

EVLA Front-End CDR

EVLA
K-Band (18-26 GHz)
Receiver



EVLA K-Band Receiver Overview



1) EVLA Upgrade

- Existing VLA Configuration
- Required Modifications
- New Upgraded EVLA Block Diagram

2) Block Converter Scheme

3) Noise & Headroom Model

4) Upgrade Details

5) Test Results

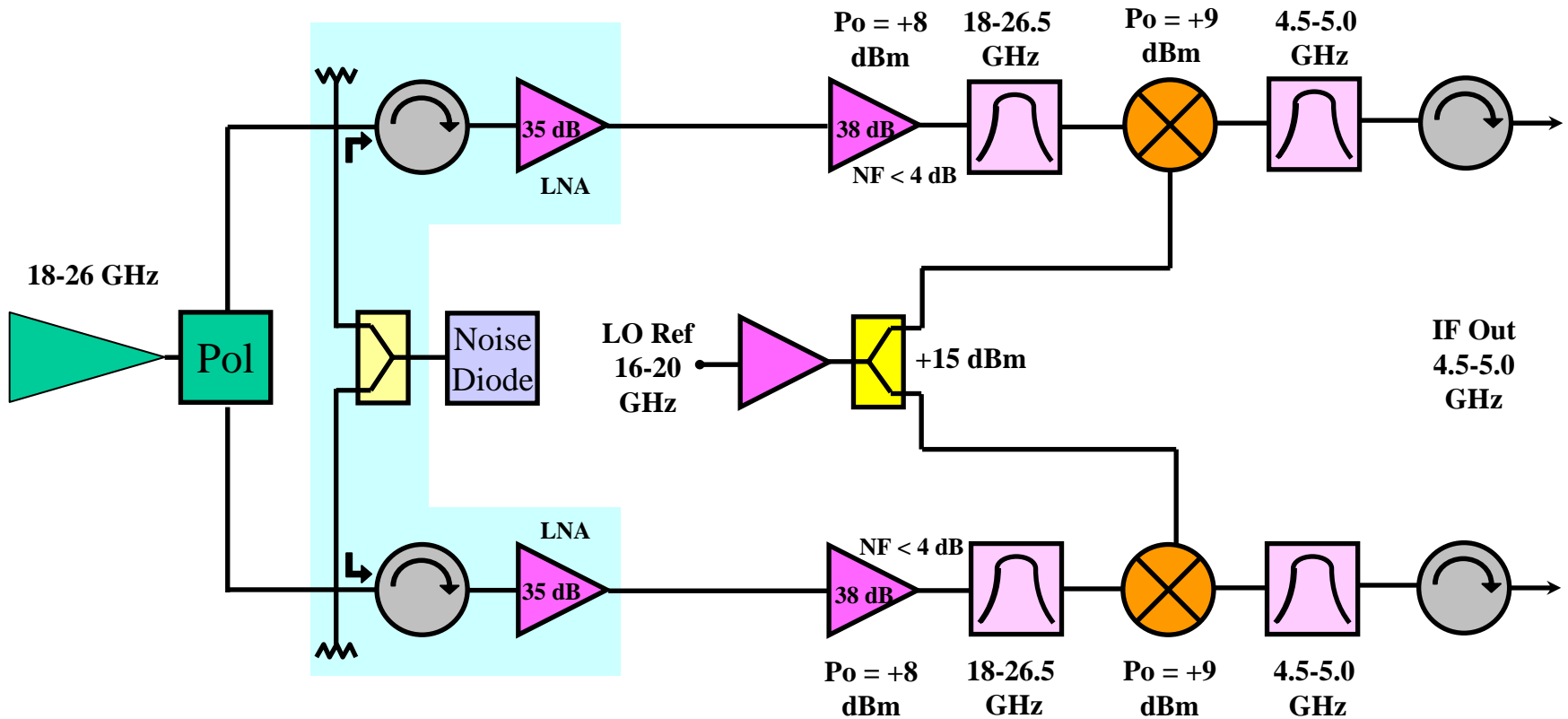
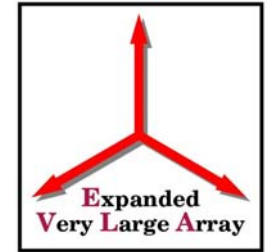
- Swept LO1 vs. Block Converter Mode
- Equalization
- Ellipticity



VLA K-Band Receiver

Current Configuration

(No WVR)





