McVan Instruments PTY LTD
ABN 56 007 283 963

BWD604 MINI-LAB
Ver 3
OPERATION HANDBOOK

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Important Notice

SAFETY INFORMATION

In this handbook and on the instrument panels may be found statements or symbols calling attention to a safety requirement or feature.

Symbols and statements used include the following:

DANGER - HIGH VOLTAGE

CAUTION

DANGER To alert of possible danger to either operator or equipment that may be present during the described procedure.

WARNING To alert operator that damage may occur to equipment under test if certain precautions as detailed are not followed.

Do not use this instrument in an explosive environment.

Do not remove the covers of the instrument unless you are qualified and experienced in servicing this class of instrument. Lethal voltages are present within the instrument.

This instrument must be grounded via the ground (earth) wire in the power cord, or by means of the ground terminal on the back panel if present. Loss of the safety ground will make conductive parts capable of rendering an electric shock and make operation of the instrument unreliable.

Always ensure the power cord is an approved type and in good condition and connected to a properly wired power outlet.

Use only the fuse type and rating as specified on the back panel.

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1. INTRODUCTION

The model BWD604 MINI-LAB is a combination of eleven versatile instruments and facilities in a stylish compact cabinet. Each facility can be used independently or in conjunction with each other to further increase MINI-LAB capabilities in providing such unusual outputs as square waves in excess of 10MHz to less than 10 days.

All outputs and inputs are short circuit proof. All inputs and outputs can be shorted together except the Function Generator BNC output. If +15V is shorted to the +5V supply it will not cause an over-voltage greater than +6V.

MINI-LAB's high performance, stability, accuracy, versatility and compact format makes it the ideal instrument for laboratories, service centres, production lines and education. Applications range through digital and analog electronics, electrical, biomedical, mechanical, chemical or optical, and more.

1.1 Summary of BWD604 MINI-LAB features.

a. Sine, triangle, square, ramp, pulse Function Generator output from <0.1Hz to >20MHz with digital frequency readout. Output up to 20Vp-p open circuit from a 50Ω source with variable offset and may be AM or FM modulated.
b. Logarithmic and linear Ramp Generator can be switched to the Function Generator to provide up to 2 decades of sweep.
c. Power Amplifier or Bi-polar Power Supply. Power Supply is continuously variable ±15V at 1 amp output. Amplifier gain is adjustable from x1 to x100 with ±15V at 1 amp output with polarity selection and a direct switching to Function Generator output.
d. Variable +15V and - 15V, 1 Amp stabilised Power Supplies with floating common which can be taken up to ±100V.
e. Fixed +5V, 3 amp regulated Power Supply.
f. Frequency Counter with 4 digit readout and spanning less than 5Hz to greater than 30MHz.
g. Volt, Amp, Ohm Digital Meter with true rms AC voltage and current measurement. 3½ digit readout.
h. Counter / Function Generator decade divider, providing a square wave output with a division ratio of 1 to 10,000.

2. *SPECIFICATIONS*

All parameters are measured after the instrument has been on for 15 minutes at room temperature between 20° and 25°C. All measurements made with all other outputs not in use unless otherwise stated. Function Generator specifications are based on a 50Ω load unless otherwise stated.

2.1 Function Generator.

Waveforms:	Sine, Triangle, Square, Ramp or Pulse.
Frequency Range:	Less than 0.1Hz to greater than 20MHz. Each range covers over 2 decades.
Readout:	Direct - 4 digit 8mm LED display Accuracy ±1 count. Gating Period 1 sec.
Output Volts:	20V p-p open circuit max. 10V p-p into 50Ω, short circuit protected.
Attenuator:	10, 20 and 30dB switch selected and a continuously variable 20:1 control.
Level Stability:	**Square wave** ±1dB from 0.1 Hz to 20MHz. **Triangle wave** ±1dB from 0.1Hz to 10MHz. **Sine wave** ±1dB from 0.1Hz to 20MHz.
Output Offset:	Output is normally centred about ground. A rotary control applies a continuously variable ±10V offset voltage to the output waveform into an open circuit load or ±5V into 50Ω.
Sync Output:	0 to +2.8V min. from 2.5kΩ source in quadrature to the main output.
Symmetry:	**Fixed:** Within ±2% from 0.1Hz to 10MHz. **Variable:** Selection of + or - continuously variable symmetry over 30% to 70% typical.
Sine Distortion:	5Hz to 1MHz - 2% typical, 5% max. Typically 1.5% 10Hz to 20kHz.
Rise and Fall Time:	(Square or pulse) <15nsec.
Triangle Linearity:	Better than 99% from 0.1 Hz to 1MHz.
Frequency Modulation:	Function Generator can be swept ±70% typically on each range by a ±10V external input or the internal sweep generator.
Modulation Input:	91kΩ and 33pF nominal.
Response:	Frequency, DC to >1MHz. Linearity better than 2%. ±10V gives ±70% change typical.

2.2 Log - Linear Sweep Generator.

Switch selection of LOG, EXT or LINEAR ramp voltages. Maximum span of sweep generator will sweep over 2 decades of each range of the Function Generator. Any portion of each range can be swept depending on the setting of the vernier and sweep amplitude control.

Linear Ramp:	100msec to >5 seconds, continuously variable.
Log Ramp:	200msec to >5 seconds, continuously variable.
Gate Output:	0 to +6V pulse during the reset period - can be used to trigger an oscilloscope and blank the return trace. Source impedance 10 kΩ.

2.3 Amplitude Modulator (or Balanced Modulator).

Amplitude modulation of all Function Generator waveforms from 0 to 95% modulation.

Modulation Frequency:	DC to 5MHz.
Input Impedance:	100kΩ and 33pF nominal.
Output Level:	Sine wave, unmodulated 10V p-p O/C, 5V p-p into 50Ω. Response ±2% to 1MHz, ±5% 1MHz to 10MHz. Modulation voltage ±2.0V for 95% modulation. When modulation signal is superimposed on approximately -1.5V then output will be balanced modulated.

2.4 Frequency Counter.

Digital counter can be switched from displaying Function Generator frequency to the frequency of an external signal input via the BNC connector. Function Generator remains fully operational when counter is used externally.

