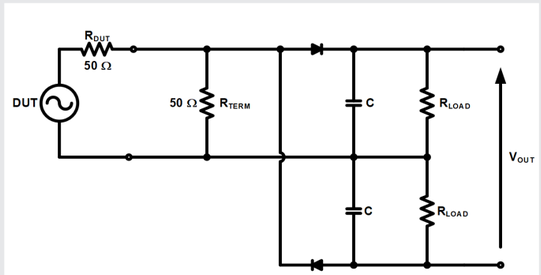
PRINCIPLES OF RF & MICROWAVE POWER MEASUREMENT

How Is RF Power Detected?

High-frequency diodes detect the RF voltage developed across a terminating load resistor. The diodes directly perform an AC to DC conversion, and the DC voltage is measured by the power meter and scaled to produce a power readout.

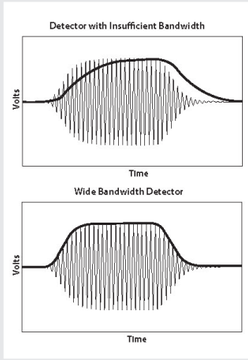
The relation of the DC voltage to the power measured is dependent on the diode region of operation.



Peak sensors use a low-impedance load across the smoothing capacitors to discharge them very quickly when the RF amplitude drops. This, in combination with a very small smoothing capacitance, permits peak power sensors to achieve fast rise times and wide video bandwidths.

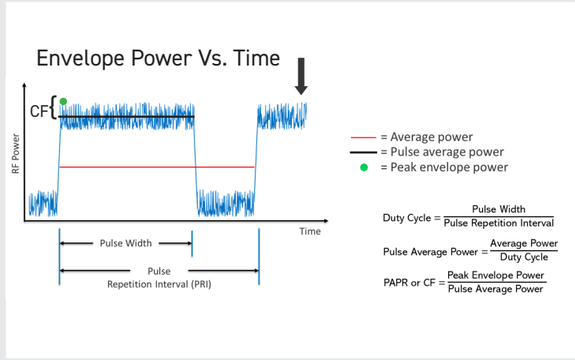
Why Are Video Bandwidth and Rise Time Important?

- Video bandwidth (VBW) describes the ability of a sensor to track envelope power
- Rise time characterizes the response time (t_r) of the power measurement circuit and it is inversely proportional to the video bandwidth; VBW ≈ 0.35/t_r
- Video bandwidth and fast rise time are critical in acquiring reliable measurements for envelope, average, pulse and peak power

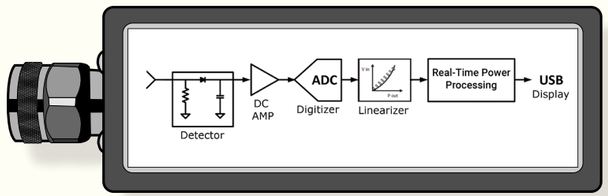


Peak vs. Average Power Measurements

- Average power is the average energy transfer rate across many time periods of the RF waveform
- Envelope power is the average power over one or a few cycles of the carrier
- Pulsed average power is the average power over the duty cycle of the pulse
- Peak envelope power (PEP) is the singular maximum value of the envelope power
- Crest factor (CF), or peak-to-average power ratio (PAPR), is the ratio of peak envelope power to pulsed average power
- Peak power sensors can make these measurements and more



Real-Time Power Processing

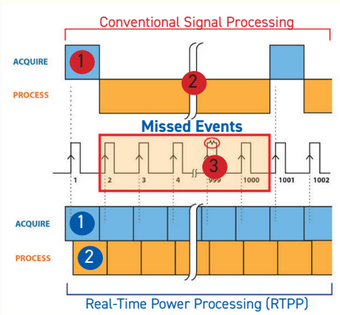


Conventional Signal Processing

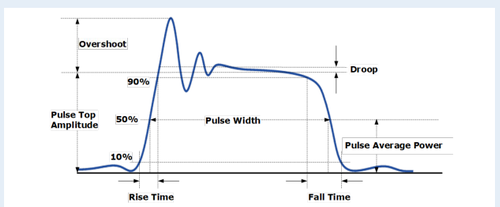
1. Enough samples are captured to create a trace on the screen
2. Sample acquisition is HALTED to perform the process of converting samples to a trace
3. Important data and events from DUT are lost during the long processing cycle

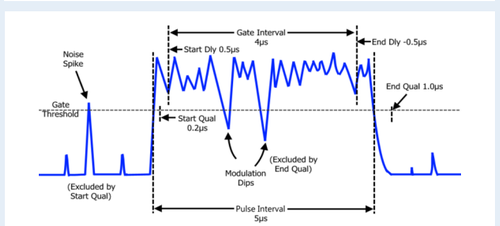
B&K Precision's Unique Real-Time Power Processing (RTPP)

1. Samples are captured and quickly processed in parallel to the acquisition
2. Acquisition is never halted and data continues to be captured **VIRTUALLY NO INFORMATION IS LOST**



Pulsed Power Measurements





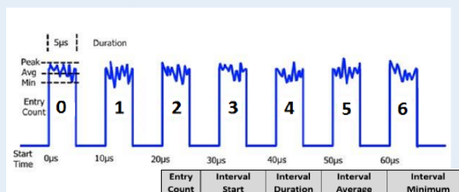
B&K Precision power meters provide up to 16 pulse measurements automatically:

- Pulse width
- Rise time
- Fall time
- Period
- Pulse repetition frequency
- Duty cycle
- Off time
- Waveform average
- Pulse average
- Pulse peak
- Pulse top power
- Pulse bottom power
- Droop
- Overshoot
- Edge delay
- Skew

Gate qualifiers and delay options can be used to include or exclude portions of a pulse.

Measurement Buffer Mode

B&K Precision real-time power sensors include a measurement buffer mode that has the ability to collect and process samples from a virtually unlimited number of consecutive pulses. Information provided for each pulse:



Entry Count	Interval Start	Interval Duration	Interval Average	Interval Minimum	Interval Peak
0	0.00 us	5.01 us	-0.043 dBm	-39.042 dBm	8.826 dBm
1	9.99 us	5.00 us	-0.006 dBm	-38.431 dBm	8.827 dBm
2	19.99 us	5.01 us	0.039 dBm	-41.549 dBm	9.742 dBm
3	30.00 us	5.00 us	0.017 dBm	-38.551 dBm	9.802 dBm
4	40.01 us	5.00 us	0.022 dBm	-40.699 dBm	9.477 dBm
5	49.99 us	5.00 us	-0.020 dBm	-39.706 dBm	8.102 dBm
6	60.00 us	5.00 us	0.036 dBm	-37.803 dBm	9.750 dBm

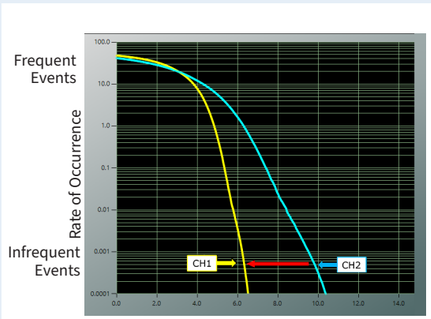
Statistical Measurements

A CCDF curve shows the rate of occurrence of a specific crest factor.

The power level is expressed in dB relative to the average power.

CH1 is the output of the amplifier. CH2 is the input of the amplifier.

The red arrow indicates the CH1 crest factors have decreased indicating the amplifier output is compressed.



Complementary Cumulative Distribution Function