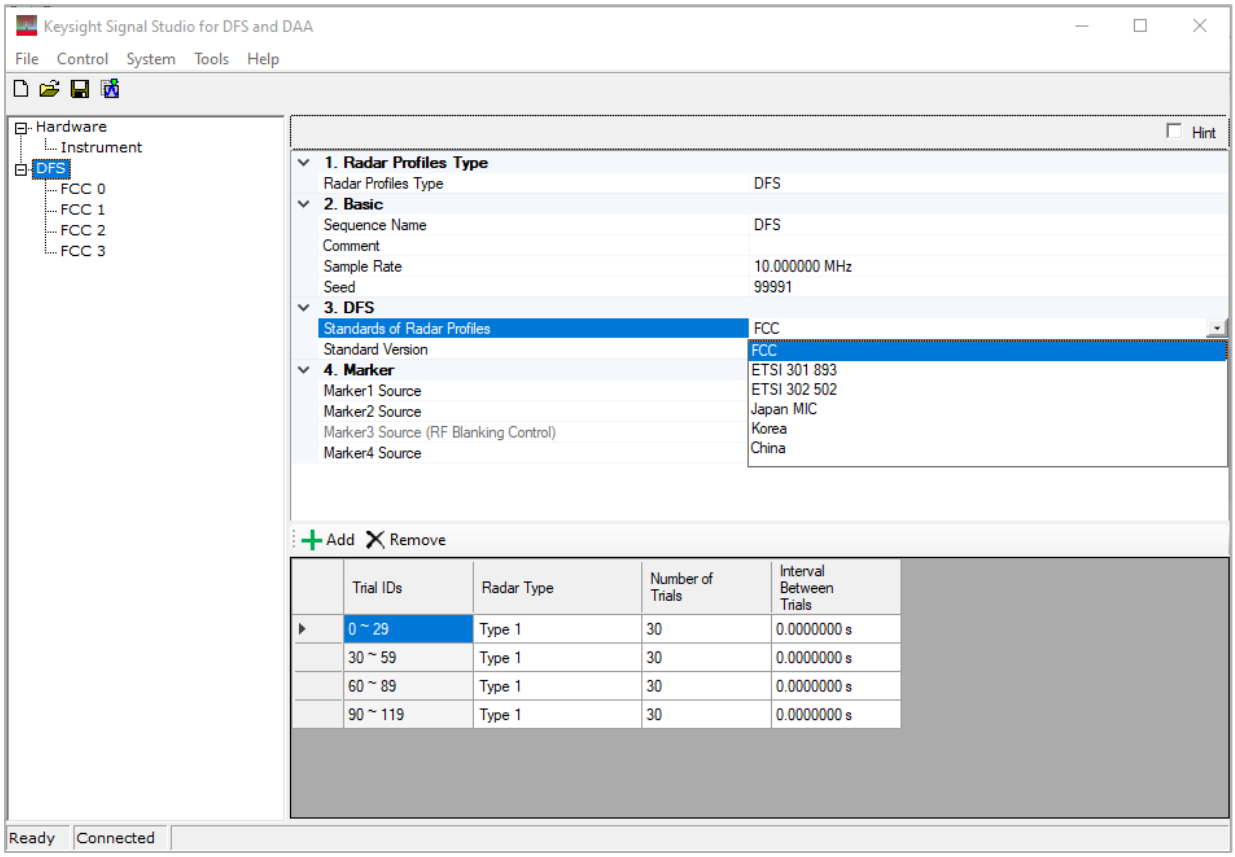
N7607C Signal Studio for DFS and DAA

2025 Update 1.0 release

Key Features

- Create Keysight validated and performance optimized DFS profiles
- Enable creation of FCC, ETSI, Japan MIC, Korea, or China compliant signals for DFS test
- Create Keysight validated and performance optimized DAA profiles
- Enable creation of ETSI compliant signals for DAA test
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation



KEYSIGHT

Simplify DFS and DAA test signal creation

Keysight Technologies, Inc. Signal Studio software is a flexible suite of signal-creation tools that will reduce the time you spend on signal simulation.

