



**flowPACK 1 SiC**

**750 V / 23 mΩ**

**Topology features**

- 3xHalf Bridge
- 3xIntegrated DC capacitor
- Kelvin Emitter for improved switching performance
- MOSFET
- Open Emitter configuration
- Temperature sensor

**Component features**

- Easy paralleling
- Low on-resistance
- Fast switching speed
- Fast recovery body diode

**Housing features**

- Base isolation: Al<sub>2</sub>O<sub>3</sub>
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

**Target applications**

- Elevator Drives
- Servo Drives
- Special Application

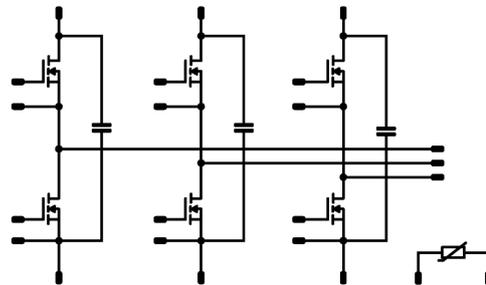
**Types**

- 10-FY086PA023MR-L222F48

**flow 1 12 mm housing**



**Schematic**





Vincotech

## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
<b>Inverter Switch</b>				
Drain-source voltage	$V_{DSS}$		750	V
Drain current (DC current)	$I_D$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	45	A
Peak drain current	$I_{DM}$	$t_p$ limited by $T_{jmax}$	122	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	83	W
Gate-source voltage	$V_{GSS}$		-4 / 21	V
		dynamic	-4 / 23	
Maximum Junction Temperature	$T_{jmax}$		175	°C

## Capacitor (DC)

Maximum DC voltage	$V_{MAX}$		630	V
Operation Temperature	$T_{op}$		-55 ... 150	°C

## Module Properties

### Thermal Properties

Storage temperature	$T_{stg}$		-40...+125	°C
Operation temperature under switching condition	$T_{jop}$		-40...+( $T_{jmax} - 25$ )	°C

### Isolation Properties

Isolation voltage	$V_{isol}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
Isolation voltage	$V_{isol}$	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			>12,7	mm
Clearance			12,12	mm
Comparative Tracking Index	CTI		≥ 600	

\*100 % tested in production



Vincotech

### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GE}$ [V] $V_{GS}$ [V]	$V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V]	$I_C$ [A] $I_D$ [A] $I_F$ [A]	$T_j$ [°C]	Min	Typ	Max		

#### Inverter Switch

##### Static

Drain-source on-state resistance	$r_{DS(on)}$		18		34	25 125 150		21 32,3 37	28,5 <sup>(1)</sup>	mΩ
Gate-source threshold voltage	$V_{GS(th)}$				0,01778	25	2,8	3,5	4,8	V
Gate to Source Leakage Current	$I_{GSS}$		21	0		25	-200		200	nA
Zero Gate Voltage Drain Current	$I_{DSS}$		0	750		25		2	160	μA
Internal gate resistance	$r_g$							2		Ω
Gate charge	$Q_g$							126		nC
Gate to source charge	$Q_{GS}$		18	500	34	25		28		
Gate to drain charge	$Q_{GD}$							38		
Short-circuit input capacitance	$C_{iss}$							2920		pF
Short-circuit output capacitance	$C_{oss}$	$f = 1$ Mhz	0	500	0	25		138		
Reverse transfer capacitance	$C_{rss}$							10		
Diode forward voltage	$V_{SD}$		0		34	25		3,3		V

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,15		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----



Vincotech

10-FY086PA023MR-L222F48  
datasheet

### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GE}$ [V] $V_{GS}$ [V]	$V_{CE}$ [V] $V_{DS}$ [V] $V_F$ [V]	$I_C$ [A] $I_D$ [A] $I_F$ [A]	$T_j$ [°C]	Min	Typ	Max		
<b>Dynamic</b>										
Turn-on delay time	$t_{d(on)}$					25 125 150		27,12 25,2 24,66		ns
Rise time	$t_r$	$R_{gon} = 8 \Omega$ $R_{goff} = 8 \Omega$				25 125 150		14,45 13,19 12,94		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		69,35 77,68 79,69		ns
Fall time	$t_f$				25 125 150		10,46 10,63 10,67		ns	
Turn-on energy (per pulse)	$E_{on}$	$Q_{rFWD}=0,185 \mu C$ $Q_{rFWD}=0,259 \mu C$ $Q_{rFWD}=0,321 \mu C$				25 125 150		0,434 0,413 0,427		mWs
Turn-off energy (per pulse)	$E_{off}$		-1,5/18	500	51	25 125 150		0,216 0,226 0,227		mWs
Peak recovery current	$I_{RRM}$					25 125 150		25,26 28,8 31,82		A
Reverse recovery time	$t_{rr}$					25 125 150		12,8 14,61 15,79		ns
Recovered charge	$Q_r$	$di/dt=3788 A/\mu s$ $di/dt=4321 A/\mu s$ $di/dt=4595 A/\mu s$				25 125 150		0,185 0,259 0,321		$\mu C$
Reverse recovered energy	$E_{rec}$					25 125 150		0,034 0,058 0,077		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		5147,28 5825,31 4806,51		A/ $\mu s$



Vincotech

### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$V_{CE}$ [V]	$T_j$ [°C]	Min	Typ	Max	

#### Capacitor (DC)

##### Static

Capacitance	$C$	DC bias voltage = 0 V				25		33		nF
Tolerance							-5		5	%

#### Thermistor

##### Static

Rated resistance	$R$					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	$P$					25		130		mW
Power dissipation constant	$d$					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$						3962		K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$						4000		K
Vincotech Thermistor Reference									I	

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.

