MPS Micro-Power Isolated Power Module Introduction

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rev 20180504

Why do we need Isolation?

Moving signals and power across an isolation barrier is a common challenge for designers. Isolation might be required for safety, noise immunity or large potential differences between system domains

Human

No matter industrial robot, EV charging or CAT scan, Isolation technology can always protect human from electrical shock

Asset

Protect important device from electrical surge and other hostile environment conditions

Data

Keep data integrity where electrical disturbance happens

What’s Isolation?-Isolation Type

Transformer Isolation

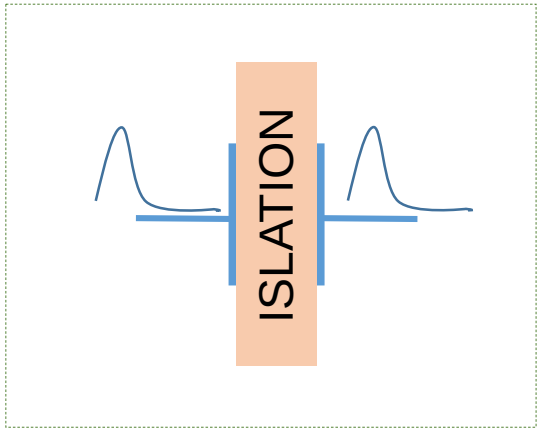
Power Transmission

AC-DC Power Module

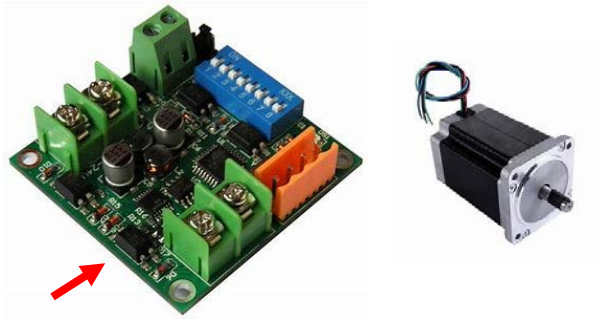
Low Speed Communication

What’s Isolation?-Isolation Type

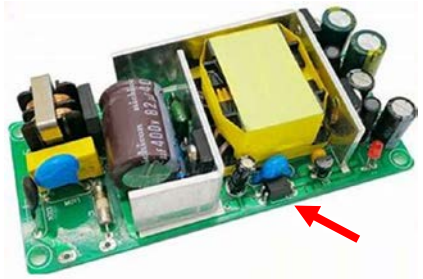
Opto-coupler Isolation



Capacitor Isolation



Motor Driver



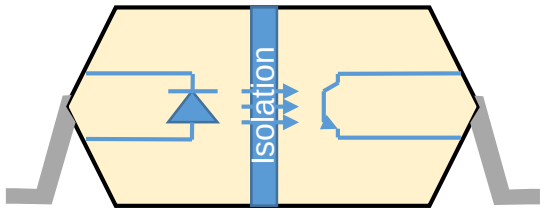
AC-DC Power Module

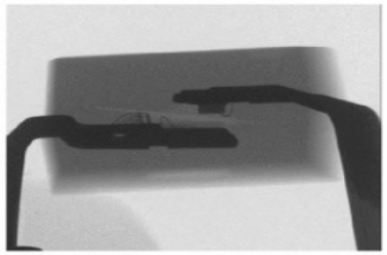
RS485 Communication

Isolation Technologies Comparison for Isolator

Opto-coupler Solution

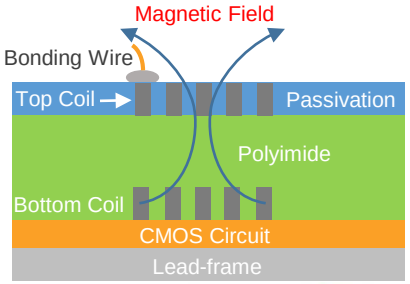
- Large supply current
- Space consuming
- Low data rate <10Mbps
- Low CMTI, ~20kV/us
- Long propagation delay

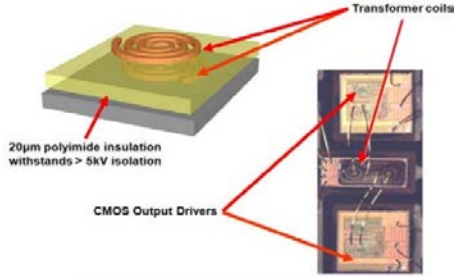




Magnetic Solution

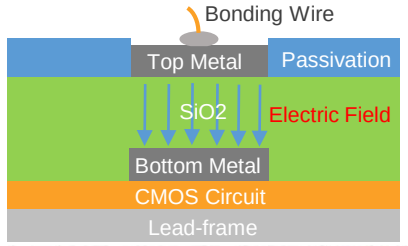
- Low supply current
- Saving space
- High data rate, >100Mbps
- High CMTI, >100kV/us
- Short propagation delay
- Higher emission than capacitive solution
- Low immunity for magnetic noise

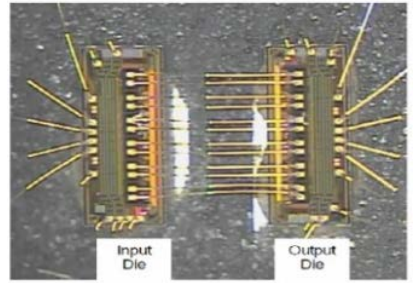




Capacitive Solution

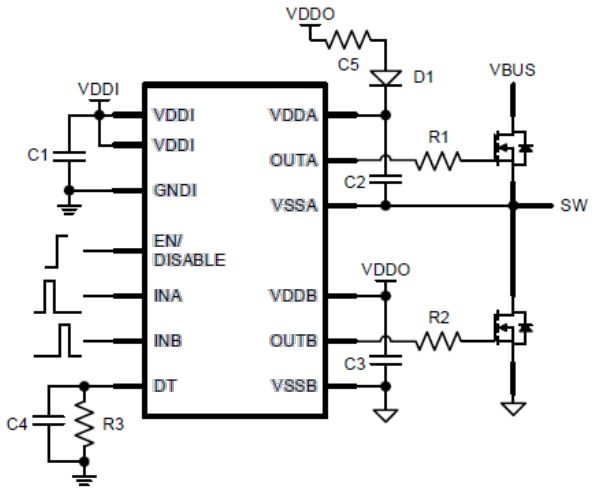
- Low supply current
- Saving space
- High data rate, >100Mbps
- High CMTI, >100kV/us
- Short propagation delay
- Low emission
- High immunity for magnetic noise



