



PowerDsine™ PoE Midspans & LED Lighting

From the inventors of Power over Ethernet

INTRODUCTION

**Doug Spinella – Global Market Segment Manager,
PowerDsine PoE System Sales**

Vision

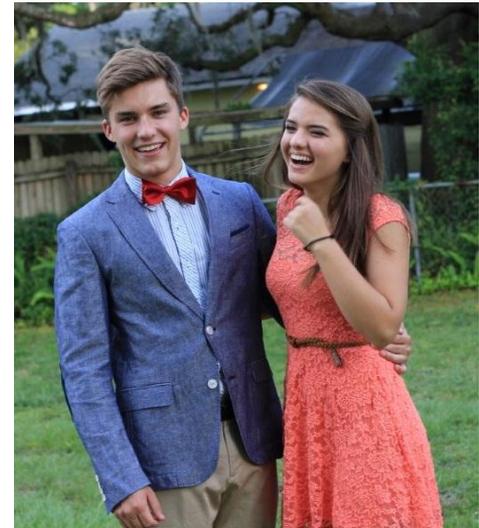
To be the premiere intelligent network power solutions provider.

Mission

To Empower our partners success by providing innovative industry leading network power solutions.

863-248-2194

Doug.Spinella@Microsemi.com

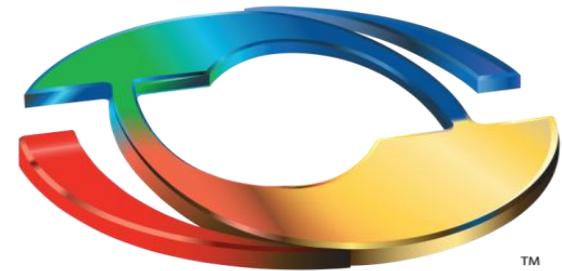


Dedicated to the things that matter

Power Matters

Who is Microsemi

- Established in 1960
 - Headquarters: Irvine, California
 - Revenues: FY10 \$514M, FY11E \$850M, FY12E \$1.1B
- Industry's most extensive technology portfolio, solving the most critical system challenges
 - High-performance, high-reliability analog and RF devices
 - Mixed signal integrated circuits
 - Complete subsystems
 - NEW: Customizable SoCs (Programmable FPGA)
- Target high growth markets
 - Enterprise and commercial
 - Security and defense
 - Aerospace
 - Industrial



Microsemi[®]

Power over Ethernet and PowerDsine

- PowerDsine Established in 1995
- Patented PoE Technology-Hold Majority of Patent's
 - Protects Customers on patents Network 1 holds (we pay royalties to Network 1)
 - **Only** Midspan to protect customer from Network 1 suites and don't infringe on PoE Patents
- Leading the Power over Ethernet (PoE) market
- **Only** Company to Provide: PoE IC's, PoE Midspans & PoE Test Equipment.
- Designer & Manufacturer of ICs and systems
- Over 80% Market share of PoE Midspan market
- Key contributor to the IEEE 802.3af & 802.3at standard definition
- Heading PoE at the Ethernet Alliance and HDBaseT
- Designed into more than 400 industry-leading switches
- Acquisition by Microsemi in January, 2007

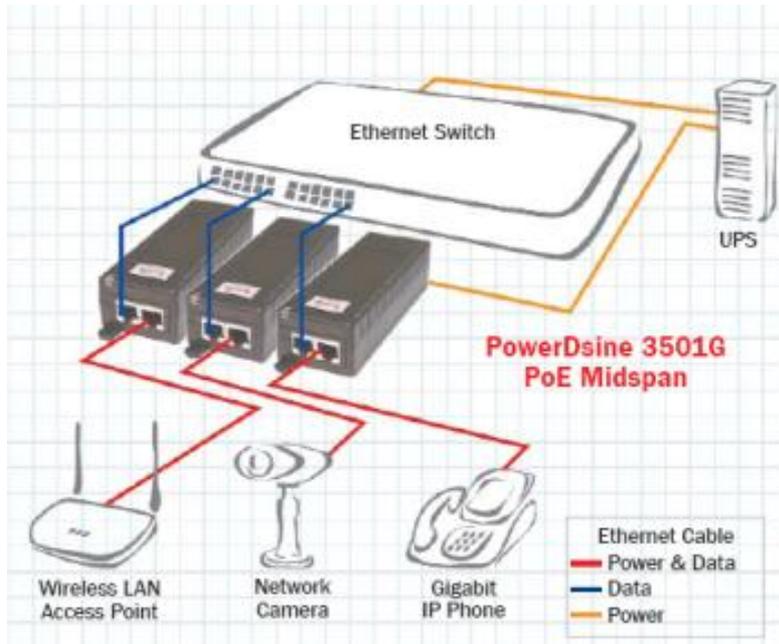
Key Contributor

Our Partners (partial list)



What is Power over Ethernet?

- Technology that enables delivery of power over standard Ethernet cables into IP-based data terminals
- IEEE802.3AF & AT or HDBaseT standard; 100m range
- Compatible with 10/100/1000Mbps; Cat5 channel



Cost Savings on AC outlet installation

Improved Network Reliability

Ease of Deployment

Improved Safety

Standard Compatibility

Power over Ethernet Technology

- **802.3af** send **15.4W**; receive 12.95W ~48VDC
- **802.3at** send **30.0W**; receive 25.50W ~54VDC
- **802.3at 4-pairs** send **60.0W**; receive 51.00W ~54VDC
- **Power over HDBaseT** send **95.0W**; receive 72.00W ~54VDC

Standard **IEEE 802.3af**

| CLASS | PSE (W) |
|-------|------------|
| 0 | 15.4 |
| 1 | 4 |
| 2 | 7 |
| 3 | 15.4 |
| 4 | Treat as 0 |

Standard **IEEE 802.3at** (4-pairs get double)

| CLASS | PSE (W) |
|-------|----------|
| 0 | 30 or 60 |
| 1 | 4 |
| 2 | 7 |
| 3 | 15.4 |
| 4 | 30 or 60 |

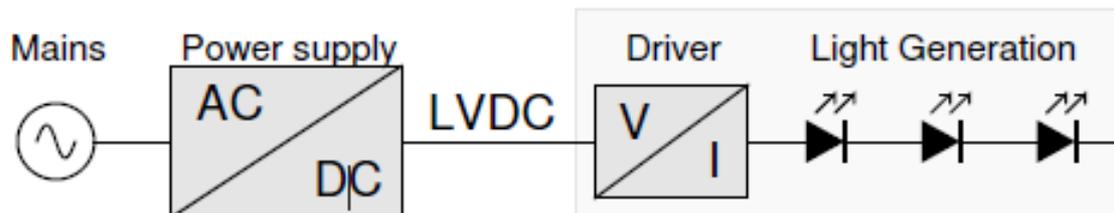
IEEE802.3af vs. IEEE802.3at vs. PoH

| Standard | 802.3af (Type 1) | 802.3at (Type 2) | PoH (Type 3) |
|--------------------|------------------|------------------------------------|---|
| PSE Min Power | 15.40W (2-pairs) | 30W (2-pairs) 60W (4-pairs) | 47.5W (2-pairs) 95.0W (4-pairs) |
| PD Max Power | 12.95W (2-pairs) | 25.5W (2-pairs) 51.0W (4-pairs) | 36W (2-pairs) 72.0W (4-pairs) |
| PSE Voltage range | 44V to 57V | 50V to 57V | 50V to 57V |
| PD Voltage range | 37V to 57V | 37V to 57V | 37V to 57V |
| Max Current | 350mA | 600mA | 950mA |
| Min Cabling | Cat3 (20ohm) | Cat5 (12.5ohm) | Cat5 (12.5ohm) |
| Max Cable Bundle | Not defined | 100 cables | Cat7: 96 cables Cat6: 48 cables Cat5: 24 cables |
| Max Speed | 1Gbit/s 2-way | 1Gbit/s 2-way | 8.2Gbit/s 1-way |
| PSE Classification | 1-event optional | 2-event <u>or</u> LLDP | 3-event MUST |
| PD Classification | 1-event optional | 2-event <u>and</u> LLDP | 3-event <u>and</u> LLDP |

PoE for Lighting

PoE for Lighting – Why LED?

- Global market shift to LED
 - 50% of all lighting is LED by 2020
- Market trend drivers
 - Energy efficient lighting
 - LED cost down & increased quality
 - ‘Smart Lighting’ benefits



Low Voltage DC distribution for Lighting

- Many luminaires operate with current sources driving 40V loads or less (well below 60V SELV)
- Low voltage distribution is safer for the installer
- Centralized drivers can be more cost effective
- Lower efficiency compared to best in class mains drivers
- Single point of failure in central driver



PoE for Lighting – Why PoE?

