FLUKE

General Purpose Test Catalog

Keeping you world up and running

In January 2000 the Fluke Corporation acquired the Precision Measurement Division of Wavetek Wandel Golterman (formerly knows as Datron). Bringing together over 70 years of experience in precision measurement, Fluke Corporation and Wavetek-Datron continue to provide innovative product development, total solutions for the customer and world class customer service.

About this catalog:

- Combination of both Fluke and Wavetek-Datron signal source, time and frequency, data acquisition and VXI products
- Comprehensive product information and specifications
- Products designed to handle exacting real world applications which meet your requirements within your budget
- Ideal solutions for aerospace, medical, manufacturing and test applications

Problems with product integration?

- Our in-house product experts are here to help you get up and running
- Fluke is an international business that provides test solutions to customers worldwide
- Our products are sold and serviced in more than 100 countries around the world
- A robust service organization provides maintenance, repair, and calibration as well as value added services

With both Fluke and Wavetek-Datron products now sitting together in one catalog is is even easier for you to compare products and make the best selection for your application, with the broader range of products available you will find we have the right solution for even you most demanding applications.

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Contents

Using this catalog

To help you find the best product to suit your requirements this catalog is divided into four main product sections. All sections begin with a selection guide to help you quickly and easily compare key features and specifications. Full detailed specifications are given in the subsequent pages to help you make an informed choice.

Customer support service

Let Fluke help you integrate signal sources into your application

Problem - When you have a particular signal requirement in mind and you're not sure which signal source from the Fluke range will meet your needs or how to program it to emulate required signal conditions, Fluke's customer supports services can help:

- Demonstrate product meets requirement prior to purchase.
- Improve your integration time reducing cost.
- Transfer complex signals ready for use anywhere in the world.

Solution - Tell us what you signal requirements are and let us program the software or signal source for you!

How - Our teams of experts are on hand to assist you with your signal requirements. All you need do is contact your local sales office, provide them with some basic signal information and leave the rest to us.

The Fluke support team can work from a wide variety of information including:-

- Timing diagrams; include amplitude, frequency and pulse period.
- Timing data including equations or direct data point information (Microsoft Excel™ is a useful communication tool for this).
- Relevant interchannel timing relationships (if more than one output is required).

Who to contact?

Contact your local sales office, the address can be found on the catalog rear cover.

FLUKE

Signal sources

Section 1

Contents

Fluke offers a range of function, pulse/function and universal waveform generators that are designed to meet your requirements within your budget. Whether you require a simple LF function generator, or a powerful multi channel arb, we have a product designed with you in mind. Products like the 395 100 MS/s universal waveform generator provide tremendous versatility by combining seven instruments in one. The 39A 40 MS/s universal waveform generator provides similar versatility at an amazingly low price. For multi-channel applications, the 195 universal waveform generator can be configured with up to four independent output channels.

Model 395

Model 19

Model 39A

Signal sources selection guide

Model	19	25	29A
Channels (standard/maximum)	1	1	1
Standard waveforms			
Sine maximum frequency	2 MHz	5 MHz	10 MHz
Square maximum frequency	2 MHz	5 MHz	10 MHz
Pulse maximum frequency waveforms	2 MHz	5 MHz	10 MHz
Pulse trains	No	No	No
Noise generator	No	No	Random
Universal waveforms			
Maximum sampling frequency	NA	NA	27.48 MS/s
Waveform memory (standard/optional)	NA	NA	5 x 1k blocks
Vertical resolution	NA	NA	10 bits
Waveform sequencing (max. # of segments)	NA	NA	No
Operating modes			
Triggered	No	No	Yes
Gated	No	No	Yes
Burst	No	No	Yes
Frequency sweep	Yes	Yes	Yes
Modulation	AM	AM	AM, FSK, Tone
Amplitude			
Maximum amplitude (into 50Ω)	10 Vpp	10 Vpp	10 Vpp
General			
Phase lock to external analog signal	No	No	No
Multi-unit phase locking	No	No	Yes
Built-in 20 MHz frequency counter	No	No	No
GPIB interface	No	No	Yes
RS-232 interface	No	No	Yes
Must be remotely programmed	No	No	No
Software drivers	NA	NA	LabWindows™
Compatible with Waveform DSP2 software			Yes

*HP 8116A LabView driver maybe used with the model 81

Signal sources

39A	80	81	195	395
1	1	1	2/4	1
16 MHz	50 MHz	50 MHz	16 MHz	40 MHz
16 MHz	50 MHz	50 MHz	16 MHz	50 MHz
10 MHz	NA	50 MHz	10 MHz	10 MHz
Yes	No	No	Yes	Yes
No	No	No	No	Analog, digital, Signal+Noise
40 MS/s	NA	NA	40 MS/s	100 MS/s
64k blocks	NA	NA	64K blocks	4k/256k
12 bits	NA	NA	12 bits	12 bits
16	NA	NA	16	4
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	No	Yes	Yes
AM, Tone	AM, FM, VCO	AM, VCO, PWM	AM, Tone	AM, FM
10 Vpp	16 Vpp	16 Vpp	10 Vpp	10 Vpp
No	Yes	Yes	No	No
Yes	Yes	Yes	Yes	Yes
No	No	No	No	No
Yes	Yes	Yes	Yes	Optional
Yes	No	No	Yes	Yes
No	No	No	No	No
LabView™	No	NA *LabView™	LabWindows™ LabView™	LabView™ & LabWindows™
Yes			Yes	Yes

19 Function Generator

Versatile yet affordable benchtop generator

- Low cost
- High quality waveforms
- Internal Lin/Log sweep generator
- Internal/external AM to 100%
- Variable symmetry
- Digital display of frequency, amplitude, and offset

Model 19's very low cost, compact size, and high quality sine, square, and triangle waveforms make it ideal for benchtop applications.

Output
Main output can be as great as 20 Vpp into open circuit or 10 Vpp into a 50Ω load. Built-in attenuator and Vernier allow continuous level control down to 30 mV into 50Ω. Output can be offset up to ± 10V. A detent guarantees zero offset when desired. An auxiliary output provides a fixed 0 to +5V level for driving TTL or CMOS loads.

Internal sweep
The internal sweep generator sweeps frequencies linearly or logarithmically. Start and stop frequencies are set independently, and sweep ranges of over 1000:1 are possible. Sweep times typically can be set from 20 ms to 20s. A sweep signal output is provided for oscilloscope or x-y recorder.

External sweep
Frequency can be swept using an external signal. Sweep range of 1000:1 is possible.

Amplitude modulation
Amplitude modulation can be external or internal (via a 400 Hz internal generator) with modulation levels fully variable between 0% and 100%.

Symmetry control
Symmetry can be controlled from 1:9 to 9:1 ratios for creating ramp and pulse waveforms.

Digital display
The display provides a read-out of frequency, amplitude, and offset.

Specifications

NOTE: Specifications apply after a 20 minute warmup.

Waveforms
Sine, triangle, square, and DC.

Sine distortion:
200 Hz, 2 kHz, and 20 kHz.
Ranges: < 1.0%.

2 Hz, 20 Hz, and 200 kHz.
Ranges: < 1.5%. 2 MHz Range: All harmonics > 25 dB below fundamental.

Triangle linearity:
99% to 200 kHz.

Square wave rise and fall time: < 100 ns.

Symmetry:
Waveforms may be varied to produce sawtooth and variable duty cycle waveforms from 1:9 to 9:1 ratio (on the top decade of each frequency range). When symmetry control is used, indicated frequency is divided by 10.

Frequency Range:
2 mHz to 2 MHz in seven overlapping ranges.

Meter accuracy:
± 5 digits on 2 kHz through 2 MHz ranges.
1.5% of full scale on 2 through 200 ranges.

Amplitude

Range:
0.4V to 10 Vpp into 50Ω
(20 Vpp max into open circuit).
Adjustable in 2 overlapping ranges:
0 dB Range: 0.3V to 10 Vpp into 50Ω
(20 Vpp into open circuit).
-20 dB Range: 30 mV to 1 Vpp into 50Ω
(2 Vpp into open circuit).

Offset

Range: ± 5V into 50Ω
(± 10V into open circuit).
Offset attenuated in -20 dB range.

Sweep modes

Continuous and reverse.
Internal: Linear or logarithmic.
External:
0 to 3V for 1000:1 sweep.

Amplitude modulation

Range: 0 to 100%.
Frequency: 400 Hz (internal). DC to 100 kHz (external).
External sensitivity:
2 Vpp for 50% modulation.

Outputs

Main out (50Ω): Sine, triangle, square waveforms, and DC outputs with adjustable attenuation.
Aux out (600Ω): 0 to 5V output drives CMOS and 2 TTL loads.
Sweep out (600Ω):
0 to 6V triangle.

Inputs

AM/sweep in (10 kΩ):
For external modulation signal.
Sweep input sensitivity:
3.0V for 1000:1 sweep.
AM input sensitivity:
2 Vpp for 50% modulation.

General

Power: 110/120 Vac 50/60 Hz or 220/240 Vac 50/60 Hz. 20 VA max power consumption.

Environment

Operating range:
+5° to +40°C, 20% to 80% RH.
Storage range: -10° to +65°C.

Ordering information

Model 19:
2 MHz Sweep/Function Generator.

19-001: Rack Mount Kit.

25 Function Generator

Combination 5 MHz function generator & 20 MHz frequency counter

- 5 mHz to 5 MHz frequency range
- Simultaneous display of frequency and amplitude
- Frequency locking for crystal controlled stability
- Precision internally or externally controlled frequency sweep
- External frequency counter with 7 digit resolution
- Very high waveform quality at all frequencies and levels
- 10 Vpp from 50Ω or 600Ω, plus TTL/CMOS output
- 1000:1 frequency change by vernier or sweep voltage
- Internal or external amplitude modulation up to 100%

This function generator is one of the most versatile pieces of test and measurement instrumentation available. It can generate a variety of precision wave shapes over a range of frequencies from mHz to MHz. It can provide a wide range of controlled amplitudes from a low-impedance source, and maintain constant amplitude as the frequency is varied. Voltage control of frequency enables a source of swept frequency to be generated for frequency response testing. AM and FM modulation can also be added. The 25 represents the state-of-the-art in 5 MHz analog function generators.

Exceptional waveform quality
The 25 provides very high waveform quality under all conditions. That means low sinewave distortion, low aberration triangle waves and fast edged square waves with low overshoot. Unlike many competitive products good waveform quality is maintained throughout the frequency range and at low output levels.

Variable symmetry pulses and ramps
The 25 provides bi-directional variable symmetry from 1:9 to 9:1. Unlike some products, frequency is independent of symmetry setting.

Wide range level control
The 25 provides a main output with a maximum emf of 10 Vpp from a 50Ω or 600Ω source. An amplitude vernier with a range of 20 dB is combined with two switched attenuators of -20 dB and -40 dB to provide levels down to 2 mVpp unterminated.

Variable DC offset of ± 10V is available via a center detent control. An auxiliary output provides a fixed 0V to +5V level suitable for driving both TTL and CMOS loads.

Wide sweep range
Each range can be swept by at least 1000:1 either manually, via the external input, or using the built-in sweep generator.

Frequency locking for ultra stability
The 25 includes a digital frequency locking system that gives it a level of frequency stability that cannot be matched by conventional analogue function generators. Once the frequency has been set, pressing the Lock key engages a measure-and-correct circuit which compensates the small thermal and mechanical drifts that inevitably occur in an analog generator. The frequency is compared to a crystal controlled reference and is maintained to within 0.01% of the set frequency.

Dual digital displays for precision and convenience
The 25 incorporates a large dual section digital display. Unlike competitive products the display provides a read out not just of frequency, but of amplitude or offset simultaneously. Fast and accurate frequency measurement Auto-ranging reciprocal measurement gives 4-digit resolution with rapid update right down to Hz levels. Accuracy is within ± 1 digit
(± 0.02% at full scale).
To maintain a fast update at sub-Hz frequencies, the measurement mode is changed resulting in 3-digit resolution and reduced accuracy.
However, when compared to the normal fixed gate-time meters used in other products the 25 provides both higher accuracy and faster display update across the whole frequency range.

RMS or peak-to-peak amplitude display
The output level display can be selected to show any of three values:
1. The peak-to-peak amplitude
2. The RMS amplitude
3. The offset
RMS values are calculated correctly for each waveform shape. The decimal point and units are changed automatically resulting in a display of the true amplitude regardless of the attenuator setting. A display indicator warns against illegal combinations of offset and amplitude setting that would create clipping in the output stage.

Advanced internal sweep
The 25 incorporates a versatile internal sweep generator capable of providing linear or logarithmic frequency sweeps. Start and stop frequencies can be set with precision using the digital display. Sweep ranges of over 1000:1 are possible. The sweep rate is adjustable over a wide range with good setability between limits of 20 ms and 20s. A sweep output socket is provided for use with an oscilloscope or an X-Y recorder. Unlike many other sweep generators, the sweep ramp is triangular which gives a superior display when using an oscilloscope to display swept frequencies.

Amplitude modulation for extra versatility
The 25 also incorporates comprehensive AM facilities. The modulation can be external or internal (via a 400 Hz internal generator) with modulation levels fully variable between
0% and 100%.

External counter with seven digit resolution
The 25 has an external counter mode which utilises the full width of the display to provide up to seven digits of resolution. The frequency range is from
5 Hz up to 20 MHz and the input sensitivity is better than 50 mVrms. A measurement period of 0.5 or 5 seconds can be selected. A reciprocal counting measurement system is used which ensures high resolution regardless of input frequency. Thus, for example, mains frequency can be measured to a resolution of better than 1 mHz. Accuracy is better than
10 ppm (0.001%) and an external adjustment point allows for closed case recalibration.

Specifications

Frequency

Frequency range:
0.005 Hz to 5 MHz in 7 overlapping decade ranges with fine adjustment by verniers.
Vernier range:
1000:1 on each range.

Frequency locking

Operating range: 0.5 Hz to 5 MHz with vernier setting within 10% to 100% of range maximum.
Locking accuracy: Better than 0.01% of displayed value.

Display
LCD, 8 digits (11mm high) plus 14 annunciators.
Meter functions (generator mode)
Frequency: Auto-ranging reciprocal measurement giving 4 digit resolution for frequencies down to 1Hz; maximum resolution is 0.001 Hz accuracy
± 1 digit 0.2 Hz to 5 MHz; accuracy ± 1% of range full
scale below 0.2 Hz.

Amplitude: Display shows peak-to-peak amplitude or rms value. Display corrected for attenuator setting. 3-digit resolution, accuracy typically 5% of range DC Offset: 3-digit resolution; accuracy typically ± 2% of setting ± 1 digit. Display corrected for attenuator setting.

25 Function Generator

Outputs
Main - 50Ω
Amplitude: 2 mV to 20 Vpp open circuit (1 mV to 10 Vpp into 50Ω) in four switch-selectable ranges with 20 dB vernier control within each range Attenuator
Ranges: 0 dB, -20 dB, -40 dB, -60 dB
DC Offset Range: ± 10V from 50Ω. DC offset plus signal peak limited to ± 10V (± 5V into 50Ω). DC offset plus waveform attenuated proportionally by the attenuator.
Main - 600Ω
Alternative output socket offering the same facilities as the 50Ω socket.

Aux out
0 to 5V TTL/CMOS logic levels capable of driving 2 standard TTL loads. Frequency, symmetry and phase as z outputs.

Sweep out
3V ramp from 600Ω.

External counter
Frequency range:
5 Hz to 20 MHz, fully auto-ranging.
Input sensitivity:
50 mVrms (sinewave).
Input impedance: 1 MΩ/25 pF.
Measurement time:
Selectable 0.5s or 5s.
Resolution:
6 digits in 0.5s; 7 digits in 5s.
Accuracy:
± 1 digit ± timebase accuracy.
Timebase accuracy:
± 10 ppm initial error; ± 5 ppm/year ageing rate; typically less then 0.5 ppm/˚C. Adjustment point for closed-case recalibration.

Operating modes
Specifications apply for the top decade of each frequency range and maximum output into 50Ω termination.

Sine
Distortion: < 0.5% on 500, 5k and 50k ranges; < 1% on 5, 50 and 500k ranges; all harmonics >25 dB below fundamental on 5M range.

Amplitude flatness: ± 0.2 dB to 200 kHz; ± 2 dB to 5 MHz.

Triangle
Linearity:
Better than 99% to 200 kHz.

Square wave
Rise and fall times: < 45 ns.
Mark - space ratio:
1:1 ± 1% to 100 kHz.

DC
Range: ± 10V unterminated.
Symmetry
Symmetry range: Variable typically 1:9 to 9:1 (on top decade of each range), frequency divided by 10.

Sweep modes
Internal
Sweep range:
>1000:1 within each range.
Sweep Rate: Adjustable, typically 20 ms to 20s. Sweep mode: Linear or logarithmic. Sweep start and stop frequencies displayed by button press.

External
Input impedance: 10 kΩ.
Input sensitivity:
0 to 3V for 1000:1 sweep.
Max. input voltage: ± 10V.
Sweep linearity: Better than 1%.
Max. Voltage rate: 0.1 V/us.

Amplitude modulation
Depth: Variable 0 to 100%.
Frequency: 400 Hz (internal). DC to 100kHz (external).
External sensitivity:
Approx. 2 Vpp for 50% modulation.

General specifications

Power
Input voltage: 230V or 115V nominal 50/60 Hz, by internal adjustment; operating range ± 14% of nominal. Installation category II.
Consumption: 25VA max.

Environmental
Operating range:
+5°C to +40°C, 20% to 80% RH.
Storage range: -10°C to +65°C.
Environment: Indoor use at < 2000m, Pollution degree I.

Mechanical

Size:
260(W) x 88(H) x 235(D)mm (10.2 x 3.4 x 9.2 inches), excluding handle and feet.
Weight: 1.9 kg (4.2 lb) approx.

Safety
Complies with EN601010-1

EMC.

Complies with EN50081-1 & EN50082-1.

Ordering information

Model 25: Combination 5 MHz Function Generator and 20 MHz Frequency Counter.
25-001: Rack Mount Kit.

Fully programmable 10 MHz Generator

- RS-232 and IEEE-488 (GPIB) interfaces
- Standard and universal waveforms
- 10 MHz function generator
- Direct Digital Synthesis
- 10 ppm frequency accuracy with 7 digit resolution
- Multi-unit phase locking
- Trigger, burst, gate and sweep
- Amplitude modulation, frequency shift keying and frequency hop
- Store and recall nine complete instrument setups
- Compatible with Waveform DSP2 software

The 29A uses Direct Digital Synthesis (DDS) techniques to bring you a full featured, programmable 10 MHz function generator with universal waveform capability. Loaded with features and affordably priced, the 29A includes both RS-232 and IEEE-488 (GPIB) interfaces for remote programming.

Based on Direct Digital Synthesis techniques the 29A provides excellent frequency accuracy (10 ppm over 1 year) and stability (1 ppm/°C) with 7 digit resolution. Standard as well as universal waveforms may be generated. Standard functions include sine, square, positive pulse, negative pulse, multi-level square, triangle, ramp up, ramp down, sin x/x, DC and pseudo-random noise. For multi-channel applications multiple 29As may be phase locked. Phase relationship between units is programmable. Operating modes including trigger, burst, gate, sweep, amplitude modulation, frequency shift keying (FSK) and frequency hop provide the versatility required for a wide range of applications. Nine complete instrument setups may be stored and recalled from battery backed memory for frequently used applications. The 29A bears CE marking for safety and EMC.

Specifications

NOTE: Specifications apply after a 20 minute warmup.

Waveform

Standard
Sine, square, positive pulse, negative pulse, multi-level square, triangle, ramp up, ramp down and pseudo-random noise.

Universal
(five 1,024 point waveforms)
Sampling frequency: 27.48 MS/s.
Waveform length:
1024 points maximum.
Vertical resolution: 10 bits.

Frequency

Frequency ranges for standard waveforms:
Sine: 100 µHz to 10 MHz.
Square: 100 µHz to 10 MHz.
Positive/negative pulse:
100 µHz to 10 MHz.
Triangle: 100 µHz to 100 kHz.
Positive/negative ramp:
100 µHz to 100 kHz.
Multi-level square:
100 µHz to 100 kHz.
Pseudo-random noise:
30m Hz to 700 kHz.
Resolution: 7 digits.
Accuracy: Typically 10 ppm for 1 year, 18°C to 28°C.
Stability: Typically 1 ppm per °C: outside 18°C to 28°C.

29A Function Generator

Waveform characteristics

Sine distortion:

< 0.3% to 500 kHz
< -50 dBc to 1 MHz
< -35 dB to 10 MHz

Non-harmonic spurs:
Typically -50 dBc to 10 MHz.
Square rise/fall time: < 25 ns.
Square aberrations:
< 5% + 2 mV.
Square symmetry control
1 to 99%: 100 µHz to 30 kHz.
20 to 80%: 30 kHz to 10 MHz.
Triangle linearity error:
< 0.5% to 30 kHz.
Triangle symmetry control
1 to 99%: 100 µHz to 100 kHz.
Pulse rise/fall time: < 25 ns.
Pulse aberrations:
< 5% + 2 mV.
Pulse symmetry control:
1 to 99%: 100 µHz to 30 kHz.
20 to 80%: 30 kHz to 10 MHz.
Multi-level square: Maximum of 16 steps of discrete amplitude and duration (1 to 1,024 points). Allows generating 3 level square, staircase, multiplexed LCD driver signals, etc.

Output characteristics
Output impedance:
50Ω or 600Ω switchable.
Amplitude:
2.5 m +Vpp to 10 Vpp into 50Ω/600Ω: 5 mVpp to 20 Vpp into open circuit.
DC offset:
± 5V into 50Ω/600Ω: ± 10V into open circuit
Resolution: 3 digits.
(limited by 1 mV)
Accuracy: 5% + 1 mV at 1 kHz.
Flatness: ± 0.2 dB to 500 kHz.

Operating modes

Continuous
Continuous cycles of the selected waveform are output at the programmed frequency.

Trigger/burst/gate
Phase coherent triggering of the programmed number of cycles of the selected waveform.
Trigger Sources: External signal, manual, internal trigger generator or remote command
Burst count: 1 to 1023 cycles
Trigger Repetition Rate:
DC to 50 kHz:
(internal trigger generator)
DC to 1 MHz:
(external trigger signal).

Sweep
Sweep mode: Linear or logarithmic, single triggered cycle or continuous.
Frequency Range:
100 µHz to the maximum frequency for selected waveform
markers: Two variable markers during sweep.
Trigger Sources: External signal, manual or remote command.

Frequency hop
Up to 16 different hop waveforms, each with independently settable frequency, amplitude, offset, waveform (except noise), and duration for each waveform. Switching between frequencies can be executed via software or manually (front panel key). Waveform duration can be set from 2 ms to 65s in 1 ms increments.

Amplitude modulation (AM)
Carrier frequency Range:
100 µHz to the maximum frequency for selected waveform
Carrier Waveforms: All
Depth: Typically variable from 0% to 100% in 1% increments.
Internal Source:
1 kHz fixed sinewave or
5 mHz to 50 kHz squarewave.
External Source:
DC to 100 kHz (4 quadrant)
External Sensitivity:
Approximately 2 Vpp for 50% modulation.

Frequency shift keying (FSK)

Phase coherent switching between two selected frequencies at a rate defined by the switching signal source.
Carrier frequency:
100 Hz to the maximum frequency for selected waveform
Carrier Waveforms: All Switch Repetition Rate: dc to 50 kHz
(internal trigger generator)
dc to 1 MHz:
(external trigger signal).

Switching signal source

Internal from front panel key or internal trigger generator:
External from Trig/Gate input or remote interface.

Start/stop phase
Phase relationship between main out and aux out is determined by the start stop phase setting.

Trigger generator
Internal source 5 mHz to 50 kHz squarewave adjustable in 20 µs steps with 3 digit resolution.

Outputs/inputs

Front panel connections
Main out: Waveform output at 50Ω or 600Ω (selectable) impedance.
Aux out: CMOS/TTL level signal at the frequency and symmetry of main output. Phase relationship between main out and aux out is determined by the start stop phase setting.
Ext trig: External trigger input for trigger, gate, sweep and FSK operating modes. It is also used to synchronize one 29A (as a slave) to another 29A (as a master). Maximum input voltage is ± 10V.

Rear panel connections
Clock in/out: The function of the clock in/out connector is set from the front panel SYS (system) menu as follows.
Clock in: The connector serves as an input for an external clock.
Clock in: When two or more 29As are synchronized the clock out is used as a master to drive the clock in of the slave units.
AM in: Input connector for externally controlled amplitude modulation (AM). Impedance is nominally 6 kΩ.
Sync out:
When two or more generators are synchronized the sync out connector on the master generator is connected to the ext trig inputs of the slave generators.
Trig/sweep out:
A fixed amplitude squarewave whose frequency is set in the trig or gate menus. In sweep mode the output is a 3-level waveform, changing from high (4V) to low (0V) at the start of the sweep, with narrow 1V pulses at marker points. In HOP mode the output goes low on entry to each waveform step and high after the new frequency and waveshape of that step have been set.

Interfaces

Full remote control facilities are provided through RS-232 and IEEE-488 (GPIB) interfaces.
RS-232: Variable baud rate, 9600 baud max., 9-pin D connector.
IEEE-488: Conforms with IEEE-488.2.

Stored settings
Up to 9 complete instrument setups may be stored and recalled from battery backed memory.

General specifications

Display: 20 character by 4 row alphanumeric display
Size: 5.12" (130 mm) H X 8.35" (212 mm) W X 13.0" (330 mm) D
Weight: 9 pounds (4.1 kg)
Power: 115V or 230V nominal 50/60 Hz, adjustable internally, operating range ± 14% of nominal, 30 VA maximum.
Operating temperature:
+5°C to +40°C, 20-80% RH.
Storage temperature:
-20°C to +60°C.
Options: 19" Rack Mount Kit (single or dual in 5.25").
Safety:
Complies with EN61010-1.
EMC: Complies with EN50081-1 and EN50082-1.

Ordering information

Model 29A:
10 MHz DDS Function Generator with serial cable.
29A-001: Rack Mount Kit.
WaveForm DSP2:
Universal waveform creation software.

39A Universal Waveform Generator

Seven generators in one versatile box

- Universal waveforms up to 65,536 points with 12-bit resolution
- Waveform sequencing
- Synthesized function generator including square and sine waves to 16 MHz
- Pulse/pulse-train generator
- Trigger generator
- Sweep, AM and tone modes
- Multi-unit phase locking
- GPIB and RS-232 interfaces

Fluke's 39A universal waveform generator combines seven generators in one to provide extensive capabilities. For one low price, it is a universal waveform generator (arb), function generator, pulse/pulse-train generator, sweep generator, trigger generator, tone generator and AM modulation source.

Universal waveform generator Model 39A is a powerful 12-bit universal waveform generator with 65,536 points of waveform memory and clock speeds up to 40 MS/s. Up to 100 waveforms can be stored in non-volatile memory. Waveforms can be created and modified from the front panel or can be downloaded over the included RS-232 and GPIB interfaces with Fluke's WaveForm DSP2 software. For complex applications, multiple waveforms can be linked together in a sequence.

