

High Efficiency Single Inductor Auto Buck-Boost Converter

Features

- 1.8V ~ 5.5V Input Voltage Operation
- Adjustable Output Voltage from 2.8V to 5.5V
- 95% Efficiency DC/DC Converter
- 1.5A Output Current at 3.3V for VIN > 3.6V
- Auto-Transition Between Buck and Boost Mode
- Pulse-Skipping Mode at light load for Efficiency
- DC/DC Converter can be set to lower quiescent current at light load
- Fixed 2.4MHz Frequency and Synchronization Possible
- Internal Soft-Start
- Built-In Cycle-by Cycle Current Limit and Over Voltage Protection
- Built-In Thermal Shutdown Function
- WLCSP2X4-8 Package (0.4mm pitch)

General Description

The G2228 is a high efficiency single inductor Buck-Boost converter which can supply the load current up to 1.5A. It provides auto-transition between Buck and Boost Mode. The G2228 operates at 2.4MHz switching frequency in CCM. DC/DC converter operates at Pulse-Skipping Mode at light load. The output voltage is programmable using an external resistor divider, or is fixed to 3.3V internally. The load is disconnected from the VIN during shutdown.

The G2228 is available in WLCSP2X4-8 package.

Applications

- Mobile Handsets
- Smart Phone

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G2228CD1U	YWWS 2228	-40°C~+85°C	WLCSP2X4-8

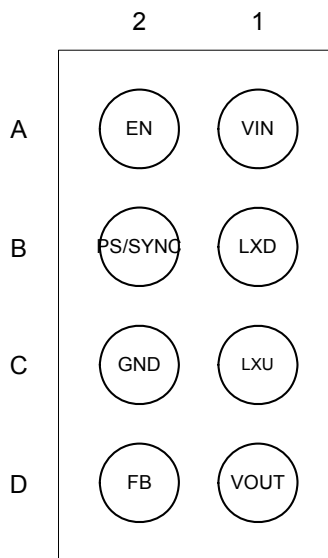
Note: CD: WLCSP2X4-8

1: Bonding code

U: Tape & Reel

Green : Lead Free / Halogen Free.

Pin Configuration



Bottom View
WLCSP 2X4-8

Absolute Maximum Ratings

VIN, VOUT	-0.3V to +6.5V	Operating Ambient Temperature	-35°C to 85°C
LXD, LXU	-0.3V to +6.5V	Storage Temperature Range.	-55°C to +150°C
EN, PS/SYNC, FB	-0.3V to +6.5V	Reflow Temperature (soldering, 10 sec)	260°C
Thermal Resistance Junction to Ambient, (θ_{JA})		EDS Susceptibility (Human Body Mode)	2kV
WLCSP2X4-865°C/W	EDS Susceptibility (Machine Mode)	200V
Continuous Power Dissipation ($T_A=25^\circ\text{C}$)			
WLCSP2X4-82W		

- 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

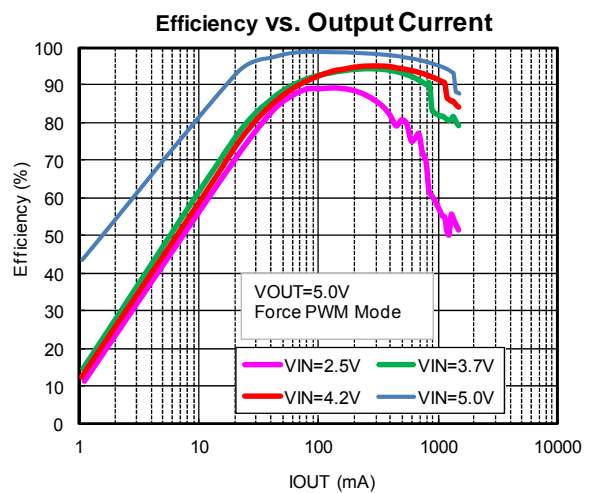
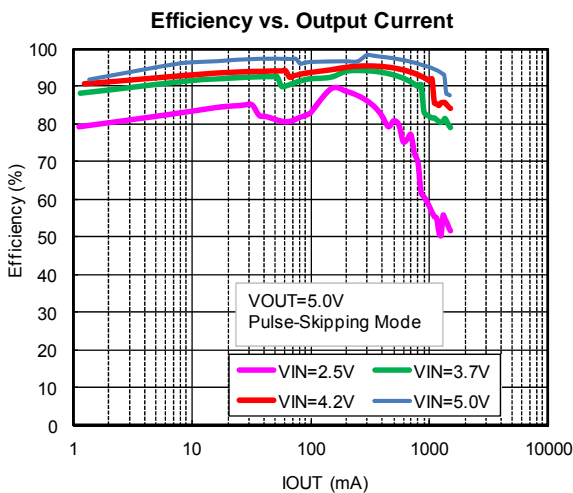
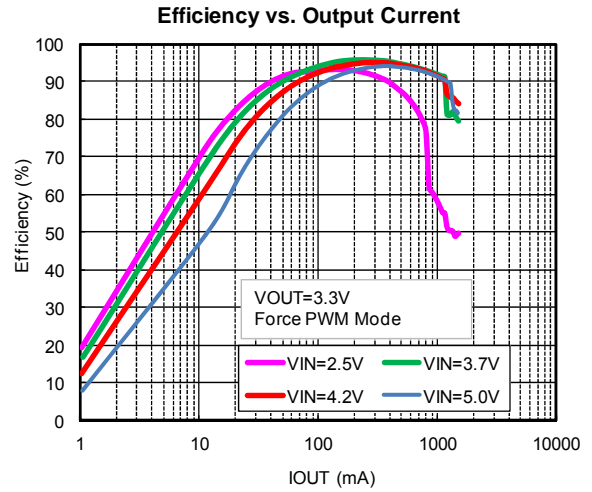
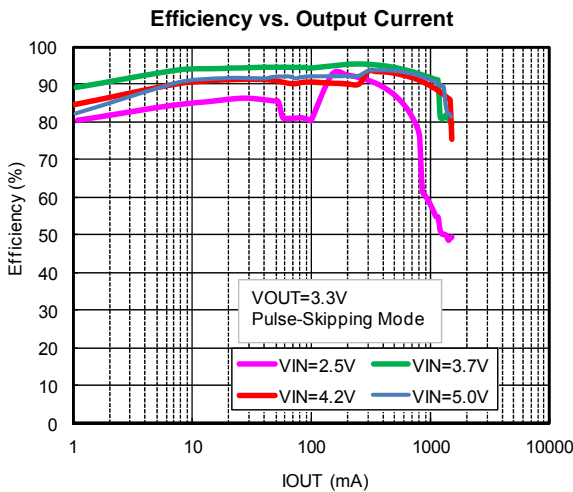
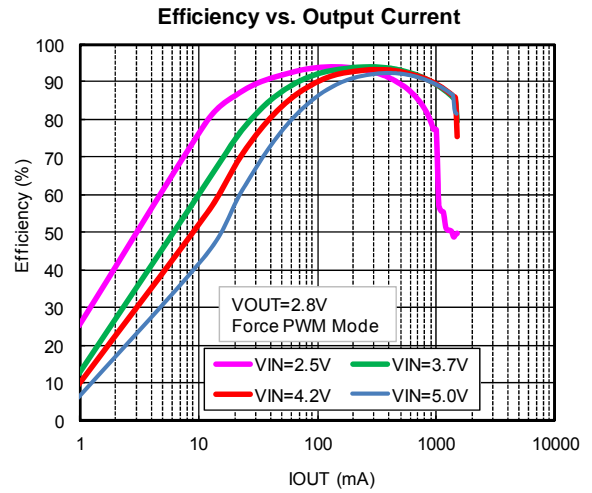
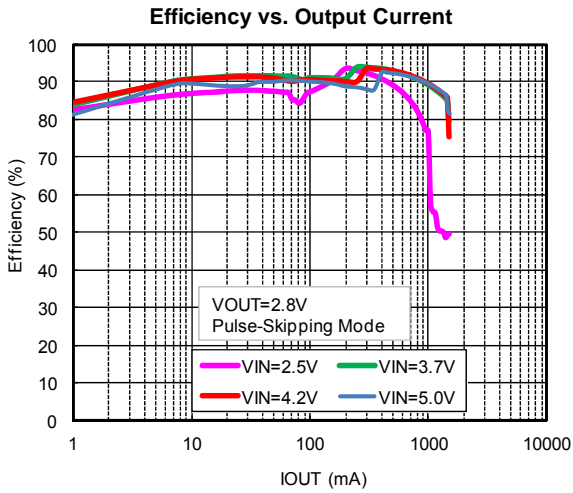
(VIN=VINA=3.6V, TA=25°C, unless otherwise specified)

