10V Single Channel Load Switch

General Description

The EM5220 is a single channel load switch with programmable rise time and with an integrated output discharge control. The device contains a P-channel NOSFET that can operate over an input voltage range of 4.5V to 10V. The switch is controlled by an on and off low level logic input, which is capable of interfacing with GPIO signals.

The programmable rise time of the device can reduces inrush current caused by large load capacitances during power up. The configurable DIS pin controls the on/off time of the device to allow design flexibility for controlling the power on/off sequence.

Ordering Information

Part Number	Package	Note
EM5220VDT	TDFN2.0X2.0-08	

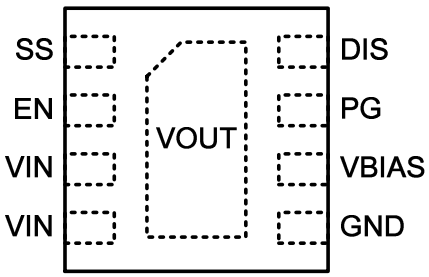
Features

- No External Gate Pull-Up Resistor Required
- 4.5V to 11V Input Voltage Range
- Low Typical $R_{DS(ON)}$ of 21mΩ
- Adjustable Start-Up and Discharge Rate
- TDFN2.0x2.0 with Thermal Pad
- Over Temperature Protection
- RoHS Compliant and 100% Lead (Pb)-Free

Applications

- Ultrabook
- Notebooks & Netbooks
- Set-top Boxes
- Tablet PC
- Telecom systems
- Consumer electronics

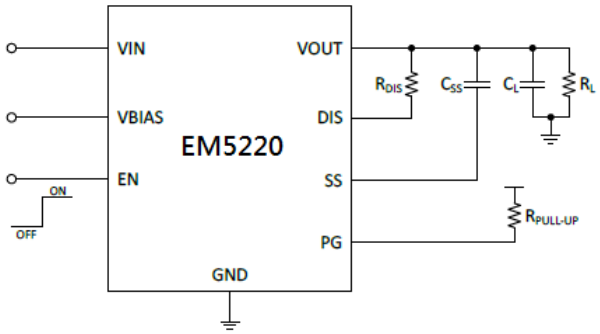
PIN Configuration



TOP VIEW

TDFN2.0X2.0-08

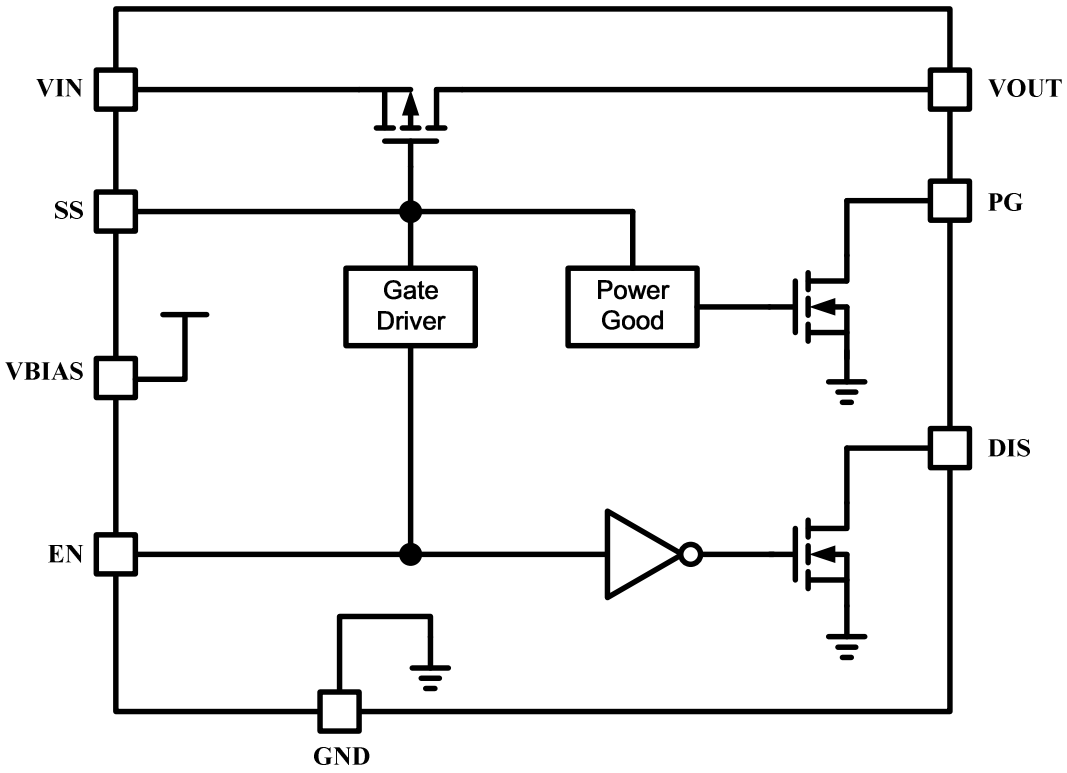
Typical Application Circuit



Pin Assignment

Pin Name	Pin Number	Pin Function
SS	1	**Soft Start.** An external capacitor connected between SS and VOUT sets the soft-start time of the output voltage. The internal circuit controls the slew rate of the output voltage at turn on in order to limiting the inrush current.
EN	2	**Enable Input** Active high
VIN	3, 4	**Input Voltage** Connects to the Source of the P-channel MOSFET
GND	5	Ground
VBIAS	6	**Bias supply voltage.** Power supply to the device. Recommended voltage range for this pin is 2.5V to 5.5V.
PG	7	**Power Good** The PG pin is connected to the drain of an internal NFET. An external pull-up resistor is required at PG to indicate the status to downstream device.
DIS	8	**Output Discharge** An external resistor between DIS and VOUT sets the discharge rate of VOUT
VOUT	PAD	**Output Voltage.** VOUT is power output pin. PAD connects to the Drain of the P-channel MOSFET.

