

Remote I/O-16-485 Module

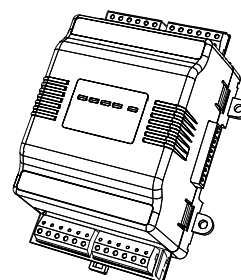
T-IO-16-485

Mounting and Wiring Guide

This document covers the mounting and wiring of a Remote I/O Module (T-IO-16-485), for expanding a Tridium® JACE® controller. It assumes that you are an engineer, technician, or service person who is performing access system design or installation. Please read through this entire document before beginning the installation procedures.

These are the main topics included in this document:

- [Product Description](#), page 1
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This document does not discuss mounting and wiring of other components, or software configuration. For more information on these topics, refer to documents listed in the [“Related Documentation”](#) section on page 2.

Product Description

The T-IO-16-485 expands a Tridium JACE controller¹ with 16 I/O points that can be remotely located, including

- 8 – universal inputs (UIs), compatible with 0–10Vdc, 4–20mA, dry contacts, pulsing dry contacts, 0–100K ohm resistive, or Type 3 thermistor temperature sensors.
- 4 – digital outputs with Form-A relay contacts, for on/off control of loads up to 24Vac/dc, at 0.5A max.
- 4 – 0–10Vdc analog outputs for analog control of loads at 2.5K ohm minimum, or 4mA drain maximum.

The IO module uses DIN rail mounting, and has two end-mounted 6-pin connectors that support direct-chaining (in-line attachment) to other T-IO-16-485 modules.

Communications to the remote JACE uses RS-485 multidrop on 3 wires of an end-mounted 6-pin connector. The other 3 wires on that connector are primary DC power and battery backup for the module, which can be supplied from that same JACE controller (such as a T-x02-XPR-24 or T-700). Alternatively, you can power the T-IO-16-485 locally with a DIN-mountable NPB-PWR-UN universal AC power supply, or a third-party 12–15Vdc power supply, and wire only the RS-485 bus back to the parent JACE controller.

¹ JACE with NiagaraAX-3.4 or later and an available RS-485 port. See [“System Planning,”](#) page 2 for more details.

JACE, Niagara Framework, Niagara AX Framework and the Sedona Framework are trademarks of Tridium, Inc.

Related Documentation

For more information on mounting and wiring a system, refer to appropriate

- *JACE (model) Mounting & Wiring Instructions* document.

For software configuration details on the I/O points provided by the T-IO-16-485 module, refer to:

- *NiagaraAX NRIO Guide*.

System Planning

The maximum number of T-IO-16-485 modules supported by a JACE controller differs according to its model. In addition, depending on the station resource usages in a JACE, *fewer* (than maximum) T-IO-16-485 modules *may be added*, while still retaining acceptable system operation. See [“Supported numbers of T-IO-16-485.”](#)

Other considerations also apply when adding T-IO-16-485 modules. For example, a T-IO-16-485 module under a JACE 2/3E/6/6E series controller will *not have* the inherent “battery backup” feature provided by the later T-202/602-XPR (M2M JACE) or T-700 controller platforms. See [“About battery-backup operation.”](#)

Finally, when cabling power to T-IO-16-485 modules located in other locations than the JACE, allowances must be made for “voltage drops” introduced by cabling distances. See [“Voltage drop considerations.”](#)

Supported numbers of T-IO-16-485

Table 1 provides a quick comparison of JACE controller models compatible with T-IO-16-485 modules, including the maximum possible number of T-IO-16-485 modules supported.



- Notes**
- Station operation of each JACE at maximum limits below with *only* the necessary NiagaraAX software components (Nrio driver and associated points) is roughly at 50% resource usage, without other driver networks, control logic, and so on. Therefore, maximum numbers *may be less*, say if an existing JACE 2/3E/6/6E with one or more “Ndio based” (T-IO-16, T-IO-34) modules.
 - Currently, only JACE models listed below, at NiagaraAX-3.4 or later, support T-IO-16-485 modules.

Table 1 Maximum number of T-IO-16-485 modules supported, by compatible JACE platform models.

JACE model	Max. Number of T-IO-16-485	6-Position Power/RS-485? ¹	Max. Number Powered by JACE ²
T-700 (JACE 7)	16	Yes	8
T-202-XPR-24 (M2M JACE 2)	3 ³	Yes	3
T-602-XPR-24 (M2M JACE 6)	15 ³	Yes	3
T-SEC-6xx (Security JACE)	4 ⁴	Yes	4
T-200 (JACE 2), T-300E (JACE 3E)	4	No	— ⁵
T-600/T-600E (JACE 6, JACE 6E)	16	No	— ⁵

1. Powering T-IO-16-485 modules from a JACE with 6-position power/RS-485 provides battery backup during “power blips”.
2. Max. number powered by JACE assumes T-IO-16-485 are located nearby with minimal “voltage drop” from power cabling. If a JACE supports more T-IO-16-485 modules than this (e.g. T-700), or if some T-IO-16-485 modules are long distances away (for example 900 feet away), they need to be powered locally by NPB-PWR-UN, or other battery-backed 12V power supply.
3. In addition to 16 points of onboard I/O provided by this JACE controller.
4. A T-SEC-6xx (Security JACE) will likely have some number of security modules (T-SEC-R2R, T-SEC-RIO), which reduces this maximum number limit. Enterprise Security version 2.2 is required to configure T-IO-16-485 modules from within the Security application.
5. JACE 2/3E/6/6E series controllers do not have a 6-position power/RS-485 connector to power T-IO-16-485 modules. Therefore, all modules must be powered directly from a NPB-PWR-UN, or other battery-backed 12V power supply. The maximum number (16) shown for a T-600 (JACE 6) or T-600 (JACE 6) assume a dedicated NPB-PWR-UN for just the T-IO-16-485 modules.

About battery-backup operation

When T-IO-16-485 modules are powered by JACE platforms with 6-position power/RS-485 connectors, that is, wired to the PS+, PS-, and BB terminals, they can benefit from “battery backed” protection against system power events. Note this requires the JACE to have the optional (external) 12V sealed lead acid battery installed—as the JACE’s internal NiMH battery provides “power blip” backup only for its onboard circuitry, as well as a “graceful shutdown” of its running station, if a longer power outage occurs.



Note The other “direct attachment type” I/O expansion modules (T-IO-16, T-IO-34, using Ndio driver) already provide this type of “shutdown protection” described above.

A T-IO-16-485 with battery backup can provide *continuous system operation* during a power event—essentially making it a “non event” for both the JACE and the IO module. Depending on the capacity of the external battery(ies), this backup operation can extend over many minutes of AC power loss, and/or over multiple successive power blips. A T-IO-16-485 wired this way is often described as “powered by the JACE”, although during normal operation, sometimes power is actually supplied by the NPB-PWR-UN module attached to, and powering, the JACE itself (T-700, T-SEC-6xx).

Note this “supplied by JACE” battery-backup operation is *not available* when using T-IO-16-485 modules with T-200 / T-300E / T-600/T-600E (JACE 2/3E/6/6E series) controllers, that is JACEs *without* the 6-position power/RS-485 connector. Or, in any scenarios where T-IO-16-485 modules must be located many hundreds of feet away from the JACE (cabling “voltage drop” issues). In these cases, you must *locally power* those T-IO-16-485 modules, using one of two methods:

- Local NPB-PWR-UN attachment to the T-IO-16-485 module(s). Although convenient, be aware that this invites power event issues. See [“Operation without battery-backup.”](#)
- Third party, battery-backed 12Vdc power supply, wired to the PS+ and PS- terminals of the T-IO-16-485 module’s 6-position end connector. This is *typically recommended*, for reasons noted below.

Note that power wiring for all different scenarios is included in this document. See [“Wiring Details,”](#) page 10.

Operation without battery-backup

If a T-IO-16-485 module is powered locally with a NPB-PWR-UN (for example, a JACE-6 series job), and a momentary AC power loss occurs, note that a number of *undesirable things can result*, including:

- Load cycling from T-IO-16-485 relays dropping out, including several seconds lag to first re-establish communications with the JACE (Nrio driver) before relays can pull in again, as needed.
- Totalized “counts” zeroed out.
- History (logging) entries for associated IO points as “down,” as well as Nrio “device down” alarms.

Further, loss of power without battery backup makes an IO firmware upgrade a risky operation. Such an upgrade is initiated from the “Nrio Device Manager” view (in a station connection to the JACE). If this upgrade process is interrupted by a T-IO-16-485 power cycle, the module may be rendered inoperable—and will likely need to be replaced.

Therefore, consider powering NPB-PWR-UN modules with a battery-backed 12V power supply, as necessary.

Voltage drop considerations

When using the JACE and its backup battery to power T-IO-16-485 modules, and some modules are not in the same enclosure with the JACE, you must be aware of voltage drops in the connecting “trunk power” cabling. Typically, this applies only if modules are located in different locations—that is, not near the JACE.



Note The 15Vdc power supply and the backup battery(ies) charged by the JACE must always be located nearby the JACE, either in the same enclosure (typical), or in an adjacent enclosure.

Note that each T-IO-16-485 draws (at most, when all four relays are pulled in) 0.125A, and thus can introduce voltage drop when long cabling distances are used for power/backup battery. In addition, when sizing the sealed lead-acid battery(ies) for a JACE, you should factor in additional Ah capacity according to the numbers of T-IO-16-485 modules. [Table 2](#) provides a summary of T-IO-16-485 power consumption for these purposes

Table 2 Amps/Watts, and Recommended Minimum 12V SLA battery A-Hr capacities, per T-IO-16-485.

Device	Max per System	Amps / W used @ 15Vdc (each)	12V Backup Battery (4 hours) min. recommended Ah (each)	Notes
T-IO-16-485	see Table 1	0.125 A / 1.88 W	0.65 Ah	Has 4 on-board relays.

