

SLG59H1302C

A Surge-protected, 28 V Tolerant Power Splitter in WLCSP

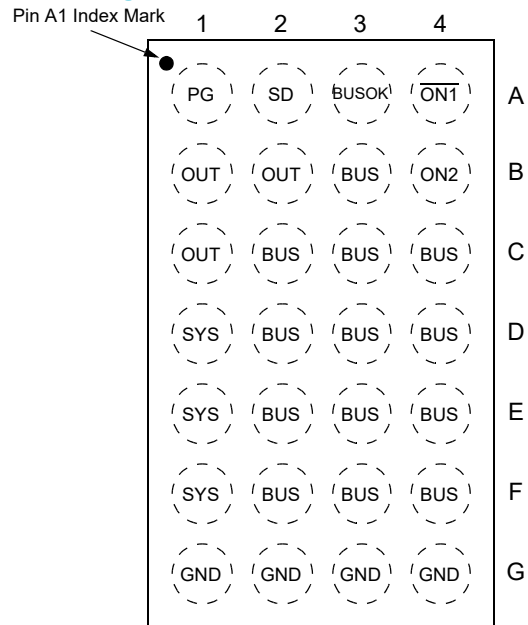
General Description

The SLG59H1302C is a 130-V surge-protected, 28-V tolerant power splitter with two high-current switches and a 0.1 A capable LDO in 28-ball WLCSP. With independent control for each channel, the SLG59H1302C contains a 6 A capable, 12 mΩ nFET switch for the BUS-to-OUT path and a reverse-blocking 6 A capable, 24 mΩ nFET switch for the BUS-to-SYS path. An internal, “always ON” LDO is 0.1 A capable and can be used to supply power to downstream devices when the BUS terminal voltage is higher than 2.7 V. When the SYS terminal turns on, the IC’s push-pull PG output becomes asserted. The SLG59H1302C is fully specified over the industrial -40 °C to 85 °C temperature range.

Features

- 130 V-tolerant TVS (IEC61000-4-5)
- BUS-to-OUT nFET: 12 mΩ/6 A, 28 V tolerant
- BUS-to-SYS nFET: 24 mΩ/6 A B2B RB
- Always ON, BUS LDO: ±10% tol, 0.1 A capable
- BUS UVLO & OVLO Protection
 - OVP Response Time: 200 ns
- Push-pull PG (Power Good) Output
- Thermal Shutdown Protection
- Active-HIGH IC Shutdown Input
- Active-LOW $\overline{\text{ON1}}$ Input (BUS-to-OUT)
- Active-HIGH ON2 Input (BUS-to-SYS)
- 28-ball CSP, 2.98 x 1.69 x 0.44 mm, 0.4 mm pitch
- Pb-Free / Halogen-Free / RoHS Compliant Packaging

