

Dual Bootstrapped 20V MOSFET Driver

Features

- Drive Two N-MOSFETs
- Adaptive Shoot-Through Protection
- 5V~20V VCC operating voltage
- 1.2A source current, 1.8A sink current
- Adjustable Dead-Time of Driver
- Tri-State PWM Input for Power Stage Shutdown
- Output Disable Function
- Embedded Bootstrap Diode
- VCC POR Feature Integrated
- MSOP-10, SOP-8 (FD), TDFN3X3-8 Package.

General Description

The M2105 is a high frequency, synchronous rectified, single phase dual MOSFET driver. Each of the drivers is capable of driving a 3000pF load with fast rising/falling time and fast propagation delay. This device implements bootstrap diode on the upper gate with only a single external capacitor. This reduced implementation complexity and allows the use of higher performance, cost effective, N-MOSFETs. Adaptive shoot through protection is integrated to prevent both MOSFETs from conducting simultaneously.

The Tri-state PWM input can turn off both high-side and low-side MOSFETs.

Applications

- High Frequency Low Profile DC/DC Converters
- High Current Low Voltage DC/DC Converters

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
M2105AP71U	2105A	-40°C~+85°C	MSOP-10
M2105AF11U	2105A	-40°C~+85°C	SOP-8 (FD)
M2105BF11U	2105B	-40°C~+85°C	SOP-8 (FD)
M2105BK51U	2105B	-40°C~+85°C	TDFN3X3-8 P0.5

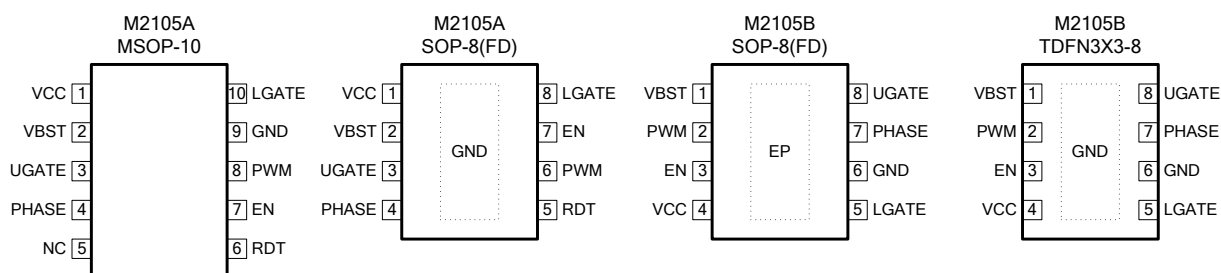
Note: P7: MSOP-10 F1: SOP-8 (FD) K5:TDFN3X3-8

1: Bonding code

U: Tape & Reel

Green : Lead Free / Halogen Free

Pin Configuration



Absolute Maximum Ratings

VCC	.....	-0.3V to +25V
VBST to PHASE	.....	-0.3V to +25V
PHASE to GND		
DC	.....	-5V to +25V
<200nS	.....	-15V to +35V
LGATE		
DC	.....	-0.3V to (VCC+0.3V)
<200nS	.....	-2V to (VCC+0.3V)
UGATE		
DC	.....	(V _{PHASE} -0.3V) to (V _{VBST} +0.3V)
<200nS	.....	(V _{PHASE} -2V) to (V _{VBST} +0.3V)
PWM, RDT	.....	-0.3V to +7V
EN	.....	-0.3V to (VCC+0.3V)

Thermal Resistance Junction to Ambient, (θ_{JA})

MSOP-10	.....	125°C/W
SOP-8 (FD)	.....	75°C/W
TDFN3X3-8	.....	TBD
Continuous Power Dissipation (T _A =25°C)		
MSOP-10	.....	1W
SOP-8 (FD)	.....	1.33W
TDFN3X3-8	.....	TBD
Operating Ambient Temperature	.....	-40°C to 85°C
Storage Temperature Range	.....	-55°C to +150°C
Reflow Temperature (soldering, 10 sec)	.....	260°C
EDS Susceptibility (Human Body Mode)	.....	2KV
EDS Susceptibility (Machine Mode)	.....	200V

- 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 are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
- Device is ESD sensitive. Handling precaution recommended. The Human Body model is a 100pF capacitor discharged through a 1.5KΩ resistor into each pin.