K-Band Receiver

VLA to EVLA Modifications



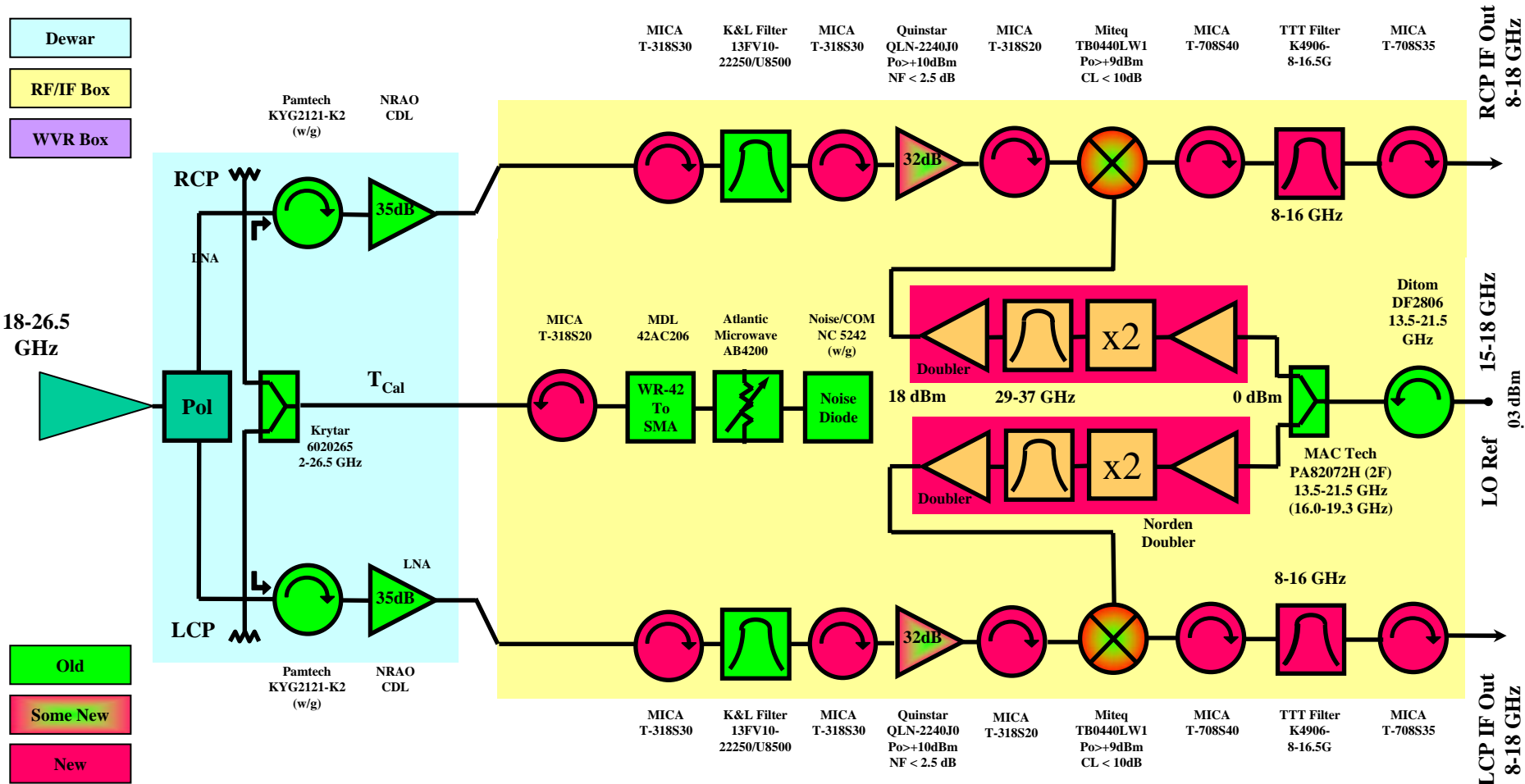
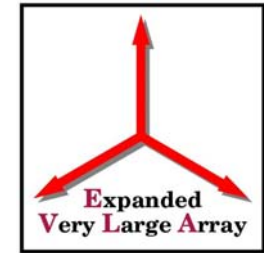
- Switch to High-side LO injection
 - **Requires new Mixers (Miteq RF/LO=4-40 GHz, IF=DC-20 GHz)**
 - **Requires new Limiting Frequency Doubler for LO Reference**
- Adopt Block Converter Scheme (18-26.5 → 8-16.5 GHz)
- Remove narrow 4.5-5.0 GHz IF components
- Replace 38 dB Miteq post-amps with 32 dB Quinstar units
 - **To avoid compromising Headroom**
 - **Already have 47% (28 out of 60) of the Quinstar QLN-2240J0 amps that will be required**
- Add Isolators on RF, IF & Cal signals
 - **To reduce passband and T_{Cal} ripple**



EVLA K-Band Receiver

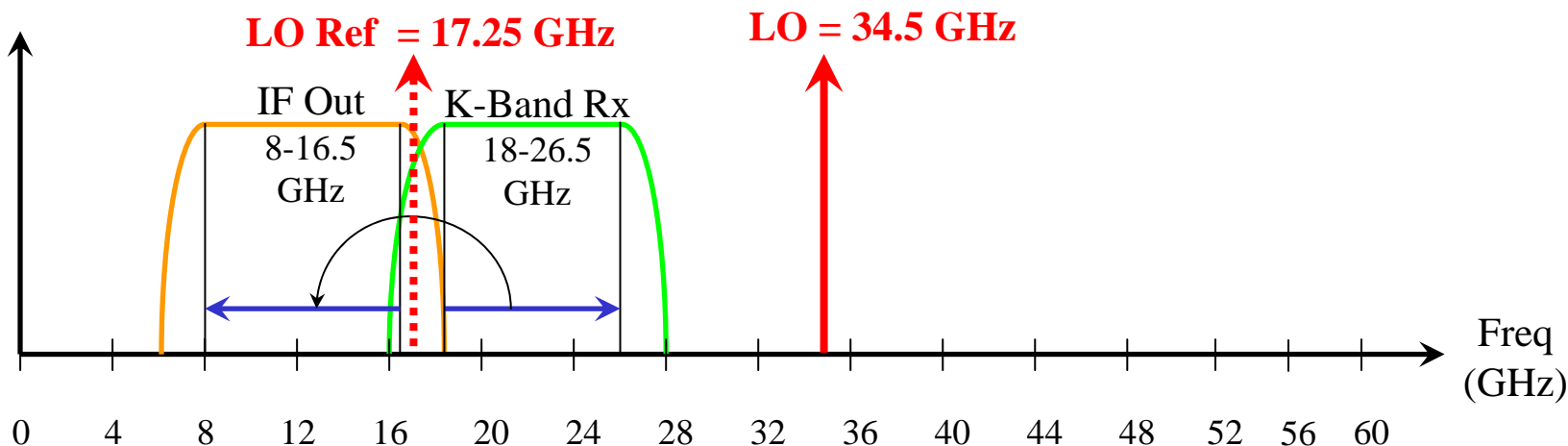
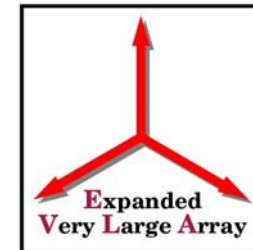
Baseline Configuration

(without WVR capability)





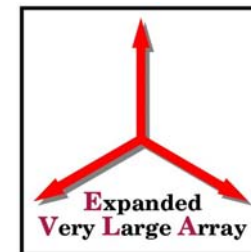
K-Band Block Conversion Frequency Diagram



- Translation of 18-26.5 GHz down to 8-16.5 GHz
- LO Ref 17.250 GHz $\times 2 = 34.5$ GHz
 - Closest L301 Lock Point is actually 17.280 GHz