For Dynamic Frequency Selection (DFS) profiles and Detect And Avoid (DAA) profiles, Signal Studio's performance-optimized reference signals—validated by Keysight— enhance the characterization and verification of your devices. Through its application- specific user-interface you'll create standards-based and custom signals for DFS or DAA tests.

Signal Studio's capabilities use waveform playback mode to create and customize the waveform files needed to test DFS for fixed wireless access (FWA) devices or to test DAA for ultra wide band (UWB) devices. Its user-friendly interface lets you configure signal parameters, calculate the resulting waveforms, and download files for playback.

Apply your signals in real-world testing

Once you have set up your signals in Signal Studio, you can download them to a variety of Keysight instruments. Signal Studio software complements these platforms by providing a cost-effective way to tailor them to your test needs in design, development, and production test.

Vector signal generators

- X-Series: N5182B MXG, N5172B EXG and N5166B CXG
- E8267D PSG[1]
- M9383B VXG-m / M9384B VXG [2]
- N5186A MXG[3]
- M9484C VXG[4]

PXIe Vector Transceiver

- M9420A / M9421A VXT
- E6640A EXM Wireless Communication Test Set[2]
- E6680A/E6680E Wireless Test Set[4]

1. When N7607C runs with the PSG for DFS testing, it requires option E8267D-UNW of narrow pulse modulation.
2. This requires the N7607C for DFS 2022 Update 1.0 release or above.
3. This requires the N7607C for DFS 2024 Update 1.0 release or above.
4. This requires the N7607C for DFS and DAA 2025 Update 1.0 release or above.

What is DFS (Dynamic Frequency Selection)

Unlicensed devices, typically WLAN/WiMax™, are being allowed to operate in the same frequency spectrum that is currently allocated to licensed devices, typically radar systems (mainly for military & weather). Radar systems are guaranteed to have spectrum protection. Therefore, unlicensed devices must not transmit on the same frequency upon which a nearby radar system is operating. They must instead choose an operating channel that covers a frequency range not currently utilized by a nearby operational radar. This choice is made dynamically during operation and is called Dynamic Frequency Selection (DFS).

Currently DFS is mainly defined in U-NII band, which is used primarily for WLAN systems, including three frequency bands: 5.150 to 5.350 GHz, 5.470 to 5.725 GHz, and 5.735 to 5.915 GHz.

DFS tests typically define the DFS profiles which describe the RF and time domain characteristics of a given DFS signal type. The DFS profiles are defined by various government communication agencies including FCC, ETSI, Japan MIC, Korea, and China DFS standards.

DFS signal time domain characteristics include:

- DFS pulse width (sec), pulse repetition frequency (Hz), or pulse repetition interval (sec)
- Number of pulses per DFS burst
- Number of DFS bursts

Frequency domain characteristics include::

- Burst center frequency (Hz) for a signal-burst profile which is fixed. For multi-burst frequency hopping profiles, this value changes from burst to burst.
- Chirp bandwidth (Hz)--each pulse has a linear frequency modulated chirp between each bandwidth

