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MODEL SM-128A

AUTO-RANGING
FREQUENCY COUNTER

595-1556-01

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
a Schlumberger company

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INTRODUCTION

This instrument is a compact, lightweight, auto-ranging counter designed for frequency measurement from less than 5 Hz to greater than 110 MHz. The front panel range switch allows selection of two preset gate intervals (1s and 10ms) and AUTO-range. This unique function automatically determines the correct range for maximum resolution without overranging the counter. In the two manual range positions, the LSD (least-significant digit) will remain valid even though the MSD (most significant digit) is beyond display range.

A sensitivity control allows input trigger level selection above and below the signal zero-crossing level. Refer to Figure 1 (fold-out from Page 5) for typical and guaranteed sensitivity-vs-frequency parameters. High input sensitivity and an input impedance of 1 megohm proves ideal for use with a ÷10 oscilloscope probe where source loading is critical.

Display consists of seven 7-segment LED (light emitting diode) arrays and three incandescent lamps for Range and Overrange information. In addition, leading-zero blanking is provided when less than seven digits of data is displayed.

A time base of 1 MHz is produced by a conventional crystal clock. However, a rear panel connector is provided for connection of external clock frequencies (e.g. a 1 MHz standard when extreme accuracy is desired).

Rugged compact design and exceptional accuracy combine to make the counter an invaluable tool for the scientist, engineer, experimenter, and service technician. While this instrument is excellent in the laboratory, it is rugged enough for use in the field. Low input power of 25 watts facilitates its use with a dc-to-ac power inverter.

SPECIFICATIONS

INPUT*

Frequency Range	5 Hz to 110 MHz minimum (typ. 130 MHz at 25°C).
Sensitivity	15 mV rms.
Input Impedance	1 MΩ shunted by 15 pF.
Maximum Voltage	200 V rms.

TIME BASE OSCILLATOR (Referenced to 25°C after 1/2-hour warmup.)

Frequency	1 MHz.
Setability	±0.1 Hz.
Maximum Aging Rate	<1 ppm/mo (<7.5 ppm/yr).
Temperature Stability	±10 ppm, maximum, 0° to 40°C ambient.

EXTERNAL OSCILLATOR

Frequency	DC to 2 MHz.
Sensitivity	TTL or 2.5 V rms from 50 Ω source.
Protection	–5V peak to +10V peak.

RANGES-GATE INTERVAL

Manual	kHz - 1s, MHz - 10ms.
Auto	kHz - 10s, kHz - 1s, MHz - 100ms or MHz - 10ms (dependent on incoming signal).

GENERAL

Display Time	200ms plus Gate Interval.
Power Requirements	105-130V, 50/60 Hz, 25 watts maximum. (210-260V, 50/60 Hz switch selected.)
Fuse:	
125-volt Operation	1/4-ampere, 125V slow-blow.
250-volt Operation	1/8-ampere, 250V slow-blow.
Dimensions	2.75" high, 7.25" wide, and 10.5" deep (less handle). (6.98 cm high, 18.4 cm wide, and 26.67 cm deep.)
Net Weight	5 lbs. (2.3 kgs.)

*See Input curves Figures 1 and 2 on fold-out from Page 5. Specifications were obtained using a generator with 50 Ω source impedance. This was connected to the counter with 50 Ω coaxial cable through a 50 Ω terminator (between cable and counter).

OPERATION

Your counter was carefully checked and calibrated at the factory prior to shipment and is ready for operation when it is unpacked. If the shipping container shows evidence of rough handling, inspect the unit carefully for damage. Report any damage immediately to the carrier.

CAUTION: Before you proceed with this section, be sure you have read the Specifications. Damage to the instrument can result if excessive voltage is applied to the input. Input protection is provided as shown in the Derating Curve of Figure 2.

120-240 VOLT OPERATION

When shipped, this instrument is ready for operation from a 105-130 volt (120 volt nominal) ac power source. If 210-260 volt (240 volt nominal) ac operation is desired, remove the handle and the four screws from the bottom and rear of the cabinet shell. Remove the cabinet shell, then set the 120-240 power switch to the 240 position. Replace the 1/4-ampere fuse with a 1/8-ampere, 250-volt slow-blow fuse and reinstall the cabinet shell and handle.

NOTE: Electrical regulations in some areas require a special line cord and/or plug for 240-volt operation. Replace if necessary.

CONTROLS-CONNECTORS AND DISPLAY

RANGE SWITCH: Selects either of two gate intervals or AUTO-range. In the Auto mode, the proper gate interval is selected by the instrument to provide the greatest resolution without Overrange. NOTE: For external clock frequencies other than 1 MHz, the display must be interpreted.

SENSITIVITY CONTROL: Serves as the power switch and allows adjustment of the input amplifier trigger level above and below zero-crossing point. Thus, the trigger point can be set above most noise or signal distortion to insure an accurate count. Its full-clockwise switched position presets the input to its calibrated sensitivity level. NOTE: The Preset circuitry requires 10-15 seconds to stabilize. The instrument will not count during this period.

DISPLAY: Seven 7-segment LED's display the count, while the decimal points and range indicators provide complete range information. In addition, all insignificant leading zeros are blanked.

OVERRANGE LAMP: Lights to indicate that the MSD is beyond the range of the display.

INPUT: High impedance signal input connector. CAUTION: Signal cables not terminated in their characteristic impedance may cause erratic counting due to reflections or possible signal degradation.

OSCILLATOR (clock) SELECT SWITCH: Selects internal 1 MHz time base clock or externally applied clock signal.

EXTERNAL OSCILLATOR INPUT: Rear panel connector allows application of an external clock signal (Oscillator Select switch must be in the EXT position). Refer to the counter specifications for signal parameters.

OPERATING PROCEDURE

Place the EXT/INT Oscillator switch in the INT position. Turn the unit ON and switch to the PRESET position. Select the desired range (manual 1 second or 10 milliseconds, or AUTO) and connect the signal to be counted to the INPUT connector.

CAUTION: Be sure the signal is within the parameters specified for this instrument. Always terminate the transmission line in its characteristic impedance (e.g. 50 ohm coaxial cable should drive into a 50 ohm resistive load). This will eliminate reflections along the line which could damage the equipment under test, or produce inaccurate readings.

If the display overranges in the 1 second range, switch to 10 milliseconds or AUTO, and read the frequency directly in kHz or MHz. When in the AUTO mode, allow the unit enough time to select the correct range and display the frequency. For frequencies below 1 MHz, the AUTO Mode will select the 10 second time base. This will result in a delay between 10 and 20 seconds, depending on the count time and signal applied, before a correct count is displayed. In applications where noise exceeds 15 millivolts or signal distortion occurs above 15 millivolts and causes count inaccuracies, use the Sensitivity control to raise the tigger level above the noise level.

NOTE: When this instrument is in the AUTO mode with no input signal applied, a few counts may appear on the display. This is a normal condition attributed to the highly-sensitive input, and to the long time base used in the Auto mode. A correct display will appear within seconds after you apply an input signal.

