Series 3400

Pulse/Pattern Generators

- **Broad-purpose voltage pulse and pattern generation**
- **Programmable pulse parameters: amplitude, rise time, fall time, pulse width, and duty cycle**
- **Pulse and burst modes for material and device characterization**
- **Serial data pattern simulation for functional characterization tasks**
- **Choice of single- or dual-channel signal outputs**
- **1mHz–165MHz frequency output range**
- **Independently adjustable rise and fall times**
- **3ns–1000s pulse width range**
- **Four operating modes: pulse, burst, pattern, external width**
- **GPIB and USB interfaces**
- **2U full-rack design**

Series 3400 Pulse/Pattern Generators are the latest additions to Keithley's growing line of instrumentation with pulse generation functions. They offer users extensive control over a wide variety of pulse parameters, including pulse amplitude, rise time, fall time, width, and duty cycle via the instrument's flexible user interface or over the GPIB and USB interfaces. This operational flexibility makes Series 3400 instruments readily adaptable to the needs of a wide range of users, including nanotechnology researchers, research and education organizations, and semiconductor and RF device design and development departments. Built-in pattern generation capabilities simplify simulating serial data patterns when testing devices to characterize their performance when operated under sub-optimal conditions.

Series 3400 instruments offer users some important performance advantages over some of the best-selling pulse/pattern generators on the market, including:

- Clean transient response
- Less edge-to-edge jitter
- Simpler user interface
- Easier integration into existing test and measurement systems

The user interface for Series 3400 generators is designed to simplify configuring complex pulses and patterns. By using intuitive parameter menu keys and context-sensitive soft menu keys, users can navigate quickly to their desired parameter controls with just a few key presses, unlike competitive generators, which often have many levels of confusing sub-menus and shift-key operations. An industry-standard SCPI command set makes Series 3400 instruments code-compatible with the command set of other popular generators. This compatibility simplifies migrating existing applications from older hardware to the Series 3400 by minimizing the need to rewrite existing program code, reducing start-up time and the costs associated with replacing older instrumentation.

Single- and Dual-Channel Options

The Model 3401 is a single-channel pulse/pattern generator. The Model 3402's specifications are identical to the Model 3401's, with the addition of a second signal output channel, which is useful for applications that require sourcing multiple streams of pulses or patterns simultaneously. Both instruments can source pulses at frequencies ranging from 1mHz to 165MHz with pulse amplitudes of up to ±10V (with 50Ω source impedance) or ±20V (with 1kΩ source impedance). Pulse widths ranging from less than 3ns to 1000s in length can be programmed, with rise times as short as 2ns.

Four Operating Modes

Four built-in operating modes simplify programming and integrating Series 3400 instruments with other test hardware, such as oscilloscopes, Keithley's Series 2600 and 2400 lines, low level instruments, and the Model 4200-SCS system:

- *Pulse mode* delivers a single pulse per trigger event to the outputs. The pulse's delay and duration (duty cycle) are programmable.
- *Burst mode* sources a "burst" of 2–65,536 pulses per trigger event, with pulses configured much like the single pulses produced in pulse mode.
- *Pattern mode* delivers a programmable pattern per trigger event to the outputs. Users can program a unique pattern or select from a library of pre-configured patterns. The pattern may be presented in either NRZ (non-return to zero) or RZ (return to zero) formats. In NRZ mode, the pattern crossing point is programmable. In RZ mode, the duration (duty cycle) of the pulse is programmable.
- *External width mode* produces a pulse level that follows the edges of the signal on the Ext In input. A rising edge causes the output to go high; a falling edge causes the output to go low.

Generate pulses and signal patterns for device characterization

PULSE/PATTERN GENERATORS

Series 3400

Pulse/Pattern Generators

Ordering Information

3401-F Single-Channel Pulse/Pattern Generator

3401-R Single-Channel Pulse/Pattern Generator with Rear Panel Option

3402-F Dual-Channel Pulse/Pattern Generator

3402-R Dual-Channel Pulse/Pattern Generator with Rear Panel Option

ACCESSORIES SUPPLIED

CD-ROM Manual Package, Line Cord, Rack Mount/Handle Kit

Multi-year extended warranty and calibration contract available for this product.

