DI-128 Design Idea
PeakSwitch®

36 W (72 W Peak) Variable-Speed DC Motor Drive

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
DC Motor Drive	PKS606YN	36 W (72 W Peak)	90 - 265 VAC	12 V	Flyback

Design Highlights

- Replaces a two-stage, linear power supply and chopper circuit with a simple, single-stage design
- Eliminates the chopper circuits normally used to achieve variable-speed control of DC motors
- Motor speed is controllable by a small potentiometer or a 3.6 V to 10 V variable DC voltage
- Low component count: only 47 parts
- Efficiency: ≥77% (at a load of 36 W)
- Meets EN55022 B conducted EMI limits
- ON/OFF control scheme is stable over the entire motor speed (output voltage) range

Operation

The flyback converter shown in Figure 1 uses a member of the PeakSwitch family (U1, a PKS606YN) to drive a 36 W motor, while delivering startup and load transition peaks of up to 72 W. The motor's speed is variable by two methods: 1) potentiometer R20 (connected to J3), or 2) an externally supplied 3.6 V to 10 VDC voltage source (connected to J4). The motor speed controls vary the output voltage of the supply.

The controller in U1 receives feedback from the output and enables or disables the switching of its integrated MOSFET. Regulation is maintained by disabling or skipping MOSFET switching cycles. The output voltage is sensed across the series string of R12, Zener diode VR2 and the LED in U2 (in parallel with R13). As the output voltage rises above the VR2 conduction threshold, the current that flows through the U2 LED turns on transistor Q3. As Q3 pulls current out of the EN/UV pin of U1 switching cycles are skipped and less energy is transferred to the output. Once the output voltage falls, switching cycles are enabled again.

A bias winding (T1, pins 4 and 5) on the transformer is rectified and filtered by D7 and C6, and supplies operating current to U1, through R7. A smart AC sense circuit–comprised of D5, C7, R5 and R6–enables the under-voltage lockout (UVLO) and latching shutdown functions of U1. The frequency jitter function within U1, a shield winding in T1, and two small Y-capacitors (C10 and C19)

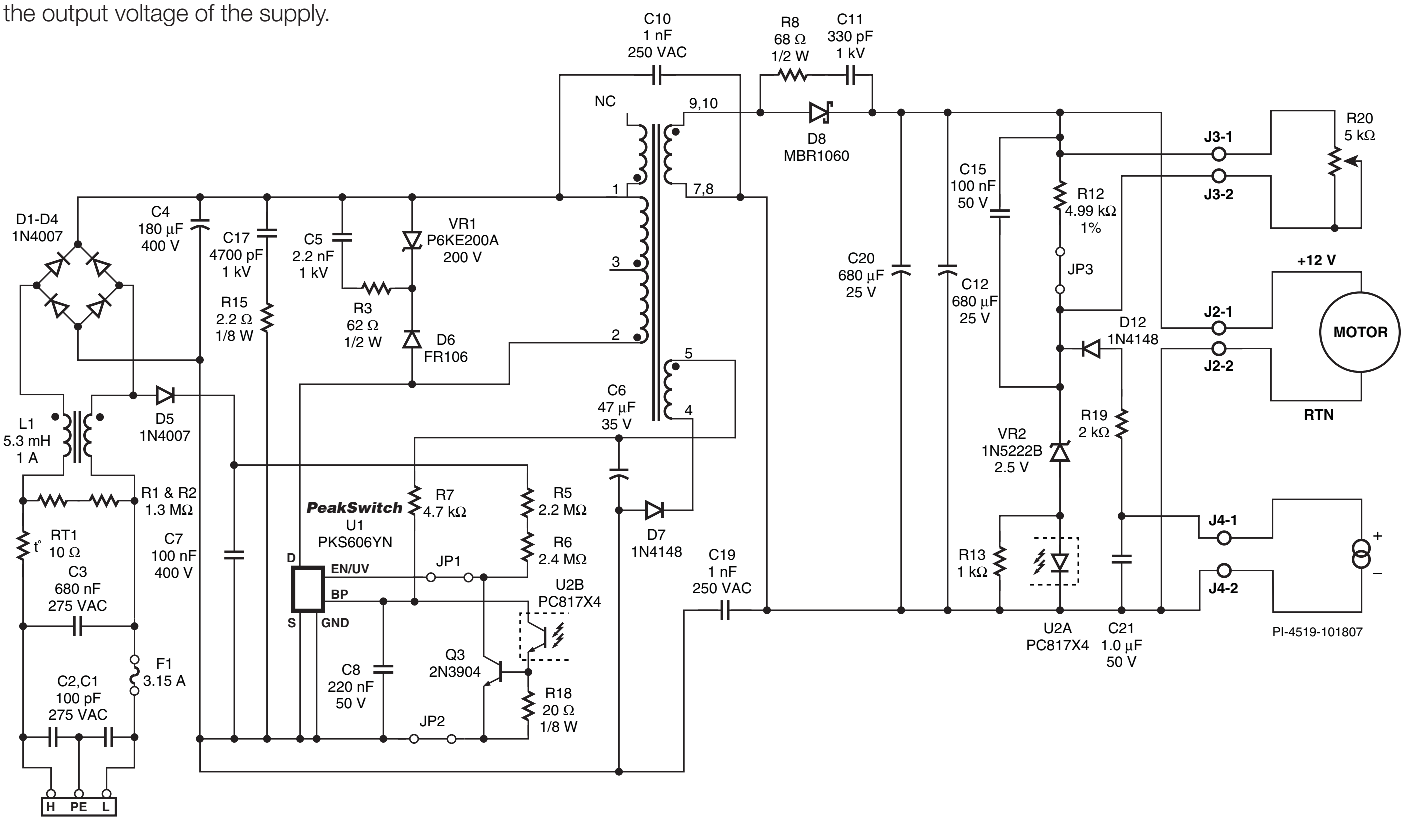

Figure 1. Circuit Diagram of 35 W Continuous, 75 W Peak, Motor Drive Power Supply With Dual Speed Control Inputs.