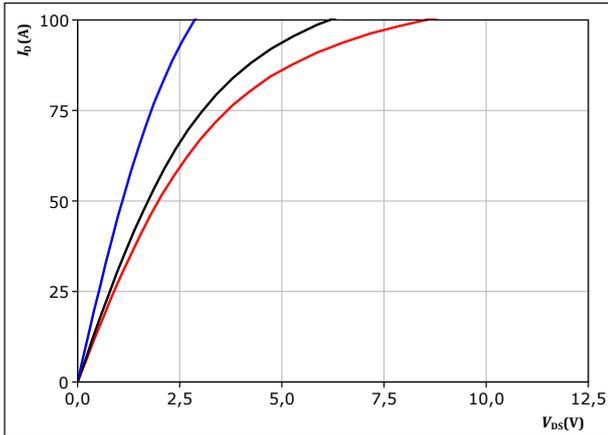


## Inverter Switch Characteristics

**figure 1.** MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$



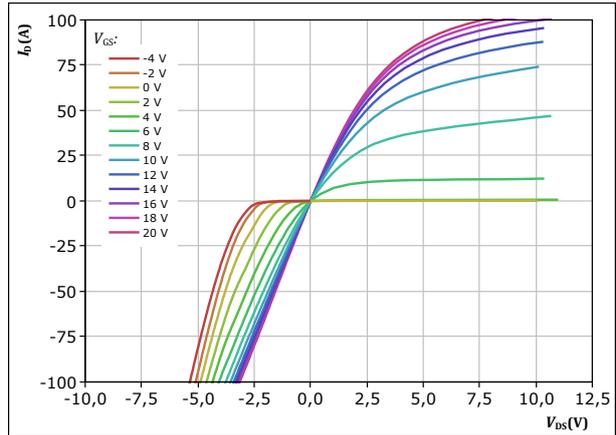
$t_p = 250 \mu s$   
 $V_{GS} = 18 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 2.** MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

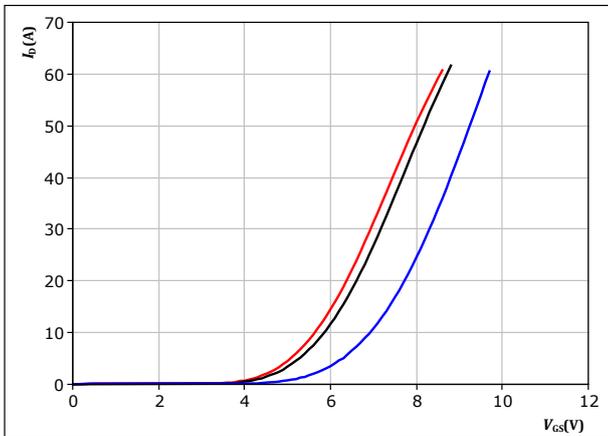


$t_p = 250 \mu s$   
 $T_j = 150 \text{ °C}$   
 $V_{GS}$  from -4 V to 20 V in steps of 2 V

**figure 3.** MOSFET

Typical transfer characteristics

$$I_D = f(V_{GS})$$



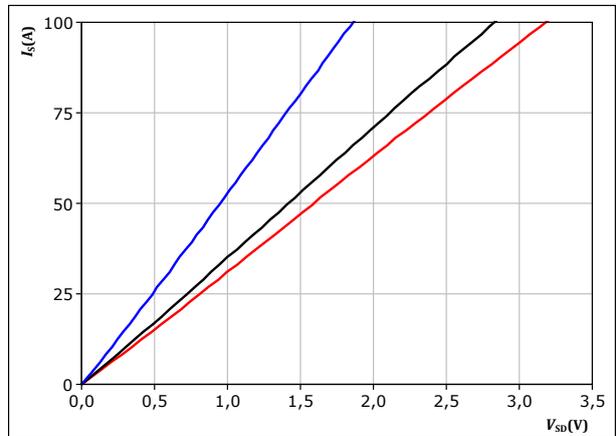
$t_p = 250 \mu s$   
 $V_{DS} = 10 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 4.** MOSFET

Typical reverse drain current characteristics

$$I_{SD} = f(V_{SD})$$



$t_p = 250 \mu s$   
 $V_{GS} = 18 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

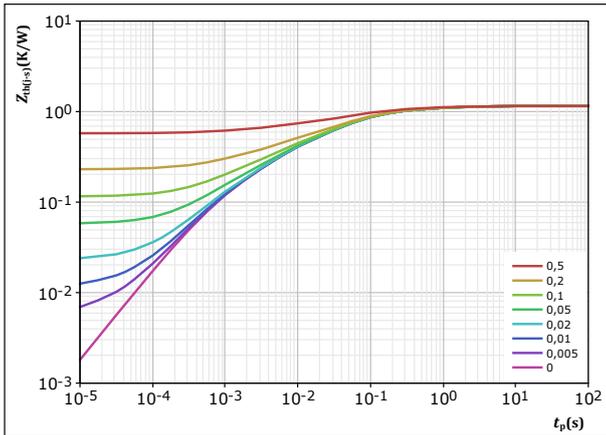


## Inverter Switch Characteristics

**figure 5.** MOSFET

Transient thermal impedance as a function of pulse width

$$Z_{th(j-c)} = f(t_p)$$



$$D = t_p / T$$

$$R_{th(j-c)} = 1,151 \text{ K/W}$$

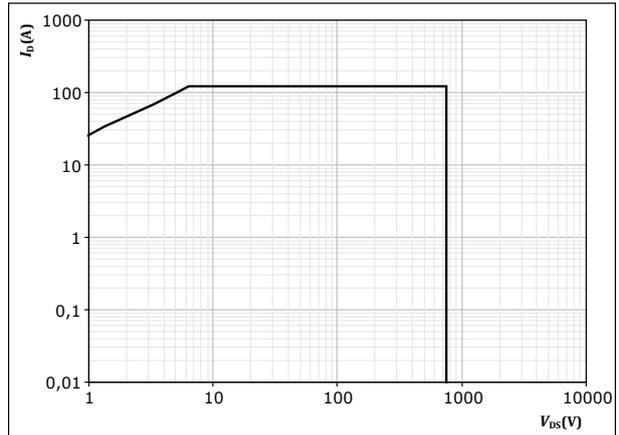
MOSFET thermal model values

R (K/W)	$\tau$ (s)
8,76E-02	1,74E+00
3,12E-01	1,74E-01
4,40E-01	3,51E-02
2,33E-01	4,75E-03
7,91E-02	6,68E-04

