ABB Power T&D Company Inc.
Relay Divisions
Coral Springs, FL 33065

Instruction Leaflet
41-745A

Type MVH Microprocessor Volts Per Hertz Relay

Effective: October 1988
Supersedes I.L. 41-745, Dated May 1987

★ Denotes Changed Since Previous Issue

TABLE OF CONTENTS

Section		Page
1	Application	1
2	Construction	1
3	Theory of Operation	3
4	Characteristics	5
5	Settings	5
6	Installation	6
7	Adjustments and Maintenance	6
8	Renewal Parts	9

CAUTION

It is recommended that the user of this equipment become acquainted with the information in this instruction leaflet before energizing the relay. Failure to do so may result in injury to personnel or damage to the equipment, and may affect the equipment warranty.

The relay contains static sensitive components. Electrostatic Discharge (ESD) precautions must be practiced when handling printed circuit boards and components. Use of anti-static handling materials and grounding procedures is required.

Before putting relay into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Operate the relay to check the settings and electrical contacts.

The operation of this relay is based on Westinghouse proprietary software, resident-in-memory components. Purchase of this relay includes a restrictive license for the use of any and all programs solely as part of the protective functions. Westinghouse reserves the right to request return of the memory components should the relay no longer be used as a protective device. The programs may not be copied, transferred or applied to any other device.

1. APPLICATION

The MVH relay is applied to protect transformers and generators from excessive overexcitation. Excessive flux density in the magnetic circuit of the protected apparatus causes intolerable heating. A key indicator of flux density is the ratio of voltage to frequency.

The MVH relay receives three phase input voltage and senses the maximum voltage-to-frequency ratio. It is applicable to the protection of generators and transformers. It has an inverse time characteristic that is compatible with the capability of these devices.

2. CONSTRUCTION

The MVH is a microprocessor-based volts per hertz relay. It monitors three phase input voltages through three input transformers and integrates them separately to obtain the maximum phase volts-per-hertz level. The microprocessor will determine the trip time based on the maximum input volts-per-hertz value and the inverse time setting.

The relay consists of five printed circuit modules:

1. Transformer

2. Processor

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

3. Power Supply

4. Display

5. Motherboard

The MVH relay is mounted in an FT-22 Flexitest case. The outline plan is shown in Fig. 15.

2.1 Transformer Module

There are three transformers on the module and each transformer is a two-winding type with a center tapped secondary winding. The three center taps are connected to the dc power supply common. The maximum continuous input voltage for each transformer is 150% of the V/Hz setting, i.e. for a setting of 120 volts, 60 hertz the maximum continuous input voltage is 180 volts, 60 hertz; or 60 volts for a 20 Hz input at the same setting.

2.2 Processor module

The printed circuit board of the Processor module is a four layer p.c. board. The 5 Vdc and common leads are laminated inside the board. This module contains an INTEL 8031 microprocessor and an erasable-programmable-read-only-memory (EPROM), an analog-to-digital converter, two Westinghouse customer linear ICs, several analog switches and logic gates.

The microprocessor reads all settings from the Display module and then selects one of the inverse time curves stored in the microprocessor. The voltages from the secondary windings of the input transformers are monitored and the integration for obtaining the V/Hz value is performed, in the microprocessor. The integration is done every half-cycle, (8.3 msec), and an averaged V/Hz figure is produced every 12 cycles, (200 milliseconds).

As soon as the input signal exceeds the pickup setting, the microprocessor turns on the Pickup LED indicator and if this condition lasts for more than two seconds, the Alarm-1 relay (Figure 7) picks up.

The microprocessor will block the trip action for the first 3 seconds (0.05 minutes) or 6 seconds (0.1 minutes) depending on the setting, and regardless of the input V/Hz value.

This module contains a self test circuit and linear reset feature which will be discussed in the Operation Section.

2.3 Power Supply Module

Two dc power supplies, 5Vdc and 24Vdc, are regulated by two Westinghouse custom linear IC's which are located on the Processor module. The 5 Vdc is for the logic gates and microprocessor and the 24 Vdc is for the output relays. There are five miniature relays and one reed relay on this module. The functions of these relays are as follows: two (2) for trip purposes, one (1) for the pickup alarm, one (1) for self test or loss of dc power alarm and the fifth one (1) is for the application of the Westinghouse transformer differential HU relays. The reed relay is for monitoring and indicating Trip current flow.

2.4 Display Module

The Display module contains five switches, three LED indicators and one magnetic flip flop trip indicator. The functions of these components are described as follows:

1. MVH Curve # Switch - This switch contains three positions for three families of curves, i.e, MVH curve #1, #2, and 3. It determines the inverse curve slope (time scale factor).

2. K-factor switch -- The K switch contains 10 positions from 0 to 9. It selects one of 10 curves within the same family. It actually performs th time dial setting or the V/Hz scale factor.

3. AC Voltage Switch -- There are seven positions 0, 1, 2, 3, 4, 5, 6 for the rated voltages of 90, 95, 100, 105, 110, 115, and 120 volts respectively.

4. Pickup setting switch -- This is a 16 position switch from 1 to 9 and A to F for the volts-per-hertz pickup setting from 105% to 120% in 1% steps.

5. Minimum trip time -- The minimum trip time switch selects one of two programmed timers in the microprocessor. It provides either 3-second or 6 second minimum trip time delay, regardless of the V/Hz value.

6. Frequency setting -- line frequency selection is either 60 or 50 Hz.

7. Pickup LED Indicator -- It shows that the V/Hz value is above the pickup setting.

8. Monitor LED Indicator -- When the relay is energized this LED indicator will be turned on. This relay contains hardware and software self-test

features. If an unsatisfactory condition or loss of dc power supply occurs, the LED will be turned off.

9. Trip Indicator and Reset Switch -- A magnetic flip flop is used to indicate the actual trip current flow condition. The indicator will show the orange color only for the following condition: the trip relay, K2 (Figure 7), picks up and a trip current between 0.5 and 30 amperes is present. The indicator can be reset by pushing up the reset lever, which extends through the lower right corner of the cover.

2.5 Motherboard Module

The motherboard contains several connectors for the interconnections between the Power Supply, Display, Transformer and Processor modules. Two rows of capacitors on the top and bottom of the board are used for surge protection. The capacitors are rated for 3 KVdc and are connected between the relay terminals and the case frame (earth). Any electrical surge at the input terminals will be filtered out by these capacitors.

3. THEORY OF OPERATION

The MVH microprocessor based relay digitally integrates a three phase voltage input with respect to each half cycle in order to determine the ratio of voltage to frequency. The integration on each input is shown below in equation (1):

$$\int_{0}^{T/2} V \sin x \, dt = V/ pf \qquad \text{(eq. 1)}$$

where f = l/T = frequency in Hz.

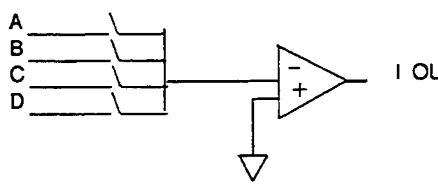
After 200 ms, the individual V/Hz computations are averaged and the largest of the three is compared to a pickup value. If it exceeds the pickup value it is input to an inverse time tripping algorithm. The tripping algorithm obeys equation (2)

$$t = e^{\frac{K1 - X}{C}} \quad \text{(minutes)} \qquad \text{(eq. 2)}$$

where t is the time to trip, X is the percentage of V/Hz ratio, and K1 and C are constants.

The digital integration performed on each phase is accomplished by sampling the waveform every 0.768 milliseconds. The zero crossing of the waveform marks the end of one integration and the start of the next. Three phase voltages A,B,C are input to the three transformers TX1, TX2 and TX3 respectively (Figure 7). These transformers are center tapped and provide a 4:1 step down voltage on the secondaries. The phase A secondary voltages are labeled PA+ and PA-. The secondary voltages of Phase B and C are labeled as PB+, PB- and PC+, PC- respectively. These signals are then input into the processor module. On the processor module (Figure 7A), signal PA+ and PA-. are input to separate zero crossing detectors. The output signals form the zero crossing circuits are labeled ZCA, ZCB and ZCC for phases A,B, and C respectively. Each zero crossing signal produces a logic 0 when its input is positive, and a logic 1 when its input is negative.

The processor module (Figure 7A) contains two identical custom linear integrated circuits, U7 and U8. These custom chips contain a 4 channel analog multiplexer and a programmable gain amplifier which is shown below in simplified form.



Only one input channel to the multiplexer can be selected at a time. This is controlled by S1 and S2 pins on the custom chip. The truth table for the S1, S2 pins and the selected channel are shown below:

S1	S2	Input
0	0	A
0	1	B
1	0	C
1	1	G

The gain of the programmable amplifier is controlled by the R1, R2 pins on the custom chip. Figure C is the truth table for R1, R2 and the selected gain are shown below:

R1	R2	Gain
0	0	1.0
0	0	0.5
1	1	0.25

The programmable gain amplifier works on a negative current, i.e., the current flows out of the summing junction and to pins labeled A, B, C, or G. Signals PA- and PA+ are input to the channel A and B of the of custom chip U8, signal PB- and PB+ are input to the C and G inputs of U8, and signals PC- and PC+ are input to the A and B inputs of custom chip U7.

When the microprocessor takes a voltage sample from the phase A input waveform, it must write to latch U11 so that signal U11-ZCAB and U11-S1 are a logic 1 and zero respectively. With U11-S1 a zero, the S1 input of U8 is 0. Hence only analog mux channels A or B will be selected. U11-ZCAB a logic 1 causes switch U2 to select the phase A zero crossing signal ZCA to be present at the S2 input of U8. This automatically forces only the negative signal to be chosen by the analog mux.

When the microprocessor takes a voltage sample from the phase B input, it must write to latch U11 so that U11-ZCAB and U11-S1 are a logic 0 and 1 respectively. Now only analog mux channels C or G may be chosen. Switch U2 now allows the phase B zero crossing signal ZCB to control input S2 on U8 allowing only negative polarity signal to be chosen.

The S1 input on U7 is grounded and the phase C zero crossing signal ZCC is fed directly to the S2 input. This allows only negative polarity signal from phase C to be chosen by the analog mux.

Once the microprocessor selects a phase it must then select the proper gain on the programmable amplifier. This is accomplished by writing to latch U11 and controlling the states of U11-R1 and U11-R2. These two signals feed directly into the R1 and R2 gain control inputs of the custom chips U7 and U8.

The custom chips are designed to produce a current output between 0 and 100 micro amperes proportional to the current input at a given gain.

Table below shows the relationship between current input, gain and current output.

Current Input	Gain	Current Output
0 - 100 uA	1	0 - 100 uA
100 - 200 uA	1/2	50 - 100 uA
200 - 400 uA	1/4	50 - 100 uA

The microprocessor initializes the gain to unity. If the input current is greater than 100 microamperes the overrange output pin (OR) on the custom chip will go to a logic 1. Once the processor sees this, it will then switch to a gain of 1/2 and again examine the overrange output pin. If the overrange is still a logic 1, the processor will switch to a gain of 1/4. The input signal range is such that no overrange will occur at a gain of 1/4.

The phase A and B output current signal is labeled IOUTAB and the phase C output current is labeled IOUTC. Each phase output current has its own current to voltage resistor and trimpot for independent gain adjustment. The trimpot for phase C is labeled P1 and the trimpots for phase B and A are labeled P2 and P3 respectively.

The microprocessor switches the correct current output and current to voltage resistor and trimpot to buffer amplifier U1-A. The buffer amplifier U1-A feeds a sample-and-hold circuit made up of U3 and U1-B. The output of the sample-and-hold circuit feeds the A/D converter U6. The microprocessor reads the contents of the A/D converter on 8 of its I/O pins.

The microprocessor must know when each input signal zero crossing occurs. Signals INTA, INTB, and INTC on U5 provide the edge triggered zero crossing interrupts to the processor. The signals ZCCONA, ZCCONB and ZCCONC are under the processor control and keep the interrupt signals normally in the one state. Hence any zero crossing results in a high to low transition on the interrupt signal. This is done because the processor only responds to high to low transitions on its interrupt signals.

After the analog signals are sampled and pass through the auto-range stage and A/D converter, the microprocessor performs integration based on equation (1) and calculates the average value of V/Hz every 200 ms. The inverse time is based on equation (2). If the calculated value t is greater than the number stored in the accumulator, an increment of 200 (ms) will be added to the accumulator. This process will be repeated until the number in the accumulator is equal to or greater than the calculated value t and then a trip signal will be generated to energize the tripping relay.

The general equation (2) can be rewritten for the MVH curve 1, 2, and 3 as follows:

Curve 1: $$t = e^{\frac{(115 + K \times 2.5) - X}{4.8858}} \quad \text{(eq.3)}$$

Curve 2: $$t = e^{\frac{(113.5 + K \times 2.5) - X}{3.04}} \quad \text{(eq.4)}$$

Curve 3: $$t = e^{\frac{(108.75 + K \times 2.5) - X}{2.4429}} \quad \text{(eq. 5)}$$

where X is the percentage of V/Hz ratio and K is the front panel dial setting from 0 to 9 and t is the time in minutes to trip.

