



# EiceDRIVER™ F3 – 新一代单通道带短路保护的隔离型驱动芯片

2022 HA赋能课堂  
郑姿清



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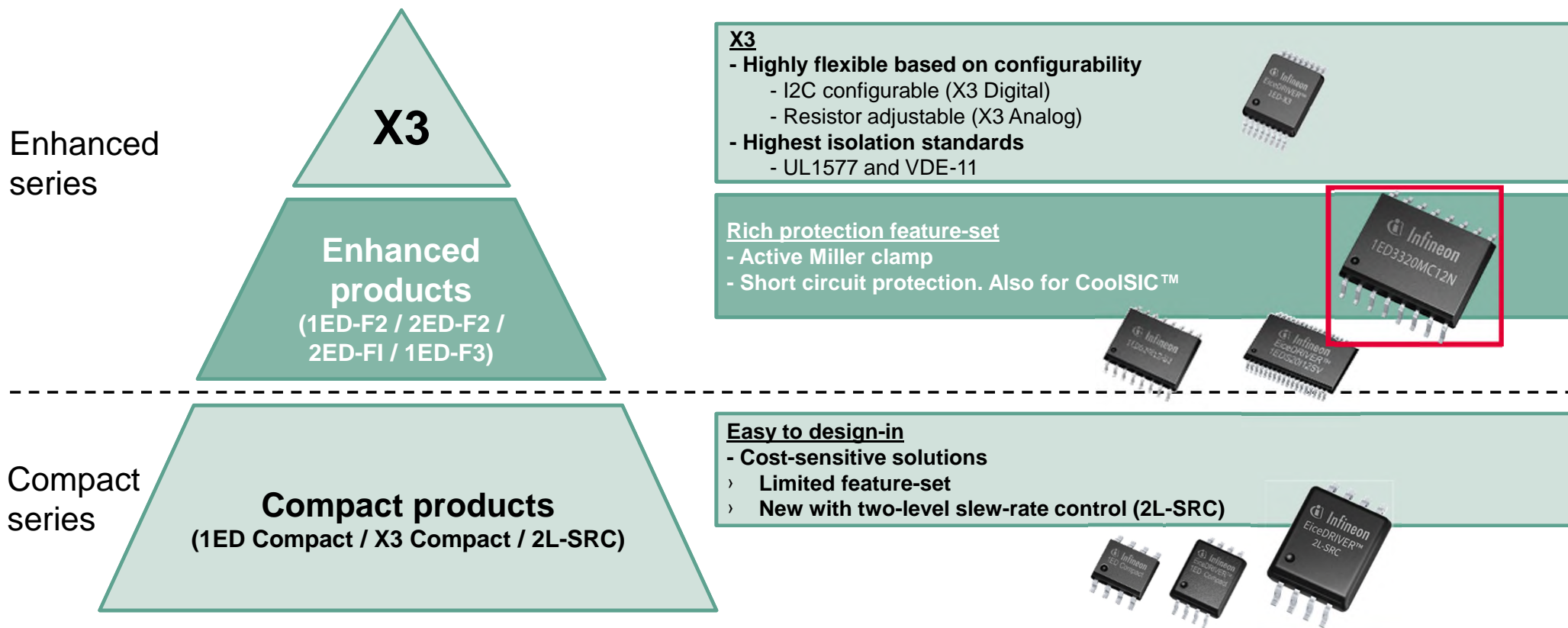
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# 产品定位 (隔离型驱动)



**F3 Enhanced – 适用于IGBT和CoolSiC™的多功能带短路保护的驱动芯片**

# EiceDRIVER™ F3 (1ED33xx) – 家族系列



F3				
	1ED3320MC12N	1ED3321MC12N	1ED3322MC12N	1ED3323MC12N
Output current (typ.)	+ 3.3 A / -6 A	+ 6 A / -8.5 A	+ 6 A / -8.5 A	+ 6 A / -8.5 A
UVLO2 on / off (typ.)	12.0 / 11.0 V	12.0 / 11.0 V	13.6 / 12.6 V	12.0 / 11.0 V
Output configuration	Separate source/sink	Separate source/sink	Separate source/sink	Single output
Prop. delay / filter time (typ.)	85 ns / 35 ns			
Protection features	Active Miller Clamp, DESAT	Active Miller Clamp, DESAT	Active Miller Clamp, DESAT	Active Miller Clamp, DESAT
DESAT behavior	Soft-off	Soft-off	Standard	Standard
CMTI	300 kV/μs			
Output supply voltage range	40 V			
Package	300-mil (DSO-16)			
Pinouts	<pre> 1 0 2 VEE2 GND1 16 3 DESAT VCC1 15 4 GND2 /RST 14 5 OUTH /FLT 13 6 VCC2 RDY 12 7 OUTL IN- 11 8 CLAMP IN+ 10 9 VEE2 GND1 9                     </pre>		<pre> 1 0 2 VEE2 GND1 16 3 DESAT VCC1 15 4 GND2 /RST 14 5 /NC /FLT 13 6 VCC2 RDY 12 7 OUT IN- 11 8 CLAMP IN+ 10 9 VEE2 GND1 9                     </pre>	

## Certification

- 1ED332xMC12N: UL 1577, 5.7kV(rms) + VDE 0884-11, 1767 V(peak)

