MRO FTT/NAS & FLC ICD

FTT/NAS & FLC to Enclosure ICD

MRO-ICD-CAM-1000-0109

The Cambridge FTT Team

Rev 1.0

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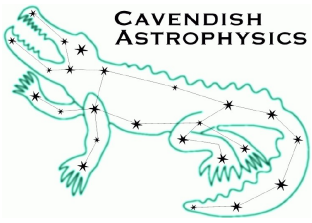

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ICD Description

ICD Number	Sub-systems		Org	Owner	Brief description and preliminary contents
MRO-ICD-CAM-1000-0109	FTT/NAS	Enclosure	MRAO	MF	Defines the interfaces between the FTT/NAS & FLC and the enclosure • Housing space in Q5 • Power requirements • Cable routing • Coolant and air services • Connection locations

Change Record

Revision	Date	Author(s)	Changes
0.1	2010-07-09	MF	First draft version
0.2	2012-03-09	MF	Detail added to sub-sections
0.3	2012-03-23	JSY	Converted to ODT format, no changes to content
0.4	2012-04-27	MF	Minor corrections & power supply figures
0.5	2012-04-28	MF	Minor corrections & update fig1
0.6	2013-04-26	MF	Major update prior to release
1.0	2013-05-14	MF	Revised figure 1, minor corrections and removal of TBCs

Notification List

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Table of Contents

Scope

This document defines the connections between the FLC/FFT camera thermal enclosure and the EIE enclosure, i.e. the services that are required and the electronics in the control cabinet assigned. It refers to but does not define other connections in the control cabinet which are defined by other ICDs.

Acronyms and Abbreviations

BSP British Standard Pipe Thread

EIE Enclosure vendor

EMCCD Electron-Multiplying Charge-Coupled Device

FTT Fast Tip-Tilt

FTTA Fast Tip-Tilt Actuator

FLC First Light Camera

ICD Interface Control Document

ID Inner Diameter

MROI Magdalena Ridge Observatory Interferometer

MRAO Mullard Radio Astronomy Observatory

NAS Narrow-field Acquisition System

NMT New Mexico Tech

PC Personal Computer

PSU Power Supply Unit

UT Unit Telescope

UTCS Unit Telescope Control System

UTE Unit Telescope Enclosure

WFS WaveFront Sensor

Drawings

AD1 Nasmyth Table Space Envelope INT-403-DWG-0100 rev0.5

AD2 Control Cabinet Q5 MRO-DWG-EIE-00-410-02-05c

Reference Documents

RD1 MRO FTT-NAS Technical Requirements INT-403-ENG-0003 rev 2.2

RD2 UTE-FTT Interface Control UTE-FTT ICD MRO-ICD-EIE-0032d

1 Introduction

This ICD describes the interfaces between the FLC and FTT/NAS and the enclosure designed by EIE. There are several locations where the interfaces need to be defined, namely: the electronics cabinet, the services at the Nasmyth table and the routing for cables between the cabinet and the table. These areas are depicted in the schematic diagram shown in Figure 1.

Space is allocated in the cabinet for the control computer and the camera control electronics. The services to the Nasmyth table are specifically for the camera enclosure and include cooling fluid for the camera and cold plates and dry air to flush the enclosure. Cables between the camera enclosure and the cabinet include the camera cable, the Peltier cooler supply, thermal enclosure temperature control cable and temperature and humidity sensing cables. There are also signal cables from flow sensors for dry air and cooling fluid. These sensors are for diagnostic purposes and for setting the manual flow control valves. The flow of dry air is switched by a valve under control of the FTT-NAS PC so that is it only activated when required.

