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SYSTEMS INTERFACE

FOR 8000B SERIES COUNTERS

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SECTION 1 GENERAL DESCRIPTION

1.1 INTRODUCTION.

1.2 This manual describes the use and operation of the Models 008 and 009 Systems Interface options, used on the Dana Series 8000B Electronic Counters. The options are internally mounted in the counter and receive all operational power from the counter. The options permit the instrument to be operated remotely by electrical input and provide data from the counter readout in Binary Coded Decimal (BCD) form for use by a digital recorder or other digitally operated device.

1.3 RECORDER.

1.4 The Recorder output from both options is the same and is in the form of BCD, positive-true, 1-2-4-8 code from TTL integrated circuits. The output supplies, in digital form, the numeric value of the readout, the annunciator displayed, and the position of the decimal.

1.5 Physically the output consists of a cable assembly connecting various points on the counters readout board to two edge-type connectors (J111, J112), located on the rear panel of the counter.

1.6 008 PROGRAMMING OPTION.

1.7 The programming portion of the 008 option consists of a cable assembly providing interconnection between programming edge connector J110 on the rear panel and the readout PC board, and interconnection from J110 through connector P8 to the signal control module.

1.8 The programming portion of the 008 option provides single line commands for the control of function, time base, external gate, +/– slope, hold, and reset. The single line inputs are held true by internal pull up resistors; commands are initiated on these lines by means of a contact closure to ground potential or low TTL level (inputs are TTL gates). Analog programming is available through programming connector J110. The analog inputs determine the trigger level of the signal control module circuitry. A synopsis of 008 capabilities is provided in table 1.1.

1.9 009 PROGRAMMING OPTION.

1.10 The programming portion of the 009 option also consists of a cable assembly and provides interconnection between a 50 pin programming connector J113 on the rear panel and the readout PC board. The cabling also includes interconnection from J113 and a specially modified version of the signal control module.

1.11 The programming portion of the 009 module provides binary encoded commands for the control of function, time base, channel range, and trigger level. It provides single line commands for external gate, +/– slope, hold, reset, separate/common, and ac/dc.

1.12 The digital input lines are held true by internal pull up resistors; commands are generated on these lines, for both single line commands or binary encoded, by contact closure to ground potential or low TTL level (inputs are TTL gates). Analog programming is also available through programming connector J113. The analog inputs are provided as an alternative to digitally selecting the trigger level of the signal control module or can be used in conjunction with the digital controlled input for continuous adjustment between the incremental steps. A synopsis of 009 capabilities is shown in table 1.2.

1.13 SPECIFICATIONS.

1.14 The specifications for all remote selected instrument functions, with the exception of trigger levels, are the same as for local selection and are provided in the counter manual. Specifications for remote selection of trigger levels are provided in table 1.3.

1.15 Miscellaneous.

1.16 ITEMS FURNISHED (008).

1.17 Included with instruments equipped with the 008 option are three edge-type mating connectors, Dana P/N 600698 (with hoods, Dana P/N 453890).

1.18 ITEMS FURNISHED (009).

1.19 Included with instruments equipped with the 009 option are two edge-type mating connectors, Dana P/N 600698 (with hoods, Dana P/N 453890), and one 50-pin connector, Dana P/N 600047.

1.20 REQUIRED TOOLS AND TEST EQUIPMENT.

1.21 No calibration is required for the 008 option. The calibration equipment needed and the tools used for the 009 option are a portion of the equipment used for the calibration of the counter. An aid for calibrating the 009 option consists of a 50-pin mating connector for programming connector J113 with certain pins interconnected. This is described in Section 4.

Table 1.1 - Option 008 Programming

Program Title	Program Mode	Applicable to Models:				
		8010B	8015B	8020B	8030B	8035B
Functions:						
Remote	Single Line Digital	X	X	X	X	X
Check	Single Line Digital	X	X	X	X	X
Period	Single Line Digital	X	X	X	X	X
Period Ave.	Single Line Digital	X	X	X	X	X
Frequency A	Single Line Digital	X	X	X	X	X
Frequency C	Single Line Digital			X	X	X
Totalize	Single Line Digital	X	X	X	X	X
A/B Ratio	Single Line Digital	X	X		X	X
Time Interval	Single Line Digital	X	X		X	X
Time Int. Ave.	Single Line Digital	X			X	
Input Controls:						
Slope A	Single Line Digital	X	X	X	X	X
Trig Level A	Single Line Analog	X	X	X	X	X
Slope B	Single Line Digital	X	X		X	X
Trig Level B	Single Line Analog	X	X		X	X
Time Base:						
10 ns	Single Line Digital		X			X
1+100 ns	Single Line Digital	X	X	X	X	X
10+1 μs	Single Line Digital	X	X	X	X	X
10^2+10 μs	Single Line Digital	X	X	X	X	X
10^3+100 μs	Single Line Digital	X	X	X	X	X
10^4+1 ms	Single Line Digital	X	X	X	X	X
10^5+10 ms	Single Line Digital	X	X	X	X	X
10^6+100 ms	Single Line Digital	X	X	X	X	X
10^7+1 sec	Single Line Digital	X	X	X	X	X
10^8+10 sec	Single Line Digital	X	X	X	X	X
10^9+100 sec	Single Line Digital	X	X	X	X	X
Program Functions:						
HOLD	Single Line Digital	X	X	X	X	X
RESET	Single Line Digital	X	X	X	X	X
Ext. Gate	Single Line Digital	X	X	X	X	X

Table 1.2 - Option 009 Programming

Program Title	Program Mode	Applicable to Models:			
		8010B	8015B	8030B	8035B
Functions:					
Remote	4-Line BCD	X	X	X	X
Check	4-Line BCD	X	X	X	X
Period	4-Line BCD	X	X	X	X
Period Ave.	4-Line BCD	X	X	X	X
Frequency A	4-Line BCD	X	X	X	X
Frequency C	4-Line BCD			X	X
Totalize	4-Line BCD	X	X	X	X
A/B Ratio	4-Line BCD	X	X	X	X
Time Interval	4-Line BCD	X	X	X	X
Time Int. Avg.	4-Line BCD	X		X	
Input Controls:					
Sep/Com	Single Line Digital	X	X	X	X
Slope A	Single Line Digital	X	X	X	X
AC/DC A	Single Line Digital	X	X	X	X
Range A	2-Line BCD	X	X	X	X
Anal. Trig. Level A	Single Line Analog	X	X	X	X
Dig. Trig. Level A	7-Line Binary	X	X	X	X
Slope B	Single Line Digital	X	X	X	X
AC/DC B	Single Line Digital	X	X	X	X
Range B	2-Line BCD	X	X	X	X
Anal. Trig. Level B	Single Line Analog	X	X	X	X
Dig. Trig. Level B	7-Line Binary	X	X	X	X
Time Base:					
10 ns	Single Line Digital		X		X
1+100 ns	4-Line BCD	X	X	X	X
10+1 μs	4-Line BCD	X	X	X	X
10^2+10 μs	4-Line BCD	X	X	X	X
10^3+100 μs	4-Line BCD	X	X	X	X
10^4+1 ms	4-Line BCD	X	X	X	X
10^5+10 ms	4-Line BCD	X	X	X	X
10^6+100 ms	4-Line BCD	X	X	X	X
10^7+1 sec	4-Line BCD	X	X	X	X
10^8+10 sec	4-Line BCD	X	X	X	X
10^9+100 sec	4-Line BCD	X	X	X	X
Program Functions:					
HOLD	Single Line Digital	X	X	X	X
RESET	Single Line Digital	X	X	X	X
Ext. Gate	Single Line Digital	X	X	X	X

Table 1.3 - Trigger Level Specifications

Analog (Options 008/009)	Supply Voltage (.1V per % of range) into 10 kohms to set desired level; Accuracy: ±2% of range ±.2% of range per °C ±Transient Error* ±Attenuator Error**
Digital (Option 009)	7 Bit Code, 5% of range per step, ±300% of Range Span; Accuracy: ±5% of range ±.2% of range/°C ±Transient Error* ±Attenuator Error**

*Transient Error $\leq \left[\frac{\text{Slope}}{\text{Range}}\left(\frac{V}{\mu S}\right)\right]^{1/2}$ Percent of Range

**Attenuator Error

Frequency	Accuracy (% of Range)		
	Range		
	X1	X10	X100
0 ⟶ 1 kHz	1	2	3
1 kHz ⟶ 10 kHz	1	4	4
10 kHz ⟶ 100 kHz	1	8	8
100 kHz ⟶ 1 MHz	1	8	8

2.1 RECORDER OUTPUT.

2.2 The recorder output is provided at the back panel of the instrument on two edge-type connectors J111 and J112. The connectors are slotted between pins 2 and 3 of J111 and pins 3 and 4 of J112 to permit keying of the mating connectors.

2.3 The data from the two connectors is a Binary Coded Decimal (BCD), positive-true, 1-2-4-8 code. The logic levels for the output are defined as:

"0" = 0 volts to +0.8 volts

"1" = +2.4 volts to +5 volts

2.4 The recorder produces a binary coded representation of the instrument display. This includes the numeric readout, the decimal position and the annunciator as shown in figure 2.1.

2.5 Cabling.

2.6 Two mating connectors (Dana P/N 600698) come with the instrument for the RECORDER output. Pin identification for the connectors is provided in figure 2.2, and table 2.1. The outputs are described in the following paragraphs.

2.7 NUMERIC READOUT.

2.8 The numeric readout lines have the designations V1 through V9. The designators represent the corresponding readout "windows" with V1 to the right, the least-significant bit. For example, a seven in the most-significant bit is shown as:

V9-8	logic 0
V9-4	logic 1
V9-2	logic 1
V9-1	logic 1

2.9 ANNUNCIATOR.

2.10 A separate line is provided for each unit on the annunciator. The units identify the units of time or frequency in which the measurement is expressed and is indicated when the particular output line is at logic true.

2.11 DECIMAL.

2.12 A separate line is provided for each of the eight decimal points. The designators DP1 through DP8 describe the number of places to the left of the least-significant digit the decimal is located. The decimal position is indicated by a logic true.

2.13 PRINT.

2.14 The print command indicates that the data is at the output connectors and is available for recording. The print pulse is a 0 to +5 volt pulse of 5 microsecond duration.

