

# MPS High Power & Isolation Solutions

Industrial Power Supply Seminar  
@ Nanjing

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rev 20180504

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## Industrial Applications

### Energy Storage



- Supports various isolation requirements to maximize system safety level
- Industry leading performance
- Isolated power module: switching frequency up to 10MHz to minimize solution size

Isolated products compliant to different safety specifications:

- UL1577
- VDE V 0884-11
- IEC62368-1

## Products

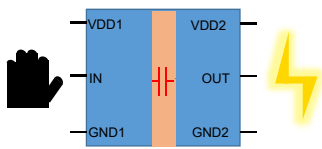
- Isolated Gate Driver
- Digital Signal Isolator
- Isolated Power Module
- Isolated Amplifier
- Half Bridge GaN Driver
- Digital Controllers

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## Why It Needs Isolation?

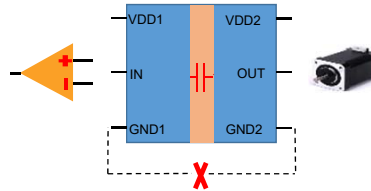
### Safety

- Protect the human body and low voltage devices



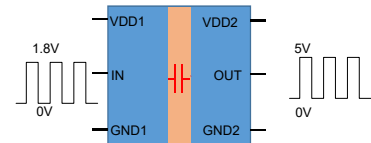
### Noise Immunity

- Isolate analog and power GND
- Improve communication quality



### Level Shift

- Shift from 1.8V up to 5V for example

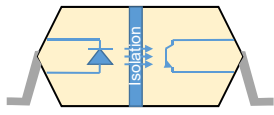


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## Isolation Technologies Comparison

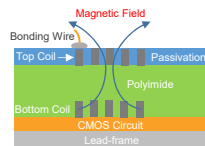
### Opto-coupler Solution

- Short lifetime
- Large supply current
- Space consuming
- Low data rate <10Mbps
- Low CMTI, ~20kV/us
- Long propagation delay



### Magnetic Solution

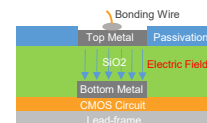
- Long lifetime
- Low supply current
- Saving space
- High data rate, >100Mbps
- High CMTI, >100kV/us
- Short propagation delay
- Higher emission than capacitive solution
- Low immunity for magnetic noise



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### Capacitive Solution

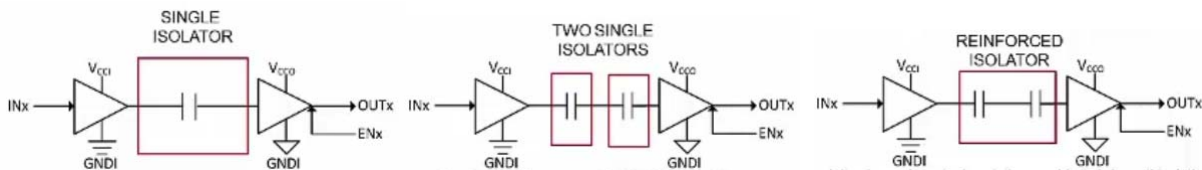
- Long lifetime
- Low supply current
- Saving space
- High data rate, >100Mbps
- High CMTI, >100kV/us
- Short propagation delay
- Low emission
- High immunity for magnetic noise



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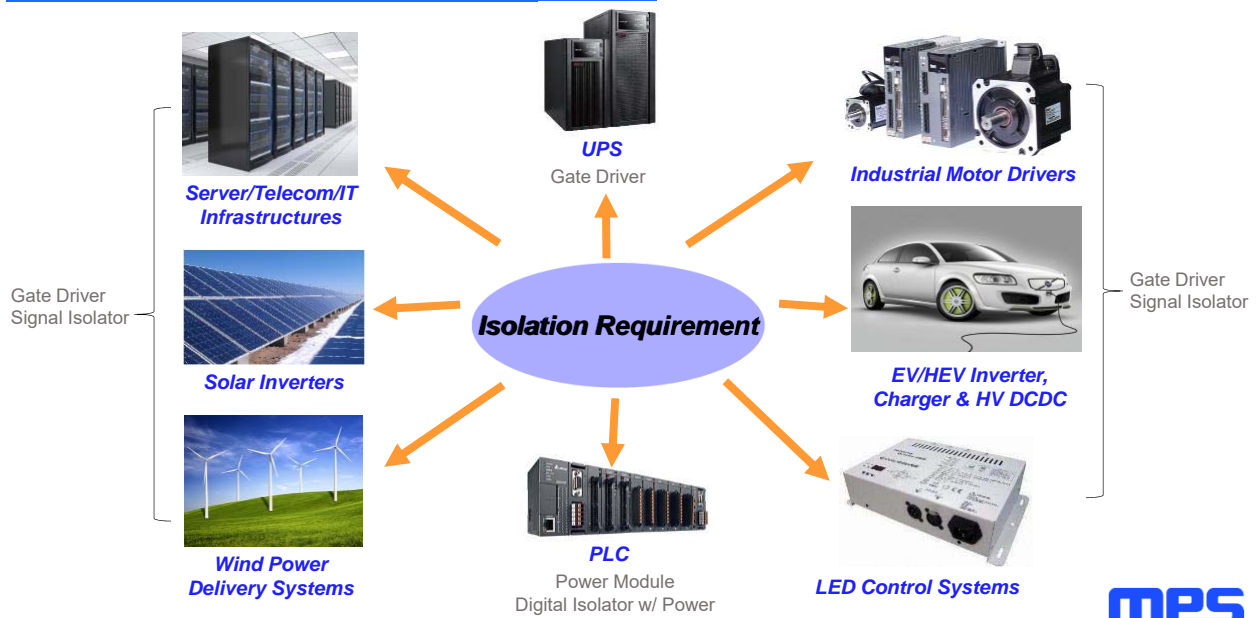
## Basic & Reinforced Isolation