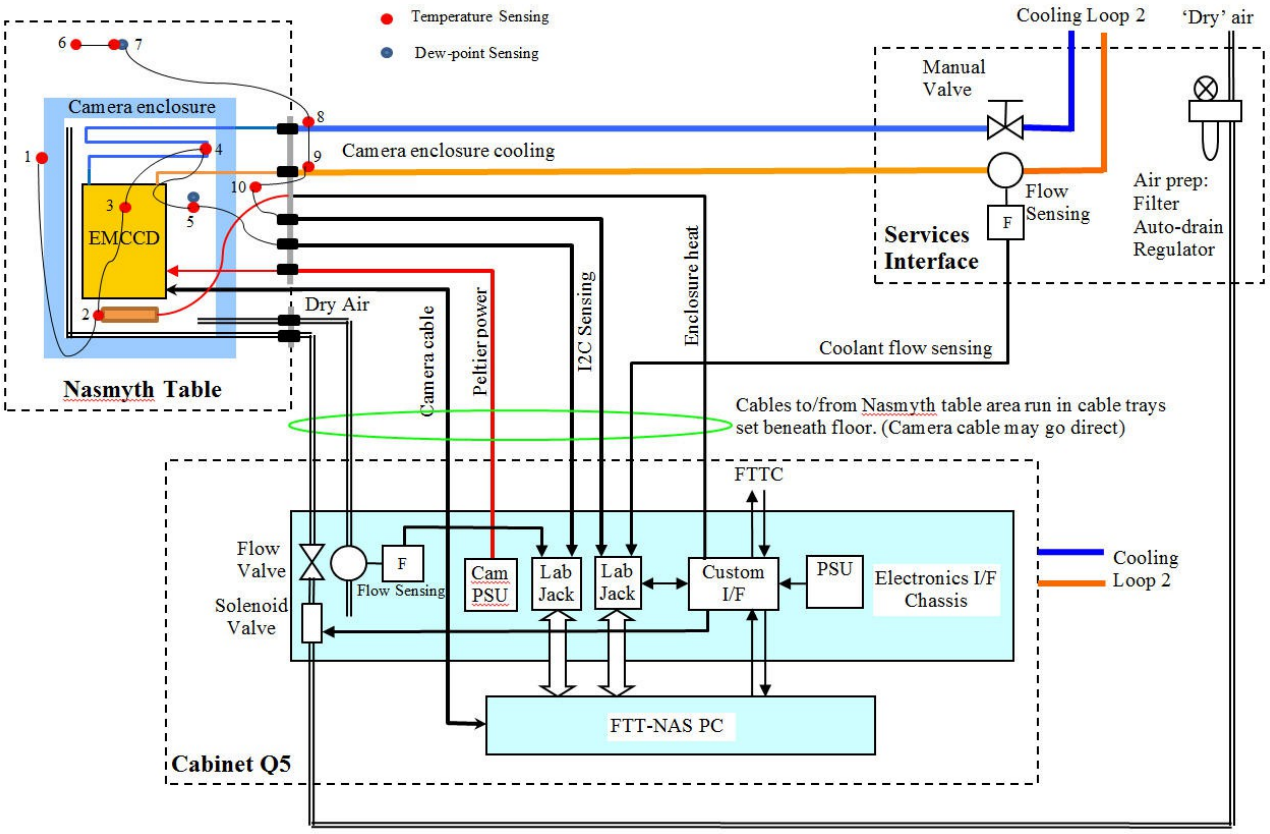


Figure 1 Schematic of the connections between the FLC/FTT camera enclosure, the services and the electronics in cabinet Q5. The interface with EIE services is at the Services interface panel which is to be located on the enclosure wall beneath the Nasmyth table. The remaining interface is the space allocated in Cabinet Q5 and the cable tray between it and the Nasmyth table.

2 Requirements

The requirements of the ICD are to define the cable routes, the connections and locations of the component parts covered by the ICD. These requirements are treated individually in the subsections below.

2.1 Electronics cabinet

The space available for the FTT hardware which needs to reside in this thermally controlled enclosure is 5U high (RD2). This space shall house the following:

1. The FFT/NAS PC
2. The camera Peltier cooler power supply
3. Any additional signal conditioning and electronics interfacing required.
4. Cable routing or connection areas for FTT system cables (including the cables to the FTTA controller)

The maximum power to be used by the components in this space is 250 W (RD1).