Estimated EVLA K-Band T_{RX}, Output Power & Headroom



EVLA K-Band Rx (RHH : 28 March 2006)	P (1dB) (dBm)	P (1%) (dBm)	Temp (K)	NF/C (dB)	Loss/Gain (dB)	Loss/Gain (linear)	Delta T (K)	Trx (K)	BW (MHz)	Pnoise (dBm)	Pnoise dBm/GHz	Headroom (dB)
										for Tsky of		
										25.0		
										(K)		
									12000	-83.8	-94.6	
Weather Window			300		-0.05	0.9886	3.474			-83.3		
Feed Horn			300		-0.05	0.9886	3.514			-82.9		
Vacuum Window			300		-0.01	0.9977	0.708			-82.8		
Phase Shifter			15		-0.1	0.9772	0.358			-82.8		
OMT			15		-0.2	0.9550	0.742			-82.9		
W/G or Coax			15		-0.1	0.9772	0.384			-83.0		
Cal Coupler (IL)			15		-0.2	0.9550	0.795			-83.1		
Cal Coupler (Branch)			300	-30	0	1.0000	0.300			-83.0		
Isolator			15		-0.5	0.8913	2.155			-83.3		
LNA	-10	-22	15		35	3162.2777	19.819			-46.4		24.4
Stainless Steel Coax			157.5		-4	0.3981	0.099	32.35		-50.4		
Isolator			300		0	1.0000	0.000			-51.4		
Coax Cable			300		-1	0.7943	0.082			-51.4		
Isolator			300		-0.5	0.8913	0.048			-53.4		
Filter (18-26.5 GHz)			300		-1.5	0.7079	0.183		8500	-54.9	-64.2	
Isolator			300		-0.5	0.8913	0.077			-55.4		
Post-Amp	10	-2	446.0	4	32	1584.8932	1.048			-23.3		21.3
WVR Coupler+Iso+Coax			300		0	1.0000	0.000			-23.3		
Isolator			300		-0.5	0.8913	0.000			-23.8		
Mixer (Level 15)	9	-3	300		-10	0.1000	0.004			-33.8		20.8
Isolator			300		-0.5	0.8913	0.001			-34.3		
Filter (8-16 GHz)			300		-1	0.7943	0.001		8000	-35.6	-44.6	
Isolator			300		-0.5	0.8913	0.001	33.79		-36.1		



Old vs. New K-Band

- Longer legs
- New Card Cage
- Block Converter
- New bottom Feed section
- Easy access to fridge & manifold

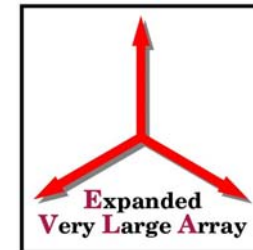


EVLA

VLA

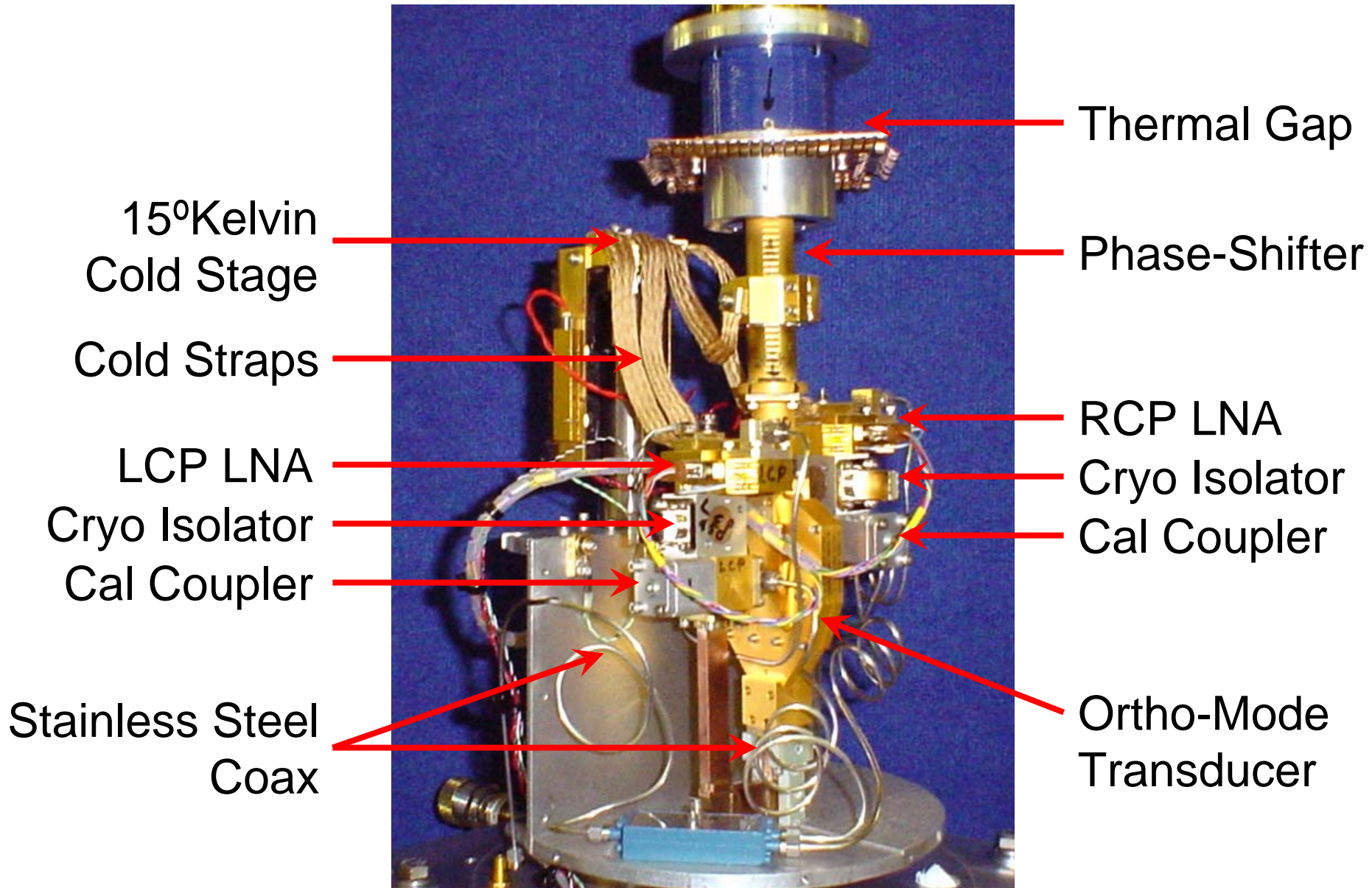


Feed Horn & Receiver Mounting Modifications



- In the EVLA configuration the receiver is essentially hung from the Vertex Cabin roof by the feed.
- New bottom section of feed is more robust to carry the receiver's weight.
- New thicker Top Plate.
- New anti-cocking flange addresses the problem with the old boss/deboss mating system which caused large broad bumps in T_{RX} .
- New Ring-Load section has improved compression system to eliminate their distortion.

