COUNTER /TIMER
model 1772

Features

- Timer and Scaler Operation
- Solid State LED Display (Light-Emitting Diodes)
- Built-in Integral Discriminator
- Electronic Gating Capability
- Accepts Positive or Negative Logic Input
- Pulse Pair Resolution less than 40 Nanoseconds
- Seven Decade Count Capacity with Built-in Prescaler

Description

The Canberra Model 1772 Counter/Timer combines in a dual-width NIM module one six-decade 25MHz non-printing scaler slaved to an internal line frequency timer. The module may function as a system master to control the duration of counting experiments on the basis of preset time utilizing electronic gating techniques.

Independent thumbwheel switches select the preset time limit for the switch selectable time base of 0.1 seconds or 0.01 minutes. The N switch selects a multiplier (0-9) and the 10^M switch selects the power of ten (10^0 - 10^5) by which it is multiplied.

The scaler input is equipped with an integral discriminator covering an input voltage range of +0.5 to +10 volts by means of a front panel screwdriver adjustment. This discriminator can replace a separate integral discriminator in many counting systems.

The six numeric indicators utilize seven-segment light-emitting diodes to provide solid state reliability and long life. Because this is a flat surface display, the viewing angle is far wider than that obtained with tube display. A circularly-polarized filter allows brilliant readout even in direct sunlight. Leading zeros are suppressed for viewing ease.

The counter/timer may operate in Single (one cycle) or Recycle modes. In single mode, counting stops when the preset time is reached and the unit will await new manual commands. In Recycle mode, counting stops momentarily for ≈ 2 seconds, then the timer and scaler are reset and counting begins again.

The Model 1772 Counter/Timer features fast gating capability. An internal jumper allows the gate input to control only the scaler or both the timer and the scaler. The gate output is controlled by the preset time or by the stop pushbutton and is activated until preset is reached or the stop pushbutton is depressed, except when inhibited by the gate input signal. A front panel indicator lights when the scaler is in a condition to accept counts.

Front panel Start, Stop and Reset pushbutton switches are provided for manual control of the nuclear counter.
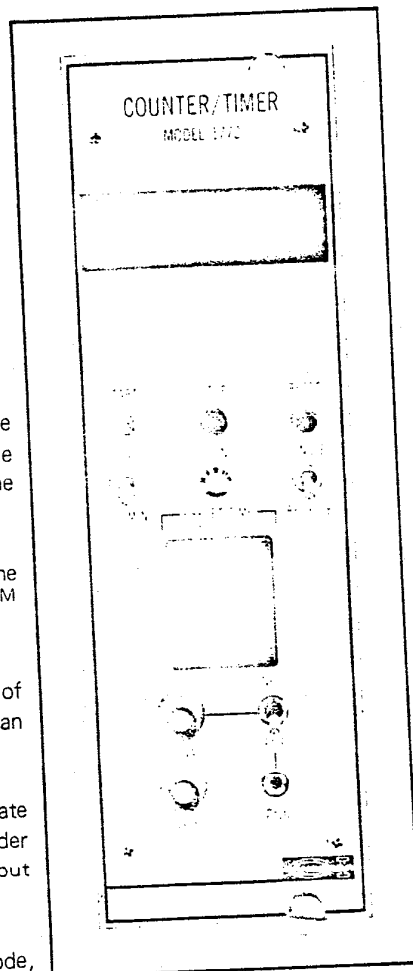
Specifications

INPUTS

POSITIVE SIGNAL IN - accepts 0.5 to 10 volts (+50 volt maximum) pulses; any rise time; minimum pulse width, 20 nanoseconds; input impedance greater than 1000 ohms; DC coupled; front and rear panel BNC connectors

NEGATIVE SIGNAL IN - accepts -0.6 to -2.0 volt pulses; minimum width, 20 nanoseconds; input impedance 50 ohms; DC coupled; front and rear panel BNC connectors

GATE IN - +3 to +10 volt DC level or pulses (or open circuit) enables accumulation; less than 0.8 volt DC level or pulse (or short circuit) inhibits accumulation; 3mA current sinking; input impedance greater than 1000 ohms, DC coupled, front and rear panel BNC connectors

OUTPUTS

OVERFLOW - +5 volt pulses at reset of sixth decade; rise time less than 200 nanoseconds, width 5 microseconds; DC coupled; rear panel BNC connector

GATE OUT - provides +5 volt DC level during accumulation, +0.5 volt DC level when not accumulating (except when inhibited by Gate Input); rise time less than 200 nanoseconds; will gate up to 50 compatible scalers and timers; current sinking 150mA, DC coupled; rear panel BNC connector

