



威世

One of the World's Largest Manufacturers of
Discrete Semiconductors and Passive Components

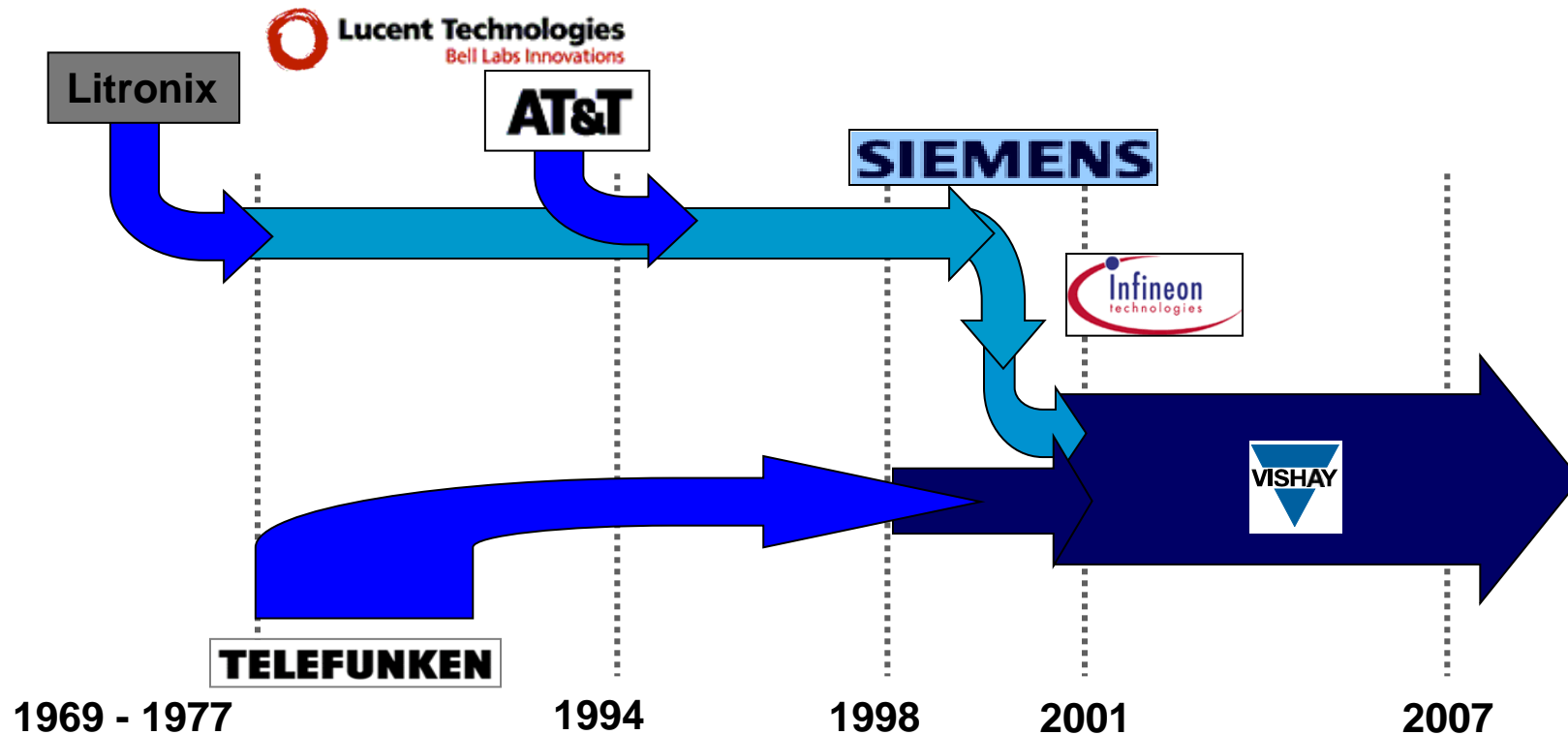
Optocouplers For Safety and Performance

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Product Marketing Manager

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Build **Vishay**
into your **Design**

Vishay Opto History



1969 Litronix starts shipping Optocouplers

1977 Litronix acquired by Siemens

1994 Siemens acquires AT&T's SSR

1998 Vishay acquires Telefunken

2000 Siemens spins of Infineon

2001 Vishay acquires Infineon's Optocoupler

Why Use Optocouplers? 为何使用光耦?

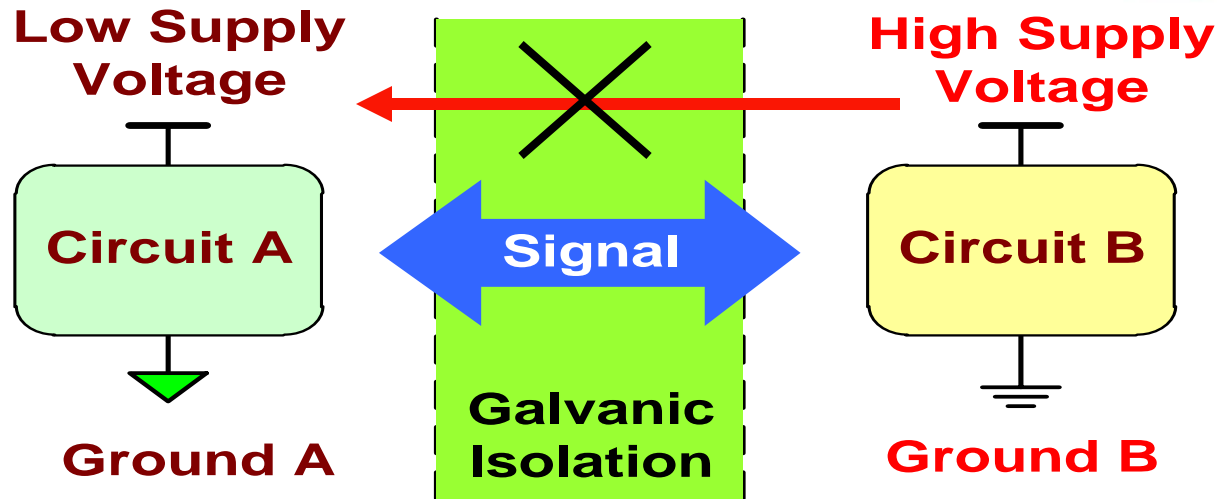
1. Safety 安全

- a) **Currently the largest application** 是目前应用最广泛的
- b) **Vishay meets all major agency requirements**
Vishay光耦符合所有主要的安规要求
 - **UL**
 - **VDE**
 - **BSI**
 - **FIMCO**
 - **IEC – 70747**

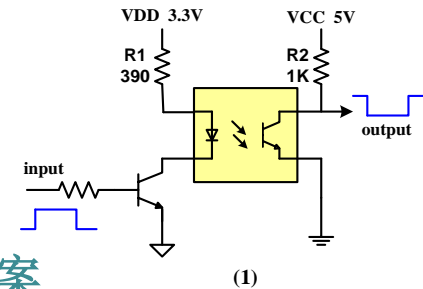
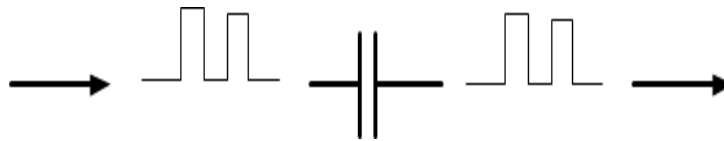
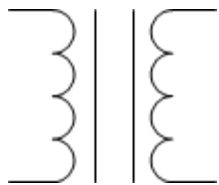
2. Performance 特性

- a) **Noise decoupling** 隔离干扰
- b) **Ground Loop elimination** 消除对地串扰
- c) **RFI decoupling** 隔离电磁干扰

Optocouplers for Safety



Possible Solutions



Isolation Design compromises 隔离设计方案

1. Isolation Voltage 电压隔离
2. PCB Footprint PCB印脚隔离
3. Frequency response 频率响应
4. Power Handling 功率控制
5. Optoisolators – best provide optimum trade-off
光耦隔离---提供最佳优化方案

Electrical Safety Basics 电气安全要求

Fundamental rule of electrical Safety 电气安全的基本规则:

A system shall not be designed such that a **'single' point failure** will not create a safety hazard.
一个系统的设计不会因某一局部点产生失效而危害整个系统的安全性

Types of Insulation 绝缘类型

1. Basic Insulation 基本绝缘:

- a) **One layer of insulation that provides isolation from a hazardous voltage**
对危险电压提供单层绝缘保护
- b) **Provides "single point failure" protection**
提供单点失效保护

2. Double Insulation 双重绝缘:

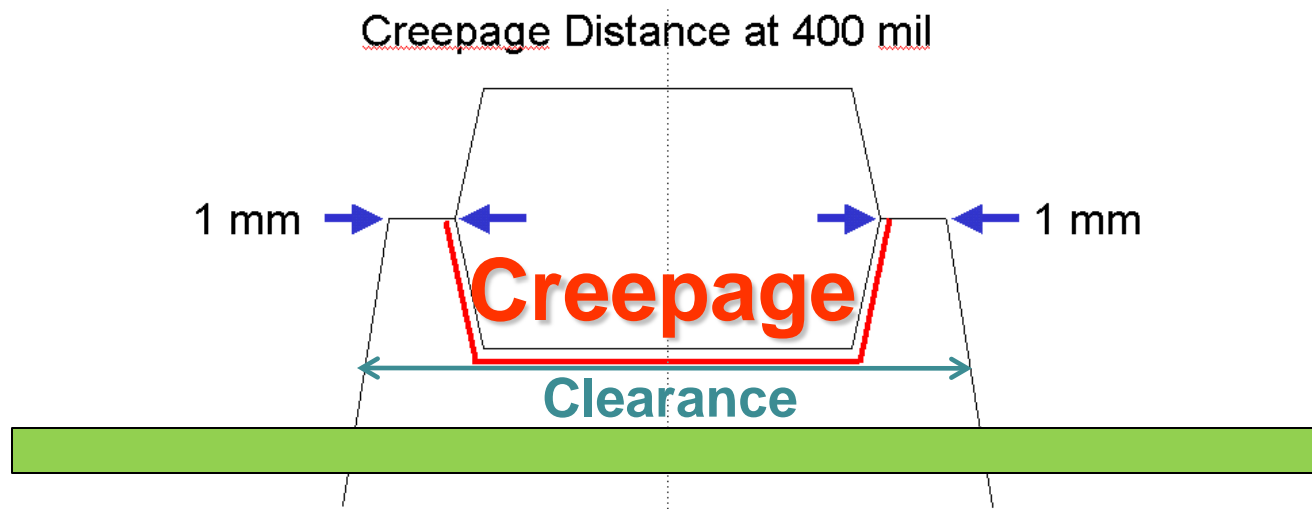
- a) **Two layers of insulation that provide an additional layer of insulation protection**
提供双层绝缘保护
- b) **Provides "single point failure" protection**
提供单点失效保护

3. Reinforced Insulation 强力绝缘:

- a) **Single layer of insulation functionally equivalent to double insulation**
单层绝缘保护的性性能达到双层保护的要求
- b) **Provides "single point failure" protection**
提供单点失效保护
- c) **All Vishay couplers are considered reinforced insulation systems**
所有Vishay光耦都是满足强力绝缘系统的要求
- d) **Two ways to achieve Reinforced insulation** 两种方式可实现强力绝缘要求:
 1. **Minimum of 0.4 mm internal insulation distance** 最低0.4mm内绝缘距离
 2. **Testing as per IEC60950** 按照IEC60950标准测试

Creepage & Clearance 爬电距离及净间隙尺寸

Aspects at different Lead bendings 不同引脚类型



Creepage: Distance along an insulating surface between conductors

爬电距离：导体间隔离绝缘体之间的距离

Clearance: Distance across air between conductors

净间隙尺寸：导体间空气隔离距离

What Creepage Distance is Required?

