								<	Ref Lvl C dBm			- 1 (T1) -83 92.76550	.52 dBm	RBW VBW SWT	10 kH 100 kH 440 ms	z	Ati It	30 dB dBm	
									- 10						<b>▼</b> 1 [	T1] 992	-83 2.76550	.52 dBm 240 MHz	A
Noise Power Ratio 9	timulue v2 A	0								il .					CH P ACF	WR Up	-21 -39	.04 dBm .72 dB	
<u>D</u> evices! <u>H</u> elp	501110103 42.0								<u>مر در ح</u>						ACR	Гом	-0	.14 dB	
Sample Rate/MHz	50.000000	Notch	Center Frg / MHz	Width / MHz	Start Freg / MHz	Stop Freq / MHz S	itart Idx St	op Idx D	epth/dB Acp 💽										
Sample Hate/MHz 🚽 Noise BW / SRate 🛢	1.000000	1	994.506836	4.992676	992.010498	997.003174			-100.0 🗖										188
	50.000000	2	1006.994629	4.992676	1004.498291	1009.490967	368		-100.0										
FFT Length	4096	3	1019.494629	4.992676	1016.998291	1021.990967		1801	-100.0 🗖			ll							
Line Spacing/MHz 0		4	0.000000	0.000000	0.000000	0.000000	0	0	Ú.Ú										
Line spacing/min2	.01220703	5	0.000000	0.000000	0.000000	0.000000	0	Û.	Ú.Ú 🥅										
Notch Count 🗧 🌻	3	6	0.000000	0.000000	0.000000	0.000000	0	0	Ú.Ú ////										
Notch Width/MHz	5.000000	(	0.00000	0.000000	0.000000	0.000000	0	0 0	0.0 177										
Notch Offset/MHz	7.000000	8	0.000000	0.000000	0.000000	0.000000	0	0	0.0 m 0.0 m										
Notch Depth / dB 🛢	-100.0	10	0.000000	0.000000	0.000000	0.000000	0		0.0 F										
Auto Calc			0.000000	0.000000	0.000000	0.000000	·····	×1.										101	
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Lenter/MHz 🚽 TU Ref. Level / dB 🌲	0.000000	*11856/1	magn r irrj			Rnd (const.seed)- Rnd (continue)- Parabolic- Constant-	Const	art			cl		э <b>р</b>		- 10	AL THE RE	UP V	MU UM	
	0.0	1				Parabolić - Constant -	Liri	њы - <sup>В</sup>				Ĭ.							
Ch. Power / dB/Hz Al	CP Lower / dBc	ACP U	pper/dBc P	reset ACP Meas	Mode					0.14	1 8924 M	H7	1.74743	66 MH77		Span	17 474	366 MHz	
-86.43	-6.84		40.70		Cont	<u>M</u> easure			Quit			3:40:41		www.inid./		Sport		and mild	
-00.40	-0.0	•		ACP Nr. 🗘 2	📄 Single 🖿			-		IFR.		0.40.41			-				

Products: AMIQ, SMIQ, SMR, FSEx, FSIQ, FSP, FSU

# NPR - Noise Power Ratio Signal Generation and Measurement

### **Application Note**

Noise Power Ratio (*NPR*) is an add-on tool for *WinIQSim* to generate noise power ratio stimulus signals and measure the resulting noise power ratio of a device under test (DUT) using Rohde & Schwarz instruments via the IEC/IEEE bus.



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## **1** Overview

Noise Power Ratio (*NPR*) is an add-on tool for *WinIQSim* to generate noise power ratio stimulus signals and measure the resulting noise power ratio of a device under test (DUT) using Rohde & Schwarz instruments via IEC/IEEE bus. The Noise Power Ratio measurement technique can characterize the linearity of a wide band amplifier over a custom frequency range. Since NPR drastically reduces measurement time compared to classic gain wobbling, it is particulary interesting for production specific applications.

