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Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral
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VERY LARGE TELESCOPE

PRIMA Metrology Laser Interlock System Acceptance Test

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CHANGE RECORD

Issue	Date	Affected Paragraphs(s)	Reason/Initiation/Remarks
1	21.04.2008	All	First Issue

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1 SCOPE

This document defines the acceptance test procedure for the PRIMA Metrology Laser Interlock System. Detailed information on the purpose and functioning of this system is given in [AD1, AD2].

The acceptance test is split in two independent test procedures. The first procedure describes the safety acceptance tests, the second procedure concerns the non safety relevant functions of the system. The safety acceptance test procedure must be followed after any change to the safety part of the system, concerning hardware or software changes. Furthermore, the safety tests listed should be carried out once per annum to verify that the system is still working. If only non safety relevant parts of the system have changed, the safety acceptance test is optional. The test procedures are therefore split in two groups:

- Safety functions
- Non Safety functions

The last page of this document provides for convenience a template for the acceptance test protocol.

2 APPLICABLE AND REFERENCE DOCUMENTS

Ref	Document Number	Issue	Date	Title
AD 1	VLT-TRE-ESO-15730-4546	1	02/04/2008	Prima Metrology Safety and Reliability Analysis
AD 2	VLT-SPE-ESO-15735-4544	1	01/04/2008	Design of the PRIMA Metrology Laser Interlock System / Technical Manual
AD 3	A5E00109537-04	N/A	10/2007	S7 Distributed Safety - Configuring and Programming, Siemens AG (http://support.automation.siemens.com)

