

5.5V, 7A Low $R_{DS(on)}$ Load Switch

Features

- Built-in 10m Ω Low $R_{DS(on)}$ MOSFET
- Adjustable Soft Start Function
- V_{IN} Operating Range: 0.5V to 5.5V
- Programmable up to 7A Current Limit
- Output Discharge Function (Only in G5409)
- Push-pull V_{in} PG Indicator
- Fast Short Circuit Protection
- Thermal Protection
- Available in AQFN2X2-12 Package

Applications

- Solid State Drivers
- Notebook Computers
- Portable Devices

General Description

The G5409 is a load switch with a built-in 10m Ω MOSFET. It is designed to provide up to 7A current limit protection covering 0.5V to 5.5V input voltage range. With tiny package, G5409 provides very high efficiency and space-saving solution for solid state driver (SSD), notebook, and other portable devices

With the soft start function, the G5409 can avoid in-rush current during circuit start up. The G5409 also provides other features, like power good, thermal shutdown, and output discharge function (There is no discharge function in G5409A.)

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

G5409 is available in a small AQFN2X2-12 package.

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G5409AS1U	5409	-40°C to +125°C	AQFN2X2-12
G5409AAS1U	5409A	-40°C to +125°C	AQFN2X2-12

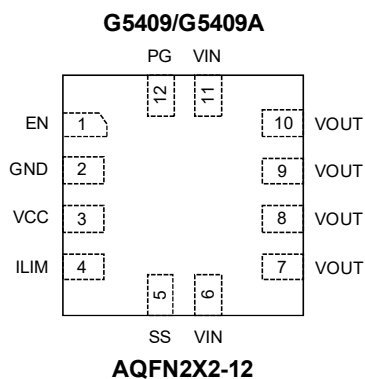
Note: AS: AQFN2X2-12

1: Bonding Code

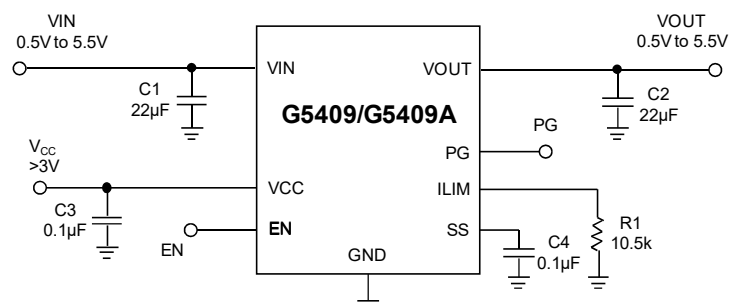
U : Tape & Reel

Green : Lead Free / Halogen Free.

Pin Configuration



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, ILIM to GND	-0.3V to V _{CC} +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
ESD Susceptibility (HBM)	2kV
ESD Susceptibility (CDM)	1kV

