ADVANCED MECHANICAL AND OPTICAL SYSTEMS

Magdalena Ridge Observatory

# MROI Unit Telescopes

## MROI Unit Telescope ICD

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|---|---|
| Doc. nr : | MRO-ICD-AMO-0000-022 |
| Issue : | 5 |
| Date : | Oct 10, 2009 |

| | NAME | DATE | SIGNATURE |
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# CHANGE RECORD

| ISSUE | DATE | NB OF PAGES | MODIFIED PAGES | REMARKS |
|---|---|---|---|---|
| 1 | 26 Nov 2007 | 23 | | Initial issue |
| 2 | 13 Dec 2007 | 23 | | Update acc. to MRO Comments |
| 3 | March 12, 2008 | 23 | §5 add milestone and reference to procedure.<br>§11 add reference to procedure<br>§14. definition of the cable routing trough cable wrap; MRO to proposed hardware.<br>§15. add reference to drawing and procedure.<br>§16. MCS rack 3U → 5U and add the M2 hexapod controller rack (4U). | PDR update |
| 5 | Oct 10, 2009 | 33 | All | Update acc. to Final Design |

# TABLE OF CONTENTS

# 1. SCOPE

As a master document, this document defines the interfaces between the unit telescope and any other system of the MRO Interferometer. Whenever it is necessary, the detailed definition of the interface is specified in an applicable sub-document. The configuration control of the full set of document is managed through the CIDL (configuration control data list). The collection of interfaces is presented by product item.

For the optical point of view, the image of the star seen through the UT is not described in the ICD. The compliance with the requirement specification determines the characteristic of the optical interface.

# 2. APPLICABLE DOCUMENTS

[AD1] Technical Requirements: Unit Telescopes for the MRO Interferometer (Document no. INT-403-TSP-0003, 27th October 2006 –Requirements document);

[AD2] Appendix to the Technical requirements: Unit Telescope for the MRO Interferometer (Document no. INT-403-TSP-0004 rev 0.2);

[AD3] Statement of Work: Unit Telescopes for the MRO Interferometer (Document no. INT-403-CON-0010, July 10$^{th}$ 2007 – This document) ;

[AD4] Requirements for the Unit Telescope Optics for the MRO Interferometer (Document no.INT-403-TSP-0002, 8th September, 2006–Optics requirements document) ;

## INTERFACE DOCUMENTS

| | | |
|---|---|---|
| [AD5] | INT-405-SKT-0001 | Pier location for Beam Relay and Cans |
| [AD6] | MRO-TRE-AMO-8000-005 | Pier Interface Design Report |
| [AD7] | MRO-PLA-AMO-0000-023 | Telescope relocation plan |
| [AD8] | MRO-PLA-AMO-1000-024 | Primary mirror AIV plan |
| [AD9] | MRO-ICD-AMO-6000-025 | Unit Telescope Electrical ICD |
| [AD10] | MRO-TRE-OSL-6100-004 | The UTCS Software Design Description |
| [AD11] | MRO-TRE-OSL-6100-007 | The UTCS to ICS Interface |
| [AD12] | MRO-TRE-OSL-6100-010 | The UTCS to FTTA Interface |

[AD13] MRO-TRE-OSL-6100-011 The UTCS to Weather Server Interface

*Drawings:*

[AD14] MRO-DWG-AMO-0000-091 Telescope envelope dimensions

[AD15] MRO-DWG-AMO-0000-092 Telescope-Transporter interface

[AD16] MRO-DWG-AMO-0000-093 Telescope envelope for relocation and maintenance

[AD17] MRO-DWG-AMO-1100-000 M1 Assembly

[AD18] MRO-DWG-AMO-1100-001 M1 Cell Interface

[AD19] MRO-DWG-AMO-2210-000 M2 Unit Assembly

[AD20] MRO-DWG-AMO-2210-001 M2 Cell Interface

[AD21] MRO-DWG-AMO-2310-000 M3 Unit Assembly

[AD22] MRO-DWG-AMO-2310-001 M3 Cell Interface

[AD23] MRO-DWG-AMO-4400-091 Nasmyth Table Interface

[AD24] MRO-DWG-AMO-5000-091 Telescope-wire ways interface

[AD25] MRO-DWG-AMO-8000-001 Pier Interface

[AD26] MRO-DWG-AMO-9250-000 M1 Unit Integration

[AD27] MRO-DWG-AMO-9250-091 Interface for the M1 Unit Integration

[AD28] INT-403-SKT-0100 rev0.8 Optical Table Space (NMT document)

## 3. REFERENCE DOCUMENTS

[RD1] MRO-PLA-AMO-0000-023 Telescope relocation plan

[RD2] MRO-TRE-AMO-0000-030 System Analysis Report

[RD3] MRO-PRO-AMO-1000-034 Primary Mirror Integration Procedure

[RD4] MRO-TRE-AMO-0000-050 Pier Alignment Procedure

[RD5] MRO-TRE-AMO-0000-071 Final Design Report

[RD6] MRO-PRO-AMO-2200-084 M2 Gluing Procedure

[RD7] MRO-PRO-AMO-2300-085 M3 Gluing Procedure

[RD8] Bc637PCI-V2 Time and Frequency Processor User's Guide, Symmetricom, 098-00007-000

## 4. ACRONYMS

| | |
|---|---|
| AIV | Assembly Integration and Verification |
| API | Application Programming Interface |
| CIDL | Configuration Item Data List |
| CRE | Change Request |
| FE | Finite Element |
| FOR | Field of Regard |
| FTTA | fast Tip-Tilt Actuator |
| ICD | Interface Control Document |
| I/F | Interface |
| MCS | Mount Control System |
| OPL | Optical Path Length |
| PLC | Programmable Logical Controller |
| PDU | Power Distribution Unit |
| RFW | Request For Waiver |
| SOW | Statement of Work |
| TBC | To Be Confirmed |
| TBD | To Be Defined |
| UT | Unit Telescope |
| UTCS | Unit Telescope Control System |
| WFS | WaveFront Sensor |
| wrt | with respect to |

# 5. TELESCOPE-ARRAY INTERFACE

**Product item :**

8000

**Description:**

The telescope positioning in the array is defined by the location of the nominal pivot point and orientation of the nominal center line.

