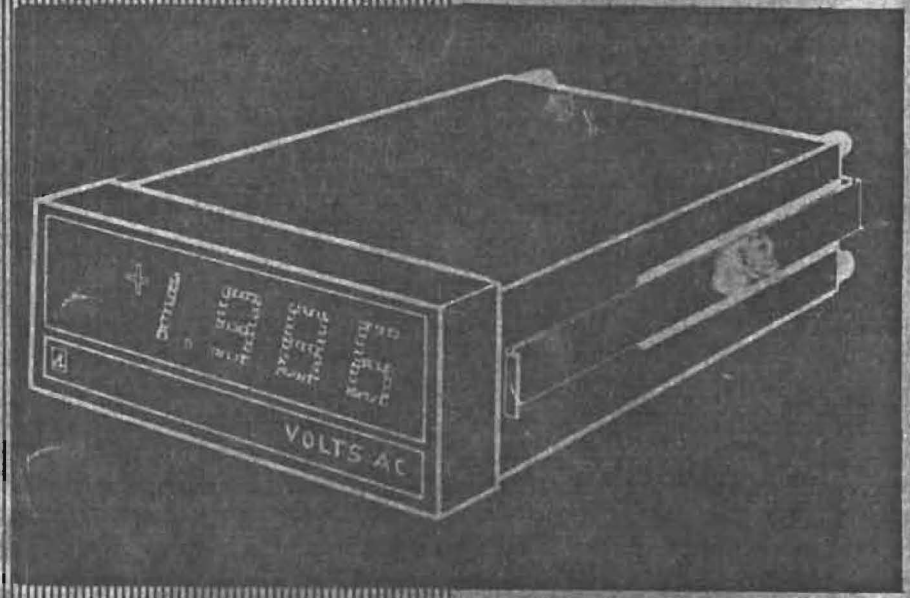
3½ DIGIT

Panel Instrument

Model 3312



Operation Manual

Printed in USA

DATA TECH

A DIVISION OF P[illegible]RIL COR[illegible]

GENERAL DESCRIPTION

The DATA TECH Model 3312 is a 3-1/2-digit, digital panel meter. Four basic units are available, providing either ±200-millivolt, ±2-volt, ±20-volt, or ±200-volt analog ranges. These units are available for operation from 100, 115, and 230 volt ac power sources. See Table 1 for model and assembly numbers.

Table 1. Model and Assembly Numbers

Model	Assembly	Range	ac Power
3312-01	548381-100	±200mV	115Vac
3312-02	548381-101	±2V	115Vac
3312-11	548381-109	±20V	115Vac
3312-12	548381-110	±200V	115Vac
3312-03	548381-102	±200mV	100Vac
3312-04	548381-103	±2V FS	100Vac
3312-13	548381-111	±20V	100Vac
3312-14	548381-112	±200V	100Vac
3312-05	548381-104	±200mV	230Vac
3312-06	548381-105	±2V	230Vac
3312-07	548381-113	±20V	230Vac
3312-08	548381-114	±200V	230Vac

All model 3312 assemblies include digital input-output lines for those wishing to obtain BCD data and control the convert rate. An optional connector kit, part number 548387-100, includes a connector and fasteners for the input-output interface.

Special Modifications

Data Tech's design of the Model 3312 allows for the addition of many special features not available with standard units. Information on non-standard features is available from Data Tech and associated representatives. Refer to page 13 for modifications of equipment related to this manual.

Specifications

ANALOG INPUT

Configuration ..... Bipolar

*Bias Current

2V Range ..... 70nA nom, 250nA max

200mV Range ..... 2nA nom, 7nA max

*** Other ranges have attenuators isolating the input**

Specifications (Continued)

ANALOG INPUT (continued)

*Offset Current

2V Range	3nA nom, 50nA max
200mV Range	0.2nA nom, 2nA max
Input Impedance	
200mV, 2V Range	1000MΩ min
20V, 200V Range	10 MΩ
Overvoltage Protection	±200V max input w/o damage
ACCURACY (absolute) at 25 ±1°C 90 days	±(0.1% rdg +1 count)
WARM-UP TIME	No warm-up time required for specified accuracy
STABILITY	
Temp Coefficient of FS	50ppm/°C of rdg typ; 80ppm/°C max
Temp Coefficient of Zero Offset	
200mV Model	0.005% FS/°C typ 0.01% FS/°C max
2V, 20V, 200V Model	0.0005% FS/°C typ 0.002% FS/°C max
Calibration Interval	3 months
CONVERSION	
Clock	Crystal controlled 5MHz ±0.0004%/°C
Mode	Responds to step input in one conversion cycle independent of previous measurement
Rate	Factory set for 3/s nom; externally variable from 3 to 30/s. Also, externally triggerable from 0 to 30/s.
AC AND NOISE REJECTION	
Common Mode Rejection	80dB, 50 — 60Hz, w/1kΩ source unbalance
Common Mode Voltage	±300Vdc or 600Vac pk-pk max (input floating)
Normal Mode	18dB at 60Hz nom

*Other ranges have attenuators isolating the input.

