



The High-Performance Alternative

# **DNA-STP-SYNC**

## **Synchronization and Screw Terminal Panel**

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### **User Manual**

Accessory Panel  
for PowerDNA Cube (DNA) Systems

February 2009 Edition  
PN Man-DNA-STP-SYNC-0209  
Version 1.2

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# Chapter 1 The DNA-STP-SYNC Panel

## 1.1 DNA-STP-SYNC Panel

The DNA-STP-SYNC accessory panel facilitates the interconnection of multiple cubes for the purpose of synchronizing operations. Some of the characteristics of the unit are:

### Features

- Compatible with all UEI Cubes
- Easy connections with standard accessory cables
- Provides BNC, RJ-45, and screw terminal connections on single board
- Easy DIN-rail mounting
- One sync-in and one sync-out line connection, via BNC, RJ-45, or screw terminal
- Buffers internal or external sync signal to up to 6 slaved chassis
- Allows a master Cube to channel its trigger pulse through the board's buffers so that its timing matches that of its slaves
- Drives triggers up to 25 feet
- Daisy-chains to additional boards with standard BNC cables

### Specifications

Sync input connections	3 available, Screw-Terminal, BNC or from a Master Cube via the standard DNA-CBL-SYNC-RJ cable
Slave Cube outputs	6 (DNA-CBL-SYNC-RJ cable compatible)
Buffering	All outputs fully buffered
Intercube distance	25 feet max
Size / Weight	4.25" by 4.0" / less than 8 oz.
Operating Temp. (tested)	-40°C to +85°C
Operating Humidity	0 - 95%, non-condensing
Power Required	+5 VDC (automatically provided by master or slaved cubes)

**Figure 1-1. Technical Specifications**

Photo

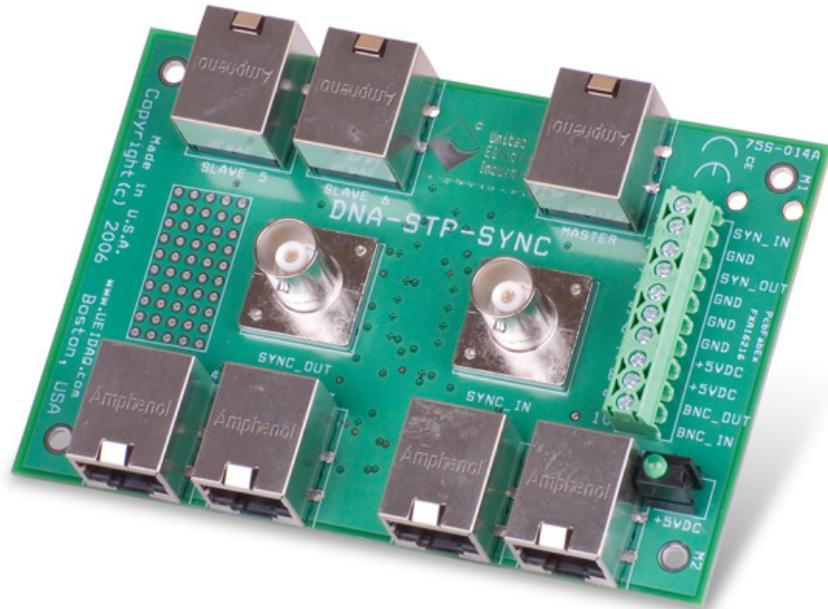
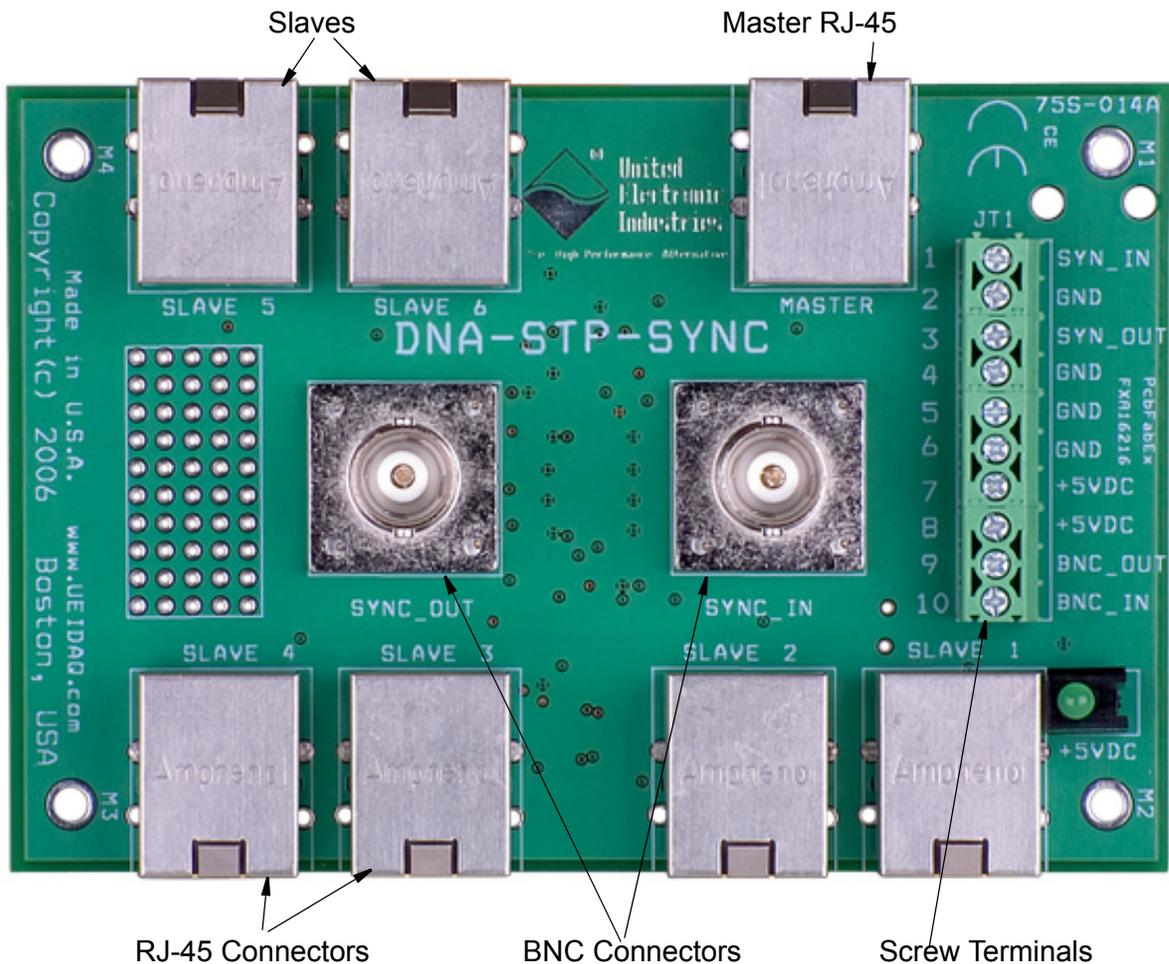


