USER MANUAL

9480

TIME AND FREQUENCY SYSTEM

PUBLICATION NO. R-OM-9480

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PUBLICATION DATE: October 31, 2001

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2. Product model number
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RETURN of PRODUCT

Authorization is required from Racal Instruments before you send us your product for service or calibration. Call your nearest Racal Instruments support facility. A list is located on the last page of this manual. If you are unsure where to call, contact Racal Instruments, Inc. Customer Support Department in Irvine, California, USA at 1-800-722-3262 or 1-949-859-8999 or via fax at 1-949-859-7139. We can be reached at: helpdesk@racalinstruments.com.

PROPRIETARY NOTICE

FOR YOUR SAFETY

SYMBOLS AND HEADINGS

The following symbols and headings are used in this manual to indicate Safety hazards. Personnel using this equipment must read this manual and familiarize themselves with each safety requirement before operating the equipment. Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

WARNING
A Hazard to Personnel

A WARNING indicates a hazard that affects personnel. The instructions in a WARNING must be observed; if the WARNING is ignored, injury or loss of life may result.

CAUTION
Risk of Electrical Shock

A CAUTION indicates a hazard that affects the equipment. The instructions in a CAUTION must be observed; if the CAUTION is ignored, damage may be caused to the equipment.

CAUTION
Refer to Accompanying Documents

This symbol is used on the equipment to indicate that it is necessary to refer to, and comply with, all instructions in this manual regarding the use of such marked facilities.

GENERAL SAFETY PRECAUTIONS

Always operate the product in accordance with the instructions in this manual.

WARNING: (1) THIS EQUIPMENT IS A SAFETY CLASS 1 PRODUCT PROVIDED WITH A PROTECTIVE EARTHING CONDUCTOR INCORPORATED IN THE POWER CABLE. THE MAINS PLUG MUST ONLY BE INSERTED IN A MAINS SOCKET OUTLET PROVIDED WITH A MATCHING EARTH CONTACT. ANY INTERRUPTION OF THE EARTH CONDUCTOR, INSIDE OR OUTSIDE THE EQUIPMENT, IS LIKELY TO CAUSE THE EQUIPMENT TO BECOME DANGEROUS TO PERSONNEL. DELIBERATE INTERRUPTION OF THE EARTH CONDUCTOR IS FORBIDDEN.

(2) THE EQUIPMENT MUST BE POSITIONED SO THAT THE MAINS POWER INPUT CABLES CAN BE EASILY DISCONNECTED IN AN EMERGENCY.

(3) THE ENVIRONMENTAL OPERATING CONDITIONS SPECIFIED FOR THE EQUIPMENT MUST BE OBSERVED. DO NOT ALLOW THE EQUIPMENT TO BECOME WET, AND DO NOT ALLOW WATER TO ENTER THE EQUIPMENT. DO NOT OPERATE THE EQUIPMENT WHEN WET BECAUSE IN THIS CONDITION THE SAFETY OF THE EQUIPMENT MAY BE DEGRADED.

(4) IF THE EQUIPMENT HAS BEEN STORED AT LOW TEMPERATURES, TIME SHOULD BE ALLOWED FOR RECOVERY TO THE LOCAL AMBIENT TEMPERATURE BEFORE USE. WHERE CONDENSATION OF WATER VAPOR IS EITHER PRESENT OR LIKELY TO BE PRESENT, ALLOW THE EQUIPMENT TO DRY OUT BEFORE USE. CONDENSATION IS LIKELY TO OCCUR WHEN A COLD OBJECT ENCOUNTERS A WARMER, HUMID, ENVIRONMENT.

(5) THIS EQUIPMENT CONTAINS LETHAL VOLTAGES. DO NOT REMOVE THE COVERS. RETURN THE EQUIPMENT TO RACAL INSTRUMENTS LTD OR APPROVED SERVICE AGENT FOR SERVICING.

(6) THIS EQUIPMENT MUST BE KEPT CLEAN AND FREE FROM CONTAMINATION. IF NECESSARY, CLEAN THE EQUIPMENT AS DESCRIBED IN THIS MANUAL. IF THE EQUIPMENT IS SEVERELY CONTAMINATED, IT SHOULD BE RETURNED TO RACAL INSTRUMENTS LTD OR APPROVED SERVICE AGENT.

(7) ANY DEVIATION FROM THE INSTRUCTIONS PROVIDED IN THIS MANUAL MAY CAUSE THE PROTECTION PROVIDED BY THE EQUIPMENT TO BE IMPAIRED.

(8) THE MAINS FUSES MUST BE REPLACED ONLY WITH THE SAME TYPE AND RATING (SEE SECTION 2). THE USE OF OTHER FUSES OR MATERIAL MAY CAUSE A FIRE HAZARD AND IS FORBIDDEN.