Specifications (Continued)

DISPLAY

Type	Sperry 7-segment gas discharge
Number of Digits	3 full plus "1"
Range	±1999
Decimal Point	3 positions, externally selectable
Polarity	Automatic, plus and minus displays
Overrange	display flashes at >±1999
ENVIRONMENTAL	
Temperature	
Operating	0° to +50°C
Storage	-25° to +85°C
Relative Humidity	80% max
POWER	
Input	115, 100, and 230Vac, ±10%, 50 — 60Hz
Power Consumption	2.5W typ
DIGITAL OUTPUTS AND CONTROL INPUTS	
Logic	TTL and DTL compatible
Output Drive (TTL unit loads)	
BCD Data (13 lines)	5 ea
POLARITY (+)	8
$\overline{\text{OVERRANGE}}$	8
$\overline{\text{PRINT}}$	8
Input Load (TTL unit loads)	
EXTERNAL TRIGGER	4
EXTERNAL BLANKING	4

INSTALLATION AND OPERATION

Mounting (Figure 1)

The meter is designed for mounting in a 1.682 ±.010 by 3.924 ±.010 inch panel cutout. To mount, remove the mounting bracket, position the meter in

the panel cutout, and replace the mounting bracket. Do not obstruct the vent slots on either side of the meter case. See Figure 2 for dimensions.

Wiring

Any of the following connectors are suitable for a J1 interface.

Masterite — Type 2MC18D/1-2
SAE Advanced Packaging — Type SAC18D/1-2
Greg Electronics — Type 81260-18DR1H
Data Tech — Part Number 531768-001
**Elco* — Type 00-6007-36-980-002
**Cinch* — Type 251-18-30-160

The connector fastens to the rear of the case using 7/16 inch long 4-20 self-tapping screws. See Figure 1.

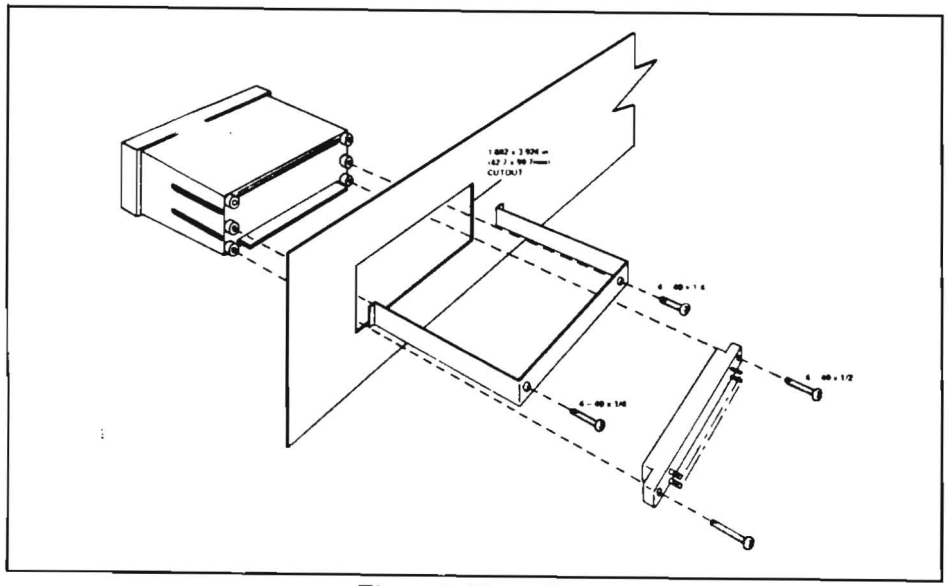


Figure 1. Mounting

**Cinch and Elco connectors are 0.020 inch wider than the other connectors and, therefore, offer reduced reliability in Model 3312 applications.*