Undersized selection of power cabling can result in unacceptably high voltage drops, and remotely located T-IO-16-485 modules may not operate correctly—especially during emergency (battery backup) operation.

The maximum allowable voltage drop due to wiring is 1.5V. This equates to the difference in voltage measured across the PS+ and PS- at the source JACE power supply, and the PS+ and PS- at the furthest expansion module (T-IO-16-485). Or, when powered by battery backup, the difference in voltage measured across the BB and PS- at the source JACE, and the BB and PS- at the furthest expansion module (T-IO-16-485).

[Table 3](#) provides a voltage drop chart, showing voltage drops per 100 feet of paired wire of different gauges (AWG), at different load amps.

Table 3 Voltage Drop Per 100 Feet Run (30m) of Paired Wire.

Gauge (AWG)	Load Current						
	0.10A	0.25A	0.5A	1.0A	1.5A	2.0A	4.0A
10	0.020	0.05	0.10	0.20	0.30	0.40	0.80
12	0.032	0.08	0.16	0.32	0.48	0.64	1.27
14	0.050	0.13	0.25	0.50	0.75	1.01	2.02
16	0.080	0.20	0.40	0.80	1.20	1.60	3.20
18	0.127	0.32	0.64	1.27	1.91	2.54	5.08
20	0.202	0.50	1.01	2.02	3.03	4.03	8.07
22	0.320	0.80	1.60	3.20	4.80	6.40	12.81

For an example, consider a system where two T-IO-16-485 modules are mounted remotely in a location 500 feet (366m) away. In this example, worst-case amps used by each remote T-IO-16-485 is 0.125A. Looking at [Table 3](#) at the 0.25A column, a #16 AWG cable pair drops 0.20V per 100 feet, meaning a 500 foot run would drop slightly over 1V—this would be a good choice over an #18 AWG cable, which would drop over 2V (above the 1.5V maximum allowable drop).

Preparation

Unpack the T-IO-16-485 module and inspect the contents of the package for damaged or missing components. If damaged, notify the appropriate carrier at once, and return for immediate replacement (see [“Returning a Defective Unit,”](#) page 22). See the next sections [“Included in this Package”](#) and [“Material and Tools Required”](#).

Included in this Package

Included in this package you should find the following items:

- a Remote I/O Module (T-IO-16-485).
- this *Remote I/O Module (T-IO-16-485) Remote I/O-16-485 Module*, Part Number 11625, Rev 2.3.
- a hardware bag containing the following items:
 - Four (4) pin-mount, 6-position, screw-terminal connectors for connection of universal inputs, analog outputs, and relay outputs. For more details, see [“About Screw Terminal Connectors,”](#) page 9.
 - One (1) 6-position screw terminal end-plug, for wiring RS-485 communications from the parent JACE, as well as 15Vdc power and battery backup.
 - One (1) grounding wire, with quick-disconnect 0.187" female connector.
 - Eight (8) 499-ohm resistors, used for 4–20mA inputs.

Material and Tools Required

The following supplies and tools are required for installation:

- Approved 12–15Vdc power supply source and (optional) 12Vdc backup battery source, by either:
 - Wiring to the remote parent JACE controller’s 6-position “Powered RS-485” connector, such as on a T-x02-XPR-24 controller or T-700 controller. This is the recommended method.
 - Using a DIN-mountable NPB-PWR-UN power supply to furnish 15Vdc power to the T-IO-16-485.
 - Using a third-party 12–15Vdc power supply, with output regulated to within $\pm 4\%$.
- If DIN mounting, a DIN rail, type NS35/7.5 (35mm x 7.5mm) and DIN rail end-clips (stop clips), and screws for mounting. See [Figure 1](#) on page 8. If DIN rail not used, suitable screws for mounting base of Remote I/O Module module.
- Suitable tools and supplies for making all wiring terminations.

Precautions

This document uses the following warning and caution conventions:



Caution

Cautions remind the reader to be careful. They alert readers to situations where there is a chance that the reader might perform an action that cannot be undone, might receive unexpected results, or might lose data. Cautions contain an explanation of why the action is potentially problematic.



Warning

Warnings alert the reader to proceed with extreme care. They alert readers to situations where there is a chance that the reader might do something that can result in personal injury or equipment damage. Warnings contain an explanation of why the action is potentially dangerous.

Safety Precautions

The following items are warnings of a general nature relating to the installation and start-up of a compatible JACE controller. Be sure to heed these warnings to prevent personal injury or equipment damage.



Warning

- A 15Vdc circuit powers the T-IO-16-485 module from the JACE controller. Disconnect power before installation or servicing to prevent electrical shock or equipment damage.
- Make all connections in accordance with national and local electrical codes. Use copper conductors only.
- To reduce the risk of fire or electrical shock, install in a controlled environment relatively free of contaminants.
- JACE controllers and I/O modules are only intended for use as monitoring and control devices. To prevent data loss or equipment damage, do not use them for any other purposes.

Static Discharge Precautions

These items are cautionary notes to help prevent equipment damage or loss of data caused by static discharge.



Caution

- Static charges produce voltages high enough to damage electronic components. The microprocessors and associated circuitry within a Remote I/O Module are sensitive to static discharge. Follow these precautions when installing, servicing, or operating the system:
- Work in a static-free area.
- Discharge any static electricity you may have accumulated. Discharge static electricity by touching a known, securely grounded object.
- Do not handle the printed circuit board (PCB) without proper protection against static discharge. Use a wrist strap when handling PCBs, with the wrist strap clamp secured to earth ground.

Module Connection Precautions



Caution

Do not connect more than the maximum number of T-IO-16-485 modules to the RS-485 port of the parent JACE controller—note that *16 is the maximum number supported in software*. However, less T-IO-16-485 modules may be supported. See “Supported numbers of T-IO-16-485,” page 2.

WEEE (Waste of Electrical and Electronic Equipment)



Recycling of Electronic Products: (International Installations)

In 2006 the European Union adopted regulations (WEEE) for the collection and recycling of all waste electrical and electronic equipment. It is no longer allowable to simply throw away such equipment. Instead, these products must enter the recycling process.

To properly dispose of this product, please return it to your local authority collection point. If such a facility is not available, please send it to one of these offices:

Tridium Europe Ltd
1, The Grainstore
Brooks Green Road
Coolham, West Sussex
RH138GR United Kingdom

Tridium Asia Pacific Pte Ltd
17 Changi Business Park Central 1
Honeywell Building
Singapore 486073

Tridium Inc.
2256 Dabney Road, Suite C
Richmond, VA 23230

Installation and Start-up Outline



Note If installing the JACE and T-IO-16-485 module at the same time, please refer to the appropriate *JACE Mounting & Wiring Guide* document to install the JACE controller.

The major steps to installing and starting the T-IO-16-485 module are outlined as follows:

1. Physically mount the T-IO-16-485 module onto DIN rail. See [“Physical Mounting.”](#) If directly attaching to other modules, ensure that the 6-position end connector(s) are properly seated into the end connectors of the other units. Note the previous [“Module Connection Precautions”](#) on page 6.
2. Make wiring connections for grounding, power, RS-485 communications, and I/O points. See [“Wiring Details,”](#) page 10.
3. Apply power and perform an initial checkout. See [“Power up and Initial Checkout”](#) on page 19.

Physical Mounting

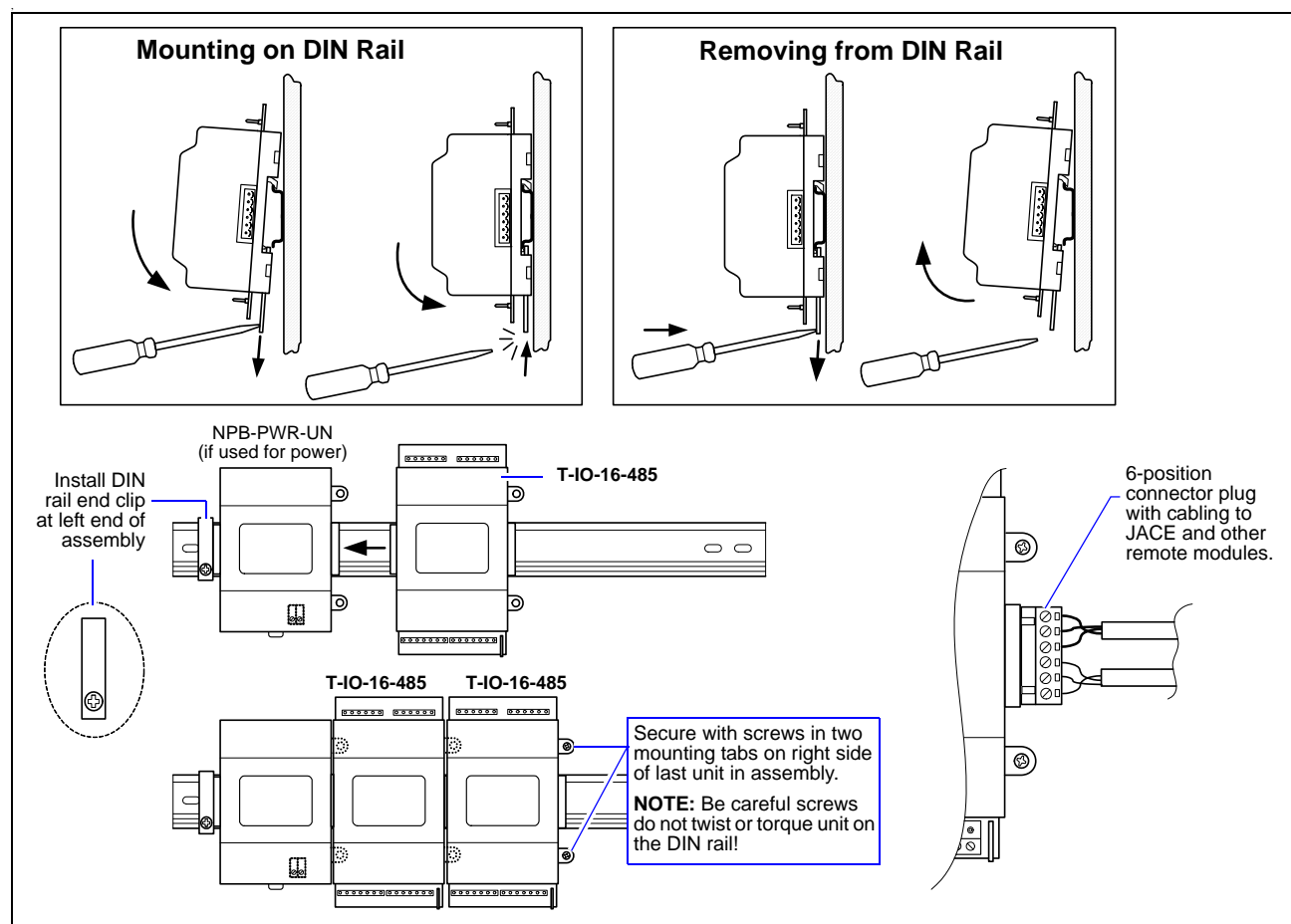
The following applies to mounting a T-IO-16-485 Remote I/O Module:

- You can mount the unit in any orientation. It is not necessary to remove the cover before mounting.
- Mounting on a 35mm wide DIN rail is recommended. The T-IO-16-485 unit base has a molded DIN rail slot and locking clip, which simplifies mounting 2 or more units together, and/or to a NPB-PWR-UN power supply. Mounting on a DIN rail ensures accurate alignment of connectors between all modules.
- If DIN rail mounting is impractical, you can use screws in mounting tabs on the T-IO-16-485. Mounting tab dimensions are on the [last page](#) of this document.

[Procedure 1](#) provides step-by-step instructions for mounting the T-IO-16-485 module on an installed DIN rail.

Procedure 1 To mount on DIN rail.

-
- | | |
|---------------|---|
| Step 1 | Position the T-IO-16-485 module on the rail, tilting to hook DIN rail tabs over one edge of the DIN rail (Figure 1). |
| Step 2 | Use a screwdriver to pry down the plastic locking clip, and push down and in on the T-IO-16-485, to force the locking clip to snap over the other edge of the DIN rail. |
| Step 3 | Slide the T-IO-16-485 module along the DIN rail to its intended location.
If connecting to another module already mounted, seat its 6-position plug into that module's connector socket. |
| Step 4 | Install DIN rail end clips to secure the assembly, or install screws in mounting tabs. |
| Step 5 | Repeat this for all items, until all are mounted on the DIN rail(s), firmly connected to each other, and secured with DIN rail end clips or mounting tab screws. |
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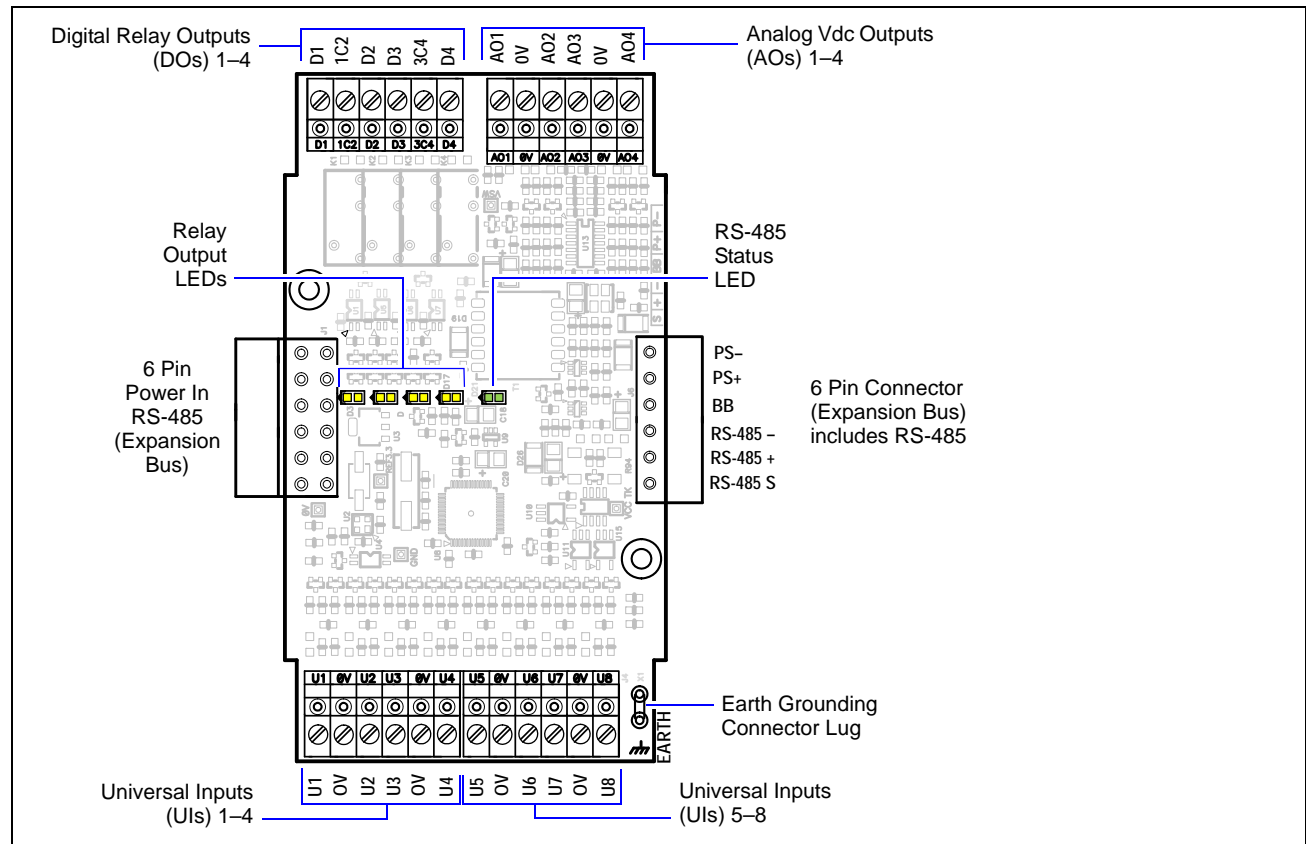
Figure 1 T-IO-16-485 module DIN mounting details.**Note**

To remove a T-IO-16-485 module from DIN rail, remove DIN rail end clips or mounting tab screws, and (if applicable) slide it away from other modules. Insert a screwdriver in the center plastic locking tab and pull downwards, then lift the unit outwards.

T-IO-16-485 Board Layout and Terminals

The T-IO-16-485 module provides 8 universal [inputs](#), 4 digital [relay outputs](#), and 4 0–10Vdc [analog outputs](#). Wiring terminal positions are shown below ([Figure 2](#)), along with LED locations.

Figure 2 Remote I/O Module Wiring Terminal Locations (screw terminal connectors shown installed).



About Screw Terminal Connectors

Screw-terminal connectors are shipped loose in a separate hardware bag. If desired, you can make wiring terminations to connectors *before* installing on the T-IO-16-485 circuit board pins. Removal of the pin-mounted connectors may be difficult, especially if they are pushed all the way down and wiring has been landed.

In general, it may be easiest to wire to *loose* connectors (held next to pins), then install them after completing.



Caution

Before using the method below to remove connectors, remove all power to the T-IO-16-485, and remove power to any other connected external devices. Otherwise, a short circuit will result!

To remove a pin-mounted connector plug using *needle nose pliers*, with all power removed (see [Caution](#)).

- Insert the tips of the pliers into the *outermost* wiring termination ports of the connector. Note that if wiring is already landed in those ports, you may need to remove those wires first.
- With a gentle rocking motion, pull upwards, perpendicular to the circuit board.
- The connector will come free from the circuit board pins. If you removed wiring from the outermost connector ports, reconnect that wiring as it was before.

Wiring Details

See [Figure 2](#) to locate connectors and other components on the Remote I/O Module.

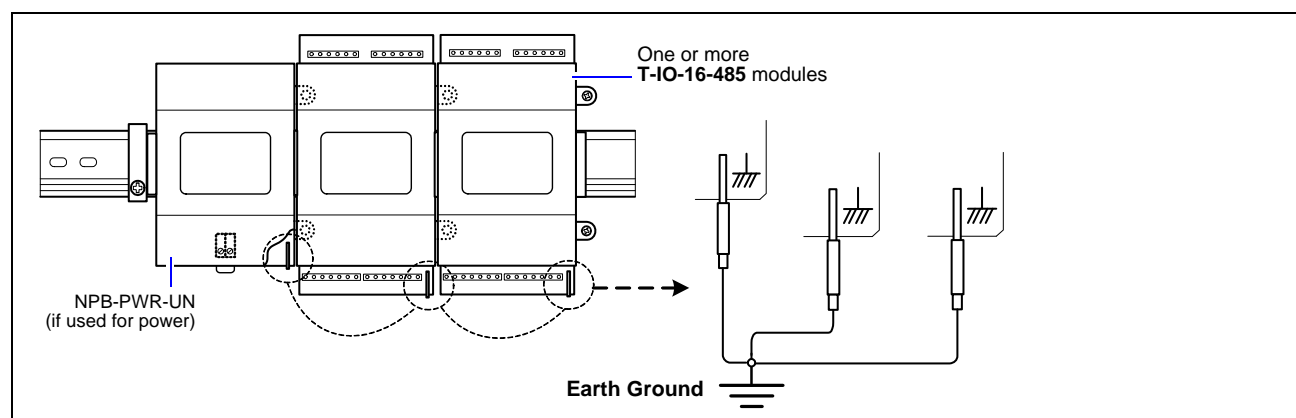
Make connections to the Remote I/O Module in the following order.