3 LIST OF ABBREVIATIONS/ACRONYMS

ACKN	Acknowledge
IL	Interlock
LED	Light Emitting Diode
UT	Unit Telescope

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4 SYSTEM OVERVIEW

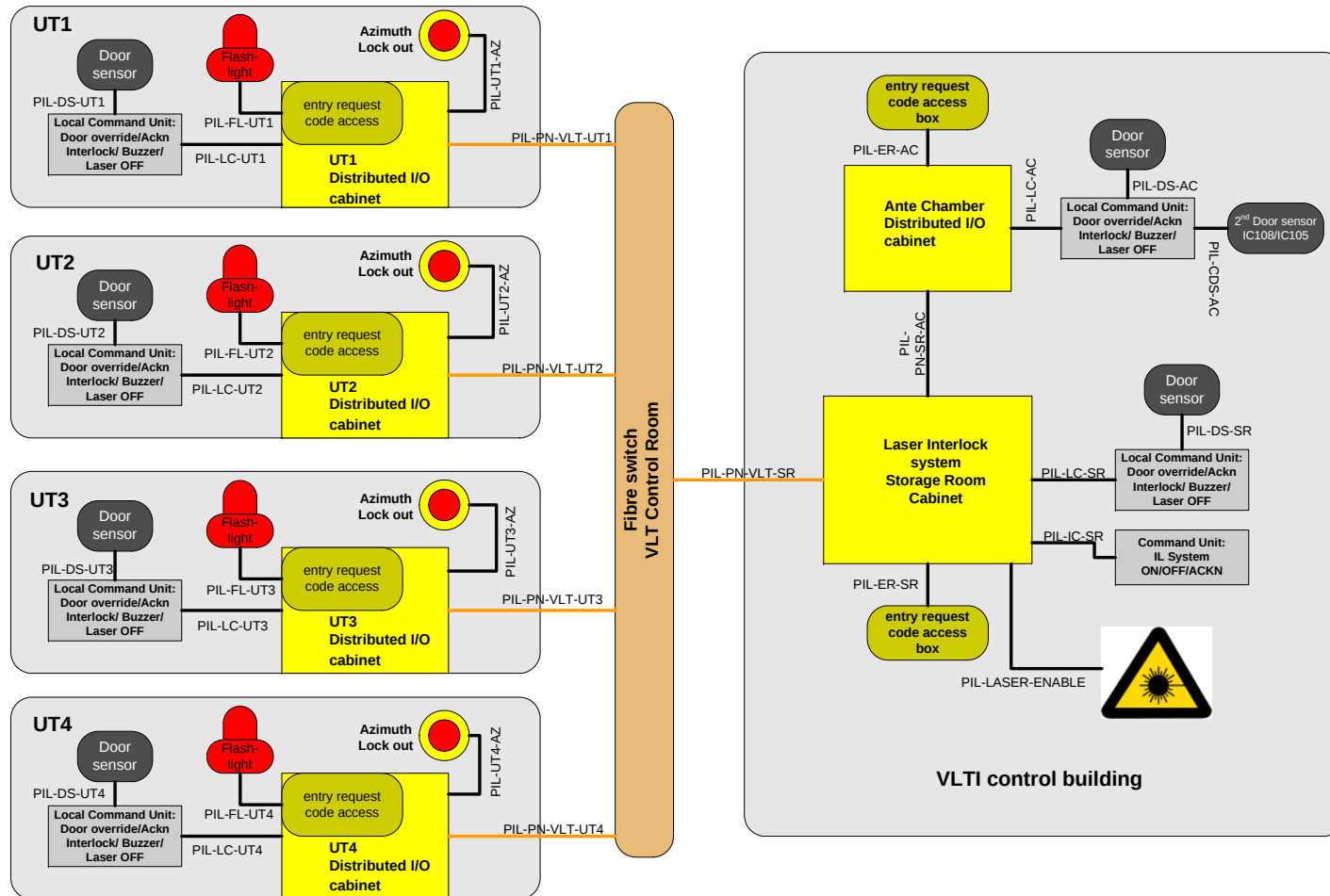


Figure 1 Laser Interlock System overview

The IL system consists of 6 cabinets with almost identical functions. Only the Storage Room cabinet includes additional functionality to display interlocks and to turn the system ON/OFF. All of the following described tests apply to each location/cabinet. Therefore all tests have to be repeated at all 6 locations (Ante Chamber, Storage Room, UT1 – UT4) if not noted otherwise.

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5 ACCEPTANCE TEST PROCEDURE FOR SAFETY FUNCTIONS

5.1 General

The safety hardware of PRIMA consists of

- the S7 317F CPU
- ET200S
- 4/8F-DI
- 4F-DI/3F-DO
- PME DC24-48V (connected right before the safety modules mentioned above)
- Ethernet link to the CPU including switches and media converter

The safety program is clearly separated from none safety program functions. The safety program is password protected and the compiled code version can be identified by the collective signature of the safety program. See [AD2] for more details and flowcharts of the safety program. See [AD3] for additional information given by Siemens concerning acceptance tests for safety systems.

5.2 Verify Safety program properties and collective signature

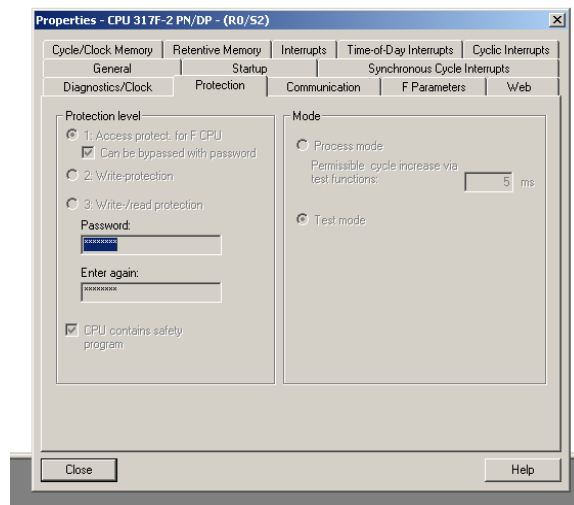


Figure 2 CPU protection properties

- Connect PC with Step 7 and safety option installed to the Profinet network
- Check CPU properties:
 - o Password protection
 - o Mode: Process mode
- Record safety signature from safety program

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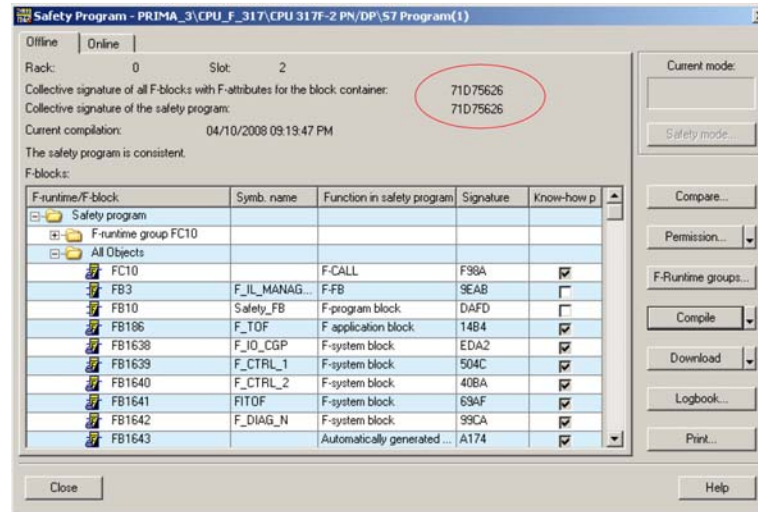