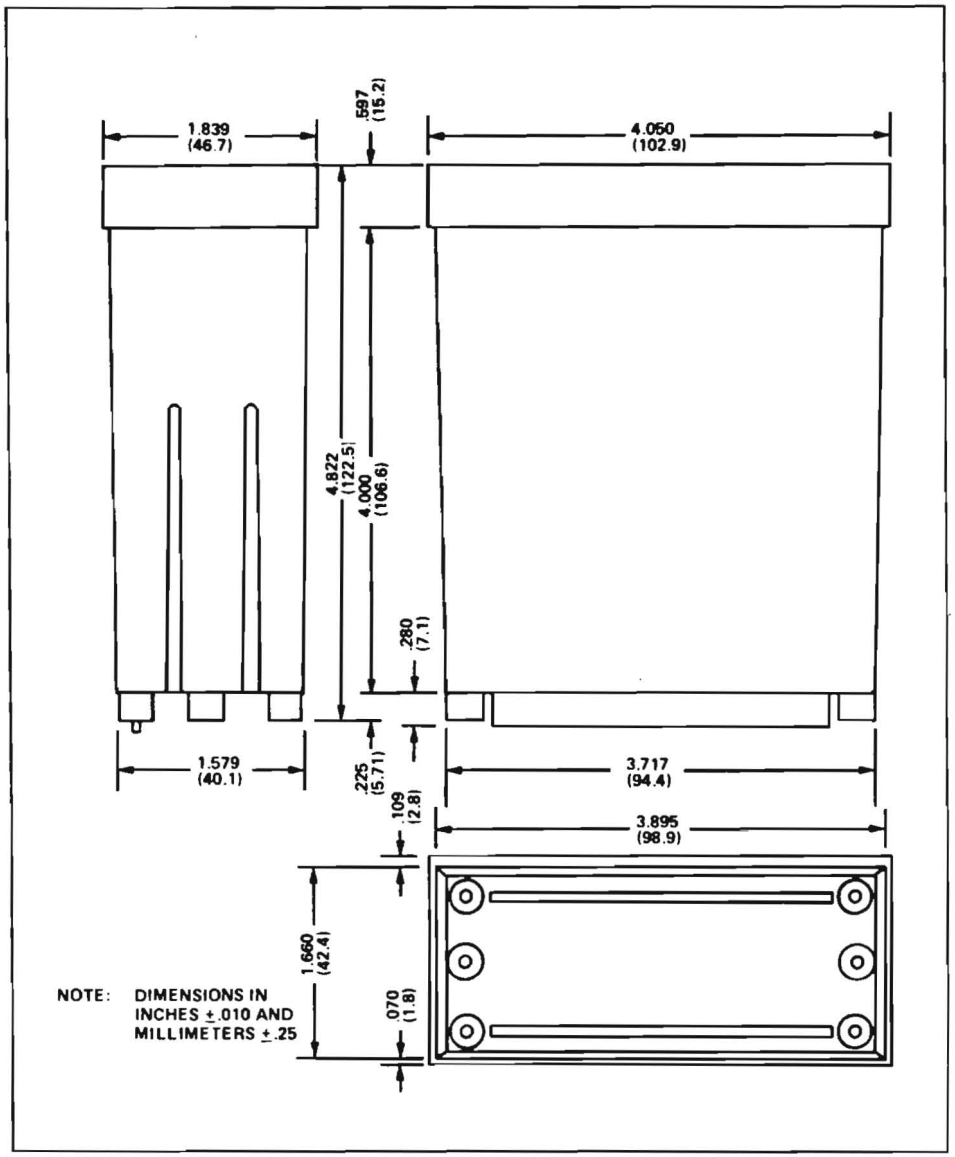


Figure 2. Dimensions

Using Table 2, connect the SHIELD to the SYSTEM GROUND; connect the source to be measured between ANALOG INPUT HIGH and LOW, and when applicable, establish the decimal point. Jumper the INTERNAL TRIGGER output (J1-E) to the EXTERNAL TRIGGER INPUT (J1-9) when external control of conversions is not desired.

Table 2. Input-output Pin Assignments

Pin	Signal	Pin	Signal
1	ANALOG INPUT (LOW)	A	ANALOG INPUT (HI)
2	+5V	B	GND for Decimal Pt 18.88
3	2 x 10^1 BCD DIGIT	C	GND for Decimal Pt 1.888
4	GND for Decimal Pt 188.8	D	INT TRIG RATE CONTROL
5	2 x 10^0 BCD DIGIT	E	INT TRIG Output
6	4 x 10^1 BCD DIGIT	F	4 x 10^0 BCD DIGIT
7	1 x 10^0 BCD DIGIT	H	8 x 10^0 BCD DIGIT
8	$\overline{\text{PRINT}}$	J	$\overline{\text{EXT BLANKING}}$
9	EXT TRIG Input	K	$\overline{\text{OVERRANGE}}$
10	8 x 10^2 BCD DIGIT	L	1 x 10^2 BCD DIGIT
11	1 x 10^1 BCD DIGIT	M	POLARITY (+)
12	2 x 10^2 BCD DIGIT	N	4 x 10^2 BCD DIGIT
13	1 x 10^3 BCD DIGIT	P	8 x 10^2 BCD DIGIT
14	DIGITAL GND	R	SHIELD
16	ac POWER INPUT (HI)	T	ac POWER INPUT (HI)
18	ac POWER INPUT (RTN)	V	ac POWER INPUT (RTN)

Operation

CAUTION

If the display flashes, an overrange condition exists. Excessive overrange levels can cause damage to the meter. Remove the ANALOG INPUT and determine that any overrange level does not exceed ±200 volts.

DISPLAY BLANKING

The display is inhibited OFF when the EXTERNAL BLANKING line is jumpered to DIGITAL GROUND (logic "0"). Display blanking automatically occurs during the time segment allotted to the conversion process. The EXTERNAL BLANKING line can either remain unconnected or receive a logical "1" (+5 volts) for the unblanked state.

VARYING INTERNAL TRIGGER RATE

The speed which conversions occur when the INTERNAL TRIGGER output is jumpered to the EXTERNAL TRIGGER input is set at the factory at about three conversions per second. Up to 30 conversions per second are possible by shunting resistance between J1-2 and J1-D. The INTERNAL TRIGGER RATE is inversely proportional to the shunt value. The likelyhood of display "Blinking" increases as the INTERNAL TRIGGER RATE is increased. The INTERNAL TRIGGER signal can be monitored between J1-E and GROUND (J1-14).

HOLD ON COMMAND OPERATION

A "0" (GND) on J1-D initiates hold mode; whereby, conversions are terminated and BCD and display data corresponding to the last conversion remain stored. When hold mode is initiated during a conversion, the stored BCD and display data correspond to the conversion in progress.

An ungrounded (open) J1-D returns the unit to free-run mode.

Calibration (Figure 3)

The accuracy of the meter should be established at 90-day intervals. Accuracy is confirmed when known inputs yield corresponding displays, within specified accuracy.

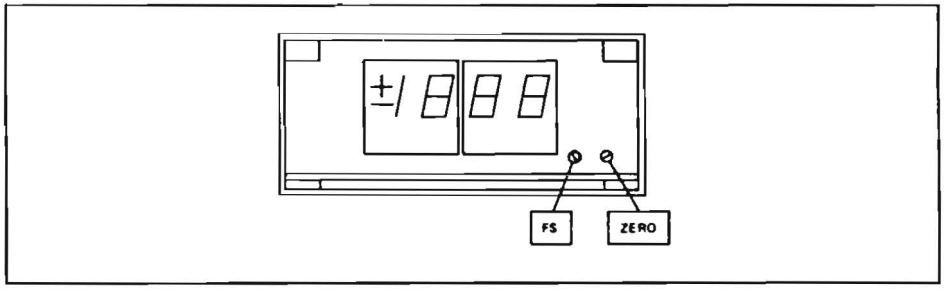


Figure 3. Calibration Adjustment Locations

To calibrate, remove the display bezel by inserting a screwdriver in the slot located in the center of the bottom bezel edge. Free the associated retaining tab with a slight downward prying motion of the screwdriver handle. Pivot the lower bezel edge outward and upward for the complete removal. Calibrate as follows:

1. Short J1-A to J1-1 (0-volt ANALOG INPUT).

2. Adjust the zero potentiometer for a 000 and toggling polarity display.

3. Apply a full scale (1999) input level in place of the short between J1-A and J1-1.

4. Adjust the full scale potentiometer for a 1999 display.

5. Replace the bezel by aligning the retaining tabs in front of their respective slots and pushing the bezel until these tabs snap in place.