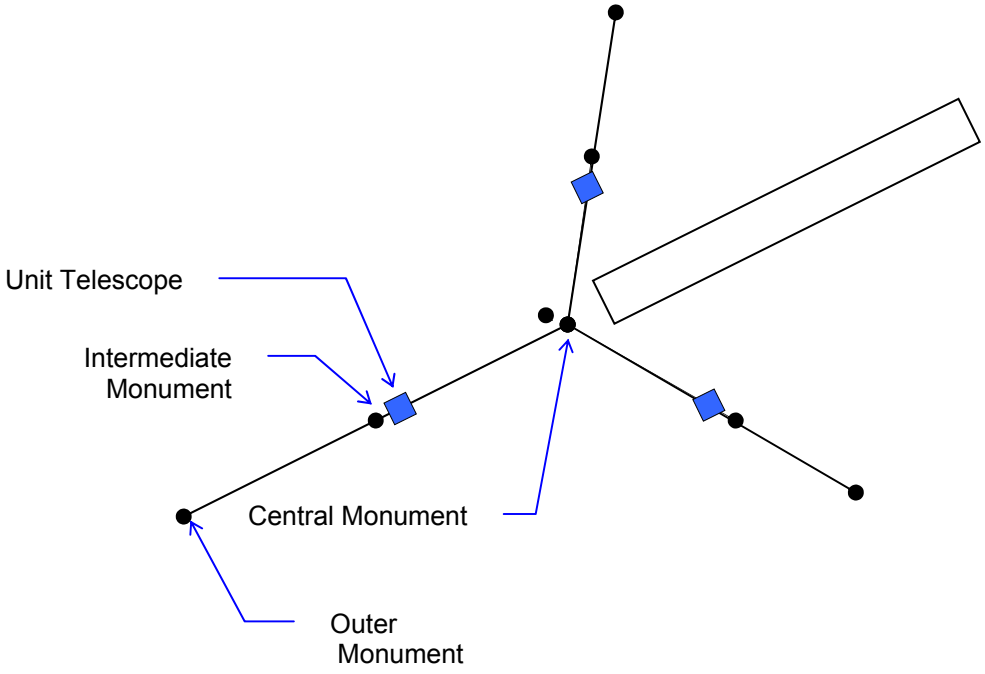
Note that the positioning accuracy is given by the station alignment (see [RD4]).

**Applicable documents:**

INT-405-SKT-0001 Pier location for Beam Relay and Cans

**Interface definition:**

- Nominal array geometrical definition
- Grade level definition: 1600 mm below the nominal output beam level
- Reference monuments installed by MRO will define the axis of each arm of the array: monument accuracy of positioning over the array: ± 2 mm. Quantity and location of the monuments TBD by MRO. The minimum distance between two monuments is 30 m.



# 6. TELESCOPE-PIER INTERFACE

**Product item :**

8000

**Description:**

Mechanical interface between the unit telescope and the piers.

**Applicable documents:**

MRO-TRE-AMO-8000-005 Pier Interface Design Report
MRO-DWG-AMO-8000-001 Pier Interface

**Interface definition:**

- Fixation definition
- Geometrical definition incl. dimensional and geometrical tolerances
- Footprint to the ground
- Loads applied to the interface
- Requirement of dimensional stability of the interface
- Mechanical insulation requirement from the enclosure foundation

# 7. TELESCOPE ALLOCATED VOLUME & MASS

**Product item :**

0000

**Description:**

Definition of the maximum volume occupied by the telescope. This interface is geometrical.

**Applicable documents:**

MRO-DWG-AMO-0000-091 Telescope envelope dimensions
MRO-DWG-AMO-0000-093 Telescope envelope for relocation and maintenance

**Interface definition:**

- In operation configuration, any equipment that is not part of the telescope shall stand outside the "telescope envelope dimension"
- In relocation mode, any equipment that is not part of the telescope shall stand outside the "telescope envelope in relocation mode"
- The envelope volume for the primary cell removal through the enclosure is also defined in [AD16]
- Telescope mass characteristics:
  - Mass : 15500 kg
  - Center of gravity : (X ;Y ;Z) = (100 ; 0 ; -540) mm
    Origin = pivot point, Z vertical upward, X on output beam towards the Nasmyth table
  - Inertia : $I_{X-X}$ = 1.95E+4 kgm² ; $I_{Y-Y}$ = 4.15E+4 kgm² ; $I_{Y-Y}$ = 3.80E+4 kgm²

# 8. TELESCOPE-ENCLOSURE INTERFACE

**Product item :**

0000

**Description:**

Definition of the mechanical interface between the UT structure and the enclosure in relocation configuration.

**Applicable documents:**

MRO-DWG-AMO-0000-092 Telescope-Transporter interface

**Interface definition:**

This interface includes:

- Fixation definition: each flange is equipped with one central pin bore Ø30 mm to take the force parallel to the flange and six M20 threaded holes to take the reaction normal to the flange and the torque reaction. The structure behind the interface plates (8 places) are designed to bear the force induced by the loads mentioned below. The MRO-owned fixation devices attached to the fixation plates will be designed in the way that the six M20 threaded holes and the central pin bore Ø30 mm of each interface plate are not overstressed.
- Geometrical definition incl. dimensional and geometrical tolerances. The MRO owned structure/mechanisms connected to the interface shall lie outside the telescope envelope as defined in Telescope allocated volume definition (see §7).
- Maximum allowable loads that can be applied to the telescope –INPUT LOAD- (static and dynamic that originate from relocation process). The loads induce reaction to the interface with the enclosure.
  - *Telescope self-weight*
  - *Quasi-static load applied to the interface flange (f<0.1 Hz):*

    0.3g horizontal and 0.1g vertical
  - *Dynamic load applied to the interface flange (0.1 to 100 Hz):*

    Defined as the acceleration PSD.

