SGM38045
Charge Pump Mode Power Supply for Wearable AMOLED Products

GENERAL DESCRIPTION

The SGM38045 is a power source device for biasing small AMOLED panels. It can be powered from a single-cell Lithium-Ion/polymer battery or a DC supply in the range of 2.7V to 4.8V to provide OVDD, OVSS and AVDD voltage sources for an AMOLED panel. Two interim voltage rails (positive and negative) are generated by the integrated adaptive ×1/×1.5 charge pump converter and an inverting charge pump inverter. These rails are regulated by LDOs to get clean and low ripple positive (AVDD and OVDD) and negative (OVSS) outputs. This device is optimized for symmetric output to get highest efficiency from the charge pump inverter.

The SGM38045 is available in a Green WLCSP-1.2×2.4-17B package.

APPLICATIONS

Wearable AMOLED Products
Phones with AMOLED Vice Screen

FEATURES

- **2.7V to 4.8V Input Voltage Range**
- **2.8V to 3.5V OVDD (Default: 3.3V ±0.9%, 0.1V/Step)**
- **-2.8V to -3.5V OVSS (Default: -3.3V ±0.9%, 0.1V/Step)**
- **3.3V AVDD (Default: 3.3V ±0.9%)**
- **Up to 70mA OVDD & OVSS Combined Output Current Capability**
- **Excellent Line and Load Regulation**
- **Low Ripple and Excellent Transient Response**
- **Soft-Start**
- **Bi-Directional Input - Output MOSFET Isolation**
- **Protection Features**
  - **Under-Voltage Lockout Protection (UVLO)**
  - **Over-Current Protection (OCP)**
  - **Short-Circuit Protection (SCP)**
  - **Over-Temperature Protection (OTP)**
- **Power-Save Mode for Light-Load Efficiency**
- **Less than 1µA Shutdown Current**
- **Available in a Green WLCSP-1.2×2.4-17B Package**

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM38045	WLCSP-1.2×2.4-17B	-40℃ to +85℃	SGM38045YG/TR	SGM 38045 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.

Date Code - Year
Trace Code
Vendor Code

X X X X X
XX # XX

Coordinate Information
Wafer ID Number ("A" = 01, "B" = 02, ⋯ "Y" = 25)
Coordinate Information
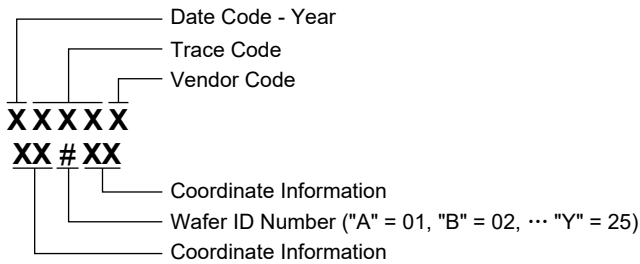
Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

Supply Input Voltage, VIN to AGND .... -0.3V to 6V
VOP, AVDD, OVDD, SWIRE, AVDDEN to AGND
.... -0.3V to 6V
CFxP, CFxN to AGND .... -0.3V to 6V
VON, OVSS to AGND.. -6V to 0.3V
Switch Transient Spike on CFxP, CFxN
.... -1V_{PP} to +1V_{PP}, in 10ns FWHM
Package Thermal Resistance
WLCSP-1.2×2.4-17B, θ_{JA} .... 100℃/W
Junction Temperature...+150℃
Storage Temperature Range ....-65℃ to +150℃
Lead Temperature (Soldering, 10s)...........................+260℃
ESD Susceptibility
HBM...4000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Input Voltage..2.7V to 4.8V
Operating Junction Temperature Range......-40℃ to +125℃
Operating Ambient Temperature Range........-40℃ to +85℃

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.
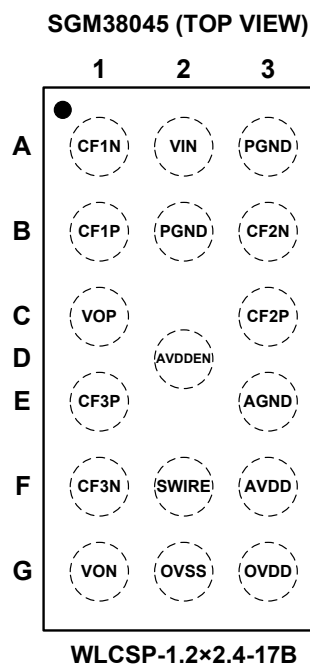
ESD SENSITIVITY CAUTION

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

SGM38045 (TOP VIEW)

	1	**2**	**3**
A	CF1N	VIN	PGND
B	CF1P	PGND	CF2N
C	VOP		CF2P
D		AVDDEN	
E	CF3P		AGND
F	CF3N	SWIRE	AVDD
G	VON	OVSS	OVDD

WLCSP-1.2×2.4-17B

PIN DESCRIPTION

| PIN	NAME	FUNCTION
A1	CF1N	Negative Connection for the Charge Pump Flying Capacitor 1.
A2	VIN	Power Input Pin. V_{IN} is measured between VIN and PGND.
A3, B2	PGND	Power Ground.
B1	CF1P	Positive Connection for the Charge Pump Flying Capacitor 1.
B3	CF2N	Negative Connection for the Charge Pump Flying Capacitor 2.
C1	VOP	Positive Charge Pump Regulator Output Rail (Positive Voltage).
C3	CF2P	Positive Connection for the Charge Pump Flying Capacitor 2.
D2	AVDDEN	Active High Enable Input Pin for AVDD.
E1	CF3P	Positive Connection for the inverter Charge Pump Flying Capacitor.
E3	AGND	Analog Ground Return for AVIN (Internal). Connect it to the PGND under the chip.
F1	CF3N	Negative Connection for the inverter Charge Pump Flying Capacitor.
F2	SWIRE	SWIRE Control Interface Input Pin.
F3	AVDD	AVDD LDO Output Pin.
G1	VON	Inverter Charge Pump Output Rail (Negative Voltage).
G2	OVSS	OVSS LDO Output Pin.
G3	OVDD	OVDD LDO Output Pin.