EXTERNAL OSCILLATOR

When a clock frequency other than 1 MHz, or where a 1 MHz standard is required, connect the signal to the External Oscillator jack and switch the Oscillator Select to EXT. To prevent reflections, terminate the transmission line. Refer to the Counter Specifications for External Oscillator signal parameters.

OPERATION NOTES

Because of the high input sensitivity, power line frequency may be counted if the instrument under test does not share the power line ground bus with the counter.

High level voltage transients may also produce inaccurate indications due to the sensitive input.

SENSITIVITY

The Sensitivity control acts in a manner similar to a trigger level control. Instead of attenuating the incoming signal, it changes the point at which the counter will trigger.

As shown in Figure 3, maximum sensitivity is either in the center of the control rotation or in the preset position (CW).

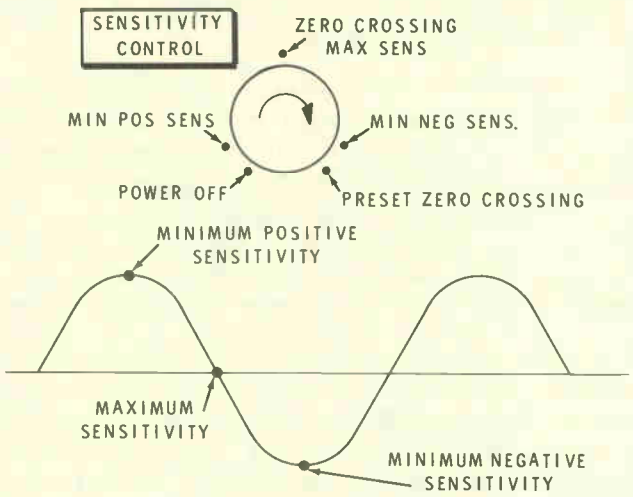


Figure 3

Minimum sensitivity (1V RMS) can be realized just prior to the Power off position or just prior to the Preset position.

When you measure a signal with a high noise floor (see Figure 4), you may experience incorrect readings if you have the counter set for maximum sensitivity (or zero crossing). To avoid the problem, adjust the Sensitivity control to either side of zero crossing to the point where it will not trigger on the noise but will still trigger on the desired signal.

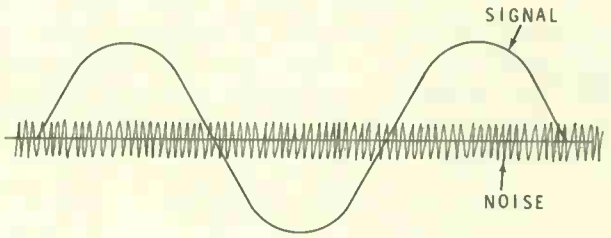


Figure 4

NOTE: The Sensitivity control will not reduce the problem where an erratic reading is caused by noise riding on the signal, as shown in Figure 5. This problem can, however, be reduced by using an attenuator between the equipment being tested and the frequency counter. A 10:1 oscilloscope probe such as the Heathkit PKW-101 is ideal for this.

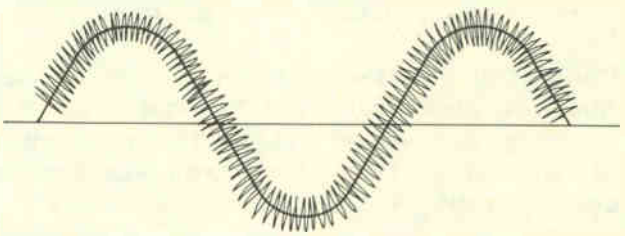


Figure 5

CIRCUIT DESCRIPTION

This Frequency Counter consists of an input section, control circuits, display, auto-ranging circuits, and a power supply. Refer to the Block Diagram (Figure 3) and the Schematic for interrelation of these circuits as described in the paragraphs that follow.

INPUT

The Input circuitry consists of a protected, high-impedance FET/Bipolar pair; a two-stage, direct-coupled, differential cascode amplifier; and a Schmitt trigger. For stabilization, the cascode amplifier has 100% dc feedback. This is provided by an operational amplifier so that a maximum of 15 mV offset exists at the input of the Schmitt trigger in the Preset mode. The Sensitivity control adjusts the offset level when not Preset.

CONTROL

A precise time base that controls all of the gate and timing

circuits, and determines the accuracy of the instrument, is produced by the 1 MHz Oscillator/Scaler. The oscillator section can be replaced with an external clock for special applications. To obtain the desired gate time, the 1 MHz clock (or external clock) is divided by the number of decades determined by the Range switch. Auto-range will be described later. A single MOS LSI integrated circuit (IC-9) performs the scaling function and is directly controlled by the Range switch. Decimal point placement and the range lamps are also controlled by the Range switch. The output of the scaler is processed by the Gate Control to provide ECL-level timing pulses required by the Control Gate. A second output produces the necessary TTL levels for the Reset and Memory Control.

Reset and memory pulses of 30μs, and a 200ms hold-off pulse, are generated by the Reset and Memory Control. These pulses update the memory readout registers, reset the DCU's and Overrange circuit, and inhibit the counter during the display time. The reset pulse is also used by the Auto-Ranging Circuit.

DISPLAY

The gated input signal (ECL level) is counted by the First DCU. Its BCD output is translated to a TTL level and connected to the LSD Display. Bits C and D from the first DCU are also NOR'ed for carry-over to the second display device. The LSD device is a single package that contains a memory, decoder drivers, and a 7-segment LED. The remaining six displays are similar, except they also contain a decade counter. Each display package is designed to provide leading-zero blanking. However, for meaningful display, the blanking function for readout #4 and #5 is gated by the decimal signal.

Should the count-per-unit-time exceed the capacity of the Display, the spillover from the MSD will trigger the Overrange circuit and turn on the Overrange lamp.

AUTO-RANGING CIRCUIT

Auto-ranging control signals are derived from a 2-bit binary counter. The trailing edge of the Reset pulse toggles the counter and its binary output programs the scaler. The ripple-blanking output of the MSD and the overrange output determine whether the counter will increment, halt, or reset.

POWER SUPPLY

The supply operates from either 105-130 volts or 210-260 volts, 50/60 Hz, depending on the position of the primary-power-select switch. It supplies three lines of regulated 5 volts; one line to the Input and First DCU circuits, a second line to the Display, and the third line to the Control circuits. The Input circuit is also supplied with regulated ±15 volts. A regulated −12 volts powers the Oscillator/Scaler.

