SGM3844
Triple-Output 1000mA AMOLED Display Power Supply

GENERAL DESCRIPTION

The SGM3844 is designed for powering AMOLED displays which requires V_{ELVDD}, V_{ELVSS} and V_{AVDD}. The device integrates two Boost converters, VO1 for V_{ELVDD} and VO3 for V_{AVDD} and a dual-phase 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 SGM3844 is available in a Green WLCSP-2.1×2.1-25B-A package.

FEATURES

- **2.5V to 5V Input Supply Voltage Range**
- **Synchronous Boost Converter VO1 (ELVDD)**
  - **4.6V to 5.0V Output Voltage with 100mV Steps**
  - **4.6V Default Output Voltage**
  - **0.7% Accuracy at 4.6V**
- **Synchronous Inverting Buck-Boost Converter VO2 (ELVSS)**
  - **-6.0V to -0.5V Output Voltage with 100mV Steps**
  - **-1.4V Default Output Voltage**
  - **±25mV Variation at -3V**
- **ELVDD-ELVSS Combined Output Current Capability (V_{VO1} = 4.6V)**
  - **1000mA @ V_{IN} = 2.5V, V_{VO2} = -4.5V**
  - **1000mA @ V_{IN} = 2.9V, V_{VO2} = -6V**
- **Synchronous Boost Converter VO3 (AVDD)**
  - **5.5V to 8.0V Output Voltage with 100mV Steps**
  - **7.3V Default Output Voltage**
  - **0.7% Accuracy at 7.3V**
  - **150mA Output Current Capability**
- **V_{IN} and V_{OUT} Bi-Directional Isolation**
- **SWIRE Interface**
- **Under-Voltage Lockout (UVLO)**
- **All Channels Soft-Start**
- **All Channels Fast Discharge Function (FD)**
- **All Channels Short-Circuit Protection (SCP)**
- **All Channels Over-Current Protection (OCP)**
- **Over-Temperature Protection (OTP)**
- **Start-Up Short Detection (SSD)**
- **V_{ELVSS} Start-Up Delay: 5.8ms**
- **Short-Circuit and OCP Detection Time: 1.4ms**
- **Available in a Green WLCSP-2.1×2.1-25B-A Package**

APPLICATIONS

Smartphones & Tablets

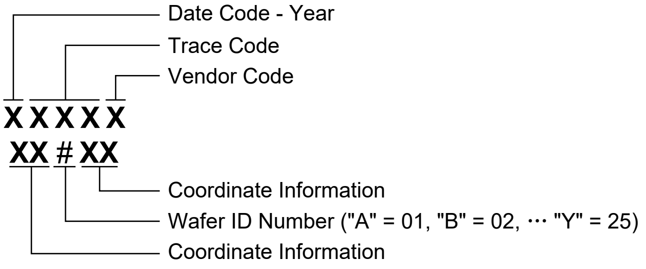
Active Matrix OLED Displays

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3844	WLCSP-2.1×2.1-25B-A	-40℃ to +85℃	SGM3844YG/TR	3844 XXXXX XX#XX	Tape and Reel, 4000

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 Voltage	-0.3V to 6V
PVIN2A, PVIN2B Voltages	-0.3V to 6V
ASWIRE, ESWIRE Voltages	-0.3V to 6V
VO1 Voltage	-0.3V to 6V
VO2A, VO2B Voltages	-7V to 0.3V
SW1 Voltage	-0.3V to 6V
SW1 Voltage (Transient: 10ns)	-1V to 8V
SW2A, SW2B Voltages	-8V to 6V
SW2A, SW2B Voltages (Transient: 10ns)	-9V to 8V
SW3, VO3 Voltages	-0.3V to 10V
SW3 Voltage (Transient: 10ns)	-1V to 12V
Package Thermal Resistance	
WLCSP-2.1×2.1-25B-A, θ_{JA}	43.5℃/W
WLCSP-2.1×2.1-25B-A, θ_{JB}	11.0℃/W
WLCSP-2.1×2.1-25B-A, θ_{JC}	15.5℃/W
Junction Temperature	+150℃
Storage Temperature Range	-65℃ to +150℃
Lead Temperature (Soldering, 10s)	+260℃
ESD Susceptibility (1) (2)	
HBM	±2000V
CDM	±1000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.

2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

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

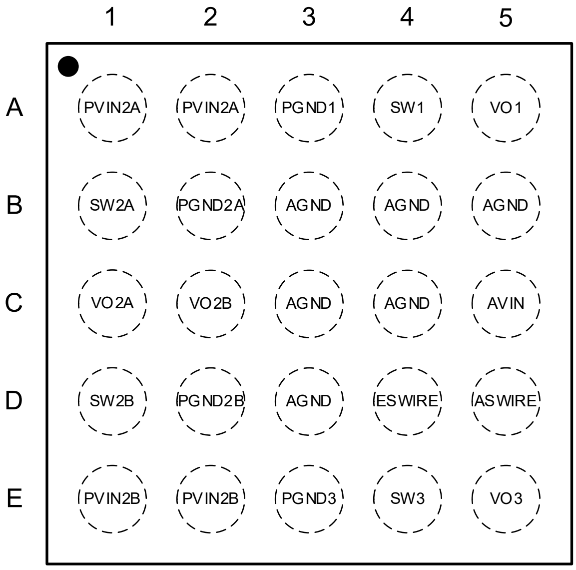
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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-2.1×2.1-25B-A

PIN DESCRIPTION

PIN	NAME	TYPE	DESCRIPTION
A1, A2	PVIN2A	P	VO2 Inverting Buck-Boost Converter Phase A Power Supply Input Pin.
A3	PGND1	G	VO1 Boost Converter Power Ground.
A4	SW1	P	VO1 Boost Converter Switching Node.
A5	VO1	P	VO1 Boost Converter Output.
B1	SW2A	P	VO2 Inverting Buck-Boost Converter Phase A Switching Node.
B2	PGND2A	G	VO2 Inverting Buck-Boost Converter Power Ground Pin.
B3, B4, B5 C3, C4, D3	AGND	G	Analog Ground Pin.
C1	VO2A	P	VO2 Inverting Buck-Boost Converter Phase A Output Pin.
C2	VO2B	P	VO2 Inverting Buck-Boost Converter Phase B Output Pin.
C5	AVIN	P	Analog Input Pin.
D1	SW2B	P	VO2 Inverting Buck-Boost Converter Phase B Switching Node.
D2	PGND2B	G	VO2 Inverting Buck-Boost Converter Power Ground Pin.
D4	ESWIRE	I	VO1 Boost Converter and VO2 Inverting Buck-Boost Converter Enable Control and Programming Pin.
D5	ASWIRE	I	VO3 Boost Converter Enable Control and Programming Pin.
E1, E2	PVIN2B	P	VO2 Inverting Buck-Boost Converter Phase B Power Supply Input Pin.
E3	PGND3	G	VO3 Boost Converter Power Ground.
E4	SW3	P	VO3 Boost Converter Switching Node.
E5	VO3	P	VO3 Boost Converter Output.

NOTE: I = input, P = power, G = ground.

