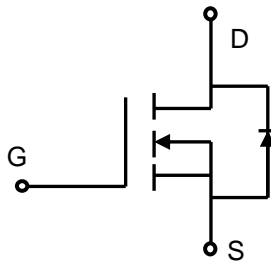# HCS65R070MD N-channel 650V, 47A   Power MOSFET

Description

Power MOSFET is fabricated using advanced super junction technology.   The resulting device has extremely low on resistance, making it especially suitable for applications which require superior power density and outstanding efficiency.

Features

◆ Ultra low $R_{DS(on)}$

◆ Ultra low gate charge (typ. Q_g = 87nC)

◆ 100% UIS tested

◆ RoHS compliant

Applications

◆ Power faction correction (PFC).

◆ Switched mode power supplies (SMPS).

◆ Uninterruptible power supply (UPS).

Product Summary

V_{DS} @ $T_{j,max}$	700V
$R_{DS(on),max}$	0.070Ω
I_{DM}	141A
$Q_{g,typ}$	87nC

TO-247

N-Channel MOSFET

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	650	V
Continuous drain current (T_C = 25°C)	I_D	47	A
(T_C = 100°C)		30	A
Pulsed drain current [1]	I_{DM}	141	A
Gate-Source voltage	V_{GSS}	±30	V
Avalanche energy, single pulse [2]	E_{AS}	1200	mJ
Power Dissipation TO-247 (T_C = 25°C)	P_D	290	W
- Derate above 25°C		2.32	W/°C
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	°C
Continuous diode forward current	I_S	47	A
Diode pulse current	$I_{S,pulse}$	141	A

Thermal Characteristics TO-247

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{θJC}$	0.43	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{θJA}$	60	°C/W
Soldering temperature, wavesoldering only allowed at leads. (1.6mm from case for 10s)	T_{sold}	260	°C

HCS65R070MD N-channel 650V, 47A Power MOSFET

Package Marking and Ordering Information

Device	Device Package	Marking	Units/Tube	Units/Real
HCS65R070MD	TO-247	HCS65R070MD	30	

Electrical Characteristics T_c = 25°C unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV_{DSS}	V_{GS}=0 V, I_D=0.25 mA	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=0.25mA	2	3	4	V
Drain cut-off current	I_{DSS}	V_{DS}=650 V, V_{GS}=0 V,				µA
		T_j = 25°C	-	-	1	
		T_j = 125°C	-	10	-	
Gate leakage current, Forward	I_{GSSF}	V_{GS}=30 V, V_{DS}=0 V	-	-	50	nA
Gate leakage current, Reverse	I_{GSSR}	V_{GS}=-30 V, V_{DS}=0 V	-	-	-50	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=23.5 A	-			
		T_j = 25°C	-	0.062	0.070	Ω
		T_j = 150°C	-	0.16	-	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V,	-	4677	-	
Output capacitance	C_{oss}	f = 1 MHz	-	2556	-	pF
Reverse transfer capacitance	C_{rss}		-	30	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 400V, I_D = 23.5A	-	28.3	-	
Rise time	t_r	R_G = 10Ω, V_{GS}=10V	-	12.9	-	ns
Turn-off delay time	$t_{d(off)}$		-	186.5	-	
Fall time	t_f		-	13.5	-	
Gate charge characteristics						
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=23.5A,	-	24	-	
Gate to drain charge	Q_{gd}	V_{GS}=0 to 10 V	-	31.24	-	nC
Gate charge total	Q_g		-	87	-	
Gate plateau voltage	$V_{plateau}$		-	5.5	-	V
Reverse diode characteristics						
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=23.5A	-	1.0	-	V
Reverse recovery time	t_{rr}	V_R=50 V, I_F=47A,	-	243.5	-	ns
Reverse recovery charge	Q_{rr}	dI_F/dt=100 A/µs	-	1.9	-	µC
Peak reverse recovery current	I_{rrm}		-	14.0	-	A

Notes:

1. Limited by maximum junction temperature, maximum duty cycle is 0.75.

2. I_{AS} = 8A, V_{DD} =60V, Starting T_j= 25°C.

Electrical Characteristics Diagrams

Figure 1. On-Region Characteristics

Common Source
T_c = 25°C
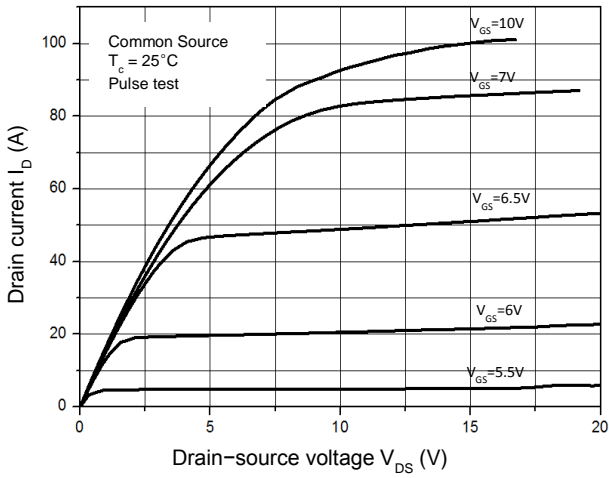Pulse test

V_{GS}=10V
V_{GS}=7V
V_{GS}=6.5V
V_{GS}=6V
V_{GS}=5.5V

Drain current I_D (A)

Drain−source voltage V_{DS} (V)

Figure 2. Transfer Characteristics

Common Source
T_c = 25°C
V_{DS}=20 V
Pulse test

Drain current I_D (A)

Gate−source voltage V_{GS} (V)
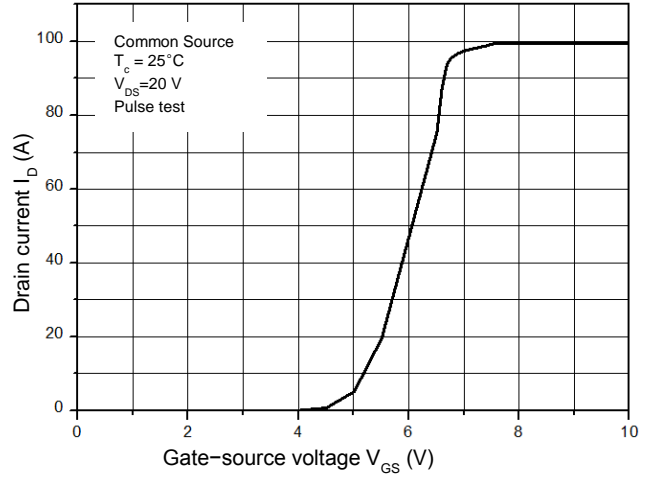
Figure 3. On-Resistance Variation vs. Drain Current

V_{GS} = 10V

T_c = 25°C
Pulse test

$R_{DS (on)}$ (Ω)

Drain current I_D (A)
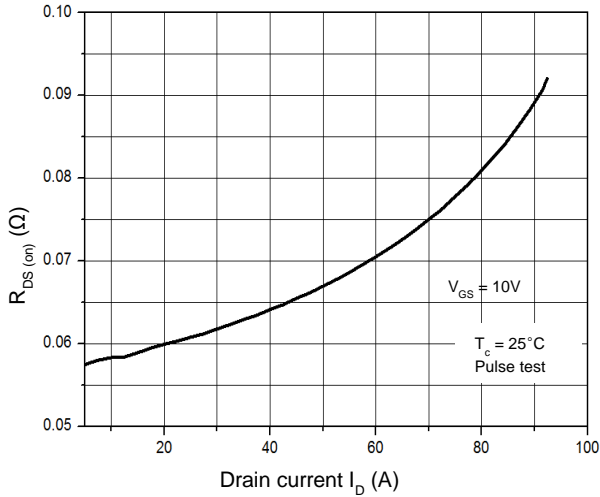
Figure 4. Threshold Voltage vs. Temperature

