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PTS 3200

OPERATION MANUAL

PROGRAMMED TEST SOURCES, inc.
Littleton, Massachusetts, USA

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OPERATION MANUAL

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Introduction

This manual covers the PTS 3200 Frequency Synthesizer and contains information necessary to install, operate and service the instrument.

The PTS 3200 is a precision frequency generator. It uses the accuracy and stability of a frequency standard operating at 5.0 or 10.0 MHz, either built-in or external, to produce output frequencies between 1.0 and 3199.999 999 MHz, with up to 10 significant digits. All output frequencies are coherent with the standard frequency and reflect its stability and accuracy. Any frequency within the above band may be selected by front panel or remote control with resolution as fine as 1 Hz. The output from the levelled system is +3 to +13 dBm into 50 ohms and may be adjusted manually by the front panel control or remotely by analog voltage.

The PTS 3200 is a direct frequency synthesizer capable of providing signals for many uses requiring stable and accurate sine wave signals with low attendant spurious outputs, low phase noise and fast transfer between selected frequencies. Typical applications include communications, spectrum analysis, surveillance and radar, and automatic test systems with both narrow and wideband coverage.

Manual Organization

The PTS 3200 is a complete and integrated system using numerous modules installed on a deck inside the instrument mainframe. All information pertaining to the instrument as a complete system is presented in this Operation Manual. This manual also covers items which are integral parts of the mainframe, such as power supply, front panel, rear panel and crystal oscillator. The GPIB interface, which mounts to the rear panel and replaces the PE-1121 parallel interface, is covered in a separate section.

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SPECIFICATIONS

Frequency

Range:	1.000 000 MHz to 3199.999 999 MHz
Resolution:	1 Hz
Accuracy:	same as frequency standard
Control:	manual by keyboard and LCD display; remote by TTL-level parallel entry BCD-encoded negative true logic

Switching Time (to within 0.1 radian at new frequency)

1 GHz - 10 MHz digits:	20 µseconds
1 MHz digit:	5 µseconds
100 KHz - 1 Hz digits:	1 µs transient, 2 µs delay

Phase Continuous Switching Range 100 KHz through 1 Hz digits

Output

Level:	+3 to +13 dBm (1Vrms max., 50 Ω)
Flatness:	±0.7 dB
Impedance:	50 Ω
Control:	manual by front panel control; remote by analog voltage
Connector:	SMA female

Spurious Outputs (at full power output, +13 dBm)

Discrete:	-60 dBc 1 - 1600 MHz -55 dBc 1600 - 3200 MHz
Harmonics:	-30 dBc (-35 dBc at lower power levels)
Phase Noise:	-60 dBc (0.5 Hz to 15 KHz, including effects of internal standard)
£ (1 Hz):	100 Hz/-99 dBc, 1 KHz/-108 dBc, 10 KHz/-116 dBc, 100 KHz/-118 dBc
Noise Floor:	-130 dBc/Hz

Optional Phase Rotation

0.36° increments, 0 - 360° (1 - 1599.999 999 MHz)
0.72° increments, 0 - 360° (1600 - 3199.999 999 MHz)

Frequency Standard (Note: internal or external standard required for operation)

Internal:	OCXO	TCXO
	3×10^{-9} / day	1×10^{-8} / day
	$\pm 1 \times 10^{-8}$/0 - 50°C	$\pm 1 \times 10^{-6}$/0 - 50°C
	1×10^{-6}/year	2×10^{-6}/year

External: 10.000 MHz, 0.4 - 2.0Vrms into 300 Ω;
5.000 MHz, 0.5 - 2.0Vrms into 300 Ω

Auxiliary Output: 10.000 MHz, 0.4Vrms into 50 Ω

General

Operating Ambient:	10 - 45°C, 95% relative humidity, altitude 0 - 2,000m
Power:	120/220-230/240 VAC ±10%, 50 - 60 Hz, 70W
IEC Installation category:	II
IEC Pollution degree:	2
Dimensions:	19 x 5.25 x 18 inches maximum (rack or bench cabinet)
Weight:	40 lbs/18 Kg approx.

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Installation

CAUTION: Refer to **Primary Power**, page 4, before connecting instrument to line voltage.

Safety Declarations

This product was designed and manufactured in accordance with international safety standards. Before connecting the instrument to line voltage, review all product instructions.

When properly used, this instrument does not present any hazard. Voltages inside this instrument, however, are dangerous and may be fatal. Careless or improper use can lead to accidents; refer to the **Operation** section of this manual before use. Service should be attempted by qualified personnel only; disconnect the power supply before servicing.

If this device is operated outside of its stated specifications, or in a manner not specified, protection provided by the equipment may be impaired.

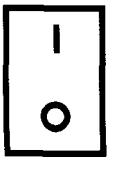
Safety Symbols



The product will be marked with this symbol when it is necesssary for the user to refer to the instruction manual (refer to the **Table of Contents**).



Indicates earth (ground) terminal.



ON

OFF

Front panel ON/OFF switch. ON (I) indicates power applied to instrument; OFF (**O**) indicates no power applied to instrument.

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Unpacking

Your instrument has been built, tested and packed carefully and should reach you in perfect mechanical and electrical condition. Please inspect both the carton and the cabinet upon receipt for evidence of damage that might have occurred in transit. In case of damage or defect, a claim must be filed with the carrier immediately.

Dimensions and Weight

Outside cabinet dimensions of the instrument for both the rack and bench versions are given in Figure 1. The weight of the instrument is approximately 40 lbs.

Primary Power

The PTS 3200 is designed to operate from power lines with 120 VAC (100, 220-230 or 240 VAC optional), ±10%, 50 - 60 Hz. Instrument line voltage is indicated on the rear panel. Instruments equipped with an optional line-voltage capability have a voltage selector switch located on the rear panel (see **Rear Panel Controls and Connectors**, page 11). Instruments without a selector switch require 120 VAC for operation. Before operating your instrument, be certain that it has been connected and fused for your line voltage. Improper connection may lead to damage of the instrument.

Proper grounding of the mainframe to the neutral or ground of the power system is accomplished via a NEMA-approved receptacle and 3-wire power cord in the United States. For the safety of the operator, an approved adapter must be used with 2-wire outlets. This adapter must provide positive connection to the electrical conduit or other low resistance ground. In the European Community, a harmonized line cord with conductor cross section of greater than 0.75 mm^2, certified by a recognized national body, must be used.

The power consumption of the PTS 3200 is approximately 70 watts.

Bench Use

For bench use the PTS 3200 is equipped with a fold-down tilt stand. Stacking of the instrument is permissible, provided that air-intake for the side-mounted fan and convection cooling of the heat sink on the rear panel are not impaired by deep, overhanging cabinets.

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Rack Mounting

The PTS 3200 may be mounted to a standard 19 inch relay rack, if ordered with the rack mounting option. Insure that air-intake for the side-mounted fan and convection cooling of the heat sink on the rear panel are not impaired. Where shock or vibration are encountered, it is suggested that rear or side supports be provided for the instrument.

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Minimum Performance / Incoming Inspection Testing

The following optional minimum performance or incoming inspection tests may be performed to ensure that the instrument is operating correctly. Equipment required to perform these tests is listed below:

Equipment	Recommended Model
Frequency Counter, 0 - 3200 MHz	HP 5383A
Power Meter, 0 - 20 dBm	HP 435B/8482A
Spectrum Analyzer, 0 - 3200 MHz	HP 8558B/182T

Frequency Verification

- Connect the output of the frequency synthesizer to the input of the counter. Connect the 10 MHz output of the counter (set to INT) to the synthesizer rear-panel 5/10 MHz external frequency standard input, and set the synthesizer rear-panel frequency standard selector switch to EXT STD (see **Rear Panel Controls and Connectors**, page 11, for more information on these connectors).
- Use the front panel or remote control interface to set the synthesizer's output frequency (see **Rear Panel Controls and Connectors**, page 11, for more information on this interface). Check that the synthesizer frequency is correct by observing that the counter reading and synthesizer setting are in agreement at the following frequencies (listed in MHz):

1.000 000
11.111 111
22.222 222
33.333 333
44.444 444
55.555 555
66.666 666
77.777 777
88.888 888
99.999 999
100.000 000 through 190.000 000 in 10 MHz steps
200.000 000 through 1500.000 000 in 100 MHz steps
1598.765 432
1599.999 999
1600.000 000
1611.111 111
1622.222 222
1633.333 333

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1644.444 444
1655.555 555
1666.666 666
1677.777 777
1688.888 888
1699.999 999
1700.000 000 through 1790.000 000 in 10 MHz steps
1799.999 999
1800.000 000 through 3100.000 000 in 100 MHz steps
3198.765 432
3199.999 999

Output Level Verification

- Connect the probe of the power meter to the output of the synthesizer. If the synthesizer has an internal frequency standard, set the rear-panel frequency standard selector switch to INT STD.
- Set the output frequency to 1000 MHz. Check that the output level is +13 dBm ±0.2 dB.
- Check that the output level does not vary more than a total of ±0.7 dB over the entire frequency range (1.0 - 3199.999 999 MHz) of the synthesizer.

Harmonic and Spurious Outputs Verification

- Connect the output of the synthesizer to the spectrum analyzer input, and set the output level to +13 dBm.
- Make the necessary adjustments on the spectrum analyzer so that the full output spectrum may be observed, making sure that the input is not over driven.
- Check that all harmonics are 30 dB or more below the main output over the entire frequency range (1.0 - 3199.999 999 MHz) of the synthesizer.
- Check that all spurious outputs are 60 dB or more below the main output over the 1.0 - 1599.999 999 MHz frequency range of the synthesizer.
- Check that all spurious outputs are 55 dB or more below the main output over the 1600.0 - 3199.999 999 MHz frequency range of the synthesizer.

Frequency Standard Verification (not applicable to instruments with no internal standard)

- Set the rear panel frequency standard selector switch to INT STD, and allow the instrument to warm up for at least 20 minutes.
- Connect the rear panel 10 MHz OUT (frequency standard output) to the input of the counter, which must now be driven from a suitable **calibrated** reference standard.
- Check that the measured frequency is 10 MHz ± 2 Hz. If adjustment is necessary, follow the procedure detailed in **10 MHz Internal Frequency Standard Calibration**, page 25.

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Operation

Power Connection

Before attempting to connect the instrument to the primary power, verify proper line voltage connection and fusing (see **Primary Power**, page 4).

Warm-Up

The PTS 3200 requires a period of 20 minutes as a warm-up for proper operation. If the instrument is equipped with an oven-type crystal oscillator, a period of 20 minutes is required at 25°C ambient for the frequency to be within $\pm 1 \times 10^{-7}$ of nominal. In general, it is desirable to operate the equipment continuously for best frequency stability.

Internal-External Frequency Standard

The synthesizer may be operated from either the internal or an external frequency standard (5.0 or 10.0 MHz). For internal standard operation, the frequency standard selector switch (rear panel) must be set to INT STD; for external standard operation, the switch must be set to EXT STD. Note that for internal standard operation, the switch **must** be set to INT STD even if no external standard is connected; otherwise, no output is generated.

Front Panel Controls

For instruments equipped with optional front panel controls, Figure 2 identifies all controls.

(a) *Power Switch* - The primary power to the instrument is controlled by this switch. The LCD displays also serve as line-power indicators. ON position (**I**) indicates that power is applied to the instrument; OFF position (**O**) indicates that no power is applied to the instrument.

(b) *Output Connector* - This SMA connector supplies the instrument's main output signal. (Note: for instruments equipped with rear panel output, this connector is inactive.)

