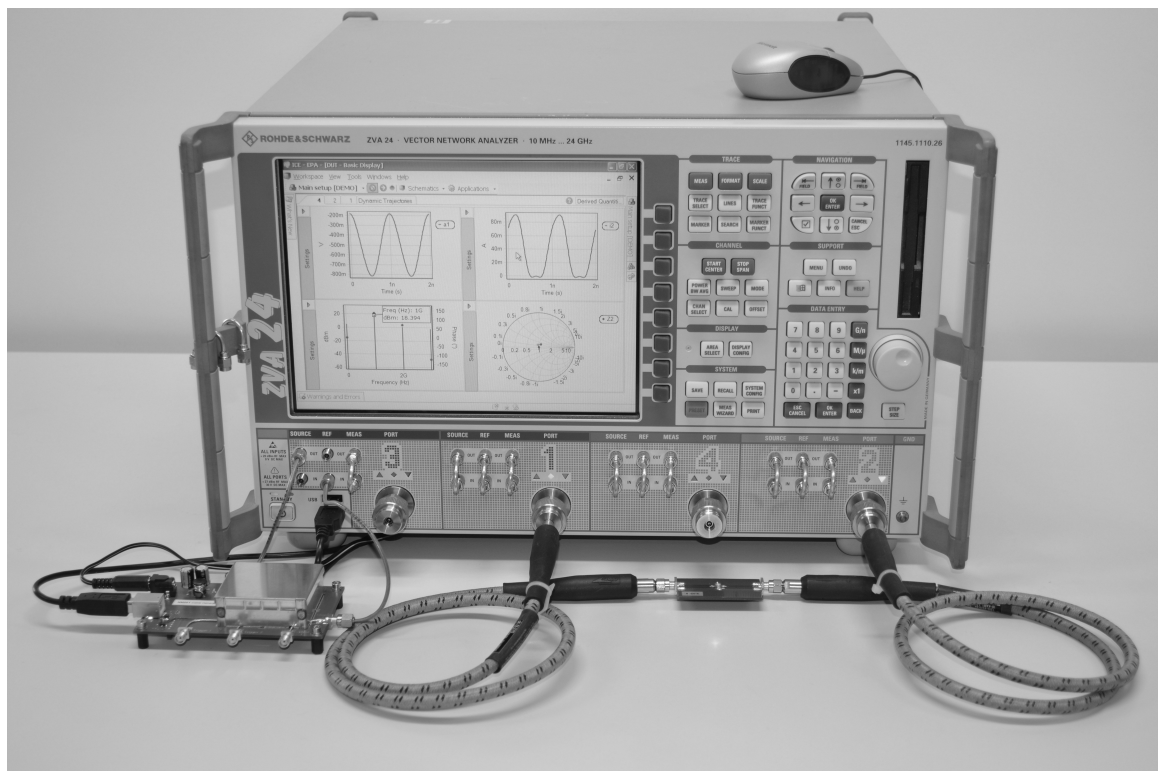


## Nonlinear Starter Kit for R&S Network Analysers

### Make your first steps in the nonlinear world



---

# Contents

<b>Introduction.....</b>	<b>7</b>
General block diagram.....	8
<b>Connectivity.....</b>	<b>11</b>
NM201 Comb Generator.....	11
SMA Connection Kit.....	11
<b>ICE software requirements.....</b>	<b>13</b>
Specifics for ICE software installed on ZVx.....	13
<b>Specifications.....</b>	<b>15</b>
<b>Hardware specifications.....</b>	<b>15</b>
ZVA24 Vector Network Analyser.....	15
Overall Specifications for ZVxPlus.....	15
Reflectometers.....	15
Port bias.....	16
Receivers.....	17
Receiver step attenuators (B3x).....	18
Maximum power level versus receiver attenuation.....	18
ZVT8 Vector Network Analyser.....	19
Overall Specifications for ZVxPlus.....	19
Reflectometers.....	19
Port bias.....	19
Receivers.....	20
Maximum power level versus receiver attenuation.....	21
ZVA40 Vector Network Analyser.....	22
Overall Specifications for ZVxPlus.....	22
Reflectometers.....	22
Port bias.....	22
Receivers.....	23
Receiver step attenuators (B3x).....	23
Maximum power level versus receiver attenuation.....	24
ZVA50 Vector Network Analyser.....	25
Overall Specifications for ZVxPlus.....	25
Reflectometers.....	25
Port bias.....	25
Receivers.....	26
Receiver step attenuators (B3x).....	27
Maximum power level versus receiver attenuation.....	27
ZVA67 Vector Network Analyser.....	28
Overall Specifications for ZVxPlus.....	28
Reflectometers.....	28
Port bias.....	28
Receivers.....	29
Receiver step attenuators (B3x).....	30
Maximum power level versus receiver attenuation.....	30
NM201 Comb Generator.....	31

