

DARTINGTON FREQUENCY STANDARDS

MOOR ROAD, STAVERTON, DEVON TQ9 6PB ENGLAND ☐ Telephone (080426) 282 ☐ Telex 42928 A/B WETRAV G (Quartzlock)

Quartzlock

model **2A** Off Air Frequency Standard

INSTRUCTION MANUAL



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URGENT NOTE

DESCRIPTION

MODEL NO.

AE 198-200

10 - AS

3 & 3A

Access to external use or in connection with screened room use of SA

As SA with very low distortion levelled sine wave outputs and auto unlock inhibit

Standard R Quartz Frequency Standard that may also be used with SA/SA-01 to achieve 1:10⁶ accuracy (7 second & 1:10⁶)

up to 1000 Hz accuracy

Please keep **QUARTZ FILTER** for 198 kHz in a safe place. Page 12 & 3A
SA/SA-01 to achieve 1:10⁶ accuracy (7 second & 1:10⁶)
SA/SA-01 to achieve 1:10⁶ accuracy (7 second & 1:10⁶)
SA/SA-01 to achieve 1:10⁶ accuracy (7 second & 1:10⁶)

Solder with care using heat sink between joint and **QUARTZ FILTER** unit

Provides up to 30 outputs of low distortion sine wave output of 1, 2 and 10 MHz outputs levelled at +10dBm, 2V 50 ohm

DARTINGTON FREQUENCY STANDARDS

Phase and Frequency Difference Meter to 1:10⁶ A with chart, meter, oscilloscope
Phase Difference meter 100 and 1000 ranges with chart recorded output
Tel: (024080) 121

Droitwich RRC Radio 4 changes frequency from 200 kHz to 198 kHz 1st Feb 1988

60 kHz Radioclock

FREQUENCY STANDARD MATCHING & SUPPORTING INSTRUMENTS manufactured by:

DARTINGTON FREQUENCY STANDARDS

MODEL NO.	DESCRIPTION
AE 198-200	Active antenna for external use or in conjunction with screened room use of 2A
2A - 01	As 2A with very low distortion levelled sinewave outputs and auto unlock inhibit.
3 & 3A	Standalone MASTER Quartz frequency standards that may also be used with 2A/2A-01 to achieve 1:10 ⁹ short term accuracy (1 second) & 1:10 ¹⁰ long term accuracy.
4A	Frequency standard divider provides with 2A/2A-01 0.01Hz to 1MHz in 1, 2, 5 and decade steps with 2A accuracy.
5	Distribution Amplifier Provides up to 30 outputs of low distortion sinewave output of 1, 5 and 10 MHz outputs, levelled at +10dBm. 2V 50 ohm.
7	Phase and Frequency Difference Meter to 1:10E12 Af with chart, meter, oscilloscope.
6	Phase Difference meter 1μS, and 10μS ranges with chart recorded output.
9	UNINTERRUPTABLE/FIELD RECHARGEABLE power supply
8	60 kHz Radioclock.

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*	Urgent Note See Page 12. & 5 Reference BBC Radio 4 Frequency Change, Feb. 1988.

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Tel: (080426) 282

Telex: 42928 A/B WETRAV G (Quartzlock)

1 INTRODUCTION

The Model 2A Off Air Frequency Standard is a compact, lightweight instrument whose outputs are phase locked to the BBC Radio 4 Droitwich transmission.

The two BBC satellite transmitters, phase locked to Droitwich, at Aberdeen and Westerglen, allow virtually complete UK coverage using only the instrument integral antenna.

The unit is normally mains powered, but may be operated from a nominal 9V or 12V battery for field use.

2 SPECIFICATION

(a) Outputs:

10MHz, 5MHz and 1MHz, TTL compatible, square waves. These outputs will drive 50ohm loads with TTL levels. "Core" output at 200kHz (198kHz) at 1Kohm impedance.

* NOTE Core output is only useable if Rx meter reading is above the mark and steady.

(b) Frequency Accuracy and Stability:

2 parts in 10E8 (typical 1 part in 10E8) over 1 sec.
2 parts in 10E9 (typical 1 part in 10E9) over 10 sec.

(c) Phase Jitter:

Better than 0.1 cycle peak to peak.

(d) Settling Time:

Within specification 60 seconds after switch on (Typical 40 sec).

(e) Input Sensitivity:

Better than 2uV from external antenna.
Integral ferrite aerial is adequate for most UK locations

(f) Power Requirements:

210V-250V AC 46-56Hz or
Single 9V battery or DC, (8V min, 13.8V max), supply via rear socket.

