DSI INSTRUMENTS INC.

DSI

Model 3550

550 MHz

Frequency Counter

Owners Manual

7914 Ronson Road #G, San Diego, California, 92111

TABLE OF CONTENTS

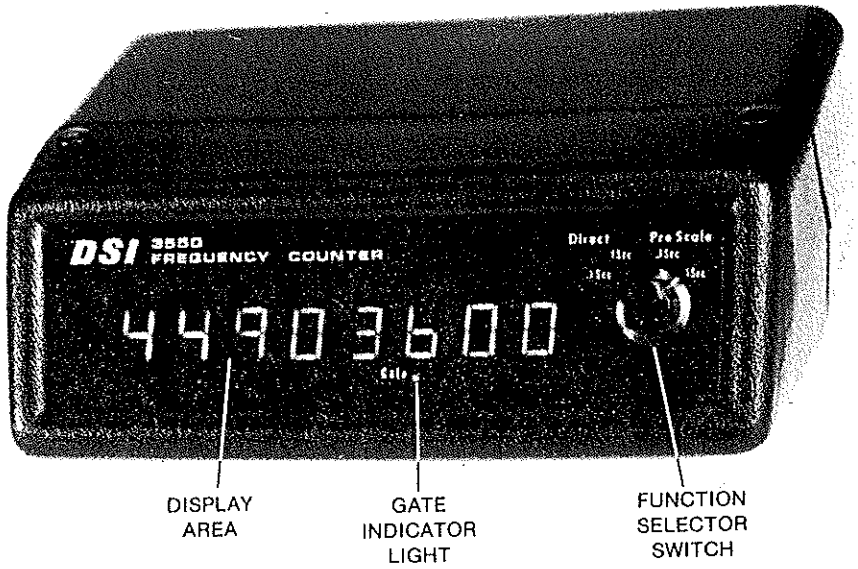
SECTION I — INTRODUCTION

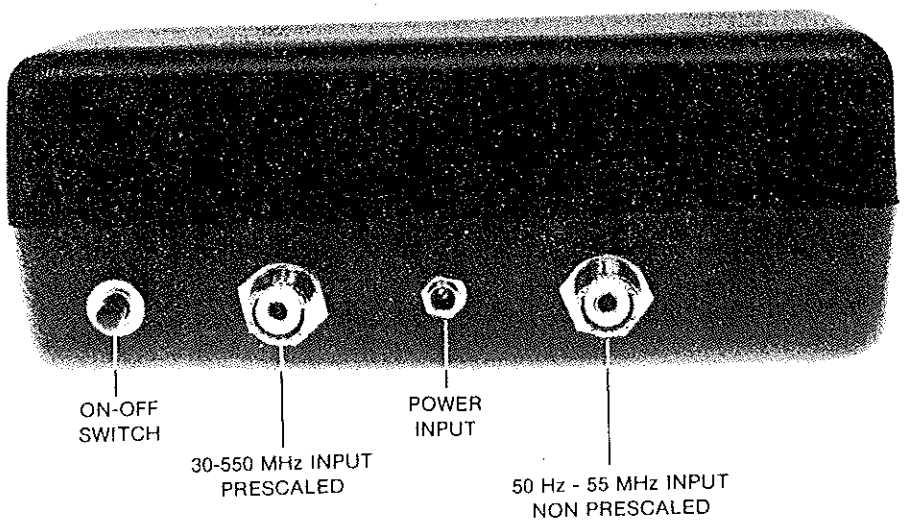
You are the proud owner of a DSI Model 3550 Frequency Counter which has been designed and manufactured to the strictest standards. Advanced MOS/LSI circuitry has been incorporated to guarantee years of reliable operation as well as provide the exceptional electrical performance inherent in these units.

The 3550 features a high intensity, large digital LED display, direct frequency readings from 50Hz to 550MHz, selectable gate times, and direct and prescaled inputs. The counter may be used with AM, CW, FM or SSB, making it the most versatile and accurate frequency counter in its price range.

All time bases on factory assembled units are set with standards which are traceable to National Bureau of Standards.

3550 FRONT VIEW





3550 REAR VIEW

SECTION II

DSI

SPECIFICATIONS, MODEL 3550

DSI INSTRUMENTS, INC.

PERFORMANCE

Frequency Range	Direct	50Hz to 55MHz
	Prescaled	30MHz to 550MHz
Gate Times		Selectable 0.1 second 1.0 second
Sensitivity		25MV Typical 100Hz to 25MHz 20MV Typical 25MHz to 250MHz 30MV Typical 250MHz to 450MHz
Resolution		1Hz 50Hz to 55MHz* 10Hz 55MHz to 550MHz**
		* using 1 second gate and non-prescaled input.
		** using 1 second gate and built-in prescaler.
Accuracy		1 part in 10^6 65° to 85° F typ.
Aging		1 part in 10^7/month typ.
Input Impedance	Direct	1 meg in parallel with 25pf
	Prescaled	50Ω in parallel with 25pf

GENERAL

Display

8 Digit LED with following features:

Easy to read .5" high seven segment characters.

Leading zero suppression assures error-free readings.

Display blanking to minimize power consumption.
When no input signal is present first seven digits are blanked, eighth digit displays 1 or 0.

Operating Temperature

65° to 85°F for 1 ppm accuracy
32° to 100°F for reduced accuracy

Storage Temperature

-40° to +140°F

Input Connectors

Two SO-239

Power Requirements

A. 8.2 VDC to 14.5 VDC

B. 115 AC 50/60Hz with optional AC adapter.

C. Battery pack: 6 "C" cells (10 hours service typ.)
(non-rechargeable alkaline batteries recommended).

D. Current requirements:
150 ma standby
300 ma operating.

Dimensions

Length: 8¼"
Depth: 6"
Height: 2¾"

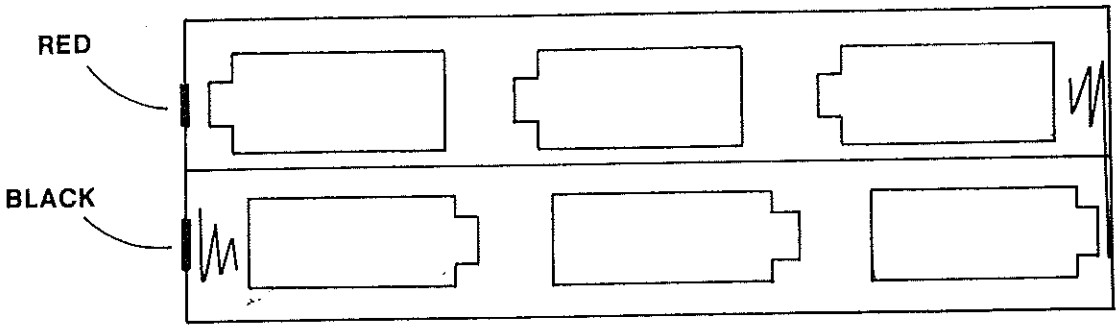
Weight without batteries (approx.) 15 oz.
Weight with batteries (approx.) 29 oz.

SECTION III — UNPACKING AND SETTING UP

The 3550 is packaged and shipped in a custom molded styrofoam block containing recesses for the instrument, antenna, and battery eliminator. This packaging provides protection which minimizes the possibility of damage in shipment. In addition, each item is individually packaged in a heavy vinyl bag for protection against dust, dirt, and moisture. We recommend that all packaging material be saved and carefully stored in the event the instrument must be either placed in storage or shipped at some future date.

INSTALLATION OF BATTERIES

1. Remove the four mushroom-headed pins securing the front and back halves of the case (two top and two bottom).
2. Separate the two case halves using caution to avoid any unnecessary strain on the wiring harness between the front and back halves of the case.
3. Install six "C" cell batteries as shown in the sketch below. Be sure to observe polarity markings molded into the battery box.
4. Reassemble case. Use care in replacing wiring harness.



BATTERY LIFE

DSI recommends the use of alkaline batteries. Because battery life is strongly affected by discharge rate the following information is supplied as a rough guide only.

1. Continuous operation (non-standby) 12 hours.
2. Intermittent operation, ½ hour per day, 2-3 months.

— CAUTION —

If the counter is to be stored for any appreciable time period the batteries should be removed to prevent damage to the inside of the instrument.

BATTERY ELIMINATOR (OPTIONAL ACCESSORY)

The DSI Battery Eliminator is a self-contained DC power supply which plugs into any 50/60Hz 110V AC outlet and provides approximately 9.0 VDC to the counter through the power supply jack at the back of the instrument. It may be used even with batteries installed in the counter because the jack is provided with a switch which automatically disconnects the internal battery pack.

