AN 241104

Negative Voltage Generator (NVG) Spurious note

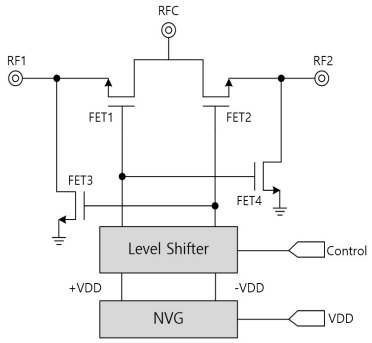
Application Note

Devices that incorporate switches, such as RF Switches and digital step attenuators (DSAs), require a negative voltage to control specific MOSFETs in the circuit.

An NVG is used to generate this negative voltage, supplying the appropriate voltage to ensure smooth switch operation.

The internal configuration of a typical switch with an applied NVG is shown in Figure 1.

Figure1. Switch Block Diagram



As shown in Figure1, turning the FET ON/OFF needs gate voltages of +VDD and -VDD. These voltages are supplied by the NVG, which delivers +VDD and -VDD to the FET gate according to the level shifter's control logic.

For example, to turn FET1 ON, +VDD voltage is applied to the gate, and to turn it OFF, -VDD voltage is applied.

The control logic signals (RFC-RF1, RFC-RF2) are determined by the level shifter, which manages the FET according to predefined logic signals.

A key component of the NVG is the Oscillator, which generates the negative voltage. However, due to this oscillator, low-frequency spurious signals may occasionally appear in the RF path.

All DSA and RF switch products from BeRex incorporate an internal NVG to control switching. The NVG is used despite the possibility of spurious signals, as it enables straightforward implementation across a wide frequency range. Additionally, since an external negative voltage circuit is not required, the application circuit is simplified, reducing the PCB footprint. Moreover, using the NVG ensures effective FET control, which improves RF performance (e.g., insertion loss, isolation, linearity).

This application note provides information on spurious signals across the frequency range of BeRex products that utilize the NVG, helping clients choose suitable products.

Table1. Switches and DSAs Device Type

Device Type	Part Number	Description
Spurious-Free	BDA4620	6-bit, 31.5dB range / 0.5dB step
	BDA4630	6-bit, 31.5dB range / 0.5dB step
	BDA4700	7-bit, 31.75dB range / 0.25dB step
	BDA4710(V)	7-bit, 31.75dB range / 0.25dB step
	BDA4730	7-bit, 31.75dB range / 0.25dB step
	BSW6620	SPDT, Absorptive
	BSW6622	SPDT, Absorptive
General Purpose (Some spurious generated in low frequencies)	BSW6420	SPDT, Absorptive
	BSW6440	SP4T, Absorptive
	BSW6321	SPDT, Reflective
	BSW7221(V)	SPDT, Reflective
	BSW722T	SPDT, Reflective
	BSW7321	SPDT, Reflective
	BSW7421	SPDT, Reflective
	BDA4601	6-bit, 31.5dB range / 0.5dB step

Spurious-Free Devices

Spectrum Analyzer Test Condition :