Current requirement: 90mA - OFS2A

150mA - OFS2A 01 OPTION

110V AC version available

(g) Operating Temperature Range:

0 to 40C ambient.

(h) Weight and Dimensions:

Approximately 1.6Kg (3.5lbs).

Maximum dimensions: 222mm by 32mm by 180mm.

3 INDICATOR:

Meter - Enables PCB supply, received signal level and lock to be monitored as selected by the front panel switch.

4 CONTROLS:

MAINS ON/OFF. Located at rear of instrument.

ANTENNA SELECT. Located at rear of instrument. Allows either integral ferrite aerial assembly or external antenna into adjacent BNC socket to be selected.

DC ON/OFF. Front panel control to isolate the PCB's only, from either the mains derived supply or external supply via rear socket.

METER SWITCH. Front panel rotary switch to enable monitoring of DC supply, received signal level (Rx), or lock condition of the unit.

5 OPERATION:

The unit should be positioned such that the rear antenna assembly is not screened by large metal surfaces or objects immediately next to it.

If local screening is unavoidable (e.g. metal building construction etc.) it may be necessary to use an external wire antenna or, preferably, active antenna type AE 198-200 - see Section 5.2

5.1 Switch on rear panel MAINS switch and front panel ON/OFF switches and check SUPPLY reading on the meter is at the reference mark.

5.2 Set the Rx signal.

Select Rx on the meter and note the readings. In most operational locations only on Droitwich locked signal will be received and the unit should be positioned for a received signal indication greater than the scale marker for reliable operation.

* THE RX READING MUST BE STEADY. ANY JITTER INDICATES THAT THE RX SIGNAL IS NOT USABLE AND THAT CORRECT LOCK MAY NOT BE OBTAINED.

If this level can not be obtained by repositioning the unit, an external wire (or active antenna type AE 198-200) should be plugged into the rear BNC antenna socket and EXT ANT selected. Any external wire "antenna" should be as long as possible and insulated at the far end. A Stable meter reading at or above the scale mark must be obtained.

5.3 Check lock condition

Allow the unit 60 seconds to fully settle. During this time, the meter will normally read low and then rise to a reading close to the reference mark in the first 40 seconds and fully settle after a further 10 seconds.

NOTE: The supply lead from the antenna AE 198-200, if used must be plugged into the rear D socket.

NOTE 1. The reference mark is an indication only and a reading ± 15 degrees of this mark is normal. At an ambient temperature of 0C, the meter will read just above half fsd, rising to the mark at an ambient temperature of 15-20C and reaching a maximum reading of 10 degrees above the mark at 40C ambient.

NOTE 2. A high LOCK reading at "switch on" may occur and the reading then fall to the reference mark after 40 seconds. This is also normal operation.

5.4 The unit is now ready for use.

5.5 Operation from external dc supply.

ENSURE 240V INPUT IS DISCONNECTED BEFORE EXTERNAL DC SUPPLY IS APPLIED.

An external dc voltage between 8V min and 13.8V max may be applied to the rear D socket. Remember Pin 1 is always the +ve supply.

5.6 A second mains fuse is fitted internally below the rear panel mains ON/OFF switch. To replace, DISCONNECT 13AMP PLUG FROM SUPPLY and lift fuse cover. A faulty fuse must be replaced by a 1 AMP or $\frac{1}{2}$ AMP rated Anti-Surge, ceramic fuse.

6 CIRCUIT DESCRIPTION

(a) Main PCB.

The main PCB circuit diagram is shown as Figure 1.

The Droitwich signal (either 200kHz or 198 kHz), is received and selected by the high Q ferrite antenna (or external antenna), and amplified by the RC coupled

amplifier comprising Tr1,2,3 and the output emitter follower Tr4.

The input amplifier is followed by a single crystal filter, X1 to reduce the amplitude modulation sidebands present on the signal, and a non-saturating, limiting amplifier, consisting of Tr6,7,8, to further reduce amplitude effects to a low level. Tr9 provides the correct amplitude of drive to the +N stage consisting of IC1, IC2, and diodes D1, D2 and D6.

* Link LK1, allows selection of the division ratios to be either 200, (link 2-3), or 198, (link 1-2), when the Droitwich transmission frequency is changed.

The output of the divider is a 1KHz reference waveform for either input frequency. A buffer stage, Tr13, drives the edge triggered phase comparator IC3, and also supplies the 'lock detect' circuitry on the 01 board via P20.

