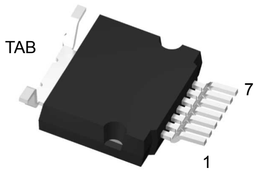
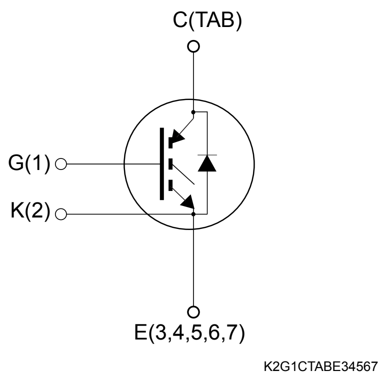
STGHU30M65DF2AG

Datasheet

Automotive-grade trench gate field-stop 650 V, 30 A low-loss M series IGBT in an HU3PAK package



HU3PAK



Product status link
STGHU30M65DF2AG

Product summary	
Order code	STGHU30M65DF2AG
Marking	G30M65DF2AG
Package	HU3PAK
Packing	Tape and reel

Features

- AEC-Q101 qualified
- Maximum junction temperature: T_J = 175 °C
- 6 µs of minimum short-circuit withstand time
- $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 30 A
- Tight parameter distribution
- Safer paralleling
- Low thermal resistance
- Soft and very fast-recovery antiparallel diode
- Excellent switching performance thanks to the extra driving kelvin pin

Applications

- Automotive motor control
- e-compressor
- Industrial motor control
- Power supplies and converters

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where the low-loss and the short-circuit functionality is essential. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and the tight parameter distribution result in safer paralleling operation.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	84	A
	Continuous collector current at T_C = 100 °C	57	
I_{CP} [(1)]	Pulsed collector current (t_p ≤ 1 µs)	120	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage (t_p ≤ 10 µs, D < 0.01)	±30	
I_F	Continuous forward current at T_C = 25 °C	69	A
	Continuous forward current at T_C = 100 °C	43	
I_{FP} [(1)]	Pulsed collector current (t_p ≤ 1 µs)	120	A
P_{TOT}	Total power dissipation at T_C = 25 °C	441	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Defined by R_{thJC} and limited by maximum junction temperature, not tested in production.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	0.34	°C/W
	Thermal resistance, junction-to-case, diode	0.82	
R_{thJA}	Thermal resistance, junction-to-ambient	30	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 250 µA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 30 A		1.60	2.0	V
		V_{GE} = 15 V, I_C = 30 A, T_J = 125 °C		1.84		
		V_{GE} = 15 V, I_C = 30 A, T_J = 175 °C		2.0		
V_F	Forward on-voltage	I_F = 30 A		1.86	2.65	V
		I_F = 30 A, T_J = 125 °C		1.6		
		I_F = 30 A, T_J = 175 °C		1.5		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 500 µA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 650 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	2393	-	pF
C_{oes}	Output capacitance		-	146	-	pF
C_{res}	Reverse transfer capacitance		-	45.4	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 30 A, V_{GE} = 0 to 15 V (see Figure 26. Gate charge test circuit)	-	90	-	nC
Q_{ge}	Gate-emitter charge		-	16.5	-	nC
Q_{gc}	Gate-collector charge		-	39	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 30 A, V_{GE} = 15 V, R_G = 10 Ω (see Figure 25. Test circuit for inductive load switching)		22	-	ns
t_r	Current rise time			10	-	ns
$di/dt_{(on)}$	Turn-on current slope			2350	-	A/μs
$t_{d(off)}$	Turn-off delay time			151	-	ns
t_f	Current fall time			152	-	ns
E_{on} (1)	Turn-on switching energy			210	-	μJ
E_{off} (2)	Turn-off switching energy			1147	-	μJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 30 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see Figure 25. Test circuit for inductive load switching)		165	-	ns
t_r	Current rise time			11	-	ns
$di/dt_{(on)}$	Turn-on current slope			2120	-	A/μs
$t_{d(off)}$	Turn-off delay time			165	-	ns
t_f	Current fall time			238	-	ns
E_{on} (1)	Turn-on switching energy			382	-	μJ
E_{off} (2)	Turn-off switching energy			1530	-	μJ
t_{sc}	Short-circuit withstand time	V_{CC} = 400 V, V_{GE} = 15 V, starting T_J ≤ 150 °C	6		-	μs

1. *Including the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

Table 6. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 30 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/μs (see Figure 25. Test circuit for inductive load switching)	-	223	-	ns
Q_{rr}	Reverse recovery charge		-	1.207	-	μC
I_{rrm}	Reverse recovery current		-	16	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	90	-	A/μs
E_{rr}	Reverse recovery energy		-	0.265	-	mJ
t_{rr}	Reverse recovery time	I_F = 30 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/μs, T_J = 175 °C (see Figure 25. Test circuit for inductive load switching)	-	325	-	ns
Q_{rr}	Reverse recovery charge		-	3.35	-	μC
I_{rrm}	Reverse recovery current		-	25	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	450	-	A/μs
E_{rr}	Reverse recovery energy		-	0.845	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs temperature