Electrical characteristics

(VCC=12V, T_A=25°C, unless otherwise specified)

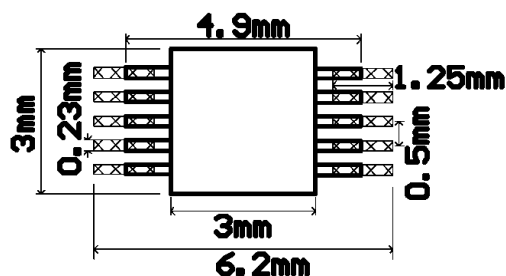
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
GENERAL						
VCC Operating Voltage	V _{VCC}		4.5	---	22	V
VCC Under Voltage threshold	V _{VCC_UVLO}	VCC rising	---	3.7	4.4	V
VCC Under Voltage Hysteresis	V _{VCC_UVLO_HYS}	Hysteresis	---	150	---	mV
Quiescent Current	I _{VCC1}	PWM pin High or Floating, V _{EN} =5V	---	120	170	μA
	I _{VCC2}	PWM pin Low, V _{EN} =5V	---	400	500	μA
Shutdown Current	I _{SD}	V _{EN} =0V	---	0.1	1	μA
PWM Input						
Maximum Input Current	I _{PWM}	PWM=0V or 5V	---	300	---	μA
PWM Floating Voltage	V _{PWM_FL}		1.7	---	2.0	V
PWM Rising Threshold	V _{PWM_RTH}		3	---	---	V
PWM Falling Threshold	V _{PWM_FTH}		---	---	0.6	V
EN Input						
EN Logic-Input Threshold	V _{ENH}	High threshold	3	---	---	V
	V _{ENL}	Low threshold	---	---	0.6	V
EN Internal Pull Low Resistance	R _{ENL}		---	260	---	kΩ
Timing						
UGATE Rise Time	t _{UGATE_R}	VCC=12V, 3nF Load	---	35	---	nS
UGATE Fall Time	t _{UGATE_F}	VCC=12V, 3nF Load	---	15	---	nS
LGATE Rise Time	t _{LGATE_R}	VCC=12V, 3nF Load	---	35	---	nS
LGATE Fall Time	t _{LGATE_F}	VCC=12V, 3nF Load	---	15	---	nS

Electrical characteristics (continued)

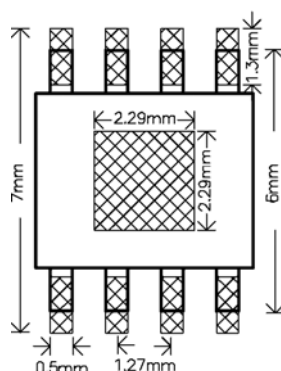
PARAMETER		SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Propagation Delay	M2105A/B	t _{UGATE_PDL}	V _{VBST} -V _{PHASE} =12V	---	35	---	nS
	M2105A/B	t _{LGATE_PDL}	VCC=12V	---	25	---	nS
	M2105A	t _{UGATE_PDH}	V _{VBST} -V _{PHASE} =12V, RDT=10kΩ	---	70	---	nS
	M2105A	t _{UGATE_PDH}	V _{VBST} -V _{PHASE} =12V, RDT=30kΩ	---	130	---	nS
	M2105A	t _{UGATE_PDH}	V _{VBST} -V _{PHASE} =12V, RDT=100kΩ	---	400	---	nS
	M2105A	t _{LGATE_PDH}	VCC=12V, RDT=10kΩ	---	70	---	nS
	M2105A	t _{LGATE_PDH}	VCC=12V, RDT=30kΩ	---	130	---	nS
	M2105A	t _{LGATE_PDH}	VCC=12V, RDT=100kΩ	---	400	---	nS
Propagation Delay	M2105B	t _{UGATE_PDH}	V _{VBST} -V _{PHASE} =12V	---	35	---	nS
		t _{LGATE_PDH}	VCC=12V	---	25	---	nS
Output							
UGATE Drive Source		I _{UGATE_SR}	V _{VBST} -V _{PHASE} =12V, V _{UGATE} -V _{PHASE} =2V,	---	2	---	A
UGATE Drive Sink		R _{UGATE_SK}	V _{VBST} -V _{PHASE} =12V	---	1.4	---	Ω
LGATE Drive Source		I _{LGATE_SR}	VCC=12V, V _{LGATE} =2V,	---	2	---	A
LGATE Drive Sink		R _{LGATE_SK}	VCC=12V	---	1.4	---	Ω
Internal BOOT Switch							
Internal Boot Switch On Resistance		R _{RST}	VCC=12V	---	20	---	Ω

Minimum Footprint PCB Layout Section

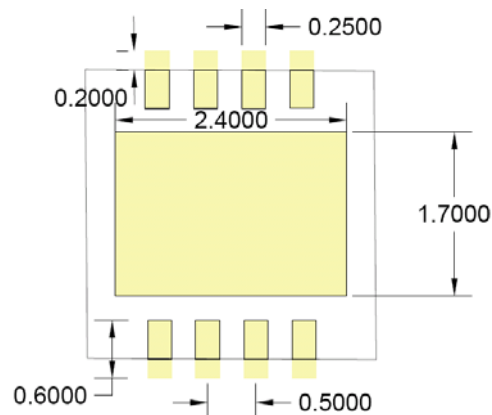
MSOP-10



SOP-8 (FD)