对爬电距离有何要求?

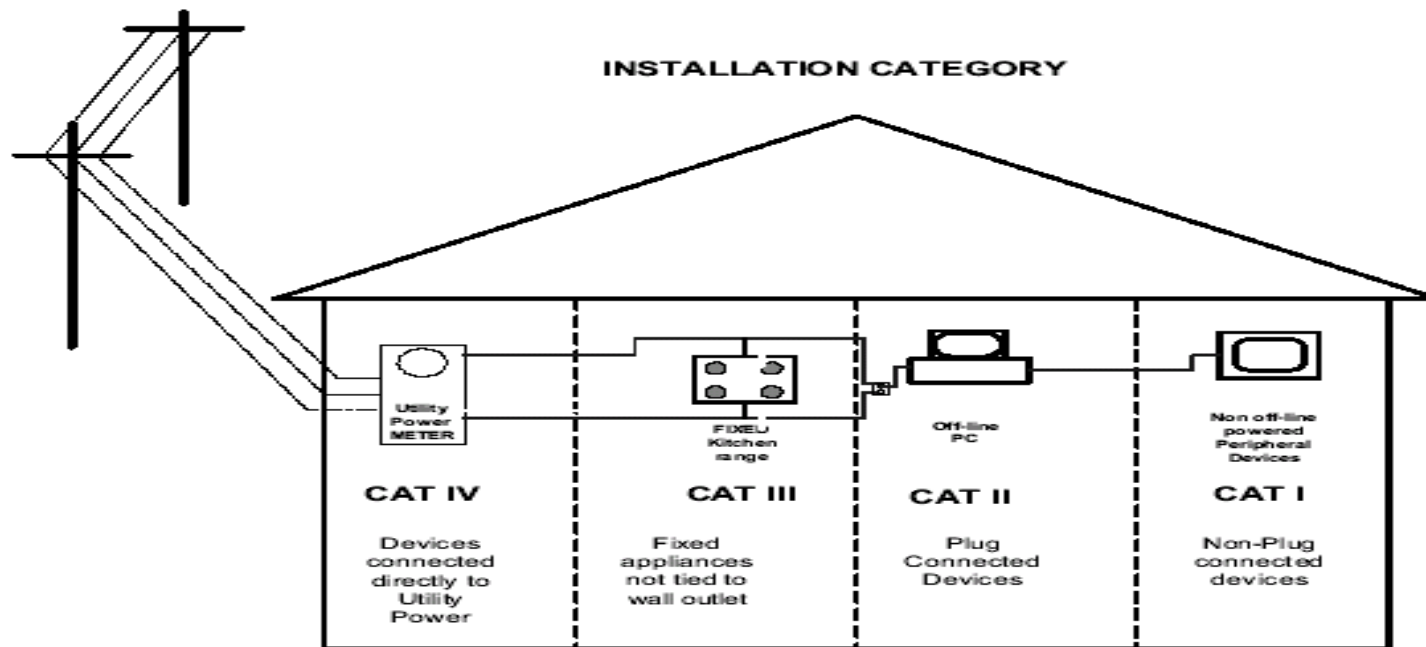
Table 2L – Minimum creepage distances

CREEPAGE DISTANCES in millimetres

WORKING VOLTAGE V r.m.s or d.c	FUNCTIONAL, BASIC AND SUPPLEMENTARY INSULATION						
	Pollution Degree 1	Pollution Degree 2			Pollution Degree 3		
	Material Group	Material Group			Material Group		
	I, II, IIIa or IIIb	I	II	IIIa or IIIb	I	II	IIIa or IIIb
≤50		0,6	0,9	1,2	1,5	1,7	1,9
100	Use the CLEARANCE from the appropriate table	0,7	1,0	1,4	1,8	2,0	2,2
125		0,8	1,1	1,5	1,9	2,1	2,4
150		0,8	1,1	1,6	2,0	2,2	2,5
200		1,0	1,4	2,0	2,5	2,8	3,2
250		1,3	1,8	2,5	3,2	3,6	4,0
300		1,6	2,2	3,2	4,0	4,5	5,0
400		2,0	2,8	4,0	5,0	5,6	6,3
600		3,2	4,5	6,3	8,0	9,6	10,0
800		4,0	5,6	8,0	10,0	11,0	12,5
1000		5,0	7,1	10,0	12,5	14,0	16,0

Linear interpolation is permitted between the nearest two points, the calculated spacing being rounded to the next higher 0,1 mm increment.

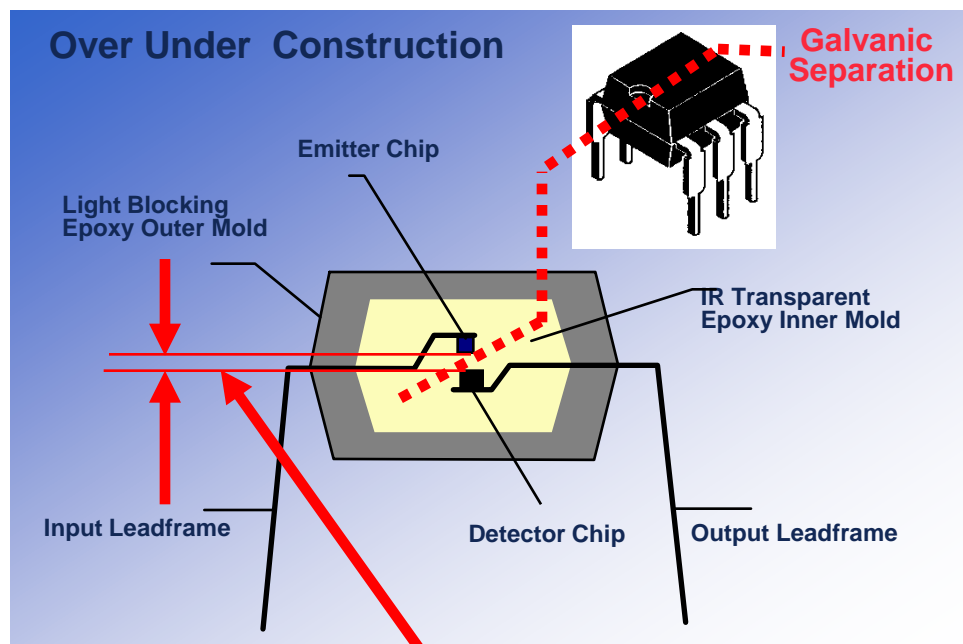
Installation Category 接线类别



Working Voltage Vrms oder DC	Installation Category			
	IV	III	II	I
50	1500	800	500	330
100	2500	1500	800	500
150	4000	2500	1500	800
300	6000	4000	2500	1500
600	8000	6000	4000	2500
1000	12000	8000	6000	4000

Vishay's Reinforce Insulation Couplers

Vishay 强力绝缘型光耦

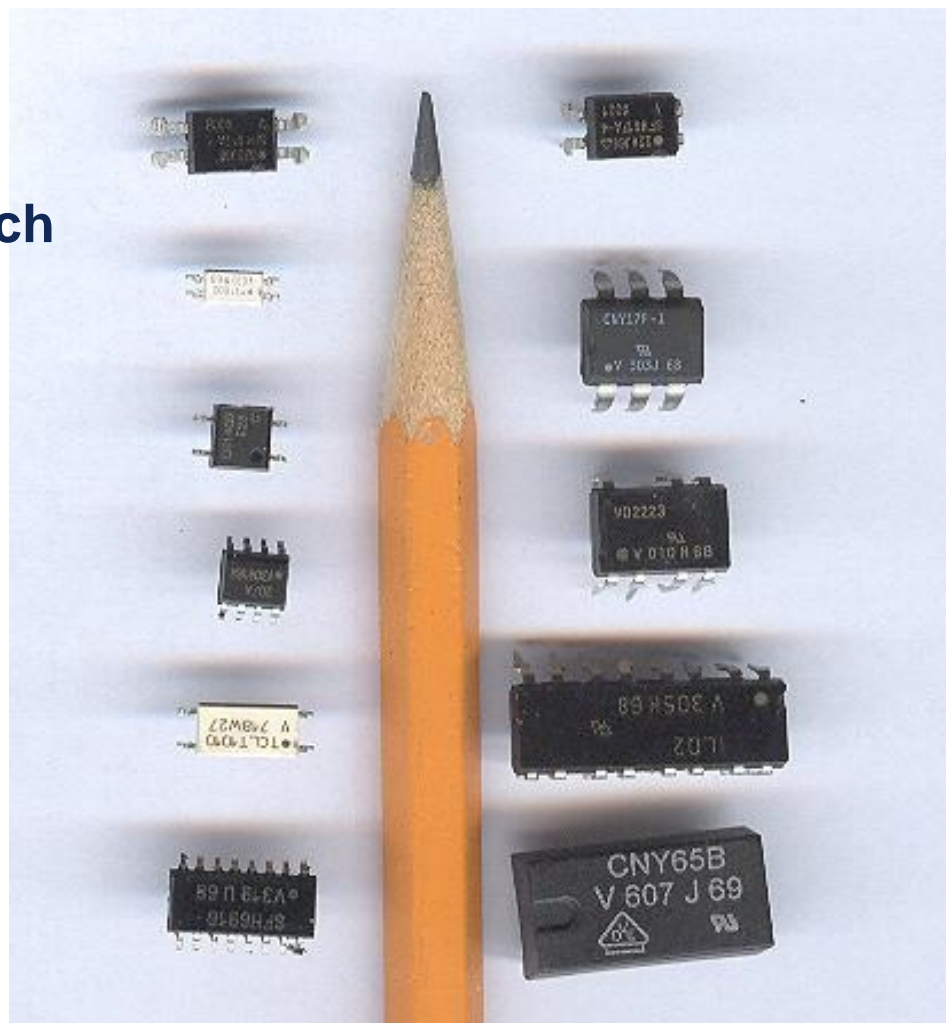


Insulation Thickness

Wide Variety of Packages Available

各种封装类型的光耦

- SMD-4
- SOP-4 / half-pitch
(1.27 mm)
- SOP-4
(2.54 mm)
- SOIC-8
- Long mini-flat
- SOP-16
(4-channel)