TYPICAL APPLICATION
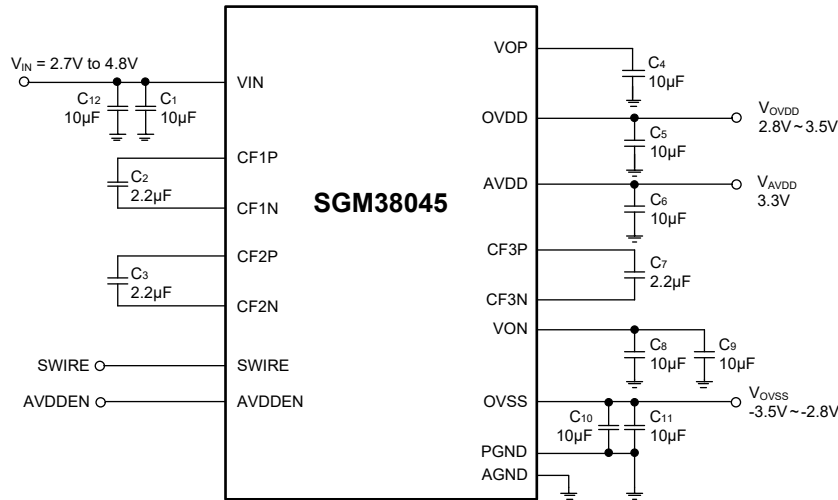
Figure 1. Typical Application Circuit

Table 1. Recommended BOM for Typical Application (< 50mA)

Reference	Quantity	Description	Part Number	Package	Supplier
C_1, C_4, C_5, C_6, C_8, C_9, C_{10}, C_{11}, C_{12}	9	10µF/10V/X5R	GRM155R61A106ME11 CL05A106MP5NUNC	0402	Murata Samsung
C_2, C_3, C_7	3	1µF/6.3V/X5R	GRM033R60J105MEA2	0201	Murata

Table 2. Recommended BOM for Typical Application (> 50mA)

Reference	Quantity	Description	Part Number	Package	Supplier
C_1, C_4, C_5, C_6, C_8, C_9, C_{10}, C_{11}, C_{12}	9	10µF/10V/X5R	GRM155R61A106ME11 CL05A106MP5NUNC	0402	Murata Samsung
C_2, C_3, C_7	3	2.2µF/6.3V/X5R	GRM033R60J225ME01	0201	Murata

FUNCTIONAL BLOCK DIAGRAM
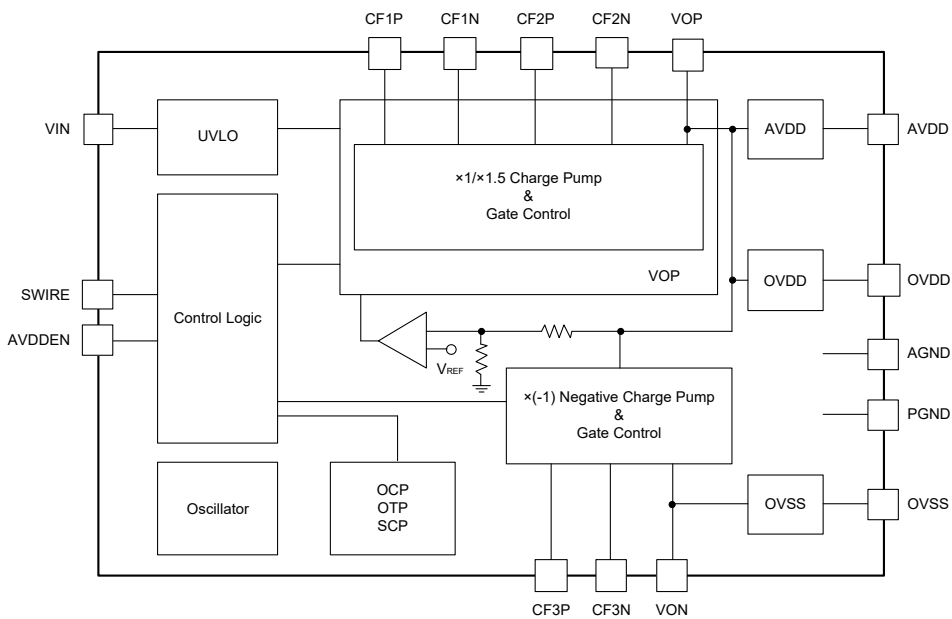
Figure 2. SGM38045 Functional Block Diagram

ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.7V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, T_J = +25℃, unless otherwise noted.)
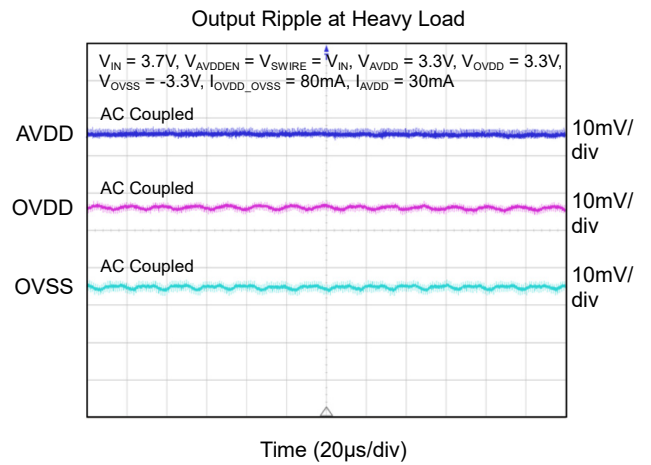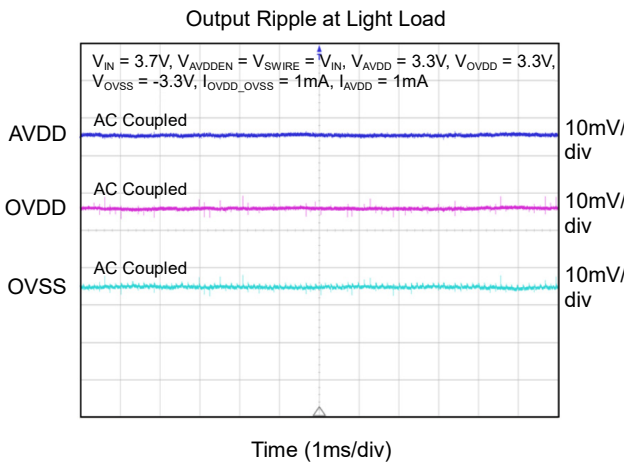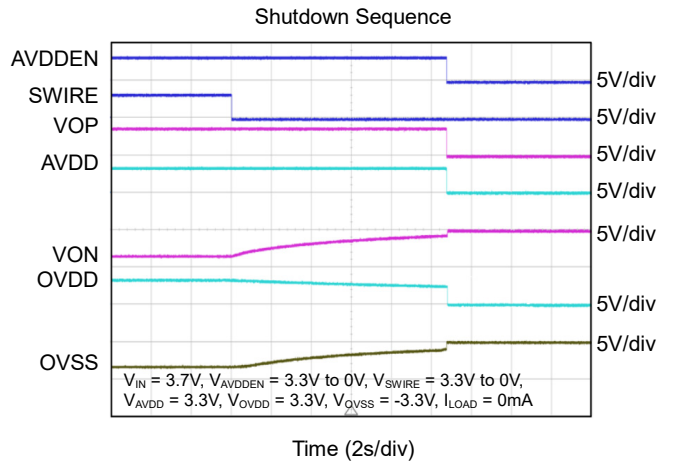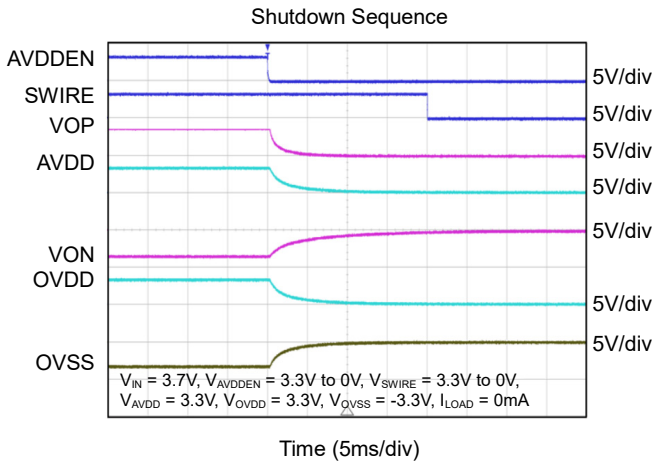
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Power Supply						
Input Supply Voltage Range	V_{IN}	T_J = -40℃ to +85℃	2.7	3.7	4.8	V
Quiescent Current	I_Q	V_{IN} = 3.7V, no load, AVDDEN = SWIRE = high		310		μA
		V_{IN} = 3.7V, no load, AVDDEN = high, SWIRE = low		190		
Shutdown Current	I_{SHDN}	AVDDEN = SWIRE = low		0.1	1.0	μA
Under-Voltage Lockout Threshold	V_{UVLOH}	V_{IN} rising		2.40	2.50	V
	V_{UVLOL}	V_{IN} falling	2.10	2.25		V
Thermal Shutdown	T_{SD}	Junction temperature rising		140		℃
Thermal Shutdown Hysteresis	ΔT_{SD}	Junction temperature falling		10		℃
SWIRE						
Logic High-Level Voltage	V_{SRH}	V_{IN} = 2.7V to 4.8V, T_J = -40℃ to +85℃	1.1			V
Logic Low-Level Voltage	V_{SRL}	V_{IN} = 2.7V to 4.8V, T_J = -40℃ to +85℃			0.4	V
Pull-Down Resistor	R_{SR}			550		kΩ
Turn-Off Detection Time	t_{OFF_DLY}		300			μs
Signal Stop Indicate Time	t_{STOP}		300			μs
Rising Time	t_R				200	ns
Falling Time	t_F				200	ns
Pulse High Level Time Period	t_{ON}		4		20	μs
Pulse Low Level Time Period	t_{OFF}		4		20	μs
SWIRE Frequency Range	f_{SWIRE}		25		125	kHz
AVDDEN						
Logic High Level Voltage	V_{IH}	V_{IN} = 2.7V to 4.8V, T_J = -40℃ to +85℃	1.1			V
Logic Low Level Voltage	V_{IL}	V_{IN} = 2.7V to 4.8V, T_J = -40℃ to +85℃			0.4	V
Positive Charge Pump Regulator						
Positive Output Voltage Range	V_{VOP_RANGE}		3.6		4.8	V
Positive Charge Pump Switching Frequency	f_{SW_P}		0.8	1	1.1	MHz
Negative Charge Pump						
Negative Output Voltage Range	V_{VON_RANGE}		-3.65		-2.95	V
Negative Charge Pump Switching Frequency	f_{SW_N}		0.8	1	1.1	MHz
AVDD						
AVDD Output Voltage Range	V_{AVDD_RANGE}	Normal operation, default		3.3		V
AVDD Output Voltage Accuracy	$AVDD\_Acc$	V_{AVDD} = 3.3V	-0.5		0.5	%
		V_{AVDD} = 3.3V, T_J = -40℃ to +85℃	-0.9		0.9	
AVDD Output Current Capability	I_{AVDD}	No load on OVDD and OVSS	30			mA
AVDD Line Regulation	V_{AVDD_LINE}	V_{IN} = 2.7V to 4.8V, I_{AVDD} = 30mA		0.1		%
AVDD Load Regulation	V_{AVDD_LOAD}	I_{AVDD} = 0 to 30mA		0.1		%
AVDD Output Voltage Ripple	V_{AVDD_RIPPLE}	I_{AVDD} = 0 to 30mA		1		mV_{PP}
AVDD Current Limit	I_{AVDD_LIMIT}		40	60	80	mA
AVDD Discharge Resistance	R_{AVDD_RDIS}			450		Ω
AVDD Short-Circuit Protection	$AVDD\_SCP$	Percentage of nominal V_{AVDD}		80		%

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN} = 3.7V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, T_J = +25℃, unless otherwise noted.)