- Plug and play with worldwide standard 8P8C connector (RJ45)
- CAT cable is universally known and installed efficiently by installers
- No need for certified electricians
- No need to run copper/AC outlets
 - Global organizations can deploy PoE everywhere
- Single cable for power and control
- Lower Cost of Installation
- Safe for People
- Safe for Equipment
- 4-pair PoE provides opportunity to increase power to a level required for sufficient product portfolio coverage at lower cable losses



Why PoE over AC?

▪ Safe for People

- Complies with UL60950-1 LPS
 - On going operating voltage is below 60V: requirement for dry area
- Voltages our below 30V for any non-PoE PD
 - Detection: ~5V, Classification: ~20V, Passes 30V wet location “finger test”

▪ Safe for Equipment

- PoE power is only applied to devices compatible with PoE
- Structure Cabling (CAT5 and better) can be used to connect ANYTHING, including devices that cannot survive voltages above 5V

→ DO NOT DEPLOY DUMB INJECTOR, USE ONLY POE COMPATIBLE MIDSPANS

▪ Lower cost – SELL OUR QUALITY

- There is no need for an AC outlet at the location of the endpoint (phone, access point, camera),
- Also saves on design of PD (NO need for a AC power jack on each devices, as well as you can use Buck instead of Flyback on DC/DC Topology)

▪ Less cables & cheaper cost

- Not needing an AC adapter is one less cable to deal with which helps to provide a more “professional look.”
- Cat 5 cable is cheaper than USB repeaters, and the cost and task of meeting building code requirements to run AC power cable is eliminated.

▪ Global organizations can deploy PoE everywhere

- Without concern for any [local variance in AC power standards](#), outlets, plugs, or reliability.

▪ Symmetric distribution is possible.

- Unlike USB and AC outlets, power can be supplied at either end of the cable or outlet. This means the location of the power source can be determined after cables and outlets are installed.

Professional Lighting Industry

Market size for new fixtures per year (in million) and LED fixture penetration in %1:

| | 2012 | 2016 | 2020 |
|-----------------|------|------|------|
| Luminaires | 311M | 365M | 431M |
| LED Penetration | 6% | 31% | 60% |
| Total LED | 18M | 113M | 258M |

Infotetics 2013

This represents a significant number of potential PoE ports!

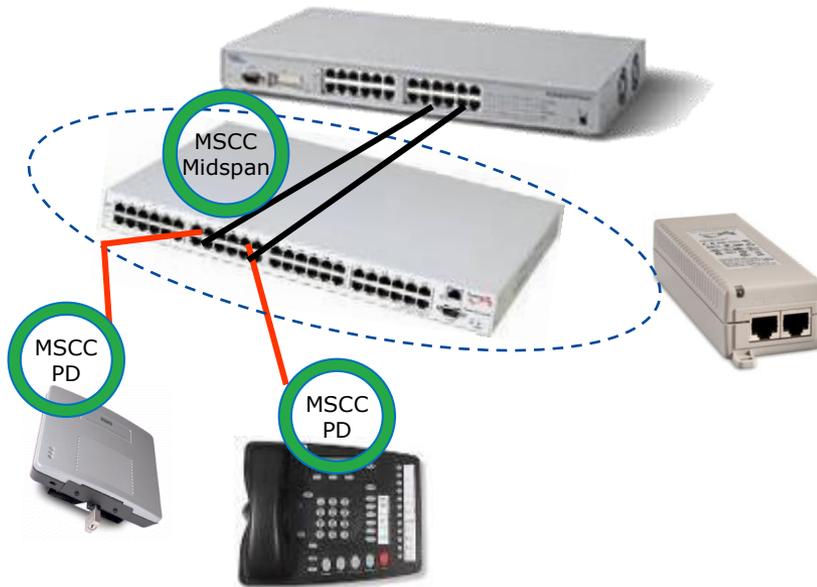
How will you Power That?

1. PoE Midspan
2. PoE Switch
3. AC Power

PSE Types – Midspan vs. Endspan

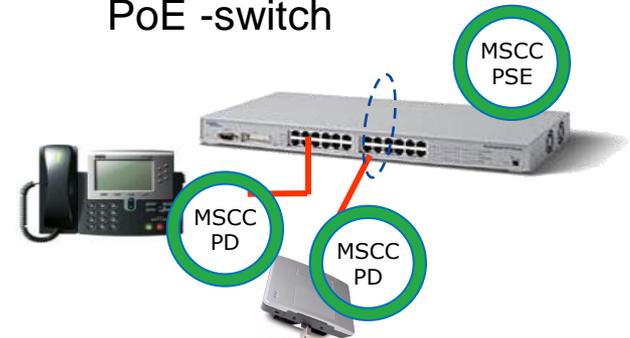
Midspan Architecture

Power-Hub between switch and PD



Endspan Architecture

PoE -switch



Midspan enables simultaneous delivery of DC Power and Ethernet data over the Ethernet cable without a need to replace an existing (non PoE) switch



Microsemi is the industry's leading PoE provider, providing all PoE requirements – Midspans, PSE ICs, and now PD ICs.

Microsemi* PoE Chip Solutions

■ PoE PSE Managers: PoE Switches

- From 1-port to 24-port IC's and modules
- Up to 100W/port
- Lowest power dissipation
- Smallest footprint
- Unique Power Supply Management



■ PoE PD IC's: IP Phones, WLAN AP's, Network Cameras

- Internal and External PWM Controllers
- Up to 100W/port
- Lowest power dissipation



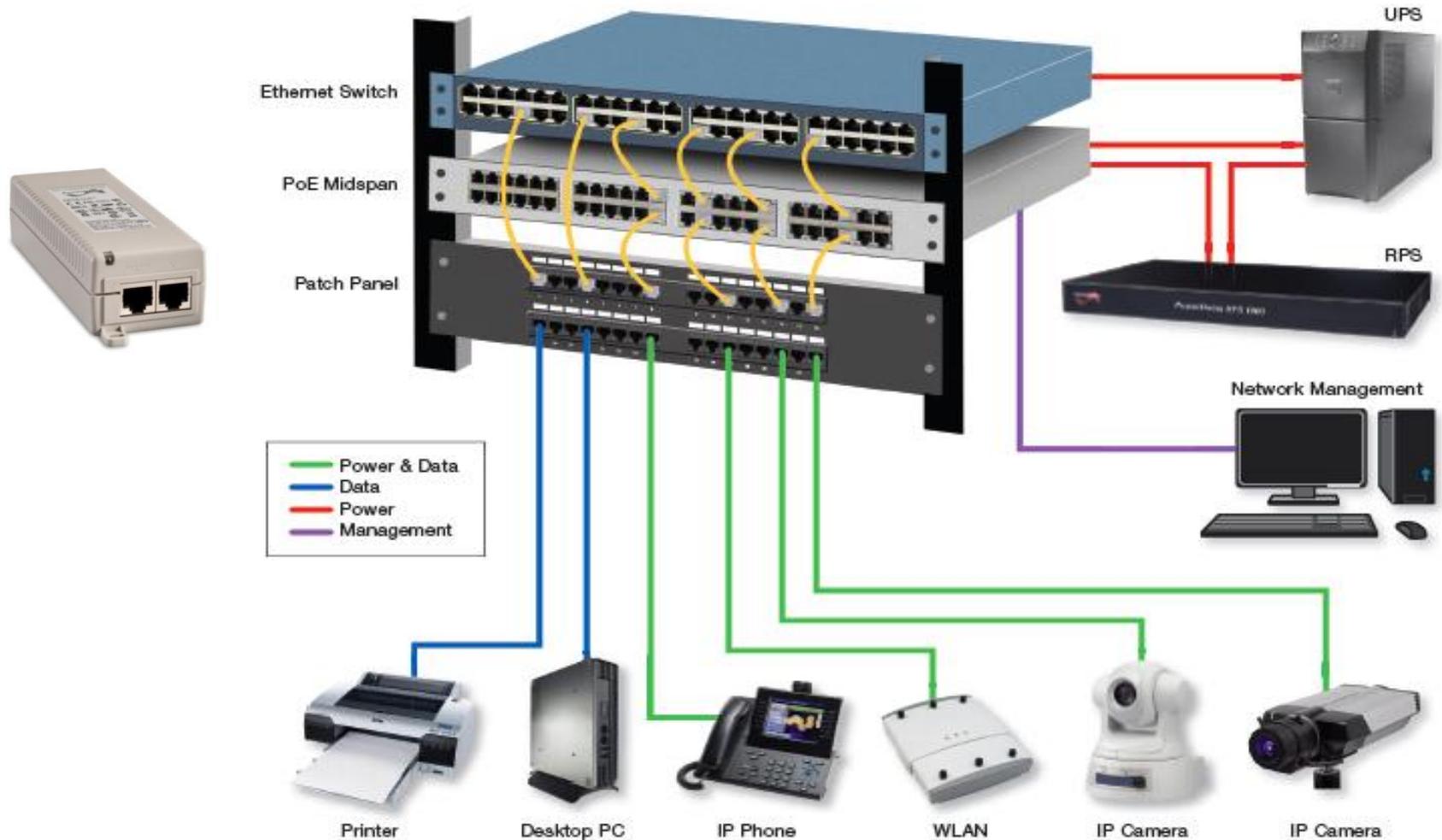
■ Midspans: Add PoE to a network without a PoE switch

