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DFS Radar Pattern
MX370073B

Vector Signal Generator
MG3710A/MG3710E

DFS Radar Pattern MX370073B

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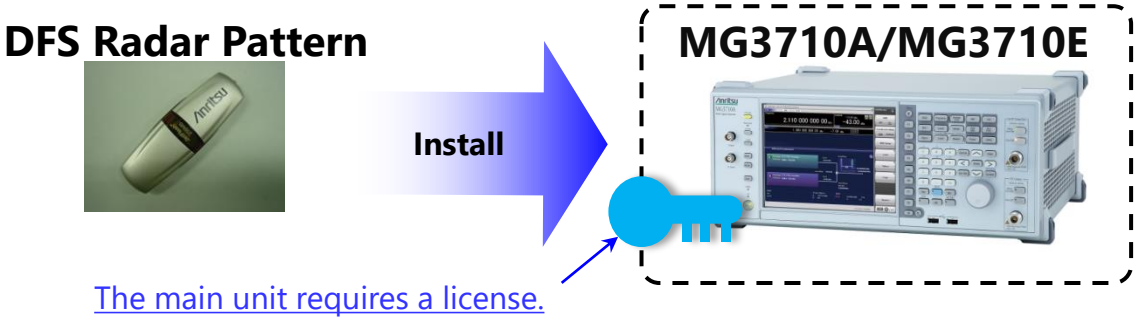
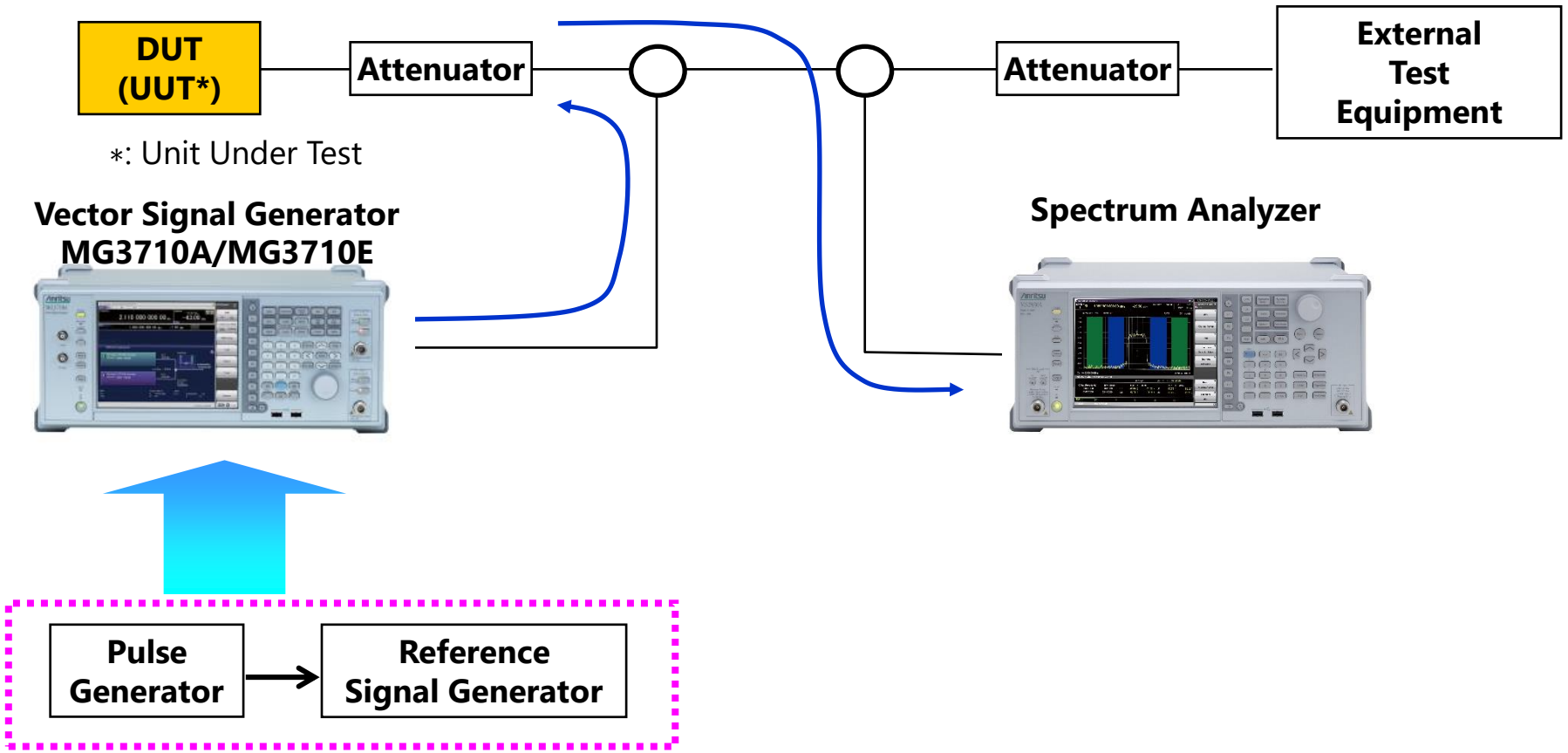
Installing the DFS Radar Pattern MX370073B option in the Vector Signal Generator MG3710A/MG3710E supports output of FCC 06-96 (Released: June 30, 2006), FCC 13-22 (Released: February 20, 2013) and Japan MIC (Reference: TELEC-T403 (V14.0) DFS test signals. Output of complex combinations of pulse, chirp and hopping signals required to support the DFS tests is made easy just by selecting combination files supplied with the MX370073B.