(c) *Numeric Keys* - The numeric keys are used for entry of the synthesizer's signal parameters: frequency, frequency step size, amplitude and amplitude step size. To set or modify a parameter, press the appropriate parameter key, type the new value using the numeric keys, and terminate the entry with an appropriate unit key. The BACKSPACE key may be used to erase numbers entered and correct any errors.

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d) *Unit Keys* - The unit keys are used to terminate the entry of a signal parameter value. A unit key must always be used to terminate the entry of a numeric value via the numeric keys. In addition, if the AMP key is pressed and followed immediately by a unit key (i.e., no numeric key is pressed), the displayed units will change to the units selected.

(e) *AMP and STEP Parameter Keys* - The AMP key is used to set the signal amplitude level. The amplitude STEP key is used to set the increment by which the amplitude will be changed when the amplitude increment/decrement keys are pressed. For either key, a numeric value entered via the numeric keys must be terminated with an appropriate unit key. Pressing the AMP key followed immediately by a unit key will cause the displayed value to change to the units selected. Amplitude and amplitude step size may be entered in dBm, mV(rms), and for instruments equipped with an optional attenuator, in µV(rms).

Only amplitude and amplitude step settings within the specified range of the instrument can be entered. Entry of an invalid setting results in the display flashing for approximately 5 seconds, and then the previous setting being restored.

(f) *Amplitude INCREMENT/DECREMENT Keys* - The amplitude UP ARROW and DOWN ARROW keys are used to increment and decrement the signal amplitude level by the amplitude step size currently set. Holding either key depressed will result in automatic continuous incrementing or decrementing until the instrument's limit value is reached .

An attempt to increment or decrement beyond the specified range of the instrument results in the display flashing for approximately 5 seconds, and then the previous setting being restored.

(g) *Amplitude LCD Display* - The amplitude LCD displays the current signal amplitude, or the current amplitude step size if the amplitude STEP key has been depressed. To return the amplitude LCD display to the current signal amplitude after viewing the step size, press the AMP key.

When operating in the remote-control mode, the amplitude LCD displays '- - - -' and does NOT give an indication of the signal amplitude set via remote control.

(h) *FREQ and STEP Parameter Keys* - The FREQ key is used to set the signal frequency. The frequency STEP key is used to set the increment by which the frequency will be changed when the frequency increment/decrement keys are pressed. For either key, a numeric value entered via the numeric keys must be terminated with an appropriate unit key. Frequency and frequency step size may be entered in MHz, KHz, and Hz.

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Frequency and frequency step size have a maximum resolution of 1 Hz. For instruments equipped with resolution coarser than 1 Hz (e.g., 10 KHz resolution), data entered for unpopulated decades is ignored.

Only frequency and frequency step settings within the specified range of the instrument can be entered. Entry of an invalid setting results in the display flashing for approximately 5 seconds, and then the previous setting being restored.

(i) *Frequency INCREMENT/DECREMENT Keys* - The frequency UP ARROW and DOWN ARROW keys are used to increment and decrement the signal frequency by the frequency step size currently set. Holding either key depressed will result in automatic continuous incrementing or decrementing until the instrument's limit value is reached .

An attempt to increment or decrement beyond the specified range of the instrument results in the display flashing for approximately 5 seconds, and then the previous setting being restored.

(j) *Frequency EDIT Keys* - The LEFT ARROW and RIGHT ARROW edit keys are used to alter selected digits within the current frequency or frequency step size setting. Pressing the LEFT ARROW or RIGHT ARROW key moves the blinking digit cursor one position left or right, and selects a digit for direct modification. To change a particular digit within the frequency or frequency step size setting, move the blinking digit cursor to the digit to be changed, and enter the new value with the numeric key. The selected digit will be changed accordingly.

(k) *Frequency Encoder Knob* - The frequency encoder knob is used to rapidly modify the current frequency setting. The current frequency STEP size setting is used as the basis of the frequency changes, and each 360 degree rotation of the knob corresponds to approximately 16 frequency step size increments.

The frequency encoder knob is not active during remote-control operation.

(l) *Frequency LCD Display* - The frequency LCD displays the current signal frequency, or the current frequency step size if the frequency STEP key has been depressed. To return the frequency LCD display to the current signal frequency after viewing the step size, press the FREQ key.

The frequency display has a maximum resolution of 1 Hz. For instruments equipped with resolution coarser than 1 Hz, the LCD will display '--' in unpopulated decades. (E.g., on

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instruments equipped with 10 KHz resolution, LCD positions corresponding to 1 KHz through 1 Hz will be displayed as '--', indicating that these positions are non-active.)

When operating in the remote-control mode, the frequency LCD displays the remotely programmed frequency. In this mode, the maximum resolution of 1 Hz is always displayed, even if some decades are unpopulated, so that the user may observe the full remote programming command data. Any invalid remote frequency programming data is displayed as '*' and indicates that non-numeric data has been transmitted to the synthesizer and must be corrected for proper operation.

(m) *REMOTE Indicator* - The REMOTE annunciator indicates when the instrument is under remote control. The remote mode is enabled via the program connector on the rear panel. See also **Rear Panel Controls and Connectors**, below.

Rear Panel Controls and Connectors

Figure 3 shows rear panel controls and connectors for frequency, signal level and control mode programming and auxiliary inputs and outputs.

(a) *3-Wire Primary Power Cord Receptacle* - Accepts power cord for instrument operation.

(b) *Fuse Holders* - Fuse rating and primary supply voltage for the instrument are indicated beside the fuse holders.

(c) *Optional Location for Instrument Main Output Connector* - If this connector is present, any front panel output connector is inactive.

(d) *5/10 MHz External Frequency Standard Input* - Accepts an external frequency standard of either 5.0 or 10.0 MHz, 0.4 - 2.0V into 300 ohms to control instrument. **Important**: see also *Frequency Standard Selector Switch*, below.

(e) *Frequency Standard Selector Switch* - Slide switch which selects between an internal or external frequency standard. This switch **must** be set to INT STD if no external frequency standard is provided.

(f) *10 MHz Standard Frequency Output* - 10.0 MHz, 0.4V into 50 ohm output which may be used to drive other synthesizers without internal standards as *slaves*.

(g) *Remote Programming Connector* - Amphenol 57-40500 connector which requires 57-30500 connector for control. This connector provides remote frequency, signal level and mode control programming. All functions employ negative true programming logic; with no connector attached, all functions are in a default off or false state. All functions connect directly to 74-type ICs. Connection to ground will enable all functions. To set

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the instrument to the local mode for front panel control, either remove any attached 57-30500 connector or make certain that pin 42 is high. A complete pin-out of this connector is given in Table 1. See also **Remote Frequency, Signal Level and Control Mode Programming**, below.

(h) *Access Hole for Output Level Control* - Access to potentiometer for adjusting default output level for remote-control operation.

(i) *Optional Line Voltage Selector Switch* - Selects optional line voltage for instrument operation.

Remote Frequency, Signal Level and Control Mode Programming

The output frequency, output signal level or amplitude, and the mode of control (local or remote) are all remotely programmable through the Amphenol 57-type connector located on the rear panel. Table 1 lists the pin assignments for the 57-40500 connector. Output signal level programming is analog DC voltage level-controlled; all other programming on this connector is level (or state) triggered and employs TTL-level **negative** true logic.

The programming format for frequency control is parallel entry, 4 bit BCD (1, 2, 4, 8 weighting) for each digit. By default, all frequency programming pins are internally pulled to a high (false) state; to program a specific frequency the appropriate pins must be brought to the low state.

For the 1 Hz through 100 KHz digits, remote frequency programming changes result in an output signal at the new frequency (within 0.1 radian) within 3 μseconds. For the 1 MHz digit, frequency changes are effected within 5 μseconds; for the 10 MHz through 1 GHz digits, frequency changes are effected within 20 μseconds.

Data latches are included which provide storage when a "latched" mode of operation is required. By default, all Latch Enable (LE) pins are internally pulled to a high (false) state, disabling the latches. To store remote frequency programming input, the LE pins must be brought to the low state. To accept new remote frequency programming input, the LE pins must be returned to the high state. To operate in a "transparent" (i.e., non-latched) mode, the LE pins may be left unconnected, or must be placed in the high state. A separate latch enable line is provided for each pair of digits so that serial operation with separate frequency programming data bytes is possible. Table 1 also lists the LE pin assignments.

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Output level programming is by analog voltage, with a default output level set by a rear-panel accessible 10K ohm potentiometer (see **Rear Panel Controls and Connectors**, page 11). The default output level can be set to any valid level in the instrument's output range of +3 to +13 dBm. To enable remote amplitude programming, the user must provide a DC analog voltage from a low-impedance source on pin 22 of the remote interface, which will override the 10K ohm potentiometer default setting. The RMS output signal level is one-half (0.5) of the DC analog voltage present. The valid input voltage range is 0.6 - 2.0 VDC corresponding to an output signal level range of 0.3 - 1.0 Vrms into 50 ohms (+3 - +13 dBm).

The mode of frequency control, local or remote, is remotely programmable through the Remote Enable pin 42. By default this pin is internally pulled to a high (false) state; to enable the remote mode pin 42 must be brought to a low (true) state. If it is desired to go to remote frequency programming, but to do this under local control, a switch should be installed between pin 42 and ground.

See also **Parallel Entry Board PE-1121**, page 27.

Phase Rotation Programming

Instruments may also be equipped with optional phase rotation, with resolution of 0.36° from 1 - 1600 MHz, and 0.72° from 1600 - 3200 MHz.

Phase rotation is programmed through a separate 15 pin D-type connector located on the rear panel; Table 2 lists the pin assignments. Programming on this connector employs the same TTL-level **negative** true logic and BCD coding as described under **Remote Frequency, Signal Level and Control Mode Programming**, page 12. In addition, the same "latched" and "transparent" modes of operation are available; Table 2 also lists the LE pin assignments. By default, all pins are internally pulled to a high (false) state, corresponding to 0° phase rotation. To program a specific phase rotation, the appropriate pins must be brought to the low (true) state.

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Principles of Operation

General

An overview of the system is presented in this section by discussing the block diagram in Figure 4. Figure 5 shows the location of the modules discussed. This material is essential for efficient service, and familiarity with it is assumed in the service instructions.

All output frequencies of the PTS 3200 are derived from a crystal oscillator by arithmetic operations and are fully coherent with this 10 MHz reference frequency. The instrument uses a simplified direct synthesis in which all auxiliary fixed frequencies are produced from a 10 MHz pulse. The final output frequency comes from a two-stage beat-frequency system as follows:

> A signal of 355 to 365 MHz, which carries all 1 Hz to 1 MHz steps, is subtracted from a 565 to 655 MHz signal, which carries the 10 MHz steps. The resultant output ranges from 200 MHz to 299.999 999 MHz. In the following stage, this 200 to 300 MHz signal is upconverted to the range of 1850 to 1950 MHz.
>
> This signal of 1850 to 1950 MHz, which now carries all 1 Hz to 10 MHz steps, is subtracted from a 1950 to 3450 MHz signal, which carries the 100 MHz steps. The resultant output ranges from 1 MHz to 1599.999 999 MHz. The low frequency of 1 MHz is the practical cutoff in the output amplifier; lower frequencies could otherwise be obtained. Frequencies from 1600 - 3200 MHz are produced by doubling; frequency commands are appropriately adjusted by an Arithmetic Processor (AP) module.

The block diagram shows a crystal oscillator (which is the prime reference in the system) and six synthesis sections: a Standard Frequency Section, a Fine Resolution Section, a 1 MHz Step Section, a 10 MHz Step Section, a 100 MHz Step Section, and a Doubler/Output Amplifier Section.

Standard Frequency Section

This section consists of the SGA (Standard Generator A), SGB (Standard Generator B) and PF (Picket Fence) modules. Operating from an input of 10.000 MHz (or an automatically doubled 5.000 MHz input), the modules provide all fixed standard frequencies used in the instrument.

