G5409N

5.5V, 7A Low R_{DSON} Load Switch with Current Monitoring

Features

- **Built-in 10mΩ Low R_{DSON} MOSFET**
- **Adjustable Soft Start Function**
- **V_{IN} Operating Range: 0.5V to 5.5V**
- **Programmable up to 7A Current Limit**
- **IMON Function with high to 3% accuracy**
- **Output Discharge Function**
- **Push-pull Vin PG Indicator**
- **Fast Short Circuit Protection**
- **Thermal Protection**
- **Available in AQFN2X2-12 Package**

Applications

- **Solid State Drivers**
- **Notebook Computers**
- **Portable Devices**

General Description

The G5409N is a load switch with a built-in 10mΩ MOSFET. It is designed to provide up to 7A current limit protection covering 0.5V to 5.5V input voltage range. With tiny package, G5409N provides very high efficiency and space-saving solution for solid state driver (SSD), notebook, and other portable devices

With the soft start function, the G5409N can avoid inrush current during circuit start up. The G5409N also provides other features, like power good, thermal shutdown, and output discharge function

The maximum load at the output (source) is current limited. The current limit is programmed by an external resistor from IMON pin to ground.

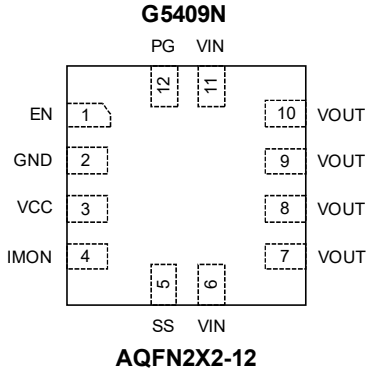
G5409N is available in a small AQFN2X2-12 package.

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G5409NAS1U	5409N	-40°C to +125°C	AQFN2X2-12

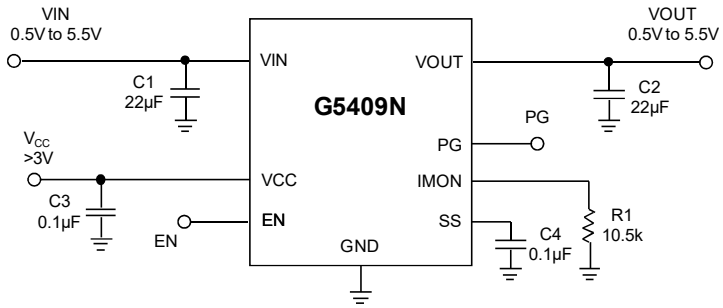
Note: AS: AQFN2X2-12
1: Bonding Code
U : Tape & Reel
Green : Lead Free / Halogen Free.

Pin Configuration



AQFN2X2-12

Typical Application Circuit



Absolute Maximum Ratings

V_{IN} to GND . . . . . -0.3V to 6.5V
V_{CC} to GND . . . . . .-0.3V to 6.5V
V_{OUT} to GND . . . . . .-0.3V to 6.5V
EN, SS, IMON to GND . . . .-0.3V to VCC+0.3V
Continuous Power Dissipation (T_A = +25°C)
AQFN2X2-12. . . . . .1.6W
Junction Temperature . . . . . 150°C
Thermal Resistance Junction to Ambient, (θ_{JA})
AQFN2X2-12 . . . . . .80°C/W
Thermal Resistance Junction to Case, (θ_{JC})
AQFN2X2-12 . . . . . .17°C/W
Reflow Temperature (soldering, 10sec) . . . . . 260°C

Operating Ratings

Supply Voltage (V_{CC}) . . . . . 3V to 5.5V
Supply Voltage (V_{IN}) . . . . . 0.5V to 5.5V
Supply Voltage (V_{OUT}) . . . . . 0.5V to 5.5V
Ambient temperature (T_A) . . . . . .-40 to 125°C

Electrical Characteristics

(V_{IN} =3.6V, V_{CC}=3.6V, T_A = 25°C.)

