



**INSTRUCTION MANUAL
WITH
PARTS LIST**

DIGITAL PANEL METER

MODELS 2471/2472

U.S. Patents 3,051,939; 3,316,547
and other Patents Pending

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DIVISION OF SYCON CORPORATION
959 CHENEY AVENUE • P.O. BOX 491
MARION, OHIO 43302

SECTION 1

INTRODUCTION


The Model 2471/2472 Series is a group of single-range, bipolar, high input impedance, 4 1/2 digit, LED Display panel meters. Models 2471 and 2472 both feature single-ended input. Model 2472 also offers isolated and buffered BCD output.

Both are available in any one of 4 DC ranges from 10.0mV to 100V. A customized version is also available with adjustable offset and sensitivity for display of engineering units.

Based on an LSI implementation of Weston's patented dual-slope technique, these DPM's feature a basic range accuracy of $\pm 0.01\%$ Rdg ± 2 digits. Auto-zeroed conversion, a single thermally-stabilized reference and low power consumption provide rapid warm-up and excellent control of zero and full-scale calibration.

Maximum reading is ± 19999 counts on a 0.56 inch LED display. Polarity and outrange indications are automatic, clear, and unambiguous. Numerous optional modes of operation are possible within each instrument to facilitate special customer requirements and systems operation. A capability to "Read on Command" to rated accuracy within one conversion makes the 2471 and 2472 particularly attractive for multiplexed input applications.

WARNING

THE SYMBOL  ON THE INSTRUMENT LABEL IS AN INTERNATIONAL SYMBOL MEANING "REFER TO OPERATING INSTRUCTIONS." WARNINGS AND PRECAUTIONS TO AVOID PERSONAL INJURY AND INSTRUMENT DAMAGE ARE LISTED THROUGHOUT THIS MANUAL.

SECTION 2

2471/2472 PERFORMANCE SPECIFICATION

COMMON CHARACTERISTICS

Display Scale Length: +19999
Type of Display: Monsanto MAN 6600 Series LED,
0.56 inches high.
Polarity: Negative inputs: Minus sign at
far left. Positive inputs: Blank
at far left (+at far left is a factory
option)
Outrange Indications:
Free running mode: Alternating
between 0000 and a 1 in the MSD
location, with the polarity sign
preserved.
Command-start mode: Initially 0000,
followed by an MSD 1, with the
polarity sign preserved.
Decimal Points: Available at any of the following
four positions, by grounding a
selected terminal at the card-edge
connector.
D.P.1 1.XXXX
D.P.2 1X.XXX
D.P.3 1XX.XX
D.P.4 1XXX.X

Conversion
Technique Dual-Slope A/D conversion with auto-zero and single
reference.
Integration is "True-Bipolar" (non-absoluting)
Free running mode: 2.5 conversions /second
100 ms signal Integration time
Externally Triggered mode: 100 ms delay from command
start until signal integrate,
during which converter auto-
zeros
100 ms input settling time in
response to \pm FS step (to
within 0.01%)
Return to "HOLD" mode after
conversion.

Response Time: Typically 1 conversion to within 0.005% of final value

Control Functions:
(TTL Compatible)

1. External Hold - Grounding Start/Hold terminal at card-edge connector to pin N will retain most recent reading. (grounding circuit must sink 100uA) (Pin K to N for 2471) J or K to BCD connector Pin 2 for 2472.
2. Command Start-Momentary release of Start/Hold; duration 1 ms minimum
3. External Decimal Point Control - Connection of one of 4 terminals to Pin N will enable one of 4 decimal points. External circuitry should be capable of sinking 25 mA peak. (Pin N reference for 2471 or 2472)
4. Blanking Input - Connection of pin P to pin N will blank all but the decimal point and polarity. Sink requirement is 500 uA nominal. (Pin N reference for 2471 or 2472).

Outputs

Available .. Auxiliary Power output for driving customer circuitry
+12 volts +5% at 10 mA max.
+5 volts +5% at 10 mA max.

Physical

Characteristics .. Size: Panel Cutout Dimensions: 3.924 in. x 1.682 in. (99.67 mm x 42.72 mm)

Instrument Dimensions: 3.875 in. x 1.75 in. x 4.56 in. (98.42 mm x 44.45 mm x 115.82 mm)

Depth Behind Panel: 4.00 in. (101.6mm)

Bezel Thickness: .56 in. (14.22mm)

Weight: 12.7 oz. (360g)

Pinout: Compatible with Model 1234

Case Style: Same as 2460 and 1234, Weston standard case.

Environment Operating Temperature: 0°C to 50°C
Storage Temperature: -55°C to $+85^{\circ}\text{C}$
Humidity: 50°C at 85% RH, non
condensing*

Ratiometric
Operation Available as a factory or Weston Modification
Center option, with no degradation of per-
formance over a reference voltage range of
7 volts $\pm 33\%$. Other nominal reference voltages
can be accommodated on special order while
maintaining the same two to one range, by
changing the internal resistance reference
divider. Standard input impedance of the
reference circuit is 15 kilohms.

Power
Requirements . . . 100VAC, 117VAC, 220VAC or 240VAC, per
customer order.
Tolerance: $\pm 10\%$
Frequency: 47 to 440 Hz
Power at 117VAC 60Hz: 3.5 watts with display at
 -1.8888 , for basic 2 volt 2471 with no external
power supply loading.

* At elevated temperature and humidity, 100mV model should be
rezeroed for optimum accuracy.

1 VOLT RANGE

Reference
Conditions $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$, for 90 days

Accuracy: $\pm 0.005\%$ Rdg ± 2 digits

Accuracy near Zero:

Input shorted: ± 0000

Monotonic through zero with no
observable hysteresis or dead-
band (less than one count)

Zero band is 100 μV wide, nominal

Linearity: $\pm 0.005\%$ FS $\pm 1/2d$

Warm Up Requirements: Zero: essentially instantaneous

FS Cal: 10 minutes, maximum
(within 0.01% of final
value)

Operating
Conditions (18°C to 28°C)

Accuracy: $\pm 0.01\%$ Rdg ± 2 digits

Temperature Influence: Zero: ± 0 counts (no more than
1 count from 0°C to 50°C)

FS Cal.: ± 10 ppm/ $^{\circ}\text{C}$ Max

10V, 100V RANGE

Reference
Conditions $\pm 0.005\%$ Rdg ± 2 digits

Operating Conditions: $\pm 0.025\%$ ± 2 digits

Temp. Coeff: 35ppm/ $^{\circ}\text{C}$ max.

100 mV RANGE

Reference

Conditions, after
30 minutes warm-
up, zeroing and
calibration

$\pm 0.005\%$ Rdg. ± 2 digits

Operating

Conditions

$\pm 0.015\%$ Rdg ± 2 digits

Zero Temp Coeff: $\pm 3\mu\text{V}/^{\circ}\text{C}$

Calibration Temp Coeff: ± 20 ppm/ $^{\circ}\text{C}$ max.

10 mV RANGE

Sensitivity.....

1 Microvolt

Input Circuit

Single ended

Zero Suppression: $\pm 100\mu\text{V}$ by control behind
window

Zero TC: $\pm 0.15\mu\text{V}/^{\circ}\text{C}$, max. Auto zeroed

Bias Current: 7mA max.

Bias Current TC: $50\text{pA}/^{\circ}\text{C}$, max

Input Impedance: 1000 megohms, min

Protection: $\pm 20\text{V}$, max.

NMR

40dB, min at 60Hz, typically 50dB

CMR

100dB, min at DC and 60Hz

Accuracy

$\pm 0.005\%$ Rdg $\pm 0.015\%$ FS

Gain TC

± 10 ppm/ $^{\circ}\text{C}$

Linearity

± 3 counts, max.

BCD Data

Data

Available

Four 4 bit decimal words

One 1 bit "10000" word

Polarity: positive high

Outrange: positive high

Print Command (Data ready): Low when

conversion is complete

Control Inputs Start/Hold (Analog Connector, Pin K) to
BCD Connector, Pin 2.
Remote/Hold (Analog Connector, Pin J) to
BCD Connector, Pin 2.

Either Hold line activates Hold of the
conversion process and retention of
both display and BCD data when connected
to BCD connector, Pin 2.

Logic Levels Data: Positive, TTL, 2UL
Print Command: Negative, TTL, 7UL
Control Inputs: Negative, TTL, 1 Low Power
Load

Isolation Potential difference between Instrument ground
and BCD ground, 200 VAC max.

TABLE 2-1
RANGES

RANGE	INPUT IMPEDANCE	FULL SCALE PRESENTATION	OVERLOAD MAX. VOLTAGE
100 mV	1000 M ohms	199.99	+60V
1 V	1000 M ohms	1.9999	+150V
10 V	1 M ohms	19.999	+500V
100 V	5 M ohms	199.99	+500V
Custom	1000 M ohms	199.99	+60V

NMRR: 50dB at 60Hz (with single pole filter:100 ms settling time)

CMRR: 100dB at 60Hz (with 1k ohm unbalance)

Max. CMV: 500Vrms (2471)

200Vrms (2472)

TABLE 2 - 2

CATALOG NUMBERS

RANGE	Catalog Number 2471 XXXXXX						With BCD - Catalog Number 2472 XXXXXX			
	100 VAC	117 VAC	220 VAC	240 VAC	100 VAC	117 VAC	220 VAC	240 VAC		
10 mV	280591	280593	280592	280594	280595	280597	280596	280598		
100 mV	280551	280561	280556	280566	280571	280581	280576	280586		
1 V	280552	280562	280557	280567	280572	280582	280577	280587		
10 V	280553	280563	280558	280568	280573	280583	280578	280588		
100 V	280554	280564	280559	280569	280574	280584	280579	280589		
Custom	280555	280565	280560	280570	280575	280585	280580	280590		

SECTION 3

MECHANICAL INSTALLATION

GENERAL

Figure 3-1 shows a pictorial view and overall dimensions of the DPM.

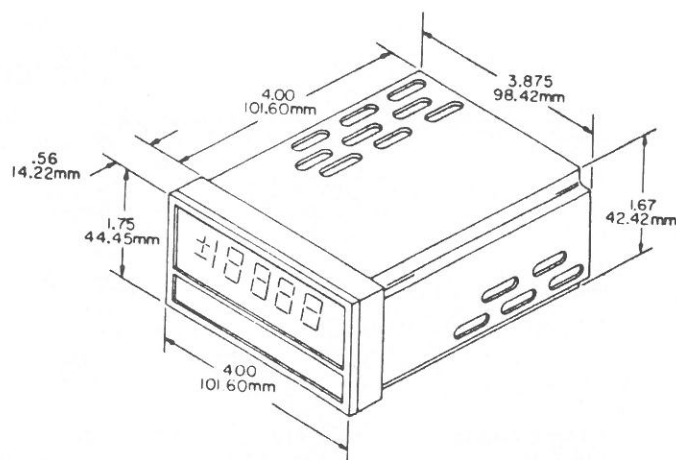


Figure 3-1 Outline Dimensional Drawing

PANEL PREPARATION

Prepare a panel cutout at the desired mounting location in accordance with Figure 3-2. If panel thickness exceeds 0.375" (9.5 mm), it may be necessary to reverse the axial orientation of the four panel retaining clamps located just behind each corner of the DPM case flange.

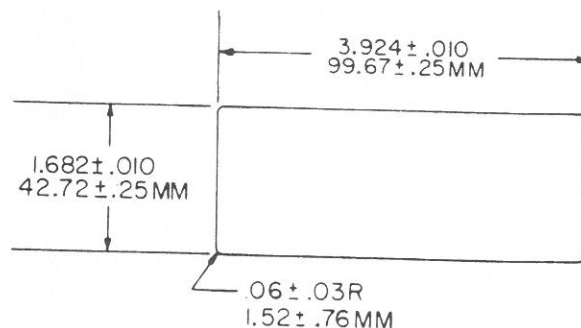


Figure 3-2 Panel Cutout Dimensions

DPM INSTALLATION

Remove the DPM front bezel by inserting a blade or screwdriver tip near a corner and gently prying bezel off. Loosen panel retaining clamps by rotating each associated screw 3-4 turns counter-clockwise. Install the DPM from the panel front, being sure that each clamp clears the panel rear surface. Rotate clamp adjusting screws clockwise until DPM is secure

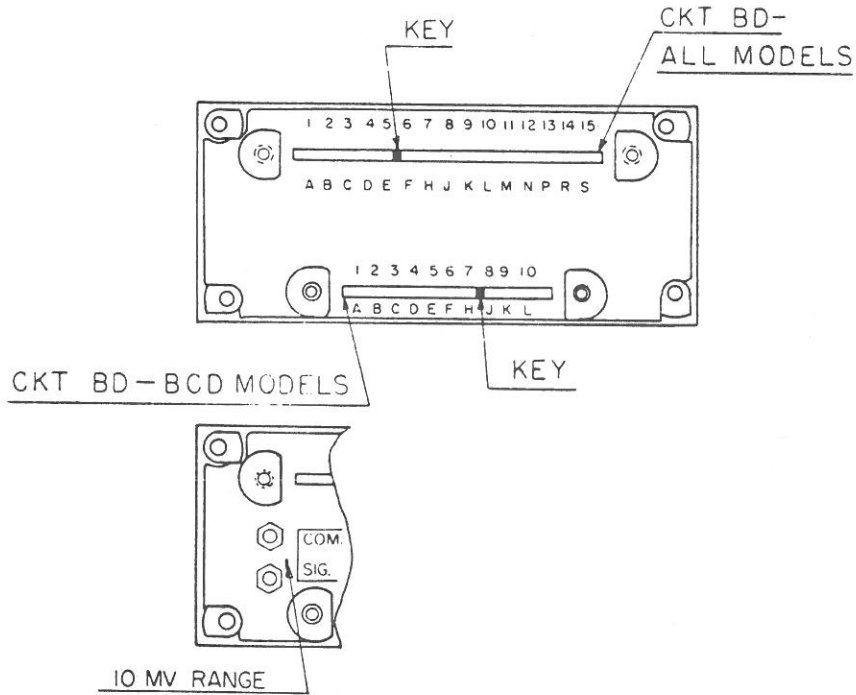


Figure 3-3. Rear Case View

SECTION 4

ELECTRICAL INSTALLATION


The Digital Panel Meter has provisions to accept up to two connectors at the rear of the case. The upper row of contacts (30 terminals) shown in Figure 3-3 is used for all models. The lower row of contacts (20 terminals) is used on those models providing BCD output.

