APPLICATION NOTE

Measuring the Burst Time-Gated Power Signal of Wireless Technologies Using Keysight Power Sensors

For TDMA, GSM, WiMAX™, WLAN, and LTE devices

KEYSIGHT TECHNOLOGIES

Introduction

Measuring pulse, burst, or modulated signals for wireless technologies such as TDMA, GSM, WLAN, WiMAX, and LTE is very important because it is part of functionality testing and power amplifier module verification during the manufacturing process. High-performance, and average and peak power meters and power sensors are required for measuring the average power and crest factor (peak-to-average ratio) of modulated signals throughout various research and development stages and the manufacturing verification process. To measure the average power of a time-gated pulse or burst signal in a specific timeframe, a lower cost solution is sufficient.

As this application note illustrates, the compact Keysight Technologies, Inc. U2000A Series USB power sensor is a low cost solution for measuring the average and time-gated average power of burst signals. The Keysight U2020 X-Series USB peak and average power sensor is a high performance USB power sensor with additional 30 MHz video bandwidth capability for measuring average, peak, and peak-to-average power burst signal. Both USB power sensors series allow the power measurement to be displayed on a PC and provide the same functionality and performance as conventional average power and peak power meters and sensors.

In this paper, we pick one of the wireless technologies; timeslot burst structure signal, GSM (Global System for Mobile communication) for reviewing.

This application note applies to the following products from Keysight

- U2020 X-Series USB peak and average power sensor
- U2000A Series USB average power sensor

Methodology

This demonstration shows the power measurement of the GSM timeslot burst signal structure. The GSM burst signal consists of eight timeslots (slots 0 to 7) each having a 4.613 ms frame duration and a duration of 577 µs (see Figure 1). The GSM signal can be transmitted using the same carrier frequency simultaneously, occupying different timeslots. In other words, each GSM timeslot can be turned on and off, allowing the transmission to be used to verify the functionality of power amplifier module.

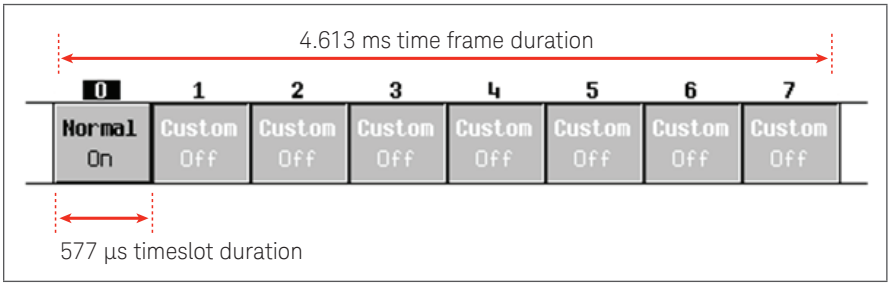

Figure 1. GSM timeslot pattern with timeslot 0 On

Using a USB average/peak power sensor to measure the GSM timeslot (with GSM timeslot 0 On) provides 447 µs for gated duration after having 80 µs offset at the rising edge of the signal and 50 µs offset at the falling edge of the signal (see Figure 2). This ensures that the measurement is not affected by the trigger jitter and settling time of the USB average/peak power sen

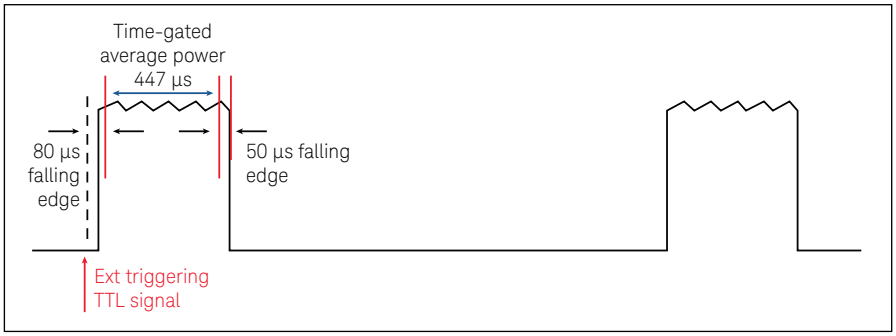

Figure 2. Measuring GSM timeslot 0 with USB average/peak power sensor

Measuring Time-Gated Burst Power

A USB average/peak power sensor offers two triggering mechanisms to perform the average time-gated burst power measurement: external and internal. Both triggering mechanisms allow the gate offset (rising edge), and gate length (time-gated duration) to be specified. Once set, configure the USB average/peak power sensor in gated mode to perform the measurement.

External triggering

External triggering requires a trigger signal that comes from other instruments via the sensor's built-in TTL-compatible trigger input. The USB average/peak power sensor has built-in trigger circuitry that controls the timing of a pulse-signal capture to enable measurement synchronization with an external instrument or event. An external signal greater than 1.9 V applied to the TRIG IN of a USB average/peak power sensor triggers the power sensor to start capturing the measurement.

Measuring Time-Gated Burst Power *(cont'd)*

Internal triggering

With internal triggering, an adjustable measurement-dependent threshold is used to define the trigger point of the signal being measured. This is especially useful for measuring pulses that do not occur at fixed intervals. Internal triggering does not require an external triggering signal to trigger the power sensor to start capturing the measurement.

Test Configuration and SCPI Commands

Figure 3 and Figure 4 illustrate the measurement configuration when using external and internal triggering respectively.