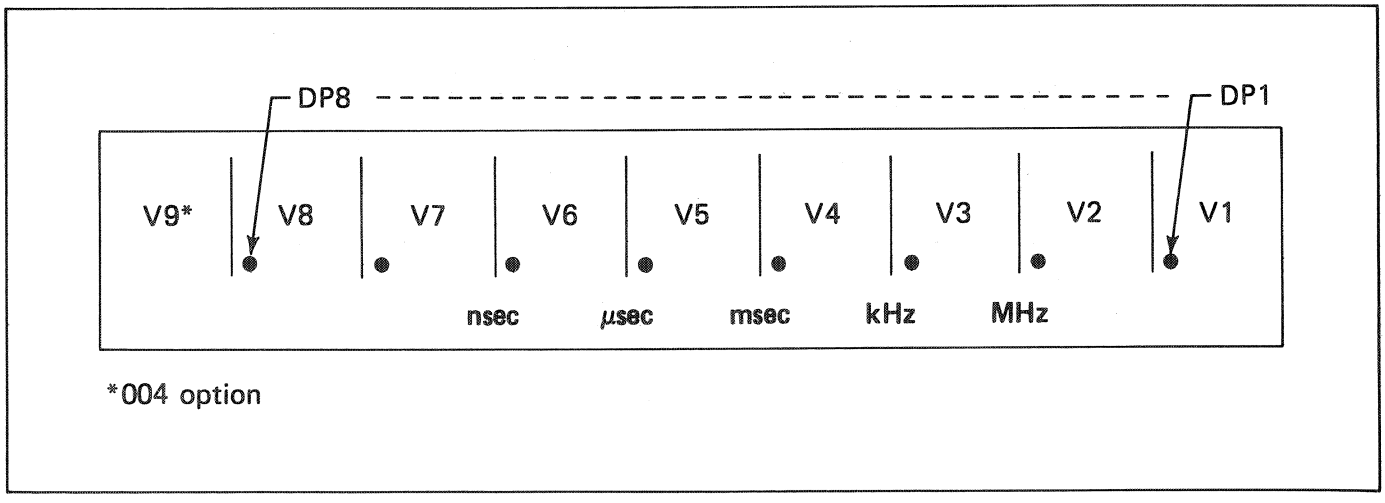


Figure 2.1

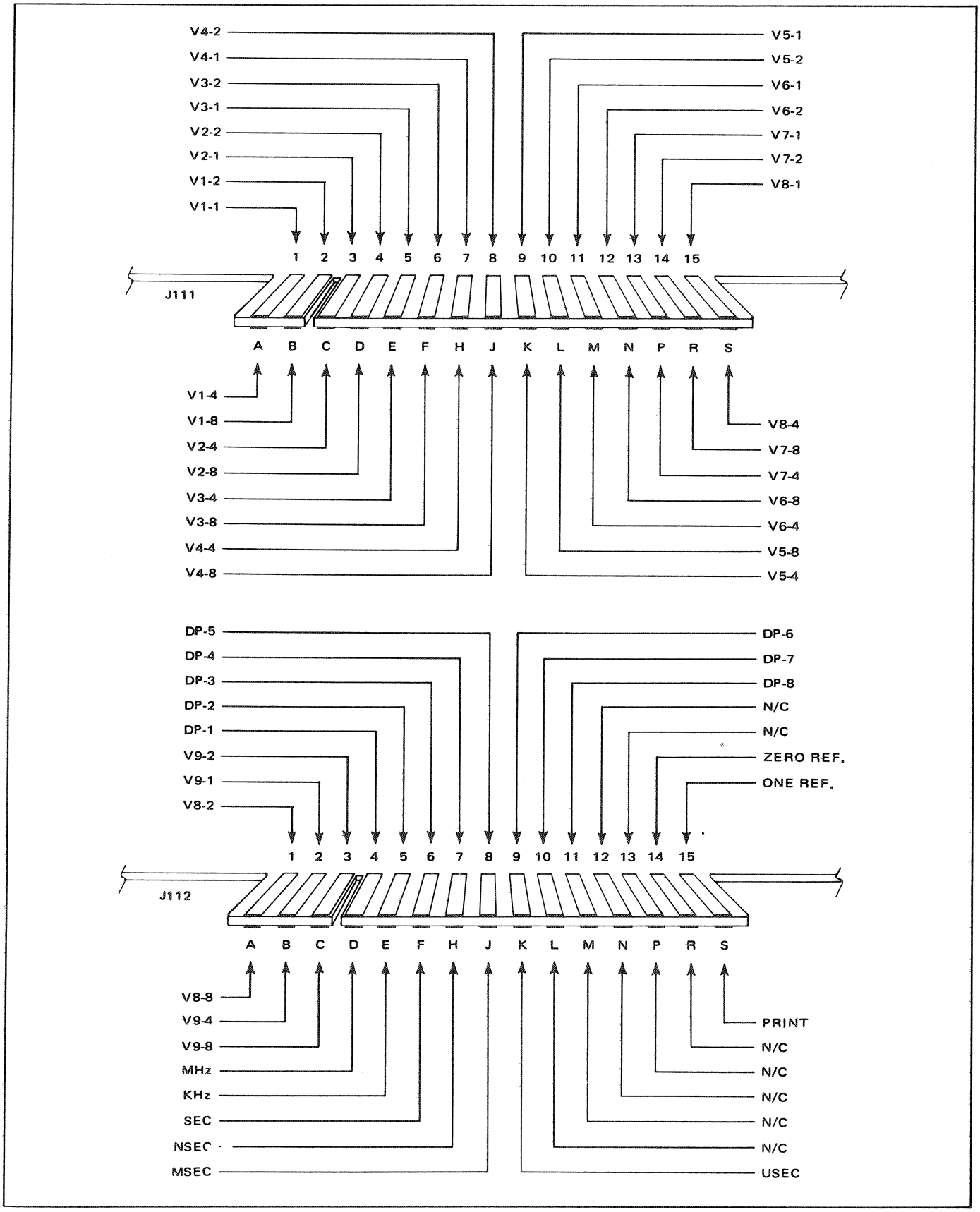


Figure 2.2 - J111 and J112 Recorder Outputs

Table 2.1 - Recorder Cabling Guide

Output	Designator	Connector	Pin No.	Output	Designator	Connector	Pin No.
Numeric	V1-1	J111	1	Numeric	V7-4	J111	P
	V1-2		2		V7-8		R
	V1-4		A		V8-1		15
	V1-8		B		V8-2	J112	1
	V2-1		3		V8-4	J111	S
	V2-2		4		V8-8	J112	A
	V2-4		C		V9-1		2
	V2-8		D		V9-2		3
	V3-1		5		V9-4		B
	V3-2		6		V9-8		C
	V3-4		E	Decimal	DP-1	J112	4
	V3-8		F		DP-2		5
	V4-1		7		DP-3		6
	V4-2		8		DP-4		7
	V4-4		H		DP-5		8
	V4-8		J		DP-6		9
	V5-1		9		DP-7		10
	V5-2		10		DP-8		7
	V5-4		K	Unit	MHz	J112	D
	V5-8		L		kHz		E
	V6-1		11		SEC		F
	V6-2		12		MSEC		H
	V6-4		M		NSEC		J
	V6-8		N		μSEC		K
	V7-1		13	Other	PRINT	J112	S
	V7-2		14		ONE REF.		15
					ZERO REF.		14

2.15 ONE REFERENCE.

2.16 The one reference is provided for those recorders requiring a reference voltage. The line supplies approximately +2.5 volts with an impedance of 1 kilohm ±5%.

2.17 ZERO REFERENCE.

2.18 Zero reference is the recorder common line to which all of the other output lines are referenced.

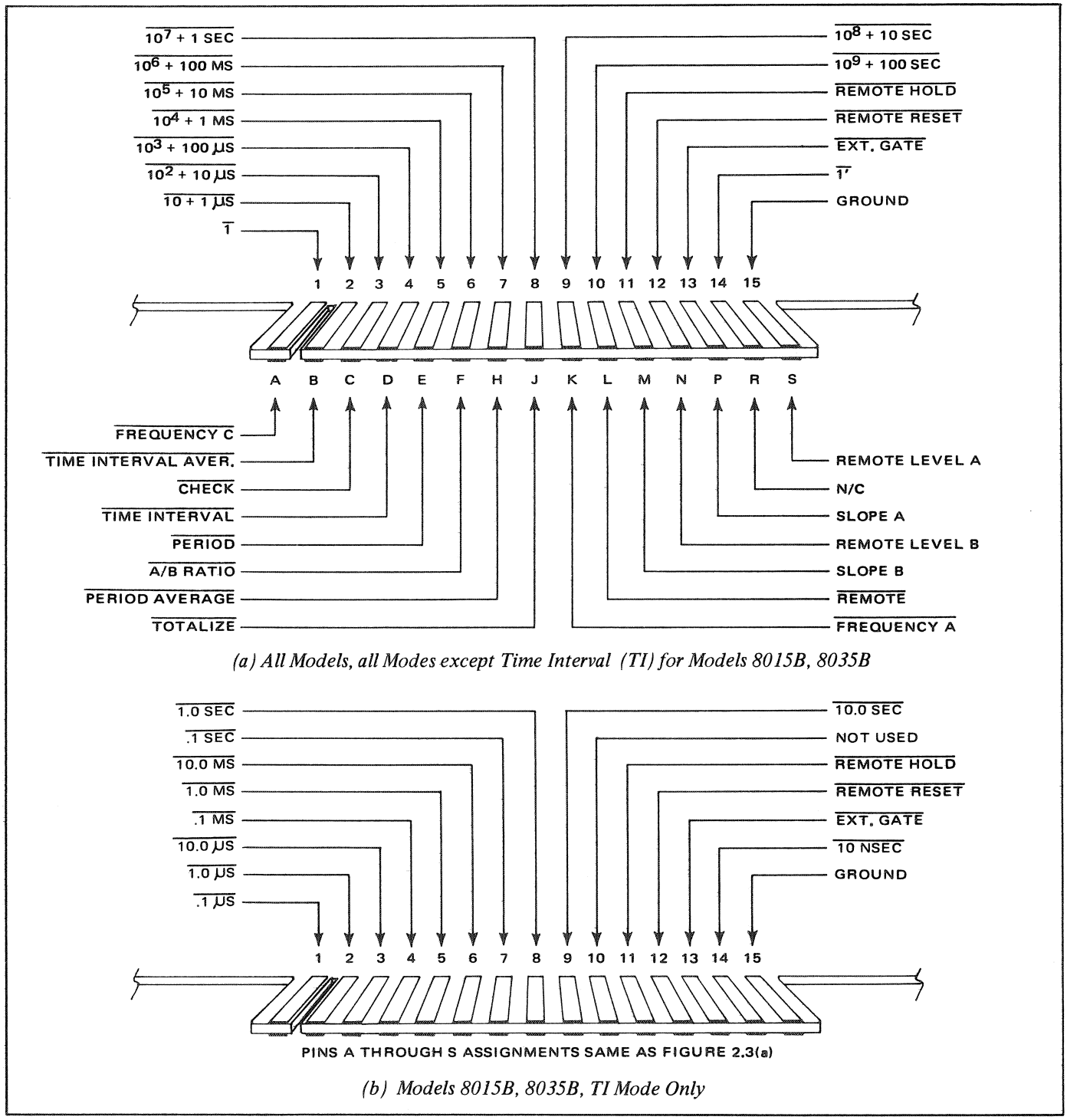


Figure 2.3 - REMOTE Connector J110 Pin Assignments

2.19 REMOTE PROGRAMMING, 008.

2.20 The Option 008 REMOTE input is connector J110, located on the rear panel of the instrument. A slot between pins 1 and 2 of the edge-type connector is provided for the keying of the mating connector (Dana P/N 600698), supplied with the instrument.

2.21 Remote programming commands are received through the remote connector and are generated by a

Table 2.2 - 008 Programming Cabling Guide

Input	Designator	J110 Pin No.	Mode
Function	$\overline{\text{Freq. C}}$	A	Single Line
	$\overline{\text{TI Ave.}}$	B	
	$\overline{\text{Check}}$	C	
	$\overline{\text{TI}}$	D	
	$\overline{\text{Period}}$	E	
	$\overline{\text{A/B Ratio}}$	F	
	$\overline{\text{Period Avg.}}$	H	
	$\overline{\text{Totalize}}$	J	
	$\overline{\text{Freq A}}$	K	
Signal In	Slope A	P	
	Level A	S	Analog
	Slope B	M	Single Line
	Level B	N	Analog
Time Base All Functions/ Models except TI of 8015B, 8035B	$\overline{1'}$	14	Single Line
	$\overline{1}$	1	
	$\overline{10+1\ \mu s}$	2	
	$\overline{10^2+10\ \mu s}$	3	
	$\overline{10^3+100\ \mu s}$	4	
	$\overline{10^4+1\ ms}$	5	
	$\overline{10^5+10\ ms}$	6	
(Time Base 'Std.' cont.)	$\overline{10^6+100\ ms}$	7	Single Line
	$\overline{10^7+1\ sec}$	8	
	$\overline{10^8+10\ sec}$	9	
	$\overline{10^9+100\ sec}$	10	
Time Base (for TI of 8015B, 8035B only)	$\overline{10\ ns}$	14	
	$\overline{100\ ns}$	1	
	$\overline{1\ \mu s}$	2	
	$\overline{10\ \mu s}$	3	
	$\overline{100\ \mu s}$	4	
	$\overline{1\ ms}$	5	
	$\overline{10\ ms}$	6	
	$\overline{100\ ms}$	7	
	$\overline{1\ sec}$	8	
	$\overline{10\ sec}$	9	
Other	$\overline{\text{REMOTE}}$	L	
	$\overline{\text{HOLD}}$	11	
	$\overline{\text{RESET}}$	12	
	$\overline{\text{Ext. Gate}}$	13	
	GROUND	15	

closure to the $\overline{\text{REMOTE}}$ line (pin L of J110). Pin assignments of J110 are listed in figure 2.3 and table 2.2. Typical programming timing is shown in figure 2.4. Programming requirements are as follows:

a. Logic "1" is the passive state and is defined as +2 volts to +5 volts.

b. Logic "0" is the command state and is defined as 0 to +0.8 volts.

c. Output of programmer must be able to sink 3 milliamps.

2.22 FUNCTION.

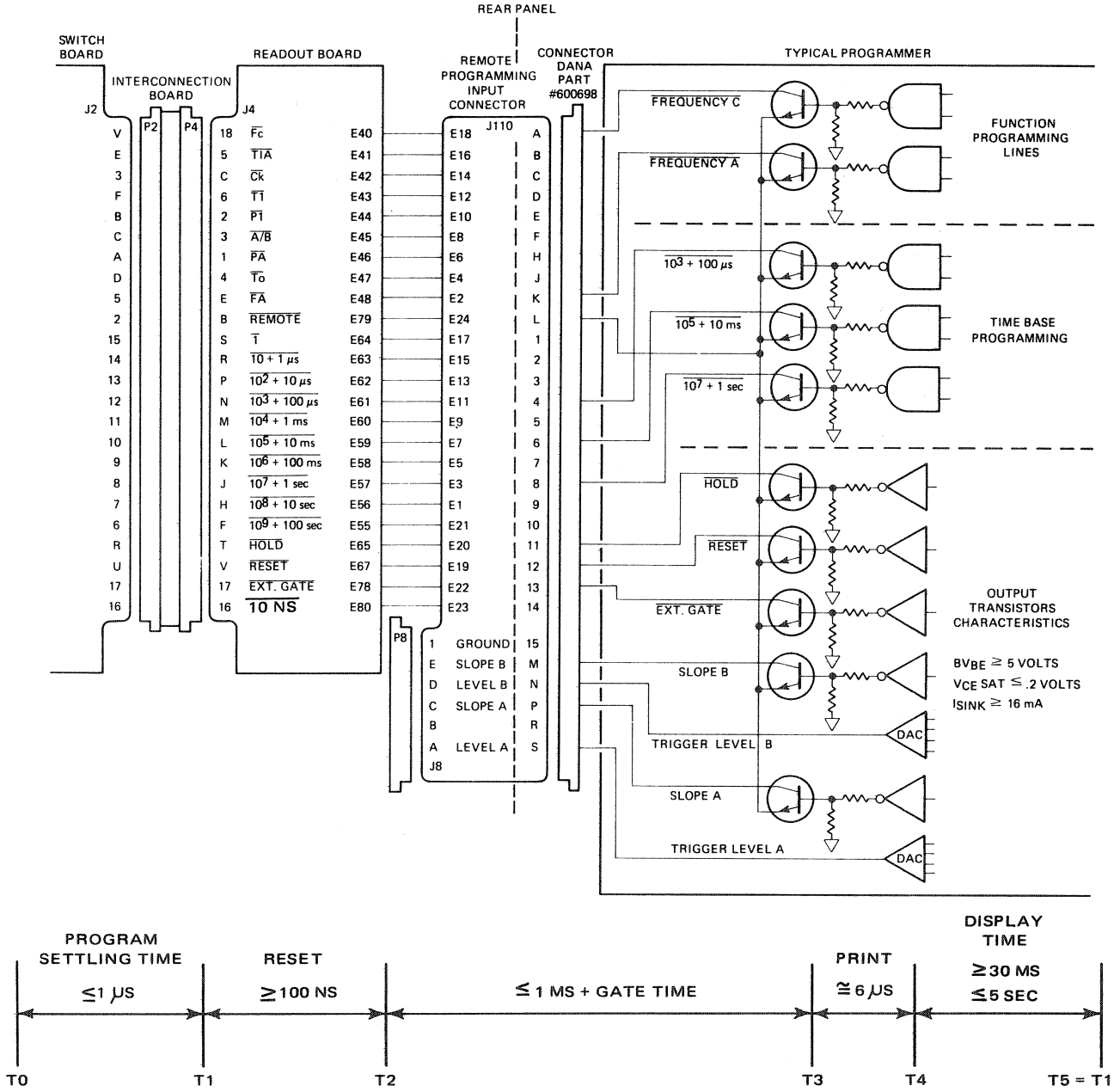
2.23 Pins A through K of J110 are the input lines corresponding to the FUNCTION switch on the front panel. Note that the function lines are the complements of the corresponding function as indicated by a bar over the name. For example: with FREQ A function selected the line marked Freq A should be low ($\overline{\text{Freq A}}$). To remotely program any of the operating modes, the front panel FUNCTION switch must be in the REMOTE position. The function is then programmed by a closure to J110 - pin L from the appropriate pin. Settling time for the function lines are 100 ns.