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In the SGA module, a filtered 10 MHz signal is fed to a pulse generator, where harmonics of 20 MHz through 160 MHz are generated with equal amplitude. This "picket fence" is the basis for all standard frequencies. Through arithmetic operations on this picket fence, the SGA and SGB modules generate 14, 16, 18, 20, 22, 112 and 113 MHz for use in the 1 MHz Step Section. In the PF module, a filtered 100 MHz signal is fed to a second pulse generator, where harmonics of 200 MHz through 1300 MHz are generated with equal amplitude.

The 10 MHz picket fence (10 - 160 MHz) from the SGA is also supplied to the Fine Resolution Section (which makes use of the 60 MHz picket only) and the 10 MHz Step Section. The 100 MHz picket fence (100 - 1300 MHz) is supplied to the 100 MHz Step Section. Any optional frequency-generating modules, such as a filtered-comb picket fence output, may also make use of various selected frequencies.

Fine Resolution Section

This section consists of the DDS (Direct Digital Synthesizer) and UC (Up-Converter) modules. The function of the DDS module is to produce frequency increments on a 2 MHz *carrier* in accordance with the remote programming for the 1 Hz through 100 KHz steps. The function of the UC module is to then shift this signal to a 14 MHz carrier suitable for input to the following DMA module.

As an example, if a frequency of 0.654 321 MHz has been selected for the 1 Hz through 100 KHz digits, the output of the DDS module will be 2.654 321 MHz, and the output of the UC module will be 14.654 321 MHz.

(Note: the DDS module actually provides frequency resolution to 0.1 Hz. Although not directly accessible to the user, this decade is automatically programmed by the AP module to provide 1 Hz resolution across the output frequency band, including the "frequency doubled" range of 1600 to 3200 MHz.)

1 MHz Step Section

This section consists of the DMA (Digit Type A) module. The DMA module accepts the fine-resolution frequency carrier from the previous section, adds the 1 MHz step, and then transfers this information to a 140 MHz carrier frequency which can more readily carry a 10 MHz bandwidth.

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Continuing with the example and expanding it to include a setting of 7.654 321 MHz for the 1 MHz through 1 Hz digits, the output of the DMA module will be 147.654 321 MHz.

10 MHz Step Section

This section consists of an IM (Intermediate Mix) and SO (Stepped Oscillator) module, and the 505 MHz cavity filter. The section accepts the 140 MHz carrier from the previous section, adds the 10 MHz step, and then transfers this information to a 200 MHz carrier frequency which can more readily carry a 100 MHz bandwidth.

In this section, frequencies are used which are not derived from the frequency standard. Frequencies generated in previous stages were all as accurate as the 10 MHz reference frequency. Here, however, the VCO frequencies from 565 to 655 MHz (in 10 MHz steps) may differ from their nominal values by as much as 1 MHz. As explained below, such deviation from nominal values has no effect on the accuracy of the section's output frequency. The Stepped Oscillator operates in a drift-cancelled loop which serves two functions:

1. Selection and filtering of one of the 10 MHz pickets by a fixed 505 MHz filter.
2. Supply of frequencies high enough for the output mixer, with a high degree of coherence in the two mixer inputs.

The block diagram lists VCO frequencies corresponding to selected 10 MHz steps as examples. These will be helpful in understanding the complete synthesis process via the sample frequency.

Continuing with the sample frequency of the previous sections, and assuming that the 10 MHz digit has been set to *8*, the frequency setting up through the 10 MHz step is 87.654 321 MHz. From the block diagram, for a digit setting of *8* the VCO will produce a frequency of 645 MHz, which is fed to two different mixers. In the SO module mixer, the 10 MHz picket fence frequency of 140 MHz will subtract from 645 MHz and feed 505 MHz through the filter and into the IM module. In the IM module, 505 MHz is mixed with the 147.654 321 MHz output of the 1 MHz Step Section. A 355 to 365 MHz bandpass filter at the top of the IM module selects the lower sideband of this mix; for the current example, the selected frequency is 357.345 679 MHz. This selected frequency is then fed to the output mixer in the SO module, where it is mixed with the VCO frequency of 645 MHz. A low-pass filter selects the resultant difference of 287.654 321 MHz, which is the section's output frequency.

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As can be seen, the VCO feeds both inputs to the output mixer, one directly and the other after an intermediate mix. Therefore, if the VCO frequency deviates from nominal, *both* mixer inputs deviate from nominal by the *same* increment. This obviously does not alter the difference between these two frequencies, which is the section's output frequency.

The output from the SO module is a low-level signal. The IA (Intermediate Amplifier) module provides intermediate gain to the output signal prior to input to the following section.

100 MHz Step Section

This section again consists of an IM (Intermediate Mix) and SO (Stepped Oscillator) module, and the 2150 MHz cavity filter. In this section, frequencies are again used which are not derived from the frequency standard. Frequencies up to the 10 MHz Step Section were all as accurate as the 10 MHz reference frequency. Here, however, the VCO frequencies from 1950 to 3450 MHz (in 100 MHz steps) may differ from their nominal values by as much as 10 MHz. As explained below, such deviation from nominal values has no effect on the accuracy of the final output frequency. The Stepped Oscillator operates in a drift-cancelled loop which serves two functions:

1. Selection and filtering of one of thirteen 100 MHz pickets by a fixed 2150 MHz filter.
2. Supply of frequencies high enough for the final mixer, with a high degree of coherence in the two mixer inputs.

The block diagram lists VCO frequencies corresponding to selected 100 MHz steps as examples. These will be helpful in understanding the complete synthesis process via the sample frequency.

Continuing with the sample frequency of the previous sections, and assuming that the 100 MHz and 1 GHz digits have been set to *12*, the complete frequency setting is 1287.654 321 MHz. From the block diagram, for a digit setting of *12* the VCO will produce a frequency of 3150 MHz, which is fed to two different mixers. In the SO module mixer, the picket fence frequency of 1000 MHz will subtract from 3150 MHz and feed 2150 MHz through the filter and into the IM module. In the IM module, the 2150 MHz is mixed with the 287.654 321 MHz output of the 10 MHz Step Section. An 1850 to 1950 MHz bandpass filter at the top of the IM module selects the lower sideband of this mix; for the current example, the selected frequency is 1862.345 679 MHz. This selected frequency is then fed to the final output mixer, where it is mixed with the VCO frequency of 3150 MHz. A low-pass filter selects the resultant difference of 1287.654 321 MHz, the desired output frequency.

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As can be seen, the VCO feeds both inputs to the final output mixer, one directly and the other after an intermediate mix. Therefore, if the VCO frequency deviates from nominal, *both* mixer inputs deviate from nominal by the *same* increment. This obviously does not alter the difference between these two frequencies, which is the desired output frequency.

Doubler, Output Amplifier and Level Control

The final output from the 100 MHz Step Section is a signal in the 1.0 - 1599.999 999 MHz frequency range. For frequencies in the 1600 - 3199.999 999 MHz band, a doubler is employed. The AP (Arithmetic Processor) module accepts input from the optional front panel or remote programming interface, and for desired frequencies of 1600 MHz and above, halves the frequency commands sent to the various sections, so that the output of the final 100 MHz Step Section when doubled is the correct output frequency. In addition, the necessary double command is sent to the OA (Output Amplifier) module.

The output from the 100 MHz Step Section is a low-level signal. The OA module provides intermediate gain to drive the doubler, as well as wideband gain, output filtering and levelling-control of amplitude to produce instrument outputs up to +13 dBm across the band from a 50 ohm source-impedance with substantially flat response. In the doubled range, two band-switched filters are employed to attenuate one-half and three-half frequency components; the necessary filter-switching command is also generated by the AP module.

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Service

CAUTION: When properly used, this instrument does not present any hazard. Voltages inside this instrument, however, are dangerous and may be fatal. Careless or improper use can lead to accidents. Disconnect power supply before opening; service by qualified personnel only!

General

In general, no preventive maintenance is required for the PTS 3200. Minor recalibration of the instrument may be performed annually as described in the **Calibration** section.

Unless used in an abnormally dusty environment, no cleaning of this instrument is required.

The PTS 3200 contains no user-serviceable parts, with the exception of the optional front panel backup battery (see **Front Panel Battery Replacement**, below). Should the instrument require service, the **System Troubleshooting** section provides information which permits identification of a defective module. In the case of malfunction, all modules are easily removed from the deck and replaced; defective modules must then be returned to the factory for service.

Front Panel Maintenance and LCD Contrast Adjustment

For instruments equipped with optional front panel controls, no preventive maintenance is required for the LCD display and keypad module. The presence of an output signal of correct frequency and amplitude indicates that the module is operating properly.

At power-on, a software self-test is performed during which all LCD characters are briefly activated. If no errors are detected, normal operation commences and the last settings prior to power-off are restored.

If a ROM or battery backup memory error is detected, the error message 'EEE 100' is displayed in the frequency LCD until any key is pressed. Following an error, the module will attempt to operate normally, using defaults if appropriate.

The LCD display contrast is set at the factory for normal room-temperature operation (25°C). If unusual service conditions result in poor display contrast, LCD contrast may be adjusted for improved viewing. Remove the instrument top cover, and the front top horizontal cabinet support which retains the LCD and keypad assembly. Viewed from the top-front, the left-most pot (P3)

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adjusts the frequency LCD contrast, and the center pot (P2) adjusts the amplitude LCD contrast. After adjustment, securely reassemble the retaining support and reinstall the instrument cover.

The LCD display and keypad are supplied as an integrated unit, and no field service is possible. A faulty module must be returned to the factory for repair and/or replacement.

Front Panel Battery Replacement

For instruments equipped with optional front panel controls, the LCD and keypad module is equipped with battery backup (single 3V lithium coin-cell type CR2340) for retention of the last signal parameters (frequency, frequency step size, amplitude and amplitude step size). The battery life span is approximately 3 years.

If settings are not properly retained during power off, the battery should be replaced. Remove the instrument top cover, and the front top horizontal cabinet support which retains the LCD and keypad assembly. The battery is located above the unit keys. After replacement, securely reassemble the retaining support and reinstall the instrument cover.

System Troubleshooting

EXTREMELY IMPORTANT!

For operation, the unit **must** be driven from either an internal or external 5 or 10 MHz frequency standard, and the Frequency Standard Selector Switch set to INT STD or EXT STD, accordingly (see **Rear Panel Controls and Connectors**, page 11). After verifying that a frequency standard is correctly connected and/or selected, if no instrument output is present, proceed as described below.

The following test equipment is recommended for troubleshooting:

RF-Voltmeter V	1 - 3200 MHz, 10 mV - 1V, high impedance probe (3 pF, DC resistance 100K Ω)
HF-Counter C	0 - 3200 MHz or 0 - 150 MHz, 10 mV sensitivity, high impedance or 50 Ω input, 1 Hz resolution; input for External Drive for synchronization with 10 MHz standard, 0.5V into 50 Ω
Spectrum Analyzer SA	10 - 3200 MHz, 50 Ω input; min. 60 dB on-screen dynamic range; max. BW 1 MHz; min. sensitivity - 40 dBm
Multimeter	Analog or digital; 0-15V, 0.1V resolution; 0-2A, 0.1A resolution

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Test equipment is referred to in Table 2 as noted above (V, C, SA). The Voltmeter and Counter must have high DC input resistance since connection is made to points with +5.4V potential. The RF-Voltmeter probe connects directly to test points. The Counter is connected via an RG 174 or similar cable equipped with small alligator clips. The Spectrum Analyzer is connected via a cable equipped with an SMA male connector and via a high impedance 500 Ω (10X) probe.