NOTE: The open circuit voltage of the battery eliminator is 15.0 - 18.0 VDC.

USER-FURNISHED POWER SUPPLY

Any ripple free supply of 8.2 VDC to 14.5 VDC capable of supplying 300 ma may be used.

The output plug from power supply to counter is a female 2.5 mm DC power plug. The plug must be wired with positive voltage on the ID and negative on the OD.

SECTION IV — OPERATING INSTRUCTIONS

W A R N I N G ! ! !

DO NOT FEED MORE THAN 10 VRMS DIRECTLY TO INPUT CONNECTORS.

The 3550 Frequency Counter can be used in several different operating modes.

Inputs:	
Antenna	1MHz - 55MHz 30MHz - 550MHz Figure I
Through T tap	2MHz - 55MHz 30MHz - 550MHz Figure II
Direct from oscillator (audio or RF)	50Hz - 55MHz 30MHz - 550MHz
Sniffer probe	1MHz - 55MHz
Direct OR probe	30MHz - 550MHz

A simple sniffer probe can be constructed as follows:

Materials required:	1 PL-259 (UHF) connector 3 feet RG58 coaxial cable 4" - 5" heat shrinkable tubing.

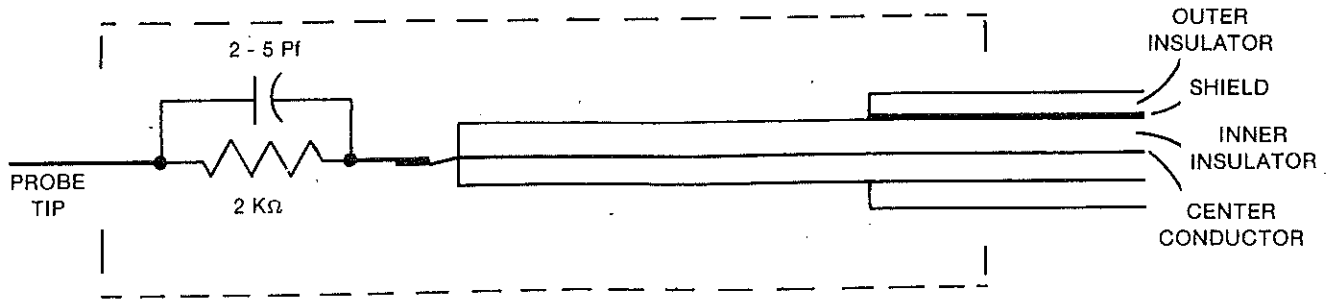
To make the probe first dress one end of the coaxial cable and solder the inner conductor to the center terminal of the PL-259 connector. Dress and solder the braided shield to the outer shell of the connector in the usual manner. This end of the sniffer probe is the input to the counter.

The other end of the 3' coaxial cable is prepared as follows:

1. Make a clean flush cut at the end of the cable so that a minimum of inner conductor shows.
2. Remove outer insulation and braided shield for a distance of 3" back from the end of the wire. Leave inner insulation intact.
3. Use a piece of heat shrinkable tubing to cover the entire end, including the exposed ends of the shield. Make sure that the inner conductor is also covered by the heat shrinkable tubing. This last step is necessary to prevent either the conductor or shield from making electrical contact with any energized section of the transmitter or oscillator under test.

In use, the connector end of the sniffer probe is attached to the appropriate input connector at the rear of the case. The other end of the probe is placed in an area containing ½ watt minimum of RF energy, such as near the output stage of the transceiver under test.

A direct contact probe can be made by adding an RC network to the end of the coaxial center conductor as shown in the following sketch. Heat shrinkable tubing should be used over the capacitor and resistor or the network should be mounted in a plastic probe handle.



THIS AREA COVERED BY SHRINK TUBING OR PLASTIC PROBE HANDLE

Note that all of the above applications involve transmit frequencies only. There is no simple, convenient way to read receive frequencies with the 3550. It was designed for reading transmit frequencies only.

FIGURE I

3550 Counter used with Antenna Input into 30 MHz - 550 MHz Jack

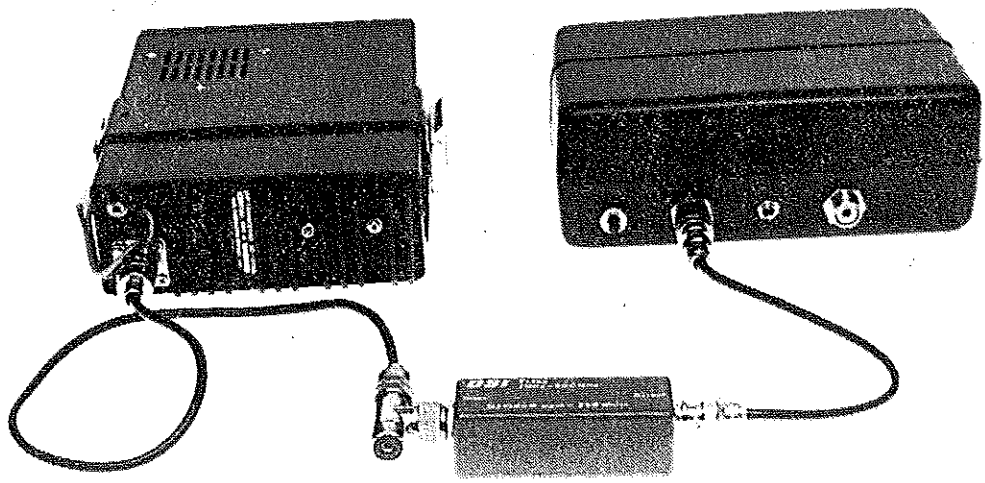


FIGURE II 3550 Counter Input from Transmitter through T TAP into 30 MHz - 550 MHz Jack.

OPERATION

1. Select power supply option:
   a. battery pack
   b. battery eliminator
   c. 8.2V - 14.5V power supply.

2. Turn power on (push-push switch located at the right rear corner of the case). The counter is ready for immediate use but greater accuracy will be achieved when the instrument has warmed up for about fifteen minutes and the temperature inside the case has stabilized.

3. Select input mode (discussed above).

4. Select gate time desired. Two gate time options are provided to increase the versatility of the instrument. .1 second gate time is used when rapid readings are required, such as when adjusting transmit frequency. 1 second gate times are used when maximum accuracy, rather than speed, is required. The gate indicator light on the front panel blinks at the gate frequency, i.e. 1 blink per second on 1 second gate time, 10 blinks per second on .1 second gate time.

5. Apply input signal.

6. Read frequency on the LED display. All leading zeros are automatically suppressed to avoid confusion.

Significant figure data is displayed as follows:

INPUT

		Freq. greater than 1MHz	Freq. less than 1MHz
Gate	1 Sec.	Freq. displayed in MHz	Freq. displayed in Hz
Time	.1 Sec.	Freq. displayed in MHz	1/10 Freq. displayed in Hz

For audio applications requiring greater accuracy an optional audio scaler is available from DSI which provides resolution to .1Hz or .01Hz, depending on frequency and gate time.

NOTE: The 3550 is designed to measure all CW, AM, FM, or SSB outputs. Some difficulty may be encountered in accurately measuring overmodulated AM, some SSB, pulse coded modulation and some teletype transmissions because the carrier is not always present in these types of transmissions. If operation with SSB is required and cannot be read normally, try modulating the transmitter with a single frequency, continuous audio tone to insure that the carrier is always present.

SECTION V — THEORY OF OPERATION

The 3550 may be conveniently divided into six sections by function. See block diagram on page 13.

1. Timing and control
2. Input signal conditioning and amplification
3. Signal gate
4. Counter
5. Display latches and drivers
6. Display

A precise clock frequency is provided by the oscillator portion of the timing and control section in conjunction with the crystal oscillator.

The oscillator frequency is divided down in the timing and control section to provide very precise gate times of either .1 second or 1 second (selectable).

The gate drive output is used to open and close a gate which controls the input from the signal conditioning section to the counter section. It also provides strobe and reset signals to the counter section.

The signal conditioning section squares up and amplifies the input signal on low frequency operation. It also prescales (divides by 10) the input signal on high frequency inputs prior to squaring up.

The sequence of events in the function of the counter is as follows:

Starting at time zero the timing and control section delivers a signal to the control gate which opens it for the time duration of the gate period (.1 second or 1 second). During the time that the gate is open a pulse train from the signal conditioning section is fed directly into the counter. The counter accumulates and stores the number of pulses received during the gate period. When the gate closes the pulse train is shut off and the counter transfers the accumulated data to the latch and driver section which drives the LEDs and displays the data stored in it. While this information is being displayed the gate opens again and a new pulse train is accumulated and stored in the counter. When the gate closes the data is transferred from the counter section to the latch and driver section and the information in the display is instantly updated.

