The PULS Advantage

Issue 7

CD5 Series
Clean Regulated DC Voltage When None is Available

The PULS CD5 Series - DC/DC Converters

Switch-mode DC power supplies have excellent regulation on the output and are mostly unaffected by input conditions. However, the output voltage of a supply can be affected by factors such as wire length, wire size and electrical noise. Because certain applications are large, long wire lengths are a reality and are required to connect all the control equipment together. Couple this along with a small wire size and the DC voltage loss can be substantial, possibly affecting the load. Even if the wire size is appropriate for the load, peak currents such as starting motors can further aggravate the voltage loss.

Remote Applications

There are also DC only control applications in remote sites where DC is the only available voltage and the source could be a battery, solar panel or DC fed from a local panel. In addition to the voltage drop that will occur in these remote locations because of the wire length, wire size and current draw, the DC voltage can also be made “dirty” by the electrical noise interjected into the wires by the surrounding equipment. Safety along with cost will determine if AC is feasible in a remote site. The cost of supplying AC to a remote site can be very expensive if only DC is required.

DC/DC Converters

The conditions of voltage drop and “dirty” DC voltage in large or remote applications can be rectified by installing a DC/DC converter. Simply put, a DC/DC converter will take a DC input voltage, filter it and then produce a regulated output voltage. While some loads will cease to operate because of the large drop in DC voltage, most DC/DC converters operate on a wide input range. Some converters take a compromised 24VDC voltage, clean it up and produce a regulated 24VDC. Other models can step up or step down the DC voltage. However, not all DC/DC converters are manufactured the same and no two units perform in the same manner.

Voltage Drop

It might be hard to understand just how much voltage is lost on a long

Voltage Drop Formulas

Voltage Drop = 2 * (K * I * L) / (CMA)

or

Voltage Drop = 2 * (R * I * L) / (1000)

K = 12.9 for copper - Direct Current Constant (DC Resistance for 1000 circular mils wire, 1000 feet long at 75°C)
I = Amps
L = Length in feet
CMA = Circular Mil Area - National Electrical Code, 3rd column of Chapter 9, Table 8
R = Resistance per 1000 feet - National Electrical Code, 12th column of Chapter 9, Table 8 at 75°C
Temperature change other than 75°C: $R_2 = R_1 * (1 + \alpha (T_2 - 75))$ $\alpha_{cu} = 0.00323$

wire run, so let's take a look at an example: A 24VDC power supply is feeding a 10A motor over a wire length of 164 feet using 14AWG stranded wire. What is the voltage at the motor? For the first calculation, we can keep things simple and use the resistance formula above assuming the operating temperature is 75°C. There are many references to the National Electrical Code Chapter 9, Table 8 above but let's put some values to the 14 AWG stranded wire being used in this example. The twelfth column over in the 14 AWG multi strand wire row is labeled "Direct-Current Resistance at 75°C, (Copper, Uncoated) ohm/kFT" and has a value of 3.14.

VD = 2 * (3.14 * 10 * 164) / 1000

The result is 10.3V and when subtracted from the 24V source leaves only 13.7V remaining at the motor. This is a very dramatic drop in voltage and the motor would have difficulty starting. Temperature is just one of many factors that affects voltage drop and if we change the previous example to a 40°C environment we can see what occurs. Using the temperature change formula above:

$R_2 = 3.14 * (1 + 0.00323(40 - 75))$

The new resistance is 2.79, resulting in a voltage drop of 9.15V (using the previous formula) or 14.9V to operate the motor. This is a small improvement, but a larger wire size would be required to lessen the voltage drop or the output voltage would have to be increased. In some cases a DC/DC converter might need to be installed near the load to restore the DC voltage to the proper level.

PULS CD5 DC/DC Converters

PULS has introduced a new line of DC/DC converters that are amazingly different than most found in the market today. Each converter is rated 120W (12V: 96W), and has galvanically isolated outputs with a large wide range input. Full output power can be achieved over the range of -25°C to +60°C, with a 20% power reserve. Higher currents can be achieved by paralleling units. One of the unique features is the soft-start function which slowly ramps up the output voltage. This feature reduces the inrush current resulting in minimal additional voltage drop on the input of the converter, allowing a smooth startup. Other converters on the market have a large inrush current which can drop the input voltage to an extremely low level, preventing startup. The CD5 series also utilize an electronic inrush current limiter and reverse polarity protection all packaged in a 32mm wide housing. The output voltage is regulated and clean, allowing even the most sensitive loads to be operated without interference. There are six models currently available with four different voltages ranges; 24V to 24V, 24V to 12V, 12V to 24V and 48V to 24V. A separate 24V to 24V unit offers additional functionality for battery applications. Included are an Input Low and DC OK contacts. A special 24V CD5 also offers a NEC Class 2 output which is usefull when a large power supply may be used but a particular load requires NEC Class 2. The DC/DC converters from PULS offer the same high quality, long life and reliability found in our power supplies and are the latest product offering from the DC experts!