Figure 3 Safety program signature

5.3 Check Laser Enable/Disable function

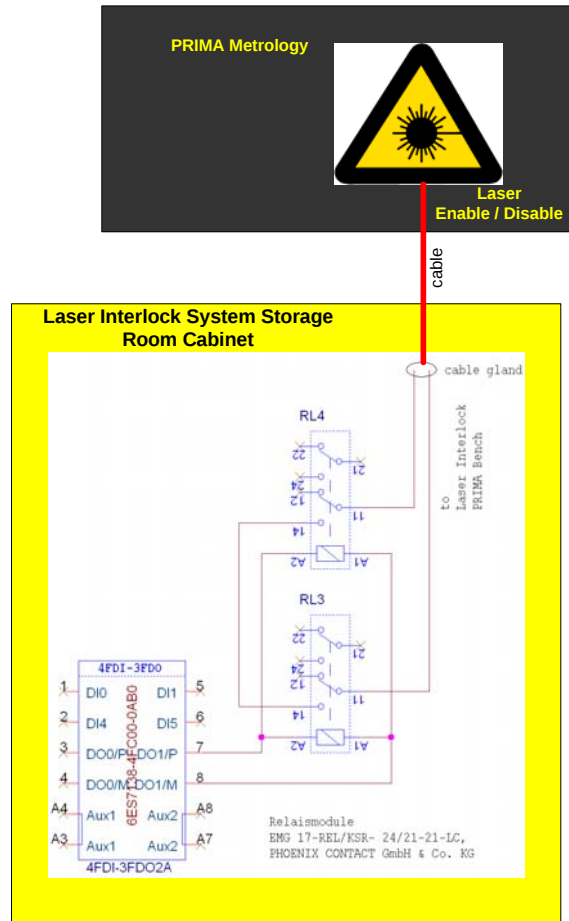


Figure 4 Laser Enable/Disable interface

The following steps must be carried out to verify that the “Laser Enable/Disable” function works properly:

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- Turn laser interlock system “ON” using the Interlock System Command Unit “IL System ON/OFF/ACKN” to enable the laser
- Turn the laser “ON” (see [AD1])
- Verify that the laser is “ON”
- Check the yellow LED on the Phoenix relays (Figure 1) to see if the relays is activated → yellow LED on
- Turn laser “OFF” via Command Unit “IL System ON/OFF/ACKN” function button “OFF”
- Verify that the laser has been disabled and that the laser is “OFF”
- Verify that the yellow LED on the Phoenix relays is “OFF”

The laser does not have to be turned on for the following tests. It is sufficient to monitor the yellow relays LED indicating the relays status to verify that the Laser Enable/Disable function is working correct after the test above has been passed.

Yellow relays LED ON (Relays activated → contact closed) = Laser Enable
Yellow relays LED OFF (Relays OFF → contact open) = Laser Disabled

The laser is disabled by the interlock system when the yellow relays status LED is OFF.

Note: This test applies only to the hardware in the Storage Room.

5.4 “ACKN IL” button

All occurred interlock must be acknowledged by pressing the “ACKN IL” button of the command unit “IL System ON/OFF/ACKN” before the laser can be enabled again by pressing the button “Laser IL System ON”. The “ACKN IL” button of the **local command unit** must be activated/pressed after an interlock is triggered at a monitored door. This must be done before the interlock can be acknowledged by activating the “ACKN IL” button of the **interlock system command unit** (located in storage room). The blue ACKN LED of the **interlock system command unit** is flashing, if a local acknowledge is required.

5.5 Door interlock

The door interlock is triggered in case no door override function is activated and the door (monitored by the door sensor) is opened. The door can be opened without triggering the interlock if either the “Door override” button or “Keypad CODE access” has been activated before opening the door.

5.5.1 Trigger door interlock

- Turn laser interlock system “ON” → enable the laser
- Verify that the laser is enabled
- Open each door monitored by a magnetic door switch → trigger interlock
- Check that the interlock system disables the laser
- Press the button “IL System ON” → the interlock system cannot be turned ON again
- Press the “IL System ACKN” button (IL system command unit) → the interlock cannot be acknowledged
- Press the “ACKN IL” button (local command unit)
- Press the “IL System ACKN” button (IL system command unit) → the interlock is now acknowledged
- Press the laser interlock system “ON” button → verify that the laser is enabled

5.5.2 Override door interlock

- Turn laser interlock system “ON” → enable the laser
- Verify that the laser is enabled
- Press the door override button for each door monitored by a magnetic door switch
- Open and close each door monitored by a magnetic door switch within the specified override time [AD2]
- Verify that the interlock system does not disable the laser
- Press the door override button for each door monitored by a magnetic door switch again

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- Wait until the specified override time [AD2] has finished
- Open the door
- Verify that the interlock system disabled the laser

Repeat the procedure above, but use the door access code instead of the door override button.

