



N-Channel Synchronous MOSFETs with Break-Before-Make

FEATURES

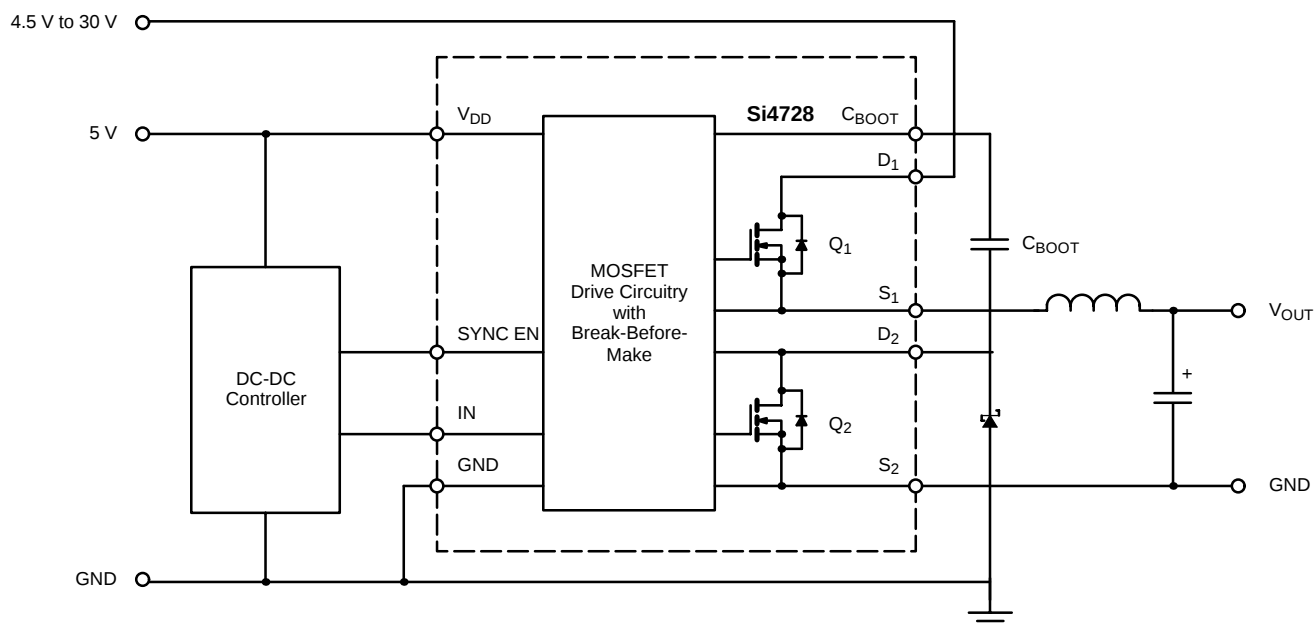
- 4.5- to 30-V Operation
- Driver Impedance— $3\ \Omega$
- Undervoltage Lockout
- Fast Switching Times (30 ns typ.)
- 30-V MOSFETs
- High Side: $0.018\ \Omega$ @ $V_{DD} = 4.5\text{ V}$
- Low Side: $0.0105\ \Omega$ @ $V_{DD} = 4.5\text{ V}$
- Switching Frequency: 250 kHz to 1 MHz

DESCRIPTION

The Si4728CY n-channel synchronous MOSFET with break-before-make (BBM) is a high speed driver designed to operate in high frequency dc-dc switchmode power supplies. Its purpose is to simplify the use of n-channel MOSFETs in high frequency buck regulators. This device is design to be used with any single output PWM IC or ASIC to produce a

highly efficient low cost synchronous rectifier converter. A synchronous enable pin (disable = low, enable = high) controls the synchronous function for light load conditions. The Si4728CY is packaged in Vishay Siliconix's high performance LITTLE FOOT® SO-16 package.

FUNCTIONAL BLOCK DIAGRAM





Vishay Siliconix

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

Parameter		Symbol	Steady State	Unit
Logic Supply		V _{DD}	7	V
Logic Inputs		V _{IN}	-0.7 to V _{DD} + 0.3	
Drain-Source Voltage		V _{DS}	-1.0 to 30	
Bootstrap Voltage		V _{BOOT}	7	
Synchronous Pin Voltage		V _{SYNC}	-0.7 to V _{DD} +0.3	
Maximum Power Dissipation ^a		P _D	4	W
Operating Junction and Storage Temperature Range	Driver	T _J , T _{stg}	-65 to 125	°C
	MOSFETs		-65 to 150	