DIP-4

DIP-6

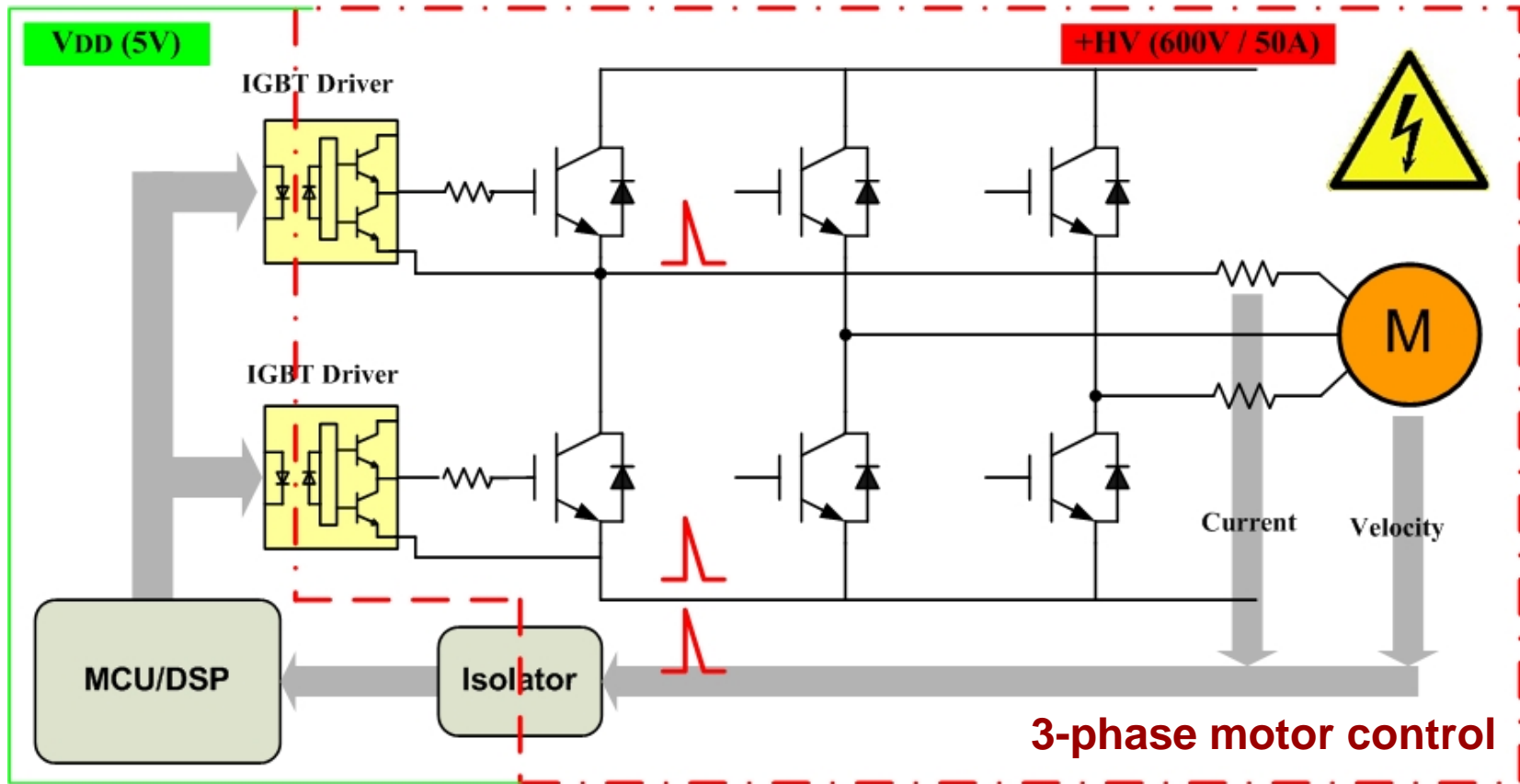
DIP-8

DIP-16

超高隔离电压

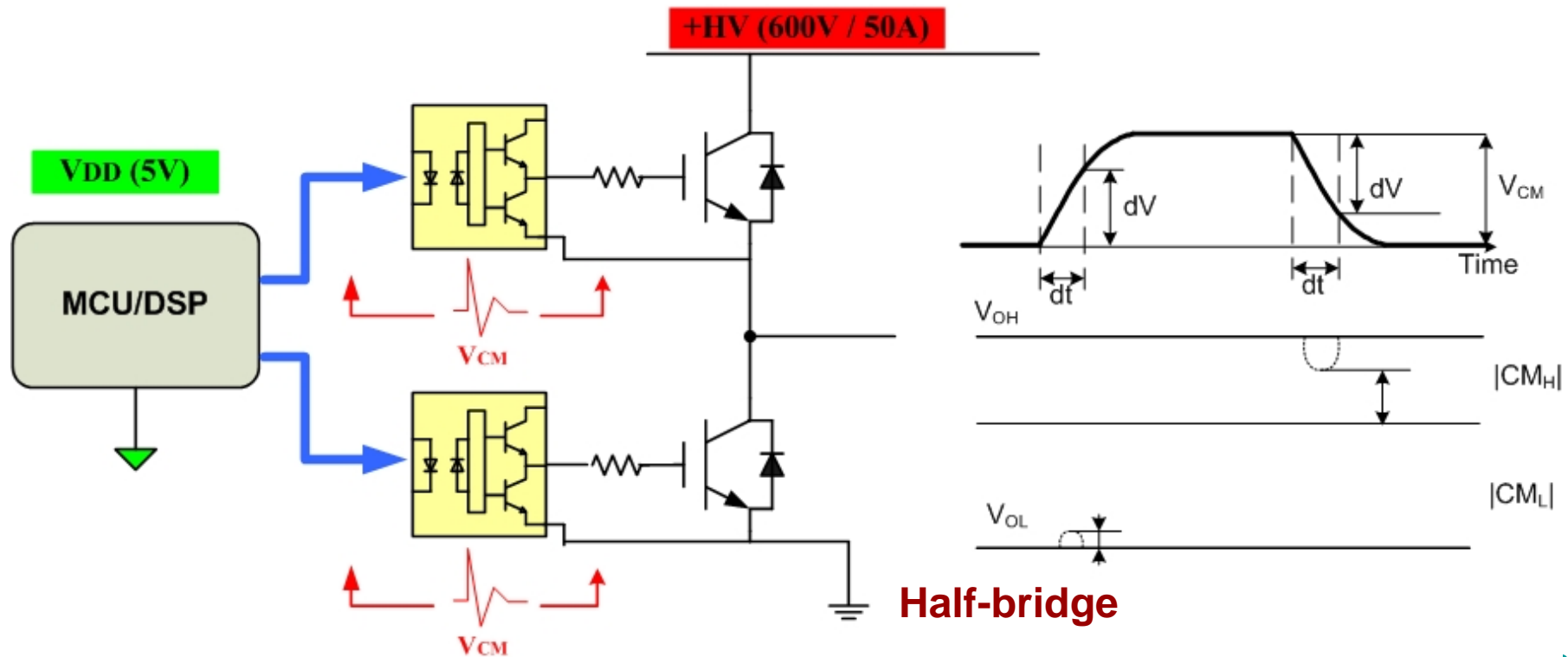
Noise Coupling Reduction 降低干扰耦合

1. **Isolating sensitive microcontrollers from noisy power stages**
隔离功率元件对微控制器产生的干扰
2. **Greatly simplify the task of isolating “analog” from digital in PCB design**
隔离数字信号对模拟信号产生的干扰
3. **Isolate sensitive circuits from ground bounce**
隔离对地串扰对敏感电路产生的影响



Quantifying Noise Isolation 噪声隔离的量化

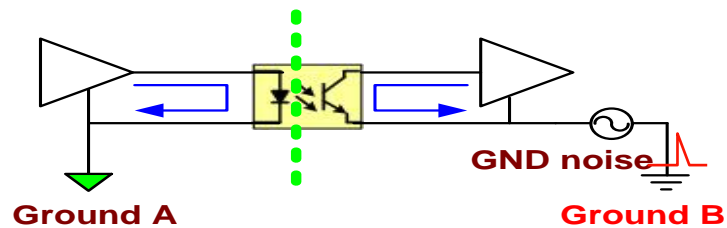
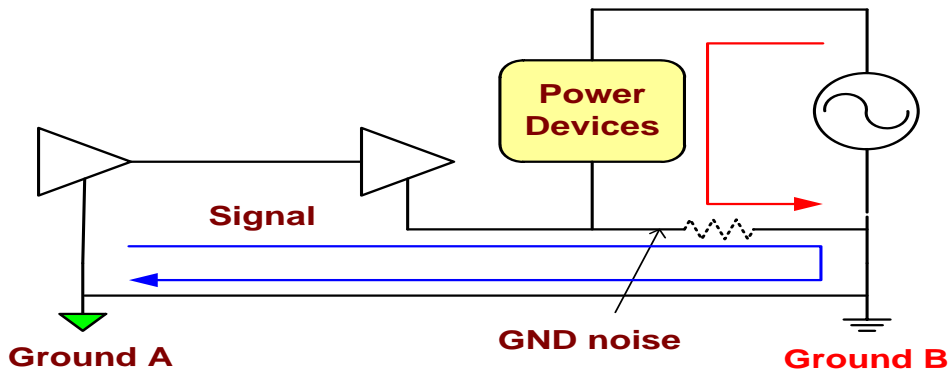
1. **C** _{input-output} 输入/输出之间的电容
 1. Typically $\ll 1\text{pF}$ 典型值 $\ll 1\text{pF}$
 2. Difficult to measure 较难测量
2. **CMR (common mode rejection)** 抗共模串扰
 1. Easier to measure 较易测量
 2. Given as dv/dt value in $\text{KV}/\mu\text{s}$ @ test voltage
 3. Typical $25\text{KV}/\mu\text{s}$ @ 1.5KV 典型值 $25\text{kV}/\mu\text{s}$ @ 1.5kV










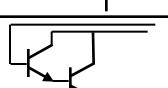







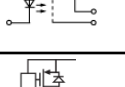


Reduce Ground Loops & Reduce EMI

降低对地串扰和电磁干扰

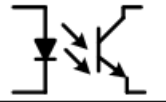
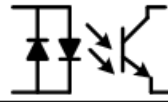
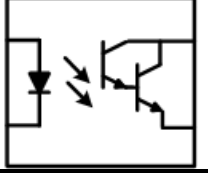
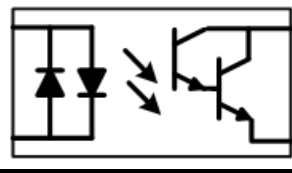
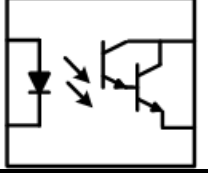
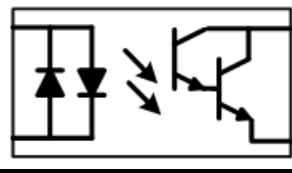
1. Optocouplers provide small footprint, economical solutions to diminishing the Areas of Gnd Loops. 光耦提供了可消除对地串扰，而且小尺寸印脚的经济方案
2. Loops make effective Antennae, more loop area - more effective antenna 串扰环路会产生有效的天线效应，越多的环路会产生越多的天线效应
3. Reduce loop area 减少环路面积
 1. Reduce potentially harmful ground currents 降低潜在的对地电流的危害
 2. Reduce RF emissions from system and RF susceptibility of system 降低系统的射频发射及降低对射频敏感系统的影响