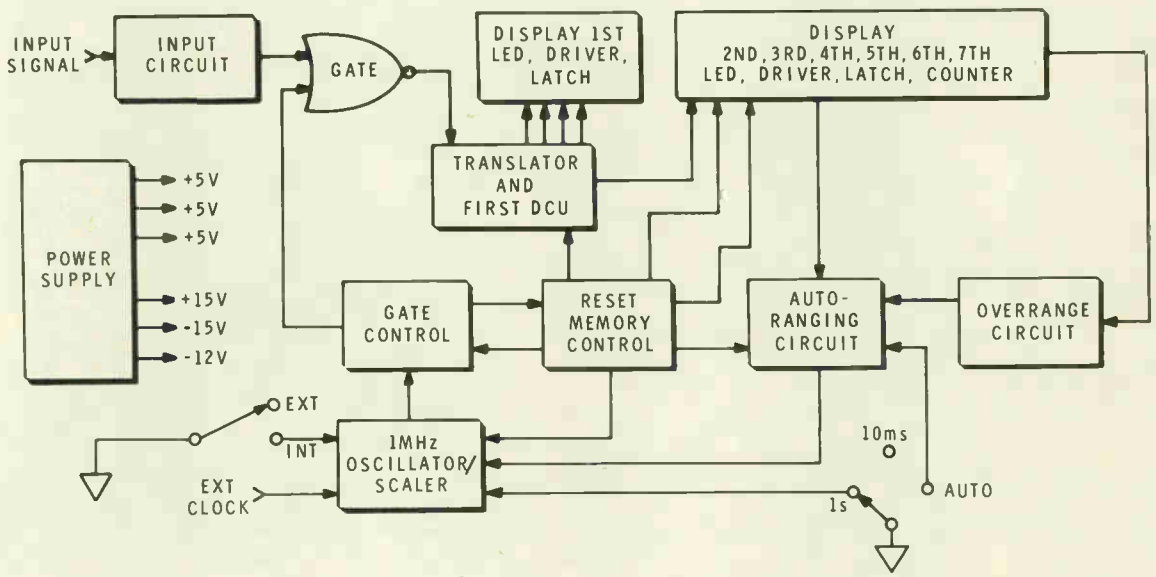


Figure 6 Block Diagram of the Auto-Ranging Frequency Counter

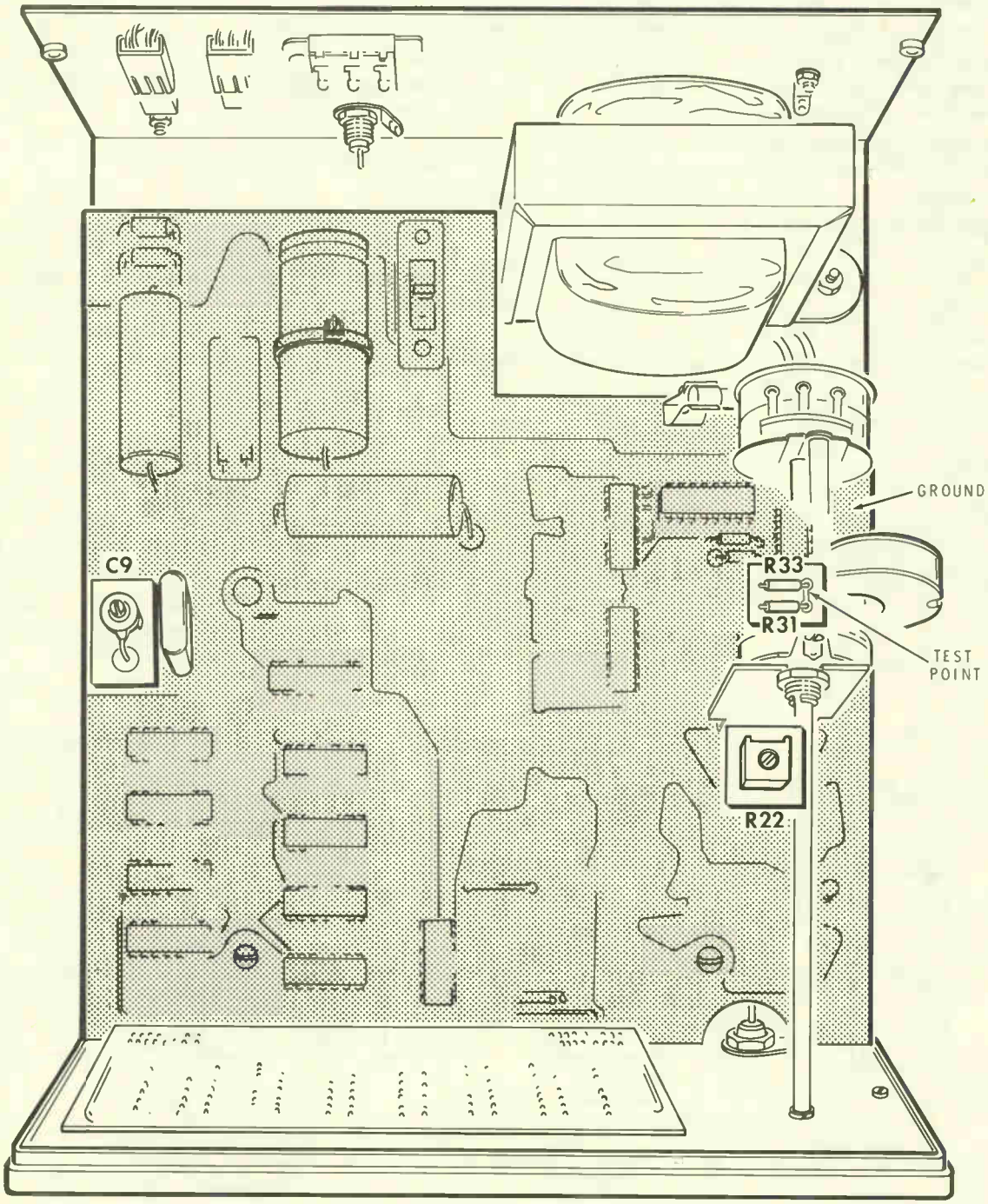


Figure 7 Instrument test point and calibration controls.