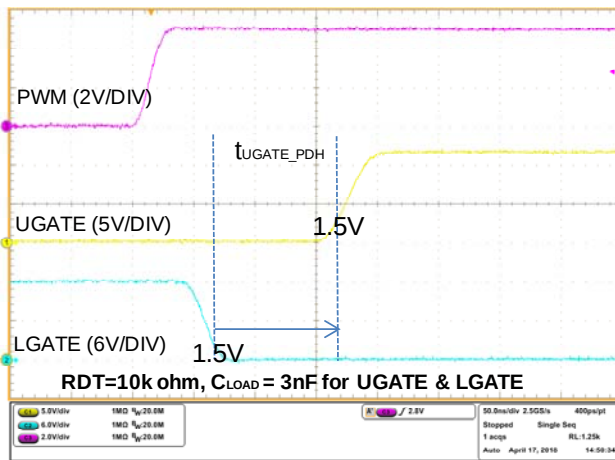


TDFN3X3-8



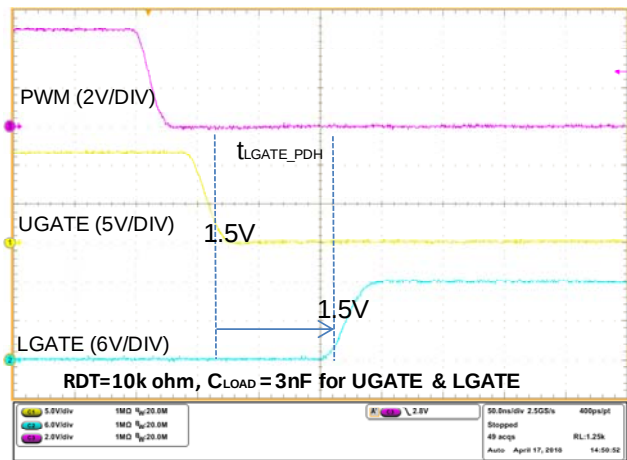
Typical Performance Characteristics
(VCC=12V, TA=25°C, unless otherwise specified)

UGATE Rise and LGATE Fall times



Scope time scale =50ns

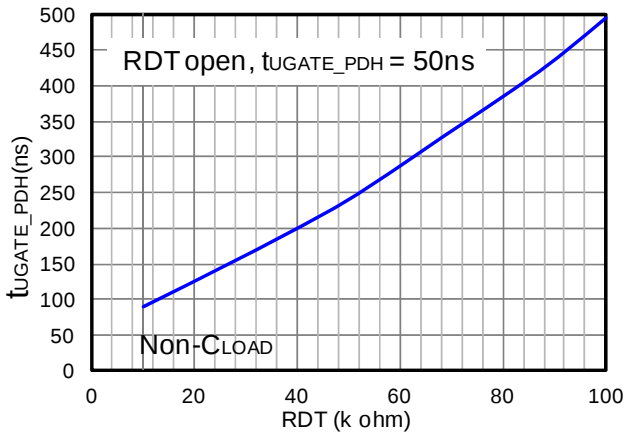
UGATE Fall and LGATE Rise times



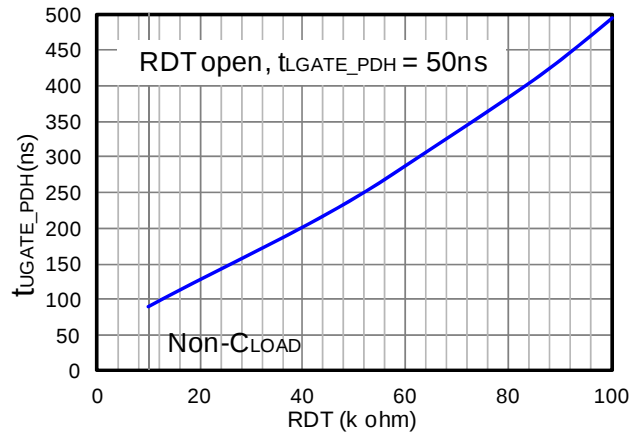
Scope time scale =50ns

Typical Performance Characteristics (continued)

