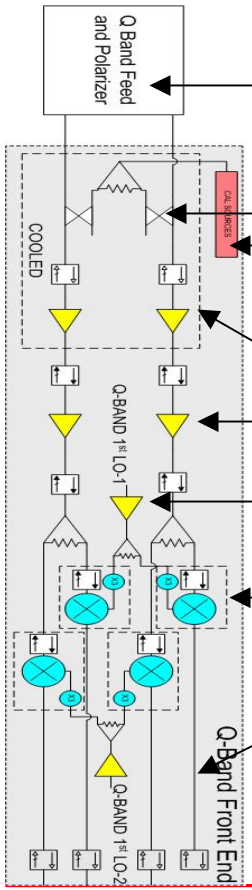
EVLA Systems PDR

Receivers/Feeds

Q-band



40 – 50 GHz, 2 x 2 x 4 GHz channel EVLA Q-band Receiver Upgrade

Current VLA Q-band feedhorn, NRAO design—At 290 K

Septum polarizer, Atlantic Microwave design—At 15 K

Cal coupler, part of polarizer—At 15 K

Cal source, NoiseCom– At 290 K.

S-Cal source, NoiseCom + S-cal amp– At 290 K

LNA, NRAO current design—At 15 K, Te=35 K, G=35 dB

RF post-amp, ALC/Spacek—At 290 K, NF<5 dB, G>20 dB (**Add**)

LO amp, Quinstar—At 290 K, NF<7 dB, G>17 dB, 1dBC>17 dB (**Add 2nd amp to existing receivers**)

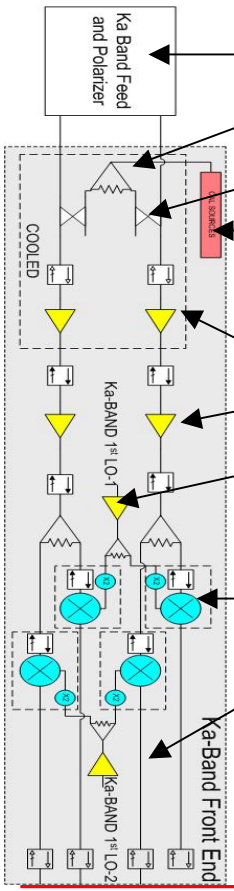
LO multiplier/mixer WG chain, x3, Spacek: At 290 K, (**Add 2nd pair to existing receivers**)

4 outputs at 8 – 12 GHz, -45 dBm

Cryogenics: CTI-22 refrigerator.

Receiver FE NF=56 K

Ka-band



26 – 40 GHz, 2 x 2 x 4 GHz channel EVLA Ka-band Receiver Development

Scaled K-band feedhorn, NRAO design—At 290 K

Scaled K-band ph shifter/OMT, NRAO electroformed design—At 15 K

Scaled K-band Cal coupler, NRAO electroformed design—At 15 K

Cal source, NoiseCom– At 290 K.

S-Cal source, NoiseCom + S-cal amp– At 290 K

LNA, NRAO current design—At 15 K, Te=20 K, G=35 dB

RF post-amp, ALC/Spacek—At 290 K, NF<5 dB, G>20 dB

LO amp, Quinstar—At 290 K, NF<7 dB, G>17 dB, 1dBC>17 dB

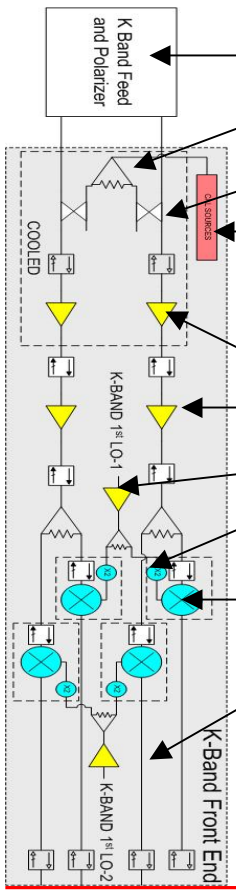
LO multiplier/mixer WG chain, x3, Spacek: At 290 K,

4 outputs at 8 – 12 GHz, -46 dBm

Cryogenics: CTI-350 refrigerator.