- 1 to 48-port systems
- Up to 72W/port
- Managed or Unmanaged



* [Pre-Zarlink Acquisition](#)

PoE as part of the Infrastructure



Midspan is the optimal PoE solution

Midspan Product Portfolio

PowerDsine Multiport Midspan Product Portfolio

3500/3500G SERIES

802.3af 15.4w 4-6-12-24 port
Non-managed



6500/6500G SERIES

802.3af 15.4w 6-12-24 port
SNMP Management



9000G SERIES

802.3at 30w 4*-6-12-24 port
SNMP Management Optional RPS



Most Robust Line
of PoE Midspans

Only company to do:

1. PoE Midspans
2. PoE IC's
3. PoE Test Equipment

9600G SERIES HDBaseT

95w 6 port
SNMP Management



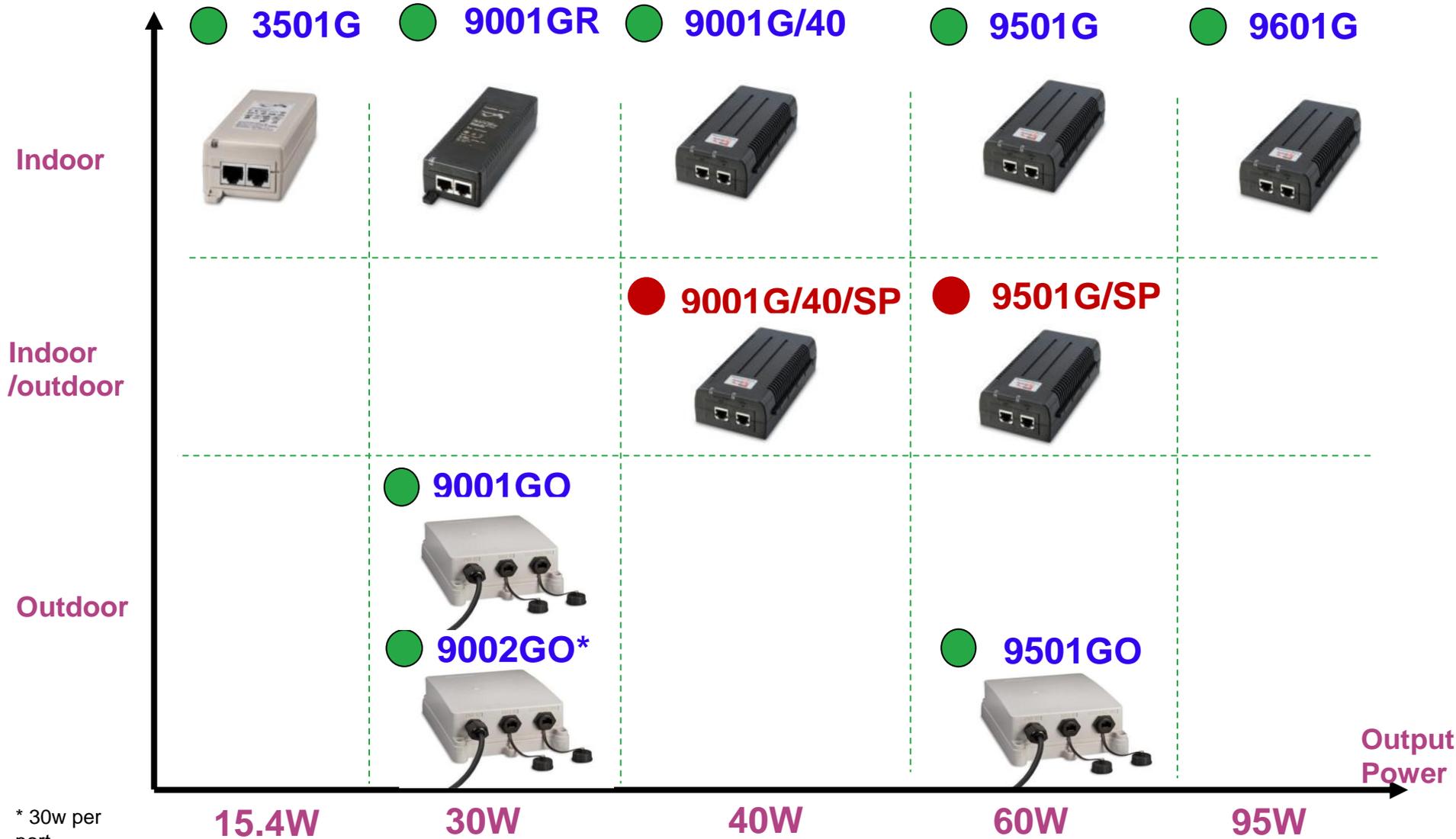
9500G SERIES Super HiPoE

802.3at up to 72w 6-12 port
SNMP Management



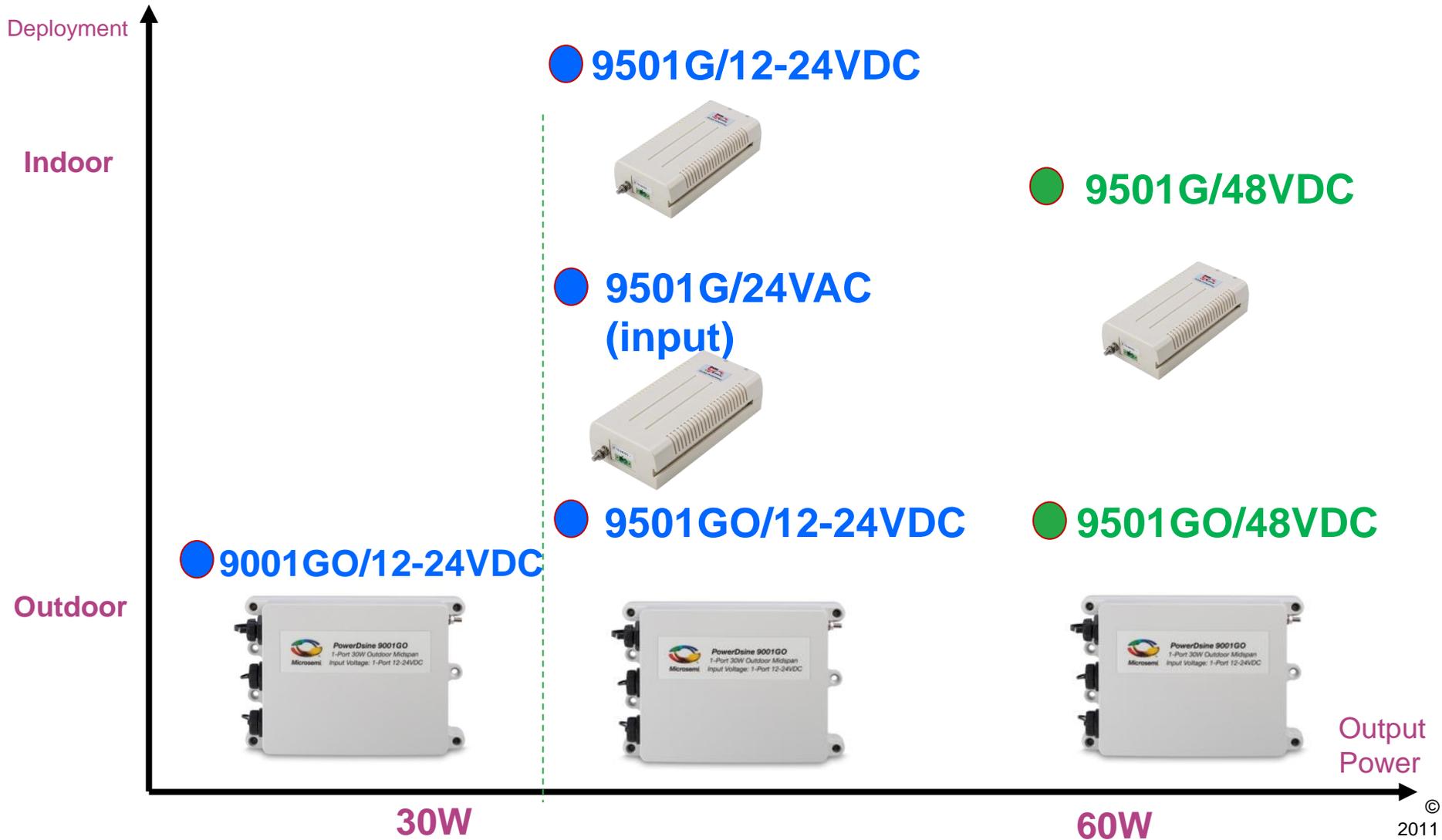
* PD9004 unmanaged

Single Port PoE Midspans Portfolio (AC input)