A 30 pin mating connector is available from Weston under catalog number 9790-0267253; the connector is ELCO P/N 00-6007-030-980-002, Amphenol P/N 225-21524-601(117) or equal. The polarizing key should be located between pins 5 and 6 to prevent misapplication and possible damage to the DPM.

The lower (20 pins) BCD connector is a high-retention type available from Weston under catalog number 9790-0271102-000.

Table 4-1 shows the connector pin assignments applicable to the main board (BCD versions in parentheses where different) Table 4-2 shows the additional pin assignments applicable to the BCD board.

ELECTRICAL INSTALLATION

 When mounting printed circuit connectors on the back of the panel meter, be sure that neither signal voltage nor line voltage are present on any leads which may be affixed to the connectors.

USE AND CALIBRATION FOR 10mV RANGE

Application - To minimize thermal emfs and pickup, signal input is made at special rear panel screw terminals. Crimp connectors have been provided to permit a solid connection without the need for solder. Fasten the shield and one lead to COM terminal with the remaining lead connected to SIG terminal. The shield should be left floating at its far end.

Calibration -

1. Allow 30 minutes for instrument to stabilize with leads shorted. Avoid exposure to drafts.
2. Adjust control R113 for reading of zero with "-" sign just barely extinguished.
3. Apply +17.000mV and adjust R125 for reading of 17000. Calibration at this point will insure best accuracy over full input voltage range spanning both positive and negative input signals.

TABLE 4 - 1
PIN-OUT STRUCTURE

Pin No.	2471/2472	Pin no.	2471/2472
1	No Connection - N.C.	A	Ranged Signal Input
*2	Signal Input	B	N.C.
3	N.C.	C	External Reference Input
4	Analog Power Supply Common	D	N.C.
5	+ 12V	E	N.C.
6	N.C.	F	-12V
7	Spare	H	+5V
8	N.C.	J	Remote <u>Hold</u> /2472 only
9	N.C.	K	Start/Hold
*10	Signal Common	L	Spare (Overrange/2472)
11	D.P. 4-XXX.X	M	N.C.
12	D.P. 3-XX.XX	N	Digital Com (See Note below)
13	D.P. 2-X.XXX	P	Blanking
14	D.P. 1-.XXXX	R	Earth Ground - Shield
15	Power Input - High	S	Power Input - Low

TABLE 4 - 2
BCD BOARD PIN-OUT

Pin No.	2471/2472	Pin No.	2471/2472
1	4	A	1
2	Digital Common (Isolated)	B	2
3	8	C	10
4	40	D	20
5	80	E	<u>100</u>
6	400	F	PC Print Command
7	800	H	200
8	4000	J	1000
9	8000	K	2000
10	+ Polarity	L	10000

* On 10mV range, input terminals are isolated screw terminals at rear.

Note: On both BCD and non-BCD instruments, decimal points are activated by connection to digital common, Pin N. However on BCD instruments, Print Command, Hold and BCD data is referenced to isolated digital common, BCD connector, Pin 2.

SECTION 5 OPERATION

COMMON FEATURES

Power

Connect power line wiring to pins R, S and 15 as shown in Table 4-1. Note that the instrument is factory wired for operation at only one of four nominal line voltages: 100, 117, 220 or 240 VAC as determined by the catalog number ordered. Operation at other voltages will cause either unsatisfactory performance or damage to the instrument. Conversion from 117 VAC to 100 VAC or from 240 VAC to 220 VAC is possible on a given unit by opening pad B and soldering closed pad C on the bottom of the mother board.

Signal Input

For 200 mV and 2 Volt ranges, apply the input signal between terminals 2 and 10 for the upper connector. The low or grounded side of the signal source should be connected to pin 10. Note that there are other grounds (pins 4 and N) available at the upper connector. These have other functions and are not to be used for signal ground. For 10mV range, use screw terminals at rear of case.

20 Volt and 200 Volt range signals are applied between pins A and 10. An internal input attenuator at pin A divides these higher voltages by 10 and 100 respectively for processing at the 2 volt range level.

Input connections for current ranges are made at pins 2 and 10. An internal shunt between these two terminals is provided to convert current to voltage.

Decimal Point Selection

Decimal point may be programmed to appear in any one of 4 locations from 1.XXXX to 1XXX.X. Normally these will correspond to voltage ranges of 200mV (1XX.XX) to 200V (1XX.XX). Other selections can be made to provide readout in natural units (e.g. 1.0000V=100.00 psi). A jumper should be connected from either of pins 11, 12, 13, 14 to pin N on the upper connector, and will carry 25 mA peak, pulsed 100 times per second at a 20% duty factor.

Blanking

The display numerics may be independently blanked at any time, without affecting any other part of the instrument, by connecting pin P on the upper connector to digital ground N. Polarity sign and decimal point will remain lit. The grounding circuit will be required to sink no more than 500 uA.

Use of auxiliary supplies to power external circuits

External circuits such as amplifiers and bridges can be provided with limited amounts of regulated DC power. Up to 10 mA at ± 12 VDC and 10 mA at +5 VDC are available at the upper connector in accordance with Table 4-1. Pin 4 should be used as common for both 12 volt supplies; pin N for the +5 Volt supply. Heavier loading than 10 mA may cause indicator error particularly at low line voltages.

Display Hold

A reading may be held indefinitely by connecting Start/Hold, pin K, to digital ground N. When this is done, the instrument will complete its conversion and then remain in its auto-zero mode until the "hold" is released. Input voltage changes during this time will be ignored. Upon release of the "hold" the converter will display, within one conversion, the signal level currently being applied.

The Hold feature can be used to drive the indicator at less than its free-running conversion rate of 2.5 per second. If the Hold line is driven by a pulse generator (TTL compatible) which supplies a narrow positive going pulse at a slower rate than 2.5 per second the instrument will convert once for each pulse and hold until the next one. A width of from 1 μ s, minimum to 1 ms maximum should be used.

BCD DATA OUTPUT (Ground reference is BCD Connector, Pin 2)

Isolated, buffered, data is available in unlatched-parallel BCD form for a minimum of 100 ms of every conversion cycle. During conversion it is unreadable, reflecting the changing status of the internal counters. At the end of conversion, while the converter is in its auto-zero phase, counting ceases and data is stable or ready to read. Data ready is signaled by the zero state of print command, PC, terminal for the lower board.

Peripheral equipment, such as remote displays or printers, which need their input data to be stable for longer periods than 100 ms can hold the information for as long as necessary.

Several options are available to effect this:

1. External latch - When Print Command goes to zero, use its negative transition to transfer the BCD data into external storage registers. This is particularly useful in developing a non-blinking remote display.
2. Hold after Print Command - In printer applications, a Busy signal (Logic "0") can be generated by the printer and fed back to the DPM as a Hold Command after receipt of a print command signal. The conversion process will be halted and the previous data held until printout is completed and the printer busy signal is removed. The response of the printer in generating a busy signal should take place within 1 ms of receipt of the print command from the DPM.

3. Hold before Print Command - If a Hold Command is not automatically generated by the peripheral equipment, the converter "Hold" may be manually switched to ground. Transfer of data to the peripheral equipment, however, must be synchronized by the Print Command to avoid transfer of count before conversion is complete. The hold may be manually released after transfer is complete.
4. Use of Start/Hold and Remote/Hold - The availability of two independent Hold lines makes possible alternate modes of operation. If Remote/Hold is connected to a Printer "Busy" terminal, and Start/Hold to a manual switch, the printer can be operated in either a one-shot or free running mode.

For example, Start/Hold can be left at "1" permitting the converter to free-run. The printer's Busy signal, connected to Remote/Hold, will slow down and extend the duration of the auto-zero phase until printing has been completed. Conversion and printing will be continuous, but at a slower rate.

Alternately, if data is not changing rapidly, printer paper can be conserved by using the Start/Hold signal to operate the converter in a 1-shot mode. Converter and printer will both be inactive between conversions, while Start/Hold = "0". A momentary release to Start/Hold = 1 produces one conversion and an indefinite hold. Remote/Hold need not be used in this application.

ADDITIONAL USER OPTIONS

These require removal of the instrument from the case and should be done with care or referred to your local Weston Modification Center for assistance.

Ratiometric Operation

An external reference source can be substituted for the internal reference to produce a change in sensitivity over a 2 to 1 range for direct display of engineering units or for ratio measurement. The internal reference is generated by a stable 7 volt supply and a 7 to 1 attenuator. The 7 volt supply may be replaced by an external source of from 4.66 volts to 9.33 volts to control the sensitivity over a 2 to 1 range. It can be applied on any instrument range by opening normally closed solder pad A on bottom of the board and soldering closed, normally open pad H on the top of the board. The external reference is then applied between pin C of the upper connector and signal ground, pin 10.

SECTION 6 THEORY OF OPERATION

- 6.1 General- The 2471/2472 DPM is basically a bipolar 2 volt range instrument with a maximum scale length of 20,000 counts (0 to 19999). It comprises a two-chip A/D converter, supported by clock oscillator, voltage-reference, display circuitry and line operated power supply, organized as shown in Figure 6-1. Voltage ranges other than 2 volt are achieved by preamplification (200 mV range) or input attenuation (20V, 200V). Current ranges are achieved by shunts applied at the input of a gain of 10 pre-amplifier and pose a 200mV full scale burden. Each of the major circuit sections is treated in detail below. Refer also to Figure 7-1 at the rear of this manual.
- 6.2 A/D Converter - The heart of the instrument is the two-chip integrating type Dual Slope converter shown in block form in Figure 6-2. Pertinent wave-forms helpful in understanding the theory are in Figure 6-3. A linear integrated IC, U104, provides a unity gain-buffer A1, an inverting integrator A2, and a high gain comparator A3, which is referenced to an internal -1.2 volts. A digital IC, U105, provides a 40,000 bit BCD counter, storage latches, an output multiplexer and control logic. It also includes 6 analog switches which sequence a three phase conversion process, under control of the 40,000 bit counter. Each conversion occupies 40,000 clock pulses (CP) which, at a 100 KHz clock rate, takes 400 ms (2.5 conversions/second). The three phases are:
1. Auto zero - 10,000 CP duration
 2. Signal Integrate - 10,000 CP duration
 3. Reference Integrate - 0 to 20,000 CP duration

Figure 6-2 shows the sequence of the switch closures during the three phases and how this sequence is affected by signal polarity.

Phase 1 (Auto-Zero, 0-10 KCP)- Here the system measures the offsets of its own amplifiers, storing the net error on a capacitor for correction of offsets during the signal and reference - integrate phases.

C105 charges, through S2 and S1, to 1 volt, thereby applying 1 volt to buffer A1. Buffer output, waveform B, sets at 1 volt plus the buffer's own offset during Phase 1. S3 is also closed, establishing a servo loop around A2 and A3, charging C104 up to a voltage sufficient to reduce the net integrating voltage to zero and stabilizing the output of A2 at the -1.2V return level of A3. Thus C104 charges to 1 volt plus the net offset of A1 and A2. This voltage is stranded on C104 at the end of phase 1 due to the opening of S3. Figure 6-3 shows the buffer output to be 1 volt during auto-zero.

