

Thurlby + SINCLAIR

OM358
eight channel
oscilloscope multiplexer
SERVICE MANUAL

FOR SERVICE MANUALS
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1532

Principles of Operation

The circuit of the OM358 may be conveniently divided into four sections, as follows:

1. The power supply and reference generation.
2. The clock oscillator and divider.
3. The input signal conditioning, multiplexing and triggering.
4. The staircase generator.

1. The power supply and reference generator

The OM358 uses a main transformer/rectifier to produce $\pm 25\text{v}$ dc to power the instrument. This supply is regulated by IC5 (positive) and IC6 (negative) to produce $\pm 12\text{v}$ regulated. The $\pm 12\text{v}$ rails supply the input buffer amplifiers and the trigger amplifier. IC7 (in conjunction with Z3, Q7 and associated components) generates a $+7\text{v}$ reference supply which is adjustable via PR2. IC8 and its associated components generates a -7.7 volt supply which tracks the $+7\text{v}$ supply. The $+7$, -7.7v supplies are used as the main reference voltage which sets the accuracy of the output staircase waveform. These supplies also power the CMOS logic devices.

2. The clock oscillator and divider

The multiplexer rate is controlled by a free running oscillator (IC1 pins 1 to 4, C2, VR1, R1).

In automatic (1-8, 4-8, 1-4) mode, SW1 is open and Q1 is off, allowing Q2 to act as an inverter, inverting the clock waveform, and driving the clock input of IC3. IC3 is a 4 bit synchronous up/down counter. Only the bottom three bits are used. C6 and R15 generate a positive pulse to reset the counter when switching to manual mode, thus ensuring that channel 1 is always chosen when manual mode is entered. In manual mode the counter counts up, and in automatic mode it counts down.

In manual mode, D1 stops the oscillator, leaving IC1 pin 4 high, and enabling Q1 and Q2 to function as a Schmitt trigger. R2, R3 and C1 eliminate the effects of contact bounce in SW1 (manual step push button), and the Schmitt trigger generates a fast edge to clock the counter.

The blanking pulse is generated by differentiating the clock waveform (C3, R9, PR1) and squaring the differentiated waveform. The width of the blanking pulse is set by C3 and PR1. C5 is included to dc restore the blanking pulse (in conjunction with D2 or D3). The blanking pulse may be set to go positive or negative with respect to ground. R25 slows the blanking pulse down, preventing the high speed edges from disturbing the oscilloscope trace.

3. The input signal conditioning, multiplexing and triggering

(a) Input signal conditioning

The input amplifier acts as a unity gain buffer with high input impedance and low output impedance. Since its gain is always less than unity, the output attenuator is arranged so as to compensate for the gain errors.

In the following, the component references will refer to channel 8. R801 is $1M\Omega$ and sets the dc input impedance to $1M\Omega$. R802, C801, D801 act as high voltage input protection, limiting the input current to a safe maximum value. C802 increases the input capacitance to match a typical oscilloscope. R803 helps to reject R.F. interference, and prevents self oscillation of the input amplifier when a cable is attached. PR801 adjusts Q801 bias current, and hence the dc output voltage of the stage. Q802 provides low output impedance, and dc 'bootstraps' PR801, greatly reducing its loading effect on Q801 source.

(b) Multiplexing and triggering

The eight input channels are multiplexed onto a single output line by IC2. The channels are sequentially multiplexed onto the output line, controlled by the A, B and C inputs.

The trigger output signal is buffered by Q3 and its associated current source Q4. R10 allows the trigger signal to have 50 ohms output impedance. SW2 selects the trigger source channel.

The multiplexed signals appear on IC2 pin 3, and are buffered by emitter follower Q5 into the output attenuator.

The attenuator consists of resistors R16 and R27 inclusive and provides attenuation levels of X20, X50, X100 and a ground position. A further requirement is that it has constant output impedance in all positions, so as not to affect the staircase step accuracy. Capacitors C7, C8 and C9 provide a.c. compensation. R27 provides part of the attenuator, and also sets the output impedance of the vertical output to 50ohms.

4. The staircase generator

The staircase waveform is generated by a binarily weighted set of switch resistors (R28, R29, R31, R34) driven by a set of switches controlled in IC4. The switches switch the resistors to either +7 volts or -7.7 volts. Resistors R32 and R34 ensure that the three networks represent equal loading at IC4 pins 4, 14 and 15, thus ensuring that switch resistance does not cause step errors. The switch resistors switch precise currents into R27, generating the staircase. Since the switches within have low output resistance, and R27 is low in value, the staircase rise and fall times are short (approximately 40ns), giving rise to a clean staircase waveform even when running at high multiplexer rates. The +7v, -7.7v supplies are adjusted to give precisely 100mV/step on the staircase.

