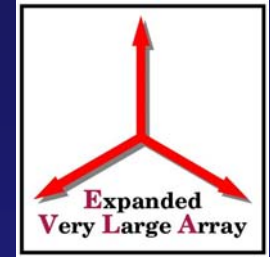




IF Subsystem

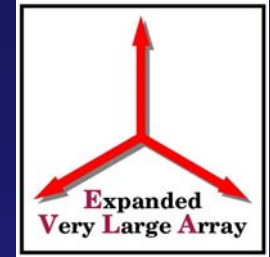


Specs & Measured Test Data





EVLA Converter Modules

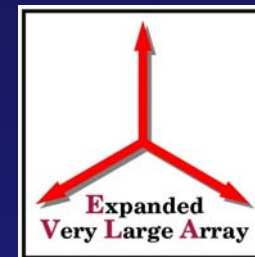


Module

T301	4/P-Band Converter
T302	L/S/C-Band Converter
T303	UX Converter (coaxial version)
T303	UX Converter (MMIC version)
M301	Converter Interface Module
A-SW	Receiver Band Switches (p/o T303)
B-SW	B-Rack System Switches



Converter Frequencies

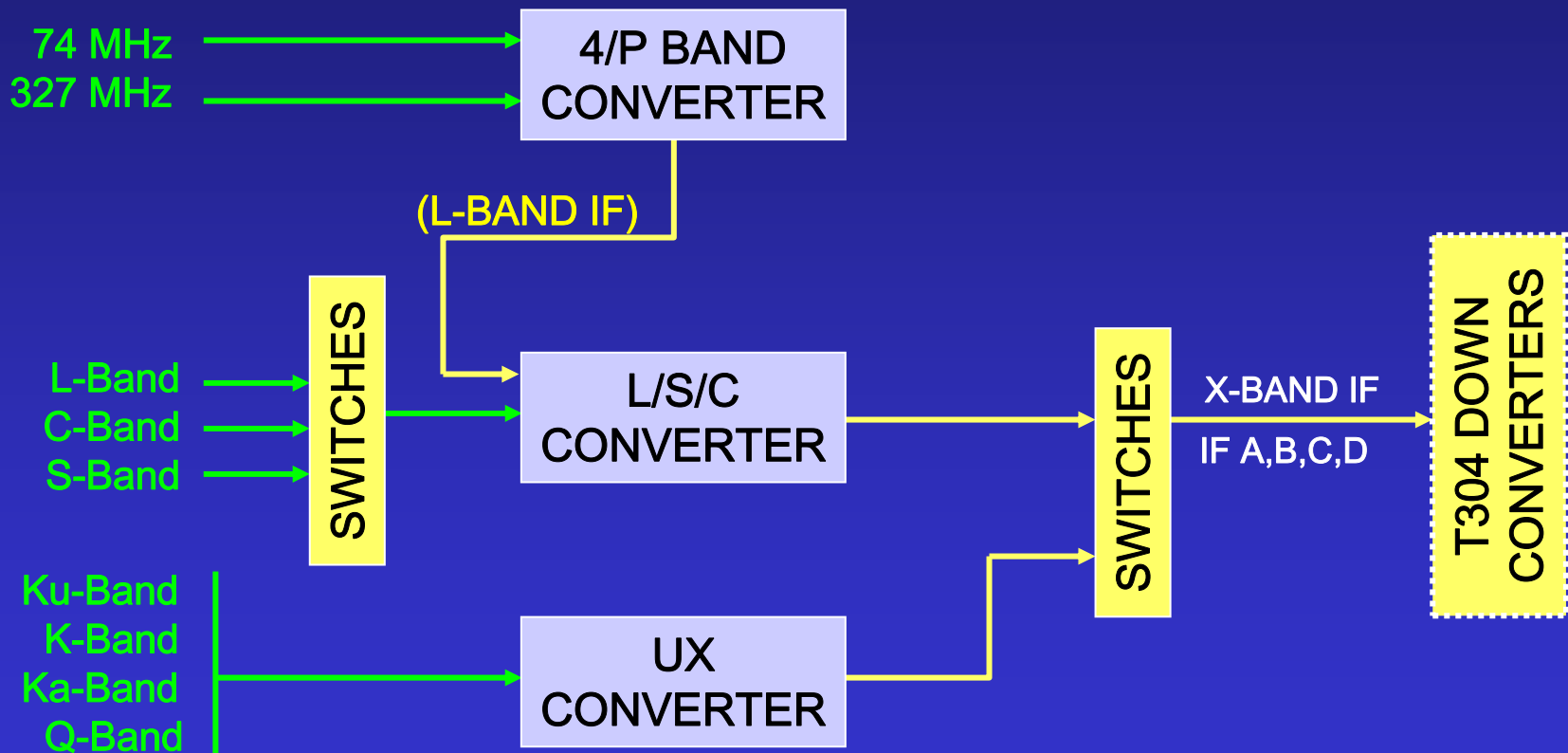
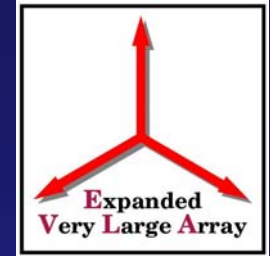


	RF	1st IF
T301	(4) 73 - 75 MHz	1097-1099 MHz (L)
	(P) 308-348 MHz	1332-1372 MHz (L)
T302	(L) 1 - 2 GHz	12-11 GHz (X)
	(S) 2 - 4 GHz	11 - 9 GHz (X)
	(C) 4 - 8 GHz	12 - 8 GHz (X)
T303	(Ku-Q) 8 -12 GHz	12- 8 GHz (X)
	12 -18 GHz	12- 8 GHz (X)



