Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:
- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

Test equipment Solutions Ltd
Unit 8 Elder Way
Waterside Drive
Langley
Berkshire
SL3 6EP

T: +44 (0)1753 596000
F: +44 (0)1753 596001

Email: info@TestEquipmentHQ.com
Web: www.TestEquipmentHQ.com
**Time and Frequency Distribution System Model 9480**

- Modular Design Features Plug-In Power Supply and Output Cards
- AC or DC Operation
- Up to 40 Buffered Frequency Outputs
- 1 Pulse-Per-Second and Reference Monitor Outputs
- Ovened or Atomic Standard Options
- Optional Redundant Frequency Changeover and Battery Backup

**Introduction**

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

System capabilities vary from a simple 5-output distribution amplifier card to a complex frequency standard with multi-frequency outputs referenced to both primary and secondary standards.

With field-upgradable options, the 9480 enables users to “build up” the system over a period of time at minimum expense.

**Description**

The time and frequency mainframe is the heart of the 9480 system. It houses both the power supply and frequency-management sub-system. The mainframe has the capacity for an oven-controlled crystal oscillator or a rubidium frequency standard, an optional battery backup supply, and up to eight, 5-output, distribution amplifier cards. Up to 40 outputs can be distributed from one mainframe.

The instrument operates from a wide range of AC power voltages with the ability to additionally operate via an external DC supply. Upon AC power failure, the unit automatically switches to the external DC supply (if connected). Users may add an optional battery backup capability for maintaining power to the frequency standard in absence of both the mains and external DC power. Front-panel indicators designate which power source is in use.

The 9480 series offers a 1-pulse-per-second and 10 MHz output on the front panel. In addition, users may select five-output distribution amplifier cards with output frequencies of 100 kHz, 1 MHz, 5 MHz, 10 MHz, 13 MHz, or 2.048 MHz.

**Applications**

The Model 9480 is ideally suited to almost any requirement for a precision time reference, frequency reference, and/or distribution system.

When used for UHF Quasi-Sync or Simulcast system testing, the flexible number of outputs and frequencies remains ideally suited for phase-locking transmitter/receiver base stations. The rubidium standard achieves the desired stability without the need for frequent oscillator calibration or expensive environmental control. When used for satellite ground stations and calibration laboratories, a wide-range of options, including specialized low-noise standards, are available.
Selecting A 9480 System
When selecting a frequency and/or time standard and distribution system, consider the following:

- Frequency standard performance
- Power supply requirements
- Number and frequency of outputs

Using the 9480 With External Frequency Standards
The 9480 series can be used as a frequency distribution system fed by an existing external standard. Users may additionally install an internal standard (see below) as a back-up reference. The 9480 will then automatically switch to its internal standard if the external input is lost, fails, or is removed for calibration.

Internal Standard Options
The 9480 series offers a range of frequency standard options suited for internal fitting. They include an ovened crystal oscillator, low-phase noise, high stability, and a choice of highly-stable rubidium standards.

When selecting a frequency standard, consider the following parameters:

- Aging
- Short-term stability
- Phase noise
- Retrace

Aging
Aging refers to the process by which an oscillator’s frequency changes with time, specified in fractions of a Hertz per time period. Also known as long-term stability, aging specifically refers to periods of one day or more.

Figure 1. Typical Aging Characteristic

In general, aging occurs exponentially and is greatest during the first month of operation. Figure 1 depicts the typical accuracy characteristic of a high-stability, ovened crystal oscillator in the first year of operation.

In some instances, high-quality crystal oscillators may not be sufficient for applications such as UHF quasi-sync or Simulcast Systems, where accuracies approaching $1 \times 10^{-9}$ are required. Such accuracies are achievable with a crystal but will require frequent adjustment and careful temperature control. In contrast, a rubidium oscillator would only drift by $1 \times 10^{-10}$ per year.

Although rubidium standards are more expensive than crystal oscillators, they maintain a longer calibration cycle than crystal, which can save costly calibration downtime.

Short-Term Stability
Short-term stability is the characterization of oscillator-frequency changes over periods shorter than 100 s.

An Allan Variance calculation is often used to characterize the short-term stability of precision oscillators. This statistical method presents the average variance in frequency over a given time and selected sample interval.

Phase Noise
Phase noise measures the random fluctuations in frequency or phase due to noise. It is normally measured in a 1 Hz bandwidth at various offsets from the fundamental frequency. The standard generates close-to-carrier phase noise. At offsets of 1 MHz or more, noise may occur due to the frequency distribution system. The 9480 was designed with special low-noise amplifier technology throughout to minimize phase noise.