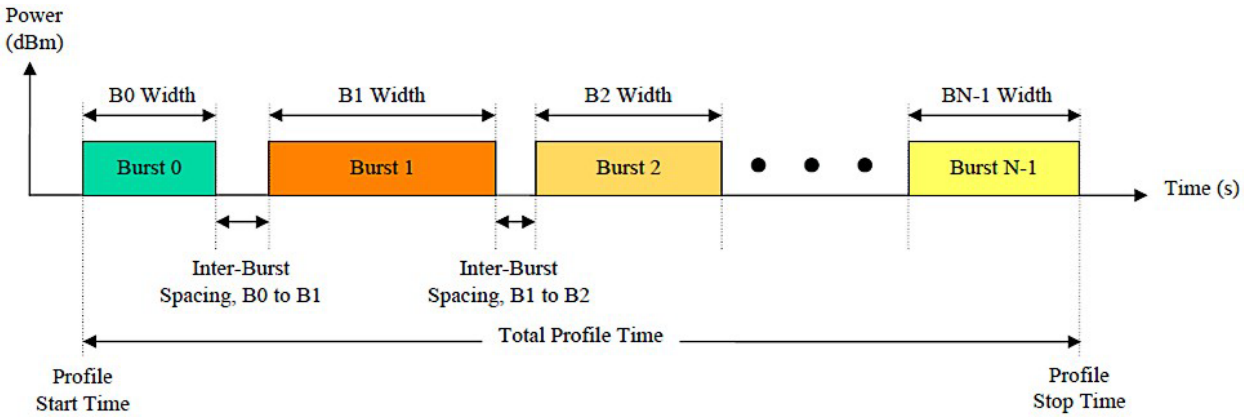


Figure 1. Time domain view of a DFS profile

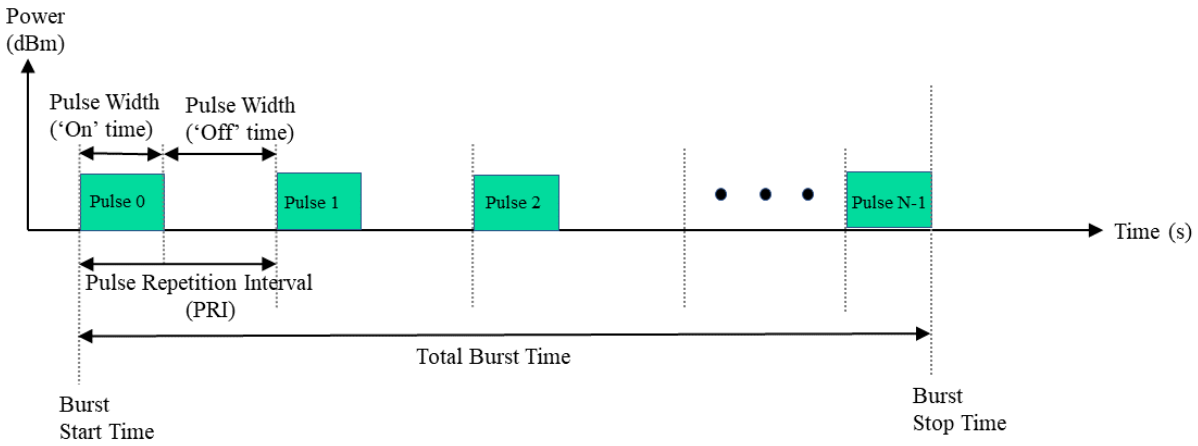


Figure 2. Burst level view of a DFS profile

What is DAA (Detect And Avoid)

The Detect And Avoid (DAA) based interference mitigation architecture is used for UWB devices to protect active victim services, in which UWB systems listen for other UWB transmissions before they themselves transmit. Before transmitting, a system should sense the channel within its operative bandwidth in order to detect the possible presence of other systems. If another system is detected, the first system should avoid transmission until the detected system disappears.

DAA tests typically define the DAA profiles which describe the RF and time domain characteristics of a given DAA signal type. The DAA profiles are defined by ETSI 102.754 standard.

DAA signal time domain characteristics include:

- DAA pulse width (sec), pulse repetition frequency (pps) or burst interval (sec)
- Number of pulses per DAA burst
- Number of DAA bursts

Frequency domain characteristics include:

- Frequency band – 3.1 to 3.4 GHz, 3.4 to 3.8 GHz, 8.5 to 9 GHz
- Modulation format and bandwidth (Hz) -- A pulse can be QPSK modulated or chirp modulated with certain frequency deviation which constitutes the modulation bandwidth.