1. Connect the earth grounding wire (with spade connector) from the earth ground lug on the T-IO-16-485 to a nearby earth grounding point. See the [“Grounding”](#) section on page 10 for details.
2. Wire to supply power to the T-IO-16-485, but *do not energize the power source* until all other wiring is completed. Depending on how you are powering the T-IO-16-485, methods differ:
 - a. If powering the T-IO-16-485 from a JACE *that is equipped* with a 6-position “Powered RS-485” connector (supplies 15Vdc and battery backup on 3 wires of this connector), unplug this connector at the JACE. Then wire to the 6-position connector plug for each assembly of T-IO-16-485 modules, in a “shortest route” fashion. See [“Power from JACE 6-Position Connector,”](#) page 11. This power method is not available for most JACE 2/6 series—instead use method [b](#) or [c](#) below.
 - b. If powering the T-IO-16-485 from a local NPB-PWR-UN power supply module, wire the disconnected AC line circuit to the 2-position terminal block under the NPB-PWR-UN’s cover. See [“Power from local NPB-PWR-UN module”](#) on page 12.
 - c. If powering the T-IO-16-485 from a third-party 12–15Vdc power supply, wire the positive and negative lines from the power supply to the PS+ and PS– terminals of the 6-position end connector plug. See [“Power from third party 12–15Vdc power supply”](#) on page 13.
3. Connect RS-485 wiring between the T-IO-16-485 and the JACE, and (if applicable) to other remote T-IO-16-485 modules, in a continuous multidrop fashion. See [“RS-485 Communications”](#) on page 14.
4. Connect I/O wiring. See sections [“Inputs”](#) on page 14, and [“Outputs”](#) on page 17.
5. Apply power to the unit. See [“Power up and Initial Checkout,”](#) page 19.

Grounding

An earth ground spade lug (0.187") is provided on the circuit board of the T-IO-16-485 (and NPB-PWR-UN) for connection to earth ground. For maximum protection from electrostatic discharge or other forms of EMI, connect each device’s earth ground using a #16 AWG or larger wire. Keep these wires as short as possible. See [Figure 3](#) for the location of the earth grounding wire for both the T-IO-16-485 and NPB-PWR-UN.

Figure 3 Earth ground connection required to each T-IO-16-485 module as well as NPB-PWR-UN (if using).



Note Connect any remote T-IO-16-485 modules to a nearby earth ground in the same manner.

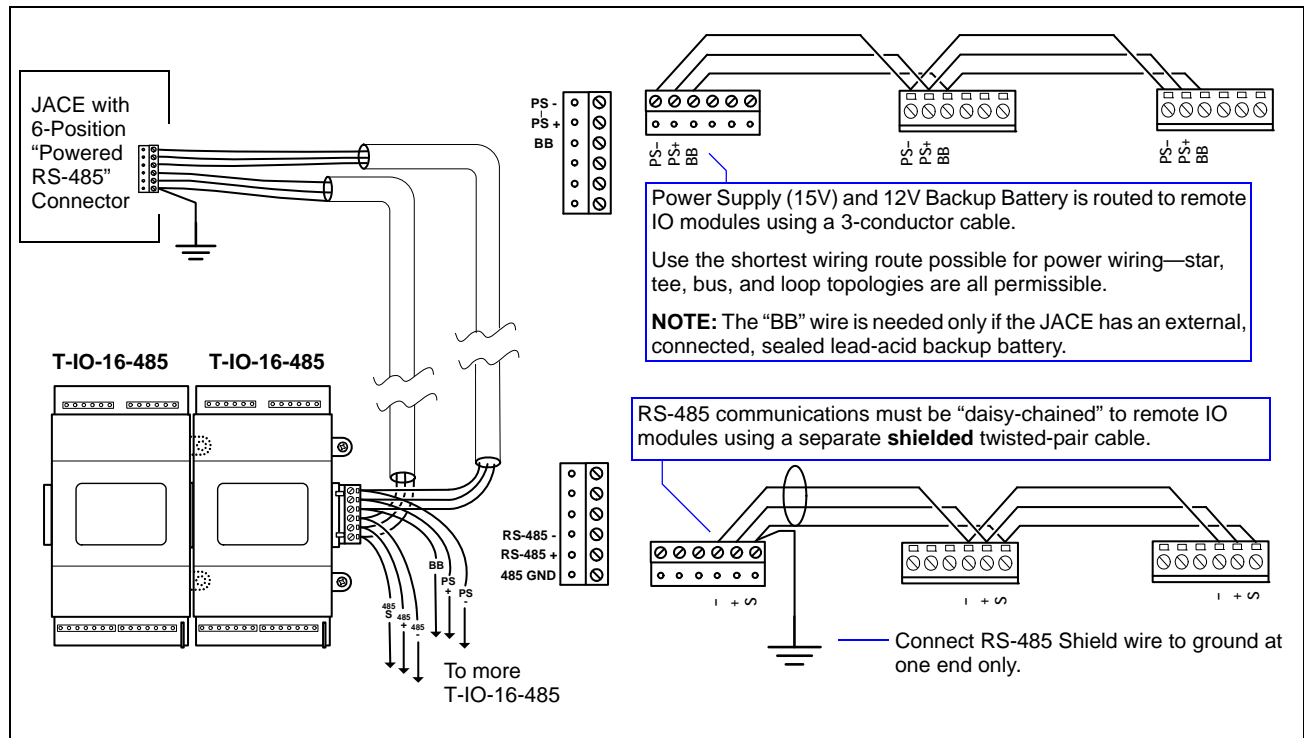
Power from JACE 6-Position Connector

(Not an option for JACE 2/3E/6/6E series controllers) If powering one or more T-IO-16-485 modules from a JACE with a 6-position “Powered RS-485” connector, the 15Vdc and 12V backup battery (BB) is typically routed to the modules via a 3-conductor cable. The remaining 3 positions are used for RS-485 communications between the JACE and the IO modules, using a separate *shielded* twisted pair cable. See [Figure 5](#).



- Notes**
- If the JACE is not connected to a (optional, external) sealed lead-acid battery, the “BB” wire is not required. This permits use of a *single pair* cable, versus a 3-conductor cable.
 - For power budgeting purposes, estimate each T-IO-16-485 module to consume 2W nominal (125mW @ 15V). Typical current will be less— as this estimate factors in all four relays being pulled in.
 - Do not apply power (plug in the 6-position connector at the JACE) until all other wiring is completed. See “[Power up and Initial Checkout](#),” page 19.

Figure 4 T-IO-16-485 modules powered by JACE connection (RS-485 wiring also shown).



In some cases, some number of T-IO-16-485 modules may be powered this way (from JACE), while others may be powered locally using either a NPB-PWR-UN power supply module or a third-party 12–15Vdc power supply. This may be advisable when IO modules are located long distances from the JACE, to avoid excessive voltage drops due to wiring resistances. See the following sections:

- “[Power from local NPB-PWR-UN module](#),” page 12
- “[Power from third party 12–15Vdc power supply](#),” page 13

Power from local NPB-PWR-UN module

If powering T-IO-16-485 modules from a directly-attached AC power supply (NPB-PWR-UN module), wire the AC circuit to the NPB-PWR-UN's 2-position terminals (must remove cover). See [Figure 5](#), left.



Warning

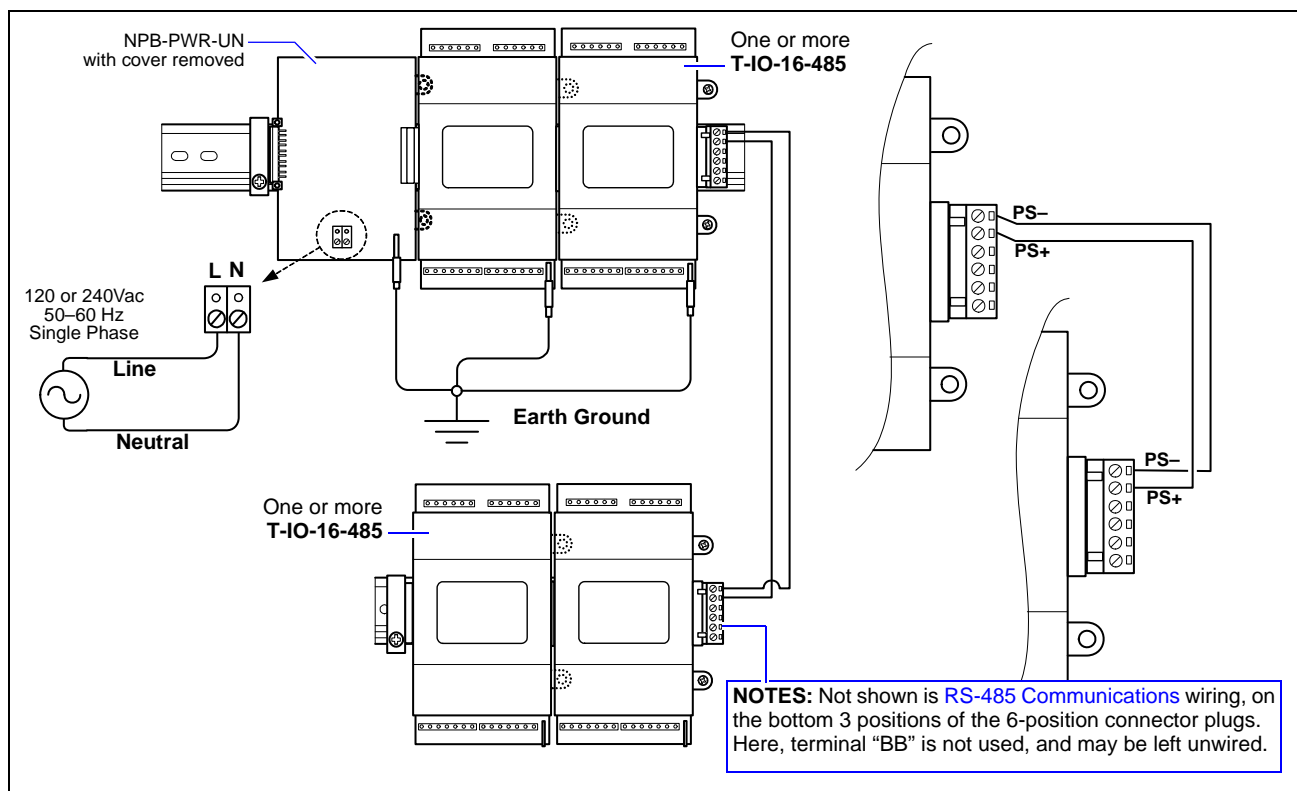
- A 120Vac or 240Vac circuit powers the NPB-PWR-UN. Disconnect power to this circuit before installation to prevent electrical shock or equipment damage.
- Make all connections in accordance with national and local electrical codes. Use copper conductors only.
- Do not exceed the 30W capacity of NPB-PWR-UN by the powered devices.



