Information note

N° 012/22

Dear customer,

With this Infineon Technologies AG information note, we would like to inform you about the following

Datasheet update for HybridPack Drive SiC product family

On 16 April 2020, Infineon acquired Cypress.
We are now in the process of merging and consolidating our tools and processes for PCN, Information Notes, Errata and Product Discontinuance.
For further details, please visit our website:
https://www.infineon.com/cms/en/about-infineon/company/cypress-acquisition/

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Information note

N° 012/22

▶ **Products affected**	Please refer to attached affected product list "INF_012_22_[*customer-no*].pdf"

▶ **Detailed change information**

Subject	Datasheet update for HP Drive SiC product family.
Reason	Improvement of determination of R_{th} values. Transfer to new datasheet tool and correction of various typographical errors. Additional information on product validation (as e.g. AQG324 + revision).

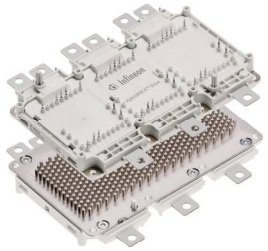
Description	**Old**	**New**
Datasheet FS03MR12A6MA1B	■ Rev. 1.00	■ Rev. 1.10
Datasheet FS03MR12A6MA1LB	■ Rev. 1.00	■ Rev. 1.10
Datasheet FS05MR12A6MA1B	■ Rev. 3.10	■ Rev. 1.10

▶ **Product identification**	Not applicable (no change of products)
▶ **Impact of change**	Documentation update only
▶ **Attachments**	INF_012_22_[*customer-no*].pdf affected product list 4_cip01222 datasheets
▶ **Intended start of delivery**	Valid with immediate effect (documentation update)

If you have any questions, please do not hesitate to contact your local sales office.

HybridPACK™ Drive module with CoolSiC™ Automotive MOSFET

Features



- Electrical features
  - V_{DSS} = 1200 V
  - $I_{D,nom}$ = 400 A
  - New semiconductor material - silicon carbide
  - Low $R_{DS,on}$
  - Low switching losses
  - Low Q_g and C_{rss}
  - Low inductive design <10 nH
  - $T_{vj,op}$ = 150°C
- Mechanical features
  - 4.2 kV DC 1 second insulation
  - High creepage and clearance distances
  - Compact design
  - High power density
  - Direct-cooled PinFin base plate
  - High-performance Si3N4 ceramic
  - Guiding elements for PCB and cooler assembly
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - RoHS compliant
  - UL 94 V0 module frame

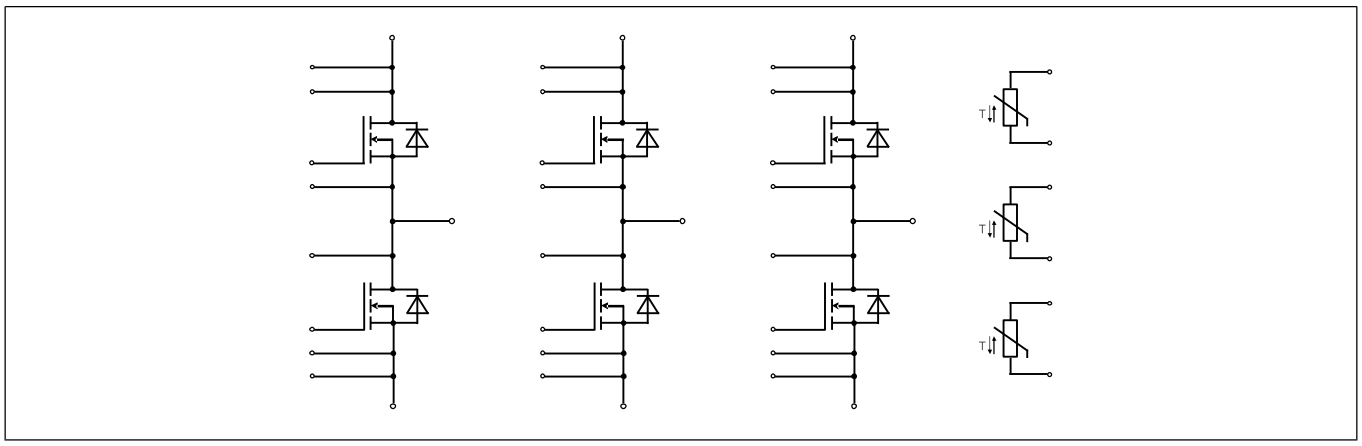
Potential applications

- Automotive applications
- (Hybrid) electrical vehicles (H)EV
- Motor drives
- Commercial agriculture vehicles

Product validation

- Qualified according to AQG 324, release no.: 03.1/2021

Description



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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 0 Hz, t = 1 sec	4.20	kV
Material of module baseplate			Ni+Cu[1)]	
Internal isolation		basic insulation (class 1, IEC 61140)	Si3N4	
Creepage distance	d_{creep}	terminal to heatsink	9.0	mm
Creepage distance	d_{creep}	terminal to terminal	9.0	mm
Clearance	d_{clear}	terminal to heatsink	4.5	mm
Clearance	d_{clear}	terminal to terminal	4.5	mm
Comparative tracking index	*CTI*		> 200	

1) Ni plated Cu baseplate

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Maximum RMS module terminal current	$I_{t,rms}$	$T_{terminal}$ = 105 °C, T_f = 75 °C	550	A

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Pressure drop in cooling circuit	Δp	$\Delta V/\Delta t$ = 10 dm³/min, 50% water/50% ethylenglycol, T_f = 60 °C		64[1)]		mbar
Maximum pressure in cooling circuit	p	$T_{baseplate}$ < 40°C (relative pressure)			2.5	bar
		$T_{baseplate}$ ≥ 40°C (relative pressure)			2.0	
Stray inductance module	$L_{s,DS}$			8.5		nH
Module lead resistance, terminals - chip	$R_{DD'+SS'}$	T_f = 25 °C, per switch		0.75		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	Screw M4 baseplate to heatsink	1.8	2.0	2.2	Nm
Weight	G			722		g

1) Cooler design and flow direction according to application note AN-HPDPERF-ASSEMBLY.

2 MOSFET

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	1200	V
DC drain current	$I_{D,nom}$	V_{GS} = 15 V, T_f = 60 °C	$T_{vj,max}$ = 175 °C	400	A
Pulsed drain current	$I_{D,pulse}$	verified by design, t_p limited by T_{vjmax}		800	A
Gate-source voltage	V_{GSS}			-10/20	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS,on}$	I_D = 400 A, V_{GS} = 15 V	T_{vj} = 25 °C		2.75	3.70	mΩ
			T_{vj} = 125 °C		4.00		
			T_{vj} = 150 °C		4.55		
Gate threshold voltage	$V_{GS,th}$	I_D = 240 mA, V_{GS} = V_{DS}, (tested after 1ms pulse at V_{GS} = +20 V)	T_{vj} = 25 °C	3.25	4.40	5.55	V
Total gate charge	Q_G	V_{DS} = 600 V, V_{GS} = -5/15 V			1.32		µC
Internal gate resistor	$R_{G,int}$		T_{vj} = 25 °C		0.23		Ω
Input capacitance	C_{iss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		42.6		nF
Output capacitance	C_{oss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		1.86		nF
Reverse transfer capacitance	C_{rss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.17		nF
C_{OSS} stored energy	E_{oss}	V_{DS} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		438		µJ
Drain-source leakage current	I_{DSX}	V_{GS} = -5 V, V_{DSS} = 1200 V	T_{vj} = 25 °C			100	µA
Gate-source leakage current	I_{GSS}	V_{GS} = 20 V, V_{DS} = 0 V	T_{vj} = 25 °C			400	nA
Turn-on delay time, inductive load	$t_{d,on}$	I_D = 400 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		77		ns
			T_{vj} = 125 °C		62		
			T_{vj} = 150 °C		59		
Rise time (inductive load)	t_r	I_D = 400 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		79		ns
			T_{vj} = 125 °C		70		
			T_{vj} = 150 °C		69		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time, inductive load	$t_{d,off}$	I_D = 400 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		263		ns
			T_{vj} = 125 °C		287		
			T_{vj} = 150 °C		294		
Fall time (inductive load)	t_f	I_D = 400 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		64		ns
			T_{vj} = 125 °C		64		
			T_{vj} = 150 °C		65		
Turn-on energy loss per pulse	E_{on}	I_D = 400 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C, di/dt = 4 kA/µs		19.48		mJ
			T_{vj} = 125 °C, di/dt = 4.6 kA/µs		19.85		
			T_{vj} = 150 °C, di/dt = 4.6 kA/µs		20.16		
Turn-off energy loss per pulse	E_{off}	I_D = 400 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C, du/dt = 7.3 kV/µs		17.61		mJ
			T_{vj} = 125 °C, du/dt = 7.2 kV/µs		17.95		
			T_{vj} = 150 °C, du/dt = 7.1 kV/µs		18.21		
Short circuit data	I_{SC}	V_{DD} = 800 V, V_{GS} = -5/15 V, $R_{G,on}$ = 5.1 Ω, $R_{G,off}$ = 5.1 Ω, V_{DSmax} = V_{DSS}-L_{sDS} · di/dt	t_{SC} = 3 µs, T_{vj} = 25 °C		5300		A
			t_{SC} = 3 µs, T_{vj} = 150 °C		4800		
Thermal resistance, junction to cooling fluid	$R_{th,j-f}$	per MOSFET, T_f = 60 °C, $\Delta V/\Delta t$ = 10 dm³/min, 50% water/50% ethylenglycol			0.1	0.108[1)]	K/W
Temperature under switching conditions	$T_{vj,op}$			-40		150	°C

1) EoL criteria see AQG324, verified by characterization with 4.5 sigma. Cooler design and flow direction according to application note AN-HPDPERF-ASSEMBLY

3 Body diode

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	$I_{F,S}$	$T_{vj,max}$ = 175 °C, V_{GS} = -5 V	T_f = 60 °C	210	A
Pulsed body diode current	$I_{F,S,pulse}$	verified by design, t_p limited by T_{vjmax}		800	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	$V_{F,SD}$	$I_{F,S}$ = 400 A, V_{GS} = -5 V	T_{vj} = 25 °C		4.42	6.15	V
			T_{vj} = 125 °C		4.22		
			T_{vj} = 150 °C		4.16		
Peak reverse recovery current	I_{rrm}	$I_{F,S}$ = 400 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		165		A
			T_{vj} = 125 °C		287		
			T_{vj} = 150 °C		309		
Recovered charge	Q_{rr}	$I_{F,S}$ = 400 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		11.20		µC
			T_{vj} = 125 °C		18.10		
			T_{vj} = 150 °C		19.30		
Reverse recovery energy	E_{rec}	$I_{F,S}$ = 400 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C, $-di/dt$ = 5.9 kA/µs		1.4		mJ
			T_{vj} = 125 °C, $-di/dt$ = 6.9 kA/µs		4.0		
			T_{vj} = 150 °C, $-di/dt$ = 6.9 kA/µs		4.7		

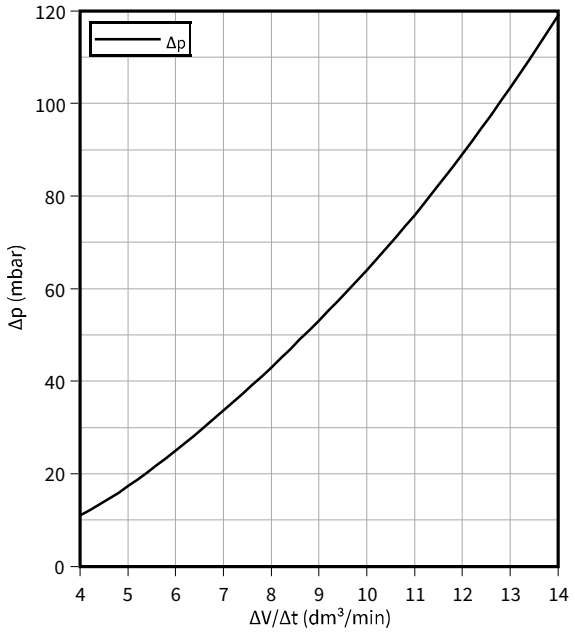
4 NTC-Thermistor

Table 8 Characteristic values

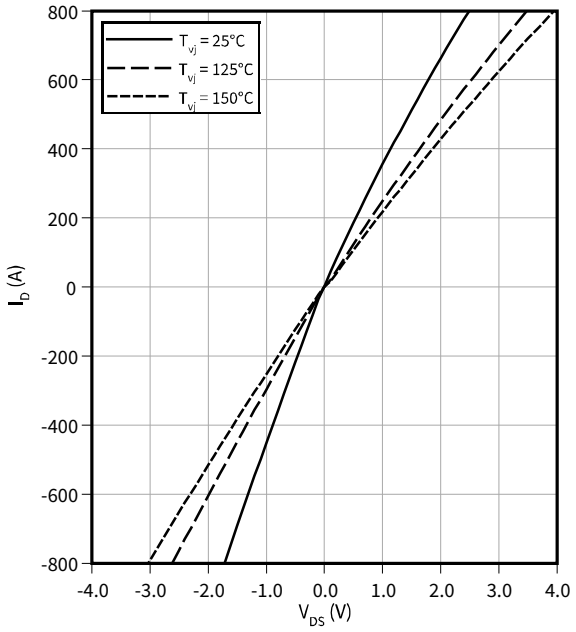
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3433		K

5 Characteristics diagrams

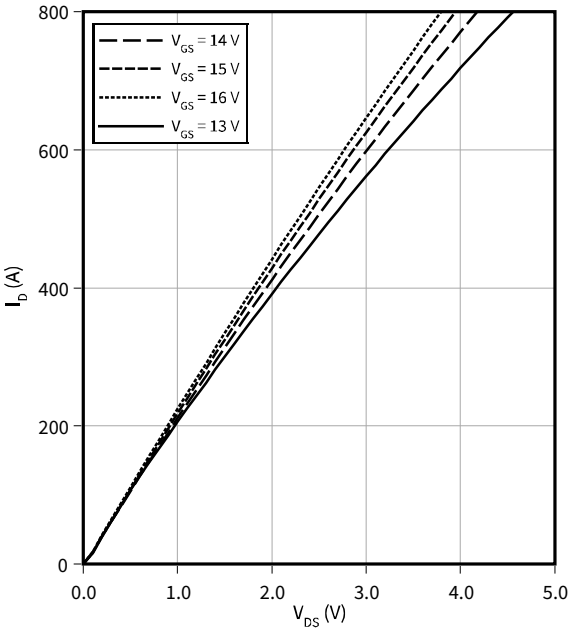
Pressure drop in cooling circuit, Package
$\Delta p = f(\Delta V/\Delta t)$
T_f = 60 °C, fluid = 50% water/50% ethylenglycol



