

Specifications for 11m Ku-Band Full Motion Antenna Systems

S/N	Item description	Specification
Electrical and RF Specification		
1	Operating Frequency Receive Tracking Transmit Ku Band	10.70 to 12.25 GHz 10.70 to 12.25 GHz 12.75 GHz to 13.75 GHz
2	Antenna gain Receive at LNA input Transmit Ku band at FEED input	60.0 dBi +20 log (f/10.70 GHz) 61.7 dBi +20 log (f/13.00GHz)
3	Feed Type	Multimode, Mono-pulse Tracking Feed having 4-port (2-Tx and 2-Rx ports orthogonal to each other)
4	Feed Insertion Loss	To be provided by the supplier
5	G/T at 5 deg. Elevation	37.5 dB/K + 20 log (f/10.70GHz) (Break up analysis details of G/T shall be provided)
6	Antenna Side lobes	Better than the ITUR 580-6,First side lobe level better than 14 dB below main beam peak
7	Cross Polarization Isolation (Within 1 dB Beam width) Linear	≥ 33 dB
8	Axial ratio Circular	1.06 (0.51 dB)
9	Port to Port Isolation Transmit to Receive Transmit to Tracking Receive to Receive Transmit to Transmit Receive to Receive Transmit to Transmit	100dB 100 dB 17 dB 17 dB 30 dB 30 dB
10	Transmit Port Power rating	5 KW CW per Port
11	VSWR (Both transmit and receive ports)	1.5:1 Typical
12	Wave guide Interface Tx. Ports Rx Ports	WR 75 WR 75
13	Pressurization	Pressurized with dry air with in a range of 0.5 to 0.15 PSI. Duration over which pressure decreases from 0.5 to 0.15 PSI owing to leakage shall exceed 15 minutes.
Servo Specifications		
14	Az / El Drive configuration Az El	Zero Backlash Motor Drives
15	Az / El Drive speeds	Max: ≥ 1 deg/sec, Min: 0.001 deg/sec
16	Azimuth and El acceleration	1 ⁰ /sec ² min
17	Antenna control unit (ACU) Modes of operations	Standby, Rate mode, Memory Track, Autotrack (monopulse), Auto Phase, manual phase, Program Track, Step track, Built-in-Search, Preset Position, Star Track, Ephemeris Drive, Slew, Stow Lock, Single motor selection, Remote Computer Control, TLE Track, Autotrack over program drive ,option to feed offset angle to program drive mode
18	Primary Power supplies	230 V ± 5% single phase, 400V ± 5% three phase, 50 Hz ± 2 Hz

Monopulse Tracking Specifications		
19	Tracking	In LP and CP
20	Phasing	Manual and Auto phasing
	Angular resolution – Az. & El.	0.001 ⁰
21	Polarization angular resolution	0.1 ⁰
22	Az. / El Tracking speed (deg/sec)	Max: ≥ 1 deg/sec, Min: 0.001 deg/sec
23	Tracking Accuracy	Better than 1/10th of 3 dB Beam width (Break up analysis details shall be provided)
24	Pointing accuracy	Better than 1/5th of 3 dB Beam width (Break up analysis details shall be provided)
25	Beacon Tracking Dynamic range	> 65 dB
26	Acquisition range	± 150 KHz with anti side band rejection facility
27	Beacon carrier tracking threshold	Minimum C/KT of 45dBHz @ 1 kHz LBW
28	Tracking Beacon settability	1 KHz step size
29	Frequency stability	2 x 10 ⁻⁶ over 0 to 50 ⁰ C with internal reference
30	Receiver PLL bandwidth	100 Hz, 300 Hz, 1 KHz, 3 KHz (Typical)
31	Auto loop response for 3 dB error	Az: 0.6 sec rise time typical El: 0.6 sec rise time typical
32	Bore sight tracking null depth	25 dB typical
33	System shall support single motor operation also in case of one motor failure.	
	Antenna Mechanical characteristics	
34	Antenna size	About 11m diameter or more
	Mount	Elevation over Azimuth
	Optics	Shall be suggested by the supplier
35	panel surface accuracy Main Reflector Sub reflector	< 0.5 mm (RMS). < 0.3 mm (RMS).
36	Azimuth Travel	± 270 ⁰
37	Elevation Travel	-1 to 91 ⁰
38	Polarization Travel in linear	± 100 deg
39	Environmental	
40	Wind Speeds	80 KMPH Operational, 100 KMPH Gusting, 150 KMPH Survival (zenith)
41	Operational temperature	0 ⁰ to + 50 ⁰ C
42	Relative humidity	0 to 100% with condensation
43	Corrosion	Anti-corrosive, protective coating to all parts exposed to environment.
44	The tracking plate, tracking LNA, Tracking down-converter, Tracking Receiver, ACU, 1:2 LNA system (Ku-Band), Inject Couplers, etc., shall be the responsibility of the supplier	

