

Description

The SE8404 is a high voltage, synchronous step-down converter operates over a wide range input voltage 9V to 100V.

The SE8404 delivers 5A continuous load current with up to 96% efficiency. The SE8404 operates with fixed frequency peak current control with built-in compensation eliminates the need for external components.

Cycle-by-cycle current limit in high-side MOSFET protects the converter in an overload condition. Hiccup mode protection is triggered if the over-current condition has persisted for longer than the present time.

The SE8404 exhibits protection features that protect the load from faults like under-voltage, over-current and over-temperature.

The SE8404 is available in an QFN5x5-20L package.

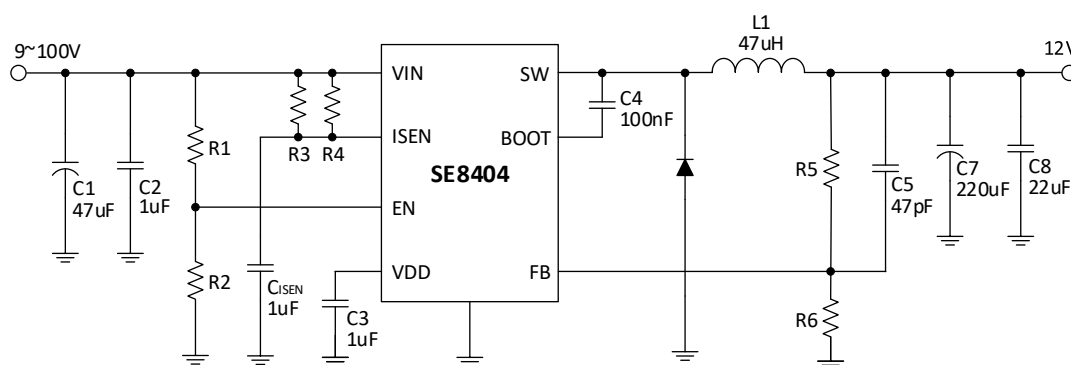
Features

- Wide Input Voltage Range : 9-100V
- output current: 5A
- Up to 96% efficiency
- 18mΩ/20mΩ Internal Power MOSFET
- Peak Current mode control
- 300 kHz Fixed Frequency
- Internal compensation for ease of use
- Up to 92% duty cycle
- 1μA shutdown current
- cycle-by-cycle current limit
- 150ms Hiccup mode short circuit protection Function
- Thermal shutdown Function
- QFN5x5-20L package

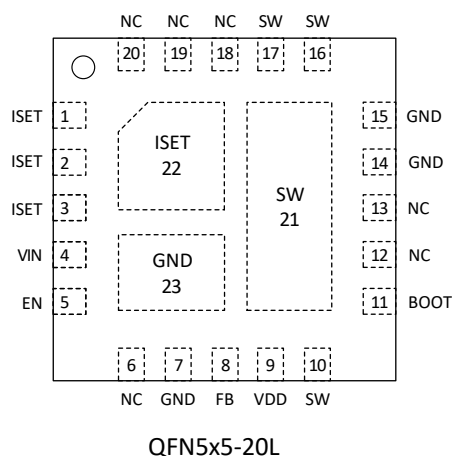
Applications

- Automotive Systems and Industry Systems
- Distributed Power Systems
- Battery Powered Systems
- GPS tracker, Charger in vehicle
- Motor Drives, Telecom