Figure 1-2. Photo of DNA-STP-SYNC Panel



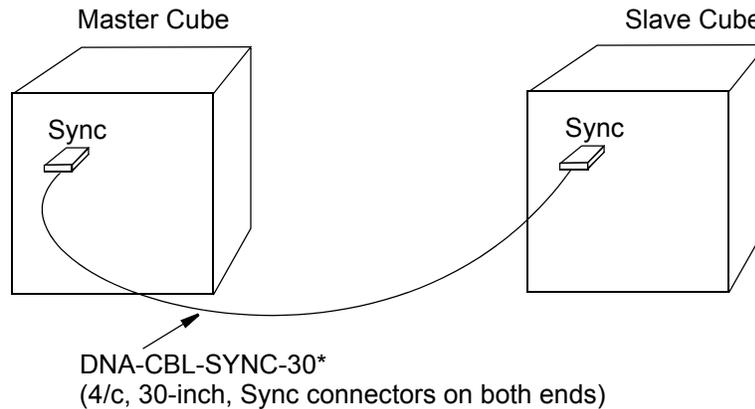
**Figure 1-3. DNA-STP-SYNC Synchronization Panel**

**1.2 Description** The DNA-STP-SYNC Sync Interface Interconnection Panel provides a simple means of connecting and synchronizing multiple Cube systems. A single Master Cube or an external Sync signal source can be used as a Master for up to 6 systems. Groups of up to six Cubes can be slaved together by daisy chaining STP-SYNC panels with standard BNC cables. Connectors for UEI Sync cables, inputs, and outputs are provided on screw terminals and BNC connectors, which simplifies synchronization to an external device.

**1.3 Synchronizing Multiple Cubes** This section describes typical methods used to synchronize clocks of multiple Cubes and chassis.

**1.3.1 Synchronizing a 2-Cube System** Synchronizing a 2-Cube Logger system is easily accomplished by simply connecting a cable between the Sync connectors on the two Cubes as shown in **Figure 1-4**. One Cube is designated as Master and the other as a Slave. The connecting cable, called DNA-CBL-SYNC-30, is a 30-inch 4-conductor cable with Sync connectors on both ends. For greater distances, use two DNA\_CBL-SYNC-RJ cables plus an Ethernet crossover extender cable, as shown below.

