Integrated Power Supply for TFT-LCD

Features

- **Input Supply Range: 2.5V ~ 5.0V**
- **I^2C Interface**
- **Current Mode Sync. Boost Converter for AVDD**
  - **Programmable Switching Frequency**
  - **7V to 13.5V Programmable Output**
  - **Fast Transient Response to Pulsed Load**
  - **High-Accuracy Output Voltage (±1%)**
  - **High Efficiency up to 88%**
- **Sync. Buck Converter for V_{CORE}/V_{IO}**
  - **Programmable Switching Frequency**
  - **0.8V to 2.0V Programmable Output for V_{CORE}**
  - **1V to 2.8V Programmable Output for V_{IO}**
  - **Fast Transient Response to Pulsed Load**
  - **High-Accuracy Output Voltage (±1.5%)**
  - **High Efficiency up to 90%**
- **Sync. Boost Converter For V_{GH}**
  - **Programmable Switching Frequency**
  - **10V to 34V Programmable Output**
  - **Fast Transient Response to Pulsed Load**
  - **High-Accuracy Output Voltage (±3%)**
  - **High Efficiency up to 80%**
- **Negative Charge-pump regulator for V_{GL}**
  - **Programmable Switching Frequency**
  - **-4.4V to –(AVDD-0.5)V Programmable Output**
  - **High-Accuracy Output Voltage (±3%)**
- **Low Dropout Regulator**
  - **1.8V to 2.8V Programmable Output**
- **Programmable VCOM, GMA1&2, HAVDD Voltage and Buffer**
  - **High-Accuracy Output Voltage**
- **Programmable Voltage Detector**
  - **2.0V to 2.7V Programmable Output**
- **Protection Function**
  - **Over-Current Protection (OCP)**
  - **Over-Temperature Protection (OTP)**
  - **Over-Voltage Protection (OVP)**
  - **Output Under Voltage Protection (UVP)**
  - **Short Circuit Protection (SCP)**
- **Available in WQFN3.5X3.5-28 pin Package**

General Description

The G2514A includes 2-wire I^2C interface, two synchronous boost converters for AVDD and VGH, two buck converters for Vcore and VIO, one charge pump for VGL, one LDO regulator, one voltage detector, one programmable V_{COM} generator with a high-speed amplifier for DVCOM, one high-speed operation amplifier for HAVDD, two high-speed operation amplifiers for GMA, for active-matrix, thin-film transistor, liquid-crystal displays (LCDs).

One synchronous boost converter (AVDD) provides the regulated supply voltage for the panel source driver ICs. The converter is a high-frequency current-mode regulator with integrated MOSFET that allows the use of ultra-small inductors and ceramic capacitors. It provides fast transient response to pulsed loads while achieving efficiencies over 88%.

One synchronous boost converter (VGH) provides the regulated supply voltage for the panel gate driver ICs. The converter is a high-frequency current-mode regulator with integrated MOSFET that allows the use of ultra-small inductors and ceramic capacitors. It provides fast transient response to pulsed loads while achieving efficiencies over 80%.

Two buck converters (Vcore and VIO) provides the regulated supply voltage for T-con. The converter is a high-frequency current-mode regulator with an integrated MOSFET that allows the use of ultra-small inductors and ceramic capacitors.

The VGL charge pump provides regulated TFT gate-off supply.

Voltage detector monitors the supply voltage to issue a RESET signal while the detected voltage is too low.

The high-performance voltage buffer can driver the LCD VCOM.

PMIC is available in a 28-pin thin FC WQFN3.5X3.5 package.

Applications

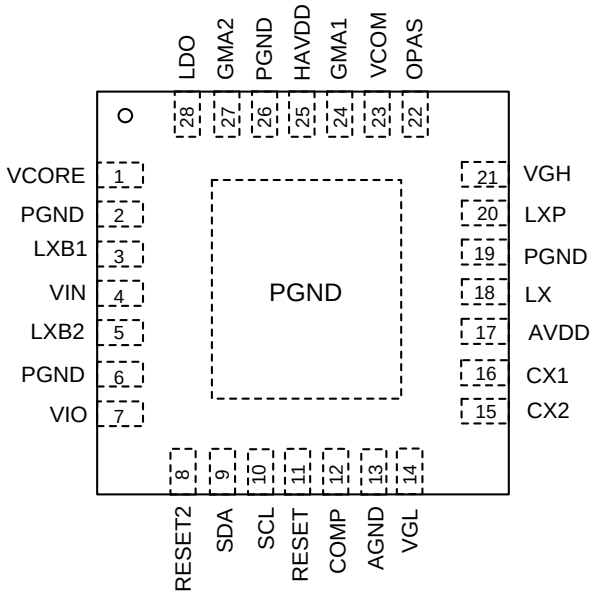
- **NB PCs**
- **Table PCs**

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G2514AUG1U	2514A	-40°C to 85°C	WQFN3.5X3.5-28

Note: UG: WQFN3.5X3.5-28
1: Bonding Code
U: Tape & Reel
Green : Lead Free / Halogen Free.

Pin Configuration



G2514A WQFN3.5X3.5-28

Note: Recommend connecting the Thermal Pad to the Ground for excellent power dissipation

Absolute Maximum Rating

VIN to PGND. . . . . 0.3V to 6V
SDA, SCL to AGND . . . . . -0.3V to 6V
VIN, SDA, SCL to PGND (100mS pulse). . 0.3V to 12V
PGND, AGND to GND. . . . . ±0.3V
COMP, RESET, RESET2 o AGND . . . . . -0.3V to 6V
AVDD, LX to PGND . . . . . .-0.3V to 14.5V
LXB1, LXB2 to PGND . . . . . -0.3V to 6V
VGH, VGHLX to PGND. . . . . -0.3V to 35V
VCORE, VIO, LDO to PGND. . . . . -0.3V to 6V
VOPAS to PGND . . . . . .-0.3V to (V_{AVDD}+0.3V)
VCOM to PGND . . . . . -0.3V to (V_{AVDD}+0.3V)
HAVDD to PGND. . . . . -0.3V to (V_{AVDD}+0.3V)
CX1 to PGND. . . . . -0.3V to 14.5V
VGL, CX2 to PGND . . . . . -14.5V to 0.3V
GMA1, GMA2 to PGND . . . . . -0.3V to (V_{AVDD}+0.3V)

Thermal Resistance Junction to Ambient, (θ_{JA})
WQFN3.5X3.5-28 . . . . . .31.7°C/W
Continuous Power Dissipation (T_A = +25°C)
WQFN3.5X3.5-28 . . . . . 3.1W
Thermal Resistance Junction to Case, (θ_{JC})
WQFN3.5X3.5-28. . . . . 2.4°C/W
Operating Temperature Range . . . . . .-40°C to 85°C
Storage Temperature Range. . . . . -65°C to 150°C
Junction Temperature . . . . . 160°C
Reflow Temperature (soldering, 10sec) . . . . . 250°C
Electrostatic Discharge, VESD (note1)
Human Body Mode (HBM) 2kV/8kV
Machine Mode (MM) 200V

Note1 :
Devices are ESD sensitive. Handing precaution is recommend.
Except SDA, SCL, VIN pin 8kV for HBM.

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
VIN Supply Range	V_{IN}		2.5	3.3	5	V
AVDD Output Range	AVDD	Step:100mV	7	8.5	13.5	V
VCORE Output Range	V_{CORE}	Step:50mV	0.8	1.1	2	V
VIO Output Range	V_{IO}	Step:50mV	1.0	1.8	2.8	V
LDO Output Range	V_{LDO}	Step:100mV	1.8	2.5	2.8	V
VGH Output Range	V_{GH}	Step:1V	10	15	34	V
VGL Output Range	V_{GL}	Step:100mV	-13	-8	-4.4	V
D-Vcom Output Range	D-V_{com}	Step:20mV	1.5	---	6.2	V
	D-V_{com_P}	Step:10mV	VCOM-10mVx64	---	VCOM+10mVx63	
Half AVDD Range	HAVDD	Step:50mV	3.5	---	6.5	V
GMA1 Output Range	GMA1	Step:50mV	AVDD-1	---	AVDD-0.1	V
GMA2 Output Range	GMA2	Step：50mV	0.1	---	1	V
Operating ambient temperature	T_A		-40	---	85	°C
Operating junction temperature	T_J		-40	---	125	°C

Electrical Characteristics

(V_{IN}=3.3V, V_{AVDD}=9V, Vcore=1.2V, VIO=1.8V, VLDO=2.5V, VGH=22V, VGL=-8V, T_A = 25°C)

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
GENERAL					
Input Voltage Range		2.5	3.3	5	V
VIN Quiescent Current	All converter no switching	---	2.5	---	mA
	All converter switching	---	5.5	---	
Under-voltage Lockout Threshold	V_{IN} rising	---	2.3	---	V
	V_{IN} falling hysteresis	---	0.3	---	
VIN Program MTP Voltage	Rising	3	---	5	V
Duration to Trigger Fault Condition	Boost, Buck, Charge pumps (Fcount = 1MHz)	---	60	---	ms
Thermal Shutdown Protection	Temperature rising	---	150	---	°C
AVDD Boost Converter					
Output Voltage Range	Programmable	7	---	13.5	V
Output Voltage Bit		---	7	---	Bits
Output Voltage Resolution		---	0.1	---	V
Output Voltage Accuracy	AVDD = 9V	-1	--	+1	%
Switching Frequency	Programmable (Accuracy ±10%)	600	715	1225	kHz
Switching Frequency Bit		---	3	---	Bits
Maximum Duty Cycle		86	90	94	%
Line Regulation	V_{IN} = 2.5V to 5V	-0.3	---	+0.3	%/V
LX Leakage Current	V_{LX} = 14.5V	---	1	5	uA
LX Current Limit	Programmable	---	1.5	---	A
Output Current Ability		250	---	---	mA
Current Limit Bit		---	2	---	Bits
Current Limit Resolution		---	0.5	---	A
Soft-start time	Programmable	5	---	20	ms
Soft-start time Bit		---	2	---	Bits
Soft-start time Resolution		---	5	---	ms
Under Voltage Fault Trip Level	VAVDD falling edge	---	NOM X80%	---	V
VGH Boost Converter					
Output Voltage Range	Programmable	10	---	34	V
Output Voltage Bit		---	5	---	Bits
Output Voltage Resolution		---	1	---	V
Output Voltage Accuracy	VGH = 20V	-3	---	+3	%
Switching Frequency	Programmable (Accuracy ±10%)	600	715	1225	kHz
Switching Frequency Bit		---	3	---	Bits
Maximum Duty Cycle		86	90	94	%
Line Regulation	V_{IN} = 2.5V to 5V	-0.3	---	+0.3	%/V
LX P Leakage Current	V_{LXP} = 35V	---	1	20	uA
LXP Current Limit		---	0.7	---	A
Output Current Ability		30	---	---	mA
Soft-start time	Programmable	2	---	8	ms
Soft-start time Bit		---	2	---	Bits
Soft-start time Resolution		---	2	---	ms
Under Voltage Fault Trip Level	V_{GH} falling edge	---	NOM X80%	---	V

