



IPD60N10S4-12

OptiMOS™-T2 Power-Transistor



Product Summary

V_{DS}	100	V
$R_{DS(on),max}$	12.2	mΩ
I_D	60	A

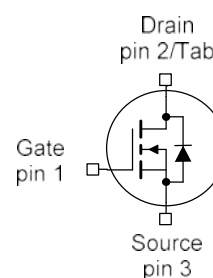
Features

- N-channel - Normal Level - Enhancement mode
- AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- RoHS compliant
- 100% Avalanche tested

PG-TO252-3-313



Type	Package	Marking
IPD60N10S4-12	PG-TO252-3-	4N1012



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25\text{ °C}$, $V_{GS}=10\text{ V}$	60	A
		$T_C=100\text{ °C}$, $V_{GS}=10\text{ V}^{1)}$	43	
Pulsed drain current ¹⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	240	
Avalanche energy, single pulse ¹⁾	E_{AS}	$I_D=30\text{ A}$	120	mJ
Avalanche current, single pulse	I_{AS}	-	40	A
Gate source voltage	V_{GS}	-	±20	V
Power dissipation	P_{tot}	$T_C=25\text{ °C}$	94	W
Operating and storage temperature	T_j, T_{stg}	-	-55 ... +175	°C

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics¹⁾

Thermal resistance, junction - case	R_{thJC}	-	-	-	1.6	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	-	62	
SMD version, device on PCB	R_{thJA}	minimal footprint	-	-	62	
		6 cm ² cooling area ²⁾	-	-	40	

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

Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=1mA$	100	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=46\mu A$	2.0	2.7	3.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=100V, V_{GS}=0V$	-	0.01	1	μA
		$V_{DS}=100V, V_{GS}=0V, T_j=125\text{ °C}^{2)}$	-	1	100	
Gate-source leakage current	I_{GSS}	$V_{GS}=20V, V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=60A$	-	10.4	12.2	m Ω



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Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics¹⁾

Input capacitance	C_{iss}	$V_{GS}=0V, V_{DS}=25V,$ $f=1MHz$	-	1900	2470	pF
Output capacitance	C_{oss}		-	600	900	
Reverse transfer capacitance	C_{rss}		-	40	80	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=50V, V_{GS}=10V,$ $I_D=60A, R_G=3.5\Omega$	-	6	-	ns
Rise time	t_r		-	3	-	
Turn-off delay time	$t_{d(off)}$		-	9	-	
Fall time	t_f		-	13	-	

Gate Charge Characteristics¹⁾

Gate to source charge	Q_{gs}	$V_{DD}=80V, I_D=60A,$ $V_{GS}=0 \text{ to } 10V$	-	10	13	nC
Gate to drain charge	Q_{gd}		-	5	10	
Gate charge total	Q_g		-	26	34	
Gate plateau voltage	$V_{plateau}$		-	5.1	-	V

Reverse Diode

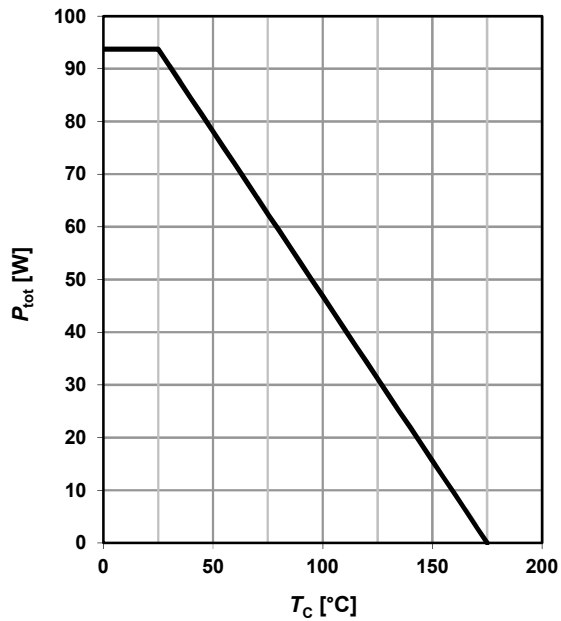
Diode continuous forward current ¹⁾	I_S	$T_C=25^\circ C$	-	-	60	A
Diode pulse current ¹⁾	$I_{S,pulse}$		-	-	240	
Diode forward voltage	V_{SD}	$V_{GS}=0V, I_F=60A,$ $T_J=25^\circ C$	-	1.0	1.3	V
Reverse recovery time ¹⁾	t_{rr}	$V_R=50V, I_F=50A,$ $di_F/dt=100A/\mu s$	-	60	-	ns
Reverse recovery charge ¹⁾	Q_{rr}		-	110	-	nC

