DUAL COUNTER TIMER
Model 2071A
Operator's Manual
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Section 1. 
Introduction

The Canberra Model 2011A Dual Counter/Timer provides a single IN1/IN2/NIM module, two eight-decade counters, a crystal time base, and presetting logic. A normal operation is as a preset timer and event counter, or as a preset event counter and timer. However, the Model 2011A timer also operates as a dual counter/timer plus preset timer without display or preset data.

Both input IN1 inputs accept negative NIM or positive pulses, jumper selectable. A discriminator is provided allowing positive input to be compatible with unequal and bipolar logic signals or TTL logic signals. The front-panel push button DISCRIMINATOR covers an input range of +100 mV to +40 V per step in 1 mV steps. This permits counting in a wide range of environments.

The Model 2011A accommodates input counting rates of 100 million counts per second (100 MHz) for negative inputs and 25 million counts per second (25 MHz) for positive inputs.

The internal crystal time base provides increments of 0.01 seconds or 0.01 minutes, and the time setting at the microsecond resolution.

Display of either counter's content is accomplished with a six-digit Liquid Crystal Display. The LCD includes eight annunciators which display the display and dynamic state of the unit. Automatic +100 range shift provides an indication of the six most or six least significant digits.

Preset control is accomplished with a three-digit thumbwheel switch providing a preset range from 0 to 99 x 10^7 increments.

The Single/Recycle mode switch provides a method to automatically place the unit or system back into the counting mode ten seconds or 100 microseconds, jumper selectable, after preset or termination of the count mode is reached.

Master-Slave system operation can be accomplished via the front or rear panel interconnection of the ENABLE signal, or by either of the two optional L/C interfaces.

The Canberra NIM/Daisy Chain option provides interconnecting to all Canberra printing counters, printers, and video systems. Standard with the NIM Daisy Chain option is a Read Out Buffer capability which allows for any number of counting modules a total of only 102 microwatt second dead time is required.

The alternate Canberra GPIB (IEEE-488) option provides interfacing to the GPIB bus. It also allows a GPIB Controller to start, stop, and read out counting systems.

A convenient ENABLE output will allow any 2011A or 2011B to start, stop, and reset single or multiple combinations of other Canberra Series 2000 counting modules.

For an accumulation of data in channel A, a jumper can be changed to prevent reading of channel A.

External connection to the A or B GATE inputs will permit gating of incoming pulses when in the preset count mode. Gating of the time base for channel A or B, jumper selectable, when in the preset time mode. In this mode the gate provides a microsecond resolution. Thus when a system Busy signal is connected to input, the Model 2011A will provide extremely accurate dead time corrections.

Section 2. 
Specifications

2.1 INPUTS

A and B IN - Front panel BNC connectors accept positive, TTL, or negative hold fast logic signals, jumper selectable. Positive operation accepts p-polar, bipolar or TTL triangular amplitude, R = +10 V, +2 V maximum. Input, minimum, must exceed the adjustable discriminator level for 20 V to be detected. Negative -50 mV fast logic amplitude, -0.5 V to +5 V, minimum width 4 nsec below -0.5 V. Input rise and fall times: 1 nsec to 50 nsec; 40 = 1 A charge do for positive signals and + 50 ohms for negative signals.

GATE B - Counting control for channel B. jumper selectable with three gate selected, the gate-time resolution can be obtained, shipped as channel B counting control. Amplitude: +5 to +5 V or open circuit allows counting, zero to 0.8 V will counting. Z = +500 ohms to +5 V but. Whenever as time gating system busy can be used for accurate dead-time correction. 
2.3 FRONT PANEL CONTROLS

START/STOP - Two-position momentary toggle switch initiates or terminates a counting sequence.

RESET - Manual push button resets both counters to zero.

SINGLE/RECORD - Two-position toggle switch selects single or record mode of operation upon reaching a preset count.

0.01 SEC/COUNT 0.01 MIN - Channel B time base or counter with zero position toggle switch to select 0.01 seconds 0.01 minute. The external B as the start and present function. When time is selected, channel A counts the external events through A.N. When Count is selected, channel A counts time to 0.01 second intervals. An additional output is selected by internal jumpers provides a time reset, and event counting in channel A and B. In this case time base becomes manual for display or output.

A/B DISPLAY SELECT - Two-position toggle switch selects which counter's contents are displayed on the LCD, PRESET N=10 - Three-digit seven-segment display for channel B preset. N=1 units, N=1 tenths, N=1 thousandths. P is the power of 10. N and M range from 0 to 99. If a range of 0 to 9, N = M = 0 disables the preset function.

2.4 PERFORMANCE

CAPACITIES: Eight decades per channel, allowing 10^1 - 10^8 counts. The maximum count is limited by the capacity of each display.

COUNT RATE: 100 MHz max., negative 26 kHz positive. PULSE RATE RESOLUTION: 10 nanoseconds, negatives, 40 ns positive.

CRISTAL TIME BASE ACCURACY: ± 0.0002% over operating temperature range.

TEMPERATURE OPERATING RANGE: 0 to 50°C.

PRESET COUNT CHANNEL - Limited to 1 MHz count rate; pulse width minimum 300 nsec.

INDICATORS - Six-digit Liquid Crystal Display with auto (x100) shift for displaying six-digit signed data. Eight annunciators on LCD describe the display. These are: OVR (overflow), x100, CNT, MIN, SEC, A, B, decimal point. Active counting is indicated by CNT, MIN, or SEC blinking. Leading zeros are suppressed.

2.5 INTERNAL CONTROLS

STANDARD JUMPERS (When net, perform the following):

- Inhibit output of channel A when starting. In this mode channel A accumulates counts and is reset only by the manual pushbutton.
- Select OVERFLOW or ENABLE as the function of the rear panel connector.
- Select OVERFLOW output from channel B instead of channel A.
- Permit counting in both channels. In this mode the module may still be present on time, but the time cannot be read out.
- Allow a pulse on ENABLE input to start the module.
- Change resets from 10 sec to 100 sec.
- Select CNT A or B to time the channel.
- Select CNT A or ENABLE as the function of the front panel connector.
- Select input A and B to accept positive linear or TTL, or negative NIM signals.

2.6 POWER

207A Alone

with -01
with -02
+12 120 mA 120 mA
+12 120 mA 120 mA
+24 25 mA 25 mA
+24 25 mA 25 mA
+40 0 0

2.7 PHYSICAL

SIZE - Standard single Nu-Mini Module: 43.0 x 22.12 cm (1.35 x 8.71 inches) per TDR-33HS (Rev A)
NET WEIGHT: 0.94 kg (2.0 lb.)
SHIPPING WEIGHT: 3.2 kg (7.0 lb.)

2.8 OPTION: 2071-01

GPIB (IEEE 488) INTERFACE

A. Features

- Asynchronous ASCII data transmission bit parallel, character serial
- Uniquely addressable, switch controlled
- Tel/Lab Interface
- Talk Only mode
- Auto reset minimizes readout dead time
- Auto relatime
- Form feed or carriage return at end of word

B. Description

The General Purpose Interface Bus links a Canberra NIM counting module into the IEEE 488 standard communications network. As a Listener, this interface module Start, Stop, and Readout commands from a controller as a Talker. It supplies its accumulated data to a peripheral device. A Talk Only mode provides a controllerless means for a single module to read out to a peripheral Listener. The Auto Cycle mode allows the selected module to place itself (and all the rest of the Canberra counting system) back into the counting mode at the conclusion of its readout, thus minimizing system dead time. A side panel output provides
access to Test or Verify -> Talk/Listen Address, select Talk Only mode enable Auto/Recycle or select Fixed-Field Content Return to Baud of lowest. This interface is a single PC board with a connector that allows convenient field installation.

