product data

WM-10

Wandermeter for SDH synchronization testing

Find sync problems fast and easy

- Wander measurement on E1 clock and data
- MTIE and TDEV masks (ETSI)
- Very easy-to-use, no experts needed
- Auto-calibration of internal Rubidium standard
- Portable, compact, and complete
- Portable E1 clock generator too
- Affordable

Incorrect synchronization in digital communication networks can cause severe transmission problems. Voice calls (fixed or cellular) will be lost, Fax machines will misprint, data will be lost or frequently re-transmitted. In any case, network performance is degraded, the operators service costs are increased and revenues are down.

The main cause for synchronization problems in transport networks is *wander* of the synchronization clock. Quality control of the synchronization clock requires monitoring of wander over a longer period (hours or days) using an ultra-stable clock as reference.

So far measurement of Wander has involved bulky, complex and very expensive instrumentation To be able to view the wander parameters MTIE and TDEV specified in international standards, external computers were often needed.

Now Pendulum Instruments introduces WM-10, a very accurate and easy to use portable Wandermeter, designed for wander measurements on E1 clock and data signals. And last but not least, the WM-10 comes with an affordable price tag. No need anymore to refrain from preventive maintenance of wander, due to budget limitation.

Applications

The WM-10 Wandermeter could be used for several purposes:

- As an *accurate certification tool*, to document conformance to standards (ITU G811-813, ETS 300 462) for telephone network operators, network leasers, and buyers and sellers of synchronization services.

- As a *preventive (diagnostic) maintenance tool* in local exchange stations (SDH or PDH)

- As a *quick trouble-shooting tool* in SDH or PDH networks when a node is suspected not to operate correctly. The WM-10 can be used both by the transport network owners and all users of the network, e.g. radio link services and GSM network operators

- As a *design tool* for manufacturers of equipment for SDH and PDH network elements, PBX'es, GSM access, Radio links etc.

Measures to Standards

The WM-10 Wandermeter is designed to measure wander according to ITU standards, of 2.048 MHz or 2.048 Mbits/s (E1) signals in SDH- or PDH-network nodes, with graphical presentation of TIE, MTIE and TDEV and comparison to standard masks (PRC, SSU, SEC). It is possible to create user-defined masks, for new or changed standards, for easy recall of the operator during measurements.

WM-10 can measure both “absolute” and “relative” wander. In the first case the measured signal (clock or data) is compared to the ultimate stability of the internal Rubidium “atomic” clock. In the second case, the relative wander between two signals, e.g. in- and outgoing E1-signal from a network element, is measured. This makes it possible to verify wander tolerance and the amount of “extra wander” created by the device under test.

Complete unit

The instrument is compact, lightweight and fully self-contained with a built-in Rubidium reference clock and a graphical display. There is no need to carry around also an external frequency standard or a separate PC to make and view the measurement. Also the PC-cable and two 120Ω-to-75Ω transformers are included as standard, to enable measurement on any kind of cable system, whether 75Ω unbalanced or 120Ω balanced.

pendulum

Very easy to operate and calibrate

The unit is very easy to use and can be operated also by unskilled personnel. For standard measurements only a few keystrokes are required. Once the measurement is started, the WM-10 can be left unattended for automatic measurements. It stops automatically after set measuring time and can even delay its measurement start when required.

A fully automatic signal check informs the user whether he/she has connected the right signal from the rack.

On-line context-sensitive help is available, making the operator's manual obsolete.

Also the calibration and adjustment of the internal Rubidium clock is fully automatic and very easy. Just connect a known reference signal from a Cesium or a GPS-controlled Rubidium clock, enter the calibration mode of WM-10 and leave the unit over-night. Next morning, the WM-10 is perfectly adjusted, without any manual trimming involved.

The WM-10 is also easy to carry and transport, and includes e.g. side handles and a flight-proof transport case (extra accessory).

