

VLA-VLBA Interference Memo No.13

Harmonic Emissions Testing of Hand-Held Radios

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During the filming on "Contact", it was noted that there was some unusual Radio Frequency Interference (RFI) occurring when one of the VLA Hand-Held Radio's was being used. It was decided that the Interference Protection Group (IPG) was to test this radio for the power levels of its' harmonics, and also to determine if it was emitting any non-harmonic emissions which might be the cause of the RFI.

These emissions were tested using a spectrum analyzer (TekTronix 2712) hooked up to a discone antenna, with an approximate frequency range of 800MHz - 1.8GHz. On the input to the spectrum analyzer was a filter with a bandpass frequency range of 1 - 2Ghz. This prevented emissions at the fundamental frequency of 162.025MHz from generating harmonic frequencies within the analyzer itself. All the levels from the radio (VLA HT#46, a Motorola Radius P50 5 Watts) were measured approximately three meters away from the antenna.

The first test measured the power levels of the harmonic frequencies of the radio. Using a Resolution Bandwidth (RBW) of 30Khz, a total span on the analyzer of 1MHz centered on each harmonic frequency, and a reference level of -20dBm, the noise floor was measured at ~ -94dBm. The results of this test are summarized in table 1.

The next test was a total sweep of the frequency range of 900MHz to 1900MHz, looking for any non-harmonic emissions produced by the radio. Starting with a center frequency of 900MHz and a total span of 100MHz, incrementing in steps of 100MHz was required to sweep the whole frequency range of interest. The RBW used for this was 300khz, the reference level used was -20dBm, and the noise floor was measured at ~ -87dBm. In this frequency range, no non-harmonic emissions were found above the noise floor.

f (MHz)	H.	Pm(dBm)	Pm (W)	PFD (W/m ²)	EIRP (W)	EIRP (dBW)
162.025	1	---	---	---	---	---
972.15	6	-74	4.0E-11	5.3E-9	6.0E-7	-62
1134.175	7	-76	2.5E-11	4.5E-7	5.1E-5	-43
1296.2	8	-69	1.3E-10	3.0E-8	3.4E-6	-54
1458.225*	9	-60	1.0E-9	3.0E-7	3.4E-5	-45
1620.25	10	-75	3.2E-11	1.2E-8	1.3E-6	-58
1782.275	11	-76	2.5E-11	1.11E-8	1.3E-6	-59

f = frequency testing

Pm = Power measure at Spectrum Analyzer

PFD = Power Flux Density

EIRP = Effective Isotropic Radiated Power

H = Harmonic Number

* Frequency within a VLA continuum default passband, 1410-1460 MHz.

Table 1

Two Motorola P-200 Hand-Held Radio Units, each 5 Watts, were also tested using similar setup as in the first test above, except that the test was performed approximately 2.5 meters away from the discone antenna and there was a 1350-1450 MHz Band Pass Filter at the input of the spectrum analyzer. Both units measured within 1dB of each other. Results are summarized in Table 2.

f (MHz)	H	Pm (dBm)	Pm (W)	PFD (W/m ²)	EIRP (W)	EIRP (dbW)
173.3	1	-60	---	---	---	---
1386**	8	-82	6.3E-12	1.7E-9	1.3E-7	-69

** Frequency within a VLA continuum default passband, 1340-1390 MHz.

Table 2

Note that the P50 radio harmonic emission near 1400MHz was 24dBm greater than the P-200 radio. Consequently, the P-50 radios were removed from service to reduce RFI in the VLA at L-Band.