- **Basic Isolation:**
  - Provides single level insulation for protection against electric shock.
- **Double Isolation:**
  - Provides double layers of electric shock isolation robust enough to provide protection for a double fault scenario.
- **Reinforced isolation:**
  - A single isolation layer that is equivalent in protection to a double isolation system regarding electric shock.



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## Target Markets – Isolation Products



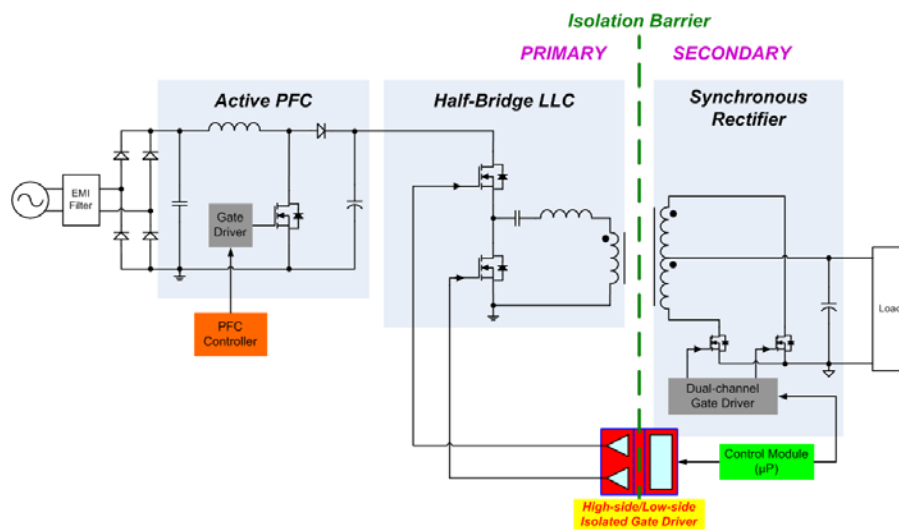
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## MPS Isolation Products - *Isolated Gate Driver*

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### Typical Application Circuit for Isolated Power Supply

Power supply with PFC, LLC and synchronous rectification stage



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## Power Device Requirements Comparison for Gate Driver

	Si FET	IGBT	SiC FET	GaN FET
Switching Frequency	High (>20kHz)	Low-to-Medium (<100kHz)	High (>20kHz)	Very High (>1MHz)
Rail Voltage	Up to 650V	>650V/1000V	>650V	<650V
Power	Low-to-Medium (<10kW)	Medium-to-High (>3kW)	Medium-to-High (>3kW)	Low-to-Medium (<10kW)
Operating Driving Voltage	10V to 12V	12V to 15V	>20V (positive + negative)	~5V
Negative Gate Drive Voltage	Generally not needed	Recommended	Generally needed	Not critical
Output UVLO	5V/8V	8V/10V	12V/15V or above	3V
Driving Current Requirements	Dependent on application. When higher power device is used, the higher current is required.			Relative Low
Propagation Delay	Shorter the better	Not critical	Short	Short

