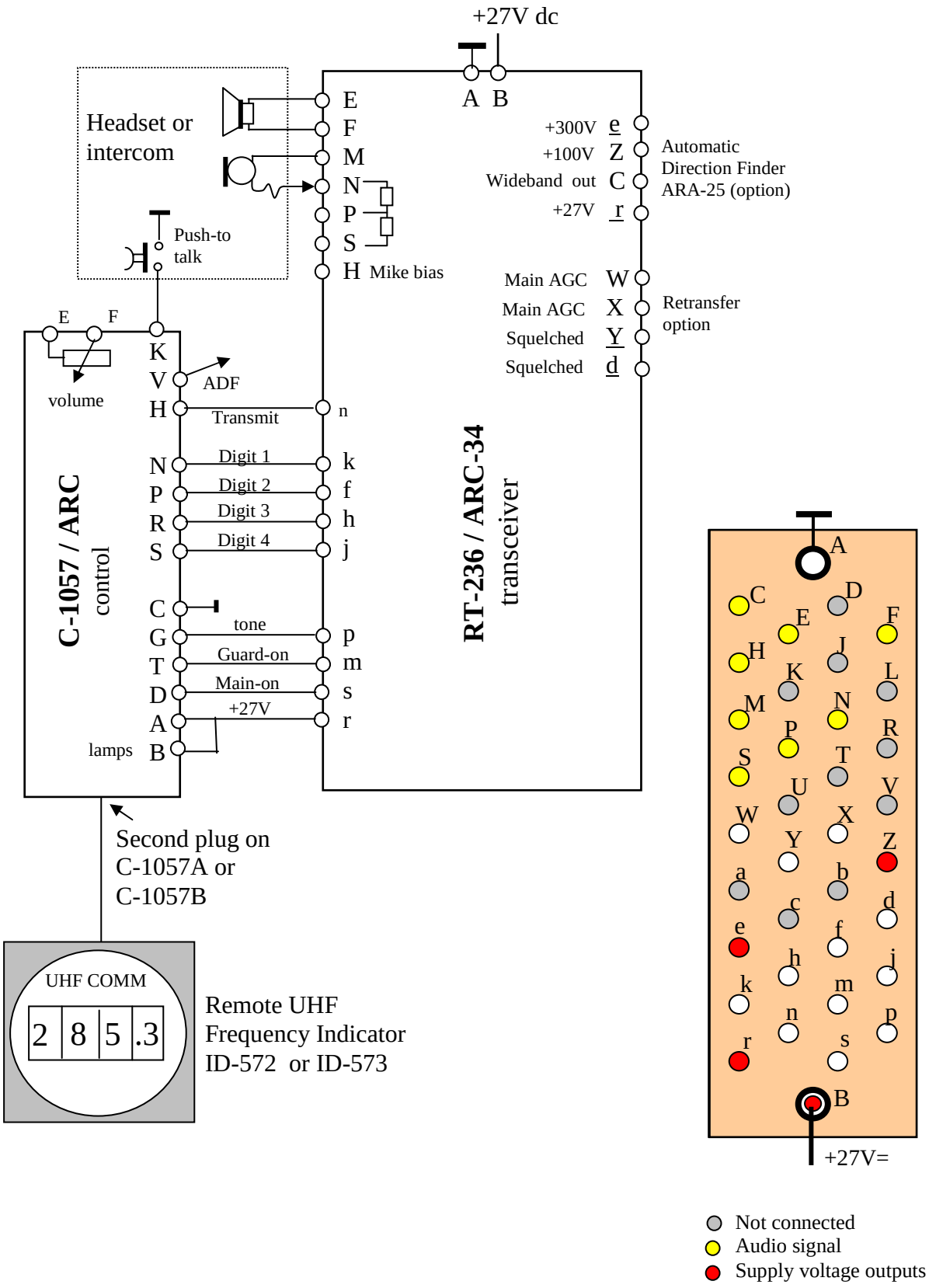
AN/ARC-34

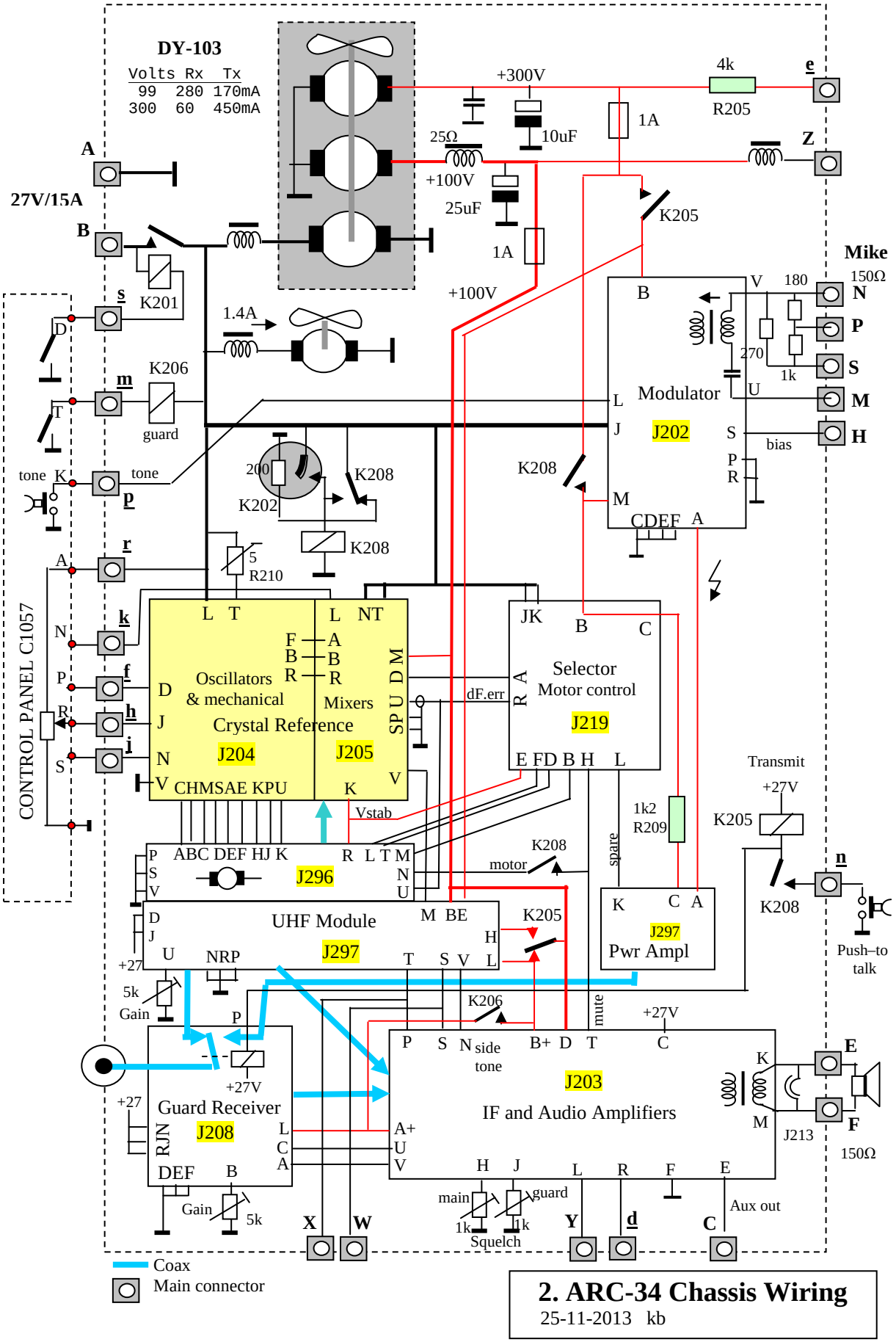
Made in 1952 by RCA and Magnavox

Reverse engineered drawings may contain errors.
Check my internet site for updates:

https://vintageavionics.nl/index_bestanden/ARC34.htm

ARC-34 System wiring





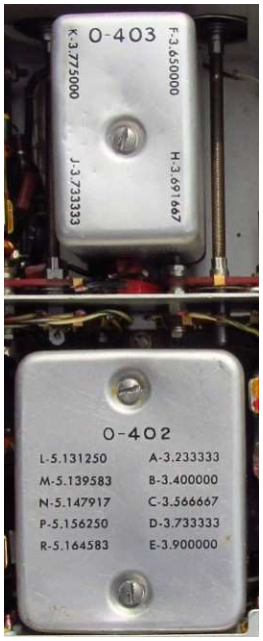
2. ARC-34 Chassis Wiring

25-11-2013 kb

ARC-34 Frequency control

Frequency control of the ARC-34 is done in 2 steps. There is a motor which tunes a voltage controlled oscillator and all VHF and UHF resonant circuits by variable capacitors via a gearbox. Second, the VCO frequency is locked to a crystal reference, set up using 3 Ledex stepper motors and a relay, all controlled by the digits on the remote frequency control panel.

