AR5000 Bulletin Page

AR5000 brief production history

The AR5000 first appeared in 1996, the serial numbers were 5xxxx (six digit numbers starting with the number five). In the first few months of production, some beefing up of the internal power PCB took place, a trimmer was added to the SSB insertion oscillator (PCB) and some noise reducing changes added (DDS decoupling, change of RS232 device).

A revision to operation (firmware) appeared after about one year, the serial numbers changed to 07xxxx (six digit numbers starting zero seven with four digits following).

A board change occurred around serial number 070661 when the AR5000+3 additions appeared (Synchronous AM, noise blanker, AFC). If the serial number is lower than 070661 we cannot retrospectively add the +3 options:

Around 070661 the EEPROM switching was revised so that an alternate bank of memories and search banks could be switched (doubling the memory capability).

Minor firmware revisions have taken place since, mainly to boost the durability of EEPROM when under computer control (commercial operators).

The AR5000C is a frequency coherent version of the AR5000, designed for commercial operators.

Current serial numbers (February 2003) are around 077xxx.

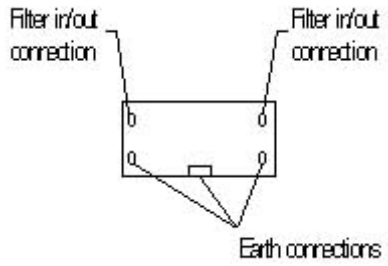
Retrospective and free updates are NOT available. The AR5000 has been designed & manufactured by AOR Japan who are officially responsible for international distribution and support... comment presented here may not reflect their official status or views, AOR UK LTD.

AR5000 1kHz filter modification

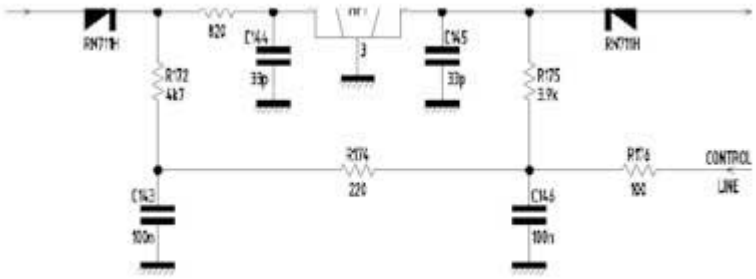
We have had several enquiries regarding the fitting of a 1kHz data filter to the AR5000; in particular the CFJ455K8 which we originally sourced for our AR7030 HF receiver. The main problem in fitting this filter to the AR5000 is the physical incompatibility; we have found however that by turning the filter upside down you can attach short leads to it and connect it in the MF1 Collins 500Hz filter position on the AR5000 IF board without any great difficulty.

The diagram below shows the CFJ455K8 filter connection details. All three earth connections should be connected together using tinned copper wire and then soldered to the original Collins earth connection using thick tinned copper wire to achieve a good physical stability on the board. Short lengths of wire can now be used to make the in/out connections between the filter and PCB. If you require a more permanent fixing of the filter to the board we suggest

double sided tape to hold the filter in an upside down position before making the soldered connections.



Careful examination of the PCB around the filter connections will show that there are two 33pF SMD capacitors connected between the filter in/out and earth. Ideally these could be removed to give a flatter frequency response along with changing R173 to 1k8. In practice however you will probably not notice any change and we recommend that they are left as standard. The circuit is shown below



After fitting the filter, refer to page 68 and 69 of the AR5000 instruction manual in order to register the new filter. You must register the new filter as a 500Hz filter - this is also the bandwidth that will be displayed when the filter is selected. Unfortunately there is no 1kHz bandwidth available on the display.

AR5000 DETECTOR OUTPUT

The AR5000 is capable of running various decoders from its ACC1 socket on the front panel (pin2 gives approx. 180mV RMS -100Kohm).

This is suitable in most cases, but is slightly limited by two 0.1uf capacitors and switching circuits in line between the detector output and the socket.

If problems are experienced, then the solution will probably be direct connection to the FM detector IC on the IF unit.

To do this, remove the top case of the receiver to reveal the IF and PLL units underneath. The IF unit is the rearmost board (fitted with various filters). Once the six screws are undone and the IF OUT mini-coax plug disconnected, the board will pull slightly forward and hinge towards the front panel.

The detector output can be taken from pin 9, IC8. This is a surface mount IC located on the underside of the board (roughly under the 10.245Mhz crystal).

IC8 is labelled as MC3372M.

The output can be taken by directly soldering a wire to the output pin or from the capacitor it feeds (C88 - located directly next to pin 9). Care must obviously be taken when carrying out any work of this type. Note that there is a small DC level present on this pin and some DC decoupling will be needed if none is present in the decoder input.

As all pins on ACC1 socket are used, the new detector output will now have to brought out of the set separately or possibly connected to pin 4 on ACC2 if that socket is not being used.

Refit the board and test before re-fitting the top cover.

Approximate output levels to be expected directly from the IC are (with a large signal input and 1kHz tone):

Filter used	Deviated at 3kHz	Maximum deviation for filter bandwidth
6kHz	900mV (p / p)	1.2V (p / p)
15kHz	600mV	1.2V
30kHz	300mV	1.2V
110kHz	200mV	1.2V

Further specification - measurements

The following additional specification has been generated at the request of customers, much of the test data has been provided by AOR Japan and represents 'typical' measurements:

Maximum signal input:

+17dBm input is acceptable without damage over the entire frequency range of the AR5000, this represents about 1.5V into 50 OHMS.

