



# **DNA/DNR-DIO-462 Guardian<sup>TM</sup> 12-channel Electromechanical Relay Output Layer**

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## **User Manual**

12 Form C (NO/NC) SPDT Relays  
Max. Operating Voltage — 220 VDC, 250 VAC  
Max. Switching Capacity — 94 VA, 90 W  
Rated Load — 2A@30 VDC, 0.75 A@ 150 VAC continuous

**Release 4.6**

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**PN Man-DNx-DIO-462-0314**

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# Chapter 1 Introduction

This document outlines the feature set and use of the DNA/DNR-DIO-462 electromechanical relay output layer when used with the PowerDNA I/O Cube or RACKtangle chassis, respectively.

## 1.1 Organization of this Manual

This PowerDNA DNx-DIO-462 User Manual is organized as follows:

- **Introduction**  
This chapter provides an overview of PowerDNA DNx-DIO-462 Electromechanical Relay Drive Output board features, accessories, and software.
- **The DIO-462 Layer**  
This chapter provides an overview of the device architecture, connectivity, and logic of the DNx-DIO-462 layer.
- **Programming with the High-Level API**  
This chapter provides a general description of the how to create a session, configure the session for relay drive/output, and format relevant data.
- **Programming with the Low-Level API**  
This chapter describes Low-level API commands for configuring and using the DNx-DIO-462 layer.
- **Appendix – Accessories**  
This appendix describes the accessories available for use with the DNx-DIO-462 layer.
- **Index**  
This is an alphabetical listing of the topics covered in this manual.

## Manual Conventions

To help you get the most out of this manual and our products, please note that we use the following conventions:



*Tips are designed to highlight quick ways to get the job done, or reveal good ideas you might not discover on your own.*

**NOTE:** Notes alert you to important information.



**CAUTION!** *advises you of precautions to take to avoid injury, data loss, and damage to your boards or a system crash.*

Text formatted in **bold** typeface generally represents text you should be entered verbatim. For instance, it can represent a command, as in the following example: “You can instruct users how to run setup using a command such as **setup.exe**.”



**Before plugging any I/O connector into the Cube or Layer, be sure to remove power from all field wiring. Failure to do so may cause severe damage to the equipment.**

## 1.2 The DIO-462 Layer

The DNx-DIO-462 is a 12-channel Electromechanical Relay Output Layer designed for driving solenoids, motors, or other inductive loads attached to a PowerDNA Cube or RACKtangle. The board is available in two versions, the DNA-DIO-462 for mounting in UEI Cube products, and DNR-DIO-462, for insertion into UEI RACKtangle and HalfRACK chassis.

The DNx-DIO-462 has 12 digital outputs that can be configured to provide output control for 12 channels (total). The maximum current drive is 2 A @ 30 VDC per channel (or 0.75A @ 125 VAC).

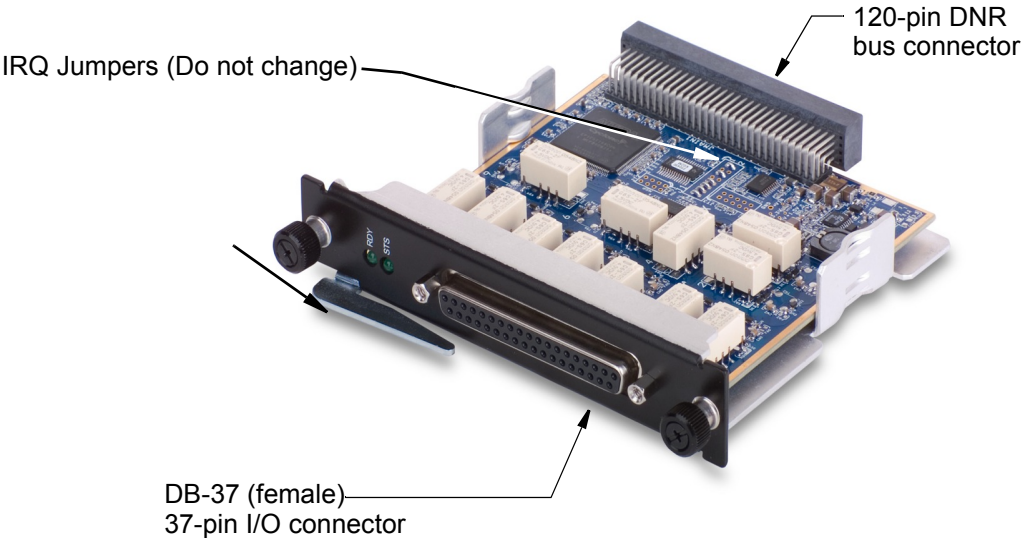
**NOTE:** Users who connect inductive loads to the DIO-462 must provide anti-kickback diodes on each such output.