5.6 Laser OFF Interlock button

- Turn laser interlock system “ON” → enable the laser
- Verify that the laser is enabled
- Press the red mushroom button labeled “Laser OFF Interlock”
- Check that the interlock system disables the laser
- Release the red mushroom button using the key
- Verify that the interlock system requires an acknowledge before restart

5.7 Lock-out button on the azimuth platform

- Turn laser interlock system “ON” → enable the laser
- Verify that the laser is enabled
- Press the “Lock out button labeled “ PRIMA METROLOGY Laser Lock-Out”
- Check that the interlock system disables the laser
- Release the lock-out button
- Verify that the interlock system requires an acknowledge before restart

5.8 System failure

- Turn laser interlock system “ON” → enable the laser
- Verify that the laser is enabled
- Unplug the Profinet connection from each “Distributed I/O cabinet” (shown in Figure 1)
- Check that the interlock system disables the laser
- Check that the red “System Failure” LED is ON
- Plug the Profinet connection back
- Turn the CPU power supply OFF and on again using the OFF switch of the S7 PS307 PSU to perform a “Cold Start”
- Set the CPU STOP/RUN switch from RUN to STOP
- Set the CPU from STOP to RUN to perform a “Warm Start”
- Verify that the Interlock System is operational again

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6 ACCEPTANCE TEST PROCEDURE FOR STANDARD FUNCTIONS (NON SAFETY)

6.1 Check Laser Enable/Disable

- Turn laser interlock system “ON” → enable the laser
- Verify that all buzzers in all location buzz 2-3 times when the laser interlock system is activated
 - This procedure might have to be repeated several times to verify that the signal is available in all locations
- Verify that the red OFF LED is ON in the command unit “IL System ON/OFF/ACKN”
- Verify that the LED “Laser ON” is green
- Turn the laser interlock system OFF by pressing the red OFF button
- Verify that the green ON LED button is ON in the command unit “IL System ON/OFF/ACKN”
- Verify that the LED Laser OFF is green on the interlock display panel, verify that the LED Laser OFF is off

6.2 Red LED flash light

- Turn laser interlock system “ON” → enable the laser
- Verify that the red flash light is flashing at all installed location
- Turn laser interlock system “OFF” → enable the laser
- Verify that the red flash light is “OFF” at all locations
- Turn laser interlock system “ON” → enable the laser
- Trigger an interlock
- Verify that the red flash light is “OFF” at all location

6.3 Entry request

- Turn laser interlock system “ON” → enable the laser
- Verify that the laser is enabled
- Press the green entry request button
- Both buzzer buzz continuously for the time specified in [AD2]

6.4 Door interlock

6.4.1 Trigger door interlock

- Turn laser interlock system “ON” → enable the laser
- Set the Door Code (Figure 5) to 4457
- Enter a different door code into the keypad
- Verify that both buzzer buzzes 2-3 times indicating invalid code
- Open the door and verify that the door override is not active and the system triggers the interlock
- Verify if the IL LED (Storage Room IL Monitor Display) corresponding to the door is red on the interlock display panel (Located in Storage Room)
- Verify if the general IL LED second row interlock display panel and the Laser OFF LED are red
- Verify that both buzzer buzz with a frequency of 5 Hz for the time specified in [AD2]
- Verify that the blue LED in the command unit “IL System ACKN” is flashing, and no other LED in this command unit is on
- Press the Laser IL System ON button and verify that the IL system cannot be switched ON
- Press the blue ACKN button of the **IL system command unit** and verify that the Laser IL System cannot be activated before the ACKN button of the **local command unit** has been activated
- Press the blue ACKN button of the **local command unit** and verify that the blue ACKN button of the **IL system command unit** stop flashing but remains ON
- Press the blue ACKN button of the **IL system command unit** and verify that the Laser IL System can be activated

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6.4.2 Override door interlock

- Turn laser interlock system “ON” → enable the laser
- Set the Door Code (Figure 5) to 4457
- Enter the door code into the keypad
- Verify that the door override function is active, both buzzers buzz with 0.6Hz interval for the time specified in [AD2]
- Verify that the green LED in the entry request button flashes for the override time
- Verify that the IL LED for the door for which the override is active flashes green on the interlock display panel
- Open the door within the override time and verify that the interlock is not triggered



Figure 5 Door Code

Repeat the procedure above, but use the door override button instead Door code access.