    $45\,\mathrm{mg}/\sqrt{\mathrm{Hz}}$ RMS in horizontal direction

    $100\,\mathrm{mg}/\sqrt{\mathrm{Hz}}$ RMS in vertical direction

The relocation plan is provided in [RD1].

# 9. TELESCOPE-TRANSPORTER INTERFACE

**Product item :**

0000

**Description:**

Definition of the mechanical interface between the UT structure and the transporter in relocation configuration.

**Applicable documents:**

MRO-DWG-AMO-0000-092 Telescope-Transporter interface

**Interface definition:**

This interface includes:

- Fixation definition: the same interface can be used for either the enclosure or the transporter. See §8.
- Geometrical definition incl. dimensional and geometrical tolerances. The MRO owned structure/mechanisms connected to the interface shall stand outside the telescope envelope as defined in Telescope allocated volume definition (see §7).
- Maximum allowable loads that can be applied to the telescope –INPUT LOAD- (static and dynamic). See §8.

The relocation plan is provided in [RD1].

# 10. NASMYTH TABLE INTERFACE

**Product item :**

4300

**Description:**

Definition of the mechanical and thermal interface between the Nasmyth table and the MRO owned components. This interface covers the operational and relocation configurations.

**Applicable documents:**

MRO-DWG-AMO-4400-091 Nasmyth Table Interface
MRO-DWG-AMO-0000-091 Telescope envelope dimensions
INT-403-SKT-0100 rev0.8 Optical Table Space (NMT document)

**Interface definition:**

This interface includes:

- Pattern of threaded holes definition
- Geometrical definition incl. dimensional and geometrical tolerances
- Stainless steel upper face
- Mass distribution on the table: see [AD28] / total < 145 kg
- Table weight: 230 kg (table without supporting structure)

The thermal load shall be limited and the surface temperature requirements are assumed to be applicable to the Nasmyth table components. The power dissipation of the components installed on the Nasmyth table are outside the allocated budgets defined in §2.10 of [AD1].

If necessary, a MRO owned insulating cover shall be implemented with some impact on the mechanical interface. In any case, the cover shall be out of the allocated volume as defined in [AD14].

# 11. PRIMARY MIRROR-CELL INTERFACE

**Product item :**

1000

**Description:**

Definition of the mechanical interface between the mirror and its support.

**Applicable documents:**

MRO-DWG-AMO-1100-000 M1 Assembly
MRO-DWG-AMO-1100-001 M1 Cell Interface

**Interface definition:**

Requirement specification for the connection of the mirror to the support and for the alignment of the mirror in the telescope.

This interface includes:

- Geometrical definition incl. dimensional and geometrical tolerances of the mirror wrt the optical surface. Note that most of the tolerances are required for the alignment but not for the support performance
- Choice of glue and gluing procedure to be agreed
- Procedure for integration and gluing the pads and blade support with the supplied gluing tooling
- Pads and blade position (18 axial pads, one or two radial pads and one central blade)
- 3 pads position for accurate positioning.

The primary unit integration procedure is provided in [RD3].

# 12. SECONDARY MIRROR-CELL INTERFACE

**Product item :**

2200

**Description:**

Definition of the mechanical interface between the mirror and its support.

**Applicable documents:**

MRO-DWG-AMO-2210-000 M2 Unit Assembly
MRO-DWG-AMO-2210-001 M2 Cell Interface

**Interface definition:**

Requirement specification for the connection of the mirror to the support and for the alignment of the mirror wrt the cell interface. Note that these specifications shall be agreed with the mirror manufacturer.

This interface includes:

- Geometrical definition incl. dimensional and geometrical tolerances of the mirror wrt the optical surface. Note that most of the tolerances are required for the alignment but not for the support performance
- Choice of glue and gluing procedure to be agreed
- Procedure for integration and gluing the flexure with the supplied gluing tooling
- Flexure position
- Overall dimensions of the M2 Support
- Geometrical definition incl. dimensional and geometrical tolerances of the interface of the M2 support with the M2 mechanism

The secondary unit integration procedure is provided in [RD6].

# 13. TERTIARY MIRROR-CELL INTERFACE

**Product item :**

2300

**Description:**

Definition of the mechanical interface between the mirror and its support.

**Applicable documents:**

MRO-DWG-AMO-2310-000 M3 Unit Assembly
MRO-DWG-AMO-2310-001 M3 Cell Interface

**Interface definition:**

Requirement specification for the connection of the mirror to the support and for the alignment of the mirror wrt the cell interface. Note that these specifications shall be agreed with the mirror manufacturer.

This interface includes:

- Geometrical definition incl. dimensional and geometrical tolerances of the mirror wrt the optical surface. Note that most of the tolerances are required for the alignment but not for the support performance
- Choice of glue and gluing procedure to be agreed
- Procedure for integration and gluing the flexure with the supplied gluing tooling
- Flexure position
- Overall dimensions of the M3 Support
- Geometrical definition incl. dimensional and geometrical tolerances of the interface of the M3 support with the M3 mechanism

The tertiary unit integration procedure is provided in [RD7].

# 14. WAS – WIDE FIELD TELESCOPE INTERFACE

**Product item :**

2400

**Description:**

Definition of the mechanical, thermal and optical interface between the telescope and the MRO owned CCD installed at the focal plane of the wide field telescope (WAS).

**Applicable documents:**

N/A

**Interface definition:**

The WAS will be mounted on the wide field acquisition telescope. A standard mounting interface will be available at the focal plane of the telescope.