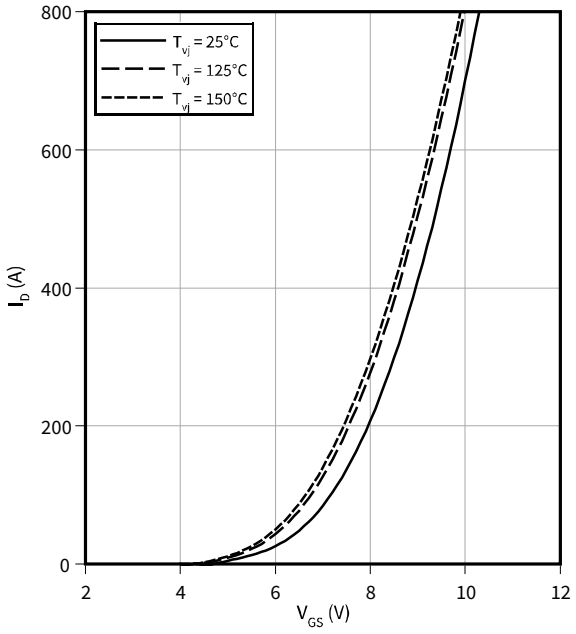
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
V_{GS} = 15 V



Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
T_{vj} = 125 °C



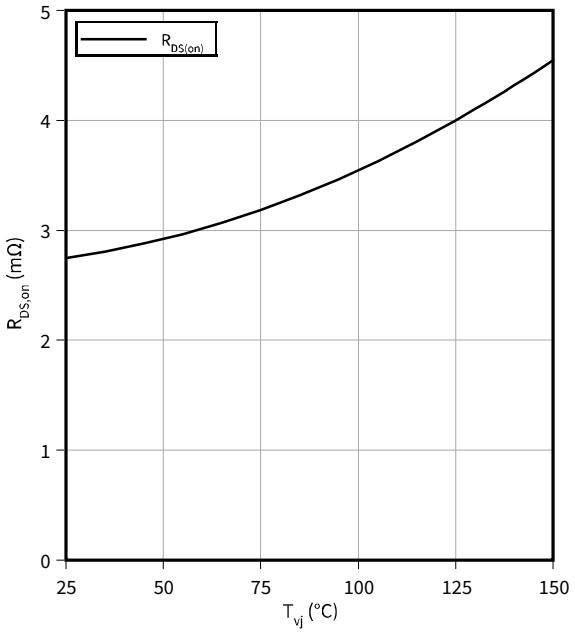
Transfer characteristic (typical), MOSFET
$I_D = f(V_{GS})$
V_{DS} = 20 V



Drain-source on-resistance (typical), MOSFET

$R_{DS,on} = f(T_{vj})$

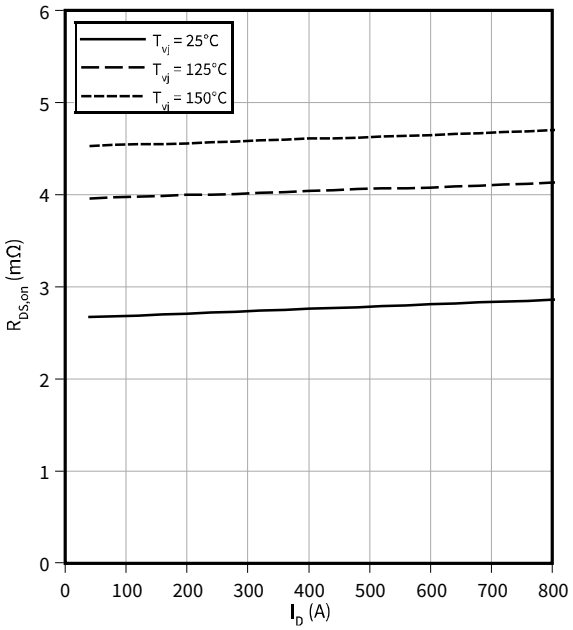
$I_D = 400$ A, $V_{GS} = 15$ V



Drain-source on-resistance (typical), MOSFET

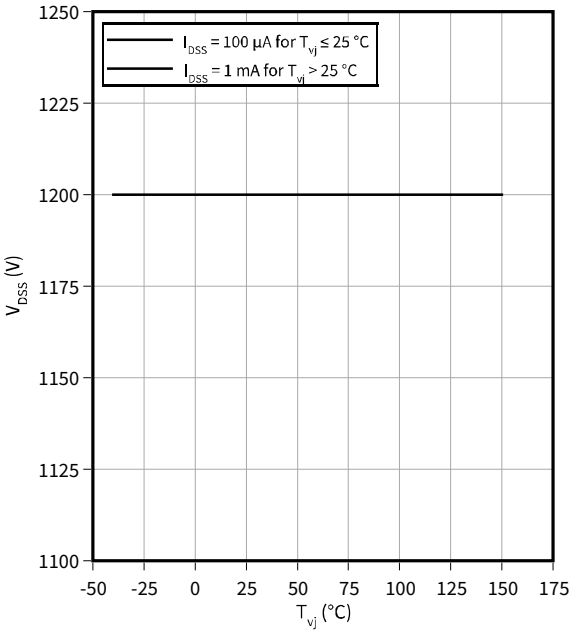
$R_{DS,on} = f(I_D)$

$V_{GS} = 15$ V



Maximum allowed drain-source voltage, MOSFET

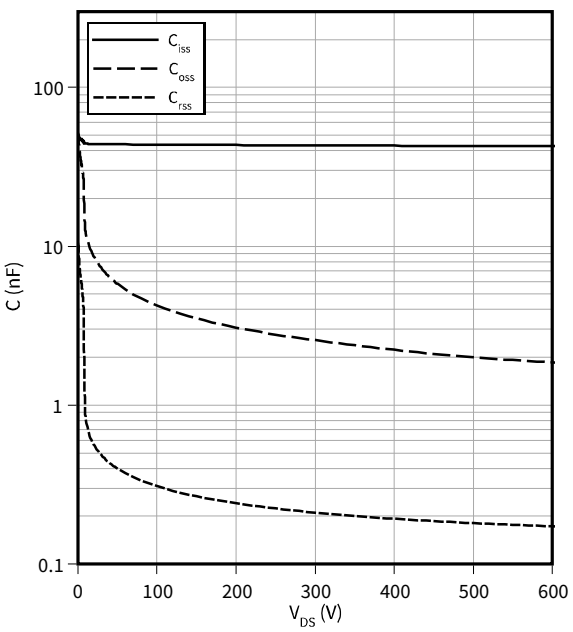
$V_{DSS} = f(T_{vj})$



Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

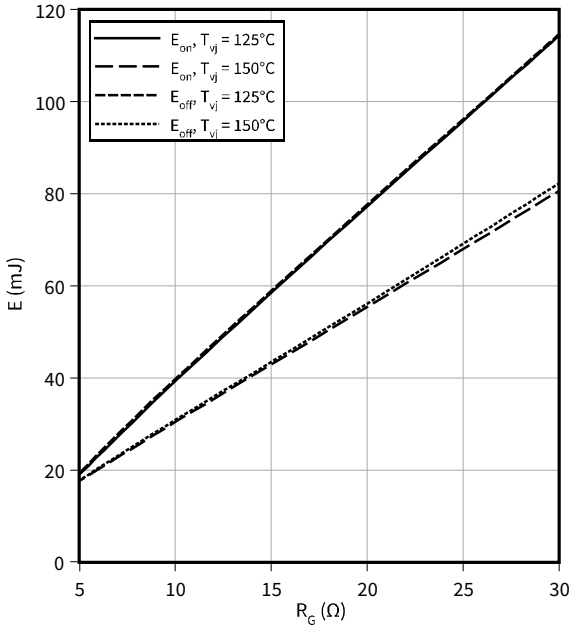
$f = 1$ MHz, $V_{GS} = 0$ V, $T_{vj} = 25$ °C



Switching losses (typical), MOSFET

$E = f(R_G)$

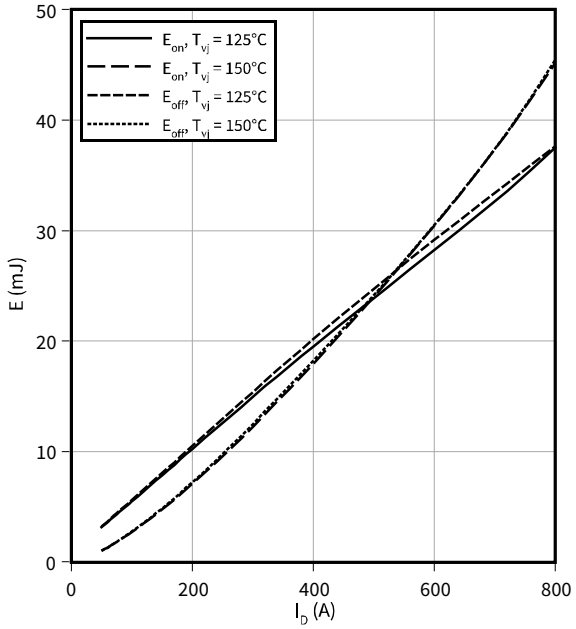
$I_D = 400$ A, $V_{DS} = 600$ V, $V_{GS} = -5/15$ V



Switching losses (typical), MOSFET

$E = f(I_D)$

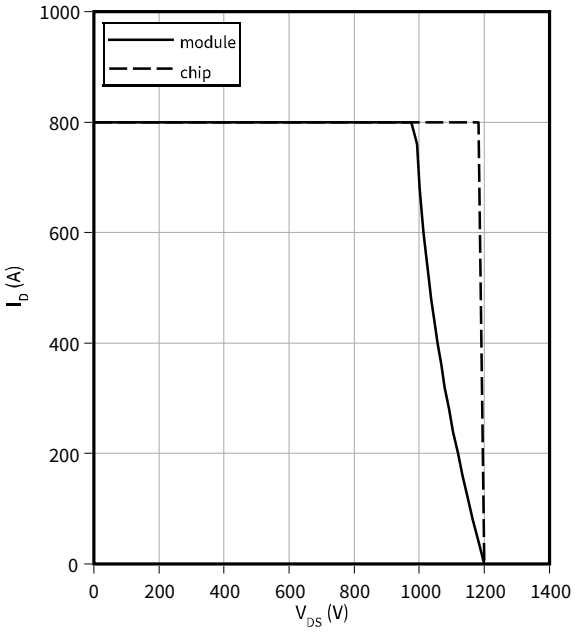
$V_{DS} = 600$ V, $R_{G,off} = 5.1\ \Omega$, $R_{G,on} = 5.1\ \Omega$, $V_{GS} = -5/15$ V



Reverse bias safe operating area (RBSOA), MOSFET

$I_D = f(V_{DS})$

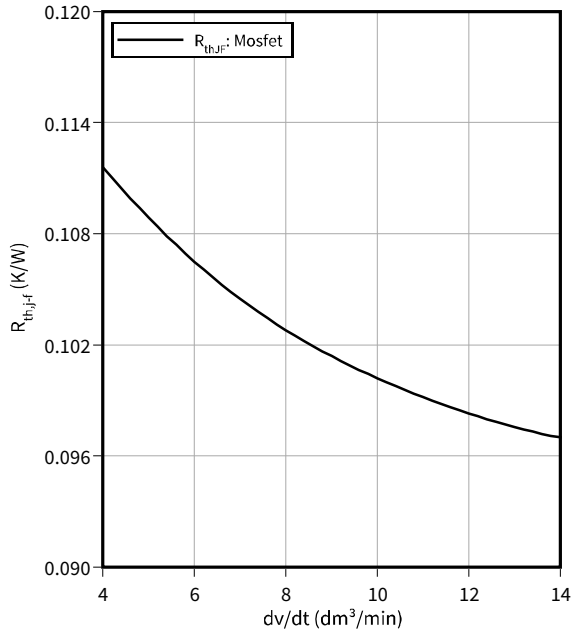
$R_{G,off} = 5.1\ \Omega$, $V_{GS} = +15V/-5$ V, $T_{vj} = 150$ °C



Thermal impedance , MOSFET

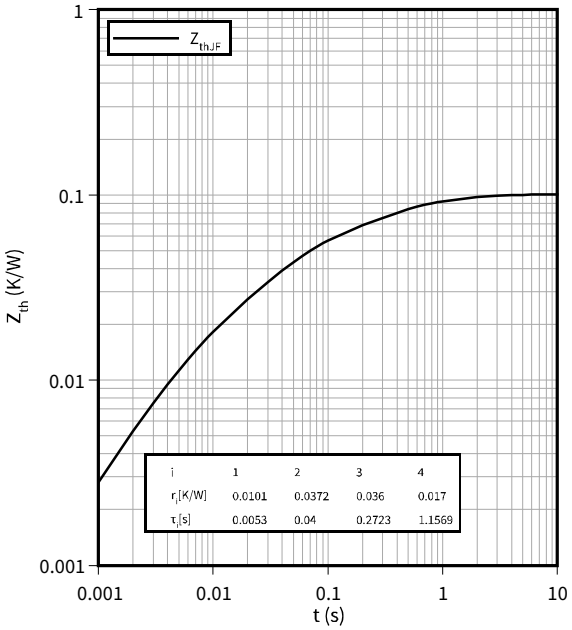
$R_{th,j\text{-}f} = f(dv/dt)$

fluid = 50% water/50% ethylenglycol , $T_f = 60$ °C



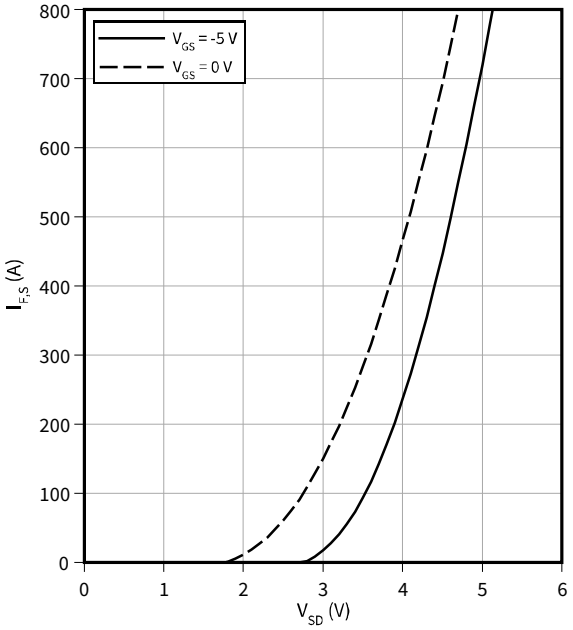
Transient thermal impedance , MOSFET

$Z_{th} = f(t)$
$\Delta V/\Delta t$ = 10 dm³/min, fluid = 50% water/50% ethylenglycol , T_f = 60 °C