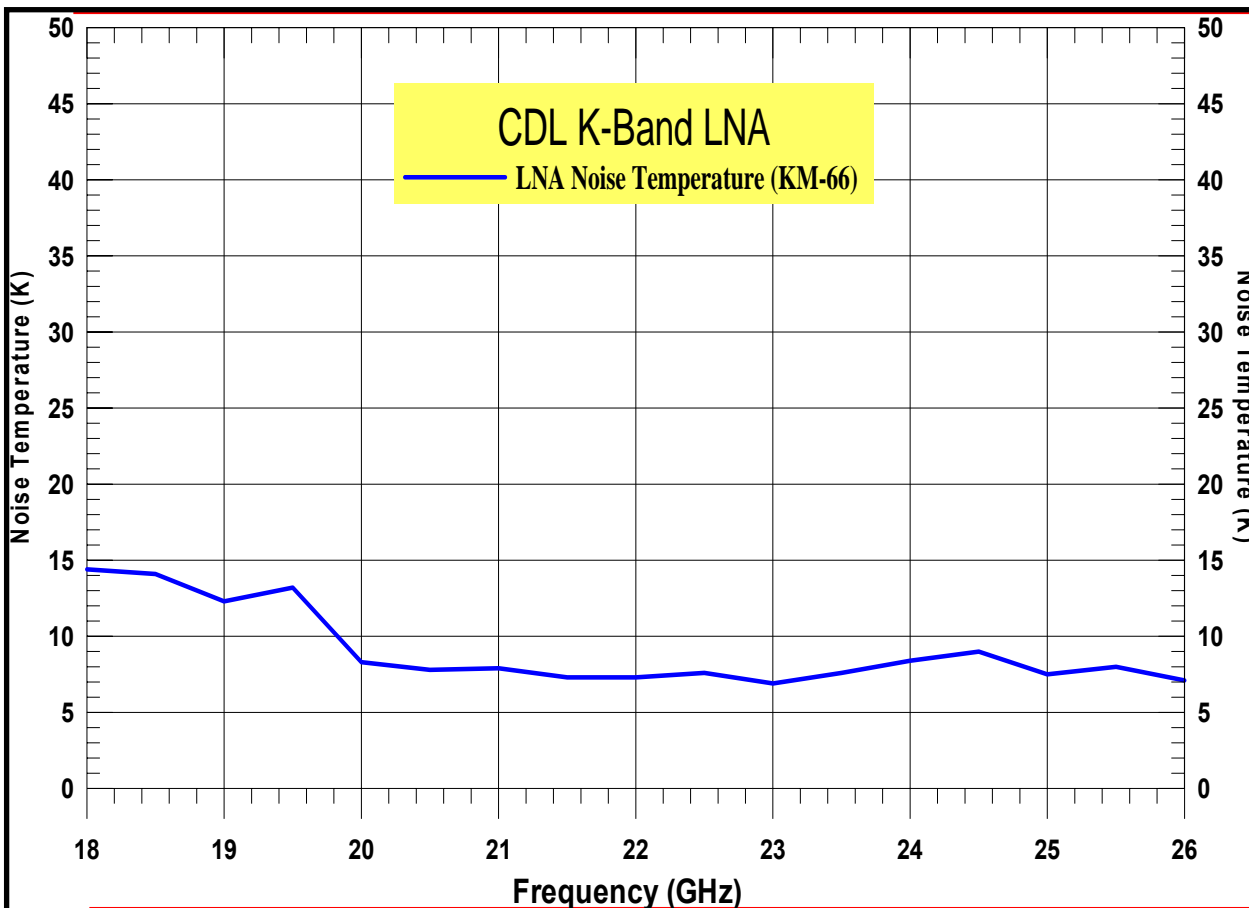
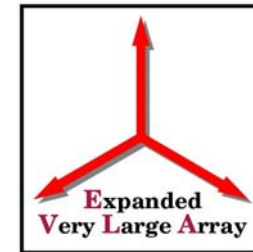
EVLA 18-26.5 GHz Receiver





CDL K-Band LNA

Cryo-3 Device in 1st Stage



Replace old-style GaAsFET cooled amplifiers with new MAP-style InP units as well several existing MAP units which have inferior performance.

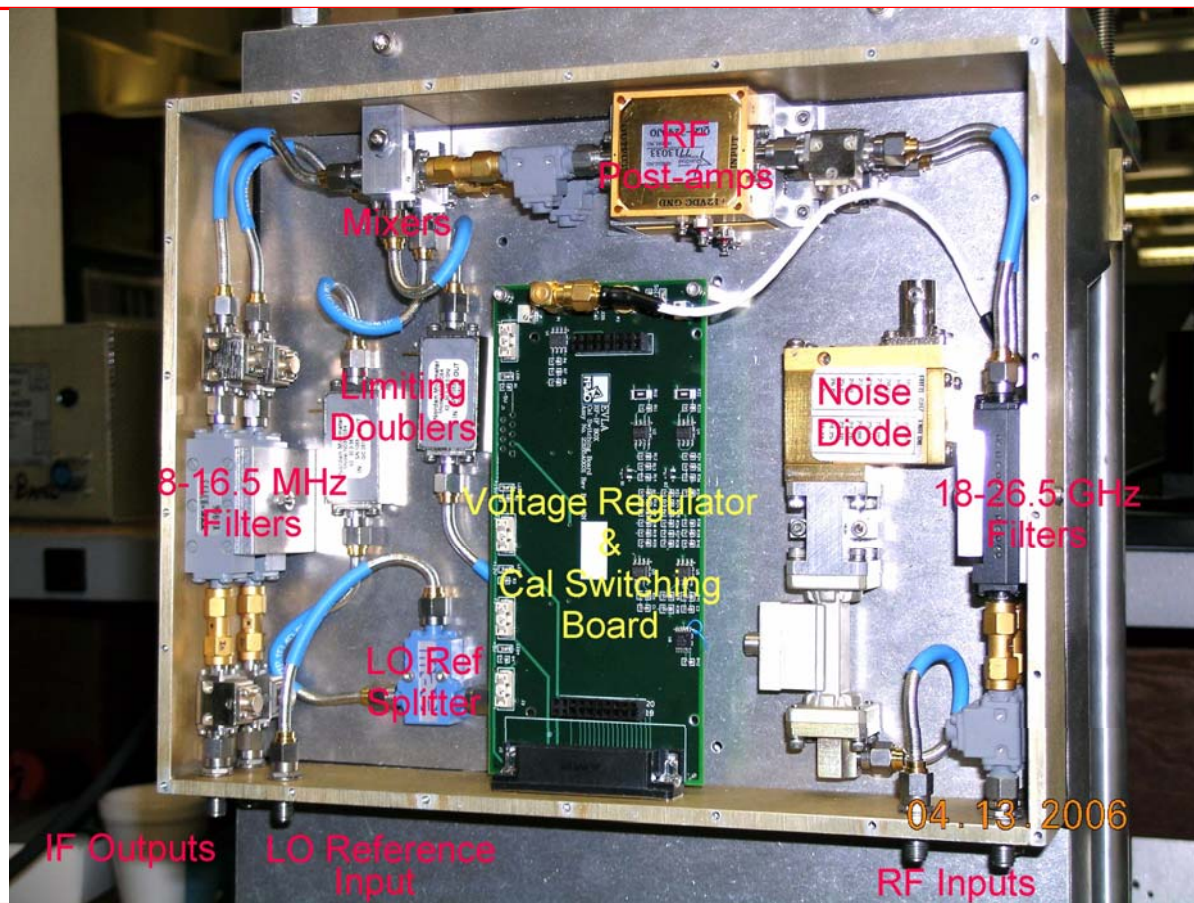
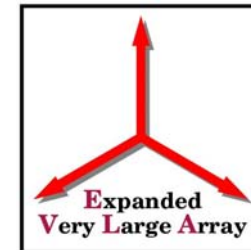
28 new LNA's