Function Block Diagram



Absolute Maximum Rating

- Input Voltage, V_{IN} ---------- -0.3V to +12V
- Output Voltage, V_{OUT} ---------- -0.3V to +12V
- Bias Voltage, V_{BIAS} ---------- -0.3V to +6.0V
- Soft-start, V_{SS} ---------- -0.3V to +12V
- DIS Pin, V_{DIS} ---------- -0.3V to +12V
- Enable Voltage, V_{EN} ---------- -0.3V to +6.0V
- Power Good, V_{PG} ---------- -0.3V to +12V
- Power Dissipation, P_D @ T_A = 25°C, TDFN2.0X2.0-08
  - (Note 2) ---------- 0.35W
  - (Note 3) ---------- 1.8W
- Package Thermal Resistance, θ_{JA}, TDFN2.0X2.0-08 (Note 2)
  - (Note 2) ---------- 300 °C /W
  - (Note 3) ---------- 60 °C /W
- Junction Temperature---------- 150°C
- Lead Temperature (Soldering, 10 sec.)---------- 260°C
- Storage Temperature ---------- –65°C to 150°C
- ESD susceptibility (Note4)
  - HBM (Human Body Mode)---------- 2KV
  - MM (Machine Mode)---------- 200V
  - CDM(Charge Device Mode)---------- 1KV

Recommended Operating Conditions (Note5)

- Input Voltage, V_{IN} ---------- +4.5V to +11V
- Bias Voltage, V_{BIAS} ---------- +2.5V to +5.5V
- Enable Voltage, V_{EN} ---------- +0V to +5.5V
- Junction Temperature ---------- -40°C to 125°C
- Ambient Temperature ---------- -40°C to 85°C

Electrical Characteristics

V_{BIAS} = 2.5 ~ 5V, C_{IN}=1uF, C_L=100nF, T_A=25°C, unless otherwise specified

Parameter	Symbol	Test Conditions		Min	Typ	Max	Units
VIN Quiescent Current	I_{VIN_Q}	I_{OUT} = 0A, V_{BIAS}=5V	V_{IN} = 10V		1		uA
			V_{IN} = 8.4V		0.65		
			V_{IN} = 5V		0.14		
	I_{VIN_Q}	I_{OUT} = 0A, V_{BIAS}=2.5V	V_{IN} = 10V		1		uA
			V_{IN} = 8.4V		0.65		
			V_{IN} = 5V		0.14		
VIN Shutdown Current	I_{VIN_SD}	V_{IN} = 10V, V_{EN} = 0V			1.5		nA
VBIAS Quiescent Current	I_{VBIAS_Q}	V_{IN} = 10V, V_{BIAS}=5V, I_{OUT} = 0A			0.3		nA
		V_{IN} = 10V, V_{BIAS}=2.5V, I_{OUT} = 0A			0.1		
VBIAS Shutdown Current	I_{VBIAS_SD}	V_{IN} = 10V, V_{BIAS}=5V, V_{EN} = 0V			0.2		nA
		V_{IN} = 10V, V_{BIAS}=2.5V, V_{EN} = 0V			0.1		
Load Switch On-Resistance	$R_{DS(ON)}$	I_{OUT} = 1A	V_{IN} = 10V		21	31	mΩ
			V_{IN} = 8.4V		21	31	
			V_{IN} = 5V		23	33	
EN Input Logic High Voltage	V_{IH_EN}			1			V
EN Input Logic Low Voltage	V_{IL_EN}					0.5	V
EN Input Leakage	I_{LEAK_EN}	V_{EN} = V_{BIAS}				100	nA
Discharge FET On-Resistance	R_{DS_DIS}	V_{EN} = 0V, I_{DIS}= 10mA	V_{BIAS} = 5.0V		8	20	Ω
			V_{BIAS} = 2.5V		11	25	
Power Good Output Low Level	V_{OL_PG}	I_{OL_PG} = 100uA, V_{EN} = 0V				0.2	V
Power Good High-Impedance Current	I_{OZ_PG}	V_{PG} = V_{BIAS}, V_{EN} = V_{BIAS}				0.05	uA

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.

Note 2. For a device surface mounted on minimum recommended pad layout, in still air conditions; the device is measured when operating in a steady state condition.

Note 3. For a device surface mounted on 25mm by 25mm by 1.6mm FR4 PCB with high coverage of single sided 2oz copper, in still air conditions; the device is measured when operating in a steady state condition.

Note 4. Devices are ESD sensitive. Handling precaution is recommended.

Note 5. The device is not guaranteed to function outside its operating conditions.