This interface includes:

- Type of interface: C-mount (adjustable back focus on camera)
- Type of Camera: Prosilica model GC-650 gigabit camera
- Cables:
    1. Gigabit Ethernet cable cat 5e (Ø 6 mm)
    2. WAS power cable (Ø 5 mm)
    3. Heater cable (Ø 5 mm)
    4. Temperature sensor power cable (Ø 5 mm)
    5. Temperature sensor data (Ø 5 mm)

  The cables are routed on the telescope from the WAS to the fork connection box (west side) and then inside the telescope cable way. From the cable way interface (see section 20), 8 m of cable are foreseen to connect to the WAS cables inside MRO-owned cabinet.

The thermal load shall be limited and the surface temperature requirements are assumed to be applicable to the WAS. The power dissipation of the WAS is outside the allocated budgets defined in §2.10 of [AD1]. No liquid cooling of the camera foreseen by MRO.

# 15. M1 HANDLING TOOL INTERFACE WITH THE ENCLOSURE

**Product item :**

9200

**Description:**

Definition of the mechanical interface between the M1 unit handling tool and the enclosure.

**Applicable documents:**

| | |
|---|---|
| MRO-DWG-AMO-0000-093 | Telescope envelope for relocation and maintenance |
| MRO-DWG-AMO-9250-000 | M1 Unit Integration |
| MRO-DWG-AMO-9250-091 | Interface for the M1 Unit Integration |

**Interface definition:**

When the M1 cell is removed from the telescope for maintenance (coating), the cell shall be moved horizontally out of the telescope, through the enclosure. A handling tool to be connected to the enclosure and the telescope fork is foreseen for that purpose. The procedure for integration/removal of the M1 unit is the telescope is provided in [RD3].

This interface includes:

- Rails fixations definition
- Geometrical definition incl. dimensional and geometrical tolerances
- Load applied to the fixation: 850 kg max, vertically
- Clearance for passing the cell through the enclosure

# 16. MAIN CABINETS INTERFACE

**Product item :**

5000

**Description:**

Definition of the mechanical and thermal interface requirements for the equipments to install inside the main electrical cabinet.

**Applicable documents:**

Q4 cabinet layout provided here after (ref. AMOS-2000-29-15)

**Interface definition:**

The electrical and electronic equipments are installed in two MRO owned Cabinets Q4 and Q5 as presented in the table here below. The heat generated inside the cabinet is evacuated by means of the MRO cooling system. The allowable temperature inside the cabinets: +5°C to 35°C, not condensing (HR ≤ 95%).

Q4 cabinet:

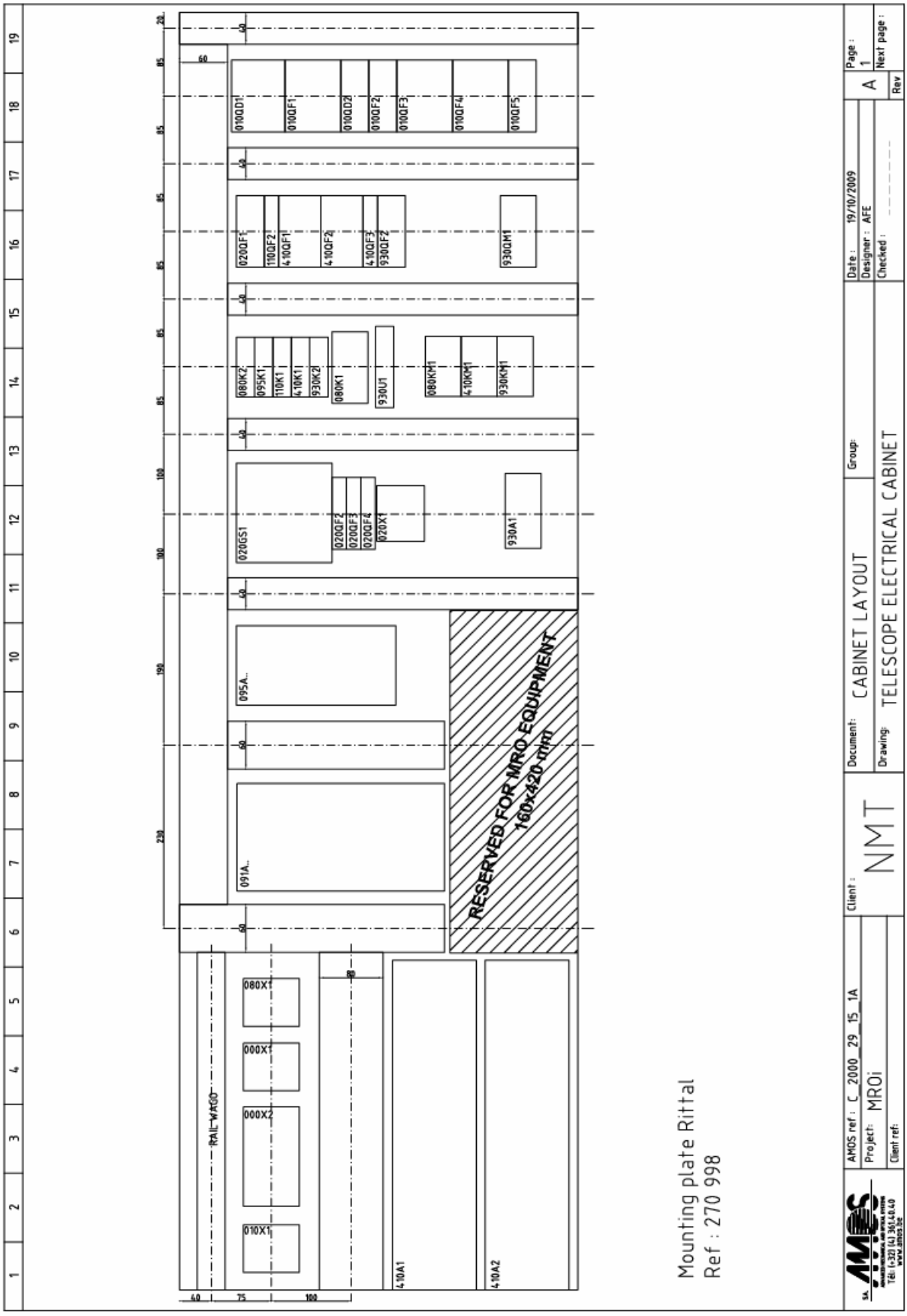
- Rittal ref. 8685.500
- Size: 600*500*1800 mm³
- One full width access door located at the front side
- AMOS Components installed on a AMOS owned mounting plate Rittal ref. 270998
- Reserved area on the mounting plate for MRO owned equipment: 160x420 mm² (see Q4 cabinet layout here after)
- AMOS components power dissipation inside the cabinet: 790W