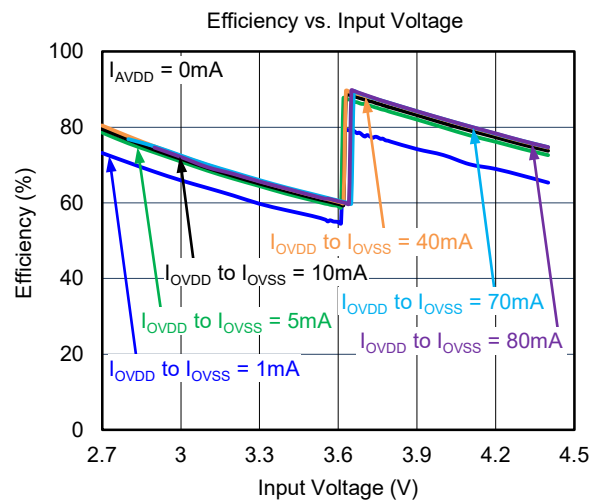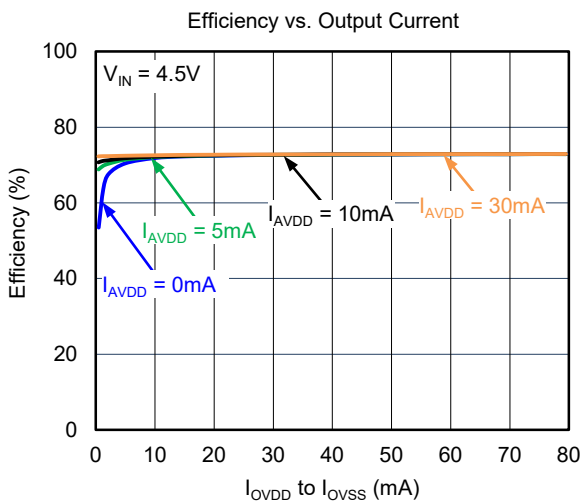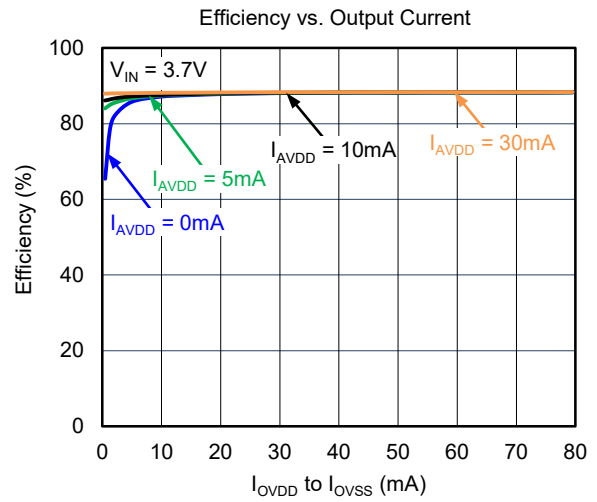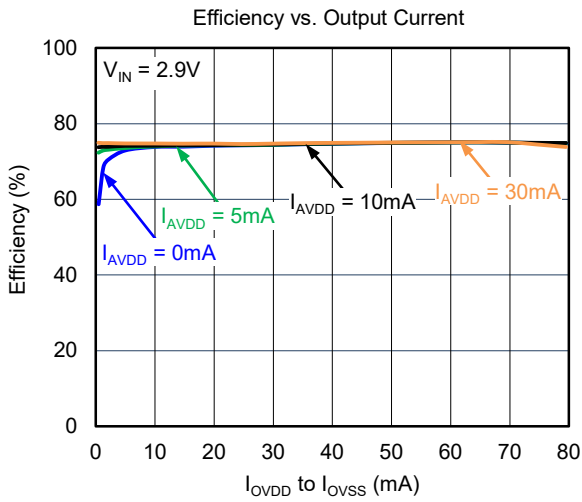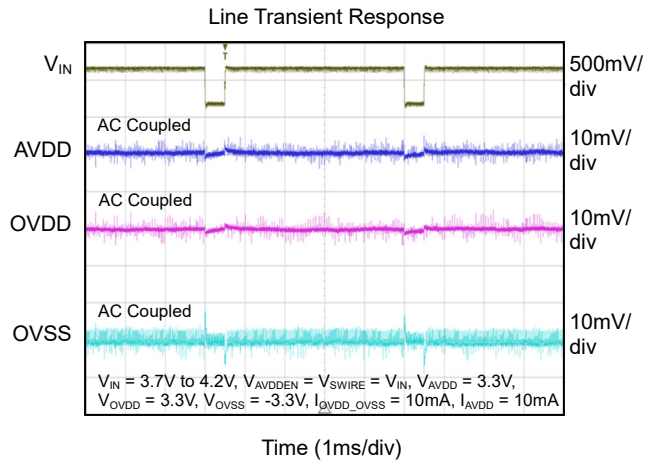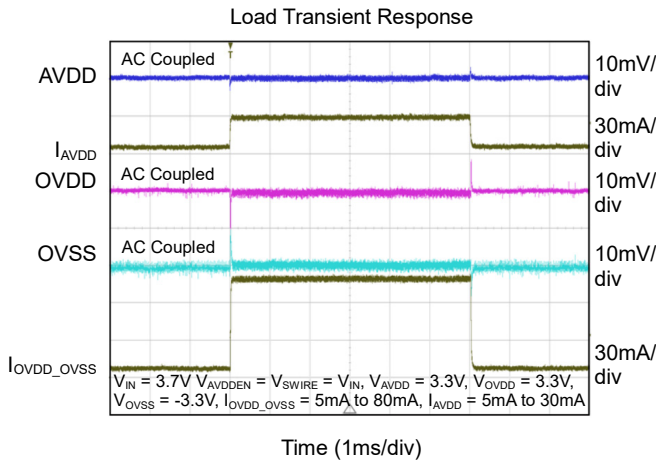| PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
OVDD						
OVDD Output Voltage Range	V_{OVDD_RANGE}	2.8V to 3.5V with 0.1V/step, default 3.3V	2.8	3.3	3.5	V
OVDD Output Voltage Accuracy	$OVDD\_Acc$	V_{OVDD} = 3.3V, no load	-0.5		0.5	%
		V_{OVDD} = 3.3V, no load, T_J = -40℃ to +85℃	-0.9		0.9	
OVDD Output Current Capability	I_{OVDD}	V_{IN} = 2.7V, I_{AVDD} = 10mA, I_{OVSS} = 70mA	70			mA
OVDD Line Regulation	V_{OVDD_LINE}	V_{IN} = 2.7V to 4.8V, I_{OVDD} = 10mA		0.1		%
OVDD Load Regulation	V_{OVDD_LOAD}	I_{OVDD} = 0 to 70mA		0.1		%
OVDD Output Ripple	V_{OVDD_RIPPLE}	I_{OVDD} = I_{OVSS} = 0 to 70mA		5		mV_{PP}
OVDD Current Limit	I_{OVDD_LIMIT}		70	95	120	mA
OVDD Discharge Resistance	R_{OVDD_RDIS}			450		Ω
OVDD Short-Circuit Protection	$OVDD\_SCP$	Percentage of nominal V_{OVDD}		80		%
OVSS						
OVSS Output Voltage Range	V_{OVSS_RANGE}	-3.5V to -2.8V with 0.1V/step, default -3.3V	-3.5	-3.3	-2.8	V
OVSS Output Voltage Accuracy	$OVSS\_Acc$	V_{OVSS} = -3.3V, no load	-0.6		0.6	%
		V_{OVSS} = -3.3V, no load, T_J = -40℃ to +85℃	-0.9		0.9	
OVSS Output Current Capability	I_{OVSS}	V_{IN} = 2.7V, I_{AVDD} = 10mA, I_{OVDD} = 70mA	70			mA
OVSS Line Regulation	V_{OVSS_LINE}	V_{IN} = 2.7V to 4.8V, I_{OVSS} = 10mA		0.1		%
OVSS Load Regulation	V_{OVSS_LOAD}	I_{OVSS} = 0 to 70mA		0.1		%
OVSS Output Ripple	V_{OVSS_RIPPLE}	I_{OVDD} = 0 to 70mA		5		mV_{PP}
OVSS Current Limit	I_{OVSS_LIMIT}		70	105	150	mA
OVSS Discharge Resistance	R_{OVSS_RDIS}			450		Ω
OVSS Short-Circuit Protection	$OVSS\_SCP$	Percentage of nominal V_{OVSS}		80		%

TYPICAL PERFORMANCE CHARACTERISTICS

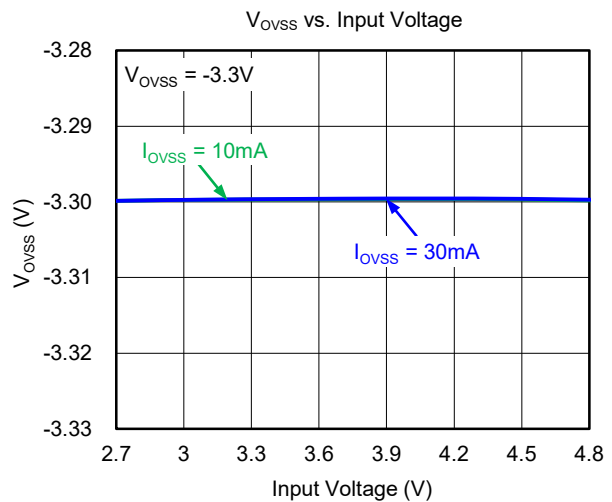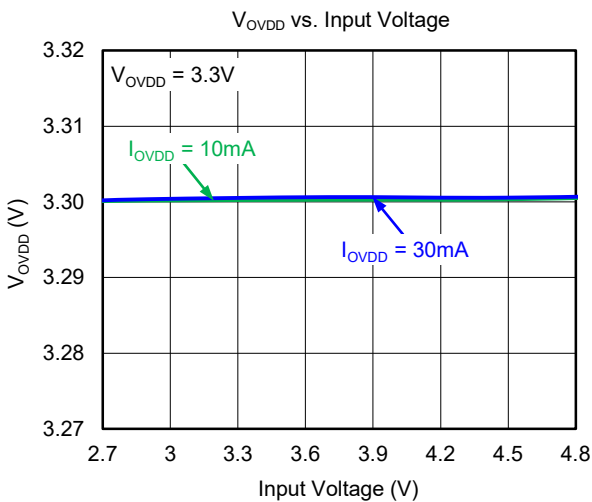V_{IN} = 3.7V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, unless otherwise noted.