Span = 200MHz , RBW = 10Hz , VBW = 10Hz

Figure2. Spurious-Free Devices

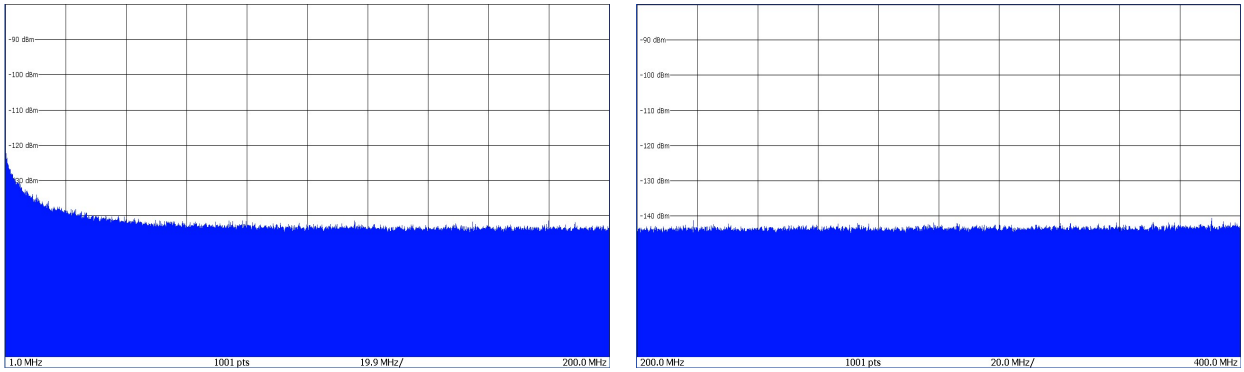


Table2. Maximum Spurious Level of Spurious-Free Devices

Part No.	Path	Condition	Min	Typ	Max	Unit
BDA4620	RF1—RF2	1MHz—8GHz(1)		<-145		dBm/10Hz
BDA4630	RF1—RF2	1MHz—8GHz(1)		<-145		dBm/10Hz
BDA4700	RF1—RF2	1MHz—8GHz(1)		<-145		dBm/10Hz
BDA4710(V)	RF1—RF2	1MHz—8GHz(1)		<-145		dBm/10Hz
BDA4730	RF1—RF2	9kHz—8GHz(1)		<-145		dBm/10Hz
BSW6620	RFC—RFx	5MHz—9GHz(1)		<-145		dBm/10Hz
BSW6622	RFC—RFx	5MHz—9GHz(1)		<-145		dBm/10Hz

(1) No spurious signals were detected in all frequency range.

General Purpose Devices

Spectrum Analyzer Test Condition :

Span = 200MHz , RBW = 10Hz , VBW = 10Hz

Figure3. BSW6420 Spurious Graph

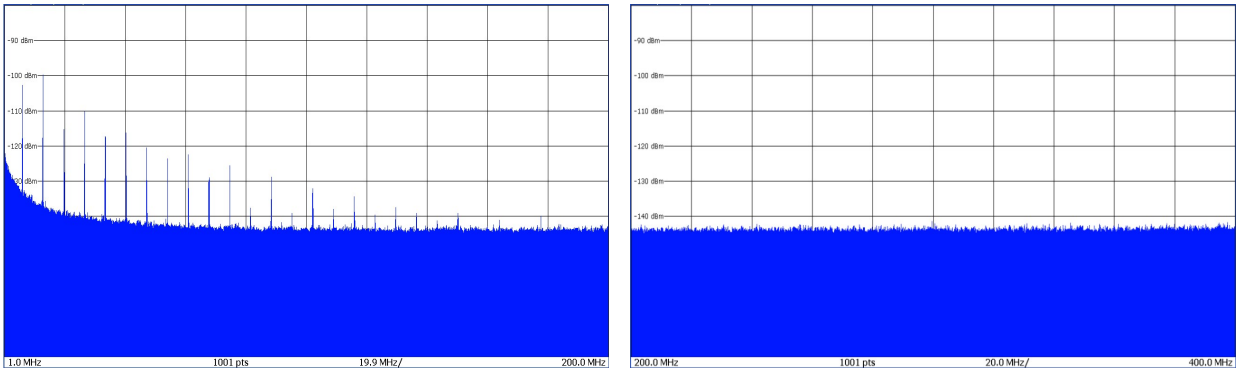


Table3. BSW6420 Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz 50MHz—200MHz > 200MHz(1)		-100 -125 < -145		dBm/10Hz

(1) No spurious signals were detected above 200MHz.