Electrical Characteristics (Continued)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
VCORE Buck Converter					
Output Voltage Range	Programmable	0.8	1.2	2.0	V
Output Voltage Bit		---	5	---	Bits
Output Voltage Resolution		---	0.05	---	V
Output Voltage Accuracy	Vcore = 1.2V	-1	--	+1	%
Switching Frequency	Programmable (Accuracy ±10%)	600	715	1225	kHz
Switching Frequency Bit		---	3	---	Bits
LXB1 Current Limit		---	1.2	---	A
Output Current Ability		300	---	---	mA
LXB1 Leakage Current	V_{LXB1} = 3.3V and 0V	---	1	5	µA
Under Voltage Fault Trip Level	V_{CORE} falling edge	---	NOM X80%	---	V
VIO Buck Converter					
Output Voltage Range	Programmable	1	1.8	2.8	V
Output Voltage Bit		---	6	---	Bits
Output Voltage Resolution		---	0.05	---	V
Output Voltage Accuracy	VIO=1.8V	-1	---	+1	%
Switching Frequency	Programmable (Accuracy ±10%)	600	715	1225	kHz
Switching Frequency Bit		---	3	---	Bits
LXB2 Current Limit		--	1.2	---	A
Output Current Ability		250	---	---	mA
LXB2 Leakage Current	V_{LXB2} = 3.3V and 0V	---	1	5	µA
Under Voltage Fault Trip Level	V_{IO} falling edge	---	NOM X80%	---	V
VGL Charge Pump Regulator					
Output Voltage Range	Programmable	-13	---	-4.4	V
Output Voltage Bit		---	7	---	Bits
Output Voltage Resolution		---	-0.1	---	V
Operation Frequency	Programmable	0.5*AVDD LX Freq.	---	AVDD LX Freq.	kHz
Operation Frequency Bit		---	1	---	Bits
Line Regulation	VIN=2.5V to 5V	-0.3	--	+0.3	%/V
Output Current Ability	AVDD-VGL=0.5V, Fly Cap=0.1µF	20	---	---	mA
Soft-start time	Programmable	2	---	8	ms
Soft-start time Resolution		---	2	---	Bits
Under Voltage Fault Trip Level	V_{GL} falling edge	---	NOM X80%	---	V

Electrical Characteristics (Continued)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Low Dropout Linear Regulator					
Output Voltage Range		1.8	---	2.8	V
Output Voltage Bit		---	4	---	Bits
Output Voltage Resolution		---	0.1	---	V
Output Voltage Accuracy	V_{LDO} = 2.5V	-1	---	+1	%
Dropout Voltage	V_{IN} = 3.3V, I_{OUT} = 200mA	---	0.2	---	V
Current Limit		--	200	---	mA
Output Current Ability		100	---	---	mA
Under Voltage Fault Trip Level	V_{LDO} falling edge	---	NOM X80%	---	V
HAVDD Output					
OPAS Quiescent Current		---	2.5	---	mA
Output Voltage Range		3.5	---	6.5	V
Output Voltage Bit		---	6	---	Bits
Output Voltage Resolution		--	0.05	---	V
Output Current Ability		---	±75	---	mA
Short-Circuit Current	Source	---	250	--	mA
	Sink	---	-250	---	
-3dB Bandwidth	R_L=10kΩ, C_L=10pF	---	10	---	MHz
Gain-Bandwidth Product	R_L=10kΩ, C_L=10pF	---	5	---	MHz
Integral Nonlinearity Error	HAVDD=3.5V to 6.5V	---	1	---	LSB
Differential Nonlinearity Error	HAVDD=3.5V to 6.5V	---	1	---	LSB
D-VCOM Amplifier					
Output Voltage Range		1.5	---	6.2	V
Input Offset Voltage	D-VCOM-=3.7V	-15	---	+15	mV
Input Bias Current		-100	---	+100	nA
Soft-start time	0V to 3.7V	---	3	---	ms
Output Voltage Swing High	IOUT = 100uA	AVDD -0.03	VSUP -0.05	---	V
	IOUT = 75mA	AVDD -1.9	AVDD -1.5	---	V
Output Voltage Swing Low	IOUT = -100μA	---	GND+5	GND+3	mV
	IOUT = -75mA	---	GND+1.5	GND+1.9	V
Short-Circuit Current	Source	---	+150	---	mA
	Sink	---	-150	---	mA
Output Current	VAVDD/2 , |Δ VOS|<10mV, Source	45	75	---	mA
	VAVDD/2 , |Δ VOS|<10mV, Sink	-45	-75	---	mA
-3dB Bandwidth	R_L=10kΩ, C_L=10pF	---	10	---	MHz
Gain-Bandwidth Product	R_L=10kΩ, C_L=10pF	---	5	---	MHz
Programmable VCOM Calibrator					
Resolution		---	7	---	Bits
Integral Nonlinearity Error		---	1	---	LSB
Differential Nonlinearity Error		---	1	---	LSB

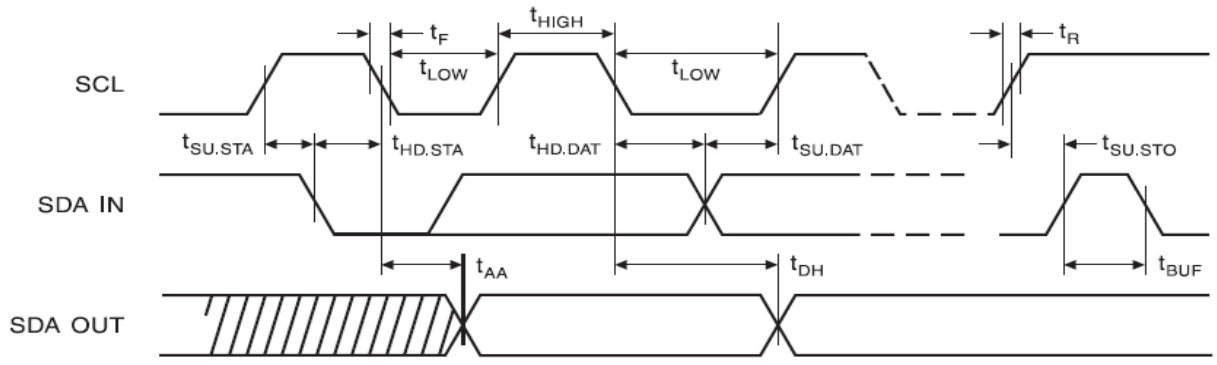
Electrical Characteristics (Continued)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
GMA Output					
GMA1 Output Voltage Range		AVDD-1	---	AVDD-0.1	V
GMA2 Output Voltage Range		0.1	---	1	V
Output Current Ability		1	---	---	mA
GMA1 Output Voltage Swing High	IOUT = 1mA	AVDD -0.2	---	---	V
GMA2 Output Voltage Swing Low	IOUT = 1mA	---	---	GND+0.2	V
Resolution		---	5	---	Bits
Integral Nonlinearity Error		---	1	---	LSB
Differential Nonlinearity Error		---	1	---	LSB
Voltage Detector -- RESET/RESET2					
Output Voltage Range	Programmable	2.0	2.2	2.7	V
Output Voltage Bit		---	3	---	Bits
Output Voltage Resolution		---	0.1	---	V
Output Voltage Accuracy		-2	---	+2	%

I²C Timing Characteristics

PARAMETER	Symbol	CONDITIONS	MIN	TYP	MAX	UNITS
Logic Input High Voltage Threshold	VIH	SDC, SCL	1.2	---	---	V
Logic Input Low Voltage Threshold	VIL	SDC, SCL	---	---	0.4	V
SDA Output Sink Current	$I_{SINK-SDA}$	V_{SDA}=0.4V	---	6	---	mA
Serial-Clock Frequency	F_{SCL}		0.2	400	1000	kHz
Data Setup Time	$t_{SU,DAT}$		100	---	---	ns
Data Hold Time	$t_{HD,DAT}$		---	---	300	ns
SDA and SCL Rise Time	t_R		20+0.1CB	---	200	ns
SDA and SCL Fall Time	t_F		20+0.1CB	---	200	ns
SDA and SCL Input Capacitance			---	5	---	pF
START Condition of Setup Time	$T_{SU.STA}$		0.25	---	---	μs
START Condition of Hold Time	$T_{HD.STA}$	10% of SDA to 90% of SCL	0.25	---	---	μs
Bus Free Time Between STOP and START Conditions	t_{BUF}		0.5	---	---	μs
SDA_ACK on Voltage			---	---	0.4	V
Pulse Width of Suppressed Spike	T_{SP}		---	---	50	ns
Clock Pulse Width Low	t_{LOW}		1.3	---	---	μs
Clock Pulse Width Low	t_{LHIGH}		0.6	---	---	μs
Bus Free Time Between Stop	$t_{SU.STO}$		0.6	---	---	μs
Clock Low to Data Out Valid	t_{AA}		0.1	---	0.9	μs
Data Out Hold Time	t_{DH}		50	---	---	ns