NOTE

Either the 5/10 MHz input or the 10 MHz output can be used to synchronize the Counter in the troubleshooting of an instrument. For **complete** correspondence of front panel or remote control settings and counter readings, synchronization is **required**; otherwise, any differences between the two frequency standards will result in differences between settings and readings.

Connect the instrument to the AC power line. For instruments equipped with front panel controls, turn the power switch to the ON position; the LCD will indicate the presence of AC line power. For remote-control-only instruments, the operation of the side-mounted venting fan will serve as an AC line power indicator. Check the AC power line fuses if neither indication is obtained. Use only a fuse of the proper rating as a replacement. If AC line power is present, set a test frequency either by front panel or remote control (see **Operation**, page 8).

If no output is obtained, check the rear panel 10 MHz OUT. A 10 MHz, 0.4V output should be obtained. If no 10 MHz signal is present, insure that a 5 or 10 MHz frequency standard has been properly connected and/or selected. For instruments operating on an internal frequency standard, set the Frequency Standard Selector Switch set to EXT STD and connect an external 5 or 10 MHz frequency standard; if the instrument now functions properly, the internal frequency standard is defective and must be replaced.

If, after these steps, the instrument still does not operate properly, the instrument's top and bottom covers must be removed for further testing. Disconnect the unit from the power line; remove the screws attaching the covers, and carefully withdraw them.

After the unit is again powered, check for the presence of supply voltages -12.4V (blue wire) and +5.4V (green wire) at the terminals of the power supply on the rear panel, and +15.0V (white wire) at the output of the switching power supply attached to the rear of the deck adjacent to the power supply. If voltages are within ±0.2V, proceed to the next step; if voltages are absent or low, measure current in the leads from the power supplies. The proper 12.4V current is 1.0 - 1.3A

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(dependent on the crystal oven temperature); the proper 5.4V current is 1.5 - 1.8A; the proper 15.0V current is 0.7A. Improper or missing currents indicate a faulty power supply, or a short or overload within the instrument.

If a fault is localized to a particular decade (e.g., all 100 KHz steps defective), or to a particular bit within a decade (e.g., 1 bit defective in the 100 KHz decade, resulting in only even 100 KHz steps), perform a careful DC voltage and continuity check of the related control signal wiring and processing with the aid of the following functional descriptions and schematics:

- **Parallel Entry Board PE-1121**, page 27
- **Arithmetic Processor AP-1128(3200)**, page 28
- **Figure 4: PTS 3200 Block Diagram**, page 38
- **Figure 7: PE-1121 Schematic**, page 41
- **Figure 8: AP-1128(3200) Schematic**, page 42

Insure that valid TTL-level positive-true control signals are delivered to all related synthesis modules.

Assuming that proper supply voltages are present and that wiring and logic IC faults on the PE-1121 and AP-1128(3200) modules have been eliminated, the tests described in Table 3 will identify a defective module. Table 3 lists test points and expected signal frequencies and levels; Figure 5: Module and Test Point Locations shows the location of the test points.

To perform a full diagnostic check, all test instruments with the upper frequency limits are required. However, it is possible to complete some tests of the instrument with the RF-Voltmeter and the 150 MHz Counter. Proceeding from the crystal oscillator, through the Standard Frequency Section, the Fine Resolution Section and the 1 MHz Step Section, most tests for presence of signal and proper frequency can be made *bridging,* without opening connections. Tests of these sections will cover most of the instrument. To test the 10 MHz Step Section, 100 MHz Step Section and the Doubler/Output Amplifier Section, 50 ohm SMA connections must be made.

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Calibration

General

In general, no preventive maintenance is required for the PTS 3200. The presence of an output signal of the correct frequency indicates that the instrument is functioning properly. To offset the effects of aging and insure uninterrupted proper instrument operation, minor recalibration of the SO-1084 and SO-2005 modules may be performed annually; the **SO-1084 Module Calibration** and **SO-2005 Module Calibration** sections below provide the information necessary to perform this.

For instruments equipped with an optional internal 10 MHz frequency standard, recalibration of the frequency standard should be performed on a schedule dictated by the user's accuracy requirements and the specified drift characteristics of the optional frequency standard; see **Crystal Oscillator OCXO (XT-1012) or TCXO (XT-1013)**, page 26, and **10 MHz Internal Frequency Standard Calibration**, page 25.

SO-1084 Module Calibration

Over long periods of time, minor recalibration of the SO-1084 module may become necessary due to aging of the module's tuned circuits. The 10 MHz steps of the SO-1084 module (565 to 655 MHz) must be within ±1.0 MHz for proper operation of the instrument. **However, since the SO-1084 module operates inside a drift-cancelled loop, any frequency errors within ±1.0 MHz do not affect the overall accuracy of the output frequency**; see **Principles of Operation**, page 14.

The following adjustments assume familiarity with the procedures described in **System Troubleshooting**, page 20. For these adjustments, the instrument **must** be at operating temperature after having warmed up for at least 3 hours. After warm-up, remove the instrument's top and bottom covers. The SO-1084 module, employed in a variety of PTS synthesizers, includes a total of 31 steps, numbered step 0 through step 30. **Only 10 steps are utilized in the PTS 3200, steps 20 through 29**. Pots for the adjustment of all 10 MHz steps are accessible after removing the aluminum tape over the slots on the top of the SO-1084 module. Oriented from the front of the unit, step 0 corresponds to the back-most pot (closest to the rear of the instrument), step 1 to the adjacent pot, and so on through step 30, the front-most pot. Identify the pots corresponding to steps 20 through 29.

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Step 18 of the troubleshooting procedure (see Table 3: System Troubleshooting) allows the measurement of a 365 MHz IF frequency generated by the 10 MHz steps. With the 1 MHz through 1 Hz digits set to zero, proceed through the 10 MHz steps (10 steps, 1000 - 1090 MHz, pot 20 through 29), observing the frequency on the Counter. For each step, adjust the appropriate pot 20 through 29 so that the Counter reading is 365 MHz ± 0.2 MHz. In general, it is necessary for aluminum shielding tape to cover pots not being adjusted (i.e., uncover the pots corresponding to the first five steps, but leave the remainder of the tape in place; after completing the first five steps, replace the tape and proceed to the next five steps). After completing all steps, be sure that aluminum shielding tape covers all slot openings.

SO-2005 Module Calibration

Over long periods of time, minor recalibration of the SO-2005 module may become necessary due to aging of the module's tuned circuits. The 100 MHz steps of the SO-2005 module (1950 to 3450 MHz) must be within ±10.0 MHz for proper operation of the instrument. **However, since the SO-2005 module operates inside a drift-cancelled loop, any frequency errors within ±10.0 MHz do not affect the overall accuracy of the output frequency**; see **Principles of Operation**, page 14.

The following adjustments assume familiarity with the procedures described in **System Troubleshooting**, page 20. For these adjustments, the instrument **must** be at operating temperature after having warmed up for at least 3 hours. After warm-up, remove the instrument's top and bottom covers. Pots for the adjustment of all 100 MHz steps are accessible after removing the aluminum tape over the slots on the top of the SO-2005 module. Oriented from the front of the unit, step 0 corresponds to the back-most pot (closest to the rear of the instrument), step 1 to the adjacent pot, and so on through step 15, the front-most pot.

Step 24 of the troubleshooting procedure (see Table 3: System Troubleshooting) allows the measurement of a 1950 MHz IF frequency generated by all 100 MHz steps. With the 10 MHz through 1 Hz digits set to zero, proceed through all 100 MHz steps (16 steps, 0 - 1500 MHz), observing the frequency on the Counter. For each step, adjust the appropriate pot so that the Counter reading is 1950 MHz ± 2.0 MHz. In general, it is necessary for aluminum shielding tape to cover pots not being adjusted (i.e., uncover the pots corresponding to the first five steps, but leave the remainder of the tape in place; after completing the first five steps, replace the tape and proceed to the next five steps, etc.). After completing all steps, be sure that aluminum shielding tape covers all slot openings.

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(Note: Some models of PTS 3200 synthesizers require the use of non-slotted SO-2005 module covers. In these cases, an alignment cover with access slots, purchased from the factory, must be temporarily installed for the calibration procedure and subsequently removed.)

10 MHz Internal Frequency Standard Calibration

For instruments equipped with an internal TCXO or OCXO frequency standard, calibration of the standard at periodic intervals may be necessary due to normal aging of the standard's quartz crystal. All quartz crystal oscillators are secondary standards which require a primary reference for calibration. PTS oscillators are set to within 1 x 10^{-7} of nominal at the time of delivery from the factory. Thereafter, these oscillators are subject to the time-drift and temperature-drift given in the specifications (see **Crystal Oscillator OCXO (XT-1012) or TCXO (XT-1013)**, page 26). A suitable recalibration interval must be determined by the user, and should take into account the accuracy requirements of the user's particular application, and the drift specifications of the oscillator supplied with the instrument.

For this adjustment, the instrument **must** be at operating temperature after having warmed up for at least 3 hours. After warm-up, **without** disconnecting or turning off the primary power, remove the instrument's top cover. Each type of oscillator includes a potentiometer for frequency adjustment which is accessible from the top of the oscillator. In the case of the TCXO, it is located under aluminum shielding tape; for the OCXO, it is beneath a screw-cover; remove the adjustment-pot cover.

Connect the rear panel 10 MHz OUT (frequency standard output) to the input of a frequency counter driven from a suitable **primary reference standard**. Insure that the rear panel Frequency Standard Selector Switch is set to INT STD. Carefully adjust the internal standard's frequency so that the counted frequency reads 10 MHz ± 1 Hz. After completing the adjustment, reinstall the adjustment-pot cover, and carefully reinstall the instrument top cover.

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Mainframe Components

Power Supply PS-1019

The PS-1019 board, operating from commercial power lines, generates DC voltages of +5.4V and -12.4V. The +5.4V is used for TTL and MECL logic (fed by decoupling networks), and the -12.4V powers transistor amplifiers. Maximum current is 2.0A at +5.4V and 1.5A at -12.4V, approximately.

Both regulators operate from capacitor input filters, fed by silicon rectifier bridges. The series-pass transistor, gain and reference elements are integrated in a TO-3 package which is heat-sunk to the rear panel. Both supplies are short-circuit proof with fold-back current limiting.

The transformer uses paralleled primaries for 120V input or optional switch-selectable 100V, 220-230V and 240V inputs.

In case of malfunction, refer to the schematic (Figure 6: PS-1019 Schematic) which lists essential DC voltages for both supplies to locate the faulty component or replace the supply-board as a unit.

Crystal Oscillator OCXO (XT-1012) or TCXO (XT-1013)

The PTS 3200 may be supplied with a built-in OCXO (XT-1012) or TCXO (XT-1013) crystal oscillator operating at 10 MHz. If installed, it is mounted on the instrument deck and has the following characteristics:

Type:	**OCXO (XT-1012)**	**TCXO (XT-1013)**
Frequency:	10.000 000 MHz	
Aging:	3×10^{-9} / day 1×10^{-6} / year	1×10^{-8} / day 2×10^{-6} / year
Temperature Coefficient:	$\pm 2 \times 10^{-10}$ / °C	$\pm 2 \times 10^{-8}$ / °C
Output:	1Vrms into 500 Ω	1Vrms into 500 Ω
Warm-Up Time:	24 hrs for 1×10^{-8}	-
DC Supply:	-12.4V, 250 mA (500 mA turn-on)	-12.4V, 20 mA

Both oscillators have provision for adjustment to compensate for long-term drift.

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Parallel Entry Board PE-1121

The PE-1121 board contains circuitry to interface remote programming signals for frequency, output signal level and control mode (remote or local) with the appropriate modules within the instrument. The board is mounted to the rear of the unit, and is directly connected with an Amphenol 57-type input connector. Table 1 lists pin assignments for the 57-40500 connector.