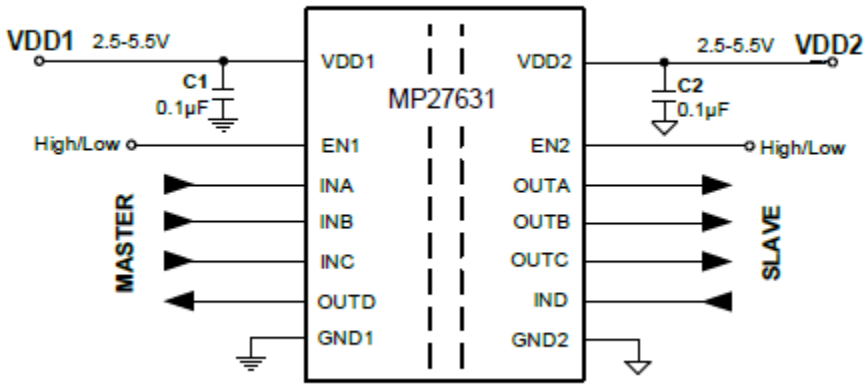


2. Isolated IC types and Isolated Power Module Introduce

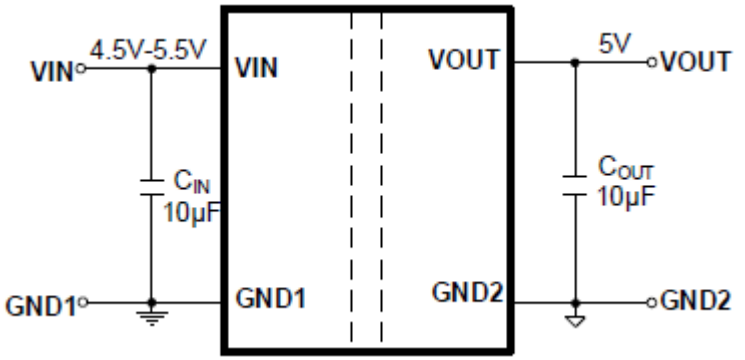
Isolated IC Category



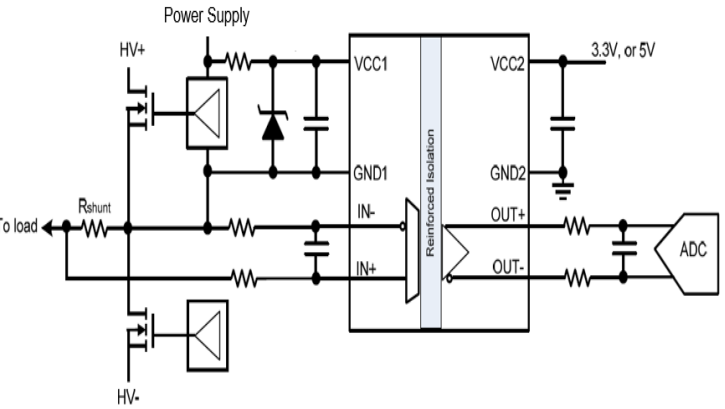
Isolated Gate Driver



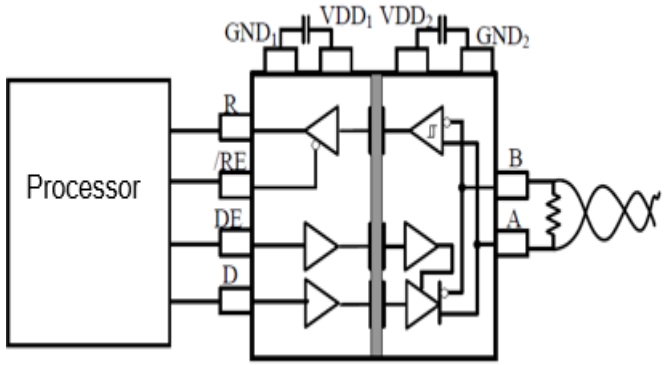
Digital Isolator



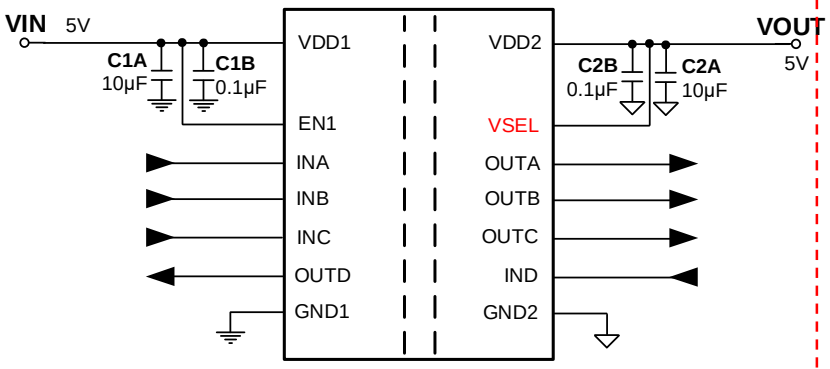
Isolated Power Module



Isolated Amplifier



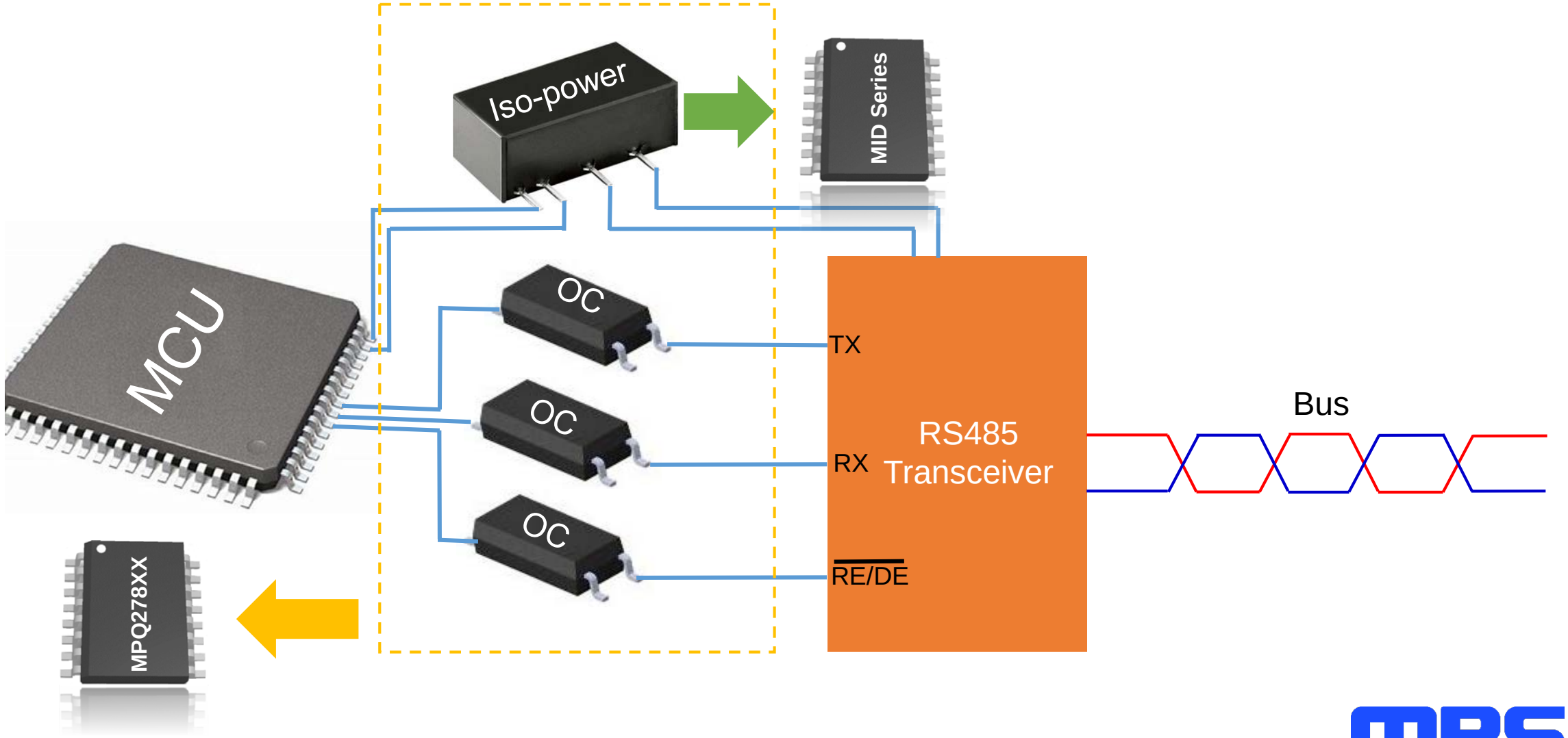
Isolated Transceiver: I2C/485/CAN



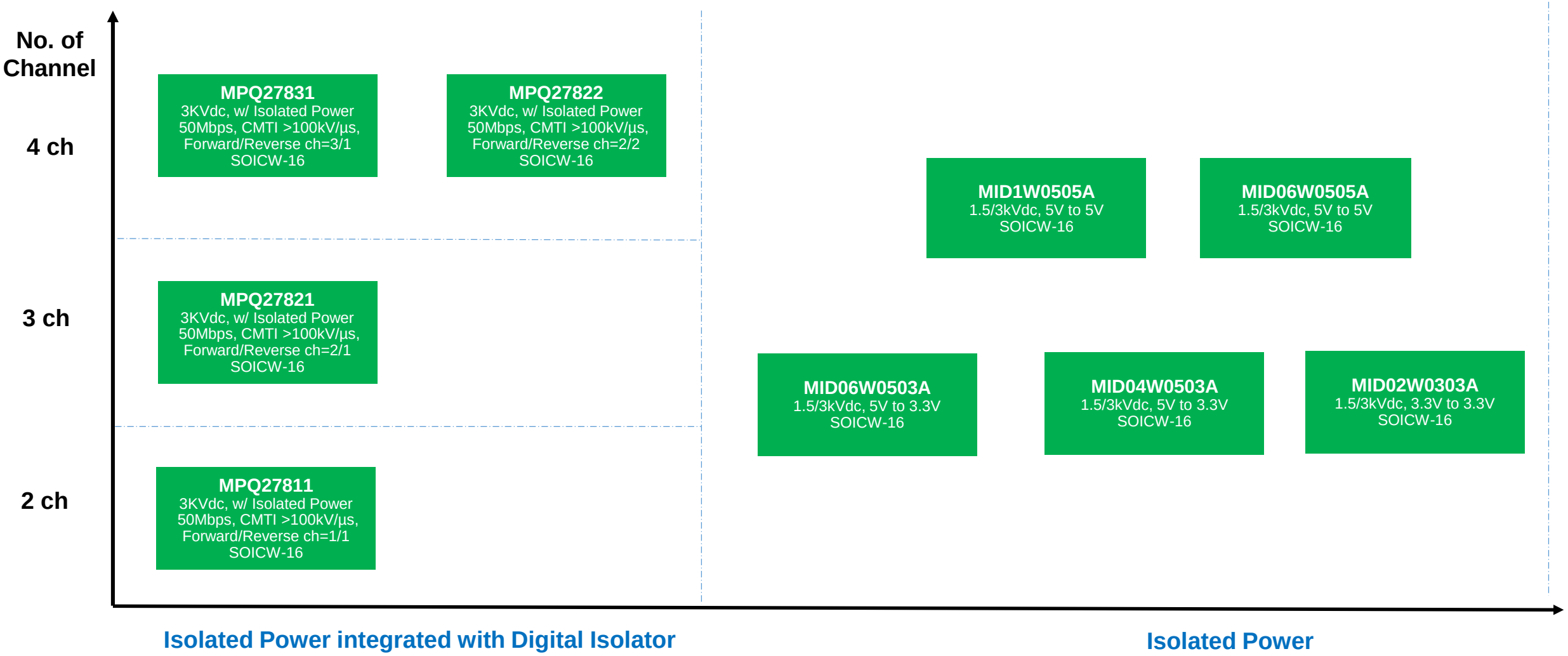
Digital Isolator Integrated with power

Total Solution for Digital Isolation and Power Isolation

Traditional RS485 Application:



Isolated Module & With Integrated Digital Isolator

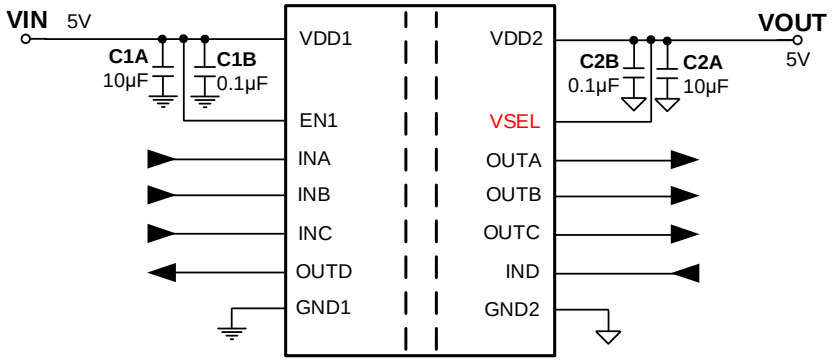


MPQ278xx – 3kVDC 2-4 Ch digital isolator with Isolated Power

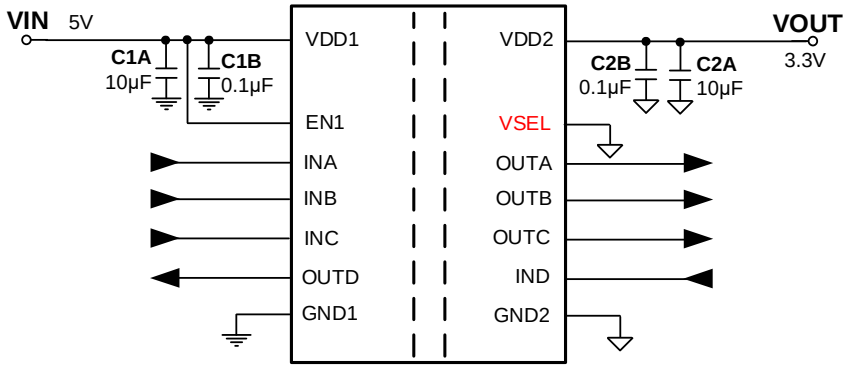
Key Feature:

- Input Range: 4.5-5.5V
- Programmable 5V and 3.3V Output
- Up to 5V/1W Output Power
- Up to 50Mbps Data Rate
- High Electromagnetic Immunity
- >±100kV/μs Common-mode Transient Immunity
- 3kVDC Isolation
- Selectable Channel Direction
- Selectable Output Default Value
- SCP, OCP, OTP Protection
- CB Certification
- Available in SOICW-16 Packages