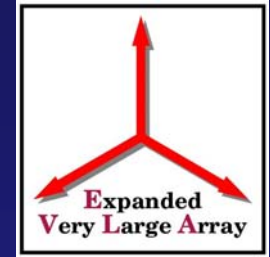
EVLA Converters

RF/IF Signal Flow





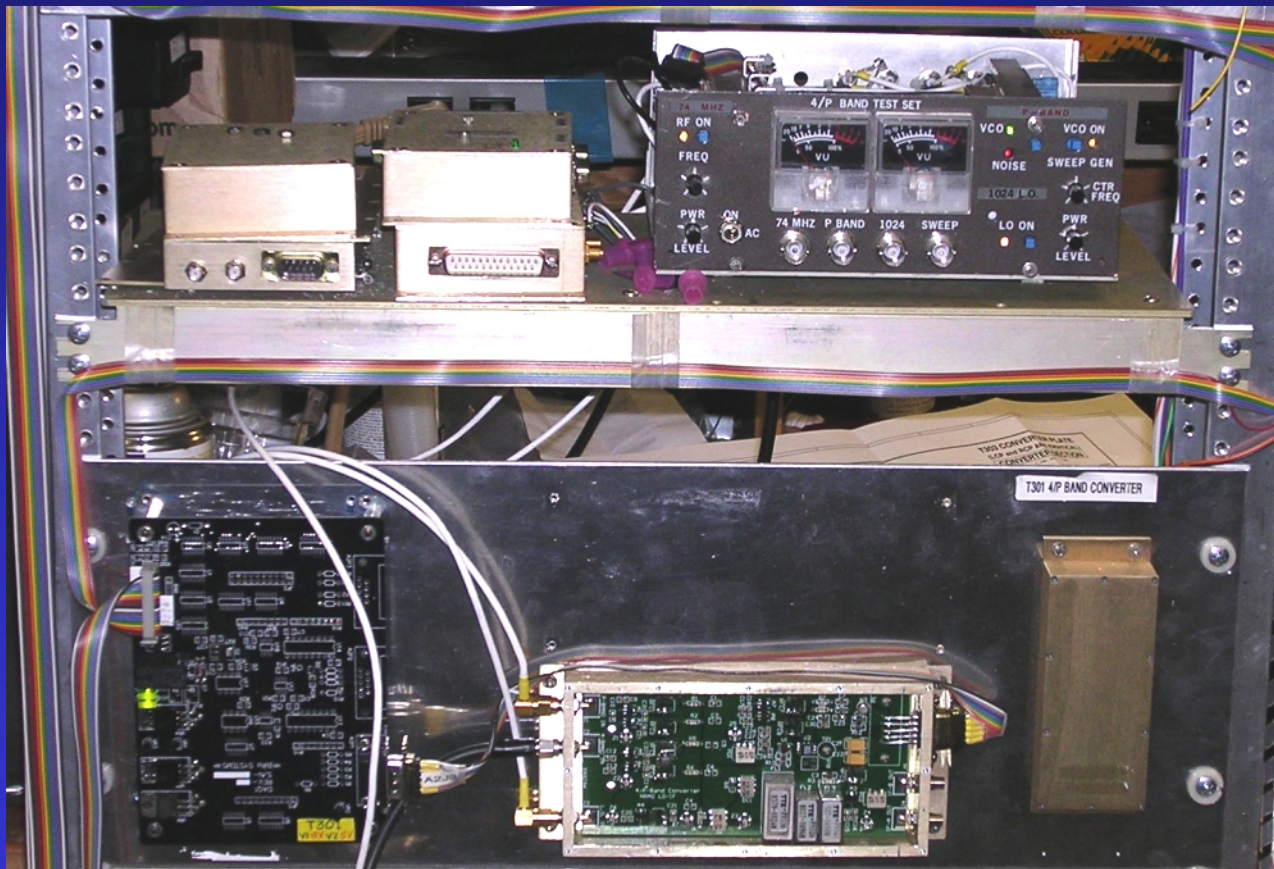
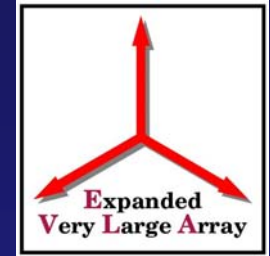
System Specifications



- System Phase Stability spec 200fs/min over 30 min
- Converter spec is 1/3 of this spec
- Not yet measured
- Have not determined exactly how much will be allocated to each converter

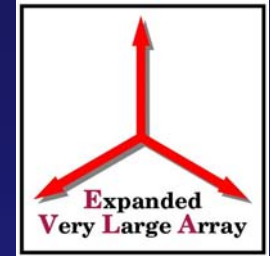


T301 4/P Converter





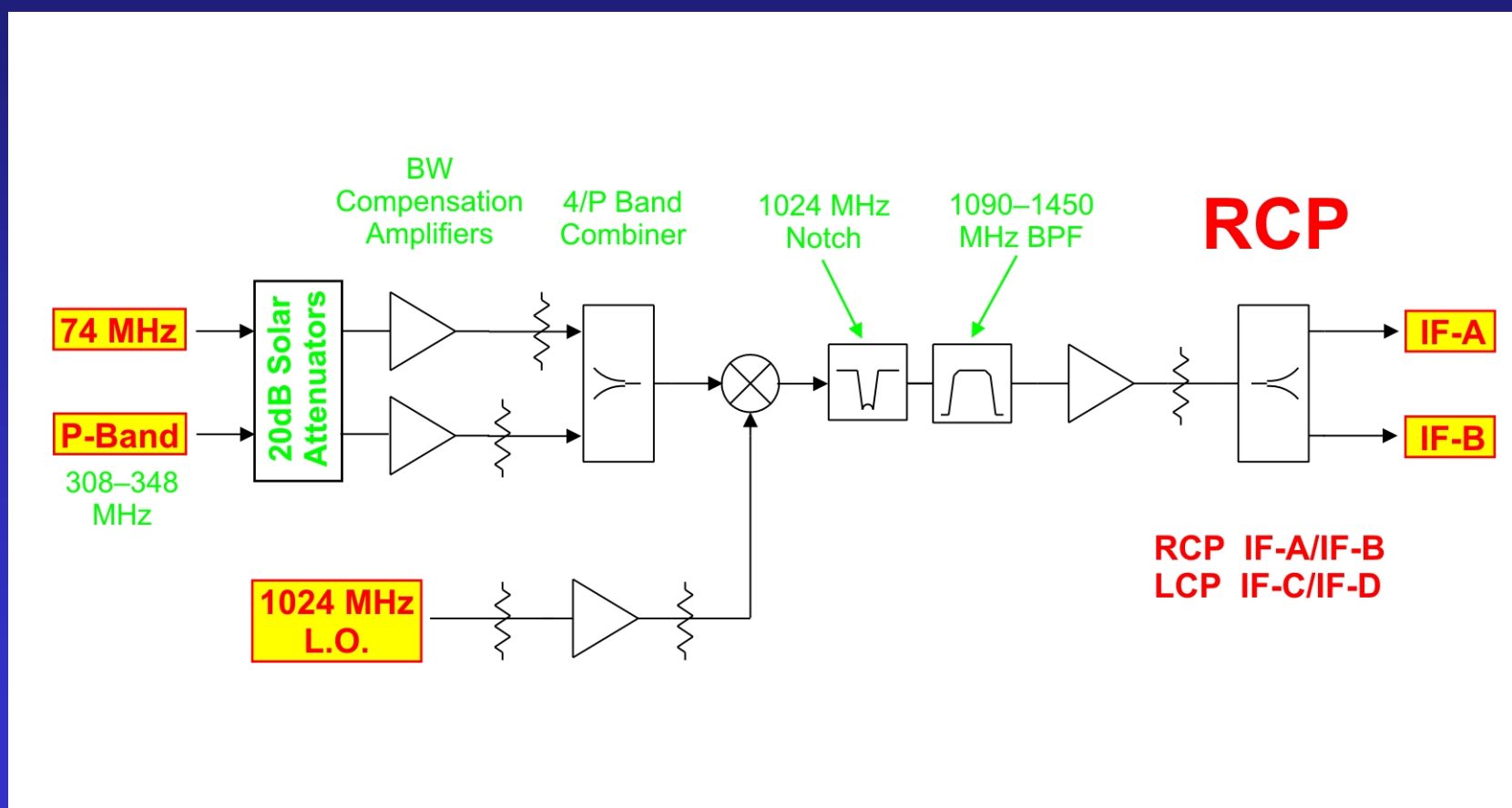
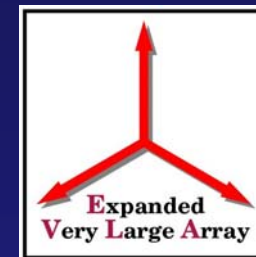
T301 4/P Converter Design Notes



