

# MOSFET – Single, P-Channel, POWERTRENCH<sup>®</sup>, Logic Level

**-30 V, -4 A, 50 mΩ**

## FDC658AP, FDC658AP-G

### General Description

This P-Channel Logic Level MOSFET is produced using onsemi advanced POWERTRENCH process. It has been optimized for battery power management applications.

### Features

- Max  $R_{DS(on)}$  = 50 mΩ @  $V_{GS} = -10$  V,  $I_D = -4$  A
- Max  $R_{DS(on)}$  = 75 mΩ @  $V_{GS} = -4.5$  V,  $I_D = -3.4$  A
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- Pb-Free, Halide Free and RoHS Compliant

### Applications

- Battery Management
- Load Switch
- Battery Protection
- DC-DC Conversion

### ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Ratings	Unit
$V_{DS}$	Drain-Source Voltage	-30	V
$V_{GS}$	Gate-Source Voltage	±25	V
$I_D$	Drain Current – Continuous (Note 1a) – Pulsed	-4 -20	A
$P_D$	Maximum Power dissipation (Note 1a)	1.6	W
	(Note 1b)	0.8	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	°C

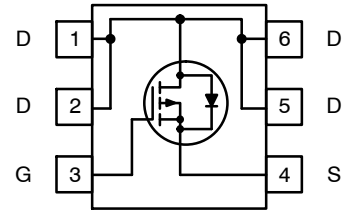
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS

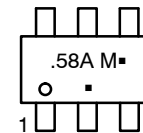
Symbol	Parameter	Ratings	Unit
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	78	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	30	°C/W



TSOT23  
CASE 419BL



### MARKING DIAGRAM



.58A = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

Device	Package	Shipping†
FDC658AP	TSOT23 (Pb-Free/ Halide Free)	3000 / Tape & Reel
FDC658AP-G	TSOT23 (Pb-Free/ Halide Free)	3000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, [BRD8011/D](#).

# FDC658AP, FDC658AP-G

**ELECTRICAL CHARACTERISTICS**  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D = -250 \mu\text{A}, V_{GS} = 0 \text{ V}$	-30	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	-22	-	mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS} = 0 \text{ V}, V_{DS} = -24 \text{ V}$	-	-	-1	$\mu\text{A}$
$I_{GSS}$	Gate-Body Leakage	$V_{GS} = \pm 25 \text{ V}, V_{DS} = 0 \text{ V}$	-	-	$\pm 100$	nA

**ON CHARACTERISTICS** (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250 \mu\text{A}$	-1	-1.8	-3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	4	-	mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D = -4 \text{ A}, V_{GS} = -10 \text{ V}$ ,	-	44	50	m $\Omega$
		$I_D = -3.4 \text{ A}, V_{GS} = -4.5 \text{ V}$	-	67	75	
		$I_D = -4 \text{ A}, V_{GS} = -10 \text{ V}$ , $T_J = 125^\circ\text{C}$	-	60	70	
$I_{D(on)}$	On-State Drain Current	$V_{DS} = -5 \text{ V}, V_{GS} = -10 \text{ V}$	-20	-	-	A
$g_{FS}$	Forward Transconductance	$V_{DS} = -5 \text{ V}, I_D = -4 \text{ A}$	-	8.4	-	S

**DYNAMIC CHARACTERISTICS**

$C_{iss}$	Input Capacitance	$V_{DS} = -15 \text{ V}, V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	-	470	680	pF
$C_{oss}$	Output Capacitance		-	126	180	
$C_{rss}$	Reverse Transfer Capacitance		-	61	90	

**SWITCHING CHARACTERISTICS** (Note 2)

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -15 \text{ V}, I_D = -1 \text{ A}$ , $V_{GS} = -10 \text{ V}, R_{GEN} = 6 \Omega$	-	7	14	ns
$t_r$	Turn-On Rise Time		-	12	22	
$t_{d(off)}$	Turn-Off Delay Time		-	16	29	
$t_f$	Turn-Off Fall Time		-	6	12	
$Q_g$	Total Gate Charge	$V_{DS} = -15 \text{ V}, I_D = -4 \text{ A}$ , $V_{GS} = -5 \text{ V}$	-	6	8.1	nC
$Q_{gs}$	Gate-Source Charge		-	2.1	-	
$Q_{gd}$	Gate-Drain Charge		-	2	-	

**DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS**

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	-	-	-1.3	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_S = -1.3 \text{ A}$ (Note 2)	-	-0.77	-1.2	V

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

**NOTES:**

- $R_{\theta JA}$  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  $R_{\theta CA}$  is determined by the user's board design.



a)  $78^\circ\text{C/W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz. copper.



b)  $156^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz. copper.

- Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2.0%

# FDC658AP, FDC658AP-G

## TYPICAL CHARACTERISTICS

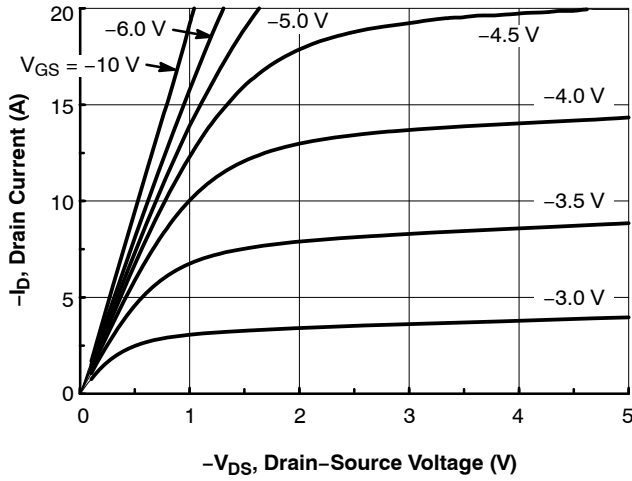


Figure 1. On-Region Characteristics

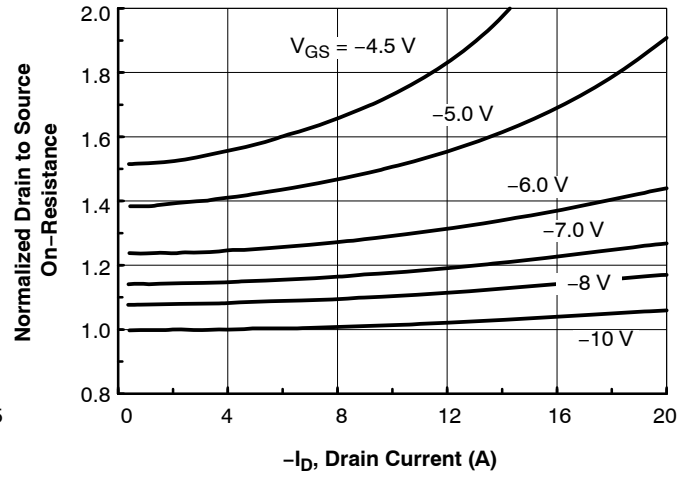


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

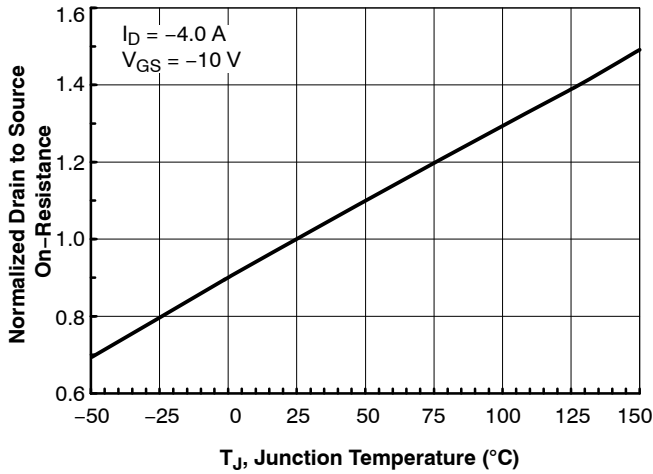


Figure 3. Normalized On-Resistance vs. Junction Temperature

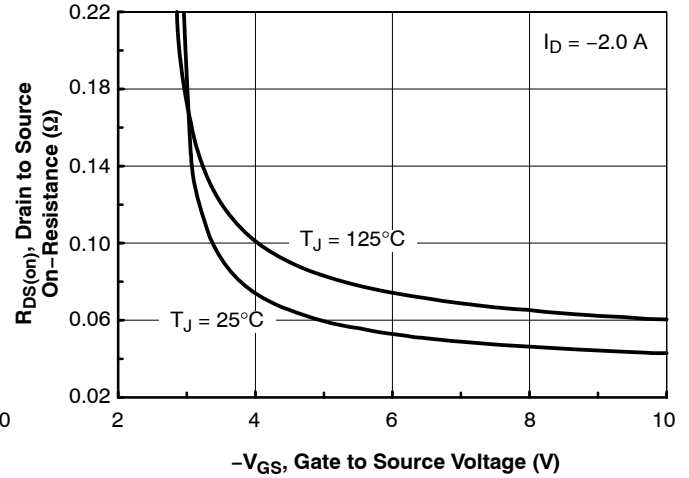


Figure 4. On-Resistance vs. Gate to Source Voltage

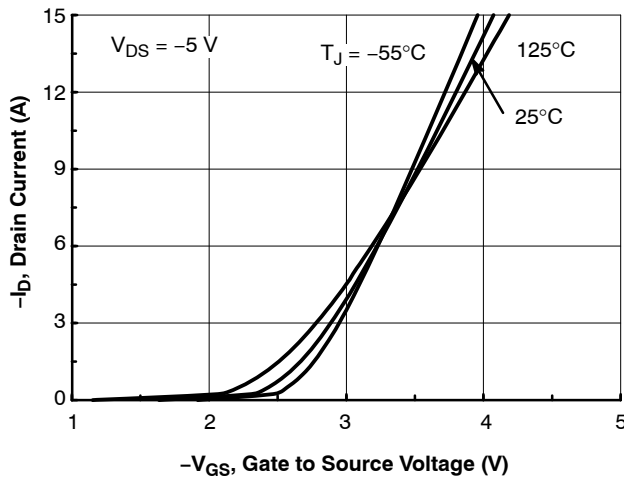


Figure 5. Transfer Characteristics