5V Output



3.3V Output



MPQ278XX PN list

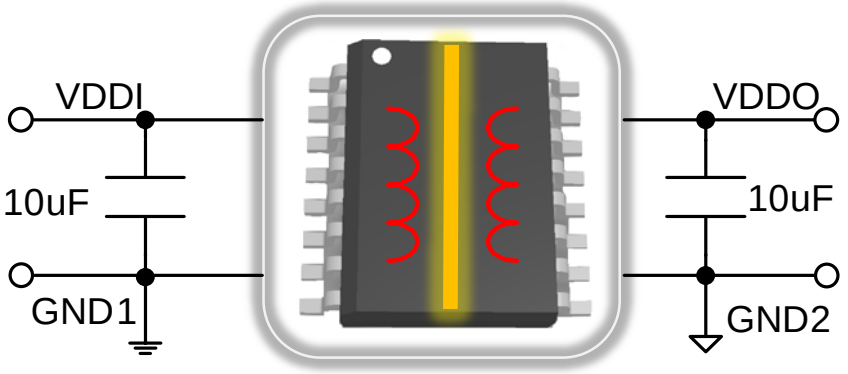
MPN	Chanel No.	Forward/Reverse Channels	Default H or L	Data Rate(Mbps)	Isolation Rating(KVdc)	Operating Temperature(° C)	Package	Power	Vout
MPQ27811-HP-MGY-3	2	1/1	H	50	3	-40 to +125	SOICW-16	1Wmax	5V/3.3V
MPQ27821-LP-MGY-3	3	2/1	L	50	3	-40 to +125	SOICW-16	1Wmax	5V/3.3V
MPQ27822-LP-MGY-3	4	2/2	L	50	3	-40 to +125	SOICW-16	1Wmax	5V/3.3V
MPQ27811-HP-MGY-3	4	3/1	H	50	3	-40 to +125	SOICW-16	1Wmax	5V/3.3V

MID Series Isolated Module

Key Features:

- Input Range: 3V-5.5V
- 5V/3.3V Output Voltage
- Excellent Load Transient Performance
- Excellent Regulation
- Strong Magnetic Field Immunity
- 0.25W~1W Output Rating Option
- SCP, OCP, OTP Protection
- 3kVDC/1.5kVDC Isolation Option
- Low Emission: meet CISPR 32 Class B
- CB Certification
- Small SOICW-16 Package (10.3mmx10.3mmx2.5mm)

Typical Circuit



MID1W & <1W PN list

PN	Input Voltage Range(V)	Output Voltage(V)	Output Power(W)	Isolation Voltage(kVdc)
MID1W0505AGY-3S-Z	4.5~5.5	5	1	3
MID1W0505AGY-2S-Z	4.5~5.5	5	1	1.5
MID06W0505AGY-3R-Z	4.5~5.5	5	0.6	3
MID06W0505AGY-2R-Z	4.5~5.5	5	0.6	1.5
MID06W0503AGY-3S-Z	4.5~5.5	3.3	0.6	3
MID06W0503AGY-2S-Z	4.5~5.5	3.3	0.6	1.5
MID04W0503AGY-3R-Z	4.5~5.5	3.3	0.4	3
MID04W0503AGY-2R-Z	4.5~5.5	3.3	0.4	1.5
MID02W0303AGY-3R-Z	3~3.6	3.3	0.25	3
MID02W0303AGY-2R-Z	3~3.6	3.3	0.25	1.5

3. Applications

Industrial Communication

SPI

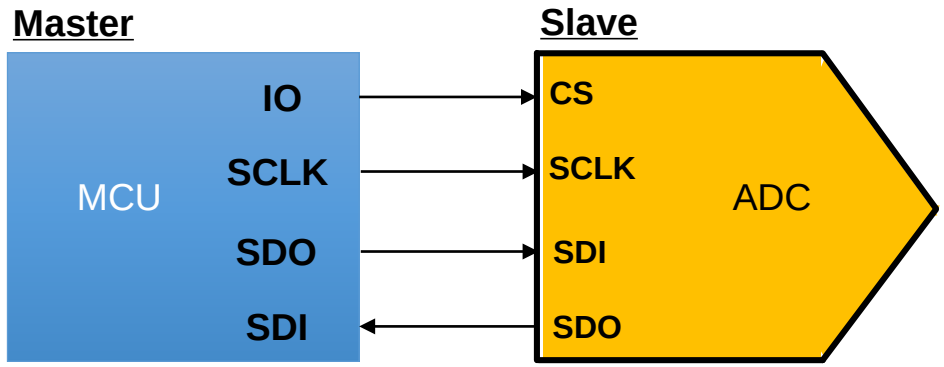
RS485

RS232

CAN

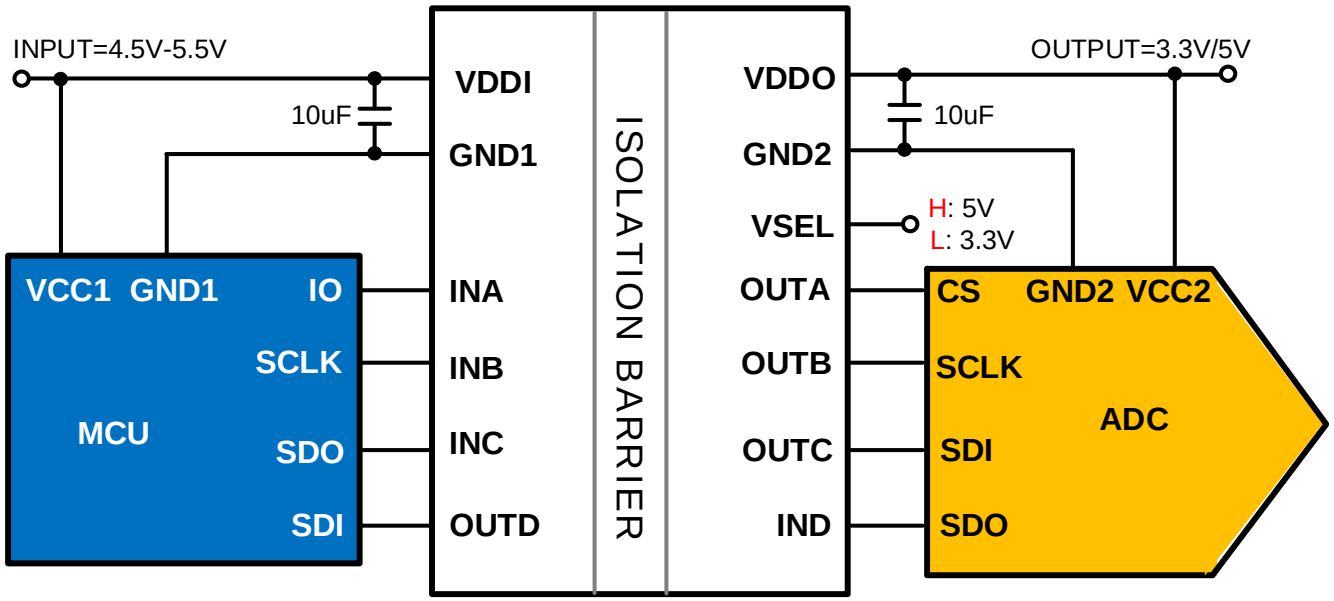
Unless there are above **signal transmission** and **need isolation**, then there might be demand of 5V/5V Isolated Power Module!

SPI Communication

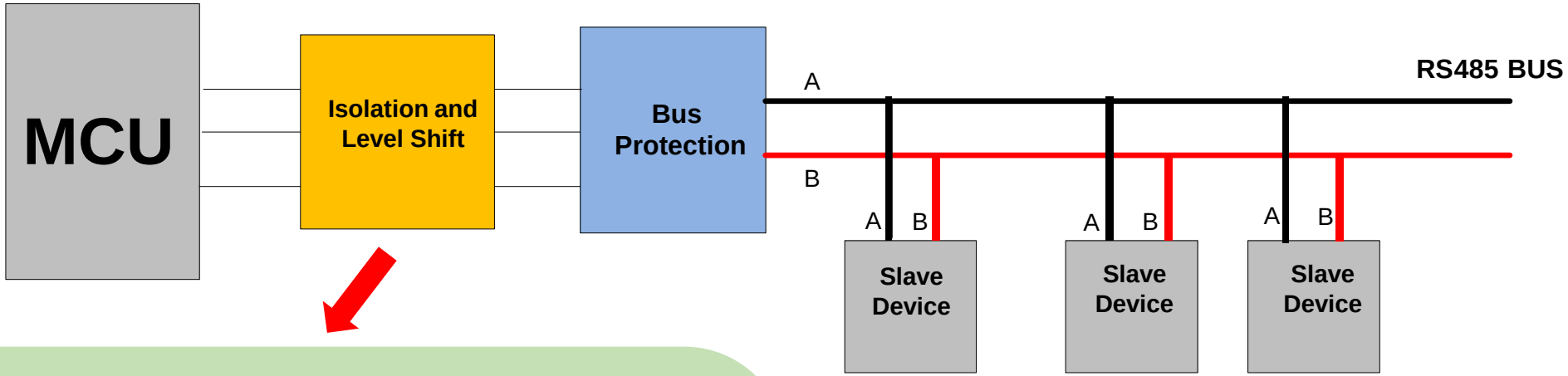


Serial Peripheral Interface(SPI) is high speed, **full duplex** communication protocol, only need **4 wires(3/1)** to transmit signal from Master device to Slave, or reversely from slave to Master.

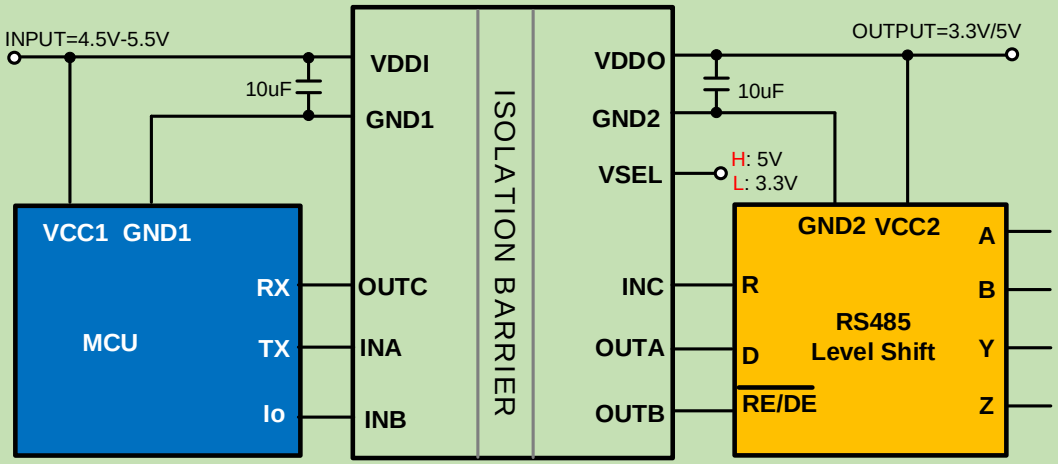
MPQ27831-HP:
- Output Default High
- 3IN,1OUT