# 2 Software Features

The software offers:

- custom notch definition
- generator and analyzer control
- load / save device configuration
- automatic measurement of specified notch with adjacent channel power (ACP) option

# **3 Hardware and Software Requirements**

### Hardware Requirements

The software runs on a PC with:

- CPU: 486, Pentium or better
- RAM: 64 MBytes or more
- Monitor: VGA color monitor
- IEC/IEEE bus: Rohde & Schwarz IEEE-488.2 bus interface **PS-B4**, 1006.6207.04, or National Instruments **AT-GPIB/TNT**

It requires the instruments named below:

- AMIQ: I/Q modulation generator
- **SMIQ**: Signal generator with I/Q inputs
- FSEx, FSIQ, FSP or FSU spectrum analyzer with ACP capability.
- SMR microwave generator is supported, but not mandatory.

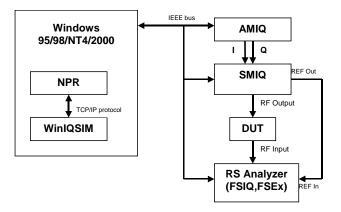
### **Software Requirements**

- Windows 95/98/NT4/2000
- *NI-488.2 v1.2* (or higher) IEC/IEEE bus driver from National Instruments. See <u>http://www.natinst.com</u> for the latest revision.
- TCP/IP network protocol installed.
- *WinIQSim v3.5* (or higher) installed. This is a software tool that allows generates standard and custom I/Q signals e.g. for *ACP* measurements. It can download I/Q data to an *AMIQ* I/Q modulation generator and control an *SMIQ* generator. NPR communicates with WinIQSIM via the TCP/IP network protocol. Both programs must run simultaneously to enable data transfer. Download the latest *WinIQSim* version from http://www.rohde-schwarz.com.
- *VISA v2.01* (or higher) driver from National Instruments. See <u>http://www.natinst.com</u> for the latest revision.

# 4 Connecting the Computer and Instrument

### **Connecting the instruments**

Connect the computer running NPR to the instruments that are involved with the measurement, such as an AMIQ IQ modulator, an SMIQ IQ generator and an FSEx, FSIQ, FSP or FSU analyzer. Make sure that all instruments have a different IEC/IEEE bus address.



## 5 Installing NPR

Make sure you have *WinIQSIM* installed on your hard disc. For NPR installation you need the following files on floppy or hard disc:

#### SETUP.EXE

NPR.001

#### NPR.002

Execute SETUP.EXE and select the installation directory. A new menu item *Noise Power Ratio* will be created in *Start -> Program Files*. The installation directory will contain the files named below:

NPR.EXE	NPR executable
NPR.CFG	NPR configuration file
NPR.IQS	WinIQSim configuration file
NPRPHMG.PMC	Custom phase / magnitude demonstration file
1MA29_0E.PDF	NPR application note / operating manual
NPR.CHM	NPR online help manual

### 6 Starting the Software / Measurement

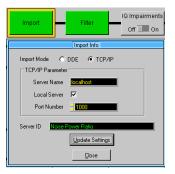
Execute **NPR.EXE**. The example setup below shows three notches generated with *AutoCalc Notches*. NPR configuration is stored in **NPR.CFG** at exit.

Noise BW 80.0 FFT Length 🗘 1	00000 00000 MHz 31072	2	1006.999969	4,999542						
FFT Length 📮 1		2		4.399542	1004.500198	1009.499741	5898	12451	-100.0	-
	31072	J	1026.999664	4.999542	1024.499893	1029.499435	32112	38665	-100.0	
Line Spacing / 62		4	0.00000	0.00000	0.00000	0.00000	Ú	Ú	Ú.Ú ľ	
	2.9395 Hz	- ș	0.00000	0.00000	0.00000	0.00000	Ú	Ú	Ú.Ú	·····
Notch Count 🛢	3	Ģ	0.00000	0.00000	0.00000	0.000000	Ú.	Ú	Ú.Ú	
	00000 MHz	2	0.00000	0.00000	0.00000	0.000000	Ú.	Ú	Ú.Ú	
	00000 MHz	8	0.00000	0.00000	0.00000	0.000000	Ú.	Ú	Ú.Ú	
	-100.0 dB	3	0.00000	0.00000	0.00000	0.000000	Ú.	Ú	Ú.Ú	
	Calc Notches	10	0.000000	0.00000	0.00000	0.00000	Û	0	Ú.Ú [	
Phace/Magn File ct/Programme\Rot	nde8 Schwa	rz\NprGe	Custom 🗖 an/test.pmc 🛛 Rr	Phase Distr. nd (const.seed) – = Rnd (continue) –	Const.Seed	Data Valid 🗾	Calc	EFT	Conn	
				Parabolic - Constant -		Crest Fac	tor 11.1	643 dB		100

