SGM3837
Triple-Output 600mA AMOLED Display Power Supply

GENERAL DESCRIPTION

The SGM3837 is designed for powering AMOLED (Active Matrix Organic LED) displays which require V_{ELVDD}, V_{ELVSS} and V_{AVDD}. The device integrates two Boost converters, VO1 for V_{ELVDD} and VO3 for V_{AVDD}, and one inverting Buck-Boost converter VO2 for V_{ELVSS}. Output voltages of all the three converters can be programmed in digital steps through the digital interface control pins (ASWIRE & ESWIRE).

The SGM3837 is available in a Green WLCSP-2.0×2.0-25B package.

FEATURES

- **2.9V to 5.0V Input Supply Voltage Range**
- **Synchronous Boost Converter (ELVDD)**
  - **4.6V to 5.0V Output Voltage with 100mV Steps**
  - **4.6V Default Output Voltage**
  - **600mA Output Current Capability**
- **Synchronous Inverting Buck-Boost Converter (ELVSS)**
  - **-6.6V to -1.0V Output Voltage with 100mV Steps**
  - **-4.0V Default Output Voltage**
  - **-600mA Output Current Capability (V_{ELVSS} = -1.0V to -5.4V)**
- **Synchronous Boost Converter (AVDD)**
  - **7.1V to 7.8V Output Voltage (SET = Low)**
  - **6.9V to 7.9V Output Voltage (SET = High)**
  - **7.6V Default Output Voltage**
  - **150mA Output Current Capability**
- **Selectable ASWIRE Setting via SET pin**
- **V_{IN} and V_{OUT} Bi-Directional Isolation**
- **Short Circuit Protection (SCP)**
- **Overload Protection**
- **Thermal Shutdown**
- **V_{ELVSS} Start-Up Delay: 10.4ms**
- **Short Circuit and OLP Detection Time: 0.08ms**
- **Available in a Green WLCSP-2.0×2.0-25B Package**

APPLICATIONS

Smartphone & Tablet
Active Matrix OLED Display

TYPICAL APPLICATION

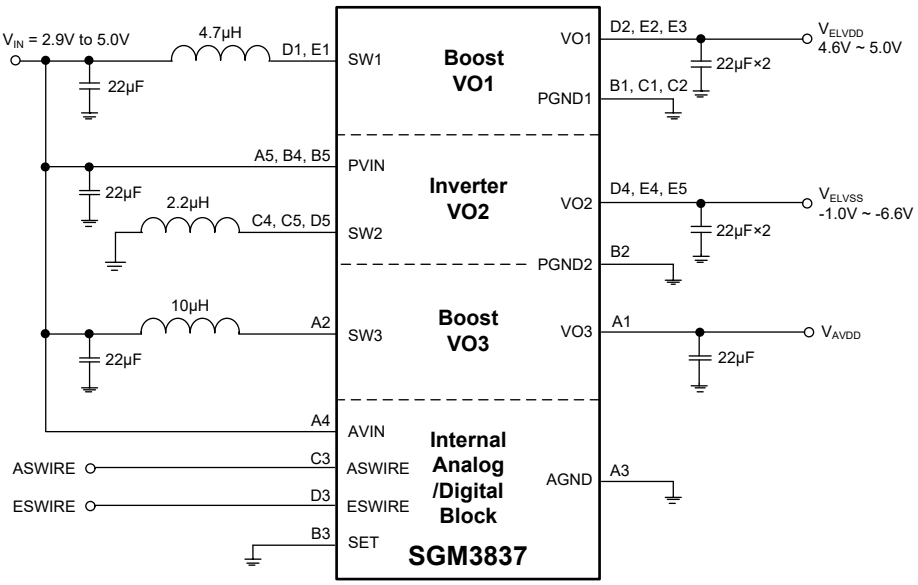


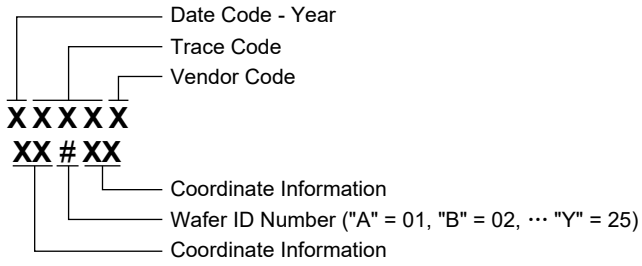
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3837	WLCSP-2.0×2.0-25B	-40℃ to +85℃	SGM3837YG/TR	3837 XXXXX XX#XX	Tape and Reel, 3000

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

Voltage Range (with Respect to Ground Pin)
AVIN, PVIN, VO1, ASWIRE, SET, ESWIRE, SW1 ..... -0.3V to 6V
VO2 ..... -7V to 0.3V
VO3, SW3 ..... -0.3V to 11V
SW2 ..... -7V to 6V
PGND1, PGND2 to AGND ..... -0.3V to 0.3V
Package Thermal Resistance
WLCSP-2.0×2.0-25B, θ_{JA} ..... 81℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 3000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating Ambient Temperature Range ..... -40℃ to +85℃
Operating Junction Temperature Range ..... -40℃ to +125℃

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

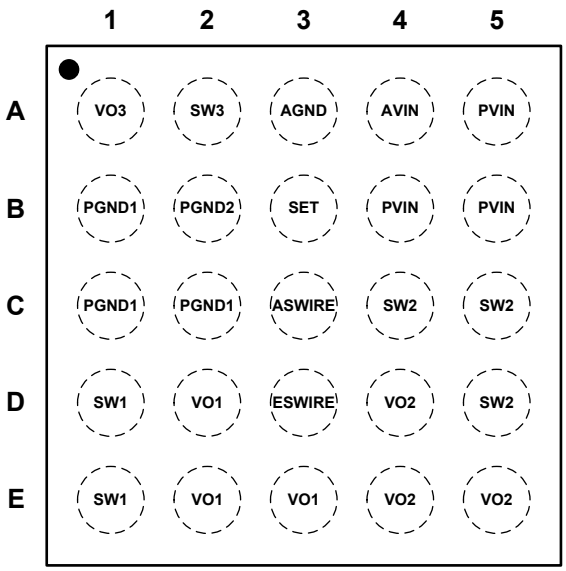
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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

(TOP VIEW)



WLCSP-2.0×2.0-25B

PIN DESCRIPTION

PIN	NAME	TYPE	DESCRIPTION
A1	VO3	O	VO3 Boost Converter Output.
B1, C1, C2	PGND1	G	VO1 Boost Converter Power Ground.
D1, E1	SW1	I/O	VO1 Boost Converter Switching Node.
A2	SW3	I/O	VO3 Boost Converter Switching Node.
B2	PGND2	G	VO2 Inverting Buck-Boost Converter and VO3 Boost Converter Power Ground.
D2, E2, E3	VO1	O	VO1 Boost Converter Output.
A3	AGND	G	Analog Ground Pin.
B3	SET	I	VO3 Output Voltage Table Setting Pin.
C3	ASWIRE	I	VO3 Boost Converter Enable Control and Programming Pin.
D3	ESWIRE	I	VO1 Boost Converter and VO2 Inverting Buck-Boost Converter Enable Control and Programming Pin.
A4	AVIN	I	Analog Input Supply Pin.
B4, A5, B5	PVIN	I	Power Input Supply Pin.
C4, C5, D5	SW2	I/O	VO2 Inverting Buck-Boost Converter Switching Node.
D4, E4, E5	VO2	O	VO2 Inverting Buck-Boost Converter Output.

NOTE: I: input, O: output, I/O: input or output, G: ground.

