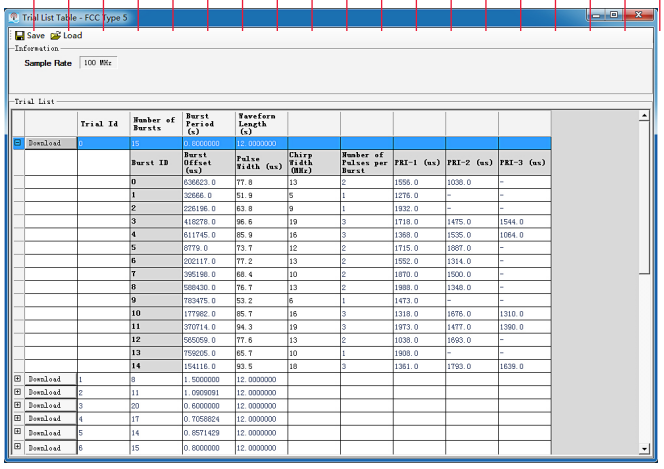
Keysight Technologies
Signal Studio for DFS Radar Profiles
N7607B

Technical Overview



KEYSIGHT TECHNOLOGIES

Introduction

- Create Keysight Technologies, Inc. validated and performance optimized Dynamic Frequency Selection (DFS) reference test signals, compliant with radar signals defined by FCC, ETSI and Japan MIC
- Generate multiple waveforms:
- Short (Type 1-4) and long (Type 5) pulse radar test and frequency hopping radar test defined in FCC 06-96
- Reference and Type 1-6 radar profiles defined in ETSI 301 893 Version 1.7.1
- W53 fixed and W56 fixed and variable radar test and chirp and frequency hopping test defined by Japan MIC
- Randomize the radar parameter sets of each trial with the Seed setting
- Adjust pulse width, pulse repetition interval, number of bursts, number of pulses, etc. within the range defined in the standard
- Save and recall the settings of the generated trial list table with all parameters for repeatability testing
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

Typical Measurements

Test transmitters with DFS capability:

- Detection threshold
- Channel availability check
- Off-channel CAC (channel availability check)
- In-service monitoring
- Channel shutdown
- Non-occupancy period

Simplify Dynamic Frequency Selection (DFS) Radar Profile Creation

Keysight Signal Studio software is a flexible suite of signal-creation tools that will reduce the time you spend on signal simulation. For DFS radar 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 radar signals for DFS tests.

Dynamic Frequency Selection (DFS) test

Signal studio's capabilities use waveform playback mode to create and customize the waveform files needed to test DFS. Its user-friendly interface lets you configure signal parameters, calculate the resulting waveforms, and download files for playback.

Applications include:

- Create radar signals according to profiles defined by FCC, ETSI and Japan MIC
- Create fixed pulse radar signals, short pulse radar signals, long pulse signals (w/chirp) and frequency hopping radar signals
- Pulse width, pulse repeat interval or frequency, number of bursts and trials, etc. can be adjusted within the standard-defined range
- Waveforms generated for each trial are unique, including randomized sets of radar profiles
- The radar signal Trial List can be saved and loaded for test repeatability

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: MXG and EXG
- PSG
- ESG
- First-generation MXG

Dynamic Frequency Selection (DFS) Overview

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 two frequency bands: 5.15 - 5.35 GHz and 5.47 - 5.725 GHz.

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

Radar signal time domain characteristics include:

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

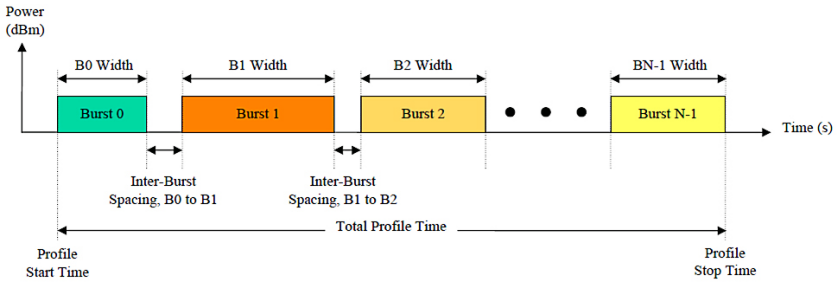


Figure 1. Time domain view of a radar profile.

