PROGRAMMABLE VCOM BUFFER

FEATURES

- **I²C Interface**
- **Output Range Adjustable by Resistors**
- **7 Bits Adjustable Sink Current Output**
- **2.6V to 5.5V Logic Voltage**
- **6V to 18V Analog Voltage**
- **EEPROM for VCOM Value Memory**
- **High SR, 200mA Output Short-Current OP**

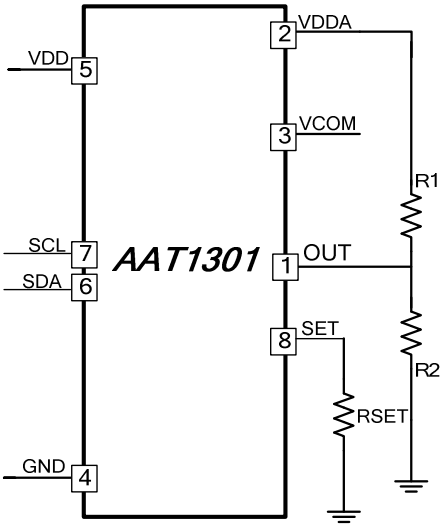
GENERAL DESCRIPTION

The AAT1301 is a programmable VCOM buffer for TFT LCD panel application. VCOM voltage can be adjusted and recorded by I²C interface in this device. In addition, users may also set VCOM voltage with 7-Bit accuracy (128 steps). To make AAT1301 an even easier component to use, all programmed settings can be stored in the EEPROM and recalled during power-up.

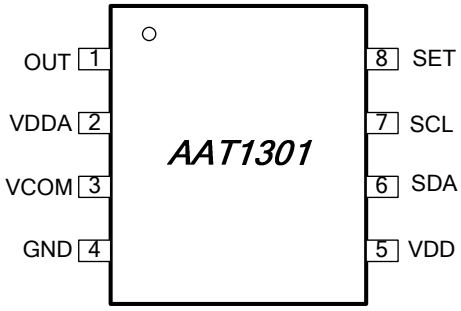
APPLICATIONS

- **TFT LCD Panel**

TYPICAL APPLICATION



PIN CONFIGURATION



ORDERING INFORMATION

DEVICE TYPE	PART NUMBER	PACKAGE	PACKING	TEMP RANGE	MARKING	MARKING DESCRIPTION
AAT1301	AAT1301-T2-T	T2: TSSOP8	T: Tape and Reel	–20°C to +85°C	AAT1301 XXXXXX	Device Type Lot no. (6~9 Digits)
AAT1301	AAT1301-Q9-T	Q9: VSON8L-3x3	T: Tape and Reel	–20°C to +85°C	AAT1301 XXXXXX	Device Type Lot no. (6~9 Digits)

Note: All AAT products are lead free and halogen free.

ABSOLUTE MAXIMUM RATINGS

CHARACTERISTICS	SYMBOL	VALUE	UNIT
Supply Analog Voltage	V_{DDA}	19	V
Supply Logic Voltage	V_{DD}	6	V
Input Voltages to GND (SET, SCL, SDA)	V_I	–0.5V to V_{DD} +0.5V	V
Output Voltages to GND (OUT, VCOM)	Vo	–0.5V to V_{DDA} +0.5V	V
Maximum Junction Temperature	T_J	+125	°C
Operating Temperature	T_C	–20 to +85	°C
Storage Temperature	$T_{STORAGE}$	–45 to +125	°C
Lead Temperature (Soldering for 10 Seconds)		260	°C

Note: Stresses exceeding values indicated in ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. Exposure to ABSOLUTE MAXIMUM RATINGS conditions for extended period of time may also compromise device reliability.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Operating Free-Air Temperature	T_C	–20	+85	°C

ELECTRICAL CHARACTERISTICS

(V_{DD} = 2.6V to 5.5V, T_C = –40°C to +85°C , unless otherwise specified. Typical values are tested at +25°C ambient temperature, while V_{DD} = 3.3V, and V_{DDA} = 10V.)