FRONT PANEL CONTROLS

START - pushbutton to renew or begin accumulation

STOP - pushbutton to terminate accumulation

RESET - pushbutton to reset all decades to zero; accumulation will begin unless the Stop pushbutton is first depressed

MODE - toggle switch to select Single or Recycle mode of operation upon reaching a preset condition

PRESET - two digit thumbwheel switches for the time base; selectable preset limit is $N \times 10^M$, N is the 0-9 digit multiplier and 10^M is the power of ten being multiplied; N = 0 is preset OFF, disabling the preset functions of the time base

NEG./POS. - front panel toggle switch to select input pulse polarity for the scaler

DISC. - front panel screwdriver adjustment to inhibit counting of input pulses to the scaler below selected level from +0.5 to 10 volts

INTERNAL CONTROLS

PRESCALER - jumper plugs to insert a decade prescaler in the desired channel; this prescaler is non displaying

GATE MODE - jumper plug allows the gate input to control either the scaler or both the timer and the scaler

PERFORMANCE

CAPACITY - six decades; 10^6-1 counts; a non-displaying decade may be selected by internal jumper

COUNT RATE - 25MHz minimum, 30MHz typical

PULSE PAIR RESOLVING TIME - less than 40 nanoseconds

TIME BASE ACCURACY - equivalent to line frequency accuracy

TEMPERATURE OPERATING RANGE - 0 to 60°C

AUTOMATIC RESET - initiated when power is first turned on or after power failed; resets all decade counters to zero

INDICATORS

VISUAL DISPLAY - six solid state numeric indicators for each channel; leading zeros are suppressed

COUNT - front panel light is illuminated during accumulation and extinguished when Stop command is initiated

CONNECTORS

SIGNAL IN, GATE IN - front and rear, BNC, UG-1094/U

OVERFLOW, GATE OUT - rear panel, BNC, UG-1094/U

POWER

+24V	— 0mA	+12V	— 50mA
-24V	— 0mA	-12V	— 160mA
115VAC	— 200mA		

PHYSICAL

SIZE - standard double width module (2.70 inches wide) per TID-20893

WEIGHT - 3.2 lbs (1.47 kgs)

COUNTER/TIMER
Model 1772

Instruction Manual

COUNTER/TIMER
Model 1772

CONTENTS

COUNTER / TIMER
MODEL 1772

SECTION 1
INTRODUCTION

The Canberra Model 1772 Counter/Timer combines in a dual-width NIM module one six-decade 25MHz non-printing scaler slaved to an internal line frequency timer. The module may function as a system master to control the duration of counting experiments on the basis of preset time utilizing electronic gating techniques.

Independent thumbwheel switches select the preset time limit for the switch selectable time base of 0.1 seconds or 0.01 minutes. The N switch selects a multiplier (0-9) and the 10^M switch selects the power of ten (10^0-10^5) by which it is multiplied.

The scaler input is equipped with an integral discriminator covering an input voltage range of +0.5 to +10 volts by means of a front panel screwdriver adjustment. This discriminator can replace a separate integral discriminator in many counting systems.

The six numeric indicators utilize seven-segment light-emitting diodes to provide solid state reliability and long life. Because this is a flat surface display, the viewing angle is far wider than that obtained with tube display. A circularly-polarized filter allows brilliant readout even in direct sunlight. Leading zeros are suppressed for viewing ease.

The counter/timer may operate in Single (one cycle) or Recycle modes. In single mode, counting stops when the preset time is reached and the unit will await new manual commands. In Recycle mode, counting stops momentarily (~ 3 seconds), then the timer and scaler are reset and counting begins again.

The Model 1772 Counter/Timer features fast gating capability. Internal jumpers allow the gate input to control the scaler or timer or both. The gate output is controlled by the preset time or by the stop pushbutton and is activated until preset is reached or the stop pushbutton is depressed, except when inhibited by the gate input signal. A front panel indicator lights when the scaler is in a condition to accept counts.

Front panel Start, Stop and Reset pushbutton switches are provided for manual control of the nuclear counter.