CAUTION: DO NOT OBSTRUCT THE AIR INLET OR OUTLETS, IN ANY WAY. RESTRICTING THE FLOW OF COOLING AIR COULD CAUSE THE EQUIPMENT TO OVERHEAT AND MAY CAUSE DAMAGE.

ELECTROMAGNETIC COMPATIBILITY (EMC)

To ensure that EMC integrity is retained always follow good EMC practice. In particular:

(1) Use good quality coaxial connections for signal input and output leads.

(2) Use good quality screened data or control cables and connectors. Use double screened cable if necessary (e.g. when distributing TTL signals via coaxial leads).

(3) Ensure that cable screens are properly terminated within the connectors. Do not use cables if the terminations are loose or frayed.

(4) Ensure that the screening is continuous through to the chassis of the equipment.

(5) Ensure that any associated equipment is CE marked or is of good EMC design and performance.

ELECTROSTATIC DISCHARGE (ESD)

Electrostatic discharge may damage or degrade the performance of the Equipment if proper precautions are not taken:

(1) Where they are provided, protective covers must always be fitted on any rear panel connectors that are not in use (i.e. have no cable connected). Replacement protective covers are available from Racal Instruments Ltd or approved Service Agents.

(2) Before connecting free cables (i.e. not connected at either end) to any item of equipment, it is recommended that the cable connector pins are momentarily grounded to discharge any static build up within the cable.

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Chapter 1

TECHNICAL SPECIFICATION

Description

The 9480 Mainframe is housed in a 3U high, 19 inch rack mounting assembly with power supply, time and frequency management system, front panel display, and rear slots for up to eight distribution amplifier output cards.

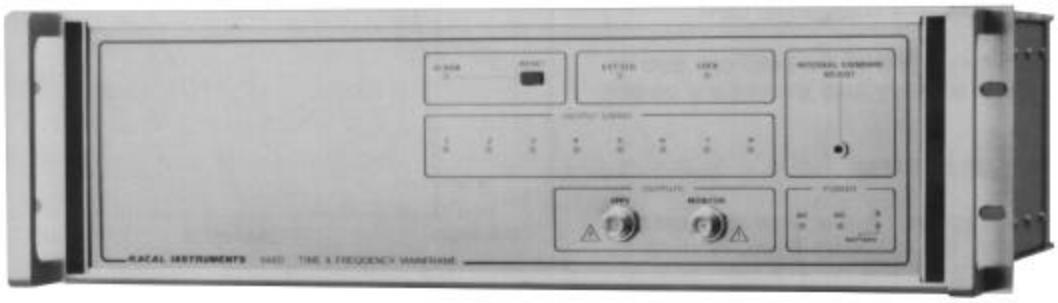

Figure 1-1, 9480

AC Power Supply Input

Voltage Ranges	: 85 - 130VAC and 180 - 264VAC
Frequency Range	: 45 - 66Hz
Power Consumption	: 170VA maximum

DC Power Supply Input

External 23.4 -30VDC, reverse polarity protection and fuse.

DC Current Consumption 1.5A maximum (after warm-up)

Internal, rechargeable battery (option).

External Frequency Standard

Frequency:	10MHz (or 13MHz –See Note 1)
Signal Level:	100mV or 1.2Vrms (AC coupling)
Max. Safe Level:	5Vrms, 500VDC blocking
Input Impedance:	500Ω (at 100mV –500mV input level)

Note 1: A 13MHz external standard frequency is needed for the 13MHz sinewave output cards.

Mechanical Dimensions

Height	: 210mm
Width	: 355mm (excluding the bail arm)
Depth	: 420mm
Weight	: 14.5kg approx.

Environmental Specification

Operating Temperature	: 0° to 50°C (13° to 45°C for full specification)
Altitude	: 2000m maximum
Humidity	: BS 2011 - Test Ca IEC68-2-3 (Endurance)
Calibration Period	: 1 year
EMC and RFI	: As stated on the Declaration of Conformity
Safety	: Complies with BS EN61010-1:1993+A2:1995 as follows: Class I Equipment Overvoltage Category II Pollution Degree 2

Options

Sinewave Output Cards:

Available Frequencies:	10MHz, 5MHz, 1MHz and 100KHz and 13MHz (See Note 1)
Outputs per card:	Five
Frequencies per card:	One
Maximum number of cards pre mainframe:	Eight
Output Power:	+13dBm ±2 dB
Output impedance:	50Ω
Output VSWR:	<1.3

Isolation:	>40dB between Outputs
	>60dB between Cards
Output Protection:	Indefinite Short Circuit
	<500mW reverse power
	>30V applied DC
Harmonics:	<-30dBc
Sub-harmonics:	<-70dBc
Spurious:	<-70dBc

TTL Output Cards:

Available Outputs:	2.048MHz and 13MHz
Outputs per card:	Five
Output level:	TTL

Frequency Standard Options

Frequency Multiplier (Option DIV)

A frequency multiplier option (factory fitted) enables the use of any external standard frequency that is 1MHz or higher and a submultiple of 10 MHz. The frequency must be within $\pm 1 \times 10^{5}$ to ensure phase lock. This option is not usable with the 13MHz ext. std. Required for Option 13.