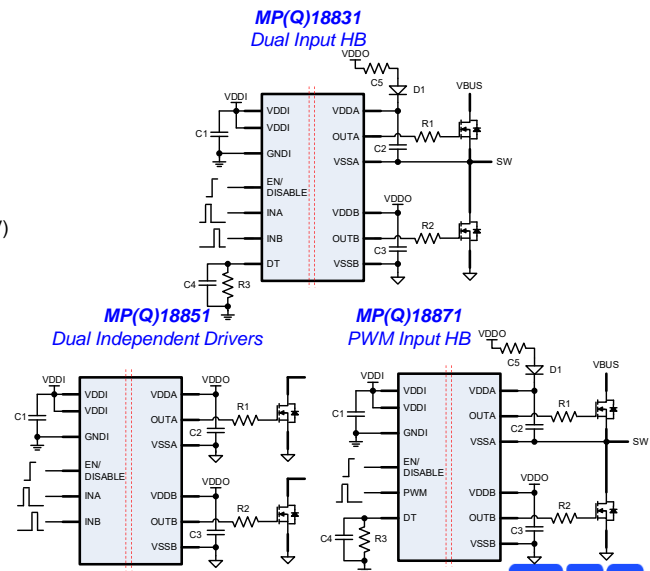


## MP18831/51/71 - Isolated Dual-Channel Gate Driver

### FEATURES

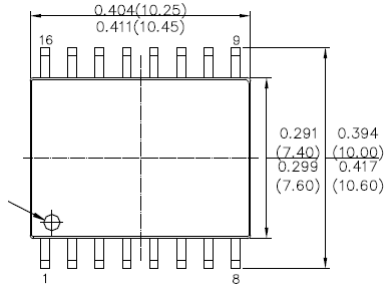
- Flexible Configuration: Rich Family, Independent Dual-Channel Driver, Dual-/PWM-Input Half-Bridge Driver
- Up to 5kV<sub>RMS</sub> Isolation
- CMTI >100kV/μs
- TTL and CMOS Compatible Inputs
- 30V Output Drive Supply with UVLO Options (5V/8V/10V/12V/15V)
- 4A Source/ 4A Sink Peak Current Output
- AECQ: 4A Source/ 8A Sink Peak Current Output
- 50ns Typical Propagation Delay
- Tight ±5ns Distribution from Part to Part
- Operating Junction Temperature Range -40°C to +150°C
- Standard Packages: Narrow Body SOIC-16; Wide Body SOIC-16, 5mm x 5mm LGA-13
- Applications: Solar Inverters, DC/AC Inverters, Offline isolated AC/DC Converters, Half/Full Bridge Converter, Bias for IGBT/SiC/MOSFET

P2P: Si823X, UCC20520/21520/21521

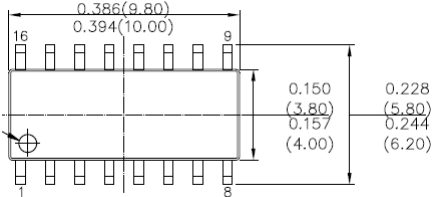


## Isolation voltage rating with different package

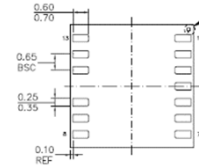
SOIC-16 WB



SOIC-16 NB



LGA-13



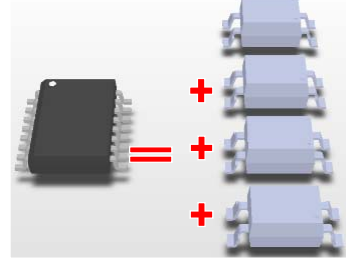
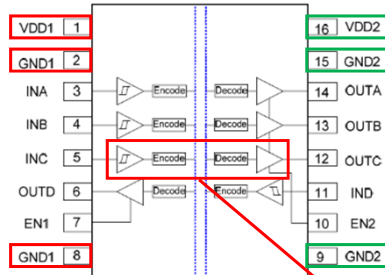
Package	Isolation Rating
SOIC-16 WB	5k $V_{rms}$
SOIC-16 NB	3k $V_{rms}$
LGA-13	2.5k $V_{rms}$

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**MPS Isolation Products**  
- *Digital Isolator*

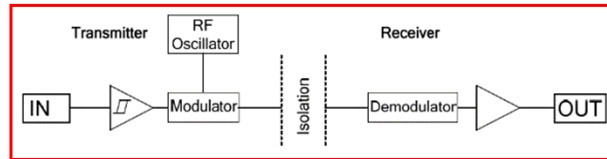
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## What is a Digital Isolator?



One digital isolator can replace 4/6 opto-coupler

- Isolated power supplies
- Isolated in/out signals



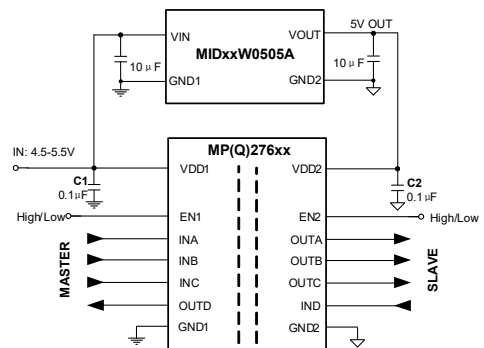
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## MP276xx – 2~6 Channel digital isolator

### Key Features

- Wide Input Range: 2.5V-5.5V
- Up to 150Mbps Data Rate, 20Mbps option
- Ultra Low Power Supply Current
- High Electromagnetic Immunity
- $>\pm 100\text{kV}/\mu\text{s}$  Common-mode Transient Immunity
- 13ns Propagation Delay for 5V Operation
- 5kVrms Isolation, 2.5kVrms Option
- Selectable Channel Direction
- Selectable Output Default Value
- Available in SOICW-16
- Applications: E-meter, Isolated ADC/DAC, Motor control, Industrial automation, SPI Isolation

