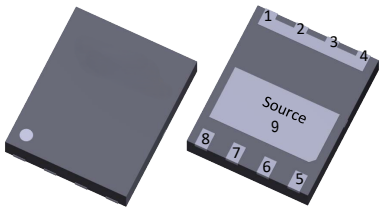
RoHS

Green

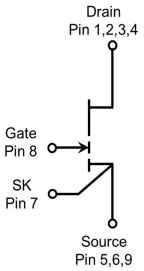
CoolGaN™ Transistor 650 V N-Channel Enhancement Mode

Features

- Enhancement mode transistor
- Ultra-fast switching
- No reverse-recovery charge
- Capable of reverse conduction
- Low gate and output charge
- Superior commutation ruggedness
- 2 kV HBM ESD standards



Gate	8
Drain	1, 2, 3, 4
Kelvin Source	7
Source	5, 6, 9



ORDERING INFORMATION

HT65N16EVDRZ

T_A = -55° to 150° C for all packages

Benefits

- Normally OFF transistor technology ensures safe operation
- Enables rapid and precise power delivery control
- Improves system efficiency and reliability
- Ensures robust performance under challenging conditions

These features collectively make CoolGaN™ a game-changer in therealm of power conversion, offering a compelling combination of efficiency, compactness, and reliability.

Potential applications

Industrial, telecom, datacenter SMPS based on half-bridge hard and soft
switching topologies such as totem pole PFC and high frequency LLC, as well as charger and adapter.

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key performance parameters

Parameter	Value	Unit
$V_{DS,max}$	650	V
$V_{DS,trans-max}$	900	V
$R_{DS(on),max}$	240	mΩ
$Q_{g,typ}$	1.3	nC
$I_{D,pulse}$	16	A
Q_{oss} @ 400 V	9.6	nC
Q_{rr}	0	nC

1 Maximum ratings

at T_j = 25°C, unless otherwise specified. Stresses beyond max ratings may cause permanent damage to the device. For optimum lifetime and reliability, htcsemi recommends operating conditions that do not continuously exceed 80% of the maximum ratings stated (unless otherwise explicitly stated). For further information, contact your local htcsemi sales office.

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Drain source voltage, continuous	$V_{DS,max}$	-	-	650	V	V_{GS} = 0 V; derating recommendation according JEDEC JEP198
Leakage current at drain source transient voltage	$I_{DS,trans}$	-	-	3.3	mA	V_{GS} = 0 V; $V_{DS,trans}$ = 900 V
Drain source voltage transient	$V_{DS,trans}$	-	-	900	V	<1% duty cycle; <1 µs; 1 million pulses
Drain source voltage, pulsed	$V_{DS,pulsed}$	-	-	750	V	T_j = 25°C; V_{GS} ≤ 0 V; cumulated stress time ≤ 1 h
				650		T_j = 125°C; V_{GS} ≤ 0 V; cumulated stress time ≤ 1 h
Switching surge voltage, pulsed	$V_{DS,surge}$	-	-	750	V	DC bus voltage = 700 V; turn off $V_{DS,pulse}$ = 750 V; turn on $I_{D,pulse}$ =7.3 A; T_j = 105°C; f ≤ 100 kHz; t ≤100 s (10 million pulses)
Continuous current, drain source [1]	I_D	-	-	9.2	A	T_C=25°C; T_j = $T_{j,max}$
Pulsed current, drain source	$I_{D,pulse}$	-16	-	16	A	T_j=25°C; I_G=7.1 mA; See Diagram 3, 5
		-9.7		9.7		T_j=125°C; I_G=7.1 mA; See Diagram 4, 6
Gate current, continuous [2]	$I_{G,avg}$	-	-	5.3	mA	T_j=-55°C to T_j=150°C; See Table 9
Gate current, pulsed [2]	$I_{G,pulsed}$	-0.53	-	0.53	A	T_j=-55°C to T_j=150°C; t_{pulse}= 50 ns; f = 100 kHz; See Table 9
Gate source voltage, continuous [2]	V_{GS}	-10	-	-	V	T_j=-55°C to T_j=150°C; See Diagram 12
Gate source voltage, pulsed [2]	$V_{GS,pulse}$	-25	-	-	V	T_j=-55°C to T_j=150°C; t_{pulse}= 50 ns; f = 100 kHz; open drain
Power dissipation	P_{tot}	-	-	34	W	T_C=25°C
Operating junction temperature	T_j	-55	-	150	°C	-
Storage temperature	T_{stg}	-55	-	150	°C	Max shelf life depends on storage conditions
Drain-source voltage slew-rate	dv/dt	-	-	200	V/ns	-

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	3.7	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	163	°C/W	Device on PCB, minimum footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	74	°C/W	Device on 40 mm*40 mm*1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thickness) copper area for tab (source) connection and cooling. PCB is vertical without air stream cooling.
Soldering temperature	T_{sold}	-	-	260	°C	MSL3, wave & reflow soldering allowed