¹⁾ Defined by design. Not subject to production test.

²⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

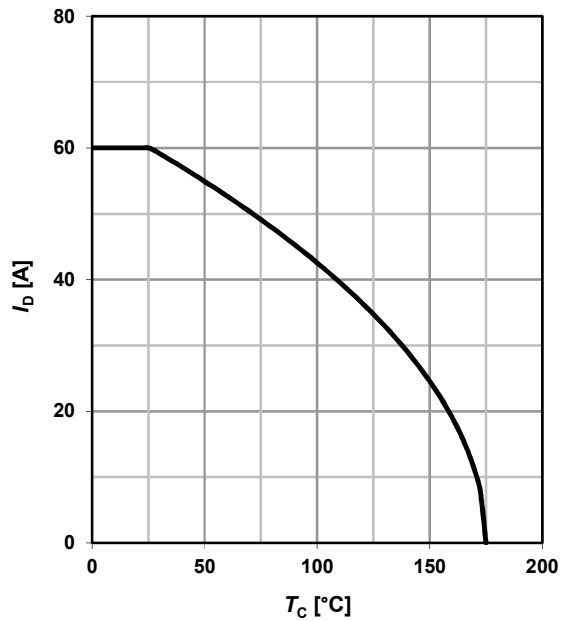
1 Power dissipation

$$P_{\text{tot}} = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



2 Drain current

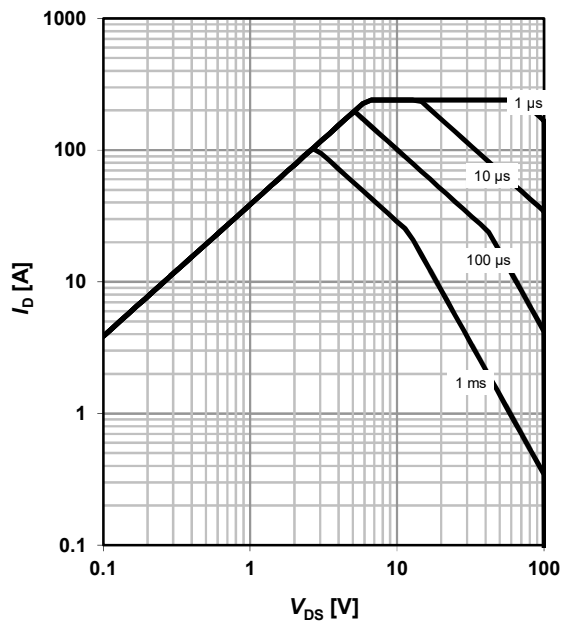
$$I_D = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