Frequency is controlled in 4 digits, in 0.1 MHz steps. The crystal reference system has 4 oscillators. The 1st and 2nd digit select a harmonic of an 833.333 kHz crystal oscillator (osc.1)

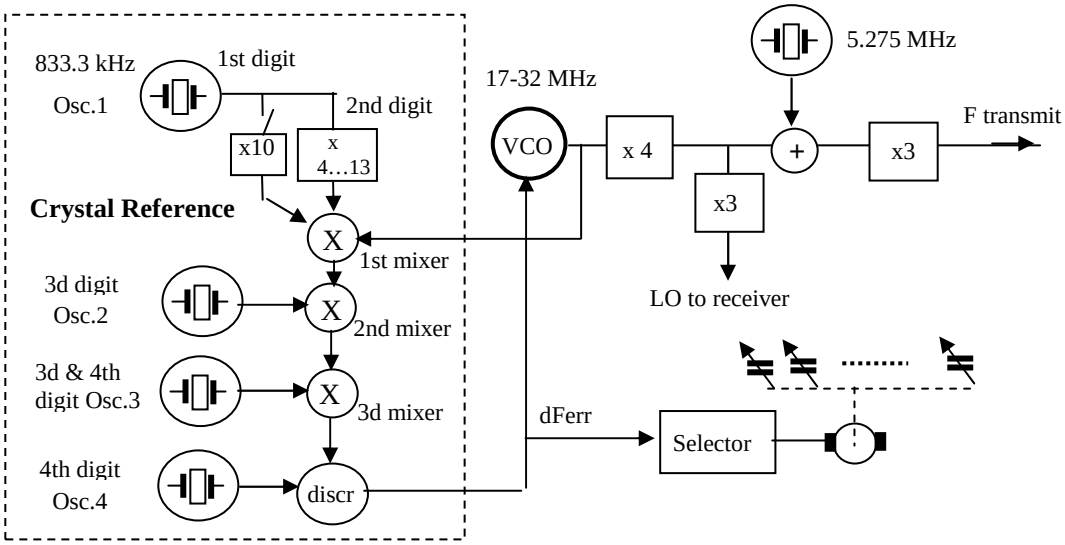


The 3d and 4th digit control a bank of 5+ 4+5 = 14 crystals, for 5 x 4 x 5 =100 frequencies, using 3 oscillators : osc2, osc3 and osc4.
The 15 crystals are in 3 ovens.

The crystal frequencies are

A	3.233333 MC		stepsize 1/6 MC
B	3.400000		osc.2 controlled by 3d digit
C	3.566667		
D	3.733333		
E	3.900000		
---	---	---	---
F	3.650000 MC	V 3.654167	stepsize 1/24 MC
H	3.691667	W 3.695833	osc.3 controlled by
J	3.733333	X 3.737500	combined 3d and 4th digit.
K	3.775000	Y 3.779167	ARC34**C** with 50kHz channels has also
---	---	---	Xtalls VWXY that are 50kHz/12 higher
L	5.131250 MC		stepsize 1/120 MC
M	5.139583		osc.4 controlled by 4th digit
N	5.147917		
P	5.156250		
R	5.164583		

The lowest frequency is A + F + L = 12.0146 at dial xx0.0
The highest frequency is E + K + R = 12.8396 at dial xx9.9



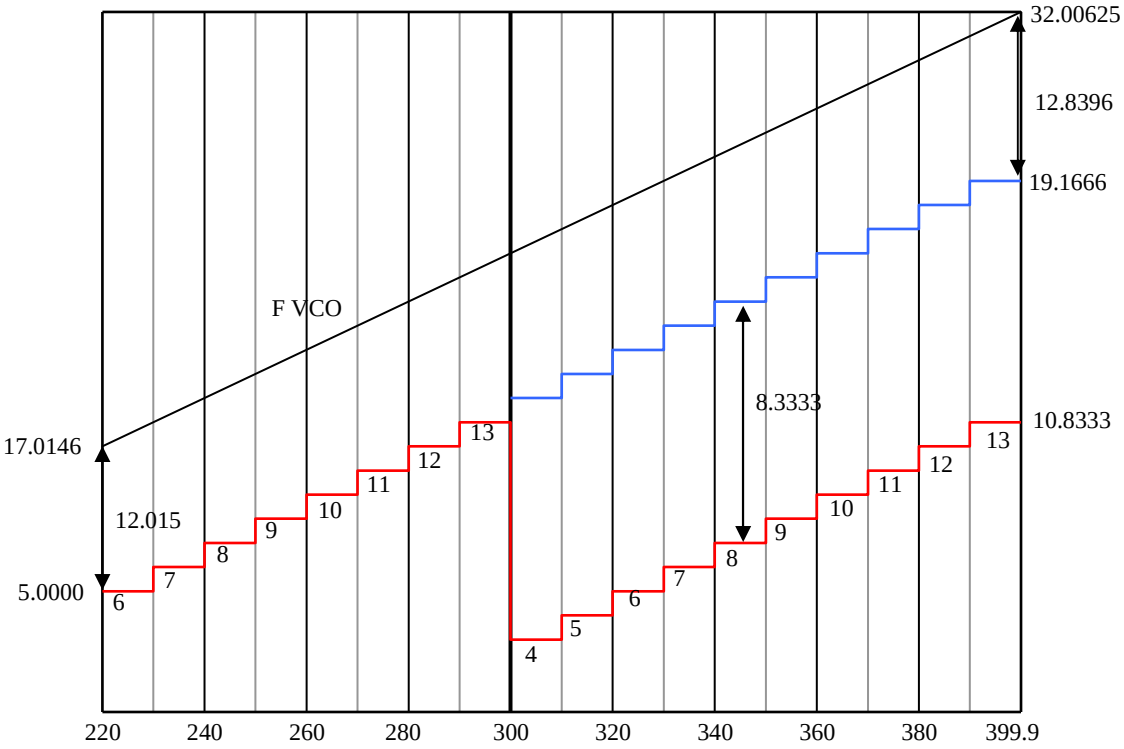
The lowest xmit frequency is (12.0146 + 4 x 0.83333) x12 + 15.825 = 200.0 MHz
The highest xmit frequency is (12.8396 + 23 x 0.83333) x12 + 15.825 = 399.9 MHz
The first 250 channels are below the military band of 225.0 – 399.9 MHz and result in continuous running of the tuning motor.

Mixers

The first mixer compares the VCO frequency with the oscillator 1 frequency
This gives a first intermediate frequency of 12.01 - 12.84 MHz. (first digit=2) or
20.34 - 21.17 when the first digit =3
The second mixer compares this with the osc. 2 frequency plus 8.333 MHz when the first digit = "3"
This gives a second intermediate frequency of 8.78 - 8.94 MHz
The third mixer compares this with the oscillator 3 frequency
This gives a third intermediate frequency of 5.13 - 5.16 MHz
Finally, this signal is compared with the signal from oscillator 4 in a **phase detector**, resulting in zero Hz when locked. This is the dF err signal. Note dFerr= 0 occurs also without VCO signal or large mistuning. Therefore, dFerr= 5V was chosen as the normal value.
With 1 kHz difference, the output of the phase comparator is a 1 kHz sinewave of approx. 30 Vpp

The first (fixed) IF in the main receiver is at 15.825 MHz. (15.025 for the guard receiver)
Guard,- and main IF have a common 13.025 MHz oscillator to step down to the second IF frequency at 2.8 MHz for the main receiver, or 2.0 MHz for the guard receiver.