Figure 1-6 illustrates the method used to synchronize multiple Cubes.



\*For greater separation distances, use two DNA-CBL-SYNC-RJ cables with Ethernet extender cables in between, as shown below.

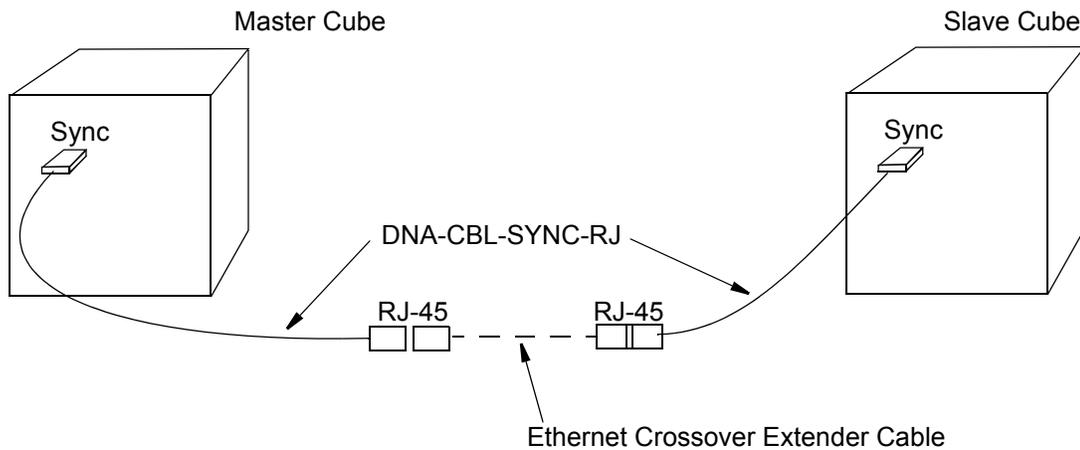


Figure 1-4. Interconnection Diagram for 2-Cube Synchronization

### 1.3.2 Synchronizing Multiple Cubes with DNA-STP-SYNC Panels

Synchronizing a multi-cube system requires the use of one or more DNA-STP-SYNC interconnection panels, as illustrated in Figure 1-6.

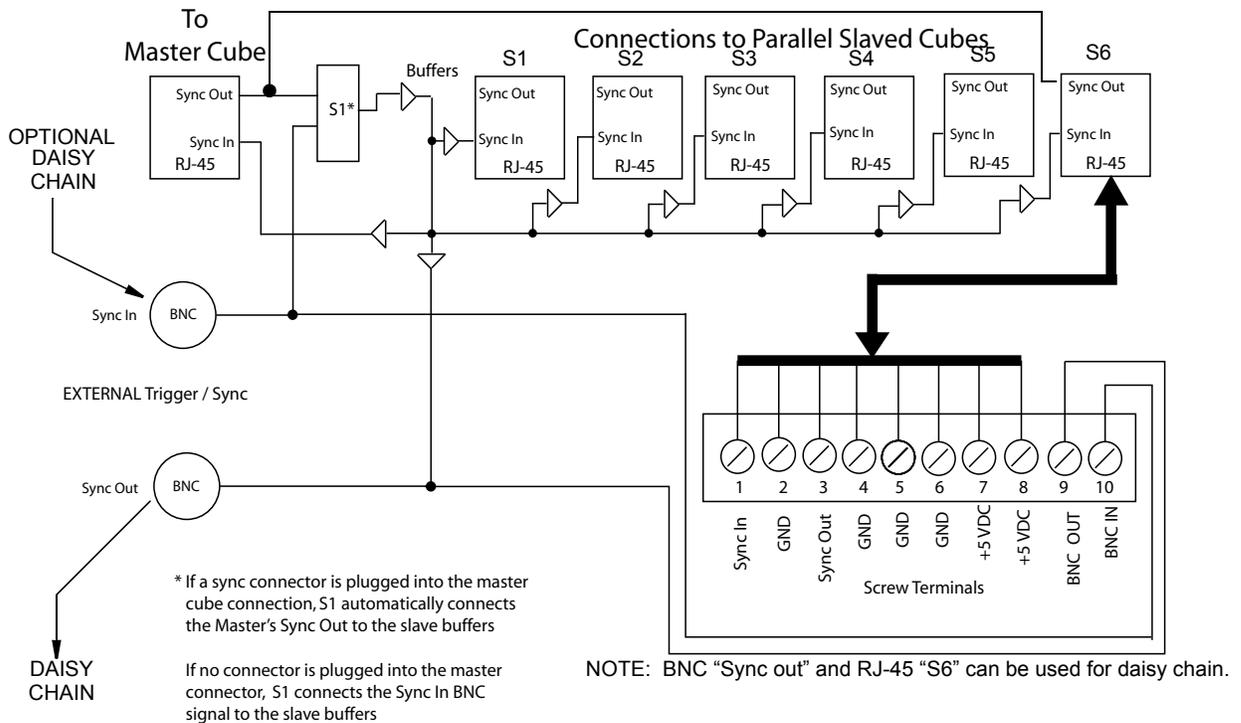
There are two Sync cables available, the DNA-CBL-SYNC-RJ and the DNA-CBL-SYNC-30. The DNA-CBL-SYNC-RJ provides a Sync connector on one end and an RJ-45 connector on the other. This cable is used to connect external signals to the cube. Typically, the DNA-CBL-SYNC-RJ is plugged into the cube and also into the DNA-STP-SYNC panel. The DNA-STP-SYNC panel provides three sets of connections as shown below.