Antenna and Feed System Safety

Sl.No	Item description	Specification
1	Limits and Display	Stow, Up pre-limit, Up final limit, Down Pre-limit, Down final limit, CW pre-limit, CW final limit, CCW Pre-limit, CCW Final limit, CW/CCW Zone change over, Low Elevation alarm switch.
2	End Stoppers	Mechanical stoppers at the final limit position for each axis of antenna rotation to withstand slew speed of antenna motion.
3	Hand held Portable Maintenance Unit	To be provided for manual movement during maintenance. One is required at ACU drive unit and one at antenna elevation platform.
4	Stow Lock Device	Stow lock devices in Az and El axis to mechanically arrest the antenna during hostile environmental conditions.
5	Auxiliary drive	Hand cranking facility for both the Az and El axis.

6	Emergency Stop Switches & Indication	Shall be deployed at all the critical antenna locations to inhibit the drive in the event of emergency. Viz., at Az Cone, at El platform, at ACU & in elevation hub.
7	Lightning Arrester	Lightning arrester assembly conforming to the latest safety standards to be provided for Antenna quadrapod and backup structure area. Earthing pits to be provided – 2Nos.
8	Cable wrap	Suitable arrangement to be provided for overcoming cable wraps.
9	Operator safety	Approach ladder with built-in safety measures to provide access to the El. Platform & Reflector surface. Safety railings around the azimuth cone and elevation platform.
10	Equipment lifting	Proper facility like motorized chain pulley or rope for lifting heavy equipment to the elevation platform to be provided.
11	Aviation lamp	Should be provided at appropriate locations with good visibility.
12	Seismic protection	Design should take care of seismic condition of site.

The general requirements

1. 1:2 LNA Ku-band Complex with remote controller for Ku-band frequencies (10.70 – 12.25 GHz) to be supplied. The output interface of both the bands and the carrier inject ports shall be N-type (female). 30 dB couplers to be incorporated before the LNA for carrier inject facility in all the feed ports. The minimum gain of the LNAs shall be 60 dB.
2. The Gain and G/T analysis breakup, Pointing and tracking accuracy analysis breakup to be provided along with the quote.
3. All sub-systems shall have serial or TCP/IP interface for remote monitor and control purposes.
4. All sub-systems shall have full-fledged Remote / Local control provision.
5. ACU shall have at least 02 Nos of serial or TCP/IP interface for MCS.
6. Remote shall mean control via MCS (Server & Client) and local shall mean control via the respective equipment front panel. However Feed switches control unit shall have local and remote units in addition to M & C port for computer interface.
7. Local / Remote selection shall be at the front panel of the respective local equipment.
8. Suitable racks to be supplied by the supplier to place supplier supplied equipments.
9. Supplier shall provide communication protocol for all the equipment for remote control through MCS.
10. MCS (software & hardware) will be the responsibility of MCF.
11. 2 Sets of operational and service manuals with maintenance (preventive and corrective) procedures and schedules to be provided for the supplied equipments.
12. The supplier shall organize the following major reviews during the project, to achieve better interaction and understanding with participation of MCF.

- a. **Preliminary Design Review (PDR):** To review the soundness of the design specifications and to define the QA procedures, work plan and schedules.
 - b. **Critical Design Review (CDR):** To critically review, evaluate and finalize design aspects, firm up the details of equipment to be supplied and agree upon the subsequent test and evaluation procedures.
 - c. **Operational Readiness Review (ORR):** To review and evaluate the results of all tests on the systems vis a vis the specifications.
13. Supplier shall propose standard inspection practices and procedures, starting from raw materials to finished products. Joint inspection with MCF involvement, wherever necessary, shall be clearly specified.
14. As part of the “Factory Acceptance Tests” and “Site Acceptance Tests”, Supplier shall propose adequate tests and test-procedures which are acceptable to the ISRO in order to confirm the compliance to the specifications.
15. Supplier shall propose one set of critical spares required for 24X7 support with separate pricing.
16. Supplier shall involve MCF personnel during the installation, interfacing and testing of the systems.
17. Installation, Testing, commissioning and operational training to MCF personnel shall be the responsibility of the supplier.
18. The “factory acceptance testing” and the “site acceptance testing “ of the Feed, Antenna mechanical structure, ACU, antenna, Tracking receiver and the feed switching unit etc are to be conducted and will be witnessed by MCF Engineers.
19. Provision to be made for routing additional RF, control & power cables through the cable wrap at site during installation.

Support system

The following needs to be provided by the supplier.

Civil

- A finished built-up area of 25 Sq Mtrs with a height of 4 mtrs is to be provided for housing the HPAs, RF equipment, Antenna drive unit, ACU, Tracking Receiver, Electrical Distribution, etc.
- The antenna is to be mounted on top of the above mentioned equipment building / pedestal.
The Elevation axis shall have a clearance of about 13 mtrs from the ground level.
- The equipment building / pedestal shall have a 2 mtr wide door to facilitate movement of equipment.

