ADVANTEST

ADVANTEST CORPORATION

# TR3110

## Frequency Standard

## INSTRUCTION MANUAL

*MANUAL NUMBER OEB02 9602*

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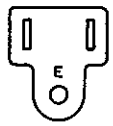
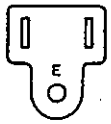
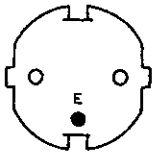
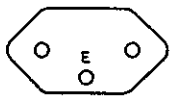
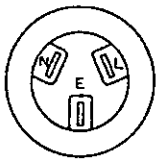
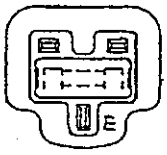
# NOTICE

*ADVANTEST provides the following power cables for each country. If there was any inconvenience on your use, please contact our subsidiaries or ADVANTEST representatives.*

| | Plugs | Standards/Countries | Ratings/Color/ Length | Accessory Codes |
|---|---|---|---|---|
| 1 |  | JIS : JAPAN | Rating :125V 7A<br>Color :Black<br>Length :2m | A01402<br><br>A01412 |
| 2 |  | UL : USA<br>CSA : CANADA | Rating :125V 7A<br>Color :Black<br>Length :2m | A01403 (Opt.95)<br><br>A01413 |
| 3 |  | CEE : EUROPE<br>VDE : FRG<br>OVE : AUSTRIA<br>SEMKO : SWEDEN<br>DEMKO : DENMARK<br>KEMA : NETHERLANDS<br>FIMKO : FINLAND<br>NEMKO : NORWAY<br>CEBEC : BELGIUM | Rating :250V 6A<br>Color :Gray<br>Length :2m | A01404 (Opt.96)<br><br>A01414 |
| 4 |  | SEV : SWITZERLAND | Rating :250V 6A<br>Color :Gray<br>Length :2m | A01405 (Opt.97)<br><br>A01415 |
| 5 |  | SAA : AUSTRALIA<br>NEWZELAND | Rating :250V 6A<br>Color :Gray<br>Length :2m | A01406 (Opt.98) |
| 6 |  | BS : UK | Rating :250V 6A<br>Color :Black<br>Length :2m | A01407 (Opt.99)<br><br>A01417 |

Note : "E" shows earth (ground).

C O N T E N T S

# CHAPTER 1 INTRODUCTION

## 1-1 Description

The TR 3110 FREQUENCY STANDARD is a portable secondary frequency standard having a stability of aging rate 5 X $10^{-10}$/day.

The internal standard frequency is generated by a crystal oscillator and then divided and multiplied to produce 100kHz and 1MHz (10MHz and 100MHz optional) signals. These output frequencies retain the stability of the internal crystal oscillator (1MHz) and a precisely calibrated with an atomic frequency primary standard (Atomicro: accuracy 1 X $10^{-11}$), thus transferring the atomic frequency primary standard.

Since a backup power supply is self contained, it is ideal for portable calibration and periodic frequency supervision service.

The internal circuitry consists of a crystal oscillation control section, amplifier, frequency multiplication/division section (optional) and a power supply section and utilizes all silicon semiconductors.

Therefore, operation is stable against external noise and temperature changes. The crystal oscillation control section is sealed in a constant temperature oven to eliminate the effects of variations in the external environment.

Moreover, it has been designed to be small, lightwight and portable and contains a self-contained battery which permits its use for up to 12 hours in locations where a power source is unavailable. An optional DC-AC inverter ( TR 1911) is also available to permit its use with a DC power source (12V or 24V) when there is no AC power source available.

The TR 3110 boasts the following features:

1. Extremely stable output frequency

   Precisely calibrated by a primary frequency standard (Atomicron: Accuracy 1 X $10^{-11}$)

   ±10% power line voltage variation: Under 5 X $10^{-10}$

±20% load resistance (600Ω or 50Ω) variation: Under $5 \times 10^{-10}$

Ambient temperature 25°C ±25°C

2. Portable type

   Since it is all transistorized, it is compact and lightweight.

3. Can be used in location where an AC and DC power source is unavailable.

4. Output frequencies of 100kHz and 1MHz (10MHz, 100MHz optional) provided. Output frequency is adjustable.

   Output voltage is over 2Vp-p for both 50Ω (10MHz) and 600Ω (100kHz, 1MHz) load and over 0.8Vp-p for 50Ω load (100MHz).

**Applications**

- ☐ In crystal oscillator calibration
- ☐ As a frequency substandard
- ☐ In frequency counter periodic calibration and servicing
- ☐ In computer, communications equipment, oscillator frequency checks

Accessories

| Product | Type | Stock No. | Remarks | Q'ty |
|---|---|---|---|---|
| Power cable | MP-25 | DCB-DS0054 | | 1 |
| Output cable | A01036-1500 | —— | 50Ω BNC cable 1.5m | 1 |
| Fuse | EAWK0.5A | DFT-AAR5A | 0.5A Slow-blow fuse | 2 |
| Instruction manual | | E3110 | English manual | 1 |

## CHAPTER 2 SPECIFICATIONS

### 2-1 Specifications

| | |
|---|---|
| Power source voltage | AC: 220V ±10%, 50/60Hz |
| | DC: +24V ±10% |
| | At OPERATE Approx 10hours |
| | At STAND-BY Approx 20hours |
| Power consumption | At OPERATE Approx 30VA |
| | At STAND-BY Approx 23VA |
| Frequency stability | Aging rate 5 X $10^{-10}$/day |
| | AC220V ±10% variation Under 5 X $10^{-10}$ |
| | 50Ω or 600Ω ±20% load resistance variation Under 5 X $10^{-10}$ |
| | Ambient temperature variation at 25°C ±30°C 5 X $10^{-9}$ |
| Warm-up time | Immediate use possible (However, 48 hours when AC power and internal battery OFF and when internal battery changed.) |
| Output frequencies | 100kHz, 1MHz 10MHz over 2Vp-p sine wave |
| | 100MHz over 2Vp-p sine wave |
| Output inpedance | Approx 600Ω (100kHz, 1MHz) |
| | Approx 50Ω (10MHz, 100MHz) |
| Frequency adjustment range | 2 ~ 4 X $10^{-8}$ |
| Operating temperature range | 0 ~ +50°C |
| Dimensions | Approx 250 (W) X 149 (H) X 350 (D) mm |
| Weight | Approx 10kg |

MEMO

## CHAPTER 3 OPERATING INSTRUCTIONS

### 3-1 General Preparations and Precuautions Prior to Use

1) Use an AC power source of 220V ±10%.

2) Use in an ambient temperature range of 0 ~ +50°C.

3) Since a crystal is used, handle the instrument with care and do not subject it to shock or vibration.

4) Use a noise filter when the AC power line is extremely noisy (when motor and high capacity loads are switched nearby).

5) Since the internal signals of theinstrument may leak out, always ground the chassis.

6) A self-contained battery is provided to permit operation during power failures or when a power source is unavailable.
   Operation on the battery is possible for up to 12 hours (approximately 10 hours when equipped with 10MHz, 100MHz option), but care is required since the battery cannot be recharged if used for more than 12 hours.

7) Set the DISCHARGE switch to OFF when transporting the instrument.

## 3-2 Panel Description (See Fig. 3-1)

### Front Panel

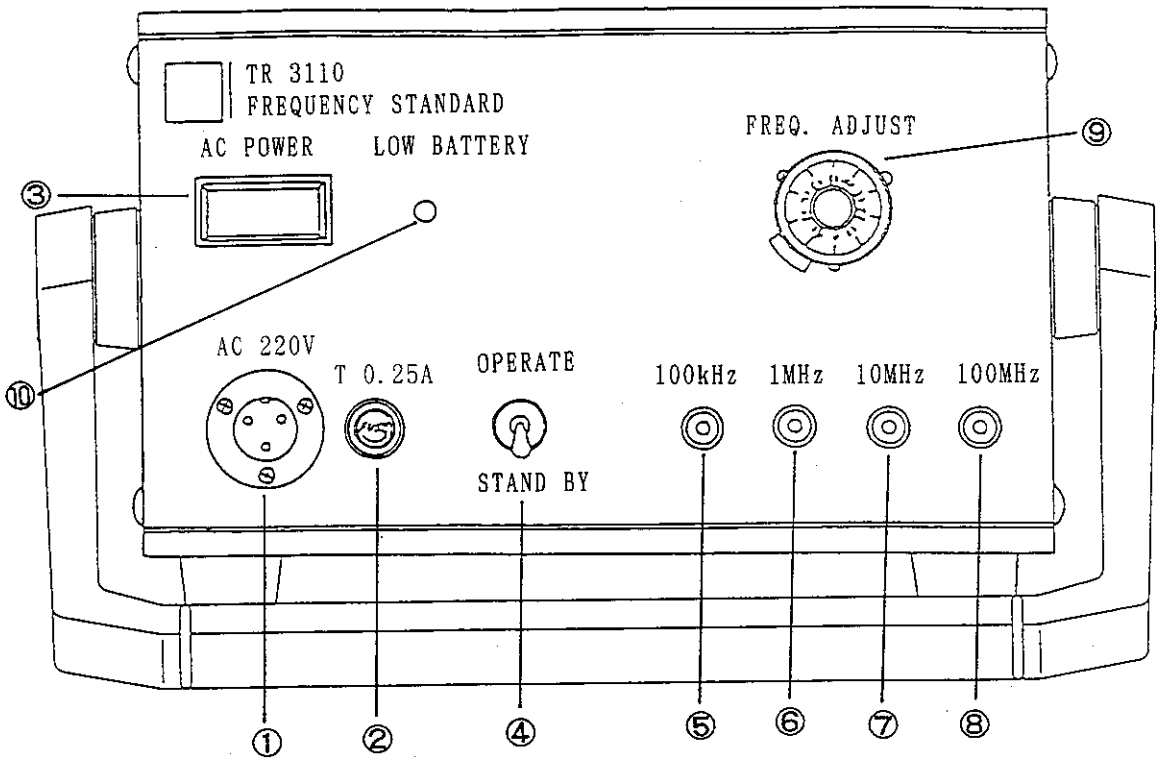



**Fig. 3-1 Panel description**

① AC 220V

AC power input terminal. Rated input voltage is AC220V ±10%, 50/60Hz.

