
**Figure 1-1. Model 711 Frequency Counter**

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## SAFETY SYMBOLS

The following Safety Symbols are now common and are defined here for the benefit (and education) of instrument users who may not be familiar with them or their meaning.

This symbol adjacent to a terminal, operating device, or other marking, indicates that the Operator must refer to the operating instructions for further information or instructions to avoid damage to the equipment and/or to avoid personal injury.

**WARNING** This WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.

**CAUTION** This CAUTION sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the Instrument.

**HIGH VOLTAGE WARNING:** An output terminal at which a voltage, with respect to another terminal or to earth ground, exists or may be adjusted to exceed 1000 volts AC or DC if a current exceeding 0.5 milliampere can be delivered into a 1500 ohm resistive load connected between the same points. The symbol is an additional warning that a very dangerous voltage may exist at the terminal, and the terminal and its connecting leads must not be handled while energized.

**GROUNDED TERMINAL (PROTECTIVE):** A terminal which must be connected to earth ground by the Operator or Installer prior to making any other connections to the equipment for personal protection from electrical shock.

**GROUNDED TERMINAL:** A terminal which is connected to earth ground by means of an earth grounding system and which is intended to be connected to other circuits or equipment by the Operator or Installer for purposes other than protection from electrical shock.

**WARNING**

**This Instrument is designed to prevent accidental shock to the Operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.**

**SHOCK HAZARD:** As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

**NOTE:** The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC Leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

# SECTION I

# INTRODUCTION

## 1.1 GENERAL

**1.1.1** The Simpson 711 Frequency Counter (hereafter referred to as the 711 or the Instrument) is a highly accurate, versatile frequency counter suitable for use in C.B. communications, servicing, production line testing, laboratory, and in digital systems for industrial controls. Specifically, the 711 (Figure 1-1), is intended for any use where frequencies are to be measured. The Instrument provides direct counting capability from 10 Hz to frequencies in excess of 80 MHz. When interfaced with a high frequency prescaler such as the Simpson 7020, the 711 counting capability is extended to high frequency signals in excess of 500 MHz. For other applications, refer to paragraph 4.4 of this manual.

## 1.2 DESCRIPTION

**1.2.1** This highly accurate Instrument features an overrange capability which provides up to nine-digit resolution in frequency measurements. Maximum reliability, with a minimum number of components, is achieved by using monolithic integrated circuits. The Instrument maintains its rated accuracy over a wide temperature range and line voltage variations. Standard features include: 0.35 inch high LED display, display storage, automatic decimal point location, ±10 PPM time base accuracy, overrange indication, high input impedance, and input over-load protection. This Instrument can operate with 120V AC 50-400 Hz adapter (catalog number 00751); 230V AC 50-400 Hz adapter (catalog number 00752) or 12V DC auto cigarette lighter adapter (catalog number 00756).

**1.2.2** The 711 provides numerical display of average frequencies from 10 Hz to 80 MHz in two ranges.

**1.2.3** Components in the frequency counter have been placed for ease of maintenance and increased instrument durability. All circuit components are mounted on only two printed circuit boards for both instrument reliability and access to test points. Ambient lighting effects are minimized by a filter which reduces reflections and background illuminations. With simplified switch and control nomenclatures, operator errors are reduced to a minimum. Personnel with no experience with an instrument of this type can obtain quick and accurate measurements with minimum training.

## 1.3 SAFETY CONSIDERATIONS

**1.3.1** This Operator's Manual contains cautions and warnings alerting the user to hazardous operating and service conditions. This information is flagged by CAUTION or WARNING headings throughout this publication, where applicable, and are defined at the front of this manual under SAFETY SYMBOLS. To ensure the safety of operating and servicing personnel and to retain the operating conditions of the Instrument these instructions must be adhered to.

## 1.4 SUPPLIES AND ACCESSORIES

**1.4.1** All supplies and accessories required for the operation of the Frequency Counter are furnished with each Instrument and listed in the accompanying Table 1-2. Available replacement parts are listed in Table 6-2.