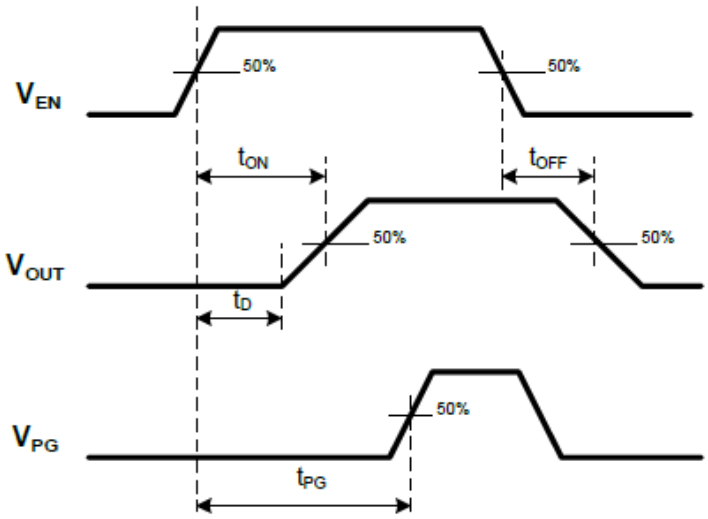
Note 6. EMC will review datasheet by quarter, and update new version.

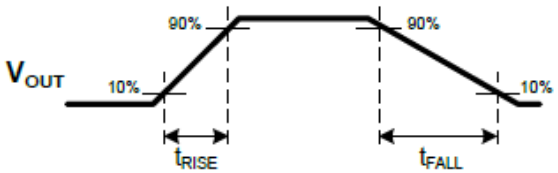
Switching Characteristics

V_{BIAS} = 2.5 ~ 5V, C_{IN}=1uF, C_L=100nF, T_A=25°C, unless otherwise specified

Parameter	Symbol	Test Conditions		Min	Typ	Max	Units
Output Rise Time	t_{RISE}	R_L = 10Ω C_{SS} = 10nF	V_{IN} = 10V V_{IN} = 8.4V V_{IN} = 5V		150		us
Output Turn-ON Delay Time	t_{ON}	R_L = 10Ω C_{SS} = 10nF	V_{IN} = 10V V_{IN} = 8.4V V_{IN} = 5V		90		us
Output Fall Time	t_{FALL}	R_L = Open R_{DIS} = 240Ω, C_{SS} = 10nF	V_{IN} = 10V V_{IN} = 8.4V V_{IN} = 5V		70		us
Output Turn-OFF Delay Time	t_{OFF}	RL = Open R_{DIS} = 240Ω, C_{SS} = 10nF	V_{IN} = 10V V_{IN} = 8.4V V_{IN} = 5V		30		us
Output Start Delay Time	t_D	R_L = 10Ω C_{SS} = 10nF	V_{IN} = 10V V_{IN} = 8.4V V_{IN} = 5V		20		us
Power Good Delay Time	t_{PG}	R_L = 10Ω C_{SS} = 10nF	V_{IN} = 10V V_{IN} = 8.4V V_{IN} = 5V		400		us