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	CONDITIONS	MIN	TYP	MAX	UNIT
GENERAL						
VIN minimum Startup Voltage	V _{IN,ST}		---	---	1.7	V
VIN Operating Voltage	V _{IN}		1.8	---	5.5	V
Output Voltage Range	V _{OUT}		2.8	---	5.5	V
Under Voltage Lockout Threshold	V _{UVLO,R}	V _{INA} voltage rising	---	1.7	---	V
	V _{UVLO,F}	V _{INA} voltage falling	---	1.6	---	V
Quiescent Current	I _Q	V _{EN} =V _{IN} =V _{INA} =3.6V, I _{OUT} =0A (No Switching)	---	40	65	μA
Shutdown Current	I _{SD}	V _{EN} =0V, V _{IN} =V _{INA} =3.6V	---	0.1	1	μA
OSCILLATOR						
Oscillator Frequency	F _{OSC}		2.2	2.4	2.6	MHz
Frequency range for Synchronization	F _{SYN}		4.4	4.8	5.2	MHz
DCDC Converter						
Soft-Start Internal	SS	V _{IN} =V _{INA} =3.6V	---	0.5	---	ms
Feedback voltage	V _{FB}	Adjustable Output	495	500	505	mV
Output voltage		Fixed 3.3V Output	3.267	3.3	3.333	V
Line Regulation	ΔV _{OUT,LINE}	PWM	---	0.5	---	%
Load Regulation	ΔV _{OUT,LOAD}	PWM	---	0.5	---	%
Maximum Duty Cycle	D _{MAX,D}	LXD	---	100	---	%
	D _{MAX,U}	LXU	90	93	96	%
FB Leakage Current	I _{FB,LK}	Adjustable Mode	---	---	1	μA
VOUT Leakage Current	I _{VO,LK}	V _{LXU} =0V, V _{OUT} =5V	---	1	5	μA
LXD, LXU Leakage Current	I _{LXD,LK} , I _{LXU,LK}	V _{LXD} =V _{LXU} =5V	---	1	5	μA
Switch ON Resistance	R _{ON,P}	V _{IN} =V _{INA} =3.6V	---	150	---	mΩ
	R _{ON,N}	V _{IN} =V _{INA} =3.6V	---	130	---	
Peak Current Limit	I _{LIM}	V _{IN} =V _{INA} =3.6V	---	2	---	A
Maximum Output Load Capability	I _{OD_MAX}	V _{IN} ≥ 3.3V, V _O =3.3V	1.5			A
	I _{OU_MAX}	V _{IN} =1.8V, V _O =3.3V	250			mA
Protection						
Over Voltage Protection Threshold	%V _{OVP}	Ratio=V _{OVP} /V _{OUT} , V _{OUT} voltage rising	---	120	---	%
Short Circuit Protection threshold	%V _{SCP}	Ratio=V _{SCP} /V _{OUT} , V _{OUT} voltage falling	---	20	---	%
Thermal Shutdown Protection	T _{SD}		---	150	---	°C
Thermal Shutdown Hysteresis	ΔT _{SD}		---	20	---	°C
Control Signal						
EN, PS/SYNC Input Voltage	V _{TH}	High Threshold	1.2	---	---	V
	V _{TL}	Low Threshold	---	---	0.4	V
EN, PS/SYNC Leakage Current	I _{EN,LK}	EN=V _{INA} or 0V			1	μA