The frequency of the VCO (black) , and that of osc.1 (red) are shown in this plot, with the control panel dial setting on the X-axis. All values are in MHz.



Adjustments.

The intermediate frequency filters are factory tuned inside a hermetic seal.

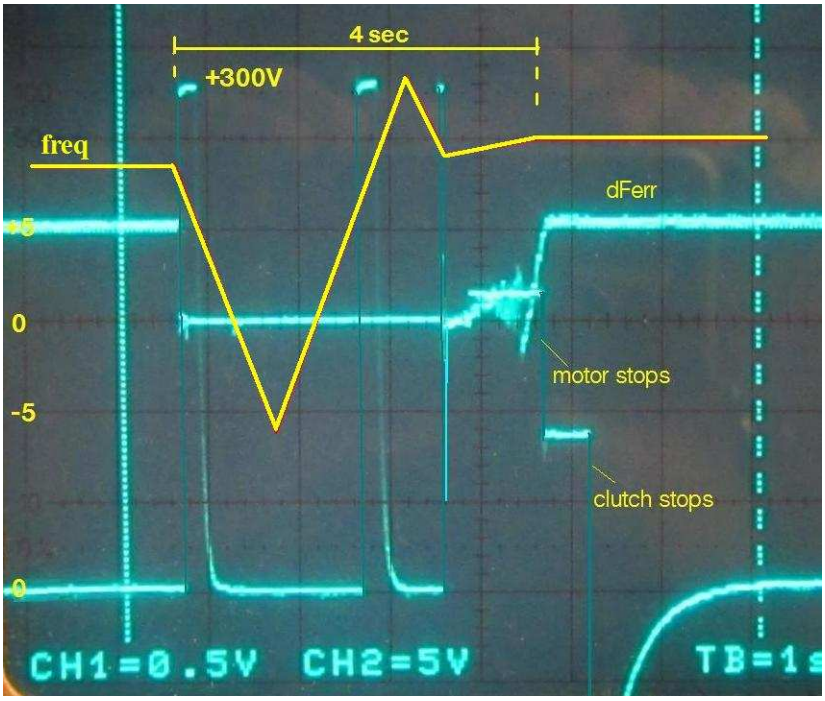
Use of dFerr

The output of the Crystal Reference System , dFerror, is fed to
1) the motor controller (Selector) , which does the coarse tuning of the master oscillator and all doubler and tripler circuits,. The motor stops when dFerr = 5V
2) and to a reactance tube, which phase-locks the master oscillator to the CRS.

Tuning control

See drawing of the Selector (C-1256 / ARC-34)
Normally, when tuned, relay K1 is ON, (via its holding contact and the positive dFerr voltage) and the motor does not run.
After a change in selected frequency, dFerr drops to zero, K1 drops OFF, and the motor starts running. The variable capacitors are tuned at a speed of 100MHz/sec (!) until they are in the right segment, and a negative peak occurs in dFerr, indicating that the correct frequency was passed.
This triggers the thyratrons, and a coil selects low (0.5%) *reverse* gear, so the variable capacitors move backward slowly. The motor itself runs still in forward direction, so the phase detector remains active. The current in the low gear coil sets K2 ON, and when the phase lock loop closes, dFerr becomes positive to compensate for the still slowly moving tuning capacitors. When dFerr reaches +5V, K1 turns on and the motor stops. After 0.2 sec, K2 drops OFF, so the thyratrons stop conduction, but K1 remains ON to keep the motor off.

In this plot, the anode voltage of thyratrons is recorded together with the dFerr signal.
Every time the tuning passes the right (20MC wide) segment, the anode voltage is +300V.
Yellow is the tuned frequency, cycling between 220 and 400 MHz.
The timebase is 1 sec/div. Total tuning takes approx. 4 sec.
The phase lock detector is only operative with decreasing frequency,
The variable capacitors shafts run at 30 rpm in coarse mode and -0.15 rpm in fine mode.



RT-263/ARC-34 Tube layout

9-9-2013 kb

1. Modulator MD- 198 / ARC-34

Testconnector = brown

V101 6021 preamp
V102 5896 limiter
V103 6021 splitter
V104 6021 drivers
V105 6005 = 6AQ5W = EL90
V106 6005 (,,)
V107 6005 (,,)
V108 6005 (,,)

2 Frame CY-1398A/ARC-34

incl dynamotor and main plug

Dynamotor DY103 input **27V 10A max**

Output 99V – 280 mA or at Tx 99V – 170 mA
320V – 60 mA or at Tx 300V- 450 mA

3. Dual IF strip R-568 /ARC-34

Testconnector = red

301		302	
303		304	
305		306	
307		308	
309	5896	310	5896 dual diode
311	5896	312	5896 ,,
313	5840	314	5840
318	5906 *	315	5636
316	5718	317	5902 lang

Plus 1 subunit with 5840 is 19 tubes

* 26V filament, otherwise identical to 5840

4 Oscillators MX-1489 / ARC-34

Testconnector = orange

Z401	first osc	Z406	2 mix
V402	5840	V407	5636
V403	5840	Z408	3mix
V404	5636	Z409	discr
Z405	1 mix	V410	5840

Plus 3 subunits V1501 is 13 tubes in this module

5 UHF module AM-868 / ARC-34

Local osc. train

Testconn = yellow

501	5639	
502	5977	osc.
503	5840	doubler
504	5840	doubler
505	5639	osc.

PA Driver

Testconn = green

551	5840	bal. mixer
552	5840	bal.mixer
553	6AN5	driver
554	5686	driver
555	5687	pwr dual triode
556	5687	as series stab
557	5840	
558	5783	85V neon ref

–

RCA and Magnavox

6 UHF final ampl AM - / ARC-34

Testcon = pink *Testconn=blue*

Power Ampl		Receiver	
V601	6264	V651	5876 pencil
V602	6263	V652	5876 pencil
V603	6263	V653	5719 mixer
V604	6263	V654	5840 tripler
		V655	5636 first IF

7 Guard Receiver R-567 / ARC-34

Testconn = grey

V701 5718
V702 5718
V703 5840
V704 5719 mixer
V705 5636 first IF
V706 5718 butler osc.
V707 5840 butler osc.

