



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



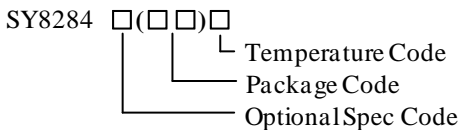
General Description

The SY8284 develops a high efficiency synchronous step-down DC/DC regulator capable of delivering 4A current over a wide input voltage range of 4V to 23V.

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.

Internal 85mΩ power and 35mΩ synchronous rectifier switches provide excellent efficiency over a range of applications, especially for low output voltages and low duty cycles. SY8284 also integrates a bypass switch which allows the IC to be powered by external DC source. 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. The SY8284 is available in a compact QFN3×3-20 package.

Ordering Information



Ordering Number	Package type	Note
SY8284RAC	QFN3×3-20	--

Features

- Low $R_{DS(ON)}$ for Internal Switches (Top/Bottom): 85/35mΩ
- Wide Input Voltage range: 4~23V
- Instant PWM Architecture to Achieve Fast Transient Responses
- Internal 600μs Soft-start Limits the Inrush Current
- Pseudo-constant Frequency: 500kHz
- 4A Output Current Capability
- ±1% Internal Reference Voltage
- Optional Bypass Input
- Power Good Indicator
- Output Discharge Function
- Output Current Limit Protection
- Latch off Mode Output Under Voltage Protection
- Latch off Mode Output Over Voltage Protection
- Programmable Bottom FET Current Limit
- Input Under Voltage Lock-out(UVLO)
- Latch off Mode Over Temperature Protection
- 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

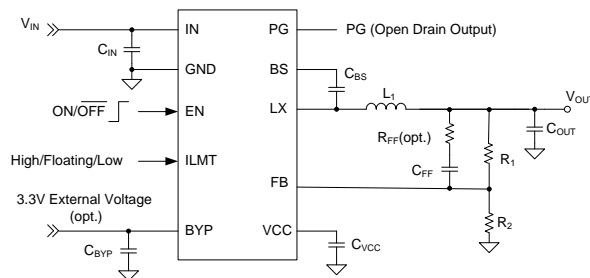


Figure 1. Schematic

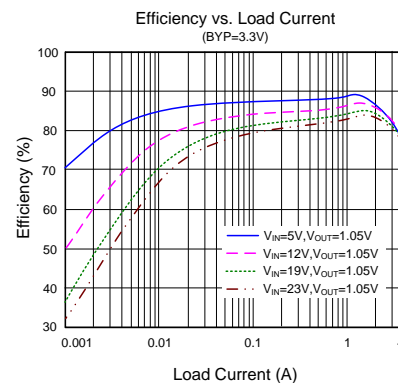
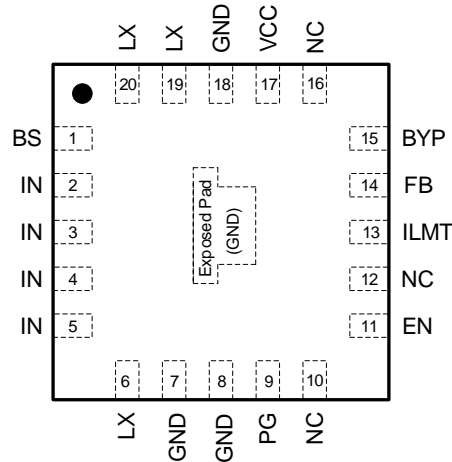


Figure 2. Efficiency vs. Load Current

Pinout (top view)



(QFN3×3-20)

Top Mark: BIDxyz, (Device code: BID, *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 μF ceramic capacitor between BS and LX pin.
IN	2, 3, 4, 5	Input pin. Decouple this pin to GND pin with at least a 10 μF 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.
NC	10, 12, 16	Do not connect.
EN	11	Enable pin. Pull this pin high to turn on IC. Do not leave this pin floating.
ILMT	13	Output current limit threshold selection.
FB	14	Output feedback pin. Connect to the center point of resistor divider.
BYP	15	External 3.3V bypass power supply input. Decouple this pin to GND with a 1 μF ceramic capacitor. Leave this pin floating if it is not used.
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 μF ceramic capacitor.