SPECIFICATIONS

2.1 INPUTS

POSITIVE SIGNAL IN

Accepts 0.5 to 10 volts (+50 volt maximum) pulses
Rise time: any
Pulse width: 20 nanoseconds, minimum
Input impedance: greater than 1000 ohms, DC coupled, front and rear panel BNC connectors

NEGATIVE SIGNAL IN

Accepts -0.6 to -2.0 volt pulses
Pulse width: 20 nanoseconds minimum
Input impedance: 51 ohms, DC coupled, front and rear panel BNC connectors

GATE IN

+3 to +10 volt DC level or pulses (or open circuit) enables accumulation; less than 0.8 volt DC level or pulse (or short circuit) inhibits accumulation; 3mA current sinking; input impedance greater than 1000 ohms, DC coupled, front and rear panel BNC connectors

2.2 OUTPUTS

OVERFLOW

+5 volt pulses at reset of sixth decade
Rise time: less than 200 nanoseconds
Pulse width: 5 microseconds, DC coupled, rear panel BNC connector

GATE OUT

Provides +5 volt DC level during accumulation, +0.5 volt DC level when not accumulating (except when inhibited by Gate Input)
Rise time: less than 200 nanoseconds; will gate up to 50 compatible scalers and timers; current sinking 150mA, DC coupled; rear panel BNC connector

2.3 FRONT PANEL CONTROLS

START

Pushbutton to renew or begin accumulation

STOP

Pushbutton to terminate accumulation

RESET

Pushbutton to reset all decades to zero

MODE

Toggle switch to select Single or Recycle mode of operation upon reaching a preset condition

PRESET

Two digit thumbwheel switches for the time base; selectable preset limit is $N \times 10^M$, N is the 0-9 digit multiplier and 10^M is the power of ten being multiplied; $N = 0$ is preset OFF, disabling the preset functions of the time base

NEG./POS.	Front panel toggle switch to select input pulse polarity for the scaler
DISC.	Front panel screwdriver adjustment to inhibit counting of input pulses to the scaler below selected level from +0.5 to 10 volts

2.4 INTERNAL CONTROLS

PRESCALER	Jumper plugs to insert a decade prescaler in the desired channel; this prescaler is non-displaying
GATE MODE	Jumper plugs allow the gate input to control either the scaler or timer or both

2.5 PERFORMANCE

CAPACITY	Six decades; 10^6-1 counts; a non-displaying decade may be selected by internal jumper, increasing the capacity to 10^7-1
COUNT RATE	25MHz minimumm 30MHz typical
PULSE PAIR RESOLVING TIME	Less than 40 nanoseconds
TIME BASE ACCURACY	Equivalent to line frequency accuracy
TEMPERATURE OPERATING RANGE	0 to 50°C
AUTOMATIC RESET	Initiated when power is first turned on or after power fails

2.6 INDICATORS

VISUAL DISPLAY	Six solid state numeric indicators; leading zeros are suppressed
COUNT	Front panel light is illuminated during accumulation and extinguished when Stop command is initiated

2.7 CONNECTORS

SIGNAL IN, GATE IN	Front and rear, BNC, UG-1094/U
OVERFLOW, GATE OUT	Rear panel, BNC, UG-1094/U

2.8 POWER

+24V	–	0mA	+12V	–	50mA
-24V	–	0mA	-12V	–	150mA
115VAC	–	200mA			

2.9 PHYSICAL

SIZE	Standard double width module (2.70 inches wide) per TID-20893
WEIGHT	3.2 lbs (1.47 kgs)

CONTROLS/INDICATORS

3.1 FRONT PANEL

3.1.1 START PUSHBUTTON

When depressed, initiates data accumulation in the 1772. Scaler is *not* reset to zero.

3.1.2 STOP PUSHBUTTON

When depressed, terminates data accumulation in the 1772.

3.1.3 RESET PUSHBUTTON

When depressed, resets scaler contents to zero. The RESET pushbutton does *not* terminate data accumulation.

3.1.4 COUNT LAMP

Illuminates while data accumulation is enabled (between START and STOP commands). The COUNT lamp is *not* inhibited by the GATE input.

3.1.5 SIGNAL INPUT

Accepts positive or negative pulses for accumulation.

3.1.6 POS/NEG SWITCH

Selects polarity of input pulse to be counted and discriminated. If in NEG position, the SIGNAL input is terminated in 51 Ω and the discriminator level is fixed at -.6v. If in POS position, input impedance is 1000 Ω, and a variable discriminator level is enabled.

3.1.7 DISC POTENTIOMETER

When enabled by POS/NEG switch selects discriminator level for positive input pulses. Ten-turn pot gives variation from .5 to +10 volts.

3.1.8 GATE INPUT

When open (or at a HIGH logic level) enables accumulation of input pulses; when grounded (or receiving a LOW logic level) inhibits accumulation of input pulses.