2.24 MULTIPLIER TIME BASE.

2.25 Pins 1 through 10 of J110 are lines corresponding to each of the MULTIPLIER/TIME BASE pushbutton switches. Settling time for the Multiplier Time Base lines is 100 ns.

2.26 INPUT CONTROLS.

2.27 The INPUT CONTROLS and the "+/−" slope switch on the front panel are duplicated by lines on pins M through S of J110. For remote programming of these input controls, the trigger level for input A and B must be in the PRESET



T0	Select function, multiplier time base, slope, trigger level. The following are set internally: units, decimal point and the arm flip-flop.
T0 - T1	Time for inputs to settle ≤100 ns; trigger levels ≤1 µs.
T1 - T2	Reset or external gate time ≥100 ns.
T2 - T3	≤1 ms + gate time, gate opens, counts accumulate in the counter, gate closes, display flip-flop is reset, arm flip-flop cleared and fires a 1 µsec delay for update.
T3 - T4	Print pulse External Hold takes effect if applied.
T4 - T5	Display time times out ≥30 ms to ≤5 sec selectable on front panel.

Figure 2.4 - Typical Programmer and Timing Diagram

position. The channel A trigger level is then controlled by the voltage applied to J110, pin S; channel B trigger level is controlled by the voltage applied to pin N. The value of the external trigger level voltage applied to pins S and N can be calculated according to the following formula.

$$Vp = 10 \frac{TL}{R}$$

Where: Vp = external trigger level voltage
TL = desired trigger level
R = input voltage range

Example 1: to obtain a trigger level of .7 volts on the 1 volt range.

$$Vp = 10 \frac{.7}{1} = 7 \text{ volts to pin S or N}$$

Example 2: to obtain a trigger level of –50 volts on the 100 volt range.

$$Vp = 10 \frac{-50}{100} = -5 \text{ volts}$$

2.28 Both positive and negative trigger levels may be programmed into pins S or N. Settling time is 1 microsecond for the trigger level up to ±300% of the input range.

2.29 SLOPE.

2.30 The counter triggers on the positive slope unless there is a closure from pin M to pin L for channel B slope or (and) pin P to pin L for channel A slope. With a closure, a negative slope is programmed. Settling time is less than 1 microsecond.

2.31 HOLD.

2.32 The Hold line, pin 11 of J110, corresponds to the full clockwise position of the DISPLAY TIME control on the front panel. When the Hold line is low, the counter takes one reading and holds the measurement until the Reset is activated.

2.33 RESET.

2.34 Reset corresponds to the front panel RESET switch. The reset must be held low for a minimum of 100 nanoseconds. The main gate opens in less than 1 millisecond after the positive edge of the reset closure.

2.35 EXTERNAL GATE.

2.36 The external gate line, pin 13 of J110, is used in the Totalize mode to externally establish a gate time during which Frequency A is counted. The external gate must be greater than 100 nanoseconds. Two contact closures are required per gate time or measurement. The gate is initiated in less than 50 nanoseconds after the falling edge of the first contact closure. The next contact closure terminates the gate and holds the accumulated reading. The next external gate continues the count and so on. The count may be cleared by pulling the Reset line low.

2.37 REMOTE PROGRAMMING, 009 (8010B, 8015B, 8030B, 8035B).

2.38 The Option 009 enables external electrical operation of all front panel controls (except POWER and DISPLAY TIME) and provides BCD output data including numeric value, annunciator and decimal position. All inputs* and outputs are in the form of logic levels with logic "1" levels defined as +2 volts to +5 volts and logic "0" levels defined as 0 volts to 0.8 volts.

2.39 Programming data is applied through a 50-pin blue ribbon connector (J113), located on the rear panel. All command lines* are initially biased at a logic "1" level, control settings are made by 'pulling' the appropriate control lines to GROUND (J113, pin 33). Pin locations are indicated in figure 2.5 and table 2.3.

2.40 System Control.

2.41 The $\overline{\text{SYSTEM CONTROL}}$ line (pin 37 of connector J113) programs remote operation when placed at logic 0 (pin 33 of J113); all front panel controls are inhibited (except POWER and DISPLAY TIME) when system control is selected. When system control is not selected, the instrument can be placed in remote operation by setting the front panel FUNCTION switch to the REMOTE position.

2.42 FUNCTION.

2.43 The remote selection of function is made by applying a binary code to the four function command lines located on J113. The remote selection duplicates the

*except ANALOG TRIGGER LEVEL inputs

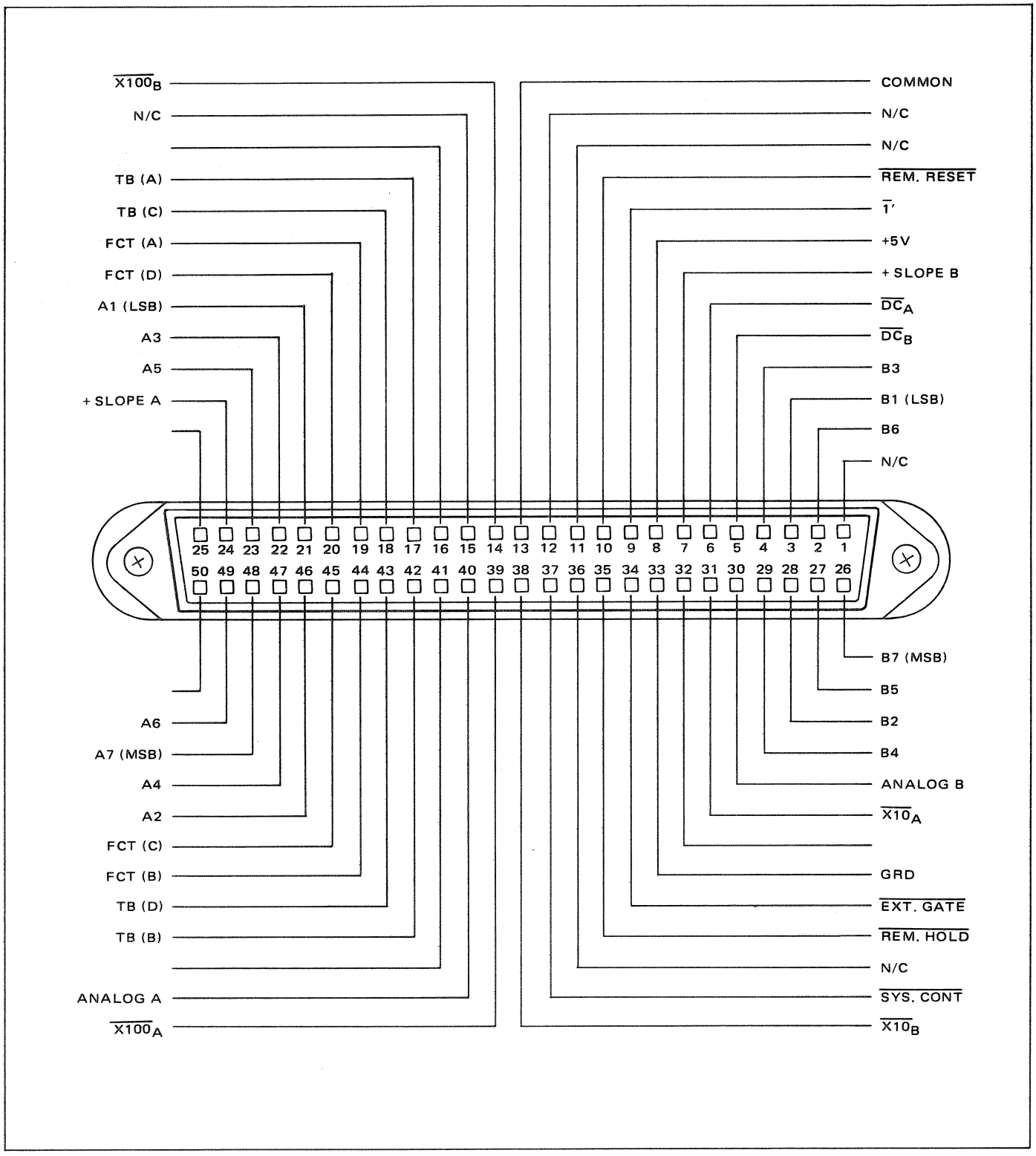


Figure 2.5 - Pin Location of J113 Programming Connector

Table 2.3 - 009 Programming Cabling Guide

Input	Designator	J113 Pin No.	Mode
Function	FCT A	19	4-Line
	FCT B	44	
	FCT C	45	
	FCT D	20	
Time Base	TB A	17	
	TB B	42	
	TB C	18	
	TB D	43	
Sep/Com	Common	13	Single Line
A Range	$\overline{\text{X10A}}$	31	2-Line
	$\overline{\text{X100A}}$	39	
A Slope	+A	24	Single Line
A AC/DC	DC A	6	
A Trigger (Binary)	A_1	21	7-Line
	A_2	46	
	A_3	22	
	A_4	47	
	A_5	23	
	A_6	49	

Input	Designator	J113 Pin No.	Mode
(A Trig cont.)	A7	48	7-Line
A Trig Analog	Analog A	40	Analog
B Range	$\overline{\text{X10B}}$	38	2-Line
	$\overline{\text{X100B}}$	14	
B Slope	+B	7	Single Line
B AC/DC	DC B	5	
B Trigger (Binary)	B_1	3	7-Line
	B_2	28	
	B_3	4	
	B_4	29	
	B_5	27	
	B_6	2	
	B_7	26	
B Trig Analog	Analog B	30	Analog
Other	$\overline{\text{RESET}}$	10	Single Line
	$\overline{\text{HOLD}}$	35	
	$\overline{\text{System Contrl}}$	37	
	$\overline{\text{External Gate}}$	34	
	+5 Volts	8	
	GROUND	33	

operation of the front panel FUNCTION switch. Coding for each function is shown below.

Function	J113 Pin No. 20	45	44	19	BCD Weight
Check	0	0	0	0	0
Periodic	0	0	0	1	1
Periodic Avg	0	0	1	0	2
Frequency A	0	0	1	1	3
Frequency C	0	1	0	0	4
Total	0	1	0	1	5
Time Interval	0	1	1	0	6
A/B Ratio	0	1	1	1	7
Time Interval Avg	1	0	0	0	8

2.44 MULTIPLIER TIME BASE.

2.45 The remote selection of the multiplier time base is made by applying a binary code to the four time base command lines located on J113. The remote selection duplicates the operation of the front panel pushbuttons. Coding for each time base is shown below.

Timebase	J113 Pin No. 43	18	42	17	BCD Weight
1 + 100 ns	0	0	0	0	0
10 + 1 μs	0	0	0	1	1
10^2 + 10 μs	0	0	1	0	2
10^3 + 100 μs	0	0	1	1	3
10^4 + 1 ms	0	1	0	0	4
10^5 + 10 ms	0	1	0	1	5
10^6 + 100 ms	0	1	1	0	6
10^7 + 1 sec	0	1	1	1	7
10^8 + 10 sec	1	0	0	0	8
10^9 + 100 sec	1	0	0	1	9

Input code for all functions except TI on 8015B & 8035B

Timebase	J113 Pin No. 43	18	42	17	BCD Weight
100 ns	0	0	0	0	0
1 μs	0	0	0	1	1
10 μs	0	0	1	0	2
100 μs	0	0	1	1	3
1 ms	0	1	0	0	4
10 ms	0	1	0	1	5
100 ms	0	1	1	0	6
1 sec	0	1	1	1	7
10 sec	1	0	0	0	8
10 ns	1	0	0	1	9

Input code for TI on 8015B & 8035B only

2.46 INPUT CONTROLS.

2.47 The remote operation of input controls for channels A and B consists of both single line and binary coded inputs. Coding for the input controls is provided below.

	J113 Pin No.
Separate/Common	13
Separate	1
Common	0

Channel A Range	39	31	BCD Weight
X100	0	1	1
X10	1	0	2
X1	1	1	3

Channel A Slope	J113 Pin No. 24
+	1
–	0

Channel A AC/DC	J113 Pin No. 6
AC	1
DC	0

Channel A Trigger Level	J113 Pin No. 48*	49	23	47	22	46	21
	Codes provided in table 2.4						

*Most Significant Bit

Channel B Range	14	38	BCD Weight
X100	0	1	1
X10	1	0	2
X1	1	1	3

Channel B Slope	J113 Pin No. 7
+	1
–	0

Channel B AC/DC	J113 Pin No. 5
AC	1
DC	0

Channel B Trigger Level	J113 Pin No. 26*	2	27	29	4	28	3
	Codes provided in table 2.4						

*Most Significant Bit

2.48 HOLD.

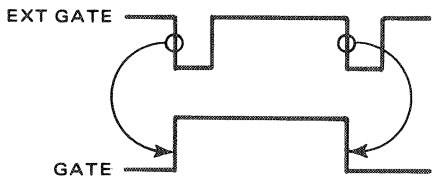
2.49 The Hold line, pin 35 of J113, corresponds to the full clockwise position of the DISPLAY TIME control on the front panel. When the Hold line is at logic 0, the counter takes one reading and holds the measurement until the Reset is activated.