Figure4. BSW6440 Spurious Graph

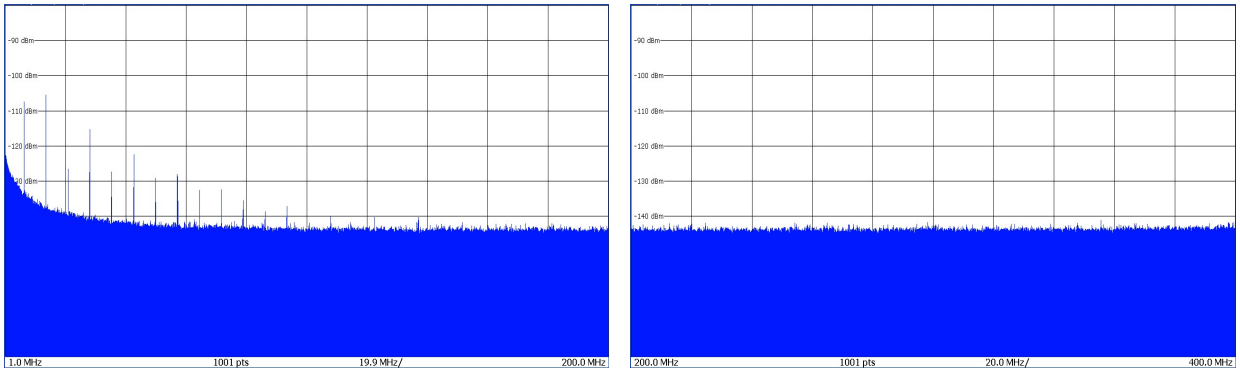


Table4. BSW6440 Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz 50MHz—200MHz > 200MHz(1)		-105 -130 < -145		dBm/10Hz

(1) No spurious signals were detected above 200MHz.