## 1ED-F3 vs. 1ED-F2

Requirement	1ED-F2	1ED-F3
Reinforced Isolation	N.A	UL1577/VDE0884-11
Output Peak current	+2.4A/-2.4A (max.)	+6A/-8.5A (typ.)
VCC2 UVLO Threshold (on)	12V	12V/13.6V
Propagation delay	170ns (typ.)	85ns (typ.)
Prop. Delay distortion	35ns (max.)	11ns (max.)
Prop. Delay variation due to Temp.	40ns (max.)	15ns (max.)
Prop. Delay part to part matching	not specified	15ns (max.)
CMTI performance	<100kV/us	>300kV/us
VCC2 Absolute Maximum rating	28V	40V
Logic IO threshold	1.5V, 3.5V	30%, 70% /5V
Desaturation charge current	10%	14%
Input side Quiescent current	9mA (max.)	3mA (max.)
Output side Quiescent current	6mA (max.)	3mA (max.)
ESD HBM	1kV	4kV

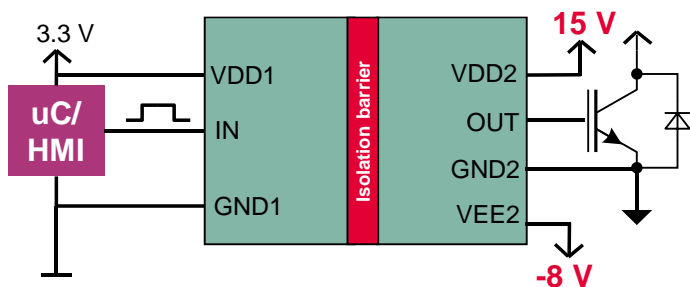
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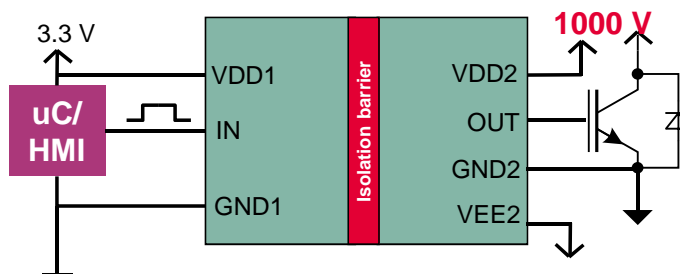
# 为什么需要隔离型驱动?

## Independent supplies



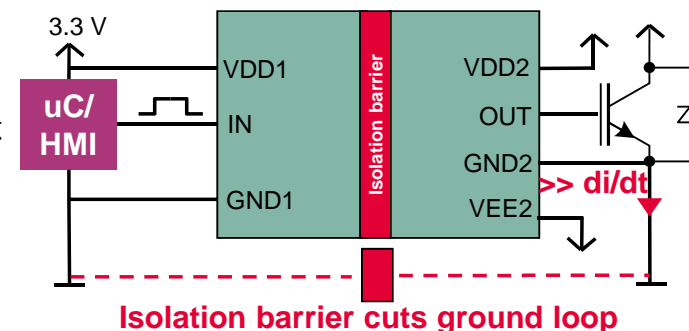
- > **Independent input & output supply**
- > **No limitation** of output voltage in **polarity**
- > **Ideal for power modules & SiC MOSFETs**

## Safe isolation barrier



- > **Safe input from high voltage output**
- > **No elect. shock** in case of **high voltage failure**
- > **Proven by certification** e.g., **VDE 0884-11**

## Ground shift immunity



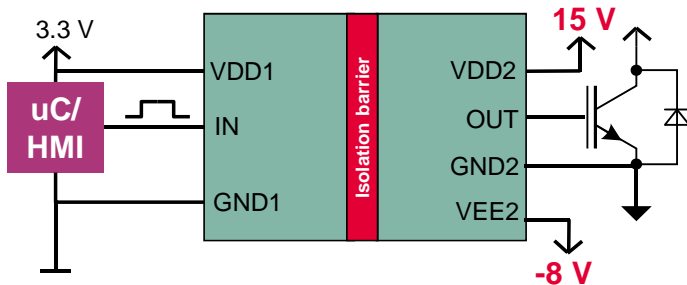
- > **High current transients** can cause **ground shift**
- > **Ground shift** can cause **input side malfunctions**
- > **Isolated GDs cut common ground**

Isolated gate drivers have **zero level-shift losses** → Highly suitable for **higher power and fast switching applications**



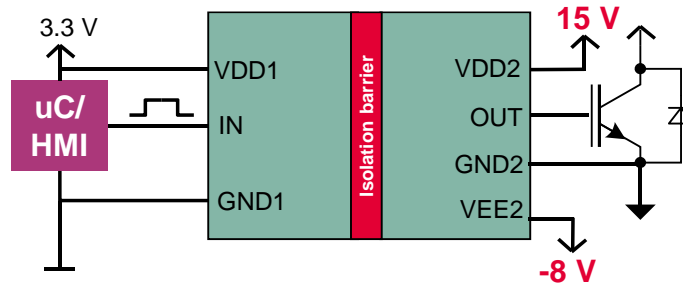
# Functional vs reinforced isolation – Infineon’s functional, UL 1577 vs. VDE-11 (reinforced isolation)