## 1.5 TECHNICAL DATA

**1.5.1** Table 1-1 lists the technical data for the Simpson 711.

**Table 1-1. Technical Data**

**1. FREQUENCY**

| | |
|---|---|
| Frequency Range: | 10 Hz to 80 MHz |
| Gate Time: | 10 msec (0.1 kHz resolution), 1 sec (1 Hz resolution) |
| Accuracy: | ±1 count ±time base accuracy |

**2. INPUT CHARACTERISTICS**

**INPUT (AC coupled)**

| | |
|---|---|
| Impedance: | 1 MΩ shunted by 30 pF |
| Frequency Range: | 10 Hz to 80 MHz |
| Sinewave Sensitivity: | 50 mV RMS, from 10 Hz to 60 MHz; 100 mV RMS 60 MHz to 80 MHz |
| Maximum Input: | 240 V peak, from 10 Hz to 100 kHz derated to 100V peak at 1 MHz and 15V peak to 60 MHz. |

**3. INTERNAL TIME BASE**

| | |
|---|---|
| Frequency: | 6.5536 MHz |
| Temperature Stability: | ±10 ppm maximum, 0 °C to +45 °C |
| Aging Rate: | ±5 ppm maximum per year |
| Stability with Line Voltage Variations: | ±1 ppm for ±10% line voltage variation |

**4. INPUT FILTER:** 3 dB at 1 MHz

**5. GENERAL**

| | |
|---|---|
| Display: | 0.35 inch character height, 7-segment LED type 6 digits |
| Sample Rate: | 5 sample/sec at MHz position<br>0.5 sample/sec at Hz position |

**6. TEMPERATURE RANGE**

| | |
|---|---|
| Operating: | 0 °C to +45 °C |
| Storage: | −40 °C to +70 °C |

**7. POWER REQUIREMENT:** 120 VAC ±10%, (standard) or 230 VAC ±15% (optional) 50, 60, 400 Hz; approximately 5 VA

**8. DIMENSIONS**

| | |
|---|---|
| Height: | 2 in. (50.8 mm) |
| Width: | 5.6 in. (142.2 mm) |
| Depth: | 4.6 in. (116.8 mm) |

**Table 1-2.**
**Accessories and Items Furnished with Instrument**

| DESCRIPTION | NUMBER |
|---|---|
| 711 Frequency Counter | 10-865570 |
| AC Adapter 120VAC (Standard) | 00751 |
| AC Adapter 230VAC (Optional) | 00752 |
| Operator's Manual | 6-114167 |

# SECTION II

# INSTALLATION

## 2.1 GENERAL

**2.1.1** This section contains information and instructions for the installation and shipping of the 711. Included are unpacking and inspection procedures, warranty, shipping, power source requirements and installation.

## 2.2 UNPACKING AND INSPECTION

**2.2.1** Unpack and inspect the Instrument for possible damage in shipment. Check the electrical performance as soon as possible. If damage is noted, notify the carrier and supplier before using the Instrument. Also, check that all items are included (Table 1-2).

**2.2.2** Save the shipping carton and packing materials for future storing or shipping of the Instrument.

## 2.3 WARRANTY

**2.3.1** The Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting a warranty repair.

**NOTE:** For assistance of any kind, including help with the Instrument under warranty, contact the nearest Authorized Service Center for instructions (listed on the last pages of this manual). If it's necessary to contact the factory directly, give full details of the difficulty and include the Instrument model number, serial number (at the back of the Instrument) and date of purchase. Service data or shipping instructions will be sent to you promptly. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without prior approval.

## 2.4 SHIPPING

**2.4.1** Pack the Instrument carefully and ship it prepaid to the proper destination. Insure the shipment.

## 2.5 POWER SOURCE REQUIREMENTS

**WARNING**

**The 711 is designed specifically to be used with the Simpson 120 VAC adapter (Cat. No. 00751) or the 230 VAC adapter (Cat. No. 00752). If a substitute adapter is used, make certain it is insulated for at least 250 VAC between the primary and secondary circuits in accordance with applicable safety standards.**

**2.5.1** Connect the adapter supplied to the appropriate external power source. (Refer to the markings on the adapter for power source requirements.)

**WARNING**

**Before proceeding with the operation of the 711, review the SHOCK HAZARD at the front of this manual.**

## 2.6 INSTALLATION

**2.6.1** The Instrument may be set horizontally on its rubber feet or vertically on its back and operated in either position. The Instrument can also be set at an inclined angle by positioning the stand under the unit.

