INSTRUMENT HANDBOOK

Applicable to Serial No. .....

MODEL 112B

SINE & SQUARE WAVE GENERATOR

B.W.D. ELECTRONICS PTY. LTD.,
331 - 333 BURKE ROAD, GARDINER,
VICTORIA, 3146, AUSTRALIA

Telephone : 25-4425

B.W.D. ELECTRONICS PTY. LTD.,
127 BLUES POINT ROAD, NORTH SYDNEY,
NEW SOUTH WALES, 2060, AUSTRALIA.

Telephone : 929-7452

B.W.D. ELECTRONICS PTY.LTD.

INSTRUCTION MANUAL CHANGES

MODEL bwd .....112B.....

FROM SERIAL NO.	MAKE MANUAL CHANGES	FROM SERIAL NO.	MAKE MANUAL CHANGES
15291	No.1		

Change No.	Page	Sect.	Para.	AMENDMENT
1	1A			Change R25 to 8.2K ½ W 5%
	1A			Change R26 to 560Ω 6W metox res.
	1A			Delete R27
	1A			Delete R28
	CCT			Change R25 to 8.2K ½ W 5%
	CCT			Change R26 to 560Ω 6W metox Res.
	CCT			Delete R27
	CCT			Delete R28

DATE ISSUED : ...20.1.1972.....

F75/1/127/kmc

INSTRUMENT HANDBOOK

MODEL bwd 112B

SINE & SQUARE WAVE GENERATOR

1. GENERAL. Model bwd 112B is a precision Sine and Square Wave Generator providing simultaneously a high level, low distortion Sine Wave Output and a fast rise time Square Wave over the range of 10Hz to 1MHz.

The Sine Wave Output has a level of better than 3% over the entire range and a distortion under 0.2% from 50Hz to 50kHz.

The Square Wave has a constant rise and fall time of 100 nano seconds into low capacitive loads with no low frequency tilt irrespective of load impedance.

All ranges are in decade steps, controls are clearly marked, operation is simple and straightforward.

When used in conjunction with an Oscilloscope such as Model bwd 506, 509A and 539, etc., measurement of amplifier, filter, speakers, transformers, performance, etc., can be made from virtually DC through audio, ultrasonic, video and low RF frequencies.

External synchronising will lock the oscillator over a 3% range.

2. PERFORMANCE

SINE WAVE

Frequency Range

10Hz to 1MHz in five overlapping ranges.

Range 1	10Hz	-	100Hz
2	100Hz	-	1000Hz
3	1000Hz	-	10kHz
4	10kHz	-	100kHz
5	100kHz	-	1.0MHz

Frequency Accuracy

Within 2% ± 0.5Hz over the entire range.

Output Voltage

25V RMS Open Circuit
12.5V RMS into 600Ω } 25V Range
1.25V RMS into 600Ω 2.5V Range
1.25V RMS into 600Ω .25V Range
0.125V RMS into 600Ω .025V Range

Output Control

Continuously variable 26db 600Ω bridge 'T' followed by a 4 step 20db (decade) 600Ω attenuator.

Output Level

(into 600Ω load)
Within 3% over entire range at all settings of attenuator with Vernier at max. into a low capacitance 600Ω load.

P9
106

Output Impedance. Constant at 600Ω all ranges including vernier.

Distortion. 10Hz less than 0.4% (All output levels).
100Hz to 50kHz less than 0.2% (into 600Ω or O/C).
100kHz less than o.3%
600kHz less than 0.5%
1MHz less than 1%

Hum and Noise. Less than 0.05% of output.

Frequency Stability. <0.02%/°C.

Amplitude Stability. <0.15%/°C.

NOTE: Output level of 25V O/C and 12.5V into 600Ω is at <25°C.

SQUARE WAVE.

Frequency Range. 10Hz to 1MHz.

Frequency Accuracy. Within 2% ±0.5Hz over entire range.

Output. 20V p-p O/C.

Output Control. Continuously variable 0 to 20V p-p followed by a 4 - step decade attenuator.

Output Level. (Into less than 100 pf load), within 3% over entire range on 20V, 2V and 0.2V ranges, within 10% up to 200kHz on 0.02 range.

Output Impedance.

0 - 20V	range, 33-270Ω depending on vernier setting.
0 - 2V	range, 100Ω.
0 - 0.2V	range, 100Ω.
0 - 0.02V	range, 100Ω.

Rise and Fall Times.

Range	Capacitive Load	Rise & Fall
0 - 20V	<10pf	150nSec
	<100pf	200nSec
0 - 2V 0 - 02V 0 - 0.02V	<100pf	

Low Frequency Tilt. Negligible. Output is positive going to ground.

GENERAL.

Synchronising. 3 V RMS applied to the Sync. socket will lock the oscillator over a range of ±3% approx.
i.e. 1V RMS/1% locking range.

Constant Amplitude Monitor Signal. When the phase lock facility is not required, a 1V RMS signal is available at the Sync socket to operate a counter or to externally trigger an oscilloscope. Output impedance 27KΩ.

Power Requirements	90 to 130 and 190 to 260 Volts, 15 watts approx.
NOTE:	Characteristics expressed in numerical values with tolerances stated are quaranteed by the factory. Numerical values without tolerances represent the values of an average instrument. All data applies in case of nominal mains voltage unless otherwise stated.

