

LO Distribution Module Changes

(from Single Pixel test results)

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Several issues were raised during single-pixel KFPA prototype testing with regard to the LO system:

1. Why does the output power fall off rapidly at the band edges? Can we increase the frequency range of the 1st LO output?
2. Should the output power specification be modified?
3. Should additional spectral purity requirements be added to the specification?

Background:

Two local oscillator sources (HP/Agilent 83620 synthesizers that generate up to 20 GHz) are available in the GBT receiver room.

The original specification called for two LO inputs to the down-converter modules:

- LO1:
 - 25.7 to 32.4 GHz
 - At 25.7 GHz, -2 dBm (+/- 5 dBm)
 - At 32.4 GHz, -4 dBm (+/-7 dBm)
- LO2: 8.9 GHz @ +3 dBm (+/- 5 dBm)

LO1 is generated through a x2 multiplier with input drive of 12.85 to 16.2 GHz.

No spectral purity specification was imposed. However, a self-imposed specification of 30 dB rejection of the third harmonic of the 1st LO input signal (as provided by the 83620 generator) seemed reasonable and was used as a design guide.

The following are slides from the Conceptual Design Review giving the schematic of an LO Distribution Module. One module will supply LO power to all 7-pixels. (one output is not used and is terminated)

Single-pixel testing:

Single-pixel tests were performed using a test fixture consisting of the multiplier and bandpass filter shown in the schematic (LO Distribution Module (High Frequency Side)) above.

Tests showed the following problems:

1. The LO multiplier output dropped off sharply outside the original frequency range.
2. During test, the LO drive desired for the input of the downconverter was significantly higher than called for by the LO1 specification.
3. A spur was detected at the noise floor during a one minute integration. Its frequency indicated that one of the mixing inputs that created it was the LO1 input to the x2 multiplier.

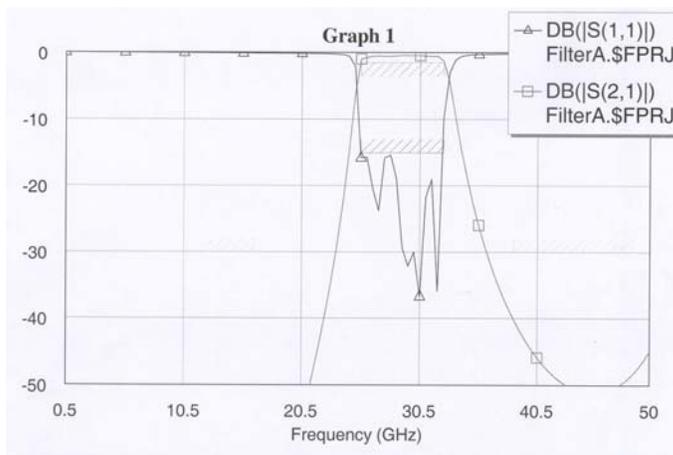
Corrective Action:

1. The multiplier output filter was originally designed around the initial specification. The original bandwidth was kept as narrow as possible to improve the 3rd harmonic rejection and to give some margin to allow for manufacturing tolerances.

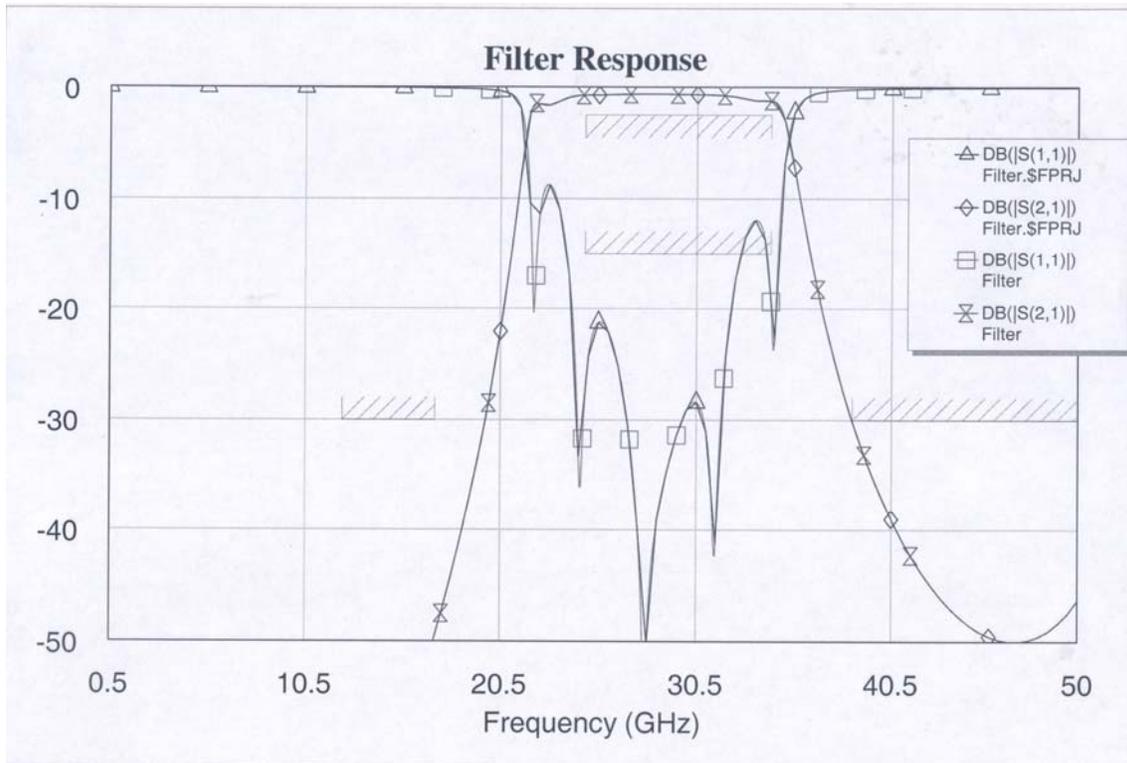


Filter (original)

(5-Pole Parallel-Coupled Half-wave Resonators)



The redesigned filter response is shown below.



Modified Bandpass Filter

2. The specification was modified on the basis of the single-pixel tests to the following:

- **LO1:**
 - **24.8 to 34.3 GHz**
 - **At 25.7 GHz, -5 dBm to +3 dBm**
 - **At 32.4 GHz, -3 dBm to +4 dBm**
- **LO2: 8.9 GHz @ +3 dBm (+/- 5 dBm)**

The wider LO1 frequency range will allow operation over the sky frequency range of 18.0 to 27.5 GHz. The minimum power levels to be applied to the Down-Converter Module were also increased.

3. A high-pass filter was added to the multiplier output. Details will be presented at the review.

4. The addition of the high-pass filter and the change in the output power specification forced the addition of an amplifier to the multiplier output. The large attenuators placed at the input and output serve two functions:

- a) to lower the amplifier output