V_{th}, (Normalized)
Gate threshold voltage

I_{DS}=0.25 mA
Pulse test

Junction temperature T_j (°C)
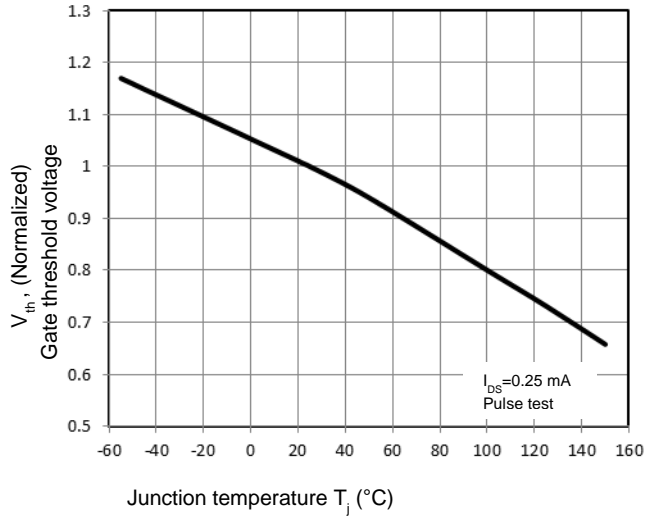
Figure 5. Breakdown Voltage vs. Temperature

BV_{DSS}, (Normalized)
Drain-Source Breakdown Voltage

V_{GS}=0 V
I_{DS}=0.25 mA
Pulse test

Junction temperature T_j (°C)
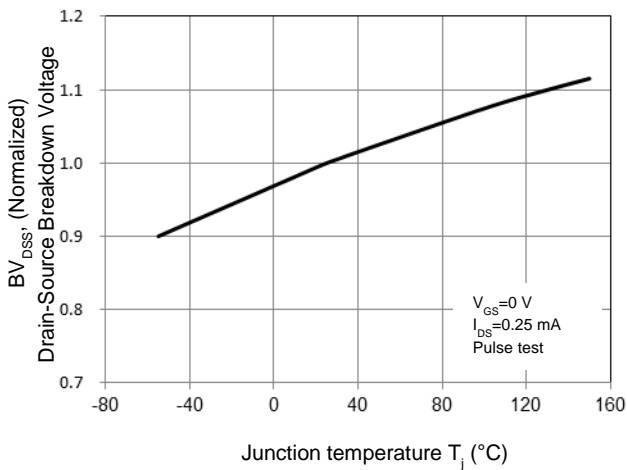
Figure 6. On-Resistance vs. Temperature

$R_{DS(on)}$, (Normalized)
Drain-Source On-Resistance

V_{GS}=10 V
I_{DS}=23.5 A
Pulse test

Junction temperature T_j (°C)
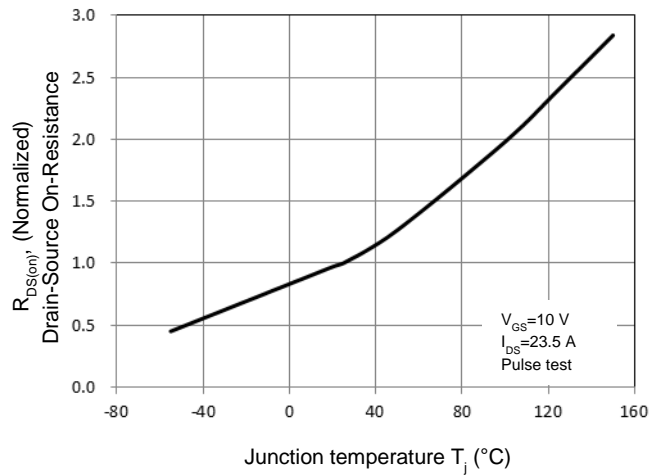
Figure 7. Capacitance Characteristics

$C_{iss} = C_{gs} + C_{gd}$ (C_{ds} = shorted)
$C_{oss} = C_{ds} + C_{gd}$
$C_{rss} = C_{gd}$

Notes:
f = 1 MHz
V_{GS} = 0 V
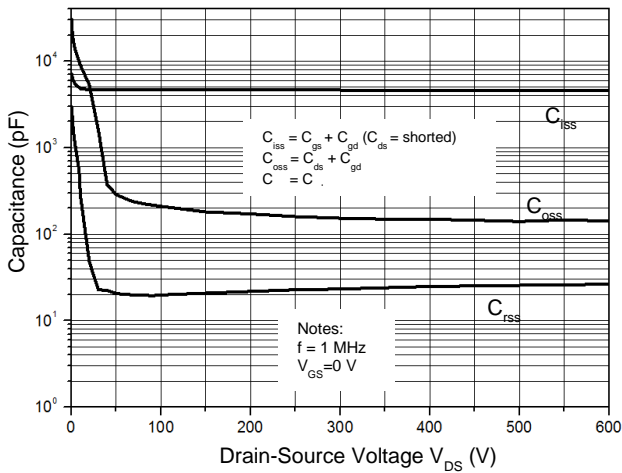
Figure 8. Gate Charge Characterist