The general structure of radio location bursts is given in Figure 3. The test patterns to be used throughout testing, together with the relevant frequencies of operation are given in Table 11.

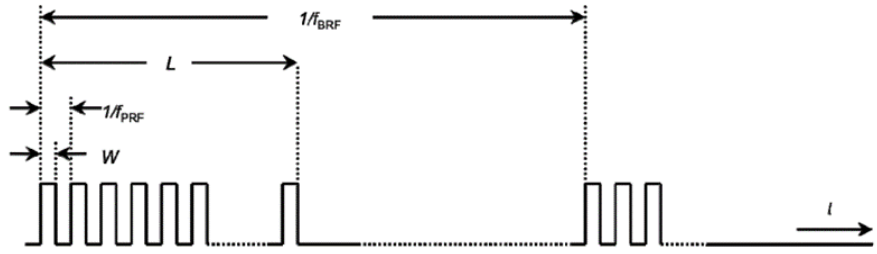


Figure 3. General structure of the bursts for DAA radiolocation test transmissions

DFS and DAA Test

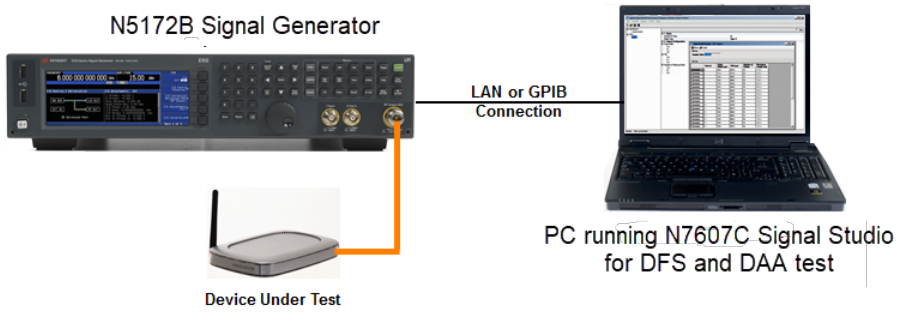


Figure 4. DFS and DAA test setup

N7607C Signal Studio for DFS and DAA can help you create FCC Part 15 Sub part E (FCC 06-96 and FCC 13-22), ETSI EN 301 893 V2.1.1, ETSI EN 302 502 V2.1.1, Japan MIC, Korea and China standard-compliant signals for DFS test, or ETSI TS 102 754 V1.3.1 standard compliant signals for DAA test, which can be used for R&D or performance test. N7607C provides a user-friendly interface to let you easily generate DFS and DAA test signals with the following steps:

1. Select Profiles Type in the tree view, for example, DFS. Next, select Standards of Profiles, and use the drop-down arrow to display a menu from which you can select the desired profile from FCC, ETSI, Japan MIC, Korea, or China standards.
2. Select the node of Standards in the tree view, for example, FCC. Next, select Radar Type, and use the drop-down arrow to display a menu from which you can select the desired type, for example, Type 5.
3. Select Create Trial List. A new window named “Trial List Table” will be displayed as the bottom graph.
4. Select Download for each trial to generate and download the waveform to the signal generator for playback. The signal for each trial is unique as required by the standards.

Typical DFS measurements include the following tests:

- DFS detection threshold
- Channel Available Check (CAC) time
- Off-channel CAC time
- Channel move time
- Channel closing transmission time
- Non-occupancy period

WLAN performance test solution including DFS function testing

N7607C Signal Studio for DFS and DAA can be paired with N7617C Signal Studio for WLAN 802.11a/b/g/j/p/n/ac/ah/ax, and integrated with a signal generator, signal analyzer and other general-purpose hardware to set up a total solution for WLAN performance testing, including DFS functional testing. This solution can provide a dramatic cost savings for customers who already own a signal generator or signal analyzer.