### Typical Circuit



P2P: ISO7741/7761, Si8641, MAX14931

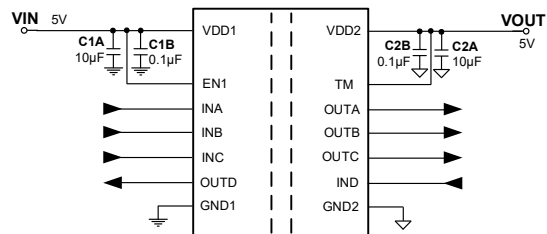
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## MP278xx – 2~6 CH Digital Isolator with Isolated Power

### Key Features

- Input Range: 4.5-5.5V
- Integrated 1W Isolated Power
- Up to 50Mbps Data Rate
- High Electromagnetic Immunity
- $>\pm 100\text{kV}/\mu\text{s}$  Common-mode Transient Immunity
- 3kVrms Isolation
- Selectable Channel Direction
- Selectable Output Default Value
- SCP, OCP, OTP Protection
- Available in SOICW-16 Packages
- Applications: Battery management systems (BMS), EV Charging Stations, Industrial Communication systems, Industrial automation/PLC

### Typical Circuit



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**MPS Isolation Products**  
*- Isolated Power Module*

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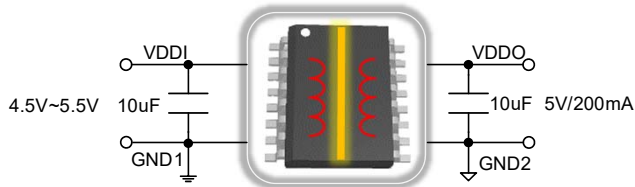


## MIDxxW0505A- 5V to 5V Isolated Module

### Key Features:

- Input Range: 4.5V-5.5V
- 5V Output Voltage
- Excellent Load Transient Performance
- 0.5% Load Regulation, 1.5% Line Regulation
- Strong Magnetic Field Immunity
- 0.6W, 1W, 2W Output Rating Option
  - MID01 – 1W, MID06 – 0.6W
- SCP, OCP, OTP Protection
- 3kVrms Isolation, 5kVrms Option
- 54% Efficiency
- Low Emission: meet CISPR 32 Class B
- Small SOICW-16 and SOICW-8 Package
- Applications: Industrial Automation, PLC I/O modules, Grid protection relays, Isolated sensor power, Isolated bias for RS-485/CAN

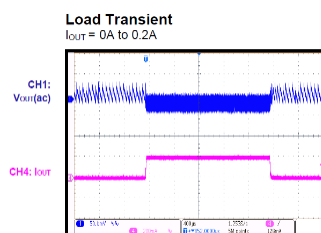
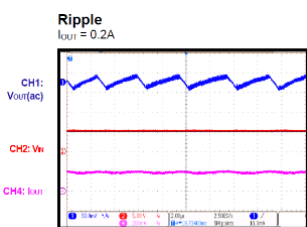
### Typical Circuit



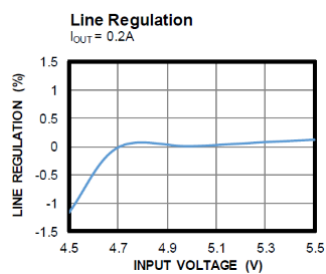
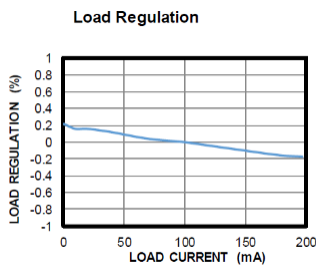
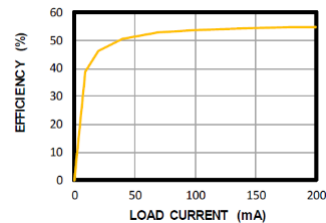
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## MIDxxW0505A – 1W/0.6W Isolated Module

$V_{IN} = 5V$ ,  $V_{OUT} = 5V$ ,  $C_{IN} = C_{OUT} = 10\mu F$ ,  $T_A = 25^\circ C$

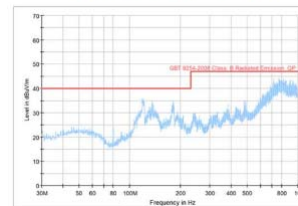


Efficiency vs. Load Current



Radiated Emission

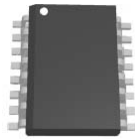
$V_{in}=5V$ ,  $V_{out}=5V$ , Output Current=200mA, CISPR 32 Class B



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## Comparison with traditional Module