C. Specifications

- SIGNALS: The input/output signals on the GRIIP connector are TTL compatible. True square 0 ± 0.4 V, false square 2.5 ± 5 V.
- CONTROLS - Side-panel output provides access to:
  - Address select/switch
  - Talk/Listen/Talk Only switch
  - Auto Recycle switch
  - FF/0/1 action
- Interlocking enables Stop comment response (DC 2).
- CONNECTOR - Standard GRIIP connector on rear panel.
- CONFORMITY - Option DU contains the following subset of capabilities for explanation are IEEE-488 Standard bits, AHT, T1, TEO, 10, LED, SRT, RUP, PFD, DTO, DO, DCC/O/DCC selectable.

D. General Description of GRIIP

The General Purpose Interface Bus is a link or network by which system components communicate with each other.

Each system participant performs at least one of three roles: Controller, Talker, or Listener.

A Controller manages bus communications primarily by directing or commanding which devices are to send data to other devices (Talkers), receive data from other devices (Listeners) during an operational sequence. A controller may also be interrupted or may command interaction between devices.

The GRIIP consists of 16 lines which are grouped into three sets according to function: there are 6 data lines, 3 control lines, and 7 general management lines. The 8 data lines carry ASCII characters (bit parallel) asynchronously; the control lines provide data transfer handshake compatible with both slow and fast devices; the bus management lines allow initialization, interrupts, and special controls.

E. Cable

The Cabernet Model (C675-02) connector cable is supplied for connection to the GRIIP bus.

F. SUPPORTS: 2011-02

G. CABERNET AND DAISY CHAIN INTERFACE

- Features:
  - Synchronous: BCD data transmission bit parallel, chariacted.
  - Optional sequence determined by interconnect order.
  - Fast start.
  - System control via individual Start, Stop, and Reset signals.
  - Compatibility with Cabernet interfaces and scanners.
  - Read-Out Buffer

H. Description

The Cabernet Mix Daisy Chain Interface Option provides a basic 2011A module with a restorated output capability compatible with previous Cabernet data-acquisition-series modules.

Read-Out Buffering is available by moving jumper DD to position CC (This sets the Recycle time to 100 microseconds and does not need to be carried out on the 2011A as selected at factory. Operating the mixer, and hence the entire system, initially Recycle mode provides a minimal 100 microseconds; dead time buffers' counting system.

The problem of data transfer from the eight-digit 2011A to the standard six-digit system is handled by a simple switch on the Interface Board. It selects either the event most significant digit or the least significant digit. Two digits are lost in either case.

Control signals, Start, Stop, and Reset are received only if the unit is in the system place. A manual unit will generate Start, Stop, and Reset. This logic is under internal jumper control.

C. Signals

- CONTROL IN - Accepts Start, Stop, Reset, and Exponent pulses (V negative going from +5 V level; rise time 200 nanoseconds maximum, with 12 microseconds minimum. Also HOLD command (no level change from +5 V to +0.5 V maximum during hold) is activated. Front panel 16-pin "D" connector (Amphenol 17-10510).
- CONTROL OUT - Provides Start, Stop, and Reset commands (V negative going from +5 V level; rise time 200 nanoseconds maximum, with 12 microseconds minimum). Data output information is presented in the form of serial BCD logic (1 m = 1 or 0 V DC, logic 0 = 0 or +0.5 V, logic 1 = 1 or 5 V DC). This connector also provides the "next unit" Print command eighth and eventually is used for control purposes. Ground command is used directly between Control In and Control Out connectors. Front panel 16-pin "D" connector (Amphenol 17-10510).

D. Connective

SIGNIFICANT DIGIT SWITCH (10" - 10^10") - 100 - 10^10 position selects output of the six most significant digits of the eight-digit words. 10^-10 position selects output of the six least significant digits of the eight-digit word. Jumper allows the model 2011A to act as a system master for a slave.

E. Cable

One Cabernet Model C464-2 Data Control cable 0.5 m (2 feet) long is supplied for connection to other Cabernet data-acquisition-series modules.
Section 3. Controls and Connectors

This section outlines the use of the Model 3071A's controls and connectors. A complete listing of signal parameters will be found in Section 3, SPECIFICATIONS.

3.1 FRONT PANEL

**DISPLAY**
A four-digit LED display shows the channel in operation.

**DISPLAY SELECT**
Selects channel A or channel B for display.

**SEG/SEG/COUNT/SEG**
Selects segment function, or uses segment or count function.

**RESET**
Resets both countersto zero when pressed.

**GATE A ENABLE**
Activates gate A when pressed.

**GATE B**
Gates counting in channel B high. Press to disable and permit counting in channel A.

**DICTA**
Sets display against red. Between 50 V and 120 V for positive input.

**NAR**
Acceptance range of digit or negative current pulses for counting.
### 3.3 JUMPER OPTIONS

The Model 2011A jumpers are defined as follows:

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<td>A*</td>
<td>Allows the GATE B signal to enable counter B</td>
</tr>
<tr>
<td>B</td>
<td>Prevents the GATE B signal from disabling counter B</td>
</tr>
<tr>
<td>C</td>
<td>Allows the GATE A signal to enable counter A</td>
</tr>
<tr>
<td>D</td>
<td>Prevents the GATE A signal from disabling counter A</td>
</tr>
<tr>
<td>E</td>
<td>Enables counting in channel A</td>
</tr>
<tr>
<td>F</td>
<td>Enables counting in channel B</td>
</tr>
<tr>
<td>U</td>
<td>Enables Dual Counting</td>
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<tr>
<td>G*</td>
<td>Allows the logic to reset channel A</td>
</tr>
<tr>
<td>H</td>
<td>Prevents the logic from resetting channel A</td>
</tr>
<tr>
<td>J*</td>
<td>Channel A provides OVERFLOW signal</td>
</tr>
<tr>
<td>K</td>
<td>Channel B provides OVERFLOW signal</td>
</tr>
<tr>
<td>N*</td>
<td>Enables preset select, time or count</td>
</tr>
<tr>
<td>T</td>
<td>Enables only preset time for Dual Counting</td>
</tr>
<tr>
<td>R*</td>
<td>Selects front panel GATE A function</td>
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<tr>
<td>D*</td>
<td>Selects front panel ENABLE function</td>
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<td>Enables LCD annunciation CNT for Dual Counting</td>
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<td>Disables LCD annunciation CNT</td>
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<td>2</td>
<td>Disables LCD annunciation SEC for Dual Counting</td>
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<td>3</td>
<td>Enables LCD annunciation MIN</td>
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<tr>
<td>4</td>
<td>Disables LCD annunciation MIN for Dual Counting</td>
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<td>5</td>
<td>Enables channel A live time gating</td>
</tr>
<tr>
<td>6</td>
<td>Enables channel B live time gating</td>
</tr>
<tr>
<td>CC</td>
<td>Selects 10 µs in recycle time</td>
</tr>
<tr>
<td>DD*</td>
<td>Selects 10 sec in recycle time</td>
</tr>
</tbody>
</table>

*Indicates factory set position.
<table>
<thead>
<tr>
<th>Jumper</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE</td>
<td>Selects rear panel ENABLE function</td>
</tr>
<tr>
<td>EP</td>
<td>Selects rear panel OVERFLOW function</td>
</tr>
<tr>
<td>AP</td>
<td>Selects positive A input</td>
</tr>
<tr>
<td>AN</td>
<td>Selects negative A input</td>
</tr>
<tr>
<td>BP</td>
<td>Selects positive B input</td>
</tr>
<tr>
<td>BN</td>
<td>Selects negative B input</td>
</tr>
</tbody>
</table>

*Indicates factory set position.