- ✓ ***Supports both FCC and Japan MIC Standards.***
- ✓ ***One MG3710A/MG3710E supports pulse, chirp and hopping signals.***
- ✓ ***External PC not required. Simply selecting prepared waveform pattern outputs various signals using MG3710A/MG3710E built-in Sequence function.***
- ✓ ***Offers 5.3-GHz band waveform patterns adopted by Japan MIC standard in July 2019***

DFS Test Setup (Example)



- ***One MG3710A/MG3710E supports pulse, chirp and hopping signals.***
- ***PC not required.***

Difference between MX370073A and MX370073B

✓: Supported

Model	Vector Signal Generator			Note
	MG3710E 	MG3710A (discontinued) 	MG3700A (discontinued) 	
MX370073A (discontinued)		✓	✓	• Does not include 5.3-GHz band waveform patterns adopted by Japan MIC standard in July 2019
MX370073B	✓	✓		• Includes all waveform patterns offered by MX370073A • Includes 5.3-GHz band waveform patterns adopted by Japan MIC standard in July 2019

Sequence Function and Combination File

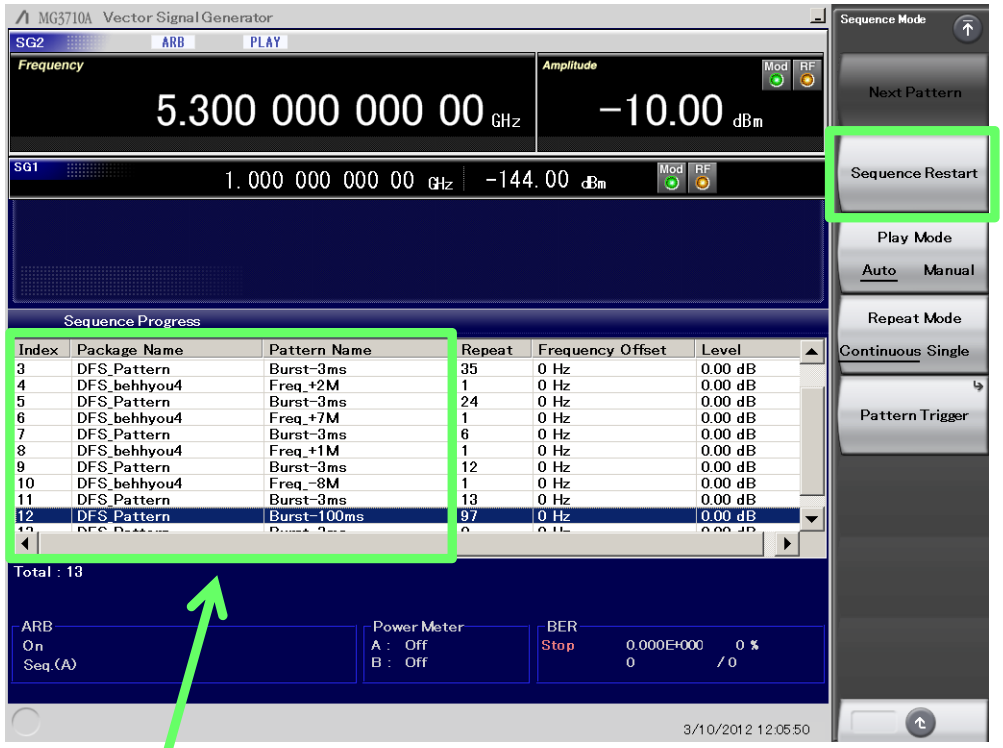
Sequence Function

This standard function switches and outputs multiple waveform patterns continuously.
Standards-compliant test signals can be created by combining complex patterns of pulse, chirp, hopping, and null signal waveforms.
Clicking “Sequence Restart” on the right starts output of the DFS test signal according to the standards.

Combination File:

Users can output pulse, chirp and hopping signals for DFS tests easily just by selecting a combination file with this sequence information.

Sequence function:
[Mode] > (Page2) [F7: Sequence Mode]



Sequence Function Display

Switches and outputs multiple waveform patterns continuously.

DFS Radar Pattern List (MX370073B)

DFS Radar Pattern List (MX370073B)

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- Simple output just by selecting combination file.
- Supports 40 variable signal types - 20 times each for main test and retest.
  Selecting in order supports tests with random conditions