2.2 Services Interface

The services required by the FLC/FTT thermal enclosure are cooling fluid from Cooling Loop 2 and dry air from the enclosure compressed air system.

2.2.1 Compressed air

The compressed air shall be passed through a local filter auto-draining water trap and a pressure regulator to ensure that any condensate is removed before it is passed to the control valve in cabinet Q5. As liquid cooling to the camera enclosure is not allowed to fall below dew point then additional drying is not necessary and air is only released into the warm environment of the camera or Q5. The airflow requirement for flushing the camera intermittently is approximately 5 litre per minute and is set by a flow valve in Q5. Any components used must operate over the environmental operating range specified in RD1.

2.2.2 Cooling fluid

Fluid is required to carry heat away from the camera Peltier cooler and from the enclosure itself. The temperature of this cooling fluid should not fall below 0 °C under normal operation. The amount of heat to be carried away is small, approximately 10 W, therefore the flow rate can be met by the cabinet cooling loop and can be adjusted by a manual flow valve if necessary. Any components used must operate over the environmental operating range specified in RD1.

2.3 Cable routing

The cable route from the Nasmyth table to the FTT/NAS PC in Q5 must be no longer than 6 m because of the restriction in length of the cable between the camera and its interface located in the PC. This restriction does not apply to other sensing and control cables between the camera enclosure and the PC but they will use the same route.

3 Design

3.1 Electronics cabinet

The FFT-NAS PC shall be no more than 3U in height and shall be located at the bottom of the 5U space available. The remaining 2U will be occupied by a 2U chassis onto which are mounted the Peltier power supply, the external interface modules for camera thermal enclosure control and environmental monitoring, a custom interface circuit board and intermediate connections for the signals between the PC and the FTTA controller electronics. Connections to this 2U module will be accessed at the rear of the cabinet.

3.2 Services Interface

The coolant and air supply services components are to be mounted on a single panel which is attached to the enclosure structure close to but beneath the Nasmyth table at the end closest to cabinet Q1. The connections from the telescope enclosure will terminate on this panel. The coolant services to the camera will be connected from the valve and flow monitor on the panel to an interface plate fixed to the edge of the Nasmyth table. The compressed air will be filtered and passed on to cabinet Q5 via the cable trays.

3.2.1 Cooling Fluid

The cooling circuit for the camera is shown in Figure 1. A manual valve on the cold inflow controls the flow of the coolant through the camera enclosure and an electronic flow meter on the warmer outflow monitors the flow of coolant for both setting and monitoring purposes. The valve and flow meter are sized at ½" BSP and compatible tubing is used to connect to self-sealing connectors at the Nasmyth table interface plate.

3.2.2 Dry air supply

The 'nominally dry' air supply from the enclosure receiver is regulated, filtered and auto-drained at the services interface panel and passed to the valve and flow meter in Q5. The air is then passed to a self sealing coupling on the Nasmyth table interface plate where a tube from the camera thermal enclosure connects to it. Air returning from the camera enclosure is passed back, through another self-sealing coupling to cabinet Q5 where it is vented to atmosphere.

3.2.3 Nasmyth table interface plate

The interface plate allows easy, local disconnection of the camera from the services and cabling connecting to it. For the coolant fluid and air supplies self sealing couplings will be mounted on this panel for easy disconnection and removal of the camera enclosure. For the coolant reducers are used to connect 10mm ID tubing to the 6 mm ID pipe used in the camera enclosure. For the air supply 6mm ID tubing is used throughout. The interface plate will also provide a cable clamp for the camera cable and connector couplings for cables being routed from the Nasmyth table to the electronics in Q5. Connection from the coolant flow sensor on the services panel shall also be routed via this plate.

3.3 Cable routing

The cable route from the Nasmyth table to the FTT/NAS PC in Q5 must be no longer than 6 m because of the restriction in length of the cable between the camera and its interface located in the PC. This restriction does not apply to other sensing and control cables between the camera enclosure and the PC but they will probably use the same route. The proposed route is depicted in the diagram in Figure 2 below. The route of the cable is segmented into five parts for the purpose of calculating the total path length and the length of each segment is provided in Table 1.

