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WRITTEN BY: Joan Ariño

CHECKED BY: Albert Tomás

APPROVED BY: Albert Tomás

PRODUCT ASSURANCE: Enrique Garcia

.

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1.0	02/04/00	1-37	Issue released as part of the MARES CDR data package	Joan Ariño

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LIST OF ACRONYMS

ADAS	Ambulatory Data Acquisition System
ADP	Acceptance Data Package
BMU	Basic Motion Unit
CB	Crew Branch
CCB	Configuration Control Board
CIL	Critical Items List
C.o.G.	Centre of Gravity
COTS	Commercial-of-the-Shelf
CSCI	Computer Software Configuration Items
CR	Change Request
DCN	Drawing Change Notices
DR	Discrepancy Report
EEE	Electrical, Electronic, and Electromechanical
EGSE	Electrical Ground Support Equipment
ESA	European Space Agency
EUE	Experiment Unique Equipment
FMEA	Failure Modes and Effects Analysis
FRD	Functional Requirements Document
GIDEP	Government and Industry Data Exchange Program
GSE	Ground Support Equipment
HRD	Hardware Requirements Document
ISPR	International Standard Payload Rack
ISS	International Space Station
HRF	Human Research Facility
JSC	Johnson Space Center
LSA	Launch Structure Assembly
MARES	Muscle Atrophy Research and Exercise System
MGSE	Mechanical Ground Support Equipment
NASA	National Aeronautic & Space Administration
MVC	Maximal Voluntary Contraction
NSTS	National Space Transportation System
PDA	Pre-delivery Acceptance Test
PEMS	Percutaneous Electrical Muscle Stimulator
PIA	Pre-installation Acceptance
PRD	Program Requirements Document
PSC	Physiological Signal Conditioner
QA	Quality Assurance
ROM	Range of Motion
S&MA	Safety and Mission Assurance
SDP	Software Development Plan
SIR	Standard Interface Rack
SMACAR	Safety and Mission Assurance Certification Approval Request Form
SMD	Strength Measurement Device
STO	Sub-Task Order
TBD	To Be Determined

TPS	Test Preparation Sheet
TRR	Test Readiness Review
UOP	Utility Outlet Panel
VIF	Vibration Isolation Frame

1. Introduction

1.1 Purpose

The purpose of this Document is to define the MARES interfaces with HRF human research facility.

1.2 Scope

The specifications established herein are applicable only to the MARES. This document defines the external interfaces in the section three and the internal ones in the section four.

1.3 Muscle Atrophy Research and Exercise System (MARES)

MARES is a physiological research facility, part of the HRF, to be used on board ISS.

MARES will be used to carry out research on muscle-skeletal, biomechanical, neuromuscular and neurological physiology, to study the effect of microgravity on the human being, and to evaluate the effect of the countermeasures to the Space environment induced physiological effects.

MARES can also be used to evaluate the performance of exercise tests protocols.

The MARES hardware is aisle mounted hardware, capable of assessing the strength of isolated muscle groups, around specific joints or on complete limbs, by measuring and controlling the interrelation between speed and torque/force, as functions of time.

The principal components of MARES shall be: main assembly consisting of main box and vibration isolation frame, chair, human interface adapters, launch structure assembly and a laptop computer for interaction with the crew. MARES shall also include the associated cables to connect the various MARES components together, to the ISS and to HRF.

During launch and landing, the MARES elements will either be mounted on the Launch Structure Assembly (LSA) or stowed in launch containers. During on-orbit operations, MARES will be deployed in the aisle. When not used on-orbit MARES will be stowed.

The MARES facility will be launched in different packages for easy launch accommodation. Once in orbit MARES will have to be assembled.

The Main Assembly for MARES will consist of the Main Box and the Vibration Isolation Frame.

The MARES Main Box will contain a motor, controller, power electronics, supervision electronics, battery, set of harnesses devoted to subsystems interconnection, heat rejection systems and angular motion and torque sensors.

2. Applicable and Reference Documents

2.1 SPECIFICATIONS

SSP-30245	rev. B	Space Station Electrical Bonding Requirements
SSP 30512C	rev. C	Space Station Ionizing Radiation Design Environment
SSP 57000	Rev. A 2 Feb. 98	Pressurized Payloads Interface Requirements Document
SSP 50018	28 June 96	International Space Station (ISS) Standard Stowage Accommodations Handbook

2.2 STANDARDS

JHB-8080.5	.5	JSC Design and Procedural Standards Manual
SSP-50005B	Aug. 95	International Space Station Flight Crew Integration

2.3 PUBLICATIONS

GPQ-010 + Change Not. 01	Issue 1, Revision 0	Product assurance requirements for ESA microgravity projects.
GPQ-010-PSA-101	Issue 1, Revision 0	Safety and materials requirements for ESA microgravity payloads (ISSA)
GPQ-010-PSA-102 + Change Not. 01	Issue 1, Revision 0	Reliability and maintainability for ESA microgravity facilities (ISSA)
LS-71053-1	Issue 2, Revision 3, August, 1998	Hardware Requirements Document (HRD) For the Muscle Atrophy Research And Exercise System (MARES) Of The Human Research Facility (HRF)
LS-71001	rev. A Nov. 25, 1996	Functional Requirements Document for the Human Research Facility
MARES-SP-007-03-NTE	31.07.97	MARES Payload Software Specification
MAR-701-ESA/AK	4.D 23 March 1998	Science and Operations Evaluation Plan (SOEP)
PIRN 57000-NA-066B to SSP 57000	03/4/98	Fire Detection and Suppression Requirements
LS-40104	April 30, 1997	Neurolab Experiment, SRD for E049, E095, and E294. Studies of the Autonomic Nervous System.
LS-40105	May 28, 1997	Neurolab Experiments, SDD.

2.4 SELECTION OF SPECIFICATIONS AND STANDARDS

Specifications and standards necessary for design and development shall be selected in the following order of preference, except as otherwise specified in this document. The exact issue shown is to be used, unless otherwise specified in this document.

In case of conflict, the order of precedence shall be:

1. The MARES HRD LS-71053-1
2. The three ESA publications quoted at the start of 2.3
3. SSP 57000
4. LS-71xxx documents from the Human Research Facility
5. NASA specifications and standards
6. Manned spacecraft criteria and standards
7. Federal specifications and standards
8. Military specifications and standards
9. Other governmental specifications and standards
10. Specifications released by nationally recognised associations, committees, and technical societies

2.5 Reference documents

LS-71098	April 1997	Common Hardware Implementation Plan (Chip) For the Human Research Facility
SSP 30242	03/06/94 Revision C	Space Station Cable/Wire Design Requirements for Electromagnetic Compatibility

3. Interfaces

3.1 Interfaces definition

MARES interfaces either with, HRF Workstation or second HRF Portable Computer for data communications, external instrumentation like Physiological conditioner (PSC), and Percutaneous Electrical Muscle Stimulator (PEMS) for data acquisition and control.

Furthermore MARES will have a test connector for calibration and troubleshooting purposes.

MARES HRF interfaces definition matrix

	MARES			
	Mechanical i/f	**Electrical i/f**	**Thermal i/f**	**Comd&DH i/f**
HRF Removable Hard Disck	MARES-HD-M			
HRF Work Station				MARES-WS-SW
MARES HRF Portable Computer		MARES-PC-E		MARES-PC-SW
External Devices		MARES-ExD-E		MARES-ExD-SW
HRF Common Hardware		MARES-Test-E		

M: mechanical interface

E: Electrical interface

TH: thermal interface

SW: Command and data handling interface

3.2 Interfaces Requirements

3.2.1 Structural Mechanical Interfaces

3.2.1.1 MARES to HRF removable Hard Disck interface (MARES-HD-M)

Through this interface MARES will be able to interchange files with the HRF workstation by the procedure of carry the Hard Disk from MARES to HRF workstation and viceversa.

HRFIS 3.2.1.1.1.1.1.10

MARES shall be able to accommodate two HRF removable Hard Disks being compatible with the interface defined in the NASA drawing 'SDG46115663'.