For FCC Standard

Test No.		Package	Combination File Name	Note	File Size [MB]
Short Pulse Radar	Type 0	RadarType0	ShortPulse0	Fixed Pulse Radar Signals: 1 pattern.	830 (All MX370073B)
	Type 1	RadarType1	Test A: ShortPulse1A-01 to ShortPulse1A-23	Variable Pulse Radar Signals: 23 patterns each.	
			Test B: ShortPulse1B-01 to ShortPulse1B-15	Variable Pulse Radar Signals: 15 patterns each.	
	Type 2	RadarType2	ShortPulse2-01 to ShortPulse2-40	Variable Pulse Radar Signals: 40 patterns each.	
	Type 3	RadarType3	ShortPulse3-01 to ShortPulse3-40		
	Type 4	RadarType4	ShortPulse4-01 to ShortPulse4-40		
Long Pulse Radar	Type 5	RadarType5	LongPulse-01 to LongPulse-40	Variable Chirp Radar Signals: 40 patterns each.	
Frequency Hopping Radar	Type 6	RadarType6_20M	Hopping_20M-01 to Hopping_20M-40	Frequency Hopping Radar Signals: 40 patterns each. For 20 MHz/ch	
		RadarType6_40M	Hopping_40M-01 to Hopping_40M-40	Frequency Hopping Radar Signals: 40 patterns each. For 40 MHz/ch	
		RadarType6_80M	Hopping_80M-01 to Hopping_80M-40	Frequency Hopping Radar Signals: 40 patterns each. For 80 MHz/ch	
		RadarType6_160M*	Hopping_160M-01 to Hopping_160M-40	Frequency Hopping Radar Signals: 40 patterns each. For 160 MHz/ch	

DFS Radar Pattern List (MX370073B)

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- Simple output just by selecting combination file.
- Supports 40 variable signal types - 20 times each for main test and retest.
  Selecting order supports tests with random conditions.

For Japan MIC Standard (Reference: TELEC-T403)

Test No.		Package	Combination File Name	Note	File Size [MB]
Appended Table 1*1	Type 1	DFS_behhyoudai1gou-1_2	behhyou_dai1gou-1	Fixed Pulse Radar Signals: 1 pattern each	830 (All MX370073B)
	Type 2		behhyou_dai1gou-2		
Appended Table 1*2	Type 1	W53_DFS_Radar_Pattern	CN_V11_variable_W53 to CN_V16_variable_W53	Radar Radio Waves: 6 patterns	
	Type 2		CN_V21_variable_W53	Radar Radio Waves: 1 pattern	
	Type 3		CN_V31_chirp_W53 to CN_V37_chirp_W53	Radar Radio Waves: 7 patterns	
	Type 4		CN_V41_chirp_W53 to CN_V46_chirp_W53	Radar Radio Waves: 6 patterns	
	Type 5		CN_F01_chirp_W53	Radar Radio Waves: 1 pattern each	
	Type 6		CN_F02_chirp_W53		
	Type 7		CN_F03_chirp_W53		
	Type 8		CN_F04_chirp_W53		
Appended Table 2	Type 1	DFS_behhyoudai2gou-1_2_3	behhyou_dai2gou-1	Fixed Pulse Radar Signals: 1 pattern each	
	Type 2		behhyou_dai2gou-2		
	Type 3		behhyou_dai2gou-3		
	Type 4	DFS_behhyoudai2gou-4	behhyou2-4-1 to behhyou2-4-40	Variable Pulse Radar Signals: 40 patterns each	
	Type 5	DFS_behhyoudai2gou-5	behhyou2-5-1 to behhyou2-5-40		
	Type 6	DFS_behhyoudai2gou-6	behhyou2-6-1 to behhyou2-6-40		

*1: Uses waveform patterns prior to July 2019 Japan MIC Standard revision
*2: Uses new waveform patterns adopted by July 2019 Japan MIC Standard revision

DFS Radar Pattern List (MX370073B)

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Test No.		Package	Combination File Name	Note	File Size [MB]
Appended Table 3	Type 1	DFS_behhyoudai3gou	behhyou3-1 to behhyou3-40	Variable Chirp Radar Signals: 40 patterns each	830 (All MX370073B)
Appended Table 4	Type 1	DFS_behhyoudai4gou	behhyou4-01 to behhyou4-40	Frequency Hopping Radar Signals: 40 patterns each For DUT 20 MHz detection bandwidth	
		DFS_behhyoudai4gou_40M	behhyou4-01_40M to behhyou4-40_40M	Frequency Hopping Radar Signals: 40 patterns each For DUT 40 MHz detection bandwidth	
		DFS_behhyoudai4gou_80M	behhyou4-01_80M to behhyou4-40_80M	Frequency Hopping Radar Signals: 40 patterns each For DUT 80 MHz detection bandwidth	
		DFS_behhyoudai4gou_160M*	behhyou4-01_160M to behhyou4-40_160M	Frequency Hopping Radar Signals: 40 patterns each For DUT 160 MHz detection bandwidth	

DFS Test Signals
for FCC and Japan MIC Standards

DFS Test Signals for FCC 06-96 and FCC 13-22 (1/4)

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Test Objects

Test Items	Radar Type	Chapter Number
Short Pulse Radar	0	6.1
	1	6.1
	2	6.1
	3	6.1
	4	6.1
Long Pulse Radar	5	6.2
Frequency Hopping Radar	6	6.3 (20 MHz)*1
		6.3 (40 MHz)*2
		6.3 (80 MHz)*3
		6.3 (160 MHz)*4

*1: Frequency Hopping Bandwidth = 20 MHz
*2: Frequency Hopping Bandwidth = 40 MHz
*3: Frequency Hopping Bandwidth = 80 MHz
*4: Frequency Hopping Bandwidth = 160 MHz

DFS Test Signals for FCC 06-96 and FCC 13-22 (2/4)

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Short Pulse Radar

Used for combining randomly extracted combinations of pulse width, pulse repetition frequency and continuous pulse count at each repetition cycle

Radar Type	Pulse Width (W) [µs]	Pulse Repetition Interval (PRI) [µs]	Pulse Per Burst for each PRI (PPB)
0	1	1428	18
1	1	518 to 3066 (1 µs step)	18 to 102 (1 step)
2	1 to 5 (1 µs step)	150 to 230 (1 µs step)	23 to 29 (1 step)
3	6 to 10 (1 µs step)	200 to 500 (1 µs step)	16 to 18 (1 step)
4	11 to 20 (1 µs step)	200 to 500 (1 µs step)	12 to 16 (1 step)

*See slides 16 and 18 for signal images.