Reference Changeover (Option RC0)

A (factory installed) reference changeover option is available. This card provides a changeover facility of frequency reference in systems requiring possible removal of both the primary and secondary back-up frequency sources.

Battery Back-Up (Option BBU)

The internal battery will supply standby power to the Frequency Standard for up to 1 hour. It is used with a Battery Control Board that is part of the battery back-up option (Option BBU).

Rubidium FRKH

Frequency Drift:	$\pm 1 \times 10^{-11}$ per month
Allan Variance:	$<1 \times 10^{-12}$ over 100 seconds
Warm-Up:	< 10 minutes to reach 2×10^{-10} at 25°C ambient

Rubidium FR-LP

Frequency Drift:	$\pm 5 \times 10^{-11}$ per month; 5×10^{-10} per year
Allan Variance:	$< 2.5 \times 10^{-12}$ over 100 seconds
Warm-Up:	< 7 minutes to reach 1×10^{-9} at 25°C ambient

Quartz 04F

Aging:	$\pm 2 \times 10^{-10}$/day, 3×10^{-8} /year
Allan Variance:	$< 5 \times 10^{-11}$ over 10 seconds
Phase Noise:	-145dBc/Hz at 1kHz offset
Warm-up:	Typically < 20 minutes to reach 1×10^{-8} at 25°C ambient

Quartz 04A

Aging:	$\pm 3 \times 10^{-9}$/day
Warm-up:	< 6 minutes to reach 1×10^{-7}

PSU Service Option (Option PSO)

This option allows continuous operation of the 9480 while withdrawing and servicing the plug-in PSU. The option is comprised of an internally mounted assembly and a cable.

Chapter 2

GENERAL DESCRIPTION

Introduction

The 9480 Time and Frequency Distribution System is a modular frequency standard[1] time standard and distribution system. The product offers a high degree of flexibility for designers of satellite systems, calibration systems, test systems and other applications requiring a frequency and/or a time standard.

The system provides a versatile means of generating and distributing a number of highly stable and accurate time signals and output frequencies derived from a self-contained, accurate atomic oscillator with a long-term stability better than 10^{-9}/ year. High-quality crystal standard options are also available.

The mainframe houses a Power Supply Unit, Distribution Board, Display Board, and up to eight Output Cards. It can accept the following optional items: internal frequency standard, external reference board and battery back-up pack.

The system can operate as a simple five output distribution amplifier or a complex system time and frequency standard with multiple frequency outputs.

Up to eight cards of five outputs each can be fitted to provide individual outputs at 1V level, 50Ω impedance, or TTL. A wide range of output frequency combinations can be configured.

The system may be operated as a slave and will switch over automatically when a suitable external input frequency is applied.

All options are retrofitable, enabling user to build up the system over a period of time without redundancy.

The unit operates from AC mains or an external DC. There is also an internal battery back-up option to maintain power to the internal reference if all external power fails.

The unit is 136.3mm high (3U) and is suitable for standard 19 inch rack mounting.

9480 DESCRIPTION

The heart of the system is the time and frequency mainframe. This houses a power supply and the frequency and time management sub-system. The mainframe has the capacity for either an oven controlled crystal oscillator or rubidium frequency standard, a digital clock display, a battery back-up supply and up to eight, five-output, distribution amplifiers.

Distribution amplifier output cards are available in frequencies of 100kHz, 1MHz, 5MHz, 10MHz, 13MHz and TTL output cards of 2.048MHz and 13MHz.

Applications

The 9480 is suited to requirements demanding a precision time reference, frequency reference and/or distribution system.

For satellite ground stations, there is a range of options, including low noise frequency standards. For calibration laboratories, up to 40 outputs can be distributed from a single mainframe.

15 For UHF Quasi-Sync systems or Simulcast Systems, the flexible number of outputs and frequencies is ideal for phase-locking transmitter/receiver base stations. The FR-LP rubidium standard achieves the desired stability without the necessity of frequent oscillator calibration or expensive environmental controls.

THE 9480 SYSTEM

When selecting a suitable frequency and/or time standard and distribution system, consideration is given to:

(a) Frequency standard accuracy.

(b) Power supply requirements.

(c) Number and frequency of outputs.

Frequency Standards External

The 9480 can be used as a frequency distribution system, fed by an external standard. Under these circumstances, it may also have a standard installed in the 9480 as a back-up. The 9480 will then switch automatically to its internal standard if the external input is lost or is not available.

