

High Efficiency Fast Response, 4A, 23V Input Synchronous Step Down Regulator

General Description

The SY8284C develops a high efficiency synchronous step-down DC/DC regulator capable of delivering 4A current. The device integrates main switch and synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss. In addition, it operates at pseudo-constant frequency of 600kHz under heavy load conditions to minimize the size of inductor and capacitor. SY8284C also provides a fixed 5V LDO with 100mA current capability, which can be used to power the external peripherals, such as the keyboard controller in notebook. The 5V LDO can switch over to Buck regulator output to save power loss.

Silergy's proprietary Instant-PWM™ fast-response, constant-on-time (COT) PWM control method supports high input/output voltage ratios (low duty cycles), and fast transient response while maintaining a near constant operating frequency over line, load and output voltage ranges. This control method provides stable operation without complex compensation and even with low ESR ceramic capacitors.

The SY8284C operates over a wide input voltage range from 5.5V to 23V. Cycle-by-cycle current limit, input under voltage lock-out, internal soft-start, output under voltage protection and over voltage protection, and thermal shutdown provide safe operation in all operating conditions.

Ordering Information

SY8284 □(□)□□
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 Temperature Code
 Package Code
 Optional Spec Code

Ordering Number	Package type	Note
SY8284CRAC	QFN3×3-20	--

Features

- Low $R_{DS(ON)}$ for Internal Switches (Top/Bottom): 85/35 mΩ
- Wide Input Voltage Range: 5.5~23V
- Integrated Bypass Switch: 1.5Ω
- Instant PWM Architecture to Achieve Fast Transient Responses
- Internal 0.8ms Soft-start Limits the Inrush Current
- Pseudo-constant Frequency: 600kHz
- Fixed 5.1V Output Voltage
- 4A Output Current Capability
- 100mA LDO Current Capability
- ±1% Internal Reference Voltage
- Power Good Indicator
- Output Discharge Function
- Output Current Limit Protection
- Latch-off Mode Output Under Voltage Protection
- Latch-off Mode Output Over Voltage Protection
- Latch-off Mode Over Temperature Protection
- Input Under Voltage Lock-out(UVLO)
- RoHS Compliant and Halogen Free
- Compact package: QFN3×3-20

Applications

- LCD-TV/Net-TV/3DTV
- Set Top Box
- Notebook
- High Power AP

Typical Applications

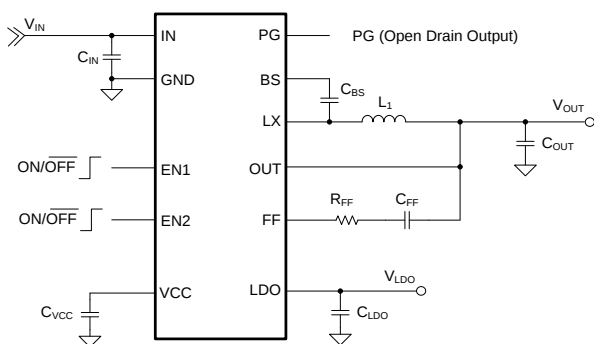


Figure1. Schematic Diagram

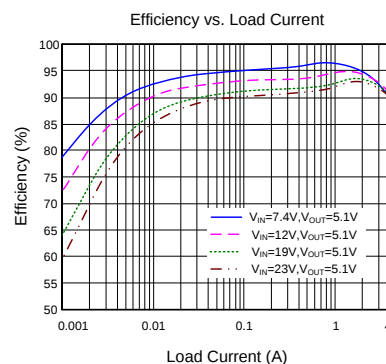
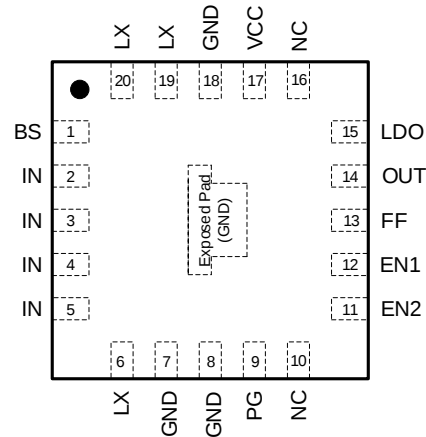