The time equations for 3, 4, and 5 are plotted in Fig. 4, 5, and 6 respectively.

One of the unique capabilities of the MVH relay is its linear rate reset characteristic. The reset time constant is 204 seconds. If any system disturbance causes the value of V/Hz to go above the pickup setting and then the value of V/Hz is reduced below the pickup to a normal level, it takes 204 seconds to completely reset the system. If the fault condition happens again before the system is completely reset, the time to trip will be faster and it depends on the number remaining in the accumulator. The design simulates the heat dissipation in a generator.

This relay is equipped with self check and test features. A dead man circuit keeps track of the programming routine and the crystal timing. The voltage drop on the capacitor C8 should be maintained between 1.66V and 3.3V. If the programming routine is upset or the timing frequency becomes irregular, the microprocessor will be restarted and the Alarm-2 relay will drop out. The microprocessor also checks all bits in the read-only memory every 12 minutes. Any bit change in the memory will be indicated by turning off the Monitor LED and the Alarm-2 relay.

4. Characteristics

Temperature range: -20 deg. to +55 deg. C

Frequency: 50 Hz or 60 Hz selected by a switch

Operating Frequency Range: 12.5 Hz to 90 Hz (maximum V/Hz input of 150%)

AC Voltage Range:
90, 95, 100, 105, 110, 115, & 120v.

Voltage Input: Three two wire isolated ac inputs for maximum V/Hz sensing

V/Hz Pickup Setting: From 105% to 120% in 1% steps with repeatability of 0.5%.

V/Hz Pickup Accuracy: Using the PICKUP light as an indicator. 2% over the operating temperature range.

Dropout Ratio: 98% (approx.)

Inverse Time Characteristics: Three curve families selected by Curve #1, #2 or #3 and each family contains 10 curves selected by K factors from 0 to 9 as shown in Fig. 4, 5 and 6.

Operating Time Repeatability: +/- 5%.Testing of this value requires a very stable input source, see acceptance test.

Alarm-1: 2 seconds +/- 10% for any V/Hz in excess of the pickup setting.

Alarm-2: One normally closed (NC) contact for an unsatisfactory self-check or loss of dc power supply.

Minimum Trip Timer: 3 or 6 seconds selectable by a front panel switch.

Reset Characteristics: Linear reset with a time constant of 204 seconds to complete reset. After trip, reset is immediate.

Trip Contacts: Two N.O. (normally open) contacts capable of making and carrying 30 amperes at 250 Vdc for 1 second.

Alarm Contact Rating: 0.25 amperes at 250 Vdc.

Trip Indicator: Magnetic Flip-flop to indicate trip current flow (the minimum trip current for indication is 0.5 amperes).

LED Indicators: Two, one for V/Hz pickup (PICKUP) and one for self-test/dc power (MONITOR).

Special Contact Output (HU): 1 from C (transfer) contact. Output indicates for all three phases are in excess of 120% V/Hz rating.

DC Power Supply: Separate styles for 48V, 125V, and 250V.

DC Power Drain: 0.15 amps for 48V. 0.037 amps for 125V.

AC Voltage Burden: 0.25 VA at 120 Vac and 60 Hz.

5. Settings

Provisions are provided for selecting:

1. Nominal ac voltage
2. Frequency
3. V/Hz (volts per hertz) pickup
4. Characteristic Curve Slope
5. Time Curve (K factor)
6. Minimum Trip Time

5.1 Normal ac Voltage

Seven levels of nominal ac RMS voltage may be chosen 90, 95, 100, 105, 110, 115, and 120 volts. Select a setting corresponding to: $Vn = Vr/Rv$

where
Vn = nominal ac voltage setting
Vr = line to line voltage rating of the protected device.
R_V = ratio of the line voltage transformer.

If two different types of apparatus such as a generator and a unit connected transformer are to be protected with a single MVH relay, use the lowest rated voltage of the two for the Vr.

5.2 Frequency (FREQ. - position 50 Hz or 60 Hz)

This relay is designed to accommodate 50 or 60 hertz applications. Choose a switch position corresponding to the power frequency.

5.3 V/Hz Pickup (P/U SETTING positions 0 to F)

Pickup choices vary in 1% steps from 105 to 120 percent of the nominal value. Choose a setting slightly above the highest voltage level at which continuous operation is permitted on the protected device. In general, a generator can deliver rated KVA at 5% overvoltage. A setting of 110 percent usually will be a reasonable setting for the MVH. The rotary switch position corresponding to the desired level should be chosen from the following table:

Rotary Switch Position	Percent Volts/hertz At Pickup
0	105
1	106
2	107
3	108
4	109
5	110
6	111
7	112
8	113
9	114
A	115
B	116
C	117
D	118
E	119
F	120

5.4 Characteristics Curve Shape (MVH CURVE # position 1, 2, 3)

Three different curve shapes are selectable. The particular curve to be chosen is dependent on the V/Hz vs time characteristic for the particular device being protected. The rotary switch settings are marked 1, 2, and 3. Figures 4, 5 and 6 define the slope of these characteristic curves for the respective setting.

5.5 Time Curve (K FACTOR positions 0 to 9)

The K setting in conjunction with the above Curve Shape selection establish the protective level of the MVH relay. Time Curve settings are chosen to complete isolation of the protected device before damage can result.

5.6 Minimum Trip Time (positions 3 sec or 6 sec)

Provision is included to delay the tripping at the very high levels of volts/hertz to assure security in the device. By selecting a switch position, this minimum trip time can be chosen to be 3 seconds or 6 seconds. The 6 second position is recommended.

6. Installation

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration, corrosive fumes and heat. The maximum temperature outside the relay case should not exceed +55° C for normal operation (See CHARACTERISTICS for temperature range specifications.)

Mount the relay vertically by means of the four mounting holes on the flanges for semi-flush mounting or by means of the rear stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. External toothed washers are provided for use in the locations shown on the outline and drilling plan to facilitate making a good electrical connection between the relay case, its mounting screws or studs, and the relay panel. Ground wires should be affixed to the mounting screws or studs as required for poorly grounded or insulating panels. Other electrical connections may be made directly to the terminals by means of screws for steel panel mounting or the terminal studs for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench. See Figure 15 for Outline and Drilling Plan. For detailed FT case information refer to I.L. 41-076.

7. Adjustments and Maintenance

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay, no customer adjustments other than those covered under "SETTINGS" should be required.

7.1 Acceptance Check

NOTE: Before every time delay measurement, push the reset button to reset the timer.

Connect a rated dc power supply to terminals 3 (positive) and 2 (negative). Connect one set of contacts of a DPDT switch in series with the ac input lead, and connect the other set of contacts to the timer start. Connect the timer stop leads across terminals 11 and 20. Allow 5 minutes for the relay to warm up (Ref. Figure 14).

7.2 Checking Phase A and MVH Curve #1.

7.2.1 Settings

Set the relay per the following table.

Function	Setting	Value
P/U SETTING	0	105%
MVH CURVE #	1	–
AC VOLTS	6	120 VOLTS
K FACTOR	5	–
FREQUENCY	60 HZ	–
MIN TRIP TIME	3 SEC	–

Connect the single phase voltage input back to terminals 4 and 5 (Phase A).

7.2.2 Voltage Pickup Checks

Apply a 60 Hz voltage source to the input terminals, maintain the input frequency at 60 Hz, slowly increase the voltage. The pickup LED turns on between 124.75 and 127.25 volts (nominal 126 volts).

Explanation of PICKUP value:

PICKUP = 105% of the V/Hz setting.
PICKUP = 105% (AC VOLTS/FREQ) volts/Hz
PICKUP = 105% (120/60) = 1.05(2) = 2.1

Pickup volts at rated frequency (60 Hz)

$$\text{PICKUP} = 2.1\ \text{Volts/Hz} = \frac{\text{applied volts}}{60\ \text{Hz}}$$

Applied PICKUP Volts = 2.1 x 60 = 126 volts

7.2.3 Frequency Pickup Check

Maintain the input voltage at 120 volts and vary the input frequency from 60 Hz. The Pickup LED turns on between 56.7 and 57.6 Hz (nominal 57.14).

Explanation:

Pickup Frequency at Rated Voltage (120 volts)

$$\text{PICKUP} = 2.1\ \text{volts/Hz} = \frac{120\ \text{volts}}{\text{applied freq.}}$$

$$\text{Applied PICKUP freq.} = \frac{120}{2.1} = 57.14\ \text{Hz.}$$

7.2.4. Repeat step 7.2.2 for the following frequencies.

Frequency	Pickup Voltage
20	41.6 - 42.4
40	83.1 - 84.8
60	124.75 - 127.50
80	166.3 - 169.7

7.2.5 Operating Time Check

NOTE: When checking the operate time, use precision frequency and volt meters. A 1% error in the measurement reflects a large error in the delay time.

Because of the extreme inverseness of the time curve as a function of frequency or voltage variation, the following procedure is recommended as an acceptance test. Establish a fixed frequency and apply a voltage of 1% below the nominal "Input Voltage" from the table. Record the time to trip. Apply a voltage of 1% above the nominal "Input Voltage" from the table. Record the time to trip. The "Delay Time" from the table should fall between these two time values.

Maintain input frequency at 60 Hz (or 50 Hz) and suddenly apply phase A voltage then measure the delay time per the following table.

% V/Hz Setting	Trip Time Sec.	Trip Time (Min.)	Input Volts +/- 1%
140	4.65	(0.076)	168
130	36	(0.60)	156
125	100	(1.67)	150

7.2.6 Trip Indicator and Minimum Trip Timer

Connect a NC trip switch between the dc supply and terminal 10, and connect a 40 watt resistor between terminal 1 and dc common. The value of the resistor depends on the trip dc voltage. The minimum current for the trip indicator is 0.5 amperes. Apply Vin = 180 Vac, 60 Hz (150% of the V/Hz setting). The MVH output contact closes in 3 seconds (+/-10%) and the magnetic indicator flips. Turn off the trip switch and then the ac input voltage. The indicator should be reset by depression of the reset pushbutton. Turn on the trip switch again.

Change the setting from 3 sec. to 6 sec. Repeat the test and the output contact closes in 6 sec. (+/-10%). Set the switch back to 3-second setting and disconnect the trip circuit.

7.2.7 Alarm-1 and Alarm-2.

Reconnect the timer stop leads from terminals 11 and 20 to 12 and 13 AL1 contacts. Apply Vin = 132 volts and the Alarm-1 contact should close in 2 sec. (+/-10%). Connect an ohmmeter across terminals 14 and 15 AL2 contacts. It should be open. Turn off the dc power supply and the meter should read zero ohm, AL2 contacts closed. Disconnect the ohmmeter and reconnect the timer stop leads to terminals 11 and 20.

7.2.8 Reset characteristics.

Reference information: A 204 second linear reset time constant is used in this design and from test step 7.2.5 the trip time for an input of 130% is 36 seconds.

The following sequence can be used to verify the action of the reset characteristics.

a. Apply an input voltage of 156 volts for 18 seconds. (t_1 = 18 sec., 50% of the trip time.)

b. Turn off the input voltage for 102 sec. (t_2 = 102 sec., 50% of total reset time).

c. Turn on the input voltage again. The counter will start to increase the number from the 25% level, or $t_3 = 0.75 \times 36 = 27$ sec.

d. Verify the total trip time $t = t_1 + t_2 + t_3 = 18 + 102 + 27 = 147$ sec.

The accuracy of the value is subject to all of the comments in section 7.2.5 Operating Time Check.

7.3 Checking Phase B and MVH Curve #2

1. Settings

   Set the relay per the following table.

Function	Setting	Value
P/U SETTING	0	105%
MVH CURVE #	2	–
AC VOLTS	6	120 VOLTS
K FACTOR	3	–
FREQUENCY	60 HZ	–
MIN TRIP TIME	3 SEC	–

   Connect the single phase voltage input leads to terminals 6 and 7 (Phase B).

2. Repeat steps 7.2.2 to 7.2.5 except use the following table for step 7.2.5.

% V/Hz Setting	Delay Time Sec.	Delay Time Sec.	Input Volts +/- 1%
130	3.12	(.052)	156V
125	16.1	(268)	150V
120	83.4	(1.39)	144V

7.4 Checking Phase C MVH and Curve #3

1. Settings

   Set the relay per the following table.

Function	Setting	Value
P/U SETTING	0	105%
MVH CURVE #	3	–
AC VOLTS	6	120 VOLTS
K FACTOR	4	–
FREQUENCY	60 HZ	–
MIN TRIP TIME	3 SEC	–

   Connect the single phase AC voltage input leads to terminals 8 and 9 (Phase C).