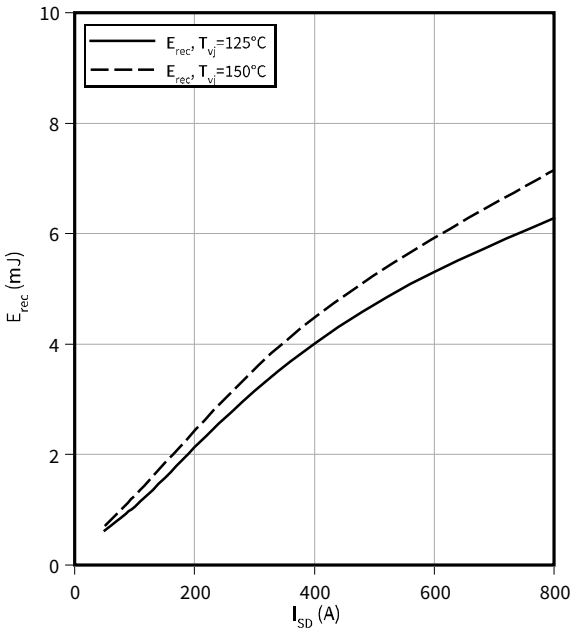
Forward characteristic body diode (typical), MOSFET

$I_{F,S} = f(V_{SD})$
T_{vj} = 25 °C



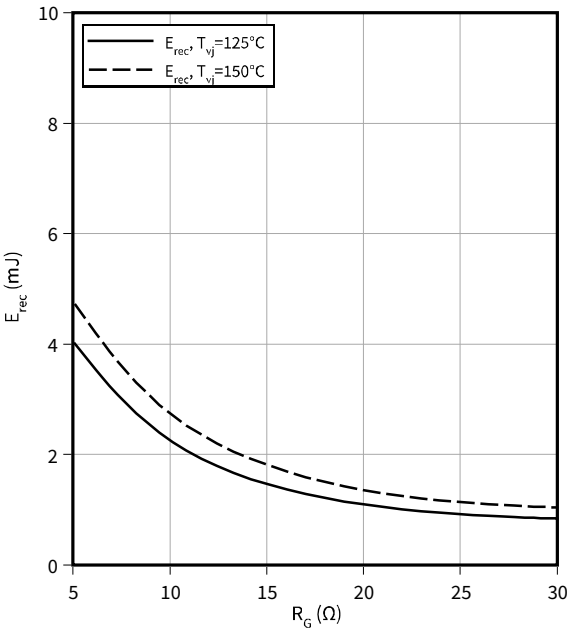
Switching losses body diode (typical), MOSFET

$E_{rec} = f(I_{SD})$
V_r = 600 V, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V



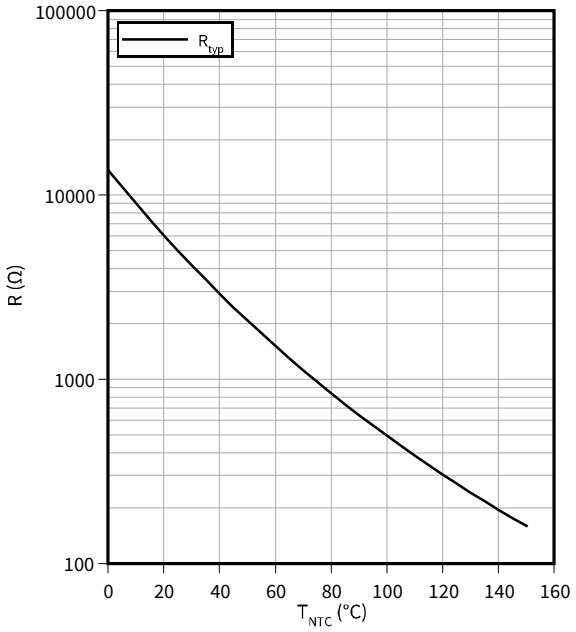
Switching losses body diode (typical), MOSFET

$E_{rec} = f(R_G)$
V_r = 600 V, $I_{F,S}$ = 400 A, V_{GS} = -5/15 V



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

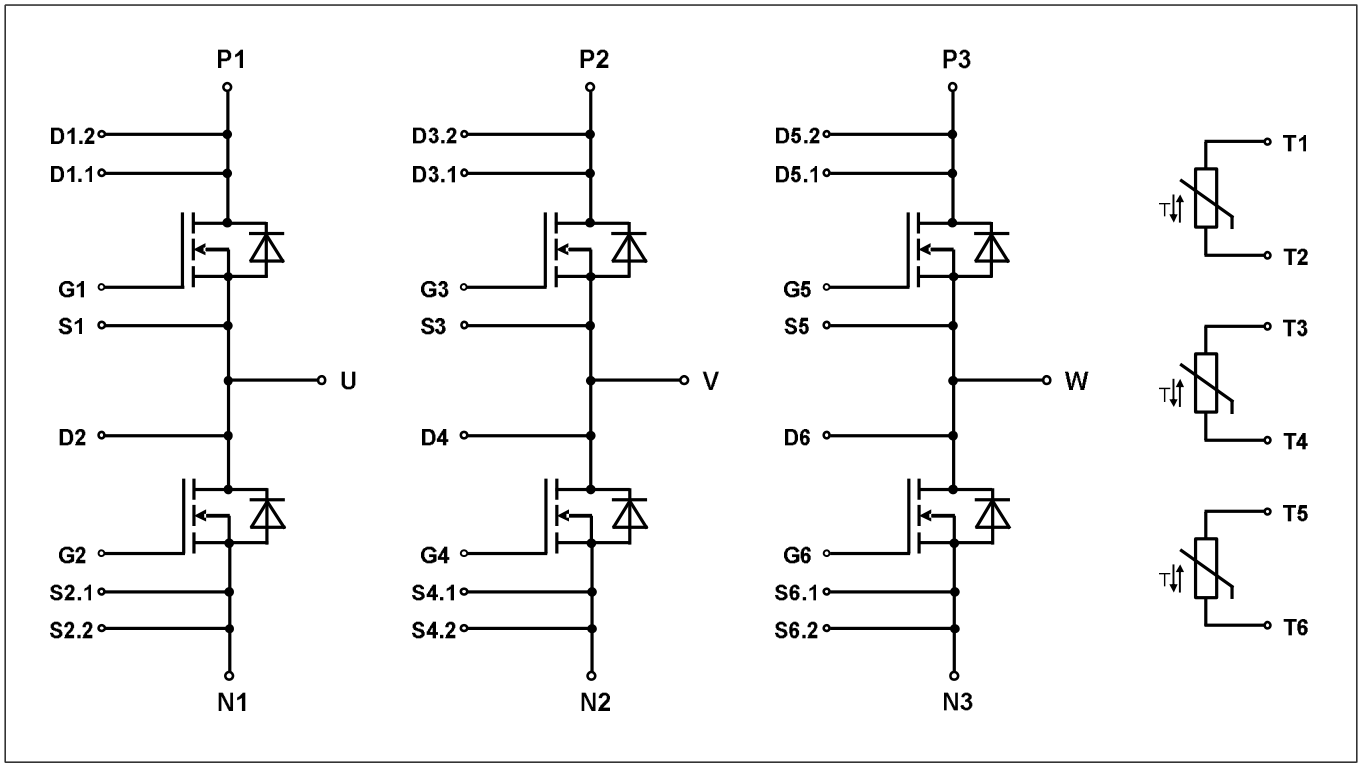


Figure 1

7 Package outlines

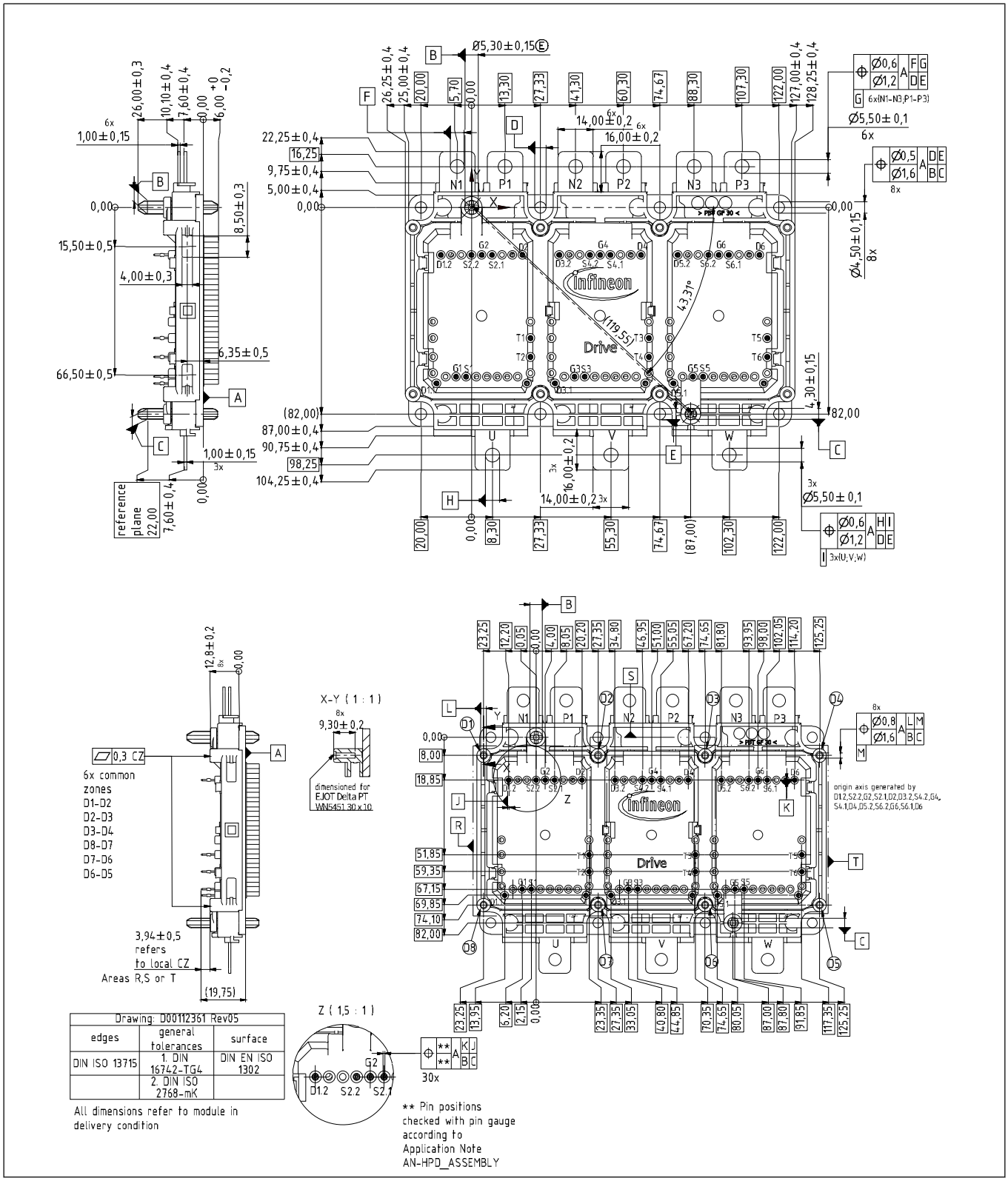
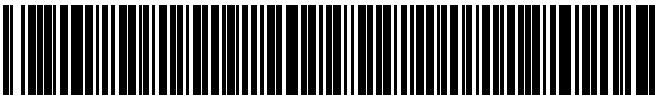


Figure 2

8 Module label code

Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 715491428465505499115 30	 715491428465505499115 30	

Packing label code				
Code format	Barcode Code128			
Encoding	Code Set A			
Symbol size	34 digits			
Standard	IEC8859-1			
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Identifier* X 1T S 9D Q	*Digit* 2 – 9 12 – 19 21 – 25 28 – 31 33 – 34	*Example* 95056609 2X0003E0 754389 1139 15
Example	 X950566091T2X0003E0S754389D1139Q15			

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2017-11-06	Target datasheet
V1.1	2018-11-28	Extention of target datasheet data
n/a	2020-10-05	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.00	2021-03-23	Final datasheet
1.10	2022-07-19	Adaption of product identification Adding electrical feature diagram Correction of typos

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Email: erratum@infineon.com

Document reference
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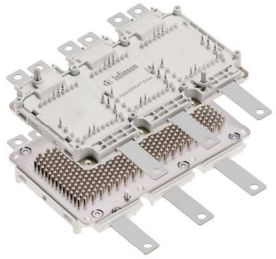
HybridPACK™ Drive module with CoolSiC™ Automotive MOSFET



Features

- Electrical features
  - V_{DSS} = 1200 V
  - $I_{D,nom}$ = 400 A
  - New semiconductor material - silicon carbide
  - Low $R_{DS,on}$
  - Low switching losses
  - Low Q_g and C_{rss}
  - Low inductive design <10 nH
  - $T_{vj,op}$ = 150°C
- Mechanical features
  - 4.2 kV DC 1 second insulation
  - High creepage and clearance distances
  - Compact design
  - High power density
  - Direct-cooled PinFin base plate
  - High-performance Si3N4 ceramic
  - Guiding elements for PCB and cooler assembly
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - RoHS compliant
  - UL 94 V0 module frame

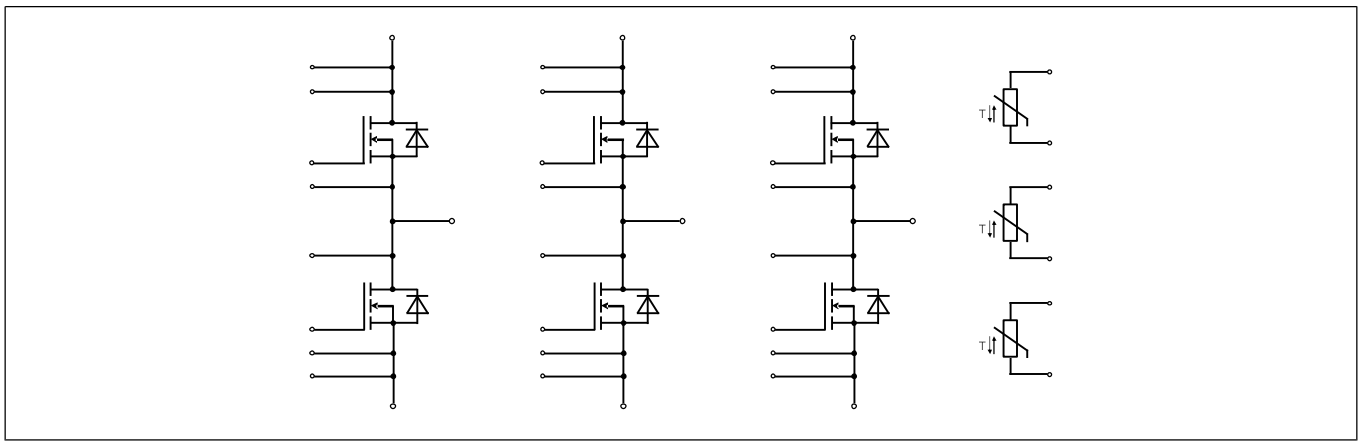
Potential applications

- Automotive applications
- (Hybrid) electrical vehicles (H)EV
- Motor drives
- Commercial agriculture vehicles

Product validation

- Qualified according to AQG 324, release no.: 03.1/2021

Description



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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 0 Hz, t = 1 sec	4.20	kV
Material of module baseplate			Ni+Cu[1)]	
Internal isolation		basic insulation (class 1, IEC 61140)	Si3N4	
Creepage distance	d_{creep}	terminal to heatsink	9.0	mm
Creepage distance	d_{creep}	terminal to terminal	9.0	mm
Clearance	d_{clear}	terminal to heatsink	4.5	mm
Clearance	d_{clear}	terminal to terminal	4.5	mm
Comparative tracking index	*CTI*		> 200	