## Functional isolation



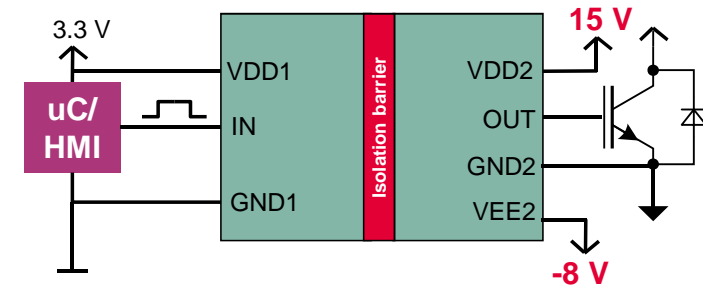
- › Independent supplies ✓
- › Ground shift immunity ✓
- › Safe isolation barrier ✓

## F3 UL 1577 certified



- › Independent supplies ✓
- › Ground shift immunity ✓
- › Safe isolation barrier ✓
- › UL 1577 certification ✓
  - › Withstands 5.7 kV(rms) overvoltage test

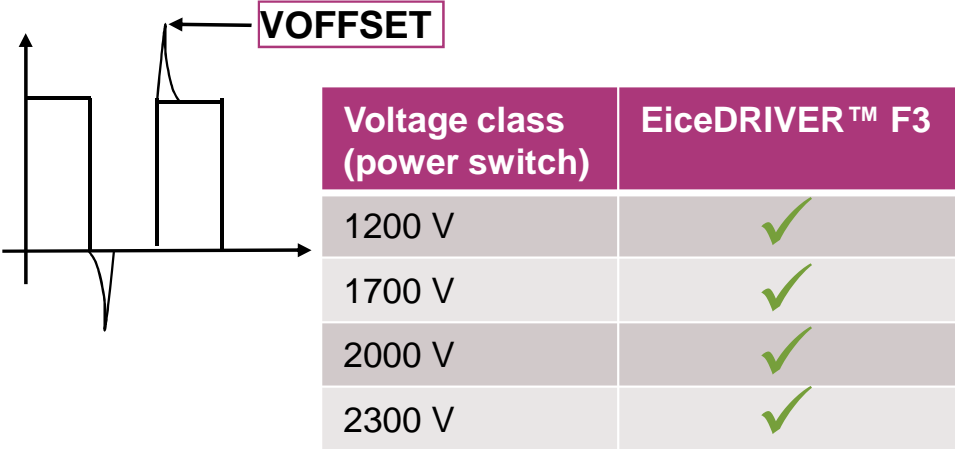
## F3 VDE-11 certified (Reinforced isolation)



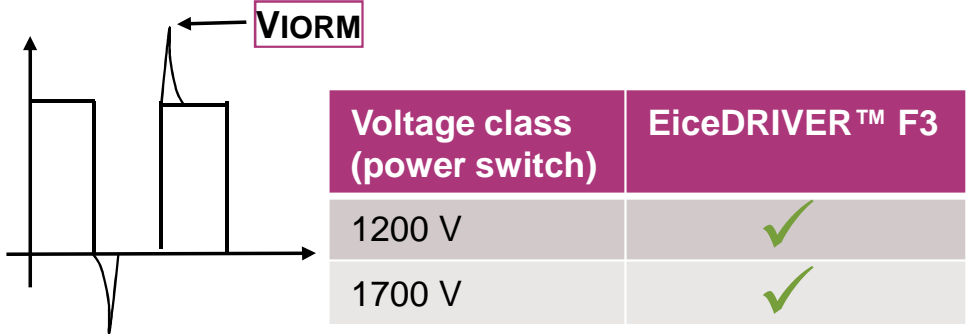
- › Independent supplies ✓
- › Ground shift immunity ✓
- › Safe isolation barrier ✓
- › UL 1577 certification ✓
- › VDE 0884-11 certification ✓
  - › Isolation lifetime of 37.5yrs

# Functional vs reinforced isolation – Functional isolation vs. reinforced isolation terms

## Functional isolation



## Reinforced isolation



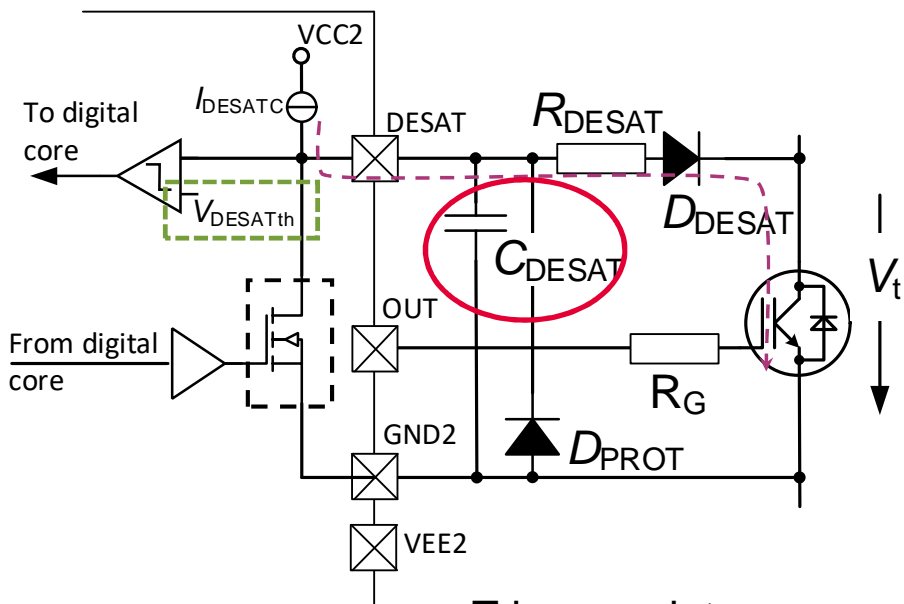
- › EiceDRIVER™ F3 datasheet entries
  - Functional isolation
  - Reinforced isolation