- Required cut-outs to be provided in the equipment building / pedestal for Air-conditioning facilities.
- The antenna foundation and load analysis breakup to be provided along with the quote
- Required cut-outs to be provided in the equipment building / pedestal for HPA Exhaust.
- The equipment building / pedestal shall have cable trenches / trays for routing RF, control and Power cables.
- Provision to be made for routing the HPA output waveguide from the equipment building / pedestal to antenna hub.

Electrical

- The equipment building / pedestal shall have required energy efficient electrical fittings for lighting, wall sockets for utility, electrical DB's for UPS and utility separately, etc.
- Customer responsibility is to provide one feeder point for short break (Utility Power) and one feeder point for Uninterruptible Power Supply (Technical Power).
- Internal Distribution for the supplied equipment including Distribution Panels and Power Cables shall be the scope of the Supplier.
- The equipment Building /Pedestal shall have the Lighting circuits with 30% from the Technical Power and remaining from the Utility Power.
- The Lighting shall be designed such that the illumination levels in the area shall be suitable for Operation and Maintenance of the Equipments & as per relevant Indian and international Standards. The Design shall take care of light output at the end of life.
- All switchgears shall be of Industrial standard only.
- All the Cables & Wires should be ISI mark or International Standards. The insulation of Cables shall be FRLS OR HFFR type.
- Additional points to be made available in the technical & utility power Distribution Panels for powering customer supplied equipments like Racks, HPAs, future augmentation, etc.

Safety

- Required Grounding System for Antenna, Electrical DBs and RF Systems is to be designed and installed near the Building. The Supplier shall consider installing suitable connection points for antenna, RF and related equipments.
- Lightning Protection System for Building as well as Antenna to be designed and installed by the supplier.

- State of the art Analog Addressable Smoke / fire detection and alarm initiation system with Fire Alarm Control Panel to be installed.
- First aid & fire fighting equipment to be deployed in and around the facility in sufficient number.
- The building design shall take care of all safety aspects including human safety in the event of fire hazard or any calamity of similar nature.
- The entry and exit to and from the station is to be regulated through an electronic access control system (supplied by customer); the door should be compatible for the above mentioned system.

Delivery Schedule

The entire work involving Supply, Installation, Testing and Commissioning of the proposed antenna with civil structure is envisaged to be completed on TURN KEY basis, in about 24 months from the Effective Date of Contract (EDC).

The supplier shall project best possible schedules with respect to fabrication, inspection, dispatch, installation, testing, commissioning, training and any other relevant matter related to the system, keeping in view the overall schedule indicated above.

**Government of India
Department of Space
Indian Space Research Organization**

**REQUEST FOR QUOTATION
OF
11m FMA TTC&R ANTENNA SERVO
& MONOPULSE TRACKING SYSTEM**

(GSAT 7A Project)

April 2016

**Master Control Facility
Hassan - 573 201**

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1.0 Scope

Master Control Facility (MCF) Hassan is the prime facility to control the geo stationary & navigation satellites of ISRO, Department of Space under Government of India. This proposal is for establishing a Ku band TT&C Terminal at MCF Hassan to operate GSAT 7A satellite which will have TTC in both C-band and Ku band frequencies. The proposed facility consists of 11m FMA in Ku band at Master control facility, Hassan. GSAT-7A is configured such that C-band TTC will be used during LEOP and Ku-band TTC will be used during on-orbit mode. Therefore, existing facility in C- Band will be used for Telemetry, Tracking, Command and ranging operation (TTC&R) during Launch early orbit Phase (LEOP). The detailed description and specifications for the proposed system are given in the following sections.

2.0 Site Location

The location of TTC earth station site will be at Master Control Facility Hassan. At present many TTC & IOT terminals are operational in S, C, Ext-C, Ku & Ka band frequencies at MCF & now this terminal is also proposed to be operational at MCF.

Details of Site Location:

Location	Hassan, Karnataka, India.
Nearest Highway	NH-75, 10 Km
Nearest Railway Station	Hassan, 12 Km
Nearest Airport	Bangalore, 200 Km
Latitude	13.07° North
Longitude	76.098° East
Altitude	980 Meters MSL
Soil	Gravelly
Load Bearing Capacity	18 T per sq. m
Rainfall	Annual 2809 mm, maximum rainfall in a day 163 mm
Temperature (in °C)	Max 37.0°C
	Min 10.0°C
Relative Humidity	31 – 81 %
Wind	Mean monthly speed 80 KMPH Max speed 100 KMPH
GEO arc visibility	1° E to 148° E @ 5° EL angle

Table-1

3.0 Introduction:

GSAT 7A space craft will have TTC functions in C Band and Ku Band frequencies. GSAT 7A spacecraft is planned to be positioned at 63°E orbital slot. Due to frequency coordination regulatory constraints it is not possible to perform TT&C functions in C-band in on orbit. Similarly due to available space and lift off mass constraints it is not possible to have Ku-band TT&C during LEOP. Hence GSAT-7A spacecraft is configured with TT&C functions in both C and Ku Band frequencies.