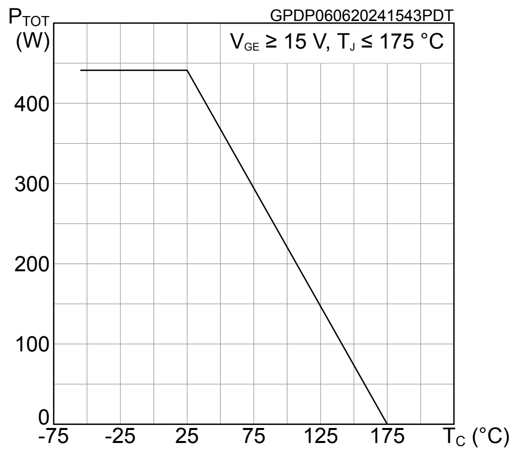


Figure 2. Collector current vs temperature

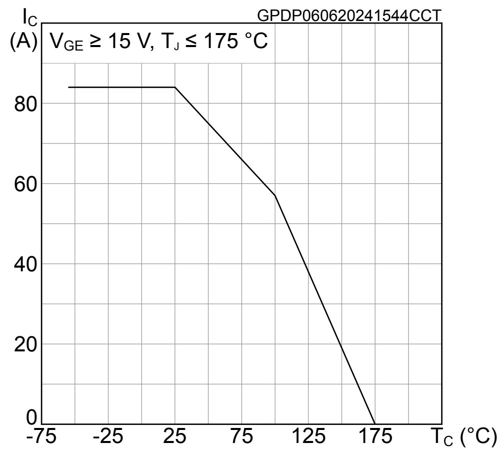


Figure 3. Typical output characteristics (T_J = 25 °C)

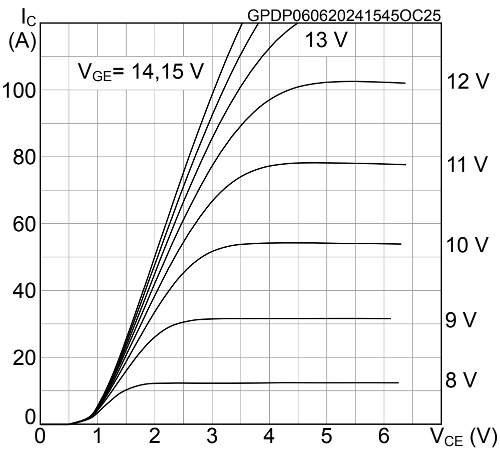


Figure 4. Typical output characteristics (T_J = 175 °C)