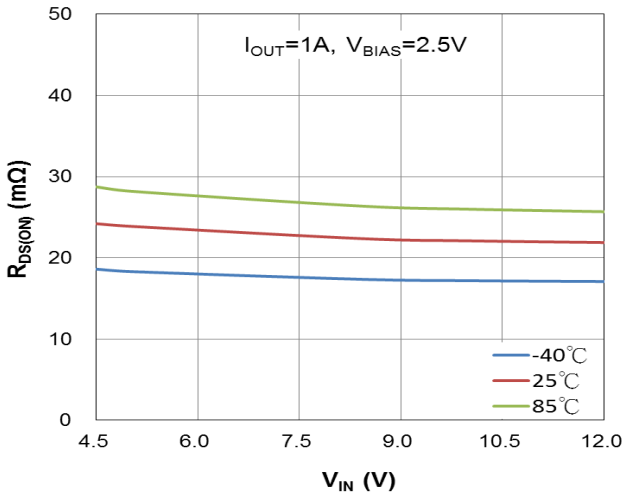
t_{ON}/t_{OFF} Waveforms



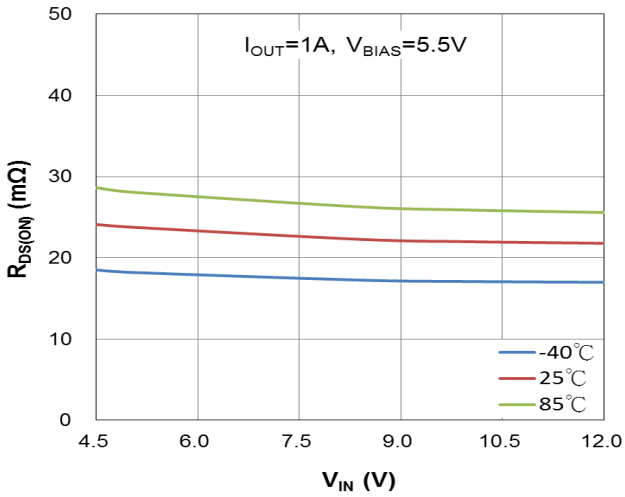


Typical Operating Characteristics

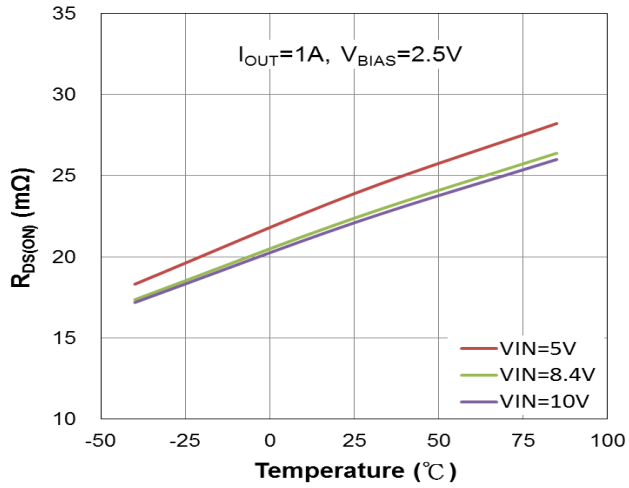
$R_{DS(ON)}$ vs. V_{IN} (V_{BIAS}=2.5V)



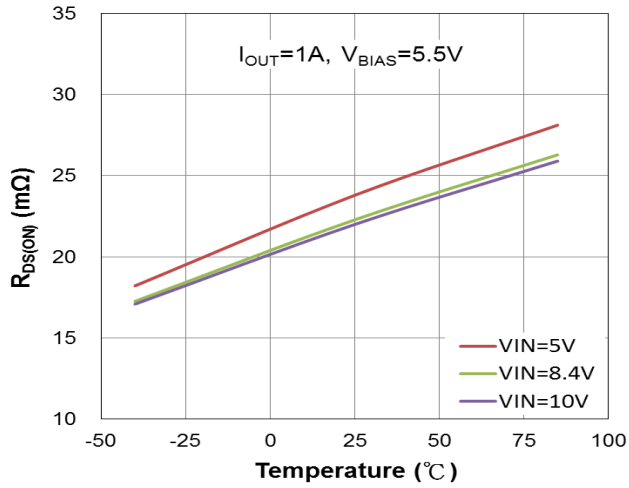
$R_{DS(ON)}$ vs. V_{IN} (V_{BIAS}=5.5V)



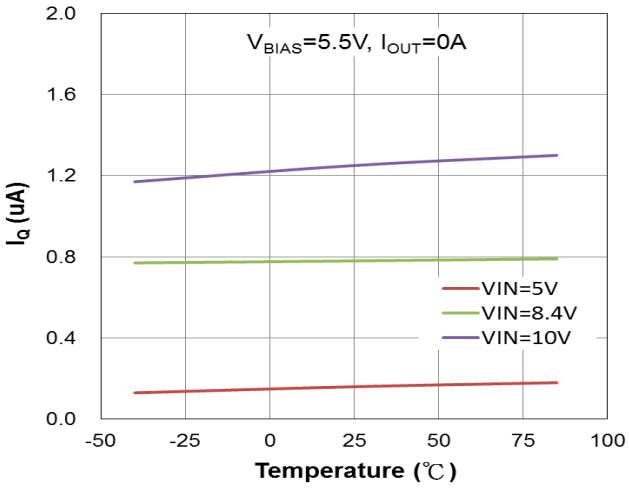
$R_{DS(ON)}$ vs. Temperature (V_{BIAS}=2.5V)



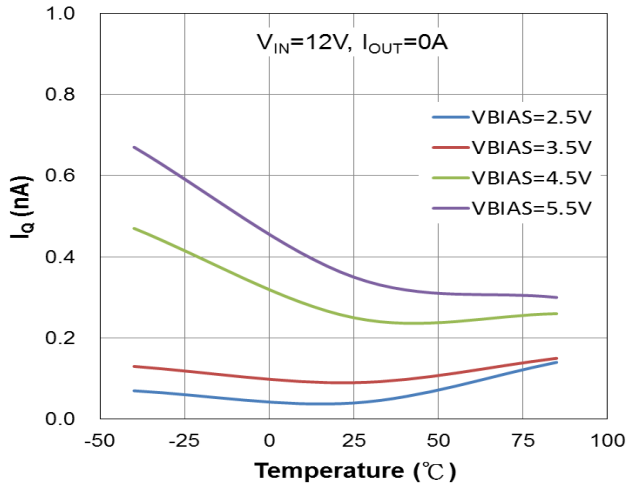
$R_{DS(ON)}$ vs. Temperature (V_{BIAS}=5.5V)