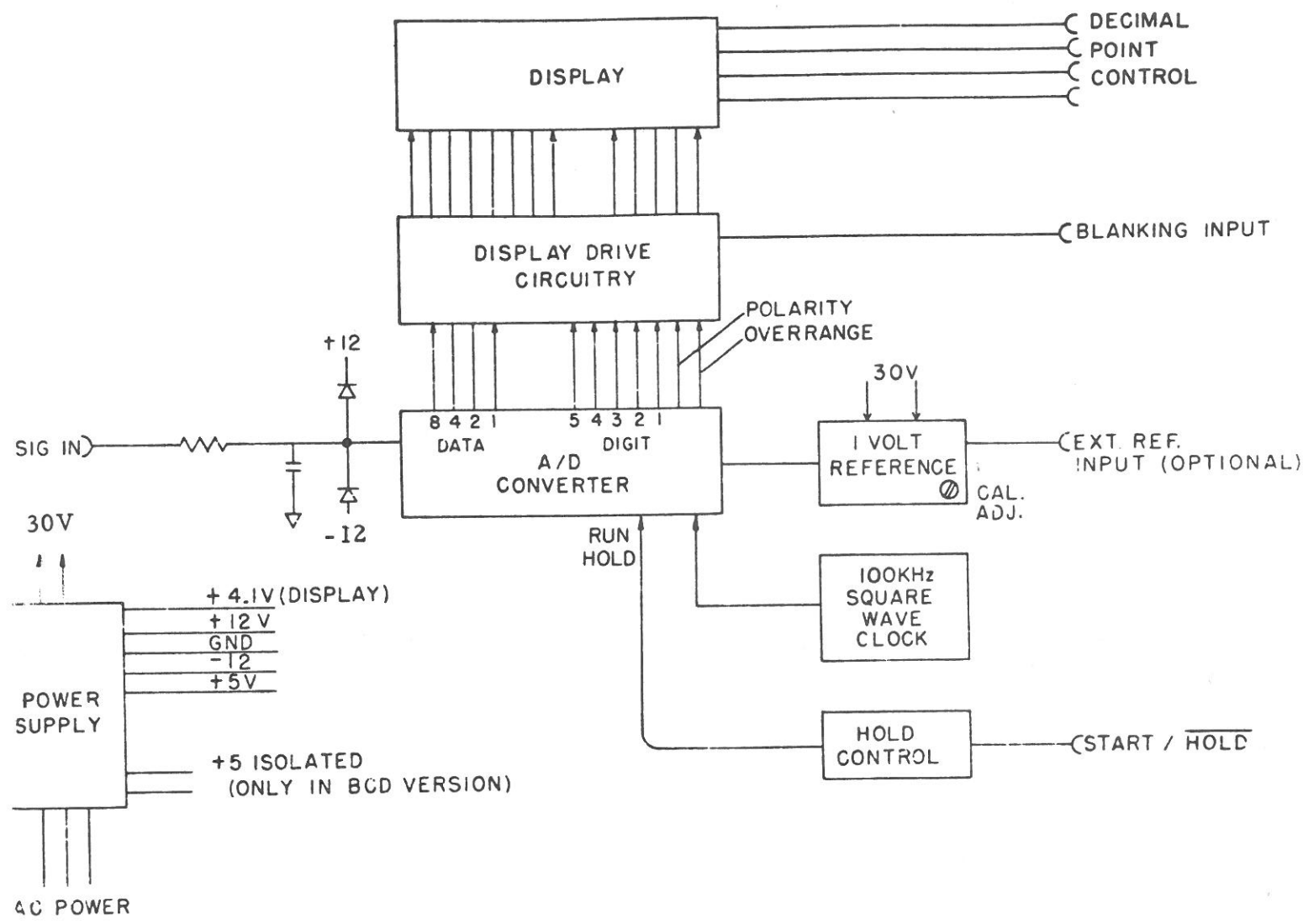
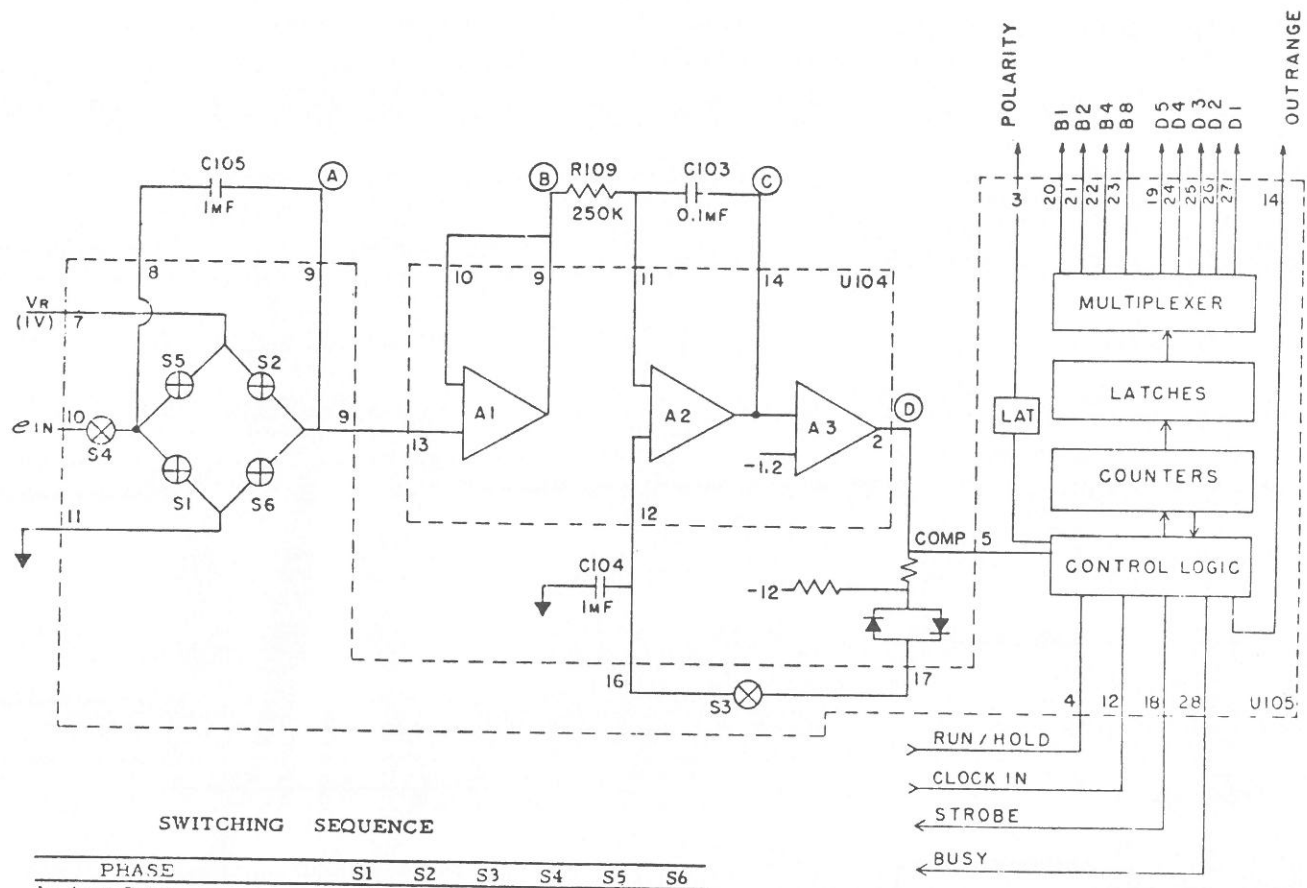


Figure 6-1. Block Diagram - 1 Volt Range



SWITCHING SEQUENCE

PHASE	S1	S2	S3	S4	S5	S6
1- Auto Zero	1	1	1	0	0	0
2- Signal Int.	0	0	0	1	0	0
3- Ref. Int. (+Sig)	0	0	0	0	0	1
3- Ref. Int. (-Sig)	0	0	0	0	1	0

Fig. 6-2. Functional Block Diagram-A/D Converter

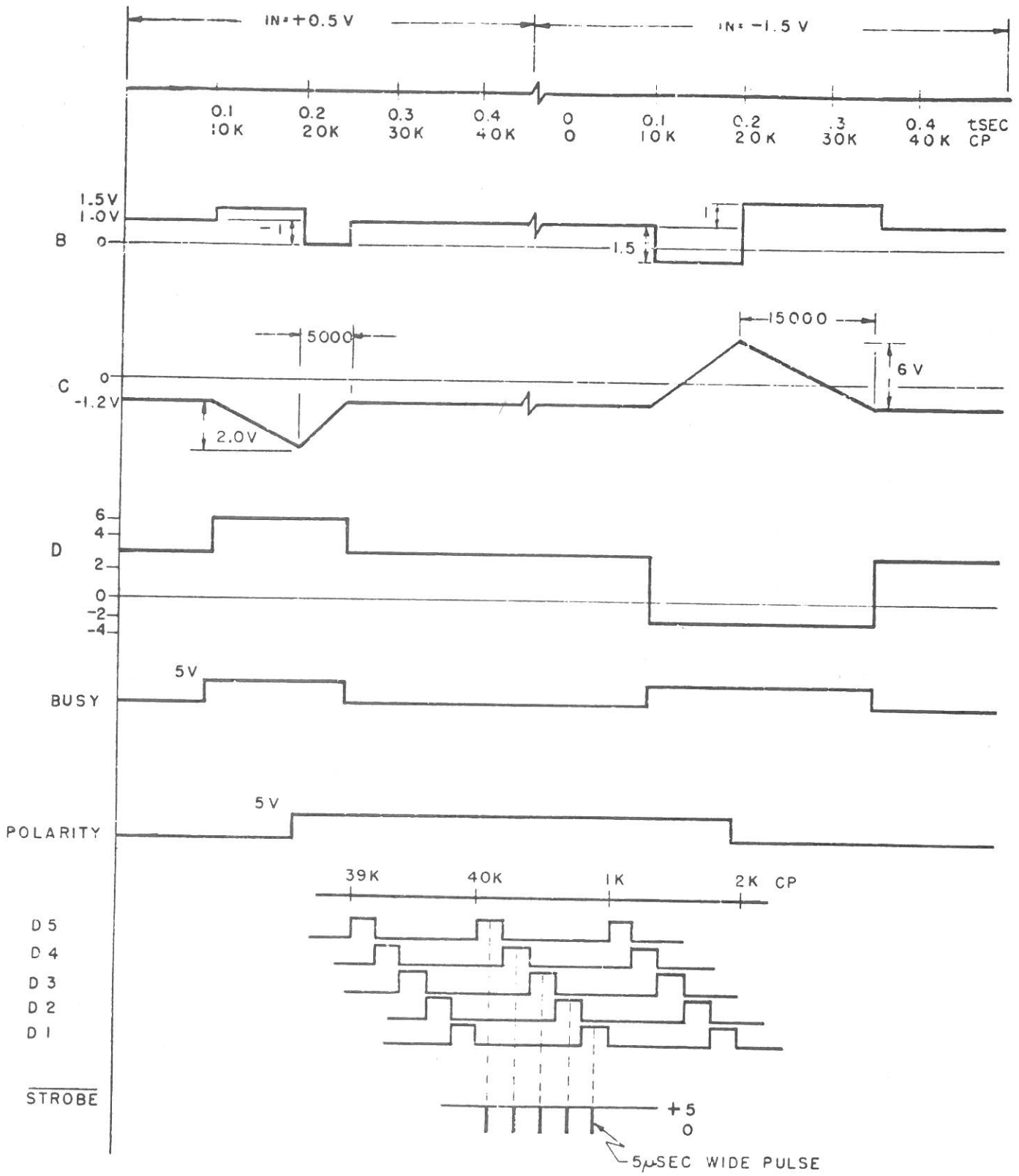


Figure 6-3. A/D Converter Waveforms

(the offsets are deleted for clarity.) With the integrator output hovering at -1.2 volt the comparator output D, is constrained by the feedback path and the resistive divider to the middle of its operating range about 2.5 volts. It is capable of reaching +6 volts and -2.4 volts when driven to saturation.

Phase 2 - Signal Integrate (10K to 20K CP) S4 closes, connecting E_{in} through C105 to the buffer input. All other switches are open. C105, which had been charged to 1 volt, appears as a series battery bringing buffer output B to $E_{in} + 1$ volt. In the first case illustrated on Figure 6-3, $E_{in} = 0.5$ volt and $V_B = 1.5$ volt. The net integrating voltage is $V_B - V_{C104}$ or 0.5 volts. (Note that the offsets due to A1 and A2 are still present but are cancelled by the error component stored on C104. Likewise, the 1 volt reference in series with E_{in} is cancelled by the 1 volt component stored on C104, so that only the unknown E_{in} contributes to the integration). The constants of the integrator cause it to ramp negatively 4 volts per volt of net integrating voltage. It therefore drops 2 volts to -3.2V by the time the count reaches 20000. Since the integrator output is at -3.2 volts, comparator A3 is saturated at +6 volts. Logic circuitry in U105 senses the comparator output polarity when the count reaches 20,000 and stores it for use in Phase 3 and for annunciator control.

Phase 3 - Reference Integrate During this phase, the circuit must apply a 1 volt reference of appropriate polarity to ramp the integrator back to its -1.2 volt baseline level. Since the net excursion had been proportional to signal voltage, the time taken to return to -1.2 volts (comparator crossing) is also proportional to signal level and may be read out as clock pulse count on a display.

For positive signal, S6 only is closed. This grounds the A1 input and leaves a net -1 volt for integration due to the 1 volt stored on C104. S5 is closed for negative signals, leaving +1 volt ($V_R + V_{C105} - V_{C104}$) available for integration.

Data Output

At the end of Phase 3, counter status is transferred to BCD latches in U105 where it is thereafter made available in multiplexed BCD form (1, 2, 4, 8). Four 4-bit words and one 1-bit word represent up to 19999 at U105 (20 Pins 21, 22, 23). Each of the digital 4 bit words is made available for 2 milliseconds, 100 times per second. The sequence is Digit 5, 4, 3, 2, 1, 5 ..., with digit 5 being the MSD. Digit drive pulses are concurrently made available at U105 (Pins 19, 24, 25, 26, 27) in step with the BCD information so that the display circuitry will reproduce the BCD information in decimal form.

Polarity information, which had been stored in U105 at the end of Phase 2, is also multiplexed out along with data for digit 5.