The technical specifications for the DIO-462 layer are listed in **Table 1-1** below.

**Table 1-1. DNx-DIO-462 Technical Specifications**

| Technical Specifications:                        |   |
|--|---|
| Output specifications                            |   |
| Rated Load                                       | 2 A at 30 VDC, 0.75 A at 125 VAC continuous       |
| Max Switching Capacity                           | 94 VA, 90 W                                       |
| Max Operating Voltage                            | 220 VDC, 250 VAC                                  |
| Min Permissible Load                             | 10 $\mu$ A, 10 mVDC                               |
| Contact Material                                 | Ag (Au clad)                                      |
| Contact ON impedance                             | 200 mOhm max (at the I/O connector)               |
| Contact OFF impedance                            | >100 MOhm   |
| Off Leakage Current                              | < 100 $\mu$ A                                     |
| Turn-On Time                                     | 4 mS max, 2.5 mS typ                              |
| Turn-Off Time                                    | 4 mS max, 1.5 mS typ                              |
| Max Operating Freq.                              | 125 operations/second (36000/hour limit)          |
| Service Life                                     |   |
| Mechanical                                       | 100 000 000 min                                   |
| Electrical                                       | 100 000 at 2 A 30 VDC or 0.75 A and 125 VAC       |
| Monitor/circuit breaker specs                    |   |
| Resolution                                       | 16 bit  |
| Range  | +150/-30 VDC                                      |
|  | $\pm$ 2 A DC                                      |
|  | 0.3-2 A AC  |
|  | -55/+100 $^{\circ}$ C                             |
| Accuracy   |   |
| DC Voltage                                       | 5% of measurement + 0.25% of the full scale       |
| DC Current                                       | 5% of measurement + 0.25% of the full scale       |
| AC Voltage                                       | 15% of measurement + 1% of the full scale         |
| Relay Temperature                                | $\pm$ 2 $^{\circ}$ C typ                          |
| Protection (only one type activated per channel) |   |
| DC Voltage                                       | $\pm$ 5 V to $\pm$ 220 V                          |
| DC Current                                       | 50 mA to 2 A                                      |
| AC Current                                       | 400 mA to 2 A                                     |
| Relay Temperature                                | 0-85 $^{\circ}$ C                                 |
| Disconnection Time                               | 1 sec   |
| Power up / reboot state                          | Off (NC Energized)                                |
| Power dissipation                                | < 3.5 W   |
| Isolation  | 350 Vrms  |
| Operating Temp. Range                            | Tested -40 to +85 $^{\circ}$ C                    |
| Operating Humidity                               | 95%, non-condensing                               |
| Vibration IEC 60068-2-6                          | 5 g, 10-500 Hz, sinusoidal                        |
| IEC 60068-2-64                                   | 5 g (rms), 10-500 Hz, broad-band random           |
| Shock IEC 60068-2-27                             | 50 g, 3 ms half sine, 18 shocks @ 6 orientations  |
|  | 30 g, 11 ms half sine, 18 shocks @ 6 orientations |
| MTBF   | 260,000 hours                                     |