Upgrade existing 4-stage MAP amps by returning to them to CDL for substitution of Cryo-3 device in the first stage

24 upgraded LNA's



The New RF/IF Box

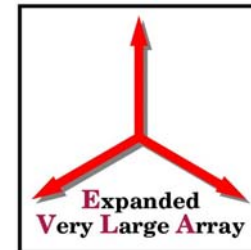




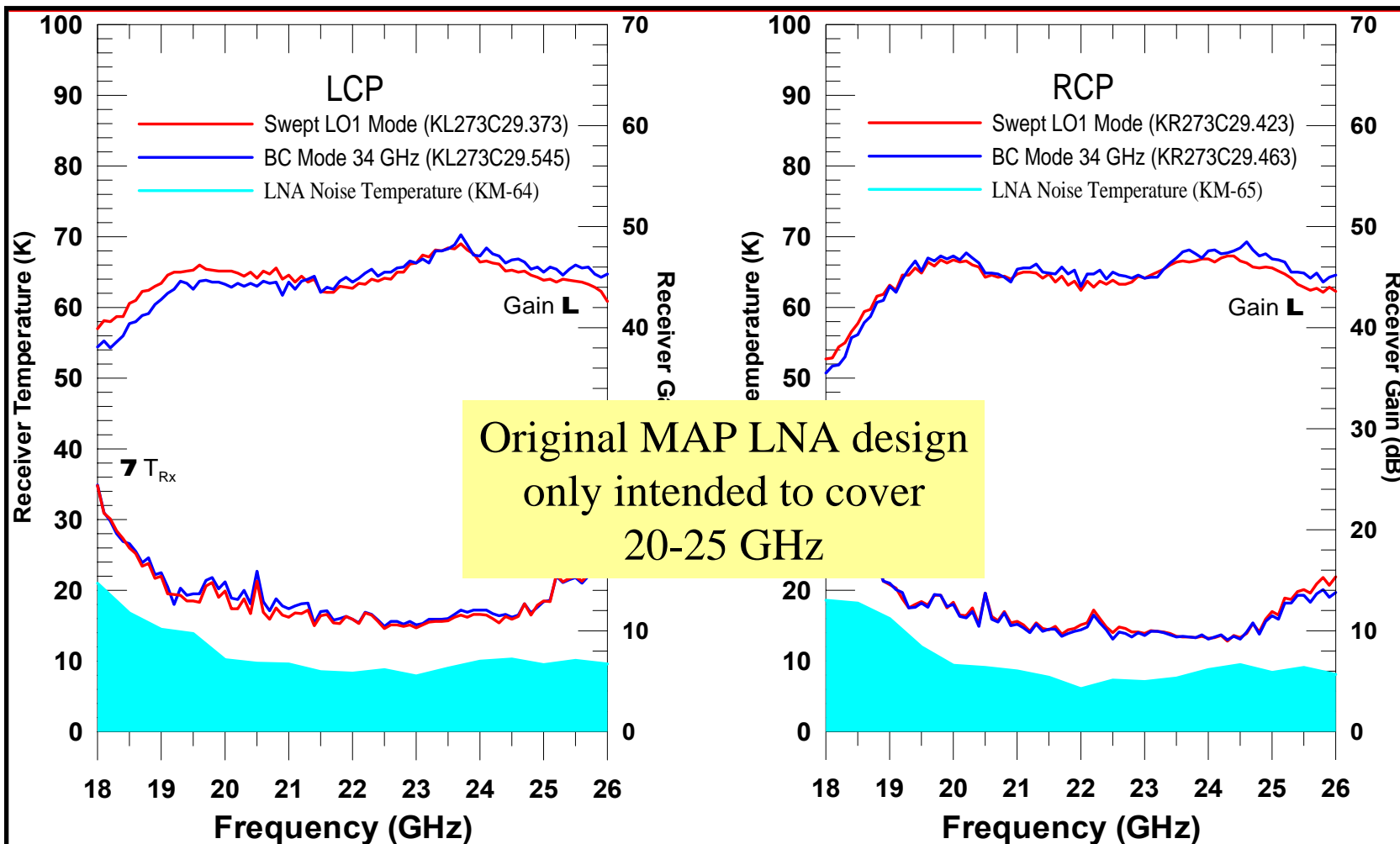
K-Band SN 27 - First EVLA Prototype

Swept LO1 vs. Block Converter Mode

27 May 2004



Swept LO 1 Mode : LO1 = 29.0 to 37.0 GHz, LO2 = 11.0 GHz
Block Converter Mode : LO1 = 34.0 GHz, LO2 = 16.0 to 8.0 GHz

