Industrial

White Paper - Industial Power Supply Selection

Industrial Power Supply Selection

Unlike traditional office or commercial-grade switches and media converters, Industrial Ethernet devices are generally designed to run off low voltage DC power supplies. There are several reasons for this:

1. Historically, factory automation systems were designed to run off 24 VDC, which was commonly used to energize relays and I/O devices. These low voltage DC busses are already available today—so it makes sense to leverage this in new equipment.

2. Industrial Ethernet equipment is designed to maximize space within equipment cabinets. This means making the products as compact as possible. It also means in many cases avoiding the use of fans as cooling mechanisms. Many times the cabinets may be located in hazardous or outdoor locations with little or no ventilation. High AC voltage power supplies consume space and produce heat, which would necessitate the use of fans.

3. Many times a redundant power input is desired to keep the network running in the event that the grid or main power source fails; this is often a 12 or 24 VDC battery.

4. Many industrial automation devices are generally low voltage for safety reasons and the inability to provide good earth-grounding.

+24 VDC is the defacto power bus for the majority automation voltage. +12 VDC is also common, but typically more as a battery backup voltage or sourced by an alternative energy source (e.g. solar-powered remote control cabinets). The introduction of Power-over-Ethernet (PoE) as a standard within the last few years means much of the industrial rated equipment is now being designed to use 48 VDC, as well, since the IEEE 802.3af and 802.3at PoE standards have mandated this higher DC voltage be used when powering devices via Cat5 copper cables.

We see, then, a range of voltages used in industrial applications, generally from 12 / 24 to 48 VDC. In fact, ALL Transition Networks' Industrial Ethernet switches, media converters and serial device servers will operate over this range, with one caveat: if PoE is used, then a 48 VDC supply is required (for compatibility with the IEEE 802.3af and –at standards).

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Table 1: Lists Transition Networks' Industrial Products and their corresponding Operating Voltage ranges:

Transition Networks	Operating Voltage Input			
Product #	**Min**	**Max**	**PoE**	**Notes**
SISTF101x-211-LRT	12 VDC	48 VDC	NA	NA = Not Applicable
SISTF101x-x41-LRT	12 VDC	48 VDC	NA	
SISTF1010-250-LRT	12 VDC	48 VDC	NA	
SISTF1010-280-LRT	12 VDC	48 VDC	NA	
SISTF1040-162D-LRT	12 VDC	48 VDC	NA	
SISTG10xx-211-LRT	12 VDC	48 VDC	NA	
SISTM101x-162-LRT	12 VDC	48 VDC	NA	
SISTM1010-180-LRT	12 VDC	48 VDC	NA	
SISTP10xx-141-LRT	12 VDC	48 VDC	48 VDC	48 VDC required if using PoE
SISPM1040-182D-LRT	12 VDC	48 VDC	48 VDC	48 VDC required if using PoE
SISTM1040-262E-LRT	12 VDC	48 VDC	NA	
SISGM1040-262D-LR	12 VDC	48 VDC	NA	
SISGM1040-244-LRT	12 VDC	48 VDC	NA	
E-TBT-FRL-05(xxHT)	9 VDC	12 VDC	NA	Power supply provided
E-100BTX-FX-05(xxHT)	9 VDC	12 VDC	NA	Power supply provided
SDSFE3110-120	9 VDC	32 VDC	NA	Power supply provided
M/E-ISW-FX-01	12 VDC	48 VDC	NA	
SPS-2460-xx	24 VDC or 24 VAC	60 VDC		Converts Input Voltage to +12 VDC output

Table 1

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Power Supply Options for Transition Networks Industrial Products

Based upon the Operating Voltage ranges given in Table 1, the following are the recommended Transition Networks Industrial Power Supplies:

Voltage Required (Output)	Voltage Available (Input)	TN P/N
12 VDC	12 VDC	None required - Customer Provided ‣
48 VDC	48 VDC	None required - Customer Provided ‣
12 VDC	90 - 264 VDC	SPS-UA12DHT - Universal AC Input
12 VDC	24 - 60 VDC	SPS-2460-xx
12 VDC	24 -42 VAC	SPS-2460-xx
48 VDC	88 - 264 VAC / 248-370VDC	25080 - Universal AC Input
12 VDC	88-264 VAC / 120-370 VDC	25083PS - Universal AC or DC Input

Table 2

‣ **NOTE:** Remember, in most cases DC power will already be available and can be used to power Transition Networks equipment; in these cases the available power rating of the customer's power supply must be checked to ensure there is enough additional current for the Transition Networks equipment.