2. Repeat steps 7.2.2 to 7.2.5 except use the following table for step 7.2.5.

% V/Hz Setting	Delay Time Sec.	Delay Time (Min.)	Input Volts +/- 1%
125	4.6	(0.076)	150V
120	36	(0.6)	144V
117.5	100	(1.67)	141V

7.5 HUC and HUO contacts

Contact outputs and HUO at terminals 16, 17 and 18 are for the use of Westinghouse differential relay HU. If all three V/Hz inputs exceed 120% of rating, the contact between terminals 16 and 17 should be open. This can be tested by connecting three AC voltages to terminals 4, 6, 8 respectively and the neutral line to terminals 5, 7, 9 together. By setting the relay as shown in step A and applying an AC phase to neutral voltage of 144 Vac (+/-2%) to the inputs, the HUC contact between terminals 16 and 17 should be open, and HUO contacts between 17 and 18 should be closed.

7.6 Routine Maintenance

All relays should be checked at least once every year per the description as shown in the Acceptance Test section.

7.7 Calibration

The proper adjustment of the three trimpots P1, P2, and P3 have been calibrated by the factory and should not be disturbed by the customers unless the relay is out of calibration shown in the Acceptance Test.

The relay's accuracy not only depends on the trimpot's adjustment but also on the instrument measuring accuracy. One percent reading error at the input side could cause very large output timing error.

The trimpots P1, P2 and P3 are for the adjustments of phase C,B and A respectively.

1. Apply a single phase voltage to phase A (terminals 4 and 5).
2. Set the frequency at 60 Hz (or 50 Hz).
3. Select the line voltage at 120 volts (or 110 volts for 50 Hz setting).
4. Set the Pickup setting to 105%.
5. Slowly increase the input voltage to 126 volts (115.5V for 50 Hz) and the Pickup LED should be turned on. Slightly adjust P3 if necessary.
6. Connect the input voltage to terminals 6 and 7. Repeat step #5. Slightly adjust P2 if necessary (Phase B).
7. Connect the input voltage to terminals 8 and 9. Repeat step #5. Slightly adjust P1 if necessary (Phase C).

8. Renewal Parts

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

REFERENCE DRAWINGS

1.	MVH Relay (Picture)	
2.	Simplified Terminal Connection Drawing	9644A52
3.	MVH Block Diagram	1494B54
4.	Typical Time Curve #1 for the MVH Relay	9644A55
5.	Typical Time Curve #2 for the MVH Relay	9644A56
6.	Typical Time Curve #3 for the MVH Relay	9644A57
7.	Internal Schematic - MVH Relay	1351D77
8.	Component Location - Transformer Module	1496B06
9.	Component Location - Processor Module	1496B07
10.	Component Location - Power Supply Module	1496B05
11.	Component Location - Display Module	1496B08
12.	Component Location - Motherboard Module	1496B09
13.	External Schematic of the MVH Relay	1494B55
14.	Typical Test Diagram for Type MVH Relay	9650A31
15.	Outline and Drilling Plan for the MVH Relay in FT-22 Case	183A158