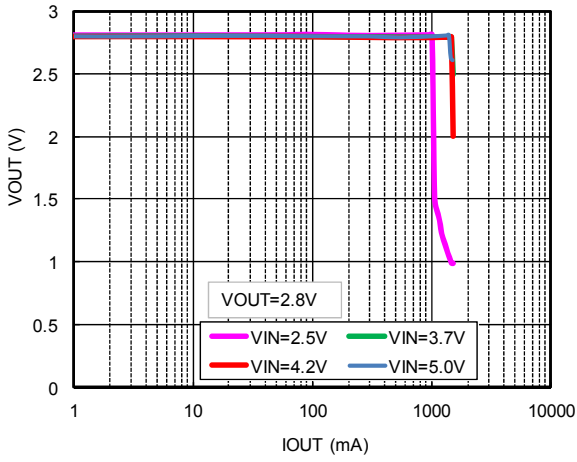
Typical Performance Characteristics

T_A=25°C, unless otherwise noted.

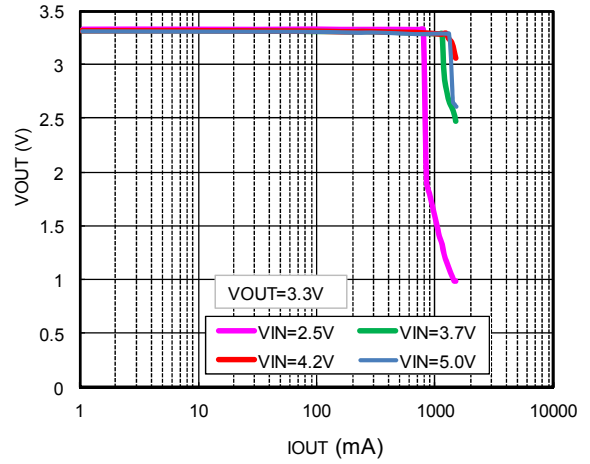


Typical Performance Characteristics (Continued)

