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**H2 PSL EtherCat Slow Controls Chassis**

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## 1 Introduction

The purpose of the H2 PSL EtherCAT Slow Control Chassis is to monitor the surrounding environment of the H2 PSL Laser, Ante, Diode, and Chiller rooms to ensure proper operation of the laser system. Its design is based on the ISC Slow Control Chassis design by Daniel Sigg. The chassis provides the capability to both monitor and control functions through a Beckhoff EtherCAT module. An EtherCAT module consists of a coupler and multiple terminals which are used for binary and analog input/output. The module interacts with the ISC EtherCAT system via fiber optic connections. This system monitors temperature, relative humidity, and pressure differential. The module receives the analog signals coming from the environmental sensors and converts them into a binary output in order to facilitate computer readout and user friendly controls.

## 2 Module Description

Included in the module are one Beckhoff EK1501 EtherCAT Coupler, four Beckhoff EL3054 Terminals, and one Beckhoff EK1110 EtherCAT extension. The EL3054 analog input terminal processes current signals in the range between 4 and 20 mA and digitizes them to a resolution of 12 bits. The EK1501 Coupler converts the passing information from Ethernet 100BASE-FX to E-bus signal representation. The module samples the signals at a frequency of 1 kHz, and they are transmitted by a 100BASE-FX multimode glass fiber connection to a Fiber Optic Transceiver located in the H2 electronics building. They are then sent to the DAQ. The signals coming out of the transceiver are processed using EPICS software and MEDM screens such that real time user interface is enabled.

The Beckhoff EK1501 Coupler and EL3054 Terminals operate with 24 VDC. The EK1501 power contacts, (24 V) and (+), serve as supply voltage input for both the EK1501 Coupler and EL3054 Terminals. EK1501 power contacts, (0 V) and (-), serve as reference ground input for both the coupler and terminals as well. The power contacts of EK1501 (24 V) and EL3054 (+) are connected internally through the modules. The EL3054 power contact (+) supplies a 24 VDC output in order to enable the connection of 2-wire sensors without an external power supply. The EK1501 (0 V) power contact is used as reference ground connection for the inputs of sensors. The signal state of the EtherCAT Terminal is indicated by Light Emitting Diodes. The Error LEDs indicate an overload condition or an open circuit condition.

The EK1501 Coupler has three hexadecimal ID switches for assigning an ID to a group of EtherCAT components. This group can then be located at any position within the EtherCAT network. The chassis module offers flexibility of expansion. If an extra channel is required a new ELxxxx module can be added, depending on the requirements of the new channel. The last four digits of the Beckhoff ELxxxx determine the number of channels, analog input, digital input, resolution, single output, differential output, current, and input voltage as well as the medium of the output data.

### 3 Sensor connections

The H2 PSL Chassis connects to the sensors in each room via a D-Sub-25 Pin twisted cable to a Phoenix D-Sub-25 Pin connector that is also located in each room. The Phoenix connector joins with the sensors via 22 AWG twisted pair wires. Then the wires are routed across the room to the respective sensor (see Figure 1). The amount of current allowed to flow in the loop will vary between 4 and 20 mA depending on the relative humidity, temperature and pressure being measured by the sensors. The chassis uses two types of sensors: the Omega HX93AC for relative humidity and temperature measurements and the Dwyer DM-2001 for pressure measurements.

