INSTRUCTION MANUAL

TC 952 HIGH VOLTAGE POWER SUPPLY

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1.0 INTRODUCTION

The TENNELEC Model TC 952 HIGH VOLTAGE POWER SUPPLY is a double-width NIM powered from the 115 VOLT AC line. The TC 952 incorporates state-of-the-art electronics to provide an extremely well regulated, low ripple output voltage. The output range of the TC 952 is ±1 to ±3000V at currents up to 10 mA. The TC 952 provides a continuous digital display of the output voltage.

To provide protection of fragile detectors, the TC 952 incorporates several protective features. The TC 952 incorporates overvoltage protection at a level 200 volts over the front panel controls and a maximum output voltage of 3300 volts. The rate of increase in the output voltage is controlled. The output current is limited to a level of approximately 12 mA.

In the event of a failure due to an overvoltage or overcurrent condition, the TC 952 will be disabled and the output voltage will decay to zero. The output voltage will be reset in approximately 7 seconds until the fault is cleared or after the TC 952 AC power is cycled off and on. The mode of high voltage reset is user selectable.

The TC 952 has external inputs allowing remote control of the output voltage and disable/enable operation. The external voltage control input has user selectable gains of -100V/V and -300V/V. The external disable input will disable the TC 952 regardless of any control settings.

2.0 SPECIFICATIONS

2.1 PERFORMANCE

OUTPUT VOLTAGE	±1V to ±3000V dc
OUTPUT POLARITY	Positive or negative, switch selectable
OUTPUT CURRENT	0 to 10 mA
OUTPUT RIPPLE	≤10mV pk-pk, 5Hz to 50 MHz (typically <2mV)

LINE and LOAD REGULATION	≤0.001% or 3 mV (whichever is greater) variation in output voltage for line and load changes within operating range (0 to 10mA output current 105 to 129 VAC input power)
TEMPERATURE COEFFICIENT	≤30ppm/°C 0 to 50°C (typically <10ppm/°C)
LONG-TERM STABILITY	≤0.001%/hr and ≤0.001%/24 hr period at constant line, load and temperature after a 10 minute warm up.
CALIBRATION ACCURACY	Output voltage will differ from front panel settings by less than 0.25%.
RESOLUTION	0.5V or better
RESETABILITY	Resetable to within 1V
DISPLAY ACCURACY	≤0.03% ± 1 LSD
DISPLAY TEMP. CO.	typically ≤30ppm/°C
DISPLAY STABILITY	typically ≤0.001%/hr and ≤0.001%/24 hr period at constant line, load and temperature after a 10 minute warm up.
OPERATING TEMPERATURE	0 to 50°C

2.2 CONTROLS

2.2.1 FRONT-PANEL CONTROLS

POWER Locking toggle switch for main ac power input. When in the ON position, the ac circuit is completed and power is applied to the module.

HIGH VOLTAGE Locking toggle switch for control of high voltage circuit. When in the OFF position, the high voltage circuit is disabled but power is applied to the low voltage section allowing the precision voltage references to remain at a stable operating temperature. When the HIGH VOLTAGE switch is in the ON position, the high voltage section is enabled.

0 to 1000V Ten-turn precision potentiometer with linear calibration from 0.0 to 1000 corresponding to output voltages of 0 to 1000V respectively.

VOLTS Five-position rotary switch selects the output voltage in steps of 500 volts from 0 to 2000V.

DISPLAY TEST Push button switch used to test operation of the TC 952 digital display. When DISPLAY TEST switch is pressed, the TC 952 digital display should indicate ±18888. The polarity indicated will correspond to the polarity of the output voltage.

2.2.2 INTERNAL CONTROLS

POLARITY Two-position slide switch (accessible through the module's side shield) selects either positive (POS) or negative (NEG) high voltage polarity. **Refer to Section 3.2 for instructions on changing the high voltage polarity.** The TC 952 is shipped with the POLARITY switch in the POS position.

EXTERNAL GAIN Two-position slide switch (accessible through the module's side shield) selects either -100V/V or -300V/V gain for the external control input.

RESET MODE Two-position slide switch (accessible through the module's side shield) selects either 7 second (7 SEC) or POWER ON reset mode of operation. When in the 7 SEC position, the TC 952 will recover from a fault condition and restore normal operation approximately 7 seconds after a fault condition was sensed. If the initial fault was not cleared, the

TC 952 will continue resetting approximately every 7 seconds until the fault is cleared. When the TC 952 is operated in the POWER ON position, the TC 952 will not recover from a sensed fault condition until the ac power is removed for a minimum of at least 2 seconds and reapplied. Note that the RESET MODE operates on sensed faults and not on the EXTERNAL DISABLE signal.

OVER VOLTAGE PROTECT Two-position slide switch (accessible through the module's side shield) selects either ON or OFF for the OVER VOLTAGE PROTECT feature. When in the ON position, the maximum output voltage is limited to approximately 200 volts over the TC 952 front-panel control settings or a maximum of 3300 volts. If the TC 952 front-panel control settings are set to produce +1000V, the maximum output voltage for any internal fault is +1200V. Operation with an external VOLTAGE CONTROL signal to produce +1000V will result in a maximum output voltage of +1200V for any internal fault. If the TC 952 is operated at maximum output voltage ±3000V, the maximum output voltage, due to an internal fault is ±3200V. When using the external VOLTAGE CONTROL input, the maximum output voltage, due to an internal fault is ±3200V. The maximum output voltage, due to excessive external control voltage, is ±3300V. If the OVERVOLTAGE PROTECT switch is set to the OFF position, external VOLTAGE CONTROL inputs could generate excessive output voltages if not limited to the level required to produce ±3000V output levels (30V for the -100V/V range and 10V for the -300V/V range).

2.2.3 REAR PANEL CONTROLS

VOLTAGE CONTROL Two-position toggle switch selects internal (INT) or external (EXT) voltage control. When the INT mode is selected, no external VOLTAGE CONTROL inputs are accepted. If the EXT voltage control mode is selected, the output voltage is determined by the external VOLTAGE CONTROL signal, the EXTERNAL GAIN setting and the front-panel control settings.