---

<b>Additional Hardware.....</b>	<b>33</b>
<b>Supported equipments.....</b>	<b>33</b>
DC Sources (including DC Voltage and Current Meters).....	33
DC Voltage and Current Meters.....	33
RF Sources.....	34
Pulsed IV Systems.....	34
Power Meters.....	35
Calibration Units.....	35
Tuners.....	35
<b>Customization.....</b>	<b>35</b>
Instrument drivers.....	35
External Test sets.....	35
<b>Order Information.....</b>	<b>37</b>
<b>Trademark Information.....</b>	<b>39</b>
<b>Contact Information.....</b>	<b>41</b>



# Introduction

The NM310S is a cost-efficient nonlinear starter kit, allowing you to make your first steps in the nonlinear world with your vector network analyser. It combines hardware and software that runs on top of a selection of vector network analysers (VNA) from Rohde&Schwarz. The combination of the ZVx and the NM310S starter kit is referred to as “ZVxPlus”.

On top of the standard measurement capabilities of the R&S VNA, the ZVxPlus provides calibrated measurement capability of the time waveforms of the incident and reflected waves or voltages and currents at the ports of a component under test. The time waveforms are periodic with a minimal frequency of 20 MHz and with spectral components up to 3 GHz.

The NM310S starter kit consists of:

- 1x NM201 double-output comb generator (20MHz-3GHz) used as synchronizer and Harmonic Phase Reference
- 1x NM311S Connection Kit
- 1x USB stick containing the NMDG's ICE software installer, a ICE 30 day demo license<sup>1</sup>, a quick start guide and several tutorials.

This starter kit runs on top of the 4-port R&S®ZVA8/24/40/50/67 and on top of the R&S®ZVT8/20 (at least 3 ports), with the following options:

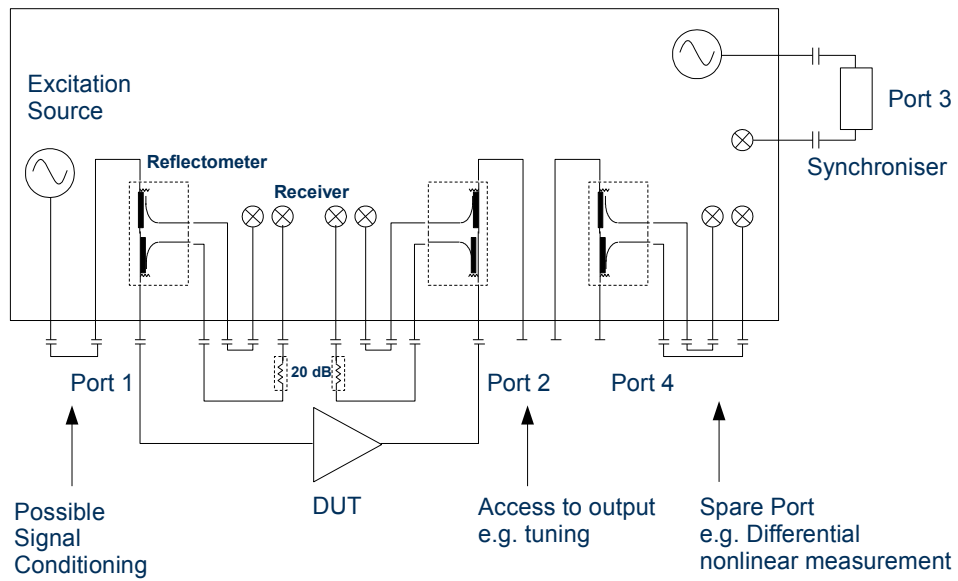
- Direct generator/receiver Access option (R&S®ZVAxx-B16 or R&S®ZVTxx-B16)
- Frequency conversion option (R&S®ZVA-K4)
- Optional: step attenuator option for measurement receivers at Port 1 and Port 2, allowing automatic range adaptation (R&S®ZVAxx-B31 and -B32 or R&S®ZVTxx-B31 and -B32)

When the step attenuator option on Port 1 (option B31) and/or Port 2 (option B32) is missing, one needs to put external attenuators in front of the corresponding measurement receiver.