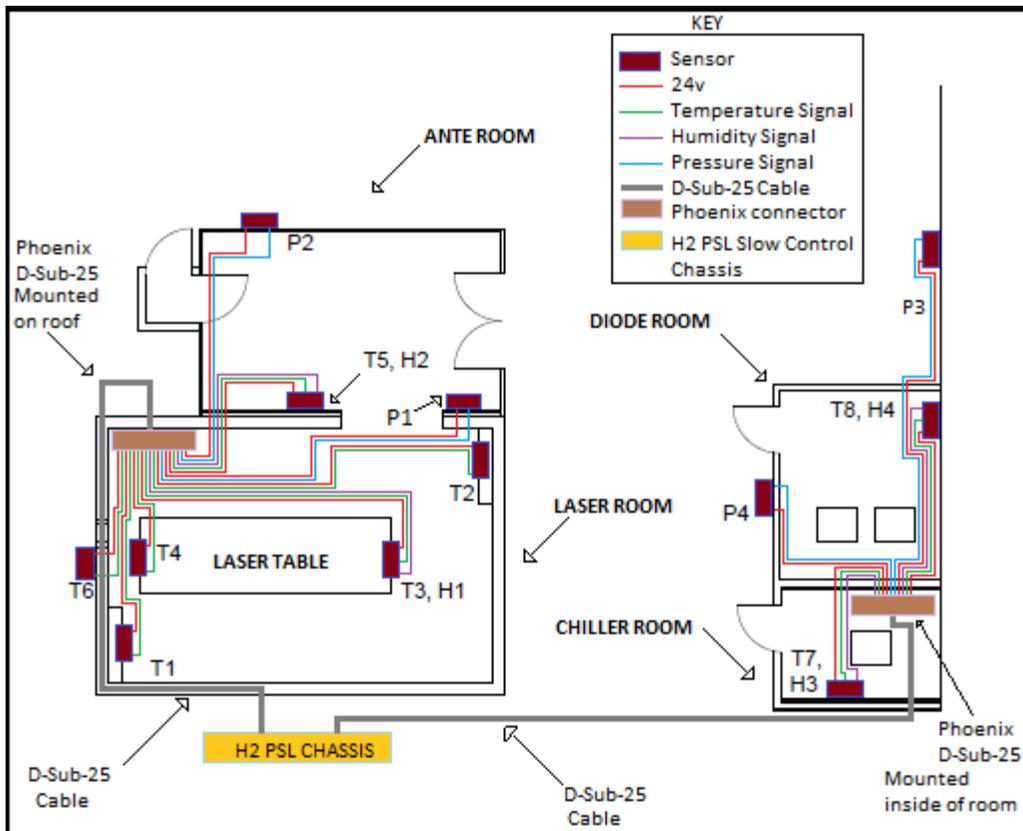


Figure 1: Cable routing.

### 3.1 Omega HX93AC

The Omega HX93AC measures relative humidity in the range of 5.4% to 95%, and temperature in the range of -20°C to 75°C. These sensors are connected to 24 V at connectors TB2 pin1 and TB1 pin1. TB2 pin3 is connected in series to the EL3054 temperature current input. TB1 pin3 is connected in series to the EL3054 humidity current input (see Figure 2).

#### 3.1.1 Wiring description

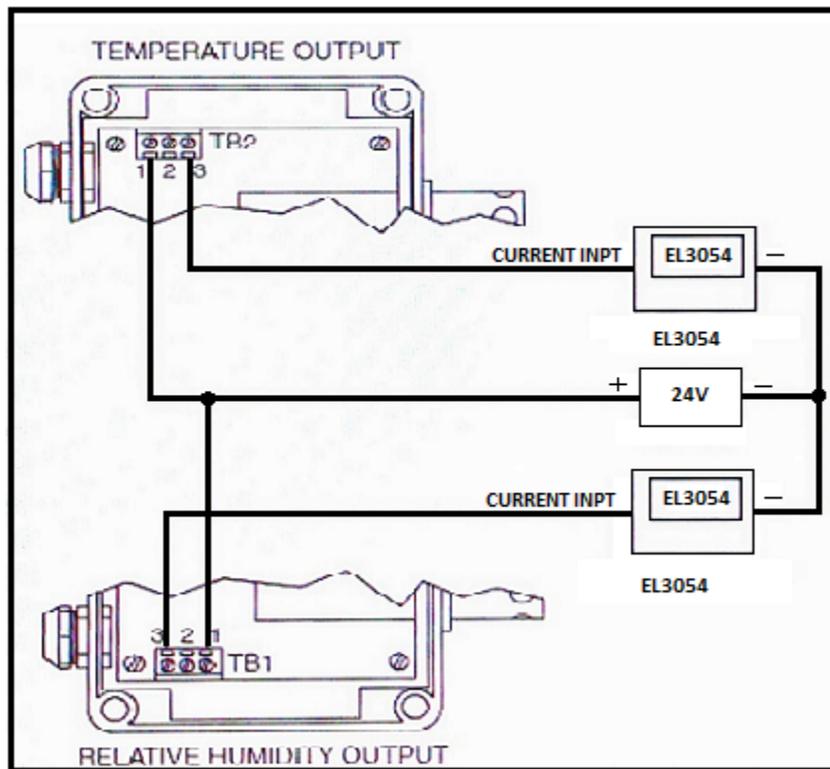


Figure 2: HX93AC wiring connections.