1) Ni plated Cu baseplate

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Maximum RMS module terminal current	$I_{t,rms}$	$T_{terminal}$ = 105 °C, T_f = 75 °C	500	A

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Pressure drop in cooling circuit	Δp	$\Delta V/\Delta t$ = 10 dm³/min, 50% water / 50% ethylenglycol, T_f = 60 °C		64[1)]		mbar
Maximum pressure in cooling circuit	p	$T_{baseplate}$ < 40°C (relative pressure)			2.5	bar
		$T_{baseplate}$ ≥ 40°C (relative pressure)			2.0	
Stray inductance module	$L_{s,DS}$			8.5		nH
Module lead resistance, terminals - chip	$R_{DD'+SS'}$	T_f = 25 °C, per switch		0.75		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	Screw M4 baseplate to heatsink	1.8	2.0	2.2	Nm
Weight	G			729		g

1) Cooler design and flow direction according to application note AN-HPDPERF-ASSEMBLY

2 MOSFET

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	1200	V
DC drain current	$I_{D,nom}$	V_{GS} = 15 V, T_f = 60 °C	$T_{vj,max}$ = 175 °C	400	A
Pulsed drain current	$I_{D,pulse}$	verified by design, t_p limited by T_{vjmax}		800	A
Gate-source voltage	V_{GSS}			-10/20	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS,on}$	I_D = 400 A, V_{GS} = 15 V	T_{vj} = 25 °C		2.75	3.70	mΩ
			T_{vj} = 125 °C		4.00		
			T_{vj} = 150 °C		4.55		
Gate threshold voltage	$V_{GS,th}$	I_D = 240 mA, V_{GS} = V_{DS}, (tested after 1ms pulse at V_{GS} = +20 V)	T_{vj} = 25 °C	3.25	4.40	5.55	V
Total gate charge	Q_G	V_{DS} = 600 V, V_{GS} = -5/15 V			1.32		µC
Internal gate resistor	$R_{G,int}$		T_{vj} = 25 °C		0.23		Ω
Input capacitance	C_{iss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		42.6		nF
Output capacitance	C_{oss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		1.86		nF
Reverse transfer capacitance	C_{rss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.17		nF
C_{OSS} stored energy	E_{oss}	V_{DS} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		438		µJ
Drain-source leakage current	I_{DSX}	V_{GS} = -5 V, V_{DSS} = 1200 V	T_{vj} = 25 °C			100	µA
Gate-source leakage current	I_{GSS}	V_{GS} = 20 V, V_{DS} = 0 V	T_{vj} = 25 °C			400	nA
Turn-on delay time, inductive load	$t_{d,on}$	I_D = 400 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		77		ns
			T_{vj} = 125 °C		62		
			T_{vj} = 150 °C		59		
Rise time (inductive load)	t_r	I_D = 400 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		79		ns
			T_{vj} = 125 °C		70		
			T_{vj} = 150 °C		69		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time, inductive load	$t_{d,off}$	I_D = 400 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		263		ns
			T_{vj} = 125 °C		287		
			T_{vj} = 150 °C		294		
Fall time (inductive load)	t_f	I_D = 400 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		64		ns
			T_{vj} = 125 °C		64		
			T_{vj} = 150 °C		65		
Turn-on energy loss per pulse	E_{on}	I_D = 400 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C, di/dt = 4 kA/µs		19.48		mJ
			T_{vj} = 125 °C, di/dt = 4.6 kA/µs		19.85		
			T_{vj} = 150 °C, di/dt = 4.6 kA/µs		20.16		
Turn-off energy loss per pulse	E_{off}	I_D = 400 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C, du/dt = 7.3 kV/µs		17.61		mJ
			T_{vj} = 125 °C, du/dt = 7.2 kV/µs		17.95		
			T_{vj} = 150 °C, du/dt = 7.1 kV/µs		18.21		
Short circuit data	I_{SC}	V_{DD} = 800 V, V_{GS} = -5/15 V, $R_{G,on}$ = 5.1 Ω, $R_{G,off}$ = 5.1 Ω, V_{DSmax} = V_{DSS}-L_{sDS} · di/dt	t_{SC} = 3 µs, T_{vj} = 25 °C		5300		A
			t_{SC} = 3 µs, T_{vj} = 150 °C		4800		
Thermal resistance, junction to cooling fluid	$R_{th,j-f}$	per MOSFET, T_f = 60 °C, $\Delta V/\Delta t$ = 10 dm³/min, 50% water / 50% ethylenglycol			0.1	0.108[1)]	K/W
Temperature under switching conditions	$T_{vj,op}$			-40		150	°C

1) EoL criteria see AQG324, verified by characterization with 4.5 sigma. Cooler design and flow direction according to application note AN-HPDPERF-ASSEMBLY

3 Body diode

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	$I_{F,S}$	$T_{vj,max}$ = 175 °C, V_{GS} = -5 V	T_f = 60 °C	210	A
Pulsed body diode current	$I_{F,S,pulse}$	verified by design, t_p limited by T_{vjmax}		800	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	$V_{F,SD}$	$I_{F,S}$ = 400 A, V_{GS} = -5 V	T_{vj} = 25 °C		4.42	6.15	V
			T_{vj} = 125 °C		4.22		
			T_{vj} = 150 °C		4.16		
Peak reverse recovery current	I_{rrm}	$I_{F,S}$ = 400 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		165		A
			T_{vj} = 125 °C		287		
			T_{vj} = 150 °C		309		
Recovered charge	Q_{rr}	$I_{F,S}$ = 400 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		11.20		µC
			T_{vj} = 125 °C		18.10		
			T_{vj} = 150 °C		19.30		
Reverse recovery energy	E_{rec}	$I_{F,S}$ = 400 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C, $-di/dt$ = 5.9 kA/µs		1.4		mJ
			T_{vj} = 125 °C, $-di/dt$ = 6.9 kA/µs		4.0		
			T_{vj} = 150 °C, $-di/dt$ = 6.9 kA/µs		4.7		

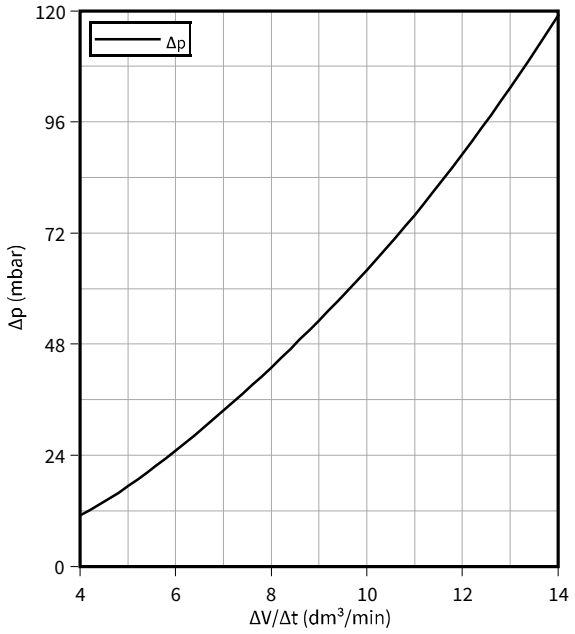
4 NTC-Thermistor

Table 8 Characteristic values

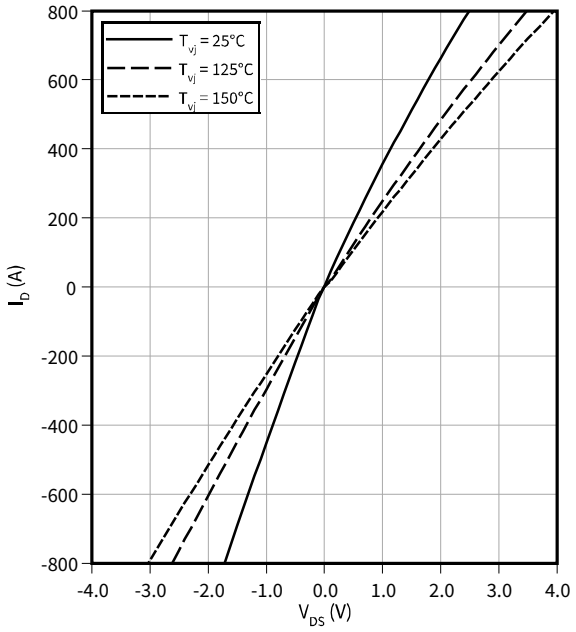
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3433		K

5 Characteristics diagrams

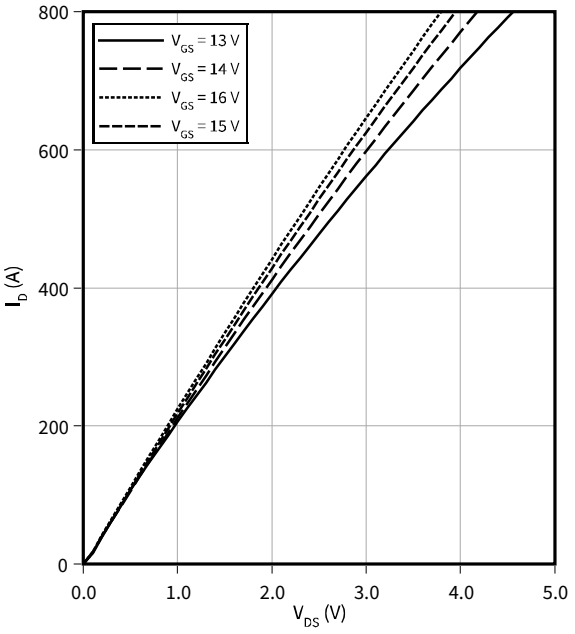
Pressure drop in cooling circuit, Package
$\Delta p = f(\Delta V/\Delta t)$
T_f = 60 °C, fluid = 50% water/50% ethylenglycol



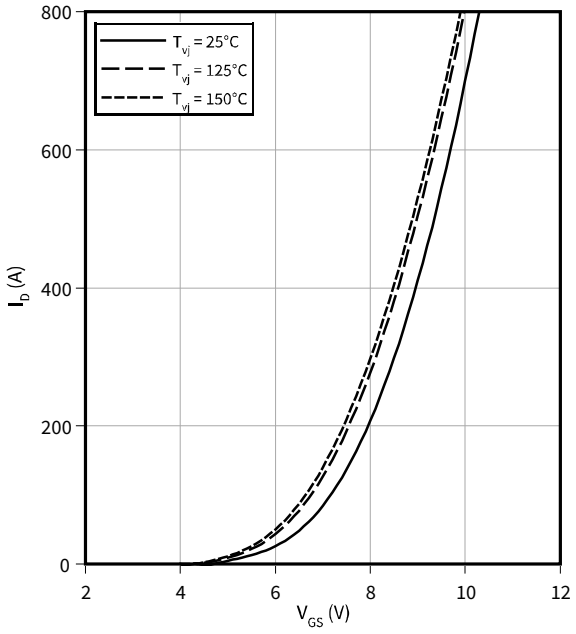
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
V_{GS} = 15 V



Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
T_{vj} = 125 °C



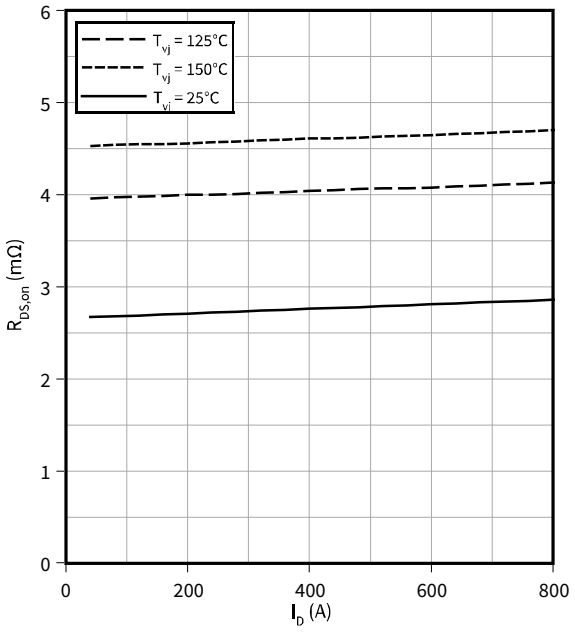
Transfer characteristic (typical), MOSFET
$I_D = f(V_{GS})$
V_{DS} = 20 V