- The board provides a screw terminal connection for each of the Sync signals.
- The board provides 6 parallel RJ-45 connectors. All SYNC signals are connected in parallel as well. These parallel connections allow the user to easily connect the identical external trigger signals to multiple cubes.

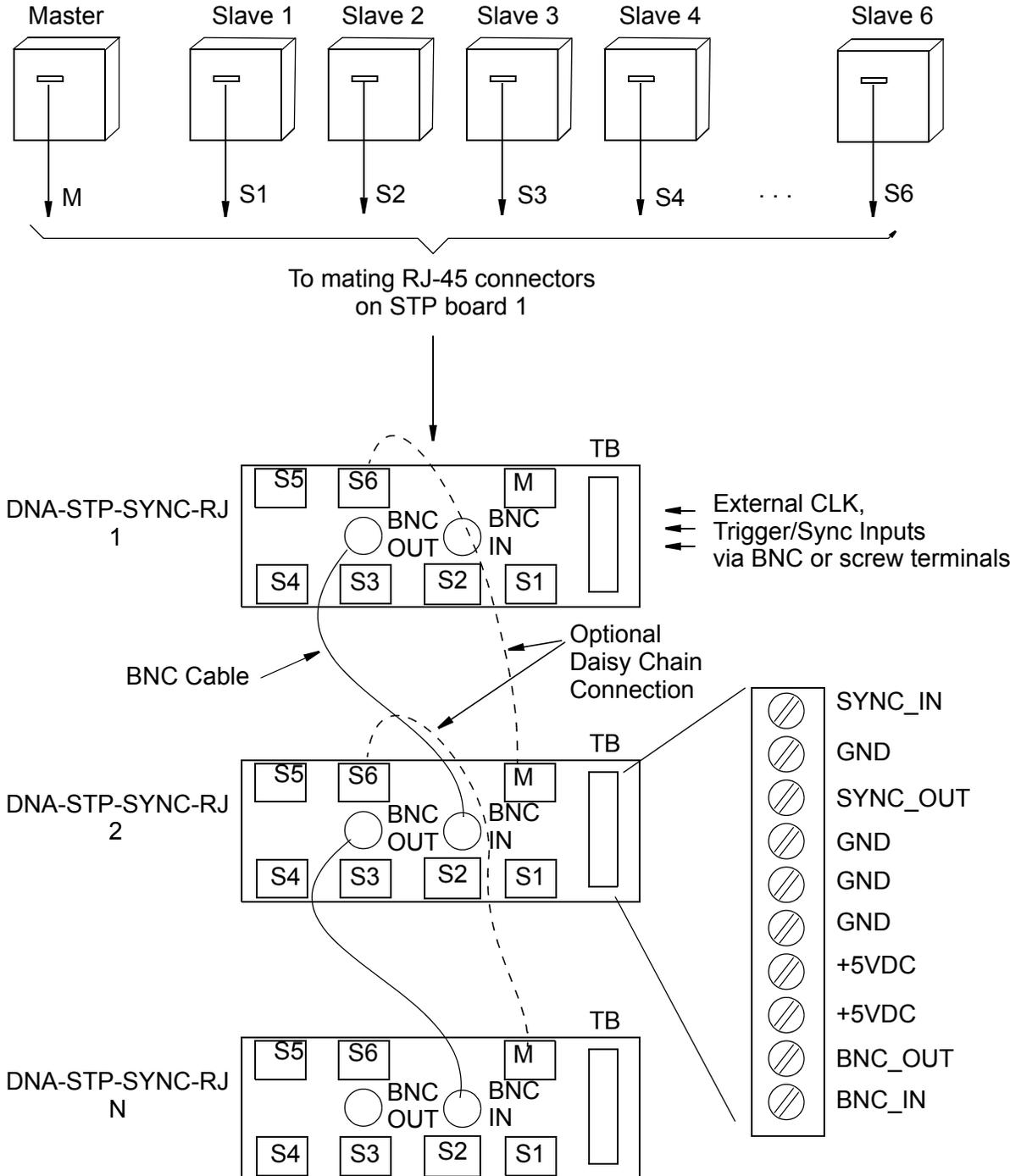
- The board provides a seventh RJ-45 connector (Master) with its Sync Out pin connected to the Sync In terminals of the six paralleled connectors. This will allow the Sync output of a single Cube to control other Cube Sync inputs without injecting the additive delays of multiple daisy-chained DNA-CBL-SYNC-30 connections.

