AMR 1000 (S)   CIRCUIT DESCRIPTION

The Navico AMR1000(S) is a fully frequency synthesised FM transceiver designed for the 2 metre Amateur FM band.   Drawing No. E00908 shows a block diagram of the circuitry.   The unit is designed to the highest specification consistent with 12.5 KHz channel spacing.

There are two main printed circuit boards:

1. Control P.C.B.

2. Rx/Tx P.C.B.

1. Control P.C.B.

The control PCB is located directly behind the front panel controls and display.   It is split into two interconnected boards due to size restrictions.

Drawing no. E00779 gives the detailed circuit diagram of the control PCB.

IC1, a single chip microprocessor, carries out commands from the front panel switches (S1-S6), controlling the frequency of operation, power of transmissions, mode of reception (priority watch, scan-all, memory scan,for the AMR1000S), and choice of channel or frequency mode of operation. PTT and Mute are also treated as inputs to the Micro.

A custom two phase L.C.D. is driven directly by the microprocessor to give information regarding the status of operation.   Six levels of back lighting of the L.C.D. can be selected for night time use.

On the AMR1000S, Memory channels and programming information are held in a non volatile memory (EEPROM), IC2, avoiding the need for a backup battery.

The detected noise level from the IF amplifier is fed through selection switches, IC4, to the A/D converter IC3. IC4 also allows the reading of the position of the squelch control and the calibration value set by R14 and R16. The micro uses these values to display signal strength on the "S" Meter, and to control the squelch lines to the speaker mute transistor, TR4 and to the RF Board.

Data to the synthesizer is sent as a synchronous 19 bit serial data stream with an enable signal sent immediately after the 19th bit.

The format of this 19 bit word is as follows:

7 bit + A	10 bit + N	2 bit switching
+A...............+A	+N.................+N	Power Select Rx/Tx

2. RxTx PCB

Drawing No. E00946 gives the detailed circuit diagram of the Rx/Tx PCB.

i)   **Synthesizer**   The V.C.O. (grounded gate oscillator - TR14) oscillates at the frequency of transmission in transmit mode or the first local oscillator frequency (wanted signal frequency less 21.4 MHz) in receive mode. Switching the oscillator between transmit and receive frequencies is accomplished by PIN DIODE D13.

AMR 1000 (S)   CIRCUIT DESCRIPTION

The oscillator is tuned by varactor diode D14.

The VCO output is buffered by TR13 and fed to a dual modulus prescaler (÷40/÷41) IC5.   The output of IC5 is fed to a specialised frequency synthesizer chip which houses the necessary frequency dividing circuitry, reference oscillator (12.8 MHz) and phase comparator.

Temperature compensation of the reference oscillator is provided by varicap D20 controlled by thermistor TH1.   Compensation is only applied at high temperatures, the range being controlled by D21.

The synthesizer accepts serial data from the control PCB which in turn controls the divide ratio required for the particular frequency to be used. Phase comparison of the VCO signal with the reference oscillator is carried out at 12.5 KHz.   The output of the phase detector is filtered by R90, R89, C138, C148, R92, C140, R95 and C154 to give the control voltage to varactor diode D14.

ii)   **Voltage supplies.**   The majority of the circuitry operates from +8V regulated by REG1.   Three +8V lines are used - pin 1 + 8V at all times, pin 6 + 8V transmit only, pin 8 + 8V receive only.   The audio amplifier IC7 operates from +12V as does the final output stage of the transmit amplifier and the voltage control transistor (TR10) for the penultimate transmit output stage.

iii)   **Modulation**.   The audio signal from the microphone is amplified by IC6b having been given a 6dB/Octave pre-emphasis by C135 and R81: C136 provides a high frequency roll-off point.   The output of IC6b (pin 7) is fed through a diode limiting circuit (D15, D16) to a filter circuit R72, C131, R71, C128, R70, C130 and IC6a.   VR3 controls the maximum modulation.