② T 0.25A

AC power fuse. A 0.25A slow-blow fuse is used.

③ AC POWER

AC power pilot lamp. This lamp is lighted when AC power is being supplied to the instrument and is extinguished when.

④ OPERATE/STAND-BY

When this switch is set to OPERATE, power is supplied to the internal circuits and the standard signal appears at the output terminals. When it is set to STAND-BY, power is only supplied to the crystal oscillator constant temperature oven, oscillation circuit, and amplifier

circuit and no signal appears at the output terminals. Consequently, set this switch to STAND-BY when the output signal of the standard is not in use.

⑤ ⑥ ⑦ ⑧ 100kHz, 1MHz (10MHz, 100MHz)

Signal output terminals. Signal output is 100kHz and 1MHz as standard. 10MHz and 100MHz are optional.

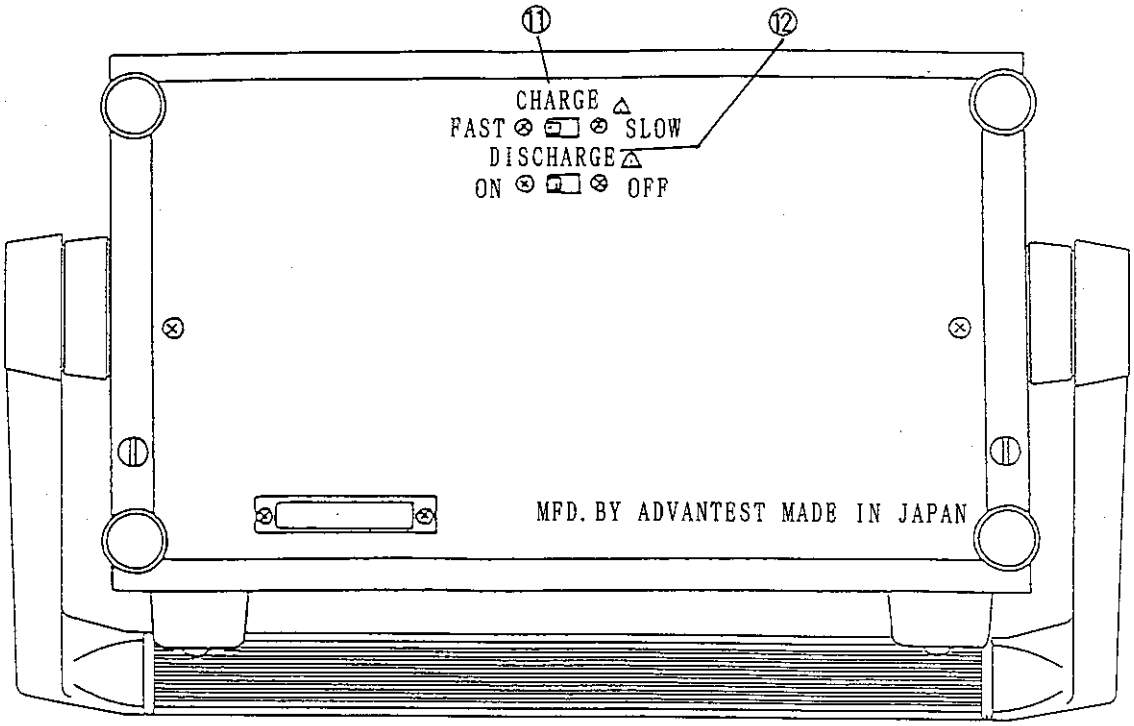
⑨ FREQ ADJUST

Ten turn potentiometer. Output can be varied $2 \sim 4 \times 10^{-8}$ with the [50] position as the center.

⑩ LOW BATTERY

Lights when the self-contained battery voltage drops to about +18V. When this lamp lights, halt use of the battery and use an AC power source to charge the battery.

**Rear Panel**




⑪ **CHARGE FAST-SLOW**

**Used when charging the self-contained battery.**

**When set to FAST, the charging current becomes approximately 60mA and charging requires 2 days. When set to SLOW, the charging current becomes about 30mA and charging requires 5 days.**

**If charged for more than 2 day under the FAST state, the battery will be overcharged and damaged.**

**Normaly set to SLOW.**

⑫ DISCHARGE ON-OFF

**Set to ON when the self-contained battery is used.**

**Set to OFF when the standard is being stored and when the battery is not being used.**

## 3-3 Operating Instructions

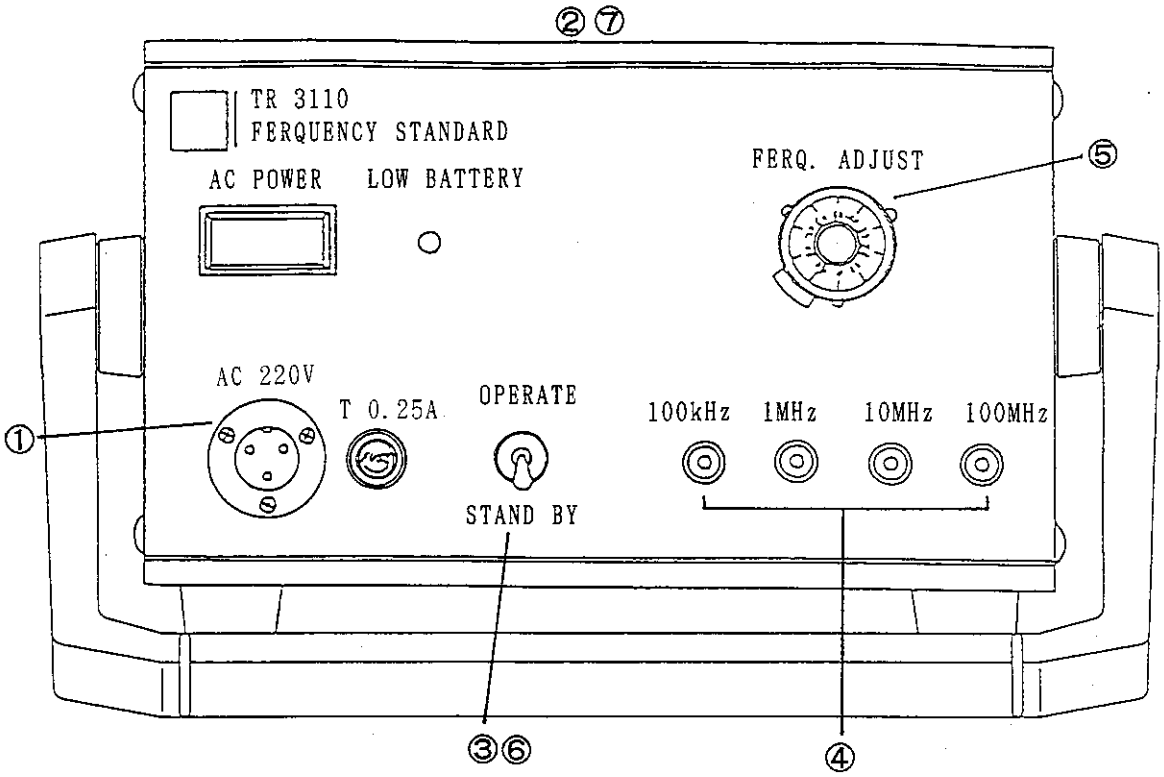



**Fig. 3-2 Operating instructions**

Match the below numbers with the numbers in Fig. 3-2.

① Supply power using the accessory cord at the AC220V.

AC power input terminal. Rating is AC220V ±10%, 50/60Hz.

② Set the rear panel CHARGE switch to SLOW and the DISCHARGE switch to ON.

③ Set the OPERATE/STAND-BY switch to OPERATE.

④ The standard signal is output from the respective output terminal.

Output impedance is 600Ω for the 100kHz and 1MHz terminals and 50Ω for the 10MHz and 100MHz terminals.

⑤ When desiring to change the frequency slightly, adjust with FREQ ADJUST potentiometer.

A $\pm 2 \times 10^{-8}$ change is possible with the [50] graduation at the center.

⑥ When the frequency standard is not in use, set the OPERATE/STAND-BY switch to STAND-BY.

⑦ When the internal battery is used, pull the power cord and set the rear panel DISCHARGE switch to ON.