Devices can be configured in the device menu. See **Devices** for details. Then define a custom signal with the sampling and notch specific parameters (**Sample Rate, FFT Length**, **Notch Count**, etc.). Prepare the IQ data for transmission to WinIQSIM by pressing **Calc FFT**. The **Data Valid** LED indicates that the data is ready for transfer. After transferring the data to the AMIQ via WinIQSIM (see following section, step 4) press the **Preset NPR Meas** button to put the analyzer in ACP measurement mode. Then select a **Notch Nr** and press the **Measure** button to receive the signal's **NPR** and calculated **Signal Power** values.

Execute *WinIQSIM.EXE* and load the configuration file *NPR.IQS*. This affects following settings:

1. *Import* settings for TCP/IP link.



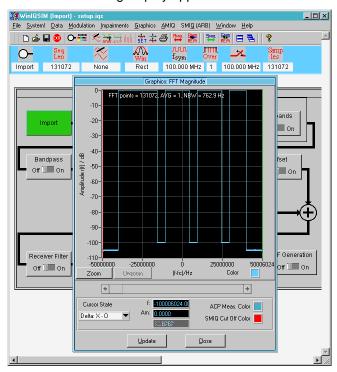
2. Filter set to ideal low pass.

Filter	IQ Impairm Off 🏾		Phase Noise Off 🗐 On
	Import Filte	ering	
Filter / Window	Iter Function	Ideal Low	Pass
Fi		Tabarzon	
	Fill Para	0.00	
Wind	ow Function	Hanning	<b>-</b>
Crebyshe	/ Ripple 7dB	000	
Imp	oulse Length	\$128	
Oversampling	🗖 Auto	1	
Baseb	and Impulse	Dirac	<b>•</b>
<u></u> K			ancel

#### 3. Graphic Display

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	tay 🖄 🕡		
Con Off	cer 🗘 ()	000	
Scaling			
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t/T sym	V Auto	0 000	100 000
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r	🛛 Aut	0 000	1 100
phi	🛛 Auto	45.000	\$ 500 000
f	🛛 Aut	↓ 94.000	\$ 150 000
FFT F	🔽 Auto	0.000	\$ 0.000
FFT MAG	□ Auto	• -110.000	\$10.000
FFT Phase	🛛 Auto	a <b>⊉</b> -180.000	180.000
FFT GD	🛛 Átte	o <b>⊉</b> -1.000	1000
Freq/Tir	ne Abs	<b>▼</b> E	ye Length 糞 4
ACP Meas	urement	Show SM	IIQ ARB Cut Off Range
<u>o</u> k		Cancel	<u>P</u> lot Graph

Be sure to run NPR *before WinIQSim* at restart to a avoid a *TCP/IP* warning. After pressing the *Update* button in the WinIQSim graphics window the following display appears.

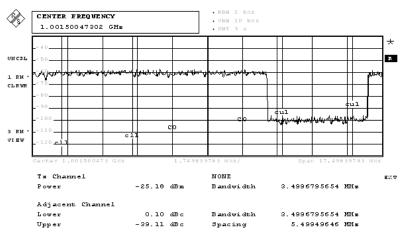


4. To transfer the signal to the AMIQ press the WinIQSim menu item AMIQ -> Transmission or the short cut key AMIQ <->.



- 5. *NPR* can set up the analyzer for NPR measurement of a specified notch automatically (see *Performing NPR Measurements*). Following analyzer parameters are affected.
  - Detector RMS,
  - resolution bandwidth: manual < 30ms depending on sample rate,
  - sweep time > 0.5s.
  - Channel bandwidth = notch width \* 0.8,
  - channel spacing = notch width \* 1.1.
  - Center frequency is moved so adjacent channel fits inside notch.

The analyzer (e.g. FSP) would show following display. The adjacent channel fits perfectly into the second notch (cu1 - ACP upper). If the notch's mid frequency is smaller than the generator's center frequency then cl1 - ACP lower channel is used.