For more information, please visit:
www.keysight.com/find/n7617c
www.keysight.com/find/wlan

DFS features summary

N7607C standard-based tests	Features
Common	• Provide a Seed parameter to randomize the parameter sets of each trial • Number of trials (1-200) can be adjusted and waveforms generated for each trial are unique • Save and load the Trial List of radar signals for repeatability testing • All advanced trigger functions defined by the hardware instrument • Trigger type can be single, continuous, gated or segment advanced • Trigger source can be external, bus or trigger key • External source can be pattern trigger In 1 or 2 • Real-time AWGN (Opt. required) • I/Q adjustment • Sample rate adjustment
FCC	• FCC version 06-96 and version 13-22 • Type 0-4 short pulse radar test waveforms (New Type 1 is defined in FCC 13-22) • Type 5 long pulse radar test waveforms • Type 6 frequency hopping radar test waveforms • For detailed parameters of the radar test signals defined in the FCC standard for each type, please see Tables 1-3
ETSI	• ETSI 301 893 V2.1.1 and ETSI 302 502 v2.1.1 • For detailed parameters of the radar test signals defined in the ETSI standard for each type, please see Table 4-6
Japan MIC	• Japan MIC W53 and W56 radar test signals • For detailed parameters of the radar test signals defined in the Japan MIC standard for each type, see Table 7 and 8
Korea standard	• Type 1-3 fixed or variable radar profiles • Type 4 hopping radar profiles • For detailed parameters of the radar test signals defined in the Korea standard for each type, see Table 8
China standard	• Radar Type 1-4 are constant PRF based signals • Radar Type 5 and 6 are single pulse based or packet based staggered PRF radar test signals using 2 or 3 different PRF values

Table 1. Short pulse radar test waveform (Type 1-4) defined in FCC (13-22)

Radar type	Pulse width[1] (µs)	PRI (µs)[1]	Number of pulses[1]	Number of bursts	Number of trials (default = 30)
0	1	1428	18	1	1 to 200
1	1	See footnote 3	Roundup $\{\left(\frac{1}{360}\right)*\left(\frac{19*10^6}{PRI_{usec}}\right)\}$	1	1 to 30
2	1 to 5	150 to 230	23 to 29	1	1 to 200
3	6 to 10	200 to 500	16 to 18	1	1 to 200
4	11 to 20	1000 to 2000	12 to 16	1	1 to 200

Table 2. Long pulse radar test waveform (Type 5) defined in the FCC standard (FCC 06-96 and FCC 13-22)

Radar type	Pulse width[1] (µs)	PRI (us)[1]	Pulse per hop[1]	Hopping rate[1] (kHz)	Number of trials (default = 30)
5	50-100	1000-2000	5-20 MHz	8-20	1-200

Table 3. Frequency hopping radar test waveform defined in the FCC standard (FCC 06-96 and FCC 13-22)

Radar type	Pulse width[1] (µs)	PRI (µs)[1]	Pulse per hop[1]	Hopping rate[1] (kHz)	Number of bursts	Number of trials (default = 30)
62	1	333.3	9	0.333	100	1-200

1. This parameter can be adjusted within the range as defined in the table.
2. The frequency hopping range is 5250 to 5724 MHz with 1 MHz step and the channel bandwidth is dependent upon the instrument analysis bandwidth. The N5182B MXG X-Series signal generator with Option 657 can support up to 160 MHz BW.
3. Test A: 15 unique PRI values randomly selected from the list of 23 pre-defined PRI values. Test B: 15 unique PRI values randomly selected within the range of 518 to 3066 µs, with a minimum increment of 1usec, excluding PRI values selected in Test A.