* 30w per port

DC input Midspans (12-72w range)



PowerView Pro : Remote SNMP

- Only available on our Multiport units (65XX,90XX,95XX)
- SNMP v3 Ipv4 & 6
- Remotely reboot PD's (from any web browser)
- Port Scheduling (Turn on/off, saves energy and protects from intrusion)
- Prioritize Ports to increase UPS life
- Set Traps, alerts and monitor power consumption, and more

View - Status
Midspan Nickname: Midspan PoE Device

Port status panel

| # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Power (W) | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | |
| Description | | | | | | | | | | | | | | | | | | | | | | | | | |

General power status table

| | |
|--------------------------------|-----------------------|
| Midspan Status | |
| Total Power Consumption (Watt) | 8.4 |
| Maximum available Power (Watt) | 200 |
| System Voltage (Volt) | 49.1 |
| PD Detection Method | IEEE 802.3af + Legacy |
| Midspan Status | Active |

UPS Power Management

| | |
|-------------------------------------|-----|
| Midspan UPS Powered by | AC |
| Midspan UPS Battery Level(%) | 100 |
| Midspan UPS Battery Time Left (min) | 64 |

UPS Power management Dedicated Information

Ports power status table

View - Configuration Summary

IP in-use

| | |
|-------------------|--------------|
| Obtain IP by DHCP | No |
| IP Address | 172.16.4.10 |
| IP Mask | 255.255.0.0 |
| Default Gateway | 172.16.1.254 |

Static Network Configuration

| | |
|-----------------|-------------------|
| IP Address | 172.016.004.010 |
| IP Mask | 255.255.000.000 |
| Default Gateway | 172.016.001.254 |
| MAC Address | 00:05:5A:01:02:5A |

Remote Servers

| | |
|---------------|-----------------|
| NTP Server | 128.249.001.010 |
| SysLog Server | 000.000.000.000 |

Remote Trap SNMP Managers List

| | |
|-------------|---------|
| Manager #1 | 0.0.0.0 |
| Manager #2 | 0.0.0.0 |
| Manager #3 | 0.0.0.0 |
| Manager #4 | 0.0.0.0 |
| Manager #5 | 0.0.0.0 |
| Manager #6 | 0.0.0.0 |
| Manager #7 | 0.0.0.0 |
| Manager #8 | 0.0.0.0 |
| Manager #9 | 0.0.0.0 |
| Manager #10 | 0.0.0.0 |

Remote Access & Security

| | |
|-----------------------|-------------------------------------|
| Telnet/SSH | None |
| SNMP v2 | <input checked="" type="checkbox"/> |
| SNMP v3 | <input checked="" type="checkbox"/> |
| Web SSL Encryption | <input checked="" type="checkbox"/> |
| RADIUS Authentication | <input type="checkbox"/> |
| RADIUS Accounting | <input type="checkbox"/> |

Advanced Features

| | |
|----------------------|--------------------------|
| Weekly Schedule | <input type="checkbox"/> |
| UPS Power Management | <input type="checkbox"/> |

Date and Time

| | |
|-----------------|------------|
| Time (GMT) | 11:42:38 |
| Date (DDMMYYYY) | 06/06/2006 |

What's Next?

Roadmap

- **Indoor/Outdoor 30W/60W 12-24/48V DC Input**
- **Indoor 60W 24V AC Input**
- **Indoor 10G PoE Midspan (802.11ac)**
- **2-port Outdoor Hub ,3-port Outdoor PoE Managed Switch**
- **Surge Protector**
- **NMS Tool**



Q3 - New Outdoor 3 ports PoE Managed Switch



Microsemi

Main

Configuration

Advanced

Information

My Device

Unit Status

| | Status |
|-------------------|----------------------|
| Uplink Ethernet | 1000 Mbps |
| Total Power Usage | 42W (70% out of 60W) |

Ports Status/Reset

| | Port #1 | Port #2 |
|-----------------|--------------------------------------|--------------------------------------|
| Ethernet Link | 1000 Mbps | Off |
| PoE Port Status | Delivering Power | Disable |
| Power Usage | 19.2W (out of 30W) | --- |
| Power Reset | <input type="button" value="Reset"/> | <input type="button" value="Reset"/> |

PowerDsine

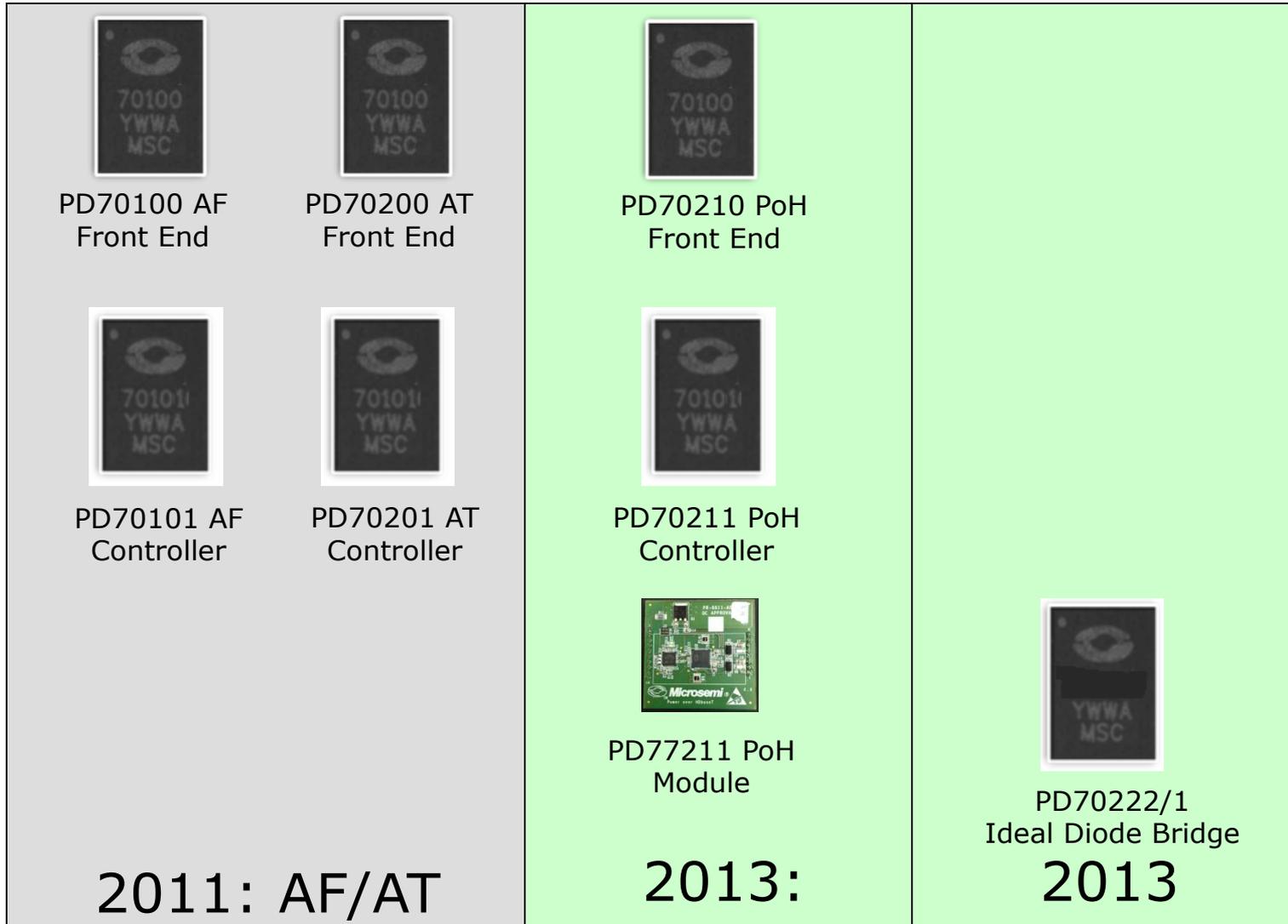
9003G/M - Think outside the building.