Internal

The 9480 mainframe has a range of frequency standard options that include rubidium oscillators, a fast warm-up ovened crystal oscillator and a low phase noise, high stability, ovened crystal oscillator.

The choice of a frequency standard will depend on the application and consideration of Aging, Allan Variance, Phase Noise and Retrace Error.

Available Standards

FRKH is a ultra-stable, rubidium atomic oscillators with drift values of $\pm 1 \times 10^{-11}$. For references that are later multiplied into the Gigahertz range a low phase noise option Is available.

FR-LP Is a lower cost, yet extremely stable atomic oscillator. It has a one-month drift of $\pm 5 \times 10^{-11}$ and warms-up in less than five minutes.

04F is a precision ovened crystal oscillator which combines $\pm 2 \times 10^{-10}$/day aging with very low phase noise.

04A is a fast warm-up, oven controlled crystal oscillator. It has an aging characteristic of $\pm 3 \times 10^{-9}$/day and warms-up in less than 4 minutes.

Aging

Aging is the way in which an oscillator's frequency changes with time, stated as fractions of a Hertz per time period. Short term stability is stated for time periods of less than 100 seconds, whereas long term stability is stated for time periods of one day or more.

In general, aging occurs exponentially and is greatest during the first month of operation. Sometimes even high quality crystal oscillators may not be good enough for applications such as UHF quasi-sync or Simulcast systems, where accuracy's of 1×10^{-9} are required. Such accuracy can be achieved with a crystal but will require frequent adjustment and careful temperature control.

In contrast, a rubidium oscillator would only drift by 1×10^{-10} per year, but are more expensive than crystal oscillators.

Allan Variance

Allan Variance is used to characterize the long and short term stability of precision oscillators. It is a statistical method of presenting the average variance in frequency over a given time at a chosen sample interval. Mathematically it is expressed as:

Allan Variance

$$\sigma_y^2(\tau) = \frac{1}{2m}\sum_{k=1}^{m}(\overline{y}_{k+1} - \overline{y}_k)^2$$

where

$$y_k = \frac{\phi(t_k + \tau) - \phi(t_k)}{2\pi\nu_o\tau}$$

$\phi(t_k)$ is the phase at time t_k

ν_o is the frequency at which the phase measurement is made

m is the number of samples

Phase Noise

Phase Noise is a measure of the random fluctuations in frequency or phase due to noise. It is normally measured in a 1 Hz bandwidth at various frequency offsets from the fundamental frequency. Close-to-carrier noise is generated by the standard itself but at offsets of 1 MHz or more noise due to the frequency distribution system predominates. The 9480 uses low noise amplifiers throughout that have little effect on the quality of the standard. Figure 2-2 shows typical phase noise plots of the various standard option.

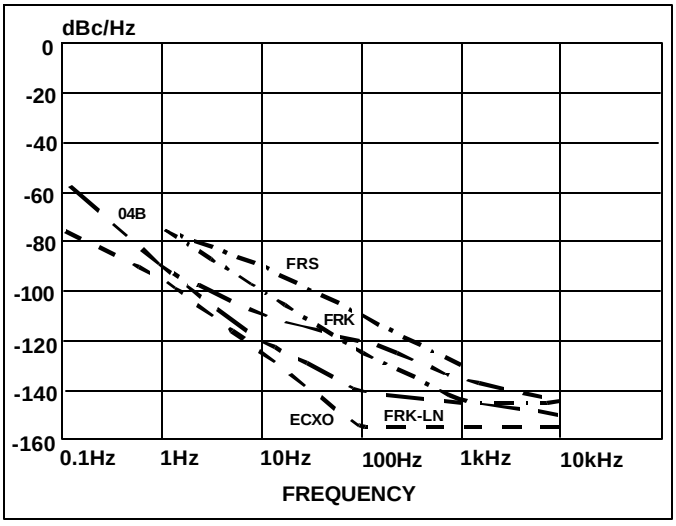

Figure 2-1, Phase Noise Performance Retrace

Retrace

Retrace is a particular problem of quartz crystal oscillators and is a shifted frequency offset caused by removing and re-applying power. Refer to Figure 2.3. In order to prevent retrace errors, the 9480 is available with an internal battery supply, which maintains supply to the oscillator in the event of loss of primary power.