Block Diagram

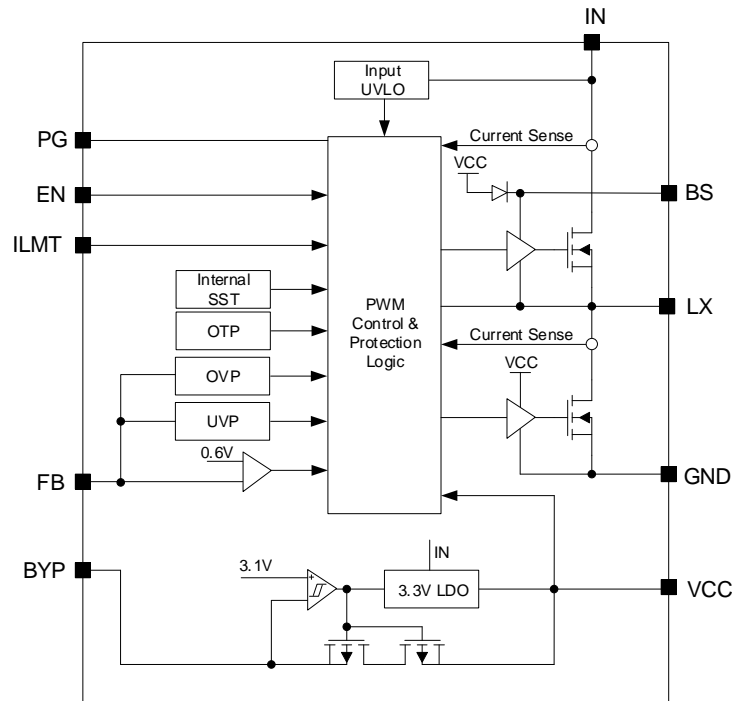


Figure 3. Block Diagram

Absolute Maximum Ratings (Note 1)

Supply Input Voltage	-----	-0.3V to 25V
EN, ILMT, PG, LX Voltage	-----	-0.3V to IN+0.3V
BYP Voltage	-----	-0.3V to 6V
BS-LX, VCC, FB Voltage	-----	-0.3V to 4V
Maximum Power Dissipation, P _{D,MAX} @ T _A = 25 °C QFN3×3-20	-----	3.33W
Package Thermal Resistance (Note 2)		
θ _{JA} , QFN3×3-20	-----	30 °C/W
θ _{JC} , QFN3×3-20	-----	4.5 °C/W
Junction Temperature Range	-----	-40 °C to 150 °C
Lead Temperature (Soldering, 10 sec.)	-----	260 °C
Storage Temperature Range	-----	-65 °C to 150 °C
Dynamic LX Voltage in 10ns Duration	-----	IN+3V to GND-5V

Recommended Operating Conditions (Note 3)

Supply Input Voltage	-----	4V to 23V
Junction Temperature Range	-----	-40 °C to 125 °C
Ambient Temperature Range	-----	-40 °C to 85 °C