PRI: Pulse Repetition Interval

DFS Test Signals for FCC 06-96 and FCC 13-22 (3/4)

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Long Pulse Radar: Chirp Signal

Used for combining randomly extracted combinations of pulse width, chirp width, pulse repetition frequency, continuous pulse count and burst count at each repetition cycle. However, the chirp frequency band is within the occupied frequency band.

Radar Type	Pulse Width (W) [µs]	Pulse Repetition Interval (PRI) [µs]	Pulse Per Burst for each PRI (PPB)
5	50 to 100 (1 µs step)	1000 to 2000 (1 µs step)	1 to 3 (1 step)

*See slides 20 and 21 for signal images.

PRI: Pulse Repetition Interval

DFS Test Signals for FCC 06-96 and FCC 13-22 (4/4)

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Frequency Hopping Radar

Hopping is performed at each 0.333 kHz hopping time interval. The hopping frequency can be selected randomly from 475 waves at 1 MHz intervals between 5250 and 5724 MHz. The 9 pulses in every burst are at the same frequency. However, the pulse pattern for the 20 or 40 MHz frequency band detected by the Rx module within the frequency hopping band is output as the test signal.

Radar Type	Pulse Width (W) [µs]	Pulse Repetition Interval (PRI) [µs]	Pulse Per Burst for each Hopping
6	1	333	9

*See slides 22 and 23 for signal images.

PRI: Pulse Repetition Interval

DFS Test Signals for Japan MIC Standard (1/9)

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Test Objects

Test Items	Frequency	Test signal	Test No.	Note
Carrier Sense (2)	5.3 GHz	Fixed Pulse Radar Signals	Table No. 1 Type. 1	Uses waveform patterns prior to July 2019 Japan MIC Standard revision
			Table No. 1 Type. 2	
Carrier Sense (2)	5.3 GHz	Radar Radio Waves	Table No. 1 Type. 1	Uses new waveform patterns adopted by July 2019 Japan MIC Standard revision
			Table No. 1 Type. 1	
			Table No. 1 Type. 1	
			Table No. 1 Type. 1	
			Table No. 1 Type. 1	
			Table No. 1 Type. 1	
			Table No. 1 Type. 1	
			Table No. 1 Type. 1	
Carrier Sense (3)	5.6 GHz	Fixed Pulse Radar Signals	Table No. 2 Type. 1	
			Table No .2 Type. 2	
			Table No. 2 Type. 3	
		Variable Pulse Radar Signals	Table No. 2 Type. 4	
			Table No. 2 Type. 5	
			Table No. 2 Type. 6	
		Chirp Radar Signals	Table No. 3 Type. 1	
		Frequency Hopping Radar Signals	Table No. 4 Type. 1 (20 MHz)	Frequency Hopping Bandwidth = 20 MHz
			Table No. 4 Type. 1 (40 MHz)	Frequency Hopping Bandwidth = 40 MHz
			Table No. 4 Type. 1 (80 MHz)	:Frequency Hopping Bandwidth = 80 MHz
			Table No. 4 Type. 1 (160 MHz)	Frequency Hopping Bandwidth = 160 MHz

DFS Test Signals for Japan MIC Standard (2/9)

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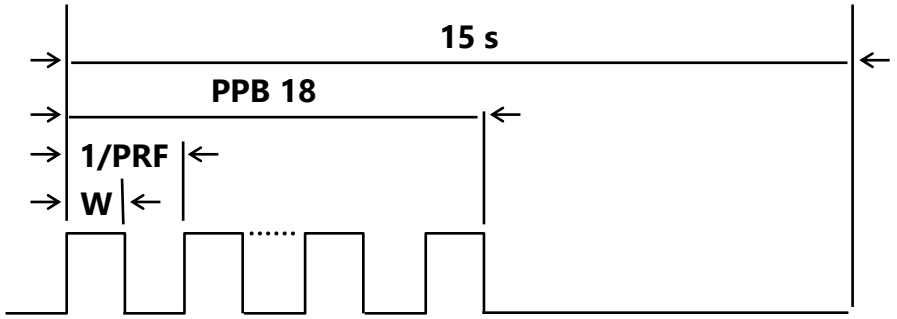
Fixed Pulse Radar Signals: (Table No.1 Type.1, 2)
Fixed Pulse Radar Signals: (Table No.2 Type.1, 2, 3)