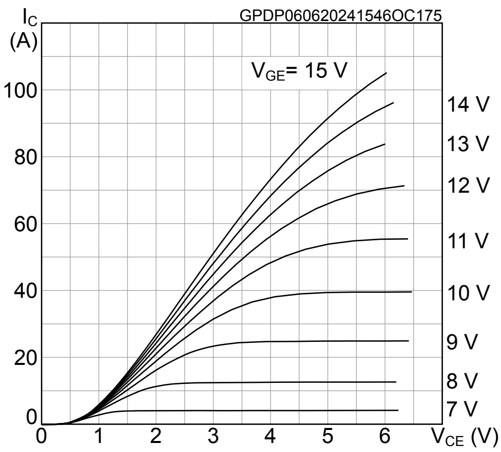


Figure 5. Typical transfer characteristics

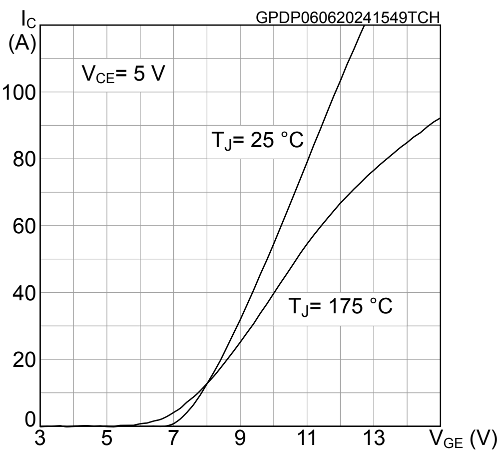


Figure 6. Typical $V_{CE(sat)}$ vs temperature

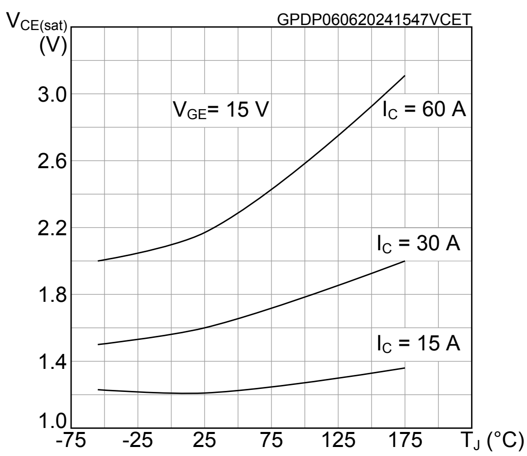


Figure 7. Typical $V_{CE(sat)}$ vs collector current

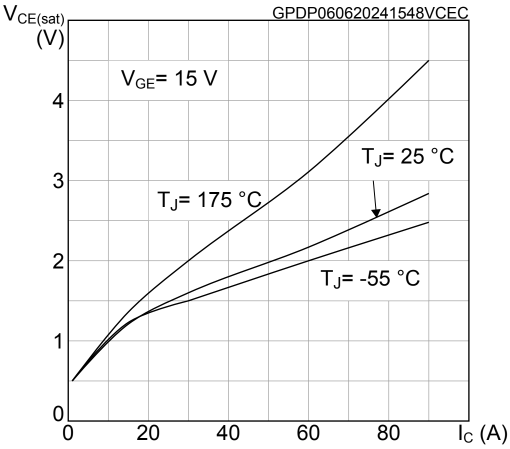


Figure 8. Forward bias safe operating area

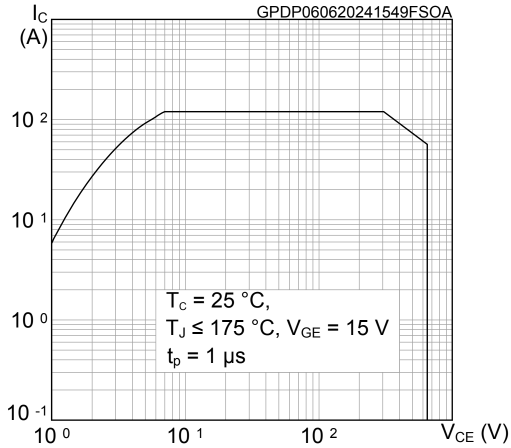


Figure 9. Diode typical forward characteristics

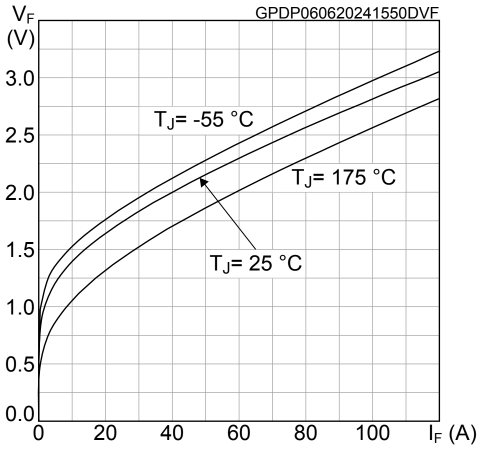


Figure 10. Normalized gate treshold vs temperature

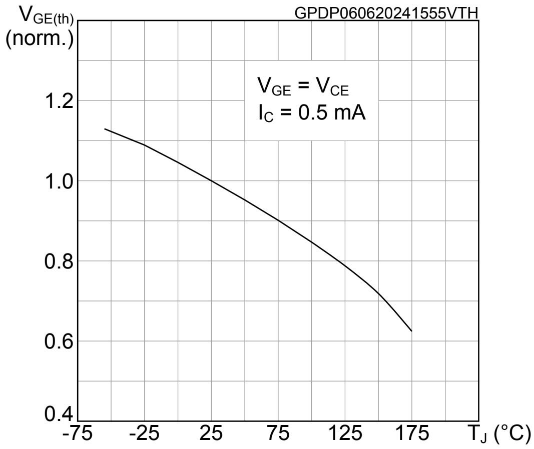


Figure 11. Typical capacitance characteristics