Receiver FE NF est=TBD K

K-band



18 – 26 GHz, 2 x 2 x 4 GHz channel EVLA K-band Receiver Upgrade

Current VLA K-band feedhorn, NRAO design—At 290 K.

Current K-band ph shifter/OMT, NRAO e-formed design—At 15 K

Current K-band Cal coupler, NRAO electroformed design—At 15 K

Cal source, NoiseCom– At 290 K. +

S-Cal source, NoiseCom + S-cal amp– At 290 K.

LNA, NRAO current design—At 15 K, Te=15 K, G=35 dB

RF post-amp, ALC/Spacek—At 290 K, NF<5 dB, G>20 dB

LO amp, Quinstar—At 290 K, NF<7 dB, G>17 dB, 1dBC>17 dB

LO multiplier WG chain x2, Spacek: At 290 K (**add**)

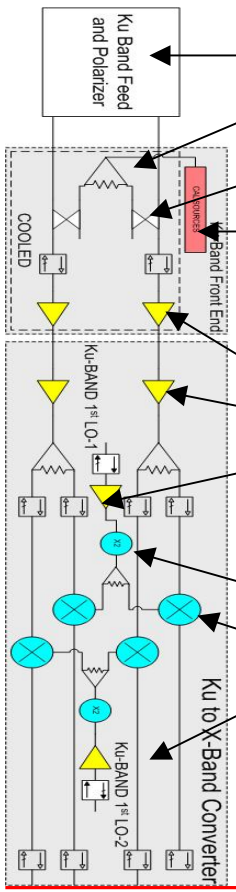
WG Mixer, Miteq: At 290 K, 4-40 GHz in/.5-20 GHz out (**mod**)

4 outputs at 8 – 12 GHz, -47 dBm

Cryogenics: CTI-22 refrigerator.

Receiver FE NF est=27 K

Ku-band



12 – 18 GHz, 2 x 2 x 4 GHz channel EVLA Ku-band Receiver Development

Scaled K-band feedhorn, NRAO design—At 290 K

Scaled K-band ph shifter/OMT, NRAO electroformed design—At 15 K

Scaled K-band Cal coupler, NRAO electroformed design—At 15 K

Cal source, NoiseCom– At 290 K. +

S-Cal source, NoiseCom– At 290 K.

LNA, NRAO current design—At 15 K, Te=10 K, G=40 dB

RF post-amp, Quinstar—At 290 K, NF<5 dB, G>20 dB

LO amp, Quinstar—At 290 K, NF<5 dB, G>17 dB, 1dBC>17 dB

LO multiplier WG chain, x2, Spacek: At 290 K,

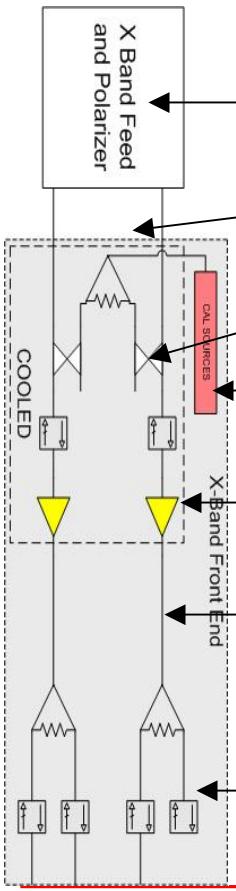
WG Mixer, Miteq: At 290 K, 4-40 GHz in/.5-20 GHz out

4 outputs at 8 – 12 GHz, -42 dBm

Cryogenics: CTI-350 refrigerator.

Receiver FE NF est=28 K

X-band



8 – 12 GHz, 2 x 2 x 4 GHz channel EVLA X-band Receiver Development

Scaled K-band feedhorn, NRAO design—At 290 K

Scaled K-band ph shifter/OMT, NRAO electroformed design—At 15 K

Scaled K-band Cal coupler, NRAO electroformed design—At 15 K

Cal source, NoiseCom– At 290 K. +

S-Cal source, NoiseCom– At 290 K.

