Two-in-one instrument

Frequency reference & Frequency/phase counter

Extremely high-precision frequency references & ultra-fast high-accuracy frequency measurements:

Key features

- ✓ High-precision and high-accuracy 10-MHz atomic reference.
- ✓ High-precision time & frequency measurements based on the on-board rubidium oscillator.
- ✓ 1 PPS disciplined references and measurements available.
- ✓ Fail-safe and fast readings based on a 2-GHz FPGA-implemented phase comparison.
- ✓ Input frequency ranging from 10 kHz – 6 GHz.
- ✓ Ultra clean reference up to 1 GHz.
- ✓ Ultra accurate reference from 1 Hz up to 125 MHz with a resolution as low as 0.0776 Hz.
- ✓ Multiple 10-MHz atomic reference signals available at once.
- ✓ Direct communication through micro-USB interface.

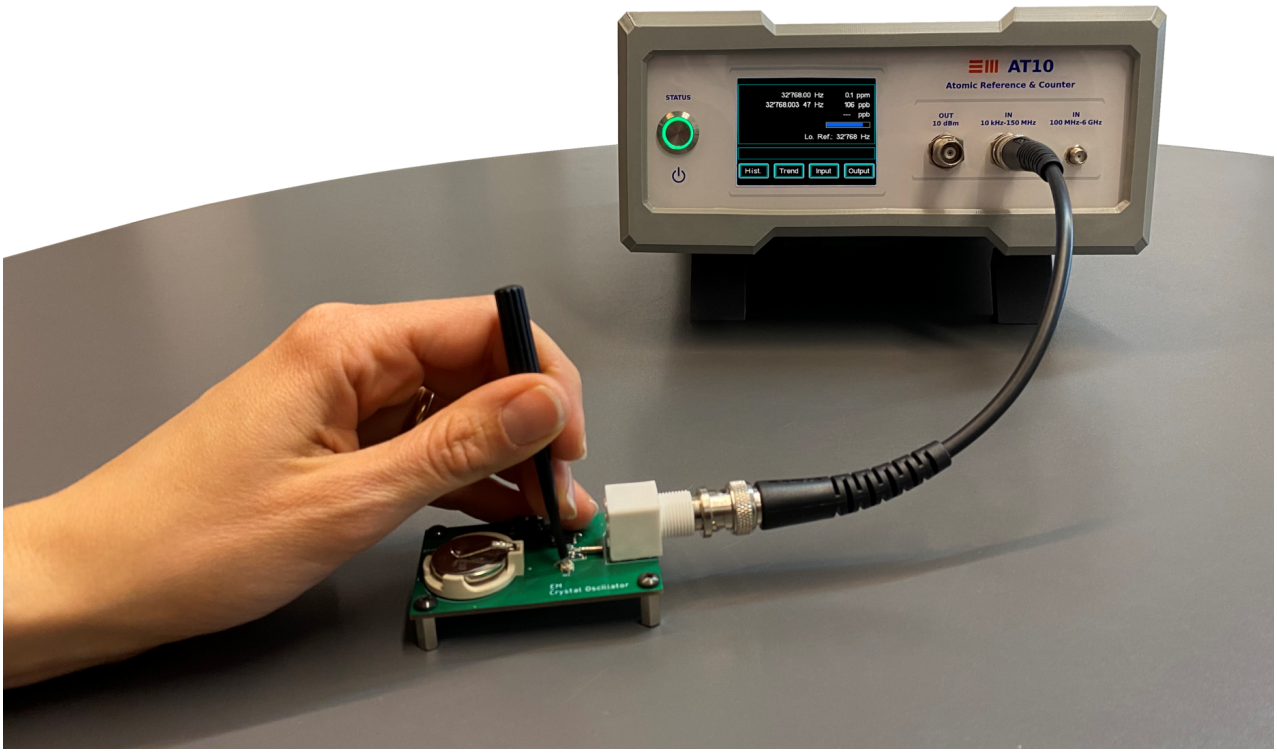

Figure 1: AT10 ultra-fast high-accuracy frequency adjustment

Product description

The AT10 is both a programmable frequency reference and a frequency/phase counter; a two-in-one instrument that finds applications in virtually any calibration and R&D laboratory where high-precision time and frequency measurements are performed, as well as all facilities requiring an accurate frequency standard. Indeed, thanks to the on-board atomic rubidium oscillator, the AT10 guarantees frequency reference outputs and frequency measurements with an accuracy better than ±5E-11, a short-term stability better than 3E-12, and a frequency drifting less than 5E-11 per month.

The AT10 can achieve a frequency accuracy better than 10E-12 when disciplined via an external 1PPS signal (normally a GPS signal without S.A.). Indeed, the AT10 has an auto-calibration/disciplining mechanism which, based upon an externally-provided 1PPS signal, zeroes phase and frequency changes as well as other long-term effects such as ageing. The averaging mechanism guarantees an excellent long-term stability. The AT10 autodetects a 1PPS reference, if any, and starts auto-calibrating; after 14 hours GDO accuracy is guaranteed to be within 10E-12. Auto-calibration is permanent and remains effective also after power cycling.