Test No.		Pulse Width (W) [μs]	Pulse Repetition Frequency (PRF) [Hz]	Pulse Per Burst for each PRF (PPB)	Repetition Interval [s]
Table No1*	Type. 1	1	700	18	15
	Type. 2	2.5	260	18	15
Table No.2	Type. 1	0.5	720	18	15
	Type. 2	1	700	18	15
	Type. 3	2	250	18	15

*: Uses waveform patterns prior to July 2019 Japan MIC Standard revision



DFS Test Signals for Japan MIC Standard (3/9)

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Variable Pulse Radar Signals: (Table No. 2 Type. 4, 5, 6)

Used for combining randomly extracted combinations of pulse width, pulse repetition frequency and continuous pulse count at each repetition cycle

Test No.		Pulse Width (W) [μs]	Pulse Repetition Frequency (PRF) [Hz]	Pulse Per Burst for each PRF (PPB)	Repetition Interval [s]
Table No. 2	Type. 4	1 to 5 (1 μs step)	4347 to 6667 (1 Hz step)	23 to 29 (1 step)	15
	Type. 5	6 to 10 (1 μs step)	2000 to 5000 (1 Hz step)	16 to 18 (1 step)	15
	Type .6	11 to 20 (1 μs step)	2000 to 5000 (1 Hz step)	12 to 16 (1 step)	15

PRF: Pulse Repetition Frequency

DFS Test Signals for Japan MIC Standard (4/9)

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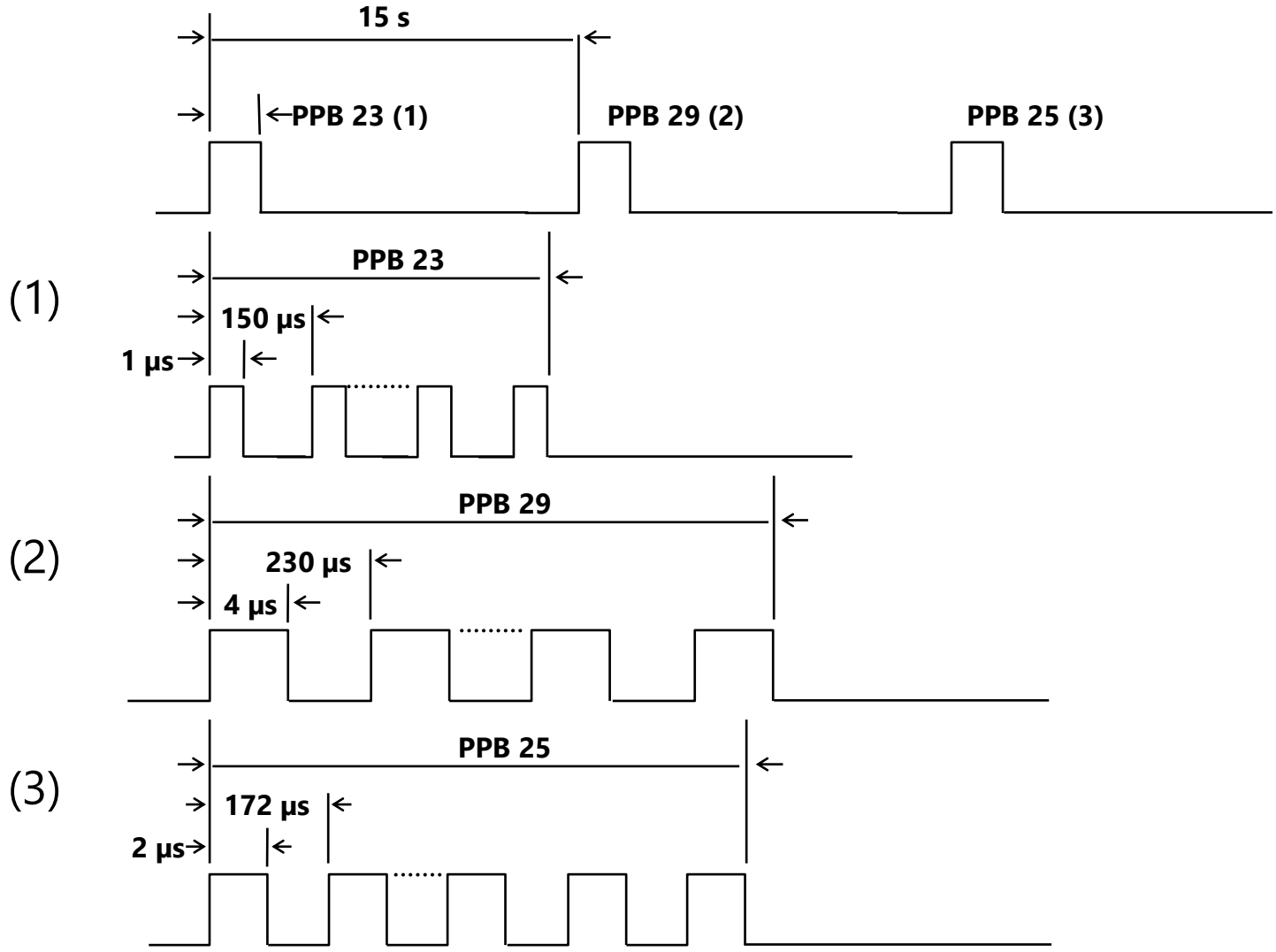
Variable Pulse Radar Signals: (Table No. 2 Type 4, 5, 6)