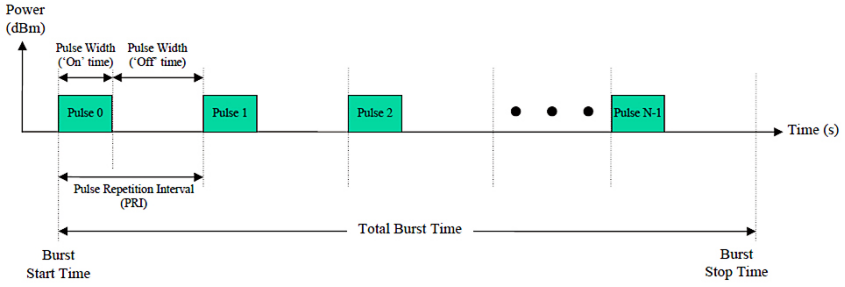


Figure 2. Burst level of a radar profile.

Dynamic Frequency Selection (DFS) Test

WLAN performance test with DFS functional testing

N7607B signal studio for DFS radar profiles can be paired with N7617B Signal Studio for WLAN 802.11a/b/g/n/ac, 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/n7617b
www.keysight.com/find/wlan

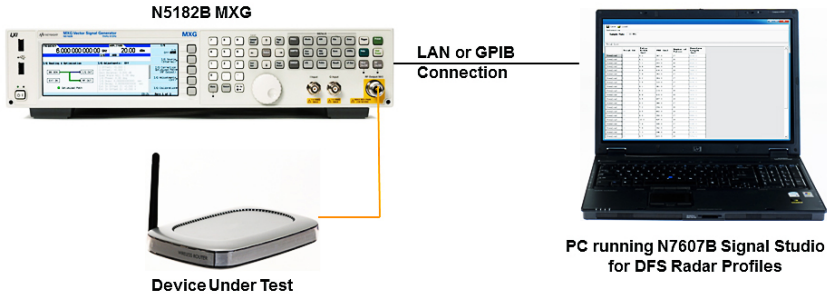


Figure 3. DFS test setup.

N7607B Signal Studio for DFS Radar Profiles can help you create FCC Part 15 Sub part E (2006/6), ETSI EN 303 893 v1.7.1 (2012/6) and Japan MIC standard-compliant radar signals for DFS test, which can be used for R&D or performance test. N7607B provides a user-friendly interface to let you easily generate radar test signals with the following steps:

1. Select DFS in the tree view. Next, select Radar Profiles, and use the drop-down arrow to display a menu from which you can select the desired radar profile from FCC, ETSI or Japan MIC.
2. Select FCC in the tree view. 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 “Radar Profile Display” 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

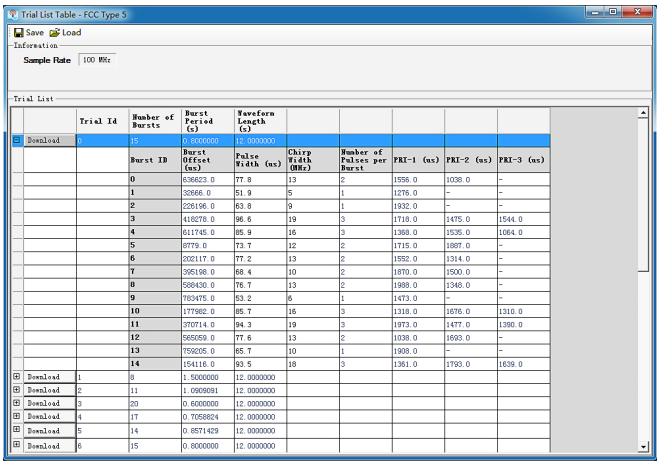


Figure 4. N7607B FCC Type 5 test waveform settings with trial list table.

