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March 2015

# FDD4685 40V P-Channel PowerTrench<sup>®</sup> MOSFET

-40V, -32A, 27mΩ

## Features

- Max  $r_{DS(on)}$  = 27mΩ at  $V_{GS} = -10V$ ,  $I_D = -8.4A$
- Max  $r_{DS(on)}$  = 35mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -7A$
- High performance trench technology for extremely low  $r_{DS(on)}$
- RoHS Compliant

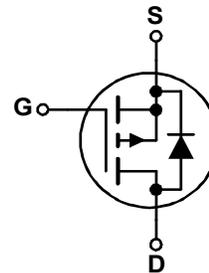
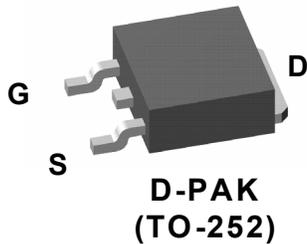


## General Description

This P-Channel MOSFET has been produced using Fairchild Semiconductor's proprietary PowerTrench<sup>®</sup> technology to deliver low  $r_{DS(on)}$  and good switching characteristic offering superior performance in application.

## Application

- Inverter
- Power Supplies



## MOSFET Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	-40	V
$V_{GS}$	Gate to Source Voltage	±20	V
$I_D$	Drain Current -Continuous(Package Limited) $T_C = 25^\circ C$	-32	A
	-Continuous(Silicon Limited) $T_C = 25^\circ C$ (Note 1)	-40	
	-Continuous $T_A = 25^\circ C$ (Note 1a)	-8.4	
	-Pulsed	-100	
$E_{AS}$	Drain-Source Avalanche Energy (Note 3)	121	mJ
$P_D$	Power Dissipation $T_C = 25^\circ C$	69	W
	Power Dissipation (Note 1a)	3	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ C$

## Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.8	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	40	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD4685	FDD4685	D-PAK(TO-252)	13"	16mm	2500 units

FDD4685 40V P-Channel PowerTrench<sup>®</sup> 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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$	-40			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		-33		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -32\text{V}, V_{GS} = 0\text{V}$			-1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$			$\pm 100$	nA

### On Characteristics (Note 2)

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$	-1	-1.6	-3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		4.9		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = -10\text{V}, I_D = -8.4\text{A}$		23	27	m $\Omega$
		$V_{GS} = -4.5\text{V}, I_D = -7\text{A}$		30	35	
		$V_{GS} = -10\text{V}, I_D = -8.4\text{A}, T_J = 125^\circ\text{C}$		33	42	
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{V}, I_D = -8.4\text{A}$		23		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -20\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		1790	2380	pF
$C_{oss}$	Output Capacitance			260	345	pF
$C_{rSS}$	Reverse Transfer Capacitance			140	205	pF
$R_g$	Gate Resistance	$f = 1\text{MHz}$		4		$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -20\text{V}, I_D = -8.4\text{A}, V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$		8	16	ns
$t_r$	Rise Time			15	27	ns
$t_{d(off)}$	Turn-Off Delay Time			34	55	ns
$t_f$	Fall Time			14	26	ns
$Q_{g(TOT)}$	Total Gate Charge		$V_{DD} = -20\text{V}, I_D = -8.4\text{A}$		19	27
$Q_{gs}$	Gate to Source Gate Charge	$V_{GS} = -5\text{V}$		5.6		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			6.1		nC

### Drain-Source Diode Characteristics

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = -8.4\text{A}$ (Note 2)		-0.85	-1.2	V
$t_{rr}$	Reverse Recovery Time	$I_F = -8.4\text{A}, di/dt = 100\text{A}/\mu\text{s}$		30	45	ns
$Q_{rr}$	Reverse Recovery Charge			31	47	nC

#### 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  $R_{\theta JA}$  is determined by the user's board design.
  - 40 $^\circ\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper
  - 96 $^\circ\text{C}/\text{W}$  when mounted on a minimum pad.
- Pulse Test: Pulse Width < 300 $\mu\text{s}$ , Duty cycle < 2.0%.
- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = 9\text{A}$ ,  $V_{DD} = 40\text{V}$ ,  $V_{GS} = 10\text{V}$ .