- 2-wide module in LO/IF Rack
- Internal Solar Attenuators
- Simultaneous 74 MHz & P-band observing
- Bandwidth can be changed at a later time by changing filters.
- LCP/RCP transfer switches (added 3-2004) to allow simultaneous 4/P and L band observing

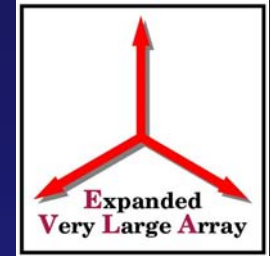


T301 4/P Converter Block Diagram





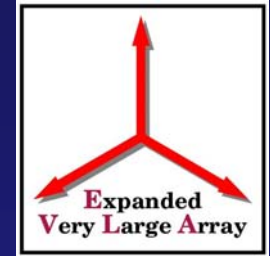
T301 4/P-Band Converter Specs



- Input Frequencies: 74 MHz (73-75 MHz)
P-Band (308-348 MHz)
- Bandwidths: 2 MHz (*74 MHz*)
Narrow Band 40 MHz (*P-band*)
- Input Power: -35 dBm/BW
- P1dB of Converter: +12 dBm
- Headroom: ~74 dB



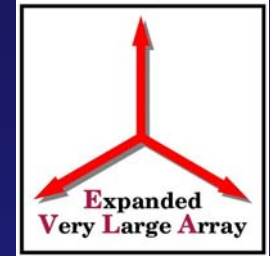
T301 4/P-Band Converter Specs



- LO: 1024 MHz @ +3dBm
- IF Frequency: 1097-1099 MHz
Narrow Band
- IF Output Power: -45 dBm/BW
(To be compatible with L-Band Converter input)
- IF flatness: <1 dB/2 MHz
- IF-IF Isolation: >65 dB



T301 4/P-Band Converter Specs

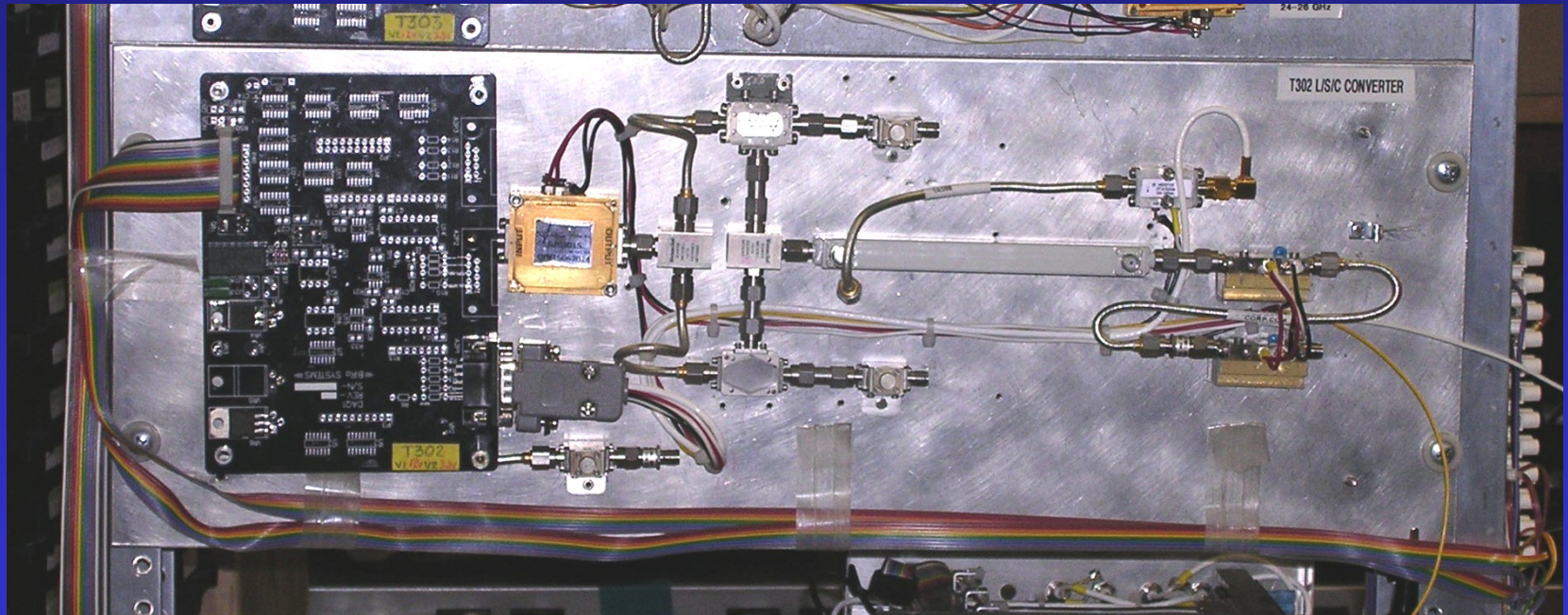
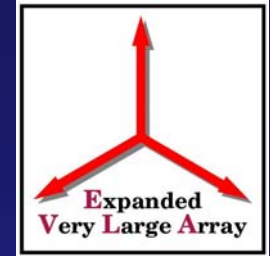


IF distribution was recently changed to allow simultaneous 4/P and L-band observing, and to reduce the number of system switches by:

- *Adding L/S/C or 4/P selector switches to the T302 L/S/C Converter (completed)*
- *Adding RCP/LCP normal/reverse transfer switches to the T301 4/P converter (not yet completed – preventing full T301 testing)*