Figure5. BSW6321 Spurious Graph

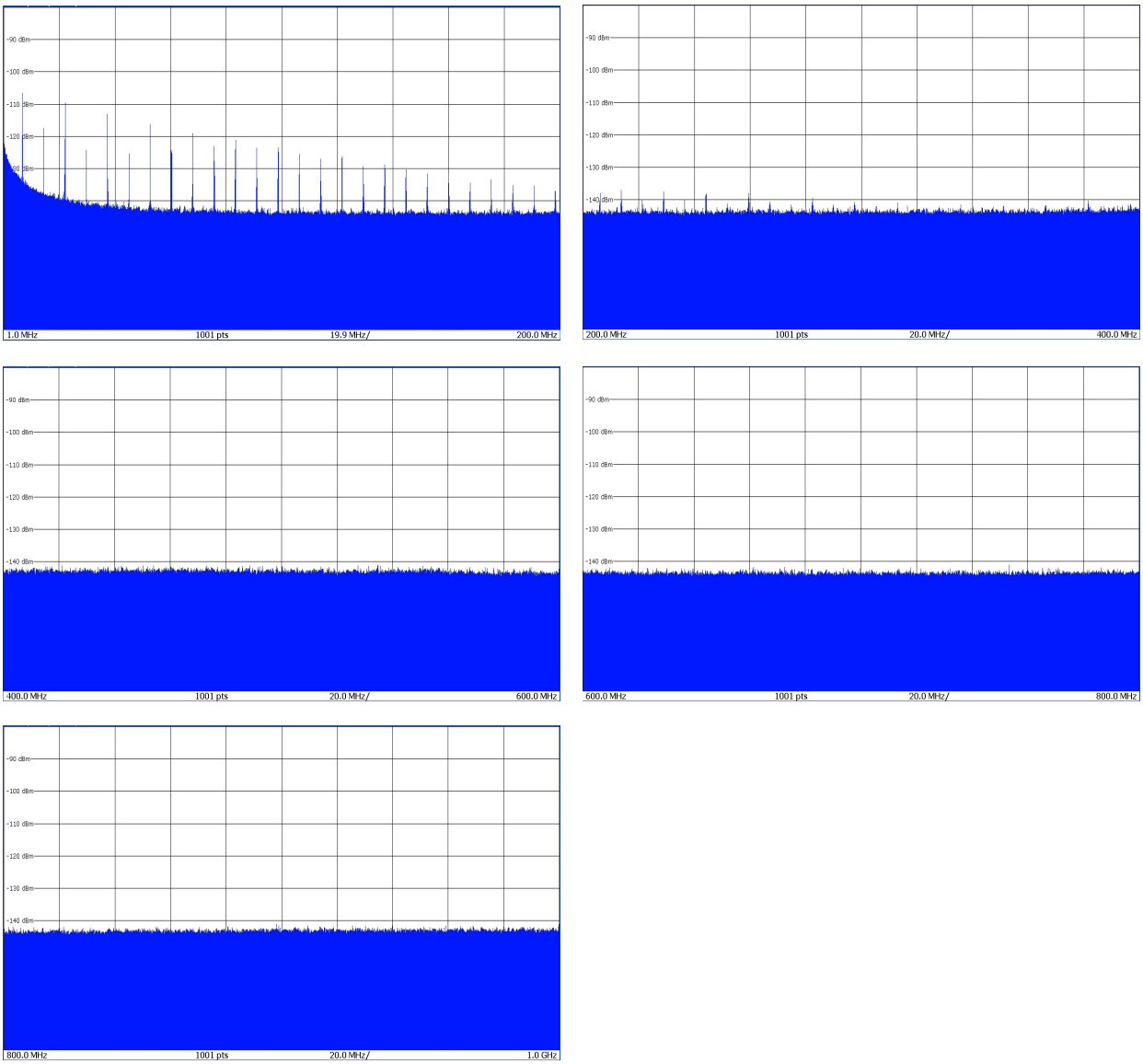


Table5. BSW6321 Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz 50MHz—200MHz 200MHz—500MHz > 500MHz(1)		-105 -125 -138 < -145		dBm/10Hz

(1) No spurious signals were detected above 1GHz.