RS485 Communication

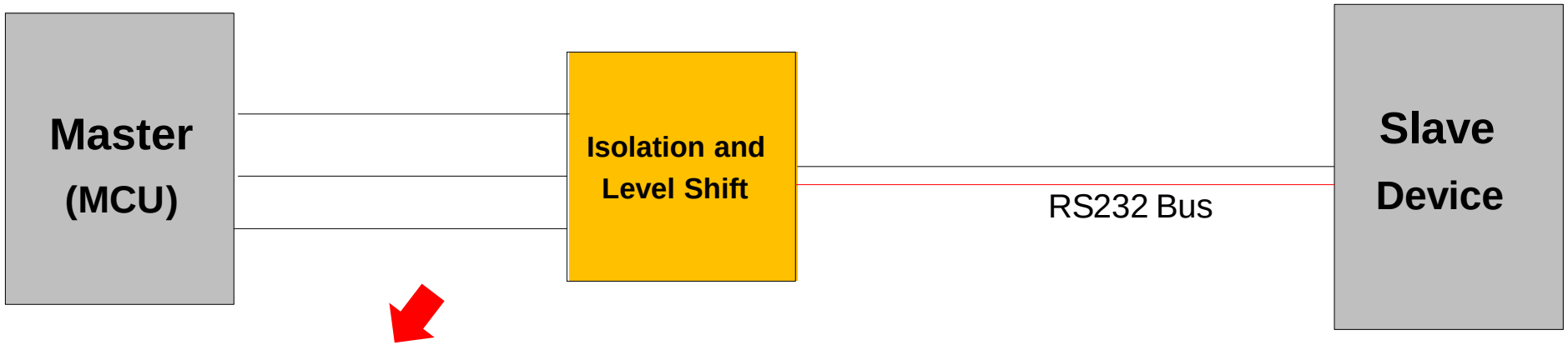


MPQ27821-LP:
- Output Default low
- 2IN,1OUT

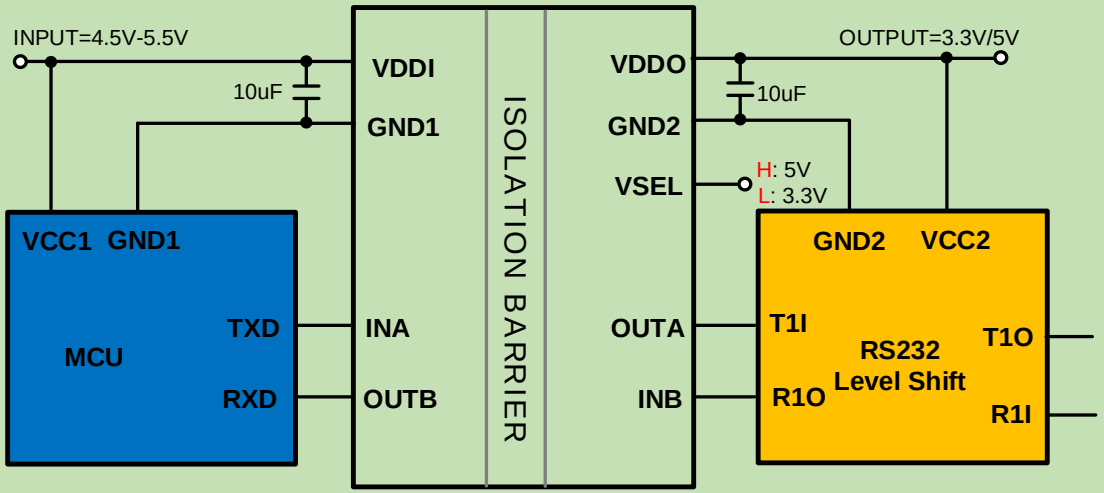


RS485 Defines two Logic, positive logic is +2V～+6V, negative logic is -2V ～-6V, digital signal was transmitted in **differential**, so it can significantly safe from **noise disturbance**, RS485 is widely used in industrial automation, motion control, process control, etc.

RS232 Communication

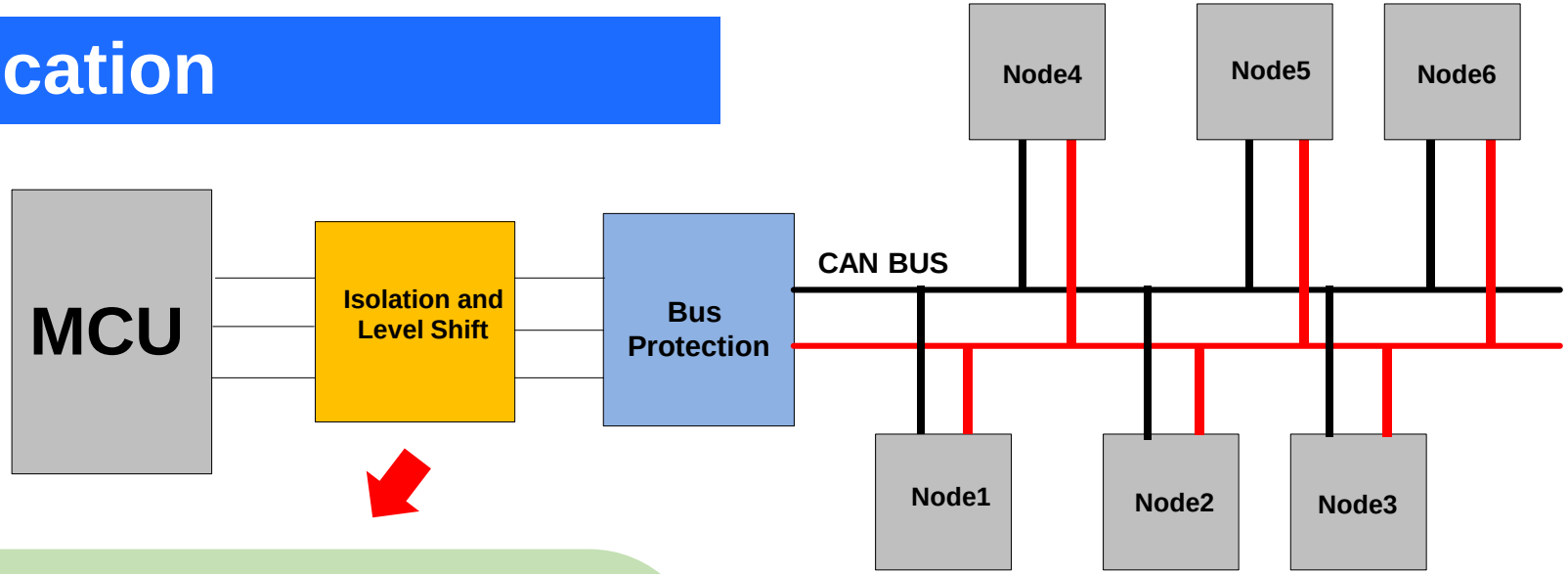


MPQ27811-HP:
- Output Default High
- 1IN,1OUT

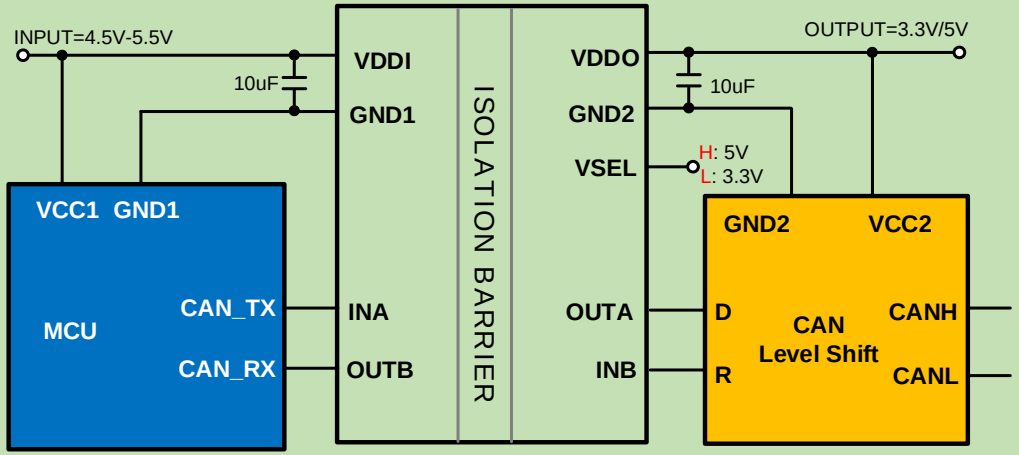


The architectures difference between RS232 and RS485 is that 232 is a bi-directional **point to point** communication, whereas 485 is a single channel bus which can have multiple slave devices.

CAN Communication



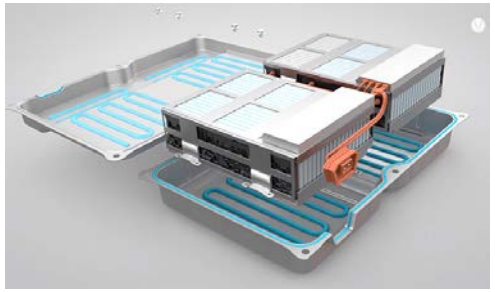
MPQ27811-HP:
- Output Default High
- 1IN,1OUT



Developed by BOSCH, CAN protocol has **high reliability and performance**, compare with RS485, CAN's real time communication speed is faster and more stable. Widely used in Automotive, Industrial Automation, Medical, etc.

Typical Application

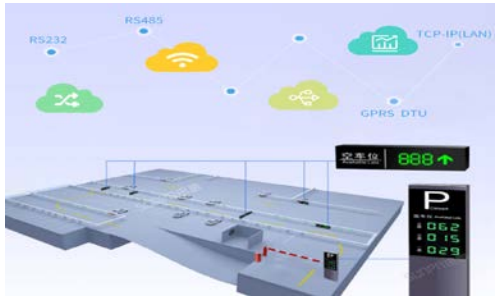
Industrial Automation + PLC



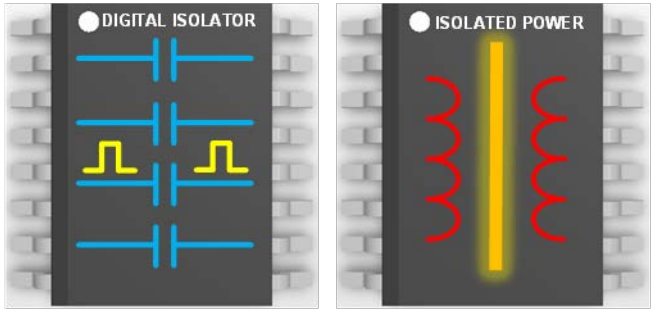
BMS(Ebike)

Charging Station

5G RRU/Industrial CPE/Network Gateway, etc.