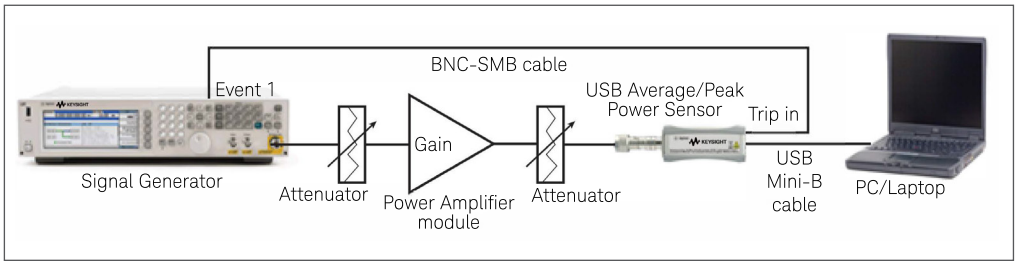

Figure 3. Simple setup diagram of a time-gated burst power measurement with a USB average/peak power sensor's external triggering mechanism

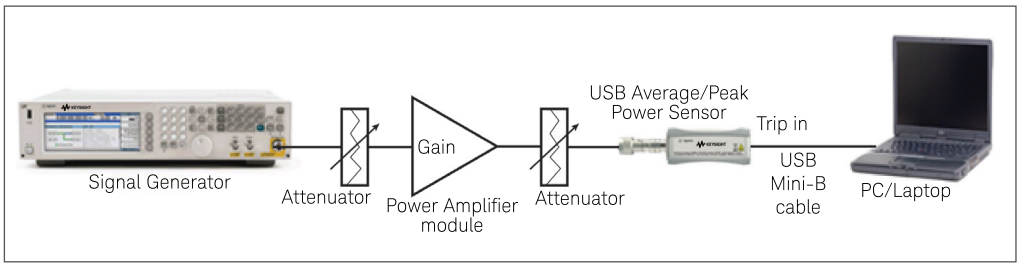

Figure 4. Test setup when using the USB average/peak power sensor with internal trigger to measure the burst-gated signal of a power amplifier module

Test Configuration and SCPI Commands *(continued)*

Measurement data is acquired using the following SCPI commands.

SCPI	Description
Keysight ESG/MXG/EXG signal generator	
SYST:PRES	Preset the instrument to its default settings
FREQ 1GHZ	Set frequency to 1 GHz (example)
POW:LEVEL 0DBM	Set output power to 0 dBm (example)
OUTP:MOD:STAT ON	Turn on modulation signal
OUTP:STAT ON	Turn on RF output
For ESG signal generator only	
SOUR:RAD:GSM:STAT ON	Recall GSM burst signal waveform
SOUR:RAD:GSM:BURST:STAT ON	Turn on GSM burst signal waveform
For MXG/EXG signal generator only	
SOUR:RAD:ARB:WAV \"WFM1:GSM_BURST_WFM\"	Recall GSM burst signal waveform
*OPC?	Wait for operation to complete. A return of 1 means the operation has been completed
SOUR:RAD:ARB:STAT ON	Turn on GSM burst signal waveform
ROUT:CONN:EVENT1 M2	Set triggering event to Event1
For U2020 X-Series USB peak power sensor and U2000A Series USB average power sensor only	
SYST:PRES	Preset the instrument to its default settings
SENS:FREQ 1GHZ	Set frequency to 1 GHz (example)
SENS:AVER:SDET OFF	Turn off the step detector
SENS:DET:FUNC NORMAL	Set measurement to Normal mode for burst-signal power measurement
TRIG:SOUR EXTERNAL	Set triggering source to “EXTERNAL” Note: If triggering source is “INTERNAL”, execute below SCPI TRIG:SEQ:LEVEL –20 (example –20 dBm)
SENS:SWEEP:OFFSET:TIME 80u	Set offset time duration of burst signal upon triggering to 80 us (example)
SENS:SWEEP:TIME 447u	Set sweep time duration of burst signal to 447 us (example)
SENS:AVER:COUNT 1	Set average count to 1 (example)
INIT:CONT OFF	Set to Single Trigger mode. In this mode, return the measurement using READ?
SENS:MRATE FAST	Set measurement speed to Fast mode to improve the measurement speed. Note: Applicable for U2020 X-Series USB peak power sensor only. (The default speed mode is Normal)
CALC:FEED \"POW:AVER ON SWEEP\"	Set Input Measurement mode to time-gated average power
READ?	Query time-gated average power
For U2020 X-Series USB peak power sensor only	
CALC:FEED \"POW:PEAK ON SWEEP\"	Set Input Measurement mode to time-gated peak power
READ?	Querying time-gated peak power
CALC:FEED \"POW:PTAV ON SWEEP\"	Set Input Measurement mode to time-gated peak-to-average power
READ?	Querying time-gated peak-to-average power

Conclusion

The low-cost U2000A Series USB power sensor and high performance U2020 X-Series USB peak and average power sensor support internal and external triggering, making it easy to measure the necessary pulse, burst or modulated signals for wireless technologies such as TDMA, GSM, WLAN, WiMAX, and LTE.

References

- *Keysight U2000 Series USB Power Sensor GSM Timeslot Burst Power Measurement*, application note, literature number 5990-4447EN.
- *Keysight U2020 X-Series USB Peak and Average Power Sensor*, demonstration guide, literature number 5991-1221EN.

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

KEYSIGHT TECHNOLOGIES