In manual mode, the Enable input of IC4 (pin 6) is taken high, thus disabling the switches and removing the staircase voltage steps.

OM358 Calibration Procedure

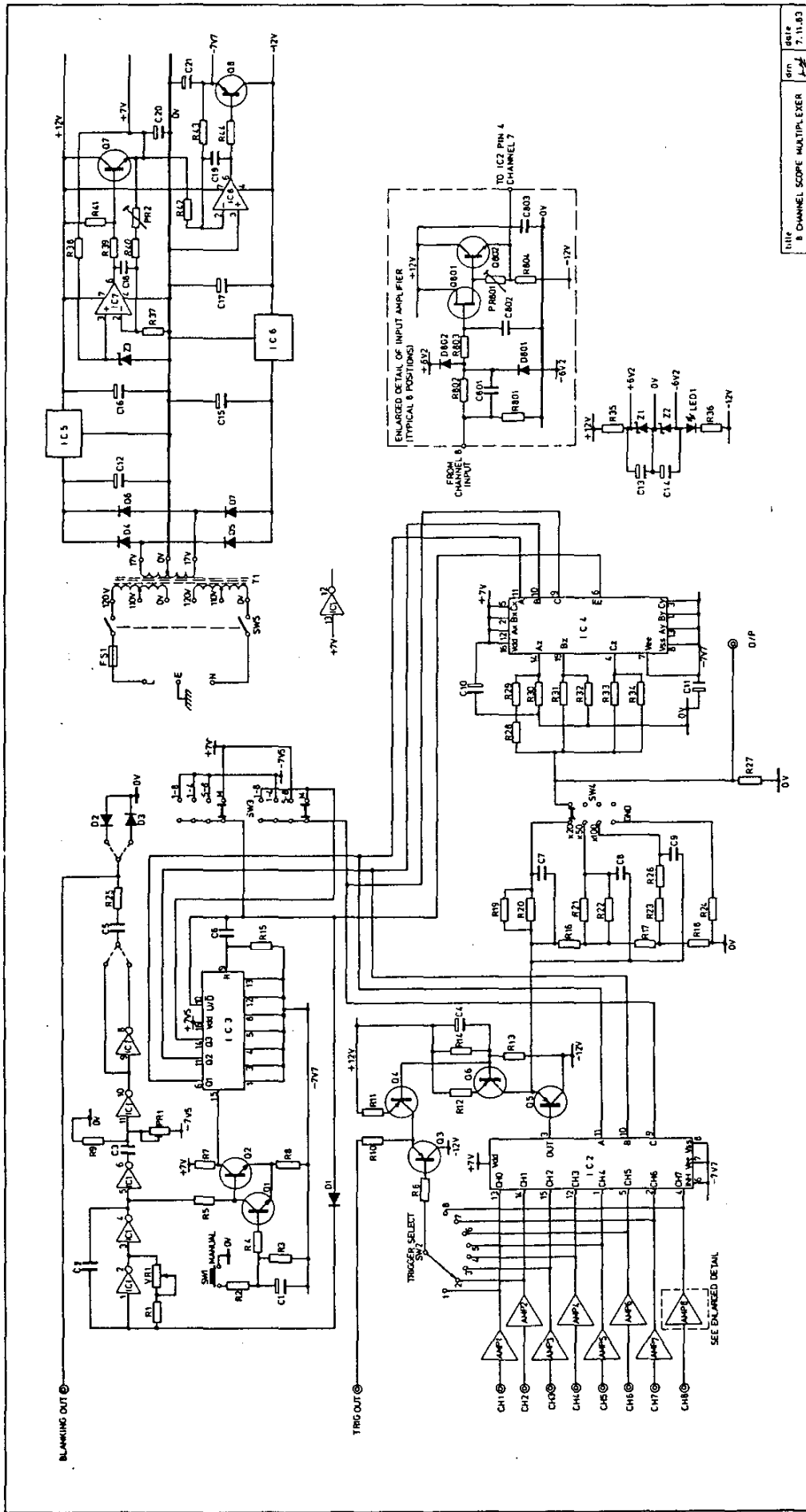
Equipment required

1. Oscilloscope with Y channel delay line, blanking input and accurately calibrated 0.1 v/div range eg Hitachi V1050 or similar.
2. Signal generator capable of generating 13 volts p-p at 1KHz.

