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ON Semiconductor®

# FDWS5360L-F085

## N-Channel Power Trench® MOSFET

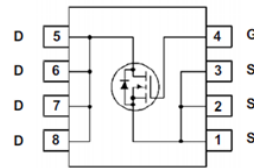
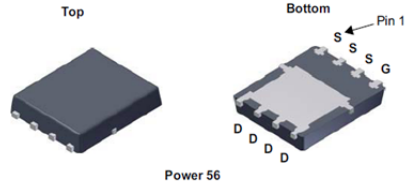
60V, 60A, 8.5mΩ

### Features

- Typ  $r_{DS(on)}$  = 6.5mΩ at  $V_{GS}$  = 10V,  $I_D$  = 60A
- Typ  $Q_{g(tot)}$  = 64nC at  $V_{GS}$  = 10V,  $I_D$  = 60A
- UIS Capability
- RoHS Compliant
- Qualified to AEC Q101
- Wettable flanks for automatic optical inspection (AOI)

### Applications

- Automotive Engine Control
- Powertrain Management
- Solenoid and Motor Drivers
- Integrated Starter/alternator
- Primary Switch for 12V Systems



### MOSFET Maximum Ratings $T_J = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Conditions	Ratings	Units
$V_{DSS}$	Drain to Source Voltage		60	V
$V_{GS}$	Gate to Source Voltage		±20	V
$I_D$	Drain Current - Continuous ( $V_{GS}=10$ ) (Note 1)	$T_C = 25^\circ\text{C}$	60	A
	Pulsed Drain Current	$T_C = 25^\circ\text{C}$	See Figure 4	
$E_{AS}$	Single Pulse Avalanche Energy	(Note 2)	115	mJ
$P_D$	Power Dissipation		150	W
	Derate above $25^\circ\text{C}$		1	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature		-55 to + 175	$^\circ\text{C}$
$R_{\theta JC}$	Thermal Resistance Junction to Case		1	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Maximum Thermal Resistance Junction to Ambient	(Note 3)	50	$^\circ\text{C}/\text{W}$

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDWS5360L	FDWS5360L-F085	Power 56	13"	12mm	3000 units

#### Notes:

- 1: Current is limited by junction temperature.
- 2: Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1\text{mH}$ ,  $I_{AS} = 48\text{A}$ ,  $V_{DD} = 60\text{V}$  during inductor charging and  $V_{DD} = 0\text{V}$  during time in avalanche
- 3:  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta JA}$  is determined by the user's board design. The maximum rating presented here is based on mounting on a 1 in<sup>2</sup> pad of 2oz copper.

FDWS5360L-F085 N-Channel Power Trench® MOSFET

**Electrical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**Off Characteristics**

$B_{VDSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	60	-	-	V
$I_{DSS}$	Drain to Source Leakage Current	$V_{DS} = 60\text{V}, T_J = 25^\circ\text{C}$	-	-	1	$\mu\text{A}$
		$V_{GS} = 0\text{V}, T_J = 175^\circ\text{C}(\text{Note } 4)$	-	-	1	$\text{mA}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	$\text{nA}$

**On Characteristics**

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	1.0	1.9	3.0	V
$r_{DS(on)}$	Drain to Source On Resistance	$I_D = 60\text{A}, T_J = 25^\circ\text{C}$	-	6.5	8.5	$\text{m}\Omega$
		$V_{GS} = 10\text{V}, T_J = 175^\circ\text{C}(\text{Note } 4)$	-	14.3	17.5	$\text{m}\Omega$
		$I_D = 60\text{A}, T_J = 25^\circ\text{C}$	-	8.7	10.5	$\text{m}\Omega$
		$V_{GS} = 4.5\text{V}, T_J = 175^\circ\text{C}(\text{Note } 4)$	-	18.2	21.6	$\text{m}\Omega$

