W. M. KECK OBSERVATORY
On the summit of Mauna Kea, Island of Hawai'i

DATE: January 22, 2014

TO: Distribution

FROM: Steve Milner

SUBJECT: LRIS Calibration Lamp Upgrade

This memo describes a project to upgrade and enhance the LRIS calibration lamp system. It is desirable to add more lamps to the present regimen in the instrument. Also, the plan is to relocate the present power supplies so that the cables to the lamps do not need to be extended. (Extending the power supply cabling is not recommended by the lamp manufacturers). Once implemented, the LRIS lamp controller will control sixteen lamps independently by controlling the AC supply to each power supply. Figure 1 is a block diagram of the hardware.

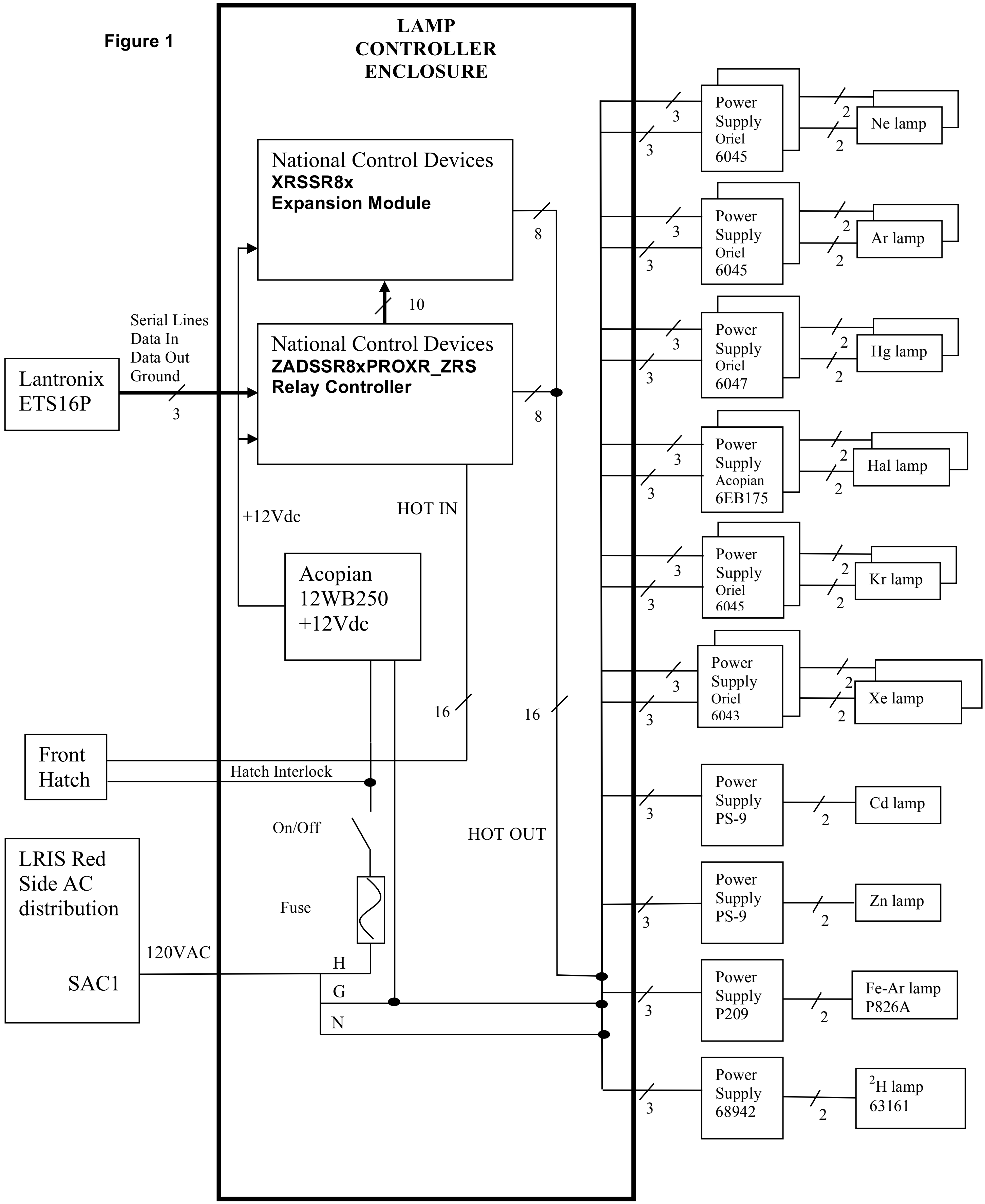
The new controller and power supplies will be mounted in the "nose" section at the front of the instrument adjacent to the MAGIQ guider system. A new enclosure for the controller and a mounting system for the power supplies will be fabricated as well as mountings for the new lamps. Communication to the controller will be through a serial interface from the Lantronix terminal server presently in LRIS's red side (tsred). Commands to the controller will be a series of 2 to 6 bytes that specify the relay number and the action to perform on that relay. The relays will switch AC power to the power supplies for each lamp. Power to the controller, its relays and power supplies will be a single 120 VAC feed from LRIS's red side AC distribution box. A small power supply will be mounted in the controller housing to supply +12 VDC to the controller.