Typical Application



Pin Configuration



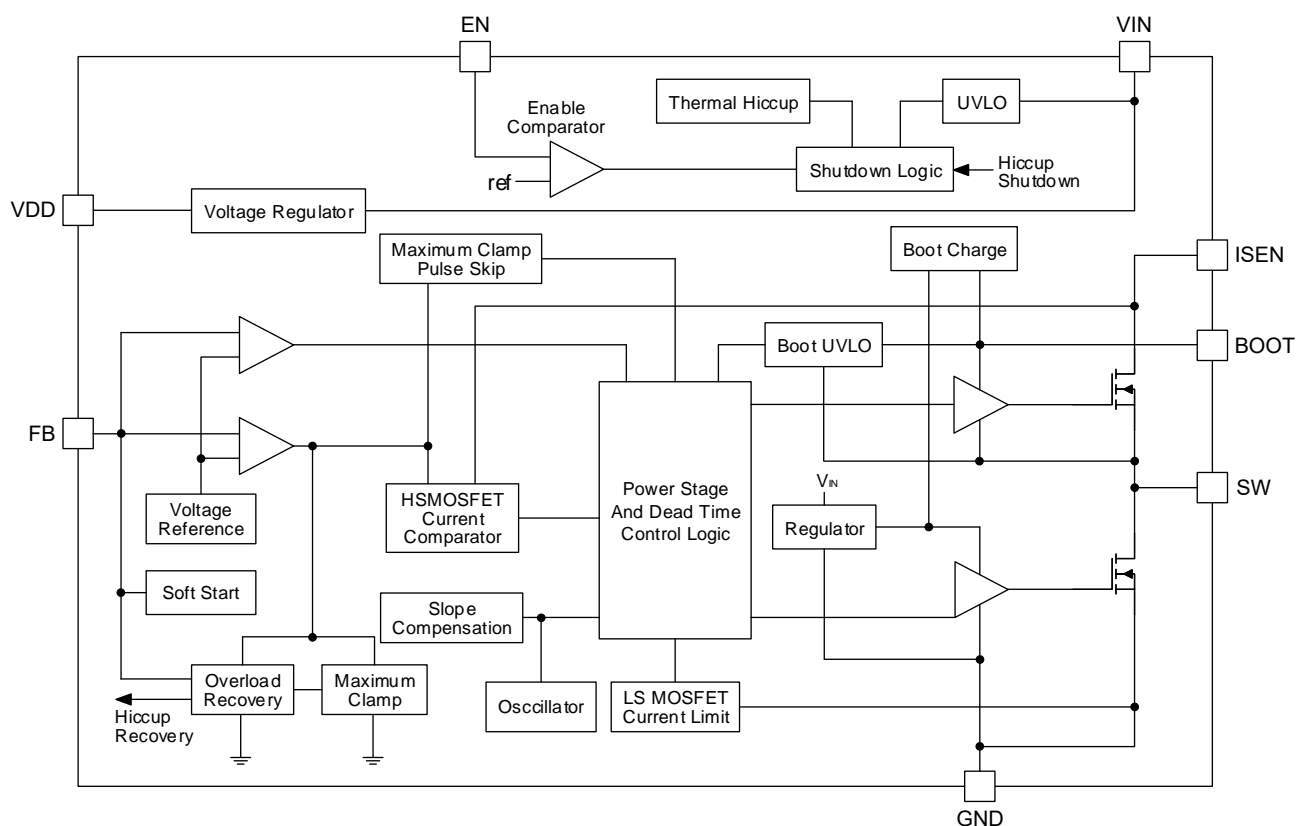
Functional Pin Description

PIN No.	Name	Description
1, 2, 3	ISET	Connecting a resistance from ISEN to VIN sets the output short circuit detection threshold.
4	VIN	Input supply. VIN supplies power to all of the internal control circuitries, both BOOT regulators, and the high-side switch.
5	EN	Enable input. Pull EN below the specified threshold to shut down the SE8404. Pull EN above the specified threshold or leave EN floating to enable the SE8404.
6, 12, 13, 18, 19, 20	NC	No Connection
7, 14, 15	GND	Ground. GND should be placed as close to the output capacitor as possible to avoid the high-current switch paths. Connect the exposed pad to GND plane for optimal thermal performance.
8	FB	Feedback. FB is the input to the voltage hysteretic comparators. The average FB voltage is maintained at 800mV by loop regulation.
9	VDD	Power input to the controller.
10, 16, 17	SW	Switch node. SW is the output from the high-side switch. A low forward voltage Schottky rectifier to ground is required. The rectifier must be placed close to SW to reduce switching spikes.
11	BOOT	Bootstrap. BOOT is the positive power supply for the internal, floating, high-side MOSFET driver. Connect a bypass capacitor between BOOT and SW.

