In a typical application, the NPH series of dc-dc converters require nothing more than a dc supply of correct polarity and voltage to generate its specified output. These notes are intended to offer help in the use of other facilities offered by these converters, and to provide assistance in achieving their full potential.

The product range includes optional control pins on each side of the isolation barrier. These can be programmed with external circuits to perform a variety of functions.

VOLTAGE TRIMMING

The trimming (adjust) input on the secondary side allows output voltage adjustment within the capability of the power circuit.

When open circuit, the trimming pin ADJ operates at near half the output voltage. A basic trimming arrangement consists of a potentiometer of 10kΩ to 100kΩ connected across the output, with its wiper connected to the ADJ pin (see figure 1). Dependent on model, the output will be reduced by about 15% when the wiper is at the positive output, or increased by about 24% when at the negative rail. Regulation will be maintained to at least 10% adjustment either way.

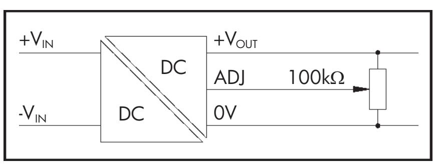

Figure 1. Voltage trimming

If finer adjustment is required, a resistor may be included between the wiper and the pin. For example, 62kΩ will restrict a 3.3V model to ±5% adjustment range. The corresponding values for the other voltages are 5V:56kΩ, 12V:100kΩ and 15V:150kΩ.

SET VOLTAGE

The output voltage of all units is set to 100mV above nominal, to offset resistive losses and thus assist with worst case error calculations. For the Ei versions, this allowance can be altered with a single fixed resistor, connected from the trimming pin to one of the output pins.

SHUTDOWN

When the shutdown pin is shorted to the negative input, the converter will stop. Its current consumption will then be less than 1mA at nominal supply voltage. The low voltage must be less than 1.5V to ensure that the unit stops, and must sink the above small input current.

The unit will restart if the control pin is left open circuit or raised to a value close to its normal open circuit voltage. This is typically 10V. Note however, that the unit will not meet specification while a significant current drain remains.

If the shutdown pin is to be connected to a long wire, it is recommended that a capacitor decouples the pin to the supply common in order to avoid the risk of injecting noise into the converter circuit. A series resistor may also be helpful. Values of 10nF and 1k may be used.

Many NPH series converters may be switched together simply by linking the primary control pins. The primary common pins must also be linked.

FREQUENCY CONTROL

If the primary side dc control voltage is pulled away from its open circuit voltage, the converter frequency will be changed, approximately in proportion to the voltage. With +8.5VDC voltage to SS pin, the typical switching frequency will be 300kHz. If this is raised to 15VDC, the switching frequency will typically be 510kHz. The frequency may thus be moved away from a sensitive value or into a safe area. Deviation of at least –10% to 30% is achievable, though the efficiency will decline with significant changes. Also note that if the frequency is lowered, the switching frequency component of output ripple will increase. Since the design uses no large electrolytic capacitors, any use of a lower frequency must allow for the effects of increased ripple. Additional external filtering may be required.

SYNCHRONISATION

The converter frequency may be synchronised to an external frequency by connecting a negative going pulse to the sync/shutdown pin. The drive signal is typically 8V to 12V amplitude and 100ns to 200ns duration. A suitable circuit consists of a CMOS timer (7555 series or TLC555) connected as an oscillator or as a pulse shaper. Its logic output (not the discharge output) should be connected via a 4.7nF capacitor to the converter pin. The synchronised frequency is above the free running value. However, the free running frequency can be lowered, so that sychronisation may include frequencies near or below the natural value. An example of a practical circuit is shown in figure 2, which uses a zener diode to lower the natural frequency. If the zener diode does not have a sufficiently sharp characteristic, it may be necessary to add a bias resistor.

Several converters of this family may be synchronised from the same reference provided the waveform can be maintained by the use of an adequate driver circuit. If the rise time is more than 20ns, for example, synchronisation may not be achieved over the specified frequency range. For best efficiency, set the frequency within the specified range of its natural state.