Function generator
With 12 standard functions built-in, the 39A is an excellent function generator capable of generating square and sine waves to 16 MHz.

Pulse and pulse-train generator
Single pulses and complex pulse trains are generated with programmable period, width, delay and amplitude. Pulse trains containing up to 10 independently programmed pulses provide a powerful capability not found in standard pulse generators.

Versatile operating modes
Model 39A provides a wide range of operating modes including continuous, triggered burst, gated, frequency sweep, tone generation, external amplitude modulation and external signal summing modes.

Remote operation
Model 39A comes standard with GPIB and RS-232 interfaces plus an RS-232 cable. All functions are programmable from the front panel or remotely.

Phase locking
Multiple units may be phase locked for multi-channel applications. Phase angle is programmable between units.

Stored settings
Up to 9 complete instrument setups can be stored in non-volatile memory and power-on settings are programmable.

Value
Model 39A provides tremendous functionality at a very affordable price. At one low price, the 39A combines the capabilities of seven generators in one.

Specifications

Specifications apply at 18°C-28°C after 30 minutes warm-up, at maximum output into 50Ω.

Waveforms

Standard waveforms
Sine, square, triangle, DC, ramp, negative ramp, sin(x)/x, pulse, pulse train, cosine, haversine, havercosine.

Sine, cosine, haversine, havercosine

Range: 0.1 mHz to 16 MHz.
Resolution: 0.1 mHz (7 digits).
Accuracy: 10 ppm for 1 year.
Stability: < 1 ppm/°C.
Harmonic distortion:
< -60 dBc (0.1%) to 20 kHz.
< -50 dBc to 1 MHz.
< -35 dBc to 10 MHz.
Non-harmonic spurii:
< -65 dBc to 1 MHz.

Square

Range: 1 mHz to 16 MHz.
Resolution: 1 mHz (4 digits).
Accuracy: ± 1 digit of setting.
Rise and fall times: < 25 ns.

Triangle, ramps, sin(x)/x

Range: 0.1 mHz to 100 kHz.
Resolution: 0.1 mHz (7 digits).
Accuracy: 10 ppm for 1 year.
Linearity error:
< 0.1% to 30 kHz.

Pulse and pulse train

Trains of up to 10 pulses may be specified, each having independently defined width, delay and amplitude level. Baseline voltage is separately defined and the pulse/pulse-train repetition rate is set by the pulse/pulse-train period.

Rise and fall times: < 25 ns.

Period:
Range: 133.3 ns to 100s.
Resolution: 4 digits.
Accuracy: ± 1 digit of setting.

Delay:
Range: -99.9s to +99.9s.
Resolution:
0.002% of period or 33.33 ns.

Width:
Range: -33.33 ns to 99.99s.
Resolution:
0.002% of period or 33.33 ns.

Universal waveforms

Up to 50 universal (100 user defined) waveforms may be stored in RAM. Universal waveforms can be defined from front panel editing controls or by downloading waveforms via RS-232 or GPIB. Front panel editing tools include insertion of stored waveforms, point editing and line draw. Waveform DSP2 is an optional software tool for creating and downloading waveforms over RS-232 or GPIB.

Memory size: 65,536 points. Maximum waveform size is 65,536 points, minimum waveform size is 4 points.
Vertical resolution: 12 bits.
Sample clock range:
100 mHz to 40 MHz.
Resolution: 4 digits.
Accuracy: ± 1 digit of setting.
Waveform sequencing:
Up to 16 waveforms may be linked. Each waveform can have a loop count of up to 32,768. A sequence of waveforms can be looped up to 1,048,575 times or run continuously.

Amplitude

Output impedance: 50Ω
Range: 2.5 mVpp to 10 Vpp (5 mVpp to 20 Vpp into open circuit). Amplitude can be specified open circuit (Hi Z) or into an assumed load of 50Ω or 600Ω in Vpp, Vrms or dBm.
Accuracy:
< 2% ± 1 mV at 1 kHz into 50Ω.
Amplitude flatness:
± 0.2 dB to 200 kHz; ± 1 dB to 5 MHz; ± 2 dB to 10 MHz.
Resolution: 3 digits or 1 mV.

Offset

Range:
± 5 Vp. DC offset plus signal peak limited to ± 10V into 50Ω
Accuracy:
Typically ± 3% plus 10 mV, unattenuated.
Resolution:
3 digits or 1 mV.

Output filter

Selectable between 10 MHz Elliptic, 10 MHz Bessel or none.

Operating modes

Continuous
The selected waveform is output continuously at the programmed frequency.

Triggered burst
Each active edge of the trigger signal will produce one burst of the waveform, starting and stopping at the waveform position specified by the sync marker setting.

Waveforms:
All standard and universal.
Burst count: 1 to 1,048,575.

39A Universal waveform generator

Trigger source:
Manual trigger key, internal trigger generator, external trigger input or remote trigger command.

Trigger rate: Internal trigger generator: DC to 100 kHz. External signal: DC to 1 MHz.

Gated

The selected waveform is output continuously at the programmed frequency while the selected trigger signal is true.
Waveforms: All standard and universal waveforms.
Gate trigger source:
Manual trigger key, internal trigger generator, external trigger input or remote trigger command.
Trigger rate: Internal trigger generator: DC to 50 kHz.
External signal: DC to 1 MHz.

Frequency sweep

Both standard and universal waveforms may be swept. Universal waveforms are expanded or condensed to exactly 4,096 points and DDS techniques are used to perform the sweep.
Waveforms:
All waveforms except pulse, pulse-train and sequence.
Sweep modes:
Manual, continuous, triggered; linear or logarithmic; up or down.
Sweep range: 1 mHz to 10 MHz in one range. Phase continuous. Independent setting of start and stop frequencies.
Sweep time: 30 ms to 999s (3 digit resolution).
Marker:
Programmable at any single frequency in the sweep range.
Sweep trigger source: Manually from keyboard, internal trigger generator, external trigger input or remote trigger command.
Sweep hold: Sweep can be held and restarted by the hold key. Must be used in continuous sweep mode.

Tone

Allows standard or universal waveform frequency switching up to 16 frequencies. Generating DTMF signals is possible by summing the outputs of two the 39As.
Waveforms:
All waveforms except pulse, pulse-train and sequence.
Frequency list:
Up to 16 frequencies from 1 mHz to 10 MHz.
Switching sources:
External trigger input.

External amplitude modulation

Carrier frequency: Entire range for selected waveform.
Carrier waveforms:
All standard and universal waveforms.
Modulation source:
VCA/SUM IN input.
Modulation frequency range:
DC-100 kHz.
Modulation signal range:
Approximately 2.5 Vpp for 100% level change at maximum output.

External signal summing

Carrier frequency: Entire range for selected waveform.
Carrier waveforms: All standard and universal waveforms.
Sum source: VCA/SUM IN input.
Frequency range: DC-10 MHz.
Signal range: Approximately 2.5 Vpp for 10 Vpp output (50Ω).

Remote interfaces

RS-232
Variable baud rate, 9600 baud maximum. 9-pin D-connector.
GPIB
Conforms with IEEE-488.1and IEEE-488.2.
Drivers
LabVIEW™ driver available upon request.

Inputs

Trigger input
Frequency range: DC to 1 MHz.
Level range: ± 10V.
Minimum pulse width: 50 ns for trigger and gated modes; 50 µs for sweep mode; 20 ms for tone mode.
Input impedance: 10 kΩ.

VCA input (for AM mode)

Frequency range:
DC to 100 kHz
Signal range: 2.5V for 100% level change at maximum output.
Input impedance:
Typically 6 kΩ.

Summing input

Frequency range:
DC to >8 MHz.
Signal range: Approximately 2 Vpp input for 20 Vpp output.
Input impedance:
Typically 1 kΩ.

Hold input

A TTL low switch closure causes a universal waveform to hold at its current position (address). The hold function can be invoked by an input signal to the Hold input, remotely or via the front panel hold key.
Input impedance: 10 kΩ.
Reference clock input/output
Set to input: Input for an external 10 MHz reference clock. TTL/CMOS threshold level.
Set to output: Buffered version of the internal 10 MHz reference clock. Outputs levels nominally 1V and 4V from 50Ω.
Set to phase lock:
Used together with SYNC OUT on a master and TRIG IN on a slave to phase lock multiple 39As.

Outputs

Main output
Outputs selected waveform at programmed frequency, amplitude and offset.
Output impedance: 50Ω

Sync output

Multifunction output that can be user definable or automatically selectable for any of the following:
Waveform sync:
Produces a square wave with 50% duty cycle at the waveform frequency for standard waveforms or a pulse coincident with the first few points of a universal waveform.
Position markers:
May be used when generating universal waveforms, any point(s) on the waveform may have associated marker bits set high or low.
Burst done:
Produces a pulse coincident with the last cycle of a burst.
Sequence sync:
Produces a pulse coincident with the end of a waveform sequence.
Trigger:
Selects the current trigger signal. Useful for synchronizing gated or burst signals.
Phase lock out:
Used to phase lock two or more 39As. Produces a positive edge at the 0° phase point.

Cursor/marker output

Adjustable output pulse for use as a marker in sweep mode or to modulate the Z-axis input of an oscilloscope to provide a cursor for waveform editing.
Output signal level: Adjustable from 2V to 14V, normal or inverted; adjustable width as a cursor.
Output impedance:
Typically 600Ω.

General

Display: 20 character by 4 row alphanumeric LCD.
Stored settings: Up to 9 complete instrument setups and up to 100 universal waveforms can be stored in battery backed memory.
Dimensions: 130 mm (height), 212 mm (width), 330 mm (depth).
Weight: 4.1 kg (9 lb).
Power: 230V, 115V or 100V nominal 50/60 Hz, adjustable internally; operating range ± 14% of nominal; 100VA maximum.
Operating range: 5°C to 40°C, 20% to 80% RH.
Storage range: -20°C to 60°C.
Environmental:
Indoor use at altitudes to 2 km, Pollution degree 2.
Safety:
Complies with EN61010-1.
EMC:
Complies with EN50081-1 and EN50082-1.

Ordering information

Model 39A: 40 MS/s Universal Waveform Generator.
39A-001: Rack Mount Kit.
WaveForm DSP2: Universal waveform creation software.

80 and 81 Function/Pulse Generators

Ideal replacement for the HP 8116A generator

- Model 81 pulse/function generator
- Model 80 function generator
- Powerful performance affordably priced
- Triggered, gated, and burst modes
- AM, FM, VCO and phaselock/offset control modes
- Autocalibration
- Ideal for both benchtop and ATE applications
- HP 8116A emulation mode (model 81 only)

Fluke's family of versatile 50 MHz waveform generators provides an unmatched combination of powerful operating features and affordable pricing. Each model generates sine, triangle, square, positive pulse, and negative pulse waveforms from 10 mHz to 50 MHz with up to 16 Vpp amplitude into 50Ω.

With numerous continuous and non-continuous operating modes — including triggered, gated, and triggered burst, as well as externally controlled AM, VCO and phaselock/offset — the 80 and 81 are ideal for a wide range of applications.

Model 80 Provides Sweep and FM. In addition to the functions listed above, the 80 offers linear and logarithmic sweep functions and external FM. This makes the 80 an extremely versatile low-cost function generator.

Model 81 Pulse/Function Generator. With programmable pulse period, width, and transition times combined with the function generator features common to the 80 family, the 81 provides an impressive set of capabilities for both analog and digital applications.

Store common setups
Each model stores 30 complete front panel setups, allowing easy recall of test setups.

Remote operation
The 80 and 81 include an IEEE-488.2 (GPIB) interface as standard.

Autocalibration optimizes performance
Each model has an autocalibration feature that allows the user to ensure maximum accuracy each time the unit is used.

Specifications

Except as noted, specifications apply to the 80 and 81.
NOTE: Specifications apply after a 20 minute warmup.

Standard waveforms

Sine, triangle, square, positive and negative pulses, and (the 80 only) DC.

Frequency

Range: 10 mHz to 50 MHz.
Resolution: 4 digits.
Accuracy (Continuous Mode):
10 mHz to 999.9 mHz: ± 3%.
1 Hz to 50 MHz: ± 0.1%.
Jitter: 0.1% ± 50 ps.

80 and 81 Function/Pulse Generators

Waveform quality

Harmonic Distortion (Sine):
100 mHz to 1 MHz:
< 1% THD.
1 MHz to 5 MHz:
Max harmonic < -40 dB.
5 MHz to 50 MHz:
Max harmonic < 21 dB.

Flatness:
10 mHz to 999.9 kHz: ± 1%.
1 MHz to 9.999 MHz: ± 2%.
10 MHz to 50 MHz: -15%.

Triangle and ramp linearity
≤5 MHz (10% to 90% of amplitude): > 99%.

Square rise/fall time
(10% to 90% of amplitude):
< 6 ns.

Square aberrations: < 5%.

Pulse and ramp (81 only)

Pulse modes:
Symmetrical pulse, positive pulse, negative pulse, and the complement to all pulse waveforms.

Pulse period:
Range: 20 ns to 99.99s.
Resolution: 4 digits.
Accuracy and Jitter:
As for frequency.

Pulse width:
Range: 10 ns to 999 ms.
Setting accuracy:
10 ns to 99.9 ns: ± (5% + 2 ns).
100 ns to 999 ms:
3% ± (4% + 2 ns).
Duty cycle range:
1% to 80%. Up to 99% using the complement mode.
PWM range: 0 to 5V ± 20% produces > 10% pulse width change from pulse width setting.
PWM bandwidth: DC to 70 kHz.
Ramp modes:
Positive or negative going ramp.

Ramp period:
Range: 7 µs to 99.99s.
Resolution: 4 digits.

Ramp width:
Range: 5µs to 999 ms.
Setting accuracy
(5 µs to 999 ms): 3%.
Resolution: 3 digits.
Duty cycle range: 1% to 80%.

Transition times:
Range: 8 ns to 99.9 ms in six overlapping ranges. Leading and trailing edges are independently programmable.
Max ratio between ranges:
100 to 1.
Accuracy:
8 ns to 99 ns: ± (5% + 2 ns).
100 ns to 99.9 ms: ± (4% + 2 ns).

Modulation

AM and SCM:
External 0 to 10V produces 0 to 200%.
Range: 0 to 200%, reduced to 70% at 1 MHz.
Bandwidth: DC to 1 MHz.

VCO:
Range:
4.7V change produces approx 1000:1 frequency change.
Bandwidth: DC to 50 kHz.

FM (80 only):
Range: 0 to 0.5V change produces 1% deviation.
Bandwidth: DC to 50 kHz.

80 and 81 Function/Pulse Generators

Amplitude

Range
Into 50Ω: 10 mV to 16 Vpp.
Into open circuit:
20 mV to 32 Vpp.
Resolution: 3 digits.
Accuracy (at 1 kHz):
± 4 % reading.

DC offset

Offset and amplitude are independently adjustable within two windows:
-800 mV to +800 mV.
-8V to +8V.
Range:
± 800 mV window:
± 795 mV.
± 8V Window: ± 7.95V.
Resolution: 3 digits.
Accuracy (at 1 kHz)
± 800 mV window:
± (1% of setting + 1% of amplitude + 0.2 mV).
± 8V window: ± (1% of setting + 1% of amplitude + 2 mV).

Main output

Modes:
Normal (on) or disabled (off).
Impedance: 50Ω ± 1%.
Output protection:
Protected against continuous short to chassis ground.

Sync output

Level (into 50Ω)**:** 0 to 1V.
Rise/fall time: < 3 ns.

Operating modes

Continuous, triggered, phaselock, start phase, and
(80 only) sweep.

Sweep operation (80 only)

Modes:
Sweep may be continuous or triggered by any trigger mode.
Sweep spacing:
Linear and logarithmic.
Sweep directions: Up, down, up-down, and down-up.
Sweep range:
Log: 10 decades max.
Linear: 3 decades max.
Sweep rate:
Log: 10 ms to 999s per decade.
Linear: 10 ms to 999s.
Sweep out:
0 to 5V ramp proportional to frequency at rear panel BNC.
Marker output:
Output signals when marker frequency is reached.

Triggered operation

Modes:
Single shot, gated, and burst.
Sources:
Manual (front panel key), internal trigger rate generator, and external signal input.
Triggered: For each trigger, one output cycle is generated.
Gated: Continuous waveform cycles are generated for the duration of the active portion of the trigger signal. Last cycle is always completed.
Burst: Preset number of waveform cycles are generated by a trigger: 1 to 4,000.
Manual trigger:
Key provides trigger signal.
Internal trigger Rate Generator: 1 mHz to 50 kHz.
External input:
Via Trig input BNC.
Impedance: 10 kΩ ± 5%.
Sensitivity: 500 mVpp.
Max input voltage: ± 20V.
Min pulse width: 20 ns.
Max frequency: 50 MHz.
Slope: Positive or negative going leading edges.
Trigger level:
Variable -10V to +10V.
Start phase of triggered waveform:
To 500 kHz:
Adjustable from -90° to +90°.
From 500.1 kHz to 50 MHz:
Adjustable range proportionally reduced as frequency increases.
Accuracy (to 500 kHz): ± 3°.

Phaselock operation

Output waveform locks to frequency and phase of external signal. Phase may be offset.
Impedance: 10 kΩ ± 5%.
Min pulse width: 10 ns.
Locking range:
10 Hz to 60 MHz.
Phase offset (10 Hz to 19.99 MHz):
Continuously adjustable from -180° to +180°.
Resolution: 1°.
Accuracy
(10 Hz to 100 kHz.):
3° + 3% of reading.

General

Remote operation:
GPIB interface is standard.
HP8116A emulation mode
(81 only).
Environment:
Operating temperature:
0° to 50° C, ambient. For specified
Accuracy: Within ± 5° C and
24 hours of last internal
calibration.
Storage temperature:
-40° to +70° C.
Humidity: 80% R.H.
Power: 115/230 Vac, optional
100V, 50 or 60 Hz, 60W max.
Stored setups: Complete sets of
front-panel setups stored: 30
Dimensions: 8.9 cm (3.5 in) high
x 21.1 cm (8.3 in) wide x 39.1 cm
(15.4 in) deep.
Rack mount dimensions:
Single: 8.9 cm (3.5 in.) H x 48.3 cm
(19 in.) W.
Dual: 13.3 cm (5.25 in) H x 48.3 cm
(19 in) W.
Weight: 6 kg (12 lb).

Ordering information

Model 80:
50 MHz Function Generator.
Model 81:
50 MHz Pulse/Function Generator.

Options for the 80 and 81

8X-001: Single Rack Mount Kit.
8X-003: Dual Rack Mount Kit.

195 Universal Waveform Generator

2 or 4 channel 40 MS/s Universal waveform generator

- 2 or 4 independent waveform channels
- 40 MS/s universal waveform generator
- Synthesized function generator to 16 MHz
- 12 bit vertical and 64k points horizontal resolution
- Synthesized function generator to 16 MHz
- Pulse/pulse train and tone generator
- Amplitude modulation
- Waveform linking, looping and sequencing
- Inter-channel triggering, summing and phase control
- GPIB and RS-232 interfaces

Complex simulation

Today's engineers need to simulate more complex signals than ever before. The ability to easily simulate complex signals requires tools that are powerful, easy to use, and affordable. Fluke's 195 Universal Waveform generator is just such a tool. It is designed to provide powerful, sophisticated capabilities that make generating complex signals easy and convenient. Combining synthesized performance with 2 or 4 independent 40 MS/s channels, the 195 is a powerful test tool for a wide variety of applications. Best of all, the 195 is priced to fit your budget!

The 195 uses a combination of Direct Digital Synthesis, phase lock loop techniques and innovative firmware to provide high performance and extensive facilities in a compact instrument. In fact, the 195 provides the user with the functionality of several waveform generators for one low price.

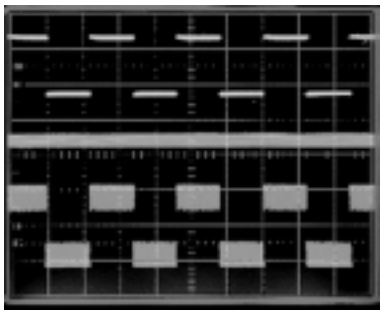
Universal waveforms
Model 195 includes a 40MS/s universal waveform generator with 12 bits of vertical resolution and 64k points of waveform memory per channel. Extensive waveform editing features are incorporated, including waveform insert, point edit, line draw, amplitude adjust and invert. Up to 100 waveforms may be stored in the 195's non-volatile memory.

Synthesized function generator
Model 195 is also a synthesized function generator that provides sine and square waves up to 16 MHz. Other standard functions include, positive ramp, negative ramp, pulse, pulse train, sin (x)/x, cosine, haversine and havercosine waveforms. With 7 digit resolution and 10 ppm accuracy for sine waves, the 195 is ideal for multi-channel applications requiring standard functions.

Phase locking
Two or more channels can be phase locked together. Slave channels can be offset with respect to the assigned master channel. Phase resolution is 0.1° for standard functions and 360°/number of waveform points for universal waveforms. Multiple 195s can be phase locked together for applications requiring more than four phase locked channels.

Pulse and pulse train
Model 195 has a built-in pulse generator capable of generating far more complex pulses than typical pulse generators. In addition to single pulses at up to 10 MHz, the 195 generates complex pulse trains of up to 10 pulses. Each individual pulse has independently programmed width, level and delay.

This versatility makes the 195 suitable for applications as diverse as video, automotive, communications, medical and semiconductor device testing.

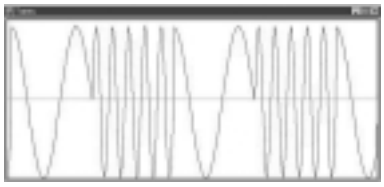


Square wave summed with noise

Summing
Waveforms from two adjacent channels may be summed to create modulated signals or signal plus noise. Any waveforms can be summed.

Tone generator
Model 195 includes tone generator capability for all waveforms except pulse, pulse train and sequences. Up to 16 frequencies between 1 mHz and 10 MHz can be listed for setting up complex tone generation signals. Switching between frequencies can be synchronously or asynchronously triggered from a front panel key, an adjacent channel, the internal trigger generator, an external signal or by remote command. Outputs from 2 channels can be summed together for generating DTMF test signals.

Waveform sequencing
For long or very complex waveforms, up to 16 waveforms may be linked together to form a sequence of waveforms. Each waveform may have a user defined repeat, or loop count from 1 to 32768. Transition from one waveform to the right occurs phase continuously.

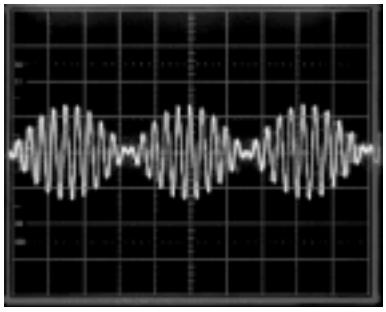


FSK signal

WaveForm DSP2
More comprehensive features are available using Fluke's WaveForm DSP2 universal waveform creation software. WaveForm DSP2 is a powerful tool for creating complex waveforms and downloading them to Fluke Universal Waveform generators. Waveforms can be created using any combination of drawing, math expression, uploading signals from DSOs, the supplied library of waveforms or by importing files from other applications such as Microsoft Excel®. The standard Windows® interface makes cutting, copying, pasting, and editing sections of waveforms easy. WaveForm DSP2 easily switches between time and frequency domains. Powerful editing, drawing, and library features are available in either domain. For example, capture a signal with a DSO, upload to WaveForm DSP2, and view the waveform in the frequency domain to analyze its frequency content.

You can add frequency spurs, change frequency content, or manipulate phase relationships. Then switch to the time domain and view your new waveshape. A library of waveforms is included with WaveForm DSP2. And it is easy to add waveforms to the library as you create them.

Amplitude modulation
Amplitude modulation and suppressed carrier modulation is available for all waveforms and can be controlled from another channel in the 195 or from an external signal.



Amplitude Modulation Signal

195 Universal Waveform Generator

Specifications

Waveforms
Standard Waveforms
Sine, square, triangle, DC, positive ramp, negative ramp, sin(x)/x, pulse, pulse train, cosine, haversine and havercosine.

Sine, cosine, haversine, havercosine
Range: 0.1 mHz to 16 MHz.
Resolution: 0.1 mHz or 7 digits.
Accuracy: 10 ppm for 1 year.
Output level:
2.5 mV to 10 Vpp into 50Ω.
Harmonic distortion:
< 0.1% THD to 100 kHz.

Square
Range: 1 mHz to 16 MHz.
Resolution: 1 mHz (4 digits).
Accuracy: ± 1 digit of setting.
Output Level:
2.5 mV to 10 Vpp into 50Ω.
Rise and fall times: < 25 ns.

Triangle
Range: 0.1 mHz to 100 kHz.
Resolution: 0.1 mHz or 7 digits.
Accuracy: 10 ppm for 1 year.
Output level:
2.5 mV to 10 Vpp into 50Ω.

Ramps and sin(x)/x
Range: 0.1 mHz to 100 kHz.
Resolution: 0.1 mHz (7 digits).
Accuracy: 10 ppm for 1 year.
Output level:
2.5 mV to 10 Vpp into 50Ω.
Linearity error:
< 0.1% to 30 kHz.

Pulse and pulse train
Output level:
2.5 mV to 10 Vpp into 50Ω.
Rise and fall times:
< 25 ns Period.
Range: 100 ns to 100s.
Resolution: 4-digit.
Accuracy: ± 1 digit of setting

Delay
Range: -99.99s to + 99.99s.
Resolution:
0.002% of period or
25 ns,whichever is greater.

Width
Range: 25 ns to 99.99s.
Resolution: 0.002% of period or
25 ns,whichever is greater.

Note: Pulse width and absolute value of the delay may not exceed the pulse period.

Pulse trains up to10 pulses may be specified, each pulse having independently defined width, delay and level. Baseline voltage is separately defined and sequence repetition rate is set by pulse train period.

Universal
Up to 100 user defined waveforms may be stored in RAM. Waveforms can be defined by front panel editing controls or by downloading waveform data via RS232 or GPiB.
Memory Size:
64k points per channel.
Vertical resolution: 12 bits.
Sample clock range:
100 mHz to 40 MHz.

Sequence
Up to 16 waveforms may be linked. Each waveform can have a loop count of up to 32,768. Sequence can be looped up to 1,048,575 times or continuously.

Output filters
16 MHz Elliptic, 10 MHz Elliptic, 10 MHz bessel or none.

Operating modes
Triggered burst
Each active edge of the trigger signal will produce one burst of the waveform, starting and stopping at the waveform position specified by the sync marker setting.
Gated
Waveform runs while the gate signal is true and stop while false.
Sweep
Frequency sweep capability is provided for standard and universal waveforms. Universal waveforms are expanded or condensed to exactly 4096 points and DDS techniques are used to perform the sweep. Sweep Modes are linear or logarithmic; up or down; up/down or down/up.
Sweep time: 30 ms - 999s.
Sweep range:
1 mHz - 16MHz in one range.