TYPICAL APPLICATION

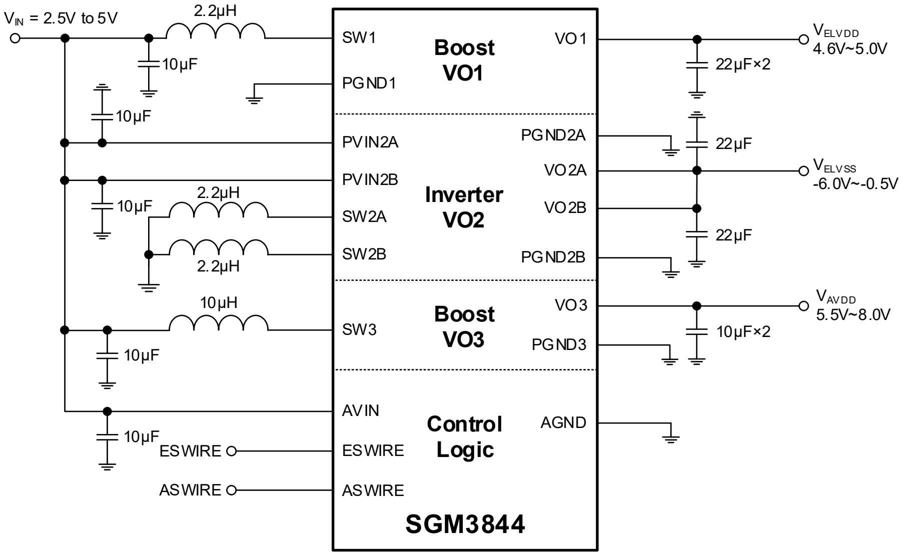


Figure 1. Typical Application Circuit

RECOMMENDED COMPONENT SELECTION

Table 1. Recommended Component Selection

Converter	Component	Value	Total Number	Electrical Spec	Part Number	Manufacturer
ELVDD	C_{IN1}	10μF	1	X5R, 6.3V, 0402	GRM155R60J106ME05	Murata
	C_{VO1}	22μF	2	X5R, 6.3V, 0603	GRM188R60J226MEA0	Murata
	L_{VO1}	2.2μH	1	3.2A, 57mΩ, 252010	MWTC252010S2R2MT	Sunlord
ELVSS	C_{PVIN2A} C_{PVIN2B}	10μF	2	X5R, 6.3V, 0402	GRM155R60J106ME05	Murata
	C_{VO2A} C_{VO2B}	22μF	2	X5R, 10V, 0603	GRM187R61A226ME15	Murata
	L_{VO2A} L_{VO2B}	2.2μH	2	3.2A, 57mΩ, 252010	MWTC252010S2R2MT	Sunlord
AVDD	C_{IN3}	10μF	1	X5R, 6.3V, 0402	GRM155R60J106ME05	Murata
	C_{VO3}	10μF	2	X5R, 16V, 0603	GRM188R61C106KAAL	Murata
	L_{VO3}	10μH	1	1.3A, 390mΩ, 252012	SDEM25201B-100MS	Cyntec
Other	C_{AVIN}	10μF	1	X5R, 6.3V, 0402	GRM155R60J106ME05	Murata

ELECTRICAL CHARACTERISTICS

(At T_J = +25℃, V_{IN} = 3.8V, V_{ESWIRE} = V_{ASWIRE} = V_{IN}, V_{VO1} = 4.6V, V_{VO2} = -1.4V, V_{VO3} = 7.3V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current and Thermal Protection						
Input Voltage Range	V_{IN}	T_J = -40℃ to +85℃	2.5		5	V
Shutdown Current into PVINx, AVIN	I_{SD}	All channels off		0.4	1.3	μA
Quiescent Current into PVINx, AVIN	I_{QON}	All channels on, no load		3.5		mA
Under-Voltage Lockout Threshold (AVIN)	V_{IT-}	V_{IN} falling		2.05	2.1	V
	V_{IT+}	V_{IN} rising		2.25	2.35	
Thermal Shutdown Temperature	T_{SD}	Junction temperature rising		145		℃
		Junction temperature falling		130		
Boost Converter (V_{VO1} = V_{ELVDD})						
Positive Output 1 Voltage	V_{VO1}	4.6V to 5.0V with 0.1V/step, default 4.6V, T_J = -40℃ to +85℃	4.6	4.6	5.0	V
Positive Output 1 Voltage Accuracy		V_{VO1} = 4.6V, no load, T_J = +25℃	-0.5		0.5	%
		V_{VO1} = 4.6V, no load, T_J = -40℃ to +85℃	-0.7		0.7	
SW1 MOSFET On-Resistance	$R_{DS(ON)11}$	I_{DS} = 200mA		85		mΩ
SW1 MOSFET Rectifier On-Resistance	$R_{DS(ON)12}$	I_{DS} = 200mA		95		
SW1 Switch Current Limit	I_{SW1}	Inductor valley current	1.9	2.4	2.9	A
SW1 Switching Frequency	f_{SW1}	I_{VO1} = 100mA, T_J = -40℃ to +85℃	1.3	1.45	1.6	MHz
Output Current Capability	I_{VO1}		1000			mA
Short-Circuit Threshold in Operation	$V_{VO1(SCP)}$	Percentage of nominal V_{VO1}		85		%
VO1 Leakage, No Discharge	I_{LEAK_VO1}	V_{ESWIRE} = GND		0.3	0.9	μA
VO1 Discharge Resistance	$R_{VO1(DCG)}$	V_{ESWIRE} = GND, VO1 FD on, I_{VO1} = 20mA		30		Ω
VO1 Discharge Time	t_{DVO1}	V_{ESWIRE} = GND, VO1 FD on		3		ms
Efficiency	$Eff_{VO1\text{-}VO2}$	V_{IN} = 3.8V, V_{VO1} = 4.6V, V_{VO2} = -1.4V, I_{VO1_VO2} = 20mA to 50mA		90		%
		V_{IN} = 3.8V, V_{VO1} = 4.6V, V_{VO2} = -1.4V, I_{VO1_VO2} = 80mA to 150mA		94		
		V_{IN} = 3.8V, V_{VO1} = 4.6V, V_{VO2} = -3V, I_{VO1_VO2} = 300mA		93		
Line Transient	$VO1_{LINETRA}$	ΔV_{IN} = 0.5V, t_R = t_F = 10μs, I_{VO1} = 300mA		20		mV
Line Regulation	$VO1_{LINEREG}$	I_{VO1} = 100mA, V_{IN} = 2.5V to 5V		±0.008		%/V
		No load, V_{IN} = 2.5V to 5V		±0.009		
Output Voltage Ripple	$VO1_{RIPPLE}$	I_{VO1_VO2} = 0mA to 1000mA		20		mV_{PP}
Load Transient	$VO1_{LOADTRA}$	ΔI_{VO1} = 10mA to 1000mA, t_R = t_F = 5ms		25		mV
		ΔI_{VO1} = 10mA to 300mA, t_R = t_F = 5ms		10		
Load Regulation	$VO1_{LOADREG}$	0mA ≤ I_{VO1} ≤ 1000mA, V_{IN} = 2.5V to 4.5V		10		mV
		0mA ≤ I_{VO1} ≤ 1000mA, V_{IN} = 4.5V to 5V		15		
Buck-Boost Converter (V_{VO2} = V_{ELVSS})						
Negative Output Voltage Range	V_{VO2}	-6V to -0.5V with 0.1V/step, default -1.4V, T_J = -40℃ to +85℃	-6	-1.4	-0.5	V
Negative Output Voltage Accuracy		V_{VO2} = -3V, no load, T_J = -40℃ to +85℃	-25		25	mV
		V_{VO2} = -6.0V, no load, T_J = -40℃ to +85℃	-60		60	
SW2 MOSFET On-Resistance-Phase A	$R_{DS(ON)A1}$	I_{DS} = 200mA		150		mΩ
SW2 MOSFET Rectifier On-Resistance-Phase A	$R_{DS(ON)A2}$	I_{DS} = 200mA		95		
SW2 MOSFET On-Resistance-Phase B	$R_{DS(ON)B1}$	I_{DS} = 200mA		150		mΩ
SW2 MOSFET Rectifier On-Resistance-Phase B	$R_{DS(ON)B2}$	I_{DS} = 200mA		95		

ELECTRICAL CHARACTERISTICS (continued)