A Butler type 10MHz crystal oscillator, comprising Tr10, Tr11 has a total capacity in series with the crystal, consisting of C28 and the reverse bias capacity of the parallel combination of D7, D8. This capacity allows a fine pulling of the crystal frequency. C27 provides dc blocking to the emitter of Tr11.

Tr12 buffers the 10MHz crystal oscillator output and drives a line driver output gate, IC6a, and the separate divide by 5 and divide by 2 inputs of IC7. The symmetrical 5MHz and 1MHz output waveforms of IC7 are also buffered by IC6c and IC6b respectively, and fed to the output sockets.

* See page 12.

The unbuffered 1MHz output of IC7 also drives a divide by 1000 stage, IC8, to give a 1KHz waveform. This feeds the second input to the edge - triggered phase comparator IC3, and also the 01 board via P19.

The resultant phase detector error signal from the two 1KHz inputs to IC3, is smoothed by the active loop filter, IC4 and this DC output voltage is used to vary the frequency of the 10MHz crystal oscillator. The 10MHz output is thus phase locked to the Droitwich signal.

R50 and C34 provide additional control voltage smoothing against transient voltages.

The on-board voltage regulator, IC5 ensures the correct supply voltage to both the main PCB and the 01PCB, for both mains supply and external DC operation.

7 ALIGNMENT AND SETTING UP PROCEDURE

(i) OFS2A Main PCB.

(a) Check all coaxial leads for possible inner/outer short circuits before applying power.

Check that P15 is linked to P18.

(b) Check that the supply voltage at the output of IC5 is 5V +/-200mV. The front panel meter should show a reading at about the scale mark in the 'SUPPLY' position.

(c) Monitor the emitter to Tr5 with a suitable oscilloscope. Set the ANT. switch to EXT. and apply a 50uV rms signal at 200.00KHz, (198.00 KHz after 1988), to the EXT. ANT. socket. Adjust C5, (set filter frequency capacitor), for maximum

reading on the oscilloscope. A peak to peak limited signal of 2.6V should be obtained.

Reduce the input level to 4uV rms and repeat C5 for maximum. A half sinewave signal of at least 0.5V peak to peak should be obtained with C5 approximately 3/4 unmeshed.

Check that a 4V limited signal appears at the collector of Tr9 and this output drops to approximately 500mV peak noise with the input signal removed.

(d) Set LK1 to the 2-3 position. A negative 4V pulse, 1.6uS wide, at a prf of 1KHz should be present on P20.

(e) Switch the ANT. switch to INT and monitor the emitter of Tr5. Adjust the 500pF antenna trimmer capacitor on the inside of the rear panel to give a maximum amplitude on the oscilloscope. NOTE - if the monitored signal is in a limiting condition, adjust the unit position until the amplitude drops sufficiently to enable correct peaking of the 500pF capacitor to be obtained. Recheck the setting of C5 in the non-limiting condition for maximum signal.

Reposition the unit for a limiting signal and check that the front panel meter reads above the reference mark.

(f) Switch the ANT switch to EXT and remove the input from the EXT ANT, BNC socket.

Monitor the 1MHz output frequency with a suitable calibrated frequency meter, and adjust C28 to give a reading of 999.980 KHz. The meter should be reading

low on the 'LOCK' position. If the reading is 'high', switch the unit off, wait 10 seconds and switch the unit off, wait 10 seconds and switch on again to obtain a low reading before setting C28.

(g) Switch EXT ANT to INT position and check that the 'LOCK' reading on the meter settles near the reference mark within 60 seconds. The meter should give a reading at or near the mark at the room temperature of 20C. Check the voltage at P14 with a high resistance meter or oscilloscope and set to the value given on Figure 3. for the actual ambient temperature by means of C28.

(h) Check that the 1MHz output into a 50ohm load is 1.000000 MHz and stable when compared with the Droitwich signal at P13.

(i) Check the 10 MHz waveform into a 50 ohm load.

The main PCB is then set.