1. To enable the Unit as a dual counter:
   - move jumper F to position U
   - move jumper G to position 2
   - move jumper H to position 4

2. To disable logic reset of channel A and use manual reset only:
   - move jumper G to position H

3. To change time gating:
   - move jumper S to position 6 to disable A to channel B
   - move jumper P to position F to change from channel A to channel B

4. To disable the gate signal to channel A:
   - move jumper C to position D

5. To disable the gate signal to channel B:
   - move jumper A to position B

6. To change the Overflow output from channel A to channel B:
   - move jumper J to position F

7. To change rear panel OVERFLOW to ENABLE:
   - move jumper FF to position EE

8. To change front panel ENABLE to GATE A:
   - move jumper S to position H

9. To change A input from positive to negative (NIM) input:
   - move jumper AP to position AN

10. To change B input from positive to negative (NIM) input:
    - move jumper BP to position BN

11. To change recycle time from 10 seconds to 100 microseconds:
    - move jumper CD to position CC

12. To allow the falling edge of the ENABLE input pulse to zero the Unit in count:
    - move diode H to position Z
    - be sure to orient the diode with the band toward the bottom of the board

**Figure 3.3 Internal Jumpers**
Section 4. Operation

The Model 2013 Dual Counter-Timer can be used as an event counter with a time preset, as a timer with a preset on a selected number of events, or with internal jumper changes, as a dual counter preset on time. In the latter mode, time is not displayed or read out.

The unit will accept positive voltage logic pulses or negative current pulses (jumper selected). Positive inputs are internally clamped to +5 V and will set a nominal input impedance of 1 kohms. Negative inputs are a nominal 50 ohm input impedance.

4.1 DISPLAY ANNUNCIATORS

The liquid crystal display panel will, in addition to numerals to display counter contents, eight annunciators which describe the display contents as the dynamic state of the unit.

X100 Shows the six most significant digits are being displayed.

X10 Shows the six least significant digits are being displayed.

OF Shows that the displayed channel has overflowed and is counting down from zero again.

CNT Shows that the selected channel is displaying counts. Blinks when the channel is active.

A/B Shows which channel's contents are being displayed.

MIN Shows that time, counted in minutes, is being displayed. Blinks when the channel is active.

SEC Shows that time, counted in seconds, is being displayed. Blinks when active.

The eight annunciators is a decimal point.

4.2 PRESET

The preset condition is set with the 0.01 SEC/COUNT B/D/01 MIN preset select switch and the three dith bevel switches. N, M, and 10" Selecting 0.01 SEC or 0.01 MIN will enable the unit to be used as an event counter with the time preset in increments of 0.01 seconds or 0.01 minutes (3.6 seconds). Setting N = M = 0 disables the preset function.

Selecting COUNT B will enable the unit to be used as a timer with a preset on number of counts.

If the unit is to be changed to a dual counter, the time preset, 0.01 seconds or 0.01 minutes, will be used but not displayed.

The thumbwheel switches are used to select the number of preset units as chosen by the preset select switch. The M switch sets the units of the preset, the N switch sets the tens, and the 10" switch sets the power-of-ten multiplier.

For instance, if the switches are set to N = 1, M = 0, P = 3 and the preset select switch is in the 0.01 SEC position, the time preset will equal 10 x 10^3 hundredths of a second, or 100 seconds. If the select switch is in the 0.01 MIN position, the preset will equal 10 x 10^3 hundredths of a minute, or 100 minutes. If the select switch is in the COUNT B position, the preset will equal 10 x 10^3 counts, or 10,000 counts.

4.3 EVENT COUNTER

To use the Model 2011A as an event counter, Input A receives the external events to be counted. The 0.01 SEC/COUNT B/D/01 MIN switch must be placed in one of the time positions and the PRESET thumbwheel switches must be set for the desired time preset, as explained above.

Pressing the START/STOP switch to START will start data accumulation. When the preset is reached, channel A will contain the total counts accumulated and channel B will contain the time during which the count in channel A were accumulated. The time shown will be equal to the preset time.

To display the contents of either channel, move the DISPLAY SELECT switch to either A or B. Only one channel will be displayed at a time. The annunciators on the liquid crystal display will show either CNT (counts) or SEC or MIN (the selection time preset).

4.4 TIME COUNTER

To use the Model 2011A as a time counter, the channel B input receives the external events to be counted and channel A records elapsed time in increments of 0.01 seconds.

In this mode, the preset select switch is placed in COUNT B and the PRESET switches can be set to stop the counting cycle at the selected number of counts. Channel A will show the time that it took to record the preset number of events.

4.5 DUAL COUNTER

By changing internal jumpers as outlined in Section 3.5.1, both channel A and channel B can count external events up to a preset time set in 0.01 second or 0.01 minute increments as defined by the setting of the preset select switch and the PRESET switches. In this mode, the time is not displayed or read out.

4.6 SINGLE/RECYCLE

With the SINGLE/RECYCLE switch in the SINGLE position, the counter, once started, will count to preset and stop. If the switch is moved to the RECYCLE position, the counter will count to preset, pause 10 seconds or 100 seconds, as selected by the setting of the DUAL/COUNT switch, and start counting again. The recycle mode will continue until manually stopped, by setting the SINGLE/RECYCLE switch to the SINGLE and pressing STOP.
4.7 RESET
At any time, even during a count cycle, pressing the RESET button will cause both counters to zero. If a counting cycle is in progress, it will resume as soon as the RESET button is released.

In the RECYCLE mode, the counters are automatically reset at sample-count. By changing an internal jumper, channel A automatic reset can be inhibited. In this mode, channel A can be reset only by pressing the RESET button. See Section 3.3.2.

The RESET button also functions as a display check. When the button is pressed, the display will show all "00"s. Therefore, holding the button down will allow the operator to verify that the display is functioning correctly.

4.8 SYSTEM OPERATION
Several of the Series 3000 counting modules can be configured in a Master/Slave relationship by connecting their ENABLE connectors in parallel with 90 ohm coaxial cable (type RG-62) using female-female-female "tee" connectors between the cable segments.

When the system is connected in this way, pressing START on one unit will start all units together.

The Master unit in the system is the one whose START button has been pressed, all other units are Slaves. Note that in this mode, the Slave presets are disabled. The Master unit's preset will control the entire system. Pressing STOP on the Master will stop all units together.

Either of the input/output options may also be used to set the system up in the Master/Slave mode. See Sections 5 and 6 for details.

4.9 GATE A AND B

The GATE A function is available on the front panel GATE A ENABLE connector. The factory set internal jumper must be moved from the ENABLE position to the GATE A position to allow GATE A inputs. See Section 3.3.3.

The GATE connectors accept positive logic pulses or a dc level for counting in either channel. Internal jumpers may be moved to disable the function for either channel or both channels. See Sections 3.3.4 and 3.3.5.

A logic high signal (1 to +5V) or a normal input will enable counting, a logic low signal (0 to +0.8 V) will disable counting.

The gating signal gates the crystal-controlled time base, giving a gating time resolution of 1 usec. Using channel A as the event counter and channel B as the timer counter, a system-busy signal may be connected to the GATE A input to disable counting and the timer for accurate dead time compensation. By moving an internal jumper, "Time gating can be done with GATE B" can be disabled. See Section 3.3.3.

4.10 ENABLE

The ENABLE function is available on both the front and rear panel. The front panel GATE A ENABLE connector is factory set to the ENABLE position. To select the front panel GATE A function, see Section 3.3.7. The rear panel ENBLOW (ENABLE or OVERFLOW) connector is factory set to the OVERFLOW position. To select rear panel ENABLE function, see Section 3.3.7.