Optocoupler Portfolio (by function)

Function	Input	Output	# of Channels	Key Parameters
Photodiode / Linear			1	CTR
Phototransistor			1, 2, 4	CTR
Phototransistor			1, 2, 4	CTR
Photodarlington			1, 2, 4	CTR
Photodarlington			1, 2, 4	CTR
Phototriac			1	ZC/NZC, dV/dt , V_{DRM} , I_{FT}
High Speed			1, 2	CMR, t_{PHL} , t_{PLH}
IGBT Driver			1	CMR, t_{PHL} , t_{PLH}
Solid State Relay			1, 2	Form A, Form B V_L , R_{ON} , I_{FT} , t_{PHL} , t_{PLH}

Transistor Optocouplers

	Name	Function	Structure	
General Purpose	Photo-transistor	Analog / digital	DC-Input 	AC-Input 
			DC-Input 	AC-Input 
	Photo-Darlington	Analog / digital	Photo-diode-transistor 	Photo-diode-Darlington 

1. Transistor Output Optocouplers 晶体管输出光耦

- 1) DC Input
- 2) AC Input
- 3) Single Transistor Output
- 4) Darlington Output

2. Terms 术语

- 1) I_F : LED input current (mA)
- 2) CTR : Current Transfer Ratio = I_{CE} / I_F (%)

3. Critical Parameters 关键参数

- 1) CTR
 - a) CTR(sat) & CTR (unsat)
 - b) Varies with I_f , temperature, component life
- 2) I_F

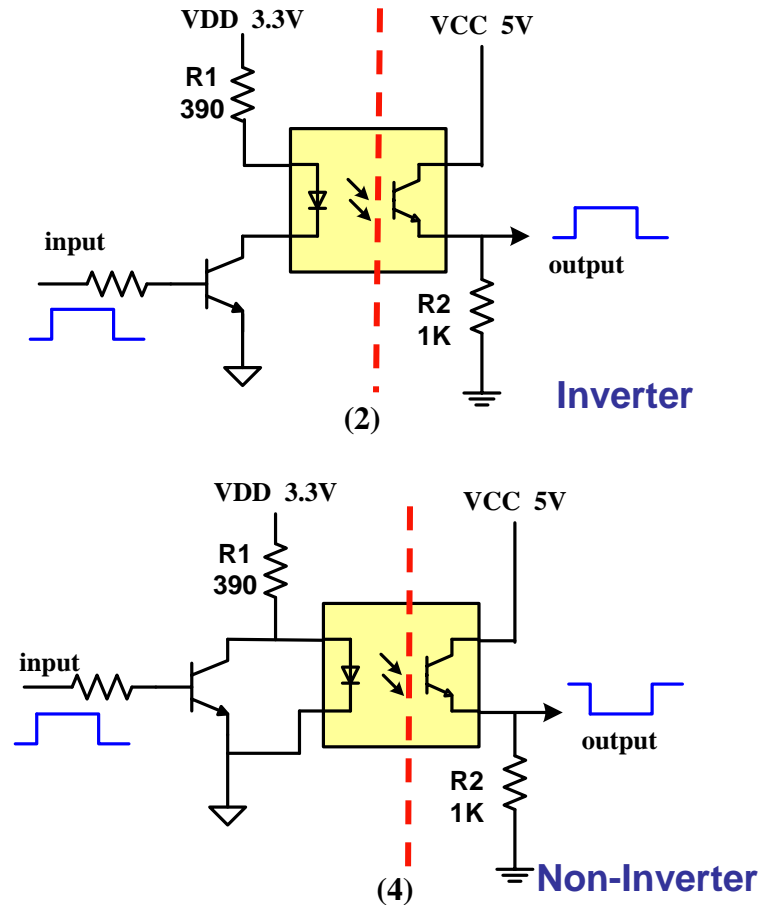
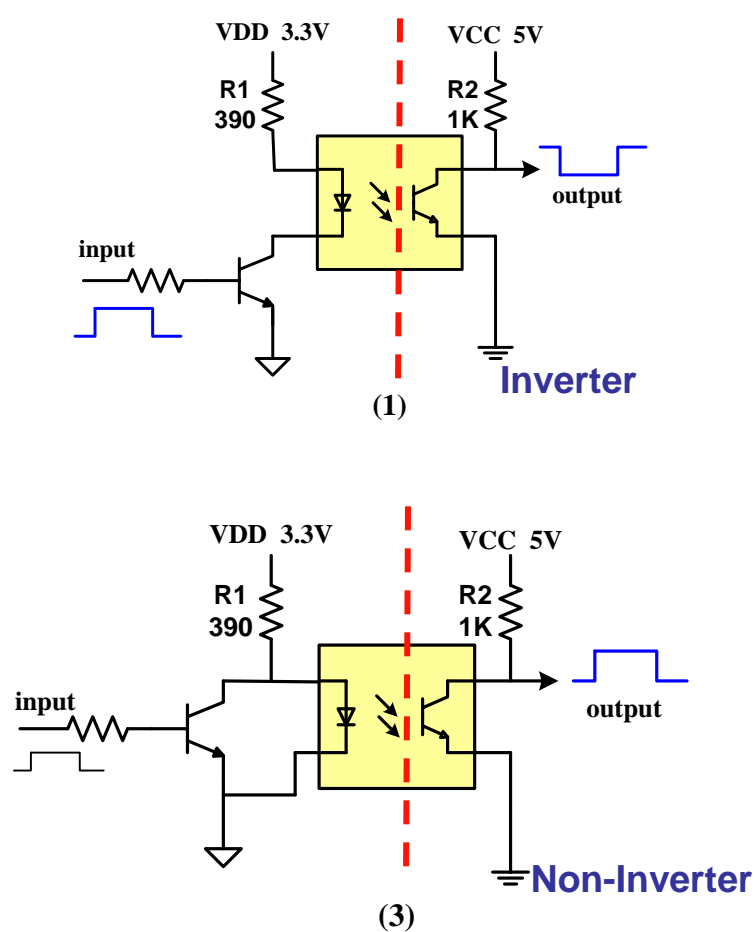
Transistor OUTPUT $CTR_{(sat)}$ Application

晶体管光耦饱和CTR输出的应用

Digital I/O: 1/0, High/Low, True/False, ON/OFF, Sat./OFF
Key Parameter:

Current Transfer Ratio (sat):

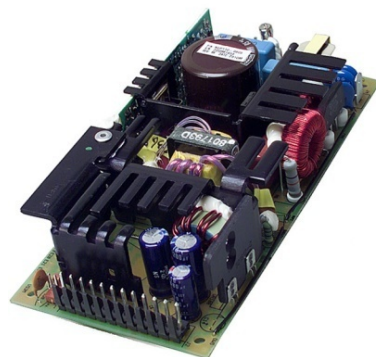
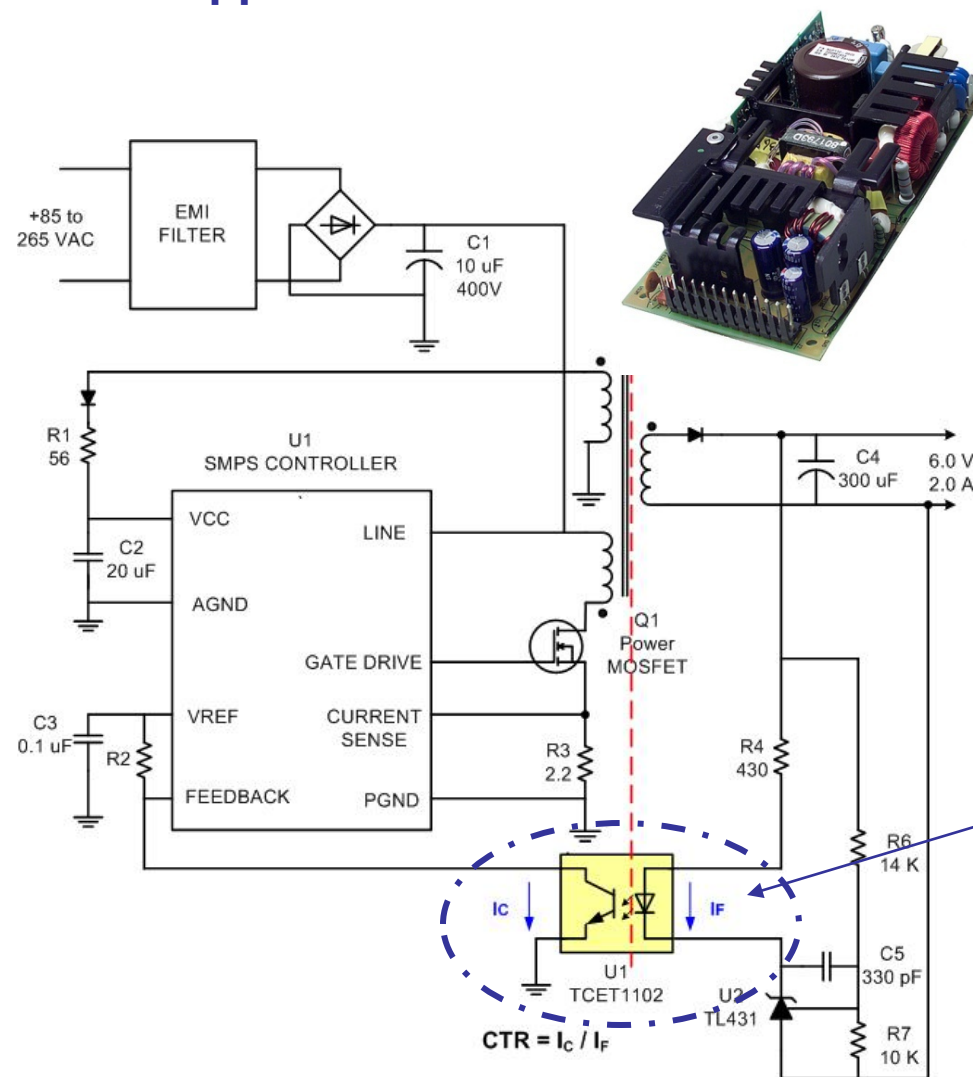
$$CTR = I_C / I_F$$



Typical $CTR_{(desat)}$ Application

典型非饱和CTR输出的应用

Power Supplies



Key Parameter:

Current Transfer Ratio

$$CTR = I_C / I_F$$



Example:

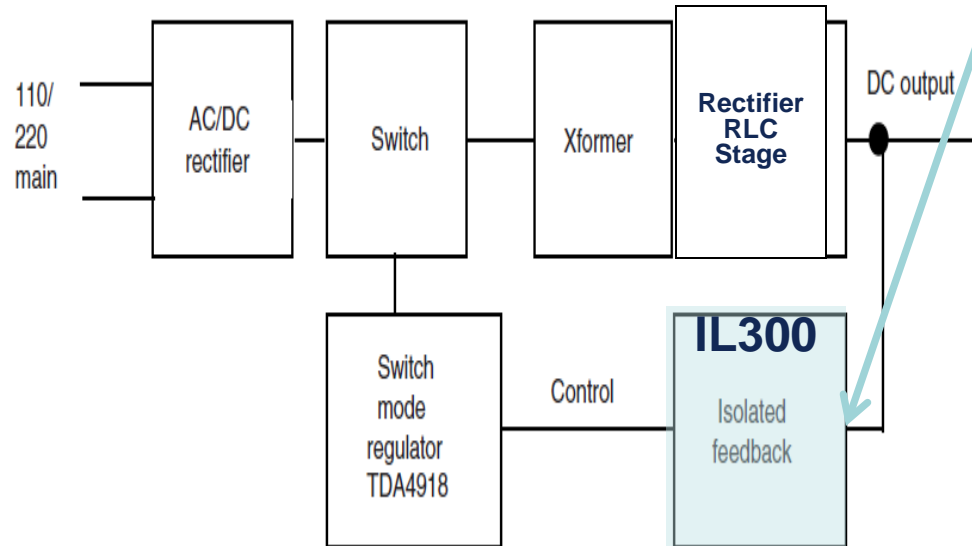
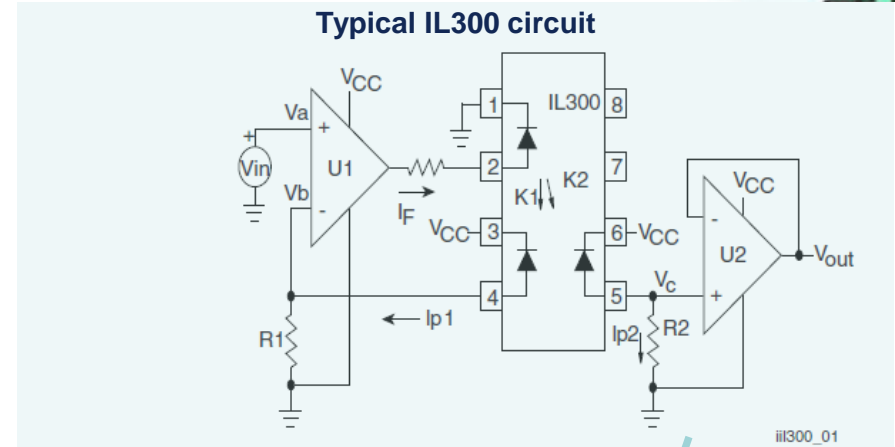
$$CTR = 4.8\text{mA} / 5.6\text{mA} \\ = 0.86 = 86\%$$

Design Considerations:

1. Creepage requirement 爬电距离的要求
2. CTR drift 光传输比的漂移
 - 1) Temp 工作温度
 - 2) If 正向电流
 - 3) Life time of product 产品寿命

Too Much Variation with Typical Transistor Coupler?

Linear Optocoupler	
 	
Products	IL300
Benefits	<ul style="list-style-type: none"> Linear output High stability gain Different K3 BIN



Advantages 优点

1. Constant Gain 恒定的线性关系

- a) Over Temp 超温
- b) Over life of component 过寿命

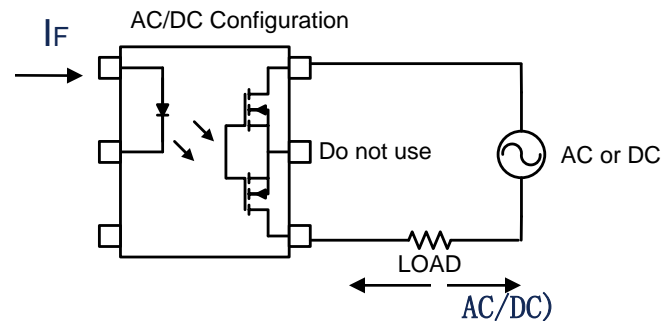
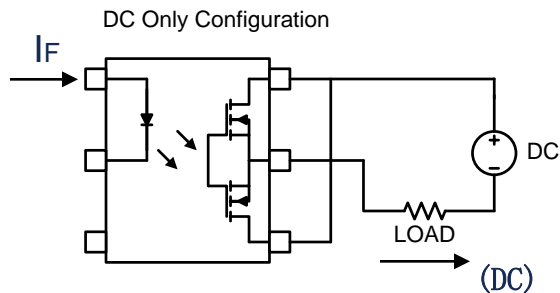
2. High linearity Output 高线性输出

SSR – PhotoMOSFET

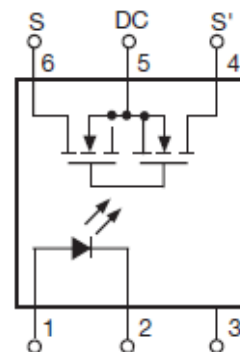
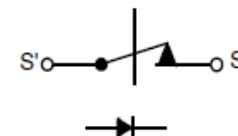
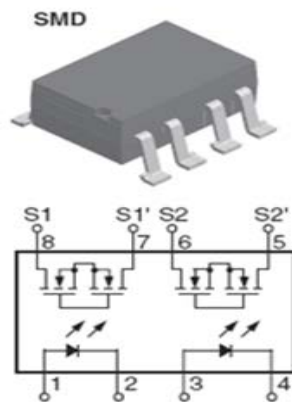
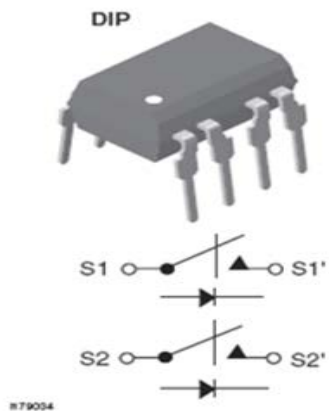
	Load Voltage (V)	AC/DC Load Current (mA)	ON/OFF time (ms, max)	I/O Isolation Voltage (VRMS)	Part number
1 Form A	60	100	0.5/0.5*	1500	VO1400
	60	1000/2000	0.8/0.8*	5300	VO14642
	200	200/350	2.0/2.0	5300	LH1510
	350	150/250	2.0/2.0	5300	LH1500
	400	120/250	1.0/1.5	5300	LH1525
Dual 1 Form A	200	140	2.0/2.0	5300	LH1520
	350	110	2.0/2.0*	5300	LH1522
	400	100	1.0/1.5	5300	LH1526
1 Form B	200	200/300	3.0/3.0*	3750	LH1511
	350	150/200	3.0/3.0	3750	LH1501
Dual 1 Form B	200	140	3.0/3.0	3750	LH1523
	350	110	3.0/3.0	3750	LH1521

* IF = 10 mA, others 5 mA

(DC / AC)



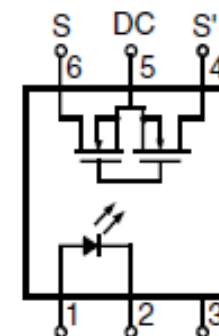
SSR (MOSFET)



Form A

Normally-open

常开



Form B

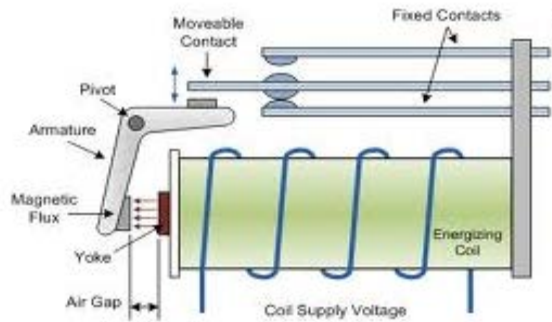
Normally-close

常闭

Critical Parameters 关键参数:

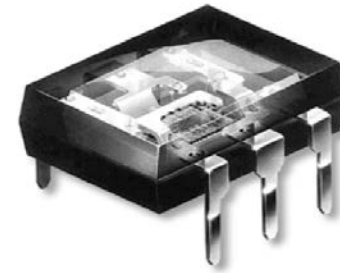
- 1) $I_{f(on)}$: LED input current required to achieve specified R_{on} (mA)
- 2) $I_{f(off)}$: LED input current required to achieve specified max leakage current (mA)
- 3) Maximum Output Voltage (V) – 60V – 600V
- 4) Load current (mA) – 100mA – 2Amps
- 5) T_{on}/T_{off} - 0.5usec

MOSFET OUTPUT SSRs



EMR

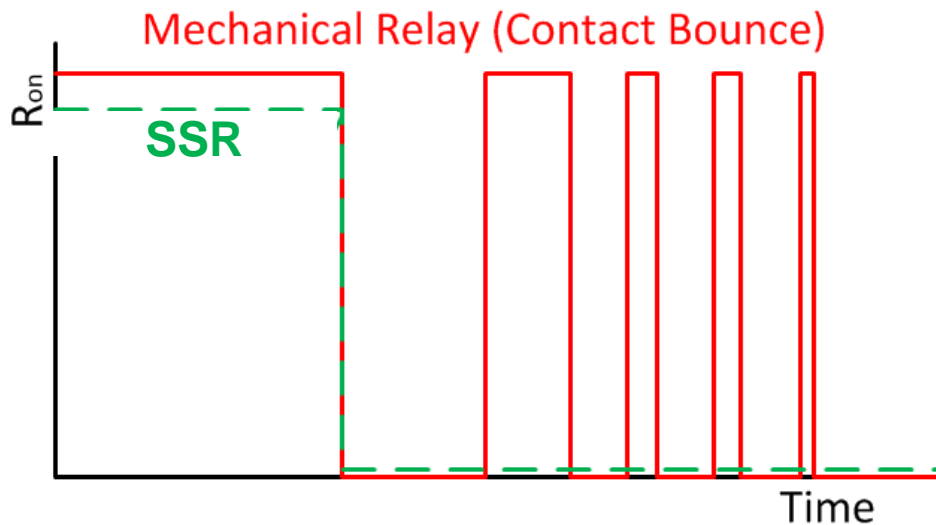
VS.