Pin Configuration

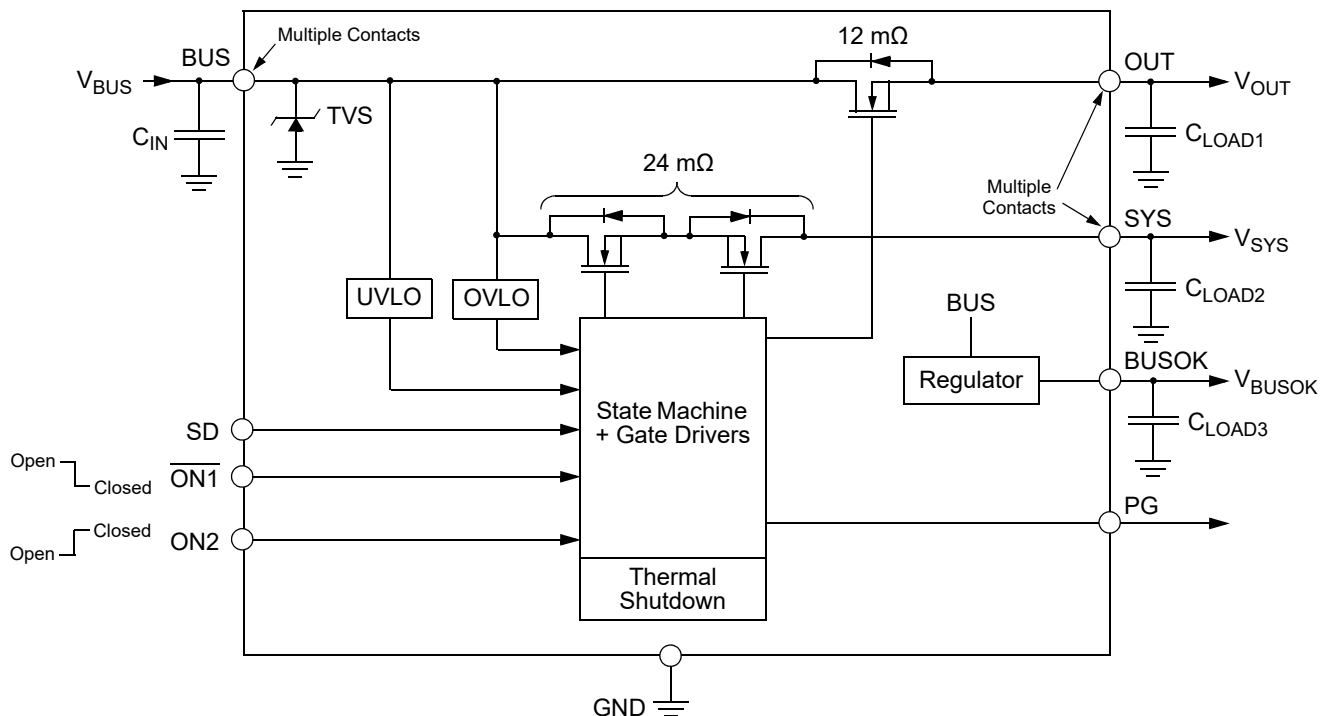


(Laser Marking View)
2.98 x 1.69 x 0.44 mm, 0.4 mm pitch

Applications

- Wearable Device
- Tablet PCs and Smartphones

Block Diagram



A Surge-protected, 28 V Tolerant Power Splitter in WLCSP

Pin Description

Pin Name	Pin #	Type	Pin Description
BUS	B3, C2, C3, C4, D2, D3, D4, E2, E3, E4, F2, F3, F4	Input	IC power supply and power switch input (13 contacts)
OUT	B1, B2, C1	Output	Power switch output to Load (3 contacts)
SYS	D1, E1, F1	Output	Power switch output to VBAT (3 contacts)
BUSOK	A3	Output	Always ON fixed output voltage from internal LDO
ON2	B4	Digital Input	BUS-to-SYS Switch Enable; Asserted active high digital input; 1 M Ω pull-down
$\overline{\text{ON1}}$	A4	Digital Input	BUS-to-OUT Switch Enable; Asserted active low digital input; 1 M Ω pull-down
SD	A2	Digital Input	IC shutdown; asserted active high; 1 M Ω pull-down
PG	A1	Digital Output	Asserted active-high push-pull output.
GND	G1, G2, G3, G4	GND	Analog GND (4 contacts)

Ordering Information

Part Number	Type	Production Flow
SLG59H1302C	WLCSP 28L	Industrial, -40 °C to 85 °C
SLG59H1302CTR	WLCSP 28L (Tape and Reel)	Industrial, -40 °C to 85 °C

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Absolute Maximum Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
V _{BUS} to GND	Power Switch Input Voltage to Ground	Continuous	-0.3	--	28	V
V _{SYS} to GND	Power Switch Output Voltage to Ground	Continuous	-0.3	--	6	V
		Max pulse width 0.1 s	-0.3	--	7	V
V _{OUT} to GND	Power Switch Output Voltage to GND	$\overline{\text{ON1}} = \text{LOW}$	-0.3	--	V _{BUS}	V
ESD _{HBM}	ESD Protection	Human Body Model, All pins	2000	--	--	V
ESD _{CDM}	ESD Protection	Charged Device Model, All pins	1000	--	--	V
ESD _{SURGE}	ESD Protection	VBUS Surge Protection, IEC 61000-4-5	+130	--	--	V
OUT IDS	Maximum Current from BUS to OUT	Continuous	-0.3	--	6	A
		Max pulse width 10 ms	-0.3	--	7	A
SYS IDS	Maximum Current from BUS to SYS	Continuous	-0.3	--	6	A
		Max pulse width 10 ms	-0.3	--	7	A
BUSOK IDS	Maximum Current from BUS to BUSOK	Continuous	-0.3	--	100	mA
θ_{JA}	Package Thermal Resistance, Junction-to-Ambient	2.98 x 1.69 mm 28L WLCSP; Determined using a 1 in ² , 1 oz. copper pad under each BUS, SYS, and OUT terminal and FR4 pcb material.	--	45	--	°C/W

Note: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

T_A = -40 °C to 85 °C (unless otherwise stated)

Parameter	Description	Min.	Typ.	Max.	Unit
Basic Operation					
V _{BUS}	IC Power supply and power switch input voltage	2.7	--	13.3	V
C _{IN} /C _{OUT}	Input and Output Capacitance	--	1	--	μF
C _{SYS}	SYS Capacitance	47	--	--	μF
C _{BUSOK}	Output Capacitance	--	4.7	--	μF
T _A	Operating Temperature	-40	--	85	°C

Electrical Characteristics

T_A = -40 °C to 85 °C (unless otherwise stated)

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
Basic Operation (V_{BUS} = 12 V, no load)						
I _Q	Input Quiescent Current	V _{BUS} = 4 V, $\overline{\text{ON1}} = \text{LOW}$, No Load	--	180	--	μA

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Electrical Characteristics (continued)

T_A = -40 °C to 85 °C (unless otherwise stated)