LINE VOLTAGE SELECT Two-position slide switch selects 115V ac operation or 230V ac operation.

2.3 CONNECTORS

2.3.1 REAR PANEL CONNECTORS

OUTPUT Four SHV type connectors provide ±1V to ±3000V output voltage. All four connectors are wired in parallel. The connectors are isolated from the TC 952 Rear Panel to aid in the prevention of ground loops.

DISABLE BNC type connector that accepts a NIM positive logic zero, or a short to ground, to disable the high voltage section. A NIM positive logic high, or an open circuit, is used to enable the high voltage section.

2.4 INDICATORS

2.4.1 FRONT PANEL INDICATORS

POWER Red LED is illuminated when the POWER switch is set to ON and ac power is applied.

HIGH VOLTAGE Red LED is illuminated when the HIGH VOLTAGE switch is set to ON.

DISABLE Red LED is illuminated to indicate that the TC 952 high voltage section is disabled. The disable signal can be externally or internally generated.

OUTPUT POLARITY Two green LEDs to indicate output polarity selected. The LEDs indicate the polarity selected regardless of the position of the HIGH VOLTAGE switch to allow verification of the correct polarity before applying high voltage to a detector.

2.4.2 FRONT PANEL DIGITAL DISPLAY

The TC 952 digital display is a 4 1/2 digit voltmeter with polarity indication. The digital voltmeter monitors the actual output voltage of the TC 952 through a 1×10^4:1 divider network. The accuracy of the digital voltmeter is .03% ± 1 least significant digit. This would result in a worse case error of ±2V at 3000V and ±1V error at 1000V. The temperature stability of the digital voltmeter is not as good as the temperature stability of the output voltage. Any drift in the output voltage as indicated by the digital display is probably due to the instability of the digital voltmeter. Typically, the TC 952 output

voltage will drift less than 0.7 volt at a setting of 3000V over a 0°C to 55°C change (=4.2ppm/°C). The TC 952 digital display will typically show a change of 2 to 3 volts out of 3000V for the same temperature change (12 to 18ppm/°C).

2.5 POWER REQUIREMENTS

All power is obtained from the ac power line via captive 3-prong NEMA line cord; maximum current is 1.0A.

2.6 OTHER INFORMATION

WEIGHT	(Shipping)	10 lbs.	(4.54 kg)
	(Net)	8 lbs.	(3.64 kg)

DIMENSIONS Standard double-width NIM module (2.70 x 8.714 in.) per TID 20893 (Rev.).

INSTRUCTION MANUAL One provided with each instrument ordered.

3.0 INSTALLATION

3.1 GENERAL

The TC 952 HIGH VOLTAGE SUPPLY is normally used in conjunction with other NIMs comprising a system. The TC 952 may be installed in a TB3/TC 911 BIN and POWER SUPPLY or may be operated directly on an equipment support area such as a bench. The BIN and POWER SUPPLY is intended for rack mounting. When using the TC 952 in a rack mounted system, superior temperature stability will be obtained if an adequate flow of air is maintained to prevent the module from developing "hot" spots due to uneven air flow. If the TC 952 is operated at the full output voltage and full load current, the ambient air circulating to instruments above the TC 952 may exceed 50°C.

3.2 POLARITY SELECTION

The polarity of the output voltage is selected by a two position switch accessible through the side shield. The switch positions are labled on the side shield. In the event the side shield is lost or replaced with a

standard side shield, the switch positions are labled on the printed circuit board. When changing the output polarity always follow the procedure below. Failure to do so may damage the TC 952 and void the warranty.

TO CHANGE THE OUTPUT POLARITY:

1) REDUCE DIAL SETTINGS TO ZERO.
2) SET HIGH VOLTAGE SWITCH TO OFF.
3) VERIFY OUTPUT VOLTAGE IS ZERO AS INDICATED BY THE FRONT PANEL DISPLAY.
4) SET POWER SWITCH TO OFF.
5) SET HIGH VOLTAGE POLARITY SWITCH TO CORRECT POSITION.

3.3 POWER CONNECTION

The TC 952 obtains its operating power from the ac power line by way of a 3 wire captive line cord with a standard NEMA male connector. A rear panel slide switch permits the selection of the proper input circuit for either 115V or 230V ac nominal power input. Before connecting the TC 952 to ac power, set the front panel POWER and HIGH VOLTAGE switches to OFF. When the POWER switch is set to ON, the selected output polarity will be indicated by the appropriate OUTPUT POLARITY LED before high voltage is actually supplied from the output connectors. Before setting the HIGH VOLTAGE switch to ON, verify the 0 to 1000V dial and the VOLTS switch are set to 0. When the HIGH VOLTAGE switch is set to ON, the high voltage section is enabled and the output voltage can be set to the desired value. Due to the 7 second RESET feature of the TC 952, if the HIGH VOLTAGE switch is set to ON immediately after the POWER switch is set to ON, the high voltage section will be disabled for approximately 7 seconds as indicated by the DISABLE LED. The 7 second turn on delay is normal. If the HIGH VOLTAGE switch is set to ON after a minimum delay of 7 seconds since the POWER switch was set to ON, the high voltage section is enabled immediately.

3.4 OUTPUT CONNECTIONS

The TC 952 HIGH VOLTAGE SUPPLY is compatible with all TENNELEC preamplifiers that include provisions to accept the high voltage bias for the detector. The output cables will require SHV type connectors at each end (For example, Tennelec model NC-595-12 cable).

4.0 OPERATION

4.1 FIRST TIME OPERATION

Users will find it helpful to familiarize themselves with the TC 952 HIGH VOLTAGE SUPPLY by conducting a few simple tests.

4.1.1 CONTROL SETTINGS

Set the TC 952 controls as follows:

FRONT PANEL	
POWER	OFF
HIGH VOLTAGE	OFF
0 to 1000V	0
VOLTS	0

REAR PANEL	
VOLTAGE CONTROL	INT
LINE VOLTAGE SELECT	SET ACCORDING TO LINE VOLTAGE AVAILABLE

INTERNAL CONTROLS (accessible through the side shield)

OVER VOLTAGE PROT.	ON
RESET MODE	7 SEC
HIGH VOLTAGE POLARITY	AS DESIRED
EXTERNAL GAIN	100V/V

4.1.2 POWER SUPPLY OPERATION

Connect the TC 952 to a source of ac power and set the POWER switch to ON. Verify that the DISABLE LED and POWER LEDs are illuminated. The digital display should indicate ±0000 ±1. Press DISABLE TEST switch on the TC 952 Front Panel. The digital display should indicate ±18888.