Beyond Voltage: What about Power (Current)?

In addition to accounting for the required input voltage, the product will require a certain amount of load current. This can be determined from the Input Power specification given on Industrial Ethernet product data sheets—by using the following formula:

$$\text{Current} = \frac{\text{Power}}{\text{Voltage}}$$

In order to calculate the Current needed by a specific Transition Networks product, both Power and Voltage are needed.

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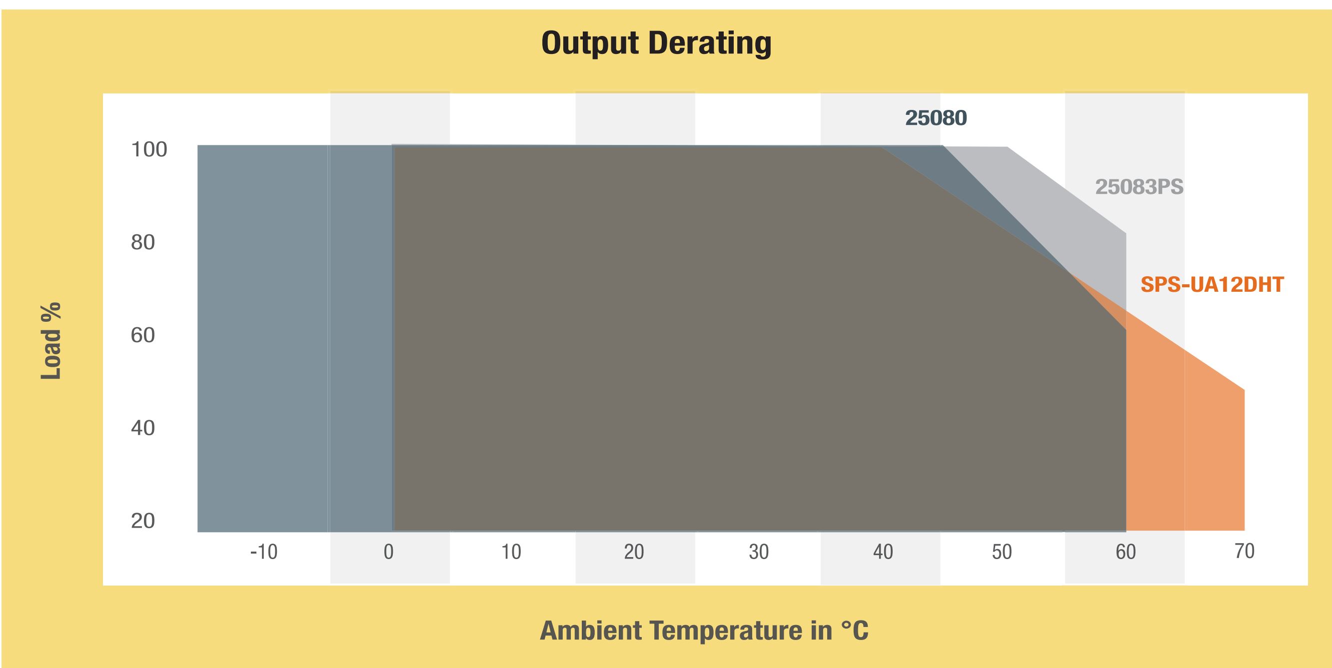
Table 3: How to find the Voltage:

Product Used	Voltage	Max Current Output
SPS-UA12DHT	12 VDC	1.3 A ▸
SPS-2460-xx	12 VDC	1.0 A
25080	48 VDC	2.5 A ▸▸
25083PS	12 VDC	2.0 A

Table 3

▸ Max Current specified at 40° C; current must be linearly derated to 50% at 70° C.
▸▸ Max Current specified at 45° C; current must be linearly derated to 60% at 60° C



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How to find the Power:

The Power rating is obtained from the device's data sheet.