3. CONTROLS AND THEIR FUNCTIONS

Main Tuning Dial	Provides continous frequency adjustment over the range selected by the range switch.
Range Switch	Selects five decade frequency ranges from 10Hz to 1MHz.
Sine Wave Vernier	Adjusts Sine Wave Output over a 26db (14-1 approx) range but maintains a constant 600Ω output impedance within 10%.
Sine Wave Attenuator	Attenuates the signal in 20db (10 - 1) steps down to 60db, with the additional 26db variation available from the vernier control a total attenuator of -86db is available.
Square Wave Vernier	Adjusts the square wave output over an 11 - 1 amplitude range.
Square Wave Attenuator	Attenuates the signal in decade steps down to 20mV p-p, with the vernier control the waveform can be reduced to under 1mV p-p.
Power Switch	Applies power to instrument.
Sync Socket	An external signal of 3V RMS will lock the oscillator over a range of approx.±3%(1V/1%) when applied between this socket and ground. Alternatively an output of approx. 1V RMS is available from the socket for external drive of a counter or oscilloscope.

4. OPERATION

Check that transformer is connected to correct tapping for 110 or 220V operation to suit local supply mains. (See page 7)

Plug in to supply and switch on; instrument will come up to correct output level within five seconds and will stabilise its frequency to within specification within one minute. To check the output and general operation couple the Sine Wave Output to an oscilloscope (e.g. bwd 502,506,509A etc.) with loose leads to reduce capacitive loading. With no termination across the line check the response and note how the input capacitance of the oscilloscope causes a high frequency fall off. A25pf capacitive load will cause a 1db drop at 1MHz.

If the Output is terminated with a 600Ω resistor the variation in Output will be reduced by 50%.

4. OPERATION (Cont'd)

The Square Wave Output can be checked in a similar manner, however, the oscilloscope must be DC coupled to display the low frequency range of the generator, an AC coupled instrument will display tilt on the top and bottom which increases as the frequency is reduced.

At high frequencies and high output the lead and oscilloscope input capacitance will cause a loss of rise time. The effect can be readily noticed by feeding 20V p-p at 1MHz to an oscilloscope, then grasp the interconnecting lead firmly thus increasing the input capacitance and note how the leading and trailing edge of the waveform becomes rounded.

Low level outputs at high frequencies displayed on a good oscilloscope will indicate ringing on the top and bottom of the waveform when unterminated leads are used for the signal leads. This is due to the very high frequencies present in the square wave causing the interconnecting leads to act as resonant lines thus modifying the signal passing along them.

As a general rule always use an earth lead between the oscillator and equipment under test particularly at low levels or when using the square wave output.

Synchronising The Sync socket has two uses. If an external reference signal of 1V RMS is fed into the socket the oscillator can be locked to it if the range and vernier frequency dial is adjusted to within approx. 3% of it. This enables a low distortion high amplitude, adjustable sine wave to be generated at the input reference frequency.

A square wave is also available simultaneously with the same characteristics as the synchronised generator.

The second use of this socket is to supply a synchronising signal of 1V RMS constant amplitude into a low capacitance circuit to drive a counter or to externally trigger an oscilloscope to obtain a constant display irrespective of the attenuator setting or output level.

5. CIRCUIT DESCRIPTION

The circuit can be divided into 3 sections -

1. The sine wave generator and output.
2. The square wave generator and output.
3. Power Supply.

SINE WAVE

The Sine Wave Generator consists of a Wein Bridge Circuit, C4 dual gang capacitor and the selectable high stability range resistors form the series - shunt arm of the Wein network whilst R18 and TH1 thermistor form the remaining two arms of the bridge.

Signals fed into a Wein network produces a phase shift from +90° to -90° depending on the applied frequency. At one particular frequency however no phase shift occurs, only an amplitude attenuation.

5. CIRCUIT DESCRIPTION (Cont'd)

SINE WAVE (Cont'd)

If the output of the network is therefore coupled to an amplifier with sufficient gain to make up the loss in the network (approx.X3) which has no phase shift in itself from input to output, the Wein network when fed from the amplifier output permits one frequency to pass around the loop. This frequency will build up due to the circuit regeneration until it saturates.

We now have an oscillator but it is uncontrollable. Control of the amplitude is established by using negative feed back to balance the positive feed back that starts the oscillation.

In this instrument the same signal that drives the frequency selective network also applies a signal to a thermister TH1. This device has the property of decreasing its resistance with temperature. As current flows through a resistor it generates heat directly proportional to I x R, the thermistor likewise will change its resistance with the current flowing through it from the output stage to the source of Q1. As the signal increases its resistance drops, feeds back more signal so that signal reduces until a stable operating condition is reached in which the negative feed back just equalises the amplifier gain to the network loss.

In this Model Q1 FET presents a high source impedance to the Wein network and also provides a low impedance drive to Q2 amplifier. The signal is inverted at Q2 collector then returned to the same phase as the input signal at Q3 collector. Q5 doubles as an emitter follower and cascode driver. Signals taken from the emitter drive the Wein network via C9, supply negative feed back via TH1, thermistor, and the square wave circuit drive via C16 R43.

The collector of Q5 drives the emitter of Q4 output stage operating with a 550Ω load - this in series with R32 100Ω provides the 600Ω output impedance. To accomodate variation in thermistors output from Q5 emitter is taken via RV2, R24 divider which permits the output amplitude to be accurately adjusted.