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 30\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$	-	3695	-	$\text{pF}$
$C_{oss}$	Output Capacitance		-	295	-	$\text{pF}$
$C_{rss}$	Reverse Transfer Capacitance		-	155	-	$\text{pF}$
$R_g$	Gate Resistance	$f = 1\text{MHz}$	-	1.3	-	$\Omega$
$Q_{g(ToT)}$	Total Gate Charge at 10V	$V_{GS} = 0 \text{ to } 10\text{V}$	-	64	72	$\text{nC}$
$Q_{g(th)}$	Threshold Gate Charge	$V_{GS} = 0 \text{ to } 2\text{V}$				
$Q_{gs}$	Gate to Source Gate Charge	$V_{DD} = 48\text{V}, I_D = 60\text{A}$	-	13.8	-	$\text{nC}$
$Q_{gd}$	Gate to Drain "Miller" Charge		-	13.5	-	$\text{nC}$

**Switching Characteristics**

$t_{on}$	Turn-On Time	$V_{DD} = 30\text{V}, I_D = 60\text{A}, V_{GS} = 10\text{V}, R_{GEN} = 6\Omega$	-	-	40	$\text{ns}$
$t_{d(on)}$	Turn-On Delay Time		-	22	-	$\text{ns}$
$t_r$	Rise Time		-	14	-	$\text{ns}$
$t_{d(off)}$	Turn-Off Delay Time		-	79	-	$\text{ns}$
$t_f$	Fall Time		-	16	-	$\text{ns}$
$t_{off}$	Turn-Off Time		-	-	104	$\text{ns}$

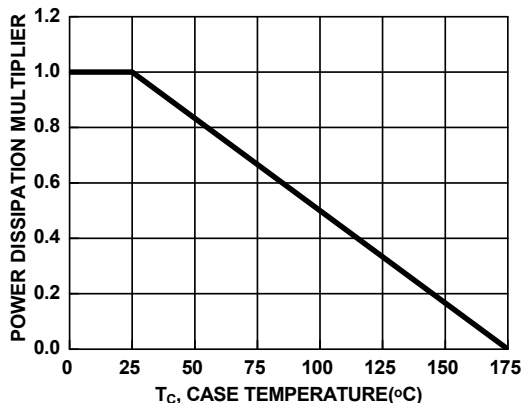
**Drain-Source Diode Characteristics**

$V_{SD}$	Source to Drain Diode Voltage	$I_{SD} = 60\text{A}, V_{GS} = 0\text{V}$	-	-	1.25	V
$T_{rr}$	Reverse Recovery Time	$I_F = 60\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	36	41	$\text{ns}$
$Q_{rr}$	Reverse Recovery Charge	$V_{DD} = 48\text{V}$	-	36	45	$\text{nC}$

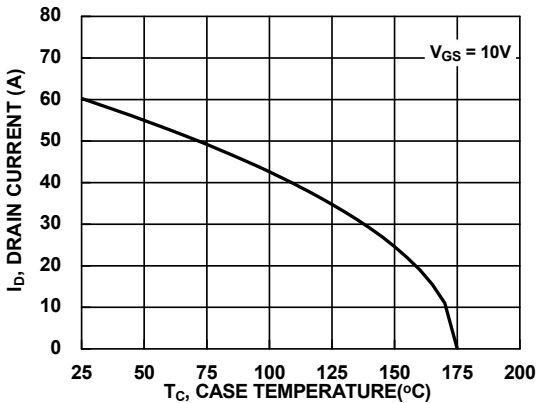
**Notes:**

4: The maximum value is specified by design at  $T_J = 175^\circ\text{C}$ . Product is not tested to this condition in production.