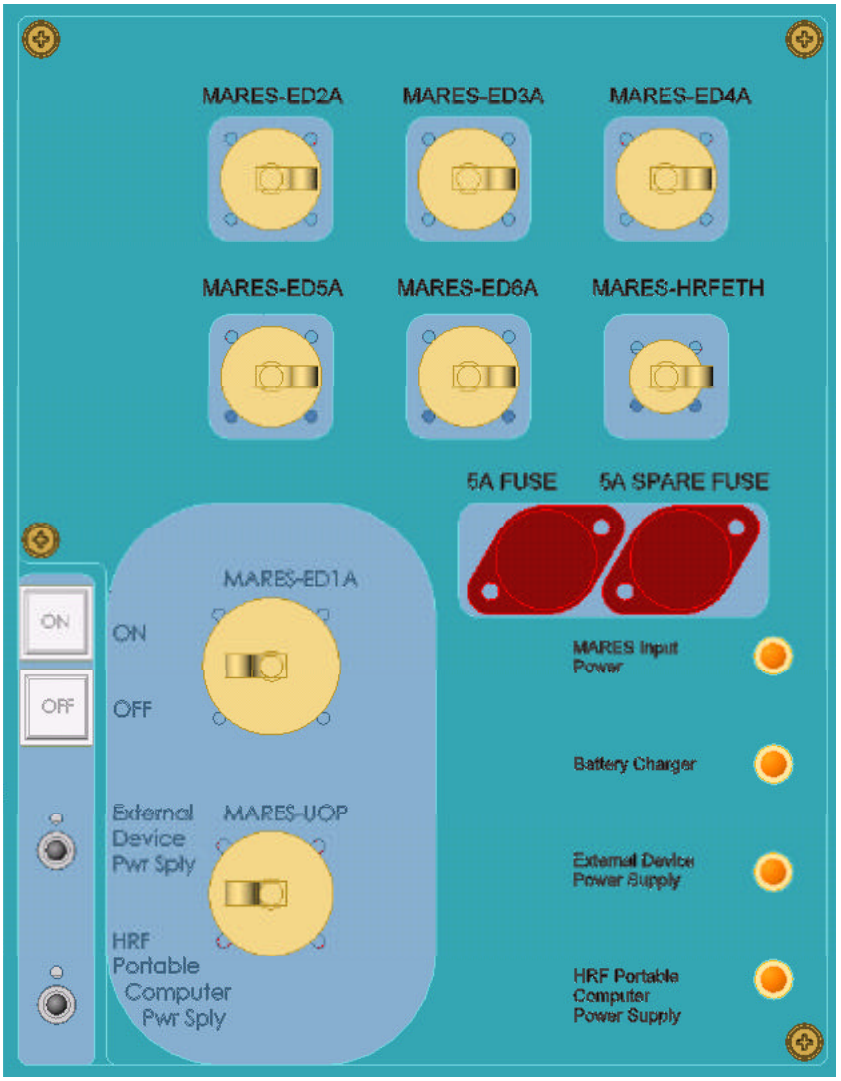
3.2.1.2 MARES conector pannel

MARES shall have a so called Conector Pannel grouping

- All the external connectos
- 4 leds indicating the MARES status.
- The MARES ON/OFF pushbuttons
- Two circuit breakers. That protects the External Devices and MARES PCS power suplies outputs
- Two fuses holders. One with the fuse that protects the MARES interface with the ISS power bus and another carring a spare fuse.

HRFIS 3.2.1.2.1.1.1.10

This CMP shall be placed in the right (front view) lateral pannel of the MARES main box and shall have the following distribution:



3.2.2 Electrical Interfaces

3.2.2.1 MARES to HRF Portable Computer Electrical Power Interface (MARES-PC-E)

Although this is an internal interface due the fact that this Portable Computer will be provided by HRF its electrical characteristics are included in this document

Through this interface the MARES HRF Portable Computer will be powered from the MARES main box.

HRFIS 3.2.2.1.1.1.10

MARES will provide power connection for the Portable Computer through the connector defined in Table 3.2-1.

Connector name:	**Type:**	**Features:**
MARES-PCPW	MS27656T17F6S	Female 6 pins #12 (Series I)

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
A	Portable Computer +28 V	Power/out	HO	Voltage: 28±0.5 Current: up to 2 Amps Load reg(Pout 10% to 100%) ±500mV	Portable Computer power supply
B	Portable Computer +28 V return	Power/out	HO		
C	Chassis Ground				
D-F	Not connected				

Table 3.2-1 Portable computer power interface

HRF will provide the following external cables:

- SEG46115568 defined as HRF common hardware in LS-71098 Document
- SEG46115488, SEG46115488 defined in Interface Definition Document For The Human Research Facility Portable Computer.

HRFIS 3.2.2.1.1.1.20

MARES shall provide 28 ± 1 volts through this interface under any load condition defined below.

HRFIS 3.2.2.1.1.1.30

MARES shall be able to provide a continuous current of 2 amps.

HRFIS 3.2.2.1.1.1.40

MARES shall be able to provide a peak current of 2.5 amps until the circuit breaker will trip.

HRFIS 3.2.2.1.1.1.50

MARES output power supply shall provide a load regulation of ± 500 mV for a load change from 10% to 100%.

HRFIS 3.2.2.1.1.1.60

MARES output power supply shall provide a ripple lower than 100 mV.

HRFIS 3.2.2.1.1.1.70

MARES shall provide an over-current protection using a circuit breaker. This circuit breaker will be 2 amps rated and will met the requirements of the MIL-C-39019C, time delay A.

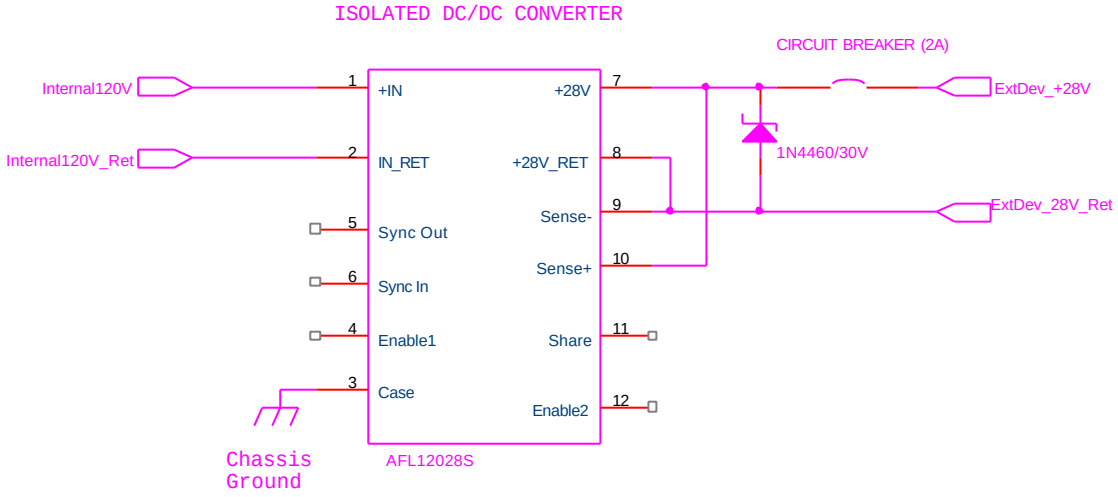
HRFIS 3.2.2.1.1.1.80

This power outlet shall be protected against reverse currents of up to:

- 5 Amps, in pulses of up to 1 ms
- 2.5 Amps, in pulses of up to 10 ms
- 0.15 Amps, in steady-state

HRFIS 3.2.2.1.1.1.90

The equivalent circuit of the power supplies output shall be:



3.2.2.2 MARES to External Devices Electrical Power Interface (MARES-ExD-E)

MARES will provide power supply for external instrumentation like Physiological conditioner (PSC), and Percutaneous Electrical Muscle Stimulator (PEMS).

HRFIS 3.2.2.2.1.1.10

MARES shall provide power supply to external devices through the connector defined in Table 3.2-2

Connector name:	**Type:**	**Features:**
MARES-ED1A	MS27656T17F6S	Female 6 pins #12 (Series I)

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
A	ExtDev+28 ps	Power/out	HO	Voltage: 28±0.5 Current: up to 2 Amps	External device power supply
B	ExtDev+28 ps return	Power/out	HO		
C	Chassis Ground				

Connector name:	**Type:**	**Features:**
MARES-ED1A	MS27656T17F6S	Female 6 pins #12 (Series I)

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
D-F	Not connected				

Table 3.2-2 External Device power supply connector

HRFIS 3.2.2.2.1.1.1.20

MARES External Device Power supply shall be in accordance with the defined in HRFIS 3.2.2.1.1.1.1.10 to 90

3.2.2.3 MARES-Test-E

Through this interface it will be possible to monitor the Control Electronics power supply, and the time base used by MARES .

The interface will consist on four BNC connectors compatible with the Scopemeter Assembly defined as part of the Diagnostic Caddy as common hardware in the Common Hardware Implementation Plan (CHIP) for the Human Research Facility LS-71098 document.

In order to acces to these connectors it shall be necessary to remove the MARES back cober.

HRFIS 3.2.2.3.1.1.1.10

Connector name:	**Type:**	**Features:**
MARES-TC1A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	CE+5Mon	Analogue/ out	ML	Nominal value=5Volt	CE +5 PS monitoring
2	CE+5Mon Ret				

HRFIS 3.2.2.3.1.1.1.20

Connector name:	**Type:**	**Features:**
MARES-TC2A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	CE+12Mon	Analogue/ out	ML	Nominal value=12Volt	CE +12 PS monitoring
2	CE+12Mon Ret				

HRFIS 3.2.2.3.1.1.1.30

Connector name:	**Type:**	**Features:**

MARES-TC3A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	CE-12Mon	Analogue/ out	ML	Nominal value= -12Volt	CE –12 PS monitoring
2	CE-12Mon Ret				

HRFIS 3.2.2.3.1.1.1.40

Connector name:	**Type:**	**Features:**
MARES-TC4A		BNC

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	4Kclock	Digital signal, VH = 3 Volts VL = 1 Volt	RF	Nominal value=4 KHz	Time base monitoring
2	4Kclock ret				

HRFIS 3.2.2.3.1.1.1.50

Serial lines compatibles with the HRF PCS, ComCard232/422/485/2 PCMCIA card connector

Connector name	**Type**	**Features**	**Remarks**
MARES-TC5A	DBEE 1031Z012-130	Receptacle, 12 male pins	Serial RS232 Debug Chanel from MASTER CPU
MARES-TC6A	DBEE 1031Z012-130	Receptacle, 12 male pins	Serial RS232 Debug Chanel from SLAVE CPU