Q5 cabinet:

- Rittal ref. 7821.302
- Size: 600*600*1200 mm³
- Full width access door on front and back side
- 19U rack mounted equipment
- AMOS components power dissipation inside the cabinet: 482W

List of equipment and location:

| Item | Description | Loc. | Dimensions (Width*High*Depth) | Mass ([kg]) |
|---|---|---|---|---|
| 010QS1 | Network switchable Power Distribution Unit | Q5 | 19 ” * 1U (1.75 ”) * 9.5 ” | 19 lbs (8.6 kg) |
| 090A0 | UTCS PC (including GPS card) | | 19” * 2 U * 460 mm³ | 15 kg |
| 210A1 | M2 hexapod controller | | 19 “rack 450*180*460 mm³ | 11 kg |
| 220A1 | M2 FTTA controller | | 19 ” rack 450*132*342 mm³ | 10 kg |
| 093U1 | TTL/RS422 Converter (Time synchronization signal) | | 80 * 80 * 60 mm³ | 0.5 kg |
| 091A0 | MCS Controller (UMAC) | Q4 | Assembled on the mounting plate Rittal reference 270998. | Mounting plate: 17kg<br>Drives:2*5.5=11kg<br>Others: 5 kg<br>Total: 33 kg |
| 095A0 | PLC | | | |
| 410A1<br>410A2 | Outer axis drives (2) | | | |
| | Circuit breakers and accessories | | | |



# 17. ELECTRICAL INTERFACES

**Product item :**

6000

**Description:**

Definition of the electrical interface between the telescope and the overall system.

**Applicable documents:**

MRO-ICD-AMO-6000-025 Unit Telescope Electrical ICD

**Interface definition:**

The electrical hardware interface can be divided in five types:

1. The non-UPS power consumption is less then 7 A @ 208 V line-line, three-phase (+ neutral + protective earth) AC. The interface point will be a terminal block located in the main cabinet. The actual calculated current value is 6.7 A.
2. The UPS power consumption is less then 12 A @ 110 V phase-neutral, one phase (+ neutral + protective earth) AC. The interface point will be a terminal block located in the main cabinet. The actual calculated current value is 11.6 A.
3. Emergency stop signal: From the discussion during the PDR meeting, we have developed the interface described on the electrical drawing given in [AD9]. The three main components of the UT safety line are: the control room (MRO side), the enclosure safety line (MRO side) and the telescope safety line itself (AMOS side). Each emergency stop button will stop motion of both the enclosure and the telescope. The rearm can be activated either remotely from a location selected by MRO (i.e. the control room) either locally from the telescope Local Command Box.
4. FTTA signals: analog +/- 10 V signal. The controller will be placed in the Q5 Cabinet. Interface connectors are the ones available on the controller itself. Corresponding data from the PI user manual are also attached to the document.

   Input & Output signal scale factor: 24.5 µrad / volt

5. Network. The network switch is provided by MRO. The interface are the 8 cables coming from the switch and entering into the Cabinets.
6. GPS card signals are input into a conversion box. One output connector is dedicated to AMOS while the other one is dedicated to MRO and serves as interface point. More details concerning the time card specifications are provided in [RD8].

*Note: the hazard resulting from lightning strikes is not considered in the proposed wired configuration and shall be handled by MRO.*

# 18. SOFTWARE INTERFACES

**Product item :**

6100

**Description:**

Definition of the direct interface between the UTCS and the ICS.

**Applicable documents:**

MRO-TRE-OSL-6100-007 The UTCS to ICS Interface
MRO-TRE-OSL-6100-010 The UTCS to FTTA Interface
MRO-TRE-OSL-6100-011 The UTCS to Weather Server Interface

**Interface definition:**

The definition of the interface includes:

- Communication protocol definition
- Set of commands,
- Set monitoring and error message
- Logging features
- Simultaneous connection
- UTCS to FTTA Interface
- The UTCS to Weather Server Interface
- Time system: UTCS acts as a pseudo master (Stratum 1) time server using the NTP protocol. More detail are given in [AD10].

The non-direct interface concerns the remote reboot of the UTCS. This will be managed trough the Pulizzi network switchable power distribution unit (PDU). TCS, UMAC and PLC will be powered through this PDU so that it will be possible to reboot them by switching off and on this line.

# 19. LIQUID COOLING INTERFACE

## Product item :

5100

## Description:

Definition of the thermal and mechanical interface between the telescope cooling system and the MRO owned chilled water supply lines.

## Applicable documents:

[AD24] MRO-DWG-AMO-5000-091 Telescope-wire ways interface

## Interface definition:

In order to meet thermal requirements (surface temperature and power consumption), it is necessary to cool down some equipment that dissipates power. The concerned devices are the altitude (inner and outer) motors and the gimbal cabinets (power cabinet and control cabinet) which are located on the gimbal structure. Two independent liquid cooling circuits are used for that purpose.