I_D = 23.5 A
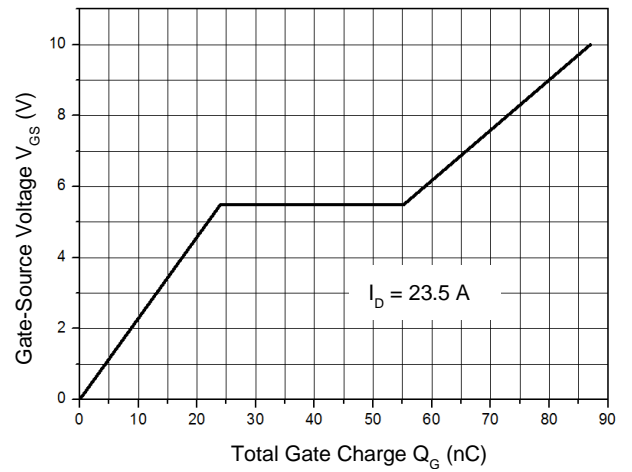
Figure 9. Maximum Safe Operating Area

Limited by $R_{DS(on)}$
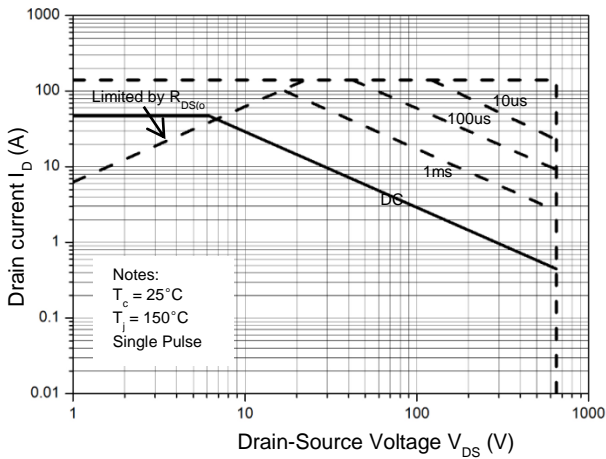
10us
100us
1ms
DC

Notes:
T_c = 25°C
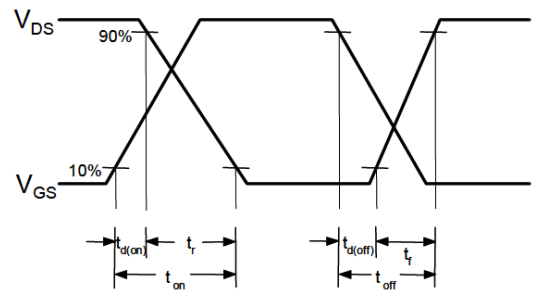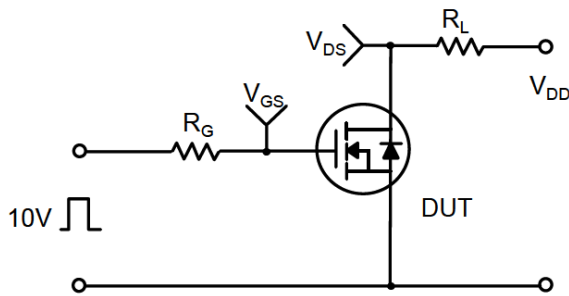T_j = 150°C
Single Pulse

Figure 10. Power Dissipation vs. Temperature
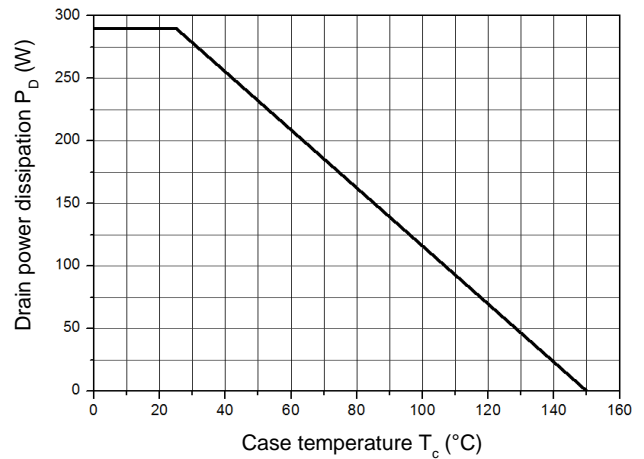
Figure 11. Transient Thermal Response Curve