Notes

- a. Surface mounted on 1" x 1" FR4 board, full copper two sides.
b. Pulse test: pulse width $\leq 300 \mu\text{s}$, duty cycle $\leq 2\%$.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Steady State	Unit
Drain Voltage	V_{D1}	4.5 to 30	V
Logic Supply	V_{DD}	4.5 to 5.5	
Input Logic High Voltage	V_{IH}	$0.7 \times V_{DD}$ to V_{DD}	
Input Logic Low Voltage	V_{IL}	-0.3 to $0.3 \times V_{DD}$	
Bootstrap Capacitor	C_{BOOT}	100 n to 1 μ	F
Ambient Temperature	T_A	-40 to 85	$^\circ\text{C}$

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Highside Junction-to-Ambient ^a	R_{thJA1}	85	105	$^\circ\text{C/W}$
Lowside Junction-to-Ambient ^a	R_{thJA2}	68	85	
Highside Junction-to-Foot (Drain) ^b	R_{thJF1}	24	30	
Lowside Junction-to-Foot (Drain) ^b	R_{thJF2}	16	20	

Notes

- a. Surface Mounted on 1" x 1" FR4 Board.
b. Junction-to-foot thermal impedance represents the effective thermal impedance of all heat carrying leads in parallel and is intended for use in conjunction with the thermal impedance of the PC board pads to ambient ($R_{thJA} = R_{thJF} + R_{thPCB-A}$). It can also be used to estimate chip temperature if power dissipation and the lead temperature of a heat carrying (drain) lead is known.



SPECIFICATIONS								
Parameter	Symbol	Test Conditions Unless Specified T _J = 25°C 4.5 V < V _{DD} < 5.5 V, 4.5 V < V _{D1} < 30 V		Limits			Unit	
				Min	Typ	Max		
Power Supplies								
Logic Voltage	V _{DD}			4.5		5.5	V	
Logic Current	I _{DD(EN)}	V _{DD} = 4.5 V, V _{IN} = 4.5 V			280	500	μA	
	I _{DD(DIS)}	V _{DD} = 4.5 V, V _{IN} = 0 V			220	500		
Logic Input								
Logic Input Voltage (V _{IN})	High	V _{IH}	V _{DD} = 4.5 V	3.15	2.3		V	
	Low	V _{IL}		-0.3	2.25	0.8		
Protection								
Break-Before-Make Reference	V _{BBM}	V _{DD} = 5.5 V			2.4		V	
Undervoltage Lockout	V _{UVLO}	SYNC = 4.5 V		3.75	4	4.25		
Undervoltage Lockout Hysteresis	V _H				0.4			
MOSFET Drivers								
Driver Impedance	R _{DR1}	V _{DD} = 4.5 V	Driver 1		3.6		Ω	
	R _{DR2}		Driver 2		2			
MOSFETs								
Drain-Source Voltage	V _{DS}	I _D = 250 μA		30			V	
Drain-Source On-State Resistance ^a	r _{DS(on)1}	V _{DD} = 4.5 V, I _D = 10 A T _J = 25°C		Q1	13	18	mΩ	
	Q2			8	10.5			
Diode Forward Voltage ^a	V _{SD1}	I _S = 2 A, V _{GS} = 0 V		Q1	0.7	1.1	V	
	V _{SD2}			Q2	0.7	1.1		
Dynamic ^b (Unless Specified—F _s = 250 kHz, dc = 10%. V _{DD} = 5 V, I = 10 A, Refer to Switching Test Setup)								
Rise Time	t _{rd1}	10% - 90%		Driver 1		31	60	ns
	t _{rd2}			Driver 2		23	40	
Fall Time	t _{fd1}	90% - 10%		Driver 1		9	20	
	t _{fd2}			Driver 2		15	40	
Turn-Off Delay	t _{d(off)1}	See Timing Diagram		V _{IN} to G ₁		50	100	
	t _{d(off)2}			V _{IN} to G ₂		27	60	
Δt	Δt ₁₋₂			G ₁ to G ₂		19	40	
	Δt ₂₋₁			G ₂ to G ₁		38	80	
Rise Time	t _r	10% - 90%		S ₁ /D ₂		29	60	
Fall Time	t _f	90% - 10%		S ₁ /D ₂		10	20	
Source-Drain Reverse Recovery Time—Q ₂	t _{fr2}	I _F 2.7 A, di/dt = 100 A/μs				50	80	

Notes

a. Pulse test: pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.