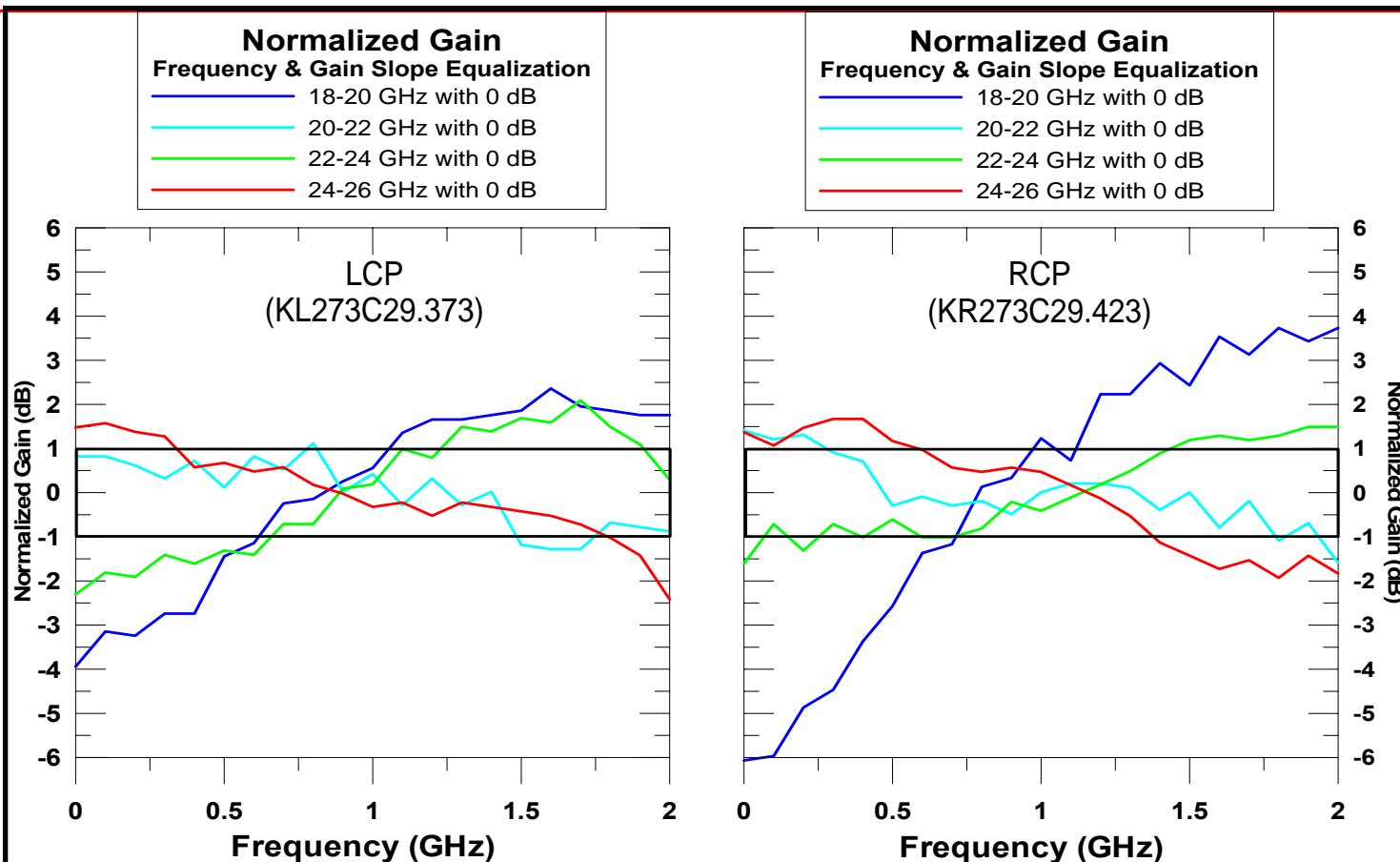
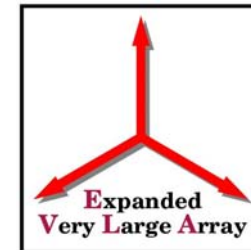


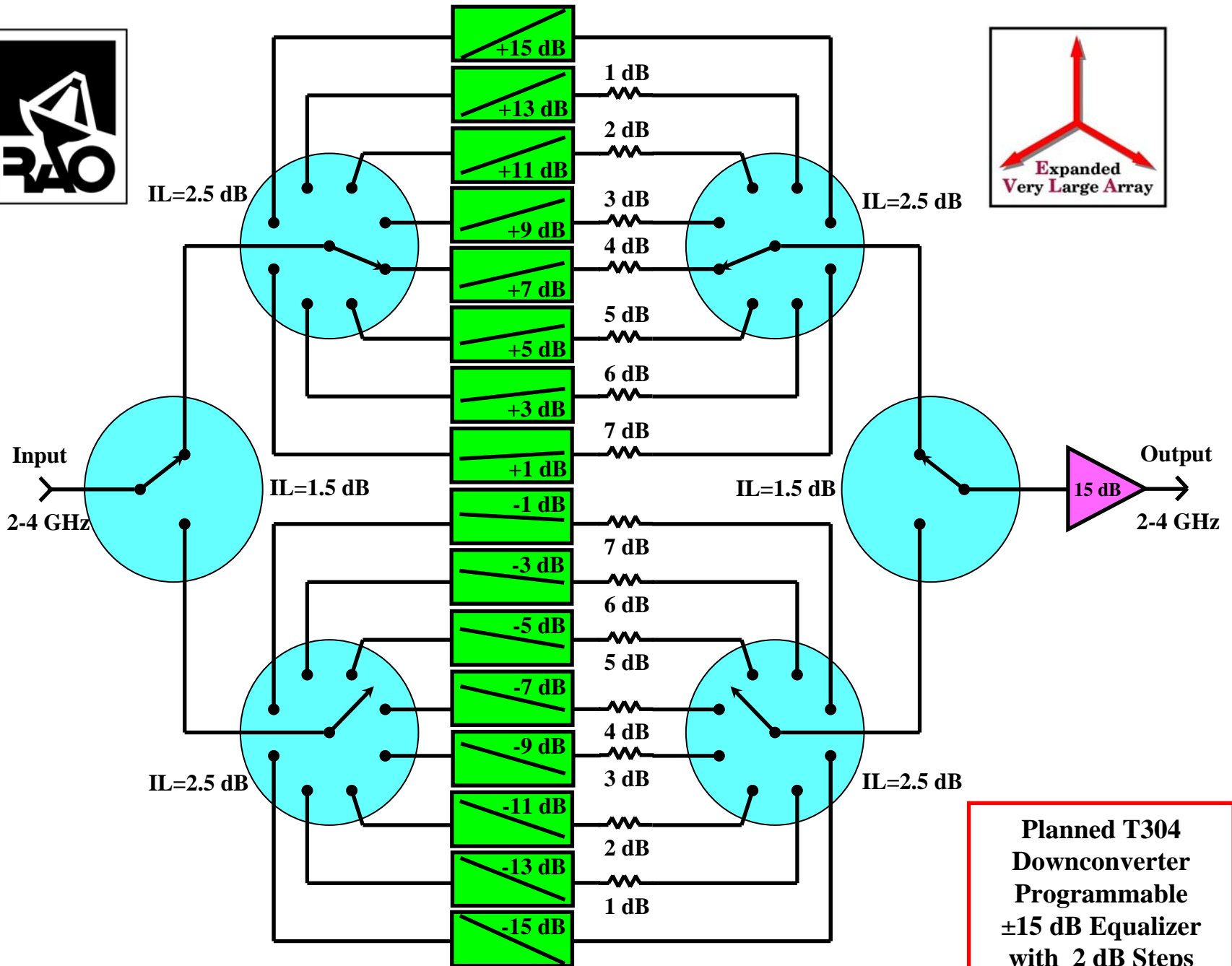
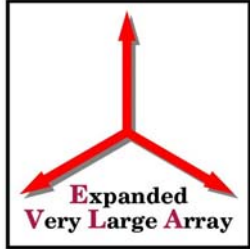