CHAPTER 4 PRINCIPLES OF OPERATION

4-1 Description

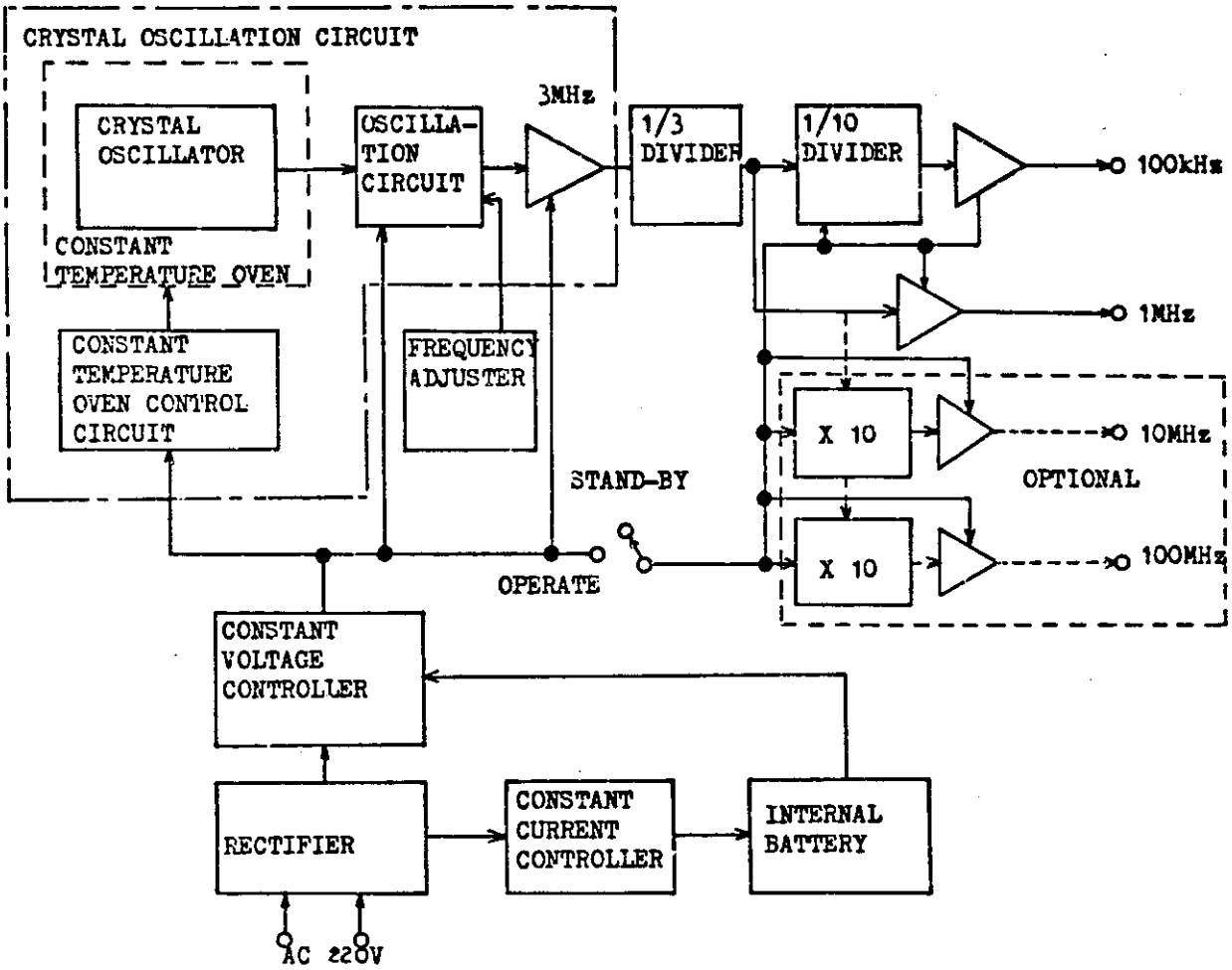



Fig. 4-1 Block diagram

The TR 3110 consists of a crystal oscillation circuit section, power supply section, and 1/10 divider circuit as illustrated in Fig. 4-1. Moreover, a 10MHz multiplier circuit and 100MHz multiplier circuit can be added as options. The crystall oscillation circuit section consists of a crystal, oscillation circuit, and constant temperature oven control circuit and the power supply section consists of a constant voltage control circuit and an internal battery control circuit.

4-2 Constant Temperature Oven Control Circuit

The constant temperature oven control circuit maintains the temperature of the constant temperature oven containing the crystal constant. The operating temperature is set to within 0.1°C of the tuning point temperature of the crystal resonator and changes are held to $10^{-3}$ order by a proportional control system.

4-3 Oscillation Circuit

The No.1 frequency determining element of the frequency standard is the crystal. This crusal is hermetically sealed inse a glass container to obtain maximum Q and consists of a precision resonater vacuum sealed in a container to obtain minimum aging characteristics.
A high degree of crystal temperature control must be applied to this circuit by a proportional constant temperature oven to make the reactance shift due to time, voltage and temperature minimum at a constant drive level. This circuit consists of two transistors and their related components.

The oscillator transistor is used in a modified Colpitts oscillation circuit and the ends of the moving element in this circuit are shunted with a large capacitance. Since the capacitance of the transistor element is comparatively smaller than that of the shunt capacitor, the overall value changes very little even when the capacitance of these elements changes.

4-4 Divider

(1) 1/3 divider: The 3MHz output supplied from the crystal oscillator is amplified by Q3 and applied to the injection oscillator circuit of Q4 where it is divided by 1/3 to 1MHz.
This 1MHz signal is supplied to a 2D10 through the impedance converter of Q5.

(2) 1/10 divider: A regenerative divider circuit is used to produce the 100kHz frequency standard output. The 1MHz signal supplied from the 1/3 divider is amplified by Q1 and applied to the emitter of mixer stage Q2. The collector circuit of Q2 is tuned to 100kHz, the capacitive impedance tap of the tuning circuit supplies the 100kHz signal to Q3 where it is multiplied 9 times. The 900kHz signal of the collector circuit of Q3 is fed-back to the base circuit of Q2 where it is mixed with the 1MHz signal from the crystal oscillator to produce the 100kHz signal.

This 100kHz signal is extracted from the capacitive impedance tape of Q2, applied to Q4, and the tuned output is connected to the front panel 100kHz output terminal through an impedance converter circuit.

4-5 10MHz, 100MHz Divider Circuit (Optional)

This circuit is a multiplier employing an LC resonant circuit. The 1MHz and 10MHz standard signals are multiplied by 5 and then further multiplied by 2.

4-6 Power Supply Circuit

The power supply circuit consists of a rectification section, constant voltage section and internal battery charging circuit. The rated power input of the frequency standard is AC220V ±10%, 50/60Hz and DC24V 12V ±10% (when used with TR 1911). The AC power input is converted to DC 40 ~ 42 through a power transformer, diode rectifier, and smoothing circuit.

The rectified voltage is applied to the voltage control circuit consisting of Q1 of this circuit and Q1, Q2 of 5D11.

The output voltage of Q1 of this circuit is applied to zener diode D16 through R22 by these circuits. The constant voltage obtained with this zener diode is applied to the emitter of Q2 of 5D11 and drives the Darlington connected emitter follower consisting of Q1 of 2E10 and Q1

of this circuit to maintain the output voltage contant.

If the input voltage rises, the base potential of Q2 becomes high than the emitter potential, Q2 conducts, the base potential of Q1 moves in the negative direction, the base of Q1 of mainframe circuit also moves in the negative direction (cutoff direction), the voltage drops between the collector-emitter of Q1 of the mainframe increases, and the output voltage is protected against changes in the input voltage.

If the AC or DC power source is interrupted, the automatic battery cwitching circuit is operated and power is supplied to the instrument through D16.

# CHAPTER 5 MAINTENANCE AND INSPECTION

## 5-1 Maintenance Precautions

Pay careful attention to the following items to insure stable operation over an extended period of time.

1) Always wear white gloves when performing maintenance, inspection, and adjustment on this instrument.
2) Use an AC power source (AC220V ±10%, 50/60Hz) and DC power source (+24V ±10%) within the rated values.
3) Used in an ambient temperature range of 0 ~ +50°C.
4) Since a crystal resonator is used, handle the instrument with care and do not subject it to large mechanical shock.
5) Use a noise filter when the AC power source is noisy.
6) Since a certain amount of time is required for the standard to reach the rated stability, apply power beforehand when it is to be used.
7) Since the internal battery can be used for up to 12 hours, be careful not to use it for more than 12 hours.
   The internal battery cannot be recharged if used for more than 12 hours.
8) Be careful not to loose the screws when removing the instrument.

## 5-2 Test Equipment Required in Maintenance and Inspection

Table 5-1

| Equipment | Ratings | Application |
|---|---|---|
| Slidac | AC220V use 100VA | Power source voltage variation check. |
| Vacuum tube voltmeter | DC: Input impedance Over 10MΩ<br>Accuracy 5% 0.1 ~ 100V<br>AC: Input impedance Over 1MΩ<br>Accuracy 5% 0.1 ~ 200V<br>Low input capacitance | Voltage measurements |
| DC voltmeter | 0.1 ~ 50V Accuracy 0.5% | Power source voltage measurements |
| Signal generator | Frequency 100kHz ±10kHz<br>1MHz ±150kHz<br>Output voltage 0 ~ 2Vrms | Output frequency checks |
| Load resistance | 50Ω, 600Ω | Output frequency checks |
| Synchroscope | Frequency range DC ~ 100MHz<br>Foltage sensitivity 0.1 ~ 100V | Observation of waveforms |
| Frequency counter | Measurement range 10Hz ~ 100MHz<br>Input impedance 50Ω | Output frequency observation |

5-3 Disassembly

1) Removing the case

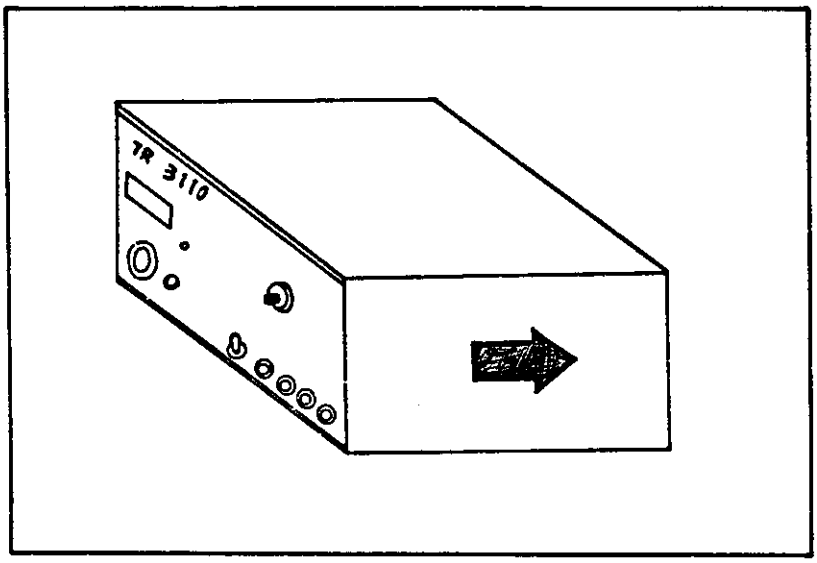



Fig. 5-1 Removing the case

Remove the two screws at the rear of the case and remove the case by pulling it in the direction of the arrow as shown in Fig. 5-1.