- **1 x 1000Mbps Uplink Port**
- **2 x 1000Mbps 802.3AT ports (30W per port)**
- **Outdoor Rated - IP66, UV Protection, UL60950-1 & UL60950-22**
- **Lightning Protection**
 - **GR-1089**
 - **EN61000-4-5 Class 5 (6kV CM)**
- **Operating Ambient Temperature:**
 - 40C to 50C - for full load 60W**
 - 40C to 55C - for half load 30W**
- **AC Input (waterproof connector)**



PD Solutions

PD IC Roadmap



2011: AF/AT

2013:

PoH

2013
PD70222/1
Ideal Diode Bridge

PoE PD Family Features

- **IEEE802.3at-2009 compatible**
 - PD7010x: Type 1 only
 - PD7020x: Type 1 or Type 2;
- **4-pairs applications with single IC**
- **0.6ohm Isolating switch with thermal protection**
- **Wall adapter support**
- **2-event classification per IEEE802.3at supporting classes 0 to 4**
- **DC/DC input cap fast discharge:**
 - Prevent long delays between connection and disconnection of PD's
- **T_A: -40°C to +85°C**
- **Outdoor Application available for GR-1089 compliance**
- **PD70100/200: DFN-12L 4x3mm**
 - External PWM controller with power good
- **PD70101/201: QFN-32 5x5mm**
 - Internal PWM Controller

Full Production

POH PD Family Features (exclusive in red)



- **PoH compatible**
 - Type 1, Type 2, **Type 3**
 - Twin Type 2, **Twin Type 3**
- **4-pairs applications with single IC (up to 95W)**
- **25Kohm input signature disconnection after turn-on**
 - Eliminates power dissipation
 - $57V^2/25K = \underline{0.13W}$
- **0.3ohm Isolating switch with thermal protection**
 - Dissipates only 0.036W in AF or 0.11W in AT 2-pairs (vs. 0.36W for 1ohm Rdon in competition)
- **DC barrel connector input support with classification disconnection**
- **Wall adapter support**
- **2-event classification per IEEE802.3at supporting classes 0 to 4**
- **3-event classification support per PoH**
- **DC/DC input cap fast discharge:**
 - Prevent long delays between connection and disconnection of PD's
- **T_A: -40°C to +85°C**
- **Outdoor Application available for GR-1089 compliance**
- **PD70219: MLPD-16 5x4mm**
 - External PWM controller
- **PD70211: QFN-36 6x6mm**
 - Internal PWM Controller

PD70210 in Production

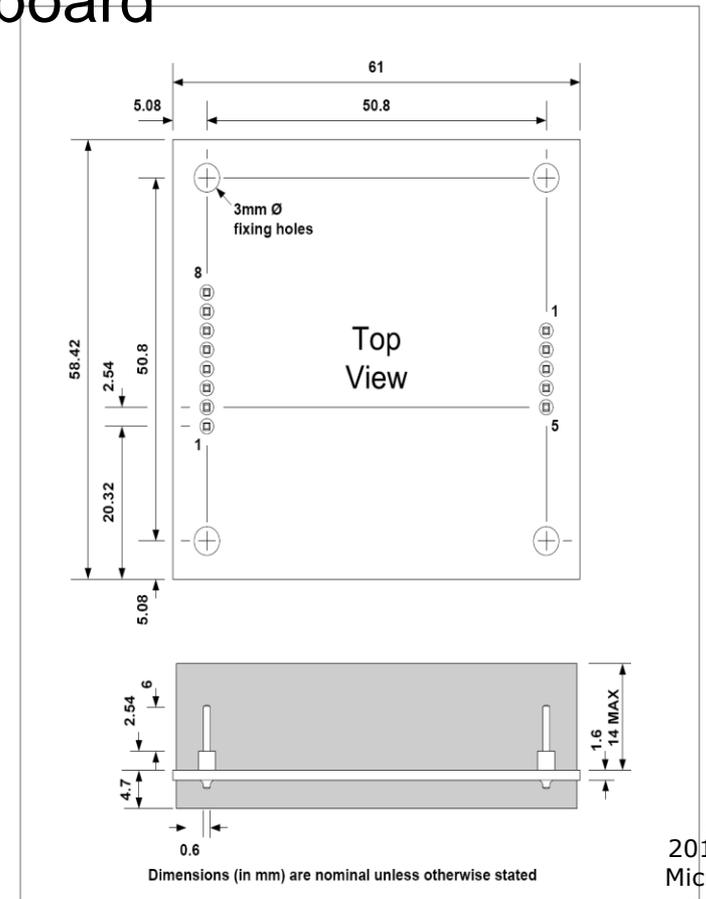
PD70211 Samples Available

PD70x01 PWM Features

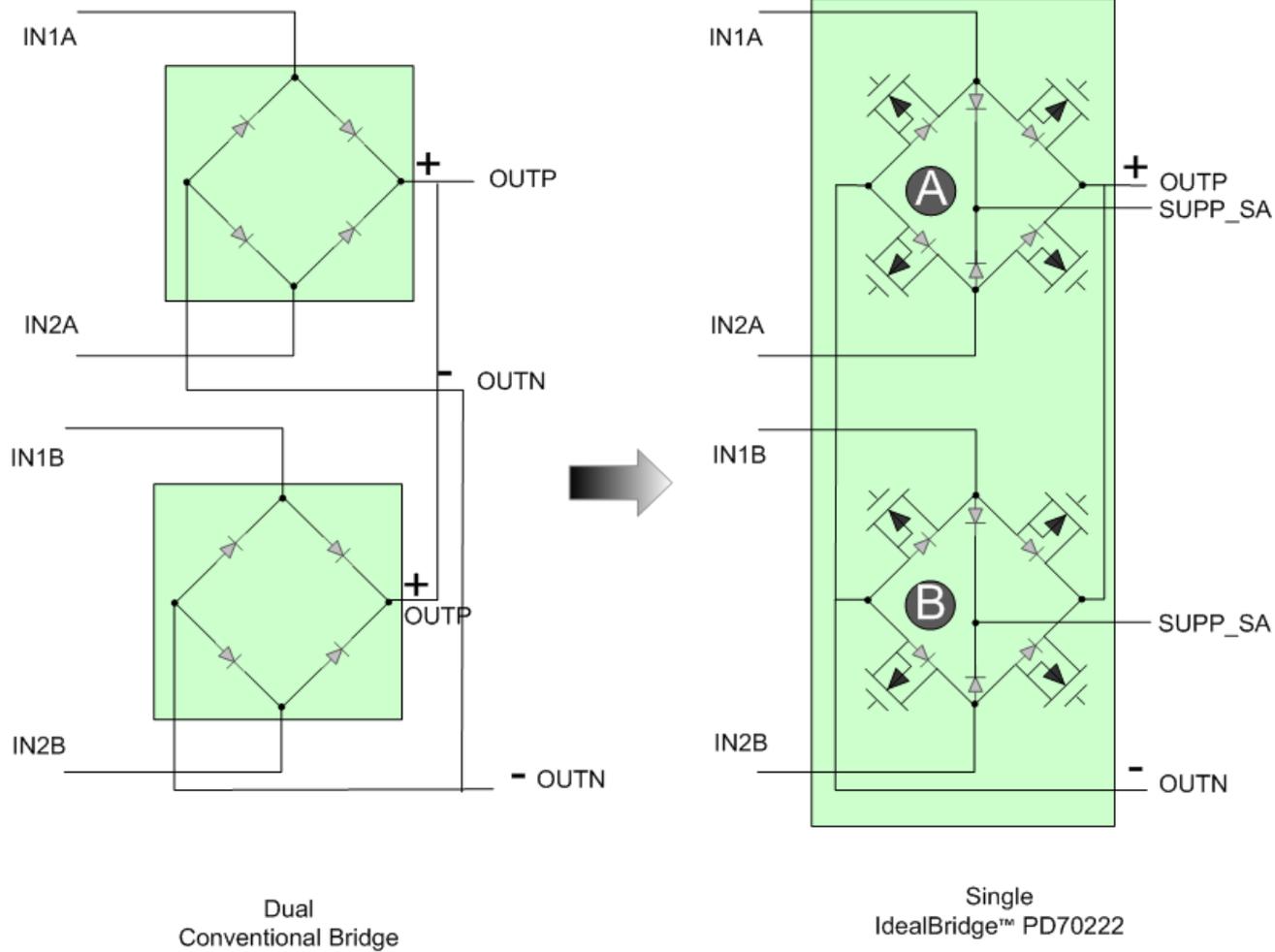
- **Supports Flyback with Synchronous rectification**
 - No need for slope compensation while lowering External MOSFET Voltage Rating
- **Supports Buck, and Forward Architectures**
 - Max D is 50% --- no need for slope compensation while also lowering MOSFET Voltage Rating
- **Programmable UVLO and hysteresis**
 - Can be used with non-standard voltages for long-range PoE
- **Low Power (Pulse Skip) Mode**
 - Reduces switching losses when PD enters low power mode by 80%
 - Can be enabled/disabled by host based on any event (e.g. Magic Packet)
- **Port Fail Warning**
 - Allows PD Host to perform an orderly shutdown within 1.8 milliseconds
- **Adjustable frequency 100kHz to 500kHz**
 - Allows picking optimization for size or efficiency, and avoiding RF interference