4.0 Customer Furnished Items (MCF Support)

The following facilities and support shall be provided by MCF, Hassan at the installation site.

1. Single point 3 phase, four Wire (3P+N) AC power supply for one 11m full motion antenna and its associated equipments. AC power includes both Technical Power (Un-Interruptible Power Supply) 230V±3% single phase, 400V±3% three phase, 4 Wire, 50Hz±4%, and Utility Power supply 230V±5% single phase, 400V±5% three phase, 4 Wire, 50Hz±4%.
2. Access roads and parking areas.
3. Onsite communication (phone and fax) for installation, test and co-ordination.
4. Cable trench connectivity from the existing facility will be provided.
5. MCS (software & hardware) will be the responsibility of MCF.
6. Air conditioning of the antenna pedestal/equipment room.

5.0 System Requirements

5.1 Proposed Ku -band 11m Full Motion Antenna Configuration

The proposed Ku band TTC&R Earth Station full motion antenna shall have the following subsystems and features. The major specifications are given under the heading “major specifications”. The proposed antenna shall have about 11m diameter full motion antenna with zero backlash drive system for azimuth and elevation axes. The feed system comprises of 4 port i.e. 2 orthogonal Transmit ports in Ku band (12.75-13.75 GHz) and 2 orthogonal receive ports in Ku band (10.70-12.25 GHz). All the ports shall have the capability to have rotatable linear polarization and switchable Circular polarization (RHCP and LHCP). The tracking electronics, antenna drives and control system shall meet high pointing and tracking accuracies.

5.2 Antenna Hub

The Hub shall have enough space to accommodate 1:2 Ku band LNA's, Tracking LNA, tracking Down converter, and TLT with other components such as Directional coupler, Wave guide switches, Co-axial switches, Feed switching unit, power sensor , dummy load, etc.

5.3 Reflector and back up structure

The reflector, sub reflector and the backup structure shall withstand the rough weather and a range of environmental condition. The reflector shall be coated with high conductive paint for minimum thermal effect.

The high efficiency shaped reflector provides superior gain and side lobe performance with good surface accuracy for both reflector and sub reflector at Ku band.

5.4 4-port feed

The feed shall operate from 10.70 to 12.25 GHz in receive and tracking band with dual port (CP/LP polarization selectable). The transmit port Tx-1 and Tx-2 are orthogonally polarized in both CP/LP and operate in Ku band 12.75 – 13.75 GHz frequency. Feed shall be rotatable in LP mode.

The feed feature includes:

- High efficiency wide band corrugated horn radiator with high return loss and high cross polarization performance.
- Two Ku-band transmit ports, and two Ku-Band receive ports with selectable circular or linear polarization networks for all the four ports.
- TE21 tracking mode coupler provides mono pulse auto tracking capabilities across the 10.70 - 12.25 GHz receive band with optimum tracking slope.
- The feed shall have minimum losses to achieve better EIRP and G/T.
- The feed shall have required polarization changeover and rotation mechanism to operate in circular and linear polarization.
- Rx chains shall have high performance low noise amplifier assembly (1:2 configuration) and tracking LNA with trans reject filter to optimize the Transmit –Receive isolation for normal operation
- The Transmit and receive port shall have directional couplers along with switches to integrate the customer furnished TLTs and power meter. The couplers shall have high directivity and around 30 dB coupling factor in receive and around 50 dB coupling factor in transmit band with N-F connector at coupling port. Please refer to Fig-1 (Station block diagram). The couplers and switches shall be configured as per Fig-1.

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- Supplier shall provide feed switching unit in local & remote configuration to control waveguide switches for CP/LP polarization switching & port selection and co-axial switches for configuring TLT's, power meter & downlink inject signal to required path. Local unit is for controlling the switches from RF room and remote shall mean control from M&C System through RS 232/422/LAN connectivity.

5.5 Rain Blower

A rain blower assembly shall be provided and shall become operational only during rain.

5.6 Pressurization

A positive pressure of less than 0.5 psig shall be provided using dehydrator to prevent moisture from entering the wave-guide lines. A pressure relief valve with a 1- psig nominal cracking pressure is to be provided on the feed to prevent over-pressurization and to protect the feed window.

5.7 Wave Guide plumb lines and rotary joint

The customer furnished high power amplifier of 2.4 KW rating in Ku-Band amplifiers shall be installed at antenna pedestal/RF equipment room. These amplifiers need to be interfaced with the feed using low loss waveguides. LNA complex output is also required to bring to pedestal/RF equipment room. There should be provision to inject RF signal to LNA complex from the pedestal/RF equipment room. Accordingly, the required wave-guide plumb lines along with the Azimuth and Elevation rotary joint shall be laid up to the pedestal/RF equipment room.