10 Selector C-1256 / ARC-34

Testconnector = white

V1001 6AH6
V1002 -
V1003 5727 (2D21)
V1004 5727
V1005 5727

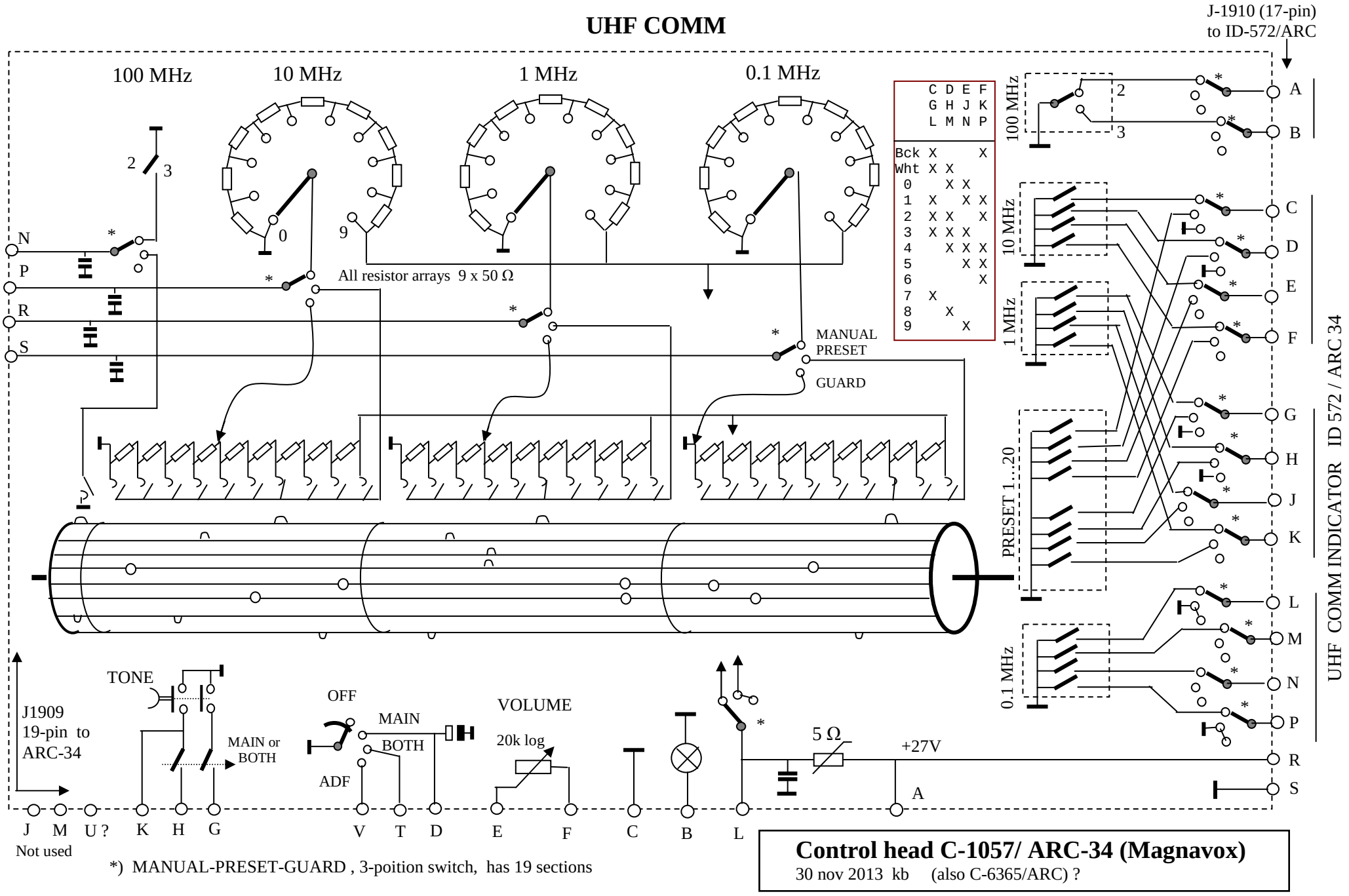
Control panel C-1057 / ARC-34

No tubes

Remote indicator ID-573A

4 transistors RCA 3593

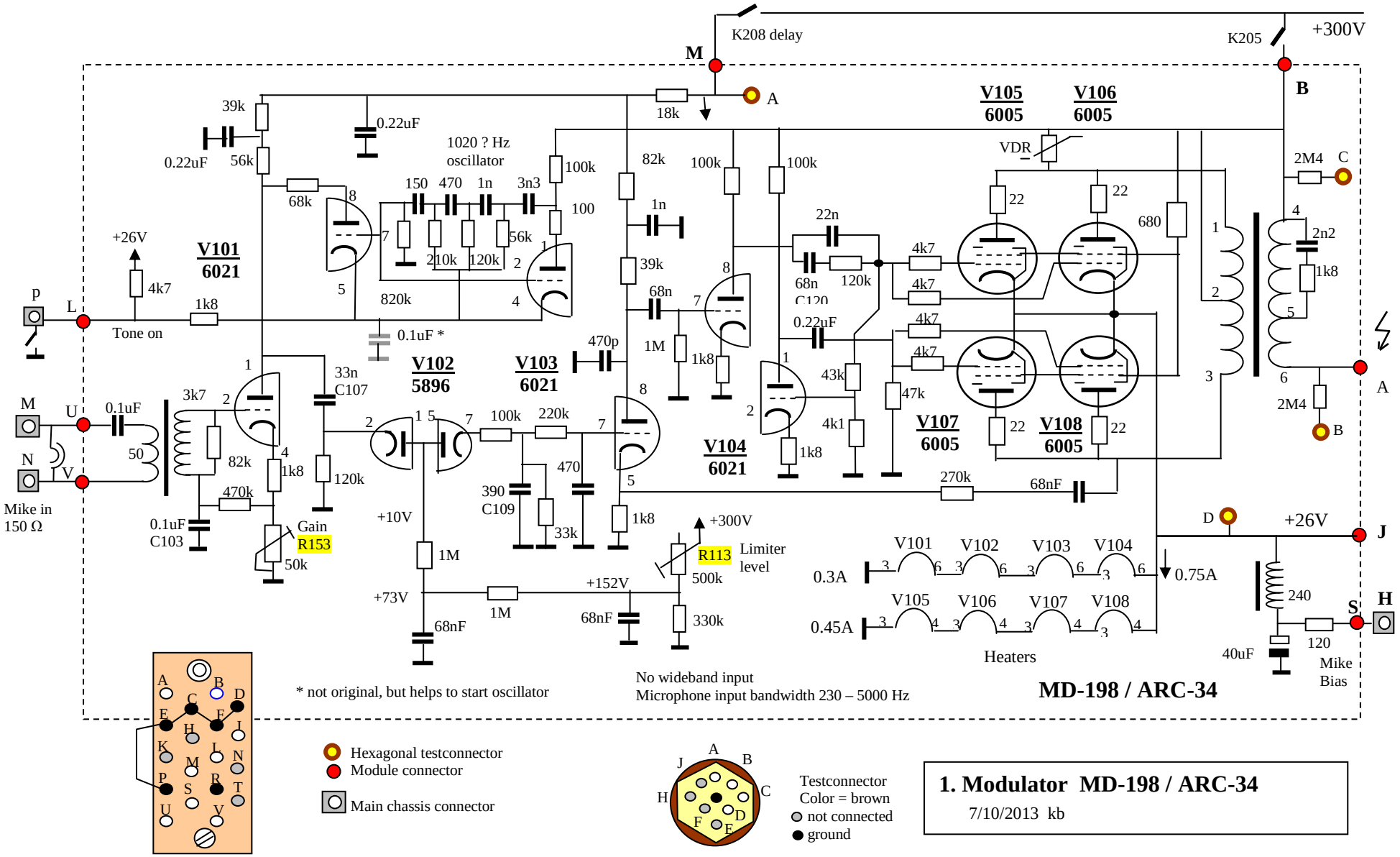
1. Modulator	8
3. Dual IF strip	19
4 Oscillator	13
5a Local osc train	5
5b PA driver + V-stab.	8
6a PA final	4
6b Main receiver	5
7 Guard receiver	7
10 Selector	4
Total	**73 tubes**

