PRODUCT SELECTOR GUIDE
DC-DC PRODUCTS

POWER INTEGRATIONS®

INNOVATION IN POWER CONVERSION

April 2006

Features & Benefits

***DPA-Switch*® cost effectively combines a high frequency power MOSFET, PWM control, fault protection and other control circuitry onto a single CMOS chip. Features include short circuit and open loop protection, programmable current limit, under-voltage and overvoltage detection, hysteretic thermal shutdown, soft-start, feedback compensation and remote ON/OFF. *DPA-Switch* ICs can save over 20 external components when compared to conventional discrete designs, providing significant savings in both board space and cost.**

Product Highlights

- Wide input voltage range: 16 VDC to 75 VDC
- Supports flyback and forward topology
- Eliminates all external current sensing circuitry
- Auto-restart for output overload/open loop protection
- Voltage mode control allows 75% duty cycle without slope compensation while providing 5-10 kHz loop bandwidth
- Line under-voltage (UV) detection: meets ETSI standards
- Line overvoltage (OV) shutdown protection
- Low-cost synchronous rectification: line UV/OV shutdown limits gate drive voltage range when driven directly from the transformer winding
- Fully integrated soft-start for minimum stress/overshoot
- Externally programmable current limit for high-efficiency low-cost designs and power limiting
- Programmable maximum duty cycle varies with input voltage to guarantee core reset in forward converter designs

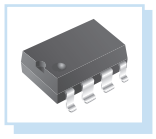
EcoSmart® Energy Efficiency

- Extremely low consumption at no-load (10 mA typ.) and in remote off (2 mA max.)
- Cycle skipping at light load for high standby efficiency

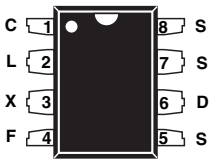
Package Information

- S, P and G packages are available in Pb-free finish (100% matte tin), are RoHS compliant and meet requirements of JEDEC standard J-STD-020C table 4.2

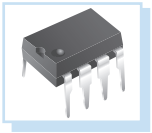
G Package



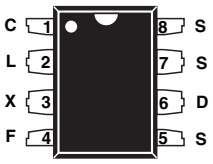
SMD-8



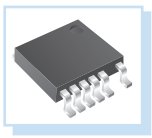
P Package



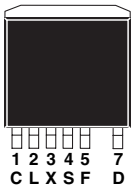
DIP-8



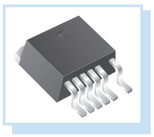
S Package



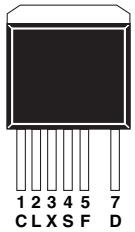
MO-169-7C
(S-PAK)



R Package



TO-263-7C
(Not available in Pb-free)