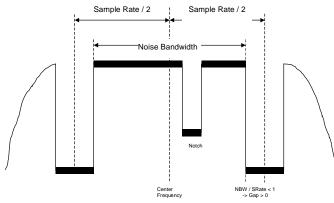


## Parameters

#### **Sampling Parameters**

Sample Rate 🛢 🚺	.000000 MH	Ιz
NBW/SRate	.000000	
Noise BW 50	).000000 MH	łz
FFT Length	4096	
Line Spacing 12.	2070312 kH	z

- Sample Rate Configures the AMIQ D/A converter sample rate. This
  value affects the Line Spacing display. A noise and notch pattern can
  be minimized by decreasing and expanded by increasing the sample
  rate. Range: 10 kHz 105 MHz.
- **Noise BW / Samp.Rate** Configures the noise bandwidth to sample rate ratio. This limits the noise bandwidth to prevent upper and lower side band aliasing effects from influencing the signal. Range: 0.01 to 1.



• **Noise Bandwidth (NBW)** - Displays the valid spectral area for custom notch insertion, which is:

NBW = Sample Rate \* NBW/Srate

• *FFT Length* – the number of points in the frequency domain axis that are inversely Fourier transformed into time domain mode for download to WinIQSIM. This value affects the *Line Spacing* display.

FFT Length 🏮	131072
Line Spacing	4194304 !!!
Natal Carros	2097152 !!!
Notch Count	1048576 !!!
	524288 !!!
Notch Offset 📮 Notch Depth 🖨	262144 !!!
Notion Deptn	✓131072
	65536
	32768
Phace/Magn Fil	16384
d \RSApply	8192
	4096
	2048
Signal Power/	1024
0.0	512
	256
	128
	64

FFT lengths greater than 128kS are marked with an exclamation mark to indicate that the Calc FFT function takes unproportionally long in case memory runs out and Windows uses the memory swapping option. The latest WinIQSIM revision 3.5 can only display FFT lengths up to 128kS correctly. An FFT length of 4MS requires an AMIQ 04. Following warning occurs when decreasing the FFT length:

₩Warning	×
Decreasing notch count Press Yes to accept n	
Yes	No

No changes take place after pressing **No**. After pressing **Yes** all the notches defined previously are deleted. This step is necessary because a smaller FFT length decreases resolution and can leads to an erratic notch list display.

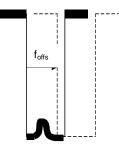
• Line Spacing - Displays the frequency resolution of FFT lines, which is:

Line Spacing = Sample Rate / FFT Length

#### **Notch Related Parameters**

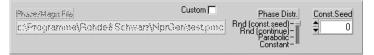
Notch Count 🚔	3					
Notch Width	5.000000	MHz				
Notch Offset 🌲	7.000000	MHz				
Notch Depth 🛢	-100.0	dB				
AutoCalc Notches						

- Notch Count Specifies the number of notches within the current noise bandwidth. With Auto Calc Notches the number of notches is restricted to: Notch Count ≤ NBW / Notch Width.
- Notch Width The notch width is limited by the current noise bandwidth. With Auto Calc Notches all notches have equal widths. If the notch width is smaller than the line spacing no notch will be generated. Range: 0.01 MHz - Noise Bandwidth.
- **Notch Depth** With **Auto Calc Notches** all notches have equal depths. Range: 0 - 100 dB.
- Notch Offset Specifies a frequency offset that is added to the notch center frequencies with Auto Calc Notches. Avoid effects from insufficiently suppressed carriers by moving the notch out of the "danger zone".



• **Auto Calc Notches** - Automatically produces notches with the specified parameters to fit perfectly into the noise bandwidth range. The *Notch Count* is reduced, if necessary.