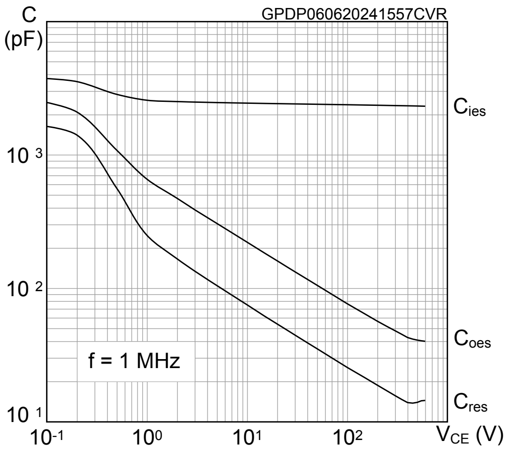


Figure 12. Typical gate charge characteristics

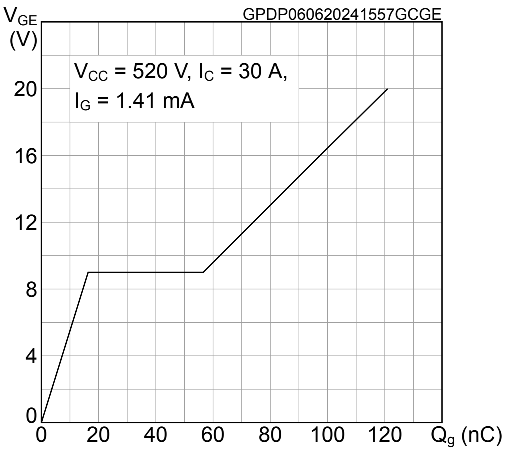


Figure 13. Typical switching energy vs collector current

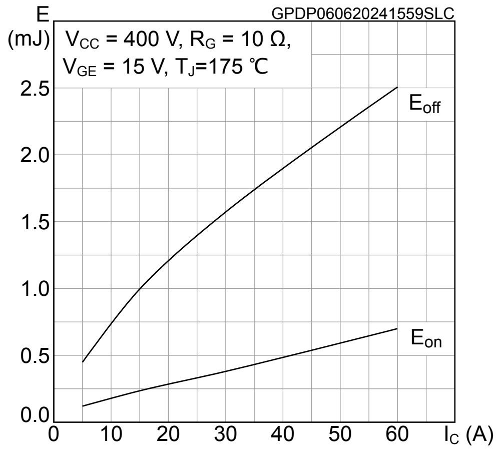


Figure 14. Typical switching energy vs temperature

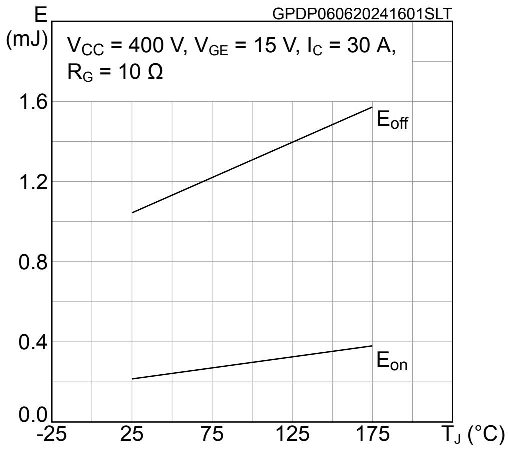


Figure 15. Typical switching energy vs supply voltage

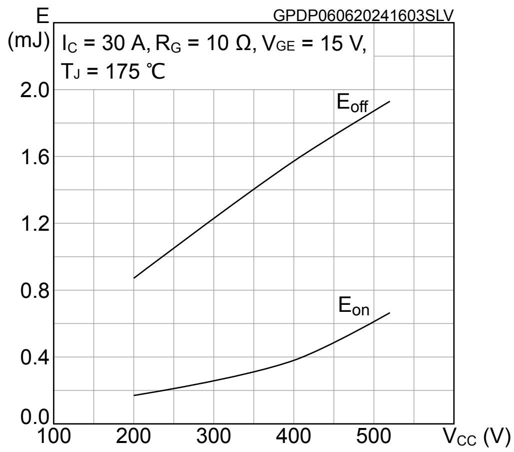


Figure 16. Typical switching energy vs gate resistance

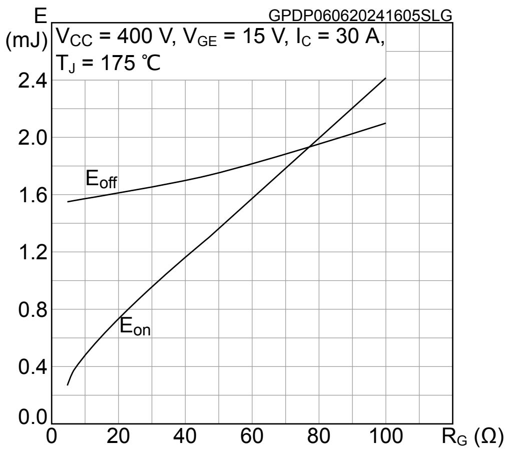


Figure 17. Typical switching times vs collector current

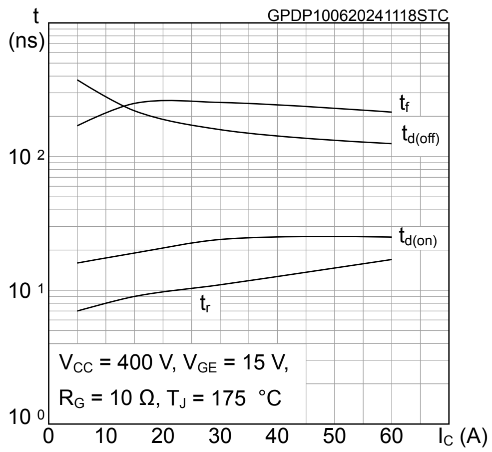