A block diagram of the DNA-STP-SYNC is shown in **Figure 1-5**.

The DNA-CBL-SYNC-30 cable is a 30-inch cable that simply crosses the Sync In and Sync Out connections. This connects the Sync Out of one Cube to the Sync In of the next, allowing the second cube to be slaved to the first.



**Figure 1-5. DNA-STP-SYNC Block Diagram**



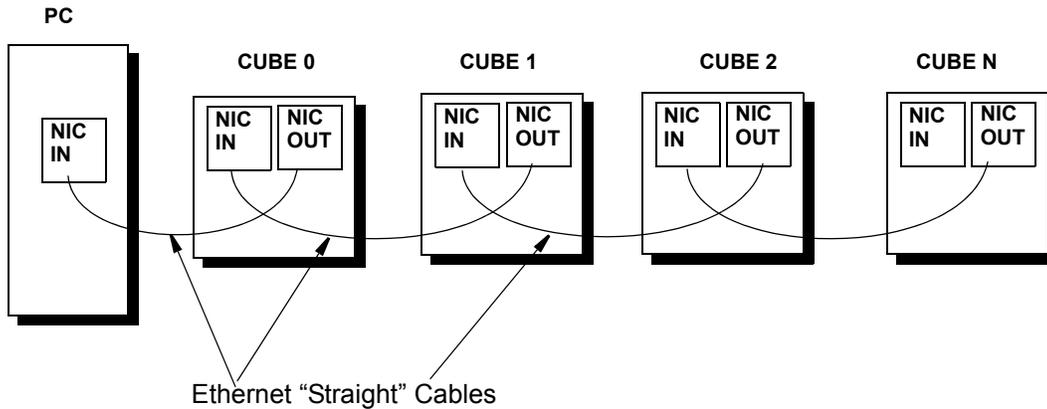
**Figure 1-6. Interconnection Diagram for Multi-Cube System**

The Sync Interconnection Panel allows a master cube to channel its trigger pulse through buffers to the slaves (and also back to the master Sync In) so that timing of the master matches that of the slave cubes. All cubes then use the same sync trigger signal.

Additional STP panels can be daisy-chained together through BNC connectors, as shown in the diagram of **Figure 1-6**.

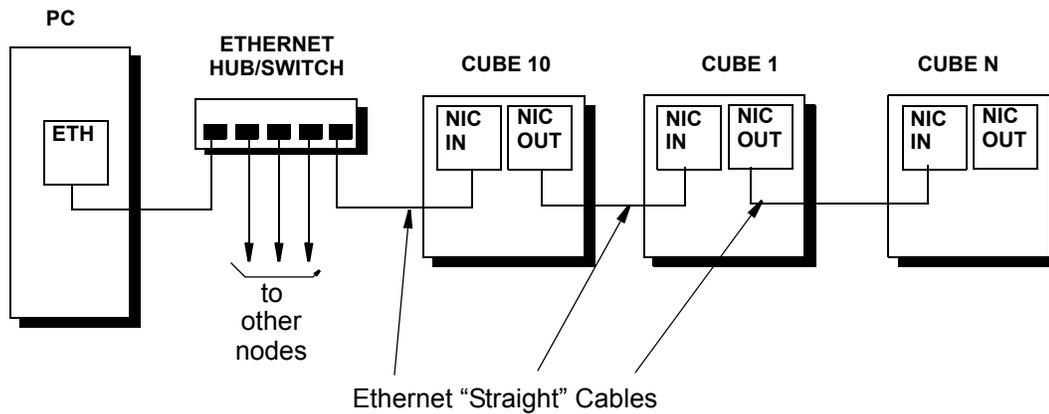
### 1.1 Daisy-chaining Multiple Cubes

A system can also be configured with multiple Cubes daisy-chained together as shown in **Figure 1-7**. To do this, use straight Ethernet cables connected as shown in the diagram below. Start with the Ethernet In port on the host PC and connect the other end to the NIC Out port on the first Cube, and then proceed to the next as illustrated.