---

<sup>1</sup> The ICE 30 day demo license will allow you to begin immediately your first steps in the nonlinear world. A final license is delivered for your system on demand.

## General block diagram



*Block diagram of ZVxPlus for the different R&S VNAs*



# Connectivity

## NM201 Comb Generator

Input port connector	SMA, female
Output port 1 connector	SMA, female
Output port 2 connector	SMA, female
Trigger port 1 connector	SMA, female
Trigger port 2 connector	SMA, female
USB control port	USB Type B
DC Power Connector	2.1 mm DC Jack

## NM311S Connection Kit

2x semi-rigid cables (Synchroniser)	
Input port connector	3.5 mm, male
Output port connector	3.5 mm, male
1x flexible cable (Harmonic Phase Reference)	
Input port connector	SMA, male
Output port connector	SMA, male
1 x adapter	
Input port connector	3.5 mm, female
Output port connector	3.5 mm, female



# ICE software requirements

Please refer to the [NMDG Software Requirements](#) document, for general information about the requirements.

## Specifics for ICE software installed on ZVx

External equipments control Required ZVx accessories	R&S®ZVAB-B44 Option
Installed software .NET Framework	.NET Framework 2.0 SP2*
Recommended accessories External display	Minimal resolution 1024 x 768 Recommended resolution 1280 x 1024

\* The ICE software installer will automatically install this in case it is missing otherwise.

# Specifications

## Hardware specifications

### ZVA24 Vector Network Analyser

#### *Overall Specifications for ZVxPlus*

Frequency range	20 MHz – 3 GHz	limited by NM201
Minimal frequency grid spacing	20 MHz	

#### *Reflectometers*

Insertion loss	<7 dB, typ. 5dB	
Return loss	>8 dB, typ. 15 dB	
Coupling factor in Reference channel in Measurement channel	typ. 14 dB typ. 12 dB	18dB @ 600MHz 15dB @ 600MHz
Directivity	>40dB	
Damage power level	+27 dBm	
Damage DC voltage	30 V	

## Specifications

---

### ***Port bias***

Maximum nominal input voltage	30 V	
Maximum nominal input current	200 mA	
Damage voltage	30 V	
Damage current	500 mA	

**Receivers**

Noise floor		@ Test port
Reference receiver channel		
IF BW: 100 kHz	-61 dBm	
10 kHz	-71 dBm	
1 kHz	-81 dBm	
100 Hz	-91 dBm	
10 Hz	-101 dBm	
Measurement* receiver channel		
IF BW: 100 kHz	-68 dBm	
10 kHz	-78 dBm	
1 kHz	-88 dBm	
100 Hz	-98 dBm	
10 Hz	-108 dBm	
Compression		@ Test port
Reference receiver channel		
Odd harmonics only	+26 dBm	60 dBc SFDR**
All harmonics	+6 dBm	60 dBc SFDR**
Measurement* receiver channel		
Odd harmonics only	+27 dBm	60 dBc SFDR**
All harmonics	+12.5 dBm	60 dBc SFDR**
Cross talk		
from Reference to Measurement receiver	None	
from Measurement to Reference receiver	-80 dB	
Damage power level	+20 dBm	
Damage DC voltage	0V	

\* Including 25 dB Attenuator

\*\* Spurious Free Dynamic Range including harmonics

## Specifications

### *Receiver step attenuators (B3x)*

Attenuation	0 dB to 35 dB	
Attenuation steps	5 dB	
Attenuation accuracy	<2 dB	
Systematic amplitude error	typ. 0.5 dB	
Systematic phase error*	5°	

\* After nominal delay compensation

### *Maximum power level versus receiver attenuation*

Attenuation	Reference receiver	Measurement receiver	
	Maximum power @ Source Input (Odd harm. Only/All harm.)	Maximum power @ Test Port (Odd harm. Only/All harm.)	
	External attenuator	External attenuator (25 dB included)	Internal step attenuator (B3x)
0 dB	+26 / +6 dBm	+27 / +12.5 dBm	+4.5 / -12.5 dBm
5 dB	+27 / +11 dBm	+27 / +17.5 dBm	+9.5 / -7.5 dBm
10 dB	+27 / +16 dBm	+27 / +22.5 dBm	+13.5 / -2.5 dBm
15 dB	+27 / +21 dBm	+27 / +27 dBm	+18.5 / +2.5 dBm
20 dB	+27 / +26 dBm	+27 / +27 dBm	+23.5 / +7.5 dBm
25 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +12.5 dBm
30 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +17.5 dBm
35 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +22.5 dBm