Table 1 Cable length from Nasmyth table to FTT/NAS PC in cabinet Q5.

Segment	Path description	Expected length (m)
1	From camera within enclosure via a clamp arrangement to edge of optical table above the cable tray.	0.5
2	Vertical segment from optical table to cable tray beneath	1.65
3	From cable tray to under cabinet Q1	0.8
4	From under cabinet Q1 to underneath of Q5	2.1
5	From rear of Q5 to FTT/NAS PC	0.75
All	(Specified in RD2 Nasmyth table to bottom of Q5 = 5.5m)	5.8

The location of the 5U of space for the FTT/NAS PC and interface modules is shown in Error: Reference source not found below. This diagram and more detailed information is available in AD2. Assuming the FTT computer is mounted in locations 11 to 12 (or 13) the distance from the bottom of the rack to this height is 12 × U, where U = 44.5 mm. Together with some allowance for bringing the cable up from the cable tray and for plugging into the camera interface at the height of the PC the length required for this segment is approximately 533 + 100 + 100 = 733 mm. This cable length is assessed using straight lines following the ducting and so over-estimates the length required. It also assumes that cable exit from the camera connector is towards the rear of the camera.

Should this cable route be too short an alternative might be to bring the cable up from the Nasmyth table to the enclosure structure and route around to a location above Q5 but cable entry may only be available from the bottom of Q5 and so there would be little saving.

Table 2 Allocated space within cabinet Q5.

24	UTE (9U)
23	
22	
21	
20	
19	
18	
17	
16	
15	FTT (5)
14	
13	
12	
11	
10	Network switchable Power Distribution Unit (1U)
9	UTCS PC (including GPS card)
8	(2U)
7	M2 hexapod controller
6	(4U)
5	
4	
3	M2 FTTA controller
2	(3U)
1	