K-Band SN 27 - First EVLA Prototype

Gain Flatness in 2 GHz Bandwidths - No Equalization
Swept LO1 Mode (LO1 = 14.5-18.5 GHz, LO2 = 11 GHz)

27 May 2004

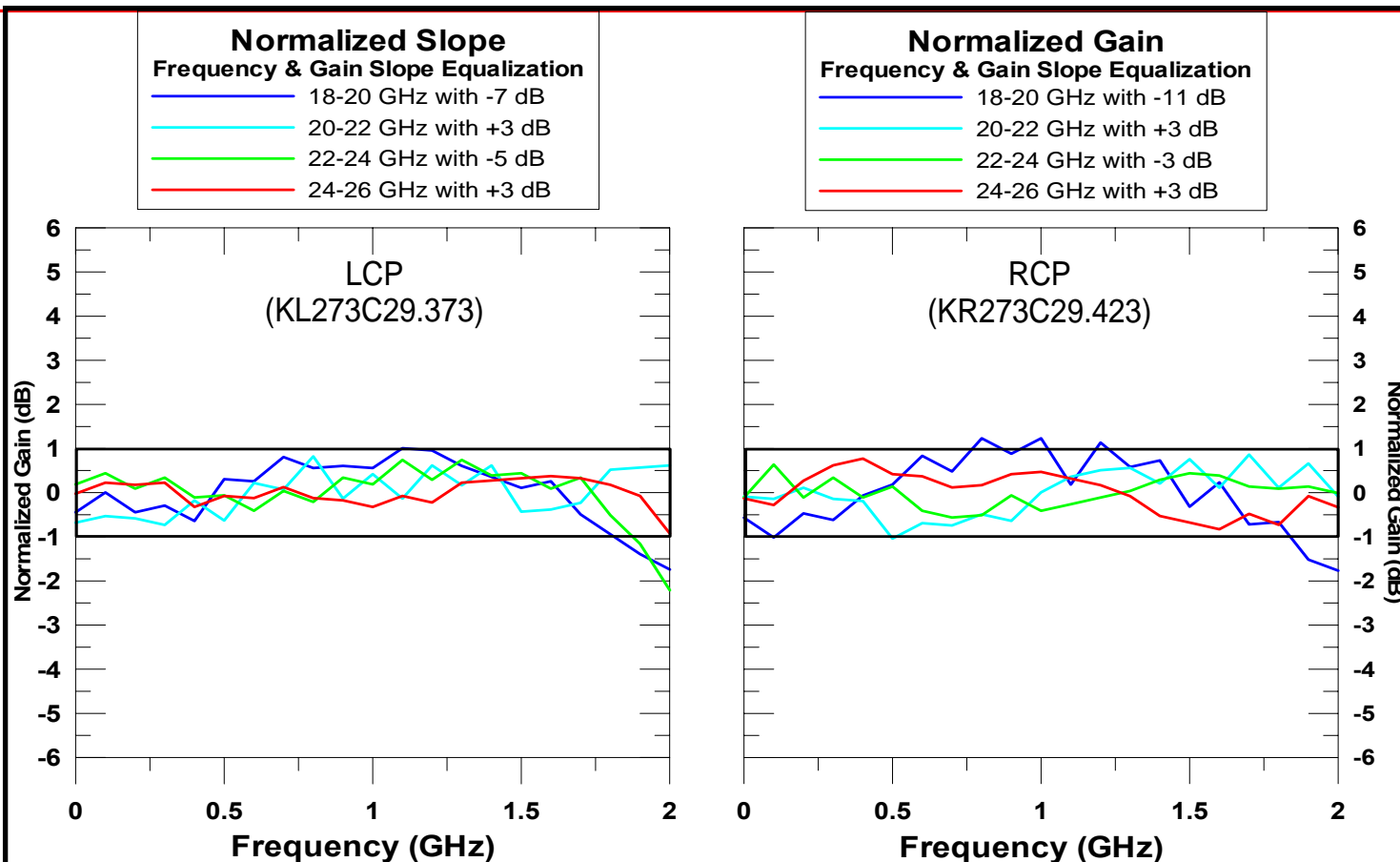
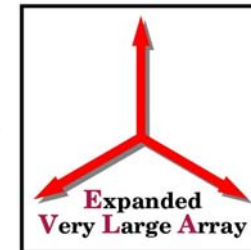