Output level is controlled by a 600Ω 'bridged T' RV4 A & B and R41 and 42 and then applied to the attenuator via S2B. S2A selects the required attenuator step.

SQUARE WAVE

The Square wave is generated by a two transistor Schmitt trigger Q6 and Q7. When Q6 is driven into conduction by the negative going portion of Sine Wave its collector rises and via R48 and R46 cuts off Q7 whose collector falls to zero. When the incoming Sine Wave reverses polarity, Q6 is cut off, its collector falls bringing Q7 into conduction. Q7 collector rises and remains switched until the input wave again reverses. The resulting Square Wave is developed across RV7 output vernier and further attenated by the 'T' networks selected by S3.

5. CIRCUIT DESCRIPTION (Cont'd)

SQUARE WAVE (Cont'd)

The DC supply for the generator is rectified by Diodes D 2 - 5 bridge rectifier, filtered by C25 and C24. It is stabilised by Q9 pass transistor controlled by Q10 emitter follower and Q11 amplifier which senses the difference between the voltage on its base from the divider R63 RV8 and R54 and the voltage at its emitter across D1 zener. Any variation in output voltage is fed back in antiphase to the series transistor to maintain a conatant output irrespective of load or line change.

The Square Wave circuit requires a lower voltage, this is dropped to approx. +30V by Q8 emitter follower controlled by R73, 53 and RV6.

6. ALIGNMENT PROCEDURE

Test equipment required.
10Hz to 1.2MHz counter.
Noise and Distortion meter e.g. HP 333A.
Oscilloscope e.g. bwd 506, 539, etc.
Level meter. RMS indicating.

Turn instrument on and leave for five minutes before attempting to align.

With covers off, check the +100V rail on the P/C Board, adjust RV8 to set voltage if necessary.

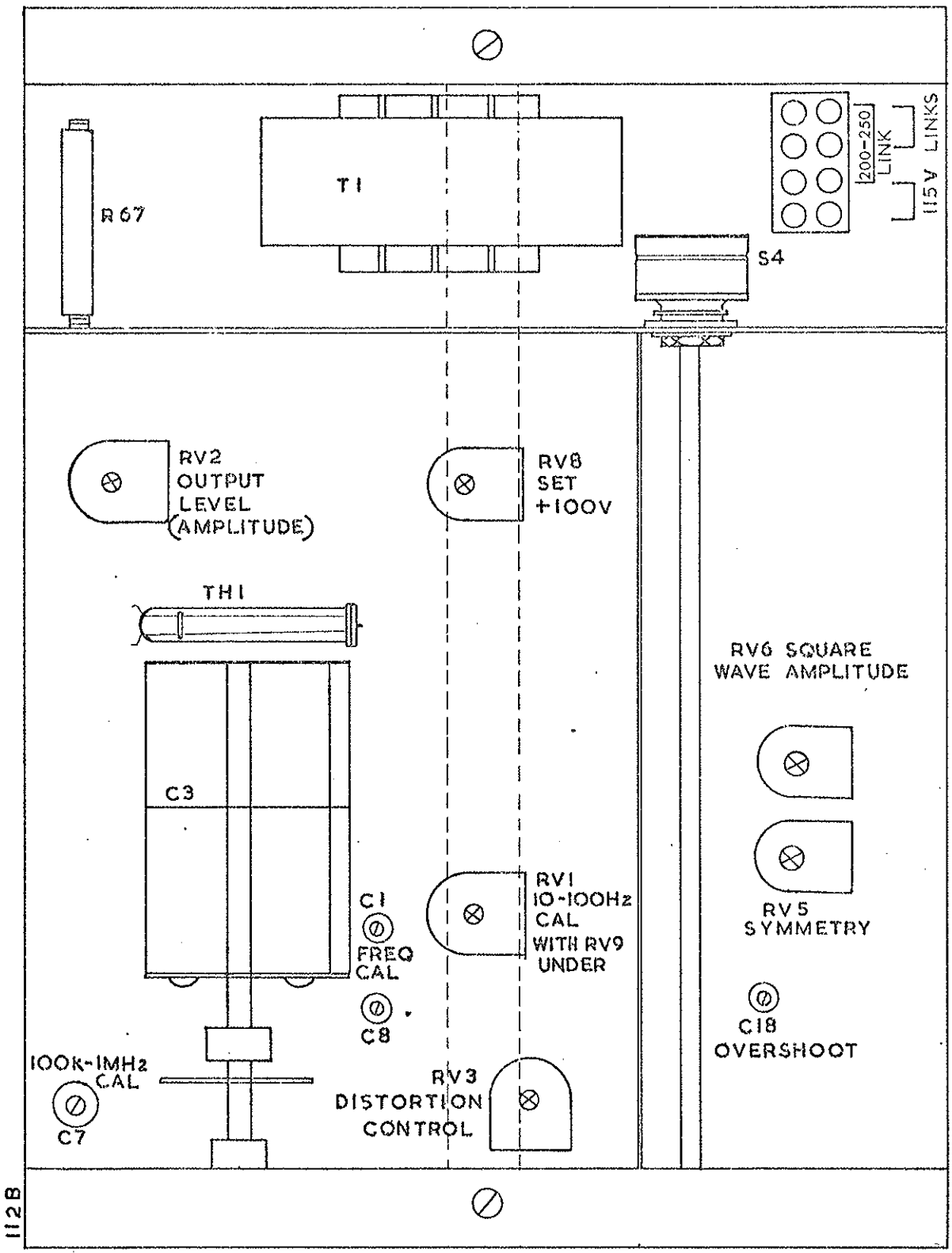
Set Frequency to 2kHz, turn Sine Wave attenuator and vernier to max. Output (fully clockwise), Connect high impedance RMS measuring meter across output, adjust RV2 for 25V RMS output. If only a 600Ω terminated meter is available set output to 12.5V RMS.