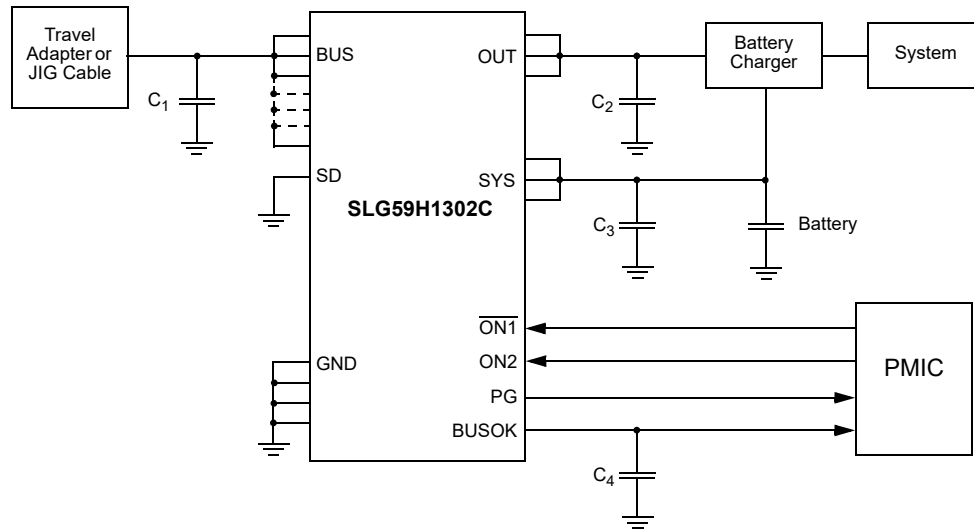
Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
I _{IN_Q}	Input Supply Current when V _{OUT_OVLO} or V _{SYS_OVLO} threshold is reached	V _{BUS} = 15 V, $\overline{ON1}$ = LOW, ON2 = HIGH, BUSOK = 1 k Ω Load	--	4.2	--	mA
I _{SD}	Shutdown Current	V _{BUS} = 12 V	--	1	2	μ A
V _{BUS_UVLO}	Under Voltage Trip Level	T _A = 0 °C to 85 °C	2.3	2.4	2.7	V
t _{BUS_START}	Soft-Start Time	See timing diagram	--	30	--	ms
THERM _{ON}	Thermal Shutdown Turn-on Temperature		--	145	--	°C
THERM _{HYS}	Thermal Shutdown Hysteresis		--	20	--	°C
BUS To OUT Switch						
V _{OUT_OVLO}	Over Voltage Trip Level	V _{BUS} Rising	13.3	13.9	14.5	V
V _{OUT_HYS}	V _{OUT} Hysteresis		--	350	--	mV
RDS _{ON}	ON Resistance	V _{BUS} = 12 V, I _{OUT} = 0.1 A, T _A = 25 °C	--	12	14	m Ω
		V _{BUS} = 12 V, I _{OUT} = 0.1 A, T _A = 85 °C	--	16	18	m Ω
t _{DEB_OUT}	Debounce Time	$\overline{ON1}$ = 0 V; V _{BUS} > V _{BUS_UVLO} to 0.1 x V _{OUT} ; See timing diagram	--	15	--	ms
t _{ON_OUT}	Switch Turn-On Time	R _{LOAD} = 100 Ω , C _{LOAD} = 4.7 μ F; V _{OUT} from 0.1 x V _{BUS} to 0.9 x V _{BUS}	--	2.5	--	ms
t _{OV_P_OUT} ¹	Overvoltage Protection Time	I _{LOAD} = 100 mA, no C _{LOAD} ; V _{BUS} step up over V _{OUT_OVLO} to V _{OUT} start separate from V _{BUS}	--	200	--	ns
t _{OFF_OUT}	Switch Turn-Off Time	50 % $\overline{ON1}$ \uparrow to 0.9 x V _{OUT} ; V _{BUS} = 12 V R _{LOAD} = 100 Ω , no C _{LOAD}	--	5	--	μ s
BUS To SYS Switch						
V _{SYS_OVLO}	Over Voltage Trip Level	V _{BUS} Rising	4.9	5.25	5.5	V
V _{SYS_HYS}	V _{SYS} Hysteresis		--	110	--	mV
RDS _{ON}	ON Resistance	V _{BUS} = 4.5 V, I _{SYS} = 0.1 A, T _A = 25 °C	--	24	29.6	m Ω
		V _{BUS} = 4.5 V, I _{SYS} = 0.1 A, T _A = 85 °C	--	30	38	m Ω
I _{RCB}	Reverse Current	V _{SYS} = 4.4 V, measured from V _{BUS} to GND ¹	--	10	--	nA
t _{DEB_SYS}	Debounce Time	See timing diagram	--	15	--	ms
t _{SYS_START}	Soft-Start Time	See timing diagram	--	30	--	ms
t _{ON_SYS}	Switch Turn-On Time	R _{LOAD} = 100 Ω , C _{LOAD} = 4.7 μ F; V _{SYS} from 0.1 x V _{BUS} to 0.9 x V _{BUS}	--	3.0	--	ms

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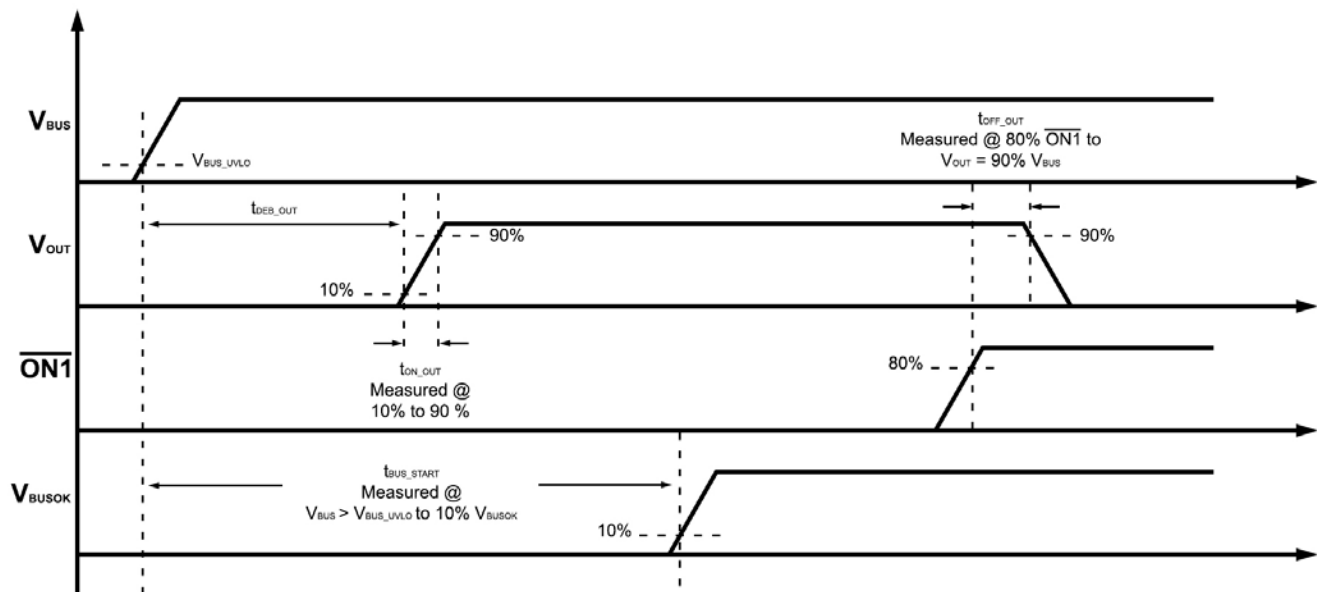
Electrical Characteristics (continued)T_A = -40 °C to 85 °C (unless otherwise stated)