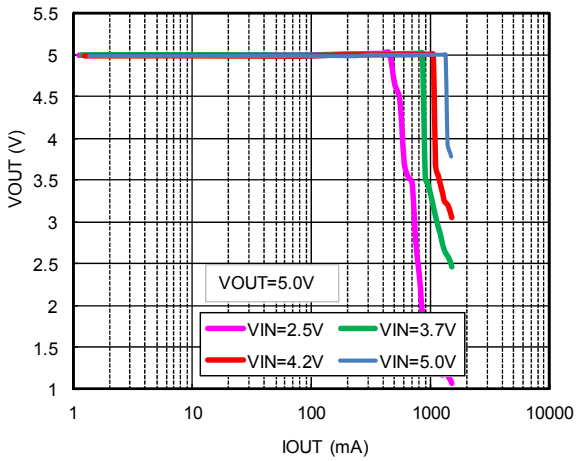
Output Voltage vs. Output Current



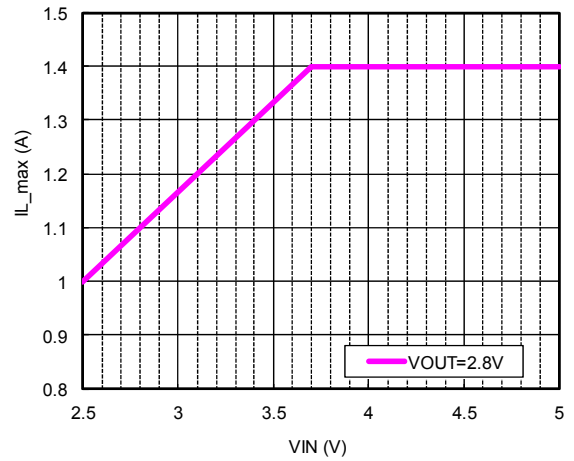
Output Voltage vs. Output Current



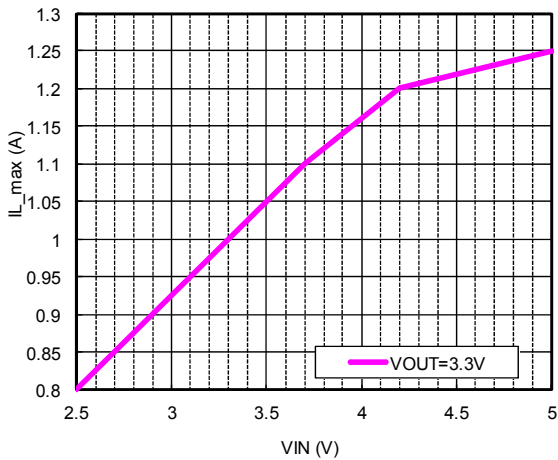
Output Voltage vs. Output Current



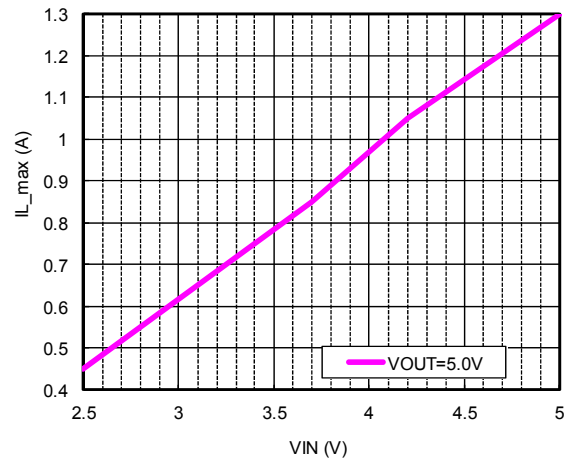
Max. Output current vs. Input Voltage



Max. Output current vs. Input Voltage

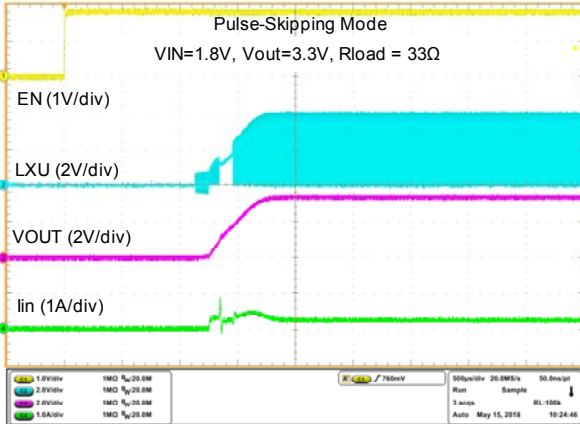


Max. Output current vs. Input Voltage

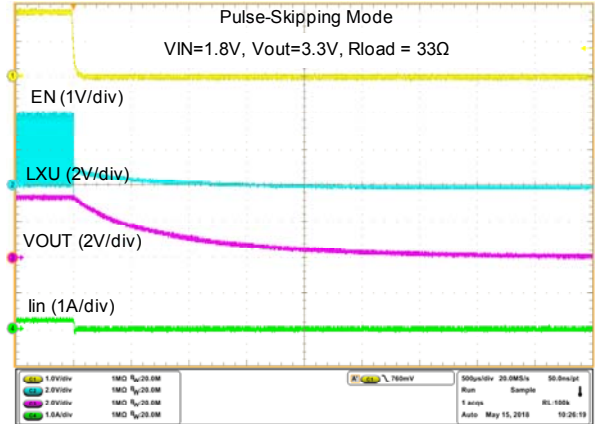


Typical Performance Characteristics (Continued)