Figure 18. Typical switching times vs gate resistance

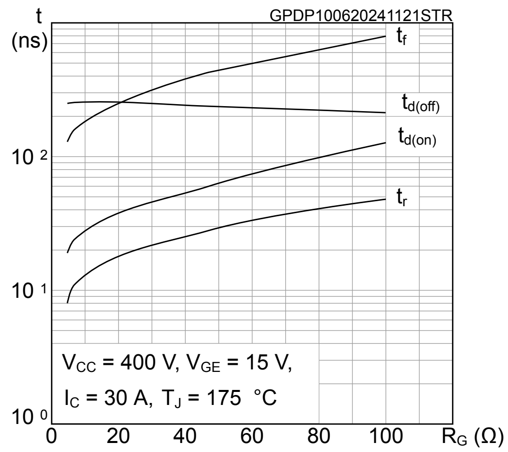


Figure 19. Typical reverse recovery current vs diode current slope

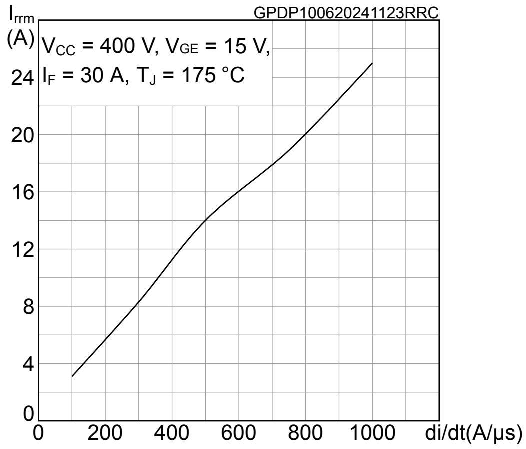


Figure 20. Typical reverse recovery time vs diode current slope

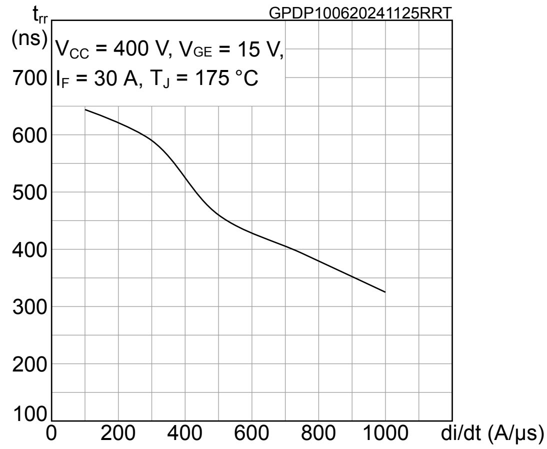


Figure 21. Typical reverse recovery charge vs diode current slope

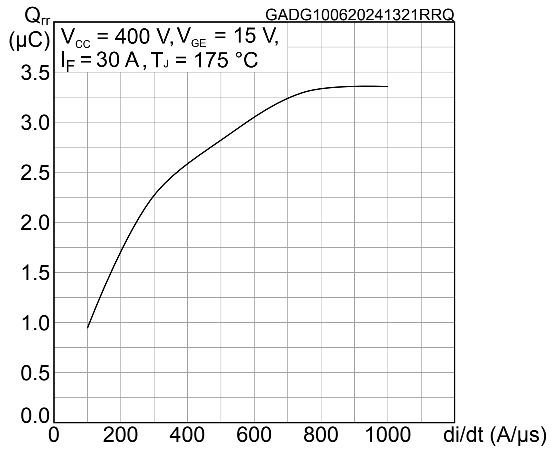


Figure 22. Typical reverse recovery energy vs diode current slope

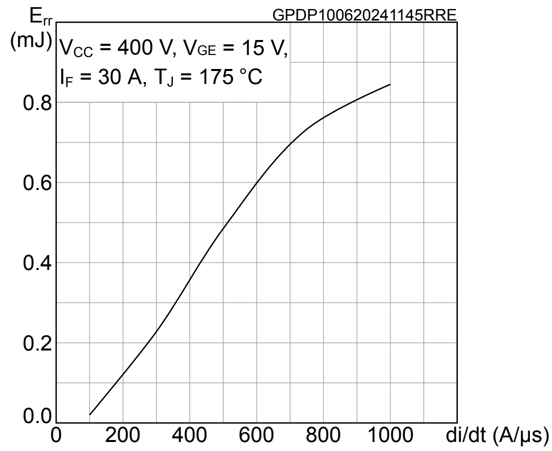


Figure 23. IGBT maximum transient thermal impedance

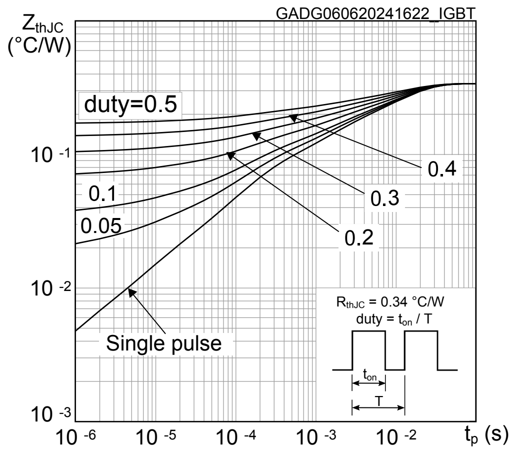
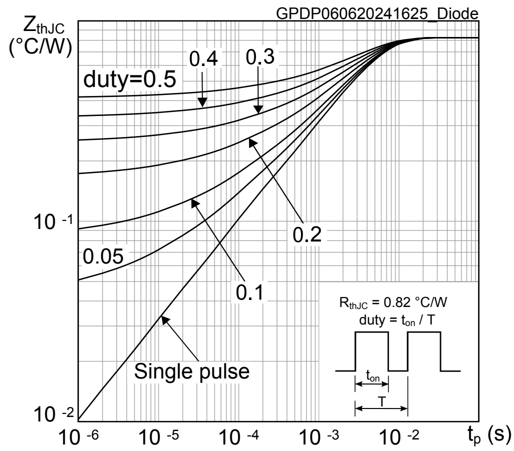