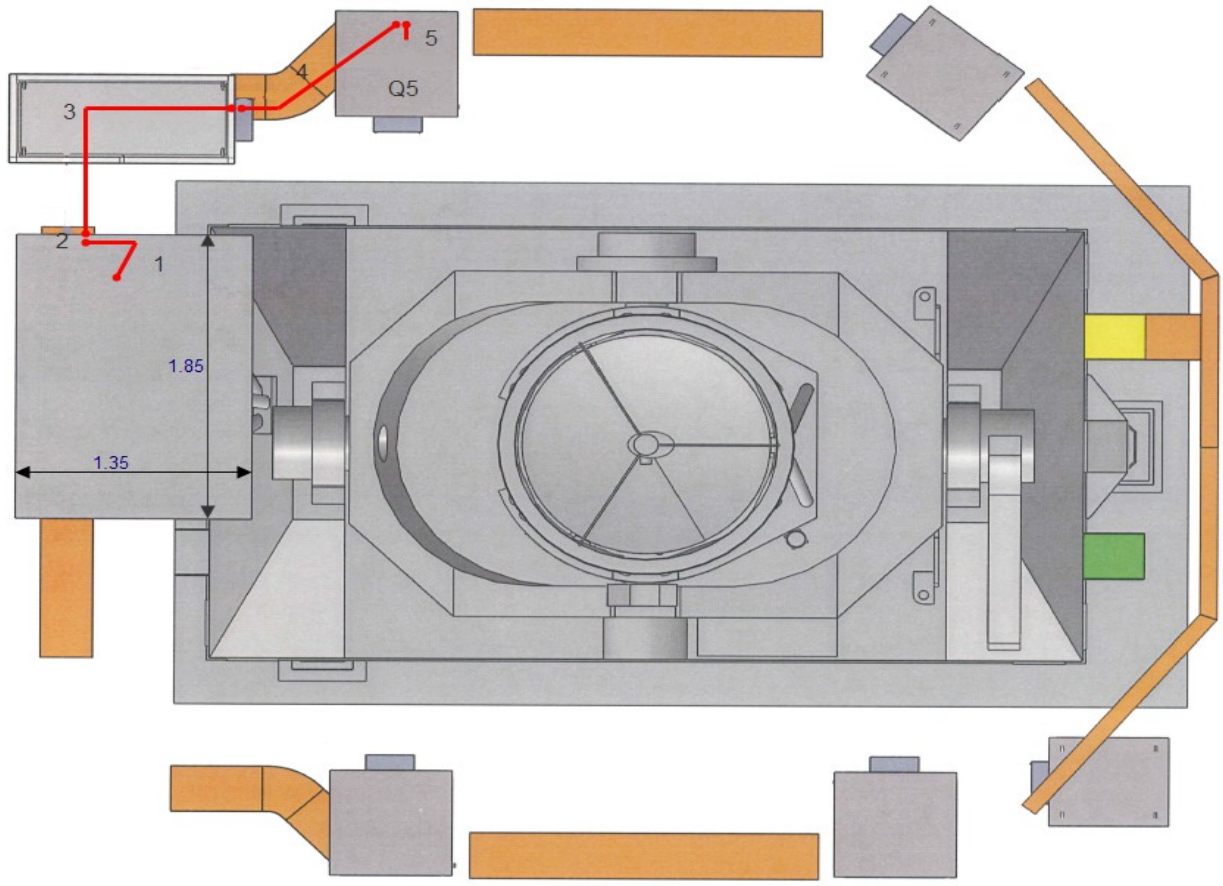


Figure 2 The conventional cable route from Nasmyth table to electronics enclosure Q5. The cable path is segmented from 1 to 5 and the calculated lengths of these segments is provided in Table 1.

4 Interface Control

4.1 Electronics cabinet Q5

4.1.1 Space allocation

5U space required (3U maximum for FTT/NAS PC and 2U for interface chassis)

Location: 11U to 15U slot (lower locations preferred if camera cable length becomes an issue)

4.1.2 Power supply

The power requirements for the NAS/FTT (or FLC) components at the electronics cabinet are listed in Table 3 below. This is slightly less than the 250W budget for the system.

Component	Power consumption (W)
FTT/NAS PC	150
PCI Analog interface board	13.5
Camera, including PCI I/F Peltier supply	25 15
Interfacing components Labjacks PSU	10 0.5 10
Enclosure heater (when on)	10 max
Total power consumption	234 max

Table 3: Power requirements for FTT/NAS or FLC systems

4.2 Services Interface Requirements

4.2.1 Cooling

Cooling Loop 2 to be available at Nasmyth Table services interface panel.

Connection: ½” BSP

Maximum pressure: 7 bar

Flow rate requirement: minimum of 2 litres per minute

4.2.2 Air supply

Air supply to be available at Nasmyth Table services interface panel.

Connection: ½” BSP

Air pressure not to exceed 15 bar.

Flow rate requirement: approximately 5 litres per minute

Water content: nominally dry air (for use in warm enclosures).

5 Appendix

For information only: extract from MRO-ICD-AMO-0000-022

5.1 Common specifications

- Type of coolant: Water + 50% Vol. propylene glycol
- Fluid connection:

Placed in the North-West (-X/+Y) wire way of the telescope

AMOS side: quick coupling two way self-locking connectors Staubli RMI 9

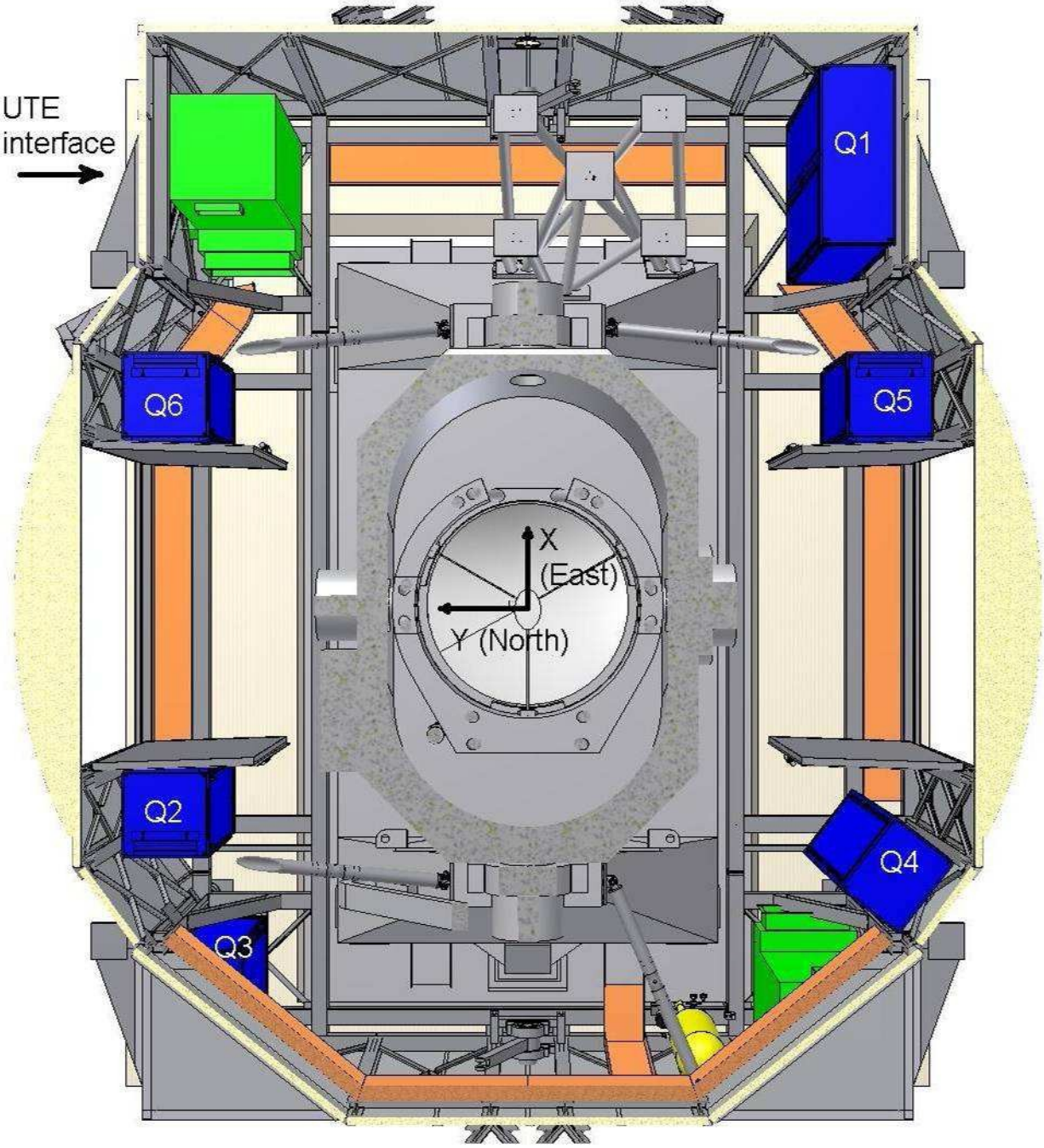
MRO side: flexible rubber hose, 12 mm inside diameter

5.2 Loop 1 Main Motors Cooling

- Inlet Pressure: 5.5±0.5 bar
- Night time operation only (not fed during daytime)
- Temperature range: -20°C to +15°C
- Temperature set point: $T_{ambient}$ - 5°C and above the due point
- Liquid flowrate: 6 l/min
- Pressure drop: 3.5 bar @ -20°C

5.3 Loop 2 Gimbal Cabinets & WFS Cooling

- Inlet Pressure: 4.5±0.5 bar
- Continuously in operation (daytime/nightime)
- Temperature range: +1°C to +18°C
- Temperature set point: $T_{ambient}$ - 2°C and above the due point
- Liquid flowrate: 3.6 l/min
- Pressure drop: 1.5 bar @ 1°C


UTE
interface
Q1
Q6
Q5
X
(East)
Y (North)
Q2
Q4
Q3