ELECTRICAL CHARACTERISTICS

(At $T_A = T_J$ = +25℃, $V_{AVIN} = V_{PVIN} = V_{IN}$ = 3.7V, $V_{ESWIRE} = V_{ASWIRE} = V_{AVIN}$, V_{VO1} = 4.6V, V_{VO2} = -4.0V, V_{VO3} = 7.6V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current and Thermal Protection						
AVIN, PVIN Input Voltage Range	V_{S_VIN}		2.9		5.0	V
AVIN Start Threshold Voltage	V_{START}	V_{AVIN} rising	2.27	2.35	2.40	V
AVIN Stop Threshold Voltage	V_{STOP}	V_{AVIN} falling	2.10	2.15	2.23	V
AVIN, PVIN Supply Current when Disabled	I_{SD_VIN}	V_{IN} = 4.5V, V_{ASWIRE} = 0V, V_{ESWIRE} = 0V (sum of I_{AVIN} and I_{PVIN})		0.3	1.0	μA
AVIN, PVIN Supply Current	I_Q	No switching		1.1	1.5	mA
		No load, $V_{ASWIRE} = V_{ESWIRE}$ = High		4		
Switching Frequency	f_{SW}			1.45		MHz
			-10		10	%
Thermal Shutdown Temperature	T_{SD}	Temperature rising		145		℃
Boost Converter ($V_{VO1} = V_{ELVDD}$)						
Positive Output 1 Voltage	V_{VO1}		4.6	4.6	5.0	V
Positive Output 1 Voltage Variation		V_{VO1} = 4.6V, no load	-0.5		0.5	%
		V_{VO1} = 4.6V, no load, T_J = -40℃ to +85℃	-0.8		0.8	
SW1 Current Limit	I_{SW1_LIM}	Inductor peak current	2.0	2.2	2.4	A
Maximum Output Current	I_{O1_MAX}	V_{IN} = 2.9V to 5.0V	600			mA
SW1 Low-side TR On-Resistance	R_{DSON_SW1L}	I_{SW1} = 0.2A		0.20	0.30	Ω
SW1 High-side TR On-Resistance	R_{DSON_SW1H}	I_{SW1} = 0.2A		0.13	0.20	Ω
VO1 Short Circuit Protection	V_{O1_SCP}	V_{VO1} falling, 80μs delay latch		0.87 × V_{VO1}		V
Discharging Resistance	R_{DCHG_VO1}			140		Ω
Line Regulation	$VO1_{LINEREG}$	I_{VO1} = 100mA, V_{IN} = 2.9V to 5.0V		±0.006		%/V
Load Regulation	$VO1_{LOADREG}$	1mA ≤ I_{VO1} ≤ 600mA		±0.2		%/A
Buck-Boost Converter ($V_{VO2} = V_{ELVSS}$)						
Negative Output Voltage	V_{VO2}		-6.6	-4.0	-1.0	V
Negative Output Voltage Variation		V_{VO2} = -4V, no load	-25		25	mV
		V_{VO2} = -4V, no load, T_J = -40℃ to +85℃	-40		40	
SW2 Current Limit	I_{SW2_LIM}	Inductor peak current	2.6	3.3	4.0	A
Maximum Output Current	I_{O2_MAX}	V_{IN} = 2.9V to 5.0V			-600	mA
SW2 Low-side TR On-Resistance	R_{DSON_SW2L}	I_{SW2} = 0.2A		0.07	0.10	Ω
SW2 High-side TR On-Resistance	R_{DSON_SW2H}	I_{SW2} = 0.2A		0.18	0.30	Ω
VO2 Short Circuit Protection	V_{VO2_SCP}	V_{VO2} rising, 80μs delay latch		0.89 × V_{VO2}		V
Discharging Resistance	R_{DCHG_VO2}			160		Ω
Line Regulation	$VO2_{LINEREG}$	I_{VO2} = 100mA, V_{IN} = 2.9V to 5.0V		±0.003		%/V
Load Regulation	$VO2_{LOADREG}$	1mA ≤ I_{VO2} ≤ 600mA		±0.2		%/A
Boost Converter ($V_{VO3} = V_{AVDD}$)						
Positive Output 2 Voltage	V_{VO3}	SET = Low (GND)	7.1	7.6	7.8	V
		SET = High (VIN)	6.9	7.6	7.9	V
Positive Output 2 Voltage Variation		V_{VO3} = 7.6V, no load	-0.8		0.8	%
		V_{VO3} = 7.6V, no load, T_J = -40℃ to +85℃	-1.2		1.2	
SW3 Current Limit	I_{SW3_LIM}	Inductor peak current	0.75	1.05	1.35	A
Maximum Output Current	I_{O3_MAX}	V_{IN} = 2.9V to 5.0V	150			mA

ELECTRICAL CHARACTERISTICS (continued)

(At T_A = T_J = +25℃, V_{AVIN} = V_{PVIN} = V_{IN} = 3.7V, V_{ESWIRE} = V_{ASWIRE} = V_{AVIN}, V_{VO1} = 4.6V, V_{VO2} = -4.0V, V_{VO3} = 7.6V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SW3 Low-side TR On-Resistance	R_{DSON_SW3L}	I_{SW3} = 0.1A		0.38	0.5	Ω
SW3 High-side TR On-Resistance	R_{DSON_SW3H}	I_{SW3} = 0.1A		1.1	1.5	Ω
VO3 Short Circuit Protection	V_{VO3_SCP}	V_{VO3} falling, 1ms delay latch		0.87 × V_{VO3}		V
Discharging Resistance	R_{DCHG_VO3}			250		Ω
Line Regulation	$VO3_{LINEREG}$	I_{VO3} = 50mA, V_{IN} = 2.9V to 5.0V		±0.009		%/V
Load Regulation	$VO3_{LOADREG}$	1mA ≤ I_{VO3} ≤ 150mA		±0.7		%/A
ESWIRE						
ESWIRE Input High Threshold Voltage	$V_{ESWIREH}$	V_{IN} = 2.9V to 5.0V, T_J = -40℃ to +85℃	1.1			V
ESWIRE Input Low Threshold Voltage	$V_{ESWIREL}$	V_{IN} = 2.9V to 5.0V, T_J = -40℃ to +85℃			0.4	V
ESWIRE High Time (1)	t_{ESH}		2	10	20	μs
ESWIRE Low Time (1)	t_{ESL}		2	10	20	μs
ASWIRE						
ASWIRE Input High Threshold Voltage	$V_{ASWIREH}$	V_{IN} = 2.9V to 5.0V, T_J = -40℃ to +85℃	1.1			V
ASWIRE Input Low Threshold Voltage	$V_{ASWIREL}$	V_{IN} = 2.9V to 5.0V, T_J = -40℃ to +85℃			0.4	V
ASWIRE High Time (1)	t_{ASH}		2	10	20	μs
ASWIRE Low Time (1)	t_{ASL}		2	10	20	μs

NOTE:
1. Guaranteed by design. Not production tested.

TIMING REQUIREMENTS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Short-Circuit Timer					
VO1 Short Circuit Detection Time in Start-Up	$t_{VO1(SCP)}$		5.2		ms
VO1 Short Circuit Detection Time in Operation			0.08		
VO2 Short Circuit Detection Time in Start-Up	$t_{VO2(SCP)}$		12		
VO2 Short Circuit Detection Time in Operation			0.08		
VO3 Short Circuit Detection Time in Start-Up	$t_{VO3(SCP)}$		1.2		
VO3 Short Circuit Detection Time in Operation			1		
ESWIRE Interface					
Initialization Time	t_{INIT_E}		350	400	µs
Shutdown Time Period	t_{OFF_E}	35	45	55	
Pulse High Level Time Period	t_{H_E}	2	10	20	
Pulse Low Level Time Period	t_{L_E}	2	10	20	
Data Storage/Accept Time Period	t_{STORE_E}	35	45	55	
ASWIRE Interface					
Initialization Time	t_{INIT_A}		350	400	µs
Shutdown Time Period	t_{OFF_A}	35	45	55	
Pulse High Level Time Period	t_{H_A}	2	10	20	
Pulse Low Level Time Period	t_{L_A}	2	10	20	
Data Storage/Accept Time Period	t_{STORE_A}	35	45	55	
Power Sequence					
VO1 Start-Up Time	t_{SS1}		1.6		ms
VO2 Start-Up Time	t_{SS2}		1.6		
VO2 Start-Up Time Delay after VO1	t_{DELAY}		8.4		
VO3 Start-Up Time	t_{SS3}		2.6		
VOx Discharge Time after ASWIRE or ESWIRE Goes Low	t_{DISCHG}		10		