Figure2. Buck Efficiency vs. Load Current

Pinout (top view)



(QFN3×3-20)

Top Mark: BIL_{xyz}, (Device code: BIL, *x*=year code, *y*=week code, *z*=lot number code)

Pin Name	Pin Number	Pin Description
BS	1	Boot-strap pin. Supply high side gate driver. Connect a 0.1 μ F ceramic capacitor between the BS and the LX pin.
IN	2, 3, 4, 5	Input pin. Decouple this pin to the GND pin with at least a 10 μ F ceramic capacitor.
LX	6, 19, 20	Inductor pin. Connect this pin to the switching node of inductor.
GND	7, 8, 18, EP	Ground pin.
PG	9	Power good Indicator. Open drain output when the output voltage is within 90% to 120% of regulation point.
EN2	11	Enable control of the IC and internal LDO. Pull this pin high to turn on the IC and internal LDO. Do not leave this pin floating.
NC	10, 16	Not connected.
EN1	12	Enable control of the DC/DC regulator. Pull this pin high to turn on the regulator. Do not leave this pin floating.
FF	13	Output feed forward pin. Connect RC network from the output to this pin.
OUT	14	Output pin. Connect to the output of DC/DC regulator. The pin also provides the bypass input for internal LDO.
LDO	15	5V LDO output. Decouple this pin to ground with at least a 4.7 μ F capacitor.
VCC	17	Internal 3.3V LDO output. Power supply for internal analog circuits and driving circuit. Decouple this pin to GND with a 2.2 μ F ceramic capacitor.

Block Diagram

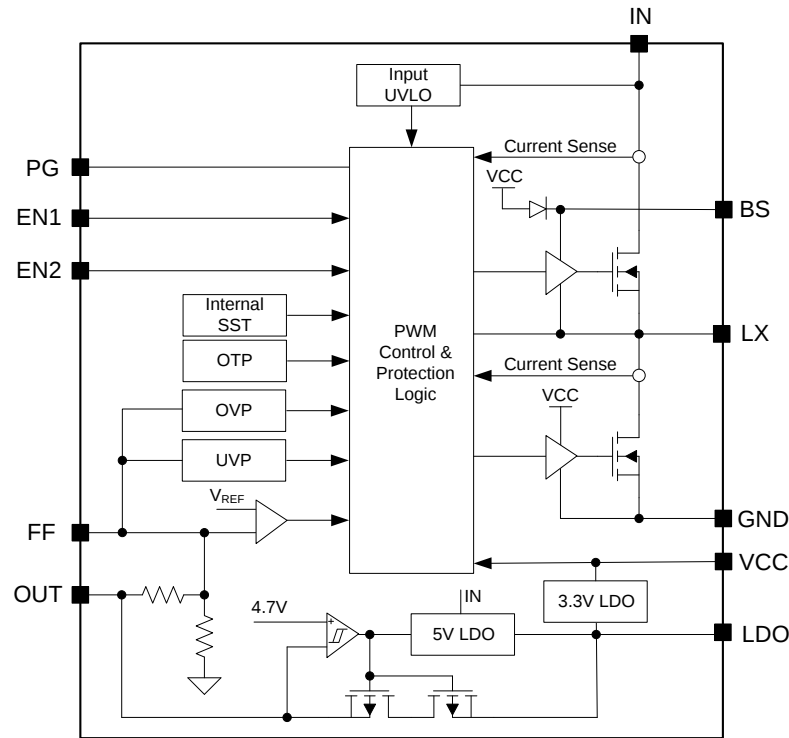


Figure3. Block Diagram

Absolute Maximum Ratings (Note 1)