Connectors pin out

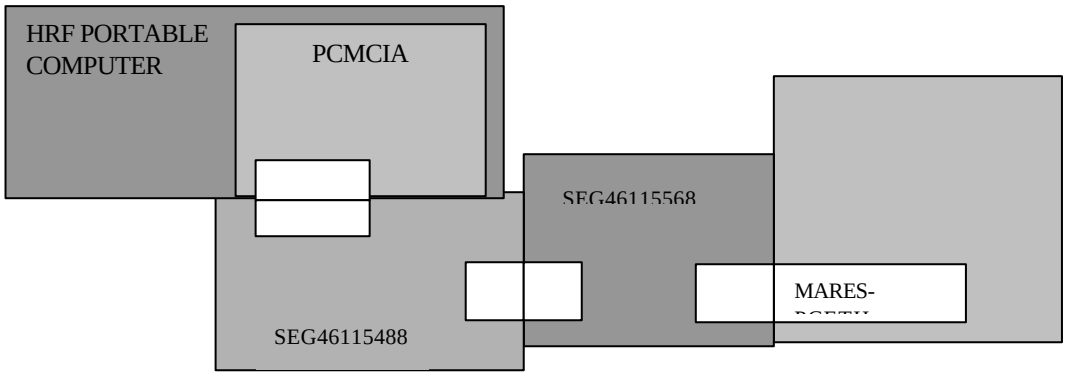
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	Controller RST	TTL IN GND	HO	Connect the two signals to reset the CE	Controller reset. To be used only during development
2	Controller RST ret				
3	Not connected				
4	Not connected				
5	Not connected				
6	Chassis ground				
7	Not connected				
8	Not connected				
9	Not connected				
10	RS 232 Rx	RS232/IN		RS232 serial channel: 9600, 8bits, No parity, 1stop bit	Serial debug and troubleshooting channel
11	RS 232 Tx	RS232/OUT			
12	RS 232 GND				

3.2.3 Command and Data Handling Interfaces

3.2.3.1 MARES to HRF Portable Computer Command and Data Handling Interface (MARES-PC-SW)

Although this is an internal interface due the fact that this Portable Computer will be provided by HRF it is included in this document

Through this interface MARES Main box will establish communication with MARES HRF Portable Computer over



an Ethernet link.

HRFIS 3.2.3.1.1.1.10

MARES shall provide Ethernet connection for the Portable Computer through the next defined connector (MARES-PCETH)

Connector name:	**Type:**	**Features:**
MARES-PCETH	MS27497T8F35S	Female 6 pins #22

Connectors pin out

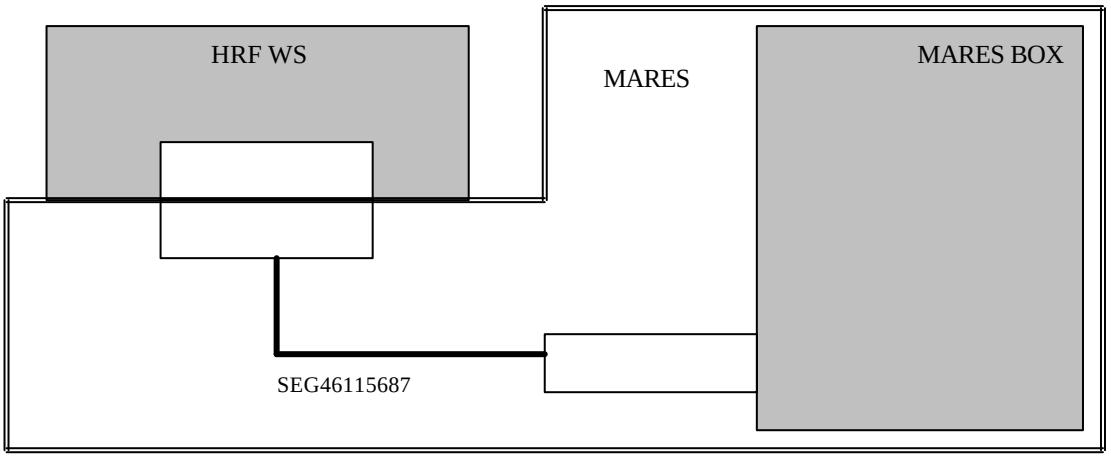
Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	Ethernet TX+	Ethernet	RF	IEEE 802.3 i 10-BASE-T Ethernet/ IEEE 802.3 u 100-BASE-Tx Ethernet. Automatic sensing	Ethernet channel TX
2	Ethernet RX Shield				
3	Ethernet RX+	Ethernet	RF		Ethernet channel RX
4	Ethernet RX-	Ethernet	RF		Ethernet channel RX
5	Ethernet TX-	Ethernet	RF		Ethernet channel TX
6	Ethernet TX Shield				

Table 3.2-3 Portable Computer Ethernet interface

3.2.3.2 MARES to Human Research Facility Rack Command and Data Handling Interface (MARES-HRF-SW)

This interface shall consist on a connector on the MARES connector panel plus a cable able to connect MARES to the HRF WS connector.

Although the MARES external interface consist only in the MARES-HRFETH connector all the harness definition is included



HRFIS 3.2.3.2.1.1.1.10

MARES shall interface with the HRF Ethernet port through a standard harness 5 meters long, SEG46115687 as defined in LS-71098 Document, provided by HRF.

The MARES-HRFETH connector in the MARES main box connector panel is defined in Table 3.2-4

Connector name:	**Type:**	**Features:**
MARES-HRFETH	MS27497T8F35S	Female 6 pins #22

Connectors pin out

Pin Num	Signal	Signal type	Circuit Class (SSP30242)	Remarks	Description
1	HRF Ethernet TX+	Ethernet	RF	IEEE 802.3 i 10-BASE-T Ethernet/ IEEE 802.3 u 100-BASE-Tx Ethernet Automatic sensing	Ethernet channel TX
2	HRF Ethernet RX Shield				
3	HRF Ethernet RX+	Ethernet	RF		Ethernet channel RX
4	HRF Ethernet RX-	Ethernet	RF		Ethernet channel RX
5	HRF Ethernet TX-	Ethernet	RF		Ethernet channel TX
6	HRF Ethernet TX Shield				

Table 3.2-4 Ethernet connector MARES-HRFETH.

As reference, the harness description is presented in Table 3.2-5.

Connector name:	**Type:**	**Type:**	**Connector name:**
MARES-HRFETH	MS27484T8F35P	MS27484T8F35P	HRF.WS-C1B

Male: 6 pins #22			Male: 6 pins #22	
Connectors pin out			**Connectors pin out**	
Pin Num	**Signal**	**Description**	**Signal**	**Pin Num**
1	TX+		RX+	3
2	RX Shield		RX Shield	2
3	RX+		TX+	1
4	RX-		TX-	5
5	TX-		RX-	4
6	TX Shield		TX Shield	6

Table 3.2-5 SEG46115687 Ethernet cable.

HRFIS 3.2.3.2.1.1.1.20

The network protocol will be TCP/IP.

The data to be transferred may be grouped in the following two categories:

- Files transferring: That includes MARES software updating, up-loading of experiments and down-loading of experiments executions related data.
- On line data transferring: real time transmission of experiment execution related data for down-link purposes by HRF.

3.2.3.2.2 MARES IP addresses

HRFIS 3.2.3.2.2.1.1.10

The MARES IP address seen from HRF will be TBD.
In this document all references to this address will be as **MARES_HRF_IP**

3.2.3.2.3 MARES-HRF files transfer

Through this interface it will be possible to do the maintenance of the MARES Hard disk, updating the MARES SW, storing new experiments files, and retrieving the data files obtained in experiments previously executed.

HRFIS 3.2.3.2.3.1.1.10

In order to make the MARES Hard Disk available to HRF, MARES will provide a File Transfer Protocol (FTP) server. This FTP server will support the following commands suggested by RFC-959 for minimal FTP server implementation.

- HELP –List supported commands
- USER- Verify user name
- PASS –Verify password for the user
- QUIT – Quit the session
- LIST - List out contents of directory
- NLST -List directory contents using a concise format
- RETR –Retrieve a file
- STOR -Store a file
- CWD - Change working directory
- TYPE - Change data representation type
- PORT - Change the port number
- PWD - Get the name of current working directory

- STRU - Change file structure settings
- MODE - Change file transfer mode
- ALLO - Reserve sufficient storage
- ACCT - Identify the users account
- PASV -Make the server listen on a port for data connection
- NOOP -DO nothing

HRFIS 3.2.3.2.3.1.1.20

It will be possible to connect to this server with any user name and password including the standard anonymous connection. This server will be accessible by a FTP client at the IP address stated for the HRF connection **MARES_HRF_IP** (see previous section **MARES IP addresses**).

3.2.3.2.4 MARES file system

UIS and PCUS applications rely on the existence of a MARES File System storing all MARES software executable files, configuration data, experiment definition files and other data within the fixed logical directory and file structure next defined.
MARES has two 18 Gbytes removable units, that will be used as follow :

HRFIS 3.2.3.2.4.1.1.10

MARES will divide each disk in four 4gbytes partitions. Building on each partition a Dos file system, FAT 16, compatible with MS-DOS versions up to and including 6.2. Supporting filenames lenth up to 40 character.