LNA, NRAO current design—At 15 K, Te=10 K, G=40 dB

RF post-amp, Quinstar—At 290 K, NF<3 dB, G>20 dB (Not shown)

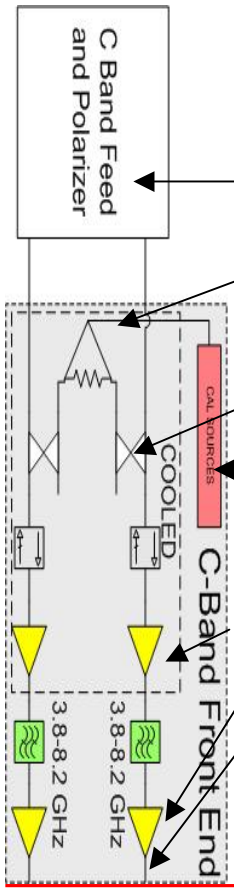
4 outputs at 8 – 12 GHz, -42 dBm

Cryogenics: CTI-22 refrigerator.

Receiver FE NF est=24 K

C-band

4 – 8 GHz, 2 x 4 GHz channel EVLA C-band Receiver Development



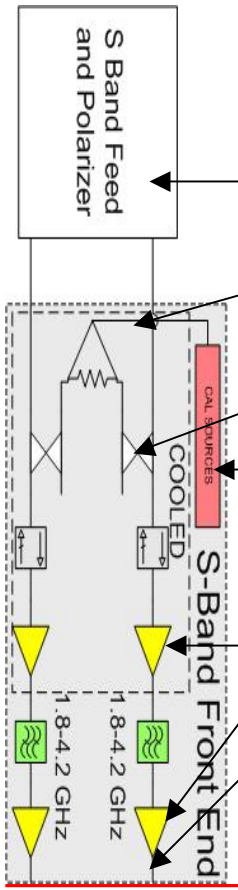
Custom feedhorn, NRAO design—At 290 K

Custom quadridge OMT, NRAO electroformed design—At 15 K
+ Commercial wide-band hybrid, quadrature phase shifter—At 15 K.
Cal coupler—At 15 K
Cal source, NoiseCom– At 290 K. +
S-Cal source, NoiseCom– At 290 K.

LNA, NRAO current design—At 15 K, Te=8 K, G=40 dB
RF post-amp, various OEMs—At 290 K, NF<3 dB, G>20 dB
2 outputs at 4–8 GHz, -43 dBm
Cryogenics: CTI-350 refrigerator.
Receiver FE NF est=24 K

S-band

2 – 4 GHz, 2 x 2 GHz channel EVLA S-band Receiver Development

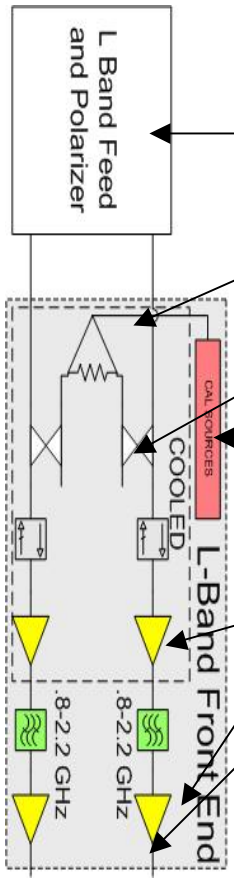


Custom feedhorn, NRAO design—At 290 K

Custom quadridge OMT, NRAO electroformed design—At 15 K
+ Commercial wide-band hybrid, quadrature phase shifter—At 15 K.
Cal coupler—At 15 K
Cal source, NoiseCom– At 290 K. +
S-Cal source, NoiseCom– At 290 K.

LNA, NRAO planned design—At 15 K, Te=4 K, G=40 dB
RF post-amp, various OEMs—At 290 K, NF<3 dB, G>20 dB
2 outputs at 2–4 GHz, -46 dBm
Cryogenics: CTI-350 refrigerator.
Receiver FE NF est=15 K

L-band



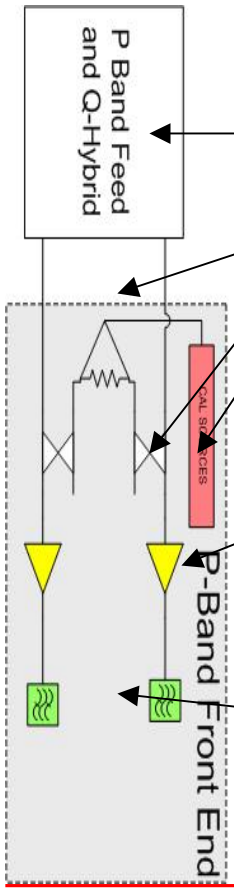
1 – 2 GHz, 2 x 1 GHz channel EVLA L-band Receiver Development