Common specifications:

- Type of coolant: Water + 50% Vol. monoethylene glycol
- Inlet Pressure: 4.5±0.5 bar
- Fluid connection
  Placed in the North-West (-X/+Y) wire way of the telescope as defined in [AD24]
  AMOS side: quick coupling two way self-locking connectors Staubli RMI 9
  MRO side: flexible rubber hose, 12 mm inside diameter
- Coolant temperature always set above the dew point

**Loop 1** ***Main Motors Cooling***

- Night time operation only (not fed during daytime)
- Temperature range: -20°C to +13°C
- Temperature set point: $T_{ambient}$ – 2°C and above the due point
- Liquid flowrate: 6 l/min
- Pressure drop: 1.5 bar

**Loop 2** ***Gimbal Cabinets & WFS Cooling***

- Continuously in operation (daytime/nightime)
- Temperature range: +1°C to +13°C
- Temperature set point: $T_{ambient}$ – 2°C and above the due point
- Liquid flowrate: 3.6 l/min
- Pressure drop: 1.5 bar

# 20. WIRE WAYS

**Product item :**

5000

**Description:**

Definition of the location and size of the wire ways that are connecting the telescope to the MRO owned electrical cabinets.

**Applicable documents:**

MRO-DWG-AMO-5000-091 Telescope-wire ways interface

**Interface definition:**

The wire ways provide space for both AMOS and MRO owned cables and pipes.

This interface includes (for AMOS owned hardware only)

- Number per type of cable / hosepipes
- Outside diameter of cables / hosepipes
- Static bending radius

| Cable type | Qty | Outside diameter [mm] | Static bending radius [mm] | Wire Way | Remarks |
|---|---|---|---|---|---|
| Outer axis motor cable | 2 | 15 | 200 | South-West | |
| Outer axis resolver cable | 2 | 7 | 150 | South-West | |
| Outer axis encoder cable | 4 | 8 | 150 | South-West | |
| Outer axis temperature sensor cable | 2 | 5 | 100 | South-West | |
| Outer axis brake valve command | 2 | 5 | 100 | South-West | |
| 3-way valves | 2 | 12.5 | 200 | South-West | Spare |
| Ethernet cable for service plug | 1 | 6 | 150 | South-West | |
| Digital signals cable | 3 | 10 | 150 | South-West | |
| Liquid cooling hose | 4 | 35 | 240 | North-West | Incl. insulation foam (thickness 8 mm) |
| Protective earth | 1 | 6 | 80 | South-West | |
| Power supplies | 3 | 12 | 150 | South-West | Main, Pulizzi, Hydraulic group |

| Cable type | Qty | Outside diameter [mm] | Static bending radius [mm] | Wire Way | Remarks |
|---|---|---|---|---|---|
| Macro Bus Optical fiber | 1 | 9 | 150 | South-West | Optical fiber |
| PLC field bus | 2 | 6 | 150 | South-West | |
| M2 Hexapod signal | 1 | 8 | 100 | South-West | |
| M2 Hexapod power | 2 | 8 | 150 | South-West | |
| M2 FTTA | 4 | 10 | 150 | South-West | |
| Hydraulic group t° sensor | 1 | 5 | 100 | South-West | |
| WFS CCD signal cable | 1 | 9 | 150 | South-West | Optical fiber |
| WAS Ethernet cable | 1 | 6 | 80 | South-West | MRO Owned cable |
| WAS power cable | 1 | 5 | 80 | South-West | MRO Owned cable |
| WAS Heater | 1 | 5 | 80 | South-West | MRO Owned cable |
| WAS Temp. sensor power | 1 | 5 | 80 | South-West | MRO Owned cable |
| WAS Temp. sensor data | 1 | 5 | 80 | South-West | MRO Owned cable |

Note that the AMOS-owned cables and hosepipes will be equipped with connectors. It is therefore necessary to design the wire ways so that it is possible to route the cable without dismounting any connector.

Note also that there are four optical fibers in wire ways. So, they are to be designed accordingly.

Cables length:

- From wire way interface to the bottom of the Q4 electrical cabinet:
  5600 mm without spare length

- From wire way interface to the bottom of the Q5 electrical cabinet:
  9500 mm without spare length

- From the bottom of the Q4 electrical cabinet to the bottom of the Q5 electrical cabinet:
  3900 mm without spare length

WAS cables are let un-terminated at both sides. There are 9 m from Fork Connection Box. On the other side, there are routed up to the center piece, -X side.

# 21. OPTICAL FIBERS

**Product item :**

6000

**Description:**

Definition of the type, quantity and location of connection for optical fibers necessary for the communication and data transfer between the WFS and the WFS computer.

**Applicable documents:**

*None*

**Interface definition:**

Each UT will be equipped with an optical fiber connection from the telescope (nearby the Nasmyth table) to the electrical cabinet Q4, in the case the WFS is installed on the unit telescope.

At the level of the **electrical cabinet Q4**, it shall be possible to connect the pair of optical fibers to other fibers routed toward the control room. Each pier is equipped with fibers dedicated to the WFS.

Type of coupling: *LC-Duplex*

Type of fiber: *multi mode*

Number of fiber connection per pier: 1 pair + 1 redundant recommended

# 22. GPS ANTENNA

## Product item :

6000

## Description:

Definition of the mechanical interface and requirements for the installation of the GPS antenna externally, attached to the enclosure.

## Applicable documents:

N/A

## Interface definition:

Each UT will be equipped with a GPS time receiver is a Symmetricom type bc 637 PCI situated inside the UTCS computer. The antenna will be installed on the enclosure according to the GPS antenna manufacturer prescription.