If an input signal exceeds 2 volts, return to baseline takes more than 20,000 counts. This fact is sensed in U105 and latches an O.R. output signal, useful in providing proper information to the display. In addition, the BCD output is locked at 0000 and the digit drive pulse are blanked on every other conversion, providing a pattern of blinking zeroes.

A supporting function which is only utilized in instruments designed for BCD output versions is BUSY, a logic level which goes high at the beginning (2472) of signal integrate and returns to zero when the integrator output returns to its -1.2 volt baseline. The system reverts to auto-zero operation and remains there through the completion of a full 40,000 counts and through Phase 1 of the next conversion.

An additional supporting function, utilized in BCD versions, is strobe output. As shown in Figure 6-3, this consists of a group of five negatively going pulses each 1/2 clock period 5 μ s wide, and 2 ms apart. They occur once per conversion, and are centered on the first 5 digit drive pulses which follow the 40,000 count state.

- 6-3 Clock Oscillator - The clock circuit consists of a resonator controlled 400 KHz transistor oscillator, Q122 and a 2 stage binary divider, U112. A roughly sinusoidal 5 volt peak waveform is generated at Q122 collector and 5 volt symmetrical 100 KHz square waves at U112, (1, 2, 5).
- 6-4 Reference Circuit - The 1 volt reference voltage source is generated by a 7 volt integrated Zener reference having on-chip temperature regulation (U107). An adjustable 15 Kiloohm divider network attenuates the 7 volt source to 1 volt. The network, R119 through R124, comprises two TC matched and aged thin-film resistors, a selection of smaller resistors and a calibrate potentiometer, R125. The smaller resistors are selectively bridged to extend the limited span of R125 (about 1.2% FS p-p) to (6 % p-p) to allow for tolerances in the Zener and the resistors.

6-5

Display Circuitry - The 4 1/2 digit display in this instrument uses the Monstanto 6600 series common anode, seven-segment LED displays. The five common anode lines D5 through D1, are sequentially driven from a +4 volt supply through darlington transistor followers, Q116 through Q120 respectively on the main board. BCD information available at U105 is translated into 7 segment-drive logic (positive logic) in converter U103. Blanking of the MSD when that digit is zero is enabled by inverting the D5 drive signal, thereby grounding the RBI input of U103 (pins) when the MSD is enabled. A BCD zero at that time will result in all segments being blanked. In addition, auxiliary blanking of all digits is available by the remote grounding of U105 (4).

The circuitry on the display board includes the displays, a ballast resistor network, and an integrated 7 transistor saturated switch driver. This driver U102 selectively grounds the 7 cathodes and their associated ballast resistors, in step with the output of the BCD-7 segment converter. Figure 6-4 shows schematically, a portion of the total display circuit.

Additional circuitry is provided to selectively energize programmed decimal points and a polarity indicator.

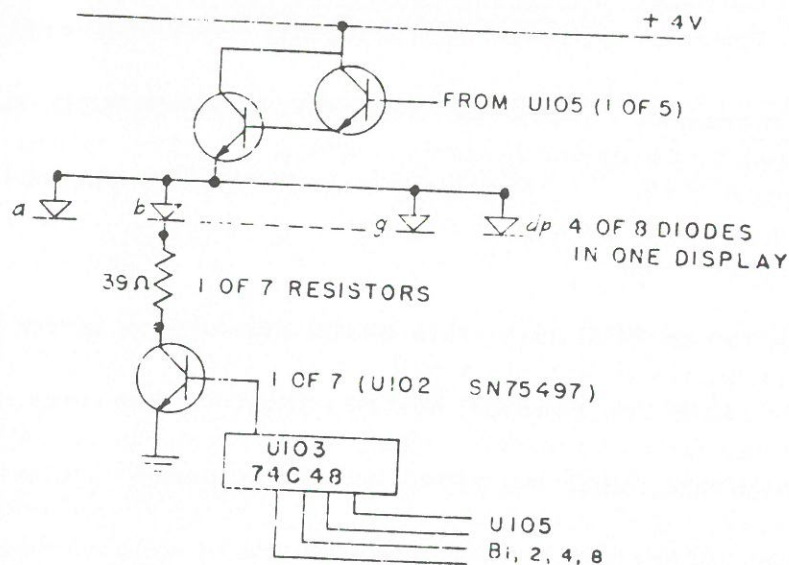


Figure 6-4. Display Circuitry

6.6 Power Supply - A line operated power supply provides the following voltages:

- (a) 30 volts unregulated DC drives the oven in the reference U107.
- (b) +12 volts DC is derived from the unregulated 30 volts by a 24 volt IC regulator U108. Ground is derived synthetically, thereby splitting the 24 volt range into +12.
- (c) + 5 volts DC and +4 volts DC supplies are derived from a common winding. The +5 volts is regulated by U109. It is dropped by Schottky diode CR114 to 4.7 volts at the base of pass transistor Q111, producing a 4.1 volt supply at the Q111 emitter.
- (d) Isolated 5 volt supply - included only for BCD versions .

6.7 Control Circuit for HOLD - Transistor Q110 is provided to either pull U105 (4) to ground or allow it to remain high, depending on whether or not output terminal K is grounded or left floating. When pulled low, conversion ceases, the last display is retained and the converter is maintained in Auto-Zero. Release of terminal K initiates a new conversion.

6.8 BCD Operation - Isolated, buffered, parallel BCD is provided by an optional circuit board, shown in block form in Figure 6-5. Pertinent waveforms are shown in Figure 6-6 . A detailed schematic is given in Section 7 as Figure 7-3.

In addition to BCD data, this board provides polarity and outrange signals (positive logic), a print command signal ("0" state when data is ready for readout) and two Hold - Input lines either of which can halt conversion when returned to zero. All are referenced to a separate, isolated power supply ground to minimize ground-loop problems. Isolation is achieved by 4 pulse transformers (for coupling of transition information) and by an opto-coupler for steady state - Hold information.

In principle, BCD data is formed at the same time as the A/D conversion, by means of a separate counter chain on the BCD board. The 100 KHz clock is gated into the BCD counter chain between the start of Signal Integrate and the end of Reference Integrate, these two transitions coinciding with the leading and trailing edges of BUSY, generated by U105 (Figure 6-6A) Signal Integrate lasts 10001 counts and the number of the remaining clock pulses is a measure of the unknown signal. The counter chain is preset initially to 09999, enabling it to reach 20000 (equivalent to 0000) by the beginning of Reference Integrate (referred to in the following as Apex) clock pulse count from this time to the end of BUSY is thus a duplication of the count displayed on the basic instrument.

Polarity information is latched once per conversion in Polarity F/F U310, which is Reset to zero at the start of Busy. Depending on the signal polarity which is latched in U105 at Apex. The polarity F/F is either set to "1" or allowed to remain at "0"

Outrange is detected as an overflow of the BCD counter chain and is generated and handled like numerical data. A Print Command (Data ready) is available at the A/D converter output as BUSY. However, since it is coupled to the BCD circuitry through a pulse transformer, it must be reconstituted as a rectangular pulse, which is done by a F/F in U311.

The last function is HOLD. Manual Hold may be initiated by grounding either of two Hold inputs, resulting in the transmission of this state through an opto-coupler to the Run/Hold input of U105 (Pin 4).

If U105 (4) is switched to "0" during a conversion, the current reading is held. If switched to zero during auto-zero, it will be effective only on the next conversion. If the system is to respond to a hold request from a printer which has just received a Print Command U105 (4) must be at "0" before the end of conversion. The Internal Hold F/F accomplishes this by generating a Hold command at the start of BUSY.

If no printer Hold request occurs within 1 ms after the 40000th count, the Internal Hold F/F will be reset (by strobe) and permit further conversions. A printer Hold request within 1 ms will override the changing state of the internal F/F and force the A/D convertor to Hold for as long as the printer maintains its Hold request.

The paragraphs below detail the operations which affect the above.

The busy signal (A) is inverted (B) and fed through the pulse transformer (C) to a pair of pulse shaper/inverters. The negative pulse of waveform (C) which is generated by the leading edge of busy, generates a positive pulse out of pulse shaper I (D). This pulse resets the polarity F/F (E) the internal hold F/F (F) and presets the counter chain to 09999. The internal hold F/F (F) in turn causes the P.C. output to go high (G) (not-ready signal) and through the opto isolator circuitry drives the hold line low. At the beginning of the busy signal the clock is also gated and fed through the pulse transformer to the counters.

At the end of the reference integrate time, the Busy signal (A) goes low. The positive pulse at the transformer output (C) generates a negative going pulse at the output of pulse shaper II (H). This pulse drives the P.C. output (G) low (data ready). At the same time the logic "0" level of the Busy signal turns off the clock gate stopping the counters. The inverted Busy signal (B) is also fed to a 1us delay gate circuit for the polarity information. For a positive polarity (Logic 1) the output of the delay circuit (J) is the same as the Busy signal (A) except for the 1us delay. The trailing edge of this waveform generates a positive pulse at the transformer output (K) which sets the polarity F/F high (E). For a negative polarity (Logic 0) the delay gate is off, no pulse is generated at (K) and the polarity F/F stays low.

30, 100 clock pulses after the beginning of Busy the first strobe pulse occurs (I) and generates a positive pulse at the transformer output which sets the hold F/F high. If by this time no hold signal has been applied to either of the external hold inputs the opto isolator circuitry switches the hold line high and the next conversion begins. If either of the external hold inputs are low the hold line will remain low and no conversion will take place until the external hold inputs are returned to logic 1.