Features Summary

N7607B 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
	– Radar profiles standards for FCC, ETSI and Japan MIC

FCC	– FCC version 06-96 – Type 1-4 short pulse radar test waveforms – 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 V1.7.1 – Reference and type 1-6 radar test signals – For detailed parameters of the radar test signals defined in the ETSI standard for each type, please see Table 4
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 5

Table 1. Short pulse radar test waveforms (Type 1-4) defined in the FCC standard (06-96)

Radar type	Pulse width[1] (us)	PRI (us)[1]	Number of pulses[1]	Number of bursts	Number of trials (default = 20)
1	1	1428	18	1	1-200
2	1-5	150-230	23-29	1	1-200
3	6-10	200-500	16-18	1	1-200
4	11-20	1000-2000	12-16	1	1-200

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

Radar type	Pulse width[1] (us)	PRI (us)[1]	Chirp width[1] (MHz)	Number of bursts	Number of trials[1]
5	50-100	1000-2000	5-20 MHz	8-20	1-200

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

Radar type	Pulse width[1] (us)	PRI (us)[1]	Pulse per hop[1]	Hopping rate[1] (kHz)	Number of bursts	Number of trials (default = 20)
6[2]	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 5250-5724 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.*

Table 4. Radar test signal parameters as defined in ETSI 301 893 V1.7.1

Radar type	Pulse width[1] (us)	PRI (us)[1]	Number of pulses[1]	Number of different PRFs	Number of bursts (default = 1)	Number of trials (default = 20)
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
5[2]	0.5-2	300-400	10	2-3	1-100	1-200
6[2]	0.5-2	400-1200	15	2-3	1-100	1-200

Table 5. Radar test signal parameters as defined by the Japan MIC standard

Radar type	Pulse width[1] (us)	PRF (Hz)[1]	Number of pulses[1]	Number of bursts	Repetition cycle(s)	Number of trials (default = 20)
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[3] 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. *The frequency hopping range is 5250-5724 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.*
4. *N7607B 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.*

Supported Standards

DFS standard	Specification	Version	Release date
FCC	DFS standard MO&O Federal Communication Commission FCC-06-96	06-96	2006-06
ETSI	ETSI EN 301 893 V1.7.1, Harmonized European Standard, "Broadband Radio Access Networks (BRN), 5GHz high performance RLAN, Harmonized EN Covering the essential requirements of article 3.2 of the R&TTE Directive"	V1.7.1	2012-06
Japan MIC	Testing procedures for implementation of Dynamic Frequency Selection (DFS) in the 5GHz band	W53 & W56	2010

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

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

Signal Studio Promotion

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Ordering Information

Software licensing and configuration

Signal Studio offers flexible licensing options, including:

- Fixed license: Allows you to create unlimited I/Q waveforms with a specific Signal Studio product and use them with a single, specific platform.
- Transportable/floating license: Allows you to create unlimited I/Q waveforms with a specific Signal Studio product and use them with a single platform (or PC in some cases) at a time. You may transfer the license from one product to another.
- Waveform license: Allows you to generate up to 545 user-configured I/Q waveforms with any Signal Studio product and use them with a single, specific platform.

The table below lists fixed, perpetual licenses only; additional license types may be available. For detailed licensing information and configuration assistance, please refer to the Licensing Options web page at www.keysight.com/find/SignalStudio_licensing

N7607B Signal Studio for DFS Radar Profiles

Model-Option	Description
Connectivity	
N7607B-1FP	Connect to E4438C ESG
N7607B-2FP	Connect to E8267D PSG
N7607B-3FP	Connect to N5182/62 MXG, N5172 EXG
Capability	
N7607B-EFP	DFS Radar Profiles for FCC, ETSI and Japan MIC

Please note that N7607B is stand-alone Signal Studio software which does not require N7620B Signal Studio for Pulse Building or Option UNW for pulse modulation.

Additional Information

Websites

Access the comprehensive online documentation, which includes the complete software HELP, download the software, and request a trial license.
www.keysight.com/find/n7607b
www.keysight.com/find/SignalStudio

Keysight's WLAN design and test solutions
www.keysight.com/find/n7617b
www.keysight.com/find/wlan
www.keysight.com/find/802.11ac

Literature

Signal Studio Software, Brochure, 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

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