*Extract from*

Bc637PCI-V2 Time and Frequency Processor User's Guide, Symmetricom, 098-00007-000 :

### Antenna Specifications (bc637PCI-U)

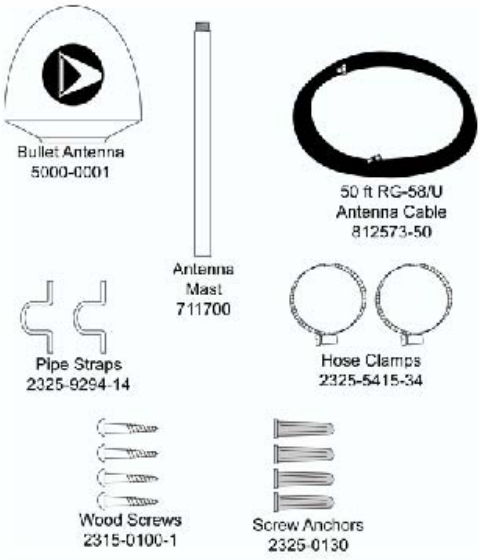
To operate in the GPS Synchronized Generator mode, the bc637PCI-U unit requires an external antenna. The standard antenna kit supplied with this option is part number 912005 that includes 50 feet (15.24 meters) of coaxial cable and antenna mounting hardware.

Note: The GPS antenna and cable described in this manual have been replaced as described in "Appendix C: Antenna Replacement Kit" on page 98.

| Part Number | Description |
|---|---|
| 5000-0001 | Bullet II or III |
| 812573-50 | 50 foot RG58 |
| 912002 | Antenna mounting HW |

*Symmetricom type bc 637 PCI User guide (extract)*:






The antenna is housed in completely waterproof packaging designed to withstand the elements. The plastic dome enclosure is weatherproof and waterproof, with a corrosion resistant threaded socket at the antenna base. A type F connector is embedded in the center of antenna mast socket (see Figure 3), allowing the antenna cable to be routed inside the pole, protecting the cable connection for added reliability. This socket has standard ¾ inch 14 NPT threads that mate to the antenna mast (711700) furnished with this kit.

Note: The GPS antenna and cable described in this manual have been replaced as described in "Appendix C: Antenna Replacement Kit" on page 98.

Figure 3 Antenna mast socket with type F connector

| | |
|---|---|
| WARNING | Model bc637PCI-U supplies +5 VDC to the antenna SMB. Connection to an alternate antenna may impact the board and/or antenna functionality. |

*Symmetricom type bc 637 PCI User guide (extract)*:



| General Specifications for the 5000-0001 Antenna | |
|---|---|
| Size | 3.05 in diameter x 2.61 in (7.75 cm dia x 8.62 cm); see Figure 4. |
| Weight | 6.0 oz (170 grams) |
| Operating Temperature | –40°C to +85°C (–40°F to +185°F) |
| Storage Temperature | –40°C to +100° C (–40°F to +212°F) |
| Humidity | 100% condensing |
| Power | 30 mA @ 5 V (supplied by card) |

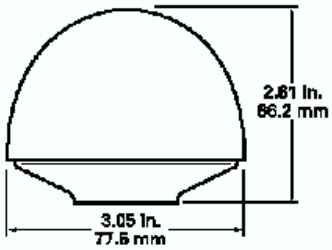



Figure 4 Antenna diagram with dimensions

| Cable Specifications for the 812573-50 Antenna Cable | |
|---|---|
| Type | RG-58 |
| Length | 50 feet (15.24 meters) |
| Weight | 1.2 lb. (0.545 kg) |
| Humidity | All weather, outdoors |
| Connectors | Type 'F' male to SMB male |

Cable lengths from 250 feet (76.2 meters) to 1,500 feet (457.2 meters) require the antenna Down/Up Converter option, part number 142-615s. Refer to the optional 142-6150 Down/Up Converter antenna manual for specifications. (Note: The GPS antenna and cable described in this manual have been replaced as described in "Appendix C: Antenna Replacement Kit" on page 98.)

Antenna and Down/Up Converter units are mounted on a 12-inch (30.48 cm) long PVC mast with 3/4-inch (1.9 cm) Male Pipe Thread (MPT) on both ends.

Refer to the Symmetricom *Antenna Mounting Guide*, Document 8500-0080, for detailed antenna mounting instructions.

*Symmetricom type bc 637 PCI User guide (extract)*:



# 2 — Installation

## Installing the Card

This section contains installation instructions for the Model bc635PCI-U and bc637PCI-U cards, and information regarding operating modes and the use of registers to configure the card. The Model bc637PCI-U has the additional feature of GPS mode that will automatically synchronize the card to UTC time.

Installation of PCI boards is quite a bit simpler than in most bus architectures due to two factors:

- Geographical addressing, which eliminates the need for DIP switches and jumpers normally required to select a "base address" or interrupt level for plug-in modules.
- Auto configuration that allows the host computer to read the device ID and other configuration information directly from the PCI Configuration Registers.

Installation is as easy as choosing a vacant PCI slot, plugging in the Symmetricom bc635/7PCI-U Time and Frequency Processor (TFP) and installing the device driver. Be sure to consult the user documentation that came with your particular workstation for any specific PCI card installation instructions.

The TFP is shipped with software suitable for use with Microsoft Windows 98/98SE/NT 4.0/2000/XP Professional. The kit includes drivers for low-level access, as well as software programs for configuring and accessing the card.

### Installation

- Unpack the card and carefully inspect it for shipping damage. Report any damage to the carrier immediately.
- Record the card's serial number.
- With the computer's power turned OFF, install and secure the card in an empty PCI card slot. Fabricate any required I/O cables and connect them to the appropriate connectors.

### Antenna Location and Installation (GPS only)

Note: The GPS antenna and cable described in this manual has been replaced as described in "Appendix C: Antenna Replacement Kit" on page 98.

When selecting a site for the antenna, find an outdoor location that provides full 360-degree visibility of the horizon. In most cases, this means locating the antenna as high as possible. Any obstruction will degrade unit performance by blocking the satellite signal or causing a reflection that cancels some of the signal. Blocked signals can significantly increase the time for satellite acquisition, or prevent acquisition all together.