Display:	4 digit 8mm LED with over range indication.
Frequency Range:	<5Hz to >30MHz 10kHz, 100kHz, 1MHz, 10MHz, >30MHz. (5 ranges)
Resolution:	1Hz, 10Hz, 100Hz, 1kHz, 10kHz. (respectively)
Sensitivity:	200mV p-p, 100Hz to 12MHz increasing to 500mV p-p at 30MHz and 2V at 5Hz.
Input:	1MHz and 20pF approx. Max input 250V DC or p-p AC. Input diode protected.
Gate Period:	1 second fixed.
Count accuracy:	±1 count.

2.5 Decade Frequency Divider.

Signals applied to counter input are available divided down in decade steps and converted to a square wave output.

Division Ratios:	1 to 10,000 in 5 decade steps	
Max Input Frequency:	/1	500kHz
	/10	5MHz
	/100, /1000 and /10,000	>30MHz.
Output:	0 to +5V from 4.7kΩ source impedance.	

2.6 Clock Output.

Frequency:	1 Hertz square wave, accuracy <0.01%.
Output:	0 to +5V from 4.7kΩ source impedance.

2.7 Power Amplifier/Bi-polar Power Supply (Switch Selection).

2.7.1 Amplifier

Voltage Gain:	x1 to x100 continuously variable.		
Polarity:	Switch selection of normal or inverted output.		
Input Selection:	Switch selection of Function Generator output or an External source.		
External Input:	100kΩ and 10pF nominal		
Output Volts:	±15V into 15Ω		
Output Current:	±1Amp with constant current overload.		
	Gain: **x1**	**x20**	**x100**
Bandwidth: (-3dB)	All at ±15V output swing		
Bandwidth into 50Ω	DC-350kHz	DC-200kHz	DC-50kHz
Bandwidth into 15Ω	DC-250kHz	DC-150kHz	DC-35kHz
Rise Time into 50Ω	1usec	2.5usec	10usec
Output Impedance:	<0.1Ω	<0.2Ω	<1Ω
Hum and Noise O/C input:	1mV p-p	5mV p-p	<30mV p-p
Distortion:	All at ±15V output swing		
Distortion into 50Ω	<0.5%	<4%	N/A DC-100kHz
Distortion into 15Ω	<0.2%	<1.5%	<2% DC-10kHz
Distortion into 15Ω	<1%	<2%	<6.5% DC-30kHz

2.7.2 Power Supply

Output Volts:	Continuously variable from +15V to -15V.
Output Current:	0 to 1Amp maximum with constant current overload.
Output Impedance:	<0.05Ω.
Hum and Noise:	<5mV p-p at full output when Function Generator frequency is set to less than 100kHz.

2.8 -15V To 0 To +15V Isolated Power Supply.

Output Volts:	-15V to 0V and 0V to +15V with a common isolated 0V rail. Either output or the 0V terminal may be grounded or taken to a maximum of ±100V DC to ground.
Output Current:	1 Amp from each supply with constant current overload.
Output Impedance:	<0.01Ω for ±10% line change. <0.1Ω for 0 to full load change.
Hum and Noise:	<5mV p-p at full load when Function Generator frequency is set to less than 100kHz.

2.9 5V, 3A Fixed Supply.

Output Volts:	+5 Volts ± 0.25V
Output Current:	0 to 3 Amp. (Line voltage 210V/105V min) 0 to 2.5Amps. (Line voltage 200V/100V min). Output is protected against overload and over-voltage from any other BWD604 power supply.
Output Impedance:	<0.1Ω
Hum and Noise:	<10mV p-p at full output

2.10 Digital Volt, Ohm, Amp, Meter.

Display:	3½ digit, 8mm LED with over range indication.

2.10.1 DC Voltmeter

Ranges:	200mV, 2V, 20V, 200V, 500V (5 ranges)
Resolution:	100uV, 1mV, 10mV, 100mV, 1V (respectively)
Polarity:	+ or - with automatic indication
Accuracy:	<1% ±1 count
Input:	10MΩ
Common Mode Voltage:	±500V Maximum

2.10.2 AC Voltmeter

Ranges:	200mV, 2V, 20V, 200V, 350V rms (5 ranges)
Resolution:	100uV, 1mV, 10mV, 100mV, 1V rms (respectively)
Reading:	True rms with max 3-1 peak to trough waveforms
Accuracy:	<3% ±1 count, 5Hz to 5kHz
Bandwidth:	3Hz to 100kHz on 200mV range 3Hz to 50kHz on 2V range 3Hz to 10kHz on 20V range 3Hz to 5kHz on 200 and 350V range

2.10.3 Ohmmeter

Ranges:	200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ (5 ranges)
Resolution:	100mΩ, 1Ω, 10Ω, 100Ω, 1000Ω (respectively)
Accuracy:	<1% ±1 count

2.10.4 DC Ammeter

Ranges:	200uA, 2mA, 20mA, 200mA, 2A (5 ranges)
Resolution:	100nA, 1uA, 10uA, 100uA, 1mA (respectively)
Accuracy:	<1% ±1 count

2.10.5 AC Ammeter: **True rms reading**

Ranges:	200uA, 2mA, 20mA, 200mA, 2A (5 ranges)
Resolution:	100nA, 1uA, 10uA, 100uA, 1mA (respectively)
Accuracy:	<3% ±1 count
Frequency:	5Hz to 1kHz on all ranges
Protection:	2 amp quick blow fuse and diodes.

2.11 Interconnection Facilities.

Push pull waveforms are available from Function Generator and Power Amplifier switched to the inverted mode. Bandwidth DC to 400kHz into an open circuit or 50Ω termination
All power supplies can be used separately or interconnected to provide the following range of voltage/current capabilities.

1. 0 to +15V 1A, -15V to 0 1A, 0 to ±15V 1A, and 5V at 3A.
2. 0 to ±15V 1A, 0 to + or - 30V 1A, and 5V at 3A.
3. 0 to ±45V 1A, and 5V at 3A
4. -10V to +5V and +5V to +20V at 1A, 0 to ±15V at 1A and 5V at 2A.
5. Interconnection of 1Hz square wave or the f/N output to Power Amplifier produces a 0 to > +15V or 0 to > -15V 1A square wave.
6. When the 1 second clock pulse is connected to the counter, the f/N output can be selected from 1 sec to 10,000 seconds
7. When the Function Generator output is connected to the counter input, the f/N output extends down to >10 days.
8. The ±15V Power Supply can be remotely programmed from -15V to +15V at 1Amp by an external voltage applied to the amplifier input. Control voltage is from ±150mV to ±15V depending on gain setting.

