Measurably better value

Double Pulse on the TGP3100 Series

Application Note
82110-0160-1

Products:

TGP3151
TGP3121
TGP3152
TGP3122

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Double Pulse Testing

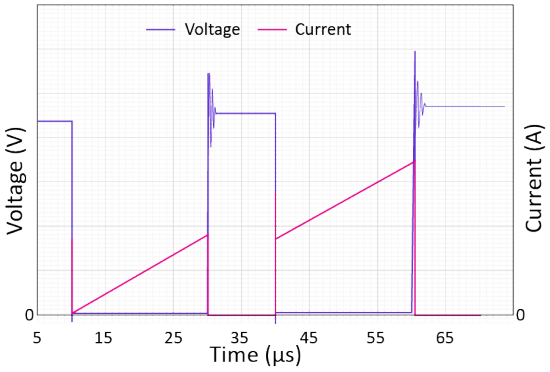
Double pulse testing is a method used to evaluate the performance and behaviour of electronic devices, especially in power electronics, under two consecutive electrical pulses. The technique is commonly used in testing components like semiconductor devices, circuits, and systems to assess their response to rapid changes in voltages or current.

The TGP3100 Series true pulse generators offer incomparable versatility in generating the double pulse waveform required for this testing.

Width Range	10ns to ~500s
Width Accuracy	±200ps ±0.01% of period
Width Resolution	100ps
Delay range	0ns to ~1000s
Delay Accuracy	±200ps ±0.01% of period
Delay Resolution	100ps
Edge Time Range	5ns to ~400s
Edge Time Accuracy	±500ps ±0.01% of period
Edge Time Resolution	100ps
Double Delay Range	20ns to ~1000s
Double Delay Accuracy	±200ps ±0.01% of period
Double Delay Resolution	100ps

TGP3100 Double Pulse Specification

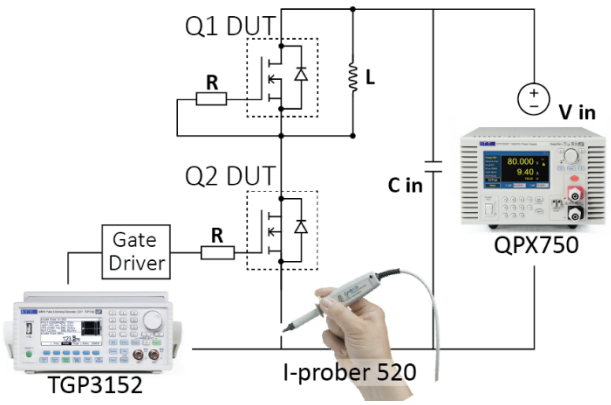
In power electronics, double pulse test is a commonly used method to characterise the switching performance of power semiconductor devices, like MOSFETs, IGBTS, or diodes, within a circuit.



Typical simulation results of a double pulse setup

The double pulse waveform for these applications can be generated using a microcontroller, but this requires a lot of effort and considerably more time to program.

Typically, the double pulse is generated using a function / arbitrary waveform generator where the desired double pulse waveform is created as an arbitrary waveform. The arbitrary waveform is often created using a PC waveform creation software platform and then downloaded to the instrument and played out.



Typical double pulse test setup

However, to change any parameters of the double pulse waveform generated using this way will require recreation and reloading of the pulse waveform in the waveform memory. Many function generators have limited high speed memory to play back the waveform, which may limit the creation of pulses with narrow widths and long periods, as well as limiting the setting resolution of these parameters.

Some function / arbitrary waveform generator models offer pre-configured application that can be downloaded in the instrument to allow quick set up of the double pulse for ease of use. But they are still essentially arbitrary waveforms and therefore requires reloading of high-speed memory to vary pulse parameters which will cause phase discontinuity or glitches. Setting resolution, narrow widths and long periods will still be limited by the size of the memory. Typically, these pre-configured applications generate double pulses with fixed edge times. This can sometime be a limitation.