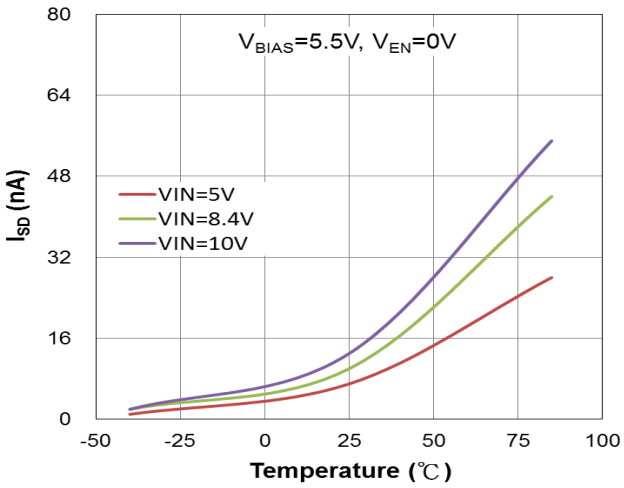
V_{IN} Quiescent Current vs Temperature



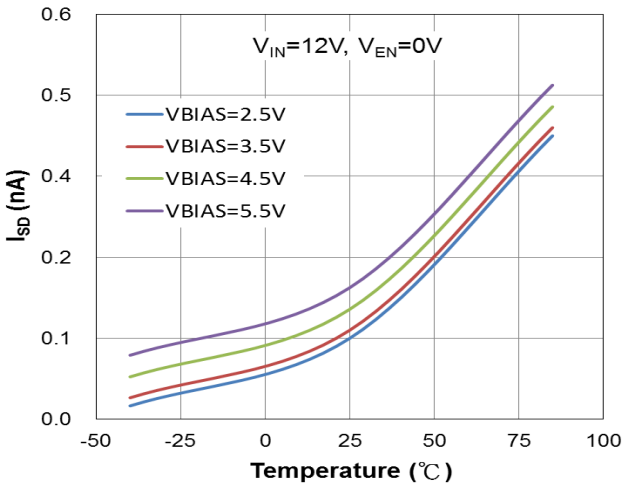
V_{BIAS} Quiescent Current vs Temperature



V_{IN} Shutdown Current vs Temperature

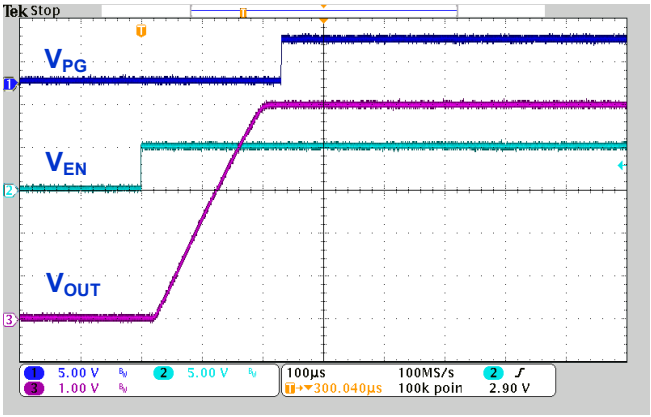


V_{BIAS} Shutdown Current vs Temperature



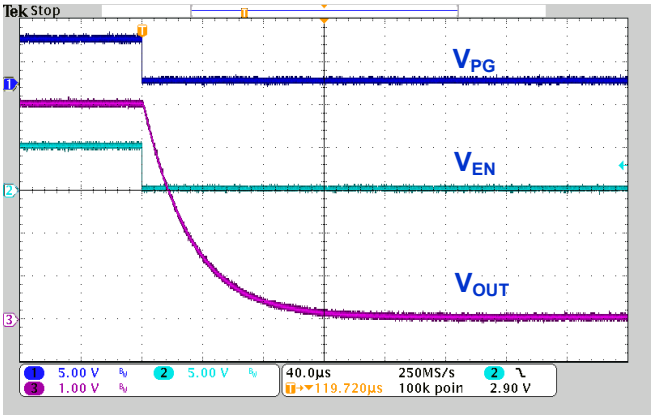
Turn On Test Waveform (V_{IN}=5V)

(T_A=25℃, R_L=10Ω, C_{SS}=10nF, C_L=0.1uF, C_{IN}=1uF)



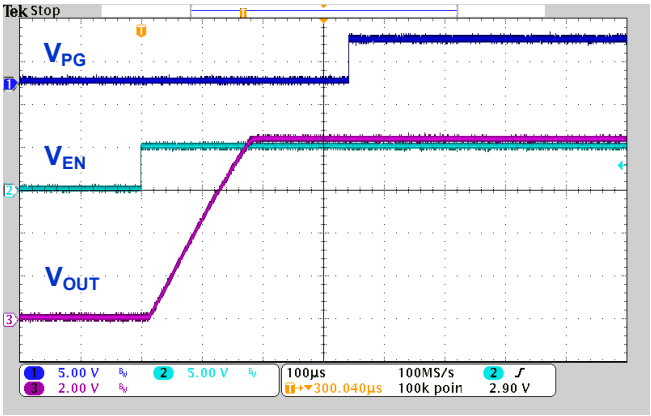
Turn Off Test Waveform (V_{IN}=5V)

(T_A=25℃, R_{DIS}=243Ω, C_{SS}=10nF, C_L=0.1uF, C_{IN}=1uF)



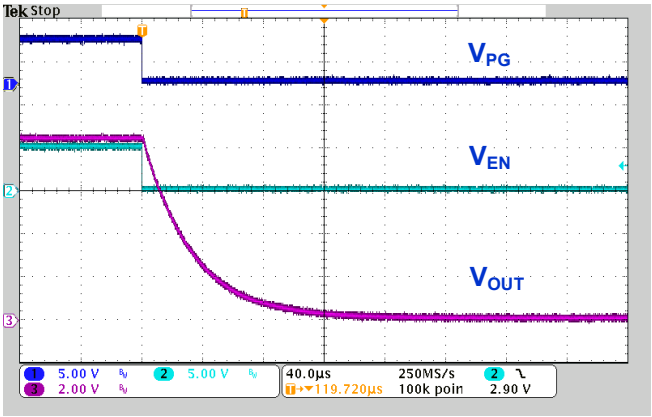
Turn On Test Waveform (V_{IN}=8.4V)

