

# FDMC86520DC

## N-Channel Dual Cool™ PowerTrench® MOSFET

60 V, 40 A, 6.3 mΩ

### Features

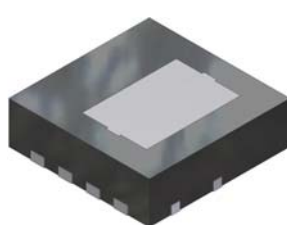
- Dual Cool™ Top Side Cooling PQFN package
- Max  $r_{DS(on)}$  = 6.3 mΩ at  $V_{GS} = 10$  V,  $I_D = 17$  A
- Max  $r_{DS(on)}$  = 8.7 mΩ at  $V_{GS} = 8$  V,  $I_D = 14.5$  A
- High performance technology for extremely low  $r_{DS(on)}$
- RoHS Compliant

### General Description

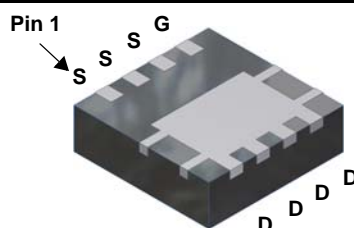
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process. Advancements in both silicon and Dual Cool™ package technologies have been combined to offer the lowest  $r_{DS(on)}$  while maintaining excellent switching performance by extremely low Junction-to-Ambient thermal resistance.

### Applications

- Primary DC-DC Switch
- Motor Bridge Switch
- Synchronous Rectifier

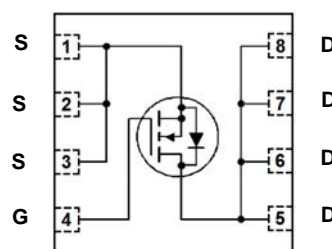


Top



Power 33

Bottom



### MOSFET Maximum Ratings $T_A = 25$ °C unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	60	V
$V_{GS}$	Gate to Source Voltage	±20	V
$I_D$	Drain Current -Continuous $T_C = 25$ °C	40	A
	-Continuous $T_A = 25$ °C (Note 1a)	17	
	-Pulsed	80	
$E_{AS}$	Single Pulse Avalanche Energy (Note 3)	128	mJ
$P_D$	Power Dissipation $T_C = 25$ °C	73	W
	Power Dissipation $T_A = 25$ °C (Note 1a)	3.0	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to + 150	°C

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case (Top Source)	4.2	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case (Bottom Drain)	1.7	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	42	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1b)	105	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1i)	17	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1j)	26	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1k)	12	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
86520	FDMC86520DC	Dual Cool™ Power 33	13"	12 mm	3000 units

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

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0\text{ V}$	60			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^{\circ}\text{C}$		30		mV/ $^{\circ}\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 48\text{ V}$ , $V_{GS} = 0\text{ V}$			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**

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$	2.5	3.7	4.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^{\circ}\text{C}$		-10		mV/ $^{\circ}\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}$		5.1	6.3	m $\Omega$
		$V_{GS} = 8\text{ V}$ , $I_D = 14.5\text{ A}$		6.5	8.7	
		$V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}$ , $T_J = 125\text{ }^{\circ}\text{C}$		8.2	10.2	
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}$ , $I_D = 17\text{ A}$		49		S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 30\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$		2097	2790	pF
$C_{oss}$	Output Capacitance			557	745	pF
$C_{rss}$	Reverse Transfer Capacitance			13	40	pF
$R_g$	Gate Resistance		0.1	0.5	2.5	$\Omega$

**Switching Characteristics**

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 30\text{ V}$ , $I_D = 17\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$		18	33	ns
$t_r$	Rise Time			6.6	14	ns
$t_{d(off)}$	Turn-Off Delay Time			19	35	ns
$t_f$	Fall Time			4	10	ns
$Q_g$	Total Gate Charge	$V_{GS} = 0\text{ V}$ to $10\text{ V}$	$V_{DD} = 30\text{ V}$ , $I_D = 17\text{ A}$	29	40	nC
$Q_g$	Total Gate Charge	$V_{GS} = 0\text{ V}$ to $8\text{ V}$		23	33	nC
$Q_{gs}$	Gate to Source Charge			12		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			5.5		nC