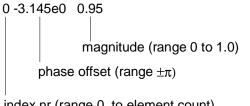
#### Phase / Magnitude Distribution



#### Phase Distribution

- **Random (const. Seed):** I/Q- phase arrays are filled with random values between  $-\pi$  and  $+\pi$ . The random generator always starts wit**h Const.Seed**.
- **Random (continue):** as above except that the random generator's seed depends on the last value.
- **Parabolic**: I- and Q- phase arrays are filled with an unsymmetrical chirp signal ranging from  $-\pi$  to  $+\pi$ . This signal can be used to simulate a wobble generator.
- **Constant**. I/Q phase arrays are filled with constant values. This signal results in one or more peaks in time domain mode due to identical phases of numerous frequency lines.
- Custom Loads a custom phase / magnitude configuration (\*.pmc) file. After loading the \*.pmc file the FFT length input field is dimmed and the number of FFT elements in the file is used. The file has the structure shown below.

4096 Element count (usually based on 2<sup>n</sup>)



index nr (range 0 to element count)

.....

4095 2.4567e0 0.34

#### **Notch List**

All active fields (not dimmed) of the notch list can be edited except *Notch* index. If there are more than 10 items use the scroll bar to display the desired notch configuration line. Since all values are based on a discrete  $2^{N}$  array it is likely that a straight value, e.g. 10.00000 is locked to the nearest point in the array, e.g. 9.987654. The resolution depends on the FFT length.

Notch	Center Frq / MHz	Width / MHz	Start Freq / MHz	Stop Freq / MHz	Start Idx	Stop Idx	Depth/dB Npr
1	3002.996826	4.998779	3000.497437	3005.496216	81	900	-100.0 🗖
2	0.000000	0.000000	0.000000	0.000000	Ú	Ú	Ú.Ú
3	n nnnnnn l	0.00000	0.00000	0.00000	n	n	ú ú <b>f</b>

**Note:** All values displayed in one line depend on each other. The last input value reconfigures the other ones to make sense.

- Notch Displays the notch index number.
- **Center Freq** Edit notch center frequency. Range:

 $f_{carrier} - NBW / 2 \le f_{center} \le f_{carrier} + NBW / 2$ 

• Width - Specifies the notch width. Range: 0 - NBW.

- Start Frequency The start frequency is calculated as:  $f_{start} = f_{center} - Width / 2$
- Stop Frequency The stop frequency is calculated as:

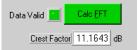
 $f_{stop} = f_{center} + Width / 2$ 

• Start Index - Notch's first frequency line number. Range:

FFT Length /2 - FFT length \* (NBW / SRate) / 2  $\leq$  Start Index < FFT Length / 2 + FFT length \* (NBW / SRate) / 2

- Stop Index Notch's last frequency line number. Range: see Start Index.
- **Note:** An automatic plausibility check avoids Start Frequency (Start Index) being larger than Stop Frequency (Stop Index) and switches them, if necessary. If Start- and Stop Index are equal, the notch consists of only one frequency line. On the other hand a single frequency can be generated by defining two notches ranging from minimum index to frequency index-1 and frequency index + 1 to maximum index.
- **Depth** Specifies the notch depth. Range: 0 -100 dB.
- **Note:** While WinIQSIM displays correct notch depths, the depth of the actual signal is limited to > -70dB by the AMIQ.

#### **Calculate FFT**



 Press the Calc FFT button to calculate the NPR signal in WinIQSIM complient I/Q format. The green LED indicates that the data is valid and can be imported by WinIQSIM via TCP/IP. The crest factor of the signal is also calculated.

#### Connected



- When NPR and WinIQSIM (TCP/IP import mode) are running the *Connected* LED turns green to indicate that NPR has been recognized by WinIQSIM.
- The *TCP/IP Port* number may be varied to enable multiple client access to WinIQSIM.

### Menu

#### Load / Save Configuration File

All program and device specific data can be loaded / saved from / to a configuration file.

🞹 Noise Power Ratio Stimulus v2.91								
<u>F</u> ile	<u>D</u> evices!	<u>H</u> elp						
_	ad Cfg File ave Cfg File		.000000	MHz				
	uit The second	<b>A</b>	.000000	MHz				

• Load Configuration - the default file extension is \*.cfg.

Load NPR Co	onfiguration		? ×
Directory <u>H</u> istory:	C:\NPR		T
<u>S</u> uchen in:	🔁 NPR	· 🖻 (	* 🔳
npr.cfg			
Datei <u>n</u> ame:	npr.cfg		Load
Datei <u>t</u> yp:	*.cfg	 •	Abbrechen

• Save Configuration - the default vfile extension is \*.cfg.