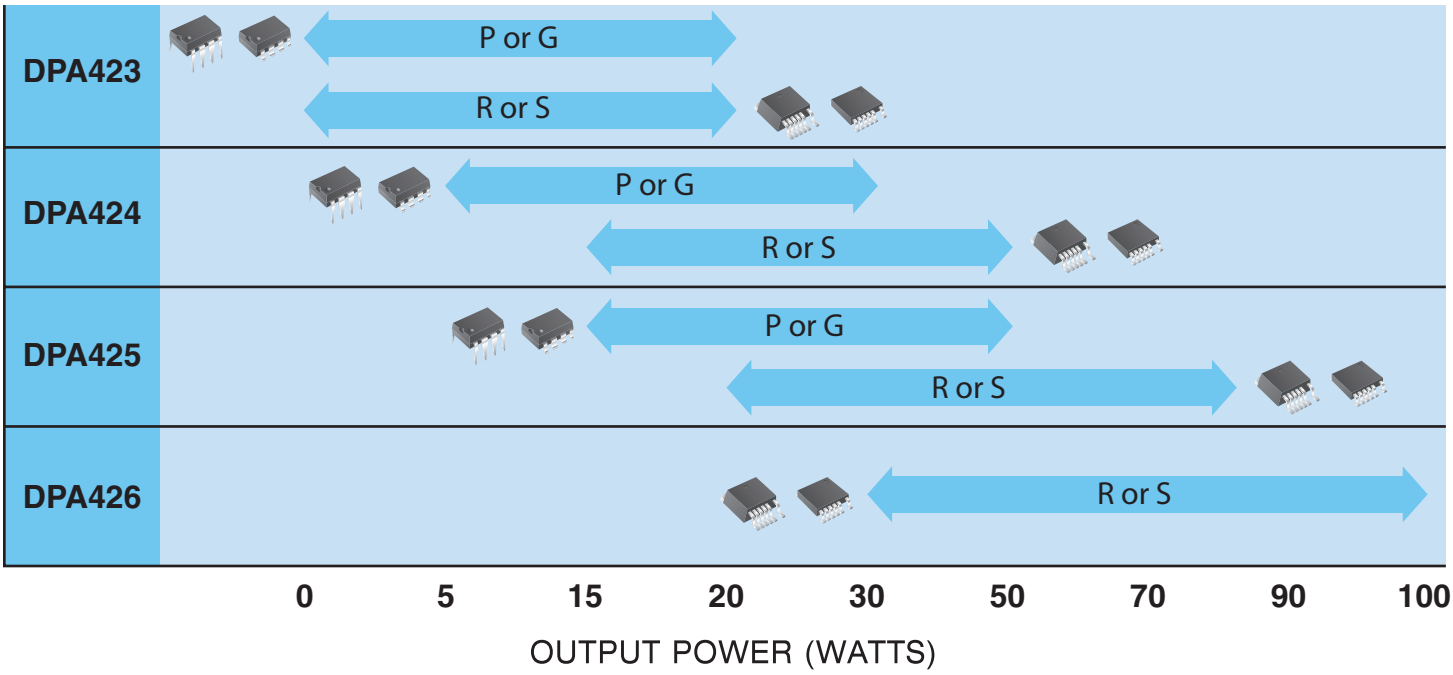
Typical Applications

- PoE Powered Devices: VoIP Phones, WLAN and WAP Transmitters, Security Cameras, Bar Code Scanners, Alarm Systems and Smoke Detectors
- Telco Central Office Equipment: xDSL, ISDN, PABX, etc.
- Distributed Power Architectures (24/48 V Bus, etc.)
- Industrial Control (24/48 V)

Visit our Web site **www.powerint.com/dpaproduct.htm** for more information.

Selector Guide

DPA-Switch Device Selector Guide



24 V / 48 V DC-DC Power Conversion (Up to 100 W)

Output Power Table

36-75 VDC INPUT RANGE (FORWARD)[4,5]

Total Device Dissipation[3] / PRODUCT[1,2]	0.5 W	1 W	2.5 W	4 W	6 W	Max Power Output
DPA423	12 W	16 W	-	-	-	18 W
DPA424	16 W	23 W	35 W	-	-	35 W
DPA425	23 W	32 W	50 W	62 W		70 W
DPA426	25 W	35 W	55 W	70 W	83 W	100 W

36-75 VDC INPUT RANGE (FLYBACK)[4,5]

Total Device Dissipation[3] / PRODUCT[1,2]	0.5 W	0.75 W	1 W	1.5 W	Max Power Output
DPA423	9 W	13 W	-	-	13 W
DPA424	10 W	14.5 W	18 W	24 W	26 W
DPA425	-	-	-	25.5 W	52 W

Integrated Features

HV-FET Rating	220 V	Soft-Start	✔	Hysteretic Thermal Shutdown	✔	Remote ON/OFF	✔
Switching Frequency (kHz)	400/300	Fully Integrated Current Sensing	✔	Power Limiting	✔	*EcoSmart*® Low Standby/ No-load Power Consumption	✔
Max. Duty Cycle (DC_{MAX})	75%	Adjustable Current Limit	✔	Line UV Detection	✔	Synchronizable to Lower External Clock Frequency	✔
Control Method	PWM	Auto Restart	✔	Line OV Detection	✔	Simultaneous Line Sensing and Current Limit	✔

Notes:
1. Packages: P–Plastic DIP, G–Surface Mount DIP, R–TO-263, S–MO-169. Pb-free package options are available for P, G, & S packages. Consult data sheet for product ordering information. **2**. Shipping quantities per package: Tubes: P and G - 50 pc. Tape and reel: G-TL- 1000 pc., R-TL- 750 pc., S-TL- 1000 pc. R-package and S-PAK are available in tape and reel only. **3**. For example, in a 55 W output design, the DPA426R will dissipate a worst case total of 2.5 W. **4**. See data sheet for power capability at 16 VDC and 24 VDC input. **5**. Power based on diode rectification assuming worst case $R_{DS(ON)}$ @ T_J=100 ºC. Up to 5% higher output power possible using synchronous rectification.