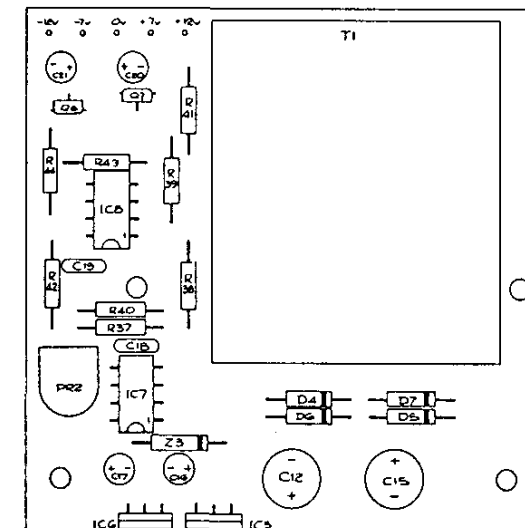
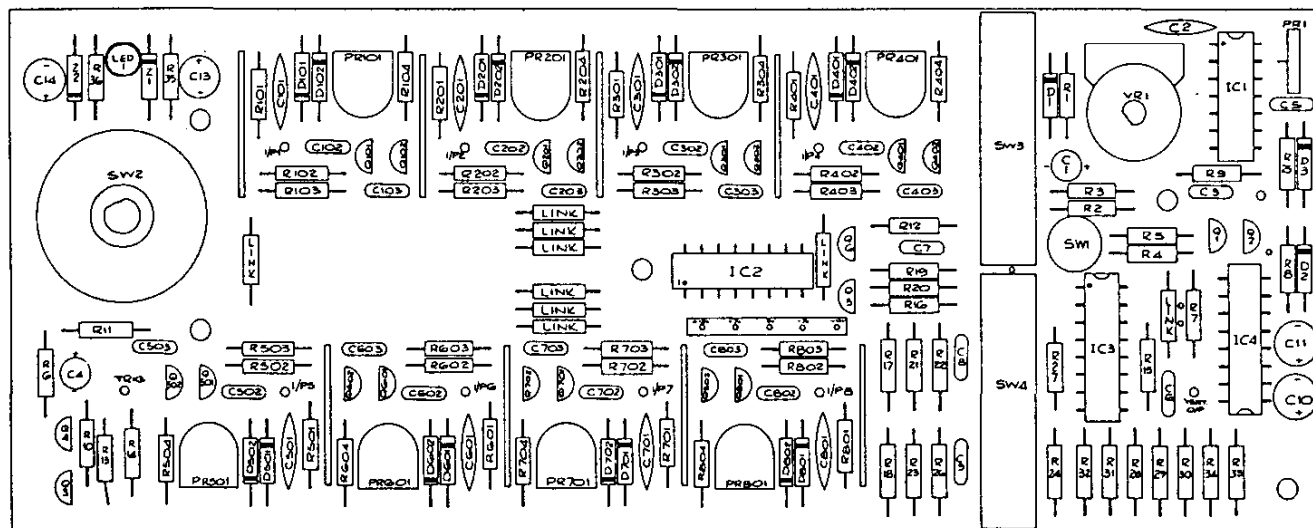
Procedure

1. Set the OM358 attenuator to 'gnd' position.
Set the oscilloscope channel 1 sensitivity to 0.1 v/div. Connect the OM358 vertical output signal to channel 1 of the oscilloscope. Allow the trace to free run.
2. Select 1-8 on the OM358. Ensure that 8 channels appear, spaced 1 div apart.
3. Select 1-4 on the OM358. Ensure that the top 4 channels appear, spaced 1 div apart.
4. Select 5-8 on the OM358. Ensure that the bottom 4 channels appear, spaced 1 div apart.
5. Select manual mode on the OM358. Ensure that only one trace appears.
6. Select the X100 position on the OM358 attenuator. Select mode 1-8. Trigger the oscilloscope from the 1KHz input signal. Apply the signal to each input channel in turn, ensuring that a $\pm 6.2\text{v}$ swing signal (referred to the input) is obtained in every position. This ensures that all channels are working correctly.
7. Remove the 1KHz input signal. Set the OM358 mode to manual. Select the X20 attenuator position. Set the oscilloscope channel 1 sensitivity to 1mV/cm. Adjust PR101 to PR801 to set the dc output voltage of each channel to be within 1mV of ground (using the manual push button to advance from one channel to the next.)
8. Set the oscilloscope to 0.1V/cm and select 1-8 on the OM358. Set the multiplex rate to slow, and the oscilloscope time base to 0.5uS/cm. Allow the trace to free run. The oscilloscope should now show 8 traces. Adjust PR2 to give exactly 100mV per step between the traces.
9. Trigger the oscilloscope from channel 1, set the OM358 multiplexer rate control to its fastest setting. Connect the blanking signal to the oscilloscope blanking input. Set the oscilloscope brightness to maximum. Ensure that the staircase transitions are fully blanked, and adjust PR1 if not.