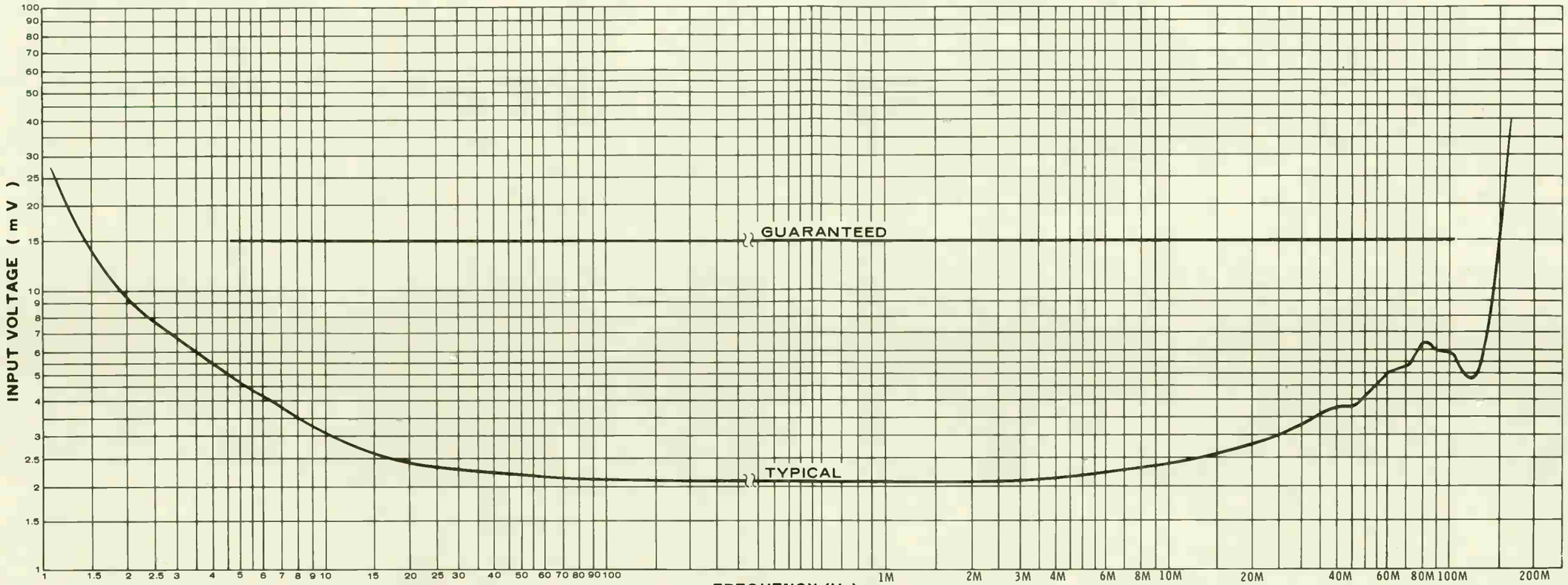


Figure 1 Input frequency response curves showing typical and guaranteed response with sensitivity control in the Preset position.

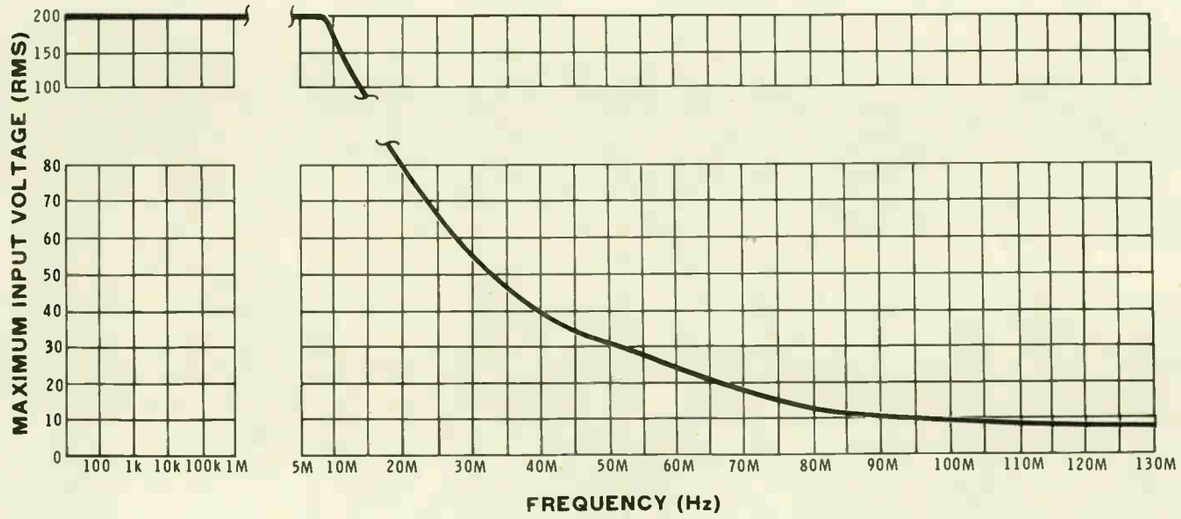


Figure 2 Input derating curve

RECALIBRATION

Calibration of this instrument should not be attempted unless you are experienced and have the use of precision laboratory equipment. Figure 7 shows the location of the adjustments and test point. Either the clock or input amplifier calibration can be performed independently of the other.

CLOCK CALIBRATION

To calibrate the oscillator, a 1 MHz, or greater, standard with an accuracy of at least ±1 part in 10^7 is required. Remove the handle and the four screws located on the bottom and rear of the counter. Allow the counter to warm up for at least 30 minutes. Connect the standard frequency to the front panel input. Set the Range switch to the 1 second position and Sensitivity to the PRESET position. Quickly remove the cover and, with a nonmetallic alignment tool, adjust C9 for a display equal to the Standard frequency. Reinstall the cover and allow the instrument temperature to stabilize. Readjust C9 if necessary. Remove the Standard and install the cover, screws, and handle.

INPUT AMPLIFIER ADJUSTMENT

A dc voltmeter with 1 mV sensitivity is required for this adjustment. Allow the meter and counter sufficient time to warm up. Remove the handle and cover. Connect the meter to the counter ground, near the test point, and to the test point illustrated in Figure 4 (R31 or R33). With no signal input, adjust R22 in the counter for 3.60 volts, ±10 millivolts. The input amplifier is now properly adjusted. Remove the meter leads and install the cover and handle.

PARTS LIST

RESISTORS

(All resistors are 1/4-watt, 5% unless otherwise specified.)

KEY No.	PART No.	DESCRIPTION
R1	1-87-12	1 MΩ
R2	1-87-12	1 MΩ
R3	1-63-12	270 Ω
R4	1-62-12	220 Ω
R5	1-60-12	100 Ω
R6	1-106-12	3600 Ω
R7	1-78-12	6800 Ω
R8	1-64-12	390 Ω
R9	1-69-12	1000 Ω
R10	1-64-12	390 Ω
R11	1-60-12	100 Ω
R12	1-60-12	100 Ω
R13	1-56-12	15 Ω
R14	1-72-12	2200 Ω
R15	1-62-12	220 Ω
R16	1-62-12	220 Ω
R17	1-65-12	470 Ω
R18	1-67-12	680 Ω
R19	1-67-12	680 Ω
R20	63-702	1000 Ω control, part of switch S1
R21	1-118-12	620 Ω
R22	10-940	200 Ω control

Resistors (cont'd.)

KEY No.	PART No.	DESCRIPTION
R23	1-55-12	10 Ω
R24	1-55-12	10 Ω
R25	1-63-12	270 Ω
R26	1-63-12	270 Ω
R27	1-107-12	82 Ω
R28	1-137	200 Ω, 1/2-watt
R29	1-63-12	270 Ω
R30	NOT USED	
R31	1-63-12	270 Ω
R32	1-84-12	100 kΩ
R33	1-84-12	100 kΩ
R34	1-65-12	470 Ω
R35	1-69-12	1000 Ω
R36	1-63-12	270 Ω
R37	1-63-12	270 Ω
R38	1-65-12	470 Ω
R39	1-102-12	68 Ω
R40	NOT USED	
R41	1-63-12	270 Ω
R42	1-60-12	100 Ω
R43	1-63-12	270 Ω
R44	1-63-12	270 Ω
R45	1-63-12	270 Ω
R46	1-60-12	100 Ω
R47	1-63-12	270 Ω

