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AIRPAX®

NORTH AMERICAN PHILIPS CONTROLS CORP.

INSTRUCTION MANUAL

78 DIGITAL PROCESS MONITOR E.P.U.T. MODE

990-600-0040 REV. B

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MODEL MAP

GATE/NORMALIZATION TYPE
1. Gate time fixed
2. Gate time internally adjustable
3. Gate time front panel adjustable
4. No normalization
5. Normalization fixed
6. Normalization internally adjustable
7. Normalization front panel adjustable
8. Normalization fixed M/N
X. Special

DIGITS AND BLANKING
0. No display
1. Four digits/no blanking
2. Five digits/no blanking
3. Four digits/most significant digit blanked
4. Five digits/most significant digit blanked
5. Four digits/no blanking/fixed last zero
6. Five digits/no blanking/fixed last zero
X. Special

TYPE OF INSTRUMENT
1. E.P.U.T. (tachometer)
3. Accumulator (counter)
4. Accumulator (counter with stop/start)
6. Timer
7. Ratio
X. Special

DECIMAL POINT LOCATION
0. No decimal point
1. One digit to the right of the decimal point
2. Two digits to the right of the decimal point
3. Three digits to the right of the decimal point
4. Four digits to the right of the decimal point
5. Five digits to the right of the decimal point
X. Special

0 7 8 - [ ] [ ] [ ] - [ ] [ ] [ ] [ ]

POWER & ENCLOSURE
1. 120 vac. & 12 vdc. - standard enclosure
2. 120 vac. & 12 vdc. - "W" enclosure (Nema 3 & 12)
3. 120 vac. & 12 vdc. - "W" enclosure (Nema 4)
4. 120 vac. & 12 vdc. - "E" enclosure (Class 1, Group D)
5. 240 vac. & 12 vdc. - standard enclosure
6. 240 vac. & 12 vdc. - "W" enclosure (Nema 3 & 12)
7. 240 vac. & 12 vdc. - "W" enclosure (Nema 4)
8. 240 vac. & 12 vdc. - "E" enclosure (Class 1, Group D)
X. Special

SIGNAL INPUTS

	INPUT A	INPUT B
1.	Standard	Standard
2.	Z.V.P.U.	Standard
3.	Form "C"	Standard
4.	Standard	Z.V.P.U.
5.	Z.V.P.U.	Z.V.P.U.
6.	Form "C"	Z.V.P.U.
7.	Standard	Form "C"
8.	Z.V.P.U.	Form "C"
9.	Form "C"	Form "C"
X.	Special	

ANALOG 1 OUTPUT
0. None
1. 0-1 ma. (from input A)
2. 0-1 vdc. (from input A)
3. 0-50 mv. (from input A)
4. 0-1 ma. (from input B)
5. 0-1 vdc. (from input B)
6. 0-50 mv. (from input B)
X. Special

SET POINT #1 & 2 - RELAY TYPE
0. None
1. SPDT 5 amp
2. DPDT 5 amp
3. SPDT 10 amp
4. DPDT 10 amp
5. SPDT 5 amp w/power up clear (EPUT & accumulator only)
6. DPDT 5 amp w/power up clear (EPUT & accumulator only)
7. SPDT 10 amp w/power up clear (EPUT & accumulator only)
8. DPDT 10 amp w/power up clear (EPUT & accumulator only)
X. Special

SET POINT #3 - RELAY TYPE
0. None
1. SPDT 5 amp
3. SPDT 10 amp
5. SPDT 5 amp w/power up clear (EPUT & accumulator only)
7. SPDT 10 amp w/power up clear (EPUT & accumulator only)
X. Special

SET POINT #1 - TYPE
0. None
1. Analog (from analog 1 output)
2. Analog (from analog 2 output - ratio mode only)
3. Digital (fixed)
4. Digital (front panel adjustable)
5. Digital cut-to-legnth (accumulators only)
X. Special

SET POINT #2 & 3 - TYPE
0. None
1. Analog (from analog 1 output)
2. Analog (from ananog 2 output - ratio mode only)
3. Digital (fixed)
4. Digital (front panel adjustable)
X. Special

[ ] [ ] [ ] [ ] - [ ] [ ] [ ] - [ ] [ ] [ ]

ANALOG 2 OUTPUT
0. None
1. 0-1 ma. (from input A)
2. 0-1 vdc. (from input A)
3. 0-50 mv. (from input A)
4. 0-1 ma. (from input B)
5. 0-1 vdc. (from input B)
6. 0-50 mv. (from input B)
X. Special

SET POINT #3 - RELAY MODE
0. None
1. Overspeed/failsafe/non-latching
2. Overspeed/failsafe/latching
3. Overspeed/non-failsafe/non-latching
4. Overspeed/non-failsafe/latching
5. Underspeed/failsafe/non-latching
6. Underspeed/failsafe/latching
7. Underspeed/non-failsafe/non-latching
8. Underspeed/non-failsafe/latching
X. Special

SET POINT #1 & 2 - RELAY MODE
0. None
1. Overspeed/failsafe/non-latching
2. Overspeed/failsafe/latching
3. Overspeed/non-failsafe/non-latching
4. Overspeed/non-failsafe/latching
5. Underspeed/failsafe/non-latching
6. Underspeed/failsafe/latching
7. Underspeed/non-failsafe/non-latching
8. Underspeed/non-failsafe/latching
X. Special

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Rev. A DRN#16051 1/78
Rev. B DRN#17328 12/78

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INTRODUCTION-GENERAL

Not all digital tachometers manufactured today are the same, and this is certainly true of the AIRPAX Series 78 Digital Process Monitors. Designed with the severest industrial environments in mind, these units will provide reliable around-the-clock operation for years under adverse conditions. Our design engineers have paid close attention to trouble areas such as vibration, power line noise and R. F. interference. Additionally, at no time in our over 25 years of providing instruments to industry, have we offered an instrument with the versatility that the Series 78 Digital Process Monitor offers. The basic instrument comes in six different operating modes - E.P.U.T. (tachometer), ACCUMULATOR (counter), ACCUMULATOR WITH STOP/START (counter with electronic stop/start), TIMER (time per event), or RATIO (ratio speed A / speed B).

In combination with these six basic operating modes there are literally thousands of combinations of options. These options include both ANALOG and DIGITAL SET POINTS (either fixed or adjustable, latching or non-latching, normal or reverse logic), FOUR or FIVE DIGIT DISPLAY (L.E.D. for bright presentation, excellent readability and long life), AUXILIARY ANALOG OUTPUTS (0-1 mA., 0-1 vdc., 0-50 mV.) for remote meters, computer interface or recorders, CHOICE OF SIGNAL INPUTS (STANDARD - from magnetic pickups or PULSE - from encoders or Zero Velocity Pickups or CONTACT - from form "C" contacts such as are found in flowmeters) and ENCLOSURES (explosion proof, weather proof or standard panel mounting).

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introduction - e.p.u.t.

The function of an E.P.U.T. (rate) monitor is to count the events which occur in a fixed period of time. The result can be displayed in any convenient engineering units provided they have a fixed numerical relationship with the signal source.

The fixed period of time (gate time) may be:

1) Fixed internally

2) Internally adjustable

3) Front panel adjustable

The input signal rate (Hz.) times the gate time equals the display number (ignoring the decimal point). Or conversely, the display number (again ignoring the decimal point) divided by the input signal (Hz.) equals the gate time.

In addition to these features the unit can be equipped with up to three digital or analog setpoints, proportional current (0-1 ma.) or voltage (0-1 vdc or 0-50 mv) outputs for remote indicators or recorders, inputs for standard pickups, zero velocity pickups, TTL signals or form "C" contacts.

Each setpoint can be individually configured for underspeed or overspeed operation, to be latching or non-latching, for 5 amp or 10 amp contacts, standard or wide hysteresis and S.P.D.T. or D.P.D.T. contacts. For other options please consult the model map on the inside front cover.

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SPECIFICATIONS - GENERAL

POWER

AC: 120 volts 50 - 400 Hz. ±10%, 15 watts max. (standard)
240 volts 50 - 400 Hz. ±10%, 15 watts max. (optional)

DC: 12 - 15 VDC. approximately 600 mA. (standard)

SIGNAL INPUT (type specified at time of order)

SINEWAVE/ PULSE
Frequency range: 0 - 30 KHz.
Input impedance: 1200 ohms minimum
Amplitude: 50 mV. to 25 v. RMS @ 1 KHz. (sinewave)
100 mV. to 35 v. peak (pulse)
Width: 10 us. to .5/maximum freq. (50% duty cycle max.) (pulse)
Rise time: 5 volts/us. minimum (pulse only)
Common mode rejection ratio: 40 db minimum @ 1 KHz. (sinewave)
Isolation: Transformer

T.T.L. (ZVPU)
Frequency range: 0 - 30 KHz.
Isolation: None
Loading: 2 LP TTL loads.

FORM "C"
Frequency range: 0 - 1 KHz.
Isolation: None
Connection: 3 wire
Maximum voltage to contacts: 10 volts
Maximum current through contacts: 1 mA.

TEMPERATURE RANGE

Operating: 0°C to +50°C
Storage: -40°C to +75°C

DISPLAY

Color: Red
Digits: 4 standard or 5 optional
Type: L.E.D.
Height: .43" (10.9 mm)
Decimal Point: Any location or none

SETPOINTS

GENERAL
Contacts: 5 amp 120 vac. or 28 vdc. resistive (standard)
10 amp 120 vac. or 28 vdc. resisitve (optional)
Relays: S.P.D.T. (standard)
D.P.D.T. (optional)
Logic: Each one independly set at factory for either normal or reverse logic and for overspeed or underspeed.
Reset: Each one independly set at factory for either automatic or manual reset.

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specifications – general con't

SETPOINTS con't

DIGITAL

Maximum quantity: 3 (2 if unit has front panel adjustable normalization or gate time)
Minimum quantity: 0
Number of digits: Same as display
Type of adjustment: Thumbwheel switch on front panel or fixed internally
Accuracy: ± 1 count and ± time base (if e.p.u.t. or timer)
Hysteresis: None
Input to setpoints: In all cases the input is from a signal related to the display
Setpoint inhibit: As an option the setpoints can be inhibited so that upon application of power the setpoints will not make a transition into an alarm state. E.P.U.T. and accumulator only. E.P.U.T. - 2.5 times the gate time or less. Accumulator - 100 ms. or less.
Response time: 1 gate period or less

ANALOG

Maximum quantity: 3 (2 when mixed with 1 digital setpoint. Total 3 setpoints in one unit)
Minimum quantity: 0
Setability: ± $\frac{1}{4}$% of full scale
Repeatability: ± $\frac{1}{2}$% of full scale
Temperature coefficient: .018%/°C typical
.054%/°C maximum
Hysteresis: 2% of full scale maximum unless specified as wider
Input to setpoints: In all cases the input is from the rate signal and not from the display (as in the case of an accumulator). Provision is made for splitting the setpoints between the A and B inputs when both analog outputs are installed
Response time: (typical)
30 - 49 Hz. full scale: 2 sec.
50 - 99 Hz. full scale: 1 sec.
100 - 499 Hz. full scale: 500 ms.
500 - 1999 Hz. full scale: 125 ms.
2000 - 30 KHz. full scale: 50 ms.
Setpoint inhibit: As an option the setpoints can be inhibited so that upon application of power the setpoints will not make a transition into an alarm state. E.P.U.T. and accumulator only. E.P.U.T. - 2.5 times the gate time or less. Accumulator - 100 ms. or less.

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specifications - general con't

ANALOG OUTPUT*

Ranges available: 0 - 1 volt, 1000 ohms min. load impedance
0 - 1 mA, 300 ohms max. load impedance
0 - 50 mv, 10K ohms min. load impedance
Accuracy: ± ½% of full scale
Linearity: ± .1% of full scale from 1% to 100% of full scale
Ripple: Less than ½% of full scale RMS, from 10% to 100% of full scale
Minimum full scale frequency: 30 Hz.
Maximum full scale frequency: 30 KHz.
Response time: 30 - 49 Hz. full scale: 2 sec.
50 - 99 Hz. full scale: 1 sec.
100 - 499 Hz. full scale: 500 ms.
500 - 1999 Hz. full scale: 125 ms.
2000 - 30 KHz. full scale: 50 ms.
Temperature coefficient: .018% / °C typical
.054% / °C maximum

PICKUP POWER OUTPUT

Voltage: 12 vdc. ± 2.0 volts
Current: 100 ma. maximum (will power 2 zero vel. pickups)

* NOTE: Analog output is proportional to the Rate of input only, and Not the accumulated number on the display.