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

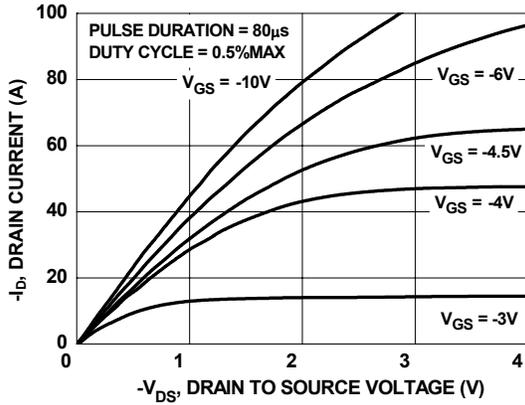


Figure 1. On Region Characteristics

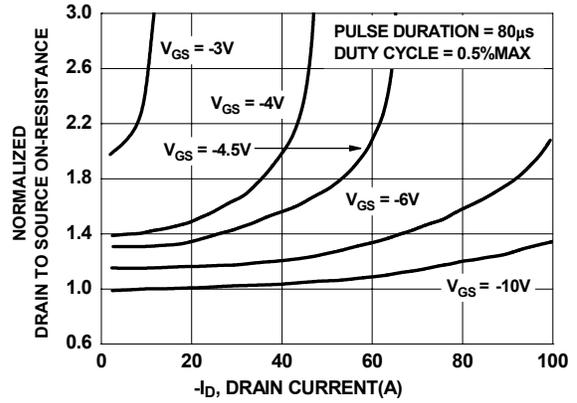


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

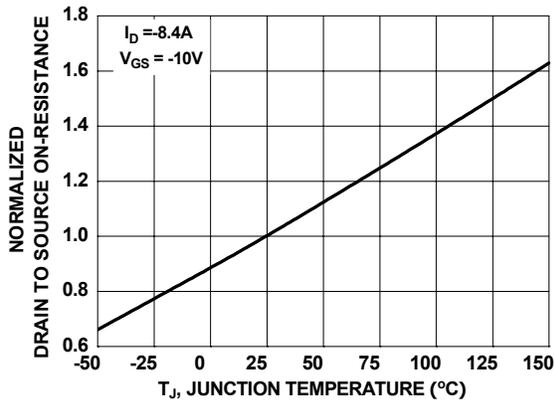


Figure 3. Normalized On Resistance vs Junction Temperature

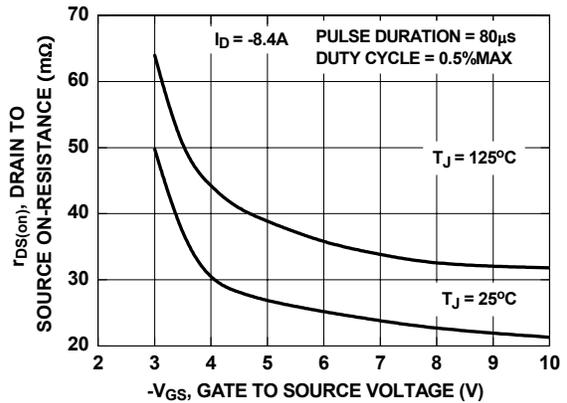


Figure 4. On-Resistance vs Gate to Source Voltage

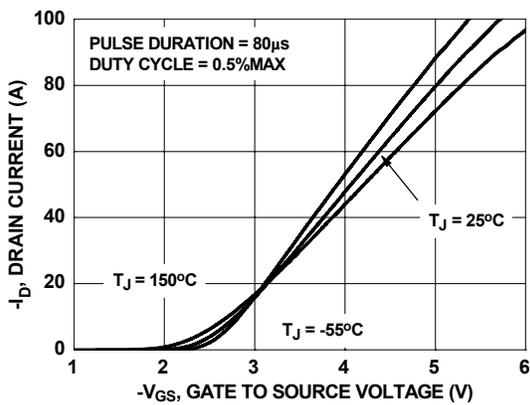