Basic Specs	MID1W0505A	Competitor1	Competitor1
Output Power	1W	1W	1W
Package	SOICW-16: 10.3 x 10.3 x 2.5mm	DFN: 9.00 x 7.00 x 3.10mm	SIP: 19.65 x 6 x 10.16mm
Isolation Voltage	3kVrms	3kVDC	1.5kVDC
Operation Temperature	-40°C to 125°C	-40°C to 125°C	-40°C to 105°C
Input Voltage Range	4.5V to 5.5V	4.5V to 5.5V	4.5V to 5.5V
Load Regulation	1% (0%-100% load)	8% (10%-100% load) 10% (0%-100% load)	8% (10%-100% load) 10% (0%-100% load)
Line Regulation	1.50% @Vin=4.75V to 5.25V	10% @Vin=4.75V to 5.25V	10% @Vin=4.75V to 5.25V
Magnetic Field Immunity	Strong	Weak	Weak
Load Transient Performance	<100mV	>400mV	>400mV
Comments	Better regulation, Isolation and Immunity	Bad regulation	Bad regulation, Lager size



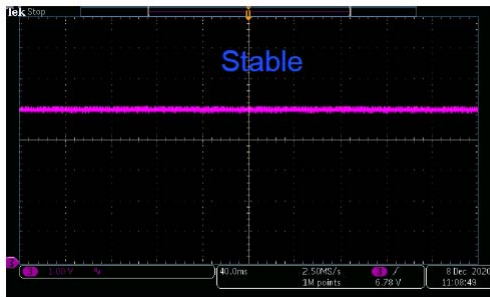
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## Strong Magnetic Field Immunity

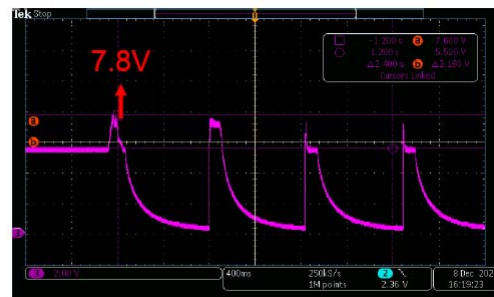
Testing condition



MID1W0505A



Traditional Module



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# MPS Isolated Products Selection Table

Gate Drivers											
Family	Part Number	P2P Replacement	Channels	Power Switch	Isolation Rating	Driver Bias (V)	Driver Bias UVLO (V)	Peak output Current (A)	Min CMTI	Package	Applications
MP18831/51/71	MP18831-4CGY	S1823x UC20520 UC21520 UC21521	2	SIC/IGBT/MOSFET/GaN	5kVrms	6.5-30V	3/5/8/10/12	4	100V/ns	SOIC-16 (WB) 10.3x7.5mm	Server PSU Telecom Charging Station EV/Solar/Wind Motor Drive PSE
	MP18851-A4CGY		2	SIC/IGBT/MOSFET/GaN		6.5-30V	3/5/8/10/12	4	100V/ns	SOIC-16 (WB) 10.3x7.5mm	
	MP18851-A4CGSE		2	SIC/IGBT/MOSFET/GaN	3kVrms	6.5-30V	3/5/8/10/12	4	100V/ns	SOIC-16 (NB) 9.9x3.9mm	
	MP18831-A4BGLJ		2	SIC/IGBT/MOSFET/GaN	2.5kVrms	6.5-30V	3/5/8/10/12	4	100V/ns	LGA-13 5x5mm	
	MP18851-A4BGLJ		2	SIC/IGBT/MOSFET/GaN		6.5-30V	3/5/8/10/12	4	100V/ns		
	MP18851-A4BGLJ		2	SIC/IGBT/MOSFET/GaN		6.5-30V	3/5/8/10/12	4	100V/ns		
MP18871-A4BGLJ	2	SIC/IGBT/MOSFET/GaN	6.5-30V	3/5/8/10/12		4	100V/ns				

Digital Isolator with Integrated Power												
Family	Part Number	P2P Replacement	Channel Number	Channel (Fwd/Reverse)	Data Rate	Isolation Level	CMTI (min)	Vin Range (V)	Vout (V)	Max Output Power (W)	Package	Applications
MP278xx	MPQ27831-HP-MGY-3	ISOW784x ISOW7821	4	3/1	50 Mbps	3kVRMS	100V/ns	4.5-5.5	3.3V/5V	1	SOIC-16 (WB) 10.3x7.5mm	Industrial PLC Power Meter EV BMS
	MPQ27821-LP-MGY-3		3	2/1	50 Mbps	3kVRMS	100V/ns	4.5-5.5	3.3V/5V	1	SOIC-16 (WB) 10.3x7.5mm	
	MPQ27811-HP-MGY-3		2	1/1	50 Mbps	3kVRMS	100V/ns	4.5-5.5	3.3V/5V	1	SOIC-16 (WB) 10.3x7.5mm	