**figure 6.** MOSFET

Safe operating area

$$I_D = f(V_{DS})$$



D = single pulse

$$T_c = 80 \text{ } ^\circ\text{C}$$

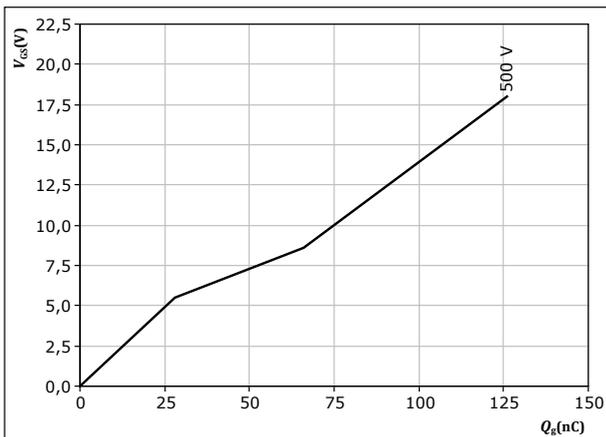
$$V_{GS} = 18 \text{ V}$$

$$T_j = T_{jmax}$$

**figure 7.** MOSFET

Gate voltage vs gate charge

$$V_{GS} = f(Q_g)$$



$$I_D = 17 \text{ A}$$

$$T_j = 25 \text{ } ^\circ\text{C}$$

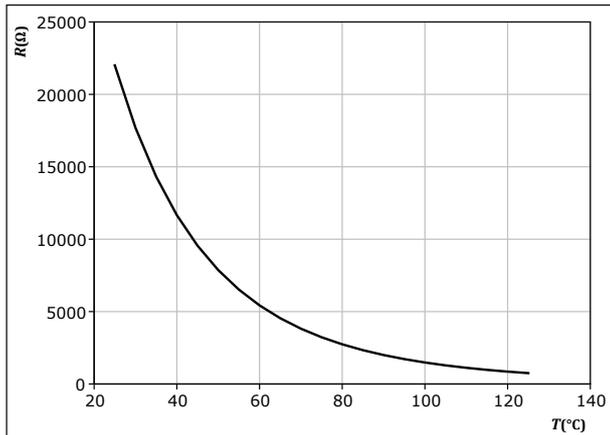


## Thermistor Characteristics

figure 8. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

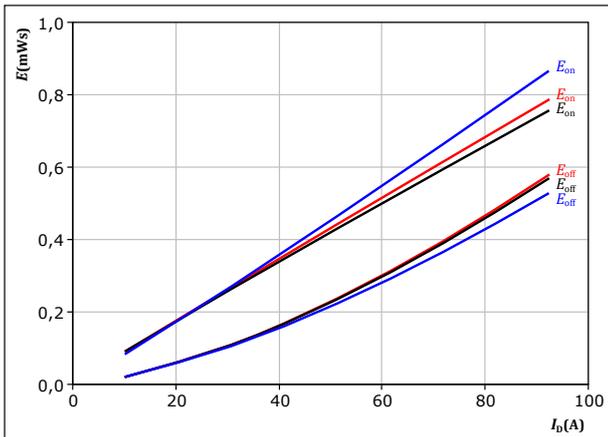




## Inverter Switching Characteristics

**figure 9.** MOSFET

Typical switching energy losses as a function of drain current  
 $E = f(I_D)$

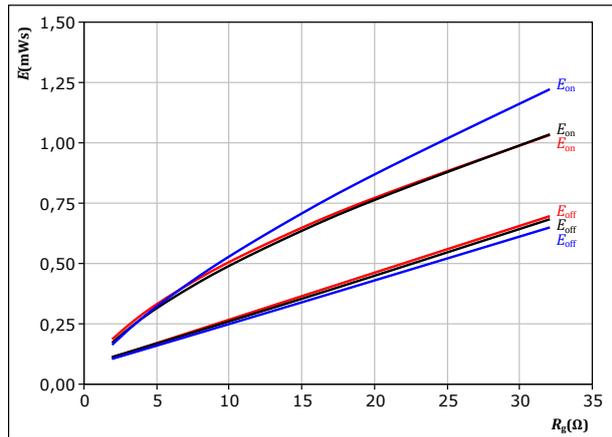


With an inductive load at

$V_{DS} =$	500	V	$T_j:$	25 °C
$V_{GS} =$	-1/18	V		125 °C
$R_{gon} =$	8	$\Omega$		150 °C
$R_{goff} =$	8	$\Omega$		

**figure 10.** MOSFET

Typical switching energy losses as a function of MOSFET turn on gate resistor  
 $E = f(R_g)$