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specifications — e.p.u.t.

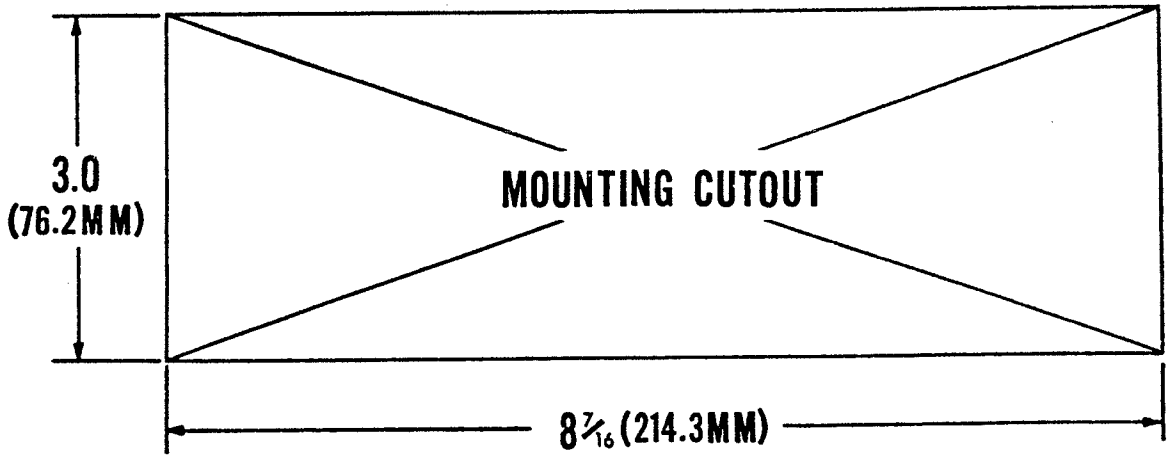
TIME BASE

Type: Crystal
Frequency: 5.0000MHz.
Accuracy: ±.0075% over temperature range and line voltage varations
Off time: 8 us. typical
Range of adjustment - fixed: 10 ms. to 53 sec. in 3.2 us. intervals
adjustable: 10 ms. to 9.9999 sec. in 100 us. intervals
Type of adjustment: Diode decoded on main p.c. board (std)
Internal D.I.P. switch (optional)
Front panel thumbwheel switch (optional)
Gate light: None
Display accuracy: ± 1 count and ± time base accuracy and ± 4 us.

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INSTALLATION

For all standard units, the panel cutout information is shown in the accompanying drawing. For special units the panel cutout requirements may vary. Installation is accomplished by removing the two wing bolts from the rear, sliding the two mounting brackets off from the rear, inserting the SERIES 78 DIGITAL TACHOMETER from the front of the panel and reassembling the mounting brackets and wing bolts from the rear. The mounting brackets will automatically adjust for panel thickness from 1/8" to 1/2".



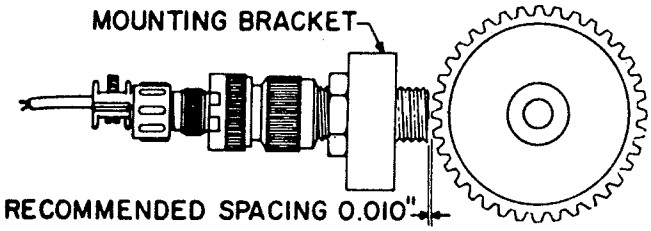
The mounting for the pickup should be provided with a threaded hole. The mounting should be of sufficiently heavy metal to accommodate several complete threads in the threaded hole and should be attached to a frame free from excessive vibration. Normal vibration attendant with machine operation will not affect the accuracy of the readings obtained.

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installation - con't

However, when using pickups with high output, relative motion between pickup and gear (caused by vibration) can cause spurious indication when the gear is not rotating, or at very low speeds. In such cases, the vibration induced voltage could exceed the useful signal.

Mounting of the pickup is shown in the drawing below. Screw the pickup into the mounting and adjust for a clearance of approximately 0.005" to 0.010" between the pole piece and the gear. Make sure there is sufficient clearance between the pickup and gear to prevent damaging the pickup. Lock the pickup securely in position with the locknut.



MOUNTING OF PICKUP ASSEMBLY (11-0001)

Spacing can be checked by backing off the pickup about a quarter-turn. Any decrease in display indication should be, at most, barely perceptible. Any sharp decrease denotes excessive spacing.

The diametral pitch of the recommended gear is 16 less for 500 Hz. or less.

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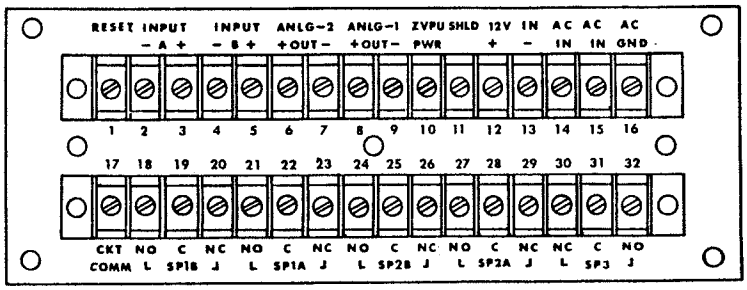
installation - con't

Because of the higher surface speeds, smaller teeth can be used for those above 500 Hz. The dimensions of the gear teeth are dictated by the diameter of the pickup pole piece. If a standard AIRPAX pickup is used, the pole piece diameter is 0.106". For maximum output from the pickup and maximum permissible pickup to gear spacing, tooth surface width should be at least 0.106" and tooth height at least 0.106". The space between tooth surfaces should be approximately two or three times 0.106". See AIRPAX General Catalog 0200 or AIRPAX pickup publication "MAGNETIC PICKUPS AT WORK" for additional information on the use of magnetic pickups with AIRPAX tachometers.

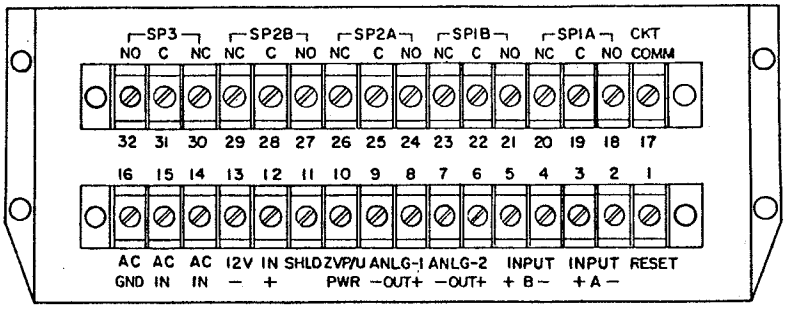
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WIRING

All wiring connections are described on the rear panel of the SERIES 78 as well as shown in the drawing below. Not all terminals are used in any particular model. Please compare the model number with the model map on the inside front cover to determine the options present in your unit.



STANDARD ENCLOSURE



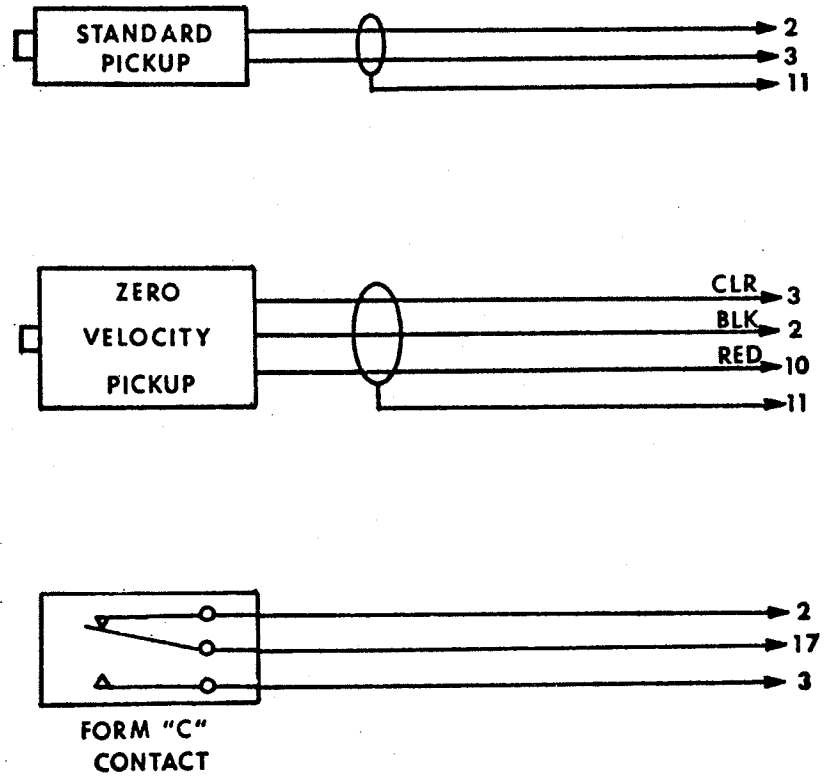
E & W ENCLOSURE

All pickup wiring, whether shielded or unshielded, should not be run in close proximity to AC power lines or other wiring which might be carrying large voltages, currents or switching transients. If they are run in conduit, they should be in a separate conduit or run with the other low-level signal leads. The input leads should be especially well protected and separated from the wiring of SCR motor speed control systems and the wiring to large contactors.

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wiring - con't

Signal input wiring is shown in detail in the drawing below. Please refer to the model number and the model map on the inside front cover to determine the correct input wiring.



Relay output capability in the SERIES 78 DIGITAL is available in SPDT (form C) configuration, 5 and 10 amp ratings and DPDT (2 form C) configuration, 5 and 10 amp ratings. The maximum number of setpoints available is three (3). The maximum number of contact sets (a set is a form C contact pair) is five (5). This allows a maximum of 2 DPDT relays and 1 SPDT relay.

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wiring - con't

The rear panel of the SERIES 78 describes the condition of the relays when in the ENERGIZED condition. It is normally desirable that all relays be in the energized condition during normal operation to promote a "failsafe" system. Should power be lost, the relay(s) would transfer to the de-energized (alarm) condition.

All setpoints (relays) are described as either FAILSAFE or NON-FAILSAFE, OVERSPEED or UNDERSPEED, LATCHING or NON-LATCHING.

FAILSAFE or NON-FAILSAFE - A setpoint is FAILSAFE if the relay coil is ENERGIZED while the tachometer is in the normal operating range, and NON-FAILSAFE if the coil is DE-ENERGIZED in the normal operating range.

OVERSPEED or UNDERSPEED - A setpoint is OVERSPEED if the relay coil changes condition (from energized to de-energized or from de-energized to energized) at and above the upper limit of the normal operating range, and UNDERSPEED if it changes condition below the lower limit of the normal operating range.

LATCHING or NON-LATCHING - A setpoint is LATCHING if when the signal returns to the normal operating range, the relay coil remains in the "alarm" condition; and NON-LATCHING if the coil returns to the "normal" condition.

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OPERATION

If all of the options are "fixed" such as fixed gate time or fixed setpoints, then there are no adjustments to be made before starting up the SERIES 78.

If however some of the options are "adjustable" then it will be nessessary to make the correct settings (for internally adjustable gate time, this will be nessessary before mounting the unit in the panel).

GATE TIME: The gate time determines the period for which a tachometer (E.P.U.T.) counts the incoming signal and therefore adjusts the relationship between the incoming signal and the display.

1) convert rpm to frequency (Hz): $\frac{\text{RPM X NO.TEETH}}{60} = \text{Hz.}$

2) find the gate time: $\frac{\text{DISPLAY}}{\text{Hz}} = \text{GATE TIME (seconds)}$

NOTE: ignore the decimal point in the display when making gate time calculations.

EXAMPLE 1: Find the gate time when using a 30 tooth gear on the main shaft of a compressor running at 4800 RPM.

$$\text{Hz} = \frac{\text{RPM X NO. TEETH}}{60} = \frac{4800 \text{ X } 30}{60} = 2400$$

$$\text{GATE TIME} = \frac{\text{DISPLAY}}{\text{Hz}} = \frac{4800}{2400} = 2.000 \text{ sec.}$$

EXAMPLE 2: Find the gate time when using a 72 tooth gear on a govenor coupled to the main shaft of a turbine by a 10.75:1 gear reduction and the turbine is turning at 13,502 RPM.