3 Safe operating area

$$I_D = f(V_{\text{DS}}); T_C = 25^\circ\text{C}; D = 0$$

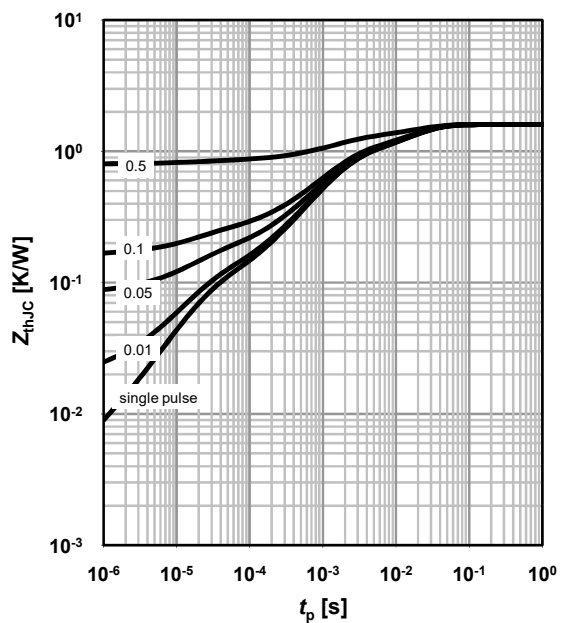
parameter: t_p



4 Max. transient thermal impedance

$$Z_{\text{thJC}} = f(t_p)$$

parameter: $D = t_p/T$

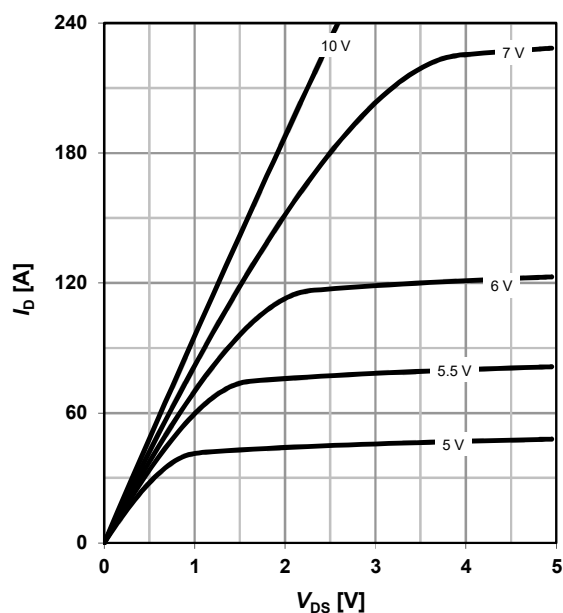




5 Typ. output characteristics

$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$

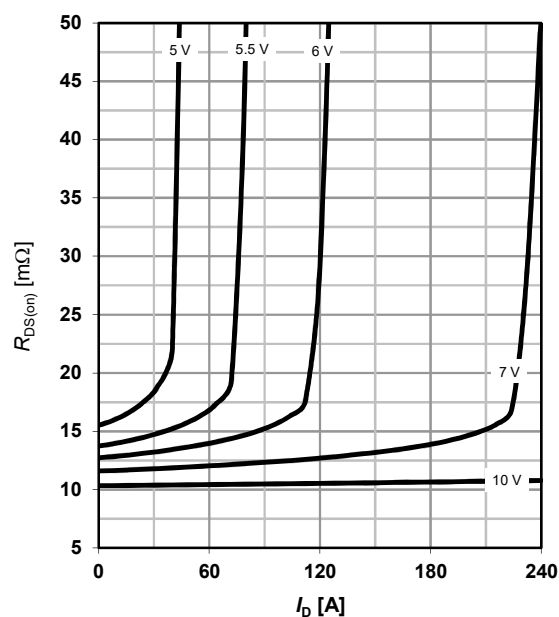
parameter: V_{GS}



6 Typ. drain-source on-state resistance

$R_{DS(on)} = f(I_D); T_j = 25^\circ\text{C}$