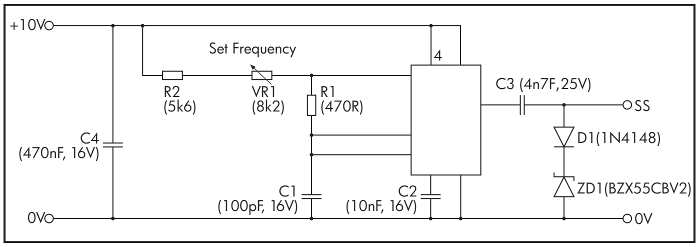

Figure 2. Synchronisation

FILTERING

The module includes a basic level of filtering, sufficient for many applications. Where lower noise levels are desired, filters can easily be added to achieve any required noise performance.

A dc-dc converter generates noise in two principle forms: that which is radiated from its body and that conducted on its external connections. There are three separate modes of conducted noise: input differential, output differential and input-output.

This last appears as common mode at the input and the output, and cannot therefore be removed by filtering at the input or output alone. The first level of filtering is to connect a capacitor between input and output returns, to reduce this form of noise. It typically contains high harmonics of the switching frequency, which tend to appear as spikes on surrounding circuits. The voltage rating of this capacitor must match the required isolation voltage. (Due to the great variety in isolation voltage and required noise performance, this capacitor has not been included within the converter.)

Input ripple is a voltage developed across the internal input decoupling capacitor. It is therefore measured with a defined supply source impedance. Although simple series inductance will provide filtering, on its own it can degrade the stability. A shunt capacitor is therefore recommended across the converter input terminals, so that it is fed from a low impedance.

If no filtering is required, the inductance of long supply wiring could also cause a problem, requiring an input decoupling capacitor for stability. An electrolytic will perform well in these situations.

See figure 3 for a recommended configuration to reduce all three conducted modes.

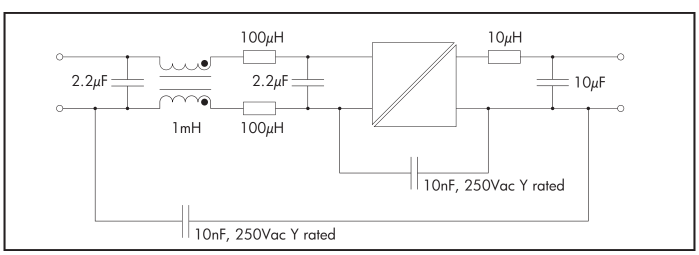

Figure 3. Recommended Configuration to Reduce Noise

The component values and ratings will depend on the converter rating and voltage, and the required noise performance, but the values quoted in figure 3 suit a 48V to 5V 10W converter. The input-output filtering is performed by the common-mode choke on the primary. This could be placed on the output, but would then degrade the regulation and produce less benefit for a given size, cost, and power loss.

Radiated noise is present in magnetic and electrostatic forms. The latter is suppressed by the metal case, which is connected to the output return, typically a zero-volt point. Thanks to the small size of these units, neither form of noise will be radiated “efficiently”, so will not normally cause a problem. Any question of this kind usually better repays attention to conducted signals.

MOUNTING CONSIDERATIONS

The copper case is connected to the output (0V) pin. Care is needed in the design of the circuit board on which the converter is mounted. Top side tracks must not contact the edge of the case or the ferrite core, visible on the underside of the unit.

PROTECTION

The “absolute maximum” ratings in the specification define conditions which may degrade life but will not result in immediate damage. This section of the application notes deals with those unavoidable or accidental occasions when the ratings are exceeded. The unit will protect itself against a wide range of abnormal conditions. In others, where failure is inevitable, the consequent hazards have been minimised.

If the supply polarity is reversed, the unit is unable to protect itself. The simple preventative measure of a series diode would add unacceptable power loss for the basic product, but it may be appropriate in some applications to fit this diode externally.

With no polarity protection, tracks and components will safely fail to high impedance, disconnecting the power. A large fault current will occur in this process.

NOTES

Absolute maximum ratings indicate limits beyond which damage may occur. Sustained operation outside the specified operating conditions is not recommended and may degrade reliability. Performance in this region is not specified.

Murata Power Solutions, Inc.
11 Cabot Boulevard, Mansfield, MA 02048-1151 U.S.A.
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