power integrations™

GaN Switches Will Dominate the Market

June 2020

ac-dc converters · led drivers · gate drivers · motor drivers

World Leader in Power Conversion ICs

- **Pioneer in high efficiency conversion**
- **Proven quality and delivery**
  - Recognized as industry leader by major OEMs worldwide
- **Products are easy-to-use**
- **Full-service design tools**
  - Reference designs, PI Expert™, PI Databook App

ICs for Energy Production, Transmission & Consumption

ac-dc converters

Technology leader in ICs for energy-efficient AC-DC power supplies

led drivers

High-efficiency driver ICs energizing the LED lighting revolution

gate drivers

Reliable gate drivers for vital systems when safety is paramount

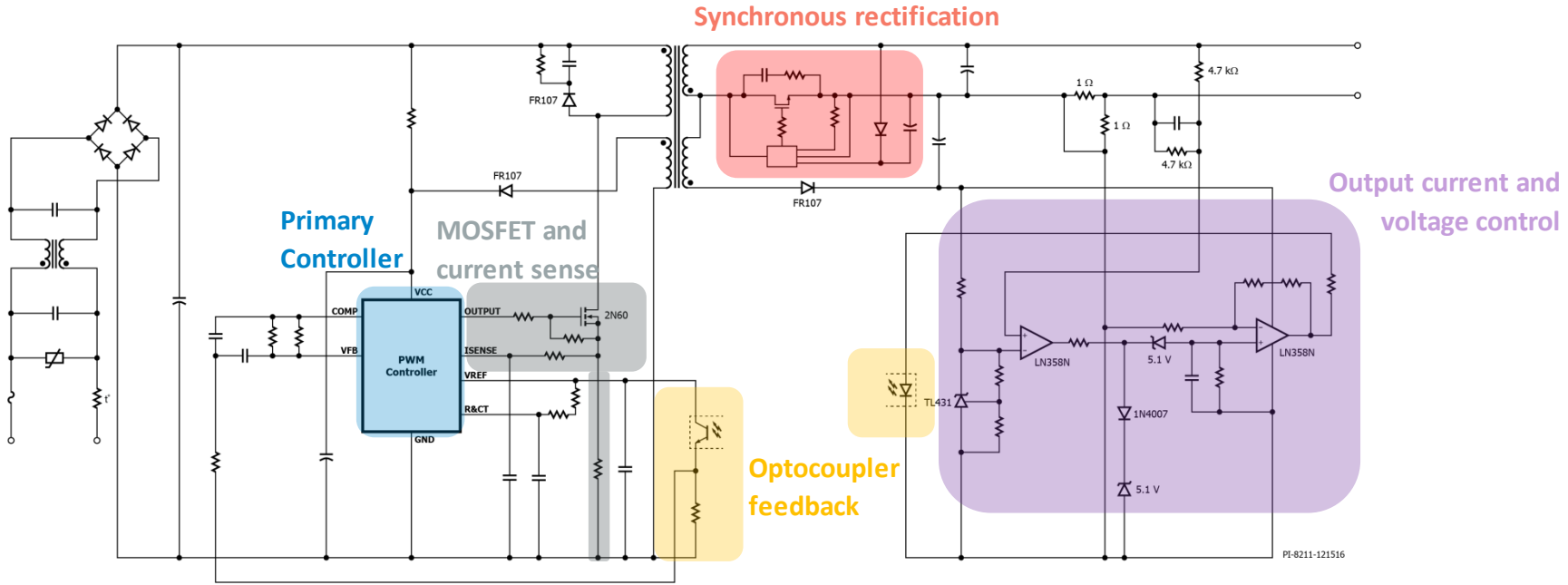
motor drivers

Highly-efficient, reliable and integrated motor drivers

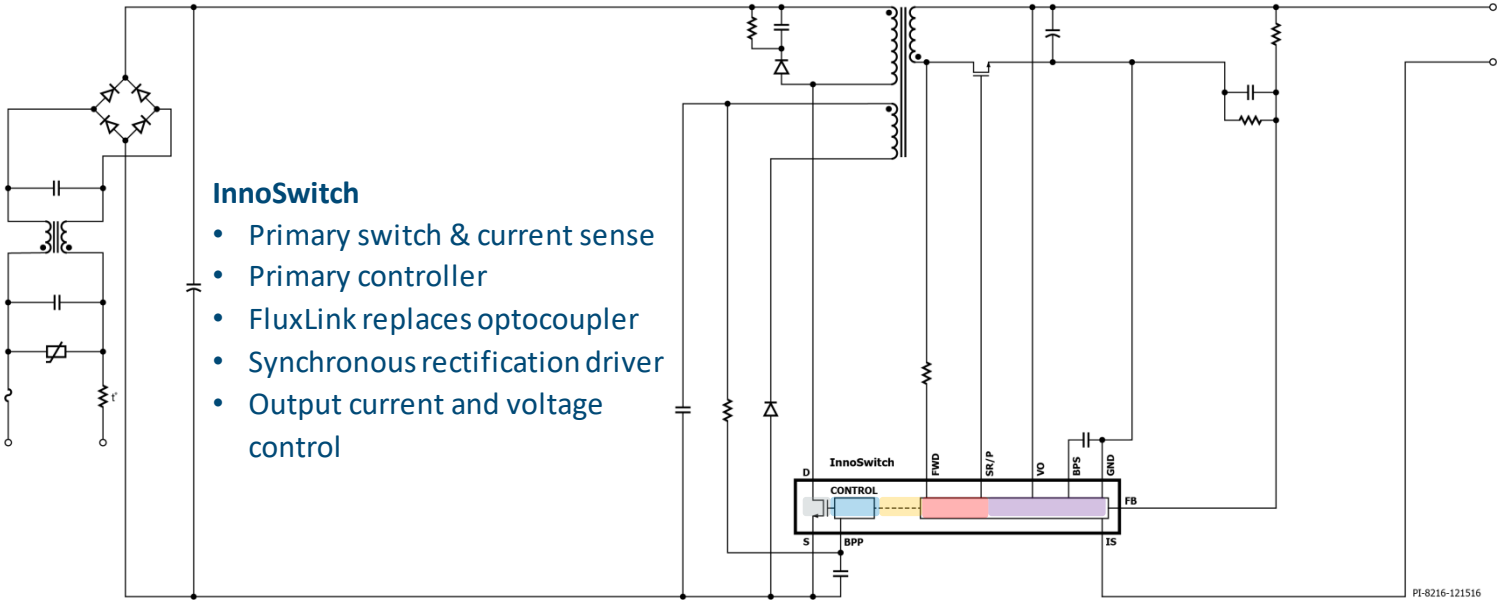
Power Everywhere

The InnoSwitch Advantage

Conventional High Efficiency Charger



InnoSwitch High Efficiency Charger



InnoSwitch

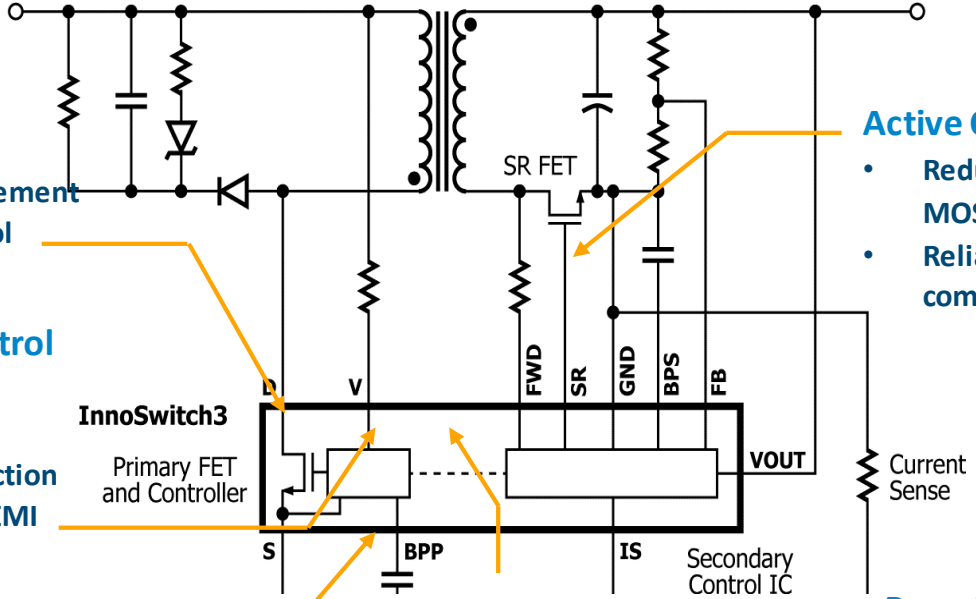
- Primary switch & current sense
- Primary controller
- FluxLink replaces optocoupler
- Synchronous rectification driver
- Output current and voltage control