Tone switching
Capability provided for standard and universal waveforms. Universal waveforms are expanded or condensed to exactly 4096 points and DDS techniques are used to allow instantaneous frequency switching.
Carrier waveforms: All waveforms except pulse, pulse train and sequence.
Frequency list:
Up to 16 frequencies from
1 mHz to 10 MHz.
Trigger repetition rate: dc to 1 MHz internal or external. Using 2 channels with their outputs summed together it is possible to generate DTMF test signals.

Trigger generator
Internal source 0.005 Hz to 100 kHz square wave. Available for external use from any sync out socket.

Outputs

Main output - one for each channel
Output impedance: 50Ω
Amplitude:
5 mV to 20 Vpp open circuit (2.5 mV to 10 Vpp into 50Ω).
Amplitude accuracy:
2% ±1 mV at 1 kHz into 50Ω.
Amplitude flatness:
±0.2 dB to 200 kHz; ±1 dB to 5 MHz; ±2 dB to 16 MHz.
DC offset range:
±10V DC offset plus signal peak limited to ±10V from 50Ω.
DC offset accuracy:
Typically 3% ±10 mV, unattenuated.
Resolution: 3 digits or 1 mV for both amplitude and DC Offset.
Sync out - one for each channel
Multifunction output user definable or automatically selected to be any of the following:
Waveform sync (all waveforms):
A square wave with 50% duty cycle at the main waveform frequency, or a pulse coincident with the start of a universal waveform.

Position markers (universal only): Any point(s) on the waveform may have associated marker bit(s) set high or low.
Burst done:
Produces a pulse coincident with the last cycle of a burst.
Sequence sync:
Produces a pulse coincident with the end of a waveform sequence.
Trigger:
Selects the current trigger signal.
Sweep sync: Outputs a pulse at the start of sweep to synchronize an oscilloscope or recorder.
Phase lock out:
Used to phase lock two generators. Produces a positive edge at the 0˚ phase point.
Output signal level: TTL/CMOS logic levels from typically 50Ω.
Cursor/marker out
Adjustable output pulse for use as a marker in sweep mode or as a cursor in universal waveform editing mode. Can be used to modulate the Z-axis of an oscilloscope or be displayed on a second scope channel.
Output signal level:
Adjustable from nominally 2V to 14V, normal or inverted; adjustable width as a cursor.
Output impedance:
600Ω typical.

Inputs

TRIG IN
Frequency range: DC - 1 MHz.
Signal range:
Threshold nominally TTL level; maximum input ±10V.
Minimum pulse width:
50 ns, for Trigger and gate modes; 50 us for Sweep mode.
Polarity: Selectable as high/rising edge or low/falling edge.
Input impedance:
10 kΩ Modulation In.
Frequency range:
DC - 100 kHz.
Signal range: 2.5V for 100% level change at maximum output.
Input impedance:
Typically 6 kΩ.

Sum in

Frequency range: DC - 10 MHz.
Signal range: Approximately 5 Vpp input for 20 Vpp output.
Input impedance:
Typically 1k2Ω.

Hold
Holds a universal waveform at its current position. A TTL low level or switch closure causes the waveform to stop at the current position and wait until a TTL high level or switch opening which allows the waveform to continue. The front panel HOLD key or remote command may also be used to control the Hold function.
Input impedance:
10 kΩ
Ref Clock in/out.
Set to input:
Input for an external 10 MHz reference clock. TTL/CMOS threshold level.
Set to output:
Buffered version of the internal 10 MHz clock Output levels nominally 1V and 4V from 50Ω.

Inter-channel operation

Inter-channel modulation
The waveform from any channel may be used to amplitude modulate (AM) or suppressed carrier modulate (SCM) the next channel. Alternatively any number of channels may be modulated (AM or SCM) with the signal at the modulation input socket.

Carrier frequency:
Entire range for selected waveform.

195 Universal Waveform Generator

Carrier waveforms:
All standard and universal waveforms.
Modulation types AM:
Double sideband with carrier.
SCM: Double sideband suppressed carrier.
Modulation source:
Internal or external.
Frequency range:
DC to >100 kHz.
Internal AM:
Depth: 0% to 105%.
Resolution: 1%.
Carrier suppression (SCM):
> -40 dB.
External modulation signal range:
Approximately 2.5 Vpp for 100% level change at maximum output.
Inter-channel analog summing
Waveform Summing sums the waveform from any channel into the next channel. Alternatively any number of channels may be summed with the signal at the SUM input socket.
Carrier frequency: Entire range for selected waveform.
Carrier waveforms: All standard and universal waveforms.
Sum source: Internal or external.
Frequency range:
DC to 10 MHz.
External signal range:
Approximately 5 Vpp input for 20 Vpp output.
Inter-channel phase locking
Two or more channels may be phase locked together. One channel is assigned as the Master and the other channels as Slaves. Each Slave can have a phase angle relative to the Master. Universal waveforms and waveform sequences may be phase locked but certain constraints apply to waveform lengths and clock frequency ratios.
Phase resolution
DDS waveforms: 0.1˚.
Non-DDS waveforms:
0.1˚ or 360˚/ number of points whichever is the greater.
Phase error
DDS waveforms: < 0.1˚.
Non-DDS waveforms:
< 25 ns The signals from the ref in/out socket and the sync out socket can be used to phase lock two instruments.
Inter-channel triggering
Any channel can be triggered by the previous or next channel. The previous/next connections can be used to 'daisy chain' a trigger signal from a 'start' channel, through any number of channels to an 'end' channel. In this way, complex and versatile inter-channel trigger schemes may be set up. Each channel can have its trigger out and its output waveform set up independently. Trigger out may be selected from Waveform end, Position Markers, Sequence Sync or burst done. Using this scheme it is possible to create a sequence of up to 64 waveform segments, each channel producing up to 16 segments and all channels being summed to produce the complete waveform at the output of channel 4.

Interfaces

Full remote control facilities are available through the RS-232 or GPIB interfaces.
RS232: Variable Baud rate, 9600 Baud maximum.
9-pin D-connector.
IEEE-488: IEEE488.2.

General

Display:
20 character x 4 row alphanumeric LCD.
Data entry: Keyboard selection of mode, waveform etc.; value entry direct by numeric keys or by rotary control.
Stored settings:
Up to 9 complete instrument setups may be stored and recalled from battery-backed memory. Up to 100 universal waveforms can also be stored independent of the instrument settings.
Size: H x W x D :
130 (3U) x 350 x 335mm.
Weight: 7.2 kg. (16 lb).
Power: 230V, 115V or 100V nominal 50/60 Hz, 100VA max.
Operating range:
+5˚C to 40˚C, 20-80% RH.
Storage range: -20˚C to + 60˚C.
Environmental:
Indoor use at altitudes up to 2000m, Pollution degree 1.
Safety: Complies with: EN61010-1.
EMC: Complies with EN50081-1 and EN50082-1.

Ordering information

Model 195:
195:
2 Channel 40MS/s Synthesized Universal Waveform Generator.
195-001:
4 Channel 40MS/s Synthesized Universal Waveform Generator.
195-002: Rack Mount Kit.
WaveForm DSP2: Universal waveform creation software.

FLUKE

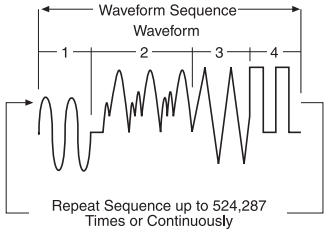
395 Universal Waveform Generator

Unique noise generation capabilities

- Universal signal source
- High-speed performance
- 100 MS/s sampling clock
- 12-bit vertical resolution
- 16 Standard functions
- Pulse train generator
- Noise generator
- Function generator including
  - Sine waves to 40 MHz
  - Square waves to 50 MHz
  - Triangle waves to 10 MHz
- Internal/external AM and internal FM modulation
- Sweep, trigger, and gate operation
- Waveform linking and summing
- Compatible with WaveForm DSP2
- SCPI compatible

Model 395 Universal Waveform generator provides the functionality of seven instruments for the price of one. You can use it as an arb, pulse generator, function generator, noise generator, sweep generator, trigger generator, or modulation source. Whatever the mix of your applications, the 395 is the best price/ performance choice. The latest digital technology, coupled with Fluke's innovative design, means that the 395 can provide the functionality of seven instruments for the price of one. The 100 MS/s 395 has the power and flexibility to provide the right signals for applications ranging from in-circuit testing of semiconductors to the complex pulse patterns required in communication testing. And no other waveform generator provides such an easy and low-cost solution to performance characterization testing of all kinds of electronic devices.

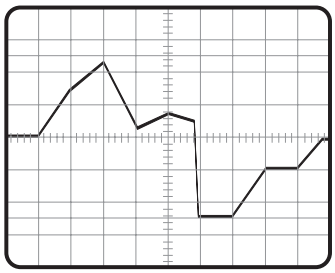
Universal waveform generator
Model 395 takes its place in the impressive Fluke family of synthesized universal waveform generators as the worldwide price/performance leader among single-channel arbs. There simply isn't another 100 MS/s arb on the market that can match its price, especially when you consider the supporting features. User-defined



(universal) waveforms can be generated at clock rates from 100 mS/s to 100 MS/s with 12 bits of vertical resolution and 64k (256k optional) points of horizontal memory. Direct Digital Synthesis (DDS) techniques are used to provide accuracies comparable to those available in expensive frequency synthesizers. A waveform sequencing feature allows up to four waveforms to be linked in a sequence for creating long waveforms. Universal waveforms can be created from the front panel or remotely downloaded via the RS-232 interface (an RS-232 cable is included with the 395) or optional GPIB interface.

395 Universal Waveform Generator

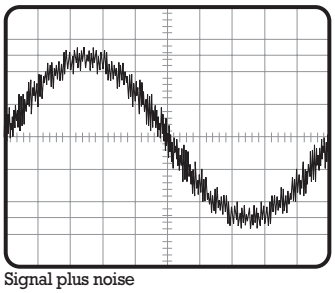
The GPIB option includes direct DSO waveform transfer, which allows you to upload waveforms directly into the 395 that have been captured with any of 25 different digital storage oscilloscopes from a variety of vendors. Fluke also offers WaveForm DSP2, a software tool that makes waveform creation, modification, and downloading easy over either interface. These are the kinds of high-performance specifications that make the 395 the arb of choice for a variety of applications that require complex, nonstandard waveforms —from simulating power line disturbances such as drop out and spiked signals to providing complex signals for pressure sensors used in mechanical testing.



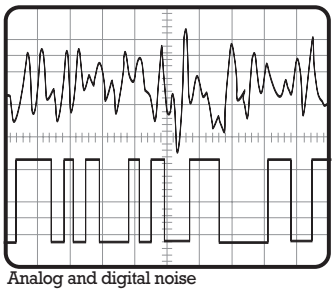
Mechanical testing

Function generator

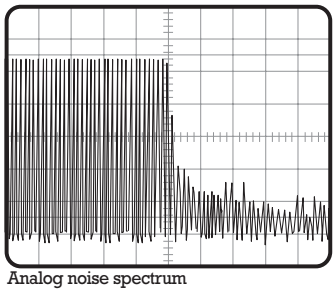
With the introduction of the versatile and low-cost 395, there's no longer any reason to buy an ordinary function-only generator. The 395 generates 16 standard waveforms: square, sine, positive and negative ramps, pulse, pulse train, five different noise functions, triangle, positive and negative haversines, (sin x)/x, and DC. And the performance specifications are first rate, providing square waves to 50 MHz, sine waves to 40 MHz, and triangles to 10 MHz, with synthesized accuracy and outputs up to 10 Vpp into 50Ω. Direct



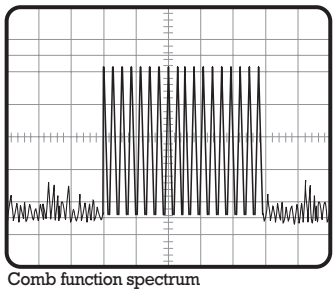
Signal plus noise



Analog and digital noise



Analog noise spectrum



Comb function spectrum

Digital Synthesis enables 10-digit frequency resolution for sine waves to 20 MHz and for most other standard waveforms to 100 kHz. Waveforms can be output continuously or in triggered, gated, or swept modes for applications like simulating input signals to sensors. Other capabilities give you the flexibility of the very best function generators including frequency and amplitude modulation, and summing the 395's waveform with an external signal.

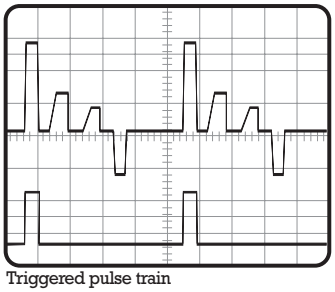
Noise generator

The built-in noise generator is ideal for applications where precise noise is required, such as testing electronic engine module noise susceptibility in automobiles. Extensive noise generation capabilities are provided by 5 programmable noise functions: analog (white) noise, digital noise, comb function, signal-plus-noise, and signal-plus-comb. Other programmable features include sequence length for white and digital noise, bandwidths to 10 MHz for comb and white noise, bandwidths to 50 MHz for digital noise, and noise-to-signal ratios from 1% to 99%.

Pulse generator

Model 395 has a built-in pulse generator that offers a greater degree of control over pulse shape and amplitude than many other pulse generators. Simple pulses up to 10 MHz can be generated. You can create complex pulse trains of up to 10 pulses with individually programmable rise time, fall time, width, level, and negative or positive delay (with respect to the sync pulse).

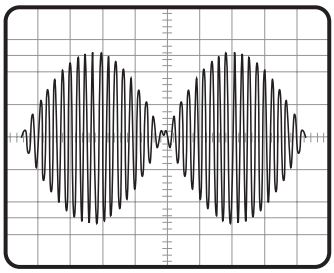
This versatility makes the 395 suitable in pulse applications as diverse as measuring the baseband frequency response in a microwave system, measuring the real-time impedance of biological cells, and testing propagation delay in electronic circuits.



Triggered pulse train

Trigger generator
Model 395 makes a great trigger generator for devices under test, whether you are using standard functions or user-defined waveforms. Burst count is programmable from 1 to 1,048,575 cycles. Gated mode provides continuous output of the waveform for the duration of the gating signal. Four different trigger sources are available for maximum versatility: internal trigger generator with programmable trigger period, external signal with programmable trigger level and slope, remote trigger command, and manual trigger key.

Sweep generator
Use the 395 as a sweep generator for performance characterization and frequency response testing, such as testing amplifier response or rapid cycling of a mechanical servo. Standard or universal waveforms can be swept in one continuous range from 1 mHz to 20 MHz. Triggered and manual sweep operations also can be performed. Seven sweep modes, with linear and logarithmic sweep spacing, a TTL level sweep marker, and a ramp output give you the flexibility you need. There's even a pen lift function for use with chart recorders.



Suppressed carrier modulation

Modulation source
If you do communication or audio design and test, the 395 offers internally generated amplitude modulation and frequency modulation, as well as externally controlled amplitude modulation in two modes.

Convenience and versatility
Fluke designed the 395 for user convenience. The user screens are tailored to the particular jobs you want to perform, such as setting up a pulse generator or a noise function.

From any screen, you can access help screens that guide you in using the instrument's extensive capabilities. And you can store at least 10 instrument setups so you don't have to spend valuable time duplicating past effort.

Low cost of ownership is assured by the high reliability and ease of calibration of the 395. Calibration is performed with covers on in less than 15 minutes, under front panel or remote control.

Specifications

Specifications apply within the specified environmental conditions after a 20 minute warm-up.

Amplitude

Range:
10 mVpp to 10 Vpp into 50Ω.
Resolution: 3.0 digits.
Accuracy:
25 ± 10° C: ± (1% + 2 mVpp).

Offset

Range: ± 5V into 50Ω.
Resolution: 3 digits.
Accuracy:
25 ± 10° C: ± (1% + 20 mV).

Standard waveforms

Sine, square, triangle, pulse, pulse trains, DC, positive/negative ramp, positive/negative haversine, (sin x)/x, and five noise functions.

Frequency (sine and Haversine)
Range: 1 µHz to 40 MHz.
Resolution:
(Resolution limited by 1 µHz.)
≤ 20 MHz: 10 digits; ± 30 ppm.
> 20 MHz: 4 digits; ± 100 ppm.

Frequency (square)
Range: 1 µHz to 50 MHz.
Resolution: 4 digits; ± 100 ppm.

Frequency (triangle)
Range: 1 µHz to 10 MHz.
Resolution:
≤ 100 kHz: 10 digits; ± 30 ppm.
> 100 kHz: 4 digits; ± 100 ppm.

Frequency (ramp)
Range: 1 µHz to 2 MHz.
Resolution:
≤ 100 kHz: 10 digits; ± 30 ppm.
> 100 kHz: 4 digits; ± 100 ppm.

395 Universal Waveform Generator

Frequency (sin (x)/x)
Range: 1 µHz to 1 MHz.
Resolution:
≤ 100 kHz: 10 digits; ± 30 ppm.
> 100 kHz: 4 digits; ± 100 ppm.

Waveform quality
Square transition time: < 8 ns.
Square aberrations:
< (5% + 20 mV).
Sine distortion:
< 100 kHz: 0.15% (-56 dBc).
< 5 MHz: No harmonic > -35 dBc.

Universal waveforms

Sampling frequency
Range: 100 mS/s to 100 MS/s.
Resolution: 4 digits.
Accuracy: ± 100 ppm.
Waveform memory size
64k points; 256k points optional.
Minimum waveform size:
10 points.
Vertical resolution: 12 bits.
Output filters (selectable):
20 MHz Elliptic (8 pole), 40 MHz Elliptic (8 pole), 10 MHz Bessel (2 pole), no filter.
Waveform sequencing:
Up to 4 waveforms can be linked. Each waveform can have a repeat (loop) count of up to 65,535 or run continuously, conditional upon an external trigger event (repeat until event true). Additionally, a sequence of waveforms can be repeated up to 524,287 times or run continuously.

Pulse waveforms

Up to 10 pulses may be independently programmed in a pulse pattern. Parameters that can be independently programmed for each pulse are rise time, fall time, width, delay, and amplitude.

For periods ≤ 655 µs
Range: 100 ns to 655 µs.
Resolution: 20 ns.
Accuracy: ± 100 ppm.
Rise/fall:
Fixed: 8 ns.
Variable: 50 ns to 500 µs.
Resolution: 8 ns.
Accuracy: ± 0.1% ± 5 ns
(< 8 ns for fixed rise/fall).
Delay:
Range: -600 to +600 µs.
Resolution: 10 ns.
Accuracy: ± 0.1% ± 5 ns.
Width:
Range: 10 ns to 655 µs.
Resolution: 10 ns.
Accuracy: ± 0.1% ± 5 ns.
For periods > 655 µs
Range: 655 µs to 10s.
Resolution: 4 digits.
Accuracy: ± 100 ppm.
Rise/fall:
0.1% to 79% of period (or < 8 ns).
Delay:
-99.9% to +99.9% of period.
Width:
0.002% to 99.9% of period.

Noise

White (analog) noise
Uniform frequency distribution with programmable noise bandwidth. Noise BW Range: 10 mHz to 10 MHz.
Sequence length
Standard: 2n - 1, n = 6 to 16.
Digital noise
Provides a random 0,1 pattern with programmable sequence length.
Clock Range: 10 mHz to 100 MHz.
Sequence Length:
Standard: 2n - 1, n = 6 to 16.

Comb
Uniformly distributed frequency spectra within a well-defined frequency band.
Start/Stop Range: 1 Hz to 10 MHz.
Number of Lobes: 3 to 256.
Signal-Plus-Noise, Signal-Plus-comb
Adds analog noise or comb to any standard or universal waveform with precise, controlled noise-to-signal ratio.
N/S Ratio: 1% to 99% Vpp.
Resolution: 1%.

Operational modes

Continuous: The selected waveform is output continuously at the programmed frequency.
Gated: The selected waveform is output continuously at the programmed frequency while the selected trigger signal is true.
Triggered: Upon transition of the selected trigger from false to true, the number of cycles specified by the count is output at the specified frequency. Burst count is programmable from 1 to 1,048,575. (One to 524,287 for waveform sequence operation.)
Sweep: Frequency sweep.

Triggering

Trigger sources: 4 trigger sources: External TRIG IN BNC, internal trigger generator, front panel manual trigger key, and remote trigger command.
Trigger level: The trigger level at the TRIG IN BNC is programmable.
Range: -10V to +10V.
Trigger slope: Positive or negative.
Internal trigger source
Range: 200 ns to 1000s.
Resolution: 100 ns limited by 6 digits.

Sync Output
Sync output can be selected from among the following 7 sources: waveform sync, trigger signal, burst done, loop done, sweep marker, position marker, pen lift.

Modulation
For both standard and universal waveforms.

Internal frequency modulation
Carrier signal source:
Sine wave.
Center frequency range:
0.01 Hz to 40 MHz.
Deviation frequency range:
0.01 Hz to 40 MHz.
Note:
Center frequency plus deviation frequency must be 40 MHz.
Modulating signal source:
Any waveform except noise, AM, FM, or pulse.
Modulation frequency range:
0.01 Hz to 40 MHz.

Internal amplitude modulation modes
AM: 0 to 200% modulation.
SCM: 200% modulation.
Carrier signal source:
Sine wave.
Carrier frequency range:
0.01 Hz to 40 MHz.
Modulating signal source:
Any waveform except noise, AM, FM, or pulse.
Modulation frequency range:
0.01 Hz to 40 MHz.

External amplitude modulation
Normal AM:
0 to 100% modulation.
Suppressed carrier modulation (SCM):
± 100% modulation.
Signal summing
External signals can be summed directly to the 395 output through the SUM IN BNC.
Sweep
Standard and universal waveforms can be swept.
Sweep start/stop
Range: 1 mHz to 20 MHz.
Resolution: 4 digits limited by 1 mHz.
Sweep time
Range: 30 ms to 1000s.
Resolution: 1 ms.
Sweep types:
Sweep off, continuous, continuous with reverse, triggered, triggered with reverse, triggered with hold, triggered with hold and reverse, and manual.
Sweep spacing:
Linear and logarithmic.

Outputs
Reference output (50Ω)
TTL level into open circuit:
> 1.2 Vpp.

Main output (50Ω)
Output may be selected on or off.
AM input (2.5 kΩ): ± 2.5V.
Sweep output (1 kΩ):
0 to 10V ramp proportional to completion of sweep.

Sync output (50Ω)
Low level: < 0.4V into 50Ω.
High level: > 2.0V into 50Ω.
Rise/fall time: < 7 ns.

Inputs
Trigger input (2 kΩ)
Level: ± 10V (programmable).
Maximum frequency: 10 MHz.

Sum input (600Ω)
Level: ± 5 Vpp max.
Bandwidth: > 30 MHz.
Protection: Over-voltage to ± 10V.

Reference input (5 kΩ)
Level: 1 Vpp minimum, 10 Vpp maximum; 50 Vdc maximum.
Frequency: 10 MHz ± 5%.

General
Remote operation
RS-232 interface is standard.
IEEE-488.2 (SCPI compatible) GPIB interface is optional.

Environment
Designed to MIL-T-28800C class 5.
Temperature range: Operates from 0° to +50°C: -20° to +70°C for storage.
Dimensions: 35.6 cm (14.00 in) wide, 13.3 cm (5.22 in) high, and 39.4 cm (15.5 in) deep.
Weight: Approximately 7.7 kg (17 lb) net; 10.0 kg (22 lb) shipping.
Power: 90 to 132, 198 to 252 Vrms; 50/60 Hz; 1 phase;
< 80 VA.

Ordering information
Model 395: 100 MHz Synthesized Universal Waveform Generator with serial cable and Quick Start demo disk.
395-001:
IEEE-488 (GPIB) interface/direct DSO waveform transfer.
395-002: 256k extended memory.
395-004: Rack Mount Kit.
WaveForm DSP2: Universal waveform creation software.

FLUKE

Time and Frequency

Section 2

Contents

Fluke offers the broadest selection of counters in the industry. For traditional bench counter applications such as R&D, automated systems test, or calibration in the Cal-Lab, Fluke can address your measurement needs with economical solutions and state-of-the-art performance.

Bench models PM6680B, PM6681 and PM6685 offer the ultimate in frequency counter performance at a price for any budget. The 908 and 910 frequency standards provide an accurate reference clock for use in R&D, Test-systems or calibration laboratory applications. Combined with TimeView™ software, the PM6681 becomes a modulation domain analyzer, to characterize frequency hopping/modulation or time jitter over time in amazing detail.

The PM6681R, PM6685R and 910R are equipped with Rubidium reference oscillator for on-site calibration of e.g. GSM base station clocks or Cal Lab calibrators of frequency, time interval or phase.

PM 6681

910R

PM6685

Time and frequency counter selection guide

Model	PM6685	PM6685R	PM6680B	PM6681	PM6681R
Counter					
Frequency LF MHz	300	300	225	300	300
Opt. 1.3 2.7 GHz	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes
Ratio	Yes	Yes	Yes	Yes	Yes
Burst/PRF/FM	Yes	Yes	Yes	Yes	Yes
Totalize modes	1	1	6	6	6
Timer					
Time interval on 2 ch.			Yes	Yes	Yes
Pulse Width	Yes	Yes	Yes	Yes	Yes
Rise- & fall Time			Yes	Yes	Yes
Duty factor	Yes	Yes	Yes	Yes	Yes
Phase			Yes	Yes	Yes
Analyzer					
Measuring speed Rdgs/s	1600	1600	2000	8-20-40k	8-20-40k
Memory capacity Rdgs	2600	2600	2600	6100	6100
Modulation domain SW	Opt.	Opt.	Opt.	Incl.	Incl
Volt					
Vmax/Vmin (AC or DC)			Yes	Yes	Yes
Trigger					
Level Auto Man GPIB	AMG	AMG	AMG	AMG	AMG
Sensitivity Auto Man GPIB	AMG	AMG	AMG	AMG	AMG
Resolution					
Frequency resolution dig/s	10	10	10	11	11
Time resolution single	250 ps	250 ps	250 ps	50 ps	50 ps
Time resolution average	100 ps	100 ps	100 ps	1 ps	1 ps
Trigger level resolution mV			20	1.25	1.25
Input sensitivity mV	10	10	20	20	20
Accuracy					
1 year [1]	2×10^{-8}	2×10^{-10}	2×10^{-8}	2×10^{-8}	2×10^{-10}
Time base options [2]	3	Rubidium	3	3	Rubidium
Features					
Analog output	Yes	Yes	Yes	Yes	Yes
Arming	Yes	Yes	Yes	Yes	Yes
Hold-off/digital filter			Yes	Yes	Yes
Low pass filter analog	Yes	Yes	Yes	Yes	Yes
Statistics/full math			Yes	Yes	Yes
Analog bargraph (signal strength)	Yes	Yes			
Nulling	Yes	Yes	Yes	Yes	Yes
Digit blanking	Yes	Yes	Yes	Yes	Yes
Interface RS-232	GPIB(opt.)	GPIB(opt.)	GPIB(std)	GPIB(std)	GPIB(std)
GPIB (Rdgs/s)	125	125	125	250	250
Size 19" 2HE	1/2	3/4	3/4	3/4	3/4
Warm up time [Min.]	30	6	30	30	6
Battery supply	Opt				

[1] Best achievable accuracy with best Time base option up to one year after calibration
[2] Time base Options: PM6680 Series: Standard/Oven; PM6685R & PM6681R: Rubidium

Option Model	PM668-/-1-	PM668-/-5-	PM668-/-6-
Retrofittable option:	Non retrofit	PM9691 OCXO	PM9692 OCXO
Time base type:	Standard		
Uncertainty due to			
Calibration adjustment tolerance, at +23°C ± 3°C	< 1 x 10^{-6}	< 2 x 10^{-8}	< 5 x 10^{-9}
Aging: per 24 hr.	N.A.	< 5 x 10^{-10} *	< 3 x 10^{-10} *
per month	< 5 x 10^{-7}	< 1 x 10^{-8}	< 3 x 10^{-9}
per year	< 5 x 10^{-6}	< 7.5 x 10^{-8}	< 2 x 10^{-8}
Temperature variation: 0°C -50°C,	< 1 x 10^{-5}	< 5 x 10^{-9}	< 2.5 x 10^{-9}
20°C -26°C (typical values)	< 3 x 10^{-6}	< 6 x 10^{-10}	< 4 x 10^{-10}
Power voltage variation: ± 10%	< 1 x 10^{-8}	< 5 x 10^{-10}	< 5 x 10^{-10}
Power-on stability			
Deviation versus final value after 24hr on time, after a warm-up time of:	N.A. 30 min	1 x 10^{-9} 10 min	5 x 10^{-9} 10 min
Total uncertainty, for operating temperature 0°C to 50°C, at 2 sigma (95 %) confidence interval			
1 year after calibration	< 1.2 x 10^{-5}	< 1 x 10^{-7}	< 2.5 x 10^{-8}
2 year after calibration	< 1.5 x 10^{-5}	< 2 x 10^{-7}	< 5 x 10^{-8}
Typical total uncertainty, for operating temperature 20°C to 26°C, at 2 sigma (95 %) confidence interval			
1 year after calibration	< 7 x 10^{-6}	< 1 x 10^{-7}	< 2.5 x 10^{-8}
2 years after calibration	< 1.2 x 10^{-5}	< 2 x 10^{-7}	< 5 x 10^{-8}

N.A. not discernible, neglectable versus 1°C temperature variation.
* after 48 hours of continuous operation, PM9692 typical value 1 x 10^{-10}
Explanation Calibration Adjustment Tolerance:
Is the maximal tolerated deviation from the true 10MHz frequency after a calibration. When the reference frequency does not exceed the tolerance limits at the moment of calibration, an adjustment is not needed.
Total uncertainty
Is the total possible deviation from the true 10MHz value under influence of frequency drift due to aging and ambient temperature variations versus the reference temperature. The operating temperature range and the calibration interval are part of this specification.

