



EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

VERY LARGE TELESCOPE

PRIMA Metrology Control electronics

Doc. No. VLT-TRE-ESO-15735-2963

Issue 2

Date 03/04/2008

Prepared .. S. Leveque
Name Date Signature

Approved .. F.Delplancke
Name Date Signature

Released .. R.Gilmozzi
Name Date Signature



Change Record

Issue / Rev.	Date	Section / Page. affected	Reason/Remarks
2	03/04/2008	all	Issue for PRIMA PAE

Table of Contents

1	Scope	3
2	Applicable documents	3
3	Reference documents	3
4	Acronyms	3
5	Introduction	4
6	Definition of Cabinet #1	6
6.1	Purpose	6
6.2	Composition of the cabinet#1	7
6.3	Internal cabling of Cabinet #1	9
6.3.1	Overview	9
6.3.2	Cabling of the lprmls LCU	10
6.3.3	Cabling of the AOM proximity sensors	19
6.4	Interface definition	21
7	Definition of Cabinet #2	23
7.1	Purpose	23
7.2	Composition of the cabinet #2	23
7.3	Internal cabling	24
7.3.1	Cabling of the lprmac and lprma2 LCU's	24
7.3.2	Cabling/configuration of the Phase Meters	26
7.3.3	Cabling of the Phase Meter Proximity sensors	30
7.3.4	Cabling of the lprmpd LCU	30
7.3.5	cabling of the 4-quadrant detector electronics	32
7.4	Interface definition	32
8	Definition of Cabinet #3	36
8.1	Purpose	36
8.2	Composition of the cabinet #3	36
8.3	Internal cabling	36
8.4	Interface definition	37
9	Definition of the Control HW located on the optical table	38
9.1	Purpose	38
9.2	Internal Cabling	38
9.3	Interface definition	38
10	Layout of the LAN ,TIM and Reflective Memory Network	44



11	Laser Safety Interlock System	46
12	Power consumption and dissipation	46
13	Cabling between the storage room and the Interferometric lab. 47	
14	Prima Metrology Control Model	53
15	Spare parts	53
16	Appendix	53
	16.1 Composition of the electronics cabinets #1 and #2	53
	16.2 Composition of cabinet #3	55
	16.3 Connection for single phase meter operation	56
	16.4 Settings for the ISER12 board	57
	16.5 Settings of the Reflective memory board VMIPMC-5565	58
	16.6 Jumper settings for the TIM board	59

1 Scope

This document describes the control electronics of the PRIMA Metrology System.

2 Applicable documents

- AD 1 Design Description of the PRIMA Metrology System, VLT-TRE-ESO-15730-3000, Issue 1, March '03
- AD 2 As built Phase Meter configuration for the PRIMA Metrology System, VLT-TRE-IMT-15734-3726, issue 1, 20.7.2005.
- AD 3 Design of the Laser Assembly of the PRIMA Metrology System, VLT-TRE-IMT-15731-3154, issue 4, 19/12/2003.
- AD 4 User Manual Mephisto Laser (www.innolight.de)
- AD 5 User Manual: Diode-pumped Fiber-coupled Non planar Ring laser, Model 125-1319-200, Lightwave Electronics.
- AD 6 PRIMA Metrology safety and reliability analysis, VLT-TRE-ESO-15730-4546, issue 1, 02/04/08.
- AD 7 VLT electronic design specifications, VLT-SPE-ESO-10000-0015, issue 4, 9/12/96
- AD 8 VLT-SPE-ESO-15732-3799, Specifications for high sensitive 4-quadrant detectors for the PRIMA Metrology System, Issue 1.0, 5/7/07

3 Reference documents

- RD 1 Internal Memorandum "Transfer of data between the Phase meter and the Metrology LCU. HW/SW Interfaces", VLT-VIF-02-074, 31/10/02
- RD 2 Instruction manual of the heat exchanger RK-2114A: see <http://www.seifert-mtmsystems.de>.
- RD 3 Design of the PRIMA Metrology Interlock System, VLT-TRE-ESO-15735-4544, issue 1.

4 Acronyms

- AT: Auxiliary Telescope
- AIT: Assembly, Integration and Test
- AOM: Acousto-Optics Modulator

- AD: Applicable Document
- CPU: Central Processing Unit
- EOM: Electro-optics Modulator
- FCU: Fiber Coupling Unit
- HW: Hardware
- ICD: Interface Control Document
- I/F: Interface
- Ip: Input Channel of the VLTI laboratory
- I/O: Input/Output
- LCU: Local Control Unit
- OPD: Optical Path Difference
- OT: Prima Metrology Optical Table (located in the storage room)
- PM : Phase Meter
- PRIMET: Prima Metrology System
- PRIMA:Phase Referenced Imaging and Micro-arcsec Astrometry
- SHG: Second Harmonic Generation
- SW: Software
- TBC:To Be Confirmed
- TBD:To Be Defined

5 Introduction

The PRIMA Metrology System is a component of the PRIMA facility. This system ties together the two interferometric signals obtained by the simultaneous coherent observation of two celestial objects. The PRIMA Metrology system is a “sensor” which outputs the differential internal OPD, upon request from the PRIMA Workstation and make it available on the PRIMA Reflective memory Network. An overview is shown in Fig. 1. More details can be found in AD 1 and AD 2.

Fig. 2 shows the main interface between the PRIMA Metrology and the VLTI infrastructure.

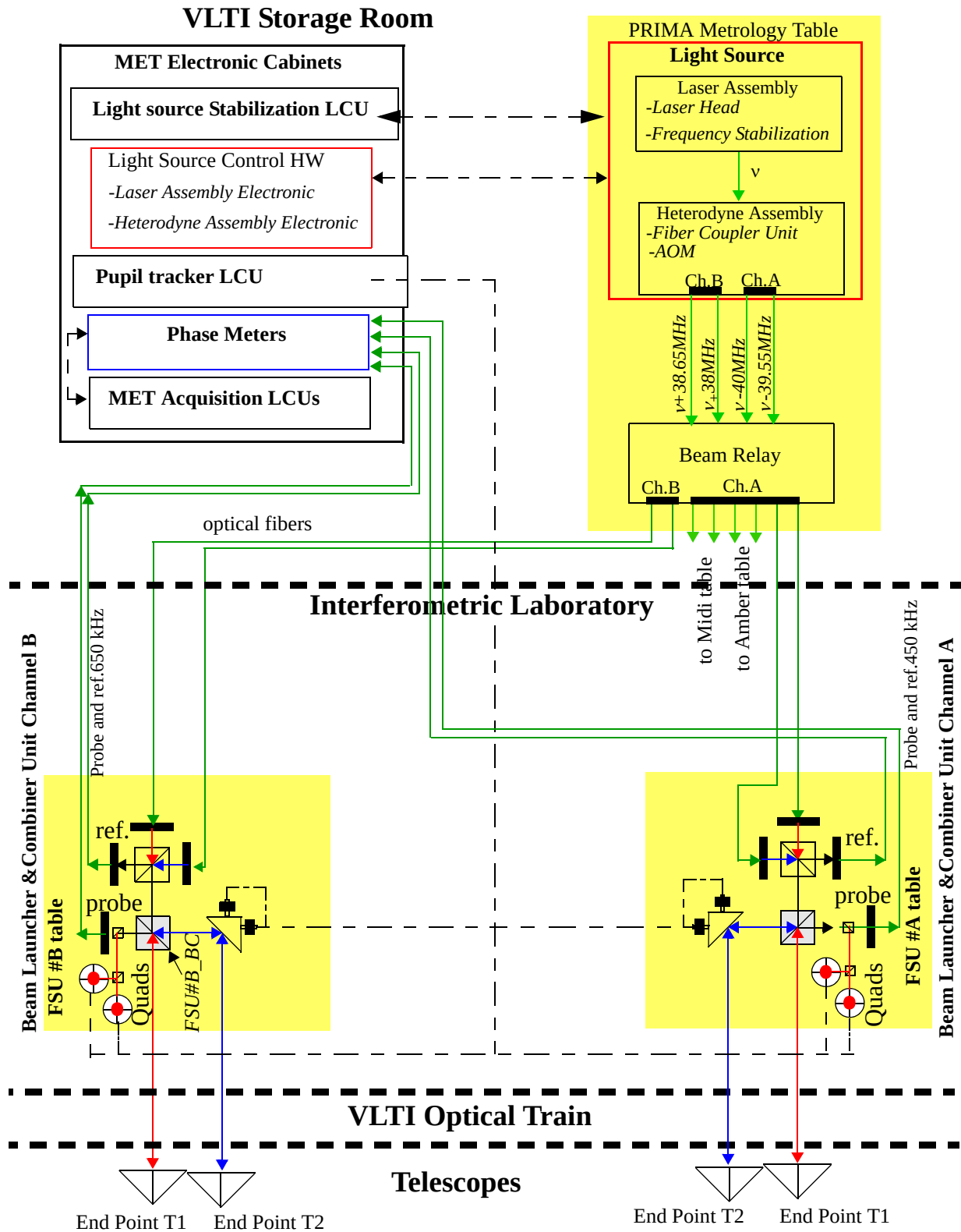


Figure 1 PRIMA Metrology hardware Overview: green lines represents optical fibers; dashed lines represents control lines. $\nu = c/\lambda$ represents the frequency of the laser

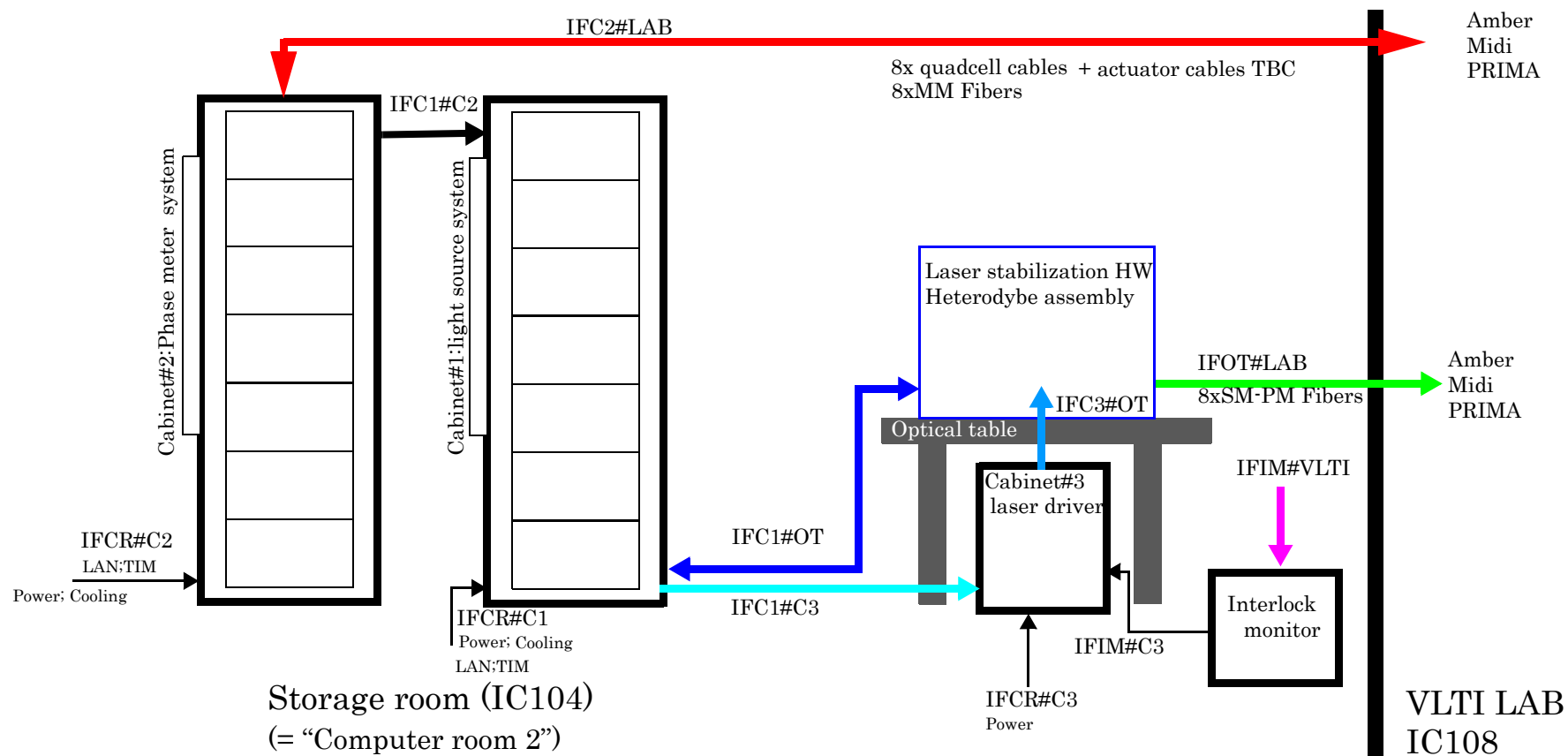


Figure 2 Overview of the Metrology HW located in the Storage room (IC104)

Selected cabinet for cabinet 1 and cabinet 2: 600(w)x800(D) x 46 U (H) from knurr/Miracel. See details in appendix

PRIMA Metrology Control electronics	
Doc	2
Issue	03/04/2008
Date	7 of 60
Page	
VLT-TRE-ESO-15735-2963	



6 Definition of Cabinet #1

6.1 Purpose

Cabinet #1 includes all the control electronics necessary to operate the laser, the laser frequency stabilisation as well as the AOM's.