The output of the filter (IC6 pin 1) is fed to the VCO and applied to varactor D12.

iv)   **Transmit amplification:**   The output from the VCO is buffered by cascode TR11 and TR6, filtered by the double tuned circuit L21, C79, L23, C80 and fed to amplifier TR5.   The output of TR5 is tuned (L20, C74, C75) and connected to drive transistor TR4.   TR4 operates in class C and has only a nominal bias voltage.   The output of TR4 is filtered and connected to a 25 watt class 'C' amplifier module.   Power control is effected by varying the supply voltage to driver transistor TR4 and the first stage of the power module.

The output of the power module is fed via switching diode D2 and low pass filter (fo = 165 MHz) L15, L14, L13, L44, C55, C58, C54, C53, C174 to the antenna socket.

D1 protects the receiver from high voltages during transmit mode.   The current to switch this on is fed through both D1 and D2.

v)   **Power control:**   The r.f. level is monitored by C57, rectified by D5 and D6 and smoothed by C87 and R43, to provide a negative going DC voltage proportional to the transmit output power.   VR1 and VR2 control a voltage pot-down which is fed to amplifier TR8 and then to the voltage control transistor TR10.   This transistor controls the supply voltage to the two penultimate output stages.   TR9 provides temperature compensation for the circuit operation.

AMR 1000 (S)   CIRCUIT DESCRIPTION

vi) **Receiver front end, mixer and 1st I.F.**   The incoming signal is filtered by a tuned couple L2, C3, L3, C4 and amplified by TR1.   The signal is further filtered by tuned triple L4, C9, L6, C12, L7 C14 to significantly attenuate the image frequency and other out of band signals.   TR2 mixes the received frequency with the local oscillator (from VCO buffer TR11, TR12) to convert the wanted signal to 21.4MHz.   Crystal filter X2 and X3 provide at least 40dB of adjacent channel rejection.   The signal is then fed to specialised I.F. chip IC1.

vii) **2nd I.F. Demodulation and audio**.   The 21.4 MHz signal is mixed with 21.855 MHz (X4) to convert to the 2nd I.F. frequency of 455 KHz.   Further filtering, using the Murata "G" Series filter gives the required 12.5 KHz adjacent channel rejection, followed by limiting amplification takes place in the IF chip IC1.   Demodulation takes place on quadrature coil L31.   The recovered audio has high frequency (i.e. 455 KHz) removed by L10 and C26.

De-emphasis at 6dB/octave is achieved by R21 and C29 and the resulting audio signal is fed to both the headphone amplifier IC2b and audio power amplifier IC7.   The volume control cuts the level of signal to the audio power amplifier only.   The audio signal to both the headphone amplifier and power amplifier can be squelched by grounding the junction of C30, C31 and C35.

viii) **Squelch & "S" Meter:**   The recovered audio signal from the demodulator will have high frequency components (up to 25 KHz) with the absence of an incoming signal.   This noise is filtered by C27 and L11 and amplified by an amplifier built into IC1 (pins 12, 13) Preset resistor, VR4 is used to set the level for a low signal strength.

The output of the amplifier is rectified and smoothed by D3, D4 & C24. A DC offset is added by R118, R117, and D2; the 9 + 40 dB point being adjusted by selection of R117.   This signal is further amplified by IC2 which is given a non-linear characteristic by the inclusion of D 23 and D 24 in the feedback loop.   The output is taken via the 16 way ribbon cable to the micro circuit board.
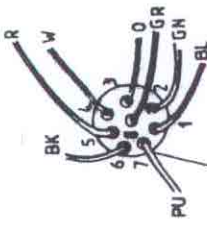
A secondary squelch line returns from the micro to control the mute function of the IF amplifier ICI. On the AMR1000S this function is selectable allowing the headphone output to stay unsquelched at all times.

