



DNx-DIO-470

—

User Manual

10-channel electromechanical-relay board
with high-current digital input/outputs
for the PowerDNA Cube and RACK series chassis

September 2018

PN Man-DNx-DIO-470

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Chapter 1 Introduction

This document outlines the feature set and use of the DNx-DIO-470 board.

The DIO-470 is an electromechanical relay interface module for the PowerDNA I/O Cube and RACK series chassis.

The following sections are provided in this chapter:

- Organization of This Manual (Section 1.1)
- Manual Conventions (Section 1.2)
- The DIO-470 Board (Section 1.3)
- Features (Section 1.4)
- Specification (Section 1.5)
- Device Architecture (Section 1.6)
- Indicators (Section 1.7)
- Board Height (Section 1.8)
- Connectors and Wiring (pinout) (Section 1.9)
- Fuses (Section 1.10)
- Anti-kickback Diodes (Section 1.11)

1.1 Organization of This Manual

This DIO-470 User Manual is organized as follows:

- **Introduction**
Chapter 1 provides an overview of the device architecture, connectivity, and logic of the DIO-470 board.
- **Programming with the High Level API**
Chapter 2 provides an overview of the how to create a session, configure the session for relay drive/output, and interpret results on the DIO-470 series board.
- **Programming with the Low Level API**
Chapter 3 provides low-level API commands for configuring and using the DIO-470.
- **Appendix A - Accessories**
This appendix provides a list of accessories available for use with the DIO-470.
- **Index**
The Index provides an alphabetical listing of the topics covered in this manual.

NOTE: A glossary of terms used with the PowerDNA Cube/RACK and I/O boards can be viewed or downloaded from www.ueidaq.com.



1.2 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! 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 that 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**.”

Bold typeface will also represent field or button names, as in “Click **Scan Network**.”

Text formatted in *fixed* typeface generally represents source code or other text that should be entered verbatim into the source code, initialization, or other file.

Before you begin:



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

No HOT SWAP



Always turn POWER OFF before performing maintenance on a UEI system. Failure to observe this warning may result in damage to the equipment and possible injury to personnel.

Usage of Terms



Throughout this manual, the term “Cube” refers to either a PowerDNA Cube product or to a PowerDNR RACKtangle™ rack mounted system, whichever is applicable. The term DNR is a specific reference to the RACKtangle, DNA to the PowerDNA I/O Cube, and DNx to refer to both.



1.3 The DIO-470 Board

The DNx-DIO-470 is a 10-channel electromechanical relay output board designed for driving solenoids, motors, or other inductive loads. The 10 independent digital outputs on the DIO-470 are configurable to provide output control and switching (up to 750 VA) for 10 channels (total).

DNA-DIO-470, DNR-DIO-470, and DNF-DIO-470 boards are compatible with the UEI Cube, RACKtangle, and FLATRACK chassis respectively. These board versions are electronically identical and differ only in mounting hardware. The DNA version is designed to stack in a Cube chassis. The DNR/F versions are designed to plug into the backplane of a RACK chassis.

NOTE: Refer to Section 1.8 for additional information about DNA version height requirements.

1.4 Features

The main features of the DIO-470 are listed below:

- 10 Form C electromechanical relay outputs (total)
- 5 A @ 30 VDC or 0.4 A @125 VAC continuous per channel maximum current rating
- Ideal for driving solenoids, motors, or other inductive loads
- Output throughput rate 125 updates per second max
- Guaranteed output OFF state on initial power-up, external power OFF, internal power OFF, and overload detected
- Isolation of 350 VDC between channels, and other components
- Output OFF leakage <100 uA