NOTE

No further instructions are required when the digital input-output lines are not used. The units begin operating upon receipt of the inputs prescribed under "wiring"; if not, refer to the warranty for proper action.

DIGITAL INPUT-OUTPUT LINES

The digital input and output lines are DTL and TTL compatible, with positive true positive logic levels as follows:

Logical "1" = +2.4 to +5.5 volts dc

Logical "0" = 0 to 0.4 volts dc

Refer to the specification for specific line load capabilities and requirements.

BCD Output Lines (13)

The 13 lines labeled BCD DIGIT in Table 3 provide binary-coded-decimal logic levels representative of the ANALOG INPUT. These lines carry valid data of the previous conversion when the $\overline{\text{PRINT}}$ line is a logical "0."

$\overline{\text{OVERRANGE}}$ Output Line

The $\overline{\text{OVERRANGE}}$ line is normally a logical "1." The line is a "0" for conversions yielding displays greater than ±1999.

POLARITY (+) Output Line

The POLARITY (+) line is a logical "1" for positive ANALOG INPUT levels and a logical "0" for negative ANALOG INPUT levels.

$\overline{\text{PRINT}}$ Output Line (Figure 4)

The PRINT line is a logical "1" when the other DATA OUTPUT lines are updating due to a conversion in process. The line is a logical "0" when the OUTPUT lines carry valid data. The duration of the "1" level is proportional to the input level, exclusive of polarity. Therefore, near-zero input levels produce very narrow pulse widths.

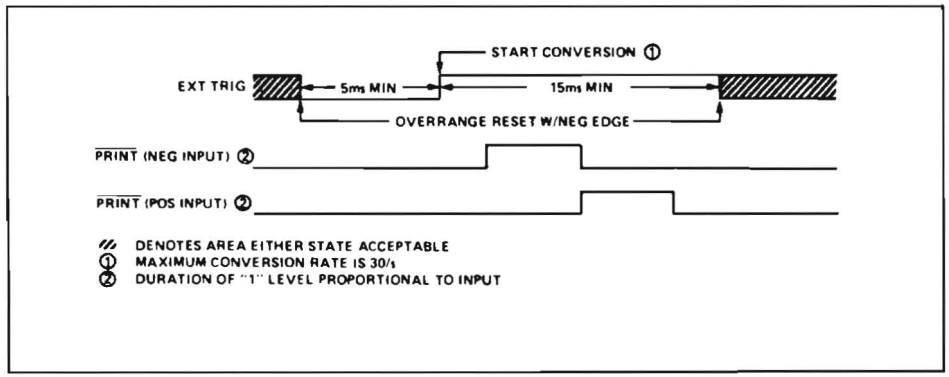


Figure 4. Timing

EXTERNAL TRIGGER Input Line (Figure 4)

Conversions may be controlled externally. When using an external trigger source, connect no jumper between J1-E and J1-9. Instead, initiate conversions via the EXTERNAL TRIGGER input. Figure 4 shows the requirements for this mode of operation. A failure to adhere to the minimum durations specified, results in inaccurate conversions. Note that OVERRANGE is reset back to a "1" with the negative EXTERNAL TRIGGER edge.

DECIMAL POINT CONSIDERATION

When the decimal point is established by external circuitry, that circuitry must be capable of withstanding 60 volts when OFF.

THEORY OF OPERATION

Conversion Technique (Figure 5)

The analog-to-digital conversion is made by comparing the input levels to an integrating waveform. In the case of negative inputs, when the integration voltage reaches the input level, clocking of a counter begins. This clocking is subsequently stopped when the integration voltage reaches 0 volts. The number of counts entered into the counter during the clocking interval is a digital representation of the analog input.

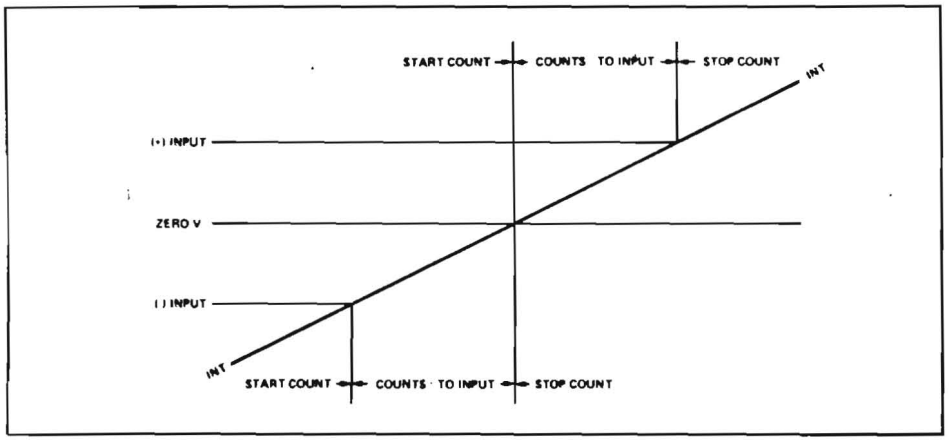


Figure 5. Conversion Technique

In the case of positive input levels, the clocking begins when the integration voltage reaches 0 volts and continues until the integration voltage reaches the input level. As with the negative case, the number of counts entered during clocking determines the digital output.