6.5 Laser OFF Interlock button

- Turn laser interlock system “ON” → enable the laser
- Press the red mushroom button labeled “Laser OFF Interlock”
- Verify if the IL LED corresponding to the location on the interlock display panel is red
- Verify if the general IL LED (second row interlock monitor display) and the Laser OFF LED are red
- Verify that both buzzer buzz with a frequency of 5 Hz for the time specified in [AD2]
- Verify that the blue LED in the IL system command unit “ACKN IL” is ON or flashing, and no other LED in this command unit are ON
- Press the Laser IL System ON button and verify that the IL system cannot be switched ON
- Verify that the blue LED in the IL system command unit “IL System ACKN” is ON
- Press the blue ACKN button of the IL system command unit and verify that the Laser IL System can be activated again

Note: Pressing the local ACKN button of the local command unit is not required.

6.6 Lock-out button on the azimuth platform

- Turn laser interlock system “ON” → enable the laser
- Press the lock-out button on the azimuth platform
- Verify if the IL LED corresponding to the location on the interlock display panel is orange
- Verify if the general IL LED (second row interlock display panel) and the Laser OFF LED are red
- Verify that both buzzer buzz with a frequency of 5 Hz for the time specified in [AD2]
- Verify that the blue LED in the command unit “IL System ACKN” is ON or flashing, and no other LED in this command unit is ON
- Press the Laser IL System ON button and verify that the IL system cannot be switched ON
- Release the lock-out button and verify that the IL LED corresponding to the location is OFF
- Press the blue ACKN button of the IL system command unit and verify that the Laser IL System can be activated again
- Verify that the blue LED in the command unit “IL System ACKN” is ON

Note:

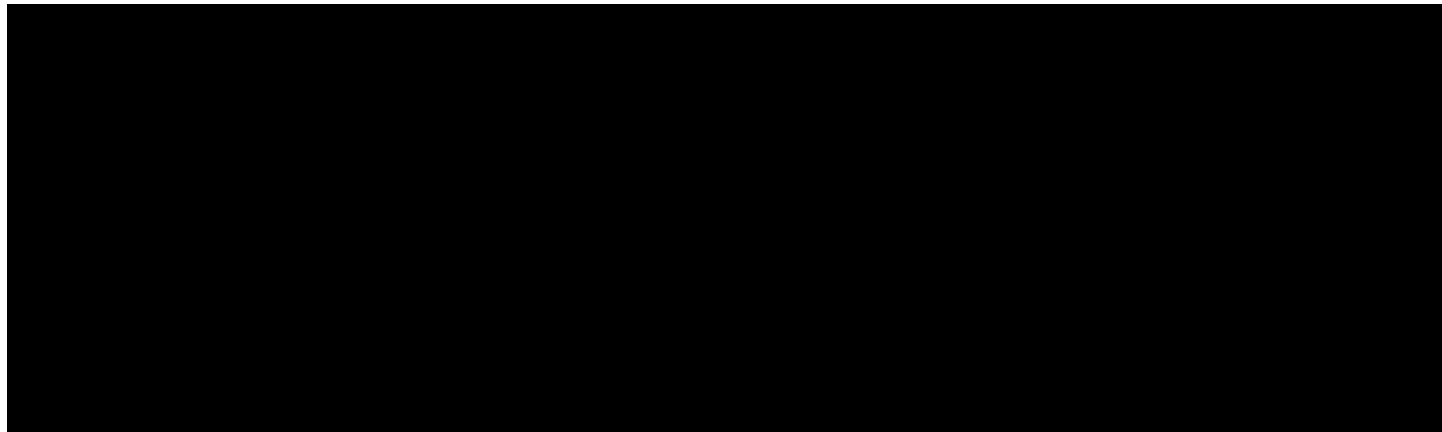
In case of the Ante chamber, open the door between VLTI Lab IC108 and Ante Chamber IC105 instead of pressing the lock out button. This door should be normally closed, and is therefore only monitored as interlock. This test does not apply for the Storage Room.

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Prima Metrology Laser Interlock System Acceptance Test

Date:

Acceptance Test Engineer:



- ☐ Safety Functions tested
- ☐ Non safety functions tested

Signature Acceptance Test Engineer