HRFIS 3.2.3.2.4.1.1.20

One of the partitions shall be reserved to the system files. This partition with the name of MARESSYS will have the following basic directories structure:

MARESSYS	PCUS	PCUS executables and system configuration files		
	UIS	UIS executables, system configuration files, Crew Member Database		
	Templates	Experiments	Pre-defined Experiment Templates	
		Profiles	Pre-defined Profile Templates	
		Ref Docs	Reference Documentation templates	
		Tables	Pre-defined Tables templates	
		Batch_files	Batch files created for troubleshooting	
		…		
	Temporal	Ipp_files	Files archived for ipp.	
		Log_files	MARES Log files	
	User_templates	Templates defined by the user		
	Permanent_Data	Experiment 1	Subject Name 1	Permanent data
		…	…	
		Experiment N	Subject Name N	Permanent data

Figure 4. MARES_SYSTEM

HRFIS 3.2.3.2.4.1.1.30

All the other partition shall have the following structure and will be used for experiments (definition and data) storage and will be named (volume name) as MARESD00 to MARESD06

MARESD0n	Experiments	Experiment 1	Definition	Experiment procedures, profiles, waves, tables, data pool configuration, etc.
			Temporal_data	Temporal storage of data to be later moved to the HRF workstation for down-link
		Experiment 2	Definition	
			Temporal_data	
		…		

Data resulting from the definition of a given experiment will be stored, under a dedicated directory for that experiment. During the experiment's execution, this data will be picked up and used to control the motor appropriately.

HRFIS 3.2.3.2.4.1.1.40

The relevant scientific data obtained during the experiment's execution will be stored under the experiment's directory at the folder Temporal_data\SubjectName\Exptime.
In case that the SubjectName has blank spaces MARES shall replace them by the underscore character "_".
Where "Exptime" is the date+time at which the experiments run starts in the following format: DDmmmyyyy[HHhMMmSSs] (f.i. 03Dec2000[14h23m05s]).
These files will contain a stream of experiment packets with the same format that the ones defined for HRF on line data transfer (See next section 3.2.3.2.5).

HRFIS 3.2.3.2.4.1.1.50

The maximum file size allowed is 1.4Mbytes. The files will be named with the daytime at which the oldest data they contain was acquired.
The format will be HHhMMmSS. Being the characters "h"; "m" separators (f.i. 23h04m35.dlk)
The filename extension will be "dlk"

3.2.3.2.5 MARES-HRF on line data transfer

HRFIS 3.2.3.2.5.1.1.10

During the execution of experiments MARES will transmit to HRF the experiment related data, using TCP/IP stream socket protocol in a client/server configuration with a maximum throughput of 100 Kbytes/s.

HRFIS 3.2.3.2.5.1.1.20

MARES will act as server waiting (listen) for the HRF(client) connection at the IP address **MARES_HRF_IP** port number 2000.

HRFIS 3.2.3.2.5.1.1.30

MARES will support the connection of only one client at the same time

HRFIS 3.2.3.2.5.1.1.40

At client HRF connection MARES will continuously send the experiment data packets.

HRFIS 3.2.3.2.5.1.1.50

Simultaneously with the experiment execution MARES will store the experiment data packets in its Hard Disk independently if a HRF connection is done or not. This will allow to recover the data by FTP (see section **MARES-HRF files transfer**) in case of transmission error or no connection during experiment execution.

3.2.3.2.6 Experiment Data packets

The data packets defined in this section has been designed in order to accommodate the following kinds of data:

- High sampling rate data, up to 4KHz.
- Low sampling rate data, below 1Hz.
- Trigger signals: Digital signals that only change one time every several seconds, but with synchronisation constrains of 1 millisecond.
- 16 bits wide data
- 32 bits wide data
- Strings

Other constrains:

- Only a subset off all MARES related data will be transmitted/stored for one specific experiment.
- The sampling rate and the acquisition time slots of each data are experiment specific.
- For each experiment it is possible to define new signals (user defined, unknown at MARES design time)
- The Synchronisation among the data corresponding to different signals must be kept inside 1milisecond for sampling rates over 1KHz and trigger signals, and a half of the sampling period for the others.

HRFIS 3.2.3.2.6.1.1.10

MARES experiment data packet definition:
Each packet will contain a header defining the packet contents followed by a data block containing the experiment data with the following format:

Start Header Codes		Version	Experiment Id code	
0x5374 0	0x6148 1	2	3	4
Experiment Name (32 chars)				
5				21
Subject Name (32 chars)				
22				38
Experiment num of repeat				
39				
Experiment Timestamp				
Year	Month –Day	Hour-Minutes	Secon.-hundredths	
40	41	42	43	
Packet Timestamp				
Year	Month –Day	Hour-Minutes	Secon.-hundredths	
44	45	46	47	
Packet time offset				
48	49	50	51	
N. of parameters	Packet length	Packet Sequence		
N+1 52	53	54	55	
Parameter 1 id Code	Parameter 1 Sequence	Parameter 1start index	Parameter 1 length	Parameter 1 time offset
56	57	58	59	60 61
Parameter N id Code	Parameter N Sequence	Parameter N start index	Parameter N length	Parameter N time offset
62+N*6	63+N*6	64+N*6	65+N*6	66+N*6 67+N*6
End Header Codes				
0x456E	0x6448			
Data blocks				
Packet checksum				
16 bits word	16 bits word	16 bits word	16 bits word	16 bits word 16 bits word
Bits scale				

Start Header Codes: 32 bits codes identifying the beginning of a packet. This code corresponds to the ASCII characters “StaH”.
End Header Codes: 32 bits code identifying the end of a header. This code corresponds to the ASCII characters “EndH”.
The aim of the previous codes is to allow the recovery of the data from damaged files. It may be used as packet synchronism flags. The possibility that in the packet body it exists the same codes in the same sequence and with the same separation between the Start Header Codes and the End Header Codes is very low.

Version: 16 bits identifying the packet version, BCD coded. It will start at version 1.0 to be coded as 0x0100
Experiment Id code: 32 bits identifying the experiment.
Experiment Name: The first 32 characters of the experiment name
Subject Name: the first 32 characters of the subject name
Experiment num of repeat: number of times the experiment has been executed by the present subject.
Experiment Timestamp: Absolute time at which the experiment started. In the format defined in the definition of Packet Timestamp.

Packet Timestamp: Absolute time at which the first parameter was acquired and added to the packet
This timestamp will contain the year, month, day, hour, minutes, second and Seconds hundredths coded in BCD. For example the date/time 11:58:23,89 of the 1998-12-28 will be coded as

Timestamp (64 bits)							
Year		Month –Day		Hour-Minutes		Secon.-hundredths	
0x19	0x98	0x12	0x28	0x11	0x58	0x23	0x89

At MARES power on the time/data of MARES will be synchronised with the time/data of the Thinkpad (PCS) connected to MARES.

Packet time offset: 64 bits double giving the time (in microseconds) between the start of the experiment and the time point in which the firts parameter of the packet was acquired.

N. of parameters: 16 bits unsigned integer giving the number of parameters inside the packet

Packet length: 16 bits unsigned integer giving the number of 16-bits word of the packet. It includes the packet header and the Packet checksum bytes. The overall packet length is limited to 2*2^16 ≅130Kbytes.

Packet Sequence: 32 bits unsigned integer giving the packet sequence number. This sequence number will be restarted to zero at each start experiment execution and increased by one at each new packet. In case of overflow this number will be restarted.

For each parameter in the packet the following 6 words will be added to the header

Parameter id Code	Parameter Sequence	Parameter start index	Parameter length	Parameter time offset	

Parameter id Code: 16 bits code identifying the parameter. These codes will be build at experiment definition time. The high nibble will identify the type of parameter as follows:

0x0XXX	8 bits ASCII character
0x1XXX	8 bits unsigned
0x2XXX	8 bits signed
0x3XXX	16 bits signed integer
0x4XXX	16 bits unsigned integer
0x5XXX	32 bits signed integer
0x6XXX	32 bits unsigned integer
0x7XXX	32 bits float
0x8XXX	64 bits signed integer

0x9XXX	64 bits unsigned integer
0xaXXX	64 bits float (double)
0xbXXX	String of ASCII characters
0xcXXX	Digital signal (8 bits coded: 0 for zero, any other code for one)
0xdXXX	Digital signal (1 bit coded)
0xeXXX	Timestamp
0xfXXX	Unused

This identification code assignment mechanism allows 4096 different parameters of each type

Parameter Sequence: 16 bits unsigned integer giving the count of the parameter presence in the transmission packets. At experiment start and at overflow the sequence count will be reset to zero. At each presence of the parameter in a packet the Parameter Sequence will be increased by one.

Parameter start index: 16 bits unsigned integer giving the offset, in 16 bits words from the beginning of the packet header, to the first value of the parameter.

Parameter length: 16 bits unsigned integer giving the number of samples of the parameter contained in the packet. The number of bytes or words will depend of the kind of parameter (see Parameter id Code)

Parameter time offset: 32 bits unsigned integer giving the time offset (in microseconds) from the Packet time offset to the time at which the first sample of the parameter on the packet was acquired.

Packet checksum: 32 bits unsigned integer giving the checksum of the entire packet excluding only the checksum itself.