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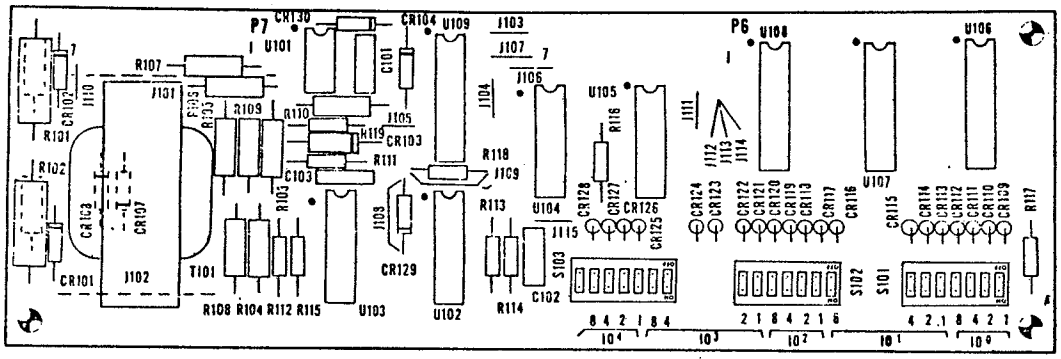
operation – con't

$$Hz = \frac{RPM \times NO.\ TEETH}{60} = \frac{1256 \times 72}{60} = 1507.2$$

(the gear is only turning $\frac{13,502}{10.75}$ or 1256 RPM)

$$GATE\ TIME = \frac{DISPLAY}{Hz} = \frac{13502}{1507.2} = 8.9583\ sec.$$

If the gate time is front panel adjustable, then it will only be necessary to dial the correct gate time on the thumbwheel switch. If however the gate time is internally adjustable then it will be necessary to first remove the SERIES 78 from the case and then set the internal D.I.P. switches for the correct gate time. To remove the SERIES 78 from the standard case, first remove the 2 screws on each side (right behind the bezel) and second, remove the 3 screws from the center of the rear panel (leave the 4 corner screws in place). Slide the chassis out of the enclosure from the front. To remove the SERIES 78 from the "W" enclosure, remove the 4 large corner screws on the base plate and lift streight out. To remove the SERIES 78 from the "E" enclosure remove the 4 screws from the side of the display bracket (2 short and 2 long). Lift the bracket up through the opening in the case. The location of the 3 switches (S101-S103) is shown in the drawing below.



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operation - con't

Note that the individual sections of the 3 switches are divided up into 5 groups (10^4, 10^3, 10^2, 10^1, 10^0). Each group represents a digit in the gate time. Seconds are 10^4, 1/10's of seconds are 10^3, 1/100's of seconds are 10^2 etc. Each group is divided into 4 switches numbered 1, 2, 4 and 8. It is only nessessary to turn on the switches which will total the number for that digit.

Some examples are shown below:

GATE TIME	10^4	10^3	10^2	10^1	10^0
2.0000	2	OFF	OFF	OFF	OFF
8.9583	8	8+1	4+1	8	2+1
0.7306	OFF	4+2+1	2+1	OFF	4+2

Turning on switches totaling more than 9 will cause the unit to stop operating until the error is corrected. The unit will not operate, but no damage will result.

SETPOINTS: Since all setpoints are either fixed internally or front panel adjustable, it will only be nessessary in the latter case to set the thumbwheel switches to the proper alarm point, or if the setpoints are analog, to set them with the equipment running at the proper speed or with an input from an external source (see the calibration section).

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THEORY OF OPERATION

As each section of the SERIES 78 is covered, please refer to the appropriate schematic and parts list at the end of this manual.

INPUT AMPLIFIER: The input signal is applied to the channel "A" input terminals and processed by input pre-amplifier U1 and its associated circuitry. This pre-amplifier uses a combination of bias and hysteresis to eliminate noise on the input signal. The output of U1 is a square wave at the signal frequency and is applied to the clock input of U8.

TIME BASE: If the time base is fixed it will consist of crystal XTL 1, transistor Q1, U10, U11 and U12. The osc. runs at 5.0000MHz. and is divided by 16 in U10 and then divided again in U11 and U12 depending upon the gate time. The division is set by the proper selection of diodes CR6 thru CR29. If the time base is adjustable then U10 thru U12 are replaced by U104 thru U108. U104 is a divide by 5, U105 is a divide by 10 and U108(A) is also a divide by 10. This will supply a 10KHz signal to the input of the adjustable divider.

RESET GENERATOR: At the time base divider coincidence, one-shot U7(A) enables the latch on counter U8, transfering the information to the display. At the same time trigering one-shot U7(B), which resets the time base dividers.

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theory of operation - con't

COUNTER/MULTIPLEXER: U8 accepts the gate time information and the input signal and delivers both the 7 segment output and multiplex information to drive the display. U8 is capable of handling 4 digits. For the addition of a fifth digit U3(b), U4, U5 and U6 are added as a seperate counting stage operating from the overflow of U8. U2(d) and U9 operate the zero blanking functions.

DISPLAY: The output of U8 drives the 4 displays in parallel and transistors Q301 - Q304 which do the strobing (multiplexing). RN1 is the current limiting resistor network for the main 4 digits and RN301 is for the fifth digit. U306 is for applications requiring a fixed last zero. Decimal point location is determinde by using one of the resistors R304 - R309.

DIGITAL SETPOINTS: Up to three setpoints can be accommodated using three identical circuits. The circuitry for setpoint one will be described here. The digital setpoints use a counter string which is completely separated from the display circuitry. If there are no analog setoponts present, this counter string consists of U501 and U502. If there are digital setpoints mixed with analog setpoints then this counter string consists of U601 and U602. If the unit has five digits then U3(a) is added as the most significant digit of this counter string. When the value in the counters equals the digital setpoint a coincidence signal is developed which for setpoint one is called SP1 over. This signal is routed through the main board to the relay card to U401.

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theory of operation - con't

U401 converts the coincidence pulse into a steady state D.C. level. The output of U401 is then routed to U405 through either jumper J405 or J406. This jumper selection determines whether the setpoint will function as an under speed or over speed setpoint. U405 either passes the signal directly through or functions as a latch, as determined by J418 and J419. This determines whether the setpoint will be latching or non-latching. R401 and R402 are used to determin whether the setpoint will have normal or reverse logic. A power up clear option is available and is implemented by one-shot U408 which produces an output pulse upon application of power. This pulse is used to inhibit the setpoint for a specific period of time as determined by R409 and C401. This time is normally set to be approximately $2\frac{1}{2}$ times the gate time.

ANALOG OUTPUT: Analog output #1, if installed, consists of one-shot circuit U13 and Q2. The output of which is a square wave having a volt second area proportional to the input frequency. This square wave is then applied to active filter U14. The output of U14 is a 0 - 1 VDC level which is proportional to the input frequency. Resistors R34 and R35 are used to set the putput range to 0 - 1 VDC, 0 - 1 ma or 0 - 50 mv. Analog output two if installed, is functionally identical and consists of U606, U601 and U607.

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theory of operation - con't

ANALOG SETPOINTS: Analog setpoints use similar relay logic to the digital setpoints. U401 is replaced by comparator U603 in setpoint one. The inputs to U603 are from an adjustable reference which represents the setpoint and from one of the analog outputs, which represents RPM. The output of U603 is a DC. logic level which represents over speed when high and under speed when low. This signal replaces the output of U401 (digital setpoints).

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CALIBRATION

No calibration is normally required on this unit, or are there any adjustments that can be made in the field, except for the analog output and those options that are adjustable (analog setpoints, digital front panel adjustable setpoints, adjustable gate time, adjustable normalization etc.). The setting of the gate time (internally adjustable) is covered under "OPERATION".

If it is desired to either bench test the unit, recalibrate the analog output or set the analog setpoints, then the recommended procedure is to use a stable signal source and a frequency counter. Please remember: Any adjustment to the analog output will require re-setting the analog setpoints (if any).

To calibrate the analog output: Consult the label for the full scale frequency. It will be written "ANLG 1 01,200.0" or if there are 2 analog outputs the second will be written "ANLG 2 01,200.0". In this example the full scale frequency is 1200 Hz. Set the signal source for 10% of full scale and adjust R32 (or R624 if analog 2) for 10% output. If the output is 0-1 mA., be sure you are using the correct load resistance. Setting the signal source for full scale, adjust R27 (R620) for full output. It may be nessessary to repeat one or two times.

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calibration - con't

To set the analog setpoints, first determin if the setpoint is overspeed or underspeed. Set the signal source at the at the setpoint frequency (remember: $\frac{\text{RPM X NO. TEETH}}{60}$ = Hz.)

For overspeed setpoints: Starting with the setpoint adjustment full clockwise, turn counter-clockwise slowly until the setpoint trips.

For underspeed setpoints: Starting with the setpoint adjustment full counter-clockwise, turn clockwise slowly until the setpoint trips. Check for proper operation by varying the signal source to make the setpoint trip, and make fine adjustment as nessessary.

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TROUBLE SHOOTING

SYMPTOM	POSSIBLE CAUSE
All displays blank or dim	No power input Power supply failure U8
One digit blank (non blanked digits)	Defective display digit Digit drive (Q301-Q304) U8
Fourth digit blank (Unit with blanking	Defective display digit Q304 U8 U9
Fifth digit blank	Defective display digit U6
Same segment out on all displays	RN1 U8
Segment out on one display	Defective display U6 if segment is out in fifth digit

NOTE: DISPLAY PROBLEMS SHOULD BE CORRECTED BEFORE ATTEMPTING ADDITIONAL TROUBLECHOOTING.

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trouble shooting - con't

SYMPTOM	POSSIBLE CAUSE
Display reads zero's	Pickup or cable Pickup to far from gear U1 or associated circuitry Crystal oscillator U10 through U12 (fixed timebase) U104 through U108 (adj timebase) U2, U7, U8
Unit reads improper frequency (fixed timebase)- incorrect reading	Improper input signal level Noise on input signal CR6-CR29 U10 through U12 crystal oscillator U8 U3 through U6 - If fifth digit only is in error
Unit reads improper frequency (adj. timebase)- incorrect reading	Improper signal level Noise on input signal CR109-CR128 U104 through U108 crystal oscillator U8 U3 through U6 - if fifth digit only is in error Thumbwheel switch (front panel) S101 through S103 (internal adj.)