DFS Test Signals for Japan MIC Standard (5/9)

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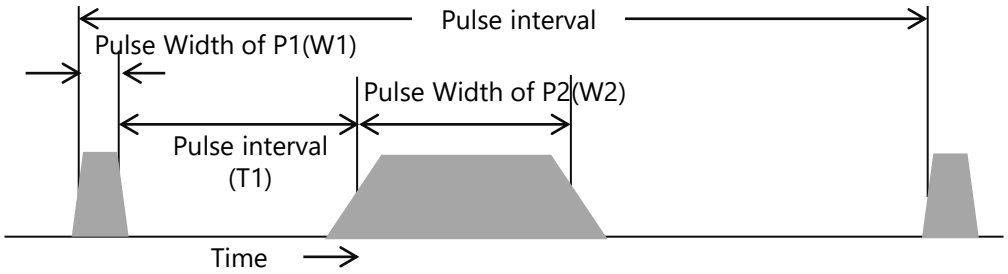
Radar Radio Waves: (Table No.1 Type.1, 2,3,4,5,6,7,8)

Radar Radio Waves						
Test No.		Pulse Width [μs]		Pulse Repetition Frequency [Hz]		Minimum Continuous Pulse Count
		Minimum value	Maximum value	Minimum value	Maximum value	
Table No.1*	Type 1	0.5	5	200	1000	10
	Type 2	0.5	15	200	1600	15
	Type 3	0.5	5	200	1000	min{max{22, [0.026 × PRF] , 30}
	Type 4	0.5	15	200	1600	min{max{22, [0.026 × PRF] , 30}
	Type 5	0.5	1.5	1114	1118	30
	Type 6	0.5	1.5	928	932	25
	Type 7	0.5	1.5	886	890	24
	Type 8	0.5	1.5	738	742	20

*: Uses new waveform patterns adopted by July 2019 Japan MIC Standard revision

Type 3, 4	Frequency range (chirp)	±1 MHz from ±0.5 MHz
	Pulse interval of P1 (T1)	70 μs min
	Pulse Width of P2 (W2)	20 μs min, 100 μs max
	Difference between P1 and P2 Pulse Widths	15 μs min based on W2 – W1
	Duty Cycle	<10%

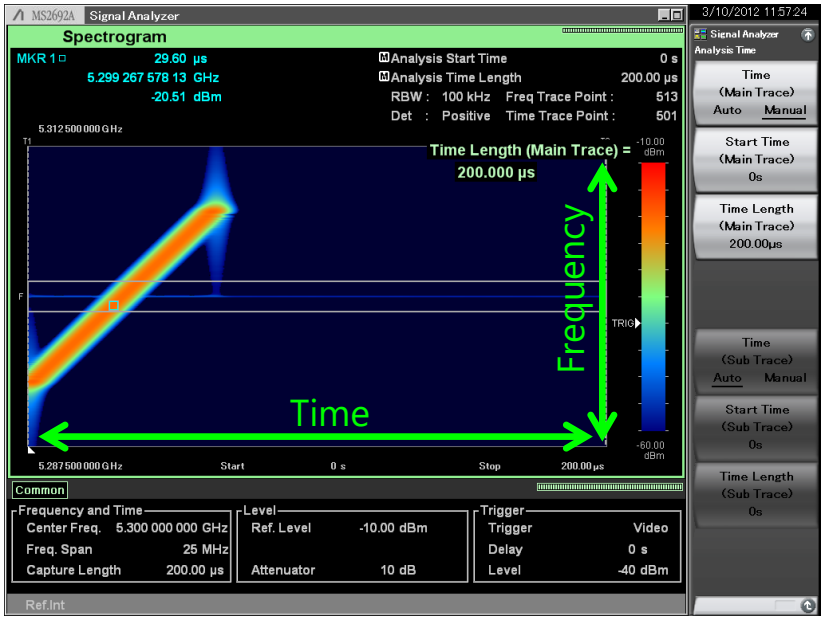
Type 5, 8	Frequency range (chirp)	±1 MHz from ±0.5 MHz
	Pulse interval of P1 (T1)	50 μs min
	Pulse Width of P2 (W2)	28.5 μs min, 33.6 μs max



DFS Test Signals for Japan MIC Standard (6/9)

Chirp Radar Signals: (Table No. 3)

Used for combining randomly extracted combinations of pulse width, chirp width, pulse repetition frequency, continuous pulse count and burst count at each repetition cycle. However, the chirp frequency band is within the occupied frequency band.



Example for chirp signal (zoomed-in)

Test No.		Pulse Width (W) [µs]	Pulse Repetition Frequency (PRF) [Hz]	Pulse Per Burst for each PRF (PPB)	Repetition Interval [s]
Table No. 3	Type. 1	50 to 100 (1 µs step)	500 to 1000 (1 Hz step)	1 to 3 (1 step)	12

PRF: Pulse Repetition Frequency

DFS Test Signals for Japan MIC Standard (7/9)