b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

DETAILED BLOCK DIAGRAM

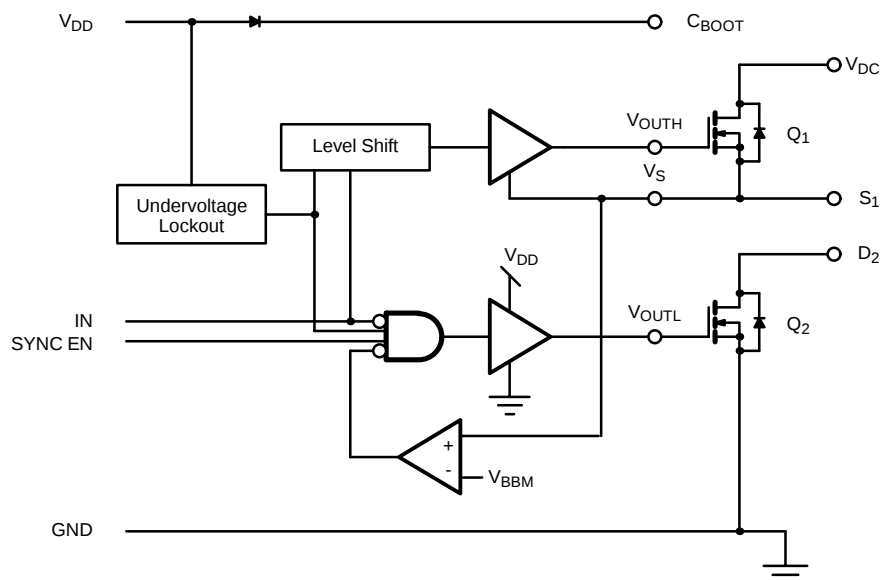
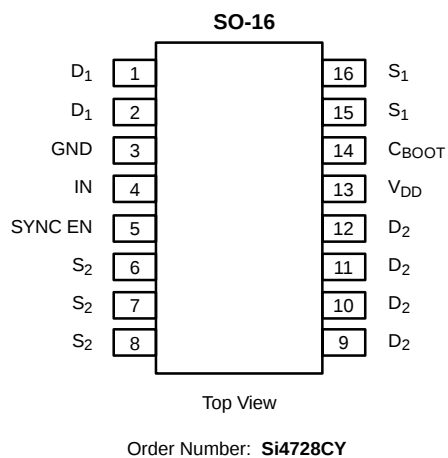


FIGURE 1.

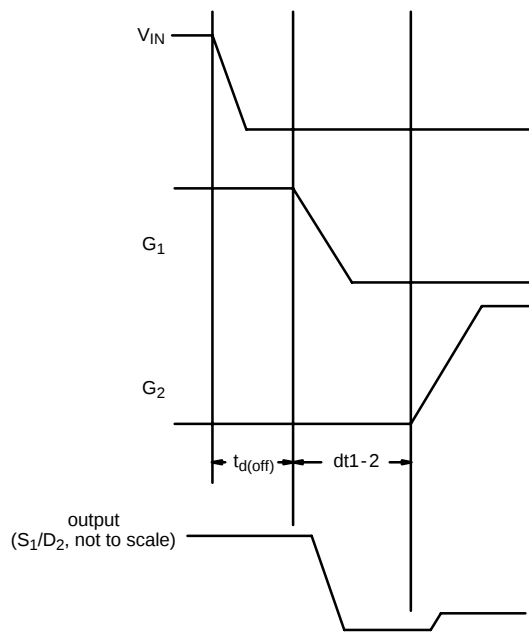
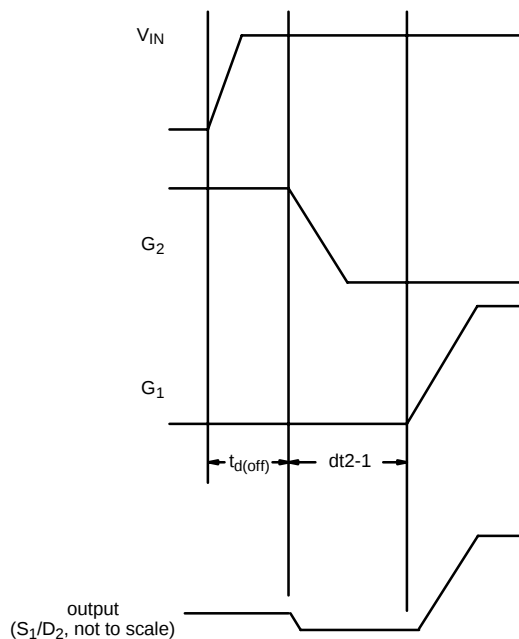
PIN CONFIGURATION