6.2 Composition of the cabinet#1

Table 1 *Composition of the Electronic cabinet 1: Light Source System (Laser assembly/heterodyne assembly)*

Item	Size	Power Consumption	Comments
Laser Assembly			
EOM driver	3U	50	
Temp.Controller I2-SHG	3U	10	
Temp.Controller EOM	3U	10	
Lock-in	3U	70	
Wavemeter	6U (210mm)	100W (TBC)	
Sub-total			
Heterodyne Assembly			
AOM Driver 1 CH#A (38;38.65 MHz)	3U	160	
AOM Driver 2 FSUB (-40;-39.55MHz)	3U	160	
lprmls LCU (+fan) 1xMVE2700 CPU 1xTIM board 1 A201S carrier board +1x M58 module 1x M36 Module 1 AO board MPV955 1 AI board VMIVME3123	7U	250	
Sub-total			
TOTAL Cabinet 1		810	

The cabinet is equipped with a 1400W heat exchanger RK-2114A (see RD 2)

6.3 Internal cabling of Cabinet #1

6.3.1 Overview

An overview of the control HW configuration of Cabinet #1 is shown in Fig. 3. Some of the hardware is distributed in several locations:

- The AOM proximity sensors, the Detector electronics, and the Power meter are located on the Prima metrology optical table
- The Phase Meter proximity sensors are located inside cabinet #2 but their status is read by lprmls

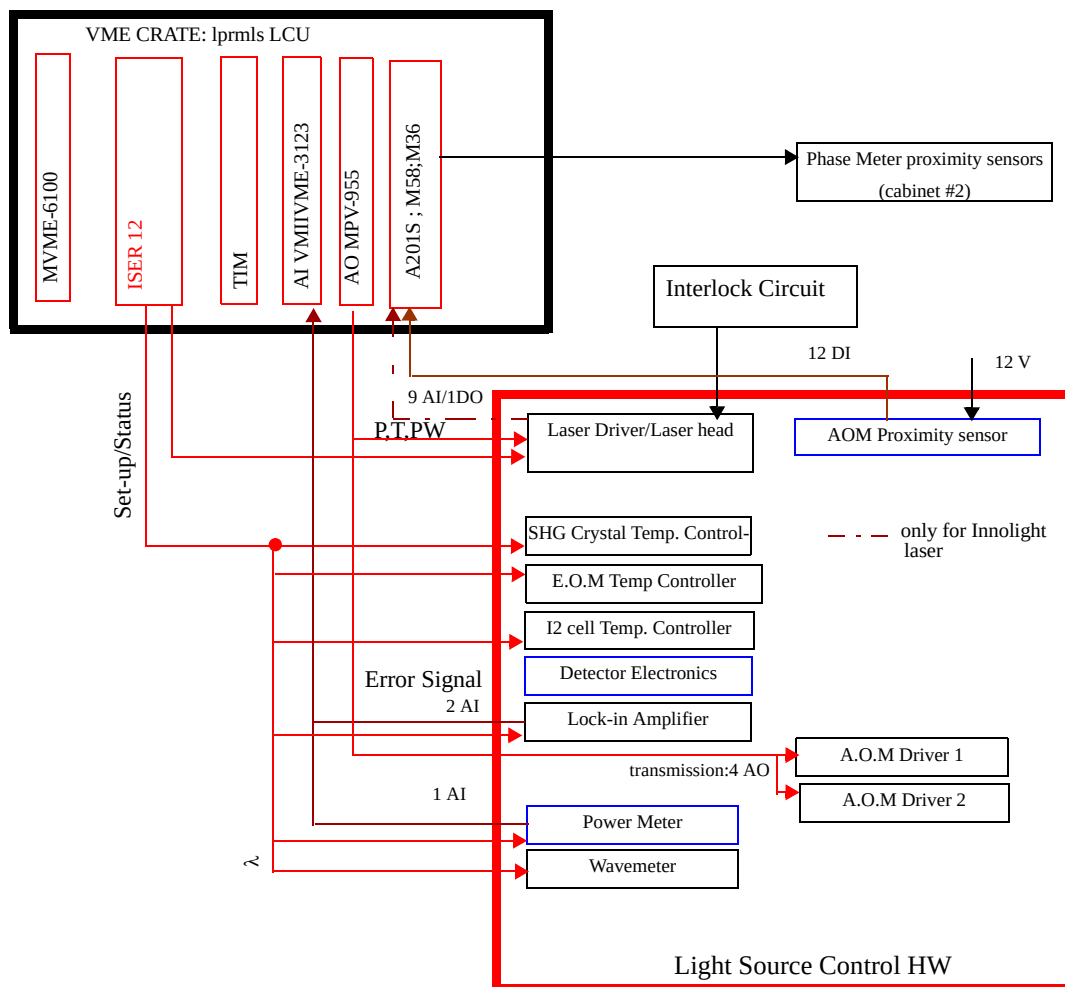


Figure 3 Control HW configuration for the Stabilization system.

The detail description of the cabling of the laser stabilization hardware (SHG crystal temperature controller, EOM temp controller, I2 cell, detector electronics, lock-in amplifier) can be found in AD 3.

6.3.2 Cabling of the lprmls LCU

The lprmls LCU controls the laser head, the laser frequency stabilization and reads the status of the fiber connections (i.e which PRIMA channels are fed with the laser through the AOM and which PRIMA channels are monitored by the phase meter). This status given by the AOM and Phase meter proximity sensors.

The laser frequency error signals are processed by the LCU (TAC blocks) to generate the proper corrections to the laser head.

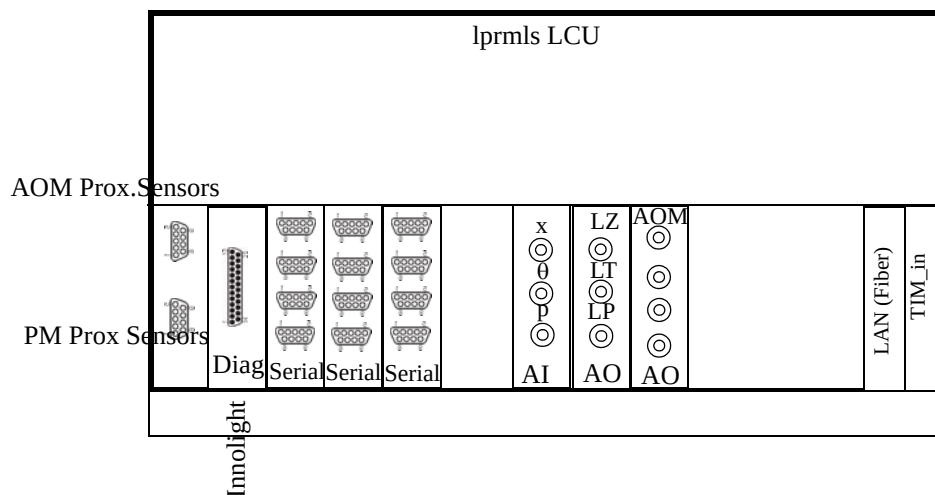


Figure 4 Rear view of the lprmls LCU

TIM board

Provides the timing reference to the lprmls LCU

Jumper settings: Time bus signal source via P2 connector
see appendix

Analog Output (MPV955):

The role of the Analog Output board MPV955 (pentland system) is to generate the control voltages for the laser stabilization (Piezo and temperature) going to the laser head and the laser driver

Also it allows to tune the laser power transmitted by the AOM and routed to the selected PRIMA channels.

The laser light can be attenuated by modulating the power of acoustic wave used in the AOM. This can be done remotely by applying a voltage to the AOM driver (0-1V). This can be done for the four AOM independently. It requires using 4 channels of the MPV955.

As the voltage applied to the AOM driver must be in the range 0-1V, the MPV 955 channels 3 to 6 should be configured to deliver an output between 0-5 V to optimize the resolution. This is achieved by setting the jumpers on the board.

Device	MPV 955
Laser Driver Piezo Input (LZ)	Ch #0 [-10V;+10V]
Laser Driver Temperature Input (LT)	Ch #1 [-5V;+5V]
Laser Driver Power input (LP)	Ch #2 [-10V;+10V]
AOM serial 417649 (-40.00MHz, FSUB, Pol s, Ip2)	Ch #3 [-5V;+5V]
AOM serial 417650 (-39.55MHz, FSUB, Pol p, Ip4)	Ch #4 [-5V;+5V]
AOM serial 417651 (38MHz, CHA, Pol s, Ip1)	Ch #5 [-5V;+5V]
AOM serial 417652 (38.65MHz, CHA, Pol p, Ip3)	Ch #6 [-5V;+5V]

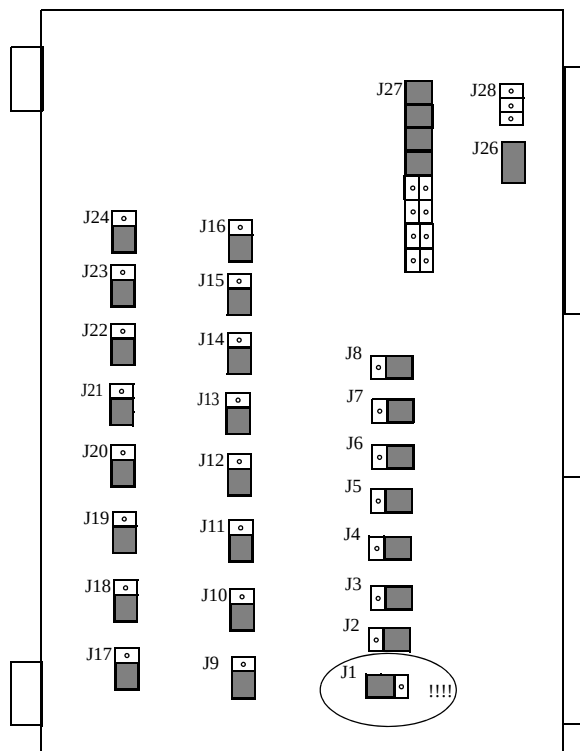


Figure 5 Jumper settings of the MPV955 AO board inside *lprmls*, to provide the correct voltage scaling

Analog Input m(VMIVME3123):

The role of the Analog Input board is to:

- read the error signals generated by the lock-in amplifier for the laser frequency stabilization
- read the relative laser power fluctuations recorded by the power meter before the I2 cell

VMIVME-3123-130 from GE Fanuc (Distributor: VSystems GmbH)

Bipolar Input (+/- 10 and +/- 5 V Input Ranges)-> set to +/- 10 Volt by Software

Bessel Low Pass Filter, 24 kHz Frequency,

16 Input Channels, 4 Megasamples Data Buffer Size

Device	VMIVME3123-130
Lock-in X Error signal (X)	Ch #0 [-10V;+10V]
Lock-in Theta Error signal (θ)	Ch #1 [-10V;+10V]
Power meter (P)	Ch #2 [-10V;+10V]

No jumper settings necessary

Serial board (ISER12)

The role of the ISER12 is to read the status and configure the devices participating to the laser stabilization.

Device	ISER12
Lightwave laser controller	Ch1: (RS232)
Lock-in amplifier	Ch2: (RS232)
Wavemeter	Ch3: (RS232)
Not connected	Ch4: (RS232)
Not connected	Ch5: (RS232)
Power Meter	Ch6: (RS232)
Temperature Controllers EOM, I2, oven	Ch7: (RS485)
Not connected	Ch8: (RS485)
Not connected	Ch9: (RS232)

Configuration of the temperature controller RS485 links:

8 bits, 1 stop bit, no parity, 9600 Baud

EOM: Address 1; I2: Address 2; Oven: Address 3

Jumper settings of the ISER12: see section 16.4

Men Carrier Board A201S with TTL I/O (M58) and AI boards (M36)

The TTL I/O board M58

- reads the status of the proximity sensors used to know which PRIMA channels are fed with the laser through the AOM and which PRIMA channels are monitored by the phase meter)
- allows to switch ON/OFF the innolight laser

The AI board M58 reads the diagnostic signals of the Innolight signals

The A201S configured in A16 address mode, address 0x1000

1 ON
2 OFF
3 OFF
4 ON
5 OFF
6 ON
7 ON
8 ON

1 OFF
2 OFF
3 OFF
4 OFF
5 OFF
6 OFF
7 OFF
8 OFF

Figure 6 Jumper settings of the A201S carrier Board.

5.2 Selecting the Gain Factor

A jumper on the top side of the board determines whether a software-defined gain factor of between 1 and 8 (selected through bit *GAIN*) or a fixed factor of 16 is used.

Figure 3. Position of Jumper J1

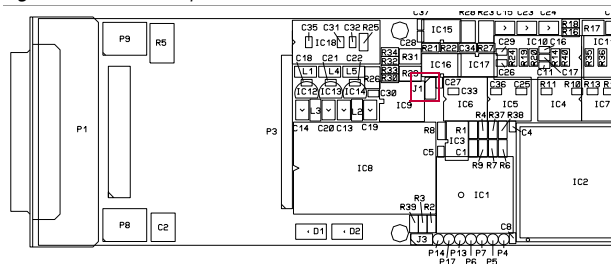


Table 11. Setting the Gain Factor

Jumper Setting	Gain
1 2	Software-configurable (1..8)
1 2	Fixed (16)

Figure 7 Jumper settings of the AI board M36 (the Gain is SW configurable)



2.1.2.1 Configuring the PIO_C4/PIO_C7 Function

Pins PIO_C4 and PIO_C7 of the 24-pin connector can be assigned one of three functions: the standard I/O function (PIO_Cx) or one of two alternative functions (PTRIG or GND).

Jumpers J1 (pin 21) and J2 (pin 24) determine whether the PIO signal or the alternative signal is driven to the pins.

Jumper J3 defines whether the alternative function is PTRIG or GND.

Figure 1. Position of Jumpers J1...J3

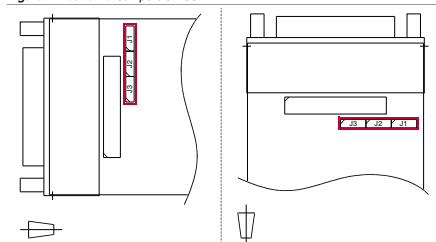


Table 5. Jumper Configurations for PIO_C4 - Pin 21

Pin 21 Function	Jumper Settings
PIO_C4	
PTRIG	
GND	



Figure 8 Jumper settings of the M58 : PIO_C4=GND . Default configuration. (PIO_C4 is actually not used for reading the proximity sensors)

Connection of the Module 0 : TTL I/O (M58) ; Channels are counted from 0

Device	Channel	Function
AOM Proximity Sensors	PIA0	Not connected
	PIA1	MIDI ip1
	PIA2	MIDI ip3
	PIA3	AMBER ip1
	PIA4	AMBER ip3;
	PIA5	FSU#A ip1 ; (AOM 38 MHz)
	PIA6	FSU#A ip3 ; (AOM 38.65 MHz)
	PIA7	Not connected
Phase Meter Proximity Sensors (Probe/Ref from Cabinet #2)	PIB0	Not connected
	PIB1	MIDI Probe
	PIB2	MIDI Ref
	PIB3	AMBER Probe
	PIB4	AMBER Ref
	PIB5	FSU#A Probe (650 kHz)
	PIB6	FSU#A Ref (650 kHz)
	PIB7	Not connected
Innolight Laser Driver	POC0	Switch On/Off

Connection of the Module 1 : Differential AI (M36); Channels are counted from 0

Device	Channel	Function
Innolight	+/- I0	Not connected
Diagnostic	+/- I1	D1 Power (0.1 A/V)
	+/- I2	D2 Power (0.1 A/V)
	+/- I3	Crystal TEC Error (10V/Deg C)
	+/- I4	D1 TEC Error (10V/Deg C)
	+/- I5	D2 TEC Error (10V/Deg C)
	+/- I6	D1 Temp guard
	+/- I7	D2 Temp guard

Default: Temp crystal 36.44 deg---> changed to 37.1 during MPE test period to reach the proper transition

Diode laser 1 Temp: 29.45deg

Diode laser 2 Temp: 27.18

Connection of the Module 2 : Differential AI (M36); Channels are counted from 0

Device	Channel	Function
Innolight	+/- I0	Not connected
Diagnostic	+/- I1	Noise heater Monitor
	+/- I2	Interlock Monitor