3 Electrical characteristics

at T_j=25°C, unless specified otherwise

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate threshold voltage	$V_{GS(th)}$	0.9	1.2	1.6	V	I_{DS}=0.71 mA; V_{DS}=10 V; T_j=25°C
		-	1	-		I_{DS}=0.71 mA; V_{DS}=10 V; T_j=150°C
Gate-Source reverse clamping voltage	$V_{GS,\ clamp}$	-	-	-8	V	I_{GS}=-1 mA
Drain-Source leakage current	I_{DSS}	-	0.27	27	µA	V_{DS}=650 V; V_{GS}=0 V; T_j=25°C
			5.4	-		V_{DS}=650 V; V_{GS}=0 V; T_j=150°C
Drain-Source on-state resistance	$R_{DS(on)}$	-	0.200	0.240	Ω	I_G=7.1 mA; I_D=2.1 A; T_j=25°C
			0.430	-		I_G=7.1 mA; I_D=2.1 A; T_j=150°C
Gate resistance	$R_{G,int}$	-	0.87	-	Ω	LCR impedance measurement; f=f_{res}, open drain;

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	91	-	pF	V_{GS}=0 V; V_{DS}=400 V; f=1 MHz
Output capacitance	C_{oss}		15			
Reverse transfer capacitance	C_{rss}		0.21			
Effective output capacitance, time related [3]	$C_{o(tr)}$	-	24	-	pF	V_{GS}=0 V; V_{DS}=0 to 400 V; I_D=const
Effective output capacitance, energy related [4]	$C_{o(er)}$	-	18	-	pF	V_{DS}=0 to 400 V
Output charge	Q_{oss}		9.6	-	nC	
Coss stored energy	E_{oss}		1.4	.	µJ	
Turn-on delay time	$t_{d(on)}$	-	7	-	ns	I_D= 2.1 A; R_{ON}=18 Ohm; R_{OFF}=18 Ohm; R_{SS}=1200 Ohm; C_C=0.82 nF; V_{DRV}=12 V; see Table 8
Turn-off delay time	$t_{d(off)}$		9			
Rise time	t_r		6			
Fall time	t_f		28			

[3] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400 V

[4] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400 V

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate charge	Q_G	-	1.26	-	nC	V_{GS}=0 to 3 V; V_{DS}=400 V; I_D=2.1 A

Table 7 Reverse conduction characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Source-Drain reverse voltage	V_{SD}	-	2.0	2.4	V	V_{GS}=0 V; I_{SD}=2.1 A
Pulsed current, reverse	$I_{SD,pulse}$	-	-	16	A	I_G=7.1 mA
Reverse recovery charge [5)]	Q_{rr}	-	0	-	nC	I_{SD}=2.1 A; V_{DS}=400 V

5) Excluding Qoss

4 Electrical characteristics diagrams

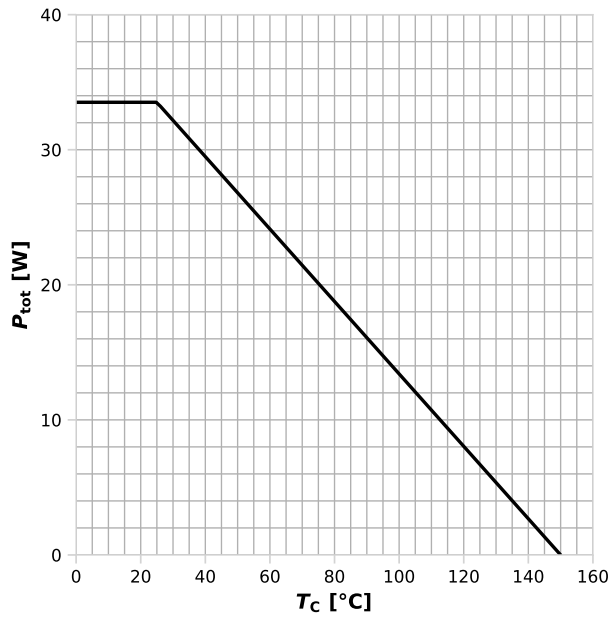
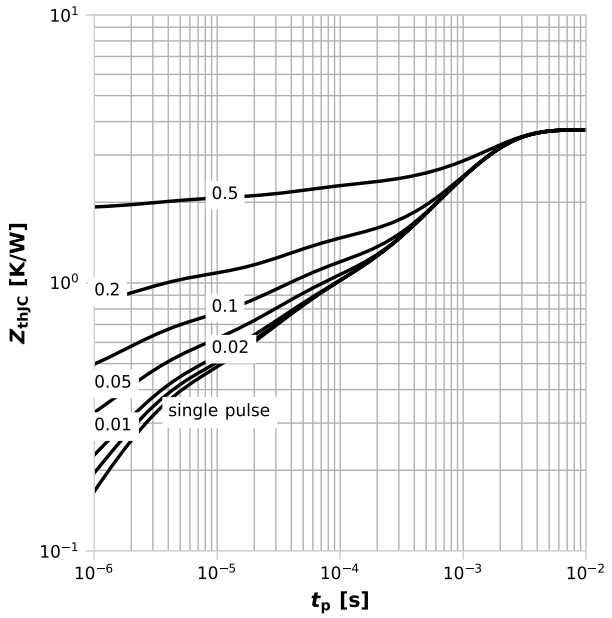
Diagram 1: Power dissipation	Diagram 2: Max. transient thermal impedance
	