Startup Sequence

V_{IN} = 3.7V, V_{AVDDEN} = 0V to 3.3V, V_{SWIRE} = 0V to 3.3V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, I_{LOAD} = 0mA

Time (2ms/div)

Startup Sequence

V_{IN} = 3.7V, V_{AVDDEN} = 0V to 3.3V, V_{SWIRE} = 0V to 3.3V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, I_{LOAD} = 0mA

Time (5ms/div)

Shutdown Sequence

V_{IN} = 3.7V, V_{AVDDEN} = 3.3V to 0V, V_{SWIRE} = 3.3V to 0V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, I_{LOAD} = 0mA

Time (5ms/div)

Shutdown Sequence

V_{IN} = 3.7V, V_{AVDDEN} = 3.3V to 0V, V_{SWIRE} = 3.3V to 0V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, I_{LOAD} = 0mA

Time (2s/div)

Output Ripple at Light Load

V_{IN} = 3.7V, V_{AVDDEN} = V_{SWIRE} = V_{IN}, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, I_{OVDD_OVSS} = 1mA, I_{AVDD} = 1mA

Time (1ms/div)

Output Ripple at Heavy Load

V_{IN} = 3.7V, V_{AVDDEN} = V_{SWIRE} = V_{IN}, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, I_{OVDD_OVSS} = 80mA, I_{AVDD} = 30mA
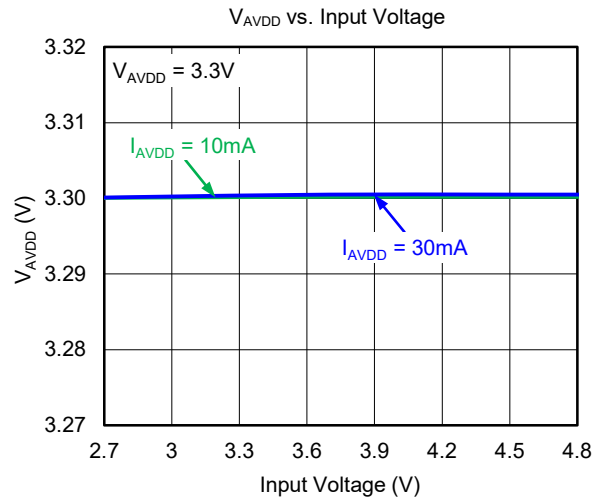
Time (20μs/div)

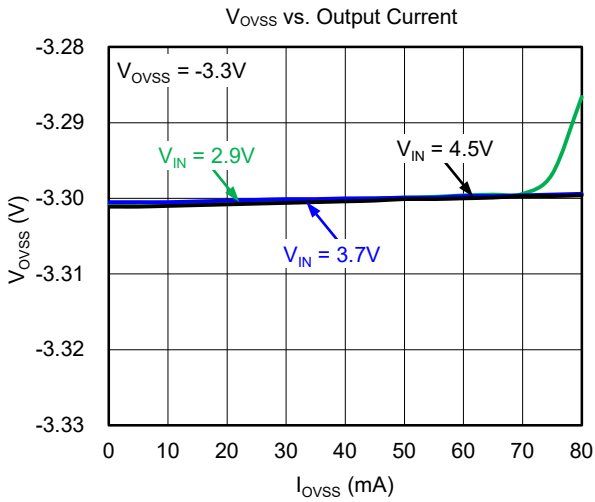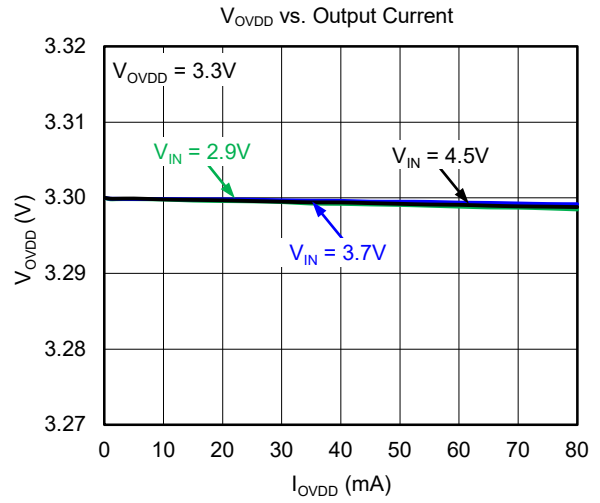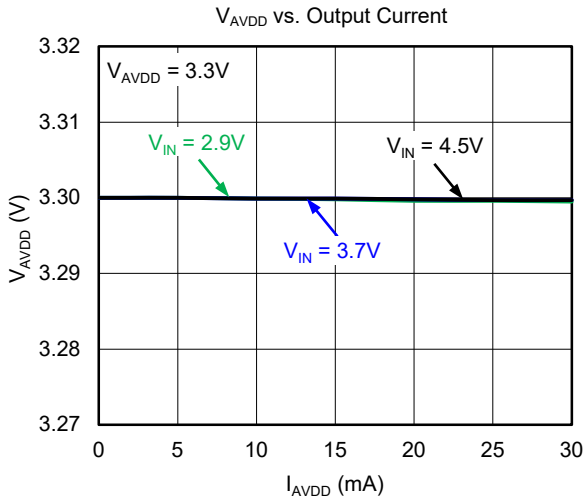# TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN} = 3.7V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, unless otherwise noted.

Load Transient Response

Time (1ms/div)

Line Transient Response

Time (1ms/div)

Efficiency vs. Output Current

Efficiency vs. Output Current

Efficiency vs. Output Current

Efficiency vs. Input Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN} = 3.7V, V_{AVDD} = 3.3V, V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, unless otherwise noted.