Ordering Information

Product model	Packaging form	Smallest packaging	Logo
SE8404	QFN5*5-20L	4000PCS	SE8404

Block Diagram



Absolute Maximum Ratings

Item	Description	Range	Unit
V_{SW} , V_{EN} , V_{IN} , V_{ISET}	SW , EN , VIN Voltage	-0.3 ~ +105	V
V_{FB} , V_{VDD}	FB , V_{VDD} Voltage	-0.3 ~ +7	V
V_{BOOT}	BOOT Voltage	$V_{SW}-0.3 \sim V_{SW}+7$	V
T_{stg}	Storage Junction Temperature	-55 ~ 150	°C
T_{solder}	Lead Temperature (Soldering 10 sec.)	260	°C
ESD	Human Body Model	2	kV

Note: exceeding the range specified by the rated parameters will cause damage to the chip, and the working state of the chip beyond the range of rated parameters cannot be guaranteed. Exposure outside the rated parameter range will affect the reliability of the chip.

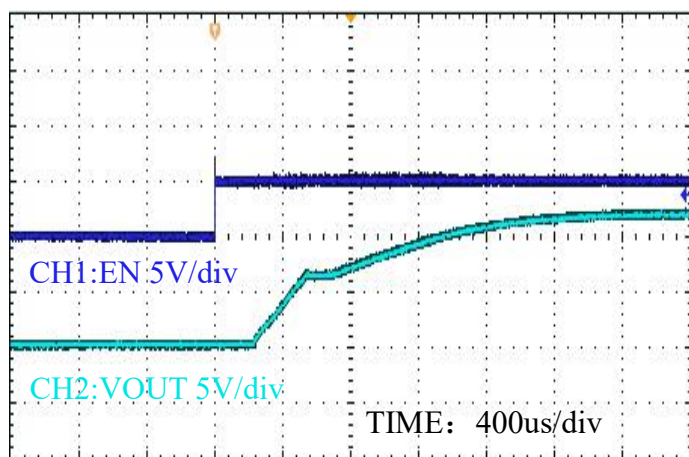
Electrical Characteristics

(At $T_A=25^{\circ}\text{C}$, $V_{IN}=48\text{V}$, $V_{OUT}=12\text{V}$, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
VCC SUPPLY VOLTAGE						
Input Voltage	V_{IN}		9	-	100	V
UVLO	V_{STRAT}		-	8	-	V
UVLO Hysteresis	V_{UVLO1}		-	0.3	-	V
Shutdown supply current	I_{SHUT}	$EN=0V$	-	2	-	μA
Input Quiescent Current	I_Q	$V_{FB}=1V$	-	400	-	μA
ENABLE						
Enable threshold voltage	V_{EN}		-	2.2	-	V
Enable threshold voltage Hysteresis	V_{UVLO2}		-	0.2	-	V
FEEDBACK						
FB Reference Threshold	V_{FB}		-	0.8	-	V
Feedback short voltage	$V_{FB(short)}$		-	0.35	-	V
Feedback short voltage Hysteresis	V_{FB2}		-	0.42	-	V
OSCILLATOR						
Switching frequency	F	$I_{OUT}=500\text{mA}$	-	300	-	kHz
Maximum Duty Cycle	D_{MAX}	$V_{IN}=12V$	-	92	-	%
CURRENT LIMIT						
Current Limit Threshold	I_{PEAK}		-	6	-	A
HIGH-SIDE MOSFET						
On-resistance	$R_{DS(on)}$	$V_{IN}=18V$	-	18	-	$\text{m}\Omega$
THERMAL SHUTDOWN						
Thermal shutdown Temp	T_{SD}		-	150	-	$^{\circ}\text{C}$
Thermal shutdown Temp Hysteresis	T_{SH}		-	30	-	$^{\circ}\text{C}$