$P_{tot}=f(T_C)$	$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

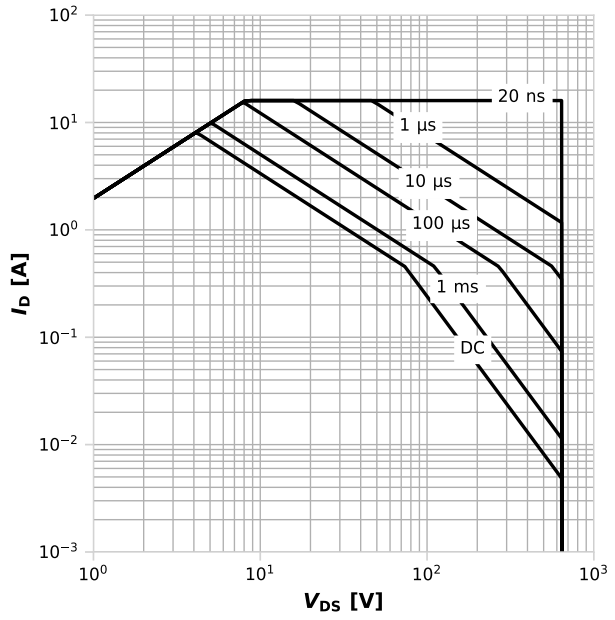
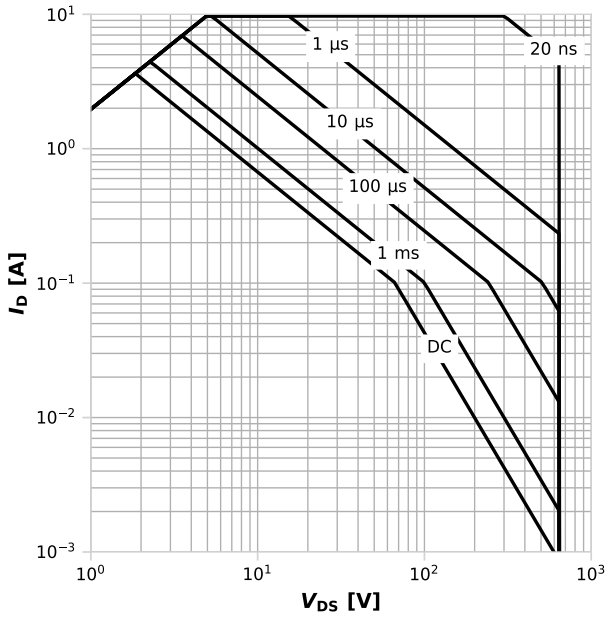
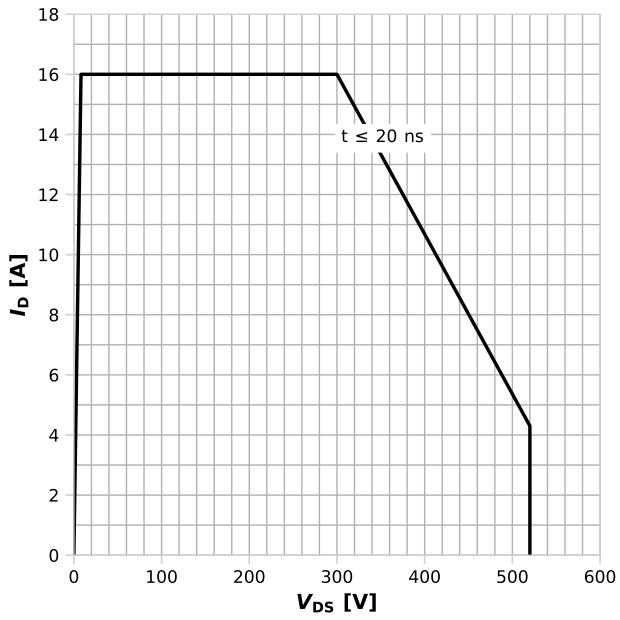
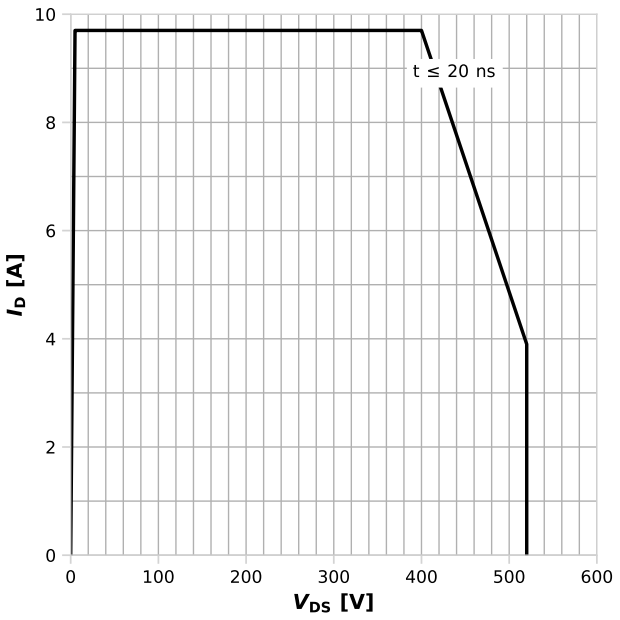
Diagram 3: Safe operating area	Diagram 4: Safe operating area
	
$I_D=f(V_{DS})$; $T_C=25°C$; $D=0$; parameter: t_p	$I_D=f(V_{DS})$; $T_C=125°C$; $D=0$; parameter: t_p

