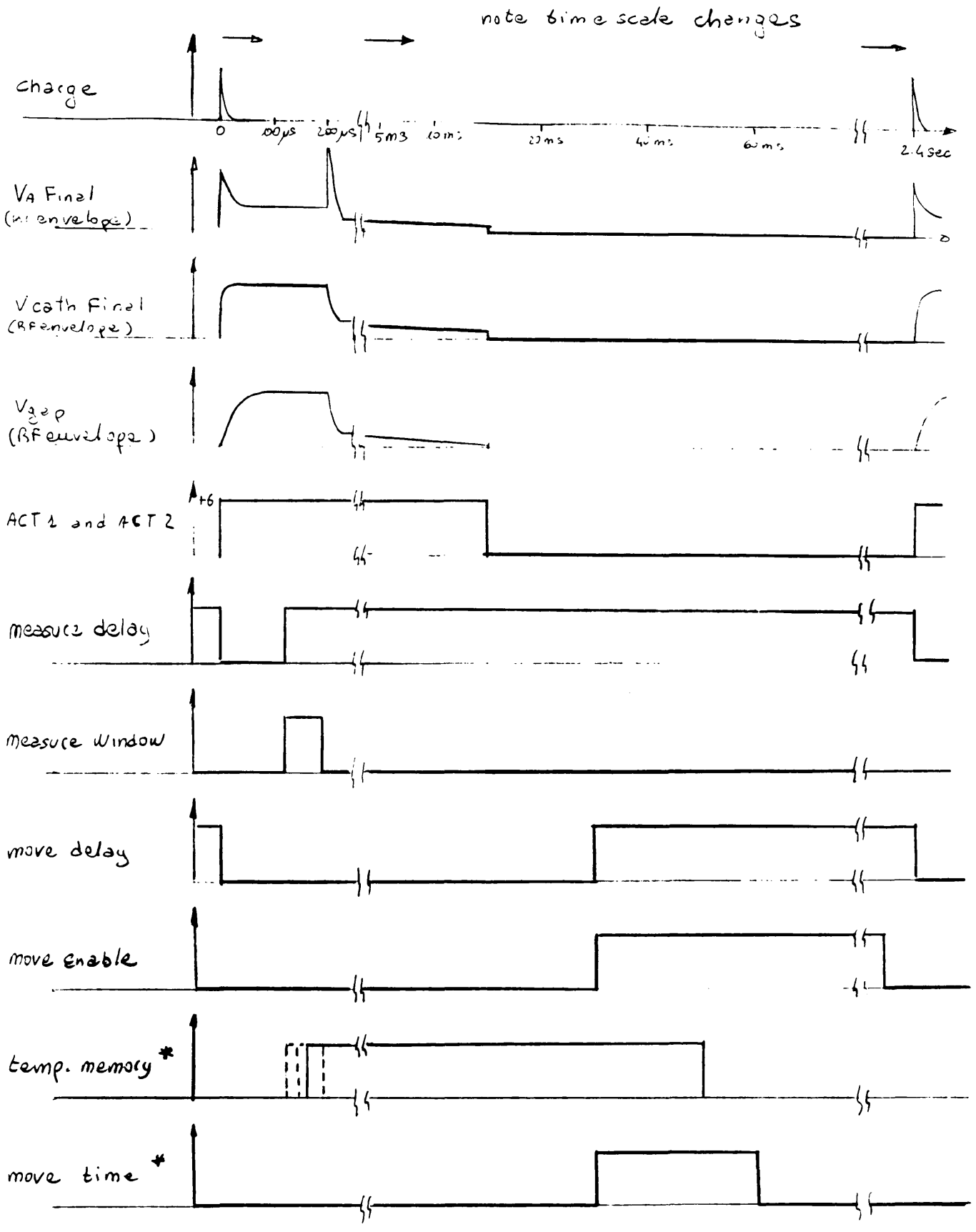