Electrical Characteristics

($V_{IN} = 12V$, $C_{OUT} = 44\mu F$, $T_A = 25\text{ }^\circ\text{C}$, $I_{OUT} = 1A$ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		4		23	V
Input UVLO Threshold	V_{UVLO}	V_{IN} Rising			3.9	V
Input UVLO Hysteresis	V_{HYS}			0.3		V
Quiescent Current	I_Q	EN=1, $I_{OUT}=0A$, $V_{OUT}=V_{SET}\times 105\%$		121	145	μA
Shutdown Current	I_{SHDN}	EN=0		6	10	μA
Feedback Reference Voltage	V_{REF}		0.594	0.6	0.606	V
FB Input Current	I_{FB}	$V_{FB}=1V$	-50		50	nA
Top FET $R_{DS(ON)}$	$R_{DS(ON)1}$			85		m Ω
Bottom FET $R_{DS(ON)}$	$R_{DS(ON)2}$			35		m Ω
Output Discharge Current	I_{DIS}	$V_{OUT}=1.2V$		50		mA
Top FET Current Limit	$I_{LMT, TOP}$		10			A
Bottom FET Current Limit	$I_{LMT, BOT}$	ILMT=Low	5			A
		ILMT=Floating	6.5			A
		ILMT=High	8			A
Soft Start Time	t_{SS}	V_{OUT} from 0% to 100% V_{SET}		600		μs
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
ILMT/MODE Rising Threshold	$V_{ILMT, R}$		$V_{CC}-0.7$			V
ILMT/MODE Falling Threshold	$V_{ILMT, F}$				0.45	V
Switching Frequency	f_{SW}	$V_{OUT}=1.2V$, CCM	410	500	590	kHz
Min ON Time	$t_{ON, MIN}$	$V_{IN}=V_{INMAX}$		50		ns
Min OFF Time	$t_{OFF, MIN}$			150		ns
VCC Output Voltage	V_{CC}	VCC with 1mA Load	3.15	3.3	3.45	V
Output Over Voltage Threshold	V_{OVP}	V_{FB} rising	115	120	125	% V_{REF}
Output Over Voltage Hysteresis	$V_{OVP, HYS}$			5		% V_{REF}
Output OVP Delay	$t_{OVP, DLY}$			25		μs
Output Under Voltage Protection Threshold	V_{UVP}	V_{FB} falling	55	60	65	% V_{REF}
Output UVP Delay	$t_{UVP, DLY}$			250		μs
Power Good Threshold	V_{PG}	V_{FB} rising (good)	87	90	93	% V_{REF}
Power Good Hysteresis	$V_{PG, HYS}$			5		% V_{REF}
Power Good Delay	$t_{PG, R}$	Low to high		250		μs
	$t_{PG, F}$	High to low		10		μs
Bypass Switch $R_{DS(ON)}$	$R_{DS(ON), BYP}$			1.5		Ω
Bypass Switch Turn-on Voltage	V_{BYP}		2.97	3.1	3.21	V



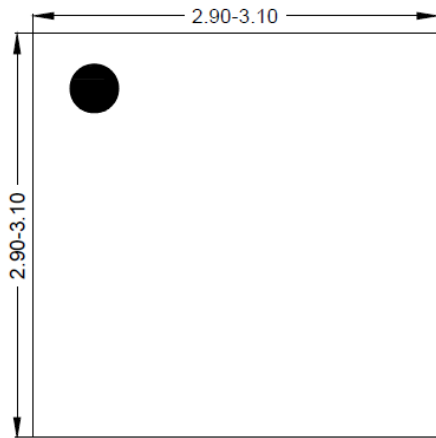
Bypass Switch Switchover Hysteresis	$V_{BYP,HYS}$		0.18		V
Bypass Switch OVP Threshold	$V_{BYP,OVP}$		120		% V_{CC}
Bypass Switch OVP Hysteresis	$V_{BYP,OVP,HYS}$		5		% V_{CC}
Thermal Shutdown Temperature	T_{SD}	T_J rising	150		°C
Thermal Shutdown Hysteresis	T_{HYS}		15		°C

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

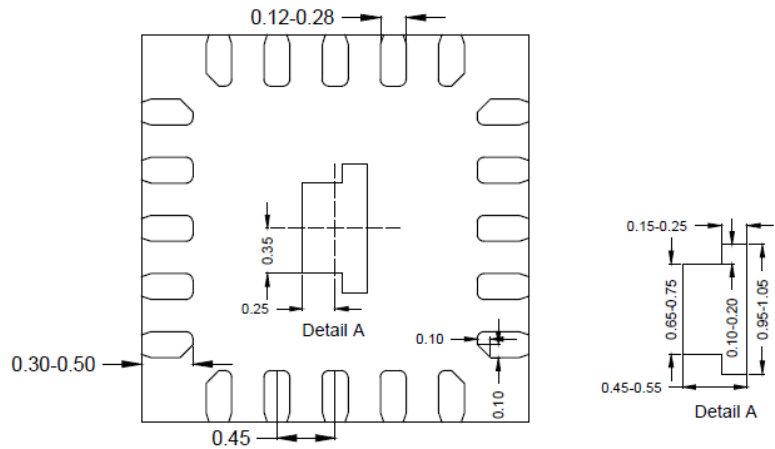
Note 2: Package thermal resistance is measured in the natural convection at $T_A = 25^\circ\text{C}$ on a four-layer Silergy Evaluation Board.