# SECTION III

# CONTROLS, CONNECTORS AND INDICATORS

## 3.1 GENERAL

**3.1.1** All operating and adjustment controls, connectors, and indicators are described in this section along with a list (Table 3-1) describing their function. Become familiar with each item prior to operating the Instrument.

## 3.2 FRONT AND SIDE PANEL DESCRIPTION

**3.2.1** Table 3-1 lists all front, rear panel controls, connectors and indicators. Figure 3-1 shows the locations.

**Table 3-1. Front and Side Panel Description**

| | |
|---|---|
| 1. **POWER Switch:**<br>**ON**<br>**OFF** | Pushbutton switches used to apply or turn off input power to the Instrument. |
| 2. **MHz Switch:** | Selects 10 msec gate time for frequency measurements. Automatically locates decimal point for MHz reading. |
| 3. **Hz Switch:** | Selects 1 sec gate time for frequency measurements. Readings are in Hz. |
| 4. **Filter:**<br>**IN**<br>**OUT** | Selects low-pass filter to eliminate high frequency noise on low frequency signals. |
| 5. **INPUT Connector:** | Provides AC coupling to the amplifier. |

6. **Overrange Indicator:** Illuminates when the measured signal value exceeds the full scale range (999999 counts).

7. **Numeric Display Indicator:** 7 Segment LED display to indicate magnitude of the signal being measured.

8. **INPUT POWER:** This receptacle accepts the DC power from AC adapter or 12V DC Auto Cigarette lighter adapter.

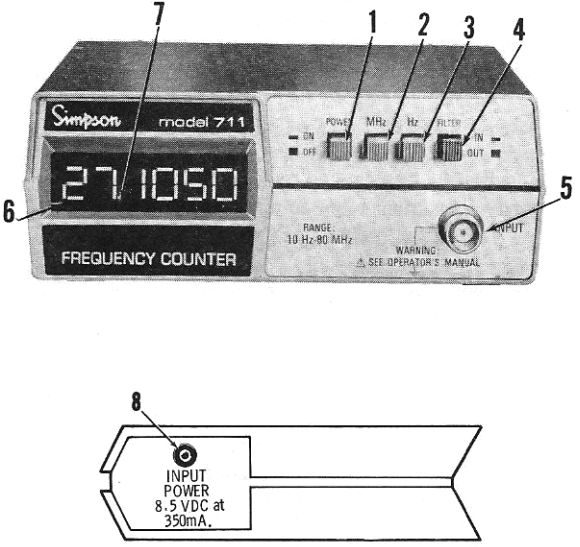



**Figure 3-1. Front and Side Panel, Controls, Connectors, and Indicators**

# SECTION IV

# OPERATION

## 4.1 GENERAL

**WARNING**

**Before proceeding with the operation of the 711, review the SHOCK HAZARD at the front of this manual.**

**4.1.1** The 711 measures frequency from 10 Hz to in excess of 80 MHz. The following contains all the information related to the operation of the Instrument. Special notes and instructions have also been provided for added safety and convenience.

## 4.2 SAFETY PRECAUTIONS

**4.2.1** The 711 is designed to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury.

**4.2.2** Do not work alone when making measurements where a shock hazard can exist. Notify a nearby person that you are making, or intend to make, such measurements.

**4.2.3** Do not exceed the maximum input voltage ratings of the 711 which are tabulated in Table 1-1. To do so endangers personal safety and may also damage the Instrument.

**WARNING**

**The input BNC connector is not grounded. To avoid electrical shock, connect the outer shell of the input BNC connector only to ground potential or to a potential no greater than 42.4 volts peak (30 VRMS) with respect to ground.**

**4.2.4** Observe the correct polarity when making connections, as the input connector outer shell is not grounded to the powerline.

**Remember:** Voltage might appear unexpectedly in defective equipment. An open bleeder resistor can result in a capacitor retaining a dangerous charge. Remove all power and discharge all capacitors in the circuit being measured before making connections or disconnections.

**4.2.5** Locate all voltage sources prior to making any connections. Do not touch leads, circuits or the Instrument, while power is applied to the circuit being measured. Always inspect leads and connectors for cracks, breaks or crazes before each use. If any defects exist, replace the defective item immediately.

**4.2.6** Use extreme caution when making measurements in a circuit where a dangerous combination of voltages could be present, such as in an r-f amplifier.

