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Behlman Electronics

BEHLMAN BRIEFING

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Theory behind the BEHLMAN BL Motor Test (MT) Option.

It is generally difficult to start motors because the peak current required to start a motor can be in the range of 3-6 times the current needed to run the motor at full load. After the peak current has just started the motor turning, there is a period of several seconds where the current falls to the run value. The problem is that if you size the power supply so that it has just sufficient capability to run the motor and load after start-up, you often find that it cannot start the motor without severe output voltage distortion or possibly even going into an over-current shut-down. If you size the power supply so that it can start the motor without significant output distortion, then you have purchased a power supply that is 3-5 times larger than what is needed for most of its operational time, that's very expensive. The ideal solution is to design a power supply that can supply the extra, short term current during the startup, but is basically sized for the long term run current needed.

In any power amplifier there are two major factors that limit the output current. The first is the peak current handling capabilities of the output devices, in this case an output IGBT. The second is the requirement to dissipate the internal heating caused by losses in the amplifier. There are usually two types of current limit features built into a power supply to protect it. One senses peak current through the output device and rapidly limits the peak output current to prevent damage to the IGBT. The other senses the RMS output current, and, somewhat more slowly, limits the RMS output current to keep the unit from over-heating. In a typical BEHLMAN BL unit, the RMS current limit is set at about 105-115% of the rated current.

A motor start sequence in a typical AC power supply may be something like this: The motor is turned on. If the peak current is too high the AC power supply shuts off because it sees what it thinks is a short circuit. In this instance, there is no possibility that the AC power supply can start the motor. If the AC power supply doesn't shut down because of the high peak current, then the motor didn't start because the small initial peak current couldn't overcome the bearing friction and get the motor turning, or the AC power supply sees a short and just runs at zero output voltage and heats up the motor until the motor over-temperature sensor disconnects the power. The motor still didn't start. The last possibility is that the motor starts turning but doesn't get up to speed. The AC power supply runs at full current and at some reduced voltage but things just never get fully started.

The peak current capabilities of an AC power supply are usually limited by the size of the output device, in this case the output IGBT. BEHLMAN doubles the rating of the output IGBT in the BL units with the MT option, and, since the circuitry that limits the peak current in the output is basically part of the IGBT, doubling the rating of the IGBT doubles the peak current available to provide the initial startup load. That large peak current rating is essential to getting a motor started.
The peak current gets the motor turning, but the Power Supply must be able to supply enough RMS

current to get the motor up to speed. In MT option units, we also delay the action of the RMS limit a few tenths of a second to allow more time at a higher current before current limit restricts the output voltage. Several conditions allow this, first the larger IGBT allows more current. Second, internal heating takes some time to be a problem. Third, motors present a low power factor to the output meaning that the internal heating of the amplifier is low compared to a resistive load of the same current.

As an example, a 1HP motor is rated at 746W but would need about 1000VA to run it due to motor losses and inefficiencies. A typical BL1350 can provide 10Arms at 120V and approximately 25-30A peak. This may not be enough to start the motor. A BL1350 MT can provide approximately 50-55A peak and a higher RMS current for a sufficiently period to have the ability of starting that motor.

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