2.12 General.

Power Requirements:	100 to 132V or 200 to 265V, 50 - 60Hz. Range selection on rear panel. 150VA max.
Environmental Specifications:	
	Operating: Specifications are met within the prescribed input voltage range from +5° to 45°C and humidity from 0 to 95% RH.
	Storage: -40°C to +75°C non-operating
Safety Standards:	Instrument closely conforms to IEC348 recommendations. All components in the input power circuits including the power transformer are UL, CSA and VDE approved.
Dimensions:	328mm wide x 175mm high x 240mm deep, including knobs, feet, heat sinks etc.
Weight:	6kg, 7kg packed.
Ordering Code:	BWD604 MINI-LAB. Includes operating manual, power cord (Australia and New Zealand only) and meter leads.
Optional Accessories:	BNC to BNC cables 1 meter long. P32 1:1 and 10:1 probe (for frequency counter input). Meter leads - red and black. Maintenance Handbook. Operation Handbook. Power cord (Australia and New Zealand only)

All specifications subject to change without notice.

3. *CONTROLS AND THEIR FUNCTIONS*

The panels are divided into the following sections:

1. Function Generator and Ramp Generator and Frequency Counter.
2. Power Amplifier/Bipolar Power Supply and Fixed 5V Power Supply.
3. Digital Meter.
4. Rear Panel

Refer to the drawings at the rear of this chapter for a schematic layout of the front and rear panels.

3.1 Function Generator, Ramp Generator and Frequency Counter.

1. Range switch. The desired frequency range is selected by depressing the correct button.
2. Frequency Vernier multi-turn control. Uncalibrated control covers over 2 decades of frequency on each range.
3. Digital readout. When switch 4 is up, the readout will display the output frequency of the waveform present at the Function Generator BNC output socket. The range switch 1 automatically selects the readout in kHz or MHz.
4. Counter source switch. In the up position readout is as described in 3. In the down position the counter displays the frequency applied to the BNC input socket 6. The counter range switch 5 selects the correct frequency range for the externally applied frequency. Frequency overload will cause the display to flash on and off.
5. Counter Range and Frequency Divider switch. This switch controls two functions.
   As a counter range switch it enables the most appropriate range to be selected to suit the applied input frequency. The maximum frequency that can be counted without overload is marked on each step.
   NOTE: A higher input frequency than the counter will accommodate will cause it to indicate overload by flashing on and off but this does not affect the divider facility.
6. Counter input socket (BNC). Input socket for frequency counter or frequency divider.
7. Symmetry Vernier control. Fully counter clockwise the waveform remains symmetrical, as it is turned one side of the waveform will be extended.
8. Symmetry Selector switch. In the centre position, the Function Generator output waveforms are symmetrical. When pushed UP or DOWN, the rising or falling waveform symmetry can be adjusted by the Symmetry Vernier control.
9. Sweep Frequency control. Counter-clockwise the ramp selected by the LIN-EXT-LOG switch is at the slowest speed and fastest when fully clockwise.
10. LIN-EXT-LOG switch. In the centre position external signals applied to the FM input will frequency modulate the Function Generator output. A +ve voltage will increase the frequency, and a -ve voltage will decrease it.
    When LIN is selected a linear sawtooth waveform will sweep the frequency. The minimum frequency is with the Sweep Range control fully counter clockwise and the range increases as the Sweep Range control is turned clockwise. The rate of the sweep is controlled by the Sweep Frequency control.
    When LOG is selected the operation is the same as for linear except the sweep waveform is logarithmic.
11. Sweep Range control. Sets the high frequency limit of the sweep width as described for the LIN-EXT-LOG switch. Note that as the sweep width is reduced the sweep repetition rate increases.
12. Amplitude control. Adjusts the output voltage over a 20:1 amplitude range. Output impedance is not affected by the level control.
13. Frequency Generator output socket (BNC). Output socket for Function Generator waveforms.

14. Attenuator switches 10 and 20dB. Independent switches to select output levels. When both are depressed output is reduced 30dB. The level control 12 provides a further 26dB of attenuation making a total of 56dB , i.e. an approx 600:1 range in output level control.
15. Offset control. Fully counter-clockwise and switched off, the output waveform will be centred about ground. When the control is turned, the position of the output waveform about ground is adjustable over ±10V open circuit, or ±5V into 50Ω.
16. Waveform Selector switches. Both switches out, output waveform is sinusoidal. Left hand switch only pressed in, output waveform is triangular. Right hand switch only pressed, only waveform is rectangular. (See Fig 4.1)
17. AM switch. In the OUT position waveform is normal, when IN the output amplitude is reduced to 50% and signals applied to the AM socket (input 100kΩ and 30pF) will control the amplitude of the output waveform.
    Note: Distortion, linearity and rise time specifications do not apply to amplitude modulated waveforms.
18. 1Hz clock output socket. A +5V one second square wave is available from a 4700Ω source impedance.
19. f/N socket. Output at this socket is the waveform applied to Frequency Input socket, divided down by the decade ratio selected by the Frequency Divider switch. The output is a square wave for any division ratio and a clipped off version of the input waveform in the /1 position. +5V output from a 4700Ω source impedance.
20. AM socket. Signals applied to this socket will amplitude modulate the Function Generator waveforms when the AM selector switch is depressed. A positive voltage will increase amplitude, a negative voltage will decrease it. Approximately 3V p-p is required to provide 100% amplitude modulation. Input impedance is 100kΩ and 30pF nominally.
21. FM socket. Signals applied to this socket will modulate or change the frequency when the LIN-EXT-LOG switch is in the centre EXT position. A positive voltage will increase the frequency, a negative voltage will decrease it.
22. Ground (common) socket. Ground terminal for input or output waveforms.
23. SYNC socket. A positive going signal of 0 to 2.8V min. from a 2500Ω source. The signal is 90° out of phase to the main output waveform.
24. RAMP gate pulse. A positive going 0 to +6V pulse from a 10,000Ω source is available during the return sweep period of the internal ramp to provide an oscilloscope trigger and CRT blanking pulse.