**Figure 1-1** is a photo of the DNR-DIO-462 version of the DNx-DIO-462 board. The DNA version is functionally identical except that it is designed for insertion into a UEI Cube-type chassis



**Figure 1-1. A DNR-DIO-462 Digital I/O Layer**

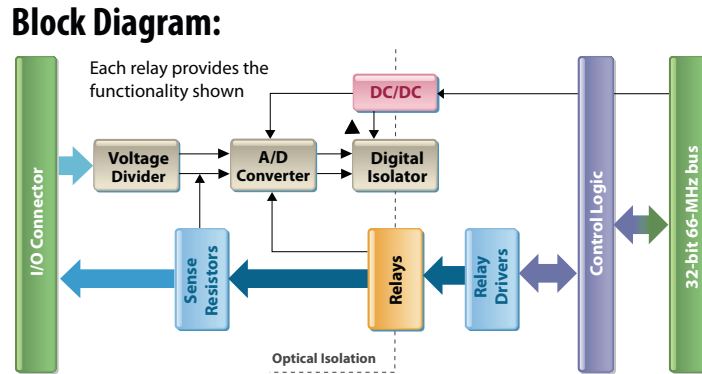


### 1.3 Features

The main features of the PowerDNx DNA-DIO-462 Relay Drive Output Layer are:

- 12 Form C electromechanical relay outputs (total)
- 2A @ 30VDC or 0.75A @125 VAC continuous per channel maximum current rating
- 220 VDC or 250 VAC maximum operating voltage
- Ideal for driving solenoids, motors, or other inductive loads (user must provide anti-kickback diodes)
- 10  $\mu$ A, 10 mV DC min permissible Load
- Programmable Overcurrent Duration Limits
- Monitors each channel's output voltage and current, allowing automatic detection of shorts/opens and other system failures
- DNR-DIO-462 for use with RACKtangle I/O chassis
- DNA-DIO-462 for use with "Cube" I/O chassis
- 200 milliOhm ON resistance (not including cable)
- Output Throughput rate 125 updates per second max
- Interrupt on over- and under-current conditions
- Contact Material Ag (Au clad)
- OFF leakage current <100  $\mu$ A

**1.4 Device Architecture** The DNx-DIO-462 Layer has 12 Form C relay outputs. A block diagram of the board is shown in **Figure 1-2**.



**Figure 1-2. DNx-DIO-462 Device Architecture**

Note that the I/O part of the layer is isolated from the logic interface and that overload protection is provided on all output lines.

**1.4.1 Guardian Feature**

As shown in **Figure 1-2**, the Guardian feature of the DIO-462 monitors the voltage drop across a series resistor in the circuit of each output relay, continuously sensing AC current, DC current, and output voltage relative to the COM terminal. An on-board ADC detects undercurrent, overcurrent, shorts, opens, and other off-normal conditions (such as high/low temperature), all of which are user-programmable as to magnitude and/or duration.

The Guardian feature is a valuable diagnostic and troubleshooting tool for ensuring system uptime.

**1.4.2 Circuit Breaker Function**

The DIO-462 can be programmed to provide a circuit breaker function when any of the measurements exceeds a user-defined limit.

After a fault is detected, this circuit breaker function can be set to re-connect in either of 2 ways:

- **Auto reconnect:** In this mode, the board will reconnect after a 1 second delay and test the limit again. This will result in the relay continually cycling on and off until the overlimit condition is resolved.
- **User re-enable:** In this mode, the relay will be set to the OFF state and remain there until the user software re-writes the ON command to the relay.