InnoSwitch3 Uses PI Innovations for Best Performance

Monolithic Power Switch
- Lowest switching losses
- Lossless current sensing
- Direct temperature measurement
- Optimized driver and control

Proprietary Switch and Control
- Highest full load efficiency
- Lowest light load losses
- Accurate reliable fault detection
- Frequency jitter – reduced EMI

Integrated Start-Up
- Internal tap driven
- No external start-up components



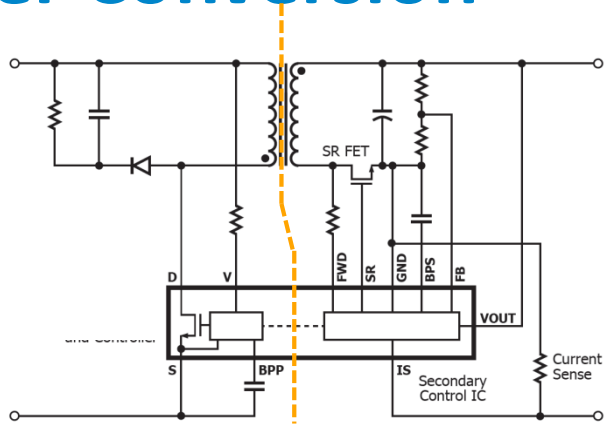
Active Control of Rectifier MOSFET
- Reduced diode conduction, increase MOSFET conduction for best efficiency
- Reliable: supports all line/load combinations

FluxLink™ Barrier Crossing
- PSR cost and SSR performance
- Highest reliability, lifetime

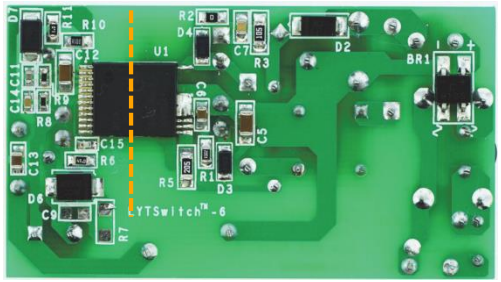
Proprietary InSOP-C Package
- Widest creepage and clearance
- Source potential heat transfer
- Multiple pins for sense/control

FluxLink Accurately Controls Power Conversion

- **Magneto-inductive coupling primary-to-secondary**
  - Benefits of secondary-side control
  - Simplicity of primary-side driver
  - Isolation without optocouplers
- **Crosses isolation barrier**
  - Controls both primary and secondary switching
    - Optimizes performance for highest efficiency
  - Meets all regulatory and hi-pot isolation requirements
- **Directly monitors output**
  - Accurate output voltage and current
- **Drives synchronous rectification MOSFET**
  - Simple design
  - Highly reliable under all conditions



FluxLink: Magneto-inductive coupling crosses the isolation barrier



CQC, UL and TUV certified isolation as barrier component

Applications for InnoSwitch

- **Applications**
  - SMPS
  - HBA & IOT
  - Instrumentation
  - Motorized Products
  - Metering
  - USB Wall Socket
  - Lighting Controls
  - Industrial Battery Chargers
  - Applications are everywhere….