All functions connect directly to 74-type ICs, and use TTL level, negative true logic. By default, all logic control pins are internally pulled to a *high* (false) state. The programming format for frequency control is parallel entry 4 bit BCD (1, 2, 4, 8 weighting) for each digit. 74HCT533 latches provide storage when a *latched* mode of operation is desired. To store remote frequency programming input, the Latch Enable pins must be brought to the *low* state. The output signal level is remotely controlled through a DC analog voltage on pin 22, with the RMS output voltage (into 50 ohm) set at one-half (0.5) the DC level. The remote/local mode is remotely programmed through pin 42. With reference to Figure 7, U6 is used to control a switch consisting of two transistors. U6 accepts the remote enable signal, which is negative true. In the local mode, latches are set to the *off* (third) state, and 5.1V is supplied to the front panel.

See also **Remote Frequency, Signal Level and Control Mode Programming**, page 12.

Front Panel Assembly PTA-0100

For instruments equipped with optional front panel controls, the PTA-0100 LCD and keypad assembly contains circuitry to interface user-input settings for output signal frequency and amplitude with the appropriate modules within the instrument. The assembly is mounted to the front of the instrument; in case of malfunction it must be repaired or replaced at the factory.

See also **Front Panel Controls**, page 8, and **Service**, page 19.

Switching Power Supply 81-1001

The switching power supply, operating from the 120VAC transformer tap, generates a DC voltage of +15.0V for use in the instrument. Normal input current (120VAC) is 350 mA; normal output current is 700 mA. The switching power supply is attached to the instrument deck at the rear of the instrument; in case of malfunction it must be replaced at the factory.

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505 MHz Filter 390-1003

The 505 MHz multi-pole filter forms part of the 10 MHz step section. It is fixed-tuned and cannot be retuned in the field. The 390-1003 is bolted to the instrument deck.

2150 MHz Filter 390-1002

The 2150 MHz multi-pole filter forms part of the 100 MHz step section. It is fixed-tuned and cannot be retuned in the field. The 390-1002 is bolted to the instrument deck.

Arithmetic Processor AP-1128(3200)

The AP-1128 board is functionally inserted between the frequency controlling digital signals originating from the optional front panel or remote control parallel entry board PE-1121 and the frequency generating modules. The main function of the module is to monitor the frequency command and to control the digital signals as follows:

1. For frequencies below 1600 MHz, the digital control signals are passed through directly via channel A of the board's data selectors.

2. For frequencies greater than or equal to 1600 MHz, the numerical value of the digital control signals are divided by 2 and routed to the output via channel B of the on-board data selectors. This compensates for the automatic doubling which takes place in generating frequencies in the 1600 - 3200 MHz band.

In addition, two crossover points of 1000 MHz and 2260 MHz are also detected to generate filter switching signals "SOBAND" and "HIBAND" for use in the SO and OA modules, respectively.

The doubling and crossover points are detected by comparators. They compare variable inputs against fixed threshold values. The signal "DBL" goes high when the input exceeds 1599.999... MHz and is fed to the bank of data selectors U20 - U29 and also to the OA module to turn on the doubler section. The signal "HIBAND" goes high when the input exceeds 2259.999... MHz and goes to the OA module to select the high-band filter. The signal "SOBAND"goes high when the input exceeds 999.999... MHz and goes to the SO module to select a pass-band filter.

All functions are performed in parallel. Since the board's ICs operate at very high speed, the inherent switching speed of the synthesizer is not degraded. All input lines are buffered by a bank of 7 non-inverting buffers U1- U7.

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TABLE 1: PTS 3200 REMOTE FREQUENCY, SIGNAL LEVEL AND CONTROL MODE PROGRAMMING

Amphenol 57-40500 - On Equipment
Amphenol 57-30500 - Required to Control

Digit	BCD Weight:	1	2	4	8	Latch Enable
		Pin Numbers				
1 GHz		43	44			23
100 MHz		15	16	40	41	23
10 MHz		17	18	19	20	24
1 MHz	(0 - 9 BCD valid;	1	2	26	27	24
100 KHz	10 - 15 invalid)	3	4	28	29	25
10 KHz		5	6	30	31	25
1 KHz		7	8	32	33	46
100 Hz		9	10	34	35	46
10 Hz		11	12	36	37	47
1 Hz		13	14	38	39	47

Frequency and Control Mode Programming

Frequency and Control Mode programming employ TTL-level, **negative** true logic.
Remote Enable = Pin 42
+5 - +5.4V = Pin 48 (100 mA max)
Ground = Pin 50

Signal Level Programming

Output signal level programming is through analog DC control voltage on Pin 22.
Remote Level = Pin 22
RMS output = 0.5 x Pin 22 DC control voltage, +0.6 - +2.0 VDC
Ground = Pin 21

TABLE 2: PTS 3200 PHASE ROTATION PROGRAMMING

15 pin D-type female connector - On Equipment (OPTIONAL)
15 pin D-type male connector - Required to Control

Phase Increment (1-1600 / 1600-3200 MHz)	BCD Weight:	1	2	4	8	Latch Enable
		Pin Numbers				
36.0° / 72.0°	(0 - 9 BCD valid)	9	10	11	12	14
3.60° / 7.20°	(0 - 9 BCD valid)	5	6	7	8	15
0.36° / 0.72°	(0 - 9 BCD valid)	1	2	3	4	15

Phase Rotation programming employs TTL-level, **negative** true logic.
Ground = Pin 13

TTL Levels

Low: +0.7V max
High: +2.0V min

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TABLE 3: SYSTEM TROUBLESHOOTING

Step	Test Point	Frequency (MHz)	Level	Test Equipment	Module Checked	Notes
1	SGA, 51	10.000	0.4V	V, C	Freq. Std.	
2	SGA, 49	10.000	0.4V	V, C	SGA	
3	SGA, 20	18.000	0.1V	V, C	SGA	
4	SGA, 43	20.000	0.1V	V, C	SGA	
5	SGA, 6	22.000	0.1V	V, C	SGA	
6	SGA, 2	33.000	90mV	V, C	SGA	
7	SO, J1	10-160	-17 dBm	SA	SGA	1
8	SGB, 10	14.000	0.1V	V, C	SGB	
9	SGB, 24	16.000	0.1V	V, C	SGB	
10	DS, 50	10.000	0.4V	V, C	SGA	
11	DS, 3	2 - 3	0.22V	V, C	DS	2
12	UC, 46	10-160	-17 dBm	SA	SGA	3
13	UC, 50	14 - 15	0.2-0.3V	V, C	UC	2
14	DMA, 1	112.000	0.1V	V, C	SGB	4
15	DMA, 10	113.000	0.1V	V, C	SGB	5
16	DMA, 50	140.000	0.4V	V, C	DMA	6
17	IM-1007, J1	505 ± 1	-35 dBm	SA	SO, Filter	7
18	IM-1007, J3	365 ± 1	-16 dBm	C	IM	8
19	SO-1084, J3	200.000	-30 dBm	SA	SO	9
20	IM-2010, J2	200.000	+9 dBm	SA, C	IA	10
21	PF, J1	100-1300	-17 dBm	SA	PF	11
22	SO-2005, J3	1950 ± 5	+10 dBm	SA, C	SO	12
23	IM-2010, J1	2150 ± 5	-35 dBm	SA	SO, Filter	13
24	IM-2010, J3	1950 ± 5	-16 dBm	C	IM	14
25	Mixer, IF	1000.000	-30 dBm	SA	Final Mixer	4
26	LPF, J2	1000.000	-32 dBm	SA	LPF	4
27	OA, J1	1000.000	+13 dBm	SA	OA	4
28	OA, J1	1 - 1599	+13 dBm	SA	OA, direct band	15
29	OA, J1	1600-2259	+13 dBm	SA	OA, doubled low band	15
30	OA, J1	2260-3199	+13 dBm	SA	OA, doubled high band	15

Test point designations show the module and pin number (position) on the board-edge connector, as used in Figure 5.

Notes:

1. Open SMA connection at SO, J1.Connect SA to disconnected cable in place of SO, J1. Each 10 MHz multiple from 10 to 160 MHz to be displayed.
2. Set the instrument to 1000.000 000 MHz, +13 dBm output level. Set and test all 100 KHz through 1 Hz steps (10 steps, 0 - 9 for each decade). At each step, there must be complete correspondence between the 100 KHz through 1 Hz digits set and the 100 KHz through 1 Hz frequency increments of the test point frequency.
3. Each 10 MHz multiple from 10 to 160 MHz to be displayed.
4. Set the instrument to 1000.000 000 MHz, +13 dBm output level.
5. Set the instrument to 1001.000 000 MHz, +13 dBm output level.
6. Program 1 MHz decade through successive steps 0 to 9; test point frequency must increase in 1 MHz increments from 140.000 MHz to 149.000 MHz. Return instrument to 1000.000 000 MHz setting before proceeding to next test.
7. Open SMA connection at IM, J1. Connect SA to disconnected cable in place of IM, J1. Set and test instrument at all 10 MHz steps (10 steps, e.g., 1000 - 1090 MHz).

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TABLE 3: SYSTEM TROUBLESHOOTING (continued)

Notes: (continued)

8. Set and test instrument at all 10 MHz steps (10 steps, e.g., 1000 - 1090 MHz). At each 10 MHz step, program 1 MHz decade through successive steps 0 to 9; test point frequency must decrease in 1 MHz increments from 365.000 MHz to 356.000 MHz. Return instrument to 1000.000 000 MHz setting before proceeding to next test.
9. Program 10 MHz decade through successive steps 0 to 9; test point frequency must increase in 10 MHz increments from 200.000 MHz to 290.000 MHz. Return instrument to 1000.000 000 MHz setting before proceeding to next test.
10. Open SMA connection at IM, J2. Connect SA to disconnected cable in place of IM, J2. Repeat step 9 above.
11. Each 100 MHz multiple from 100 to 1300 MHz to be displayed.
12. Program 1 GHz and 100 MHz decades through 16 successive 100 MHz steps 0 - 1500 MHz; test point frequency must increase in 100 MHz increments from 1950 MHz to 3450 MHz. Return instrument to 1000.000 000 MHz setting before proceeding to next test.
13. Open SMA connection at IM, J1. Connect SA to disconnected cable in place of IM, J1. Program 1 GHz and 100 MHz decades through 16 successive 100 MHz steps 0 - 1500 MHz.
14. Program 1 GHz and 100 MHz decades through 16 successive 100 MHz steps 0 - 1500 MHz. At each 100 MHz step, program 10 MHz decade through successive steps 0 to 9; test point frequency must decrease in 10 MHz increments from 1950.000 MHz to 1860.000 MHz. Return instrument to 1000.000 000 MHz setting before proceeding to next test.
15. Set and test instrument over the frequency range indicated.