KEY No.	PART No.	DESCRIPTION
Resistors (cont'd.)		
R48	1-63-12	270 Ω
R49	1-63-12	270 Ω
R50	NOT USED	
R51	1-60-12	100 Ω
R52	1-63-12	270 Ω
R53	1-63-12	270 Ω
R54	1-63-12	270 Ω
R55	1-63-12	270 Ω
R56	1-60-12	100 Ω
R57	1-61-12	180 Ω
R58	1-111-12	1.5 MΩ
R59	1-87-12	1 MΩ
R60	NOT USED	
R61	1-63-12	270 Ω
R62	1-94-12	18 kΩ
R63	1-92-12	330 Ω
R64	1-68-12	820 Ω
R65	1-63-12	270 Ω
R66	1-83-12	47 kΩ
R67		27 Ω
R68	1-80-12	10 kΩ
R69	1-80-12	10 kΩ
R70	NOT USED	
R71	NOT USED	
R72	1-65-12	470 Ω
R73	1-65-12	470 Ω
R74	1-64-12	390 Ω
CAPACITORS		
C1	21-3	10 pF ceramic
C2	21-192	0.1 μF ceramic
C3	21-192	0.1 μF ceramic
C4	NOT USED	
C5	21-192	0.1 μF ceramic
C6	25-223	47 μF tantalum
C7	25-223	47 μF tantalum
C8	21-143	0.05 μF ceramic
C9	31-57	2.7-20 pF ceramic trimmer
C10	20-110	75 pF mica
C11	20-118	15 pF mica
C12	21-84	24 pF ceramic
C13	21-143	0.05 μF ceramic
C14	25-252	15 μF tantalum
C15	21-42	0.01 μF, 1.6 kV ceramic
C16	21-99	0.2 μF ceramic
C17	25-220	10 μF tantalum
C18	25-220	10 μF tantalum
C19	25-272	6000 μF electrolytic
C20	20-78	56 pF mica
C21	25-220	10 μF tantalum
C22	25-220	10 μF tantalum
C23	25-241	1200 μF electrolytic
C24	25-241	1200 μF electrolytic
C25	25-220	10 μF tantalum
DIODES		
D1	56-86	FD777
D2	56-86	FD777
D3	56-56	1N4149
D4	56-67	VR-10A 10-volt zener
D5	NOT USED	
D6	56-61	GESTB stabistor
D7	56-59	1N750A 4.7-volt zener
D8	56-56	1N4149
D9	57-71	Selected rectifier
D10	NOT USED	
D11	57-71	Selected rectifier
D12	57-65	1N4002
D13	57-65	1N4002
D14	57-65	1N4002
D15	57-65	1N4002
D16	NOT USED	
D17	56-36	VR-16.1G 16.1-volt zener
D18	56-36	VR-16.1G 16.1-volt zener
D19	56-57	1N716A 12-volt zener
TRANSISTORS		
Q1	417-828	Selected E304
Q2	417-292	2N5771
Q3	417-293	2N5770
Q4	417-235	2N4121
Q5	417-292	2N5771
Q6	417-813	2N4959
Q7	417-275	MPS6522
Q8	417-275	MPS6522
Q9	417-275	MPS6522
Q10	NOT USED	
Q11	417-275	MPS6522
Q12	417-293	2N5770
Q13	417-293	2N5770
Q14	417-293	2N5770
Q15	417-293	2N5770
Q16	417-293	2N5770
Q17	417-293	2N5770
Q18	417-235	2N4121
Q19	417-235	2N4121
Q20	NOT USED	
Q21	417-235	2N4121
Q22	417-235	2N4121
Q23	417-235	2N4121
Q24	417-235	2N4121

KEY No.	PART No.	DESCRIPTION
Transistors (cont'd.)		
Q25	417-235	2N4121
Q26	417-235	2N4121
Q27	417-118	2N3393
Q28	NOT USED	
Q29	417-224	MPSU05
Q30	NOT USED	
Q31	417-225	MPSU55

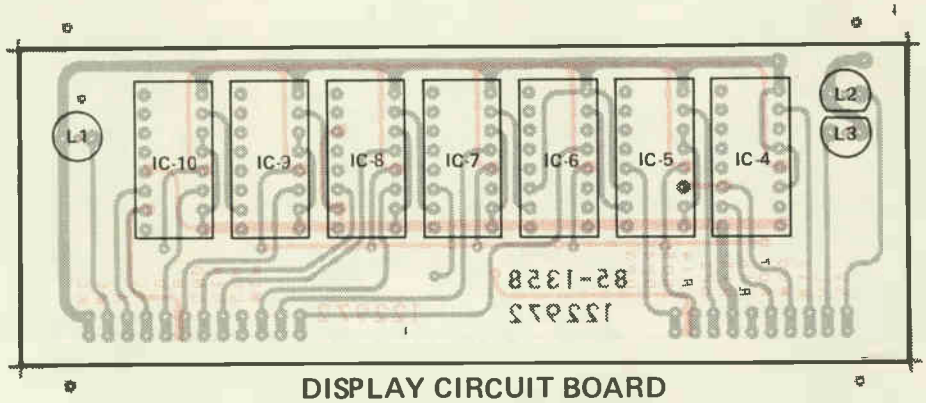
INTEGRATED CIRCUITS

IC-1	442-22	741 operational amplifier
IC-2	443-82	9528 ECL dual D-type flip-flop
IC-3	443-79	95HO3 ECL triple 2-in OR/NOR gate
IC-4	443-615	TIL308 numeric display
IC-5	443-614	TIL306 numeric display
IC-6	443-614	TIL306 numeric display
IC-7	443-614	TIL306 numeric display
IC-8	443-614	TIL306 numeric display
IC-9	443-614	TIL306 numeric display
IC-10	443-614	TIL306 numeric display
IC-11	443-6	7474 dual D-type flip-flop
IC-12	443-46	7402 quad 2-in positive NOR gate
IC-13	443-46	7402 quad 2-in positive NOR gate
IC-14	443-77	7438 quad 2-in NAND gate (open-collector)
IC-15	443-57	MC3003P quad 2-in OR gate
IC-16	443-625	74132 quad 2-in NAND gate (Schmitt trigger)
IC-17	443-46	7402 quad 2-in positive NOR gate
IC-18	443-83	95H28 ECL high speed dual D-type flip-flop
IC-19	443-82	9528 ECL dual D-type flip-flop
IC-20	NOT USED	
IC-21	443-84	MK5009 oscillator-scaler-muftiplexer
IC-22	443-5	7473 dual J-K master-slave flip-flop
IC-23	443-23	74122 monostable multivibrator
IC-24	442-54	UA7805 5-volt regulator
IC-25	442-54	UA7805 5-volt regulator
IC-26	442-54	UA7805 5-volt regulator