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trouble shooting – con't

DIGITAL SETPOINTS

SYMPTOM	POSSIBLE CAUSE
Setpoint #1 does not operate or operates at wrong alarm point	U501, U502 or U601, U602 U3 (five digit only) CR501 - CR520 or CR601 - CR620 S501 - S505 or S601 - S605 U401, U404 or U405 Q401, K401
Setpoint #1 does not operate properly in cut-to-length mode (accumulators only)	All of the above U409, Q405 or assoc. circuitry
Setpoint #2 does not operate or operates at wrong alarm point	U501, U502 U3 (five digit only) CR521 through CR540 S506 through S510 U402, U404, U406 Q402, K402
Setpoint #3 does not operate or operates at wrong alarm point	U501, U502 U3 (five digit only) CR541 through CR560 S511 through S515 U403, U404, U407

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trouble shooting - con't

ANALOG OUTPUT

SYMPTOM	POSSIBLE CAUSE
No output	No input signal Improper input signal level U1 or U101 and assoc. circuitry U13, U14 Q2 or assoc. circuitry for analog 1 U606, U607, Q601 or assoc. circuitry for analog 2
Wrong output level	Improper input signal level Noise on input signal Calibration of analog output U13, U14, Q2, C9, R24, R34, R35 or assoc. circuitry for analog 1 U606, U607, Q601, R616, R627, R629 R620 or assoc. circuitry for analog 2
Ripple on output	U14, C11 or C10 for analog 1 U607, C602 or C603 for analog 2

ANALOG SETPOINTS

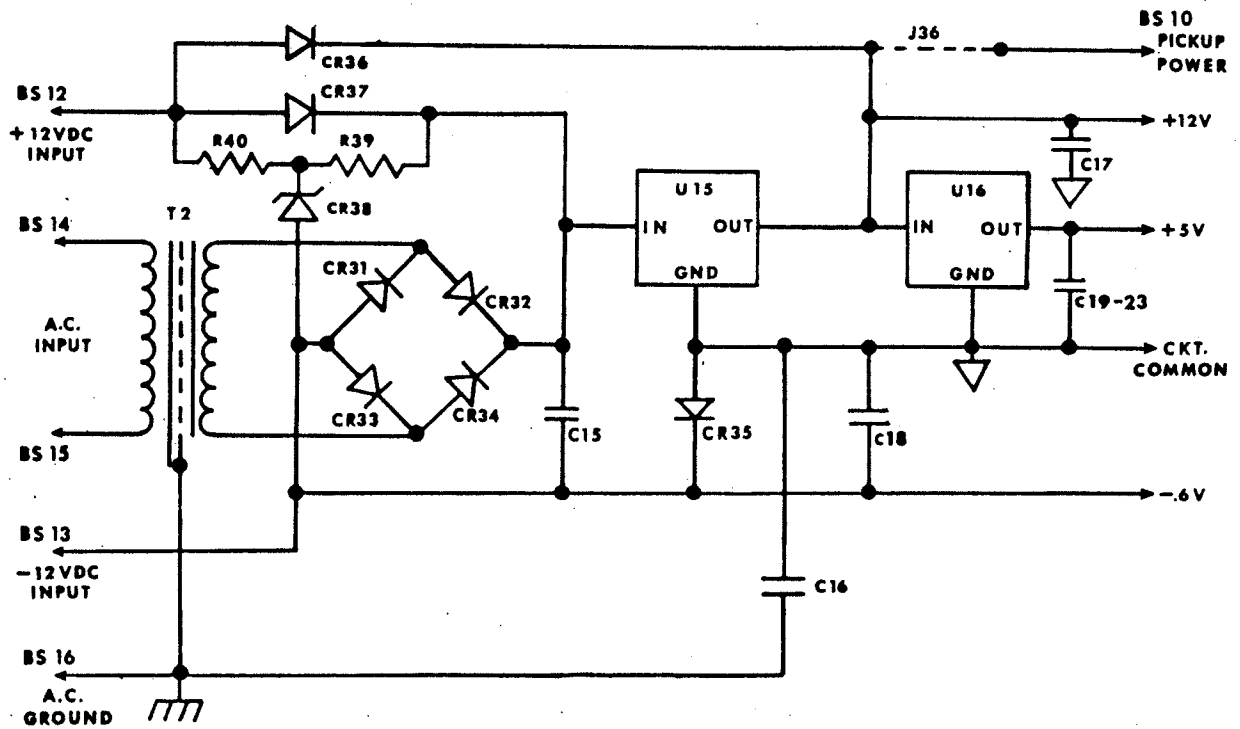
SYMPTOM	POSSIBLE CAUSE
Setpoint #1 does not operate or operates at wrong alarm point	Calibration of setpoint U603 or assoc circuitry U404, U405 Q401, K401
Setpoint #2 does not operate or operates at wrong alarm point	Calibration of setpoint U604 or assoc. circuitry U404, U406 Q402, K402
Setpoint #3 does not operate or operates at	Calibration of setpoint U605 or assoc. circuitry U404, U407 Q403, K403

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SCHEMATICS & PARTS LISTS

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POWER SUPPLY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
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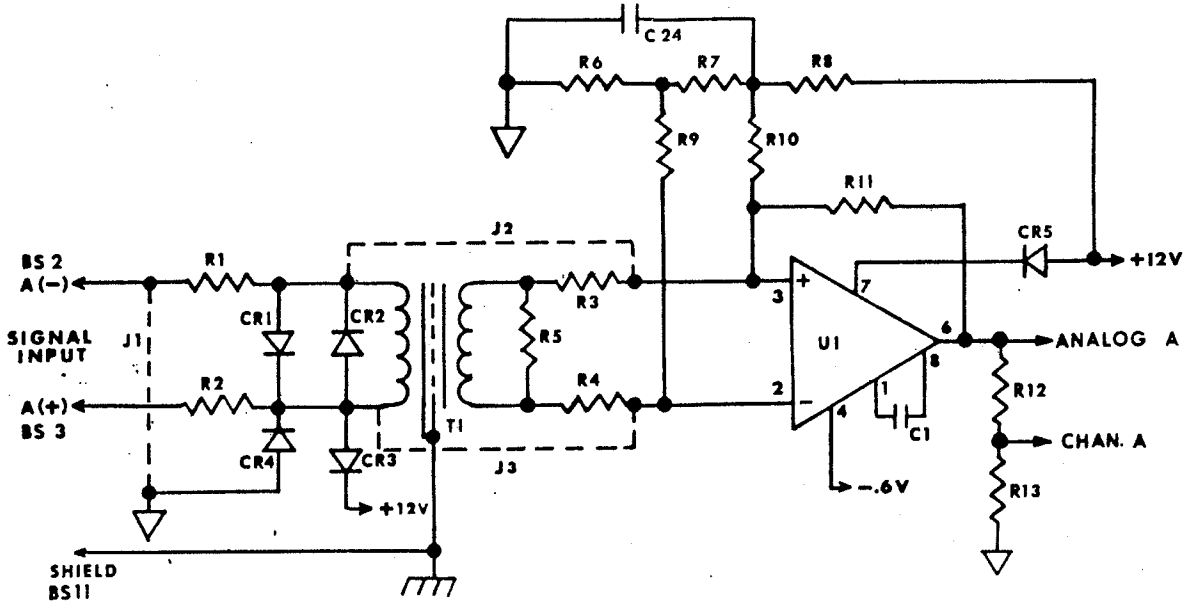
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POWER SUPPLY

SYMBOL	DESCRIPTION
C15	3200 uf..25 wvdc. -10%, +75% P/N 256-834-0138
C16	.01 uf. 1000 vdc. ±20% P/N 251-585-0002
C17 - C23	1.0 uf. 50 vdc. ±20% P/N 251-532-0004
CR31 - CR37	IN5059 or SI-2 1 amp. P/N 354-211-0005
CR38	OPTIONAL IN5351 P/N 354-721-0058
J36	INSTALL FOR Z.V.P.U. POWER OUT
R39 - R40	OPTIONAL FOR CHARGE CURRENT BATTERY
T2	POWER TRANSFORMER 120 vac. P/N 178-999-0002 POWER TRANSFORMER 240 vac. P/N 178-999-0001
U15	LM340T-12, 12 v. regulator P/N 213-123-0001
U16	LM340T-5, 5v. regulator P/N 213-123-0002

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INPUT AMP.

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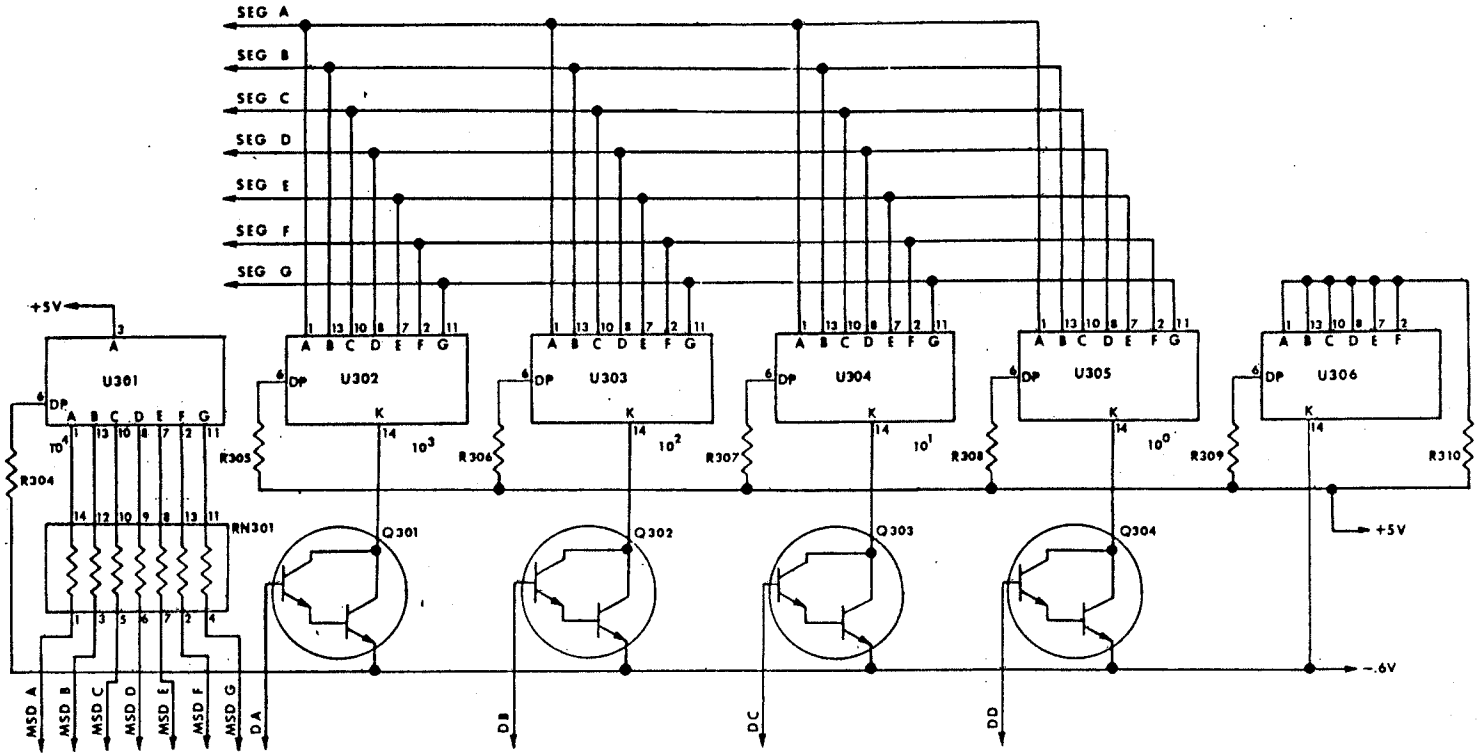
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INPUT AMPLIFIER

SYMBOL	STANDARD	ZVPU	FORM "C"
CR1, CR2 CR5	1N914 P/N 354-111-0017	1N914 P/N 354-111-0017	1N914 P/N 354-111-0017
CR3, CR4	OMIT	1N914 P/N 354-111-0017	1N914 P/N 354-111-0017
J1	OMIT	INSTALL	OMIT
J2, J3	OMIT	INSTALL	INSTALL
R1	620 ohm 1w. 5% P/N 778-147-0043	35.7K ¼w. 1% P/N 778-325-0393	15.8K ¼w. 1% P/N 778-325-0359
R2	620 ohm 1w. 5% P/N 778-147-0043	35.7K ¼w. 1% P/N 778-325-0393	10.0K ¼w. 1% P/N 778-325-0340
R3, R4	619 ohm ¼w. 1% P/N 778-325-0225	OMIT	OMIT
R5	100K ¼w. 1% P/N 778-325-0111	OMIT	OMIT
R6	10.0K ¼w. 1% P/N 778-325-0340	12.1K ¼w. 1% P/N 778-325-0348	10.0K ¼w. 1% P/N 778-325-0340
R7	1.62K ¼w. 1% P/N 778-325-0265	JUMPER	JUMPER
R8	4.67K ¼w. 1% P/N 778-325-0308	15.8K ¼w. 1% P/N 778-325-0359	6.19K ¼w. 1% P/N 778-325-0320
R9	30.1K ¼w. 1% P/N 778-325-0386	3.92K ¼w. 1% P/N 778-325-0301	10.0K ¼w. 1% P/N 778-325-0340
R10	30.1K ¼w. 1% P/N 778-325-0386	2.61K ¼w. 1% P/N 778-325-0285	10.0K ¼w. 1% P/N 778-325-0340
R11	590K ¼w. 1% P/N 778-325-0523	2.00M ¼w. 1% P/N 778-325-0589	10.0K ¼w. 1% P/N 778-325-0340
T1	≥200 Hz. f.s. P/N 175-501-0183	OMIT	OMIT
	<200 Hz. f.s. P/N 175-610-0005	OMIT	OMIT
U1	LM301AN P/N 213-000-0087	LM301AN P/N 213-000-0087	LM301AN P/N 213-000-0087
C1	3 8f, +5% 500V P/N 251-372-0002	3 8f, +5% 500V P/N 251-372-0002	3 8f, +5% 500V P/N 251-372-0002
C24	1.0 uf, 50V P/N 251-532-0004	1.0 uf, 50V P/N 251-532-0004	1.0 uf, 50V P/N 251-532-0004