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OM358 OSCILLOSCOPE MULTIPLEXER CIRCUIT DIAGRAM



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OM358 OSCILLOSCOPE MULTIPLEXER COMPONENT LAYOUT

PRODUCT

OSCILLOSCOPE MULTIPLEXER OM358

ALL RESISTORS ARE 1/4W 5% CARBON FILM UNLESS OTHERWISE STATED

REF.	DESCRIPTION	LOCATION	PART NO.
R1	1K8	Main PCB	
R2	100K	"	
R3	100K	"	
R4	47K	"	
R5	22K	"	
R6	100R	"	
R7	1K	"	
R8	100R	"	
R9	10K	"	
R10	47R	"	
R11	330R	"	
R12	100R	"	
R13	22K	"	
R14	2K2	"	
R15	2M2	"	
R16	1K0 1% Metal Film	"	
R17	330R 1% Metal Film	"	
R18	330R 1% Metal Film	"	
R19	1K 1% Metal Film	"	
R20	13K 1% Metal Film	"	
R21	560R 1% Metal Film	"	
R22	9K1	"	
R23	560R 1% Metal Film	"	
R24	910R	"	
R25	470R	"	
R26	100R 1% Metal Film	"	
R27	51R 1% Metal Film	"	
R28	3K2 1% Metal Film	"	
R29	3K2 1% Metal Film	"	
R30	2K2	"	
R31	3K2 1% Metal Film	"	
R32	3K3		
R33	3K2 1% Metal Film		
R34	3K2 1% Metal Film		
R35	1K8		

PRODUCT

OSCILLOSCOPE MULTIPLEXER OM358

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REF.	DESCRIPTION	LOCATION	PART NO.
R36	1K2	Main PCB	
R37	560K	Power Supply	
R38	560R	"	
R39	560R	"	
R40	100K	"	
R41	5K6	"	
R42	100K 1% Metal Film	"	
R43	110K 1% Metal Film	"	
R44	560R	"	
R801	1M Ω (8 off)	Main PCB	
R802	100K (8 off)	"	
R803	220R (8 off)	"	
R804	820R (8 off)	"	
C1	1 μ F 63V Electrolytic	Main PCB	
C2	150pF Ceramic	"	
C3	47pF Ceramic	"	
C4	10 μ 16V Electrolytic	"	
C5	10 μ F Ceramic	"	
C6	10 μ F Ceramic	"	
C7	4p7 Ceramic	"	
C8	2p2 Ceramic	"	
C9	1p0 Ceramic	"	
C10	10 μ 16V Tantalum	"	
C11	10 μ 16V Tantalum	"	
C12	470 μ 35V Electrolytic	"	
C13	100 μ 10V Electrolytic	"	
C14	100 μ 10V Electrolytic	"	
C15	470 μ 35V Electrolytic	Power Supply	
C16	10 μ 16V Electrolytic	"	
C17	10 μ 16V Electrolytic	"	
C18	10 μ F Ceramic	"	
C19	10 μ F Ceramic	"	
C20	47 μ 10V Electrolytic	"	

PRODUCT

OSCILLOSCOPE MULTIPLEXER OM358

DATE

MOD.NOS.

ALL RESISTORS ARE 1/4W 5% CARBON FILM UNLESS OTHERWISE STATED

REF.	DESCRIPTION	LOCATION	PART NO.
C21	47 μ 10V Electrolytic	Power Supply	
C801	1nF 7400V (8 off) Ceramic	Main PCB	
C802	15pF (8 off) Ceramic	"	
C803	10 μ F (8 off) Ceramic	"	
Q1	ZTX 239	Main PCB	
Q2	ZTX 313	"	
Q3	ZTX 214	"	
Q4	ZTX 214	"	
Q5	ZTX 214	"	
Q6	ZTX 214	"	
Q7	ZTX 239	"	
Q8	ZTX 214	"	
Q801	BF 245A (8 off) F.E.T. (Selected)	Main PCB	
Q802	BF 199 (8 off)	"	
D1	1N4148	Main PCB	
D2	"	"	
D3	"	"	
D4	1N4002	Power Supply	
D5	"	"	
D6	"	"	
D7	"	"	
D801	1N4148 (8 off)	Main PCB	
D802	" (8 off)	"	
Z1	6V2	Main PCB	
Z2	6V2	"	
Z3	5V6	Power Supply	
IC1	CD 40106	Main PCB	
IC2	CD 4051	"	