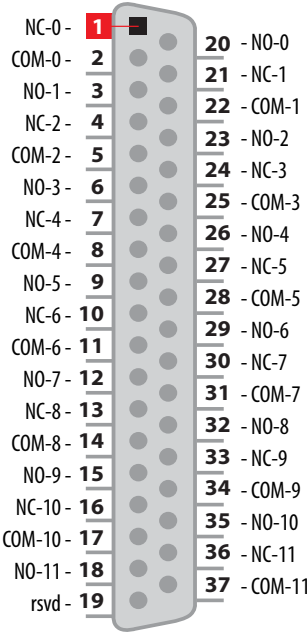
A '1' written to the digital output for any given relay will switch the relay ON, which connects COM to the N.O. contact. The circuit breaker function always acts to return the relay to the '0' or OFF state, which will connect the COM back to the N.C. contact. Thus, the circuit breaker can only disconnect a current that is flowing through the COM-N.O. connection. The user program can always read the current flowing through the relay regardless of which state the contacts are in.

When measuring voltage, the situation is reversed from the current measurement. In such cases, the voltage will be zero for the contact that is connected to the COM terminal and will be readable for the disconnected terminal.

The limit set function used by the breaker circuit always assumes that a voltage or current farther from zero is greater than one that is closer to zero. For example, a current limit of +200mA will disconnect when a current of +201mA is detected and a current limit of negative 200mA will disconnect with a current of -201mA.

**1.5 Layer Connectors and Wiring**

The pinout of the DB-37 37-pin female connector for the DNx-DIO-462 Layer board is shown in **Figure 1-3**.



**Figure 1-3. DB-37 I/O Connector Pinout**

For software compatibility with other UEI DIO products, the 12 output groups of the DIO-462 are numbered from NO-0, NC-0, COM-0 through NO-11, NC-11, COM-11. Note that the output of each channel is a set of three pins for NC contacts, NO contacts, and COM.

DO 0 uses AI channels 0 to 4 to measure NO voltage, DC current, AC current, NC voltage and ADC temperature; and in a similar way for remaining channels:

|       | NO | DC | AC | NC | °t |
|-------|----|----|----|----|----|
| DO 0  | 0  | 1  | 2  | 3  | 4  |
| DO 1  | 8  | 9  | 10 | 11 | 12 |
| DO 2  | 16 | 17 | 18 | 19 | 20 |
| DO 3  | 24 | 25 | 26 | 27 | 28 |
| DO 4  | 32 | 33 | 34 | 35 | 36 |
| DO 5  | 40 | 41 | 42 | 43 | 44 |
| DO 6  | 48 | 49 | 50 | 51 | 52 |
| DO 7  | 56 | 57 | 58 | 59 | 60 |
| DO 8  | 64 | 65 | 66 | 67 | 68 |
| DO 9  | 72 | 73 | 74 | 75 | 76 |
| DO 10 | 80 | 81 | 82 | 83 | 84 |
| DO 11 | 88 | 89 | 90 | 91 | 92 |

When power is provided to the layer, the RDY LED on the PowerDNA Cube turns on. When no power is supplied, the RDY LED is off, and the DNx-DIO-462 layer cannot operate.



***Before plugging any I/O connector into the Cube or Layer, be sure to remove power from all field wiring. Failure to do so may cause severe damage to the equipment.***

## 1.6 Anti-Kickback Diodes



***CAUTION!*** Use of the DIO-462 to drive inductive loads requires installation of anti-kickback diodes on each such output. Installation of these diodes is the responsibility of the user. Failure to provide these diodes can cause damage to components of the board.

# Chapter 2 Programming with the High Level API

This section describes how to control the DNA-DIO-462 using the UeiDaq Framework High Level API.

UeiDaq Framework is object oriented and its objects can be manipulated in the same manner from different development environments such as Visual C++, Visual Basic or LabVIEW.

The following section focuses on the C++ API, but the concept is the same no matter what programming language you use.

Please refer to the "UeiDaq Framework User Manual" for more information on use of other programming languages.

## 2.1 Creating a Session

The Session object controls all operations on your PowerDNA device. Therefore, the first task is to create a session object:

```
CUeiSession session;
```

### 2.1.1 Configuring the Resource String

UeiDaq Framework uses resource strings to select which device, subsystem and channels to use within a session. The resource string syntax is similar to a web URL:

```
<device class>://<IP address>/<Device Id>/<Subsystem><Channel list>
```

For PowerDNA, the device class is **pdna**.

