Firestar P2P In Band Emissions Test
Special Design Test Equipment

1. Measurement Requirement.

The compliance requirement of 60 dB attenuation of transmitted emissions 3 MHz removed from a 6 or 12 MHz wide channel edge poses a particular challenge for standard off-the-shelf (OTS) microwave measurement equipment.

The standard measurement instrument of choice is the spectrum analyzer. The measurement scenario requires that on the one hand, the signal power delivered to the spectrum analyzer be of sufficient magnitude so as to provide a reference in excess of 60 dB above the noise floor in a 100 kHz bandwidth. On the other hand, the signal power must be sufficiently attenuated so as to limit the magnitude of the spurious emissions generated within the internal components of the spectrum analyzer which would degrade and nullify the measurement. Experience has shown that in this measurement scenario the above concerns pose a practical limit to the measurement dynamic range of 50-55 dB, well shy of the 60 dB requirement.

2. Special Design Test Equipment.

Special design test equipment is used in conjunction with the spectrum analyzer in order to enhance its performance in this measurement scenario by extending the dynamic range an additional 10-15 dB.

The enhancement to the spectrum analyzer's performance is achieved in two ways:

a) High performance narrow band RF components are used ahead of the spectrum analyzer. The effective dynamic range of the measurement system is now set by these components, rather than the spectrum analyzer's broadband components.

b) By means of frequency translation and reject filtering of the carrier power, the total power delivered to the front-end of the spectrum analyzer is significantly reduced during the measurement at 3 MHz removed from the channel edge. At this reduced power level, the spectrum analyzer's internal attenuation can safely be set at 0 dB, and emissions due to distortion of the spectrum analyzer's components is minimized, resulting in improved dynamic range.

3. Test Equipment Description and Operation.

Referring to the attached Table 1 Equipment List and Figure 1 RF Block Diagram, the following is a brief description of the test system:

- **U3** is the spectrum analyzer.

- **U9** is the special design Linearity Test Interface Unit (LTIU), which houses the high performance RF components and provides frequency translation and reject filtering of the radio's output signal.

- **U2** and **U4** are RF synthesized signal generators which serve as the LO's for the frequency conversion that takes place in **U9**.

- **U1** is the arbitrary waveform generator that provides the digitally modulated signal used as the analog input to the radio's modified IF card.

- **U5, U6**, and **U7** are driver interfaces for controlling the RF coaxial switches and step attenuators in **U9.**

- **U10** provides the DC bias voltages for the amplifiers and oscillators in **U9.**

- **U8** is the PC controller for the test equipment.

Referring to Figure 1 RF Block Diagram, the following is a brief description of the functional blocks within the Linearity Test Interface Unit **U9.**

- **1st DNx** provides frequency down conversion of the radio's output signal from the MMDS band frequencies to a nominal 324 MHz intermediate frequency. **U2** is the tunable LO source for this stage of frequency conversion.

- **2nd DNx** provides a second stage of frequency down conversion of the radio's output signal from the nominal 324 MHz to a intermediate frequency which is tunable over the range of 60-80 MHz. **U4** is the tunable LO source for this stage of frequency conversion.

- **NOTCH** is a filter and amplification stage, which provides rejection of the carrier power when measuring 3 MHz removed from the channel edge. The **FL13** SAW filter is centered at 70 MHz and has a 3 dB bandwidth of 500 kHz.

- Blocks **B/W SELECT, 1ST UPx, 2ND UPx**, and **1st LO** are not used in these measurements.

4. Measurement Sequence.

The following is a brief description of the sequence of steps that are followed to yield a measurement of emissions attenuation 3 MHz removed from the channel edge:

a) The radio's output signal power is attenuated by setting attenuators **AT10** and **AT11** such that the power level presented to the subsequent components is well within their linear operating range. 33 dB (plus the constant losses) is a typical attenuator setting for a 1 watt radio transmission output.

b) The **U2** LO frequency source is tuned to provide a 1st intermediate frequency centered at 324 MHz.

c) The **U4** LO frequency source is tuned to provide a 2nd intermediate frequency centered at 70 MHz. The 70 MHz SAW filter is thus positioned at channel center.

d) The signal power at 70 MHz is measured with the **U3** spectrum analyzer in a 100 kHz resolution bandwidth. This measurement provides the reference level to which the emissions power measurement will be referred.

e) The **U4** LO frequency source is offset by 6 MHz in the 6 MHz channel case, and offset by 9 MHz in the 12 MHz channel case. The 70 MHz SAW filter is thus positioned 3 MHz removed from the channel edge. Since the bandwidth of the SAW filter is 500 kHz, the signal power which resides within the confines of the 6 MHz or 12 MHz channel is greatly attenuated upon exiting the filter.

f) The emissions power is measured with the **U3** spectrum analyzer in a 100 kHz resolution bandwidth. The ratio of the emissions power measurement to the in channel reference power measurement in step 4(d) above is the emissions attenuation.

g) Steps 4(e) and 4(f) are repeated by offsetting the **U4** LO frequency source by the same amount in the opposite direction to yield a measurement of emissions attenuation 3 MHz removed from the opposite edge of the channel.

h) Because the measurement is the relation of 2 individual measurements, one at channel center and one 3 MHz removed from channel edge, and because both measurements are performed at a constant frequency of 70 MHz, no special calibration steps are required.