Figure 5. Transfer Characteristics

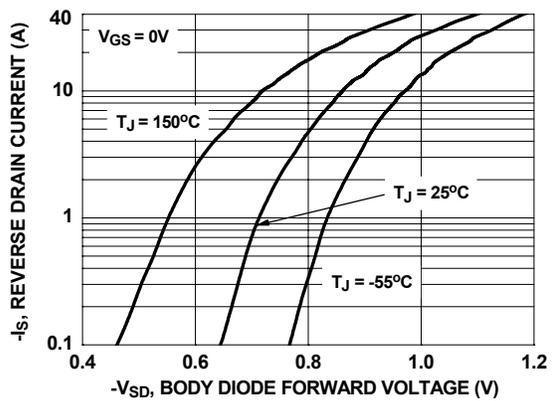
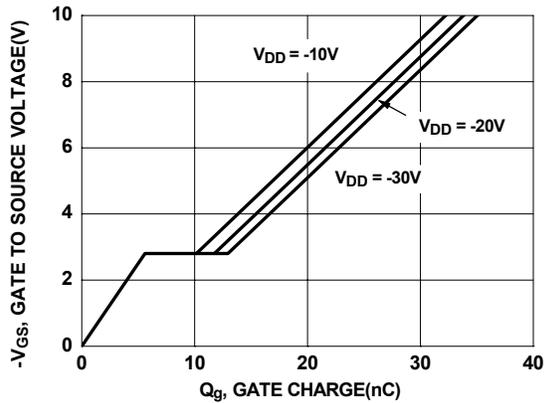
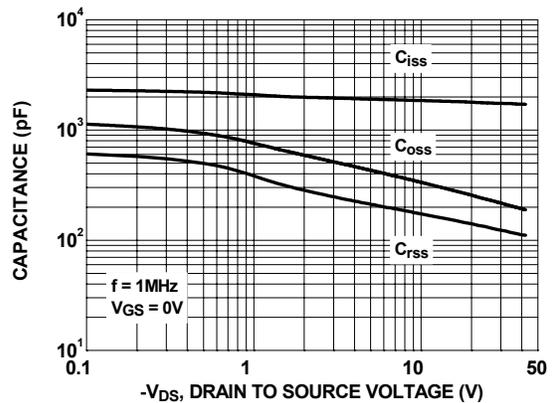


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

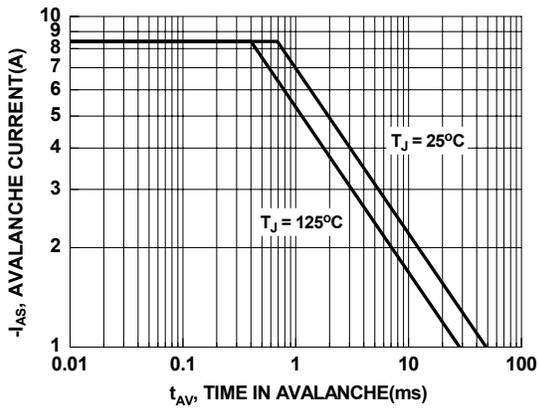
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



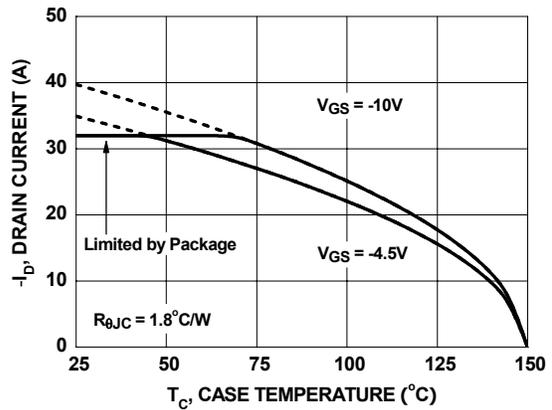
**Figure 7. Gate Charge Characteristics**



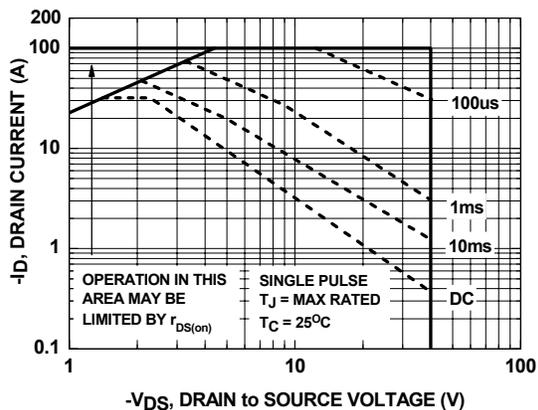
**Figure 8. Capacitance vs Drain to Source Voltage**