PoH PD Module

- Support 95W PoH
- Module size: 61mmx58.42mm
- Diode bridge located on customer's board
- Output voltage: 24V
- Samples Available



PD70222/1 Ideal Diode Bridge

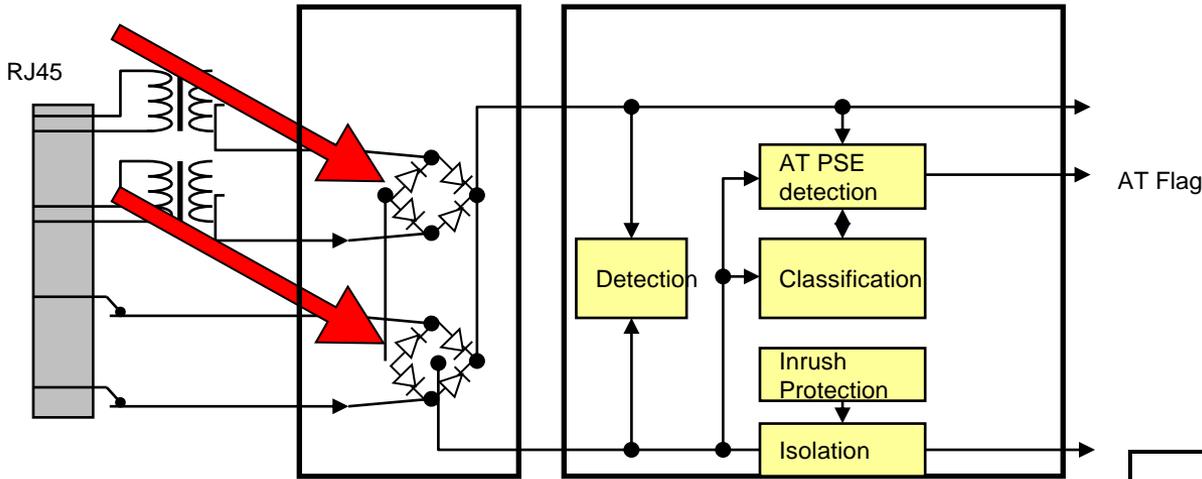


PD70222/1 Features & Benefits

| Features | Benefits |
|--|--|
| PD70222 Contains 2 bridges | 1 IC is needed for PD PoE/PoH application |
| PD70221 Contains 1 bridge | 2 ICs are needed for UPoE PD Application with 2 PD ICs only |
| Supports 1A ongoing | Support PoE 802.3 and PoH applications |
| 0.04W power dissipation in 802.3af 0.13W power dissipation in 802.3at | Saves Power. Best solution where high efficiency is required Easiest way to increase the system efficiency |
| Single IC solution | Simple design, save part count, space and complexity |
| “Power present” indicator signals for identifying 4-pair bridge power | When used with AT flag Enables the PD controller to know how much power it can consumes |
| -40c to 85c | Industrial and commercial applications |
| Samples Available Production Dec/2013 | |

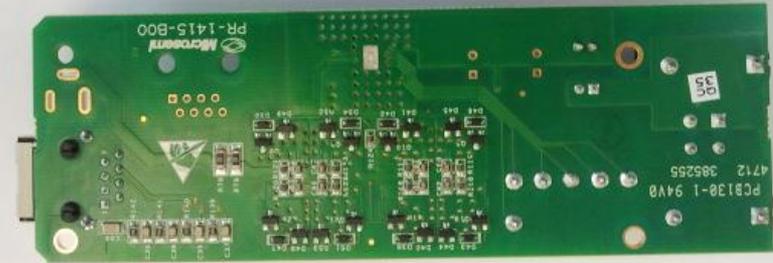
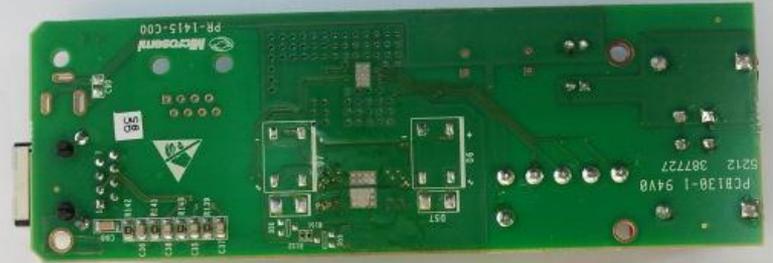
PD70222 Block Diagram & Power Comparison

Diode Bridges



| | Power (W) | Current (A) | Power Dissipation (W) | | |
|--------------------------|-----------|-------------|-----------------------|-----------------|-----------------|
| | | | PD7022x | Schottky Bridge | Standard Bridge |
| Class 1 | 3.84 | 0.09 | 0.003 | 0.10 | 0.13 |
| Class 2 | 6.50 | 0.16 | 0.009 | 0.09 | 0.22 |
| Class 3 | 12.95 | 0.35 | 0.04 | 0.44 | 0.49 |
| Class 4 (2-pairs) | 25.50 | 0.60 | 0.13 | 0.83 | 0.84 |
| PoH (2-pairs) | 47.50 | 0.95 | 0.32 | 1.42 | 1.33 |
| Class 4 (4-pairs) | 51.00 | 0.60 | 0.26 | 1.66 | 1.68 |
| PoH (4-pairs) | 95.00 | 0.95 | 0.65 | 2.83 | 4.18 |

PD70222 compared to MOSFET solution





Driving LEDs from PoE

Isolated AC/DC or DC/DC Architecture Comparison

| PARAMETER | STANDARD FLYBACK | ACTIVE CLAMP FLYBACK | LLC RESONANT |
|---------------------|------------------|--------------------------------------|--|
| BOM Cost | Lowest | 5-15% Higher | Similar To Active Clamp |
| Component Count | Lowest | 2X Higher | Similar To Active Clamp |
| Device Ratings | Highest | Similar To Flyback | About ½ Of Flyback |
| Physical Sizes | Largest | Similar To Flyback | Thin Power Transformer / Smaller Filter Caps |
| Form Factor | Highest Profile | Less Volume Needed | 20% less than Flyback |
| Efficiency | 70-85% | 85-90% | >92% |
| EMI & THD | Highest | Much Lower | Even Lower Still |
| Switching Frequency | Fixed | Variable | Variable |
| Primary Attributes | Lowest Cost | Improved Efficiency Reduced Noise | Lowest Noise, Highest Efficiency, Lowest Height |

LLC Topology: Isolated Conversion Size, Noise and Efficiency

- **Lower Noise Generation**
 - Zero Voltage Switching
 - Soft Switching
 - Lower peak currents
 - Lower voltage stress
- **Efficiency**
 - Zero Voltage Switching
 - Work at full duty, extending efficiency to all load ranges
- **Size**
 - LLC utilizes core of transformer better than Flyback → 20% reduction
 - Less noise filtering components