3.1.9 DATA DISPLAY

Provides visual readout of six decades of scaler. If the prescaling decade is employed, it is *not* displayed. Leading zeros are suppressed.

3.1.10 TIMEBASE SWITCH

Selects timebase to be either .1 sec or .01 min

3.1.11 PRESET THUMBWHEEL SWITCHES

Select counting time, with preset time being $N \times 10^M \times$ selected timebase. If $N = 0$, timer is inhibited.

3.1.12 MODE SWITCH

Selects either single or repetitive (RECYCLE) counting operations. If in RECYCLE, an internally-selected delay of several (≈ 3) seconds separates each counting operation.

3.2 REAR PANEL

3.2.1 SIGNAL INPUT

Identical to Front Panel input

3.2.2 GATE INPUT

Identical to Front Panel input

3.2.3 OVERFLOW OUTPUT

Transmits a 5 μsec positive pulse on the overflow of most significant decade.

3.2.4 FUSE

1/2 A slo-blo inserted in 110 VAC input line.

3.3 INTERNAL

3.3.1 JUMPERS

When the two jumpers shown in Figure 3.1 are in the "7" position, a prescaling decade is inserted in the accumulation path. When in the "6" position, the prescaler is bypassed.

The jumpers shown in Figure 3.1b are used to allow the GATE input to inhibit the scaler or timer. All other jumpers are used for factory-installed options and should not be moved.

4.1 INSTALLATION

The Canberra Model 1400 Bin and Power Supply or other bin and power supply systems conforming with the mechanical and electrical standards set by AEC Report TID-20893 (rev.) will accommodate the Model 1772. The right side cover of the double-width NIM module acts as a guide for insertion of the instrument. Secure the module in place by turning the two front panel captive screws clockwise until finger tight. It is recommended that the NIM bin power switch be OFF whenever the module is installed or removed.

The Model 1772 can be safely operated where the ambient air temperature is between $0^0 C$ and $+50^0 C$ ($+120^0 F$ Maximum). Perforations in the top and bottom sides permit cooling air to circulate through the module. When relay rack mounted, along with other "heat generating" equipment, adequate clearance should be provided to allow for sufficient air flow through both the perforated top and bottom covers of the NIM bin.

4.2 INITIAL CHECK

With the 1772 installed in a compatible bin/power supply, turn power ON.

Connect a source of +5V pulses to the SIGNAL input, with POS/NEG switch in POS position. Set Preset Switches to 00.

Push the Stop and Reset buttons on the unit being tested.

Then initiate counters by pushing the START button. Set the repetition rate of the pulse generator to about 10 counts per second; observe the unit count the pulses from the test pulse generator.

With the unit being tested accumulating, change the pulser repetition rate to various frequencies and observe the accumulation rate on the Scaler Display.

Push the STOP button and observe the scaler stop.

Push the RESET button and observe the visual display reset to 0.

Push the START button and again begin accumulation; rotate the Discriminator control clockwise until the unit stops accumulation: increase the amplitude of the input pulses and observe accumulation begin again.

Push the Reset button; observe the unit reset to zero and immediately begin accumulation again; the Reset button does not stop the unit but simply resets it to 0; the STOP button must first be pushed if it is desired to stop the unit.

Push the START button again and begin accumulation; using a piece of wire, ground the Gate In connector and observe the scaler cease accumulation; remove the Gate In short and observe the scaler again begin to accumulate.

Allow the scaler to count to its capacity and observe the Overflow pulse on an oscilloscope; compare the pulse observed to the specified shape of +5 volts, rise time less and 100 nanoseconds, width 5 microseconds.

Set POS/NEG switch to NEG. Replace the pulse generator with a source of negative pulses whose width is $\geqslant$ 20 nanoseconds.

Observe that all negative inputs above - 0.6 volts will cause the scaler to accumulate regardless of the discriminator setting.

Set MODE switch to Single, TIMEBASE switch to .01 Min and preset switches to 12.

Depress START button and observe that the Model 1772 accumulates counts for 1 min.

Set TIMEBASE switch to .1 sec and preset switches to 11. Depress START pushbutton and observe that the Model 1772 counts for 1 sec.

Set MODE switch to RECYCLE, and depress START pushbutton. Observe that the Model 1772 executes a series of 1 second count cycles, separated by pauses of $\approx$ 3 seconds.