2.50 RESET.

2.51 The reset corresponds to the front panel RESET switch. This is a single line control (pin 10 of J113) and is activated when set to logic 0. The line must be held at logic 0 for a minimum of 100 nanoseconds.

2.52 EXTERNAL GATE.

2.53 The external gate line (pin 34 of J113) is used in the Totalize mode to externally establish a gate time during which channel A signal is counted. The external gate command must be greater than 100 nanoseconds. Two commands are required per gate time or measurement. The gate is initiated in less than 50 nanoseconds after the following edge of the first command. The next command terminates the gate and holds the accumulated reading. The next external gate continues the count and so on. The count may be cleared by pulling the Reset line to logic 0.



2.54 TRIGGER LEVEL.

2.55 The trigger levels of channels A and B are capable of being independently set by external control with either an analog voltage level or a binary coded input.

2.56 Analog control of channel A is through pin 40 and control of channel B is through pin 30 of connector J113. Each 0.1 volt of input voltage adjusts the trigger level 1% of the selected range.

> **NOTE**
>
> When an analog level is used to set the trigger levels, in the Remote mode, J113 pins 48 and 26 must be grounded to J113 pin 33. If in the Local mode, the front panel trigger level pots are placed in the "Preset" position.

Example: A trigger level of −30 volts is desired.

1. The 100 range is selected.
2. The control voltage is equal to:

$$\left(\frac{\text{Desired trigger level}}{\text{Range}}\right) \times 10$$

3. Or: $\left(\frac{-30 \text{ volts}}{100}\right) \times 10$
4. Therefore the required control level is −3 volts.

The input impedance of the analog trigger level control inputs is 10 kilohms.

2.57 Digital control of the trigger levels for channels A and B requires the generation of digital command words for each channel. A separate command word is required for each level and 128 separate levels are available for each channel. Each command word consists of a 7-bit binary code. The available digitally programmable trigger levels along with the required 7-bit code is provided in table 2.4. Note that the available trigger levels listed in table 2.4 indicate the value of the analog signal generated within the instrument for each command word. To equate the available trigger level with the desired trigger level, the available trigger level value is multiplied by the range selected.

2.58 Also included in table 2.4 is the decimal representation for each trigger level. This value can be computed directly from the value of the trigger level by the relationship:

$$\text{Decimal Value} = 63 - 20\left(\frac{\text{Desired trigger level}}{\text{Range}}\right)$$

Example: A trigger level of +5 volts is desired.

1. Select the 10 volt range.
2. The decimal value is then equal to:

$$63 - 20\left(\frac{+5 \text{ Volts}}{10}\right)$$

3. The decimal value is 53.
4. From table 2.4, decimal value 53 is equal to +0.500 (available trigger level). +0.5 times the 10 range equals the desired +5 volts trigger level.

Table 2.4 - Trigger Level DAC Programming Information

Desired Trigger Level (VDC)	COMMAND WORD			
	Binary	Octal	Decimal	Hexidecimal
+3.150	0 000 000	000	000	00
+3.100	0 000 001	001	001	01
+3.050	0 000 010	002	002	02
+3.000	0 000 011	003	003	03
+2.950	0 000 100	004	004	04
+2.900	0 000 101	005	005	05
+2.850	0 000 110	006	006	06
+2.800	0 000 111	007	007	07
+2.750	0 001 000	010	008	08
+2.700	0 001 001	011	009	09
+2.650	0 001 010	012	010	0A
+2.600	0 001 011	013	011	0B
+2.550	0 001 100	014	012	0C
+2.500	0 001 101	015	013	0D
+2.450	0 001 110	016	014	0E
+2.400	0 001 111	017	015	0F
+2.350	0 010 000	020	016	10
+2.300	0 010 001	021	017	11
+2.250	0 010 010	022	018	12
+2.200	0 010 011	023	019	13
+2.150	0 010 100	024	020	14
+2.100	0 010 101	025	021	15
+2.050	0 010 110	026	022	16
+2.000	0 010 111	027	023	17
+1.950	0 011 000	030	024	18
+1.900	0 011 001	031	025	19
+1.850	0 011 010	032	026	1A
+1.800	0 011 011	033	027	1B
+1.750	0 011 100	034	028	1C
+1.700	0 011 101	035	029	1D
+1.650	0 011 110	036	030	1E
+1.600	0 011 111	037	031	1F
+1.550	0 100 000	040	032	20
+1.500	0 100 001	041	033	21

Table 2.4 - Trigger Level DAC Programming Information (continued)

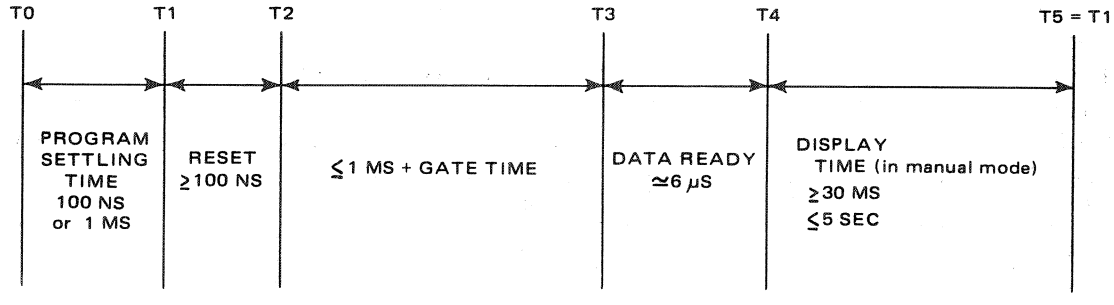
Desired Trigger Level (VDC)	COMMAND WORD			
	Binary	Octal	Decimal	Hexidecimal
+1.450	0 100 010	042	034	22
+1.400	0 100 011	043	035	23
+1.350	0 100 100	044	036	24
+1.300	0 100 101	045	037	25
+1.250	0 100 110	046	038	26
+1.200	0 100 111	047	039	27
+1.150	0 101 000	050	040	28
+1.100	0 101 001	051	041	29
+1.050	0 101 010	052	042	2A
+1.000	0 101 011	053	043	2B
+0.950	0 101 100	054	044	2C
+0.900	0 101 101	055	045	2D
+0.850	0 101 110	056	046	2E
+0.800	0 101 111	057	047	2F
+0.750	0 110 000	060	048	30
+0.700	0 110 001	061	049	31
+0.650	0 110 010	062	050	32
+0.600	0 110 011	063	051	33
+0.550	0 110 100	064	052	34
+0.500	0 110 101	065	053	35
+0.450	0 110 110	066	054	36
+0.400	0 110 111	067	055	37
+0.350	0 111 000	070	056	38
+0.300	0 111 001	071	057	39
+0.250	0 111 010	072	058	3A
+0.200	0 111 011	073	059	3B
+0.150	0 111 100	074	060	3C
+0.100	0 111 101	075	061	3D
+0.050	0 111 110	076	062	3E
0.000	0 111 111	077	063	3F
–0.050	1 000 000	100	064	40
–0.100	1 000 001	101	065	41
–0.150	1 000 010	102	066	42
–0.200	1 000 011	103	067	43

Table 2.4 - Trigger Level DAC Programming Information (continued)

Desired Trigger Level (VDC)	COMMAND WORD			
	Binary	Octal	Decimal	Hexidecimal
–0.250	1 000 100	104	068	44
–0.300	1 000 101	105	069	45
–0.350	1 000 110	106	070	46
–0.400	1 000 111	107	071	47
–0.450	1 001 000	110	072	48
–0.500	1 001 001	111	073	49
–0.550	1 001 010	112	074	4A
–0.600	1 001 011	113	075	4B
–0.650	1 001 100	114	076	4C
–0.700	1 001 101	115	077	4D
–0.750	1 001 110	116	078	4E
–0.800	1 001 111	117	079	4F
–0.850	1 010 000	120	080	50
–0.900	1 010 001	121	081	51
–0.950	1 010 010	122	082	52
–1.000	1 010 011	123	083	53
–1.050	1 010 100	124	084	54
–1.100	1 010 101	125	085	55
–1.150	1 010 110	126	086	56
–1.200	1 010 111	127	087	57
–1.250	1 011 000	130	088	58
–1.300	1 011 001	131	089	59
–1.350	1 011 010	132	090	5A
–1.400	1 011 011	133	091	5B
–1.450	1 011 100	134	092	5C
–1.500	1 011 101	135	093	5D
–1.550	1 011 110	136	094	5E
–1.600	1 011 111	137	095	5F
–1.650	1 100 000	140	096	60
–1.700	1 100 001	141	097	61
–1.750	1 100 010	142	098	62
–1.800	1 100 011	143	099	63
–1.850	1 100 100	144	100	64
–1.900	1 100 101	145	101	65

Table 2.4 - Trigger Level DAC Programming Information (continued)

Desired Trigger Level (VDC)	COMMAND WORD			
	Binary	Octal	Decimal	Hexidecimal
–1.950	1 100 110	146	102	66
–2.000	1 100 111	147	103	67
–2.050	1 101 000	150	104	68
–2.100	1 101 001	151	105	69
–2.150	1 101 010	152	106	6A
–2.200	1 101 011	153	107	6B
–2.250	1 101 100	154	108	6C
–2.300	1 101 101	155	109	6D
–2.350	1 101 110	156	110	6E
–2.400	1 101 111	157	111	6F
–2.450	1 110 000	160	112	70
–2.500	1 110 001	161	113	71
–2.550	1 110 010	162	114	72
–2.600	1 110 011	163	115	73
–2.650	1 110 100	164	116	74
–2.700	1 110 101	165	117	75
–2.750	1 110 110	166	118	76
–2.800	1 110 111	167	119	77
–2.850	1 111 000	170	120	78
–2.900	1 111 001	171	121	79
–2.950	1 111 010	172	122	7A
–3.000	1 111 011	173	123	7B
–3.050	1 111 100	174	124	7C
–3.100	1 111 101	175	125	7D
–3.150	1 111 110	176	126	7E
–3.200	1 111 111	177	127	7F



T0 - T1 TIME FOR INPUTS TO SETTLE ≤ 100 NS. IF PROGRAMMING OF TRIGGER LEVEL OR SIGNAL CONDITIONING WAS CHANGED, SETTLING TIME WILL BE 1 MS.

T1 - T2 RESET OR EXTERNAL GATE TIME ≥ 100 NS.

T2 - T3 ≤1 MS + GATE TIME, GATE OPENS, COUNTS ACCUMULATE IN THE COUNTER, GATE CLOSES, DISPLAY FLIP-FLOP IS RESET.

T3 - T4 DATA READY FLAG.

T4 - T5 DISPLAY TIME ELAPSES (≥30 MS TO ≤5 SEC SELECTABLE ON FRONT PANEL WHEN COUNTER IS IN MANUAL MODE).

Figure 2.6 - Simplified Timing Diagram

2.59 Programming Sequence.

2.60 For computer-controlled operation the switch positions on the instrument front and rear panels should be set as indicated below.

Front Panel:

Function	REMOTE
Display Time	Any position
Time Base/Multiplier	Any position

Channel A and Channel B
Input Controls

Slope	Either position
AC/DC	Either position
Attenuators	Any position
Level	Any position
Sep/Com	Either position

Rear Panel:

Storage	ON
Ref	INT

2.61 TIMING.

2.62 Required information on timing for programming the instrument are provided in figure 2.6.

2.63 Local Control

2.64 When operating instruments equipped with the 009, option in local control, some remote lines are still capable of affecting instrument operation. These lines, shown below, should be allowed to float high while operating in local control to avoid interaction between the local and remote inputs.

J113 PIN	DESIGNATOR	J113 PIN	DESIGNATOR	NOTE
6	DCA	38	$\overline{\text{X10B}}$	All lines to remain floating when operating in local control
5	DCB	14	$\overline{\text{X100B}}$	
31	$\overline{\text{X10A}}$	34	$\overline{\text{External Gate}}$	
39	$\overline{\text{X100A}}$	10	$\overline{\text{RESET}}$	
13	Common	35	$\overline{\text{HOLD}}$	

SECTION 3 THEORY OF OPERATION

3.1 GENERAL.

3.2 The basic flow of information between the Series 8000B Counter and each of the interface options is shown in simplified form in figure 3.1. This figure and others in this section are provided as reference for the text and supplement the schematic drawings at the back of this manual and the Counter manual.

3.3 RECORDER.

3.4 The recorder output, in both options, is taken directly from the Readout Assembly. Physically, it consists of a cable from the readout to connectors J111 and J112 of the rear panel. Electrically, the output is taken from TTL integrated logic outputs. These outputs are also used to drive other logic on the Readout assembly. Typical Recorder drive circuits are shown in figure 3.2 and described in the following paragraphs.

3.5 Display.

3.6 The display output is supplied by eight sets of 4-line BCD output lines (or nine sets in instruments equipped with the 004 option). The lines are driven by the 7475 latches which also drive the BCD to 10-line converters.

3.7 Annunciators.

3.8 The annunciator data is carried on six individual lines, taken from inverter or logic gate outputs. These also control the annunciator drivers (Q5, Q6, Q7, Q8, Q9, and Q10).

3.9 Decimal.

3.10 The decimal output consists of eight single-line outputs taken from logic gate and inverter outputs that feed the decimal drivers of the display (Q15, Q17, Q18, Q19, Q20, Q21, Q22, and Q23).

3.11 Print.

3.12 The print line is picked up on the readout board at terminal E66 but the circuitry generating the signal is located on the switch board as shown in figure 3.3. The circuitry consists of a 6 microsecond one-shot generator. Normally, the output of the circuitry is at logic 0 with both inputs of NAND gate MC6 at logic 1. The falling edge of a positive 1 microsecond pulse, generated by the counter control logic, initiates the positive 6 microsecond print pulse. The 1 microsecond pulse is used by the counter to transfer new data into the display logic at the end of a measurement (update pulse); the print pulse indicates the data transfer is complete.