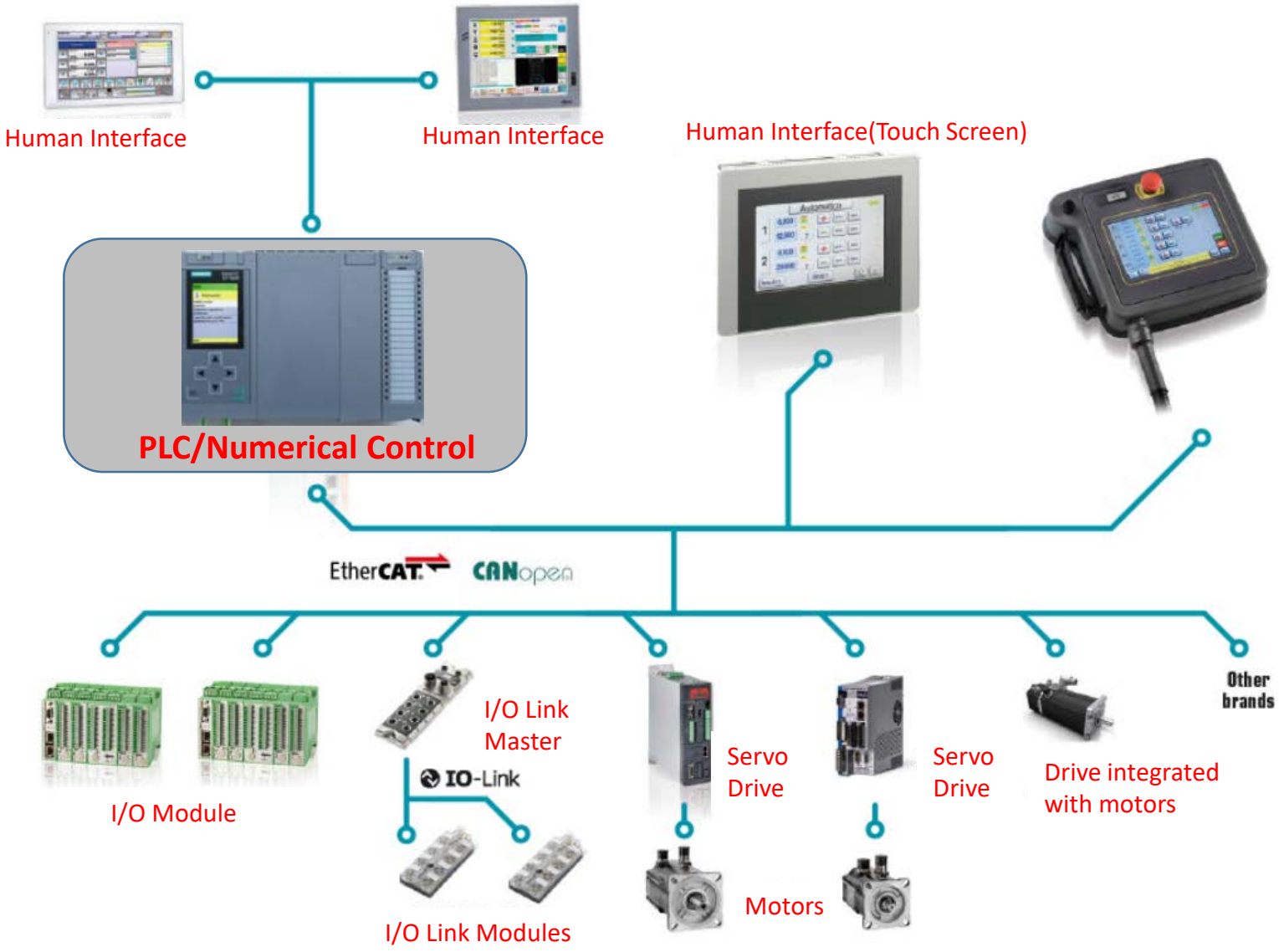


Isolated Sensor Power Supply

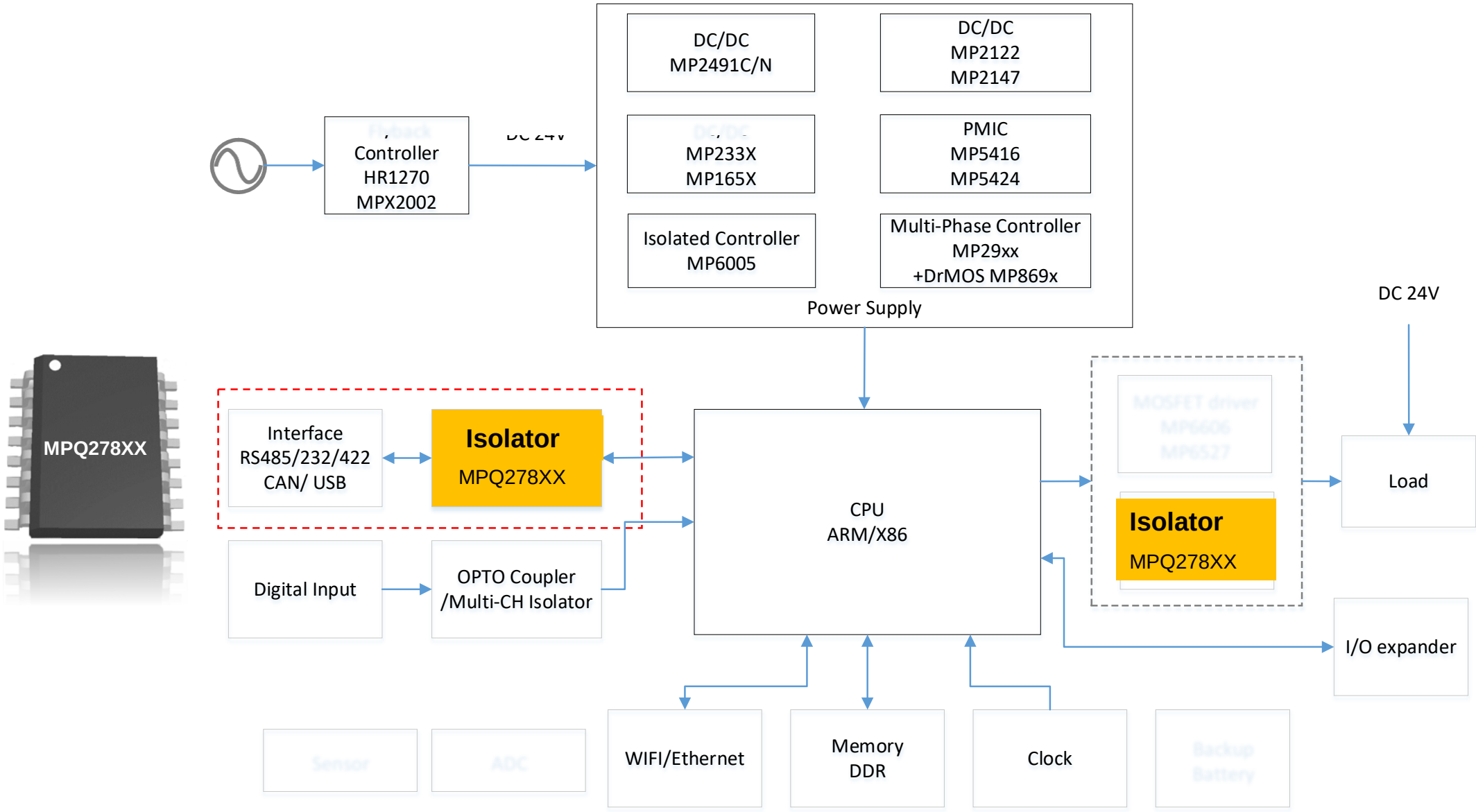


Isolated bias for digital isolators

PLC(Programmable Logic Controller)



PLC Block Diagram



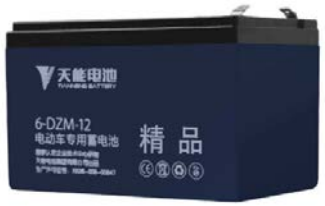
Ebike BMS

There are several different types of battery packs:

- 36V Battery Pac: 10S battery pack in pedelec.
- **48V Battery Pack: Main Stream**, 13S Lead Acid/Li-ion battery pack
- 60V Battery Pack: 16- to 18-series(16-18S) Li-ion Batteries, for e-motorcycles, some are 72V.

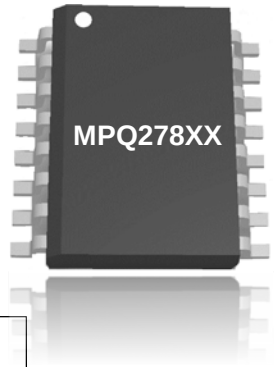
China new domestic standard:

- E-bike weight<55kg，including battery weight.
- Battery Rating Voltage<=48V
- The weight limit require battery pack change from lead-acid to Ternary Li-on /LiFePO4 Battery



Change

Ebike BMS Block Diagramm



48V Battery Pack

AFE MP2797

HV Buck MP9485/86A MP4581

3.3V/100mA

Battery Control

RS485/CAN

Isolator MPQ278XX

Power Supply MP6005

12V/10A

Head Lamp

Brake Lamp

Horn

Others

48V Battery Pack

100V HV Buck MP9485/86A MP4581/9929

15V/300mA

3 Phase Half-bridge Drivers MP6537/38

LDO MP2000 MP8801/02

3-HB MOSFETs

Display Panel

HV Buck MP9486A MP8880

3.3V/50mA

Input signal

PWM signal

MCU

3-Phase BLDC

Output signal

Hall signal

Display Alert SYS PKE, etc

EV Charging station

3 Phases
ACIN

Vienna
PFC

DC/DC
Converter

Transformer

Diode
Rectifier

Output

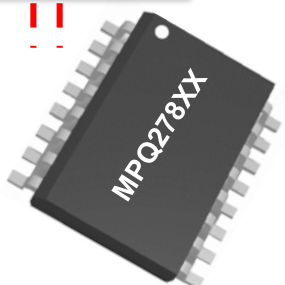
Isolated
Gate Driver
MP188XX

Isolated
Gate Driver
MP188XX

MCU / DSP

Isolator
MPQ278XX

MCU / DSP



4. MPS Isolated Power Performance and Advantages?

Comparison with Traditional Module

Basic Specs	MID1W0505A	M Company product A	M Company product B
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
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	0.4% (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 and Immunity	Bad regulation	Bad regulation, Lager size