Table 4. Radar test signal parameters as defined in ETSI 301 893 V2.1.1

Radar type	Pulse width[1] (µs)	PRI (µs)[1]	Number of pulses[1]	Number of different PRFs	Number of bursts (default = 1)	Number of trials (default = 30)
Reference	1	700	18	1	1-100	1-200
1	0.5-5	200-1000	10	1	1-100	1-200
2	0.5-5	200-1600	15	1	1-100	1-200
3	0.5-5	2300-4000	25	1	1-100	1-200
4	20-30	2000-4000	20	1	1-100	1-200
52	0.5-2	300-400	10	2-3	1-100	1-200
62	0.5-2	400-1200	15	2-3	1-100	1-200

1. The interval between bursts is fixed in V1.7.1 or earlier which is changed to variable in V2.1.1

Table 5. Parameters of radar test signals defined in ETSI 302 502 V2.1.1

Radar type	Pulse width[3] (µs)	PRI (µs)[3]	Number of pulses[3]	Number of trials (default = 30)
1	1	750	15	1 to 200
2	1, 2, 5	200, 300, 500, 800, 1000	10	1 to 200
3	10, 15	200, 300, 500, 800, 1000	15	1 to 200
4	1, 2, 5, 10, 15	1200, 1500, 1600	15	1 to 200
5	1, 2, 5, 10, 15	2300, 3000, 3500, 4000	25	1 to 200
6	20, 30	2000, 3000, 4000	20	1 to 200

Table 6. Parameters of hopping radar test signals defined in ETSI 302 502 V2.1.1

Radar type	Pulse width (µs)	PRI (µs)[1]	Pulse per burst	Burst length (ms)	Burst per trials[3]	Pulse modulation	Number of trials (default = 30)
1	1	3000	9	3	8	None	1 to 200
2	20	4500	9	2	2	Chirp	1 to 200

Table 7. Radar test signal parameters as defined by the Japan MIC standard

Radar type	Pulse width[1] (µs)	PRF (Hz)[1]	Number of pulses[1]	Number of bursts	Repetition cycles(s)	Number of trials (default = 30)
W53 Fixed Pulse 1	1.0	700	18	1	15	1-200
W53 Fixed Pulse 2	2.5	260	18	1	15	1-200
W56 Fixed Pulse 1	0.5	720	18	1	15	1-200
W56 Fixed Pulse 2	1.0	700	18	1	15	1-200
W56 Fixed Pulse 3	2.0	250	18	1	15	1-200
W56 Variable Pulse 4	1-5	4347-6667	23-29	1	15	1-200
W56 Variable Pulse 5	6-10	2000-5000	16-18	1	15	1-200
W56 Variable Pulse 6	11-20	2000-5000	12-16	1	15	1-200
W56 Chirp (5-10 MHz width, 1MHz step)	50-100	500-1000	1-3	8-20	12	1-200
W56[4] hopping	1	3000	9	100	10	1-200

1. This parameter can be adjusted within the range as defined in the table.
2. When the radar profile is Type 5 or Type 6, another parameter, Single Pulse Based Staggered PRF and Packet Based Staggered PRF can be chosen.
3. For each of the trials, the burst interval will increase from 1.25 ms to 37.5 ms in steps of 1.25 ms for radar signal 1 and from 5 ms to 150 ms in steps of 5 ms for radar signal 2
4. The frequency hopping range is 5250 -5724 MHz with 1 MHz step and the channel bandwidth is dependent upon the instrument analysis bandwidth. The N5182 B MXG X-Series signal generator with Option 657 can support up to 160 MHz BW.

Note: N7607C uses the RF blanking method to generate pulses. The pulse rise/fall time accuracy is dependent upon the sampling rate setting and RF on/off speed.