Looking for integration, high efficiency, smaller lighter power supplies → InnoSwitch

PowiGaN

PI Make GaN Easy to Use in Production

- **GaN transistors are better than silicon**
  - More efficient, cooler, smaller power supplies
  - Leading the way to “no-heatsink” designs at high power levels

- **GaN transistor technology is the future for power conversion**
- **Our strategy is to enclose and protect the GaN device within our ICs**
  - Controller, driver, PowiGaN switch, protection, SR control all-in-one
  - Engineers see significant performance benefits
  - But won’t otherwise notice a change

PI Unveiled New GaN Technology in July 2019

- **Significant step-forward in power supply performance**
  - Higher efficiency → no heatsinks → smaller size and less weight
- **Increased output power of InnoSwitch-3 family from ~60 to > 100 W**
- **In production and already highly successful**
  - Shipping parts since 2019
  - **More than 6M parts shipped so far and accelerating**

- **Multiple families use PowiGaN technology to support wide-range of Industrial applications**

5 PI IC Families Already Feature PowiGaN™ Switches

- **Integrated GaN switch used across multiple families**
  - InnoSwitch™3-EP
  - InnoSwitch3-CP
  - InnoSwitch3-Pro
  - LYTSwitch™-6
  - InnoSwitch3-MX

InnoSwitch3 ICs with PowiGaN Technology Achieve >100 W

- **InnoSwitch3 silicon transistors are highly effective up to 65 W**
- **PowiGaN switches provide more power**
  - Lower $R_{DS(ON)}$ per unit area
  - Lower switching losses
- **PowiGaN devices**
  - InnoSwitch3-CP – constant power
  - InnoSwitch3-EP – for open-frame
  - InnoSwitch3-Pro – digital control

725 / 750 V Part Number	230 VAC +/- 15%		85 - 264 VAC	
	Adapter	Open Frame	Adapter	Open Frame
INN3x74C	20 W	25 W	15 W	20 W
INN3x75C	25 W	30 W	22 W	25 W
INN3x76C	35 W	40 W	27 W	36 W
INN3x77C	40 W	45 W	36 W	40 W
INN3x78C	70 W	75 W	55 W	65 W
INN3x79C	80 W	85 W	65 W	75 W
INN3x70C	90 W	100 W	75 W	85 W

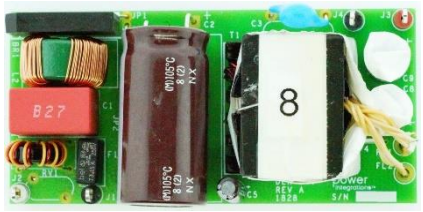
PowiGaN switches

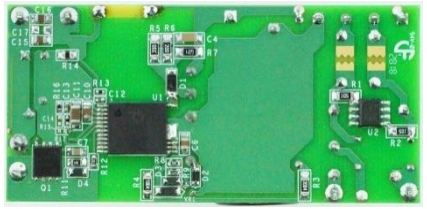
The Small Step in Efficiency…. Got Bigger

Description	Full-Load Efficiency	Heat Energy (W)	Surface Area (Adapter)	Thermally Limited Volume
Legacy Adapter	87%	5.85	1	1
"High Efficiency" Design	90%	4.5	0.77	0.67
InnoSwitch	92%	3.6	0.62	0.48
InnoSwitch3	**94%**	**2.7**	**0.48**	**0.3**
InnoSwitch3 (with PowiGaN)	**95.5%**	**2.0**	**0.35**	**0.21**

Reference Design Kits with InnoSwitch3 PowiGaN

- **RDK-747 CV Adapter**
  - InnoSwitch3-EP (INN3679C)
  - 90 – 264 VAC Input
  - 20 V 3.25 A (65 W) output





- **RDK-802 USB PD 3.0 + PPS**
  - InnoSwitch3-Pro (INN3379C)
  - 85 – 265 VAC Input
  - 5 – 20 V (60 W) dynamic output