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
t _{OVP_SYS} ¹	Overvoltage Protection Time	I _{LOAD} = 100 mA, no C _{LOAD} ; V _{BUS} step up over V _{SYS_OVLO} to V _{SYS} start separate from V _{BUS}	--	200	--	ns
t _{OFF_SYS}	Switch Turn-Off Time	50 % ON2 ↓ to 0.9 x V _{SYS} ; V _{BUS} = 5 V; R _{LOAD} = 100 Ω, no C _{LOAD}	--	5	--	μs
BUSOK						
V _{BUSOK}	BUSOK Output voltage	V _{BUS} = 5 V, no load	3.8	4.0	4.4	V
		V _{BUS} = 12 V, no load	3.8	4.0	4.4	V
		V _{BUS} = 5 V; BUSOK IDS = 100 mA	3.6	3.8	4.1	V
		V _{BUS} = 12 V; BUSOK IDS = 100 mA	3.6	3.8	4.1	V
Digital Signals						
V _{OH_PG}	PG Output HIGH Voltage	ON2 = Low to High, V _{BUS} = 3.4 V to 5 V	--	1.8	--	V
V _{OL_PG}	PG Output LOW Voltage	ON2 = High to Low, V _{BUS} = 3.4 V to 5 V	--	--	0.3	V
R _{PD(ONx, SD)}	Internal Pull-Down Resistor at ON1, ON2, and SD		--	1	--	MΩ
V _{IH(ONx, SD)}	Logic Enable HIGH Voltage		0.9	--	--	V
V _{IL(ONx, SD)}	Logic Enable LOW Voltage		--	--	0.3	V
I _{LKG(BUSOK)}	BUSOK Leakage Current		--	--	1	μA
I _{LKG(ONx, SD)}	SD, ONx Leakage current	V _{BUS} = 12 V	--	--	5	μA
Notes:						
1. Based on bench measurement only.						

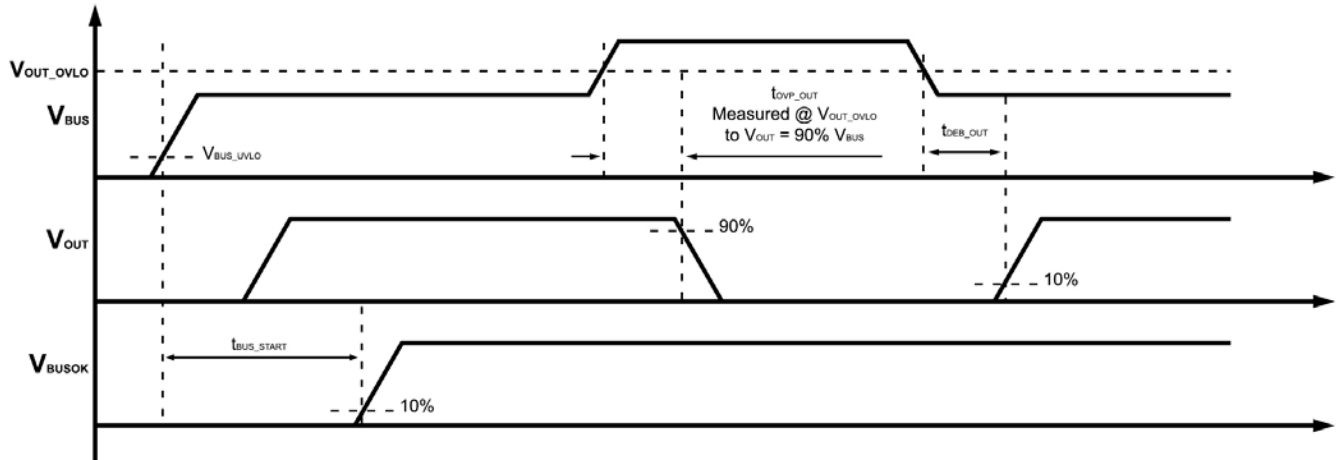
Typical Application Diagram



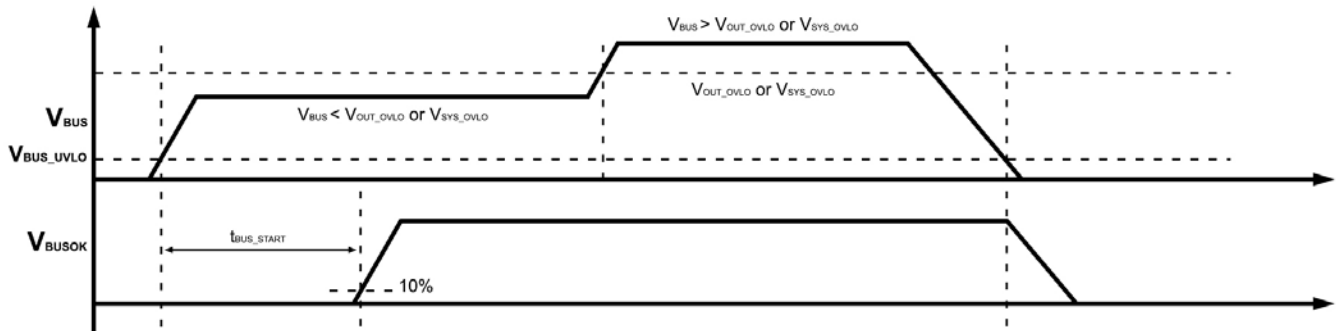
Timing for BUS to OUT Power Up/Down and Normal Operation