Set the TC 952 voltage controls to the desired value. Set the HIGH VOLTAGE switch to ON. The output voltage, as indicated on the digital display should immediately begin increasing toward the set value.

To verify operation of the 7 second delay at turn on, reduce the output voltage to zero. Reduction of the output voltage to zero can be accomplished by setting the HIGH VOLTAGE switch to OFF. Do not reduce voltage control settings. After the output voltage reaches 10V

or less, set the POWER switch to OFF and the HIGH VOLTAGE switch to ON. Set the POWER switch to ON. Note that the TC 952 DISABLE LED is illuminated for approximately 7 seconds and the output voltage does not increase until the DISABLE led is extinguished.

To verify operation of the OVER VOLTAGE PROTECT feature, quickly reduce the voltage by at least 500V using the VOLT control (1 switch position reduction). The DISABLE LED will be illuminated and the output voltage will decay toward zero. The TC 952 will recover in approximately 7 seconds.

Set the RESET MODE switch to POWER ON. Verify that the output voltage is at the desired level. Quickly reduce the VOLT control by at least 1 switch position (500V output reduction). The DISABLE LED should be illuminated, the output voltage will decay to zero and the TC 952 will not reset. To initiate reset, set the POWER switch to OFF, wait 2 seconds or longer, and return the POWER switch to the ON position. After approximately 7 seconds, the DISABLE LED will extinguish and the TC 952 output voltage will increase to the set value.

Set the OVER VOLTAGE PROTECT switch to OFF. Quickly reduce the VOLT control by at least 1 switch position (500V output reduction). The DISABLE LED should not be illuminated and the output voltage should decay to the set value.

Return the OVER VOLTAGE PROTECT switch to ON. Return the RESET MODE to 7 SEC.

4.1.3 EXTERNAL CONTROL

Verification of operation using an external voltage source requires a stable low ripple dc voltage source. Note that any low frequency noise present in the external control voltage will be amplified by the selected gain factor. The gain factors are -100V/V and -300V/V.

To operate under external voltage control, the TC 952 HIGH VOLTAGE POLARITY switch must be set for the desired output polarity. The required control voltage is the opposite polarity of the output polarity. The TC 952 is basically an inverting operational amplifier (op-amp) with a gain of -100V/V or -300V/V.

The TC 952 front panel VOLT and 0 to 1000V controls are not disabled when operating under external voltage control. This enables the user to preset a minimum voltage via the front panel controls or vary the voltage around a fixed point as set on the TC 952 front panel. In general, if the external control voltage is used, the TC 952 front panel controls should be set to zero. This will result in less confusion.

With the TC 952 set for POS polarity and the front panel controls set for 0V, a -5V dc input signal will produce a +500V output in the -100V/V EXT GAIN position. The -5V dc input will produce a +1500V output in the -300V/V EXT GAIN position. If the TC 952 Front Panel VOLTS control and the 0 to 1000V dial are set for other than 0, the actual output voltage is the sum of the front panel settings and the output voltage due to the external input voltage.

4.1.4 REMOTE DISABLE

The TC 952 rear panel DISABLE input is designed to provide normal operation for a NIM positive logic 1 or an open input. The DISABLE input will inhibit operation of the TC 952 for a short to ground or a NIM positive logic zero. Operation of the DISABLE input can be verified by shorting the input to ground by using a BNC terminator such as a 50 ohm or 100 ohm terminator.

4.2 DETECTOR CONNECTION

CAUTION

Always set the TC 952 front panel voltage controls to 0, the HIGH VOLTAGE switch to ON, and verify the output voltage is zero using the digital display before connecting the cable to or disconnecting it from the preamplifier. It is recommended to leave the HIGH VOLTAGE switch ON when connecting the system due to overshoot present when operating at low bias voltages (75V and below). The overshoot is due to system delay and is only significant at 75V and below. This overshoot is present only when the HIGH VOLTAGE switch is set from OFF to ON. No overshoot is present when adjusting the voltage up from 0V output.

After the HIGH VOLTAGE switch is set to ON and the output voltage is set at the desired level, allow approximately 20 minutes for high voltage stressing of the output filter capacitors before attempting to take data with high resolution systems.

When using the TC 952 as a bias supply for detectors that require a bias voltage of 1000V or less, use the 0 to 1000V dial and gradually increase the bias voltage to the correct operating potential.

For detectors that require a bias voltage of greater than 1000V, increase the detector bias voltage in 500V steps using the VOLTS control until the bias voltage is within 1000V or less of the correct operating potential. Use the 0 to 1000V dial to gradually increase the bias voltage to the correct operating potential.

4.3 LOADING EFFECTS

The TC 952 is, in effect, an inverting op-amp and as such has a low output impedance. The feedback signal is taken directly at the output and the output impedance is approximately zero. The output voltage is only a mild function of load, less than .001%, (typically less than .0003%) for a 0 to 10 mA change in output current. The voltage indicated by the front panel digital display is measured directly at the output.

To determine the actual voltage on a detector, the resistance between the output of the TC 952 and the detector itself must be identified. Since the bias voltage is usually supplied through a detector load resistor in the preamplifier and then to the detector, the resistance can usually be determined from the preamplifier schematic. The actual detector voltage (V_{DET}) can then be determined by

$$V_{DET} = Vo_{TC\ 952} - I_{DET}R_L$$

where I_{DET} is the detector leakage current and R_L is detector load resistor (total series resistance between the TC 952 output and the detector).

5.0 CIRCUIT DESCRIPTION

Figure 5.1 is a simplified block diagram of the TC 952. A schematic is included at the back of the manual.

The TC 952 requires an ac power input regardless of use of an internal or external voltage control reference.