Model	908	909	910	910R
Local Oscillator Type	Oven controlled crystal (OCXO)	Rubidium	Oven controlled crystal (OCXO)	Rubidium
Short Term Stability (t=1s)	5x10^{-12}	3x10^{-11}	5x10^{-12} (Locked to GPS)	3x10^{-11} (Locked to GPS)
Short Term Stability (t=10s)	5x10^{-12}	1x10^{-11}	5x10^{-12} (Locked to GPS)	1x10^{-11} (Locked to GPS)
Short Term Stability (t=100s)			3x10^{-11} (Locked to GPS)	3x10^{-12} (Locked to GPS)
Short Term Stability (t=1000s)			5x10^{-11} (Locked to GPS)	1x10^{-12} (Locked to GPS)
Frequency Offset (24 Hour Mean)			2x10^{-12}	1x10^{-12}
Warm Up	10 min. to 5x10^{-9}	11min. to 4x10^{-10}	10 min. to 5x10^{-9}	11 min. to 4x10^{-10}
10 MHz Outputs	5 (10 Opt)	5 (10 Opt)	5 (10 Opt)	5 (10 Opt)
5 MHz Outputs	1	1	1	1
2.048 MHz Outputs	-	-	5(opt.)	5(opt.)
Programmable pulse output	-	-	1(opt.)	1(opt.)
1 Pulse per Second Outputs			1	1
Data Storage (24 hour Mean)			2 years	2 years
Operating Modes	Manual	Manual	GPS-disciplined, Holdover (Manual or automatic)	GPS-disciplined, Holdover (Manual or automatic)
Aging per Year	2x10^{-8} (1 year)	1x10^{-9} (10 year)		

PM6680B/PM6681/PM6681R Timer/Counter/Analyzers

Affordable performance

- Calibrate frequency, time or phase
- Ideal for manufacturing test systems, R&D departments and calibration laboratories
- Faster than any other timer/counter currently available - with up to 8000 measurements per second
- Ultra-high resolution - up to 50 picosecond single-shot
- Frequency uncertainty of 0.0001 ppm (Rb)
- Time interval uncertainty of 500 picoseconds
- Phase uncertainty less than 0.1°
- Trigger precision resolution of 1.25 mV
- Advanced arming/hold-off
- Powerful TimeView™ analysis software included (PM6681/PM6681R)

With the PM6680B Series of timer/counters and calibrators, Fluke offers the ultimate tools for measurement, analysis and calibration of frequency, time intervals or phase, whether in test systems, on the R&D bench, in the calibration lab or even out in the field. The PM6680B Series is comprised of three models: the entry-level PM6680B, the high performance PM6681 and the ultimate PM6681R, which includes a built-in Rubidium time-base reference.

Frequency calibration
The PM6680B Series of products can directly calibrate any application-specific frequency up to 2.7 GHz. As a result, they are ideal for calibrating the timebase oscillator of other instruments, such as frequency counters and synthesizers. The Rubidium timebase of the PM6681R can perform frequency calibration on even the highest specified oven oscillators. What's more, built-in statistical averaging improves resolution still further and the standard deviation indicator provides additional and valuable information about frequency stability.

Time interval calibration
For the calibration of time intervals, the PM6681/PM6681R provide industry-leading performance with fast 50 ps single shot time resolution (1 ps averaged) and high trigger level resolution of 1.25 mV. In addition, the systematic start-stop channel difference is only 500 ps, which can be further reduced by calibrating the input channel difference.

Phase calibration
With the PM6681/PM6681R, you can measure phase differences on signals of up to 160 MHz with a resolution better than 0.01° (below 30 MHz). Such outstanding resolution means laser positioning measurements and phase meter calibration are dealt with simply and effectively.

Ideal for fast test systems
In manufacturing test systems, it's speed that counts - the quicker you can test, the more cost-effective the system becomes. The PM6681/PM6681R measure faster than any other commercially available timer/counter - at speeds of up to 8000 readings per second to internal memory. For individually triggered measurements via the GPIB interface, measurement speed is up to 250 readings per second. Up to 20 complex measurement setups can be locally stored in the counter's non-volatile memory and instantly recalled via a short bus command. This enables new measurement tasks to be executed one after another at high speed. In fact, a complete cycle "setup-measure-transfer" takes less than 8 ms. And, of course, all counters comply with the SCPI (Standard Commands for Programmable Instruments) command set so you can easily update and implement future hardware without expensive software redevelopment.

Powerful analysis software included
Both the PM6681 and the PM6681R are supplied with powerful TimeView™ analysis software as standard. With TimeView™ installed, the PM6681/PM6681R becomes a high performance modulation domain analyzer - allowing you to view rapid frequency changes vs time, analyze jitter and noise, and to pinpoint both wanted and unwanted modulation sources.

Specifications

Measuring functions
Inputs A and B can be swapped internally in all modes except rise and fall time.

Frequency A, B, C
Range:
Input A (PM6681):
up to 300 MHz.
Input A (PM6680B):
up to 225 MHz.
Input B: up to 100 MHz.
Input C (option):
Up to 1.3 or 2.7 GHz.
Resolution (PM6681):
11 digits in 1s measuring time.
Resolution (PM6680B):
10 digits in 1s measuring time.

Frequency burst A, B, C
Frequency and PRF of burst signals down to 1µs (Ch. A, B) or 50µs (Ch. C) can be measured without external control signal.

Period A
Range (PM6681): 3.3 ns to 10^{10}s.
Range (PM6680B): 6 ns to 10^{10}s.
Resolution (PM6681):
11 digits in 1s measuring time.
Resolution (PM6680B):
10 digits in 1s measuring time.

Frequency ratio A/B, C/B
Range: 10^{-9} to 10^{15}.
Time interval A to B
Range: 0 ns to 10^{10}s.
Resolution
Single shot (PM6681):
50 ps (1 ps average).
(PM6680B): 250 ps.
Pulse width A
Range: 3 ns to 10^{10}s.
Rise and fall time A
Range: 3 ns to 10^{10}s
Phase A relative B
Range: -180° to +360°.
Resolution 0.01°.
Duty factor A
Range: 0.000001 to 1.000000.
Totalize A, B
Range: 0 to 10^{17}, 0 to 10^{10} in A-B modes.

Modes:
A gated by B.
A start/stop by B.
Manual gating A minus B.
Timed gating A minus B.

V max, V min, Vpp A, B
Range: -50V to +50V.
Frequency Range:
up to 100 MHz.
Resolution (PM6681): 1.25 mV.
Resolution (PM6680B): 20 mV.

Input and output specifications

Inputs A and B
Coupling: AC or DC.
Impedance (PM6681):
1 MΩ//15 pF or 50Ω.
Impedance (PM6680B):
1 MΩ//30 pF or 50Ω.
Max. channel timing difference:
PM6681: 500 ps.
PM6680B: 1 ns.
Max. sensitivity:
20 mVrms, <100 MHz.

Attenuation: x1 or x10.
Var. hysteresis A: 60 mV to 10 Vpp up to 120 MHz.
Trigger level: read-out on display.
Range: (x1): -5V to +5V
(x10): -50V to +50V.
Resolution (PM6681): 1.25 mV.
Resolution (PM6680B): 20 mV.

Auto trigger level: Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise/fall Time, 75% and 25% for variable hysteresis A).

Auto trigger frequency
PM6681: 1 Hz (default =100 Hz).
PM6680B: 100 Hz.
Low pass filter A: 100 kHz.
Digital LP filter:
using trigger hold-off.
PM6681: 1 Hz to 10 MHz.
PM6680B: 1 Hz to 5 MHz.

Input C (Option PM 9621)
Range:
70 MHz to 900 MHz:
10 mVrms to 12V rms
900 MHz to 1100 MHz:
15 mVrms to 12V rms
1100 MHz to 1300 MHz:
40 mVrms to 12V rms
Impedance:
50Ω, AC, VSWR <2:1
Max Voltage without Damage:
12V rms during 60s
Connector: BNC

Input C (Option PM 9624)
Range:
100 MHz to 300 MHz:
20 mVrms to 12V rms
0.3 GHz to 2.5 GHz:
15 mVrms to 12V rms
2.5 GHz to 2.7 GHz:
20 mVrms to 12V rms

Impedance:
50Ω, AC, VSWR <2.5:1
Max Voltage without Damage:
12V rms during 60s
Connector: Type N Female

Rear panel inputs and outputs
Ref. input (PM6681): 1, 2, 5, or 10 MHz. >200 mVrms signal.
Ref. input (PM6680B):
10 MHz. >500 mVrms signal.
Reference output:
PM6680B, PM6681: 1x 10 MHz. >0.5 Vrms sinewave into 50Ω load.

PM6681R: 6x 10 MHz; 1x 5MHz. >0.6 Vrms sinewave into 50Ω load.
Arming input:
Most measuring functions can be performed using arming.
Gate Signal output:
Gate open/gate closed output.
Trigger level outputs:
Outputs for channel A and B trigger levels probe.
Comp.outputs: Outputs for channel A and B to adjust for best pulse response when using probes for counter input.
Analog output: 0 to 4.98V in 20 mV steps; proportional to 3 selected display digits.

Auxiliary functions

Trigger hold-off
Time delay range (PM6681):
60 ns to 1.34s, 10 ns res.
Time delay range (PM6680B):
200 ns to 1.6s, 100 ns res.
Event delay range B (PM6681):
2 to 2^{24}-1, max. 100 MHz.
Event delay range B (PM6680B): 2 to 2^{24}-1, max. 20 MHz.

External arming
Time delay range B, E:
200 ns to 1.6s, 100 ns res.

Event delay range B:
2 to 2^{24}-1, max. 20 MHz.

Statistics
Functions: Maximum, minimum, mean and standard deviation.
Sample size (PM6681):
1 to 2 x 10^{-9} samples.
Sample size (PM6680B):
1 to 65535 samples.

Mathematics
Functions: (K*X+L)/M and (K/X+L) /M. X is current reading and K, L and M are constants; set via keyboard or as frozen reference value (X_0) or as value from preceding measurement (X_{n-1}).

Other functions
Measure time (PM6681): Single cycle, 80, 160, 320, 640, 1280 ns and 20µs to 20s (or to 400s for some functions).
Measure time (PM6680B): Single cycle, 0.8, 1.6, 3.2, 6.4, 12.8 and 50µs to 20s (or to 400s for some functions).
Display hold: Freezes measuring result, until a new measurement is initiated via restart.
setups: 20 instrument setups can be saved and recalled from internal non-volatile memory. 10 can be user protected.
Auxiliary menu: Gives access to additional functions.
Display: 10-digit LCD with high-luminance back light.

GPIB interface

Programmable functions:
All front pannel accessible.
Interface functions:
SH1, AH1, T6, L4, SR1, RL, DC1, DT1, E2.
Time stamping (PM 6681):
125 ns resolution.

Measurement rate*

Via GPIB
PM6681: 250 readings/s.
PM6680B: 125 readings/s.
To internal memory:
PM6681: 8k readings/s.
PM6680B: 2k readings/s.

Time stamping (PM6681):
125 ns resolution back-to-back.
Period (PM6681): Up to 40k readings/s (100 ns resolution).
Internal memory size (PM6681)*: Up to 6100 readings
Internal memory size (PM6680B)*:Up to 2600 readings.
Data output: ASCII, IEEE double precision floating point.

TimeView™ time & frequency analysis software

TimeView runs on any PC with VGA/EGA monitor. TimeView is supported on PM6681 and PM6681R.

Data capture modes and measurement rate.

Free-run sampling:
8k readings/s.
Repetitive sampling:
Up to 10 MS/s.
Back-to-back-period:
Up to 40k readings/s.
Waveform capture:
Yes (vertical sampling)
Instrument control:
All front panel functions and some aux menu functions.
Data analysis:
Measurement data vs time, FFT graph, root Allan Variance, smoothing function, zoom function, cursor measurements, distribution histogram, setup and measurement, data archive and printing.

* Depending on measurement function and internal data format.

General specifications

Environmental data
Operating temp: 0˚C to +50˚C
Storage temp: -40˚C to +70˚C
Safety: CSA 22.2 No. 231, EN 61010-1, Cat II, pollution degree 2, CE.
EMC: FCC Part 15J class A, EN 55011-1, EN 50082-2, CE.

Power line requirements (at 25°C)
AC voltage:
90 to 265 Vrms, 45 to 440 Hz.
Power rating:
PM6680B, PM6681 max 35W.
PM6681R max 100W
(6 min warm-up) max 47W
(cont. operation).

Dimensions and weight
WxHxD: 315x86x395 mm (12.4x3.4x15.6 in).
Weight PM6680B, PM6681: Net 4 kg (8.5 lb),shipping 7 kg (15 lb).
Weight PM6681R: Net 4.8 kg (10.5 lb), shipping 7.8 kg (16.8 lb).

Specifications may be subject to change without notice

Ordering information

Basic models

PM6680B: 225 MHz, 250 ps, timer/counter.
PM6681: 300 MHz, 50 ps, timer/counter/analyzer.
PM6681R: 300 MHz, 50 ps, timer/counter/calibrator Rb timebase.

Included with instrument
Users manual, programming manual certificate of calibration, GPIB and TimeView™ software.

RF input frequency options (PM6680B, PM6681, PM6681R)*
PM9624
2.7 GHz input C.

Timebase options (PM6680B, PM6681)*
PM9691
High stability oven timebase.
PM9692
Ultra- high stability oven timebase.

Optional accessories
PM9622/02 Rack-Mount Kit.

PM9627B Carrying Case.

PM9611 Rear Panel Inputs

PM 9627H Heavy Duty Aluminium Carrying Case

PM 9020/001
200 MHz 10:1 probe 1 MΩ/30 pF

PM 9639/011 2.3 GHz 500Ω probe set, 10:1 BNC

* Options are factory installed upon order and cannot be customer retrofitted.

PM6680B/PM6681/PM6681R Timer/counter/analyzers

When ordering a PM6680B, PM6681 or PM6681R it is possible to order these products with a number of options. These are available as a individual options or can be supplied as a factory fitted option.

When ordering a factory fitted option add the relative figure to the option you require. All 3 digits must be complete when ordering.

For example: a PM6680B with a 2.7 GHz Input C **(6)**, Very high stability oven time base **(5)** and GPIB interface **(6)**. You would add the figures 656 to the initial code, i.e. PM6680B/**656.**

	Individual	Factory fitted											
Standard model		PM6680B/	0	1	6	PM6681/	0	1	6	PM6681R	0	7	6
Input frequency options													
1.3 GHz Input C	PM9621	PM6680B/	4			PM6681/	4			PM6681R	4		
2.7 GHz Input C	PM9624	PM6680B/	6			PM6681/	6			PM6681R	6		
Time base options													
Very high stability oven time base	PM9691	PM6680B/		5				5		PM6681R			
Ultra high stability oven time base	PM9692	PM6680B/		6				6		PM6681R			
Model number + fitted option		PM6680B/	_	_	6	PM6681/	_	_	6	PM6681R	_	7	6
Accessories													
Rear Panel Inputs	PM9611												
Rack Mount Kit	PM9622												
Carrying Case	PM9627B												
Heavy duty aluminium carrying case	PM9627H												
200 MHz 10:1 probe 1 MΩ/30 pF	PM9020												
2.3 GHz 500Ω probe set, 10:1 BNC	PM9639												
When ordering together with the basic counter, options are factory installed.													

PM6685/PM6685R Universal Frequency Counters

Lab performance you can take anywhere

- Calibrate frequency
- High resolution – 10 digits (1s gate time)
- Lowest frequency uncertainty – 0.0001 ppm (PM6685R)
- Short warm-up time – 10 minutes to $4x10^{-10}$
- 10 MHz buffered reference output
- Smart auto trigger system
- Measure on any type of input signal, including – bursts, AM, FM and noisy signals
- Built-in signal strength meter
- Ideal for on-site frequency calibration

With the PM6685 and PM6685R frequency counters and calibrators, Fluke offers the ultimate tools for laboratory as well as portable calibration of frequency. These counters are designed for on-site calibration of the master clock in mobile phone base stations, offering a TUR of >50 over a 10 year period. They also fit in the calibration lab or in manufacturing test systems where fast and accurate frequency measurements are needed.

On-site frequency calibration
The PM6685 frequency counter from Fluke brings cal lab accuracy to field measurements. With the (optional) ultra-stable oven timebase and a high 10 digits resolution in just one second, it delivers high-accuracy measurements instantly. An overflow mode displays also the 11th and 12th digits, when needed. The PM6685 is easy to use, compact and has a unique, smart automatic input triggering for any type of signal. A very short warm-up time of the oven oscillator, gives you ppb-performance after only 10 minutes.

PM6685R - The ultimate frequency counter/calibrator
The PM6685R from Fluke is the most accurate portable frequency calibrator on the market. It offers all the functionality of the PM6685, plus the stability and accuracy of a built-in Rubidium atomic reference. This instrument is ideal for high-accuracy frequency calibration, inside as well as outside the cal lab environment, such as in digital communication systems. The short warm-up time means that the PM6685R is instantly ready for use after a change of location. Ideal for calibration of GSM base station clocks.

The requirement for master clock calibration in base stations, can be fulfilled with both PM6685s. The PM6685 with oven oscillator has a lower purchase cost, but need occasional time base calibration and adjustment, whereas the PM6685R maintains a 50x margin to the GSM specification during 10 years without adjustment. The optional ovens in PM6685 are designed around the advanced SC-cut crystal oscillator. These have virtually no retrace, and a very short warm up period. In just 10 minutes the frequency is within $5x10^{-9}$ from the final value. The warm-up of the Rubidium oscillator version (PM6685R) is even faster; just about 5 minutes to reach $1x10^{-9}$. For protection during transport and storage, there is a carrying case available.

Dual displays - frequency and signal level
In traditional frequency counters, the user could not know whether the input signal strength was sufficient. The PM6685 and PM6685R simultaneously displays both signal frequency and signal level, eliminating the need to check signal levels with a separate instrument.

Smart automatic trigger
The PM6685/PM6685R analyze the actual input signal and sets optimum noise immunity and DC-offset and rejects influence of AM or FM. This ensures error-free triggering, irrespective of input signal waveform, duty factor, amplitude, noise, FM, AM or other disturbances. Further facilities to make operation easier include the digit blanking function, which suppresses the display of irrelevant digits when measuring unstable frequency sources. The PM6685 and PM6685R are built to handle a wide variety of measurements on e.g. continuous waves, non-repetitive events, radar bursts, TV signals, pulse trains and many other complex waveforms, with or without the use of external synchronization signals (external arming). There are many powerful facilities built-into the PM6685 and PM6685R for accurate measurements of burst frequencies and PRF (Pulse Repetition Frequency).

High-speed frequency measurements in test systems
In systems or GPIB-cluster applications, the PM6685/ PM6685R can measure and store up to 1600 frequency measurements per second in the internal memory. Fluke's PM6685 and PM6685R provide the ultimate in frequency measurement capabilities - Contact your local Fluke representative for more information or to arrange for a demonstration.

Specifications

Measuring functions

Frequency A, C
Range
Input A: 10 Hz to 300 MHz.
Input C:
Up to 1.3 or 3.0 GHz.
Resolution: 10 digits in 1 s measurement time.

Burst frequency A and C
PRF range (A): 1 Hz to 1 MHz.
PRF range (C):
1 Hz to 1 MHz.
Burst duration (A):
0.5 µs to 1.5 s.
Burst duration (C):
50 µs to 1.5 s.

Period A
Range: 6 ns to 100 ms.
Resolution:
10 digits/s measurement time.

Frequency ratio A/E, C/A
Range: 10^{-9} to 10^{9}.

Pulse width A
Range: 6 ns to 10 ms.
Frequency range:
50 Hz to 80 MHz.
Voltage range:
100 mVpp to 70 Vpp.

Duty factor A
Range: 0 to 1.
Frequency range:
50 Hz to 80 MHz.
Voltage range:
100 mVpp to 70 Vpp.

Totalize A
Event counting on input A with manual start and stop.
Range: 0 to 10^{17} 0 to 100 MHz.

Input and output specifications

Input A
Frequency range:
10 Hz to 300 MHz.
Coupling: AC.
Impedance:
1 MΩ/25 pF or 50Ω, VSWR < 2:1.
Max. sensitivity:
10 mVrms, <50 MHz.
Min. sensitivity:
50 mVrms, >200 MHz.
Manual trigger:
Sensitivity range:10 mVrms to 10 Vrms, in 3 dB steps.
Trigger level:
Selectable for duty factors <0.25, 0.25 to 0.75 and >0.75.
Auto trigger: Automatic level and sensitivity setting for optimum triggering on any waveform.
Frequency: Minimum 50 Hz.
Sensitivity range:
10 mVrms to 25 Vrms.
Signal monitor: 10 mVrms to 10 Vrms, in 3 dB steps.
Low pass filter: 100 kHz
Max. voltage without damage:
1 MΩ: 350V (dc + ac peak) at dc to 440 Hz, falling to 12 Vrms at 1 MHz and above.
50Ω: 12 Vrms.

Input C (Option PM 9621)
Range: 70 MHz to 1.3 GHz
Operating Input
Voltage Range:
70 MHz to 900 MHz:
10 mVrms to 12V rms
900 MHz to 1100 MHz:
15 mVrms to 12V rms
1100 MHz to 1300 MHz:
40 mVrms to 12V rms
Impedance:
50Ω, AC, VSWR <2:1

Max Voltage without Damage:
12V rms during 60s
Connector: BNC

Input C (Option PM 9624)
Range:
100 MHz to 3.0 GHz
Operating Input Voltage Range:
100 MHz to 300 MHz:
20 mVrms to 12V rms
0.3 GHz to 2.5 GHz:
15 mVrms to 12V rms
2.5 GHz to 2.7 GHz:
20 mVrms to 12V rms
2.7 GHz to 3.0 GHz:
100 mVrms to 12V rms
Impedance:
50Ω, AC, VSWR <2.5:1
Max Voltage without Damage:
12V rms during 60s
Connector: Type N Female

Rear panel inputs and outputs:
Reference input:
10 MHz , >200 mVrms.
Reference output: 10 MHz, sine, >0.5 Vrms into 50Ω load.

Input E: Used in ratio A/E and external arming/gating modes.
Frequency range:
DC to 80 MHz.
Trigger level:
TTL level, 1.4V nominal.
Analog output:
0.00 to 4.98V in 20 mV steps; proportional to 3 selected display digits. (Available only when GPIB option - PM9626B is installed).

Auxiliary functions

External arming/external gate
An external signal on input E can be used to inhibit start and/or stop triggering. Stop arming is not applicable to pulse width and duty factor measuring modes.
Start arming delay: OFF or 200 ns to 5 s in 100 ns steps.

Nulling/frequency offset
Nulling enable measurements to be displayed relative to a previously measured value or any frequency offset value entered via front panel keys.

Other functions
Measure time: Single cycle, 100 ns to 15 s.

Display hold:
Freezes measuring result, until a new measurement is initiated via restart.
Display overflow: Display of the 11th and 12th digits.
Blanking: Least significant digits can be blanked.
Save/recall:
19 complete instrument settings.
10 settings can be user protected.
Display: LCD with high-luminance backlight.
Number of digits:
10 digits plus exponent.
Bar graph: Displays input signal level or sensitivity setting in 3 dB steps from 10 mVrms to 10 Vrms.
Auxiliary menu: Gives access to additional functions.

GPIB
Compatibility:
IEEE 488.2-1987, SCPI
Max. Measurement rate to internal memory:
up to 1600 readings/s*.
Internal memory capacity:
up to 2600 readings*.
Data output: ASCII, IEEE double precision floating point.
* depending on measurement function and internal data format

General specifications

Environmental conditions
Temperature
Operating: 0°C to +50°C.
Storage: -40°C to +70°C.
Vibration: 3G at 55 Hz per MIL-T-28800D, Class 3, Style D.
Shock: Half-sine 40G per MIL-T-28800D, Class 3, Style D. Bench handling. Shipping container.

Safety: CSA 22.2 No. 231, EN 61010-1, Cat II, pollution degree 2, CE.
EMC: FCC Part 15J class A, EN 55011-1, EN 50082-2, CE.

Power line requirements (at 25°C)
AC voltage:
PM6685:
90 to 264 Vrms, 47 to 440 Hz.
PM6685R:
90 to 264 Vrms, 47 to 63 Hz.
Power rating:
PM6685: max 30W.
PM6685R: max 100W during warm-up (5 min.) max 47W (continuous operation).