*Symmetricom type bc 637 PCI User guide (extract)*:



Antenna placement and cable routing are the most troublesome aspects of installing a GPS based instrument. To get the GPS unit up and running as quickly as possible, to verify its operation and to become familiar with the equipment, the installation instructions are divided into "Quick Initial Setup" and "Permanent Installation" sections. We recommend that new users follow the "Quick Initial Setup" instructions first before proceeding to a permanent installation.

Additional installation details are available on-line at:
http://www.symmttm.com/pdf/Gps/an_GPS.pdf

### Quick Initial Setup

Connect the antenna cable to the unit and to the antenna. Simply run the antenna outside the building or set it on a windowsill. Depending on the lead content of the glass, it may be necessary to go outside. Turn on the unit and verify its operation.

### Permanent Antenna Installation

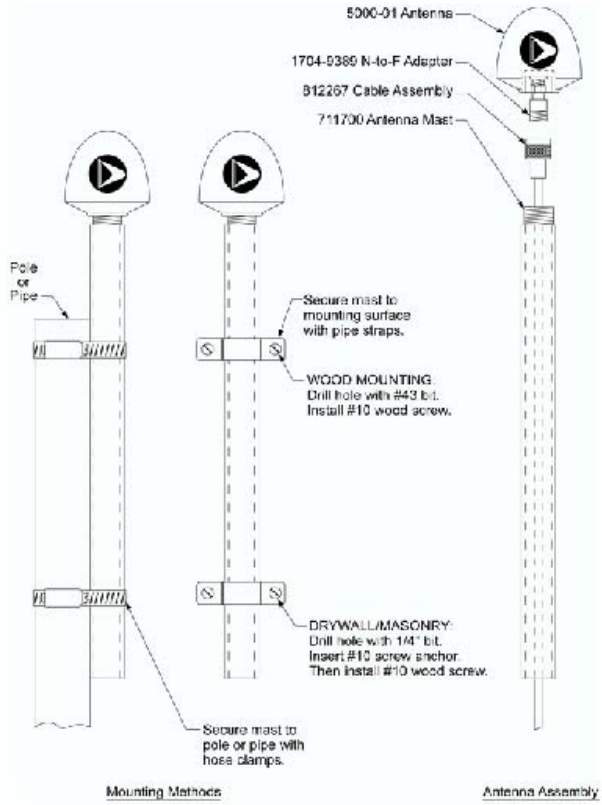



Figure 5 Permanent Antenna Installation

*Symmetricom type bc 637 PCI User guide (extract)*:



Mast top mounting is the preferred mounting method and special brackets are provided to mount the antenna to a pipe or the peak of a building. The antenna mounting mast should be 2-inch (5.08-cm) water pipe or conduit. The mast must be rigid and able to withstand high winds without flexing. Guy wires may be used to stabilize a mast longer than 10 ft. (3.048 m).

Choosing a Location

- The antenna should be located with an unobstructed clear view of the sky from horizon to horizon for optimum tracking conditions. Get the most visibility of the sky as possible. However, if the antenna must be located on the side of a building, the satellite orbits must be considered. If your location is in the Northern Hemisphere, your antenna should face South. If you are in the Southern Hemisphere, your antenna should face North. Use the corner of the building if it is available.
- Choose a location for the antenna that allows the antenna mast to be installed as close as possible to vertical. If you plan to install the antenna in a partially enclosed environment, test the ability of your antenna to receive satellite signals before committing to a permanent installation. On vehicles (vans, ships, etc.), select a location that will be safe from damage during normal operation of the host vehicle.

For installations exposed to shock and/or vibration, use a mounting scheme that isolates the antenna from excessive shock and/or vibration.

For optimal performance, avoid locating the antenna within two feet of other antennas. Chose a location that is not near radar installations, satellite communication equipment, and/or microwave dishes to prevent RF jamming. If that is not possible, move as far away from the radiating source as possible, and attempt to shadow the GPS antenna from the radiation, blocking as little of the sky as possible. Mount the antenna below and at least 10 feet away from satellite communication equipment. Shield the unit from back-scatter microwave radiation. Protection can be afforded by the use of a ground plane, a metallic shield that is mounted below the desired minimum viewing angle of the antenna.

- The GPS antenna is designed to withstand the full rigors of the elements in an exposed external location. However, performance is not warranted below –40°C. The shape of the antenna has been designed to minimize the accumulation of rain, snow, and ice. If snow or ice does accumulate, the antenna will perform when partially covered with snow, provided the snow is dry. Accumulation of ice will eventually shut off performance. However if the ice sheet is not continuous, it is possible that enough signal will be received to provide normal operation.
- The antenna can receive satellite signals through glass (depending on lead content), canvas or thin fiberglass. The antenna *cannot* receive signals through dense wood (including trees and shrubbery) or metal structures.

To run multiple units with a single 5 VDC antenna, use a splitter.

*Symmetricom type bc 637 PCI User guide (extract)*:



# Appendix C: Antenna Replacement Kit

Please note that the GPS antenna equipment described in this manual has been superseded by the following Standard Antenna Kit, consisting of:

- One wide-range 5-12 VDC L1 antenna
- One 50 ft. length of Belden 9104 coaxial cable with BNC(m) and TNC(m) connectors
- Adaptors are included for GPS receivers that have a non-BNC antenna connector

The Antenna Kit can be ordered with optional cable lengths and accessories. Please note the following when setting up longer cable runs:

- Using Belden 9104, the maximum cable length without amplification is 150 feet
- Using Belden 9104, the maximum cable length using the optional in-line amplifier is 300 feet
- For cable runs longer than 300 feet, an optional GPS Down/Up Converter kit is available

Other GPS Antenna Options:

- A Lightning Arrestor kit
- A 1:2 splitter (distributes the signal from a single antenna to two GPS receivers)