3.13 Zero Reference.

3.14 The zero reference is the logic 0 or common line. It is the zero reference line for all outputs of the RECORDER connectors J111 and J112.

3.15 One Reference.

3.16 The one reference is an internally generated reference of approximately +2.5 volts and is required by some types of printers. The circuit consists of two 2 Kilohm resistors in series, connected between zero reference and the +5 volt power supply line, with the one reference taken from the junction of the two resistors.

3.17 REMOTE OPERATION (008).

3.18 The option 008 offers remote programming of the function, multiplier/time base, and the slope and trigger level of the input control. Programming is through remote lines or remote circuitry that operate in parallel with existing instrument circuitry. Interaction of local controls by remote inputs is eliminated by switching the remote input lines to the REMOTE line (pin L); the remote inputs will not energize unless the REMOTE line is at logic 0 (when the front panel Function switch is set to REMOTE).

3.19 Remote Function.

3.20 A portion of the remote function control lines and the corresponding front panel function control lines are illustrated in figure 3.4. In all cases except the Remote position, diodes separate the remote input lines from the instrument control lines. The Function switch is shown in the remote position causing the $\overline{\text{REMOTE}}$ line to be at logic 0. Remote lines are energized when they are electrically tied to pin L of J110.

3.21 Remote Multiplier/Time Base.

3.22 Shown in figure 3.5 is a portion of the remote and local control of the multiplier/time base. To prevent front

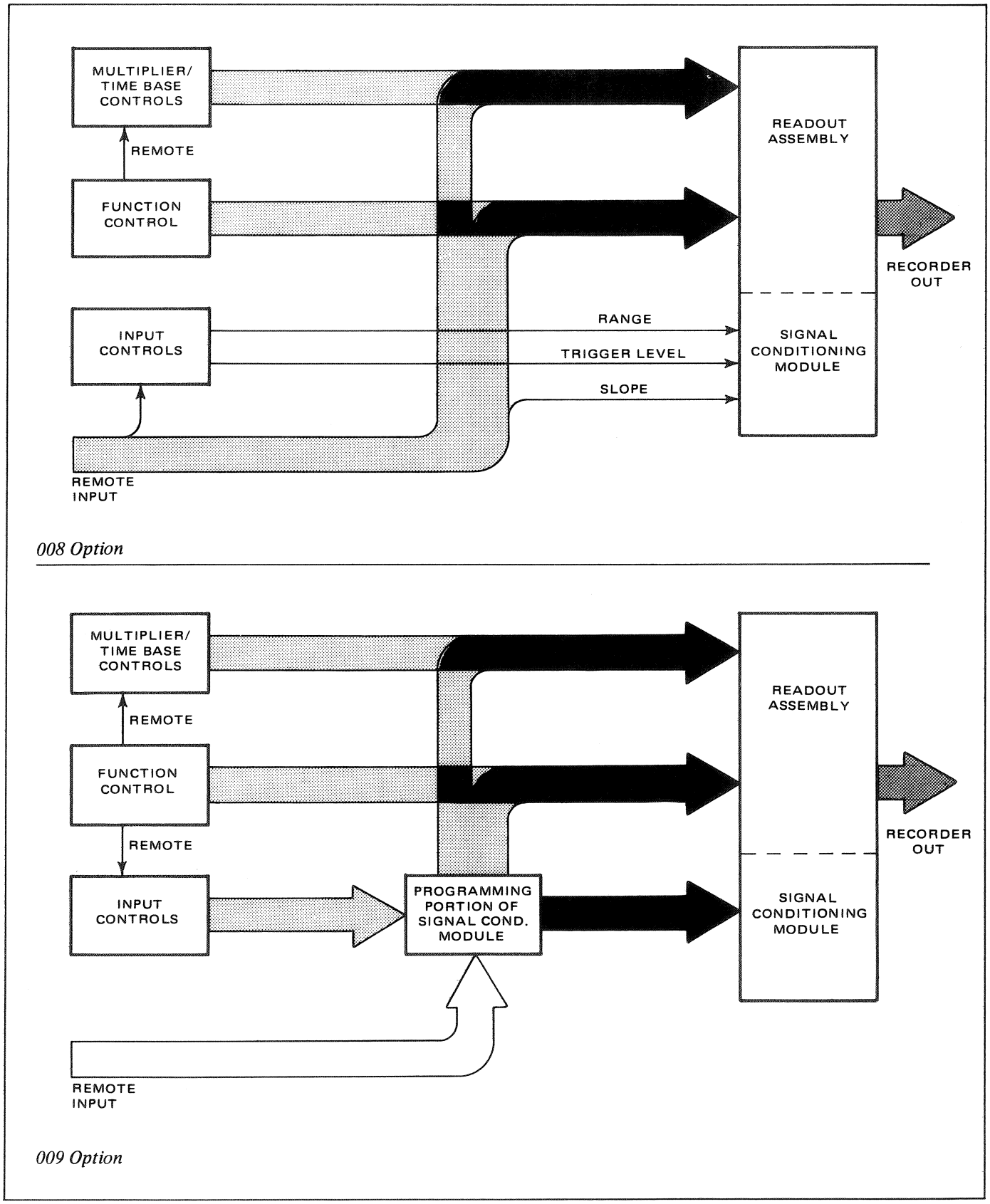


Figure 3.1 - 008/009 Programming, Block Diagram

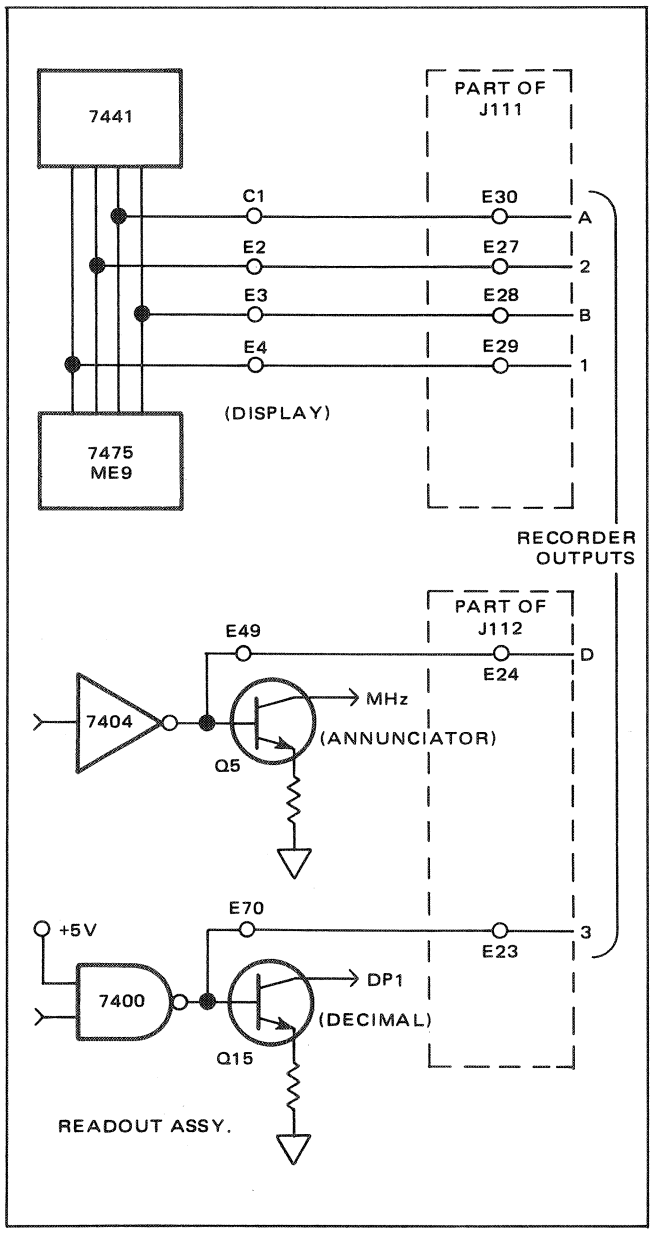


Figure 3.2 - Recorder Output Circuits

panel operation with Remote selected, inverter Q7 output is driven to logic 1, inhibiting the front panel pushbuttons from pulling any of the control lines down. Remote lines are energized when they are electrically tied to pin L of J110.

3.23 Remote Input.

3.24 The remote input (or inputs, depending on the counter model) selects the trigger level and slope of the input signal. The circuitry that controls these operations is part of the basic instrument. It is located on the signal conditioning module, and described in further detail in the 8000B Series manual; the remote programming portions of these circuits are described in the following paragraphs.

3.25 Remote Trigger Levels.

3.26 The remote trigger level circuitry, shown in figure 3.6, consists of a resistor (R27) tying the external control line (J110-S) to the trigger level circuitry. The front panel trigger level control consists of a potentiometer with a built-in switch that opens the circuit in the CCW position (PRESET). The control is placed in the PRESET position when the remote trigger level control is to be used. Because the remote trigger level control line is continuously in the circuit, it is recommended that it be externally opened when local control is used. Resistors R27 and R26 form a 10:1 voltage divider; a maximum input level of 30 volts, therefore, produces an input of 3 volts to the reference input of the amplifier.

3.27 Remote Slope Control.

3.28 The remote slope control is shown in figure 3.7. With remote selected, $\overline{\text{REMOTE}}$ is at logic 0. This causes transistor Q11 to be biased off and prevents the front panel SLOPE switch (S206) from pulling either of the two output lines down. Also, the emitter of transistor Q12 is held at logic 0. With J110-P open, Q12 is biased on through