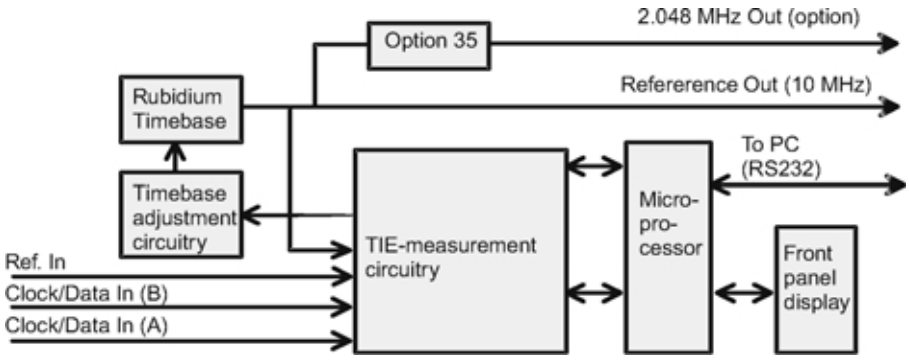


Figure 1. Block diagram of WM-10

Working principle

The Pendulum WM-10 Wandermeter is built in an EMI-proof metal cabinet and contains a Rubidium Reference Clock and a special in-house developed Time Interval Error (TIE) measuring circuitry, that phase compares the connected signal with the Rubidium reference. The WM-10 communicates its results to the user via a graphical display, and to a PC via an RS232-port. See figure 1.

The Wandermeter operates in two different modes:

Local mode operation:

The WM-10 Wandermeter can be operated stand-alone. During the measurement, the TIE-curve on the display is continuously updated, showing the performance of the sync-clock "so far". This mode is intended for automated diagnostics and/or faultfinding measurement "on-site", with direct visual feedback at any time. The sampling rate is approx. 1 Sa/s. The WM-10 Wandermeter calculates and presents the MTIE or TDEV curves after completed TIE measurement, and compares to stored masks.

Remote (PC-controlled) operation:

The WM-10 Wandermeter can be operated remotely controlled from a PC, running the *WanderView*™ SW. See figure 2. In this mode the WM-10 Wandermeter acts a sampling front-end and transfer all TIE-values continuously to the PC. The local display of the WM-10 Wandermeter is not updated. Sample speed can be set to up to 30 TIE-values/s and the storage is only limited by the PC, which means that even the fastest sample rate can be maintained during a 24h period (or longer if required). The PC-SW calculates and presents MTIE and TDEV curves after completed measurement period, and compares to the defined masks. This mode is intended for verification of conformance to ETSI-standards.

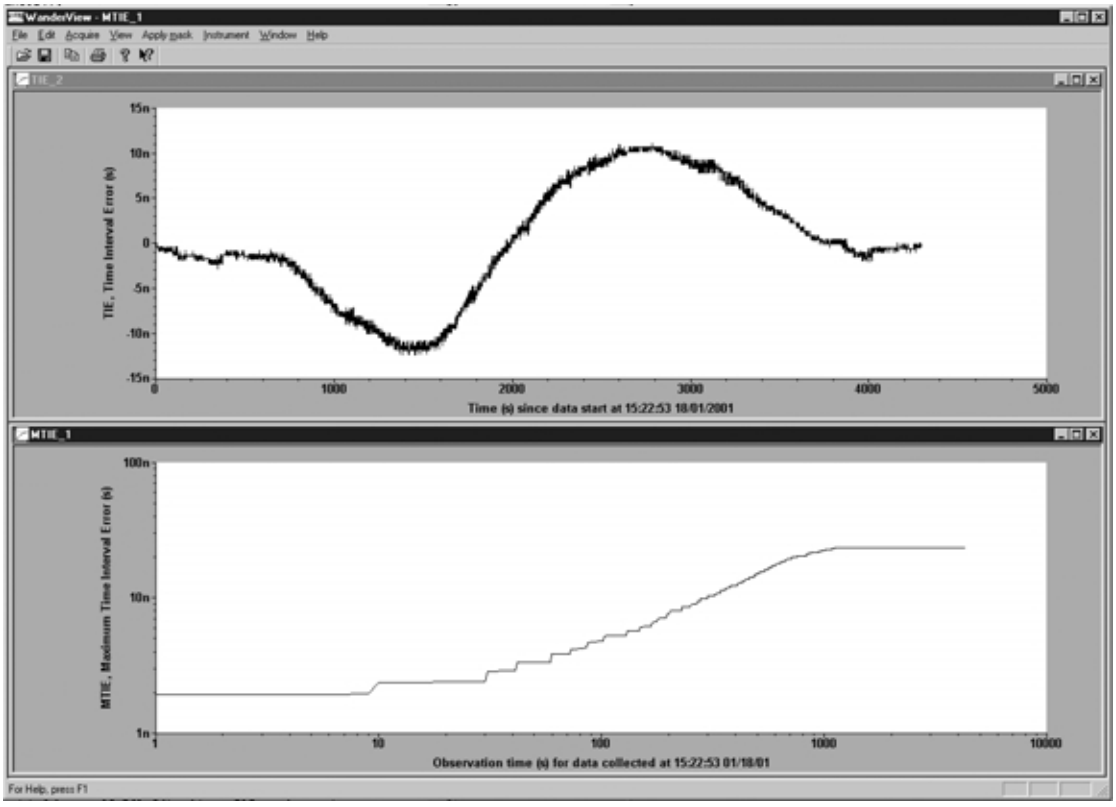


Figure 2. WanderView screen, showing a TIE-curve (top) and a MTIE curve (bottom)