(T_A=25℃, R_L=10Ω, C_{SS}=10nF, C_L=0.1uF, C_{IN}=1uF)



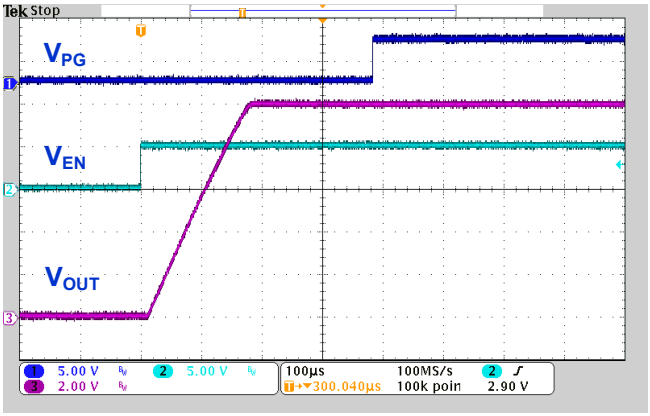
Turn Off Test Waveform (V_{IN}=8.4V)

(T_A=25℃, R_{DIS}=243Ω, C_{SS}=10nF, C_L=0.1uF, C_{IN}=1uF)



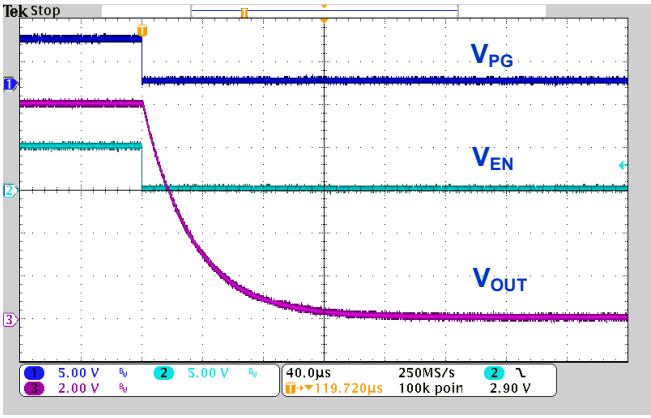
Turn On Test Waveform (V_{IN}=10V)

(T_A=25℃, R_L=10Ω, C_{SS}=10nF, C_L=0.1uF, C_{IN}=1uF)

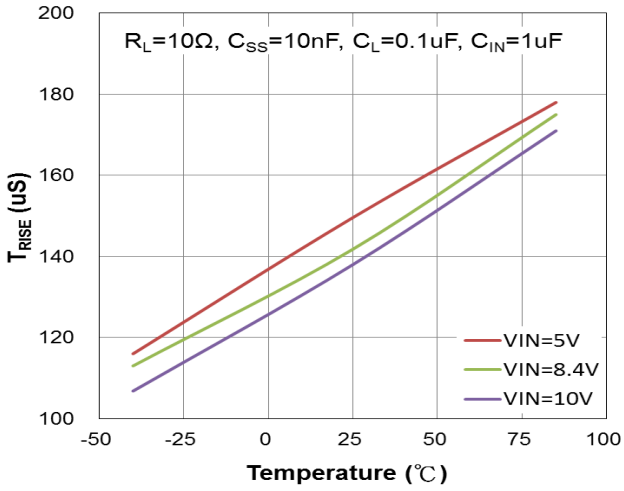


Turn Off Test Waveform (V_{IN}=10V)

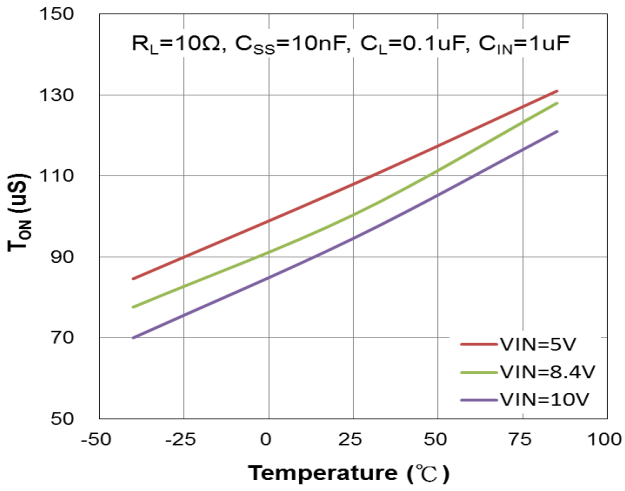
(T_A=25℃, R_{DIS}=243Ω, C_{SS}=10nF, C_L=0.1uF, C_{IN}=1uF)