What is Power over Ethernet?

Power over Ethernet (PoE) is a method whereby power is transmitted to Ethernet-connected equipment (VoIP telephones, WLAN transmitters, security cameras) from the central switch. By using the existing CAT-5 cabling, the need for AC power (and wiring costs) can be eliminated. The switch is also able to control power distribution to the powered devices, allowing sophisticated uninterruptible power management for vital systems.

Operation: Fundamentally, a PoE Powered Device (PD) must fulfill three functions in order to act in conjunction with the sending end Power Sourcing Equipment (PSE). The functions are detection, classification and under-voltage lockout.

Detection Phase: When a PoE-enabled Ethernet cable is plugged into a PD, the PSE interrogates the device to determine if it is PoE-enabled. This period is termed the detection phase. During the detection phase, the PSE applies a voltage ramp to the PD and looks for a characteristic impedance from the load (25 kΩ). If the correct impedance is not detected, the PSE assumes that the load is not PoE-enabled and shuts down the PoE sending end. The system then operates as a standard Ethernet connection. If the signature impedance is detected, the PSE moves on to the classification phase. The signature identification voltage is a ramp voltage between 2.5 V and 10 V. A 24.9 kΩ resistor provides the correct signature impedance for discovery (see Figure 1).

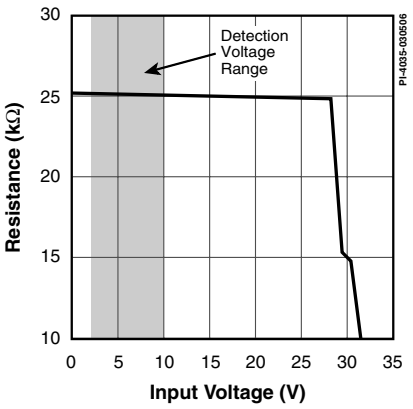


Figure 1. Detection Impedance.

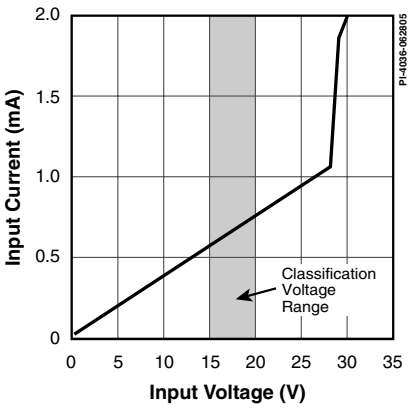


Figure 2. Classification Current (Class 0).

Classification Phase: The PSE continues to ramp the voltage to the PD. Between 14.5 V and 20.5 V, the classification phase occurs. During this voltage transition, the PD must draw a specified current to identify the device class (see Figure 2). The simplest class (Class 0) is also implemented by the use of the 24.9 kΩ signature resistor. The classification current describes the amount of power the PD will require during normal operation. It is this information that is fed to the controller by the PSE, which allows the system to determine power budget requirements. A table of classification current and operating PD power requirements is shown in Table 1.

Class	Power (MIN)	Power (MAX)	I_{CLASS} (MIN)	I_{CLASS} (MAX)
0	0.44 W	12.95 W	0 mA	4 mA
1	0.44 W	3.84 W	9 mA	12 mA
2	3.84 W	6.49 W	17 mA	20 mA
3	6.49 W	12.95 W	26 mA	30 mA
4	Reserved	Reserved	36 mA	44 mA

Table 1. Classification Power Levels.

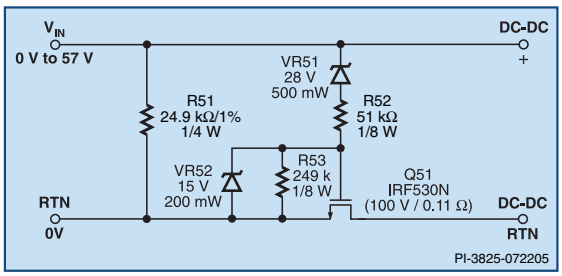


Figure 3. PoE Class 0 Interface Circuit Using a MOSFET Pass-Switch.