Note that the information displayed is the total number of pulses accumulated during one gate period. This is why the display shows one tenth the input frequency when .1 second gate time is used and input frequency is less than 1 MHz. When input frequency is greater than 1 MHz and gate time is .1 second the display truncates the least significant digit.

SECTION VI — CALIBRATION

GENERAL CONSIDERATIONS

Units to be calibrated should always be temperature stabilized by warming up for a minimum of 45 minutes.

If power supply is a battery pack, fresh batteries should be used.

To achieve maximum accuracy, calibration frequency should be 10MHz to 30MHz on non-prescaled input and 100MHz to 300MHz on prescaled input.

Several methods may be used to calibrate the 3550 Counter.

Method No. 1 (preferred)

Equipment required:

1. Calibrated frequency counter
2. RF transmitter with 10MHz to 30MHz output
3. Screwdriver.

Procedure:

1. Remove the selector knob and face plate from the 3550.
2. Turn on both frequency counters and transmitter. Allow to warm up for 45 minutes.
3. Place both frequency counters close together on bench.
4. Using antenna inputs to both counters, transmit RF to both simultaneously.
5. Adjust trimmer capacitor on 3550 until the count matches that of the calibrated unit. The trimmer capacitor is located on the front of the printed circuit board between the function selector switch and the last digit of the LED display.

Method No. 2

Equipment required:

1. RF signal source of known accuracy.
2. Screwdriver.

The RF source used in this method must have a precisely known output at least as accurate as the desired accuracy of the 3550.

One method of calibrating a local signal source is to mix its output in a communications receiver with the 10MHz signal from WWV, the beat frequency can then be either displayed on a scope or played through the receiver's speaker. When the beat frequency is reduced to zero the local source is then calibrated to a level traceable to NBS.

After the local source is calibrated it is fed into the counter either directly or through an antenna and the trimmer capacitor tuned until the counter displays the known local signal source frequency.

SECTION VII — TROUBLE SHOOTING

Tables I and II are trouble shooting guides. Table I describes problems that are solvable without disassembling the case and should be referred to for correcting problems which arise in counters still in warranty **PRIOR** to returning to factory for repair.

Table II describes more complex problems and suggested solutions for units out of warranty. These repairs require soldering, component test, voltage level readings on the printed circuit board and component replacement and should only be attempted by a moderately equipped shop or skillful amateur.

If it becomes necessary to return the counter to the factory for repair, call or write the factory for a return material authorization.

GENERAL RECOMMENDATIONS

Prior to checking integrated circuits or transistors as per Table II it is strongly recommended that all power supply connections and voltages be checked. We recommend checking ground and power supply voltages at each IC as a first step in starting any trouble shooting program.

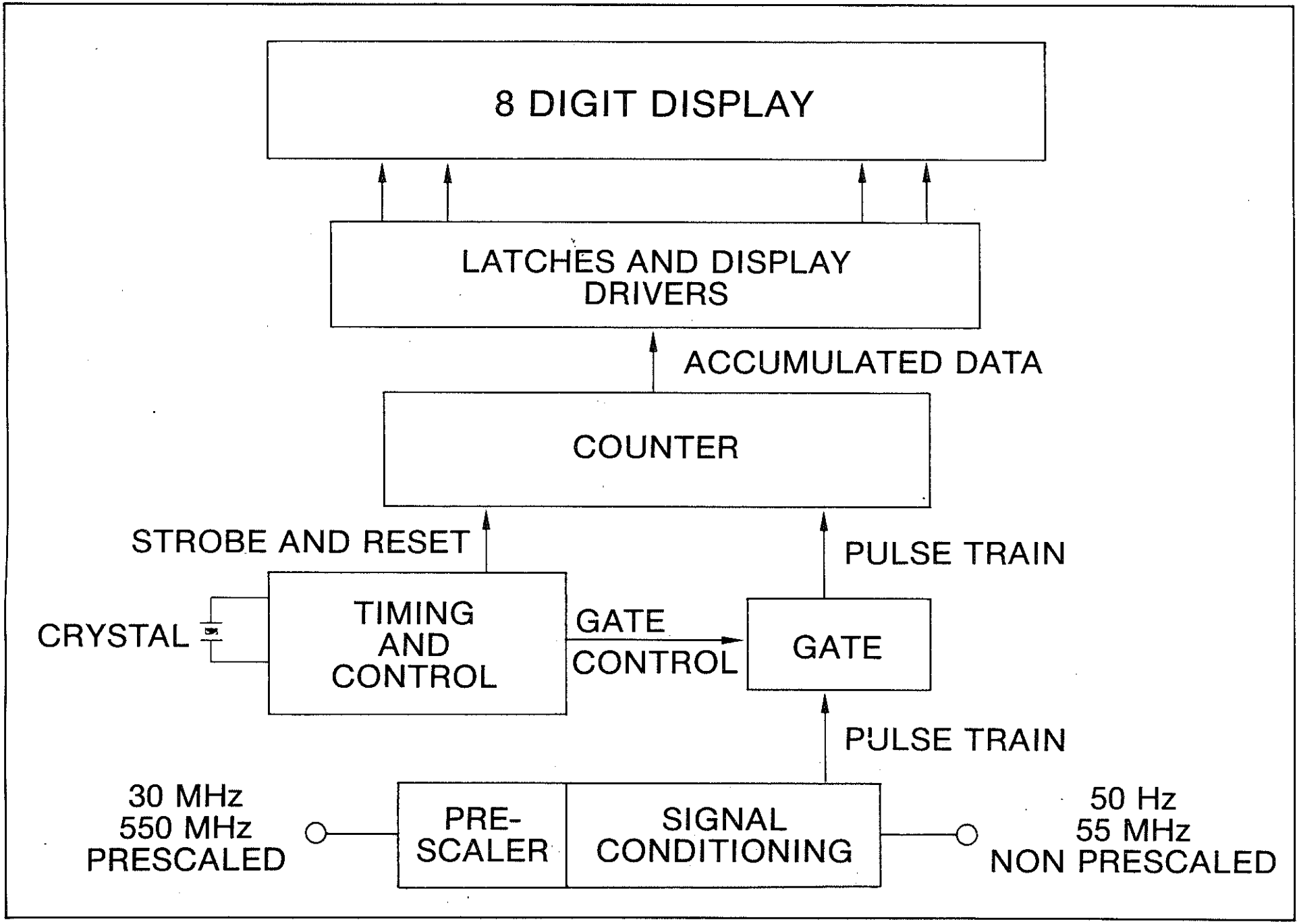
If components must be removed from the board we recommend that a solder sucker such as EREM Soldavac Model 101 suction desoldering tool be used. After the defective component has been removed we recommend the use of a socket rather than soldering the new component directly into the board. The use of a socket is particularly applicable to replacement of ICs.

TABLE I

Symptom	Probable Cause	Solution
1. Unit fails to function. Gate light off. All digits blanked.	1. Power switch off. 2. Batteries discharged. 3. Battery eliminator or power supply defective. 4. Batteries installed backwards.	1. Turn on. 2. Replace batteries. 3. Check output voltage of battery eliminator or power supply. Should be 8.2 - 14.5 VDC. Outside terminal on plug should be negative. 4. Install correctly.
2. Two or three digits light up with no signal applied.	Noisy environment.	Check area for other signal sources.
3. Erratic or unstable readings.	1. Signal too weak or too strong. 2. Signal source not spectrally pure. 3. Input to wrong connector or function switch in wrong position. 4. Duty cycle of signal not approximately 50%.	1. Change pick up distance or attenuate signal. See front cover for typical T tap schematic. 2. Check with spectrum analyzer. Clean up source. 3. Check connector & switch. Change one or both, as required. 4. Check wave form with scope. Do not attempt to count very narrow pulses at low rep rates.
4. Apparent wrong count.	Gate time switch in .1 second position.	If gate time is .1 second display will read 1/10 input frequency.