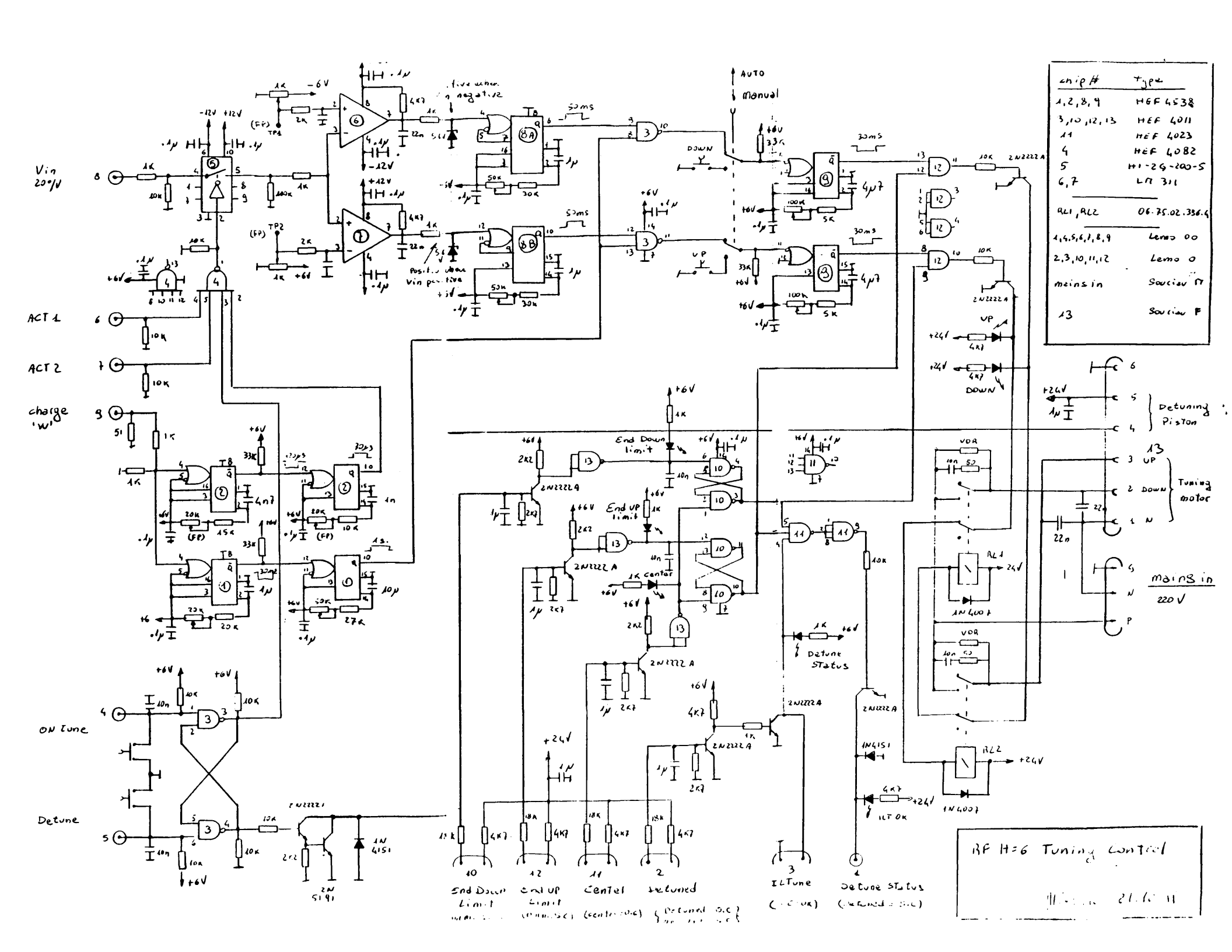
P. Maesen