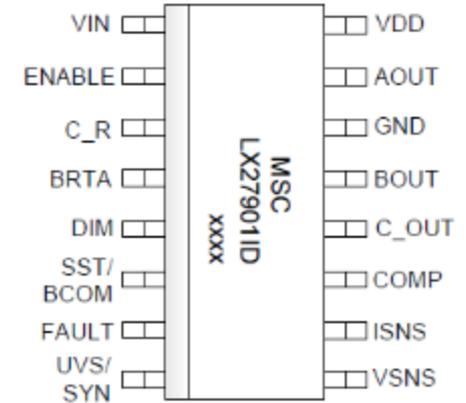
Microsemi Isolated PWM and Resonant Controllers

| P/N | LX27901 | LX7309 | IPS18 |
|---|--------------------------|------------------------|--------------|
| Topology | Resonant LLC Half-Bridge | Flyback/ Forward/Boost | Flyback |
| Control | Voltage Mode | Current Mode | Current Mode |
| Efficiency, non-synch. (AC to 12VDC, 5A) | ~93% | ~88% | ~85% |
| Efficiency, synchronous (AC to 12VDC, 5A) | ~95% | ~92% | N/A |
| Regulated Outputs | 1 | 1 | 1 |
| Frequency (kHz) | 140-1000 | 100-1000 | 30-150 |
| Duty Cycle (%) | 50 | 50 | 0-66 |
| Output Driver | 800mA | 500mA | 100mA |
| Current Sense (mV) | 421 | 200 | 700 |
| Current Sense Input Signal accuracy | 6% | 2.5% | 6.4% |
| Start-up Current (max) | <40uA | <40uA | 140uA |
| Synchronous Rectification | Yes | Yes | No |
| Power Fail Warning | No | Yes | No |
| Thermal Shutdown | No | Yes | Yes |
| Direct Optocoupler connection | Yes | Yes | Yes |
| External Synchronization | Yes | Yes | No |
| Hiccup Overload Protection | Yes | Yes | Yes |
| Pulse Skipping on Standby | No | Yes | Yes |

Microsemi LLC Controllers

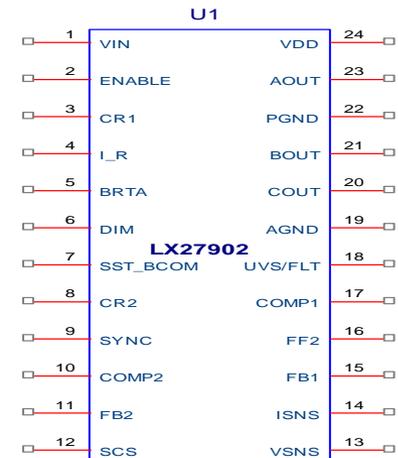
■ LX27901

- Primary side LLC resonant Controller
- Drives a half bridge DC/DC circuit with safety isolation
- Dimming control for a single string
- 0.8A Source & Sink Gate Drive Capacity
- SOIC 16
- -40 to +85°C
- $\theta_{JA}=82.2^{\circ}\text{C/W}$
- Designed into E601i-A3 and E701i-A3 Vizio TV's



■ LX27902

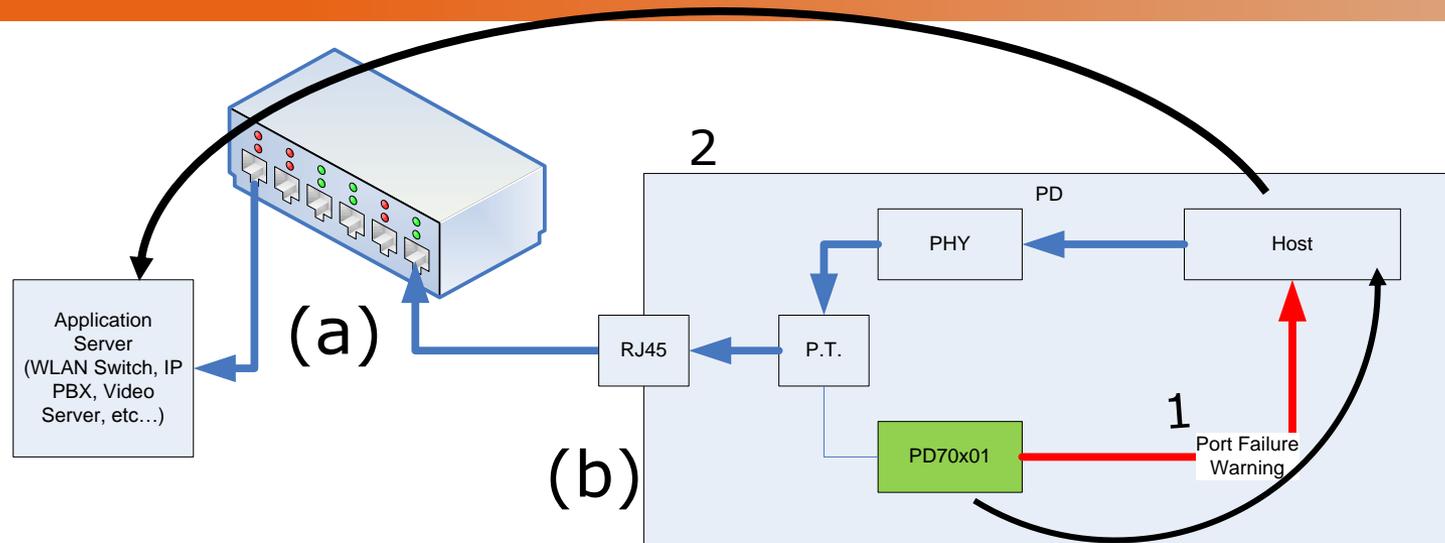
- Secondary side LLC controller with dual regulated outputs
- Dimming control fro a single string
- Synchronous regulation mode
- SOIC 24
- -40 to +85°C
- $\theta_{JA}=82.2^{\circ}\text{C/W}$



PD70x01 and LX7309 Synchronous PWM Controller w/Battery and Standby Support

- Buck, Flyback, Forward SEPIC
- Very High Efficiency Designs at Full Load
 - 200mA Current Sensing
 - Synchronous rectification
- High Efficiency in Standby
 - Pulse Skipping, reduces switching losses when system enters low power mode by 80%!
 - <40uA Startup Current
- Low Cost Application
 - <50% Duty cycle, no need for slope compensation while lowering External MOSFET Voltage
 - Direct Optocoupler connection
 - Built-in Error Amplifier, Voltage Reference and Soft Start
- Battery Backup Friendly Design
 - Power Fail Warning, 1.8 milliseconds of advance notice
- Built-in Protection
 - Hiccup overload protection
 - Thermal Shutdown with hysteresis
- Very Flexible Design optimized for size, efficiency or to avoid EMI issues
 - 100KHz to 500KHz
 - External Synchronization input

Port Failure Warning (PFW) in system

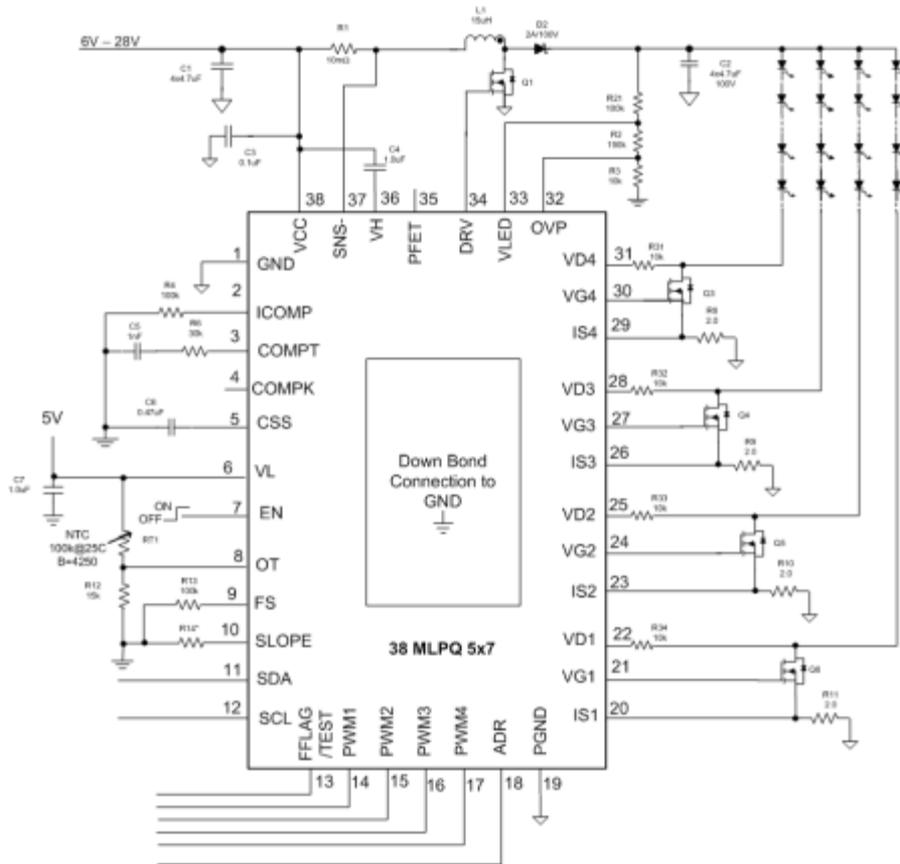


1. PoE power failure triggers interrupt (dying gasp) from PD70x01 to Host
2. Host sends packet to Application Server
3. Server loses connectivity with PD (cannot see it in the network)
 - a) PFW received: switch stopped providing power to PD → check the switch/midspan
 - b) PFW not received: cable has been disconnected → check the PD