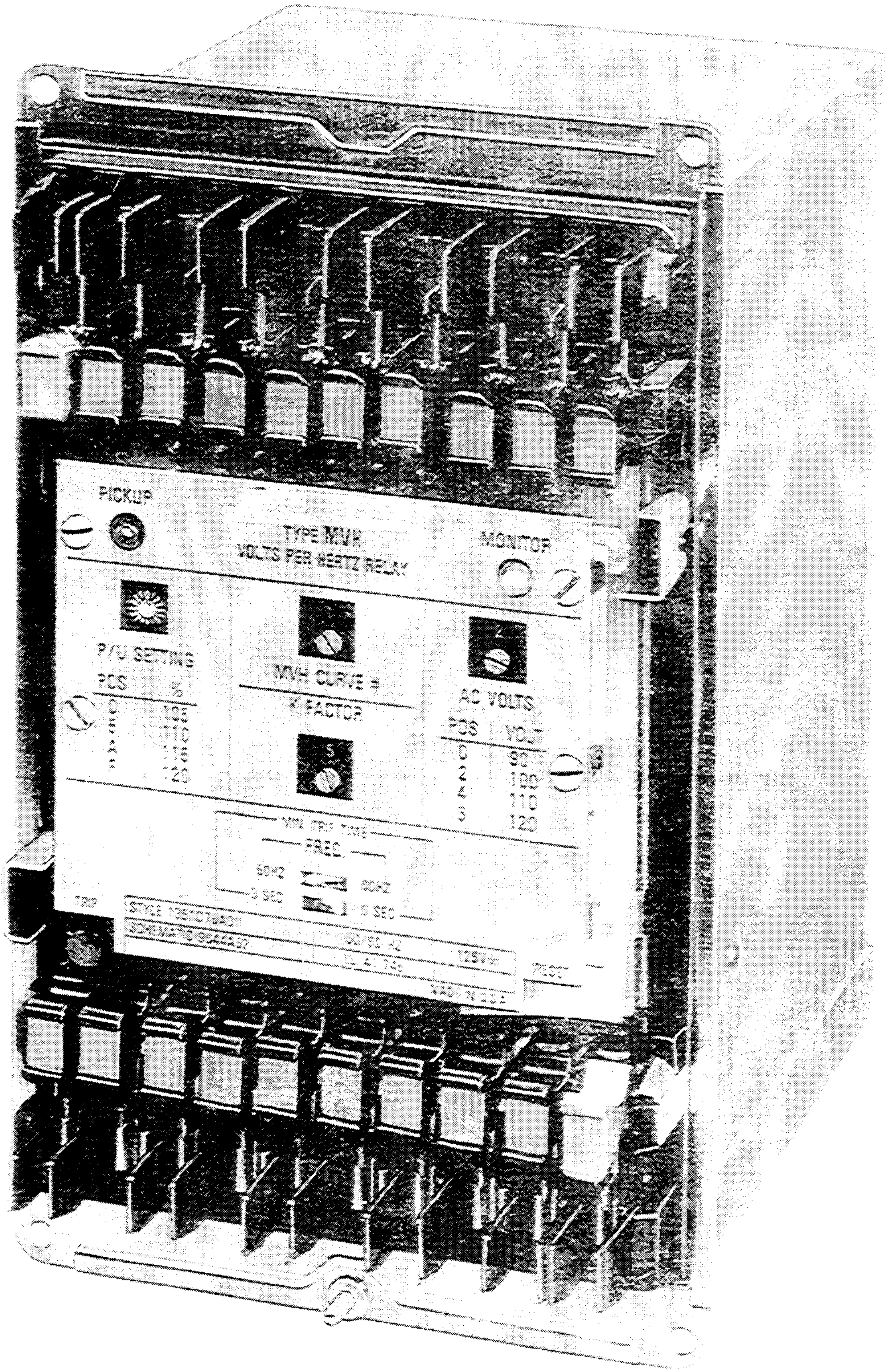


Fig. 1 MVH Relay

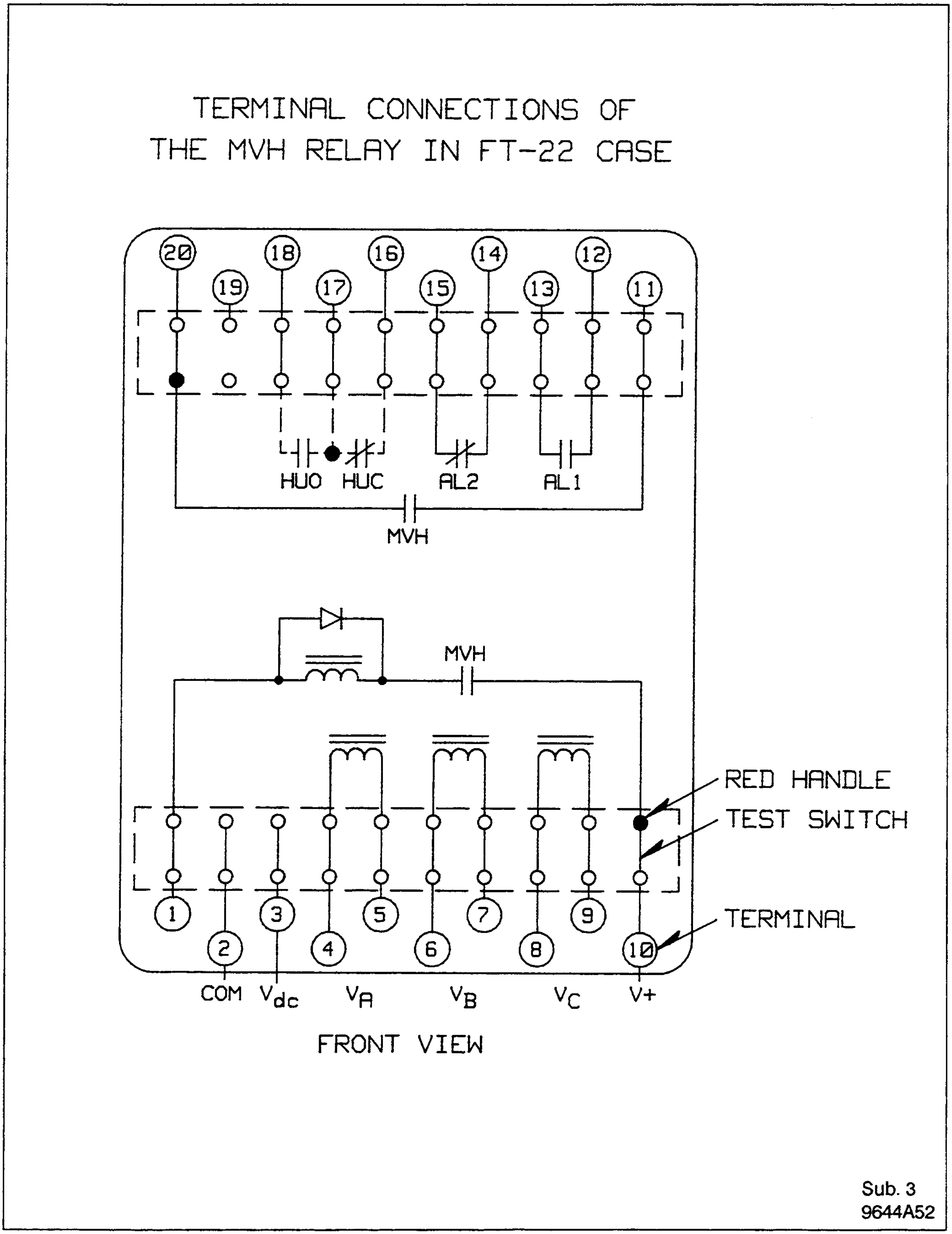


Fig. 2 Simplified Terminal Connection Drawing

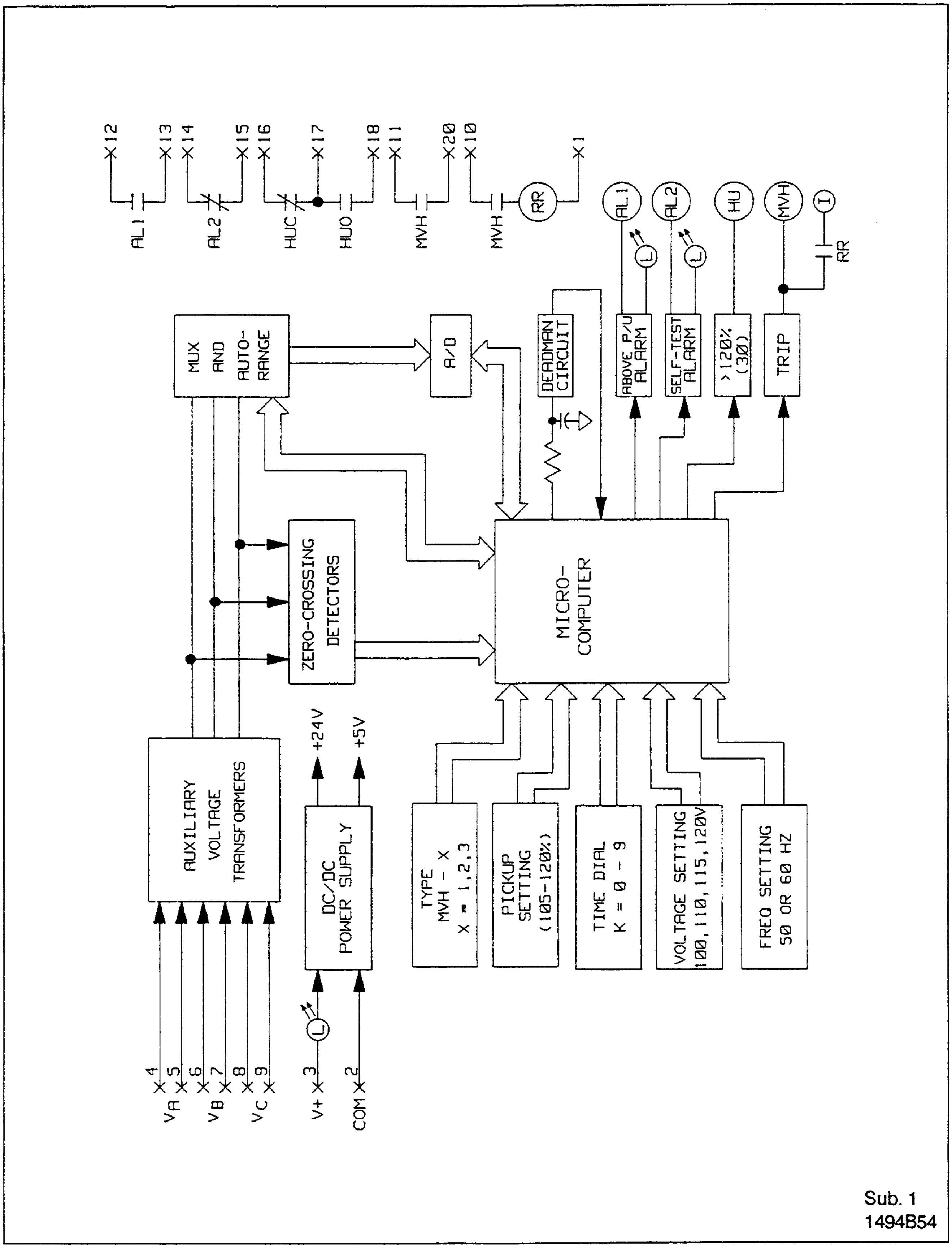


Fig. 3 MVH Block Diagram

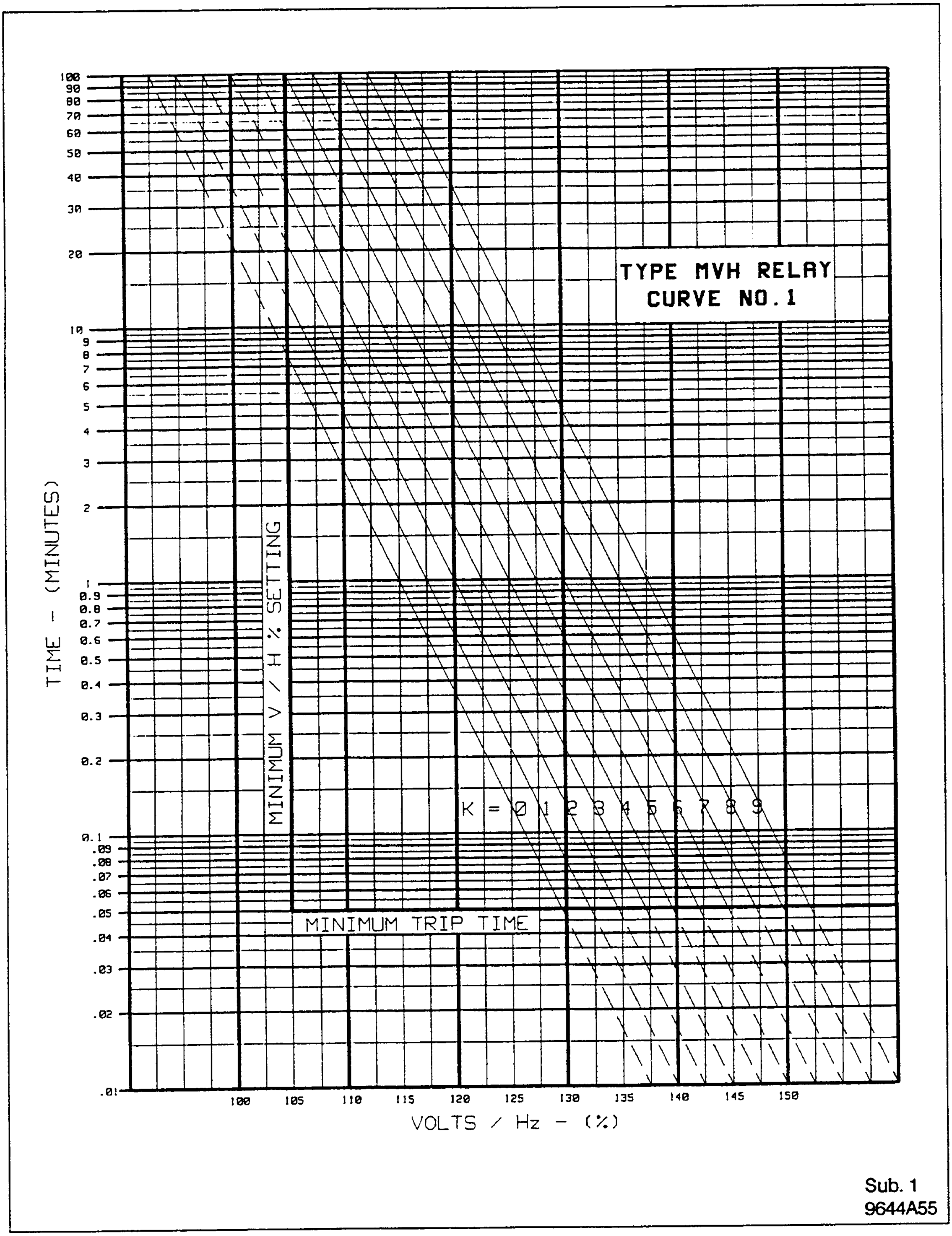


Fig. 4 Typical Time Curve #1 for the MVH Relay

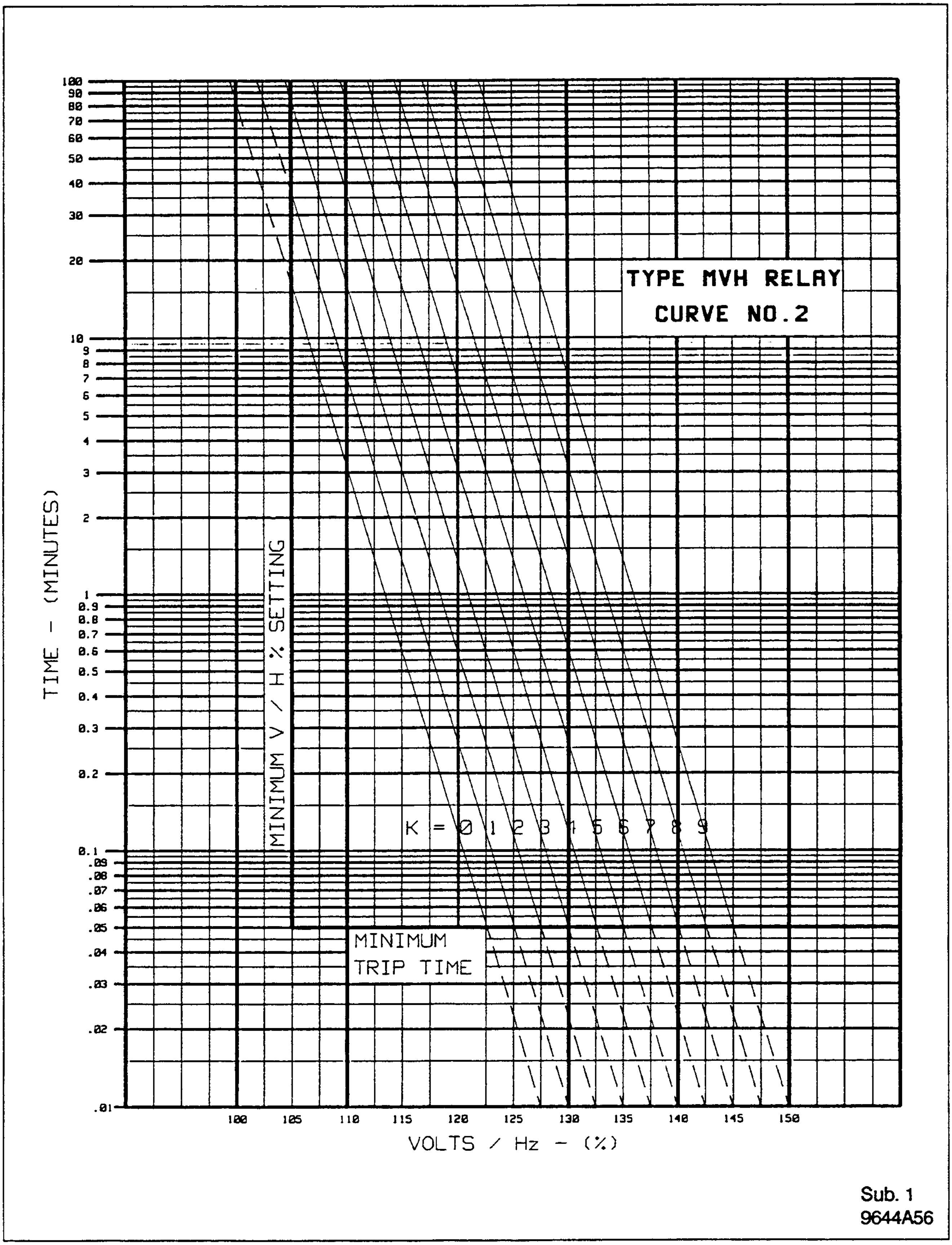


Fig. 5 Typical Time Curve #2 for the MVH Relay 1

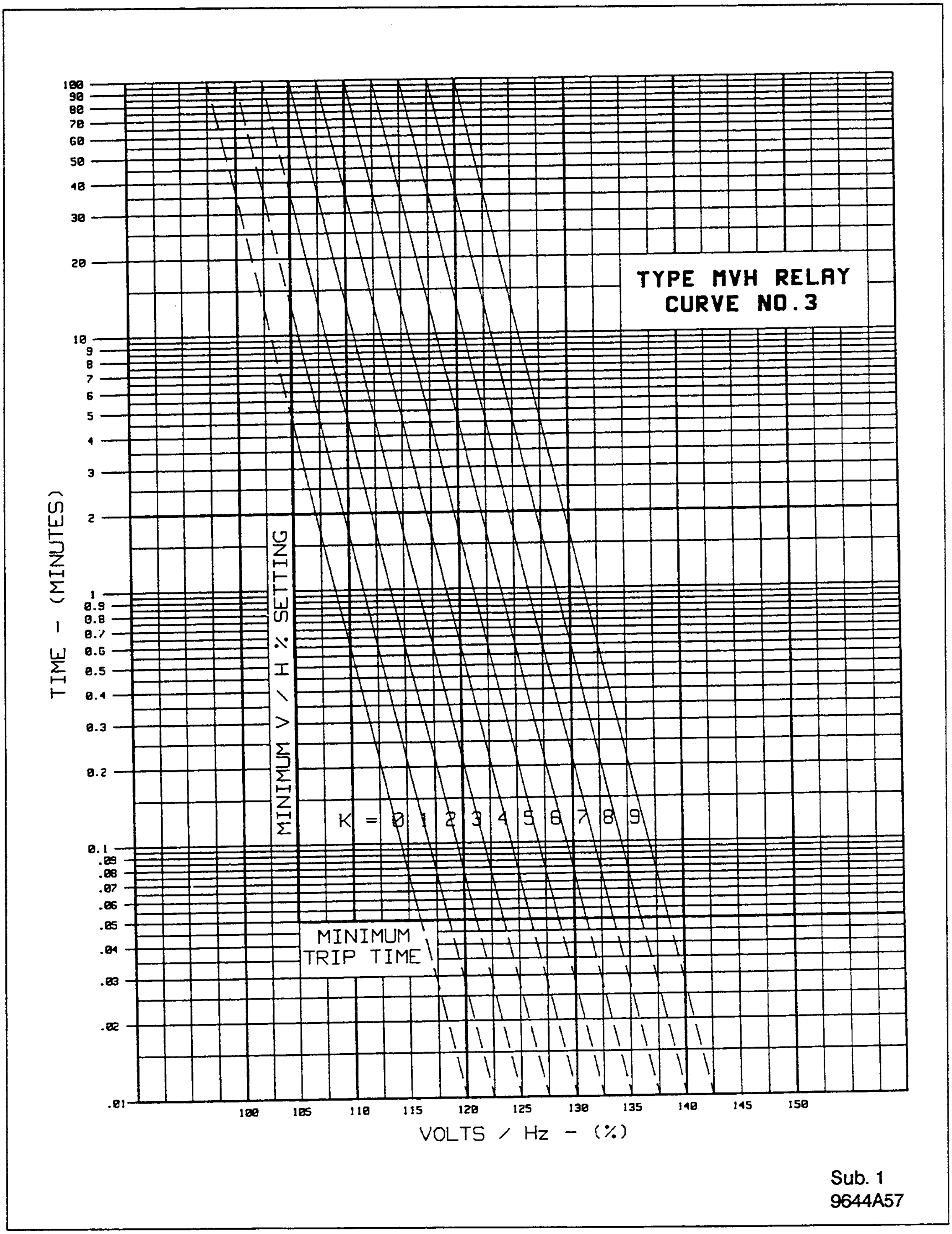
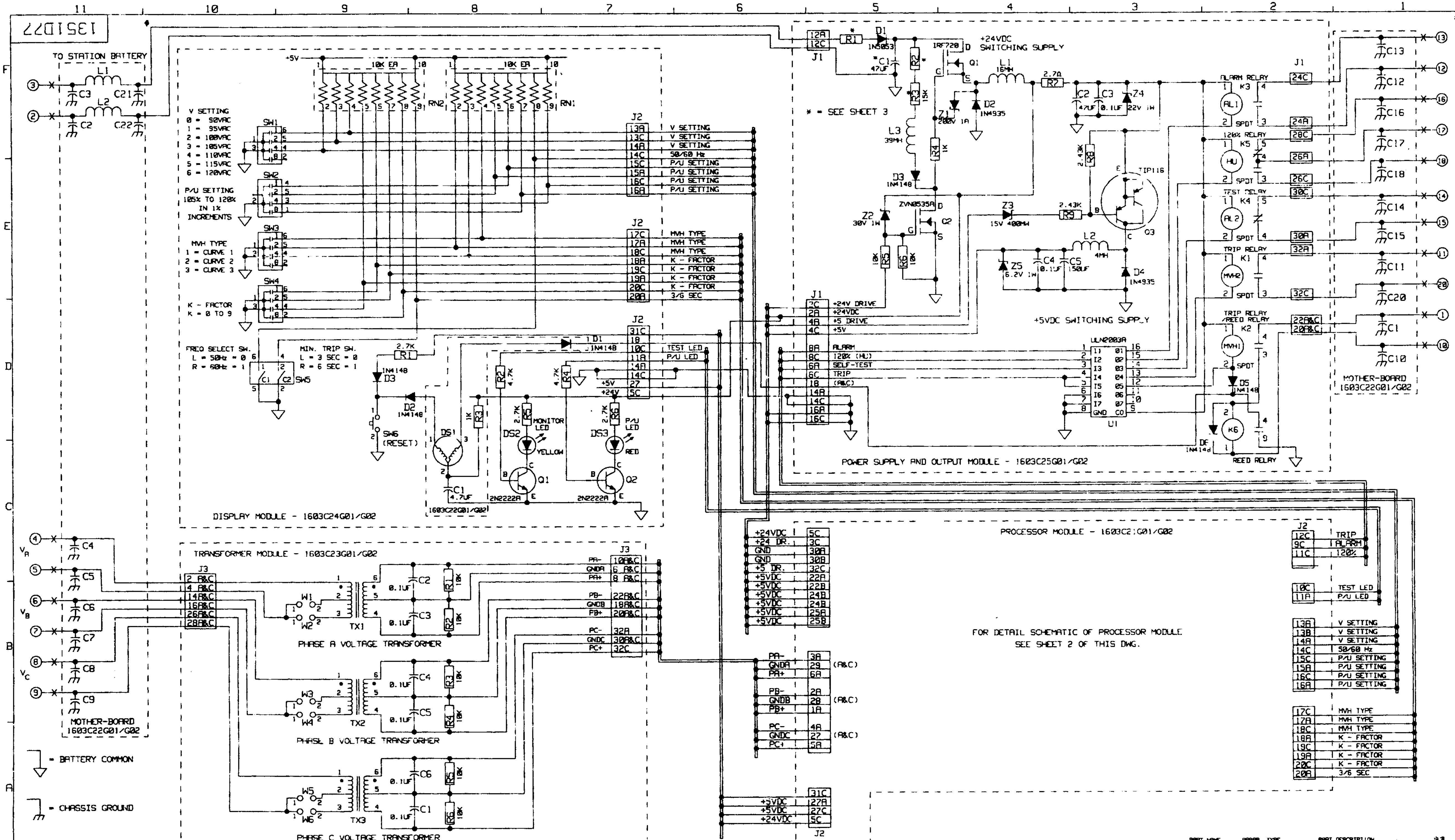
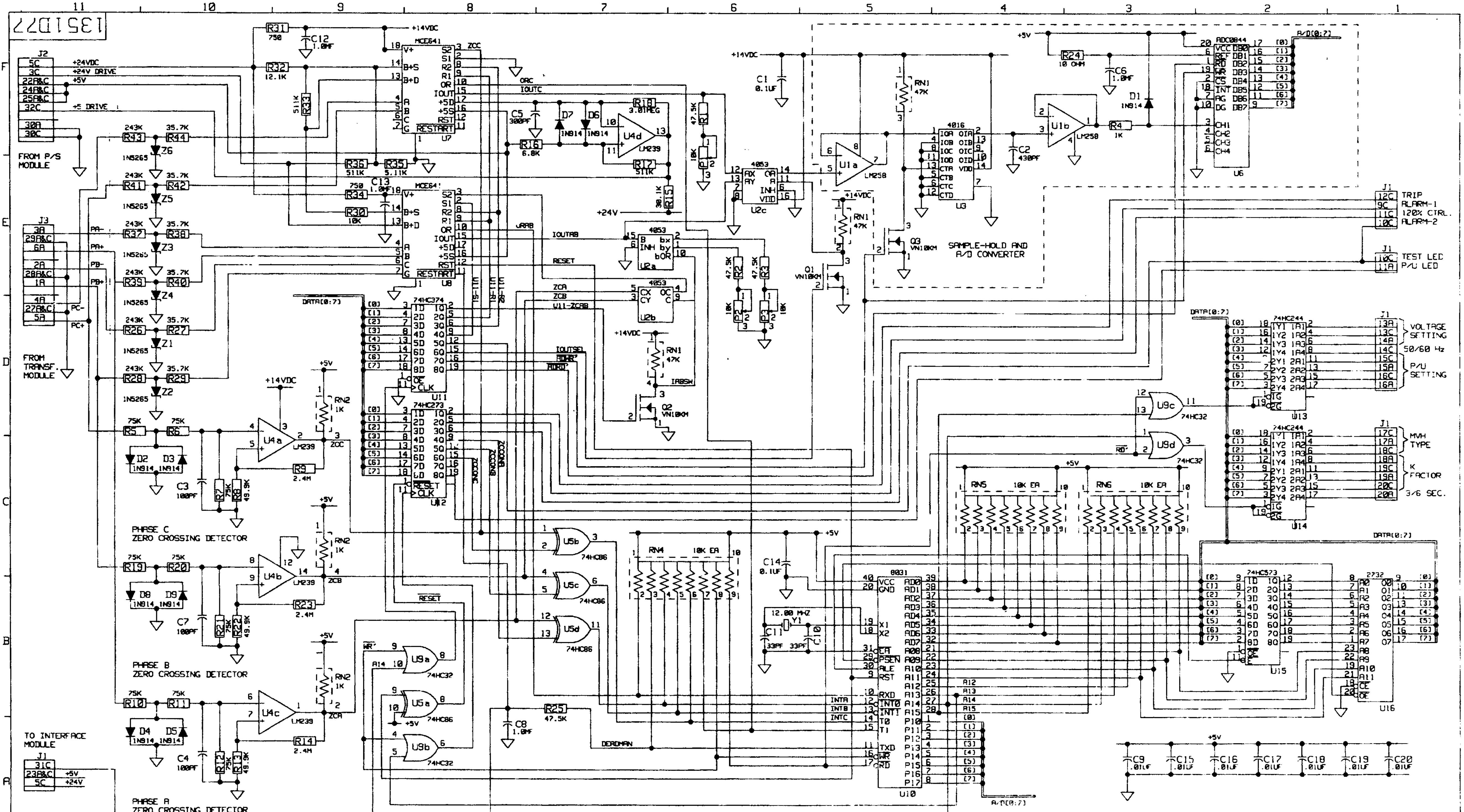


Fig. 6 Typical Time Curve #3 for the MVH Relay



PART NAME	APPAR. TYPE	PART DESCRIPTION	
MVH	RELAY	INTERNAL SCHEMATIC	14



REF DWGS: MVH BLOCK DIAGRAM ------------ 1494B54
MVH RELAY INT. SCHEMATIC ----- 1351D77
MVH MODULE ASSEMBLY DWG. ----- 1603C21

PART NAME	APPAR. TYPE	PART DESCRIPTION	SLG
MVH	RELAY	INTERNAL SCHEMATIC	14

ELECTRICAL PARTS LIST
MVH RELAY

MICROPROCESSOR MODULE 1603C21G01

CAPACITORS

COMP LOC	DESCRIPTION	STYLE	GROUP
C1	.1MFD 50VDC 20%	3509A34H03	ALL
C2	430 PF	187A584H04	ALL
C3	100PF 500V 2% DUR-MICA	762A757H01	ALL
C4	100PF 500V 2% DUR-MICA	762A757H01	ALL
C5	300 PF, 500V, +-2% MICA	187A584H09	ALL
C6	1MFD 50V 20% CERAMIC	3512A08H01	ALL
C7	100PF 500V 2% DUR-MICA	762A757H01	ALL
C8	1.0UF 50V+-5% MET-POLYCARB	3534A68H11	ALL
C9	.01UF 50V 20% CERAMIC	3509A34H02	ALL
C10	33PF 500V 2% DURA-MICA	763A209H13	ALL
C11	33PF 500V 2% DURA-MICA	763A209H13	ALL
C12	1MFD 50V 20% CERAMIC	3512A08H01	ALL
C13	1MFD 50V 20% CERAMIC	3512A08H01	ALL
C14	.1MFD 50VDC 20%	3509A34H03	ALL
C15	.01UF 50V 20% CERAMIC	3509A34H02	ALL
C16	.01UF 50V 20% CERAMIC	3509A34H02	ALL
C17	.01UF 50V 20% CERAMIC	3509A34H02	ALL
C18	.01UF 50V 20% CERAMIC	3509A34H02	ALL
