

GENERAL DESCRIPTION

The SGM41603 is an efficient 2:1 bidirectional switched-capacitor converter with integrated power switches. It can deliver 10A in forward direction (2:1 voltage divider) and 5A in the reverse direction (1:2 voltage doubler). This device allows using a 2S Li+ power source as a 1S Li+ solution by inserting it between the 2S battery pack and charger output, and saves the existing 1S power architecture that is powered from the same battery.

This 2-phase high switching frequency (1.5MHz, MAX) and inductor-less topology allow low profile design with small footprint. The high switching frequency also reduces the size and quantity of the required capacitors. Safe operation is assured by over-voltage, under-voltage, over-current and thermal protections. Interference is also minimized by the built-in frequency dithering option. This device can achieve 98.5% efficiency which is the highest in its class. Thermal management of such a low loss device is simple, which makes it an ideal choice for industrial, consumer, and medical applications.

The I²C interface allows flexible parameter settings including OCP, OVLO, switching frequency thresholds and soft-start currents and durations. The SGM41603 is available in a Green WLCSP-2.85×2.59-42B package.

APPLICATIONS

- Smartphones, Tablets, Ultrabooks
- Chromebooks, DSLR and Mirrorless Cameras
- Power Banks, 2S Li+ Battery Applications
- Smartphone Direct Charging, Portable Printers
- Portable Gaming Devices, Two-Way Radios

FEATURES

- **Bidirectional Switched Capacitor Converter**
 - ◆ Forward Direction 2:1 Conversion, Reverse Direction 1:2 Conversion
 - ◆ 2-Phase Interleaved Operation (90° or 180°)
 - ◆ 8 Integrated N-Type MOSFET Switches
 - ◆ 10A Output Current Capability
 - ◆ 98.5% Peak Efficiency
- **Low I_Q Current: 59µA Forward Operating**
- **6.7µA Shutdown Current**
- **I²C Interface with Interrupt Signaling**
- **Adjustable Soft-Start Current and Timeout**
- **0.25MHz to 1.5MHz Adjustable Switching Frequency**
- **Low EMI with Switching Frequency Dithering**
- **Enable Input**
- **Out-of-Audio Option at Light Load**
- **Power Good Output**
- **Programmable V1X & V2X Over-Voltage Lockout**
- **Separate OCP Adjustment for Each Direction**
- **Thermal Alarm and Protection**
- **Available in a Green WLCSP-2.85×2.59-42B Package**

TYPICAL APPLICATION

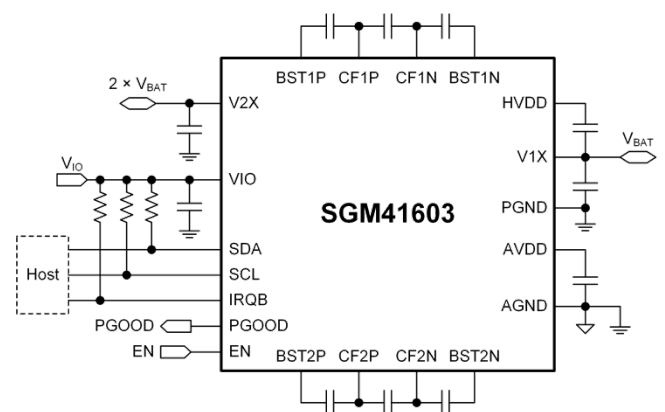


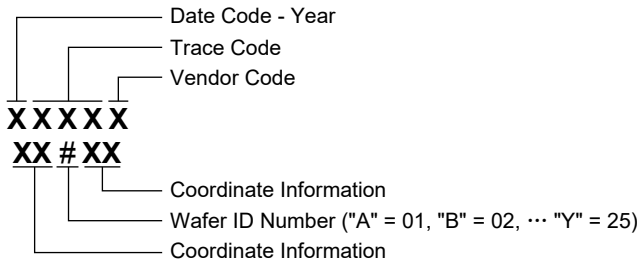
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41603	WLCSP-2.85×2.59-42B	-40°C to +85°C	SGM41603YG/TR	064 XXXXXX XX#XX	Tape and Reel, 5000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code. XX#XX = Coordinate Information and Wafer ID Number.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