AMR1000(S) COMPONENTS LIST

FRONT PANEL PCB ASSEMBLY

CIRCUIT REF	NAVICO PART NO.	DESCRIPTION	NOTES
R3	100101	75R 0.5 Watt 5%	
R19	100027	180R 0.25 Watt 5%	
R20	100029	270R	
R13	100034	680R	
R1	100036	1k	
R15	100044	4k7	
R2,R5,R8,R9, R12,R17,R18	100048	10k	
R10	100056	47k	
R11	100057	56k	
R6,R14	100060	100k	
R16	100061	120k	
R7	100064	220k	
R4	100084	10M	
VR1	150020	100k Log Switched	EGEN
VR2	150028	1k LIN	EGEN
C5		22p SOT	
C6	110056	47p	
C2,C13,C15,C2	1110065	1n	
C14,C19,C20	110000	10n ceramic	
C7,C9	110083	22n	
C1,C4	110001	100n	
C10	110043	4μ7 TANT	
C3	110029	33μF 16v Elec	
C11	110004	100μF 16v Elec	
L1-L5	240020	27μH	
ZD1	120017	4v7 500mW	
ZD2	120024	9v1 500mW	
D1	120004	IN4001	
TR1	130005	BC213	
TR2,TR4	130000	BC182	
TR3	130006	BC337	
XT1	160024	2MHz 20pF par	

COMPLETE FRONT PANEL ASSEMBLY INCLUDING MICRO.
AVAILABLE AS EITHER.
AMR 1000, E00854 :
AMR 1000 S, E00972

FRONT PANELS, WINDOW
& SPEAKER AMR 1000, E00970:
AMR 1000 S, E00971:

E00488

200089 (4 OFF)

E00435

E00432

200080 (2 OFF)
200081 (2 OFF)
200090 (2 OFF)
200080 (2 OFF)

TO 110065 (2 OFF)

E00429

140038

PWL 1000

E00434

E00428

E00851

R

BK

INCLUDES BRACKET
ASSEMBLY (E00440)

E00440

E00974

200046 (5 OFF)

E00441

E00346 (2 OFF)

E00433 (2 OFF)

17C030

170031

200082 (2 OFF)

200081

E00440 COMPLETE BRACKET ASSEMBLY

E00436

200001
200081
130002
200048

INCLUDED ON P.C.B ASSEMBLY

200051 (2 OFF)

170032

20004-8

E00443

E00850

E00045

160017

200080

200123
(3 OFF)

200032
(3 OFF)

20006

R

R.