# Section 5

THEORY OF OPERATION

5.1 INPUT DISCRIMINATOR

Input discriminator A37 is an ECL device which detects negative or positive input pulses as a function of the POS/NEG front panel switch. When the switch is in the POS position, the circuit is configured:
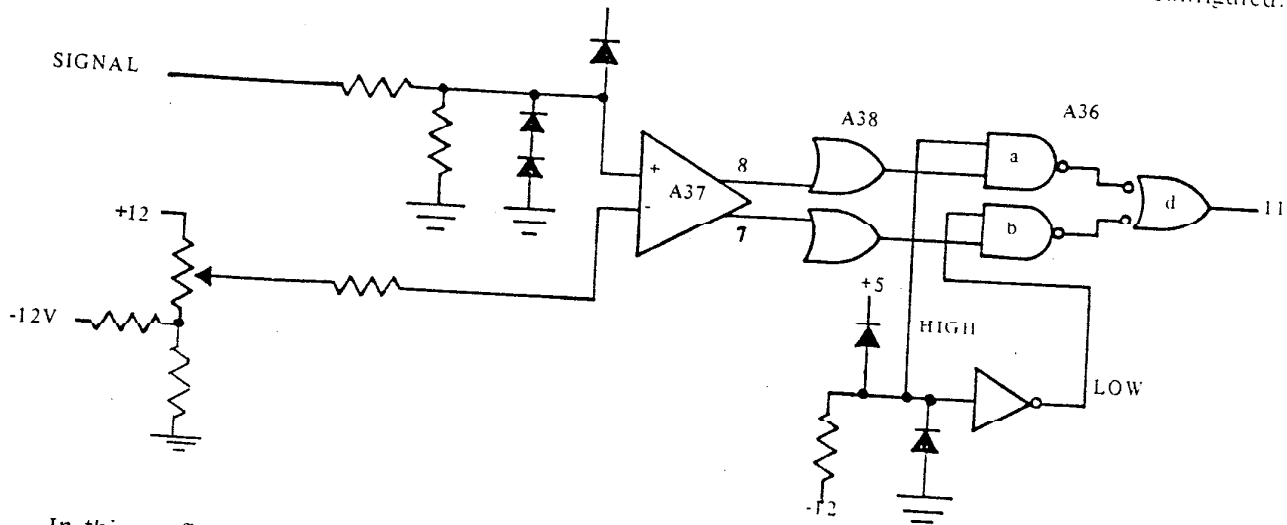
In this configuration, the input pulses are discriminated against the potentiometer setting, and of the two complementary outputs of A37, the output from pin 7 is selected to pass through A38 (an ECL to TTL converter) and A36b; the output from A36 pin 11 is the pulse train to be counted.

If the switch is in the NEG position, the configuration is:
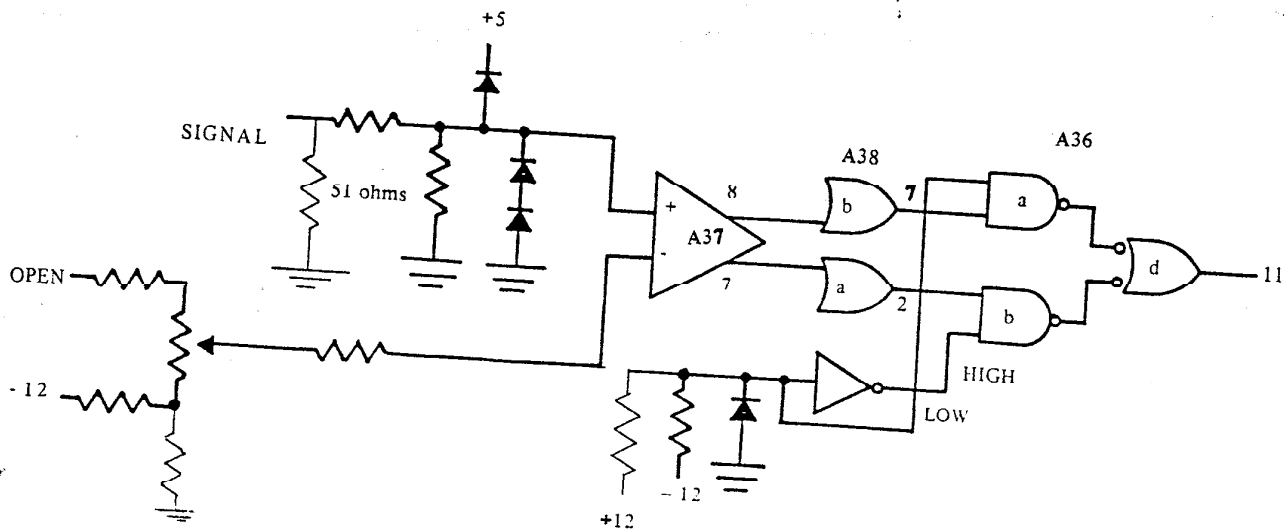
Now the discriminator level is set at ≈ -0.5V and the other output (from A37 pin 8) is selected to become the pulse train to be counted.