V2X to PGND	-0.3V to 16V
BSTxP to PGND	-0.3V to 16V
BSTxN to PGND	-0.3V to 8V
BSTxP to CFxP	-0.3V to 6V
BSTxN to CFxN	-0.3V to 6V
CFxP to PGND	-0.3V to (V _{V1X} + 6V)
CFxN, V1X to PGND	-0.3V to 6V
PGND to AGND	-0.3V to 0.3V
HVDD to AGND	-0.3V to (V _{V1X} + 6V)
AVDD, NC, IRQB, VIO to AGND	-0.3V to 6V
EN to AGND	-0.3V to 16V
SDA, SCL to AGND	-0.3V to (V _{VIO} + 0.3V)
PGOOD to AGND	-0.3V to 2.0V
V1X Continuous RMS Current (From V2X to V1X)	10A
Package Thermal Resistance	
WLCSP-2.85×2.59-42B, θ _{JA}	62°C/W
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility	
HBM	2000V
CDM	1000V

RECOMMENDED OPERATING CONDITIONS

V2X	5V to 11V
V1X	2.8V to 5.5V
I _{V1X} (Voltage Divider Mode)	0A to 10A
I _{V2X} (Voltage Doubler Mode)	0A to 5A
(BST1P - CF1P), (BST1N - CF1N)	0V to 5V

(CF1P - V1X), CF1N	0V to 5.5V
(BST2P - CF2P), (BST2N - CF2N)	0V to 5V
(CF2P - V1X), CF2N	0V to 5.5V
AVDD, (HVDD - V1X), VIO, EN	0V to 5V
PGOOD	0V to 1.8V
SDA, SCL, IRQB	0V to 5V
Junction Temperature Range	-40°C to +125°C

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

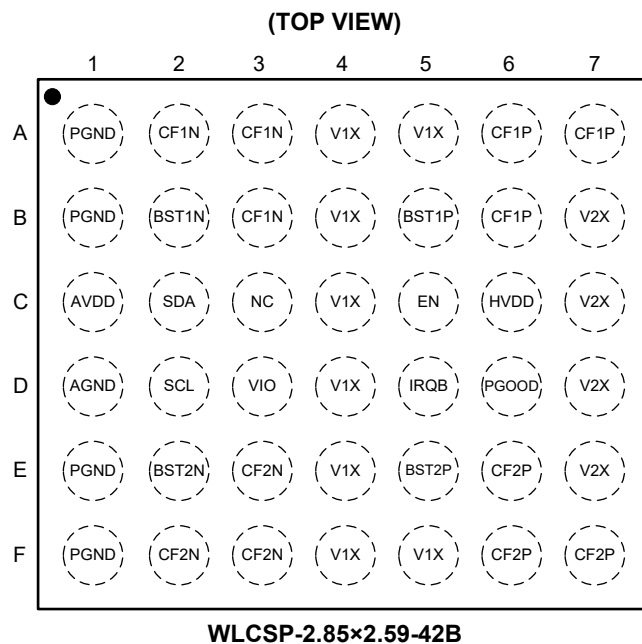
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	TYPE ⁽¹⁾	FUNCTION
A1, B1, E1, F1	PGND	P	Power Ground.
A2, A3, B3	CF1N	P	Flying Cap Phase 1 Negative Node. Connect at least two parallel 47 μ F capacitors between CF1P and CF1N pins as close as possible to these pins.
A4, A5, B4, C4, D4, E4, F4, F5	V1X	P	Lower Voltage (1X) Power Port. It is an input in forward mode and an output in reverse mode. A 22 μ F capacitor is recommended between V1X and PGND.
A6, A7, B6	CF1P	P	Flying Cap Phase 1 Positive Node. Connect at least two parallel 47 μ F capacitors between CF1P and CF1N pins as close as possible to these pins.
B2	BST1N	P	Bootstrap Capacitor Connection for Q _{CL1} Gate Driver Supply. Place a 47nF or larger ceramic capacitor between this pin and CF1N.
B5	BST1P	P	Bootstrap Capacitor Connection for Q _{CH1} Gate Driver Supply. Place a 47nF or larger ceramic capacitor between this pin and CF1P.
B7, C7, D7, E7	V2X	P	Higher Voltage (2X) Power Port. It is an input in forward and an output in reverse direction. A 22 μ F capacitor is recommended between V2X and PGND.
C1	AVDD	AO	5V LDO Output. Decouple AVDD to AGND with at least 1 μ F high quality ceramic capacitor (X5R or better). Do not connect any external load to AVDD.
C2	SDA	DIO	I ² C Interface Data Line.
C3	NC	–	No Connection. Leave this pin open.
C5	EN	DI	Active High Device Enable Input.
C6	HVDD	AO	(V _{V1X} + 5V) LDO Output. Decouple HVDD to V1X with at least 1 μ F high quality ceramic capacitor (X5R or better). Do not connect any external load to HVDD.
D1	AGND	P	Analog Ground.
D2	SCL	DI	I ² C Interface Clock Line.
D3	VIO	P	Input Voltage Supply for I/O Circuits. Bypass this pin to AGND with at least 1 μ F high quality ceramic capacitor (X5R or better).
D5	IRQB	DO	Open-Drain Active Low Interrupt Output. Pull it up with a 100k Ω resistor to VIO. A low on IRQB indicates a fault condition.
D6	PGOOD	DO	Power Good Output.
E2	BST2N	P	Bootstrap Capacitor Connection for Q _{CL2} Gate Driver Supply. Place a 47nF or larger ceramic capacitor between this pin and CF2N.
E3, F2, F3	CF2N	P	Flying Cap Phase 2 Negative Node. Connect at least two parallel 47 μ F capacitors between CF2P and CF2N pins as close as possible to these pins.
E5	BST2P	P	Bootstrap Capacitor Connection for Q _{CH2} Gate Driver Supply. Place a 47nF or larger ceramic capacitor between this pin and CF2P.
E6, F6, F7	CF2P	P	Flying Cap Phase 2 Positive Node. Connect at least two parallel 47 μ F capacitors between CF2P and CF2N pins as close as possible to these pins.