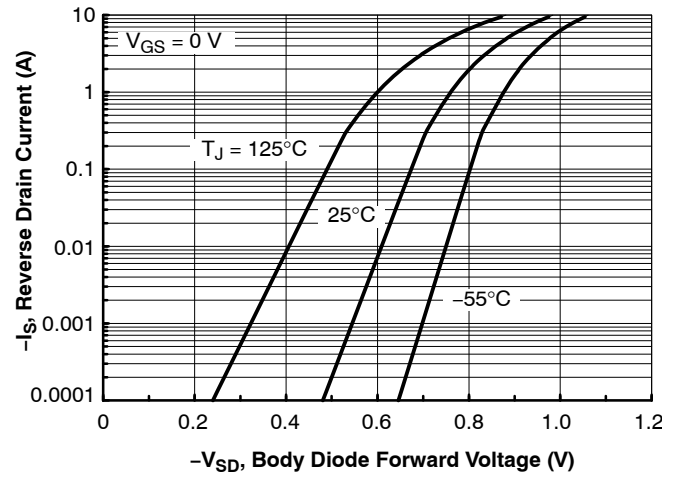


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

# FDC658AP, FDC658AP-G

## TYPICAL CHARACTERISTICS (continued)

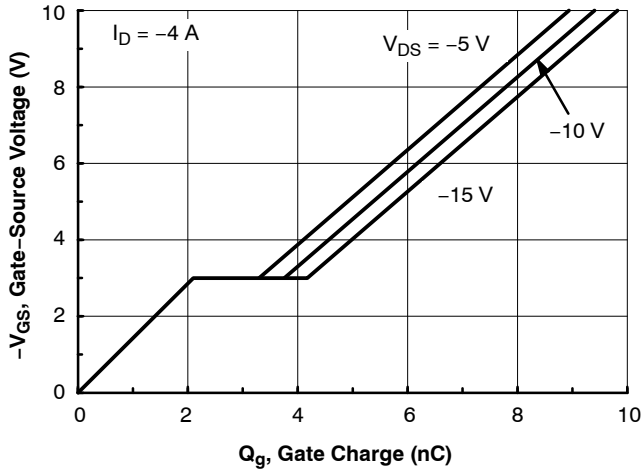


Figure 7. Gate Charge Characteristics

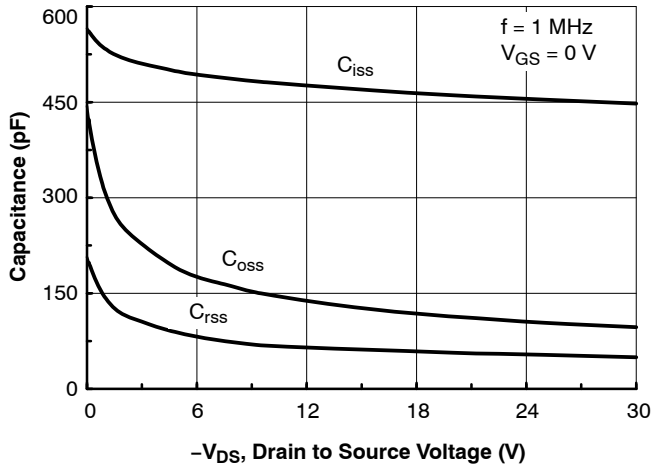


Figure 8. Capacitance vs. Drain to Source Voltage

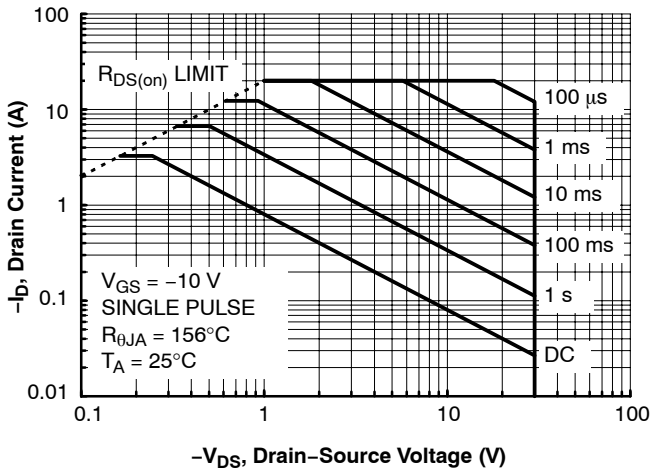


Figure 9. Forward Bias Safe Operating Area

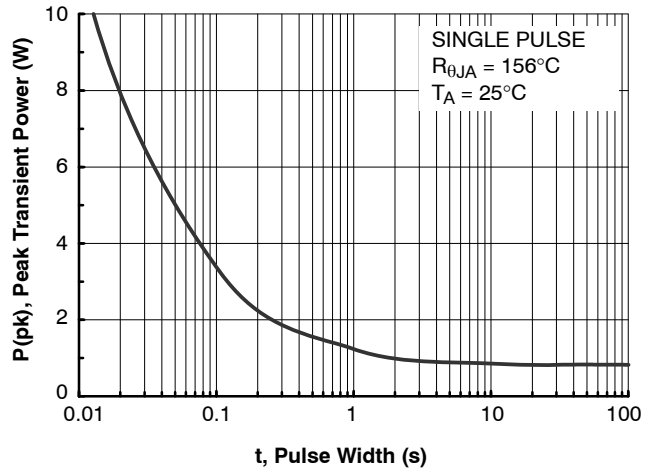


Figure 10. Single Pulse Maximum Power Dissipation

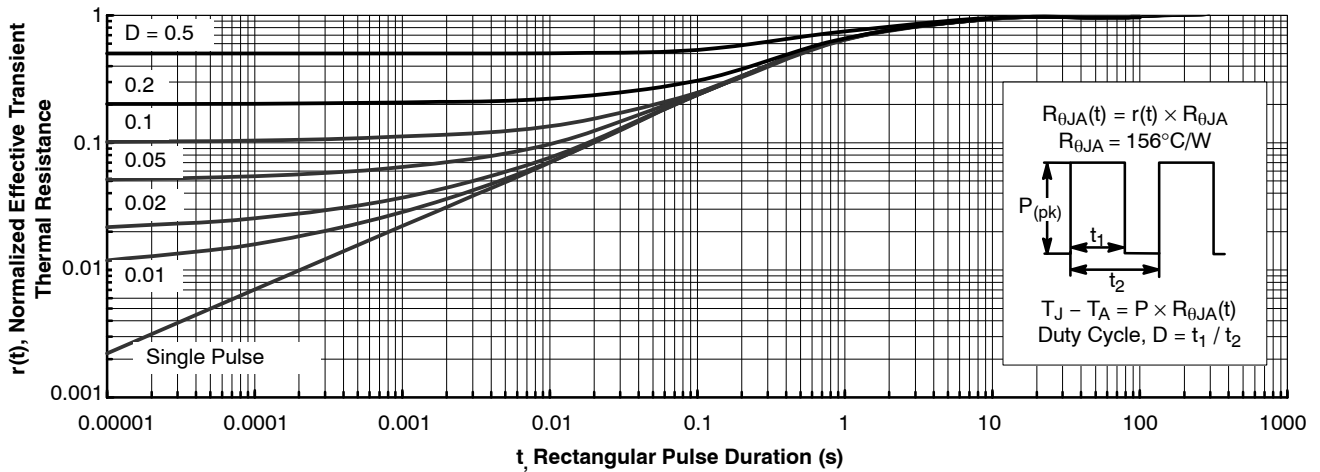