The input ac power is reduced to a lower ac voltage via transformer, rectified, filtered and then regulated to the proper internal supply voltages. One low voltage ac secondary is rectified, filtered and supplied to a low voltage switching power supply.

The basic configuration of the TC 952 is an inverting op amp. The forward gain elements consist of an op amp (IC1), a switching regulator (SR1, used as a minor feedback loop) a converter transformer (T1), a voltage doubler and polarity circuit (V_{D1}) and a low-pass filter. The feedback resistor is R1. The input resistor is R2. The overall gain from the reference voltage to the output is . The value of R_1 is nominally 10M ohm. The value of R_2 is 25k ohm. The reference voltage is varied from 0 to -7.5V for the positive output polarity and from 0 to +7.5V for the negative output polarity.

The current switched by Q1 and Q2 is related to the output current and is monitored by a comparator. When the output current level is greater than 12mA, the comparator disables the OSCILLATOR and the low voltage switcher for either 7 seconds or until a power on reset occurs (selected by user).

The output voltage is monitored by the DVM through a resistive divider. This signal is also monitored by the low voltage switcher. Whenever the output voltage is 200 Volts greater than the voltage set by the front panel controls, the exernal control input or 3300V, the OSCILLATOR and low voltage switcher are disabled.

The temperature stability of the output voltage is determined by the temperature stability of the reference voltage and the ratio tracking of R_1 and R_2.

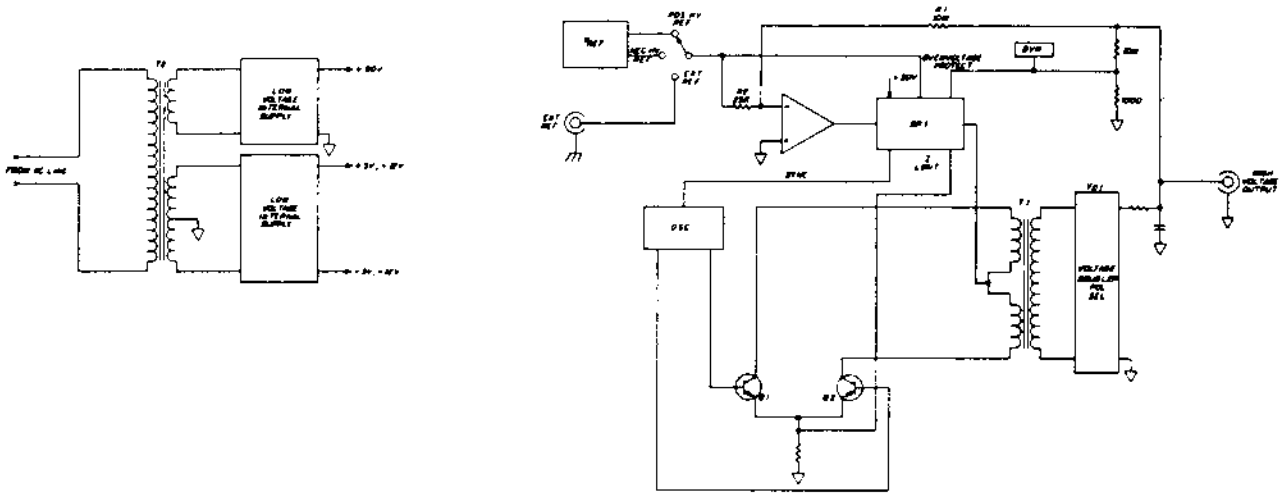


Figure 5.1

6.0 MAINTENANCE

The TC 952 is a highly stable and precision power supply. Periodic calibration or adjustment is not necessary and is not recommended as a routine procedure. Precise measurement of the TC 952's performance requires specialized and expensive test equipment. If trouble with the TC 952 should arise, it is strongly recommended that the unit be returned to TENNELEC for repair. If it is impossible to return the TC 952 to TENNELEC for repair, a detailed Test Procedure is available upon request. Observe the following procedure before removing the TC 952 side shields.

CAUTION

DANGEROUS VOLTAGES & CURRENTS EXIST INSIDE THIS INSTRUMENT. BEFORE REMOVING SIDE SHIELD:

1) REDUCE DIAL SETTINGS TO ZERO
2) SET HIGH VOLTAGE SWITCH TO OFF
3) VERIFY OUTPUT VOLTAGE IS ZERO AS INDICATED BY THE FRONT PANEL DISPLAY
4) SET POWER SWITCH TO OFF
5) DISCONNECT UNIT FROM AC LINE
6) WAIT 10 SECONDS BEFORE REMOVING SIDE SHIELDS

THE HIGH VOLTAGES PRESENT IN THIS INSTRUMENT ARE HAZARDOUS. DO NOT ATTEMPT ANY ADJUSTMENTS OR MAINTENANCE UNLESS YOU ARE EXPERIENCED WITH HIGH VOLTAGE CIRCUITS.

7.0 SHIPPING DAMAGE

Upon receipt of the instrument, examine it for shipping damage. Damage claims should be filed with the carrier. The claims agent should receive a full report: a copy of that report should be sent to TENNELEC, Inc., P.O. Box 2560, Oak Ridge, Tennessee 37830-2560. The model number and serial number of the instrument must be included in the report. Any remedial action taken by TENNELEC, Inc., will be based on the information contained in this report.

8.0 SERVICING

In the event of a component failure, replacement may be done in the field or the instrument may be returned to our plant for repair. There will be no charge for repairs that fall within the warranty except for one-way postage charges.

9.0 WARRANTY

In connection with TENNELEC's warranty (inside front cover), TENNELEC suggests that if a fault develops, the customer should immediately notify the TENNELEC Customer Service Manager. He may be able to prescribe repairs and send replacement parts which will enable you to get the instrument operating sooner and at less expense than if you returned it.

Should return prove necessary, the TENNELEC Customer Service Manager must be informed in WRITING, BY CABLE or TWX of the nature of the fault and the model number and serial number of the instrument. Pack the instrument well and ship PREPAID and INSURED to TENNELEC, Inc., 601 Oak Ridge Turnpike, Oak Ridge, Tennessee 37830-2560. As stated in the warranty DAMAGE IN TRANSIT WILL BE REPAIRED AT THE SENDER's EXPENSE as will damage that obviously resulted from abuse or misuse of the instrument.