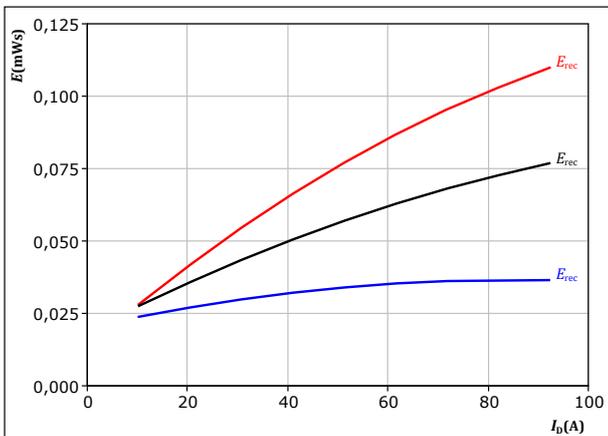


With an inductive load at

$V_{DS} =$	500	V	$T_j:$	25 °C
$V_{GS} =$	-1/18	V		125 °C
$I_D =$	51	A		150 °C

**figure 11.** MOSFET

Typical reverse recovered energy loss as a function of drain current  
 $E_{rec} = f(I_D)$

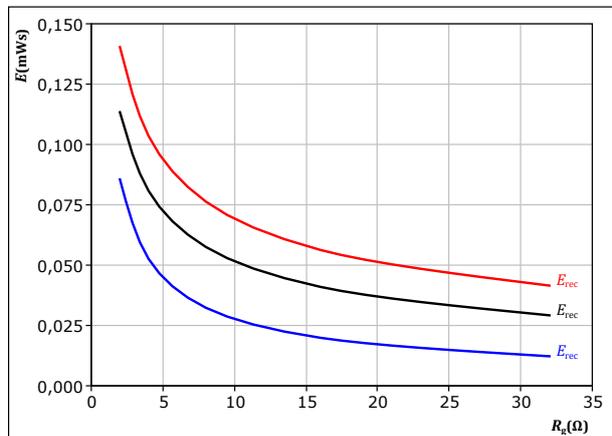


With an inductive load at

$V_{DS} =$	500	V	$T_j:$	25 °C
$V_{GS} =$	-1/18	V		125 °C
$R_{gon} =$	8	$\Omega$		150 °C

**figure 12.** MOSFET

Typical reverse recovered energy loss as a function of MOSFET turn on gate resistor  
 $E_{rec} = f(R_g)$



With an inductive load at

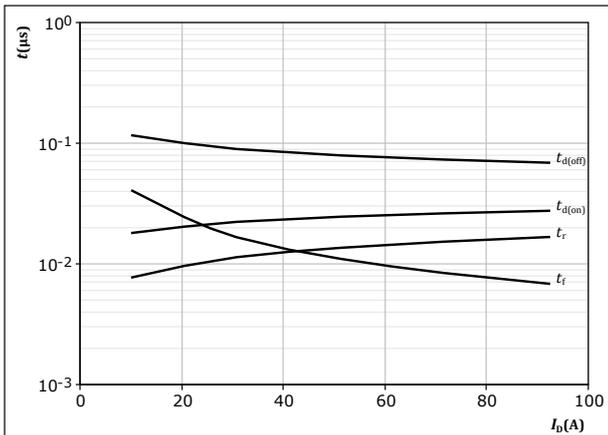
$V_{DS} =$	500	V	$T_j:$	25 °C
$V_{GS} =$	-1/18	V		125 °C
$I_D =$	51	A		150 °C



## Inverter Switching Characteristics

**figure 13.** MOSFET

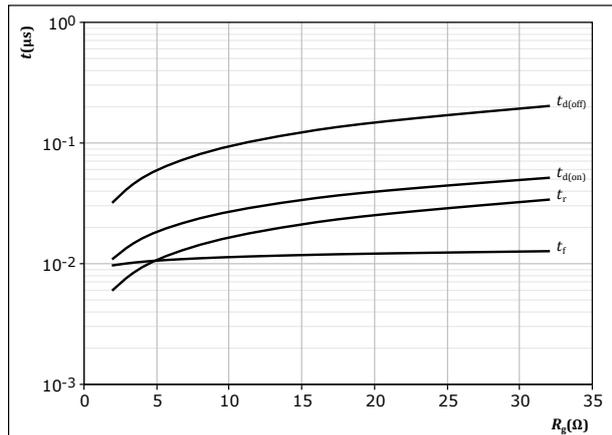
Typical switching times as a function of drain current  
 $t = f(I_D)$



With an inductive load at  
 $T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{DS} = 500 \text{ V}$   
 $V_{GS} = -1/18 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $R_{goff} = 8 \text{ } \Omega$

**figure 14.** MOSFET

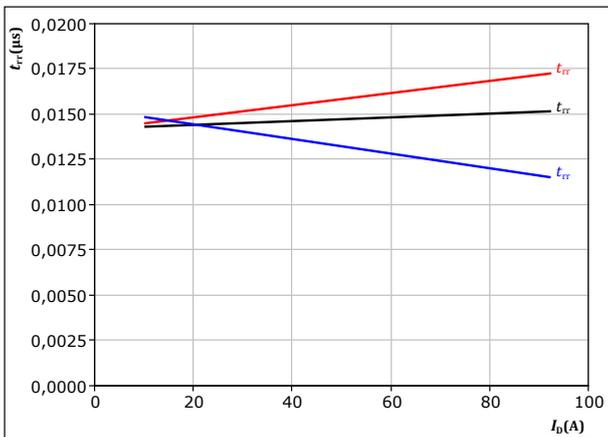
Typical switching times as a function of MOSFET turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{DS} = 500 \text{ V}$   
 $V_{GS} = -1/18 \text{ V}$   
 $I_D = 51 \text{ A}$