Although a relatively simple electrical design, there is a fair amount of mechanical design involved to mount the power supplies, to mount the new lamps, and to allow easy access to components for troubleshooting and replacement. The sixteen power supplies and the controller will be mounted on three aluminum plates that will be tucked away during operations but can be swung out for maintenance and access.

The controller selected for this project will communicate via RS-232 serial link and will have sixteen opto-isolated outputs.

LRIS Calibration Lamp Upgrade

Figure 1



1.0 Electrical

1.1 The controller board is available COTS from National Control Devices, p/n ZADSSR8xPROXR_ZRS. The controller board has eight outputs. We will need an eight output expansion board, p/n XRSSR8x. It provides the main functionality of controlling the relays that turn the lamps on/off and also the software interface via its built-in serial port. A picture of the boards is shown below. This is a very versatile unit with all the functionality that we need and a simple interface. More information can be found here.

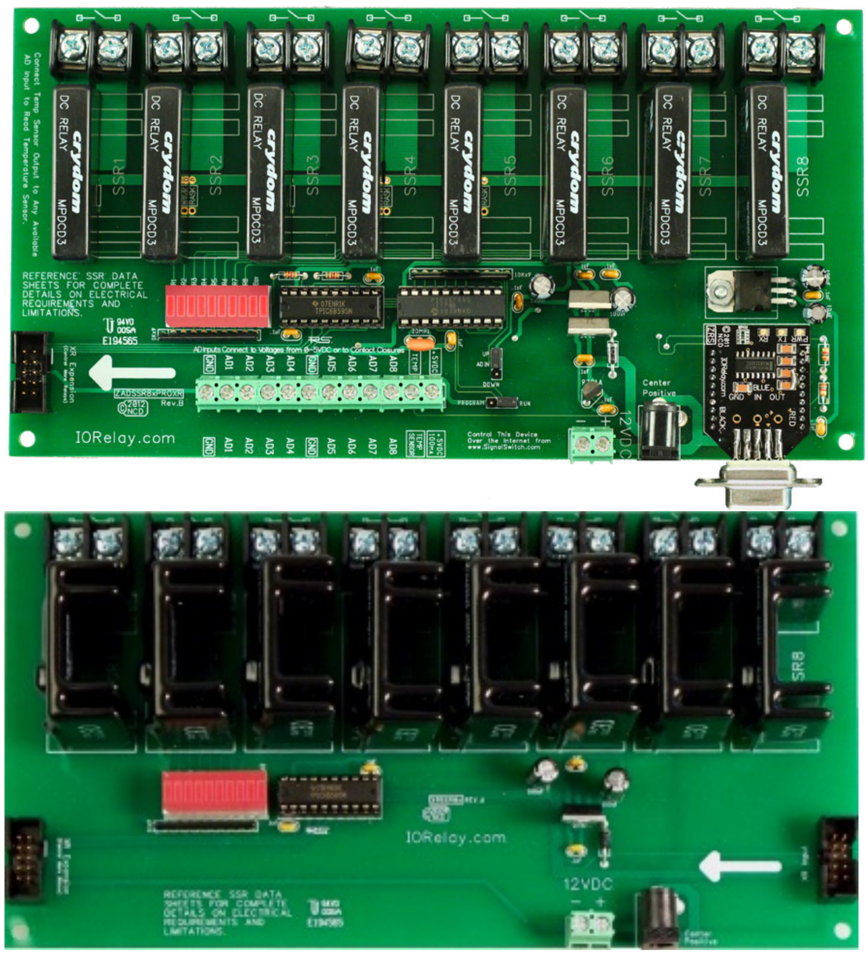


Figure 1.1 Controller and expansion boards

1.2 A +12Vdc power source is needed for the PROXR. I have selected an Acopian 12WB250 supply with mounting holes and terminal screws. The ZADSSR8xPROXR_ZRS, XRSSR8x, and the 12WB250 will be mounted within the controller enclosure that will be mounted in the LRIS Nose section.

Nominal Output Voltage	Output Current Amps. at 50°C	71°C	Ripple mV (@25MHz BW) rms	p-p	Model	Case Size	Price ($)
12	2.50	1.50	15	100	12WB250	EBW-13	180
12	4.10	2.45	15	100	12WB410	EBW-20	205

1.3 Front Hatch interlock functionality is provided using the two parallel connected switches presently installed on the front hatch. The 120VAC hot lead will be routed through the interlock loop and back to the controller enclosure to feed the lamp power supplies through the output relays. When the hatch door is open, the 120VAC supply to power supplies will be interrupted. The controller board will still be energized so the state of the relays could still be controlled. No lamps will be energized in this state. When the hatch is closed, the lamps will operate normally. If the hatch is opened and then closed, the lamps will return to their programmed state.