IN Voltage	-0.3V to 25V
LX, PG, EN1, EN2 Voltage	-0.3V to IN+0.3V
BS-LX, VCC Voltage	-0.3V to 4V
OUT, LDO Voltage	-0.3V to 6.5V
FF Voltage	-0.3V to 4V
Maximum Power Dissipation, $P_{D,MAX}$, @ $T_A = 25^\circ\text{C}$ QFN3×3-20	3.3W
Package Thermal Resistance (Note 2)	
θ_{JA} , QFN3×3-20	30 $^\circ\text{C}/\text{W}$
θ_{JC} , QFN3×3-20	4.5 $^\circ\text{C}/\text{W}$
Junction Temperature Range	-40 $^\circ\text{C}$ to 150 $^\circ\text{C}$
Lead Temperature (Soldering, 10 sec.)	260 $^\circ\text{C}$
Storage Temperature Range	-65 $^\circ\text{C}$ to 150 $^\circ\text{C}$
Dynamic LX Voltage in 10ns Duration	IN+3V to GND-5V

Recommended Operating Conditions (Note 3)

Supply Input Voltage	5.5V to 24V
Junction Temperature Range	-40 $^\circ\text{C}$ to 125 $^\circ\text{C}$
Ambient Temperature Range	-40 $^\circ\text{C}$ to 85 $^\circ\text{C}$

Electrical Characteristics

($V_{IN} = 12V$, $T_A = 25^\circ C$, $I_{OUT} = 1A$ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		5.5		23	V
Input UVLO Threshold	V_{UVLO}	V_{IN} rising			5	V
Input UVLO hysteresis	V_{HYS}			0.3		V
Quiescent Current	I_Q	$I_{OUT}=0A$, $EN2=EN1=1$, $V_{OUT}=V_{SET} \times 105\%$		115	140	μA
Shutdown Current 1	I_{SHDN1}	$EN1=0$, $EN2=1$			80	μA
Shutdown Current 2	I_{SHDN2}	$EN1=0$, $EN2=0$		6	10	μA
Output Voltage Setpoint	V_{SET}	CCM	5.023	5.1	5.177	V
Top FET $R_{DS(ON)}$	$R_{DS(ON)1}$			85		$m\Omega$
Bottom FET $R_{DS(ON)}$	$R_{DS(ON)2}$			35		$m\Omega$
Output Discharge Current	I_{DIS}	$V_{OUT}=5.1V$		60		mA
Top FET Current Limit	$I_{LMT, TOP}$		7			A
Bottom FET Current Limit	$I_{LMT, BOT}$		4			A
Soft-start Time	t_{SS}	V_{OUT} from 0% to 100% V_{SET}		0.8		ms
EN Rising Threshold	$V_{EN, R}$		1.08	1.2	1.32	V
EN Falling Threshold	$V_{EN, F}$		0.72	0.8	0.88	V
Switching Frequency	f_{SW}	CCM	510	600	690	kHz
Min ON Time	$t_{ON, MIN}$	$V_{IN}=V_{IN, MAX}$		50		ns
Min OFF Time	$t_{OFF, MIN}$			150		ns
VCC Output	V_{CC}		3.2	3.3	3.4	V
Output Over Voltage Threshold	V_{OVP}	V_{FF} rising	115	120	125	% V_{REF}
Output Over Voltage Hysteresis	$V_{OVP, HYS}$			5		% V_{REF}
Output OVP Delay	$t_{OVP, DLY}$			30		μs
Output Under Voltage Protection Threshold	V_{UVP}		55	60	65	% V_{REF}
Output UVP Delay	$t_{UVP, DLY}$			200		μs
Power Good Rising Threshold	$V_{PG, R}$	V_{FF} rising (Good)	87	90	93	% V_{REF}
Power Good Falling Threshold	$V_{PG, F}$	V_{FF} falling	81	84	87	% V_{REF}
Power Good Delay	$t_{PG, R}$	Low to high		200		μs
	$t_{PG, F}$	High to low		10		μs
Power Good Low Voltage	$V_{PG, LOW}$	$V_{FF}=0V$, $I_{PG}=5mA$			0.4	V
LDO Output Voltage	V_{LDO}	$V_{IN}=12V$, $I_{LDO}=1mA$, $EN1=0$	4.98	5.095	5.21	V
		$V_{IN}=12V$, $I_{LDO}=100mA$, $EN1=0$	4.91	5.025	5.14	V
LDO Dropout Voltage	$V_{DROPOUT}$	$I_{LDO}=100mA$		200		mV
LDO Output Current Limit	$I_{LMT, LDO}$		150		300	mA
Bypass Switch $R_{DS(ON)}$	$R_{DS(ON), BYP}$			1.5		Ω
Bypass Switch Turn-on Voltage	V_{BYP}		4.5	4.7		V
Bypass Switch Switchover Hysteresis	$V_{BYP, HYS}$			0.2		V
Bypass Switch OVP	$V_{BYP, OVP}$			120		% V_{LDO}