HRFIS 3.2.3.2.6.1.1.20

The packet checksum will be calculated with the following algorithm:

Definitions:

p_Pbuffer: pointer to the packet data buffer

packet length: unsigned short integer 16-bits wide indication the number of 16-bits words of the packet

```
unsigned short int * p_ usPackBuff;        //pointer to 16-bits wide unsigned integer
unsigned int chksum;                       //unsigned integer 32-bits wide to store the result of the calculus
unsigned int t;                            // auxiliary variables
unsigned int temp;                         //auxiliary variables
p_ usPackBuff=(unsigned short int*) p_Pbuffer;
chksum=0;                                  //initialisation
for(t=0;t< packet length-2; t++)           //for all the packet words excluding the checksum ones
        {
        temp=(unsigned int)*p_usPackBuff;
        temp=temp*t;
```

```
chcksum=chksum+temp;
p_usPackBuff++;
}
```

HRFIS 3.2.3.2.6.1.1.30

All the parameters will be transmitted in the Big Endian format (Motorola, Network standard).

HRFIS 3.2.3.2.6.1.1.40

The samples corresponding to parameters of type string will be separated in the parameter data block with the "C" standard string terminator.

HRFIS 3.2.3.2.6.1.1.50

All data blocks corresponding to a parameter will start and finish16-bits words aligned. In case of a data block finished in the middle of a 16-bits word the remaining bits will be padded with the value 0b.

3.2.3.2.7 Experiment packet definition file

HRFIS 3.2.3.2.7.1.1.10

For each experiment it will exist an ASCII file automatically created at experiment programming time with the filename **ExpPack.def** defining the identification codes of each parameter able to be transmitted, their sampling rate, type, units and scale.

HRFIS 3.2.3.2.7.1.1.20

The format of these files will be as follows:

For each parameter the file will have the next line

Parameter_label: Parameter id Code; Sampling rate; Offset factor; Scale Factor; Units

Parameter id Code: Four ASCII characters with the identification code corresponding to the parameter in hexadecimal format. Each code must be unique in the entire file and must be build using the parameter type coding mechanism described in the previous section.

Sampling Rate: Sampling rate at which the parameter will be transmitted in Hz coded in decimal

Offset factor: Offset factor to be applied to the transmitted raw data in orders to obtain the parameter value in the defined units.

Scale factor: Scale factor to be applied to the transmitted raw data in orders to obtain the parameter value in the defined units.

Units: Label identifying the units of the parameter. After applying to the transmitted raw data the Offset and the Scale factors the obtained value will have these units.

For example a file containing the following two lines

Position: 3001;1000;0;0.012;degrees

Torque:3002;4000;0;0.03125;Nm

Corresponds to an experiment where two parameters are transmitted:

The parameter "Position" with an identification code of 3001 hexadecimal which means that the parameter is transmitted as a 16 bits integer, This parameter is transmitted at 1KHz and after applying an offset of zero and a scale factor of 0.012 the value obtained will be in degrees.

The parameter “Torque” with an identification code of 3002 hexadecimal which means that the parameter is transmitted as a 16 bits integer, This parameter is transmitted at 4KHz and after applying an offset of zero and a scale factor of 0.003125 the value obtained will be in Nm.

3.2.3.2.8 NFS client installation/configuration

Although the file transfer between MARES laptop and MARES main box through the NFS is an internal interface it is defined here because NASA will provide the NFS client

HRFIS 3.2.3.2.8.1.1.10

The network file system to be installed and configured by NASA on the Laptop Computers to be used with MARES will be the **InterDrive Client v4.0** from FTP Software Inc.

The details related with its installation and configuration are stated in the Appendix A **NFS Client**, following the applicable templates defined in the HRF Software Development Plan LS-71020 section A4.0.

3.2.3.3 MARES to External Devices Command and Data Handling Interface (MARES-ExD-SW)

MARES will provide general-purpose inputs and outputs for data acquisition and control from/to external instrumentation:

- Two serial channels
- Eight analogue inputs
- Two trigger inputs
- Two trigger outputs
- Two digital outputs
- A normaly close contact activated with the MARES emergency stop button

These signals shall be abailables through the next defined connectors:

Connector name	**Type**	**Features**		
MARES-ED2A	MS27508E12F35SA	Analog in #0-3		
		Trigger in/out #1		
Connector name	**Type**	**Features**		
MARES-ED3A	MS27508E12F35SA	Analog in #4-7		
		Trigger in/out #2		
Connector name	**Type**	**Features**		
MARES-ED4A	MS27508E12F35S	Serial #1 RS422	Trigger in/out #1	
		Serial #1 RS232	Digital out #1	Parameter Setting #1
Connector name	**Type**	**Features**		
MARES-ED5A	MS27508E12F35S	Serial #2 RS422	Trigger in/out #2	

		Serial #2 RS232	Digital out #2	Parameter Setting #2
Connector name	**Type**	**Features**		
MARES-ED6A	MS27508E12F35SB	Serial #1 RS422	Trigger in/out #1	
		Stop pushbutton	Trigger in/out #2	

HRFIS 3.2.3.3.1.1.1.10

Connector name	**Type**	**Features**
MARES-ED2A	MS27508E12F35SA	Analog in #0-3 Trigger in/out #1

Connectors pin out

Pin assignment	**Pin gauge**	**Function**	**Signal Type**	**Signal Characteristics**
1				
2				
3				
4				
5		ExtAnalog0+	Analogue/in	±10 Volts/16bits Zin>1MΩ
6		ExtAnalog0-	Analogue/in	±10 Volts/16bits Zin>1MΩ
7		Chassis ground		
8		ExtAnalog1+	Analogue/in	±10 Volts/16bits Zin>1MΩ
9		ExtAnalog1-	Analogue/in	±10 Volts/16bits Zin>1MΩ
10		Chassis ground		
11		ExtAnalog2+	Analogue/in	±10 Volts/16bits Zin>1MΩ
12		ExtAnalog2-	Analogue/in	±10 Volts/16bits Zin>1MΩ
13		Chassis ground		
14		ExtAnalog3+	Analogue/in	±10 Volts/16bits Zin>1MΩ
15		ExtAnalog3-	Analogue/in	±10 Volts/16bits Zin>1MΩ
16		Chassis ground		
18		TriggIn1+	RS 422/in	TIA/EIA-422-B
19		TriggIn1-	RS 422/in	TIA/EIA-422-B
17		Chassis ground		
20		TriggOut1+	RS 422/out	TIA/EIA-422-B
21		TriggOut1-	RS 422/out	TIA/EIA-422-B
22		Chassis ground		

HRFIS 3.2.3.3.1.1.1.20

Connector name	**Type**	**Features**
MARES-ED3A	MS27508E12F35SA	Analog in #4-7 Trigger in/out #2

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4				
5		ExtAnalog4+	Analogue/in	±10 Volts/16bits Zin>1MΩ
6		ExtAnalog4-	Analogue/in	±10 Volts/16bits Zin>1MΩ
7		Chassis ground		
8		ExtAnalog5+	Analogue/in	±10 Volts/16bits Zin>1MΩ
9		ExtAnalog5-	Analogue/in	±10 Volts/16bits Zin>1MΩ
10		Chassis ground		
11		ExtAnalog6+	Analogue/in	±10 Volts/16bits Zin>1MΩ
12		ExtAnalog6-	Analogue/in	±10 Volts/16bits Zin>1MΩ
13		Chassis ground		
14		ExtAnalog7+	Analogue/in	±10 Volts/16bits Zin>1MΩ
15		ExtAnalog7-	Analogue/in	±10 Volts/16bits Zin>1MΩ
16		Chassis ground		
17		TriggIn2+	RS 422/in	TIA/EIA-422-B isolated
18		TriggIn2-	RS 422/in	
19		Chassis ground		
20		TriggOut2+	RS 422/out	TIA/EIA-422-B
21		TriggOut2-	RS 422/out	TIA/EIA-422-B
22		Chassis ground		

HRFIS 3.2.3.3.1.1.1.30

Connector name	**Type**	**Features**
MARES-ED4A	MS27508E12F35S	Serial #1 RS422 Trigger in/out #1 Serial #1 RS232 Digital out #1 Parameter Setting #1

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4	22D	422 TX1+	RS 422/out	TIA/EIA-422-B
5	22D	422 TX1-	RS 422/out	TIA/EIA-422-B
6	22D	422 RX1+	RS 422/in	TIA/EIA-422-B isolated
7	22D	422 RX1-	RS 422/in	
8	22D	Chassis ground		
9	22D	RS 232 Rx1	RS-232/in	TIA/EIA-232-F. Isolated
10	22D	RS 232 Tx1	RS-232/out	TIA/EIA-232-F.
11	22D	RS 232 GND		
12	22D	Chassis ground		
13	22D	TriggIn1+	RS 422/in	TIA/EIA-422-B isolated
14	22D	TriggIn1-	RS 422/in	
15	22D	TriggOut1+	RS 422/out	TIA/EIA-422-B
16	22D	TriggOut1-	RS 422/out	TIA/EIA-422-B
17	22D	DigOut1+	RS 422/out	TIA/EIA-422-B
18	22D	DigOut1-	RS 422/out	TIA/EIA-422-B
19	22D	Chassis ground		
20	22D	Set_par1+	Analogue/in	±10 Volts/16bits Zin>1MΩ
21	22D	Set_par1-	Analogue/in	±10 Volts/16bits Zin>1MΩ
22	22D	Chassis ground		