1.5 Specification The technical specifications for the DNx-DIO-470 are listed below in **Table 1-1**.

Table 1-1 DNx-DIO-470 Technical Specifications

Output specifications	
Rated Load	5 A at 125 VAC, 5 A at 30 VDC, 0.4 A at 125 VDC continuous
Recommended inteconnect wire size	22 gauge or larger
Circuit protection	7 A fast-blow fuse on each "Com" connection
Max Switching Capacity	750 VA
Max Operating Voltage	140 VDC, 150 VAC
Min Permissible Load	10 μ A, 10 mVDC
Contact Material	AgSnO ₂
Contact OFF impedance	>100 MOhm
Off Leakage Current	< 100 μ A
Turn-On Time	8 mS (typical)
Turn-Off Time	8 mS (typical)
Max Operating Freq.	125 operations/second
Service Life	
Mechanical	100,000,000 min
Electrical	100,000 at full rated load
Power up / reboot state	Off (NC Energized)
Power dissipation	< 3 W
Isolation	350 Vrms
Operating Temp. Range	Tested -40 to +85 °C
Operating Humidity	95%, non-condensing
Vibration	<i>IEC 60068-2-6</i> 5 g, 10-500 Hz, sinusoidal <i>IEC 60068-2-64</i> 5 g (rms), 10-500 Hz, broad-band random
Shock	<i>IEC 60068-2-27</i> 50 g, 3 ms half sine, 18 shocks @ 6 orientations 30 g, 11 ms half sine, 18 shocks @ 6 orientations
MTBF	260,000 hours



1.6 Device Architecture

The DNx-DIO-470 board has 10 Form C relay outputs. A block diagram of the board is shown in **Figure 1-1**.

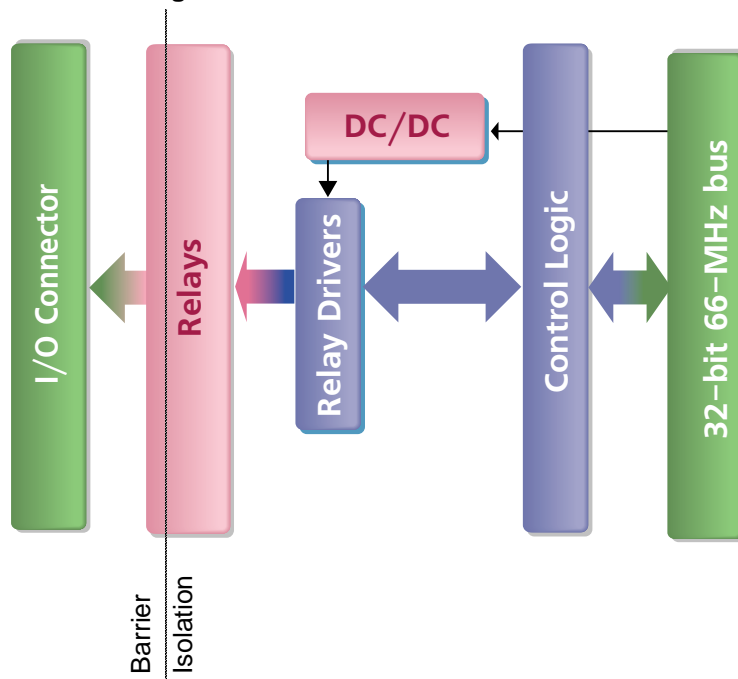


Figure 1-1 Block Diagram of DNx-DIO-470

Note that the I/O section of the board is isolated from the logic interface.

1.7 Indicators

The DNx-DIO-470 indicators are described in **Table 1-2** and illustrated in **Figure 1-2**

Table 1-2 DIO-470 Indicators

LED Name	Description
RDY	Indicates board is powered up and operational
STS	Indicates which mode the board is running in: <ul style="list-style-type: none"> • OFF: Configuration mode, (e.g., configuring channels, running in point-by-point mode) • ON: Operation mode