## 4.3 FREQUENCY MEASUREMENT PROCEDURE:

a. **Review Safety Information in Paragraphs 4-1 and 4-2.**

b. Depress POWER pushbutton switch to ON position.

c. Select MHz (2) or Hz (3) for desired count time or base time.

d. Connect signal being measured to Input Connector (5) while signal source is off. (Refer to paragraph 4.2.3)

e. Read frequency from display (7). Decimal point is correctly positioned, and correct measurement unit (MHz, Hz) is indicated by the depressed MHz or Hz pushbutton switch.

f. Depress filter (4) to IN position to eliminate high frequency noise on low frequency signals.

## 4.4 APPLICATION

### 4.4.1 C.B. Frequency Measurements:

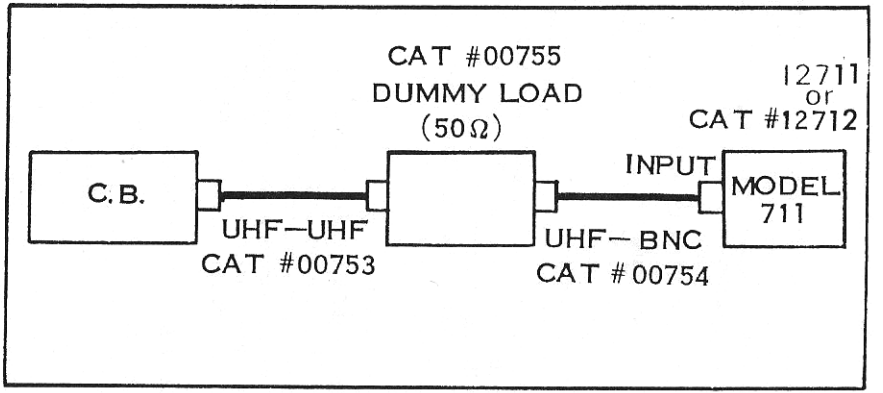
a. Connect the circuit shown in the diagram on page 4-4.

b. Select the desired C.B. channel to be measured.

c. Depress the MHz pushbutton switch IN for frequency measurement in MHz or the Hz pushbutton switch for measurement in Hz.

d. Turn C.B. unit and 711 ON.

e. Key in the microphone without speaking into it. The carrier frequency will be displayed in the 711.


CAT #00755
DUMMY LOAD
(50Ω)
12711
or
CAT #12712
C.B.
INPUT
MODEL
711
UHF—UHF
CAT #00753
UHF— BNC
CAT # 00754

# SECTION V

# THEORY OF OPERATION

## 5.1 GENERAL

**5.1.1** This section describes the theory of operation of the 711. All modes of operation are described first, then description of the circuits follows. (Figure 5-1 shows the overall block diagram of the Instrument).

## 5.2 FREQUENCY MEASUREMENT

**5.2.1** This circuit arrangement (as shown in Figure 5-1) permits control of the Gate by time base generator signals. The Gate is opened for a controlled time; therefore, the accumulated count represents the number of input cycles or pulses during this time. Controlled interval is selectable by the front panel pushbutton switch either in 10 msec or 1 sec. The decimal point is automatically positioned, and the readout is in Hz, or MHz as indicated by the pushbutton switch position (Figure 6-1 Timing Diagram).

## 5.3 AMPLIFIER

**5.3.1** The amplifier (Figure 5-1) consists of a junction field-effect (high input impedance) transistor; AC coupled to a wide-band, linear-integrated circuit amplifier. Sufficient gain is maintained for a frequency response of 10 Hz to 80 MHz. Input overload protection is provided by two silicon diodes at the input of the amplifier.

## 5.4 TIME BASE GENERATOR

**5.4.1** The Time Base Generator consists of a high stability crystal oscillator and frequency divider providing the gating signals for the count window, store function, reset function and Multiplex frequency reference. The duration of the count window may be selected by the front panel pushbutton switch for either 10 msec or 1 sec.