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DISPLAY

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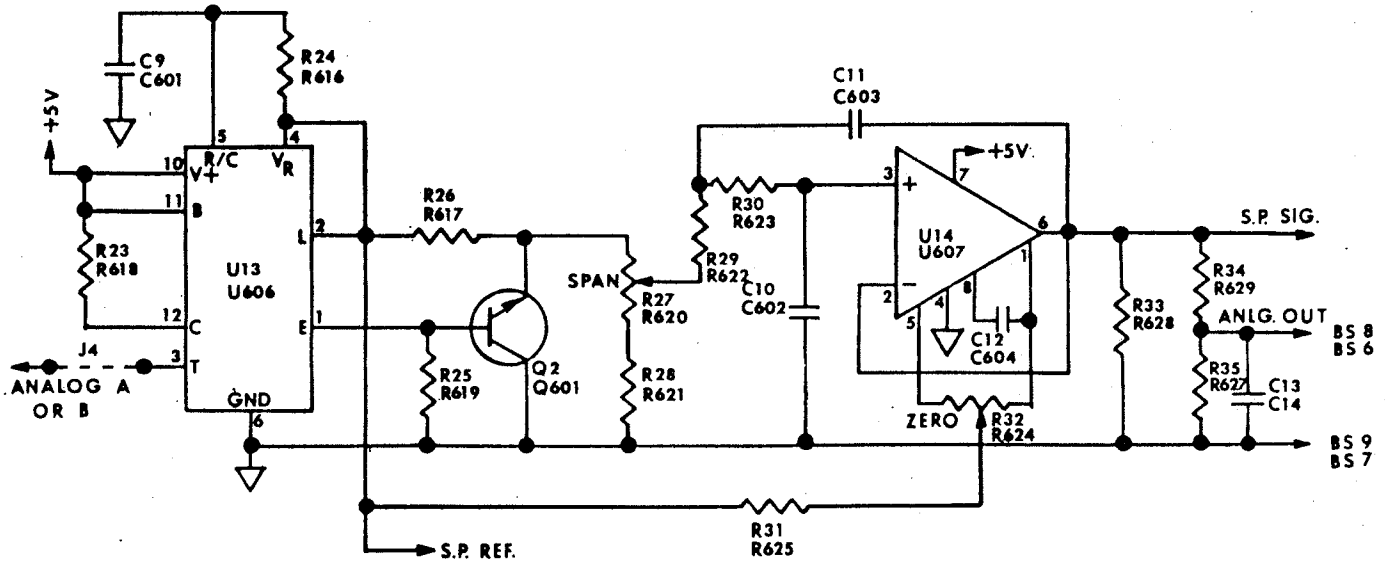
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DISPLAY

SYMBOL	DESCRIPTION
Q301-Q304	MPSA14 P/N 891-211-0042
R304-R309	82 ohms ¼w. 5% (max. 1, select for decimal point location) P/N 778-147-0037
R310	68 ohms to 120 ohms (depends on display brightness) ¼w. 5% P/N 778-127-XXXX (replace with same value) (fixed last zero only)
RN301	270 ohms to 620 ohms resistor network (depends on display brightness) P/N 214-413-00XX (replace with same P/N) (5 digit model only)
U301	5082-7650 selected (5 digit model only) P/N 632-932-0002
U302-U305	5082-7653 P/N 632-932-0001
U306	5082-7653 (fixed last zero only) P/N 632-932-0001

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ANALOG OUTPUT

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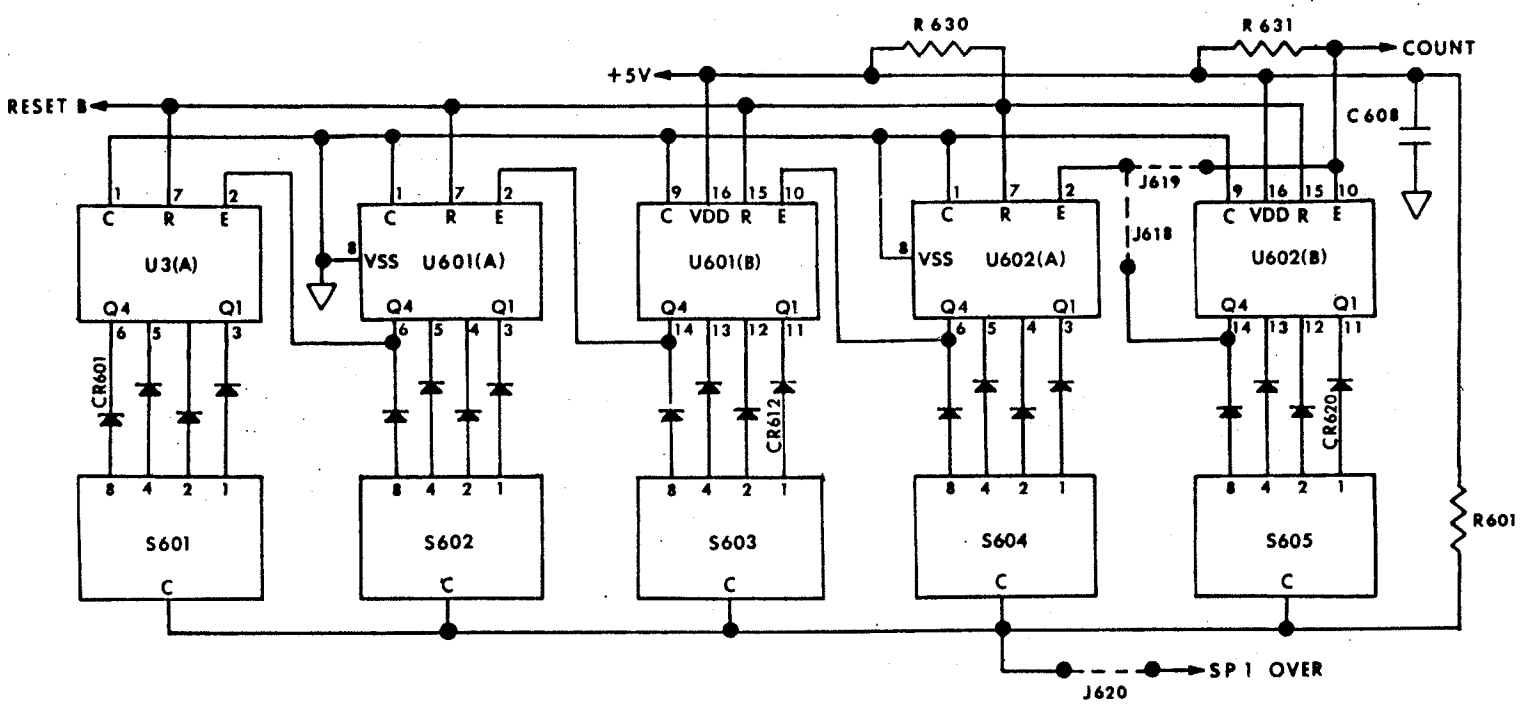
ANALOG OUTPUT

SYMBOL	DESCRIPTION
C9, C601	26,666.7 - 30,000 Hz .0012 uf. P/N 251-440-0038 20,000.0 - 26,666.6
C9, C601	26,666.7 - 30,000.0 Hz. .0012 uf. P/N 251-440-0038 20,000.0 - 26,666.6 Hz. .0015 uf. P/N 251-440-0002 18,181.8 - 19,999.9 Hz. .0020 uf. P/N 251-440-0004 14,814.8 - 18,181.7 Hz. .0022 uf. P/N 251-440-0005 12,121.2 - 14,814.7 Hz. .0027 uf. P/N 251-440-0006 10,256.4 - 12,121.1 Hz. .0033 uf. P/N 251-440-0007 8,510.6 - 10,256.3 Hz. .0039 uf. P/N 251-440-0008 8,000.0 - 8,510.5 Hz. .0047 uf. P/N 251-440-0009 5,882.4 - 7,999.9 Hz. .0050 uf. P/N 251-440-0010 4,878.0 - 5,822.3 Hz. .0068 uf. P/N 251-440-0011 4,000.0 - 4,877.9 Hz. .0082 uf. P/N 251-440-0012 3,636.4 - 3,999.9 Hz. .0020 uf. P/N 251-440-0004 2,963.0 - 3,636.3 Hz. .0022 uf. P/N 251-440-0005 2,427.2 - 2,962.9 Hz. .0027 uf. P/N 251-440-0006 2,053.4 - 2,427.1 Hz. .0033 uf. P/N 251-440-0007 1,703.6 - 2,053.3 Hz. .0039 uf. P/N 251-440-0008 1,600.0 - 1,703.5 Hz. .0047 uf. P/N 251-440-0009 1,176.5 - 1,599.9 Hz. .0050 uf. P/N 251-440-0010 975.6 - 1,176.4 Hz. .0068 uf. P/N 251-440-0011 800.0 - 975.5 Hz. .0082 uf. P/N 251-440-0012 666.7 - 799.9 Hz. .010 uf. P/N 251-440-0013 533.3 - 666.6 Hz. .012 uf. P/N 251-440-0035 400.0 - 533.2 Hz. .015 uf. P/N 251-440-0014 363.6 - 399.9 Hz. .020 uf. P/N 251-440-0015 296.3 - 363.5 Hz. .022 uf. P/N 251-440-0016 242.4 - 296.2 Hz. .027 uf. P/N 251-440-0017 205.1 - 242.3 Hz. .033 uf. P/N 251-440-0018 170.2 - 205.0 Hz. .039 uf. P/N 251-440-0019 160.0 - 170.1 Hz. .047 uf. P/N 251-440-0020 142.9 - 159.9 Hz. .050 uf. P/N 251-440-0021 117.6 - 142.8 Hz. .056 uf. P/N 251-440-0037 97.6 - 117.5 Hz. .068 uf. P/N 251-440-0022 80.0 - 97.5 Hz. .082 uf. P/N 251-440-0023 66.7 - 79.9 Hz. .10 uf. P/N 251-440-0024 53.3 - 66.6 Hz. .12 uf. P/N 251-440-0025 40.0 - 53.2 Hz. .15 uf. P/N 251-440-0026 36.7 - 39.9 Hz. .20 uf. P/N 251-440-0027 29.6 - 36.6 Hz. .22 uf. P/N 251-641-0042 24.2 - 29.5 Hz. .27 uf. P/N 251-641-0043 20.0 - 24.1 Hz. .33 uf. P/N 251-641-0044 <u>ALL CAPACITORS ARE POLYSTYRENE OR POLYCARBONATE</u>
C10, C602	2,000.0 - 30,000.0 Hz. .012 uf. P/N 251-141-0013 500.0 - 1,999.9 Hz. .056 uf. P/N 251-141-0051 100.0 - 499.9 Hz. .27 uf. P/N 251-141-0060 50.0 - 99.9 Hz. .56 uf. P/N 251-141-0065 20.0 - 49.9 Hz. 1.5 uf. P/N 251-141-0070
C11, C603	2,000.0 - 30,000.0 Hz. .018 uf. P/N 251-141-0015 500.0 - 1,999.9 Hz. .082 uf. P/N 251-141-0053 100.0 - 499.9 Hz. .39 uf. P/N 251-141-0062 50.0 - 99.9 Hz. .82 uf. P/N 251-141-0068 20.0 - 49.9 Hz. 2.0 uf. P/N 251-141-0071 <u>ALL CAPACITORS ARE + OR - 10%, MYLAR</u>

SYMBOL	DESCRIPTION
C12, C604	56 pf. ±5% 500 vdc. P/N 251-372-0023
C13, C14	.02 uf. -20%, +80% 50 v. ceramic P/N 251-532-0001
J4	INSTALL
Q2, Q601	2N4124 P/N 891-211-0041
R23, R618	499 ohms ¼w. 1% P/N 778-325-0216
R24, R616	20K 5% WW P/N 778-637-0017
R25, R619	3.74K ¼w. 1% P/N 778-325-0204
R26, R617	4.7K 5% WW P/N 778-665-0048
R27, R620	10K POTENTIOMETER WW P/N 785-435-0060
R28, R621	40K 5% WW P/N 778-667-0174
R29, R622 R30, R623	330K ¼w. 5% P/N 778-127-0123
R31, R625	301K ¼w. 1% P/N 778-325-0482
R32, R624	100K POTENTIOMETER CERMET P/N 785-433-0063
R33, R628	4.7K ¼w. 5% P/N 778-127-0079
R34, R629	850 ohms 1% WW (0-1 ma, 100-300 ohm load) P/N 778-655-0014 1K 1% WW (0-1 ma, 0-99 ohm load or 0-50 mv) P/N 778-655-0015 JUMPER (0-1 v only)
R35, R627	50 ohm 1% WW (0-50 mv only) P/N 778-667-0172
U14, U607	CA3130 P/N 213-111-0001

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#60(.040) TO 30(.1285) ±.002
#29 (.1360) TO D (.2460) ±.003
1/4 TO 1/2 ±.004 1/2 TO 3/4 ±.005
3/4 TO 1 ±.007 1 TO 2 ±.010

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AIRPAX Electronics
CONTROLS DIVISION FT. LAUDERDALE, FLORIDA

THUMBWHEEL SW. - ONE SP.