Diagram 5: Repetitive safe operating area



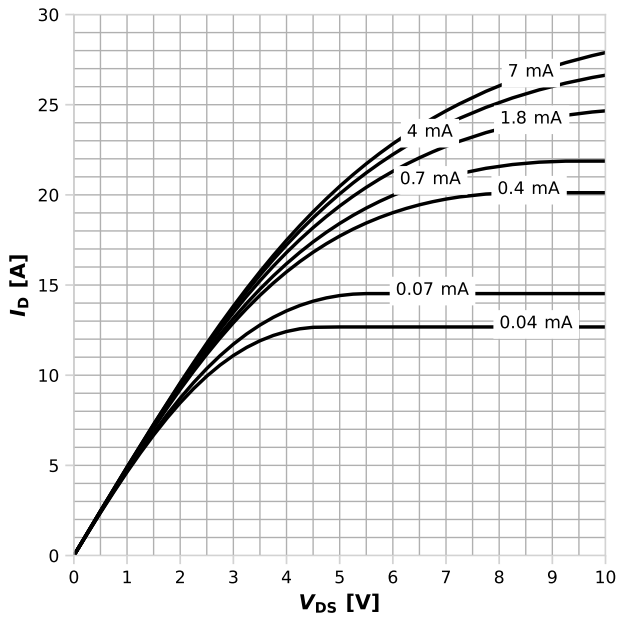
I_D=f(V_{DS}); T_C=25°C; T_j≤150°C; parameter: t_p

Diagram 6: Repetitive safe operating area



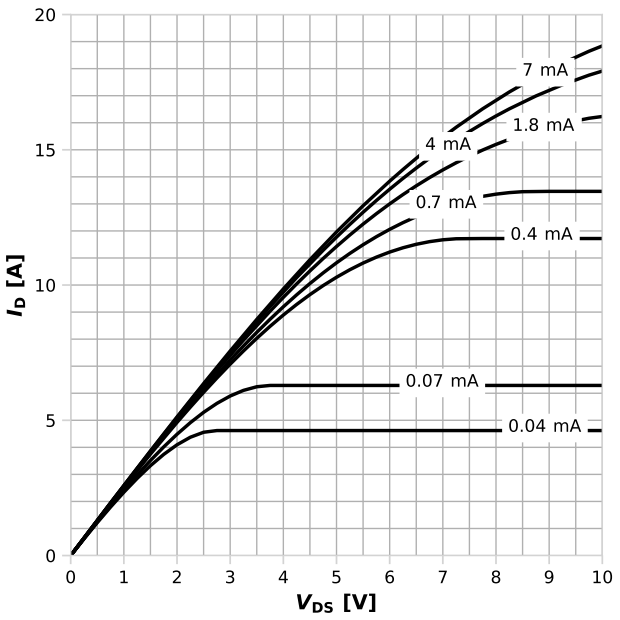
I_D=f(V_{DS}); T_C=125°C; T_j≤150°C; parameter: t_p

Diagram 7: Typ. output characteristics



I_D=f(V_{DS}); T_j=25°C; parameter: I_{GS}

Diagram 8: Typ. output characteristics



I_D=f(V_{DS}); T_j=125°C; parameter: I_{GS}

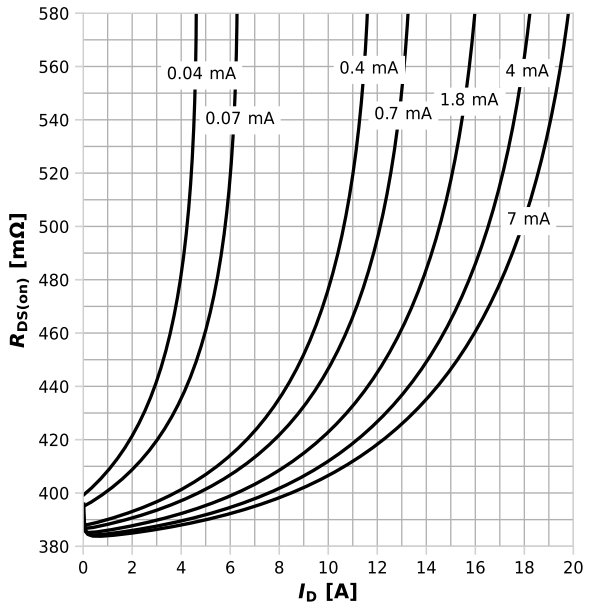
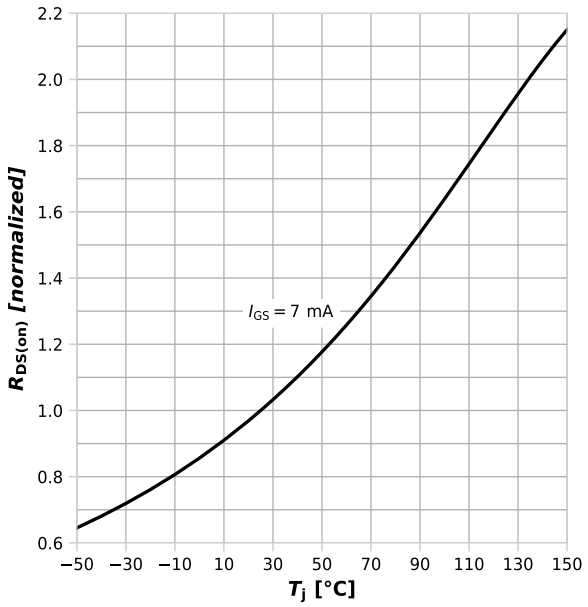
Diagram 9: Typ. Drain-source on-state resistance	Diagram 10: Drain-source on-state resistance
	