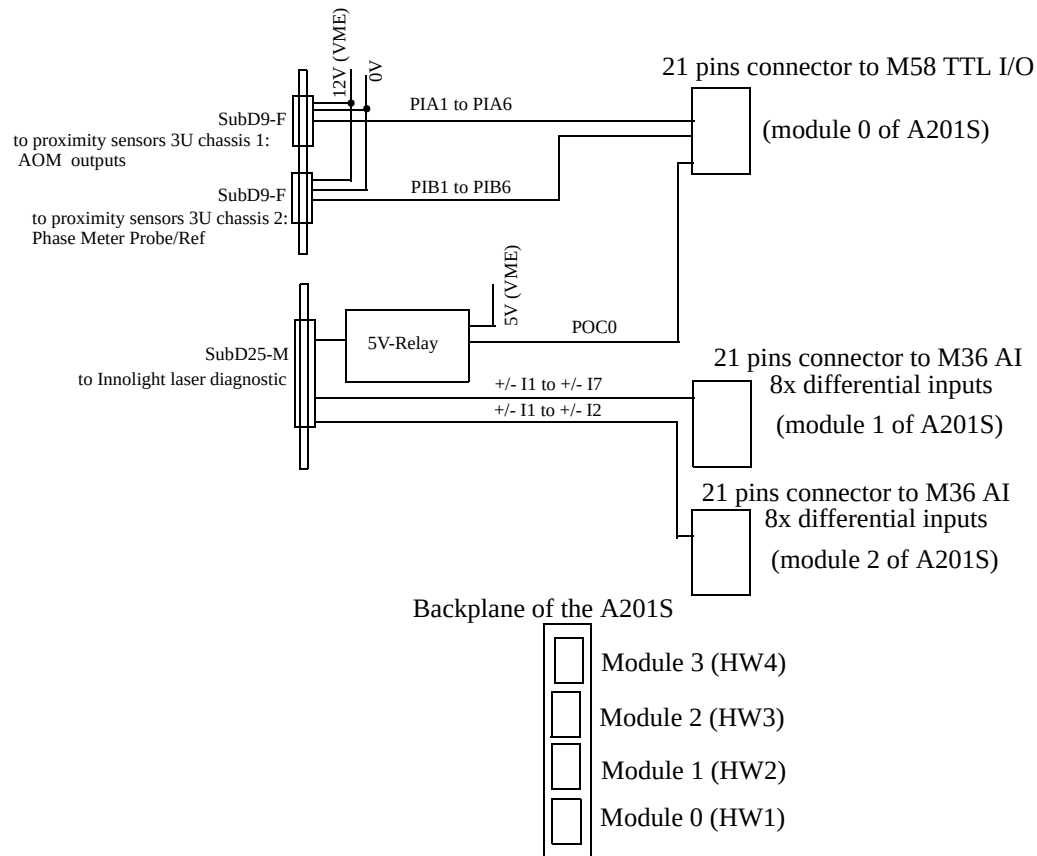
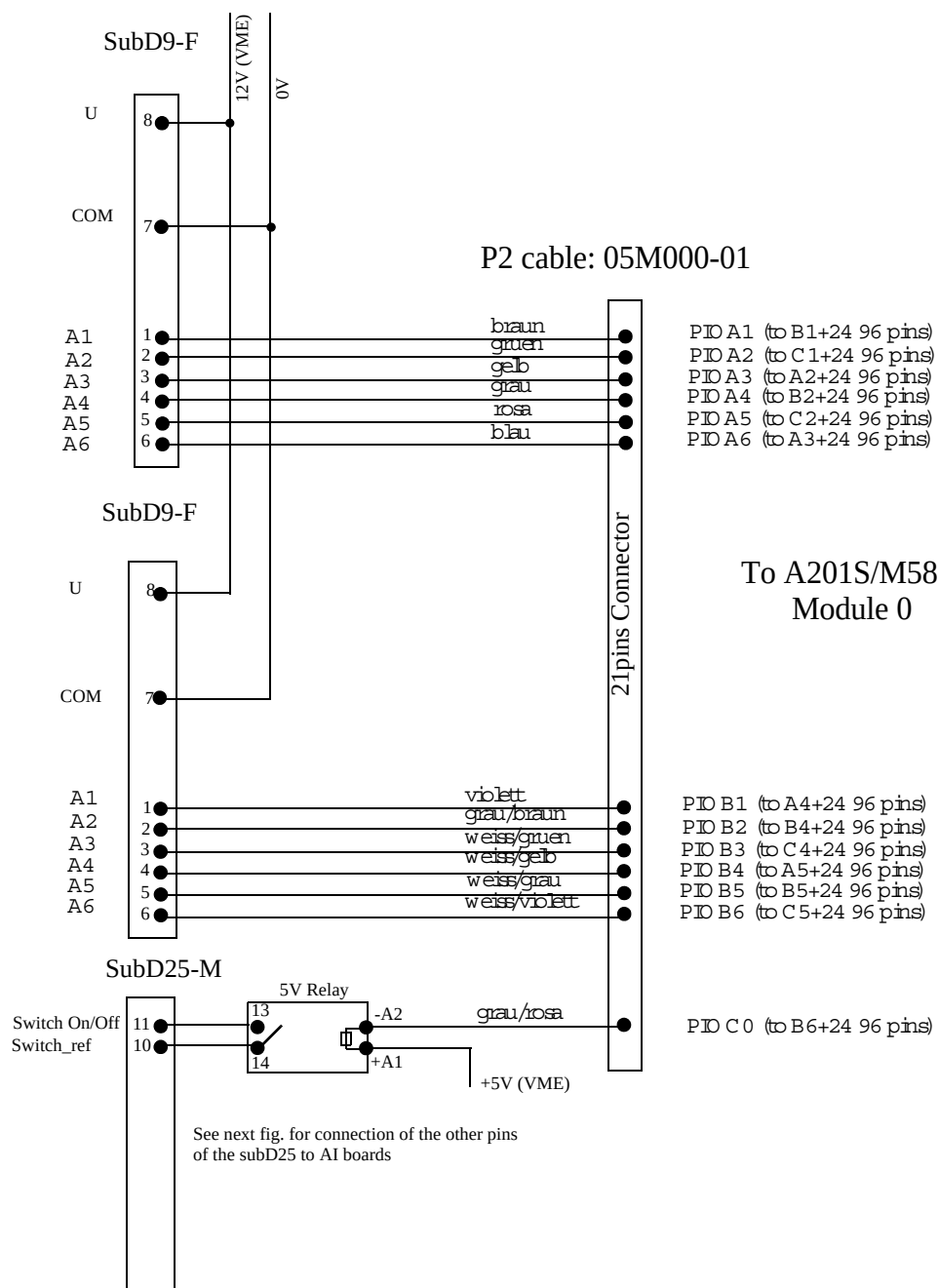
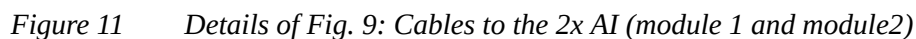


Figure 9 Overview of the connection of the proximity sensors and of the Innolight laser diagnostic signals to the TTI I/O M58 and the AI M36 boards



quantity: x1

Figure 10 Details of Fig. 9: Cable to the M58 Module 0



The “AOM proximity sensors” indicate which PRIMA channels are fed with the laser through the AOM . The sensors are mounted on the “AOM Proximity Sensor Interface Panel located on the optical table.

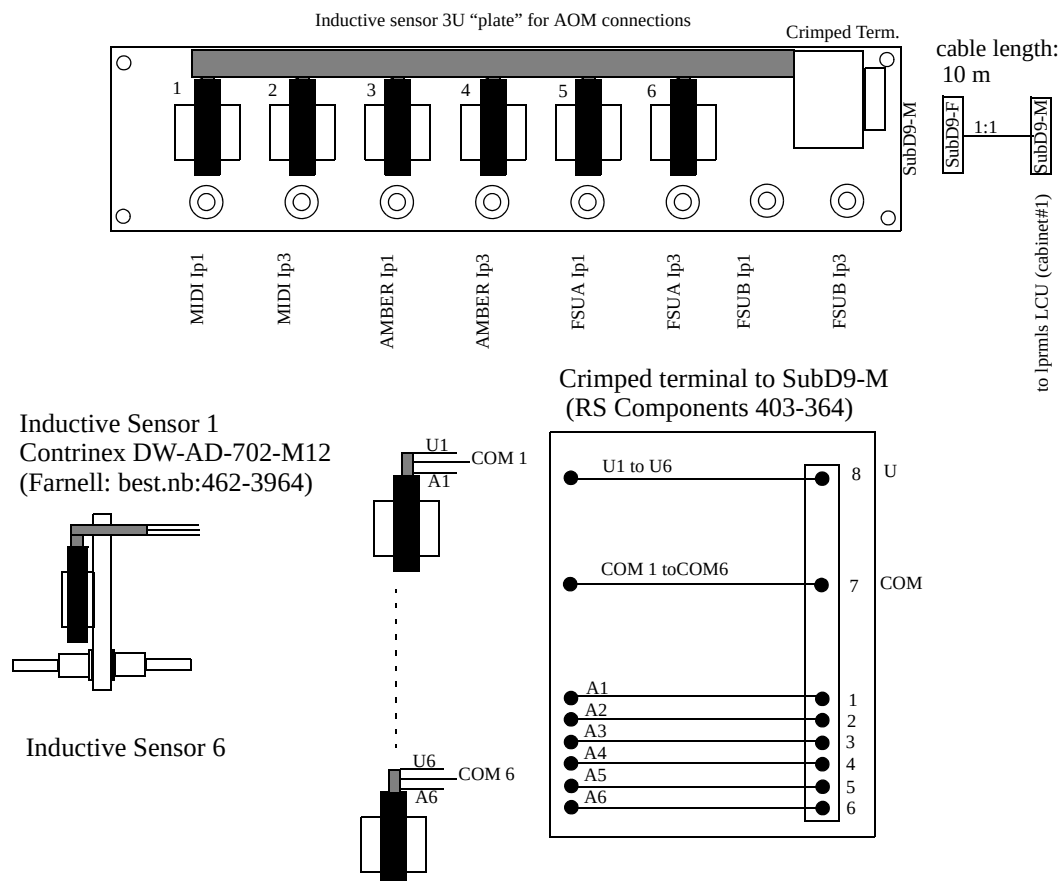


Figure 12 Internal Pin Plan for the AOM proximity sensors

6.4 Interface definition

Table 2 **IFCR#C1:** Interface definition between the **Computer Room (IC104)** and the **Cabinet #1**

Description	from/to
POWER	-SCP#32 -Cabinet# 1 main switch
LAN	-SCP#32 via Hub/switch Cabinet #2 (see section 10) -Cabinet#1 LAN Splitter
TIM	- TIM distribution box located in IC104 - lprmls LCU
COOLING	-SCP#31; -Cabinet#1 RK-2114A heat exchanger

Table 3 **IFC1#C2:** Interface definition between the **Cabinet #1** and the **Cabinet #2**

Item	from/to	Cable Type
Phase Meter Proximity Sensors (Probe/Ref)	-Cabinet#1 : lprmls LCU rear side -Cabinet#2: Phase Meter Proximity Sensors Interface Panel	Side 1:SubD9 Male Side 1:SubD9 Female Pin out: 1:1 Length: 10m
LAN	-Hub/switch Cabinet #2 (see section 10) - Hub/switch Cabinet #1	Lan Cable RJ45

Table 4 **IFC1#OT:** Interface definition between the **Cabinet #1** and the **Optical Table** “signal” I/F panel. See Fig. 24 for a view of the signal Interface Panel

Item	From/to	Cable Type
AOM -39.55MHz -40MHz 38 MHz 38.65 MHzs	-Cabinet#1 :AOM Driver1 amd Driver2 -Optical table “signal” I/F panel (see Fig. 24)	4xCoax, BNC 5 m
AOM Proximity Sensors	-Cabinet#1 : lprmls LCU rear side -Optical table “signal” I/F panel	SubD9 male/Female 5 m
Laser pzt ¹	-Cabinet#1 :lprmls LCU AO#CH0 -Optical table “signal” I/F panel	Coax, BNC 5m

Table 4 **IFC1#OT: Interface definition between the Cabinet #1 and the Optical Table** “signal” I/F panel. See Fig. 24 for a view of the signal Interface Panel

Item	From/to	Cable Type
Power Meter CHA	-Cabinet#1 :lprmls LCU AI#CH2 -Optical table “signal” I/F panel	Coax, BNC 5m
Serial	-Cabinet#1 :lprmls LCU Iser12; Ch6 -Optical table “signal” I/F panel	SubD9 (male/Female) 5m
Wavemeter	-Cabinet#1 :Wavemeter -Optical table “signal” I/F panel	Optical Fiber FC/APC -FC/PC , 5 m
EOM Driver	-Cabinet#1 :EOM Driver -Optical table “signal” I/F panel	Coax, SMA to BNC 5m
Temp	-Cabinet#1 :EOM Temp Controller -Optical table “signal” I/F panel	Coax with 2x LEMO FGG.OB 4 pins (male), 5 m
Detector Signal	-Cabinet#1 :Lock-in -Optical table “signal” I/F panel	BNC
Bias 15V	-Cabinet#1:det/Cell/Oven Controller -Optical table “signal” I/F panel	Coax with 2x LEMO FGG.OB 2 pins (male)
Cell	-Cabinet#1:det/Cell/Oven Controller -Optical table “signal” I/F panel	Coax with 2x LEMO FGA.OB 4 pins (male)
Oven	-Cabinet#1:det/Cell/Oven Controller -Optical table “signal” I/F panel	Coax with 2x LEMO FGG.OB 4 pins (male)

1. the cable used for the tuning of the laser temperature goes from the cabinet #1 directly to the laser driver located inside cabinet#3

Table 5 **IFC1#C3: Interface definition between the Cabinet #1 and the Cabinet #3**

Item	from/to	Cable Type
Innolight laser diagnostic	-Cabinet# 1: Laser stabilization LCU -Cabinet #3: laser driver input	SubD25
Laser Power adjust	-Cabinet# 1: Laser stabilization LCU -Cabinet #3: laser driver	BNC Cable
Laser Temperature	-Cabinet# 1: Laser stabilization LCU -Cabinet #3: laser driver Temp input	BNC cable



7 Definition of Cabinet #2

7.1 Purpose

Cabinet #2 includes all the control electronics necessary to compute the differential OPD and to control the lateral beam position of the laser beams propagating inside the VLTI.