ACCESSORIES AVAILABLE

CABLES/ADAPTERS

4801	Low Noise BNC Input Cable, 1.2m, BNC-BNC
4802-10	Low Noise BNC Input Cable, 3m, BNC-Unterminated
7051-2	General Purpose BNC to BNC Cable (2 ft)
7007-1	Shielded GPIB Cable, 1m
7007-2	Shielded GPIB Cable, 2m
7051-2	General Purpose BNC to BNC Cable, 0.6m (2 ft)
7051-5	General Purpose BNC to BNC Cable, 1.5 (5 ft)
7755	50Ω Feed-Through Terminator

COMMUNICATION INTERFACES

KPCI-488	GPIB/IEEE488 Interface Board for PCI Bus
KUSB-488	GPIB/IEEE488 Interface Board for USB Port

APPLICATION AREAS

- **High speed serial communication characterization**
- **Nanotechnology**
- **Materials characterization**
- **Semiconductor**
  - **Charge pumping**
  - **AC stress testing**

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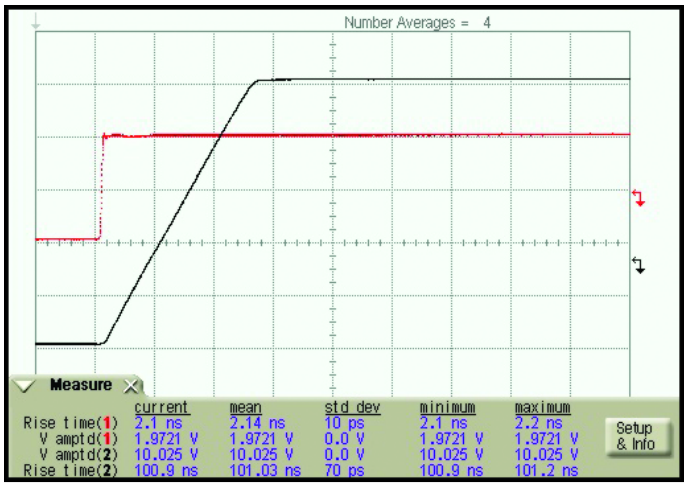
Figure 1: Superior Pulse Fidelity with Precision Edge Control.



Instrument Features

- **Large, backlit LCD display:** Makes it easy to configure the generator's operation or confirm parameter settings with a glance.
- **Enter or adjust parameter values quickly:** Use the cursor keys and either the numeric keypad or control knob.
- **Single-function keys:** Provide instant access to the main parameter menus.
- **BNC output:** One channel (Model 3401) or two channels (Model 3402).
- **Enable the pulse output with a single key press.**
- **High speed Trigger and Strobe outputs:** Coordinate the operation of external instruments, such as oscilloscopes or other pulse generators, with the Model 3401/3402.
- **High speed Clock and External Instrument inputs:** Support tight integration with other pulse generators to produce multiple pulse trains.
- **Context-sensitive soft menu keys:** Provide fast access to the commands in the sub-menus for configuring the desired pulse or pattern parameters, without the need for confusing shift-keying and cursor control.
- **Rear output option:** Moves the BNC, Trigger, and Strobe outputs and Clock and External inputs from the instrument's front panel to the rear for greater convenience in rack-mounted environments.
- **Reference Oscillator input and output:** Simplify coordinating multiple Series 3400 pulse/pattern generators with an external 10MHz signal for PLL reference.
- **Ports for GPIB and USB interfaces:** Allow controlling the instrument via an external computer, rather than the front panel controls.
- **Trigger Modes**
  - Continuous: Trigger circuitry is always armed.
  - Started: Trigger arming is edge sensitive, requires a selected edge prior to allowing trigger event.
  - Gated: Trigger arming circuitry is level sensitive, always armed when selected level is present.

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Series 3400 Pulse/Pattern Generators

- **Pulse Period Source and Burst/Pattern Period Source**
  - PLL oscillator
  - VCO (triggerable oscillator)
  - CLK IN
- **Amplitude Settings:** High/Low level or Amplitude/Offset are adjustable. Source impedance selectable, 50Ω or 1kΩ. Amplitudes double for 1kΩ. Channels have independent settings. Amplitudes may be set in either voltage or current units.
- **Timing:** Delay and duration are fully adjustable. Can also be programmed as duty cycle. Period is adjustable and can also be set as frequency. In NRZ pattern mode, crossing point is available instead of duration/duty cycle. Delay and duration are independently adjustable for each channel. Period is a common parameter.
- **Transition Time:** Leading and trailing edges can be independently adjusted for each channel.
- **Pattern:** PRBS (2^n-1 with n = 5–14), user programmable, or preset patterns can be specified. NRZ or RZ formats. User and preset patterns are two bits to 64kbits in length.

Specifications

BASIC MODES OF OPERATION

The Pulse Pattern generator may be set in one of four available modes: Pulse, Pattern, Burst, and External Width.

PULSE/LEVEL PARAMETERS

PULSE AMPLITUDE[1]: 100mV to +10V 50Ω into 50Ω
200mV to +20V 1kΩ into 50Ω.