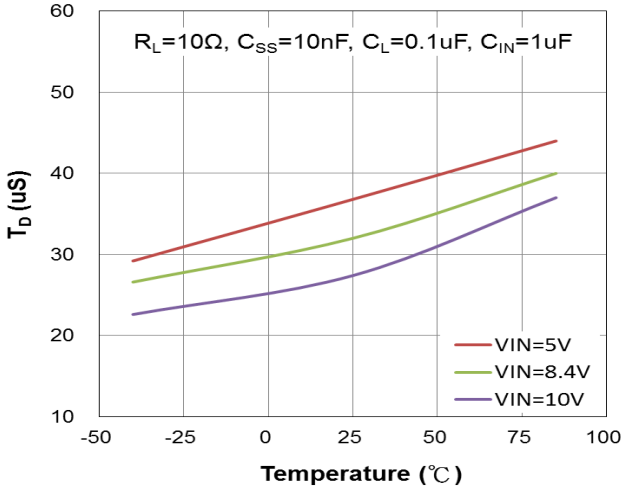
T_{RISE} vs Temperature



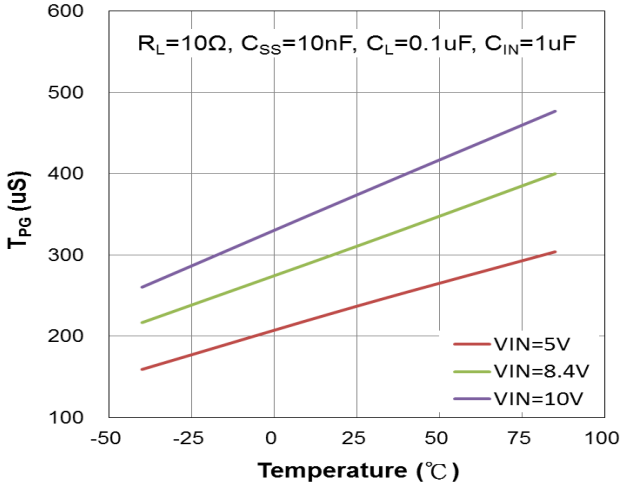
T_{ON} vs Temperature



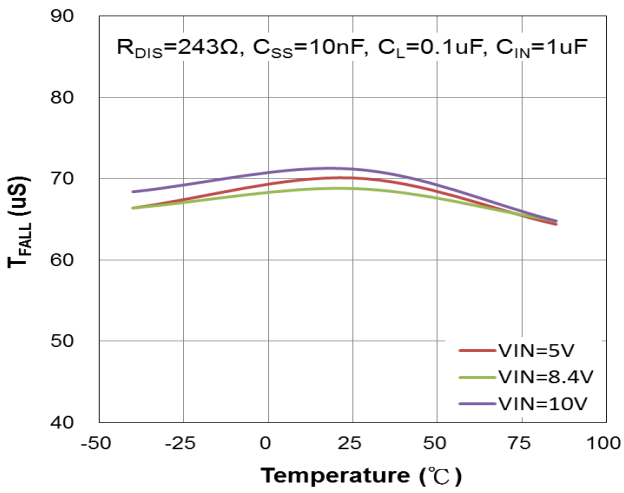
T_D vs Temperature



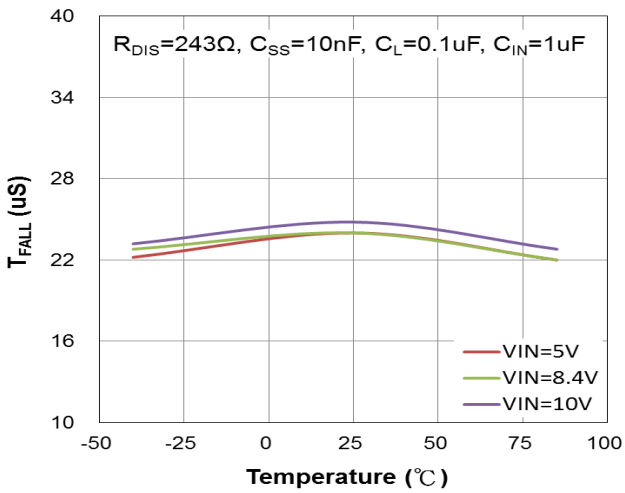
T_{PG} vs Temperature



T_{FALL} vs Temperature



T_{OFF} vs Temperature



Application Information

Adjustable Slew Rate/Soft-Start

SS pin allows the output ramp time of the switch to be controlled using an external capacitor (C_{SS}). This timing capacitor is connected between the SS and V_{OUT} pin. Rise times (μS) for different values of C_{SS} and V_{IN} are shown in the table below with V_{BIAS} = 5.5V.

Rise Time (uS) Measured at +25 °C using 0805 X7R 10% 50V capacitor, C_L=100nF, R_{DIS}=243ohm, R_L=10ohm				
C_{SS}	V_{IN}=5.0V	V_{IN}=8.4V	V_{IN}=10V	V_{IN}=12V
1nF	20.9	17.3	16.5	16.0
10nF	143	135	133	138
100nF	1430	1392	1438	1502

Table 1 Timing Capacitors and Rise Times

Adjustable Discharge

When EN goes low, V_{OUT} is discharged to ground through the discharge resistor (R_{DIS}) on the DIS pin. A value greater than 243Ω is recommended for R_{DIS}.

While the discharge/fall-time on V_{OUT} can be controlled using R_{DIS}, capacitors on V_{OUT} and SS also contribute to the timing. Higher discharge resistance increases the RC time constant and hence, the discharge time. Fall times (μS) for different values of R_{DIS} and V_{IN} are shown in the table below with V_{BIAS} = 5.5V.