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

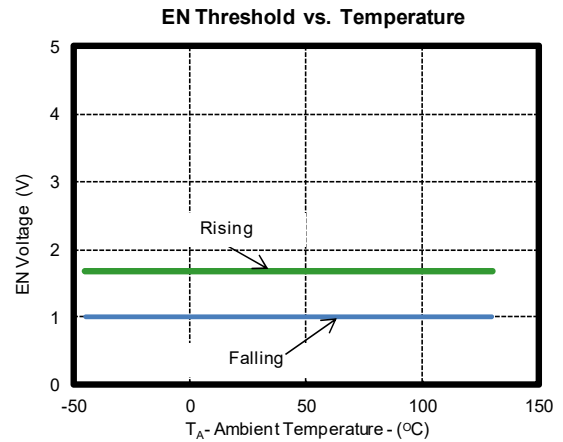
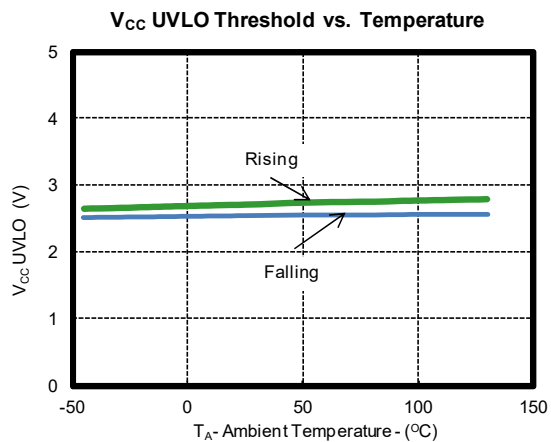
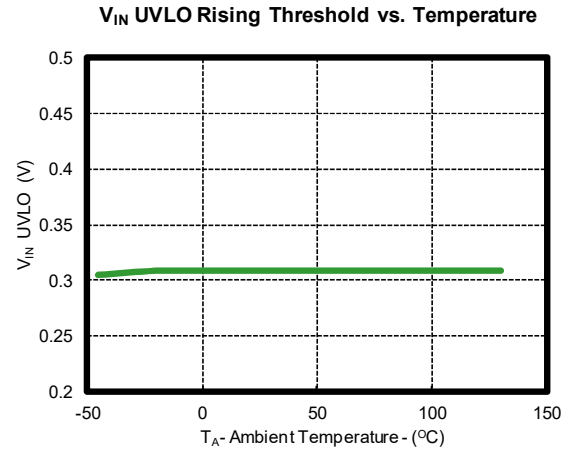
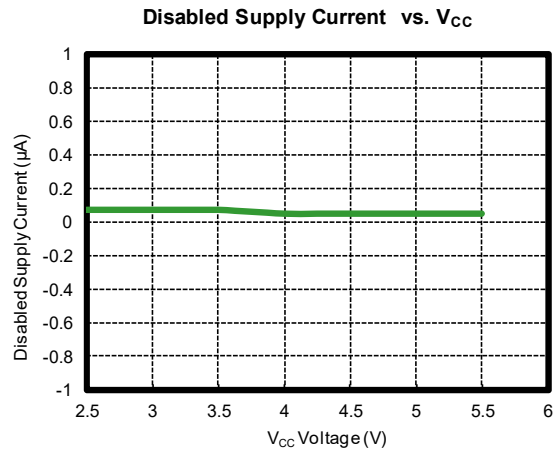
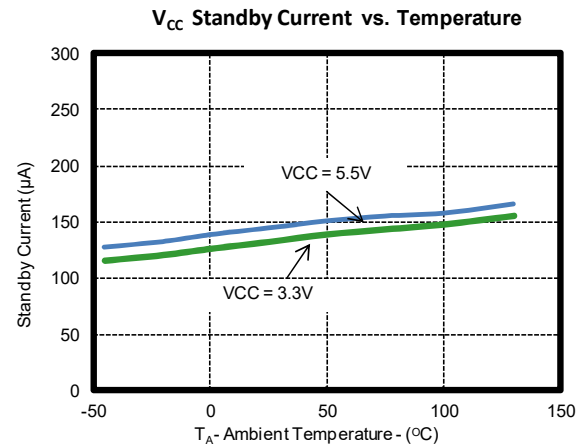
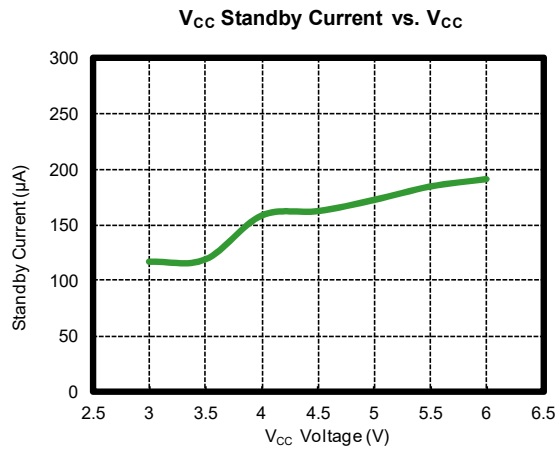
(V_{IN}=3.6V, V_{CC}=3.6V, T_A = 25°C.)

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.