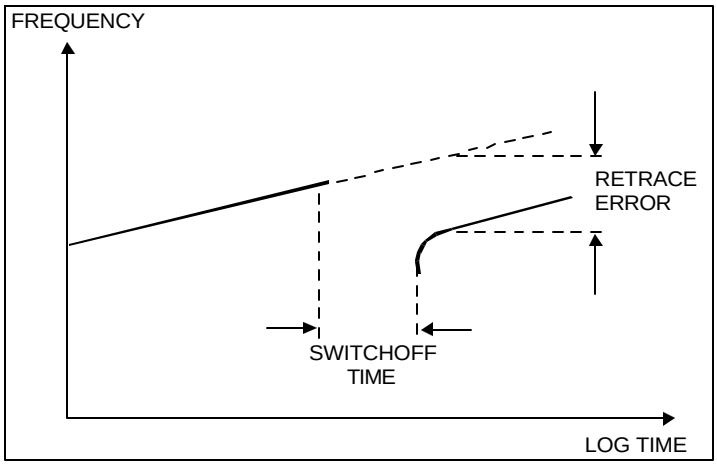

Figure 2-2, Retrace Errors

Power Supplies

The 9480 has a flexible power supply arrangement to ensure that supply to the frequency standard is maintained, thus eliminating retrace problems.

The power supply is a hierarchical system and features automatic switch over. The primary power is 89.5 to 254 Volts AC; if this is absent the unit automatically selects an externally applied 23.4-30 Volts DC and if this is absent the 9480 will select the optional internal rechargeable battery.

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Chapter 3

PREPARATION FOR USE

Introduction

To prepare the 9480 Mainframe for operational use, proceed as follows.

Unpacking

The Time and Frequency Mainframe 9480 is delivered from manufacturer to customer in a protective transit case packaging.

Carefully remove the unit from its sealed polythene bag and its protective package.

Examination

Visually inspect the unit for any damage caused by transit. Any defects should be noted on the appropriate form attached and reported to the Carrier and Company promptly.

Check for customer requested options and report any anomalies.

Output Card Description

At the rear of the 9480 Mainframe are slots for up to eight output cards. Each card has five buffered outputs available in frequencies of 13MHz, 10MHz, 5MHz$_1$ 1MHz and 100kHz.

A 2.048MHz and 13MHz TTL output card can also be fitted.

A maximum of 40 outputs is available, five from each of the eight cards.

Future Expansion

For expansion to the time and frequency distribution system, additional output cards can be fitted to the mainframe at a future date.

The quartz frequency standard can also be upgraded to a

rubidium standard without the need to purchase a second mainframe.

External Standard

If an external frequency standard is available, this is to be connected to the card fitted in the left most slot, as viewed from the rear of the unit. An External Standard card Is factory fitted and can accept 10MHz or 13MHz signals. An External Multiplier option card accepts signal inputs of 1MHz, 2MHz, 5MHz or 10MHz. A Reference Changeover option card accepts a 10MHz signal only.

For large frequency distribution systems that require multiple outputs, the facility exists for 9480s to be daisy-chained together. In this configuration the Master 9480 is the one with the frequency standard and the front panel Monitor output is connected to the EXT STD I/P on the rear panel of the slave 9480s. See Figure 3-1 for connections.