**Drain-Source Diode Characteristics**

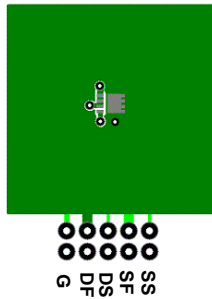
$V_{SD}$	Source-Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 17\text{ A}$ (Note 2)		0.83	1.3	V
		$V_{GS} = 0\text{ V}$ , $I_S = 2.5\text{ A}$ (Note 2)		0.74	1.2	
$t_{rr}$	Reverse Recovery Time	$I_F = 17\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		41	65	ns
$Q_{rr}$	Reverse Recovery Charge			23	37	nC

## Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case (Top Source)	4.2	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case (Bottom Drain)	1.7	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	42	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1b)	105	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1c)	29	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1d)	40	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1e)	19	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1f)	23	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1g)	30	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1h)	79	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1i)	17	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1j)	26	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1k)	12	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1l)	16	

### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a FR-4 board using a specified pad of 2 oz copper as shown below.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a. 42 °C/W when mounted on a 1 in² pad of 2 oz copper



b. 105 °C/W when mounted on a minimum pad of 2 oz copper

- Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in² pad of 2 oz copper
- Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper
- Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in² pad of 2 oz copper
- Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, No Heat Sink, 1 in² pad of 2 oz copper
- 200FPM Airflow, No Heat Sink, minimum pad of 2 oz copper
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- 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in² pad of 2 oz copper
- 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper

- Pulse Test: Pulse Width < 300  $\mu$ s, Duty cycle < 2.0%.

- $E_{AS}$  of 128 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 1$  mH,  $I_{AS} = 16$  A,  $V_{DD} = 54$  V,  $V_{GS} = 10$  V. 100% test at  $L = 0.3$  mH,  $I_{AS} = 24$  A.