	<i>a a</i>			
Gave NPR Co	nfiguration			? ×
Directory <u>H</u> istory:	C:\NPR			•
Spejchern in:	S NPR	•	È	
npr.cfg				
Datei <u>n</u> ame:	npr.cfg			<u>S</u> peichern
Dateityp:	*.cfg		•	Abbrechen

#### Devices

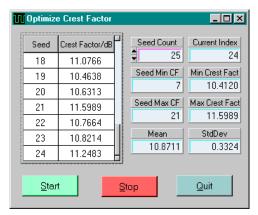
Custom configure a generator, an analyzer or a microwave generator hooked up to the GPIB bus.

Configure Devices	x
Type Addr Device Messa SMIQ <b>4</b> 28 Rohde⪼	ge Signal Generator hwarz,SMIQ06B,829986/0002,5.30 HX
Freq 1000.000000 MHz Level -10.0 dBm	Reset before test <mark>⊏ Test <u>S</u>et</mark>
Type Add Device Messa FSP V 20 Rohde⪼	ge Analyzer hwarz,FSP-7,834265/016,1.10
Freq         1000.000000         MHz           Span         50.000000         MHz           BLev         -30         dBm           Atten         10         dB □ Auto	Reset before test ☐ Test Set       Res BW     3 kHz       Vid BW     30 kHz       Swp. Time     3.000 s
Type Addr Device Messa None 👻 👙 27	ge Microwave Generator
Freq         1000.000000         MHz         II           Level         0.0         dBm         Off           Atten         0         dB         dB	Finput Placet before test T Tact 2at
	QK

- Signal Generator
  - *Type* None, SMUH58, SMIQ
  - *Addr* Range 1...31
  - **Reset** Resets generator and returns device ID (**Device Message**).
  - **Test** Checks if the generator is connected to GPIB bus and returns ID string.
  - Set Configures the generator via GPIB bus with parameters namd below .
  - *Freq* Specifies the generator's carrier frequency. Range depends on the generator type. With no generator connected this value ranges from  $-\infty$  to  $+\infty$ .
  - *Level* RF output level. Range depends on the generator option.
- Analyzer
  - **Type** None, *FSEx*, *FSIQ*, *FSP*, *FSU*
  - Addr, Reset, Test see above.
  - *Freq* Center frequency.
  - **Span** Displayed frequency range.
  - *RLev* RF reference level. Range depends on the analyzer option.
  - *Atten* RF input attenuation. With Auto checked the Atten value is calculated by the analyzer and depends on RF input and mixer level (in certain FSEx models).
  - *RBW* Resolution bandwidth. When Auto is checked the manual setup is overriden and the analyzer automatically calculates RBW depending on the video bandwidth (VBW) and sweep time.
  - **VBW** Video bandwidth. Auto overrides manual setup.
  - **Swp. Time** Specifies the time needed to sweep over the complete frequency span. **Auto** overrides manual setup.

- Microwave Generator
  - Type None, SMR
  - Addr, Reset, Test see above.
  - *Freq* Microwave signal generator frequency. Acts as local oscillator (LO) frequency in the mixer stage (see *Using NPR with Microwaves*).
  - *Level* RF output level.
  - Atten IFI input attenuation.
  - *IF Input* Mixer input. *Level* control is dimmed when *IF Input* is active.

#### **Optimize Crest Factor**



The **Optimize Crest Factor** option enables calculation of crest factors depending on the seed value. Enter **Seed Count** and press **Start** to begin calculation. **Stop** halts the calculation and **Quit** closes the window. All calculated values are listed in the left table. The **Min**imum and **Max**imum **Crest Factor**, the corresponding indexes (**Seed Min CF**, **Seed Max CF**) and **Mean** and **StdDev** (standard deviation) values are also displayed. The crest factor is defined as the ratio P<sub>peak</sub> / P<sub>RMS</sub> and usually ranges from 10 to 12 dB for NPR signals.

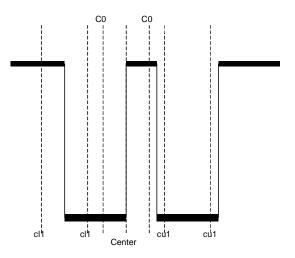
To calculate an NPR signal with a crest factor displayed in the list just enter the according seed in the **Const Seed** control of the main program window and press **Calc FFT**.