The ENABLE connector provides a logic low output (0 to +0.8 V) when the unit is enabled for counting. This output can be used to signal another unit that the Model 2071A is active. For instance, when using the Model 2071A as the Master unit in the Master/Slave System outlined in Section 4.8.

The ENABLE connector can also receive a logic low pulse to enable the Model 2071A for counting. For instance, as a Slave unit in the Master/Slave System.

To increase the Enable line's flexibility, an internal jumper (W) has been provided. If the jumper is moved to the Z position (see Section 3.3.12), the falling edge of an input pulse on the ENABLE connector will start the unit's counting cycle.

When the unit is started in this way, it is the Master unit in the system. The Enable line will be held low by the unit until its preset is reached, thus enabling all other units in the system.

If the Model 2071-02 Daisy Chain Interface is installed, it will not be necessary to use the Enable line. The Interface has all necessary signals to start and stop the unit.

If the Model 2071-02 GRIP Interface is installed, the Enable line will be used if the entire system is started and停止 at the same time. If the GRIP Controller is to address each unit separately, the Enable line will be used only if each individually addressed unit is the Master unit in separate sub-systems.

An internal jumper can be moved to change the front panel ENABLE function to GATE A. See Section 3.3.3.

4.11 OVERFLOW

The OVERFLOW function is available at the rear panel ENBLOW (ENABLE or OVERFLOW) connector which is factory set to the OVERFLOW position.

The rear panel OVERFLOW connector provides a positive logic pulse every time that channel A exceeds its count capacity (10P counts). This signal can be connected to the input of another counter to extend the counting capacity of the system.

If the Model 2071A is used in the dual counter mode, the OVERFLOW signal can be connected to the B input, instead of another counter, to extend the counting capacity of the system.

An internal jumper can be changed to allow the overlow of channel B to generate the OVERFLOW signal. See Section 3.3.6.
Section 5.
Daisy Chain Interface

The Model 207/02 Daisy Chain Interface option provides both data input/output and system control. It is compatible with all existing Canberra Daisy Chain Systems.

The CONTROLS and CONTROL OUT connectors present all Bus commands, with the exception of the Print clock, in parallel to all units in the system. The Print clock is presented serially to one unit at a time.

Since the Model 201A is an eight-digit counter and the Daisy Chain System is capable of recording only six digits, a switch has been included on the interface board to select output of the six most significant digits (10⁻⁹ - 10⁻¹) of the six least significant digits (10⁻¹ - 10⁻⁶). Refer to Figure 5.1 for switch locations.

The nature of the data collection being performed will define which six digits to include in the data output. The unit is shipped with the switch in the six least significant digit (10⁻¹ - 10⁻⁶) position.

5.1 SYSTEM SETUP
A system of up to 50 data input modules and one scanner are connected with Model C-1044 cables. One 60 cm (2 foot) cable is included with each Model 207/02.

The CONTROL OUT connector of each unit is connected to the CONTROLS IN connector of the next unit in the system. The last unit in the system is connected back to the scanner.

The master unit is defined as the one on which the START control is pressed. All other units are then Slave units.

When the master unit is actuated, it generates a System Start command on the Daisy Chain Bus, which starts all Slave units at the same time.

When any unit reaches its preset, it stops and generates a System Stop command on the Bus. All units will stop at the same time.

In the SINGLE mode, the system will run through one data collection cycle and stop when preset is reached.

In the RECYCLE count mode, the system will start, stop when any unit reaches its preset, pause ten seconds or the microsecond (jammer selectable, see Section 3.3.11), then start and count again.

5.2 PRINTING SYSTEM
If a Model 2068 Printer Scanner (RS232), or a Model 2069 Serial Printer Scanner is connected in the system, the data collected by each unit can be printed out. A Model 9118 is a 25 mA Current Loop Adapter which can be connected to the 2068 for 25 mA current stop operation.

Standard with the low Daisy Chain option is a read out buffer. By taking advantage of the buffer capacity, system dead time can be reduced. In a Recycle Mode, the buffer allows the unit to be placed back into the counting mode after the data has been transferred to the readout buffer. After 16 seconds or 100 microseconds, jammer selectable, counting resumes and readout begins. During the readout time, the display will not be updated, but output counting will go on. After both buffers, counting time must be longer than readout time.

The first unit in the system to print out will be the one connected to the Scanner's CONTROL OUT connector. The second unit to print out will be the one connected to the first unit. The last unit to print out will be the one connected to the Scanner's CONTROLS IN connector.

5.3 COMPUTER CONTROL
The Model 2068 Printer Scanner can be used to allow a computer to control the system. Refer to the Model 2068's manual for details on computer system operation.

5.4 DAISY CHAIN JUMPER OPTIONS
The Daisy Chain option board has four jumpers which will allow the user to tailor the option for specific applications. Three of these jumpers are 0.3 mm diameter; the fourth is a 2.7 ohm resistor. Refer to Figure 5.1 for jumper locations.

1. Jumper A allows the Enable pulse's rising edge on the Model 207/1A's control logic to generate the Daisy Chain Bus STOP command.

In the Os position, this will not perform the STOP command.

2. Jumper B allows the Enable pulse's falling edge on the Model 207/1A's control logic to generate the Daisy Chain Bus START command.

In the Os position, this will not perform the START command.

3. Jumper C allows the Enable pulse's rising edge on the Model 207/1A's control logic to generate the Daisy Chain Bus RESET command.

In the Os position, this will not perform the RESET command.

4. Jumper D allows the Model 201A's front panel RESET control to generate the Daisy Chain Bus RESET command.

In the Os position, manual Reset will not perform the RESET command.
Please be aware that these jumpers do not need to be changed to make this unit a Slave unit. Slave status is normally defined by system operation.

If any or all of these jumpers were to be changed to their optional positions, this unit would be permanently defined as a Slave unit. It would never become a system Master unit until the jumpers were changed back to their usual setting.

Figure 5.1
Daisy Chain Option Controls

5.5 TYPICAL SYSTEMS
The following figures show some possible system setups.

1. Multi-input system with preset time and ability to count overflow from channel A of the 2071A.

2. Multi-input 100 Mbps Daisy Chain Penning System - preset controlled by master 2071A, recycle time controlled by 2071A. Printout from 2088 printer lists preset time and contents of 5 counters.

Note: The Model 2071A will require a factory modification (SER1) in order to operate with the Model 2089 External Recycle.

3. Multi-input 100 Mbps Daisy Chain system with individual preset time for each counter. Slaves must reset preset before master. For this system, slaves are defined by changing the 2071A's internal jumpers (See Section 5.4).

5.6 USING THE MODEL 1488 SCANNER
If a Model 1488 Scanner is to be used instead of the Model 2088, the 1488 PRINT MODE switch must be set to PROMPT.

In the DELAYED mode, the HOLD command is not normally asserted until after the TTY motor-start time out, which will not allow proper data buffering.

For proper operation in the DELAYED mode, open the 1488 and look for a 10-kiloohm resistor soldered to points A-B (refer to schematic B-01777). Un solder the resistor from points A-B and solder it to points A-C. This will cause prompt generation of the HOLD command on receipt of the Daisy Chain's STOP pulse.

The 1488's FORMAT switch must be set to LINE. Setting the switch to CONTINUOUS will cause incorrect data to be read out.