SY8284C

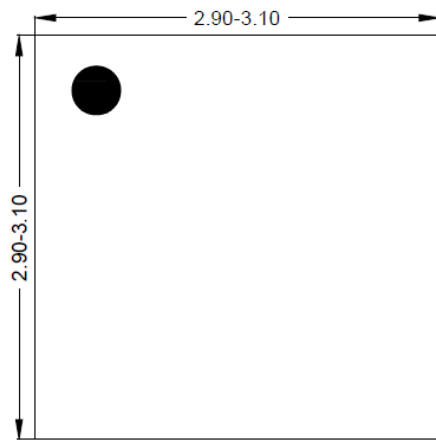
Thermal Shutdown Temperature	T_{SD}	BYP on, T_J rising		150		°C
Thermal Shutdown Hysteresis	T_{HYS}			15		°C

Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

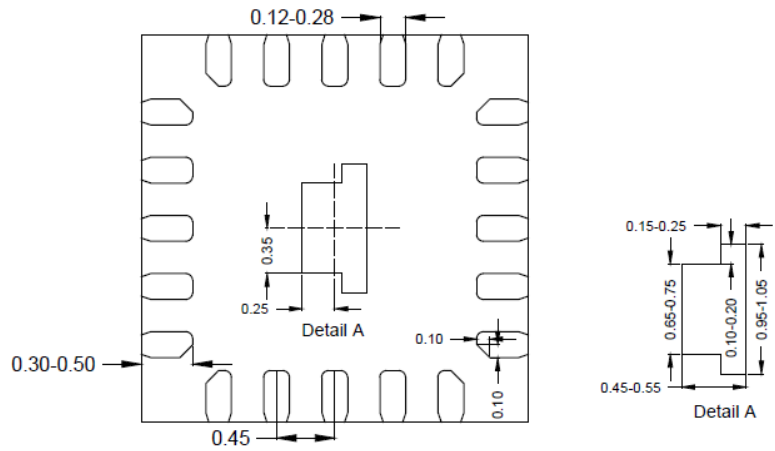
Note 2: Package thermal resistance is measured in the natural convection at $T_A = 25^{\circ}\text{C}$ on a four-layer Silergy Evaluation Board.

Note 3: The device is not guaranteed to function outside its operating conditions.