(At T_J = +25℃, V_{IN} = 3.8V, V_{ESWIRE} = V_{ASWIRE} = V_{IN}, V_{VO1} = 4.6V, V_{VO2} = -1.4V, V_{VO3} = 7.3V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SW2 Switching Frequency	f_{SW2}	I_{VO2} = 100mA, T_J = -40℃ to +85℃	1.05	1.2	1.35	MHz
Output Current Capability	I_{VO2}	V_{IN} = 2.5V to 5V, V_{VO2} = -4.5V to -0.5V	1000			mA
SW2 Switch Current Limit-Phase A	I_{SW2A}	Inductor peak current	2.7	3.3	4.1	A
SW2 Switch Current Limit-Phase B	I_{SW2B}	Inductor peak current	2.7	3.3	4.1	A
Average Load Current Threshold with Dual-Phase	$I_{RMSA\&B}$	Load current rising, V_{VO2} = -3V		300		mA
Average Load Current Threshold with Phase A Only	I_{RMSA}	Load current falling, V_{VO2} = -3V		250		mA
Short-Circuit Threshold during start-up	$V_{VO2(SCP)}$	Percentage of nominal V_{VO2}		85		%
VO2 Leakage, No Discharge	I_{LEAK_VO2}	V_{ESWIRE} = GND		0.4	1.1	μA
VO2 Discharge Resistance	$R_{VO2(DCG)}$	V_{ESWIRE} = GND, VO2 FD on, I_{VO2} = 20mA		25		Ω
VO2 Discharge Time	t_{DVO2}	V_{ESWIRE} = GND, VO2 FD on		3		ms
Output Voltage Ripple	$VO2_{RIPPLE}$	I_{VO1_VO2} = 0mA to 1000mA, V_{VO2} = -6V to -0.5V		40		mV_{PP}
Line Transient	$VO2_{LINETRA}$	ΔV_{IN} = 0.5V, t_R = t_F = 10μs, I_{VO2} = 0mA to 500mA, V_{VO2} = -6V to -0.5V		65		mV
		ΔV_{IN} = 0.5V, t_R = t_F = 10μs, I_{VO2} = 500mA to 1000mA, V_{VO2} = -6V to -0.5V		100		
Line Regulation	$VO2_{LINEREG}$	I_{VO2} = 100mA, V_{IN} = 2.5V to 5V, V_{VO2} = -3V		±0.009		%/V
Load Transient	$VO2_{LOADTRA}$	ΔI_{VO2} = 10mA to 1000mA, V_{VO2} = -3V, t_R = t_F = 5ms		75		mV
Load Regulation	$VO2_{LOADREG}$	0mA ≤ I_{VO2} ≤ 1000mA, V_{VO2} = -3V		±0.15		%/A
Boost Converter (V_{VO3} = V_{AVDD})						
Positive Output 3 Voltage Range	V_{VO3}	5.5V to 8.0V with 0.1V/step, default 7.3V, T_J = -40℃ to +85℃	5.5	7.3	8.0	V
Positive Output 3 Voltage Accuracy		V_{VO3} = 7.3V, no load, T_J = -40℃ to +85℃	-0.7		0.7	%
SW3 MOSFET On-Resistance	$R_{DS(ON)31}$	I_{DS} = 200mA		315		mΩ
SW3 MOSFET Rectifier On-Resistance	$R_{DS(ON)32}$	I_{DS} = 200mA		485		
SW3 Switch Current Limit	I_{SW3}	Inductor peak current	0.8	1.3	1.7	A
SW3 Switching Frequency	f_{SW3}	I_{VO3} = 30mA, T_J = -40℃ to +85℃	1.3	1.45	1.6	MHz
Output Current Capacity	I_{VO3}	V_{IN} = 2.7V to 5V	150			mA
Short-Circuit Threshold in Operation	$V_{VO3(SCP)}$	Percentage of nominal V_{VO3}		85		%
VO3 Leakage, No Discharge	I_{LEAK_VO3}	V_{ASWIRE} = GND		2.2	2.9	μA
VO3 Discharge Resistance	$R_{VO3(DCG)}$	V_{ASWIRE} = GND, VO3 FD on, I_{VO3} = 20mA		40		Ω
VO3 Discharge Time	t_{DVO3}	V_{ASWIRE} = GND, VO3 FD on		3		ms
Efficiency	Eff_{VO3}	V_{IN} = 3.8V, I_{VO3} = 5mA to 35mA		92		%
		V_{IN} = 3.8V, I_{VO3} = 35mA to 100mA		94		
Output Voltage Ripple	$VO3_{RIPPLE}$	I_{VO3} = 0mA to 150mA		20		mV_{PP}
Line Transient	$VO3_{LINETRA}$	ΔV_{IN} = 0.5V, t_R = t_F = 10μs, I_{VO3} = 30mA		15		mV
Line Regulation	$VO3_{LINEREG}$	I_{VO3} = 100mA, V_{IN} = 2.5V to 5V		±0.01		%/V
Load Transient	$VO3_{LOADTRA}$	ΔI_{VO3} = 50mA, t_R = t_F = 10μs, V_{IN} = 3.8V		80		mV
Load Regulation	$VO3_{LOADREG}$	0mA ≤ I_{VO3} ≤ 150mA		±0.1		%/A
Logic Signals (ESWIRE/ASWIRE)						
Input High Threshold Voltage	V_{IH}	V_{IN} = 2.5V to 5.0V, T_J = -40℃ to +85℃	0.9			V
Input Low Threshold Voltage	V_{IL}	V_{IN} = 2.5V to 5.0V, T_J = -40℃ to +85℃			0.4	V
Pull-Down Resistor	R_{DOWNES}			650		kΩ

ELECTRICAL CHARACTERISTICS (continued)

(At T_J = +25℃, V_{IN} = 3.8V, V_{ESWIRE} = V_{ASWIRE} = V_{IN}, V_{VO1} = 4.6V, V_{VO2} = -1.4V, V_{VO3} = 7.3V, unless otherwise noted.)

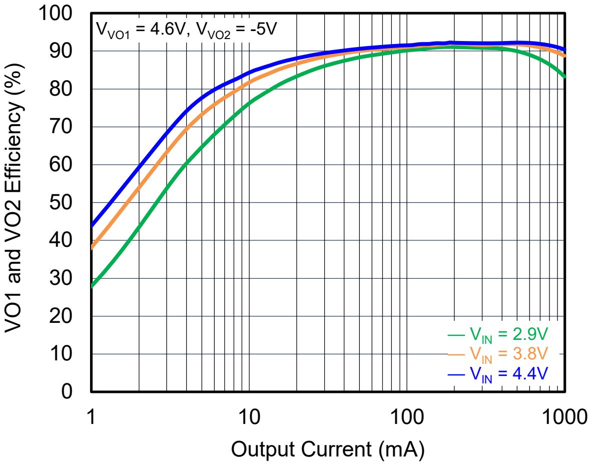
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Short-Circuit Timer					
VO1 Short-Circuit Detection Time in Start-Up	$t_{VO1(SCP)}$	2.6	2.8	3.0	ms
VO1 Short-Circuit Detection Time in Operation		1.2	1.4	1.6	
VO2 Short-Circuit Detection Time in Start-Up	$t_{VO2(SCP)}$	6.3	7.0	7.7	
VO2 Short-Circuit Detection Time in Operation		1.2	1.4	1.6	
VO3 Short-Circuit Detection Time in Start-Up	$t_{VO3(SCP)}$		3.5		
VO3 Short-Circuit Detection Time in Operation		1.2	1.4	1.6	
Power Sequence					
VO1 Start-Up Time	t_{SS1}		3.2		ms
VO2 Start-Up Time	t_{SS2}		0.65		
VO2 Start-Up Time Delay	t_{DELAY}		5.8		
VO3 Start-Up Time	t_{SS3}		1.9		

TIMING REQUIREMENTS

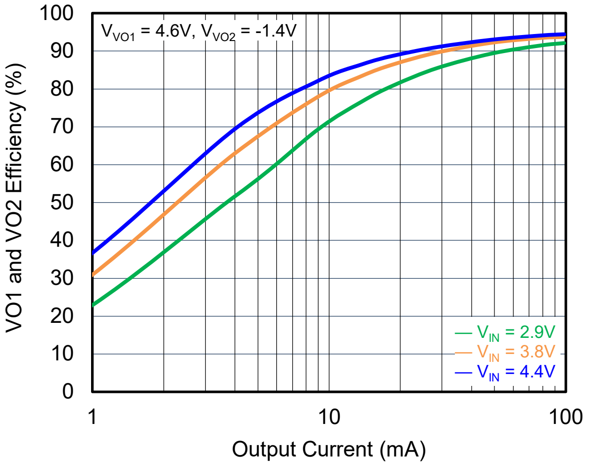
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
ASWIRE&ESWIRE Interface					
Initialization Time	t_{INIT}	450			μs
Shutdown Time Period	t_{OFF}	80			
Pulse High Level Time Period	t_{HIGH}	2	10	20	
Pulse Low Level Time Period	t_{LOW}	2	10	20	
Data Storage/Accept Time Period	t_{STORE}	80			

TYPICAL PERFORMANCE CHARACTERISTICS

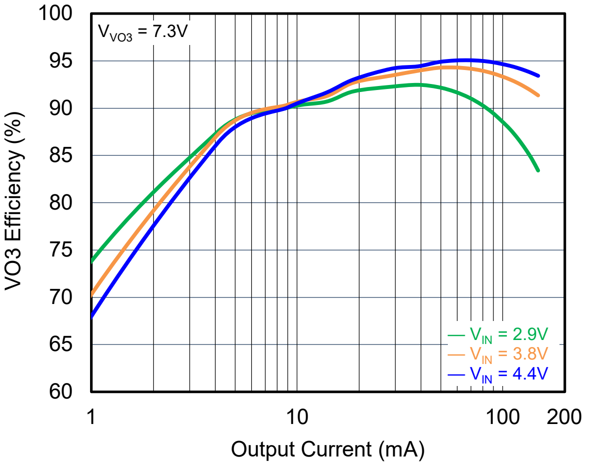
VO1 and VO2 Combined Efficiency vs. Output Current



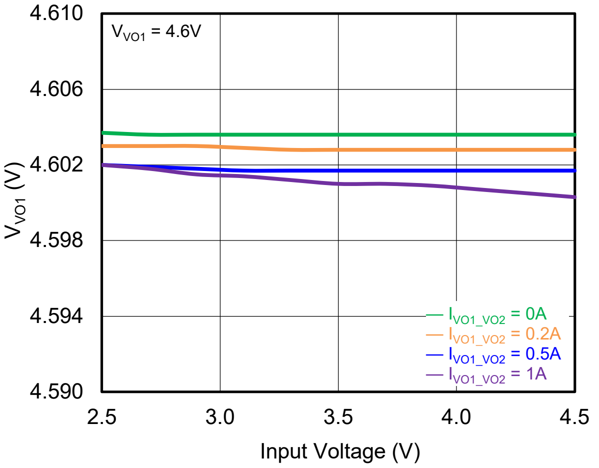
VO1 and VO2 Combined Efficiency vs. Output Current