Resistors. All resistors are 0.125 watt

R1 10K	R21 1K2	R41 820
R2 22K	R22 100K	R42 820
R3 220	R23 22K	R43 22K
R4 1K2	R24 100	R44 100K
R5 5K6	R25	R45 1M
R6 1K	R26 150	R46 180
R7 27K	R27 22K	R47 820
R8 8K2	R28 22K	R48 33K
R9 2K2	R29 22K	R49 820
R10 470	R30 1K5	R50 22K
R11 2K2	R31	R51 2K2
R12 1M	R32 10K	R52 10K
R13 1K	R33 6K8	R53 39K
R14 1K8	R34 4K7	R54 150K
R15 47	R35 560K	R55 22K
R16 6K8	R36 4K7	R56 1K
R17 120	R37 47	R57 1K
R18 470	R38 1M5	R58 15K
R19 3K3	R39 3K9	R59 470K
R20 820	R40 2K2	R60

Capacitors. B.T..... Bead Tantalum:
All others Metallised Polyester (e.g. WIMA MKS2), Unless specified

C1 10n	C15 OMIT	C29 100n
C2 1µ 10V BT.	C16 100n	C30 10n
C3 100n	C17 10µ 10V BT.	C31 100n
C4 10n	C18 10n	C32 100n
C5 60p trimmer	C19 1µ 10V BT.	C33 100n
C6 1µ 10V BT.	C20 1µ	C34 22µ 10V BT.
C7 100n	C21 22µ10 BT.	C35 470p ceramic
C8 100n	C22 1µ 10V BT.	C36 2n2
C9 1µ 10V BT.	C23 1µ 10V BT.	C37 100n
C10 100n	C24 47n	C38 47p ceramic
C11 100n	C25	C39
C12 100n	C26 100n	C40
C13	C27	C40
C14 100n	C28 60p trimmer	

Semiconductors.

Transistors Tri-Ir14 inc. Type ZTX109 or equivalent

D1 1n914	D5 IN914	D9 IN914
D2 IN914	D6 IN914	D10 IN914
D3 BAT42	D7 * IN4006(light proof)	
D4 BAT42	D8 BZX79C22 Mullard.	
IC1 4040B	IC4 LM308	IC7 74LS390
IC2 4023B	IC5 7805	IC8 14553B
IC3 4046B	IC6 74128	*or as D8

Miscellaneous.

Mains Transformer and PSU board

Antenna Assembly High Q Ref.AGW708 with 500pf compression trimmer.

IC Holders 16 pin DIL 4 off: 14 pin DIL 2 off: 8pin DIL 1 off.

Circuit pins Vero Code No. 18 0223K 25 off.

X1 200KHz, X2 10MHz,

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PIN CONNECTIONS 2A

1 MAIN PCB

Pin No.	Function
1	200KHz input coax (RG174) from antenna switch
2	Braid for P1
3,4,5	To meter switch
6,7,8	Coax outputs to front panel
9	9V Pos. from front panel ON/OFF switch
10	0V from PSU board
11	5V Pos. to O1 option P1
12	0V to O1 option P2
13	"core" output if required (coax) to rear socket
14	Control voltage of VCO. Test point only
15	INHIBIT lead to O1 option P12
16	Braid connection for P13
17	LEAVE BLANK (5V Pos. supply)
18	Braid connection for P6, P7, P8
19	1KHz-VCO derived. To O1 option P4
20	1KHz-Ref. Freq. To O1 option P3

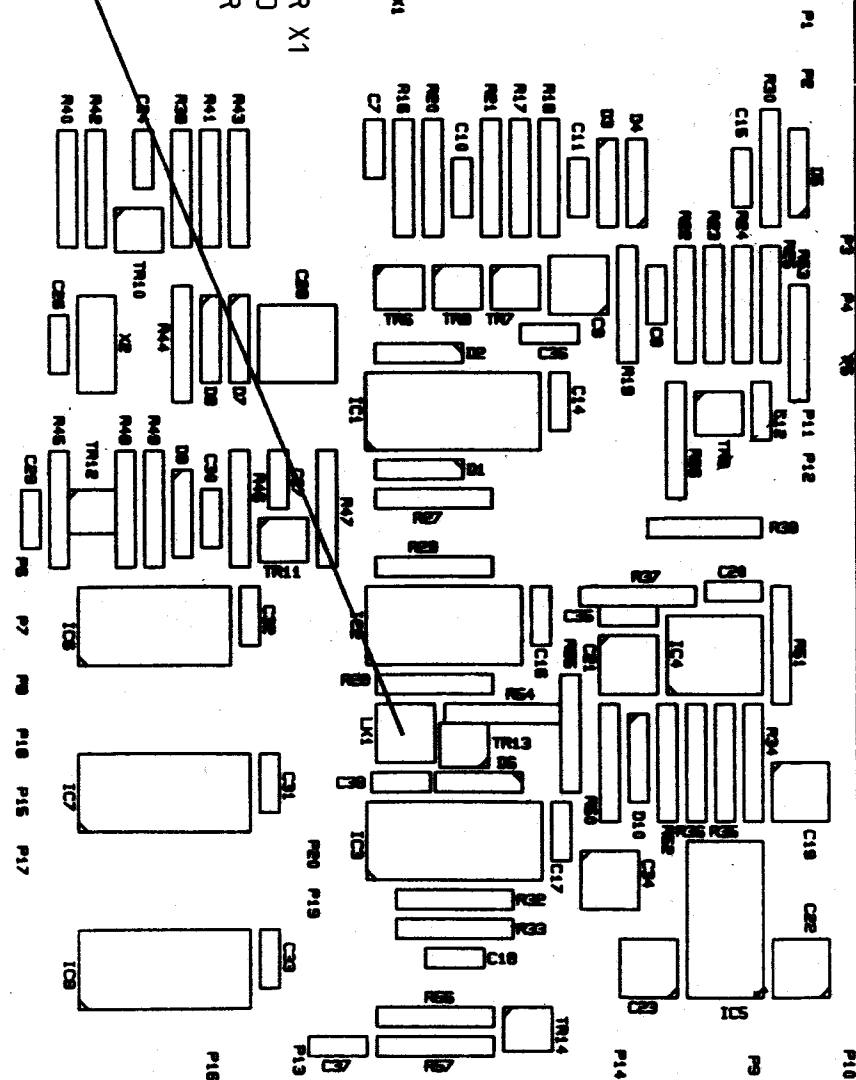
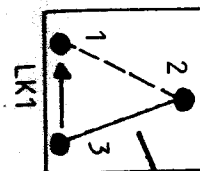
NOTE 1 Board Pins P11, P12, P19 and P20 should be left blank.