3.2 Power Amplifier/Bipolar Power Supply and Fixed 5V Power Supply.

25. Selector switches. With all switches out the Function Generator output is connected to the amplifier. With the Gain/Voltage control fully counter clockwise the same amplitude signal will appear at the Amplifier output terminals as is present at the Function Generator BNC output socket. When the INT-EXT button is pressed, external signals can be applied to the amplifier via the Amplifier Input terminals. The centre button inverts the output providing for example the Function Generator with a push pull output.
    The R.H. switch changes the circuit from a power amplifier to a Bi-Polar Power Supply when it is engaged the Gain/Voltage control adjusts the output voltage from -15V to +15V.
26. Gain/Voltage control. When the Power Amplifier is selected this control adjusts the gain from x1 to x100. When the Bi-Polar power supply is selected it adjusts the output voltage from -15V to +15V. The power amplifier can be used as a voltage programmed power supply over the range -15V to +15V. The gain control adjusts the programming voltage from ±15V at minimum gain to ±150mV at maximum gain.
27. Amplifier Input terminals. Input connections to power amplifier. Input is 100kΩ and 20pF nominally.

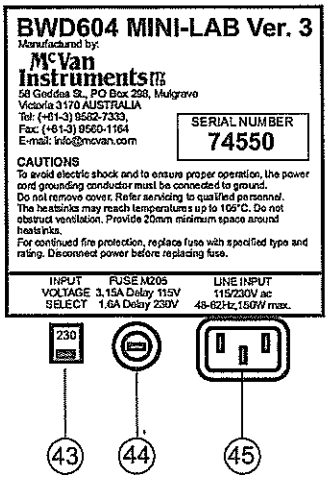
28. Amplifier output terminals. Output terminals for Power Amplifier or Bi-Polar power supply as selected by the Selector switches.
29. 0 to -15V Control. Adjusts the negative half of the isolated power supply from 0 to -15V at 1 amp.
30. 0 to -15V terminal. Output connection for -ve power supply.
31. 0 and Ground terminals. When the two terminals are linked the + and - outputs are voltages are with respect to ground. With the 0V terminal isolated, it or the positive or negative terminals can be connected to any other supply up to ±100V with respect to ground.
32. 0 to +15V control. Adjusts the positive half of the isolated power supply from 0 to +15V max at 1 amp.
33. 0 to +15V terminal. Output connection for positive power supply.
34. 5V, 3Amp Output terminals.

3.3 Digital Meter.

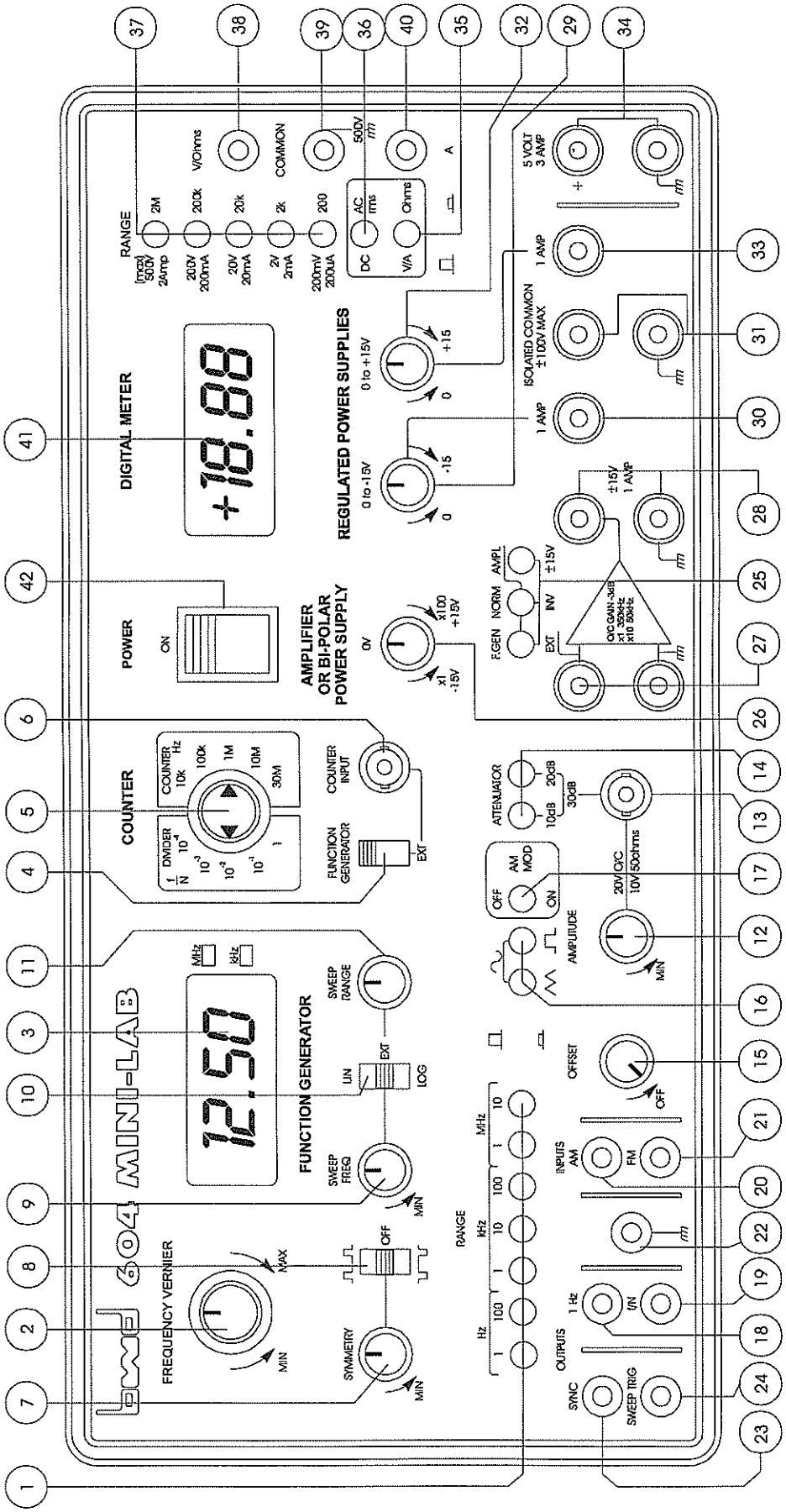
35. V/A-Ω Selector switch. Volts or Amps can be measured in the out position. Ohms are measured in the in (Ω) position.
36. DC-AC selector. DC Volts or amps are selected in the out position and AC Volts or amps (true rms) in the in position.
37. Range switches. Push buttons to select the voltage, current or ohms ranges.
38. V or Ω input socket. AC and DC voltages or ohms are applied to this input socket.
39. Common socket. Input for the low impedance side of all measurements. Socket is isolated from ground and may be taken to a maximum of + or - 500V DC from ground.
40. Amps socket. Input for AC or DC current measurement.
41. Digital Meter readout. 3½ digit readout with + or - indication for DC volts or amps. Polarity indication is automatic and a 1 on the MSD and the remaining digits blanked indicates overload.
42. Power ON-OFF. Illuminated rocker switch, switches both active and neutral input AC lines to the power transformer.