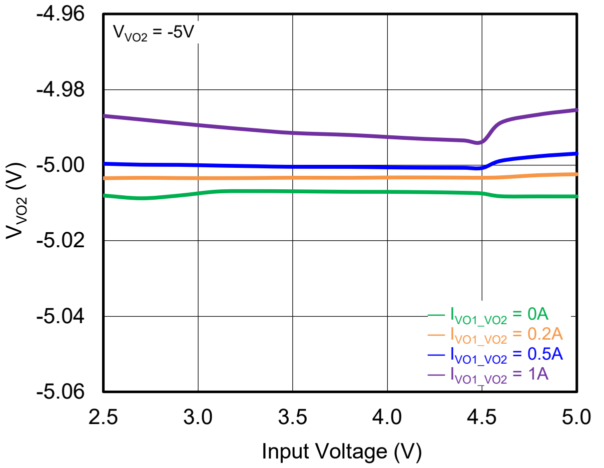
VO3 Efficiency vs. Output Current



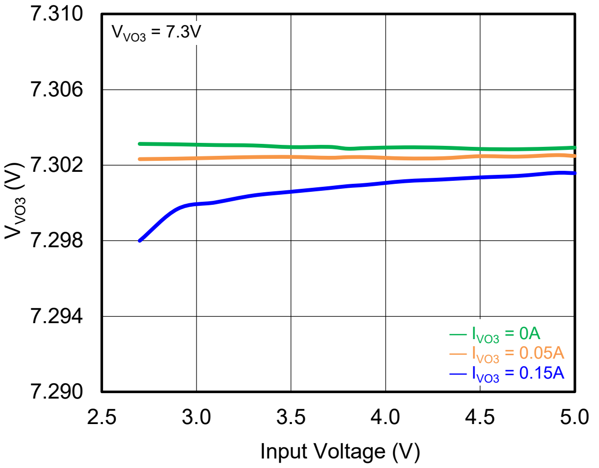
VO1 Line Regulation



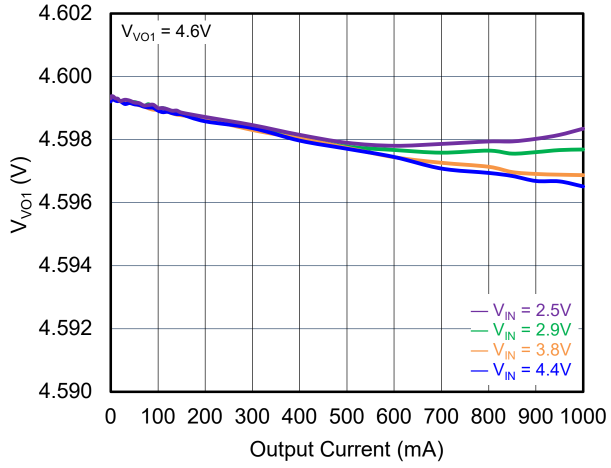
VO2 Line Regulation

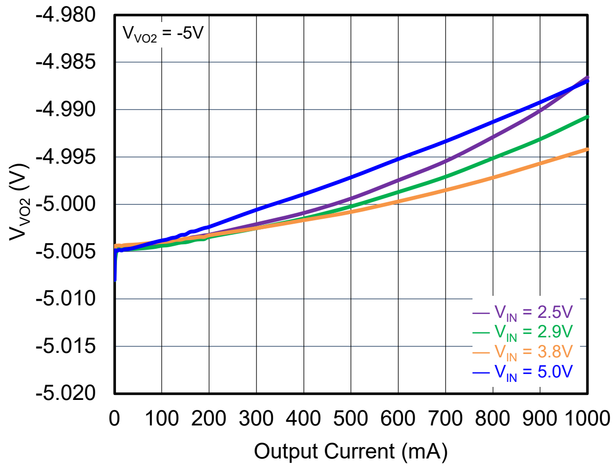


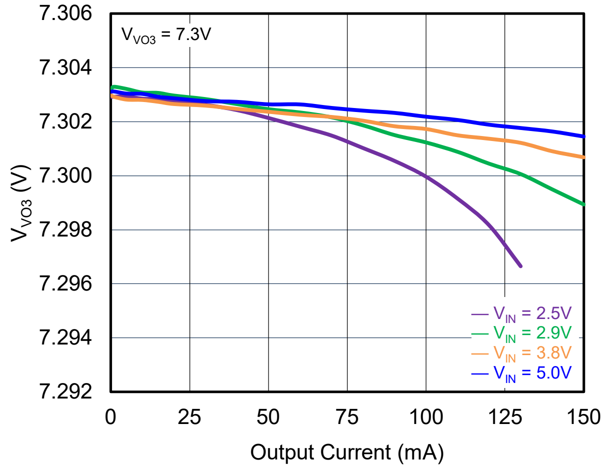
VO3 Line Regulation

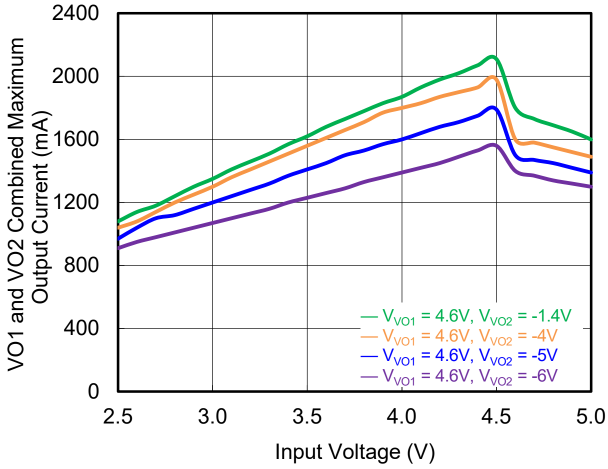


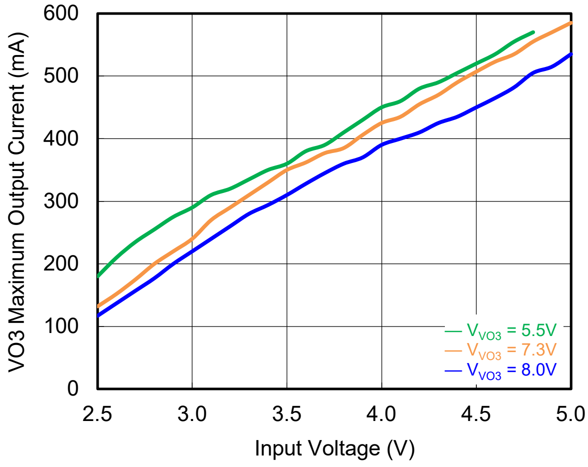
TYPICAL PERFORMANCE CHARACTERISTICS (continued)


VO1 Load Regulation


VO2 Load Regulation

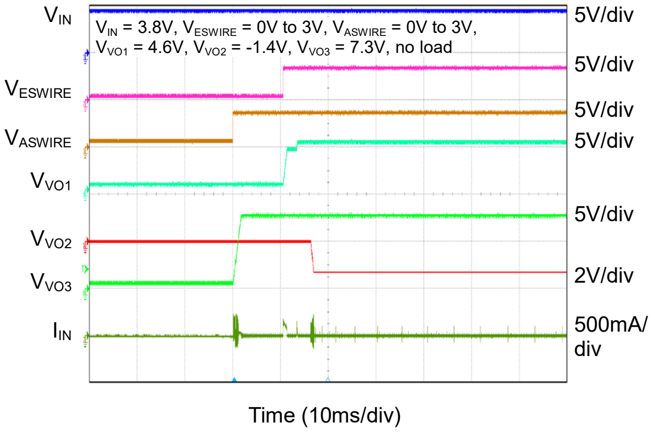

VO3 Load Regulation


VO1 and VO2 Combined Maximum Output Current vs. Input Voltage

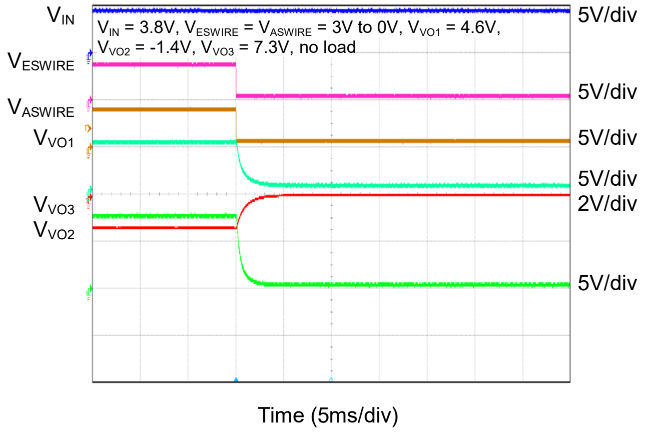

VO3 Maximum Output Current vs. Input Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