V_{AVDD} vs. Output Current

V_{OVDD} vs. Output Current

V_{OVSS} vs. Output Current

V_{AVDD} vs. Input Voltage

V_{OVDD} vs. Input Voltage

V_{OVSS} vs. Input Voltage

TIMING DIAGRAM

Startup and Shutdown Sequence 1

AVDDEN On → SWIRE On → SWIRE Off → AVDDEN Off
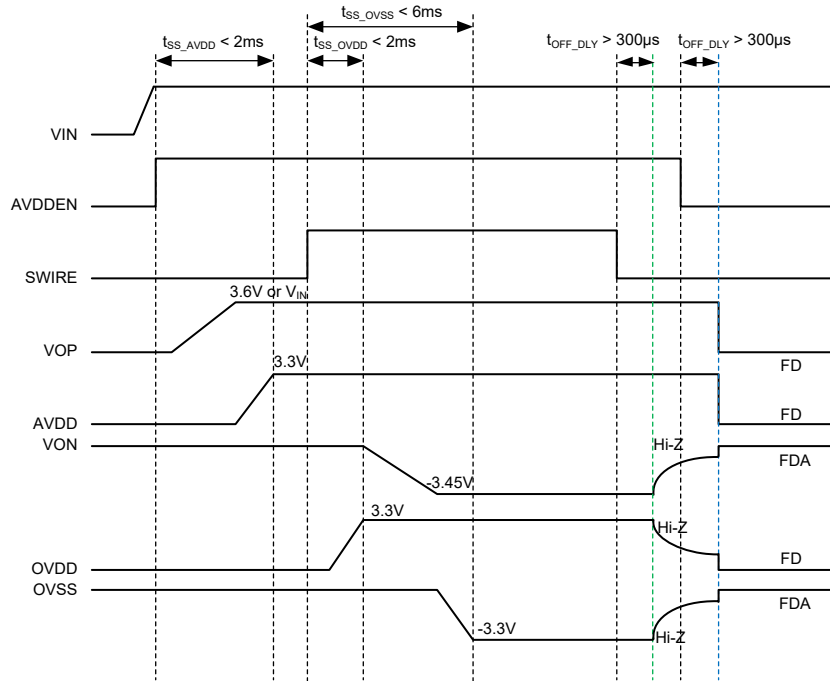
Figure 3. Startup and Shutdown Sequence 1 (FD = Fast Discharge, FDA = Fast Discharge for 30ms)

Startup and Shutdown Sequence 2

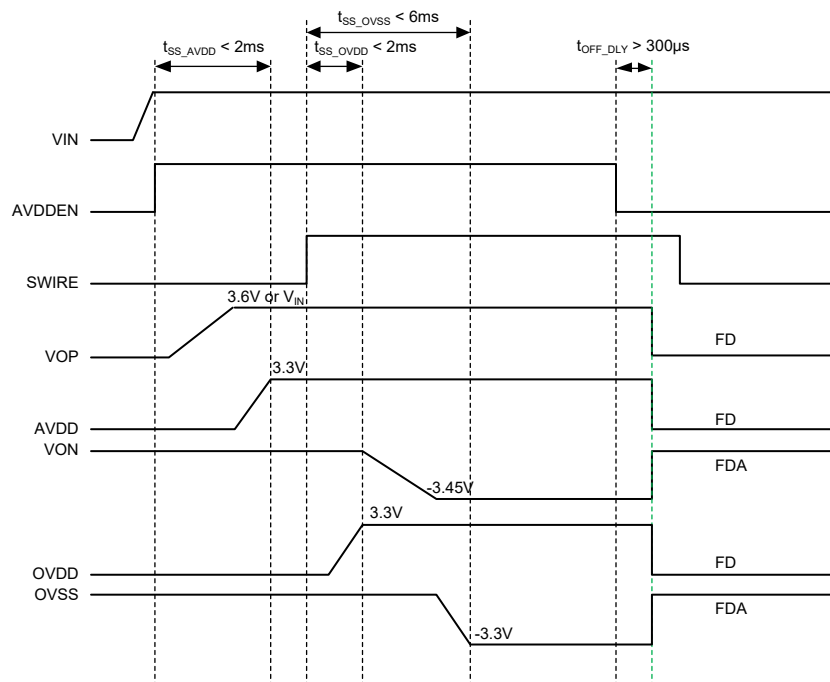AVDDEN On → SWIRE On → AVDDEN Off → SWIRE Off

Figure 4. Startup and Shutdown Sequence 2

TIMING DIAGRAM (continued)

Startup and Shutdown Sequence 3

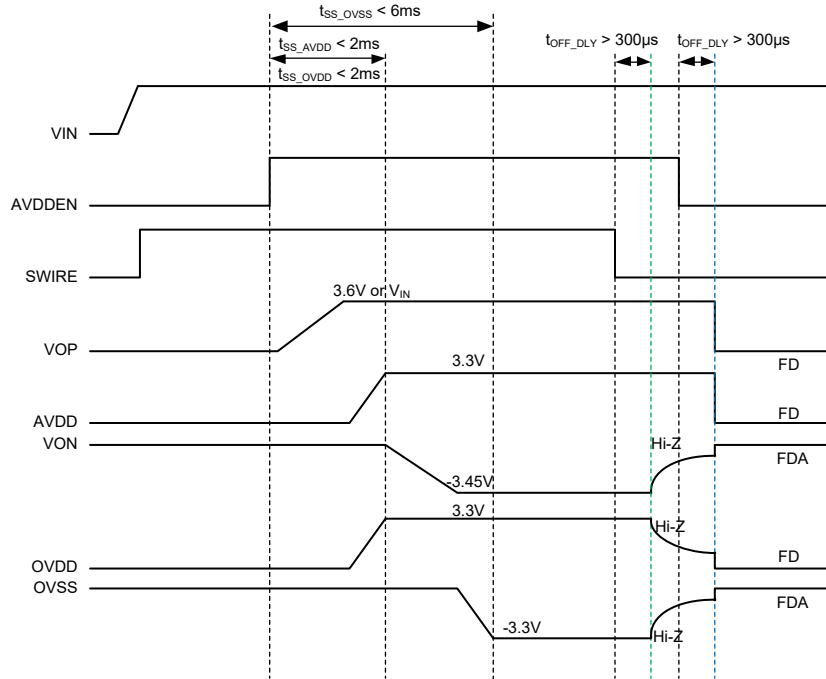SWIRE On → AVDDEN On → SWIRE Off → AVDDEN Off

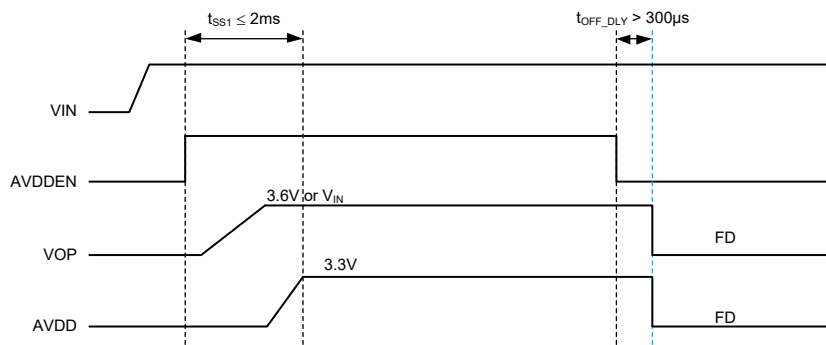**Figure 5. Startup and Shutdown Sequence 3**

AVDD Startup and Shutdown Sequence

Figure 6. AVDD On/Off Sequence by AVDDEN (SWIRE = Low or High)

TIMING DIAGRAM (continued)