Advantages of SSRs vs Mechanical Relays

光控继电器与机械继电器的比较

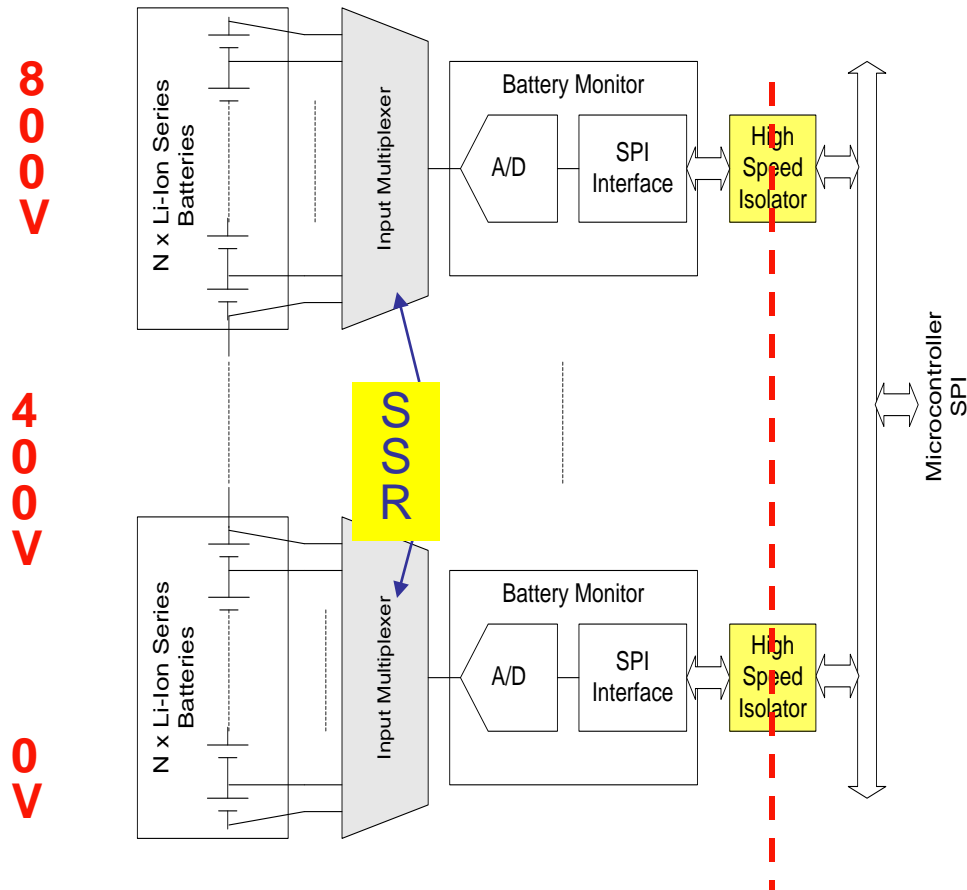
- **Higher Isolation Voltage** 高隔离电压
- **Higher Shock and Vibe Immunity** 无瞬时脉冲
- **Smaller Size** 器件小尺寸
- **Low Drive Current** 低驱动电流
- **Long Operating Life** 长寿命
- **No Contact Arcing** 无接触弧电
- **No Contact Wear** 无接触损耗
- **High Switching Speed** 高开关速度
- **No EMI Noise Generation** 不产生电磁干扰
- **No Contact Bounce** 无接触弹



Typical SSR Applications:

SSR典型应用

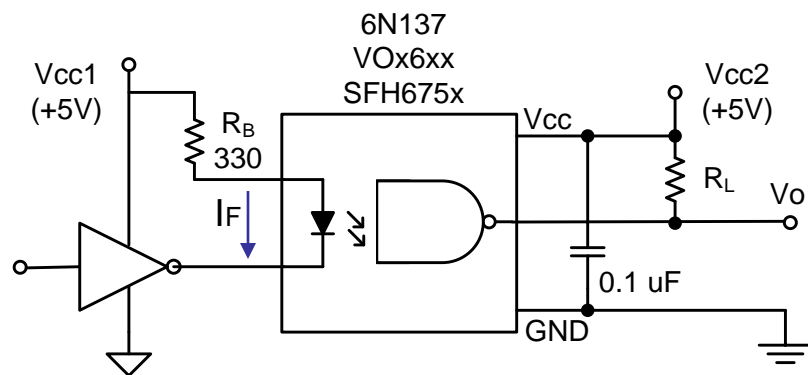
HV Battery Charge Monitor 高压电池充电监测



1. **Communications/ Telephony switching**
通讯开关
2. **Process Control** 过程控制
3. **Instrumentation** 仪器仪表
4. **Industrial Controls** 工业控制
5. **High reliability EMR replacement**
高可靠抑制电磁干扰环境的替代
6. **Test Equipment** 测试设备
7. **Chip Testers** 芯片测试

High Speed Couplers

	Data Rate	CTR min	IFON max	tPLH typ	tPHL typ	Part number
High speed (Analog)	100 Kbd/s	300 %		2 μ s	2 μ s	6N138/9, SFH6138/9
	1 MBd/s	15 %		0.2 μ s	0.2 μ s	6N136, SFH6136, SFH6343
High speed (Digital)	5 MBd/s		1.6 mA	120 ns	90 ns	SFH67xx
	10 MBd/s		5 mA	50 ns	50 ns	6N137, VOx6xx, SFH675x



Circuit example

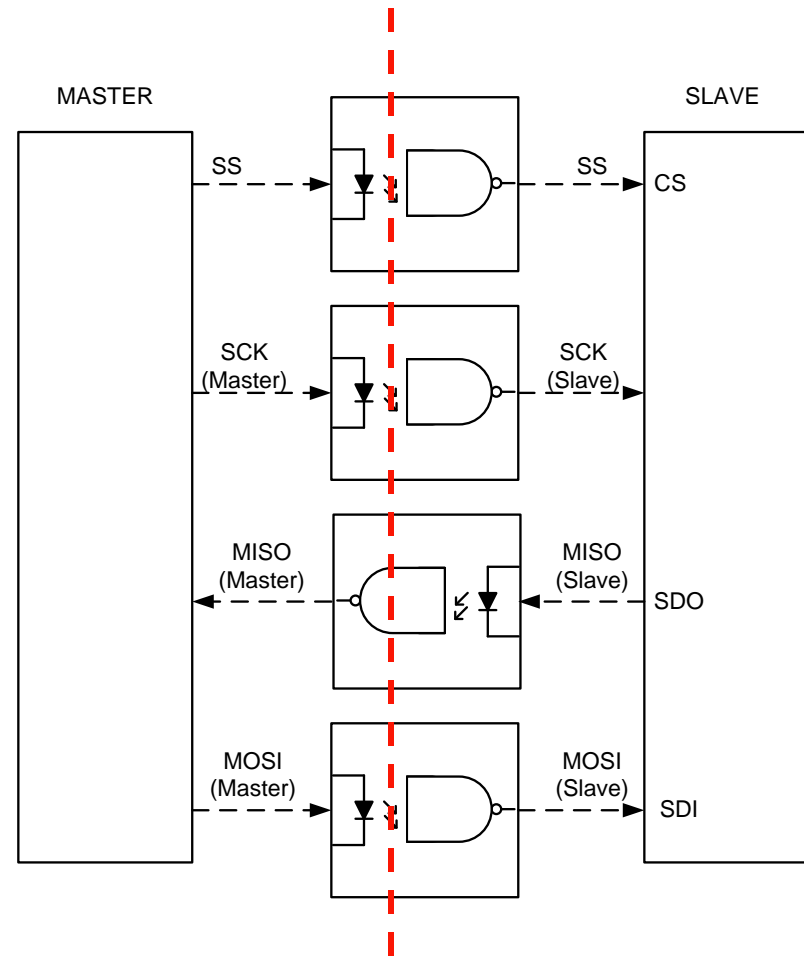
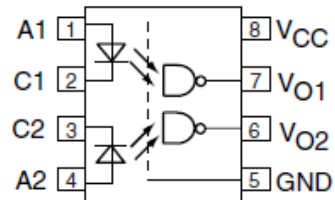


High Speed Coupler Applications

Fieldbus:

- SPI
- I²C
- PROFIBUS
- CANBUS

Example: VO0631T, VO0661T
10 MBd, dual-channel,
SOIC-8 Package



SPI Bus Adapter

Optically Isolated IGBT/MOSFET Drivers

光隔离IGBT/MOSFET驱动

- AC variable speed motor controllers 交流马达控制
- Solar Inverters 太阳能逆变器
- DC servo-motor controllers 直流伺服马达控制
- Welding Equipment 电焊机
- Induction Cooking Tops 电磁炉

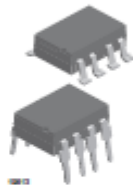


IGBT Drivers



VO3120
Vishay Semiconductors

2.5 A Output Current IGBT and MOSFET Driver



DESCRIPTION

The VO3120 consists of a LED optically coupled to an integrated circuit with a power output stage. This optocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The voltage and current supplied by this optocoupler makes it ideally suited for directly driving IGBTs with ratings up to 800 V/50 A. For IGBTs with higher ratings, the VO3120 can be used to drive a discrete power stage which drives the IGBT gate.

FEATURES

- 2.5 A minimum peak output current
- 25 kV/μs minimum common mode rejection (CMR) at $V_{CM} = 1500$ V
- $I_{CC} = 2.5$ mA maximum supply current
- Under voltage lock-out (UVLO) with hysteresis
- Wide operating V_{CC} range: 15 V to 32 V
- 0.2 μs maximum pulse width distortion
- Industrial temperature range: -40 °C to 110 °C
- 0.5 V maximum low level output voltage (V_{OL})
- Reinforced insulation rated per DIN EN 60747-5-2
- Compliant to RoHS Directive 2002/95/EC



APPLICATIONS

- Isolated IGBT/MOSFET gate driver
- AC and brushless DC motor drives
- Induction stove top
- Industrial inverters
- Switch mode power supplies (SMPS)
- Uninterruptible power supplies (UPS)

AGENCY APPROVALS

- UL - file no. E52744 system code H, double protection
- cUL - file no. E52744, equivalent to CSA bulletin 5A
- DIN EN 60747-5-2 (VDE 0884) and reinforced insulation rating available with option 1

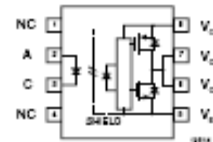
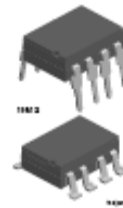
2.5 amp IGBT/MOSFET driver

VO3150

Vishay Semiconductors



Optocoupler, IGBT and MOSFET Driver



DESCRIPTION

The VO3150 consists of a LED optically coupled to an integrated circuit with a power output stage. This optocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The voltage and current supplied by this optocoupler makes it ideally suited for directly driving IGBTs with ratings up to 1200 V/50 A. For IGBTs with higher ratings, the VO3150 can be used to drive a discrete power stage which drives the IGBT gate.