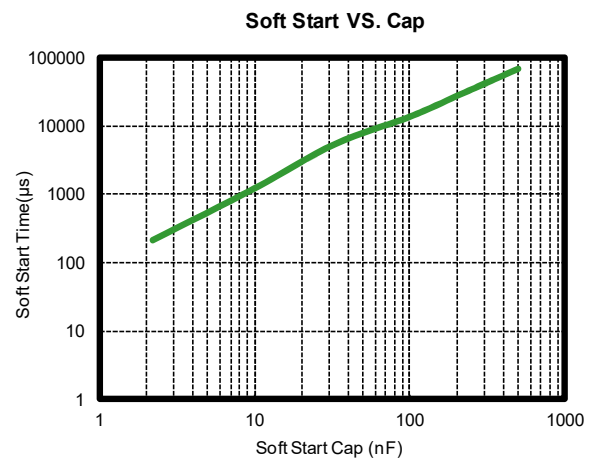
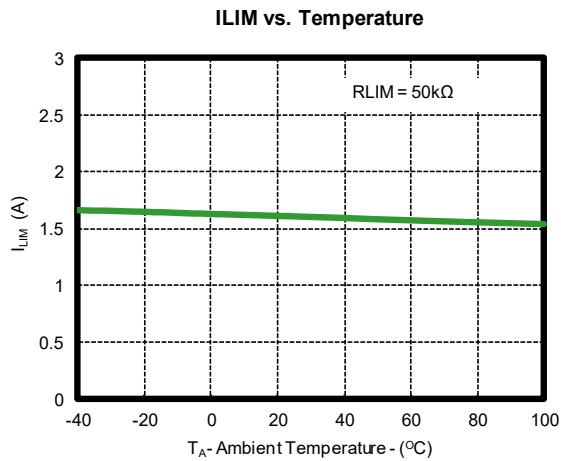
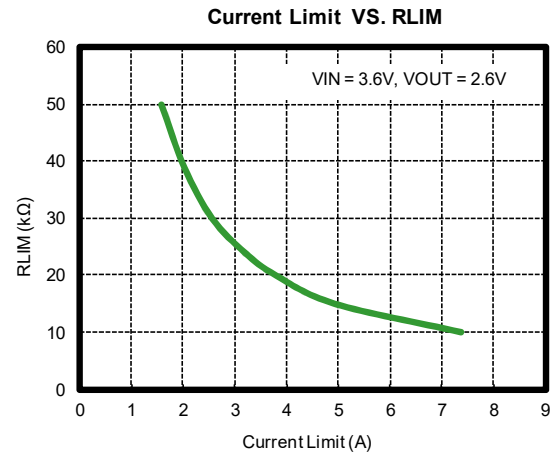
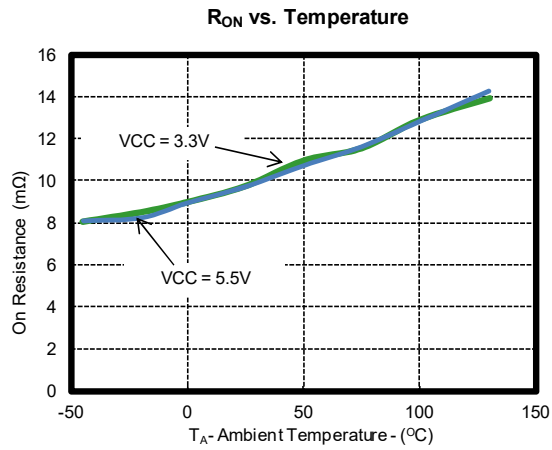
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Input and Supply Voltage Range						
Input voltage	V _{IN}		0.5	---	5.5	V
Supply voltage	V _{CC}		3	---	5.5	V
Supply Current						
Off state leakage current	I _{off}	V _{IN} =5V, EN=0	---	---	1	μA
V _{CC} standby current	I _{STBY}	V _{CC} =5V, EN=0	---	0.1	1	μA
		V _{CC} =5V, EN=1, No Load	---	130	195	
		V _{CC} =3.3V, EN=1, No Load	---	120	185	
		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 Protection						
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 _{OUT}	R _{LIM} =50kΩ	1.54	---	1.74	A
PG						
V _{IN} upper threshold	V _{INTH}		2.8	2.925	2.97	V
Hysteresis on V _{IN} pin	V _{HYS}		---	100	---	mV
Power good rising delay	T _{PG D Rise}		---	100	---	μs
Power good deglitch delay	T _{PG D Fall}		---	---	5	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}	Only in G5409	---	200	---	Ω

Typical Performance Characteristics

(VIN = VCC = 3.6V, RLIM = 10kΩ, unless otherwise noted.)

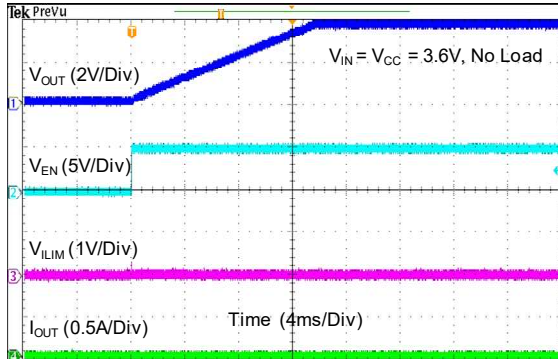


Typical Performance Characteristics (Continued)

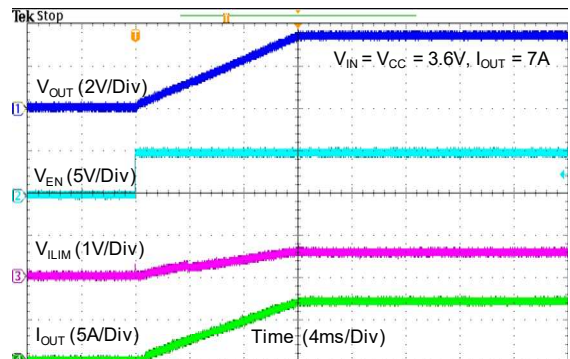


Typical Performance Characteristics (Continued)