## ZVT8 Vector Network Analyser

### Overall Specifications for ZVxPlus

Frequency range	20 MHz – 3 GHz	limited by NM201
Minimal frequency grid spacing	20 MHz	

### Reflectometers

Insertion loss	<9.5 dB, typ. 8.75 dB	8.5 dB @ 1.2GHz
Return loss	<19 dB, typ. 26 dB	
Coupling factor in Reference channel in Measurement channel	typ. 41 dB typ. 20 dB	
Directivity	>7 dB	
Damage power level	+27 dBm	
Damage DC voltage	30 V	

### Port bias

Maximum nominal input voltage	30 V	
Maximum nominal input current	200 mA	
Damage voltage	30 V	
Damage current	500 mA	

## Specifications

### Receivers

Noise floor		@ Test port
Reference receiver channel		
IF BW: 100 kHz	-100 dBm	
10 kHz	-110 dBm	
1 kHz	-120 dBm	
100 Hz	-130 dBm	
10 Hz	-140 dBm	
Measurement* receiver channel		
IF BW: 100 kHz	-108 dBm	
10 kHz	-118 dBm	
1 kHz	-128 dBm	
100 Hz	-138 dBm	
10 Hz	-148 dBm	
Compression		@ Test port, @ 600MHz
Reference receiver channel All harmonics	+27 dBm	60 dBc SFDR**
Measurement* receiver channel All harmonics	+23 dBm	60 dBc SFDR**
Cross talk		
from Reference to Measurement* receiver	- 88 dB	
from Measurement* to Reference receiver	None	
Damage power level	+20 dBm	
Damage DC voltage	0 V	

\* Including 20 dB Attenuator

\*\* Spurious Free Dynamic Range including harmonics

*Maximum power level versus receiver attenuation*

Attenuation	Reference receiver	Measurement receiver
	Maximum power @ Source Input	Maximum power @ Test Port
	External attenuator	External attenuator (20 dB included)
0 dB	+27 dBm	+23 dBm
5 dB	+27 dBm	+27 dBm



## ZVA40 Vector Network Analyser

### *Overall Specifications for ZVxPlus*

Frequency range	20 MHz – 3 GHz	limited by NM201
Minimal frequency grid spacing	20 MHz	

### *Reflectometers*

Coupling factor		
in Reference channel	typ. 21 dB	17dB @ 600MHz
in Measurement channel	typ. 10 dB	17dB @ 600MHz
Damage power level	+27 dBm	
Damage DC voltage	30 V	

### *Port bias*

Maximum nominal input voltage	30 V	
Maximum nominal input current	200 mA	
Damage voltage	30 V	
Damage current	500 mA	

**Receivers**

Compression		@ Test port
Reference receiver channel Odd harmonics only All harmonics	+27 dBm +9 dBm	60 dBc SFDR** 60 dBc SFDR**
Measurement* receiver channel Odd harmonics only All harmonics	+27 dBm +10 dBm	60 dBc SFDR** 60 dBc SFDR**
Cross talk		
from Reference to Measurement* receiver	None	
from Measurement* to Reference receiver	None	
Damage power level	+20 dBm	
Damage DC voltage	0 V	

\* Including 35 dB Attenuator

\*\* Spurious Free Dynamic Range including harmonics

**Receiver step attenuators (B3x)**

Attenuation	0 dB to 35 dB	
Attenuation steps	5 dB	
Attenuation accuracy	<2 dB	
Systematic amplitude error	typ. 0.4 dB	
Systematic phase error*	7°	

\* After nominal delay compensation

**Maximum power level versus receiver attenuation**

Attenuation	Reference receiver	Measurement receiver	
	Maximum power @ Source Input (Odd harm. Only/All harm.)	Maximum power @ Test Port (Odd harm. Only/All harm.)	
	External attenuator	External attenuator (35 dB included)	Internal step attenuator (B3x)
0 dB	+27 / +9 dBm	+27 / +10 dBm	-1.5 / -25 dBm
5 dB	+27 / +14 dBm	+27 / +15 dBm	+3.5 / -20 dBm
10 dB	+27 / +19 dBm	+27 / +20 dBm	+8.5 / -15 dBm
15 dB	+27 / +24 dBm	+27 / +25 dBm	+13.5 / -10 dBm
20 dB	+27 / +27 dBm	+27 / +27 dBm	+18.5 / -5 dBm
25 dB	+27 / +27 dBm	+27 / +27 dBm	+23.5 / 0 dBm
30 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +5 dBm
35 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +10 dBm