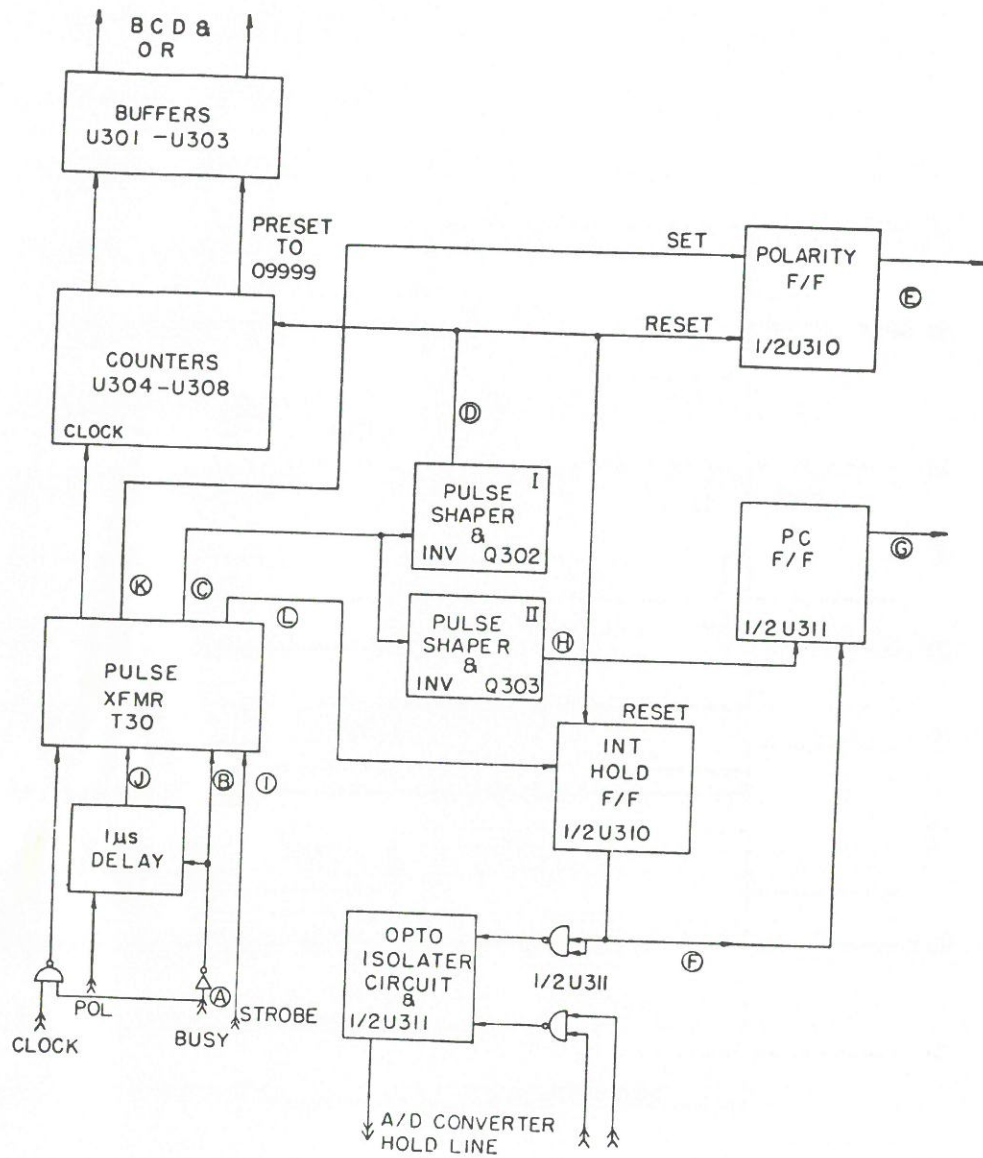


Figure 6-5. BCD Block Diagram

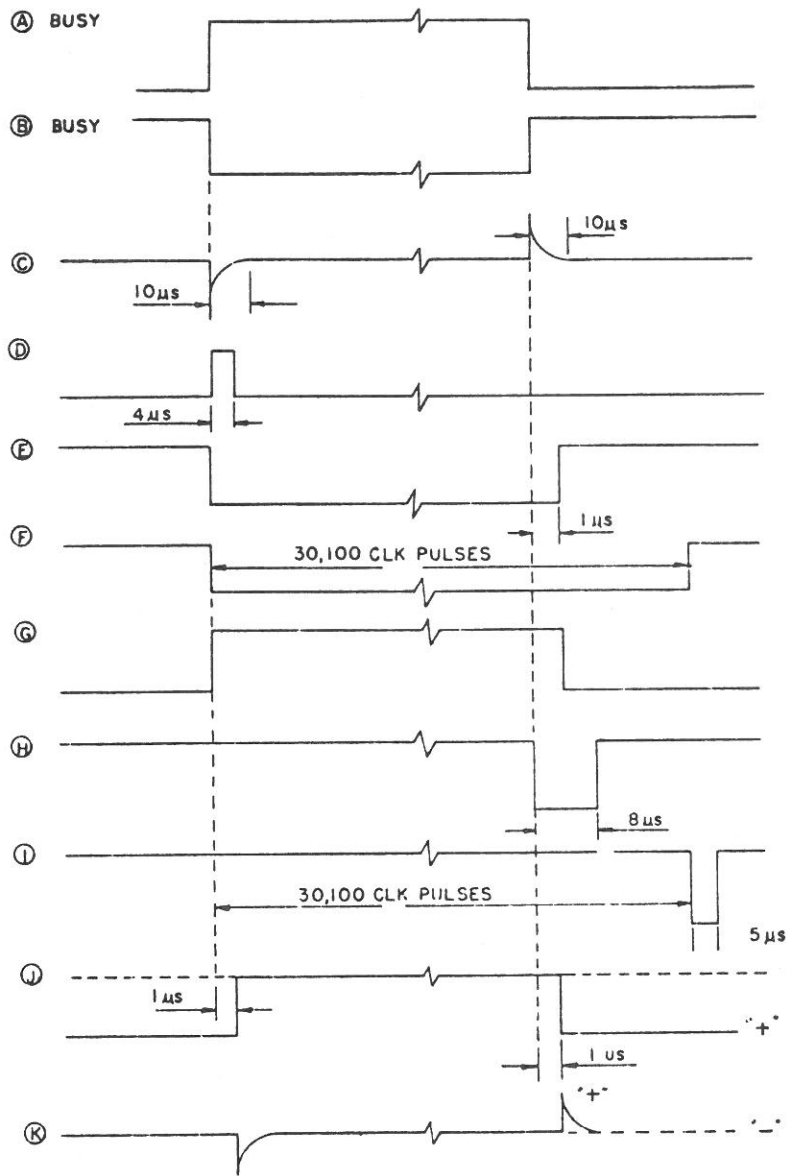


Figure 6-6. BCD Waveforms

SECTION 7

DRAWINGS AND PARTS LIST

This section contains drawings, schematic diagrams and parts list for the Weston 2471 and 2472 Series Digital Panel Meters.

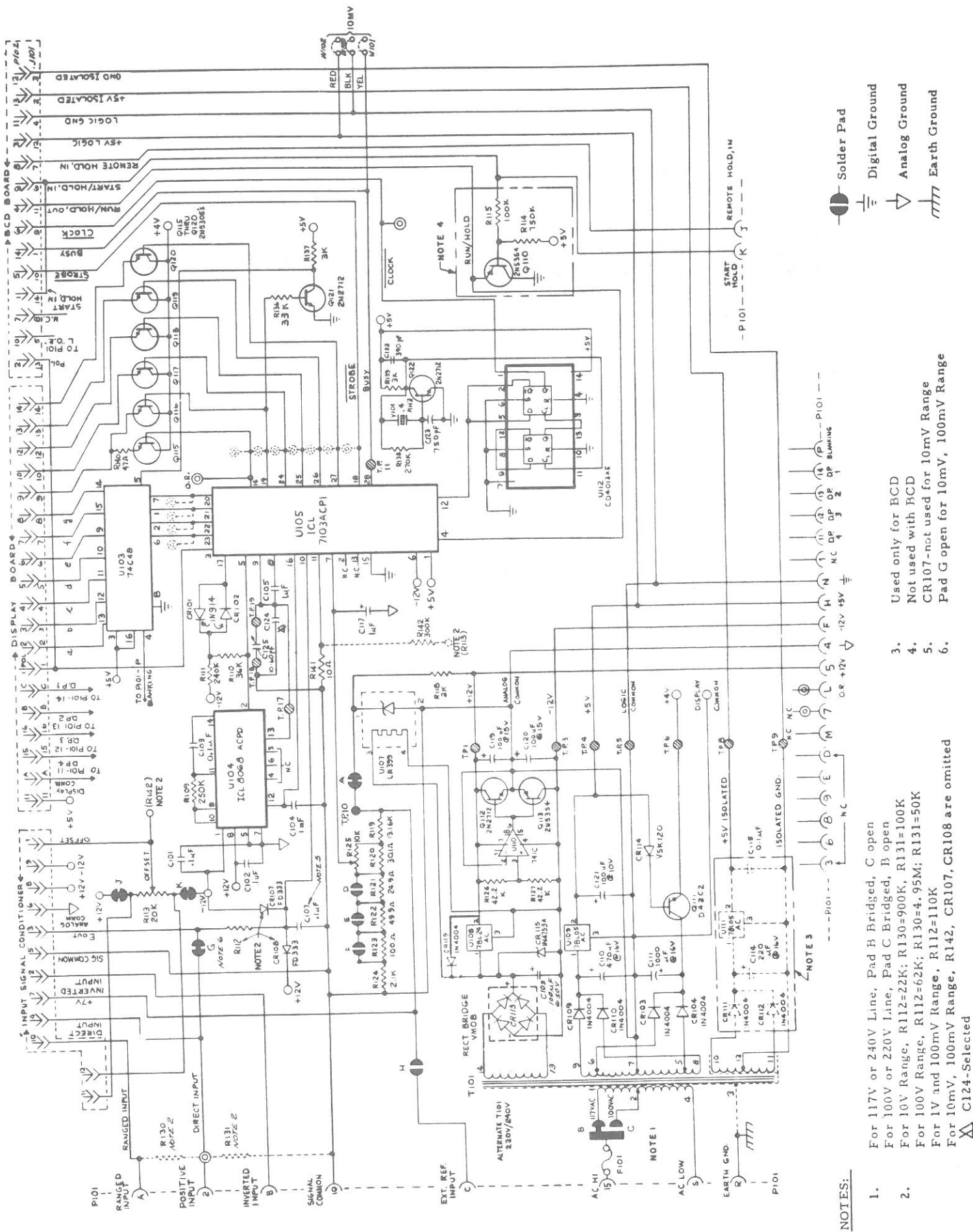
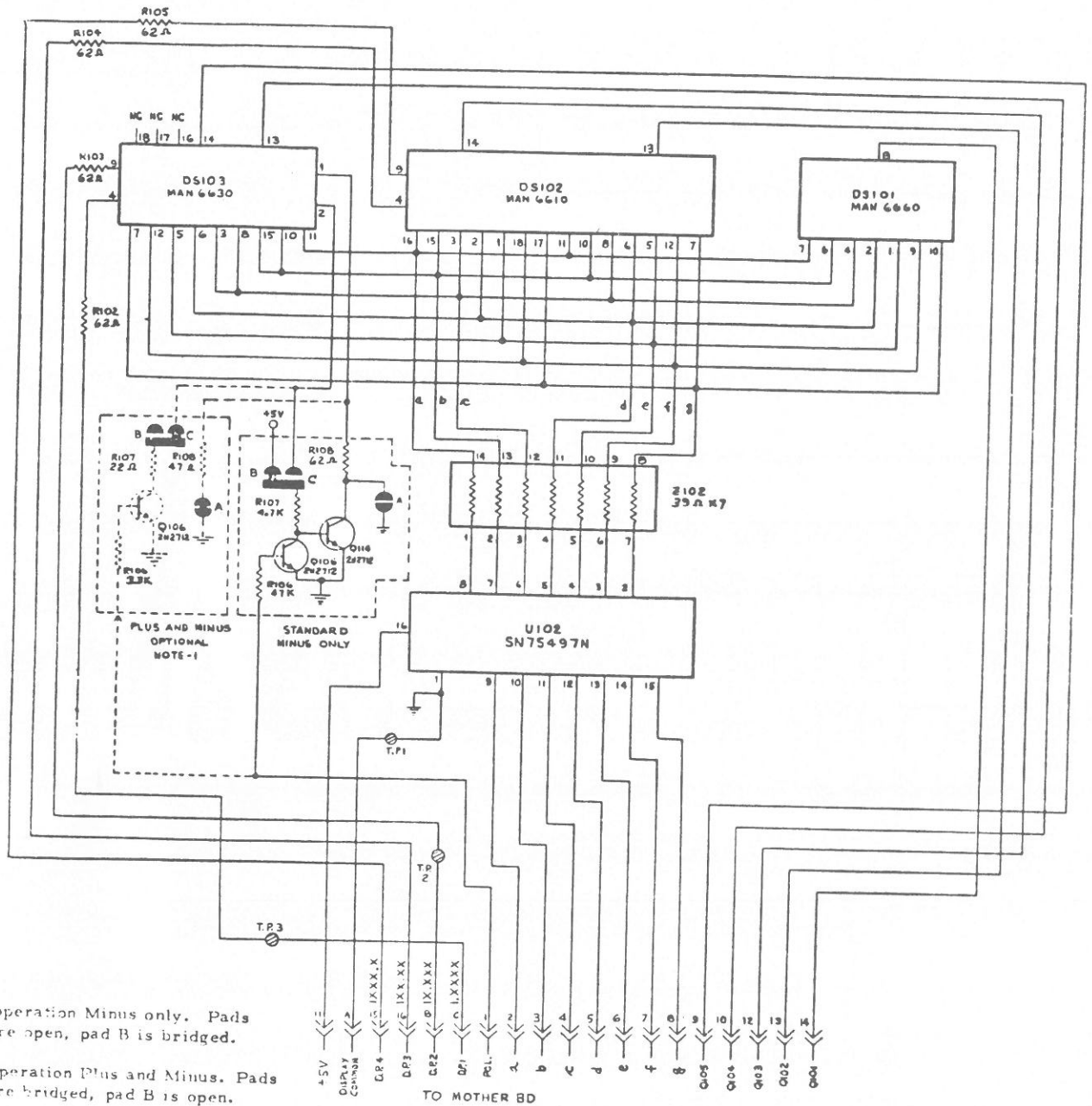


Figure 7-1. Main Board Schematic Diagram.



NOTES:

1. Standard operation Minus only. Pads A and C are open, pad B is bridged.
2. Optional operation Plus and Minus. Pads A and C are bridged, pad B is open.