<b>Input to output offset voltage</b>	<b>V<sub>OFFSET</sub></b>	-	<b>2300</b>	<b>V</b>
<b>Max. repetitive insulation voltage</b>	<b>V<sub>IORM</sub></b>	-	<b>1767</b>	<b>V(peak)</b>

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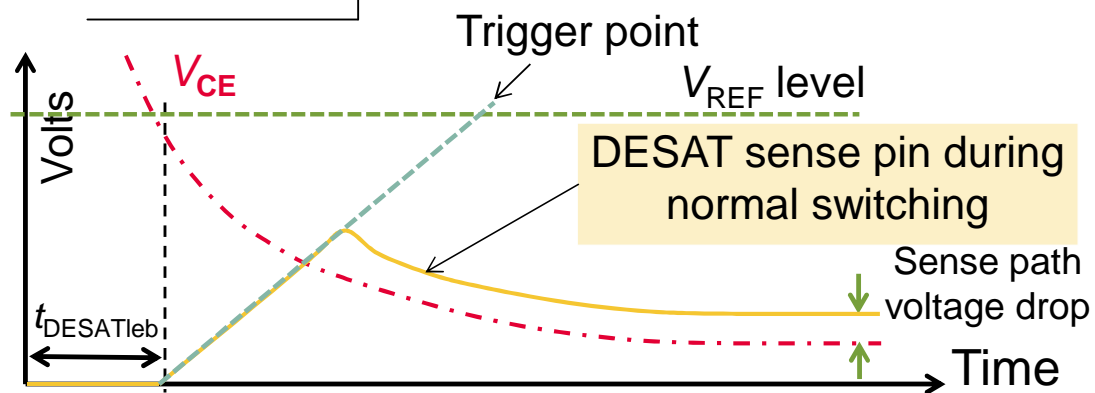
# DESAT短路保护



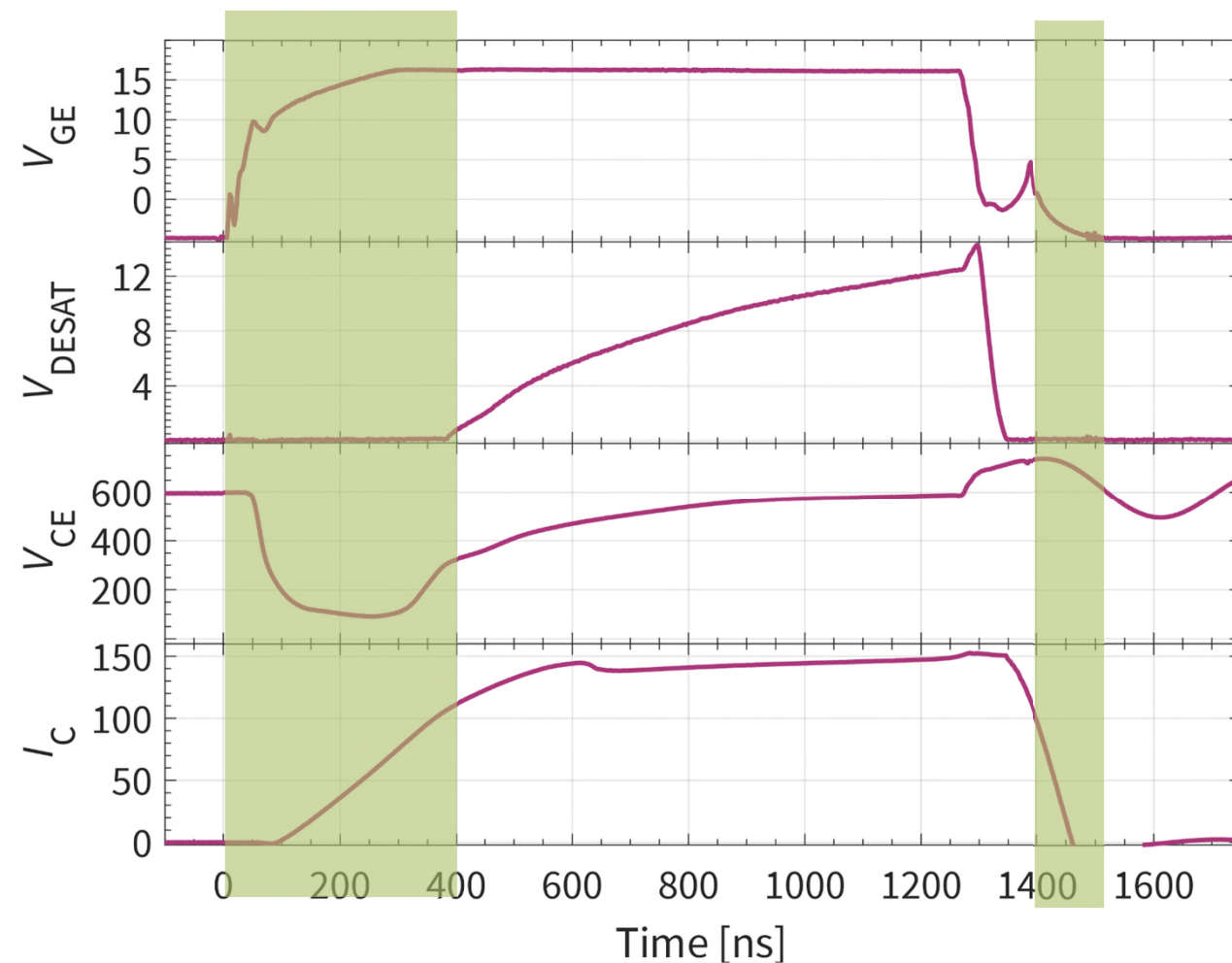
> The voltage at the DESAT pin is given by:

$$V_{DESAT} = I_{DESAT} \times R_{DESAT} + V_{F,diode} + V_{CE}$$

> The response time can be adjusted by varying  $C_{DESAT}$

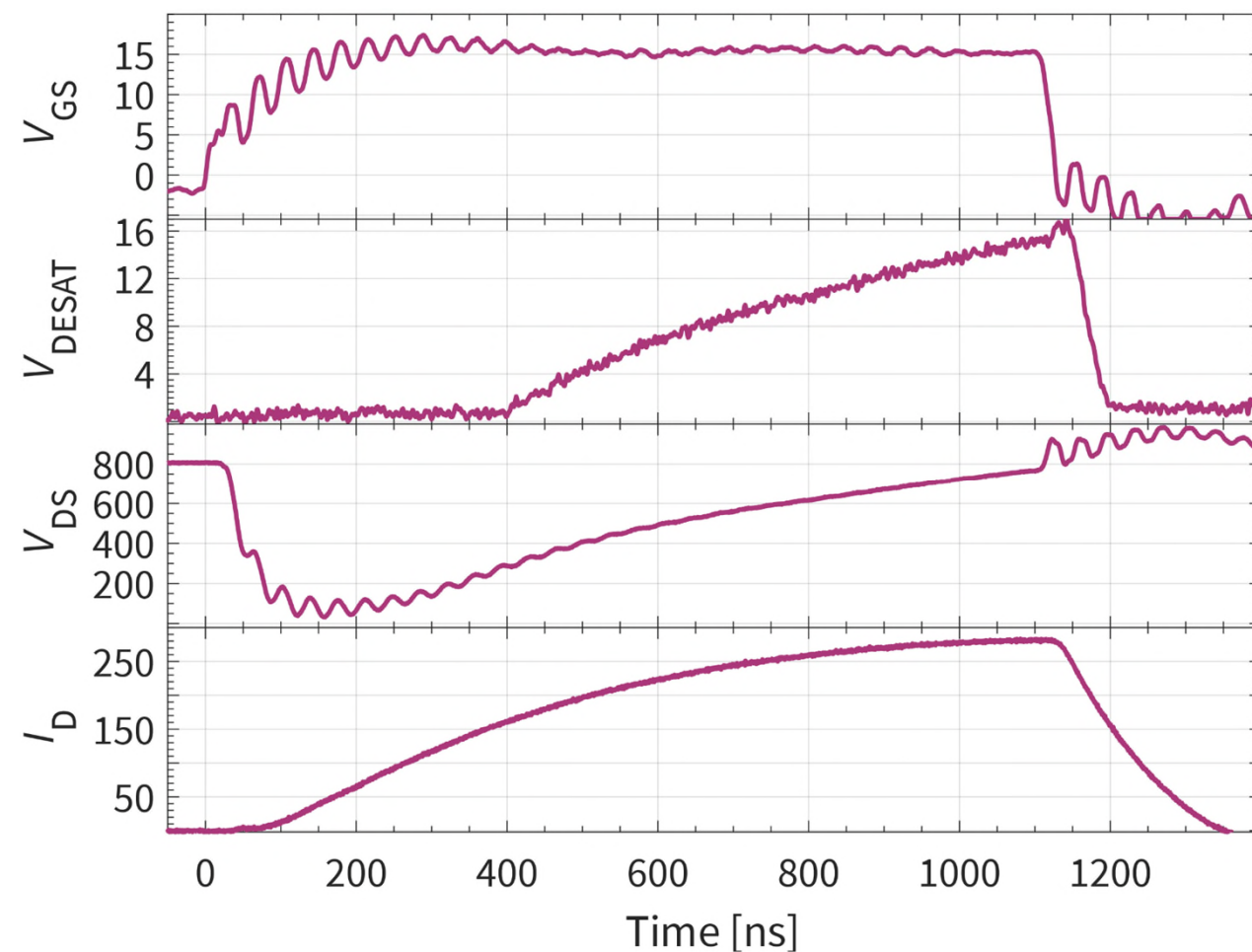


## Type I short-circuit with IGBT



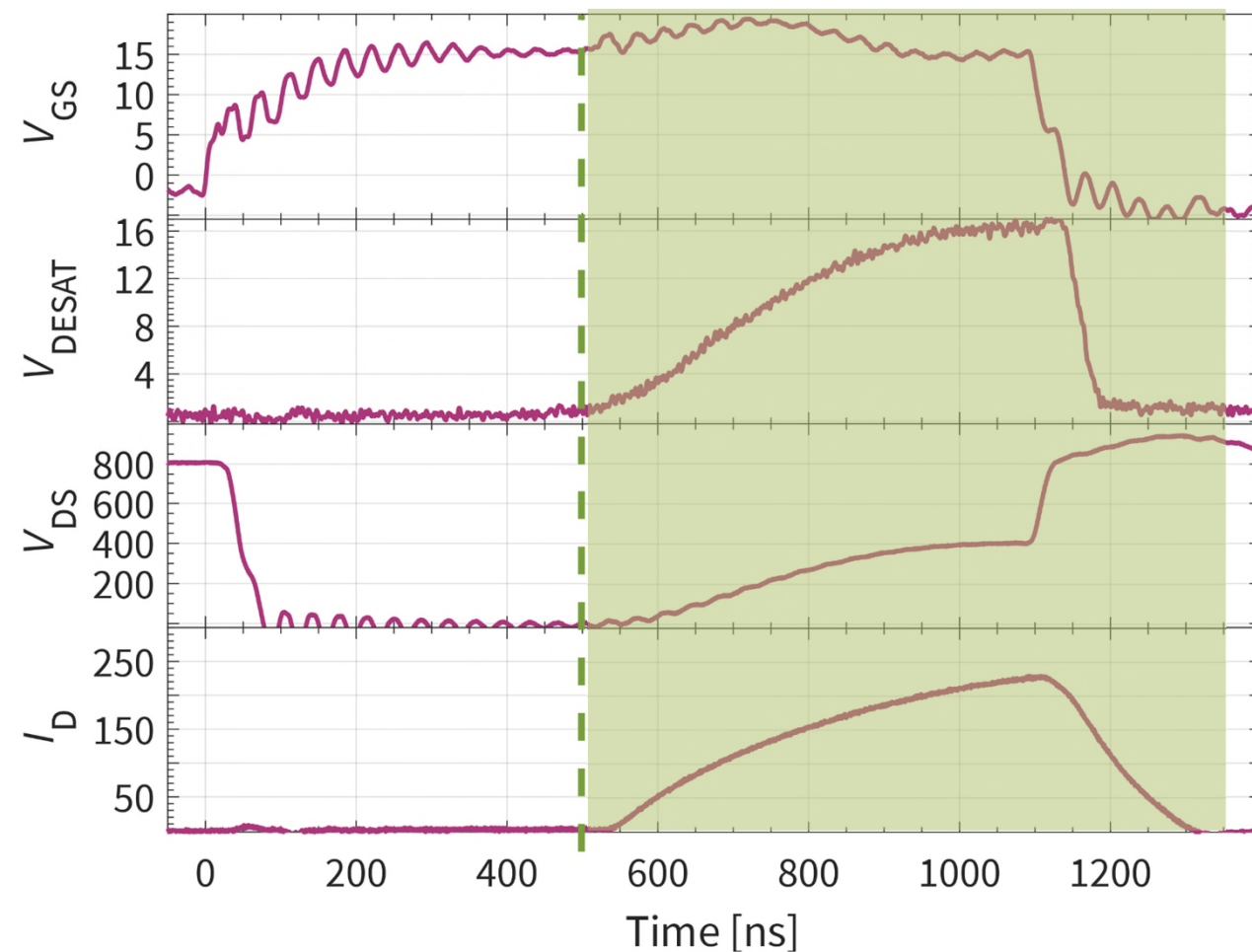
- ›  $C_{\text{DESAT}} = 51 \text{ pF}$
- ›  $R_{\text{DESAT}} = 1 \text{ k}\Omega$
- › Leading edge blanking time hold  
DESAT pin low for 400 ns to allow  
for slower IGBTs to go into  
saturation
- › Fast short-circuit protection within  
1.5  $\mu\text{s}$
- › DESAT was specifically designed  
for IGBTs and enables fast and  
safe turn-off

## Type I short-circuit with SiC MOSFET with $C_{DESAT} = 51 \text{ pF}$



- › Fast short-circuit protection within 1.4  $\mu\text{s}$
- › Leading edge blanking time hold DESAT pin low for 400 ns to transients during turn-on
- ›  $C_{DESAT} = 51 \text{ pF}$
- ›  $R_{DESAT} = 1 \text{ k}\Omega$

## Type II short-circuit with SiC MOSFET with $C_{DESAT} = 51 \text{ pF}$



- ›  $C_{DESAT} = 51 \text{ pF}$
- ›  $R_{DESAT} = 1 \text{ k}\Omega$
- › We turned on the high side MOSFET after 500 ns
- › Fast short-circuit protection within 800 ns
- › Problem solved 😊