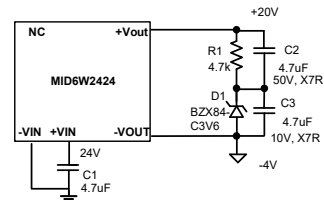
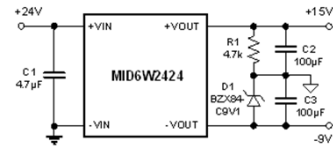
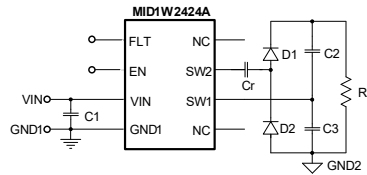
Digital Isolator – No Integrated Power												
Family	Part Number	P2P Replacement	Channel Number	Channel (Fwd/Reverse)	Data Rate	Isolation Level	CMTI (min)	Vin Range (V)	Surge Test Level	TPH (HL) 5V	Package	Applications
MP276xx	MP27631GY-Z	ISO7741 ISO7641 S18641 MAX14931	4	3/1	150 Mbps	5kVrms	100V/ns	2.5-5.5V	10kV	13ns	SOIC-16 (WB) 10.3x7.5mm	PLC Power Meter EV BMS

Isolated Power Modules											
Family	Part Number	Vin Range (V)	Vout	Isolation Rating	Outputs	Output Power (W)	Load regulation	Line Regulation	Package size	Applications	
MID1W0505A	MID1W0505AGY-3S	4.5-5.5	5	3 kVDC	1	1	1%	1.50%	SOIC16 (WB) 10.3x10.3x2.5mm	Industrial PLC Power Meter E-Meter	
MID06W0505A	MID06W0505AGY-3R	4.5-5.5	5	3kVDC	1	0.6	1%	0.50%	SOIC16 (WB) 10.3x10.3x2.5mm		

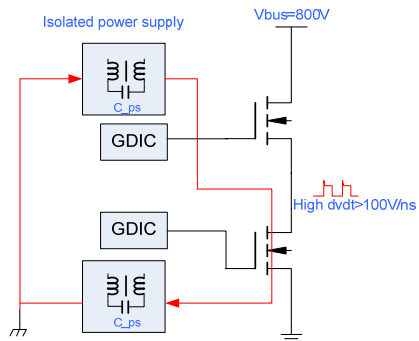
## MIDxW2424 – 24V to 24V Isolated Power Module

### Key Features

- Input Range: 24V ± 10%
- Output Power 1W, 3W, 6W option
- SCP, OCP, OTP Protection
- 3kVrms Isolation, 5kVrms Option
- Low Emission: meet CISPR 32 Class B
- Support No Load Operation
- Efficiency up to 87%
- SOICW-8 for 1W, LGA10x10mm for 3W and 6W



## Resonant Topology for Gate Driver Power Supply



- Higher Bus voltage results in higher isolation voltage for transformers
- Higher  $dv/dt$  allows for lower inter-winding capacitance
- Resonant topology allows for designs with high isolation voltage and low capacitance which is not possible with a fly-back transformer architecture

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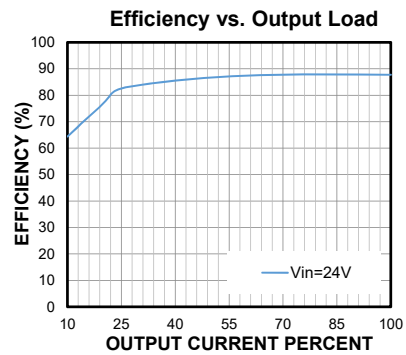
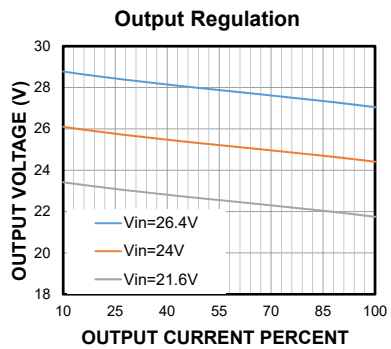
## LLC Resonant vs. Flyback Topology

	LLC Resonant Topology	Competitor PSR Fly-back Topology
Switching frequency	High (Up to 10MHz)	Low (<400kHz)
Transformer size	13uH (11x6mm)	30uH (10x10mm)
Leakage inductance	Utilize leakage inductance as part of resonant tank	Leakage inductance induce voltage spike and extra loss
Isolation voltage	Up to 5kVrms	1.5kVrms
Isolation capacitance	6 pF	13-25 pF
EMI emission	Better	Worse
Package Size	2x2.5mm	4x4mm
Diodes (including Zener)	3	6
BOM Components	21 components	26 components

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## MID6W2424A performance

$V_{IN} = 24V$ ,  $I_{out} = 0.25A$  (Full Load),  $T_A = +25^{\circ}C$ .