AGC time constant:

FM	ON/OFF
AM, USB, LSB, CW	OFF / SLOW

AFC (AR5000+3 only):
The AFC operates in AM, & FM modes, it is not operational in SSB modes. Operation typically auto-tunes to centre frequency within a few seconds when an offset of a few kHz exists. The maximum capture offset is 25kHz.

Overall noise figure:
AM S/N is as follows at 60% and 70% modulation with 3 kHz and 6 kHz filters

Freq	Filter	60%	70%
129.8 MHz	3kHz	48dB	49dB
129.8 MHz	6kHz	49dB	50dB
880.8 MHz	3kHz	33dB	33.5dB
880.8 MHz	6kHz	46dB	47dB

Also refer to attached local oscillator noise measurement.

IF / image rejection, Image rejection (1st image):

250 kHz	81dB
700 kHz	81dB
1.450 MHz	85dB
3.000 MHz	85dB
7.000 MHz	87dB
15.80 MHz	88dB
30.80 MHz	89dB
52.80 MHz	107dB
120.8 MHz	119dB
199.8 MHz	95dB
320.8 MHz	76dB
430.8 MHz	52dB
850.8 MHz	54dB
1250.8 MHz	59dB
2600.0 MHz	81dB

2nd order products:

Tested at 129.800 MHz (wanted signal) to produce 12dB SINAD	-118 dBm
Unwanted signal 2.550 MHz	- 33.5 dBm
Unwanted signal 132.350 MHz	- 33.5 dBm
	84.5dB

3rd order products:

Test frequency (wanted)	Unwanted frequencies	Product
25.800 MHz	25.925 & 26.050 MHz	-8dBm
129.800 MHz	129.925 & 130.050 MHz	-14dBm
320.800 MHz	320.925 & 321.050 MHz	-12dBm
470.800 MHz	470.925 & 471.050	-10dBm
850.800 MHz	850.925 & 851.050	-10dBm

Cross modulation:

Wanted frequency 129.800 MHz, 60% AM with 15 kHz bandwidth	-93dBm S/N 21.5dB
Interfering signal 129.900 MHz, 30% mod	-23dBm S/N 18dB 60dB -27dBm S/N 20dB 56dB

Wanted frequency 129.800 MHz, 60% AM with 15 kHz bandwidth	-89dBm
Interfering signal 129.925 MHz, 30% mod	-23dBm S/N 20dB 60dB

There are two resets for the AR5000:-

1) **CPU RESET**. If switching the set off/on does not help, the next action should be to reset the receiver using the hidden reset switch provided.

The reset switch is located behind the torque lever to the right of the main tuning dial.

i. Move the lever to the downwards position, a black cloth material covers the slot. The reset switch is located at the top of the slot about 10mm behind the front panel.

ii. Using a match stick or similar tool, press and release the reset switch (with the unit switched on, and powered in a normal manner).

iii. The back light will extinguish then all LCD characters will be displayed, the set will then power up and resume normal operation (if it has not automatically switched on again press the "Power" button).

This will re-boot the CPU without erasing the search/memory contents or going back to the default settings. The last entered frequency in VFO may be lost.

2) **CPU SOFT RESET**. If the reset switch does not help, it is possible to SOFT RESET the AR5000 CPU. This will clear all bank link information and reset the VFO to default parameters including frequency display of 128.900Mhz.

i. Switch the receiver off (unplug the power cord if necessary to power down the receiver).

ii. Press and hold the "CLR" key while switching on the receiver once again, keep hold of the "CLR" key.

iii. The clock will be displayed, wait for the default frequency/text display to appear then release the "CLR" key.

The defaults are:

Frequency 128.900MHz
Receiver Mode AM
Tuning Step 25kHz
IFBW 6.0kHz
Attenuator 00dB

AR5000 'S'Meter Response (HEX)

The following table is compiled using a standard AR5000 in NFM mode with the 15KHz filter fitted at 171.1MHz. The meter response throughout the VHF region is reasonably flat and will give readings of similar level. The responses were obtained using the LM command

Signal Input (dBm)	Hex Response	Signal Input (dBm)	Hex Response
- -	02	**-85**	7F
-120	02	**-80**	8B
-115	02	**-75**	96
-112	02	**-70**	A0
-111	06	**-65**	AA
-110	0B	**-60**	B3
-109	14	**-55**	BD
-108	1D	**-50**	C6
-107	25	**-45**	CE
-106	2B	**-40**	D7
-105	32	**-35**	E0
-104	38	**-30**	E8
-103	3D	**-25**	F1
-102	43	**-20**	F8
-101	49	**-15**	FA
-100	4E	**-10**	FB
-95	63	**-5**	FC
-90	71	**0**	FD

AR5000 Frequency stability

Measured for a ‘typical’ stock set.
Measured at 20 MHz from cold. Room temperature approx. 25 degree Celsius.

Time Elapsed	Frequency change from start
0	0 Hz
1 minute	3 Hz
2 minutes	4 Hz
3 minutes	6 Hz
4 minutes	8 Hz
5 minutes	9 Hz
10 minutes	16 Hz
20 minutes	25 Hz
30 minutes	30 Hz
40 minute	33 Hz
50 minutes	35 Hz
1 hour	36 Hz
2 hours	37 Hz

i.e. Under 2ppm from cold in 1st hour.
0.05ppm in subsequent hour.