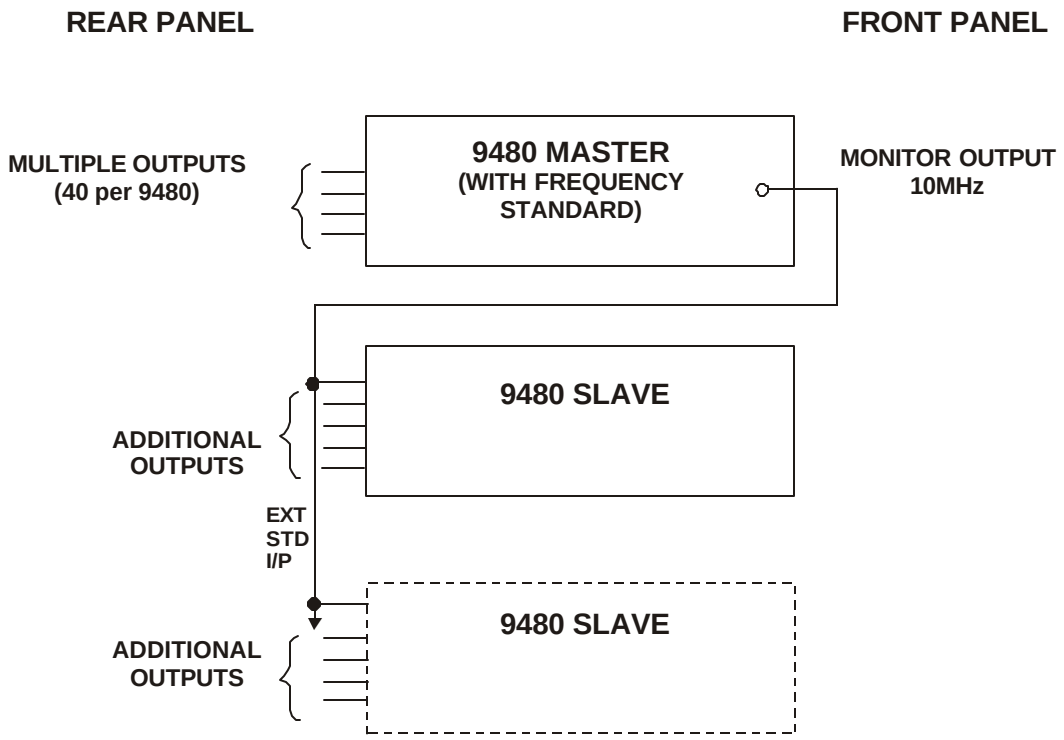

Figure 3-1, 9480 Master/Slave System

Where the continuous availability of a frequency standard signal is of paramount importance, the 9480 units can be configured as shown in Figure 3.2. This arrangement ensures automatic changeover to a second frequency standard if the prime standard should fail. Standards are connected to a Reference Changeover card in a 9480 serving as a distribution unit.

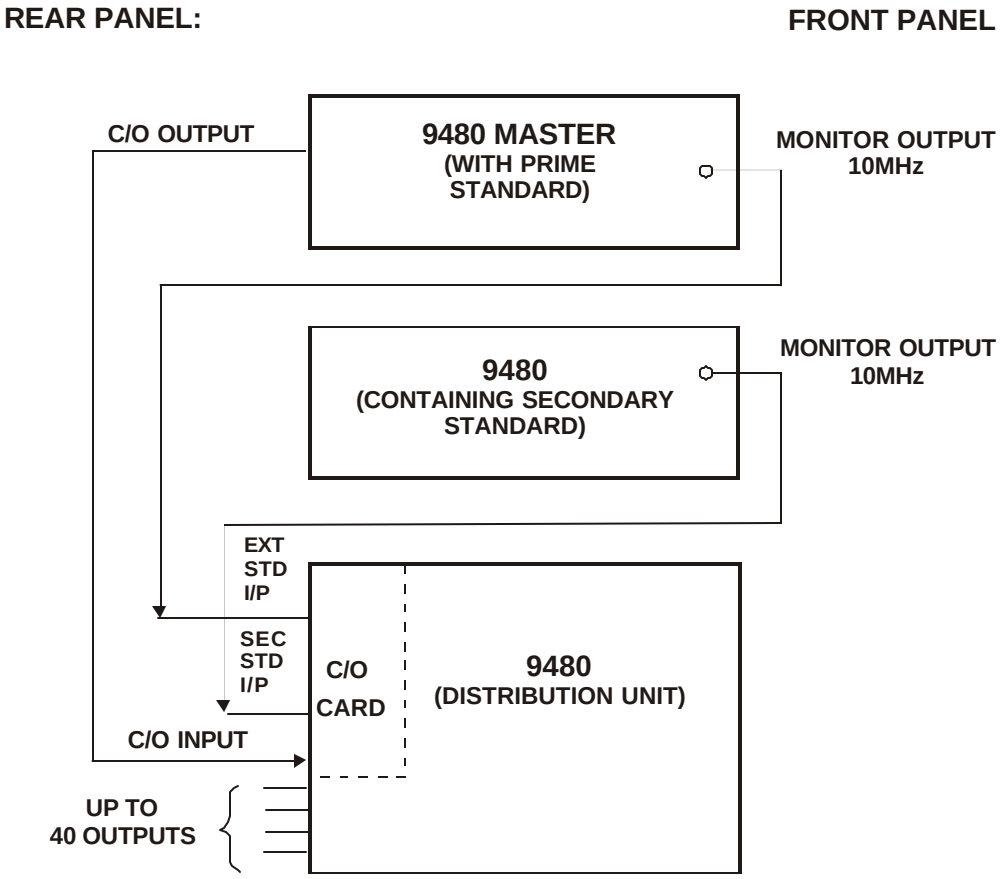

Figure 3-2, High Availability 9480 System

The two power inputs of the 9840 can also be utilized to provide a secondary power, back up, facility.

Reference Changeover Option

A reference changeover option is available. The card provides an automatic changeover to a back-up (secondary) frequency standard in a third chassis if the prime standard should fail (see Figure 3-2). The primary frequency generation (PFG) and the secondary frequency generation (SFG) inputs are to the same input specification as the normal External frequency standard. This is only required for high redundancy systems where both primary and secondary standards need to be accessible for servicing.

Power Supply System

The 9480 mainframe has a hierarchical power supply system to ensure that the supply to the frequency standard is maintained.

The unit features automatic switch over to the connected power supply.

Primary power is from an AC source in the 89.5-254 Volts AC range. If this is absent, the unit automatically selects an externally applied 23.4-30 Volts DC. In the absence of a DC source, the 9480 will select an internal rechargeable battery, if fitted for the reference.