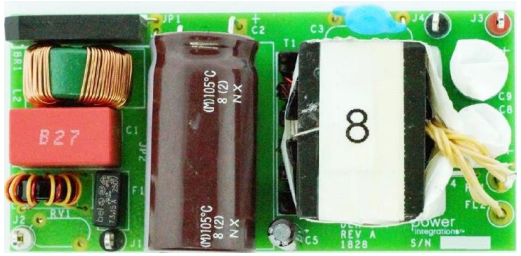
- **RDK-805 USB PD 3.0 + PPS**
  - InnoSwitch3-Pro (INN3380C) + HiperpFS™-4
  - 90 – 265 VAC Input with PFC
  - 5 – 21 V (100 W) dynamic output

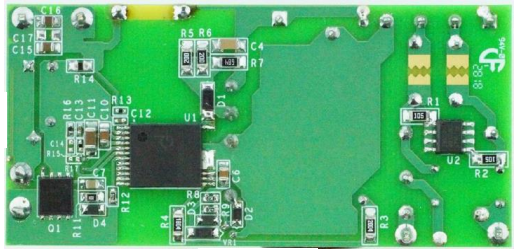
PowiGaN Delivers Best Performance

- **Highest efficiency conversion**
  - 95% efficient – flat across line and load
  - No heatsinks

- **Safe, familiar, reliable – it just works**
  - Just another switching technology from Power Integrations
  - Looks and behaves like a silicon MOSFET
  - No EMI challenges
  - High operating voltage and increased surge margin

- **In production now**
  - More than 6 million parts shipped to date





DER-747

65W 20V / 3.25A

LYTSwitch-6

LYTSwitch-6: Better than the Competition

- **± 3% CV and CC output characteristic**
  - Single design covers multiple applications
- **Low no-load <15 mW (without PF)**
  - Easily meets DOE-6 and ENERGY STAR® for North America
- **Supports analog and PWM dimming**
- **Very high efficiency**
- **Fast control reduces output ripple**
  - Less output capacitance required
- **Excellent load regulation and instantaneous transient response**
  - Ideal for multi-string applications, such as RGB with highly variable independent loads

Expanding the LYTSwitch-6 Power Range

Part Number	MOSFET $V_{DS(max)}$	Output Power - Open Frame		
		277 VAC (± 15%)	90-305 VAC	380 - 450 VDC
LYT6063C	650 V	15 W	12 W	
LYT6073C	725 V			25 W
LYT6065C	650 V	30 W	25 W	
LYT6075C	725 V			40 W
LYT6067C	650 V	50 W	45 W	
LYT6077C	725 V			60 W
LYT6068C	650 V	65 W	55 W	
LYT6078C	750 V	75 W	65 W	90 W
LYT6079C	750 V	85 W	75 W	100 W
LYT6070C	750 V	95 W	85 W	110 W

Advanced InSOP-24 package

- Reduced board space
- No heatsinks required
- Extended creepage and clearance

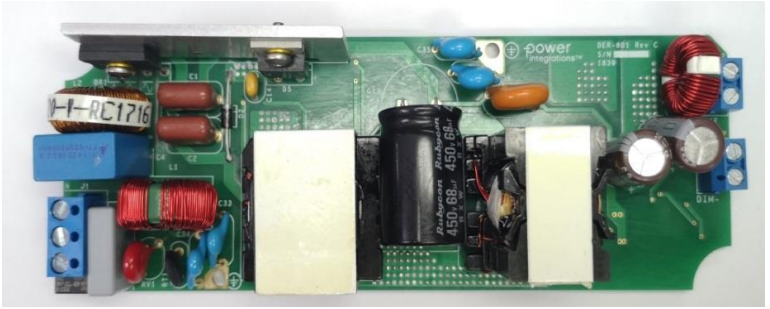
PowiGaN

Ideal for Applications that Require Small Size and High Efficiency

- Driver for low-profile flat LED ceiling panels
- Low and high bay fixtures
- Driver for LED street light