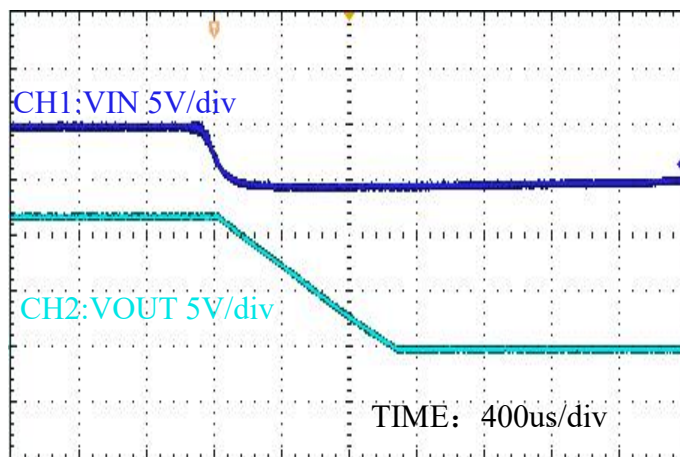
Typical Characteristics

(At $T_A=25^{\circ}\text{C}$, $V_{IN}=48\text{V}$, $V_{OUT}=12\text{V}$, Unless Otherwise Noted)



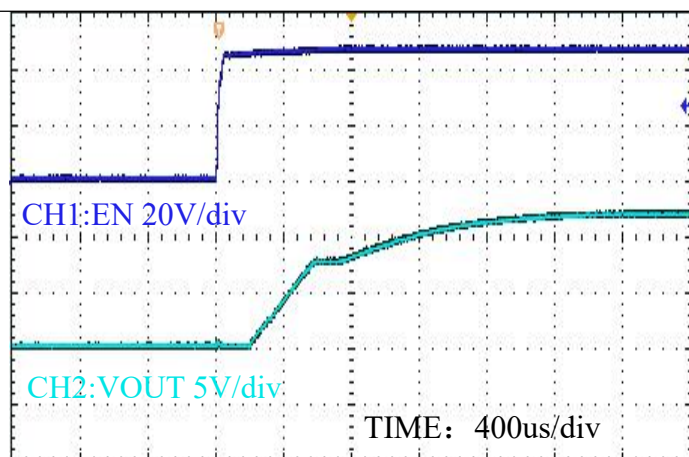
$V_{IN}=48\text{V}$ $EN=5\text{V}$

Figure1 EN Start up



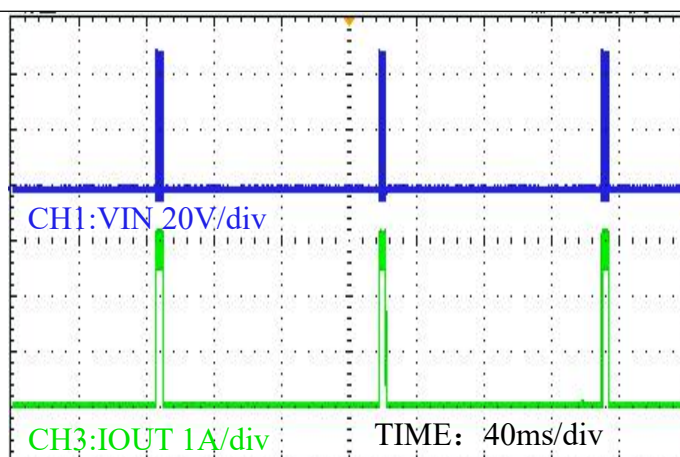
$V_{IN}=48\text{V}$ $EN=5\text{V}$

Figure2 EN Turn off