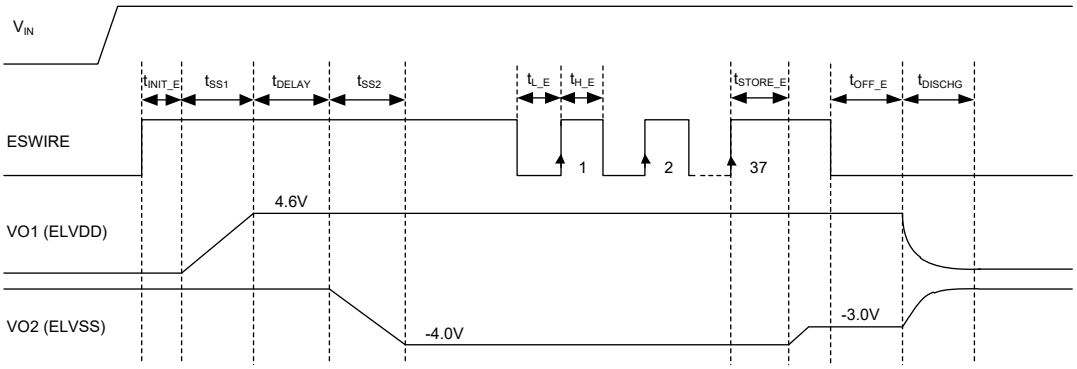
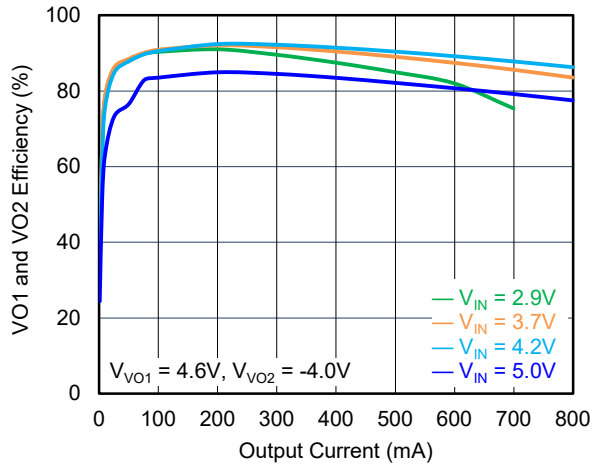


Figure 2. Timing Diagram

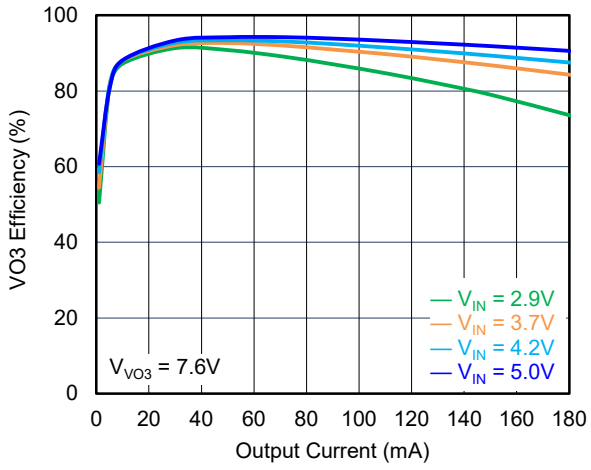
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 3.7V, unless otherwise noted.

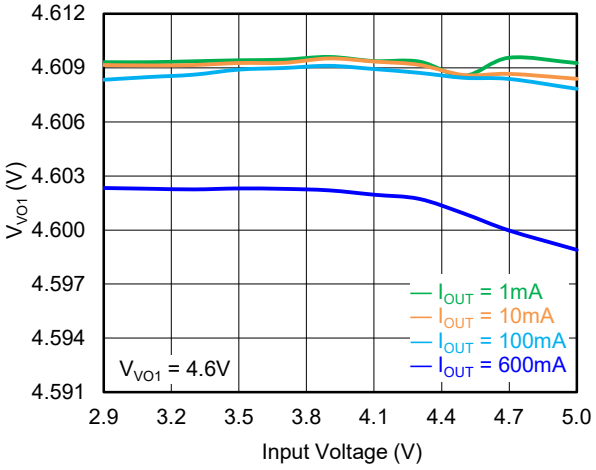
VO1 and VO2 Combined Efficiency vs. Output Current