3.  Denotes Digital Ground

4.  Denotes Solder Pad

Figure 7-2. Display Board Schematic Diagram

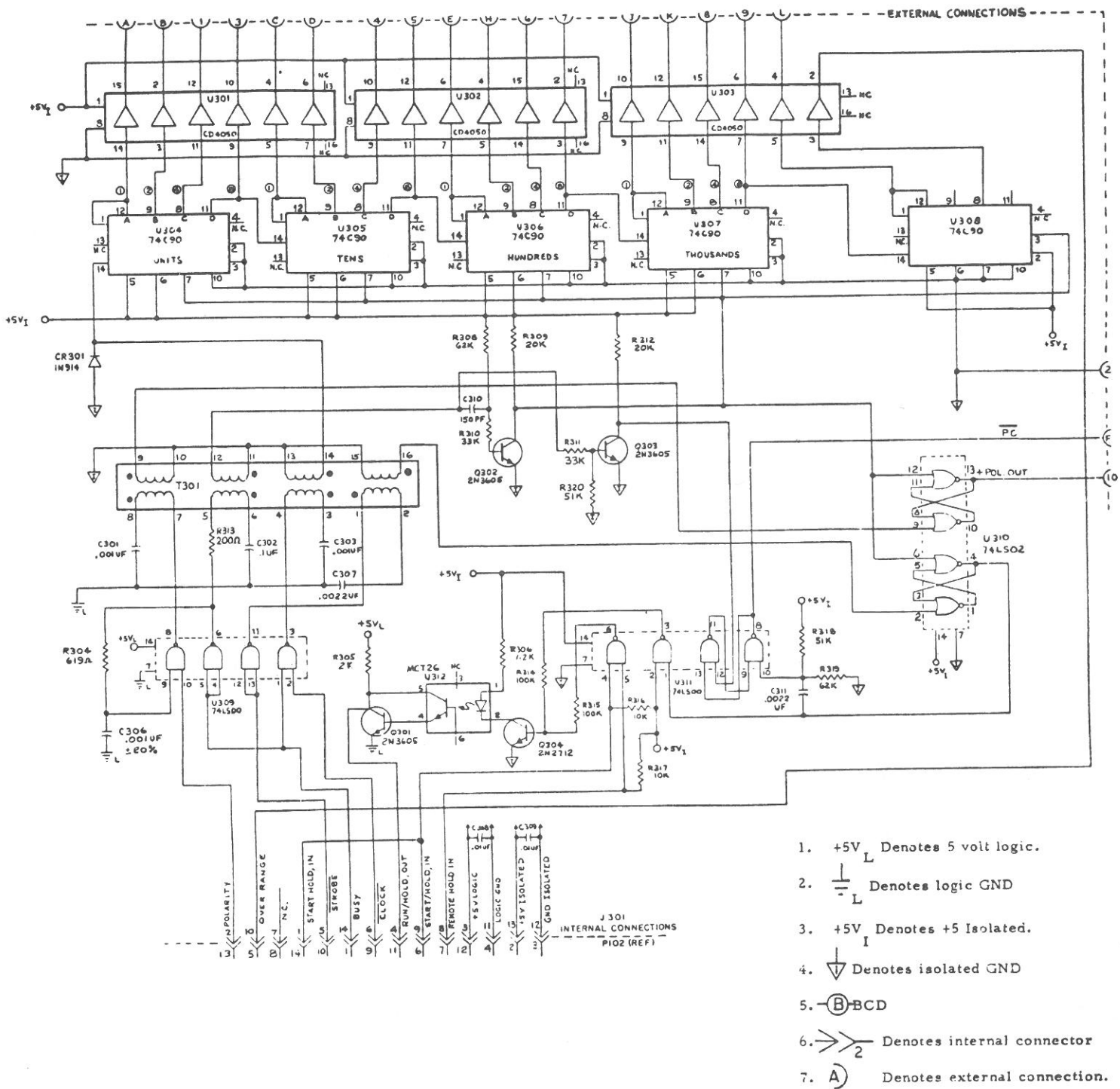
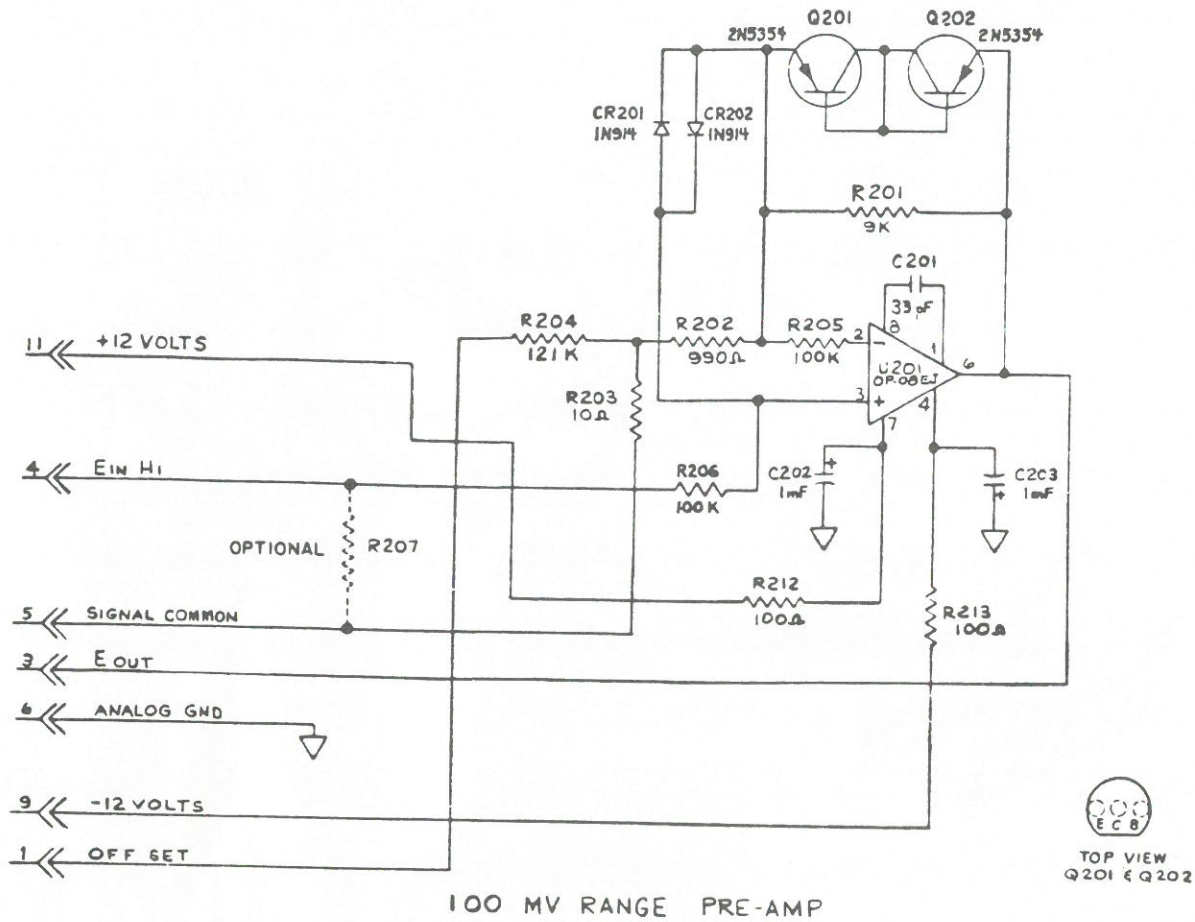


Figure 7-3. BCD Schematic Diagram




 TOP VIEW
 Q201 & Q202

Figure 7-4. Front-End Conditioners Schematic Diagram

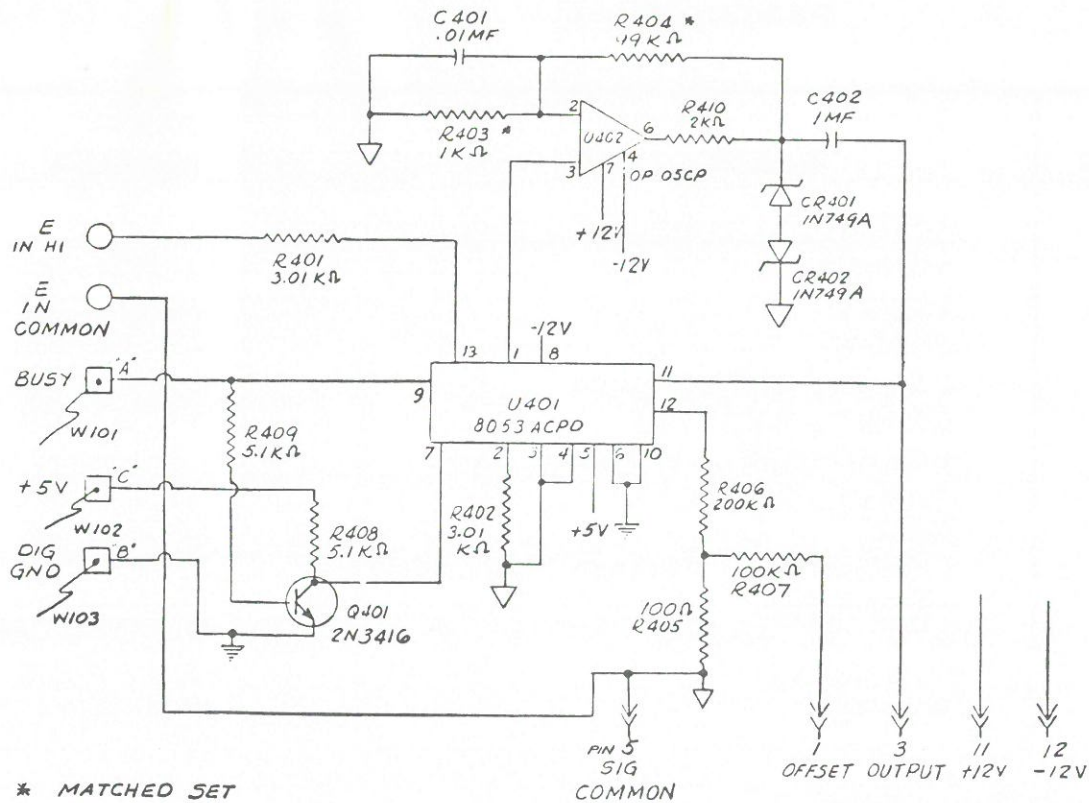


Figure 7-4A. 10mV Range Conditioner Schematic Diagram

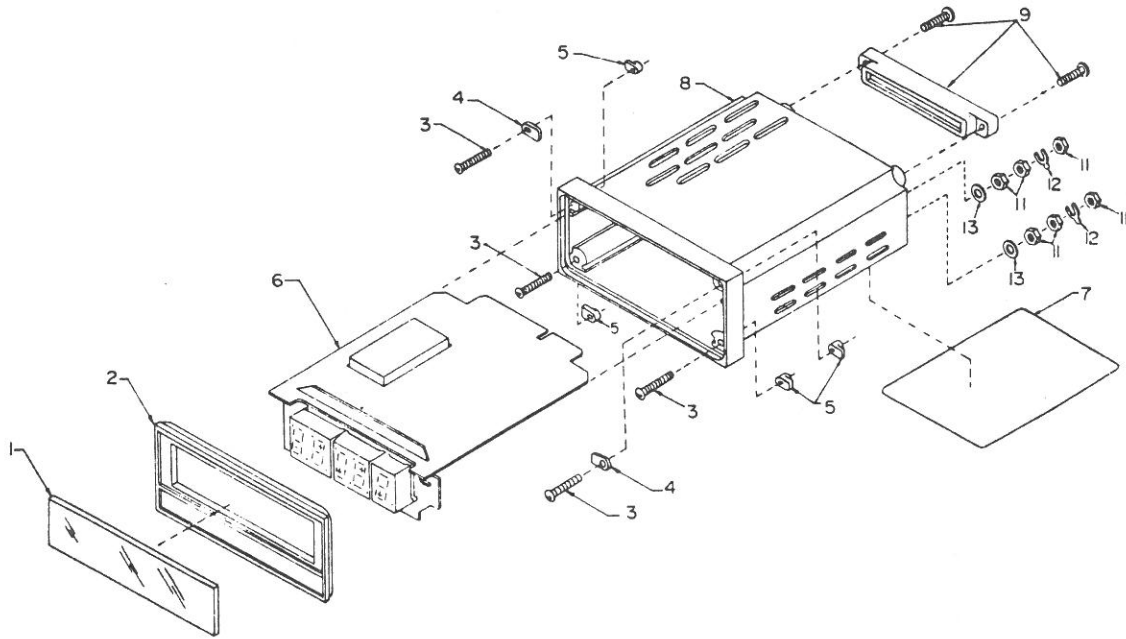


Figure 7-5 Assembly-Without BCD
PARTS LIST

ITEM NUMBER	DESCRIPTION	PART NUMBER
	<u>ASSEMBLY-Without BCD (Ref Figure 7-5)</u>	
1	WINDOW	278097-901
2	FRONT	265657-001
3	SCREW	266623-045
4	CLAMP, Circuit Board	265663-001
5	CLAMP, Panel Mtg.	265661-024
6	BOARD ASSY (Ref Figure 7-6)	-----
7	LABEL, CASE	279869-901
8	CASE	265658-001
9	CONNECTOR, Package (Per Order)	267253-901
10	DELETED	-----
*11	NUT, No. 4-40thd	ND29505-024
*12	TERMINAL	281767-001
*13	WASHER	24829-024

* For 10mV Range Only.

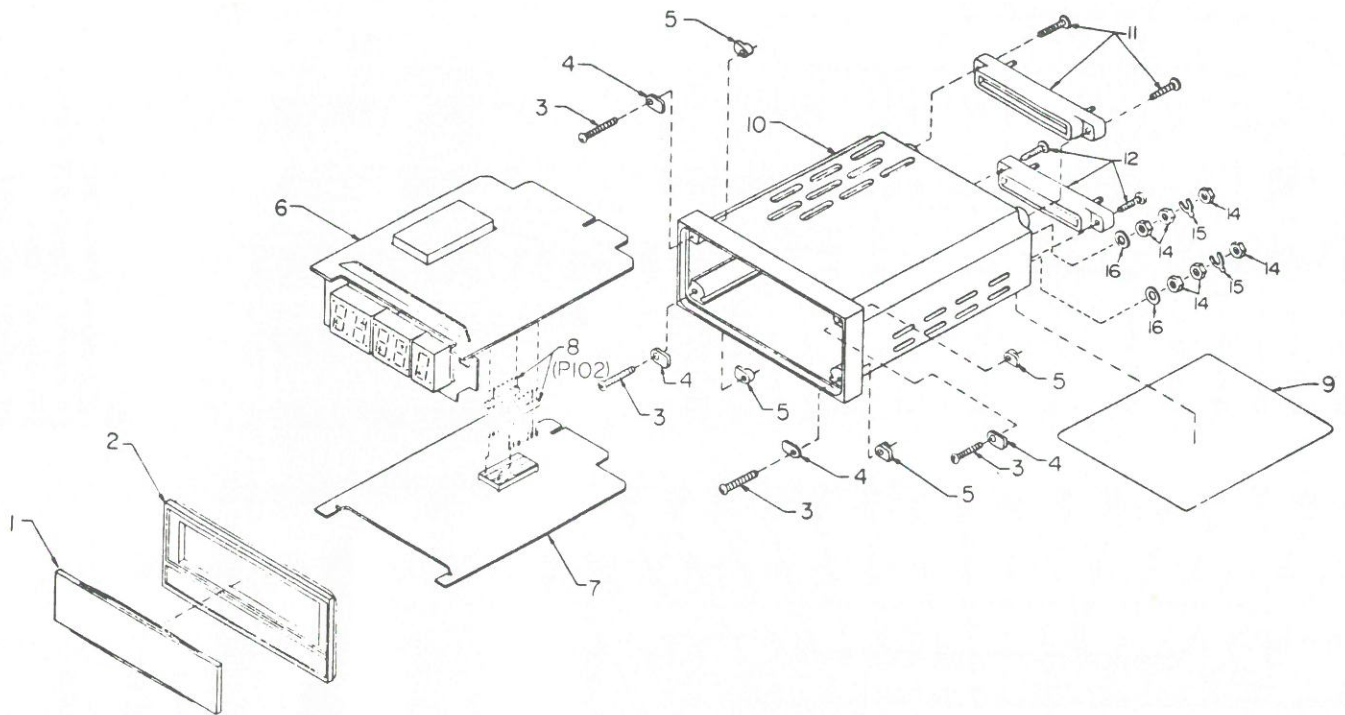


Figure 7-6. Assembly - With BCD

ITEM NUMBER	DESCRIPTION	PART NUMBER
	<u>ASSEMBLY - With BCD (Ref Figure 7-6)</u>	
1	WINDOW	278097-901
2	FRONT	265657-001
3	SCREW	266623-045
4	CLAMP, CIRCUIT BOARD	265663-001
5	CLAMP, PANEL MTG.	265661-024
6	BOARD ASSY, MAIN (Ref Figure 7-7)	-----
7	BOARD ASSY, B C D	279857-901
8	HEADER, 7 PIN (P102)(2 Reqd.)	279180-001
9	LABEL, CASE	279869-902
10	CASE	265658-001
11	CONNECTOR, MAIN BD	267253-901
12	CONNECTOR, BCD	271102-901
13	DELETED	
* 14	NUT, No. 4-40thd	ND29505-024
* 15	TERMINAL	281767-001
* 16	WASHER	24829-024