Dimensions and weight

W x H x D:
PM6685: 210 x 86 x 395 mm (8.25 x 3.4 x 15.6 in).
PM6685R: 315 x 86 x 395 mm (12.4 x 3.4 x 15.6 in).
Weight PM6685: Net 3.2 kg (7 lb) shipping 7 kg (15 lb).
Weight PM6685R: Net 5.5 kg (12 lb) shipping 8.8 kg (19 lb).

Ordering information

When ordering a PM6685 or PM6685R it is possible to order these products with a number of options. These are available as a individual options or can be supplied as a factory fitted option.

When ordering a factory fitted option add the relative figure to the option you require. All 3 digits must be complete when ordering.

For example: a PM6685 with a 2.7 GHz Input C **(6)**, Ultra high stability oven time base **(6)** and a Battery unit **(3)**. You would add the figures 663 to the initial code, i.e. PM 6685/**663.**

	Individual	Factory fitted							
Standard model		PM 6685/	0	1	1	PM6685R/	0	7	1
Input frequency options									
1.3 GHz Input C	PM9621	PM 6685/	4			PM6685R/	4		
2.7 GHz Input C	PM9624	PM 6685/	6			PM6685R/	6		
Time base options									
Standard time base		PM 6685/		1		PM6685R/		7	
Very high stability oven time base	PM9691	PM 6685/		5					
Ultra high stability oven time base	PM9692	PM 6685/		6					
Battery unit and GPIB interface options									
Standard		PM 6685/			1	PM6685R/			1
Battery unit	PM9623	PM 6685/			3				
GPIB interface*		PM 6685/			6	PM6685R/			6
Model number + fitted option		PM 6685/	_	_	_	PM 6685R/	_	7	_
Accessories									
Rack Mount Kit	PM9622								
Carrying Case for PM6685	PM9627								
Heavy duty aluminium carrying case	PM9627H								
200 MHz 10:1 probe 1 MΩ/30 pF	PM9020								
2.3 GHz 500Ω probe set, 10:1 BNC	PM9639								

*GPIB-Interface includes Analog Output.
Options ordered separately can be customer fitted.

FLUKE

908/909 Frequency References

Stable frequency references for test systems and calibration laboratories

Models 908 and 909 frequency Standards are designed for use as accurate reference clocks in automated test-systems and as in-house frequency standards. Because they require only a short warm-up time to reach specified stability, they can also be used as portable frequency standards. The 909 includes an ultra-stable Rubidium timebase ("atomic clock"), while the 908 is built around a high-stability oven-controlled SC-cut crystal oscillator. Both instruments provide five buffered 10 MHz outputs plus one 5 MHz output. Option 70 increases the number of 10 MHz outputs to ten.

Ideal for automated test (ATE) systems
Many production test systems, particularly in the telecommunications industry, require a stable external frequency clock as a reference. Depending on your needs, either the 908 or the 909 can supply a stable frequency reference to up to 11 other instruments and testers, making them ideal for use in an ATE system. In addition a Rack Mount Kit is available.

Model 909
The Rubidium version, with its negligible aging drift needs in practice no adjustment during the life time of the test system.

Model 908
With its high-stability oven-controlled SC-cut crystal oscillator offers the lowest purchase cost per output on the market in the 11 output version (option 70 installed).

In-house frequency standards
Models 908 and 909 are ideal for use in calibration laboratories where there is a need to calibrate a wide range of instruments, such as frequency counters and synthesizers. Unlike off-air frequency receivers, 908 and 909 have very-high short-term stability that enables much faster frequency calibration. Companies that require frequency standards in numerous departments spread over several buildings will find that a local Rubidium standard (909) normally offers a more cost effective solution than a central reference with a costly distribution system.

Made for portability
Models 908 and 909 are designed for portability. They perform exceptionally well as transportable fast-warm-up frequency references. Traditionally, oven oscillators using AT-cut crystal could not maintain their specification without continuous battery back-up during transportation to different sites. This is because AT-cut crystals suffer from significant frequency retrace (frequency offset after a power interruption). They also need a very long warm-up time, 24 hours or more, to arrive at the final frequency value. Model 908's oven oscillator is designed around the more advanced SC-cut crystal oscillator which has virtually no retrace. In just 10 minutes the frequency is within $5x10^{-9}$ of the final value, meaning it can be in service faster. Finally, there is no need for battery back-up during transportation. The warm-up of the 909 Rubidium oscillator is even faster, taking only 10 minutes to reach as close as $4x10^{-10}$ from the final frequency. For protection during transport and storage, there is a carrying case available.

908/909 Frequency References

Frequency Stability

Stability	908 (Oven)	909 (Rubidium)
Ageing per month	3 x 10^{-9}	5 x 10^{-11}
Ageing per year (per 10 years)	< 2 x 10^{-8} (1 year)	1 x 10^{-9} (10 years)
Temperature: (20°C to 26°C)	< 4 x 10^{-10} typ.	2 x 10^{-11} typ.
(0°C to +50°C)	2.5 x 10^{-9}.	3 x 10^{-10}
Short term (root Allan variance)	5 x 10^{-12} t=10s	1 x 10^{-11} t=10s
	5 x 10^{-12} t=1s	3 x 10^{-11} t=1s
Warm-up (at +25°C)	10 mins. to 5 x 10^{-9}	5.4 mins. to lock 11 mins. to 4 x 10^{-10}

Models 908 and 909 provide stable, cost effective solutions for your frequency reference requirements whether in ATE, laboratory or portable applications.

Specifications

Reference outputs

Base model: 5 x 10 MHz, 1 x 5 MHz: sine >0.6 Vrms in 50Ω.
With option 70:
10 x 10 MHz, 1 x 5 MHz: sine >0.6 Vrms in 50Ω.

Environment
Temperature:
0°C to +50°C (operating).
-40°C to +70°C (storage).
Safety:
Compliant to EN 61010-1, Cat II, pollution degree 2 CE.
EMI:
Compliant to EN 55011 ISM group, class B, EN 50082-2, CE.

Power consumption (90-264V, 47-63 Hz)
908: <20W at warm up, < 7W continuous operation.
909: <70W at warm up, <30W continuous operation.

Dimensions and weight
W x H x D: 315 x 86 x 395 mm.
Weight:
4.8 kg (net), 7.8 kg (shipping).

Ordering information

908: Crystal oven; 5 x 10 MHz and 1 x 5 MHz outputs.
908-70: Crystal oven; 10 x 10 MHz and 1 x 5 MHz outputs.
909: Rubidium; 5 x 10 MHz and 1 x 5 MHz outputs.
909-70: Rubidium; 10 x 10 MHz and 1 x 5 MHz outputs.

Included accessories
Operators manual and calibration certificate.

Optional accessories
PM9622: Rack Mounting Kit.
PM9627B: Carrying Case.
PM9627H:
Heavy Duty Aluminium Carrying Case.

FLUKE

910/910R GPS-Controlled Frequency Standards

The cesium controlled frequency standard that uses GPS technology and connectivity to provide primary standard traceability from any location

The 910 and 910R GPS-controlled frequency standards deliver a precision frequency and time reference which, with its many connectivity options, can be installed, monitored and managed from virtually any location. Both models receive their long-term frequency stability from the built-in cesium standards in the GPS-satellite array, yet can also provide a very high short-term stability from the built-in oven controlled crystal oscillator (OCXO) or rubidium standard (Rb).

Both the 910 and 910R are fully traceable and extremely accurate frequency standards and are ideally suited for use as frequency standards in many applications, including telecommunications, calibration and automatic test systems.

Unique traceability feature means no more re-calibrations
Off-air frequency standards have existed for several years. But until now, they all have had the same internal architecture (figure 1). The unit is, in effect, a "black box," with an antenna input and a frequency output.

The local oscillator's control process (disciplining) is hidden from the user. Typically, users have used another frequency reference (for example, a rubidium standard), a timer/counter and a PC for logging the deviation between the "black box" and the frequency reference.

The concept of traceability requires an unbroken chain of comparisons to international standards, on a continuing basis, where all comparisons produce documented results with stated uncertainty.

Now, for the first time, a documenting frequency comparator and a very stable secondary standard are united within the same instrument together with the GPS receiver.

The received GPS signal is measured continuously against the local oscillator. Phase and frequency deviation is stored internally and can at any time be transferred to any PC directly from the 910/910R or, via the optional Ethernet interface, from or to almost anywhere. Then by using the GPSView ™ software supplied with every model, a printout of the traceability record can be obtained. The unbroken calibration history chain - day by day - is maintained in the non-volatile memory for several years, with the current 24-hour mean offset being displayed continuously on the front panel's LCD display.

Such unique traceability to primary standards means that the 910 and 910R never need to be away for re-calibration. Thanks to this design, the very high stability built-in rubidium or OCXO oscillator is continuously calibrated to the primary frequency standards in the US Naval Observatory and ultimately to UTC, in whatever operating mode, disciplined or manual hold-over.

Two high-stability models to meet your application, and fit your budget
Fluke offers two standard models in its controlled frequency standards range; the very-high stability 910R with its built-in rubidium atomic clock as the local oscillator, and the affordable 910 with its high stability local oven controlled crystal oscillator.

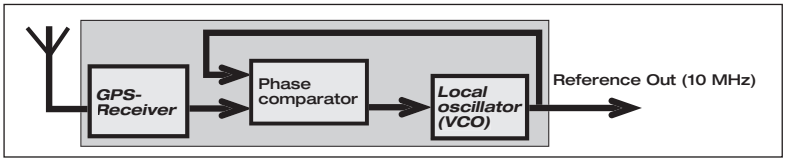


Figure 1. A typical "black box GPS receiver" (antenna in - reference out).
Internal oscillator offset adjustments are invisible to the user.

910/910R GPS-Controlled Frequency Standards

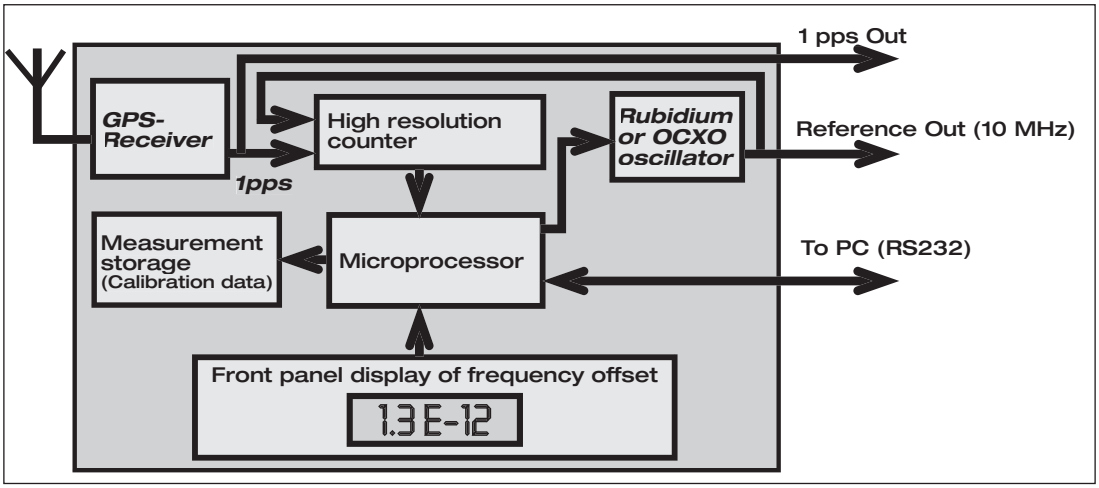


Figure 2. The Fluke 910 and 910R have built-in comparison between the GPS receiver and the internal oscillator. The frequency offset is displayed and stored and a traceability record can be produced at any time.

Up to 13 outputs, maximizing cost efficiency

Both models come with one 5 MHz and five 10 MHz sinewave outputs as standard. A 1 pulse-per-second output is also included.

If your application requires more outputs - for example, if several other instruments need to be supplied from the same frequency standard - option 70 allows you to mount five more 10 MHz outputs. Alternatively, option 72 allows you to expand your instrument to give five extra 2.048 MHz outputs, which is particularly useful in many telecoms applications. Option 73 provides five extra 13 MHz outputs, the standard frequency for GSM base station master clocks. Another variant on output configuration is offered through option 71, which gives the instrument an additional four sine wave outputs of 10 MHz, 5 MHz, 1 MHz and 0.1 Hz, plus a 0.1 MHz square wave output.

And finally, option 75 allows you to define your own pulse frequency output.

Central or remote monitoring, management and data collection, using the 910/910R Ethernet-port

The 910 and 910R can both be fitted with an optional Ethernet communication interface (Option 76) which enables on-line access. Using the GPSView™ software supplied, it is possible to monitor both instrument and GPS status, or even collect cali-bration data, via the internet or any Local Area Network.

With Ethernet interface connectivity, distances to which data can be transmitted become unlimited, unlike that of any standard GPIB or RS232 interface, thereby allowing the 910/910R to be monitored from practically anywhere.

This means that the metrologist or lab technician no longer requires a 'floating' laptop PC to directly perform instrument management tasks, as this can now be achieved from any desktop PC, from any location inside or outside the calibration laboratory. It also allows data from multiple instruments to be simultaneously viewed in real time.

Liberate your GPS controlled frequency standard with the FL-15 GPS Antenna Fiber Link

Until now, the location of every off-air frequency standard has been governed by the location of its antenna and the limiting length and thickness of the coaxial cable between the antenna and the instrument. Frequently, this has meant that the instrument has been inconveniently positioned within the lab, or even outside the controlled environment of the calibration laboratory.

The FL-15 GPS fiber link eliminates this problem and allows the user to position the instrument practically anywhere. The low loss (0.4 dB/km) lightweight fiber optic link means that the distance between antenna and instrument can be as much as 10 km. What's more, the highly flexible, lightweight fiber optic cable has a very small cable diameter and can fit into virtually any cable pipeline.

Consisting of a fiber optic link for the GPS signal, and transmitter and receiver modules, the FL-15 package also provide the 910 and 910R immunity to electrical interference, such as lightning

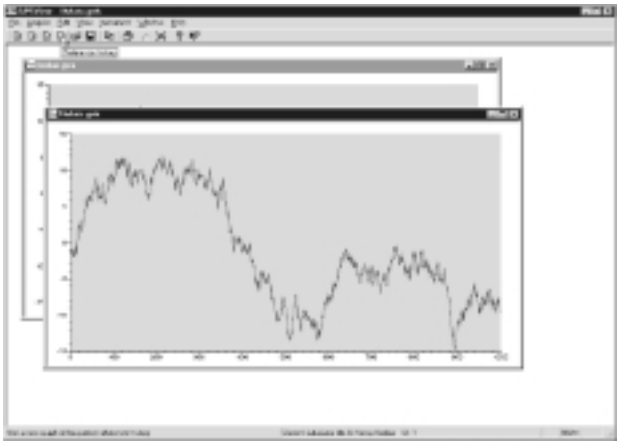


Figure 3. GPSView can print a calibration protocol at any time

strikes and EMP interference as well as electrical isolation between antenna and receiver module.

Two high-stability operating modes to suit your application
Most users prefer automatic adjustment (known as disciplining) of their frequency standard, to fully eliminate long-term frequency changes (aging). This disciplined mode is also the default mode in the 910 and 910R. As long as there is a valid satellite signal, the internal local oscillator is monitored and adjusted and the mean 24-hour frequency offset is always virtually zero. However, in this mode, the inherent short-to-medium term stability of all local oscillators, except rubidium, is compromised. This is true for all GPS frequency references. The received GPS signal has relatively large short-term frequency variations, due to variations in atmospheric conditions. This means that when using the received GPS signal for disciplining, the stability is reduced a little for averaging times of 100 s to 1000 s.

In this mode, the frequency deviation between the internal timebase oscillator and the received GPS-signal is used to continuously adjust the oscillator (disciplining). The resulting frequency offset and adjustment data is stored in non-volatile memory every 24h, to enable printout of the traceability record. The actual frequency offset (24h mean value) is calculated and displayed on the front panel.

Some applications demand superior short-medium term stability, especially for jitter and wander measurements in digital telecommunication networks.

The unique manual hold-over mode makes it possible to switch over temporarily from disciplined to hold-over mode during the actual measurement, thereby achieving a superior frequency accuracy at the start of the measurement and a superior stability through the measurement.

Here, the internal oscillator is not adjusted. This mode is normally automatically entered when there is no usable received GPS-signal. This mode can also be selected manually by activating the Manual Hold-Over Key. If Manual hold-over is set together with a valid received GPS signal, the actual frequency offset is calculated, displayed and stored in non-volatile memory every 24 hours.

For the ultra-stable rubidium oscillator in the 910R, there is no measurable difference between the stability in disciplined and hold-over mode, for averaging times up to 1000s.

Designed for portability too
When using manual hold-over mode, the 910 or 910R act as a stand-alone OCXO or rubidium frequency standard. This means that one typical drawback of a GPS receiver, lack of portability, is eliminated. A typical GPS receiver needs hours to lock after a change of location, whereas the 910 and 910R are up and running after just ten minutes.

GPSView Software
GPSView is a Windows 95/98/2000/NT program that communicates with the GPS-controlled frequency standard. Its main purpose is to provide a traceable calibration document based on the 24 hour frequency offset values, internally stored in the non-volatile memory of model 910/910R (figure 3).

It is only necessary to download data to a PC to the 910/910R once every second year to obtain an unbroken traceability chain since first use. For performance analysis over a shorter period and for short-term phase variation, data can be obtained over the latest forty-day period.

From GPSView, the user can control the operating mode (Disciplined or Hold-Over), and lock the front panel to prevent unintended change via the Manual Hold-Over Key. The user can also set the optional pulse output frequency and duty cycle.

GPSView can perform the following tasks:

- **Transfer of archived data from non-volatile memory in Model 910/910R**
  24 h frequency offset values, updated once per 24 h (2 years of data, with normal usage)

  Daily adjustment control voltage values (2 years of data)
- **Transfer of stored data from volatile memory in Model 910/910R**
  1 h frequency offset values, updated every 15 minutes (approx. 1 week of data)

  24 h frequency offset values, updated every 15 minutes (approx. 1 week of data)

  Phase deviation every 30 s (approx. 2 days of data)

  Phase deviation every 60 min (approx. 40 days of data)
- **Maintenance of instrument data base (based on updates every 40 days)**

  Print-out of
  Traceable calibration report protocol any graph.

  Position
  Latitude, longitude altitude

  Time-of-day
  Including time zone
- **GPS status**
  No. of satellites (tracked and predicted visible)

  Satellite status (Satellite ID, signal quality, elevation, azimuth, etc.)

  Position state (Hold or survey)

  Lock status (locked/unlocked)
- **Transfer of control commands to model 910/910R**
  Setting display option (time-of-day or frequency offset)

  Setting time zone

  Setting communications parameters (IP address, COM port, baud rate etc)

  Setting satellite elevation mask angle

  Setting antenna cable delay

  Setting the pulse output period and width (opt. 75)

  Setting instrument parameters

  Toggling between Hold-over or Disciplined mode

  Local lockout of front panel buttons.

  Performing internal self-tests

  Restart of instrument
- **Graphical display (x-t graphs)**
  24 h frequency offset vs. time ("frequency history").

  Adjustment history.

  Phase deviation every 30 s (volatile data).

  Phase deviation every 60 min (vol. data).

  1 h frequency offset (volatile data)

  24 h frequency offset (volatile data)

Specifications

910R (GPS-Rb)

Frequency stability - locked to GPS

Frequency offset (24h mean):
$<1 \times 10^{-12}$*
Short term (Allan dev.):
$<1 \times 10^{-12}$ (τ = 1000 s)
$<3 \times 10^{-12}$ (τ = 100 s)
$<1 \times 10^{-11}$ (τ = 10 s)
$<3 \times 10^{-11}$ (τ = 1 s)
Warm up (+25 °C):
20 mins to lock
*At temperature 23 °C ±3 °C

Frequency stability - Hold-Over
Aging/24h: $<2 \times 10^{-12}$ (typ.)
Aging/month: $<5 \times 10^{-11}$
Temp. (0 °C...+50 °C): $<3 \times 10^{-10}$
Temp. (23 °C ±3 °C):
$<2 \times 10^{-11}$ (typ.)
Short term (Allan dev.):
$<3 \times 10^{-12}$ (τ = 100 s)
$<1 \times 10^{-11}$ (τ = 10 s)
$<3 \times 10^{-11}$ (τ = 1 s)
Warm up (+25 °C):
10 minutes to 4×10^{-10}

Phase noise

Offset	*Phase noise*
1 Hz	-80 dBc/Hz (typ.)
10 Hz	-90 dBc/Hz (typ.)
100 Hz	-130 dBc/Hz (typ.)
1 kHz	-140 dBc/Hz (typ.)
10 kHz	-140 dBc/Hz (typ.)
100 kHz	-145 dBc/Hz (typ.)

910 (GPS-OCXO)

Frequency stability - locked to GPS
Frequency offset (24h mean):
$<2 \times 10^{-12}$ *
Short term (Allan dev.):
$<5 \times 10^{-11}$ (τ = 1000 s)
$<3 \times 10^{-11}$ (τ = 100 s)
$<5 \times 10^{-12}$ (τ = 10 s)
$<5 \times 10^{-12}$ (τ = 1 s)

Warm up (+25 °C):
20 mins to lock
*At temperature 23 °C ±3 °C

Frequency stability - Hold-Over
Aging/24h: <3 x 10^{-10}
Aging/month: <3 x 10^{-9}
Temp. (0 °C...+50 °C): <2.5 x 10^{-9}
Temp. (23 °C ±3 °C):
<4 x 10^{-10} (typ.)
Short term (Allan dev.):
<5 x 10^{-12} (τ = 100 s)
<5 x 10^{-12} (τ = 10 s)
<5 x 10^{-12} (τ = 1 s)
Warm up (+25 °C):
10 minutes to 5 x 10^{-9}
Phase noise

Offset	*Phase noise*
1 Hz	-100 dBc/Hz (typ.)
10 Hz	-120 dBc/Hz (typ.)
100 Hz	-130 dBc/Hz (typ.)
1 kHz	-135 dBc/Hz (typ.)
10 kHz	-135 dBc/Hz (typ.)
100 kHz	-135 dBc/Hz (typ.)

Common

Reference outputs (BNC)
10 MHz:
Sine wave, 0.6 V rms into 50 Ω
5 MHz:
Sine wave, 0.6 V rms into 50 Ω
1 pps: TTL-levels; low < 0.4 V, high > 2 V into 50 Ω load.
Pulse output (opt. 75): TTL-levels; low < 0.4 V, high > 2 V into 50 Ω load

10 MHz and 5 MHz outputs
Freq. Stability: See frequency stability specs for 910 and 910R

1-pps output (locked to GPS)
Duty cycle: Approx. 20 %
Jitter: <60 ns rms relative to UTC or GPS (position hold, SA on)

5 additional 10 MHz outputs (option 70)
See specification for 10 MHz above

Multiple reference outputs (option 71)
Sine wave outputs: 10, 5, 1 and 0.1 MHz >1 Vrms into 50 Ω
Pulse output: 0.1 MHz; >3 Vp-p into 50 Ω
0 V ≥LO <0.8 V, 3 V<HI ≥5 V

5 additional 2.048 MHz outputs (option 72)
Frequency:
2.048 MHz square wave
Output level: -1.2 V to +1.2 V ±10 % into 75 Ω (G.703:10)
Jitter: <0.01 UI

5 additional 13 MHz outputs (option 73)
Output signal: TTL (symmetrical)
Typical levels into 50 Ω:
High voltage: 2.35V
Low voltage: 0V
Jitter: < 0.01 UI
Long term stability: Same as main reference

Pulse output (option 75)
The frequency and duty cycle are set via the included PC-program
Selectable frequency:
1/N x 10^{-7} Hz;
N is an integer
Factory default setting: 1 Hz
Jitter: <500 ps rms
Freq. Stability: See frequency stability specs for 910 and 910R

Ethernet interface (option 76)
Communication Port:
Connector: RJ45
Protocol: 10Base-T
Buffer RAM: 1 kbit
Configuration Port:
Connector: Dsub9, RS232

Internal data storage
24h-freq. Offset: 2 years data, Non-volatile memory
Adjustment data: 2 years data, Non-volatile memory
Phase data (TIE): 40 days data, Volatile memory

LED indicators
Locked to GPS, Alarm, Manual Hold-over

Display indicators
7-segment area:
24h mean freq. Offset (if valid data exist)
Time of day (if GPS gives valid time)
"910" or "910R" (if GPS contact not sufficient)
Alarm text (plus Alarm LED)
REMOTE segment: Local Lock-out (from PC):
Analog bar graph: Satellite signal strength

GPS-receiver
Antenna connector: Type N
Channels: 8, parallel tracking
Carrier, code: L1, C/A

Antenna (option 01)
Type: active L1
Operating temp.:
-40 °C to +70 °C
Height: 81 mm (3.2") (excl.connector)
Weight: 230 g (8 oz.)
Gain: >30 dB
Connector: TNC

Antenna cable (option 02/20, option 02/50)
Type: RG213
Length: 20 m (02/20), 50 m (02/50)
Connectors: N-type and TNC (male)
Cable delay: 101 ns (02/20), 251 ns (02/50)
Attenuation:
Approx. 8 dB at 1.6 GHz (02/20)
Approx. 20 dB at 1.6 GHz (02/50)

FL-15 (GPS antenna fiber link)
Bandwidth:
<950 MHz to >1750 MHz
Gain Flatness: ±1 dB
Dynamic Range:
Input third order intercept: >+10 dB
Input P1 dB: >0 dBm

PC-connection
Interface: RS232, DTE

Environmental
Temperature:
0 °C...+50 °C (operating)
-40 °C...+70 °C (storage)
Safety: Compliant to CE: EN 61010-1 + A1 (1992) + A2 (1995)
EMI: Compliant to CE: EN 61326-1 (1997)

Power consumption
Line voltage: 100...240 V (±10 %)
Line frequency: 47..63 Hz
Power 910R: <75 W at warm-up
<35 W continuous operation
Power 910: <25 W at warm-up
<12 W continuous operation

Dimensions and weight
WxHxD: 315 x 86 x 395 mm
12.4" x 3.4" x 15.6"
Weight:
910R 4.4 kg (net), 7.4 kg (shipping)
9.7 lb (net), 16.3 lb (shipping)
910 3.9 kg (net), 6.9 kg (shipping)
8.6 lb (net), 15.2 lb (shipping)

Ordering information

910: GPS-Controlled OCXO Frequency Standard. 5 x 10 MHz and 1 x 5 MHz outputs

910R. GPS-Controlled Rubidium Frequency Standard. 5 x 10 MHz and 1 x 5 MHz outputs

910X-70. 5 additional 10 MHz outputs

910X-71. Multiple reference outputs - 0.1 MHz, 1 MHz, 5 MHz and 10 MHz sinewave outputs, plus a 0.1 MHz squarewave output

910X-72. 5 additional 2.048 MHz outputs

910X-73. 5 additional 13 MHz outputs

910X-75. 1 additional pulse output 0.5 Hz...5 MHz

910X-76. Ethernet interface

Included accessories
Operators manual, Calibration certificate, GPSView Software

Optional accessories
910X-50: Rack Mount Kit

910X-60: Carrying Case

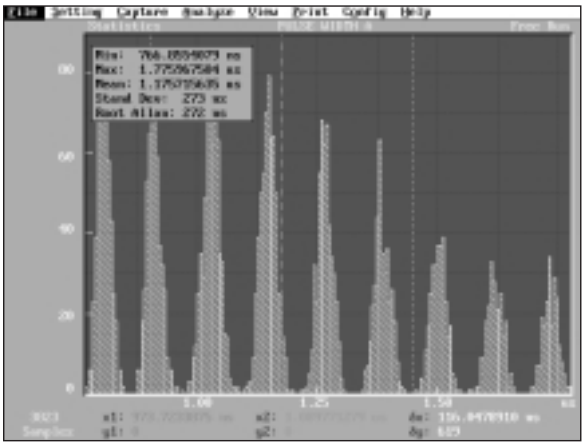
910X-01: GPS Antenna

910X-01/50: GPS Antenna Mounting Kit

910X-02/20: Antenna Cable, 20 m

910X-02/50: Antenna Cable, 50 m

910X-FL-15: GPS Antenna Fiber Link



The distribution of the pulse width of the 9 different CD symbols.