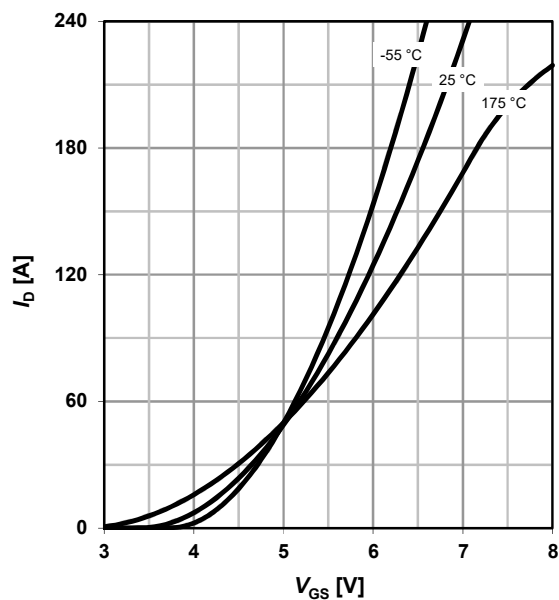
parameter: V_{GS}



7 Typ. transfer characteristics

$I_D = f(V_{GS}); V_{DS} = 6\text{V}$

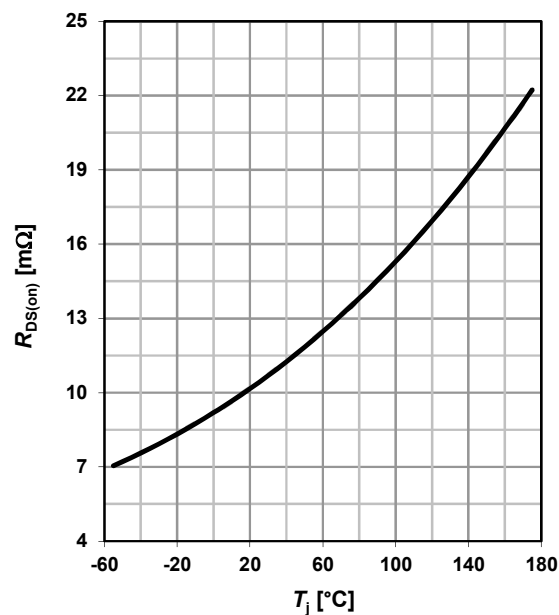
parameter: T_j



8 Typ. drain-source on-state resistance

$R_{DS(on)} = f(T_j); I_D = 60\text{ A}; V_{GS} = 10\text{ V}$

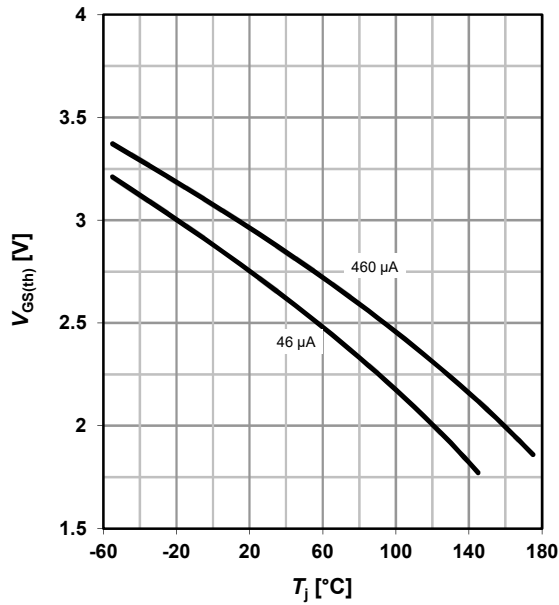
$\alpha = 0.4$



9 Typ. gate threshold voltage

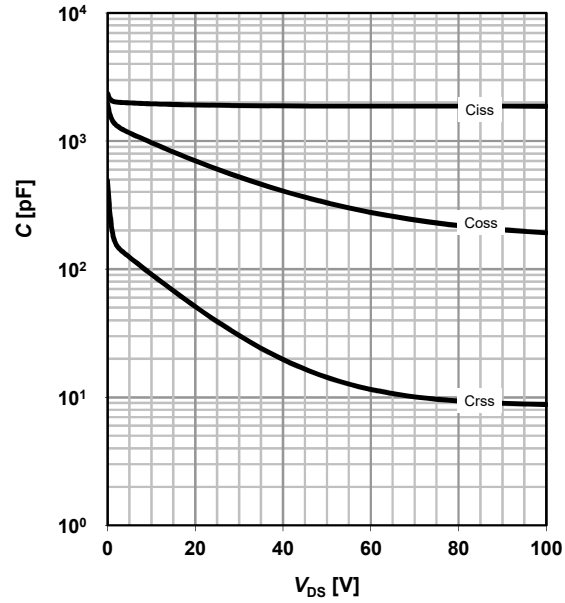
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