$R_{DS(on)}$=f(I_D); T_j=125°C; parameter: I_{GS}	$R_{DS(on)}$=f(T_j); I_D=2.1 A

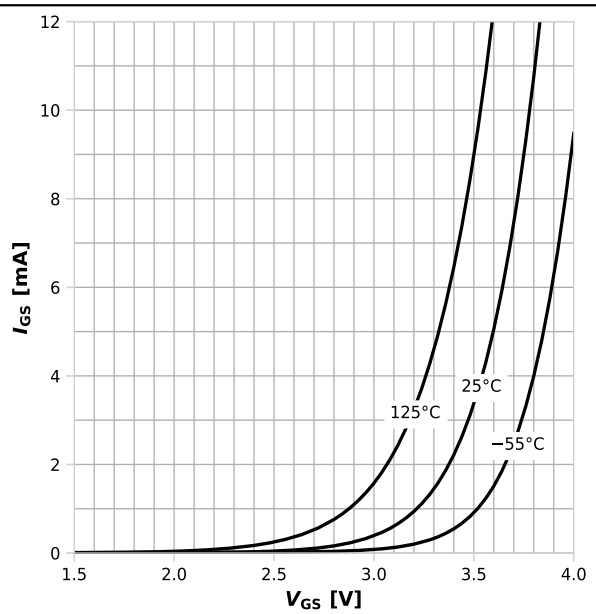
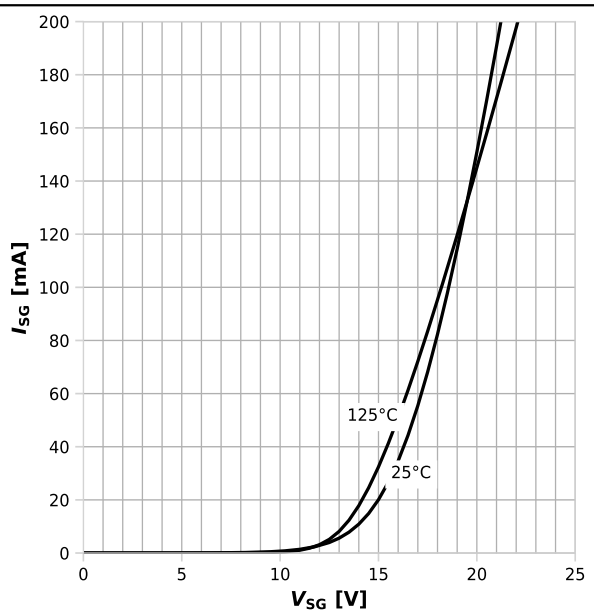
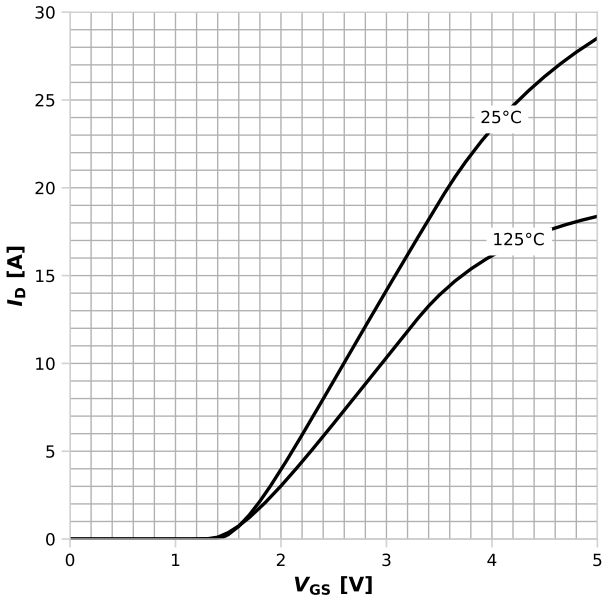
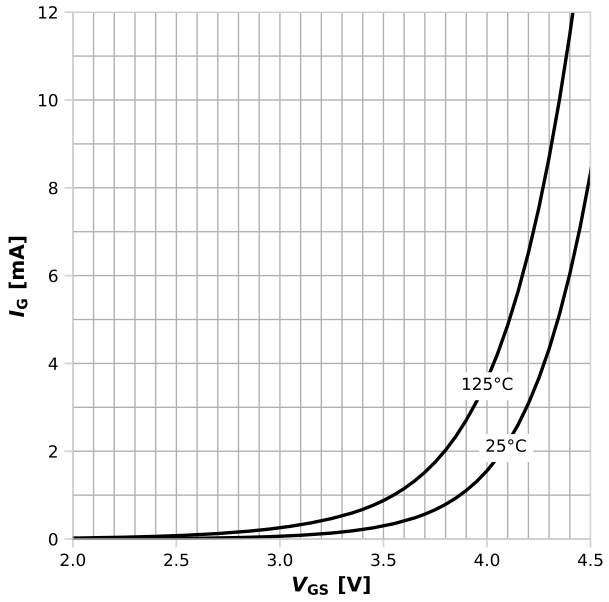
Diagram 11: Typ. gate characteristics forward	Diagram 12: Typ. gate characteristics reverse
	