5-4 Adjustment and Calibration

1) Calibration

① Crystal oscillator calibration

Calibrate the internal crystal oscillator periodically.

Perform calibration against a primary frequency standard value.

When the trouble occurs in the crystal resonator and circuit, immediately contact Takeda Riken. NEVER ATTEMPT TO REPAIR THESE PARTS. Quality cannot be guaranteed if repair is performed by the user.

② Power supply section check

The 28.5V ±0.1V output is maintained with respect to input voltage changes of AC220V ±10%. Check the stability of the voltage before using the instrument when parts have been replaced. Perform this check

by varying the AC input voltage AC220V ±10% using a slidac and measuring the voltage with a precision DC voltmeter. If the output voltage is not 28.5V, adjust R25 of circuit board 5D11.

2) Adjustment

This instrument has been constructed so as not to require almost no maintenance.

The transistor must almost never require replacement.

If adjustment should become necessary, perform it as follows.

① 1MHz - 100kHz divider adjustment

a) Disconnect the input signal from the crystal oscillation circuit.

b) Connect the output of a signal generator to pin 17 of 2D10.

c) Connect a 50Ω load resistor in parallel with the 100kHz output terminal.

d) Connect the external sweep input of the synchroscope to the resistance load and connect the vertical input to the output terminals of the signal generator.

e) Set the output of the signal generator to 1MHz, 0.15Vrms.

f) Set the front panel OPERATE/STAND-BY switch to OPERATE.
Adjust coils L71 and L72 until a 10:1 resurge waveform is obtained at the CRT of the synchroscope.

g) Change the frequency of the signal generator from 1.00MHz to 1.02MHz and check if a smooth pattern is obtained over this range.
If a smooth pattern is not obtained, adjust L71.

h) Vary the frequency of the signal generator from 1.00MHz to 0.98MHz and check if a smooth pattern is obtained over this range. If a smooth pattern is not obtained, adjust L72.

i) Adjust L73 for an output voltage of approximately 1Vrms at a 1MHz input. When the output waveform is distorted, adjust L73 so that the distortion is minimum.

j) Remove the input signal and confirm that no signal appears at the output terminals.

k) Check if the divider is operated continuously when the input signal voltage is 0.1V, 1.5V, and 2.5Vrms at a 1.00MHz signal generator Output.

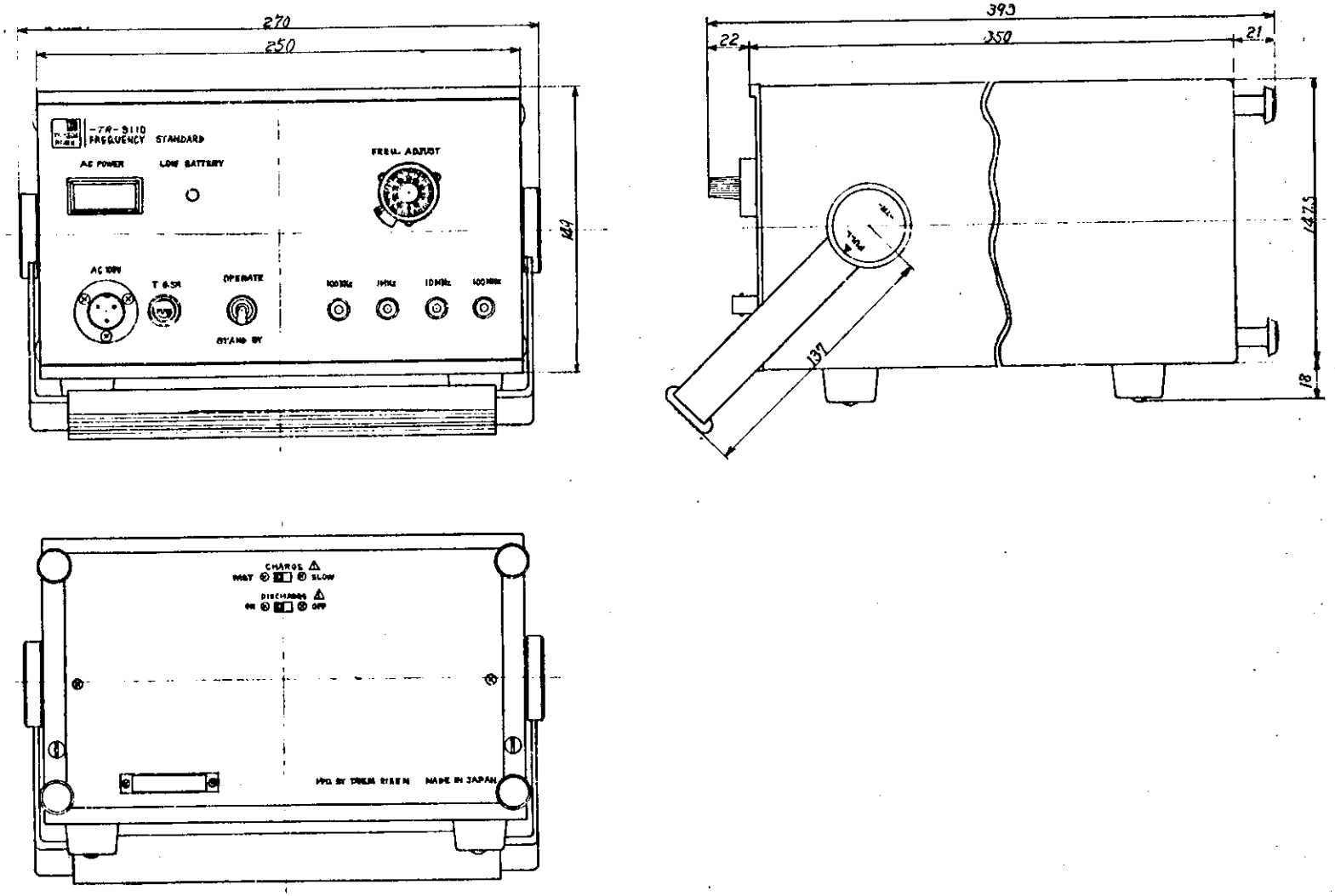
l) After adjustment is complete, return the wiring to its original state.

② 10MHz, 100MHz multiplier circuits (5F51, 5F83 optional)

The 10MHz, 100MHz multiplier circuits are connected to the output terminals when equipped. Each of these circuits consists of a multiplier circuit employing a parallel resonant circuit and a tuned amplifier circuit.

The signals are produced by the1MHz → 10MHz and 10MHz → 100MHz multiplier circuits.

# MEMO




-TR-3110
EXTERNAL VIEW

TR 3110

SCHEMATIC SECTION

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-SS-Q1 | 2SD82 | Transistor SI NPN | |
| " -Q2 | 2SD92 | Transistor SI NPN | |
| " -D1 | WZ-090 | Diode Zener | |
| " -D2 | WZ-090 | Diode Zener | |
| " -D3 | SLR-24B | Diode Light Emitting | |
| " -D4 | SD-1 | Diode SI | |
| " -R1 | HES-2 100ΩJ | R:FXD CAR 100Ω ±5% 2W | |
| " -R2 | | Not assigned | |
| " -R3 | | Not assigned | |
| " -R4 | HES-2 2.7KΩJ | R:FXD CAR 2.7KΩ ±5% 2W | |
| " -R5 | M2210-10K(6+) | R:VAR Potentiometer 10KΩ | |
| " -R6 | HES-2 22ΩJ | R:FXD CAR 22Ω ±5% 2W | |
| " -C2 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C3 | 50LBSN470 | C:FXD ELECT 470μF 50V | |
| " -C4 | 50LASN1000 | C:FXD ELECT 1000μF 50V | |
| " -C5 | 50TH47 | C:FXD ELECT 47μF 50V | |
| " -C6 | MC135YZ104P | C:FXD CER 0.1μF +100, -0% 25V | |
| " -T1 | TP-467 (S2407582) | Power Transformer | |
| " -B1 thru " -B4 | 2000F x 6 | Battery | |
| " -F1 | EAWK 0.5A | Fuse 0.5A slow blow (for AC 100-115V)<br>Fuse 0.25A slow blow (for AC 200-230V) | |
| | FH003 | Fuse Holder | |
| " -PL1 | TS 10<br>No. 5571 | Lamp<br>Lamp Socket | |
| " -S1 | S116 | Switch | |
| " -S2 | | Not assigned | |
| " -S3 | MFS-201N6 | Switch | |
| 3110-SS-S4 | MFS-201N6 | Switch | |

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-SS-J3 | PBAY-18-2AS-2G | Board Connector | |
| " -J4 | S8-403P | Socket used crystal Oscillator | |
| " -J5 | PBAY-18-2AS-2G | Board Connector | |
| " -J6 | PBAY-18-2AS-2G | Board Connector | |
| " -J7 thru " -J10 | UG-290/U | Connector | |
| " -J11 | HS-16R-3 | Power Connector | |
| " -J12 | PBAY-18-2AS-2G | Board Connector | |
| | TCO-10G | Crystal Oscillator | |
| | WE 15B | Power Noise Filter Block | |
| 3110-SS-L1 | LS21 | L:FXD Coil 4T | |