C19	.01UF 50V 20% CERAMIC	3509A34H02	ALL
C20	.01UF 50V 20% CERAMIC	3509A34H02	ALL

CONNECTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
J1	64 PIN	1496B47H01	ALL

CRYSTALS

COMP LOC	DESCRIPTION	STYLE	GROUP
Y1	12000 KHZ.015%	879A920H08	ALL

DIODES

COMP LOC	DESCRIPTION	STYLE	GROUP
D1	IN914(DHD TYPE) SILICON	836A928H01	ALL
D2	IN914(DHD TYPE) SILICON	836A928H01	ALL
D3	IN914(DHD TYPE) SILICON	836A928H01	ALL
D4	IN914(DHD TYPE) SILICON	836A928H01	ALL
D5	IN914(DHD TYPE) SILICON	836A928H01	ALL
D6	IN914(DHD TYPE) SILICON	836A928H01	ALL
D7	IN914(DHD TYPE) SILICON	836A928H01	ALL
D8	IN914(DHD TYPE) SILICON	836A928H01	ALL
D9	IN914(DHD TYPE) SILICON	836A928H01	ALL

EPROMS

COMP LOC	DESCRIPTION	STYLE	GROUP
U16	2732	1496B49G01	ALL

INT CKTS

COMP LOC	DESCRIPTION	STYLE	GROUP
U01	LM258N DUAL OP AMP	9640A97H01	ALL
U2	MC14053BCP	3533A70H01	ALL
U03	MC14066BAL QUAD BILAT SWITCH	3527A09H06	ALL
U4	LM239AF QUAD COMP.	3524A65H01	ALL
U05	74HC86J	9450A86H52	ALL
U6	ADC0844BCJ A/D CONVERT/MULTPLX	9645A03H01	ALL

INT CKTS - continued

COMP LOC	DESCRIPTION	STYLE	GROUP
U7	MCE641CUSTOM CHIP	9449A34H51	ALL
U8	MCE641CUSTOM CHIP	9449A34H51	ALL
U9	MM74HC32N	9450A32H51	ALL
U10	LD8031AH 8 BIT MICRO COMPUTER	9449A37H53	ALL
U11	MM74HC374J	9450A74H51	ALL
U12	MC74HC273N	9450A65H01	ALL
U13	74HL244N	9450A44H51	ALL
U14	74HL244N	9450A44H51	ALL
U15	***NO ITEM DESCRIPTION***	9450A56H56	ALL

RES NETS

COMP LOC	DESCRIPTION	STYLE	GROUP
RN1	47.0K +/-2% SIP (4X)	3533A81H07	ALL
RN2	4 X 1K .25W 2%	3533A81H11	ALL
RN3	10K OHM 2% SIP (9X) RES NET	3532A91H03	ALL
RN4	10K OHM 2% SIP (9X) RES NET	3532A91H03	ALL
RN5	10K OHM 2% SIP (9X) RES NET	3532A91H03	ALL
RN6	10K OHM 2% SIP (9X) RES NET	3532A91H03	ALL

RESISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
R1	47.5K .25W 1% METAL FILM	3535A37H66	ALL
R2	47.5K .25W 1% METAL FILM	3535A37H66	ALL
R3	47.5K .25W 1% METAL FILM	3535A37H66	ALL
R4	1K .25W 1% METAL FILM	3535A38H01	ALL
R5	75.K .25W 1% METAL FILM	3535A37H85	ALL
R6	75.K .25W 1% METAL FILM	3535A37H85	ALL
R7	75.K .25W 1% METAL FILM	3535A37H85	ALL
R8	49.9K .25W 1% METAL FILM	3535A37H68	ALL
R9	2.4M .25W,5%	3535A41H58	ALL
R10	75.K .25W 1% METAL FILM	3535A37H85	ALL
R11	75.K .25W 1% METAL FILM	3535A37H85	ALL
R12	75.K .25W 1% METAL FILM	3535A37H85	ALL
R13	49.9K .25W 1% METAL FILM	3535A37H68	ALL
R14	2.4M .25W,5%	3535A41H58	ALL
R15	30.1K .25W 1% METAL FILM	3535A37H47	ALL
R16	6.81K .25W 1% METAL FILM	3535A38H81	ALL
R17	511K .25W 1% METAL FILM	3532A38H69	ALL
R18	3.09 MEG .25W 1% METAL FILM	3532A39H48	ALL
R19	75.K .25W 1% METAL FILM	3535A37H85	ALL
R20	75.K .25W 1% METAL FILM	3535A37H85	ALL
R21	75.K .25W 1% METAL FILM	3535A37H85	ALL
R22	49.9K .25W 1% METAL FILM	3535A37H68	ALL
R23	2.4M .25W,5%	3535A41H58	ALL
R24	10-OHM .25W 1% METAL FILM	3535A42H01	ALL
R25	47.5K .25W 1% METAL FILM	3535A37H66	ALL
R26	243K .25W 1% METAL FILM	3532A38H38	ALL
R27	35.7K .25W 1% METAL FILM	3535A37H54	ALL
R28	243K .25W 1% METAL FILM	3532A38H38	ALL
R29	35.7K .25W 1% METAL FILM	3535A37H54	ALL
R30	10K .25W 1% METAL FILM	3535A37H01	ALL
R31	750-OHM .25W 1% METAL FILM	3535A39H85	ALL
R32	12.1K .25W 1% METAL FILM	3535A37H09	ALL
R33	511K .25W 1% METAL FILM	3532A38H69	ALL
R34	750-OHM .25W 1% METAL FILM	3535A39H85	ALL
R35	5.11K .25W 1% METAL FILM	3535A38H69	ALL
R36	511K .25W 1% METAL FILM	3532A38H69	ALL
R37	243K .25W 1% METAL FILM	3532A38H38	ALL

RESISTORS - continued

COMP LOC	DESCRIPTION	STYLE	GROUP
R38	35.7K .25W 1% METAL FILM	3535A37H54	ALL
R39	243K .25W 1% METAL FILM	3532A38H38	ALL
R40	35.7K .25W 1% METAL FILM	3535A37H54	ALL
R41	243K .25W 1% METAL FILM	3532A38H38	ALL
R42	35.7K .25W 1% METAL FILM	3535A37H54	ALL
R43	243K .25W 1% METAL FILM	3532A38H38	ALL
R44	35.7K .25W 1% METAL FILM	3535A37H54	ALL

SOCKETS

COMP LOC	DESCRIPTION	STYLE	GROUP
SU1	8 PIN IC SOCKET	774B996H02	ALL
SU2	16 PIN IC SOCKET	774B996H03	ALL
SU3	14 PIN IC SOCKET	774B996H01	ALL
SU4	14 PIN IC SOCKET	774B996H01	ALL
SU5	14 PIN IC SOCKET	774B996H01	ALL
SU6	20 PIN IC SOCKET	1479B86H04	ALL
SU7	18 PIN IC SOCKET	1479B86H03	ALL
SU8	18 PIN IC SOCKET	1479B86H03	ALL
SU9	14 PIN IC SOCKET	774B996H01	ALL
SU10	40 PIN IC SOCKET	1479B86H01	ALL
SU11	20 PIN IC SOCKET	1479B86H04	ALL
SU12	20 PIN IC SOCKET	1479B86H04	ALL
SU13	20 PIN IC SOCKET	1479B86H04	ALL
SU14	20 PIN IC SOCKET	1479B86H04	ALL
SU15	20 PIN IC SOCKET	1479B86H04	ALL
SU16	24 PIN IC SOCKET	1479B86H02	ALL

TRANSISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
Q1	VN10KM N-MOSFET	9448A76H51	ALL
Q2	VN10KM N-MOSFET	9448A76H51	ALL
Q3	VN10KM N-MOSFET	9448A76H51	ALL

TRIMMERS

COMP LOC	DESCRIPTION	STYLE	GROUP
P1	10K .75W 10%	880A826H05	ALL
P2	10K .75W 10%	880A826H05	ALL
P3	10K .75W 10%	880A826H05	ALL

ZENERS

COMP LOC	DESCRIPTION	STYLE	GROUP
Z1	1N5265B 62V .5W	862A288H34	ALL
Z2	1N5265B 62V .5W	862A288H34	ALL
Z3	1N5265B 62V .5W	862A288H34	ALL
Z4	1N5265B 62V .5W	862A288H34	ALL
Z5	1N5265B 62V .5W	862A288H34	ALL
Z6	1N5265B 62V .5W	862A288H34	ALL

MOTHERBOARD 1603C22G01

CAPACITORS

COMP LOC	DESCRIPTION	STYLE	GROUP
C1	4.7 MFD 35V +10% TANTALUM	184A661H12	ALL
C1	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C2	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C3	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C4	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C5	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C6	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C7	.01MF 20%,3000V CERAMIC	3536A32H02	ALL

CAPACITORS - continued

COMP LOC	DESCRIPTION	STYLE	GROUPC8
	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C9	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C10	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C11	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C12	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C13	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C14	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C15	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C16	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C17	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C18	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C19	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C20	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C21	.01MF 20%,3000V CERAMIC	3536A32H02	ALL
C22	.01MF 20%,3000V CERAMIC	3536A32H02	ALL

CHOKES

COMP LOC	DESCRIPTION	STYLE	GROUP
L1	2.0MH 1.3MHZ 0.8A	3500A27H01	ALL
L2	2.0MH 1.3MHZ 0.8A	3500A27H01	ALL

CONNECTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
J1	32 PIN DIN CONNECT SD32-10204-100	9646A11H03	ALL
J2	64 PIN DIN	1496B47H02	ALL
J2	12 PIN 1100-1-112-04	3534A19H07	ALL
J3	32 PIN DIN CONNECT SD32-10204-100	9646A11H03	ALL

DIODES

COMP LOC	DESCRIPTION	STYLE	GROUP
D1	1N4148	836A928H06	ALL

INDICATORS

COMP LOC	DESCRIPTION	STYLE	GROUP
DS1	MAGNETIC TRIP INDICATOR	3509A53H03	ALL

RESISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
R3	1K .25W 1% METAL FILM	3535A38H01	ALL

TRANSFORMER MODULE 1603C23G01

CAPACITORS

COMP LOC	DESCRIPTION	STYLE	GROUP
C1	.1MFD +-5% 500V	184A663H14	ALL
C2	.1MFD +-5% 500V	184A663H14	ALL
C3	.1MFD +-5% 500V	184A663H14	ALL
C4	.1MFD +-5% 500V	184A663H14	ALL
C5	.1MFD +-5% 500V	184A663H14	ALL
C6	.1MFD +-5% 500V	184A663H14	ALL

CONNECTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
J1	32 PIN RIGHT ANGLE DIN CONNECT	9646A11H02	ALL

JUMPERS

COMP LOC	DESCRIPTION	STYLE	GROUP
W2	PLUG IN	3532A54H02	ALL
W4	PLUG IN	3532A54H02	ALL
W6	PLUG IN	3532A54H02	ALL

RESISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
R1	10K 1W +-5% CARBON	187A643H51	ALL
R2	10K 1W +-5% CARBON	187A643H51	ALL
R3	10K 1W +-5% CARBON	187A643H51	ALL
R4	10K 1W +-5% CARBON	187A643H51	ALL
R5	10K 1W +-5% CARBON	187A643H51	ALL
R6	10K 1W +-5% CARBON	187A643H51	ALL

TRANSFS

COMP LOC	DESCRIPTION	STYLE	GROUP
TX1	TRANSFORMER	1496B50H01	ALL
TX2	TRANSFORMER	1496B50H01	ALL
TX3	TRANSFORMER	1496B50H01	ALL

CONNECTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
J2	CONNECTOR 12 POS	3532A99H02	ALL

DISPLAY MODULE 1603C24G01

DIODES

COMP LOC	DESCRIPTION	STYLE	GROUP
DS2	MV5353 LED YELLOW	3532A41H04	ALL
D2	1N4148	836A928H06	ALL
DS3	MV5753 LED RED	3532A41H01	ALL
D3	1N4148	836A928H06	ALL

RES NETS

COMP LOC	DESCRIPTION	STYLE	GROUP
RN1	10K OHM 2% SIP (9X) RES NET	3532A91H03	ALL
RN2	10K OHM 2% SIP (9X) RES NET	3532A91H03	ALL

RESISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
R1	2.74K .25W 1% METAL FILM	3535A38H43	ALL
R2	4.75K .25W 1% METAL FILM	3535A38H66	ALL
R4	4.75K .25W 1% METAL FILM	3535A38H66	ALL
R5	2.74K .25W 1% METAL FILM	3535A38H43	ALL
R6	2.74K .25W 1% METAL FILM	3535A38H43	ALL

SOCKETS

COMP LOC	DESCRIPTION	STYLE	GROUP
DS2	LED SOCKET	9646A89H01	ALL
DS3	LED SOCKET	9646A89H01	ALL

SWITCHES

COMP LOC	DESCRIPTION	STYLE	GROUP
SW1	10 POS 1 POLE	1496B58H01	ALL
SW2	16 POS	1606C94H01	ALL
SW3	10 POS 1 POLE	1496B58H01	ALL
SW4	10 POS 1 POLE	1496B58H01	ALL
SW5	SPDT DIP SWITCH	9642A35H02	ALL
SW6	SPST PUSH BUTTON	9646A57H01	ALL

TRANSISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
Q1	2N2222ANPN	762A672H15	ALL
Q2	2N2222ANPN	762A672H15	ALL

POWER SUPPLY MODULE 1603C25G01

CAPACITORS

COMP LOC	DESCRIPTION	STYLE	GROUP
C1	47UF 250V 20% AL ELECTRO.	9645A13H09	01
C2	47UF 35V 10%	187A508H13	01
C3	.1MFD 100V +-20% CER	762A680H14	01
C4	.1MFD 100V +-20% CER	762A680H14	01
C5	150 MFD 35V 5%	880A363H12	01

CHOKES

COMP LOC	DESCRIPTION	STYLE	GROUP
L1	EC30HL35 16MH 200UA	9645A18H01	01
L2	4MH .32A	9645A18H02	01
L3	WEE-39000 39MH	9645A17H01	01

REED RELAYS

COMP LOC	DESCRIPTION	STYLE	GROUP
D1	1N5053	188A342H12	01
D2	IN4935 200V 1A	836A928H09	01
D3	1N4148	836A928H06	01
D4	IN4935 200V 1A	836A928H09	01
D5	1N4148	836A928H06	01
D6	1N4148	836A928H06	01

RELAYS

COMP LOC	DESCRIPTION	STYLE	GROUP
K6	.5 AMP PICKUP, FORM A	1442C62G01	01

RESISTORS

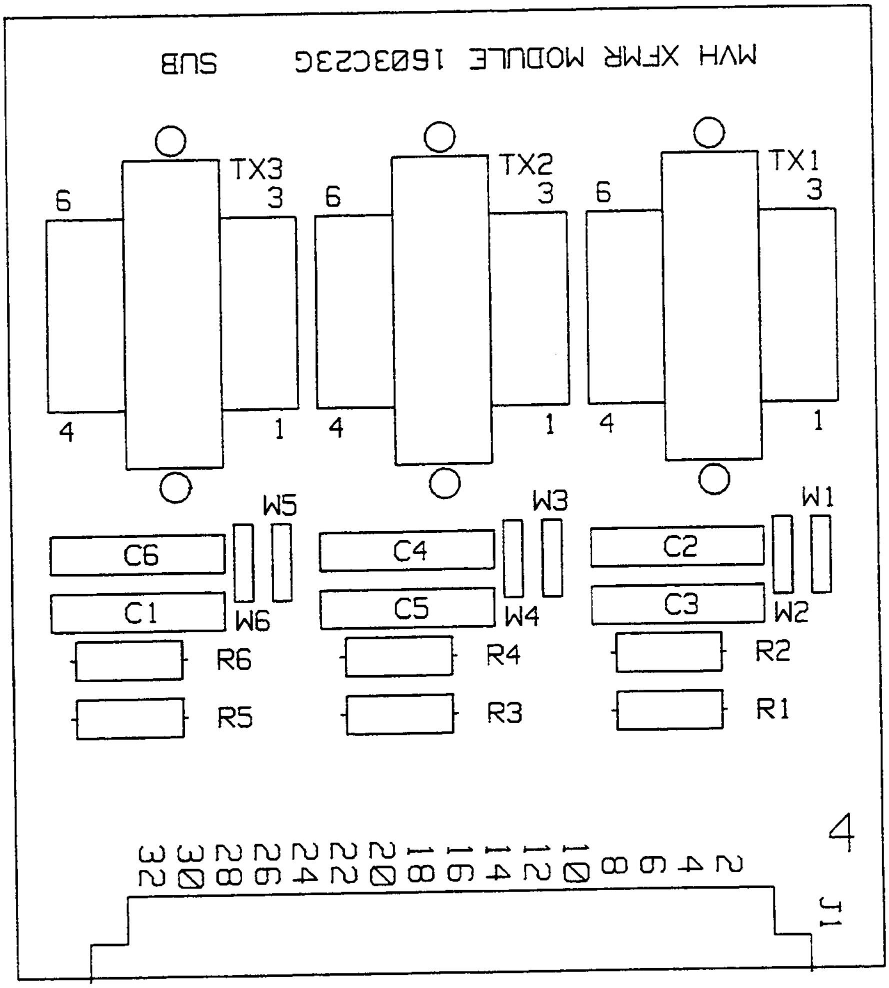
COMP LOC	DESCRIPTION	STYLE	GROUP
K1	FBR611D024	9645A10H02	01
K2	FBR611D024	9645A10H02	01
K3	FBR611D024	9645A10H02	01
K4	FBR611D024	9645A10H02	01
K5	FBR611D024	9645A10H02	01