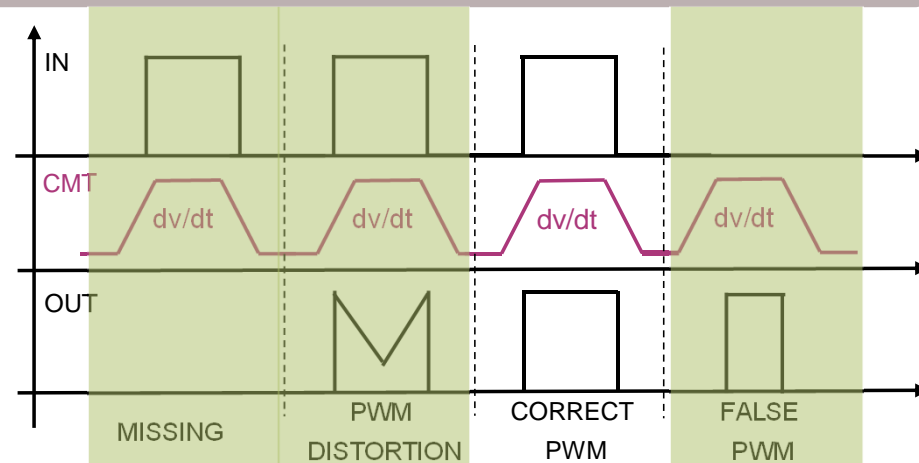
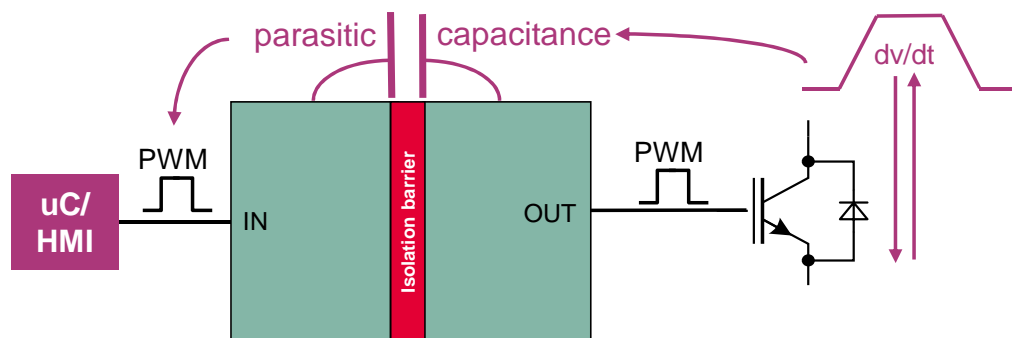
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# EiceDRIVER™ F3 (1ED33xx) – 共模瞬态抑制(CMTI)

## Common-mode transients (CMT) interference



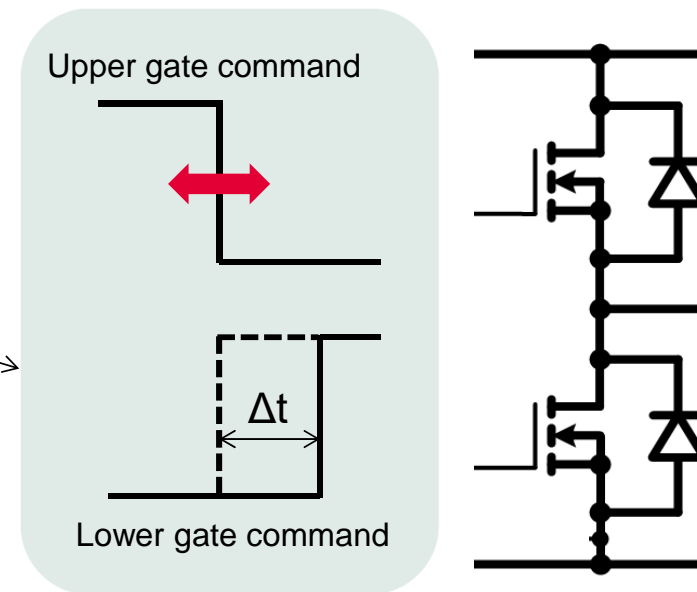
- > **CMT can cause malfunctions**
- > **CMTI defines how resilient a driver is against CMT**
- > **The higher a driver's CMTI value, the more resilient against CMT**

- > **CMTI values**
  - > **1ED332x (F3): 300 kV/us**



# 器件偏差对死区时间的影响

$\Delta t$  delay between turning off an upper device & turning on a lower device. Also vice-versa. The goal is to prevent a “micro” shoot through event.



$$t_{dead} = [(t_{doff\_max} - t_{don\_min}) + (t_{PD OFF\_max} - t_{PD ON\_min})] \times (1.2 \sim 1.5)$$

## Typical Data Sheet Values

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Input IN+, IN-, /RST to output propagation delay on	$t_{PDON}$	74	80	84	ns
Input IN+, IN-, /RST to output propagation delay off	$t_{PD OFF}$	81	86	92	ns