Custom feedhorn, NRAO design—At 290 K. TBD length

Custom quadridge OMT, NRAO e-formed design—At 15 K, TBD length
+ Commercial wide-band hybrid, quadrature phase shifter—At 15 K.
Cal coupler—At 15 K
Cal source, NoiseCom– At 290 K. +
S-Cal source, NoiseCom– At 290 K.

LNA, NRAO planned design—At 15 K, Te=2 K, G=40 dB
RF post-amp, various OEMs—At 290 K, NF<3 dB, G>20 dB
2 outputs at 2–4 GHz, -44 dBm
Cryogenics: CTI-350 refrigerator.
Receiver FE NF est=11 K

P-band



308-248 MHz, 2 channel VLA P-band Receiver (existing)

Custom cross-dipole, NRAO design, near prime focus—At 290 K.

Commercial wide-band hybrid, quadrature phase shifter—At 290 K.

Cal coupler—At 290 K

Cal source, NoiseCom/MC63147– At 290 K.

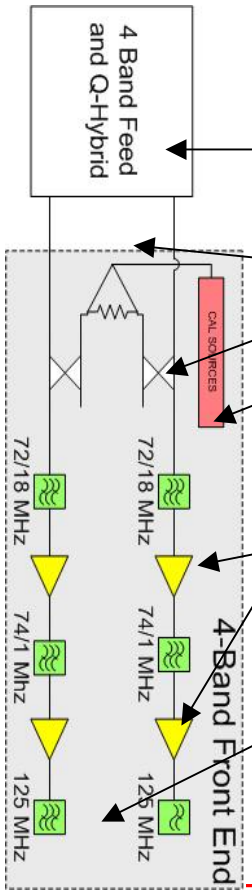
LNA, NRAO design—At 290 K, Te=28 K, G=33 dB

2 outputs at 308 - 348 MHz, -35 dBm

Cryogenics: None.

Receiver FE NF est=55 K

4-band



73-75 MHz, 2 channel VLA 4-band Receiver (existing)

Custom cross-dipole, NRL design, near prime focus—At 290 K.

Commercial wide-band hybrid, quadrature phase shifter—At 290 K.

Cal coupler—At 290 K

Cal source, NoiseCom/MC63147– At 290 K.

LNA, NRL design—At 290 K, Te=TBD K, G=TBD dB

2 outputs at 73-75 MHz, -TBD dBm

Cryogenics: None.