5.7 FIELD INSTALLATION OF THE DAISY CHAIN OPTION
The Daisy Chain interface option consists of four standoff, four lockwashers, 10 Phillips-head screws, the rear panel control connector plate, and the interface board.
To install the option, first remove both side covers, each of which is held in place by the Philips-head screws. Then:

1. If they are not already installed, install the four standoffs in the four holes in the unit's printed circuit board.
2. The standoffs are to be placed on the component side of the board and fastened to the board with one lockwasher and one screw each.
3. Carefully place the interface board in the unit so that the line of small circular connectors is at the rear of the board.
4. With the interface board's four mounting holes lined up with the four standoffs, press the board gently down to make the standoff connectors.

The interface board should make smoothly with the unit's connector. If there is a gap in the connector, or if it is not properly aligned, lift the interface board up a little and realign the four mounting holes with the standoffs before pressing down again.

5. Fasten the interface board to the standoffs with four screws, one in each corner of the interface board.
6. Mount the control component plate on the rear panel with the four remaining screws.
7. Carefully align the reion cable's pins with the sockets of J4 at the rear of the interface board.
8. Press the cable's pins firmly down into the connectors until the cable is flush with the tops of the connectors.
9. Place J1, the six-digit select switch, in the desired position.
10. Before replacing the side covers, check the installation for proper operation.

<table>
<thead>
<tr>
<th>PIN No.</th>
<th>FUNCTION</th>
<th>SIGNAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RDY Lamp</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>2</td>
<td>B/D1</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>3</td>
<td>B/D2</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>4</td>
<td>B/D3</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>5</td>
<td>Line 1</td>
<td>BC Level/Alarm</td>
</tr>
<tr>
<td>6</td>
<td>System 1</td>
<td>System</td>
</tr>
<tr>
<td>7</td>
<td>System 2</td>
<td>System</td>
</tr>
<tr>
<td>8</td>
<td>System 3</td>
<td>System</td>
</tr>
<tr>
<td>9</td>
<td>System 4</td>
<td>System</td>
</tr>
<tr>
<td>10</td>
<td>Display 1</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>11</td>
<td>Display 2</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>12</td>
<td>Display 3</td>
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<td>13</td>
<td>Display 4</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
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<td>14</td>
<td>Display 5</td>
<td>Logic 1 = +6V, Logic 0 = 0V</td>
</tr>
<tr>
<td>15</td>
<td>Ground</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Figure 5.3 Control In/Out Connector Wiring

NOTES:
- All pins and control lines except Event Clock (line 6-8) are opto-isolated directly between connecting pins of the CONTROL, IN and CONTROL OUT connectors.

The Power Cord's pulse train from the Data Sampler will appear on pins 8 of the CONTROL OUT connector after module has been turned on. The data consists:

The signals on pins 10 through 14 are not used by this unit.
Section 6.
Interaction of Model 2071A With the GPIB

6.1 GENERAL DESCRIPTION OF GPIB

The General Purpose Interface Bus is a link of network by
which system components communicate with each other.
Each system participant performs at least one of three
tasks: Controller, Talker, or Listener.

A Controller manages bus communications primarily by
directing or commanding which devices are to send data to
other devices (Talkers), or receive data from other devices
(Listeners) during an operational sequence. A Controller
may also be interrogated or it may command specific action
between devices.

The GPIB consists of 16 lines which are grouped into three
sets according to function; there are 8 data lines, 3 control
lines, and 5 general management lines. The B data lines
carry ASCII characters (bit parity) asynchronously; the
control lines provide data transfer handshake compatible
with both IBM and fast devices. The bus management lines
allow initialization, interrupts, and special controls.

6.2 GPIB SWITCHES

The eight-position GPIB switch on the option board is acces-
sible through the hole in the unit's side cover. The switches
should be set to the desired positions before putting the
unit in a hold-on. Refer to Figure 6.1.

The first five switches, counting from the top, are used to
sel the unit's GPIB address. Each switch is labeled with its
corresponding address. Address 0 is the sum of

all switches that are in the one position. An address of 31
(all switches in the ON position) is illegal, it is treated by
the GPIB command LINT/EXT.

The sixth switch is labeled TALK ONLY. Refer to Section
6.3 for its use.

The seventh switch is labeled RECYCLE. In the ON posi-
tion, the unit will clear after readout and start counting
again. In the OFF position, the unit is in the single cycle
mode.

The eighth switch is labeled FILL/READ. In the FILL posi-
tion, the message unit delimiter is sent out as an ASCII FILL
Code in the ON position. The delimiter is sent out as a carriage
return. The choice of delimiter depends on the peripheral
device being used.

6.3 SYSTEMS WITHOUT A CONTROLLER

The Model 2014 can operate in the Talk Only ON mode,
which is used when data from a single module is to be
passed directly to a single peripheral device such as
a GPIB Printer. In this case the controller is not required,
but the printer must be in the Listen mode. Not all GPIB
printers will operate in this mode.

In Talk Only ON mode, the 2071A will transmit its data to
the listener as soon as 2071A data acquisition is stopped
by STOP or reaching Printer.

Figure 6.1
GPIB Option Controls
6.4 INTERACTION WITH A CONTROLLER

Communication with a Controller requires 2017-019 TALK only, if switch to be used. The Controller must assert REN (Remote Enable) during the entire communication. If REN is disabled, the 2017-019 will reset. The first request is for the Controller to cause the 2017A to be placed in its Remote mode. It does this by transmitting on the GRIB MTA (My Talk Address) or MLA (My Listen Address), with ATN (Attention) asserted. MLA or MTA must agree with the five-bit address setting on the 2017A. The following MTA or MLA would be sent if the address setting was 5.

```
D107 D106 D105 D104 D103 D102 D101
MTA 1 0 0 0 0 1 0 1
MLA 0 1 0 0 0 1 0 0
```

If MTA is sent, the unit goes into its Remote mode and transmits all of its data (16 bytes). MLA is sent, the 2017A does not respond further than placing itself into the Remote mode. Once in the Remote mode, the unit is able to generate an SR0 (Service Request) or respond to a DC (Device Clear). Disabling REN causes the 2017A to leave the Remote mode.

A typical counting sequence would begin with the operator pressing START on a 2017A that is connected to the GRIB. After reaching a preset, the 2017A will generate SR2. The Controller would then, via a Serial Poll, determine the device requiring restart. Then send the proper MTA to reset the data by way of a Read Data Interchange (Section 7.10). If the module is in the Recycle mode (switch on GRIB Interface set to Recycle), the counters will be reset after restart and the counting cycle will begin again.

Note that there are two Recycle switches, one on the unit's front panel, and one on the GRIB interface card. The front panel which allows the user 10 seconds to manually copy the display (or just view) between cycles when the 2017A is connected to the GRIB, the front panel switch is nominated to Single, the GRIB interface switch to Recycle. The recycle time will now depend on the devices on the bus with the appropriate module must interact.

The time required to read data from a Model 2017A is determined by the sum of the response times of the Computer-Controller and 2017A. The 2017A responds to each query or handshake request within seven microseconds. This means the 2017A requires a maximum of 14 microseconds for each byte output. The 19-byte readout consumes 266 microseconds of 2017A synchronizing time. A restart to one controller was measured at 12.5 milliseconds. This requires 64 microseconds to accept data and return a handshake response per byte, or a total of 1024 bytes of data in the cycle to restart to the desired controller to 2017A of 46 1/2. It is apparent that the Controller must perform this sequence within 46 1/2 restart time.