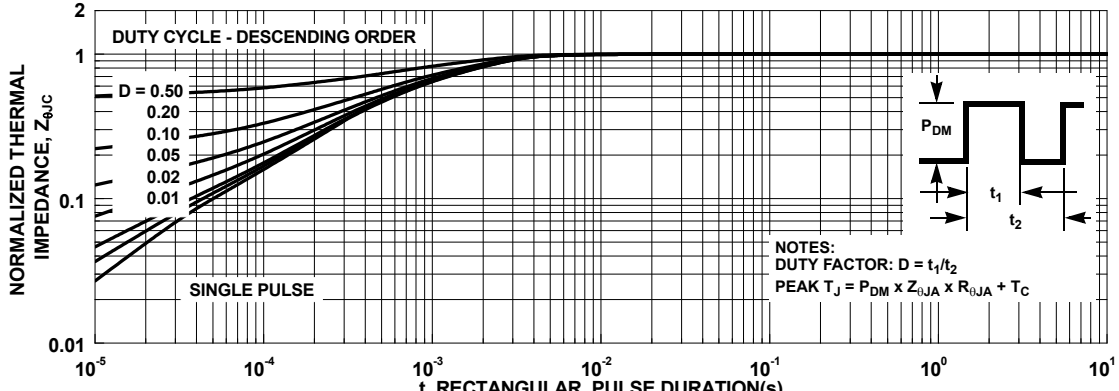
**Typical Characteristics**



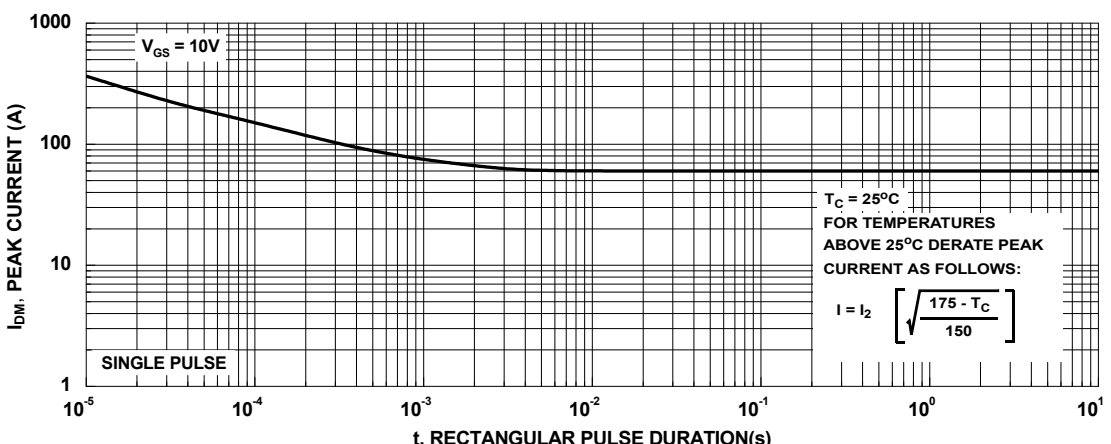
**Figure 1. Normalized Power Dissipation vs Case Temperature**



**Figure 2. Maximum Continuous Drain Current vs Case Temperature**



**Figure 3. Normalized Maximum Transient Thermal Impedance**



**Figure 4. Peak Current Capability**

## Typical Characteristics

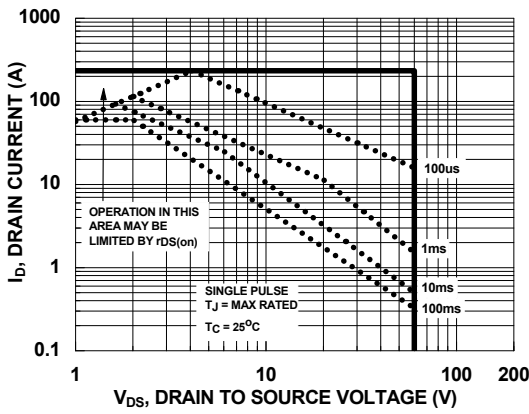
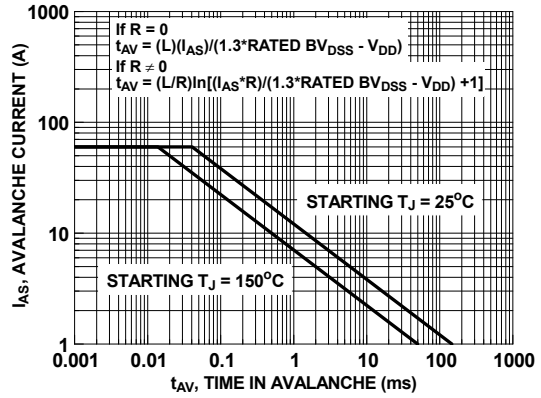