Terminate Output with 600Ω load, fit top cover and invert instrument. Connect distortion meter across Output and adjust for minimum distortion reading. Insert a small insulated screw driver into RV3, turn slightly clockwise - note whether distortion increased, if so turn anticlockwise and note effect - remove hand from screw driver and checking distortion to eliminate hum being fed into circuit. Set control for minimum distortion. As this control has a large electrolytic capacitor attached to it, it must be moved slowly. It will only require adjustment with change of Q1 FET.

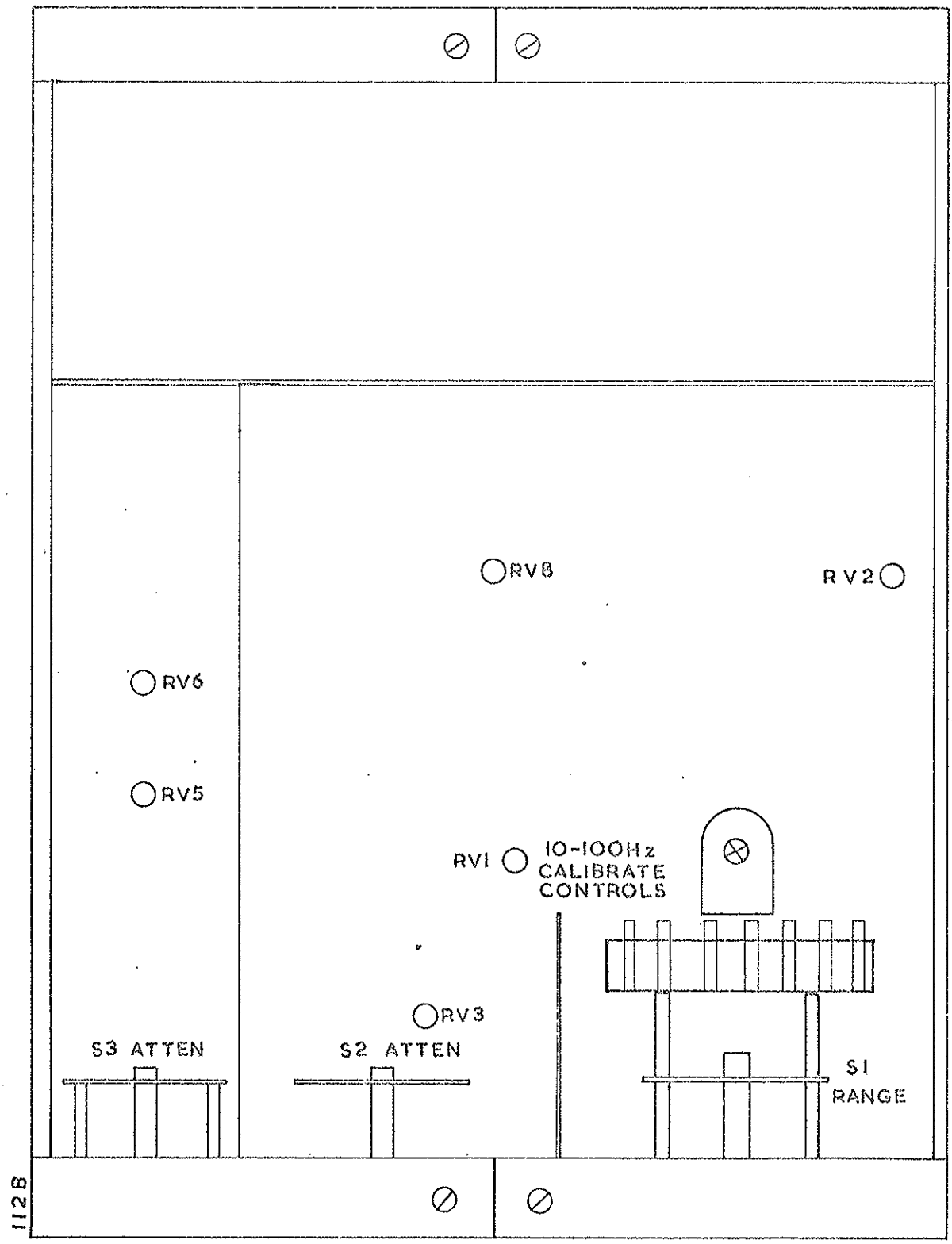
FREQUENCY ADJUSTMENT

Connect a counter across the output, turn dial to 1kHz check reading, now turn to 10kHz, if frequency is not within 2% adjust C1 and C4 equally to bring within tolerance. Check all other ranges other than the lowest and set C1 and C4 for best frequency compromise within the 2% limit. Now turn to the lower frequency range, set vernier to 100Hz adjust RV1 and RV8 for correct frequency reading, check tracking over range.