Some additional capabilities are:

a. Controller Start

Since modules are independent, the Controller can start each module by generating a READ DATA Interchange (see Section 7.10). With a counter stopped and in the GRIB recycle mode, the completion of a READ DATA Interchange will cause it to clear and start counting. The controller can individually address each module for this sequence.

b. Controller Stop

The Controller can send a Universal DEVICE CLEAR out on the bus, and all modules will stop counting. Individual modules cannot be addressed with this command, and it will not clear the modules, only stop them. If normal (jumper B is moved to A, the module will ignore the DEVICE CLEAR command (see Figure 6]).

c. Read Out While Counting

The controller can read out each individual 2017A or 2017A while it is counting by performing a READ DATA Interchange (see Section 7.10). In this case the module will be read out and will not clear, but continue counting. A point to remember here is that a module will clear itself only if it is asserted by:

1. A manual front panel START.
2. A manual front panel RESET.
3. An ENABLE signal input.
4. Being in a front panel RECYLE mode and stopped either by reaching preset or by receiving a Device Clear from the Controller.
5. Being in a GRIB RECYLE mode, stopped by reaching preset or receiving a Device Clear from the Controller, then read out by a READ DATA Interchange.

6.5 THREE COMMON METHODS OF OPERATION:

A. Controller completely controls modules.

```
Controller
```

```
2017A 2017A 2017A
```

Sequence:

1. Controller performs READ DATA Interchange to start the modules. Each module must be addressed individually by the Controller. Thus, in this case, a simultaneous start is not possible. Data from the first time is information left by previous operations.

2. Controller sends a DEVICE CLEAR, when desired, to stop all counters. Individual addressing is not possible with this command. All counters will simultaneously stop.

3. Controller again addresses each module with a READ DATA Interchange. Since they are in the Recycle mode, they would not have started in the first step if they weren't each one cleared, and restarts after read out.
B. Controller acts only as a readout device.

Controller

2071A
2072A
2071A

Sequence:
1. ENABLE input/output on all modules are connected.
2. The START switch on one 2071A is pushed (this defines it as the Master).
3. All modules are stopped when the master reaches the preset.
4. Each module sends a SERVICE REQUEST when it stops if it was first commanded to REMOTE by the Controller.
5. The Controller addresses each module and reads it out.
6. If the Master is in the front panel RECYCLE mode upon being read out it will enable the system to start counting again. All modules will have been cleared by the leading edge of the ENABLE signal. Normally the Master would be interrogated last so that it does not start the system until all other units have been read out.

C. Controller initiates simultaneous start by addressing the master module.

Controller

2071A
2072A
2071A

Sequence:
1. ENABLE input/output on all modules are connected.
2. Controller addresses first 2071A and reads it out. This defines it as the Master. Because it is in the GPIB REC mode it reads out, clears, and starts collecting. Since the ENABLE Inputs are connected, the other 2071A and 2072A modules clear and simultaneously start collecting. The single-cycle switch on each of their GPIB interface cards and front panel must be in the GPIB mode.
3. When the preset on the master 2071A is reached (it accepts all modules, and each one generates a service request on the GPIB bus), the controller now interrogates each module. It should address the Master 2071A last, since this module is in the ready mode and would start the system again once it is held out.

*The Enable Signal

5 V

Clamps counter and starts collect

Stop collect and accept SERVICE REQUEST

The modules on which the START switch is not pressed will ignore their presses and be controlled by the ENABLE signal. The Master module is defined as the module that has been started first, either manually or by being addressed from the Controller. Its order will determine the preset for all other 2071As and 2072As.

6.5 FIELD INSTALLATION OF THE GPIB OPTION

The GPIB interface option consists of four standoffs, four lockwashers, 12 Phillips-head screws, a rear panel cover plate marked J102, and the interlock board.

To install the option, work from both sides of each of which is held in place by the Phillips-head screws. Then:
1. If they are not already installed, install the four standoff in the four holes in the unit's printed circuit board.
2. The standoffs are to be placed on the component side of the board and fastened to the board with one lock washer and one screw each.
3. Carefully place the interface board in the unit so that the large connector at the rear of the board is flush with the rear panel.
4. With the interface board's four mounting holes lined up with the four standoffs, press the board gently down to make the interlock connectors fit.

The interface board should mate smoothly with the unit's connector. If any resistance is felt, the connector is not properly aligned. Lift the interlock a little and realign the four mounting holes with the standoffs before pressing down again.

5. Fasten the interface board to the standoffs with four screws, one in each corner of the interface board.
6. Place the J102 cover plate on the unit's rear panel and fasten it in place with the remaining four screws.
7. Before replacing the side covers, check the installation for proper operation.
### Pin 10 5VDC Remote Enable

16 Twisted pair with pin 9
17 Twisted pair with pin 10
18 Twisted pair with pin 11

**Figure 1.2**

**GPIB Connector Wiring**

Both GPIB signals are negative-type TTL compatible:

- **True = 0 to 5.4 V**
- **False = 2.8 to 5 V**

### Section 7. Theory of Operation

The Model 201A includes two identical eight-decade decade channels, a clock-based time generator, an eight-decade pulse counter, an eight-decade pulse display, and an eight-decade Pulse-Counter Scan. A 1024B system, suitable for logic applications, and the power supply.

#### 8 DECade COUNTING CHANNEL

Each of the two counting channels has a circuit which detects positive voltage or negative voltage logic states on the same input channel (sensor interface). Positive-voltage pulses are 50-ohm impedance while the positive voltage-pulse rises are 50-ohm impedance.

With the A input jumper in the ON position, the power supply of the positive voltage-pulse rises are 50-ohm impedance. When the input signal is present, the positive voltage-pulse rises are 50-ohm impedance. When the input signal is present, the positive voltage-pulse rises are 50-ohm impedance. When the input signal is present, the positive voltage-pulse rises are 50-ohm impedance.

With the A input jumper in the OFF position, the positive voltage-pulse rises are 50-ohm impedance. When the input signal is present, the positive voltage-pulse rises are 50-ohm impedance. When the input signal is present, the positive voltage-pulse rises are 50-ohm impedance. When the input signal is present, the positive voltage-pulse rises are 50-ohm impedance.

### Operation of Channel B

Channel B is identical to that of channel A. Multiplying counts or time ticks to the counter is carried out by the A5305D. Two gates are used by each counting channel. The first gate, which is required to count (100,000) 50 Hz. The second, counting at 10 microwatts, is a 14-bit timer. The remaining gate, which is required to count the input signal, is a 14-bit timer. The balance is determined by the feedback network admittance of the inputs, and the clock.
A counting sequence is initiated with a reset pulse setting all eight decades to zero. Either external events or time clocks are gated to the clock input of the 745196. The eight bit of the 745196 clocks the 745390, and in turn, the eight bit of the 745390 clocks the 7031 input decade.

To read the contents for display or read out the counters is transferred to latches within the 7031 by means of the Load Latch pulse. The next part of the sequence is to generate a Scan Reset which places the most significant digit in BCD format on the four data output lines. As each succeeding digit is required, a Scan Clock pulse is applied to the 7031 which places the next less significant digit on the data output lines. Because the display consists of six digits and the counter capacity is eight, at the time the 10th counter decade 8 bit resets, A29 is toggled to the one state.

The signal out of the 7031 "DE" is this is (8 x 10^7) and the output of A29 is called "X100", X100 line causes the 7032 display incrementor to turn on and causes a two digit shift in the data displayed.

The BCD data out of the 7031 is immediately passed through A28 a 4-to-16 Exclusive-OR gate. Its function is to either invert or not invert the data. The internal leading zero logic determines this and Blank Out is the result. The utilization of this function is by the LCD display driver. When they see a binary 15 they respond by displaying a blank. A BCD zero out of the 7031. If it is an insignificant (leading) zero, it is then converted to binary 15 by inverter and is blanked on the display.