**figure 15.** MOSFET

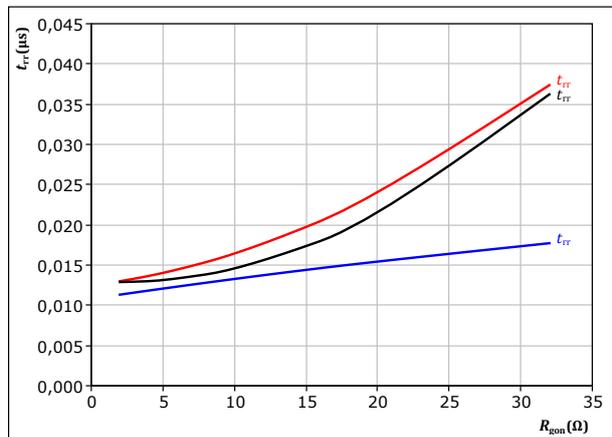
Typical reverse recovery time as a function of drain current  
 $t_{rr} = f(I_D)$



At  $V_{DS} = 500 \text{ V}$   
 $V_{GS} = -1/18 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $T_j: 25 \text{ } ^\circ\text{C}$   
 $125 \text{ } ^\circ\text{C}$   
 $150 \text{ } ^\circ\text{C}$

**figure 16.** MOSFET

Typical reverse recovery time as a function of MOSFET turn on gate resistor  
 $t_{rr} = f(R_{gon})$



At  $V_{DS} = 500 \text{ V}$   
 $V_{GS} = -1/18 \text{ V}$   
 $I_D = 51 \text{ A}$   
 $T_j: 25 \text{ } ^\circ\text{C}$   
 $125 \text{ } ^\circ\text{C}$   
 $150 \text{ } ^\circ\text{C}$

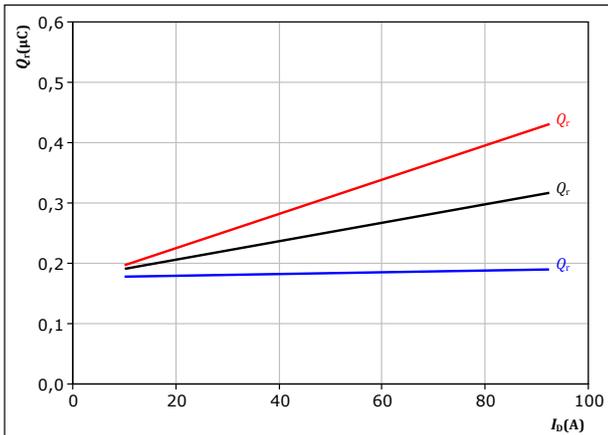


## Inverter Switching Characteristics

**figure 17.** MOSFET

Typical recovered charge as a function of drain current

$$Q_r = f(I_D)$$

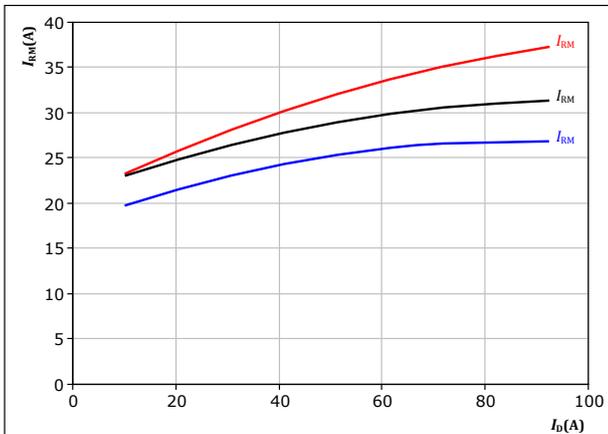


At  $V_{DS} = 500$  V  
 $V_{GS} = -1/18$  V  
 $R_{gon} = 8$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 19.** MOSFET

Typical peak reverse recovery current as a function of drain current

$$I_{RM} = f(I_D)$$

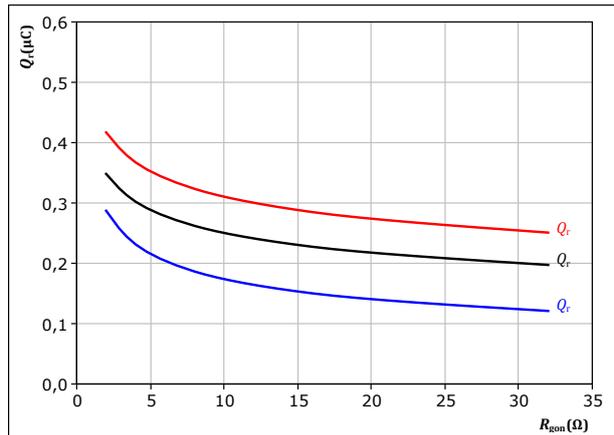


At  $V_{DS} = 500$  V  
 $V_{GS} = -1/18$  V  
 $R_{gon} = 8$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 18.** MOSFET

Typical recovered charge as a function of MOSFET turn on gate resistor

$$Q_r = f(R_{gon})$$

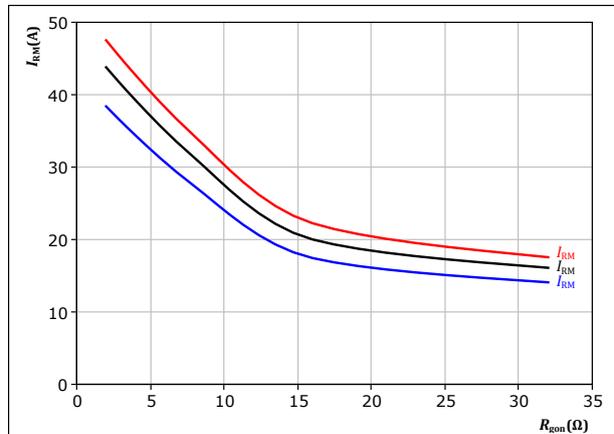


At  $V_{DS} = 500$  V  
 $V_{GS} = -1/18$  V  
 $I_D = 51$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 20.** MOSFET