AR5000 Local Oscillator Phase Noise Measurements

The following measurements are from a 'typical' AR5000 receiver. Figures supplied by AOR Japan 19 December 1997.

VCO			dBC/Hz 25KHz Offset	50KHz Offset
VCO1	10KHz	622.4MHz	109	112
	15KH	637.4MHz	110	112
	29KHz	651.4MHz	109	111
VC02	30MHz	652.4MHz	103	108
	103MHz	725.4MHz	103	108
	174MHz	796.4MHz	104	108
	675MHz	1297.4MHz	98	104
	825MHz	1447.4MHz	98	106
	974MHz	1596.4MHz	100	107
VC03	175MHz	979.4MHz	102	107
	258MHz	889.4MHz	102	107

	339MHz	891.4MHz	102	107
	975Mz	1597.4MHz	95	101
	1180MHz	1802.4MHz	98	105
	1384MHz	2006.4MHz	101	107
VCO4	340MHz	962.4MHz	100	107
	420MHz	1042.4MHz	101	108
	499MHz	1121.4MHz	101	108
	1385MHz	2007.4MHz	99	106
	1399MHz	2021.4MHz	99	106
VC05	500MHz	1122.4MHz	101	108
	588MHz	1210.4MHz	100	106
	674MHz	1296.4MHz	100	106
	129MHz	611.7MHz	107	112

'Close in' phase noise 'typical' measurements are as follows (information provided by AOR Japan):

Receiving frequency: 1500.00MHz
Spectrum analyser RBW: 10Hz, VBW: 3Hz

Offset frequency (Hz)	dBc/Hz
70	66.5
100	67.3
200	68.7
500	68.8
700	70.5
1000	71.1

AR5000 Spurii List

The following measurements are of a "typical" AR5000 receiver. Figures supplied by AOR Japan 3th February 1998.

***Note AR5000C**: Due to the design of the frequency coherent version, relatively largely spurii exists every 50MHz through the receivers frequency range, this is not a fault, nor can the spurii be removed.*

The receiver setup being:

Receiver mode: FM

IF bandwidth: 15kHz

Tuning step size: 5kHz (fine tuned to centre frequency in 100Hz

Antenna: Terminated into 50 OHMS

Spurii No.	RX Frequency	S-Meter Reading	Spurii No.	RX Frequency	S-Meter Reading	Spurii No	RX Frequency	S-Meter Reading	Surii No.	RX Frequency	S-Meter Reading
1	0.1600	0	39	681.7840	2	77	1015.7247	7	115	2085.3502	0
2	12.8000	0	40	681.8840	2	78	1019.1661	0	116	2093.4000	0
3	25.6000	3	41	683.1120	0	79	1023.4111	0	117	2093.6832	0
4	38.4000	0	42	687.8660	3	80	1040.1883	0	118	2093.9665	0
5	109.5010	0	43	688.1040	0	81	1056.9656	0	119	2328.6859	0
6	218.1031	0	44	697.9340	0	82	1057.5214	0	120		
7	236.0850	0	45	698.5730	3.5	83	1067.7214	0	121		
8	292.4500	0	46	698.6720	3	84	1073.7429	0	122		
9	297.4746	0	47	699.9340	0	85	1084.3100	0	123		
10	297.7500	4	48	704.6433	2.5	86	1084.5100	0	124		
11	300.3999	+20	49	721.4208	2.5	87	1085.5144	0	125		
12	300.4663	+20	50	738.1980	0	88	1080.5201	0	126		
13	445.3145	0	51	750.0020	0	89	1094.4856	0	127		
14	445.4006	0	52	754.9752	3	90	1107.2975	0	128		
15	450.6855	0	53	766.8270	0	91	1216.5747	4	129		
16	520.0930	0	54	771.7525	3	92	1216.9747	4	130		
17	536.8700	0	55	782.5150	0	93	1475.8859	4	131		
18	570.4250	0	56	782.6150	0	94	1544.7997	+15	132		
19	584.133	0	57	783.648	0	95	1894.89	0	133		

	3				0			56					
20	554.4000	0		58	785.5298	4		96	1809.0502	1		134		
21	587.2030	0		59	799.3035	0		97	1809.7502	0		135		
22	596.2030	0		60	799.4035	0		98	1815.0002	0		136		
23	597.3160	0		61	805.3068	0		99	1815.2402	0		137		
24	597.4168	0		62	808.3141	6		100	1815.4802	0		138		
25	603.9800	0		63	815.9921	0		101	1815.7202	0		139		
26	615.8200	0		64	816.0921	0		102	1815.9602	0		140		
27	620.7550	0		65	822.0842	0		103	1840.3825	0		141		
28	531.5190	0		66	841.1668	0		104	1841.2835	0		142		
29	631.6180	0		67	841.2835	0		105	1841.5835	0		143		
30	637.5340	0		68	849.8665	0		106	1846.8000	0		144		
31	648.3050	0		69	901.1995	9		107	1846.8299	0		145		
32	548.4050	0		70	973.0795	0		108	1847.0798	0		146		
33	654.3120	0		71	989.8566	0		109	1847.3598	0		147		
34	658.6133	0		72	1000.6668	0		110	1861.5014	7		148		
35	684.9950	1		73	1001.9434	0		111	2044.8004	8		149		
36	665.0950	1		74	1006.6339	0		112	2045.853	8		150		
37	571.0890	3		75	1011.3370	0		113	2045.3715	8		151		
38	678.2740	0		76	1011.4794	0		114	8088.0668	0		152		