TRANSISTORS

COMP LOC	DESCRIPTION	STYLE	GROUP
R1	30-OHM 1W 5% MOLDED COMP	629A371H12	01
R2	15K 1W 10% MOLDED COMP	187A644H55	01
R3	15K 1W 10% MOLDED COMP	187A644H55	01
R4	1K .25W 1% METAL FILM	3535A38H01	01
R5	10K .25W 1% METAL FILM	3535A37H01	01
R6	10K .25W 1% METAL FILM	3535A37H01	01
R7	2.74-OHM .25W 1% METAL FILM	3537A56H43	01
R8	2.43K .25W 1% METAL FILM	3535A38H38	01
R9	2.43K .25W 1% METAL FILM	3535A38H38	01

ZENERS

COMP LOC	DESCRIPTION	STYLE	GROUP
Q1	1RF720 400V 3A	9641A07H01	01
Q2	ZVN0535A,350 VOLT	9646A90H01	01
Q3	T1P116 80V 2A	3532A45H16	01



Sub 4
1496B06

Fig. 8 Component Location - Transformer Module

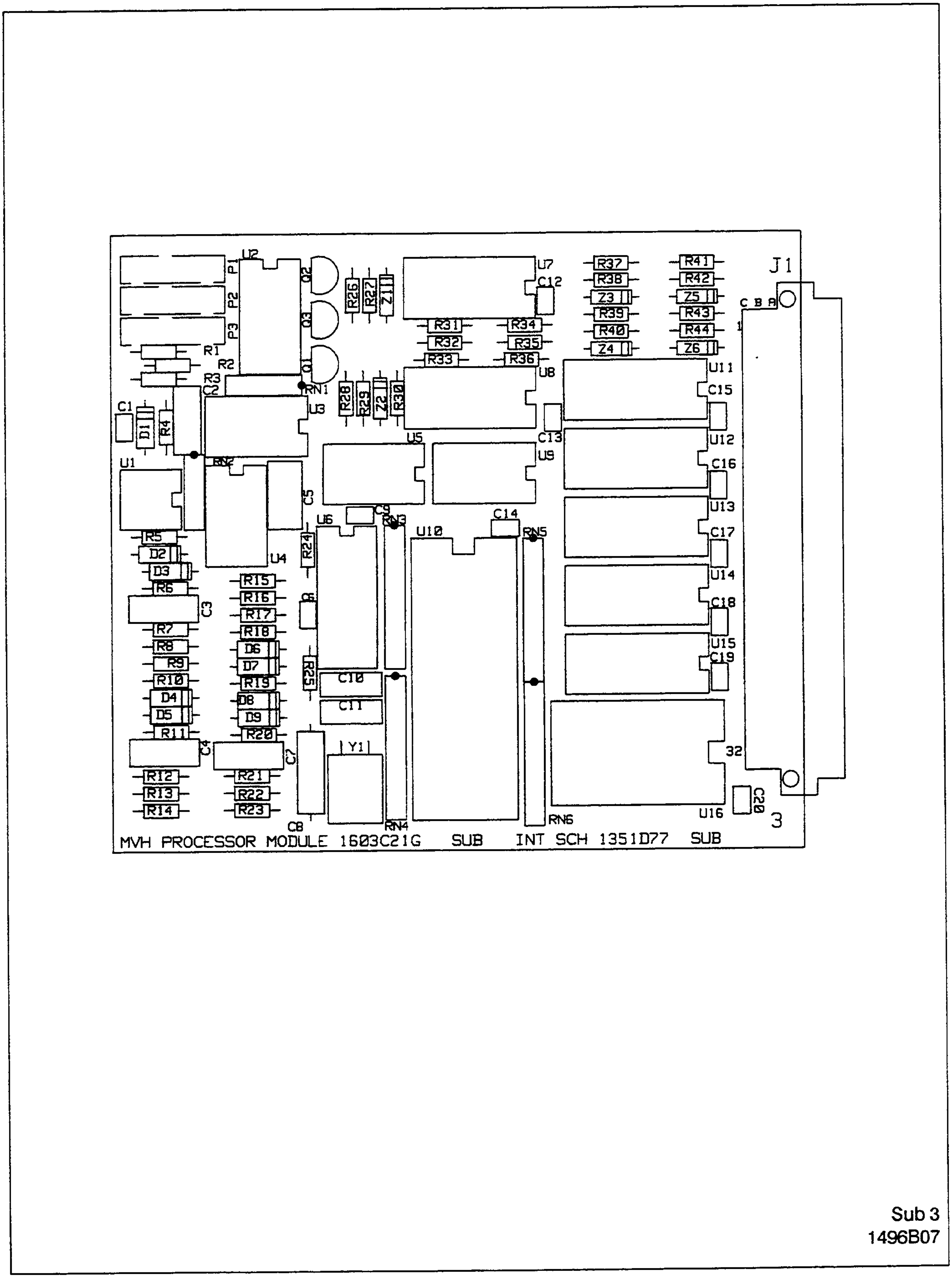
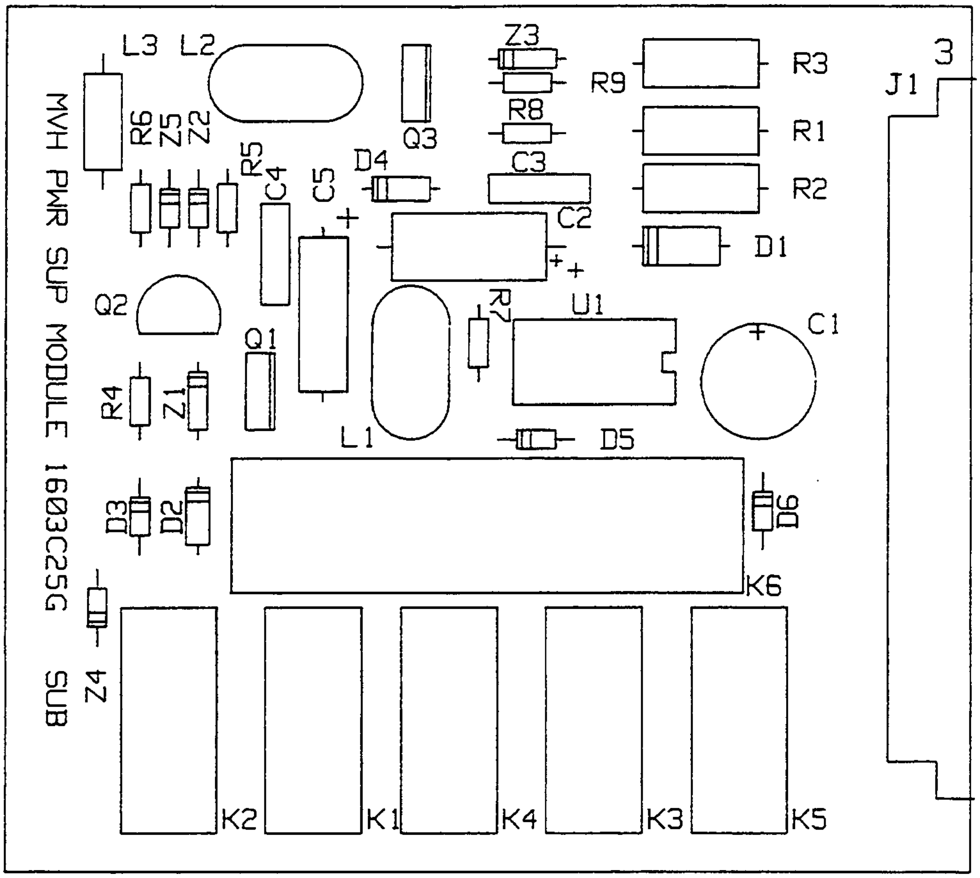
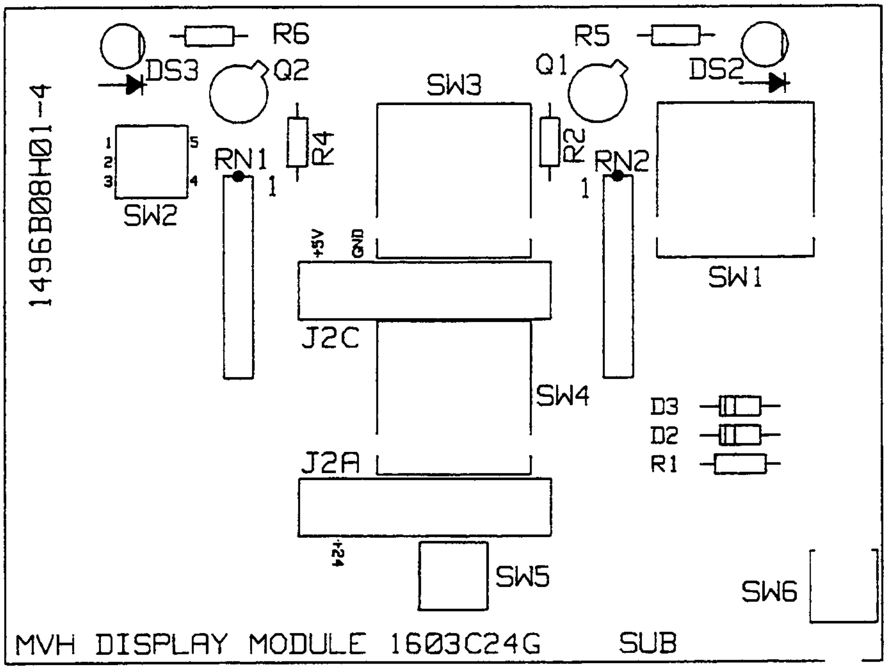