- View dynamic frequency variations over time
- Measure timing jitter
- Create histograms for distribution analysis of jitter
- Perform FFTs of frequency variations for modulation analysis
- Collect, graph, store, recall and print measurement data

Turn the PM6681 counter/timer into a high-performance modulation domain analyzer

TimeView™ lets you view signal characteristics that you have never seen before, like VCO output frequency step response, frequency sweep characterization, frequency hopping transitions, unwanted line voltage modulation of high-stability clocks, frequency dynamics of phase locked loops, statistical jitter analysis and much more.
These powerful analysis functions are very easy to access, thanks to an intuitive user interface with pull-down menus, pop-up dialogue boxes and extensive context-sensitive help screens.

View data in different ways
The PM6681 timer/counter/analyzer perform very fast frequency measurements that are stored in the counter's internal memory. TimeView™ receives the stored data and presents the frequency variations over time (f vs. t). TimeView™lets you view signal characteristics that you have never seen before, like VCO output frequency step response, frequency characterization, frequency hopping transitions, unwanted line voltage modulation of high-stability clocks, statistical jitter analysis, FM analysis and more.

View signal waveform like an oscilloscope
TimeView software, along with the unique vertical sampling methods employed by the PM6681, results in an oscilloscope-like waveform monitor.

File storage and hard copy output
TimeView™ lets you store captured data on disk for later analysis. You can make hard copy output of any TimeView™ graph with most popular dot matrix, ink-jet or laser printers.

Specifications

Data capture modes

- Free running measurements
- Repetitive sampling measurements
- Continuous back-to-back period measurements

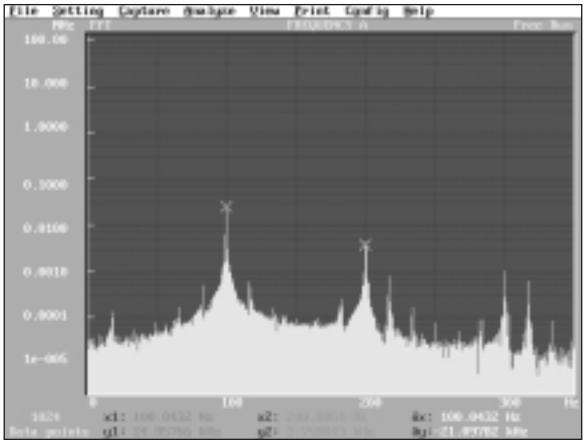
Maximum samples/s (PM6681)
Free running mode: 8000.
Repetitive sampling mode: Up to 10 MHz.
Continuous back-to-back period measurements: 40 k/s.

Data analysis features

- Time variation graph (measurement data vs. time)
- Smoothing in time variation
- Distribution histogram
- Statistics parameters: max., min., mean, standard deviation, root Allan variance
- FFT graph
- Cursor zoom and cursor measurements in all graphs

Sample size
Max. 6143 (PM6681, PM6681R)
Max. 2048 (PM6680B, PM6685, PM6685R).

TimeView™ Software



FFT analysis graph reveals modulation due to insufficient regulation of the 50 Hz power supply.

System requirements

Computer:
IBM PC or compatible.
Monitor: VGA/EGA.
GPIB interface card:
National Instruments PC-IIA or capital equipment (CEC).
Printer: Most popular dot matrix inkjet or laser printers.
Timer/counters:
Fluke PM6681, PM6681R, PM6680B, PM6685 or PM6685R.
Diskette format: 3.5 inch.

Ordering information

TimeView™
Included as standard with PM6681/81R. Limited versions for PM6680B and PM6685/85R are available, with reduced functionality (not supported versions). This software is not available as a stand alone offering.

FLUKE

Data Acquisition

Section 3

Contents

Obtaining accurate data when and where you want it and in a form you can use is a universal goal. Fluke Corporation responds to this challenge by offering reliable and quick data acquisition tools that adapt to your needs, giving you a broad choice of how you collect and transfer data for process monitoring and laboratory test systems. You can choose a stationary or portable system. Transfer data to internal memory, to a removable memory card, or to your PC. Choose a standalone or distributed networked units. And you can expand your system from 20 to 2,000+ channels, depending on the series.

The Fluke **2680 Series** delivers the precision necessary for meticulous lab work along with the rugged flexibility to meet the ever-changing needs of industrial applications. Run one standalone data logging system with 20 to 120 universal channels or connect several networked data acquisition systems to serve 2,000+ channels on your LAN.

The portable Fluke **Hydra Series** transfers data to internal memory (Hydra Data Logger), to a removable memory card (Hydra Data Bucket), or directly to your PC (Hydra Data Acquisition Unit).

Distributed Fluke **NetDAQ**® units plug right into your existing networks to send data directly to a PC. This saves the cost of setting up a new network and allows multiple users to simultaneously view data in real time. NetDAQ units can also be used as a portable dedicated system connected to a notebook computer for maintenance, product validation, research, and troubleshooting applications.

NetDAQ

Hydra Series

2680 Series

Selection guide

	Hydra Series 2620A	Hydra Series 2635A	NetDA 2640A
Measurement			
Thermocouples	9 Types	9 Type	9 types
RTDs 100 Pt. 385	100 Pt. 385	100 Pt. 385	100 Pt. 385
Resistance	To 10 MΩ	To 10 MΩ	To 3 MΩ
DC Voltage Ranges	100 mV-150V[2]/300V[1]	100 mV-150V[2]/300V[1]	90 mV-150/300V[3]
Max DC Resolution	1 µV	1 µV	1 µV
AC Voltage Ranges	300 mV-150V/300V[1]	300 mV-150V/300V[1]	300 mV-150V/300V[3]
DC current[4]	4-20 mA	4-20 mA	4-20 mA
Status (contacts)	Yes	Yes	Yes
Counter	To 1 MHz	To 1 MHz	To 1 MHz
Event Totalize	Yes	Yes	Yes
Outputs			
Status or alarms (# of chs)	12	12	8
Features			
Analog input Channels (maximum)	21	21	400
Basic accuracy (Vdc)	0.01%	0.01%	0.01%
Speed (channels/sec)	4/17	4/17	6/40/100
Instrument Setup and Operation	Front Panel or Computer	Front Panel or Computer	Computer
RS-232C/IEEE-488/ Ethernet	Std/Opt/NA	Std/NA/NA	NA/NA/Std
12 Vdc Operation	9-16 Vdc	9-16 Vdc	9-16 Vdc
Graphics	Via Host	Via Host	Via Host
Permanent data Storage	Host	PC Card	Host
Battery back-up	Program, clock, data	Program, clock, data	Program, clock
PC application Software[5]	Yes	Yes	Yes

1 300V from front panel and channels 1 and 11
2 100 mV range available for thermocouple measurements and dc volts measurements when under computer control. 300 mV range is minimum front panel selectable range.
3 300V channels 1 and 2
4 With 2620A-101, 10Ω Shunt set (12 each)
5 Download fully functional data acquisition demonstration software free at www.fluke.com
6 Via 2680A/2686A chassis

Q Series 2645A	2680 Series 2680A-DIO	2680A-PAI	2680A-FAI
9 types	-	11 types	11 types
-	100 Pt.	100 Pt.	
To 3 MΩ	-	To 3 MΩ	To 3 MΩ
90 mV-50V	-	90 mV-50V	90 mV-50V
10 µV	-	1 µV	10 µV
300 mV-30V	-	300mV-150V/300V[3]	300 mV-30V
4-20 mA	-	4-20 mA	4-20 mA
Yes	-	Yes	Yes
To 1 MHz	-	To 1 MHz	To 1 MHz
Yes	-	Yes	Yes
8	20 DIO 8 Relay	-	-
400	-	120 per chassis 2000 per system	120 per chassis 2000 per system
0.02%	-	0.01%	0.02%
45/200/1000	-	4/40/1000	45/200/1000
Computer	Computer	Computer	Computer
NA/NA/Std	Ethernet[6] 10/100 baseT	Ethernet[6] 10/100 baseT	Ethernet[6] 10/100 baseT
9-16 Vdc	9-45 Vdc	9-45 Vdc	9-45 Vdc
Via Host	Via Host	Via Host	Via Host
Host	-	Host/PC Card	Host/PC Card
Program, clock	-	Yes	Yes
Yes	Yes	Yes	Yes

2680 Series Data Acquisition Systems

Unyielding lab precision, with rugged industrial flexibility

Standalone or networked precision multi-channel DAQ

- 120-channel capacity chassis
- User-scalability from 20 to 120 universal analog input channels
- Can include digital input/output and alarm contact outputs in a single chassis Ethernet TCP/IP protocols provide a network interface to 10/100 BaseT
- Powerful reporting, HMI development software and OPC server software available

The Fluke 2680 Series delivers the precision necessary for meticulous lab work along with the rugged flexibility to meet the ever-changing needs of industrial applications.

Run one standalone data logging system with 20 to 120 universal channels or connect several networked data acquisition systems to serve 2,000+ channels on your LAN.

Two basic chassis models are available. The 2680A Data Acquisition System is a front-end style chassis for multi-channel applications requiring reliable Ethernet communications. The Fluke 2686A Data Logging System writes data to a memory card, making it ideal for remote locations and mobile or non-computer assisted data logging applications.

Both chassis models feature six slots. Five slots are available for any combination of 20-channel analog input modules. The sixth slot is reserved for a digital I/O relay module to add control capabilities to your system, or for an additional input module.

Choose the modules you need for your application

The 2680A-FAI Fast Analog Input module provides chassis

throughput rates of more than 1,000 channels-per-second. Specially manufactured field effect transistors (FETs) allow up to ± 50 V input, well above the 15 V industry norm, and channel-to-channel isolation to give you more confidence in the integrity of your measurements.

The Fluke 2680A-PAI Precision Analog Input 20-channel high precision, high isolation module offers 300 V of isolation on two channels and 150 V on 18 channels, as well as 18-bit resolution and excellent thermocouple accuracy, all in a scalable system.

Both the 2680A-FAI and the 2680-PAI modules support a wide range of inputs including dc volts, ac volts, RTD, Ohms, thermocouple, thermistor, dc current, ac current, and frequency. Other sensors and transducers, such as load cells, pressure sensors, and displacement sensors can be easily incorporated into your measurement system.

For data acquisition systems that also require control functionality, the Fluke 2680A-DIO digital I/O and relay output module provides 20 digital I/O and eight hard-contact 1 Amp form-C relays. This equips each chassis to respond to a wide range of alarm or control situations. The 2680A-DIO also includes an up/down counter with pre-set start count capability, so you don't need to begin all counts at zero.

FlukeDAQ software streamlines setup and performance

The Fluke 2680A Series systems come with our powerful, easy-to-use FlukeDAQ configuration software. FlukeDAQ enables you to quickly configure your 2680 Series unit; set up data files; collect and chart data; and manage PC card files. FlukeDAQ also enables you to integrate Fluke NetDAQ 2640A and 2645A units seamlessly into a 2680 Series system.

Optional software extends system capabilities

Optional 2680A-DEVSW Indusoft Web Studio is an object-oriented development program that enables programmers and non-programmers to develop modern HMIs which open graphical windows to your application.

2680A-OPC server software provides the configuration interface for the 2680 Series and also offers a common communication link to any software package that supports OPC, allowing you to create custom applications and most popular industrial software packages.

The Fluke 2680A-DLL library provides the full DLL toolbox for application software developers who need to write original programs for the 2680 Series, using Visual C++, Visual Basic, and other languages.

Measurement Accuracy

Model 2680A-PAI

Thermocouples[9]		Accuracy[1,6], 3σ, ± °C				
		18 to 28°C			-10 to 60°C	
	ITS90	90 Day	1 Year		1 Year	
Type	Temp (°C)	Slow	Slow	Fast	Slow	Fast
J	-100°C to 80°C	0.45	0.5	0.8	0.6	0.8
	80°C to 230°C	0.35	0.5	0.7	0.6	0.8
	230°C to 760°C	0.4	0.5	0.7	0.8	0.9
K	-100°C to -25°C	0.55	0.6	0.9	0.7	1.0
	-25°C to 120°C	0.4	0.5	0.8	0.6	0.9
	120°C to 800°C	0.5	0.65	0.9	1.0	1.2
	800°C to 1372°C	0.7	1.0	1.3	1.6	1.9
N	-100°C to -25°C	0.65	0.75	1.2	0.8	1.3
	-25°C to 120°C	0.55	0.6	1.0	0.7	1.1
	120°C to 1000°C	0.45	0.6	0.9	1.0	1.2
	1000°C to 1300°C	0.55	0.75	1.0	1.2	1.5
E	-100°C to -25°C	0.45	0.5	0.8	0.6	0.8
	-25°C to 20°C	0.35	0.4	0.6	0.5	0.7
	20°C to 600°C	0.3	0.4	0.6	0.5	0.8
	600°C to 1000°C	0.4	0.5	0.7	0.9	1.0
T	-100°C to 0°C	0.6	0.65	1.0	0.7	1.1
	0°C to 150°C	0.4	0.5	0.8	0.6	0.9
	150°C to 400°C	0.3	0.4	0.6	0.6	0.8
R	250°C to 600°C	0.9	1.0	2.1	1.2	2.2
	600°C to 1500°C	0.8	0.9	1.8	1.3	2.0
	1500°C to 1767°C	0.85	0.85	1.9	1.7	2.5
S	250°C to 1000°C	0.95	1.1	2.3	1.3	2.4
	1000°C to 1400°C	0.8	1.0	1.9	1.4	2.3
	1400°C to 1767°C	1.0	1.3	2.2	1.8	2.8
B	600°C to 900°C	1.2	1.4	3.1	1.5	3.2
	900°C to 1200°C	0.9	1.0	2.2	1.2	2.4
	1200°C to 1820°C	0.75	1.0	1.9	1.3	2.2
C	0°C to 150°C	0.8	0.9	1.6	1.0	1.7
	150°C to 650°C	0.65	0.75	1.4	1.0	1.5
	650°C to 1000°C	0.65	0.85	1.4	1.2	1.8
	1000°C to 1800°C	1.0	1.3	2.1	2.1	2.8
	1800°C to 2316°C	1.6	2.1	3.2	3.4	4.6
L	-100°C to 100°C	0.9	1.0	2.0	1.3	2.0
	100°C to 800°C	0.5	0.9	1.4	1.2	1.7
	800°C to 900°C	0.5	0.7	1.1	1.3	1.5
U	-100°C to 0°C	1.5	1.5	2.6	1.6	3.0
	0°C to 600°C	0.6	0.8	1.6	1.1	1.9

DC Voltage		Accuracy1, 3σ, ±(%input + V) 18 to 28°C		
Range	Resolution	90 Day	1 Year	
		Slow	Slow	Fast
90 mV	.3 µV	0.01%+7 µV	0.013%+8 µV	0.013%+18µV
300 mV	1 µV	0.01%+15 µV	0.013%+17 µV	0.013%+35 µV
3V	10 µV	0.01%+.1 mV	0.013%+.15 mV	0.013%+.64 mV
30V	1 mV	0.01%+4 mV	0.013%+4.9 mV	0.026%+3.5 mV
150/300V	10 mV	0.01%+15mV	0.013%+17 mV	0.052%+35 mV
Resistance		Accuracy[1,3] (4-wire), 3σ, ±(% input+Ω)		
300Ω	1 mΩ	0.015%+20mΩ	0.02%+30Ω	.02%+120Ω
3 kΩ	10 mΩ	0.02%+.3Ω	0.02%+.5Ω	.02%+1.2Ω
30 kΩ	100Ω	0.03%+3Ω	0.02%+5Ω	0.04%+15Ω
300 kΩ	1Ω	0.1%+40Ω	0.1%+60Ω	0.2%+150Ω
3 MΩ	100Ω	0.25%+800 kΩ	0.25%+1 kΩ	0.5%+1.5 kΩ

Model 2680A-PAI

Thermocouples[9]		Accuracy[1,6], 3σ, ± °C				
		18 to 28°C			-10 to 60°C	
	ITS90	90 Day	1 Year		1 Year	
Type	Temp (°C)	Slow	Slow	Fast	Slow	Fast
J	-100°C to 80°C	0.8	0.9	1.6	0.9	1.7
	80°C to 230°C	0.7	0.8	1.4	0.9	1.5
	230°C to 760°C	0.7	0.8	1.3	1.0	1.5
K	-100°C to -25°C	1.0	1.1	2.0	1.2	2.1
	-25°C to 120°C	0.8	0.9	1.7	1.0	1.8
	120°C to 800°C	0.9	1.1	1.8	1.5	2.2
	800°C to 1372°C	1.2	1.5	2.3	2.0	2.9
N	-100°C to -25°C	1.4	1.5	2.8	1.5	2.9
	-25°C to 120°C	1.1	1.3	2.3	1.3	2.4
	120°C to 1000°C	1.0	1.1	2.0	1.2	2.1
	1000°C to 1300°C	1.0	1.2	1.9	1.6	2.4
E	-100°C to -25°C	0.8	0.9	1.5	1.0	1.6
	-25°C to 20°C	0.7	0.7	1.2	0.8	1.3
	20°C to 600°C	0.6	0.7	1.1	0.8	1.2
	600°C to 1000°C	0.6	0.8	1.2	1.1	1.5
T	-100°C to 0°C	1.1	1.2	2.2	1.3	2.3
	0°C to 150°C	0.9	1.0	1.7	1.0	1.8
	150°C to 400°C	0.7	0.8	1.4	0.8	1.5
R	250°C to 600°C	2.4	2.7	5.6	2.8	5.7
	600°C to 1500°C	2.0	2.3	4.6	2.4	4.8
	1500°C to 1767°C	2.0	2.3	4.5	2.8	5.1
S	250°C to 1000°C	2.6	2.8	5.9	2.9	6.0
	1000°C to 1400°C	2.0	2.3	4.6	2.6	5.0
	1400°C to 1767°C	2.3	2.7	5.3	3.3	5.9
B	600°C to 900°C	3.6	3.9	8.5	4.0	8.6
	900°C to 1200°C	2.1	2.4	5.0	2.6	5.2
	1200°C to 1820°C	2.0	2.3	4.7	2.7	5.0
C	0°C to 150°C	1.9	2.0	4.0	2.1	4.2
	150°C to 650°C	1.6	1.7	3.5	1.8	3.6
	650°C to 1000°C	1.4	1.7	3.2	2.0	3.5
	1000°C to 1800°C	2.0	2.5	4.5	3.2	5.3
	1800°C to 2316°C	3.1	3.8	6.8	5.1	8.1
L	-100°C to 100°C	1.2	1.3	2.9	1.6	3.1
	100°C to 800°C	0.9	1.0	2.1	1.2	2.3
	800°C to 900°C	0.7	0.8	1.3	1.0	1.5
U	-100°C to 0°C	2.0	2.1	4.3	2.2	4.6
	0°C to 600°C	1.3	1.4	2.5	1.6	2.6

DC Voltage		Accuracy1, 3σ, ±(%input + V) 18 to 28°C		
Range	Resolution	90 Day	1 Year	
		Slow	Slow	Fast
90 mV	3 µV	0.01%+20 µV	0.013%+23 µV	0.013%+50 µV
300 mV	10 µV	0.01%+40 µV	0.013%+49 µV	0.013%+93 µV
3V	100 µV	0.01%+.3 mV	0.013%+.38 mV	0.013%+.64 mV
30V	1 mV	0.01%+4 mV	0.013%+4.9 mV	0.026%+9.5 mV
150/300V	10 mV	0.01%+30 mV	0.013%+40 mV	0.052%+64 mV
Resistance		Accuracy[1,3] (4-wire), 3σ, ±(% input+Ω)		
300Ω	10 mΩ	0.02%+60mΩ	0.02%+.1Ω	.02%+.2Ω
3 kΩ	100 mΩ	0.02%+6Ω	0.02%+1Ω	.02%+3Ω
30 kΩ	1Ω	0.02%+6Ω	0.02%+1Ω	0.02%+300Ω
300 kΩ	10Ω	0.5%+80Ω	0.5%+150Ω	1.0%+3 kΩ
3 MΩ	100Ω	1.3%+1 kΩ	1.3%+2 kΩ	2.0%+200 kΩ

Measurement Accuracy

Model 2680A-PAI

AC Voltage				
Range Resolution		**Frequency**	**Accuracy[1,2], 3σ, ±(% input+counts)**	
		Slow		**Fast**
300mV	1 µV	20 Hz-50 Hz	3.0%+25	6.0%+50
		50 Hz-20 kHz	0.4%+25	1.0%+50
		20 kHz-50 kHz	2.0%+30	3.0%+50
		50 kHz-100 kHz	5.0%+50	5.0%+100
3V	100 µV	Same frequencies, similar accuracies as above		
30V	1 mV	Same frequencies, similar accuracies as above		
150/300V	10 mV	Same frequencies, similar accuracies as above		

RTD (Pt 100)	Accuracy[1,5], 3σ, ± °C (4-wire)		
Temperature °C	**Resolution °C**	**90 Day, 18 to 28°C**	**1 Year, 18 to 28°C**
	Slow	**Slow**	**Slow**
-200	0.003	0.06	0.09
0	0.003	0.09	0.13
100	0.003	0.10	0.16
300	0.003	0.14	0.21
600	0.003	0.19	0.30
Thermistor[10] 2 kΩ to 100 kΩ			
-40°C to 150°C	0.003	0.3	0.4

Frequency Measurement Accuracy[1,8], -20 to 60°C				
Range	**Resolution**		**Accuracy, 3σ, ±(% input +Hz)**	
	Slow	**Fast**	**Slow**	**Fast**
15 Hz-900 Hz	0.01 Hz	0.1 Hz	0.05%+0.02 Hz	0.05%+0.2 Hz
900 Hz-9 kHz	0.1 Hz	1 Hz	0.05%+0.1 Hz	0.05%+1 Hz
9 kHz-90 kHz	1 Hz	10 Hz	0.05%+1 Hz	0.05%+10 Hz
90 kHz-900 kHz	10 Hz	100 Hz	0.05%+10 Hz	0.05%+100 Hz
1 MHz	100 Hz	1 kHz	0.05%+100 Hz	0.05%+1 kHz

Frequency Measurement Sensitivity (sine wave)		
Frequency	**Minimum Signal**	**Maximum Signal**
15 Hz-200 Hz	100 mV rms	150/300V rms
200 Hz-70 kHz	100 mV rms	30V rms
70 kHz-100 kHz	100 mV rms	20V rms
100 kHz-200 kHz	150 mV rms	10V rms
200 kHz-300 kHz	150 mV rms	7V rms
300 kHz-1 MHz	linearly increasing from 150 mV rms at 300 kHz to 2V rms at 1 MHz	linearly decreasing from 7V rms at 300 kHz to 2V rms at 1 MHz

1 Total instrument accuracy for the indicated time period and ambient temperature range. Includes A/D errors, linearization conformity, initial calibration error, isothermality errors, reference junction conformity and power line voltage effects within the range from 100VAC to 264VAC.

2 Sine wave inputs >2000 counts (slow), >200 counts (fast). Accuracies for crest factor ≤2.0.

3 For two-wire measurements add 5 to basic accuracy (does not include lead-wire resistances).

4 For two-wire measurements add 700-1000 to basic accuracy (does not includelead-wire resistances). Ohms varies due to the resistance of the solid state switches.

5 DIN/IEC 751 only, assumes no lead-wire resistance errors.

Model 2680A-FAI

AC Voltage				
Range Resolution		**Frequency**	**Accuracy[1,2], 3σ, ±(% input+counts)**	
		Slow		**Fast**
300mV	10 µV	20 Hz-50 Hz	3.0%+25	6.0%+50
		50 Hz-20 kHz	0.4%+25	1.0%+50
		20 kHz-50 kHz	2.0%+30	3.0%+50
		50 kHz-100 kHz	5.0%+50	5.0%+100
3V	100 µV	Same frequencies, similar accuracies as above		
30V	1 mV	Same frequencies, similar accuracies as above		

RTD (Pt 100)	Accuracy[1,5], 3σ, ± °C (4-wire)		
Temperature °C	**Resolution °C**	**90 Day, 18 to 28°C**	**1 Year, 18 to 28°C**
	Slow	**Slow**	**Slow**
-200	0.003	0.06	0.09
0	0.003	0.09	0.13
100	0.003	0.10	0.16
300	0.003	0.14	0.21
600	0.003	0.19	0.30
Thermistor[10] 2 kΩ to 100 kΩ			
-40°C to 150°C	0.003	0.3	0.4

Frequency Measurement Accuracy[1,8], -20 to 60°C				
Range	**Resolution**		**Accuracy, 3σ, ±(% input +Hz)**	
	Slow	**Fast**	**Slow**	**Fast**
15 Hz-900 Hz	0.01 Hz	0.1 Hz	0.05%+0.02 Hz	0.05%+0.2 Hz
900 Hz-9 kHz	0.1 Hz	1 Hz	0.05%+0.1 Hz	0.05%+1 Hz
9 kHz-90 kHz	1 Hz	10 Hz	0.05%+1 Hz	0.05%+10 Hz
90 kHz-900 kHz	10 Hz	100 Hz	0.05%+10 Hz	0.05%+100 Hz
1 MHz	100 Hz	1 kHz	0.05%+100 Hz	0.05%+1 kHz

Frequency Measurement Sensitivity (sine wave)		
Frequency	**Minimum Signal**	**Maximum Signal**
15 Hz-200 Hz	100 mV rms	150/300V rms
200 Hz-70 kHz	100 mV rms	30V rms
70 kHz-100 kHz	100 mV rms	20V rms
100 kHz-200 kHz	150 mV rms	10V rms
200 kHz-300 kHz	150 mV rms	7V rms
300 kHz-1 MHz	linearly increasing from 150 mV rms at 300 kHz to 2V rms at 1 MHz	linearly decreasing from 7V rms at 300 kHz to 2V rms at 1 MHz

6 Resolution is 0.02°C or 0.04°F over the useful range of base metal thermocouples (J, K, T, E, N, L, U) and 0.1°C or 0.2°F resolution for types R, S, B, and C with slow scan.

7 Resolution is 0.2°C or 0.4°F over the useful range of base metal thermocouples (J, K, T, E, N, L, U) and 1.0°C or 2.0°F resolution for types R, S, B, and C with slow scan.