Notes

- For power budgeting purposes, estimate each T-IO-16-485 module to consume 2W nominal (125mW @ 15V). Typical current will be less—this estimate factors all four relays being pulled in.
- For other wiring on the 6-position end connector, see “[RS-485 Communications](#),” page 14.
- Do not apply power (energize the NPB-PWR-UN) until all other wiring is completed. See “[Power up and Initial Checkout](#),” page 19.

Figure 5 NPB-PWR-UN power supply module used to power T-IO-16-485 modules.



If the NPB-PWR-UN powers additional T-IO-16-485 modules (not attached in same assembly), wire a single pair cable between assemblies, connecting PS– to PS–, and PS+ to PS+ in a “shortest route” fashion. See [Figure 5](#), right.

Power from third party 12–15Vdc power supply

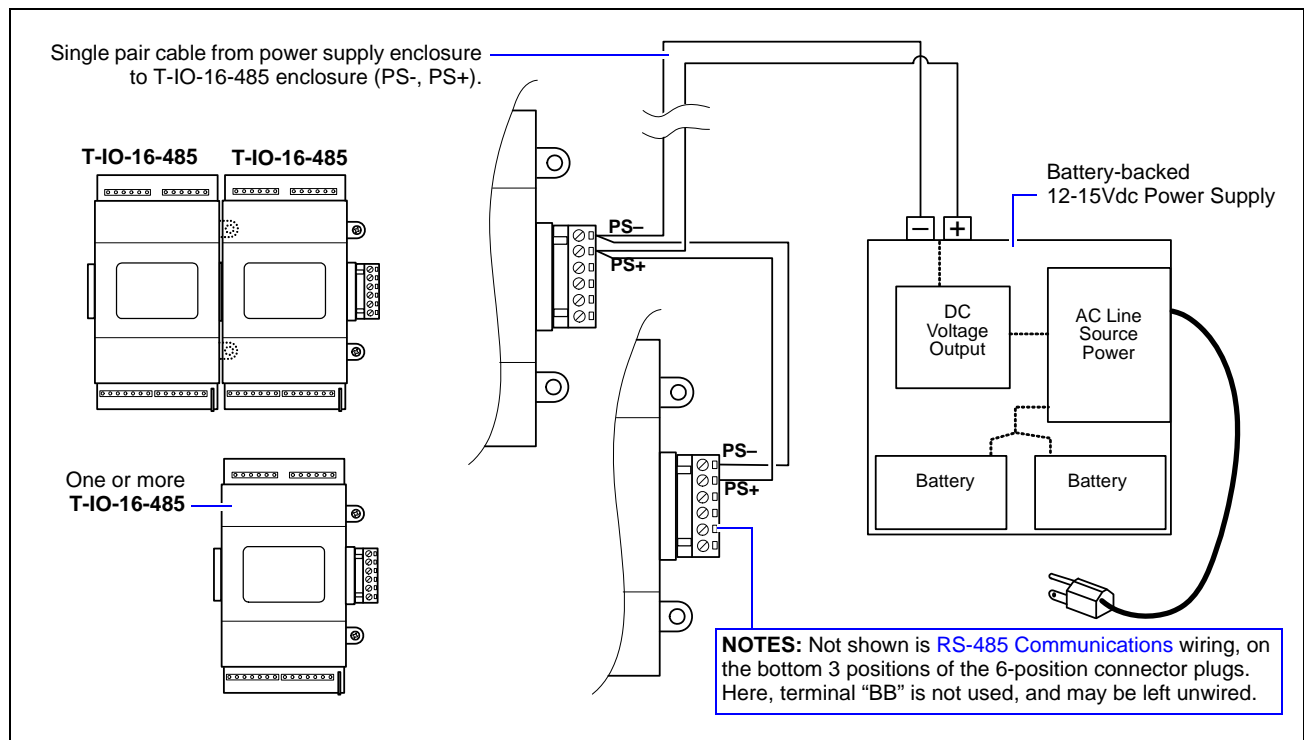
T-IO-16-485 modules can be powered by a third-party, 12V–15Vdc power supply, as an alternative to using a NPB-PWR-UN power supply module. A “battery backed” power supply is recommended. This provides power to the IO module(s) during AC power loss scenarios.

Figure 6 shows wiring for two assemblies of T-IO-16-485 modules powered by a battery-backed power supply.



- Notes**
- For power budgeting purposes, estimate each T-IO-16-485 module to consume 2W nominal (125mW @ 15V). Typical current will be less— as this estimate factors in all four relays being pulled in.
 - For other wiring on the 6-position end connector, see “[RS-485 Communications](#),” page 14.
 - Do not apply power (energize the power supply) until all other wiring is completed. See “[Power up and Initial Checkout](#),” page 19.

Figure 6 Third-party 12Vdc, battery backed, power supply powering T-IO-16-485 modules.



- Notes**
- Power must be regulated to within $\pm 4\%$.
 - Power supply models furnishing 12Vdc output are the most commonly available.
 - Only remote *T-IO-16-485* modules can be powered by a 12Vdc power supply—the JACE controller requires 15Vdc. Depending on JACE model, this 15Vdc may be furnished by an integral power supply, or from an external power supply module, such as the NPB-PWR-UN. See the appropriate *JACE (model) Mounting & Wiring Guide* document for details.

RS-485 communications from the JACE to each T-IO-16-485 module (or assembly of modules) requires a continuous “daisy-chain” wiring topology using a shielded, twisted-pair cable. Wire between T-IO-16-485 assemblies using the 6-position end connectors. At the JACE, wire to either its 3-position RS-485 connector, or if equipped, to its 6-position “Pwr/485” connector.

Figure 7 RS-485 wiring from the JACE to one or more T-IO-16-485 modules uses a “daisy-chain” connection.



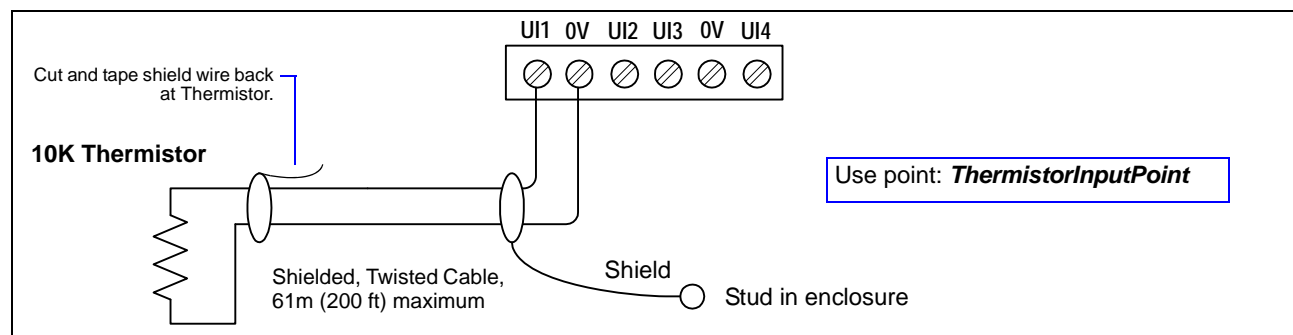
- Type-3 10K ohm **Thermistor** (also see **Caution** on page 15)
- **Resistive** 0—100K ohms
- **0–10 Vdc**
- **4–20 mA**
- **Binary Input**

Thermistor

Inputs support 10K Thermistor temperature sensors. Input accuracy is in the range of $\pm 1\%$ of span. By default, conversion is for a standard Type 3 thermistor sensor, with a sensor range of -10° to 135°F (23.3° to 57.2°C). Using a conversion type of “Tabular Thermistor,” you can specify a different thermistor response curve, by importing a thermistor curve .xml file. Currently, the *kitIo* module contains an xml folder with thermistor curves for a various thermistor temperature sensors. You can also edit and export (for reuse) *customized* thermistor curve xml files. See the *NiagaraAX NRIO Guide* for details.

Figure 8 shows the wiring diagram.

Figure 8 Thermistor wiring.



Resistive 0—100K ohms

Inputs can read a resistive signal within a range from 0 to 100,000 ohms. Wiring is the same as shown for a Thermistor temperature sensor (Figure 8).

Resistive signals require a **ResistiveInputPoint**.