The elevation hub, antenna cone, cable tray shall be designed/provided by the supplier such that wave-guide, coaxial cables, power cables, servo control cables routing and various equipments location will have better flexibility for easy maintenance.

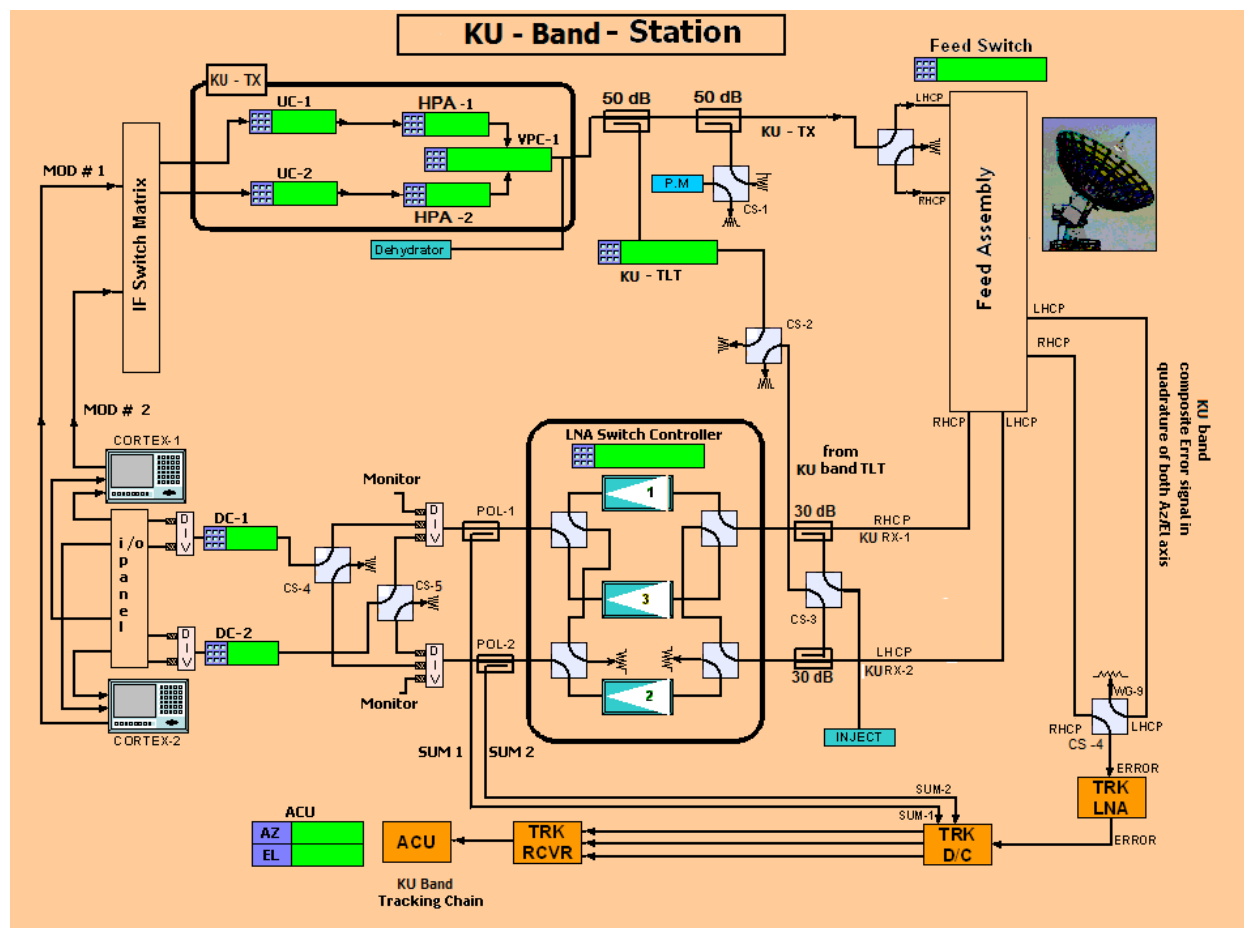
5.8 Antenna Servo and Tracking system

The servo system consists of the zero backlash drive systems in both azimuth and elevation axes when antenna is in any active mode of operation. The minimum slew speed of the servo system shall be 0.001 deg /s in both the axes and its maximum speed shall be greater than or equal to 1 deg/sec in both the axes.

The tracking down converter operating in Ku band shall translate and amplify the sum and error signals appropriately coupled from the LNA complex and tracking LNA. The 70 MHz IF signal from the tracking down converter is fed to the Tracking receiver. The error voltages from the tracking

receiver are supplied to the Antenna Control Unit (ACU) to drive the antenna system to the target (satellite). Also, the AGC voltage of ± 10 V dc must be provided for rain attenuation compensation and test purposes. Servo system shall have manual and Auto phasing feature.