Table 8. Radar test signal parameters as defined by the Japan MIC standard (July 2019)

Radar type	Pulse width (µs)		Pulse repetition	Frequency PRF (PPS)	Number of Different PRFs	Pulse Per Burst for Each PRF (PPB)
	Min	Max				
W53 Variable Pulse 3[1]	0.5	5	200	1000	1	10
W53 Variable Pulse 4[2]	0.5	15	200	1600	1	15
W53 Chirp 5	0.5	5	200	1000	1	min {max{22,[0.026xPRF]},30}
W53 Chirp 6	0.5	5	200	1600	1	min {max{22,[0.026xPRF]},30}
W53 Chirp 7	0.5	1.5	1114	1118	1	10
W53 Chirp 8	0.5	1.5	928	932	1	10
W53 Chirp 9	0.5	1.5	886	890	1	10
W53 Chirp 10	0.5	1.5	738	742	1	10

1. Chirp modulation (frequency deviation: ± 0.5 to 1.0 MHz), T1, T2≧70µs, 20µs≦W2≦110µs, |W1-W2|≧15µs, Duty cycle ratio: less than 10%.
2. Chirp modulation (frequency deviation: ± 0.5 to 1.0 MHz), T1, T2≧50µs, 30µs≦W2≦32µs(deviation: ± 5%).

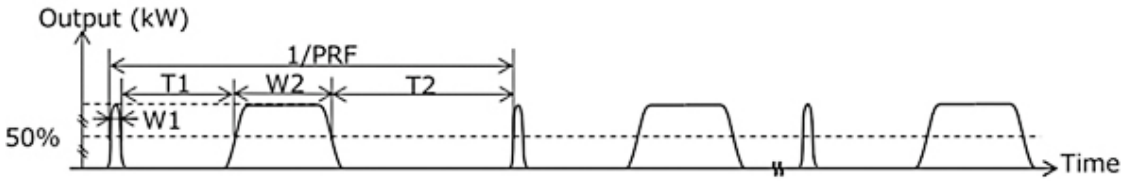


Table 9. Parameters of radar test signals defined in Korean DFS standard

Radar type	Pulse width[1] (µs)	Pulse repetition frequency (pps)[1]	Number of pulses[1]	Number of bursts	Number of trials (default = 30)
Type 1	1.0	700	18	1	1 to 200
Type 2	1.0	1800	10	1	1 to 200
Type 3	2.0	330	70	1	1 to 200
Type 4	1.0	3000	3	100	1 to 200

1. Frequency hopping between bursts range is 5250 to 5724 MHz

Table 10. Parameters of radar test signals defined in China DFS standard

Radar type	Pulse width (µs)	Pulse repetition frequency PRF (Hz)	Number of different PRFs	Number of pulses per burst[2]
Reference	1	1000	NA	20
1	0.5~5	200~1000	1	12
2	0.5~15	200~1600	1	16
3	0.5~30	2300~4000	1	24
4[1]	20~30	2000~4000	1	20
5	0.5~2	300~400	2 or 3	12
6	0.5~2	400~1200	2 or 3	16

1. Radar test signal 4 is a modulated radar test signal. The modulation to be used is a chirp modulation with a ± 2 .5 MHz frequency deviation.
2. The total number of pulses in a burst is equal to the number of pulses for a signal PRF multiplied by the number of different PRFs used.

DAA features summary

N7607C standard-based tests	Features
Common	• Provide a Seed parameter to randomize the parameter sets of each trial • Number of trials (1-200) can be adjusted and waveforms generated for each trial are unique • Save and load the Trial List of radar signals for repeatability testing • All advanced trigger functions defined by the hardware instrument • Trigger type can be single, continuous, gated, or segment advanced • Trigger source can be external, bus, or trigger key • External source can be pattern trigger In 1 or 2 • Real-time AWGN (Opt. required) • I/Q adjustment • Sample rate adjustment
ETSI	• ETSI TS 102 754 V1.3.1 • For detailed parameters of radiolocation test signals defined in the ETSI standard for DAA test, please see Table 11

Table 11. Parameters of radiolocation test signals defined in ETSI TS 102 754 standard