TRUTH TABLE			
Sync EN	V _{IN}	Q ₁	Q ₂
H	H	ON	OFF
H	L	OFF	ON
L	H	ON	OFF
L	L	OFF	OFF

PIN DESCRIPTION		
Pin Number	Symbol	Description
1, 2	D ₁	Highside MOSFET Drain
3	GND	Ground
4	IN	Input Logic Signal
5	SYNC EN	Synchronous Enable
6, 7, 8	S ₂	Lowside MOSFET Source
9, 10, 11, 12	D ₂	Lowside MOSFET Drain
13	V _{DD}	Logic Supply
14	C _{BOOT}	Bootstrap Capacitor For Upper MOSFET
15, 16	S ₁	Highside MOSFET Source

TIMING DIAGRAM

FIGURE 2. Δt_{1-2} FIGURE 3. Δt_{2-1}

SWITCHING TEST SETUP

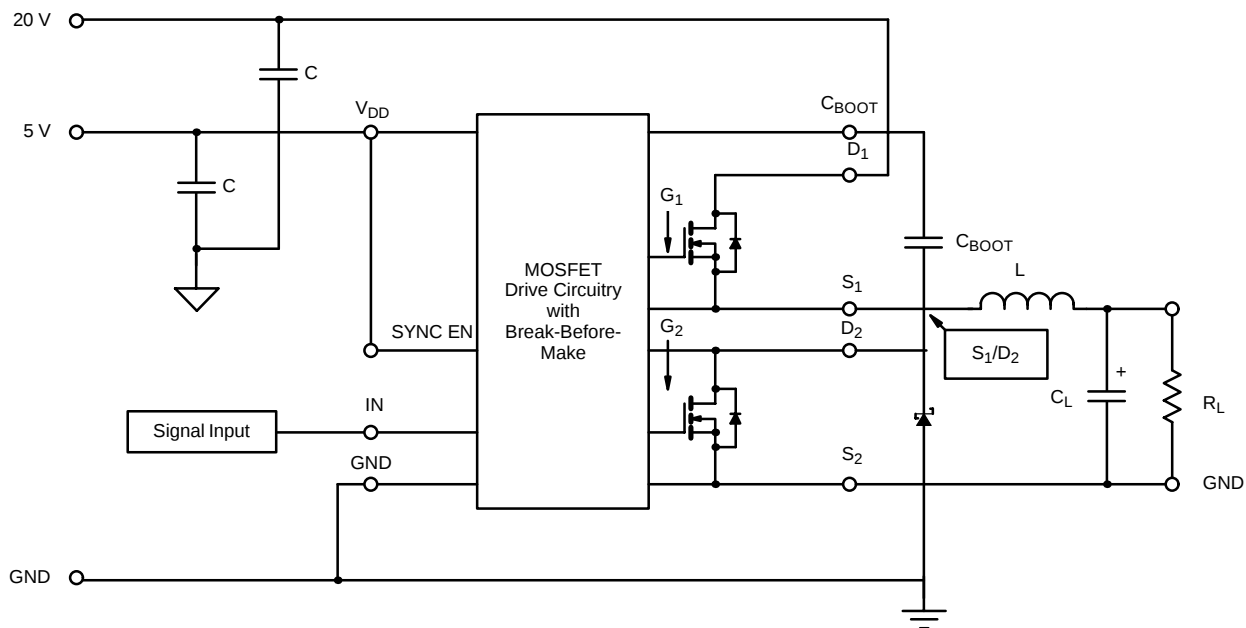
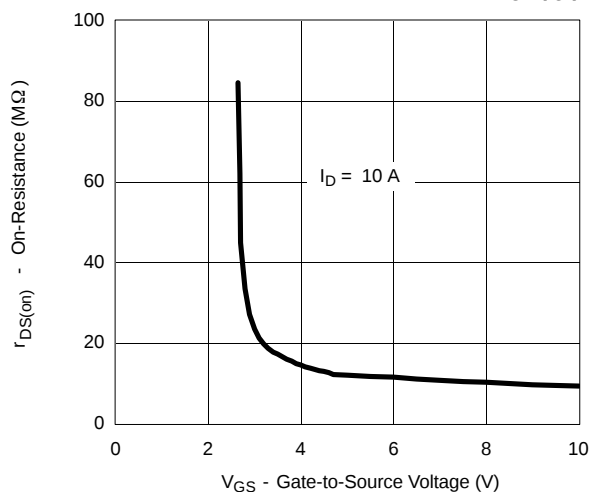
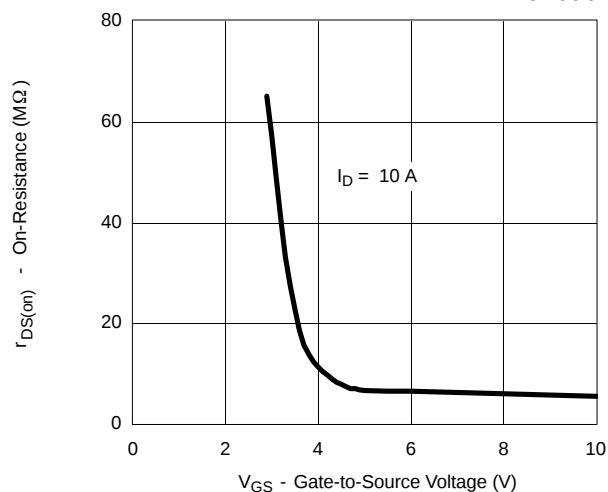
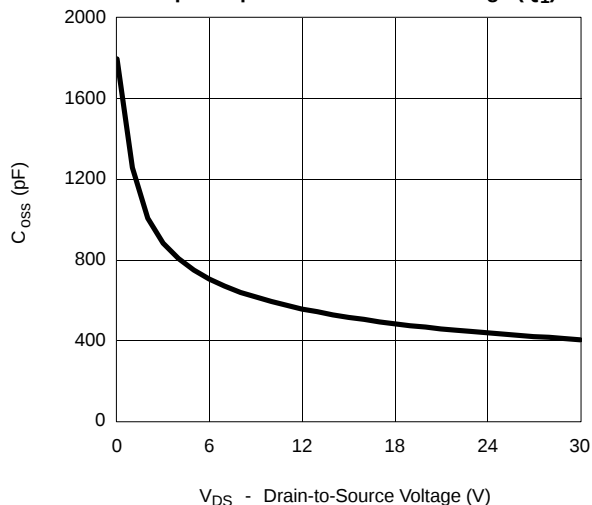
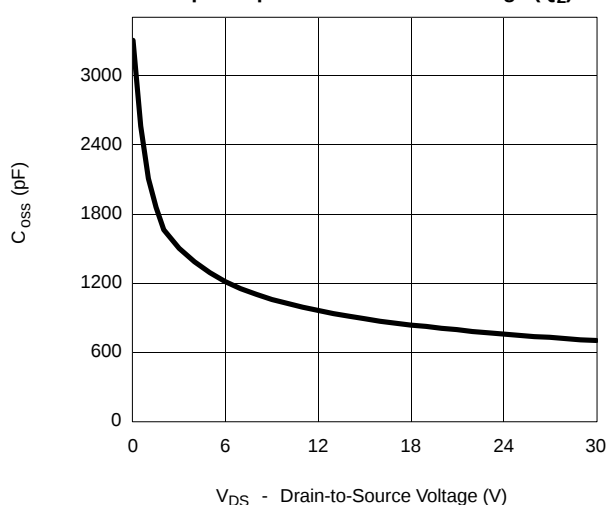
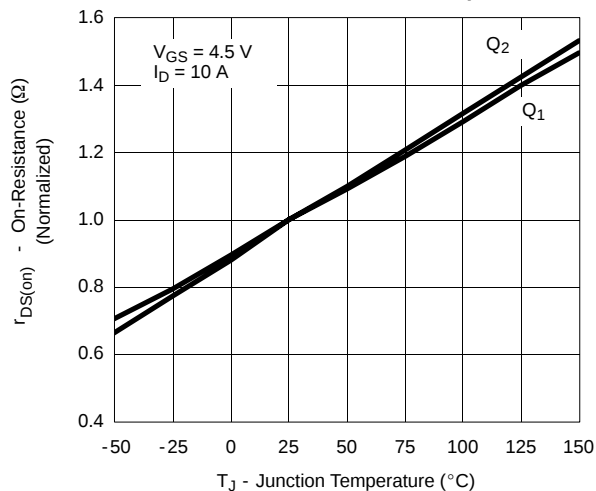
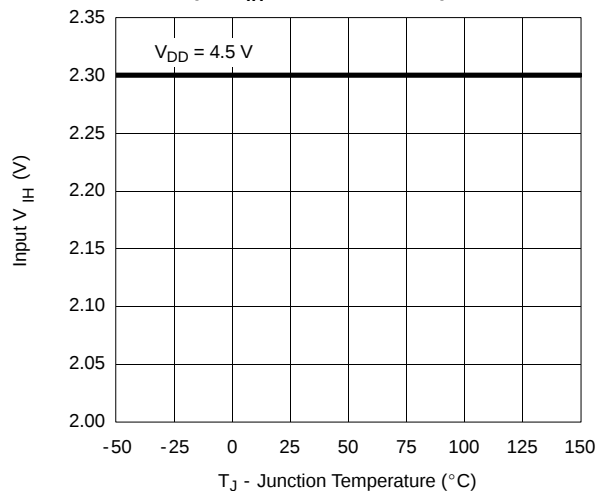
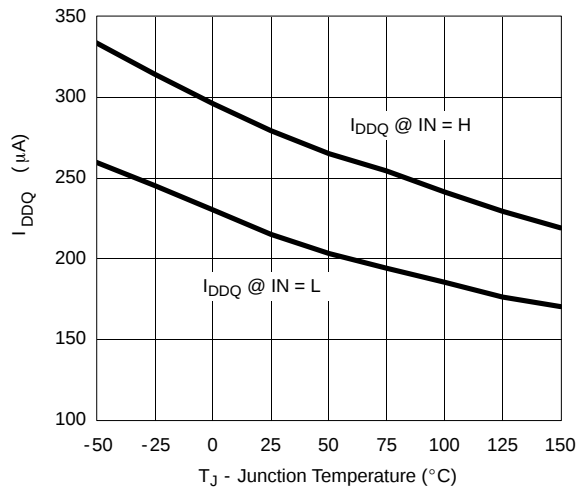
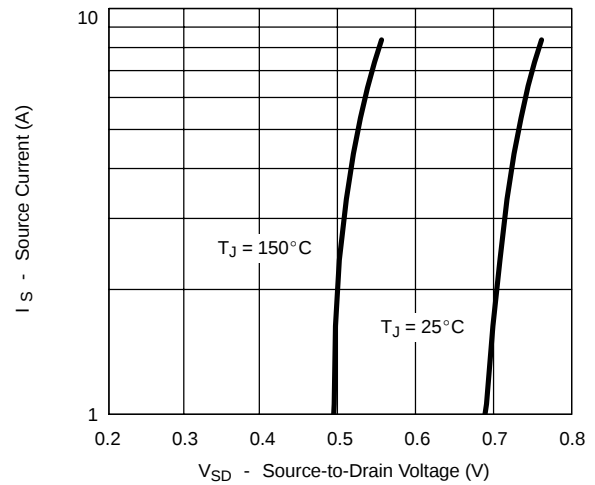