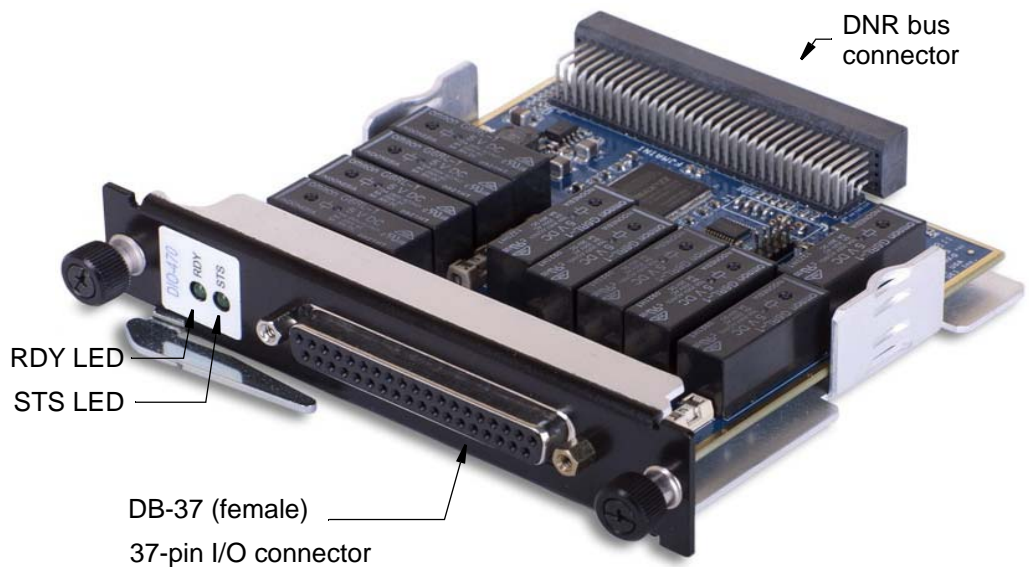


Figure 1-2 Photo of DNR-DIO-470 Electromechanical Relay Board

1.8 Board Height

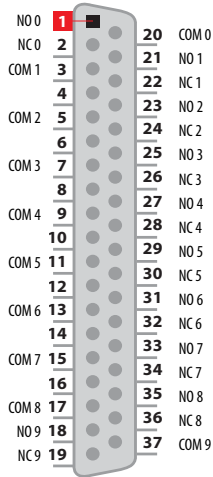
Figure 1-2 above shows the DNR-DIO-470 version of the DIO-470.

The DNA-DIO-470 version is functionally identical except that it is designed for insertion into a UEI cube chassis. The DNA version of the DIO-470 board requires a two layer slot: one for the board itself and another above it as a spacer for the electromechanical relays.



1.9 Connectors and Wiring (pinout)

The pinout of the DB-37 37-pin female connector for the DNx-DIO-470 board is shown in **Figure 1-3**.



NOTE: The standard DNA-CBL-37 and DNA-STP-32 will not handle 5A currents. Please use only the DNA-CBL-37HC and DNA-STP-37HC with the DIO-470.

Figure 1-3 DB-37 I/O Connector Pinout for DIO-470

For software compatibility with other UEI DIO products, the 10 output groups of the DIO-470 are numbered from NO-0, NC-0, COM-0 through NO-9, NC-9, COM-9. Note that the output of each channel is a set of three pins for NC contacts, NO contacts, and COM.



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

1.10 Fuses

The COM connection of each DIO-470 channel is protected by a 7 A fuse. The fuse part number is FUSE 7A 125V 6125 FAST SSQ.

Fuses can be replaced by lifting the blown fuse out of the fuse block (with tweezers) and inserting a new one.

Fuses for channels 0 through 9 correspond to “FA0” through “FA9” labeling on the board.

1.11 Anti-kickback Diodes

The DIO-470 can drive solenoids, motors, or other high-current inductive loads. An anti-kickback diode must be installed (with attention to polarity) on relay outputs to avoid voltage kickback into the DIO-470 board and other control circuitry.



Use of the DIO-470 to drive inductive loads requires installation of anti-kickback diodes on each 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 chapter provides the following information about using the UeiDaq high-level Framework API for DNx-DIO-470 programming:

- About the High-level Framework (Section 2.1)
- Creating a Session (Section 2.2)
- Configuring the Resource String (Section 2.3)
- Configuring for Digital I/O (Section 2.4)
- Configuring the Timing (Section 2.5)
- Writing Data (Section 2.6)
- Cleaning-up the Session (Section 2.7)

2.1 About the High-level Framework

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.

UeiDaq Framework is bundled with examples for supported programming languages. Examples are located under the UEI programs group in:

- *Start » Programs » UEI » Framework » Examples*

The following sections focus on the C++ API, but the concept is the same no matter which programming language you use.

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

2.2 Creating a Session

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

```
// create a session object
CUEISession session;
```

2.3 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 and RACKs, the device class is **pdna**.

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



2.4 Configuring for Digital I/O

The DIO-470 can be configured for digital output.