## ZVA50 Vector Network Analyser

### *Overall Specifications for ZVxPlus*

Frequency range	20 MHz – 3 GHz	limited by NM201
Minimal frequency grid spacing	20 MHz	

### *Reflectometers*

Coupling factor		
in Reference channel	typ. 22 dB	
in Measurement channel	typ. 10 dB	
Damage power level	+27 dBm	
Damage DC voltage	30 V	

### *Port bias*

Maximum nominal input voltage	30 V	
Maximum nominal input current	200 mA	
Damage voltage	30 V	
Damage current	500 mA	

## Specifications

---

### *Receivers*

Compression		@ Test port
Reference receiver channel		
Odd harmonics only	+27 dBm	60 dBc SFDR**
All harmonics	+12 dBm	60 dBc SFDR**
Measurement* receiver channel		
Odd harmonics only	+23 dBm	60 dBc SFDR**
All harmonics	+10 dBm	60 dBc SFDR**
Cross talk		
from Reference to Measurement* receiver	None	
from Measurement* to Reference receiver	None	
Damage power level	+20 dBm	
Damage DC voltage	0 V	

\* Including 25 dB Attenuator

\*\* Spurious Free Dynamic Range including harmonics

**Receiver step attenuators (B3x)**

Attenuation	0 dB to 35 dB	
Attenuation steps	5 dB	

**Maximum power level versus receiver attenuation**

Attenuation	Reference receiver	Measurement receiver	
	Maximum power @ Source Input (Odd harm. Only/All harm.)	Maximum power @ Test Port (Odd harm. Only/All harm.)	
	External attenuator	External attenuator (25 dB included)	Internal step attenuator (B3x)
0 dB	+27 / +12 dBm	+23 / +10 dBm	-2 / -15 dBm
5 dB	+27 / +17 dBm	+27 / +15 dBm	+3 / -10 dBm
10 dB	+27 / +22 dBm	+27 / +20 dBm	+8 / -5 dBm
15 dB	+27 / +27 dBm	+27 / +25 dBm	+13 / +0 dBm
20 dB	+27 / +27 dBm	+27 / +27 dBm	+18 / +5 dBm
25 dB	+27 / +27 dBm	+27 / +27 dBm	+23 / +10 dBm
30 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +15 dBm
35 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +20 dBm

## ZVA67 Vector Network Analyser

### *Overall Specifications for ZVxPlus*

Frequency range	20 MHz – 3 GHz	limited by NM201
Minimal frequency grid spacing	20 MHz	

### *Reflectometers*

Coupling factor		
in Reference channel	typ. 22 dB	
in Measurement channel	typ. 10 dB	
Damage power level	+27 dBm	
Damage DC voltage	30 V	

### *Port bias*

Maximum nominal input voltage	30 V	
Maximum nominal input current	200 mA	
Damage voltage	30 V	
Damage current	500 mA	

**Receivers**

Compression		@ Test port
Reference receiver channel		
Odd harmonics only	+27 dBm	60 dBc SFDR**
All harmonics	+12 dBm	60 dBc SFDR**
Measurement* receiver channel		
Odd harmonics only	+27 dBm	60 dBc SFDR**
All harmonics	+11 dBm	60 dBc SFDR**
Cross talk		
from Reference to Measurement* receiver	None	
from Measurement* to Reference receiver	None	
Damage power level	+20 dBm	
Damage DC voltage	0 V	

\* Including 35 dB Attenuator

\*\* Spurious Free Dynamic Range including harmonics



## Specifications

---

### *Receiver step attenuators (B3x)*

Attenuation	0 dB to 35 dB	
Attenuation steps	5 dB	

### *Maximum power level versus receiver attenuation*

Attenuation	Reference receiver	Measurement receiver	
	Maximum power @ Source Input (Odd harm. Only/All harm.)	Maximum power @ Test Port (Odd harm. Only/All harm.)	
	External attenuator	External attenuator (35 dB included)	Internal step attenuator (B3x)
0 dB	+27 / +12 dBm	+27 / +11 dBm	+0 / -24 dBm
5 dB	+27 / +17 dBm	+27 / +16 dBm	+5 / -19 dBm
10 dB	+27 / +22 dBm	+27 / +21 dBm	+10 / -14 dBm
15 dB	+27 / +27 dBm	+27 / +26 dBm	+15 / -9 dBm
20 dB	+27 / +27 dBm	+27 / +27 dBm	+20 / -4 dBm
25 dB	+27 / +27 dBm	+27 / +27 dBm	+25 / +1 dBm
30 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +6 dBm
35 dB	+27 / +27 dBm	+27 / +27 dBm	+27 / +11 dBm