SIZE	CODE IDENT NO.	DRAWING NO.	REV
A	07355		

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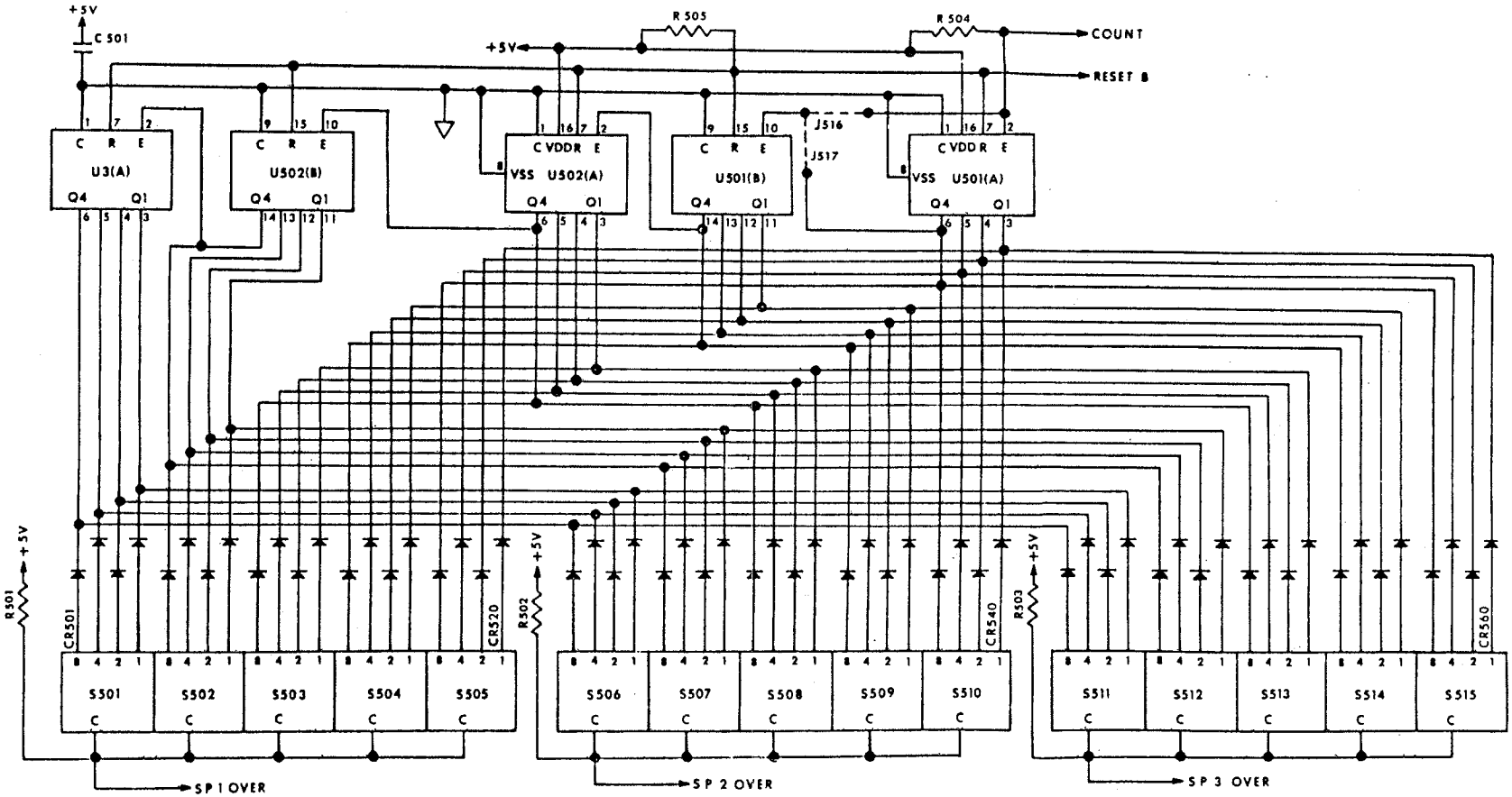
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THUMBWHEEL SW.— ONE SP.

SYMBOL	DESCRIPTION
CR601-CR620	1N914 P/N 354-111-0017
J618	INSTALL FOR 5 DIGIT ONLY
J619	INSTALL FOR 4 DIGIT ONLY
J620	INSTALL
R601	47K ¼w. 5% P/N 778-127-0103
S601-S605	THUMBWHEEL BCD (front panel adj.) P/N 841-815-0005 (each segment)
U3	MC14518CP dual BCD counter (½) P/N 213-295-0013
U601-U602	MC14518CP dual BCD counter P/N 213-295-0013
C608	1.0 uf, 50V P/N 251-532-0004
R630-631	330K, ¼w. 5% P/N 778-127-0123

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THUMBWHEEL SW. - MULT. SP.

SIZE	CODE IDENT NO.	DRAWING NO	REV
A	07355		

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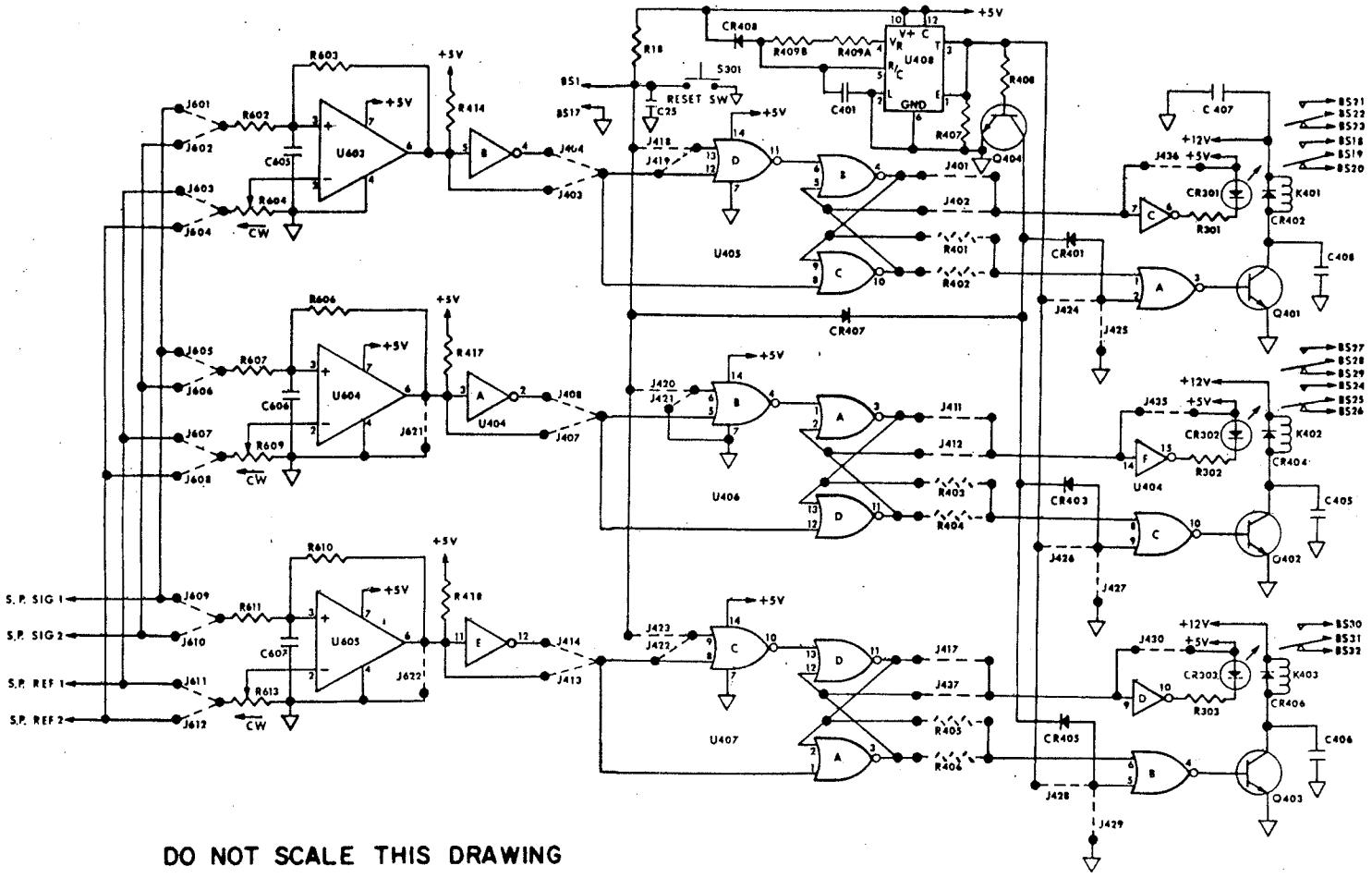
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THUMBWHEEL SW.— MULT. S.P.

SYMBOL	DESCRIPTION
CR501-CR560	1N914 P/N 354-111-0017
J516	INSTALL FOR 4 DIGIT ONLY
J517	INSTALL FOR 5 DIGIT ONLY
R501-R503	100K ¼w. 5% P/N 778-127-0111
S501-S515	BCD THUMBWHEEL SWITCH P/N 841-815-0005 (each section)
U3	MC14518CP dual BCD counter (½) P/N 213-295-0013
U501-U502	MC14518CP dual BCD counter P/N 213-295-0013
C501	1.0 uf, 50V P/N 251-532-0004
R504-505	330K, ¼w. 5% P/N 778-127-0123