Figure 24. Diode maximum transient thermal impedance



3 Test circuits

Figure 25. Test circuit for inductive load switching

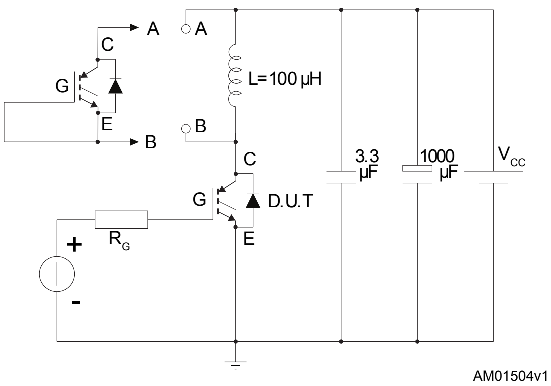


Figure 26. Gate charge test circuit

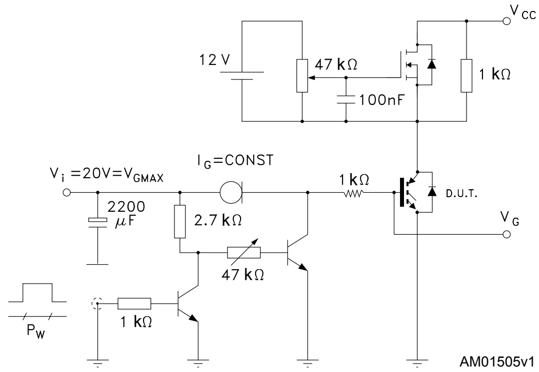


Figure 27. Switching waveform

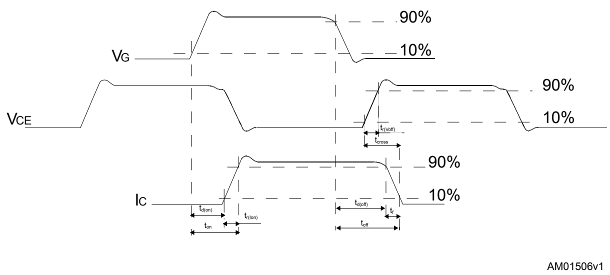
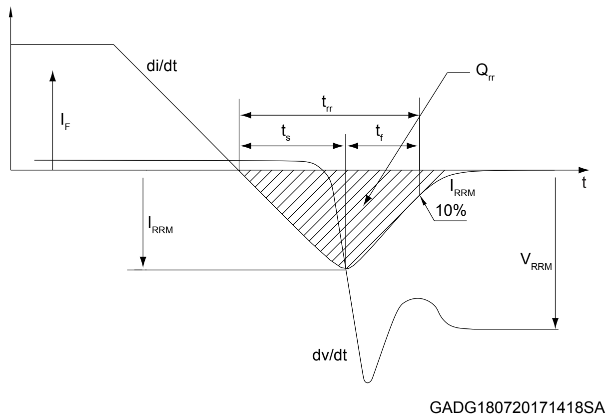