The Servo sub-system shall display the angle with a resolution of 0.001 deg. The antenna control unit shall have all the operational features such as Manual, slew drive, Auto track, Auto Phase, Step track, Star track, Memory track, Programmed drive and TLE mode of operation. Time tag data of AZ, El axes position, error, beacon signal strength status shall be provided. The polarization drive shall be a part of the ACU or the independent one for selecting and rotating the feed polarizer system. All the subsystem shall have appropriate interface i.e. RS232/422/LAN, Input, output and monitoring ports for interface and integration so that all the units can be controlled and monitored from equipment room and also through M&C.



(Fig-1)- Block diagram of 4 ports 11-m Ku-Band FMA Station
(Proper rotary joints may be planned by the supplier).

6.0 Detailed Technical Specifications:

6.1 Major Technical Specifications:

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 - c. **Operational Readiness Review (ORR):** To review and evaluate the results of all tests on the systems vis a vis the specifications.
 13. Supplier shall propose standard inspection practices and procedures, starting from raw materials to finished products. Joint inspection with MCF involvement, wherever necessary, shall be clearly specified.
 14. As part of the “Factory Acceptance Tests” and “Site Acceptance Tests”, Supplier shall propose adequate tests and test-procedures which are acceptable to the ISRO in order to confirm the compliance to the specifications.
 15. Supplier shall propose one set of critical spares required for 24X7 support with separate pricing.
 16. Supplier shall involve MCF personnel during the installation, interfacing and testing of the systems.
 17. Installation, Testing, commissioning and operational training to MCF personnel shall be the responsibility of the supplier.
 18. The “factory acceptance testing” and the “site acceptance testing “ of the Feed, Antenna mechanical structure, ACU, antenna, Tracking receiver and the feed switching unit etc are to be conducted and will be witnessed by MCF Engineers.

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19. Provision to be made for routing additional RF, control & power cables through the cable wrap at site during installation.

7.0 Support system

The following needs to be provided by the supplier.

7.1 Civil

- A finished built-up area of 25 Sq Mtrs with a height of 4 mtrs is to be provided for housing the HPAs, RF equipment, Antenna drive unit, ACU, Tracking Receiver, Electrical Distribution, etc.
- The antenna is to be mounted on top of the above mentioned equipment building / pedestal.
The Elevation axis shall have a clearance of about 13 mtrs from the ground level.
- The equipment building / pedestal shall have a 2 mtr wide door to facilitate movement of equipment.
- Required cut-outs to be provided in the equipment building / pedestal for Air-conditioning facilities.
- The antenna foundation and load analysis breakup to be provided along with the quote
- Required cut-outs to be provided in the equipment building / pedestal for HPA Exhaust.
- The equipment building / pedestal shall have cable trenches / trays for routing RF, control and Power cables.
- Provision to be made for routing the HPA output waveguide from the equipment building / pedestal to antenna hub.

7.2 Electrical

- The equipment building / pedestal shall have required energy efficient electrical fittings for lighting, wall sockets for utility, electrical DB's for UPS and utility separately, etc.
- Customer responsibility is to provide one feeder point for short break (Utility Power) and one feeder point for Uninterruptible Power Supply (Technical Power).
- Internal Distribution for the supplied equipment including Distribution Panels and Power Cables shall be the scope of the Supplier.
- The equipment Building /Pedestal shall have the Lighting circuits with 30% from the Technical Power and remaining from the Utility Power.

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- The Lighting shall be designed such that the illumination levels in the area shall be suitable for Operation and Maintenance of the Equipments & as per relevant Indian and international Standards. The Design shall take care of light output at the end of life.
 - All switchgears shall be of Industrial standard only.
 - All the Cables & Wires should be ISI mark or International Standards. The insulation of Cables shall be FRLS OR HFFR type.
 - Additional points to be made available in the technical & utility power Distribution Panels for powering customer supplied equipments like Racks, HPAs, future augmentation, etc.

7.3 Safety

- Required Grounding System for Antenna, Electrical DBs and RF Systems is to be designed and installed near the Building. The Supplier shall consider installing suitable connection points for antenna, RF and related equipments.
- Lightning Protection System for Building as well as Antenna to be designed and installed by the supplier.
- State of the art Analog Addressable Smoke / fire detection and alarm initiation system with Fire Alarm Control Panel to be installed.
- First aid & fire fighting equipment to be deployed in and around the facility in sufficient number.
- The building design shall take care of all safety aspects including human safety in the event of fire hazard or any calamity of similar nature.
- The entry and exit to and from the station is to be regulated through an electronic access control system (supplied by customer); the door should be compatible for the above mentioned system.

8.0 Delivery Schedule

The entire work involving Supply, Installation, Testing and Commissioning of the proposed antenna with civil structure is envisaged to be completed on TURN KEY basis, in about 24 months from the Effective Date of Contract (EDC).