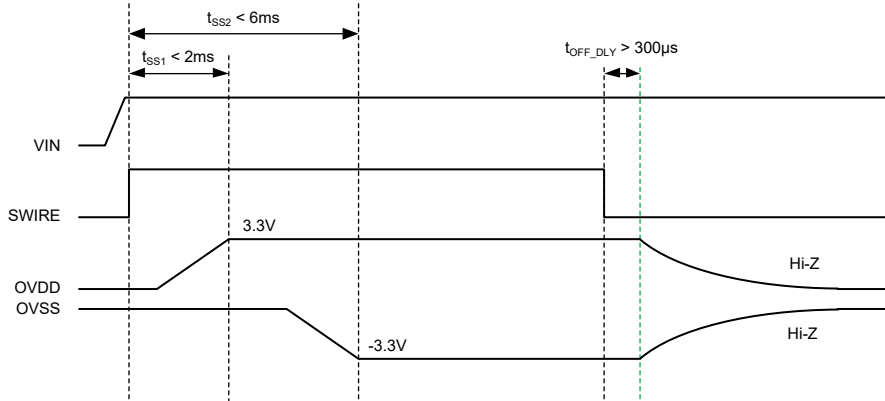### SWIRE Startup and Shutdown Sequence

Figure 7. The OVDD and OVSS On/Off Sequence by the SWIRE Input (AVDDEN = High)
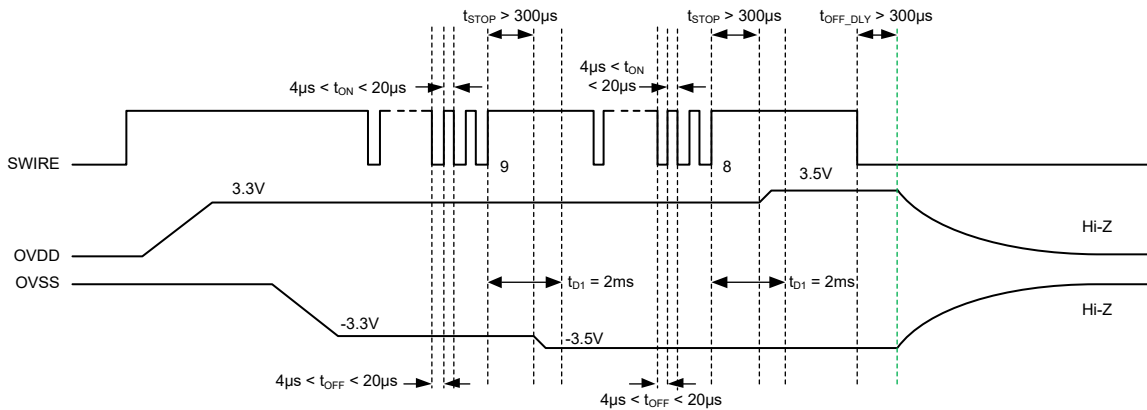
SWIRE Command Timing Diagram

Figure 8. Key Timings of a Command Processing with the SWIRE Interface

Table 3. Shutdown Discharge Table

AVDD_EN	SWIRE	AVDD	OVDD	OVSS
0	0	FD	FD	FDA
0	1	FD	FD	FDA
1	0	NA	Hi-Z	Hi-Z
1	1	NA	NA	NA

NOTE: FDA: Fast discharge is active only 30ms.

APPLICATION INFORMATION

Figure 2 shows the internal block diagram of the SGM38045. The main blocks include a ×1/×1.5 positive charge pump converter, a charge pump inverter, three LDOs, the sequence control and protection functions. This device provides three power lines to drive an AMOLED panel. The power train is optimized for symmetric output voltage on the adjustable OVDD and OVSS. With a symmetric output, the charge pump operates with an excellent efficiency. The OVDD voltage is adjustable from 2.8V to 3.5V and the OVSS voltage can be set from -3.5V to -2.8V both in 100mV steps. After the device is enabled by pulling the AVDDEN high, the positive charge pump converter generates a stable positive rail (VOP) from the 3.6V to 4.8V power input source (VIN). Then the charge pump converter generates a stable negative rail (VON) by inverting V_{VOP}. Three LDOs, two positive (AVDD and OVDD) and one negative (OVSS) regulate the converters outputs to get clean voltage sources needed for the AMOLED.

When the input voltage is high enough, the positive charge pump operates in bypass mode, and the output voltage V_{VOP} is equal to the input voltage. If the input voltage is not high enough, the V_{VOP} is automatically decided based on the headroom needed for maintaining the regulation of the V_{AVDD}, V_{OVDD} and V_{OVSS}, as specified in the following equation:

$$V_{VOP} = MAX(V_{AVDD}, V_{OVDD}, |V_{OVSS}|) + 0.3V$$

The device can be shut down by pulling both AVDDEN and SWIRE inputs to logic low. Supply current is less than 1μA in shutdown state.

Protection Features

UVLO protection is provided for VIN to shut down the device and prevent abnormal operation in case of under-voltage.

The input current is monitored cycle-by-cycle during each switch ON period for over-current limiting (OCP). This current is sensed by the ON voltage across the switches. When an over-current is detected on a switch, it is forced off right away to limit the current and prevent damage.

A short-circuit is detected when an output voltage falls to less than 80% of its programmed value (typical). Short-circuit protection (SCP) will force all switches off upon detecting a short, including short to ground, short to VIN and short in flying capacitors. The device enters the shutdown state after SCP, and the shutdown state is latched. To reset the whole device, either VIN has to cycle below UVLO threshold or AVDDEN and SWIRE have to be low at the same time for t_{OFF_DLY}.

Over-Temperature Protection (OTP) stops all power converters if the die temperature exceeds +140°C. Device operation will resume when the die is cooled down by 10°C approximately.

The Positive Charge Pump Converter

The SGM38045 uses positive charge pump converter to maintain synchronous power conversion under all operating conditions to achieve high efficiency over a wide range of input voltages and output currents. This converter is internally compensated and can change its mode automatically between ×1 bypass mode and ×1.5 charge pump mode based on the operating conditions. If $V_{IN} > V_{VOP}$ it operates in bypass mode, and it acts in ×1.5 charge pump mode if $V_{IN} < V_{VOP}$. The RMS current through the switches is thus kept to a minimum, minimizing switching and conduction losses. Controlling the switches this way lets the converter achieve high efficiency over the whole input voltage range.

Startup and Shutdown Sequences

Figure 3 to Figure 7 show the timing diagrams of the startup and shutdown sequence options for the SGM38045. The startup and shutdown sequence depends on the order of AVDDEN and SWIRE rising and falling edges after V_{IN} reaches to its normal operating range.

SWIRE I/F and Voltage/State Programming

SWIRE can also be used for programming the output voltages by an MCU or a digital controller. V_{OVDD} and V_{OVSS} can be programmed by the pulse counting in SWIRE timing sequence. V_{VOP} and V_{VON} are adjusted accordingly by the device for best efficiency and regulation. Figure 8 shows transition timings of the SWIRE in a pulse counting command session. The SWIRE must be kept high for the minimum t_{STOP} time to complete the command and apply that to the device. If the SWIRE is kept low for more than t_{OFF_DLY} time, the relevant converters will shut down and the OVDD and OVSS outputs go to discharge to ground state or Hi-Z according to Table 3. An internal pull-down resistor on the SWIRE assures that all outputs are shutdown when the host is not active.

APPLICATION INFORMATION (continued)

Layout and Component Selection

To achieve the best performance of the SGM38045, the following layout guidelines must be followed.

To get a good output regulation, place the components as close as possible to the device and use wide and short traces for connections especially for the high current loops in the outputs. The input and output bypass capacitors should be connected to the ground plane of the PCB. If the flying capacitors are not placed close to the CFxP/CFxN pins, it may cause noise radiation.