WM-10 Specifications

Note: Specifications apply after 30 minutes warm-up time

Operation Modes

Local: The WM-10 Wandermeter operates stand-alone and measures the wander of a connected E1 clock (2.048 MHz) or 2 Mbit/s data signal. Alternatively the differential wander between two connected clocks or data signals is measured. During the measurement, the TIE curve is continuously updated on the display. This mode has limitation in sampling rate and number of stored samples.
Remote: The WM-10 Wandermeter is controlled from a PC running the WanderView PC-software and measures the wander of a connected E1 clock or data signal. During the measurement, the WM-10 Wandermeter acts as a sampling front-end and the display is not updated.

Presentation Modes

TIE:	Time Interval Error is displayed and continuously updated in Local Mode operation.
MTIE:	MTIE is calculated from the measured and stored TIE-values and displayed after completed measurement in Local Mode operation.
TDEV:	TDEV is calculated from the measured and stored TIE-values and displayed after completed measurement in Local Mode operation.

Test modes (MTIE and TDEV masks)

The internal Rubidium clock is used as reference in all modes except "Differential". Mask applies for MTIE and TDEV graphs

Draft:	No masks
PRC:	Masks for G811-clock (ETS 300 462-3)
SSU:	Masks for G812-clock (ETS 300 462-3)
SEC:	Masks for G813-clock (ETS 300 462-3)
SSU (locked mode):	Masks for G812-clock (ETS 300 462-4)
SEC (locked mode):	Masks for G813-clock (ETS 300 462-5)
Differential:	Relative wander (TIE, MTIE and TDEV) between two clocks or data signals

Input signal characteristics

Frequency:	2.048 MHz
Amplitude:	inside -5V…+5V
Signal type:	Symmetrical pulse (Clock signal) HDB3-coded data (Data signal)

Time Interval Error (TIE)

Reference clock:	Built-in Rubidium clock or an external 10 MHz clock signal connected to Ext. Reference input
Measure time:	2h, 24h or continuously (local mode)
Local Mode update Rate:	
2h:	approx. 1 Sa/s
24h:	approx. 0.2 Sa/s (1Sa/5s)
Continuously:	16000/time Sa/s; max. approx. 1 Sa/s. Data compression after approx. 4h
Remote Mode update rate:	
any measuring time:	up to 30 Sa/s

Internal data storage

Size:	16000 stored TIE-values
Type:	Non-volatile storage

Measuring Time

Time:	Short (2h), Long (24h) and continuous
Start/Stop:	Via START/STOP key
Start Delay:	Selectable delay before measurement starts, to allow the instrument to warm-up properly.
Delay time:	0, 30 min, 4h or 24h

Signal Check

Measures and displays the following parameters:
Frequency
Voltage peak-peak (min. 120 mVp-p)
Signal type (Clock, HDB3-coded Data or Unknown)

Self Test

Power-up:	Test of critical digital functions
On demand (user opt.):	Test of most digital functions

INFO

A built in context sensitive help function gives guidance for all manual settings.

SAVE / RECALL

No. of instrument set-ups:	5
No. of screen images:	3 (TIE, MTIE or TDEV)
Stored TIE-value array:	16k values (1 set)
Write protection:	Saved set-up, screen image or TIE-value array can be protected against accidental over-writing

Graph display

Display Modes:	TIE, MTIE or TDEV
Vertical scale:	Displayed TIE, MTIE or TDEV value in ns or ms. AUTO scaled
Horizontal scale:	Real-time axis (TIE) or "τ"- axis (MTIE/TDEV). AUTO scaled (continuous measurement and differential test mode) or fixed scale (2h/24h full scale).
No of divisions:	8x10 (vert. x horiz.)
Masks:	MTIE and TDEV masks according to selected test mode: (PRC, SSU, SEC)

Clock/Data Inputs A and B

Connector:	BNC
Coupling:	DC Coupled
Voltage Range:	± 5.00V
Sensitivity:	60 mVpp
Impedance:	75 Ω , VSWR <2:1
Maximum Input Voltage Without Damage:	12 Vrms up to 2 MHz, decreasing to 6 Vrms at 10 MHz.
Trigger Level:	Automatically set via Signal Check. Can be manually adjusted.
Range:	± 5.00V
Resolution:	10 mV