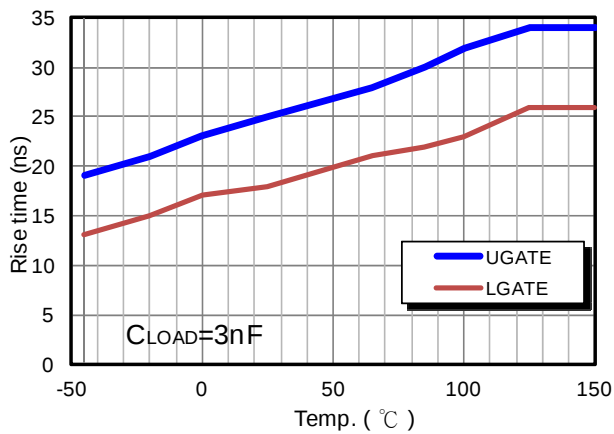
t_{UGATE_PDH} VS. RDT



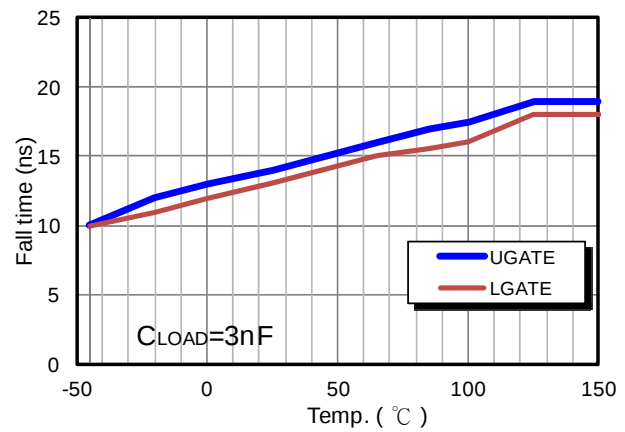
t_{LGATE_PDH} VS. RDT



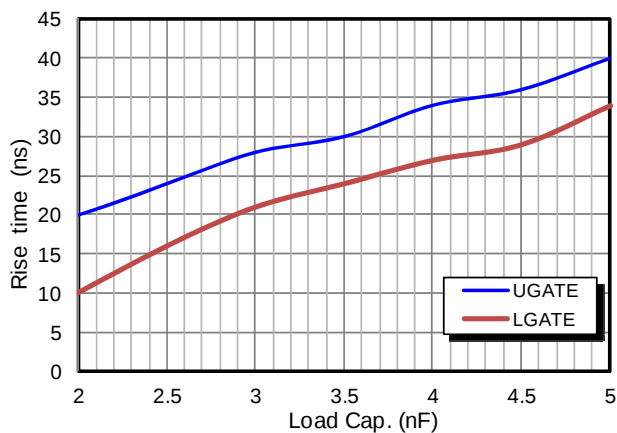
UGATE & LGATE Rise time vs. Temperature



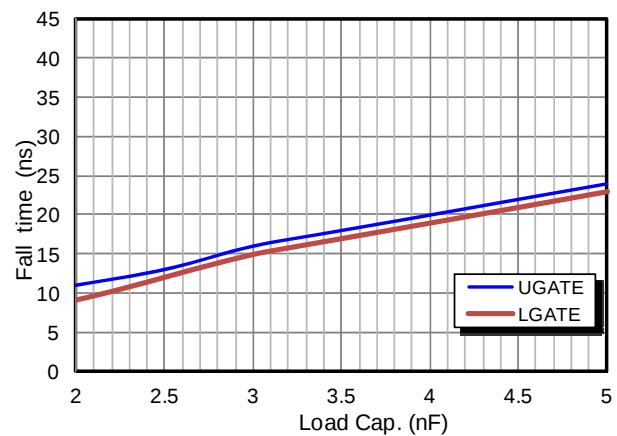
UGATE & LGATE Fall time vs. Temperature



UGATE&LGATE Rise time vs. Load Capacitance

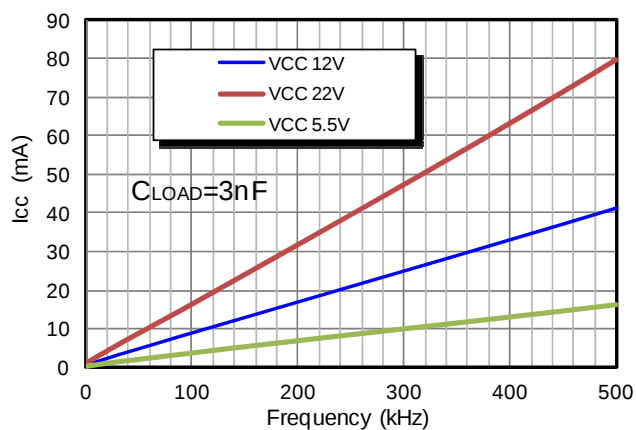


UGATE&LGATE Fall time vs. Load Capacitance

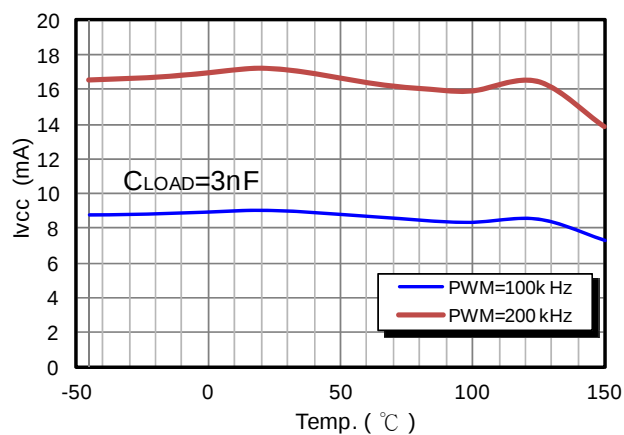


Typical Performance Characteristics (continued)