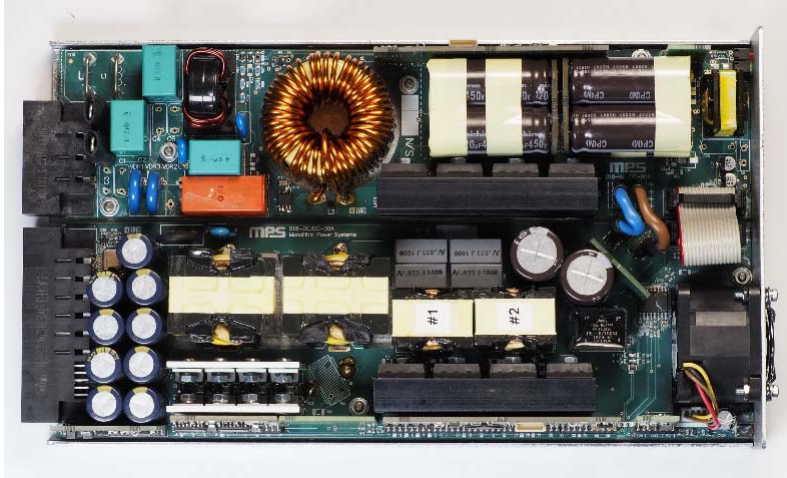


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**MPS High Power Solutions Demo**

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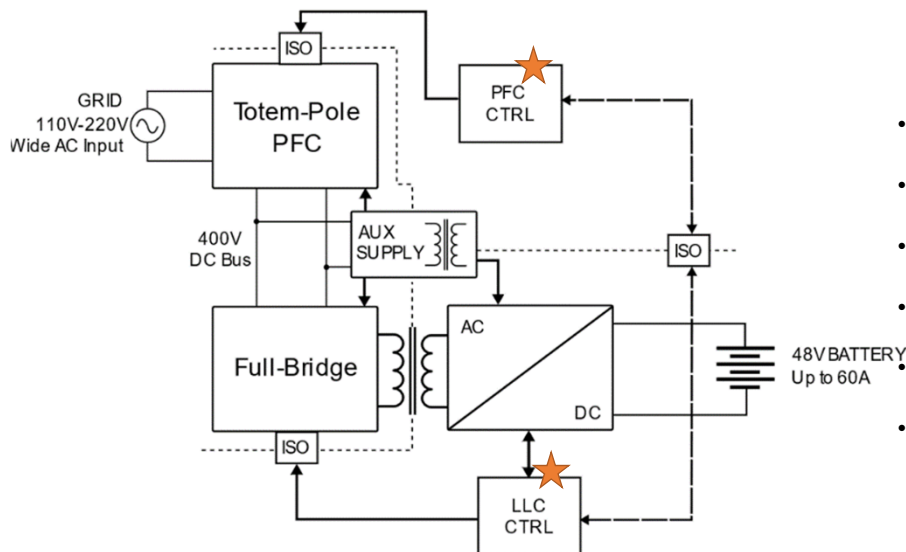
## MPS 3KW AC/DC Demo



- Power: **3 kW**
- Power Density: **2,14W/cm<sup>3</sup>**
- Efficiency: **96%**
- Size: **1U**
- Wide Input: **95 – 265 V<sub>AC</sub>**
- Output Voltage: **48V**

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## Demo Block Diagrams



- Power: **3 kW**
- Power Density: **2,14W/cm<sup>3</sup>**
- Efficiency: **96%**
- Size: **1U**
- Wide Input: **95 – 265 V<sub>AC</sub>**
- Output Voltage: **48V**

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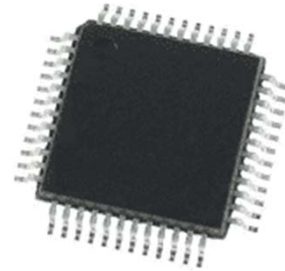
## MPF32010 – AC/DC Totem-Pole PFC Controller

### FEATURES

- **CCM Average Current** Mode Control PFC
- **Up to 100kHz** Operating Frequency
- Configurable Soft Start-Up
- **Configurable** AC Input Brown-In/Out, **Overload Protection**, Over-Current Protection (OCP), Over-Voltage Protection (OVP), and Over-Temperature Protection (OTP)
- **RS-485** and CAN Interfaces
- **User-Friendly GUI** for Parameter Configuration
- **UART** Port to Allow Communication with Companion DC/DC Controllers

### Applications:

- EV Battery Chargers
- UPS
- Energy Storage



MPF32010  
Package: TQFN-48

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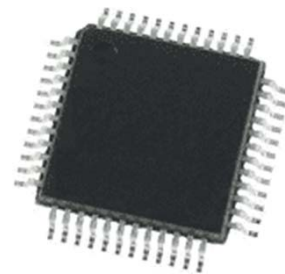
## MPF32020 – DC/DC LLC Controller

### FEATURES

- High efficiency from light load to full
- Programmable Protections
- Programmable Soft Start-up
- Support CV, CCCV profile for lithium batteries
- Current sharing compensation
- Operate up to 100kHz
- Average Current Mode Control
- Adaptive dead time
- RS-485 and CAN interface
- Isolated UART port
- User-Friendly GUI