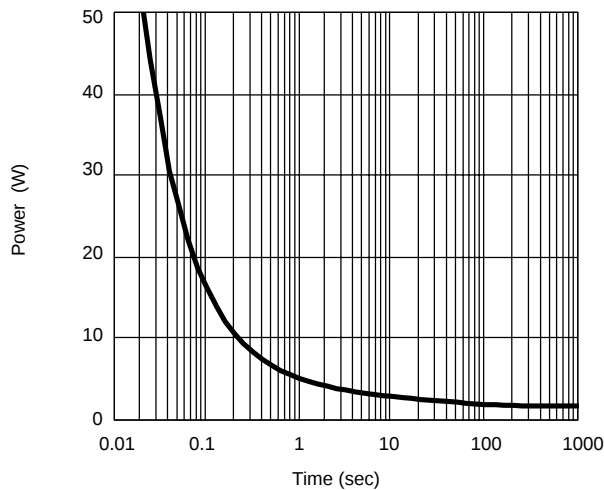
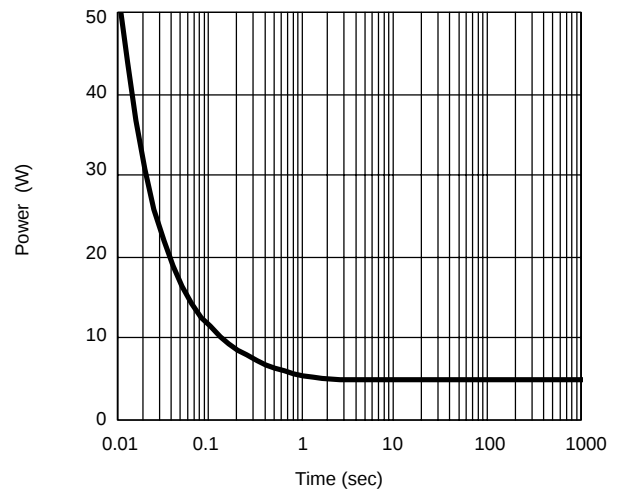
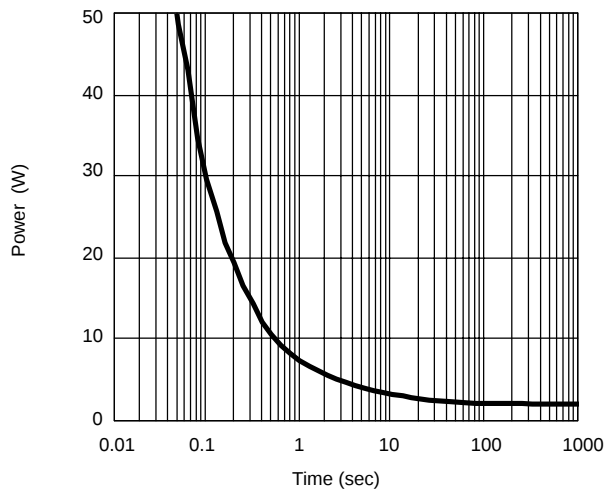
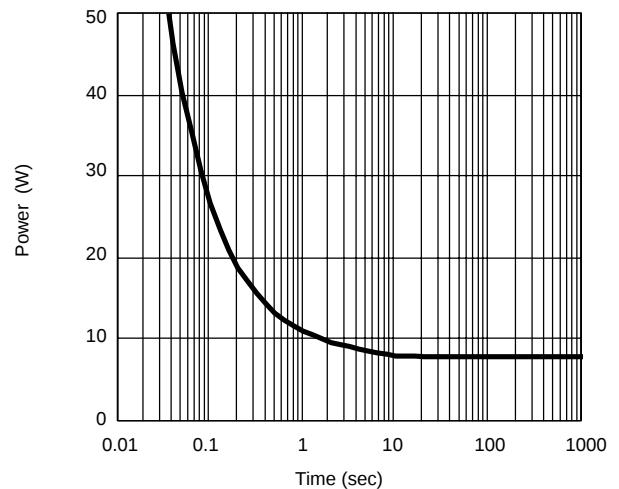
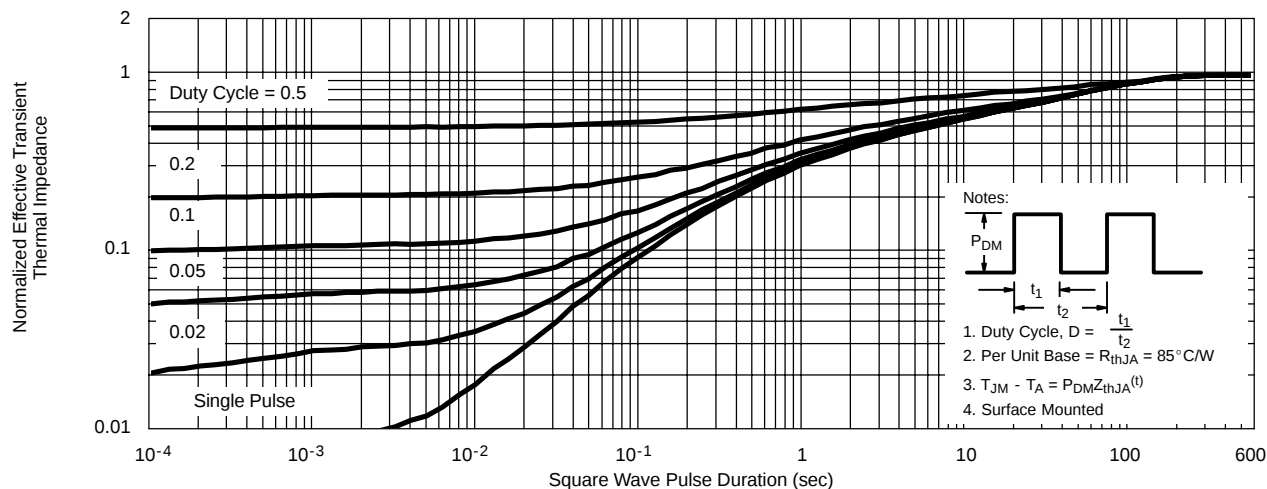
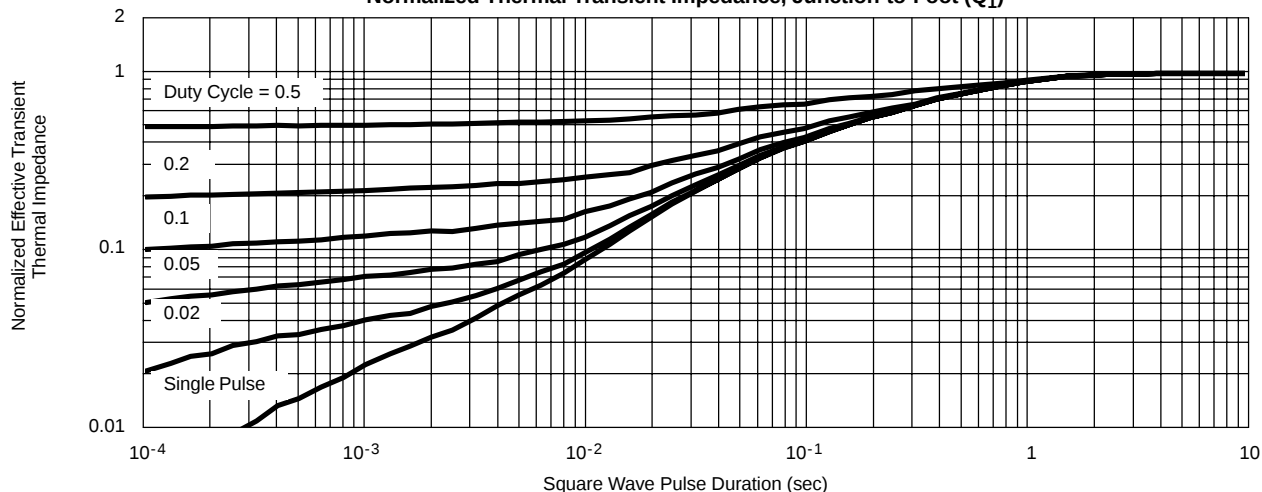
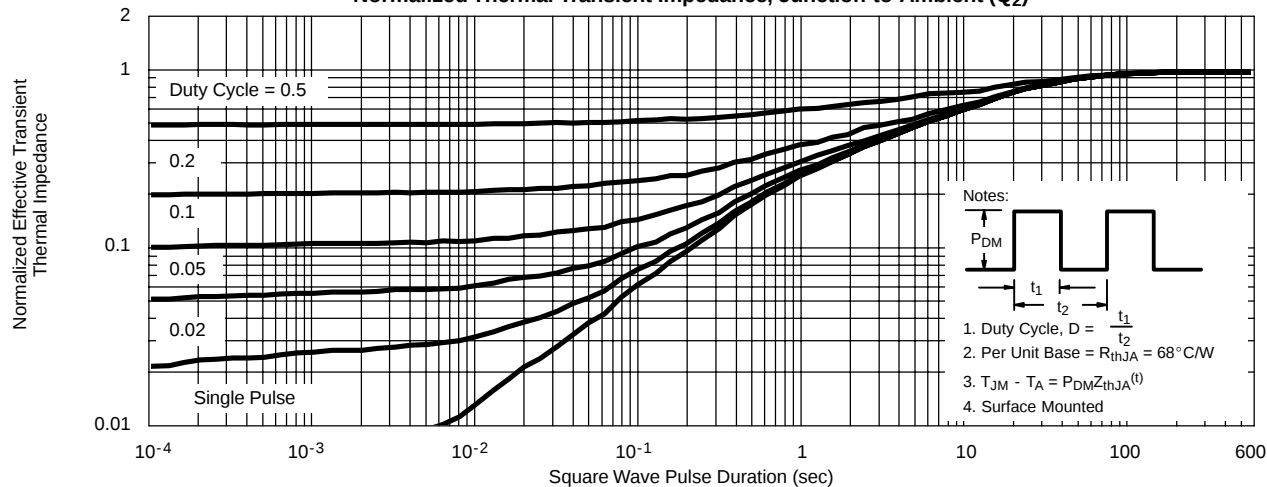


FIGURE 4.

TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)
On-Resistance vs. Gate-to-Source Voltage (Q₁)

On-Resistance vs. Gate-to-Source Voltage (Q₂)

Output Capacitance vs. Drain Voltage (Q₁)

Output Capacitance vs. Drain Voltage (Q₂)

On-Resistance vs. Junction Temperature

Input V_{IH} vs. Junction Temperature


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**Input Current vs. Junction Temperature****Source-Drain Diode Forward Voltage****Single Pulse Power, Junction-to-Foot (Q_1)****Single Pulse Power, Junction-to-Ambient (Q_1)****Single Pulse Power, Junction-to-Foot (Q_2)****Single Pulse Power, Junction-to-Ambient (Q_2)**

TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)Normalized Thermal Transient Impedance, Junction-to-Ambient (Q_1)Normalized Thermal Transient Impedance, Junction-to-Foot (Q_1)Normalized Thermal Transient Impedance, Junction-to-Ambient (Q_2)

TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)