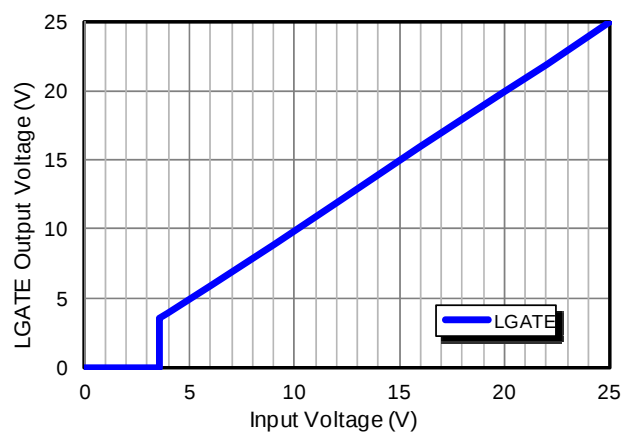
Supply current vs. Frequency



Supply current vs. Temperature



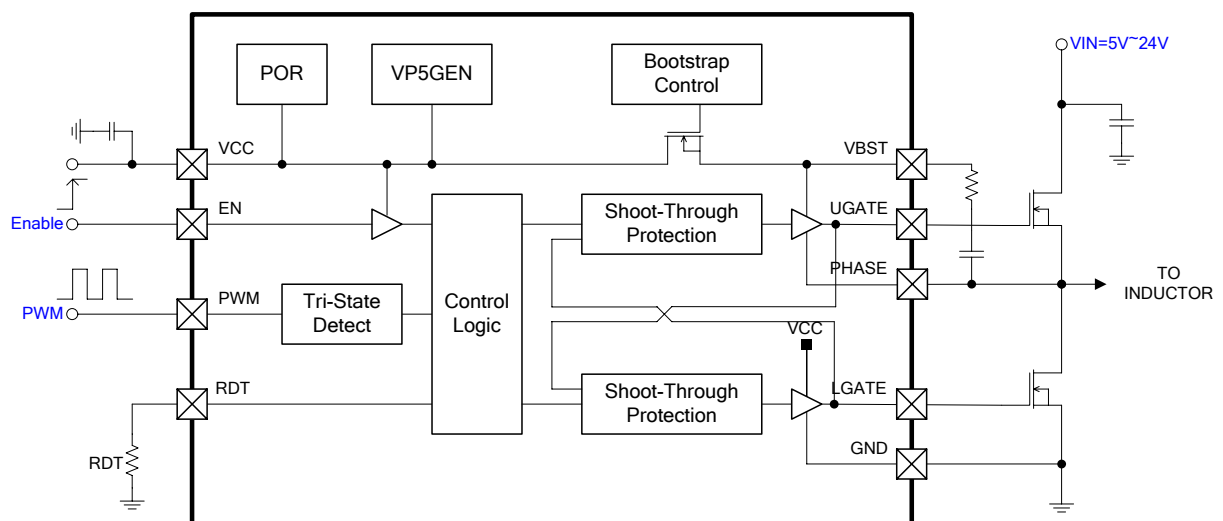
LGATE Output Voltage vs. VCC



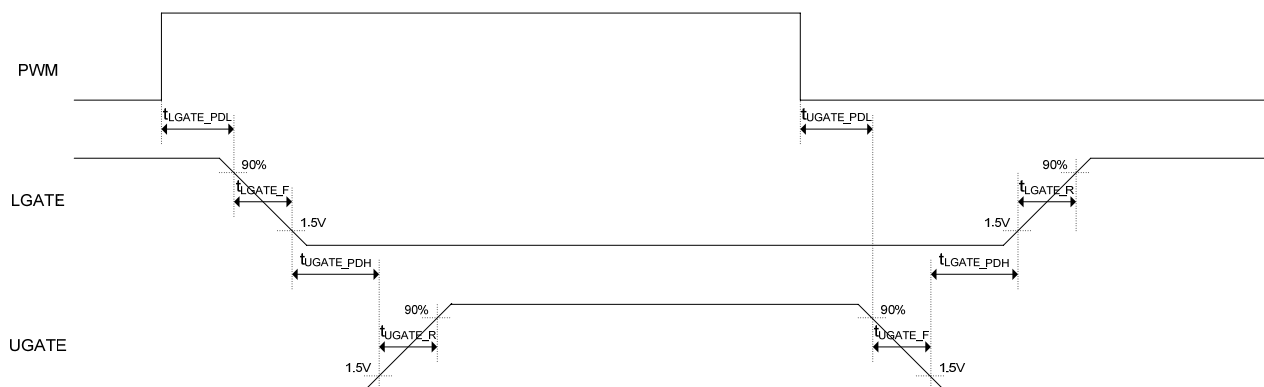
Pin Description

PIN				NAME	FUNCTION
M2105AP71U	M2105AF11U	M2105BF11U	M2105BK51U		
1	1	4	4	VCC	Input Supply Pin.
2	2	1	1	VBST	Floating Bootstrap Supply pin for Upper Gate Drive.
3	3	8	8	UGATE	Upper Gate Drive Output.
4	4	7	7	PHASE	Connect this pin to the source of the high side MOSFET and the drain of the low side MOSFET
6	5			RDT	Dead Time Control Pin.
7	7	3	3	EN	Chip Enable Control Input. Active-H. When low, both UGATE and LGATE are driven low.
8	6	2	2	PWM	Input PWM Signal for Controlling the Driver.
9	EP	6	6, EP	GND	Ground. Should be closely connected to the source of the lower MOSFET
10	8	5	5	LGATE	Lower Gate Driver.