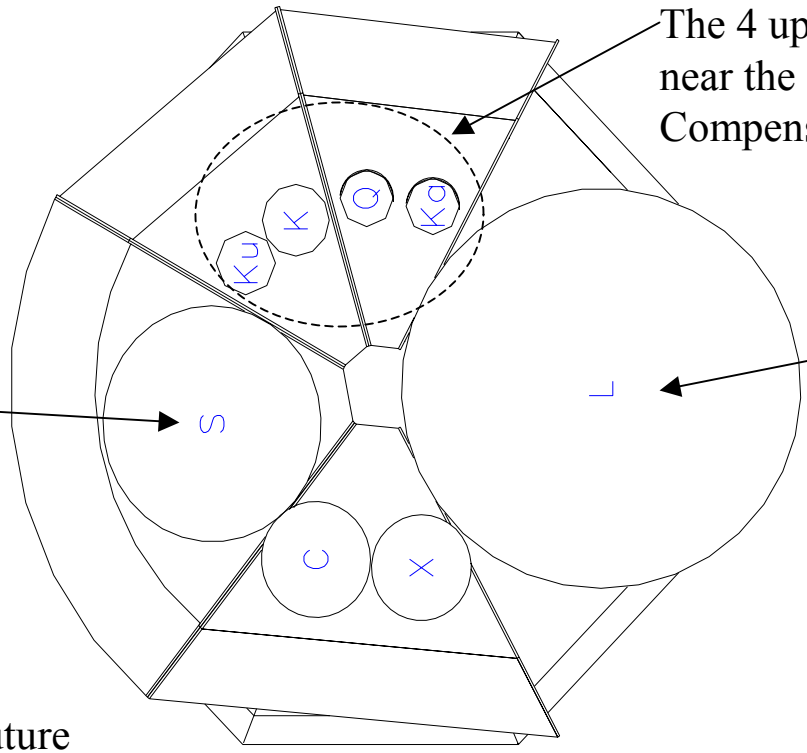
Receiver FE NF est=TBD K

Trx Projections

EVLA RX FREQ RANGES AND OP TEMPS: REQUIRED vs. PROJECTED

BAND	FRQ RANGE (GHz)	REQ Tsys[2] (K)	CURNT Tsys[3] (K)	CURNT Trx[4] (K)	REQ Trx[5] (K)	PROJECTED Trx[6]
L	1 – 2[1]	26	35	14.7	10.9	8.8
S	2 – 4	29	31	10.9	10.2	13.8
C	4 – 8	31	40	15.5	12.0	18.9
X	8 – 12	34	35	24.5	23.8	20.7
Ku	12 – 18	39	59	28.2	18.6	21.4
K	18 – 26	54	65	27.0	22.4	28.0
Ka	26 – 40	45	NA	NA	NA	37.7
Q	40 – 50	66	80	67.8	55.9	44.1

Feedhorn Layout



The 4 upper bands concentrated near the elevation axis to permit Compensation of quadripod sag.

New for EVLA

o Feed ring layout driver due to physical size.
o Attempted to avoid major structural mods to antenna.
o Positioned for "look-up" at low el angles to reduce ground & RFI pick-up.

Spacing and position constraints include future dichroics, WVR, and rack layout beneath.

Feedhorn Overview

Band Designation	Frequency (GHz)	Bandwidth Ratio	Feed Type	Feed Size (L x Dia.) (in.)
L	1.0-2.0 (1)	2.0:1	Profiled, Corrugated Conical	162.0 x 62.5
S	2.0-4.0	2.0:1	Profiled, Corrugated Conical	132.9 x 47.3
C	4.0-8.0	2.0:1	Profiled, Corrugated Conical	66.5 x 24.2
X	8.0-12.0	1.5:1	Linear Taper, Corrugated Conical	47.3 x 19.2
Ku	12.0-18.0	1.5:1	Linear Taper, Corrugated Conical	32.0 x 13.0
K (2)	18.0-26.5	1.5:1	Linear Taper, Corrugated Conical	20.7 x 8.8
Ka	26.5-40.0	1.5:1	Linear Taper, Corrugated Conical	14.3 x 5.8
Q (2)	40.0-50.0	1.25:1	Linear Taper, Corrugated Conical	8.23 x 3.724

Notes:
(1) Optimized over 1.2 - 2.0 GHz
(2) Designed and used in current VLA configuration

Polarizer Overview

Band Designation	Frequency (GHz)	Bandwidth Ratio	Polarizer Type	Polarizer Length (in.)
L	1.0-2.0 (1)	2.0:1	Quad-ridge OMT w/ 90 deg Hybrid	19.8
S	2.0-4.0	2.0:1	Quad-ridge OMT w/ 90 deg Hybrid	9.9
C	4.0-8.0	2.0:1	Quad-ridge OMT w/ 90 deg Hybrid	5.0
X	8.0-12.0	1.5:1	Phase Shifter w/ Turnstile Junction OMT (3)	24.1 (4)
Ku	12.0-18.0	1.5:1	Phase Shifter w/ Turnstile Junction OMT (3)	16.0 (4)
K (2)	18.0-26.5	1.5:1	Phase Shifter w/ Turnstile Junction OMT (3)	10.7 (4)
Ka	26.5-40.0	1.5:1	Phase Shifter w/ Turnstile Junction OMT (3)	7.3 (4)
Q (2)	40.0-50.0	1.25:1	Stepped Septum	1.5

Notes:

(1) Optimized over 1.2 - 2.0 GHz

(2) Designed and used in current VLA configuration

(3) Turnstile Junction OMT (Boifot, Wallack)

(4) Four Component Combination (Circ to Sq. Transition, 90 deg Phase Shifter, 45 Twist, OMT)