I_{GS}=f(V_{GS}); open drain; parameter: T_j	I_{SG}=f(V_{SG}); parameter: T_j

Diagram 13: Typ. transfer characteristics



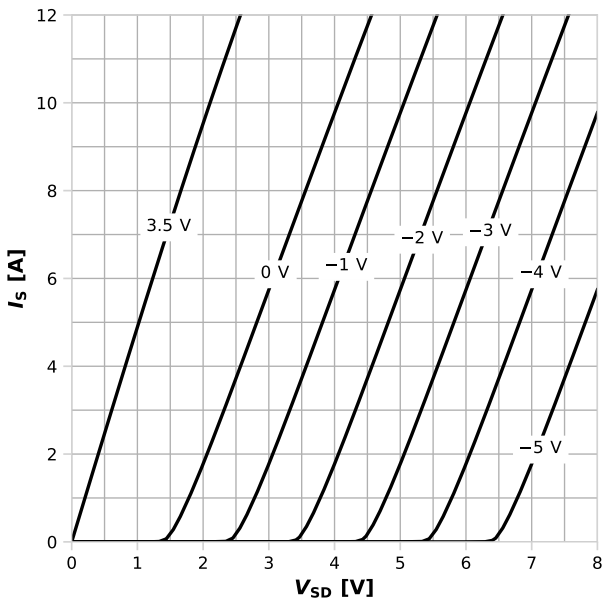
I_D=f(I_{GS}); V_{DS}=8V; parameter: T_j

Diagram 14: Typ. transfer gate current characteristic



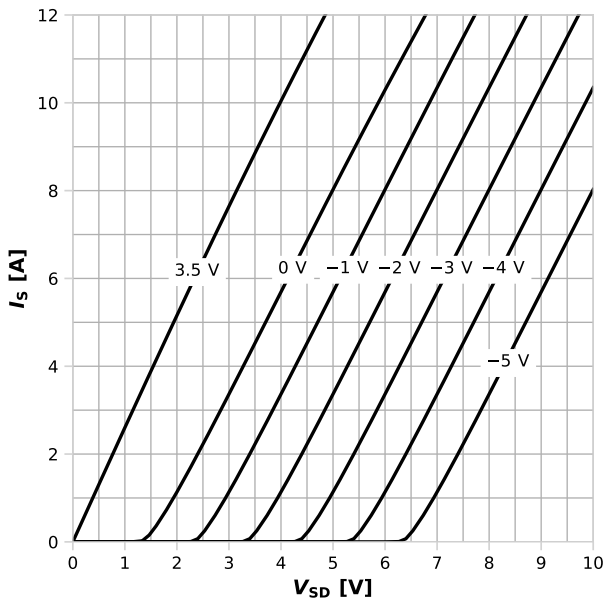
I_G=f(V_{GS}); V_{DS}=8V; parameter: T_j