7.2 Composition of the cabinet #2

Table 6 Composition of the Electronic cabinet 2: Phase meter and quadcells

Item	Size	Power Consumption
Phase Meter 1 (+1 fan): A-B 1xPhotodetector board 1xLimiter board 1x Mixer board 1x Digital Phase Meter board 2x power splitter boards	7U	200
Phase Meter 2 (+1 fan): -B 1xLimiter board 1x Mixer board 1x Digital Phase Meter board	7U	200
lprmac LCU (A-B) 1xMVE6100 CPU 1xRMN PMC board 1xPMC-HPDI-32A-64K (from General Standards) 1xTIM board 1 A201S carrier board +1 M58 module	7U	250
lprma2 LCU (-B) 1xMVE6100 CPU 1xRMN PMC board 1xPMC-HPDI-32A-64K (from General Standards) 1xTIM board 1 A201S carrier board +1 M58 module	7U	250
Phase Meter Proximity Sensor Interface Panel	3U	-
lprmpd LCU (+fan) 1x MVE6100 CPU 1xTIM board 2xVMIVME3123 AI board	7U	250
4-quadrant detectors chassis	3U	30

Table 6 Composition of the Electronic cabinet 2: Phase meter and quadcells

Item	Size	Power Consumption
TOTAL Cabinet 2	41U	1180

The cabinet is equipped with a 1400W heat exchanger RK-2114A (see RD 2)

7.3 Internal cabling

7.3.1 Cabling of the lprmac and lprma2 LCU's

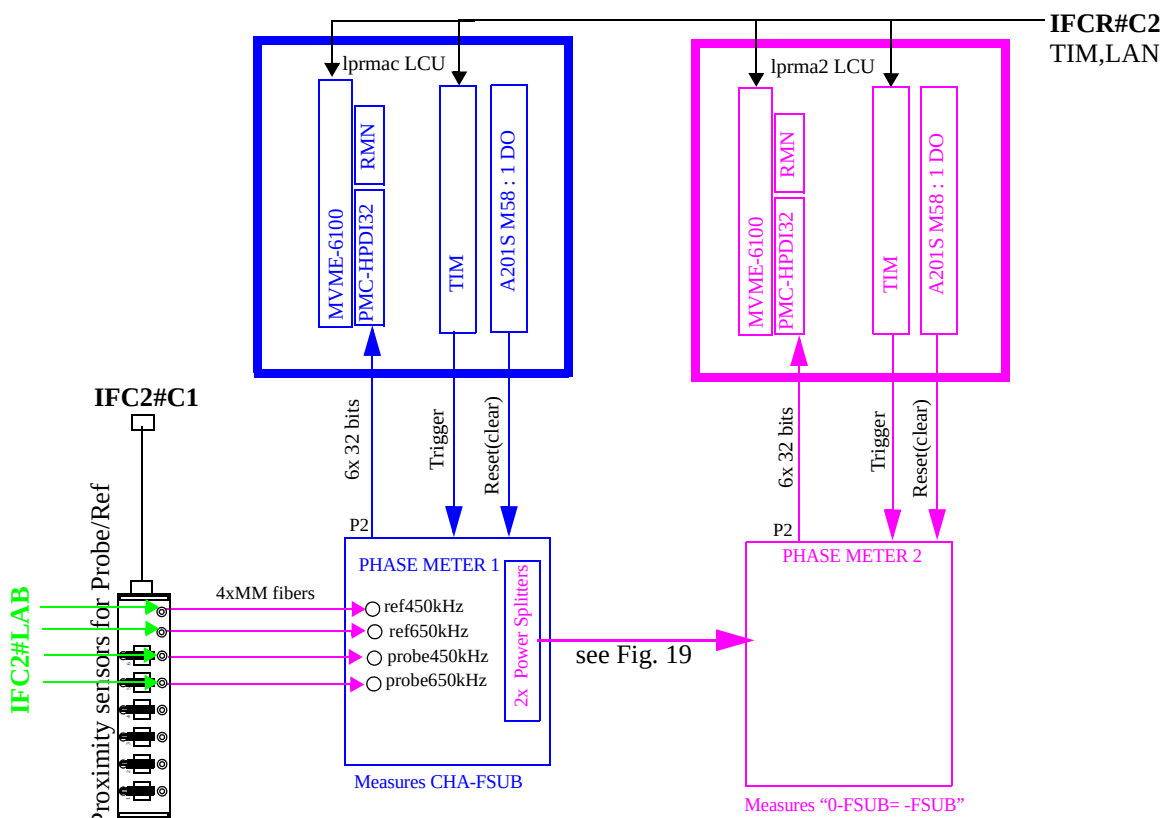


Figure 13

Lprmac LCU

Connection PMC-HPDI32A-64K to Phase meter:

CABLE6-PMC-HPDI32A (2 x 6 feet long cables for PMC-HPDI32A) from General Standards

A201S Carrier boards equipped with M58 TTL I/O Modules

Both the lprmac and lprma2 LCU's are equipped with M58 TTL I/O boards to reset the Phase Meters

The M58 is located on Module 0 (lowest module) of the A201S carrier board.

The A201S uses A16 adress mode, address 0x1800 both in lprmac and lprma2:

Connection

Device	Channel	Function	96 pin P2 connector
M58-module0	PIOB6	Reset(=clear)	PIN C29
	PIOC4	GND	PIN C31

96 pin P2 Connector connected to the back plane of the A201S board

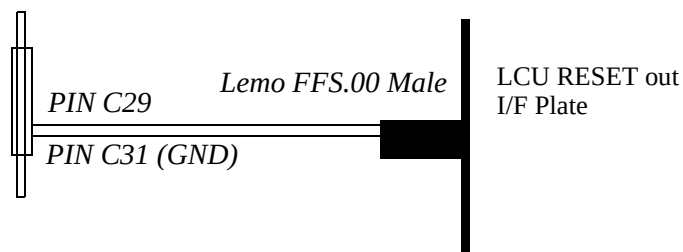


Figure 14 Cable connecting the men carrier board to the phase meter reset/clear input

2.1.2.1 Configuring the PIO_C4/PIO_C7 Function

Pins PIO_C4 and PIO_C7 of the 24-pin connector can be assigned one of three functions: the standard I/O function (PIO_Cx) or one of two alternative functions (PTRIG or GND).

Jumpers J1 (pin 21) and J2 (pin 24) determine whether the PIO signal or the alternative signal is driven to the pins.

Jumper J3 defines whether the alternative function is PTRIG or GND.

Figure 1. Position of Jumpers J1..J3

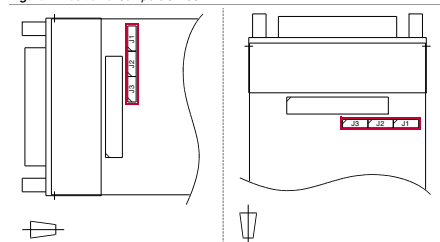


Table 5. Jumper Configurations for PIO_C4 - Pin 21

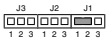
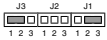
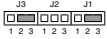
Pin 21 Function	Jumper Settings
PIO_C4	
PTRIG	
GND	



Figure 15 Jumper settings of the M58 boards of lprmac and lprma2: PIO_C4=GND.

Connection/configuration of the TIM boards

Jumper settings of the TIM board: see section 6.3.2

Device	Timer output	96 Pin P2	Function
TIM	Timer 0	A14 C14	Trigger digital GND

The TIM timer provides by default a high level and “triggers” by going low. This logic must be inverted to be compatible with the phase meter. Therefore a TTL inverter is inserted between the TIM output and the LCU trigger out interface, as shown in Fig. 16.

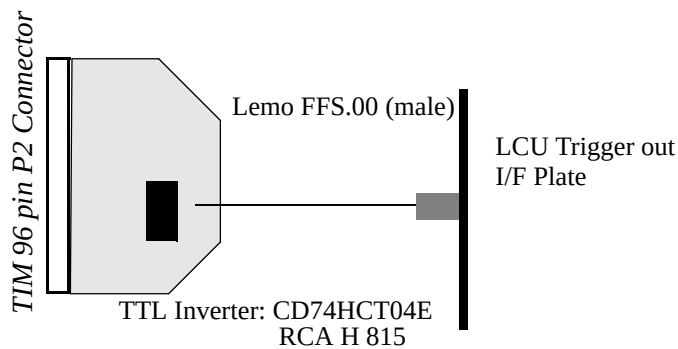


Figure 16 Cable connecting the TIM board to the LCU Trigger output

7.3.2 Cabling/configuration of the Phase Meters

A pull -up resistor and a reset button has been added to the Phase meter crates compared to the description given in AD 2. This provides 5 V to the PM clear input and a possibility to reset the PM when the PM is not connected to an external reset signal (provided by the LCU men module). When the external reset signal is connected, the reset button has no effect.

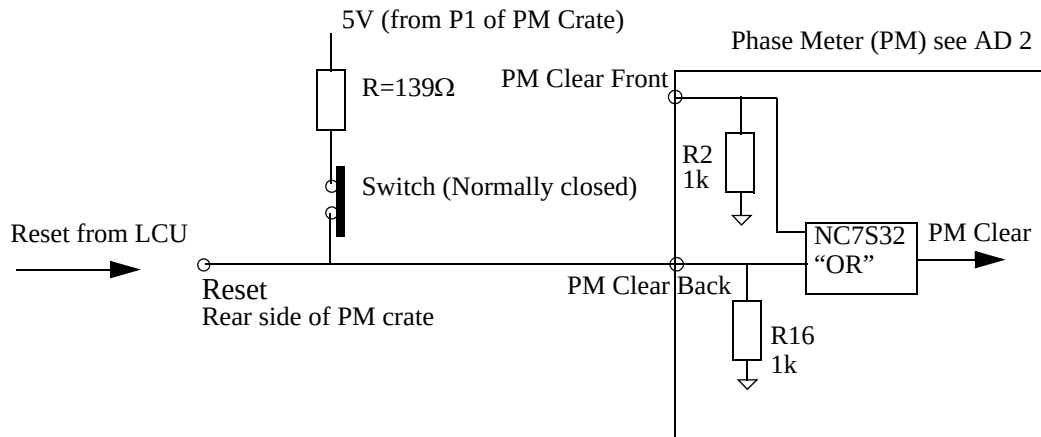


Figure 17 Reset pull-up resistor and reset button located inside on the rear side of the phase meter crate

In the initial configuration of the phase meter, the photodiode diagnostic DC voltage picked up some high frequency noise (EMC) generated by the mixer board. Therefore the backplane of the Phase meter has been redesigned to route this photodiode diagnostic signals through a PCB and not through “loose” cables anymore.

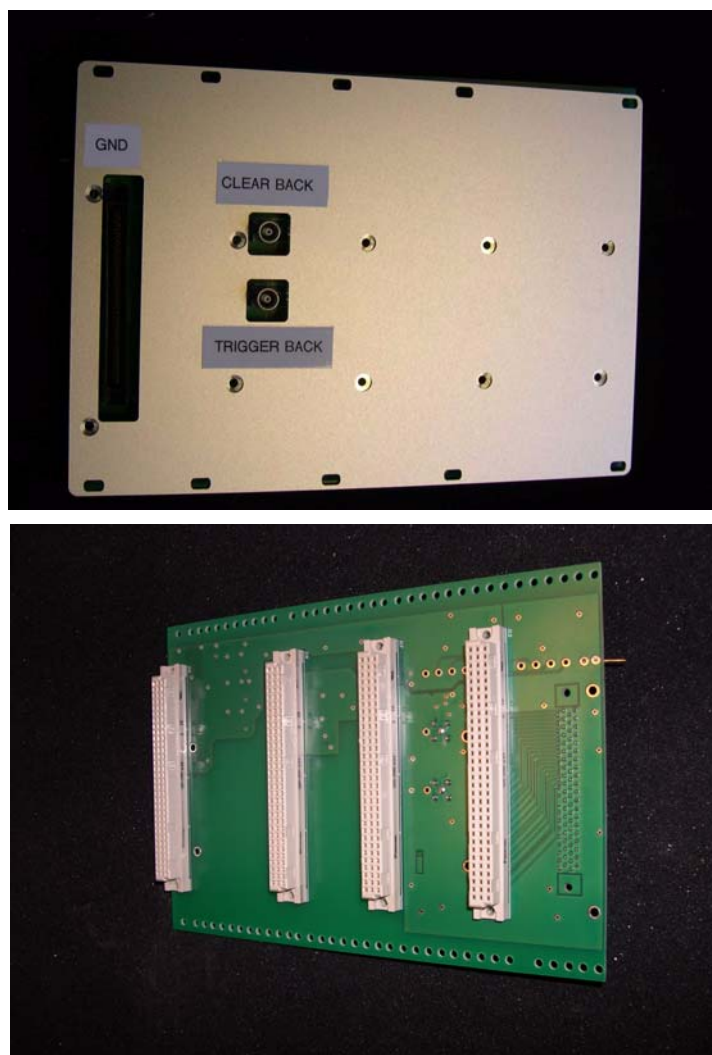


Figure 18 Re-designed back plane of the phase meter crate. See electronic archive for the detailed layout

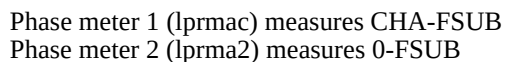


Figure 19 Connection of the phase meters

7.3.3 Cabling of the Phase Meter Proximity sensors

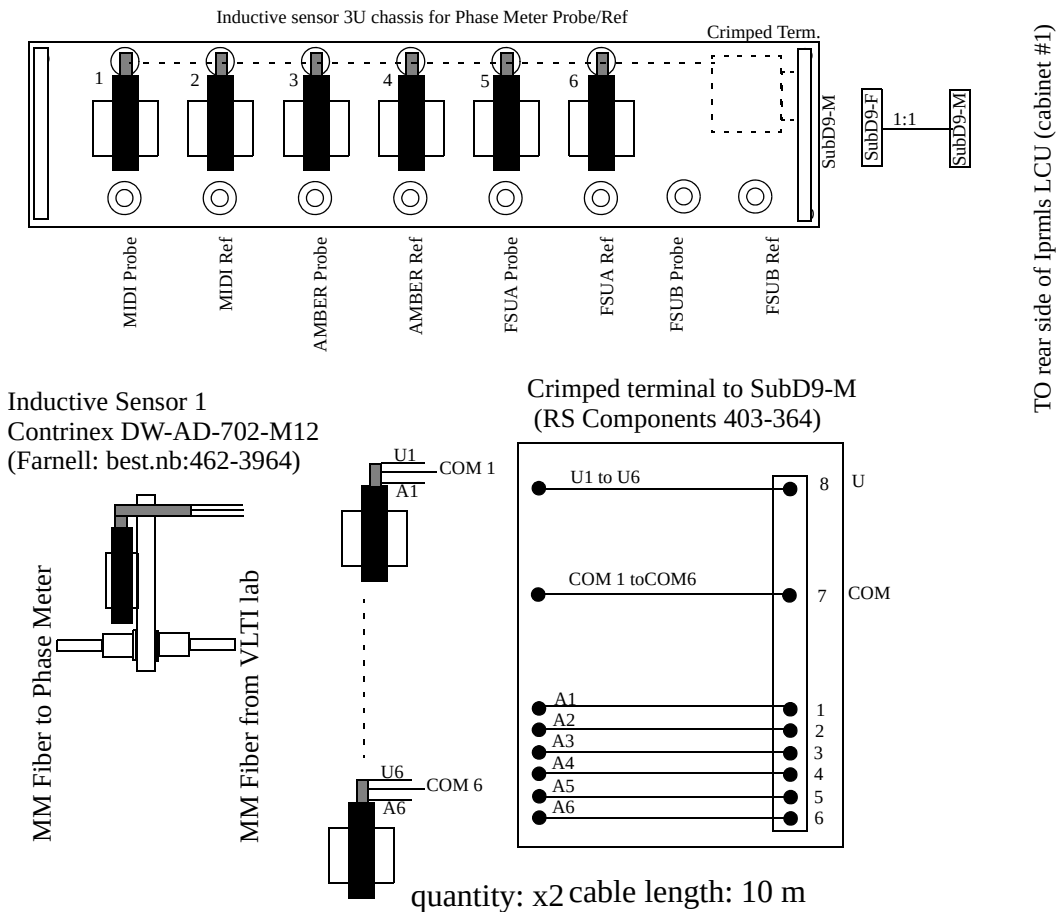


Figure 20 Internal Pin Plan for the Phase Meter proximity sensors. These sensors are connection via a single subD9 cable to the rear side of the lprmls LCU.

7.3.4 Cabling of the lprmpd LCU

The lprmpd LCU controls the pupil lateral position of the PRIMA Metrology laser beam. It reads the signal provided by all 4-quadrant detectors using 2 x VMIVME-3123-130 AI boards, then it computes the necessary corrections which are then sent via Ethernet to the Star Separator VCM LCU.

The 4-quadrant detectors and their electronics is described in details in AD 8.