### Applications:

- EV Battery Chargers
- UPS
- Energy Storage

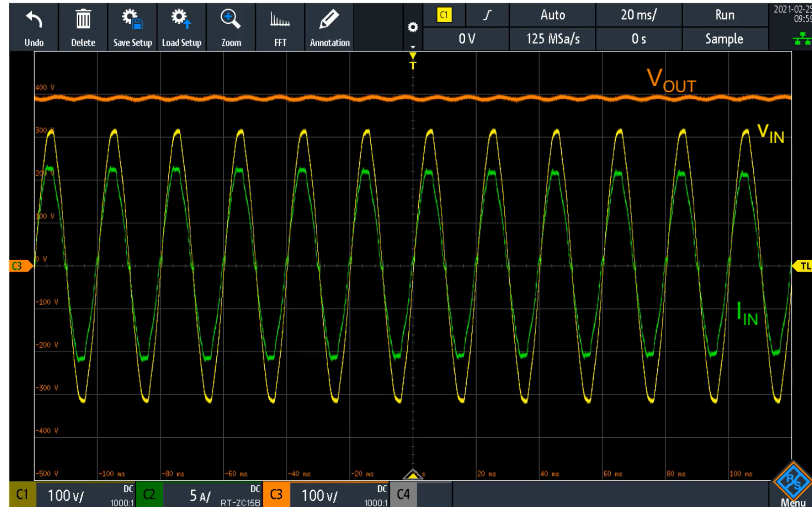


MPF32020  
Package: LQFP-64

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## Test Result - Optimal PFC Performance

- $V_{IN}$  : AC Grid (220V<sub>RMS</sub>)
- $V_{OUT}$  : 388V
- $\Delta V_{OUT\_MAX}$  : 6V
- $I_{IN}$  : 3A – 16A



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## Test Result - High Quality $V_{OUT}$ Control

- $V_{IN}$  : 400V
- $V_{OUT}$  : 50V
- $I_{LOAD}$  : 5A – 25A
- $\Delta V_{OUT\_MAX}$  : 700mV

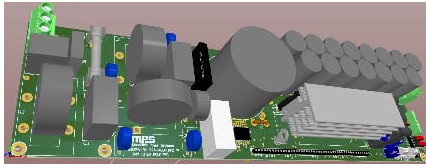


MPS

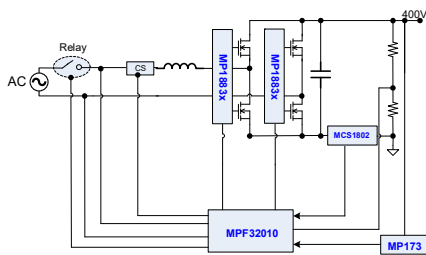


## mEZPA-3k-22A-400R PFC

COMPACT 1U POWER SUPPLY MODULES



mEZPA-3k-22A-400R PFC TP

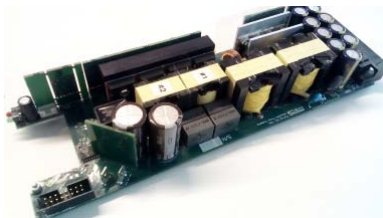


PARAMETERS	
Input voltage	80-250 VAC /45-66 Hz
Dimension	29mm x 7.5mm x 37mm
Density	61W/inch <sup>3</sup>
Output voltage	400V DC
Maximum power	3kW;
Efficiency	>98%
Power Factor	0.995
Output Voltage Ripple	<3%)
<b>STANDARDS</b>	IEC 61000-3-2 CLASS A
HARMONIC CURRENT	EN55032 CLASS A
CONDUCTED EMISSIONS	IEC 61000-4-11
VOLTAGE SAG	

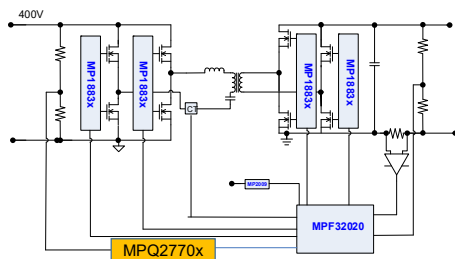
**MPS**

## mEZDA-3K-400R-048

COMPACT 1U POWER SUPPLY MODULES



MEZDA-3K-400R-048R LLC (Sept 2021)

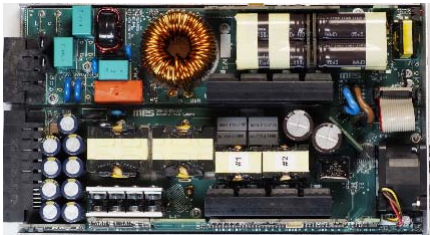


Parameters	
Input voltage	400V
Output voltage	48V fixed (39-54V charger)
Maximum power	3kW;
Dimension	29mmx 7.5mm x 37mm
Density	61W/inch <sup>3</sup>
Efficiency	96%
Output Voltage Ripple	0.5 V (<3%)
COOLING	Active cooling with housing

**MPS**

## Summary

- MPS is offering a wide range of isolated power solutions
  - Pin to pin parts available now for fast adoption/qualification
  - We have had success with key players in many applicaitons
- Large design/development teams globally in USA, China, and Spain
- Evaluation modules available for demo



- Power: **3 kW @48V output**
- Power Density:  $31W/inch^3$
- Efficiency: **96%**

**MPS**

**Thank you !!**

**MPS**