## NM201 Comb Generator

Frequency range	20 MHz – 3 GHz	
Drive frequency range	1 GHz – 2 GHz	
Nominal input power	+4 dBm	
Input damage level	+6 dBm	
Output peak voltage	-0.55 Vp	

## Waste Electrical and Electronic Equipment (WEEE)



**EU Customers** At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit [ni.com/environment/weee](http://ni.com/environment/weee).



# Additional Hardware

## Supported equipments

### DC Sources (including DC Voltage and Current Meters)

R&S®NGMO series	controlled via its IEC/IEEE-bus interface
Hameg HMP series	controlled via its USB interface
Agilent 66xxA/B/C series	controlled via its IEC/IEEE-bus interface
Agilent 662x series	controlled via its IEC/IEEE-bus interface
Agilent DC4142	controlled via its IEC/IEEE-bus interface
Agilent E363xA series	controlled via its IEC/IEEE-bus interface
Keithley 24xx series	controlled via its IEC/IEEE-bus interface
Yokogawa GS610	controlled via its IEC/IEEE-bus interface

### DC Voltage and Current Meters

Hameg HM8112-3	controlled via its USB interface
Agilent 34401A	controlled via its IEC/IEEE-bus interface
R&S® RTO scope series as DC Meters	controlled via its IEC/IEEE-bus interface

## RF Sources

Remark: A 10 MHz clock needs to be shared between the RF source and the ZVx, and the ZVx is set as the master clock.

Internal R&S® ZVx sources	
R&S® SMx100A series*,**	controlled via its IEC/IEEE-bus interface
R&S® SMBV100A source*,**	controlled via its IEC/IEEE-bus interface
R&S® SMIQ source*,**	controlled via its IEC/IEEE-bus interface
R&S® SML0x series*,**	controlled via its IEC/IEEE-bus interface
Agilent 836x series*	controlled via its IEC/IEEE-bus interface
Agilent ESG series*,**	controlled via its IEC/IEEE-bus interface
Agilent PSG series*,**	controlled via its IEC/IEEE-bus interface
Anritsu MG369x series*,**	controlled via its IEC/IEEE-bus interface
SCPI-compliant RF source*	controlled via its IEC/IEEE-bus interface

\* Not supported for calibration

\*\* Including phase control

## Pulsed IV Systems

Auriga AU4750 system	controlled via its Ethernet interface
Focus PIV system	controlled via its Ethernet interface

## Power Meters

R&S®NRVD	connected to ZVx, requires: - R&S®ZVAB-B44 Option
R&S®NRP-Z series power sensors	connected to ZVx via: R&S®NRP-Z3 (active) USB adapter or R&S®NRP-Z4 (passive) USB adapter
Agilent E4418A	connected to ZVx, requires: - R&S®ZVAB-B44 Option
Agilent N1911A	connected to ZVx, requires: - R&S®ZVAB-B44 Option
Anritsu ML2437A	connected to ZVx, requires: - R&S®ZVAB-B44 Option

## Calibration Units

R&S ZV-Z5x series*	connected to ZVx
--------------------	------------------

\* Not supported for on wafer calibration

## Tuners

Please refer to the [NMDG Software Requirements](#) document, for general information about the supported tuner models, and the required software.

## Customization

### Instrument drivers

Drivers for other equipments can be added on customer request.

### External Test sets

External test sets for high power measurement applications (such as high power amplifier measurements) can be added on customer request, with the proper calibration routines.

# Order Information

Designation	Type	Order number
20MHz-3GHz Nonlinear Starter Kit for R&S VNA	NMDG NM310S	NM310S-Z

# Trademark Information

Microsoft .NET is a brand associated with Microsoft technology.

The names of actual companies and products mentioned herein may be the trademarks of their respective owners.

# Contact Information

Rohde&Schwarz VNA

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

ZVxPlus, NM310S and other products and services, focusing on nonlinear RF and HF characterisation, behavioural modelling and test:



Phone: +32 3 890 46 13  
Email: [info@nmdg.be](mailto:info@nmdg.be)  
[www.nmdg.be](http://www.nmdg.be)

January 2013 - Product description and specification are subject to change without notice.