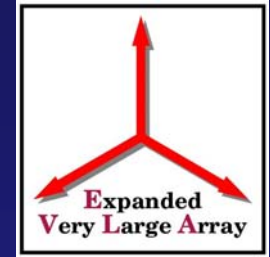


T302 L/S/C Converter





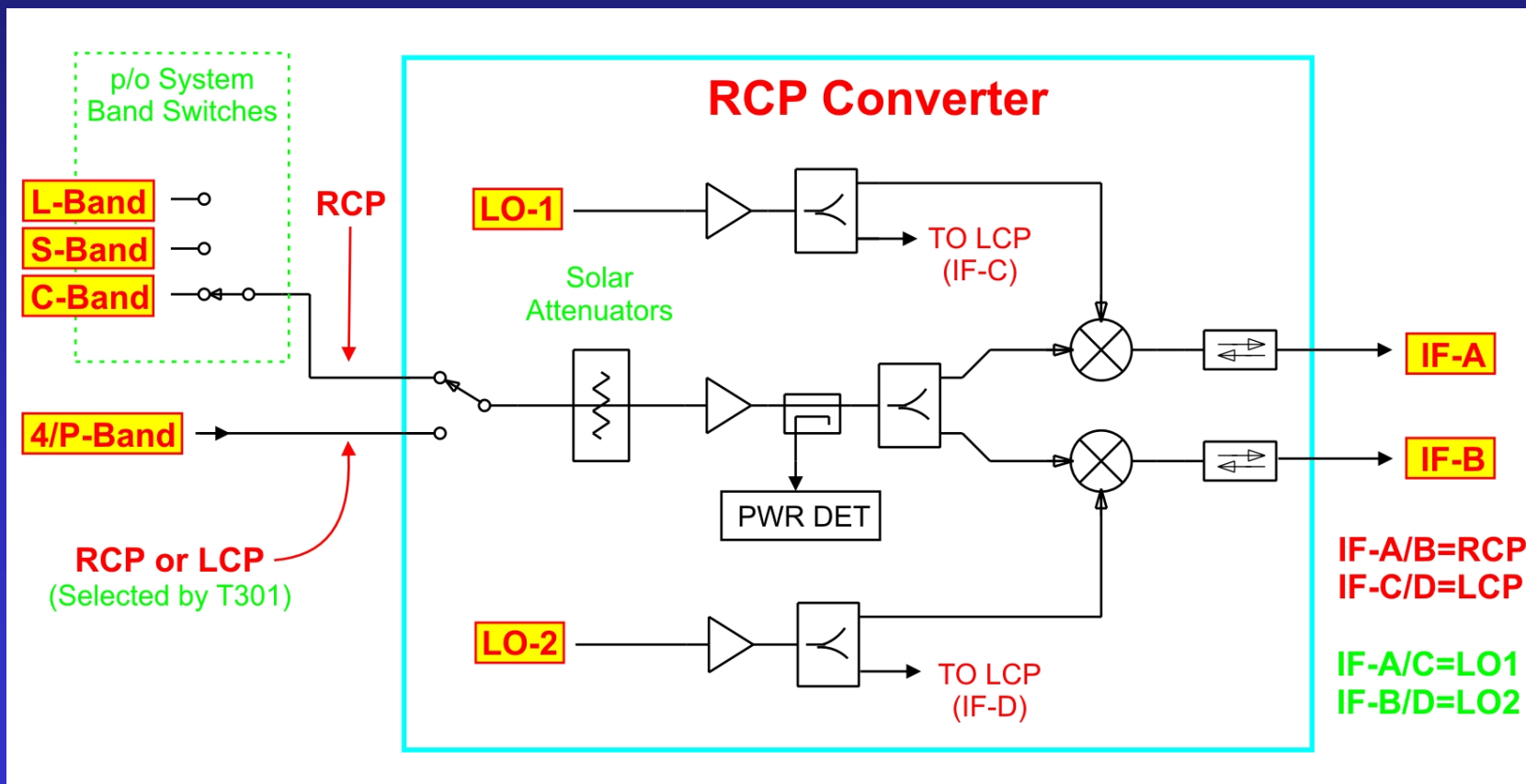
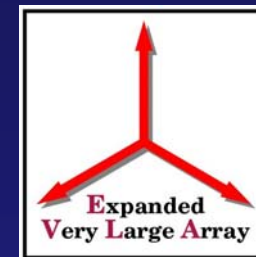
T302 L/S/C Converter Design Notes



- 2-wide module in LO/IF Rack
- System band switches selects L, S or C band
- Internal Solar Attenuators
- Internal switches selects L/S/C or 4/P band to allow simultaneous 4/P and L-band observing

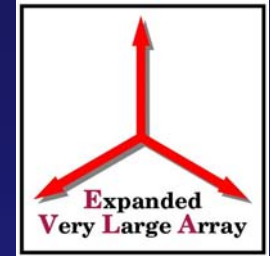


T302 L/S/C Converter Block Diagram





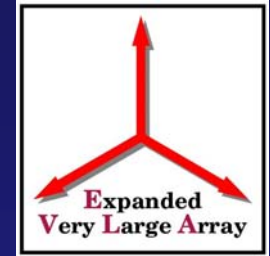
T302 L/S/C Converter RF Input Specs



Parameter	Specification	<i>Measured</i>
Frequency range	1–8 GHz	<i>1–8 GHz</i>
Input power level	-50 dBm	<i>-45 dBm</i>
1dB compression	+10 dBm	<i>+3 dBm</i>
Headroom (-50dBm in)	60dB	<i>53 dB</i>
Headroom (-45dBm in)		<i>48 dB</i>
Input VSWR	1.35:1 max	<i>1.08-1.12</i>



T302 L/S/C Converter LO Specs

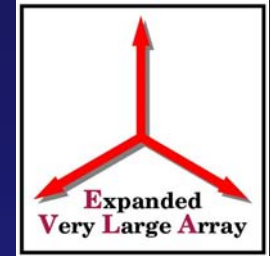


Parameter	Specification	Measured
LO frequency range	12–20 GHz	(L301)
LO input power level	+3dBm	See note
LO 2 nd harmonic	<–40 dBc	(L301)
LO spurious levels	<–70 dBc	.

NOTE: +17dBm LO mixer injection achieved with LO input power >0dBm.



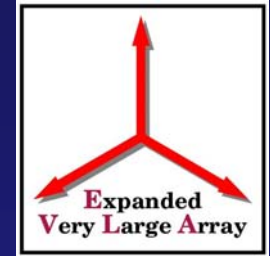
T302 L/S/C Converter IF Specs



Parameter	Specification	Measured
IF frequency range	8–12 GHz	8-12 GHz
IF output power	>–50 dBm	-38 dBm
Conversion Gain	not specified	12-13 dB
Image rejection	–30 dBc	.
Overall flatness	1.5dB/2 GHz	~1.2 dB
Passband ripple	.2dB/2MHz	~.2dB



T302 L/S/C Converter IF Output



Overall flatness & ripple

RF: 3.1–4.1 GHz

LO: 13.0 GHz

Spec: <math><1.5\text{dB}/2\text{ GHz}</math>

Meas: $\sim 1.2\text{dB}/2\text{ GHz}$

2 GHz sweep not shown

Spec: $0.2\text{dB}/2\text{ MHz}$

Meas: $\sim 0.2\text{dB}/2\text{ MHz}$

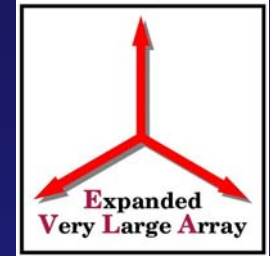
SWR 1.08–1.14

(25–29dB reflected)