The AT10 makes clock calibration an easy, fail-safe and quick process. Indeed, the AT10 guarantees an almost instantaneous feedback about the frequency error of the clock signal under test. Three measurements per second are always available, even for low-frequency clocks as low as 10 kHz, still maintaining a resolution of 0.1 ppm. Such an extraordinary performance is achieved thanks to an FPGA-based phase comparison between a 2-GHz clock and the clock under test.

Figure 2: AT10 Front Panel

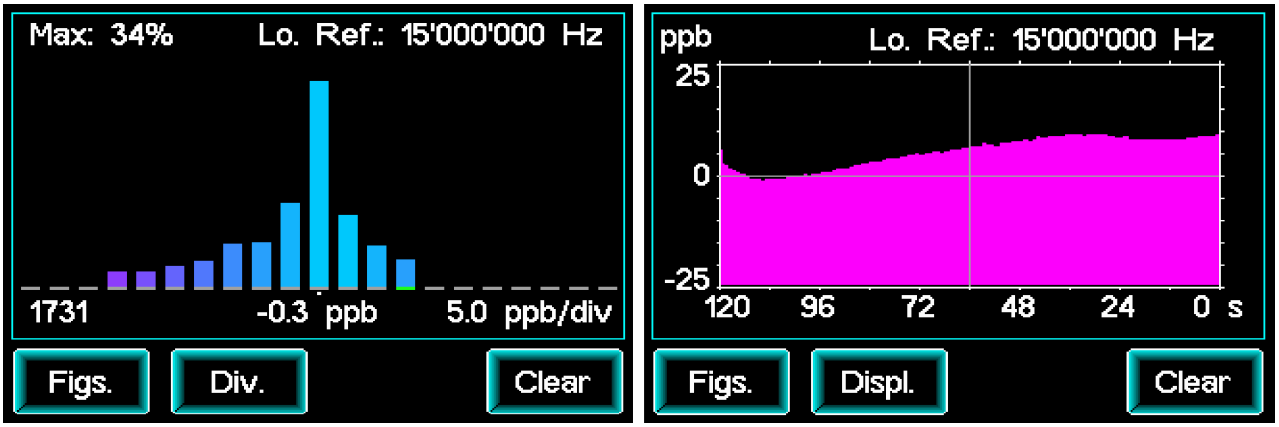

Figure 3: AT10 Graphical Representations

The AT10, as an input frequency counter, covers a wide frequency band that spans from 10 kHz up to 6 GHz. Two inputs are available: a high-impedance BNC-input for clocks from 10 kHz up to 125 MHz, and a 50-Ω SMA-input for clocks from 100 MHz up to 6 GHz.

The AT10 provides a fine-programmable frequency reference that covers frequencies from 1 Hz up to 125 MHz with a resolution as low as 0.0776 Hz. At the same time, the AT10 provides an exceptionally-low phase-noise programmable[1] output from 20 MHz up to 1 GHz, with a phase noise as good as –143 dBc/Hz at 10-kHz offset, dropping to less than –150 dBc/Hz at 1 MHz offset. The low-noise reference output includes an automatic frequency correction for outputs below 625 MHz.

The AT10 has three 10-dBm 10-MHz sine outputs, two 0-dBm 10-MHz sine outputs, two 0-dBm 10-MHz square outputs, two differential low phase-noise programmable CW outputs, one fine-programmable CW output, and one 1PPS TTL output. All these outputs, except for low phase CW outputs, have an Allan Variance less than 5E-11 at 1 s and 7E-12 at 100 s.

The AT10 can display frequency deviation figures as well as two user-configurable graphical representations to get more insights quickly. A histogram provides at run-time a representation of the numerical data distribution, thus providing a quick statistical view of the ongoing measurement. A time-series chart represents frequency deviations in time, thus giving a quick glance of the measurement trend, namely the short-term stability of the device under test.

A Micro-USB interface allows for direct communication with the AT10. This interface can be used for both fail-safe firmware updating and laboratory system integration.

[1] Not all frequencies in the span 20 MHz-1 GHz are available; they are determined according to $f = \left(round\left(\frac{5E3}{f_{MHz}}\right)\right) \cdot 5E6$.