3.4 Rear Panel.

43. Line Voltage selector switch. In the down position, 200 to 264V AC is selected. In the up position 100 to 132V is selected. Input frequency is 50 to 60Hz for either range.
44. Fuse. Line fuse is in the active line. Rating and size are detailed on the rear panel label.
45. IEC Power line socket. 240V 6A rating socket. The power cord must contain a safety ground lead which connects the to centre pin of the socket. Any suitable and approved 3 core power lead can be used with the BWD604 MINI-LAB that fits the IEC input socket.



BWD604 MiniLab Rear Panel



BWD604 MiniLab Front Panel

4. OPERATION

The purpose of this section is to outline the use of each separate function of the Model 604 MINI-LAB.

Throughout this section and the following section, drawings of the front panel and its controls are used to describe settings of switches and knobs.

1. Where a push button switch is shown filled in that button should be pushed in. All other buttons should be out.
2. The position of knobs is shown by a marker on the centre of the knob. The control should be turned so that the marker points in the same direction and setting as the drawing.
3. Where no marker appears on the drawing on a particular knob, the position of that control has no effect on the operation under discussion.

Check that the mains power selector switch on the rear panel is set correctly for the supply to which the instrument will be connected. Check the fuse rating corresponds to the information on the rear panel. The 3 pin plug may now be inserted into the correct power receptacle and power applied by switching the front panel ON/OFF switch to on.

4.1 Operation of the Function Generator.

With the controls set as indicated, the three waveforms shown on the right of the panel are available at the output socket depending on which selector buttons are engaged.

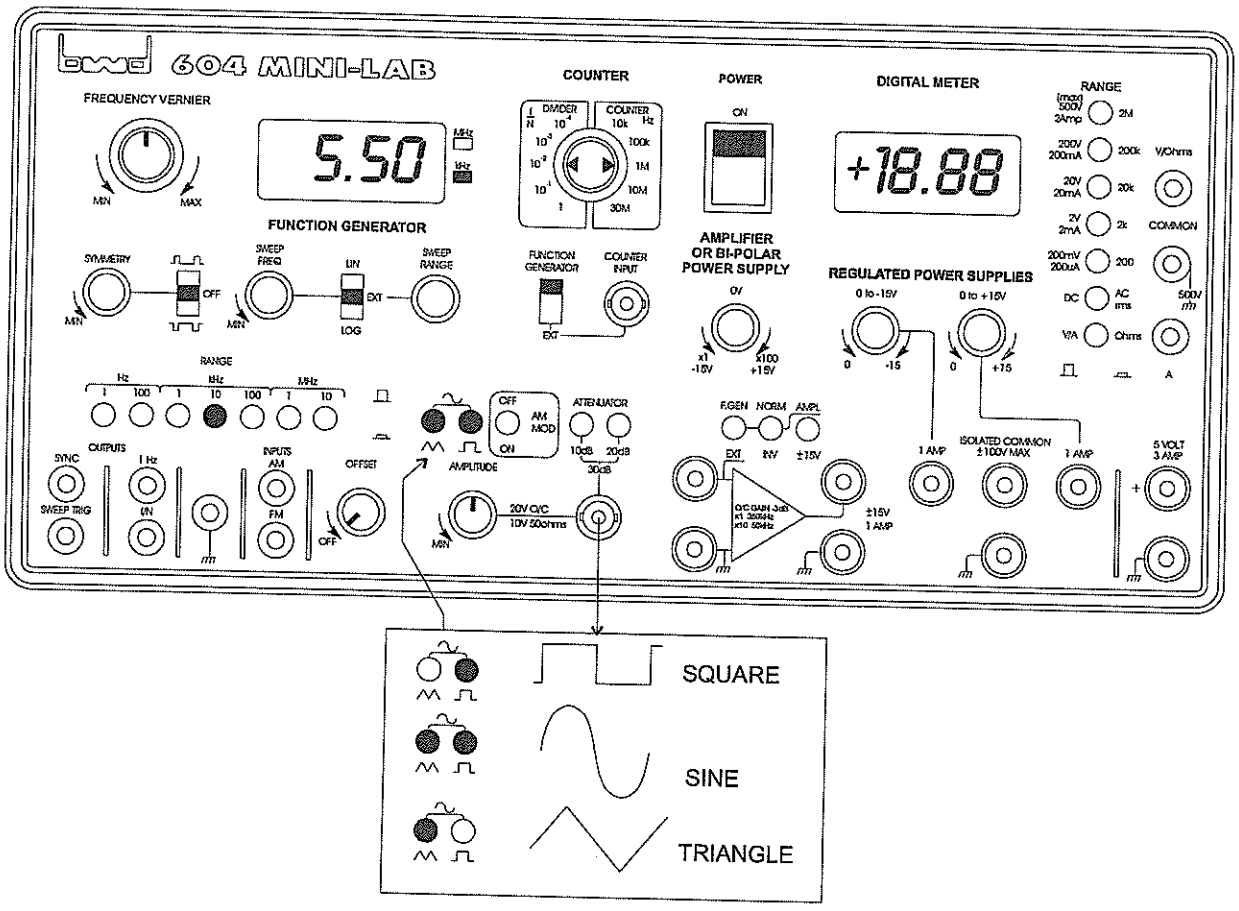


Fig 4.1 Operation of the Function Generator

The frequency will be approximately 5kHz. The Frequency Vernier control enables the frequency to be set from <100Hz to > 12kHz on this range. This is displayed on the digital readout when the Counter selector switch is in the up position.

Output amplitude is set by the Amplitude control and the attenuator switches from approx 30mV to 20V p-p O/C. A sync pulse is available at the Sync socket.

4.1.1 Offset.

The output waveform can be offset up to ±10V with respect to the normally centred position. To offset a waveform, turn the Offset control clockwise out of its switched position. In the centre position of the control no offset is applied to the output waveform. Turn it counter-clockwise and the waveform will be offset negatively, the opposite occurs when it is turned clockwise.