Drain-source on-resistance (typical), MOSFET

$R_{DS,on} = f(I_D)$

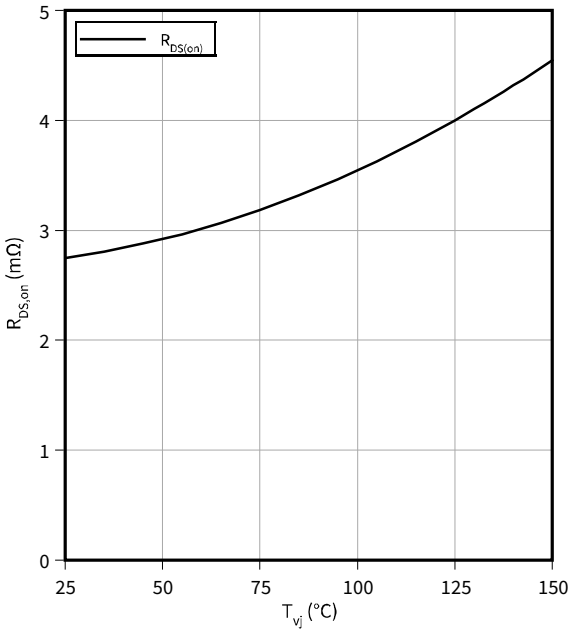
V_{GS} = 15 V



Drain-source on-resistance (typical), MOSFET

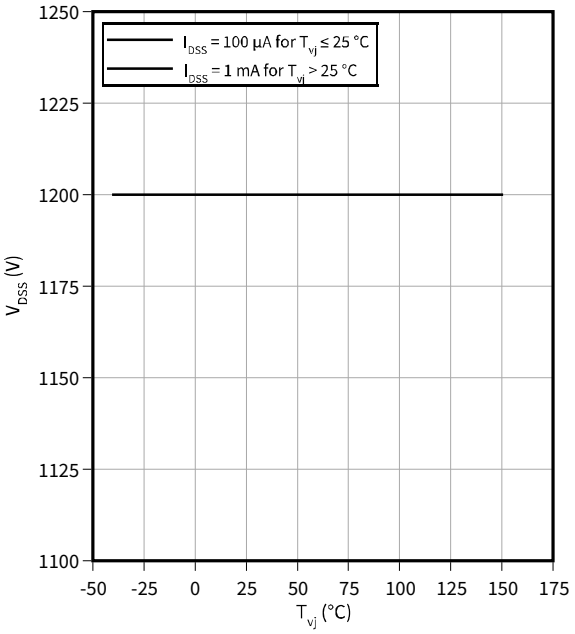
$R_{DS,on} = f(T_{vj})$

I_D = 400 A, V_{GS} = 15 V



Maximum allowed drain-source voltage, MOSFET

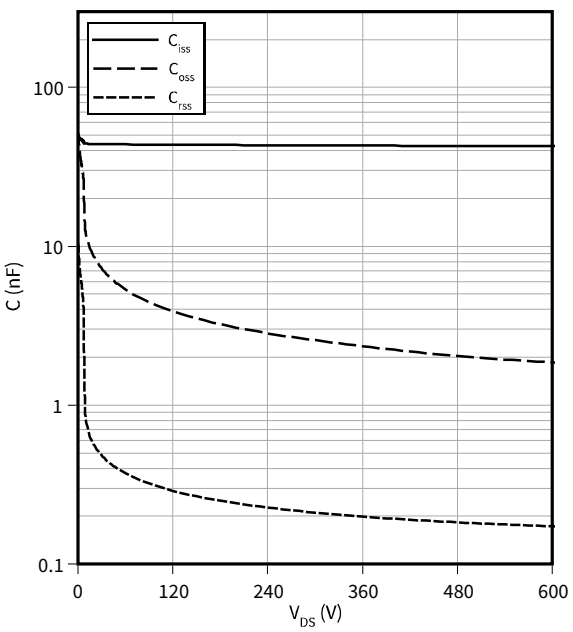
$V_{DSS} = f(T_{vj})$



Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

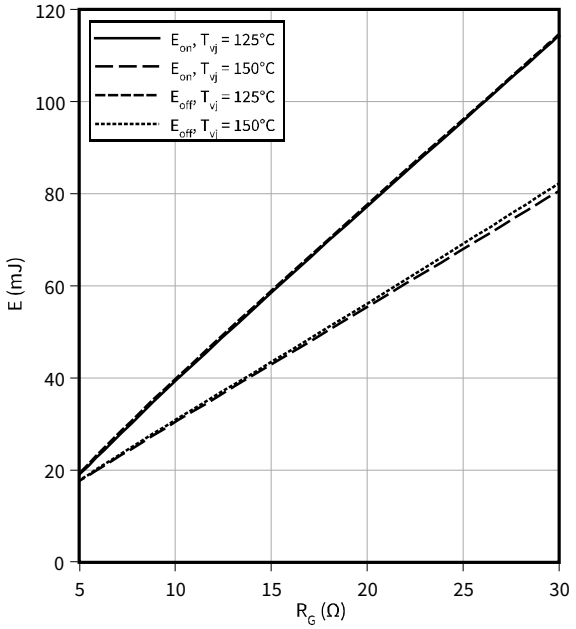
T_{vj} = 25 °C, f = 1 MHz, V_{GS} = 0 V



Switching losses (typical), MOSFET

$E = f(R_G)$

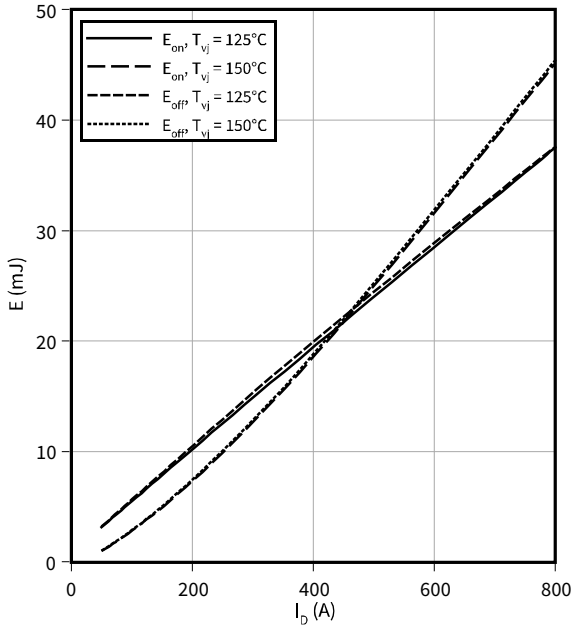
$I_D = 400$ A, $V_{DS} = 600$ V, $V_{GS} = -5/15$ V



Switching losses (typical), MOSFET

$E = f(I_D)$

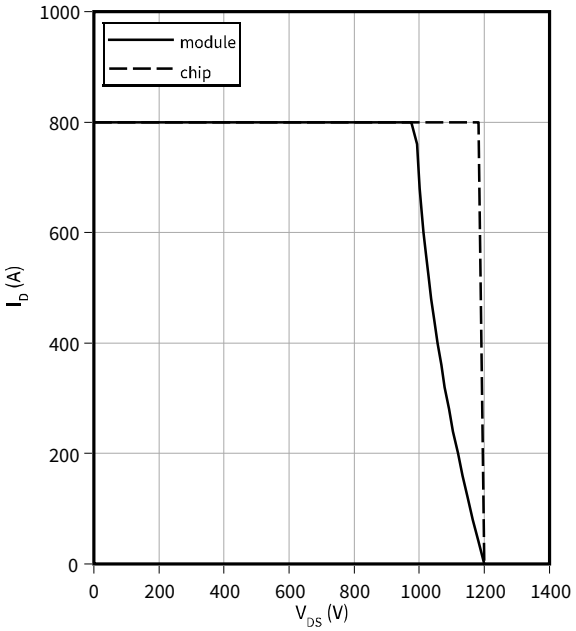
$V_{DS} = 600$ V, $R_{G,off} = 5.1\ \Omega$, $R_{G,on} = 5.1\ \Omega$, $V_{GS} = -5/15$ V



Reverse bias safe operating area (RBSOA), MOSFET

$I_D = f(V_{DS})$

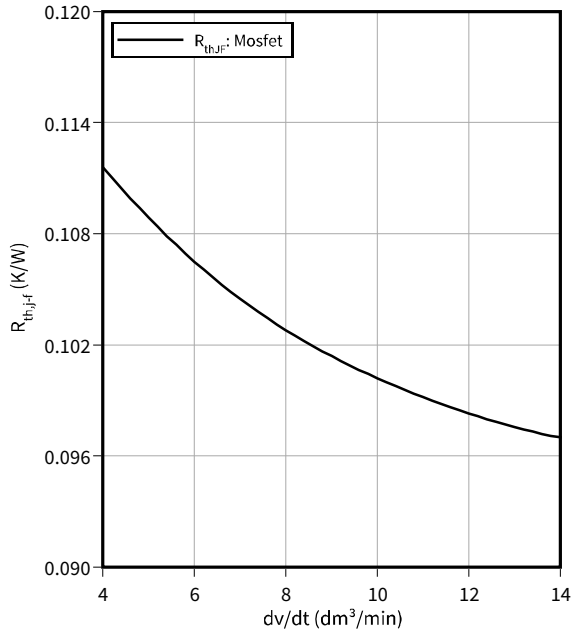
$R_{G,off} = 5.1\ \Omega$, $V_{GS} = +15/-5$ V, $T_{vj} = 150$ °C



Thermal impedance , MOSFET

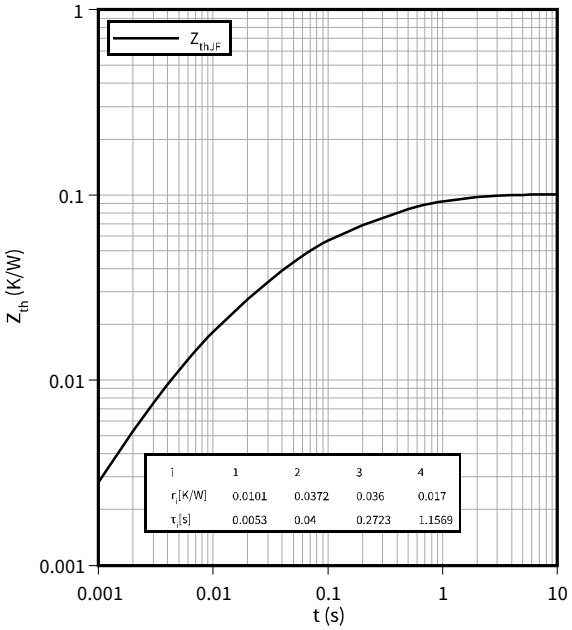
$R_{th,j\text{-}f} = f(dv/dt)$

fluid = 50% water/50% ethylenglycol , $T_f = 60$ °C



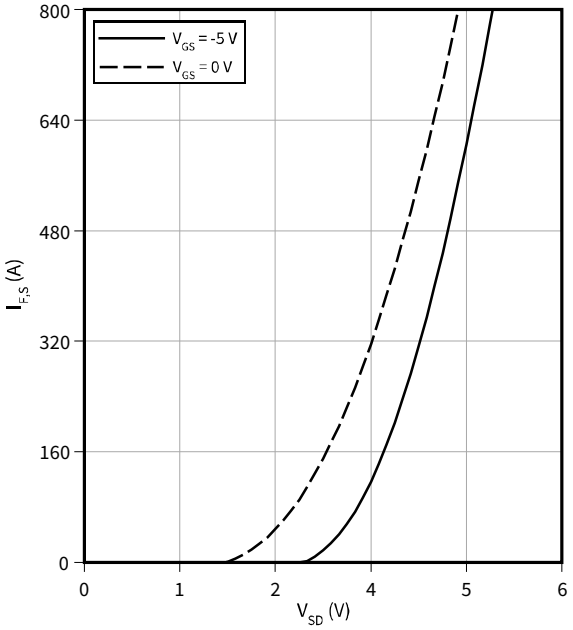
Transient thermal impedance , MOSFET

$Z_{th} = f(t)$
$\Delta V/\Delta t = 10\ dm^3/min$, fluid = 50% water/50% ethylenglycol , $T_f = 60\ °C$



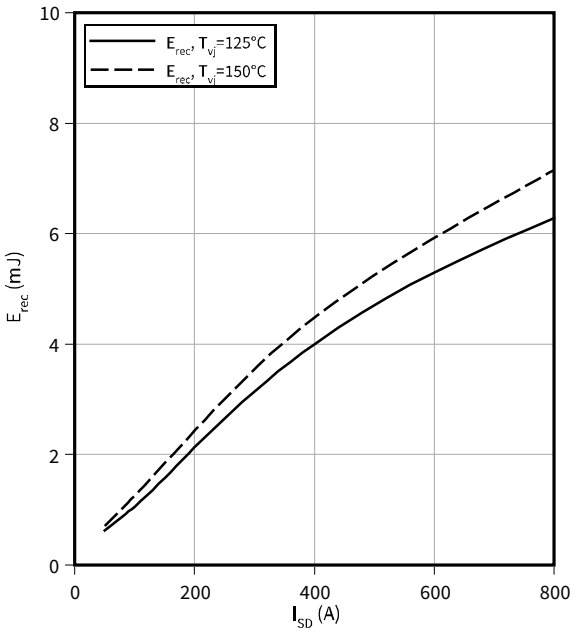
Forward characteristic body diode (typical), MOSFET

$I_{F,S} = f(V_{SD})$
$T_{vj} = 25\ °C$



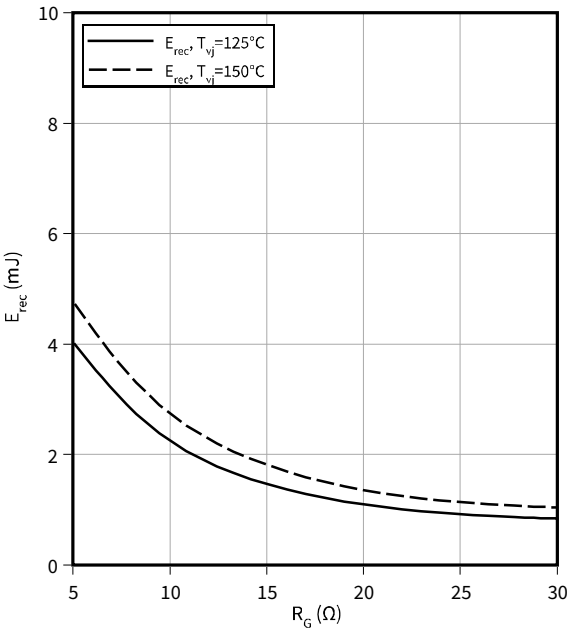
Switching losses body diode (typical), MOSFET

$E_{rec} = f(I_{SD})$
$V_r = 600\ V$, $R_{G,on} = 5.1\ \Omega$, $V_{GS} = -5/15\ V$



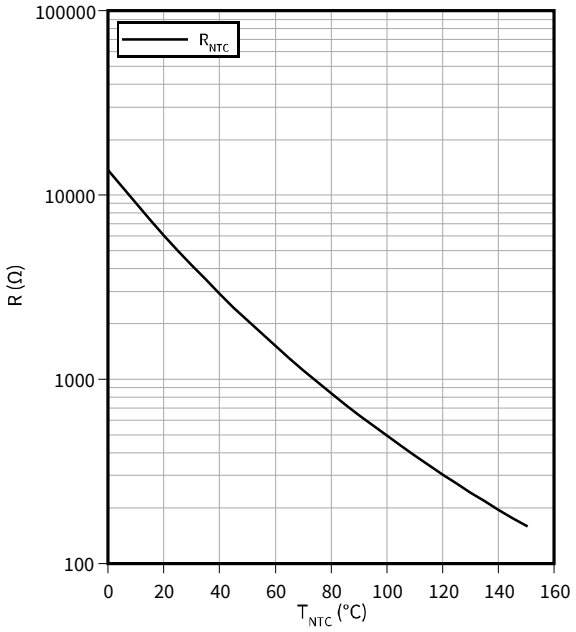
Switching losses body diode (typical), MOSFET

$E_{rec} = f(R_G)$
$V_r = 600\ V$, $I_{F,S} = 400\ A$, $V_{GS} = -5/15\ V$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