across T1 reduce the generation of conducted EMI so that a single common mode choke (L1), a small X-capacitor (C3) and two small Y-capacitors (C1 and C2) at the input allow the supply to meet EN55022B limits with more than 12 dBμV of margin. A combination RCD-Zener clamp (R3, C5, D6 and VR1) limits the peak drain-node voltage to below the 700 V rating of the integrated MOSFET.

If JP3 is removed, an external variable resistor (R20) adjusts the voltage across R12 and therefore, the output voltage. The externally supplied motor speed regulating voltage (3.6 to 10 VDC) changes the voltage at the node of R12 and VR2, which effectively adjusts the output voltage. Diode D12 blocks reverse current flow through R19 if the external adjustment voltage is less than about 3.6 VDC.

Key Design Points

- The externally supplied voltage adjusts the motor speed as follows: ≤3.6 V sets the output voltage to about 12 V (the highest motor speed) and ≥7 V sets the output voltage to about 2 V (the lowest motor speed).
- If the resistive speed control circuit is to be used, jumper J3 must be removed from the PCB.
- If the motor is stopped externally for more than 30 ms, U1's latching shutdown function activates, and MOSFET switching latches off until AC input power is removed and reapplied. If latching shutdown is not needed, the function can be disabled and the parts count reduced by not installing D5, C7, R5 and R6.

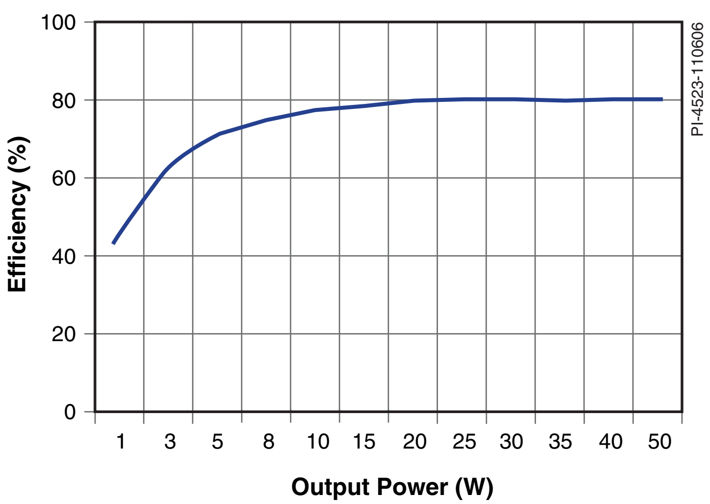

Figure 2. Efficiency Across Extended Motor Load Range.

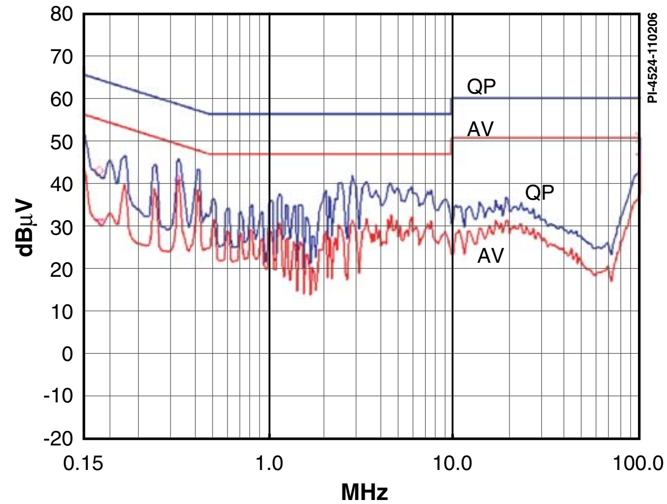

Figure 3. Conducted EMI: 230 VAC in, I_{OUT} = 4 A (48 W).

Transformer Parameters

Core Material	PC40EE25-Z
Bobbin	EE25 Vertical
Winding Details	1/2 Primary: 19T, 2 x 31 AWG Bias: 5T, 2 x 29 AWG Secondary: 4T, 4 x 23 AWG Shield: 7T, 4 x 23 AWG 1/2 Primary: 19T, 2 x 31 AWG
Winding Order	1/2 Primary (2-3), Bias (5-4), Secondary (9,10-7,8), Shield (1-NC), 1/2 Primary (3-1)
Primary Inductance	145 μH
Leakage Inductance	5.4 μH
Primary Resonant Frequency	3.4 MHz (minimum)

Table 1. Transformer Parameters. AWG = American Wire Gauge, TIW = Triple Insulated Wire, NC = No Connection, FL = Flying Lead.

Power Integrations
5245 Hellyer Avenue
San Jose, CA 95138, USA.
Main: +1 408-414-9200
Customer Service
Phone: +1-408-414-9665
Fax: +1-408-414-9765
Email: usasales@powerint.com

On the Web
www.powerint.com