In descending order
D= 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, single pulse

P_{DM}
t
Duty = t/T
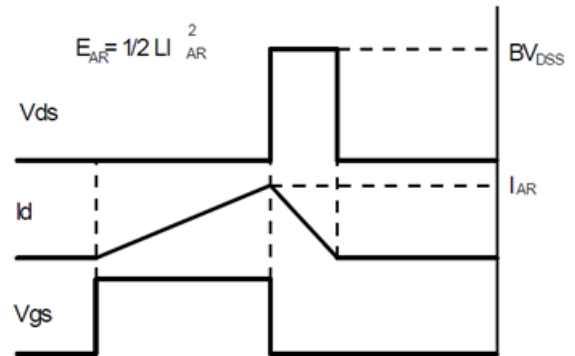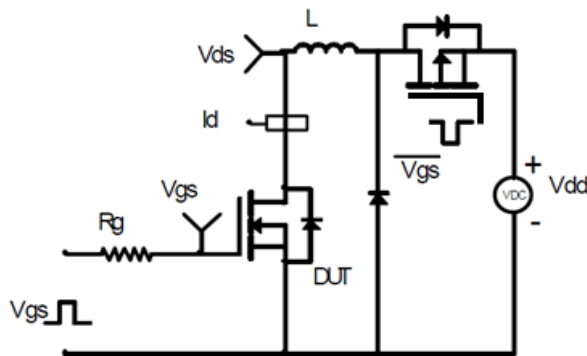Z   (t)=0.43°C/W Max.
T
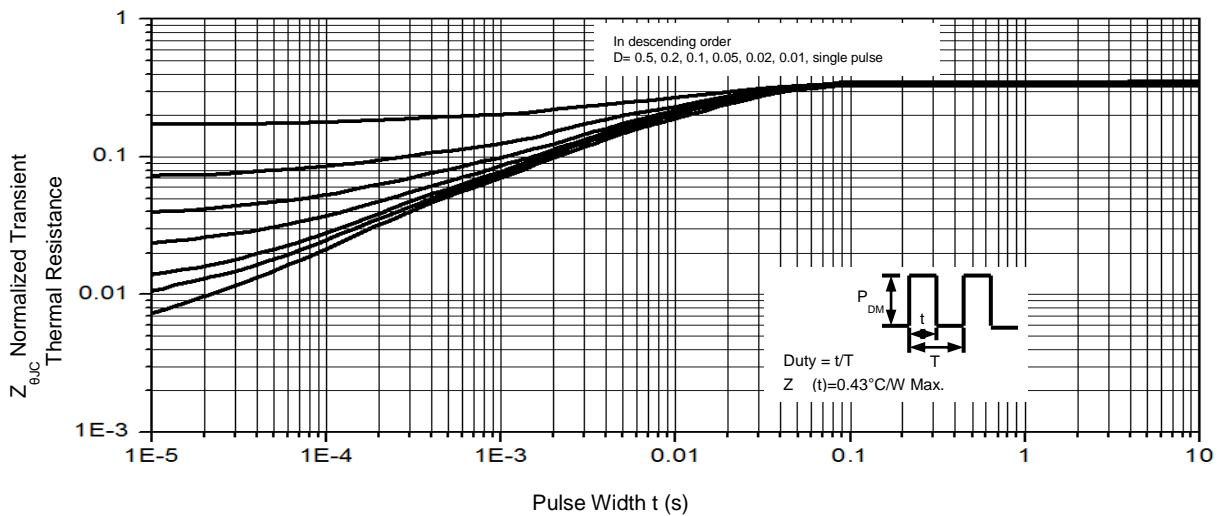
Gate Charge Test Circuit & Waveform
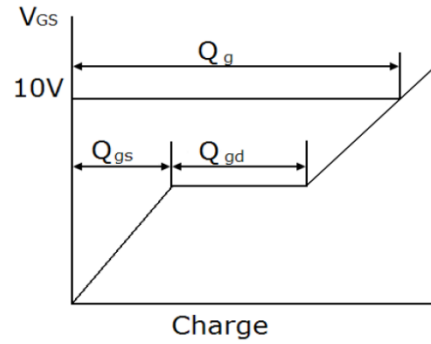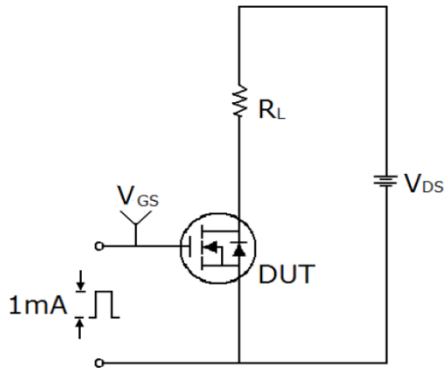
Unclamped Inductive Switching Test Circuit & Waveforms