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PS-1019 PARTS LIST

Schematic Designation	Description	PTS P/N
	CAPACITORS	
C1	10,000 µF, 25V	31-5106
C2	15 µF, 20V	30-5105
C3	6.8 µF, 25V	30-5101
C4	10,000 µF, 25V	31-5106
C5 - C6	6.8 µF, 25V	30-5101
	RESISTORS	
R1	1.91K Ω, 1%, .25W	14-5115
R2	243 Ω, 1%, .25W	14-5105
R3	500 Ω, Pot., 10%, .75W	17-5103
R4	715 Ω, 1%, .25W	14-5127
R5	243 Ω, 1%, .25W	14-5105
R6	200 Ω, Pot., 10%, .75W	17-5105
	DIODES	
CR1 - CR8	3A, 100V	74-5100
	INTEGRATED CIRCUITS	
U1 - U2	LM350K	64-0350K
	TRANSFORMERS	
T1	50-400 Hz	83-5102

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PE-1121 PARTS LIST

Schematic Designation	Description	PTS P/N
	CAPACITORS	
C1 - C7	50 nF, 80/20%, 50V, Z5V	23-0503
C8	6.8 µF, 25V	30-5101
	RESISTORS	
R1 - R2	2.2 Ω, 5%, .25W	11-1220
R3	10K Ω, Pot., 10%, .50W (For remote-only units)	16-5101
R4	4.7K Ω, 5%, .25W	11-0472
R5	1.0K Ω, 5%, .25W	11-0102
R6	4.7K Ω, 5%, .25W	11-0472
R7	2.2K Ω, 5%, .25W	11-0222
R8 - R10	2.2K Ω, 5%, .25W (optional attenuator)	11-0222
R11	680 Ω, 5%, .25W (optional attenuator)	11-0681
A1 - A9	Resistor Network, 2.2K Ω, 2%	66-5002
	TRANSISTORS	
Q1 - Q2	2N2905	42-2905
	INTEGRATED CIRCUITS	
U1 - U6	74HCT533	61-5029
U7	74LS05	63-0005
	CONNECTORS	
J1	50 pos. conn. (series 57 compatible)	78-1000
J2	50 pos. conn. (optional)	78-1000
P1	53 pin header strip from 2 @ 26 pin	79-1003
P2	4 pin header strip from 1 @ 26 pin	79-1003

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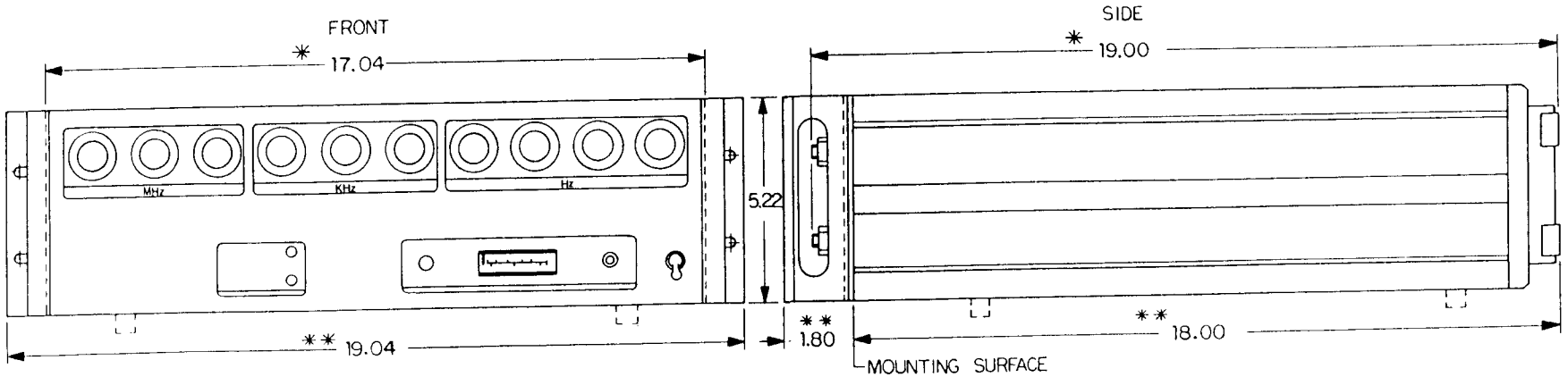
AP-1128(3200) PARTS LIST

Schematic Designation	Description	PTS P/N
	CAPACITORS	
C1	6.8 µF, 25V	30-5101
C2 - C19	50 nF, 80/20%, 50V, Z5V	23-0503
	RESISTORS	
R1	10K Ω, 5%, .25W	11-0103
R2	220 Ω, 5%, .25W	11-0221
R3 - R4	2.2K Ω, 5%, .25W	11-0222
R5	220Ω, 5%, .25W	11-0221
R6	2.2K Ω, 5%, .25W	11-0222
R7 - R8	2.2 Ω, 5%, .25W	11-1220
R9 - R12	2.2K Ω, 5%, .25W	11-0222
R13	220 Ω, 5%, .25W	11-0221
R14 - R18	2.2K Ω, 5%, .25W	11-0222
R19-R20	NOT USED	
R21- R22	220 Ω, 5%, .25W	11-0221
R23	2.2K Ω, 5%, .25W	11-0222
R24	2.0K Ω, 5%, .25W	11-0202
R25	1.0K Ω, 5%, .25W	11-0102
	TRANSISTORS	
Q1	2N3250	41-3250
Q2	2N2369	40-2369
	DIODES	
CR1 - CR5	1N4151	70-4151
CR6	1N964B	73-0964
	INTEGRATED CIRCUITS	
U1 - U7	74LS367	63-0367
U8 - U16	74LS283	63-0283
U17 - U19	74LS85	63-0085
U20 - U27	74LS157	63-0157
U28 - U29	74LS257	63-0257
U30 - U32	74LS85	63-0085

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CABINET DIMENSIONS

* BENCH MODEL DIMENSIONS
* * RACK MOUNTING MODEL DIMENSIONS



NOTE: MANUAL CONTROLS NOT APPLICABLE TO REMOTE-ONLY UNITS, WHICH HAVE A BLANK FRONT PANEL.