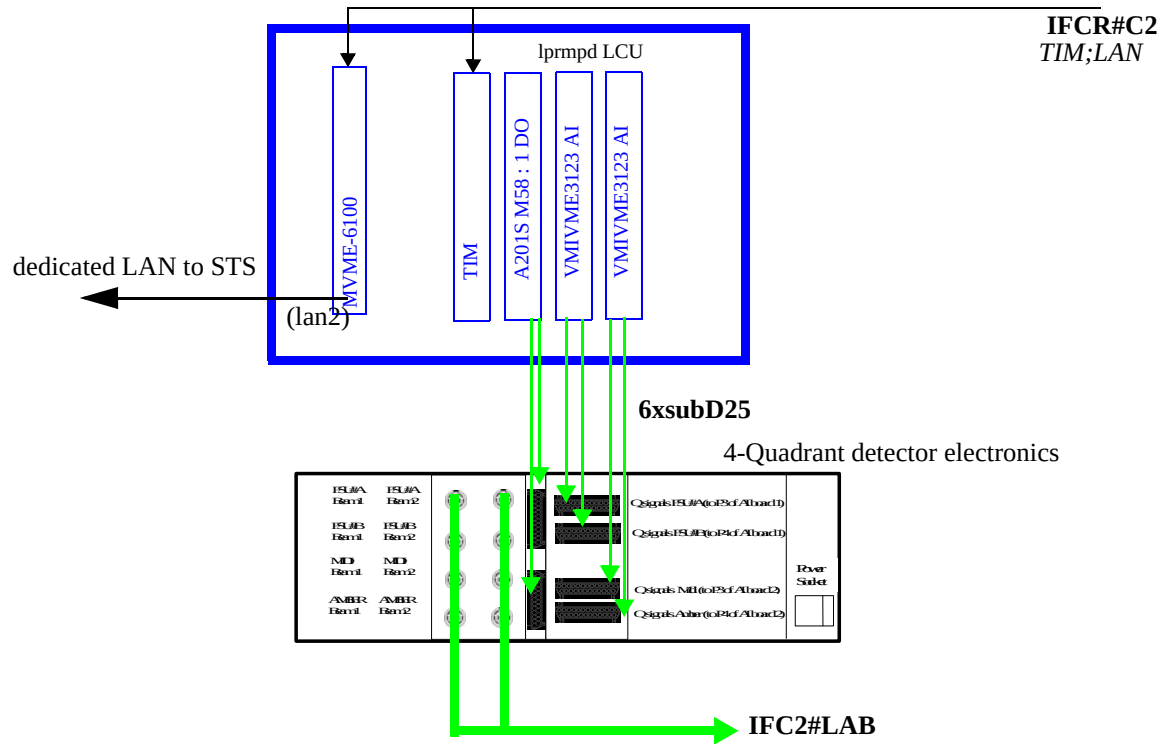


Figure 21 configuration of the lprmpd LCU

TIM board

settings identical section 6.3.2

Analog Input boards VMIVME3123:

2 analog input boards are used to read the signal from a total of 8 4-quadrant detectors located on the FSU#B, FSU#A, Midi and AMBER tables. The detectors monitor the lateral beam displacement of the laser beams retro-reflected by the star separator.

Characteristics of the boards:

VMIVME-3123-130 from GE Fanuc (Distributor: VSystems GmbH)

Bipolar Input (+/- 10 and +/- 5 V Input Ranges)-> set to +/- 10 Volts by Software

Bessel Low Pass Filter, 24 kHz Frequency,

16 Input Channels, 4 Megasamples Data Buffer Size

No jumper settings necessary

Description of the input channels: see AD 8 for the description of the AI

Men Carrier Board A201S with TTL I/O (M58).

This board is used to select the gains of all 4-quadrant detectors. see AD 8 for the description of the outputs

A201S uses A16 adress mode, address 0x1800

7.3.5 cabling of the 4-quadrant detector electronics

see AD 8 for a detailed description of the cabling

7.4 Interface definition

Table 7 **IFCR#C2:** Interface definition between the **Computer Room** (IC104) and the **Cabinet #2**

Description	from/to
POWER	-SCP#32 -Cabinet#2 main switch
LAN	- SCP#32 -Cabinet#2 LAN Splitter
TIM	-TIM distribution IC104 - lprmac; lprma2;lprmpd LCU's
COOLING	-SCP#31; -Cabinet#2 RK-2114A heat exchanger

Table 8 **IFC2#LAB:** Interface definition between the **Cabinet #2** and the **VLTI Laboratory**

Description	from/to	Characteristics
4-quadrant detectors cables (8x cables)	-Cabinet#2: 4-quadrant detector chassis - MIDI table: x2 ; AMBER table: x2 ; FSU#A table: x2 ;FSU#B table: x2	Helukabel Dataflam C Paar 6x2x0.25 mm ² /52449 500V 008118723 Connectors: FGG.2B.312.CLL.D1.00 on both side Pin out: 1:1 Length: 30 m max diameter: 15 mm max bending radius: 100mm Labels: MIDI Quadcell IP1 MIDI Quadcell IP3 AMBER Quadcell IP1 AMBER Quadcell IP3 FSUA Quadcell IP1 FSUA Quadcell IP3 FSUB Quadcell IP2 FSUB Quadcell IP4
Test BNC cables	-Cabinet#2: Interface panel - MIDI table: x2 ; AMBER table: x2 ; FSU#A table: x2 ;FSU#B table: x2	Standard BNC cables Labels: • MIDI BNC1 • MIDI BNC2 • AMBER BNC1 • AMBER BNC2 • FSUA BNC1 • FSUA BNC2 • FSUB BNC1 • FSUB BNC2



Table 8 **IFC2#LAB:** Interface definition between the **Cabinet #2** and the **VLTI Laboratory**

Description	from/to	Characteristics
Metrology signals 12x Multimode fibers (incl.4 spares)	-Cabinet#2: Phase Meter Proximity Sensors Interface Panel - MIDI table: x3 ; AMBER table: x3 ; FSU#A table: x3 ;FSU#B table: x3	Multimode fiber Thorlabs GIF65 FC connectors on both sides Length: 30 m max diameter: 10mm max bending radius: 40 mm Labels: • MIDI 650kHz Probe • MIDI 650kHz Ref • MIDI spare MM • AMBER 650kHz Probe • AMBER 650kHz Ref • AMBER spare MM • FSUA 650kHz Probe • FSUA 650kHz Ref • FSUA spare MM • FSUB 450kHz Probe • FSUB 450kHz Ref • FSUB spare MM PROTECTION for each channel <i>LAPP Silvyn Split:</i> Ref: 6180 6630 diameter (inner/outer): 12,9/18,7 mm bending radius: 75mm see Fig. 22

“Phase Meter Proximity Sensor Interface Panel” (top view)

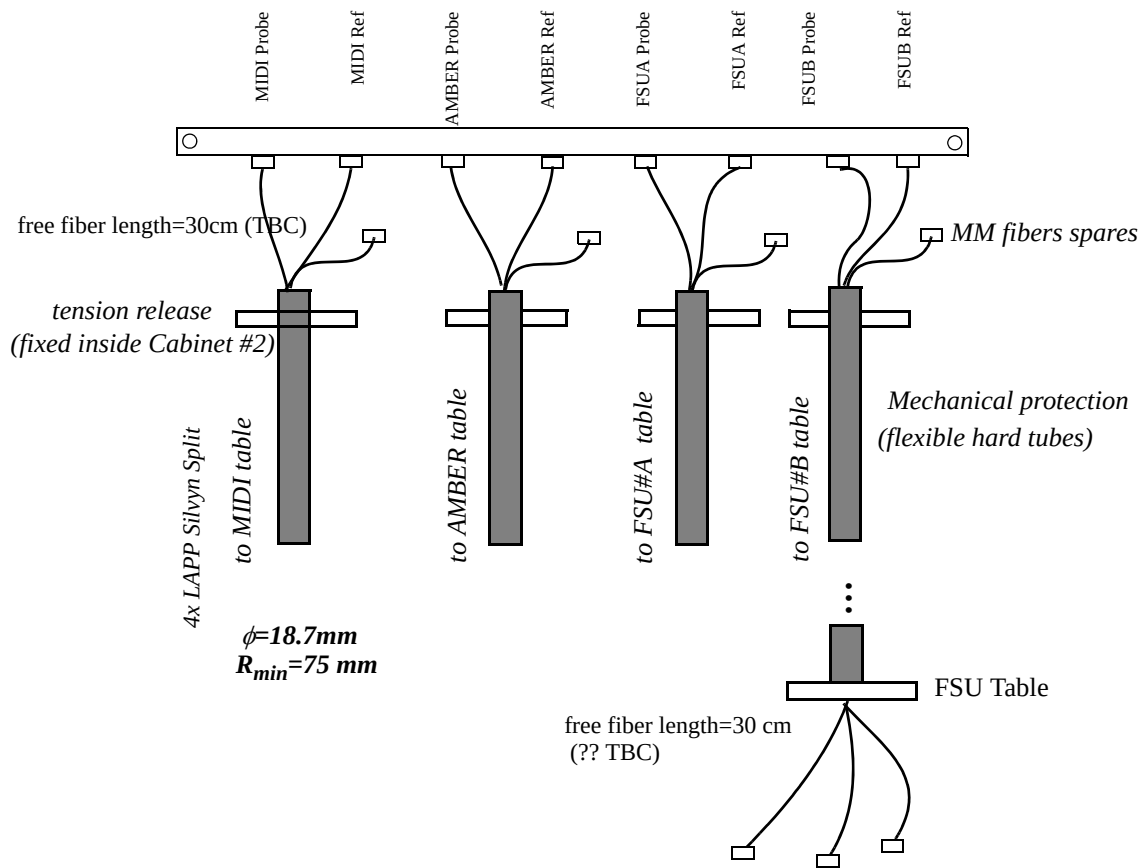


Figure 22 Cables of IFC2#LAB

8 Definition of Cabinet #3

8.1 Purpose

Cabinet #3 includes the laser driver, which has to be close to the laser head.

8.2 Composition of the cabinet #3

Table 9 Composition of the Electronic cabinet 3

Item	Size	Power Consumption
Innolight laser driver	WxDxH 260x360x110 mm	75 W (at 1.3 A)
Lightwave laser driver (spare laser)	WxDxH 350x430x140 mm	75 W
TOTAL Cabinet 3		75 W (only 1 laser operate at a given time)

(1 HE/U=44.45 mm)

8.3 Internal cabling

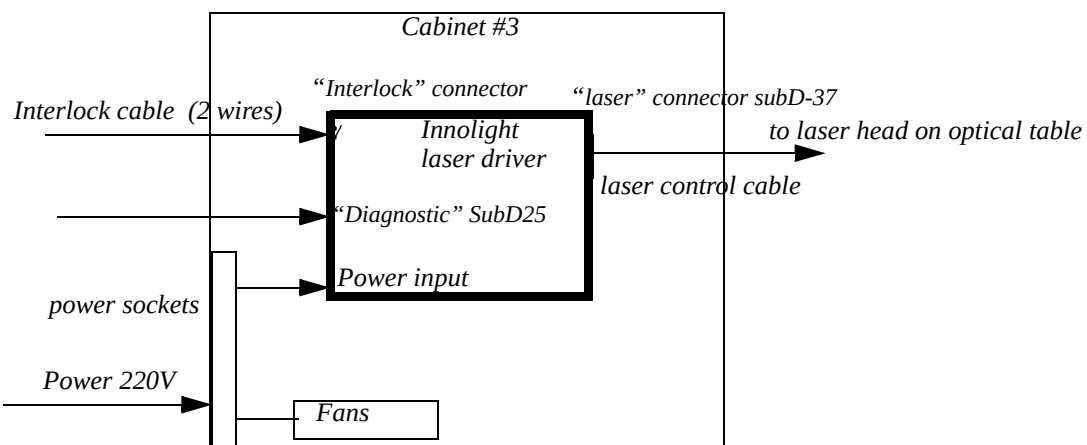


Figure 23 Internal cabling of Cabinet #3

8.4 Interface definition

Table 10 **IFCR#C3:** Interface definition between the **Computer Room (IC104)** and the **Cabinet #3**

Description	from/to	Characteristics
POWER	-SCP#32 -Cabinet#3 main switch	

IFIP#C3:

Interface between the **Interlock Panel** and the **Cabinet #3**:
see description in RD 3.

IFC1#C3: Interface definition between the **Cabinet #1** and the **Cabinet #3**

See description in section 6.4

9 Definition of the Control HW located on the optical table

9.1 Purpose

The hardware located on the optical table consists of the laser head, fiber couplers, AOM modulators as well as all the hardware necessary for the laser frequency stabilization as described in AD 3.

The hardware is protected by an enclosure which includes 2 interface panels as detailed in section 9.3

The size of the optical table is 1800x900.

The free height below the optical table is 690 mm where Cabinet #3 will be installed.

9.2 Internal Cabling

see AD 3 for the laser stabilization

9.3 Interface definition

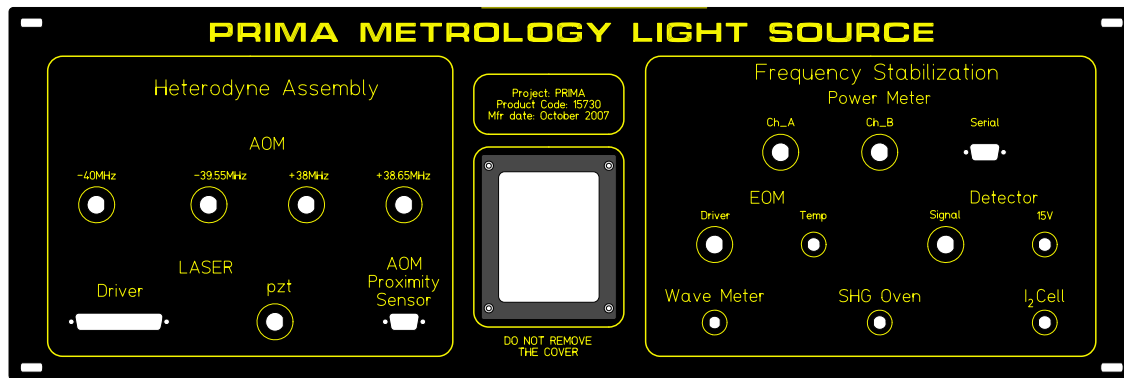


Figure 24

“Signal” interface panel of the optical table enclosure. It refers to the interface definition of IFC1#OT section 6.4 and IFC3#OT section 8.4. Note: the laser temperature adjustment is part of IFC1#C3 and it not wired through the above “signal” panel. Size of the panel: width=900mm; Height:250mm, thickness=4mm. Fixation holes: -horizontal separation: 870 mm; vertical separation:230mm; diameter:6.2 mm (length=15mm for long holes)

I

Table 11 *List of connectors of the “Signal” Interface Panels*

Item	Adaptor Type
AOM -39.55MHz -40MHz 38 MHz 38.65 MHz Proximity Sensors	BNC BNC SubD9 (male outside/female inside enclosure)
Laser Driver pzt	SubD37 (male outside/female inside enclosure) BNC
Power Meter CHA; CHB Serial	BNC SubD9 (male outside/female inside enclosure)
Wavemeter	FC/APC -FC/APC
EOM Driver Temp	BNC Adaptor for LEMO FGG.OB 4 pins (male)
Detector Signal 15V	BNC Adaptor for LEMO FGG.OB 2 pins (male)
Cell	Adaptor for LEMO FGA.OB 4 pins (male)
Oven	Adaptor for LEMO FGG.OB 4 pins (male)

The interface panel will be screwed on the front face of the enclosure located on the optical table of the storage room.