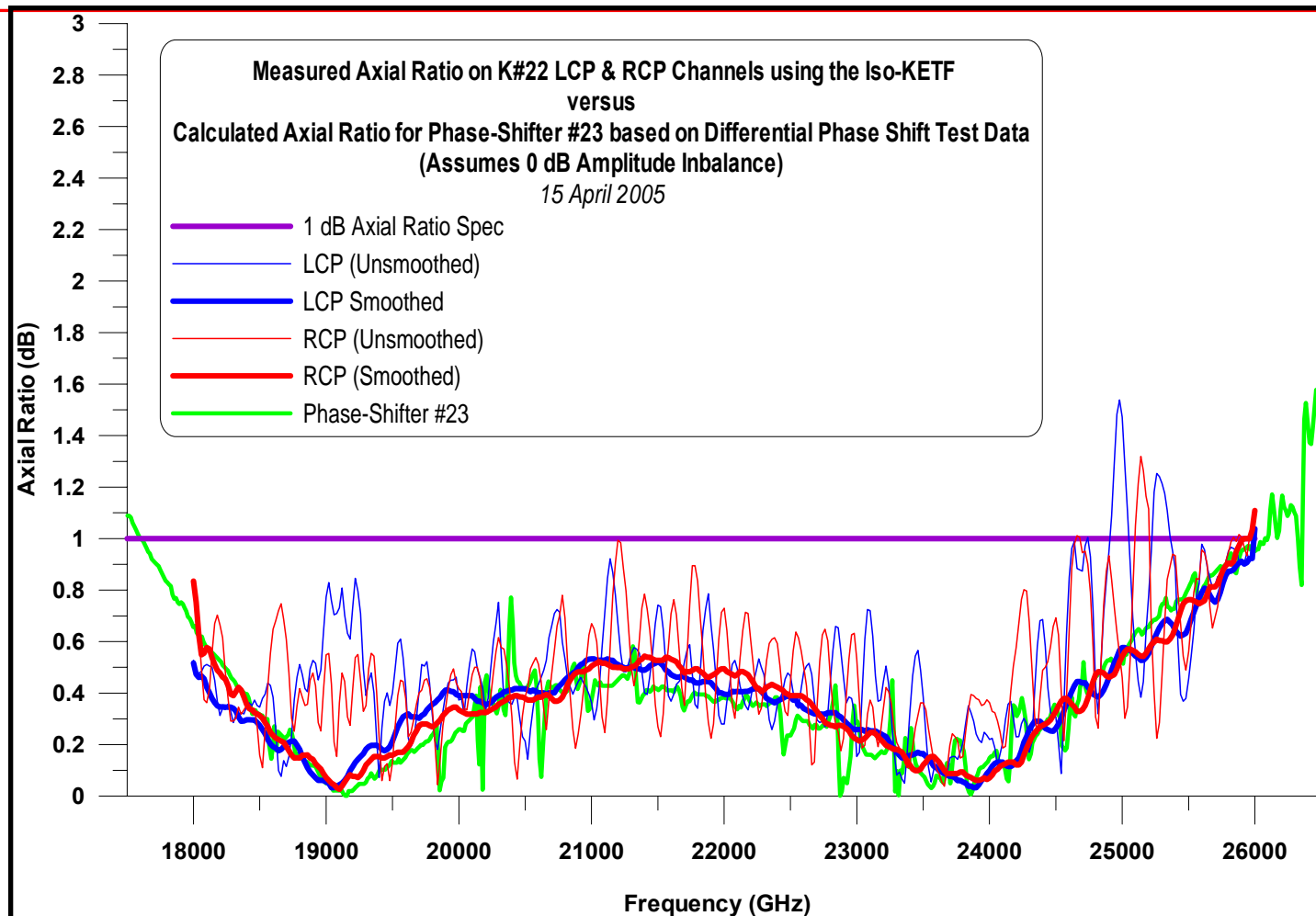
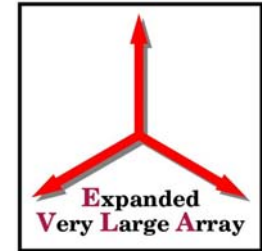
K-Band SN 27 - First EVLA Prototype

Gain Flatness in 2 GHz Bandwidths - Simulated T304 Equalizer
Swept LO1 Mode (LO1 = 14.5-18.5 GHz, LO2 = 11 GHz)
15 March 2006





Typical K-Band Axial Ratio Measurement

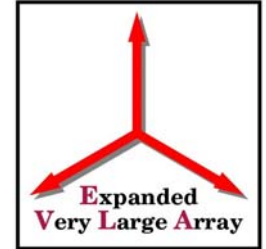




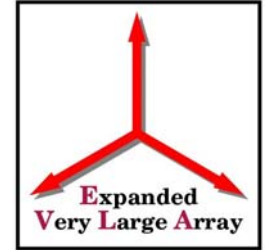
EVLA K-Band Summary



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- Incremental upgrade to an existing VLA receiver band
 - EVLA design improves sensitivity and broadband performance
 - New/upgraded LNA's will provide even more improvement
 - M&S Budget - \$289.1K already spent out of \$445.5K allotment
 - **Remaining large ticket items**
 - LNA's
 - Cables
 - New Card Cages
 - To keep within the EVLA Project spend profile, it was felt that the upgraded design was low risk and that we could confidently proceed with mass production
 - **We hope the FE CDR Panel agrees...**



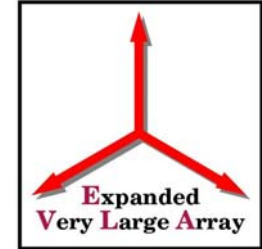
Questions ?



Backup Slides



Frequency Doubler

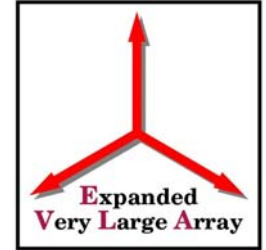


Norden Millimeter Limiting Doubler N03-2084

• Input Frequency	15-18 GHz
• Output Frequency	30-36 GHz
• P_{In} (min)	-3 dBm
• P_{In} (max)	+3 dBm
• P_{Out} (min)	+17 dBm
• P_{Out} (max)	+19 dBm
• O/P Variation over I/P Drive (max)	" 0.5 dB
• Power Flatness with Freq (max)	" 0.5 dB
• Max Input No Damage	+13 dBm
• Fundamental Rejection (min)	-50 dBc
• Harmonic	-40 dBc
• Spurious	-65 dBc



IF Filter (8-16.5 GHz)



TTE K4905-8/16.5G-A

- Insertion Loss 1 dB
- Flatness 0.5 dB
- Rejection - 1 dB 8.00 & 16.50 GHz
- - 3 dB 7.80 & 16.70 GHz
- - 30 dB 6.11 & 18.39 GHz
- - 50 dB 4.40 & 19.60 GHz
- Upper -50 dB Stopband 35 GHz



VLA/EVLA K-Band Receiver

SN 26

(28 April 2003)