TR 3110/S

POWER SUPPLY SECTION

PE 152

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110/S-PE152-IC1 | LM305AH | IC:Voltage Regulator | |
| " Q3 | 2SD220 | Transistor SI NPN | |
| " Q4 thru Q6 | 2SC1279 | Transistor SI NPN | |
| " Q7 | 2SA537 | Transistor SI PNP | |
| " D10 | MI-152 | Diode SI | |
| " D11 | | Not assigned | |
| " D12 | MI-152R | Diode SI | |
| " D13 | | Not assigned | |
| " D14 | WZ090 | Diode Zener | |
| " D15 | WZ090 | Diode Zener | |
| " D16 | SM-1-08 | Diode SI | |
| " D17 thru D19 | 1S953 | Diode SI | |
| " R21 | R1/4 27kΩJ | R:FXD CAR 27kΩ ±5% 1/4W | |
| " R22 | X-6S 5kΩ | R:VAR 5kΩ | |
| " R23 | R1/4 18kΩJ | R:FXD CAR 18kΩ ±5% 1/4W | |
| " R24 | R1/4 4.7kΩJ | R:FXD CAR 4.7kΩ ±5% 1/4W | |
| " R25 | R1/4 2.2kΩJ | R:FXD CAR 2.2kΩ ±5% 1/4W | |
| " R26 | R1/4 8.2kΩJ | R:FXD CAR 8.2kΩ ±5% 1/4W | |
| " R27 | R1/4 22kΩJ | R:FXD CAR 22kΩJ ±5% 1/4W | |
| " R28 | R1/2 1.8kΩJ | R:FXD CAR 1.8kΩ ±5% 1/2W | |
| " R29 | R1/4 18KΩJ | R:FXD CAR 18kΩ ±5% 1/4W | |
| " R30 | R1/4 10kΩJ | R:FXD CAR 10kΩ ±5% 1/4W | |
| " R31 | X-6S 5kΩ | R:VAR 5kΩ | |
| " R32 | R1/4 5.6ΩJ | R:FXD CAR 5.6Ω ±5% 1/4W | |
| " R33 | R1/4 3.3ΩJ | R:FXD CAR 3.3Ω ±5% 1/4W | |
| " R34 | | Not assigned | |
| " R35 | R1/4 4.7ΩJ | R:FXD CAR 4.7Ω ±5% 1/4W | |
| " R36 | R1/2 2MΩJ | R:FXD CAR 2MΩ ±5% 1/2W | |
| " R37 | R1/4 2.7kΩJ | R:FXD CAR 2.7kΩ 1/4W | |
| 3110/S-PE152-R38 | R1/4 1.5kΩJ | R:FXD CAR 1.5kΩ 1/4W | |

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110/S-PE152-C43 | SL-50TH-4R7 | C:FXD ELECT 4.7μF 50V | |
| " C44 | SL-50TH-4R7 | C:FXD ELECT 4.7μF 50V | |
| " C45 | SC-80YZ103P | C:FXD CER 0.01μF +100%,-0% 50V | |
| " C46 | FC-50-SL-680K | C:FXD CER 68pF ±10% 50V | |
| " C47 | SL-50TH-3R3 | C:FXD ELECT 3.3μF 50V | |
| " C48 | SL-50TH-3R3 | C:FXD ELECT 3.3μF 50V | |
| " L53 | EL0810-SKI-181K | L:FXD Coil | |
| " L54 | LF-17 | L:FXD Coil | |
| 3110/S-PE152L55 | EL0810-SKI-181K | L:FXD Coil | |

CIRCUIT BOARD

5F51

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-5F51-Q1 thru " -Q7 | 2SC2901 | Transistor SI NPN | |
| " -Q8 | 2N2894 | Transistor SI PNP | |
| " -Q9 | 2N2894 | Transistor SI PNP | |
| " -Q10 | 2SC2901 | Transistor SI NPN | |
| " -Q11 | 2SC2901 | Transistor SI NPN | |
| " -D16 | RD11A | Diode Zener | |
| " -D17 | 1S953 | Diode SI | |
| " -R20 | EPD14T 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R21 | ERD14T 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R22 | ERD14T 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R23 | ERD14T 4.7KΩJ | R:FXD CAR 4.7KΩ ±5% 1/4W | |
| " -R24 | ERD14T 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R25 | ERF14T 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R26 | ERD14T 4.7KΩJ | R:FXD CAR 4.7KΩ ±5% 1/4W | |
| " -R27 | ERD14T 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R28 | ERD14T 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R29 | ERF14T 4.7KΩJ | R:FXD CAR 4.7KΩ ±5% 1/4W | |
| " -R30 | ERD14T 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R31 | ERF14T 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R32 | ERF14T 4.7KΩJ | R:FXD CAR 4.7KΩ ±5% 1/4W | |
| " -R33 | ERD14T 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R34 | ERD14T 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R35 | ERD14T 560ΩJ | R:FXD CAR 560Ω ±5% 1/4W | |
| " -R36 | R1/4 560ΩJ | R:FXD CAR 560Ω ±5% 1/4W | |
| " -R37 | R1/4 1KΩJ | R:FXD CAR 1KΩ ±5% 1/4W | |
| " -R38 | R1/4 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R39 | R1/4 1KΩJ | R:FXD CAR 1KΩ ±5% 1/4W | |
| " -R40 | R1/4 2.2KΩJ | R:FXD CAR 2.2KΩ ±5% 1/4W | |
| " -R41 | R1/4 22KΩJ | R:FXD CAR 22KΩ ±5% 1/4W | |
| " -R42 | R1/4 560ΩJ | R:FXD CAR 560ΩJ ±5% 1/4W | |
| " -R43 | R1/4 1KΩJ | R:FXD CAR 1KΩ ±5% 1/4W | |
| 3110-5F51-R44 | R1/4 1.8KΩJ | R:FXD CAR 1.8KΩ ±5% 1/4W | |

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-5F51-R45 | R1/4 10KΩJ | R:FXD CAR 10KΩ ±5% 1/4W | |
| " -R46 | R1/4 2.2KΩJ | R:FXD CAR 2.2KΩ ±5% 1/4W | |
| " -R47 | R1/4 220ΩJ | R:FXD CAR 220Ω ±5% 1/4W | |
| " -R48 | R1/4 1KΩJ | R:FXD CAR 1KΩ ±5% 1/4W | |
| " -C51 | FC80SL221K | C:FXD CER 220pF ±10% 50V | |
| " -C52 | FC50SL050F | C:FXD CER 5pF ±1% 50V | |
| " -C53 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C54 | 200pF 50WV | C:FXD Styrol 200pF ±5% 50V | |
| " -C55 | 200pF 50WV | C:FXD Styrol 200pF ±5% 50V | |
| " -C56 | FC50SL100K | C:FXD CER 10pF ±10% 50V | |
| " -C57 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C58 | 100pF 50WV | C:FXD Styrol 100pF ±5% 50V | |
| " -C59 | FC50SL050F | C:FXD CER 5pF ±1% 50V | |
| " -C60 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C61 | 100pF 50WV | C:FXD Styrol 100pF ±5% 50V | |
| " -C62 | FC50SL100K | C:FXD CER 10pF ±10% 50V | |
| " -C63 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C64 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C65 | FC60SL470K | C:FXD CER 47pF ±10% 50V | |
| " -C66 thru " -C71 | SC120YZ473P | C:FXD CER 0.047μF +100, -0% 50V | |
| " -C72 thru " -C74 | ECE-B 25V10H | C:FXD ELECT 10μF 25V | |
| " -C75 | SC120YZ473P | C:FXD CER 0.047μF +100, -10% 50V | |
| " -C76 | TAXH25V100M | C:FXD ELECT TANTAL 10μF ±20% 25V | |
| " -C77 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -L81 | LB2 (S2466365) | L:FXD Coil | |
| " -L82 | LB2 (S2466365) | L:FXD Coil | |
| " -L83 | LB1 (S2405685) | L:FXD Coil | |
| " -L84 | LB1 (S2405685) | L:FXD Coil | |
| " -L85 thru 3110-5F51-L87 | LT-500 | L:FXD Coil 500μH | |

100MHz MULTIPLIER

5F 206

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-5F206-Q1 | 2SC1834 | Transistor SI NPN | |
| " -Q2 thru " -Q5 | 2SC1730 | Transistor SI NPN | |
| " -Q6 | 2N5109 | Transistor SI NPN | |
| " -Q7 | 2SC594 | Transistor SI NPN | |
| " -R11 | R1/4 12KΩJ | R:FXD CAR 12KΩ ±5% 1/4W | |
| " -R12 | R1/4 5.6KΩJ | R:FXD CAR 5.6KΩ ±5% 1/4W | |
| " -R13 | R1/4 330ΩJ | R:FXD CAR 330Ω ±5% 1/4W | |
| " -R14 | R1/4 1.8KΩJ | R:FXD CAR 1.8KΩ ±5% 1/4W | |
| " -R15 | R1/4 56KΩJ | R:FXD CAR 56KΩ ±5% 1/4W | |
| " -R16 | R1/4 1.8KΩJ | R:FXD CAR 1.8KΩ ±5% 1/4W | |
| " -R17 | R1/4 12KΩJ | R:FXD CAR 12KΩ ±5% 1/4W | |
| " -R18 | R1/4 5.6KΩJ | R:FXD CAR 5.6KΩ ±5% 1/4W | |
| " -R19 | R1/4 1.8KΩJ | R:FXD CAR 1.8KΩ ±5% 1/4W | |
| " -R20 | R1/4 12KΩJ | R:FXD CAR 12KΩ ±5% 1/4W | |
| " -R21 | R1/4 5.6KΩJ | R:FXD CAR 5.6KΩ ±5% 1/4W | |
| " -R22 | R1/4 1.8KΩJ | R:FXD CAR 1.8KΩ ±5% 1/4W | |
| " -R23 | R1/4 12KΩJ | R:FXD CAR 12KΩ ±5% 1/4W | |
| " -R24 | R1/4 12KΩJ | R:FXD CAR 12KΩ ±5% 1/4W | |
| " -R25 | R1/4 1.8KΩJ | R:FXD CAR 1.8KΩ ±5% 1/4W | |
| " -R26 | R1/4 3.9KΩJ | R:FXD CAR 3.9KΩ ±5% 1/4W | |
| " -R27 | | Not assigned | |
| " -R28 | R1/4 15ΩJ | R:FXD CAR 15Ω ±5% 1/4W | |
| " -R29 | R1/4 5.6KΩJ | R:FXD CAR 5.6KΩ ±5% 1/4W | |
| " -R30 | R1/4 10ΩJ | R:FXD CAR 10Ω ±5% 1/4W | |
| " -R31 | R1/4 51ΩJ | R:FXD CAR 51Ω ±5% 1/4W | |
| " -R32 | R1/2 330ΩJ | R:FXD CAR 330Ω ±5% 1/2W | |
| " -R33 | R1/4 12KΩJ | R:FXD CAR 12KΩ ±5% 1/4W | |
| " -R34 | R1/4 220ΩJ | R:FXD CAR 220Ω ±5% 1/4W | |
| " -R35 | R1/4 82ΩJ | R:FXD CAR 82Ω ±5% 1/4W | |
| " -R36 | R1/4 51ΩJ | R:FXD CAR 51Ω ±5% 1/4W | |
| " -R37 | R1/4 270KΩJ | R:FXD CAR 270KΩ ±5% 1/4W | |
| 3110-5F206-R38 | R1/4 100ΩJ | R:FXD CAR 100Ω ±5% 1/4W | |