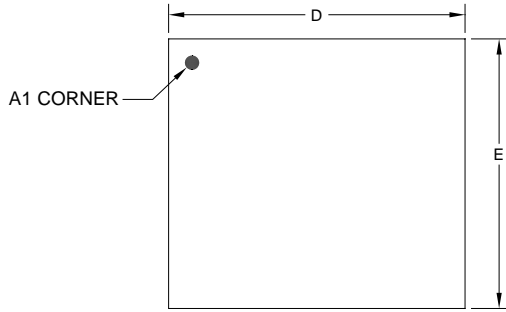
NOTE:

1. P = Power, AI = Analog Input, AO = Analog Output, AIO = Analog Input/Output, DI = Digital Input, DO = Digital Output, DIO = Digital Input/Output.

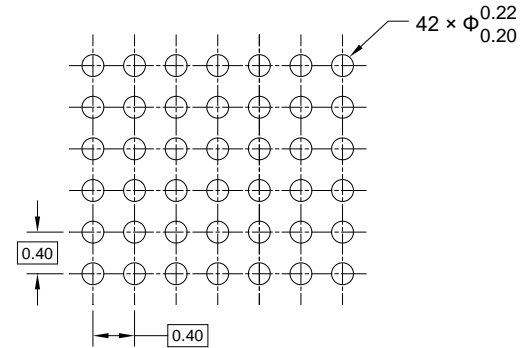
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

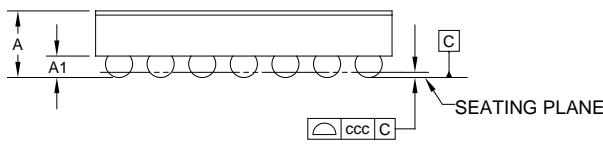
WLCSP-2.85x2.59-42B



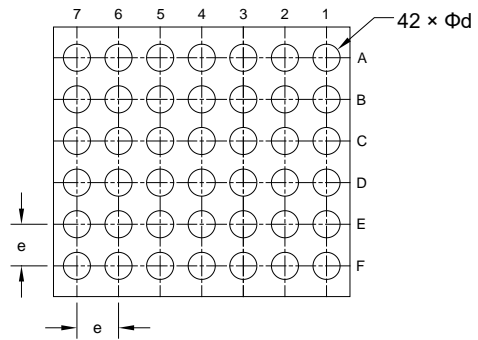
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.602	0.640	0.678
A1	0.186	0.206	0.226
D	2.823	2.853	2.883
E	2.563	2.593	2.623
d	0.240	0.260	0.280
e	0.400 BSC		
ccc	-	0.050	-

NOTE: This drawing is subject to change without notice.

PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
WLCSP-2.85×2.59-42B	13"	12.4	2.70	3.00	0.80	4.0	8.0	2.0	12.0	Q2

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PACKAGE INFORMATION

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13"	386	280	370	5

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