AR5000 AGC & RSSI

Test signals have been generated at 184 MHz FM and the results are presented here while monitoring voltage on the rear AUX connector and using the LM command via the built-in RS232 port and have concentrated on levels between -120 and -100dBm:-

Signal level		**Dev/Filter 5/15kHz AGC RS232**		**Dev/Filter 24/30kHz AGC RS232**		**Dev/Filter 24/110kHz AGC RS232**	
-117**dBm**	0.32 **uV**	4.58 **V**	03	4.58 **V**	03	4.58 **V**	03
-116	0.35	4.57	03	4.58	03	4.58	03
-114	0.45	4.56	03	4.58	03	4.58	03
-113	0.50	4.52	03	4.58	03	4.58	03
-112	0.56	4.47	03	4.58	03	4.58	03
-111	0.63	4.40	03	4.57	03	4.58	03
-110	0.71	4.34	03	4.55	03	4.58	03
-109	0.79	4.28	03	4.50	03	4.58	03
-108	0.89	4.23	08	4.44	03	4.58	03
-107	1.00	4.17	11	4.36	03	4.58	03
-106	1.12	4.13	17	4.31	03	4.57	03
-105	1.26	4.09	22	4.24	09	4.53	03
-104	1.14	4.06	27	4.19	11	4.48	03
-103	1.58	4.03	2F	4.14	1A	4.42	03
-102	1.78	4.00	36	4.10	21	4.36	03
-101	1.99	3.97	3C	4.06	2A	4.30	03
-100	2.20	3.95	41	4.03	31	4.24	08

Program search of the new 8.33kHz airband step using the AR5000

The new airband channel step comes into effect in 1999 and 2000 for most of Europe and is to be further extend after that time.

There is much confusion over the issue of 8.33 kHz, in reality it is not 8.33 but eight-and-one-third. As a third cannot be expressed in a decimal fashion, a small compound frequency error will occur every third increment. Ideally the end digits should read ‘00’ ‘33’ ‘66’ ‘00’ but will be display as ‘00’ ‘33’ ‘66’ ‘99’. In reality, the AR5000 may be programmed in 8.333 kHz steps to further minimise the compound error, the error is then very small indeed, especially when considering the sub band is only expected to occupy 132.000 - 134.500 MHz (one Hz every third tuning increment!).

Work around:

If you do not wish to live with a small compound error, it is possible to program three program search banks as a GROUP (refer to section 12-4 Page 49 onward of the English language operating manual).

It is assumed in this addendum that you understand how to program basic functions.

1. Program three program search banks with the limits 132.000 - 134.500 MHz in AUTO mode (AM 25kHz steps). Link all three search banks to form a single group... so all three are searched together. The operating manual does not specifically deal with step-adjust during program search, so ignore it at this time. Let's assume you have used banks 1, 2 & 3.

2. Bank 1 is left 'as is'.

3. Start searching bank 2. Press [STEP] then press [PASS] to engage step-adjust (the "*" legend will be displayed).

Press [UP] to access the sub-menu to allow the step-adjust value to be entered. Key in [8] [.] [3] [3] [ENT]

Now press and hold the [ENT] key **for more than one second** for the data to be accepted (do not simply press ENT momentarily).

As there is no step-adjust entry point during the data input of program search, this LONG HOLD of the [ENT] key must be used to enter step-adjust while searching in the above fashion.

The AR5000 will continue to search but will add 8.33 kHz to every 25 kHz increment.

4. Repeat the process outlined in (3) for the third search bank, in this example (bank 3) but use a step adjust value of 16.66 kHz.

The AR5000 will continue to search but will add 16.66 kHz to every 25 kHz increment.

Outcome:

By searching all three search banks as a group, the exact frequencies will be searched for the new airband allocation without a compound error creeping in. As the AR5000 has 20 search banks (twice), using three banks in this way is no great loss.

Step-adjust in program search mode using the AR5000

When inputting program search data, there is no entry point for step-adjust, however it is still possible to enter step-adjust data following the programming sequence.

Enter program search data as per section 12-7 (pages 51, 52, 53) of the English language operating manual. Activate the program search in the usual manner by pressing [SRCH] then select the required bank as directed at the end of section 12-7 (page 53).

1. While searching, press the [STEP] key, press [PASS] to engage step-adjust (the "*" legend will be displayed).

2. Press [UP] to display the current step-adjust value, such as 5kHz. Select the required step-adjust value by rotating the SUB DIAL or via the keypad (if using the keypad finish the entry with a quick press of [ENT]).

3. To complete the data entry press [ENT] **for more than one second**. The data will be accepted and display will revert to search with the "STEP-ADJ" legend displayed.

Note: if you did not complete the sequence by holding the [ENT] key for more than one second, an error beep will sound (if the beep is enabled) and the data will not be saved. Remember, there is no entry point for step-adjust data during search program entry.

SWITCHED EPROM BANKS - more memories!!!

From serial number approx 70660 upward (of the standard AR5000 and AR5000+3) the facility of switching EPROM banks is now supported (see the main operating manual section 18-6, page 71, last two items). This virtually means that the AR5000 now has 2000 memory channels, 40 search banks, 10 VFOs etc... two sets in one!

AR5000 I.F. OUTPUT LEVEL

The AR5000 is equipped as standard to give an IF output from the 2nd IF of 10.7MHz.