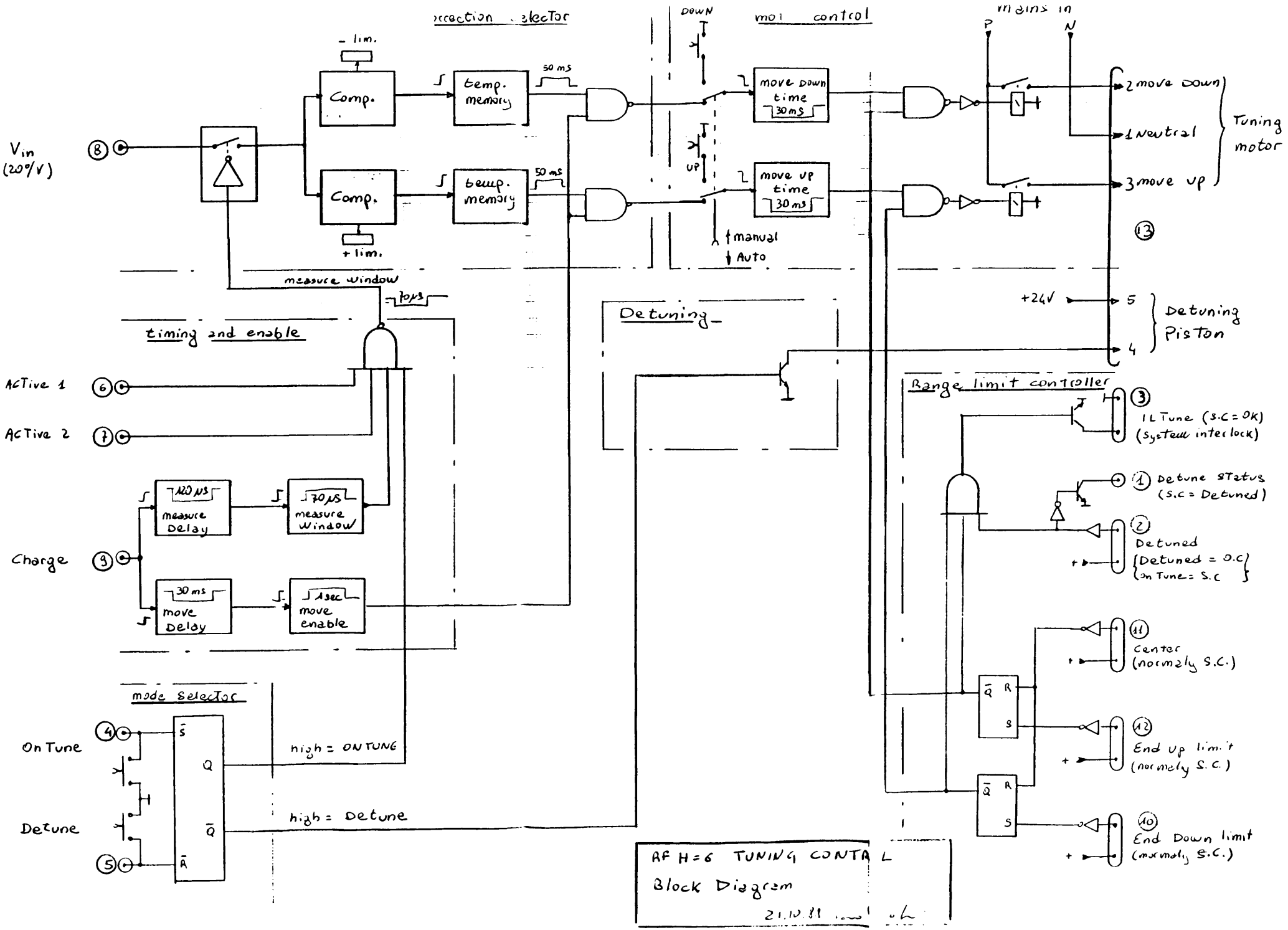


* up, down according to Vin

timing diagram



chip #	type
1,2,8,9	HEF 4538
3,10,12,13	HEF 4011
11	HEF 4023
4	HEF 4082
5	H1-26-200-5
6,7	LM 311
RL1, RL2	06.75.02.336.4
1,4,5,6,7,8,9	Lemo 00
2,3,10,11,12	Lemo 0
mains in	Socket M
13	Socket F


correction selector
- lim.
Comp.
Comp.
+ lim.
temp. memory
temp. memory
50 ms
50 ms
DOWN
UP
move down time 30ms
move up time 30ms
manual
Auto
mains in
P
N
2 move down
1 Neutral
3 move up
Tuning motor
13
Vin (20%/V)
8
measure window
10µs
timing and enable
+24V
5
4
Detuning Piston
Detuning
Range limit controller
ACTive 1
6
ACTive 2
7
120 µs
measure Delay
70µs
measure window
Charge
9
30 ms
move Delay
1sec
move enable
3
IL Tune (S.C = OK)
(system interlock)
1
Detune status
(S.C = Detuned)
2
Detuned
{Detuned = O.C
On Tune = S.C
11
Center
(normaly S.C.)
12
End up limit
(normaly S.C.)
10
End Down limit
(normaly S.C.)
mode selector
On Tune
4
Detune
5
high = ON TUNE
high = Detune
RF H=6 TUNING CONTROL
Block Diagram
21.10.81