Turn-on phase: After the classification phase, the PSE continues to ramp the input voltage up to 30 V, when the under-voltage lockout (UVLO) circuit is released and the PD is allowed to power up. Soft-start circuitry may be required to limit current drawn from the PSE. A typical under-voltage lockout circuit is shown in Figure 3.

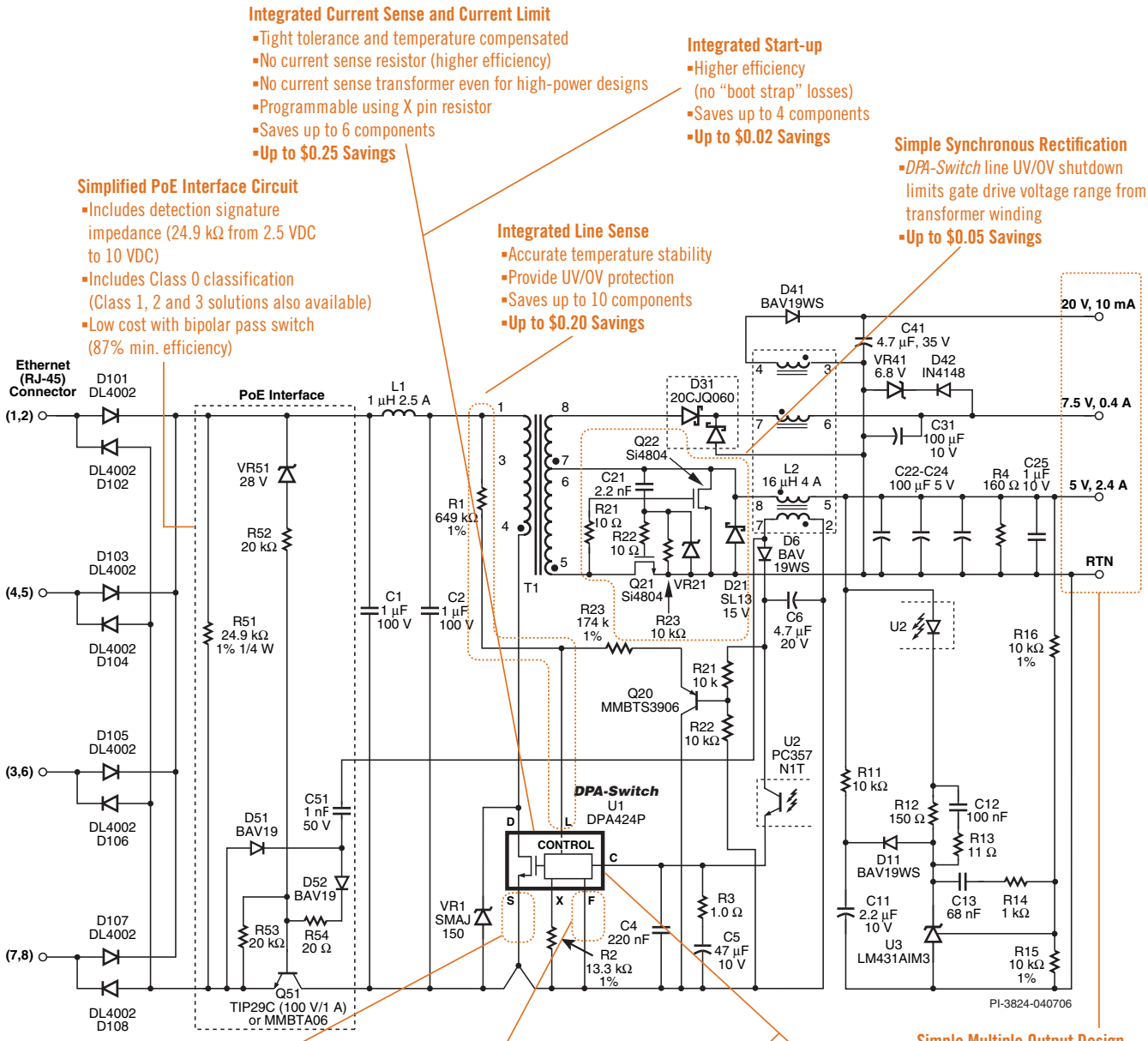
By this process, the PSE and PD work together to determine the nature of the load and apply power only to PoE enabled equipment. The system controller at the central location can determine load requirements and allocate power according to an operational needs hierarchy during power failure from its available UPS budget.