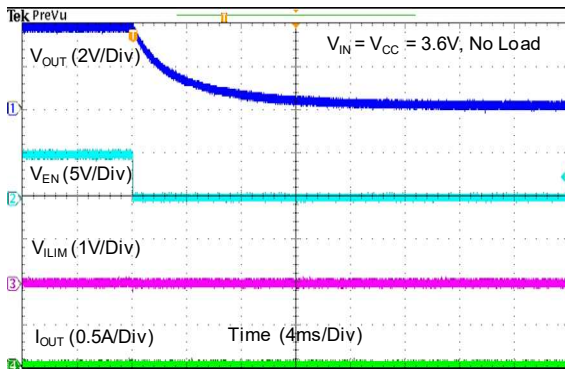
Enable Startup



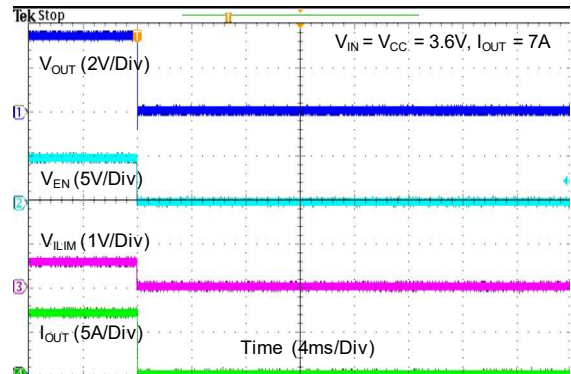
Enable Startup



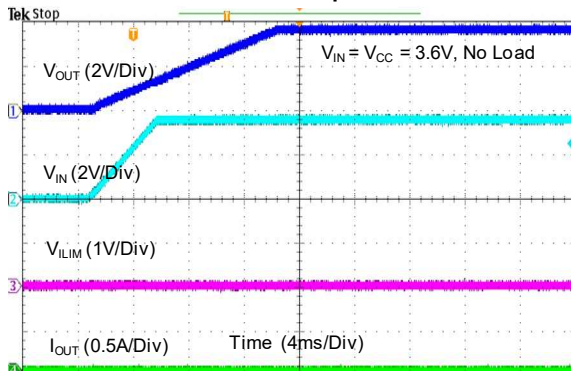
Enable Shutdown



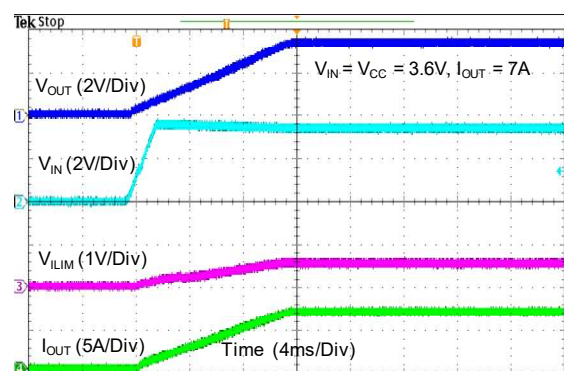
Enable Shutdown



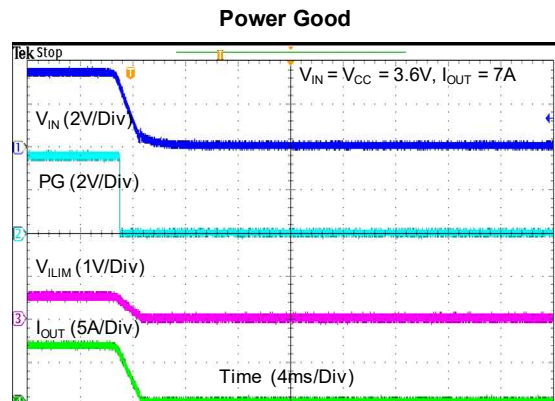
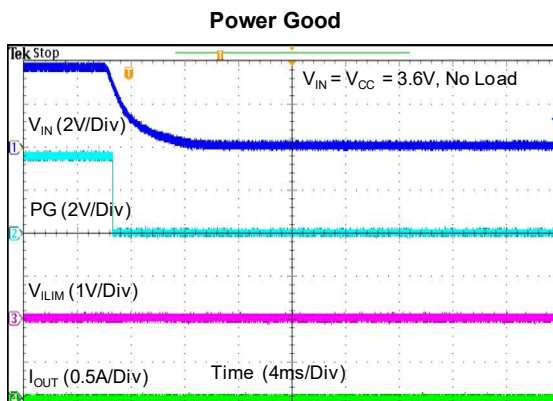
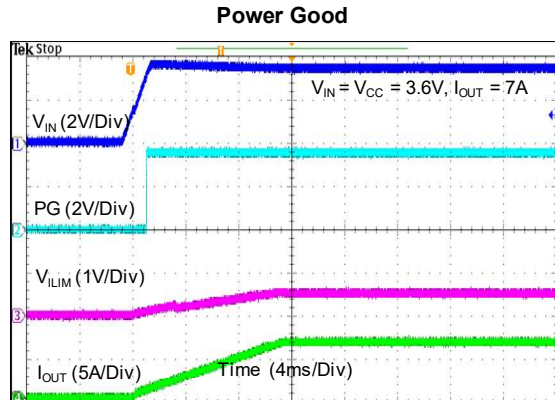
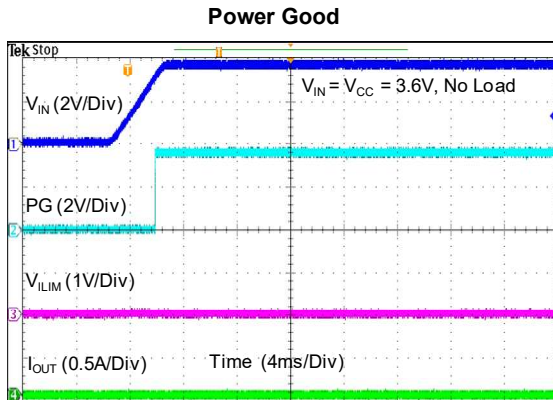
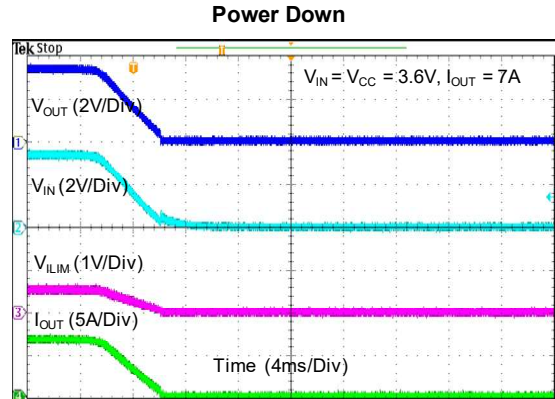
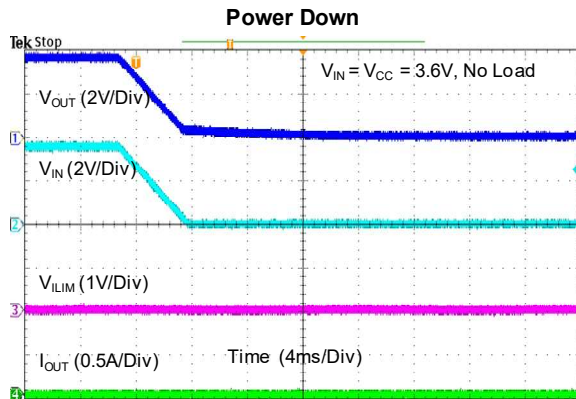
Power Up