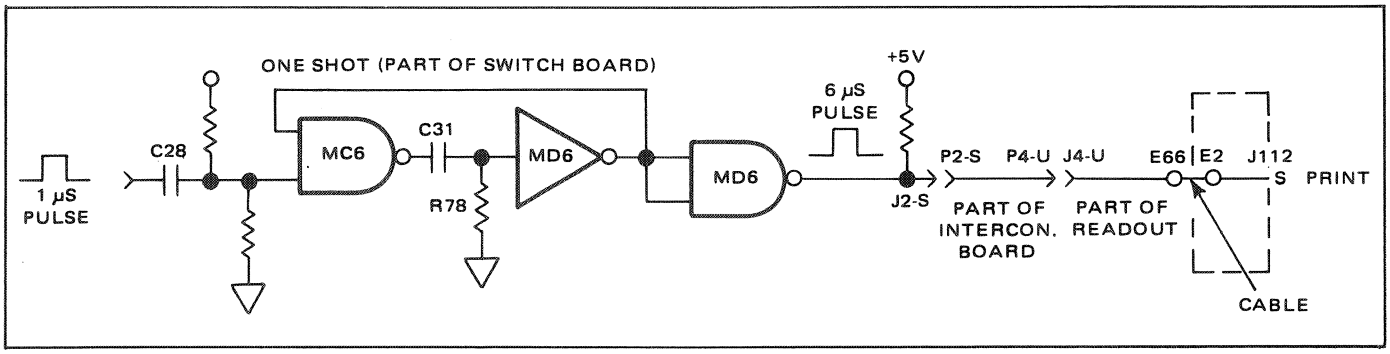


Figure 3.3 - Print Command Circuitry

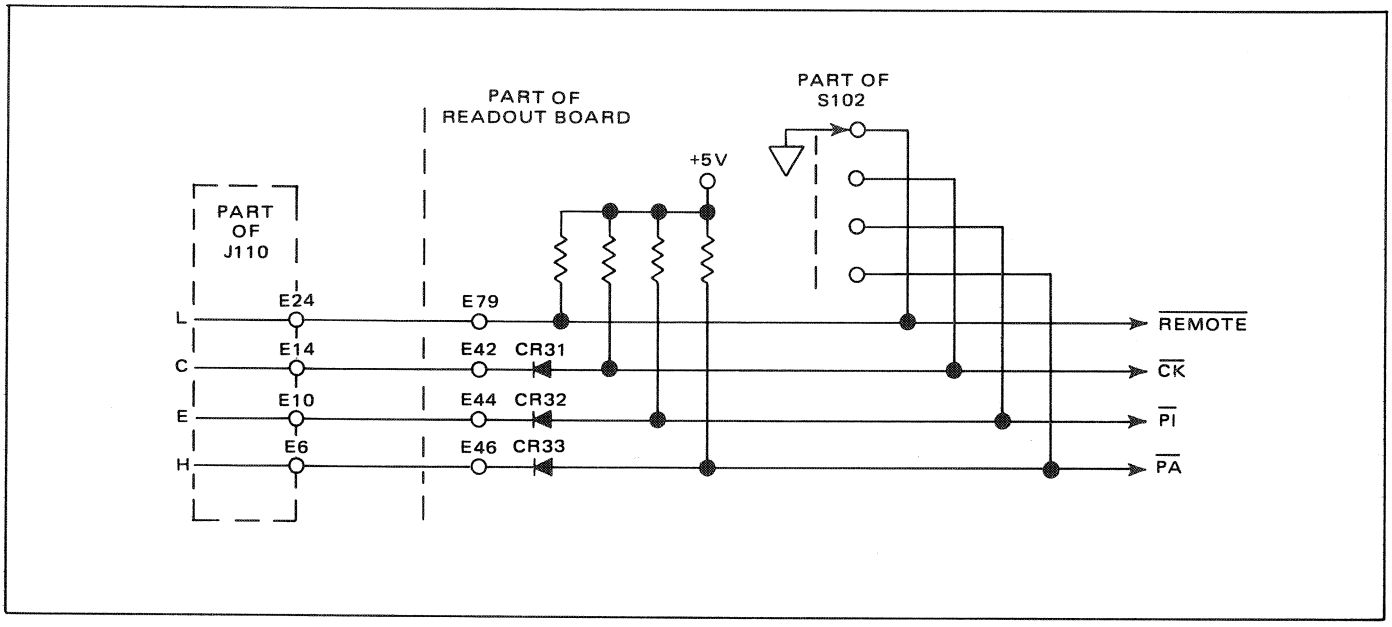


Figure 3.4 - Remote Function Select

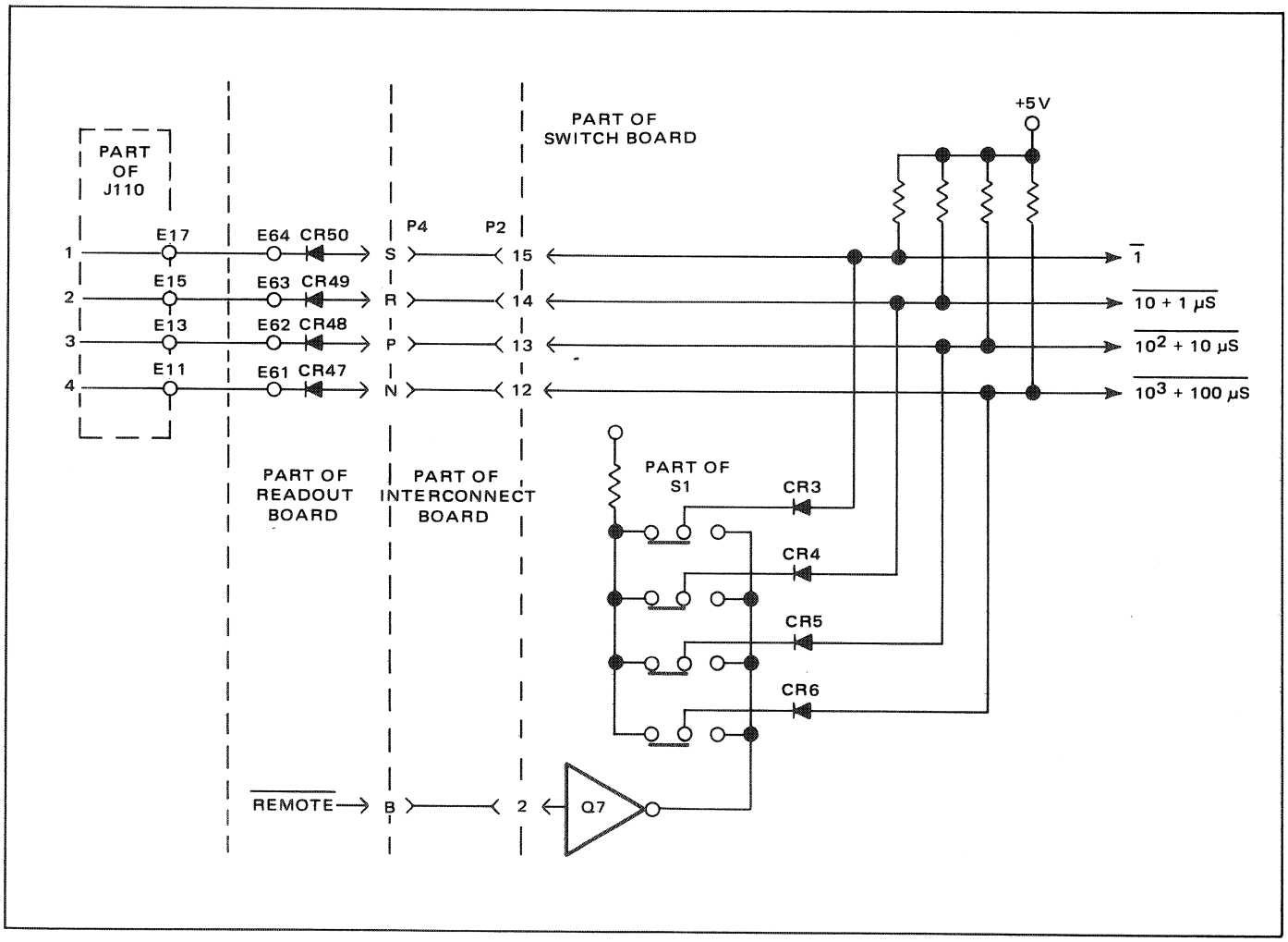


Figure 3.5 - Remote Multiplier/Time Base Select

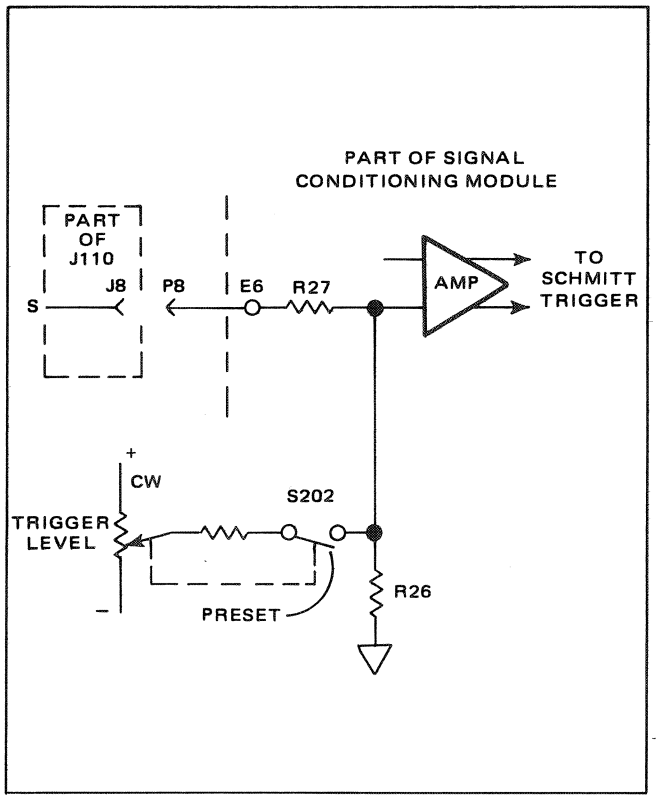


Figure 3.6 - Remote Trigger Level Control (008)

resistors R28, R37, and R32. Q12 thus pulls down the – slope line (inhibiting it) and allowing the signal on the + slope line to reach J6. When J110-P is pulled to logic 0, Q12 is biased off (allowing the – slope line to go positive) and the + slope line is pulled down through R37. The – slope signal is thus allowed to reach J6.

3.29 REMOTE OPERATION, 009.

3.30 The option 009 consists of a special signal conditioning module that replaces the standard conditioning module, a special rear panel that includes a fan, and certain changes in the standard circuitry that will be covered in the text.

3.31 The option offers remote programming of the function, multiplier/time base, and the slope and trigger level of the input control. In addition, it provides digital trigger level control, hysteresis compensation, range control and separate/common select. The option 009 is used on the 8010B, 8015B, 8030B, and the 8035B Series Counters.

3.32 Remote Function.

3.33 The functions are remotely selected by a 4-line, BCD, 1-2-4-8 code. The input lines are routed to a BCD-to-10 line converter located on the 009 Signal Conditioner

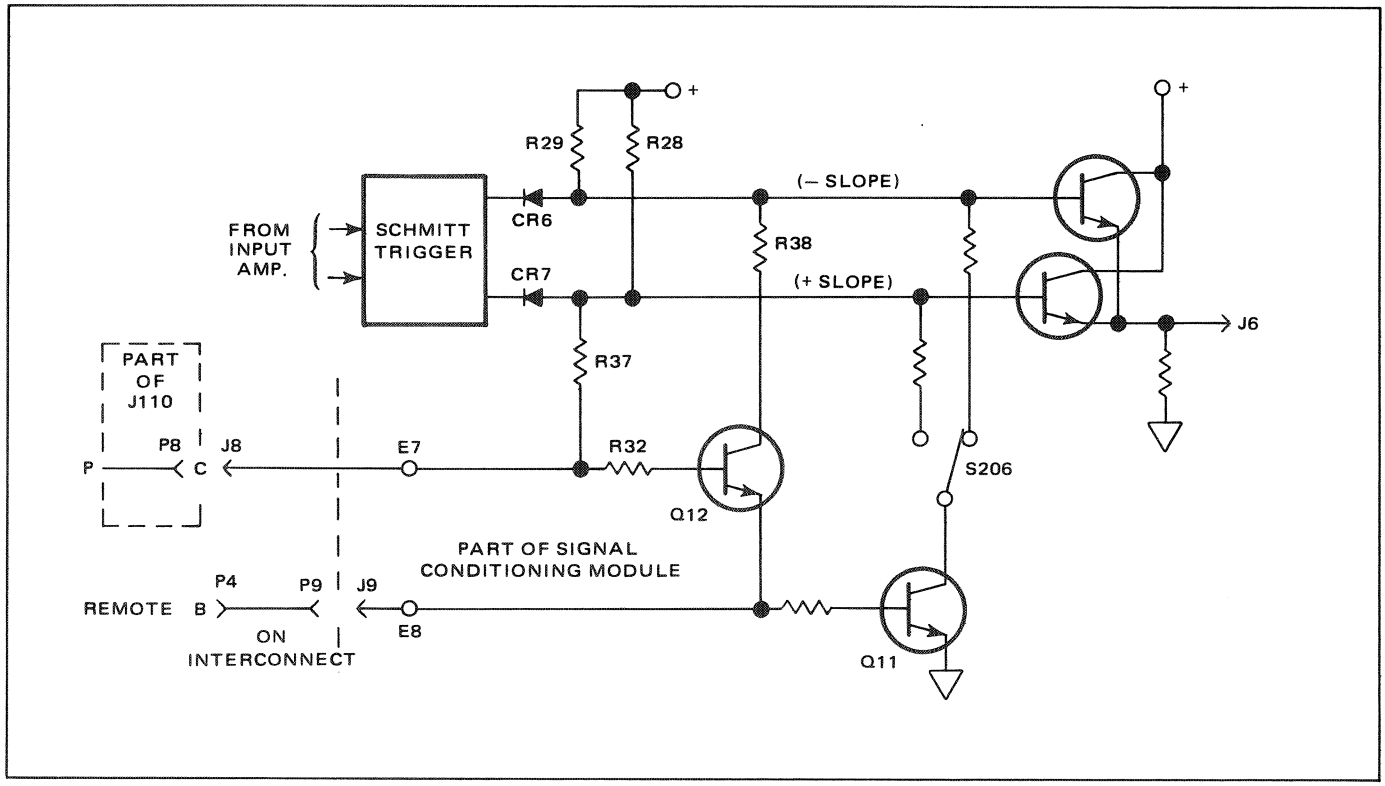


Figure 3.7 - Remote Slope Control (008)

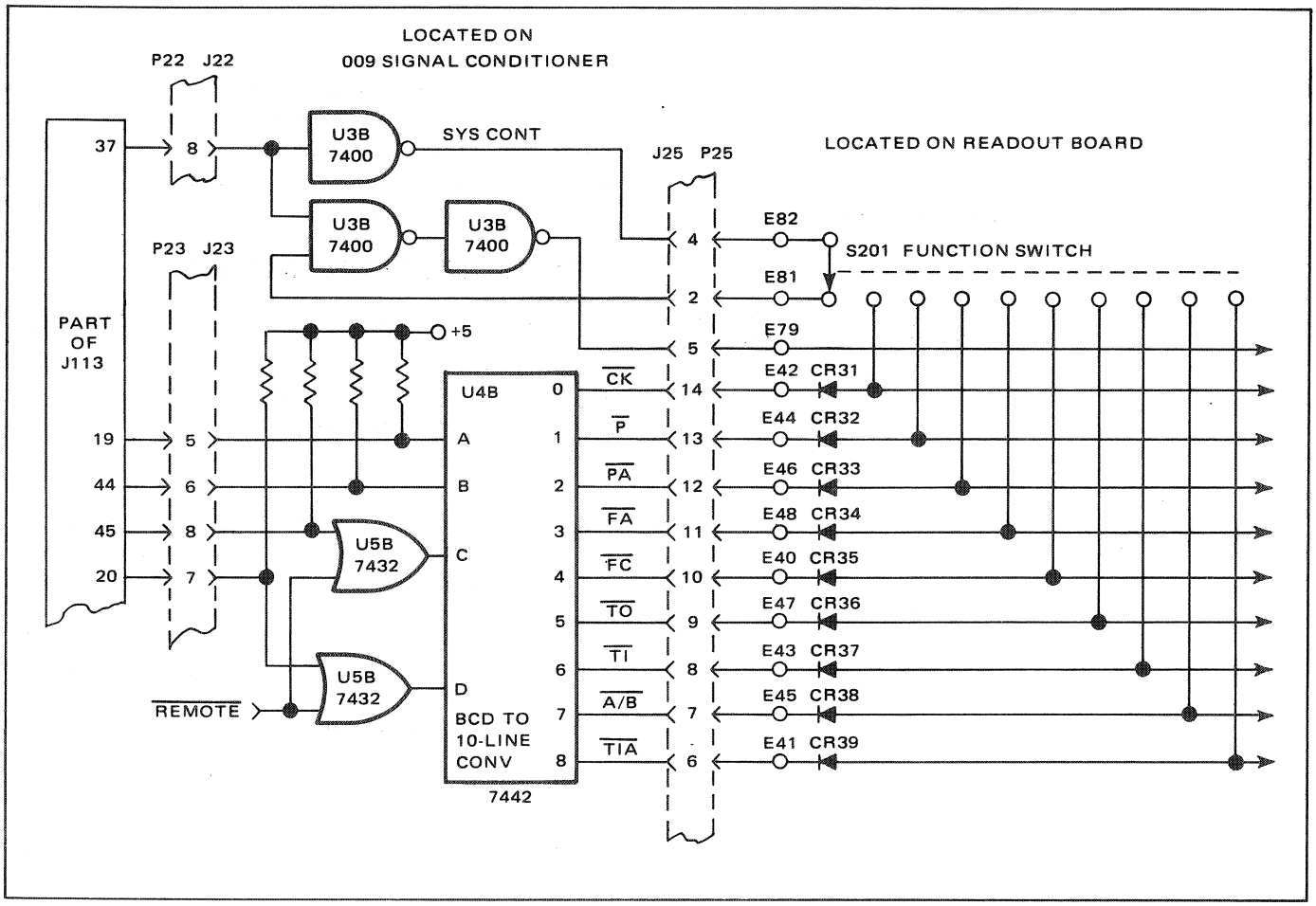


Figure 3.8 - Remote Function Decode

as shown in figure 3.8. With remote selected, the $\overline{\text{REMOTE}}$ signal appearing at the inputs of the two "OR" gates is at logic 0 and does not affect the operation of the converter. The coded function input is decoded to its numeric equivalent and appears as a logic 0 at the specified output terminal.