Diagram 15: Typ. channel reverse characteristics



I_S=f(V_{SD}); T_j=25°C; parameter: V_{GS}

Diagram 16: Typ. channel reverse characteristics



I_S=f(V_{SD}); T_j=125°C; parameter: V_{GS}

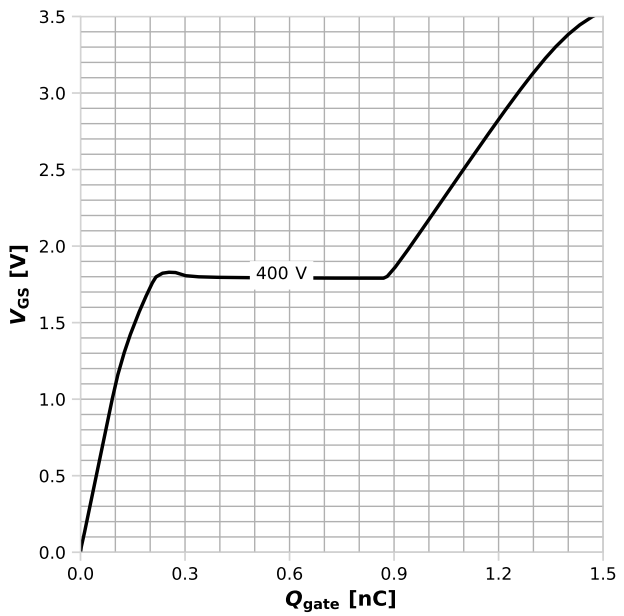
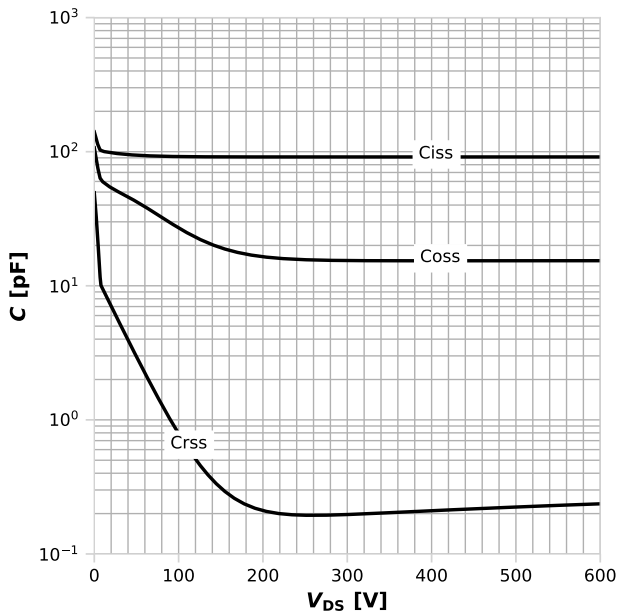
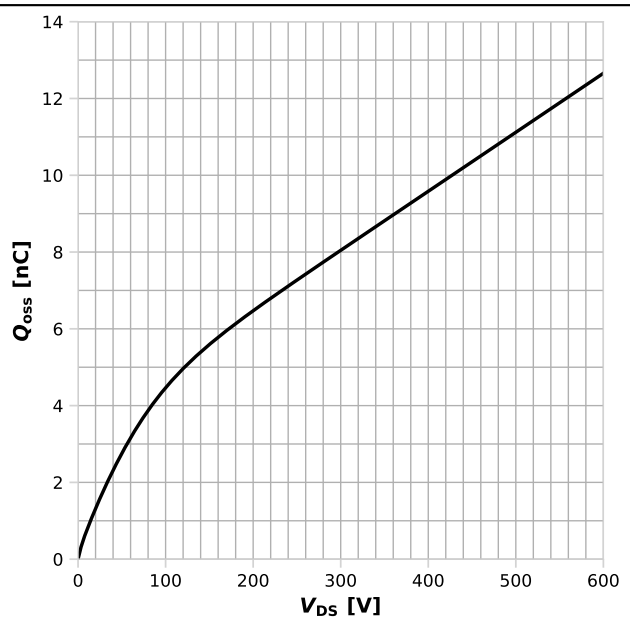
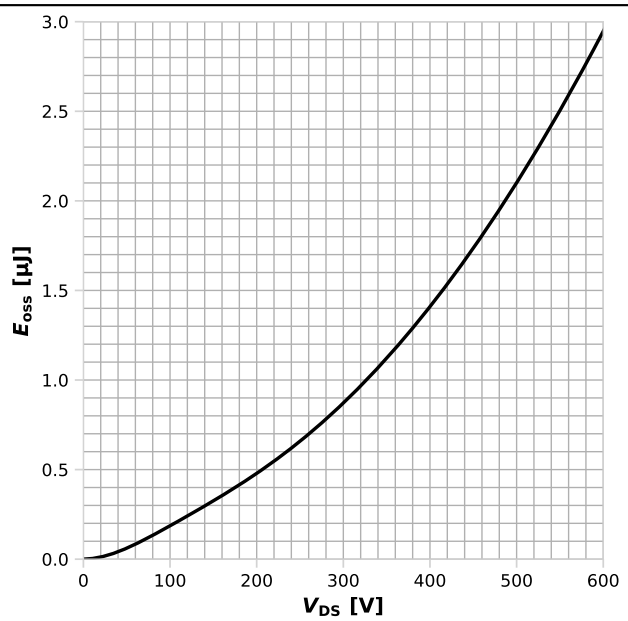
Diagram 17 Typ. gate charge	Diagram 18: Typ. capacitances
	
V_{GS}=f(Q_{gate}); I_D=2.1 A pulsed; I_G=4.5 mA; parameter: V_{DD}	C=f(V_{DS}); V_{GS}=0 V

Diagram 19: Typ. output charge	Diagram 20: Typ. Coss stored energy
	
Q_{oss}=f(V_{DS})	E_{oss}=f(V_{DS})