AC/DC Lines

The AC and DC power lines are connected at the rear panel and are fused for circuit protection.

Check that the correct fuse rating is fitted for the available power supply. Refer to the rear panel label. Figure 3-3, for this information.

AC Line Select

Access to the AC input selection for setting one of the four voltage ranges is gained by releasing the plastic cover on the AC LINE input connector.

The correct voltage is set by rotating the drum.

The internal line fuse should be the correct one for the range as displayed on the panel.

Internal Battery

An internal battery pack, if fitted as an option, is designed to supply standard power to the Frequency Standard for a period of up to one hour. It is used in conjunction with a Battery Control Board that is supplied as part of the Battery Back-up option (BBU).

A Battery Control Board (if fitted) carries a BATTERY ENABLE switch. Use of this switch allows the battery to be temporarily disconnected. This facility allows the 9480 to be disconnected from external power supplies without activating the Battery Back-up facility.

If the top cover Is on the 9480, access to the battery switch is gained after removing a rubber plug in the cover.

The battery enabled position is when the switch lever is moved towards the heatsink. This is the normal position when operating from an external AC or DC source.

If the unit is non-operational for periods of time, the battery enable should be switched off to conserve energy.

Rack Mounting

Slide the unit into its rack position. It is recommended as a two-man operation.

Make the AC/DC power and any other connections at the rear.

Secure the unit to the rack.

Switch on the appropriate power button at the Rear Panel.

See Section Four for an interpretation of front panel indications.

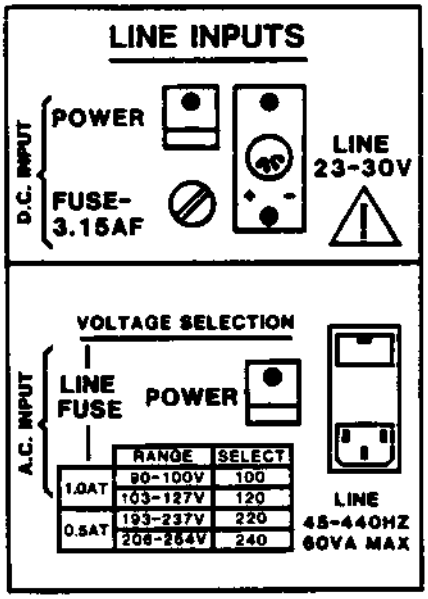

Figure 3-3, Rear Panel

Chapter 4

OPERATING INSTRUCTIONS

Master Or Slave Operation

The 9480 unit may be used as a master or as a slave for time and frequency signals distributions. It will automatically switch over when a suitable, external, signal frequency is applied to External Reference Card at the rear of the unit. This is usually a 10MHz signal or a 13MHz external signal for 13MHz sinewave outputs.

Operational Voltages

The unit can be set to operate from one of four AC line voltages (100, 120, 220 or 240V ±10, 5%) in the 45 to 440Hz frequency range. An external DC supply in the 23 to 30V range can also be used as source or an internal battery, if fitted. The 9480 unit automatically switches from AC to DC or battery in its selection of power source.

Front Panel Features

The front panel has the following indications and controls (See the front panel in Figure 4-1):

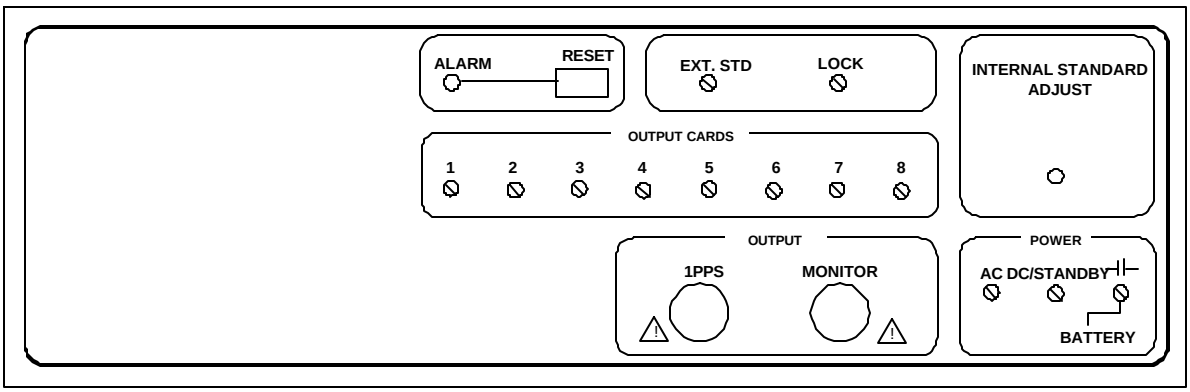

Figure 4-1, Front Panel

Output Failure (OUTPUT CARDS)

There are eight LED indicators, one for each OUTPUT CARD. An LED is lit when all five outputs from a card are functioning. An LED will flash if any of its outputs fails and extinguishes when a card is absent.