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified.

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Input and Supply Voltage Range						
Input voltage	V_{IN}		0.5	---	5.5	V
Supply voltage	V_{CC}		3	---	5.5	V
Supply Current						
Off state leakage current	I_{VIN_OFF}	V_{IN}=5V, EN=0	---	---	1	µA
	I_{VCC_SD}	V_{CC}=5V, EN=0	---	0.1	1	
V_{CC} supply current	I_{VCC}	V_{CC}=3.3V, EN=1, No Load	---	80	90	
V_{IN} supply current	I_{VIN}	V_{IN}=3.3V, EN=1, No Load	---	8	10	
Power FET						
ON Resistance	R_{DSON}	V_{CC}=5.0V	---	10	---	mΩ
		V_{CC}=3.3V		12		
Thermal Shutdown and Recovery						
Shutdown temperature	T_{STD}		---	155	---	°C
Hysteresis	T_{HYS}		---	30	---	°C
Under Voltage Proctection						
V_{CC} under voltage lockout threshold	V_{CC_UVLO}	UVLO rising threshold	---	2.6	2.8	V
UVLO hysteresis	V_{UVLO_HYS}		---	200	---	mV
Soft Start						
SS pull-up current	I_{SS}		---	9	---	µA
ENABLE						
EN rising threshold	V_{ENH}		1.3	1.5	1.7	V
EN hysteresis	V_{ENHYS}		---	400	---	mV
ILIM						
Current limit	I_{LIM}	R_{IMON}=50kΩ	1.54	---	1.74	A
IMON						
Current Monitor Accuracy	I_{MON}	V_{IN}=3.6V ,I_{OUT}=3.75A	44.35	45.73	47.11	µA
		V_{IN}=3.6V ,I_{OUT}=3A	35.49	36.59	37.69	
		V_{IN}=3.6V ,I_{OUT}=1.5A(1)	17.39	18.3	19.22	
		V_{IN}=1.2V ,I_{OUT}=3.75A	44.3	46.65	49	
		V_{IN}=1.2V ,I_{OUT}=3A	35.43	37.3	39.2	
		V_{IN}=1.2V ,I_{OUT}=1.5A(1)	17.54	18.66	19.78	
I_{OUT} to I_{MON} Current Gain	I_{MON_GAIN}	I_{OUT}/ I_{MON}	---	82000	---	A/A

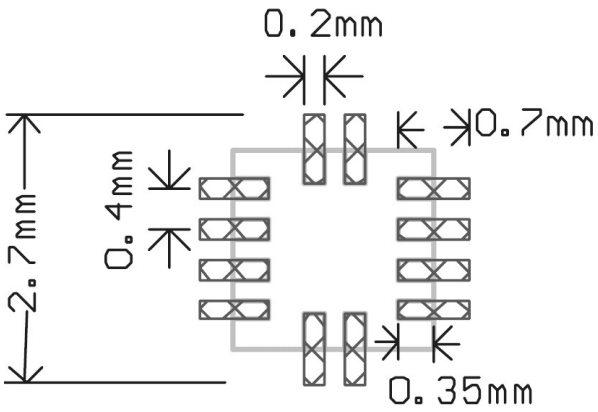
Electrical Characteristics (Continued)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
PG						
Power good rising threshold	$V_{PG\ Rise}$	Voltage gap between VOUT and VIN	110	150	250	mV
Power good hysteresis	$V_{PG\ HYS}$		---	50	---	mV
Power good rising delay	$T_{PG\ D\ Rise}$		---	100	---	μs
Power good high	$V_{PG\ H}$	V_{CC}=3.3V	3.2	---	---	V
Power good low	$V_{PG\ L}$	Sink 1mA	---	---	0.3	V
Discharge Resistance						
Resistance	R_{DIS}		---	200	---	Ω

Note(1): If load current is smaller than 1.5A, the IMON accuracy will be affected by some internal offset.