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

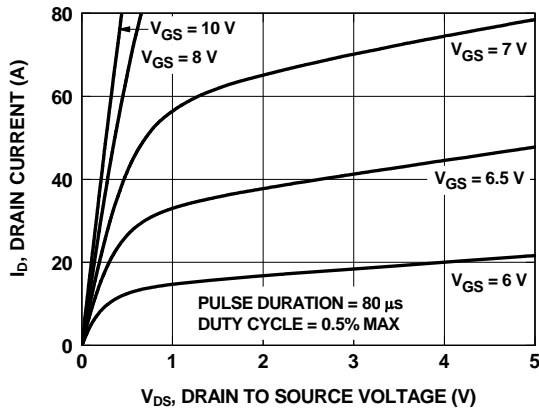


Figure 1. On-Region Characteristics

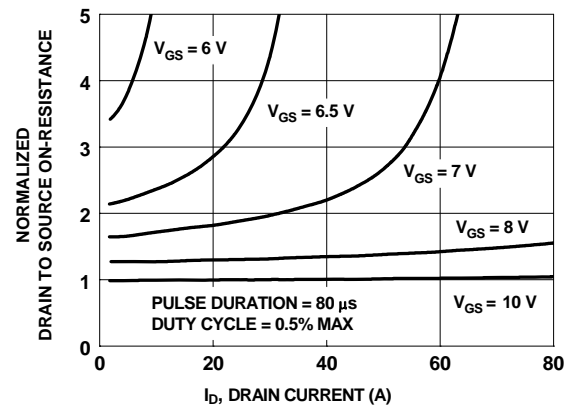


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

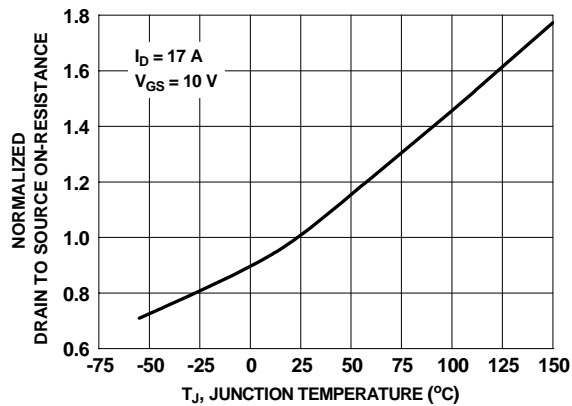


Figure 3. Normalized On-Resistance vs Junction Temperature

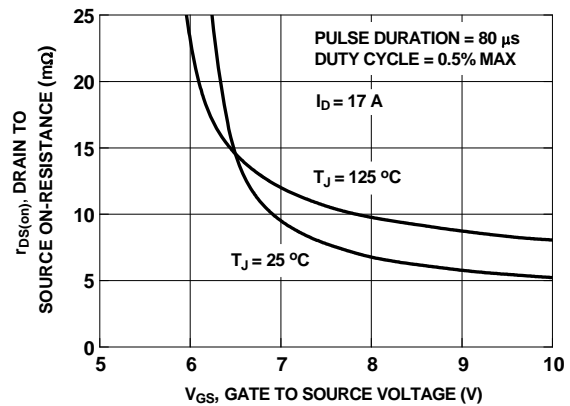


Figure 4. On-Resistance vs Gate to Source Voltage

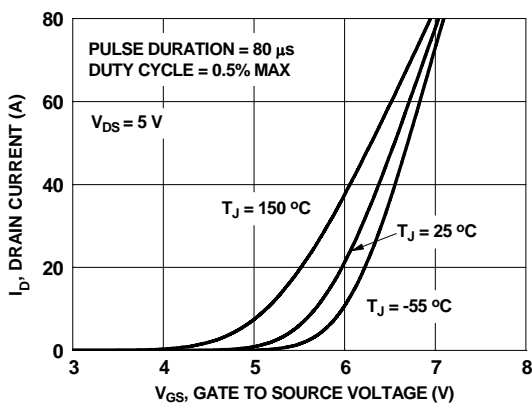


Figure 5. Transfer Characteristics

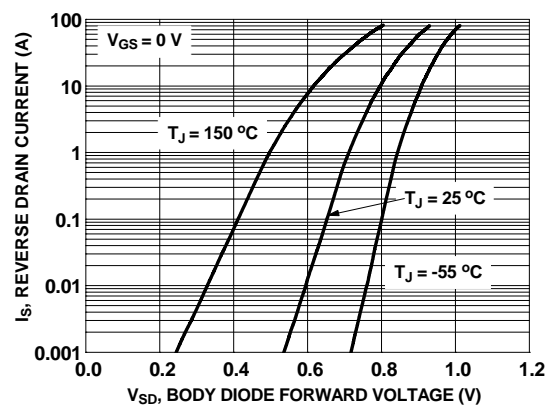


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

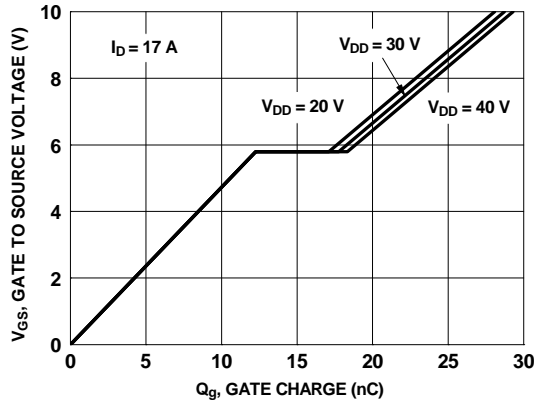


Figure 7. Gate Charge Characteristics

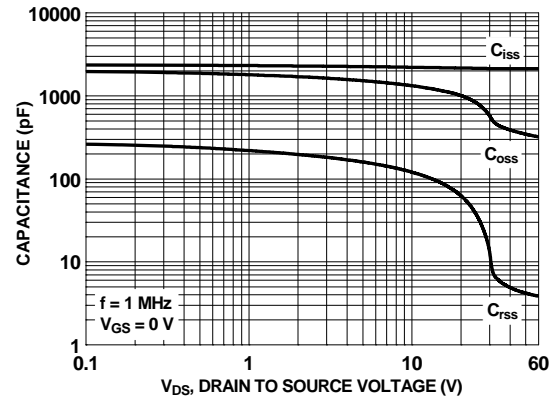