This can be further menu switched to give a bandwidth of up to +/-5MHz in the IF1 setting or variable IF filter bandwidth as selected from the IF BW front panel switch in the IF2 setting..

The output that can be expected from the IF output socket into a 50ohm load is as follows... With the **AGC switched off**, measured at VHF:

IF1 will give an output of **+25dB** relative to input signal level at the antenna socket.
IF2 will give an output of **+38dB** relative to input level at an indicated **15kHz** bandwidth.
IF2 will give an output of **+32dB** relative to input level at an indicated **220kHz** bandwidth.

These figures are good from the receivers noise floor up to a RF signal level at the antenna socket of –30dBm (7mV). Checked throughout the sets frequency range, they are correct to within 2 to 3dB up to 1GHz but will fall slightly towards BPF edges (by as much as 10dB in places).

With the **AGC switched on** and 0dB manual attenuation, the IF output relative to input is no longer a linear relationship and at VHF becomes:

RF I/P	**IF1**	**IF2 (15kHz filter)**
-110dBm	-84dBm	-73dBm
-100	-78	-73

-90	-72	-72
-80	-64	-69
-70	-57	-66
-60	-49	-61
-50	-41	-56
-40	-33	-51
-30	-25	-46
-20	-16	-39
-10	-11	-35
0	-9	-33
+10	-9	-32

AR5000 IF output relative to input frequency.

Checked with set at 145MHz, NFM, AGC off.

Input frequency	IF output level relative centre frequency level
+8MHz	-30dB
+7MHz	-20dB
+6MHz	-12dB
+5MHz	-7dB
+4MHz	-4dB
+3MHz	-2dB
+2MHz	0dB
+1MHz	0dB
145MHz	0dB *receiver centre frequency*
-1MHz	0dB
-2MHz	0dB
-3MHz	-1dB
-4MHz	-2dB
-5MHz	-5dB
-6MHz	-10dB
-7MHz	-16dB
-8MHz	-22dB
-9MHz	-30dB

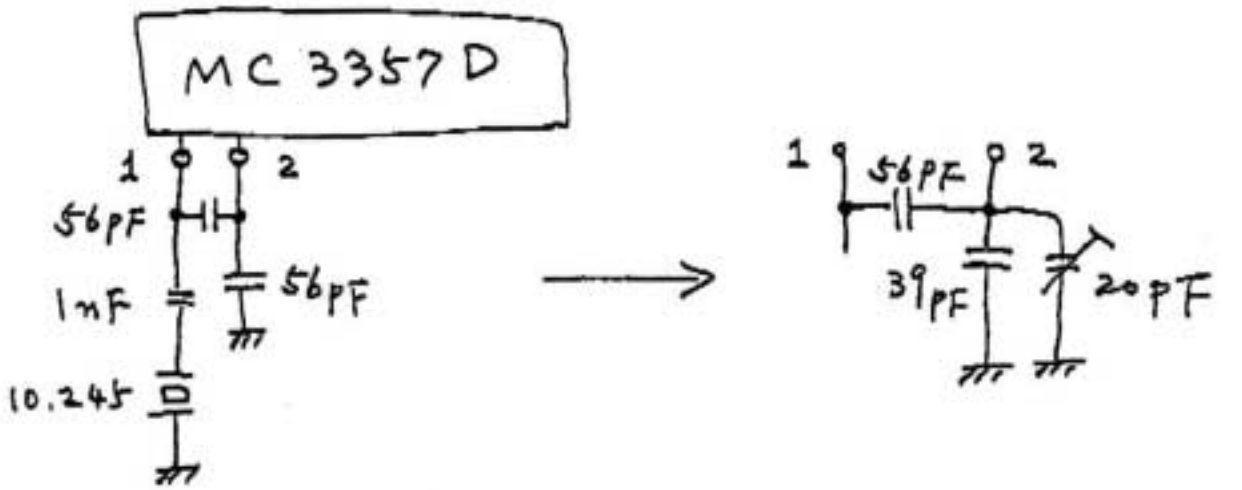
Note:

2 spurs are present at 455kHz away from centre frequency 68dB down from centre carrier

1 spur is present 4.802MHz above carrier frequency at a level of 67dBm (NFM, no other signals present)

EARLY AR5000 - SSB frequency display accuracy

The very first batch of AR5000 had no specific adjustment for SSB frequency accuracy but relied on the 10.245 MHz crystal feeding the MC3357D. If a frequency error is detected, it is fairly easy to REPLACE the 56pF capacitor to ground using a 39pF capacitor and 20pF trimmer to ground... the SSB frequency accuracy may then be adjusted - refer to the illustration:



EARLY AR5000 - squelch tail characteristics

The length of squelch tail obtained on the AR5000 is microprocessor controlled and can be altered by PC via the RS232 port when using the Hyperterminal program.

The following commands are required to do this:-

AR5BA4 (CARRIAGE RETURN)

CMA518 (CARRIAGE RETURN)

00 (CARRIAGE RETURN)

The AR5000 will now have to be re-set by pushing the button behind the brake lever.

This will give a minimum squelch tail but the 00 values can be substituted by any value up to 99 to give a longer squelch tail.

A low level oscillation may be present between 400MHz and 1GHz which may cause a long squelch tail or simply be heard imposed on top of the wanted receive signal. S meter readings may alter in sympathy with the oscillation.

This problem has been reported as possible on an early AR5000 but it has only been observed on one set (A version V3.0 set).