Table 1. Equipment List, In Band Emissions Test System

ITEM	REF. DESIG.	QTY	DESCRIPTION	MANUFAC-TURER	PART NO.
1	U1	1	Arbitrary Waveform Generator	Tektronics	AWG 2021
2	U2	1	RFSynthesizer, .01-20 GHz	HP	83712B
2		1	---Step Attenuator	HP	Opt 1E1
3	U4	1	RFSynthesizer, .1-1040 MHz	HP	8657A
4	U3	1	Spectrum Analyzer, 9 kHz-26.5 GHz	HP	8563E
4		1	---Rack Mount Kit	HP	Opt 908
5	U5-7	3	Switch/Control Unit	HP	11713A
6	U13	1	Power Supply, 2000 W	HP	6673A
7	U14-16	3	Power Supply, 50 W	HP	6612C
8	U11	1	Power Meter	HP	EPM-441A
9	U12	1	Power Sensor	HP	8481A
10	U8	1	PC Controller w/ HPIB Interface	HP	Vectra VL
11	U9	1	Linearity Test Interface Unit (LTIU)	Cisco	---
12	U10	1	System Power Supply	Acopian	S11068

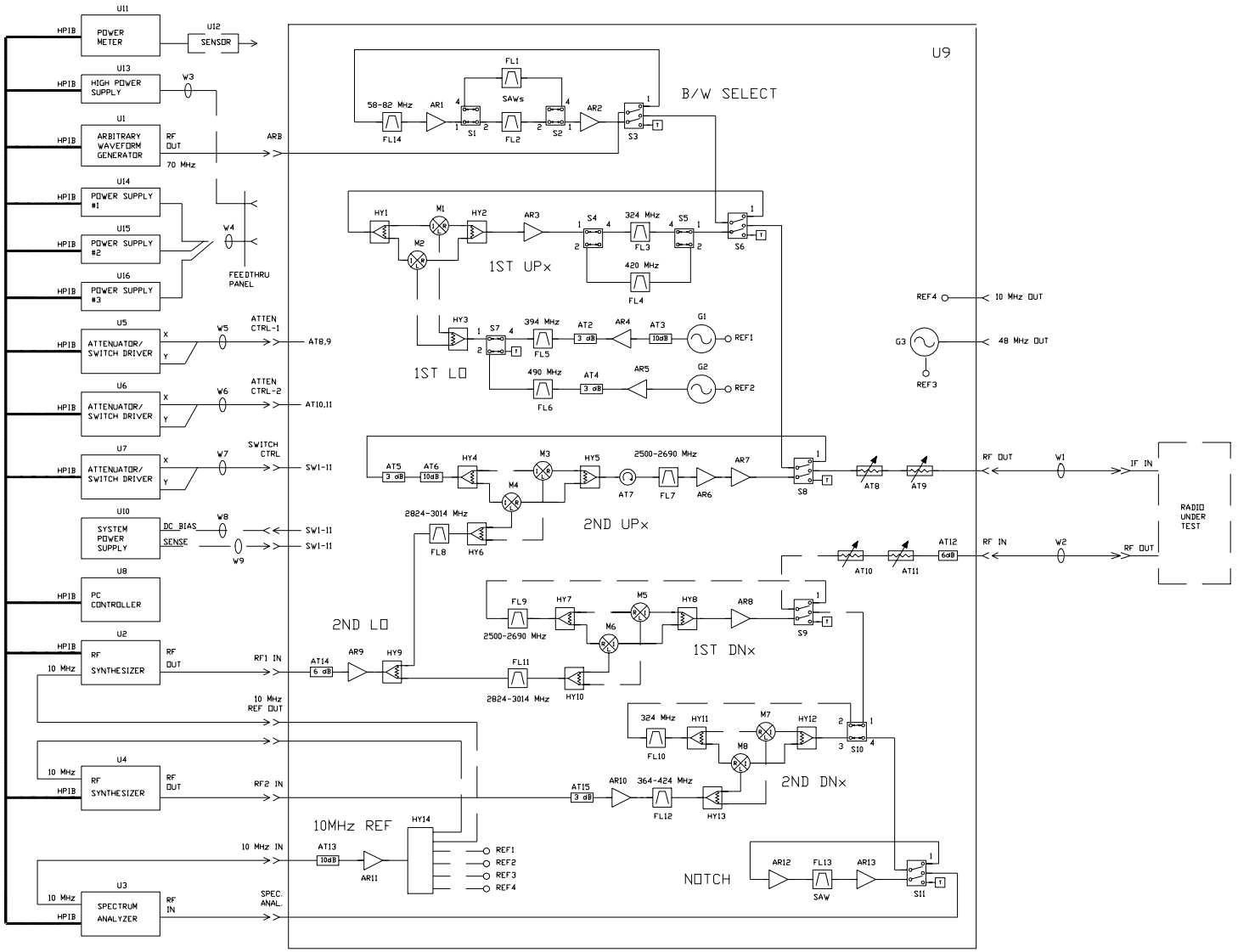

Figure 1. RF Block Diagram, In Band Emissions Test System