Figure6. BSW7221(V) Spurious Graph

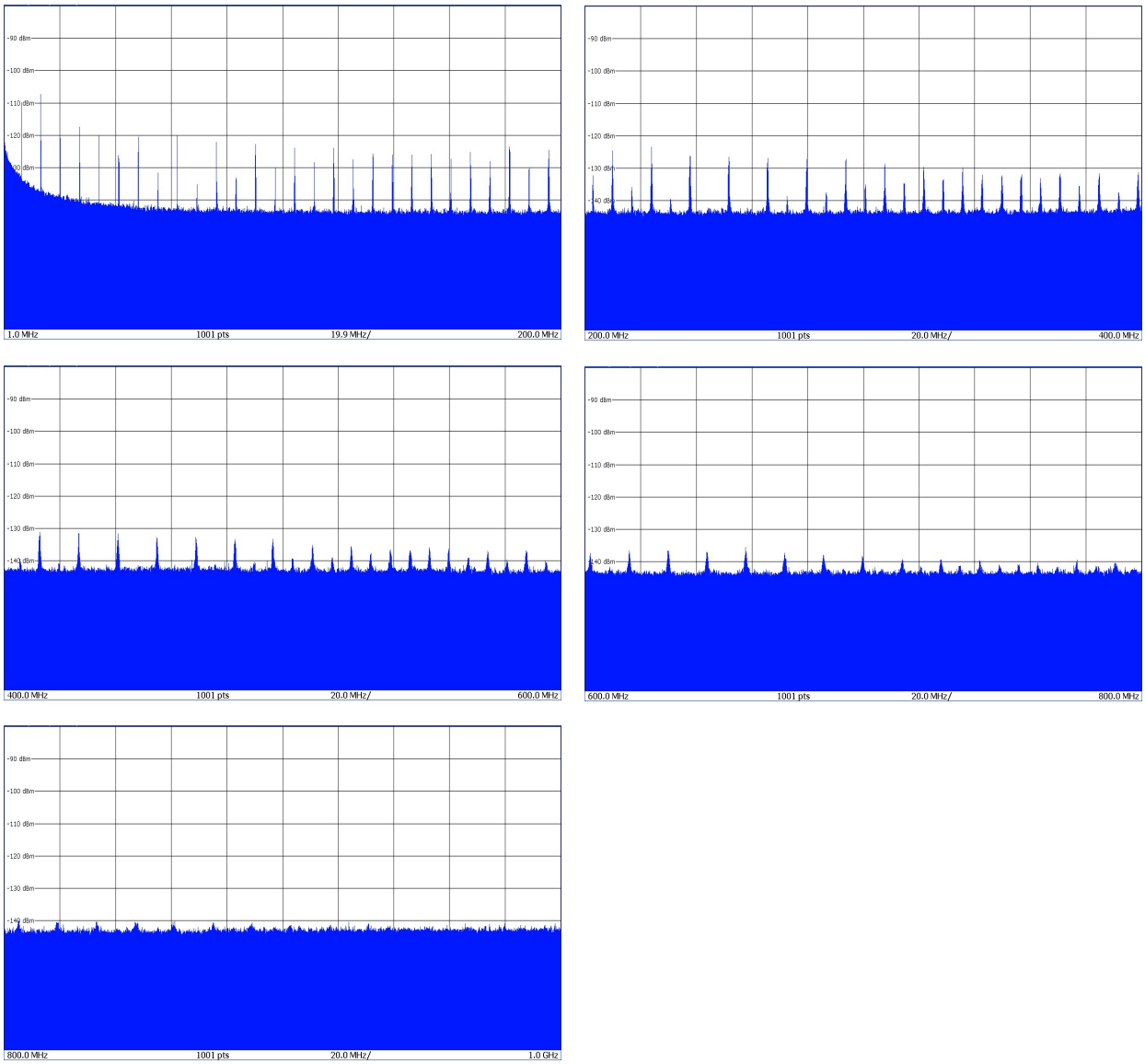


Table6. BSW7221(V) Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz		-105		dBm/10Hz
		50MHz—400MHz		-125		
		400MHz—700MHz		-135		
		700MHz—1GHz		-140		
		> 1GHz(1)		< -145		

(1) No spurious signals were detected above 1GHz.

