

Generating narrow pulses with highest level accuracy and repeatability with the R&S®SMA100B

Radar equipment is always designed to work at the technologically feasible limits. Therefore the true performance of radar equipment can only be measured with the most accurate and reliable pulsed test signals. The R&S®SMA100B analog RF and microwave signal generator with its high-quality pulse modulator provides narrow pulse modulation. Thanks to a powerful closed-loop level control concept also for narrow pulses, outstanding level accuracy and repeatability is now available for pulse widths starting at 100 ns.

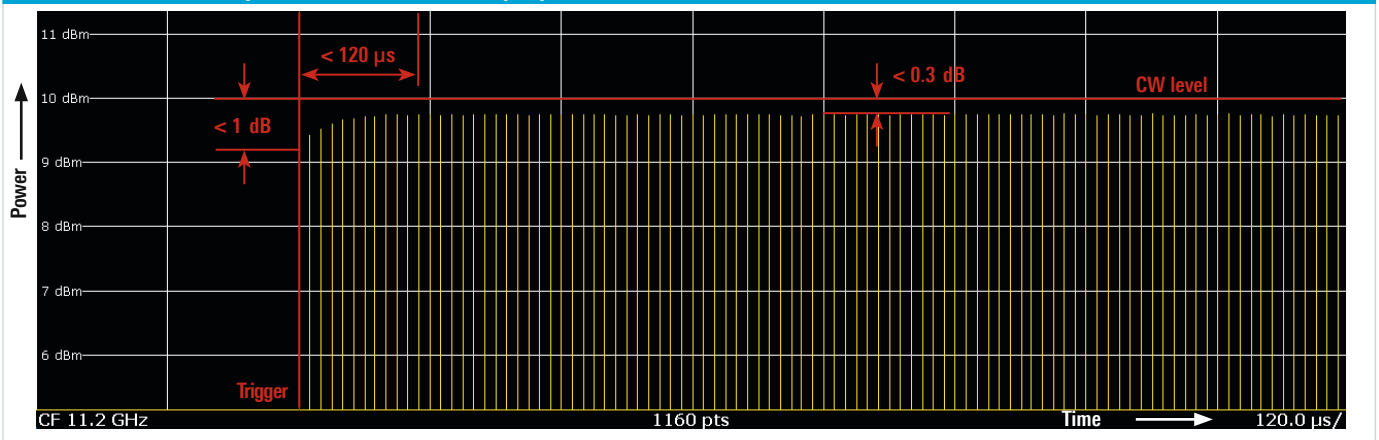
Your task

Narrow unmodulated pulses are used for short range imaging and also in scenarios with high pulse repetition frequency (PRF) for unambiguous Doppler estimation. Duty cycles of pulsed signals can vary and can easily be down in the range of a few percent. Since radar equipment is optimized for pulsed operation, it cannot tolerate too much average RF power and is – by its nature – very sensitive to power level changes. In order to measure the true performance of individual radar components or modules, the quality of the pulsed test signals is key. Due to the low duty cycle, pulses only occur from time to time, but they still need to have high level accuracy and repeatability. The pulse amplitude must not drift over time due to temperature variations during testing.

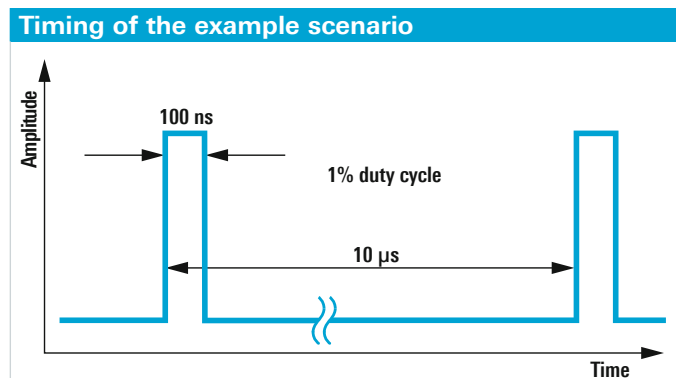
T&M solution

The R&S®SMA100B analog microwave signal generator with its high-performance pulse modulator is the perfect solution for this application. The R&S®SMA100B provides pulses that are closed-loop level controlled by its modern digital automatic level control (ALC). The ALC implemented in the R&S®SMA100B can control the level of narrow pulses (≥ 100 ns pulse width) even when they have a very low duty cycle. It ensures exceptional level accuracy and outstanding level repeatability. The pulse width for closed-loop level control is 10 times better than that of competitor products and 5 times better than that of the R&S®SMF100A.