**Figure 1-7. Daisy-chaining Multiple Cubes in a Network with a Direct-Connect Host PC**

When you use an Ethernet Hub/switch instead of a direct-connect host PC, connect the Cubes as shown in **Figure 1-8**.



**Figure 1-8. Daisy-Chaining Multiple Cubes when a Hub/Switch is Used**

# Appendix A

## A.1 Accessories

The accessory cables and STP boards offered with standard UEI PowerDNA Layers are also available for use with the Cubes. For detailed information, refer to the applicable datasheets for each product.

The following cables and STP boards are available.

### DNA-STP-SYNC-RJ

A multi-connector panel for interconnecting Sync cables between multiple Cubes. Contains 7 RJ-45 connectors (1 Master, 6 Slaves), two BNC connectors (Sync\_In, Sync\_Out), ten screw terminals (SYNC\_IN, SYNC\_OUT, 4 GND, +5VDC, +5VDC, BNC\_IN, BNC\_OUT). Supplied with DIN Rail mounting kit. You can download a datasheet for the DNA-STP-SYNC panel from [www.ueidaq.com](http://www.ueidaq.com).

### DNA-CBL-SYNC-10

A 30-inch 4-conductor cable with flat 4-pin Sync connectors on both ends for interconnecting two Cubes in a 2-cube system. The cable makes a crossover connection between two cubes.

### DNA-CBL-SYNC-RJ

A 30-inch 8-conductor cable with flat SYNC connector on one end and an RJ-45 on the other. Typically used for connecting a Cube Sync Port to a DNA-STP-SYNC interconnection panel.

### DNA-CBL-37

3-ft, 37-way flat ribbon cable, used to connect the Cube I/O Layers to external STP boards of various types.

### DNA-CBL-37S

3-ft, 37-way round shielded extender cable with thumb-screw connectors on both ends.

# Appendix B

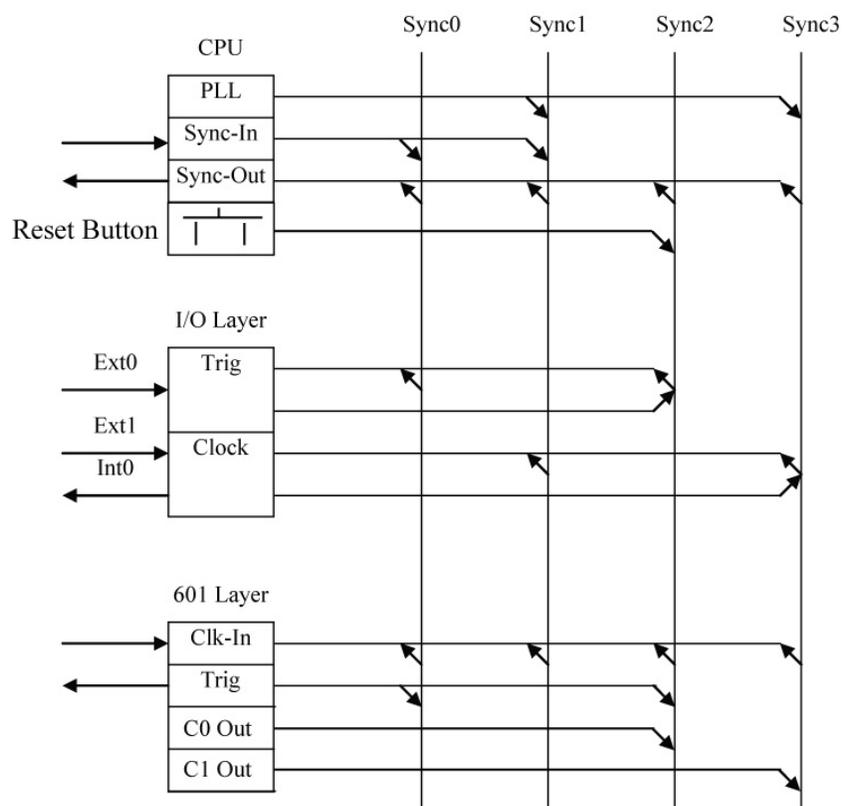
## PowerDNA Synchronization

### B.1 Overview

The PowerDNA Sync Interface provides two capabilities that are key components of many applications.