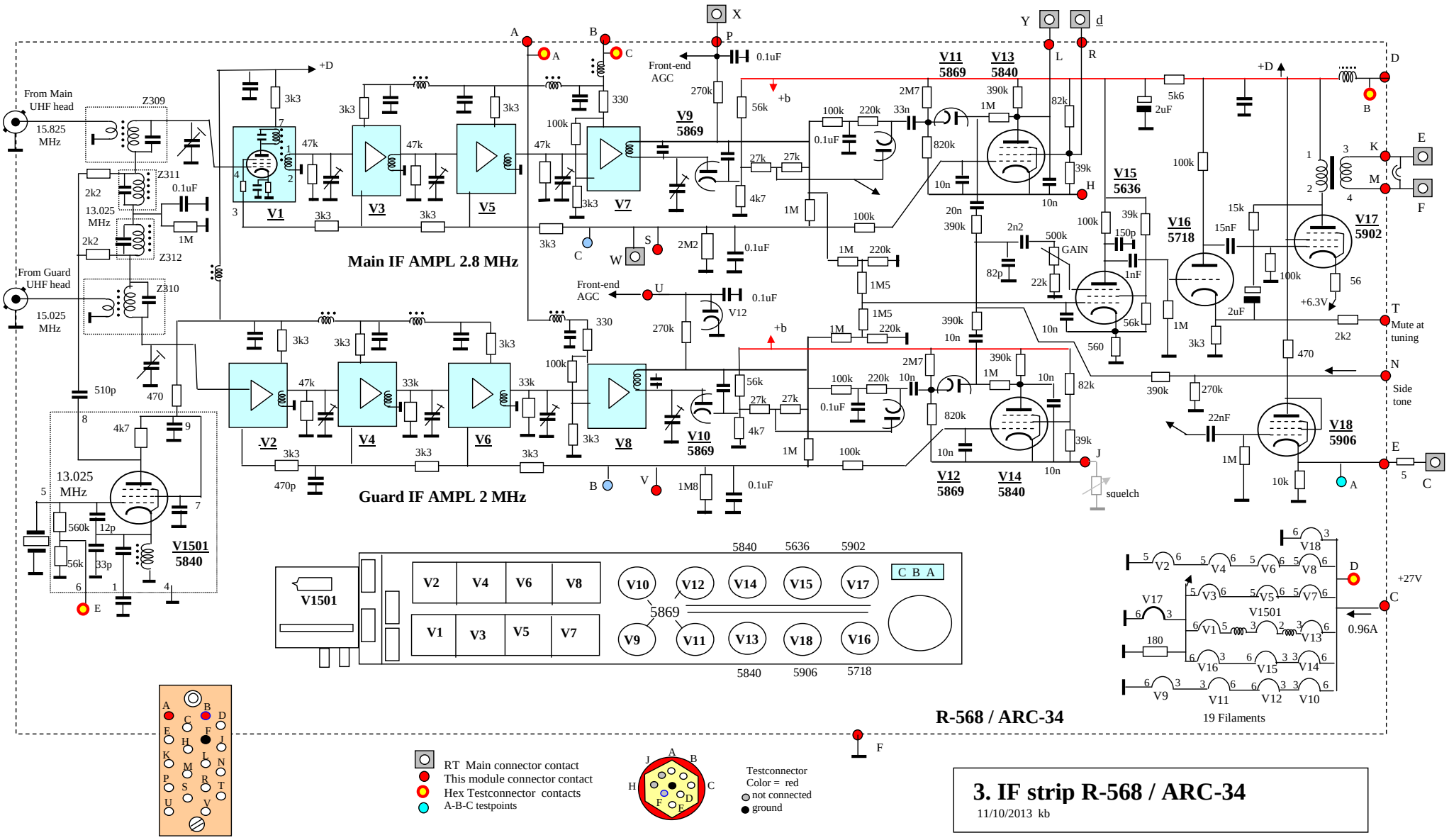


*) MANUAL-PRESET-GUARD , 3-poition switch, has 19 sections

Control head C-1057/ ARC-34 (Magnavox)

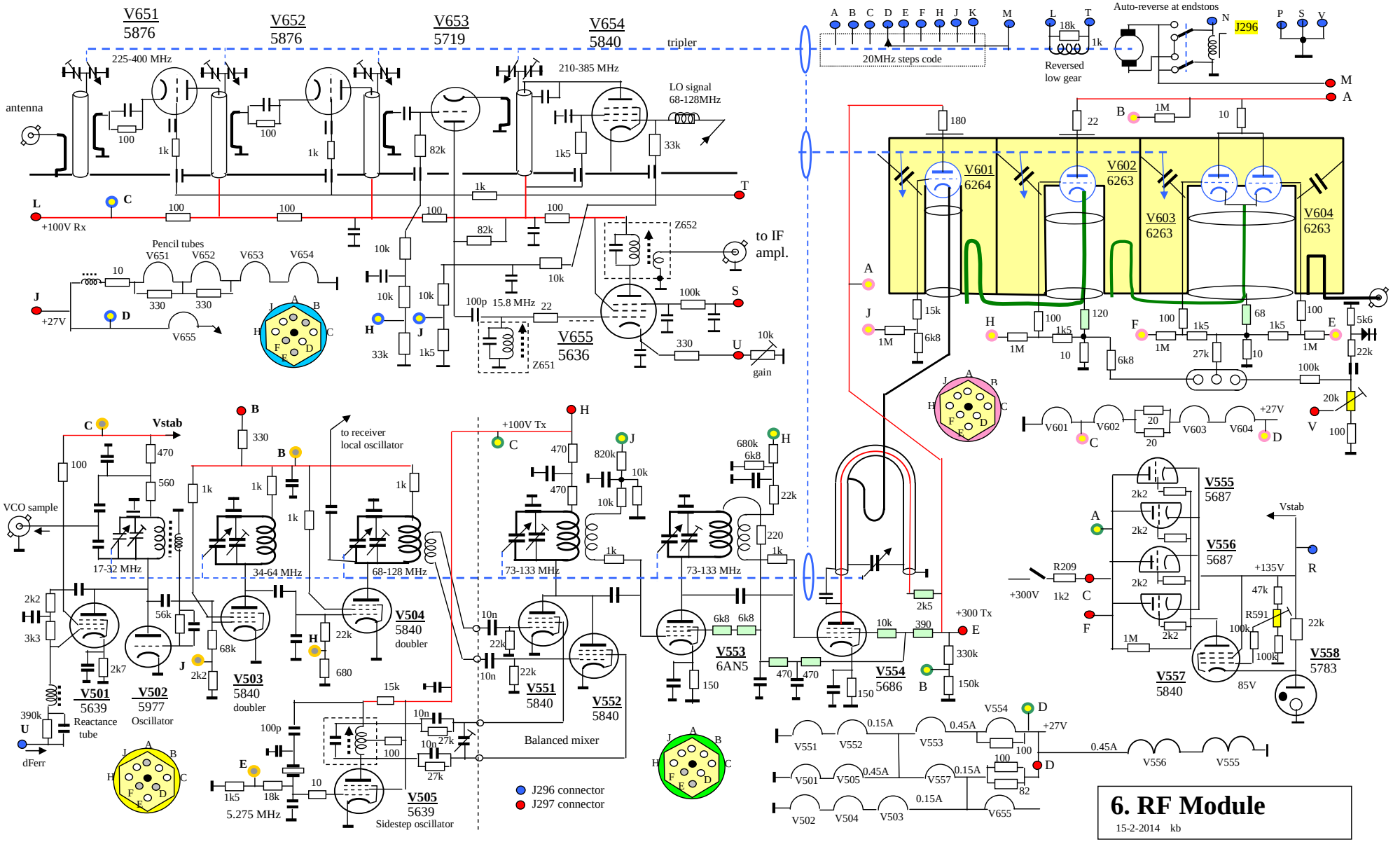
30 nov 2013 kb (also C-6365/ARC) ?