1.4 The **Serial interface** is provided by the Lantronix ETS16P already installed in the red-side of LRIS. There are many free ports (eg. 1, 3-12). A set of custom cables will be constructed to connect the Lantronix to a spare through-hole of the red-side, then to the controller enclosure, and finally to the ZADSSR8xPROXR_ZRS controller board. The serial port will be connected to provide two-way communication (ie. Tx and Rx lines), thus allowing status to be read back from the controller board. The baud rate is 115,200.

1.5 The single phase **120VAC power** will be supplied to the controller enclosure using the presently installed cable from the red-side AC distribution box. The

120VAC will be used to power ALL of the lamp power supplies and the Acopian 12WB250. The neutral and ground wires are routed directly from the input to the output connectors and to the 12WB250. The hot wire goes to a 15 amp fuse and a power switch. The switched power goes to the 12WB250 and the front hatch interlock switch. When the power switch is on, the controller will be powered up. The relay power is fed to the front hatch interlock switches such that power will not be applied to the lamps unless the front hatch is closed.

1.6 Power dissipation of the ZADSSR8xPROXR_ZRS controller board is approximately 18W when operating. The 12WB250 power supply is capable of 30W, but will be driving the controller board with approximately 1.5A (18W). The lamps and the power supplies total power dissipation is TBD.

2.0 **Mechanical –** The mechanical concept of this upgrade is a system that will house the electronics and power supplies in the nose section of the instrument adjacent to the MAGIQ guider system. The controller board and its +12VDC supply will be housed and mounted within a metal enclosure. The enclosure and power supplies will be mounted on three aluminum plates that can swing out for access and maintenance. An access door will be made in the side panel in order to gain better access to the power supplies. The plates will be mounted on hinges so that one can gain access to the top and bottom of each plate.