Caution

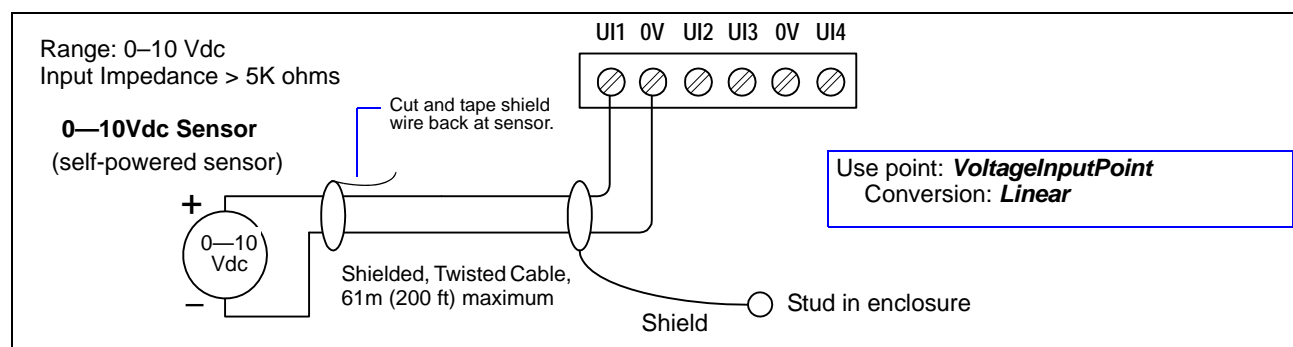
UI inputs provide optimum resistive-to-temperature resolution in the 10K ohm range. For a sensor with a range far from 10K ohms (such as a **100-ohm** or **1000-ohm sensor**), resolution is **so poor as to be unusable!** To successfully use such a sensor, install a *transmitter* that produces a Vdc or mA signal, and then wire the transmitter to the UI according to the **0–10 Vdc** or **4–20 mA** instructions.

0–10 Vdc

Inputs support self-powered 0–10 Vdc sensors. Input impedance is greater than 5K ohms. 0–10 volt accuracy is $\pm 2\%$ of span, without user calibration. Figure 9 shows the wiring diagram for a 0–10 Vdc sensor.

0–10 Vdc sensors require a **VoltageInputPoint**.

Figure 9 0–10 Vdc wiring.



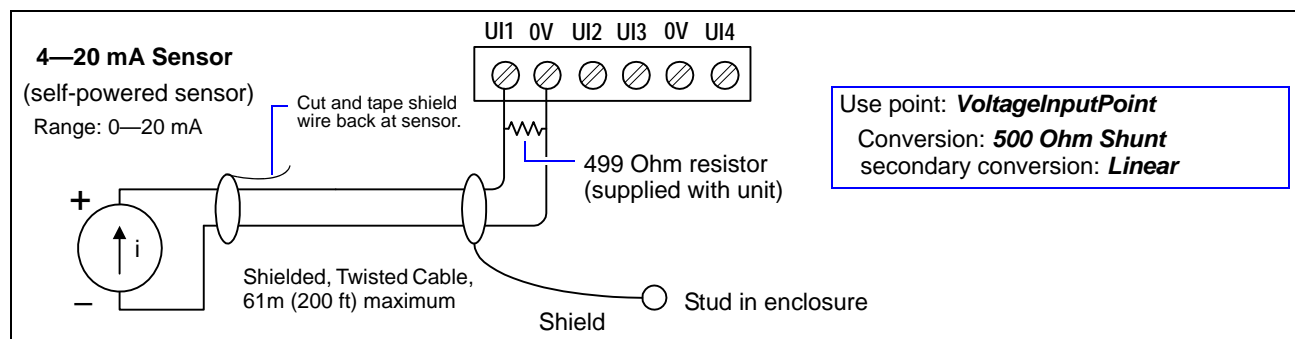
4–20 mA

Inputs support self-powered 4–20 mA sensors. Input accuracy is $\pm 2\%$ of span, without user calibration.

Figure 10 shows the wiring diagram, which requires a 499 ohm resistor wired across the input terminals.

4–20 mA sensors also require the **VoltageInputPoint**.

Figure 10 4 to 20 mA wiring.



Caution

When using an externally powered 4–20 mA sensor, be sure to de-energize its power supply before making or changing any wiring connections to the T-IO-16-485 module. This is in addition to removing power from the T-IO-16-485 module.

It is important to not apply external power to the UI inputs without the 499 ohm resistor in place. Otherwise, even a momentary application of power (say, 24Vdc) to the UI terminals without the resistor may damage circuitry on the T-IO-16-485. Only *after* completing all input wiring should you restore power to such external power supplies.

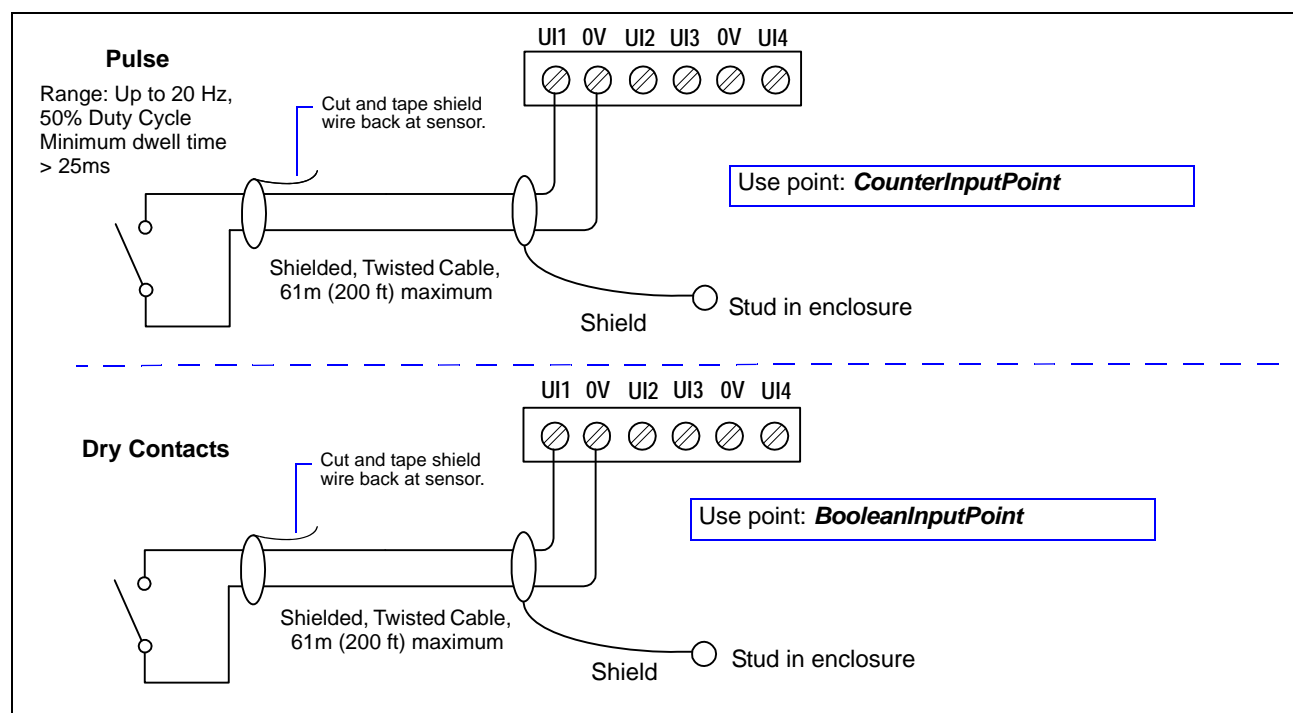
Binary Input

Inputs support both pulse contacts and normal dry (equipment status) contacts.

- Pulse contacts may have a change-of-state (COS) frequency of up to 20 Hz with a 50% duty cycle.
Note: Minimum dwell time must be $> 25\text{ms}$. (Contacts must remain open at least 25ms and be closed at least 25ms.)
- Standard dry contacts must have a 1 Hz. (or less) COS frequency, with minimum dwell time $> 500\text{ms}$. (Contacts must remain open at least 500ms and be closed at least 500ms.)

Both types of dry contacts support 3.3 Vdc open circuits or 330 μA short-circuit current. For a pulse contact, use the **CounterInputPoint** in the station database. For other dry contacts, use the **BooleanInputPoint**.

Figure 11 shows the wiring diagram (which is identical for both uses), but with different types of Nrio software points used for either application.

Figure 11 Binary input wiring.

Outputs

A T-IO-16-485 module has four (4) digital [relay outputs](#) and four (4) 0–10 volt [analog outputs](#).

Relay Outputs

Each relay output is rated at 24 Vac or Vdc at 0.5A. Relay outputs have MOV (metal oxide varistor) suppressors to support inductive-type loads such as heavy-duty relay coils.

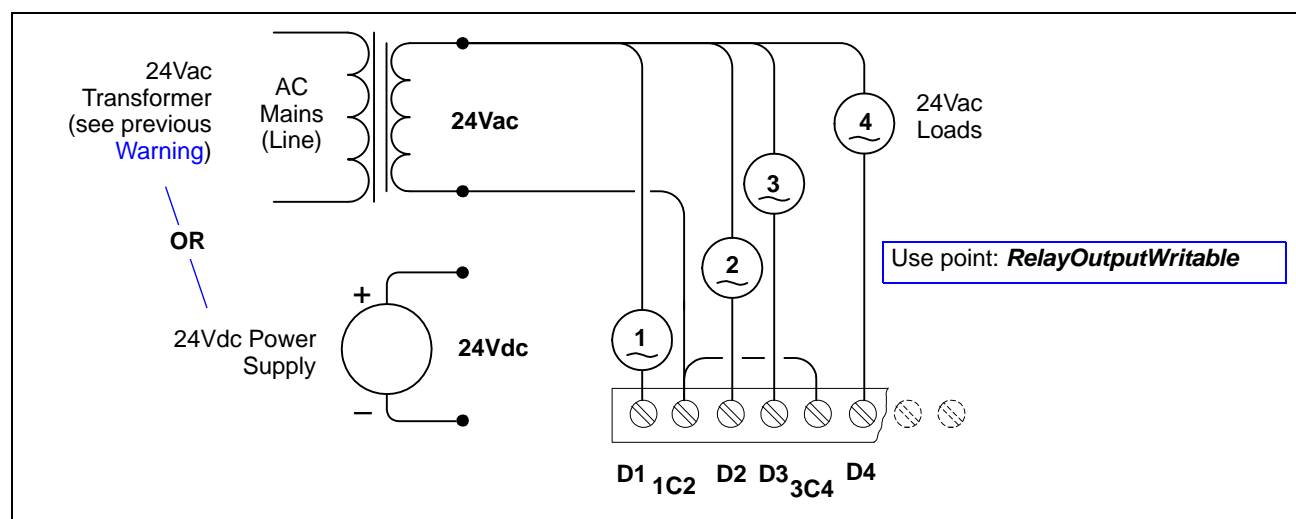


Warning

Relays are not rated for AC mains (line level) powered loads (instead, 24V maximum).
Use an external 24V transformer or a 24Vdc power supply to power loads.