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to ON Semiconductor Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

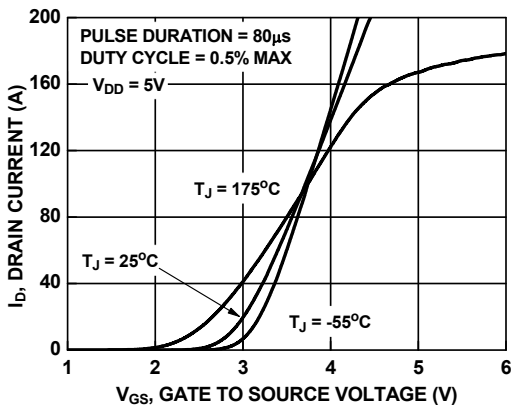


Figure 7. Transfer Characteristics

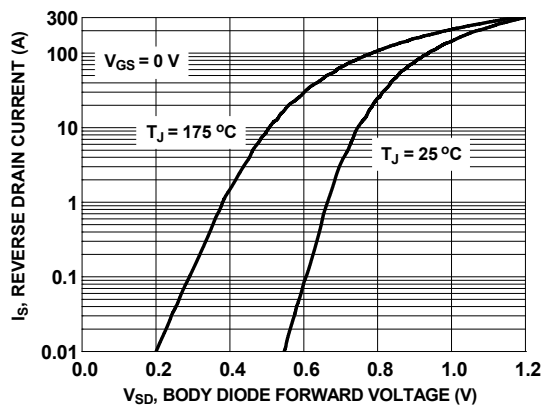


Figure 8. Forward Diode Characteristics

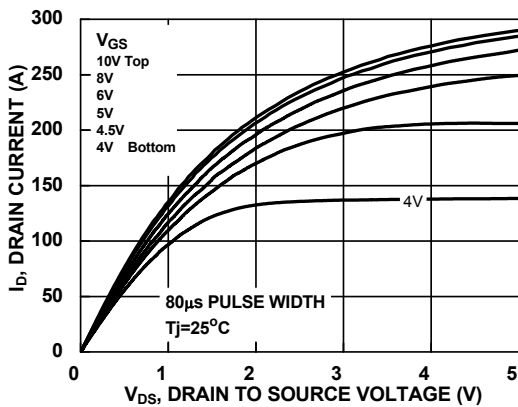


Figure 9. Saturation Characteristics

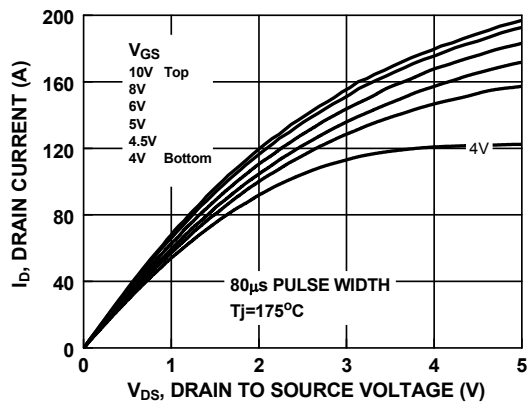


Figure 10. Saturation Characteristics

## Typical Characteristics

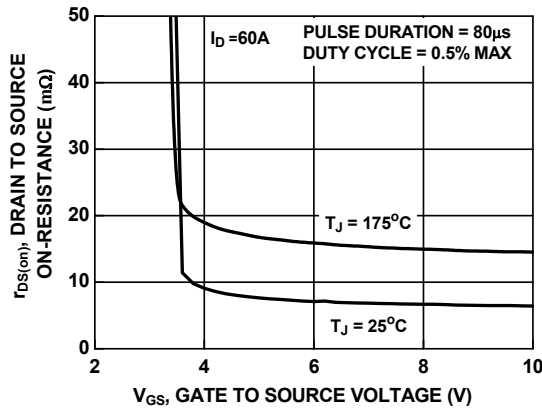


Figure 11. Rdson vs Gate Voltage