For example, the following resource string selects digital output channels 0,1,2,3 on device 1 at IP address 192.168.100.2: "pdna://192.168.100.2/Dev1/Do0:3"

**NOTE:** In Framework, a digital channel corresponds to a physical port on the device. You cannot configure a session only to access a subset of lines within a digital port.

**NOTE:** Sessions are unidirectional. If your device has both input and output ports or has bidirectional ports, you need to configure two sessions: one for input and one for output.

The DIO-462 is known as an intelligent digital output device. It can monitor the current flowing through each of its digital lines and open or close a line when the current goes above or below specified current limits.

You can configure the device to attempt to close the connection after a programmed delay whenever an over- or under-current condition occurs.

The following call configures the digital output port of a DIO-462 set as device 1:

```
// Configure session to write to port 0 on device 1
session.CreateDOProtectedChannel ("pdna://192.168.100.2/Dev1/Do0",
                                  -0.01,
                                  0.01,
                                  200.0,
                                  false,
                                  50.0);
```

It configures the following parameters:

- **Under-current limit:** when the current goes below this limit, the line opens.
- **Over-current limit:** when the current goes above this limit, the line opens.
- **Current sampling rate:** the rate at which the DIO-462 monitors current. This rate has a direct influence on how fast the DIO-462 reacts to an under or over-current condition.
- **The retry status:** specifies whether the DIO-462 attempts to close the circuit after an over or under current condition.
- **The retry rate:** specifies how often the DIO-462 attempts to close the circuit.

### 2.1.2 Configuring the Timing

You can configure the DNA-DIO-462 to run in simple mode (point by point) only. Use of ACB mode is not currently supported.

In simple mode, the delay between samples is determined by software on the host computer.

The following sample shows how to configure the simple mode. Please refer to the “UeiDaq Framework User’s Manual” to learn how to use the other timing modes.

```
session.ConfigureTimingForSimpleIO();
```

### 2.1.3 Writing Data to the Output Port

Writing data is done using a writer object. The following sample shows how to create a writer object and write data.

```
// Create a writer and link it to the session's stream
CUEiDigitalWriter writer(session.GetDataStream());

// write one scan, the buffer must contain
// one value per channel
uint32 data = 0xFEFE;
writer.WriteSingleScan(&data);
```

## 2.2 Monitoring the Current

You can monitor the current measured at each digital line.

Use an analog Input session the same way you would measure voltage from an analog Input device.

The following code shows how to measure current out of the first 4 digital lines:

```
CUEiSession aiSs;
aiSs.CreateAIChannel("pdna://192.168.100.2/Dev1/Ai0:3"
    -10.0, 10.0,
    UeiAIChannelInputModeDifferential);
aiSs.ConfigureTimingForSimpleIO();

CUEiAnalogScaledReader aiReader(aiSs.GetDataStream());
double currents[8];
aiReader.ReadSingleScan(currents);
```

### 2.3 Cleaning-up the Session

The session object will clean itself up when it goes out of scope or when it is destroyed. To reuse the object with a different set of channels or parameters, you can manually clean up the session as follows:

```
session.CleanUp();
```

## Chapter 3 Programming with the Low-level API

The low-level API offers direct access to PowerDNA DAQBios protocol and allows you to directly access device registers.

Where possible, we recommend that you use the UeiDaq Framework (see *Chapter 2*), which is easier to use.

You should need to use the low-level API only if you are using an operating system other than Windows.

Please refer to the API Reference Manual document under:

*Start » Programs » UEI » PowerDNA » Documentation*

for pre-defined types, error codes, and functions for use with this layer.



# Appendix

## A. Accessories

The following cables and STP boards are available for the DIO-462 layer.

### **DNA-CBL-37**

A 3ft, 37-way flat ribbon cable that connects the layer to a terminal panel.

### **DNA-STP-37**

37-way screw terminal panel.

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