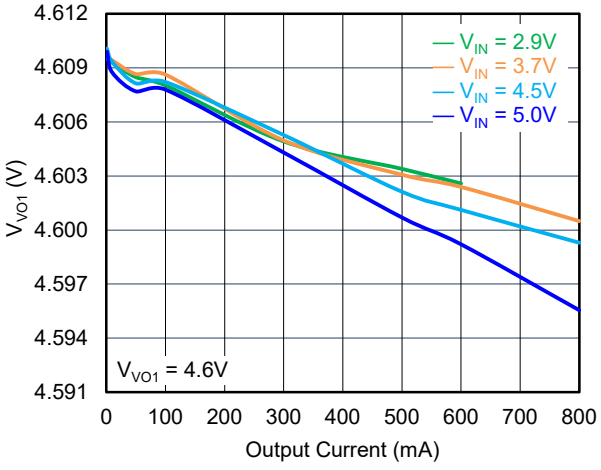
VO3 Efficiency vs. Output Current



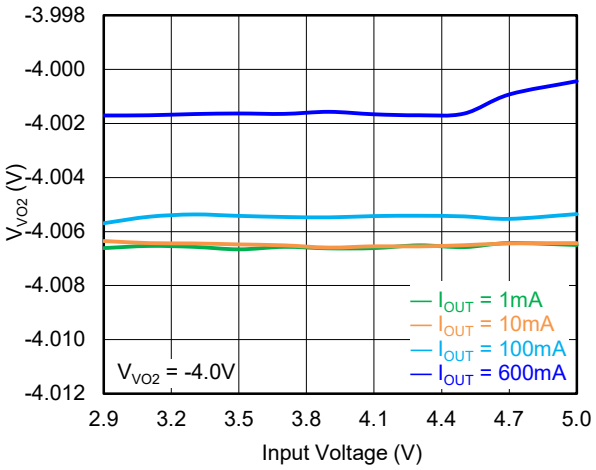
V_{VO1} Line Regulation



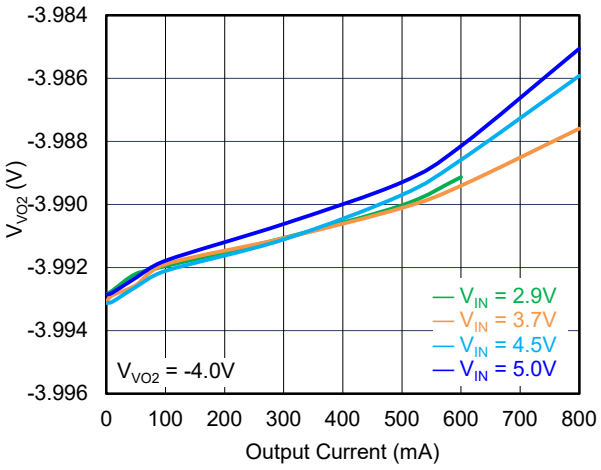
V_{VO1} Load Regulation



V_{VO2} Line Regulation



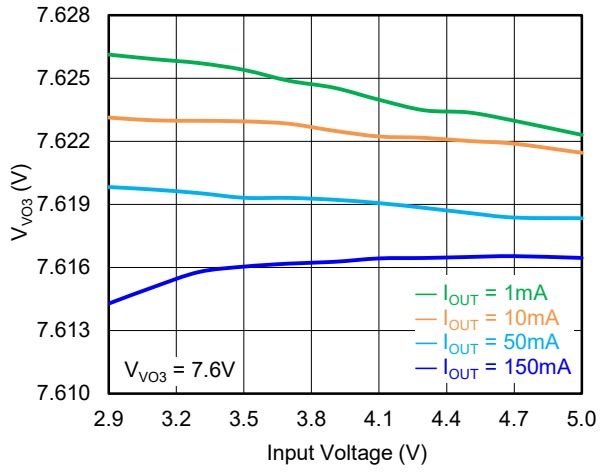
V_{VO2} Load Regulation



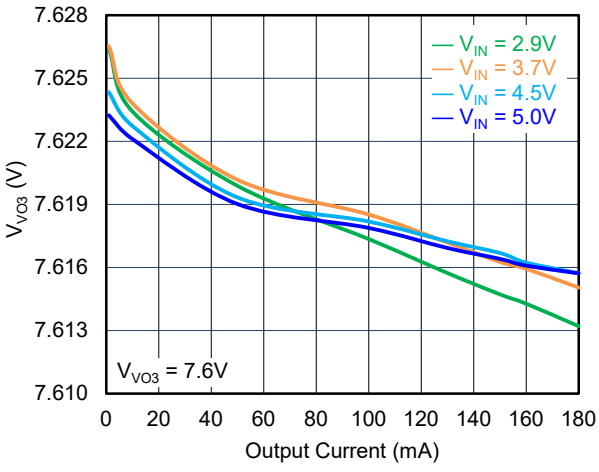
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN} = 3.7V, unless otherwise noted.

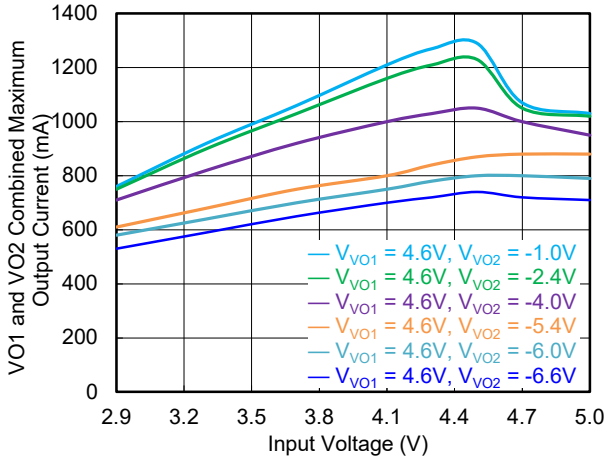
V_{VO3} Line Regulation



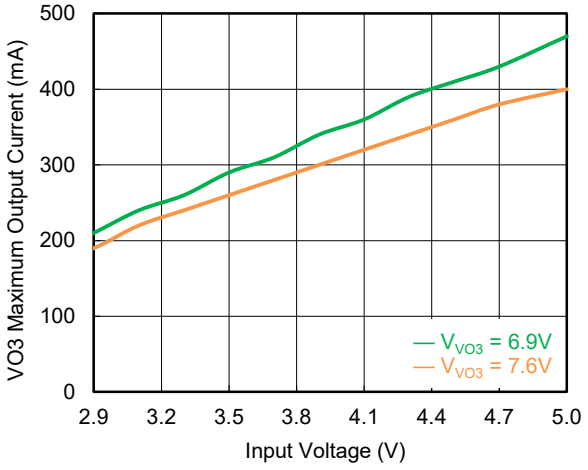
V_{VO3} Load Regulation



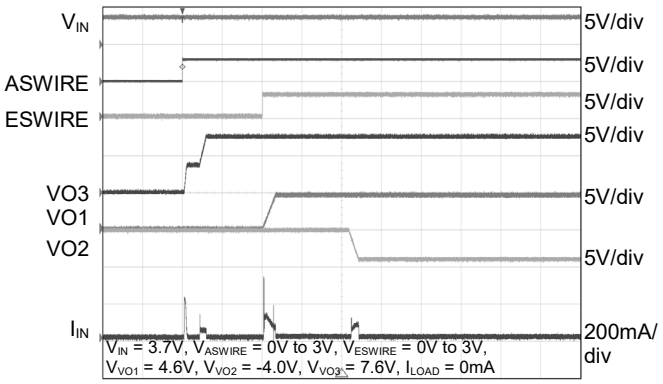
VO1 and VO2 Combined Maximum Output Current vs. Input Voltage



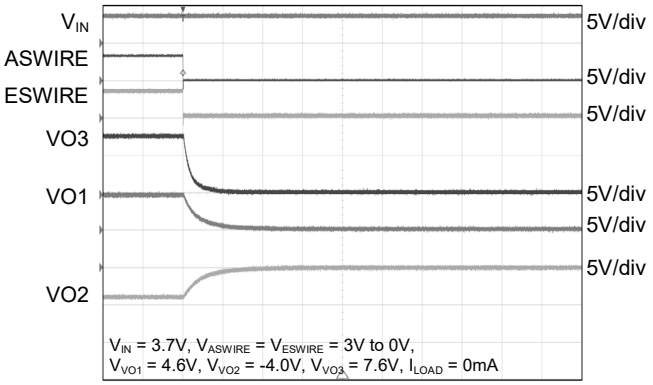
VO3 Maximum Output Current vs. Input Voltage



Start-Up Sequence



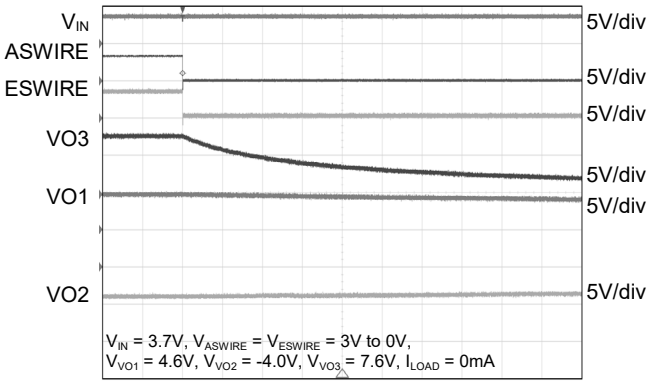
Shutdown Sequence Discharge = ON



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

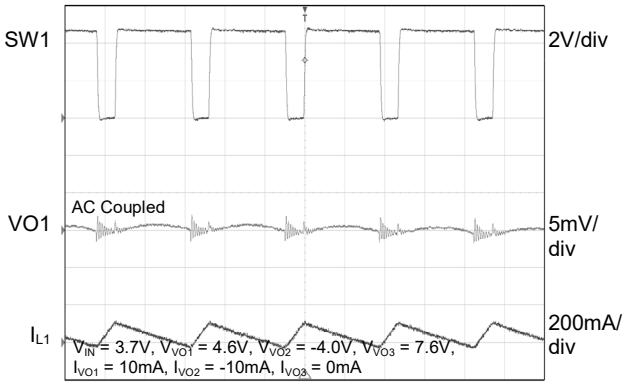
V_{IN} = 3.7V, unless otherwise noted.

