

### Ultra-low-noise Frequency

- **Low phase noise outputs** - even from noisy input reference
- Four outputs **phase locked to Reference input**
- **Autosensing frequency input**  
5 or 10 MHz for application flexibility
- 5 or 10 MHz outputs can give input **frequency doubling or halving**
- Good **holdover performance** if input signals source fails
- **Built in test** and remote control and monitoring



The TO-16 is a Precision Tracking Oscillator for 5 or 10 MHz scientific or metrology applications. The TO-16 accepts any noisy frequency input coming from e.g. Rubidium Frequency Standards or badly disciplined GPS-controlled oscillators and effectively remove the noise, while maintaining excellent long-term stability.

### TO-16 Overview

The TO-16 is a high quality Frequency Reference source that faithfully tracks the frequency accuracy of its reference input.

By using a unique conditioning algorithm, the TO-16 senses the input frequency it is supplied and adjusts the frequency of its own ovenised, low phase noise oscillator to maintain frequency and phase coherence.

Thus the product can be used to restore the quality of a frequency signal degraded by transmission over long and noisy lines, or to improve the intrinsic noise level of a signal coming from a Rubidium atomic oscillator.

Another application could be in the accurate conversion of 5 MHz signals to 10 MHz and vice versa.

### Low-noise and High Stability

Due to its highly stable internal oscillator, the TO-16 has excellent hold over capabilities if the input signal is lost for any reason.

All four sinewave outputs will be maintained with minimal drift until the reference signal is restored. As with all aspects of the TO-16 operation this is detected automatically and frequency conditioning restarted. Initial product start up and recovery from power failures all require no operator intervention or assistance.

### Frequency Doubling or Halving

A useful feature of the TO-16 is that it can be used to perform frequency conversion operations within a system. This means that a standard TO-16 unit will produce outputs at 10 MHz regardless of whether the synchronizing reference is 5 MHz or 10 MHz.

When fitted with the relevant option, the TO-16 will produce 5 MHz outputs regardless of whether the synchronizing reference is 5 MHz or 10 MHz.

Unlike synthesized outputs, these frequency converted signals from the TO-16 come directly from the on board low phase noise oscillator and so are not subject to the noise and spurious signals often associated with synthesized outputs.

### Flexible Remote Control and Monitoring

In addition to front panel indications of status, the TO-16 has a fully featured RS232 bi-directional interface to permit remote Control and Monitoring. This may be by direct serial port connection, or by use of Pendulum Instruments Ethernet interface, via a remote web browser. Built in test in the TO-16 ensures that all critical unit parameters are kept under constant observation and that exceptions are rapidly reported.

# TO-16 Technical Specifications

## Standard Inputs and Outputs

### Inputs

*Freq. Ref input:* 1x BNC, 5/10MHz auto-sensing, 50 ohm

*Status input:* 1x 9-way 'D-sub' male

### Outputs

*Freq. Ref. outputs:* 4x 10MHz reference frequency outputs, sine, +10dBm, 50ohm, BNC

*Alarm output* 1x BNC

### Basic Oscillator

10MHz SC-cut Low Phase-Noise Quartz OCXO

### Phase Noise

Oscillator:	Low noise
	10 MHz OCXO
Offset from carrier:	dBc/Hz
1 Hz	-103
10 Hz	-130
100 Hz	-138
1 kHz	-145
10 kHz	-148
Harmonics	<-35 dBc (typ.)
Spurious	<-65 dBc (typ.)

### Frequency Uncertainty

Locked to reference source	
Freq. offset (24 h averaging)	$<5 \cdot 10^{-12}$
Freq. offset (long term avg)	$<1 \cdot 10^{-12}$
Freq. stability ADEV (1000 s averaging)	$<5 \cdot 10^{-11}$
Free run mode	
Ageing per 24h (after 30 days operation)	$<1 \cdot 10^{-10}$
Short term stability ADEV 10s averaging	$<3 \cdot 10^{-12}$
Stability vs. Temperature 25 °C $\pm$ 10 °C typ.	$<2 \cdot 10^{-10}$

## 5 MHz Frequency Output (opt. 17)

5MHz frequency outputs in place of 10MHz Frequency

*Freq. Ref. outputs:* 4x 5MHz reference frequency outputs, sine, +10dBm, 50ohm, BNC

### Phase noise

Oscillator:	Low noise
	5MHz OCXO
Offset from carrier:	dBc/Hz
1 Hz	-105
10 Hz	-135
100 Hz	-143
1 kHz	-147
10 kHz	-150
Harmonics	<-40 dBc (typ.)
Spurious	<-70 dBc (typ.)

### Front Panel Indicators

AC power ON (green)

DC power ON (green)

Alarm status (red)

Loop OK status (green)

Reference OK status (green)

Oscill. OK status (green)

### Power Supply

*AC mains:* 100, 115 or 230V nominal, switch selectable, +/-10%, (45 to 66 Hz), <60VA

*Ext. DC supply:* 18V to 32V

### RS232 Communication

Standard TO-16 command set or NMEA (selectable)

Baud rate: 4800bps

Connectors: 1 x 9-pin male DB9

### Ethernet Communication

**Model 1874A (add-on option):** Ethernet Communication port in place of RS232 for alarm and status monitoring and control

Protocol Support ARP, UDP/IP, TCP/IP, Telnet, ICMP, SNMP, DHCP, BOOTP, TFTP, Auto IP, SMTP, FTP, DNS, HTTP, Modbus TCP, Modbus ASCII/RTU

RJ45 connector. 10Base-T/100Base-TX Full or half duplex, Auto negotiating

## General Specifications

### Environmental Data

*Operating Temp:* +5°C to +45°C

*Storage Temp:* -40°C to +71°C

*Humidity* 5% to 95% rel. humidity, non condensing

*Safety:* EN 61010-1, EN 60950, CE

*EMC:* EN 50081-1, EN50081-2, CE

### Dimensions and Weight

*Width x Height x Depth:*

483 x 44 x 350 mm (19" x 1 3/4" x 13 3/4")

*Weight:* 3.8 kg

### Ordering Information

**TO-16:** Tracking oscillator, 10 MHz or 5 MHz, alarm output, RS232

#### Included with shipment

Mains cable

User manual on CD

18 months warranty

#### Built in options

**Option 17:** 5 MHz output reference frequency in place of 10 MHz

#### Communication options

**Model 1874A:** RS232 to Ethernet converter + digital input/output

#### Other options

**Option 95/03:** Extended warranty to 3 years (instead of 18 months)

**Option 95/05:** Extended warranty to 5 years (instead of 18 months)

Specifications subject to change without notice

4031 600 16101 rev. 02 May 2008

#### US: Pendulum Instruments Inc

5811 Racine Street; Oakland, CA 94609-1519, USA  
Voice:(510)-428-9488 Fax: (510)-428-9469

#### International: Pendulum Instruments AB

PO Box 20020, SE-16102 Bromma, Sweden  
Voice: +46 8 598 51057 Fax:+46 8 598 51040

[www.pendulum-instruments.com](http://www.pendulum-instruments.com)

- Experts in time & frequency calibration, measurement and analysis

Pendulum Instruments is a company of the Orolia Group