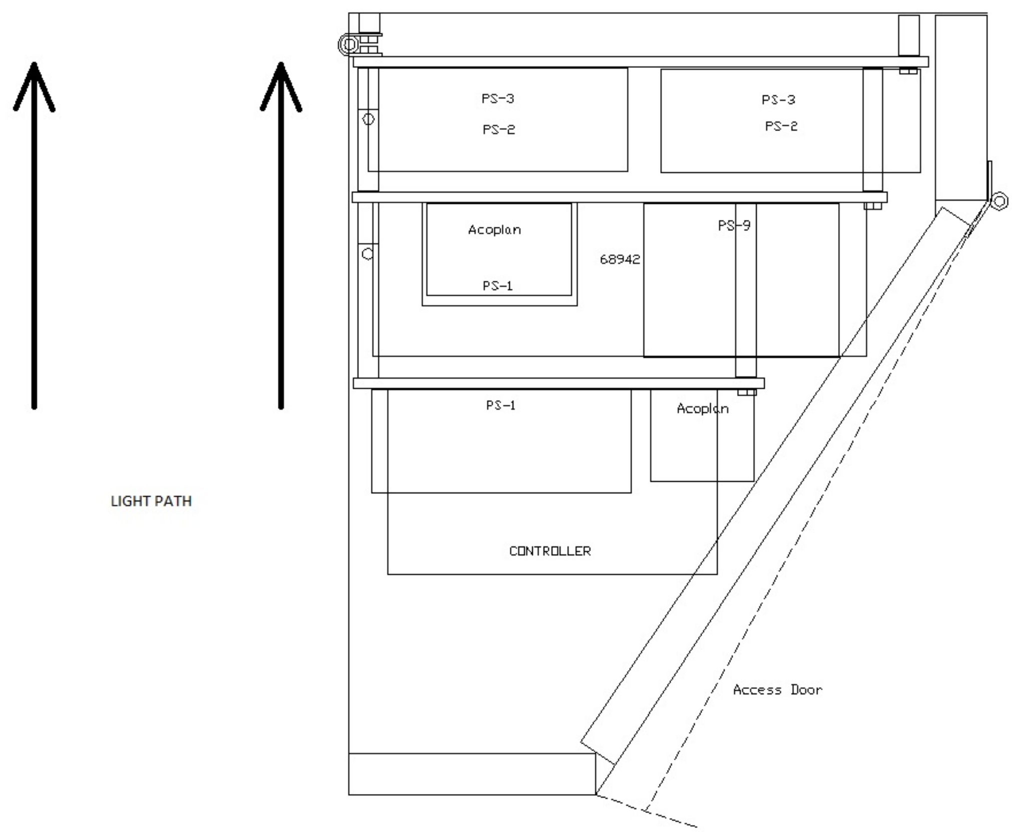


Figure 2. Mechanical Concept for Mounting Lamp Controller HW (Top View)

3.0 **Software -** The Software interface to the ZADSSR8xPROXR_ZRS controller board will be implemented with a set of low level commands that are sent via LRIS's red-side Lantronix ETS16P terminal server. The controller board comes with its own ProXR software package and GUIs if needed or desired. The set of commands are in the form of a series of 2 to 60, 8-bit bytes. There are some nice features available with this controller's software command set. The details of these commands can be found here. This is an example of the basics that we will be interested in:

***254,0-7* Turn Off Individual Relays**
***254,100-107, Bank* Turn Off Individual Relays in** Bank
***254,8-15* Turn On Individual Relays**
***254,108-115* Turn On Individual Relays in Bank**
***254,16-23* Get the Status of an Individual Relay**
***254,116-123, Bank* Get the Status of an Individual Relay in Bank**

4.0 Parts and Cost

Name	Manufacturer	Part Number	Cost	QTY Req'd	QTY Spare	Total Cost
Controller Board	National Control Devices	ZADSSR8xPROXR_ZRS	$188	1	1	$376
Expansion Board	National Control Devices	XRSSR8x	$116	1	1	$232
Solid State Relays	National Control Devices	Type C 5A/240VAC	$20	16	16	$624
Enclosure (Controller)	Protocase		$350	1		$350
Electrical Parts	Various		$600			$600
Mechanical Parts	McMaster Carr		$80			$80
Machine Parts	In-House		$100			$100
Anodizing	Pacific Coast Anodizing		$80			$80
Power supply	Oriel	6043	$253	2		
Power supply	Oriel	6045	$263	6		
Power supply	Oriel	6047	$359	2		
Power supply	Acopian	12WB250	$192	1		
Power supply	Acopian	6EB175	$164	2		
Lamp, Krypton	Oriel	6031	$232	2		
Lamp, Xenon	Oriel	6033	$275	2		
Lamp, Mercury	Oriel	6035	$218	2		
Lamp, Neon	Oriel	6032	$253	2		
Lamp, Argon	Oriel	6030	$238	2		
Lamp, Halogen	Osram	20W12V		2		
Lamp, Cadmium				1		
Lamp, Zinc				1		
Lamp, Deuterium	Oriel	63161	$424	1		
Lamp, Iron-Argon	Photron	P826S		1		
Total						$2,442

5.0 Test Plan - The general test plan will be to assemble all components in the lab and test most of the functionality there. Then install the equipment into LRIS on the summit and retest functionality. Then perform final instrument integration and testing.