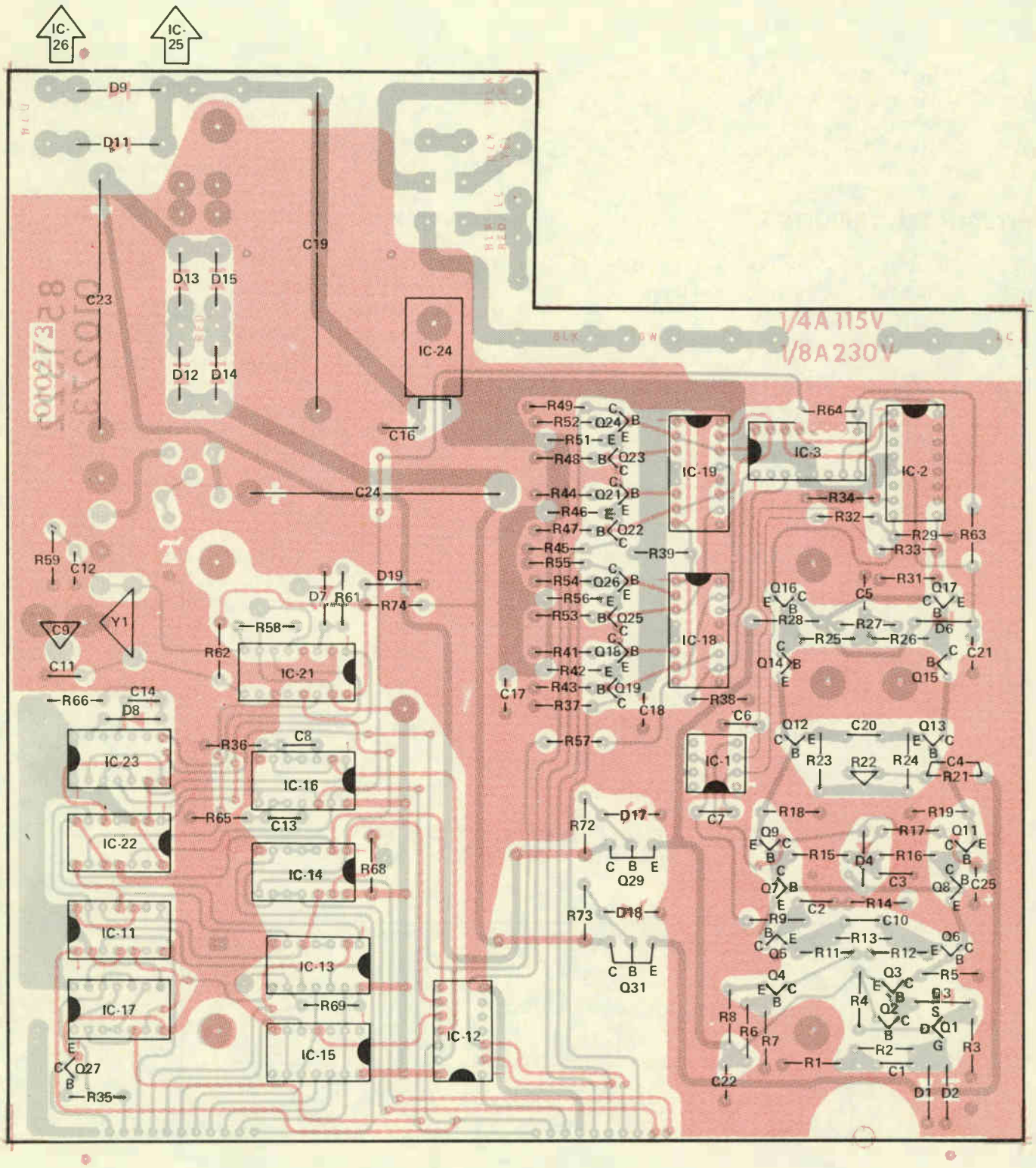
GENERAL PARTS

F1	421-33	1/4-ampere slow-blow fuse
L1	412-31	Lamp, 6V, 60 mA
L2	412-31	Lamp, 6V, 60 mA
L3	412-31	Lamp, 6V, 60 mA
S1	63-702	Range/Power/Sensitivity switch/control
S2	60-11	Internal-External slide switch
S3	60-68	Line-Voltage-Select slide switch
T1	54-834	Transformer
Y1	404-424	Oscillator crystal (1 MHz)

CIRCUIT BOARD X-RAY VIEWS



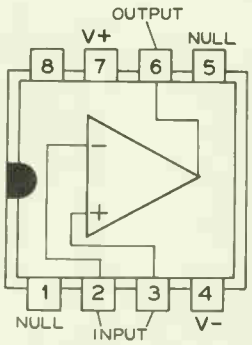
DISPLAY CIRCUIT BOARD
(Viewed from component side)



(Viewed from component side)

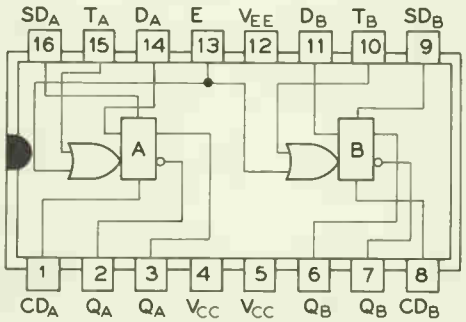
INTEGRATED CIRCUIT BASE DIAGRAMS

IC-1



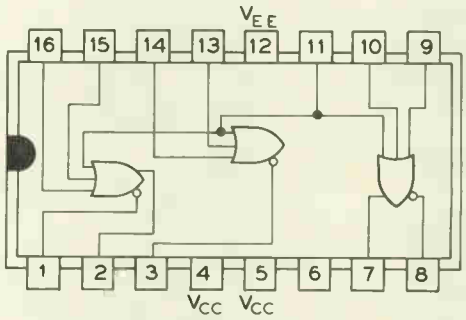
741
HIGH GAIN OP AMP

IC-2, 18, 19



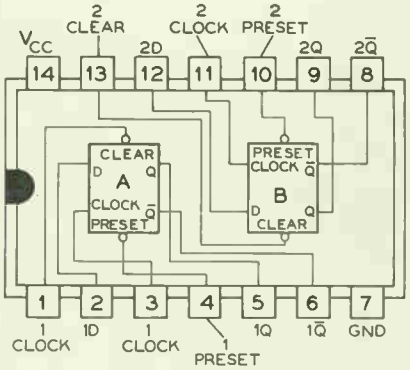
ECL 95H28
DUAL D FLIP-FLOP

IC-3



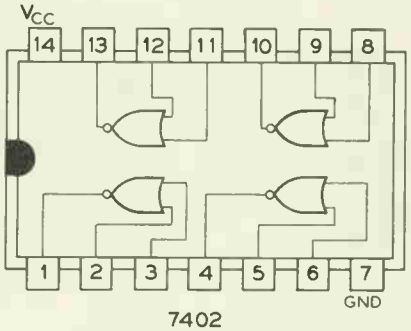
ECL 95H03
TRIPLE OR/NOR GATES

IC-11



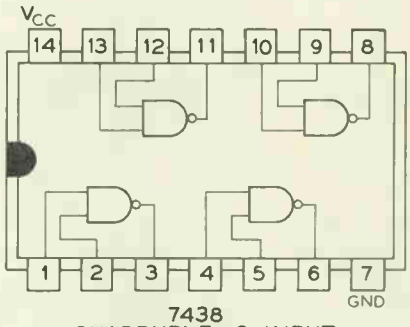
7474 DUAL D-TYPE EDGE-TRIGGERED
FLIP-FLOP