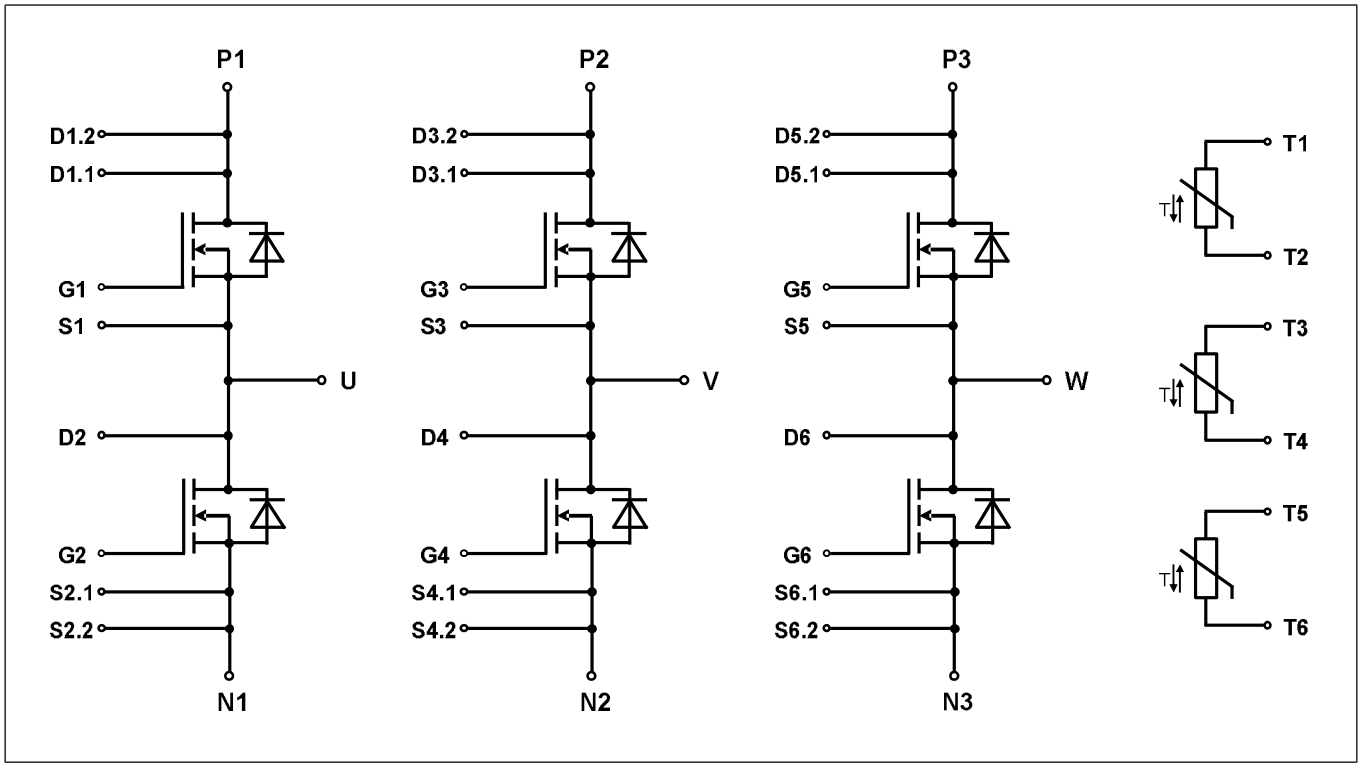


Figure 1

7 Package outlines

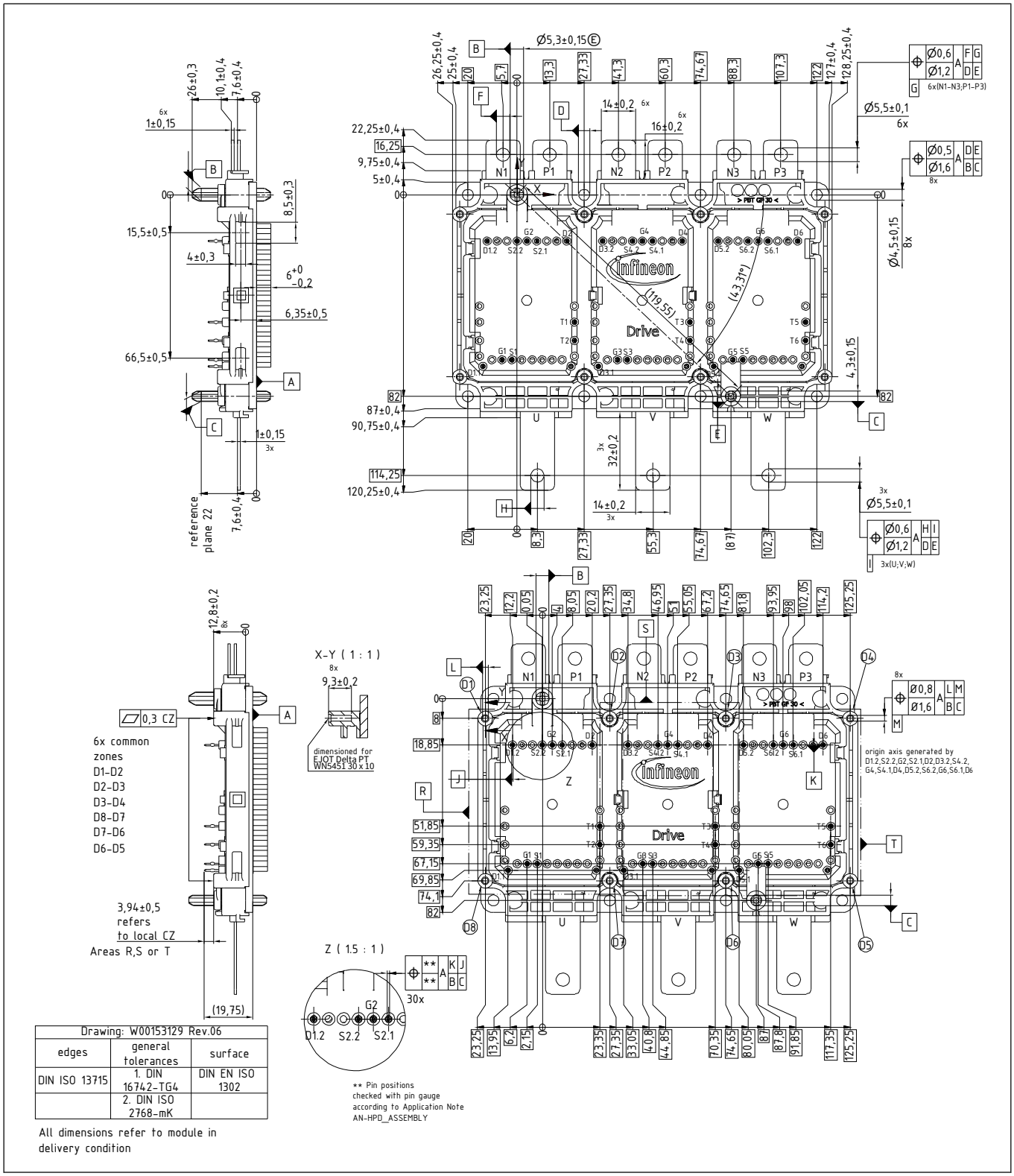
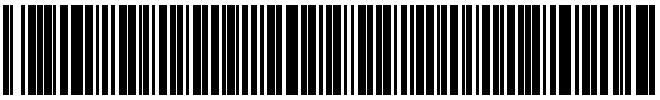


Figure 2

8 Module label code

Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 7154914284655054991530	 7154914284655054991530	

Packing label code				
Code format	Barcode Code128			
Encoding	Code Set A			
Symbol size	34 digits			
Standard	IEC8859-1			
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Identifier* X 1T S 9D Q	*Digit* 2 – 9 12 – 19 21 – 25 28 – 31 33 – 34	*Example* 95056609 2X0003E0 754389 1139 15
Example	 X950566091T2X0003E0S754389D1139Q15			

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2019-09-03	Target datasheet
V2.0	2021-01-26	Preliminary datasheet
n/a	2020-10-05	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.00	2021-03-23	Final datasheet
1.10	2022-07-19	Adaption of product identification Adding electrical feature diagram Correction of typos

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Edition 2022-07-19

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Do you have a question about any aspect of this document?

Email: erratum@infineon.com

Document reference
IFX-AAD288-004

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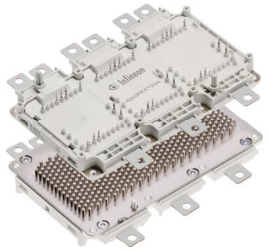
HybridPACK™ Drive module with CoolSiC™ Automotive MOSFET

Features



- Electrical features
  - V_{DSS} = 1200 V
  - $I_{D,nom}$ = 200 A
  - New semiconductor material - silicon carbide
  - Blocking voltage 1200 V
  - Low $R_{DS,on}$
  - Low switching losses
  - Low Q_g and C_{rss}
  - $T_{vj,op}$ = 150°C
  - Low inductive design <10 nH
- Mechanical features
  - 4.2 kV DC 1 second insulation
  - High creepage and clearance distances
  - Compact design
  - High power density
  - Direct-cooled PinFin base plate
  - High-performance Si3N4 ceramic
  - Guiding elements for PCB and cooler assembly
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - RoHS compliant
  - UL 94 V0 module frame

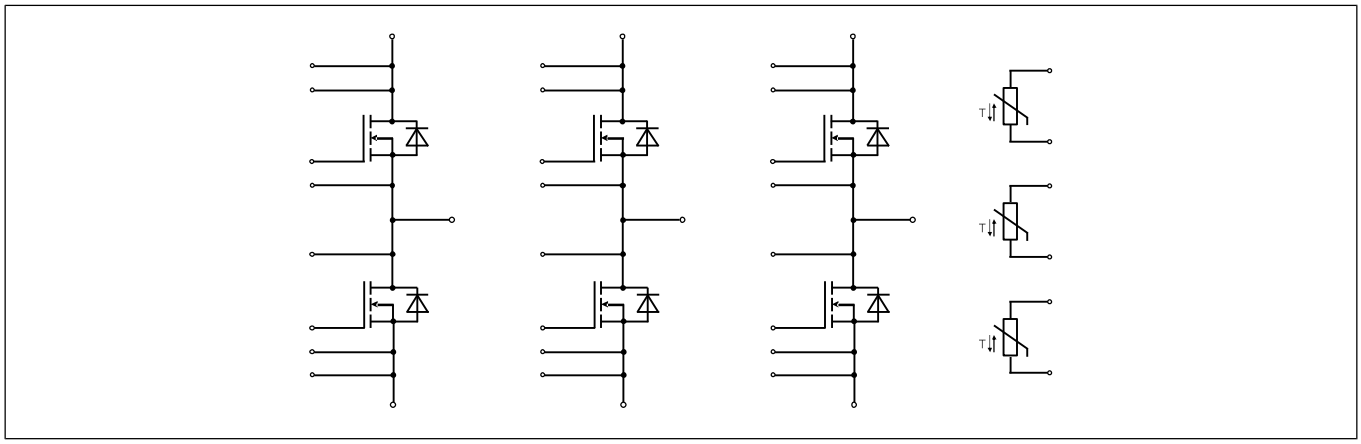
Potential applications

- Automotive applications
- (Hybrid) electrical vehicles (H)EV
- Motor drives
- Commercial agriculture vehicles

Product validation

- Qualified according to AQG 324, release no.: 03.1/2021

Description



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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 0 Hz, t = 1 sec	4.20	kV
Material of module baseplate			Cu+Ni[1)]	
Internal isolation		basic insulation (class 1, IEC 61140)	Si3N4	
Creepage distance	d_{creep}	terminal to heatsink	9.0	mm
Creepage distance	d_{creep}	terminal to terminal	9.0	mm
Clearance	d_{clear}	terminal to heatsink	4.5	mm
Clearance	d_{clear}	terminal to terminal	4.5	mm
Comparative tracking index	*CTI*		> 200	

1) Ni plated Cu baseplate.

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Maximum RMS module terminal current	$I_{t,rms}$	$T_{terminal}$ = 105 °C, T_f = 75 °C	550	A

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Pressure drop in cooling circuit	Δp	$\Delta V/\Delta t$ = 10 dm³/min, 50% water/ 50% ethylenglycol, T_f = 60 °C		64[1)]		mbar
Maximum pressure in cooling circuit	p	$T_{baseplate}$ < 40 °C (relative pressure)			2.5	bar
		$T_{baseplate}$ ≥ 40 °C (relative pressure)			2.0	
Stray inductance module	$L_{s,DS}$			8.5		nH
Module lead resistance, terminals - chip	$R_{DD'+SS'}$	T_f = 25 °C, per switch		0.75		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	Screw M4 baseplate to heatsink	1.8	2.0	2.2	Nm
Weight	G			720		g

1) Cooler design and flow direction according to application note AN-HPD-ASSEMBLY.

2 MOSFET

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	1200	V
DC drain current	$I_{D,nom}$	V_{GS} = 15 V, T_f = 60 °C	$T_{vj,max}$ = 175 °C	200	A
Pulsed drain current	$I_{D,pulse}$	verified by design, t_p limited by T_{vjmax}		400	A
Gate-source voltage	V_{GSS}			-10/20	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS,on}$	I_D = 200 A, V_{GS} = 15 V	T_{vj} = 25 °C		5.50	7.35	mΩ
			T_{vj} = 125 °C		8.00		
			T_{vj} = 150 °C		9.10		
Gate threshold voltage	$V_{GS,th}$	I_D = 120 mA, V_{GS} = V_{DS}, (tested after 1ms pulse at V_{GS} = +20 V)	T_{vj} = 25 °C	3.25	4.50	5.55	V
Total gate charge	Q_G	V_{DS} = 600 V, V_{GS} = -5/15 V			0.66		µC
Internal gate resistor	$R_{G,int}$		T_{vj} = 25 °C		0.45		Ω
Input capacitance	C_{iss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		21.3		nF
Output capacitance	C_{oss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.93		nF
Reverse transfer capacitance	C_{rss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.09		nF
C_{OSS} stored energy	E_{oss}	V_{DS} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		219		µJ
Drain-source leakage current	I_{DSX}	V_{GS} = -5 V, V_{DSS} = 1200 V	T_{vj} = 25 °C			100	µA
Gate-source leakage current	I_{GSS}	V_{GS} = 20 V, V_{DS} = 0 V	T_{vj} = 25 °C			400	nA
Turn-on delay time, inductive load	$t_{d,on}$	I_D = 200 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		52		ns
			T_{vj} = 125 °C		45		
			T_{vj} = 150 °C		44		
Rise time (inductive load)	t_r	I_D = 200 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		44		ns
			T_{vj} = 125 °C		40		
			T_{vj} = 150 °C		39		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time, inductive load	$t_{d,off}$	I_D = 200 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		142		ns
			T_{vj} = 125 °C		153		
			T_{vj} = 150 °C		156		
Fall time (inductive load)	t_f	I_D = 200 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		52		ns
			T_{vj} = 125 °C		53		
			T_{vj} = 150 °C		53		
Turn-on energy loss per pulse	E_{on}	I_D = 200 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C		6.04		mJ
			T_{vj} = 125 °C		6.66		
			T_{vj} = 150 °C, di/dt = 4.5 kA/µs		6.83		
Turn-off energy loss per pulse	E_{off}	I_D = 200 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C		4.27		mJ
			T_{vj} = 125 °C		4.41		
			T_{vj} = 150 °C, du/dt = 12.4 kV/µs		4.51		
Short circuit data	I_{SC}	V_{DD} = 800 V, V_{GS} = -5/15 V, $R_{G,on}$ = 5.1 Ω, $R_{G,off}$ = 5.1 Ω, V_{DSmax} = V_{DSS}-L_{sDS}·di/dt	t_{SC} ≤ 3 µs, T_{vj} = 25 °C		2730		A
			t_{SC} ≤ 3 µs, T_{vj} = 150 °C		2480		
Thermal resistance, junction to cooling fluid	$R_{th,j-f}$	per MOSFET, T_f = 60 °C, $\Delta V/\Delta t$ = 10 dm³/min, 50% water/ 50% ethylenglycol			0.15	0.18[1)]	K/W
Temperature under switching conditions	$T_{vj,op}$			-40		150	°C

1) EoL criteria see AQG324, verified by characterization with 4.5 sigma. Cooler design and flow direction according to application note AN-HPDPERF-ASSEMBLY