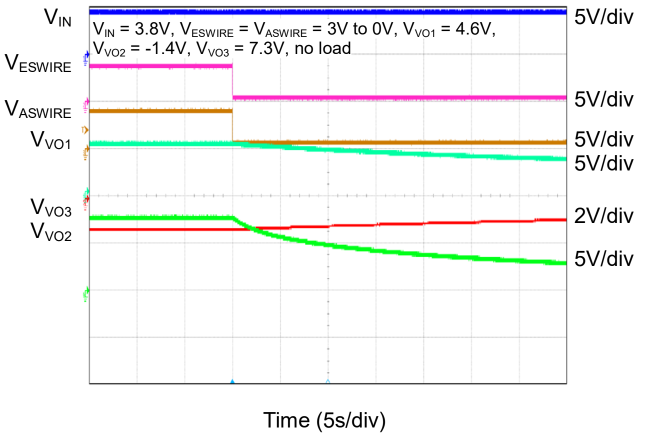
Start-Up Sequence



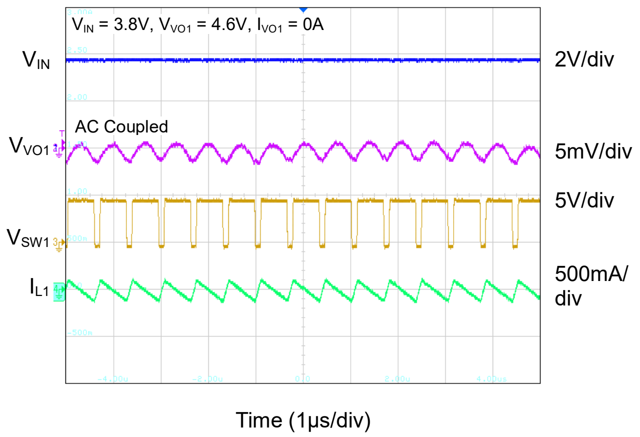
Shutdown Sequence Discharge = ON



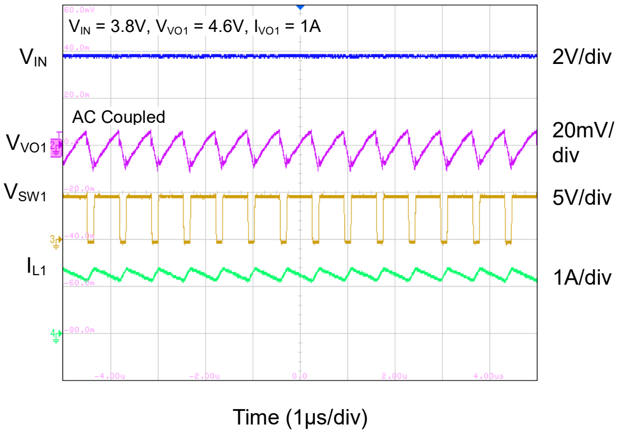
Shutdown Sequence Discharge = OFF



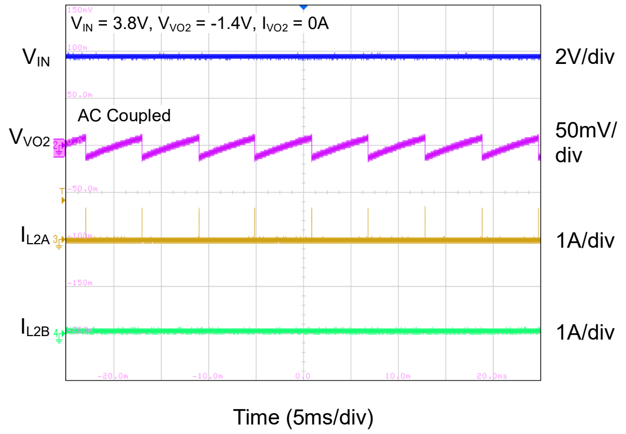
VO1 Output Ripple at No Load



VO1 Output Ripple at Full Load

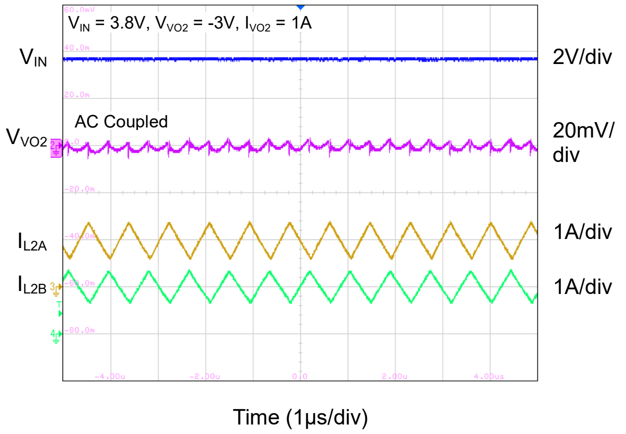


VO2 Output Ripple at No Load

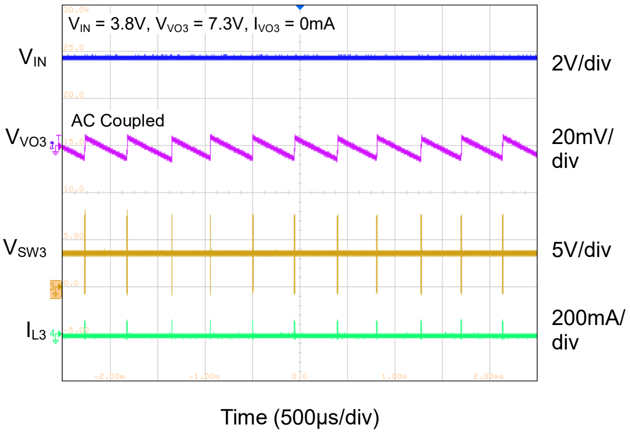


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

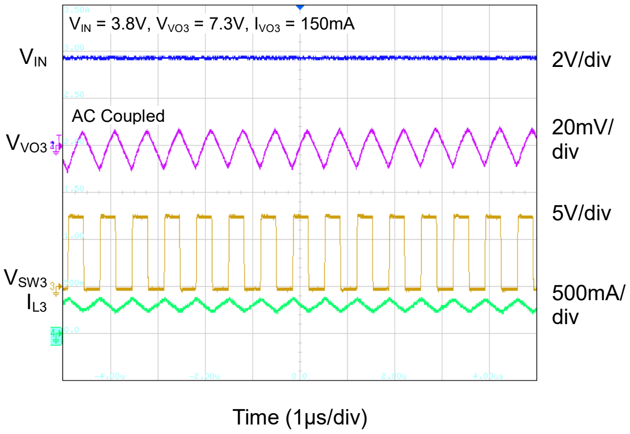
VO2 Output Ripple at Full Load



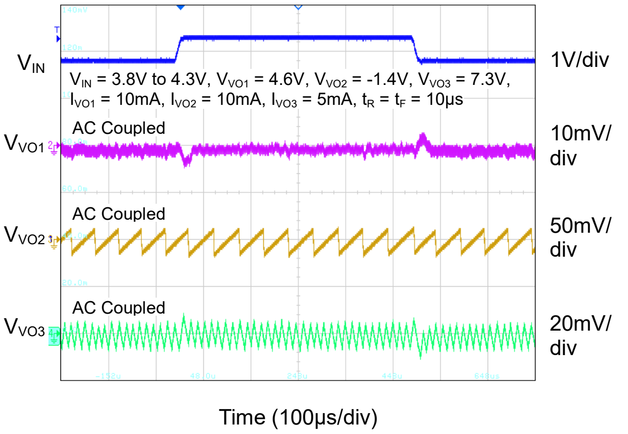
VO3 Output Ripple at No Load



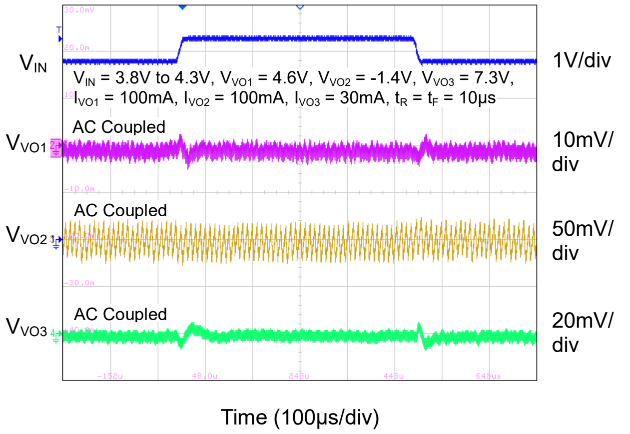
VO3 Output Ripple at Full Load



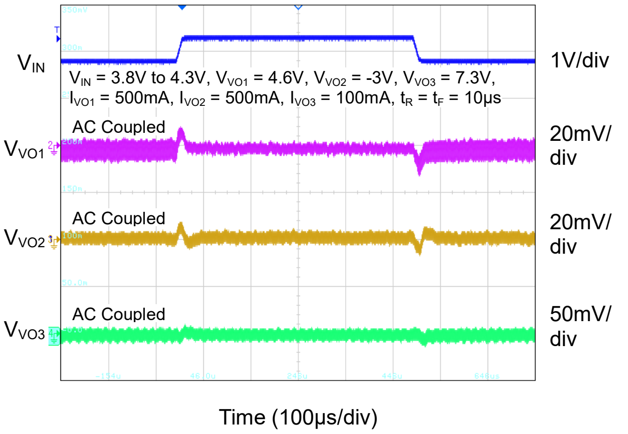
Line Transient at Light Load



Line Transient at Moderate Load

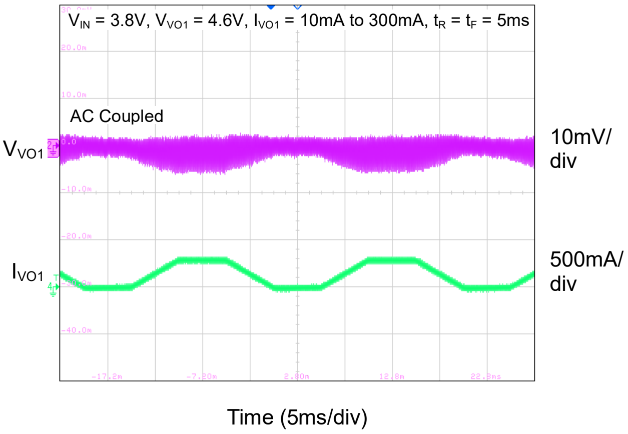


Line Transient at Heavy Load

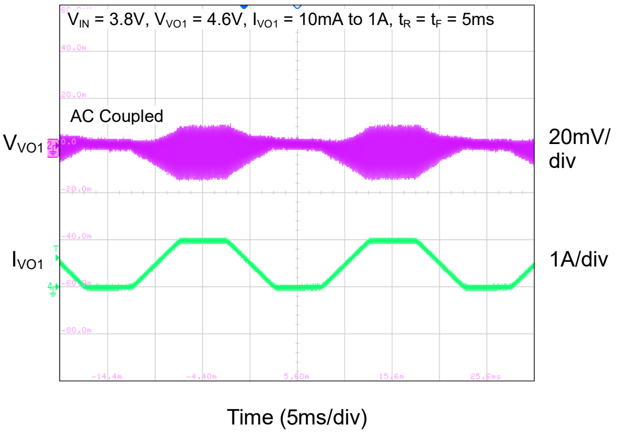


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

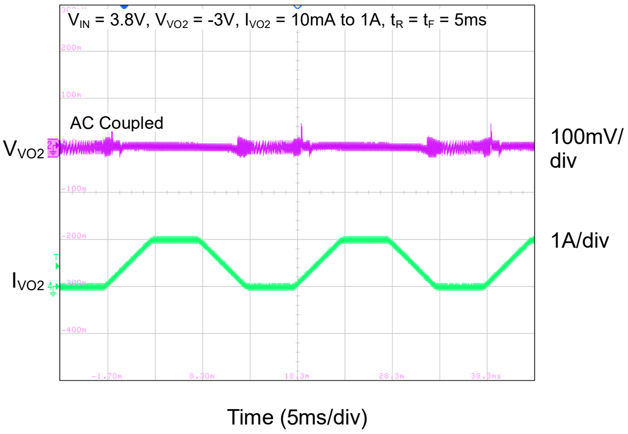
VO1 Load Transient



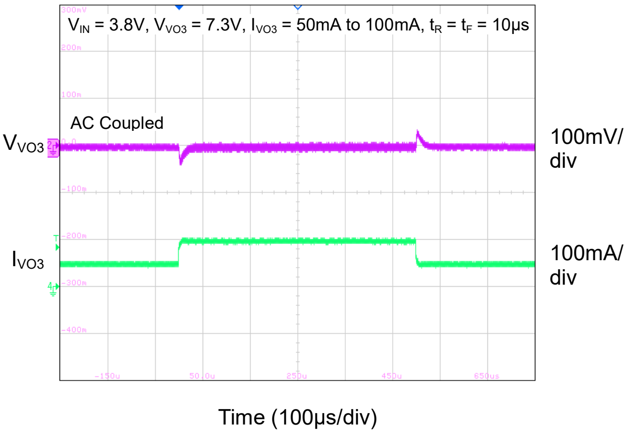
VO1 Load Transient



VO2 Load Transient



VO3 Load Transient



FUNCTIONAL BLOCK DIAGRAM

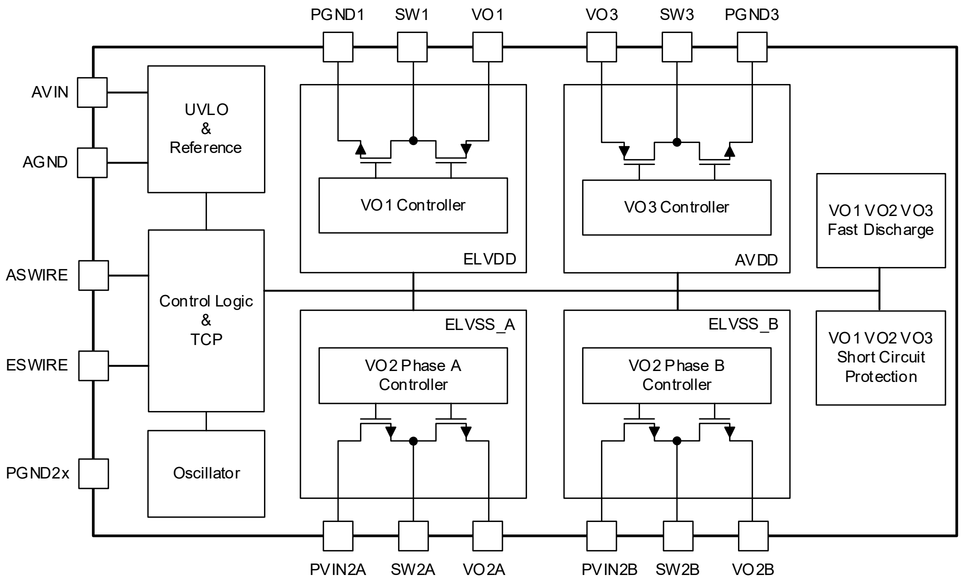


Figure 2. Functional Block Diagram

TIMING DIAGRAMS

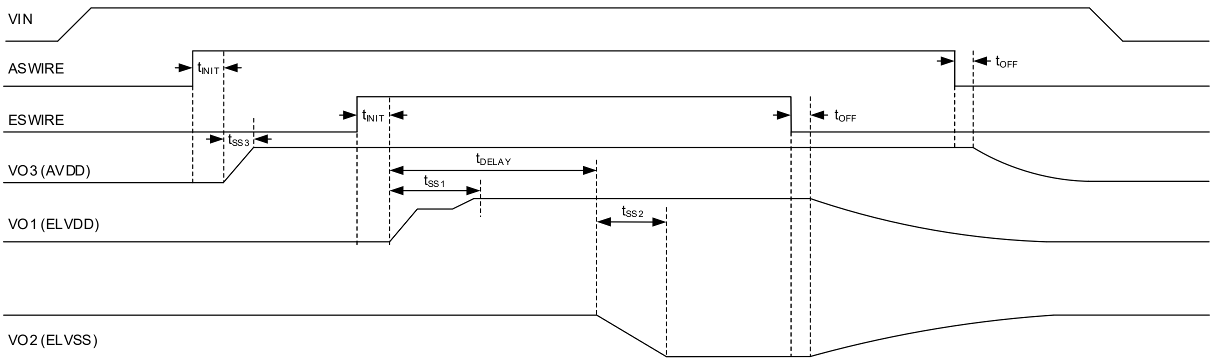


Figure 3. SWIRE Interface Timing Diagram

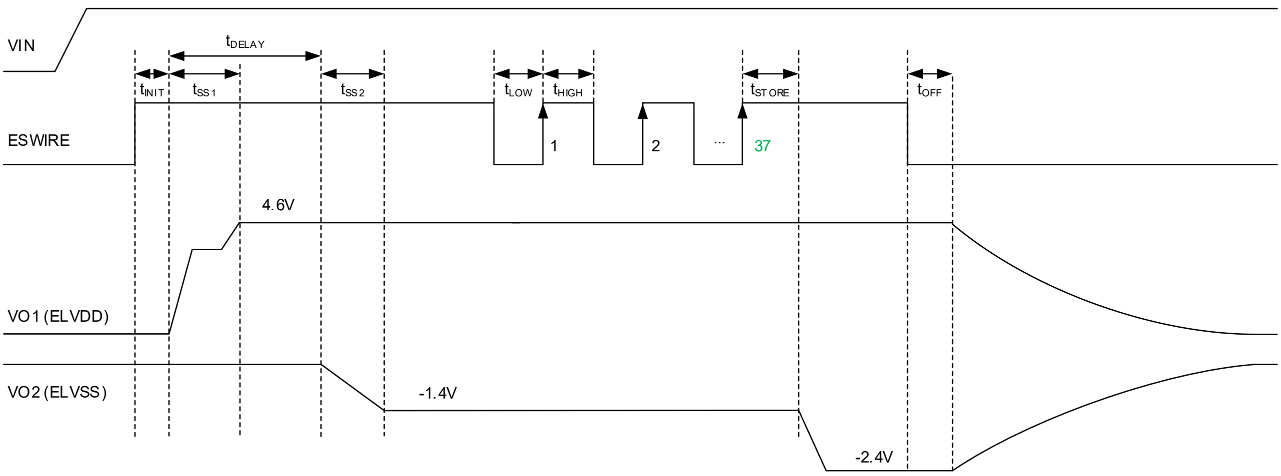


Figure 4. ESWIRE Interface Timing Diagram

TIMING DIAGRAMS (continued)

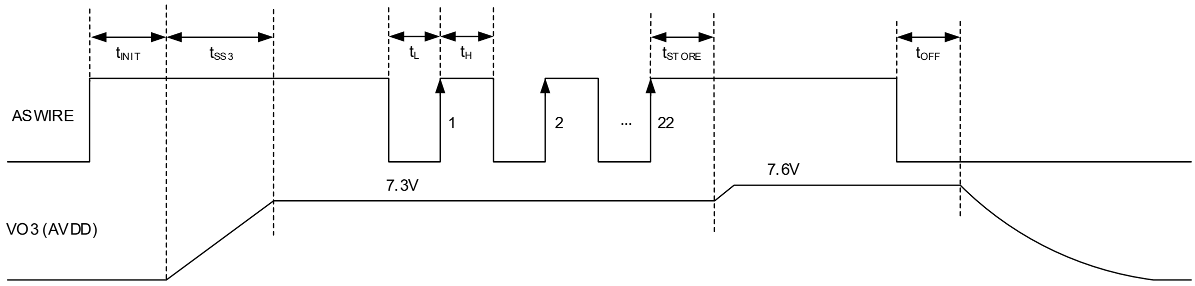


Figure 5. ASWIRE Interface Timing Diagram

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 stops switching and shuts down all the outputs when the junction temperature exceeds +145℃ (TYP), and restarts with the same programmed voltages and sequences when the temperature decreases to +130℃ (TYP).

Boost Converter VO1 (ELVDD)

The Boost converter VO1 operates with a valley-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 (ESWIRE Programming Table).

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 dual-phase fixed 1.2MHz (TYP) frequency. The VO2 output voltage can be programmed between -6V and -0.5V (default -1.4V) with 100mV steps (ESWIRE Programming Table).

When the load current exceeds 300mA at V_{VO2} = -3V, phase A and phase B of the inverting Buck-Boost converter both work. And only phase A works when the load current decreases to 250mA at V_{VO2} = -3V for reducing the switching loss.