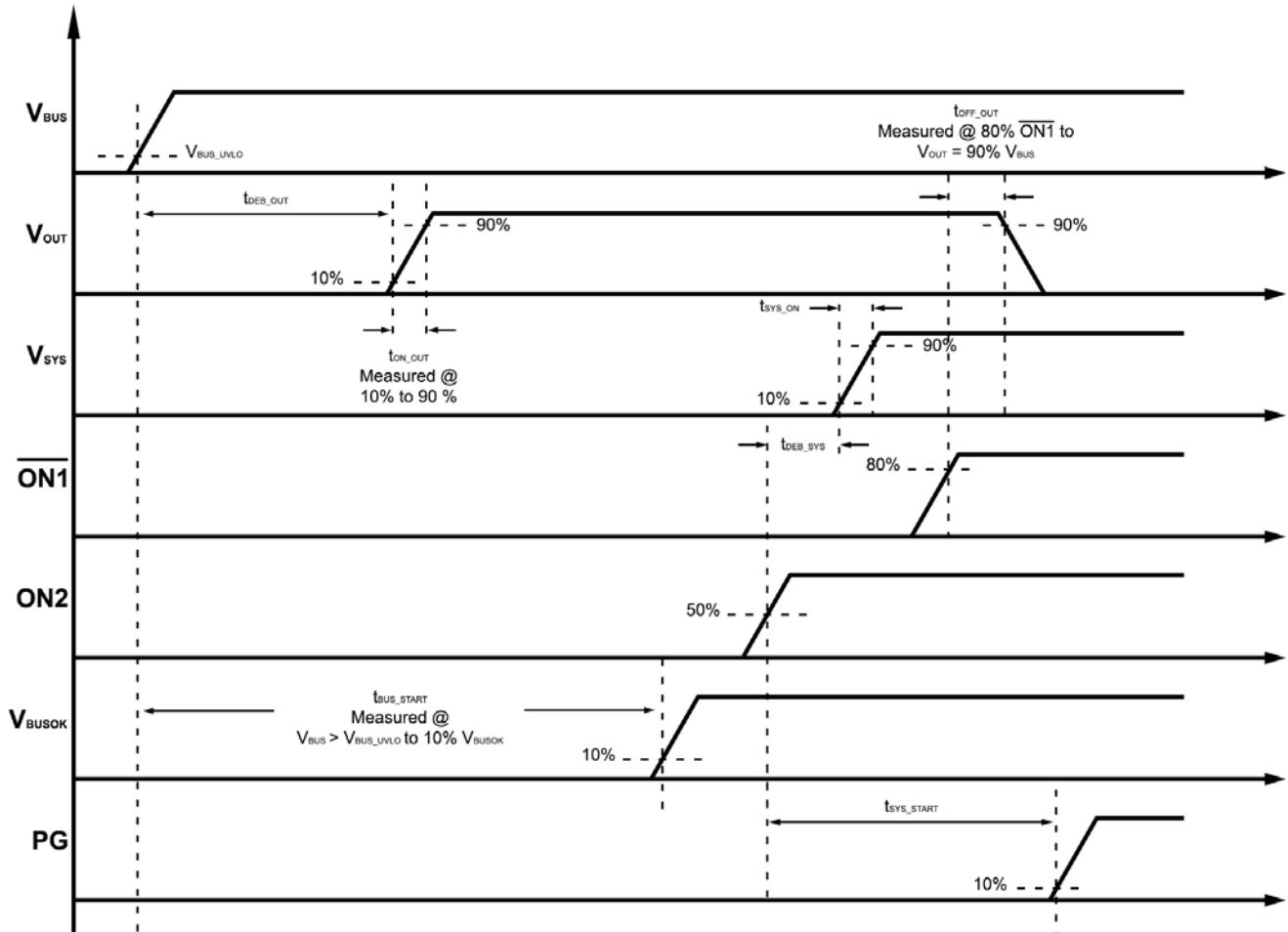
Timing for BUS to OUT OVLO Operation (ON1 = LOW)



“Always ON” based BUSOK Operation (ON1 = X, ON2 = X, SD = LOW)



Timing for Overall ON/OFF Operation (SD = LOW)



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Layout Guidelines:

1. Since the BUS, SYS and OUT pins dissipate most of the heat generated during high-load current operation, it is highly recommended to make power traces as short, direct, and wide as possible. A good practice is to make power traces with absolute minimum widths of 15 mils (0.381 mm) per Ampere. A representative layout, shown in [Figure 1](#), illustrates proper techniques for heat to transfer as efficiently as possible out of the device;
2. To minimize the effects of parasitic trace inductance on normal operation, it is recommended to connect input C_{IN} and output C_{LOAD} low-ESR capacitors as close as possible to the SLG59H1302C's BUS, SYS and OUT pins;
3. The GND pin should be connected to system analog or power ground plane.

SLG59H1302C Evaluation Board:

A HFET1 Evaluation Board for SLG59H1302C is designed according to the statements above and is illustrated on [Figure 1](#). Please note that evaluation board has BUS_Sense, SYS_Sense and OUT_Sense pads. They cannot carry high currents and dedicated only for RDS_{ON} evaluation. evaluation.