Block Diagram & Application Circuit

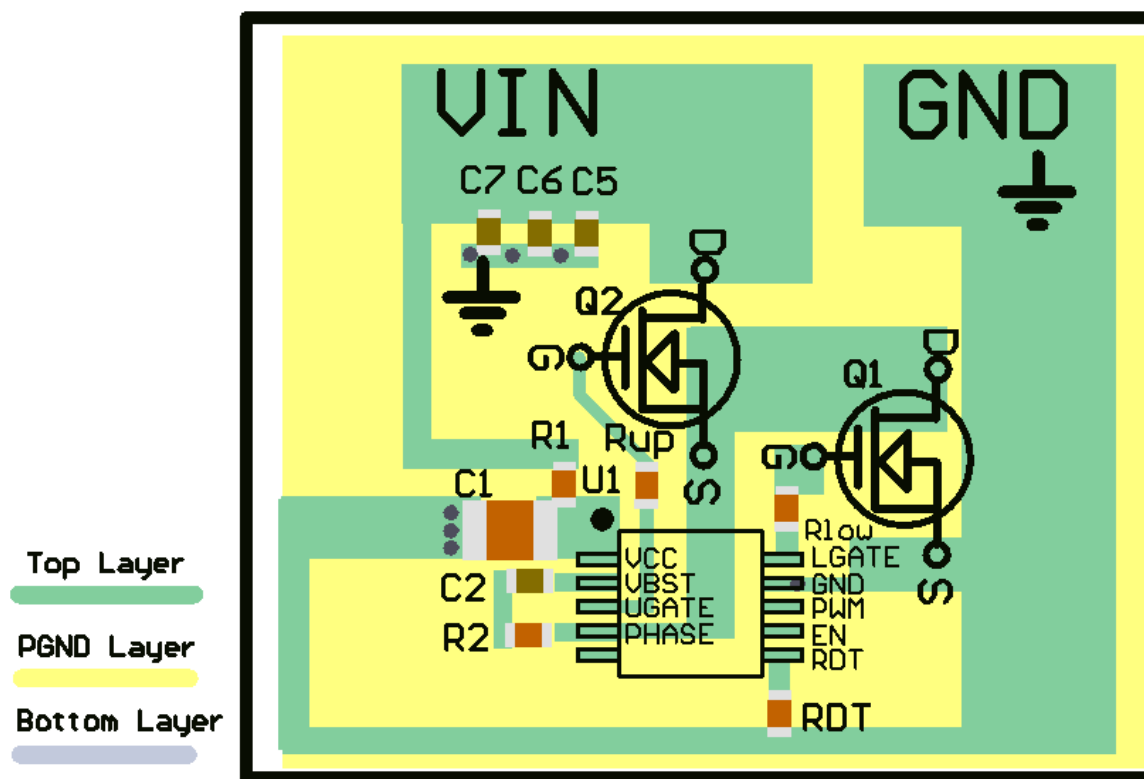


Timing Diagram



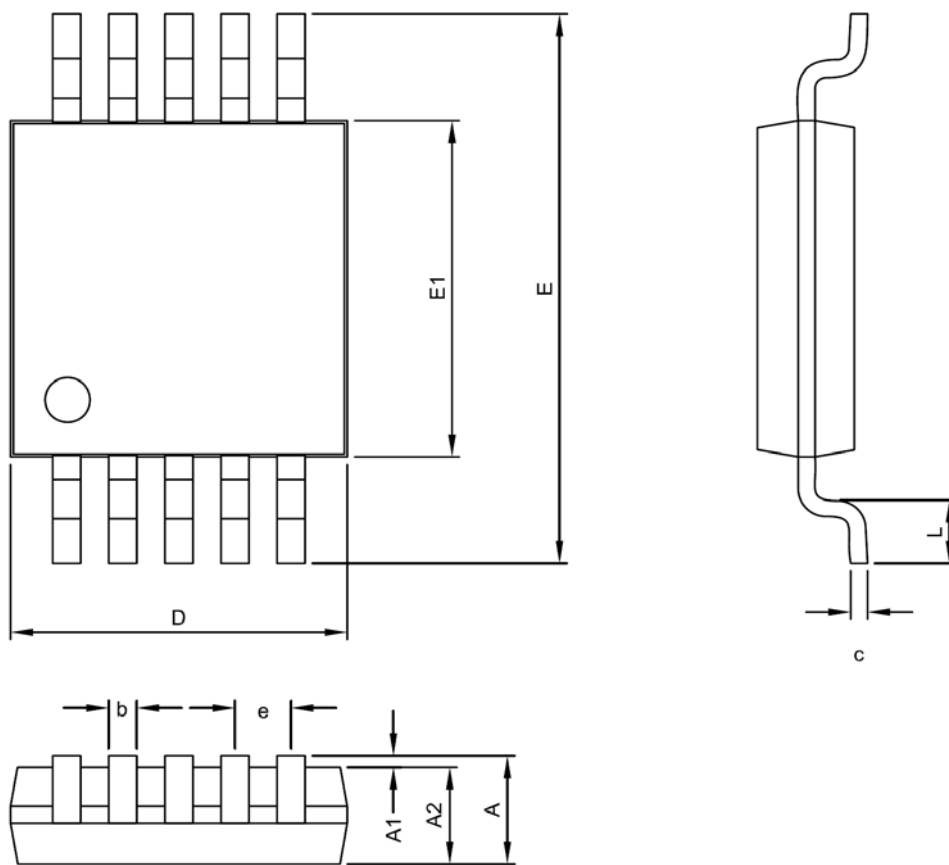
Layout guidelines

Power loops of the MOSFET Driver were considered to minimize the area. If possible, it is suggested to arrange the power loops at the top side copper plane. And the bottom side copper plane was considered to be the analog ground.



- (1) Minimize (Q1, G S)UGATE to PHASE pin & (Q2, G S)LGATE to GND pin loops as short as possible.
- (2) Connect the capacitor on C1&C2 as close to the IC as possible.