⊙ With BCD only

* For 10mV Range Only

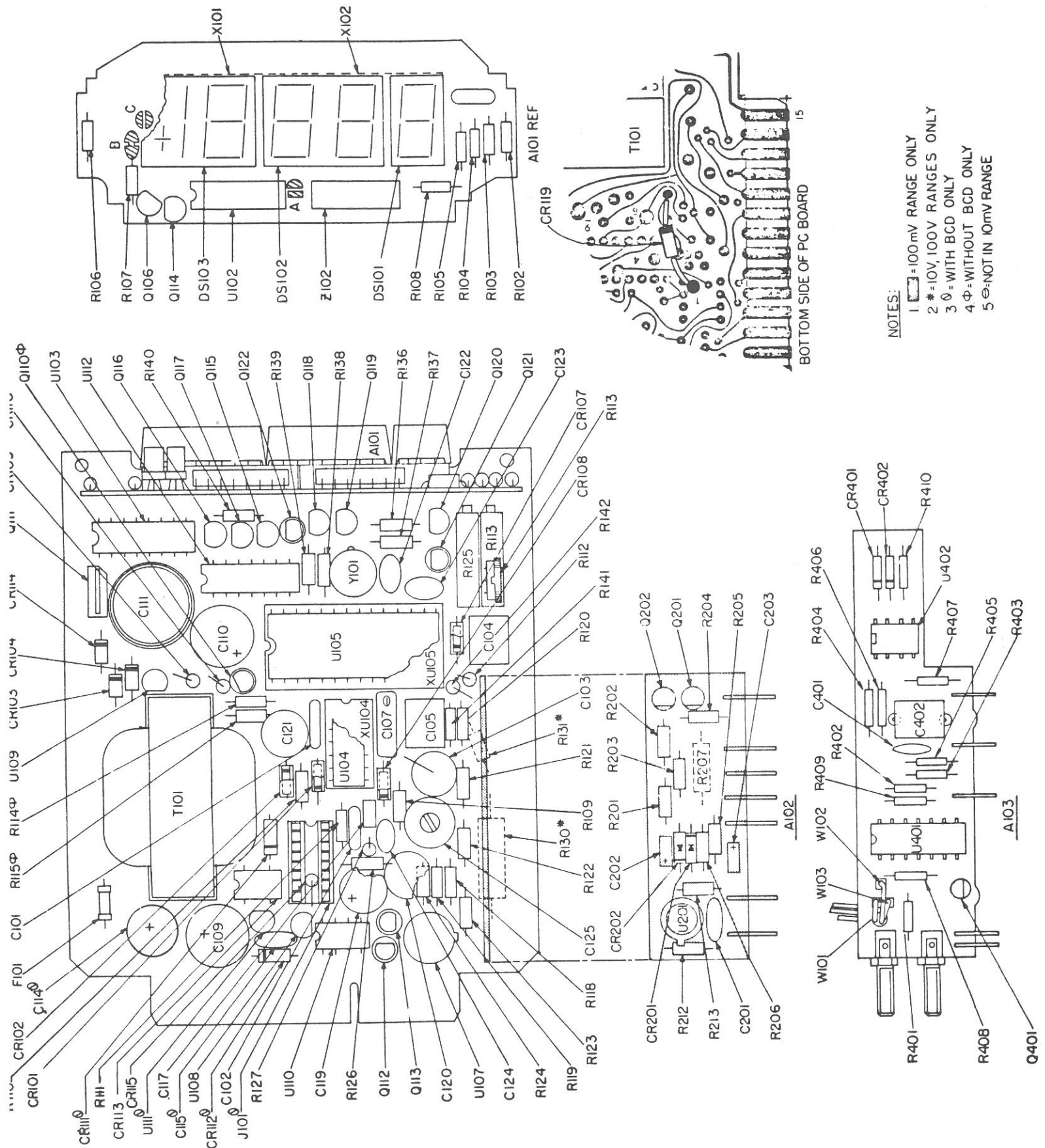


Figure 7-7. Main Board Assembly

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY. (Ref Figure 7-7)</u>	
A101	BOARD ASSY, DISPLAY (Standard-Minus operation)(See sep list for details)	279852-901
A101	BOARD ASSY, DISPLAY (Optional-Plus & Minus operation)(See sep list for details)	279852-902
A102	BOARD ASSY, 100mV Range (See sep list for details)	279861-901
A103	BOARD ASSY, 10mV Range (See sep list for details)	282168-901
C101	CAPACITOR, 0.1uF $\pm 20\%$, 50 WVDC	279184-001
C102	CAPACITOR, 0.1uF $\pm 20\%$, 50 WVDC	279184-001
C103	CAPACITOR, 0.1uF $\pm 5\%$, 100 WVDC	279163-001
C104	CAPACITOR, 1.0uF $\pm 10\%$, 100 WVDC	279164-001
C105	CAPACITOR, 1.0uF $\pm 10\%$, 100 WVDC	279164-001
⊖ C107	CAPACITOR, 0.1uF $\pm 10\%$, 100 WVDC	277894-902
C109	CAPACITOR, 100uF, -10%, +50%	279172-001
C110	CAPACITOR, 470uF -10%, +50%, 16 WVDC	279173-001
C111	CAPACITOR, 1000uF -10%, +50%, 16 WVDC	279160-001
⊖ C114	CAPACITOR, 220uF -10%, +50%, 16 WVDC	279168-001
⊖ C115	CAPACITOR, 0.1uF -20%, +80%, 10 WVDC	272376-001
C117	CAPACITOR, 1.0uF $\pm 20\%$, 35 WVDC	269954-001
C119	CAPACITOR, 100uF $\pm 20\%$, 20 WVDC	279174-001
C120	CAPACITOR, 100uF $\pm 20\%$, 20 WVDC	279174-001
C121	CAPACITOR, 100uF $\pm 20\%$, 10 WVDC	279186-001
C122	CAPACITOR, 390pF $\pm 10\%$, 1000 WVDC	268799-001
C123	CAPACITOR, 750pF $\pm 10\%$, 1000 WVDC	274154-001
C124	CAPACITOR, 180pF	278262-001
C124	CAPACITOR, 220pF	275514-001
C124	CAPACITOR, 240pF	274222-001
C124	CAPACITOR, 270pF	
C124	CAPACITOR, 47pF	} Selected 1 as reqd.
C124	CAPACITOR, 82pF	
C125	CAPACITOR, 10-60pF, 250 WVDC	282306-901
		279183-001
CR101	DIODE, 1N914	ND61025-001
CR102	DIODE, 1N914	ND61025-001
CR103	DIODE, 1N4004	278161-001
CR104	DIODE, 1N4004	278161-001
CR107	DIODE, FD333	} omitted for 10mV and 100mV Range
CR108	DIODE, FD333	
CR109	DIODE, 1N4004	269922-001
CR110	DIODE, 1N4004	269922-001
CR111	DIODE, 1N4004	278161-001
CR112	DIODE, 1N4004	278161-001
CR113	RECTIFIER BRIDGE, VM08	276161-001
		279165-001

⊖ Not used for 10mV Range

⊖ With BCD Only

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY. (Ref Figure 7-7) (Cont.)</u>	
CR114	DIODE, VSK120	279152-001
CR115	DIODE, ZENER, 1N4753A	280142-001
CR119	DIODE, 1N4004	278161-001
F101	FUSE, PICO, 1/4A, 125V	268798-001
J101 \emptyset	SOCKET, IC, 14PIN	279157-001
Q110 \emptyset	TRANSISTOR, 2N5354	268795-001
Q111 \emptyset	TRANSISTOR, D42C2	279185-001
Q112	TRANSISTOR, 2N2712	ND39917-001
Q113	TRANSISTOR, 2N5354	268795-001
Q115	TRANSISTOR, 2N5305	275559-001
Q116	TRANSISTOR, 2N5305	275559-001
Q117	TRANSISTOR, 2N5305	275559-001
Q118	TRANSISTOR, 2N5305	275559-001
Q119	TRANSISTOR, 2N5305	275559-001
Q120	TRANSISTOR, 2N5305	275559-001
Q121	TRANSISTOR, 2N2712	ND39917-001
Q122	TRANSISTOR, 2N2712	ND39917-001
R109	RESISTOR, 250k ohms $\pm 1\%$, 1/8 Watt	279051-001
R110	RESISTOR, 36k ohms $\pm 5\%$, 1/4 Watt	278433-906
R111	RESISTOR, 240k ohms $\pm 5\%$, 1/4 Watt	270082-001
R112	RESISTOR, 110k ohms $\pm 1\%$, 1/10 Watt (100 mV and 1V ranges)	270199-001
R112	RESISTOR, 22k ohms $\pm 5\%$, (10V Range)	278433-901
R112	RESISTOR, 62k ohms $\pm 5\%$, (100V Range)	278433-912
R113	RESISTOR, TRIMMER, 20k ohms $\pm 10\%$ 1 Watt (100mV range)	278125-001
R113	RESISTOR, TRIMMER, 20k ohms ± 10 ohms, 1 Watt (1, 10 and 100V Ranges)	281579-901
R114 \emptyset	RESISTOR, 750k ohms $\pm 5\%$, 1/4 Watt	278433-938
R115 \emptyset	RESISTOR, 100k ohms $\pm 5\%$, 1/4 Watt	278433-917
R118	RESISTOR, 2K ohms $\pm 5\%$, 1/4 Watt	278432-972
R119	RESISTOR, 13.165k ohms	} KIT 279872-901
R124	RESISTOR, 2.1 k ohms	
R120	RESISTOR, 30.1 ohms $\pm 1\%$, 1/10 Watt	279166-001
R121	RESISTOR, 24.9 ohms $\pm 1\%$, 1/4 Watt	278437-939
R122	RESISTOR, 49.9 ohms $\pm 1\%$, 1/10 Watt	279167-001
R123	RESISTOR, 100ohms $\pm 1\%$, 1/10 Watt	269925-001
R125	RESISTOR, TRIMMER, 10k ohms $\pm 10\%$, 3/4 Watt	279169-001

\emptyset With BCD Only
 \emptyset Without BCD Only

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY. (Ref Figure 7-7) (Cont.)</u>	
R126	RESISTOR, 42.2k ohms $\pm 1\%$, 1/8 Watt	278440-961
R127	RESISTOR, 42.2k ohms $\pm 1\%$, 1/8 Watt	278440-961
R130	RESISTOR, 900k ohms	} KIT (10V Range) 279877-901
R131	RESISTOR, 100k ohms	
R130	RESISTOR, 4.95M ohms	} KIT(100V Range) 279881-901
R131	RESISTOR, 50k ohms	
R136	RESISTOR, 33k ohms $\pm 5\%$, 1/4 Watt	278433-905
R137	RESISTOR, 3k ohms $\pm 5\%$, 1/4 Watt	278432-976
R138	RESISTOR, 270k ohms $\pm 5\%$, 1/4 Watt	278433-927
R139	RESISTOR, 3k ohms $\pm 5\%$, 1/4 Watt	278432-976
R140	RESISTOR, 47 ohms $\pm 5\%$, 1/4 Watt	278432-933
R141	RESISTOR, 10 ohms $\pm 1\%$, 1/8 Watt	278437-901
R142	RESISTOR, 300k ohms $\pm 1\%$, 1/10 Watt (1, 10 and 100V Ranges)	276936-001
T101	TRANSFORMER (100 and 117V)	279865-903
T101	TRANSFORMER (220 and 240V)	279865-902
U103	INTEGRATED CIRCUIT, 74C48	279151-001
U104	INTEGRATED CIRCUIT, 8068	279158-001
U105	INTEGRATED CIRCUIT, 7103	279159-001
U107	INTEGRATED CIRCUIT, LM399H	279134-001
U108	INTEGRATED CIRCUIT, 78L24AC	279154-001
U109	INTEGRATED CIRCUIT, 78L05AC	279155-001
U110	INTEGRATED CIRCUIT, 741CP	279153-001
U111 [Ⓞ]	INTEGRATED CIRCUIT, 78L05AC	279155-001
U112	INTEGRATED CIRCUIT, CD4013	279181-001
XU104	SOCKET, IC, 14 PIN	279157-001
XU105	SOCKET, IC, 28PIN	278163-001
Y101	RESONATOR, FA400	279182-001
---	BOARD, DRILLED (100 and 117V)	279854-901
---	BOARD, DRILLED (220 and 240V)	279854-902