Functional Block (Figure 6)

The conversion is started with the trigger signal — either generated externally or by the rate generator. The trigger causes display blanking and inhibits the clocking logic, which in turn generates a counter RESET. The generation of the TRIGGER signal initiates the positive slope from the integrator.

Note that the comparators each receive the integration waveform as an input. In one case this waveform is compared to the input level. In the other case the waveform is compared to 0 volts.

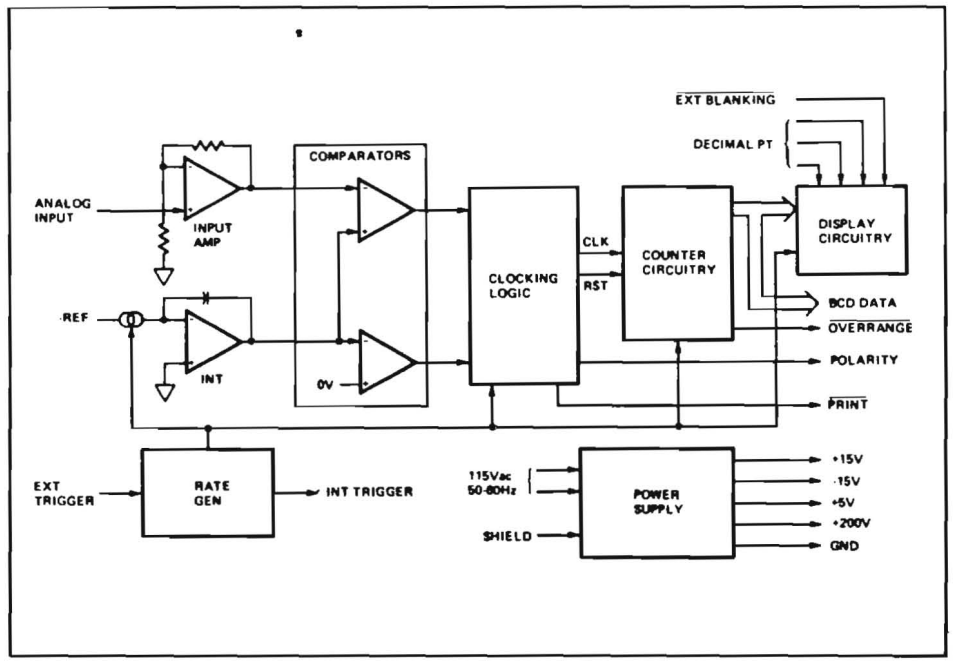


Figure 6. Functional Block Diagram

The function of the clocking logic is to sense the outputs of the comparators and transmit clock pulses following the first comparator that changes state and terminate clocking when the other comparator changes state. Note that the order in which the comparators change state is determined by the input polarity. Polarity information is also gathered from this logic.

The number of clock pulses between the comparators changing state is entered into the counter. The counter yields BCD data, which is available on the output lines and decoded for decimal display.

Factory Repair

DATA TECH maintains a factory repair facility. Our trained technicians are available to repair your instruments with a minimum of inconvenience to you. Refer to the customer service card inside the back cover for equipment return instructions.