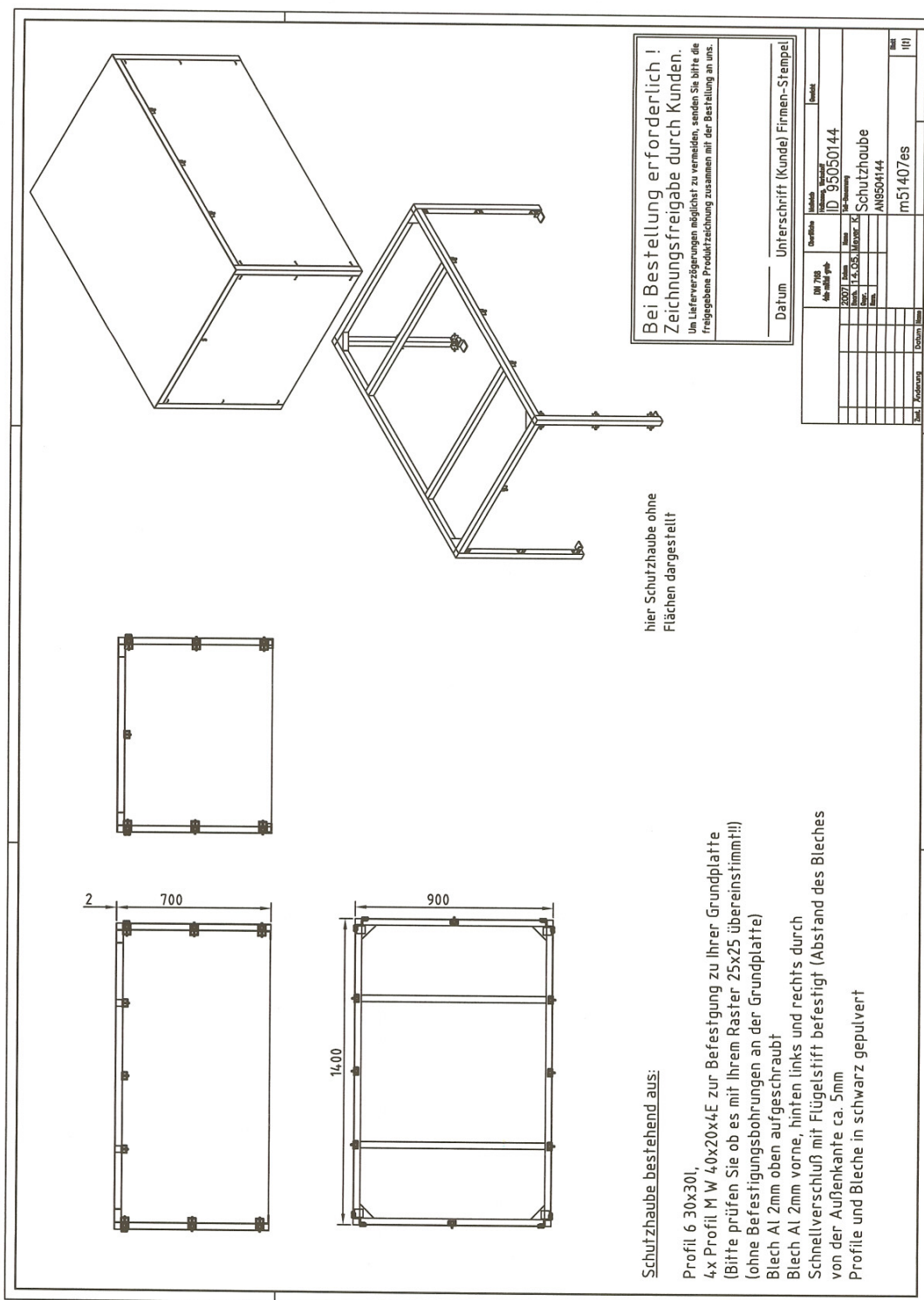


Figure 25 Drawing of the PRIMET light source enclosure

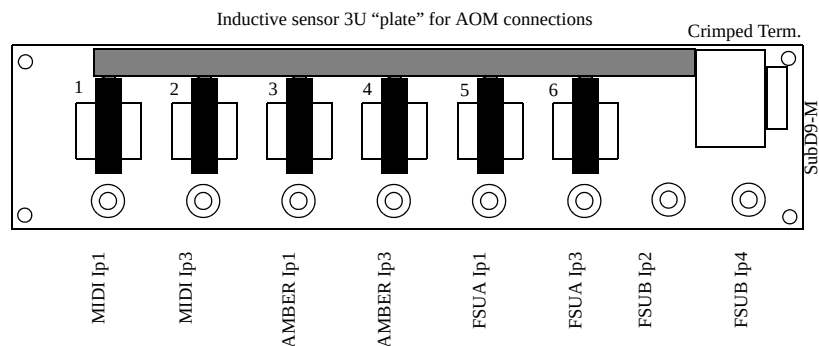


Figure 26 **AOM proximity sensor interface panel** of the optical table enclosure (seen from inside the enclosure). It refers to the interface definition of IFOT#LAB described below



Table 12 IFOT#LAB: Interface definition between the Optical Table (OT) and the VLTI Laboratory

Description	from/to	Characteristics
Metrology signals 12x Single Mode fibers(incl. 4 spares)	-Optical table: AOM proximity sensor Interface panel - MIDI table: x3 ; AMBER table: x3 ; FSU#A table: x3 ;FSU#B table: x3	SM-PM fiber from Diamond Fujikura Panda SM-13P- 7/125-UV/UV-400 FC/APC connectors on both sides Length: 30 m max diameter: 10mm max bending radius: 40 mm Labels: • MIDI +38MHz ip1 • MIDI +38.65MHz ip3 • MIDI spare • AMBER +38MHz ip1 • AMBER +38.65MHz ip3 • AMBER spare • FSUA +38MHz ip1 • FSUA +38.65MHz ip3 • FSUA spare • FSUB -39.55MHz ip4 • FSUB -40MHz ip2 • FSUB spare PROTECTION for each channel: <i>LAPP Silvyn Split:</i> Ref: 6180 6630 diameter (inner/outer): 12,9/18,7 mm bending radius: 75mm + <i>Armaflex:</i> Ref (Sahlberg Gmbh): AF-F-035; ref.240554 diameter (inner/outer): 38/60 mm see Fig. 27

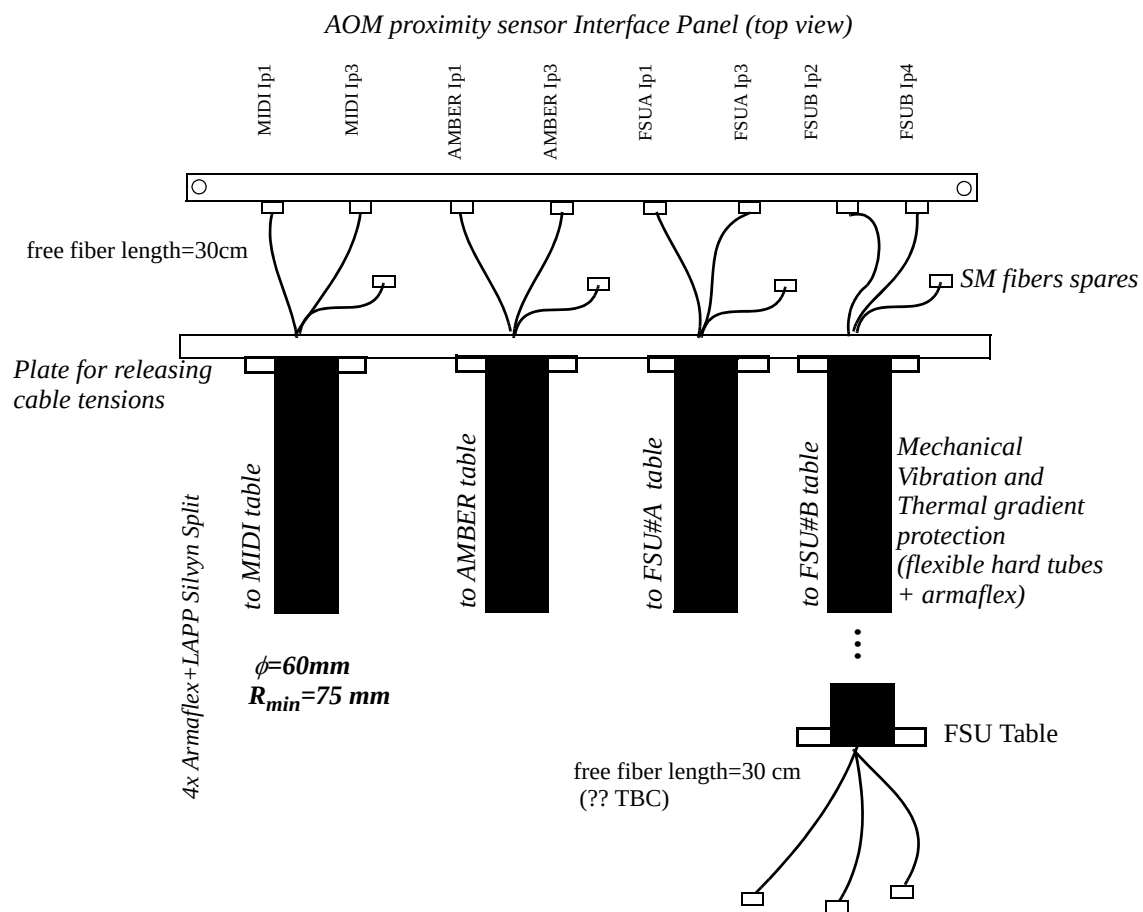


Figure 27 Cables of IFOT#LAB

10 Layout of the LAN ,TIM and Reflective Memory Network

The layout of the LAN, TIM and RMN network is shown in Fig. 28. The LAN connection is provided via SCP 32 of IC104 to a HUB/Switch located in Cabinet#2. The TIM board of each PRIMET LCU is connected to the TIM distribution box located in IC104.

PRIMET is included in the PRIMA RMN ring from the FSU LCU's and relay the RMN signal to SCP#32 (port10) for further use.

Finally a dedicated LAN is created from the lprmpd LCU to each Start Separator VCM LCU via SCP#32(port 5,6).

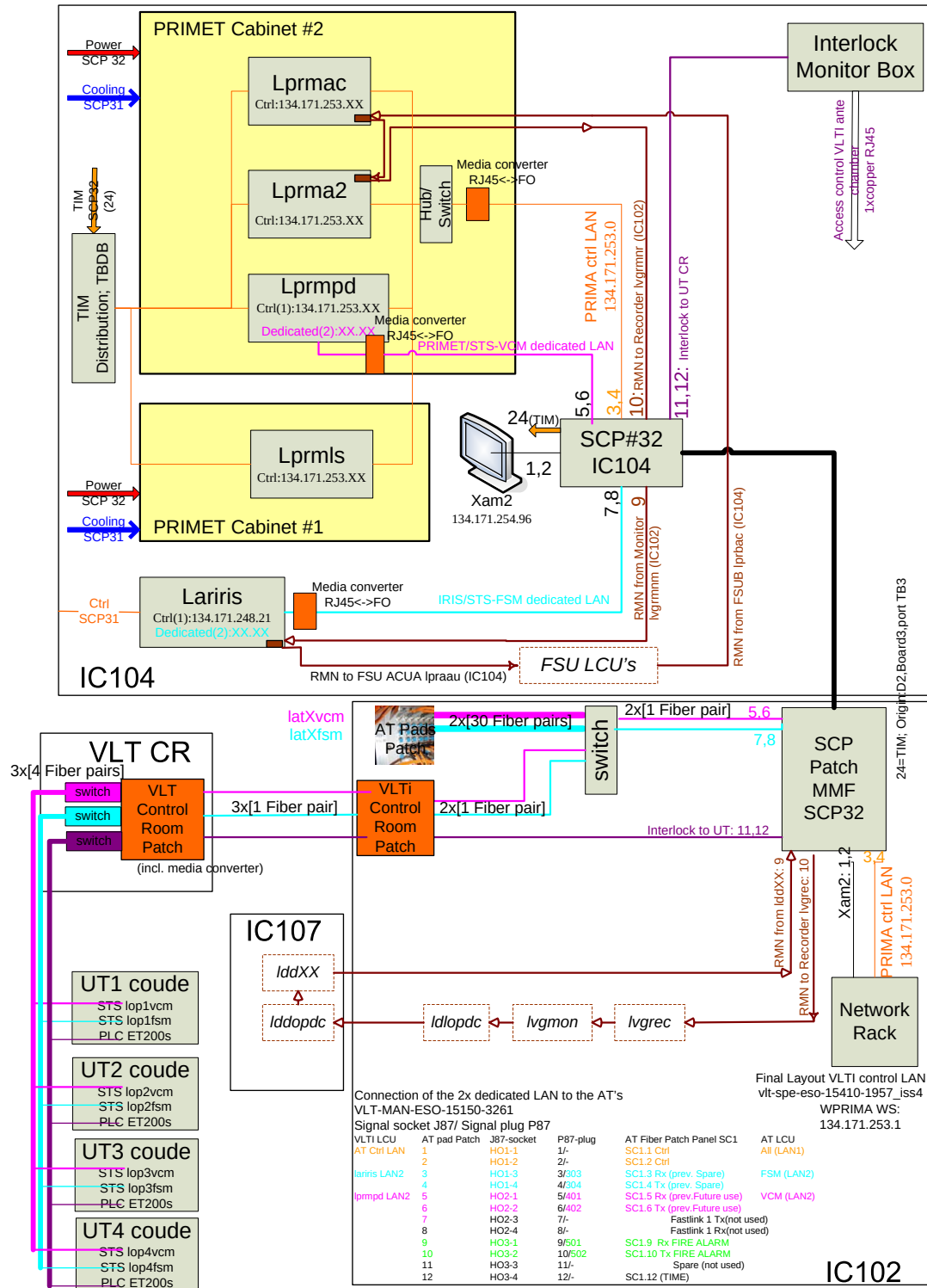


Figure 28 PRIMET LAN , TIM and RMN layout

11 Laser Safety Interlock System

The safety interlock system is described in RD 3.

Interface Definition:

Table 13 **IFIM#C3**: Interface definition between the **Interlock Monitor** (IC104) and the **Cabinet #3**

Description	from/to	Characteristics
Laser Interlock	-Interlock panel S7300F; storage room -Cabinet#3 ; laser driver interlock input	2 wire cable with C=xx capacitance in parallel

Table 14 **IFIM#VLT**: Interface definition between the **Interlock Monitor** (IC104) and the **VLT**

Description	from/to	Characteristics
see RD 3	see RD 3	see RD 3

12 Power consumption and dissipation

The estimated total power consumption is:

cabinet 1: 810 W

cabinet 2: 1180 W

cabinet 3: 75 W

Cabinets 1 & 2 are equipped with heat exchanger RK-2114A (1400W) that can be plugged into the liquid cooling system.