MID1W0505A

M Company

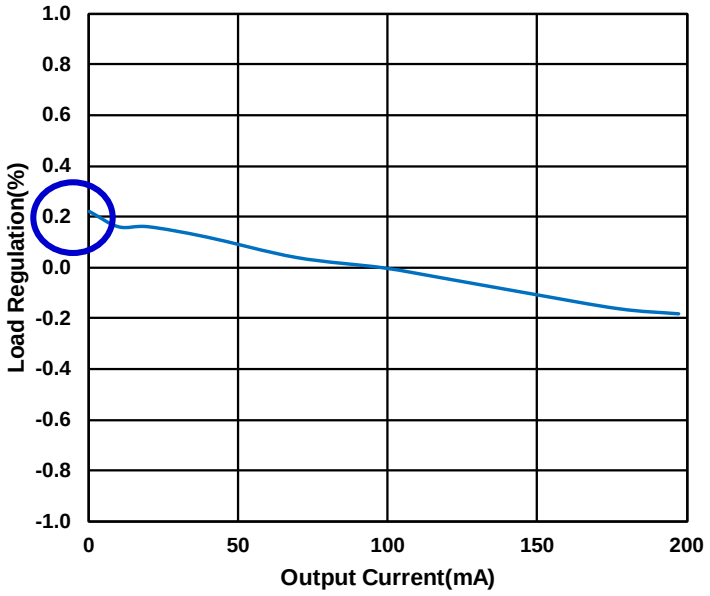
M Company

Excellent Regulation

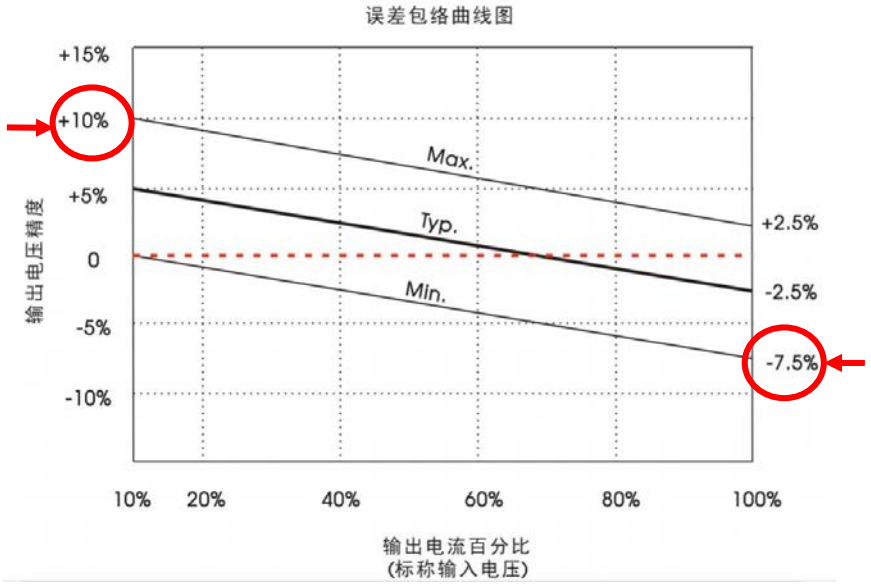
Vin=5V, Vout=5V, Output Current=0~200mA

Load Regulation vs. Output Current

MIDxxW0505A

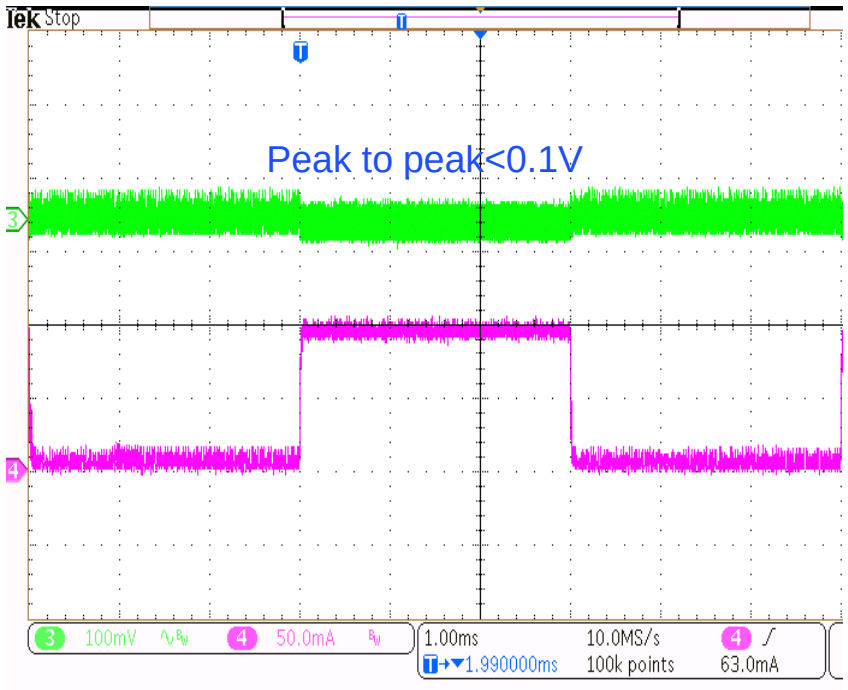


Traditional Module



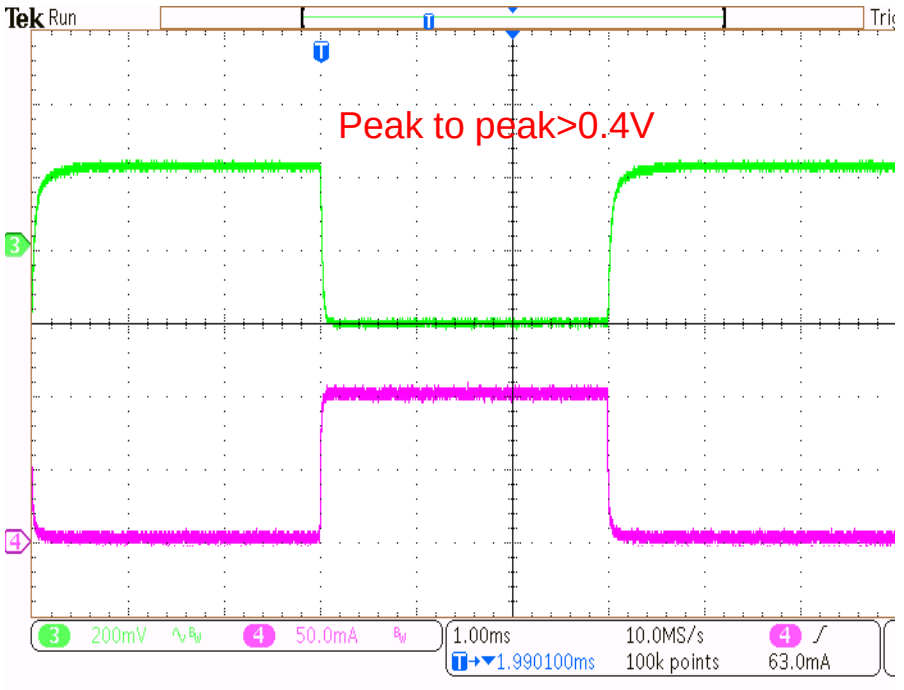
Excellent Load Transient Performance

MPS



Excellent transient performance

Traditional Module

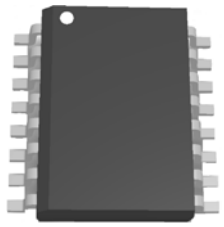


Bad transient performance

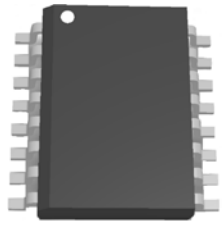
Comparison with SOICW-16 Package Competitor

Basic Specs	MIDxxW0505A	T Company	A Company
Output Power	1W/0.6W	0.5W	0.5W/0.3W
Package	SOICW-16	SOICW-16	SOICW-16/SOICW-8
Input Voltage Range	4.5V to 5.5V	4.5V to 5.5V	4.5V to 5.5V
Load Regulation	0.4%	1%	1% @0.3W, 10% @0.5W
Line Regulation	1.5% @1W	0.5% @0.5W	0.5% @0.3W, 10% @0.5W
Max Efficiency	54% @ full load	58%@ full load	33% @ full load
Transient Performance	<100mV	>200mV	>1V
Input Current @standby	7mA	50mA	8mA
Comments	higher power, low standby current	Worse transient and large standby current	Low efficiency and power