- + Deadtime avoids shoot-throughs
- Deadtime decreases system efficiency

**Tight part-to-part matching** minimizes DT requirement, thus **increases efficiency**  
**1ED332x (F3): +/-15 ns**

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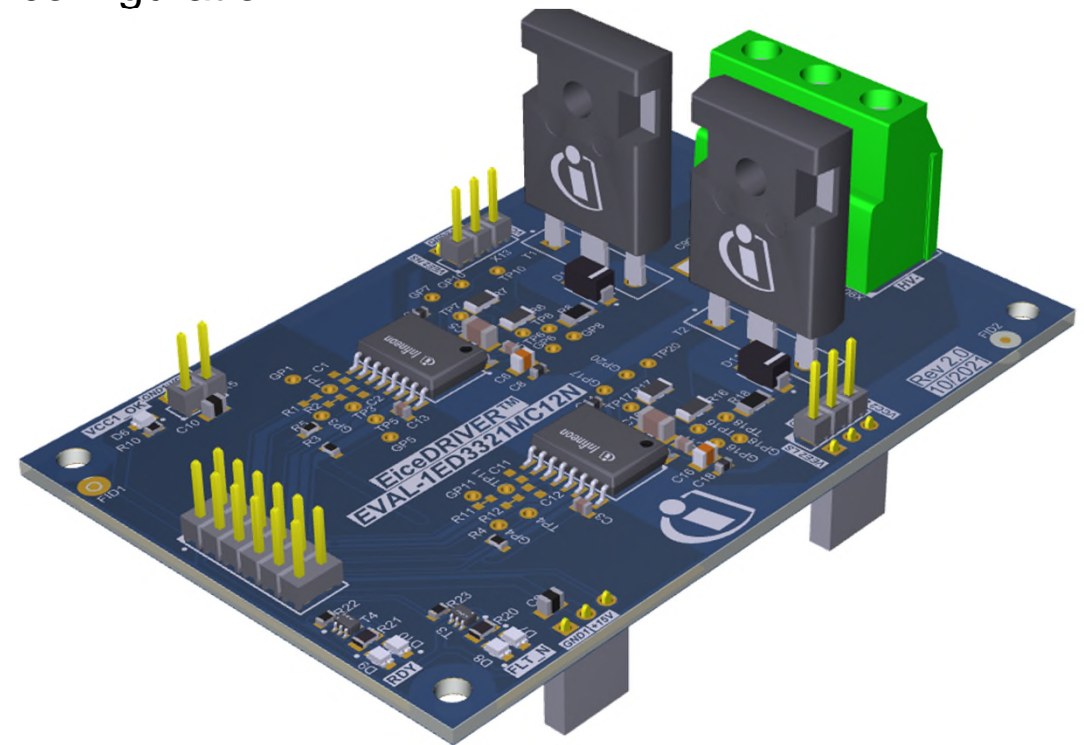
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# EiceDRIVER™ Enhanced F3 (1ED332xMx12N) – Evaluation boards



- › Evaluation board with F3 Enhanced in half-bridge configuration
- › Product application note available
- › Evaluation board user guide available



- › Available in ISAR / distribution

Type	Mat No.
EVAL-1ED3321MC12N	SP005679300

# EiceDRIVER™ F3 Enhanced (1ED332x) – Support materials



## Marketing material

- Product briefs
- Selection guides
- Application brochures
- Presentations
- Press releases, ads

## Technical material

- Application notes
- Technical articles
- Simulation models
- Datasheets, MCDS files
- PCB design data

## Evaluation boards

- Evaluation boards
- Demo boards
- Reference designs

## Videos/ Distribution trainings

- Technical videos
- Product information videos

## F3 Enhanced

- [F3 Enhanced \(1ED332x\) product page](#)
- [F3 Enhanced \(1ED332x\) datasheet](#)

## Application notes

- [Product application note](#)

## Evaluation boards

- [Evaluation board \(1ED3321\)](#)
- [Evaluation board user guide \(1ED3321\)](#)

## Trainings

- [F3 technical product training](#)

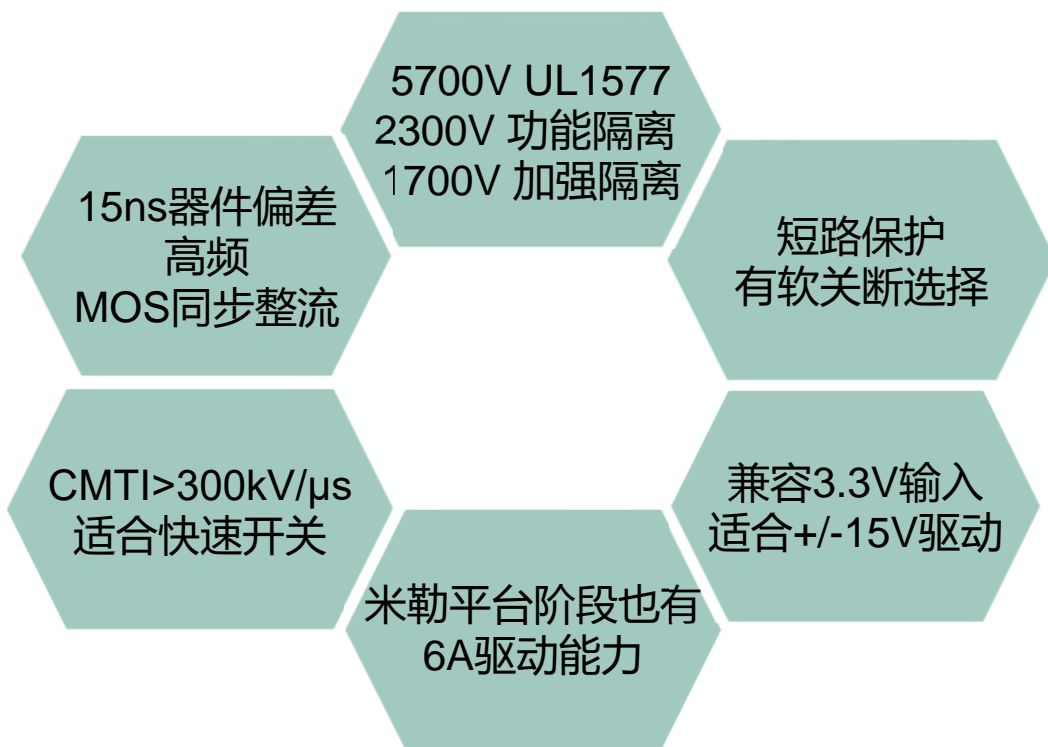
## Product presentation

- [F3 Enhanced product presentation \(MyInfineon\)](#)

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# 总结





Part of your life. Part of tomorrow.