3 Body diode

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	$I_{F,S}$	$T_{vj,max}$ = 175 °C, V_{GS} = -5 V	T_f = 60 °C	110	A
Pulsed body diode current	$I_{F,S,pulse}$	verified by design, t_p limited by T_{vjmax}		400	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	$V_{F,SD}$	$I_{F,S}$ = 200 A, V_{GS} = -5 V	T_{vj} = 25 °C		4.42	6.15	V
			T_{vj} = 125 °C		4.22		
			T_{vj} = 150 °C		4.16		
Peak reverse recovery current	I_{rrm}	$I_{F,S}$ = 200 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		87		A
			T_{vj} = 125 °C		165		
			T_{vj} = 150 °C		187		
Recovered charge	Q_{rr}	$I_{F,S}$ = 200 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		3.67		µC
			T_{vj} = 125 °C		6.81		
			T_{vj} = 150 °C		8.28		
Reverse recovery energy	E_{rec}	$I_{F,S}$ = 200 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C, $-di/dt$ = 1.0 kA/µs		0.5		mJ
			T_{vj} = 125 °C, $-di/dt$ = 1.0 kA/µs		1.1		
			T_{vj} = 150 °C, $-di/dt$ = 1.0 kA/µs		1.4		

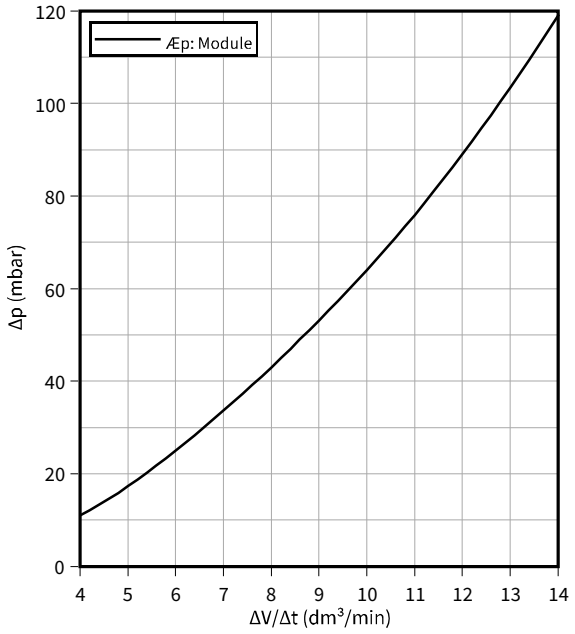
4 NTC-Thermistor

Table 8 Characteristic values

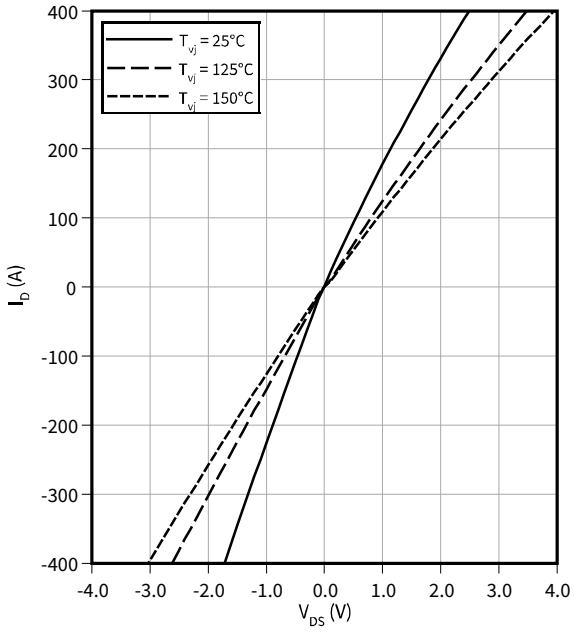
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3433		K

5 Characteristics diagrams

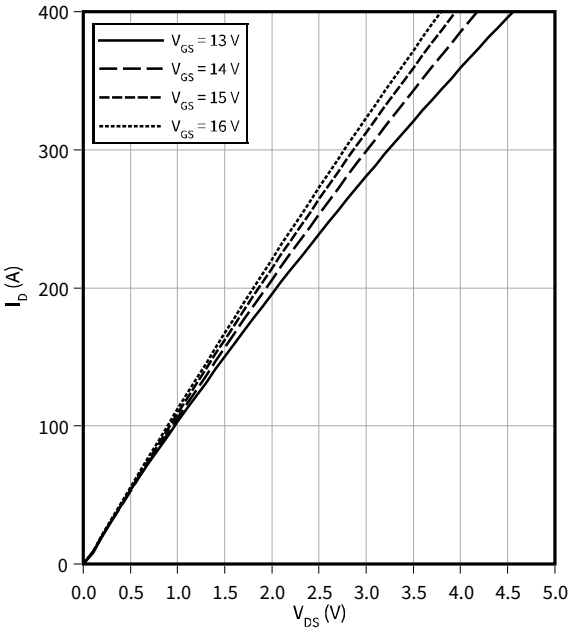
Pressure drop in cooling circuit, Package
$\Delta p = f(\Delta V/\Delta t)$
T_f = 60 °C, fluid = 50% water/ 50% ethylenglycol



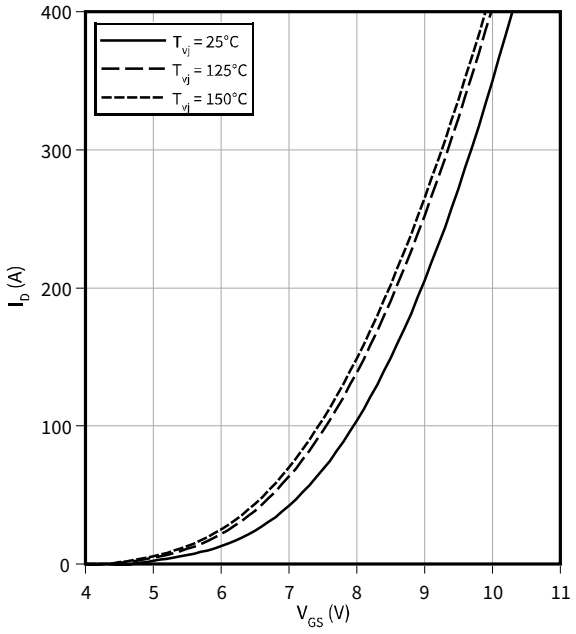
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
V_{GS} = 15 V



Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
T_{vj} = 125 °C



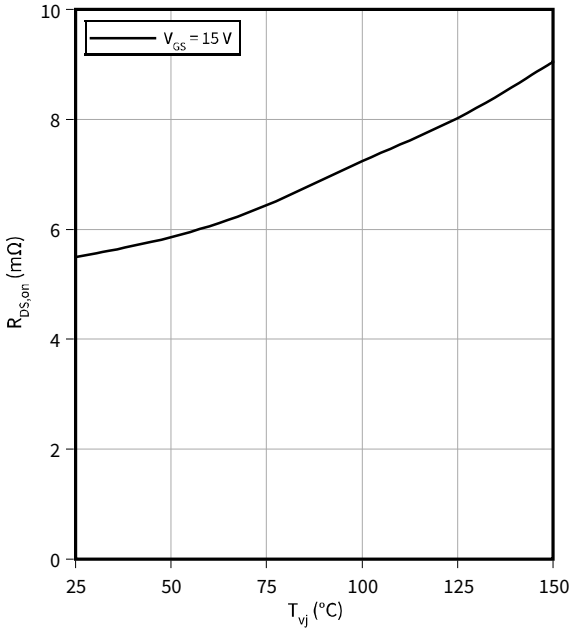
Transfer characteristic (typical), MOSFET
$I_D = f(V_{GS})$
V_{DS} = 20 V



Drain-source on-resistance (typical), MOSFET

$R_{DS,on} = f(T_{vj})$

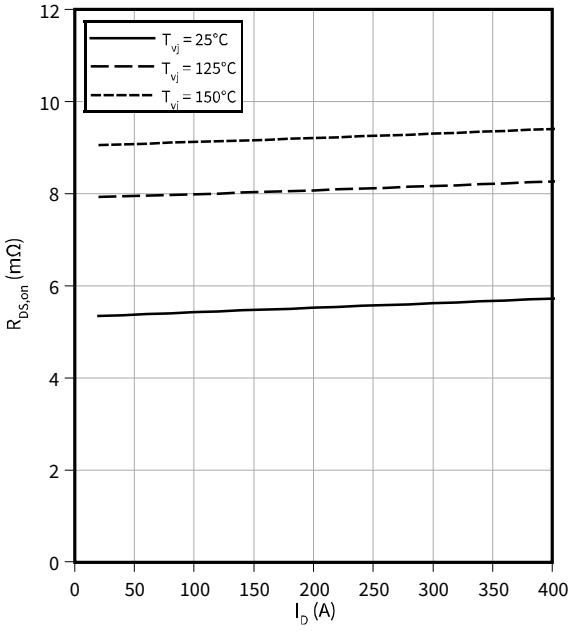
V_{GS} = 15 V



Drain-source on-resistance (typical), MOSFET

$R_{DS,on} = f(I_D)$

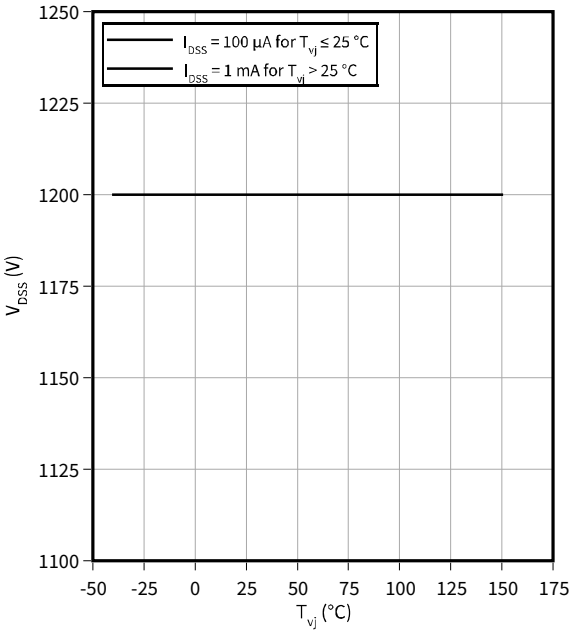
V_{GS} = 15 V



Maximum allowed drain-source voltage, MOSFET

$V_{DSS} = f(T_{vj})$

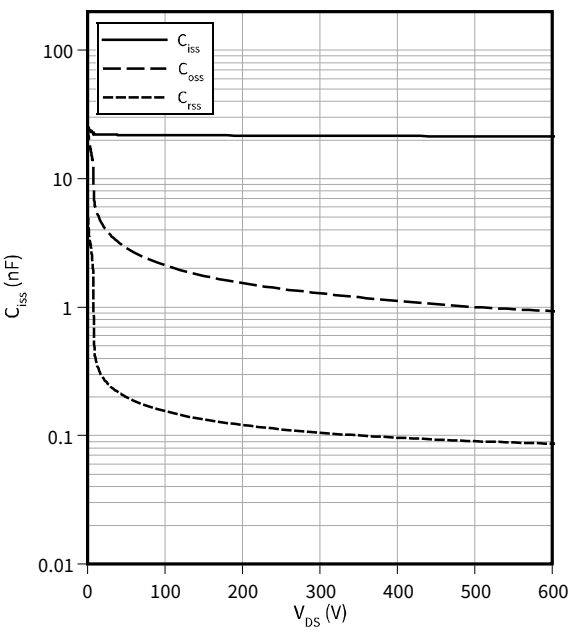
verified by characterization / design not by test



Capacity characteristic (typical), MOSFET

$C_{iss} = f(V_{DS})$, $C_{rss} = f(V_{DS})$, $C_{oss} = f(V_{DS})$

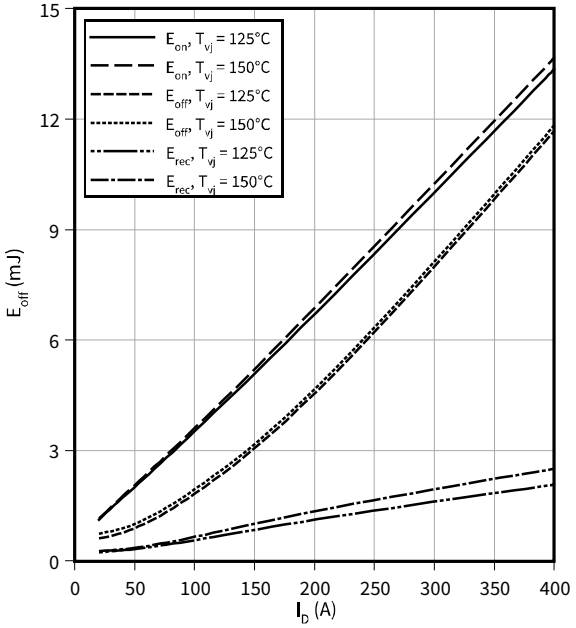
T_{vj} = 25 °C, f = 1 MHz, V_{GS} = -5/15 V



Switching losses (typical), MOSFET

$E_{off} = f(I_D)$, $E_{on} = f(I_D)$

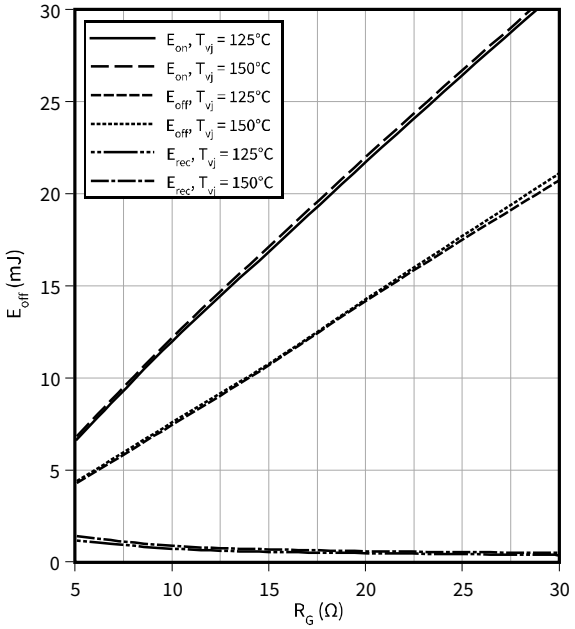
V_{DS} = 600 V, $R_{G,off}$ = 5.1 Ω, $R_{G,on}$ = 5.1 Ω, V_{GS} = ±15 V