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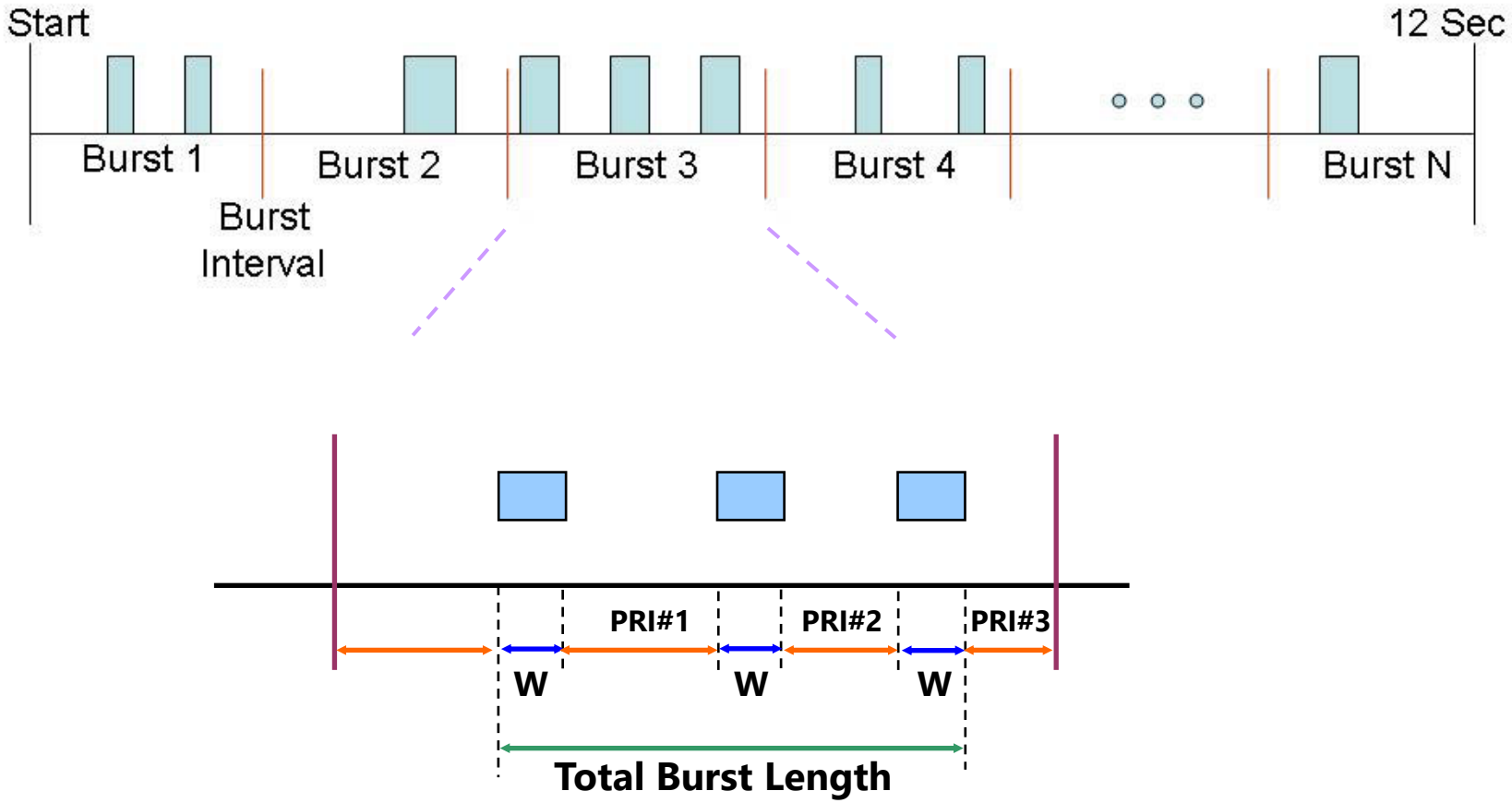
Chirp Radar Signals: (Table No. 3)



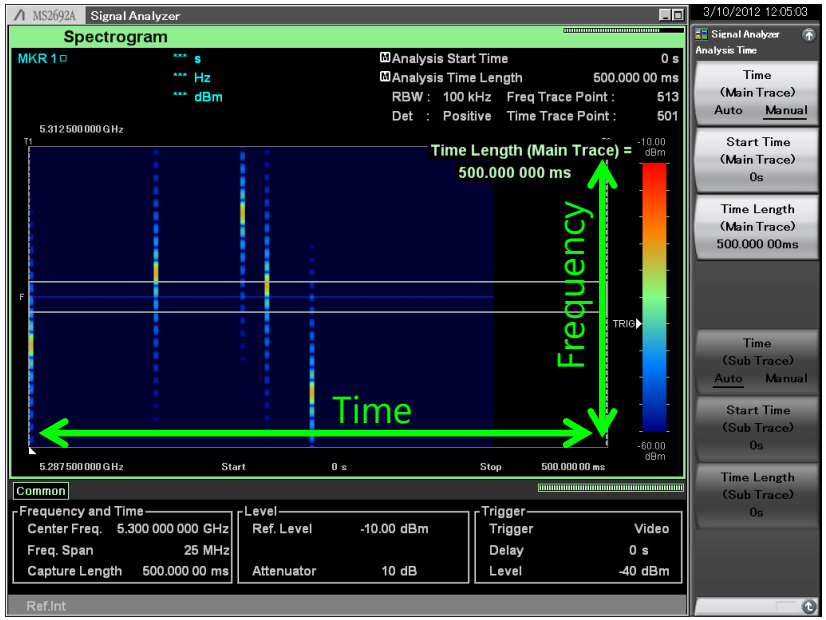
W: Pulse Width

PRI: Pulse Repetition Interval

DFS Test Signals for Japan MIC Standard (8/9)

Frequency Hopping Radar Signals: (Table No. 4)

Hopping is performed at each 3 ms hopping time interval. The hopping frequency can be selected randomly from 475 waves at 1 MHz intervals between 5250 and 5724 MHz. The 9 pulses output every 3 ms are at the same frequency. However, the pulse pattern for the 20, 40, 80 or 160 MHz frequency band detected by the Rx module within the frequency hopping band is output as the test signal.