I²C Bus Timing

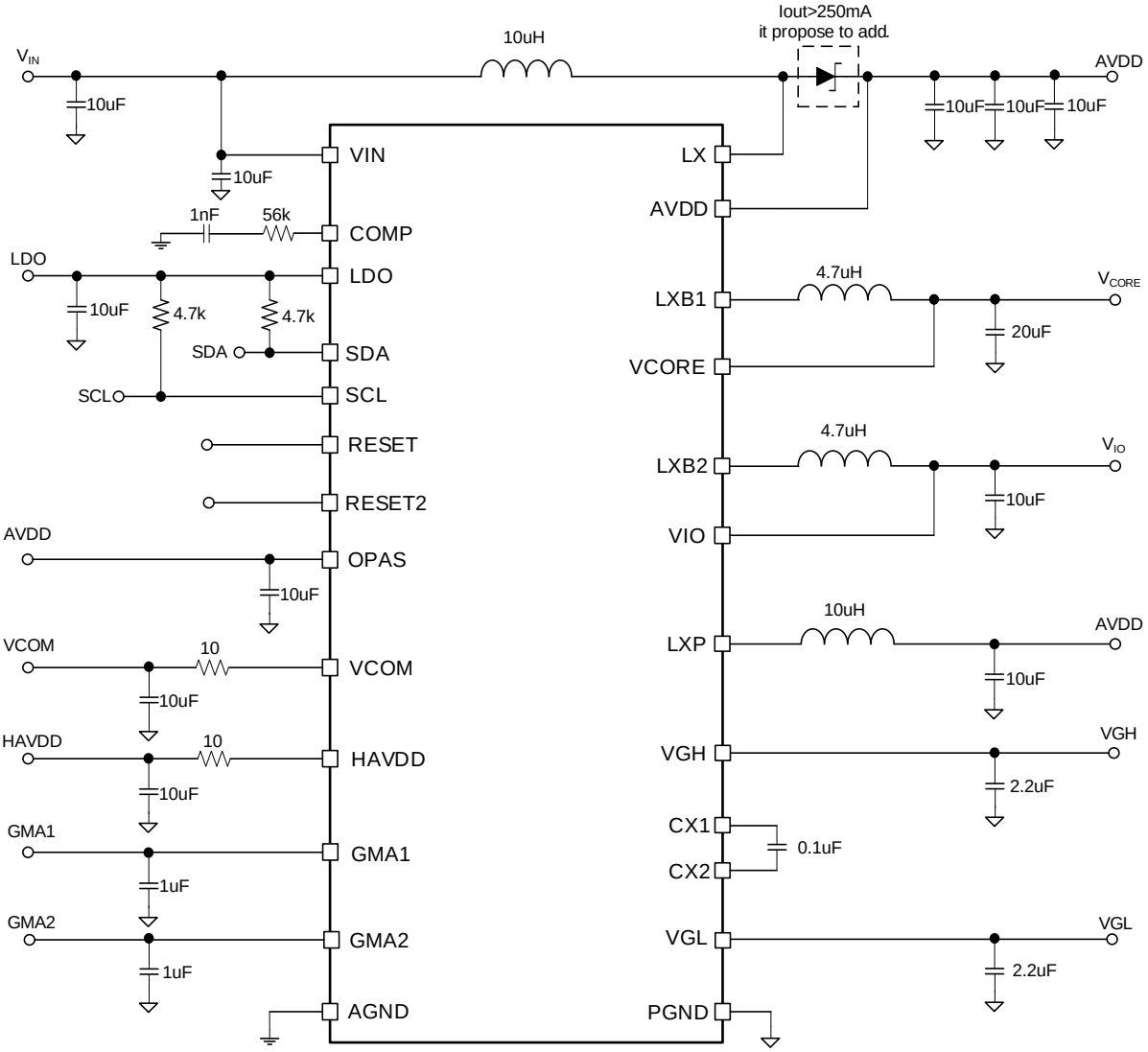


Pin Description

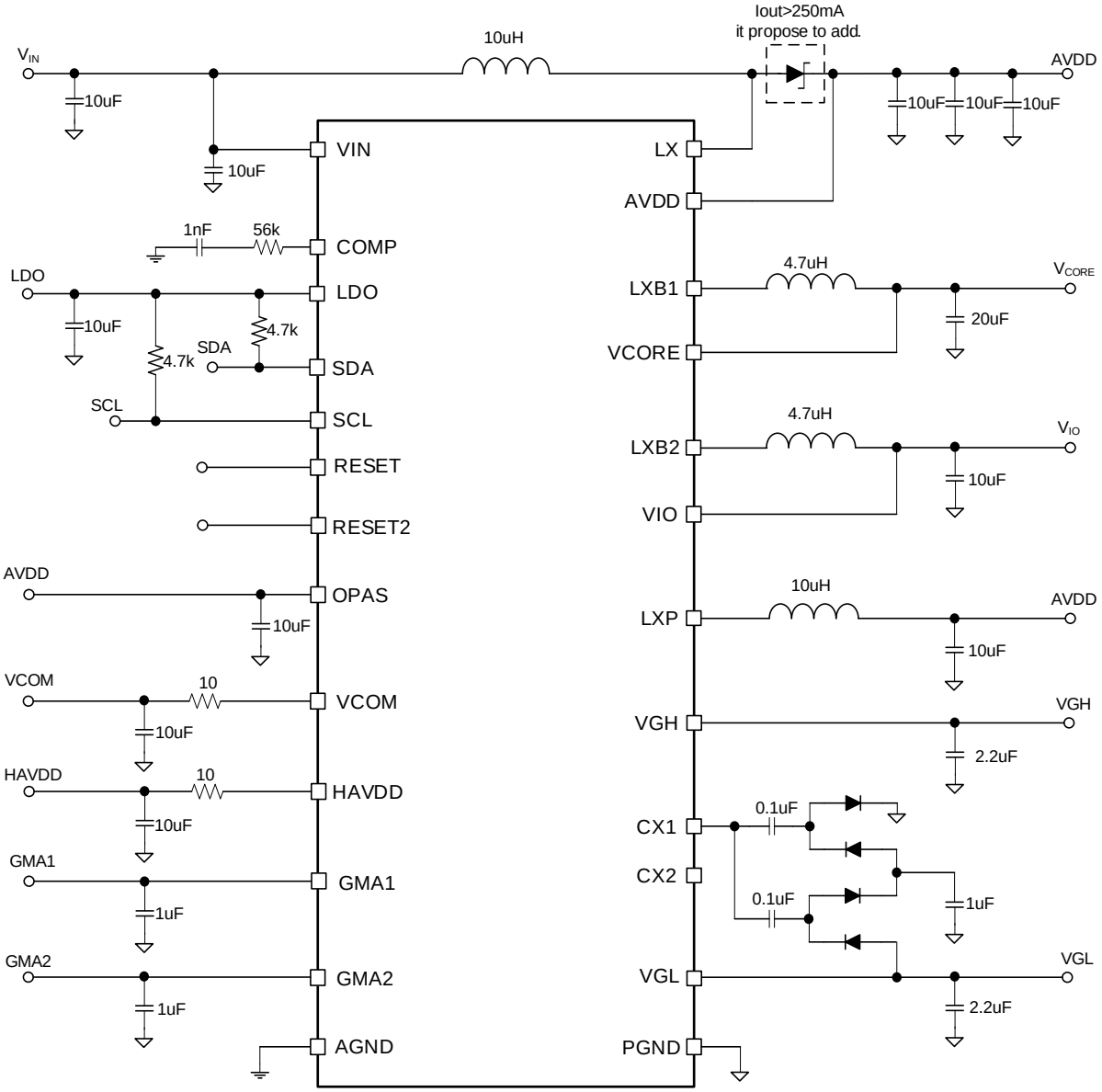
PIN	Symbol	I/O/P	FUNCTION
1	VCORE	I	VCORE output feedback.
2	PGND	G	Power ground
3	LXB1	P	VCORE buck switching node.
4	VIN	P	IC supply voltage input.
5	LXB2	P	VIO buck switching node.
6	PGND	G	Power ground
7	VIO	I	VIO output feedback.
8	RESET2	O	Output of voltage detector function.
9	SDA	I/O	Serial data input/output for I^2C Interface.
10	SCL	I	Clock Input for I^2C interface.
11	RESET	O	Output of voltage detector function.
12	COMP	O	AVDD Boost converter compensation input.
13	AGND	P	Analog Ground.
14	VGL	O	VGL charge pump output voltage.
15	CX2	O	VGL charge pump flying cap node2.
16	CX1	O	VGL charge pump flying cap node1.
17	AVDD	O	Output of AVDD Boost Converter
18	LX	P	Switching Pin of AVDD Boost Converter
19	PGND	G	Power ground
20	LXP	O	VGH switching node.
21	VGH	O	Output of VGH Boost Converter
22	OPAS	I	Power of OP amplifier
23	VCOM	O	VCOM OP-amp output.
24	GMA1	O	Gamma1 output pin.
25	HAVDD	O	HAVDD output pin.
26	PGND	G	Power ground
27	GMA2	O	Gamma2 output pin.
28	LDO	O	LDO Output
29	PGND (Exposed Pad)	P	GND. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation.

Note: P: power/ground; I: Input; O: Output; I/O: Bi-direction

Application Circuit

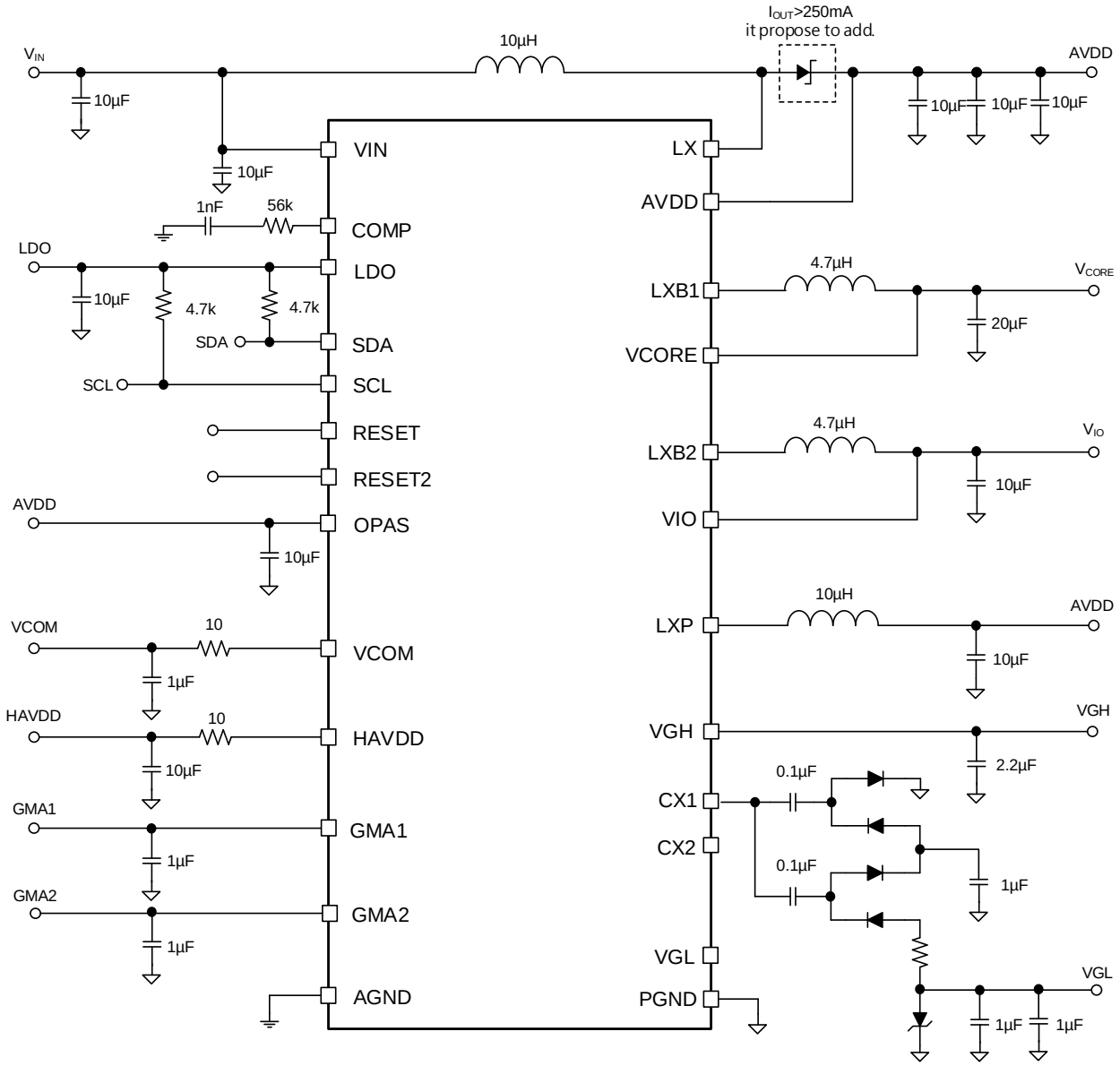


|VGL=-8V| < |AVDD=9V|
Register 0x10 Bit[7:6]=00h (VGL > -(AVDD-0.5V))