Minimum Footprint PCB Layout Section

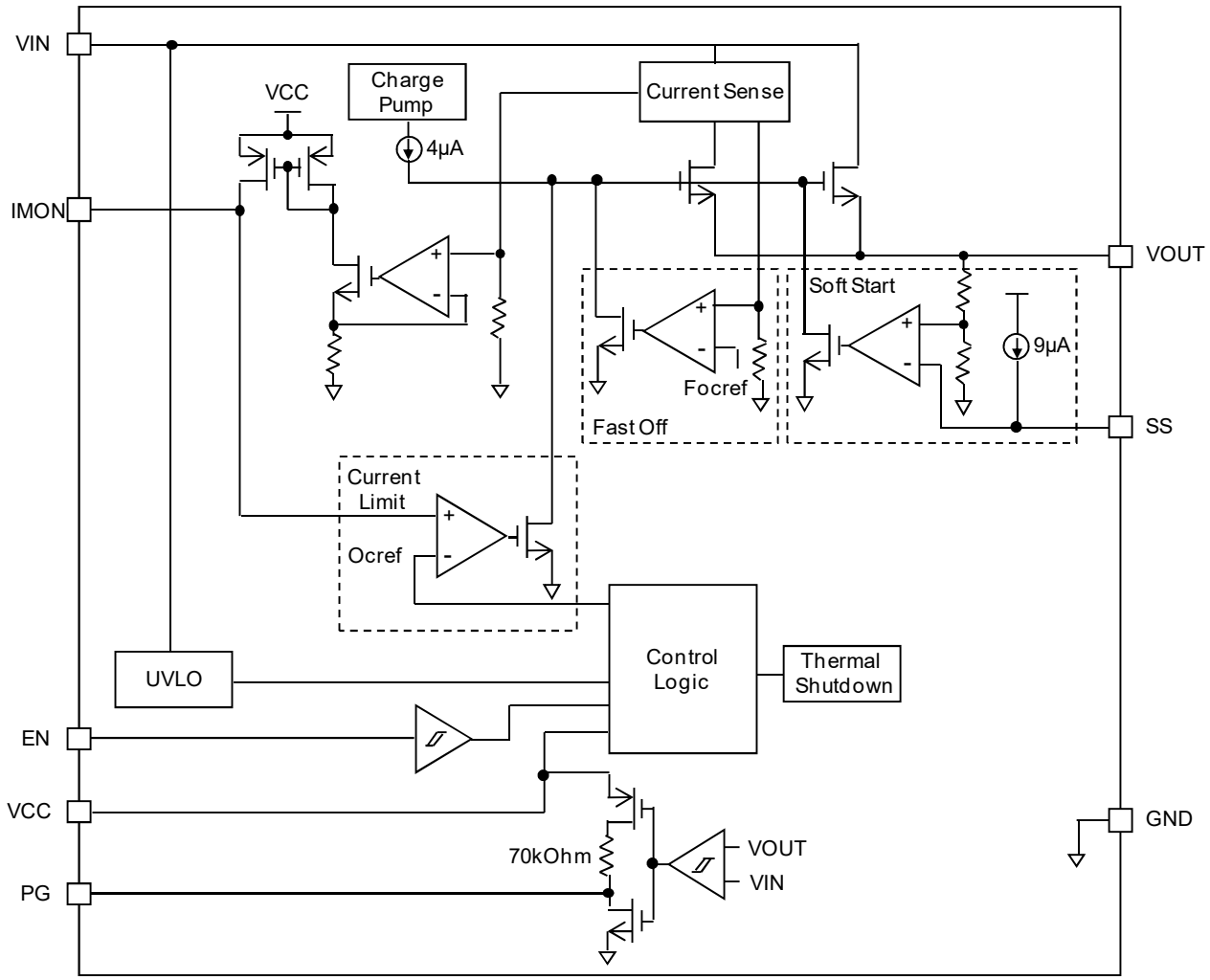
AQFN2X2-12



Pin Description

PIN	NAME	FUNCTION
1	EN	Enable Input. Pulling this pin below the specified threshold shuts the chip down
2	GND	Ground
3	VCC	Supply Voltage to the Control Circuitry.
4	IMON	Provides a current proportional of the current flowing through the power switch. Place a resistor to ground to set the current limit threshold.
5	SS	Soft Start Pin. An external capacitor connected to this pin sets the slew rate of the output voltage soft start period.
6, 11	VIN	Input Power Supply.
7, 8, 9, 10	VOUT	Output to the Load.
12	PG	Power Good Pin. Push-Pull output to monitor input voltage. If VIN pin voltage is higher than 3V, the PG voltage is high.

Block Diagram



Function description

The G5409N can limit the in-rush current to the load, thereby limiting the backplane's voltage drop and output voltage slew rate. An integrated solution to monitor the input voltage and output current eliminates the need for an external current power MOSFET, and current switch device.

Enable

When supply voltage exceeds the undervoltage lockout threshold (UVLO), typically 2.6V, G5409N can be enabled by pulling EN pin to higher than enable threshold voltage, typically 1.5V.

The recommend start up sequence is power up VIN first. After VIN is ready, pull EN voltage to high.

Current Limit

The G5409N constant current limit can be programmed by an external resistor. The pre-set current limit value can be calculated by below equation:

$$I_{IMON}(A) = \frac{82000}{R_{IMON}(\Omega)}$$

where R_{IMON} is R1 placed between IMON pin to ground in typical application circuit.