NOTE: The maximum output from the Function Generator is ±10V, so to make full use of the offset range the waveform amplitude must be reduced to half or less. At frequencies up to 100kHz offset voltages up to ±45V can be obtained via the Power Amplifier and isolated Power Supply.

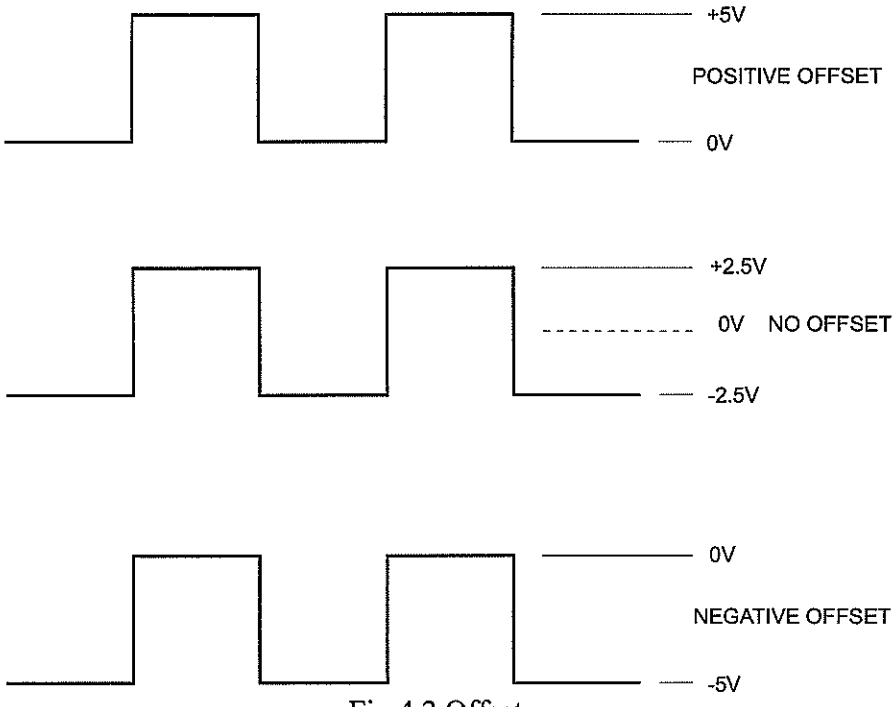


Fig 4.2 Offset

4.1.2 Variable Symmetry.

If the Symmetry switch is pushed up from its centre position the output waveform symmetry can be varied by the Symmetry control.

The change in symmetry is achieved by increasing the time duration of alternate half cycles. The overall effect is to decrease the frequency as the symmetry ratio changes from 1:1 to either 2.3:1 or 1:2.3. The start of a cycle of the square waveform coincides with the peaks of the sine and triangle waveforms. The Symmetry control works on all three output waveforms as shown below. Frequency of the asymmetrical waveform will be shown on the digital frequency display.

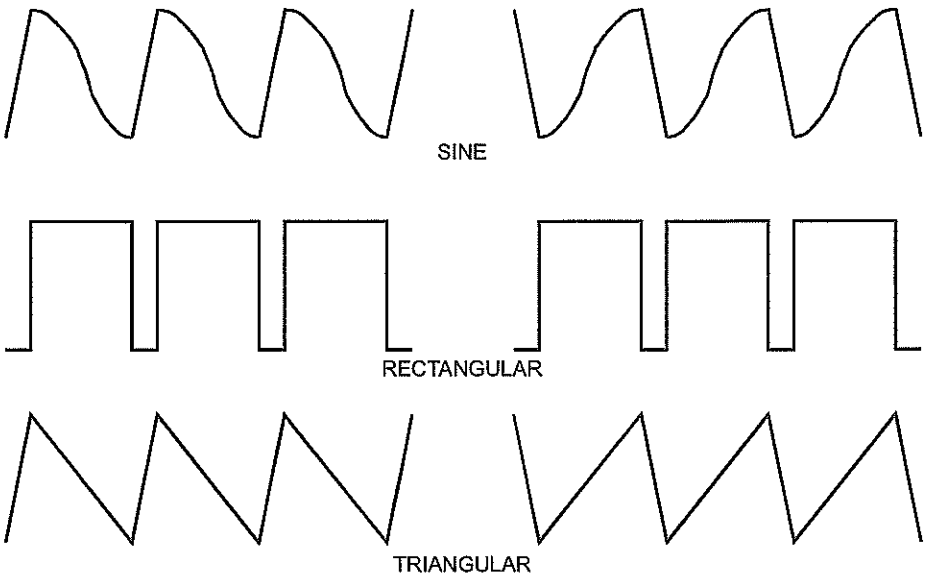


Fig 4.3 Variable Symmetry

4.1.3 Sweep Output.

Setting the controls as shown in Fig 4.4 enables the frequency of the generator to be swept over the selected frequency range. The sweep width is adjusted by the Sweep Range control running low frequency to high frequency as the control is turned clockwise. Sweep can be selected to be linear or logarithmic.

The sweep starts at the lowest frequency, with the highest frequency set by the Sweep Range control.

The sweep ramp gate pulse available at the Sweep Trig socket can be connected to ext trigger input or the CH 2 input of an oscilloscope to lock the time base to the swept frequency.