For Example: the input code for Time Interval (from Section 2) is 20 = 0, 45 = 1, 44 = 1, 19 = 0 for a BCD equivalent weight of 6. This input results in the $\overline{\text{TI}}$ output of the converter (which has a weight of 6) to be at logic 0 and all of the remaining outputs have an output of logic 1. The $\overline{\text{TI}}$ output selects the Time Interval function through diode CR37.

3.34 When Remote is not selected, the $\overline{\text{REMOTE}}$ line at the inputs of the "OR" gates is at logic 1 causing the C and D inputs of the converter to be at logic 1. This places the converter in an "impossible" code state and all output lines are held at logic 1 regardless of what BCD code is introduced at the input.

3.35 Remote Multiplier/Time Base.

3.36 The Multiplier/Time Base (M/TB) is remotely selected by 4-wire BCD 1-2-4-8 code and operates in much the same manner as the remote function selection. The operation of the circuitry as well as operating differences between counter models are described in the following paragraphs.

3.37 8010B, 8030B.

3.38 As shown in figure 3.9 the remote BCD input is converted to 10-line by U4A and routed to the switching board. With remote selected, the $\overline{\text{REMOTE}}$ line is at logic 0. The two 'OR' gates (7432) are not affected but switch S1 is disabled (the logic 0 of the $\overline{\text{REMOTE}}$ is inverted to logic 1 by Q7, and S1 can not pull down any of the control lines to logic 0). The BCD input is converted to its numeric equivalent and appears as a logic 0 at the specified output terminal.

For Example: the input code for 10 + 1 μs is 43 = 0, 18 = 0, 42 = 0, 17 = 1 for a BCD equivalent weight of 1. This input results in the 10 + 1 μs line to be at logic 0 and all the remaining outputs to be at logic 1. The 10 + 1 μs output is selected in the instrument through diode CR49.

3.39 When remote is not selected, the $\overline{\text{REMOTE}}$ line is at logic 1. Switch S1 is enabled and U4A, through the two 'OR' gates, is inhibited (see paragraph 3.34).

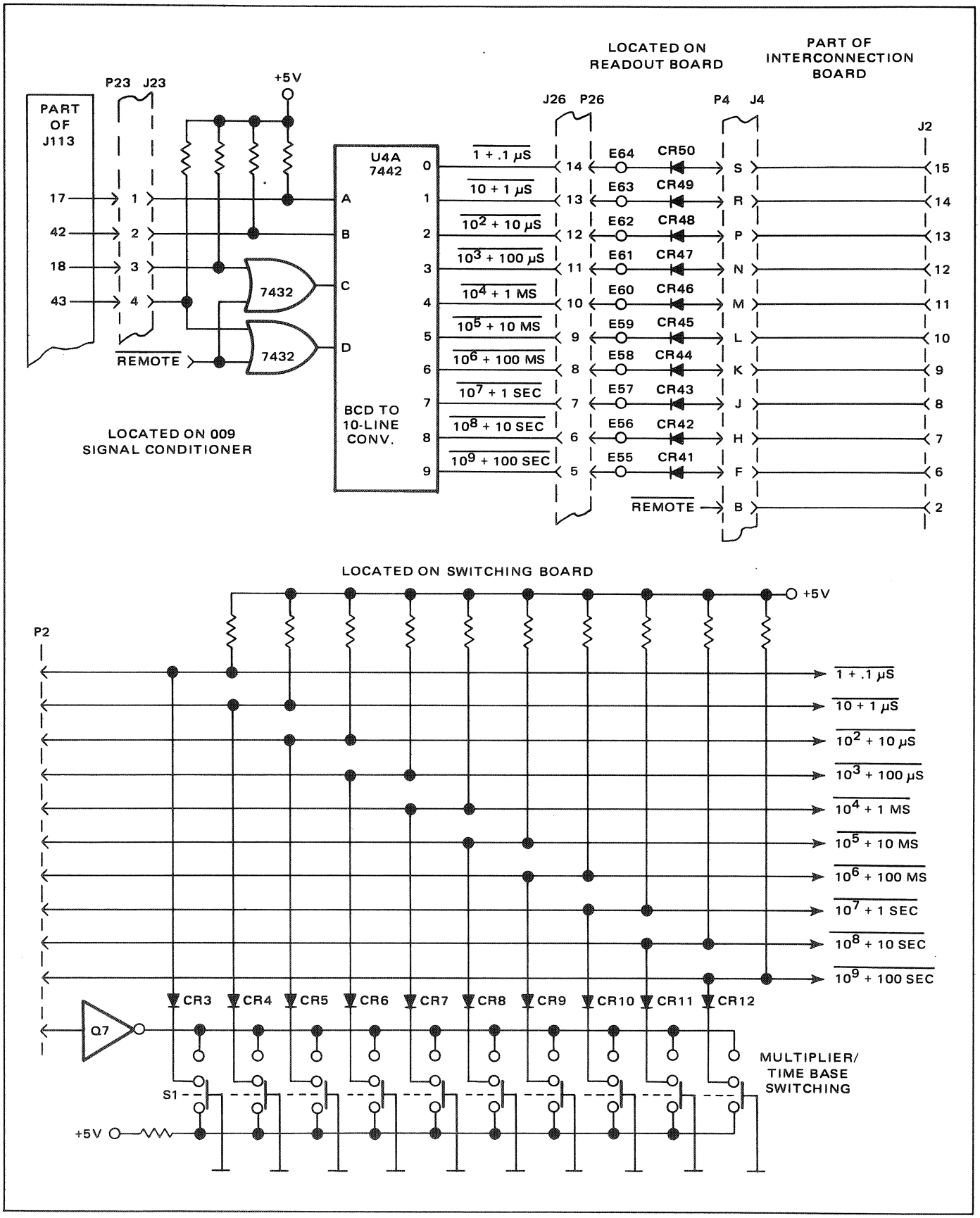


Figure 3.9 - Remote Multiplier/Time Base Decode (8010B, 8030B)

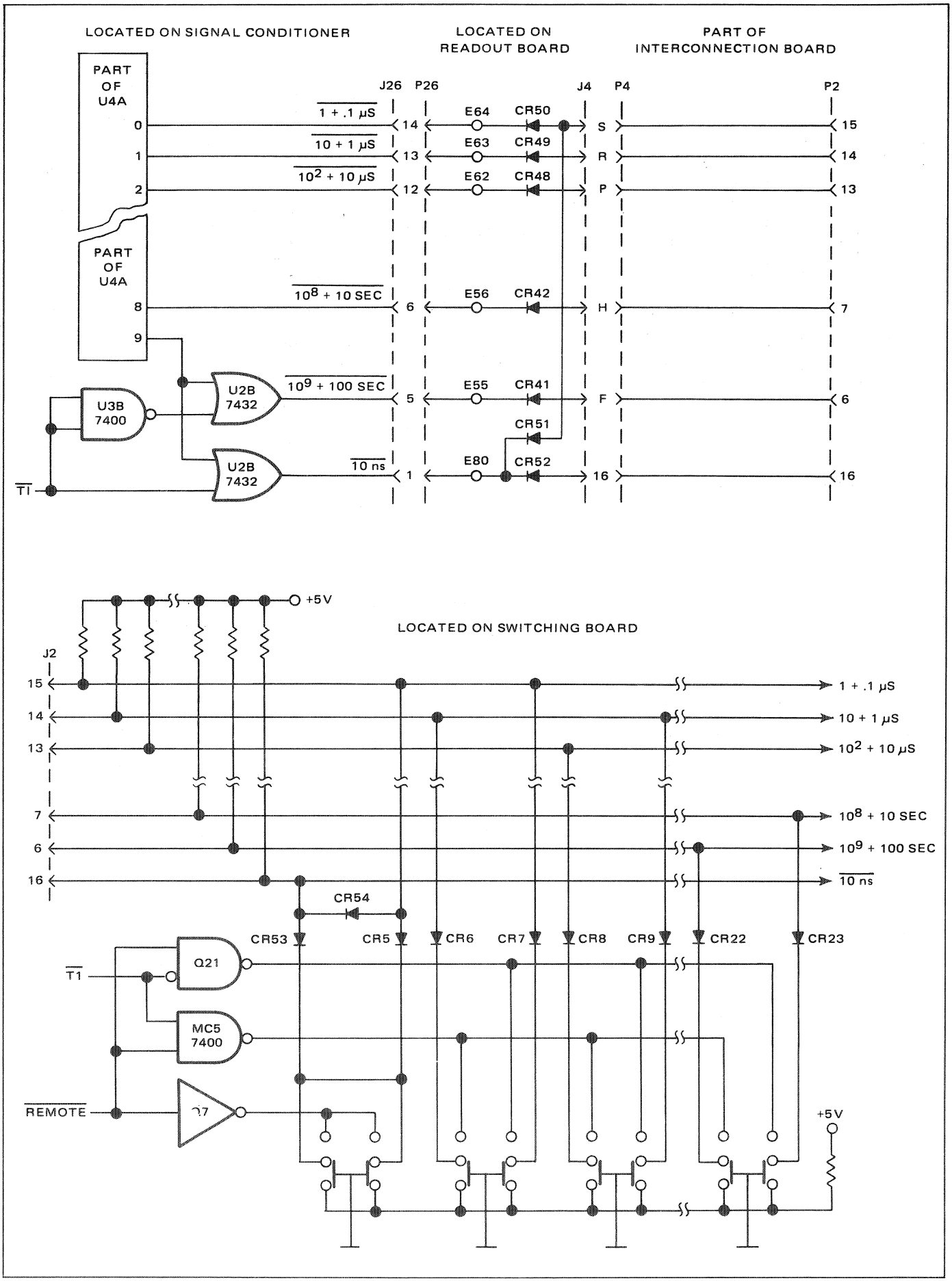


Figure 3.10 - 009 Remote Multiplexer/Time Base Decode (8015B, 8035B)

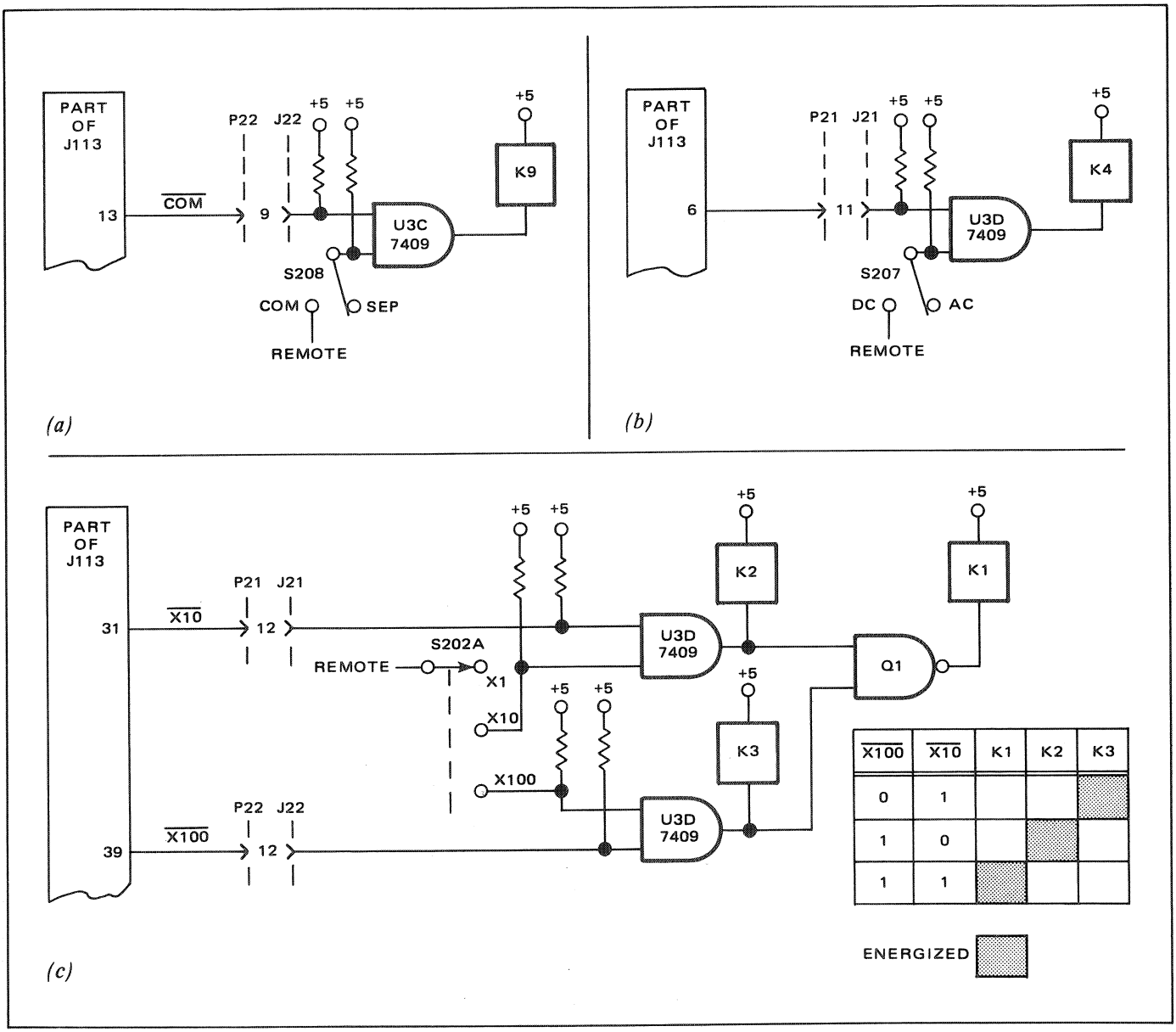


Figure 3.11 - Sep/Com, AC/DC Range Remote Inputs (009)

3.40 8015B, 8035B.