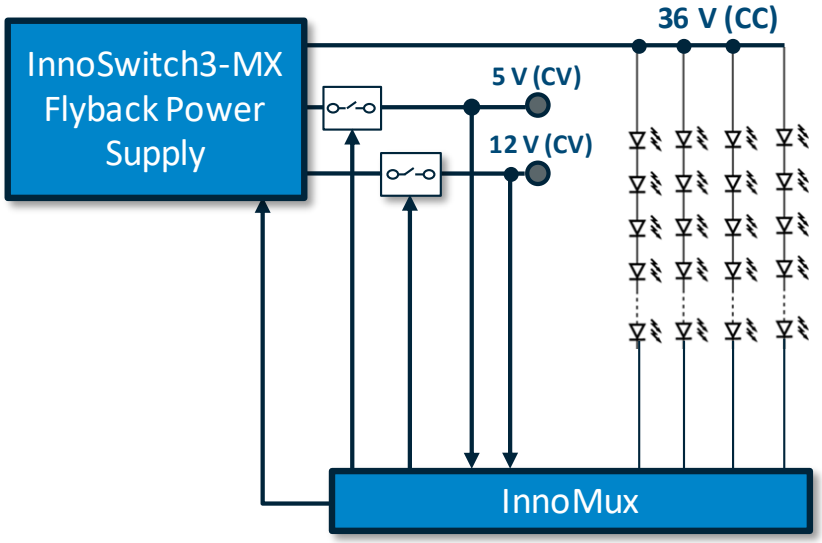
DER-801: 100 W Wide-Range Ballast-Applications

- **Features**
  - Constant voltage and constant current mode LYTSwitch-6 (LYTSwitch-6079C)
  - 90-305 VAC and active PFC with HiperPFS-4
  - 3-in-1 dimming (0-10 V, PWM and resistor)
    - Dimmable to 1% and dim-to-off
  - Low component count
  - Flicker-free operation
- **Typical Specification**
  - Output voltage: 48 V
  - Output current: 2080 mA
  - Output ripple current: <5% of nominal
  - Efficiency: >90% at 230 VAC
  - Power factor: >0.9 at full load
  - Surge withstand: 2.5 kV differential



InnoSwitch3-MX

InnoMux™ A Single Stage Power Structure for Display Application



InnoSwitch3-MX Plus InnoMux Single-Stage Conversion Provides CV and CC Outputs

InnoMux Chipset Provides Up to 75 W Output

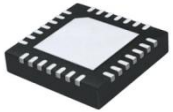
InnoSwitch3-MX

Part Number	Primary MOSFET ($V_{DS(MAX)}$)	Power (W) 85 – 264 VAC
INN34X5C	650/725	20
INN34X6C	650/725	25
INN34X7C	650/725	32
INN3468C	650	40
INN3478C	750	55
INN3479C	750	65
INN3479C	750	75

InSOP-24D (C-Package)
MSL-3 Rated - wave solder and reflow

InnoMux

Part Number	Channels		Package
	LED strings	CV O/Ps	
IMX101J	1	1	QFN
IMX101U	1	2	HSOP
IMX102U	4	1	HSOP