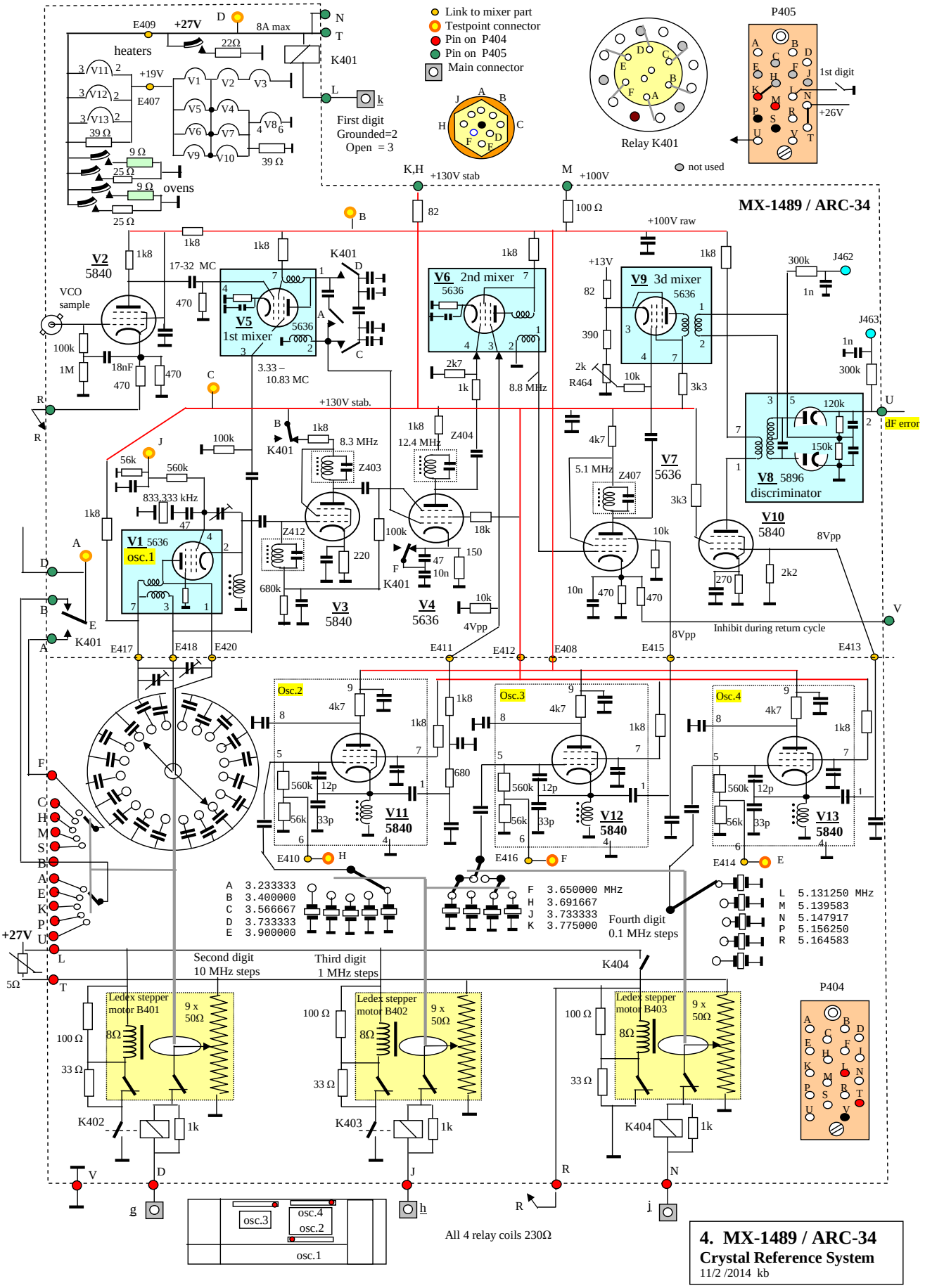

K208 delay
M
K205
+300V
B
A
18k
V105
6005
V106
6005
39k
0.22uF
56k
0.22uF
1020 ? Hz
oscillator
100k
68k
150
470
1n
3n3
100
56k
210k
120k
820k
82k
100k
100k
1n
39k
68n
VDR
22n
68n
C120
120k
0.22uF
470p
1M
1k8
43k
47k
4k1
4k7
4k7
4k7
4k7
22
22
680
22
22
2M4
C
4
2n2
1k8
5
6
2M4
B
A
+26V
4k7
V101
6021
p
L
1k8
Tone on
0.1uF *
V102
5896
V103
6021
V104
6021
V107
6005
V108
6005
M
U
0.1uF
3k7
50
N
V
82k
470k
0.1uF
C103
Mike in
150 Ω
1k8
Gain
R153
50k
33n
C107
120k
100k
220k
390
C109
470
33k
1k8
270k
68nF
+10V
1M
+73V
1M
68nF
+152V
68nF
+300V
R113
500k
Limiter
level
330k
D
+26V
J
V101
V102
V103
V104
0.3A
0.75A
V105
V106
V107
V108
0.45A
Heaters
240
S
H
120
40uF
Mike
Bias
MD-198 / ARC-34
* not original, but helps to start oscillator
No wideband input
Microphone input bandwidth 230 – 5000 Hz
Hexagonal testconnector
Module connector
Main chassis connector
Testconnector
Color = brown
not connected
ground
1. Modulator MD-198 / ARC-34
7/10/2013 kb



3. IF strip R-568 / ARC-34

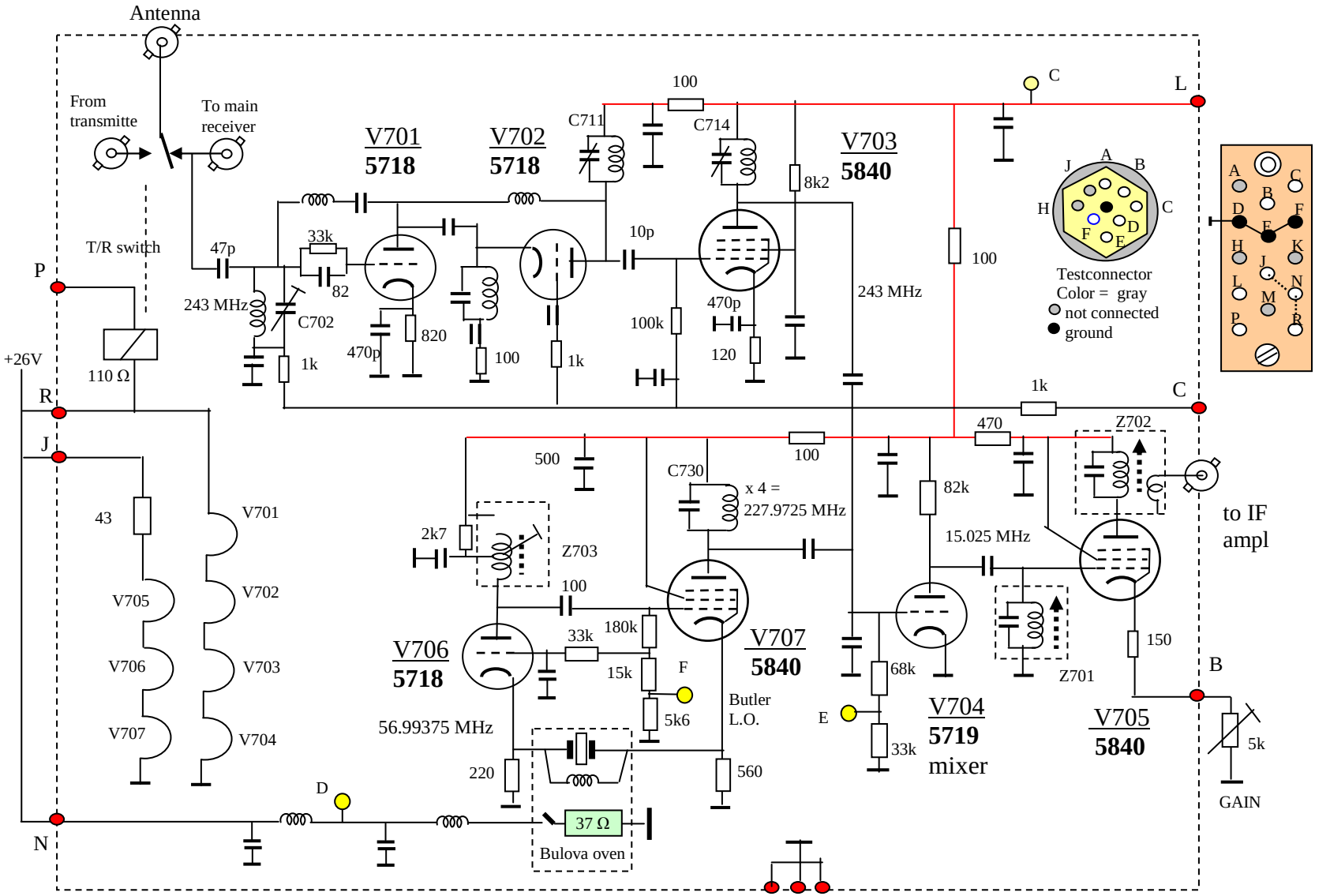
11/10/2013 kb


V651
5876
V652
5876
V653
5719
V654
5840
tripler
225-400 MHz
210-385 MHz
LO signal
68-128MHz
antenna
+100V Rx
Pencil tubes
V651 V652 V653 V654
+27V
V655
to IF
ampl.
V655
5636
Z651
Z652
gain
20MHz steps code
Reversed
low gear
Auto-reverse at endstops
J296
V601
6264
V602
6263
V603
6263
V604
6263
V601 V602 V603 V604
+27V
Vstab
VCO sample
17-32 MHz
34-64 MHz
68-128 MHz
to receiver
local oscillator
+100V Tx
73-133 MHz
73-133 MHz
V501
5639
Reactance
tube
V502
5977
Oscillator
V503
5840
doubler
V504
5840
doubler
V551
5840
V552
5840
Balanced mixer
V553
6AN5
V554
5686
V555
5687
V556
5687
V557
5840
V558
5783
R209
+300V
+300 Tx
+135V
85V
dFerr
5.275 MHz
V505
5639
Sidestep oscillator
J296 connector
J297 connector
V551 V552 V553 V554 V555 V556
V501 V505 V557
V502 V504 V503 V655
0.15A
0.45A
6. RF Module
15-2-2014 kb