#### **Performing NPR Measurements**

The program can set up the devices to automatically perform a NPR measurement of a desired notch. The NPR program uses the *ACP* measuring capabilities of the *FSEx*, *FSIQ*, *FSP* or FSU to obtain the noise power ratio of the notch.

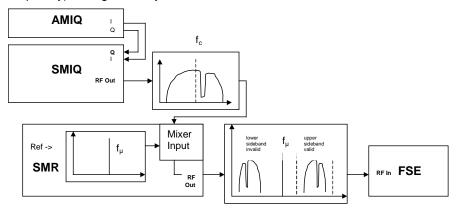


- **Preset NPR Meas** analyzer frequency, span, resolution bandwidth and sweep time are set up to get an overview of the complete sample rate.
- Notch Nr configures the analyzer for NPR measurement of a selected notch. The center frequency is changed so the adjacent channel bandwidth area fits perfectly into the notch. The span is zoomed to increase precision. ACP Channel / Adjacent Channel Bandwidth is set to 80% of the notch width while Channel Spacing is 110% of the notch width. If the notch's mid-frequency is smaller than the generator's center NPR automatically chooses ACP Lower display (yellow background) else ACP Upper.
- Mode there are two measurement modes: Continuous and Single shot. When choosing Single a measurement can be triggered by pressing the Measure button.
- **Note:** Automatic measurement only works correctly if gaps between notches are at least as wide as the notches themselves. The following figure shows how the channel bandwidth power suddenly drops in the left notch and leads to an incorrect NPR Upper display.



#### **Using NPR with Microwaves**

An interesting application is NPR measurements of microwave amplifiers. For frequencies exeeding the range of standard signal generators (> 6 GHz) it is necessary to use an additional microwave generator (e.g. SMR40) with the SMR-B24 or B23 mixer option. The schematic below shows an application consisting of AMIQ, SMIQ, SMR with a mixer option for signal generation and an FSE (FSP, FSIQ depending on maximum frequency) for signal analysis.



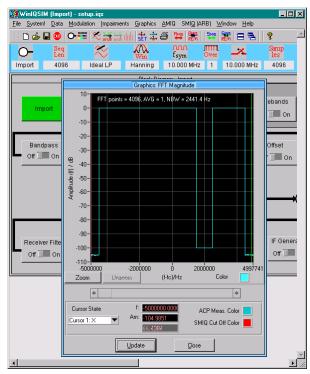
The carrier frequency of the SMIQ (f<sub>c</sub>) is mixed with the SMR microwave carrier frequency (f<sub>µ</sub>) resulting in an upper (f<sub>µ</sub> + f<sub>c</sub>) and lower (f<sub>µ</sub> - f<sub>c</sub>) sideband. The most important SMR parameters (frequency, level and IF input attenuation and IF input on/off) can be controlled from the NPR device configuration menu.

In case the DUT is not frequency selective suppress the SMR carrier frequency and lower sideband with an external filter.

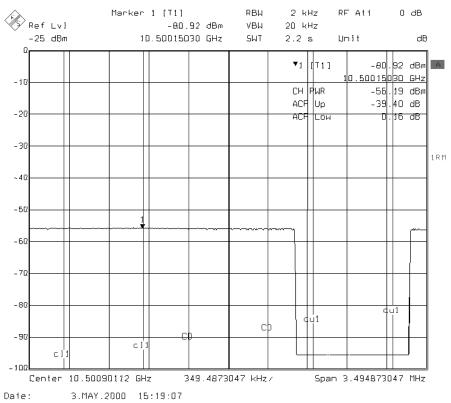
The resulting RF frequency is  $f\mu$  + fc (upper sideband). The lower sideband is mirrored and therefor not adequate for our purposes. Our example uses the following setup:  $f\mu$  = 10GHz, fc = 500MHz. Note that the resolution bandwidth is set to < 2kHz and the sweep time is >2s. It is also possible to merge both signals via an external mixing component.