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-5F206-C41 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C42 | SC60YZ102P | C:FXD CER 0.001μF +100, -0% 50V | |
| " -C43 | DM10D101J3 | C:FXD DIPPED MICA 100pF ±5% 300V | |
| " -C44 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C45 | FC50SL150K | C:FXD CER 15pF ±10% 50V | |
| " -C46 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C47 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C48 | FC50SL030F | C:FXD CER 3pF ±1% 50V | |
| " -C49 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C50 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C51 | FC50SL020F | C:FXD CER 2pF ±1% 50V | |
| " -C52 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C53 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C54 | FC50SL020F | C:FXD CER 2pF ±1% 50V | |
| " -C55 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C56 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C57 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C58 | FC50SL030F | C:FXD CER 3pF ±1% 50V | |
| " -C59 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C60 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C61 | FC50SL020F | C:FXD CER 2pF ±1% 50V | |
| " -C62 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C63 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C64 | FC50SL050F | C:FXD CER 5pF ±1% 50V | |
| " -C65 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C66 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C67 | FC90SL331K | C:FXD CER 330pF ±10% 50V | |
| " -C68 | | Not assigned | |
| " -C69 | | Not assigned | |
| " -C70 | TAXH25V 220M | C:FXD ELECT TANTAL 22μF ±20% 25V | |
| " -C71 | DM10D101J3 | C:FXD DIPPED MICA 100pF ±5% 300V | |
| " -C72 | FC100SL471K | C:FXD CER 470pF ±10% 50V | |
| " -C73 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |
| " -C74 | FC100SL471K | C:FXD CER 470pF ±10% 50V | |
| 3110-5F206-C75 | SC80YZ103P | C:FXD CER 0.01μF +100, -0% 50V | |

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110-5F206-C76 | ECV-1ZW20X32 | C:VAR CER 20pF 500V | |
| " -C77 | DM05C 100J3 | C:FXD DIPPED MICA 10pF ±5% 300V | |
| " -C78 | DM05C 150K3 | C:FXD DIPPED MICA 15pF ±10% 300V | |
| " -L81 thru " -L85 | LT500 | L:FXD Coil 500μH | |
| " -L86 | LA3 (S2466361) | L:VAR Coil 1.5 ~ 3μH | |
| " -L87 thru " -L89 | LS33 | L:FXD Coil | |
| " -L90 thru " -L93 | LS22 | L:FXD Coil | |
| " -L94 | LA3 (S2466361) | L:VAR Coil | |
| " CL101 | 223A 840 | Heat Sink | |
| " -R105 | RD25S 220KΩJ | R:FXD CAR 220kΩ ±5% 1/4W | |
| " -L96 | N-1891 | L:FXD Coil | |
| " -L97 | N-1891 | L:FXD Coil | |
| " -C109 thru " -C111 | 0.01UF 50WV | C:FXD CER 0.01μF +80, -20% 50V | |
| " -C112 | 100PF 50WV | C:FXD CER 100pF ±10% 50V | |
| " -C113 | 220PF 50WV | C:FXD CER 220pF ±10% 50V | |
| " -C114 | 220PF 50WV | C:FXD CER 220pF ±10% 50V | |
| " -C115 | 330PF 50WV | C:FXD CER 330pF ±10% 50V | |
| " -C116 | 100PF 50WV | C:FXD CER 100pF ±10% 50V | |
| 3110-5F206-C117 | 220PF 50WV | C:FXD CER 220pF ±10% 50V | |

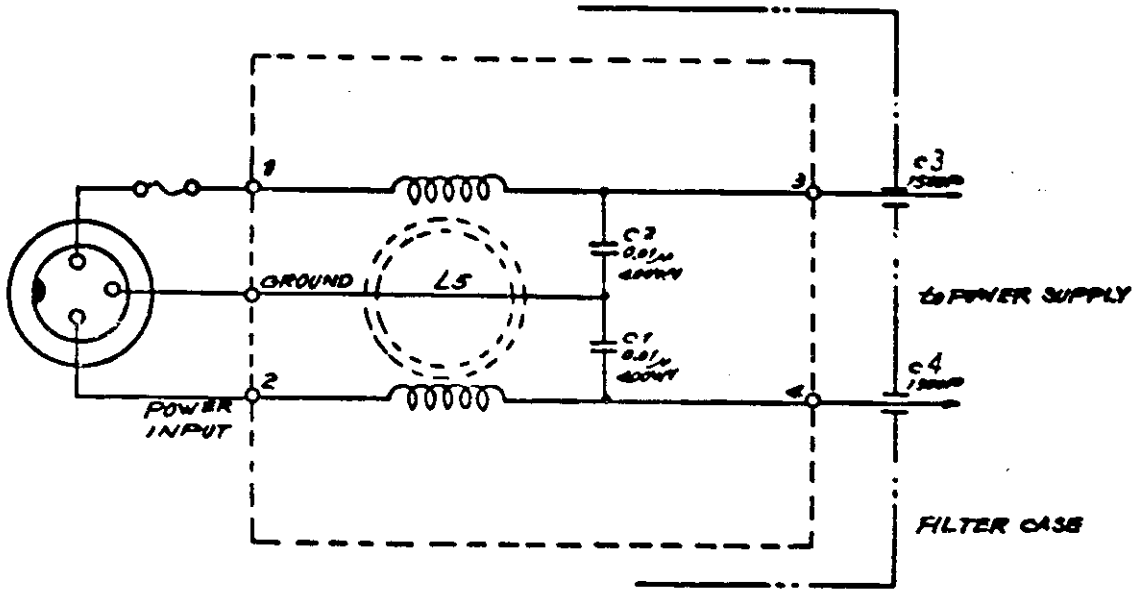
TR 3110/S

1/5 AND 1/10 DIVIDER & ISOLATOR SECTION

PD 042

| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110/S-PD042-IC1 | SN7490N | IC: Decade Counter | |
| " IC2 | SN7490N | IC: Decade Counter | |
| " Q5 | 2SC1834 | Transistor SI NPN | |
| " Q6 thru Q9 | 2SC594 | Transistor SI NPN | |
| " R13 | R1/4 22kΩJ | R:FXD CAR 22kΩ ±5% 1/4W | |
| " R14 | R1/4 1kΩJ | R:FXD CAR 1kΩ ±5% 1/4W | |
| " R15 | R1/4 33kΩJ | R:FXD CAR 33kΩ ±5% 1/4W | |
| " R16 | R1/4 22kΩJ | R:FXD CAR 22kΩ ±5% 1/4W | |
| " R17 | R1/4 6.8kΩJ | R:FXD CAR 6.8kΩ ±5% 1/4W | |
| " R18 | R1/4 100ΩJ | R:FXD CAR 100Ω ±5% 1/4W | |
| " R19 | R1/4 330ΩJ | R:FXD CAR 330Ω ±5% 1/4W | |
| " R20 | R1/4 1.2kΩJ | R:FXD CAR 1.2kΩ ±5% 1/4W | |
| " R21 | R1/4 10kΩJ | R:FXD CAR 10kΩ ±5% 1/4W | |
| " R22 | R1/4 10kΩJ | R:FXD CAR 10kΩ ±5% 1/4W | |
| " R23 | R1/4 100ΩJ | R:FXD CAR 100Ω ±5% 1/4W | |
| " R24 | R1/4 1kΩJ | R:FXD CAR 1kΩ ±5% 1/4W | |
| " R25 | R1/4 560Ω | R:FXD CAR 560Ω ±5% 1/4W | |
| " R26 | R1/4 3.3kΩJ | R:FXF CAR 3.3kΩ ±5% 1/4W | |
| " R27 | R1/4 22kΩJ | R:FXD CAR 22kΩ ±5% 1/4W | |
| " R28 | R1/4 6.8kΩJ | R:FXD CAR 6.8kΩ ±5% 1/4W | |
| " R29 | R1/4 100ΩJ | R:FXD CAR 100Ω ±5% 1/4W | |
| " R30 | R1/4 330ΩJ | R:FXD CAR 330Ω ±5% 1/4W | |
| " R31 | R1/4 1.2kΩJ | R:FXD CAR 1.2kΩ ±5% 1/4W | |
| " R32 | R1/4 10kΩJ | R:FXD CAR 10kΩ ±5% 1/4W | |
| " R33 | R1/4 10kΩJ | R:FXD CAR 10kΩ ±5% 1/4W | |
| " R34 | R1/4 100ΩJ | R:FXD CAR 100Ω ±5% 1/4W | |
| " R35 | R1/4 1kΩJ | R:FXD CAR 1kΩ ±5% 1/4W | |
| " R36 | R1/4 560ΩJ | R:FXD CAR 560Ω ±5% 1/4W | |
| " R37 | R1/4 220ΩJ | R:FXD CAR 220Ω ±5% 1/4W | |
| " R38 | R1/4 330ΩJ | R:FXD CAR 330Ω ±5% 1/4W | |
| 3110/S-PD042-C40 | SSC-80YZ103P | C:FXD CER 0.01μF +100%,-0% 50V | |