Shutdown Sequence Discharge = OFF



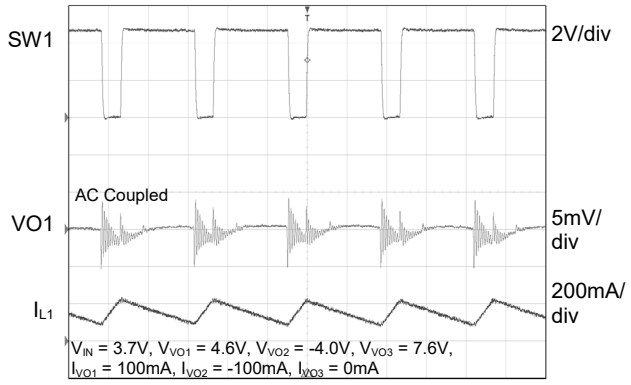
Time (1s/div)

VO1 Output Ripple at 10mA Load



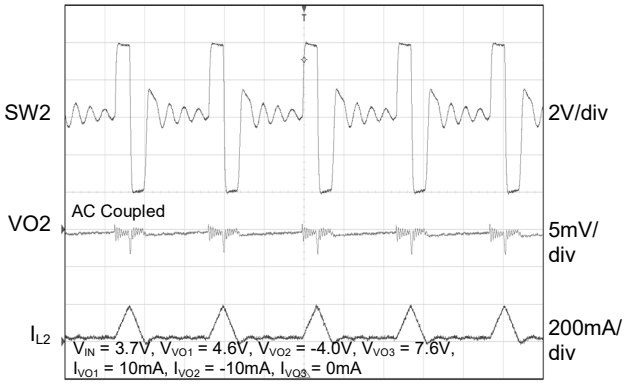
Time (300ns/div)

VO1 Output Ripple at 100mA Load



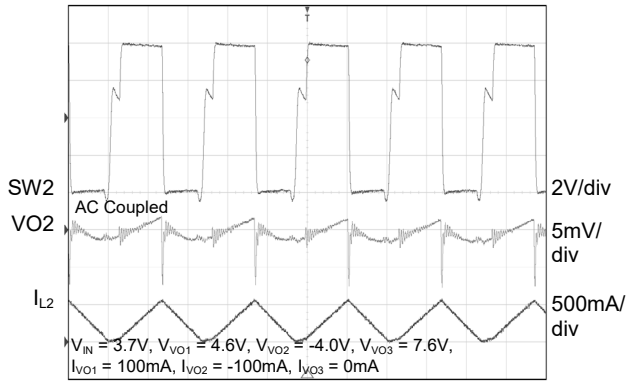
Time (300ns/div)

VO2 Output Ripple at -10mA Load



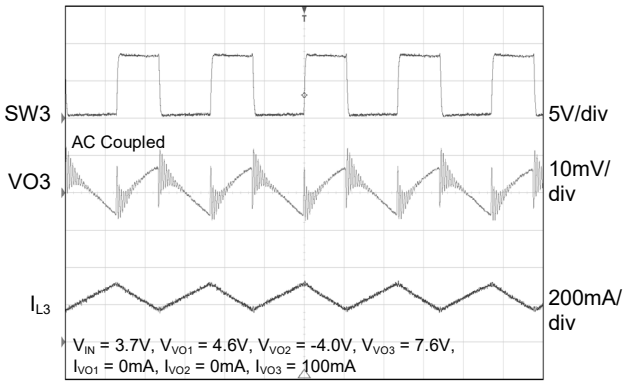
Time (300ns/div)

VO2 Output Ripple at -100mA Load



Time (300ns/div)

VO3 Output Ripple at 100mA Load

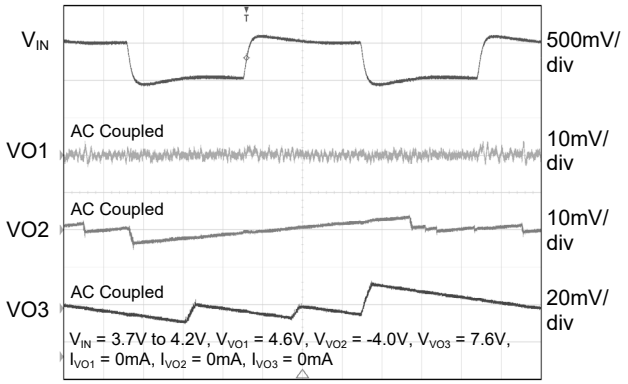


Time (300ns/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

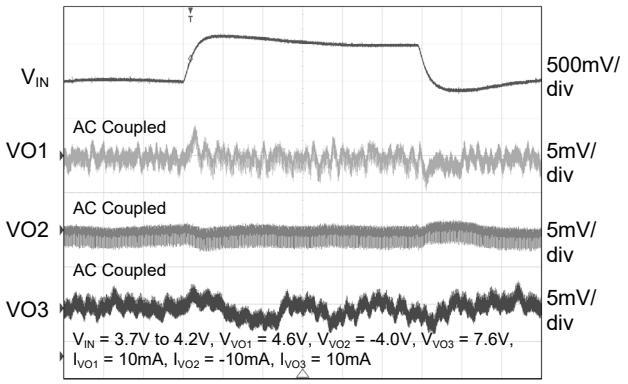
V_{IN} = 3.7V, unless otherwise noted.

Line Transient at No Load



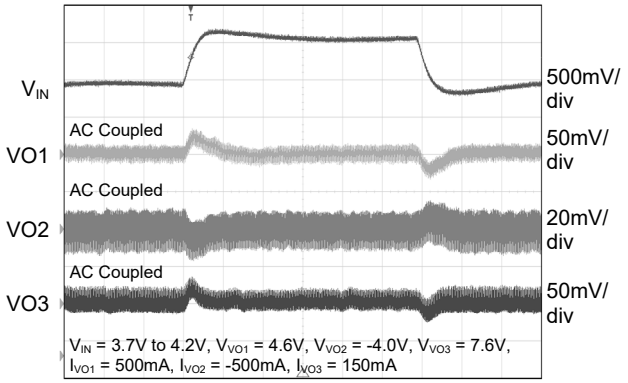
Time (100μs/div)

Line Transient at Light Load



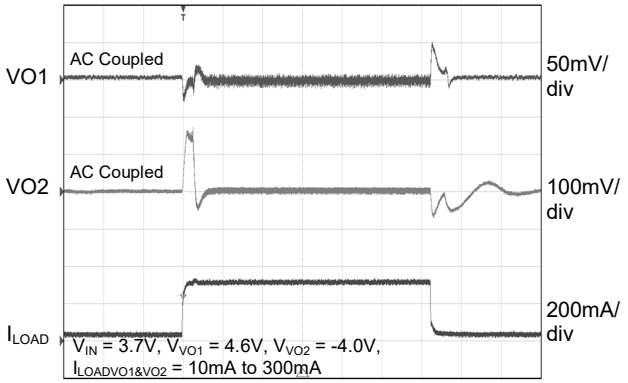
Time (50μs/div)

Line Transient at Heavy Load



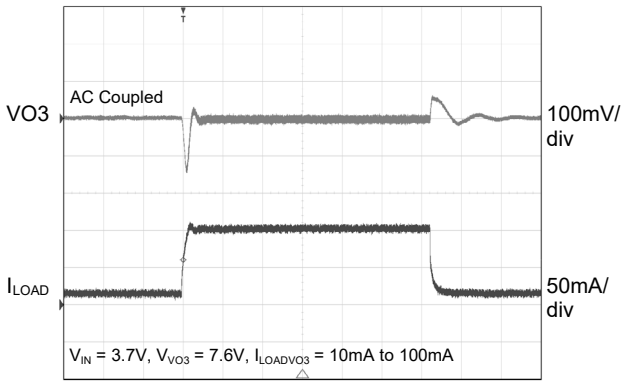
Time (50μs/div)

VO1 and VO2 Load Transient



Time (100μs/div)

VO3 Load Transient



Time (100μs/div)