BK.
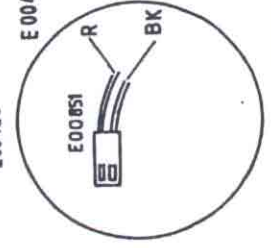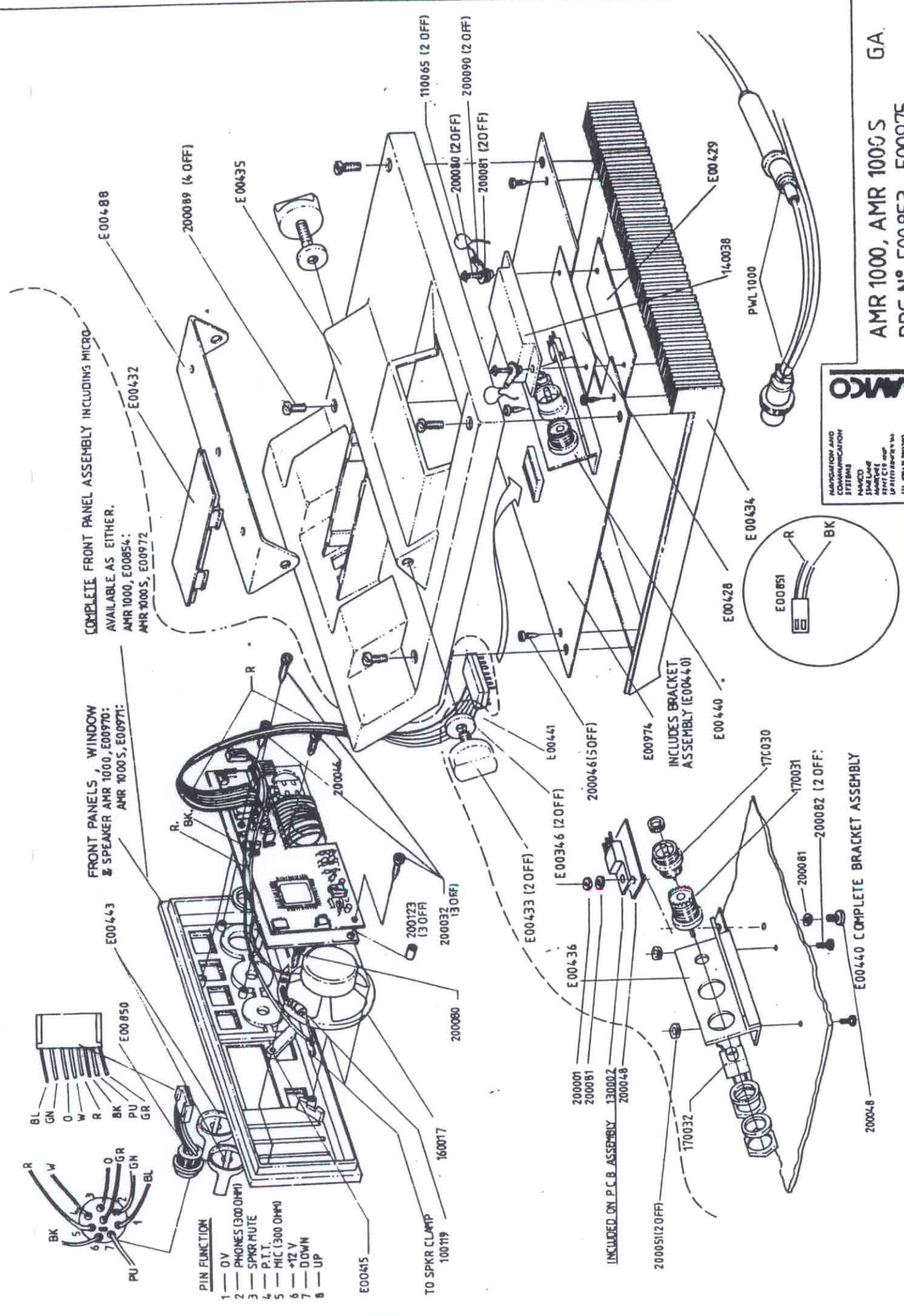
PIN FUNCTION
1 — 0V
2 — PHONES (300 OHM)
3 — SPKR MUTE
4 — P.T.T.
5 — MIC (300 OHM)
6 — +12 V
7 — DOWN
8 — UP

BL
GN
O
W
R
BK
PU
GR

R
W
O
GR
GN
BL
BK
PU

TO SPKR CLAMP
110119

NAVICO

NAVIGATION AND
COMMUNICATION
SYSTEMS

NAVICO
STAR LANE
MARGATE
KENT CT9 4NP
UNITED KINGDOM
TEL: (84-3) 290391
+ 44 843 290390
TELEX %5093 NAVICO G

AMR 1000, AMR 1000 S   GA.
DRG N°. E00853 , E00975

ISS.1: 7-1-89

AMR1000(S) COMPONENTS LIST

FRONT PANEL PCB ASSEMBLY

CIRCUIT REF	NAVICO PART NO.	DESCRIPTION	NOTES
REG1	140040	+5v 78L05	
IC1	E00846	HD4074608	Programmed
AMR1000 (IC1 AMR1000S)	E01051	HD4074608	Programmed
(IC2	140053	9346	AMR1000S only)
IC3	140051	LM358	Surface mount
IC4	140052	4066B	Surface mount
LCD	E00861	Custom Made	
SW1-SW6	210001	C&K Grey	
(SW4	210011	C&K Yellow AMR1000S)	
LP1, LP2	220000	5v 60mA Bulb	
PCB1	E00782	Top PCB	
PCB2	E00780	Base PCB	