This can be improved by the addition of a small grounded shield fitted to screen Q10 (FSX52WF) on the RF board.

EARLY AR5000 - increased noise level / AGC

In early AR5000 units under certain circumstances, the S meter can be seen to give a reading, an increase in background noise or a clicking sound can be heard under ‘no signal’ conditions. This is noticeable when a strong signal has ended or the RF gain control has been increased.

The problem appears to be due to an instability starting in the 10.7MHz section and its symptoms can be altered by changing AGC settings, modes, etc.

A cure for this problem is to add a 22ohm resistor in the IF chain in place of R352 (RF PCB). A 22ohm resister is shown on the circuit diagram at this point but on early sets a zero ohm link is fitted.

No alteration in receiver performance is noticed.

EARLY AR5000 - spurii at 200kHz spacing

It has been found on some AR5000 that there are a number of low level birdies generated between 300 MHz and 1GHz. To observe these birdies set the squelch control to threshold point, disconnect the external antenna, set to NFM and rotate the main tuning knob. The squelch will open every 200kHz approx.

The cure is to add a 10.7 MHz trap between the output from the DDS system and ground.

To carry out the modification remove the top cover and locate the PLL board - nearest the front panel with the metal screening cans and TCXO. Remove the six screws holding this board and hinge it over the front panel, removing necessary connectors - protect the top of the front panel with a soft cloth. The trap consists of a 4.7uH choke in series with a 47pF capacitor. It is connected between pin 3 of the NCO1 and ground. NCO1 is located at the left hand side of the PLL board - pin 3 is counted from the rear of the underneath of the board and is the pin whose track obviously goes to the double balanced mixer DBM1. A suitable ground connection is either pins 1 or 2 of the NCO1.

Reassembly is a reverse of the above.

AR5000 455kHz I.F. output modification

The AR5000 can be easily modified to give a 455KHz I.F. output. This can be done by removing the top cover only. Various points are provided on the IF board which are intended as test points but can easily be soldered to in order to obtain an I.F. output. The I.F. board is the rearmost board once the top cover is removed.

Various levels can be obtained depending at which point the signal is taken from. All points are clearly labelled on the board and there is no need to remove the board.

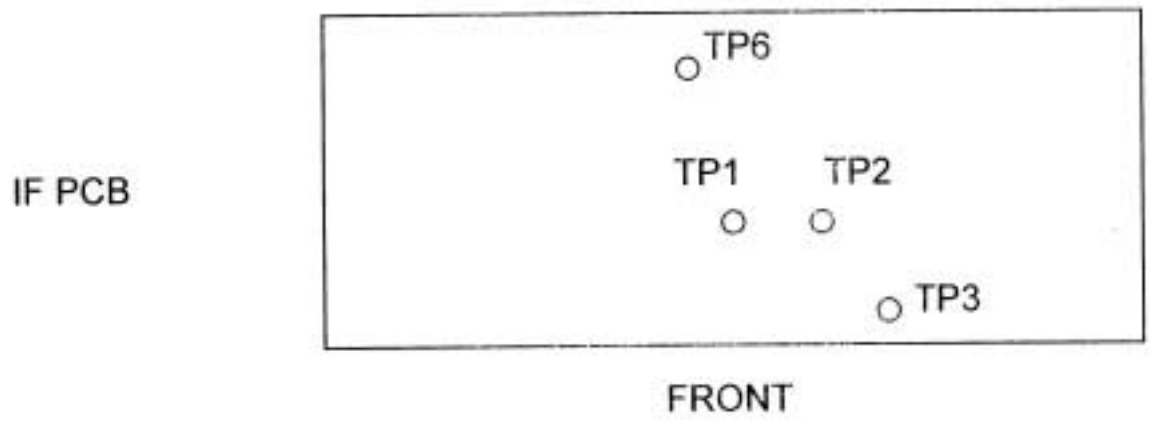
TP6 This point will give a low level output (or can be used as an I.F. input) up to about 4mV (p/p). It is unfiltered by the 455 I.F. filtering at this stage and will be relying on the 10.7MHz filtering for its bandwidth. This test point is fed by a 0.1uf cap and 18Kohm res.

TP1 This is fed directly from the first stage of amplification after the 455KHz I.F. filtering has taken place. Levels will be up to approximately 3mV (p/p).

TP2 This is probably the most useful point to take the IF from. It is taken from the unused output of the secondary winding of I.F. transformer, T11, after the second stage of amplification after filtering. Output levels will be up to 10mV (p/p).

TP3 This gives a large level output after the third stage of amplification of the filtered signal. It is fed via a 0.1uf cap and 10Kohm res. Output levels will reach up to 1.5v (p/p).

All of the above points have no D.C. voltages present and TP1 & 2 are coupled indirectly to ground. These points can be brought out to the rear panel by connection of miniature R.F. coax. Termination can be made at an additional suitable socket of one of the ones already fitted can be utilised if it is not being used (possibly 10.7MHz output of 10MHz ref' input BNC).



DS8000 voice inverter - available sub-carriers

The optional DS8000 analogue speech inverter works well with the AR5000 receiver, please refer to the operating manual for fitting instructions.

However, only FOUR sub carrier (inversion points) are supported, then they are repeated over-and-over... these frequencies are:

3.7kHz
3.5kHz
3.3kHz
3.1kHz

These tones are primarily intended for the decoding of Japanese cordless phones but may be used for simple PMR systems such as PMR446 etc.