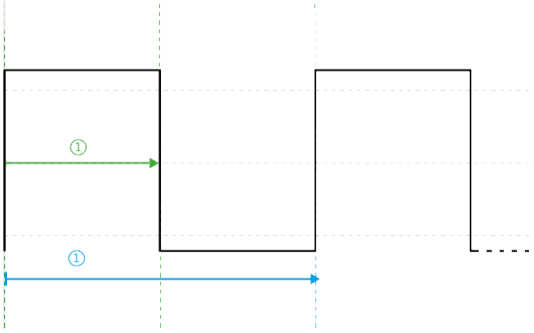
In the TGP3100 Series of products the double pulse waveform is a standard waveform that generates two identical or independent pulses in each cycle with fully variable delay between the two and can be selected simply by pressing the 'Double Pulse' hard key on the front panel. The waveform is generated using all-digital techniques and allows the user to instantly update any of the double pulse parameters without disrupting the process.

At its price point, the versatility and performance of TGP3100 high precision pulse generators is unrivalled. It can generate pulse waveforms up to 50 MHz repetition rate with incredibly low jitter (<30ps RMS). Pulse timing parameters such as period, delay, width, rise and fall times can all be varied with a setting resolution of 100ps without any glitches.
The following sections describe and illustrate pulse parameter definitions to demonstrate TGP3100 capabilities in the setting of these parameters.

Pulse Definition

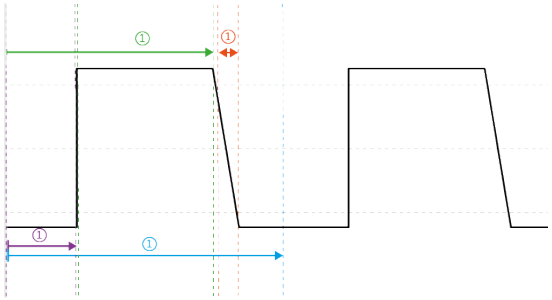
Period

Pulse period can be set as either period or frequency ①.



Width

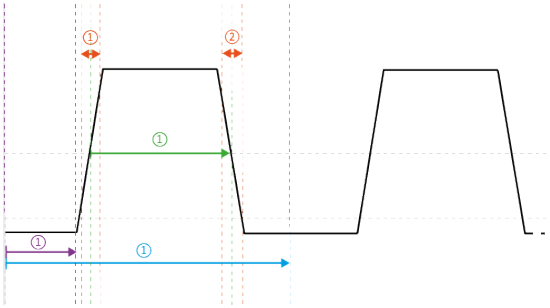
Width can be specified as width in seconds ①, where it will be independent of changes in pulse period, delay and rise and fall times.
Width can also be specified as a percentage of period, where if period is changed, then width will be adjusted to maintain the duty cycle.



Width can also be specified as fall time delay ①, defined as the delay from the start of the pulse to the start of the falling edge, where the fall time delay will be independent of changes in pulse period, delay and rise and fall times.

Delay

Delay ① can be specified as delay in seconds, where it will be independent of changes in other pulse parameters, or can be specified as a percentage of period, where if period is changed, then delay will be adjusted accordingly.



Edge

Rise and fall times ①② can be independently varied or can be varied together simultaneously and can be specified in seconds, or as a percentage of width.

Double Pulse Definition

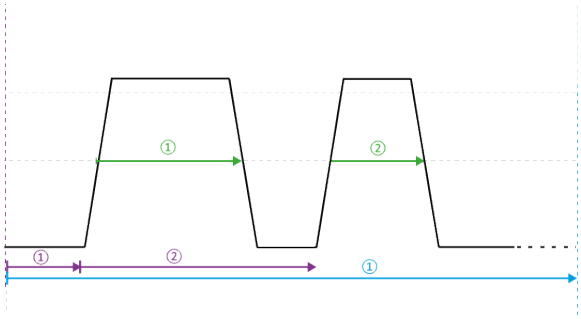
Double Pulse retains the same flexibility as the pulse setting with additional options to control the interaction between the two pulses.