5.2 SCALER

To enable the Model 1772 to count at > 25MHz the first counting stage is a high speed flip-flop (A35).

If the prescaler is not used, the jumpers are inserted to give the following circuit:
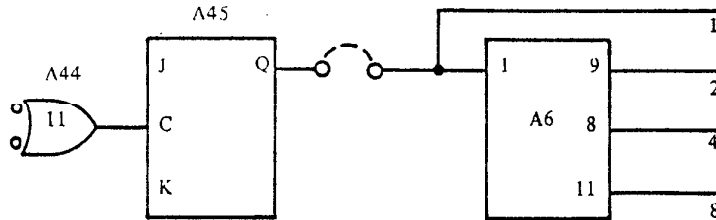
5.3 DISPLAY, READOUT

Under non-readout conditions, oscillator Q7 drives decade counter A21, whose decoded outputs (A20) multiplex scaler data and drive the LEDs. When the "7" count is reached, the counter is reset (via A30, pin 5) to 0.

When the HOLD line goes low, flip-flop A19b is set (if in the PRINT condition) and the input print clocks control data output via the Model 1404 connector.

Leading zero suppression is accomplished by A19a. On count 0, the flip-flop is cleared (giving a ripple blanking input). As each digit is strobed, the ripple blanking output is "stored" in A19b. The first non-zero digit sets the flip-flop, forcing the ripple blanking input low to allow display. The flip-flop is always set on the 6th count in any case.

5.4 TIMEBASE

The timebase for the Model 1772 is derived from the 60Hz line frequency (using the 8.2 VAC output of the units transformer). A shaping single shot A61 gives a 60Hz digital waveform.

This 60Hz output is counted down by a factor of 6 in A60 to give the 0.1 sec waveform. A further countdown of 6 is performed by A56 to give a timebase of 0.01 min.

The appropriate timebase as selected by front panel switch appears at A58 pin 8.

5.5 COUNT LOGIC

When the Model 1772 is not enabled to count, flip flops A51 pin 13 and 9 are both in the RESET (low) state. Thus, both A60 and A56 are in the RESET state also.

When the START button is depressed, A51 pin 13 is SET (via A44 pin 8). A51 pin 9 will be set on the trailing edge of the next 60Hz pulse, and counting operation is enabled.

With A51 pin 9 HIGH, the gate to the scaler is enabled (A55 pin 5) and the selected timebase is allowed to pass through the edge detector A58 pin 12 to the series of ÷ 10 counters which accumulate time.

5.6 PRESET OPERATION

A48 is a multiplexer which selects one of the overflows from the 5 decades counting channel (or its input) as a function of the "10^M" switch on the front panel. The selected waveform (A48 pin 5) passes through a trailing edge detector (A59 pin 6), and is OR'ed with the START command pulse at A54 pin 8.

This pulse train will, if enabled, be the "countdown" clock input to A52, an up/down decade counter which has been loaded prior to start with the contents of the "N" switch on the front panel. When this counter underflows, the "borrow" output triggers single shot A49b, which halts the COUNT operation and outputs a STOP pulse. Note that if the "N" switch is in the 0 position, A54 pin 12 will be LOW, inhibits the clock input to A52, and hence inhibiting preset operation.

5.7 RECYCLE OPERATION

If enabled by the front panel SINGLE/RECYCLE switch, the output of A49b at preset will trigger single shot A49a, whose time constant is ~ 2 seconds The trailing edge of this signal is derived to generate a RESET/START to the TIMER and SCALER.

5.8 CRYSTAL OPTION

If the crystal option is installed, the 3.2678 MHz output of the crystal oscillator is counted down by successive divisions of 2,2, 16,16, & 16 to give a 200Hz waveform at A63 pin 12. This timebase is further divided by 2 in A56 to give 100Hz. A division by 10 in A60 (now a decade counter) gives the .1 sec waveform for the timer.

The gate input, if used to inhibit the timer, is applied to the first stage in the timebase, thus giving resolution of well under 1 μsec.