How to Calculate Current:

After the Voltage and Power are determined using the above information, the current required by the device is calculated by dividing the product's specified Power by either Voltage 12 or 48, depending upon whether the SPS-UA12DHT, SPS-2460-xx, 25080, or 25083PS is being used.

Example:

An SISTM1013-162-LRT is to be used in an application which has 120 VAC at the site.

From Table 1, we see that the SISTM1013-162-LRT can be powered from 12 to 48 VDC.
From Table 2, we see that from a Voltage Available of 120 VAC, we can provide either 12 VDC with the SPS-UA12DHT, or 48 VDC with the 25080.
Since the SPS-UA12DHT is a lower cost power supply let's calculate the current for that solution:

From the SISTM1013-162-LRT data sheet the Maximum Power required is 6 Watts,

Using Current = Power / Voltage

Current = 6 Watts / 12 VDC

Current = 0.5 Amps

Finally, we must verify the SPS-UA12DHT can supply this current load. From Table 3, we see that the SPS-UA12DHT can supply 1.3A, or 0.65A at full derating at 70° C. Therefore, we can specify the SPS-UA12DHT as the power supply solution for this application.

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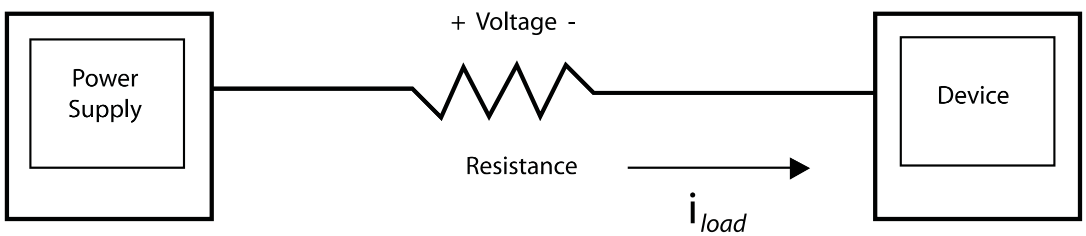
Accounting for Distance

Ohm's law states the following:

Voltage = Current x Resistance



In a copper power cable, the Current demanded by the device's load will cause a voltage drop from the power supply to the device. Copper wire resistance is specified by the AWG, in Ohms/foot. Multiplying the distance in feet from the power supply to the device will provide you with the total Resistance. If this Resistance is then multiplied by the Current, i_{load} (determined by the device load), the Voltage drop induced in the copper wire can be calculated:

Voltage = Resistance x i_{load}

Over very long distances this voltage drop can be significant, and may require the use of a higher voltage power supply to compensate for the losses. For example, if only 12 VDC is needed, but the distance is several hundred feet, then the 25080 power supply should be chosen instead. In this case, the 25080 will then supply 48 VDC, so after any voltage drop losses in the cable from the power supply to the device there should still remain a voltage at the device greater than 12 VDC (i.e. 48 –[Resistance x i_{load}]).

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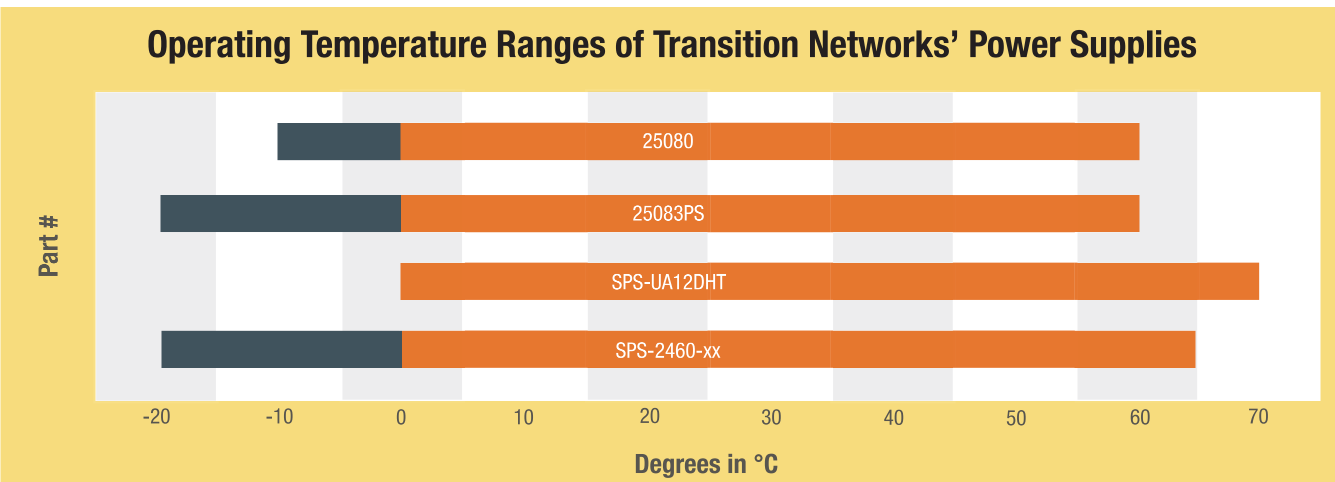
Operating Temperature Range and Derating Power Supplies:

Table 4: Illustrates the operating temperature ranges of Transition Networks' Industrial Power supplies:

Transition Networks Product #	Min Operating Temp (°C)	Max Operating Temp (°C)
25080	-10°	+60°
SPS-UA12DHT	0°	+70°
SPS-2460-xx	-20°	+65°
25083PS	-20°	+60°

Table 4



Full current load is usually only rated for operating temperature up to 40° C, with a linear de-rating to the full operating temperature range. What this means is that at warmer temperatures the maximum rated current draw from a power supply must be reduced. This is to prevent overheating of the power supply components, with a possible subsequent shutdown. If the load is well under 50% of the rated output this should be of no concern.

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Example:

The SPS-UA12DHT specifies a 50% de-rating from its 1.00 specified full-load value, beginning at 40° C. An SISTF1040-162D-LRT Industrial Switch is to be powered at 12 VDC using the SPS-UA12DHT. What is the maximum recommended operating temperature of the solution under full load?

ANSWER: From the SISTF1040-162D-LRT data sheet, we see that it draws 9 Watts. At 12 VDC a 9W load requires 9W / 12V = 0.75 Amps of current. The 0.75 A is less than the 1.0A load specified for the SPS-UA12DHT at 40° C, and half-way derated (0.5A +0.5A / 2). With a linear de-rating from 40° to 70° C the maximum operating temperature is as follows:

40 + (70 - 40) / 2

= 40 + 30 / 2

= 40 + 15

= 55° C

In this example, the solution consisting of the (SISTF1040-162D-LRT + the SPS-UA12DHT) is only rated for operating up to 55° C, even though the SISTF1040-162D-LRT and the SPS-UA12DHT are separately rated to operate at higher temperatures. The SISTF1040-162D-LRT draws enough current load from the SPS-UA12DHT to generate significant heat rise, which must be accounted for in this de-rating exercise. If operation beyond that is required then the 25080 48 VDC power supply (at higher cost) is required. The 25080 can supply 1.5 A, double what is required by the SISTF1040-162D-LRT, at 60° C.

This example illustrates the cost vs. performance tradeoffs that sometimes must be made to meet industrial application requirements.

What about Safety?

The Transition Networks industrial AC-powered SPS-UA12DHT, 25080 and 25083PS power supplies are UL-rated for safety. The power supplies provided with the E-TBT-FRL-05(xxHT), E-100BTX-FX-05(xxHT) an SDSFE3110-120 are also UL-rated and also carry Canadian and European safety approvals (CUL and CE).

The SPS-2460-xx only converts from 24 to 60 VDC, and does NOT use high voltage AC, so it is not UL-rated. The SPS-2460-xx is considered a Safety Extra Low Voltage (SELV) device and as such does not pose a shock hazard to humans.

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Monitoring Power Supplies in High Availability Networks

All of Transition Networks fully-hardened Industrial Ethernet products with redundant DC power inputs (all of the SISXX products) are equipped with Dry Contact Output Relays. These will change state when/if either of the DC power inputs fails. This contact closure output signal can be wired into a local or remote alarm system, thus providing notification that a power supply has failed. Because this signal is provided outside of the Ethernet itself, it will provide an alarm notification even if both power supplies are down.

In Closing

The above tables should provide enough information to select the appropriate power supply for most applications of Transition Networks Industrial Networking products. In situations requiring derating of power supplies or running power over extended distances, please call a Transition Networks Application Engineer to provide assistance.

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