Period

Double pulse period can be set as either period or frequency ①.

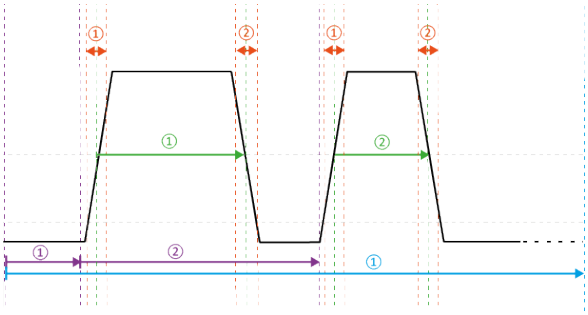
Coupled or independent width

The two pulses in double pulse function ①② can either be of identical widths or can be set independently using the Independent or Coupled mode setting.



Double pulse delay

Double pulse delay allows the user to set a delay between the pulses ②. The delay can be set in terms of a percentage of the period or in seconds with 100ps resolution.
While changing any of the timing parameters, there will never be glitches or drop-outs at the output.



Edge

Rise and fall times ①② can be independently varied as a rise value and a fall value for both edges or can be varied together simultaneously and can be specified in seconds, or as a percentage of width.

KEY:

- Pulse Period
- Pulse Width
- Delay
- Rising and falling edge

Versatile TGP3100

The capabilities listed above will offer the following advantages.

Enhanced Efficiency

Switching parameters can be adjusted more accurately to minimize losses and improve the overall efficiency of power electronic systems.

Better Thermal Management

Precise control over pulse parameters helps in better thermal characterization and management, ensuring that devices operate within safe temperature limits.

Reduced Electromagnetic Interference (EMI)

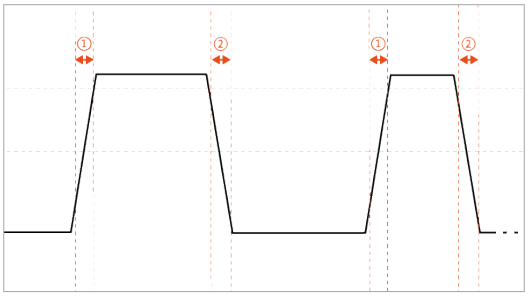
Finer resolution enables more detailed analysis and mitigation of EMI, leading to cleaner and more reliable operation of power electronic systems.

Flexibility in Testing

The flexibility of TGP3100 double pulse will make it easier to simulate real-world operating conditions in various test scenarios and improve the robustness of the design.

Improved Signal Integrity

Shaping the pulse edges can help in minimizing signal reflections and distortions, leading to better signal integrity. Edge shaping can reduce ringing and overshoot in the signal, which can otherwise lead to unwanted oscillations and potential damage to components.



Conclusion

TGP3100 double pulse feature is not just ideal for double pulse testing but will find application in numerous other test scenarios.

The double pulse can be modulated with AM, FM, PM, FSK, BPSK, and SUM modulation. The widths of the double pulse can be modulated to perform pulse width modulation (PWM). The delay can be modulated to perform pulse delay or position modulation (PDM/PPM). It is also possible to modulate just the width or the delay of the second pulse (SPWM, SPDM).

It can also be triggered (Gated or Triggered Burst) either using an internal timer or an external trigger source with external trigger to output jitter of typically 60ps RMS.

The pulse output can either be set in terms of peak-to-peak amplitude and a DC offset, or as a high-level and low-level. The maximum and minimum voltage levels depend upon the source and load impedances. The maximum and minimum EMF amplitudes (high impedance load) are 22V pk-pk and 200mV pk-pk respectively. The maximum and minimum high and low EMF levels are +11V and -11V.

The versatile TGP3100 will be ideal for many test applications in the field of communication systems, testing and simulation of digital circuits, medical and biological research, military and aerospace, optical and photonic systems, and general educational and research purposes.

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