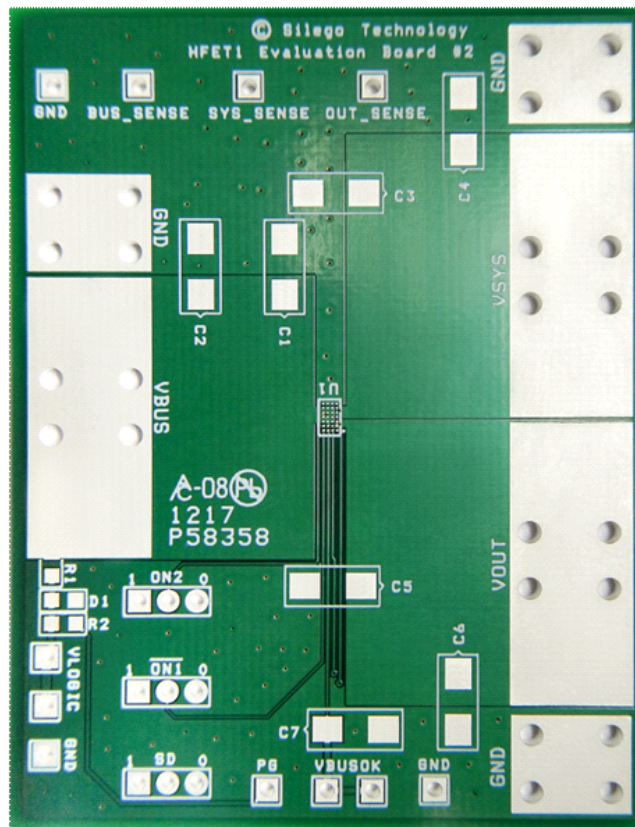


Figure 1. SLG59H1302C Evaluation Board

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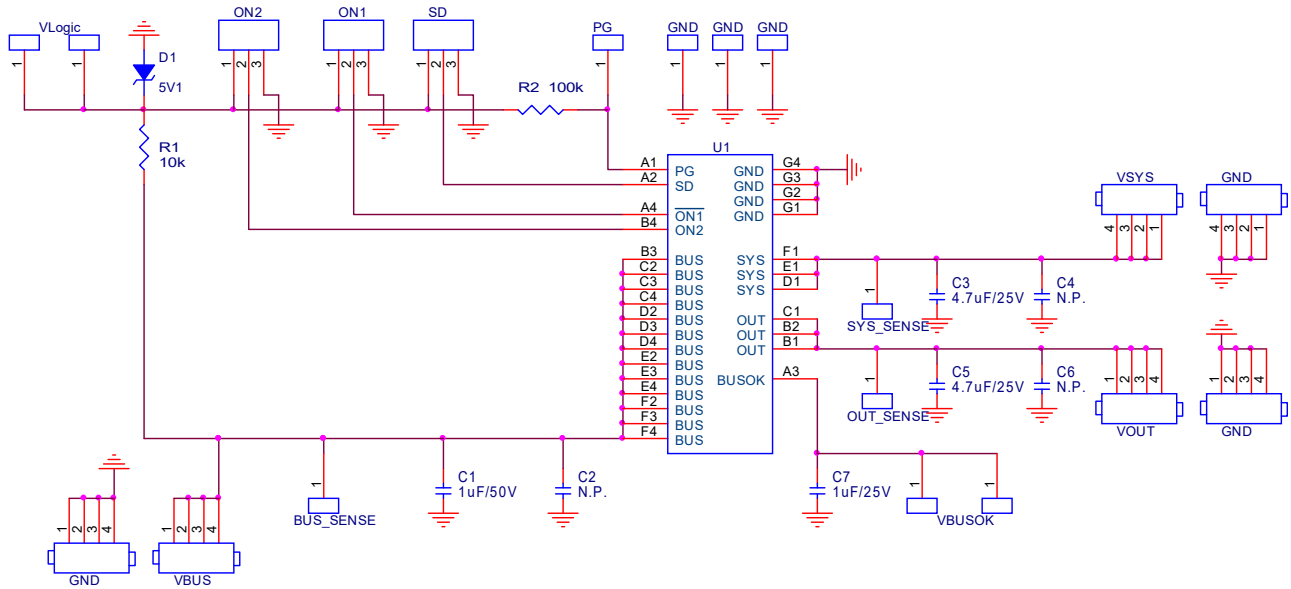


Figure 2. SLG59H1302C Evaluation Board Connection Circuit

Basic Test Setup and Connections

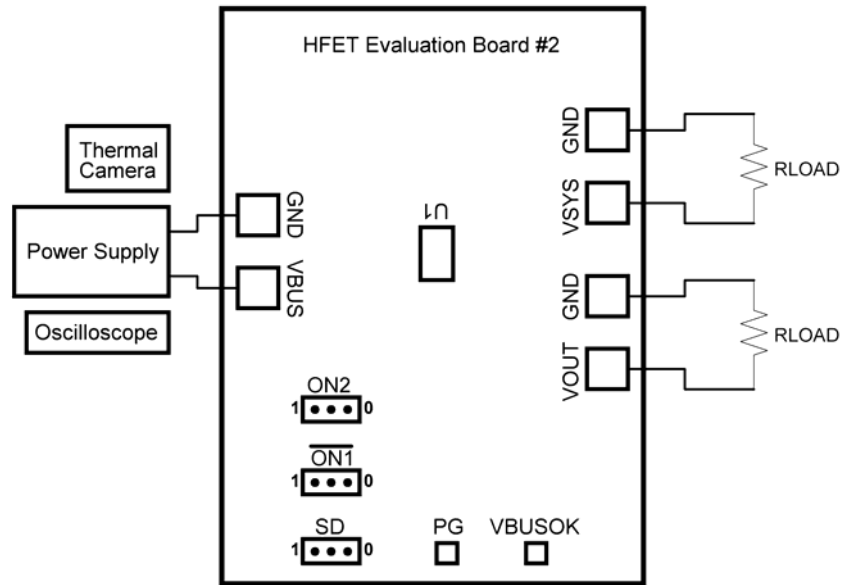


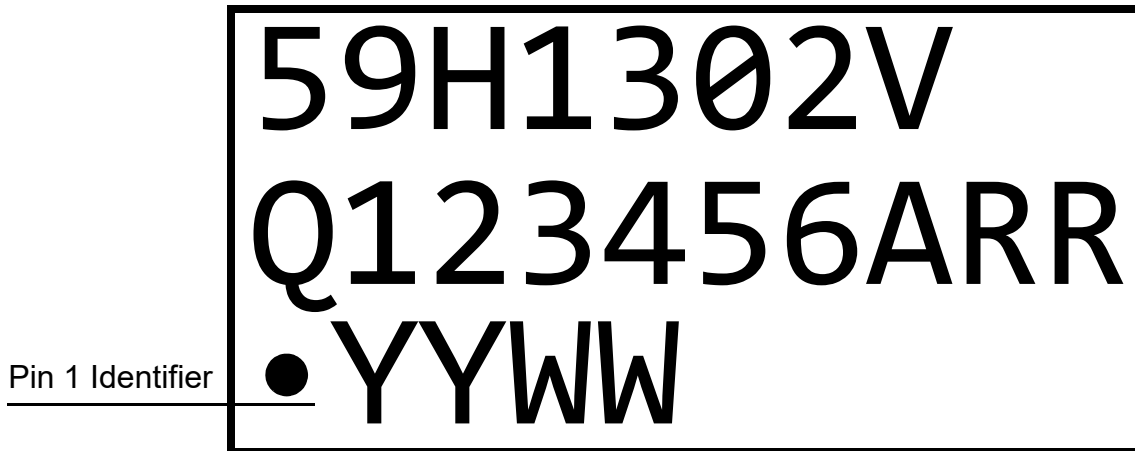
Figure 3. SLG59H1302C Evaluation Board Connection Circuit

