Test Report: DX Engineering DXE-RPA-1 Wideband Preamplifier

By Adam Farson VA7OJ/AB4OJ, 3 October 2013

1. ***Noise Power Ratio* (NPR).** The DUT was powered from +13.8V DC and connected between the RS-50 White Noise Generator and the RE-50 Noise Receiver via 75Ω coax. These instruments form the Wandel & Goltermann RK-50 Noise Test Set. In the RS-50, the 60-4100 kHz BPF and 3886 kHz bandstop filter were selected; in the RE-50, the 3886 kHz down-converter was selected. NPR was measured over the noise loading range -50 to -5 dBm. Results per **Table 1.**

Table 1: Noise Power Ratio (NPR).

BPF kHz	Bandstop kHz	P_{TOT} (Noise Loading) dBm	NPR dB	NPR (dB) at V_{CC} = +15V
60-4100	3886	-50	52	
		-40	62	
		-30	71	
		-20	77	
		-10	76	
		-5	65	68
		0	29	31.5

2. ***Gain:*** The DUT was connected between a signal source and an RF power meter as follows: Marconi 2019 signal generator ► MCL FT1.5-1B 50/75Ω transformer ►DUT ► MCL FT1.5-1C 75/50Ω transformer ► Millivac MV-723B RF millivoltmeter w/50Ω terminated probe. V_{CC} was +13.8V. Input power was increased until ≈ 3 dB compression was observed. (See **Table 2**.)

Table 2: Gain.

f MHz	P_{IN} dBm	P_O dBm	Gain dB
1.8	-30.7	-14.5	16.2
	-20.7	-4.5	16.2
	-10.7	+14	16.7
	-0.7	+15	15.7
	+9.3	+24.5	15.2
	+12.3	25	12.7

Note: *At VCC = +13.8V, P_O & gain decreased by 0.5 dB.*

3. ***Third Order Intercept (IP_3):*** The Marconi 2018A (f_1) and 2019 (f_2) signal generators were connected, each via a 10 dB pad, to an MCL ZSC-2-2 combiner followed by a 0 – 110 dB step attenuator and a MCL FT1.5-1B 50/75Ω transformer. The 75Ω output was connected to the DUT, which drove an HP 8563E spectrum analyser via an MCL FT1.5-1C 75/50Ω transformer and a 15 dB pad. The HP 8563E had the HP 85672A Spurious Response Utility installed.

   Input power was -1 dBm/tone, and output was +15 dBm/tone. 2-tone IP3 was measured at 1.8 MHz, and at 2, 50 and 150 kHz test-signal spacing. The test results are given in the following charts.

DXE-RPA-1 Preamp (VE7KW). Actual output +15 dBm/tone. 2 kHz spacing. 03.10.2013.

INTERMODULATION	MEASUREMENT	RESULTS
LOWER SIGNAL:	1.810 MHz	-.3 dBm
UPPER SIGNAL:	1.812 MHz	-.5 dBm
SIGNAL SPACING:	2.000 kHz	
IMD (LOWER PRODUCT):		-66.5 dBc
IMD (UPPER PRODUCT):		-66.3 dBc
TOI/IP3 (LOWER PRODUCT):		32.8 dBm
TOI/IP3 (UPPER PRODUCT):		32.8 dBm

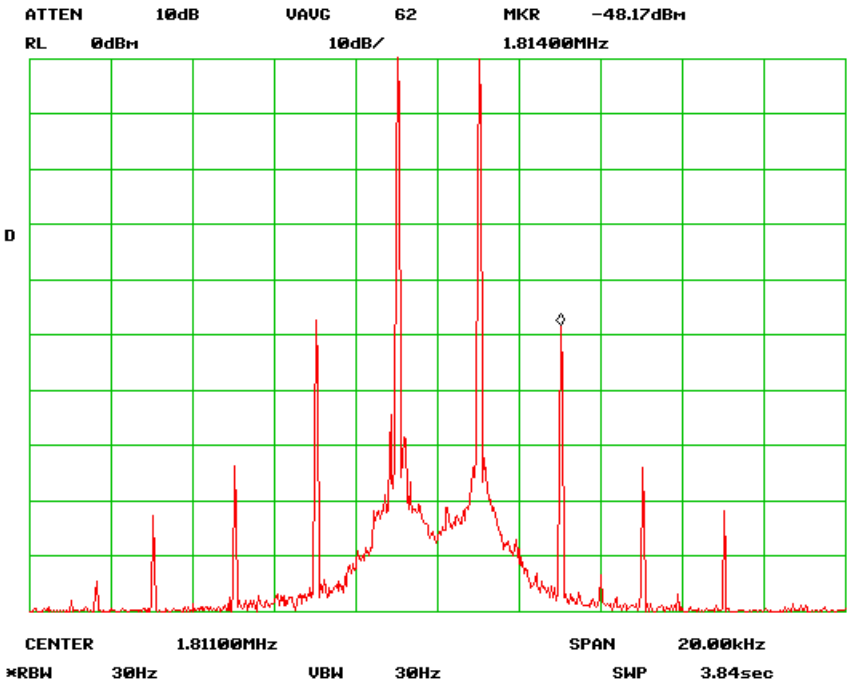
DXE-RPA-1 Preamp (VE7KW). Actual output +15 dBm/tone. 50 kHz spacing. 03.10.2013.