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

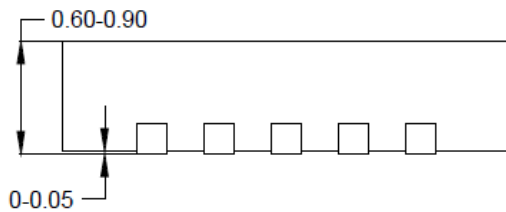
QFN3×3-20 Package Outline



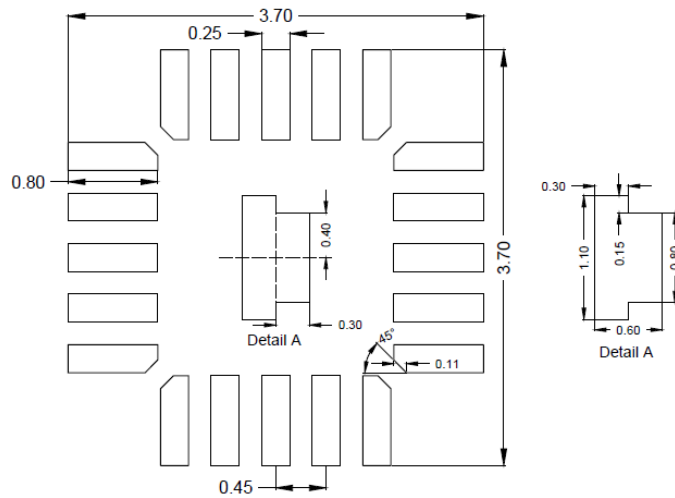
Top view



Bottom view



Side view

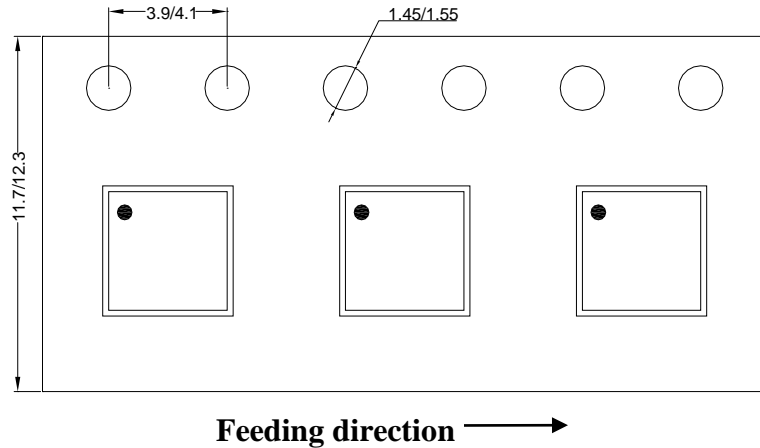


**Recommended PCB layout
(Reference only)**

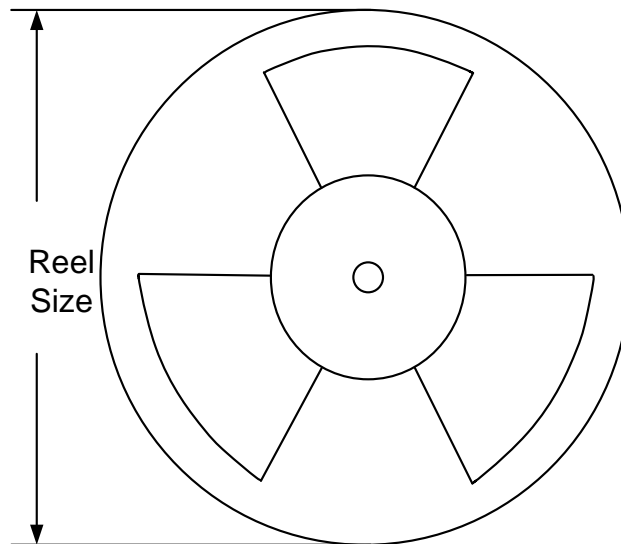
Notes: All dimension in millimeter and exclude mold flash & metal burr.

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