Example for hopping signal (zoomed-in)

Test No.		Pulse Width (W) [µs]	Pulse Repetition Frequency (PRF) [Hz]	Pulse Per Hopping for each PRF (PPB)	Repetition Interval [s]
Table No. 4	Type. 1	1	3,000	9	10

PRF: Pulse Repetition Frequency

DFS Test Signals for Japan MIC Standard (9/9)

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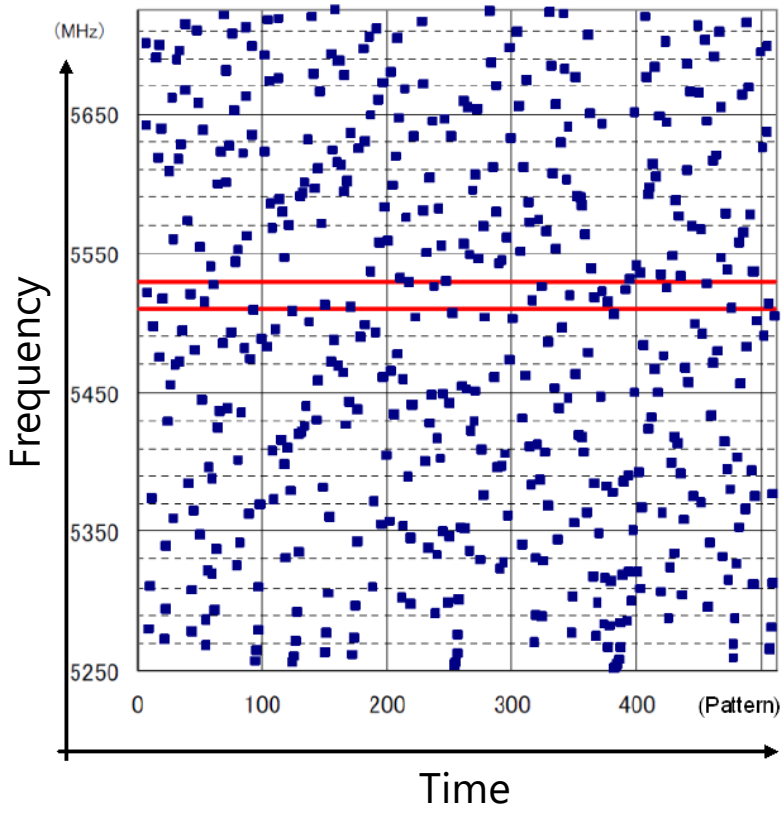
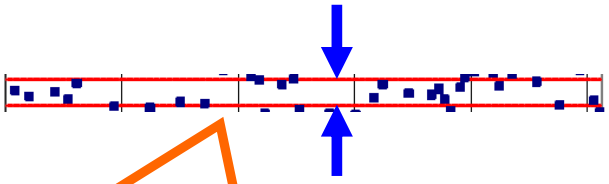
Frequency Hopping Radar Signals: (Table No. 4)



Bandwidth:
20 MHz, 40 MHz, 80 MHz, 160 MHz



The signal generator outputs any in-band pulse but no out-of-band pulse. The DUT performs carrier sensing when a pulse within the detection band is detected.

Ordering Information

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The minimum required options are as follows:

Hardware

Model (MG3710A*)	Model (MG3710E)	Name
MG3710A	MG3710E	Vector Signal Generator
MG3710A-036	MG3710E-036	1stRF 100 kHz to 6 GHz
MG3710A-045	MG3710E-045	ARB Memory Upgrade 256 Msample for 1stRF

Software

MX370073B	DFS Radar Pattern

*: Although production of the MG3710A main frame has been discontinued, the MX370073B can be installed in existing MG3710A units. In addition, the MG3710A-045 option can also be retrofitted.

[Supplement] What is DFS: Dynamic Frequency Selection?

Japan MIC Standard (Reference: TELEC-T403) specifies use of frequency bands from 5.3 GHz (5.26/5.28/5.30/5.32 GHz) and 5.6 GHz (5.50/5.52/5.54/5.56/5.58/5.60/5.62/5.64/5.66/5.68/5.70 GHz) for the WLAN 5 GHz band. Since these are the same frequency bands as used by meteorological radar[Note] and marine radar, these pulse signals are obliged to use Dynamic Frequency Selection (DFS) technology.

FCC 06-96 requires the same tests for 5.25 to 5.35 GHz and 5.47 to 5.725 GHz.

Note: Weather radar locates precipitation by transmitting pulse bursts every second. Interference from wireless LAN can be mistaken for precipitation. Therefore, use DFS to confirm the absence of weather radar before starting operation.

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