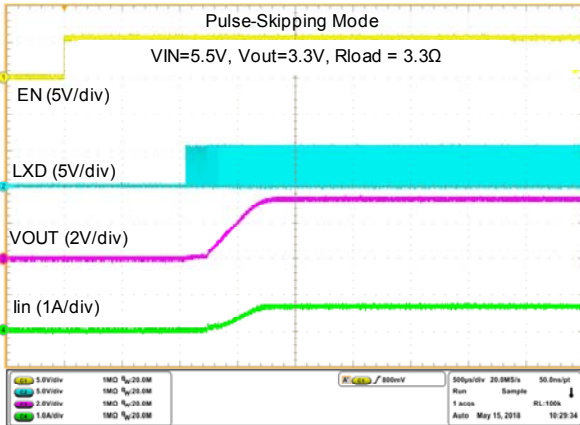
EN control IC Turn on



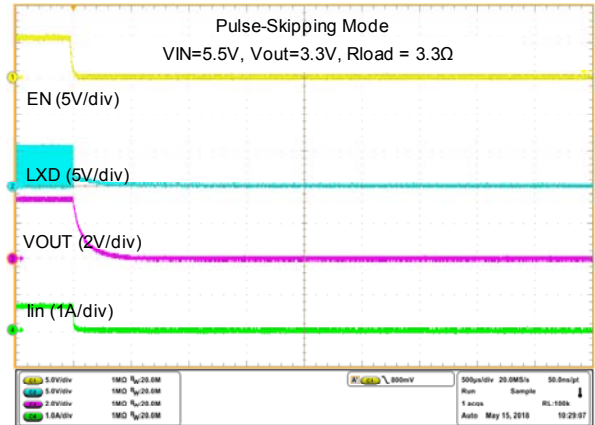
EN control IC Turn off



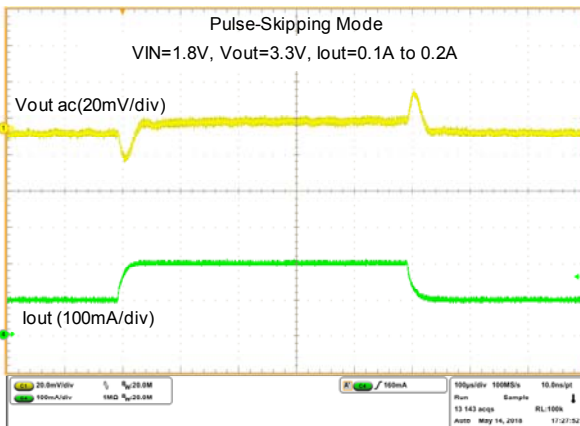
EN control IC Turn on



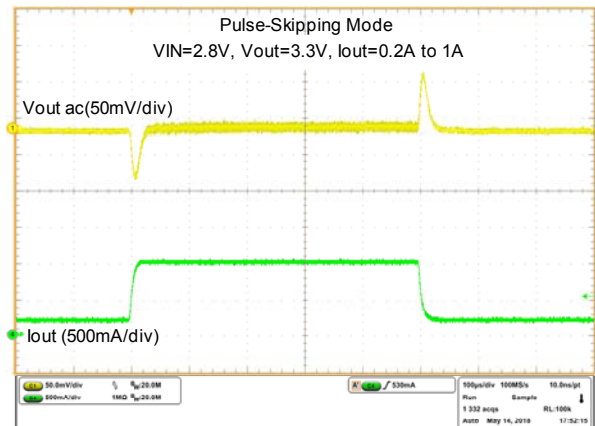
EN control IC Turn off



Load Transient

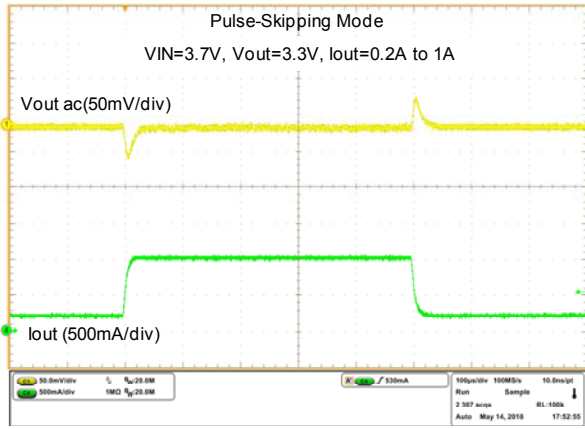


Load Transient



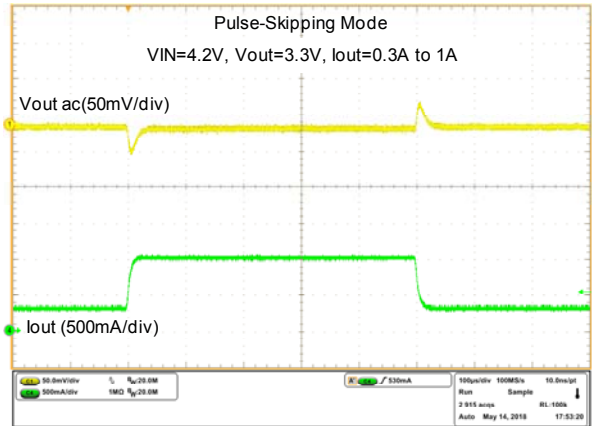
Typical Performance Characteristics (Continued)

Load Transient



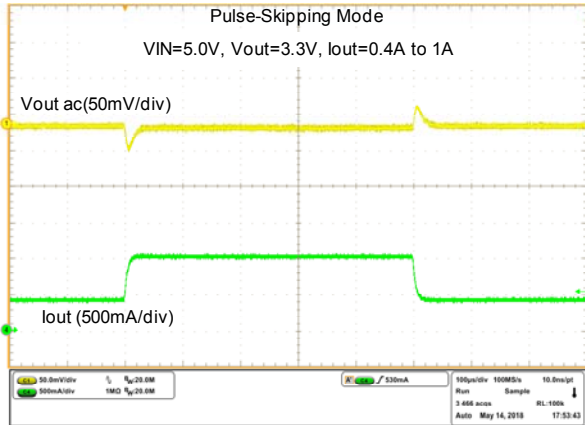
Scope time scale =100us

Load Transient



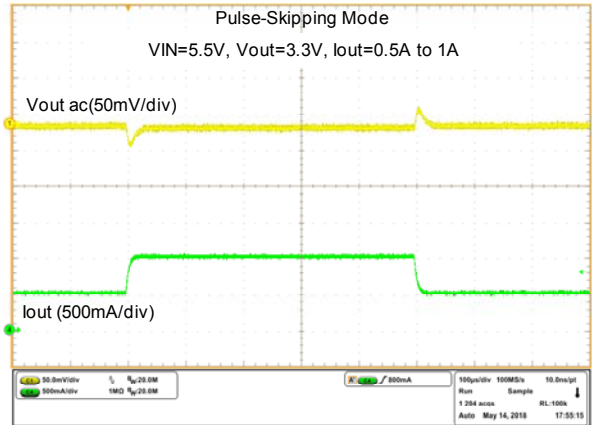
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Load Transient



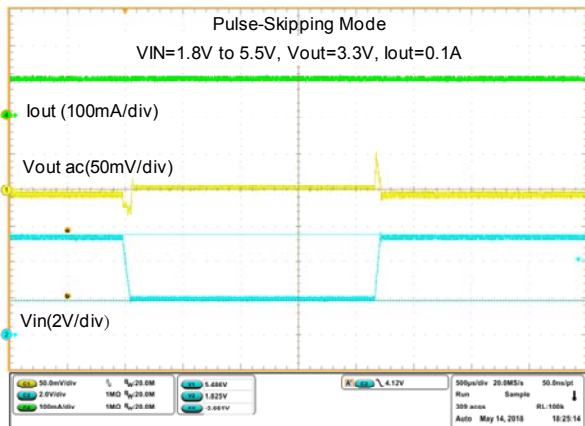
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Load Transient



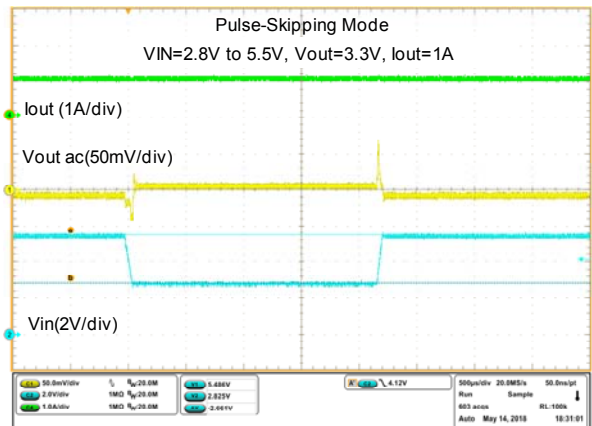
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Line Transient



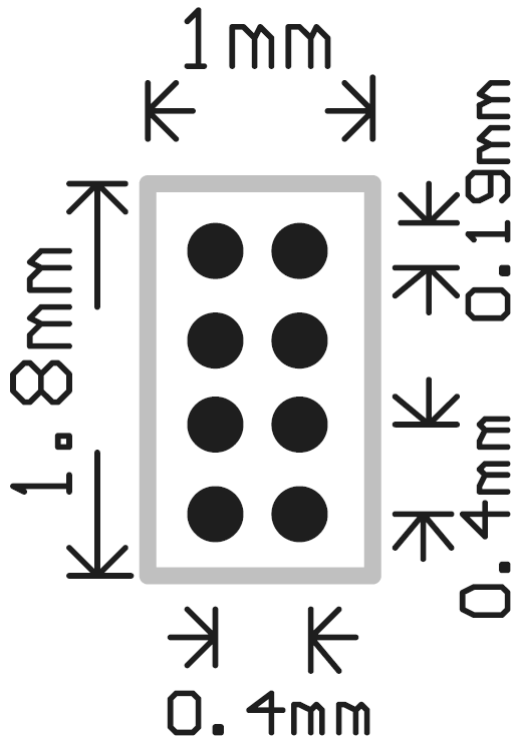
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Line Transient