Switching losses (typical), MOSFET

$E_{off} = f(R_G)$, $E_{on} = f(R_G)$

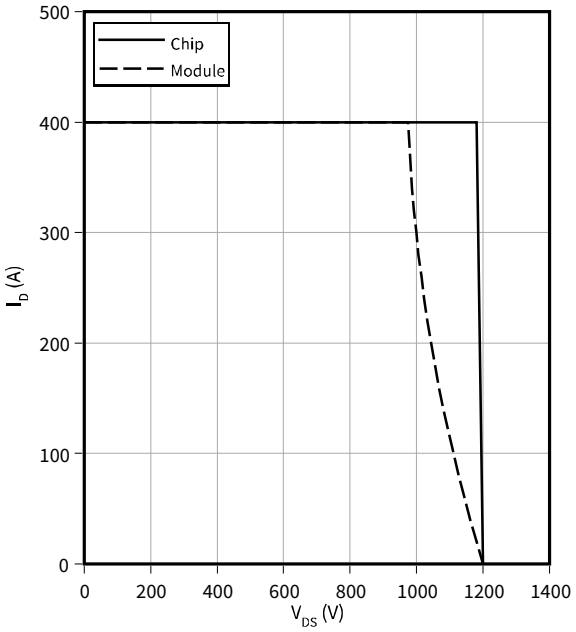
I_D = 200 A, V_{DS} = 600 V, V_{GS} = -5/15 V



Reverse bias safe operating area (RBSOA), MOSFET

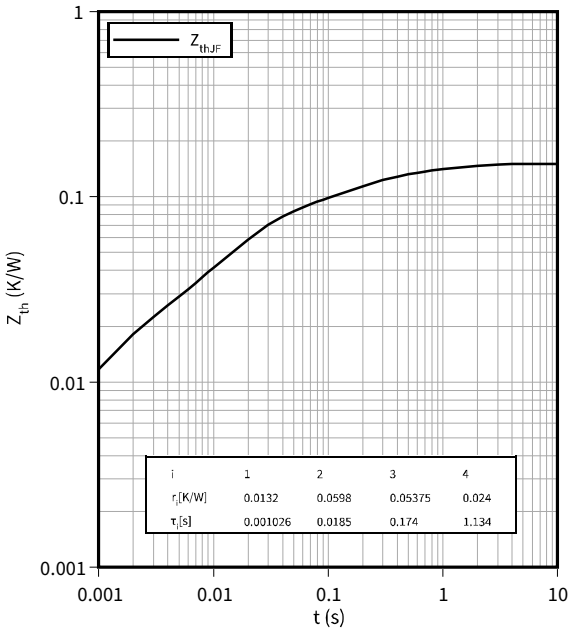
$I_D = f(V_{DS})$

V_{GS} = ±15 V, T_c = 60 °C



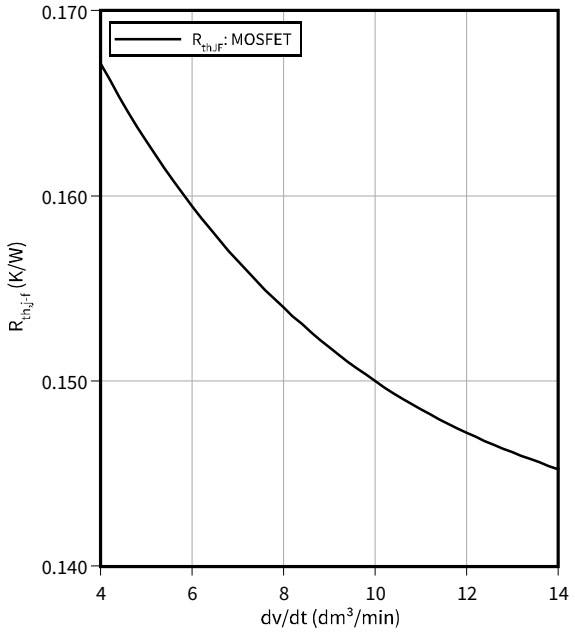
Transient thermal impedance , MOSFET

$Z_{th} = f(t)$



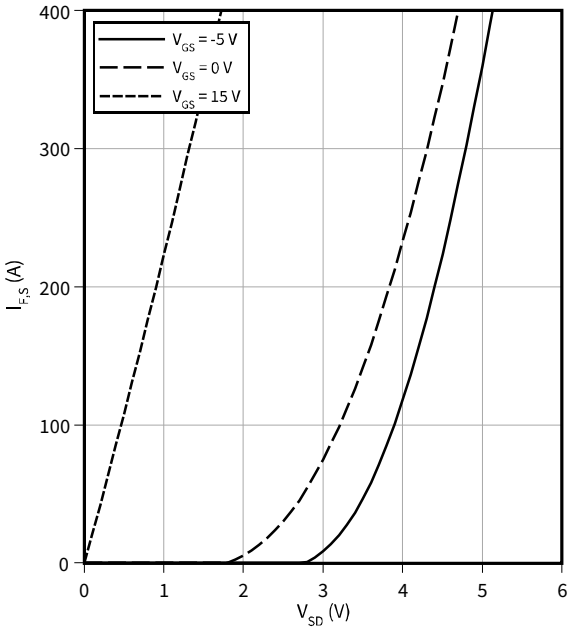
Thermal impedance , MOSFET

$R_{th,j-f} = f(dv/dt)$
fluid = 50% water/ 50% ethylenglycol , $T_f = 60$ °C



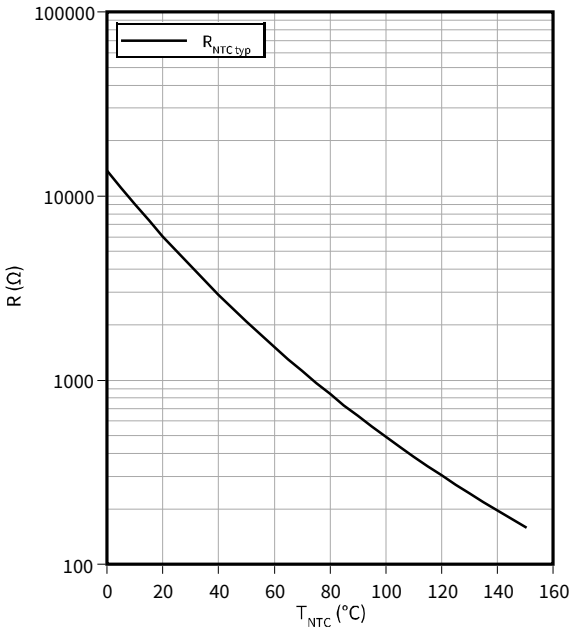
Forward characteristic body diode (typical), MOSFET

$I_{F,S} = f(V_{SD})$
$T_{vj} = 25$ °C



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

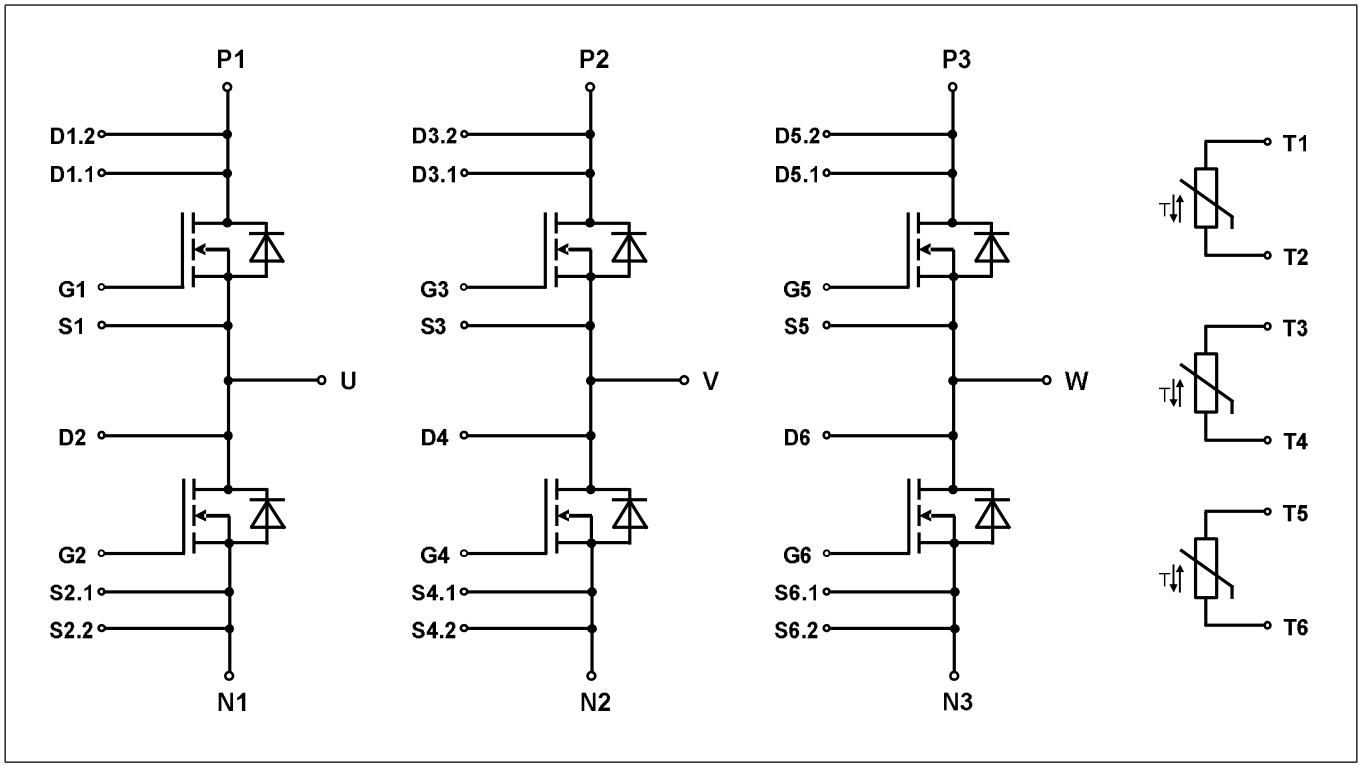


Figure 1

7 Package outlines

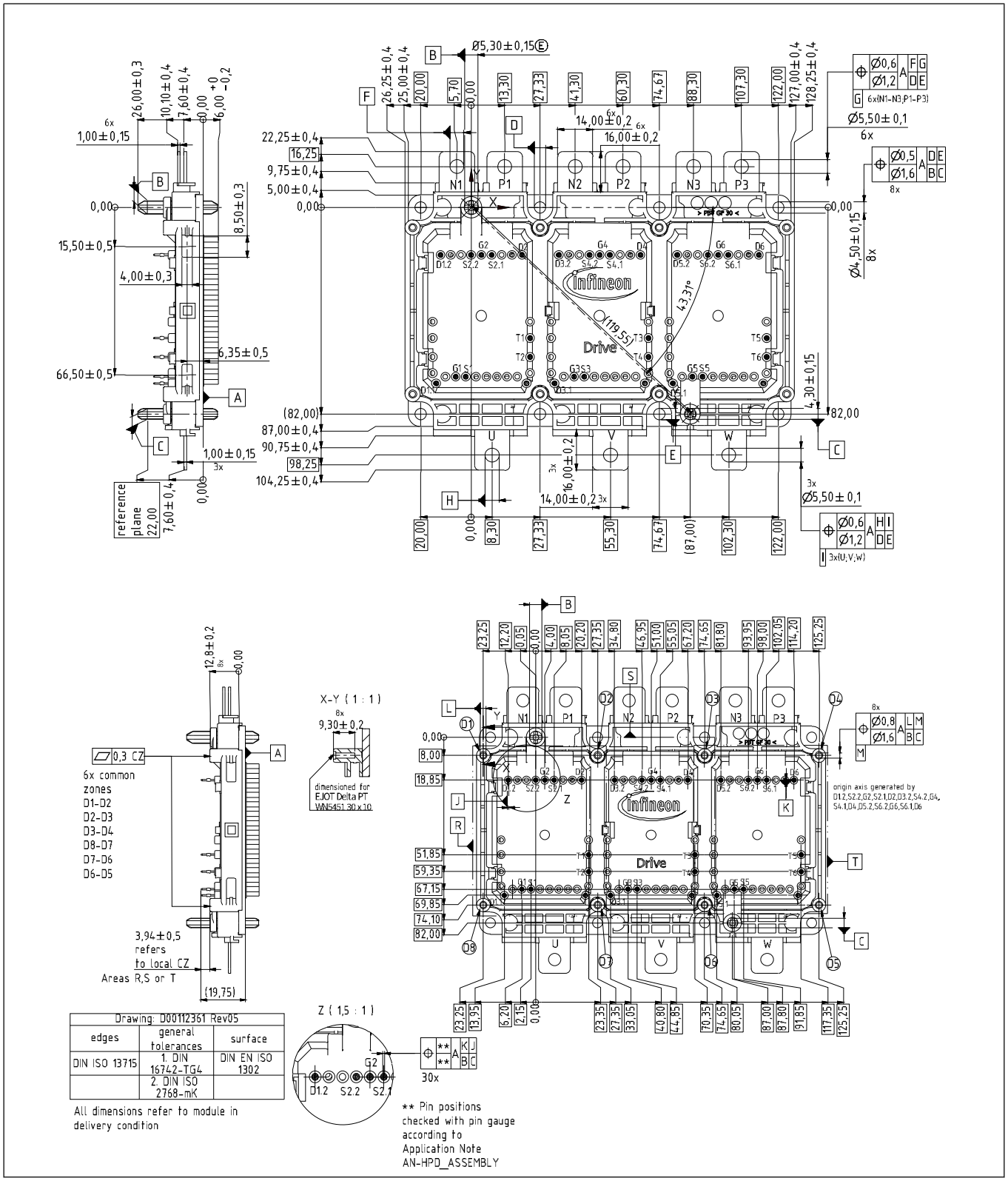
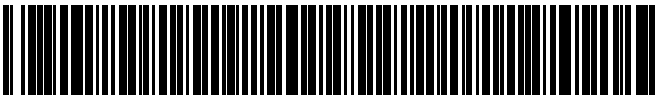


Figure 2

8 Module label code

Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 715491428465505499115 30	 715491428465505499115 30	

Packing label code				
Code format	Barcode Code128			
Encoding	Code Set A			
Symbol size	34 digits			
Standard	IEC8859-1			
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Identifier* X 1T S 9D Q	*Digit* 2 – 9 12 – 19 21 – 25 28 – 31 33 – 34	*Example* 95056609 2X0003E0 754389 1139 15
Example	 X950566091T2X0003E0S754389D1139Q15			

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2019-09-13	Target Datasheet
V2.0	2020-04-02	Preliminary Data Sheet
V3.0	2020-06-26	
V3.1	2020-09-17	Final datasheet, correction of module weight
n/a	2020-10-05	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2022-07-19	Adaption of product identification Adding electrical feature diagram Correction of typos

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The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Warnings

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies’ products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

INF 012/22

Datasheet update for HybridPack Drive SiC product family

Affected products sold to FUTURE ELECTRONICS INC. (4000624)

Sales name	SP number	OPN	Package	Customer part number
FS05MR12A6MA1B	SP005247420	FS05MR12A6MA1BBPSA1	AG-HYBRIDD-2-1	

INF 012/22

Datasheet update for HybridPack Drive SiC product family

Affected products sold to FUTURE ELECTRONICS LTD. (4049887)

Sales name	SP number	OPN	Package	Customer part number
FS03MR12A6MA1LB	SP002725554	FS03MR12A6MA1LBBPSA1	AG-HYBRIDD-2-1	