[Ⓞ] With BCD Only

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY, DISPLAY (Ref Figure 7-7)</u>	
DS101	DISPLAY, NUMERIC, 1 Digit	279874-902
DS102	DISPLAY, NUMERIC, 2 Digits	278345-902
DS103	DISPLAY, NUMERIC, 1 1/2 Digits	278346-901
Q106	TRANSISTOR, 2N2712	ND39917-001
Q114	TRANSISTOR, 2N2712(Minus operation only-standard)	ND39917-001
R102	RESISTOR, 62 ohms $\pm 5\%$, 1/4Watt	278432-936
R103	RESISTOR, 62 ohms $\pm 5\%$, 1/4Watt	278432-936
R104	RESISTOR, 62 ohms $\pm 5\%$, 1/4Watt	278432-936
R105	RESISTOR, 62 ohms $\pm 5\%$, 1/4Watt	278432-936
R106	RESISTOR, 47 k ohms $\pm 5\%$, 1/4Watt (Minus operation-standard)	278433-909
R106	RESISTOR, 3.3 k ohms $\pm 5\%$, 1/4Watt (Plus & Minus operation-optional)	278432-977
R107	RESISTOR, 4.7 k ohms $\pm 5\%$, 1/4 Watt (Minus operation-standard)	278432-981
R107	RESISTOR, 22 ohms $\pm 5\%$, 1/4Watt (Plus & Minus operation-optional)	278432-925
R108	RESISTOR, 62 ohms $\pm 5\%$, 1/4Watt	278432-936
U102	MICROCIRCUIT, SN75497N	279148-001
X101	SOCKET, DISPLAY	278175-001
X102	SOCKET, DISPLAY	278175-001
Z102	RESISTOR, MODULE	279147-001
--	BOARD, DRILLED	279851-901

REF SYMBOL	DESCRIPTION	WESTON PART NO.
<u>BOARD ASSY, 100mV Range (Ref Figure7-7)</u>		
C201	CAPACITOR, 33pF $\pm 10\%$, 1000WVDC	275553-001
C202	CAPACITOR, 1.0uF $\pm 20\%$, 35WVDC	269954-001
C203	CAPACITOR, 1.0uF $\pm 20\%$, 35WVDC	269954-001
CR201	DIODE, 1N914 DHD	ND61025-001
CR202	DIODE, 1N914 DHD	ND61025-001
Q201	TRANSISTOR, 2N5354	268795-001
Q202	TRANSISTOR, 2N5354	268795-001
R201	RESISTOR, 9k ohms } KIT	279873-901
R202	RESISTOR, 990 ohms }	
R203	RESISTOR, 10 ohms, $\pm 1\%$, 1/10 Watt	269915-001
R204	RESISTOR, 121 k ohms $\pm 1\%$, 1/10 Watt	272283-001
R205	RESISTOR, 100k ohms $\pm 1\%$, 1/10 Watt	269885-001
R206	RESISTOR, 100k ohms $\pm 1\%$, 1/10 Watt	269885-001
R207	RESISTOR, SHUNT, OPTIONAL	NO NUMBER
R212	RESISTOR, 100 ohms $\pm 5\%$, 1/4 Watt	278432-941
R213	RESISTOR, 100 ohms $\pm 5\%$, 1/4 Watt	278432-941
U201	INTEGRATED CIRCUIT, OP-08EJ	281499-001
--	BOARD, DRILLED	279860-901

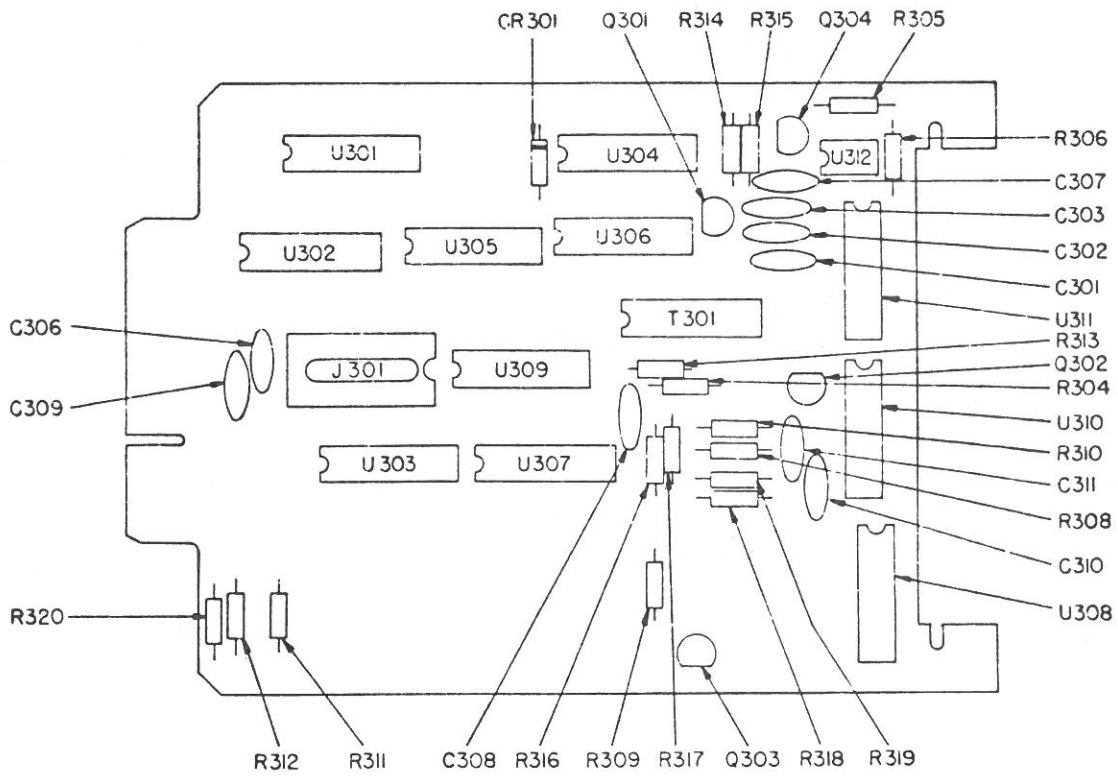


Figure 7-8. Board Assembly with BCD

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY, BCD (Ref Figure 7-8)</u>	279857-901
C301	CAPACITOR, 0.001uF $\pm 10\%$, 1000WVDC	266417-001
C302	CAPACITOR, 0.1uF $\pm 20\%$, 12 WVDC	280081-001
C303	CAPACITOR, 0.001uF $\pm 10\%$, 1000WVDC	266417-001
C306	CAPACITOR, 0.001uF $\pm 10\%$, 1000WVDC	266417-001
C307	CAPACITOR, 0.0022uF $\pm 10\%$, 600WVDC	280100-001
C308	CAPACITOR, 0.01uF -20% $+80\%$, 50WVDC	269899-001
C309	CAPACITOR, 0.01uF -20% $+80\%$, 50WVDC	269899-001
C310	CAPACITOR, 150pF $\pm 10\%$, 1000WVDC	274101-001
C311	CAPACITOR, 0.0022uF $\pm 10\%$, 600WVDC	280100-001
CR301	DIODE, 1N914 DHD	ND61025-001
J301	SOCKET, IC, 14 PIN	279157-001
Q301	TRANSISTOR, 2N3605	268796-001
Q302	TRANSISTOR, 2N3605	268796-001
Q303	TRANSISTOR, 2N3605	268796-001
Q304	TRANSISTOR, 2N2712	ND39917-001
R304	RESISTOR, 619 ohms $\pm 1\%$, 1/4 Watt	278438-977
R305	RESISTOR, 2 k ohms $\pm 5\%$, 1/4Watt	272327-001
R306	RESISTOR, 1.2k ohms $\pm 5\%$, 1/4 Watt	266614-001
R308	RESISTOR, 62k ohms $\pm 5\%$, 1/4 Watt	278433-912
R309	RESISTOR, 20k ohms $\pm 5\%$, 1/4 Watt	278432-996
R310	RESISTOR, 33k ohms $\pm 5\%$, 1/4 Watt	278433-905
R311	RESISTOR, 33k ohms $\pm 5\%$, 1/4 Watt	278433-905
R312	RESISTOR, 20k ohms $\pm 5\%$, 1/4 Watt	278432-996
R313	RESISTOR, 200 ohms $\pm 5\%$, 1/4 Watt	278432-948
R314	RESISTOR, 100k ohms $\pm 5\%$, 1/4Watt	278433-917
R315	RESISTOR, 100k ohms $\pm 5\%$, 1/4 Watt	278433-917
R316	RESISTOR, 10k ohms $\pm 5\%$, 1/4 Watt	278432-989
R317	RESISTOR, 10k ohms $\pm 5\%$, 1/4 Watt	278432-989
R318	RESISTOR, 51k ohms $\pm 5\%$, 1/4 Watt	278433-910
R319	RESISTOR, 62k ohms $\pm 5\%$, 1/4 Watt	278433-912
R320	RESISTOR, 51k ohms $\pm 5\%$, 1/4 Watt	278433-910
T301	TRANSFORMER, PULSE	278341-901

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY, BCD(Ref Figure 7-8) Cont.</u>	
U301	INTEGRATED CIRCUIT, CD4050	278177-001
U302	INTEGRATED CIRCUIT, CD4050	278177-001
U303	INTEGRATED CIRCUIT, CD4050	278177-001
U304	INTEGRATED CIRCUIT, 74C90	279177-001
U305	INTEGRATED CIRCUIT, 74C90	279177-001
U306	INTEGRATED CIRCUIT, 74C90	279177-001
U307	INTEGRATED CIRCUIT, 74C90	279177-001
U308	INTEGRATED CIRCUIT, 74C90	279177-001
U309	INTEGRATED CIRCUIT, 74LS00	279175-001
U310	INTEGRATED CIRCUIT, 74LS02	279176-001
U311	INTEGRATED CIRCUIT, 74LS00	279175-001
U312	INTEGRATED CIRCUIT, MCT26	279178-001
---	BOARD, DRILLED	279856-901

REF SYMBOL	DESCRIPTION	WESTON PART NO.
	<u>BOARD ASSY, 10mV Range(Ref Fig.7-7)</u>	
C401	CAPACITOR, 0.01uF +20%, 50WVDC	276310-001
C402	CAPACITOR, 1uF +10%, 100WVDC	279164-001
CR401	DIODE, 4.3V +5%, 1N749A	271766-001
CR402	DIODE, 4.3V +5%, 1N749A	271766-001
Q401	TRANSISTOR, 2N3416	263642-001
R401	RESISTOR, 3.01k ohms +1%, 1/10W	272217-001
R402	RESISTOR, 3.01k ohms +1%, 1/10W	272217-001
R403	RESISTOR, 99k ohms +0.5%	282176-901
R404	RESISTOR, 1k ohms +0.5% Matched Set	
R405	RESISTOR, 100 ohms +1%, 1/10W	269925-001
R406	RESISTOR, 200k ohms +1%, 1/10W	276965-001
R407	RESISTOR, 100k ohms +1%, 1/10W	266631-001
R408	RESISTOR, 5.1k ohms +5%, 1/4W	ND37341-001
R409	RESISTOR, 5.1k ohms +5%, 1/4W	ND37341-001
R410	RESISTOR, 2k ohms +1%, 1/10W	270105-001
U401	INTEGRATED CIRCUIT, 8053 ACPD	282173-001
U402	INTEGRATED CIRCUIT, OP-05CP	281765-001
W101	LEAD, Yellow, 3.0" lg	246374-915
W102	LEAD, Red, 3.0" lg	246374-916
W103	LEAD, Black, 3.0" lg	246374-946
-	STUD, TERMINAL	282172-024
-	BOARD, DRILLED	282169-901

WARRANTY

Weston warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of Seller under this warranty is limited, at Seller's option, solely to repair, replacement with equivalent Weston equipment, at an appropriate credit adjustment not to exceed the original equipment sales price, of equipment returned to the Seller provided that (a) Seller is promptly notified in writing by Buyer upon discovery of defects, (b) Upon receipt of written authorization from Seller the defective equipment is returned as directed, transportation charges prepaid by Buyer, and, (c) Seller's examination of such equipment discloses to his satisfaction that defects were not caused by negligence, misuse, improper installation, accident, or unauthorized repair or alteration by the Buyer. Any modification such as changing range resistors may void this warranty.

This warranty does not include mechanical parts failing from normal usage nor does it cover limited life electrical components which deteriorate with age such as tubes, lamps, etc.

This warranty is in lieu of all other warranties, expressed or implied, including the implied warranty of fitness for a particular purpose to the original purchaser or to any other person. Seller shall not be liable for consequential damages of any kind.

The aforementioned provisions do not extend the original warranty period of any article which has been either repaired or replaced by Seller.