TABLE II

Symptom	Probable Cause	Solution
1. One segment fails to light on all digits.	Failed segment driver IC MC14511 or open traces on printed circuit board between MC14511 & display.	Check MC14511 voltage levels. Replace if necessary. Check traces, repair if needed.
2. One or more digits fail	Failed digit driver I.C. 75492 or failed digit driver transistor 2N2222 (2).	Check 75492 and 2N2222 voltage levels. Replace if necessary. Check all traces between I.C., transistors and cathode pin on FND500 display (marked k on schematic)
3. No gate light in either switch position and power supply O.K.	Time base not running. 1. Bad crystal or bad oscillator chip MM5369. 2. No power supply to MM5369.	1. Check crystal & oscillator output. Replace as needed. 2. Check power to pin 8 of MM5369. If no power supply voltage present check all traces to power supply.
4. Gate light works but one or both gate times work erratically.	Shorted traces near function switch or divider stages on I.C. MC4518.	Check board traces and clean up as required.
5. Displayed count increases during each gate period by increments approximately equal to input signal frequency.	Reset circuitry not operating correctly.	Check for cold solder joints or trace opens or shorts near I.C. 74LS14 and associated components especially capacitors C_{14} - C_{17} and resistors $R_{22, 25, 26, 28, 29}$.
6. Gate light on display blanked to 1 or 0. Counter does not operate or makes one reading and no more in presence of input signal.	1. No strobe signal to LS7031 cuased by poor solder joints near 74LS14.	1. Check solder joints and traces for opens.
	2. No input signal to LS7031 from 74LS196.	2. Check voltage levels of 74LS196. Replace as necessary. Check all solder joints and traces between 74LS196 and LS7031.
	3. Defective pre amp 2N5179.	3. Check voltage levels in pre amp area. Replace 2N5179 if necessary.
	4. Defective 74S08.	4. Replace 74S08.


8 DIGIT DISPLAY
LATCHES AND DISPLAY DRIVERS
ACCUMULATED DATA
COUNTER
STROBE AND RESET
PULSE TRAIN
CRYSTAL
TIMING AND CONTROL
GATE CONTROL
GATE
PULSE TRAIN
30 MHz 550 MHz PRESCALED
PRE-SCALER
SIGNAL CONDITIONING
50 Hz 55 MHz NON PRESCALED

MODEL 3550 KIT ASSEMBLY INSTRUCTIONS

IMPORTANT: It is recommended that you familiarize yourself with this instrument by reading the instruction manual prior to assembling the kit.

TOOLS REQUIRED:

1. Small screwdrivers for both straight and Phillips head screws.
2. Large and small diagonal cutters.
3. Wire strippers or ex-acto knife.
4. Needle or flat nose pliers.
5. Low wattage or controlled temperature soldering iron suitable for use on printed circuit boards.

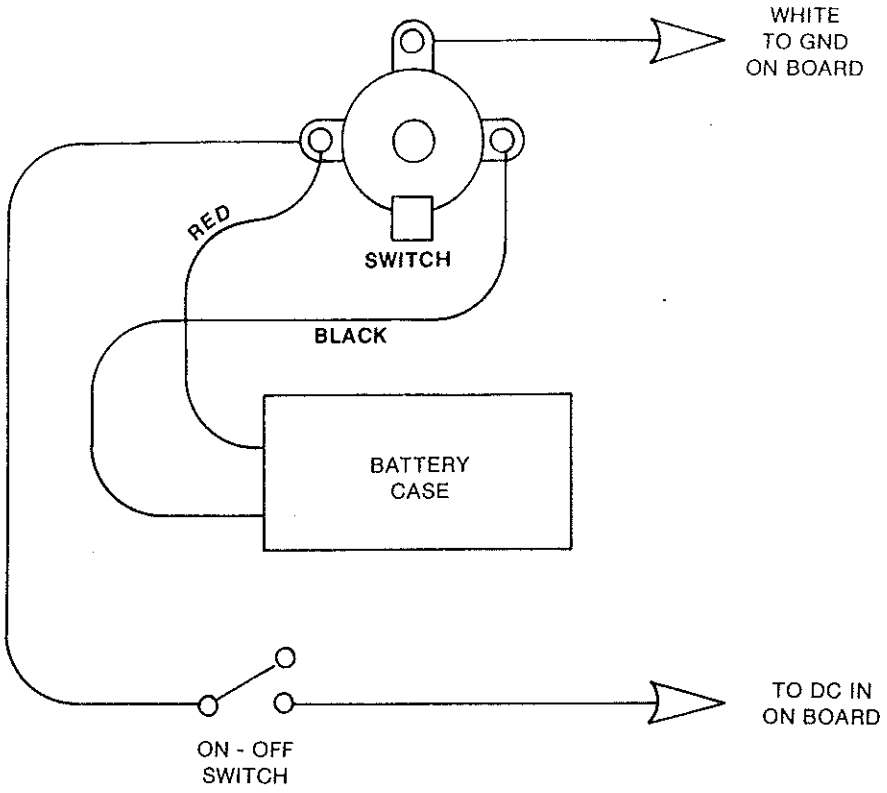
— CAUTION —

Extreme care must be exercised in soldering to printed circuit board traces. Excessive heat or long times at high temperature may destroy them.

ASSEMBLY PROCEDURE:

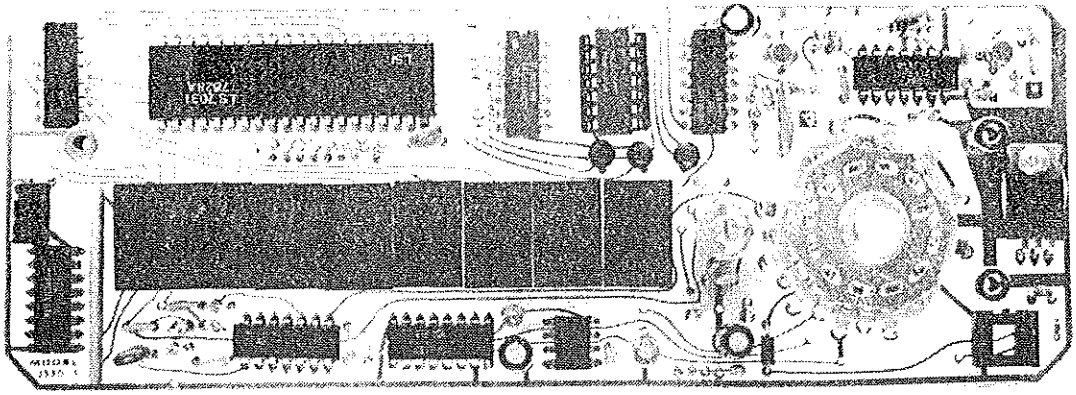
1. Remove two mushroom headed plastic rivets holding the cabinet together and separate the two halves.
2. Unwrap the parts contained in the cabinet.
3. Check parts received in kit against parts list. In the event that major parts are missing return the kit to the factory for replacement.
4. Check all corners of the printed circuit board to be sure they have been trimmed at 45° to the board edges. If not, clip off with strong diagonal cutters or tin snips just outside of the conductor traces.
5. Prepare coaxial cables as follows:
   cut coaxial cables to 8½", dress ends in normal manner.
6. Attach one end of each piece of the coaxial cables to an SO-239 connector, center conductor to center terminal, braided shield to solder lug on connector case.
7. Solder the other end of one of the subassemblies to the board as follows:
   center conductor to square pad labeled 50 MHz, braided shield to pad labeled GND.
8. Solder the other coaxial subassembly center conductor to the square block labeled 500MHz. Solder the shield to the ground lug on printed circuit board (see figure).
9. Assemble the power subassembly harness as follows:

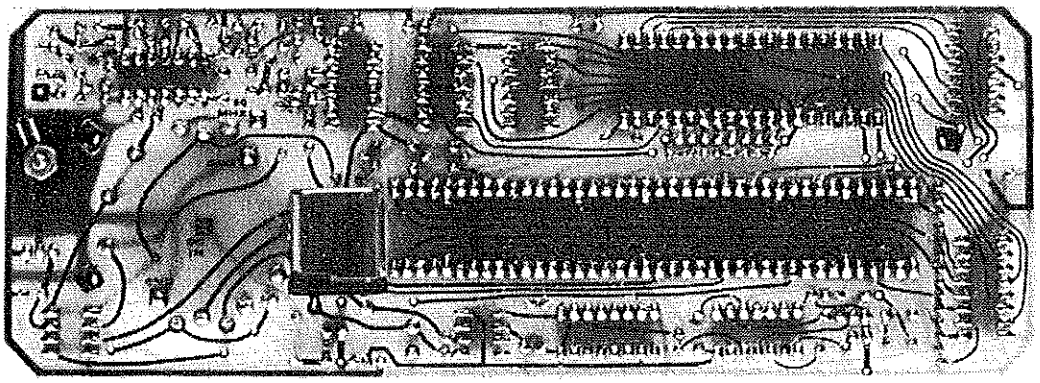
POWER CONNECTOR VIEW FROM INSIDE CASE

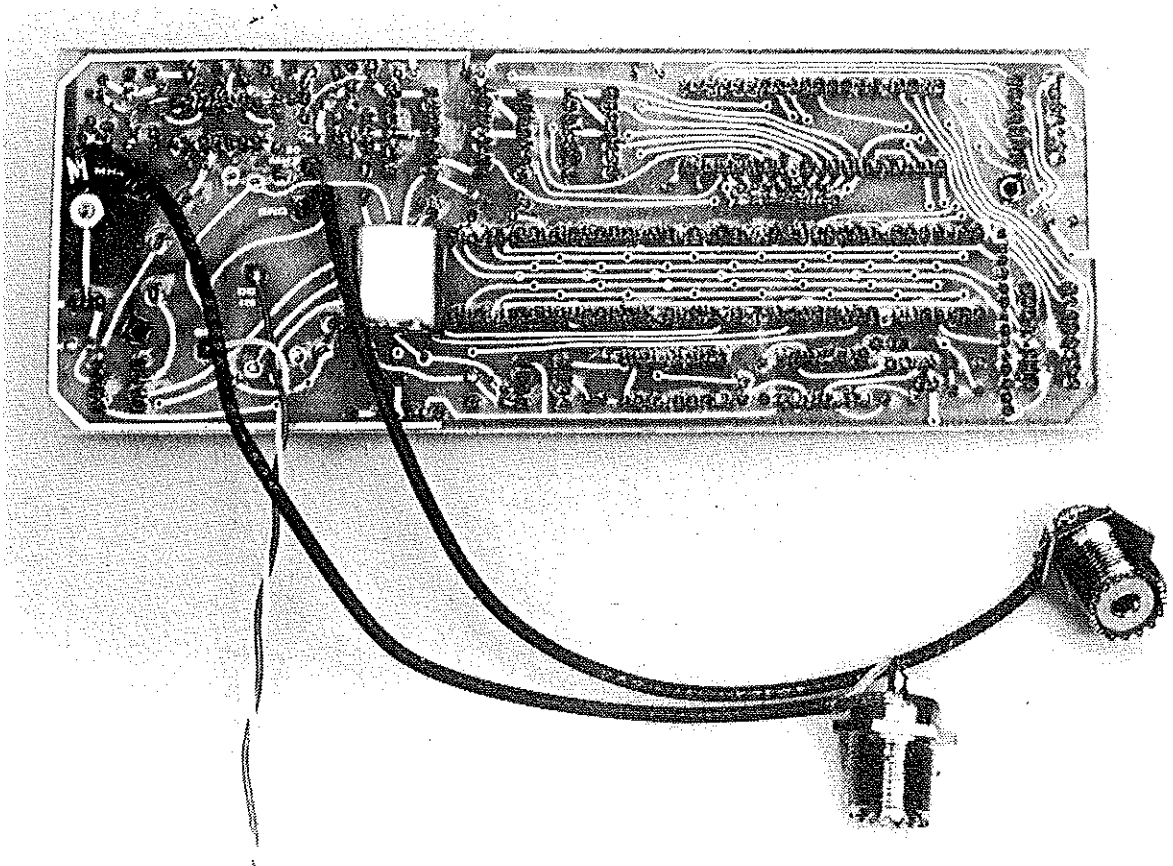


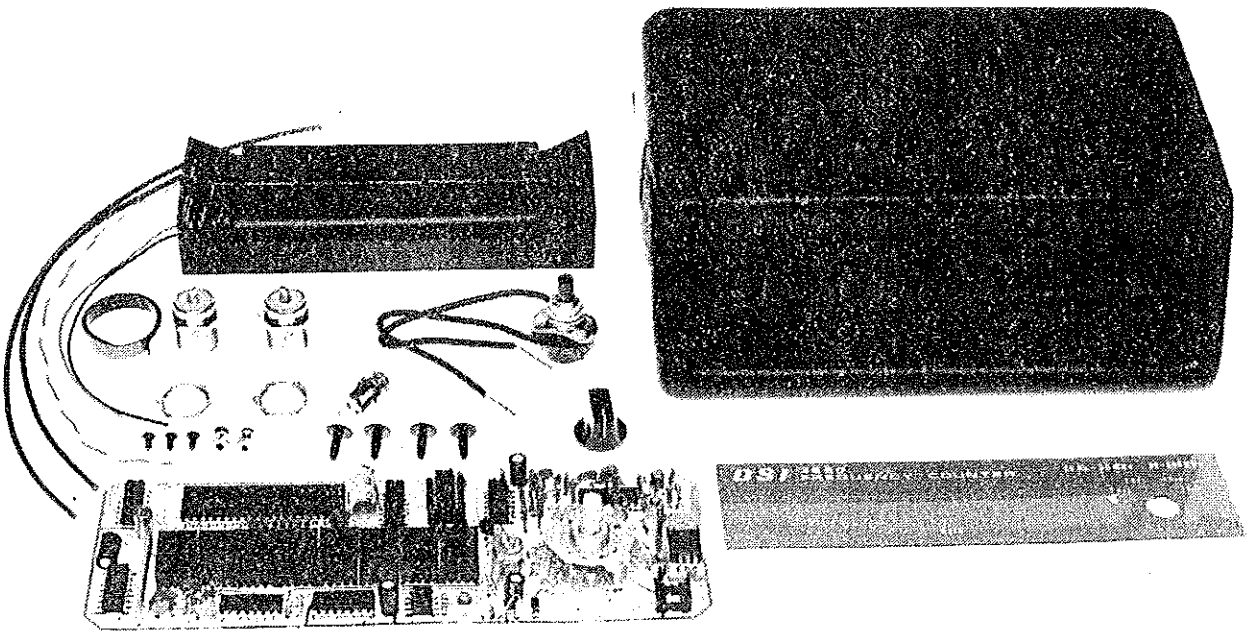
10. Install connectors, power plug and switch in back of the cabinet.
11. Install the battery case in back of the cabinet using two 4-40 x ⅜" flat head screws through the holes in the bottom of the cabinet.
12. Displays come with protective blue tape covering the top surfaces. This tape is left on to reduce scratching of the displays during assembly. Remove it by peeling it from the face of the displays.
13. Install the printed circuit board in the front half of the cabinet using three 4-40 x ¼" flat head screws screwed into stand offs.

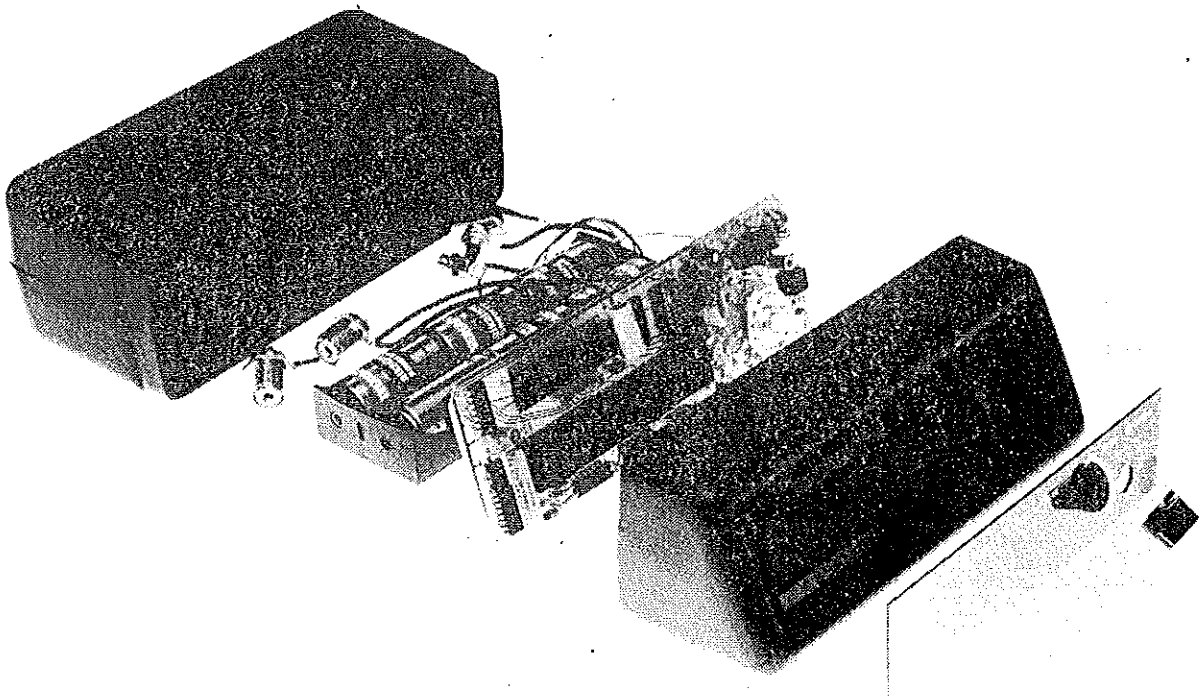
    CAUTION: Do not use excessive force when lining up the printed circuit board with the front of the cabinet. Occasionally holes in the cabinet face will require slight enlargement with a reamer or drill.
14. Install batteries or apply 8.2 VDC - 14.5 VDC and turn on switch to check the wiring. Gate light and eighth digit should light up. (See operating instructions.)
15. If unit fails to function recheck all power harness connections for proper location as per wiring diagram and quality of the solder joints. In case of further difficulties see trouble-shooting section of the operating manual.
16. Complete assembly as follows:
    slide the two halves of the cabinet together and press four plastic mushroom headed pins in place.
17. Calibrate the counter. See calibration procedure in Section VI of the operating manual.
18. Install the face plate with double-sided tape. Locate the tape strips on the front of the cabinet as shown in the exploded view. Be sure to peel off the protective tape from the back of the face plate.
19. Install the knob on function selector switch by turning the switch shaft fully counter-clockwise and lining up the pointer on the knob with .1 second 50Hz - 55MHz input. Tighten knob set screw on the shaft.