Mechanical Dimensions for TO-247
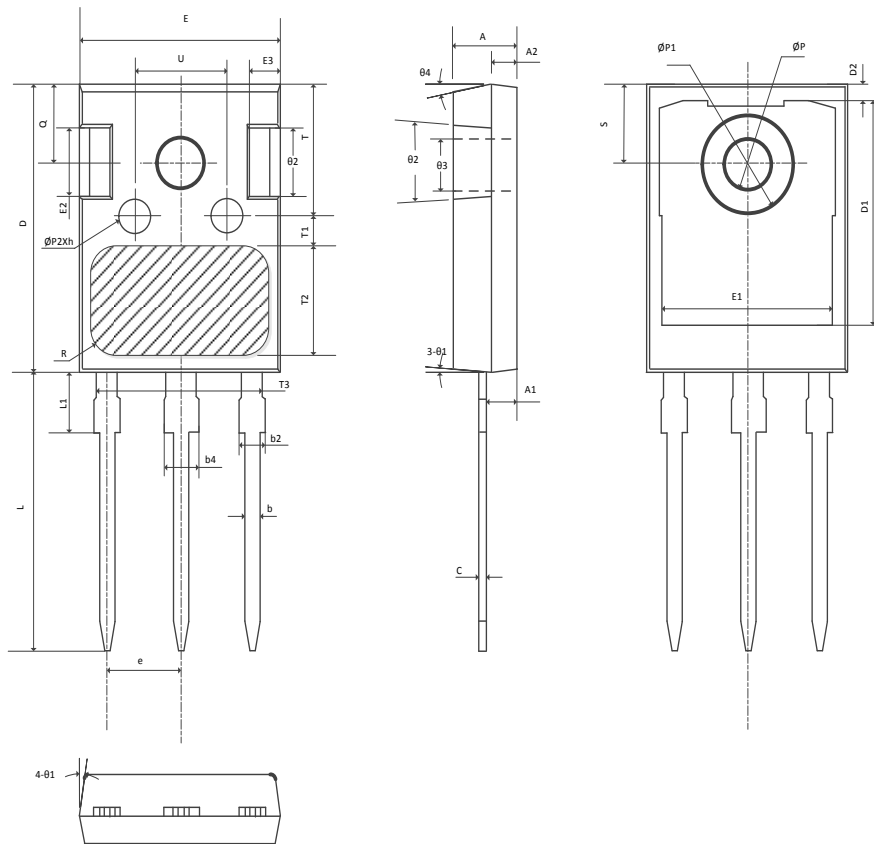
SYMBOL	mm		
	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16	1.21	1.26
b2	1.96	2.01	2.06
b4	2.96	3.01	3.06
c	0.59	0.61	0.66
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.44BSC		
h	0.05	0.10	0.15
L	19.80	19.92	20.10
L1	—	—	4.30
ØP	3.50	3.60	3.70
ØP1	—	—	7.30
ØP2	2.40	2.50	2.60
Q	5.60	5.80	6.00
S	6.15BSC		
R	0.50REF		
T	9.80	—	10.20
T1	1.65REF		
T2	8.00REF		
T3	12.80REF		
U	6.00	—	6.40
θ1	6°	7°	8°
θ2	4°	5°	6°
θ3	1°	—	1.5°
θ4	14°	15°	16°