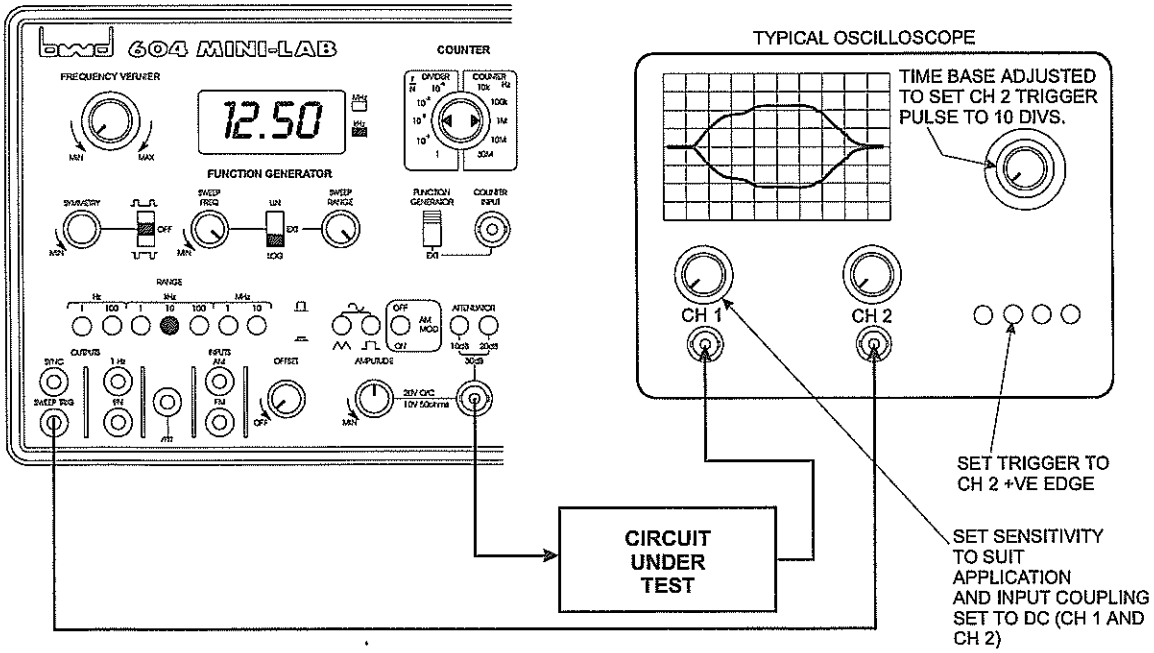


Fig 4.4 Sweep Output

4.1.4 Frequency Modulation.

The Function Generator can be frequency modulated over any part of each range by signals applied to the FM input socket when the Log-Ext-Lin switch is set to EXT.

Each range can be swept by a ±10V input. This enables the output frequency to be set remotely by a DC voltage. A signal swinging symmetrically about ground will modulate the output above and below the centre frequency set by the Frequency Vernier. Modulation is linear, e.g. if the frequency is set to 5kHz, ±2.8V will modulate the output from 4kHz to 6kHz approximately. Any output waveform can be frequency modulated.

4.1.5 Amplitude Modulation.

When the AM MOD button is selected the Function Generator output amplitude is reduced to half. Signals from DC to >1MHz applied to the AM socket will amplitude modulate the generator output. Approx 4V p-p is required for 95% modulation. All the output waveforms can be amplitude modulated. The AM facility can be used as a remote output level control. Approximately -2V will reduce the output to zero whilst +2V will increase it to maximum.

NOTE: 1. As some distortion occurs in the AM modulator the AM button should not be engaged unless the facility is required.
2. Both FM and AM can be applied to the output signal simultaneously.
3. Balanced modulation can be obtained by adding DC bias of approximately -1.5V to the modulation signal.

4.1.6 Frequency Accuracy 1 to 12Hz range.

To enable the lowest range to be set with the counter, the same timing capacitor is used for the bottom two ranges with an x10 electronic capacitance multiplication circuit to change the range. This enables the frequency to be set on the 10 to 120Hz range and then switched to the 1 to 12Hz range for use. This adds less than 2% error to the set frequency.

4.2 Operation of the Digital Counter.

When the Function Generator (4) slide switch is pushed down to the EXT counter position, the Function Generator remains fully operative but the counter is now available for external measurements. As the counter gate time is constant at 1 second the input frequency is divided down from /1 to /10,000 depending on the counter range setting.

The maximum input frequency is indicated for each range. If the frequency is too high for the range selected the display will flash on and off, increasing in frequency with the degree of overload.

Too low an input level or too low a frequency for the range selected will result in a zero or varying display. As the input to the counter is 1MΩ and 20pF in parallel, a standard 1:1/10:1 oscilloscope probe such as a type P32 available from McVan Instruments can be used to connect to circuits under test. The counter will accommodate a wide variety of waveform shapes from sine to pulse.

4.3 Frequency Divider.

The output of the counter divider circuits is buffered and brought out at the front panel f/N socket. The output at /1 is a squared off version or pulse at the input frequency. From /10 to /10,000 output is a square wave with equal mark-space ratio, irrespective of the input waveform. With a pulse or square wave input the frequency can extend down to any frequency subject to a minimum input of 200mV p-p.

If the 1 second clock output is connected across to the counter input, a square wave output down to 10,000 sec or 2.777 hours is available. If the Function Generator output is connected to the counter input (with the selector switch set to Counter), then square waves with repetition rates continuously variable to greater than 10 days can be obtained.

If the f/N output is connected to the Power Amplifier, its output can be used to operate relays, small DC motors etc. to control experiments, testing sequences and similar functions. A pulse instead of a square wave output is available by connecting the f/N output to the Amplifier via a capacitor. The value of the capacitor will control the pulse width.