Retrace
Many reference oscillators, particularly quartz, experience a frequency offset known as retrace error, caused by removing and re-applying power as described in Figure 2.

Figure 2. Retrace Error

In order to prevent retrace error, the 9480 can be fitted with an internal battery option, which maintains supply to the oscillator in the event of the loss of unit power.

Available Standards
04A is a fast warm-up, oven-controlled crystal oscillator with an aging characteristic of $3 \times 10^{-9}$/day; warms-up in less than 6 minutes.

04F is a precision oven-controlled crystal oscillator combining $2 \times 10^{-10}$/day aging with very low phase noise.

FR-LP is a new, low cost, highly stable rubidium atomic oscillator with a one-month drift of $5 \times 10^{-11}$; warms-up in less than 11 minutes.

FRK-H is an ultra-stable rubidium atomic oscillator with a one-month drift of $1 \times 10^{-11}$.

Power Supplies
The 9480 Series has a flexible power supply. Available configurations ensure the maintenance of a continuously power frequency standard, thus eliminating retrace problems. The primary power ranges from 90 to 254 VAC; with power absent, the unit automatically selects an externally applied 23.4-30 VDC (if present). If DC is absent, the 9480 selects the internal rechargeable battery (optional) for maintaining continuous power to the reference for at least one hour.
Frequency and Number of Outputs

There are up to 8 plug-in output distribution cards at the year of the 9480 mainframe. Each output card contains 5 buffered outputs available in frequencies of 100 kHz, 1 MHz, 5 MHz, 10 MHz, and 13 MHz. Also available are 2.048 MHz and 13 MHz TTL output cards.

Front panel LEDs continuously monitor and report output card status.

Dual Redundancy Configuration

When the availability of a frequency standard is of critical importance, a 9480 system can be configured to have both primary and secondary external standards. In this case (see Figure 3), by utilizing a reference changover card (RCO option), the 9480 automatically changes over to an external secondary frequency standard if the external primary standard fails.

9480 SPECIFICATIONS

OUTPUT CHARACTERISTICS

Available Frequencies (sinewave)
- 100 kHz, 1, 5, 10, and 13 MHz

Available Frequencies (TTL)
- 2.048 and 13 MHz

Card Outputs (per card)
- Channels: 5
- Frequencies: 1

Mainframe Outputs (max)
- Cards per Mainframe: 8
- Channels per Mainframe: 40

Amplitude
- Sinewave: +13 dBm ±2 dBm, 50 Ω
- TTL: 5 V, nominal

VSWR
- < 1.3:1

Isolation
- Between Outputs: > 40 dB
- Between Cards: > 60 dB

Output Protection
- Short Circuit: Indefinite
- Reverse Power: < 500 mW
- Applied DC: < 30 V

Spectral Purity
- Harmonics: < -35 dBc
- Sub-harmonics: < -70 dBc
- Spurious: < -70 dBc

TIMEBASE CHARACTERISTICS

Opened Quartz (Option 04A)
- Aging Rate: 3 x 10⁻⁹/day
- Warm-up @ 25°C: < 6 min. to 1 x 10⁻⁷
- Accuracy at Shipment: ±1 x 10⁻⁸

Opened Quartz (Option 04F)
- Aging Rate: 2 x 10⁻¹⁰/day, 3 x 10⁻⁸/year
- Allan Variance: 5 x 10⁻⁵ over 10 s
- Phase Noise: -145 dBc/Hz @ 1 kHz offset
- Warm-up @ 25°C: < 20 min. to 1 x 10⁻⁸

Rubidium FR-LP (Option FR-LP)
- Frequency Drift: ±2.5 x 10⁻¹¹/month
- Allan Variance: 2.5 x 10⁻¹² over 100 s
- Phase Noise (1 Hz offset): -75 dBc/Hz
- Phase Noise (10 Hz offset): -89 dBc/Hz
- Phase Noise (100 Hz offset): -128 dBc/Hz
- Warm-up: < 11 min. to 4 x 10⁻¹⁰

Rubidium FRKH (Option FRKH)
- Frequency Drift: ±1 x 10⁻¹⁰/month
- Allan Variance: < 1 x 10⁻¹² over 100 s
- Warm-up @ 25°C: < 10 min. to 2 x 10⁻¹⁰