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. The DIO-470 is also unidirectional, and you only need to configure one session for output.

The following snippet configures the digital ports of a DIO-470 set as device 1:

```
// Configure session to write to ports 1 to 3 on device 1
session.CreateDOChannel("pdna://192.168.100.2/Dev1/Do1:3");
```

2.5 Configuring the Timing

You can configure the DIO-470 to run in simple mode (point by point).

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 other timing modes.

```
// configure timing for point-by-point (simple mode)
session.ConfigureTimingForSimpleIO();
```

2.6 Writing Data

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());

// to write a value, the buffer must contain one value per channel
uint32 data = 0x3FE;

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

2.7 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:

```
// clean up the session
session.CleanUp();
```



Chapter 3 Programming with the Low-Level API

This chapter provides the following information about programming the DIO-470 using the low-level API:

- About the Low-level API (Section 3.1)
- Low-level Functions (Section 3.2)
- Low-level Programming Techniques (Section 3.3)

3.1 About the Low-level API

The low-level API provides direct access to the DAQBIOS protocol structure and registers in C. The low-level API is intended for speed-optimization, when programming unconventional functionality, or when programming under Linux or real-time operating systems.

When programming in Windows OS, however, we recommend that you use the UeiDaq high-level Framework API (see **Chapter 2**). The Framework extends the low-level API with additional functionality that makes programming easier and faster.

For additional information regarding low-level programming, refer to the “PowerDNA API Reference Manual” located in the following directories:

- On Linux systems:
 <PowerDNA-x.y.z>/docs
- On Windows systems:
Start » All Programs » UEI » PowerDNA » Documentation

3.2 Low-level Functions

The following table provides a summary of DIO-470-specific functions. All low-level functions are described in detail in the PowerDNA API Reference Manual.

Function	Description
DqAdv40xWrite	Writes a 10-bit word to DIO-470 board to set channel output states (each bit maps to a channel: bit 0 controls channel 0, etc.)
DqAdv470Settings	Sets up delay and dynamic control supported by the DIO-470
DqAdv40xReadLastWrite	Reads the last DIO channel states that were written to the I/O board (diagnostic)



3.3 Low-level Programming Techniques

Application developers are encouraged to explore the existing source code examples when first programming the DIO-470. Sample code provided with the installation is self-documented and serves as a good starting point.

Code examples are located in the following directories:

- On Linux systems: <PowerDNA-x.y.z>/src/DAQLib_Samples
- On Windows: *Start » All Programs » UEI » PowerDNA » Examples*

Sample code for data acquisition modes have the name of the I/O boards being programmed embedded in the sample name. For example, Sample470 contains sample code for running the an DIO-470 using immediate mode.

3.3.1 Data Collection Modes

The DIO-470 supports the Immediate (point-to-point) acquisition mode, which provides easy access to a single I/O board at a non-deterministic pace.

Immediate mode acquires or sets a single data point per channel and runs at a maximum of 100 Hz.

API that implement data acquisition modes and additional mode descriptions are provided in the *PowerDNA API Reference Manual*.



Appendix

A.1 Accessories

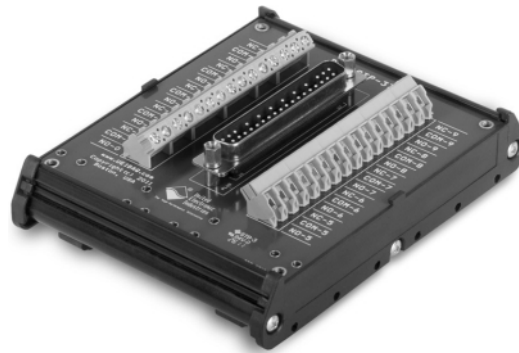
The following cables and STP boards are available for the DIO-470 board.

DNA-CBL-37HC

A 37-way cable that connects the board to a terminal panel that is 3ft to 12ft long; for use with loads up to 5A. Please ensure that your cable is a DNA-CBL-37HC for high amperage, and not the low-amperage DNA-CBL-37 (less than 2A).

DNA-STP-37HC

37-way screw terminal panel; for use with loads up to 5A.
Not to be confused with the low-amperage DNA-STP-37.



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