IC-12, 13, 17



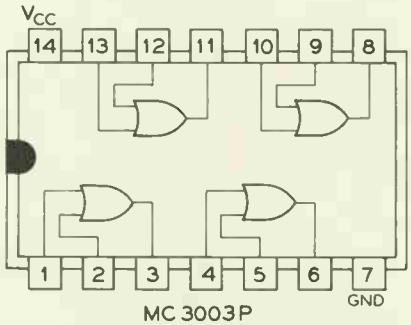
7402
QUADRUPLE 2-INPUT
POSITIVE-NOR GATES

IC-14



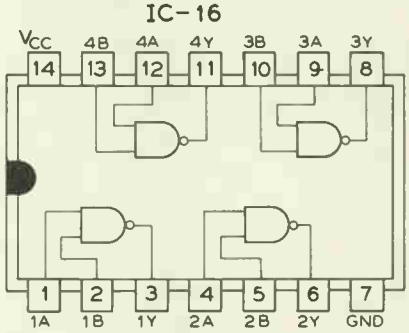
7438
QUADRUPLE 2-INPUT
POSITIVE-NAND BUFFERS

IC-15



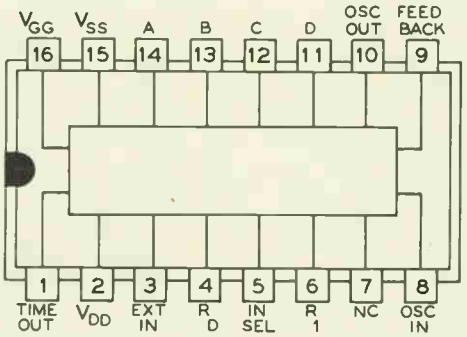
MC 3003P
QUADRUPLE 2-INPUT
POSITIVE-OR GATES

IC-16



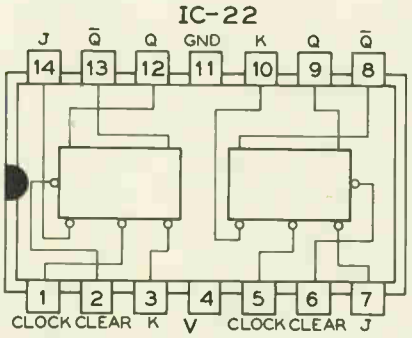
74132
QUADRUPLE 2-INPUT
POSITIVE NAND GATES
[SCHMITT TRIGGER]

IC-21



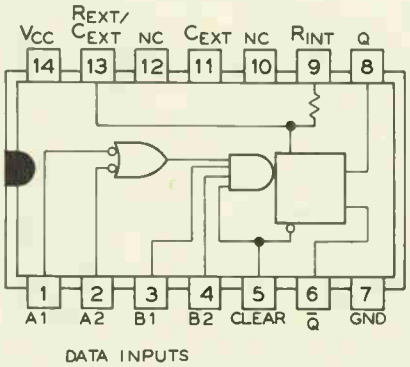
MK5009P
OSCILLATOR-SCALER-MULTIPLEXER

IC-22



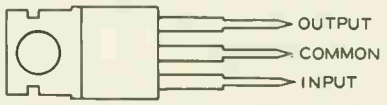
7473
DUAL J-K MASTER-SLAVE
FLIP-FLOPS

IC-23



74122
RETRIGGERABLE MONOSTABLE
MULTIVIBRATOR WITH CLEAR

IC-24,25,26



UA7805
5-VOLT VOLTAGE REGULATOR

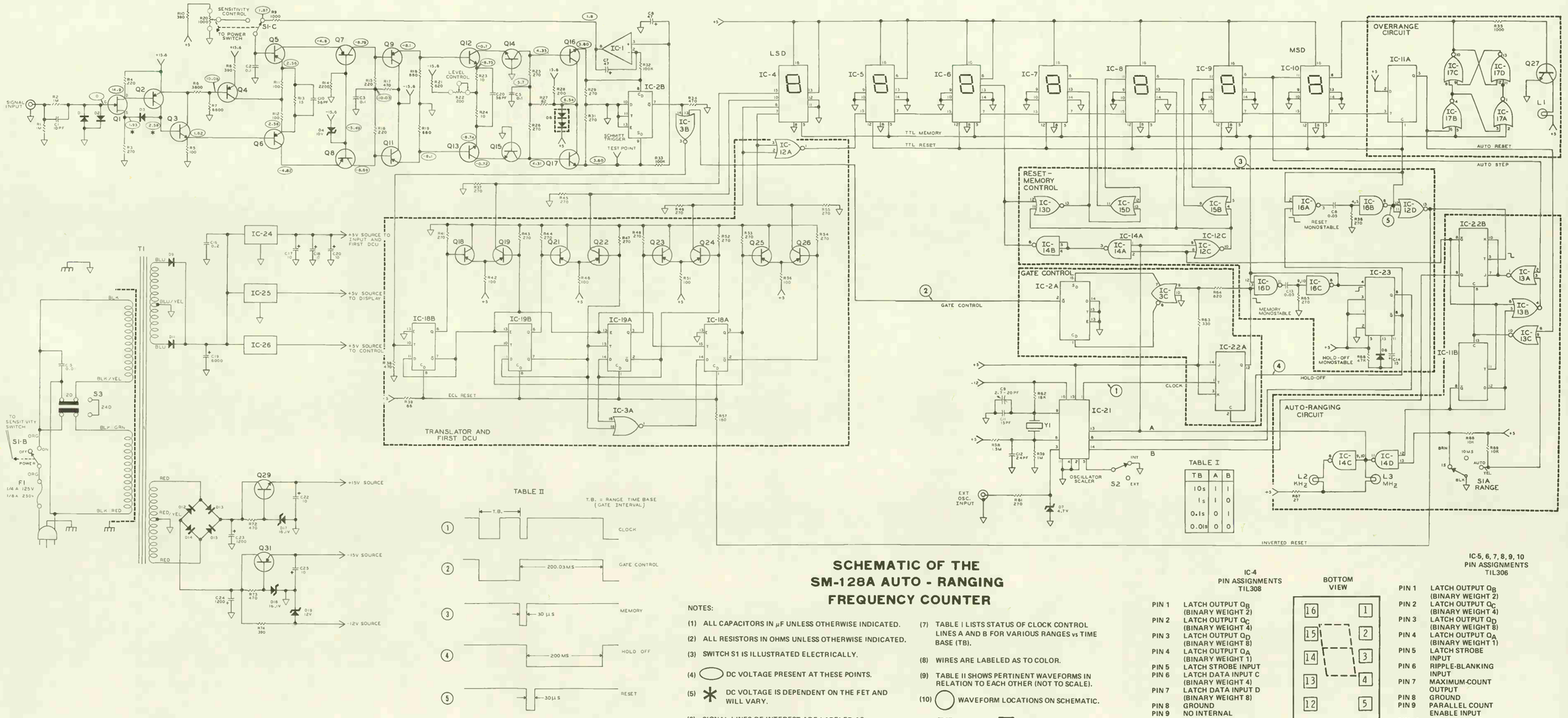


TABLE II

T.B. = RANGE TIME BASE (GATE INTERVAL)

TABLE I

TB	A	B
10s	1	1
1s	1	0
0.1s	0	1
0.01s	0	0

SCHEMATIC OF THE SM-128A AUTO - RANGING FREQUENCY COUNTER

NOTES:

(1) ALL CAPACITORS IN µF UNLESS OTHERWISE INDICATED.