1206 250mW 1% Discharge resistorT	Fall Time (uS) Measured at +25°C, C_L=100nF, R_L=Open			
	V_{IN}=5.0V	V_{IN}=8.4V	V_{IN}=10V	V_{IN}=12V
243Ω	67.2	69.3	70.4	71.5
1,000Ω	285	291	296	301
3,900Ω	1020	1030	1050	1080

Table 2 Discharge Resistors and Output Voltage Fall Time

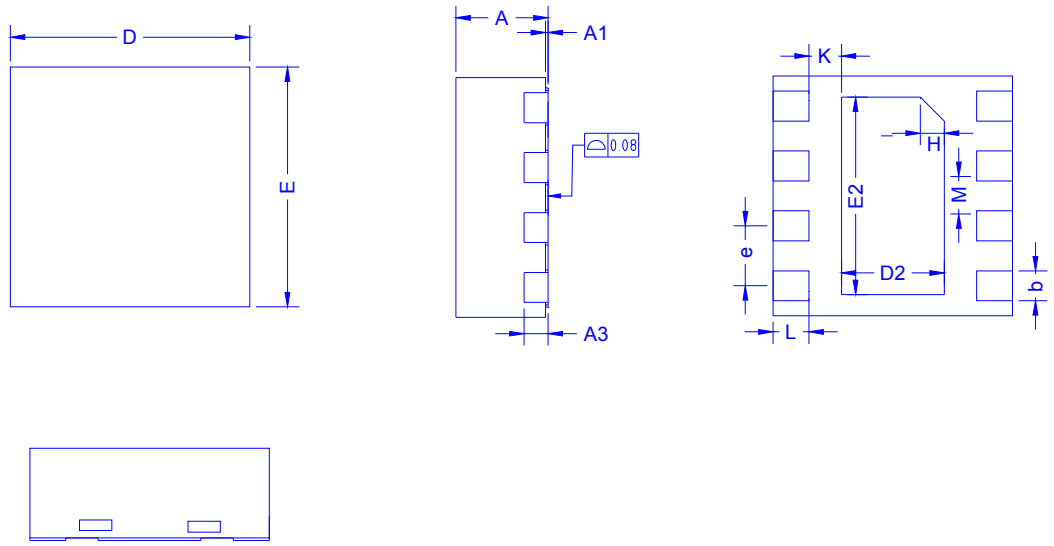
Ordering & Marking Information

Device Name: EM5220VDT for TDFN2.0X2.0-08

H1: Device Code, H1 for EM5220VDT
YWW: Date Code

Outline Drawing

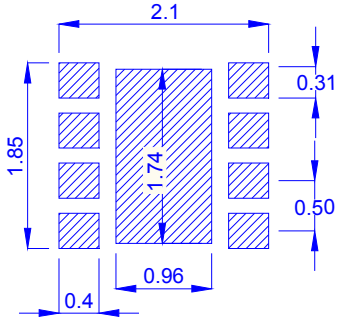
TDFN2.0X2.0-08



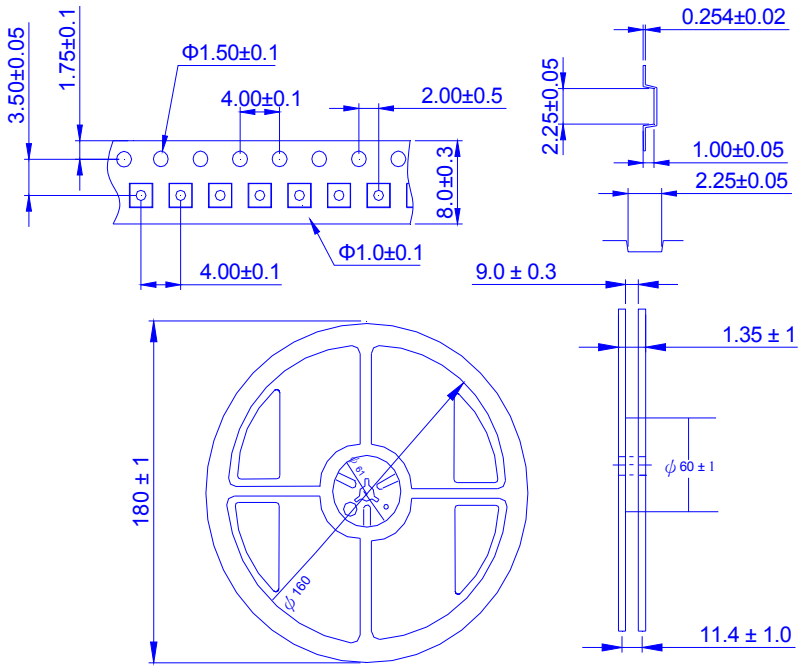
Dimension in mm

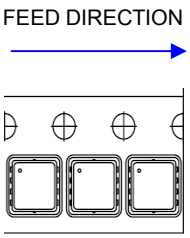
Dimension	A	A1	A3	b	D	E	D2	E2	e	K	L	H
Min.	0.50	0		0.20	1.9	1.9	0.8	1.5	0.4	0.15	0.25	
Typ.	0.55		0.15	0.25	2.0	2.0	0.9	1.6	0.5	0.25	0.30	0.2 FER
Max.	0.65	0.05		0.30	2.1	2.1	1.0	1.7	0.6	0.35	0.35	

Recommended minimum pads



Tape&Reel Information:3000pcs/Reel



產品別	TDFN2.0X2.0-08
Reel 尺寸	7”
編帶方式	
前空格	50
後空格	50
裝箱數	
滿捲數量	3K
捲/內盒比	5：1
內盒滿箱數	15K
內/外箱比	12：1
外箱滿箱數	180K