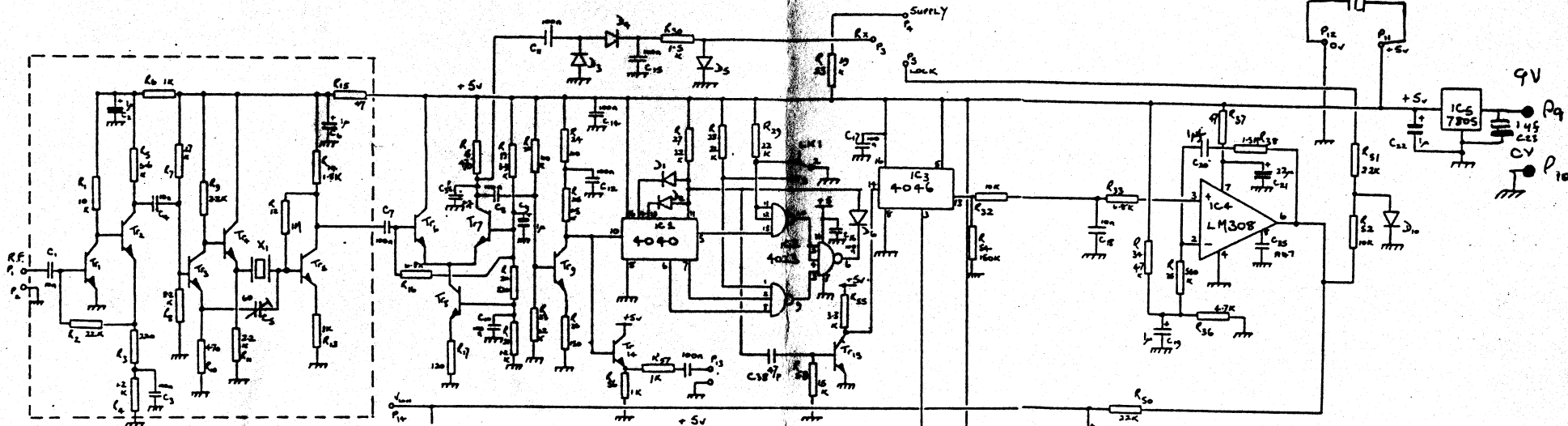
NOTE 2 P15 must be linked to P18.

'D' Connector Input/Output Fixed Plug On Rear Panel

A9 or 15 way 'D' connector is used to supply unregulated 12V dc to external equipment i.e. model AE198/200 active antenna OR as an input from the model 9 uninteruptable power supply/field PSu.

Connections	PIN	1	POSITIVE
	PIN	9	- 12 V dc (9 pin connectors)
	PIN	15	- 12 V dc (15 pin connectors)





COMPONENTS INSIDE DOTTED LINE
MAY BE WITHIN DIRECT BOX ON P.C.B.

OFS 3 A
Main PCB

Note
R27 changed
to 12KΩ.