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ANALOG SETPOINTS

SIZE	CODE IDENT NO.	DRAWING NO.	REV
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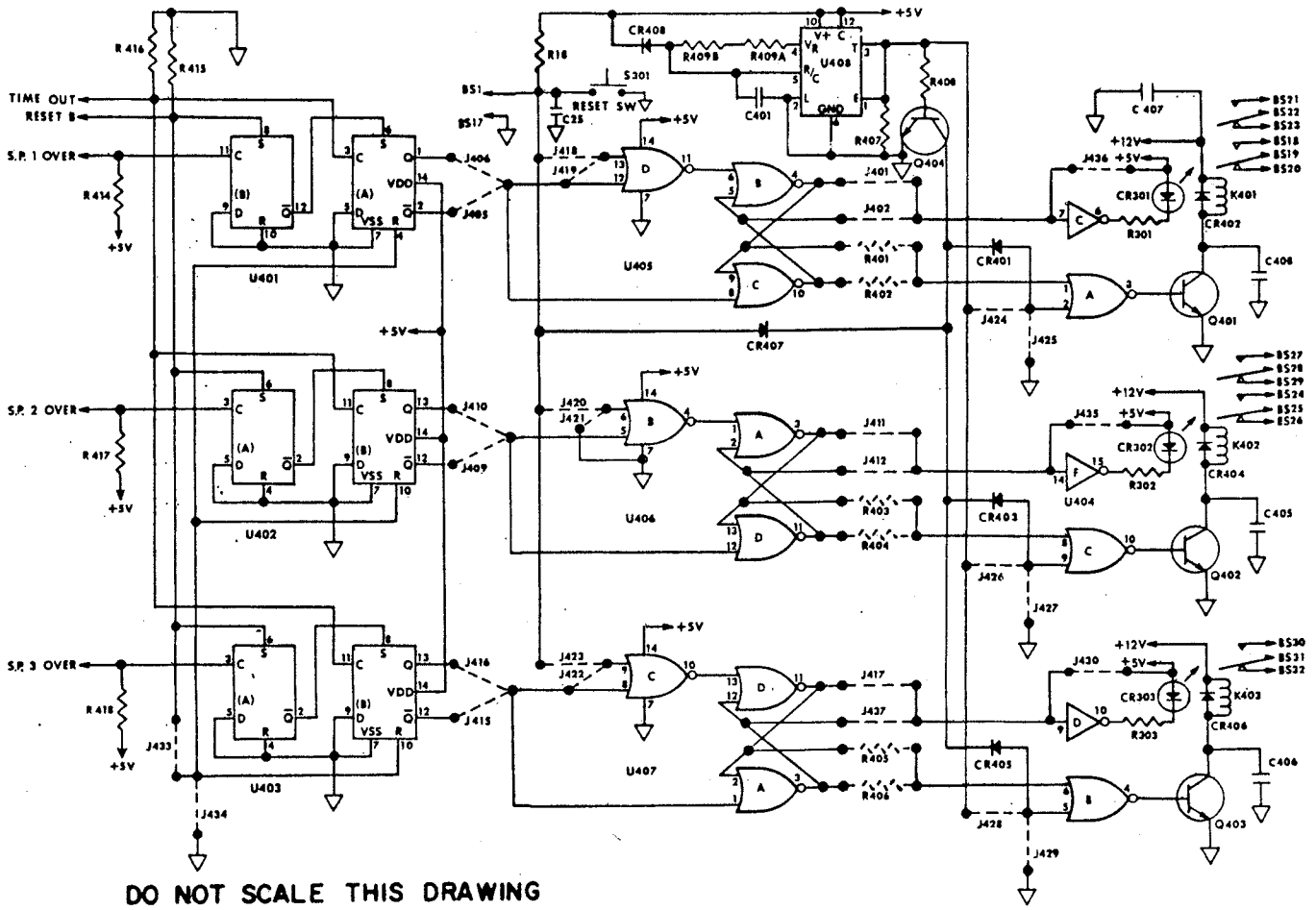
ANALOG SETPOINTS

SYMBOL	DESCRIPTION
C401	DETERMINED BY GATE TIME (power up clear only)
C605-C607	.02 uf. -20%, +80% 50 v. P/N 251-532-0001
CR301-CR303	MV5024 RED L.E.D. P/N 632-032-0001
CR401, CR403 CR405	1N914 (used only on setpoints w/power-up clear) P/N 354-111-0017
CR402, CR404 CR406	1N914 P/N 354-111-0017
CR407, CR408	1N914 (only with power-up clear option) P/N 354-111-0017
J401, J411 J417	INSTALL
J402, J412 J437, J436	OMIT
J403, J407 J413	OVERSPEED ONLY
J404, J408 J414	UNDERSPEED ONLY
J418, J420 J423	MANUAL RESET ONLY
J419, J421 J422	AUTOMATIC RESET ONLY
J424, J426 J428	POWER UP CLEAR ONLY
J425, J427 J429	NON-POWER UP CLEAR ONLY
J430, J622	INSTALL IF NO SETPOINT IN POS. 3
J435, J621	INSTALL IF NO SETPOINT IN POS. 2
J601,-J612	DEPENDS UPON SOURCE OF ANALOG SIGNAL
K401-K403	R40E0179-1 12 v. 280 ohms (S.P.D.T. 5 amp contacts) P/N 768-240-0008
	R40E0180-1 12 v. 280 ohms (S.P.D.T.10 amp contacts) P/N 768-240-0009
K401-K402	R40E0181-1 12 v. 280 ohms (D.P.D.T. 5 amp contacts) P/N 768-240-0010
	R40E0182-1 12 v. 280 ohms (D.P.D.T.10 amp contacts) P/N 768-240-0011
Q401-Q403	2N3417 P/N 891-211-0017
Q404	2N2714 (power up clear only) P/N 891-211-0010

SYMBOL	DESCRIPTION
R18	1K ¼w. 5% (manual reset only) P/N 778-127-0063
R301-R303	220 ohms ¼w. 5% P/N 778-127-0047
R401, R403 R405	10K ¼w. 5% (normal logic only) P/N 778-127-0087
R402, R404 R406	10K ¼w. 5% (reverse logic only) P/N 778-127-0087
R407, R408	10K ¼w. 5% (power up clear only) P/N 778-127-0087
R409, R415	DETERMINED BY GATE TIME
R602, R607 R611	22K ¼w. 5% P/N 778-127-0095
R603, R606 R610	10M ¼w. 5% P/N 778-127-0159
S301	N.O. switch P/N 841-211-0011
U404	CD4049 HEX INVERTER P/N 213-295-0008
U405-U407	MC14001CP quad 2 input NOR P/N 213-295-0002
U408	LM322N one shot P/N 213-395-0002
U603-U605	CA3130T op amp
R114-R118	330K, ¼w. 5% P/N 778-127-0123
C25, C407	1 uf, 50V P/N 251-532-0004
C405, C406, C408	.02 uf, 50V P/N 251-532-0001

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DIGITAL SETPOINTS

SIZE	CODE IDENT NO.	DRAWING NO.	REV
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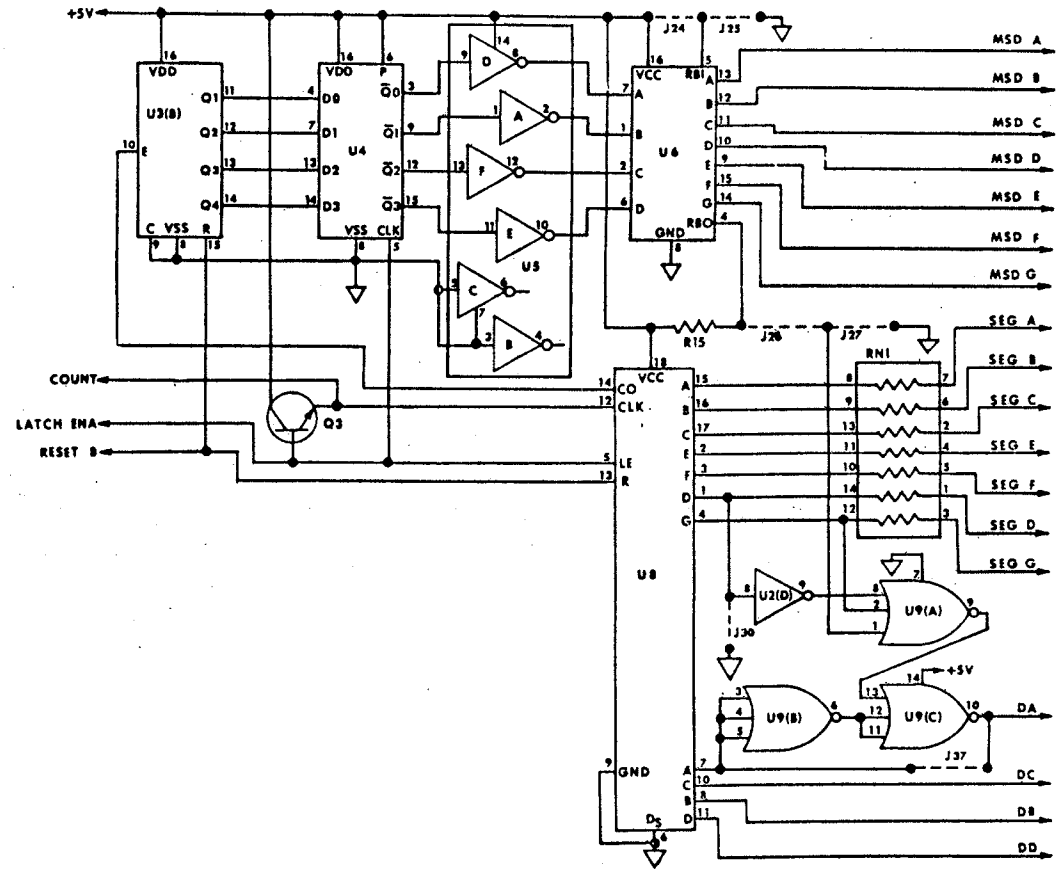
DIGITAL SETPOINTS

SYMBOL	DESCRIPTION
C401	DETERMINED BY GATE TIME (power up clear only)
CR301-CR303	MV5024 RED L.E.D. P/N 632-032-0001
CR401, CR403 CR405	1N914 (used only of setpoints w/power-up clear) P/N 354-111-0017
CR402, CR404 CR406	1N914 P/N 354-111-0017
CR407, CR408	1N914 (only with power-up clear option). P/N 354-111-0017
J401, J411 J417, J434	INSTALL
J402, J412 J433, J436 J437	OMIT
J405, J409 J415	UNDERSPEED ONLY
J406, J410 J416	OVERSPEED ONLY
J418, J420 J423	MANUAL RESET ONLY
J419, J421 J422	AUTOMATIC RESET ONLY
J424, J426 J428	POWER UP CLEAR ONLY
J425, J427 J429	NON-POWER UP CLEAR ONLY
J430	INSTALL IF NO SETPOINT IN POS. 3
J435	INSTALL IF NO SETPOINT IN POS. 2
K401- K403	R40E0179-1 12 v. 280 ohms (S.P.D.T. 5 amp contacts) P/N 768-240-0008
	R40E0180-1 12 v. 280 ohms (S.P.D.T. 10 amp contacts) P/N 768-240-0009
K401-K402	R40E0181-1 12 v. 280 ohms (D.P.D.T. 5 amp contacts) P/N 768-240-0(
	R40E0182-1 12 v. 280 ohms (D.P.D.T. 10 amp contacts) P/N 768-240-0011
Q401-Q403	2N3417 P/N 891-211-0017
Q404	2N2714 (power up clear only) P/N 891-211-0010

SYMBOL	DESCRIPTION
R18	1K ¼w. 5% (manual reset only) P/N 778-127-0063
R301-R303	220 ohms ¼w. 5% P/N 778-127-0047
R401, R403 R405	10K ¼w. 5% (normal logic only) P/N 778-127-0087
R402, R404 R406	10K ¼w. 5% (reverse logic only) P/N 778-127-0087
R407, R408	10K ¼w. 5% (power up clear only) P/N 778-127-0087
R409, R415	DETERMINED BY GATE TIME
S301	N.O. SWITCH P/N 841-211-0011
U401-U403	MC14013CP dual D flip/flop P/N 213-295-0012
U404	CD4049 HEX INVERTER P/N 213-295-0008
U405-U407	MC14001CP quad 2 input NOR P/N 213-295-0002
U408	LM322N one shot P/N 213-395-0002
R114-R118	330K, ¼w. 5% P/N 778-127-0123
C25, C407	1.0 uf, 50V P/N 251-532-0004
C405, C406, C408	.02 uf, 50V P/N 251-532-0001

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AIRPAX Electronics
CONTROLS DIVISION FT. LAUDERDALE, FLORIDA

COUNTER/MULTIPLEXER

SIZE	CODE IDENT NO.	DRAWING NO.	REV
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COUNTER/MULTIPLEXER

SYMBOL	DESCRIPTION
J24 - J27 J30, J37	SEE INSTALLATION CHART BELOW
Q3	2N4124 P/N 891-211-0041
R15	4.7K ¼w. 5% P/N 778-127-0079
RN1	39 ohms to 100 ohms resistor network (depends on display brightness) P/N 214-413-00XX (replace with same P/N)
U2, U5	MM74C04AN HEX INVERTER (partial) P/N 213-000-0071
U3	MC14518CP DUAL BCD COUNTER (partial) P/N 213-295-0013
U4	MC14042CP QUAD LATCH P/N 213-295-0008
U6	SN74LS247 7 SEGMENT DECODER/DRIVER P/N 213-205-0002
U8	MM74C926AN LSI COUNTER CHIP P/N 213-295-0010
U9	MC14025CP TRIPLE 3 INPUT NOR P/N 213-295-0011