The top range is calibrated by setting the range switch to .1 - 1MHz range and the dial to 10. Now adjust C7 at the L.H. front corner of the P/C board for 1MHz.



TOP VIEW SHOWING LOCATION OF PRESET CONTROLS ETC.



BOTTOM VIEW SHOWING LOCATION OF PRESET CONTROLS ETC.

6. ALIGNMENT PROCEDURE (Cont'd)

SQUARE WAVE ALIGNMENT

Set frequency for 2kHz. Connect oscilloscope to Square Wave Output, attenuator set to 20V, vernier fully clockwise. Check mark to space ratio of wave form, if not 1 - 1 set correctly with RV5.

Output amplitude can be set by using a calibrated oscilloscope, adjust RV6 for 20V p-p output.

High frequency shape is adjusted by increasing frequency to 500kHz, reducing attenuator to 2V step then adjusting C18 for best square wave shape.

The instrument is now correctly aligned.

7. REPLACEMENT PARTS

Spares are normally available from the manufacturer, B.W.D. ELECTRONICS PTY. LTD. When ordering, it is necessary to indicate the serial number of the instrument. If exact replacements are not to hand, locally available alternatives may be used, provided they possess a specification not less than, or physical size not greater than the original components.

As the policy of B.W.D. ELECTRONICS PTY. LTD., is one of continuing research and development, the Company reserves the right to supply the latest equipment and make amendments to circuits and parts without notice.

8. WARRANTY

The equipment is guaranteed for a period of twelve (12) months from the date of purchase against faulty materials and workmanship.

Please refer to Guarantee Registration Card No. ..... which accompanied instrument for full details on conditions of warranty.

REPLACEABLE PARTS

1. This section contains information for ordering replacement parts, it provides the following details : -

   (a) Description of part (see list of abbreviations).
   (b) Typical manufacturer or supplier of the part (see list of abbreviations).
   (c) Manufacturer's Part Number, and
   (d) Defence Stock Number, where applicable.

2. Ordering - Please quote Model Type No., e.g. bwd 511, Serial No. Circuit Reference No. and component details as listed in parts list.

COMPONENT DESIGNATORS

A	Assembly	H	Heater	RV	Resistor Variable
B	Lamp	J	Jack (socket)	S	Switch
C	Capacitor	L	Inductor	T	Transformer
D	Diode	M	Meter	TH	Thermistor
DL	Delay Line	P	Plug	V	Valve
E	Misc. Elect. Part	Q	Transistor	VDR	Voltage Dependent Resistor
F	Fuse	R	Resistor		

ABBREVIATIONS

Amp	Ampere	L	Inductor
C	Capacitor	lin	Linear
cc	Cracked Carbon	Log	Logarithmic Taper
c	Carbon	m	Milli = 10^{-3}
cd	Deposited Carbon	MHz	Mega Hertz = 10^{6}Hz
comp	Composition	MF	Metal Film
CDS	Ceramic Disc Capacitor	ma	Milli Ampere
cer	ceramic	MΩ	Meg Ohm = $10^{6}\Omega$
Com	Common	mfr	Manufacturer
DPST	Double Pole Single Throw	MO	Metal Oxide
DPDT	Double Pole Double Throw	MHT	Polyester/Paper Capacitor
elec	Electrolytic	MPC	Metalised Polyester Capacitor
F	Farad	Ne	Neon
f	Fuse	NPO	Zero temperature co-efficient
FET	Field Effect Transistor	nsr	Not separately replaceable
Ge	Germanium	NC	Normally Closed
H	Henry(ies)	NO	Normally Open
H.S.	High Stability	ns	Nano second
HTC	High Temp Coating	obd	Order by Description
ins	Insulated	OD	Outside Diameter
kHz	Kilo Hertz = 10^{3}Hz	p	Peak
KΩ	Kilo Ohm = $10^{3}\Omega$	pf	pico farad = 10^{-12}F

205

COMPONENT ABBREVIATIONS (cont.)

PL	Plug
PS	Socket
Preset	Internal Preset
PYE	Polyester
pot	Potentiometer
prec	Precision
PC	Printed circuit
PIV	Peak Inverse Voltage
PYS	Polystyrene
p-p	Peak to Peak
P.Shaft	Plain Shaft
Q	Transistor
R	Resistor
rot	rotary
R log	Reverse Logarithmic Taper
rms	Root Mean Squared
SPDT	Single Pole Double Throw
SPST	Single Pole Single Throw
S.Shaft	Slotted Shaft
Si	Silicon
Ta	Tantalum
tol	Tolerance
trim	trimmer
V	Volt(s)
var	variable
vdcw	Volts Direct Current Working
w	Watt(s)
ww	Wire Wound
Z	Zener
*	Factory Selected value, nominal value may be shown
**	Special component, no part no. assigned