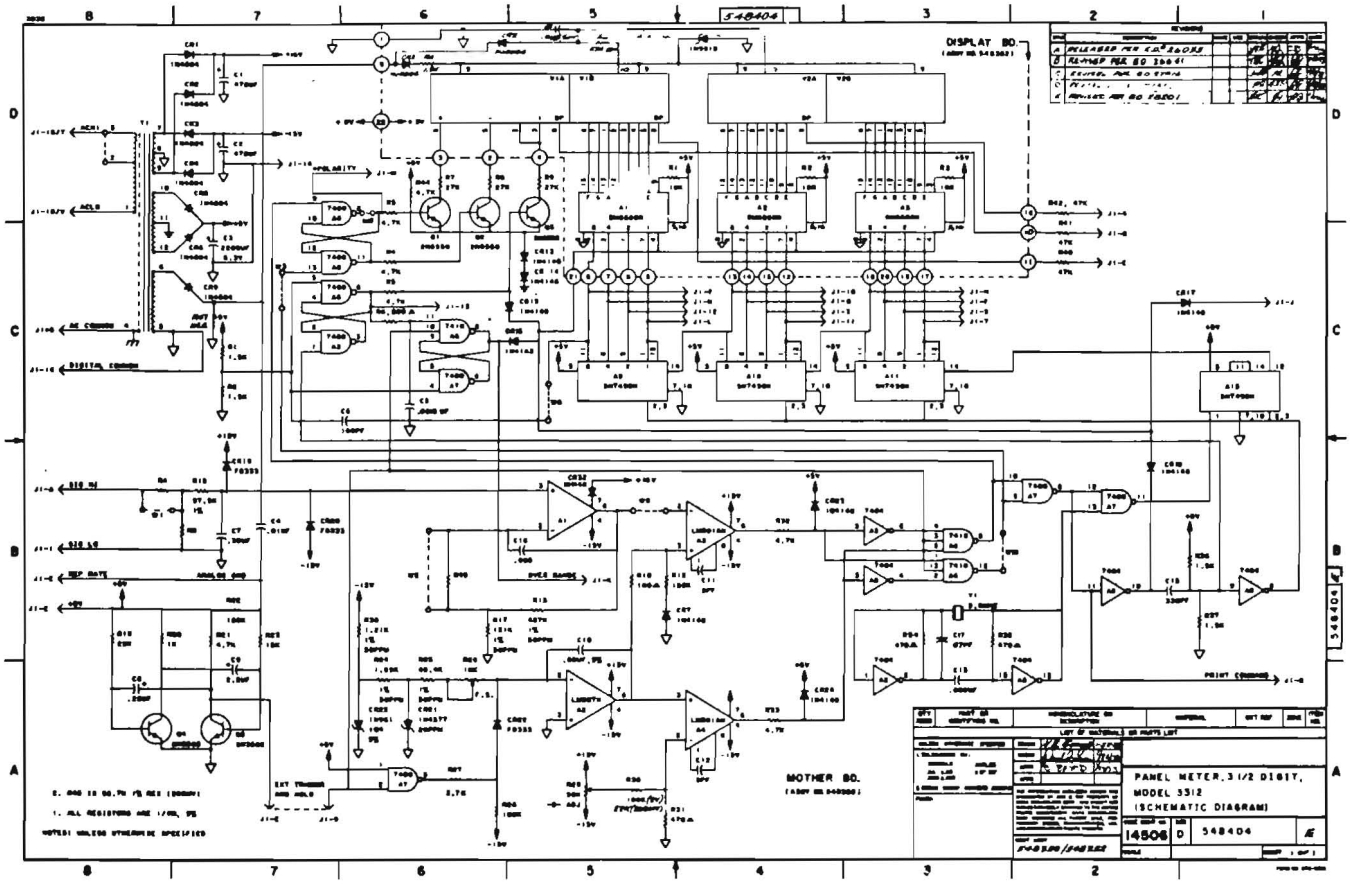
SECTION VI
DRAWINGS AND PARTS LISTS

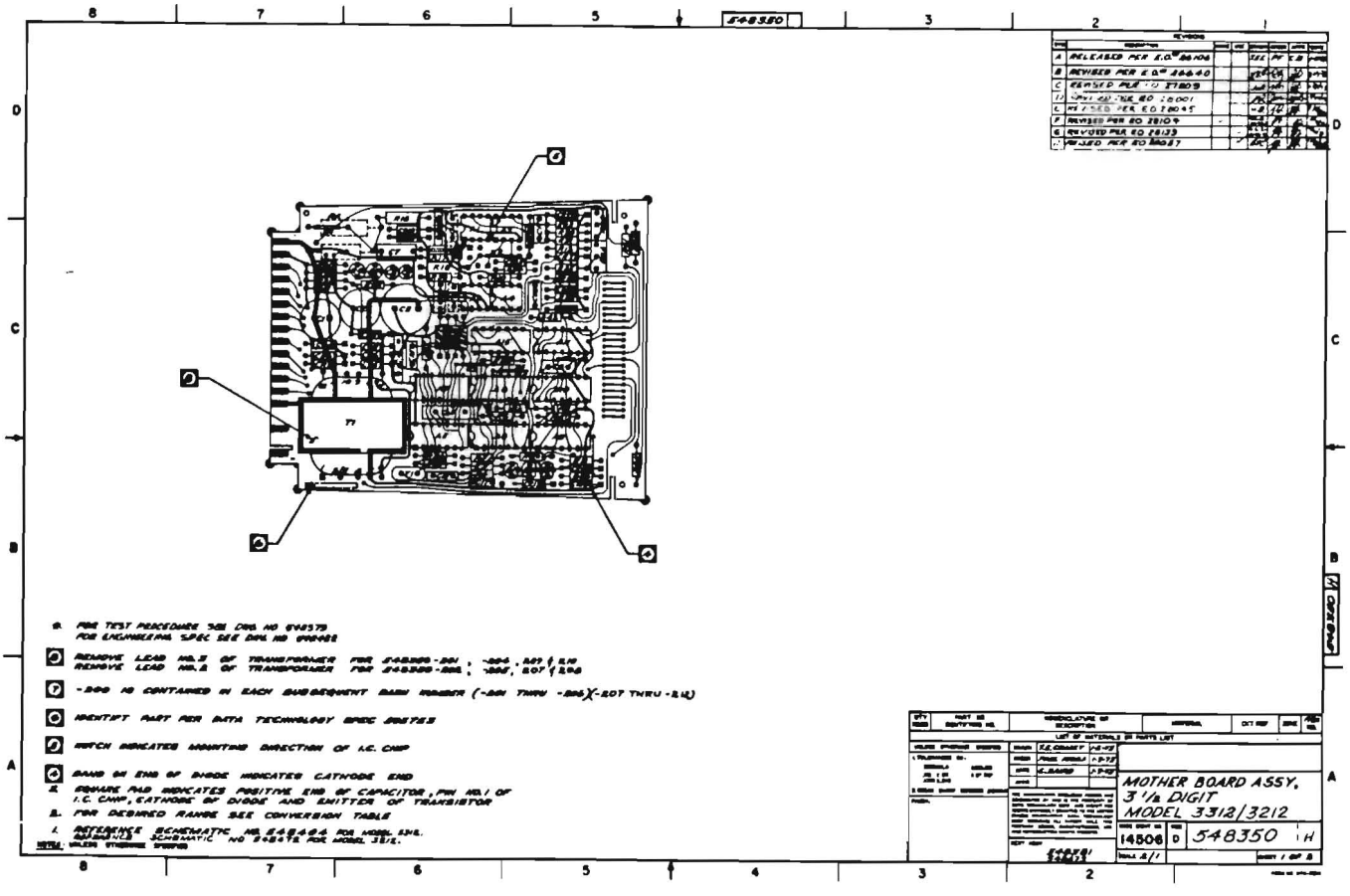
GENERAL

This section contains schematics, layout drawings, and parts lists for model 3312 sub-assemblies.