Typical peak reverse recovery current as a function of MOSFET turn on gate resistor

$$I_{RM} = f(R_{gon})$$



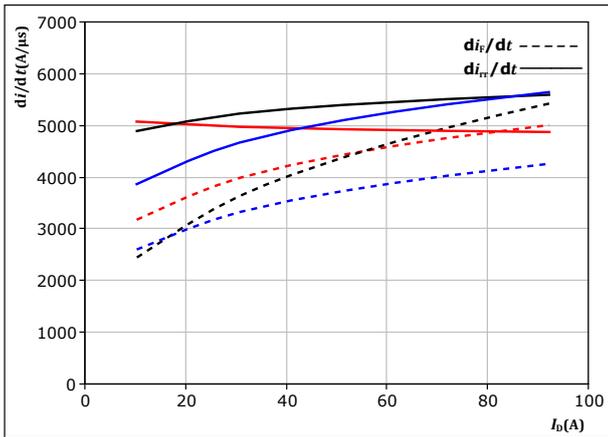
At  $V_{DS} = 500$  V  
 $V_{GS} = -1/18$  V  
 $I_D = 51$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## Inverter Switching Characteristics

**figure 21. MOSFET**

Typical rate of fall of forward and reverse recovery current as a function of drain current  
 $di_f/dt, di_r/dt = f(I_D)$

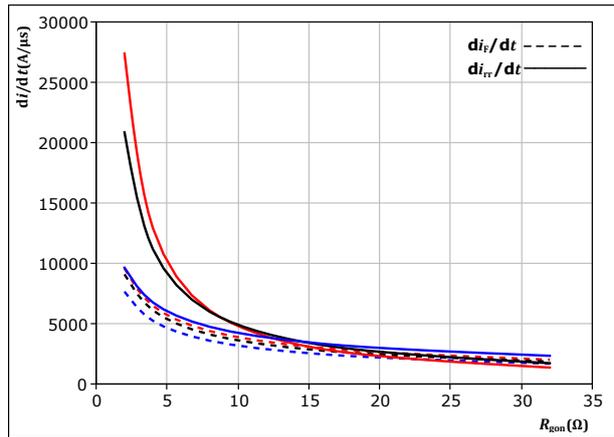


At  $V_{DS} = 500$  V  
 $V_{GS} = -1/18$  V  
 $R_{g\text{on}} = 8$   $\Omega$

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 22. MOSFET**

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor  
 $di_f/dt, di_r/dt = f(R_{g\text{on}})$



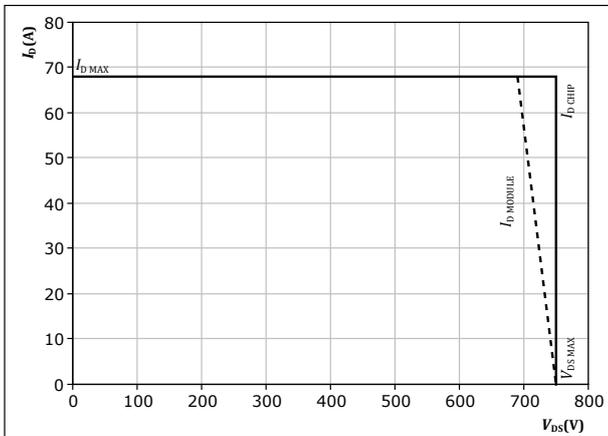
At  $V_{DS} = 500$  V  
 $V_{GS} = -1/18$  V  
 $I_D = 51$  A

$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 23. MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$



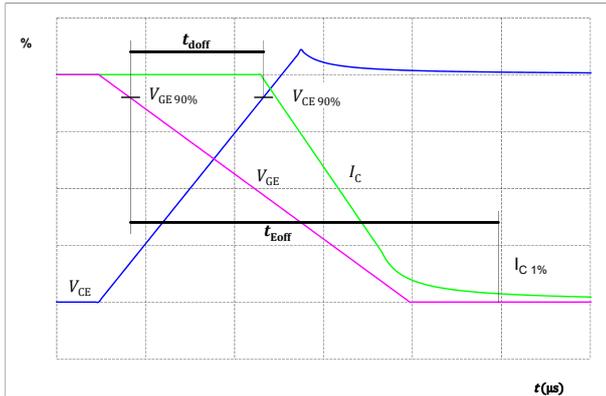
At  $T_j = 150$  °C  
 $R_{g\text{on}} = 8$   $\Omega$   
 $R_{g\text{off}} = 8$   $\Omega$



## Inverter Switching Definitions

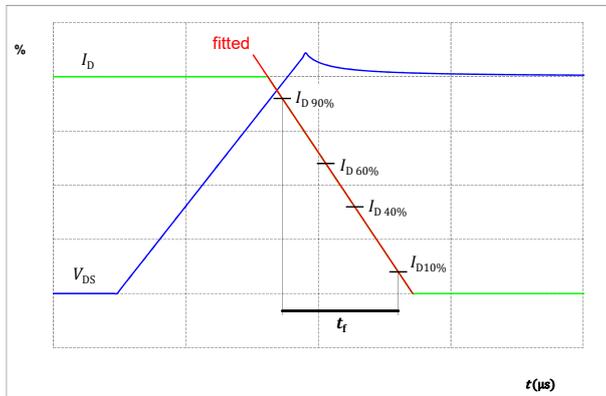
**figure 24.** MOSFET

Turn-off Switching Waveforms & definition of  $t_{doff}$   $t_{Eoff}$  ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