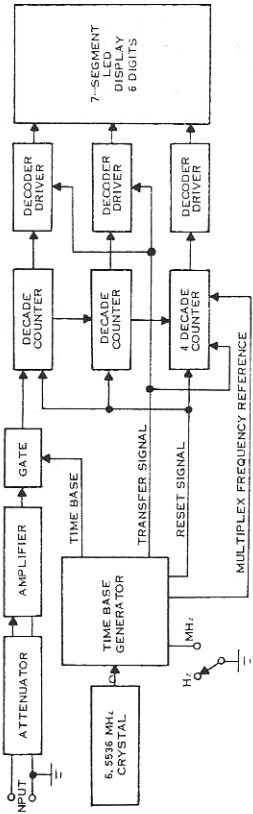



**Figure 5-1. Block Diagram**

## 5.5 GATE AND GATE CONTROL CIRCUITS

**5.5.1** The Gate is a "NAND" gate which consists of a 2-input integrated circuit whose function is to control the input pulses to the Decade Counters. In frequency measurement, the signal being measured appears at one input. The time-base signal (duration selected by the MHz or Hz switch), acts as the controlling elements, and appears at the other input.

**WARNING**

*These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform ony servicing other than that contained in the operating instructions unless you are qualified to do so.*

# SECTION VI

# SERVICING INSTRUCTIONS

## 6.1 GENERAL

**6.1.1** This section of the manual describes the line voltage, instrument cover removal and calibration necessary for servicing the 711. (Table 6-1 lists the typical power supply voltages.)

## 6.2 LINE VOLTAGE

**6.2.1** During the performance checks, the adapter shall be connected to a power source through a variable voltage device. This procedure enables the line voltage to be varied ±10% from 120 VAC or ±15% from 230 VAC, thus assuring satisfactory performance under various supply conditions.

## 6.3 INSTRUMENT COVER REMOVAL

**WARNING**

**Remove all power and connections to the Instrument prior to removing the rear cover. Do not operate the Instrument with the rear cover removed.**

**6.3.1** The following steps shall be taken when removing the instrument cover:

a. Depress the POWER switch to the OFF position.

b. Disconnect the adapter from the Instrument and input leads from Input BNC connector.

c. Turn the two screws on the back cover counterclockwise until the rear cover is removed. (The two screws will remain in the cover.)

d. Reverse this procedure when replacing the cover.

## 6.4 CALIBRATION

**6.4.1** To calibrate the 711, perform the following procedures:

a. Plug adapter into an appropriate power source. Turn power "on" and allow one hour warm-up.

b. Remove the rear panel. Depress the "Hz" switch on front panels.

c. Connect the input connector of the 711 to a precision frequency standard of 10 MHz with accuracy better than ±1 PPM.

d. Using an insulated screwdriver, adjust the trimmer capacitor, C, to allow the unit to read: 000000 ± 1 count with the OVERRANGE indicator on.

e. Replace the rear panel.

**Table 6-1. Typical Power Supply Voltage**

| POWER SUPPLY | VOLTAGE* | RIPPLE |
|---|---|---|
| +5V CIRCUIT | | |
| Pin #2 of IC15 | 4.8—5.2V | 30mV p-p |

**The above voltage is a typical value and will vary with component tolerances and line voltage.*

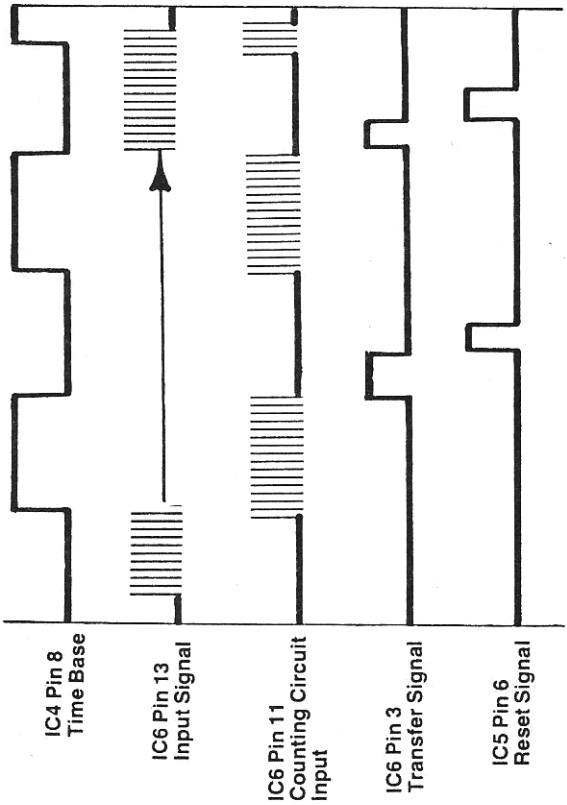



Figure 6-1. Timing Diagram Frequency Measurement shown in Hz position)

## 6.5 REPLACEMENT PARTS AND SCHEMATIC DIAGRAM

**NOTE:** This Instrument must be serviced by qualified personnel. To aid in troubleshooting, a schematic diagram is enclosed. The accompanying parts list (Table 6-2) describes the components and refers to Simpson part numbers. Reference Symbol numbers correlate the components shown on the schematic diagram with the parts list.