DRAWINGS AND PARTS LIST

Drawing Number	Title
548404	Panel Meter, 3-1/2 Digit, Model 3312 (Schematic Diagram)
548350 page 1	Mother Board Assembly, 3-1/2 Digit, Model 3312
548350 H Ref	Mother Board Assembly, Parts List
548352	Display Board Assembly, 3-1/2 Digit, Model 3312
548352 D Ref	Display Board Assembly, Parts List


548404
DISPLAY BD.
MOTHER BD.
PANEL METER, 3 1/2 DIGIT,
MODEL 3312
(SCHEMATIC DIAGRAM)
14506 D 548404 E


548350
MOTHER BOARD ASSY,
3 1/2 DIGIT
MODEL 3312/3212
14506 D 548350 H

REPLACEABLE PARTS LIST

Model 3312/3212

Description Mother Board Assembly

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531948-001	A1 Int Ckt (2V)	27014	National Semiconductor LM307N				
821169-020	A1, Int Ckt (200mV)	27014	National Semiconductor LM308N				
531948-001	A2 Int Ckt (200mV, 2V)	27014	National Semiconductor LM307N				
531968-001	A3, A4 Int Ckt	27014	National Semiconductor LM301AN				
531359-013	A5 Int Ckt	04713	Motorola MC7404P	01295	Texas Instruments SN7404N	56289	Sprague SN7404N
531359-004	A6 Int Ckt	27014	National Semiconductor DM7410	04713	Motorola MC7410P	01295	Texas Instruments SN7410N
531359-003	A7, A8 Int Ckt	27014	National Semiconductor DM7400N	04713	Motorola MC7400P	56289	Sprague MSN7400A
814951-010	A9, A10, A11, A15 Int Ckt	27014	National Semiconductor DM7490	01295	Texas Instruments SN7490AN		
532042-002	Connector Spring Clip	26364	Components Corp MC3				
531338-009	CA Cap 300pF (200mV)	56289	Sprague 10TCC-V15				
532026-003	C1, C2 Cap 470μF, 16V		Michicon R1-A16U470				
532044-019	C3 Cap 2200μF, 6.3V		Matsushita Electric ECE-A6V2200L				
818131-260	C4 Cap .01μF	71590	Centralab DD103				
531338-059	C5 Cap .0015μF	56289	Sprague Electric Co. C023B102E152M				
531338-038	C6 Cap 100pF	56289	Sprague Electric Co. C023B102E 101M				