MANUFACTURERS ABBREVIATIONS

AB	A.B. Electronics
AEE	AEE Capacitors
AN	Anodeon
AST	Astronic Imports
AWA	Amalgamated Wireless of Aust.
ACM	Acme Engineering Pty.Ltd.
AMP	Aircraft Marine Products(Aust.) P/L
AR	A. & R. Transformers
AUS	Australux Fuses
AWV	Amalgamated Wireless Valve Co.
ACA	Amplifier Co. of Aust.
ARR	Arrow
BWD	B.W.D. Electronics Pty.Ltd.
BL	Belling & Lee Pty.Ltd.
BR	Brentware (Vic.) Pty.Ltd.
BU	Bulgin
CF	Carr Fastener
CAN	Cannon Electrics Pty.Ltd.
CIN	Cinch
DAR	Darstan
DIS	Distributors Corporation Pty.Ltd.
ELN	Elna Capacitors (Sonar Elec.P/L)
ETD	Electron Tube Dist.
F	Fairchild Australia Pty.Ltd.
GRA	General Radio Agencies
GE	General Electric (USA)
GEC	General Electric Co. (UK)
GES	General Electronic Services
HW	Hurtle Webster
HOL	R.G. Holloway
H	Haco Distributors (National)
HS	Hawker Sidney
J	Jabel
McH	McKenzie & Holland(Westinghouse)
MAS	Master Instrument Co.Pty.Ltd.
MOR	Morganite (Aust.) Pty.Ltd.
MSP	Manufacturers Special Products (AWA)
McM	McMurdo (Aust.) Pty.Ltd.
MOT	Motorola
NU	Nu Vu Pty.Ltd.
NAU	A.G. Naunton Pty.Ltd.
NS	National Semiconductor
PA	Painton
PAL	Paton Elect. Pty.Ltd.
PI	Piher Resistors (Sonar Electronics)
PH	Philips Electrical Industries Pty.Ltd.
PL	Plessey Pacific
PRO	Procel
PV	Peaston Vic.
RC	Radio Corporation (Electronic Inds.)
RCA	Radio Corporation of America
RHC	R.H. Cunningham
STC	Standard Telephone & Cables
SI	Siemens Electrical Industries
SIM	Simonson Pty.Ltd.
SE	Selectronic Components
SON	Sonar Electronics
TR	Trimax Erricson Transformers
TI	Texas Instruments Pty.Ltd.
TH	Thorn Atlas
UC	Union Carbide
W	Wellyn Resistors (Cannon Elec. P/L)
WH	Westinghouse
Z	Zephyr Prod. Pty.Ltd.

B.W.D. ELECTRONICS PTY. LTD. - PARTS LIST

Model bwd 112B

CCT Ref	DESCRIPTION					Mfr. or Supplier	Part No.	
R1	8.2MΩ	Resistor	5%	½W	CC	PI		
R2	10MΩ	"	5%	½W	CC	PI		
R3	10MΩ	"	5%	½W	CC	PI		
R4	10MΩ	"	5%	½W	CC	PI		
R5	10MΩ	"	5%	½W	CC	PI		
R6	8.2MΩ	"	5%	½W	CC	PI'		
R7	2.7MΩ	"	2%	½W	CC	PI		
R8	2.7MΩ	"	2%	½W	CC	PI		
R9	270KΩ	"	1%	½W	MO	ELECTR.	TR5	
R10	270KΩ	"	1%	½W	MO	ELECTR.	TR5	
R11	27KΩ	"	1%	½W	MO	ELECTR.	TR5	
R12	27KΩ	"	1%	½W	MO	ELECTR.	TR5	
R13	3.0KΩ	"	1%	½W	MO	ELECTR.	TR5	
R14	3.0KΩ	"	1%	½W	MO	ELECTR.	TR5	
R15	10KΩ	"	5%	½W	CC	PI		
R16	27KΩ	"	5%	½W	CC	PI		
R17	15KΩ	"	5%	½W	CC	PI		
R18	220Ω	"	5%	½W	CC	PI		
R19	15KΩ	"	5%	½W	CC	PI		
R20	22KΩ	"	5%	½W	CC	PI		
R21	1.8KΩ	"	5%	½W	CC	PI		
R22	8.2KΩ	"	5%	½W	CC	PI		
R23	2.7KΩ	"	5%	½W	CC	PI		
R24	2.2KΩ	"	5%	½W	CC	PI		
R25	8.2KΩ	"	5%	½W	CC	PI		
R26	560Ω	"	5%	4W 6W	MF	METOX		
R27								
R28								
R29	68Ω	"	5%	1W	CC	PI		
R30								
R31	220KΩ	"	5%	½W	CC	PI		
R32	100Ω	"	5%	1W	CC	PI		
R33	620Ω	"	2%	1/4W	CC	ELECTR.	TR5	
R34	5.6KΩ	"	2%	½W	CC	PI		
R35	750Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R36	5.6KΩ	"	2%	½W	CC	PI		
R37	750Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R38	4.7KΩ	"	2%	1/4W	MO	ELECTR.	TR5	
R39								
R40	4.7KΩ	"	5%	½W	CC	PI		