FUNCTIONAL BLOCK DIAGRAM

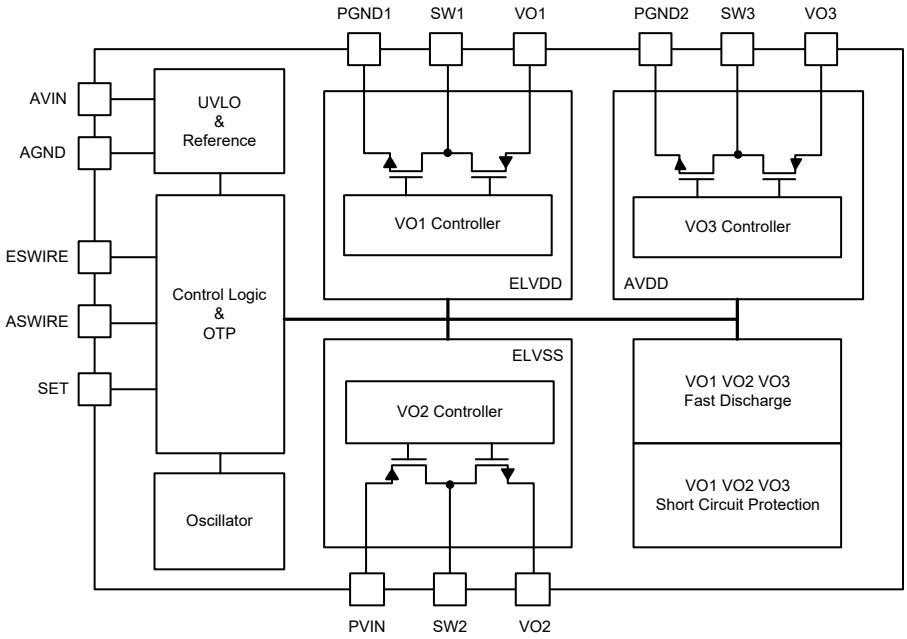


Figure 3. Functional Block Diagram

RECOMMENDED COMPONENT SELECTION

Table 1. Recommended Component Selection

Converter	Component	Value	Number	Electrical Spec	Part Number	Manufacturer
ELVDD	C_{IN1}	22μF	1	X5R, 10V, 0603	GRM188R61A226ME15D	Murata
	C_{VO1}	22μF	2	X5R, 10V, 0603	GRM188R61A226ME15D	Murata
	L_{VO1}	4.7μH	1	1.9A, 100mΩ, 252010	HTEH25201T-4R7MSR	Cyntec
ELVSS	C_{PVIN}	22μF	1	X5R, 10V, 0603	GRM188R61A226ME15D	Murata
	C_{VO2}	22μF	2	X5R, 10V, 0603	GRM188R61A226ME15D	Murata
	L_{VO2}	2.2μH	1	3.4A, 89mΩ, 252010	HMLQ25201T-2R2MSR	Cyntec
AVDD	C_{IN3}	22μF	1	X5R, 10V, 0603	GRM188R61A226ME15D	Murata
	C_{VO3}	22μF	1	X5R, 10V, 0603	GRM188R61A226ME15D	Murata
	L_{VO3}	10μH	1	0.9A, 390mΩ, 252012	SDEM25201B-100MS	Cyntec

NOTE: The minimum value of the required capacitor for 600mA load at V_{VO1} = 4.6V or V_{VO2} = -4.0V is 13.2μF and for 150mA load at V_{VO3} = 7.9V is 3.9μF.

DETAILED DESCRIPTION

Under-Voltage Lockout (UVLO)

The built-in under-voltage lockout function (UVLO) monitors the input voltage and disables the device when the input voltage is too low to operate.

Thermal Shutdown (TSD)

The device has a function of thermal shutdown, which prevents the device from damage due to overheating and excessive power dissipation. The device is latched and shuts down the outputs once the junction temperature exceeds +145℃ (TYP). It resumes operation after toggling ESWIRE and ASWIRE simultaneously.

Start-Up Sequence

Pulling ASWIRE high enables the VO3 Boost converter. Pulling ESWIRE high enables the VO1 Boost converter and VO2 Buck-Boost converter. The VO2 always starts 10ms later than VO1 with a -4V default value. All converters start with soft-start function to limit the inrush current. Figure 4 shows the start-up sequence of SGM3837.

Boost Converter VO1 (ELVDD)

The Boost converter VO1 operates with peak-current-mode topology and fixed 1.45MHz (TYP) frequency. The VO1 output voltage can be programmed between 4.6V and 5.0V (default 4.6V) with 100mV steps through ESWIRE pin (see Table 2).

The output of VO1 is fully isolated in shutdown mode.

Inverting Buck-Boost Converter VO2 (ELVSS)

The inverting Buck-Boost converter VO2 operates with a peak-current-mode topology and fixed 1.45MHz (TYP) frequency. The VO2 output voltage can be programmed between -6.6V to -1.0V (default -4.0V) with 100mV steps through ESWIRE pin (see Table 2).

The output of VO2 is fully isolated in shutdown mode.

Boost Converter VO3 (AVDD)

The Boost converter VO3 operates with a peak-current-mode topology and fixed 1.45MHz (TYP) frequency. The VO3 output voltage can be programmed through ASWIRE pin, and the output voltage table can be changed by SET pin. When SET = low, the VO3 voltage is available between 7.1V and 7.8V (default 7.6V) with 100mV steps. While SET = high, the VO3 voltage is available between 6.9V and 7.9V (default 7.6V) with 50mV steps (see Table 3).

The output of VO3 is fully isolated in shutdown mode.

Output Current Capacity

The device operates with an input voltage range of 2.9V to 5.0V. However, due to different input voltage and different output voltage, the output current capacity is quite different. A lower input voltage or a higher output voltage leads to a lower output current capacity.

Input Power Supply

The input power supply voltage is recommended between 2.9V and 5.0V. To achieve full performance, a stable and noise-free input source is needed. Once the distance between input source and SGM3837 is a bit long, additional capacitors are suggested to place as close to the device as possible. Please refer to the typical application circuit for the suggested input capacitance.

SGMICRO has patented circuits to solve the spike problem of V_{ELVDD} due to mode switching when the input voltage rises close to or higher than the programmed V_{ELVDD}.

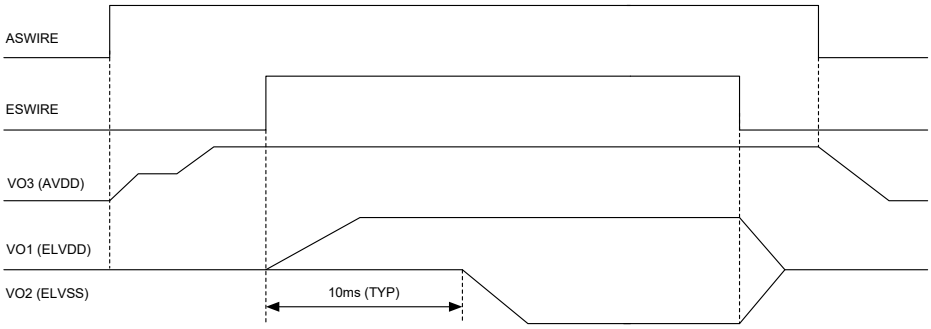


Figure 4. Start-Up Sequence

DETAILED DESCRIPTION (continued)

Table 2. Programming Table for VO1 and VO2 (ESWIRE)

ESWIRE Pulse	VO2 (ELVSS)	ESWIRE Pulse	VO2 (ELVSS)	ESWIRE Pulse	VO2 (ELVSS)	ESWIRE Pulse	VO1 (ELVDD)
0/no pulse	-4.0V	20	-4.7V	40	-2.7V	0/no pulse	4.6V
1	-6.6V	21	-4.6V	41	-2.6V	76	5.0
2	-6.5V	22	-4.5V	42	-2.5V	77	4.9
3	-6.4V	23	-4.4V	43	-2.4V	78	4.8
4	-6.3V	24	-4.3V	44	-2.3V	79	4.7
5	-6.2V	25	-4.2V	45	-2.2V		
6	-6.1V	26	-4.1V	46	-2.1V		
7	-6.0V	27	-4.0V	47	-2.0V		
8	-5.9V	28	-3.9V	48	-1.9V		
9	-5.8V	29	-3.8V	49	-1.8V		
10	-5.7V	30	-3.7V	50	-1.7V		
11	-5.6V	31	-3.6V	51	-1.6V		
12	-5.5V	32	-3.5V	52	-1.5V		
13	-5.4V	33	-3.4V	53	-1.4V		
14	-5.3V	34	-3.3V	54	-1.3V		
15	-5.2V	35	-3.2V	55	-1.2V		
16	-5.1V	36	-3.1V	56	-1.1V		
17	-5.0V	37	-3.0V	57	-1.0V		
18	-4.9V	38	-2.9V				
19	-4.8V	39	-2.8V				