10 Typ. capacitances

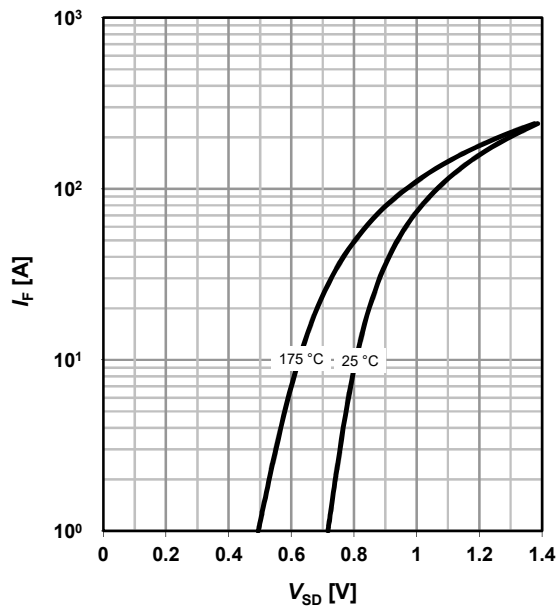
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



11 Typical forward diode characteristics

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

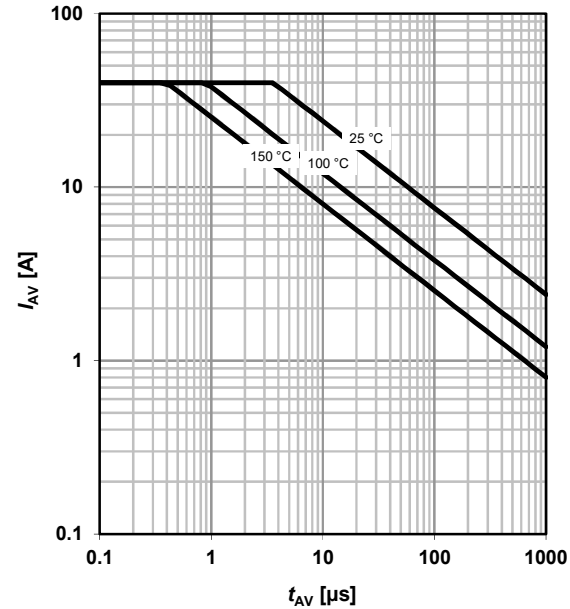
parameter: T_j



12 Avalanche characteristics

$$I_{AS} = f(t_{AV})$$

parameter: $T_{j(start)}$

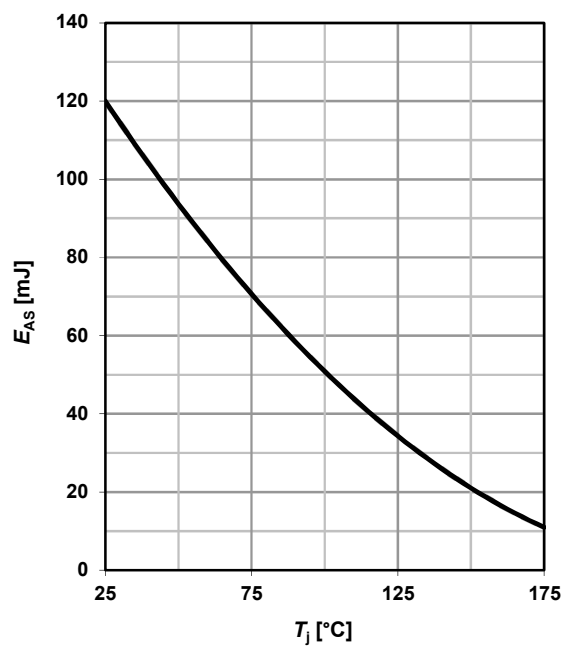




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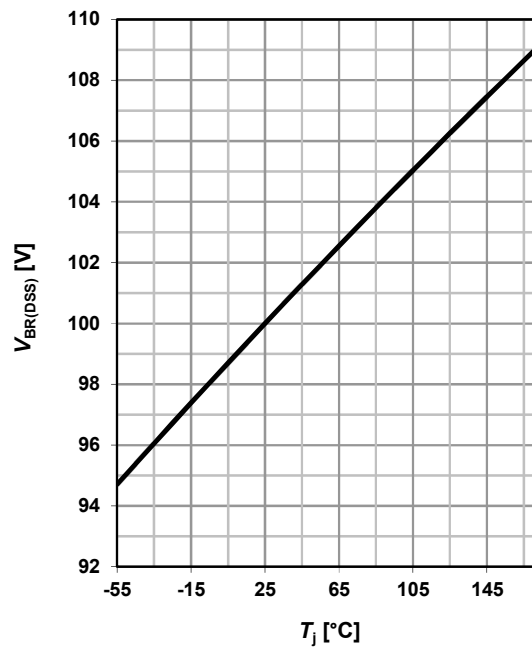
13 Avalanche energy

$$E_{AS} = f(T_j); I_D = 30 \text{ A}$$