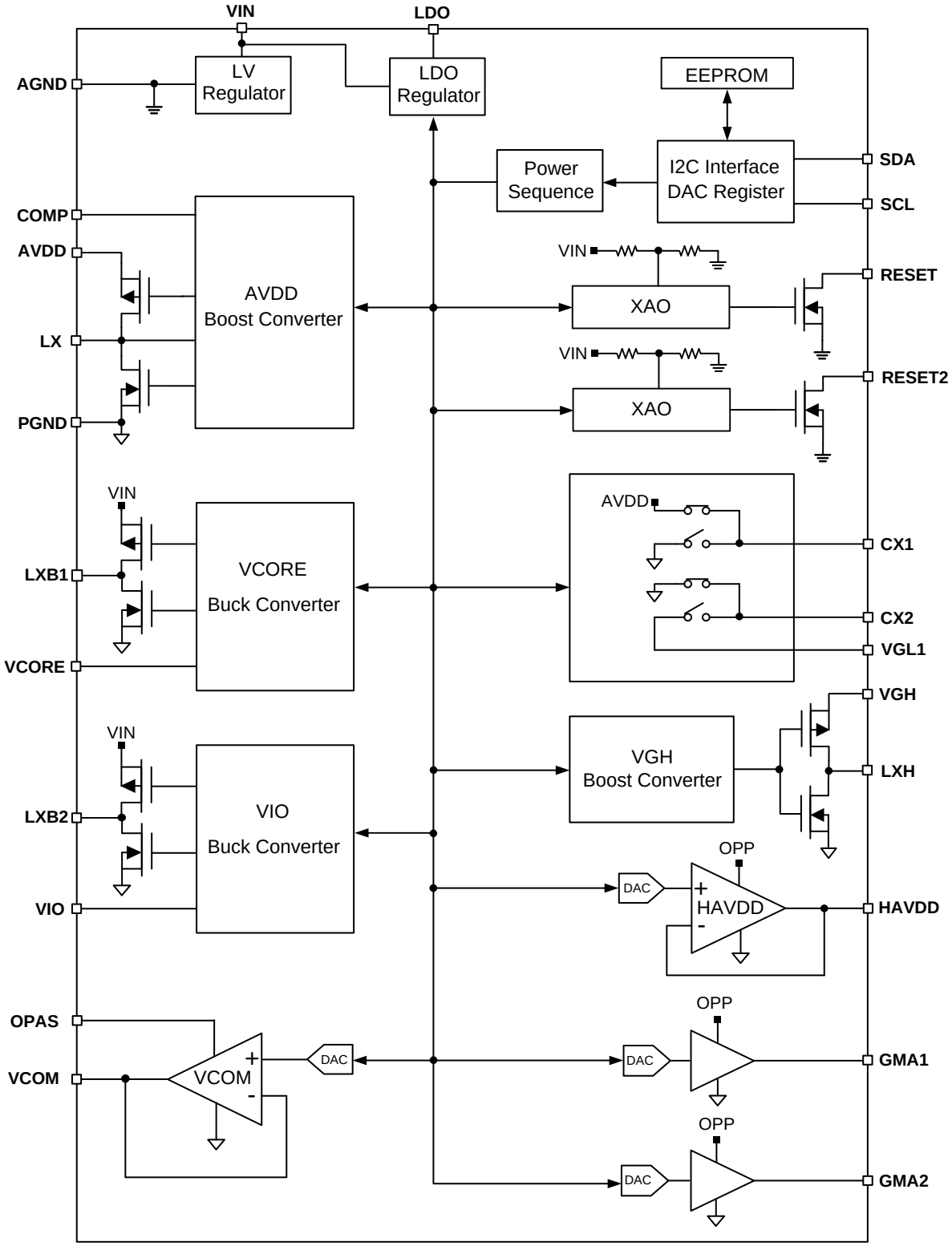
(|VGL=-12V|>|AVDD=9V|)& |VGL|>|VGL max=-13V|

Register 0x10 Bit[7:6]=01h (-13V ≤ VGL ≤ -(AVDD-0.5V))

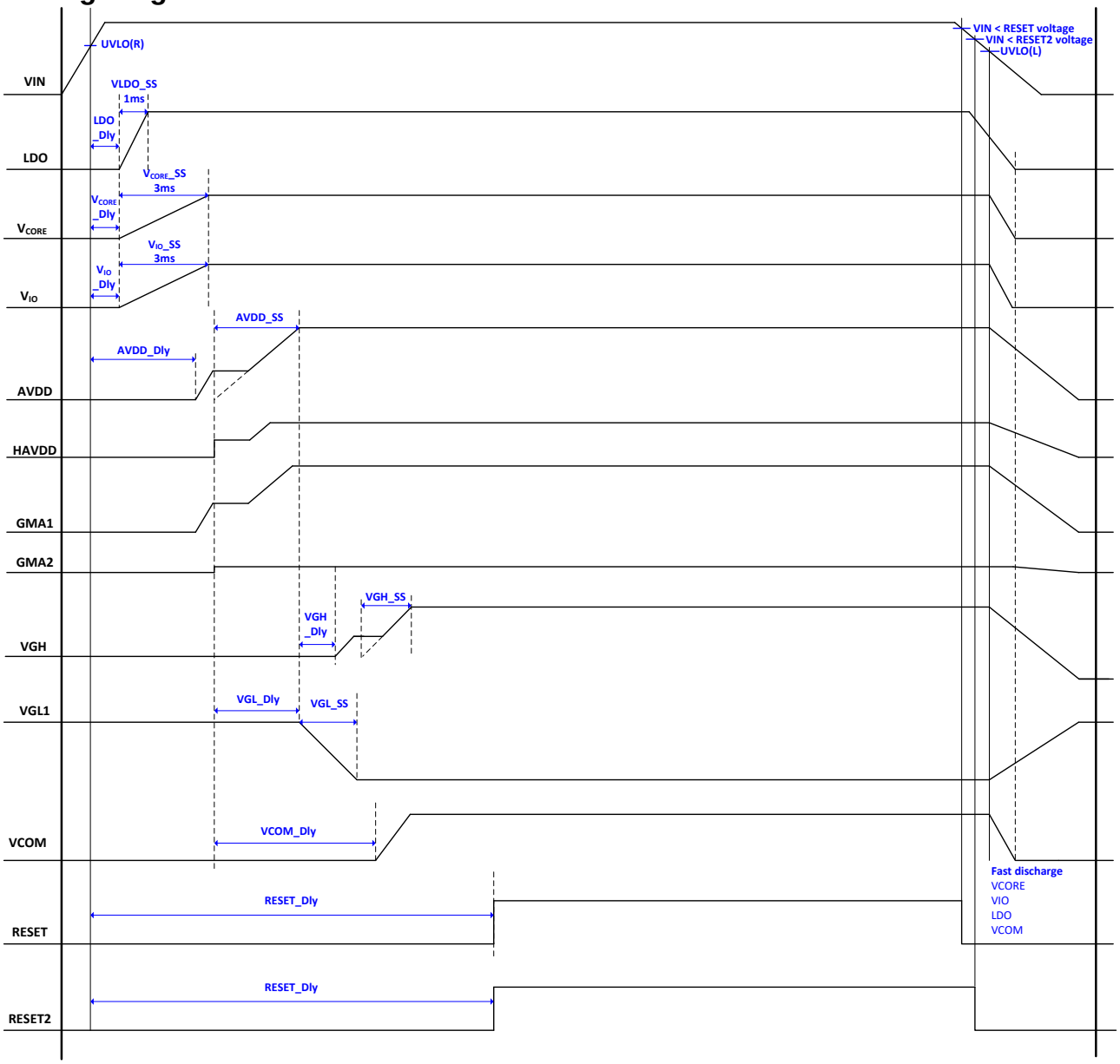


(|VGL=-18V|>|AVDD=9V|)>|VGL max=-13V|
Register 0x10 Bit[7:6]=10h (VGL<-13V)

Block Diagram



Timing Diagram



Note :

1. HAVDD/GAM1/GAM2 can power on with AVDD, but the voltage level can't be higher than AVDD
2. AVDD power on sequence : imbedded MOS for AVDD isolation.
3. Vcom power on delay time range: ~155ms, Power off Vcom to GND ≤ 1ms.

Device Address Setting

PMIC Device Address 7'b0100011

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
PMIC Slave Address 7'b0100011							Read:1 Write:0

Configuration Parameter VCOM Device Address 7'b1001111

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Configuration Parameter VCOM Slave Address 7'b1001111							Read:1 Write:0

PMIC I^2C Command

Write Operation

(a) Write Single Byte to DAC Register

Example : Writing 29h to DAC Address 07h

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	0	1	0	0	0	1	1	0	SLAVE ACK	0	0	0	0	0	1	1	1	SLAVE ACK	0	0	1	0	1	0	0	1	SLAVE ACK	Stop

(b) Write Multi Byte to DAC Register

Example : Writing 29h, 2Ah, 2Bh to DAC Address 06h, 07h, 08h

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Start	0	1	0	0	0	1	1	0	SLAVE ACK	0	0	0	0	0	1	1	0	SLAVE ACK	0	0	1	0	1	0	0	1	SLAVE ACK

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
0	0	1	0	1	0	1	0	SLAVE ACK	0	0	1	0	1	0	1	1	SLAVE ACK	Stop

(C) Write All DAC Register into EEPROM

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
0	1	0	0	0	1	1	0	SLAVE ACK	1	1	1	1	1	1	1	1	SLAVE ACK	1	0	0	0	0	0	0	0	SLAVE ACK	Stop

Read Operation

(a) Read data form DAC register

Example : Reading Data form DAC Register Address 08h, 09h, 0Ah, 0Bh

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	0	1	0	0	0	1	1	0	SLAVE ACK	1	1	1	1	1	1	1	1	SLAVE ACK	0	0	0	0	0	0	0	0	SLAVE ACK	Stop