(2) ALL RESISTORS IN OHMS UNLESS OTHERWISE INDICATED.

(3) SWITCH S1 IS ILLUSTRATED ELECTRICALLY.

(4) ⬭ DC VOLTAGE PRESENT AT THESE POINTS.

(5) ✱ DC VOLTAGE IS DEPENDENT ON THE FET AND WILL VARY.

(6) SIGNAL LINES OF INTEREST ARE LABELED AS TO THEIR FUNCTION.

(7) TABLE I LISTS STATUS OF CLOCK CONTROL LINES A AND B FOR VARIOUS RANGES vs TIME BASE (TB).

(8) WIRES ARE LABELED AS TO COLOR.

(9) TABLE II SHOWS PERTINENT WAVEFORMS IN RELATION TO EACH OTHER (NOT TO SCALE).

(10) ◯ WAVEFORM LOCATIONS ON SCHEMATIC.

(11) ⌐¬ OR ¬⌐ LEVEL TRANSISTION ACTIVATES

IC-4 PIN ASSIGNMENTS TIL308

PIN 1	LATCH OUTPUT Q_B (BINARY WEIGHT 2)
PIN 2	LATCH OUTPUT Q_C (BINARY WEIGHT 4)
PIN 3	LATCH OUTPUT Q_D (BINARY WEIGHT 8)
PIN 4	LATCH OUTPUT Q_A (BINARY WEIGHT 1)
PIN 5	LATCH STROBE INPUT
PIN 6	LATCH DATA INPUT C (BINARY WEIGHT 4)
PIN 7	LATCH DATA INPUT D (BINARY WEIGHT 8)
PIN 8	GROUND
PIN 9	NO INTERNAL CONNECTION
PIN 10	LATCH DATA INPUT B (BINARY WEIGHT 2)
PIN 11	BLANKING INPUT
PIN 12	LATCH DATA INPUT DP
PIN 13	LED TEST
PIN 14	LATCH OUTPUT DP
PIN 15	LATCH DATA INPUT A (BINARY WEIGHT 1)
PIN 16	SUPPLY VOLTAGE, V_{CC}

BOTTOM VIEW

NUMERIC DISPLAY WITH LOGIC

IC-5, 6, 7, 8, 9, 10 PIN ASSIGNMENTS TIL306

PIN 1	LATCH OUTPUT Q_B (BINARY WEIGHT 2)
PIN 2	LATCH OUTPUT Q_C (BINARY WEIGHT 4)
PIN 3	LATCH OUTPUT Q_D (BINARY WEIGHT 8)
PIN 4	LATCH OUTPUT Q_A (BINARY WEIGHT 1)
PIN 5	LATCH STROBE INPUT
PIN 6	RIPPLE-BLANKING INPUT
PIN 7	MAXIMUM-COUNT OUTPUT
PIN 8	GROUND
PIN 9	PARALLEL COUNT ENABLE INPUT
PIN 10	SERIAL COUNT ENABLE INPUT
PIN 11	RIPPLE-BLANKING OUTPUT
PIN 12	CLEAR INPUT
PIN 13	DECIMAL POINT INPUT
PIN 14	BLANKING INPUT
PIN 15	CLOCK INPUT
PIN 16	SUPPLY VOLTAGE, V_{CC}

SERVICE INFORMATION

The following Heath Company services are available if you need them: Replacement Parts, Technical Consultation, and Factory Service. Address all correspondence to:

HEATH COMPANY
Benton Harbor, Michigan 49022

For prompt service, use a separate letter for each department you write to.

Replacement parts and repair service are also available at your nearest Authorized Service Center or Heath Electronic Center. These Centers are listed in your Heath Catalog.

REPLACEMENT PARTS

If a replacement part is needed, please include the following information in your letter:

1. Part number and description.
2. Model Number and Series Number of the equipment.

If your equipment is in the Warranty period, add:

3. Date of purchase.
4. Nature of defect.

Heath Company will fill your order promptly. Please DO NOT RETURN PARTS unless they are requested. Parts that are damaged through carelessness or misuse by the customer will not be replaced without cost.

TECHNICAL CONSULTATION

You can write to our Technical Consultants for help with any Heath equipment, or for answers to any questions about the use of this equipment.

The completeness and accuracy of the advice mailed back to you depends entirely on the information in your letter. Be sure to include:

1. The Model Number and Series Number of the equipment (on blue and white identification label).
2. Date of purchase.
3. An exact description of the difficulty. Include switch positions, connections to other units, operating procedures, voltage reading, and any other information you think might be helpful.
4. List everything you have done in attempting to correct the difficulty.

FACTORY SERVICE

If you do not have qualified repair services at your disposal, you can return your equipment to the Heath Company Service Department to have it repaired for a minimum service fee. (Equipment that has been modified will not be accepted for repair.) Refer to Shipping Instructions for details on how to package and ship the equipment.

To be eligible for replacement parts under the terms of the Warranty, equipment returned for factory service must be accompanied by the invoice or the sales slip, or a copy of either. (If you send the original invoice or sales slip, it will be returned to you.)

SHIPPING INSTRUCTIONS

Check the equipment to see that all parts are in place. Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least three inches of resilient packing material (shredded paper, excelsior, etc.) on all sides between the equipment and the carton.

Seal the carton with gummed paper tape and tie it with a strong cord. Ship it by prepaid Express or insured Parcel Post to:

COMPANY
Benton Harbor, Michigan 49022

Attach a letter, containing the following information to the outside of the carton:

1. Your name and return address.
2. Date of purchase.
3. A brief description of the difficulty.
4. Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the Warranty.

WARRANTY

The Heath Company warrants that under conditions of normal use and service it will repair or replace any factory assembled unit whose performance does not meet published specifications and is returned to Heath prepaid within one year following date of shipment. The published specifications are those labelled "specifications" in the catalog and the manual for the unit. The replacement or repaired unit is shipped prepaid by us anywhere in the continental United States or to APO or FPO addresses. Shipments to other places are FOB factory. Heath's obligation is limited to such replacement or repair by Heath, and Heath is not responsible under this warranty or otherwise for any consequential damage or other loss in connection with the unit or its use.

Questions relating to repairs or warranty replacement in the continental United States (APO and FPO included) should be addressed to Heath Company, attention: Customer Relations, or the nearest Heathkit Electronic Center. In all other areas please contact the authorized Heathkit representative in your country, or Heath Company, attention: International Division.

HEATH COMPANY
Benton Harbor, Michigan 49022

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.