AR5000 relay switching frequencies

Operators have reported mechanical 'clicks' emanating from inside of the AR5000 when scanning, this is most noticeable when sited in a quiet environment such as night-time monitoring from home. The clicks are caused by internal relays, diodes have not been employed for critical RF signal paths in an attempt to reduce signal loss and minimise intermodulation products.

In particular it has been reported that the 'clicks' are most noticeable when the AR5000 is tuned across the following frequency boundaries:

40MHz
400MHz
1000MHz (1GHz)
1600MHz (1.6GHz)

Similar noise is generated by the earlier AR3000A receiver but is consistent with other manufacturers models such as the ICOM IC-R8500.

AR5000 tuning encoder adjustment and replacement

A three page Acrobat PDF file is available detailing the replacement of main tuning encoder of the AR5000. Usually replacement is only necessary if mechanical damage has been experienced.

The main encoder used (ALPS) has a specification of; 'approaching 100 pulses per revolution'.

Tuning the encoder at about 1 rev' every 5 seconds produces the nearly ideal figure of 100 steps.

Reducing the time to 4 seconds produced 96 steps

3 s 81 steps
2 s 76 steps
1 s 40 steps
0.5 s 20 steps

In practice, this produces a noticeable increase in tuning speed with increase in rotation speed up to about 1 rev / second. After that the tuning speed remains the same regardless of how much faster the encoder is rotated. The overall result is a very smooth tuning action while retaining reliable slow speed tuning.

There is very little circuit involved between the encoder and the microprocessor, just a couple of resistors and some decoupling. It appears therefore that the tuning rate is controlled mainly by the microprocessor firmware.

The main encoder is not intended to operate like an old VFO control. It is more intended as a 'rotary switch' used for several other functions in addition to frequency tuning. Operation of some of these other functions would be more difficult and jumpy if the encoder response speed was very different.

It is a wide band monitor and will never compete with the tuning operation of a VFO controlled dedicated HF set where tuning speed is directly proportional to speed of rotation. This being one reason that the AR5000 has such a versatile and large variety of programmable tuning step sizes with a different step size possible on the sub encoder.

ACC1 ready made lead for AR5000 - UK

In the UK a pre-wired ACC1 plug & lead has been made available as an option (8LMINI), however there appears to be two types of cable depending upon manufacturing batch / supplier! The two types of lead are almost identical other than the wiring order is different. The only distinguishing feature between the two leads, is that one lead has a **grey** wire and the other has a **purple** wire within its multi-cable.

Wiring order for each type is as follows:

GREY wire type PIN NUMBER	**COLOUR**
1	BLACK
2	BROWN
3	RED
4	ORANGE
5	YELLOW
6	GREEN
7	BLUE
8	GREY
	SCREEN / GROUND

PURPLE wire type PIN NUMBER	COLOUR
1	RED
2	BROWN
3	GREEN
4	YELLOW
5	ORANGE
6	BLACK
7	PURPLE
8	BLUE
	SCREEN / GROUND

The functions of each pin can be found on page 10 of the AR5000 operating manual.

Since writing the above (October 2001), a third type of cable has been supplied. This is almost indistinguishable from the above cable but is more logically wired (nearly like the resistor colour code). Wiring order for this is:

PIN NUMBER	COLOUR
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLUE
7	VIOLET
8	BLACK
	SHIELD / GROUND

Given the above, the only safe way is to meter any lead through before use.

AR5000 VLF sensitivity measurements

All tests in USB mode, 3kHz filter, AMP on, 0db ATT 10dBS/N

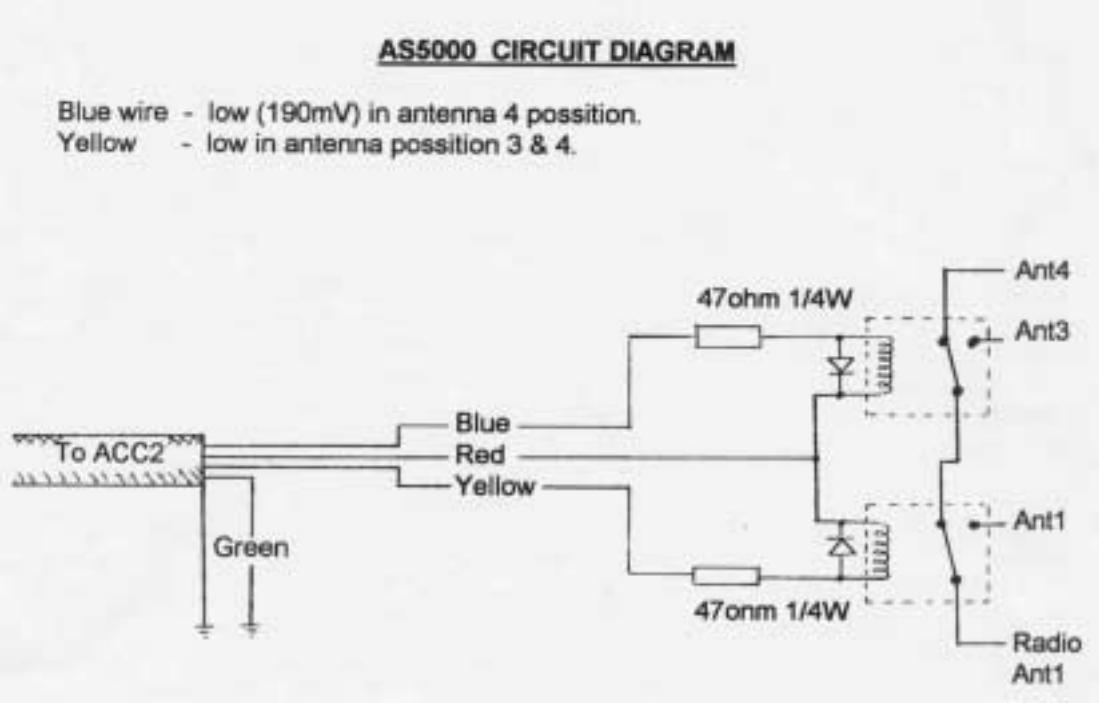
Receive frequency	Sensitivity
100k	-122 dBm (0.18uV)
50k	-119 dBm (0.25uV)