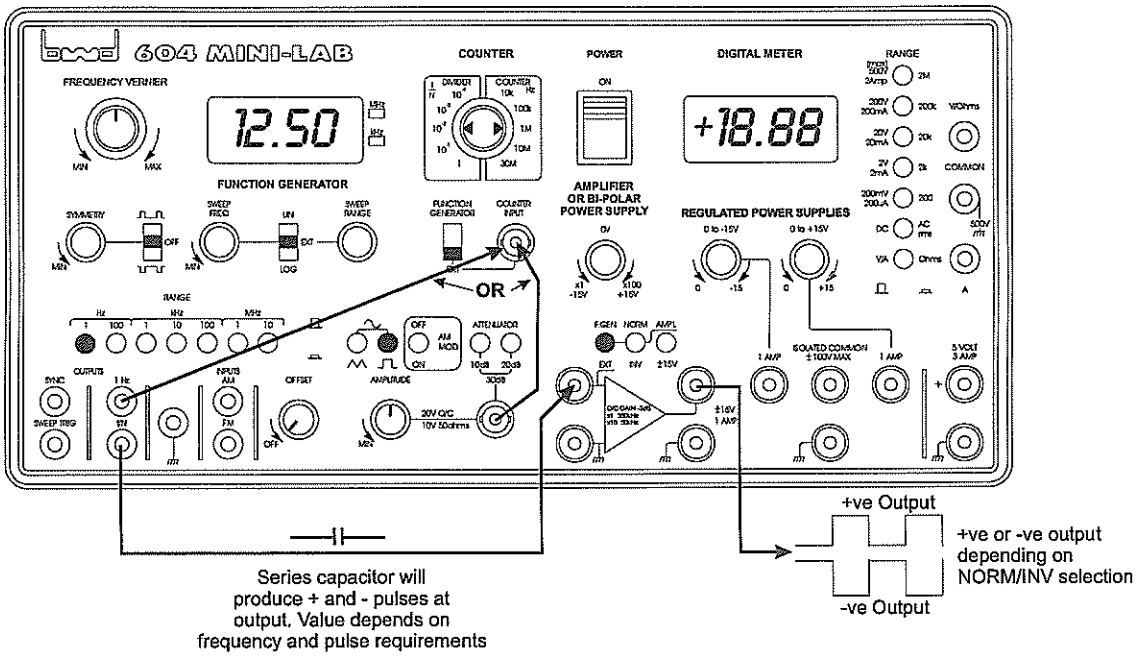


Fig 4.5 Frequency Divider

4.4 Power Amplifier.

When the three selector buttons that control the Ampl/Power Supply are all out and the gain control is fully counter-clockwise, the Amplifier output will be the same as the Function Generator (subject to upper frequency limits - see specifications). If the N/INV button is pressed the Amplifier output will be inverted providing a push-pull output with the Function Generator for applications requiring a balanced drive.

Rotating the gain control clockwise will increase the output amplitude to at least ±15V into a 15Ω load.

If offset is applied to the Function Generator output it will correspondingly offset the Power Amplifier output.

When the left hand button FG/EXT is pressed, the Function Generator is disconnected from the Power Amplifier and signals applied to the input terminals can now be amplified from x1 to x100

NOTE: It is recommended that input signals to the Power Amplifier are limited to 200kHz when operated at full load to minimise heat rise in the power output stage.

4.5 Bi-Polar Power Supply.

When the AMPL/±15V button is pressed, the amplifier input is disconnected the variable control now adjusts the output continuously from -15V to +15V with a maximum current output of 1 Amp. Constant current overload operates to limit maximum short circuit current to approximately 1.2 Amps.

4.6 Isolated + and - 15V 1 Amp Supplies.

These isolated dc power supplies can be used on many ways. With the common 0V line linked to the ground terminal directly beneath it, each output may be adjusted separately from 0 to either + or - 15V with a maximum current of 1 Amp. Constant current overload limits the short circuit current to 1.2 Amps.

With the 0V line disconnected, either the positive or negative terminal can be grounded to supply either + or - 0 to 30V at 1 Amp. The 0V terminal can also be used as an output providing for example 0, +12V and +24V.

If one of the terminals is connected to the Bi-Polar Power Supply/ Power Amplifier output terminals, then the supply will float on whatever output is set at the P.S./AMPL output terminal. e.g. if the negative terminal is connected the up to +45V at 1Amp is available at the + terminal and conversely 0 to -45V is available if the positive terminal is connected to the P.S./AMPL output.

If the P.S./AMPL is switched to Power Amplifier then waveforms from either the Function Generator or an external source can be offset by the isolated power supply at frequencies to >10kHz.

Other voltage ranges are available when the supplies are connected to the +5V supply. e.g. when the + or - terminals are connected to +5V up to +35 at 1Amp and +5V at 2Amps, or -10V to +5V and +5V to +20V are available respectively.

4.7 Fixed +5V, 3Amp Supply.

This supply is stabilised to +5V within ±0.25V. It relies on the regulator to shut down under current or thermal overload conditions. A positive over-voltage clamp prevents the output from exceeding +6V if one of the higher voltage supplies set to >+5V is connected across it. This helps to protect any digital circuits connected to the +5V supply. It as also protected against reversed voltages being connected across it.

WARNING: A short circuit across the fixed +5V supply will shutdown the Function Generator Display/Counter Display for the duration of the short circuit.

4.8 Digital Meter.

This completely isolated facility provides voltage, current or ohms measurements. The top 5 push buttons on the right hand side of the panel select the ranges whilst the voltage/current selector is at the bottom with the AC/DC selector above it. All AC measurements are true rms with trough to crest ratios up to 3:1.

Separate input sockets are provided for the voltage and current measurements with a central COMMON terminal isolated to withstand ±500V or 350V rms minimum to ground.

If the applied input overloads the selected range the display will blank out other than the first digit and the ± indicators on voltage or current measurements. To restore the reading select a higher range.

For maximum accuracy always use the highest sensitivity range possible without overload.

When measuring Ohms, the maximum voltage applied across the component under test is +5V via a 2kΩ resistor on the lowest 200Ω range. When measuring with the high resistance ranges, do not hold the component leads as skin resistance can affect the resistance reading.

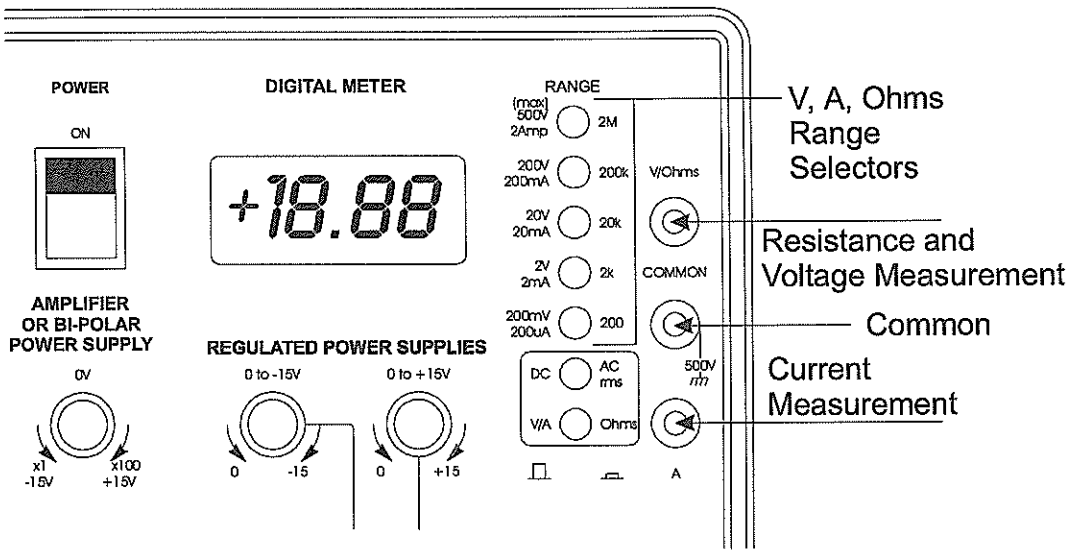


Fig 4.6 Digital Meter Section of the BWD604 MiniLab