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Start	0	1	0	0	0	1	1	0	SLAVE ACK	0	0	0	0	1	0	0	0	SLAVE ACK

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Repeat Start	0	1	0	0	0	1	1	1	SLAVE ACK	D	D	D	D	D	D	D	D	Master ACK	D	D	D	D	D	D	D	D	Master ACK

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
D	D	D	D	D	D	D	D	Master ACK	D	D	D	D	D	D	D	D	Master N-ACK	Stop

(b) Read data form EEPROM

Example : Reading Data form EEPROM Address 03h, 04h, 05h, 06h

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	0	1	0	0	0	1	1	0	SLAVE ACK	1	1	1	1	1	1	1	1	SLAVE ACK	0	0	0	0	0	0	0	1	SLAVE ACK	Stop

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Start	0	1	0	0	0	1	1	0	SLAVE ACK	0	0	0	0	0	0	1	1	SLAVE ACK

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Repeat Start	0	1	0	0	0	1	1	1	SLAVE ACK	D	D	D	D	D	D	D	D	Master ACK	D	D	D	D	D	D	D	D	Master ACK

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
D	D	D	D	D	D	D	D	Master ACK	D	D	D	D	D	D	D	D	Master N-ACK	Stop

Configuration Parameter VCOM I²C Command

Write Operation

(a) Write Single Byte to DAC Register

Example : Writing 77h (7bit data) to DAC

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	1	0	0	1	1	1	1	0	SLAVE ACK	1	1	1	0	1	1	1	1	SLAVE ACK	Stop

b) Write Single Byte to DAC Register and EEPROM

Example : Writing 77h (7bit data) to DAC and EEPROM

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	1	0	0	1	1	1	1	0	SLAVE ACK	1	1	1	0	1	1	1	0	SLAVE ACK	Stop

Read Operation

(a) Read Single data from DAC when DAC data same as EEPROM

Example : Read Data from DAC

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	1	0	0	1	1	1	1	1	SLAVE ACK	D	D	D	D	D	D	D	0	SLAVE ACK	Stop

(b) Read Single data from DAC when DAC data different to EEPROM

Example : Read Data from DAC

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
Start	1	0	0	1	1	1	1	1	SLAVE ACK	D	D	D	D	D	D	D	1	SLAVE ACK	Stop

PMIC Register Map:

PMIC Device Address : 0x23h DVCOM Device Address : 0x4Fh

Device Address 0x23h, 0x4Fh

Note	Inst/Prar	7	6	5	4	3	2	1	0	register default	description
	0x00	VCOM_Enable	VLDO_Enable	VIO_Enable	VCORE_Enable	HAVDD_Enable	VGH_Enable	VGL_Enable	AVDD_Enable	0xFF	Channel setting [7:0] : 0h=Disable 1h=Enable
	0x01					VCORE_FCCM _Enable	VIO_FCCM _Enable	RESET_Enable	GMA1/GMA2 _Enable	0x0Fh	Channel setting [1:0] : 0h=Disable 1h=Enable Buck FCCM setting [3:2] : 0h=Enable 1h=Disable
	0x02								VCOM_discharge	0x01h	Channel setting [0] : 0h=Disable 01h=Enable
	0x03		AVDD Voltage							0x14h	AVDD Voltage [6:0] : adjust AVDD output range 7V~13.5V, Resolution : 0.1V/step default : 9V
	0x04		VGL Voltage							0x24h	VGL Voltage [6:0] : adjust VGL output range -4.4V~-13.0V, Resolution : 0.1V/step default :-8V
	0x05				VGH Voltage					0x0Ch	VGH Voltage [4:0] : adjust VGH output range 10.0V~34.0V, Resolution : 1V/step default : 22V
	0x06			HAVDD Voltage						0x0Ah	HAVDD Voltage [5:0] : adjust HAVDD output range 3.5V~6.5V, Resolution : 0.05V/step default : 4V
	0x07				VCORE Voltage					0x08h	VCORE Voltage [4:0] : adjust VCORE output range 0.8V~2V, Resolution : 0.05V/step default : 1.2V
	0x08			VIO Voltage						0x10h	VIO Voltage [5:0] : adjust VIO output range 1.0V~2.8V, Resolution : 0.05V/step default : 1.8V
	0x09					VLDO Voltage				0x07h	VLDO Voltage [3:0] : adjust VLDO output range 1.8V~2.8V, Resolution : 0.1V/step default : 2.5V
	0x0A	VCOM Voltage								0x6Eh	VCOM Voltage [7:0] : adjust VCOM output range 1.5V~6.2V, Resolution : 0.02V/step default : 3.7V
	0x0B						RESET Voltage			0x02h	RESET Voltage [2:0] : adjust RESET output range 2.0V~2.7V, Resolution : 0.1V/step default : 2.2V
	0x0C				GMA1 Voltage					0x02h	GMA1 Voltage [4:0] : adjust GMA1 output range AVDD-0.1V~AVDD-1V, Resolution : 0.05V/step default : AVDD-(4*0.05)V
	0x0D				GMA2 Voltage					0x06h	GMA2 Voltage [4:0] : adjust GMA2 output range 0.1V~1.0V, Resolution : 0.05V/step default :0.4V
	0x0E		AVDD Current Limit		AVDD Slew Rate		AVDD Frequency			0x31h	AVDD FREQ. [2:0] : adjust AVDD FREQ. Range 600kHz~1225kHz default : 715khz (0x001h) AVDD Slew Rate [4:3] : adjust AVDD Slew Rate range default : Normal (0x10h) AVDD Current Limit [6:5] : adjust AVDD Current Limit range 0.5A~2.0A Resolution : 0.5A default : 1A
	0x0F				AVDD Soft Start Time		AVDD Delay Time			0x02h	AVDD Delay Time [2:0] : adjust AVDD Delay Time Range 0ms~35ms Resolution :5ms default : 10ms AVDD Soft Start Time [4:3] : adjust AVDD Soft Start Time range 5ms~20ms Resolution :5ms default : 5ms
	0x10h	VGL Architecture mode		VGL FREQ.	VGL Soft Start Time		VGL Delay Time			0x2Ah	VGL Delay Time [2:0] : adjust VGL Delay Time Range 0ms~35ms Resolution :5ms default : 10ms VGL Soft Start Time [4:3] : adjust VGL Soft Start Time range 2ms~8ms Resolution : 2ms default : 4ms VGL FREQ. [5] : adjust VGL FREQ. Range (0.5*AVDD LX)kHz~(AVDD LX)kHz 0h=(0.5*AVDD LX)kHz 1h=(AVDD LX) kHz = default VGL Architecture mode [7:6] : VGL architecture selected 00h=Mode1=default, VGL Range -4.4V to- -(AVDD-0.5)V 01h=Mode2, VGL Range -(AVDD-0.5)V to -13V 10h=Mode3, VGL<-13V
	0x11h	VGH FREQ.			VGH Soft Start Time		VGH Delay Time			0x34h	VGH Delay Time [2:0] : adjust VGH Delay Time Range 0ms~35ms Resolution :5ms default : 20ms VGH Soft Start Time [4:3] : adjust VGH Soft Start Time range 2ms~8ms Resolution : 2ms default : 6ms VGH FREQ. [7:5] : adjust VGH FREQ. Range 600kHz~1225kHz default : 715khz (0x001h)
	0x12h		LXB1 Slew Rate		LXB1 FREQ.			VCORE Delay Time		0x45h	VCORE Delay Time [1:0] : adjust VCORE Delay Time Range 0ms~9ms Resolution :3ms default : 3ms LXB1 FREQ. [4:2] : adjust VCORE FREQ. Range 600kHz~1225kHz default : 715khz (0x001h) LXB1 Slew Rate [6:5] : adjust VCORE Slew Rate range default : Normal (0x10h)
	0x13h		LXB2 Slew Rate		LXB2 FREQ.			VIO Delay Time		0x45h	VIO Delay Time [1:0] : adjust VIO Delay Time Range 0ms~9ms Resolution :3ms default : 3ms LXB2 FREQ. [4:2] : adjust VIO FREQ. Range 600kHz~1225kHz default : 715khz (0x001h) LXB2 Slew Rate [6:5] : adjust VIO Slew Rate range default : Normal (0x10h)
	0x14							VLDO Delay Time		0x01h	VLDO Delay Time [1:0] : adjust VLDO Delay Time Range 0ms~9ms Resolution :3ms default : 3ms
	0x15					RESET Delay Time				0x07h	RESET Delay Time [3:0] : adjust RESET Delay Time Range 0ms~75ms Resolution :5ms default : 35ms
	0x16			VCOM power off follow	VCOM Delay Time					0x05h	VCOM Delay Time [4:0] : adjust VCOM Delay Time Range 0ms~155ms Resolution :5ms default : 25ms VCOM power off follow setting [5] : 0h=UVLO_F 1h=RESET
	0x17				VCOM power off follow	RESET2 Voltage			RESET2_Enable	0x0Bh	RESET2 setting [0] : 0h=Disable 1h=Enable RESET2 Voltage [3:1] : adjust RESET2 output range 2.0V~2.7V, Resolution : 0.1V/step default : 2.5V VCOM power off follow setting [4] : 0h=Disable, follow 16h[5] 1h=Enable , don't care 16h[5]
	0x18						VLDO discharge	VIO discharge	VCORE discharge	0x00h	Discharge setting [2:0] 0h=Disable 1h=Enable
	0x19				VLDO power off follow	VIO power off follow		VCORE power off follow		0x00h	Buck power off follow [3:0] 00h=UVLO_F 01h=RESET 10h=RESET2 11h=RESET2 VLDO power off follow [3:0] 0h=UVLO_F 1h=RESET
		Configuration Parameter VCOM									
	0xFF	Control Register									00 : Read data form DAC register 01 : Read data from EEPROM 80 : Write all DAC into EEPROM

Registers and DAC Settings

AVDD Voltage Register – Address 03h [6:0]

DAC Value	AVDD Voltage (V)	DAC Value	AVDD Voltage (V)	DAC Value	AVDD Voltage (V)	DAC Value	AVDD Voltage (V)
00h	7	10h	8.6	20h	10.2	30h	11.8
01h	7.1	11h	8.7	21h	10.3	31h	11.9
02h	7.2	12h	8.8	22h	10.4	32h	12
03h	7.3	13h	8.9	23h	10.5	33h	12.1
04h	7.4	14h	9	24h	10.6	34h	12.2
05h	7.5	15h	9.1	25h	10.7	35h	12.3
06h	7.6	16h	9.2	26h	10.8	36h	12.4
07h	7.7	17h	9.3	27h	10.9	37h	12.5
08h	7.8	18h	9.4	28h	11	38h	12.6
09h	7.9	19h	9.5	29h	11.1	39h	12.7
0Ah	8	1Ah	9.6	2Ah	11.2	3Ah	12.8
0Bh	8.1	1Bh	9.7	2Bh	11.3	3Bh	12.9
0Ch	8.2	1Ch	9.8	2Ch	11.4	3Ch	13
0Dh	8.3	1Dh	9.9	2Dh	11.5	3Dh	13.1
0Eh	8.4	1Eh	10	2Eh	11.6	3Eh	13.2
0Fh	8.5	1Fh	10.1	2Fh	11.7	3Fh	13.3
						40h	13.4
						41h	13.5