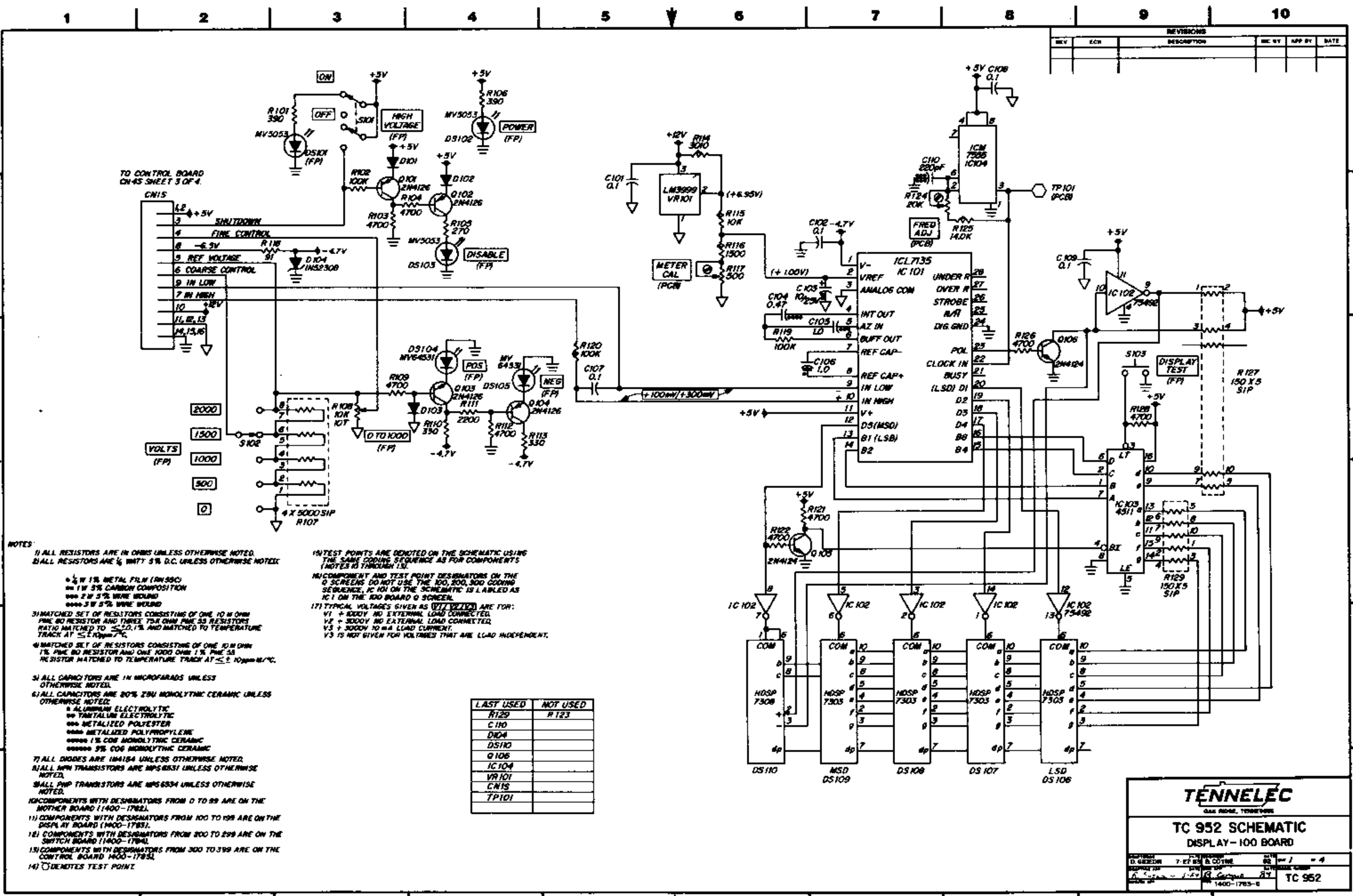
Quotations for repair of such damage will be sent for your approval before repair is undertaken.

TENNELEC'S Quality Assurance Program requires that each and every instrument be fully aged, vibrated, and electronically checked.

Should the user require a copy of the Quality Control Procedure and Test Record, please call the Customer Service Department of TENNELEC. Both model number and Serial number are required.

MANUAL REV. 0

9/83 - Engineering and component improvements may be made after date of printing.



NOTES:

1) ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE NOTED.
2) ALL RESISTORS ARE ¼ WATT 5% D.C. UNLESS OTHERWISE NOTED:

- * ¼ W 1% METAL FILM (RN55C)
- ** 1 W 5% CARBON COMPOSITION
- *** 2 W 5% WIRE WOUND
- **** 3 W 5% WIRE WOUND

3) MATCHED SET OF RESISTORS CONSISTING OF ONE 10 M OHM PME 80 RESISTOR AND THREE 75K OHM PME 55 RESISTORS RATIO MATCHED TO ≤ ±0.1% AND MATCHED TO TEMPERATURE TRACK AT ≤ ± 10ppm/°C.
4) MATCHED SET OF RESISTORS CONSISTING OF ONE 10 M OHM 1% PME 80 RESISTOR AND ONE 1000 OHM 1% PME 55 RESISTOR MATCHED TO TEMPERATURE TRACK AT ≤ ± 10ppm/°C.
5) ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
6) ALL CAPACITORS ARE 20% Z5U MONOLYTHIC CERAMIC UNLESS OTHERWISE NOTED:

- * ALUMINUM ELECTROLYTIC
- ** TANTALUM ELECTROLYTIC
- *** METALIZED POLYESTER
- **** METALIZED POLYPROPYLENE
- ***** 1% COG MONOLYTHIC CERAMIC
- ****** 5% COG MONOLYTHIC CERAMIC