**Figure 7.3**
Model 2071A Block Diagram

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7.2 CRYSTAL BASED TIME GENERATOR

The required 0.01 second and 0.001 minute time shift originates from a 12 MHz crystal oscillator circuit (OSCD). This frequency is divided by 12 in A32. The frequency may be varied (jumper selection) by the BATE signal as it passes through A15. This provides the unit with capability for measuring 1/12 Cycle with one microsecond resolution. The one MHz is then applied to a prescaler (A31) which provides a divide 1024 and a 0.001 sec output. Dividing the 0.01 sec by 60 (A40) provides the 0.01 min output. The selected time signal may be seen at TFE.

7.3 PRESET COUNTER

The eight-decade preset counter with three-digit control consists of a six-decade programmable prescaler plus a two-decade down-counter. The three digit thumbwheel switch, wafer switch N102 provides the eight decades of control. The P switch, with range zero through six, gives direct control over the prescaler (A21). A setting of zero means the input pulses are passed directly though. A setting of six results in the input prescaled (divided) by 10. The N and M switches provide the start number for the two decades down-counter (A42, A43). In normal use, the N and M decades are charged with their preset numbers, while the unit is not enabled to count. Once enabled, the N and M switches have no control. preset N and M will not be changed at any time, doing so during Bate True is not recommended. Setting both N and M to zero satisfies an eight-input NOR gate (A91) which disables the borrow from the two down-counters, which normally occurs when preset is reached. Therefore, N = M = 0 turns the preset function on. It should be noted also that the contents of A12, A16 and A43 are not available for preset.

7.4 SIX DECADE LIQUID CRYSTAL DISPLAY

The six-decade liquid crystal display (LCD) has each digit driven by a seven-segment LCD driver (C). With 5V logic scheme all digits are driven in parallel. If all six displays are driven simultaneously, the requirement on the pins of the display drivers is that an 80a voltage be applied between the backlight and particular segment and it is a greater for the segment. This is accomplished by applying 8 volts square wave to the backplane and another to each segment. Square wave square wave result in zero rms (OFF) and 180° out-of-phase result in rms of 5 V (ON). The 6.0V dc levels of the four outputs of a four-channel, a seven-segment decoder and an exclusive-OR array to select the proper phase of the signal applied to each segment.

The same circuit (A32) used to strobe the data from the 7401s also drives the approximately 36 Hz square wave display clock. In addition, to the 0.0x1 and 0.00x1 sec display, any of the four displays-A, B, C or D-can be shown to describe the display time in seconds. "C" is displayed when counts from an external source are selected for display. When time is selected, the annunciator "SEC" (seconds) or "MIN" (minutes) will be on. Seconds or Minutes are displayed with a maximum resolution of 0.01 units, therefore additional point announcement is displayed, further describing the time. "m" on the data source mark from the A channel or C channel. A and B annunciators are provided with 0.01 Second only of the number and six digits (01-10) x 1000

annunciator is enabled and the unprinted data is shifted so that the display is 10x10-10x0.0001 times the magnitude of the number. The magnitude of the number is expressed in six digits (101-10) x 1000.

annunciator is enabled and the unprinted data is shifted so that the display is 10x10-10x0.0001 times the magnitude of the number. The magnitude of the number is expressed in six digits (101-10) x 1000.

The annunciator is driven by three 4054 four-terminal devices. These include latches and exclusive-OR arrays to display the display-time signal required. The logic sequence is controlled by the front panel digital display controller (A32). A23 is used so that the data can be changed remotely in the display, allowing real-time monitoring of both channels.

An oscillator (A22) running at about 50 Hz (divided by the eight of A22) to 25 Hz for the display clock supplies the 7501 scan clock and a 10-cycle Johnson counter (A38). The eight outputs of the Johnson counter are synchronized with the 7501 Digit Sources and hence, the 7501 output code. The Johnson counter outputs strobe the data in the display LCD drivers. Also, the first (TP1) or the third (TP2) strobe generates an scan reset. This maintains synchronization and generates the X100 display data shift. Scan reset with the first strobe allows display of 10x10-10x1.5. On reset with the third strobe allows display of 10x10-10x15. This is accomplished by sending the first and third strobe pulses through A33, which is controlled by X100. The strobes are generated from the A4 counter and B counter. In reset, the A32 oscillator is replaced by fixed clock, the scan reset option. This is accomplished by half of A22.

7.5 CONTROL

This block diagram area labeled Control provides interactive control with all the blocks shown in the diagram. The primary control, capabilities are to place the unit into the count or display modes, determine which annunciators cause various events, and various jumper controlled options.

The signal BIABLE, brought to a front panel or rear panel BNC connector, indicates that the true state is indicated is counting is enabled. This is a bi-directional signal path which allows an external master unit to enable both channels for an externally determined time. The preset logic has no function in this slave mode of operation. The logic sequence in this mode is that once the ENABLE line has been pulled low by the master, a 10 microsecond reset is generated (TFF) and sent to both A and B channels. This means a 10 microsecond dead time is incurred at the beginning of a measurement period.

The error logic, however, is affected by this, that is, the time a measured (7410) microsecond delay is added on all the BABLE with only a two to three microsecond propagation delay error.
A Model 207A4 may be either a master or slave with no jumper or control changes. Determination of master or slave status is dependent on whether or not the START switch has been pressed. The START switch causes one-half of A3 to be set. If, in turn, drives the ENABLE line through A2-1 to A1. At this point any other units receiving the ENABLE signal are enabled to assist as slaves. After the 10 microsecond reset period has elapsed, both counting channels and the preset channel are allowed to accumulate data.

The presence of a Daisy Chain option results in a slightly different concept of master and slave. This option provides interconnected START, STOP, and RESET signals to all units in the system. The preset condition, M, 10, must be set N = M = 0 for a unit to operate as a slave. The ENABLE signal is not used (not connected between units). In this case the unit whose START switch was pressed (not necessarily the master unit) causes the Daisy Chain START pulse to toggle A3 to the one state via signal STS in each module.

Termination of counting occurs when the master reaches preset. This occurs in the simultaneous accumulation of borrow from both preset down-counters (A42 and A62), seen as a negative pulse at 772. Pressing the STOP switch also terminates counting. The master unit then generates the STOP signal to the remainder of the system, terminating the experiment.

Determination of whether a channel counts time or external events is normally based on the preset selector. 0.01 SEC/COULT/0.1 MIN, position. A preset of neither time nor position results in no time interval being accumulated in channel B. Channel A will then accumulate external events through the B INP connective. Selecting a preset of counts causes external events through the B INP connective to be accumulated in channel A. Channel B will accumulate 0.01 second time intervals.

The GATE input signals normally control counting in channel A or C. To control the external source, will prevent any accumulation while a trigger is present, if the experiment requires one of the two control inputs, it may be time gated. Internal jumps (S, P, and B) provide control with the GATE signal. Normally in position B, which results in the GATE A signal controlling the 1 MHz clock used to generate the time signals. This means that the time can be accumulated with a resolution approaching one microsecond. To enable GATE B instead of GATE A, change the preset from position P. To disable the Live Time gating, change this jumper to position 6.

An additional jumper controlled operating mode is available. The mode allows an experiment to be carried out counting external events in both channel A and B and presenting the experiment without. To accomplish this, move jumper F to U, move jumper N to T. For proper operation a preset of 0.01 SEC/0.01 MIN is required. Note that the time information is not available for display or results. In this special mode the display accumulators will not display averages. Jumper F to U, move jumper N to T to make the display correct.