Product specifications

Generic AT10 Oscillator Specifications

Frequency Accuracy at Shipment	better than ±5E-11 @ + 25°C
GDO Accuracy after 24h-GPS-Locked	better than ±1E-11 @ + 25°C
Lock time	≤7 minutes typical @ +25 °C ≤15 minutes @ -5 °C
Frequency - Temperature Coefficient (ambient temperature)	≤ 8E-10 [-5 °C – 60 °C] ≤ 2E-10 [20 °C – 40 °C]
Short-term Stability	1 s: ≤ 5E-11 10 s: ≤ 1.8E-11 100 s: ≤ 7E-12 1000 s: ≤ 3E-12
Long-term Stability	≤ 5E-12 per day ≤ 5E-11 per month (design guarantee)
Ground Magnetic Effect	≤ 1E-11
MTBF	≥ 100.000 hours

Input Specifications

Measurement Resolution	0.333 s 1 s 50 s 500 s	0.1E-6 1E-9 0.1E-9 1E-12
Low Frequency		
Frequency Range	10 kHz – 150 MHz	
Maximum Input Level	25 dBm	
Sensitivity Sine Wave	100 kHz 500 kHz 1 MHz 10 MHz 100 MHz 150 MHz	250 mVpp 50 mVpp 50 mVpp 50 mVpp 250 mVpp 500 mVpp
Sensitivity Square Wave	10 kHz 100 kHz 500 kHz 10 MHz	50 mVpp 50 mVpp 50 mVpp 50 mVpp
High Frequency		
Frequency Range	100 MHz – 6 GHz	
Maximum Input Level	20 dBm	
Sensitivity	100 MHz 250 MHz 500 MHz 1 GHz 4 GHz 6 GHz	-15 dBm -21 dBm -25 dBm -31 dBm -33 dBm -30 dBm

Output Specifications		
Fixed-Frequency 10 MHz		
5 x Sinusoidal Output	3 x 10 dBm ±1 dB 2 x 0 dBm ±1 dB	(1 on front and 2 on rear panel) (2 on rear panel)
2 x Square Output	2 x >0 dBm ±1 dB	(2 on rear panel)
10 MHz Phase to Noise (SSB)	10–Hz offset 100–Hz offset 1–kHz offset 10–kHz offset	-95 dBc/Hz -125 dBc/Hz -135 dBc/Hz -140 dBc/Hz
Harmonic spurs (Front)	<-80 dBc	
Termination	50 Ohm	
Pulse Per Second (PPS)		
Period	1 s	
PPS Output Level	3 Vpp ±0.5 V	(1 on rear panel, autoswitched)
PPS Output Duty Cycle	0.16 %	
PPS Input Level	2 Vpp ±1.5 V	(1 on rear panel, autoswitched)
PPS Input Duty Cycle	1-99 %	
Arbitrary Frequency		
DDS Output	square wave > 1 Vpp (50 Ω)	(1 on rear panel)
Frequency Range	1 Hz – 125 MHz	
Frequency Resolution	0.0776 Hz	
10 MHz Phase to Noise (SSB)	1–kHz offset 10–kHz offset 100–kHz offset 1–MHz offset	-105 dBc/Hz -106 dBc/Hz -103 dBc/Hz -114 dBc/Hz
Termination	50 Ohm	
RF Frequency		
2 x Differential RF Output	P and N	(2 on rear panel)
Frequency Range	20 MHz-625 MHz 625 MHz-1 GHz	(with freq. accuracy info & correction) (without freq. accuracy info)
Frequency Tollerance (≤ 625 MHz)	<0.5 PPM	(after LOCK)
Frequency Resolution	output frequency tuned as $f = (round(5e^3/f_{MHz})) * 5e^6$	
Non-harmonic Spurs	<-90 dBc	
156.25 MHz Phase to Noise (SSB)	10-kHz offset 20-kHz offset 100-kHz offset 200-kHz offset 1-MHz offset 2-MHz offset 10-MHz offset 20-MHz offset	–143 dBc/Hz –143 dBc/Hz –144 dBc/Hz –145 dBc/Hz –150 dBc/Hz –154 dBc/Hz –162 dBc/Hz –162 dBc/Hz
Amplitude Response	20 MHz 50 MHz 156.25 MHz 500 MHz 1 GHz	>-5.0 dBm >-5.0 dBm >-7.0 dBm >-10.0 dBm >-13.0 dBm
Termination	50 Ohm	

General

Power DC	12 V DC (AC-DC adaptor included)
Power Mains	110 V-220 V AC (Check local regulation)
Typical Power Consumption	Static (@ 25 °C) < 10 W Peak consumption < 30 W
Front Panel	HW Button (3-colour LEDs) 2 BNC (In, Out) 1 SMA (In)
Rear Panel	10 BNC 1 Micro (B) USB 1 IEC-60320-C14 AC 110V/220V 1 DC-12V 5.5 x 2.1 mm Jack 1 Banana Jack (GND)
Dimensions (W x L x H)	22 cm x 29 cm x 10 cm
Weight	2.1 kg

Figure 4: AT10 Rear Panel

Services for your AT10 Reference & Counter

- Fail-safe, free, user-upgradeable firmware whenever required.
- Free factory certification.
- Optional accredited certification.
- 2 Years warranty

Elettronica Monti
Piazza Guido Rossa 15
56024 Ponte a Egola (PI)
ITALY
Tel. +39 0571 497950
www.elettronicamonti.it
P.IVA IT00373480508
Registro AEE N. IT21120000013471
D-U-N-S: 432528746