The power dissipated by the equipment located on the optical table is <100W

Laser head 30W

4x AOM head negligible

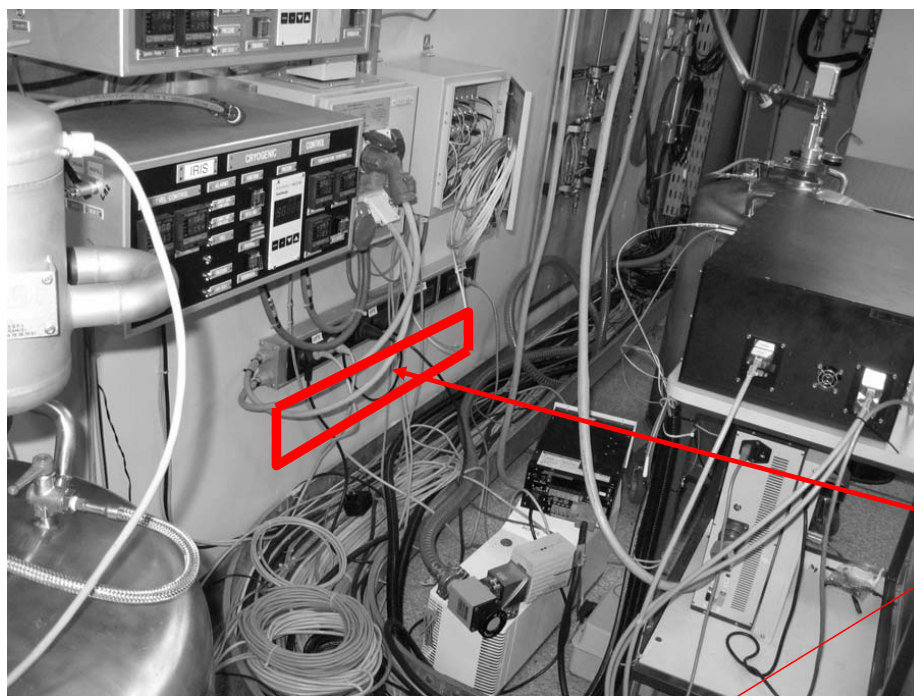
SHG Oven 7W

EOM 1 W

I2 cell 30 W

Optical detector negligible

The temperature of the storage room shall be maintained to its set-temperature +/- 2.5 deg



NEW
FT

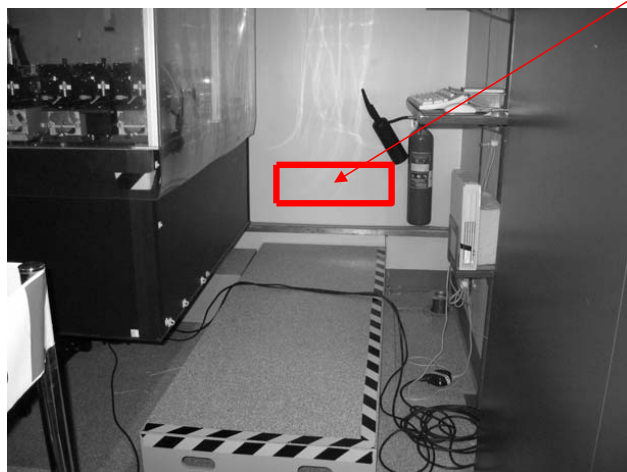


Figure 30 View of the computer room 2 (IC104) with the new feedthrough . .

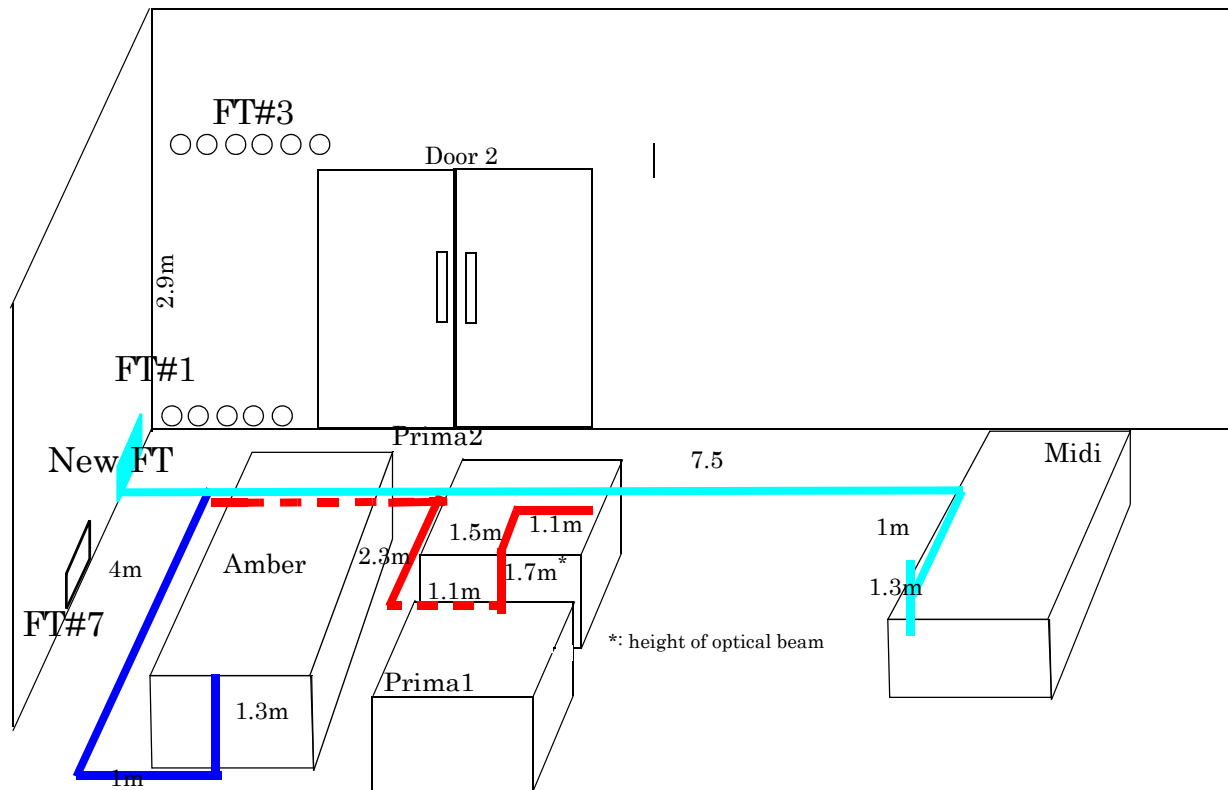


Figure 31 New cable trays required for the PRIMA Metrology inside the VLT Lab.

Max Distance from Cabinet #1 to the output of the new FT=12m

Max Distance from the output of the new FT to the AMBER MET location (blue path)= $4\text{m} + 1.0 + 1.3 = 6.3\text{m}$.
Total from Cabinet#1 to AMBER MET = **18.3m**

Max Distance from the output of the new FT to MIDI MET location (Cyan path)= $1 + 7.5 + 1 + 1.3 = 10.8\text{m}$
Total from rack to MIDI MET = **22.8m**

Max Distance from the output of the new FT to FSU #B met beam injection (red path)
 $2 + 2.5 + 2.3 + 1.1 + 1.7 + 1.5 + 1.1 = 12.2$
Total from rack to FSU MET = **24.2 m**

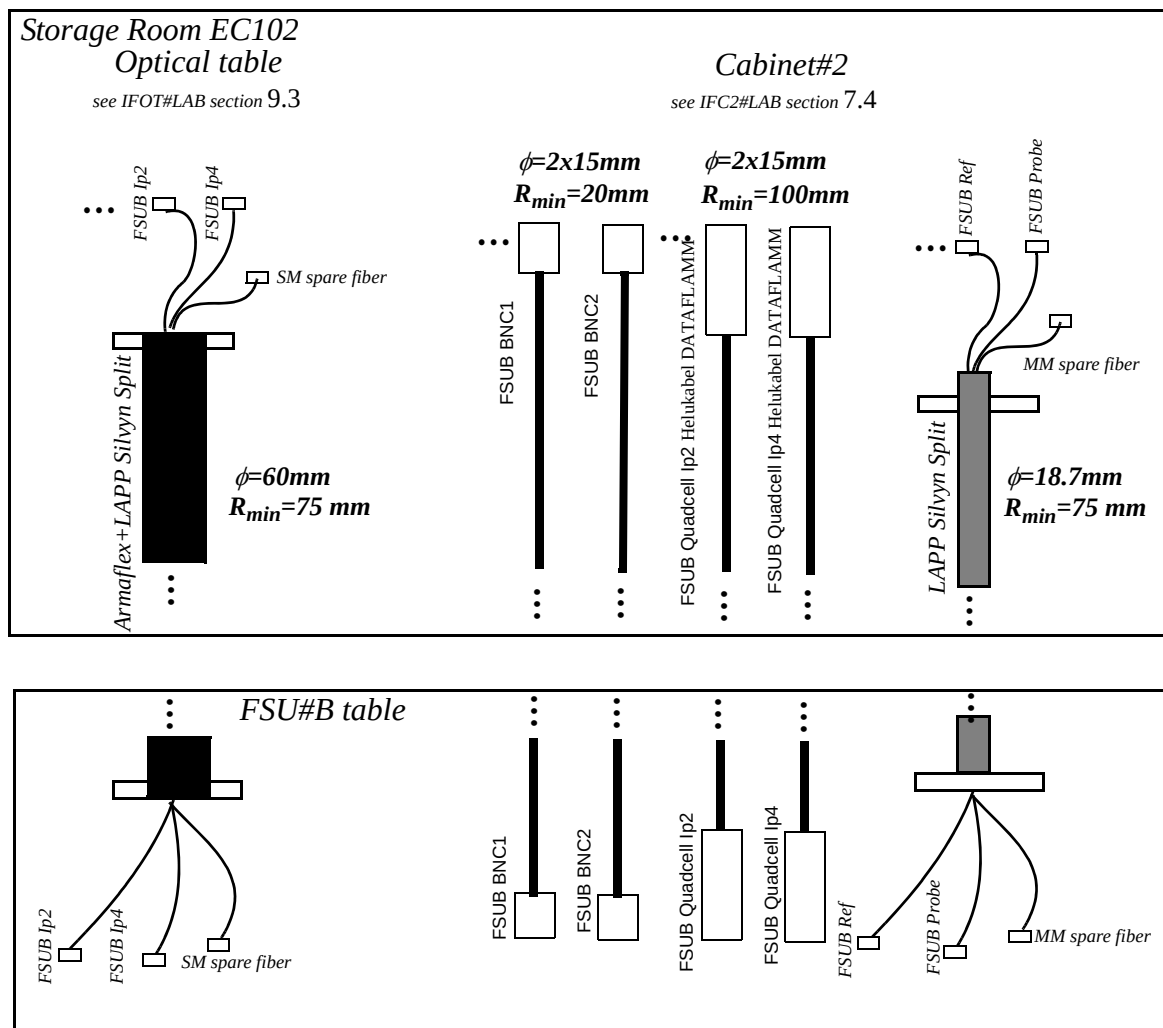


Figure 32 Example of the cabling to the FSU#B table. The sum of the diameters of all 6 cables going to FSUB is 138 mm. Identical cables are routed to the FSU#A, MIDI and AMBER tables.

LAPP Silvyn Split (Lapp Kabel)

Art.nummer: 61806630; inner/outer diameter 12.9/18.7 mm (sold per 50 m piece)

Length needed: 8x30m=240 m

-> 6 pieces ordered =300 m

396.35 euros/100m

LAPP Silvyn Split Cov (Lapp Kabel) ; Schlauchverschraubung

Art.nummer: 61806770 (sold per 100 piece)

-> 1 box ordered

318 Euros

Armaflex (sahlberg)

Typ AF-F-035; 76m/box; Art.Nummer 240554 ; 2m; inner diameter 38mm; armaflex thickness 11 mm

Length needed: 4x 30 m= 120 m-> 2 boxes ordered= 152m

2.91 euros/box

Typ AF-Tape : 3 pieces

Art.Nummer 240422

33.4 euro/piece

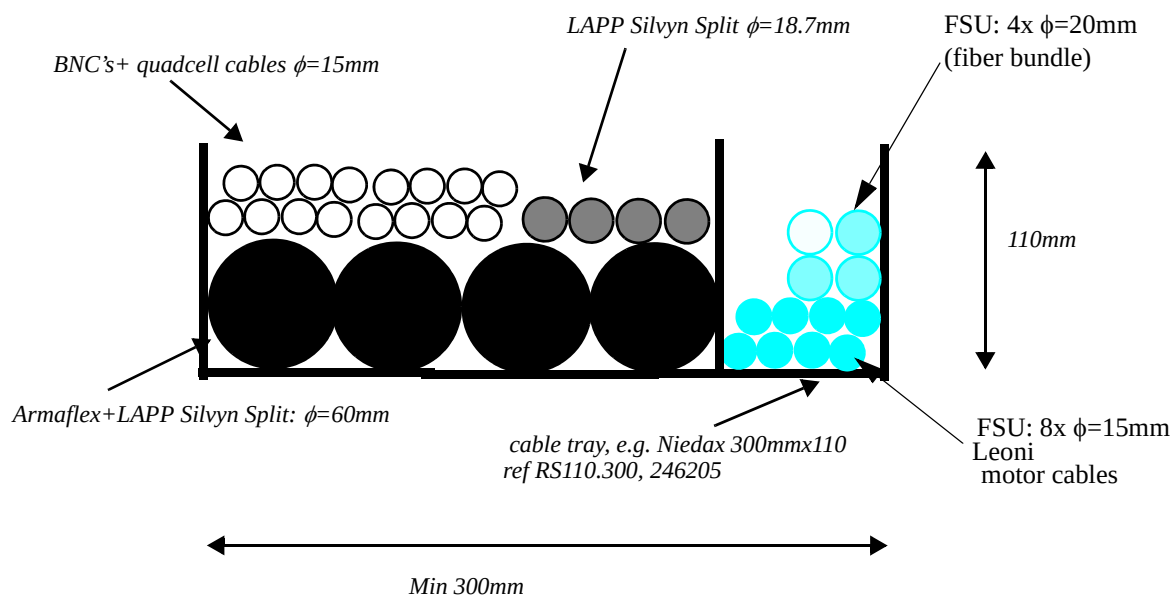


Figure 33 Proposed cable tray configuration leaving the storage room ("almost" to scale). Not included are the fibers of the interlock system (only a small space is needed). Black: Metrology cables; Cyan: FSU Cables included for information

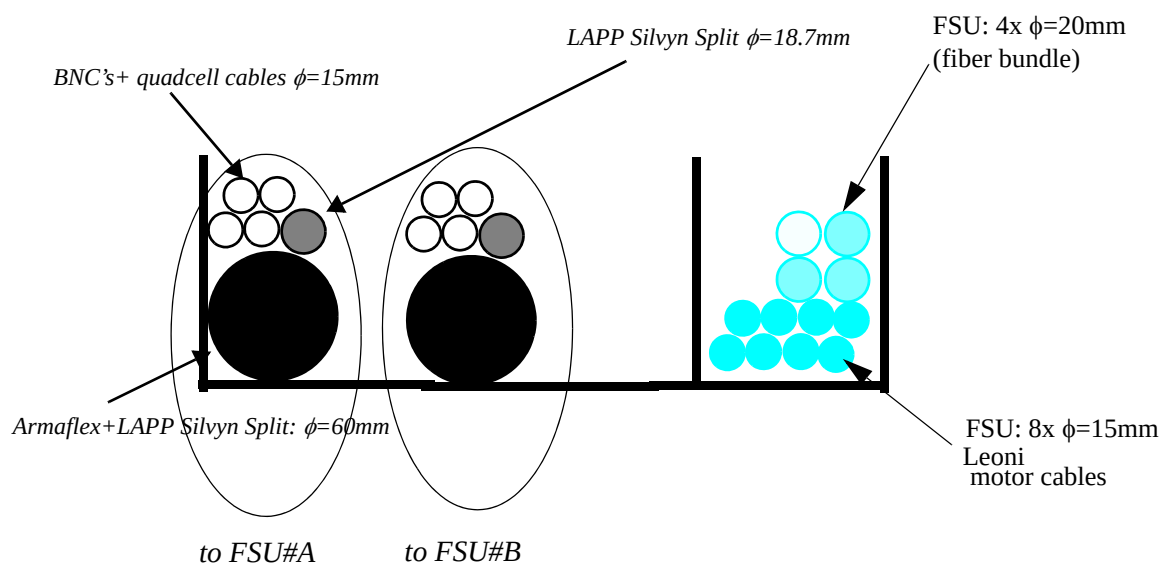


Figure 34 Cables to be routed to the FSU#A and FSU#B table; Black: Metrology Cables as shown in Fig. 32. Cyan: FSU Cables (for info)