Refer to Figure 9 for a layout reference. Recommended component values are given in Table 1 and Table 2.

Thermal Dissipation Constraint

Small size AMOLED panels are typically used in the tiny, space constraint gadgets. They have limited permissible thermal dissipation due to the close contact with the user body. The thermal shutdown threshold of the device is +140℃, which is way higher than the allowed scald-free temperature. Therefore, careful thermal dissipation analysis and tests are essential for the evaluation of the designs in such applications. The required thermal isolation causes higher operating junction temperature compared to the operation in the open space. Therefore, the device output power capacity must be derated accordingly.
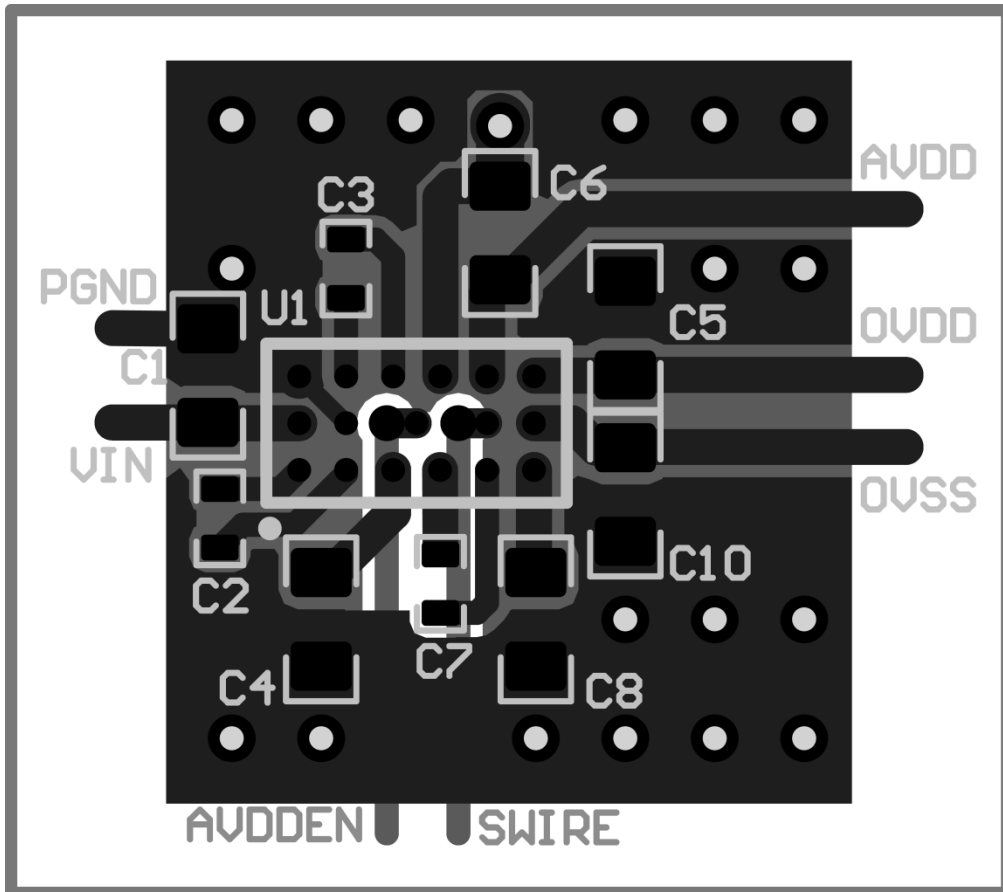

Figure 9. PCB Layout Reference

APPLICATION INFORMATION (continued)

SWIRE Setting

Table 4. SWIRE Programming 1

Pulse	Function Description
0 (no pulse programming)	Default: V_{OVDD} = 3.3V, V_{OVSS} = -3.3V, V_{AVDD} = 3.3V (AVDDEN = 1).
1 - 8	OVDD output voltage setting (2.8V to 3.5V), as explained in Table 5.
9 - 16	OVSS output voltage setting (-3.5V to -2.8V), as explained in Table 5.
17 - 18	Reserved.
19	OVDD is turned on.
20	VON and OVSS are turned on.
21	OVDD is turned off.
22	VON and OVSS are turned off.
23	VON and OVSS discharge to GND, with slow slew rate then they enter high impendence (Hi-Z) state.
24	Soft-reset. Clear all settings and reset back to default state.
25 - 31	Reserved.

Table 5. SWIRE Programming 2

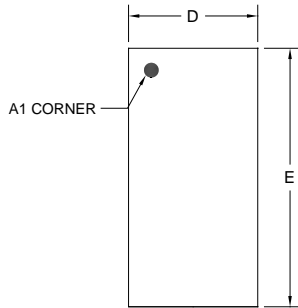| Pulse	V_{VOP} (V)	V_{OVDD} (V)	Pulse	V_{VON} (V)	V_{OVSS} (V)
0/no pulse	3.6	3.3	0/no pulse	-3.45	-3.3
1	3.6	2.8	9	-3.65	-3.5
2	3.6	2.9	10	-3.55	-3.4
3	3.6	3	11	-3.45	-3.3
4	3.6	3.1	12	-3.35	-3.2
5	3.6	3.2	13	-3.25	-3.1
6	3.6	3.3	14	-3.15	-3
7	3.7	3.4	15	-3.05	-2.9
8	3.8	3.5	16	-2.95	-2.8

REVISION HISTORY

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

PACKAGE OUTLINE DIMENSIONS

WLCSP-1.2×2.4-17B

TOP VIEW
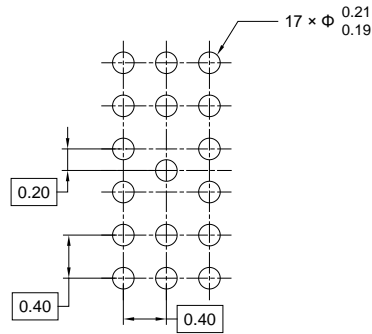
RECOMMENDED LAND PATTERN (Unit: mm)

$17 \times \Phi \, {}^{0.21}_{0.19}$

0.20

0.40

0.40

$17 \times \Phi d$

SIDE VIEW

SEATING PLANE
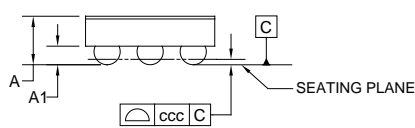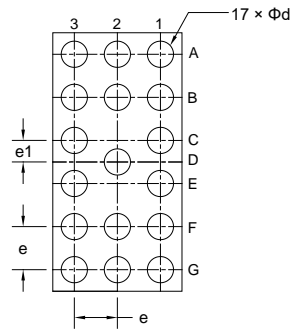
ccc C

BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	**MOD**	**MAX**
A	0.412	0.450	0.488
A1	0.152	0.172	0.192
D	1.170	1.200	1.230
E	2.370	2.400	2.430
d	0.223	0.243	0.263
e	0.400 BSC		
e1	0.200 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-1.2×2.4-17B	7″	9.5	1.32	2.55	0.62	4.0	4.0	2.0	8.0	Q1

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