In this Guide we explain some common terms and pass on a few helpful design tips regarding the use of DC power supplies, batteries, fuses, etc. This information is directed at the use of Low Voltage Power Systems up to 30 volts. Additional information for specific BASE products can be found in product manuals downloadable from product pages of our Website. Also check the Tech Tips section of the site for other useful information.

Load Current or Total Current Draw

Most manufacturers of electronic products state the current draw of the item they make. So an easy calculation of Total Current Draw is to merely add up the current draws of all the individual devices in the circuit. If the current draw for one device is not known, don't guess - power it up with a current meter in series and find out. Be as accurate as you can be when calculating Total Current Draw.

Other things that will add to the Total Current Draw of a Power Supply are;

- The no-load current draw of the internal Power Supply circuitry (see Power Supply specs)
- The max current required to charge standby batteries (if used)
- Reserved current for future devices to be added later.

The Total Current Draw must not exceed the Power Supply's limit or it may overheat. All BASE Power Supplies have built-in current limit/thermal overload protection and the DC output will turn off if either limit is exceeded. If standby batteries are used, the load may be cycling to battery power until the regulator cools down and re-starts. This sequence of events may happen often until the power supply can no longer charge low batteries before it overheats again.

A better design guidline is to limit the calculated power supply load to **50-75%** of the Power Supply's limit, especially when charging standby batteries. Then later during the installation, if you missed something in your original calculations and have to add it in, you'll have a cushion to work with.

Cable Resistance

When powering devices over considerable distances, cabling resistance may be so high that the voltage available at the device has dropped to an unacceptable level. To prevent this from occuring, system cabling should be designed with adequate sized conductors. The resistance of a given length of cabling can be easily calculated allowing the engineer to choose the correct conductor sizein the design stage.

Example: A lock requires 400 mA at 24 VDC and the estimated cable length from the power supply is 1000 feet. The lock specs state the lock will operate properely from 20-28 VDC (a drop of 4.0 VDC max). From the chart, we observe that a pair of 18 AWG stranded wires will have a resistance of 2 x 6.48 ohms/1000 feet. Using Ohm's law E = I * R;

E (voltage dropped) = I (current needed) x R (wire resistance)

E = (.4) x (2 x 1000 x (6.48/1000)) = 5.184 VDC dropped at the lock (over the limit of 4.0 V)

Recalculating using 16 AWG wire, the voltage drop = 2.9 VDC and is within the 4.0 V limit.

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Resistance of Copper Conductors

--- Solid Conductors ---		------ Stranded Conductors ------		
Wire Gauge (AWG)	Resistance (Ω/1000')	Wire Gauge (AWG)	Stranding (#/AWG)	Resistance (Ω/1000')
10	1.00	10	37/26	1.11
12	1.59	12	7/20	1.45
14	2.53	14	7/22	2.31
16	4.02	16	7/24	3.67
18	6.39	18	16/30	6.48
20	10.15	20	10/30	10.32
22	16.14	22	7/30	14.74
24	25.67	24	7/32	23.30

Heat Dissipation and Buildup Within Cabinets

A by-product of all step-down power supplies/regulators/transformers is heat. Continuously pushing power supplies to their limits will maximize heat dissipation and buildup within power cabinets - which will thereby work to reduce the life of these components. If the power supply requires a transformer, use the one recommended. As an example, if a 29 VAC transformer is used for the BASE LP5 power supply for 12VDC output instead of the recommended 16 VAC unit, more heat will be dissipated and the power supply may reach its thermal limit sooner, thereby reducing its performance. Consider locating a power supply away from other devices that will throw heat or mount it where a convective air flow can be helpful, such as near cabinet grills or vents. Also consider using fans to prevent heat buildup.

Power Distribution

Distributing power means to divide devices to be powered into separate branch circuits and separately fuse each branch. Separately fusing output devices or groups of output devices greatly reduces trouble-shooting efforts.

Example 1: If a forklift driver accidently and unknowingly bumped into a CCTV camera and blew its power supply (the one that powers all 50 facility cameras!), troubleshooting could take hours and meanwhile no camera is working!

Example 2: If water leaked into a 1/4 Amp card reader and eventually caused it to short its power supply (10 Amp power supply powering 24 other readers!), the power supply output may not blow until the reader circuitry and associated wiring draws over 10 Amps! Or maybe the 10 Amp output would just 'brown' out causing all 25 readers to fail anyway. Either way, no security until its found and fixed.

The larger the power supply and number of devices powered, the greater the need for power distribution. BASE has a variety of power distribution products that help speed installations while providing easier maintenance and a custom professional appearance.

Fuses

A fuse is intended to be the *weak link* in the circuit. If more than the estimated current flows because of a short, etc, then the fuse is *supposed* to blow, thereby preventing other components from being damaged. Unfortunately, a common service cure for a frequently blowing fuse is to replace it with a) a bigger fuse, b) a drill bit, or c) tin foil! This only makes something else the weak link in the circuit subjecting it to damage before a fuse could prevent it.

Proper troubleshooting will find the cause of the blowing fuse, then it can be fixed. Fuses are cheap compared to anything else and are commonly available everywhere.

Only use a fuse rated for just higher than the current needed to operate the devices in the circuit. Example: Camera needs 200 mA - fuse could be 0.25 A or 0.5 A, not 10 A!

Fast-blow fuses should be your first choice and they are cheaper. Use slow-blow fuses with the same guidelines and caution - they can be a step in the direction of the drill bit!

BASE Electronics, Inc. • 2856-C Janitell Road • Colorado Springs, CO 80906 • (719) 540-9697 • Fax (719) 540-9698