For additional information about driving PoE compatible load equipment and circuits for implementing Class 1 through Class 3 classification, see Design Ideas DI-70 *(www.powerint.com/PDFFiles/di70.pdf)* & DI-88 *(www.powerint.com/PDFFiles/di88.pdf)*.

Cost Savings

Cost Savings: *DPA-Switch* vs. Discrete Design*

34-57 VDC INPUT, 12.95 W MULTIPLE OUTPUT POWER OVER ETHERNET DC-DC CONVERTER



Integrated Current Sense and Current Limit
- Tight tolerance and temperature compensated
- No current sense resistor (higher efficiency)
- No current sense transformer even for high-power designs
- Programmable using X pin resistor
- Saves up to 6 components
- **Up to $0.25 Savings**

Integrated Start-up
- Higher efficiency (no "boot strap" losses)
- Saves up to 4 components
- **Up to $0.02 Savings**

Simple Synchronous Rectification
- *DPA-Switch* line UV/OV shutdown limits gate drive voltage range from transformer winding
- **Up to $0.05 Savings**

Simplified PoE Interface Circuit
- Includes detection signature impedance (24.9 kΩ from 2.5 VDC to 10 VDC)
- Includes Class 0 classification (Class 1, 2 and 3 solutions also available)
- Low cost with bipolar pass switch (87% min. efficiency)

Integrated Line Sense
- Accurate temperature stability
- Provide UV/OV protection
- Saves up to 10 components
- **Up to $0.20 Savings**

Source Connected Tab
- Heat sink connected to source reduces EMI (electrically "quiet")
- Reduces EMI filter costs
- **Up to $0.20 Savings**

Accurate Integrated Oscillator
- No external components
- Tight tolerance and temperature stable
- Selectable 300/400 kHz operation
- Saves up to 5 components
- **Up to $0.05 Savings**

Integrated Voltage Mode Controller
- >50% duty cycle operation without requiring slope compensation
- Saves up to 10 components
- **Up to $0.15 Savings**

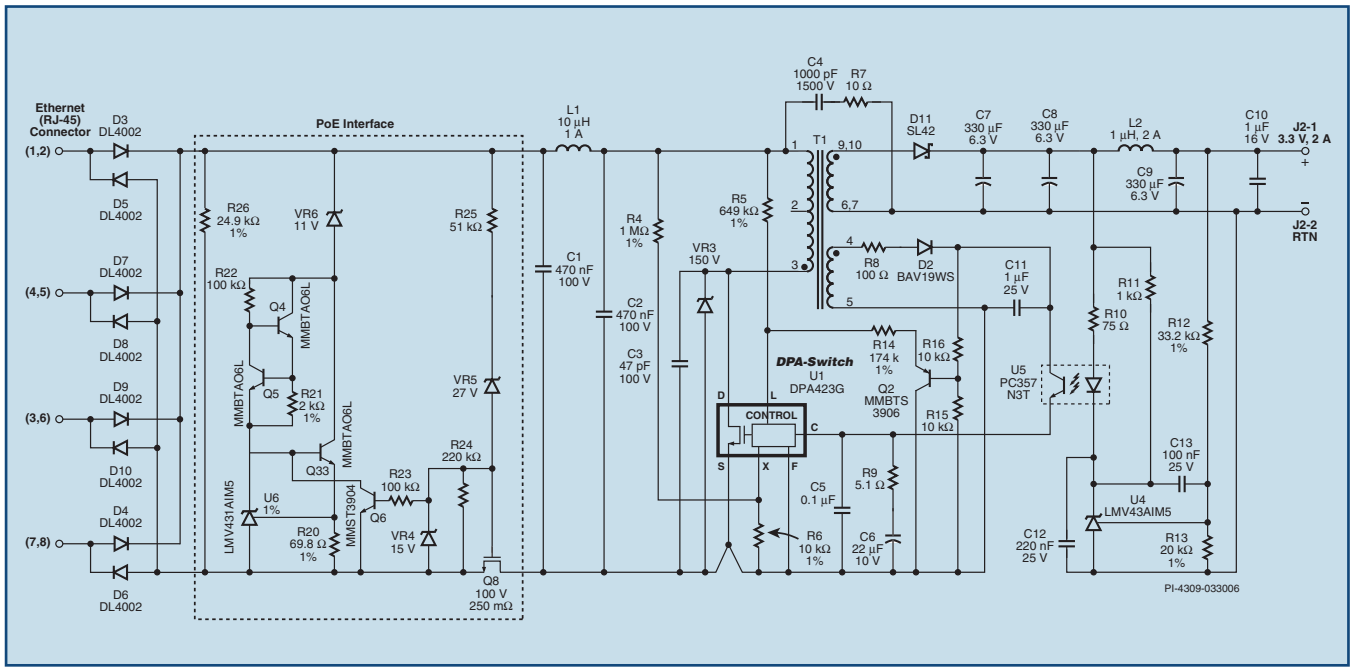
Integrated Thermal Shutdown
- Directly senses power MOSFET temperature
- Hysteretic auto-restarting
- Wide hysteresis prevents highaverage temperatures
- Saves up to 4 components
- **Up to $0.15 Savings**