3.41 In all functions except Time Interval, the multiplier/time base of these instruments is programmed and operates in the same manner as the 8010B and 8030B counters. That is, the input BCD code is converted to 10-line by converter U4A and U4A is inhibited while the instrument is in local control. As shown in figure 3.10, additional logic is provided for the TI function and includes two 'OR' gates (U2B) and a NAND gate (U3B). In all but the TI function, the $\overline{TI}$ line (from the function converter, U4B) is logic 1, U3B output is logic 0, and the 9 output of U4A, when selected, appears at J26-5. In the TI function, $\overline{TI}$ is logic 0, the output of U3B is logic 1 and the 9 output of U4A, when selected, appears at J26-1 ($\overline{10}$ ns line). Also shown in figure 3.10 is the interconnection of the remote and local multiplier/time base circuitry.

3.42 Remote Input Operation.

3.43 The control of the input circuitry (or inputs) includes remote selection of separate/common, input range, and AC/DC. The signal conditioning module of the 009 option uses relays in place of the standard instrument switches to permit remote operation. The circuitry is described in the following paragraphs.

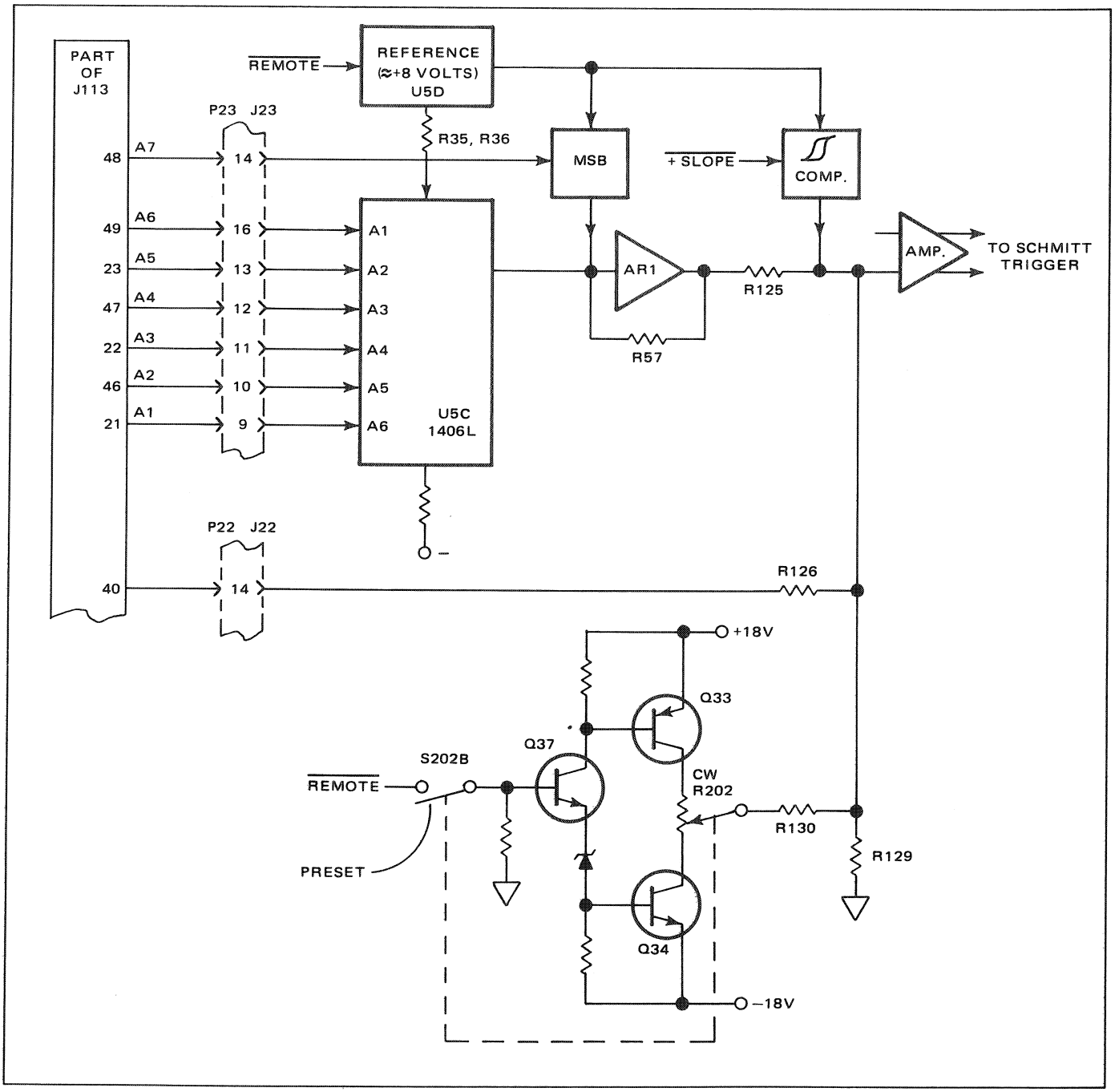


Figure 3.12 - Remote Trigger Level Control (009)

3.44 SEPARATE/COMMON.

3.45 This circuit, shown in figure 3.11(a) uses an AND gate driving a relay (K9). With remote not selected REMOTE is at logic 0 and the remote COM line is at logic 1. When S208 is in the (SEP) position, the output of the AND gate is at logic 1 and the relay is not energized; when S208 is in the (COM) position the output of the gate is at logic 0 and the relay is energized. In remote operation, the REMOTE line is at logic 1 and the switch S208 is inhibited. A logic 0 on the remote $\overline{\text{COM}}$ line (J113-13) causes the relay to energize.

3.46 AC/DC.

3.47 This circuit shown in figure 3.11(b) operates in the same manner as the Separate/Common circuit (paragraph 3.44). The circuit is remotely energized by a logic 0 on J113-6.

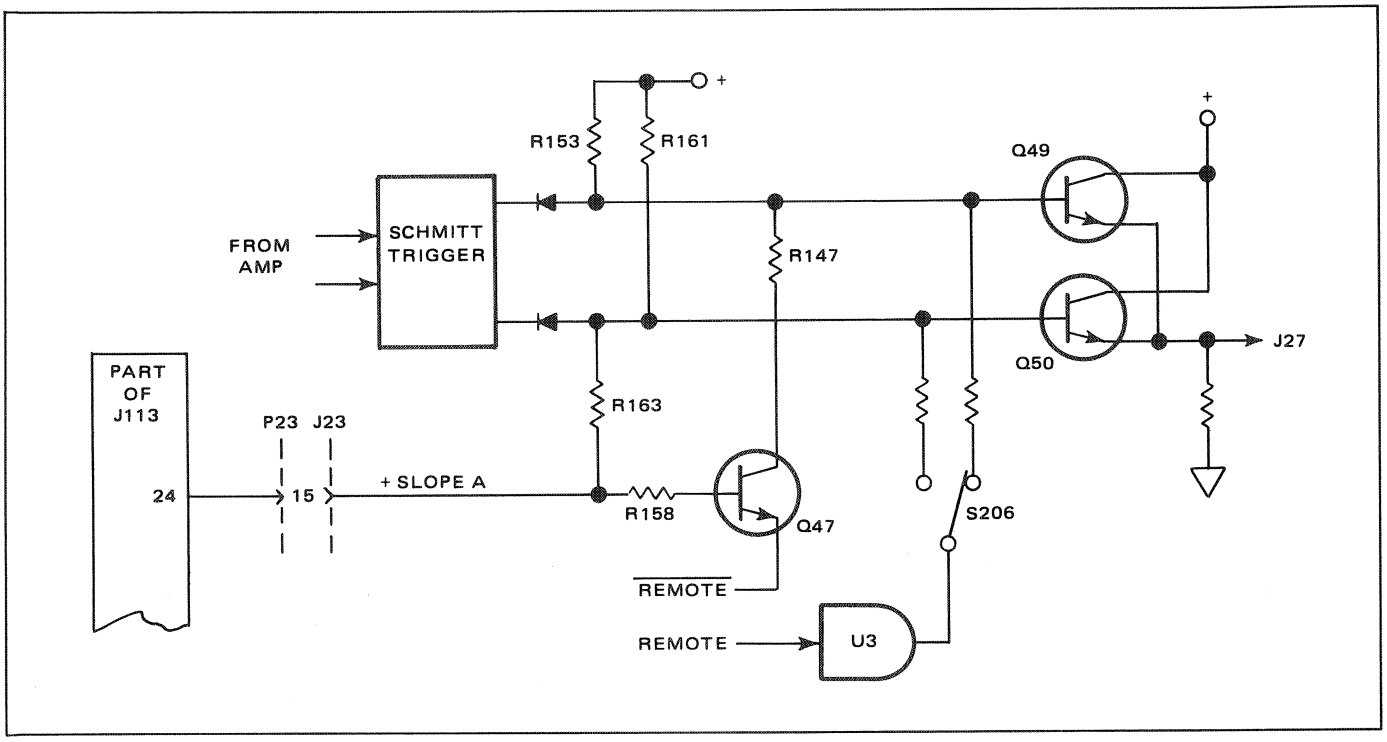


Figure 3.13 - Remote Slope Control (009)

3.48 RANGE.

3.49 The range control circuitry, figure 3.11(c), consists of two AND gates (U3D), a NAND gate and three relays. In local operation, the REMOTE line is logic 0 and S202 is capable of pulling the X10 and X100 lines down. In remote operation S202A is inhibited and selection is through the remote lines J113-31 and J113-39. The input code for selecting each of the three relays is provided in the table.

3.50 TRIGGER LEVEL CONTROL.

3.51 The circuitry shown in figure 3.12 illustrates the methods used to provide the three separate means of setting the input signal trigger level. The three methods are: Front panel control, analog input, and digital input control. All the circuitry shown is located on the 009 Signal Conditioning Module.

3.52 The front panel control circuitry basically consists of potentiometer R202 and resistor R130 working in conjunction with resistors R125 and R129 to generate a positive or negative control level. The control level is applied to the reference side of the amplifier and determines the trigger level of the Schmitt trigger. The remainder of the circuitry is used to switch the potentiometer 'in' and 'out' of the circuit. This 'pot' is in the circuit when the instrument is in local control and R202 is not in the PRESET position. In this instance, $\overline{\text{REMOTE}}$ is at logic 1 and through Q37 and CR28, biases Q34 ON. The collector current of Q37 also biases Q33 ON. This electrically connects the CW end of R202 to the +18 volt line and the CCW end of R202 to the −18 volt line. The pot is switched out of the circuit when R202 is placed in the extreme CCW position (PRESET), causing S202B to open, or when remote is selected, causing $\overline{\text{REMOTE}}$ to be at logic 0.

3.53 The analog input operates precisely as it does in the 008 option. The input (pin 40 of J113) feeds current into the circuitry through R126 and provides ±300% of the trigger range. It is used with R202 in the PRESET position or in Remote Programming.

3.54 The digital trigger level control is used only in remote operation. The circuit shown in simplified form in figure 3.12 provides 128 separate, digitally-selected, trigger levels through seven control lines. The circuitry consists of a 6-bit Digital-to-Analog converter (U5C) a seventh discrete-component bit (MSB), an 8-volt reference source (U5D), an operational amplifier (AR1), and a hysteresis compensation circuit.

3.55 The Digital-to-Analog converter generates 64 discrete output current levels from 0 to −2 milliamps. The output is fed to operational amplifier AR1 where it is

converted at the output to a voltage level of zero to +6.3 volts. The voltage is fed through resistor R125 to the input of the amplifier. A full scale output results in a trigger level of +3.150 volts.

3.56 The MSB (most-significant bit) circuit consists of a positive current source that can be switched in or out of the circuit and supplies slightly more than +2 milliamps. This current is converted to a voltage by the operational amplifier and fed through R125 to the amplifier. Its output results in a trigger level of –3.200 volts. The 6 bit Digital-to-Analog integrated logic circuit and the discrete component MSB circuit operate in conjunction to produce all of the available digitally selected trigger levels. These are shown in table 2.4.

3.57 The eight volt reference source supplies a fixed stable voltage level for the MSB and hysteresis compensation circuits and also provide a required +5 milliamp reference via R35, R36 to U5C. The reference is on only in remote operation and, by this fact, inhibits all the digital trigger level select circuitry when the instrument is in local control. The reference circuit itself consists of an integrated 5-transistor matrix (U5D) with three of the transistors used as diodes, one as an emitter follower, and one (reversed biased) as a zener diode. The output is a very stable voltage of approximately +8 volts.

3.58 The hysteresis compensation circuit provides a correcting supply of positive current to the input of the amplifier to compensate for an inherent voltage shift that occurs in the Schmitt trigger for changes in input signal polarity. This correction is necessary to enable the accurate selection of a trigger level of either + or – slope. The circuit is energized by a logic 1 signal generated by Q47, the remote + slope select transistor.

3.59 SLOPE CONTROL.

3.60 Shown in figure 3.13 is the circuitry used in the selection of the trigger slope. With remote selected, the front panel slope switch S206 is inhibited and remote + slope select transistor Q47 emitter is at logic 0. With + slope selected at J113-24 (logic 1), transistor Q47 is biased on through R158, R163, and R161, inhibiting the – slope line. With J113 at logic 0, transistor Q47 is biased off and the + slope line is biased off.