T302 L/S/C Converter IF Output



Overall flatness & ripple

Miteq Mixer

Does not meet spec

RF: 3.1–4.1 GHz

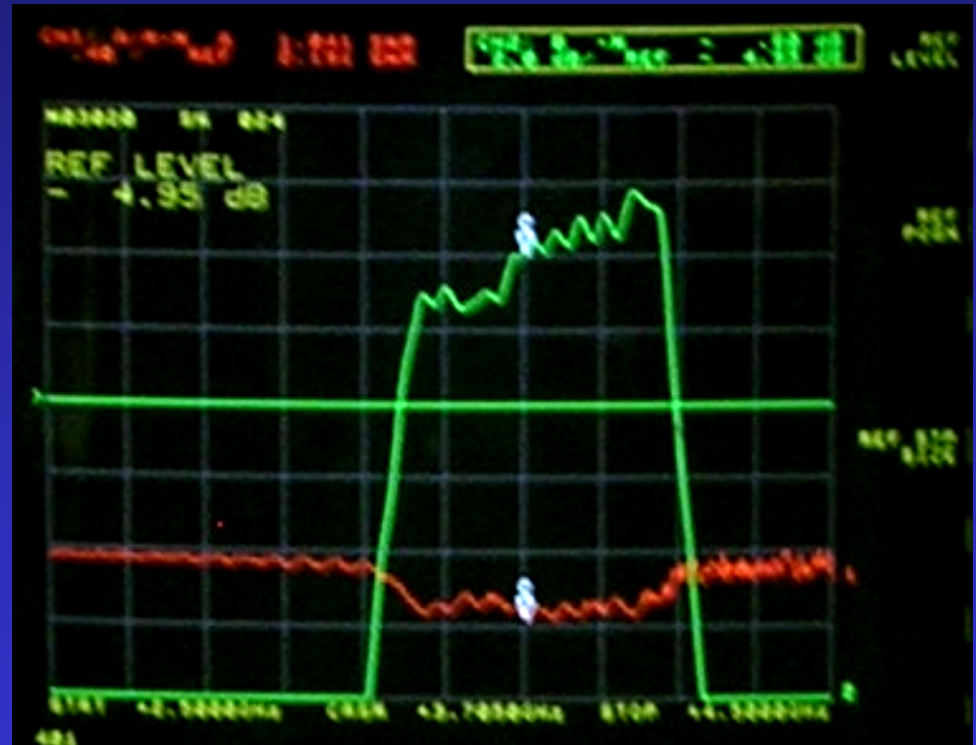
LO: 13.0 GHz

Spec: <1.5dB/2 GHz

Meas: ~7dB/2 GHz

~3.5dB/1 GHz

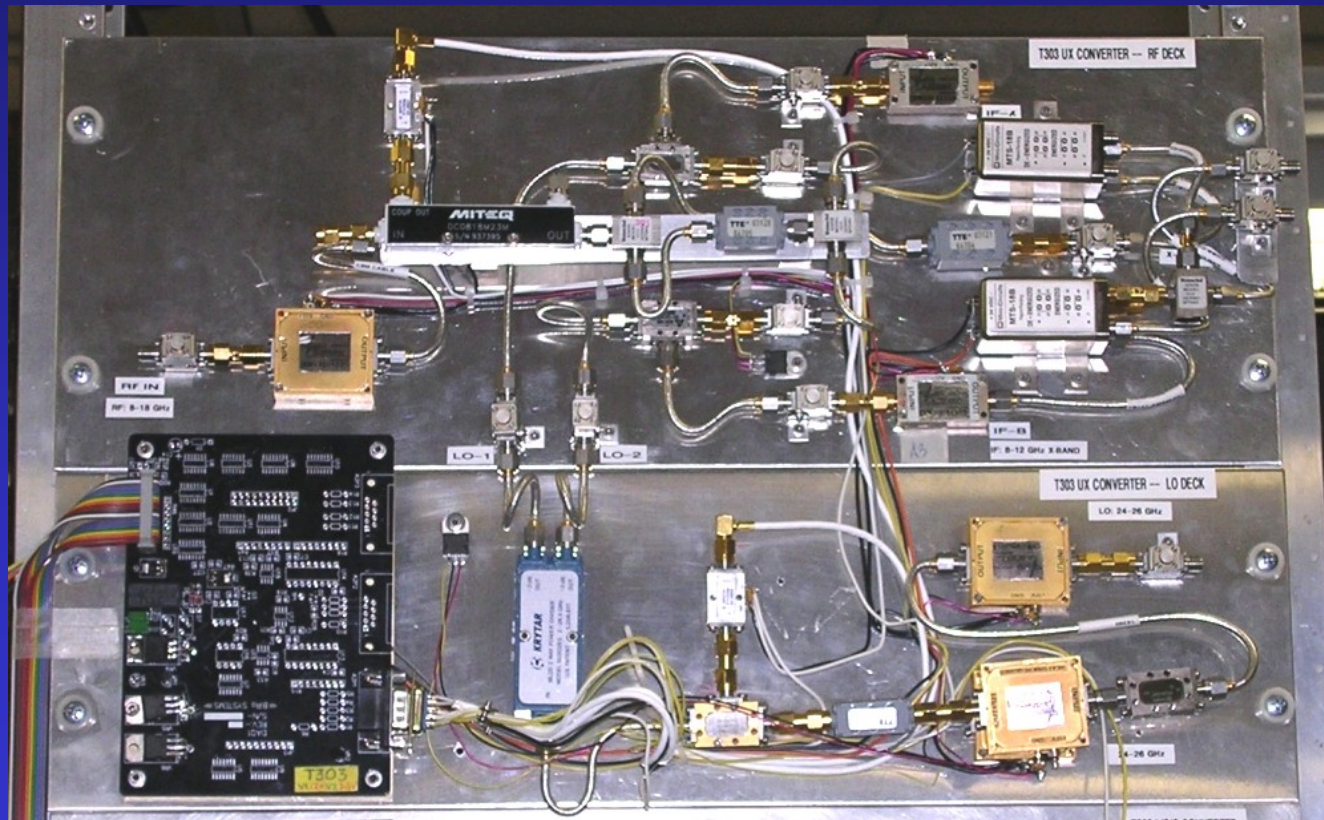
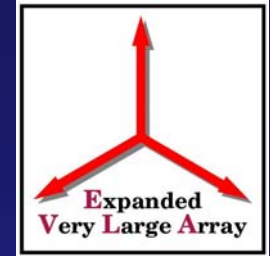
1 GHz Sweep shown