FEATURES

- 0.5 A minimum peak output current
- 15 kV/μs minimum common mode rejection (CMR) at $V_{CM} = 1500$ V
- 1.0 V maximum low level output voltage (V_{OL}) eliminates need for negative gate drive
- $I_{CC} = 2$ mA maximum supply current
- Under voltage lock-out (UVLO) with hysteresis
- Wide operating V_{CC} range: 15 V to 30 V
- 0.2 μs maximum propagation delay
- Industrial temperature range: -40 °C to 110 °C



AGENCY APPROVALS

- Isolated IGBT/MOSFET gate driver
- AC and brushless DC motor drives
- Industrial inverters
- Switch mode power supplies (SMPS)
- Uninterruptible power supplies (UPS)

APPLICATIONS

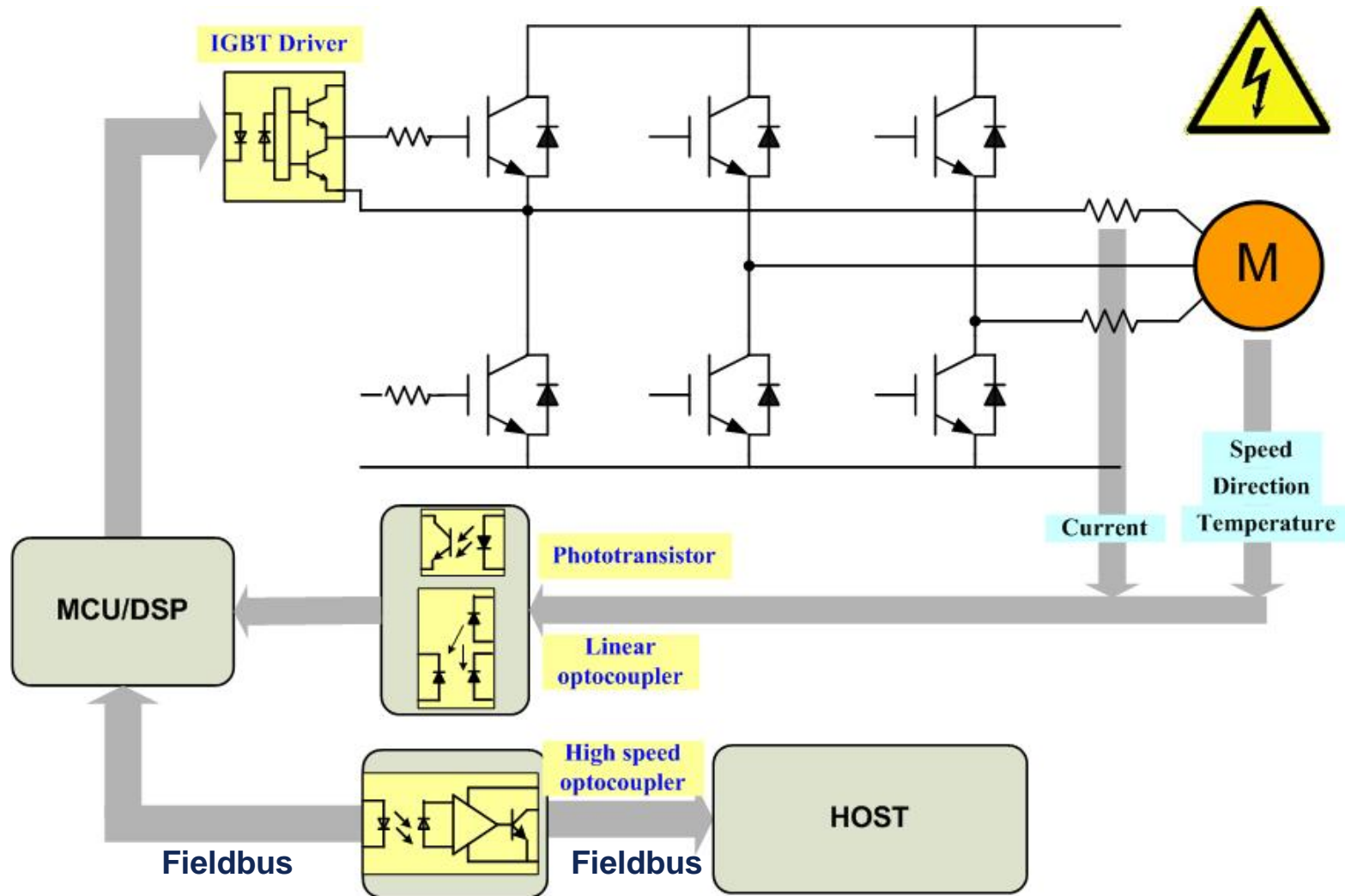
- UL - File
- cUL - File
- DIN EN 60747-5-2 (VDE 0884) available with option 1

0.5 amp IGBT/MOSFET driver

High output current 高输出电流
High speed switching 高开关速度

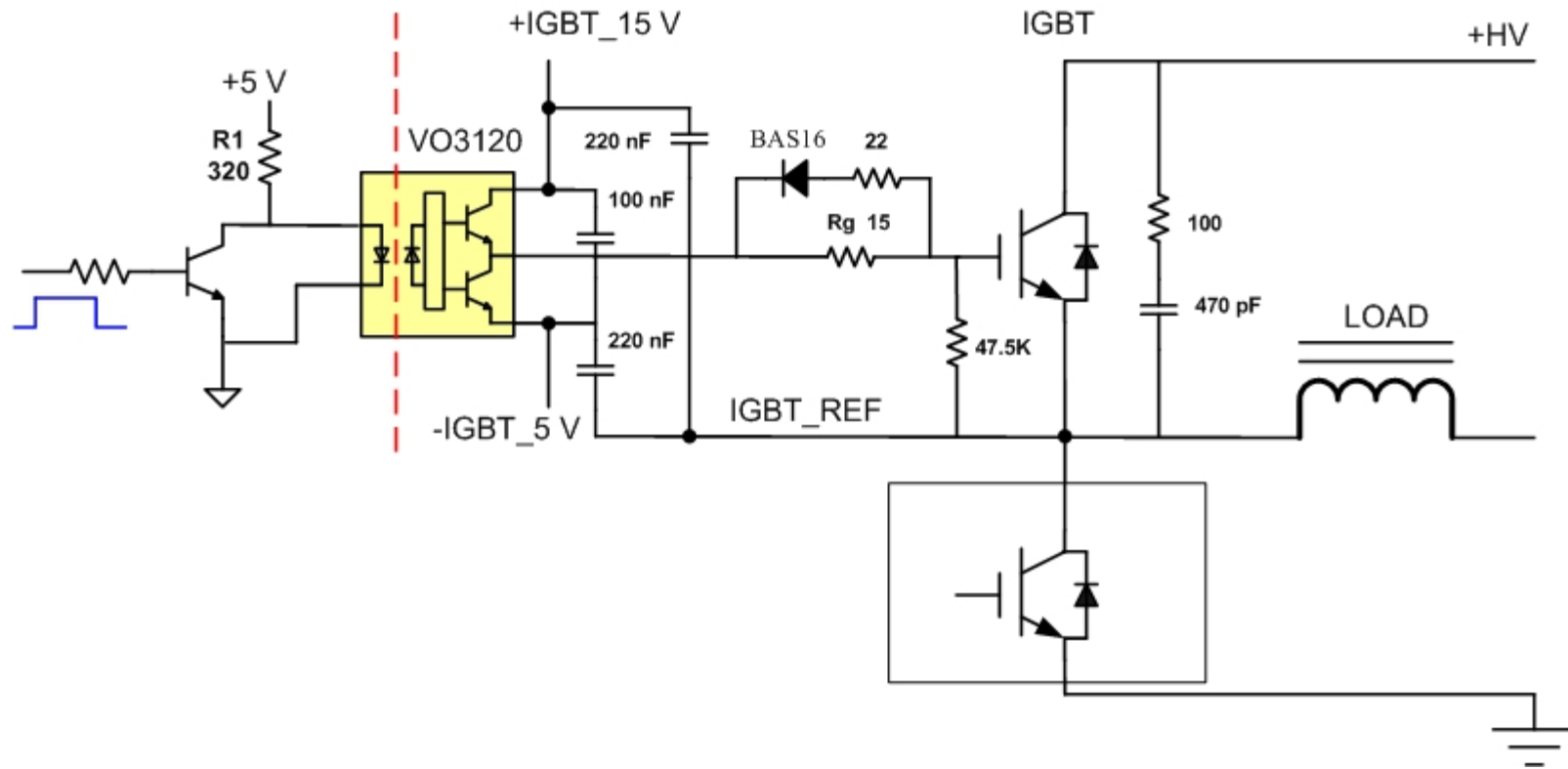
AC motor drive IGBT driver application

交流马达IGBT驱动的应用



Single Inductive Load Application

IGBT module rating up to 1200V 50A



OPTO-TRIACs

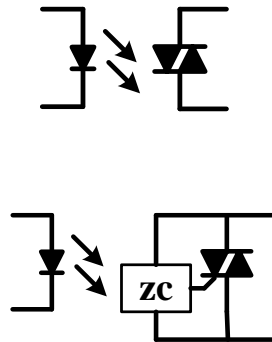
ZC(zero crossing) NZC(non-zero crossing) 过零和非过零光控晶闸管

Zero crossing Advantages:

- 1. Low RFI emissions 低射频发射
- 2. Low inrush current 低瞬时冲击电流

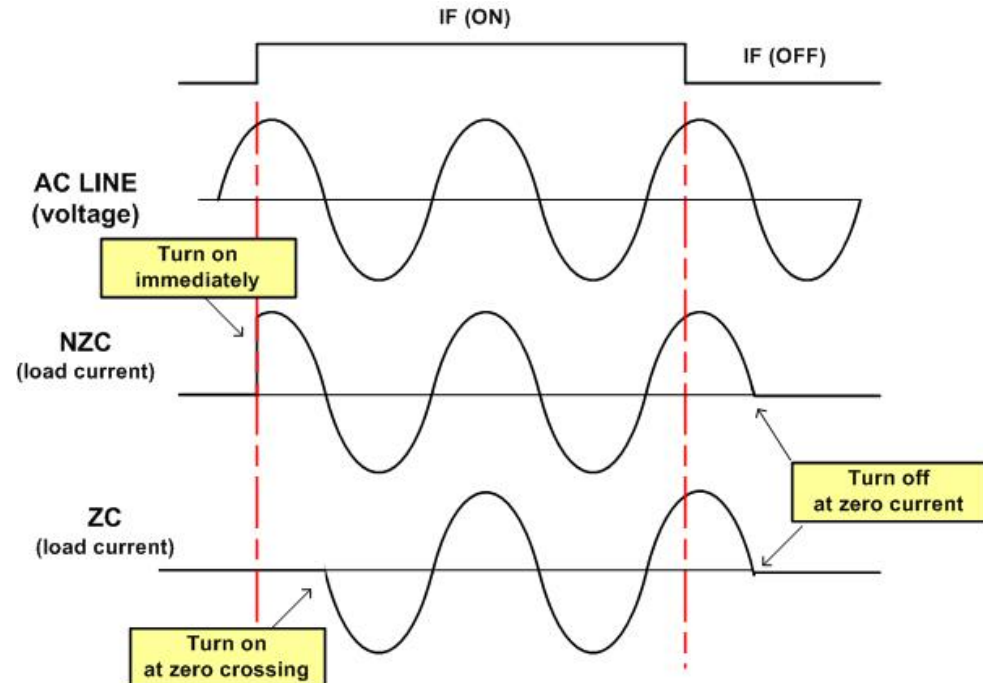
Non-Zero crossing Advantages:

- 1. Trigger phase angle flexibility 触发相位灵活
- 2. Lower Cost 成本低

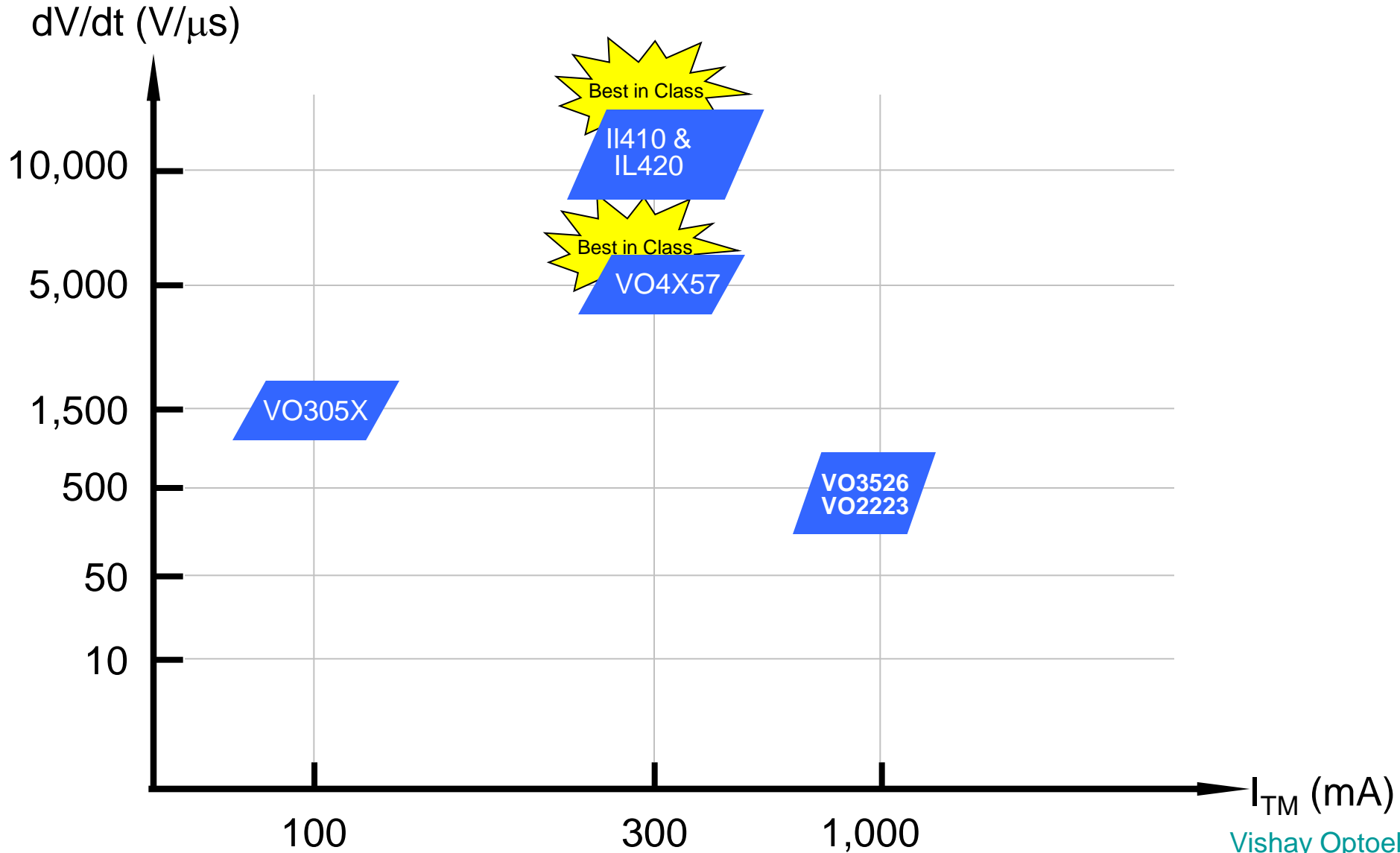


Critical parameters 关键参数

- 1. I_{FT}: Trigger Current 触发电流
- 2. V_{DRM}: Maximum off-state voltage 击穿电压
- 3. V_{tm}: on-state Voltage 导通压降
- 4. Static dv/dt 静态dv/dt
- 5. Dynamic dv/dt 动态dv/dt

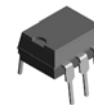


Vishay Phototriac Portfolio Based ON Application



Phototriac Applications

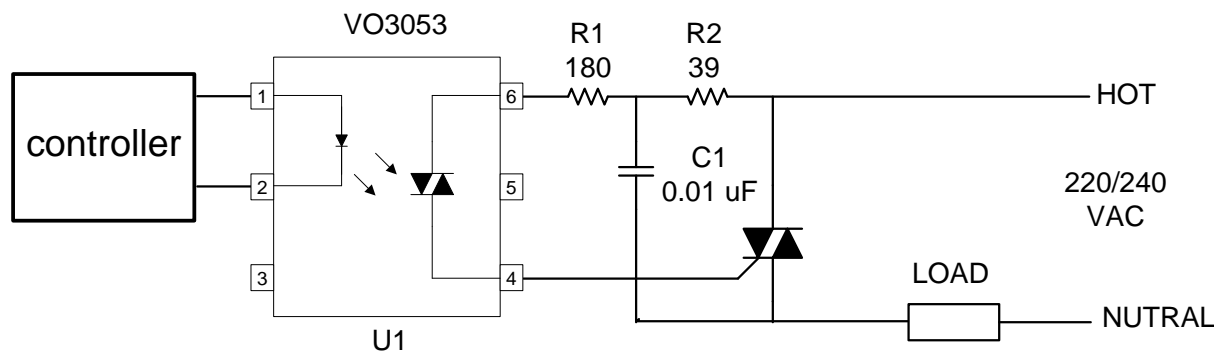
- Light dimming Modules 照明调光控制
- AC motor controls 交流马达控制



phototriac



Power phototriac



电炉



微波炉



空调



洗衣机

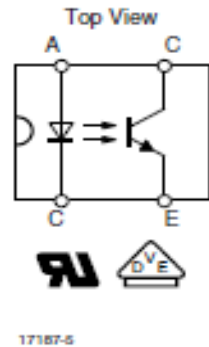


电冰箱

Ultra High Isolation Voltage Couplers

超高隔离电压光耦

HV SMD Version Optocoupler 新推出贴片封装



Major Features 主要特性

- Surface Mount Package 贴片封装
- **Repetitive Peak Voltage (V_{IORM}):** 1450 V_{peak}
可恢复瞬时耐压 V_{IORM}
- Pure tin leads, RoHS, WEEE Compliant, Green

Benefits

- Capable of undergoing Solder Reflow
可满足隧道炉装配要求
- Suitable for high noise environment
适用于高干扰环境
- Ultra High Isolation Voltage 超高隔离电压
- **Cat IV installation Category Applications**
Cat IV连接方式隔离应用



Vishay's HV Coupler Competitive Advantage

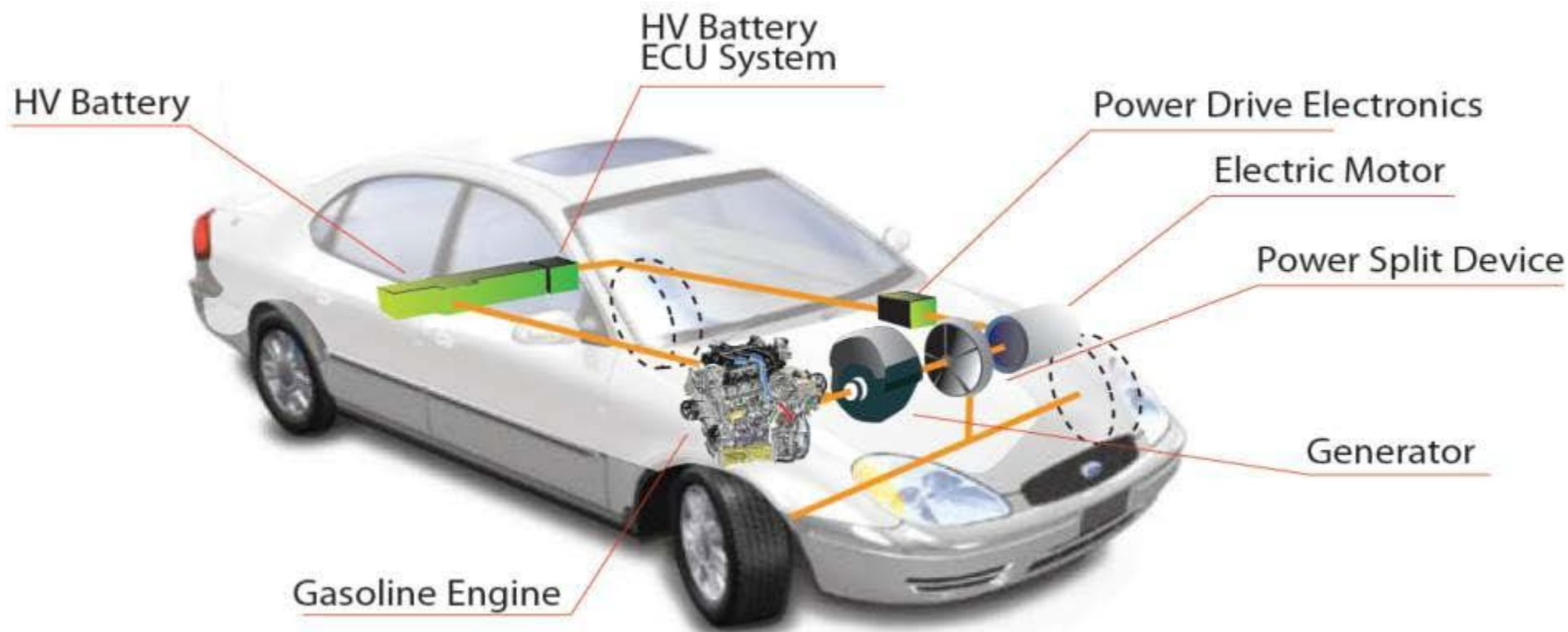
超高隔离光耦的竞争优势

- **V_{IORM} : 1450 V_{peak}** *(Best in class)*
- **Capable of undergoing Solder Reflow** 适用于隧道炉装配 *(matches competition)*
- **Pure tin leads permit lead free soldering** 纯锡 *(matches competition)*
- **Eco Friendly Green Package** 无卤封装 *(Better than competition)*

Application	Customers	Comment
Safety & Noise Isolation 安全及干扰隔离	Solar Inverter Manufacturers 太阳能逆变器制造商	Grid to Control Panel Isolation 并网控制板隔离
Safety & Noise Isolation 安全及干扰隔离	Welding Equipment 电焊机设备	
Safety & Noise Isolation 安全及干扰隔离	Smart Meters 智能电表	Grid to Control Panel Isolation 并网控制板隔离


Automotive Couplers 车规级光耦

Release of Automotive SSR – Q1 2012



Vishay's Optocoupler Portfolio

<http://www.vishay.com/optocouplers/>




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AEC-Q101 Products

Automotive




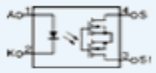
Automotive Grade Optoelectronics
... AEC-Q101 qualified, all in one place



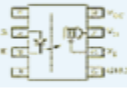
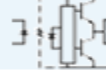
[Selector Guide](#)

OPTOCOUPLEDERS / ISOLATORS

Vishay's large portfolio of optocouplers includes devices with phototransistor, phototriac, or photodarlington outputs in a range of through-hole and surface-mount package types. Highlights include devices with maximum + 110 °C operating temperature, switching speeds up to 10 MBd, and devices designed to serve as IGBT and MOSFET drivers. Vishay optocouplers are certified by key international safety regulatory agencies.

Product Lines

- Phototransistor Output (21) 
- Photodarlington Output (13) 
- Optocoupler with AC Input (18) 
- Solid State Relays (33) 

- Linear (2) 
- Phototriac Output (12) 
- High Speed Analog (9)
High Speed Digital (6) 
- IGBT and MOSFET Driver (2) 

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