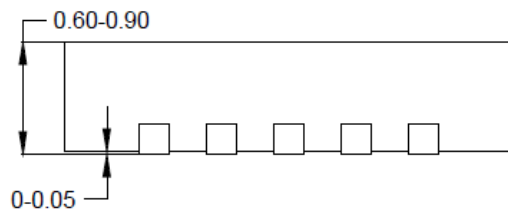
QFN3×3-20 Package Outline



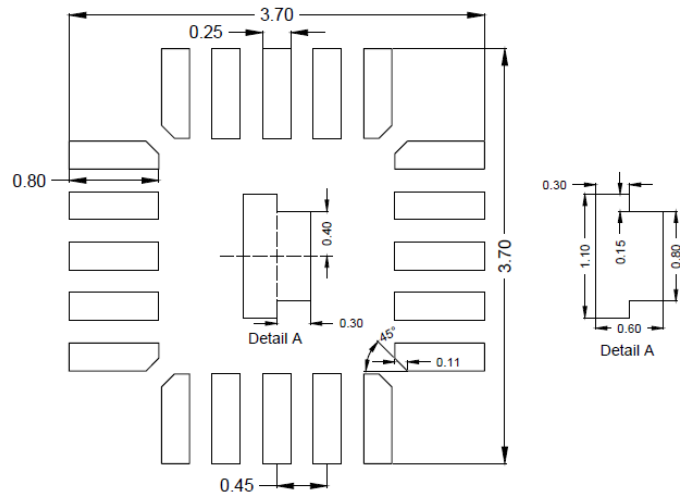
Top view



Bottom view



Side view

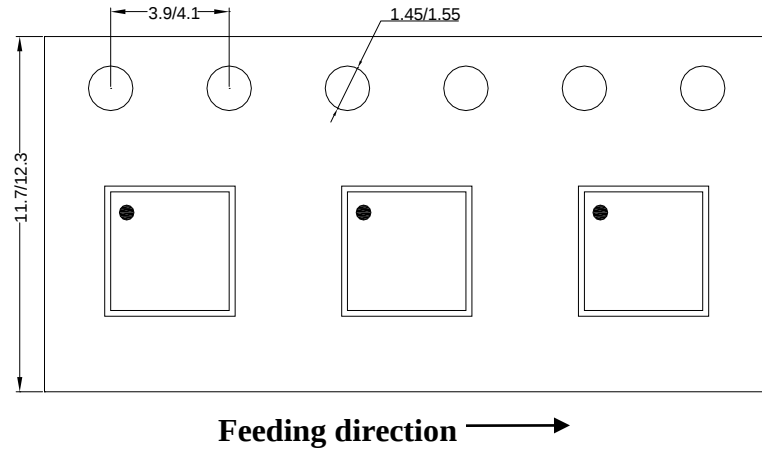


**Recommended PCB layout
(Reference only)**

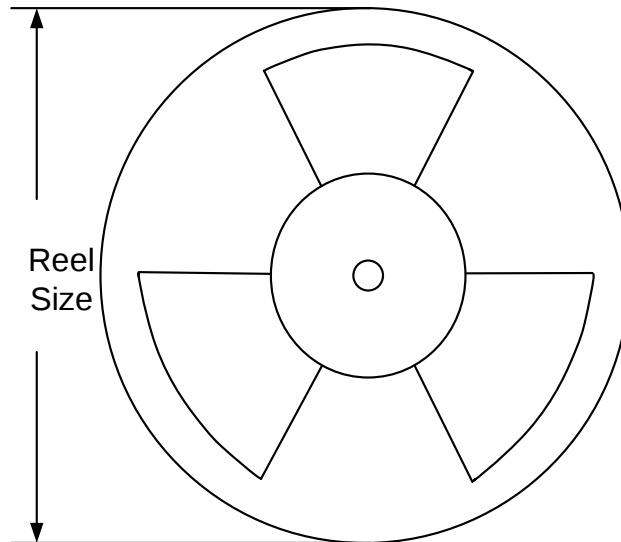
Notes: All dimension in millimeter and exclude mold flash & metal burr.

Taping & Reel Specification

1. QFN3×3-20 taping orientation



2. Carrier Tape & Reel specification for packages



Package type	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
QFN3×3	12	8	13"	400	400	5000

3. Others: NA