Simple Multiple Output Design
- Low cost secondary outputs
- No secondary regulation required
- **Up to $0.20 Savings**

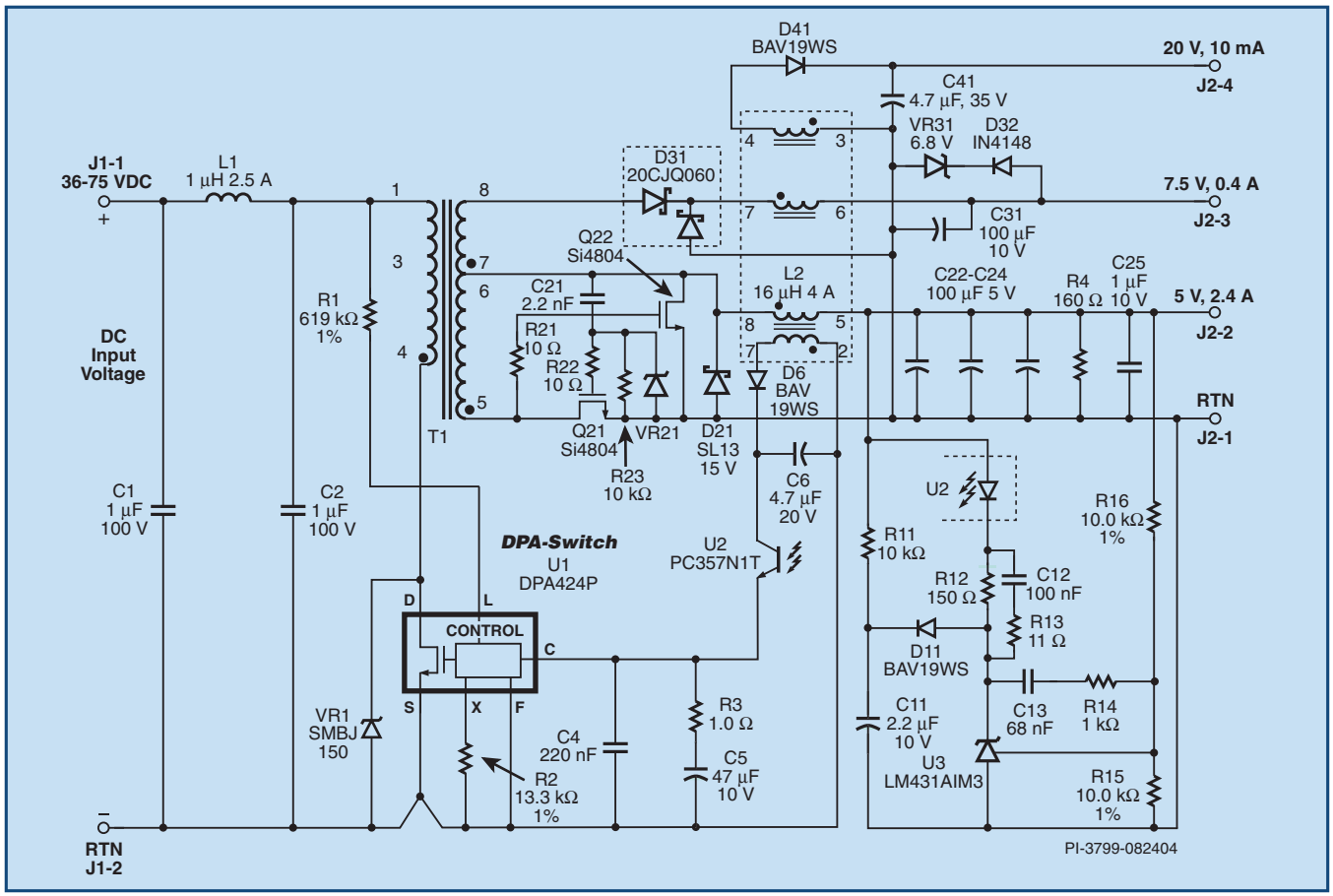
*Cost savings based on high-volume quantities (>50 k/mo.). Higher savings possible at lower volumes.
Visit our Web site **www.powerint.com/dpaproduct.htm** for more information.