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 between 5.5V and 8.0V (default 7.3V) with 100mV steps (ASWIRE Programming Table).

The output of VO3 is fully isolated in shutdown mode.

Output Current Capacity

The device operates with an input voltage range of 2.5V to 5V. 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 2.5V and 5V. To achieve full performance, a stable and noise-free input source is needed. Once the distance between input source and SGM3844 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}.

DETAILED DESCRIPTION (continued)

Soft-Start, Discharge, Start-Up and Timing Shutdown

The built-in soft-start function is adopted to limit the inrush current.

Toggling ESWIRE high or with relevant pulses during SWIRE mode enables the VO1 Boost converter. VO1 starts with a 0.15A soft-start current limit until it rises to the programmed voltage. Then the full current limit is active (2.4A, TYP).

5.8ms after VO1 enabled, the VO2 converter starts switching phase A (VO2A) with a 0.7A current limit until the VO2 rises to the default voltage (-1.4V). Then the full current limit is active (3.3A per phase, TYP).

Toggling ASWIRE high or with relevant pulses during SWIRE mode starts the VO3 Boost converter. Before VO3 rises to the default value (7.3V), it rises linearly for 1.9ms with a 0.35A current limit. Then the full current limit is active (1.3A, TYP).

The output discharge function can be controlled with the relevant pulses during SWIRE mode.

Short-Circuit and Overload Protection

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 SGM3844 will trigger the function.

When a short or an overload occurs at V_{ELVDD}, V_{ELVSS} or V_{AVDD}, all the three converters stop switching, and the outputs are shut down and latched.

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

- V_{ELVDD} is not in regulation 2.8ms after V_{ELVDD} is enabled then V_{ELVDD}, V_{ELVSS} and V_{AVDD} converters shut down.
- V_{ELVSS} is not in regulation 7ms after V_{ELVSS} is enabled then V_{ELVDD}, V_{ELVSS} and V_{AVDD} converters shut down.
- VAVDD protection is enabled when the soft-start is completed.
- V_{ELVDD} falls below 85% of the programmed output voltage longer than 1.4ms then all converters shut down.