Scope time scale =500us

Minimum Footprint PCB Layout Section

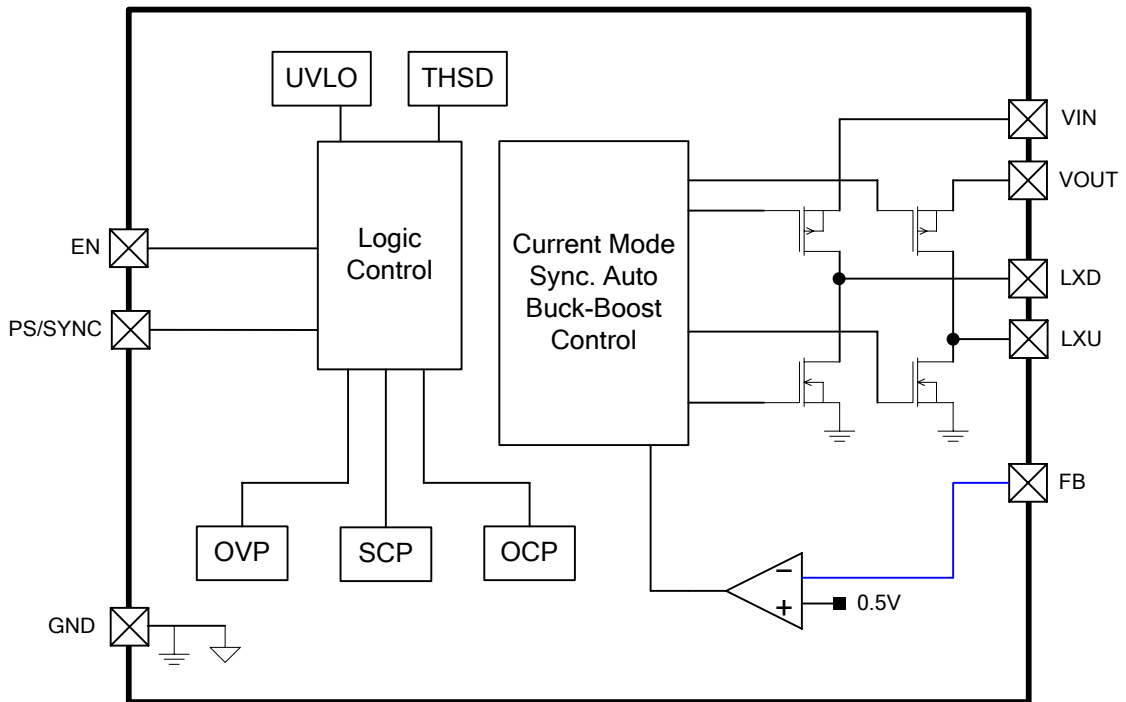


Pin Description

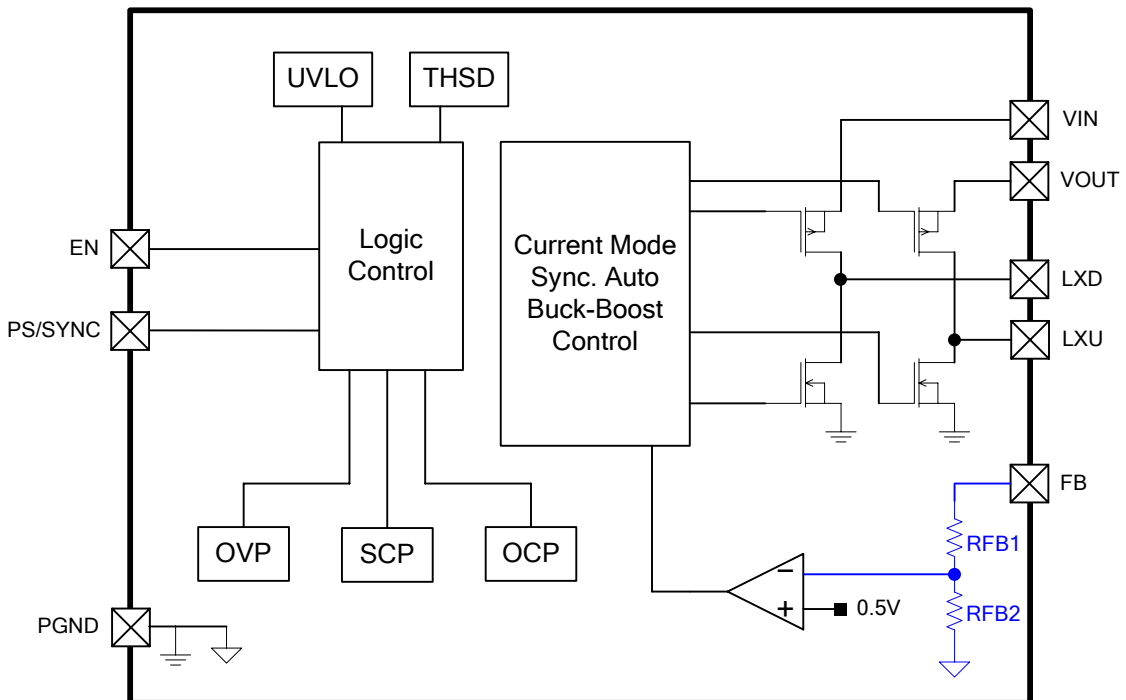
PIN	NAME	Function
A1	VIN	Power Input of Buck-Boost Converter
A2	EN	Enable PIN (1 Enabled, 0 Disabled), must not be left open.
B1	LXD	Inductor Switch Node
B2	PS/SYNC	Enable/Disable Power Save Mode (1 Disabled, 0 Enabled, clock signal for synchronization), must not be left open.
C1	LXU	Inductor Switch Node
C2	GND	Chip Analog Ground and Power Ground of Buck-Boost Converter
D1	VOUT	Power Output of Buck-Boost Converter
D2	FB	Voltage Feedback of adjustable version, and connected to VOUT on fixed output voltage version.