AMR1000(S) COMPONENTS LIST

Rx/Tx PCB E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
TR1	130025	BF964 Dual Gate Mosfet	A.E.G.
TR2, 14	130008	J309 J Fet	Motorola/Siliconix
TR5, 6, 11, 12, l3	130022	BF374	Motorola
TR4	130023	2N3866	Motorola/TRW
TR7,8,9,16,17, 18,19,20,21	130000	BC182 (or equivalent)	
TR10	130002	BDX34A PNP Darlington	RCA
TR15	130005	BC213 (or equivalent)	
DI	120025	MI308 Pin diode	Mitsubishi
D2	120034	MI407 Pin diode	Mitsubishi
D3,4,9,11,15,16, 17, 18, 19,23,24	120000	1N4148	
D5, D6	120003	BAT85 Schottky diode	Mullard
D7	120002	1N5819	Motorola
D8	120001	1N5401	
D10	120006	6V8 Zener diode 400mW	
D21	120008	5VI zener diode 400mW	
D12,14,20	120016	1S2268 Varicap	Hitachi
D13	120026	MPN3404 pin diode	Motorola
IC1	140037	ULN3659 I.F. chip	Sprague/Motorola
IC2	140025	CA358E Dual op amp	
IC7	140048	TDA1904 2w audio amp	S.G.S.
IC4	140039	MC145156P Synthesiser	Motorola
IC5	140044	MC12016P Dual Modulus Prescaler	Motorola
IC6	140046	CA082E Dual op amp	
REG1	140029	MB3756 Triple + 8v regulator	
R.F. Amplifier	140054	SAV-7 25 watt	Toshiba
Audio O/P socket	170032	3.5mm jack socket	
R.F. socket (antenna)		170031	50 ohm VHF socket
Power socket	170030	2 pole circular	
SK1	170035	16 way D.I.L. socket	

AMR1000 (S) COMPONENTS LIST

Rx/Tx PCB E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
L1, 12,13,14, 15,17,18, 19,20,28,29,44		Various air spaced coils	Navico
L5,25,27,36, 37,41,42	240015	1μH choke	
L40	240014	4μ7 choke	
L24,33,38	240017	10μH choke	
L10,11	240016	lmH choke	
L2,3,4,6,7,23,30	240006	166XNA-11078Y	Toko
L8,9	240007	TKXC-27894N	Toko
L21,22	240005	166XNA-11069X	Toko
L39	240011	VTKENA-27629Z	Toko
L31	240010	RMC-15002A	Toko
L34,35	240018	2μ5 6 amp choke	
X1	160010	12.8MHz xtal ± 5 ppm (-15 to +60 C)	
X2,3	160018	4 pole xtal filter 21.4MHz (supplied as matched pair)	
X4	160006	21.855 MHz xtal ± 7.5 ppm (-15 to + 60C)	
X5	160005	6 pole ceramic filter 455G KHz	Murata/Kyocera
TH1	100116	N.T.C. Thermistor R(25C) = 4k7	

AMR1000 (S) COMPONENTS LIST

Rx/Tx E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
C8,78,93	110067	0p68 Tubular ceramic	
C5, 13	110066	lp2 Tubular ceramic	
C57,5	110044	2p2 Ceramic disc NPO	
C124,3	110086	3p3 Ceramic disc NPO	
C4,14,48, 106,164	110045	4p7 Ceramic disc NPO	
C19	110046	5p6 Ceramic disc NPO	
C9,63	110047	6p8 Ceramic disc NPO	
C12,80,121	110048	8p2 Ceramic disc NPO	
C2,118	110049	10p Ceramic disc NPO	
C1,79,53,94,125	110050	12p Ceramic disc NPO	
C52,94,146,126	110051	15p Ceramic disc NPO	-
C149	110052	22p Ceramic disc NPO	
C55		30p Ceramic discNPO (2 x 15p in parallel)	
C54		42p Ceramic disc NPO (27p//15p)	
C64,74	110053	27p Ceramic disc NPO	
C174		27pF Ceramic disc NPO (12p//15p)	
C53,C58		41.2p Ceramic disc NPO (33p/'8p2)	
C72	110056	47pF Ceramic disc NPO	
C66	110090	82pF Ceramic disc NPO	
C42,47,105	110088	100pF Ceramic disc NPO	
C130,162	110062	390pF Ceramic disc Z5U	
C6,7,10,11,15, 16,18,32,41,51, 59,62,67,68,70, 71,75,76,81,82, 85,86,87,88,89, 91,92,95,96,98,99, 100,104,111112, 114,115,116,117, 119,123,133,145, 142,122,155,159, 170,171,172	110065	1nF Ceramic disc Z5U	