5 Test circuits

Table 8 Reverse channel characteristics test

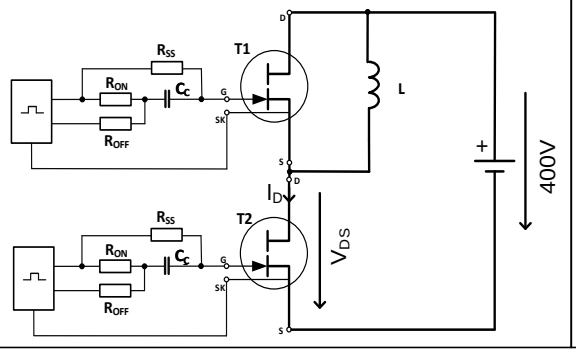
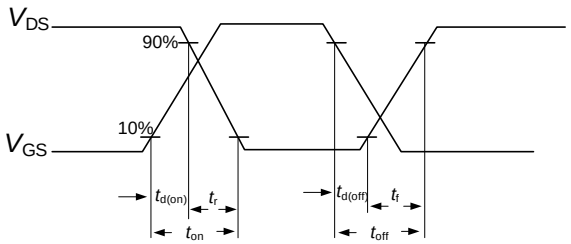
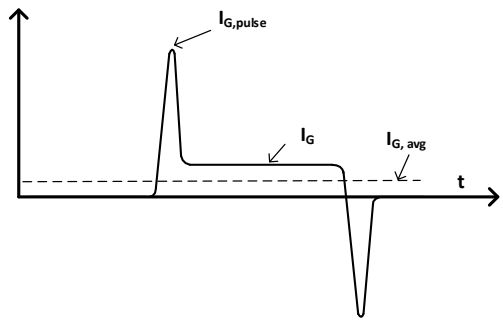
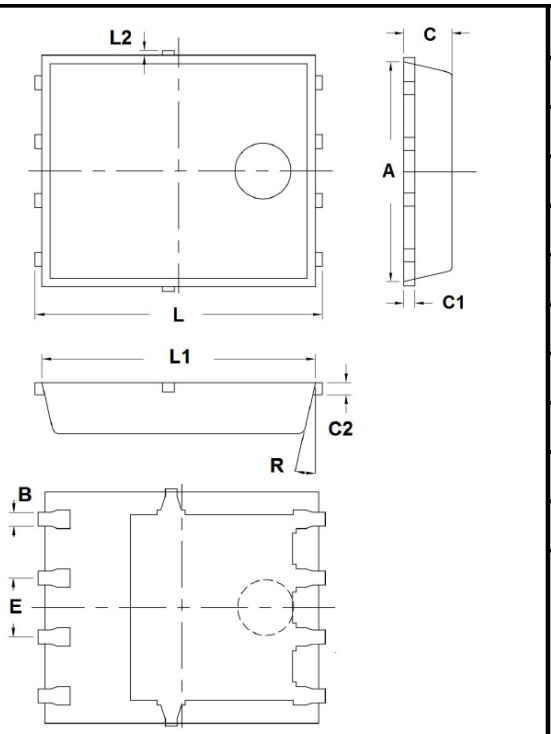
Switching times with inductive load	Switching times waveform
	

Table 9 Gate current switching waveform

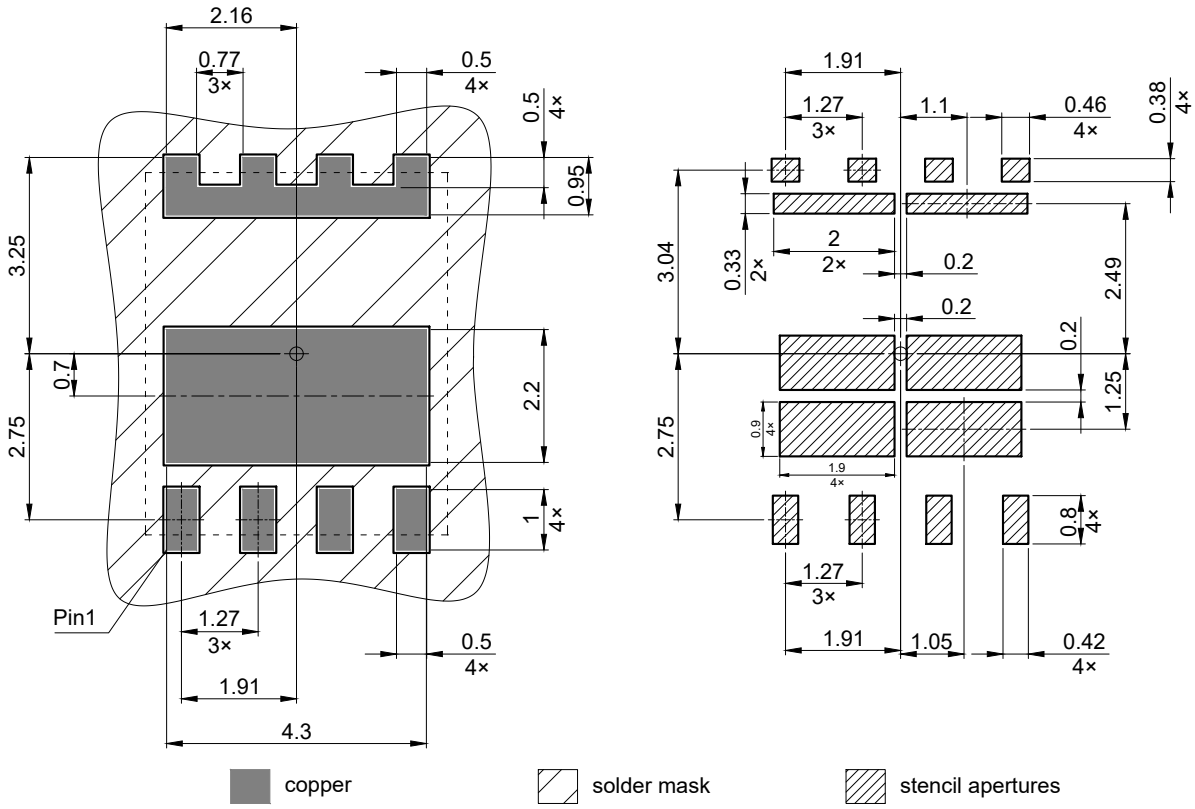
Gate current switching waveform


6 Package outlines



Dim.	Min.	Max.
A	4.8	5.2
B	0.25	0.35
C	1.0	1.2
C1	Typ 0.254	
C2	Typ 0.254	
E	Typ 1.27	
L	6.0	6.3
L1	5.7	6.0
L2	MAX 0.2	
R	Typ 13°	

All Dimensions in millimeter



All pads are non-solder mask defined
All dimensions are in units mm