Power Up

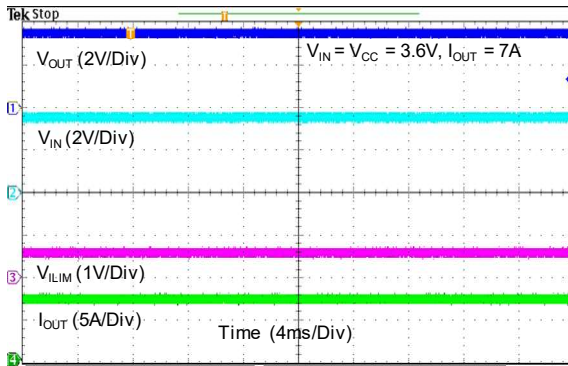


Typical Performance Characteristics (Continued)

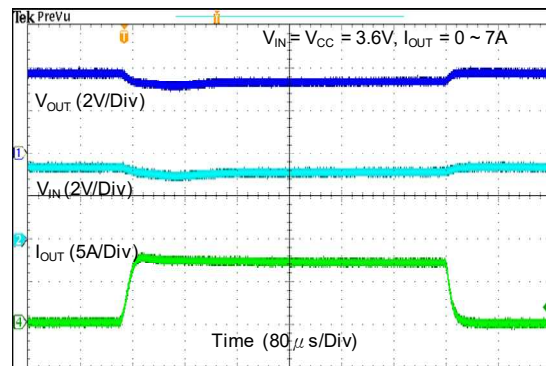


Typical Performance Characteristics (Continued)