LEVEL WINDOW[2]: –10V to +10V 50Ω into 50Ω
–20V to +20V 1kΩ into 50Ω.

LEVEL ACCURACY: ±(1% + 50mV) 50Ω into 50Ω
±(1% + 100mV) 1kΩ into 50Ω.

OUTPUT RESOLUTION: 10mV 50Ω into 50Ω
20mV 1kΩ into 50Ω.

OVERSHOOT/PRE-SHOOT/RINGING[3]: ±5% ± 20mV

SOURCE IMPEDANCE[4]: 50Ω or 1kΩ, selectable.

RISE/FALL PARAMETERS

RISE/FALL TIMES[5]: <2.5ns to 200ms, adjustable
2.5ns maximum at 10V p-p
2.3ns typical at 5V p-p
2.1ns typical at 2V p-p.

RISE/FALL TIME ACCURACY: ±10% ± 200ps.

RISE/FALL RANGES: 2ns–20ns, 10ns–200ns, 100ns–2μs, 1μs–20μs, 10μs–200μs, 100μs–2ms, 1ms–20ms, 10ms–200ms.

BURST MODE PARAMETERS

NUMBER OF PULSES: 2–65,536.

PATTERN MODE PARAMETERS

PATTERN: Data Pattern Length[6]: 2-16384 bits.
PRBS: 2^n–1 with n = 5–14.

DATA FORMATS: NRZ, RZ.

CLK IN AND EXT IN PARAMETERS

INPUT IMPEDANCE: 50Ω or 10kΩ.

THRESHOLD: –3V to +3V

MAXIMUM INPUT VOLTAGE: ±6V

COUPLING: DC.

TRIG OUT AND STROBE OUT PARAMETERS

OUTPUT IMPEDANCE: 50Ω.

LEVELS: TTL (0V/2.4V).

MAXIMUM EXTERNAL VOLTAGE: –2V to 5V

COUPLING: DC.

REF OSC IN AND REF OSC OUT PARAMETERS

IMPEDANCE: 50Ω, AC coupled.

REF OSC IN SIGNAL: 10MHz, 0dBm typical, 20dBm max.

OUTPUT AMPLITUDE: 10MHz, 1Vp-p typical.

GENERAL

POWER: 100V to 240V; Single phase; 50/60Hz; universal voltage input.

COMPLIANCE: CE; EN 061010-1; EN 61326-1.

CALIBRATION: Annual calibration cycle in system.

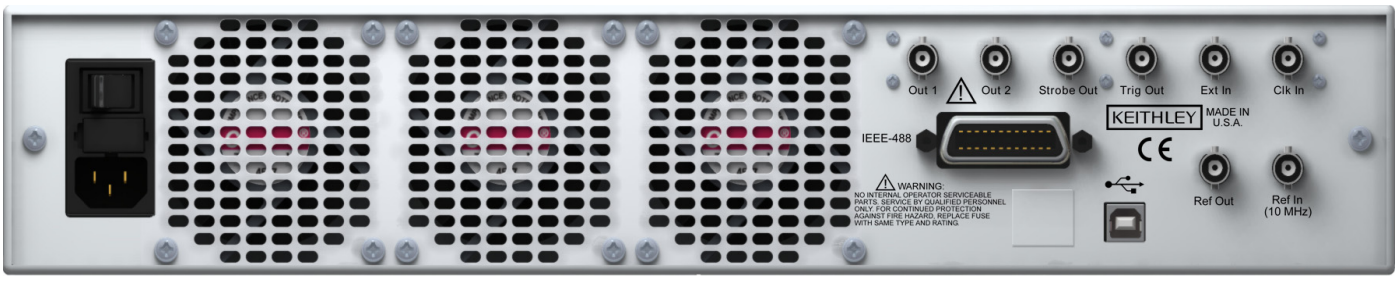
OPERATING TEMPERATURE: 0° to 55°C.

INTERFACES: The Pulse Pattern generator may be controlled via either the front panel GUI interface, a GPIB interface, or a USB interface. IEEE 488.2, SCPI compliant.

DIMENSIONS: 439 mm wide × 87 mm high × 393mm deep (17.3 in × 3.4 in × 15.5 in) .

NOTES

1. Amplitude may be set in either voltage or current units.
2. Level may be set in either voltage or current units.
3. ±1% at 10V p-p typical; ±2% at 5V p-p typical.
4. ±1% typical.
5. 10% to 90%, higher for 1kΩ source impedance, rising and falling edges independent within selected ranges.
6. Pattern for each channel is independent, must be same length.



Model 3402-R, Dual-Channel with Rear Outputs

Series 3400 Pulse/Pattern Generators

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