Figure 11. Transient Thermal Response Curve

Thermal characterization performed using the conditions described in Note 1b.  
Transient thermal response will change depending on the circuit board design.

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

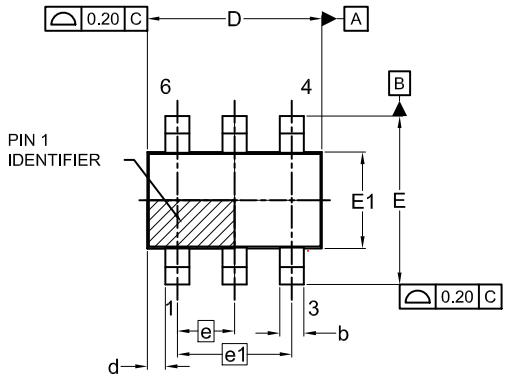
ON Semiconductor®



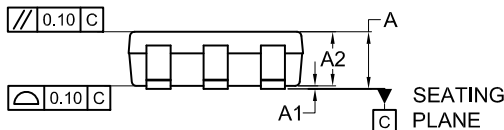
SCALE 2:1

### TSOT23 6-Lead CASE 419BL ISSUE A

DATE 31 AUG 2020



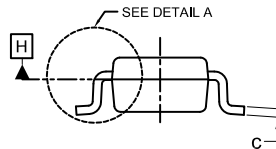
TOP VIEW



FRONT VIEW

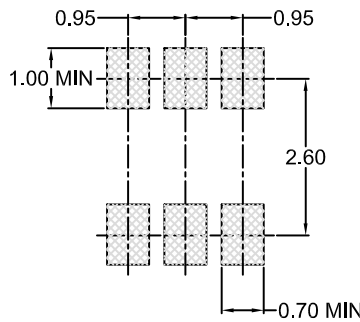


DETAIL A



SIDE VIEW

SYMM  
⌀



LAND PATTERN  
RECOMMENDATION

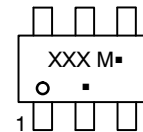
\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25MM PER END. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	0.05	0.10
A2	0.70	0.85	1.00
A3	0.25 BSC		
b	0.25	0.38	0.50
c	0.10	0.18	0.26
D	2.80	2.95	3.10
d	0.30 REF		
E	2.50	2.75	3.00
E1	1.30	1.50	1.70
e	0.95 BSC		
e1	1.90 BSC		
L1	0.60 REF		
L2	0.20	0.40	0.60
⌀	0°	--	10°

#### GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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