Block Diagram

Adjustable Output Voltage

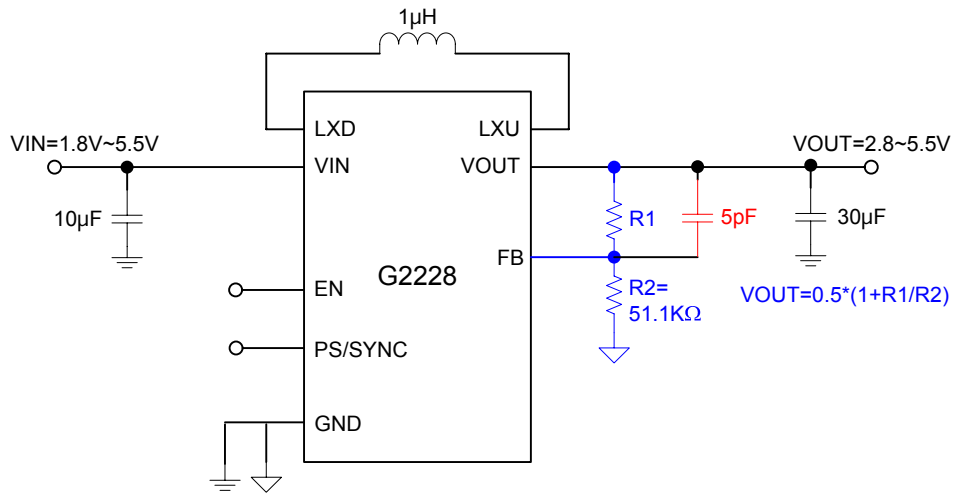


Fixed 3.3V Output Voltage



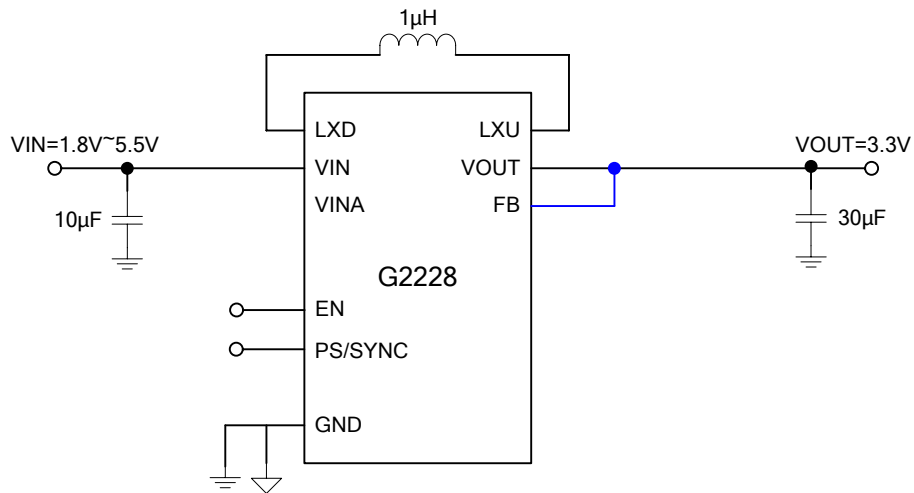
Application circuit

Adjustable Output Voltage



The recommended value for R2 should be in the range of 50kΩ .

Fixed 3.3V Output Voltage



Function Description

The G2228 includes a DC/DC Converters.

	Topology	Default V _{OUT}	V _{OUT} range	Current rating
DCDC	2.4MHz Sync. Auto Buck-Boost Converter	3.3V	Adjustable Mode: 2.8V to 5.5V Fixed Mode: 3.3V	1.5A

Fault Protection

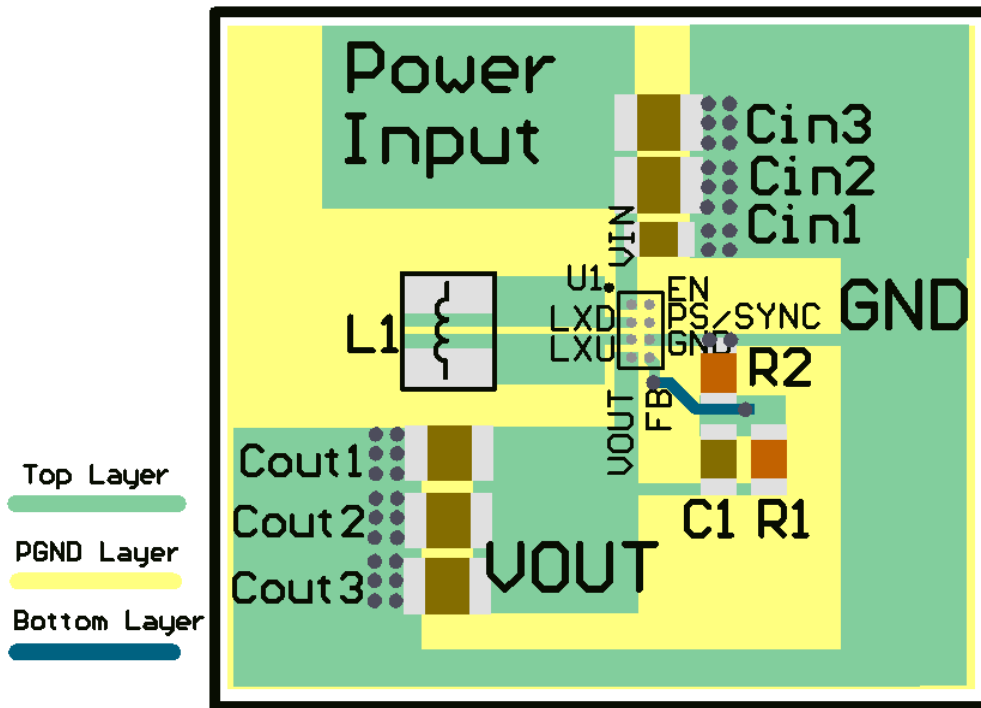
G2228 provides VIN under-voltage lockout protection, over-current protection, VOUT over-voltage protection, VOUT short-circuit protection, and thermal shutdown protection to achieve complete protection.