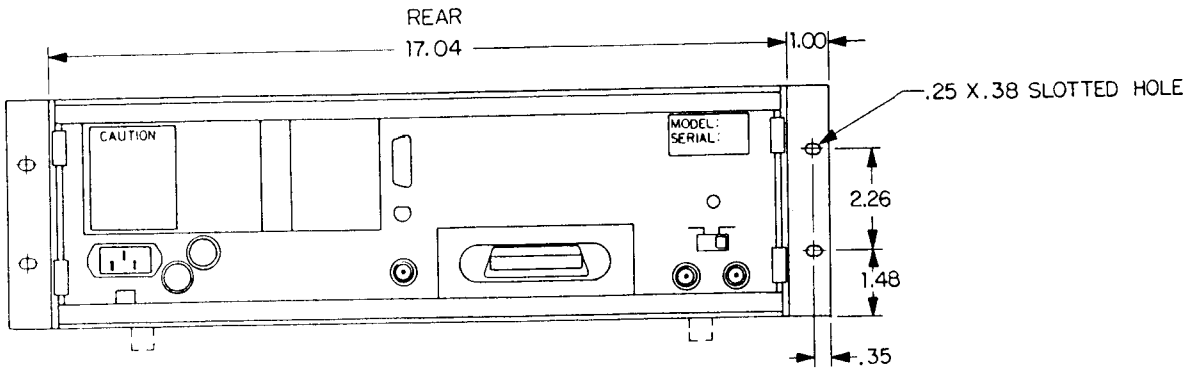


Figure 1

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FRONT PANEL

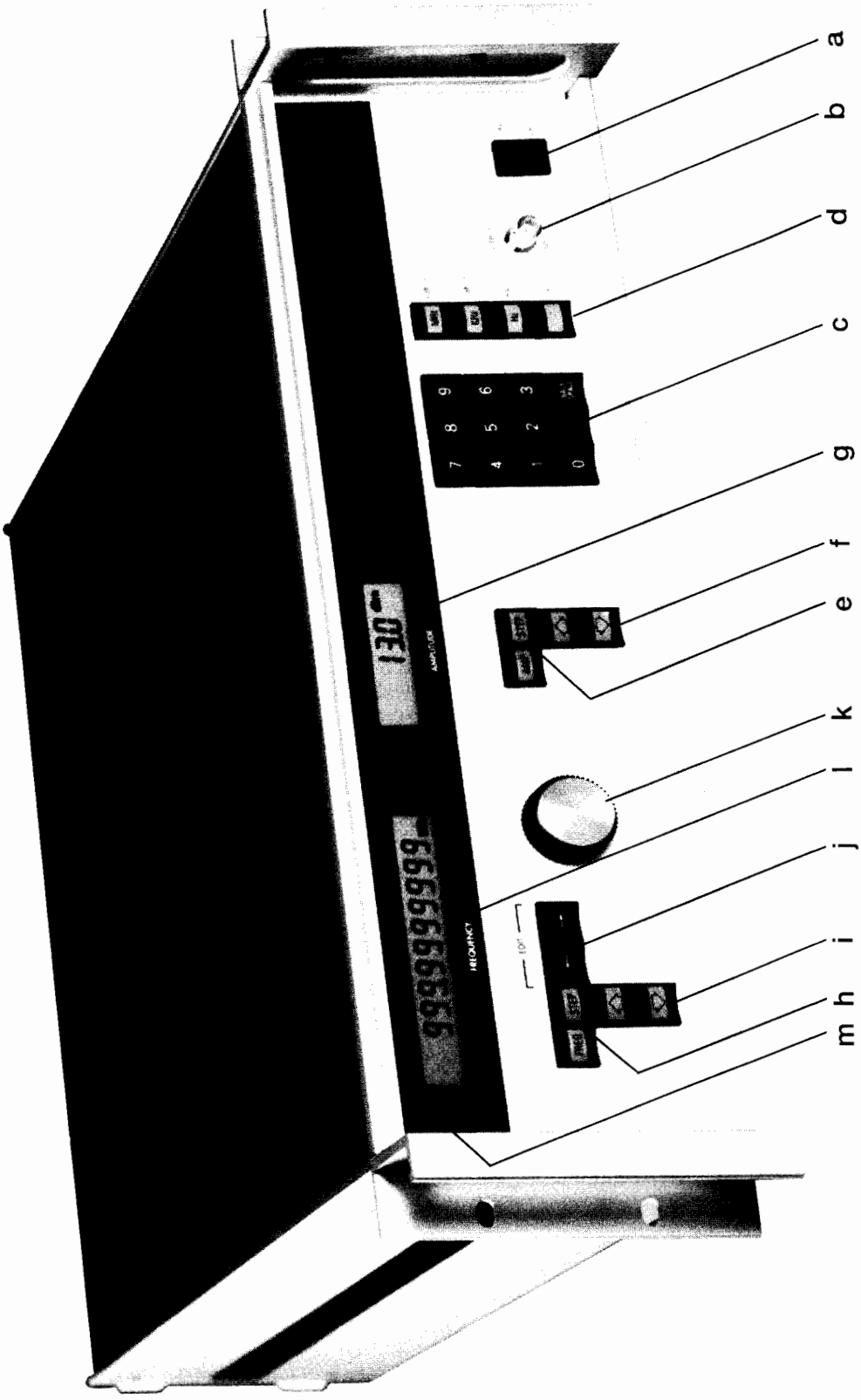


Figure 2

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REAR PANEL CONTROLS

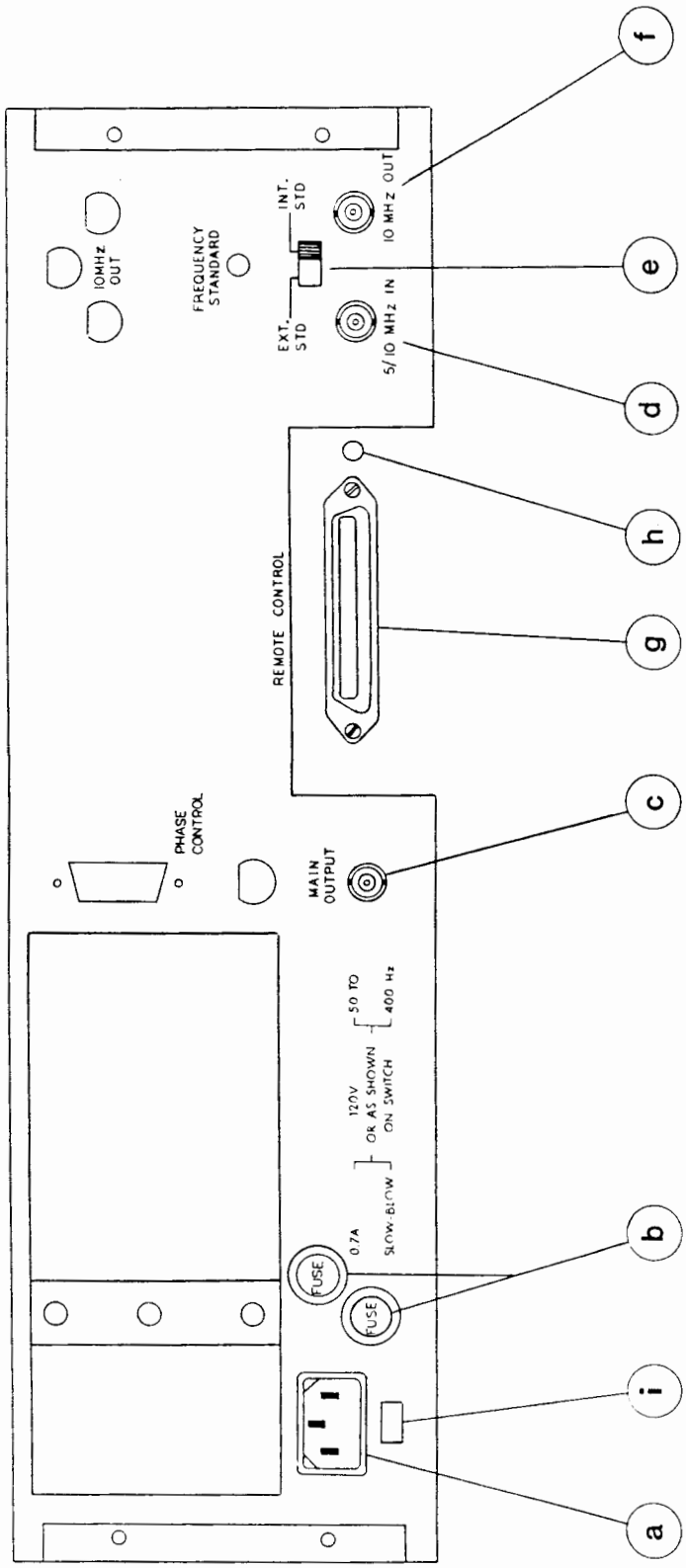
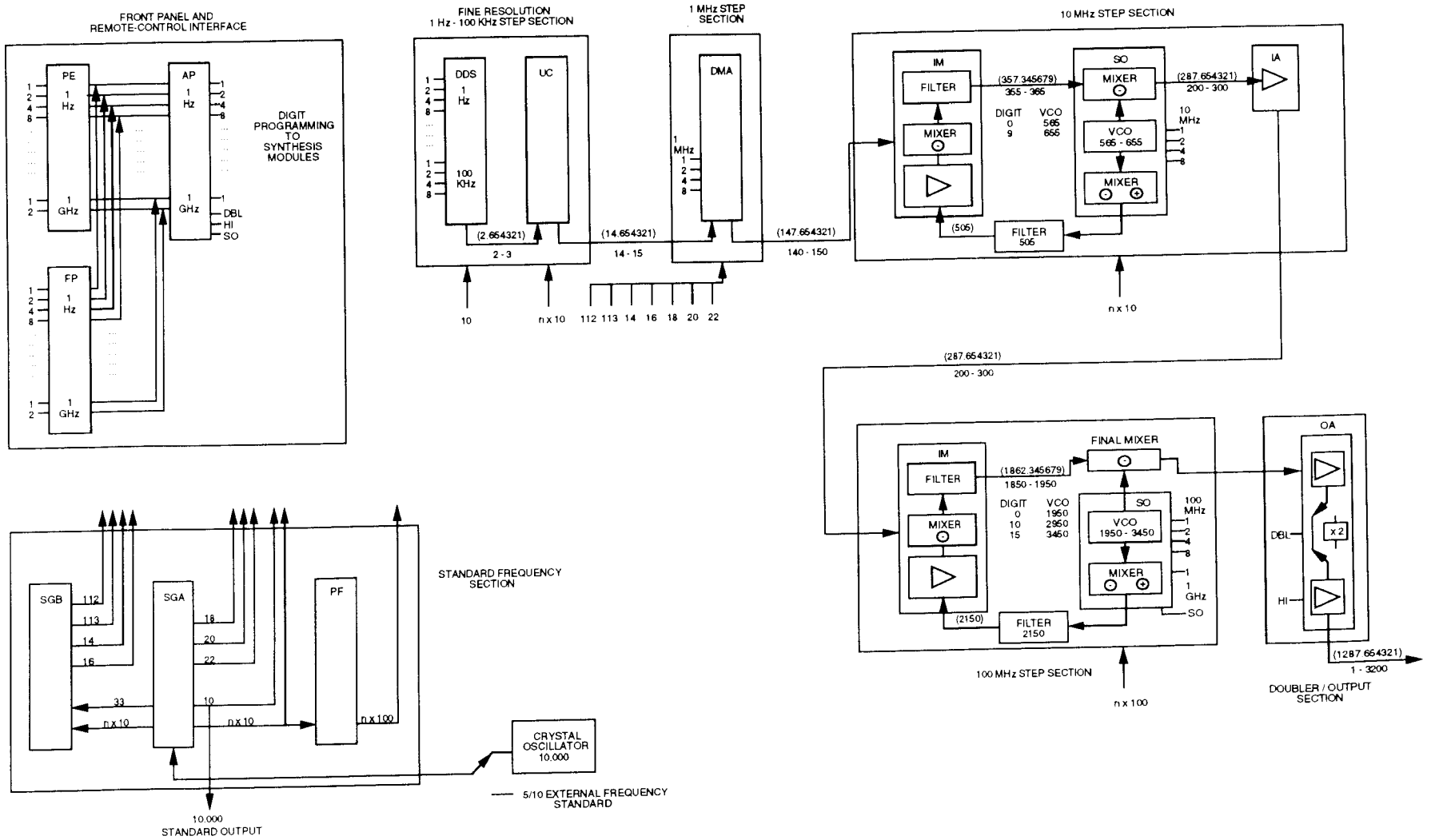


Figure 3

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PTS 3200 BLOCK DIAGRAM



FREQUENCIES IN MHz (SAMPLE FREQUENCY, 1287.654321 MHz)

Figure 4

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PTS 3200 MODULE and TEST POINT LOCATIONS