- V_{ELVSS} rises above 85% of the programmed output voltage longer than 1.4ms then all converters shut down.
- V_{AVDD} falls below 85% of the programmed output voltage longer than 1.4ms then all converters shut down.

Device Reset

- Power resetting resets the device to default settings.
- Short-circuit and overload protection reset all settings.
- Pulling ESWIRE low for t_{OFF} then V_{ELVDD} and V_{ELVSS} are reset to default values of 4.6V and -1.4V, respectively.
- Pulling ASWIRE low for t_{OFF} then V_{AVDD} is reset to default value of 7.3V.
- Pulling ASWIRE and ESWIRE low at the same time for t_{OFF} resets the SCP or overloading latch-up.

Digital Interface (ESWIRE & ASWIRE)

SGM3844 supports SWIRE interface. The positive output voltages V_{ELVDD}, V_{AVDD} and the negative output voltage V_{ELVSS} can be programmed through the SWIRE digital interfaces.

Each of the ESWIRE and ASWIRE pins can be used as a standard enable pin if programming is not required. The device starts with default values (green marked values in Table 2 and Table 3) if enabled. The ESWIRE and ASWIRE interfaces count the rising edges to set the corresponding values as shown in the tables. The device utilizes a volatile memory to store the settings.

DETAILED DESCRIPTION (continued)

Table 2. ESWIRE Programming Table

ESWIRE Rising Edges	VO2 (V_{ELVSS})	ESWIRE Rising Edges	VO2 (V_{ELVSS})	ESWIRE Rising Edges	VO2 (V_{ELVSS})	ESWIRE Rising Edges	VO1 (V_{ELVDD})	ESWIRE Rising Edges	Functions
0/no pulse	-1.4V	24	-3.7V	48	-1.3V	0/no pulse	4.6V	62	VO1/2 FD Off
1	-6.0V	25	-3.6V	49	-1.2V	57	4.6V	63	VO1/2 FD On
2	-5.9V	26	-3.5V	50	-1.1V	58	4.7V	64	Reserved
3	-5.8V	27	-3.4V	51	-1.0V	59	4.8V	65	Reserved
4	-5.7V	28	-3.3V	52	-0.9V	60	4.9V	66	1-Phase
5	-5.6V	29	-3.2V	53	-0.8V	61	5.0V	67	2-Phase
6	-5.5V	30	-3.1V	54	-0.7V			68	VO2 T-25μs
7	-5.4V	31	-3.0V	55	-0.6V			69	VO2 T-200μs
8	-5.3V	32	-2.9V	56	-0.5V			70	SSD OFF
9	-5.2V	33	-2.8V					71	SSD ON
10	-5.1V	34	-2.7V					**ELVSS_MIN_FREQ**	
11	-5.0V	35	-2.6V					72	No Limit
12	-4.9V	36	-2.5V					73	2kHz
13	-4.8V	37	-2.4V					74	7.5kHz
14	-4.7V	38	-2.3V					75	25kHz
15	-4.6V	39	-2.2V					**ELVSS_FREQ**	
16	-4.5V	40	-2.1V					76	1.2MHz
17	-4.4V	41	-2.0V					77	1.0MHz
18	-4.3V	42	-1.9V					78	0.8MHz
19	-4.2V	43	-1.8V					**ELVDD_FREQ**	
20	-4.1V	44	-1.7V					79	1.6MHz
21	-4.0V	45	-1.6V					80	1.45MHz
22	-3.9V	46	-1.5V					81	1.3MHz
23	-3.8V	47	-1.4V						