HRFIS 3.2.3.3.1.1.1.40

Connector name	**Type**	**Features**
MARES-ED5A	MS27508E12F35S	Serial #2 RS422 Trigger in/out #2

		Serial #2 RS232	Digital out #2	Parameter Setting #2

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4	22D	422 TX2+	RS 422/out	TIA/EIA-422-B
5	22D	422 TX2-	RS 422/out	TIA/EIA-422-B
6	22D	422 RX2+	RS 422/in	TIA/EIA-422-B isolated
7	22D	422 RX2-	RS 422/in	
8	22D	Chassis ground		
9	22D	RS 232 Rx2	RS-232/in	TIA/EIA-232-F. Isolated
10	22D	RS 232 Tx2	RS-232/out	TIA/EIA-232-F.
11	22D	RS 232 GND		
12	22D	Chassis ground		
13	22D	TriggIn2+	RS 422/in	TIA/EIA-422-B isolated
14	22D	TriggIn2-	RS 422/in	
15	22D	TriggOut2+	RS 422/out	TIA/EIA-422-B
16	22D	TriggOut2-	RS 422/out	TIA/EIA-422-B
17	22D	DigOut2+	RS 422/out	TIA/EIA-422-B
18	22D	DigOut2-	RS 422/out	TIA/EIA-422-B
19	22D	Chassis ground		
20	22D	Set_par2+	Analogue/in	±10 Volts/16bits Zin>1MΩ
21	22D	Set_par2-	Analogue/in	±10 Volts/16bits Zin>1MΩ
22	22D	Chassis ground		

HRFIS 3.2.3.3.1.1.1.50

Connector name	Type	Features	
MARES-ED6A	MS27508E12F35SB	Serial #1 RS422	Trigger in/out #1
		Stop pushbutton	Trigger in/out #2

Connectors pin out

Pin assignment	Pin gauge	Function	Signal Type	Signal Characteristics
1				
2				
3				
4				
5	22D	422 TX1+	RS 422/out	TIA/EIA-422-B
6	22D	422 TX1-	RS 422/out	TIA/EIA-422-B
7	22D	422 RX1+	RS 422/in	TIA/EIA-422-B isolated
8	22D	422 RX1-	RS 422/in	
9	22D	Chassis ground		
10	22D	TriggIn1+	RS 422/in	TIA/EIA-422-B isolated
11	22D	TriggIn1-	RS 422/in	
12	22D	TriggIn2+	RS 422/in	TIA/EIA-422-B isolated
13	22D	TriggIn2-	RS 422/in	
14	22D	Chassis ground		
15	22D	TriggOut1+	RS 422/out	TIA/EIA-422-B
16	22D	TriggOut1-	RS 422/out	TIA/EIA-422-B
17	22D	TriggOut2+	RS 422/out	TIA/EIA-422-B
18	22D	TriggOut2-	RS 422/out	TIA/EIA-422-B
19	22D	Chassis ground		
20	22D	Stop pushbutton	N.C. Switch contact	Isolated (>1Mohm) Maximun current 0.1 Amps, Maximum voltage 28Vdc, 115Vac (60/400 Hz) Min open inpedance 1M ohms Max Close impedance 10 ohms
21	22D	Stop pushbutton ret	N.C. Switch contact	
22	22D	Chassis ground		

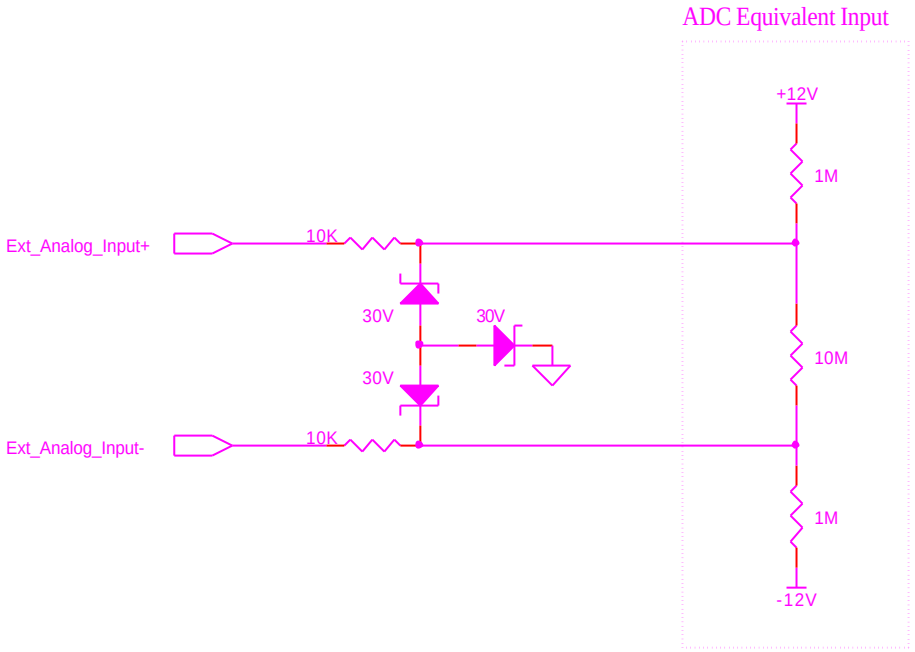
HRFIS 3.2.3.3.1.1.1.60

MARES shall place a resistor of 150 ohms between the + and – terminal of all (either digital or serial) the inpus signals defined as TIA/EIA-422-B.

3.2.3.3.2 Analog inputs eschematics

HRFIS 3.2.3.3.2.1.1.10

The equivalent circuit of the Analoge inputs shall be the following



3.2.3.3.3 Serial Channels External Interface

Both serial channels will include Receiver and Transmit channels and both will be independently configurable by software to be RS-232 or RS-422 compatible.

It will be possible to send commands and download files through any of the two RS-232/422 external channels with the options and capabilities defined below.

It will be possible to receive acquire data through any of the two RS-232/422 external channels with the options and capabilities defined below.

The following tables show the MARES connector type and pin-out.

3.2.3.3.3.1 Physical Interface

MARES Experiment editor shall allow the programming of the defined parameters HRFIS 3.2.3.3.3.1.1.10 to HRFIS 3.2.3.2.5.1.1.40, independently for each channel, but with the same setting for both transmission and reception, and fixed for the whole experiment.

HRFIS 3.2.3.3.3.1.1.10

In case of a serial channel configured as RS-232, MARES will support the following baudrates:

- 1200 bits/s
- 2400 bits/s
- 4800 bits/s
- 9600 bits/s
- 19200 bits/s

HRFIS 3.2.3.3.3.1.1.20

In case of a serial channel configured as RS-422, MARES will support the following baudrates:

- 1200 bits/s
- 2400 bits/s
- 4800 bits/s
- 9600 bits/s
- 19200 bits/s
- 38400 bits/s

HRFIS 3.2.3.3.3.1.1.30

For each RS-232/422 external channel, MARES will support the following parity options:

- No parity
- Even parity
- Odd parity

HRFIS 3.2.3.3.3.1.1.40

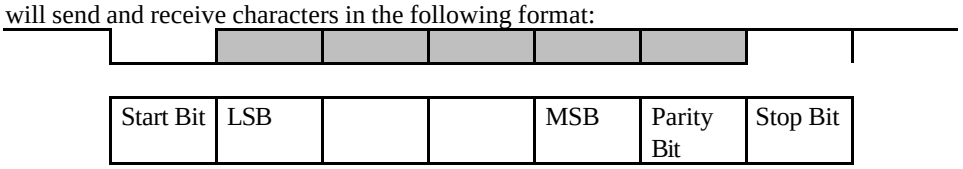
For each RS-232/422 external channel, MARES will support 1 or 2 stop bits.

HRFIS 3.2.3.3.3.1.1.50

For each RS-232/422 external channel, MARES will support characters length of 7 and 8 bits.

HRFIS 3.2.3.3.3.1.1.60

MARES will send and receive characters in the following format:



Start Bit	LSB			MSB	Parity Bit	Stop Bit

3.2.3.3.3.2 Interface Handshake mechanism

HRFIS 3.2.3.3.3.2.1.10

During transmission, MARES shall not transmit more than three complete characters from the moment that receives the last stop bit of the XOFF control code character (19 dec/13 Hex) through the reception line of the same MARES channel.

MARES shall resume the transmission in less than 100 ms from the reception of the last stop bit of the XON control code (17 dec/ 11 Hex), without skipping nor repeating any character.

HRFIS 3.2.3.3.3.2.1.20

The MARES maximum waiting time between the XOFF and XON reception will be the equivalent to the transmission of 256 characters at the selected baudrate.

If the maximum waiting time expire, MARES will assume a transmission error, the current trasmission process (command or file) shall be aborted and the XON code will not be expected to start a new transmission process.

Any XON/ XOFF received out of secuence shall be discarted by MARES.

HRFIS 3.2.3.3.3.2.1.30

During reception, MARES will accept up to four received complete characters from the moment that MARES has transmitted the last stop bit of the XOFF control code (19 dec/13 HEX).

MARES shall continue accepting data immediately after MARES has transmitted the last stop bit of the XON control code (17 dec/ 11 Hex). These data shall be treated as a continuation of the interrupted data packet.

The MARES maximum delaying time, time between the XOFF and XON tasmission will be the equivalent to the transmission of 256 characters at the selected baudrate.