Figure7. BSW722T Spurious Graph

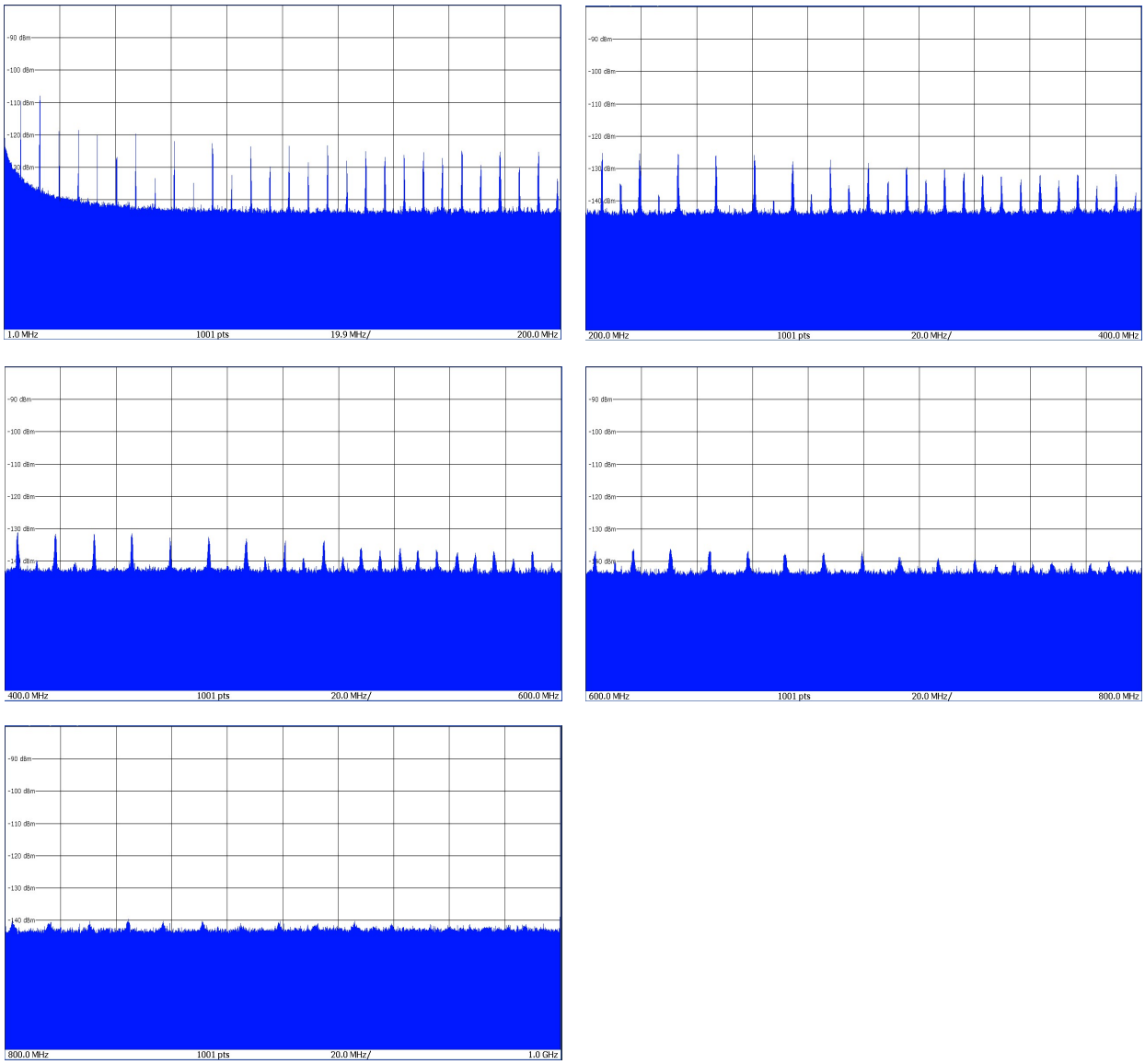


Table7. BSW722T Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz		-105		dBm/10Hz
		50MHz—400MHz		-125		
		400MHz—700MHz		-135		
		700MHz—1GHz		-140		
		> 1GHz(1)		< -145		

(1) No spurious signals were detected above 1GHz.