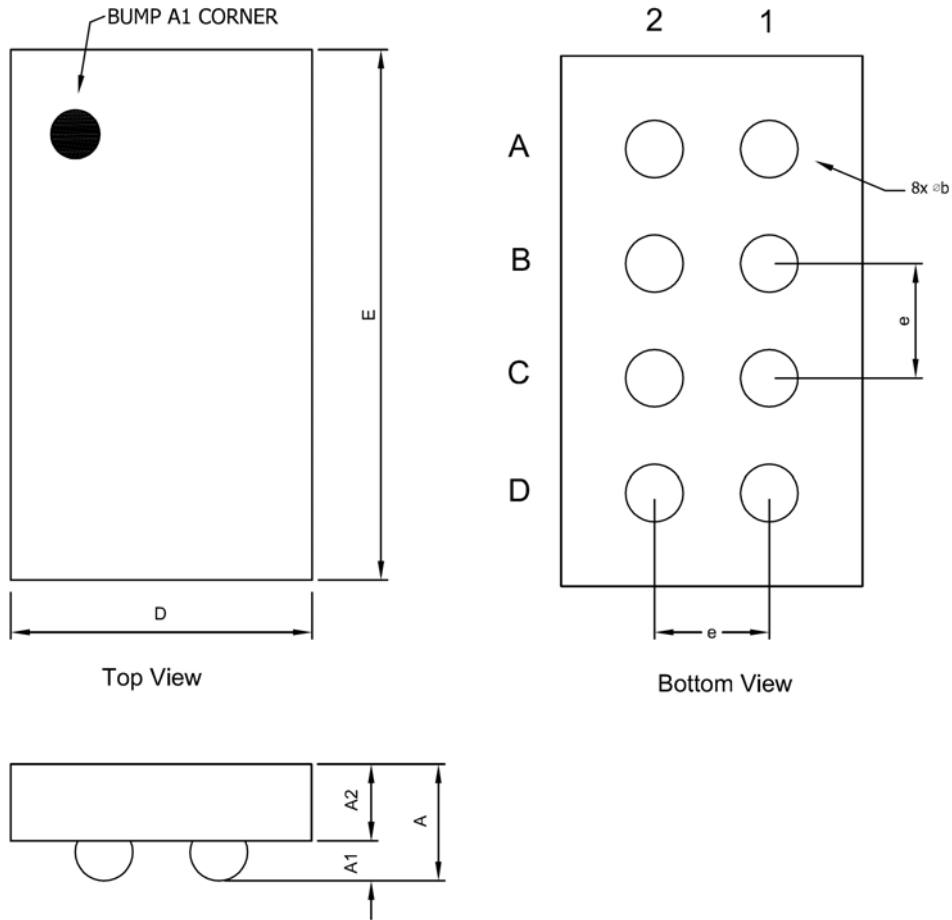
	Protection Type	Threshold	Protection methods	Reset Method
VIN	UVLO	VIN<1.6V	DCDC shutdown	VIN>1.7V
DCDC Buck-Boost	Current Limit	Peak Inductor current>2A	Buck Mode: PMOS Off, NMOS on Boost Mode: NMOS Off, PMOS on	Automatic Reset at next cycle
	OVP	VOUT>120%*VOUT _{SET}	DCDC1 stop switching	VOUT<110%*VOUT _{SET}
	SCP	VOUT<20%*VOUT _{SET}	Current Limit = 1A OSC Frequency=1.2MHz	VOUT>30%*VOUT _{SET}
Thermal	TSD	Junction Temp. >150°C	DCDC shutdown	Junction Temp. <130°C

PCB Layout Guidelines

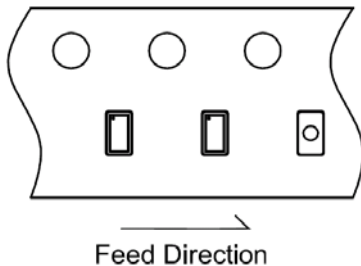
Power loops of the switching converter were considered to minimize the area. If possible, it is suggested to arrange the power loops at the top side copper plane. And the bottom side copper plane was considered to be the analog ground.

1. Connect the bypass capacitor on VIN or VOUT as close to the device as possible.
2. Switch node experiences high frequency voltage swings and should be kept in a small area. Keep analog components away from the switch node to prevent stray capacitive noise pick-up.
3. In case, the power loop crosses different layers, put vias as many as possible.



4. Package Information

WLCSP2X4-8 Package

Symble	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.450	0.500	0.550	0.0173	0.0197	0.0217
A1	0.120	0.150	0.180	0.0047	0.0059	0.0071
A2	0.330	0.350	0.370	0.0130	0.0138	0.0146
D	1.000	1.050	1.100	0.0394	0.0413	0.0433
E	1.800	1.850	1.900	0.0709	0.0728	0.0748
b	0.190	0.220	0.250	0.0075	0.0087	0.0098
e	0.40 BSC			0.0157 BSC		

Taping Specification


PACKAGE	Q'TY/REEL
WLCSP2X4-8	3,000 ea

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Ver: 0.4

May 17, 2018

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