The supplier shall project best possible schedules with respect to fabrication, inspection, dispatch, installation, testing, commissioning, training and any other relevant matter related to the system, keeping in view the overall schedule indicated above.

Specifications for 11m Ku-Band Full Motion Antenna Systems

S/N	Item description	Specification	Compliance (Yes/No)	Offered Specifications
Electrical and RF Specification				
1	Operating Frequency Receive Tracking Transmit Ku Band	10.70 to 12.25 GHz 10.70 to 12.25 GHz 12.75 GHz to 13.75 GHz		
2	Antenna gain Receive at LNA input Transmit Ku band at FEED input	60.0 dBi +20 log (f/10.70 GHz) 61.7 dBi +20 log (f/13.00GHz)		
3	Feed Type	Multimode, Mono-pulse Tracking Feed having 4-port (2-Tx and 2-Rx ports orthogonal to each other)		
4	Feed Insertion Loss	To be provided by the supplier		
5	G/T at 5 deg. Elevation	37.5 dB/K + 20 log (f/10.70GHz) (Break up analysis details of G/T shall be provided)		
6	Antenna Side lobes	Better than the ITUR 580-6, First side lobe level better than 14 dB below main beam peak		
7	Cross Polarization Isolation (Within 1 dB Beam width) Linear	≥ 33 dB		
8	Axial ratio Circular	1.06 (0.51 dB)		
9	Port to Port Isolation Circular Linear	Transmit to Receive Transmit to Tracking Receive to Receive Transmit to Transmit Receive to Receive Transmit to Transmit	100dB 100 dB 17 dB 17 dB 30 dB 30 dB	
10	Transmit Port Power rating	5 KW CW per Port		
11	VSWR (Both transmit and receive ports)	1.5:1 Typical		
12	Wave guide Interface Tx. Ports Rx Ports	WR 75 WR 75		
13	Pressurization	Pressurized with dry air with in a range of 0.5 to 0.15 PSI. Duration over which pressure decreases from 0.5 to 0.15 PSI owing to leakage shall exceed 15 minutes.		
Servo Specifications				
14	Az / El Drive configuration Az El	Zero Backlash Motor Drives		
15	Az / El Drive speeds	Max: ≥ 1 deg/sec, Min: 0.001 deg/sec		
16	Azimuth and El acceleration	1 ⁰ /sec ² min		
17	Antenna control unit (ACU) Modes of operations	Standby, Rate mode, Memory Track, Autotrack (monopulse), Auto Phase,		

		manual phase, Program Track, Step track, Built-in-Search, Preset Position, Star Track, Ephemeris Drive, Slew, Stow Lock, Single motor selection, Remote Computer Control, TLE Track, Autotrack over program drive ,option to feed offset angle to program drive mode		
18	Primary Power supplies	230 V \pm 5% single phase, 400V \pm 5% three phase, 50 Hz \pm 2 Hz		
	Monopulse Tracking Specifications			
19	Tracking	In LP and CP		
20	Phasing	Manual and Auto phasing		
	Angular resolution – Az. & El.	0.001 ⁰		
21	Polarization angular resolution	0.1 ⁰		
22	Az. / El Tracking speed (deg/sec)	Max: \geq 1 deg/sec, Min: 0.001 deg/sec		
23	Tracking Accuracy	Better than 1/10th of 3 dB Beam width (Break up analysis details shall be provided)		
24	Pointing accuracy	Better than 1/5th of 3 dB Beam width (Break up analysis details shall be provided)		
25	Beacon Tracking Dynamic range	> 65 dB		
26	Acquisition range	\pm 150 KHz with anti-side band rejection facility		
27	Beacon carrier tracking threshold	Minimum C/KT of 45dBHz @ 1 kHz LBW		
28	Tracking Beacon settability	1 KHz step size		
29	Frequency stability	2 x 10 ⁻⁶ over 0 to 50 ⁰ C with internal reference		
30	Receiver PLL bandwidth	100 Hz, 300 Hz, 1 KHz, 3 KHz (Typical)		
31	Auto loop response for 3 dB error	Az: 0.6 sec rise time typical El: 0.6 sec rise time typical		
32	Bore sight tracking null depth	25 dB typical		
33	System shall support single motor operation also in case of one motor failure.			
	Antenna Mechanical characteristics			
34	Antenna size	About 11m diameter or more		
	Mount	Elevation over Azimuth		
	Optics	Shall be suggested by the supplier		
35	Panel surface accuracy Main Reflector Sub reflector	< 0.5 mm (RMS). < 0.3 mm (RMS).		
36	Azimuth Travel	\pm 270 ⁰		
37	Elevation Travel	-1 to 91 ⁰		
38	Polarization Travel in linear	\pm 100 deg		
39	Environmental			
40	Wind Speeds	80 KMPH Operational, 100 KMPH Gusting, 150 KMPH Survival (zenith)		
41	Operational temperature	0 ⁰ to + 50 ⁰ C		