Figure8. BSW7321 Spurious Graph

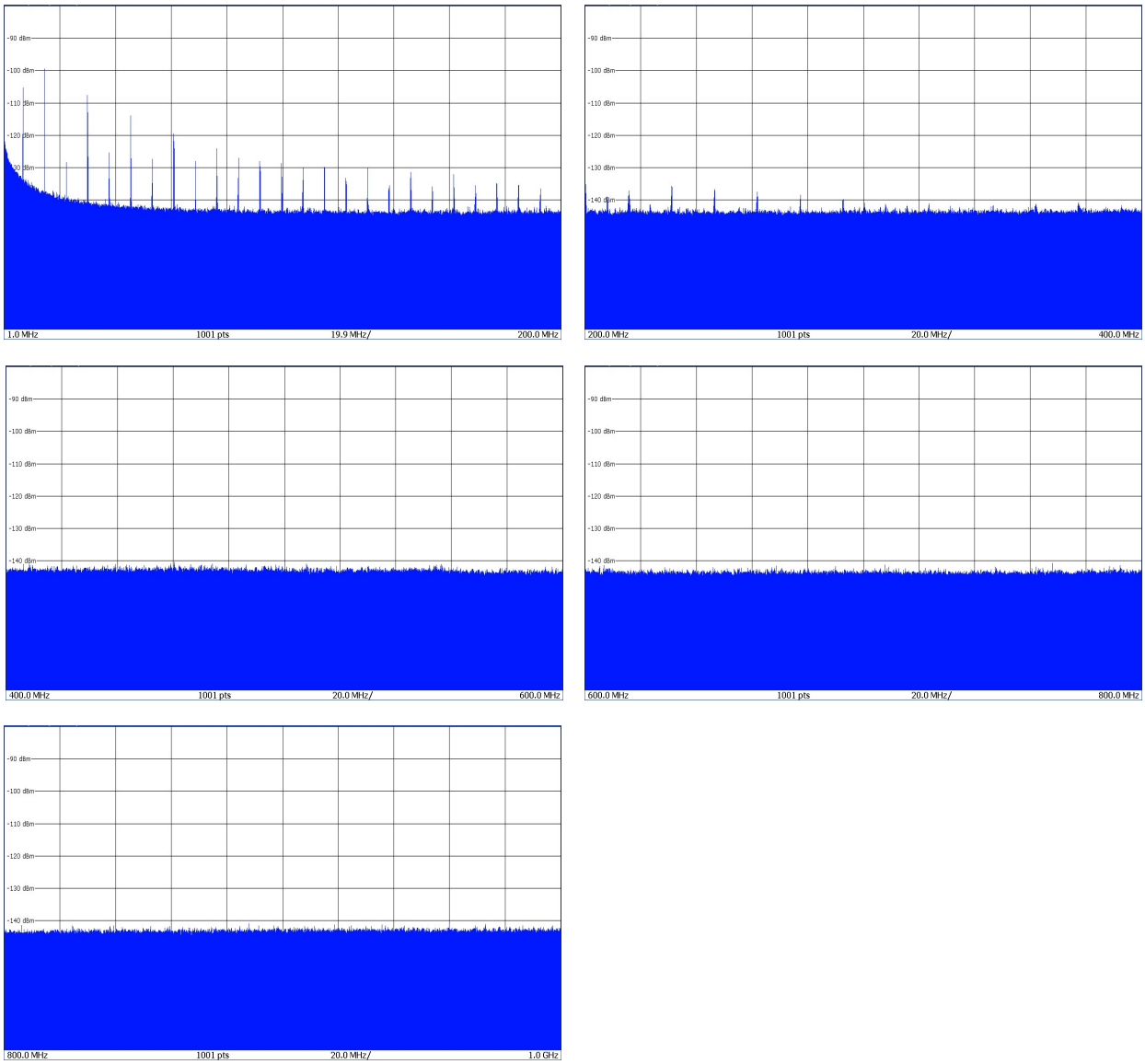


Table8. BSW7321 Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz		-100		dBm/10Hz
		50MHz—200MHz		-120		
		200MHz—500MHz		-135		
		> 500MHz(1)		< -145		

(1) No spurious signals were detected above 500MHz.