SWR: 0.1/div IF Response: 2dB/div

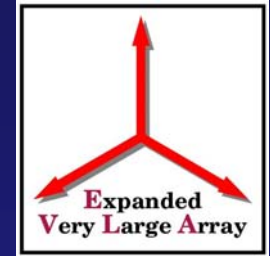


T303 UX Converter (Coaxial Version)

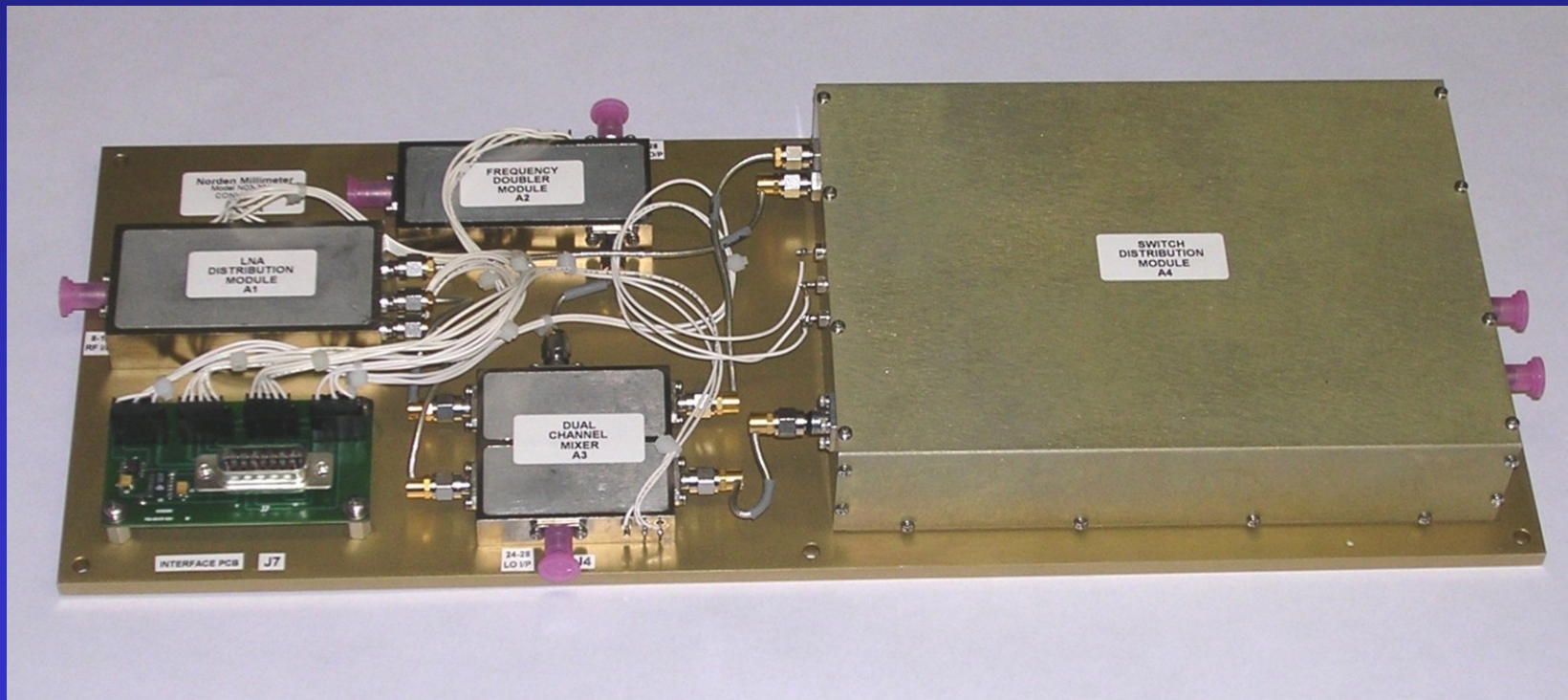




T303 UX Converter (MMIC Version)

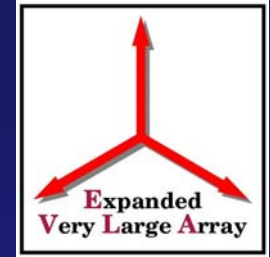


Norden Millimeter Prototype #1





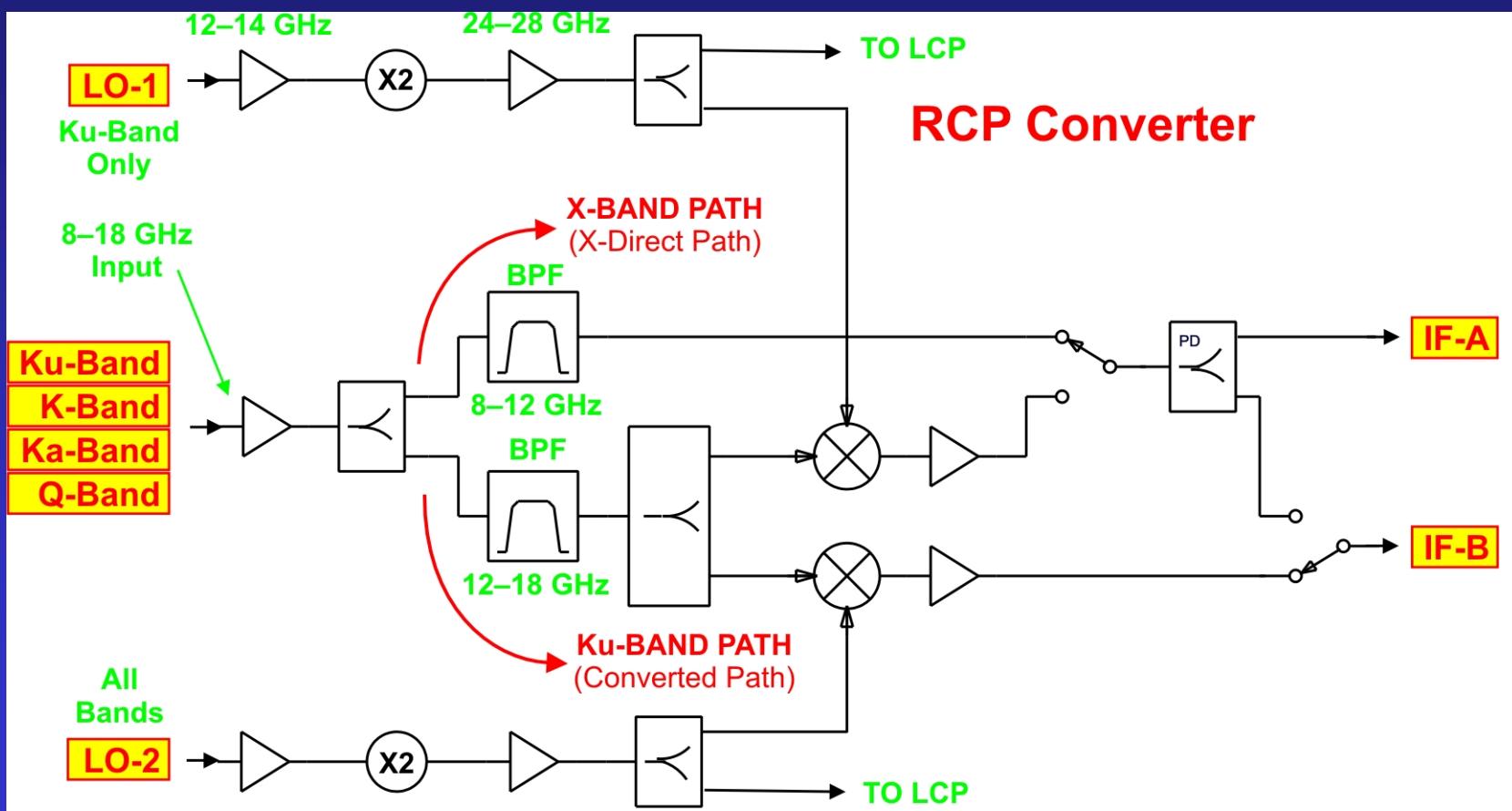
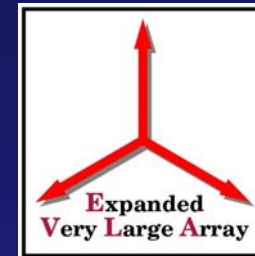
T303 UX Converter Design Notes