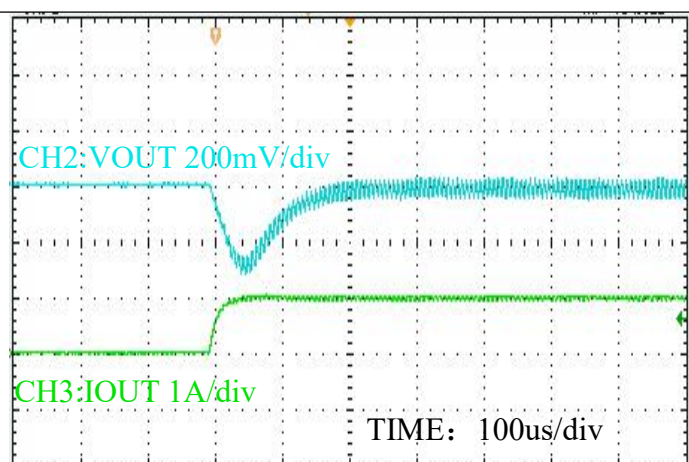
$V_{IN}=48\text{V}$ $I_{OUT}=0\text{A}$

Figure3 Start up



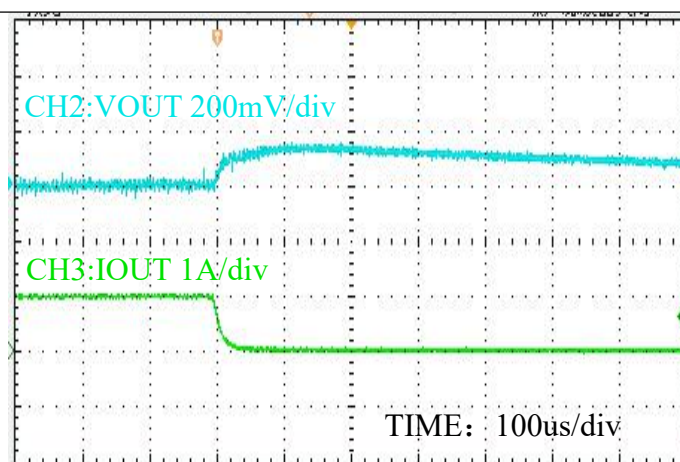
$V_{IN}=48\text{V}$ $I_{OUT}=1\text{A}$

Figure4 Start up



$I_{OUT}=10\text{mA}\sim 1\text{A}$ $V_{IN}=48\text{V}$

Figure5 Load Transient



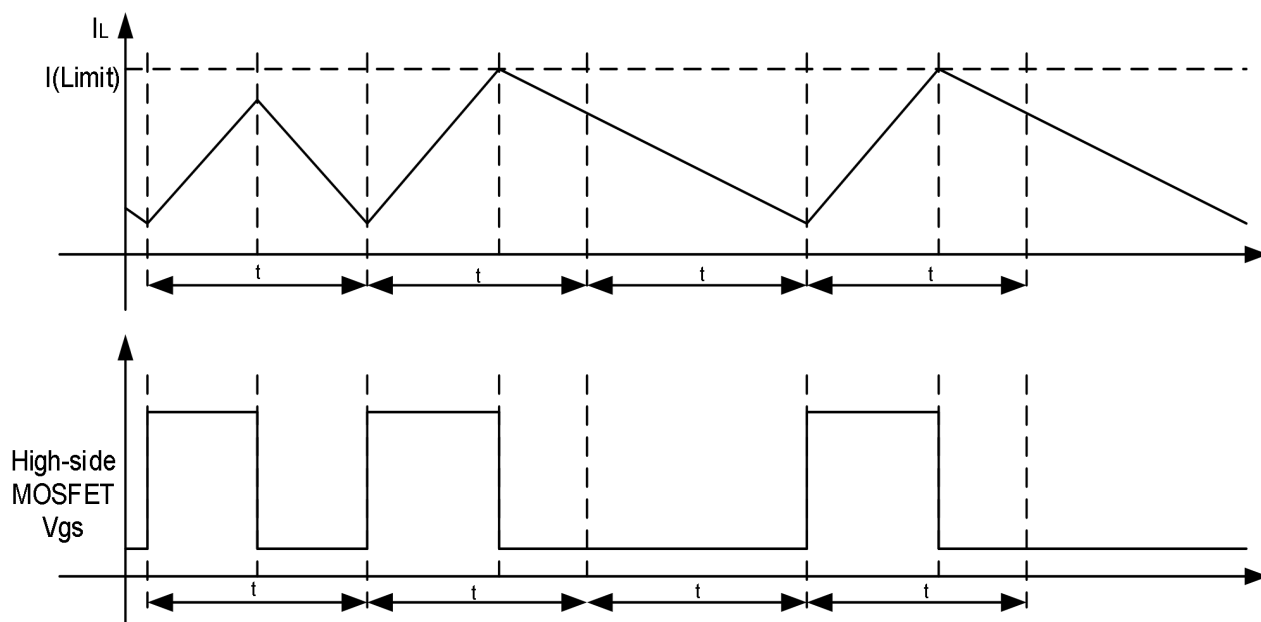
$I_{OUT}=1\text{A}\sim 10\text{mA}$ $V_{IN}=48\text{V}$