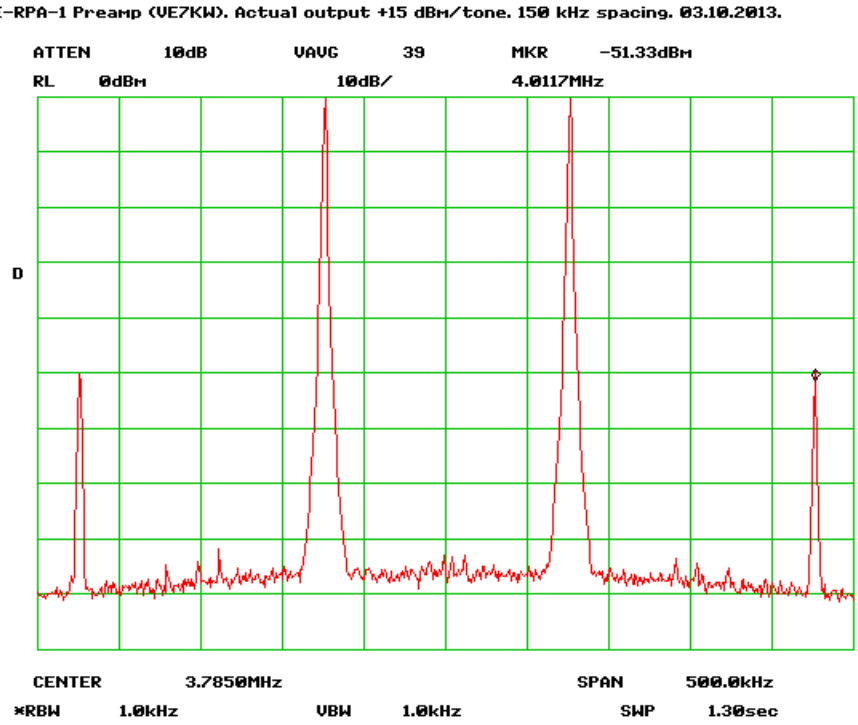
INTERMODULATION	MEASUREMENT	RESULTS
LOWER SIGNAL:	1.810 MHz	0 dBm
UPPER SIGNAL:	1.860 MHz	-.2 dBm
SIGNAL SPACING:	50.00 kHz	
IMD (LOWER PRODUCT):		-66.3 dBc
IMD (UPPER PRODUCT):		-68.2 dBc
TOI/IP3 (LOWER PRODUCT):		33.1 dBm
TOI/IP3 (UPPER PRODUCT):		34.0 dBm

DXE-RPA-1 Preamp (VE7KW). Actual output +15 dBm/tone. 150 kHz spacing. 03.10.2013.

INTERMODULATION	MEASUREMENT	RESULTS
LOWER SIGNAL:	3.710 MHz	0 dBm
UPPER SIGNAL:	3.860 MHz	-.2 dBm
SIGNAL SPACING:	150.0 kHz	
IMD (LOWER PRODUCT):		-66.3 dBc
IMD (UPPER PRODUCT):		-66.0 dBc
TOI/IP3 (LOWER PRODUCT):		33.1 dBm
TOI/IP3 (UPPER PRODUCT):		32.9 dBm

DXE-RPA-1 Preamp (VE7KW). Actual output +15 dBm/tone. 2 kHz spacing. 03.10.2013.





4. ***Noise Figure(NF):*** NF was measured by the "modified Y-Factor" method, using the following test setup: NoiseCom NC6110 noise generator ► 0-110 dB step attenuator ►MCL BLP-30 30 MHz LPF MCL FT1.5-1B 50/75Ω transformer ►DUT ► MCL FT1.5-1C 75/50Ω transformer ► MCL GALI-74* wideband amplifier ► 2 dB pad ► HP 8563E spectrum analyser. V_{CC} was +13.8V.

   Spectrum analyser settings: Centre freq. 14.100 MHz; span 1 kHz; reference level -10 dBm; RBW = 3 Hz; VBW = 1 Hz; DET = Sample; MKRNOISE On; Video averaged; read at 50 averagings.

   **GALI-74 has 2.9 dB NF, 21 dB gain.*

   1. Read marker level with noise OFF and DUT input terminated (-131.5 dBm). This corresponds to the noise output of a 75Ω resistor at room temperature ("cold").
   2. Turn noise ON, and adjust attenuator for ≈ 10 dB increase in marker amplitude. Read marker amplitude again ("hot") and record attenuator setting. Subtract "cold" from "hot" marker amplitude to obtain ΔN.
   3. Calculate NF:

      NF = Noise density of generator – attenuator setting + 174 – ΔN

      For our test, noise density of generator = -82 dBm/Hz; attenuator setting was 77 dBm; ΔN = 9.8 dB.

      Thus NF = -82 -77 -1** + 174 – 9.8 = **4.2 dB.** (DXE spec is 3.5 dB). There will be a slight error due to the residual NF of the spectrum analyser behind the GALI-74 amplifier. *** Insertion loss of matching transformers.*