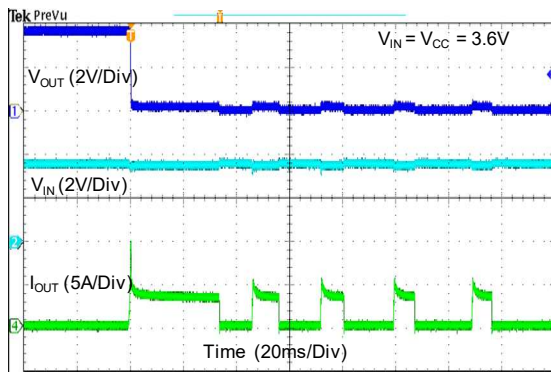
Steady State



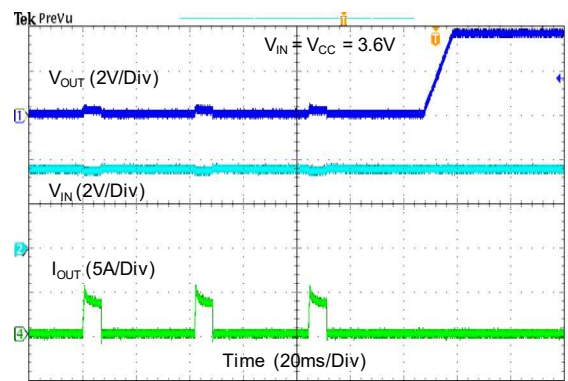
Load Transient Response



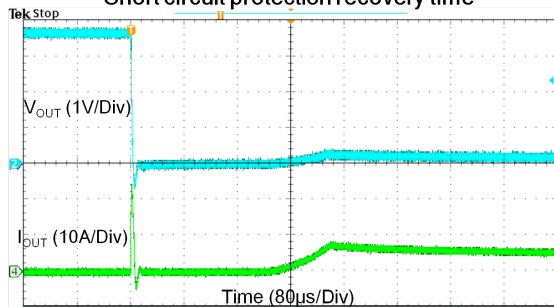
Short Circuit Protection



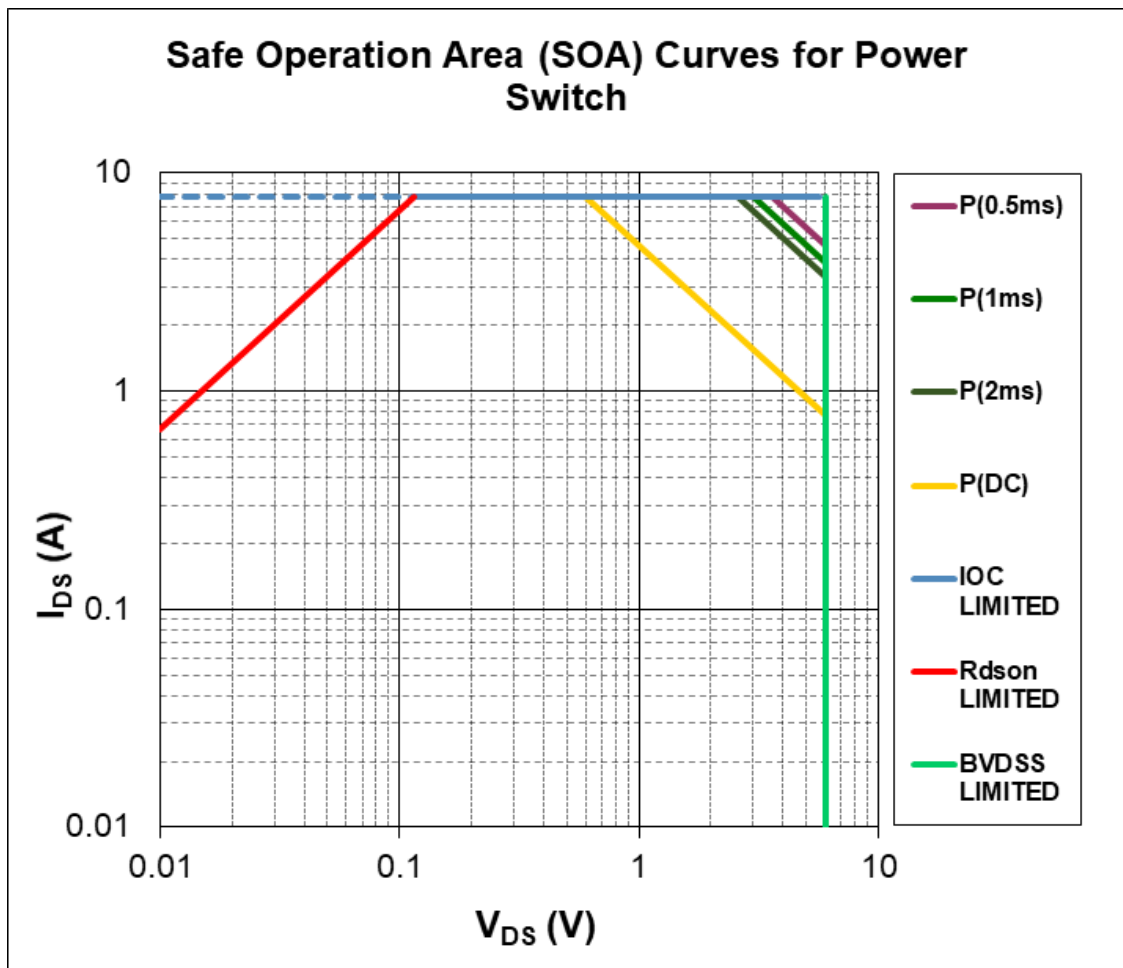
Short Circuit Removal



Short circuit protection recovery time

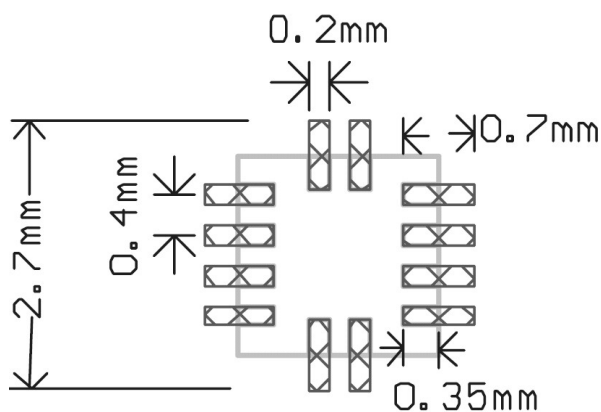


Device SOA



Minimum Footprint PCB Layout Section

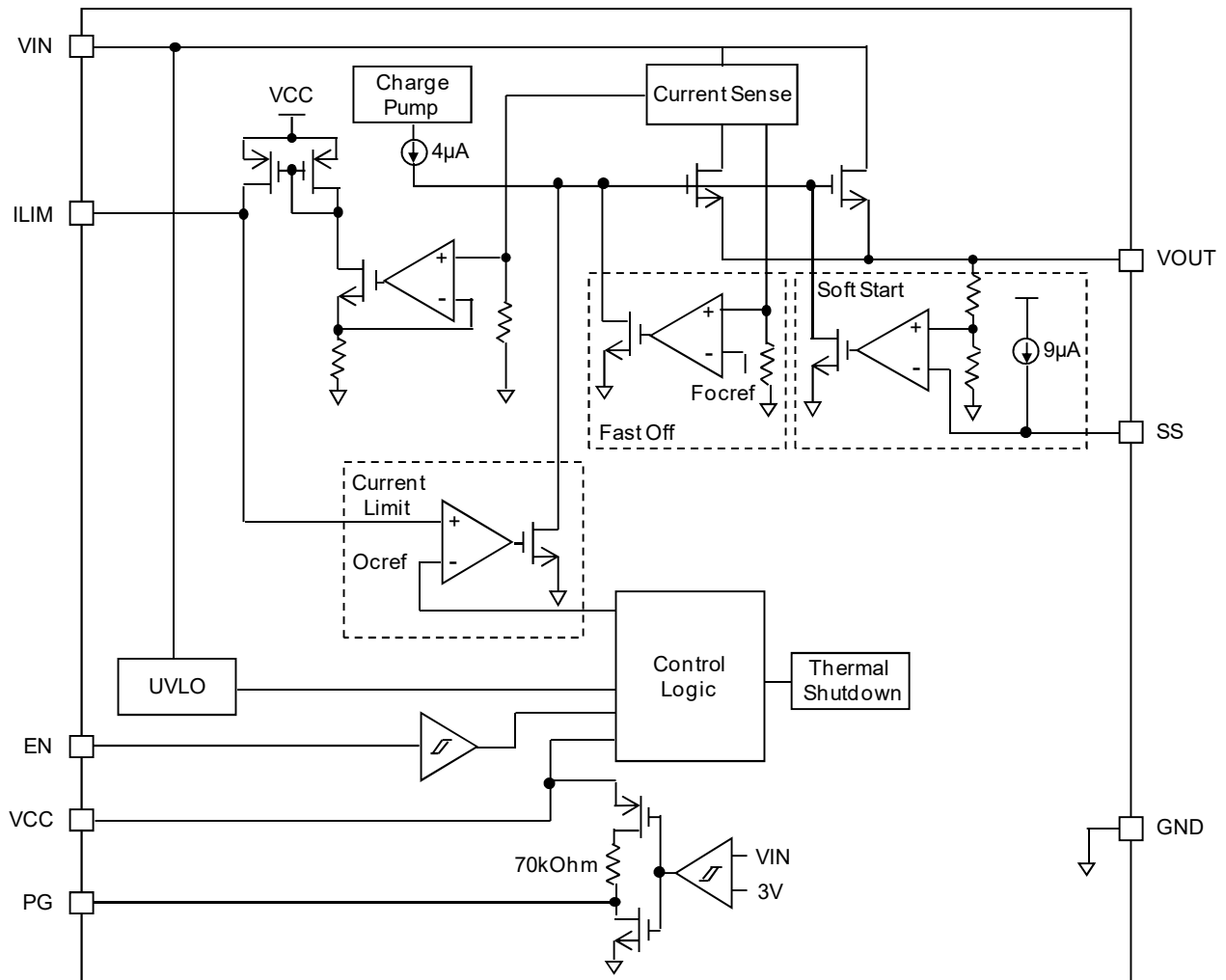
AQFN2X2-12



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	ILIM	Output Current Limit Configure. Place a resistor to ground to set the overload current limit level.
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 G5409 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 lock-out threshold (UVLO), typically 2.6V, G5409 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 G5409 