Figure6 Load Transient

Applications Information

Overcurrent Protection

The SE8404 implements current-mode control which uses the internal COMP voltage to control the turn on and the turnoff of the high-side MOSFET on a cycle-by-cycle basis. During each cycle, the switch current and the current reference generated by the internal COMP voltage are compared. When the peak switch current intersects the current reference the high-side switch turns off. Furthermore, if an output overload condition occurs for more than the hiccup wait time, which is programmed for 512 switching cycles, the device shuts down and restarts after the hiccup time of 16384 cycles. The hiccup mode helps to reduce the device power dissipation under severe overcurrent conditions.

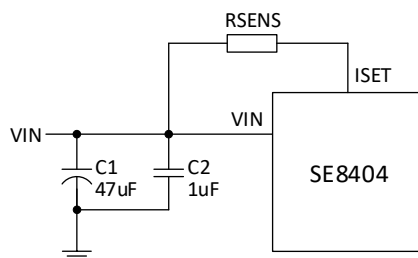


C1

This capacitor's purpose is to supply most of the switch current during the on-time, and limit the voltage ripple at VIN. To allow for the capacitor's tolerance, temperature effects, and voltage effects, a 47 μ F capacitor is used.

C2

This capacitor helps avoid supply voltage transients and ringing due to long lead inductance at VIN. A low ESR, 1 μ F ceramic chip capacitor is recommended, located close to the SE8404.

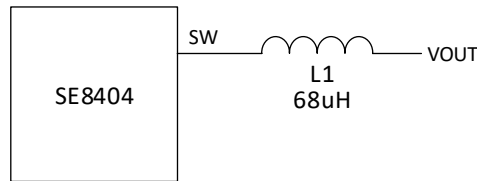


The capacitor on the VIN

L1

The inductance is determined based on the switching frequency, load current, inductor ripple current, and the minimum and maximum input voltages designated $V_{IN}(\text{min})$ and $V_{IN}(\text{max})$, respectively. The peak inductor current

during an overload condition is limited to 3 A nominal. Use the value of 68μH, 5A to prevent saturation.



The inductor on the choice

D1

A power Schottky diode is recommended. Ultra-fast recovery diodes are not recommended as the high speed transitions at the SW pin may inadvertently affect the IC's operation through external or internal EMI. The important parameters are reverse recovery time and forward voltage. The reverse recovery time determines how long the reverse current surge lasts with each turn-on of the internal buck switch. The forward voltage drop affects efficiency. The diode's reverse voltage rating must be at least as great as the maximum input voltage, plus ripple and transients, and its current rating must be at least as great as the maximum current limit specification.

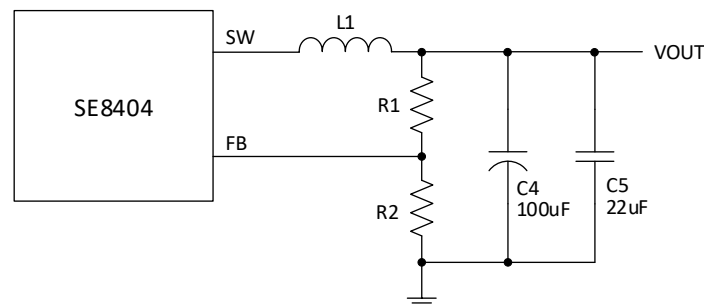
C4/C5

The output capacitor filters the inductor ripple current and provides a source of charge for transient load conditions. The best performance is typically obtained using ceramic or polymer electrolytic type components. Typical tradeoffs are that the ceramic capacitor provides extremely low ESR to reduce the output ripple voltage and noise spikes. In order to meet output ripple specification, we should choose a ceramic capacitor of 22uF and a polymer electrolytic capacitor of 100uF.