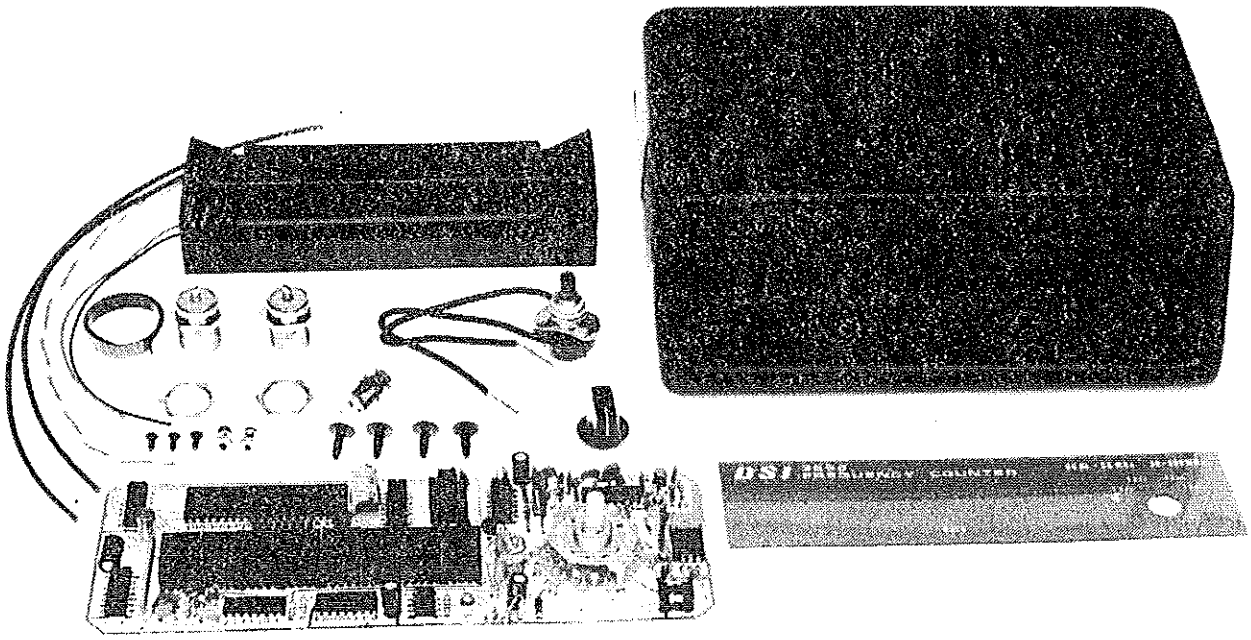


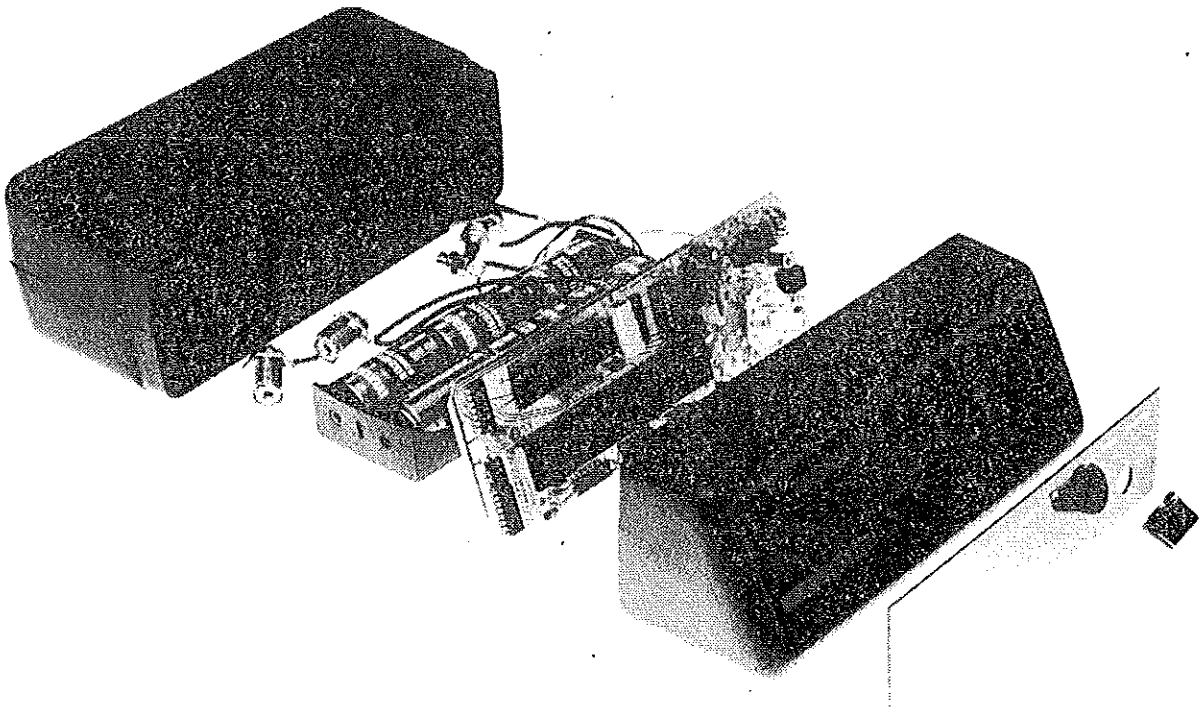




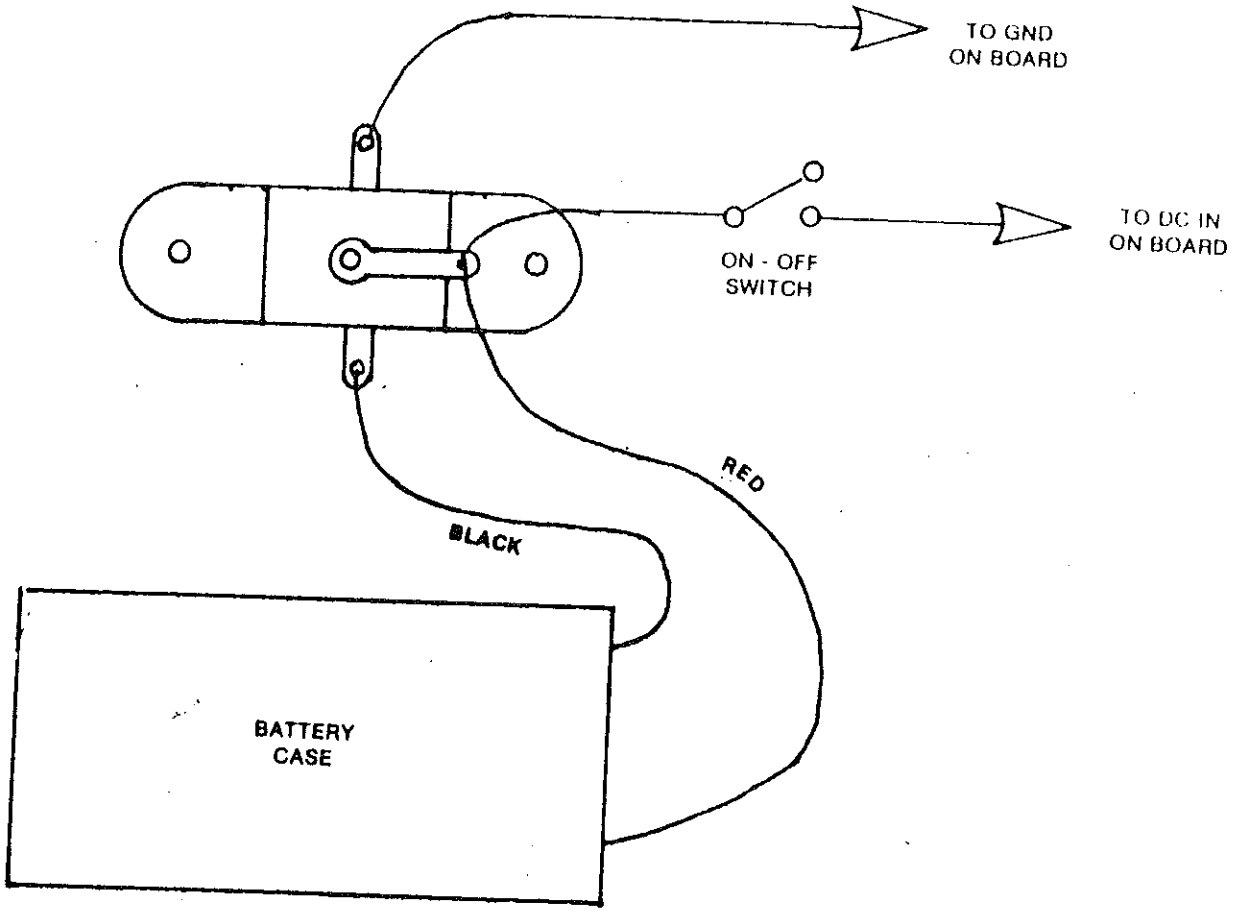






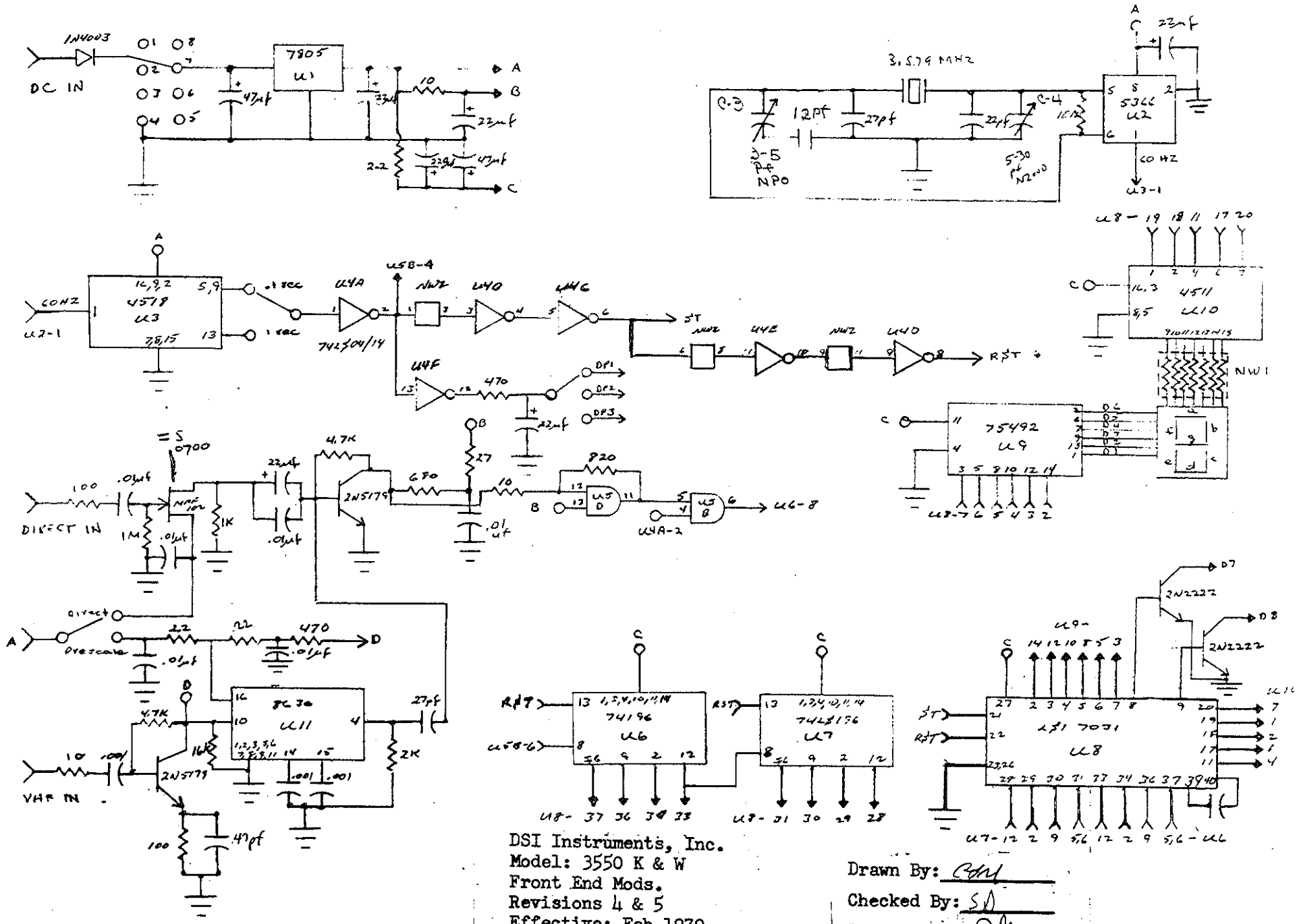


POWER CONNECTOR VIEW FROM INSIDE CASE



WIRING DIAGRAM

ALTERNATE STYLE POWER INPUT JACK



-19-

DSI Instruments, Inc.
Model: 3550 K & W
Front End Mods.
Revisions 4 & 5
Effective: Feb 1979

Drawn By: BM
Checked By: SD
Final Check: JB

ACTIVE DEVICES

IC 1	MM5369
IC 2	MC14511
IC 3	MC14518
IC 4	LS7031
IC 5	75492
IC 6 & 7	74LS196
IC 8	SP8630
IC 9	7805
IC 10	74S08
IC 11	74LS14
Q_1-Q_3	2N2222
Q_4 & Q_5	2N5179
D_1-D_4	IN914
D_5	IN4001
LED_1	T - 1¾ Red
LED_{2-9}	DL500

RESISTORS

All Carbon Film
¼ w 10%

R_1	10MΩ