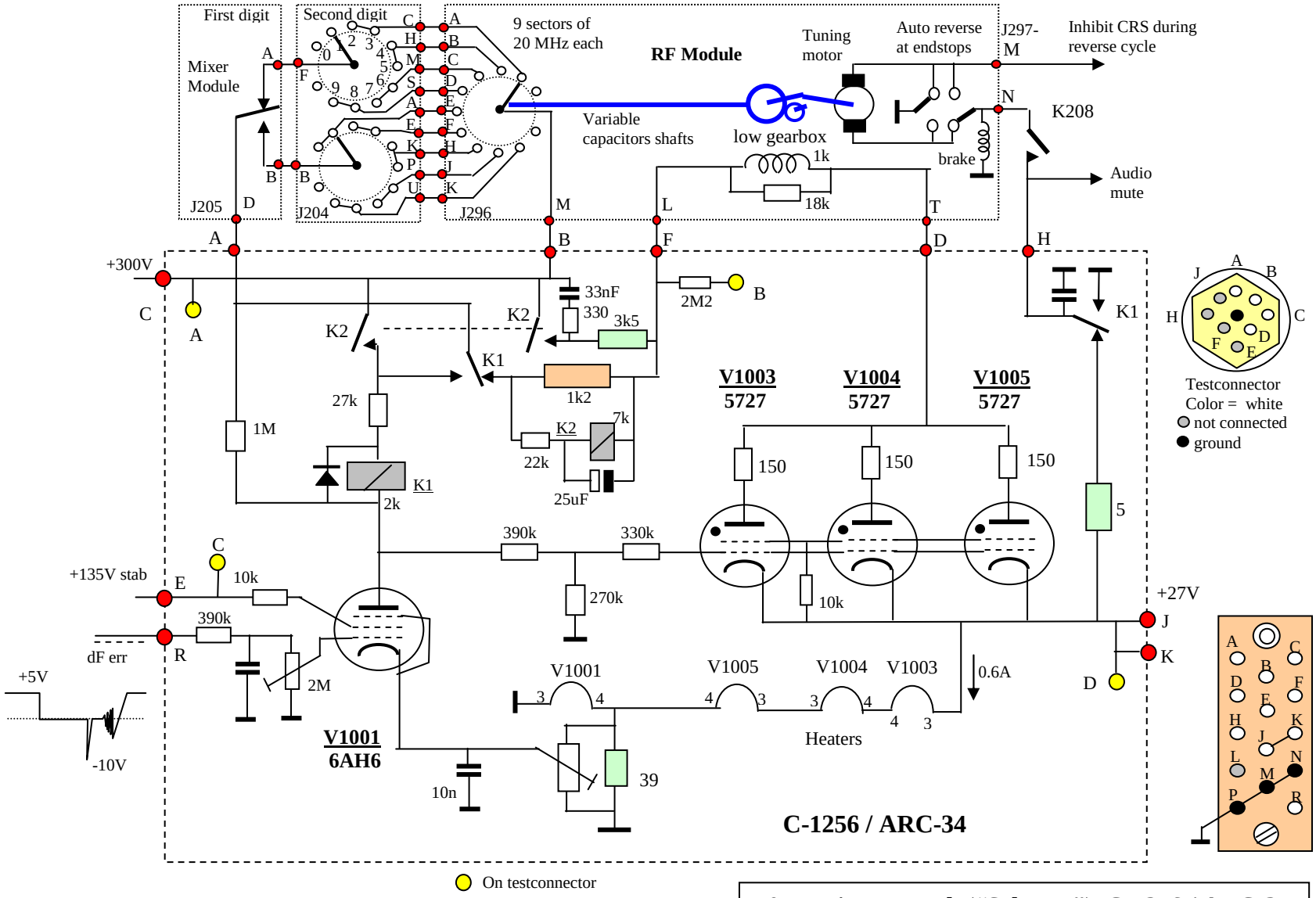


4. MX-1489 / ARC-34
Crystal Reference System

11/2 /2014 kb

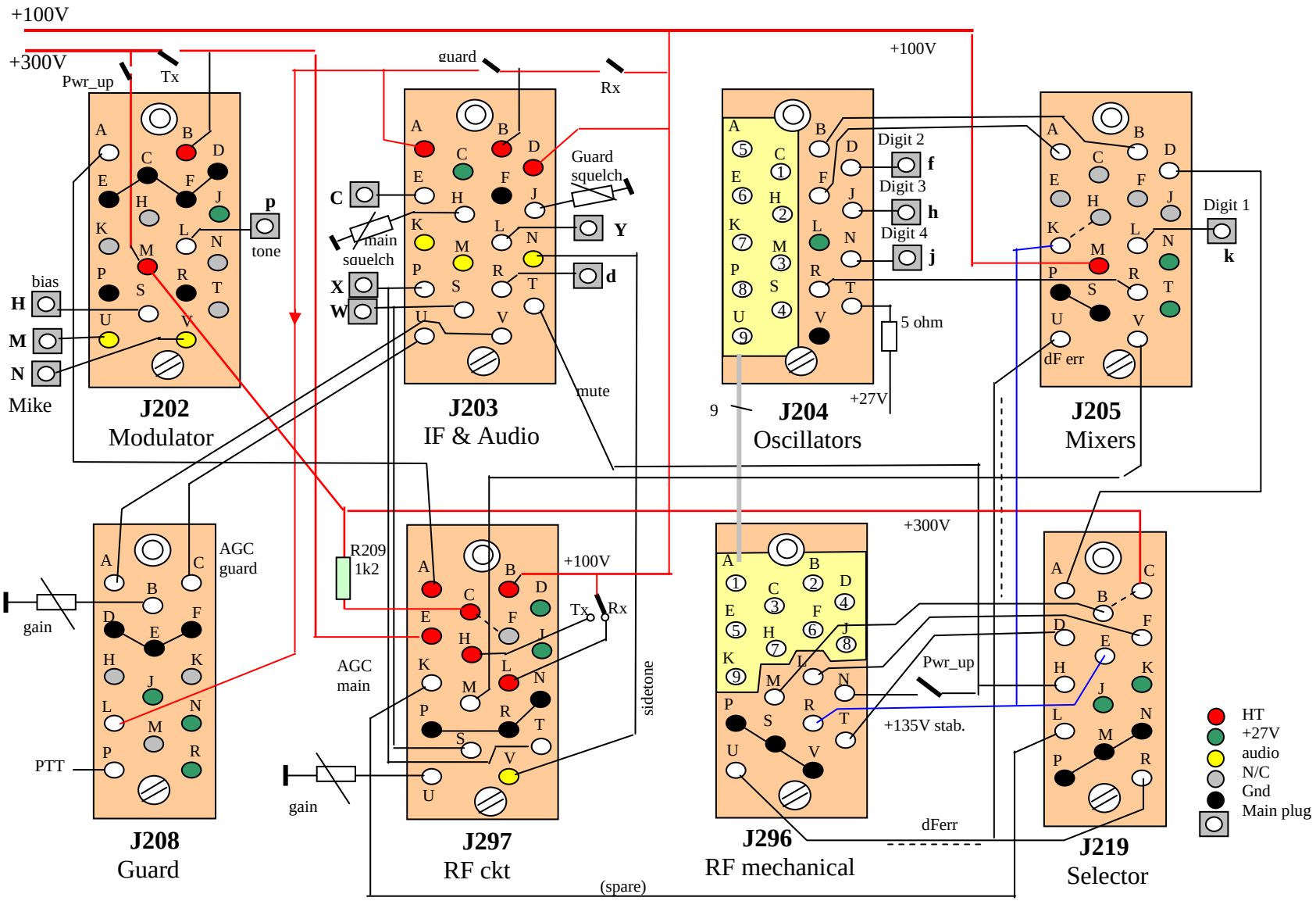


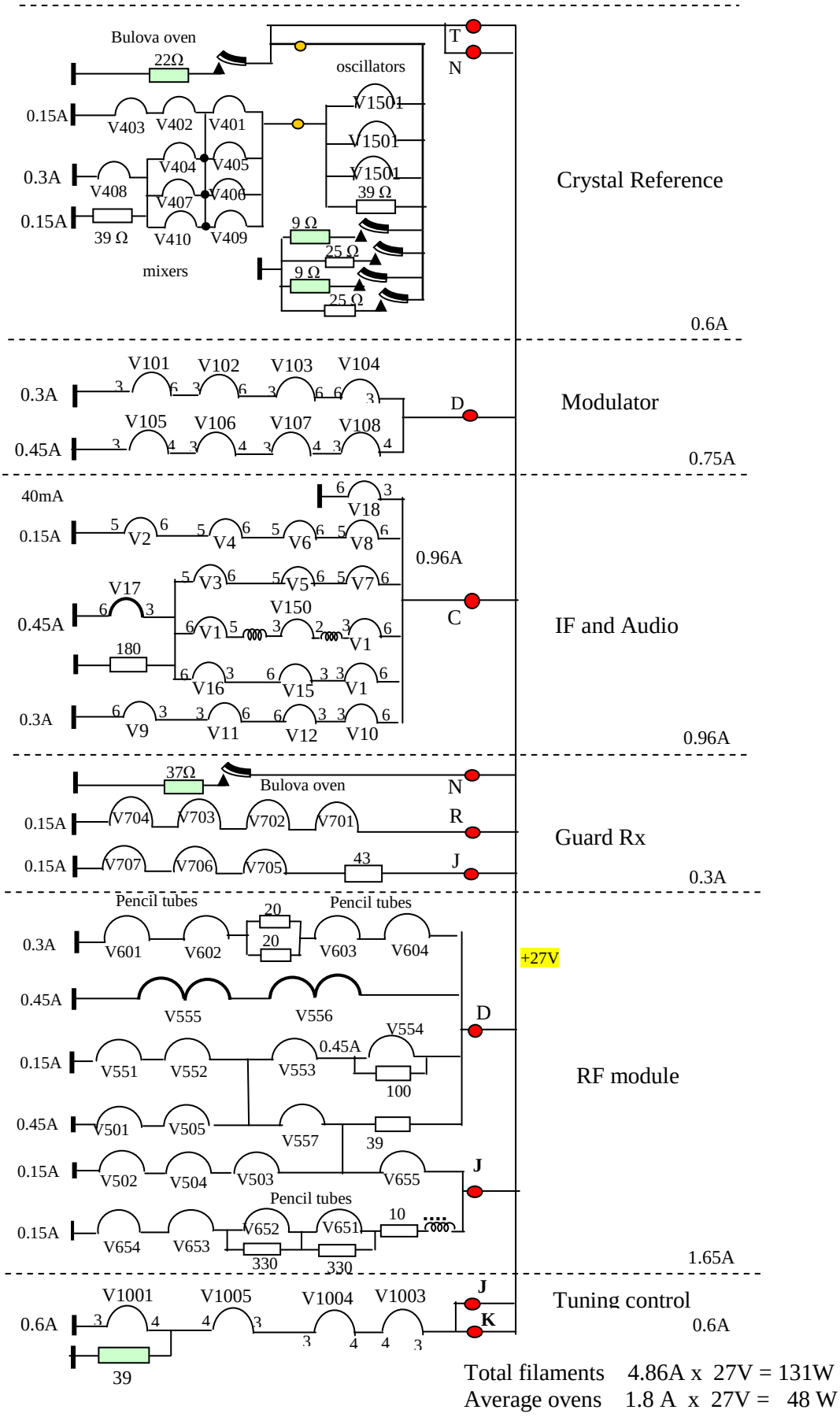
R-567 / ARC-34
7. Guard Receiver



10. Tuning control ("Selector") C-1256 / ARC-34

4/2/2014 kb


+100V
+300V
Pwr_up
Tx
guard
Rx
+100V
Digit 2
Digit 3
Digit 4
Digit 1
f
h
j
k
p
tone
bias
H
M
N
Mike
C
main squelch
X
W
Guard squelch
Y
d
mute
5 ohm
+27V
9
dF err
J202
Modulator
J203
IF & Audio
J204
Oscillators
J205
Mixers
AGC guard
gain
PTT
R209
1k2
AGC main
+100V
Tx
Rx
sidetone
gain
+300V
Pwr_up
+135V stab.
dFerr
(spare)
J208
Guard
J297
RF ckt
J296
RF mechanical
J219
Selector
HT
+27V
audio
N/C
Gnd
Main plug



Total filaments 4.86A x 27V = 131W
Average ovens 1.8 A x 27V = 48 W

ARC-34 DC input current

6 nov 2013

Input current from 27.5Vdc source

Filaments	4.86 A
Ovens (peak 8A), on average :	1.8 A
Internal fan	1.4 A
Dynamotor loss *)	2.14 A
Dynamotor load Rx/ Tx **)	1.8 A / 5.6 A
Relays	0.2 A / 0.4 A
Tuning voltage dividers (incl control)	0.36 A
Total	12.5 A / 16.5 A
	337 W / 445 W (for 10W output …)

The tuning motor adds 0.6A during 3 sec after any frequency change

*) Dynamotor input current without load. Is about 2A at any input voltage
During run-up the input current is 15A

**) Dynamotor input current portion due to load, transformed to primary current

Dynamotor DY103 input **27V 10A max**

Output 99V – 280 mA or at Tx 99V – 170 mA
320V – 60 mA or at Tx 300V- 450 mA
28 + 19 = 47.2 W 17 + 135 = 152 W output

No load dynamotor input current

Vin	I in	HT1	HT2
25V	2.5	124	324

Measured total input current and dynamotor voltages

Power supply used: 26V dc with 20A current limit. Fan disconnected, otherwise complete.
- Dynamotor run-up with supply in current limit takes 2 seconds.
- Then current decreases to 13.5A
- At 20 sec from turn-on, relay K 208 turns on the 300V distribution and the tuning motor.
- Input current rises to 16.5 A, with still running tuning motor.
and fluctuations up to 18.5A due to crystal oven heaters.