- It allows a PowerDNA Cube to be triggered by, or synchronized to, an external event or signal.
- It allows the various I/O layers/boards within a cube to be triggered by and/or synchronized to, a variety of signals within the cube or to external signals brought in directly to an I/O layer.

PowerDNA synchronization is based on two fixed-direction signal connections (*Sync In* and *Sync Out*) that are available on the CPU layer of the Cube. It is also based on four bidirectional sync signals (*Sync0* through *Sync3*) provided on the primary internal data bus of the Cube and shared by all I/O layers as well as the CPU layer. A block diagram of the system is shown **Figure B-1**.



**Figure B-1. Sync Interface Bus Diagram**

Note that the 601 Counter/Timer layer is a unique case. The counter timer capabilities of the board make it ideal for generating various timing and synchronization signals. Therefore, it is given more extensive access to the sync bus than other layers.

FPGA bases of the various layers, combined with the Cube firmware, can be configured to create an almost unlimited set of trigger and synchronization scenarios. Not all of these are supported in the standard released product. However, our standard trigger/synchronization model can satisfy the requirements of virtually all users.

The two-signal external Sync interface and the four-signal internal sync configuration are described in the two following sections, respectively.

## B.2 External Sync/Trigger interface

Each PowerPC PowerDNA Cube provides an external Sync connector on the front panel (below the reset button, above the first I/O layer). These Sync interface signals may be monitored or controlled by the logic on the processor board of the Cube, or they may be connected directly to internal Sync signals shared by the internal I/O layer boards. The remainder of this section describes the external Sync interface. Please refer to Section B.3 for details on the Cube internal sync bus.

The external Sync interface provides four connections. The Sync interface pins share a common ground, but are fully isolated from the Cube itself.

- Sync In
- Sync Out
- +5 VDC (up to 100 mA)
- Ground

*Sync In* is a dedicated input that may be used as a trigger source for the layer or to provide an external clock source to the cube. As a trigger, it supports the following modes.

- **Trigger Mode** – Start an application on a rising or falling edge (software selectable)
- **Trigger/Stop Mode** – Start an application on a rising (or falling) edge, Stop the application on the next rising (or falling) edge.
- **Gate High Mode** – Run the application while *Sync In* is High, Stop when *Sync In* is Low
- **Gate Low Mode** – Run the application while *Sync In* is Low, Stop when *Sync In* is High
- **Direct Layer Mode** – The *Sync In* terminal does not have a direct “Cube wide” function, but is connected directly to a *Sync* pin on one of the I/O Layers.

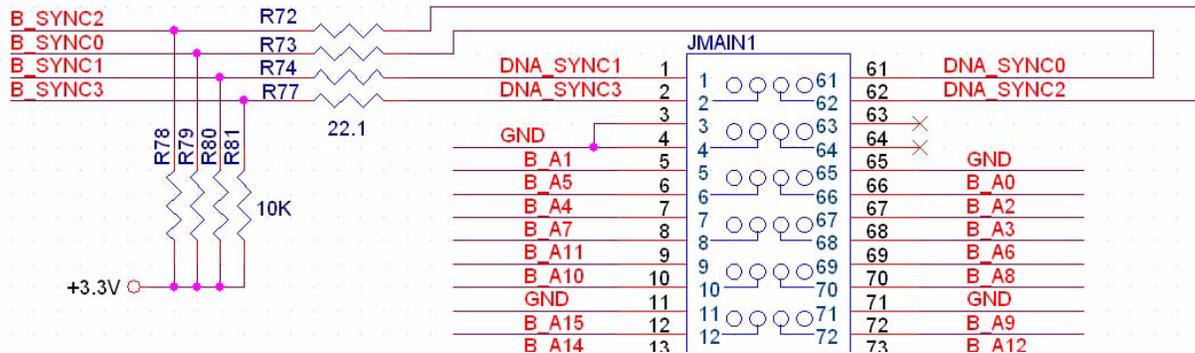
*Sync Out* is a dedicated output that may be configured to output any of the following:

- **Sync Buffer Mode** – The *Sync Out* signal is simply a buffered version of *Sync In*
- **Ext Clock Mode** – The internal clock of the cube is brought out to the *Sync Out* connection and may be used to synchronize clocks across cubes or throughout an application.
- **Direct Layer Mode** – The *Sync Out* signal is controlled by one of the I/O layers within the Cube.

### B.3 Internal Sync Connections

Four Sync signals on the internal I/O interconnect bus are brought to each layer.

These four lines are designated as “Sync0” through “Sync3”. The diagram below shows the configuration of the four internal Sync signals and also the pinout on the I/O layers.