EVB Configuration

1. Set SD to GND;
2. Connect oscilloscope probes to VBUS, VOUT, VSYS, ON1, ON2, etc.;
3. Turn on Power Supply and set desired VBUS from 2.7 V ... 13.3 V;
4. Toggle the ON1 signal High or Low to test SLG59H1302C's OUT rail operation;
5. Toggle the ON2 signal High or Low to test SLG59H1302C's SYS rail operation;

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Package Top Marking System Definition



59H1302V - Part ID Field

Q123456 - Assembly Lot Traceability Code Field¹

A - Assembly Site Code Field²

RR - Part Revision Code Field²

YY - Year Code Field¹

WW - Week Code Field¹

Note 1: Each character in code field can be alphanumeric A-Z and 0-9

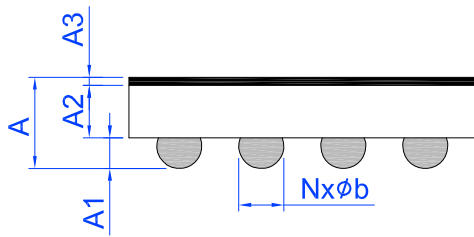
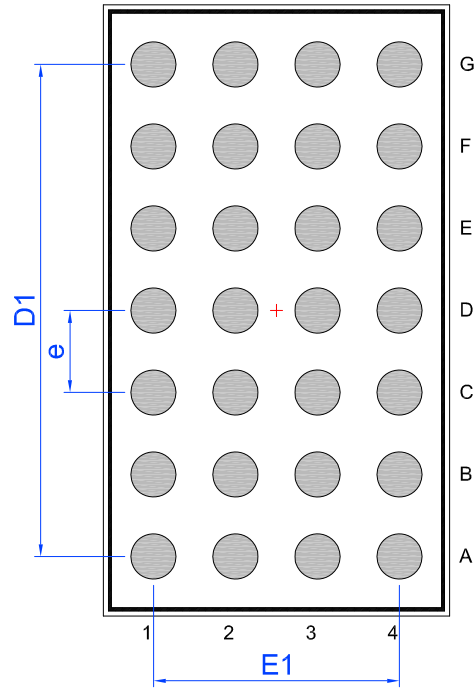
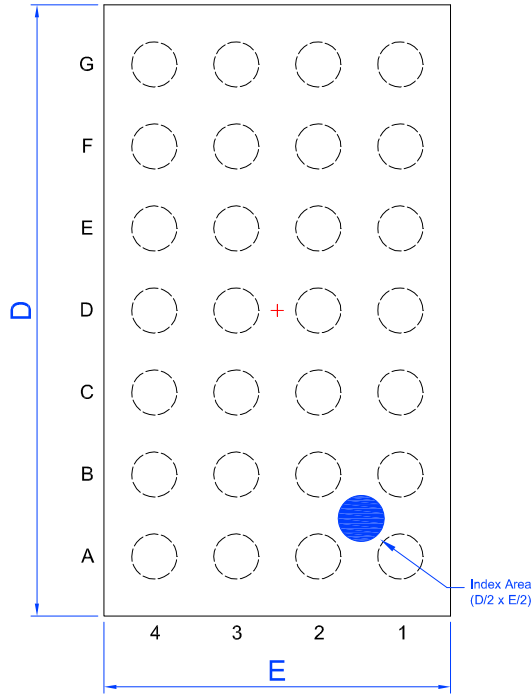
Note 2: Character in code field can be alphabetic A-Z

Package Drawing and Dimensions

28 Lead WLCSP Package

Laser Marking View

Bump View



SIDE View

TERMINALS ASSIGNMENTS				
G	GND	GND	GND	GND
F	SYS	BUS	BUS	BUS
E	SYS	BUS	BUS	BUS
D	SYS	BUS	BUS	BUS
C	OUT	BUS	BUS	BUS
B	OUT	OUT	BUS	ON1
A	SD	PG	BUSOK	ON2
	1	2	3	4