- (3) In case, the power loop crosses different layers, put vias as many as possible

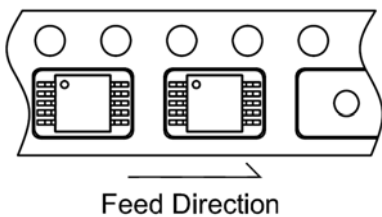
Package Information



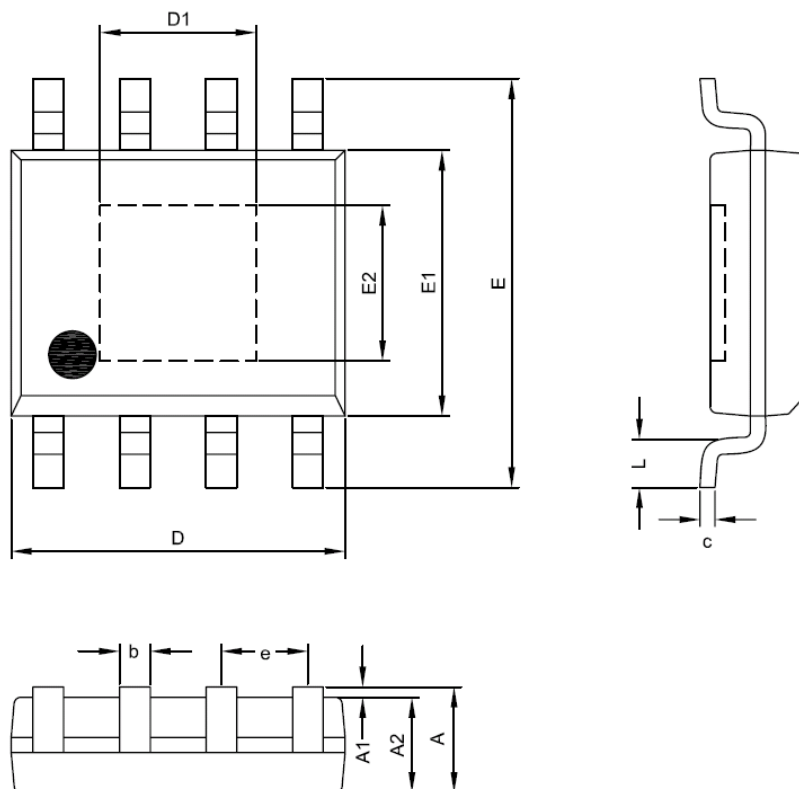
MSOP-10 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.81	0.95	1.10	0.032	0.037	0.043
A1	0.00	---	0.15	0.000	---	0.006
A2	0.75	0.86	0.96	0.030	0.034	0.038
D	2.90	3.00	3.10	0.114	0.118	0.122
E	4.80	4.90	5.00	0.189	0.193	0.197
E1	2.90	3.00	3.10	0.114	0.118	0.122
b	0.15	0.25	0.35	0.006	0.010	0.014
c	0.15 REF			0.006 REF		
e	0.50 BSC			0.020 BSC		
L	0.4	0.53	0.8	0.016	0.021	0.031