INSTALLATION CHART

OPTION "0" (NO DISPLAY) INSTALL- J30, Q3, U2

OPTION "1" (FOUR DIGITS/NO BLANKING) INSTALL- J37, Q3, RN1, U2, U8

OPTION "2" (FIVE DIGITS/NO BLANKING) INSTALL- J24, J37, Q3, RN1, U2, U3, U4, U5, U6, U8

OPTION "3" (FOUR DIGITS/MOST SIGNIFICANT DIGIT BLANKED) INSTALL- J27, Q3, RN1, U2, U8, U9

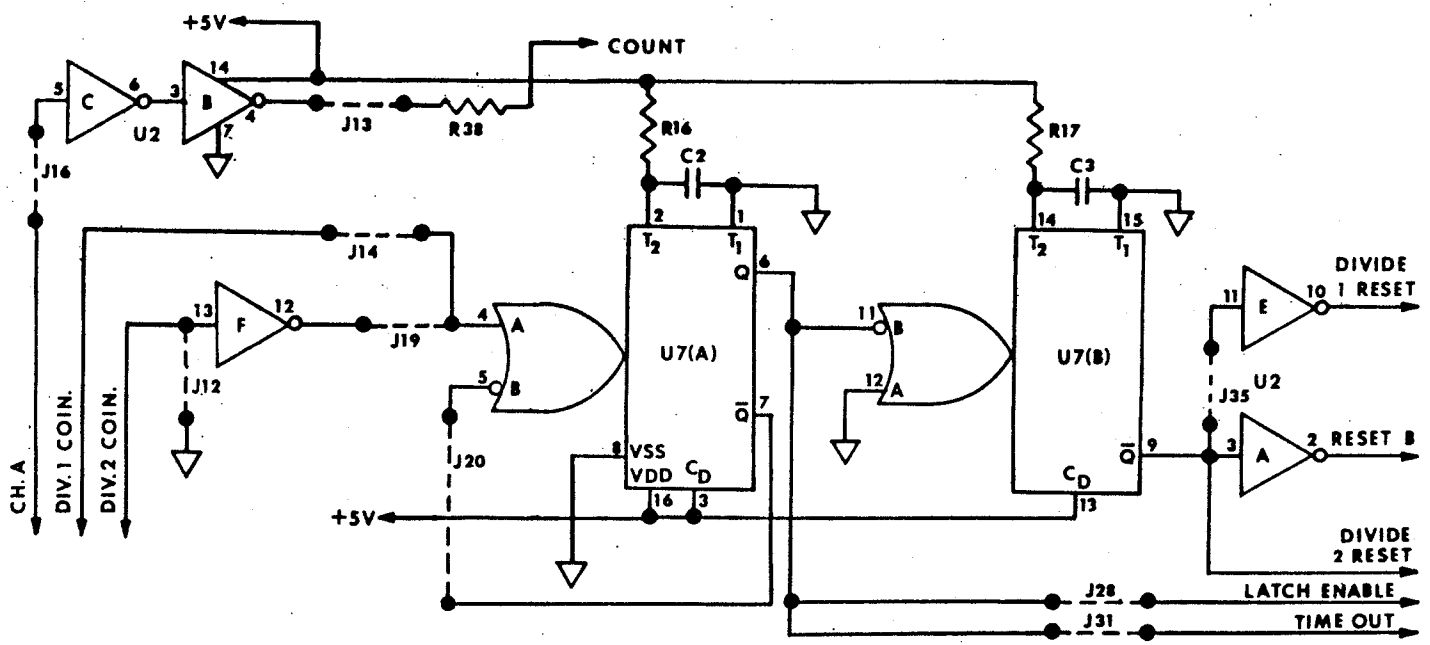
OPTION "4" (FIVE DIGITS/2 MOST SIGNIFICANT DIGITS BLANKED) INSTALL- J25, J26, Q3, R15, RN1, U2, U3, U4, U5, U6, U8, U9

OPTION "5" (FOUR DIGITS/NO BLANKING/FIXED LAST ZERO) SAME AS OPTION "1".

OPTION "6" (FIVE DIGITS/NO BLANKING/FIXED LAST ZERO) SAME AS OPTION "2".

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RESET GENERATOR

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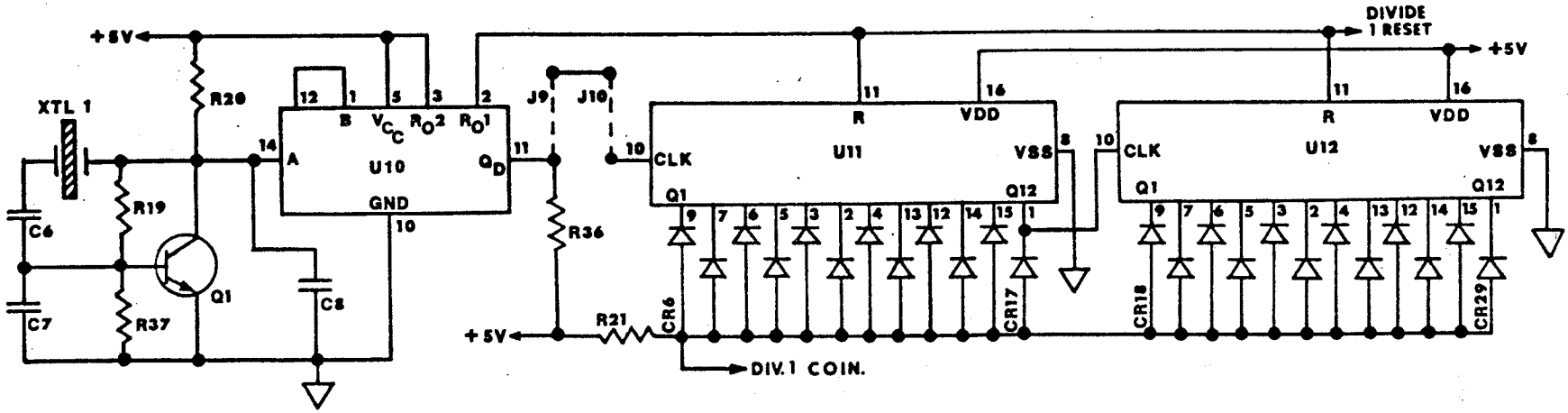
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RESET GENERATOR

SYMBOL	DESCRIPTION
C2	180 pf. ±5% 500 vdc. P/N 251-372-0035
C3	110 pf. ±5% 500 vdc. P/N 251-372-0030
J12, J14	INSTALL IF FIXED TIME BASE
J13, J16,	ALL
J20, J28,	ALL
J35	ALL
J19	INSTALL IF ADJUSTABLE TIME BASE
J31	INSTALL IF UNIT HAS DIGITAL SETPOINTS
R16	35.7K ¼w. 1% P/N 778-325-0393
R17	10.0K ¼w. 1% P/N 778-325-0340
R38	4.7K ¼w. 5% P/N 778-127-0079
U2	MM74C04AN HEX INVERTER (Partial) P/N 213-000-0071
U7	MC14528CP DUAL ONE SHOT P/N 213-295-0009

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FIXED TIME BASE

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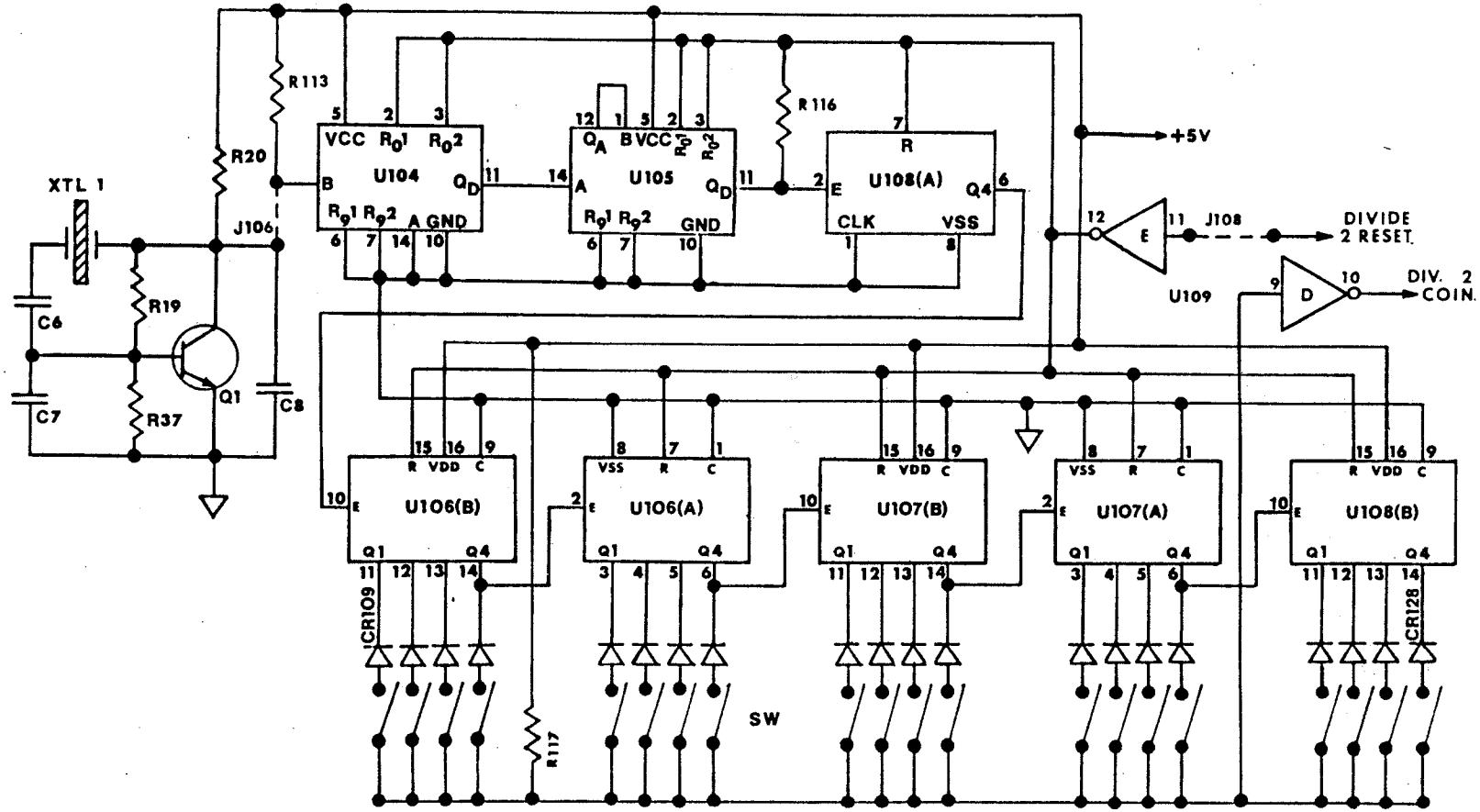
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FIXED TIME BASE

SYMBOL	DESCRIPTION
C6, C7	110 pf. ±5% 500 vdc. P/N 251-372-0030
C8	56 pf. ±5% 500 vdc. P/N 251-372-0023
CR6 - CR29	1N914 (as required) P/N 354-111-0017
J9, J10	INSTALL
Q1	2N4124 P/N 891-211-0041
R19, R21 R36, R37	27K ¼w. 5% P/N 778-127-0097
R20	2.2K ¼w. 5% P/N 778-127-0071
U10	SN74LS93 4 bit binary counter P/N 213-205-0001
U11, U12	MC14040CP 12 bit binary counter P/N 213-295-0006
XTL 1	5.00 MHz. crystal ±.005% P/N 350-100-0005

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ADJUSTABLE TIME BASE

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ADJUSTABLE TIME BASE

SYMBOL	DESCRIPTION
C6, C7	110 pf. ±5% 500 vdc. P/N 251-372-0030
C8	56 pf. ±5% 500 vdc. P/N 251-372-0023
CR109-CR128	1N914 P/N 354-111-0017
J107, J108	INSTALL
Q1	2N4124 P/N 891-211-0041
R19, R37 R117	27K ¼w. 5% P/N 778-127-0097
R20	2.2K ¼w. 5% P/N 778-127-0071
SW	DUAL INLINE, 7 pos (internal adj.) P/N 841-045-0001 (each switch) THUMBWHEEL BCD (front panel adj.) P/N 841-815-0005 (each segment)
U104, U105	SN74LS247N BCD counter P/N 213-205-0003
U106-U108	MC14518CP dual BCD counter P/N 213-295-0013
U109	MM74C04AN hex inverter (partial) P/N 213-000-0071
XTL 1	5.00 MHz. crystal ±.005% P/N 350-100-0005
C104	1.0 uf, 50V P/N 251-532-0004
R131	330K, ¼w. 5% P/N 778-127-0123
R116	4.7K, ¼w. 5% P/N 778-127-0079

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