Use a **RelayOutputWritable** in the station for each output. [Figure 12](#) on page 18 shows an example wiring diagram.

Figure 12 Relay output wiring diagram.



Note that the two common DO terminals (1C2, 3C4) are isolated from each other. This is useful if controlled loads are powered from different circuits.

An LED status indicator for each relay (D1—D4) is located on the board (Figure 2 on page 9), and also visible through the cover. Under normal operation, each digital status LED indicates activity as follows:

- **Off**—relay open / no current flows.
- **On**—relay closed / load current flows.

Therefore, an **On** status indicates that the load is powered.

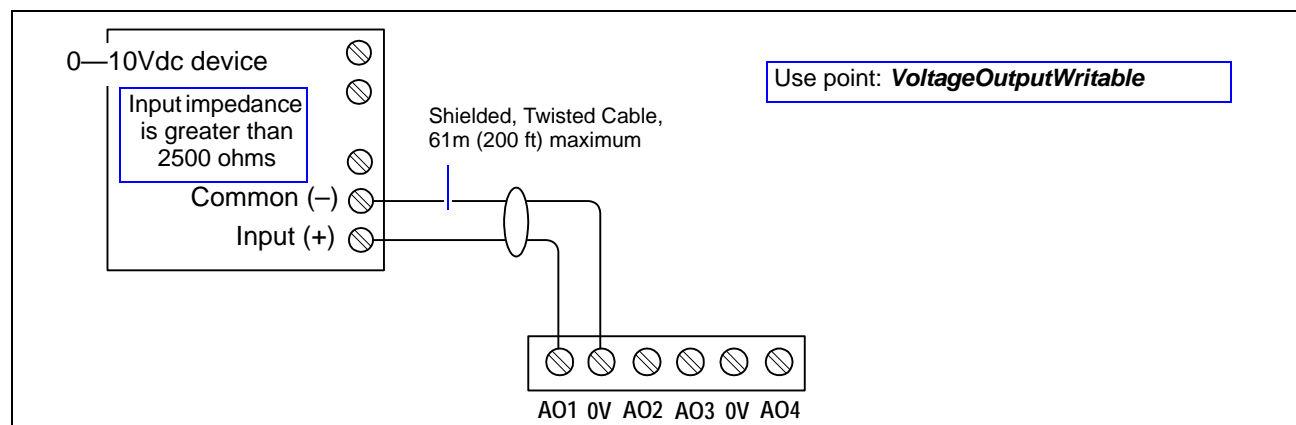
Analog Outputs

Analog outputs (AO) are referenced by the terminals labeled A_n and 0V (ground). Each AO can supply a maximum of 4 mA over the entire 0 to 10Vdc range. For this 0–10V full range, the minimum input impedance of a device controlled by the AO must be greater than 2500 ohms.

If the device's input impedance is *less* than 2500 ohms, the 4 mA “max. current” limits the voltage output range. For example, if a device with a 1000 ohm input impedance, the AO would work as a 0–4Vdc analog output.

Figure 13 shows typical wiring for an AO. For each AO, use a **VoltageOutputWritable** in the station database.

Figure 13 Analog output wiring diagram.



Nrio16Module (Software) Representation

In the NiagaraAX station interface to the JACE and T-IO-16-485 module, the module's I/O is modeled in the station's **NrioNetwork** (copied from the *nrio* palette), under a child **Nrio16Module** “device level” component. This Nrio16Module has a default name of “io16_n”.



Note After a remote I/O module is discovered and added to the station under this NrioNetwork (each as one as an Nrio16Module), the serial status LEDs for the JACE's RS-485 port continually flash, reflecting polling activity. At this time, the “STATUS” LED on that T-IO-16-485 module lights solid green.

Any time a T-IO-16-485 module's status LED is *not lit solid green*, all of its outputs are in “failsafe” state (all relay outputs OFF, and all AOs are at a 0-volt level).

Blinking of a remote I/O module's status LED occurs for two reasons, shown at different rates:

- Rapid flash (low duty cycle), meaning the unit is *unconfigured*. Discovery and addition to the station database is required.
- Equal time on and off (50% duty cycle), meaning the unit is configured, but currently *offline* with the JACE controller. Check RS-485 wiring between the controller and remote I/O module.

Each input or output used requires a special Niagara Remote Input/Output (Nrio) point to be added in the station database. These components act as the station interface to the physical I/O points. The Nrio points you need for each input or output type are noted in previous wiring sections in **boldface**.

For Nrio software details, see the *NiagaraAX NRIO Guide* in Workbench online Help, or that document in PDF.

Power up and Initial Checkout

- Step 1** Apply power to the T-IO-16-485 (depending on power source, this may mean plugging in a 6-position end connector, energizing a NPB-PWR-UN power supply module, or powering on the connected JACE or third-party 12–15Vdc power supply).
The T-IO-16-485 module's board status LED ([Figure 2](#) on page 9) will initially be blinking.
- Step 2** Using Workbench, open a station connection to the JACE. If not already present, add an **NrioNetwork** component to the station's Drivers Container.
- Step 3** Configure the NrioNetwork's “Port Name” property to match the JACE's RS-485 port COM assignment (for example, **COM2**), and set its “Trunk” property to a unique number Nrio-wide (say, **2**).
- Step 4** From the NrioNetwork's **Nrio Device Manager** view, perform a **Discover**.
Each discovered remote I/O module will be listed in the top “Discovered” pane in the view, with each T-IO-16-485 appearing as an “Io16” device type.



Note To associate a discovered device to a specific T-IO-16-485, issue a right-click “Wink Device” action—this cycles a relay output on that T-IO-16-485 several times, which you can hear or see if nearby. This action is available both *before* and after a discovered device is added to the station.

- Step 5** Add each discovered T-IO-16-485 to the station, renaming to reflect its actual location (see Note above). Each IO module is represented by an Nrio16Module component.
- Step 6** Verify that each T-IO-16-485 module's board status LED is now lit solid green.

**Note**

If an Nrio16Module is selected in the Nrio Device Manager view, and the **Upgrade Firmware** button is active, it is recommended that you upgrade its firmware. After selecting this, do not interrupt power to the T-IO-16-485 and JACE, or the communications between them, until the firmware upgrade job finishes. Typically, this takes less than 2 minutes, with job competition signaled in the Workbench view.

Step 7 You can now discover, add, and configure IO points under each Nrio16Module's Points device extension. For more details about Nrio components, refer to the *NiagaraAX NRIO Guide*, also available in Workbench online Help (doc Nrio).

Replacement Parts

Servicing the T-IO-16-485 may call for replacement parts. There are two categories of parts:

- [Standard Replacement Parts](#)
- [New Replacement Units](#)

Standard Replacement Parts

Standard replacement parts are listed in [Table 4](#) and can be ordered from stock without restriction. Standard replacement parts cannot be returned for credit and should be disposed of in an appropriate manner.

Table 4 Standard T-IO-16-485 replacement parts.

Part Number	Description
11453	Hardware bag for T-IO-16-485 module. Includes four (4) pin-mount, 6-position screw terminal connectors for I/O points, one (1) end-mount 6-position screw terminal plug for power and RS-485 communications, eight (8) 499 ohm, 1%, 0.6W resistors, and one grounding wire with quick-disconnect 0.187" female connector.

New Replacement Units

To replace a faulty unit, order and install a *new* T-IO-16-485 accessory module. If the faulty T-IO-16-485 is *still in warranty*, you can receive credit by returning it. Be sure to contact the vendor for a return material authorization (RMA) number before shipping an item for return credit. See [“Returning a Defective Unit,”](#) page 22, for more details.

**Note**

Before ordering a new T-IO-16-485, it is strongly recommended that you contact your normal technical support resource to eliminate the possibility of a software issue or mis-configuration problem.

Replacing the T-IO-16-485

**Caution**

Before handling circuit boards, discharge any accumulated static by touching the nearby earth grounding point. For details, see the [“Static Discharge Precautions”](#) section on page 6.

To replace the T-IO-16-485 accessory module in the field, proceed as follows:

Procedure 2 Replacing the T-IO-16-485 accessory module.

Step 1 Using the appropriate NiagaraAX software tool, back up the JACE’s configuration to your PC.

Step 2 Remove power to the T-IO-16-485. The unit should power down automatically.

**Note**

If any I/O points have voltage, turn the devices off or disconnect power to them.

Step 3 Note positions of all I/O wiring going to the T-IO-16-485 module to be replaced, as well as for any other installed modules. If necessary, label connectors and accessory modules to avoid mis-connection later (after T-IO-16-485 is replaced). The software that runs on the JACE expects the terminal positions to be the same in the replacement T-IO-16-485, in order to collect data from or to control the attached devices.

Step 4 Unplug all connectors from the T-IO-16-485, including all I/O connectors and earth ground wire.