Design Examples

Cost Effective 6.6 W, 3.3 V Flyback DC-DC Converter (EP-86)



15 W Multi-Output DC-DC Converter (DI-69)



Visit **www.powerint.com/appcircuits.htm** for additional design examples.

Design Tools

Reference Design Kits (DAK)

DAKs include a working prototype power supply, sample devices, unpopulated pcb, data sheet, comprehensive engineering report & other related documentation.

DAK-21A	30 W, DC-DC Forward Converter, 36-72 VDC Input
DAK-68A	6.6 W, DC-DC Flyback Converter with PoE Powered Device Interface
DAK-71A	6.6 W, DC-DC Flyback Converter
DAK-86	6.6 W, DC-DC Flyback Converter with Multi-Class Powered Device (PD) Interface for PoE

DPA-Switch Product & Design Collateral*

Data Sheet	**DPA423-426**	***DPA-Switch*** Family Data Sheet
Application Note	**AN-31**	***DPA-Switch*** DC-DC Forward Converter Design Guide
Design Ideas (2-Page Technical Circuit Document)	**DI-24**	Application: Telecom (36-75 VDC Input): 30 W, 5 V Forward Converter
	DI-25	Application: Telecom (36-75 VDC Input): 30 W, 5 V Forward Converter (Sync. Rect.)
	DI-29	Application: Telecom (36-75 VDC Input): 25 W, 7 V Flyback Converter
	DI-31	Application: Telecom (36-75 VDC Input): 70 W, 5 V Forward Converter
	DI-37	Application: Telecom (36-75 VDC Input): 16.5 W, 3.3 V Forward Converter (Sync. Rect.)
	DI-40	Application: Telecom (36-75 VDC Input): 20 W, 2.5 V Forward Converter (Sync. Rect.)
	DI-51	Application: Telecom (36-75 VDC Input): 5 W, 5 V Flyback Converter
	DI-52	Application: Telecom (36-75 VDC Input): 60 W, 12 V Forward Converter (Sync. Rect.)
	DI-53	Application: Telecom (36-75 VDC Input): 50 W, 5 V / 3.3 V Forward Converter (Sync. Rect.)
	DI-56	Application: Telecom (36-75 VDC Input): 19.2 W, ±12 V Flyback Converter
	DI-57	Application: Telecom (36-75 VDC Input): 60 W, 12 V Flyback Converter
	DI-69	Application: VoIP Phone, 15 W, 5 V / 7.5 V / 20 V Forward Converter (Sync. Rect.)
	DI-70	Application: PoE VoIP Phone, 15 W, 5 V / 7.5 V / 20 V Forward Converter (Sync. Rect.)
	DI-88	Application: PoE PD Flyback Converter with Programmable Class

Power Supply Design Software*

With ***PI Expert™ Suite***, you're only "mouse-clicks" away from determining the key components in your next switching power supply design, including the best Power Integrations power IC and detailed instructions for building the transformer! It's fast & easy...and best of all, **FREE!**

* Downloadable from ***www.powerint.com***

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About Power Integrations

Founded in 1988, Power Integrations is a leading supplier of high-voltage analog integrated circuits used in power conversion. The company's ICs have enabled a new class of lightweight, compact, energy-efficient power supplies for a wide range of consumer and industrial electronics. The company's innovative *EcoSmart*® technology dramatically reduces energy waste.

PATENT INFORMATION

The products and applications illustrated herein (including 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.