**6.5.1** The following information is provided as an adjunct to the overall text contained in this manual and should be read and understood thoroughly prior to ordering replacement parts for this Instrument.

**6.5.2** To obtain replacement parts, address order to the nearest Authorized Service Center (listed on the last pages of this manual). Refer to paragraph 2.5.1 for ordering instructions.

**Table 6-2. Replacement Parts**

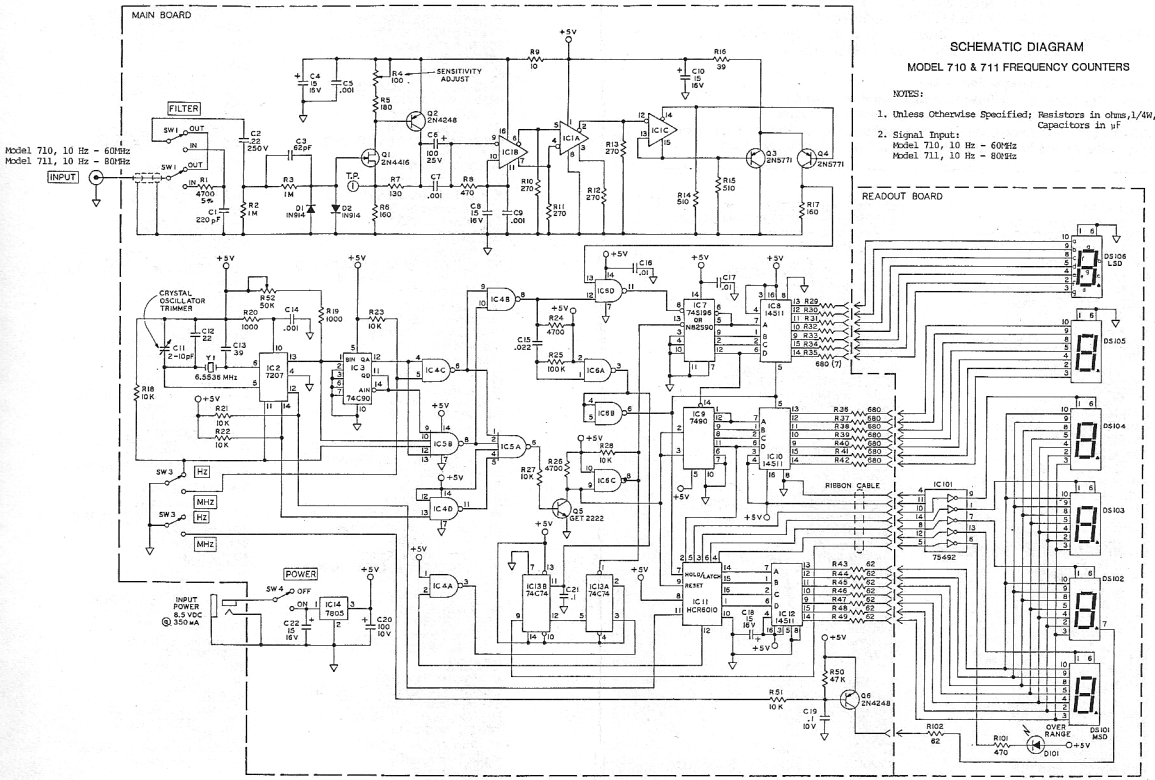
| Symbol | Description | Part No. |
|---|---|---|
| | Board P.C. Main | 6-110354 |
| | Board P.C. Readout | 6-110355 |
| C1 | Capacitor, 220pf 500V | 5-112691 |
| C2 | Capacitor, .22μf 250V | 6-110364 |
| C3 | Capacitor, 62pf 500V | 5-116187 |
| C4,8, 10,18 | Capacitor, 15μf 16V elect. | 5-115534 |
| C5,7,9, 14 | Capacitor, .001μf 25V elect. | 5-111119 |
| C6,20 | Capacitor, 100μf 16V | 5-117737 |
| C10 | Capacitor, 15μf 16V | 5-115534 |
| C11 | Capacitor, Trimmer, 2-10pf | 5-118190 |