* Refer Amendment 1

Model bwd 112B

CCT Ref	DESCRIPTION					Mfr. or Supplier	Part No.	
R41	620Ω	Resistor	2%	1/4W	MO	ELECTR.	TR5	
R42	620Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R43	8.2KΩ	"	5%	½W	CC	PI		
R44	3.9KΩ	"	5%	½W	CC	PI		
R45	39KΩ	"	5%	½W	CC	PI		
R46	100Ω	"	5%	½W	CC	PI		
R47	560Ω	"	5%	½W	CC	PI		
R48	4.7KΩ	"	5%	½W	CC	PI		
R49	1KΩ	"	5%	½W	CC	PI		
R50	10KΩ	"	5%	½W	CC	PI		
R51	560Ω	"	5%	1W	CC	PI		
R52	560Ω	"	5%	1W	CC	PI		
R53	8.2KΩ	"	5%	1W	CC	PI		
R54	10KΩ	"	5%	1W	CC	PI		
R55	1KΩ	"	5%	1W	CC	PI		
R56	910Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R57	91Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R58	10Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R59	91Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R60	91Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R61	10Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R62	91Ω	"	2%	1/4W	MO	ELECTR.	TR5	
R63	56KΩ	"	5%	½W	CC	PI		
R64	33Ω	"	5%	½W	CC	PI		
R65	10KΩ	"	5%	1W	CC	PI		
R66	1KΩ	"	5%	½W	CC	PI		
R67	750Ω	"	5%	10W	WW	HW		
R68	10KΩ	"	5%	½W	CC	PI		
R69	10KΩ	"	5%	½W	CC	PI		
R70	82Ω	"	5%	½W	CC	PI		
R71	100Ω	"	5%	4W	MF	METOX		
R72	82Ω	"	5%	½W	CC	PI		
R73	33K	"	5%	½W	CC	PI		
	CAPACITORS							
C1	4-20pf Trim					PH	6S-02/4-20	
C2	22pf		5%	500V	N750	H.S	CDS	
C3 A&B	2 x 540pf Tuning					POLAR	C73 02/1-523PF	
C4	4-20pf Trim					PH	6S-02/4-20	
C5	33uF			40 V	Electr.	PH	2222-015-17339	
C6	150uF			16V	Electr.	PH	2222-016-15151	

B.W.D ELECTRONICS PTY. LTD. - PARTS LIST

Model bwd 112B

CCT Ref.	DESCRIPTION	Mfr. or Supplier	Part No.	
C7	10-40pf Trim	RH Cun	10S/0210/40P1	
C8	82pf 5% 500V CDS	H.S	CDS	
C9	.1uF 10% 100V	SOR		
C10	33 uF 40V Electr.	PH	2222-015-17339	
C11	150 uF 16V Electr.	PH	2222-016-15151	
C12	470 uF 10V Electr.	PH	2222-017-14471	
C13	5.6pf 500V NPO	H.S	CDS	
C14	80uF 100V Electr.	PH	2222-040-10809	
C15	560pf 5% 630V PVS	H.S		
C16	33uf 40V Electr.	PH	2222-015-17339	
C17	50uf 150V Electr.	PH	2222-040-11509	
C18	4-20pf Trim			
C19	.1uf 100V	Son		
C20	33uf 40V Electr.	PH	2222-015-17339	
C21	12.5uf 150V Electr.	PH	2222-040-11139	
C22	47uf 63V Electr.	PH	2222-016-18479	
C23	.047uf 10% 100V Pye	SOR	TYPE N	
C24	40uf 200V Electr.	PH	2222-040-12409	
C25	40uf 200V Electr.	PH	2222-040-12409	
C26	4.7uf 63V Electr.	PH	2222-015-18479	
	POTENTIOMETERS			
RV1	4.7MΩ Preset	PH	2322-411-03316	
RV2	470Ω	PH	2322-411-03303	
RV3	100KΩ	PH	2322-411-03311	
RV4A	25KΩ 2% log Front Section	Plessey	} EC2	
RV4B	25KΩ 2% Anti Log Rear Sect.	Plessey	}	
RV5	4.7KΩ Preset Pot	PH	2322-411-03306	
RV6	10KΩ	PH	2322-411-03307	
RV7	1KΩ Curve A FMF	DUC		
RV8	22KΩ Preset	PH	2322-411-03308	
RV9	4.7MΩ Preset	PH	2322-411-03316	
	SWITCHES			
S1 A&B	5 Position 2 Pole	MSP	Type F	
S2 A&B	4 Position 2 Pole	MSP	Type F	
S3	2 Position 2 Pole Rotary	DUC	DSR	
S4 A&B	4 Position 2 Pole	MSP	Type F	

B.W.D. ELECTRONICS PTY. LTD. - PARTS LIST

Model bwd 112B

CCT Ref	DESCRIPTION	Mfr or Supplier	Part No.	
	SEMI CONDUCTOR			
Q1	25V DS N CHANNEL FET SI	TI	2N3819	
Q2	-45 Vce Hfe 200 PNP SI	F	2N3644	
Q3	-12 Vce Hfe 50 PNP SI	F	2N3640	
Q4	300 Vce Hfe 50 NPN SI	M	MJE 340	
Q5	45 Vce Hfe 100 NPN SI	F	2N3642	
Q6	-45 Vce Hfe 200 PNP SI	F	2N3644	
Q7	-45 Vce Hfe 200 PNP SI	F	2N3644	
Q8	300 Vce Hfe 50 NPN SI	M	MJE340	
Q9	300 Vce Hfe 50 NPN SI	M	MJE340	
Q10	300 Vce Hfe 50 NPN SI	M	MJE340	
Q11	300 Vce Hfe 50 NPN SI	M	MJE340	
	DIODES			
D1	12V Zener Diode 400mW	PH	BZX 79 C12	
D2	400V 500mA	STC	EM 404	
	MISCELLANEOUS			
B1	6.3V Indicator Lamp	SATO	3280	
T1	Power Transformer	A & R	PT 6905	
TH1	Thermister	STC	R 54	
F1	0.25A Fuse	AN	3AG 250mA	
P/C	Printed Circuit Board	BWD	160/119	