**Figure B-2. Schematic of Internal Sync Connections**

As you can see, each line is pulled up with 10k resistor. In the maximum PPC-8 cube, the total resistance is 1430 Ohms with a termination current of 2.3mA. These parameters prevent synchronization lines from bouncing and also ensure that proper drive is available from every layer.

The four synchronization lines have identical functionality and any of the synchronization signals can be routed to any one of the synchronization lines. These capabilities allow great flexibility of synchronization interface configuration. However, they make the synchronization model very complex.

To simplify the synchronization interface model, UEI has standardized on the following conventions.

- Sync0 – dedicated trigger input
- Sync1 – dedicated input clock or system timebase clock
- Sync2 – inter-layer triggering
- Sync3 – inter-layer clocking

This line assignment addresses virtually all anticipated synchronization requirements.

The logic on the CPU board allows either of the external Sync connections provided at the external Sync connector to be mapped to any of these four internal sync signals. In most applications, the master Sync input from the CPU board is connected either to the Sync0 or Sync1 terminals. If an I/O layer is being used as a master system trigger, however, it is expected that the external Sync Out connection would be mapped to either Sync2 or Sync3.

#### B.3.1 Layer Triggering and Clocking

A layer can be triggered using the following sources:

- Firmware executing DaqBIOS Start command
- EXT0 line
- Sync0 line
- Sync2 line

A layer can be clocked using the following sources:

- Internally
- EXT1 line (or EXT0 in a single-line layer)
- Sync1 line
- Sync3 line

A layer can feed its trigger signal to Sync2 line. A layer can feed its clock signal to the Sync3 line.

The Sync-Out line on the CPU layer can either output Sync[0..3] line or be used for alarm notification.

## B.4 Use Application Cases

### Use Case 1 – Starting/Stopping Multiple Layers at the Same Time (No External Trigger)

This is a very common operation in ACB and DMap modes, in which the software issues a command to begin or end an application, but multiple layers within the cube need to be synchronized. If the layers involved are in software triggering mode, the firmware proceeds as follows:

- The start sequence for all layers involved is stored (performed by prog\_...()) functions in the device driver)
- All I/O layer timestamp counters are reset and synchronized with the timestamp counter on the CPU layer (this is required to align data relative to timestamps)
- The start sequence is executed (normally it is a single write to LCR register of each layer involved)

Layers can be clocked internally or externally in this case.

### Use Case 2 – External Trigger (via Sync Connector)

An external trigger drives Sync-In. Sync-In is sampled by the CPU layer, which then drives the internal Sync0 line. Installed I/O layers use the Sync0 line as a trigger.

### Use Case 3 – External Trigger (through an I/O Layer)

An I/O layer can be used to trigger one or more of the other layers in the cube. This trigger may be based directly upon an external trigger, or based upon its own trigger or terminal count. In this case, the master layer (which provides the sync signal) drives the Sync2 line. Other layers are triggered by this Sync2 signal. Clock configuration defines what signal (software, internal, external, sync bus) will be used as a layer clock.<sup>1</sup>

---

1. Note that this changes the definition of DQ\_LN\_CxCKSRCx bits. The bit combinations used are: 0 - software, 1 - internal, 2 - external, and 3 - sync interface.

### Use Case 4 – External Clock

An external clock can be either fed into the Sync-In input on the CPU layer or the CPU-layer PLL output may be routed to SYNC-Out and then back to SYNC-In. The clock configuration defines what signal (software, internal, external, sync bus) will be used as a layer clock.<sup>1</sup>

### Use Case 5 – Master-Slave Clocking

In this case, one layer produces a clock signal and places it on the Sync3 line. Other layer(s) in the cube then use it as their clock. The clock source can be a standard (analog/digital) layer as well as a counter-timer (CT) layer.

### Use Case 6 – Synchronous Buffered Input and Output

In this case, an analog output layer feeds its clock to the Sync3 line. An analog input layer then uses this clock signal to synchronize its A/D sampling to the D/A layer's clock. This allows the PowerDNA to be used in stimulus/response applications.

### Use Case 7 – Sequenced Acquisition (Based on the DNA-CT-601 Counter/Timer Layer)

Sequenced acquisition can be accomplished by feeding the Sync-In trigger or clock signal into one of the counter-timers on CT-601 layers (via Sync0 and Sync1 lines) and then back out to other I/O layers (using Sync2 and Sync3 lines). This allows the PowerDNA Cube to acquire data, or output waveforms, based on a predefined sequence in the CT-601 FIFO.

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1. Note that this changes the definition of DQ\_LN\_TRIGEDGE<sub>x</sub> bits. The bit combinations used are: 0 - software, 1 - internal, 2 - external, and 3 - sync interface.

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