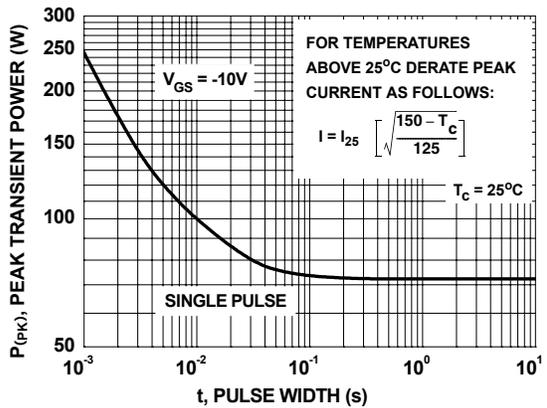
**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Maximum Continuous Drain Current vs Case Temperature**

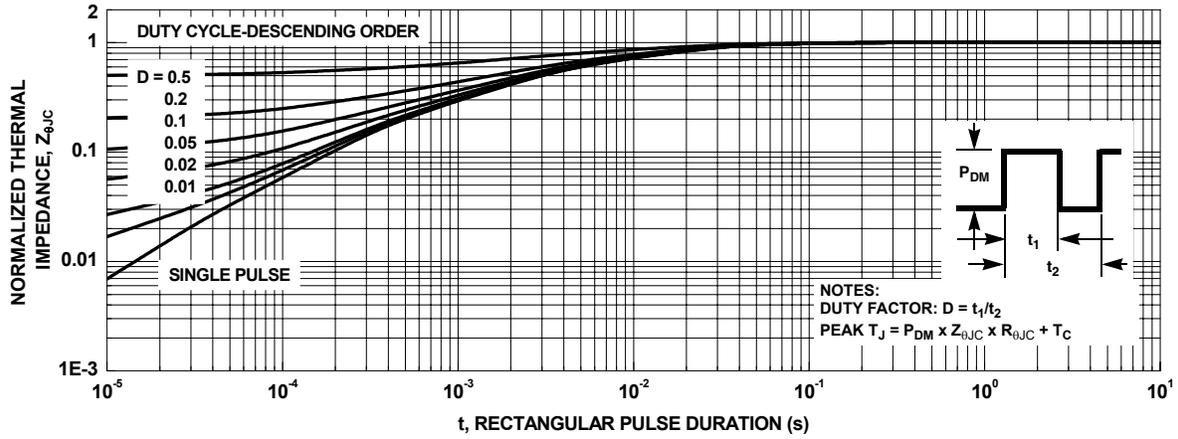


**Figure 11. Forward Bias Safe Operating Area**

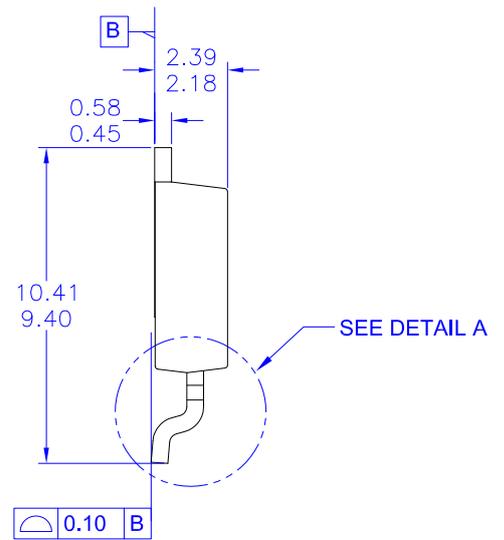
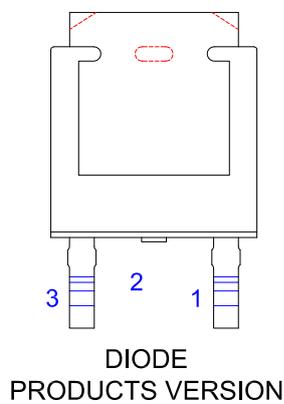
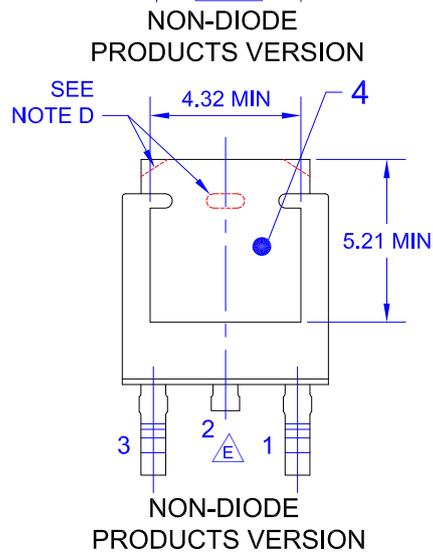
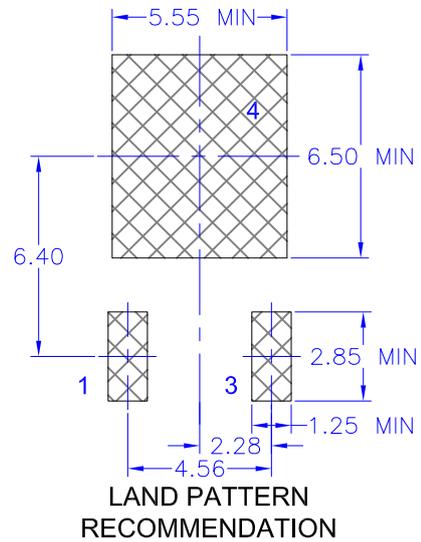
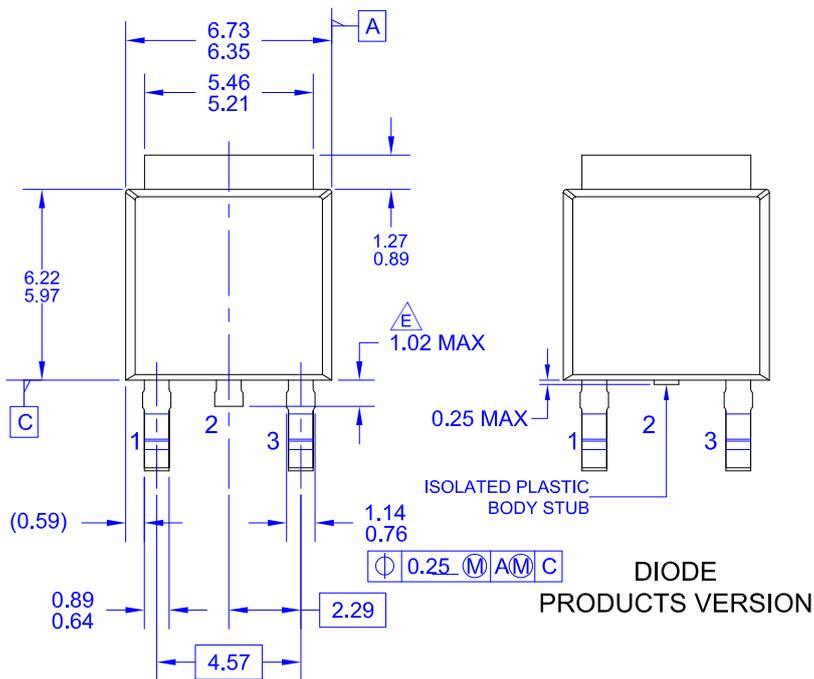


**Figure 12. Single Pulse Maximum Power Dissipation**

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



**Figure 13. Transient Thermal Response Curve**



NOTES: UNLESS OTHERWISE SPECIFIED  
A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.

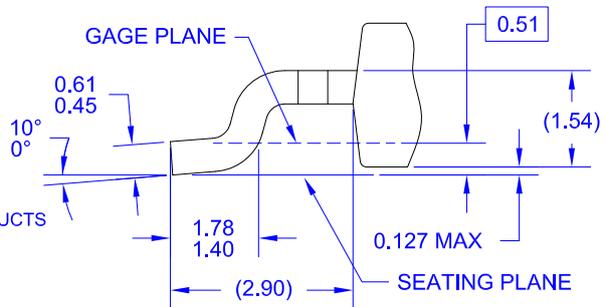
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E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS

F) DIMENSIONS ARE EXCLUSIVE OF BURS, MOLD FLASH AND TIE BAR EXTRUSIONS.

G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.

H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11



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