R_2	200Ω
R_{3-9}	33Ω array
R_{10}	47Ω
R_{11-18}	820Ω
	(1 KΩ Network Optional)
R_{19}	680Ω
R_{20}	47Ω
R_{21}	4.7 KΩ
R_{22}	270Ω
R_{23}	47Ω
R_{24}	1.5 KΩ
R_{25-26}	47 KΩ
R_{27}	1 KΩ
R_{28-29}	2.4 KΩ
R_{30}	10Ω
R_{31}	27Ω
R_{32}	2.2Ω
R_{33}	27Ω
R_{34}	2.2Ω
R_{35}	470Ω
R_{36}	4.7 KΩ
R_{37}	7.5 KΩ
R_{38}	10Ω
R_{39}	100Ω
R_{40}	1.5 KΩ

CAPACITORS

All values in Mf unless noted.

C_1	22 pf
C_2	5 pf Typ.
C_3	3-5 pf NPO
C_4	5-30 pf N2000
C_5	22
C_6	.1
C_7	.01
C_8	22
C_9	47
C_{10}	200
C_{11-12}	.01
C_{13}	.5
C_{14-16}	.01
C_{17}	260 pf
C_{18}	.01
C_{19-20}	47 pf

HARDWARE & MISCELLANEOUS

SW1	2 APA 00701374 (Centralab)
SW2	SPST
J_{1-2}	S0-239
J_3	712 Power Jack (Switchcraft)
XL_1	ECG 358