Figure 28. Diode reverse recovery waveform

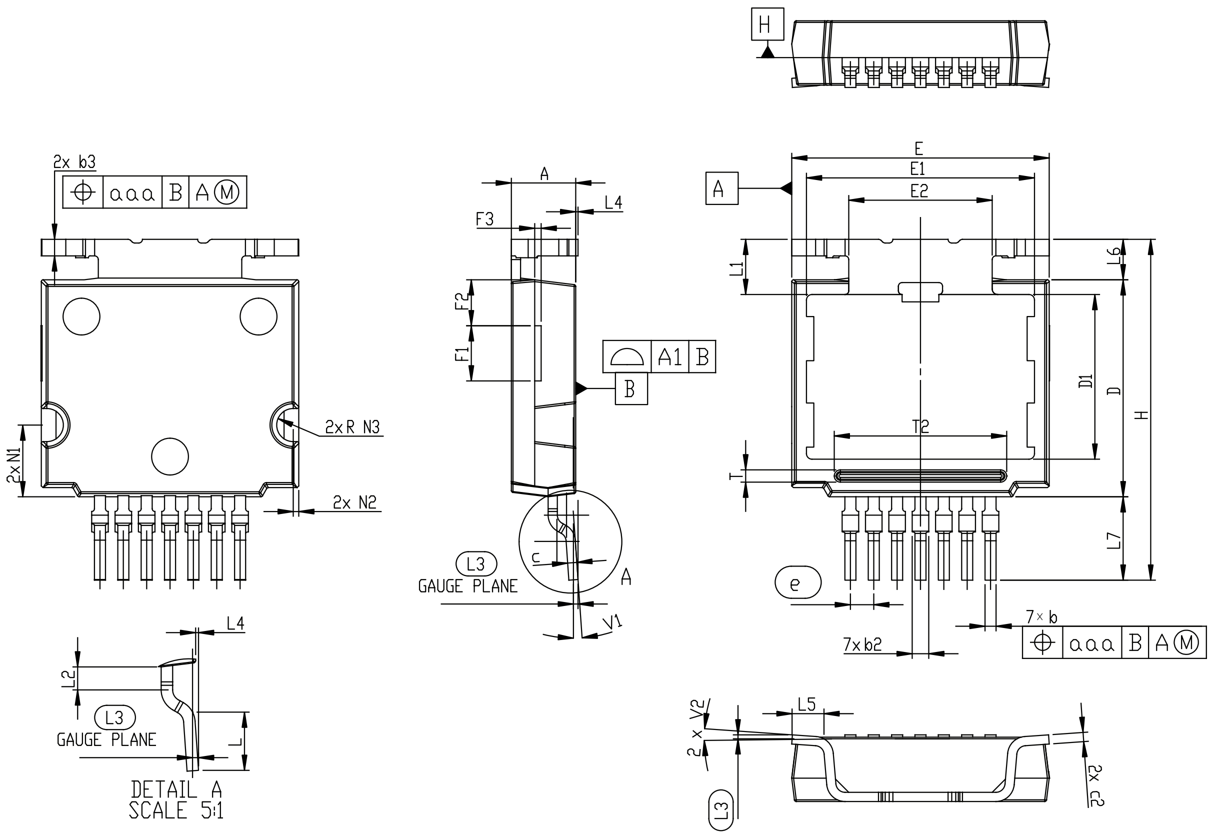


4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

4.1 HU3PAK package information

Figure 29. HU3PAK package outline

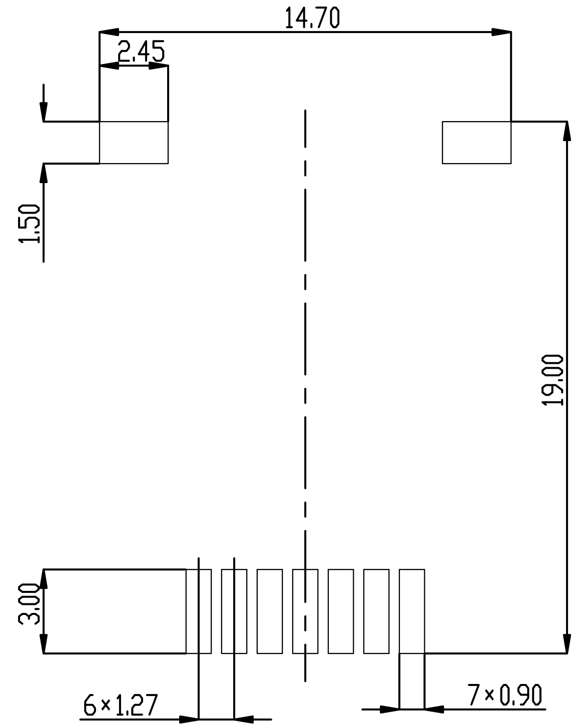


DM00674007_2

Table 7. HU3PAK package mechanical data

Ref.	Dimensions		
	mm		
	Min.	Typ.	Max.
A	3.40	3.50	3.60
A1		0.05	
b	0.50	0.60	0.70
b2	0.50	0.70	1.00
b3	0.80	0.90	1.00
c	0.40	0.50	0.60
c2	0.40	0.50	0.60
D	11.70	11.80	11.90
D1	8.80	8.955	9.10
E	13.90	14.00	14.10
E1	12.30	12.40	12.50
E2	7.75	7.80	7.85
e		1.27	
H	18.00	18.58	19.00
aaa		0.10	
L	2.40	2.52	2.60
L1		3.05	
L2	0.90	1.00	1.10
L3		0.26	
L4	0.075	0.125	0.175
L5	1.83	1.93	2.03
L6	2.14	2.24	2.34
L7	4.44	4.54	4.64
F1	2.90	3.00	3.10
F2	2.40	2.50	2.60
F3	0.25	0.35	0.45
N1	3.80	3.90	4.00
N2	0.25	0.30	0.45
N3	0.80	0.90	1.00
T	0.50	0.67	0.70
T2	9.18	9.38	9.43
V1		0 °	8 °
V2		0 °	8 °

Figure 30. HU3PAK recommended footprint (dimensions in mm)