Table 3. Programming Table for VO3 (ASWIRE)

SET = High				SET = Low	
ASWIRE Pulse	AVDD	ASWIRE Pulse	AVDD	ASWIRE Pulse	AVDD
0/no pulse	7.60V	11	7.40V	0/no pulse	7.60V
1	7.90V	12	7.35V	1	7.80V
2	7.85V	13	7.30V	2	7.70V
3	7.80V	14	7.25V	3	7.60V
4	7.75V	15	7.20V	4	7.50V
5	7.70V	16	7.15V	5	7.40V
6	7.65V	17	7.10V	6	7.30V
7	7.60V	18	7.05V	7	7.20V
8	7.55V	19	7.00V	8	7.10V
9	7.50V	20	6.95V		
10	7.45V	21	6.90V		

Table 4. Fast Discharge (FD) Function Table (ASWIRE)

ASWIRE Pulse	SET = High	ASWIRE Pulse	SET = Low
No pulse	Default: FD Off	No pulse	Default: FD Off
25	FD On	11	FD On
26	FD Off	12	FD Off

DETAILED DESCRIPTION (continued)

ASWIRE Interface (ASWIRE Pin)

The SGM3837 provides an ASWIRE pin to enable/disable the VO3, and program the VO3 output voltage. Figure 5 shows the timing.

After toggling ASWIRE high, the VO3 Boost converter starts with a 7.6V default voltage. The output voltage of VO3 can also be programmed through the ASWIRE interface. The programming table is illustrated in Table 3.

Fast Discharge (FD)

The SGM3837 supports fast discharge which is controlled by ASWIRE and SET pins. When power off and the FD is on state, all outputs of the device are discharged to GND. While the FD is off state, all outputs remain Hi-Z status. Table 4 shows the demands of the FD function.

ELVSS Transition Time Control

The SGM3837 provides ELVSS transition time control function by ESWIRE command. The transition time is 60μs in the default fast mode (see Figure 6). The SGM3837 enters slow mode after 74 ESWIRE pulses. The slow mode transition time is 16ms and V_{ELVSS} regulates by 4 steps of 25mV in 16ms.

ESWIRE Interface (ESWIRE Pin)

The positive output voltage V_{ELVDD} and the negative output voltage V_{ELVSS} can be programmed through the ESWIRE digital interface with 100mV steps.

Figure 7 shows an example for SGM3837 programming V_{ELVSS} to -6.4V. The ESWIRE pin can be used as an enable pin if programming is not required. The device starts with the default values if enabled. The ESWIRE interface counts the rising edges to set the corresponding values. The device utilizes a volatile memory to store the settings. See Table 2 for more details.

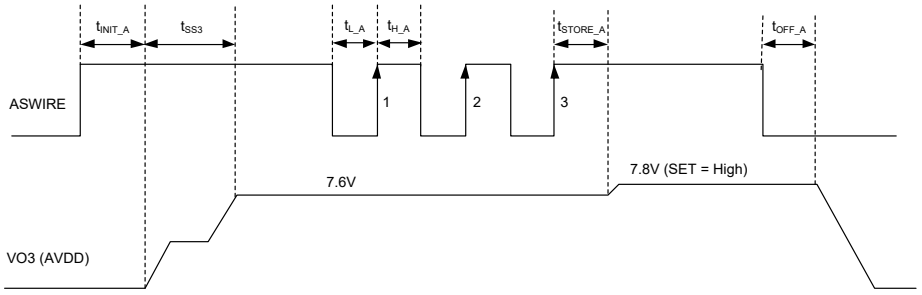


Figure 5. Timing of a Command Processing with the ASWIRE Interface



Figure 6. V_{ELVSS} Transition Time Control

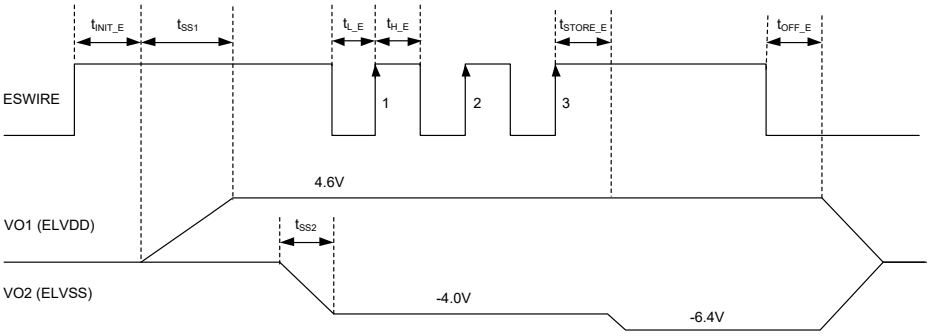


Figure 7. Timing of a Command Processing with the ESWIRE Interface

DETAILED DESCRIPTION (continued)

Soft-Start, Discharge and Start-Up Sequence

The built-in soft-start function is adopted to limit the inrush current. The output discharge function can be controlled by both SET pin and ASWIRE interface.

Toggling ESWIRE high or with relevant pulses enables the VO1 Boost converter. VO1 starts with a 0.35A soft-start current limit until it rises to the programmed voltage. Then the full current limit is active (2.2A, TYP).

10ms after toggling ESWIRE high, the VO2 converter starts with a -4V default voltage. Before VO2 rises to the default voltage it rises linearly for 1.6ms. Then the full current limit is active (3.3A, TYP).

Toggling ASWIRE high starts the VO3 Boost converter. Before VO3 rises to the default value (7.6V), it rises linearly for 1.6ms. Then the full current limit is active (1.05A, TYP).

Overload and Short Circuit Protection (SCP)

The built-in short circuit protection (SCP) prevents the device from damage. If any of the three outputs (VO1, VO2 and VO3) is shorted to the ground or VO1 and VO2 are shorted together, the SGM3837 will trigger the function.

When a short or an overload occurs, all the three converters stop switching, the outputs are shut down and latched.

Only resetting the power supply or pulling ASWIRE and ESWIRE low at the same time for more than t_{OFF_A} and t_{OFF_E} respectively can restart the device.

An SCP or overload occurs if any of the following events happens:

- V_{ELVDD} is not in regulation 5.2ms after V_{ELVDD} is enabled (ESWIRE = high for longer than 5.2ms) then all converters shut down.

- V_{ELVSS} is not in regulation 12ms after V_{ELVSS} is enabled (ESWIRE = high for longer than 12ms) then ELVDD and ELVSS converters shut down.

- V_{AVDD} protection is enabled when the soft-start is completed.

- V_{ELVDD} falls below 87% of the programmed output voltage longer than 80μs then all converters shut down.

- V_{ELVSS} rises above 89% of the programmed output voltage longer than 80μs then all converters shut down.

- V_{AVDD} falls below 87% of the programmed output voltage longer than 1ms then all converters shut down.

Device Reset

- Power resetting resets the device to default settings.

- Short circuit and overload protection reset all settings.

- Pulling ASWIRE high to enable the V_{AVDD} converter resets the output discharge.

- Pulling ASWIRE low for t_{OFF_A} then V_{AVDD} is reset to default value of 7.6V.

- Pulling ESWIRE low for t_{OFF_E} then V_{ELVDD} and V_{ELVSS} are reset to default values of 4.6V and -4.0V respectively.

- Pulling ESWIRE low for t_{OFF_E} then V_{ELVSS} transition time is reset to default value of 60μs.

- Pulling ASWIRE and ESWIRE low at the same time for t_{OFF_A} and t_{OFF_E} respectively then short circuit protection is reset.

DETAILED DESCRIPTION (continued)

Layout Guideline

AMOLED displays are sensitive to quality of power supplies. A good PCB layout is quite important to reduce the ripple and to enhance the line and load transients, as well as to achieve better noise, better EMI and loop stability. The recommended layout is illustrated in Figure 8.