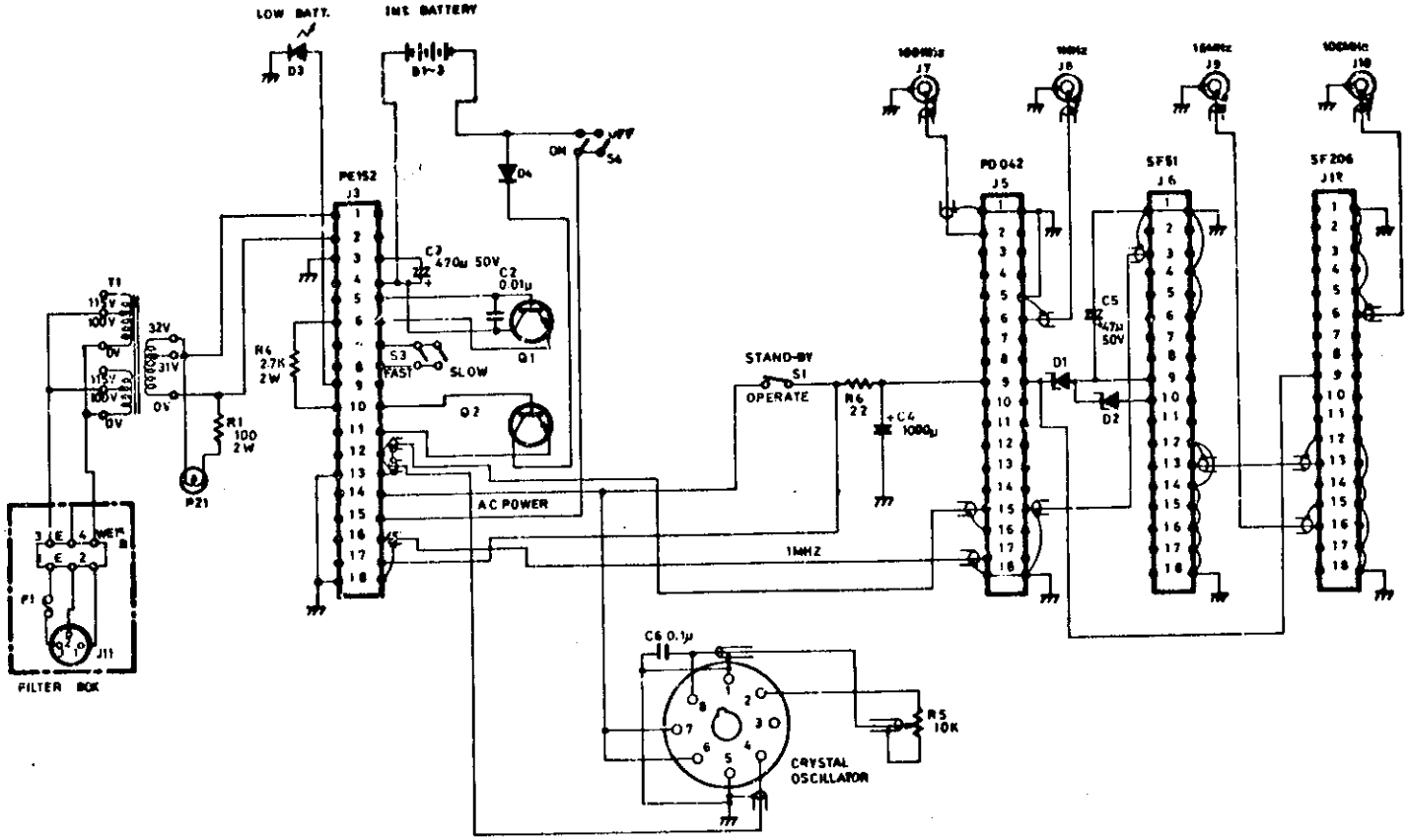
| Parts No. | Stock No. | Description | |
|---|---|---|---|
| 3110/S-PD042-C41 | SC80YZ103P | C:FXD CER 0.01μF +100%,-0% 50V | |
| " C42 | SC120YZ473P | C:FXD CER 0.047μF +100%,-0% 50V | |
| " C43 | DM19D512J3 | C:FXD Dipped Mica 0.0051μF ±5% 300V | |
| " C44 | DM15D102J3 | C:FXD Dipped Mixa 0.001μF ±5% 300V | |
| " C45 | DM19D202J3 | C:FXD Dipped Mica 0.002μF ±5% 300V | |
| " C46 | FNXH2P47K | C:FXD Metallized Film 0.47μF ±10% 200V | |
| " C47 | MXT 1P1K | C:FXD Mylar 0.1μF ±10% 100V | |
| " C48 | SL50TH4R7 | C:FXD ELECT 4.7μF ±10% 500V | |
| " C49 | MXT1P1K | C:FXD Mylar 0.1μF ±10% 100V | |
| " C50 | SC80YZ103P | C:FXD CER 0.01μF +100%,-0% 50% | |
| " C51 | DM15D102J3 | C:FXD Dipped Mica 0.001μF ±5% 300V | |
| " C52 | DM10D331J3 | C:FXD Dipped Mica 330pF ±5% 300V | |
| " C53 | FNXH 2P22K | C:FXD Metallized Film 0.22μF ±10% 200V | |
| " C54 | MXT1P1K | C:FXD Mylar 0.1μF ±10% 100V | |
| " C55 | SL50TH4R7 | C:FXD ELECT4.7μF 50V | |
| " C56 | MXT1P1K | C:FXD Mylar 0.1μF ±10% 100V | |
| " L59 | L10B3 | L:VAR Coil | |
| 3110/S-PD042-L60 | L10B1 | L:VAR Coil | |




NOTE
UNLESS OTHERWISE INDICATED
CAPACITANCE IN FARADS;