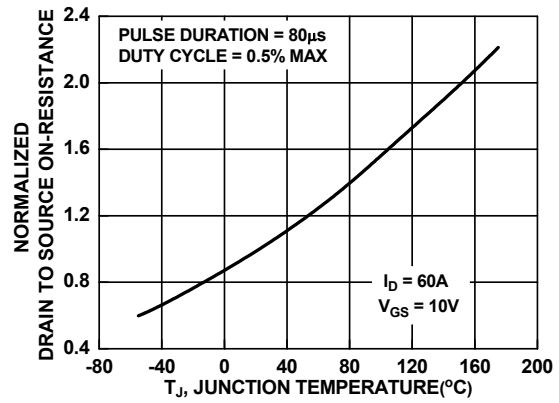


Figure 12. Normalized Rdson vs Junction Temperature

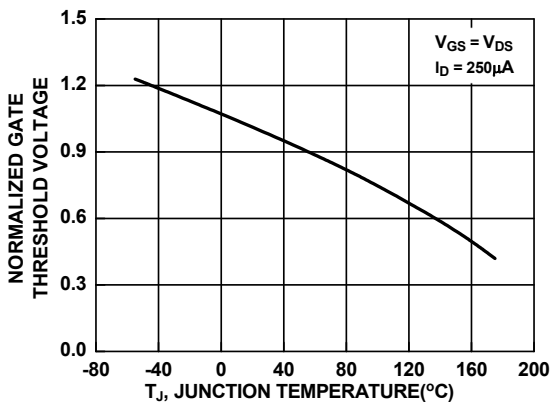


Figure 13. Normalized Gate Threshold Voltage vs Temperature

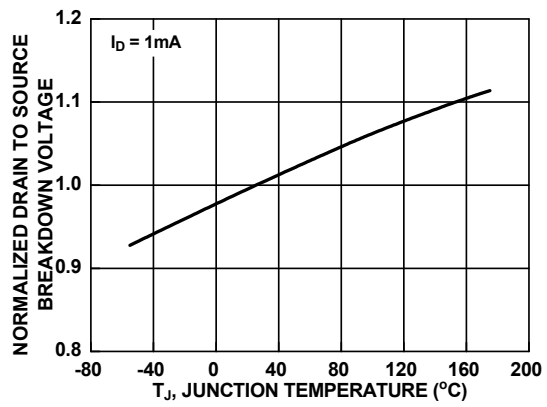


Figure 14. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

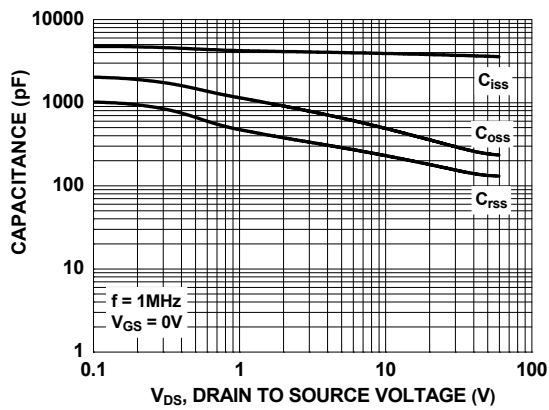


Figure 15. Capacitance vs Drain to Source Voltage

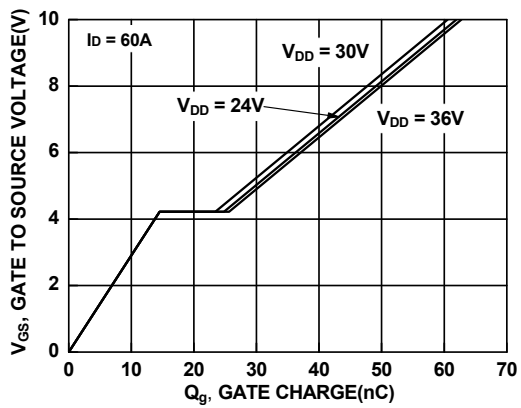


Figure 16. Gate Charge vs Gate to Source Voltage

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