**Note**

Removal of the four pin-mounted I/O connector plugs may be difficult. For related details about removing them, see [“About Screw Terminal Connectors,”](#) page 9.

Step 5 Remove any screws or DIN rail clips securing the T-IO-16-485, removing it from its mounting. See [Figure 1](#) on page 8 for details on removal from (and mounting onto) DIN rail.

Step 6 Mount the replacement T-IO-16-485 as it was previously, using the same DIN rail location and/or screws.

Step 7 Reconnect the earth ground wire to the T-IO-16-485 grounding lug.

Step 8 Reconnect all I/O connectors to the T-IO-16-485.

Step 9 If any of your I/O points have voltage, turn the devices back on, or reconnect power to them.

Step 10 Reconnect the 6-position end-mount connector, and ensure that power is applied to the T-IO-16-485 as well as the JACE. For related details, see [“Power up and Initial Checkout”](#).

Step 11 For more details, see the *Niagara^{AX} NRIO Guide* and *JACE Niagara^{AX} Install and Startup Guide*.

Returning a Defective Unit

For proper credit on an in-warranty unit, ship the defective unit per the vendor's return material procedure.



-
- Note** If the defective unit is under warranty, please follow return instructions provided in this section. If the unit is *out of warranty*, please discard it, observing all recycling regulations (see “[WEEE \(Waste of Electrical and Electronic Equipment\)](#),” page 6).
- Do not return an out-of-warranty T-IO-16-485 module.
-

Prior to returning the unit, contact your vendor to obtain a return materials authorization (RMA) number and other instructions.

Please provide:

- Product model
- Nature of defect
- PO number to secure the RMA

Certifications

Federal Communications Commission (FCC)

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference with radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case, users at their own expense will be required to take whatever measures may be required to correct the interference. Any unauthorized modification of this equipment may result in the revocation of the owner's authority to continue its operation.

Canadian Department of Communications (DOC)

- This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
- Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

RoHS Compliance

This product meets RoHS 2 (Restriction of Hazardous Substances) requirements of Directive 2011/65/EU.

CE Declaration of Conformity

Date: August, 2014			
Application of Council Directive: EU/EMC 2004/108/EC			
Manufacturer: Tridium Inc. 3951 Westerre Parkway, Suite 350 Richmond, Virginia 23233 United States of America			
Manufacturer's Representative: Nino DiCosmo, President Tridium Inc.			
Product Model Numbers: T-IO-16-485, with the following: MDR-20-15, T-SEC-J-201, T-SEC-6xx, T-SEC-R2R, T-SEC-RIO,			
Type of Equipment: Electrical Equipment for Measurement, Control and Laboratory Use			
EMS Standards Applied:	Standard	Description	Criteria Met
	EN 61000-6-4	Electro-Magnetic Compatibility Emissions, Generic	Compliant
	EN 61000-6-2	Electro-Magnetic Compatibility Immunity	Compliant, as noted below
	CISPR 22: 2006	Conducted Emissions - Telecom	Compliant
	CISPR 16-2-1 and CISPR 16-2-2	Limits of Radio Disturbance - Conducted Emissions	Pass Class A Pass Class A
	CISPR 16-2-3	Radiated Emissions	Compliant
	IEC 61000-4-2	Electrostatic Discharge Immunity	Pass Class B
	IEC 61000-4-3	Radiated Field Immunity	Pass Criteria A
	IEC 61000-4-4	Electrical Fast Transient Immunity (Signal Ports) Electrical Fast Transient Immunity (AC Power)	Pass Criteria B Pass Criteria B
	IEC 61000-4-5	Surge Immunity	Pass Criteria B
	IEC 61000-4-6	Conducted Immunity	Pass Criteria B
	ICES-003, Issue 4	Conducted Emissions - Voltage, Class A	Compliant
	ICES-003, Issue 4	Radiated Emissions - Class A	Compliant
	IEC 61000-4-11	Voltage Dips Voltage Interrupts	Pass Criteria A Pass Criteria C
	IEC 61010-1:2010 +Cor. 1:2011	Safety requirement for electrical equipment for measurement, control and laboratory use	Pass
	RoHS Directive 2011/65/EC	2011/65/EC (RoHS 2)	Compliant

I, **Nino DiCosmo**, President of Tridium Inc., hereby declare that the equipment specified above conforms to the above Directives and Standards.



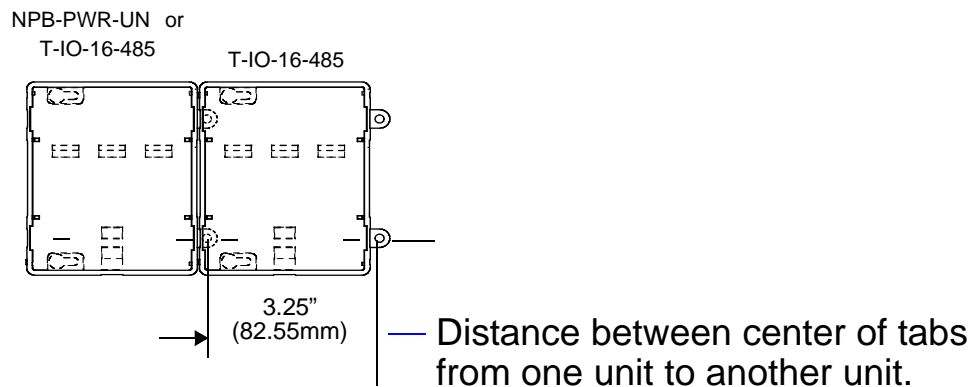
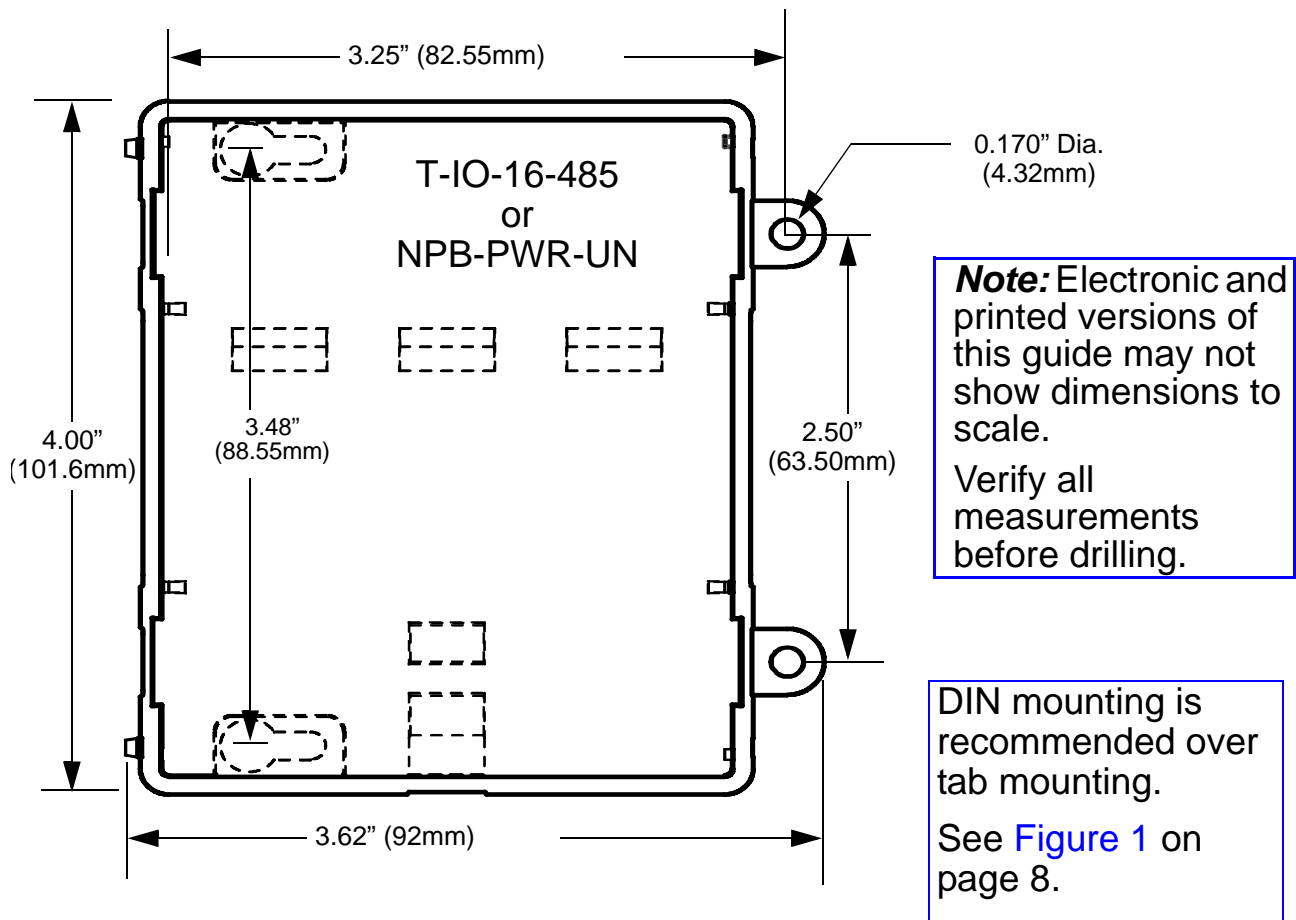
Note

For CE compliance, the NPB-PWR-UN power supply *cannot be used* to power the T-IO-16-485 or a JACE (JACE 2/3E/6/6E, T-700). In its place, use the DIN-mountable **Tridium** model **MDR-20-15**. This CE-approved power supply is 100-240Vac input, with 15Vdc output at 20W.

Or, power the T-IO-16-485 using another third-party, CE approved, battery backed 12Vdc power supply.

Note a JACE 2/3E/6/6E or T-700 must be powered by a **15Vdc** power supply with CE approval.

Tab Mounting Dimensions



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