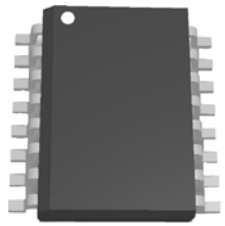
MID1W0505A



T Company

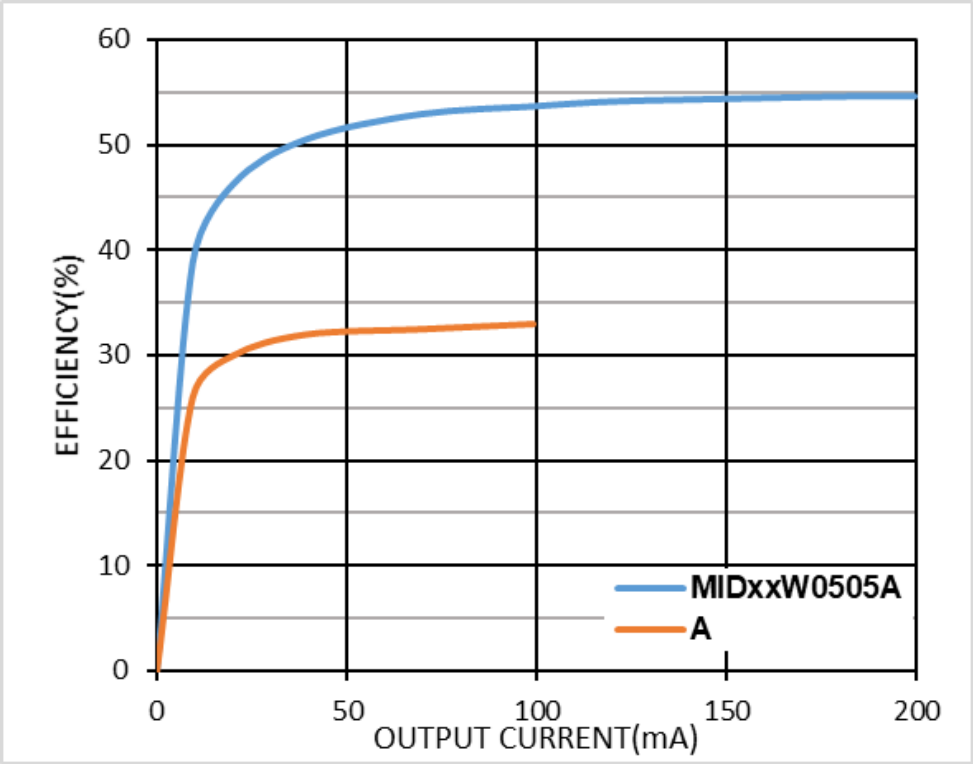


A Company



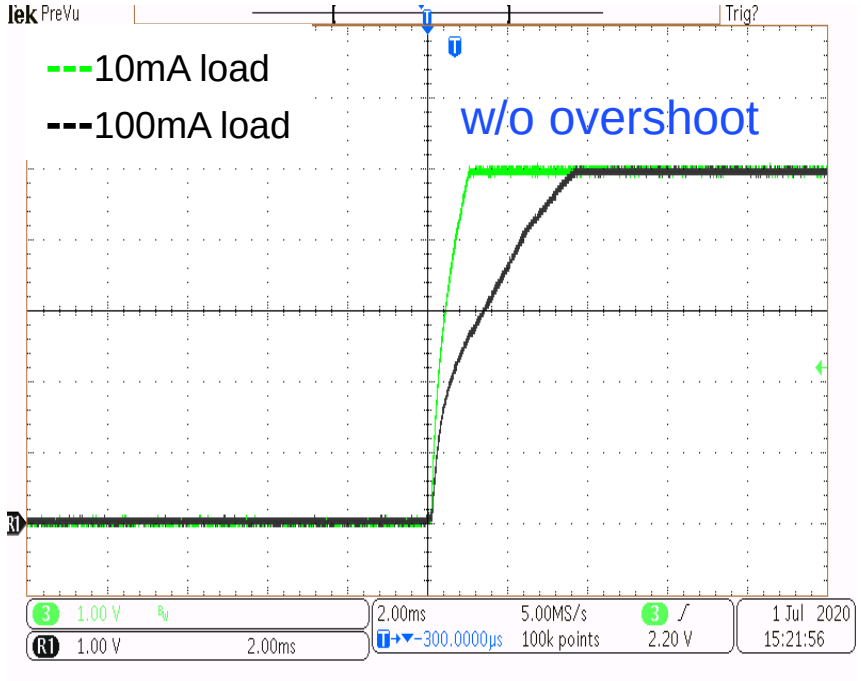
Comparison with Competitor-Efficiency

MIDxxW0505A vs. A Company

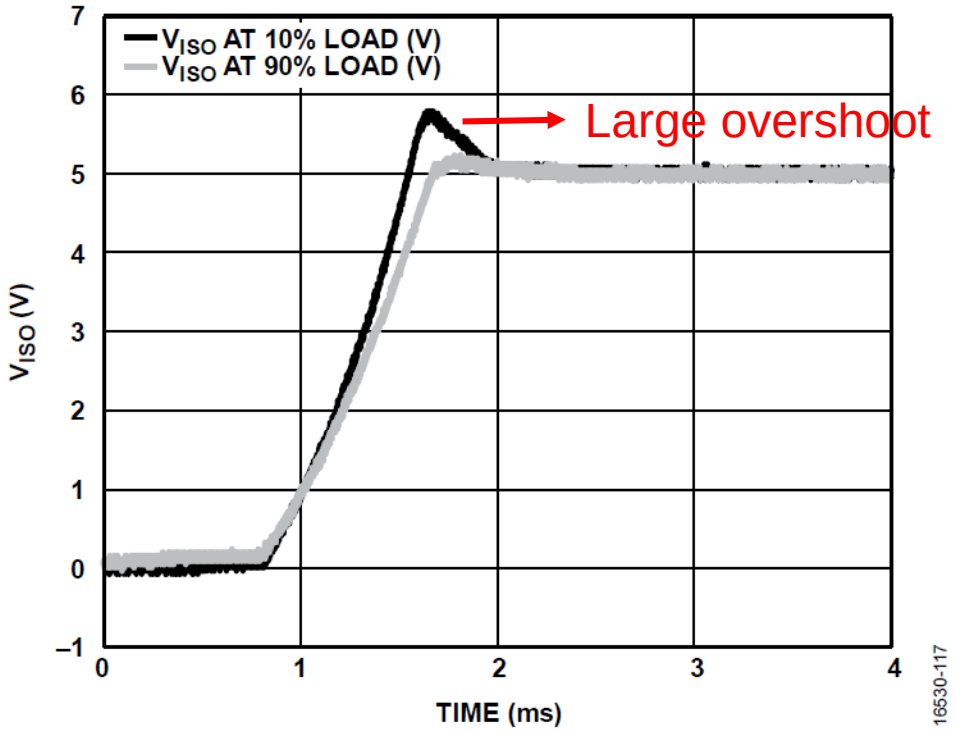


Comparison with Competitor-Startup

MIDxxW0505A

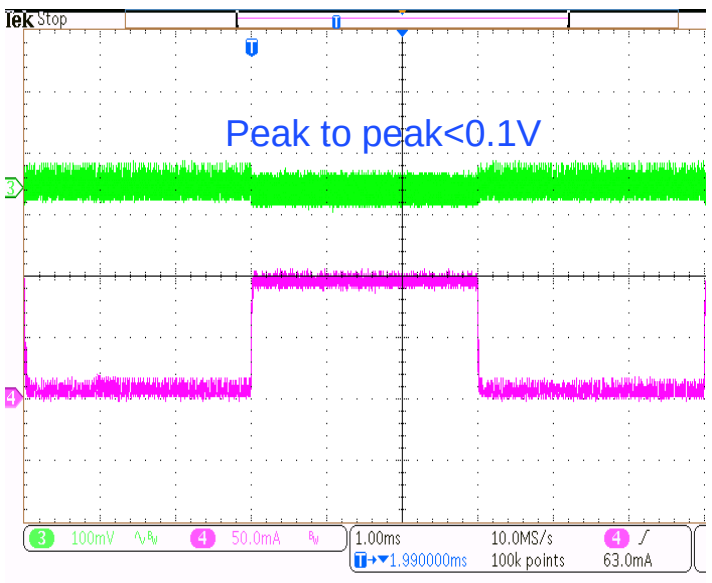


A Company



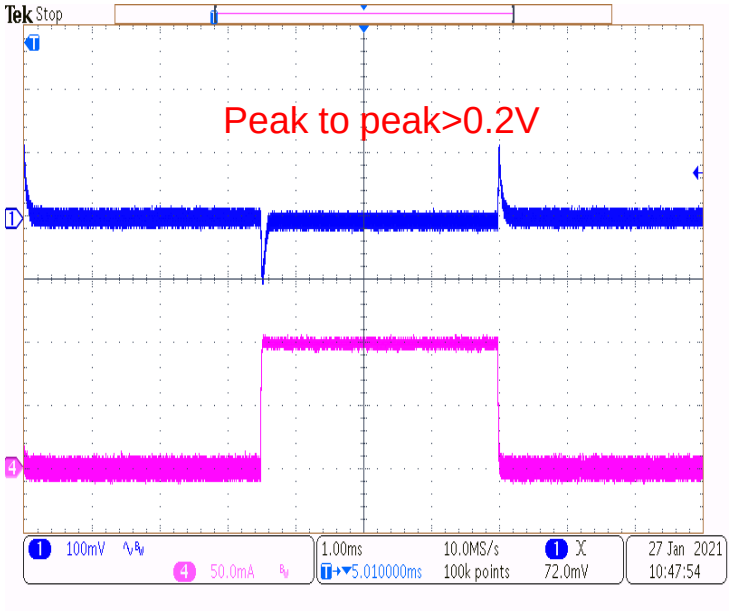
Comparison with Competitor-Transient

MIDxxW0505A



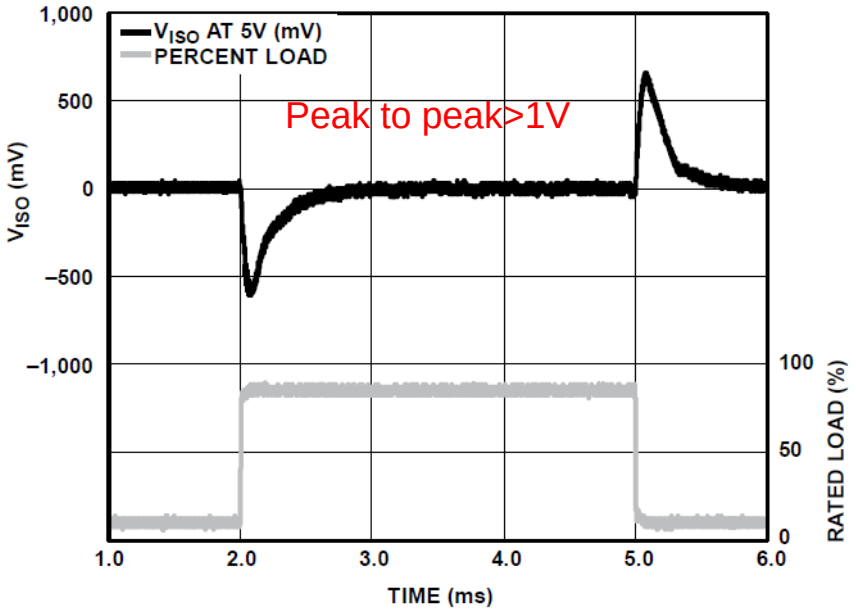
Excellent transient performance

T Company



Worse transient performance

A Company

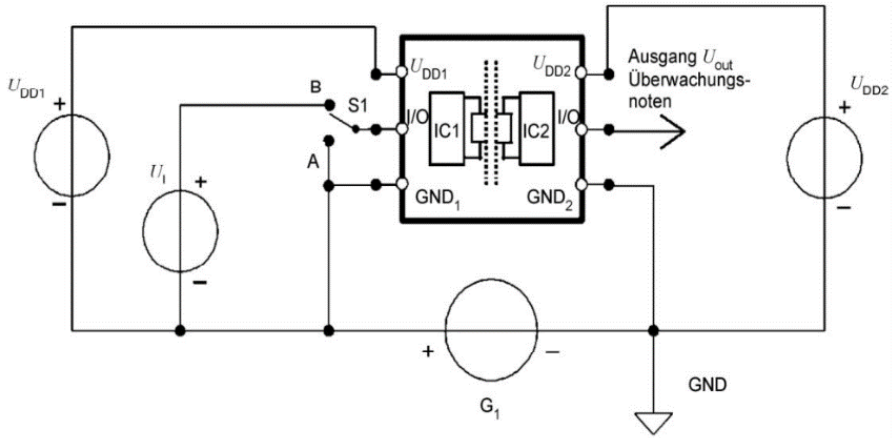


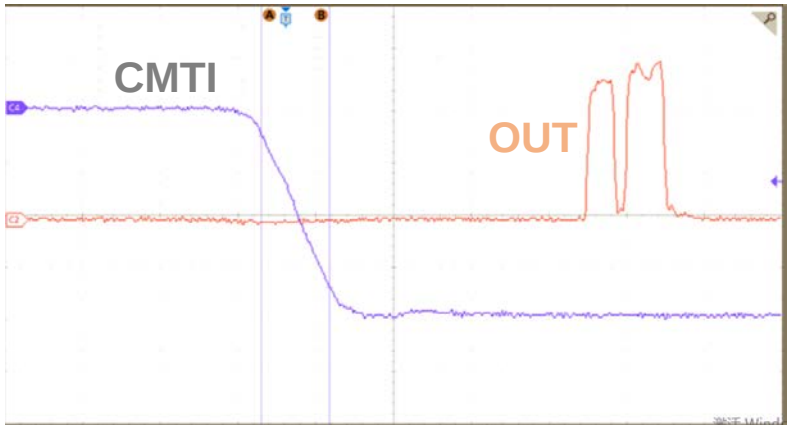
Bad transient performance

Low Emission and Strong Immunity

High CMTI- Why is CMTI Important

- Common mode transient immunity(CMTI)
- High slew rate transients can corrupt data transmission across the isolation barrier
- CMTI measures in kV/μs or V/ns





MID series and MPQ278xx support >100kv/us CMTI for application, while opto-coupler CMTI is about 20kv/us.