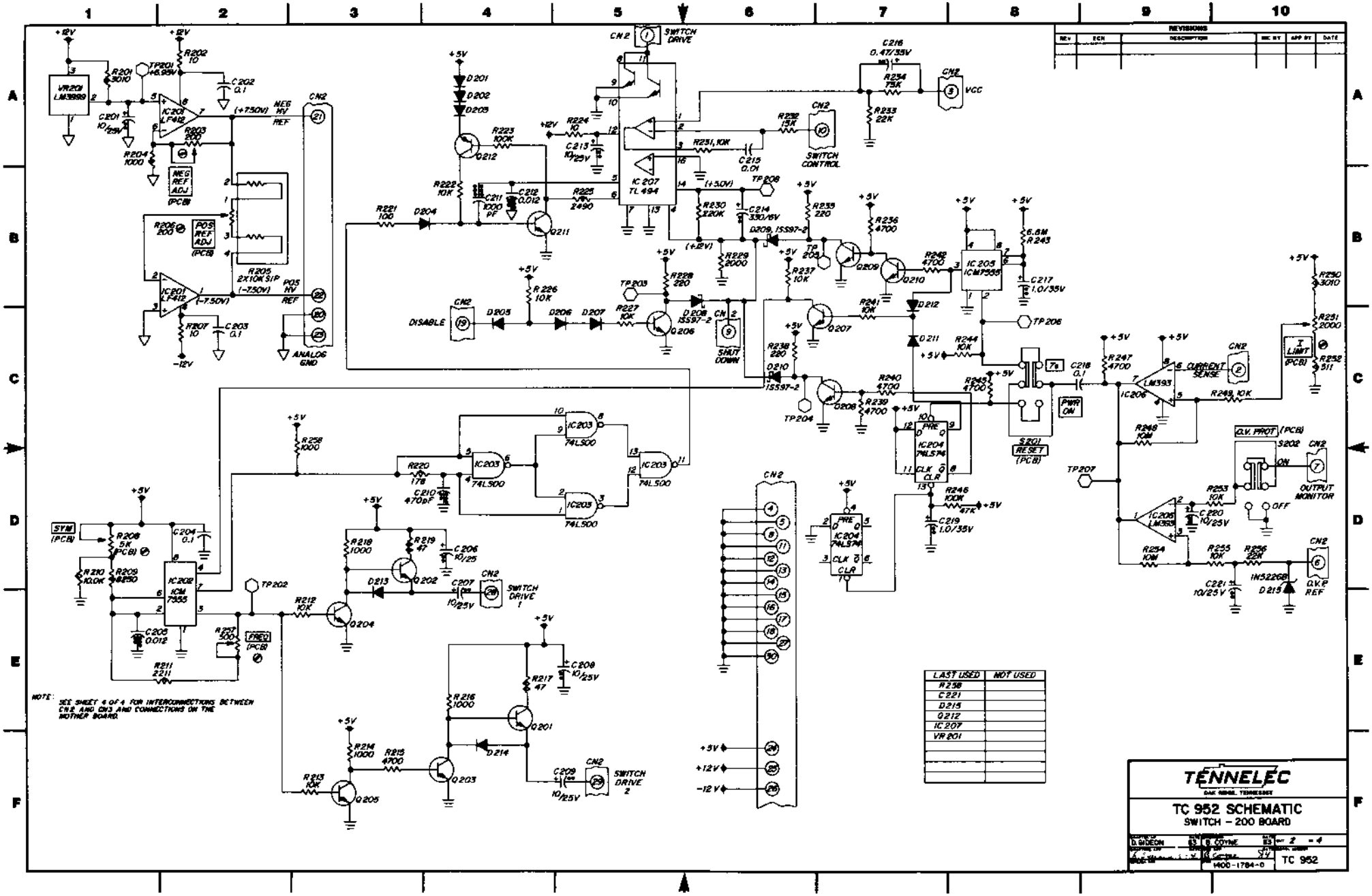
7) ALL DIODES ARE 1N4154 UNLESS OTHERWISE NOTED.
8) ALL NPN TRANSISTORS ARE MPS6531 UNLESS OTHERWISE NOTED.
9) ALL PNP TRANSISTORS ARE MPS6534 UNLESS OTHERWISE NOTED.
10) COMPONENTS WITH DESIGNATORS FROM 0 TO 99 ARE ON THE MOTHER BOARD (1400-1782).
11) COMPONENTS WITH DESIGNATORS FROM 100 TO 199 ARE ON THE DISPLAY BOARD (1400-1783).
12) COMPONENTS WITH DESIGNATORS FROM 200 TO 299 ARE ON THE SWITCH BOARD (1400-1784).
13) COMPONENTS WITH DESIGNATORS FROM 300 TO 399 ARE ON THE CONTROL BOARD 1400-1785.
14) ○ DENOTES TEST POINT.
15) TEST POINTS ARE DENOTED ON THE SCHEMATIC USING THE SAME CODING SEQUENCE AS FOR COMPONENTS (NOTES 10 THROUGH 13).
16) COMPONENT AND TEST POINT DESIGNATORS ON THE Q SCREENS DO NOT USE THE 100, 200, 300 CODING SEQUENCE, IC 101 ON THE SCHEMATIC IS LABLED AS IC 1 ON THE 100 BOARD Q SCREEN.
17) TYPICAL VOLTAGES GIVEN AS V1/ V2/ V3 ARE FOR:
V1 + 1000V NO EXTERNAL LOAD CONNECTED.
V2 + 3000V NO EXTERNAL LOAD CONNECTED.
V3 + 3000V 10 mA LOAD CURRENT.
V3 IS NOT GIVEN FOR VOLTAGES THAT ARE LOAD INDEPENDENT.