8 Accuracy for both slow and fast scan speeds.

9 Open thermocouple detection is performed on each thermocouple channel unless defeated by computer command.

10 Using Stein hart – Hart thermistor polynomial: $T = A+B\,(\ln R) + C\,(\ln R)^3$

T = temp in °K

A, B and C = fitting constants

R = resistance of thermistor in Ω

2680 Series

Channel capacity (2680A or 2686A)

20 to 120 channels per chassis (6 analog input modules of 20 channels each) One master alarm (open collector) per chassis

Communications: 10BaseT/ 100BaseT, TCP/IP via RJ45 connector, Cat 5

Math functions
In addition to its analog and digital input channels, each system supports 60 computed channels. Calculations include: time & rate, addition, subtraction, multiplication, division, log, natural log, exponent, square root, absolute value, integer function and average.

Measurement speed (2680A-PAI)
Slow: 6 readings/second nominal
Medium: 41 (50 Hz), 48 (60 Hz) readings/second nominal
Fast: 143 readings/second nominal (5 readings/second for VAC nominal, 140 readings/ second on 300 Ω range, 37 readings/ second on 3 MΩ range)

Measurement speed (2680A-FAI)
Slow: 45 (50 Hz), 54 (60 Hz) readings/second nominal
Medium: 200 readings/second nominal
Fast: 1000 readings/second nominal (5 readings/second for VAC nominal, 370 readings/ second on 300 Ω range, 44 readings/second on 3 MΩ range)

Analog to digital converter
2680A-PAI: Multi-slope type, linear to 18 bits

2680A-FAI: Multi-slope type, linear to 16 bits

Common mode rejection
2680A-PAI: AC: ≥120 dB (50/60 Hz, ±0.1 %max 1 kΩ source imbalance) DC: ≥120 dB

2680A-FAI: AC: ≥100 dB (50/60 Hz, ±0.1 % max 1 kΩ source imbalance) DC: ≥100 dB

Normal mode rejection
50 dB @ 50/60 Hz, ±0.1 %

Common mode voltage maximum
2680A-PAI: 300 VDC or VAC rms (channels 1,11); 150 VDC or VAC rms (all other channels)

2680A-FAI: 50 VDC or 30 VAC rms (all channels)

2680A-DIO

Totalizing input
Pre-settable starting count up/down counter
DC coupled, non-isolated, max +30 V, min –4 V
Max count: 4,294,967,295
Minimum signal: 2 V peak
Threshold: 1. 4 V
Rate: 0-5 kHz (debounce off)
Hysteresis: 500 mV
Input debouncing:
None or 1. 66 ms

Digital inputs/outputs: 20
Threshold: 1. 4 V
Hysteresis: 500 mV
Maximum input: +30 V, min –4 V; non-isolated

Logical "zero" output: 0.8V max|out = -1.0 mA
(1 LSTTL load equivalent)
1. 8 V max out = -20 mA
3.25 V max out = -50 mA

Logical "one" output:
Output voltage depends on external load
3.8 V min out = 0.05 mA
(1 LSTTL load equivalent)

Relays
Quantity: 8
Type: Form C; DPST
Current: 1 amp, non-inductive
Operation time: 75 ms

Alarm associations
Each Digital I/O may be randomly assigned as a digital input, status output, or alarm output (associated with any input channel or channels).

General Specifications

Trigger input

Minimum pulse: 5 µs
Minimum latency: 100 ms
Input "High": 2.0 V min, 7.0 V max
Input "Low": -0.6 V min, 0.8 V max non-isolated, contact closure and TTL compatible

Clock
Accurate to within 1 minute/ month for 0°C to 50°C range

Power
100 to 240 VAC, 50 or 60 Hz 100 VA max, or 9 to 45 VDC (50W DC) (if both sources are applied simultaneously, the greater of AC or DC is used), at 120 VAC the equivalent DC voltage ~14.5V

Temperature, humidity (non-condensing)
Operating: -20°C to 28°C, ≤ 90% RH; 28°C to 40°C, ≤ 75% RH; 40°C to 60°C, ≤ 50% RH

Storage:
-40°C to 70°C, 5% to 95% RH

Altitude
Operating: 2000 m
Storage: 12,200 m

Standards
All inputs: IEC Overvoltage rating Category II Product conforms to the following safety and emission standards:
EN50082-2
EN55022-1
EN55011 class A
EN610000-4-2,3,4,6,8
EN61326
EN61010-1, CAT II
CSA C22.2 No. 1010.1

Operating temperature
-20 °C to 60 °C (-4 °F to +140 °F)

Storage temperature
-40 °C to 70 °C (-40 °F to +158 °F)

Size
18. 6" x 17" x 9. 3"
(473 mm x 423 mm x 237 mm)

Weight
2680A/2686A chassis only:
18. 86 lbs. (8.47 kg)
2680A-FAI: 1.74 lbs. (0.79 kg)
2680A-PAI: 2.66 lbs. (1.21 kg)
2680A-DIO: 1.75 lbs. (0.80 kg)

Interfaces
Ethernet: Conforms to IEEE 802.3 Ethernet standard, compatible with 100BaseT and 10BaseT standards, uses TCP/IP protocol

RS-232C: For calibration only

Ordering Information

Model

2680A Data Acquisition System Chassis, 6 slots

2686A Data Logging System Chassis with ATA Flash memory drive; includes 16 MB memory card

2680A-FAI Fast Analog Input Module

2680A-PAI Precision Analog Input Module

2680A-DIO Digital I/O and Relay Module

Software

2680A-APSW Fluke DAQ configuration software for 2680 Series

2680A-DEVSW Indusoft Web Studio, Development software for FlukeDAQ

2680A-DLL DLL Library for 2680 Series

2680A-OPC OPC software for 2680 Series

Accessories

2680A-180 Universal Input Module, extra connector

2680A-102 2680A-DIO Connector Module, extra connector

2680A-101 Shunt resistor set (12 ea.), 10 Ω, 1%

2680A-800 16 MB ATA Flash memory card for 2686A

2680A-801 126 MB ATA Flash memory card for 2686A

2680A-802 256 MB ATA Flash memory card for 2686A

2680A-805 512 MB ATA Flash memory card for 2686A

2680A-810 1 GB ATA Flash memory card for 2686A

Y5537 Rack mount kit for 2680 Series

2686A memory card storage capacity

2686A - Active channels and number of scans to card capacity

Memory Card / Active Channels	20 ch	40 ch	60 ch	80 ch	100 ch	120 ch
16 MB	100,548	66,765	50,074	40,059	33,382	28,613
128 MB	800,00	528,000	400,000	320,000	264,000	224,000
256 MB	1.6 M	1.056 M	800,000	640,000	528,000	448,000
512 MB	3.2 M	2.112 M	1.6 M	1.28 M	1.056 M	896,000
1 GB	6.2 M	4.224 M	3.2 M	2.56 M	2.112 M	1.792 M

Estimating space: 80 bytes / scan + 4 bytes / channel scanned
(allow 4.5% overhead for card formatting)

Portable, flexible solutions for stand-alone or PC-based data acquisition

- 20 universal channels
- Signal conditioning built in and programmable per channel
- Measure Vdc, Vac, thermocouples, RTDs, resistance and frequency
- Universal input module for easy connections
- Application software

The hydra series is available in three models to fit many application requirements. The 2620A Hydra Data Acquisition Unit is a compact front end for use with your PC. The portable 2625A Hydra Data Logger features non-volatile memory that stores more than 2000 scans, for stand-alone applications. And the 2635A Hydra Data Bucket™, with its removable memory card for data and setup storage, is the most versatile model - ideal for remote monitoring applications.
All models are easy to set up and reconfigure from the front panel. Additionally, all units have bi-directional communication via RS-232C, which enables control from a host computer. The RS-232C interface also supports stand-alone use with a serial printer. An optional GPIB/IEEE-488 interface is available for the 2620A only.
The hydra series is extremely rugged and able to operate in diverse environments. Its operating range is 0 to 60°C, and it is tested to stringent shock and vibration standards. Hydra's sturdy metal chassis effectively shields against electromagnetic interference, maintaining high measurement accuracy on low level signals. The analog circuitry is also isolated from the digital circuitry so you can measure high voltages directly (up to 300 VACrms). And it conforms to I.E.C., C.E. and CSA safety standards. What's more, all setup information is battery-backed, so it's immune to power failure. Hydra will return from a power loss and resume scanning, while all configuration information and stored data remain intact.
The hydra series offers easy portability along with Fluke's built-in signal conditioning and universal input module at a price to fit your budget.
You can easily retrieve data from the hydra units via the RS-232 interface, or through a modem in upload or real-time mode. Channel information and measurement parameters can be set up directly from the front panel or your PC.
Should power fail, these instruments automatically resume data collection when power is restored.

2635A Hydra Data Bucket
The 2635A is an ideal choice for gathering and transporting large volumes of data and for working extended periods from remote locations.

Flexibility
The Hydra Data Bucket comes equipped with a 256 KB PCMCIA card and is also available with either a 1 MB, 2 MB, or 4 MB memory card to suit your data storage needs. Data may be uploaded from these cards via the hydra RS-232 port, the optional 263XA-803 memory card drive, or from your computer's standard PCMCIA slot. Real-time data can be simultaneously transferred to a PC at the same time it is recorded to the memory card.

Quick setups
Simply push a few front panel buttons or load instrument setups from the memory card.

Fail-safe features
The Hydra Data Bucket gives advance indication of a low battery or low memory condition on the memory card. Its internal memory buffer continues to store up to 70 scans while the card is removed.

Hydra Series Portable Data Acquisition

2625A Hydra Data Logger
The 2625A is a low-cost alternative for stand-alone monitoring operations.

Internal memory
Its built-in nonvolatile memory can store more than 2000 scans.

Flexible data retrieval
The 2625A can upload stored data or transfer real-time data via modem, or directly to your PC via the RS-232 port.

2620A Hydra Data Acquisition Unit
Hydra is ideal for applications that require direct connection to a PC for real-time data collection.

Easy-to-use front end
An RS-232 serial interface makes it easy to connect the Hydra Data Acquisition Unit to a PC or modem for real-time data acquisition. The 2620A can also be used as a 20-channel panel meter.

IEEE interface
An optional IEEE-488 interface easily allows you to integrate the 2620A with other IEEE-488 instruments and your PC. The 2620A delivers workhorse performance for a wide variety of applications such as test and monitoring systems.

Universal Input Module
The removable Universal Input Module enables fast, convenient setup and reconfiguration. Any combination of dc voltage, ac voltage, thermocouple, RTD, resistance, or frequency measurements can be connected to the input module without the need for additional signal conditioning. Thermocouple reference junction compensation is automatically performed by sensing the temperature of the input module's isothermal block. For applications with multiple measurement locations, purchasing additional input modules provides the ability to quickly connect and disconnect a hydra to these various sites while leaving all sensor wiring intact.

Data collection

Portable operation
The 2635A Hydra Data Bucket has been designed for applications where data is gathered in a stand-alone manner "on location" and later uploaded to a PC for analysis and/or archiving. Three models of the Hydra Data Bucket are available with PC memory cards ranging in size from 256K, 1 Mb, 2 Mb and 4 Mb in size. Up to 450,000 readings may be stored on a 2 Mb memory card. For applications where large amounts of data are generated, you may swap memory cards without interrupting the data bucket's scanning.

Memory card drive
The optional memory card drive provides an easy way to transfer your data from the Data Bucket's memory card to a PC. It may also be used to download your latest Data Bucket set up to the memory card for later use in the field.

Data Logger operation
The Hydra 2625A Data Logger is differentiated by its built-in non-volatile recording capability. This feature makes data capture and off-line storage very flexible and convenient. The memory holds 2047 sets of readings on each of the 21 analog input, 12 digital I/O, and totalizer channels - enough to hold one scan per minute for more than 24 hours. The Hydra Data Logger is ideal for recording data during environmental stress screening, thermal testing, design testing, and other applications that require a data logger with up to 20 analog measurement channels.

Software

Hydra Logger for Windows
The Hydra Logger for Windows software package gives you a powerful data acquisition system when combined with a hydra instrument and your PC. Hydra Logger gives you control of Hydra's powerful functions, including scanning, signal conditioning, sensor linearization, alarm detection and reporting, non-volatile data memory, advanced trend plotting and more. All Hydra models have modem support from within Hydra Logger.

Trend Link
With Hydra Logger's optional, trend plotting package, Trend Link for Fluke, you can control how your data is displayed. You can quickly scroll through real time and historical data, or view data from all channels simultaneously, on a single screen. Or, you can plot one or multiple channels in real time, even super imposing channels on other channels. Zoom-in-and-out features, and statistics make this optional package ideal for report and analysis needs.

System requirements:
486 (or better) PC.
Windows 95 or Windows NT.
4MB RAM.
5MB free disk space.

PC operation
The Hydra 2620A Data Acquisition Unit provides a low-cost solution for PC-based applications requiring up to 20 analog inputs. Hydra can be connected in real time to your PC. Hydra's bi-directional RS-232C interface and computer command set provide complete remote control, duplicating all front panel functions. For IEEE-488 based systems, the 2620A/05 comes equipped with an IEEE-488 interface which duplicates the remote capabilities of the RS-232C interface.

Current measurements
AC or dc current measurements may be accomplished using either 2620A-101 current shunts or external current probes. Using Mx+B scaling provides direct readings in amps. For lower current levels, shunts may be located in the input module.

Specifications

DC volts
Range: 90 mv to 300V.
Resolution: 1 µv to 10 mv.
Accuracy: (3-Sigma) 0.018%.

AC volts
Range: 90 mV to 300/150V.
Resolution: 10 µV to 10 mV.
Accuracy: (3-Sigma) 0.13%.

Resistance
Range: 300Ω to 10 MΩ.
Resolution: 10 mΩ to 1 kΩ.
Accuracy: (3-Sigma) 0.013%.

Frequency
Range: 15 Hz to 1 MHz.
Resolution: 0.01 Hz to 1 kHz.
Accuracy: (3-Sigma) 0.05%.

RTD (Pt 100)
Range: -200 to 600°C.
Resolution: 0.02°C.
Accuracy: (3-Sigma) 0.05°C.

J thermocouples
Range: -100 to 760°C.
Resolution: .01°C.
Accuracy: (3-Sigma) 0.39°C.

K thermocouples
Range: -100 to 1372°C.
Resolution: .01°C.
Accuracy: (3-Sigma) 0.45°C.

T thermocouples
Range: -150 to 400°C.
Resolution: .01°C.
Accuracy: (3-Sigma) 0.39°C.

Other thermocouple types
R, S, B, C, E, N.

2625A Data storage specifications

2625A Data storage
Stores 2047 scans; stored with each scan: time stamp, all defined analog input channels, the status of four alarm outputs and eight digital I/O, and the totalizer count.

256K card size
4 channels in scan: 8900.
10 channels in scan: 4800.
20 channels in scan: 2700.

1M card size
4 channels in scan: 36,500.
10 channels in scan: 19,800.
20 channels in scan: 11,200.

2M card size
4 channels in scan: 74,110.
10 channels in scan: 39,910.
20 channels in scan: 22,550.

4M card size
4 channels in scan: 149,000.
10 channels in scan: 80,200.
20 channels in scan: 45,359.

General specifications

Channel capacity
Analog inputs: 21.
Digital I/O and alarm outputs: 12 total.
Totalizer: 1.

Power
90 Vac to 264 Vac (50 Hz or 60 Hz), or 9 Vdc to 16 Vdc; less than 10W. (If both sources are applied simultaneously, the greater of ac or dc is used. At 120 Vac the equivalent dc voltage is ~14.5V).

Temperature, humidity (non-condensing)
Operating:
0 to 28°C, ≤90% RH; 28°C to 40°C, ≤75% RH; 40°C to 60°C, ≤50% RH.
Storage:
-40°C to 75°C, 5 to 95% RH.

Altitude
Operating: 3050m (10,000 ft).
Storage: 12,200m (40,000 ft).

Common mode and normal mode voltage
300 Vdc or ac rms (channels 0,1,11); 150 Vdc or ac rms (all other channels).

Isolation
Analog input to analog input, and analog input to any digital input: meets IEC 1010 for 300/150 volts reinforced and ANSI/ISA-S82.01-1988 and CSA 231 for 250 volts single insulation.

Safety
Complies with applicable sections of the IEC1010, ANSI/ISA-S82 01-1988, CSA 231, UL 1244, CSA 556B, CE.

RF emissions
Passes FCC EMI Class A. Equipment and VDE 0871B.

Dimensions
Size: 9.3 cm x 21.6 cm x 31.2 cm (3.67" x 8.50" x 12.28").
Weight: 2.95 kg (6.5 lb).

Memory life
10 years typical for real-time clock, setup configuration and measurement data in 2625A, memory cards typically 5 years for the 256 kB card.

Interfaces
RS-232C connector: nine pin male (DB-9P).

Signals
TX, RX, DTR, GND.

Modem control
Full duplex.

Baud rates (set from front panel)
300, 600, 1200, 2400, 4800, 9600, 19.2k, 38.4.

Echo (set from front panel)
On/Off.

Flow control
XON/XOFF.

IEEE-488 (optional, 2620A only)
Complies with IEEE-488.1 standard; disables RS-232C interface while in use.

Ordering information

2620A
Hydra Data Acquisition Unit.

2620A/05
Hydra Data Acquisition Unit with IEEE-488 interface.

2625A
Hydra Data Logger.

2635A
Hydra Data Bucket (256 KB memory card).

2635A 1MB
Hydra Data Bucket (1 MB memory card).

2635A 2MB
Hydra Data Bucket (2 MB memory card).

2635A 4MB
Hydra Data Bucket (4 MB memory card).

2620T
Recording Thermometer with probe, software and 256k PC memory card.

2635T
Recording Thermometer with probe and software.

Available accessories and options

C40
Soft Carrying Case.

C44
Transit Case.

M00-200-634
Rack Mount Kit.

RS40
RS-232C to Terminal Cable: (DB9 to DB25).

RS41
RS-232 to Modem Cable (DB9 to DB25).

RS42
RS-232-C to Printer Cable.

RS43
DB9 to DB9 Serial Cable 3m.

Y8022
Shielded IEEE-488 Cable, 2m.

2635-901
Hydra Logger.

2635A-902*
Hydra Logger w/Trending.

2600A-904
Trend Link for Fluke.

6220A-101
4-20 mA Current Shunt Set.

2620A-05K
IEEE-488 Interface Kit (2620A only).

263XA-803
Memory card drive.

263XA-804
256 KB Memory card.

2635A-805
1 MB Memory card.

2635A-806
2 MB Memory card.

2635A-807
4 MB Memory card.

2620A-100
Extra I/O connector Set: includes Universal input Module, digital I/O and Alarm Output connectors.

2600A-101
Extra SPRT Probe, 100Ω, Probe with soft case only.

*Download fully functional demonstration software at www.fluke.com

Network data acquisition

- Up to 1000 readings per second
- 20 analog input channels expandable up to 400 channels
- Extensive optional plotting and trending capabilities
- May be connected to ethernet networks
- Replaces chart recorders

Direct network connection for real time data acquisition NetDAQ data acquisition units give you a powerful combination of hardware and software that's ideal for small-to-medium scale process monitoring and test systems. They answer the escalating need for measurement, recording, and analysis tools that enable you to improve quality, maximize process efficiency and meet regulatory requirements. Building blocks of 20 channels can be expanded into integrated systems of up to 400 channels. Choose between two models for speed up to 1000 rps and accuracy up to 0.01%. All NetDAQs utilize Fluke's patented Universal Input Module which accepts any combination of analog input types for each of its 20 channels - without the need for external signal conditioning. Simply pre-wire the Universal Input Module to directly measure temperature, dc volts, ac volts, resistance, 4-20 mA, and frequency. (For more information refer to the Universal Input Module in this section.)
Distributed NetDAQ systems plug right into your existing networks to send data directly to a PC. This saves the cost of setting a new network and allows multiple users to simultaneously view data in real time. A NetDAQ unit can also be used as a portable dedicated system connected to a notebook computer for maintenance, product validation, research, and troubleshooting applications.

Features at a glance:

- Data acquisition, up to 1,000 readings per second
- 20 analog input channels expandable up to 400 channels
- Extensive optional plotting and trending capabilities
- Optional wall, cabinet, or rack mounting
- May be connected to ethernet networks
- Replaces chart recorders

System configuration
Set up your NetDAQ system the way you want it. You can set up your NetDAQ system in several different ways.
Configure an isolated system, daisy-chaining as many as 20 NetDAQ units to your PC with a high-speed communication line. This is a quick, simple way to send real time data directly to a PC (see fig. 1).
Or, add NetDAQ units directly to your company's network. Sharing the network cabling and hardware that's already installed saves you time and expense.

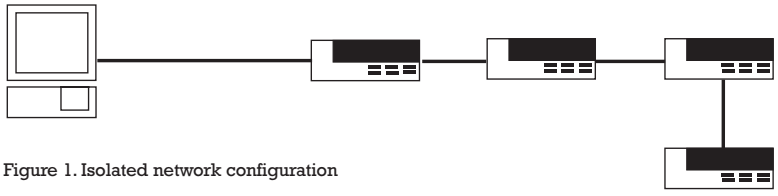


Figure 1. Isolated network configuration

And, if you wish, all the users on your network have an easy way to access the data you're collecting (see fig. 2).
A third configuration option is to add an isolated NetDAQ system to your company's network. This method isolates your data acquisition application from your company's network while still providing the advantages of multi-user viewing. High-speed applications won't be slowed down by network operations, and critical applications are completely protected from network failure (see fig. 3).
High-speed communication makes it easier to get results. No matter how you set up your data collection system, high-speed networked communication offers you a number of benefits. It gives you the ability to implement distributed applications with NetDAQ units in multiple locations. In these applications, multiple PC users can monitor data, in real time, as it is collected. Support for up to 3,000 readings per second (rps) from multiple instruments keeps throughput high. And you're ensured of highly reliable results, even over long distances.
NetDAQ supports both common ethernet network wiring types - 10Base2 (coax) and 10BaseT (twisted pair) - and all major network operating systems including: Microsoft™, Novell®, Banyan Vines™, and other ethernet networks that use TCP/IP communications protocol.

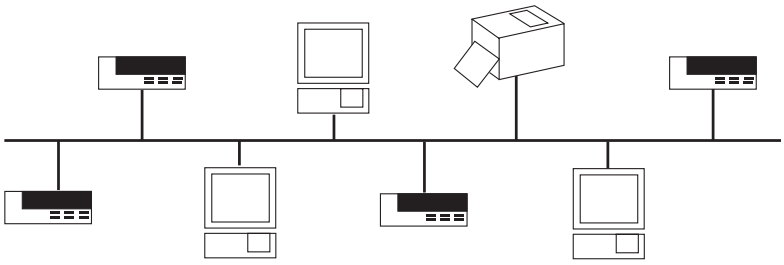


Figure 2. General network configuration

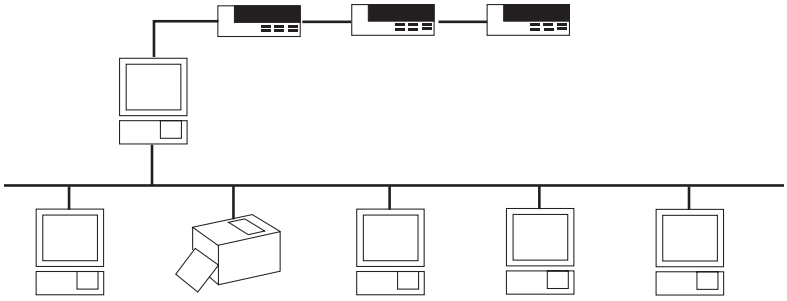


Figure 3. Isolated to general network configuration

Choose the level of performance you need
NetDAQ systems are modular and expandable up to 400 channels. With the 20-channel units as building blocks, you can buy the number of channels you need for your application. Later, add units if you need them.
Because every application is different, we offer a selection of accuracies and measurement rates to match your application needs. The 2640A offers 0.01% Vdc - 0.3°C TC accuracy and18 bit resolution, scanning 6 to 100 channels per second. The 2645A can scan at 48 to 1000 channels per second with 16 bit resolution and 0.01% vdc - 0.6°C TC accuracy.
All models offer a totalizer input channel which counts up to 4,294,967,295 "on/off" events. This channel is continuously sampled and is recorded with each scan of the other input channels.
Each analog and calculated channel has two user-defined alarm limits which can be independently configured as high, low, or off, and assigned to one of the eight digital I/O lines which can initiate action based on alarm conditions. Or these digital I/O lines can be used independently as inputs for contact closures, switches, or TTL levels.

Application software
Powerful application software makes real time decisions easier. The NetDAQ® Logger for Windows® software makes configuring and reconfiguring your system a snap. This intuitive Microsoft Windows-based software plots your data graphically, so you can get right down to making decisions.

With its advanced trending capabilities, you can look at real time data in context of historical data, compare multiple channels, or zoom in on a particular time span. You can also print plots directly from NetDAQ Logger. For further analysis or to generate reports, cut and paste either plots or data into word processor or spreadsheet programs. LabVIEW® drivers for NetDAQ are also available.

- 486 (or better) PC
- Windows 95 or Windows NT
- 4 MB RAM
- 5 MB free disk space

The Universal Input Module makes configuration a snap
NetDAQ's Universal Input Module lets you easily measure just about any electrical or physical parameter without changing hardware or adding external signal conditioning. Any combination of dc voltage, ac voltage, thermocouples, current, RTD, resistance (2- or 4-wire), or frequency measurement can be connected directly to the input module. Fluke's proprietary signal conditioning capability is built directly into the NetDAQ unit, thus eliminating the need to purchase external conditioning modules. The 2640A NetDAQ can measure up to 300V at up to 100 rps. The 2645A is the first instrument of its type capable of directly measuring multiple inputs of up to 50V at 1000 readings per second. With Mx+B scaling you can convert a wide range of signals (0-10V or 4-20 mA) into standard engineering units.
Using Fluke's patented technology, thermocouple reference junction compensation occurs automatically, by sensing the temperature of the input module's isothermal block. Excellent isothermal performance is achieved by thick copper layers embedded just beneath connection points, and an enclosure that protects inputs from changing environmental conditions. And strain relief protects sensor wires from accidental disconnection.
For calibration, or use in another application, you can leave your field connections set up at your site and merely plug and unplug the module when you want to move the NetDAQ unit.

Accurate time stamping
NetDAQ's non-volatile, on-board clock time stamps data as measurements are taken ensuring proper recording regardless of network traffic levels. NetDAQ's on-board memory buffers data in the event that network traffic prevents timely delivery of data to the host PC.

Choose the packaging that suits your application
The 2640A and 2545A NetDAQ units are housed in Fluke's standard, field-tough metal case designed to resist effects of high EMI and Rfi environments. Both models have a simple front panel interface with just eight buttons for local monitoring of all input measurements, and checking and setting communication parameters.

If you need your NetDAQ close at hand but out of the way, either unit can be permanently mounted on a wall, or in a rack or cabinet with optional mounting accessories.
For hazardous conditions, such as caustic or toxic environments, high temperatures or humidity, the optional NEMA-4X enclosure provides durable protection and easy access.

