

PeakSwitch™

35 W (75 W Peak) Variable-speed DC Motor Drive

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
DC Motor Drive	PKS606Y	35 W (75 W Pk)	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: $\geq 77\%$ (at a load of 35 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 PKS606Y) to drive a 35 W motor, while delivering startup and load transition peaks of up to 75 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

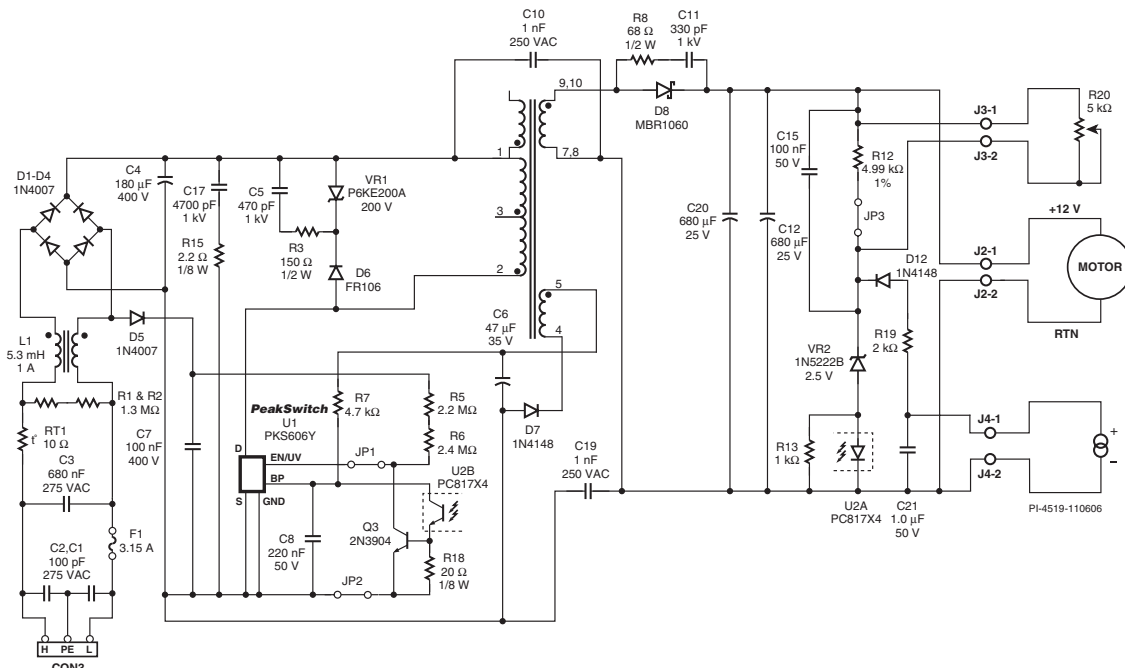


Figure 1. Circuit Diagram of 35 W Continuous, 75 W Peak, Motor Drive Power Supply with Dual Speed Control Inputs.

function within U1, a shield winding in T1, and two small Y-capacitors (C10 and C19) 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 dB μ V 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.

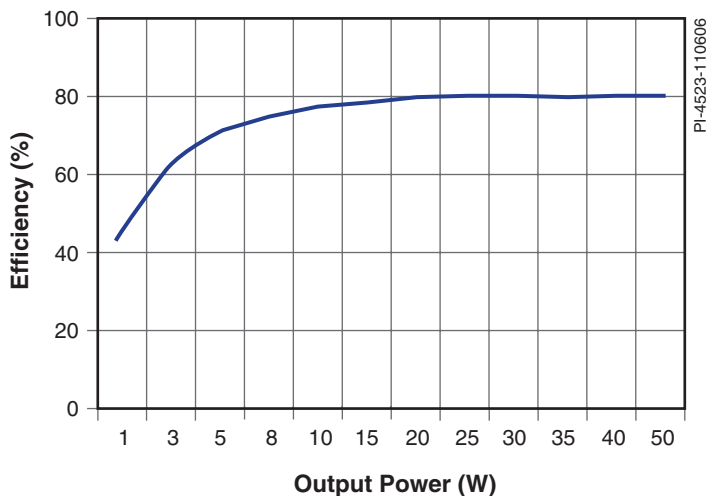


Figure 2. Efficiency Across Extended Motor Load Range.

For the latest updates, visit www.powerint.com

Power Integrations reserves the right to make changes to its products at any time to improve reliability or manufacturability. Power Integrations does not assume any liability arising from the use of any device or circuit described herein. POWER INTEGRATIONS MAKES NO WARRANTY HEREIN AND SPECIFICALLY DISCLAIMS ALL WARRANTIES INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF THIRD PARTY RIGHTS. The products and applications illustrated herein (transformer construction and circuits external to the products) may be covered by one or more U.S. and foreign patents or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.powerint.com. Power Integrations grants its customers a license under certain patent rights as set forth at <http://www.powerint.com/ip.htm>.

The PI logo, **TOPSwitch**, **TinySwitch**, **LinkSwitch**, **DPA-Switch**, **PeakSwitch**, **EcoSmart**, **Clamless**, **E-Shield**, **Filterfuse**, **StackFET**, **PI Expert** and **PI FACTS** are trademarks of Power Integrations, Inc. Other trademarks are property of their respective companies. ©Copyright 2006, Power Integrations, Inc.

- 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.

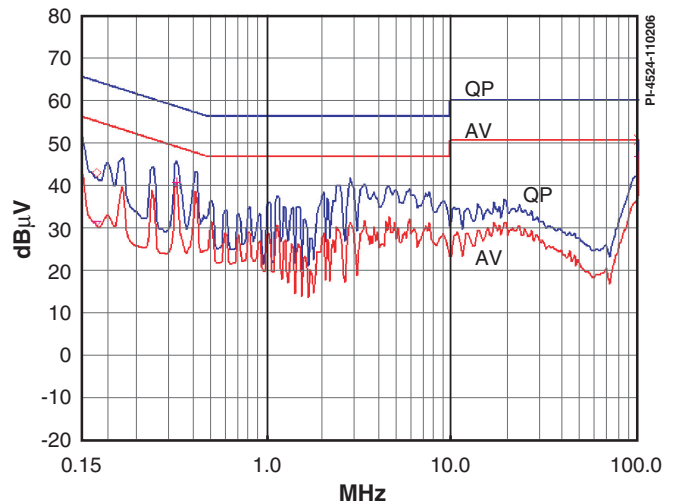


Figure 3. Conducted EMI: 230 VAC in, $I_{OUT} = 4$ A (48 W).

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

Table 1. Transformer Design Parameters.

TIW = Triple Insulated Wire, NC = No Connect, FL = Flying Lead

Power Integrations
5245 Hellyer Avenue
San Jose, CA 95138
Phone: 1-408-414-9200
Apps: 1-408-414-9660
Apps Fax: 1-408-414-9760

For a complete listing of worldwide sales offices, please visit www.powerint.com