Table 3. ASWIRE Programming Table

ASWIRE Rising Edges	VO3 (V_{AVDD})	ASWIRE Rising Edges	VO3 (V_{AVDD})	ASWIRE Rising Edges	VO3 (V_{AVDD})	ASWIRE Rising Edges	VO3 (V_{AVDD})	ASWIRE Rising Edges	Function
0/no pulse	7.3V	8	6.2V	16	7.0V	24	7.8V	27	VO3 FD Off
1	5.5V	9	6.3V	17	7.1V	25	7.9V	28	VO3 FD On
2	5.6V	10	6.4V	18	7.2V	26	8.0V		
3	5.7V	11	6.5V	19	7.3V				
4	5.8V	12	6.6V	20	7.4V				
5	5.9V	13	6.7V	21	7.5V				
6	6.0V	14	6.8V	22	7.6V				
7	6.1V	15	6.9V	23	7.7V				

APPLICATION INFORMATION

Layout Considerations

The PCB layout is quite important in the power supply design. An incorrect layout could cause many problems, such as instability, load and line transient regulation problems, output voltage noise, and EMI issues. Good grounding becomes important especially with heavy load current.

The following PCB layout guide should be applied:

- In order to avoid any inductive or capacitive coupling of the switching power supply noise to the sensitive analog control circuits, there are 5 separated grounds (AGND, PGND1, PGND2A, PGND2B, PGND3) in the SGM3844. The signal ground (AGND) and noisy power ground (PGND1, PGND2A, PGND2B and PGND3) should be well separated on the PCB, and connected only at one point.
- Traces of switching nodes (SW1, SW2A, SW2B and SW3) should be short and wide.
- Place input capacitors on PVIN (PVIN2A and PVIN2B) as close as possible to the device.
- AVIN requires an independent input capacitor. Place the input capacitor on AVIN as close as possible to the device.
- Place output capacitors on VO1, VO2A, VO2B and VO3 as close as possible to the device.
- Use short and wide traces to connect the input capacitors on PVINx and the output capacitors.

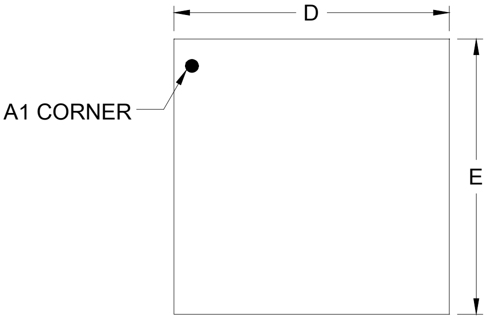
REVISION HISTORY

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

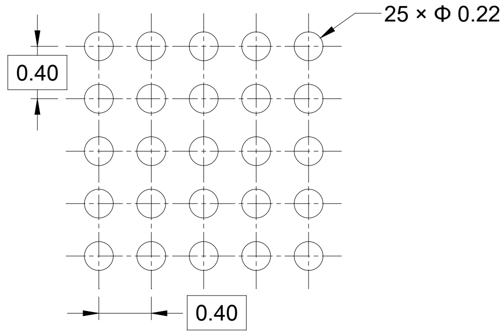
Changes from Original to REV.A (JUNE 2026)	**Page**
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

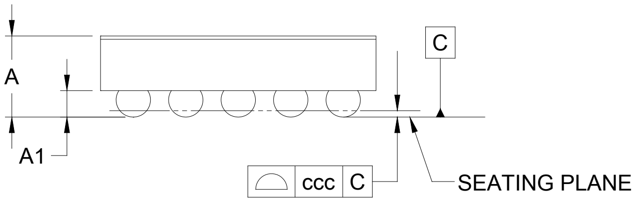
WLCSP-2.1×2.1-25B-A



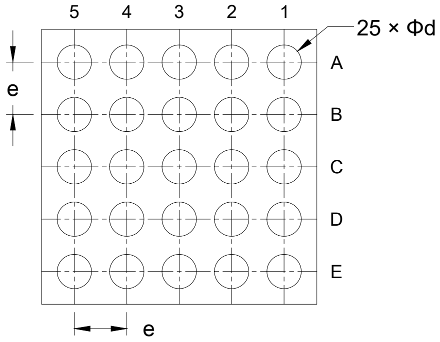
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



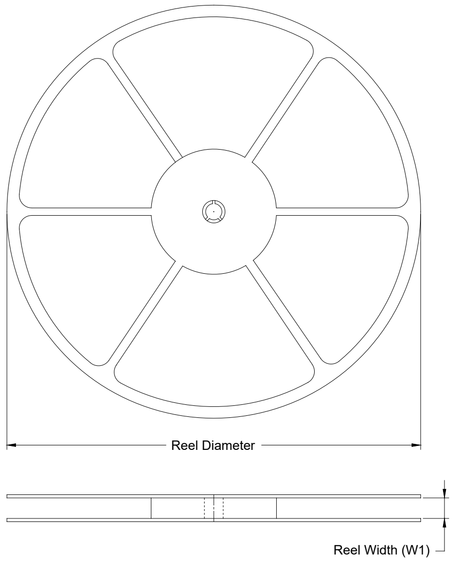
BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	**NOM**	**MAX**
A	-	-	0.665
A1	0.182	-	0.222
D	2.070	-	2.130
E	2.070	-	2.130
d	0.232	-	0.292
e	0.400 BSC		
ccc	0.050		

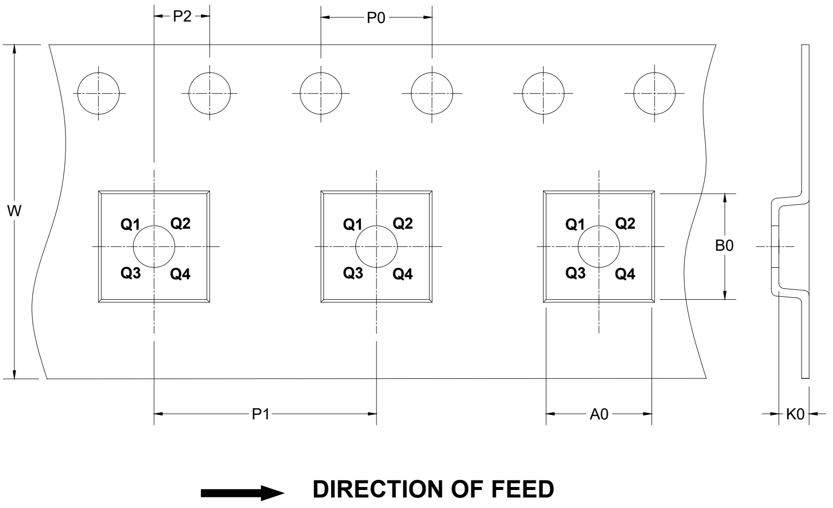
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



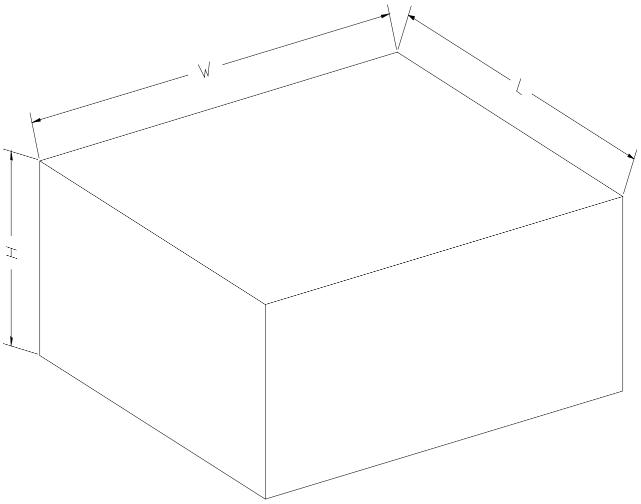
NOTE: The picture is only for reference. Please make the object as the standard.

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-2.1×2.1-25B-A	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