IPS1x family: PWM Controllers w/Standby support

- Flyback
- High Efficiency in Standby
 - Pulse Skipping, reduces switching losses when system enters low power mode (IPS18 and IPS16)
 - 140uA Startup Current
- Low Cost Application
 - 0% to 66% Duty cycle
 - When <50% no need for slope compensation while lowering External MOSFET Voltage
 - Direct Optocoupler connection
 - Built-in Voltage Reference and Soft Start
- Built-in Protection
 - Hiccup overload protection (IPS18 and IPS15H)
 - Thermal Shutdown with hysteresis
- Very Flexible Design optimized for size, efficiency or to avoid EMI issues
 - 30KHz to 150KHz
 - External Synchronization input (IPS16)

Typical application (white)



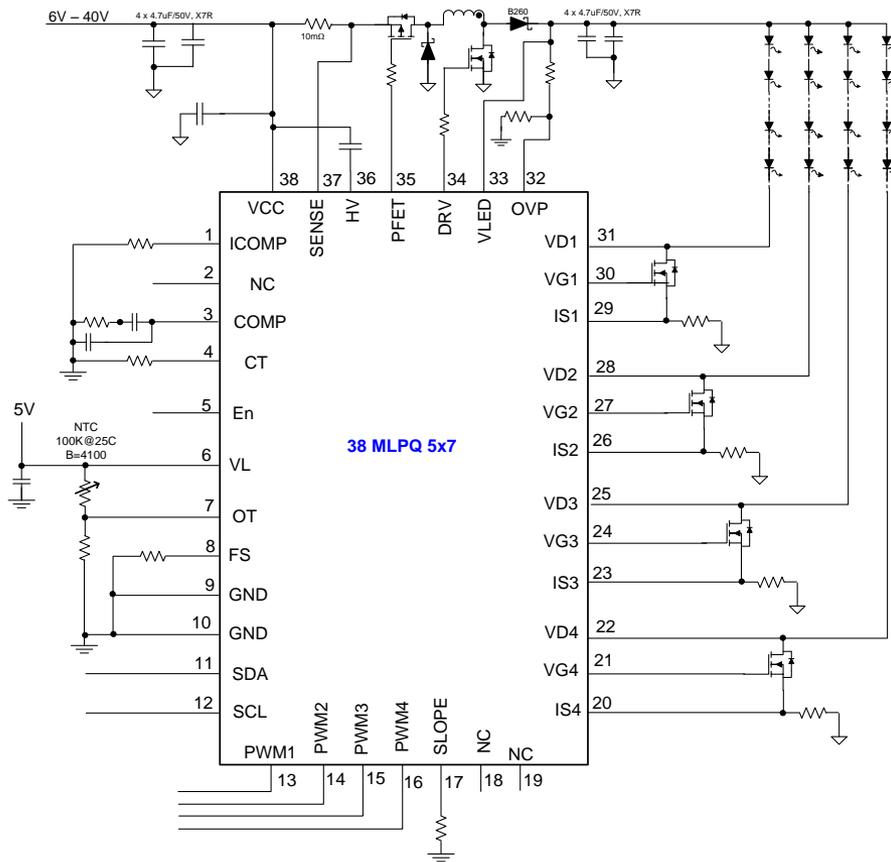
Highlights

- Vin = 8-28Vinput
- Boost Topology
- 4 LED Strings with Independent PWM Control
 - RGB or White, Strings can be left open or tied together if needed
- Each LED string can handle up to 500mA LED Current and up to 60V with the proper set up
- Analog or Digital Wide Dimming Range 3000:1
 - FPWM = 160Hz
 - Able to handle the common 0-10V dimming input
- Programmable LED Over Temperature Protection (External NTC)
- 5V/10mA output (VL)
- Soft Start to Limit Inrush Current and Protect the LEDs
- Network Integration via **I²C Digital Interface**
 - LED Fault Management and Reporting
 - Fixture Dimming (LED Current Control)
 - Individual String Voltage control for selective turn on/off
- Short Circuit Protection, Open and shorted LED detection and protection

Multichannel LED Controller for automotive: LX2260



Typical application (Automobile display illumination)



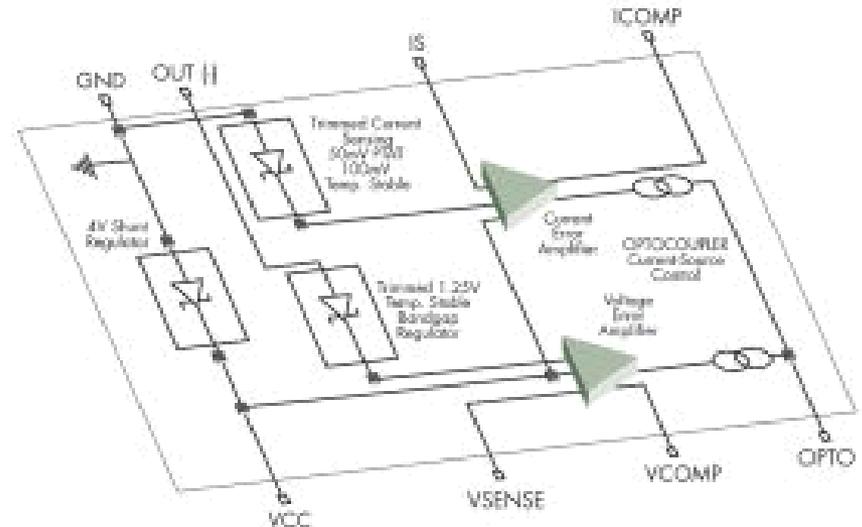
Highlights

- Vin = 8-28Vinput
- Auto Buck, Boost, and Buck-Boost Mode Transition
- 4 LED Strings with Independent PWM Control
 - RGB or White, Strings can be left open or tied together if needed
 - +/-1.5% String Current Matching
- Each LED string can handle up to 500mA LED Current and up to 60V with the proper set up
- Analog or Digital Wide Dimming Range 3000:1
 - FPWM = 160Hz
 - Able to handle the common 0-10V dimming input
- Programmable LED Over Temperature Protection (External NTC)
- 5V/10mA output (VL)
- Soft Start to Limit Inrush Current and Protect the LEDs
- Network Integration via **I²C Digital Interface**
 - LED Fault Management and Reporting
 - Fixture Dimming (LED Current Control)
 - Individual String Voltage control for selective turn on/off
- Short Circuit Protection, Open and shorted LED detection and protection
- AEC-Q100 Qualification
- Temperature Range -40°C to +85°C

LED V/I Feedback Amplifier: IPS21

Production

- Dual V and I Sense Amplifiers w/Internal References
- Dual Drive of Optocoupler for Isolated Solutions
- One amplifier can provide overvoltage limit and the other amplifier can provide LED current regulation. OV amplifier only controls the loop if the output is open circuited.
- Usable with Any Primary Side Controller
- IPS20: 50mV PTAT ISense Ref V
 - (May Use PCB Trace as Rsense)
- IPS21: 100mV ISense Ref V
- **Target Applications**
 - LED Lighting
 - Fast Chargers
 - Industrial / Bench Supplies



■ Competition

Who do you call?

Primary Contact Your Local Rep

- To Qualify Opportunity
- For Registration Pricing
- For Samples

- **Doug Spinella – Midspan OEM Sales, Global**
 - Doug.Spinella@microsemi.com
- **Heidi Gonzales– Inside Sales America**
 - hgonzales@microsemi.com

Thank you!