ample Rate 🗎	50.000000	MHz	Notch	Center Frq / MHz	Width / MHz	Start Freq / MHz	Stop Freq / MHz	Start Idx	Stop Idx	Depth/dB	Npr
BW/SRate			1	10494.506836	4.992676	10492.010498	10497.003174	-654	-245	-100.0	
loise BW	50.000000	MHz	2	10506.994629	4.992676	10504.498291	10509.490967	368	777	-100.0	
		10112	3	10519.494629	4.992676	10516.998291	10521.990967	1392	1801	-100.0	
FT Length	4096		ġ	0.00000	0.000000	0.00000	0.00000	Q	Û	Ú.Ú	r
ine Spacing	12.2070312	kHz	ş	0.000000	0.000000	0.000000	0.000000	Û	Û	Ú.Ú	m
lotch Count 🛢	3		6	0.000000	0.000000	0.000000	0.000000	Û	Û	Ú.Ú	r
lotch Width	5.000000	MHz	?	0.00000	0.000000	0.00000	0.00000	Û	Ú	Ú.Ú	r
lotch Offset	7.000000	MHz	8	0.00000	0.000000	0.00000	0.00000	Û	Ù	Ú.Ú	r
lotch Depth	-100.0		3	0.00000	0.00000	0.00000	0.00000	Ù	Ù	Ú.Ú	r"
<u></u>	AutoCalc Not	ches	10	0.000000	0.00000	0.00000	0.00000	0	0	Ú.Ú	r L
Nace/Magn Fil ::\Programm	e e\Pohde&S	chwarz	\NprG	Custom 🗖 an/stest.pmc	Phase Distr. d (const.seed) - Rnd (continue) - Parabolic - Constant -	Magn, Distr Constant - Linear -	Data Valid	Calc	EFT	Con	necteo

WinIQSim graphic display.



#### FSE screenshot.



# 7 Additional Information

Please contact **TM-Applications@rsd.rohde-schwarz.com** for comments and further suggestions.

# 8 Ordering information

<b>IQ Modulator</b> AMIQ-03 AMIQ-04	4 MSamples 16 MSamples	1110.2003.03 1110.2003.04
Vector Signal Generator SMIQ02 SMIQ02E SMIQ03 SMIQ03E SMIQ06	(300 kHz to 2.2 GHz) (300 kHz to 2.2 GHz) (300 kHz to 3.3 GHz) (300 kHz to 3.3 GHz) (300 kHz to 6.0 GHz)	1084.8004.02 1106.1806.02 1084.8004.03 1106.1806.03 1084.8004.06
<b>Spectrum Analyzer</b> FSEA20 FSEA30 FSEB20 FSEB30 FSEK20 FSEK30 FSEM20 FSEM30 FSIQ3 FSIQ3 FSIQ7 FSIQ26 FSP3 FSP7 FSP13 FSP7 FSP13 FSP30 FSU3 FSU8	(9 kHz to 3.5 GHz) (20 Hz to 3.5 GHz) (9 kHz to 7.0 GHz) (20 Hz to 7.0 GHz) (9 kHz to 40 GHz) (20 Hz to 40 GHz) (20 Hz to 26.5 GHz) (20 Hz to 26.5 GHz) (20 Hz to 26.5 GHz) (20 Hz to .3.5GHz) (20 Hz to .26 GHz) (9 kHz to 3 GHz) (9 kHz to 7 GHz) (9 kHz to 13 GHz) (9 kHz to 13 GHz) (9 kHz to 20 GHz) (20 Hz to 3.6 GHz) (20 Hz to 8 GHz)	1065.6000.20 1065.6000.30 1066.3010.20 1066.3010.30 1088.1491.20 1088.3494.30 1080.1505.20 1079.8500.30 1119.5005.07 1119.6001.26 1093.4495.03 1093.4495.03 1093.4495.13 1093.4495.30 1129.9003.03 1129.9003.08
Microwave Generator SMR20 SMR27 SMR30 SMR40 SMR B23 SMR B24	(10 MHz to 20 GHz) (10 MHZ to 27 GHz) (10 MHz to 30 GHz) (10 MHz to 40 GHz) IF-Input 20 GHz IF-Input 40 GHz	1104.0002.20 1104.0002.27 1104.0002.30 1104.0002.40 1104.5804.02 1104.6100.02



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