Taping Specification



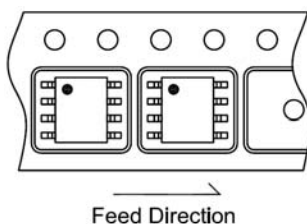
PACKAGE	Q'TY/REEL
MSOP-10	3,000 ea



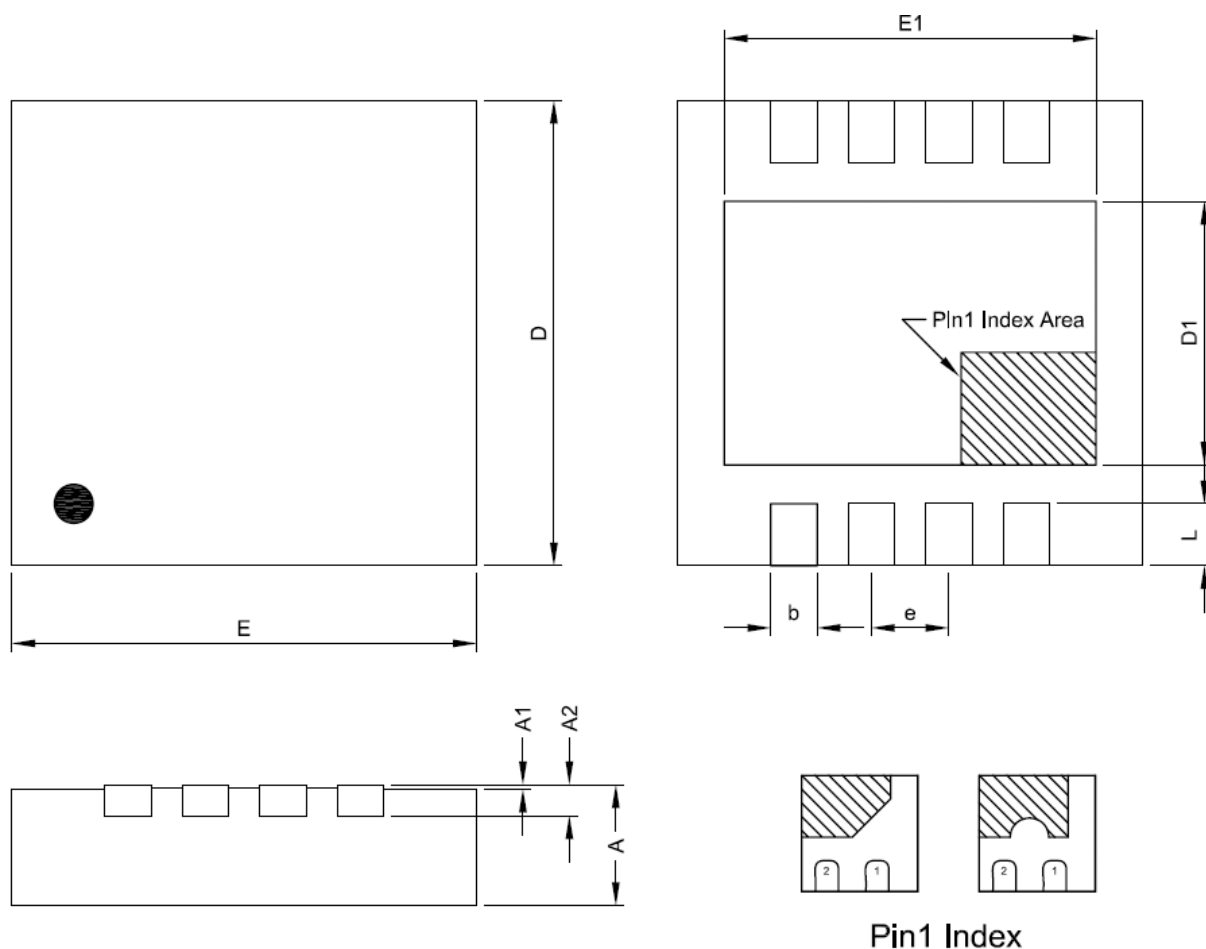
SOP- 8 (FD) Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.35	1.55	1.70	0.053	0.061	0.067
A1	0.00	---	0.10	0.000	---	0.004
A2	1.15	1.35	1.60	0.045	0.053	0.063
D	4.80	4.90	5.00	0.189	0.192	0.197
D1	2.29 BSC			0.090 BSC		
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.153	0.157
E2	2.29 BSC			0.090 BSC		
c	0.20 REF			0.008 REF		
b	0.33	0.43	0.53	0.013	0.017	0.021
e	1.27 BSC			0.050 BSC		
L	0.40	0.70	1.27	0.016	0.028	0.050

Taping Specification



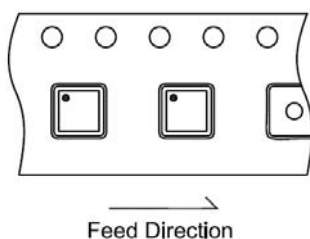
PACKAGE	Q'TY/REEL
SOP-8 (FD)	2,500 ea



TDFN3X3-8 P0.5 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.0276	0.0295	0.0315
A1	0.00	---	0.05	0.0000	---	0.0020
A2	0.203 REF			0.0079 REF		
D	2.95	3.00	3.05	0.1161	0.1181	0.1201
E	2.95	3.00	3.05	0.1161	0.1181	0.1201
D1	1.35	1.70	1.75	0.0531	0.0669	0.0689
E1	1.65	2.40	2.45	0.0650	0.0945	0.0965
b	0.18	0.25	0.30	0.0071	0.0098	0.0118
e	0.50 BSC			0.0197 BSC		
L	0.35	0.40	0.45	0.0138	0.0157	0.0177

Taping Specification



PACKAGE	Q'TY/REEL
TDFN3X3-8	3,000 ea

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