3.2.3.3.3.3 Services

MARES supports three services through both serial channels available for external devices:

- Commanding service
- File download service
- Data acquisition service

3.2.3.3.3.3.1 Commanding service

HRFIS 3.2.3.3.3.3.1.10

MARES will be able to send commands to the external devices trough the RS-232/422 external channels.

These commands will consist on a string of alphabetic characters, from the “A” to “Z” and from the “a” to “z”, numeric, from “0” to “9” and space.

The maximum supported string length will be 10 characters.

MARES will send the commands as it will be programmed, without adding, deleting or changing any character/code.

The transmission of any command shall not take longer than one and a half times the minimum transmission time for the given baud-rate.

MARES shall send the hole string command without introducing any contron code inside (XON/XOFF).

HRFIS 3.2.3.3.3.3.1.20

It will be possible to optionally program MARES to wait for acknowledge after a command transmission.

In this case, MARES will wait for the reception of the ACK control code (6 dec/6 Hex) or the NAK control code (21 dec/15 Hex) through the reception line of the same channel, during a programmable period of time. If the maximum waiting time will expire, MARES will assume a transmission error.

HRFIS 3.2.3.3.3.3.1.30

During the time that MARES waits for acknowledgement, MARES will not start the transmission of another command or download a file.

3.2.3.3.3.3.2 Files download service

HRFIS 3.2.3.3.3.3.2.10

MARES will be able to send files to the external devices through the RS-232/422 external channels.

The files will have a filename (DOS compatible) no longer than 8 characters and with the extension. SER., with a maximum length of 200Kbytes.

MARES will send the file as it will be, without adding, deleting or changing any character/code.

The transmission of the file shall be done in such way that the maximum time between two consecutive characters shall be less than the one corresponding to the transmission of 32 characters at the selected baud rate. And the total file transmission time less than one and a half the minimum transmission time.

HRFIS 3.2.3.3.3.3.2.20

It will be possible to optionally program MARES to wait for acknowledge after a file transmission.

In this case, MARES will wait for the reception of the ACK control code (6 dec/6 Hex) or the NAK control code (21 dec/15 Hex) through the reception line of the same channel, during a programmable period of the time.

If the maximum waiting time will expire, MARES will assume a transmission error.

HRFIS 3.2.3.3.3.2.30

During the time that MARES waits for acknowledgement, MARES will not start the transmission of another command or download a file.

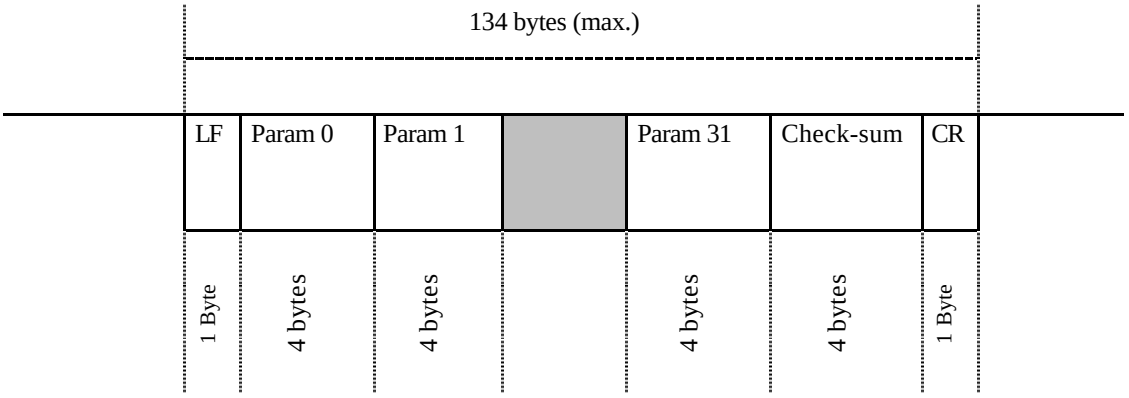
3.2.3.3.3.3 Serial data acquisition

HRFIS 3.2.3.3.3.3.10

MARES shall acquire from the external devices using the following fix packed (Serial Data Acquisition Packed).

MARES shall be able to acquire any number of parameters between 1 and 32. The number of parameters will be defined at experiment level and will remain fix along the experiment

Serial Data Acquisition Packed:



LF: Start packed control code (10 dec/0A Hex).

CR: End packed control code (13 dec/0D Hex).

MARES shall decode each 16 bits parameter and the checksum as a string of 4 ASCII characters corresponding to the hexadecimal representation of the parameter.

For example a parameter with a value of 11223 decimal will be send as the string “2BD7”.

The first character to be sent will be the one corresponding to the most significant nibble.

The hexadecimal representation will be in capital letters and numbers.

The checksum will be calculated as the sum module 16 bits of the transmitted string corresponding to the parameters 0 to 31. The start packed and end packed control codes will not be included in the checksum calculus.

MARES will handle the value of these parameters as unsigned integers of 16 bits.

HRFIS 3.2.3.3.3.3.20

MARES will support a continuos acquisition of 1Kbyte/s as a global throughput for the two serial interfaces.

HRFIS 3.2.3.3.3.3.30

In case of transmission error detection, MARES will maintain the parameters values of the last correct received packed.

3.2.3.3.4 Analogue Inputs

HRFIS 3.2.3.3.4.1.1.10

MARES shall provide eight analogue inputs for signal acquisition with the following characteristics:

- Differential input
- ± 10 volts input range

- ± 20 volts maximum input voltage
- Differential input impedance higher than 1 Mohm.
- Common mode impedance higher than 1 Mohm.
- 2 KHz analogue bandwidth at –3 dB
- 16 bits resolution

3.2.3.3.5 Parameter Set Inputs

HRFIS 3.2.3.3.5.1.1.10

MARES shall provide two analogue inputs for parameter setting with the following characteristics:

- Differential input
- ± 10 volts input range
- ± 20 volts maximum input voltage
- Differential input impedance higher than 1 Mohm.
- Common mode impedance higher than 1 Mohm.
- 50 Hz analogue bandwidth at –3 dB
- 16 bits resolution

3.2.4 Audio/Video Interfaces

Not applicable

3.2.5 Thermal Control Interfaces

Not applicable

3.2.6 Waste Gas Vent and Vacuum Interfaces

Not applicable

3.2.7 Nitrogen Interfaces

Not applicable

4. Appendix A: NFS Client

1.0 SCOPE

This document describes the software release for the Network File System client to be installed and configured by NASA on the Laptop Computer/s (HRF Portable Computer) to be used with MARES. It includes all custom, Government Furnished Software (GFS), and Commercial Off The Shelf (COTS) software. This software load is used for training and flight.

2.0 REFERENCED DOCUMENTS

Information about the InterDrive Client v4.0 for Windows NT provided by the manufacturer

3.0 VERSION DESCRIPTION

3.1 INVENTORY OF MATERIALS RELEASED

The NFS Client software will be provided by NASA/HRF.

3.2 INVENTORY OF SOFTWARE CONTENTS

InterDrive Client v4.0 for Windows NT from FTP Sofware

3.3 CHANGES INSTALLED

None. Initial installed version

3.4 ADAPTATION DATA

All the SW loads will be equals independently if they are loads for the on ground units or for the flight ones.

3.5 RELATED DOCUMENTS

Information about the InterDrive Client v4.0 for Windows NT installation process provided by the manufacturer

3.6 INSTALLATION INSTRUCTIONS

The information about the InterDrive Client installation process provided by the manufacturer is detailed by the following steps.

Tips for easy installation:
- The installer are not required to shut down other programs before you run Setup. However, doing so might avoid potential problems during the installation process.
- When Setup prompts you for the names and folders in steps 9, 10 and 12, the manufacturer recommend that you accept the default definitions.

Installation steps:

1. Start the Setup program by inserting the InterDrive CD-ROM into the appropiate drive.
2. With CD-ROM Autoplay:
   -Click *Install InterDrive NFS for Windows*.
   With CD-ROM without Autoplay:
   -On the Start menu, click *Run*.
   -Type: **d:\setup** (substitute **d** with the appropiate drive letter, if necessary)
   -Press *Enter*.
   -Click *Install InterDrive NFS for Windows*.
3. Select *InterDrive Client* by clicking on it and then click *Install* button.
4. Click *Next* button in the *Welcome to the InterDrive Client 4.0 Setup Wizard* window.
5. Click *Next* button in the *InterDrive Client 4.0-Before You Begin* window.
6. Click *I Accept* button after reading the license agreement and then click *Next* button.
7. Fill the boxes with your user information (your name and company name) and product license key and then click *Next* button. (The license key appears on the FTP Software License Certificate that comes with InterDrive Client).
8. Acknowledge the licence information.
9. Setup allows you to copy program files to a different folder from the predefined one. To do this, click *Change...* button and select desired path. Then, whether the folder have been changed or not, click *Next* button.
10. Setup allows you to place the data files created by InterDrive Client in a different folder from the predefined one. To do this, click *Change...* button and select desired path. Then, whether the folder have been changed or not, click *Next* button.
11. Select InterDrive Client component. Only this one have to appear checked (not Print Client component). Click the box beside a component to add or remove the component. Then click *Next* button.
12. Setup allows you to change the folder of Start menu entries for InterDrive Client programs. Enter the new folder name in the box and select new location if desired. Then, whether the folder have been changed or not, click *Next* button.
13. Click *Next* button in the window referred to the copied files.
14. Click *Yes* button to restart the computer. The computer must be restarted before using InterDrive Client.