It is recommended to follow the below PCB layout guidelines:

1. A common ground plane between analog ground (AGND) and power ground (PGNDx) to minimize ground shifts is recommended.

2. Traces of switching nodes (SW1, SW2 and SW3) should be short and wide.

3. Place input capacitors on PVIN and output capacitors on VO2 as close as possible to the device.

4. Place the output capacitors on VO1 and VO3 as close as possible to the device.

5. Use short and wide traces to connect the input capacitors on PVIN and the output capacitors.

6. It is recommended to use parallel capacitors to get lower ESR.

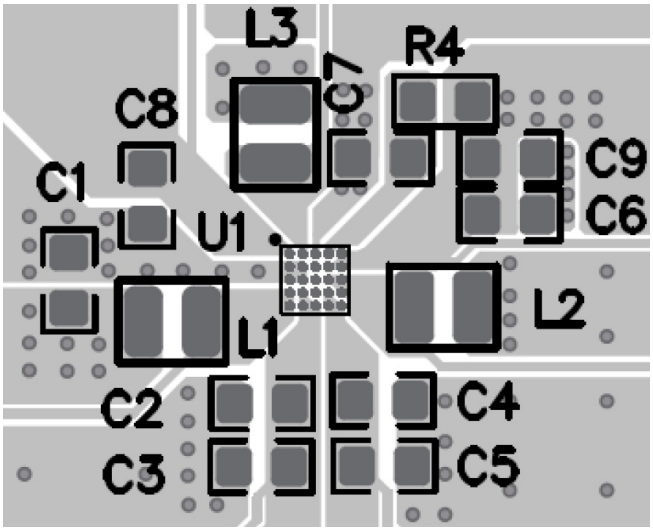


Figure 8. PCB Layout Reference

REVISION HISTORY

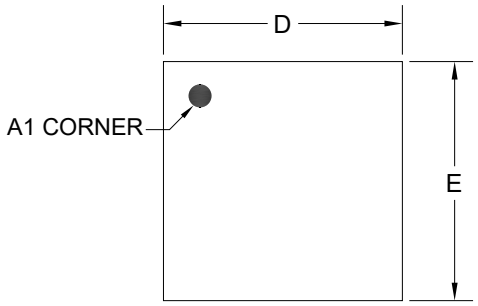
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

SEPTEMBER 2025 – REV.A to REV.A.1	Page
Updated Timing Requirements section	6

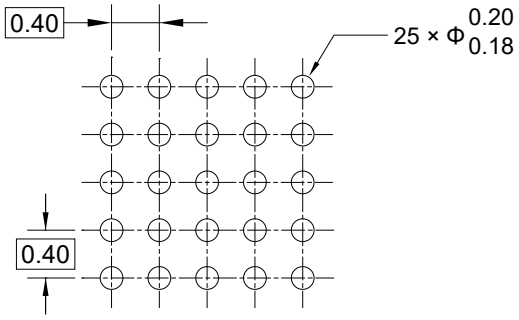
Changes from Original to REV.A (JULY 2022)	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

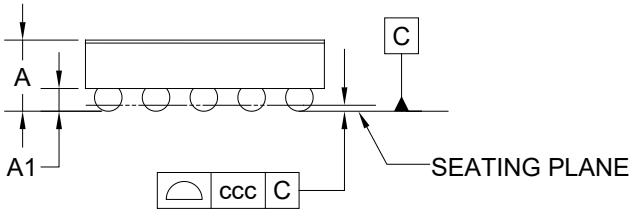
WLCSP-2.0×2.0-25B



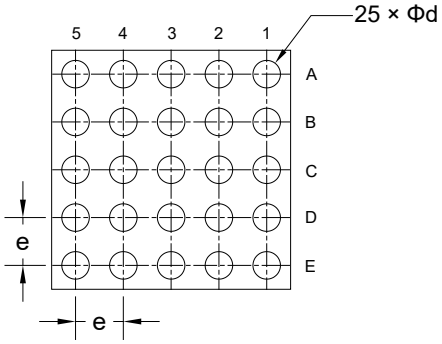
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



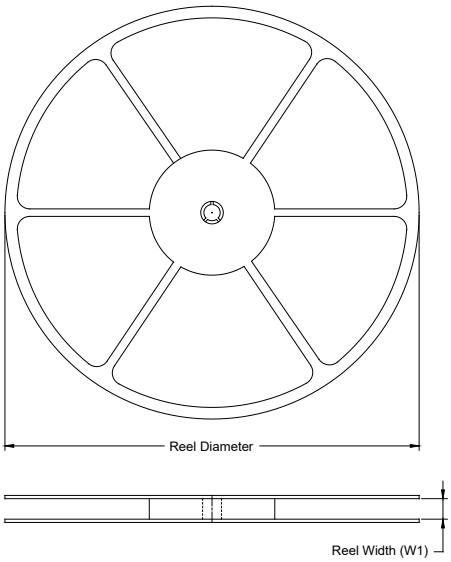
BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.575	0.620	0.665
A1	0.170	0.190	0.210
D	1.970	2.000	2.030
E	1.970	2.000	2.030
d	0.210	0.230	0.250
e	0.400 BSC		
ccc	0.050		

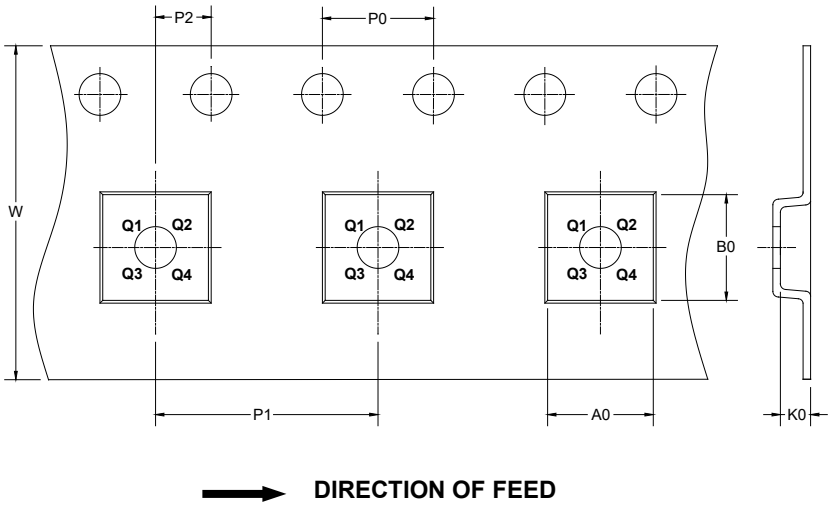
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



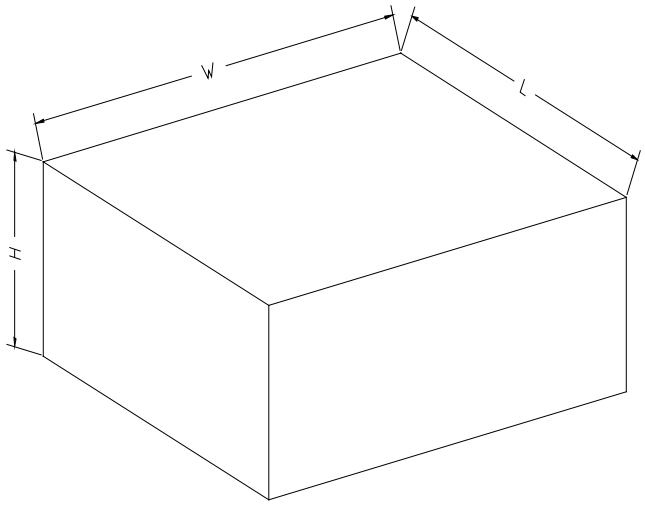
NOTE: The picture is only for reference. Please make the object as the standard.

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-2.0×2.0-25B	7″	9.5	2.24	2.24	0.75	4.0	4.0	2.0	8.0	Q1

DD0001

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
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002