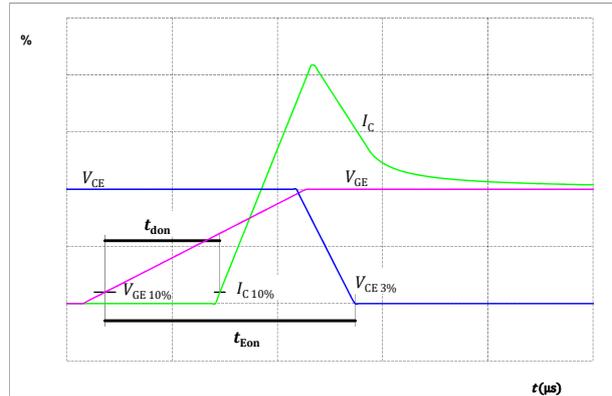
**figure 26.** MOSFET

Turn-off Switching Waveforms & definition of  $t_f$



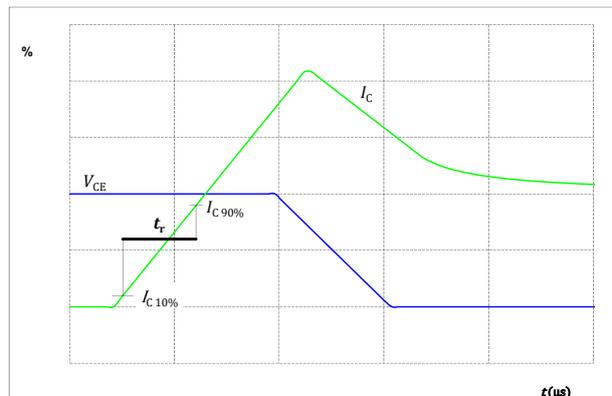
**figure 25.** MOSFET

Turn-on Switching Waveforms & definition of  $t_{don}$   $t_{Eon}$  ( $t_{Eon}$  = integrating time for  $E_{on}$ )



**figure 27.** MOSFET

Turn-on Switching Waveforms & definition of  $t_r$





### Inverter Switching Definitions

figure 28. FWD

Turn-off Switching Waveforms & definition of  $t_{tr}$

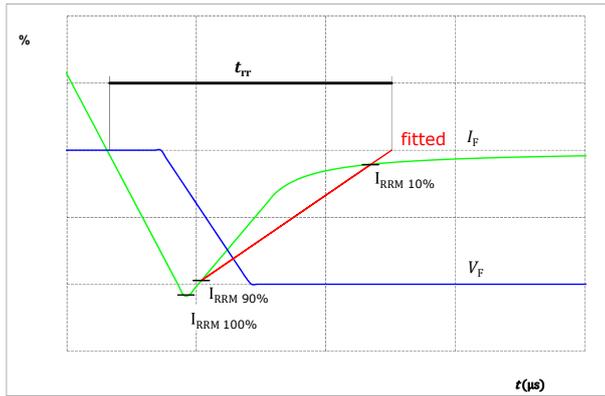


figure 29. FWD

Turn-on Switching Waveforms & definition of  $t_{Qr}$  ( $t_{Qr}$  = integrating time for  $Q_r$ )

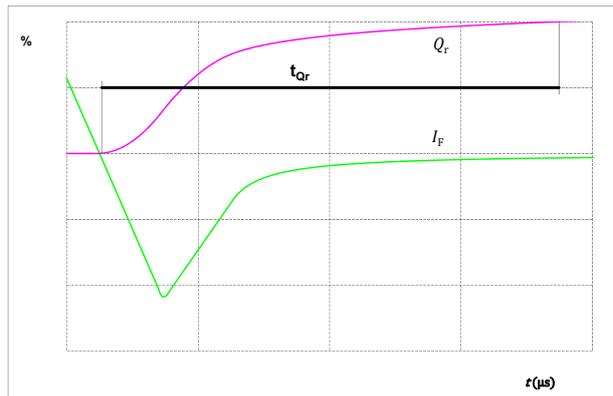
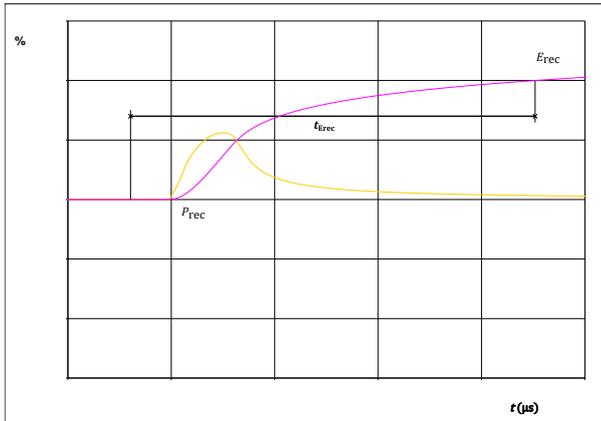


figure 30. FWD

Turn-on Switching Waveforms & definition of  $t_{Erec}$  ( $t_{Erec}$  = integrating time for  $E_{rec}$ )





Vincotech

**10-FY086PA023MR-L222F48**  
datasheet

Ordering Code	
<b>Version</b>	<b>Ordering Code</b>
Without thermal paste	10-FY086PA023MR-L222F48
With thermal paste (5,2 W/mK, PTM6000HV)	10-FY086PA023MR-L222F48-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-FY086PA023MR-L222F48-/3/