AVDD LX Frequency Register – Address 0Eh [2:0]

DAC Value	LX FREQ (KHz)	DAC Value	LX FREQ (KHz)	DAC Value	LX FREQ (KHz)
00h	600	02h	800	04h	1000
01h	715	03h	933	06h	1225

AVDD LX Slew Rate – Address 0Eh [4:3]

DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)
00h	Fastest	01h	Fast	02h	Normal	03h	Slow

AVDD Current Limit Register – Address 0Eh [6:5]

DAC Value	Current Limit (A)	DAC Value	Current Limit (A)
00h	0.5	10h	1.5
01h	1	11h	2.0

AVDD Delay Time Register – Address 0Fh [2:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	02h	10	04h	20	06h	30
01h	5	03h	15	05h	26	07h	35

AVDD Soft-Start Time Register – Address 0Fh [4:3]

DAC Value	SS Time (ms)	DAC Value	SS Time (ms)	DAC Value	SS Time (ms)	DAC Value	SS Time (ms)
00h	5	01h	10	02h	15	03h	20

VGL Voltage Register – Address 04h [6:0]

DAC Value	VGL1 Voltage (V)	DAC Value	VGL1 Voltage (V)	DAC Value	VGL1 Voltage (V)	DAC Value	VGL1 Voltage (V)
00h	-4.4	16h	-6.6	2Ch	-8.8	42h	-11
01h	-4.5	17h	-6.7	2Dh	-8.9	43H	-11.1
02h	-4.6	18h	-6.8	2Eh	-9	44H	-11.2
03h	-4.7	19h	-6.9	2Fh	-9.1	45H	-11.3
04h	-4.8	1Ah	-7	30h	-9.2	46H	-11.4
05h	-4.9	1Bh	-7.1	31h	-9.3	47H	-11.5
06h	-5	1Ch	-7.2	32h	-9.4	48H	-11.6
07h	-5.1	1Dh	-7.3	33h	-9.5	49H	-11.7
08h	-5.2	1Eh	-7.4	34h	-9.6	4AH	-11.8
09h	-5.3	1Fh	-7.5	35h	-9.7	4BH	-11.9
0Ah	-5.4	20h	-7.6	36h	-9.8	4CH	-12
0Bh	-5.5	21h	-7.7	37h	-9.9	4DH	-12.1
0Ch	-5.6	22h	-7.8	38h	-10	4EH	-12.2
0Dh	-5.7	23h	-7.9	39h	-10.1	4FH	-12.3
0Eh	-5.8	24h	-8	3Ah	-10.2	50H	-12.4
0Fh	-5.9	25h	-8.1	3Bh	-10.3	51H	-12.5
10h	-6	26h	-8.2	3Ch	-10.4	52H	-12.6
11h	-6.1	27h	-8.3	3Dh	-10.5	53H	-12.7
12h	-6.2	28h	-8.4	3Eh	-10.6	54H	-12.8
13h	-6.3	29h	-8.5	3Fh	-10.7	55h	-12.9
14h	-6.4	2Ah	-8.6	40h	-10.8	56H	-13
15h	-6.5	2Bh	-8.7	41h	-10.9		

VGL1 Delay Time Register – Address 10h [2:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	02h	10	04h	20	06h	30
01h	5	03h	15	05h	25	07h	35

VGL Soft-Start Time Register – Address 10h [4:3]

VGL1 Frequency = 500kHz							
DAC Value	SS Time (ms)	DAC Value	SS Time (ms)	DAC Value	SS Time (ms)	DAC Value	SS Time (ms)
00h	2	01h	4	02h	6	03h	8

VGL Frequency Register – Address 10h [5]

DAC Value	FREQ (kHz)	DAC Value	FREQ (kHz)
00h	0.5*AVDD_LX	01h	AVDD_LX

VGH Voltage Register – Address 05h [4:0]

DAC Value	VGHHOT Voltage (V)	DAC Value	VGHHOT Voltage (V)	DAC Value	VGHHOT Voltage (V)	DAC Value	VGHHOT Voltage (V)
00h	10	06h	16	0Ch	22	12h	28
01h	11	07h	17	0Dh	23	13h	29
02h	12	08h	18	0Eh	24	14h	30
03h	13	09h	19	0Fh	25	15h	31
04h	14	0Ah	20	10h	26	16h	32
05h	15	0Bh	21	11h	27	17h	33
						18h	34

VGH Delay Time Register – Address 11h [2:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	02h	10	04h	20	06h	30
01h	5	03h	15	05h	25	07h	35

VGH Soft-Start Time Register – Address 11h [4:3]

DAC Value	SS Time (ms)	DAC Value	SS Time (ms)	DAC Value	SS Time (ms)	DAC Value	SS Time (ms)
00h	2	01h	4	02h	6	03h	8

LXP Frequency Register – Address 11h [7:5]

DAC Value	LX FREQ (KHz)	DAC Value	LX FREQ (KHz))	DAC Value	LX FREQ (KHz)
00h	600	02h	800	04h	1000
01h	715	03h	933	05h	1225

HAVDD Voltage Register – Address 06h [5:0]

DAC Value	AVDD Voltage (V)	DAC Value	AVDD Voltage (V)	DAC Value	AVDD Voltage (V)	DAC Value	AVDD Voltage (V)
00h	3.5	0Fh	4.25	1Fh	5	2Eh	5.8
01h	3.55	10h	4.3	20h	5.05	2Fh	5.85
02h	3.6	11h	4.35	21h	5.1	30h	5.9
03h	3.65	12h	4.4	22h	5.15	31h	5.95
04h	3.7	13h	4.45	23h	5.2	32h	6
05h	3.75	14h	4.5	24h	5.25	33h	6.05
06h	3.8	15h	4.55	25h	5.3	34h	6.1
07h	3.85	16h	4.6	26h	5.35	35h	6.15
08h	3.9	17h	4.65	27h	5.4	36h	6.2
09h	3.95	18h	4.7	28h	5.45	37h	6.25
0Ah	4	19h	4.75	29h	5.5	38h	6.3
0Bh	4.05	1Ah	4.8	2Ah	5.55	39h	6.35
0Ch	4.1	1Bh	4.85	2Bh	5.6	3Ah	6.4
0Dh	4.15	1Ch	4.9	2Ch	5.65	3Bh	6.45
0Eh	4.2	1Dh	4.95	2Dh	5.7	3Ch	6.5

GMA1 Voltage Register – Address 0Ch [4:0]

DAC Value	GMA1 Voltage (V)	DAC Value	GMA1 Voltage (V)	DAC Value	GMA1 Voltage (V)	DAC Value	GMA1 Voltage (V)
00h	AVDD-(50mVx2)	05h	AVDD-(50mVx7)	0Ah	AVDD-(50mVx12)	0Fh	AVDD-(50mVx17)
01h	AVDD-(50mVx3)	06h	AVDD-(50mVx8)	0Bh	AVDD-(50mVx13)	10h	AVDD-(50mVx18)
02h	AVDD-(50mVx4)	07h	AVDD-(50mVx9)	0Ch	AVDD-(50mVx14)	11h	AVDD-(50mVx19)
03h	AVDD-(50mVx5)	08h	AVDD-(50mVx10)	0Dh	AVDD-(50mVx15)	12h	AVDD-(50mVx20)
04h	AVDD-(50mVx6)	09h	AVDD-(50mVx11)	0Eh	AVDD-(50mVx16)		

GMA2 Voltage Register – Address 0Dh [4:0]

DAC Value	GMA1 Voltage (V)	DAC Value	GMA1 Voltage (V)	DAC Value	GMA1 Voltage (V)	DAC Value	GMA1 Voltage (V)
00h	0.1	05h	0.35	0Ah	0.6	0Fh	0.85
01h	0.15	06h	0.4	0Bh	0.65	10h	0.9
02h	0.2	07h	0.45	0Ch	0.7	11h	0.95
03h	0.25	08h	0.5	0Dh	0.75	12h	
04h	0.3	09h	0.55	0Eh	0.8		

VCORE Voltage Register – Address 07h [4:0]

DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)
00h	0.8	07h	1.15	0Eh	1.5	15h	1.85
01h	0.85	08h	1.2	0Fh	1.55	16h	1.9
02h	0.9	09h	1.25	10h	1.6	17h	1.95
03h	0.95	0Ah	1.3	11h	1.65	18h	2
04h	1	0Bh	1.35	12h	1.7		
05h	1.05	0Ch	1.4	13h	1.75		
06h	1.1	0Dh	1.45	14h	1.8		

VCORE Delay Time Register – Address 12h [1:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	01h	3	02h	6	03h	9

LXB1 Frequency Register – Address 12h [4:2]

DAC Value	LX FREQ (KHz)	DAC Value	LX FREQ (KHz))	DAC Value	LX FREQ (KHz)
00h	600	02h	800	04h	1000
01h	715	03h	933	05h	1225

LXB1 Slew Rate – Address 12h [6:5]

DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)
00h	Fastest	01h	Fast	02h	Normal	03h	Slow

VIO Voltage Register – Address 08h [5:0]

DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)
00h	1	0Ah	1.5	14h	2	1Eh	2.5
01h	1.05	0Bh	1.55	15h	2.05	1Fh	2.55
02h	1.1	0Ch	1.6	16h	2.1	20h	2.6
03h	1.15	0Dh	1.65	17h	2.15	21h	2.65
04h	1.2	0Eh	1.7	18h	2.2	22h	2.7
05h	1.25	0Fh	1.75	19h	2.25	23h	2.75
06h	1.3	10h	1.8	1Ah	2.3	24h	2.8
07h	1.35	11h	1.85	1Bh	2.35		
08h	1.4	12h	1.9	1Ch	2.4		
09h	1.45	13h	1.95	1Dh	2.45		

VIO Delay Time Register – Address 13h [1:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	01h	3	02h	6	03h	9

LXB2 Frequency Register – Address 13h [4:2]

DAC Value	LX FREQ (KHz)	DAC Value	LX FREQ (KHz))	DAC Value	LX FREQ (KHz)
00h	600	02h	800	04h	1000
01h	715	03h	933	05h	1225

LXB2 Slew Rate – Address 13h [6:5]

DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)	DAC Value	S.R. Time (ms)
00h	Fastest	01h	Fast	02h	Normal	03h	Slow

LDO Voltage Register – Address 09h [3:0]

DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)	DAC Value	VCORE Voltage (V)
00h	1.8	03h	2.1	06h	2.4	09h	2.7
01h	1.9	04h	2.2	07h	2.5	0Ah	2.8
02h	2.0	05h	2.3	08h	2.6		

LDO Delay Time Register – Address 14h [1:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	01h	3	02h	6	03h	9

VCOM Voltage Register – Address 0Ah [7:0]

DAC Value	VCOM Voltage (V)	DAC Value	VCOM Voltage (V)	DAC Value	VCOM Voltage (V)	DAC Value	VCOM Voltage (V))	DAC Value	VCOM Voltage (V)
00h	1.5	30h	2.46	60h	3.42	90h	4.38	C0h	5.34
01h	1.52	31h	2.48	61h	3.44	91h	4.4	C1h	5.36
02h	1.54	32h	2.5	62h	3.46	92h	4.42	C2h	5.38
03h	1.56	33h	2.52	63h	3.48	93h	4.44	C3h	5.4
04h	1.58	34h	2.54	64h	3.5	94h	4.46	C4h	5.42
05h	1.6	35h	2.56	65h	3.52	95h	4.48	C5h	5.44
06h	1.62	36h	2.58	66h	3.54	96h	4.5	C6h	5.46
07h	1.64	37h	2.6	67h	3.56	97h	4.52	C7h	5.48
08h	1.66	38h	2.62	68h	3.58	98h	4.54	C8h	5.5
09h	1.68	39h	2.64	69h	3.6	99h	4.56	C9h	5.52
0Ah	1.7	3Ah	2.66	6Ah	3.62	9Ah	4.58	CAh	5.54
0Bh	1.72	3Bh	2.68	6Bh	3.64	9Bh	4.6	CBh	5.56
0Ch	1.74	3Ch	2.7	6Ch	3.66	9Ch	4.62	CCh	5.58
0Dh	1.76	3Dh	2.72	6Dh	3.68	9Dh	4.64	CDh	5.6
0Eh	1.78	3Eh	2.74	6Eh	3.7	9Eh	4.66	CEh	5.62
0Fh	1.8	3Fh	2.76	6Fh	3.72	9Fh	4.68	CFh	5.64
10h	1.82	40h	2.78	70h	3.74	A0h	4.7	D0h	5.66
11h	1.84	41h	2.8	71h	3.76	A1h	4.72	D1h	5.68
12h	1.86	42h	2.82	72h	3.78	A2h	4.74	D2h	5.7
13h	1.88	43h	2.84	73h	3.8	A3h	4.76	D3h	5.72
14h	1.9	44h	2.86	74h	3.82	A4h	4.78	D4h	5.74
15h	1.92	45h	2.88	75h	3.84	A5h	4.8	D5h	5.76
16h	1.94	46h	2.9	76h	3.86	A6h	4.82	D6h	5.78
17h	1.96	47h	2.92	77h	3.88	A7h	4.84	D7h	5.8
18h	1.98	48h	2.94	78h	3.9	A8h	4.86	D8h	5.82
19h	2	49h	2.96	79h	3.92	A9h	4.88	D9h	5.84
1Ah	2.02	4Ah	2.98	7Ah	3.94	AAh	4.9	DAh	5.86
1Bh	2.04	4Bh	3	7Bh	3.96	ABh	4.92	DBh	5.88
1Ch	2.06	4Ch	3.02	7Ch	3.98	ACh	4.94	DCh	5.9
1Dh	2.08	4Dh	3.04	7Dh	4	ADh	4.96	DDh	5.92
1Eh	2.1	4Eh	3.06	7Eh	4.02	AEh	4.98	DEh	5.94
1Fh	2.12	4Fh	3.08	7Fh	4.04	AFh	5	DFh	5.96
20h	2.14	50h	3.1	80h	4.06	B0h	5.02	E0h	5.98
21h	2.16	51h	3.12	81h	4.08	B1h	5.04	E1h	6
22h	2.18	52h	3.14	82h	4.1	B2h	5.06	E2h	6.02
23h	2.2	53h	3.16	83h	4.12	B3h	5.08	E3h	6.04
24h	2.22	54h	3.18	84h	4.14	B4h	5.1	E4h	6.06
25h	2.24	55h	3.2	85h	4.16	B5h	5.12	E5h	6.08
26h	2.26	56h	3.22	86h	4.18	B6h	5.14	E6h	6.1
27h	2.28	57h	3.24	87h	4.2	B7h	5.16	E7h	6.12
28h	2.3	58h	3.26	88h	4.22	B8h	5.18	E8h	6.14
29h	2.32	59h	3.28	89h	4.24	B9h	5.2	E9h	6.16
2Ah	2.34	5Ah	3.3	8Ah	4.26	BAh	5.22	EAh	6.18
2Bh	2.36	5Bh	3.32	8Bh	4.28	BBh	5.24	EBh	6.2
2Ch	2.38	5Ch	3.34	8Ch	4.3	BCh	5.26		
2Dh	2.4	5Dh	3.36	8Dh	4.32	BDh	5.28		
2Eh	2.42	5Eh	3.38	8Eh	4.34	BEh	5.3		
2Fh	2.44	5Fh	3.4	8Fh	4.36	BFh	5.32		

Configuration Parameter VCOM

DAC Value	VCOM Voltage (V)	DAC Value	VCOM Voltage (V)	DAC Value	VCOM Voltage (V)
00h	VCOM-(10mVx64)	2Bh	VCOM-(10mVx21)	56h	VCOM+(10mVx22)
01h	VCOM-(10mVx63)	2Ch	VCOM-(10mVx20)	57h	VCOM+(10mVx23)
02h	VCOM-(10mVx62)	2Dh	VCOM-(10mVx19)	58h	VCOM+(10mVx24)
03h	VCOM-(10mVx61)	2Eh	VCOM-(10mVx18)	59h	VCOM+(10mVx25)
04h	VCOM-(10mVx60)	2Fh	VCOM-(10mVx17)	5Ah	VCOM+(10mVx26)
05h	VCOM-(10mVx59)	30h	VCOM-(10mVx16)	5Bh	VCOM+(10mVx27)
06h	VCOM-(10mVx58)	31h	VCOM-(10mVx15)	5Ch	VCOM+(10mVx28)
07h	VCOM-(10mVx57)	32h	VCOM-(10mVx14)	5Dh	VCOM+(10mVx29)
08h	VCOM-(10mVx56)	33h	VCOM-(10mVx13)	5Eh	VCOM+(10mVx30)
09h	VCOM-(10mVx55)	34h	VCOM-(10mVx12)	5Fh	VCOM+(10mVx31)
0Ah	VCOM-(10mVx54)	35h	VCOM-(10mVx11)	60h	VCOM+(10mVx32)
0Bh	VCOM-(10mVx53)	36h	VCOM-(10mVx10)	61h	VCOM+(10mVx33)
0Ch	VCOM-(10mVx52)	37h	VCOM-(10mVx9)	62h	VCOM+(10mVx34)
0Dh	VCOM-(10mVx51)	38h	VCOM-(10mVx8)	63h	VCOM+(10mVx35)
0Eh	VCOM-(10mVx50)	39h	VCOM-(10mVx7)	64h	VCOM+(10mVx36)
0Fh	VCOM-(10mVx49)	3Ah	VCOM-(10mVx6)	65h	VCOM+(10mVx37)
10h	VCOM-(10mVx48)	3Bh	VCOM-(10mVx5)	66h	VCOM+(10mVx38)
11h	VCOM-(10mVx47)	3Ch	VCOM-(10mVx4)	67h	VCOM+(10mVx39)
12h	VCOM-(10mVx46)	3Dh	VCOM-(10mVx3)	68h	VCOM+(10mVx40)
13h	VCOM-(10mVx45)	3Eh	VCOM-(10mVx2)	69h	VCOM+(10mVx41)
14h	VCOM-(10mVx44)	3Fh	VCOM-(10mVx1)	6AH	VCOM+(10mVx42)
15h	VCOM-(10mVx43)	40h	VCOM	6BH	VCOM+(10mVx43)
16h	VCOM-(10mVx42)	41h	VCOM+(10mVx1)	6CH	VCOM+(10mVx44)
17h	VCOM-(10mVx41)	42h	VCOM+(10mVx2)	6DH	VCOM+(10mVx45)
18h	VCOM-(10mVx40)	43h	VCOM+(10mVx3)	6EH	VCOM+(10mVx46)
19h	VCOM-(10mVx39)	44h	VCOM+(10mVx4)	6FH	VCOM+(10mVx47)
1Ah	VCOM-(10mVx38)	45h	VCOM+(10mVx5)	70H	VCOM+(10mVx48)
1Bh	VCOM-(10mVx37)	46h	VCOM+(10mVx6)	71H	VCOM+(10mVx49)
1Ch	VCOM-(10mVx36)	47h	VCOM+(10mVx7)	72H	VCOM+(10mVx50)
1Dh	VCOM-(10mVx35)	48h	VCOM+(10mVx8)	73H	VCOM+(10mVx51)
1Eh	VCOM-(10mVx34)	49h	VCOM+(10mVx9)	74H	VCOM+(10mVx52)
1Fh	VCOM-(10mVx33)	4Ah	VCOM+(10mVx10)	75H	VCOM+(10mVx53)
20h	VCOM-(10mVx32)	4Bh	VCOM+(10mVx11)	76H	VCOM+(10mVx54)
21h	VCOM-(10mVx31)	4Ch	VCOM+(10mVx12)	77H	VCOM+(10mVx55)
22h	VCOM-(10mVx30)	4Dh	VCOM+(10mVx13)	78H	VCOM+(10mVx56)
23h	VCOM-(10mVx29)	4Eh	VCOM+(10mVx14)	79H	VCOM+(10mVx57)
24h	VCOM-(10mVx28)	4Fh	VCOM+(10mVx15)	7AH	VCOM+(10mVx58)
25h	VCOM-(10mVx27)	50h	VCOM+(10mVx16)	7BH	VCOM+(10mVx59)
26h	VCOM-(10mVx26)	51h	VCOM+(10mVx17)	7CH	VCOM+(10mVx60)
27h	VCOM-(10mVx25)	52h	VCOM+(10mVx18)	7DH	VCOM+(10mVx61)
28h	VCOM-(10mVx24)	53h	VCOM+(10mVx19)	7EH	VCOM+(10mVx62)
29h	VCOM-(10mVx23)	54h	VCOM+(10mVx20)	7FH	VCOM+(10mVx63)
2Ah	VCOM-(10mVx22)	55h	VCOM+(10mVx21)		

VCOM Delay Time Register – Address 16h [4:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
0H	0	08h	40	10h	80	18h	120
1H	5	09h	45	11h	85	19h	125
2H	10	0Ah	50	12h	90	1Ah	130
3H	15	0Bh	55	13h	95	1Bh	135
4H	20	0Ch	60	14h	100	1Ch	140
5H	25	0Dh	65	15h	105	1Dh	145
6H	30	0Eh	70	16h	110	1Eh	150
7H	35	0Fh	75	17h	115	1Fh	155