- With ovens hot, the current decrease to **12.8A**, with every 2 sec a surge when the tuning motor reverses. At lock, the current fluctuates between 10 and 11A. (without fan)

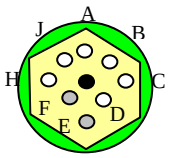
Supply voltages +107V, +317V and +135V (stabilized) All OK.

ARC-34 Testpoints

Each module of the **AN/ARC-34** has a special 9-pole test connector to check the B+ voltages, filament voltage, and oscillator negative grid voltages.

These are measured with the URM-76A voltmeter for a quick go/no-go test on each module. The 9 test connectors are color coded.

The voltmeter has a 8-position switch to measure the voltage on a pin of the test connector versus the centre pin K of the test connector which is grounded in each module.



I measured the following voltages on a healthy set with 27Vdc input using a DVM with 10M input impedance.

Module		A	B	C	D	E	F	H	J
Modulator	1	+ 330	+ 307 modulated	+ 330 300 Tx	+27				
IF Amplifier	2	+ 117 guard	+ 117	+ 117 100 Rx	+27	-0.53 LO-2			
Crystal Reference	3	+ 330	+ 117	+ 129 (+130 stab)	+27	-1.2 osc 4	-1.13 osc.3	-1.0 osc.2	-2.36 osc 1
Master oscillator	4		+ 117	+ 129 (+130 stab)		-0.71 Sidestep		-0.84 doubler 2	-0.67 doubler 1
Driver	5	+ 268 Input stab	+ 80 +300Tx/4	+ 117 100 Tx	+27			-16.5 Driver2	-0.41 Driver1
Main Receiver	6			+117 100 Rx	+27			-0.17 mixer	-0.40 tripler
RF Power Amp	7	+ 308	+ 307 modulated	+ 5.8	+27	-11.5 PA1	-12.9 PA2	-9.0 driver	-24.7 tripler
Guard Rx	8			+ 117 guard	+27	-0.23 mixer	-0.38 butler		
Selector	9	+ 330	gear/clutch See plot	+ 129 (+130 stab)	+27				

The grey positions are not connected in that module.
The blue positions shall be checked in Transmit mode (key down)
The guard positions shall be checked with the mode switch on the control panel in the position “Both”

Modulator test points B and C have a 2M4 series resistor, so measure 250V on a voltmeter with 10 MΩ input impedance.
Selector test point B has also 2M4 series resistor, add 20% when measuring with a x10 probe
Many test points in the driver or RF Power Amp have 1M series resistor. Add 10%.
The readings for the oscillators in the crystal reference module are quite independent of the frequency selected.

AN/URM-76A / ARC-34 Radio Testset