Once the device reaches the preset current limit threshold, the internal circuit regulates the gate voltage to keep the current in the power FET constant. This block typical response time is about 20μs and the output current may have a small overshoot during this time period.

If the current limit block starts to regulate the output current, the power loss on power MOSFET will cause the IC temperature rise. If the junction temperature is high enough to trigger thermal shutdown, it will disable the output until the over temperature fault remove. The over temperature threshold is 155°C and hysteresis is 30°C.

Power-Good Function

The PG pin is the push pull output that can be pulled high to V_{CC}. When the voltage difference between VIN and VOUT is smaller than 180mV, PG is high. A threshold hysteresis will prevent the chip from responding perturbation on both pins.

Short-Circuit Protection

Once the output short circuit rapidly, the load current may exceed the pre-set current limit by a lot before the current limit block activating. If the current reaches an internal secondary current limit level (about 13A), a fast turn-off circuit activates to turn off the power FET, which total short circuit response time is within 1us. If fast off works, it will keep off the power FET for a period. After that time period, it will re-turn on power FET.

Output Discharge

This function can discharge the V_{OUT} by internal pull down resistance when IC EN or VCC disabled and the load is very light.

Soft-Start

A capacitor connected between SS pin and ground with an internal 9μA constant current source charge SS cap can determine the soft start time. The output voltage rises at 3 times the slew rate to the SS voltage and the soft-start time can be calculated by below equation:

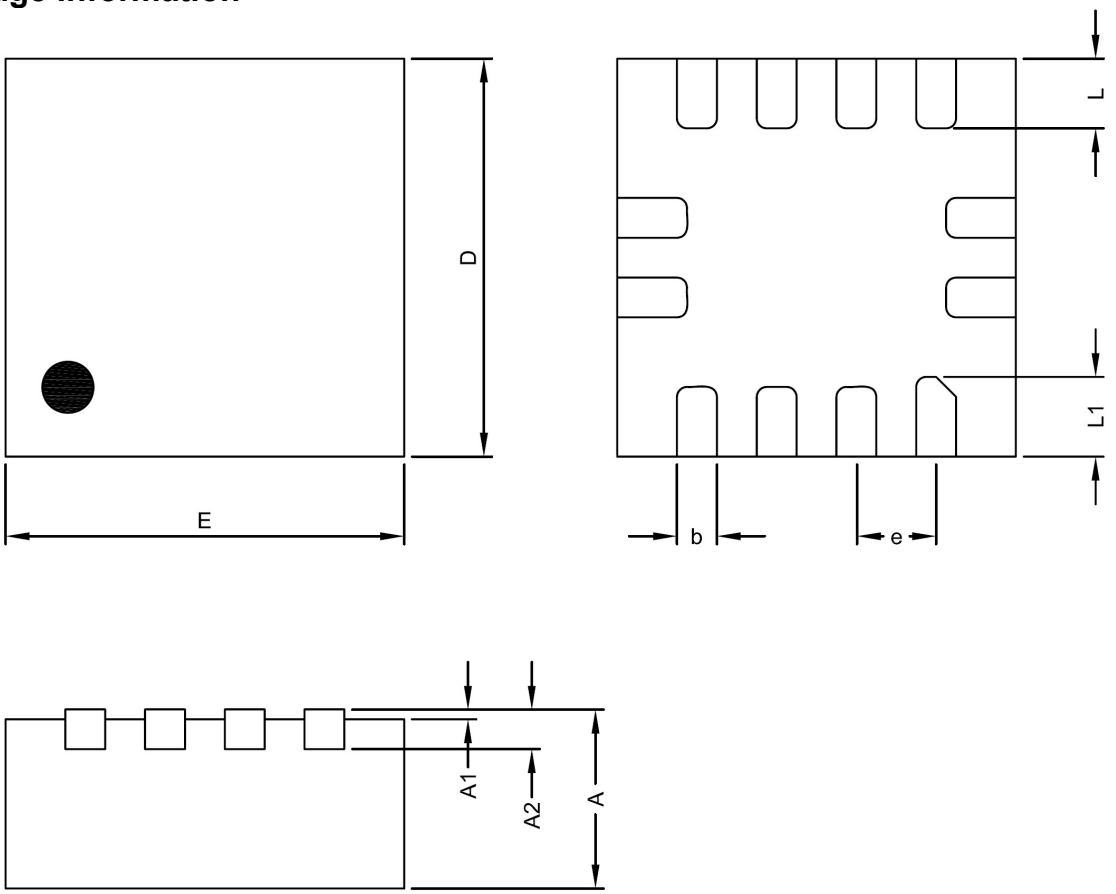
$$T_{SS}(ms) = \frac{1}{3} \times \frac{V_{OUT}(V) \bullet C_{SS}(nF)}{I_{SS}(\mu A)}$$

where T_{SS} is the soft-start time, I_{SS} is internal 9μA constant current, C_{SS} is external soft-start cap. The suggestion minimum SS cap should be bigger than 4.7nF. If the SS pin is floated or SS cap is too small, the V_{OUT} rising time will be just limited by power MOS charge time.

EV Board PCB Layout Section

EV5409N PCB	Information
Board Material	FR4
Size	40mm×30mm
Board Thickness	1.6mm
Layers	2
Copper Thickness	2 oz.

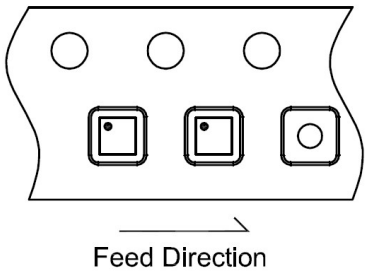
Package Information



AQFN2X2-12 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.0315	0.0354	0.0394
A1	0.00	- - -	0.05	0.0000	- - -	0.0020
A2	0.20 REF			0.0079 REF		
D	1.95	2.00	2.05	0.0768	0.0787	0.0807
E	1.95	2.00	2.05	0.0768	0.0787	0.0807
b	0.15	0.20	0.25	0.0059	0.0079	0.0098
e	0.40 BSC			0.0157 BSC		
L	0.30	0.35	0.40	0.0118	0.0138	0.0157
L1	0.35	0.40	0.45	0.0138	0.0157	0.0177

Taping Specification



PACKAGE	Q'TY/REEL
AQFN2X2-12	3,000 ea