RESET Voltage Register – Address 0Bh [2:0]

DAC Value	RESET Voltage(V)	DAC Value	RESET Voltage(V)	DAC Value	RESET Voltage(V)	DAC Value	RESET Voltage(V)
00h	2	02h	2.2	04h	2.4	06h	2.6
01h	2.1	03h	2.3	05h	2.5	07h	2.7

RESET2 Voltage Register – Address 17h [3:1]

DAC Value	RESET Voltage(V)	DAC Value	RESET Voltage(V)	DAC Value	RESET Voltage(V)	DAC Value	RESET Voltage(V)
00h	2	02h	2.2	04h	2.4	06h	2.6
01h	2.1	03h	2.3	05h	2.5	07h	2.7

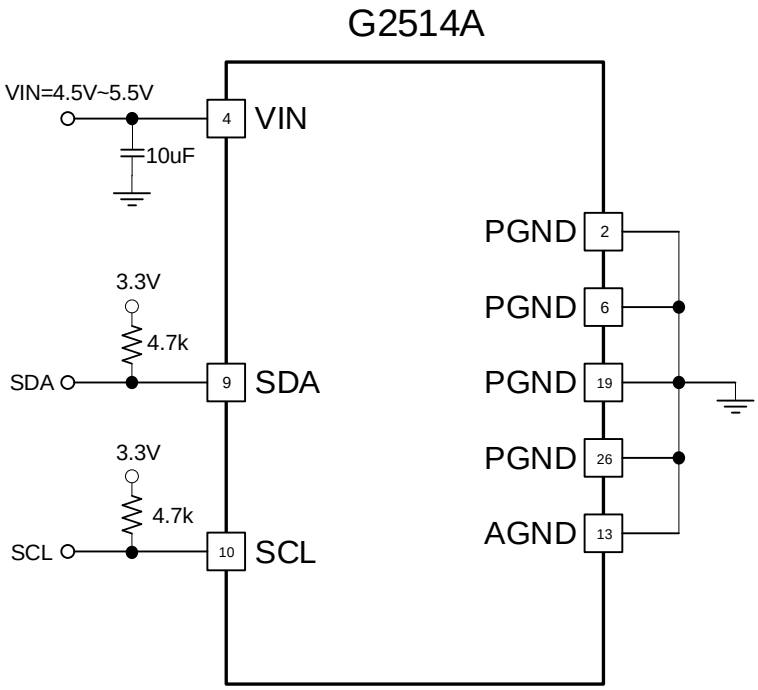
RESET Delay Time Register – Address 15h [3:0]

DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)	DAC Value	Delay Time (ms)
00h	0	04h	20	08h	40	0Ch	60
01h	5	05h	25	09h	45	0Dh	65
02h	10	06h	30	0Ah	50	0Eh	70
03h	15	07h	35	0Bh	55	0Fh	75

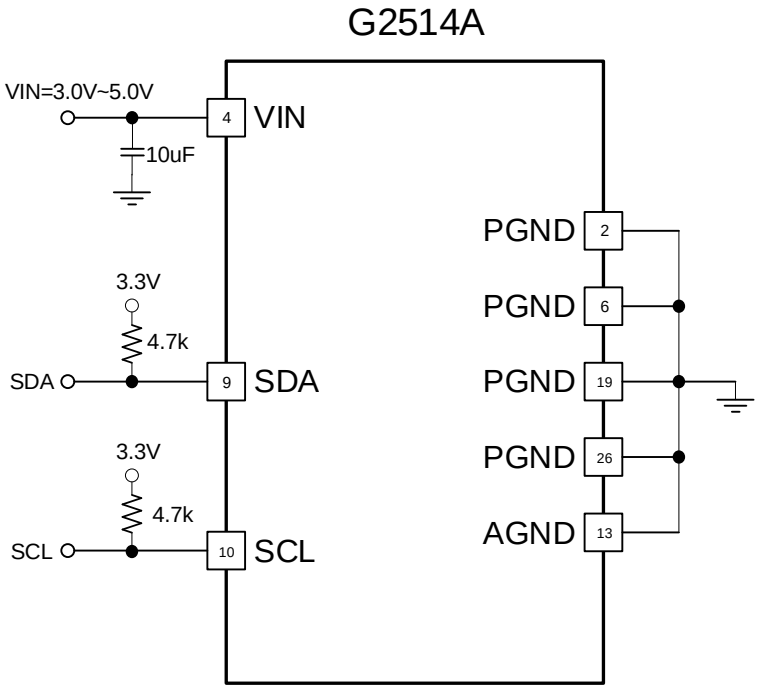
Protection table

Block	Protection	Work Condition	Action
AVDD	OCP	LS MOS current > (2.0A/1.5A/1A/0.5A)	LX stop switching
	UVP	AVDD < AVDD x 80%	IC shut down after count 60ms
	OTP	IC temp > 150	IC shut down
Vcore	OCP	HS MOS current > 1.2A	LXB1 stop switching
	UVP	VOUTB < VOUTB x 80%	IC shut down after count 60ms
	OTP	IC temp > 150	IC shut down
VIO	OCP	HS MOS current > 1.2A	LXB2 stop switching
	UVP	VOUTB < VOUTB x 80%	IC shut down after count 60ms
	OTP	IC temp > 150	IC shut down
LDO	OCP	Output Current >200mA	Current Limit to OCP level
	UVP	VLDO < VLDO x 60%	IC shut down after count 60ms
	OTP	IC temp > 150	IC shut down
VGH	OCP	LS MOS current > 0.7A	LXP stop switching
	UVP	VGH < VGH x 80%	IC shut down after count 60ms
	OTP	IC temp > 150	IC shut down
VGL	UVP	VGL > VGL x 70%	IC shut down after count 60ms
	OTP	IC temp > 150	IC shut down
VCOM	OCP	Output Current >+/-150mA	Current Limit to OCP level
	OTP	IC temp > 150	IC shut down
HAVDD	OCP	Output Current >+/-250mA	Current Limit to OCP level
	OTP	IC temp > 150	IC shut down
GMA1/ GMA2	OCP	Output Current >+/-5mA	Current Limit to OCP level
	OTP	IC temp > 150	IC shut down

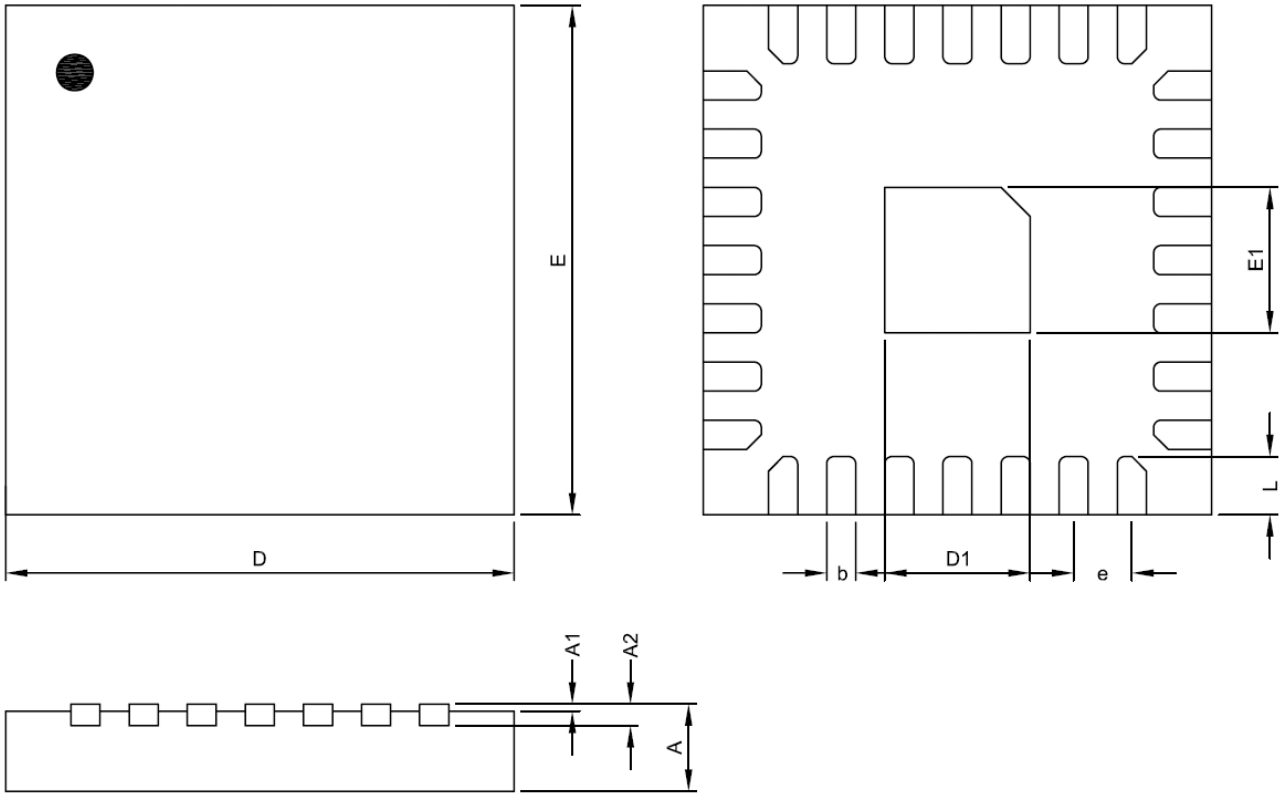
Coding Circuit for Single Chip



Coding Circuit for Panel Module



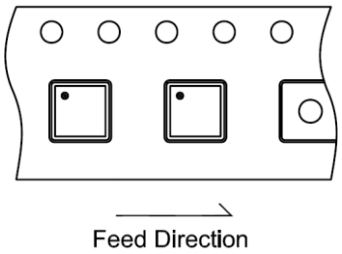
Package Information



WQFN3.5X3.5-28 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.50	0.55	0.60	0.0197	0.0217	0.0236
A1	0.00	- - -	0.05	0.0000	- - -	0.0020
A2	0.150 REF			0.0059 REF		
D	3.45	3.50	3.55	0.1358	0.1378	0.1398
E	3.45	3.50	3.55	0.1358	0.1378	0.1398
D1	0.95	1.00	1.05	0.0374	0.0394	0.0413
E1	0.95	1.00	1.05	0.0374	0.0394	0.0413
b	0.15	0.20	0.25	0.0059	0.0079	0.0098
e	0.40 BSC			0.0157 BSC		
L	0.35	0.40	0.45	0.0138	0.0157	0.0177

Taping Specification



PACKAGE	Q'TY/REEL
WQFN3.5X3.5-28	3,000 ea