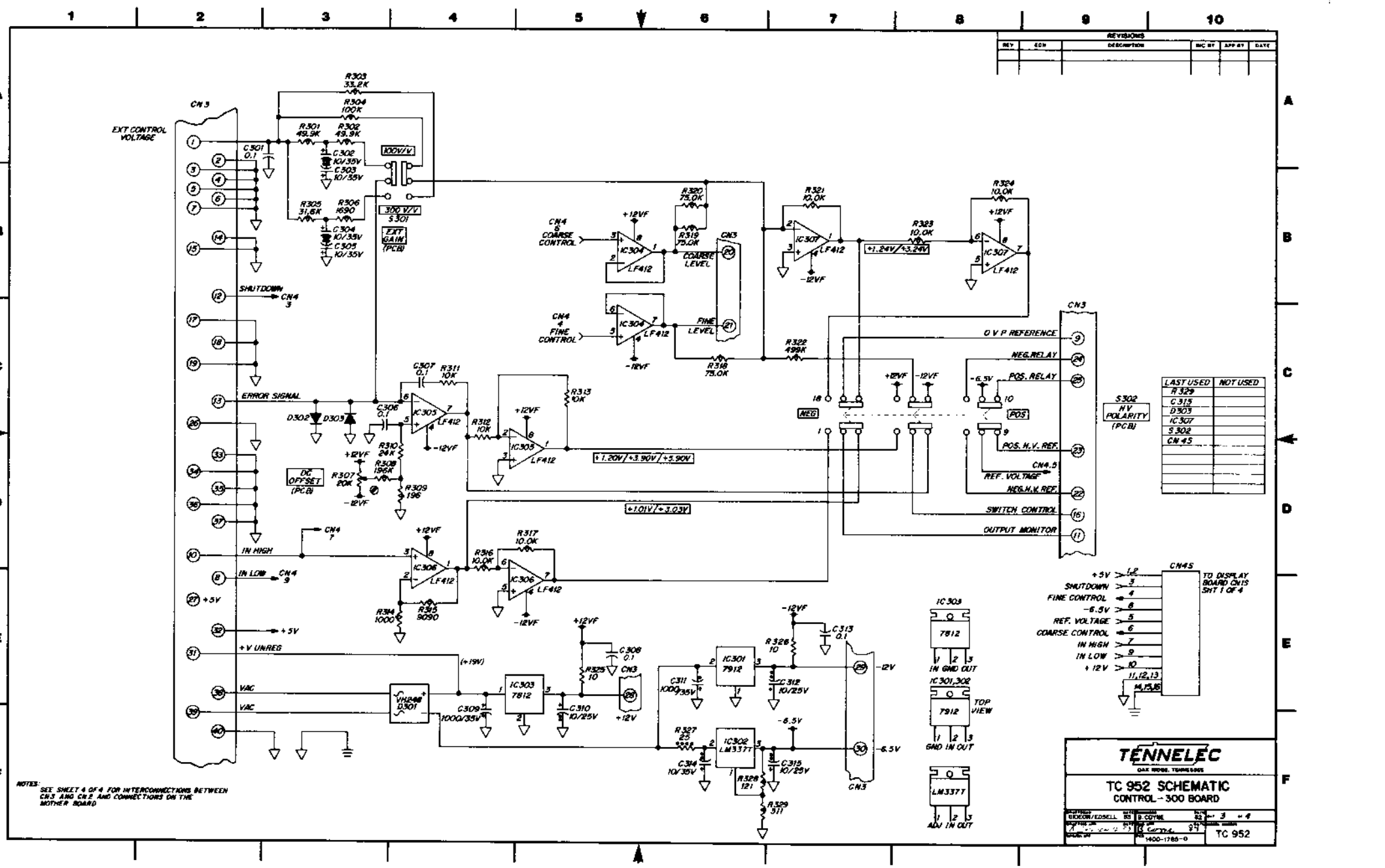
LAST USED	NOT USED
R129	R123
C110	
D104	
DS110	
Q106	
IC104	
VR101	
CN15	
TP101	