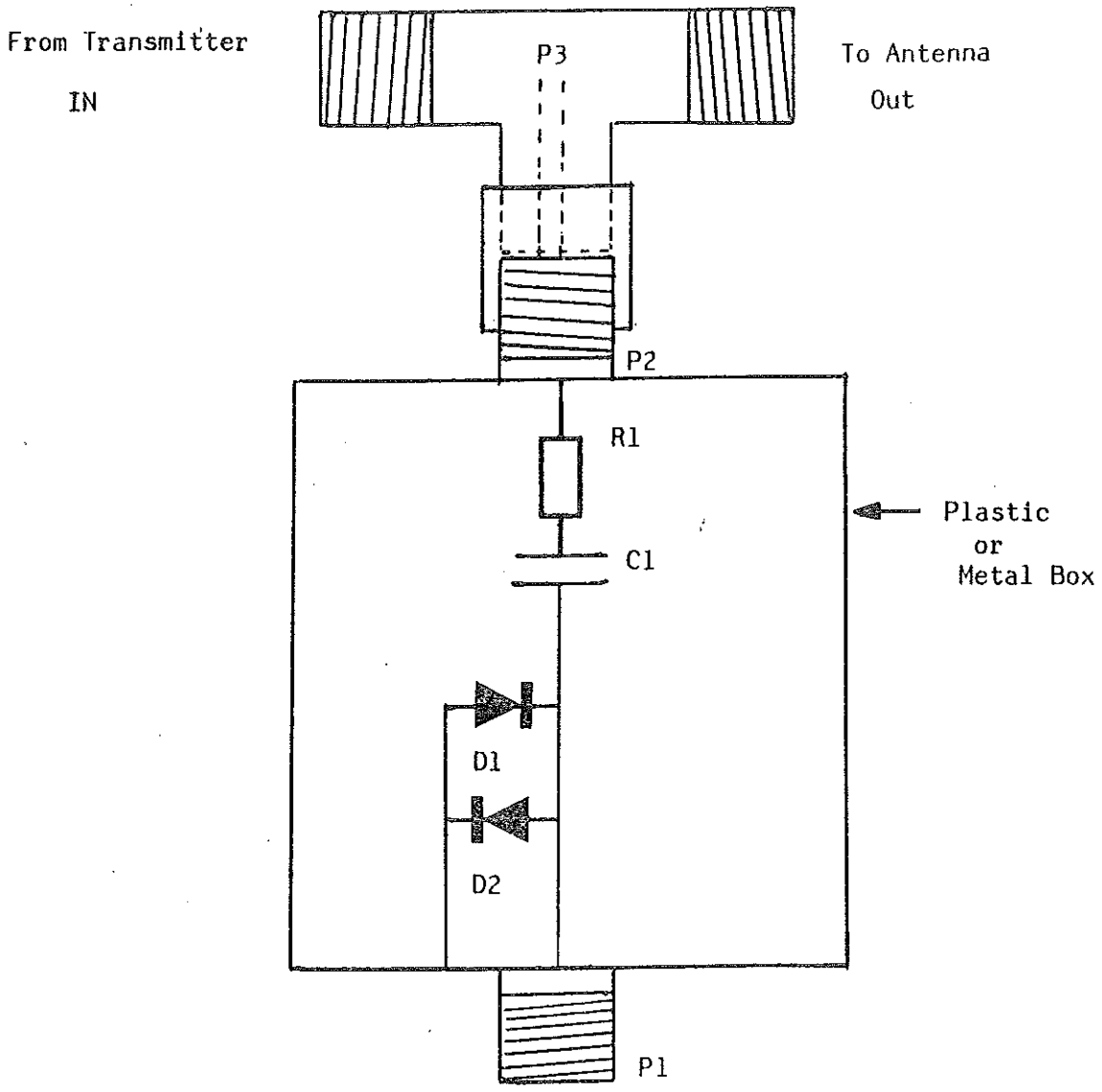
ITEM	QTY
Cabinet	1
Face Plate	1
Battery Case	1
Knob	1
Plastic Push Rivet	4
4-40 x ¼" FHS	3
4-40 x ⅜" FHS	2
4-40 Nut	2
4-40 Washer	2
4-40 Lock Washer	2
Twisted Pair 20 GA Stranded Wire	10"
RG174U Coaxial Cable	20"
Double Sided Pressure Sensitive Tape	6"

DSI INSTRUMENTS INC.

DSI

R F Tap Off Box

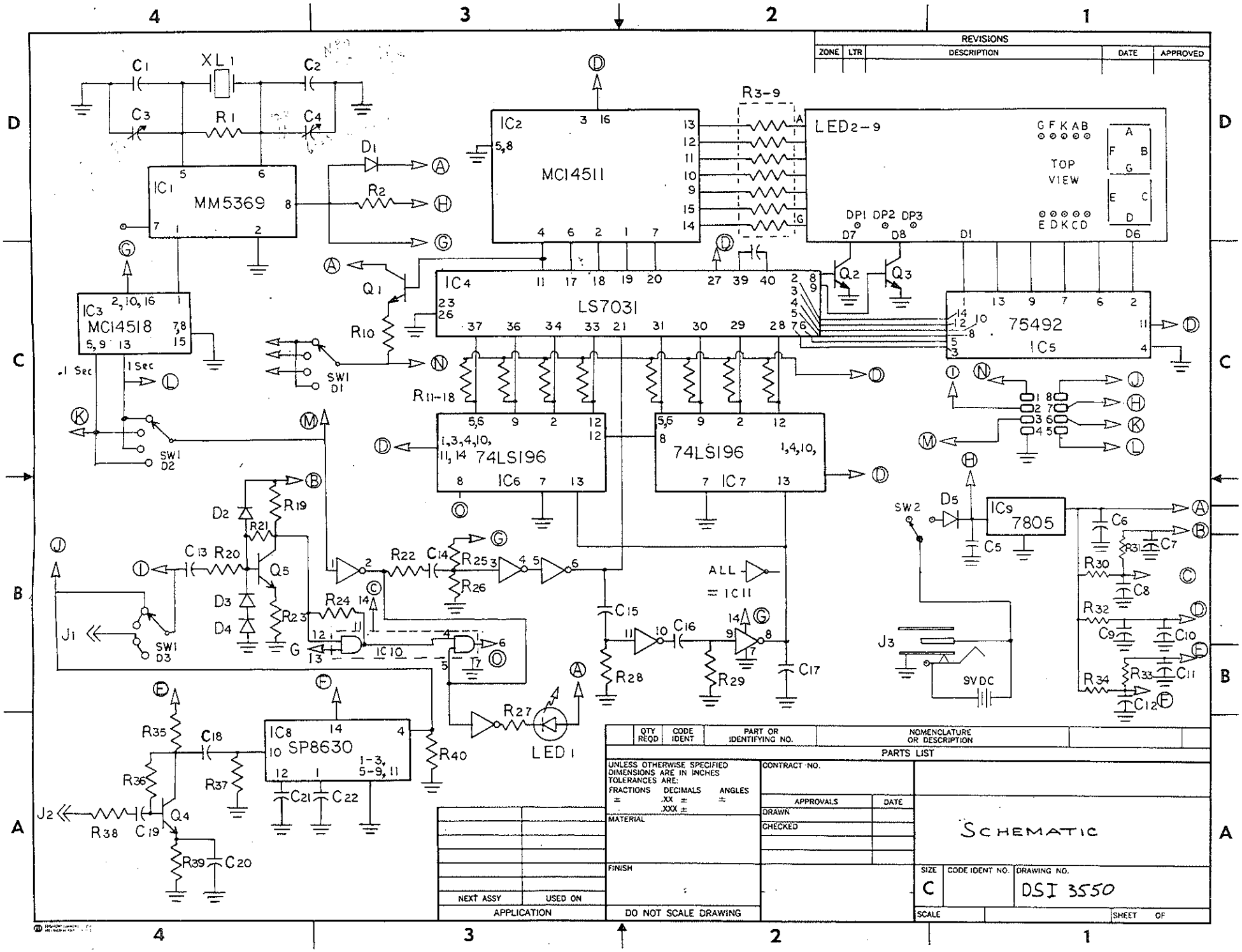
160 Meters to 450 MHZ 1 Watt to 250 Watts



R1 50 Ohms 1/4 Watt
C1 5 pf 1KV
D1 D2 1N914
P1 P2 SO239 Flange Connector
P3 PL259 T connector

Note: Diodes to ground
Note: Do not exceed 250 watts input

7914 Ronson Road No. G, San Diego, CA 92111


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
C1
XL1
C2
C3
R1
C4
IC1
MM5369
D1
R2
IC2
MC14511
R3-9
LED2-9
GFKAB
TOP VIEW
EDKCD
DP1 DP2 DP3
D7 D8 D1 D6
IC3
MC14518
.1 Sec
1 Sec
SW1 D1
SW1 D2
Q1
R10
IC4
LS7031
Q2
Q3
75492
IC5
R11-18
74LS196
IC6
74LS196
IC7
SW1 D3
J1
D2
R19
R21
C13
R20
Q5
D3
D4
R23
R22
C14
R25
R26
R24
IC10
ALL = IC11
C15
C16
R28
R29
C17
J3
9VDC
SW2
D5
IC9
7805
C5
C6
C7
R31
R30
C8
R32
C9
C10
R33
C11
R34
C12
R27
LED1
R35
C18
R36
R37
IC8
SP8630
R40
C21
C22
J2
R38
C19
Q4
R39
C20
QTY REQD | CODE IDENT | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±
MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION
DO NOT SCALE DRAWING
CONTRACT NO.
APPROVALS | DATE
DRAWN
CHECKED
SCHEMATIC
SIZE C | CODE IDENT NO. | DRAWING NO. DSI 3550
SCALE | SHEET OF