Radar type	Pulse width[1] (µs)	PRF (pps)	Pulses per burst (PPB)	Burst interval (s)	Pulse modulation	Number of trials (default = 30)
1	20, 30, 40	400-1400	10-60	5-12.5	QPSK or Chirp	1-200
2	1, 10, 20, 40, 60, 100	100-500	2-5	5-12.5	QPSK or Chirp	1-200
3	1, 2, 5, 10, 15	5000-15000	20-560	0.5-4.5455	QPSK or Chirp	1-200

Supported standards

DFS standard	Specification	Version	Release date
FCC	DFS standard MO&O Federal Communication Commission	06-96 13-22	2006 2012
ETSI	ETSI EN 301 893 V2.1.1, Harmonized European Standard, “Broadband Radio Access Networks (BRN), 5 GHz high performance RLAN, Harmonized EN Covering the essential requirements of article 3.2 of the R&TTE Directive”	V2.1.1	2017
ETSI	ETSI EN 302 502 V2.1.1 Broadband Radio Access Networks (BRAN); 5.8 GHz fixed broadband data transmitting systems; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive	V2.1.1	2017
Japan MIC	Testing procedures for implementation of Dynamic Frequency Selection (DFS) in the 5 GHz band	W53 & W56	2010
Korea	Korean standard for DFS test	Type 1-4	2014
China	Chinese standard for DFS test Type 1	Type 1-6	2019

DAA standard	Specification	Version	Release date
ETSI	ETSI TS 102 754 V1.3.1, Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics of Detect And Avoid (DAA) mitigation techniques for SRD equipment using Ultra Wideband (UWB) technology	V1.3.1	2013

Ordering Information

Software licensing and configuration

Signal Studio offers flexible licensing options, including:

- Node-locked: Allows you to use the license on one specified instrument/computer.
- Transportable: Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- Floating: Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- Subscription (Time-based): License is time limited to a defined period, such as 12, 24 or 36 months

N7607C Signal Studio for DFS and DAA License

Waveform playback license (N7607EMBC)

Software license type	Software license	KeysightCare subscription
Node-locked perpetual	SW1000-LIC-01	SW1000-SUP-01
Node-locked time-based	SW1000-SUB-01	Included
Transportable perpetual	SW1000-LIC-01	SW1000-SUP-01
Transportable time-based[1]	SW1000-SUB-01	Included

One-month KeysightCare Support and Subscription extension[3]

Support subscription	Description
SW1000-SUP-01	1-month of support subscription for node-locked perpetual licenses
SW1000-SUP-01	1-month of support subscription for transportable perpetual licenses

Try before you buy!

Free 30-day trials of Signal Studio software provide unrestricted use of the features and functions, including signal generation, with your compatible platform. Download and use it free for 30 days to make measurements with your analysis hardware: www.keysight.com/find/n7607embc

Request your free trial license today: www.keysight.com/find/signalstudio_trial

Hardware Configurations

To learn more about compatible hardware and required configurations, please visit:

www.keysight.com/find/SignalStudio_platforms

PC Requirements

A PC is required to run Signal Studio. www.keysight.com/find/SignalStudio_pc

Try Before You Buy

Free 30-day trials of Signal Studio software provide unrestricted use of the features and functions, including signal generation, with your compatible platform. Redeem a trial license online at:

www.keysight.com/find/SignalStudio_trial

Websites

www.keysight.com/find/SignalStudio

www.keysight.com/find/n7607c

Keysight's WLAN design and test solutions:

www.keysight.com/find/n7617c

www.keysight.com/find/wlan

Comprehensive Online Documentation: www.keysight.com/find/signalstudio_support

Signal Studio and Signal Creation Software: www.keysight.com/find/signalstudio_software

Literatures

Signal Studio Software, Brochure, literature number 5989-6448EN

Testing New-generation Wireless LAN, Application Note, 5990-8856EN

Creating and Optimizing 802.11ac Signals and Measurements, Application Note, 5991-0574EN

Testing Very High Throughput 802.11ac Signals, Application Note, 5990-9987EN