5.1 At HQ: Controller board, +12Vdc, Interlock Function

5.1.1 Equipment needed

5.1.1.1 +12Vdc Power supply

5.1.1.2 Simulated interlock switch

5.1.1.3 PC with serial port and NCD Base Station SW installed

5.1.1.4 120VAC feed

5.1.1.5 Multimeter

5.1.2 Assemble the controller board and +12V power supply. If available, use the 12WB250 and verify a +12Vdc output with less than 100mVp-p ripple. Connect the hot terminal of the 120VAC feed to the inputs of all the relays in parallel. Connect the serial port input to the PC's serial port.

5.1.3 Power up the controller board and verify that it is receiving the proper +12Vdc.

5.1.4 Check that all relays are open by verifying that no 120VAC is driven out of any relay and all LEDs are off.

5.1.5 Using the NCD Base Station software, turn on each relay one at a time, check that its LED turns on and verify that 120VAC is driven out of the relay to some sort of load.

5.1.6 Turn on all relays at once, check that they are all on (eg. All LEDs are on). Turn off all relays at once, check that they are all off (eg. All LEDs are off).

5.1.7 Turn on all relays and verify all LEDs are on, remove +12Vdc and re-apply. Check that all relays are off.

5.2 At HQ: Software

5.2.1 Write code to perform desired subset of functions of controller board.

5.2.2 Execute code and exercise all desired combinations. Write output codes to a data file instead of the instrument, verify that output codes are correct and as expected.

5.3 At Summit: Controller Board, +12Vdc, 120VAC, Hatch Interlock:

5.3.1 Equipment needed

5.3.1.1 Complete controller board assembly with 12WB250 supply installed

5.3.1.2 PC or laptop with serial port and NCD Base Station SW.

5.3.1.3 Multimeter

5.3.2 Mount the enclosure to LRIS, do not connect to lamp supplies yet.

5.3.3 Check that 120VAC feed to the controller board enclosure is correct.

5.3.4 Connect the 120VAC feed and the front hatch interlock switch to the enclosure.
5.3.5 Connect the controller board's serial port to a suitable PC or laptop with a serial port interface.
5.3.6 With the enclosure open, and hatch door closed, turn on the 120VAC feed, verify that the controller board is powered up and all LEDs are open.
5.3.7 Using the Base Station software running on the PC/laptop, turn on each relay one at a time, check that its LED turns on and verify that 120VAC is driven out of the relay to some sort of load.
5.3.8 Turn on all relays at once, check that they are all on (eg. All LEDs are on). Turn off all relays at once, check that they are all off (eg. All LEDs are off).
5.3.9 Turn on all relays and verify all LEDs are on. Open the front hatch, check that the lamps turn off. Close the front hatch and verify that the lamps return to their initial state

5.4 At Summit: Lamp Power Supplies and lamps:

5.4.1 Connect all lamp power supplies that are available to the enclosure
5.4.2 Connect lamp supplies to lamps
5.4.3 Using PC/laptop to sequence through all lamps on, then off. Verify that the lamps behave as expected.
5.4.4 Turn all lamps on, verify all lamps are on, and check current draw of the 120VAC. Verify that current draw is within limits (TBD).
5.4.5 Open hatch, verify that all lamps go off. Close hatch, verify all lamps turn back on.

5.5 At Summit: Instrument software control:

5.5.1 Completely install enclosure, power supplies and lamps.
5.5.2 Connect the enclosure's serial port to proper port of LRIS's lantronix terminal server.
5.5.3 Power up the lamp controller
5.5.4 Using the instruments control software, sequence through all lamps and verify proper operation.

6.0 **Documentation –** A full set of updated documents will be provided with the ECR package.

References:

Newport Corporation | Light Sources | Oriel Pencil Style Calibration Lamps

UVP :: Calibration Lamp Products

http://www.relaycontrollers.com/Relay/Device/ZUXPSSR8xPROXR_ZRS

http://www.acopian.com/single-s-screw-m.html