Fig. 9 Component Location - Processor Module



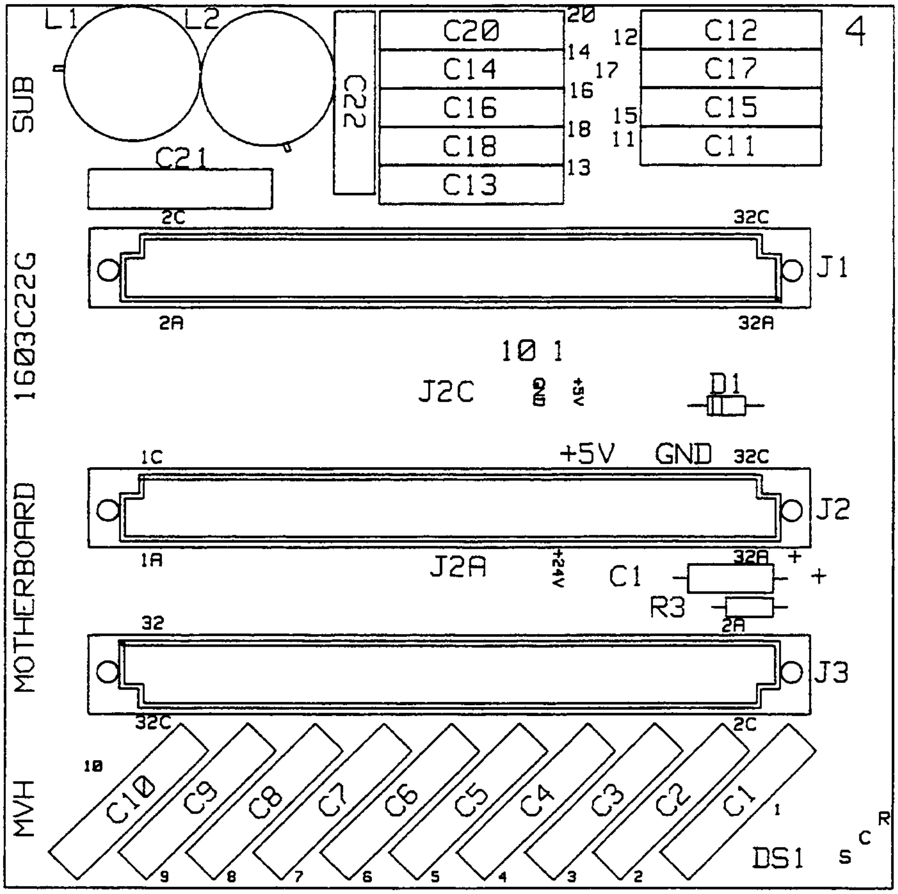
Sub. 3
1496B05

Fig. 10 Component Location - Power Supply Module



Sub. 4
1496B08

Fig. 11 Component Location - Display Module



Sub. 4
1496B09

Fig. 12 Component Location - Motherboard Module

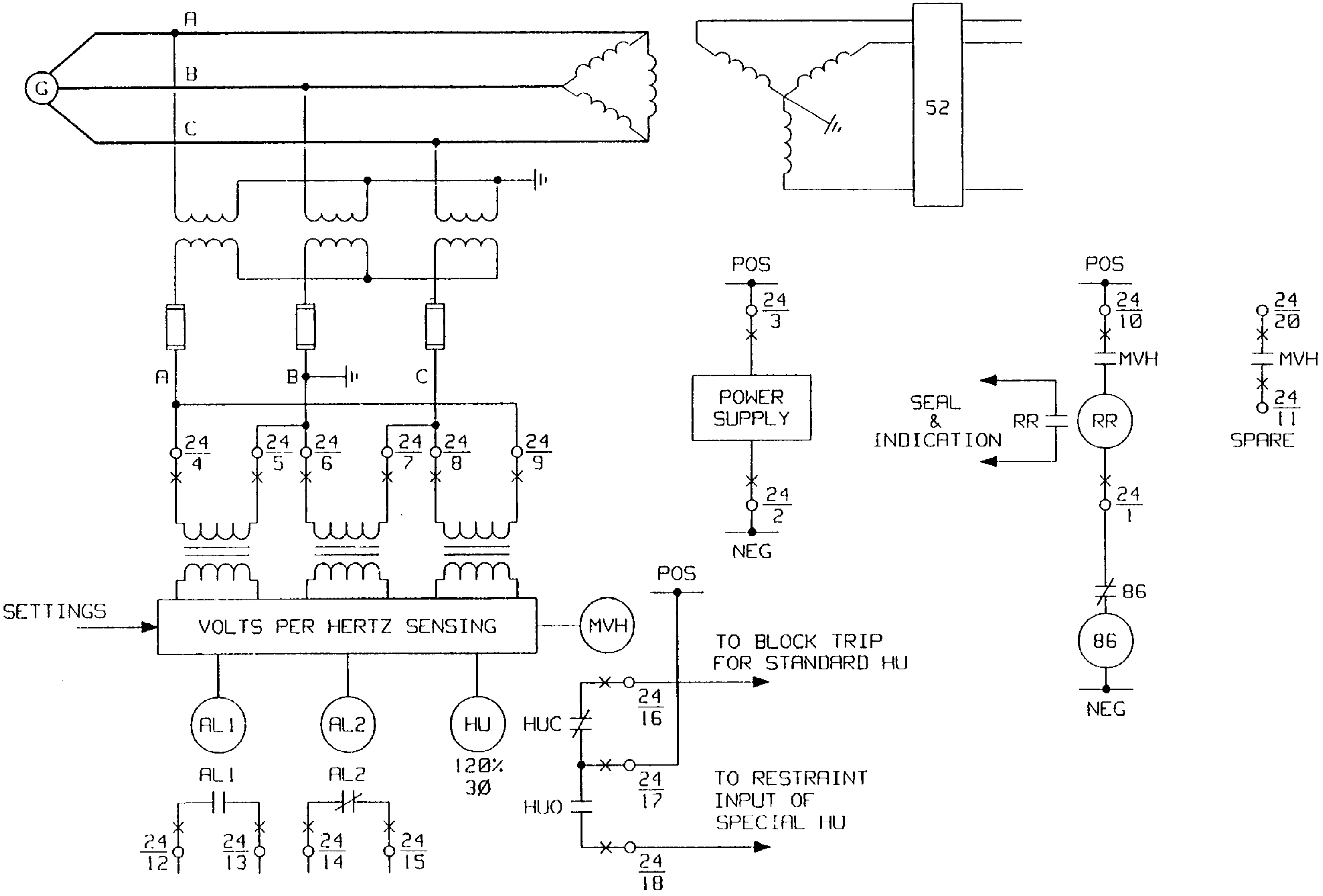


Fig. 13 External Schematic of the MVH Relay

Sub 2
1494B55

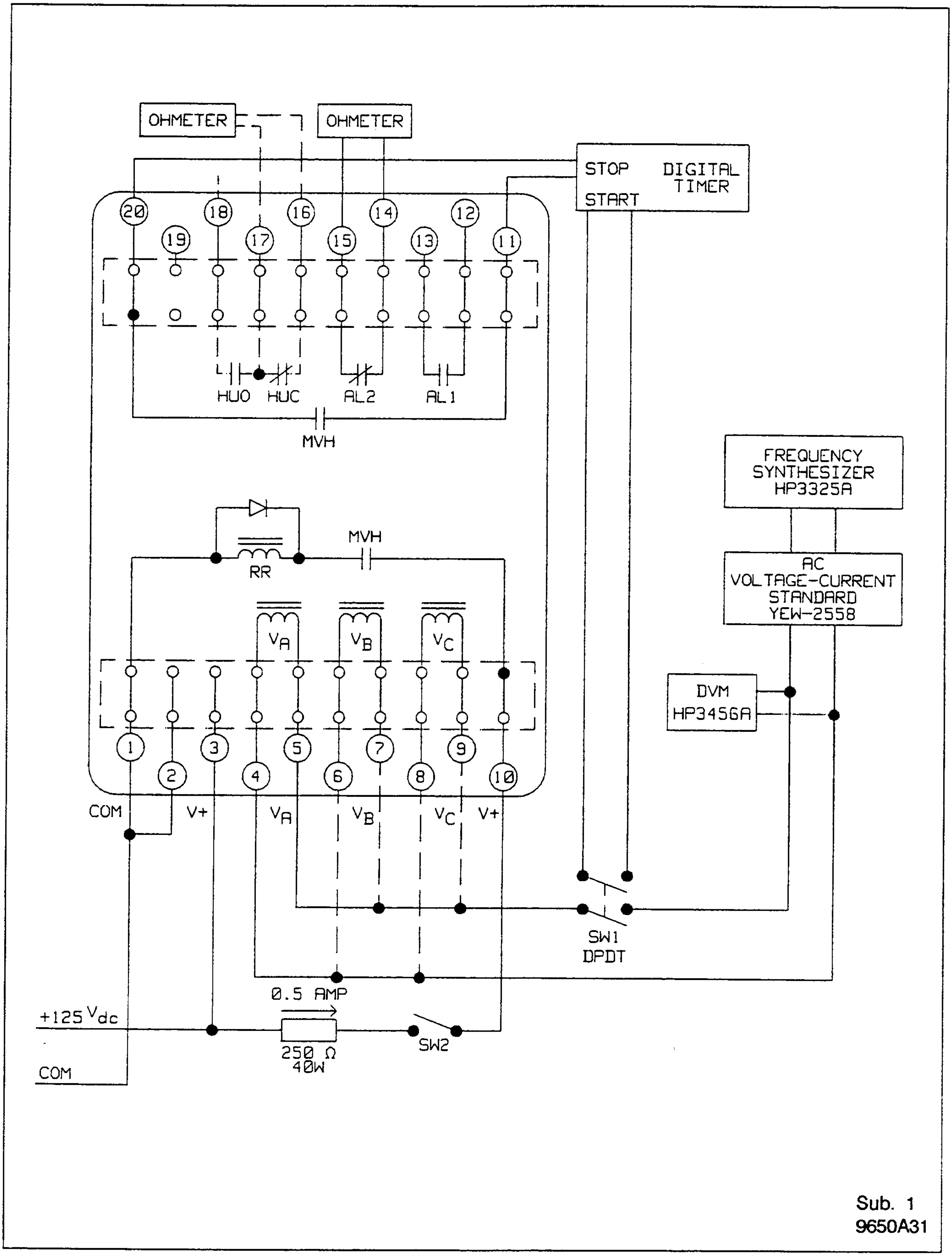


Fig. 14 Typical Test Diagram for Type MVH Relay

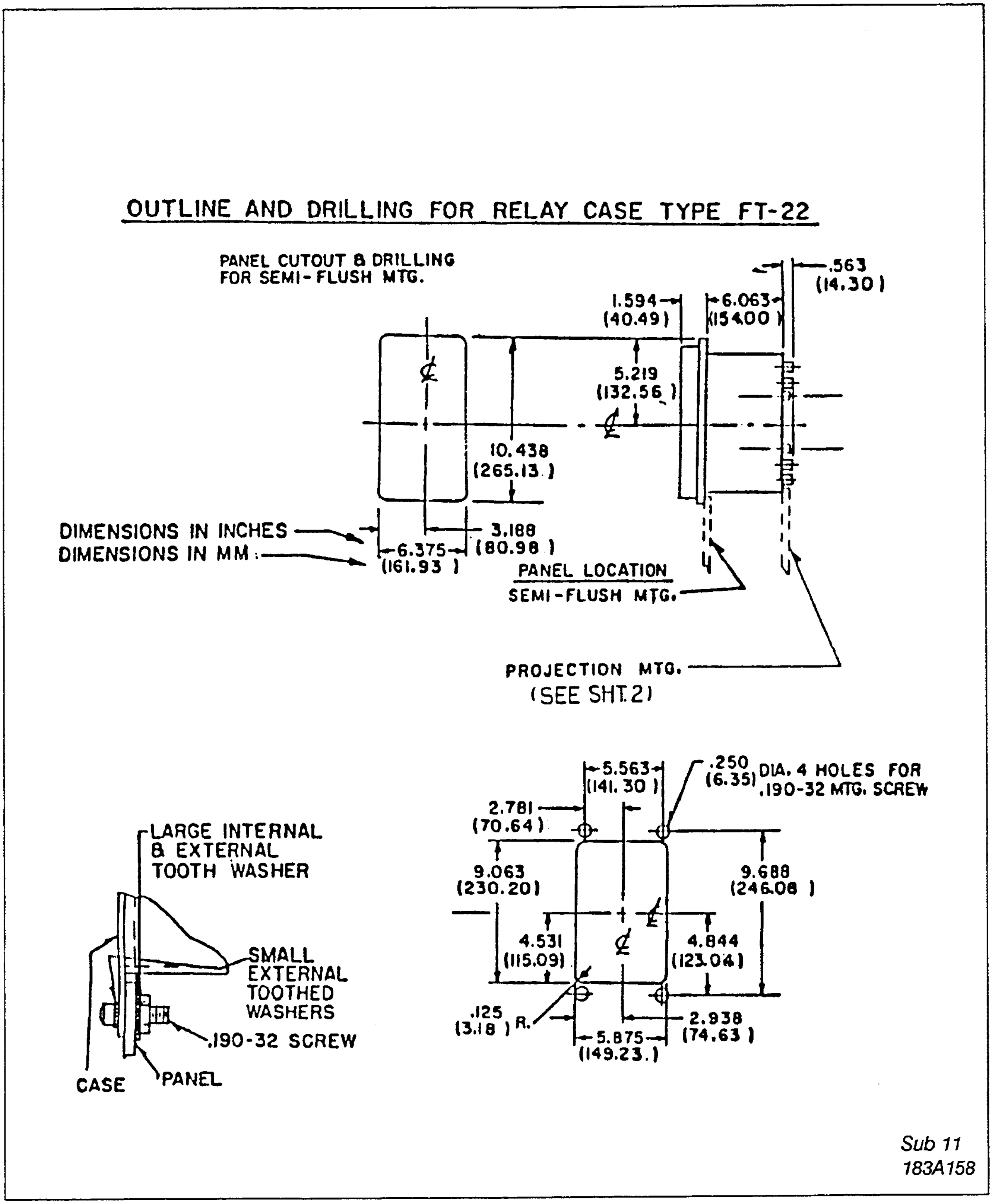


Fig. 15 Outline and Drilling Plan for the MVH Relay in FT-22 Case

ABB Network Partner

ABB Power T&D Company Inc.
4300 Coral Ridge Drive
Coral Springs Florida 33065
(954) 752-6700
FAX: (954) 345-5329

Printed in U.S.A.

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL 33065

Addendum to:
41-745A

Type MVH Microprocessor Volts Per Hertz Relay

Effective : May 1990

Add the following information to **Section 4, CHARACTERSITICS**:

The minimum and maximum allowable dc voltages for the three dc power supplies are as follows:

Nominal dc Supply	Range
48 Vdc	38 to 56 Vdc
125 Vdc	100 to 140 Vdc
250 Vdc	200 to 280 Vdc

Printed in U.S.A.