35k	-116 dBm (0.35uV)
30k	-112 dBm (0.55uV)
25k	-108 dBm (0.9uV)
20k	-104 dBm (1.4uV)
15k	-101 dBm (2.0uV)
10k	-97 dBm (3.2uV)
6k	-76 dBm (35uV)

Receiver serial No: 070020

AS5000 switch - circuit diagram

An optional switch is available for the AR5000, the part number is AS5000. The switch plugs into the rear panel ANT1 N-connector providing three N-sockets and leaves the rear chassis ANT-2 SO239 socket still available. Switching can be accomplished automatically using a defined form of bandplan or manually from the ANT select menu. The circuit is shown here:



AR5000 and TV output

The rear panel 10.7 MHz I.F. output of the AR5000 provides a wide 10 MHz usable bandwidth (+/- 5 MHz) and is suitable for running TV demodulators.

Presented here as an Acrobat PDF file (461kb) containing modification information for the ICOM TV-7000 provided by Francois Michaud-Herbst of Canada and a proposed video

converter project by Jason Reilly of Australia (posted to the AR5000 re-mailer in April 1999) -

---

PLUS modifications for the AR5000 receiver

It is not possible to PLUS upgrade AR5000 receivers outside of the AOR factory in Japan apart for one or two workshops around the world such as that of AOR UK LTD. If the AR5000 is a late serial number (at least above 70661, preferably 71xxx) it should be possible to add the PLUS features.

Based on this assumption, the following costs are involved, all prices shown exclude VAT & carriage which would have to be added to the total amounts:

Synchronous AM
parts GBP£ 89.00
workshop handling GBP£ 20.00

Automatic Frequency Control
parts GBP£ 89.00
workshop handling GBP£ 20.00

Noise blanker
parts GBP£ 89.00
workshop handling GBP£ 20.00

We can install one, two or all three as you choose (or none !).

The likely total for the upgrade of all three items including carriage from the UK to an address in Europe with VAT is £395.00 - in addition you would have the cost of shipping the unit back to the UK. Once ordered, the parts are likely to take a couple of weeks to arrive from Japan.

As these parts would be obtained as a special order (apart from the Synchronous AM parts which are already available in our UK workshop), we would need a non-refundable DEPOSIT of GBP £100.00 in order to proceed (deducted from the final costs).

AR5000 Main encoder shaft bearing

The AR5000 uses a rotary encoder for its main tuning control. The shaft is supported through the front panel by a bronze type bearing mounted in a pressed steel case.

The bearing is mounted to the front chassis by two screws.

The bearing doesn t use any lubrication and should normally operate without problem. We have had a couple of reports of slightly stiff tuning and requests about how to lubricate this.

If the tuning is slightly stiff, chances are that it is the bearing mounted slightly off centre.

To rectify this, remove the main encoder tuning knob by first sliding off the outer rubber sleeve and then loosen the small hex grub screw (only one is fitted even though there may be holes for two).

Loosen the two bearing screws now revealed.

Re-tighten these with the bearing re-positioned centrally.

If you decide to lubricate the bearing, use a light oil that will not stiffen with time.

Note that the bearing is free to rotate in its casing and the shaft free to rotate in the bearing itself, so lubrication can be added to both of these areas. Only add a small amount of oil as the main dial brake operation may be compromised if too much is added.

At worst, on well used older sets, it may be worth removing the bearing completely. Clean both the bearing and the shaft with a solvent before lubricating and re-fitting. Take care not to let any solvent enter the actual encoder as this will lead to very rapid wear.

Re-fit the encoder and test your work.

AR5000 RS232 commands for UP / DOWN tuning

The following commands can be used via Windows Hyper-Terminal using the ALT key of the PC and the NUMERIC KEYPAD (NOT the number keys above the keyboard letters):

Up arrow	ALT+30 HOLD ALT and type 30
Down arrow	ALT+31 HOLD ALT and type 31

To clarify, Up/Down Increment **n<CR>** where n is a binary byte value as follows

UP	0x1e
DOWN	0x1f

This would suggest that the command is expressed as a SINGLE HEX VALUE followed by carriage return. Ensure that you have full 8-bit data setup and not limiting it to 7-bit ASCII... otherwise all other commands would be okay but the HEX values would get screwed.

The following is comment on the subject posted to the internet in 2001:

> With VB, you would do this as:
>
> MSComm1.Output = Chr(&H1E)
>
> or

MSComm1.Output = Chr(&H1F)

and so on. To send more than one,

MSComm1.Output = Chr(&H1E) & Chr(&H1F)

---

with thanks to AOR UK