The LED will come back on when normal functioning is restored, but a failure triggers a flashing "General Alarm" and the alarm line remains activated until it is reset by the operator.

Frequency Lock (LOCK)

This indication is lit when the frequency standard is in LOCK. If the frequency multiplexer option from the external standard is fitted, that too must be in lock before the LED will light. An LED off denotes an unlocked condition.

External Frequency (EXT. STD.)

This indicator is lit when an external frequency standard is present at the rear panel giving rise to an automatic changeover from internal to external standard.

Power Source (POWER)

Three separate indicators for a choice of the power source, line AC, line DC or internal battery.

If both AC and DC power inputs are present, the 9480 automatically selects the AC input. If AC fails then DC is selected (if present). If both AC and DC fail, the internal battery, if fitted and enabled, will power the internal frequency standard, but not the rest of the 9480 circuits.

ALARM and RESET

The ALARM LED will flash if any of the output LEDs has Indicated failure. Depressing the RESET push button, provided the fault condition is no longer present, can reset it.

OUTPUTS

Two BNC connectors are available on the front panel for output signal monitoring and the 1 pulse-per-second output.

A 0.3V ± 0.1V p-p, into a 50 ohm load, monitor output signal is available at the principal internal frequency (10MHz or 13MHz). The waveform is substantially square wave and AC coupled.

A 0.3V ± 0.1V p-p (into a 50 ohm load, or TTL compatible into open circuit) square wave signal at 1Hz is available at the 1 PPS socket. This signal is derived from the internal or external frequency standard and Is DC coupled.

INTERNAL STANDARD ADJUST

This is a recessed Vernier control for fine adjustment of frequency standard. Coarse adjustment of 04A and 04B options is through the top cover on its right hand side.

REAR PANEL

(See Figure 4-2 for the rear panel)

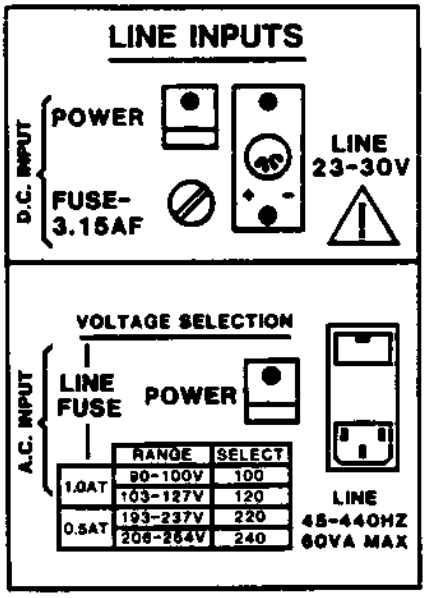

Figure 4-2, Rear Panel

Power Input

This is a combined fuse and mains input socket and supply selection.

DC Input

This is a polarized, external DC input connector. The two pins on the left are linked internally for the +ve supply, the two on the right for the -ve supply.

Ext. Std. Input

This is the plug-in card for external standard or option 9480-DIV. This is normally a 10MHz, 100mV to 1Vrms, 50 ohm signal (or 13MHz for Option 13).

Diagnostic Connector

Lines in the connector are used to monitor the status on the frequency standard, Its battery supply and the Alarm line condition.

The pin out detail is as follows:

Table 4-3, 9480 Diagnostic Pin Outs

Pins	Functions
1	Alarm (Logic 1 = Alarm)
2	BATT. ON line (Logic 1 = BATT. ON)
3	External Reference line (Logic 1 = External Signal Present)
4	Rubidium oscillator control voltage
5	Oscillator in lock (Logic 1 = In Lock)
6	GND (System earth)
7	AC/DC* Input (Logic 1 = AC Input)
8	Master Reset* (Logic 0 input will reset the 9480 alarm)
9	Spare

Chapter 5

PRODUCT SUPPORT

Product Support

Racal Instruments has a complete Service and Parts Department. If you need technical assistance or should it be necessary to return your product for repair or calibration, call 1-800-722-3262. If parts are required to repair the product at your facility, call 1-949-859-8999 and ask for the Parts Department.

When sending your instrument in for repair, complete the form in the back of this manual.

For worldwide support and the office closes to your facility, refer to the Support Offices section on the following page.

Reshipment Instructions

Use the original packing material when returning the 9480 to Racal Instruments for calibration or servicing. The original shipping crate and associated packaging material will provide the necessary protection for safe reshipment.

If the original packing material is unavailable, contact Racal Instruments Customer Service for information.

Support Offices

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