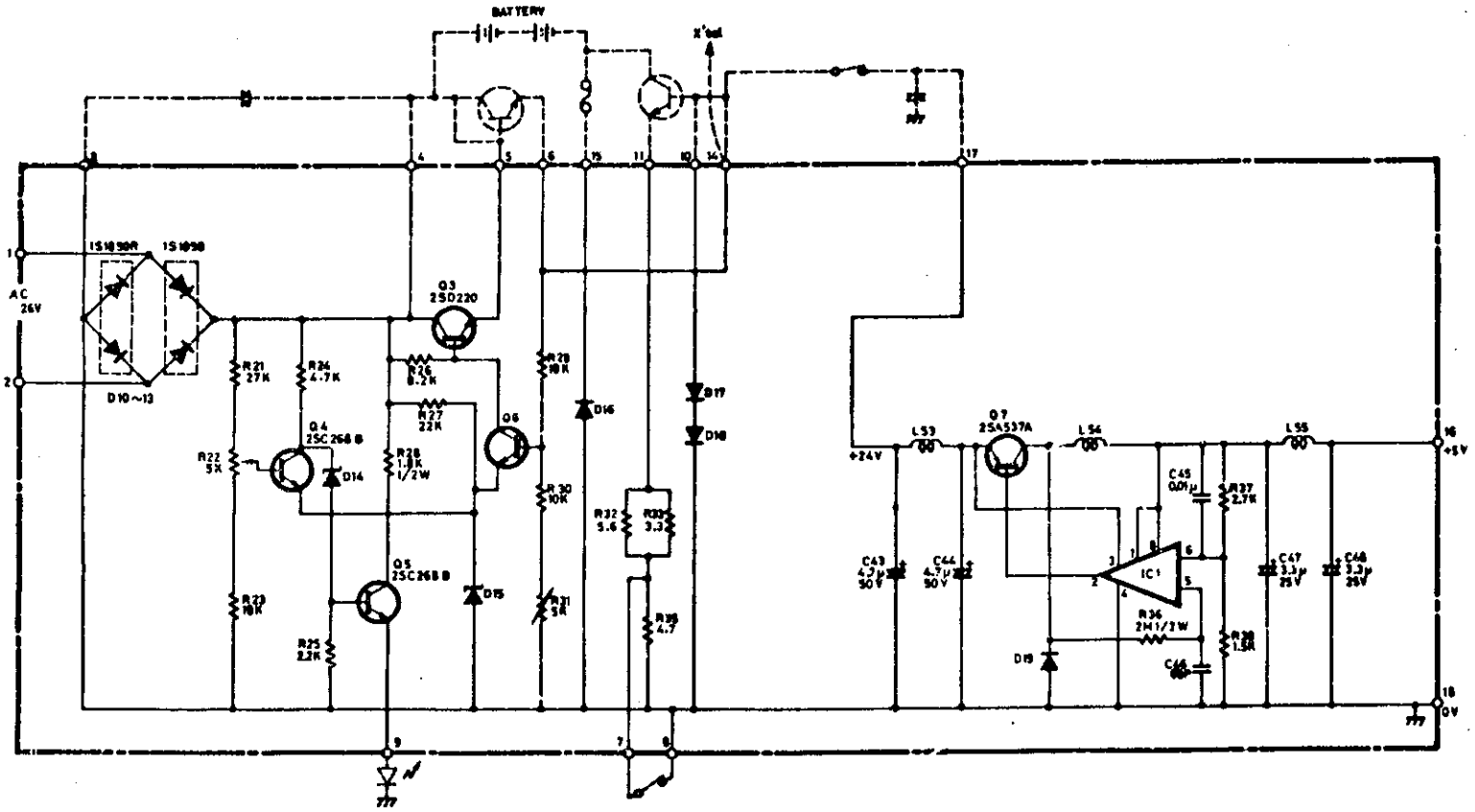
M-740004-10

WE15A/WE15B
LINE FILTER

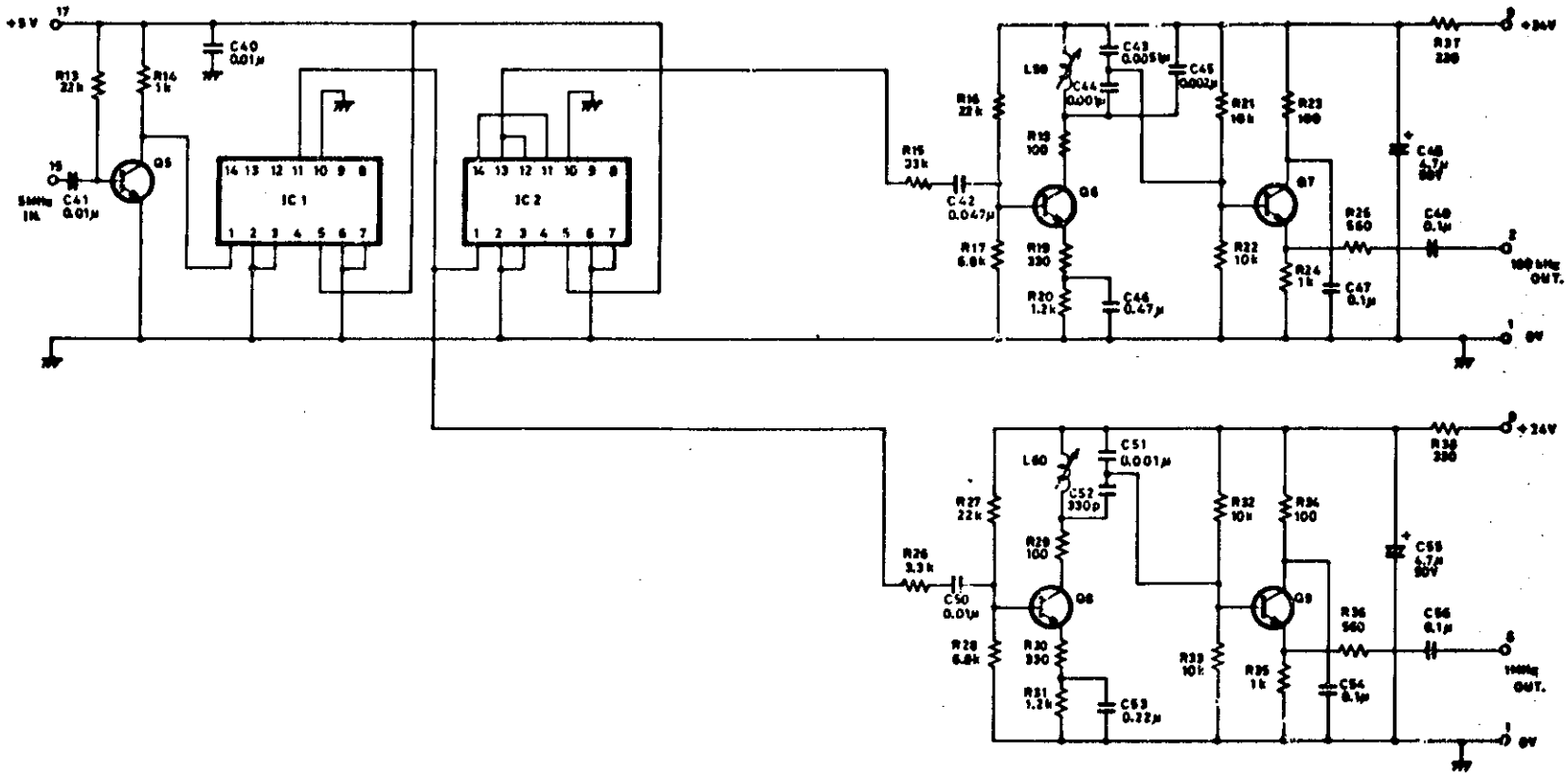



-R-2110
SCHEMATIC SECTION

0048400-9-C

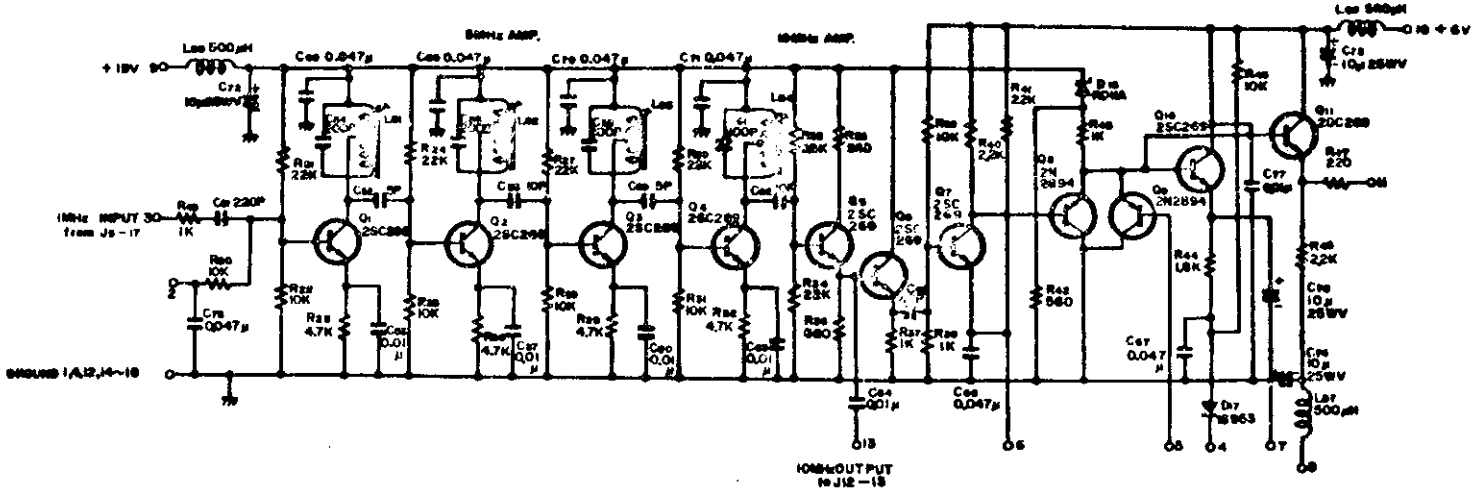



-M-3110
POWER SUPPLY
PE152



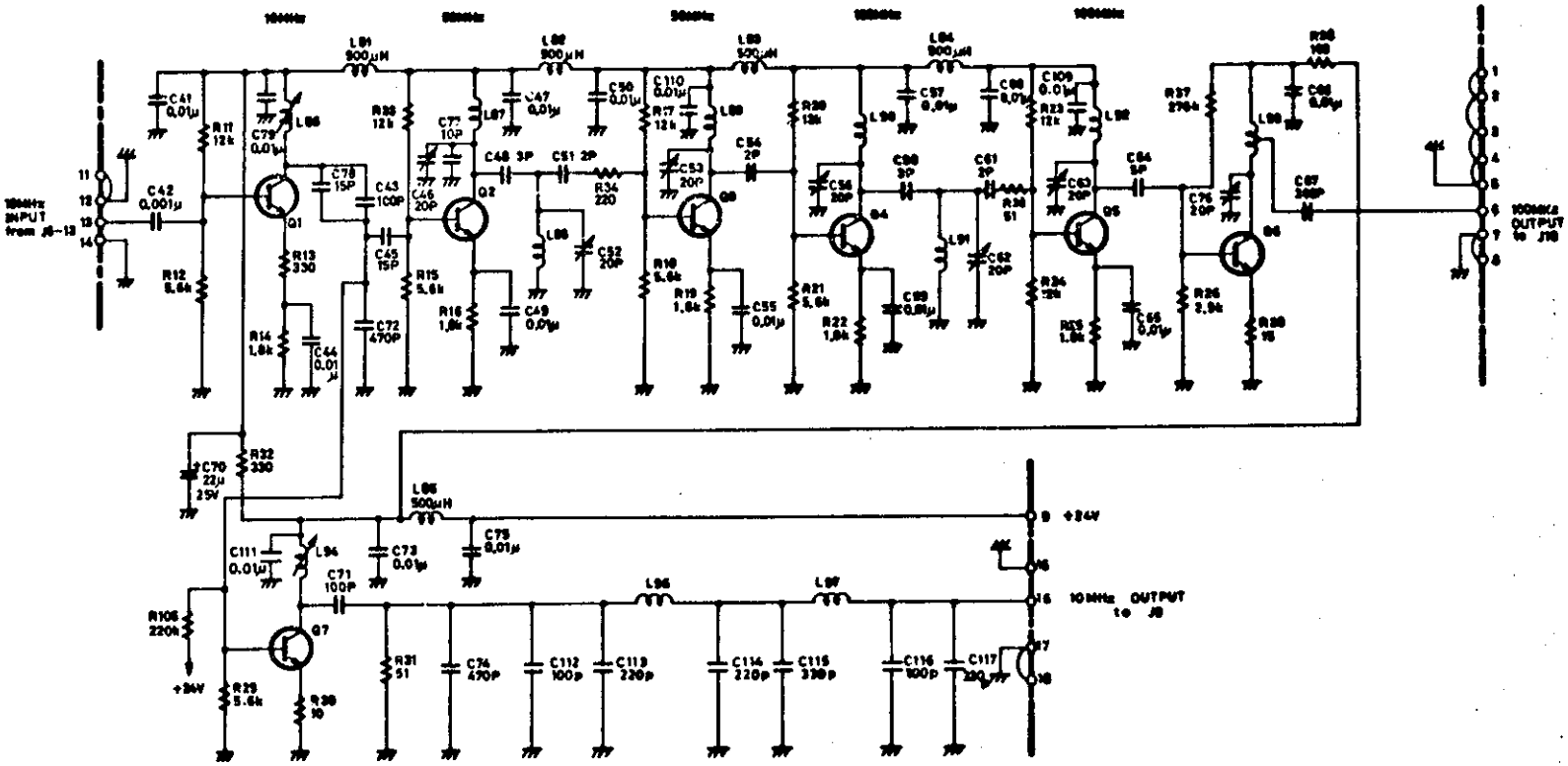

0048408-6-8

**TR3110**
**1/5 & 1/10 DIVIDER, ISOLATOR**
**PD042**



-TR-3110
5F51
MULTIPLIER

0048406-6




TR3110
100MHz MULTIPLIER
SF208

0648486-7-C

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# LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

# CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

# SALES & SUPPORT OFFICES


Advantest Korea Co., Ltd.
22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.
Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.
3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH
Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723



ADVANTEST®

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500