Ext. Reference Input

Connector:	BNC
Input frequency:	10 MHz
Voltage Range:	0.5 Vrms to 12 Vrms
Impedance:	approx. 500 Ω
Coupling:	AC coupled
Max. Input Voltage Without Damage:	30 Vrms up to 1 kHz, decreasing to 6 Vrms at 10 MHz

Reference Frequency output

Connector:	BNC
Ref. Frequency:	10MHz square-wave
Frequency stability:	See timebase oscillator spec.
Output levels:	Fixed TTL: low <0.4V, high >1.8V into 50Ω

2.048 MHz Clock output (option 35)

Connector:	BNC
Ref. Frequency:	2.048 MHz square-wave
Freq. Stability:	See timebase oscillator spec.
Jitter:	<0.01 UI
Wander:	MTIE < 15 ns + τ x (freq.offset)$^{-1}$
Output level:	Acc. to G703:10; ±1.2V ±10% in 75Ω

RS232 Data in/output

Connector:	9-pin male D-Sub connector
Baud rate:	9600 bps
Data format:	8 databits, 1 stopbit, no parity

WanderView SW

Operating system:	Windows 95 / 98 / NT
Data transfer from WM-10:	TIE-values (real-time or stored values) Stored graphs Instrument id
Calculate functions:	MTIE, TDEV
Instrument control functions to WM-10:	Local or Remote mode Auto-adjust of Rubidium osc.
Custom mask editor:	4+4 user defined MTIE+TDEV mask
File functions:	Document printout, File save/retrieve

Calibration

Principle:	Closed Case Calibration with automatic adjustment of the Rubidium timebase.
Calibration reference:	Cs-oscillator or GPS-controlled Rubidium
Calibration ref. frequency:	1, 2.048, 5 or 10 MHz
Calibration uncertainty:	<2x10^{-12}+ Cal. ref. freq. uncertainty

Internal Time Base Stability

Stability versus:		
Temperature	20° to 26° 0° to 50°	<2x10^{-11} <3x10^{-10}
Aging Rate per:	24h Month	<2x10^{-12} (typ.) <5x10^{-11}
Short term stability per:	1s 10s	<3x10^{-11} <1x10^{-11}
Warm up stability:	10 min	<4x10^{-10}
Factory adjustment uncertainty (+23°C)	<10 MHz ± 0.0005 Hz	

WM-10 Specifications

Display

Type:	Super Twisted Liquid Crystal
Size:	84 x 84 mm, 4.7" diagonal
Resolution:	240x240 pixels
Backlight:	Cold Cathode Fluorescent (CCFL) tube. Brightness approx. 50 cd/m2
Contrast ratio:	User adjustable, max. 1:15 (typical at 20°C)

Environmental Data

Temperature:	
Operating:	0°C to 50°C
Storage:	-20°C to 70°C
Humidity:	
Operating:	20°C to 30°C, 90% RH non-condensing 30°C to 50°C, 70% RH non-condensing
Storage:	95% RH
Altitude:	
Operating:	3000 m (10 000 ft)
Storage:	12000 m (40 000 ft)
Safety:	EN 61010-1:1997, CAT II, Pollution degree 2, CE
EMC:	EN 55022B, EN 61000-6-2, CE

Power Supply

Line voltage:	100 to 240 Vrms ±10% 47 Hz to 63 Hz, <60 W

Mechanical Data

WxHxD:	342x177x305 mm
Weight:	Net 5 kg (11 lb) Shipping 7 kg (15 lb)

Ordering Information

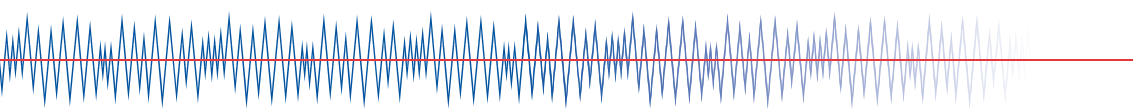
WM-10 Wandermeter	Wander-meter for E1 clock or data signals (2.048 MHz/Mbits G.703)
Included with Instrument	
	Line power cord Two 120Ω-to-75Ω transformers (BNC mounted) PC connection cable Operators Manual Certificate of calibration
Options (factory built in)	
Option 35	2.048 MHz clock output
Optional accessories	
Option 27W	Heavy Duty Hard Transport Case

Specifications subject to change without notice

4031 600 10101- rev. 02 January 2001

Pendulum Instruments AB
www.pendulum.se

– experts in Time & Frequency Calibration, Measurement and Analysis



pendulum