The Recycle operating circuit consists of the dual monostable A42. Its function is to restart the module approximately 10 seconds after termination of counting. When Recycle is enabled, A42 fires at the end of the count period (Enable goes low). After 10 seconds, the counters A, B, and Preset are reset and the cycle experiment is carried out again. When Recycle is off (Enable), A42 is held reset and the cycle does not start again. A recycle time of 100 microseconds is selectable by moving jumper DD to position GC.

Manual data reset is accomplished by pressing the front panel RESET button. Data will be held reset while the button is pressed. To account for switch bounce, a final 10 microsecond reset is applied on release by A42 (Reset). The application where manual reset is necessary is when jumper G is removed and jumper I is inserted. Now channel A is not reset with channel B, but only by the manual RESET button, allowing the A data word to accumulate continuously during succeeding count periods.

7.6 POWER SUPPLY
An inverse concept applied to supply the five volt units used by the module logic. Power supplied by the bin +12 V and -12 V buses is converted to ac by the oscillator made up of T1, Q3, Q4, and C17. Oscillation is in the 60 to 70 kHz range. The output of the secondary (T1 terminals 1, 2, and 3) is full wave rectified by D17 and D18 providing the ±5 V for the logic. T2 supplies feedback to the input of T1 (terminal 5) proportional to the output loading and ripple. As the load increases (and the ripple), current is added to the normal T1 input so that the ripple is reduced, compensating for changes in loading.

Short circuit protection is provided by the circuit consisting of Q1, Q2, and associated bas resistors and capacitors. Q1 is normally on. Q1 collector current passes through R5 to the bases of Q3 and Q4 where, in conjunction with the output of Q3 and Q4, forms the oscillator. When current through Q1 is on the order of 100 mA, the transistor current voltage drop is dropped on Q1, causing Q2 to turn off, effectively stopping the oscillation. Also Q1 and Q2 can be by shorting the 3 secondary to go zero. At the same time the R1 drop through R5 goes towards allowing Q1 to turn on, Q2 to turn off and the supply to start up. As long as current loading in excessive, the circuit will be protected by essentially turning off and on.

7.7 DAISY CHAIN OPTION
The Daisy Chain Option allows a user to choose a type of output or no output and a master or slave mode. This option is used to add the Daisy Chain option to the A42B. The option provides the ability to interface with existing Canberra counters modules and scanners with one limitation. Old Canberra counters were 8-digit devices so that the output capacity is also 8 digits. The new Daisy chain counter option includes a switch to select which six digits are to read out. The six least significant digits will be selected if the user knows his experiment will not result in more than 10-1 events counted. The six least significant digits can be selected when the experiment's results include numbers greater than 10-7. The result may show results in bits of the 10-4 and 10-2 data digits and the attendant error in the data.
The clock provides interconnection for the control sig- nals, four data-bits, and ground on two 16-pin connectors.

The control signals and their functions are:

1. **START**: a bidirectional negative-going pulse swing-
ing from +5 V to ground with a minimum width of 1.5 µs. This signal causes the counter it is applied to init-
iate a counting cycle.

2. **STOP**: a bidirectional negative-going pulse going
from +5 V to ground with a minimum width of 1.5 µs. This signal causes the counter it is applied to termi-

3. **RESET**: a bidirectional negative-going pulse going
from +5 V to ground with a minimum width of 1 µs. This signal is used to initiate a readout cycle.

4. **HOLD**: a negative level at ground potential: +5 V when idle. This signal, generated by a scanner, dis-
ables the counter display-update function and en-
ables the readout function.

5. **PRINT CLOCK**: a negative-going pulse going from
+5 V to ground with a minimum width of 3 µs. This signal originates at the scanner module and is used to
trigger the printer's BCD data character. The counting mod-
ule, after receiving its required number of print pulses, passes succeeding ones on to the next module. This
signal is the only one not wired in parallel to both 16-pin connector.

The four data bits swing between +5 V and ground, are
high line, and have 1, 2, 4, 8 weights. The signals are
directly sourced from the bus so that any module can cause a high state regardless of the others.

Readout begins with the HOLD signal going true as a result of the STOP pulse generated by any module in the system. When the module is ready, the clock signal is sent by the Data Channel interface, causes the Read Clock Enable (RCE) to be sent to the counter logic. This starts the initialization of the logic placing the most significant data digit (10) on the data lines to the interface. After about 10 µs, the logic allows propagation through the clock logic, the Readout Logic (RFL) and the EFL, onto the Digit Counter (DC) and enables the fast clock (FCX-AL) to advance the Digit

The digit output of the system is sent to the module module via the interface. The system employs a 16-bit bus allowing interconnection of up to 15 modules. Each

Bus signal nomenclature:

- **DI04** data bit: Parity (may be used in place of the bus parity)
- **DI05** data bit: IOP (Input Output Protocol)
- **DI06** data bit: nDAC (Not Data Accepted)
- **DI07** data bit: DAC (Data Accepted)
- **DI08** data bit: DAV (Data Available)
- **DI09** data bit: ERO (Emergency Request)
- **DI10** data bit: REN (Remote Enable)
7.15 TYPICAL BUS INTERCHANGE

It is not the intent of this portion to be a primer on how the GPIB controller must be programmed. Each of these has unique characteristics and must be studied in depth. There are several tutorial publications available from instrument manufacturers, including Tektronix and Fluke as well as the IEEE. The following descriptions illustrate how the 201A will respond in particular modes that it will be most commonly used.

Serial Poll

This allows the controller to determine which device requires service. The 201A will output a Service Request (SRQ) when a device requires service. The controller may then perform a Serial Poll (SRP), determine which device is requesting service. During the polling sequence, the controller will scan each of the devices and read their Talk or Address bits and then the service will be output in a text-like format. If the 201A is requesting service it will output a 4A, and remove its Service Request. If it was not the device requesting device, then it outputs a status equal to 0. The controller compares the serial polling message doing a Serial Poll Duplex (SPO) if the 201A is the only possible source of the Service Request, the controller can choose to respond by reading the data from the module, this will also clear its Service Request.

<table>
<thead>
<tr>
<th>Source</th>
<th>7-bit Hex Code</th>
<th>ATN Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller</td>
<td>14</td>
<td>ATN Asserted</td>
<td>Will cause 201A to terminate counting if jumper B is installed in GPIB interface.</td>
</tr>
</tbody>
</table>

**Read Data**

<table>
<thead>
<tr>
<th>Controller</th>
<th>3F</th>
<th>ATN Asserted</th>
<th>Unlisten all devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller</td>
<td>35</td>
<td>ATN Asserted</td>
<td>Assign Talker at decimal address 27.</td>
</tr>
<tr>
<td>Controller</td>
<td>44</td>
<td>ATN Asserted</td>
<td>Assign Talker at decimal address 4.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 0.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 1.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 2.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 3.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 4.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 5.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 6.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 7.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 8.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 9.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 10.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 11.</td>
</tr>
<tr>
<td>207A</td>
<td>30</td>
<td>ATN False</td>
<td>10' digit from counter A equals 12.</td>
</tr>
</tbody>
</table>

**Exit**

| 207A       | 30             | ATN False    | 10' digit from counter A equals 13.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 14.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 15.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 16.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 17.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 18.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 19.             |
| 207A       | 30             | ATN False    | 10' digit from counter A equals 20.             |

**Carriage return**

| 207A       | 30             | ATN False    | 10' digit from counter A equals 21.             |

**Note**

1. The carriage return indicating end-of-word may be used to select a form feed (code DC).
2. The line feed and EOI indicate to the controller that the 201A presently having is now finished sending data.
3. 27' is the address of the device which is to receive the 201A's data.
4. 4A is the 201A's address in this example with channel A and B counters equal to 016397 and 06768032, respectively.