InterDrive Client must be configured as follows:

Once the computer is restarted:

15. Open the Control Panel from the Configuration menu.
16. Double-click on *Network*.
17. Select *FTP Software InterDrive Client (NFS for Windows NT)* from *Services* tab by clicking on it and then, click *Properties...* button.
18. Click *Scope* tab and check the following setting:
    -Select *System settings* option (option by default).
19. Click *Security* tab. Check the following by default settings and configure the required ones:
    -Select *Use NIS first then PCNFS* in *Authentication method* list (option by default).
    -Enter **nobody** in Username box.
    -Leave blank *Autenthication server*, *Password*, *NIS Domain*, *Preferred Group ID* boxes (values by default).
    -Check all *Default Permissions* (Read, Write and Execute for Owner, Group and Other).
20. Click *Performance* tab. Check the following by default settings and configure the required one:
    -Select *Automatic tuning* option (option by default).
    -Fill the following values in the corresponding boxes:
    -*Max read size (bytes)*: 65536 (value by default).
    -*Max write size (bytes)*: 65536 (value by default).
    -*Streaming (requests)*: 4 (value by default).
    -*Timeout (seconds)*: 15 (value by default).
    -Select *Use TCP and fallback to UDP* as *Transport Protocol*.
    -Select *Use version 3 and fallback to version 2* in *NFS protocol* options (option by default).
21. Click *Caching* tab and check the following settings:
    -Enter *Cache timeout (seconds)* value equal to 30 (value by default).
    -Check *Enable lookup cache* option (option by default).

-Check *Enable read-write caching* option (option by default).
-Select *Read and write caching* option (option by default).

22. Click *Advanced* tab. Check the following by default settings and configure the required ones:
    -Check *Enable symbolic link processing* option (option by default).
    -Uncheck *Enable file locking/sharing, Hide filenames that begin with a dot, Work with CD-ROM, Set connection as read-only* options.
    -Check *Case-sensitive server* (option by default) and select *Try to preserve case* option.
    -Select *1252 (Windows 3.1 Latin (US, Western Europe))* option in *Character set* list (option by default).
23. Click *OK* button of InterDrive NT NFS Client Properties window.
24. Click *Close* button in the Network window.
25. Click *Yes* button to restart the computer. The computer must be restarted in order to the new configuration takes effect.

Procedures for determining whether the version has been installed properly

1. Verify Network icon with *InterDrive NT* as label is shown in the Entire Neighborhood window.
2. Connect through an Ethernet link the target computer to a host with a NFS server properly installed and running. For a complete verification the NFS server must be the provided by Wind River with the VxWorks 5.3 operative system.

2. Verify you can see the connected computer as a remote host: it's shown as a PC icon with <IP_address> as label in *NFS Servers On My Subnet* window.
3. Verify you can access the remote disk.
-

3.7 POSSIBLE PROBLEMS AND KNOWN ERRORS

None

3.8 CSCI ENVIRONMENT INFORMATION

The computer should have the following minimum capabilities:
- Operating system: Windows NT.
- Available disk space: 7MB. (Once installed, only 1216 KB are required).
- TCP/IP protocol stack: TCP/IP support must be installed and configured before installation.

Note: To install InterDrive Client on Windows NT, your user account must have Administrator privileges for the local computer.

4.0 NOTES

HRF INTERFACE Verification Matrix

Model:

VERIFICATION METHODS

T : Test
A : Analysis
I : Inspection
S : Similarity
D : Demonstration
ROD : Review of design

ACCEPTANCE PROCEDURES

PDA : Pre-delivery Acceptance (Contractor site)
PIA : Pre-installation Acceptance (JSC)
ATT : Acceptance Thermal Test
AVT : Acceptance Vibration Test
EMCT : EMC Test
AT : Acoustic Test
SOEP

QUALIFICATION PROCEDURES

LT : Load Test
SA : Stress Analysis
FT : Functional Test
PT : Population Testing
EA : Environmental Analysis
MT : Materials test
QTT : Qualification Thermal Test
QVT : Qualification Vibration Test
QSWTP : Qual. Software Test Procedure (SVP: Software Verification Plan)
QRP Qualification review procedure

Requirem Source	Spec. No.	REQUIREMENT	ACCEPT. Method	ACCEPT. Procedure	ACCEPTANCE Close-out Document	QUAL. Method	QUAL. Procedure	QUALIFICATION Close-out Document	Open (X) closed	COMMENTS / HARDWARE CONFIGURATION
3.1.5		Interface								
3.1.5.1	N/A	Structural Mechanical Interface Requirements								
3.1.5.1.1	N/A	General Requirements								
	HRFIS 3.2.1.1.1.1.1.1 0	HRF Hard Disks chasis	T	PDA&PIA		N/A				
3.1.5.1.2	N/A	Launch/landing requirements								
3.1.5.1.3	N/A	On-orbit deployed								
3.1.5.1.4	N/A	On-orbit stowed								
3.1.5.2		Electrical Interface Requirements								
	HRFIS 3.2.1.2.1.1.1.1 0	Connector pannel	I	PDA&PIA		N/A			O	
3.1.5.2.1	N/A	MARES to Utility Outlet Panel (UOP)								
3.1.5.2.2	HRFIS 3.2.2.1.1.1.1.1 0	MARES to HRF PCS	T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.1.1.1.1.2 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.1.1.1.1.3 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.1.1.1.1.4 0		N/A			ROD	QRP		O	
	HRFIS 3.2.2.1.1.1.1.5 0		N/A			ROD	QRP		O	
	HRFIS 3.2.2.1.1.1.1.6 0		N/A			ROD	QRP		O	
	HRFIS 3.2.2.1.1.1.1.7 0		N/A			ROD	QRP		O	
	HRFIS 3.2.2.1.1.1.1.8 0		N/A			ROD	QRP		O	
	HRFIS 3.2.2.1.1.1.1.9 0		N/A			ROD	QRP		O	
3.1.5.2.3	HRFIS 3.2.2.2.1.1.1.1 0	MARES to external devices	T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.2.1.1.1.2 0								O	
	HRFIS 3.2.2.3.1.1.1.1 0	Test connectors	T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.3.1.1.1.2 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.3.1.1.1.3 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.3.1.1.1.4 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.2.3.1.1.1.5 0		T	PDA&PIA		N/A			O	
3.1.5.3		Command And Data Handling Interface Requirements								
3.1.5.3.1	HRFIS 3.2.3.2.1.1.1.1 0	MARES to HRF	T	PDA&PIA		N/A			O	
	HRFIS 3.2.3.2.1.1.1.2 0		N/A			ROD	QSWTP		O	
	HRFIS 3.2.3.2.2.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.3.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.3.1.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.4.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.4.1.1.2 0		N/A			I	QSWTP		O	
	HRFIS 3.2.3.2.4.1.1.3 0		N/A			I	QSWTP		O	
	HRFIS 3.2.3.2.4.1.1.4 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.4.1.1.5 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.5.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.5.1.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.5.1.1.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.5.1.1.4 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.5.1.1.5 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.6.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.6.1.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.6.1.1.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.6.1.1.4 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.6.1.1.5 0		N/A			T	QSWTP		O	

(N/A): not applic.; "grey cell": not relevant

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	HRFIS 3.2.3.2.7.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.7.1.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.2.8.1.1.1 0		N/A			I	QSWTP		O	
3.1.5.3.2	HRFIS 3.2.3.1.1.1.1.1 0	MARES to HRF PCS	T	PDA&PIA		N/A			O	
3.1.5.3.3	HRFIS 3.2.3.3.1.1.1.1 0	MARES to external devices	T	PDA&PIA		N/A			O	
	HRFIS 3.2.3.3.1.1.1.2 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.3.3.1.1.1.3 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.3.3.1.1.1.4 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.3.3.1.1.1.5 0		T	PDA&PIA		N/A			O	
	HRFIS 3.2.3.3.1.1.1.6 0		N/A			ROD	QRP		O	
	HRFIS 3.2.3.3.2.1.1.1 0		N/A			ROD	QRP		O	
	HRFIS 3.2.3.3.3.1.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.1.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.1.1.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.1.1.4 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.1.1.5 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.1.1.6 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.2.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.2.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.2.1.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.1.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.1.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.1.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.2.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.2.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.2.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.3.1 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.3.2 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.3.3.3.3 0		N/A			T	QSWTP		O	
	HRFIS 3.2.3.3.4.1.1.1 0		N/A			ROD	QRP		O	
	HRFIS 3.2.3.3.5.1.1.1 0		N/A			ROD	QRP		O	
3.1.5.4	N/A	Audio/Video Interface Requirements								
3.1.5.5	N/A	Thermal Control Interface Requirements								
3.1.5.5.1	N/A	Worst case assumptions								
3.1.5.5.2	N/A	Thermal load								
3.1.5.5.3	N/A	Touch Temperature								
3.1.5.5.4	N/A	Condensation prevention								
3.1.5.6	N/A	Waste Gas Vent and Vacuum Interface Requirements								
3.1.5.7	N/A	Nitrogen Interface Requirements								

(N/A): not applic.; "grey cell": not relevant