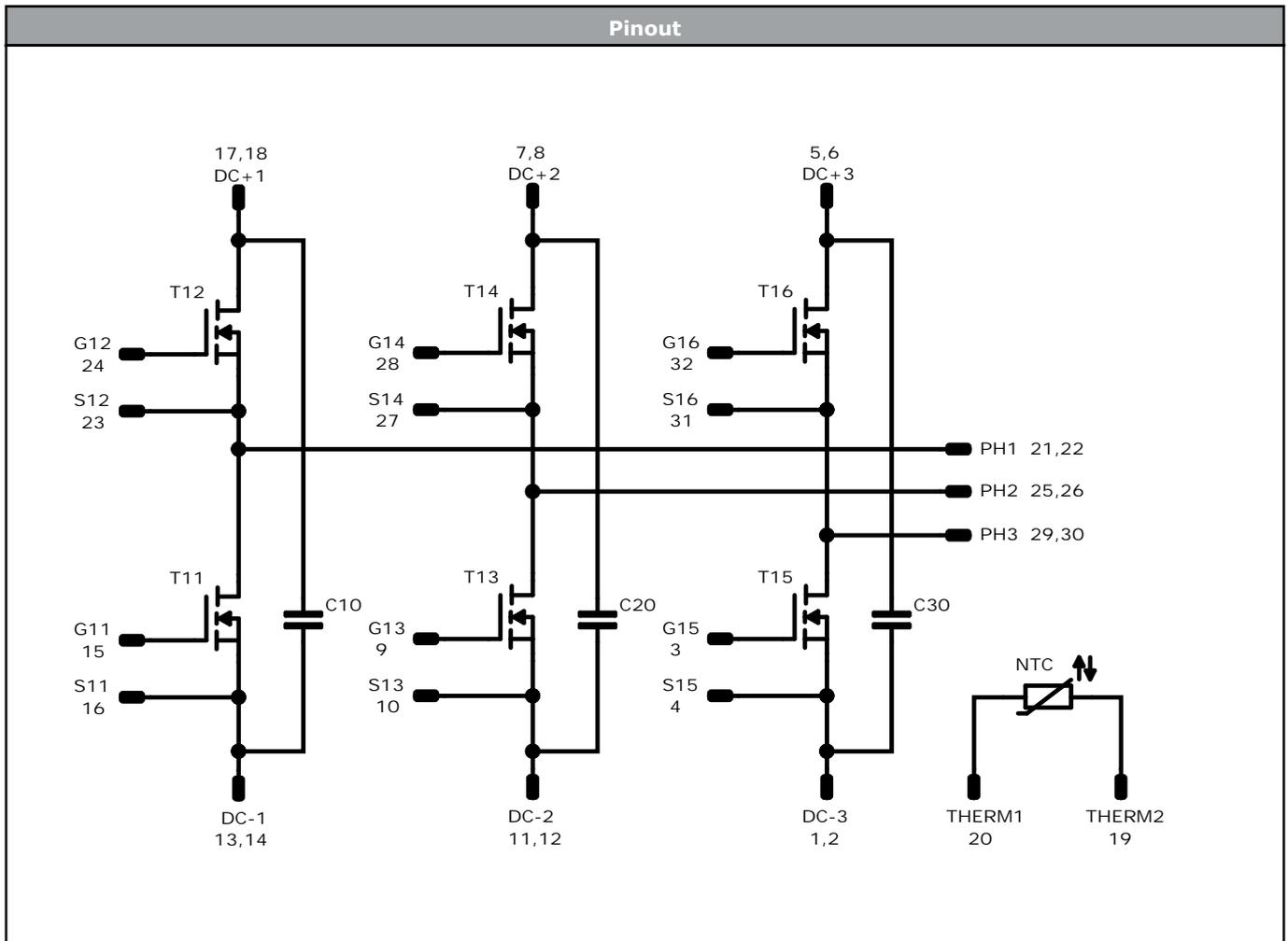
Marking						
	<b>Text</b>	<b>Name</b> NN-NNNNNNNNNNNNNN- TTTTIVV	<b>Date code</b> WWYY	<b>UL &amp; VIN</b> UL VIN	<b>Lot</b> LLLLL	<b>Serial</b> SSSS
	<b>Datamatrix</b>	<b>Type&amp;Ver</b> TTTTIVV	<b>Lot number</b> LLLLL	<b>Serial</b> SSSS	<b>Date code</b> WWYY	

Pin table [mm]			
Pin	X	Y	Function
1	52,2	2,7	DC-3
2	52,2	0	DC-3
3	45,5	12	G15
4	42,5	13	S15
5	41,2	0	DC+3
6	38,5	0	DC+3
7	33,1	0	DC+2
8	30,4	0	DC+2
9	25	10	G13
10	22	11	S13
11	19,4	0	DC-2
12	16,7	0	DC-2
13	13,7	0	DC-1
14	11	0	DC-1
15	8,7	12	G11
16	5,7	13	S11
17	0	0	DC+1
18	0	2,7	DC+1
19	14,3	15,6	THERM2
20	16,1	12,6	THERM1
21	0	28,2	PH1
22	2,7	28,2	PH1
23	5,7	26,7	S12
24	8,7	25,7	G12
25	19,4	28,2	PH2
26	22,1	28,2	PH2
27	23,1	25,2	S14
28	26,1	24,2	G14
29	36,3	28,2	PH3
30	39	28,2	PH3
31	42	26,7	S16
32	45	25,7	G16

Tolerance of pinposition:  $\pm 0,5\text{mm}$  at the end of pins  
Dimension of coordinate axis is only offset without tolerance



Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	MOSFET	750 V	22,5 mΩ	Inverter Switch	
C10, C20, C30	Capacitor	630 V		Capacitor (DC)	
Rt	Thermistor			Thermistor	



Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for <i>flow 1</i> packages see vincotech.com website.

Package data
Package data for <i>flow 1</i> packages see vincotech.com website.

Vincotech thermistor reference
See Vincotech thermistor reference table at vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. 

Document No.:	Date:	Modification:	Pages
10-FY086PA023MR-L222F48-D1-14	14 Sep. 2023		

**DISCLAIMER**

The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

**LIFE SUPPORT POLICY**

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.