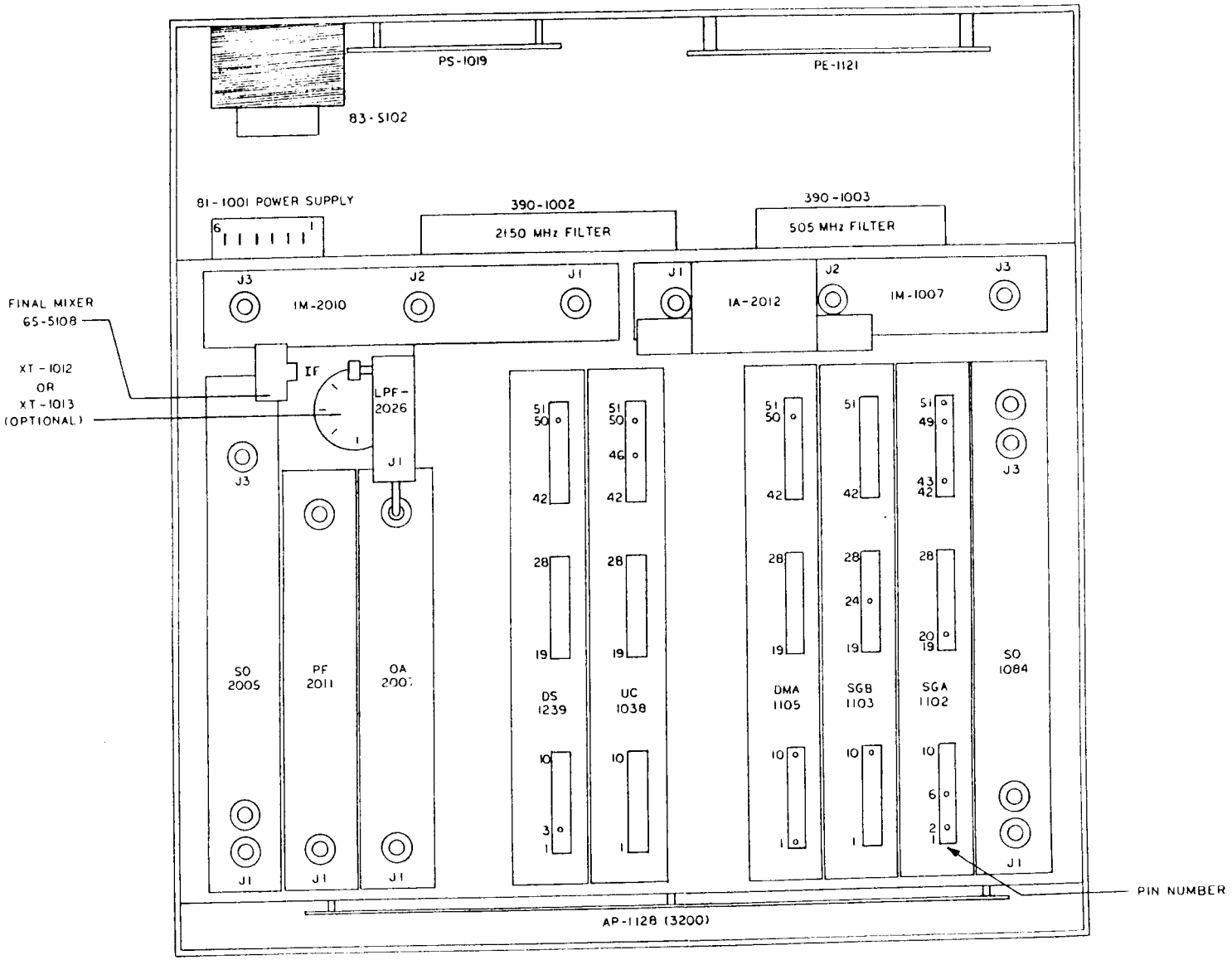


Figure 5

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SCHEMATIC, PS-1019

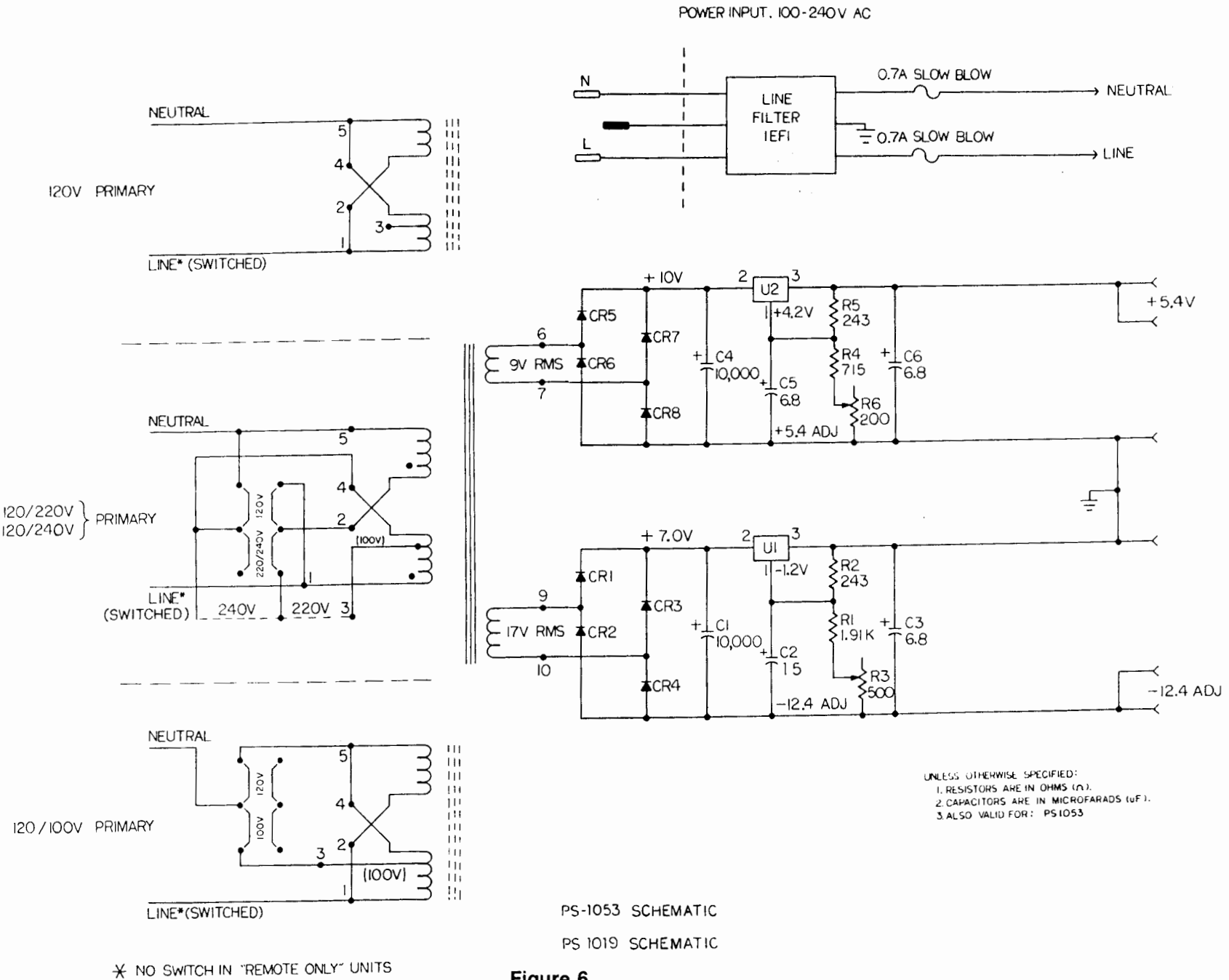
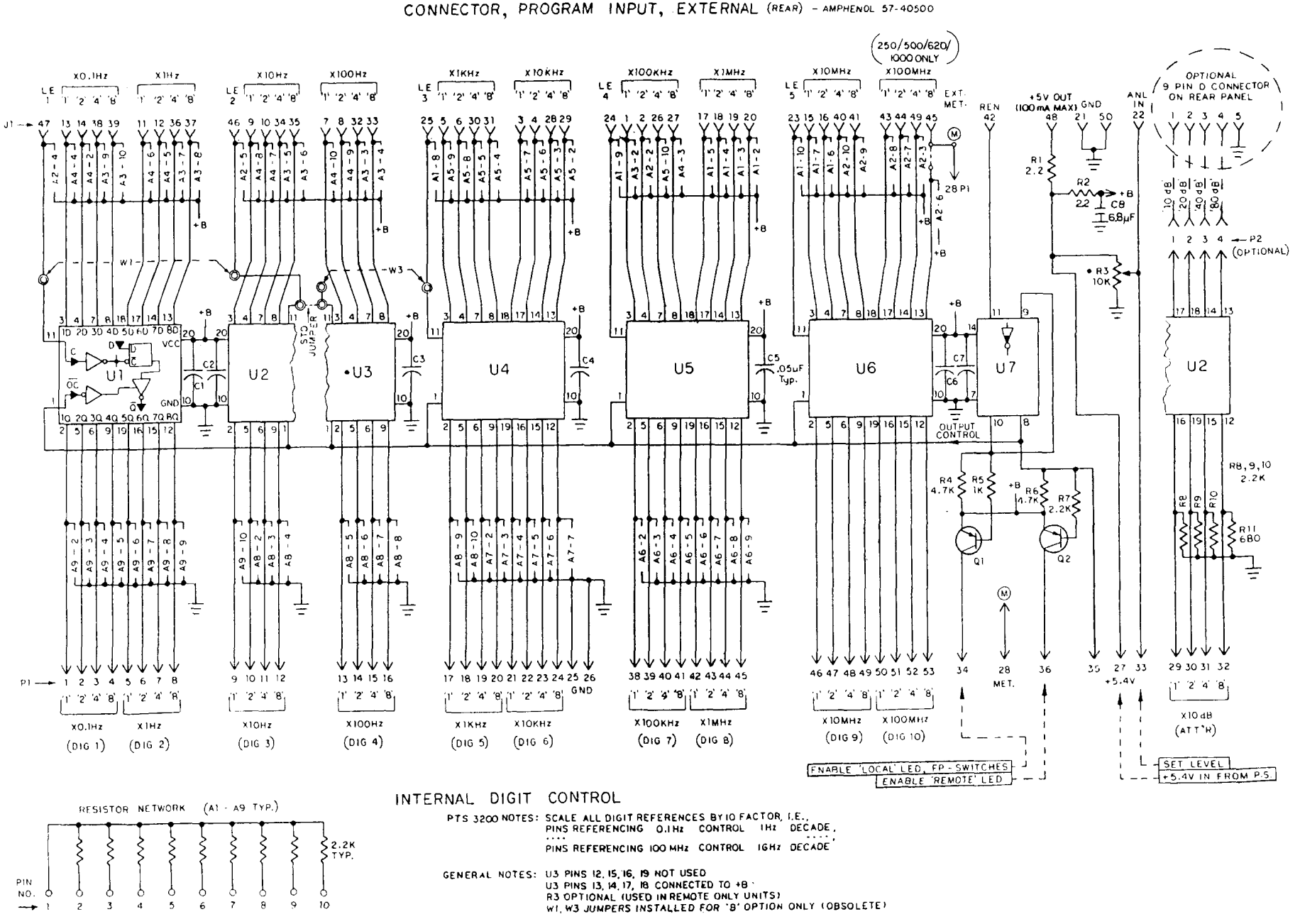


Figure 6

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SCHEMATIC, PE-1121



INTERNAL DIGIT CONTROL

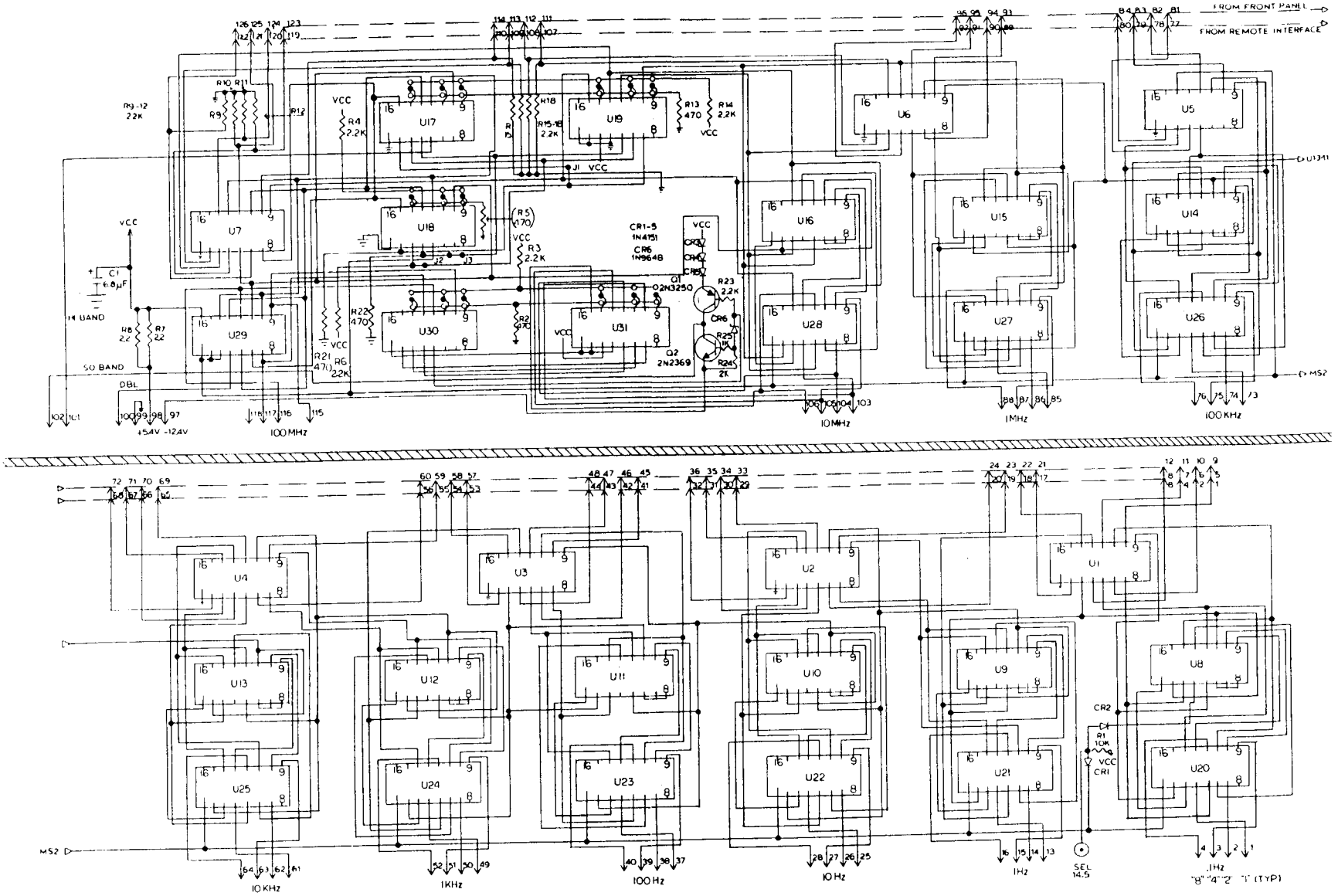
PTS 3200 NOTES: SCALE ALL DIGIT REFERENCES BY 10 FACTOR, I.E.,
PINS REFERENCING 0.1Hz CONTROL 1Hz DECADE,
....,
PINS REFERENCING 100 MHz CONTROL 1GHz DECADE

GENERAL NOTES: U3 PINS 12, 15, 16, 19 NOT USED
U3 PINS 13, 14, 17, 18 CONNECTED TO +B
R3 OPTIONAL (USED IN REMOTE ONLY UNITS)
W1, W3 JUMPERS INSTALLED FOR 'B' OPTION ONLY (OBSOLETE)

Figure 7

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SCHEMATIC, AP-1128 (3200)



NOTE:

PTS 500, OMIT: U30-31, CR3-6, Q1-2, R2-3, R6, R19-25

PTS 620, OMIT: U17, CR3-6, Q1-2, R6, R19-25

PTS 1000: OPEN J1-3, INSTALL ALL OPTIONAL COMPONENTS

PTS 3200: SCALE ALL DIGIT REFERENCES BY 10 FACTOR (E.G., 100MHz ACTUALLY CONTROLS 1GHz) INSTALL ALL OPTIONAL COMPONENTS

OTHER JUMPER SETTINGS DEPENDENT ON AP MODEL.

Vcc PIN 16	GND PIN 8	GND PIN 15
U1-31	U1-31	U1-6 U8-16 U20-30
Vcc BYPASS CAPACITORS 50nF C2-C19		

Figure 8

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