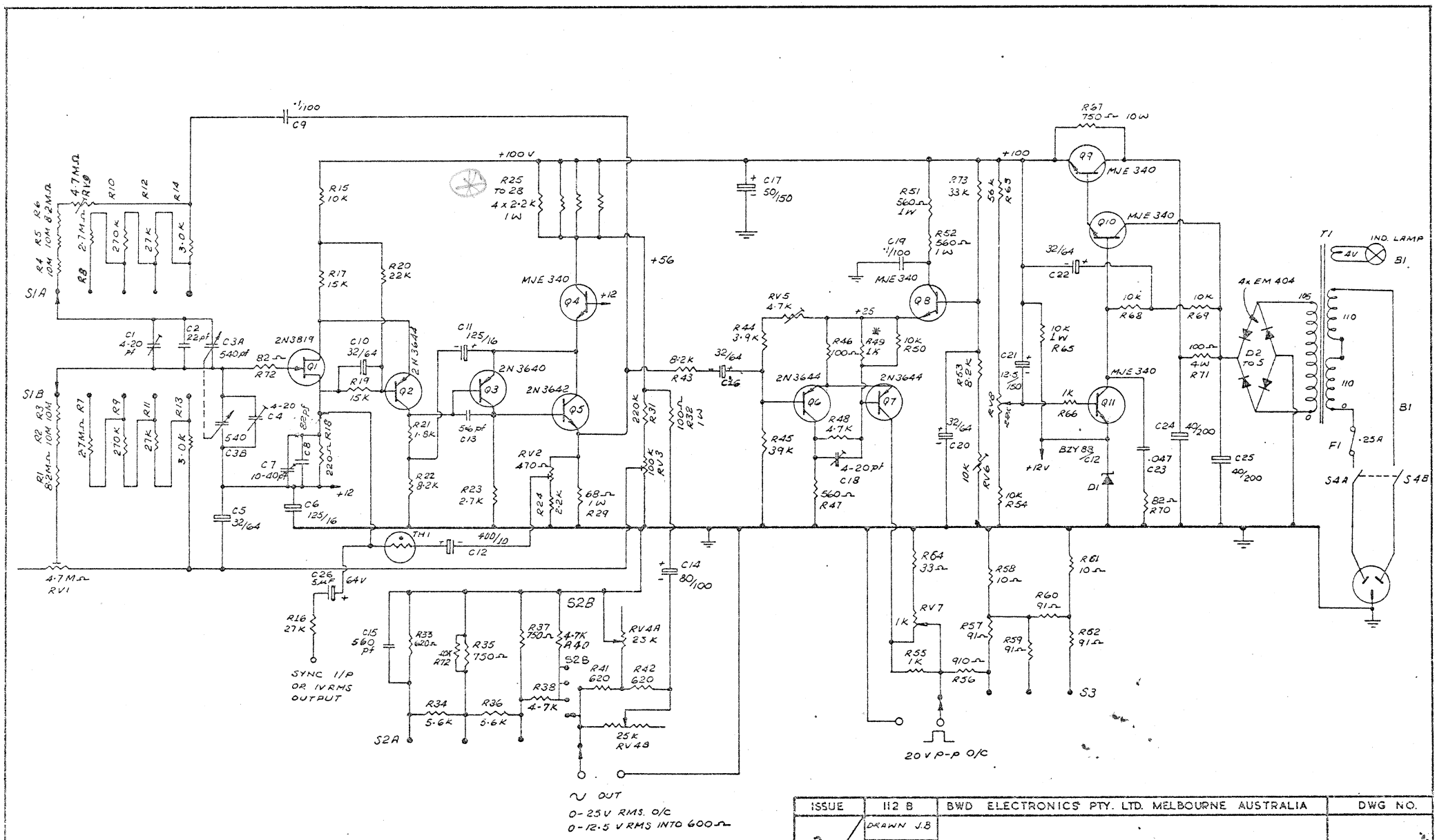
	MODIFICATIONS
R 71	ISSUE 1 12-69
C 75	ISSUE 2 11-70 PRODUCTION
D 5	
Q 11	

SWITCHES

S1 A-B	FREQUENCY RANGE SWITCH
S2 A-B	∿ WAVE ATTENUATOR
S3	⎍ WAVE ATTENUATOR
S4 A & B	MAINS ON-OFF

CONTROLS

RV 1	SET 10 - 100 Hz CAL
RV 2	SET OUTPUT LEVEL
RV 3	SET DISTORTION
RV 4	∿ OUTPUT CONTROL
RV 5	⎍ SYMMETRY
RV 6	⎍ SET AMPLITUDE
RV 7	⎍ OUTPUT CONTROL
RV 8	SET +100V HT
RV 9	SET 10-100 Hz CAL



NOTE: Components may occasionally vary from those designated due to availability or optomise performance.

* Selected component

ISSUE	112 B	BWD ELECTRONICS PTY. LTD. MELBOURNE AUSTRALIA	DWG NO.
3 / 12-70	DRAWN J.B TRACED S.E.E. CHECKED DATE 2-12-70	MODEL BWD 112 B SINE AND SQUARE WAVE GENERATOR	832

Refer Amendment 1