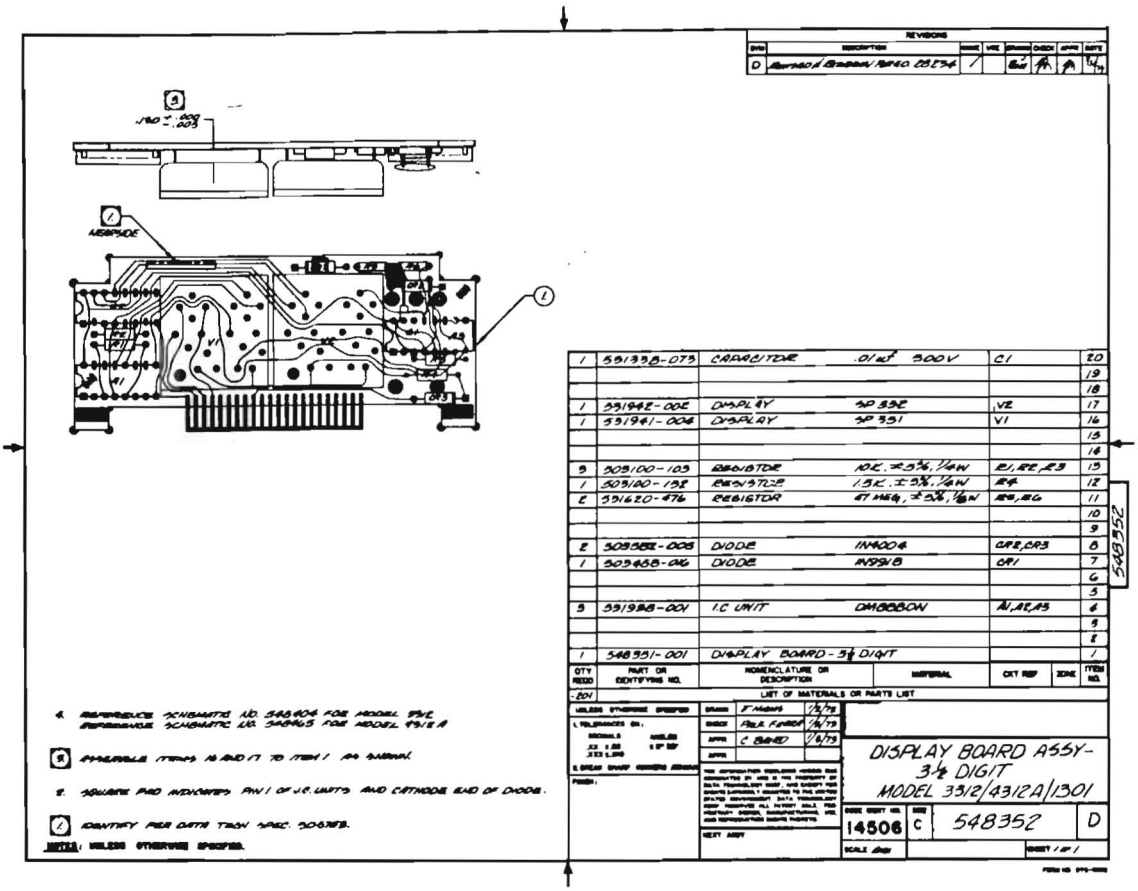
 Drawing No 548350

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
532048-049	C7 Cap .35μF, 5%		Engineered Components Co B42A354K				
532043-047	C8 Cap .22μF, 35V	14433	ITT Semiconductor TAG-30-.33/35-50				
532043-023	C9 Cap 2.2μF, 16V	14433	ITT Semiconductor TAG-20-22/16-50				
532049-001	C10 Cap .05μF, 5%		Engineered Components Co D42A503J				
817274-020	C11, C12 Cap 2pF	72136	Elmenco Capacitors DM-15-020				
531338-070	C13, C16 Cap .005μF	56289	Sprague Electric Co 3003B102G502M				
531338-047	C15 Cap 330pF	56289	Sprague Electric Co C023B102E331M				
531338-032	C17 Cap 47pF	56289	Sprague Electric Co 5GA-Q47				
503582-005	CR1 – CR6, CR9 Diode	04713	Motorola 1N4004	01295	Texas Instruments IN4004		
820284-010	CR7, CR13 – CR18, CR23, CR24, CR32	01295	Texas Instruments 1N4148	14433	ITT Semiconductor 1N4148		
531964-001	CR19, CR29, CR22 Diode	13715	Fairchild Semiconductor FD300				
818944-250	CR21 Diode	04713	Motorola 1N4577				
503458-005	CR25 Diode	04713	Motorola 1N961B				
531952-001	Q1, Q2, Q3 Transistor	04713	Motorola 2N5550				
817138-010	Q4, Q5 Transistor	07263	Fairchild Semiconductor 2N3565				
503100-152	R1, R2, R36, R37 Res 1.5k, 1/4W, 5%	01121	Allen Bradley CB1525	09021	Airco Speer 4R152J		
503100-472	R3, R4, R5, R21, R32, R33, R44 Res 4.7k	01121	Allen Bradley CB4725	09021	Airco Speer 4R472J		

 Drawing No 548350

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-201	R6 Res 200Ω, 1/4W, 5%	01121	Allen Bradley CB2015	09021	Airco Speer 4R201J		
503100-273	R7, R8, R9 Res 27k, 1/4W, 5%	01121	Allen Bradley CB2735	09021	Airco Speer 4R273J		
503100-101	R10 Res 100Ω, 1/4W, 5%	01121	Allen Bradley CB1015	09021	Airco Speer 4R101J		
503100-154	R12 Res 150k, 1/4W, 5%	01121	Allen Bradley CB1545	09021	Airco Speer 4R154J		
531317-361	R16 Res 97.6k, 1%	14574	Corning Electronics RN60C9762F	03888	Pyroflim Resistor Co RN60C9762F	07716	I.R.C. Inc RN60C9762C
532050-289	R17 Res (200mV) 10k, 1%	14574	Corning Electronics RN55C10k				
532050-457	R17 Res (2V) 121k, 1%	14574	Corning Electronics RN55C121k				
531317-377	R18 Res 487k, 1%	14574	Corning Electronics RN60C4873F	03888	Pyroflim Resistor Co RN60C4873F	07716	I.R.C. Inc RN60C4873F
503100-223	R19 Res 22k, 1/4W, 5%	01121	Allen Bradley CB2235	09021	Airco Speer 4R223J		
503100-102	R20 Res 1k, 1/4W, 5%	01121	Allen Bradley CB1025	09021	Airco Speer 4R102J		
503100-184	R22 Res 180k, 1/4W, 5%	01121	Allen Bradley CB1845	09021	Airco Speer 4R184J		
503100-153	R23 Res 15k, 1/4W, 5%	01121	Allen Bradley CB1535	09021	Airco Speer 4R153J		
532050-215	R24 Res 1.69k, 1%	14574	Corning Electronics RN55C 1.69k				
532050-417	R25 Res 46.4, 1%	14574	Corning Electronics R55C 46.4				
531970-601	R26 Res variable, 10k	73138	Beckman Instruments Inc 72XWR10k				

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-272	R27 Res 2.7k, 1/4W, 5%	01121	Allen Bradley CB2725	09021	Airco Speer 4R272J		
503100-104	R28 Res 100k, 1/4W, 5%	01121	Allen Bradley CB1045	09021	Airco Speer 4R104J		
531970-602	R29 Res variable, 50k	73138	Beckman Institute Inc 72XWR50k				
503100-223	R30 Res (200mV) 22k, 1/4W, 5%	01121	Allen Bradley CB2235	09021	Airco Speer 4R223J		
503100-104	R30 Res 100k, 1/4W, 5%	01121	Allen Bradley CB4715	09021	Airco Speer 4R471J		
503100-471	R34, R35, R31 Res 470Ω, 1/4W, 5%	01121	Allen Bradley CB4715	09021	Airco Speer 4R471J		
532050-201	R38 Res 1.21k, 1%	14575	Corning Electronics RN55C 1.21k				
503100-473	R40, R41, R42 Res 47k, 1/4W, 5%	01121	Allen Bradley CB4735	09021	Airco Speer 4R473J		
532050-444	R45 Res (200mV) 88.7k, 1%	14574	Corning Electronics RN55C 88.7k				
548342-001	T1 (100Vac, 115Vac) Transformer	14506	Data Technology 548342-001				
548342-002	T1 (230Vac) Transformer	14506	Data Technology 548342-002				
532045-001	XTAL	14506	Data Technology 532045-001				



Model 3312/4312

Description Display Board Assembly

REPLACEABLE PARTS LIST

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531938-001	A1, A2, A3 Int Ckt	07187	Sperry Information Displays Division DD700	27014	National Semiconductor DM8880N		
503458-016	CR1 Diode	04713	Motorola Semiconductor 1N991B				
503100-103	R1, R2, R3 Res 10k, 1/4W, 5%	01121	Allen Bradley CB1035	09021	Airco Speer 4R103J		
503100-152	R4 Res 1.5k, 1/4W, 5%	01121	Allen Bradley CB1525	09021	Airco Speer 4R152J		
531941-004	V1 Display	07187	Sperry Information Displays Division SP351				
531942-002	V2 Display	07187	Sperry Information Displays Division SP352				

Drawing No 548352