QFN-28 (J-Package)
MSL-1 Rated - reflow

HSOP-28 (U-Package)
MSL-1 Rated – Wave Solder

PowiGaN is Winning in the Market

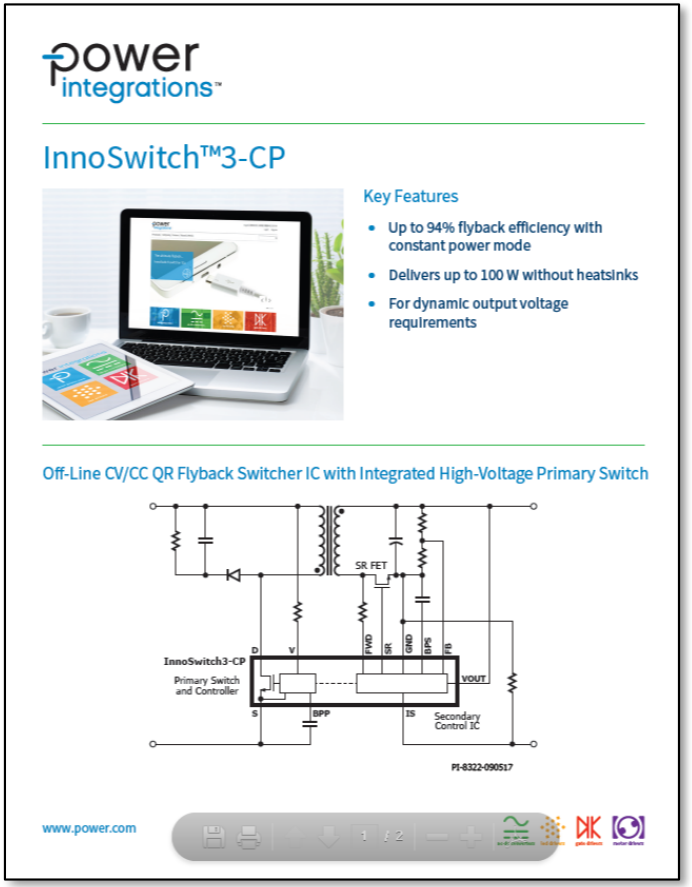
- **More GaN power devices shipped than anyone else**
  - Proprietary PI technology developed for power switching
- **Easy to use**
  - Integrated protection, drive and control eliminates challenges of discrete GaN
  - Looks like a conventional part – easy to change between designs
  - Very high reliability – More than 6 million shipped with no field failures
- **Provides major benefits across markets**
  - Smaller lighter power supplies
  - Simplifies meeting existing and emerging energy standards
  - Ideal for **many industrial applications**

No heatsinks makes open frame /embedded power more mechanically stable

Tools

Support Documentation

- **Application Note**
  - AN-72 InnoSwitch3 Family design guide
  - AN-74 InnoSwitch3-Pro programming manual
  - AN-77, 78 InnoSwitch3-Pro code Libraries
  - AN-79 Soldering guidelines
  - AN-85 InnoSwitch3-Pro master Debugger user guide
- **Product Flyer**
  - InnoSwitch3 – CP/EP/Pro
  - LYTSwitch-6
  - GaN Products
- **White paper**
  - PowiGaN Primary-side Power Switches
- **Design Example Reports**
  - Detailed reference design Information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InnoSwitch™3-CP

Key Features

- Up to 94% flyback efficiency with constant power mode
- Delivers up to 100 W without heatsinks
- For dynamic output voltage requirements

Off-Line CV/CC QR Flyback Switcher IC with Integrated High-Voltage Primary Switch

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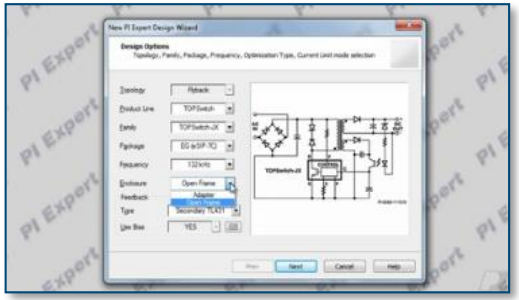
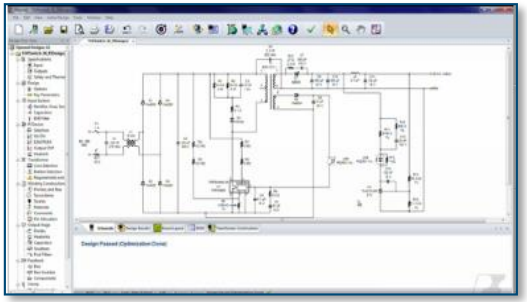
Design Made Simple

PI Expert™ Suite

- **Input your power supply specification and let the GUI do the rest**
- **Selects most-suitable IC family and device size**
- **Provides all information to build and test a working PSU**
  - Interactive schematic
  - Layout instructions
  - Complete magnetics design, winding instructions, customizable BOM



Chooses Best PI Part



Creates Complete Schematic

Provides BOM and Transformer

PI Expert Circuit Design Tool

- **Creates real-time custom solution that matches customer specification**
  - Fully functional across operating conditions, start-up and overload
  - Complete schematic –including EMI filtering and heatsinking requirements
  - BOM - User-adjustable to accommodate preferred components
  - Transformer documentation and full build information
- **Free download from PI website**
  - https://ac-dc.power.com/design-support/pi-expert/

PI Expert™ Online

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