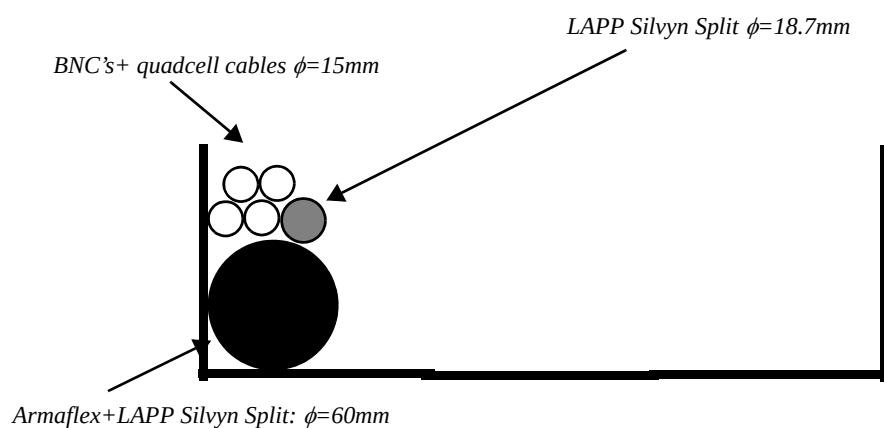


Figure 35 Metrology Cables to be routed to MIDI and AMBER as shown in Fig. 32.

14 Prima Metrology Control Model

The PRIMA Metrology control Model is located at ESO-Garching (VLT control model room).

It consists of a single 6HE crate hosting 3 LCU's:

- the Phase Meter LCU (lprmac), including 1x 6100 CPU + 1x RMN VMIPMC-5565 board + 1x DI board PMC-HPDI-32A-64K
- the Laser stabilization LCU (lprmls), including 1x 6100 CPU only
- The pupil tracking LCU (lprmpd), including 1x 6100 CPU only

The second phase meter LCU (lprma2) is simulated as it is a 1:1 copy of lprmac

15 Spare parts

- 1x DI board PMC-HPDI-32A-64K
- 2x VMIVME-3123-130
- 1 Complete phase meter

16 Appendix

16.1 Composition of the electronics cabinets #1 and #2

Components of Cabinet 1&2 Knuerr Miracel	Qty
Grundgestell Nr.1.130.285.0	2
Seitenteile Nr. 1.130.654.1	4
Deckel/Boden Nr.1.130.691.1	2
Waermetauscher Nr.03.032.326.1 RK-2114A (1400W)	2
Sockel Nr.1.130.539.1	2
Sockel Fahr. Nr.1.130.562.1	2
Filtermatte Nr.01.130.530.9	2



Bodenblech Nr.1.130.733.0	2
Glasfluegeltuer Nr.01.131.870.1	2
Tuer Verkuerzt Nr.01.131.666.1	2
Anschlussplatte Nr.1.131.601.1	2
Anschlussplatte mit Kabeleinf. Nr.1.131.607.1	2
Kranoesensatz Nr.1.131.745.9	2
Einschubschienen Nr.1.110.727.0	24
19" Blindplatte Nr.01.117.027.1	2
19" Blindplatte Nr.1.117.030.1	1
19" Blindplatte Nr.1.117.028.1	1
19" blindplatte Nr.01.117.031.1	1
Infobox Din A5 Nr.00.203.891.0	2
Schaltplantasche Nr.5.016.045.0	2
Kompakt Leuchte Nr.1.131.465.9	2
Kabelfuehrung Nr.1.312.207.9	20
Kabelabfang Nr.1.117.035.7	2
Erdungsset Nr.1.130.529.9	2
Erdungsset Nr.1.130.624.9	2
ESD Textielarmband Nr.1.346.033.9	3

Accessories available in each rack:

- Heat exchanger on the side of the rack
- Main Switch (safety fuse)
- Neon tube inside
- 2x12 power sockets (with fuses)
- cable trays for power cables or "kabelfuehrungsring p.773 x15
- Cable feed through under the cabinet and in the rear door
- "bodenblech" +Kabeleinfuehrung typ5, p.107
- double front door (transparent) p.98; Single metallic rear door
- BNC type cable holder mounted on the rear door
- Lifting anchor on top
- "Sockel (100mm) see p.106: used in Garching/ to be removed at Paranal

	PRIMA Metrology Control electronics	Doc Issue Date Page	VLT-TRE-ESO-15735-2963 2 03/04/2008 55 of 60	
---	--	------------------------------	---	---

- 4xdismountable wheels: used in Garching/ to be removed at Paranal

**Connection of the RK-2114A Heat exchanger:
see operation manual of the RK-2114A**

16.2 Composition of cabinet #3

origin: Knuerr AG

1x Smaract 19" Kleinschrank Mit lochraster profil
Best.Nr: 02.110.062.1 393 Euro

1x Smaract belueftungseinheit
Typ.2, Best.Nr: 02.111.181.9 ,192 Euro

1x Smaract 19" Stahlblech Profil mit Lochraster
12 HE, Best.Nr: 02.111.157.9 , 62 Euro

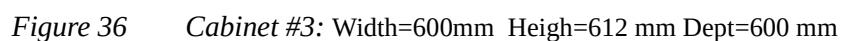
1x Smaract Kranoesen Set
Best.Nr: 01.243.440.9, 21,50 Euro

3x 19" Fachboden 2HE/U
Best.Nr: 01.113.737.1 , 43,20 Euro

Total Dimensions:

Width=600mm Heigh=612 mm Dept=600 mm

HE/U=12; weight 20 kg



The diagram illustrates the 100-MHz 1-bit DAC architecture, divided into REF and PROBE stages. The REF stage (top) includes INEL1, InOPt1, Det1Out, Out450kHz, INEL2, InOPt2, Det2Out, and Out650kHz. The PROBE stage (bottom) includes INEL1, InOPt1, Det1Out, Out450kHz, INEL2, InOPt2, Det2Out, and Out650kHz. The architecture is further divided into four functional blocks: PREAMPLIFIER, LIMITER, MIXER, and DIGITAL PM. The PREAMPLIFIER and LIMITER blocks are connected to the REF and PROBE stages. The MIXER block is connected to the REF and PROBE stages. The DIGITAL PM block is connected to the REF and PROBE stages. The diagram shows the signal flow from the REF and PROBE stages through the PREAMPLIFIER, LIMITER, MIXER, and DIGITAL PM blocks. The REF stage outputs are connected to the PREAMPLIFIER and LIMITER blocks. The PROBE stage outputs are connected to the MIXER and DIGITAL PM blocks. The diagram also shows the internal connections between the REF and PROBE stages, including the INEL1, InOPt1, Det1Out, Out450kHz, INEL2, InOPt2, Det2Out, and Out650kHz signals.

Figure 37 “Standard connection of 1 phase meter”

16.4 Settings for the ISER12 board

Coding Switches and Bridges

2. Description of Coding Switches and Bridges

2.1 Board View

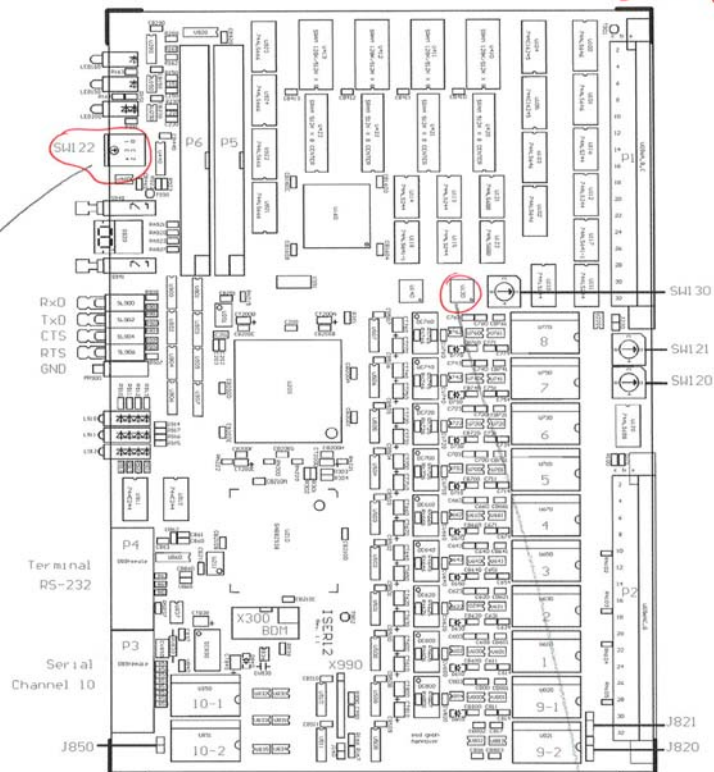


Fig. 2.1.1: Board view top layer



16.5 Settings of the Reflective memory board VMIPMC-5565

Jumper Configuration and Location

Prior to installing the VMIPMC-5565 on a host board, the desired node ID must be set by installing or removing the jumper shunts on jumper block E1. Each node in network must have a unique node ID. See Figure 2-1 on page 32 for the location of jumper block E1. Jumper block E1 can accommodate 8 jumper shunts, which correspond to 8 node ID select signal lines. The 8 node ID select lines permit any binary node ID from 0 to 255 (255 decimal). Jumper block E1, pins 1 and 2 correspond to the least significant node ID line and pins 15 and 16 correspond to the most significant node ID line. Installing a jumper shunt sets the binary node ID line low (0), while removing a jumper shunt sets the binary node ID line high (1). The Table 2-1 below provides examples of possible node IDs.

Table 2-1 Example Node ID

E1 1 to 2	E1 3 to 4	E1 5 to 6	E1 7 to 8	E1 9 to 10	E1 11 to 12	E1 13 to 14	E1 15 to 16	Node ID Hex (Dec.)
Installed	Installed	Installed	Installed	Installed	Installed	Installed	Installed	\$0 (0)
Removed	Installed	Installed	Installed	Installed	Installed	Installed	Installed	\$1 (1)
Installed	Removed	Installed	Installed	Installed	Installed	Installed	Installed	\$2 (2)
Installed	Installed	Removed	Installed	Installed	Installed	Installed	Installed	\$4 (4)
Installed	Installed	Installed	Removed	Installed	Installed	Installed	Installed	\$8 (8)
Installed	Installed	Installed	Installed	Removed	Installed	Installed	Installed	\$10 (16)
Installed	Installed	Installed	Installed	Installed	Removed	Installed	Installed	\$20 (32)
Installed	Installed	Installed	Installed	Installed	Installed	Removed	Installed	\$40 (64)
Installed	Installed	Installed	Installed	Installed	Installed	Installed	Removed	\$80 (128)
Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	\$FF (255)

Jumper E5 Configuration

Prior to installing the VMIPMC-5565 on the host motherboard, jumper E5 must be configured for the appropriate mode of operation. Jumper E5 controls three functions on the board:

1. Pins 1 and 2 select the non-redundant (fast) or redundant network transfer modes.
2. Pins 3 and 4 enable or disable the Rogue Master 0 function
3. Pins 5 and 6 enable or disable the Rogue Master 1 function.

Pins 7 and 8, are currently reserved and should not be used. Table 2-2 on page 32 details the functions selected by the installation or removal of the jumper shunts. The default factory configuration is all jumper shunts installed (except pins 7 and 8).

NOTE: Pins 7 and 8 of Jumper E5 are not use (reserved), and should not have jumper shunts installed.



2 VMIPMC-5565 Ultrahigh-Speed Fiber-Optic Reflective Memory with Interrupts

Table 2-2 E5 Jumper Configuration

E5 Pins	Installed/Omitted	Function/Mode Selected
1 to 2	Installed	Non-redundant (Fast) network transfer mode selected
	Omitted	Redundant network transfer mode selected
3 to 4	Installed	Rogue Master 0 function disabled
	Omitted	Rogue Master 0 function enabled
5 to 6	Installed	Rogue Master 1 function disabled
	Omitted	Rogue Master 1 function enabled
7 to 8	None	These pins are RESERVED, NO jumper shunt should be installed.

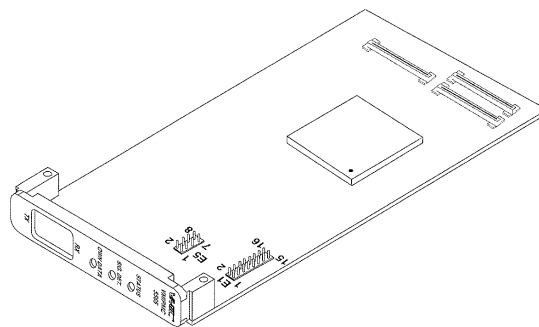
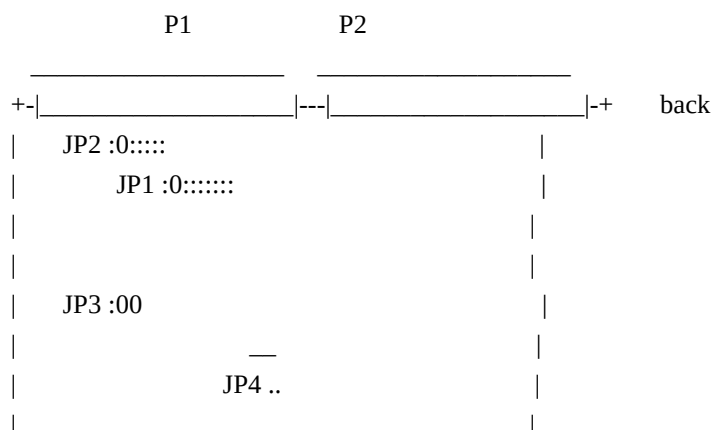


Figure 2-1 VMIPMC-5565 Jumper Locations

16.6 Jumper settings for the TIM board



| JP5 : |
 | |
 | |
 ===== front

Name	Standard-Setting	Description

JP1	15-16 installed	Base address setting: 0x0100
JP2	11-12 installed	IRQ-Level 6
JP3	3-4 and 5-6 installed	IRQ-Level 6 (see also CAUTIONS)
JP4	1-2 installed	Time bus signal source via P2 connector
	3-4 omitted	
Note: set the jumper in upper horizontal position.		
JP5	Omitted	No termination of time bus signal on the TIM board

Name	Non-standard-Setting	Description

JP4	1-2 omitted	Time bus signal source via front (fiber)
	3-4 installed	