High CMTI-Where will We Face CMTI?

Strong Magnetic Field Immunity

ISO11452.8: Immunity to magnetic fields for Road vehicles

表 2 磁场抗扰测试推荐测试严酷等级（外部场模拟）

Frequency band Hz	Test level I A/m	Test level II A/m	Test level III A/m	Test level IV A/m	Test level V A/m
0 (d.c.)	90	300	900	3 000	Specific value agreed between the users of this part of ISO 11452
15 to 60	30	100	300	1 000	
60 to 180	30/(*f*/60)	100/(*f*/60)	300/(*f*/60)	1 000/(*f*/60)	
180 to 600	10				
600 to 1 800		10			
1 800 to 6 000			10		
6 000 to 150 000				10	
NOTE *f* in Hz.					

=3.78mT

IEC61000-4-8: Power frequency magnetic field immunity test

The magnetic field strength is expressed in A/m; 1 A/m corresponds to a free space magnetic flux density of 1,26 µT.

Table 1 – Test levels for continuous field

Level	Magnetic field strength A/m
1	1
2	3
3	10
4	30
5	100
x[a]	special

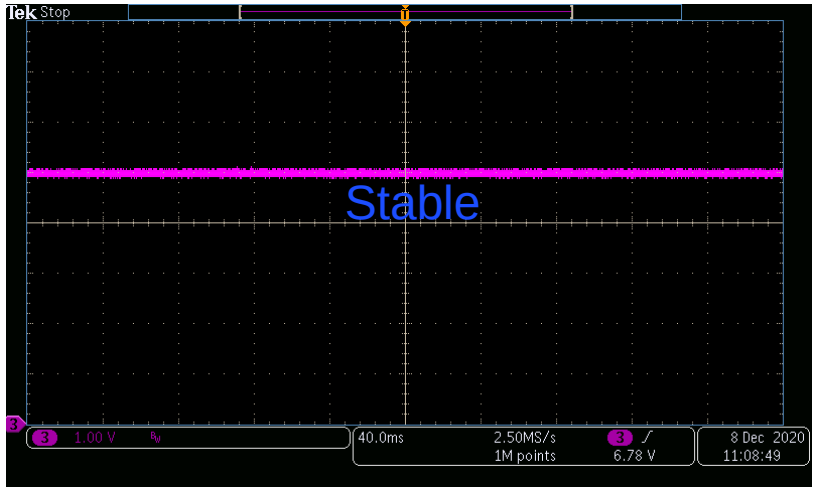
[a] "*x*" can be any level, above, below or in-between the other levels. This level can be given in the product specification.

=0.126mT

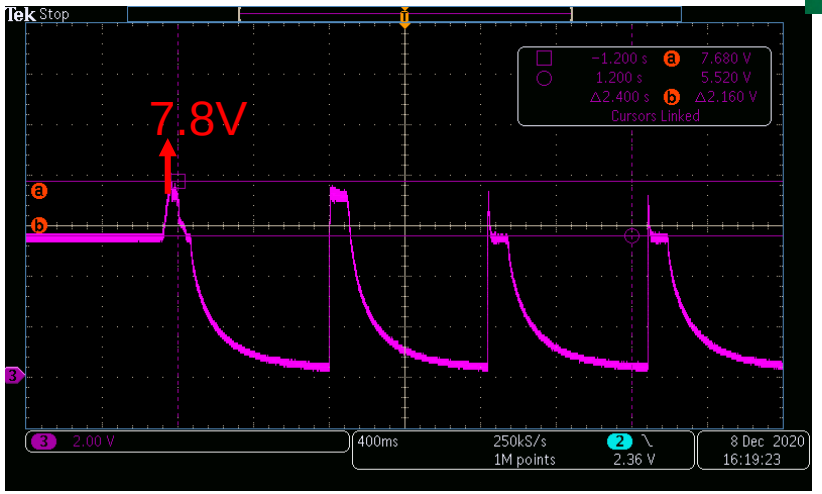
MID and MPQ278XX Magnetic field immunity>1.1T, enough margin for above standard.

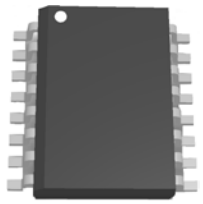
Strong Magnetic Field Immunity

MIDxxW0505A



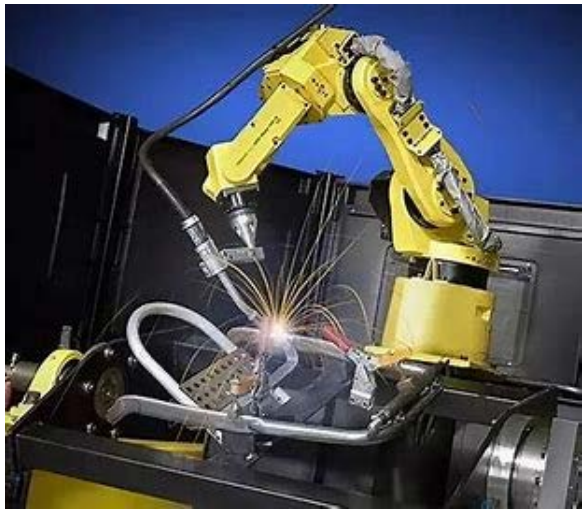
Traditional Module





Good EMS Performance

Long wire communication



Noise electromagnetic environment

24h working flow line

All the above need strong EMS performance to guarantee reliable operation

Confidential-Internal Use Only

Good EMS Performance

Test Items	Standard	Result
Pin to GND ESD	JEDEC JS-001/JESD22-C101	Pass HBM ±6kV, CDM ±2kV
Barrier ESD	IEC61000-4-2	Pass ±8kV
Radiated Immunity	IEC61000-4-3	>10Vrms/m, >30Vrms/m for MID(1)
Conducted Immunity	IEC61000-4-6	>10Vrms/m, >20Vrms/m for MID(2)

Note1: Test level of RS

Table 1 – Test levels related to general purpose, digital radio telephones and other RF emitting devices

Level	Test field strength V/m
1	1
2	3
3	10
4	30
x	Special

NOTE x is an open test level and the associated field strength may be any value. This level may be given in the product standard.

Note2: Test level of CS

Table 1 – Test levels

Level	Frequency range 150 kHz to 80 MHz	
	Voltage level (e.m.f.)	
	U_0 V	U_0 dB(μV)
1	1	120
2	3	129,5
3	10	140
X[a]	Special	

[a] "X" can be any level, above, below or in between the others. The level has to be specified in the dedicated equipment specification.

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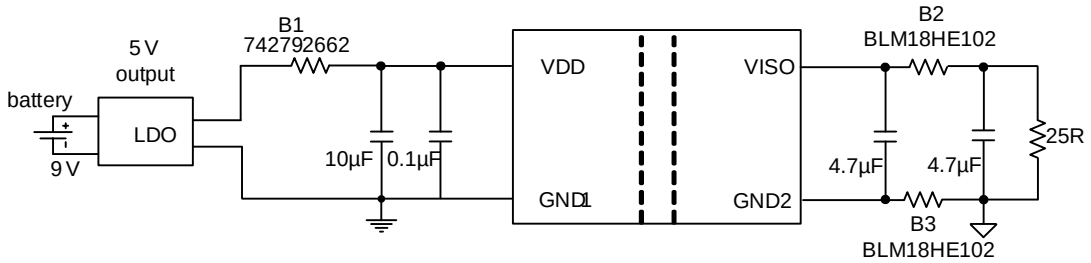
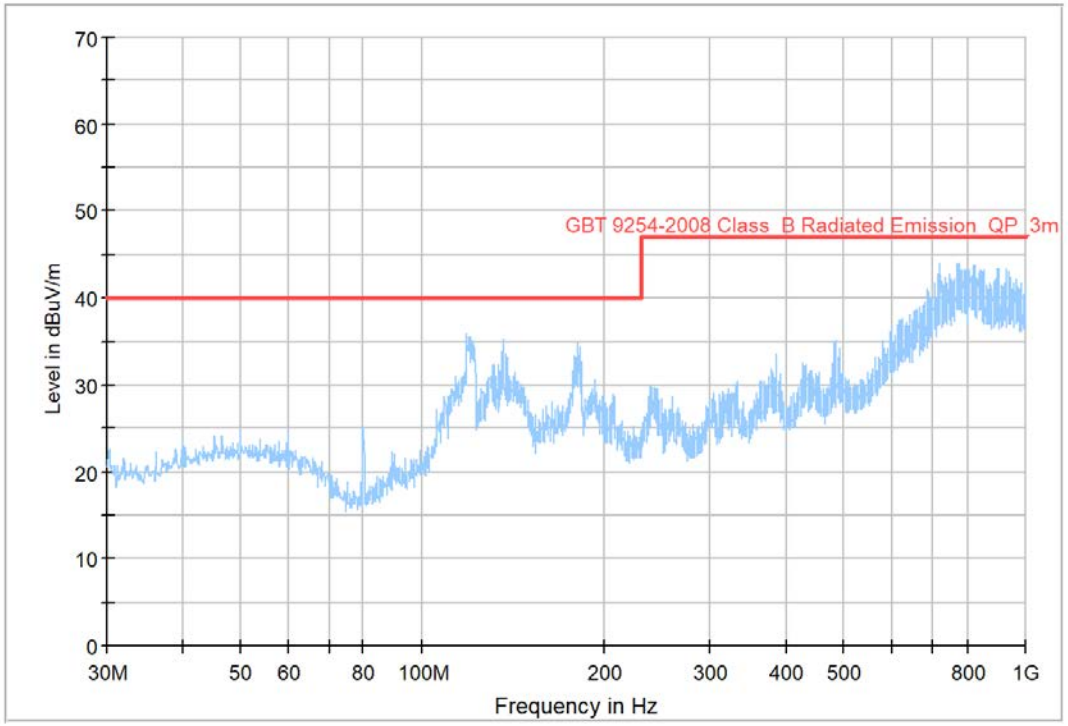
Good EMI Performance

➢ Radiated Emission

Vin=5V, Vout=5V, Output Current=200mA, CISPR 32 Class B





Thank You!

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