### 3.2 Dwyer DM-2001

The Dwyer DM-2001 measures pressure differential to 0.1" of water. This pressure sensor works at a range of 10 V to 30 V. The sensors are connected to 24 V at (+) pin. The (COM) pin is connected in series to the EL3054 pressure current input (see Figure 2). A 700 ohm resistor needs to be connected in series at each of the (COM) current output wires to compensate for a 24 V input (see Figures 3-4).

#### 3.2.1 Wiring description

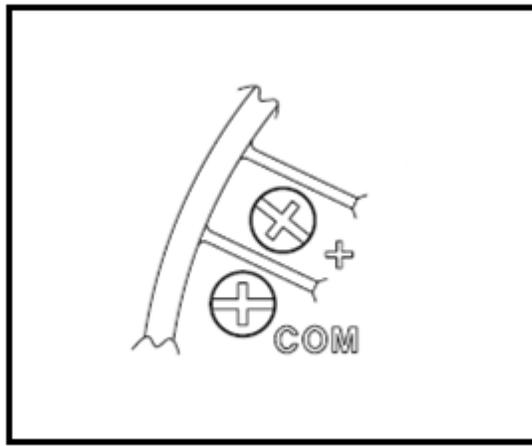


Figure 3: DM-2001 power and communication located on back of unit.

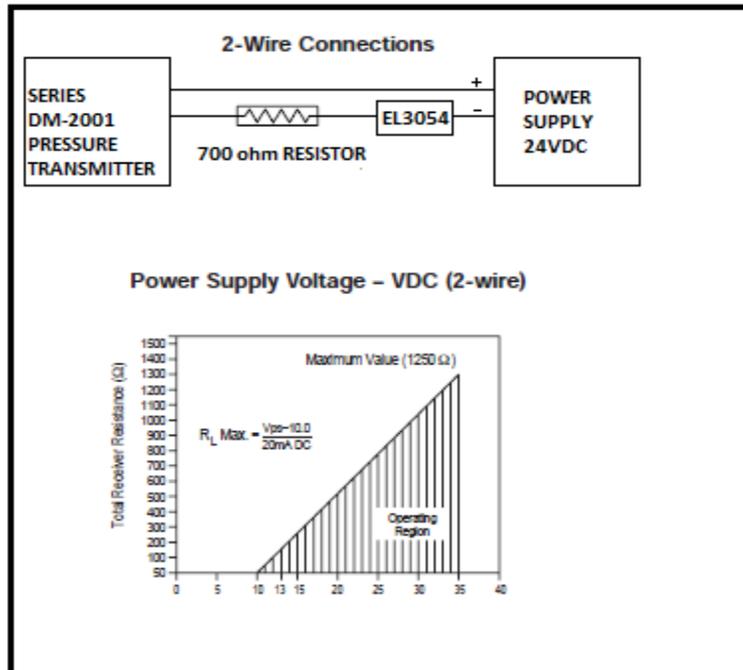


Figure 4: DM-2001 wiring connections and resistance plot. A 700 ohm resistor needs to be added in series to compensate for 24V input.

## 4 Reference Documents

Channel names and sensor locations refer to DCC document [T1100300](#).

Chassis Assembly Schematics refer to DCC document [D1101114](#) (attached to end of document).

Chassis Cabling/Wiring Diagram refer to DCC document [E1100530](#).

Laser and Ante Room Schematics refer to DCC document [E1100543](#).

Diode and Chiller Room Schematics refer to DCC document [E1100545](#).