- Located in feed cone – custom enclosure
- Contains receiver band switches
- MIB interface via M301 wire & fiber optics
- Powered from front end power supplies
- Coaxial & MMIC versions being tested simultaneously

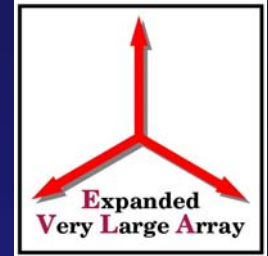


T303 UX Converter Block Diagram





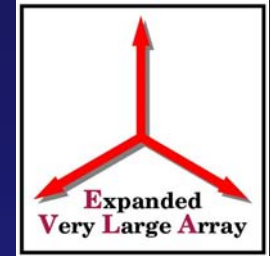
T303 UX Converter Specs



- RF input frequency: 8 –18 GHz
8–12 GHz Portion: X-band direct IF
12–18 GHz portion: converted to X-band IF
- LO input frequency: 12–14 GHz
Doubled internally to 24–28 GHz
(Only 24–26 GHz portion used)



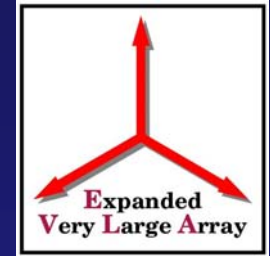
T303 UX Converter RF Input Specs



Parameter	Specification	Measured
Input power level	-53dBm/GHz	-47 dBm†
1dB compression	(X/Ku paths)	+2/-4
Headroom (X-direct)	38 dB	49 dB†
Headroom (Ku path)	25 dB	43 dB†
Input VSWR	1.35:1 max	1.08-1.18
Input Noise Figure	5.2 dB max	Not meas



T303 UX Converter LO Specs

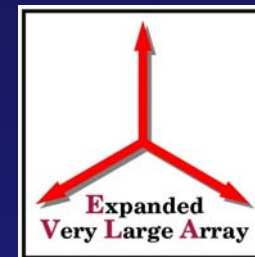


Parameter	Specification	Measured
LO input frequency	12–14 GHz	(L301)
LO input power level	+10 dBm	+10dBm
LO doubled frequency	24–28 GHz	24-27.5†
LO 2 nd harmonic	<−40 dBc	.
LO spurious levels	<−70 dBc	.

† Power reduced −3dB 27.5–28.0 GHz



T303 UX Converter IF Specs

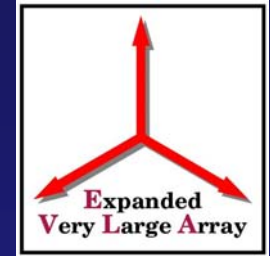


Parameter	Specification	Measured
IF frequency range	8–12 GHz	8-12 GHz
IF output power	>–48 dBm	-43 dBm
Conversion Gain	not specified	12-13 dB
Image rejection	–30 dBc	.
Overall flatness	2dB/2 GHz	1.5dB
Passband ripple	.2dB/2MHz	.2dB max