constant current limit can be programmed by an external resistor. The pre-set current limit value can be calculated by below equation:

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

where R_{LIM} is R1 placed between ILIM 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 V_{IN} voltage is over 3V, PG is high. A threshold hysteresis will prevent the chip from responding perturbation on V_{IN} pin.

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. There is no discharge function in G5409A.

Soft-Start

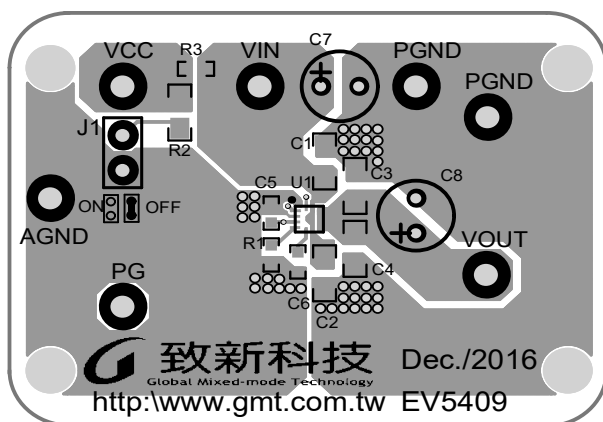
A capacitor connected between SS pin and ground with an internal 9μA constant current source charge SS cap can determine the soft start time. The output voltage rises at 3 times the slew rate to the SS voltage and the soft-start time can be calculated by below equation:

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

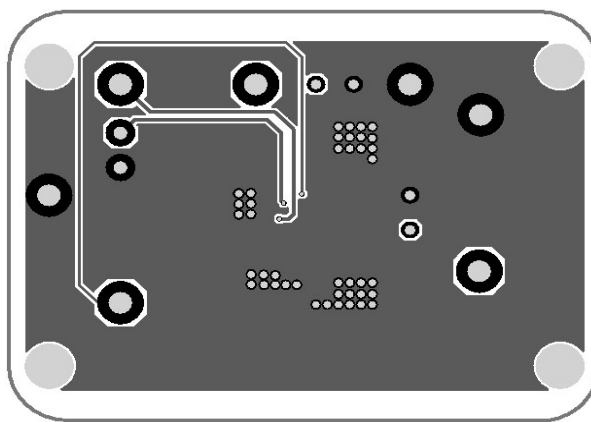
where T_{SS} is the soft-start time, I_{SS} is internal 9μA constant current, C_{SS} is external soft-start cap. The suggestion minimum SS cap should be bigger than 4.7nF. If the SS pin is floated or SS cap is too small, the V_{OUT} rising time will be just limited by power MOS charge time.

EV Board PCB Layout Section

Top Layer

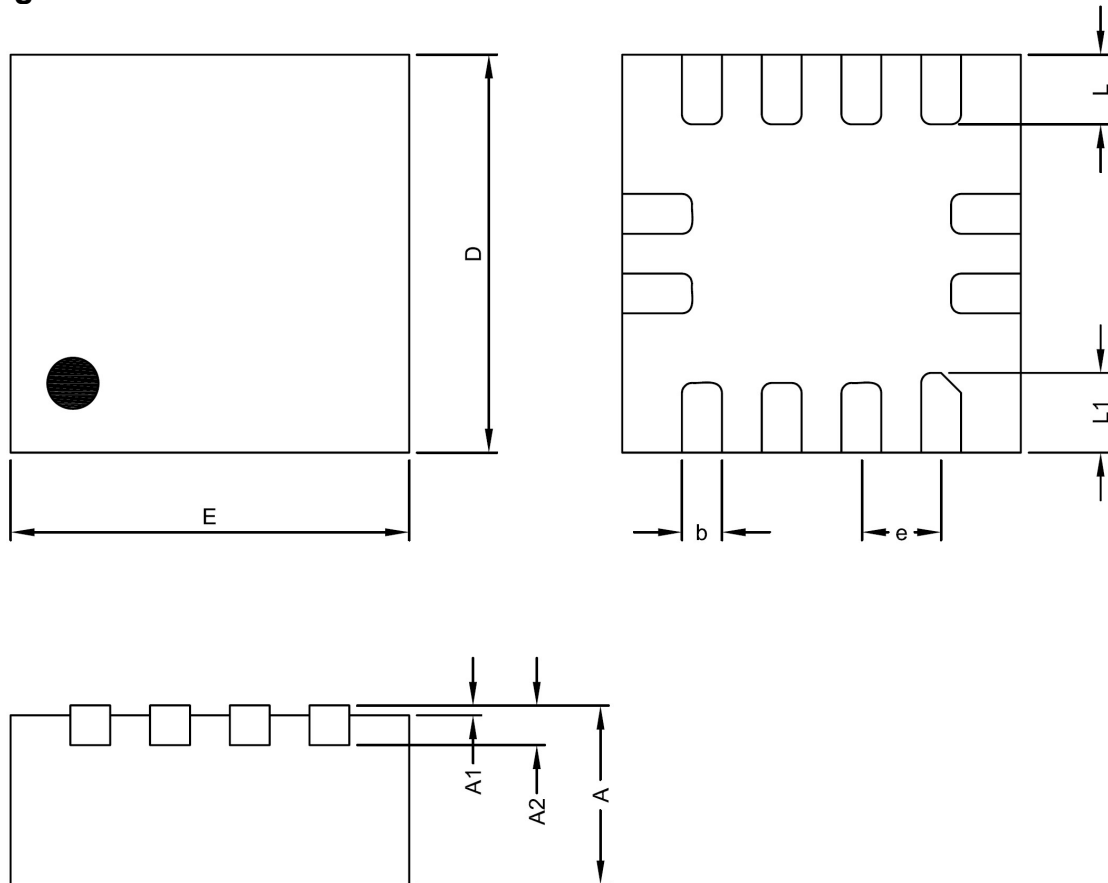


Bottom Layer



EV5409 PCB	Information
Board Material	FR4
Size	40mm×30mm
Board Thickness	1.6mm
Layers	2
Copper Thickness	2 oz.

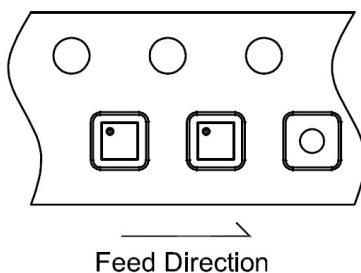
Package Information



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

GMT Inc. does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and GMT Inc. reserves the right at any time without notice to change said circuitry and specifications.