4.2 HU3PAK packing information

Figure 31. HU3PAK carrier tape outline

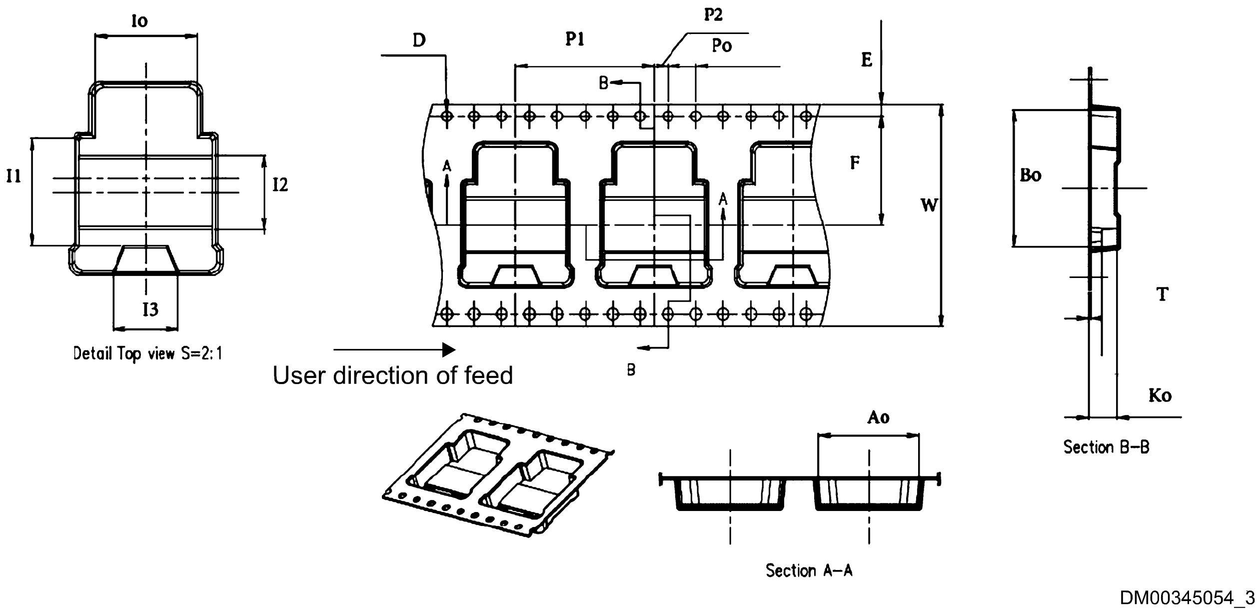
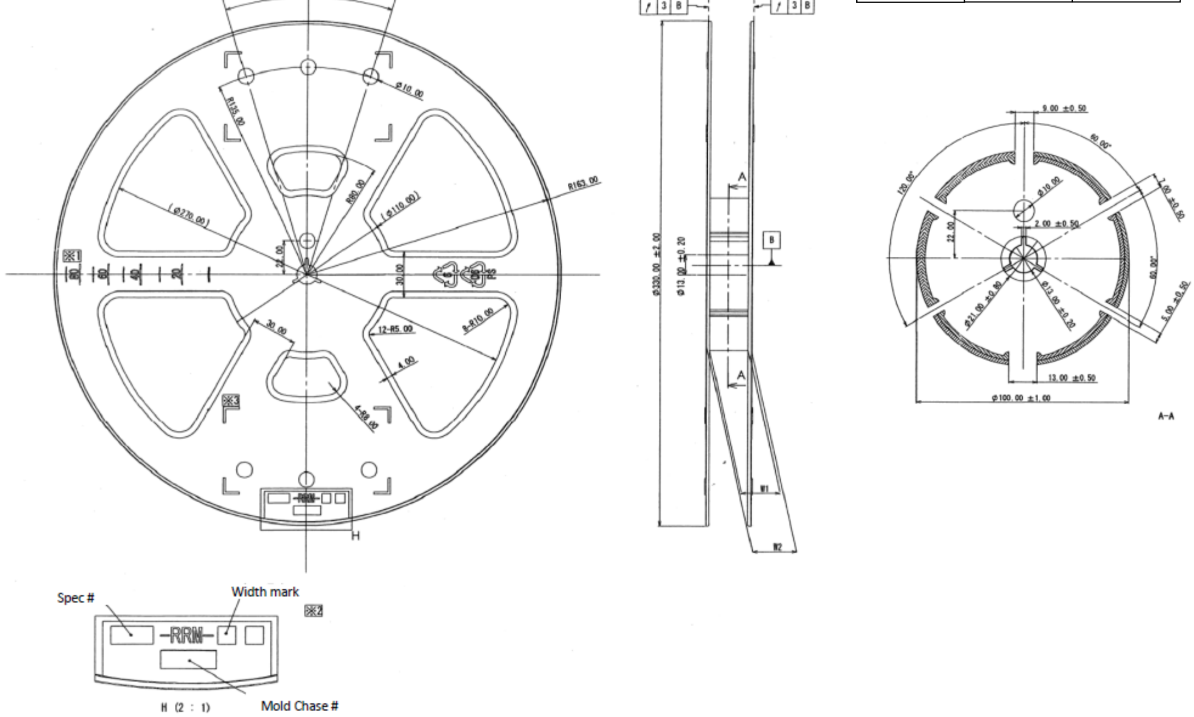


Table 8. HU3PAK tape mechanical data

Dimension	Value
	mm
A0	14.40 ±0.10
B0	19.70
D	1.50 ±0.10
E	1.75 ±0.10
F	15.65 ±0.10
I0	11.00
I1	11.60 ±0.10
I2	8.00
I3	7.00
K0	4.20
P0	4.00 ±0.10
P1	20.00 ±0.10
P2	2.00 ±0.10
T	0.40 ±0.50
W	32.00 ±0.30

Figure 32. HU3PAK reel outline (dimensions are in mm)

Reel width	Reel inner width	Reel outer width
32.0	33.4 ±1.0	37.4 ±1.0



DM00345054_3_reel

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
11-Jun-2024	1	First release.

Contents