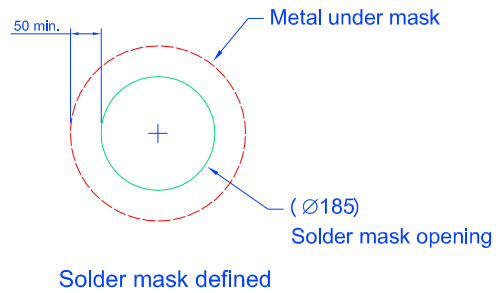
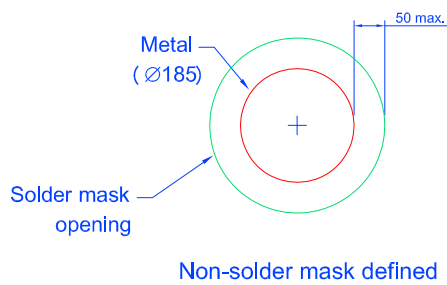
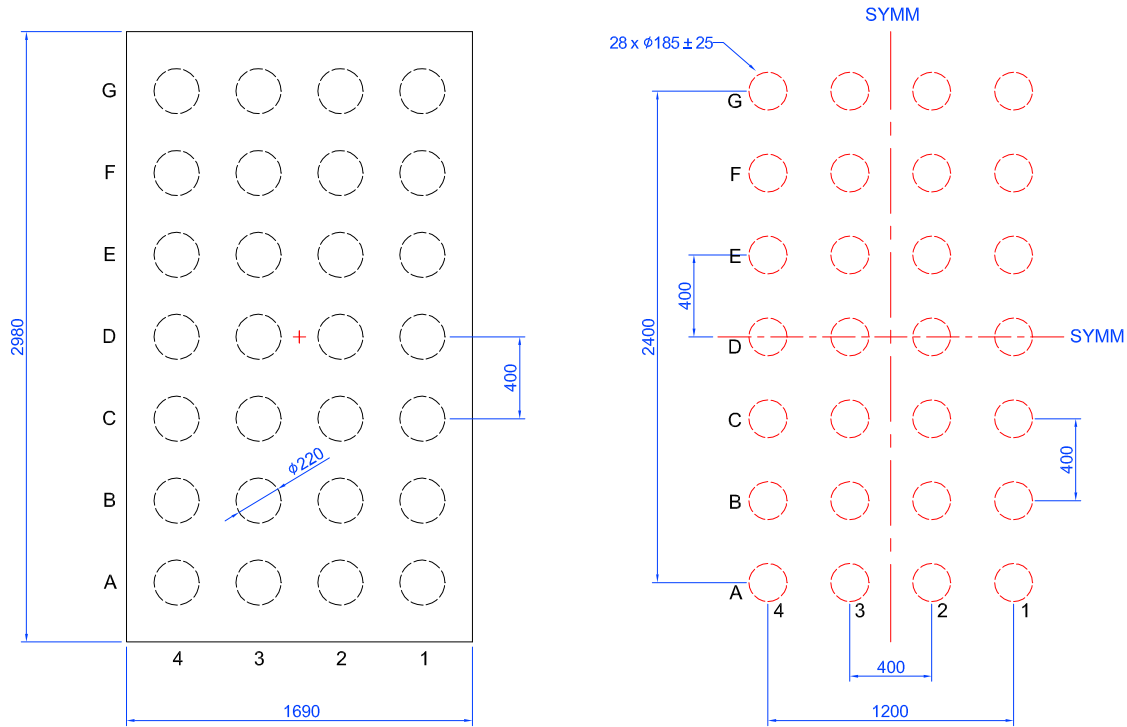
Unit: mm

Symbol	Min	Nom.	Max	Symbol	Min	Nom.	Max
A	0.380	-	0.500	D	2.95	2.98	3.01
A1	0.125	0.150	0.175	E	1.66	1.69	1.72
A2	0.240	0.265	0.290	D1	2.40 BSC		
A3	0.015	0.025	0.035	E1	1.20 BSC		
b	0.195	0.220	0.245	e	0.40 BSC		
N	28 (Bump)						

SLG59H1302C 28-pin WLCSP PCB Landing Pattern

○ Exposed Bump
(Laser marking view)

⊕ Recommended Land Pattern
(Laser marking view)



Solder mask detail (not to scale)

Unit: μm

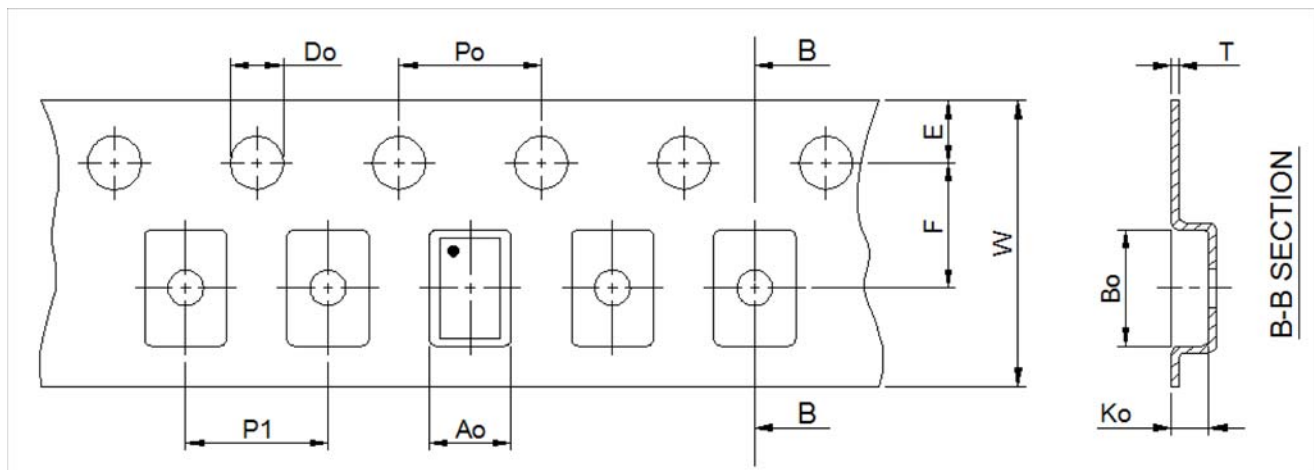
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Tape and Reel Specifications

Package Type	# of Pins	Nominal Package Size [mm]	Max Units		Reel & Hub Size [mm]	Leader (min)		Trailer (min)		Tape Width [mm]	Part Pitch [mm]
			per Reel	per Box		Pockets	Length [mm]	Pockets	Length [mm]		
WLCSP 28L 2.98x1.69 mm 0.4P Green	28	2.98 x 1.69 x 0.44	3000	3000	178/60	100	400	100	400	8	4

Carrier Tape Drawing and Dimensions

Package Type	Pocket BTM Length	Pocket BTM Width	Pocket Depth	Index Hole Pitch	Pocket Pitch	Index Hole Diameter	Index Hole to Tape Edge	Index Hole to Pocket Center	Tape Width	Tape Thickness
	A0	B0	K0	P0	P1	D0	E	F	W	T
WLCSP 28L 2.98x1.69 mm 0.4P Green	1.85	3.25	0.7	4	4	1.55	1.75	3.5	8	0.25



Refer to EIA-481 specification

Recommended Reflow Soldering Profile

Please see IPC/JEDEC J-STD-020: latest revision for reflow profile based on package volume of 2.09 mm³ (nominal). More information can be found at www.jedec.org.

Revision History

Date	Version	Change
1/6/2019	1.02	Added Layout Guidelines Fixed typos
9/18/2017	1.01	Updated EC Table
6/14/2017	1.00	Production Release