R1/R2

The output voltage (VOUT) is programmed by two external resistors as shown in the Figure15. The regulation point can be calculated as follows:

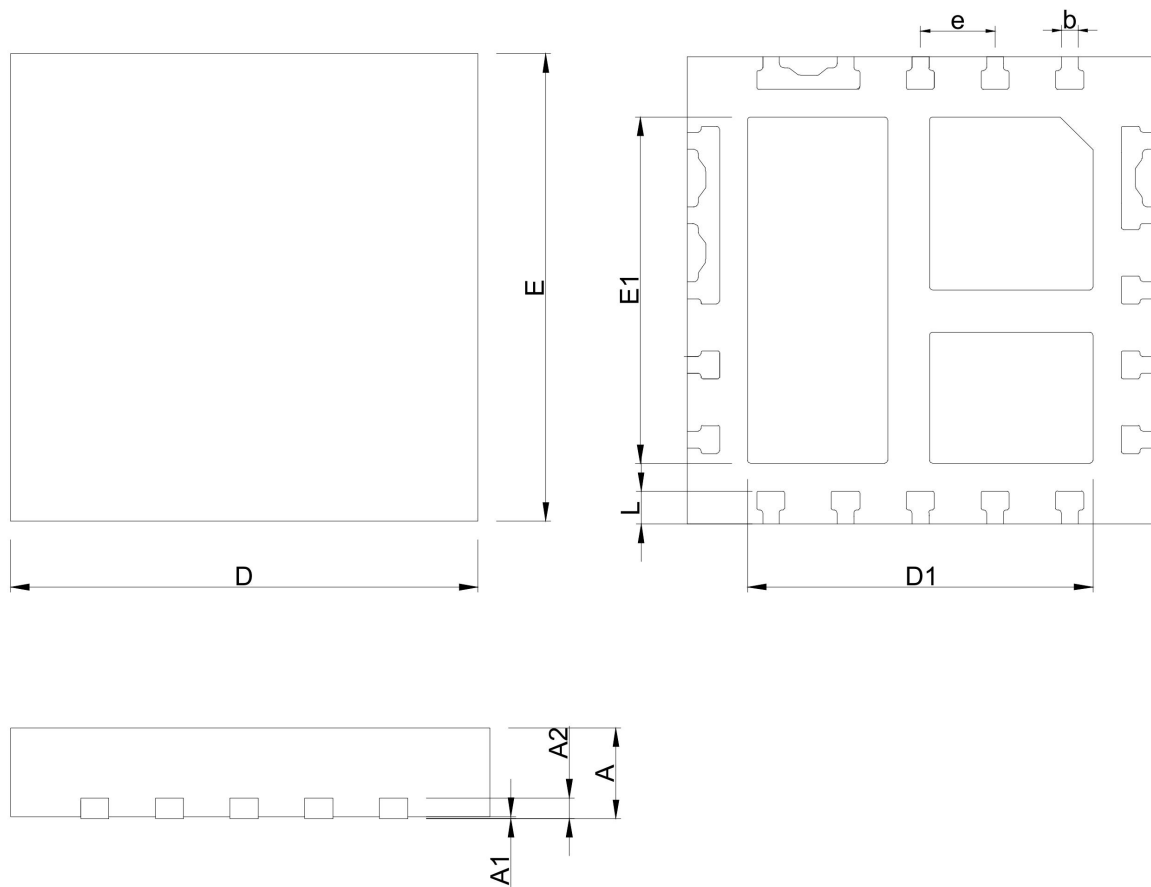
$$VOUT = 0.8 \times (R1 + R2) / R2$$



Output Capacitors and Output Configuration

Package Information

QFN5x5-20L



Symble	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.90	0.95	1.00	0.0354	0.0374	0.0394
A1	0.00	---	0.05	0.0000	---	0.0020
A2	0.19	0.20	0.21	0.0075	0.0079	0.0083
D	4.95	5.00	5.05	0.1949	0.1969	0.1988
E	4.95	5.00	5.05	0.1949	0.1969	0.1988
D1	3.60	3.70	3.80	0.1417	0.1457	0.1496
E1	3.60	3.70	3.80	0.1417	0.1457	0.1496
b	0.18	0.23	0.28	0.0071	0.0091	0.0110
e	0.80TYP			0.0315TYP		
L	0.25	0.35	0.45	0.0098	0.0138	0.0177