Figure 8. Capacitance vs Drain to Source Voltage

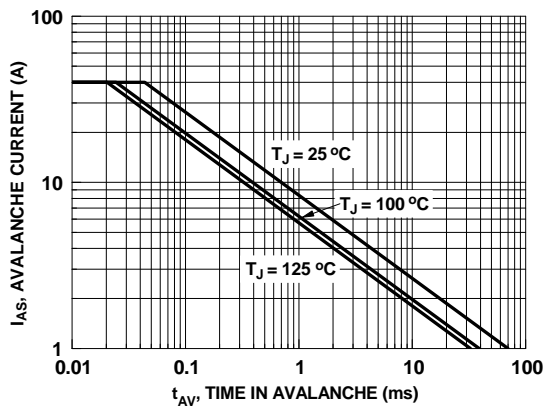


Figure 9. Unclamped Inductive Switching Capability

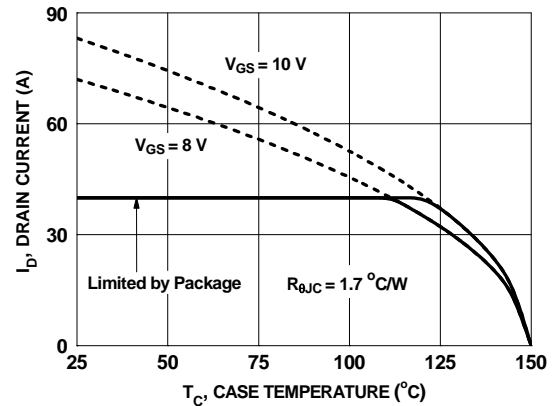


Figure 10. Maximum Continuous Drain Current vs Case Temperature

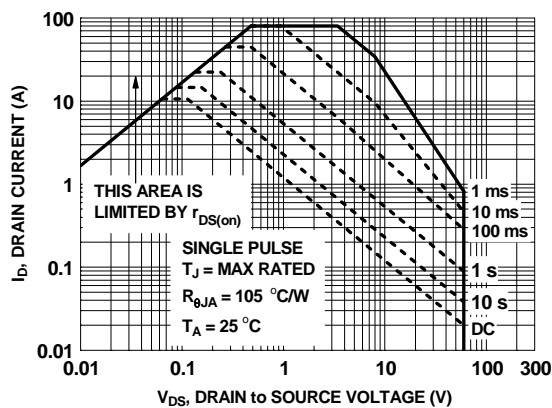


Figure 11. Forward Bias Safe Operating Area

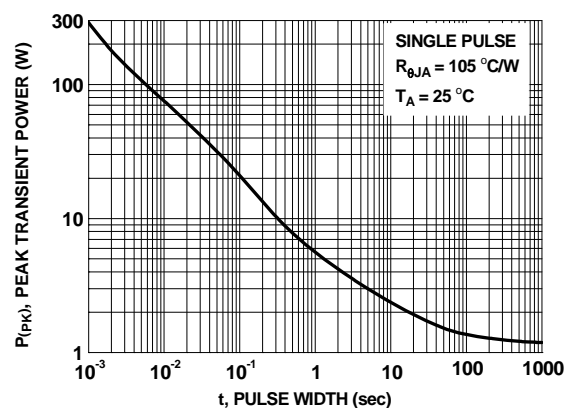
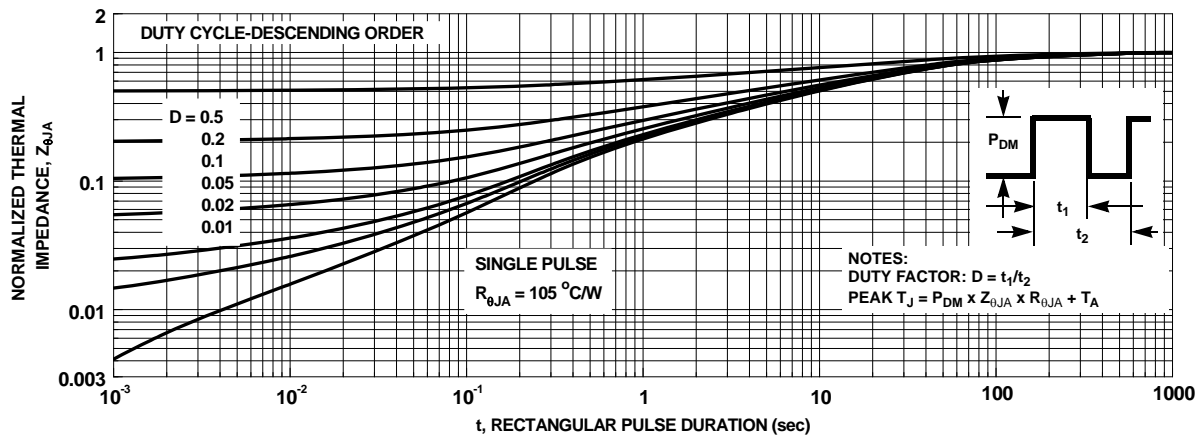


Figure 12. Single Pulse Maximum Power Dissipation

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








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CTL™	IntelliMAX™	Saving our world, 1mW/W at a time™	TinyPower™
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