42	Relative humidity	0 to 100% with condensation		
43	Corrosion	Anti-corrosive, protective coating to all parts exposed to environment.		
44	The tracking plate, tracking LNA, Tracking down-converter, Tracking Receiver, ACU, 1:2 LNA system (Ku-Band), Inject Couplers, etc., shall be the responsibility of the supplier			

Antenna and Feed System Safety

Sl. No	Item description	Specification	Compliance (Yes/No)	Offered Specifications
1	Limits and Display	Stow, Up pre-limit, Up final limit, Down Pre-limit, Down final limit, CW pre-limit, CW final limit, CCW Pre-limit, CCW Final limit, CW/CCW Zone change over, Low Elevation alarm switch.		
2	End Stoppers	Mechanical stoppers at the final limit position for each axis of antenna rotation to withstand slew speed of antenna motion.		
3	Hand held Portable Maintenance Unit	To be provided for manual movement during maintenance. One is required at ACU drive unit and one at antenna elevation platform.		
4	Stow Lock Device	Stow lock devices in Az and El axis to mechanically arrest the antenna during hostile environmental conditions.		
5	Auxiliary drive	Hand cranking facility for both the Az and El axis.		
6	Emergency Stop Switches & Indication	Shall be deployed at all the critical antenna locations to inhibit the drive in the event of emergency. Viz., at Az Cone, at El platform, at ACU & in elevation hub.		
7	Lightning Arrester	Lightning arrester assembly conforming to the latest safety standards to be provided for Antenna quadrapod and backup structure area. Earthing pits to be provided – 2Nos.		
8	Cable wrap	Suitable arrangement to be provided for overcoming cable wraps.		
9	Operator safety	Approach ladder with built-in safety measures to provide access to the El. Platform & Reflector surface. Safety railings around the azimuth cone and elevation platform.		
10	Equipment lifting	Proper facility like motorized chain pulley or rope for lifting heavy equipment to the elevation platform to be provided.		
11	Aviation lamp	Should be provided at appropriate locations with good visibility.		
12	Seismic protection	Design should take care of seismic condition of site.		

Sl. No	Item description	Compliance (Yes/No)	Offered Specifications
	General Requirements		
1	1:2 LNA Ku-band Complex with remote controller for Ku-band frequencies (10.70 – 12.25 GHz) to be supplied. The output interface of both the bands and the carrier inject ports shall be N-type (female). 30 dB couplers to be incorporated before the LNA for carrier inject facility in all the feed ports. The minimum gain of the LNAs shall be 60 dB.		
2	The Gain and G/T analysis breakup, Pointing and tracking accuracy analysis breakup to be provided along with the quote.		
3	All sub-systems shall have serial or TCP/IP interface for remote monitor and control purposes.		
4	All sub-systems shall have full-fledged Remote / Local control provision.		
5	ACU shall have at least 02 Nos of serial or TCP/IP interface for MCS.		
6	Remote shall mean control via MCS (Server & Client) and local shall mean control via the respective equipment front panel. However Feed switches control unit shall have local and remote units in addition to M & C port for computer interface.		
7	Local / Remote selection shall be at the front panel of the respective local equipment.		
8	Suitable racks to be supplied by the supplier to place supplier supplied equipments.		
9	Supplier shall provide communication protocol for all the equipment for remote control through MCS.		
10	MCS (software & hardware) will be the responsibility of MCF.		
11	2 Sets of operational and service manuals with maintenance (preventive and corrective) procedures and schedules to be provided for the supplied equipments.		
12	The supplier shall organize the following major reviews during the project, to achieve better interaction and understanding with participation of MCF.		
	a. Preliminary Design Review (PDR): To review the soundness of the design specifications and to define the QA procedures, work plan and schedules.		
	b. Critical Design Review (CDR): To critically review, evaluate and finalize design aspects, firm up the details of equipment to be supplied and agree upon the subsequent test and evaluation procedures.		
	c. Operational Readiness Review (ORR): To review and evaluate the results of all tests on the systems vis a vis the specifications.		
13	Supplier shall propose standard inspection practices and procedures, starting from raw materials to finished products. Joint inspection with MCF involvement, wherever necessary, shall be clearly specified.		
14	As part of the “Factory Acceptance Tests” and “Site Acceptance		

	Tests”, Supplier shall propose adequate tests and test-procedures which are acceptable to the ISRO in order to confirm the compliance to the specifications.		
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	Support system The following needs to be provided by the supplier.		
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42	<p>Delivery Schedule</p> <p>The entire work involving Supply, Installation, Testing and Commissioning of the proposed antenna with civil structure is envisaged to be completed on TURN KEY basis, in about 24 months from the Effective Date of Contract (EDC).</p> <p>The supplier shall project best possible schedules with respect to fabrication, inspection, dispatch, installation, testing, commissioning, training and any other relevant matter related to the system, keeping in view the overall schedule indicated above.</p>		