External Standard Input
- Frequency (standard): 10 MHz
- Frequency (Opt Div): > 1 MHz, sub-multiple of 10 MHz
- Input Range: 100 mV to 1 Vrms
- Maximum Input: 5 Vrms
- Input Impedance: 50 Ω

PANEL I/O

Front Outputs
- Monitor: 10 MHz, 0.3 Vpk-pk, BNC, 50 Ω
- 1 PPS: 1 Pulse/second, 0.3 Vpk-pk, BNC, 50 Ω

Front Indicators
- Output Failure: One per output card, flashes on failure
- Frequency Lock: On when frequency standard is locked

External Input: On when external standard is applied
- Power Source: Three (3) LED’s, AC, DC or Battery
- Alarm: On for any failed output

Front Controls
- Reset Button: Resets latched alarm
- Adjust: Frequency standard fine adjustment (recessed)

High Reliability

Racal has many years of experience in the supply and manufacture of frequency standards and distribution systems. The 9480 series is constructed with proven components and assemblies. The power supply module, distribution cards, and external reference cards are all pluggable enabling rapid fault identification and minimal repair time.

Future Expansion

The 9480 series allows future expansion at minimal cost. For example, if more outputs are required then only additional output cards need be purchased. Upgrading from a quartz standard to a rubidium is also possible, without the need to purchase an additional mainframe.
Rear Inputs
External Reference (standard): BNC, 10 MHz
External Reference (opt DIV): BNC, ≥ 1 MHz, sub-multiple of 10 MHz
DC Input: 2-pin, polarized connector, fused, reverse-protected
AC Input: 90-254 V, fused

OPTIONAL FEATURES
Option DIV
Enables the use of an external reference ≥ 1 MHz and a sub-multiple of 10 MHz

Option BBU
Battery backup maintaining power for ≥ 1 hour to the internal reference if AC and DC power fail

Option PSO
Power-supply service option allows removal of PSU for service without power loss to the 9480

Option RCO
Reference changeover option when primary and secondary external references are used

GENERAL

Power Requirements
AC: 90-127 V, 193-254 V, 45-440 Hz, 60 VA max
DC: 23.4-30 VDC, 1.5 A max after warm-up, fused, reverse power protected
BBU (optional): Internal rechargeable battery

Voltage Range Selection
Rear panel switch

Accessories Furnished

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Part Number</th>
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<td>9480</td>
<td>Time and Frequency Mainframe</td>
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<tr>
<td></td>
<td><strong>Frequency Standards</strong></td>
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<tr>
<td></td>
<td>Option FRKH High-Stability Rubidium Frequency Standard</td>
<td>R-11-9047</td>
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<td></td>
<td>Option FR-LP Rubidium Frequency Standard</td>
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<td></td>
<td>Option 04F Low Phase Noise Oscillator</td>
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<td></td>
<td>Option 04A Fast Warm-up Oscillator</td>
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<td></td>
<td><strong>Output Cards</strong></td>
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<tr>
<td></td>
<td>Option 10 5 x 10 MHz Output Card</td>
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<tr>
<td></td>
<td>Option 5 5 x 5 MHz Output Card</td>
<td>R-11-9048</td>
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<td></td>
<td>Option 1 5 x 1 MHz Output Card</td>
<td>R-11-9079</td>
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<td>Option 100 5 x 100 kHz Output Card</td>
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<td>Option 13 5 x 13 MHz Output Card</td>
<td>R-11-9076</td>
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<td>Option 13A 5 x 13 MHz TTL Output Card</td>
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<td>Option 2048 5 x 2.048 MHz TTL Output Card</td>
<td>R-11-9081</td>
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<td><strong>Other Options</strong></td>
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<td>Option BBU Battery Backup (&gt; 1 Hour)</td>
<td>R-11-9044</td>
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<td></td>
<td>Option DIV Allows integer divisions of an external 10 MHz to be accepted</td>
<td>R-11-9082</td>
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<td></td>
<td>Option RCO Reference Changeover Card</td>
<td>R-11-9087</td>
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</tbody>
</table>

Example: Model 9480/FR-LP 2 x -10/-5/-BBU is a 9480 mainframe with FR-LP rubidium standard, two 10 MHz output cards, one 5 MHz output card and, battery backup option. Supplies:
• 10 x 10 MHz outputs
• 5 x 5 MHz outputs
• All with Rubidium, 5 x 10^-11 stability.
• Battery backup capability

The CE Mark indicates that the product has completed and passed rigorous testing in the area of RF Emissions, Immunity to Electromagnetic Disturbances and complies with European electrical safety standards.