14 Drain-source breakdown voltage

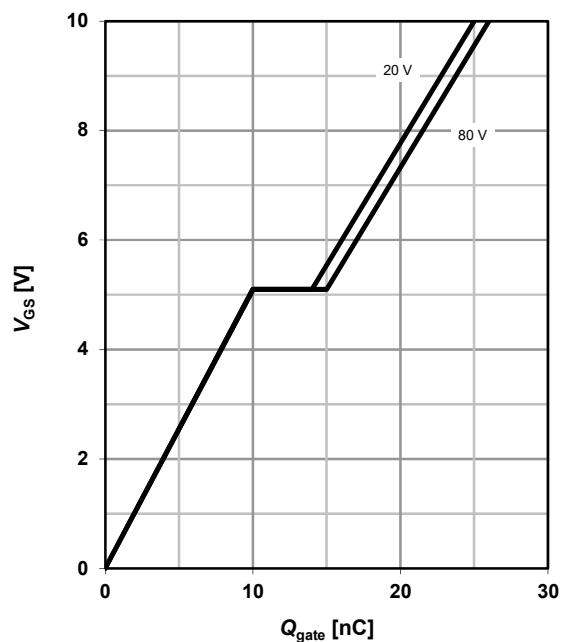
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



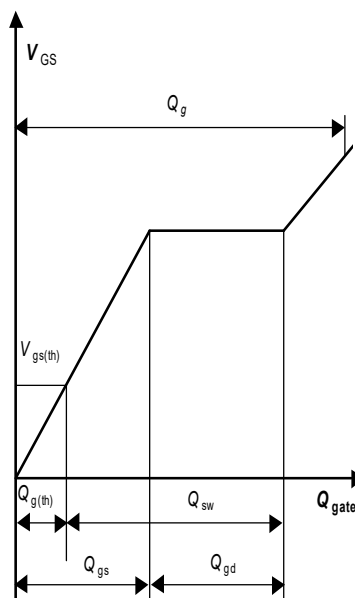
15 Typ. gate charge

$$V_{GS} = f(Q_{gate}); I_D = 60 \text{ A pulsed}$$

parameter: V_{DD}



16 Gate charge waveforms



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Revision History

Version	Date	Changes
Revision 1.0	2014-06-30	Data Sheet Revision 1.0
Revision 1.1	2023-01-30	Diagram 8 Typ. drain-source on-state resistance: used α value clarified