T303

X-Direct Path



Overall flatness & ripple

MMIC Version

X-Direct Path

RF: 8–12 GHz

LO: Not used

Spec: 2dB/2 GHz

Meas: ~1.5dB/4 GHz

4 GHz sweep shown

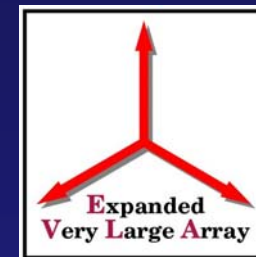
SWR 1.08–1.12



SWR 0.1/div IF OUT 2dB/div



T303



Ku Conversion Path

Overall flatness & ripple

MMIC Version

Ku-converted Path

RF: 12–18 GHz

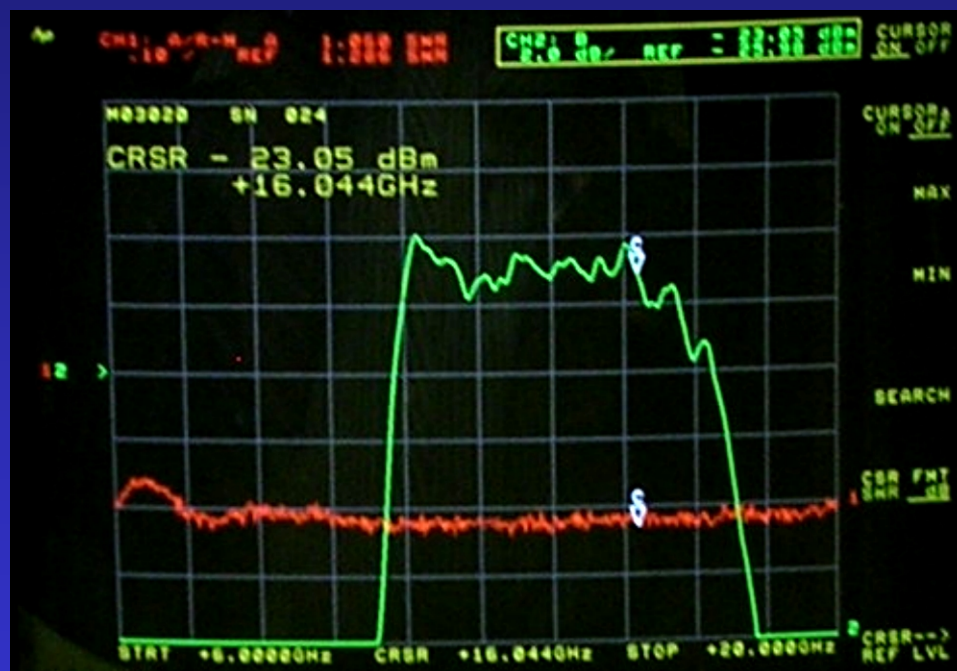
LO: 12.0 GHz

Spec: 2dB/2 GHz

Meas: 3.8dB/6 GHz

6 GHz sweep shown

Meas. SWR 1.08–1.12

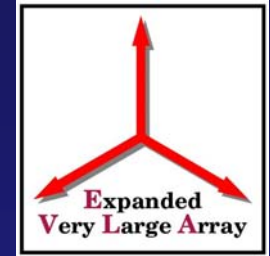


SWR 0.1/div

IF OUT 2dB/div



T303



Compression/IMD

Ku-converted Path

12–18 GHz @ +5dBm

LO: 12.0 GHz

Spec: 32dB headroom
from P1dB

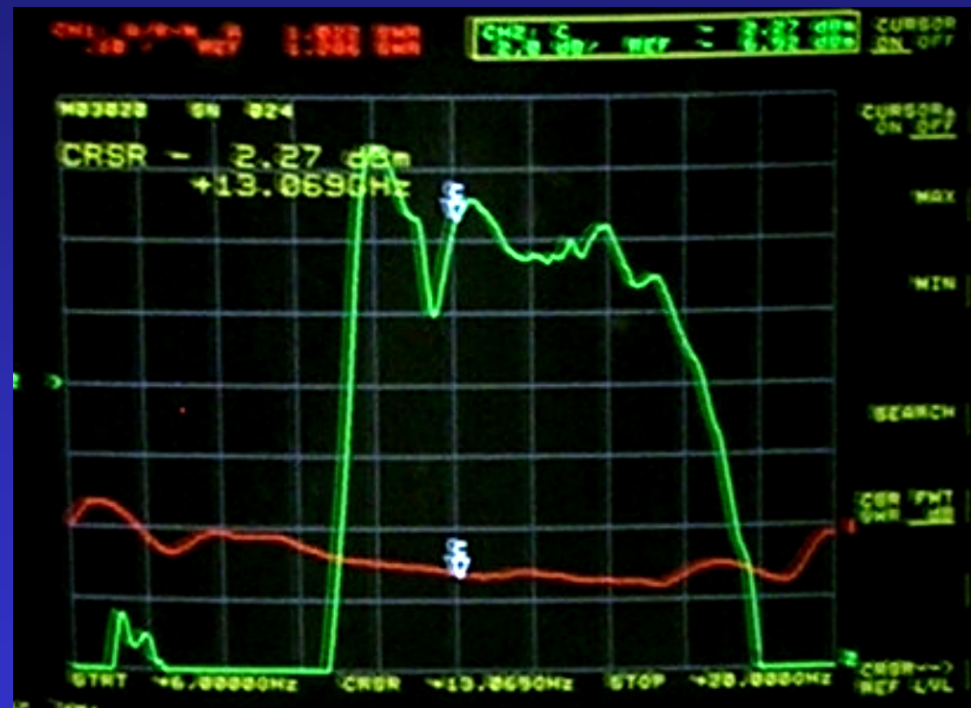
$-40\text{dBm} + 32 = -8\text{dBm}$

Meas P1dB = -2dBm

Spec: IMD $\ll 30\text{dB}$

LO spurs $< -60\text{dBc}$

IMD product -65dBc

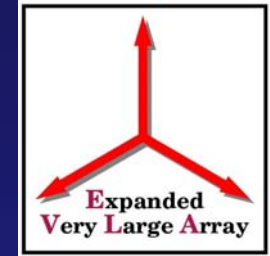


SWR 0.1/div

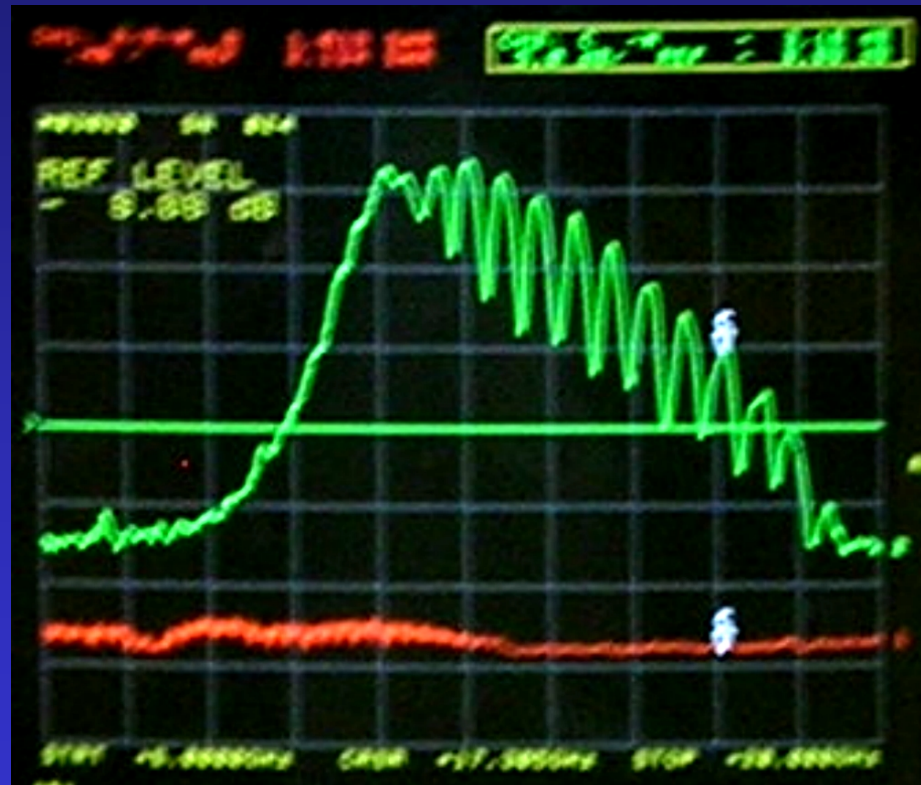
IF OUT 10dB/div



T303 UX Converter IF Output



When
things
go
wrong. . .

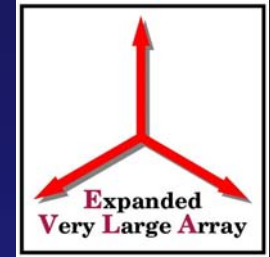


SWR 0.1/div

IF OUT 10dB/div



M301 Converter Interface Module



- One MIB services all three converters and controls all system switches
- M301 to reduce MIB RFI in converters
- Uses MIB SPI bus for all monitor/control
- Fiber Optics used for feed cone SPI lines



M301 Converter Interface Block Diagram