AMR1000 (S) COMPONENTS LIST

Rx/Tx   E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
C150		2 x ln Ceramic disc in parallel	
C27	110079	lnF Polyester box ± 10%	
C28	110080	6n8 Polyester box ± 10%	
C21,22,113,69	110000	10nF Ceramic disc Z5U	
C131,140,154	110081	10nF Polyester box ± 10%	
C135	110082	15nF Polyester box ± 10%	
C136	110083	22nF Polyester box ± 10%	
C128	110084	47nF Polyester box ± 10%	
C30	110039	47nF Mylar 100V ±10%	
C44,45,90,139, 148,161,169,173	110001	100nF Ceramic disc Z5U	
C40,23,29	110078	100nF Polyester box ± 10%-	
C24	110026	0.22µF 25V Electrolytic	
C141	110069	lµF 63V Electrolytic	
C134	110097	2µ2 16V Electrolytic	
C138	110085	2µ2 16V Tantalum ± 20%	
C25,31,35,39, 132,137,152,156, 129,166,167	110003	4µ7 16V Electrolytic	
C120,163	110017	4µ7 16V Tantalum	
C50,65,97,110, 73,168	110028	22µF 16V Electrolytic	
C60,61	110089	22µF 25V Electrolytic - low profile	
C103,165	110030	47µF 16V Electrolytic	
C101	110004	100µF 16V Electrolytic	
C34,38	110087	220µF 25V Electrolytic	
C46	110007	1000µF 25V Electrolytic	
VC1,2,3	110092	1-10pF Ceramic variable	

*Select on test

AMR1000 (S) COMPONENTS LIST

RX/TX PCB E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
		All resistors - carbon film ± 5%	
R115	100008	4R7	
R32,35	100009	5R6	
R31	100012	10R	
R38	100018	33R	
R60,103	100020	47R	
R10,102,105,116	100105	51R	
R3,4,5,34,37,55,113,	100024	100R	
R41,53,62	100028	220R	
R42	100029	270R	
R39,48,78,79,66,61,112,	100032	470R	
R7	100033	560R	
R50,47	100034	680R	
R9,18,22,58,81,111,122	100036	1K	
R76	100037	1K2	
R8,11,33	100038	1K5	
R36,46,94,20	100040	2K2	
R44,49,89,101,90,78,79,118,119	100044	4K7	
R68,110	100045	5K6	
R108	100046	6K8	
R63	100047	8K2	
R43,51,65,69,73,77,83,74 84,85,93,104,106,57,109,120	100048	10K	
R70,71,72	100102	11K	
R25,16	100049	12K	
R30,21,114	100050	15K	
R92,95	100051	18K	
R56,86,87,88,100	100052	22K	

AMR1000 (S) COMPONENTS LIST

RX/TX PCB E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
R59	100053	27K	
R27,75	100054	33K	
R2,28,40,52,54,82	100055	39K	
R26	100058	68K	
R1,19,23,29,91	100060	100K	
R99	100069	560K	
R80	100073	IM2	

AMR1000 (S) COMPONENTS LIST

RX/TX PCB E00974

CIRCUIT REFERENCE	NAVICO PART NO	DESCRIPTION	MANUFACTURER IF SPECIFIC
VR1	150023	10K Cermet Preset	Bourns
VR2	150022	500R Cermet Preset	Bourns
VR4	150025	200R Cermet Preset	Bourns
VR3	150031	47K Cermet Preset	Bourns