## Replacement Parts

| Symbol | Description | Part No. |
|---|---|---|
| C12 | Capacitor, 25pf 1kV | 5-117609 |
| C13 | Capacitor, 39pf 1 kV | 5-118561 |
| C15 | Capacitor, .022μf 100V | 5-116188 |
| C16,17 | Capacitor, .01μf 50V | 5-113215 |
| C19,21 | Capacitor, .1μf 10V | 5-113214 |
| D1,2 | Diode 1N914 | 5-112004 |
| IC1 | Line Receiver IC10216P | 6-114157 |
| IC2 | Oscillator Control ICM7207 | 6-110371 |
| IC3 | Decade Counter DM74C90N | 6-110370 |
| IC4 | Quad 2 Input Gate DM74L00N | 5-115471 |
| IC5 | Dual 4 Input Gate DM74C20N | 5-118311 |
| IC6 | Quad 2 Input Gate 74S00N | 5-117146 |
| IC7 | Decade Counter N82S90 | 5-117147 |
| IC8,10 12 | Decoder-Driver MC14511CP | 5-119927 |
| IC9 | Decade Counter DM7490N | 5-114939 |
| IC11 | 4½ Digit Counter HCTR6010 | 5-119506 |
| IC13 | Dual D.F.F. DM74C74 | 5-118312 |
| IC14 | +5V Regulator 7805 | 5-117149 |
| IC101 | MosLED Hex Driver 75492 | 5-119928 |
| Q1 | N-FET 2N4416 | 6-110373 |
| Q2,6 | PNP Transistor 2N4248 | 5-115484 |
| Q3,4 | NPN Transistor 2N5771 | 5-117827 |
| Q5 | NPN Transistor GET 2222 | 5-115934 |
| R1 | Resistor, 4.7Ω ± 5% ½W | 5-118609 |
| R2,3 | Resistor, 1MΩ ± 5% ¼W | 5-118305 |
| R4 | Potentiometer, 100Ω ± 20% | 6-110450 |
| R5 | Resistor, 180Ω ± 5% ¼W | 5-118153 |
| R6,17 | Resistor, 160Ω ± 5% ¼W | 6-110362 |
| R7 | Resistor, 130Ω ± 5% ¼W | 6-110361 |
| R8 | Resistor, 470Ω ± 10% ¼W | 1-116372 |
| R9 | Resistor, 10Ω ± 5% ¼W | 5-115117 |
| R10,11 12,13 | Resistor, 270Ω ± 10% ¼W | 5-114969 |
| R14,15 | Resistor, 510Ω ± 5% ¼W | 5-114965 |
| R16 | Resistor, 39Ω ± 5% ¼W | 6-110360 |

## Replacement Parts

| Symbol | Description | Part No. |
|---|---|---|
| R18,21 22,23, 27,28,51 | Resistor, 10kΩ ± 5% ¼W | 5-118161 |
| R19,24 26 | Resistor, 4.7kΩ ± 5% ¼W | 5-118160 |
| R20 | Resistor, 1kΩ ± 5% ¼W | 5-118155 |
| R25 | Resistor, 100kΩ ± 5% ¼W | 5-118168 |
| R29-R42 | Resistor, 680Ω ± 5% ¼W | 6-110363 |
| R43-R49 | Resistor, 62Ω ± 5% ¼W | 5-118499 |
| R50 | Resistor, 47kΩ ± 10% ¼W | 5-113628 |
| | Bracket, Power Connector | 6-160359 |
| | Cable, Fabricated, 7 Cond. Ribbon | 3-812469 |
| | Shield, Amplifier | 6-160353 |
| | Button, Push, Gray | 6-110115 |
| | Button, Push, Black | 6-110114 |
| | Button, Push, Red | 6-110113 |
| | Switch, Pushbutton, 4 Station | 6-110358 |
| | Crystal, 6.55360 MHz | 6-110356 |
| | Diode, Light Emitting, Red | 5-119411 |
| | Readout, LED, 7 Segment, w/Dec. Point | 6-110366 |

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