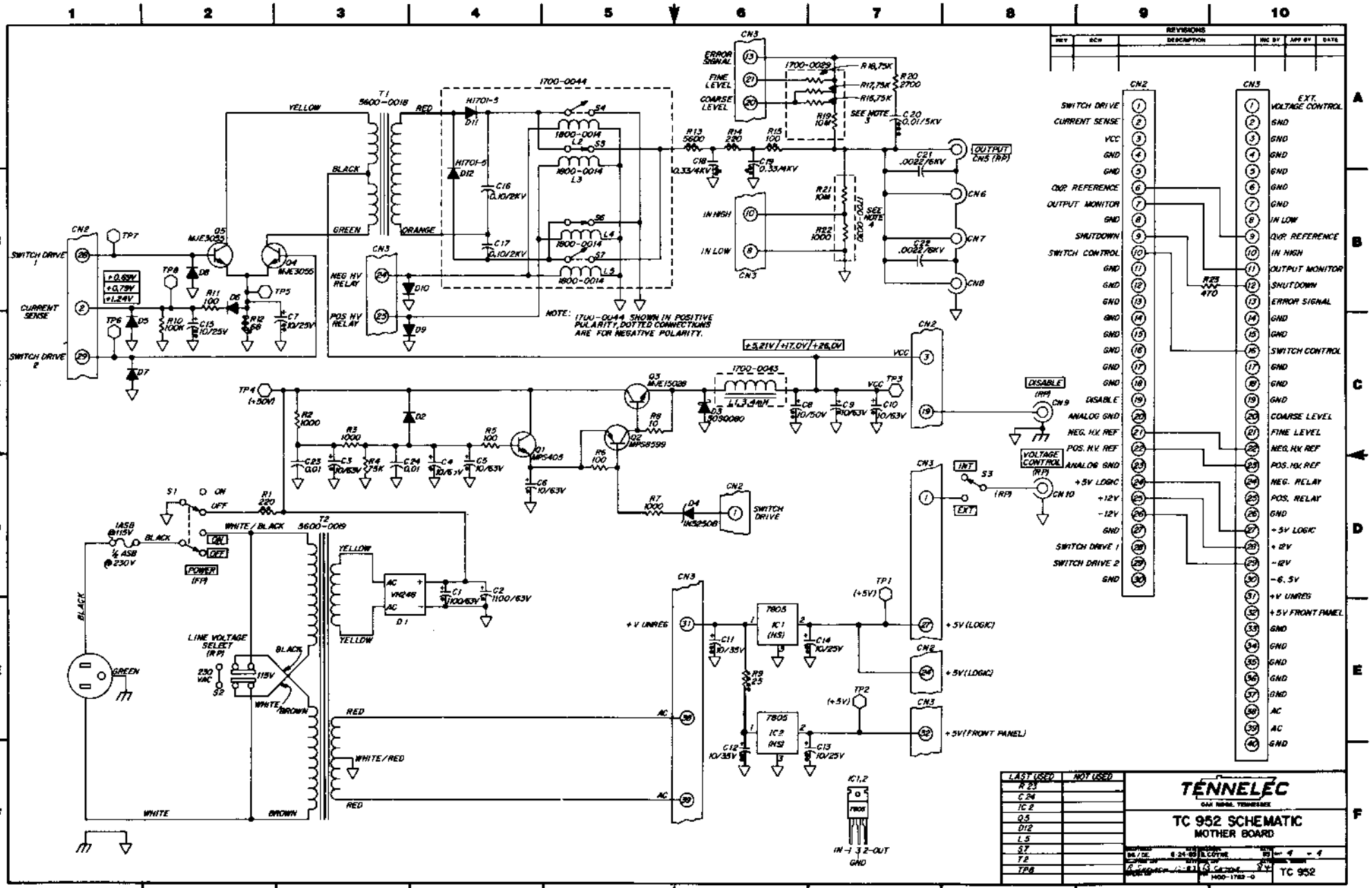
TENNELEC
OAK RIDGE, TENNESSEE

TC 952 SCHEMATIC
DISPLAY-100 BOARD

1400-1783-0
TC 952


REVISIONS
REV | ECN | DESCRIPTION | MFG BY | APP BY | DATE
SWITCH DRIVE
SWITCH CONTROL
VCC
DISABLE
SHUT DOWN
ANALOG GND
MEG HV REF
POS HV REF
SWITCH DRIVE 1
SWITCH DRIVE 2
OUTPUT MONITOR
O.V. PROT (PCB)
I LIMIT (PCB)
CURRENT SENSE
PWR ON
RESET (PCB)
O.V.P. REF
FREQ (PCB)
SYM (PCB)
MEG REF ADJ (PCB)
POS REF ADJ (PCB)
NOTE: SEE SHEET 4 OF 4 FOR INTERCONNECTIONS BETWEEN CN2 AND CN3 AND CONNECTIONS ON THE MOTHER BOARD.
LAST USED
R258
C221
D215
Q212
IC207
VR201
NOT USED
TENNELEC
OAK RIDGE, TENNESSEE
TC 952 SCHEMATIC
SWITCH - 200 BOARD
D. GIDEON
B. COYNE
1400-1784-0
TC 952


EXT CONTROL VOLTAGE
CN3
R303 33.2K
R304 100K
R301 49.9K
R302 49.9K
C302 10/35V
C303 10/35V
100V/V
R305 31.6K
R306 1690
300 V/V
S301
EXT GAIN (PCB)
C304 10/35V
C305 10/35V
C501 0.1
SHUTDOWN
CN4 3
ERROR SIGNAL
D302
D303
C306 0.1
C307 0.1
R311 10K
IC305 LF412
R312 10K
R313 10K
R310 24K
R308 196K
R307 20K
R309 196
DC OFFSET (PCB)
+12VF
-12VF
+1.20V/+3.90V/+5.90V
+1.01V/+3.03V
IN HIGH
IN LOW
CN4 7
CN4 9
IC306 LF412
R316 10.0K
R317 10.0K
R314 1000
R315 9090
+5V
+V UNREG
(+19V)
VR848 0.501
VAC
VAC
C309 1000/35V
IC303 7812
C310 10/25V
R325 10
C308 0.1
+12V
IC301 7912
C311 1000/35V
C312 10/25V
R326 10
C313 0.1
-12V
IC302 LM337T
C314 10/35V
C315 10/25V
R327 25
R328 121
R329 511
-6.5V
CN4 5 COARSE CONTROL
CN4 4 FINE CONTROL
IC304 LF412
IC307 LF412
R320 75.0K
R319 75.0K
COARSE LEVEL
FINE LEVEL
R318 75.0K
R321 10.0K
R323 10.0K
R324 10.0K
+1.24V/+3.24V
R322 499K
O V P REFERENCE
NEG. RELAY
POS. RELAY
NEG
POS
POS. H.V. REF.
CN4.5
REF. VOLTAGE
NEG. H.V. REF.
SWITCH CONTROL
OUTPUT MONITOR
S302 H.V. POLARITY (PCB)
LAST USED
NOT USED
R329
C315
D303
IC307
S302
CN 45
CN4S
TO DISPLAY BOARD CN15 SHT 1 OF 4
+5V
SHUTDOWN
FINE CONTROL
-6.5V
REF. VOLTAGE
COARSE CONTROL
IN HIGH
IN LOW
+12V
IC303
7812
IN GND OUT
IC301,302
TOP VIEW
GND IN OUT
LM337T
ADJ IN OUT
NOTES:
SEE SHEET 4 OF 4 FOR INTERCONNECTIONS BETWEEN CN3 AND CN2 AND CONNECTIONS ON THE MOTHER BOARD
TENNELEC
OAK RIDGE, TENNESSEE
TC 952 SCHEMATIC
CONTROL - 300 BOARD
SIDEOR/EDSELL
B. COYNE
1400-1788-0
TC 952


REVISIONS
TENNELEC
TC 952 SCHEMATIC
MOTHER BOARD
TC 952
1700-0044
T1 5600-0018
T2 5600-0019
1700-0043
CN2
CN3
SWITCH DRIVE 1
CURRENT SENSE
SWITCH DRIVE 2
EXT. VOLTAGE CONTROL
OVP REFERENCE
OUTPUT MONITOR
SHUTDOWN
SWITCH CONTROL
ERROR SIGNAL
IN HIGH
IN LOW
COARSE LEVEL
FINE LEVEL
NEG. HV REF
POS. HV REF
NEG. RELAY
POS. RELAY
+5V LOGIC
+12V
-12V
-6.5V
+V UNREG
+5V FRONT PANEL
DISABLE
VOLTAGE CONTROL
+5.21V/+17.0V/+26.0V
+5V(LOGIC)
+5V(FRONT PANEL)
LINE VOLTAGE SELECT
POWER
1ASB @115V
½ ASB @230V
7805
IC1,2
IN-1 3 2-OUT
GND