Easy calibration
NetDAQ units are extremely stable, but when you do need to calibrate one, we've made it very easy. The optional service manual gives you simple, step by step calibration instructions. (An RS-232 interface is provided on the NetDAQ units for calibration.)

Specifications*

2640 NetDAQ

DC volts
Range: 90 mv to 150/300V.
Resolution: 0.3 µv to 1 mV.
Accuracy (3-Sigma): 0.01%*.

AC volts
Range: 300 mv to 150/300V.
Resolution: 10 µv to 10 mV.
Accuracy (3-Sigma): 0.3%*.

Resistance
Range: 15 Hz to 1 MHz.
Resolution: 0.01 Hz to 100 Hz.
Accuracy (3-Sigma): 0.05%*.

Frequency
Range: 15 Hz to 1 MHz.
Resolution: 0.01 Hz to 100 Hz.
Accuracy (3-Sigma): 0.05%*.

RTD (Pt 100)
Range: -200 to 600°C.
Resolution: 0.003°C.
Accuracy: 0.006°C*

J type thermocouple
Range: -100 to 760°C.
Resolution: 0.02°C**.
Accuracy (3-Sigma): 0.35°C*.

K type thermocouple
Range: -100 to 1372°C.
Resolution: 0.02°C**.
Accuracy (3-Sigma): 0.4°C*.

T type thermocouple
Range: -100 to 400°C.
Resolution: 0.02%**.
Accuracy: 0.3°C*.

Other thermocouple types
R, S, B, C, E, N.

*Total instrument accuracy for 90 days following calibration and ambient temperature range of 18 to 28°C. Includes A/D errors, linearization conformity, initial calibration error, isothermality errors, reference junction conformity and power line voltage effects within the range from 107 Vac to 264 Vac.
**Resolution is 0.02°C or 0.04°F over the useful range of base metal thermocouples (J, K, T, E, N) and 0.1°C or 0.2°F resolution for types R, S, B, and C with slow scan.

2645 NetDAQ

DC volts
Range: 90 mv to 50V.
Resolution: 3 µv to 10 mV.
Accuracy: 0.01%*.

AC volts
Range: 300 to 50V.
Resolution: 10 µv to 1 mV.
Accuracy: 6%*.

Resistance
Range: 300 to 3M.
Resolution: 10m to 100.
Accuracy: 0.02%*.

Frequency
Range: 15 Hz to 1MHz.
Resolution: 0.01 Hz to 100 Hz.
Accuracy: 0.05%*.

RTD (Pt 100)
Range: -200 to 600°C.
Resolution: 0.03°C.
Accuracy: 0.16°C*.

J type thermocouple
Range: -100 to 760°C.
Resolution: 0.02°C**.
Accuracy: 0.7°C*.

K type thermocouple
Range: -100 to 1372°C.
Resolution: 0.02°C**.
Accuracy: 0.8°C*.

T type thermocouple
Range: -100 to 400°C.
Resolution: 0.02°C**.
Accuracy: 0.7°C*.

Other thermocouple types
R, S, B, C, E, N.

*Total instrument accuracy for 90 days following calibration and ambient temperature range of 18 to 28°C. Includes A/D errors, linearization conformity, initial calibration error, isothermality errors, reference junction conformity and power line voltage effects within the range from 107 Vac to 264 Vac.
**Resolution is 0.02°C or 0.04°F over the useful range of base metal thermocouples (J, K, T, E, N) and 0.1°C or 0.2°F resolution for types R, S, B, and C with slow scan.

General specifications

Channel capacity
Analog inputs: 20.
Computed channels:
10 digital I/O and alarm outputs: 8 total.
Totalizer: 1.

Computed channels
10 computed channels can be created by processing analog input channels and other computed channels with the following methods: Addition, subtraction, multiplication, division, log, natural log, exponent, square root, absolute value, integer function, average (average of a group of channels), difference (difference between any two channels), difference (between a channel and a group of averaged channels).

Scan speed

2640A
Slow: 6 channels/second nominal.
Medium: 41 (50 Hz), 48 (60 Hz) channels/second nominal.
Fast:
100 channels/second nominal.

2645A
Slow: 45 (50 Hz), 54 (60 Hz) channels/second nominal.
Medium:
200 channels/second nominal.
Fast:
1000 channels/second nominal.

Analog to digital converter

2640A:
Multi-slope type, linear to 18 bits.

2645A:
Multi-slope type, linear to 16 bits.

Common mode rejection (slow rate)

2640A
AC: ≥120 dB (50/60 Hz, ±0.1% max 1k source imbalance).
DC: ≥120 dB.

2645A
AC: ≥100 dB (50/60 Hz, ±0.1% max 1 kΩ source imbalance).

DC: ≥100 dB.

Normal mode rejection (slow rate)

50 dB @ 50/60 Hz, ±0.1%.

Common mode and normal mode voltage maximum

2640A:
300 Vdc or Vac rms (channels 1,11); 150 Vdc or Vac rms (all other channels).

2645A:
50 Vdc or 30 Vac rms (all channels).

Power
107 to 264 Vac, 50 or 60 Hz (<15W), or 9 to 16 Vdc (<6W).

Temperature, humidity (non-condensing)
-20°C to 60°C.
Storage:
-40°C to 75°C, 5% to 95% RH.

Electromagnetic interference (EMI)
Passes FCC EMI Class B equipment, Vfg. 243, European Norms EN50081-1 and EN50082-1, (CE.).

Weight
3.7 kg (8.2 lbs.).

*Download a brochure with more detailed specifications at www.fluke.com

Ordering information

2640A
NetDAQ® data acquisition unit includes: Universal input module, 4m ethernet cable, 50Ω terminator, Y BNC adaptor, T thermocouple, and power cable.

2645A
NetDAQ® data acquisition unit includes: Universal input module, 4m ethernet cable, 50Ω Terminator, Y BNC adaptor, T thermocouple, and power cable.

Available accessories and options

C44
Transit Case.

Y2641
19 Rack Mount Kit, single/dual.

Y2642
Wall/cabinet mounting plate.

Y2643
4m Ethernet Cable Kit.

Y2644
NEMA-4X (IP65) enclosure.

2600A-904*
Trend Link for Fluke.

2620A-100
Extra I/O connector Set: includes universal input module, digital I/O and alarm output connectors.

2620-101
4-20 mA current shunt strip.

264XA-801
Ethernet card (10Base2, 10BaseT).

264XA-802
Parallel-to-Lan adaptor (10Base2).

264XA-803
PCMCIA to LAN adaptor (PCMCIA ethernet card (10Base 2, 10Base T).

264XA-903
Developer's toolbox.

2640A-911*
NetDAQ® Logger for Windows®. Includes instrument manual.

2640A-912*
NetDAQ® Logger w/ trending. Includes instrument manual.

942615
NetDAQ® Service manual.

*Download fully functional NetDAQ Logger demonstration software at www.fluke.com

Real time, multi-tile viewing and zoom capabilities

- A comprehensive trend plotting and analysis package
- Access, view, and analyze tremendous amount of historical and real time data
- Zoom in on points of interest in your data
- Calculate basic statistics such as mean and standard deviation
- Attach notes to any point on a trace
- Supports NetDAQ®, hydra series.

Real time, multi-file viewing and zoom capabilities.

Features at a glance:
Control bar provides fast, easy access to basic chart functions.

Alarm shading gives visual indication of alarm point violation.

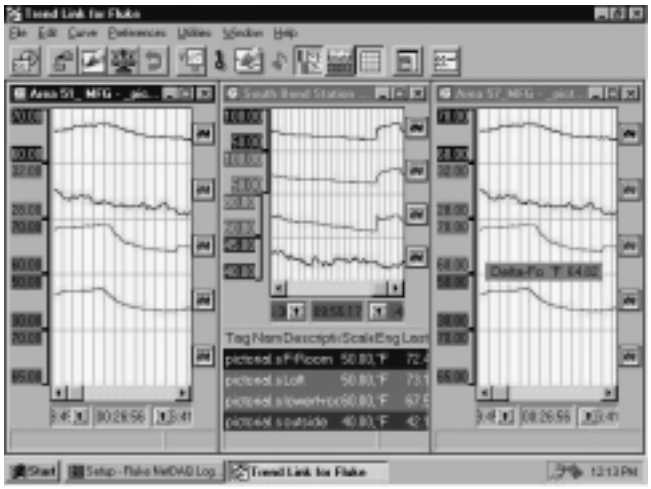
Main cursor bar under mouse control scroll through history.

Status bars offer detailed curve information.

Statistical process control function generates upper/lower control limits.

Notation system attaches your comments as a permanent part of the record.

Trend data
Trend Link time stamps data with millisecond resolution so you can find just the data you're looking for. The dead banding feature lets you record only readings outside of the range of your normal process limits, saving you valuable disk space.



File rollover
File rollover lets you manage the data file size, an especially useful feature when you're collecting data for long periods of time. You can create new data files when the file reaches a certain size, at a specific time interval, or at a specified hour each day.

Interfacing with other software packages
Trend Link for Fluke accepts data from the following Windows-based software packages:

- Hydra Logger for Windows
- NetDAQ Logger for Windows
- Microsoft Excel
- Lotus® 1-2-3®
- Quatro Pro

Supported data acquisition equipment
Trend Link for Fluke works with your PC and Fluke's full line of data acquisition equipment including:

- 2640A and 2645A NetDAQ High Speed data acquisition Tools
- 2625A Hydra Data Logger
- 2635A Hydra Data Bucket

System requirements
System:
IBM PC compatible with an Intel 486 microprocessor or greater.
Hard disk drive:
with 5 MB of free space.
Floppy disk drive:
1.44 MB (3.5").
Memory: with at least 8 MB RAM.
Operating system: Microsoft Windows version 3.1, 95 or NT.

Ordering information

2600A-904*
Trend Link for Fluke.

*Download fully functional Trend Link demonstration software at www.fluke.com

FLUKE

VXI Products

Section 4

Contents

Our VXI product line features C-size, single slot, universal waveform generators and 6.5-digit DMMs. All products are shipped with *Plug&play* software drivers.

1396

1362

VXI Product selection guide

Model	1361	1262S	1396
Instrument Type	DMM	DMM	Arb generator
Size	C	C	C
Number of slots	1	1	1
Maximum frequency	1000 readings/s	1000 readings/s	50 MS/s
Maximum amplitude (into 50 ohms)	NA	NA	15 Vpp
Maximum waveform memory	NA	NA	2M
SCPI compatible	Yes	Yes	Yes
VXI *Plug&play* driver	Yes	Yes	Yes
Comments	6.5 digits, 1000 Vrms measurement	6.5 digits, DCV, ACV and Ohms standard, ACI and DCI optional	Sequence up to 4,096 waveform segments, 16-bit digital output

Plug&play drivers combine full performance with easy installation

- 4.5 to 6.5 digit resolution
- DCV, ACV, and resistance functions
- Optional DCI and ACI
- 1000 readings/second
- VXI backplane triggers
- SCPI-compatible command language
- Unique 1000 Vrms measurement
- Software front panel/driver diskette
- VXI *Plug&play* driver provided

Model 1361 provides the full performance envelope of rack and stack system DMMs in a message-based, single-width, C-size card DMM conforming to VXI specification revision 1.4. To allow duplication of all test sequences in a VXI system, it provides DCV and ACV measurement capability to 1000 Vrms and ohms with programmable resolutions between 4.5 and 6.5 digits and read rates up to 1000 per second. At high read rates where the system controller may limit the speed of continuous operation, an internal data store can be set to record a block of between 1 and 1000 readings. Additional options provide DCI and ACI functions to 2A. Dual triggering is provided, using either an internal system trigger or an external TTL level at the front panel or through use of the VXI backplane trigger lines.

Specifications

DC Voltage
Ranges:
100 mV to 1000V in decades.
Resolution: 100 nV, 6.5 digits.
Accuracy:
90 days, 23° ± 5° C, ± (ppm R + ppm FS). FS = 2 x range.
100 mV range: 30 + 6.
1V range: 20 + 3.
10V range: 20 + 2.
100V range: 30 + 3.
1000V range: 70 + 4.
Read rate: 5/s at 6.5 digits, 1000/s at 4.5 digits.
Input impedance:
10 GΩ (0.1V to 10V ranges).
10 MΩ (100V and 300V ranges).
CMRR (1 kΩ unbalance):
>146 dB at DC > 80dB + NMRR at 1-60 Hz
NMRR: Filter out > 54 dB at 50/60 Hz + 0.1% filter in add 20 dB to above.
Protection all ranges:
300V RMS.

True RMS AC voltage ranges:
100 mV to 1000V in decades.
Resolution: 1 µV, 5.5 digits.
Accuracy: 90 days, 23° ± 5° C, Signal >1 %FS, ± (%R + %FS); FS = 2 x range.
10 - 40 Hz range: 0.4 + 0.1
40 Hz - 20 kHz range: 0.035 + 0.01.
20 - 50 kHz range: 0.1 + 0.02.
50 - 100 kHz range: 0.16 + 0.03.
Hf accuracy: (1V and 10V ranges, typical).
100 - 300 kHz: ± 1 %R + 0.1 %.
FS 300 kHz - 1 MHz:
± 2 %R + 1 % FS.
Read rate: 1/s at 5.5 digits.
Input impedance: 1MΩ/100pF.
CMRR (1 kΩ unbalance):
>80dB at DC to 60Hz.
Crest factor: 5:1 at full range.
Protection at all ranges:
300V RMS.

Resistance
Ranges:
100 Ω to 10 MΩ in decades.
Resolution: 10 µΩ, 6.5 digits.
Accuracy: 90 days, 23° ± 5° C, ± (ppmR + ppmFS);
FS = 2 x Range.
100 Ω range: 35 + 6.
1 kΩ & 10 kΩ range: 30 + 3.
100 kΩ range: 40 + 3.
1 MΩ range: 80 + 3.
10 MΩ range: 200 + 4.
Read rate: As DCV function.
Protection all ranges:
250V RMS.
Max. lead resistance:
100 Ω in any or all leads.
Open circuit voltage: 10V.

Optional DC current
Protection all ranges:
250V RMS.
Max. lead resistance:
100 Ω in any or all leads.

Open circuit voltage: 10V.
Range: 1000 mA.
Resolution: 1 µA, 6.5 digits.
Accuracy: 90 days, 23° ± 5° C, ± (ppmR + ppmFS); FS = 2 X.
Range: 200 + 10.
Read rate: as DCV function.

Optional AC current
Ranges: 1000 mA.
Resolution: 1 nA, 5.5 digits.
Accuracy: 90 days, 23° ± 5° C, ± (%R + %FS):
10 - 40 Hz: 0.4 + 0.1
40 Hz - 3 kHz: 0.08 + 0.03.
Read rate: As ACV function.

General

Input connection: Via six 4mm safety banana sockets.
Triggering:
Each of the eight backplane trigger lines are independently configured to accept TTL triggers or set to respond with a measurement complete signal. Conforms to VXI synchronous or asynchronous protocol.
Max rating:
1420 Vpk between Hi, I+ terminals and chassis. 920 Vpk between Lo, I–, guard and chassis.
Remote programming:
IEEE-488.2. As a member of the VXI *Plug&play* alliance each instrument is supplied with a software front panel and instrument driver diskette.
Operating temp: 0° to +50° C.
Dimensions: C-size: 234 mm (9.2 in) high, 340 mm (13.4 in) wide, 30 mm (1.2 in) deep.
Weight: 1.6 kg (3.5 lb).
Power:
1.5A (5V), 0.5A (± 12V) approx.

Ordering information

Model 1361:
VXIbus Precision Digital Multimeter and VXI *Plug&play* driver.

1361-30:
DCI & ACI current converter. Current to 2A.

FLUKE

1362 Precision Digital Multimeter

- 6.5 digit resolution
- DCV, ACV, and Resistance functions
- Ratio and current options
- 1000 readings/second
- MATE (CIIL) version
- Backplane triggers
- SCPI-compatible command
- Language
- Single-slot, C-size VXIbus module
- VXI *Plug&play* driver provided

The Fluke 1362 is a message-based, single-width, C-size card DMM conforming to VXI specification revision 1.4.
It provides DCV, ACV, and Ω, with resolutions between 4.5 and 6.5 digits and read rates up to 1000 per second. At high read rates where the system controller may limit the speed of continuous operation, an internal data store can be set to record a block of between 1 and 1000 readings. Additional options provide DCI and ACI functions to 2 A and a second ratio input channel. Dual triggering is provided, using either an internal system trigger or an external TTL level at the front panel or through use of the VXI backplane trigger lines.

Specifications

DC voltage

Ranges:
100 mV to 300V in decades.
Resolution: 100 nV, 6.5 digits.
Accuracy:
90 days, 23° ± 5° C, ± (ppmR + ppmFS). FS = 2 x Range.
100 mV range: 30 + 6.
1V Range: 20 + 3.
10V range: 20 + 2.
100V & 300V ranges: 30 + 3.
Read rate: 5/s at 6.5 digits, 1000/s at 4.5 digits.
Input impedance:
10 GΩ (0.1V to 10V ranges) 10 MΩ (100V & 300V ranges).
CMRR (1 kΩ unbalance):
>146dB at DC > 80dB + NMRR at 1-60Hz.
NMRR: Filter out > 54dB at 50/60Hz +0.1 % filter in add 20dB to above.
Protection all ranges:
300V RMS.

True RMS AC voltage

Ranges:
100 mV to 300V in decades.
Resolution: 1 µV, 5.5 digits.
Accuracy: 90 days, 23° ± 5° C, Signal >1 %FS, ± (%R + %FS); FS = 2 x Range.
10 - 40 Hz range: 0.4 + 0.1.
40 Hz - 20 kHz range:
0.035 + 0.01.
20 - 50 kHz range: 0.1 + 0.02.
50 - 100 kHz range:
0.16 + 0.03.
Hf accuracy: (1V and 10V ranges, typical).
100 - 300 kHz: ± 1 %R + 0.1 %FS.
300 kHz - 1 MHz:
± 2 %R + 1 %FS.
Read rate: 12 readings/sec max.
Input impedance: 1MΩ/100pF.
CMRR (1 kΩ unbalance):
>80 dB at DC to 60 Hz.
Crest factor: 5:1 at full range.
Protection at all ranges:
300V RMS.

Resistance

Ranges:
100 Ω to 10 MΩ in decades.
Resolution: 10 µΩ, 6.5 digits.
Accuracy:
90 days, 23° ± 5° C, ± (ppmR + ppmFS); FS = 2 x Range.
100 Ω range: 35 + 6.
1 kΩ & 10 kΩ range: 30 + 3.
100 kΩ range: 40 + 3.
1 MΩ range: 80 + 3.
10 MΩ range: 200 + 4.
Read rate: As DCV function.
Protection all ranges: 250V RMS
Max. lead resistance:
100 Ω in any or all leads.
Open circuit voltage: 10V.

DC current

Range: 1000 mA.
Resolution: 1 µA, 6.5 digits.
Accuracy:
90 days, 23° ± 5° C, ± (ppmR + ppmFS); FS = 2 X range.
Range: 200 + 10.
Read rate: as DCV function.

AC current
Ranges: 1000 mA.
Resolution: 1 nA, 5.5 digits.
Accuracy: 90 days, 23° ± 5° C, ± (%R + %FS):
10 - 40 Hz: 0.4 + 0.1.
40 Hz - 3 kHz: 0.08 + 0.03.
Read rate: As ACV function.

Triggering
1362S: Selectable front-panel or VXI backplane triggers, including measurement complete. Conforms to VXI synchronous and asynchronous protocol.

Remote programming
IEEE-488.2 & SCPI.

General
Operating temp: 0° to +50° C.
Dimensions: Single-slot, C-size: 234 mm (9.2 in) high, 340 mm (13.4 in) wide, 30 mm (1.2 in) deep.
Weight: 1.6 kg (3.5 lb).
Power:
1.5A (5V), 0.5A (± 12V) approx.
Configuration:
VXIbus SCPI-compatible DMM (DCV, ACV, & Ω).

Ordering information

Model 1362S: VXIbus Precision digital Multimeter and VXI *Plug&play* driver.

1362S-30:
DCI & ACI current converter. Current to 2 Amps.

1362S-40:
Comprehensive ratio.

Accessory 1505:
Single input lead.

Accessory 1506:
Ratio input lead.

50 MS/s universal waveform synthesizers

- Up to 50 MS/s sampling with 12-bit resolution
- Up to 2M waveform points
- Versatile inter-module triggering, summing and phase control
- Up to 450 user-defined waveforms
- Waveform linking and looping of up to 4,096 segments
- 16-bit digital output
- Frequency sweep and hopping
- VXI *Plug&play* drivers provided
- Compatible with WaveForm DSP2
- Single-slot, C-size VXIbus message based device

The Fluke 1396 is ideal for applications requiring standard function generator or universal waveform capability. Model 1396 adds advanced waveform sequencing capability of up to 4,096 waveform segments for complex waveform generation. It also provides a 16-bit digital output. Standard sine waves are available to 20 MHz and square waves to 25 MHz. Universal waveforms with 12 bit vertical resolution may be generated at sampling frequencies up to 50 MS/s.
For multichannel applications, multiple units may be phase locked with programmable phase offsets. Waveforms from multiple modules may be summed using the VXI backplane sumbus. Versatile intermodule triggering capabilities are provided.
In addition to built-in frequency sweep capability, a frequency list function can be used for custom sweeping or frequency hopping applications.
To simplify programming and help reduce programming time, all three models support dynamic configuration, are message based, SCPI compatible and are provided with VXI *Plug&play* drivers.

Specifications

Standard waveforms

Sine, square, triangle, ramp, haversine, random, (sine x)/x, and DC.

Frequency

Range: Sine and haversine: 1 mHz to 20 MHz.
Square: 1 mHz to 25 MHz.
All others: 1 mHz to 2 MHz.
Resolution: 8 digits limited by 1 mHz (5 digits above 20 MHz and in noncontinuous modes).
Accuracy: Same as VXI CLK10 backplane signal (± 0.01% typical).

Waveform quality

Sine distortion (elliptic filter selected):

Freq	Ampl Level	Harmonic
<100 kHz	10 Vpp	< -60 dBc.
<100 kHz	>10 Vpp	< -55 dBc.
<5 MHz	10 Vpp	< -45 dBc.
<5 MHz	>10 Vpp	< -40 dBc.
20 MHz	10 Vpp	< -35 dBc.
20 MHz	>10 Vpp	< -28 dBc.

Square transition time: < 9.5 ns.
Square aberrations: < 5 % + 20 mV.

Square wave duty cycle control
Range: 0 to 100%.
Resolution: 3.5 digits.

Triangle wave symmetry Control
Range: 0 to 100%.
Resolution: 3.5 digits.

Universal waveforms

Sampling frequency:
Range: 0.1251 S/s to 50 MS/s.
Resolution:
5 digits limited by 100 µS/s.
Accuracy: Same as VXI CLK10 (± 0.01% typical).
Horizontal resolution:
512k (2M optional).
Vertical Resolution: 12 bits.
Waveform filters: 20 MHz, 4-pole Bessel and 20 MHz, 7-pole, 6-zero elliptic.

Amplitude
Range:
15 mV to 15 Vpp into 50 Ω
(30 mV to 30 Vpp into > 10 kΩ).
Resolution: 3.5 digits.
Accuracy: ± (1 % of setting).

Offset
Range: -7.5 to +7.5V into 50 Ω
(-15V to +15V into >10 kΩ). Peak amplitude + absolute offset must be 7.5V into 50 Ω.
Resolution: 3.5 digits.
Accuracy: ± (1% of setting).

Operating modes
Continuous, sweep, triggered, gated, linked sequence, and frequency list.
Triggered: One to 1,048,576 cycles on trigger input (limited to 10 MHz).
Gated: Waveform cycle started on trigger high, completed after low.
Linked sequence: Linking, looping, and advancing of up to 4,096 waveform segments. Allows creation of long and complex waveform sequences.
Frequency list: Up to 1024 programmable frequencies. Can be output phase continuously on trigger command. (Maximum rate 2 kHz).

Frequency sweep
Range: 1 mHz to 20 mHz.
Time: 30 ms to 1000 sec.
Modes: Continuous or triggered up, down, or up/down, and triggered sweep and hold.
Spacing: Linear or logarithmic.

Triggering
Sources: External, internal, TTLTRG0-7, adjacent modules via local bus and word serial command.
Internal trigger frequency range:
10 µHz to 5 MHz.

Modulation
AM & SCM.
Range: 0 to 100 % on external voltage.
Bandwidth: DC to 500 kHz.

Multimodule summing
Input from the VXI SUMBUS may be summed with the output, or the programmed output may be sent to the SUMBUS.

Multimodule phase control
Adjacent modules may be phase synchronized on standard waveforms.
Phase resolution: 0.1°.
Phase accuracy: ± (0.05° + 5 ns).

Outputs
Main Out (50 Ω): Main waveform output, programmable on/off.
Sync/horizontal sweep (600 Ω): TTL level synchronous with main output waveform, or a 0 to 10V ramp proportional to sweep frequency.
Position Out (50 Ω): TTL-level marker, selectable for each waveform point.
Clock Out (50 Ω): TTL level, sampling frequency clock output.
Digital Output: 16 bit differential ECL updated at up to 50 MHz.
Aux analog output: ± 1.0V output updated for each segment in a sequence.

Inputs
Clock in (2 kΩ): TTL level, selectable as main waveform clock.
TRIG IN (2 kΩ): TTL level, triggered on rising or falling edge.
AM in (10 kΩ): Used for AM and SCM input.

VXI interface
Device class: DC, message-based, SCPI compatible.
TTLTRG0-7: Programmable as trigger input, output, position out, burst- or loop-complete, or sequence start/advance input.
ECLTRG0-1: Programmable as clock input or output.
SUMBUS: Full driver and receiver support. Accuracy ± 5% typical.
A24 shared memory: Supports high-speed waveform transfers, and fast frequency updates.

General
Operating Temperature: 0° to 50°C; 25° ± 10°C for specified operation.
Dimensions: Single-slot, C-size VXI module.
Weight: < 1.8 kg (3.9 lb).
Power: < 35 Watts.

Ordering information
Model 1396-EM512: VXIbus 50 MS/s Universal Waveform Generator with advanced sequencing, 16-bit digital output, 512k memory and VXI *Plug&play* driver.

Model 1396-EM2M: VXIbus 50 MS/s Universal Waveform Generator with advanced sequencing, 16-bit digital output, 2M memory and VXI *Plug&play* driver.

Wave Form DSP2: Arbitrary Waveform Creation Software.

Do You Need Further Information About Other Fluke Products

Fluke publishes additional catalogs, CD-ROMs and brochures with information about its range of Industrial, Electrical, and Network Test Tools, as well as its Calibration and Measurement solutions.

For more information about these publications, contact your local Fluke sales representative or visit our web site at calibration.fluke.com

Fluke publishes additional catalogs, CD-ROMs and brochures with information about its ranges of products. For more information, contact your Fluke representative.

Fluke. *Keeping your world up and running.*

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Printed in UK by Graphics Matter Ltd. 04/2003 DS253 1611269 C-ENG-N REV C