

How to properly set the VNWA from SDR-Kits for use of the VNWA Frequency meter feature

## **Preface:**

For optimum performance the VNWA frequency meter requires an external stable clock as reference signal of at least a magnitude better frequency accuracy that the device you want to measure. The Frequency meter can measure a frequency within a second to the utmost accuracy that no frequency counter can match. The resolution is down to uHz and accuracy only depend on the external reference input, which can have a level up to more than +20dBm and even +30 dBm has been tested. The only limitation is the frequency difference between the VNWA selected frequency at **0** span and RX S21 the source to measure must not be more than about 4Hz. The frequency meter is not a frequency counter but a real frequency meter.

For proper operation the two DDS multipliers must be set to a suitable multiplication factor.

In the Options/Setup/Instrument settings below is a good starting point for measuring frequencies below 70MHz where the entry 10 MHz is for the external reference frequency and for both RF and LO DDS the multipliers are set to 16 which produces a clock of 160MHz. We must not approach half the clock as the chosen input frequency

R PC and Instrument Hardware Related Setup	>
USB Settings Audio Settings Audio Level Aux. Audio Level Instr	ument Settings Misc. Settings
VNWA Type: S-Parameter Test Set:	S11 = low v save profile
VNWA 3	load profile
RFDDS	LO DDS
AD 9859, AD 9951 -	AD 9859, AD 9951 -
Clock = 10 × 16 v MHz × external v	Clock = 10 x 16 v MHz external
=> Clock = 160.00 MHz	=> Clock = 160.00 MHz
Calibrate Clock Frequency	
Calibrate DDS Clock Frequency	
To calibrate the DDS clock frequency, you need to measure the output	t frequency at the TX port with a frequency counter.
Real Sampling Rate = 47999.9 samples/sec	

The signal to test is in this case a HP8664A signal generator with +6dBm level feed into the VNWA RX port via a 30dB SMA inline attenuator leaving a –24 dBm signal at the VNWA RX port. It is important to monitor the input S21 dB signal, such that it is a straight line and a proper level which displayed below as -4.67dBm with a reference level of 0dB at division 9 . Try to feed the VNWA TX port directly to the RX port and compare. The TX output is -17.1dBm and a suitable level for the RX port and as S21 thru is non calibrated it will only be close to the 0dB line. For a sweep of 100 100ms point a peak deviation is about 10mHz at 10MHz and average frequency measured to be close to 0.06 E-9 and less than 0.1 E-9 for a continuous sweep, but off course when the oscillator HP 8664 drift just 10mHz, which is its minimum frequency steps, that changes accordingly.



The DDS multiplier may very well be kept at 2x16 for frequencies up to 70MHz as at 80MHz an alias of same magnitude interferes. Just monitor the S21 dB level to be close to 0dB line, or change for other combinations of DDS Multipliers. At 500MHz below Spectrum Analyzer plot shows clearly the impact of the different settings. Below is explained the mechanism when to change the two DS multipliers and be carefull not to reduce the inline attenuator in the RX port except when you know the exact levels not to be beyond -10dBm for linearity reasons. It is only the apparent level, which the S21 dB shows, because the internal DDS output for the mixer is reduced above 100MHz.



In above recommendation the multipliers was only even numbers. The odd number does work also but long ago Tom Baier recommended to use even numbers only.

Selecting the frequency meter mode is done under Options/Operation mode

🔄 DG8	SAQ - Vector N	Vetwork Ana	alyzer Software - A	2005 licensed f	to Ku	rt Poulsen OZ7OU	
File M	leasure Settir	ngs Tools	Options Help				
			Operation N	/lode →	~	VNWA	Ctrl+V
	1: T=0s 2: T=28s 3: T=49.3s	-34.10dB -34.08dB -34.08dB	Setup			VNWA, external Bridge VNWA, internal + external Bridge	Ctrl+E
		Screensaver	>	VNWA, RF-IV		Ctrl+R	
			Clear	>		Spectrum Analyzer	Ctrl+A
		Preset	>		Signal Generator	Ctrl+G	
					~	Frequency Meter	Ctrl+M
10dB7							

Position on the screen of the Frequency meter is selectable by a right click on the frequency meter window, as well to switch it off and enable autolog for long duration saving of continuous sweep and as well calculation of Allan deviation like sown below.

Precision Frequency Meter dF/F= -0.0171328							
Off		s I	Range = +/- 4 Hz		TX Offset = 0 mHz		
Position	>		Top Left	1			
autolog	>	~	Top Right				
Calculate Allan Deviation			Bottom Left				
			Bottom Right				
		_		_			

An example of an Allan deviation shown below for the HP8664A signal generator used in this report running 65000 100ms point at 10MHz with the HP58053B 10MHz GPS stabilized reference generator as external clock.



August 14 2016 Kurt Poulsen