



Similar 20m antenna (image credit: CPI)

LEGS GOCO Locations

LEGS #1 White Sands, USA

LEGS #2 Matjiesfontein, South Africa

LEGS #3 Geraldton (TBC), Australia

GOCO LEGS Antenna Information

FUNCTION	PERFORMANCE
Antenna Diameter	20-meter
Polarizations	Tx: RHC or LHC Rx: RHC & LHC
Antenna Travel Range ³	±300° Azimuth 0 to 90° Elevation
Tracking Rate ³	At least 1°/s
Autotrack Accuracy (all bands) ^{3,9}	≤ 0.01 deg Beam Radial Error (BRE)

Services Information

FUNCTION	PERFORMANCE
Services	TT&C, CCSDS Forward and Return data, Tracking (Radiometric and antenna auto-track angles)
Radiometric Tracking	Pseudo-Noise (PN) Ranging (CCSDS 414.1-B-2), 1-Way and 2-Way Doppler
Timing Reference ³	< 1.0 x 10 ⁻¹² short term stability Within ±5.0 x 10 ⁻¹³ freq. accuracy

Lunar Exploration Ground Sites (LEGS) GOCO

The LEGS mission is to provide direct-to earth communication and navigation services for missions operating from 36,000 kilometers (km) in the GEO to cis Lunar and beyond out to 2 Million km. To fully support distant orbits there will be three LEGS Government Owned Contactor Operated (GOCO) sites which will be equally spaced around the Earth. The sites utilize data rates, modulation, and coding schemes for forward and return data as listed in the International Communication System Interoperability Standard (ICSIS) maintained by Human Exploration and Operations Mission Directorate. Specialized/unique Mod-Cods are optional. User Local Equipment on site is optional. LEGS facilities are built and operated to protect data up to HIGH security categorization with High Value Asset (HVA) overlays.

LEGS GOCO Ground system performance characteristics are provided in the below tables:

Radio Frequency (RF) Band	Forward	Return
	Freq Range	Freq Range
X-Band	7145 - 7235 MHz	8400 - 8500 MHz
Ka-Band	22.55 - 23.15 GHz	25.50 - 27.0 GHz

RF Performance Criterion	Radio Frequency Performance (Forward)	
	X-Band	Ka-Band
EIRP (minimum) ³	86 dBW	89 dBW
Forward Distortions ²	1 dB max	1 dB max
Carrier Modulation ¹	Direct PCM/PM, PCM/PM/PSK OQPSK, BPSK, Filtered OQPSK, Filtered BPSK, GMSK	Filtered OQPSK, Filtered BPSK, OQPSK, BPSK, QPSK, GMSK
FEC ^{1,6}	LDPC (½, ⅔, ⅘, ⅞), uncoded	
Max Data Rate ^{1,4}	10 Msps	50 Msps

RF Performance Criterion	Radio Frequency Performance (Return)	
	X-Band	Ka-Band
G/T (minimum) ³	39 dB/°K	47.5 dB/°K
Implementation loss ²	2 dB max	2 dB max
Demodulation ¹	Direct PCM/PM, PCM/PM/PSK, BPSK, QPSK, OQPSK, Filtered BPSK, Filtered OQPSK, GMSK	BPSK, QPSK, OQPSK, Filtered BPSK, Filtered OQPSK, GMSK, 8PSK
FEC ^{1,6}	LDPC (½, ⅔, ⅘, ⅞), Convo (½), RS + Convo(½, ⅝) ⁷ , Turbo Code (⅓, ¼, ½, ⅞) ⁸ , uncoded	
Max Symbol Rate ^{1,4}	20 Msps	200 Msps

Notes:

¹ Additional modulations, coding schemes, and data rates may be defined. Availability of data rates is dependent upon required spectrum authorization.

² GSFC CLASS link calculations use a 3dB implementation loss of which, the receive system is allocated 2dB and the transmit system distortions are allocated 1dB

³ Performance data is preliminary pending finalization of system requirements, and may vary across facilities and apertures

⁴ Max Symbol Rates provided are based on uncoded OQPSK and includes encapsulation protocol overhead. For the uncoded case, this is equivalent to Rcs of CCSDS 401x0B31

⁵ BiPhase available with Direct PCM/PM and PCM/PM/PSK

⁶ NRZ-L Symbol formatting required with LDPC codes

⁷ CCSDS and NASA variants of concatenated codes are supported.

⁸ Turbo codes limited to X-band

⁹ Autotrack Accuracy specified is when winds are less than or equal to 45 mph at the antenna. Accuracy is ≤ 0.02 BRE for winds between 45 up to 65 mph