

Hi Graham,

After consulting with Marian, I am somewhat confused about the performance of the Spacek mixers to which you referred in the Monday teleconference. According to the data sheet from September 1996 for the P102-V mixer, it will accept

RF input: 90-115 GHz in WR-10

LO input: 90-115 GHz in WR-10

Noise temperature ~9 dB; measured on serial no. 7A16 (model with internal quadrupler, so LO is 22.5 to 28.75 GHz) varied from a low of 6.2 dB at RF=110 GHz to a high of 12.8 dB at RF of 98 and 102 GHz, with IF 10-500 MHz. This model has an IF amplifier which covers only 10-500 MHz.

Marian uses this mixer in a DSB configuration, with an IF passband of 50-150 MHz. He has successfully used it as low as 84 GHz with the quadrupler. Above 105 GHz, the LO quadrupler is not usable, because the 3rd harmonic at 78 GHz is at a frequency at which the W-band amplifier has appreciable gain. Thus, above 105 GHz, he removes the quadrupler and drives the mixer directly with a Gunn. This has enabled him to use the mixer as high as 116 GHz.

Thus, it seems that this particular mixer is useful from at least 84 to 116 GHz, so long as the LO is within that range as well.

I don't know how you specified the mixer you want, but my guess is that you specified a low-side LO injection with a first IF at K-band, intending to use a second, fixed LO to get down to 4-12 GHz with acceptable sideband rejection—like the LO plan in the Project Book.

There is a second possible receiver block diagram which Marian has suggested: use 2 of these W-band mixers with an input RF hybrid, an output IF hybrid, and an LO splitter to form a sideband-separating mixer. If we assume we want to stay away from the band edges and have the 86 GHz SiO and 115 GHz CO lines well inside the IF band, let's assume that the LO needs to be within 10 GHz of the observing frequency. That means the LO will be from 96 to 105 GHz, which is well within the specified LO band for the P102 mixer. The RF is a little outside the 90-115 GHz band, but we know from Marian's experience that this is not a problem. It also means the LO upper:lower ratio is only 1.09, which is easy to achieve either with a Gunn or with a YIG-amp-multiplier chain. The mixers don't really have to match very closely in order to get 10 dB image rejection, which is all we are asking of the SIS systems.

Tony Kerr has designed and built a prototype of an RF input hybrid covering 82-105 GHz; increasing the frequency range and scaling the design slightly (going from 5 holes to 7 holes) to cover 86-116 GHz should not be a problem. Tony also has a design for a 0-degree power splitter whose performance has been calculated; it looks good for the LO splitter. We just bought a commercial IF hybrid for 2-18 GHz (\$500). Thus, I think all the passive components are doable.

I don't know about cost, but I suspect that the cost of this configuration would not differ substantially from that of using a K-band first IF and a second local oscillator (if that is what you are planning).

20 '96 12:33 S
SPACEK LABS, INC.
MM-WAVE TECHNOLOGY

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From: George Spacek

P.1 6-00?
Date: 9/20/96

Deliver To:

Page: 1 of 2

Company: NRAO

Name: Dr. Marian Pospieszalski

FAX #: 804-296-0324

Message:

Dear Marian, in response to your recent telephone inquiry I am pleased to quote as follows on the various items:

1. Partial bandwidth W-Band mixer/preamp with LO quadrupler:

Model No: P102-V-4X

RF Input: 90-115 GHz, WR-10

LO Input: 22.5-28.75 GHz, +18 dBm, K-connector

IF Output: 50-550 MHz, SMA-F connector

RF to IF Gain: 25 dB nominal

Noise temperature: 2000°K (9 dB DSB noise figure)

DC Power: +15 V, 50 ma

Unit Price: \$7,800

Delivery: 60 days

2. Partial Bandwidth W-Band Mixer/preamp:

Model No P102-V

Specifications as for item 1, except:

Lo Input: 90-115 GHz, WR-10, 0 dBm min

Unit Price: \$4,300

Delivery: 45 days

3. Full bandwidth V-Band mixer/preamp with LO doubler:

Model No: PV-V-2X

RF Input: 50-75 GHz, WR-15

LO Input: 25-37.5 GHz, +18 dBm min, K-connector

IF Output: 10-500 MHz

RF-IF Gain: 25 dB nominal

Noise Temperature: 1500°K (8 dB DSB Noise figure)

Unit Price: \$6,400, Delivery: 45 days

Test Data

Spacek Labs Inc. 212 E. Gutierrez Santa Barbara,
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Customer National Radio Astronomy Observatory
Description W-Band mixer-IF amplifier-LO quadrupler assembly
Model No. P102-V-4X Serial No. 7A16 Date 6-19-97
P.O. No. 100910 Tested by [Signature]

NOISE FIGURE VS FREQUENCY

LO Freq (GHz)	LO Power (dBm)	RF Freq (GHz)	DSB Noise Fig. (dB)			
22.5	+18	90.0	10.4			
23.0		92.0	9.3			
23.5		94.0	9.8			
24.0		96.0	12.8			
24.5		98.0	10.8			
25.0		100.0	10.6			
25.5		102.0	12.8			
26.0		104.0	8.8			
26.5		106.0	10.4			
27.0		108.0	6.5			
27.5		110.0	6.2			

IF amplifier bandwidth is 10-500 MHz.

Noise Figure measured at 105 MHz IF.

Do not exceed +20 dBm LO power.