Figure9. BSW7421 Spurious Graph

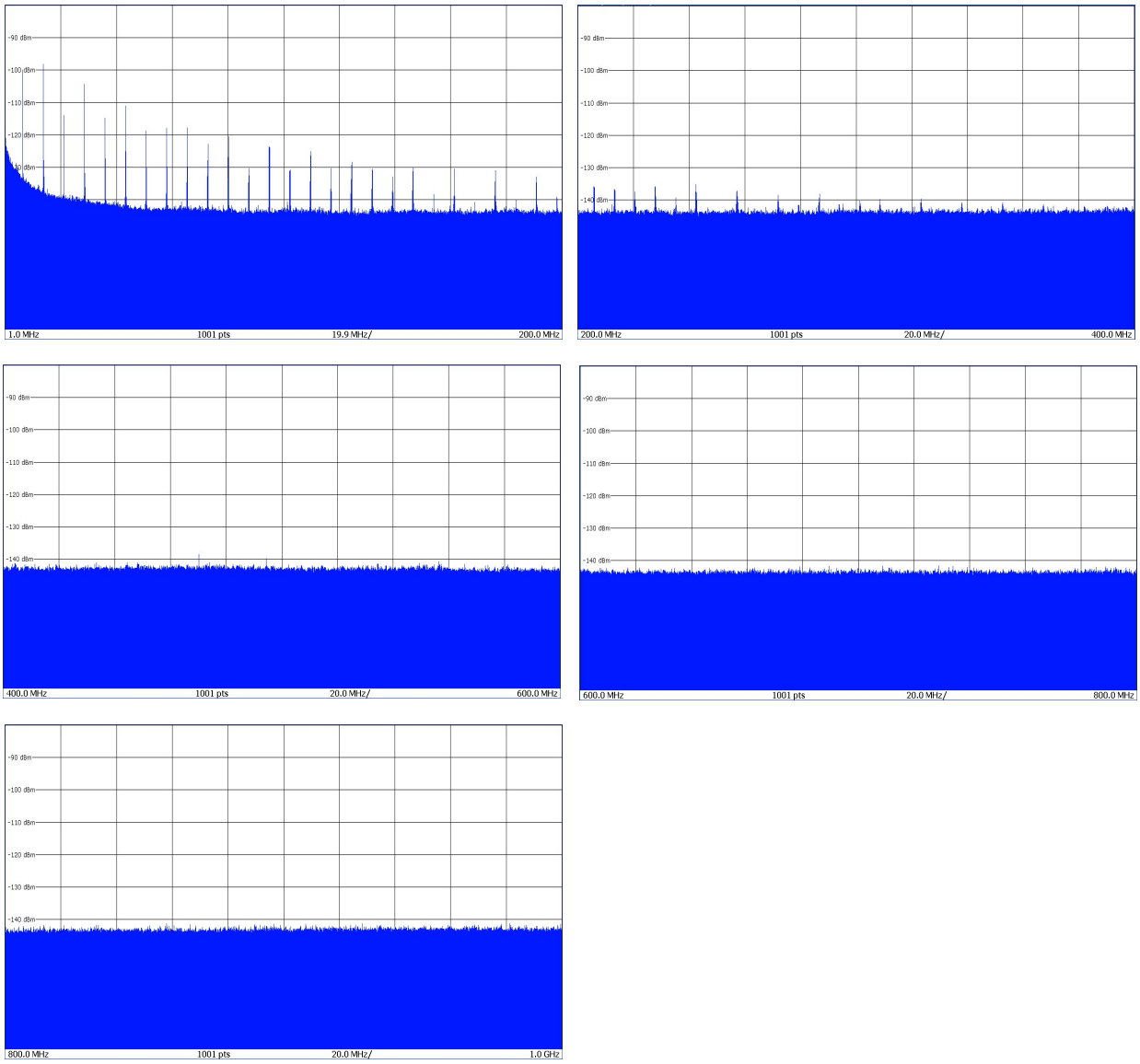


Table9. BSW7421 Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RFC—RFx	5MHz—50MHz		-100		dBm/10Hz
		50MHz—300MHz		-115		
		300MHz—500MHz		-140		
		> 500MHz(1)		< -145		

(1) No spurious signals were detected above 500MHz.

Figure10. BDA4601 Spurious Graph

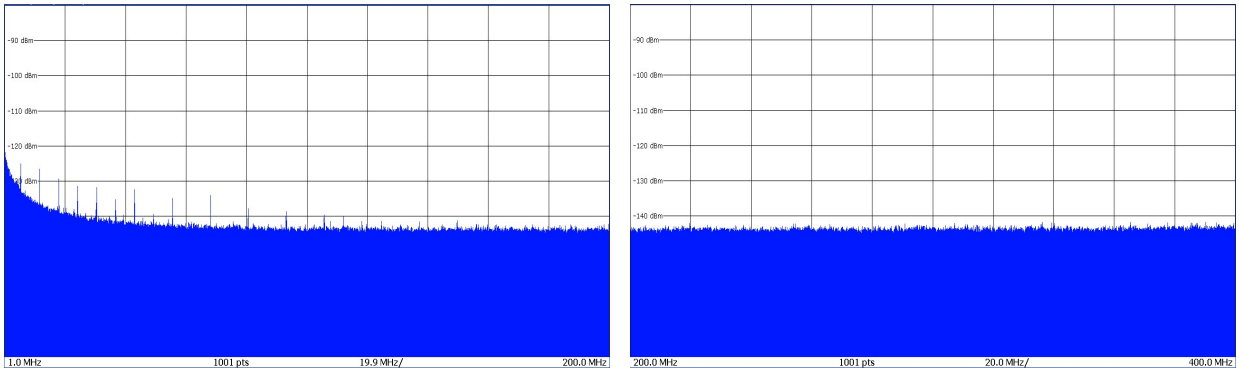


Table10. BDA4601 Maximum Spurious Level

Parameter	Path	Condition	Min	Typ	Max	Unit
Maximum Spurious Level	RF1—RF2	1MHz—50MHz 50MHz—200MHz > 200MHz(1)		-123 -135 < -145		dBm/10Hz

(1) No spurious signals were detected above 200MHz.