Transient response of the R&S®SMA100B RF output signal with externally supplied pulses (11.2 GHz, 100 ns pulse width, 1% duty cycle)



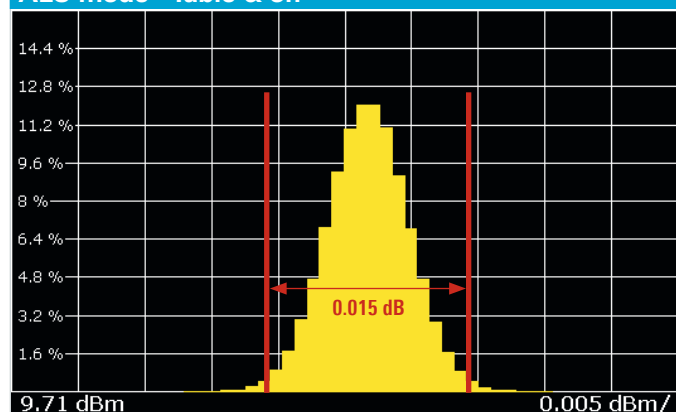
The pulse modulator of the R&S®SMA100B signal generator achieves its outstanding performance without a sample and hold mechanism, ensuring safe operation conditions for sensitive devices under test. The figure on the previous page shows an example of the transient response of the R&S®SMA100B for externally supplied narrow pulses with a 100 ns pulse width and 1 % duty cycle.



The pulses occur immediately at the RF output with high level accuracy and repeatability. The settling time of the top power level is < 120 μs. The top power level deviation of the first pulse from the CW level is < 1 dB.

The residual deviation of the final top power level from CW is < 0.3 dB. State-of-the-art signal generators show a transient response in the range of milliseconds. To avoid long transient responses for narrow pulses, the R&S®SMA100B preloads the integrator of the ALC with correction data from its internal alignment process for the first pulse, a concept normally only used in vector signal generators. The closed-loop level control effectively eliminates temperature effects even for narrow pulses with low duty cycle.

Measured level repeatability of narrow pulses, 11.2 GHz, 100 ns pulse width, 1 % duty cycle, ALC mode "Table & on"



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Level repeatability for narrow pulses with pulse widths down to 100 ns

In ALC mode "Auto", the R&S®SMA100B automatically chooses the best ALC mode. The ALC loop works with narrow pulses from the R&S®SMAB-K23 internal pulse generation option or with pulses from an external source. For narrow pulses, the best mode is "Table & on". In this mode, the ALC engine is preloaded with internal adjustment data and after the first pulse, the control loop is closed. This results in lowest settling time and highest accuracy and repeatability. The histogram on the bottom left shows the top power level distribution measured over 10 minutes.

The control loop runs continuously and corrects all level drifts with excellent pulse to pulse repeatability. In this example, almost all top power levels are within a range of 0.015 dB. The pulse width is 100 ns at a duty cycle of 1 %.

Level accuracy and level repeatability for narrow pulses with pulse widths less than 100 ns

For pulse widths below 100 ns, the R&S®SMA100B offers the ALC mode "Table". This mode does not use a closed feedback loop. It uses open-loop level control. Correction values are taken from internal adjustment tables. It works for both internally generated pulses and pulses from an external source.

Pulse modulator performance of the R&S®SMA100B equipped with the R&S®SMAB-K22 option

Parameter	Value
Minimum pulse width	< 20 ns
Minimum pulse width with closed-loop level control	100 ns
Rise and fall time	5 ns (typ.)
Measured on/off ratio	100 dB

Key benefits

- Closed-loop level control for narrow pulses starting with 100 ns pulse width
- Immediate pulse output at RF port with very fast transient response
- Open-loop level control for narrow pulses with pulse widths < 100 ns
- Excellent absolute level accuracy of pulsed signals
- Excellent level repeatability of pulsed signals
- No sample and hold mechanism needed

See also

<https://www.rohde-schwarz.com/product/SMA100B>

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