Operating Power

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Input Supply Analog Voltage	V_{DDA}		8	-	18	V
Input Supply Logic Voltage	V_{DD}		2.6	-	5.5	V
VDD Under Voltage Lockout	V_{UVLO}	Rising	2.1	2.2	2.3	V
		Hysteresis	-	0.1	-	V
Logic Supply Current	I_{VDD}		-	-	700	µA
Analog Supply Current	I_{VDDA}		-	-	3	mA

V_{COM} Buffer

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Output Swing Low	V_{OL}	I_L = 10mA, V_I = 1V	-	1.02	1.05	V
Output Swing High	V_{OH}	I_L = –10mA, V_I = 9V	8.95	8.98	-	V
Output Swing	V_{SH}	I_L = 50mA, V_I = 5V	-	5.03	5.05	V
	V_{SL}	I_L = –50mA, V_I = 5V	4.95	4.97	-	V
Slew Rate	SR	V_I = 2V to +8V, 20% to 80%	-	15	-	V/µs
Peak Drive Current	I_{SC}	V_I = 5V, C_{OUT} = 0.47µF	-	±150	-	mA

Nonvolatile Memory Characteristics

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
EEPROM Write Cycle			10,000	-	-	Write

ELECTRICAL CHARACTERISTICS

(V_{DD} = 2.6V to 5.5V, T_C = –40°C to +85°C , unless otherwise specified. Typical values are tested at +25°C ambient temperature, V_{DD} = 3.3V. V_{DDA} = 10V.)

DC Electrical Characteristic

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
OUT Voltage Range	V_{OUT}		V_{SET} +0.5	-	18.0	V
Set External Resistance	R_{SET}	V_{DDA} = 8V	3.35	-	67.00	kΩ
		V_{DDA} = 18V	6.75	-	135.00	kΩ
Set Current	I_{SET}		-	-	134	μA
SDA SCL Pull Up Resistor	R_{PU}		4.7	10.0	-	kΩ

AC Electrical Characteristics

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
SCL Clock Frequency	f_{SCL}		1	-	400	kHz
SDA SCL Capacitive Loading	CB		-	-	400	pF
EEPROM Write Time	tw		-	10	25	ms

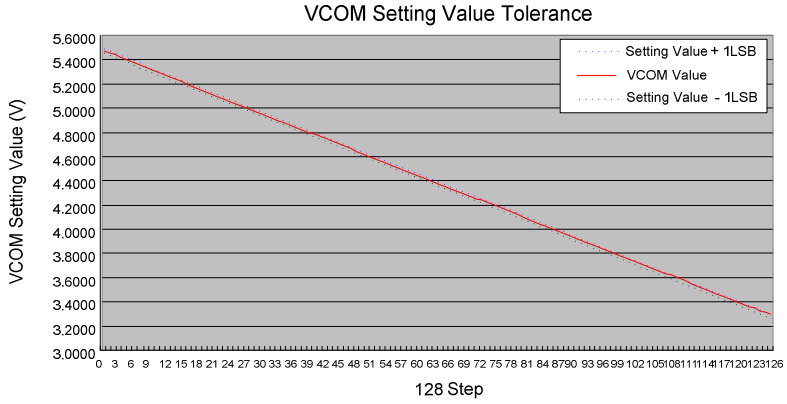
PIN DESCRIPTION

PIN NO.	NAME	I/O	DESCRIPTION
1	OUT	O	Adjustable Sink-Current Output to VCOM Voltage Buffer
2	VDDA	P	Analog Power Supply
3	VCOM	O	VCOM Voltage
4	GND	P	Ground
5	VDD	P	Logic Power Supply
6	SDA	I/O	I^2C Data Port
7	SCL	I	I^2C CLK Port
8	SET	O	Maximum Sink Current Adjustment Point

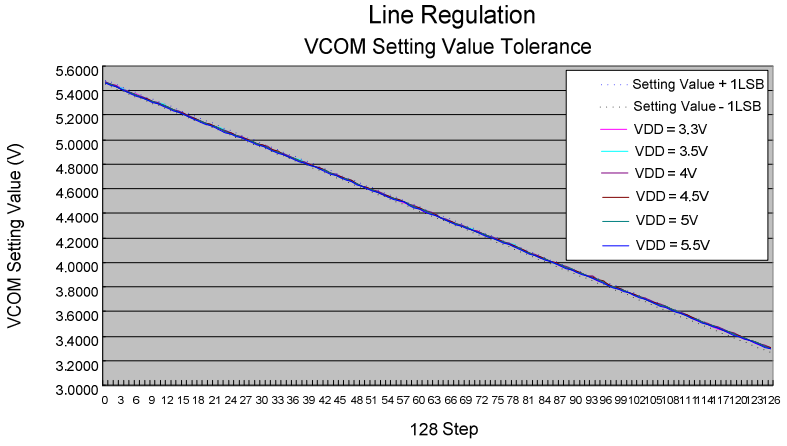
TYPICAL OPERATING CHARACTERISTICS

(AVDD = 10V, R1 = 200kΩ, R2 = 243kΩ, and R_{SET} = 24.9kΩ, T_C = +25°C Unless Otherwise Specified.)

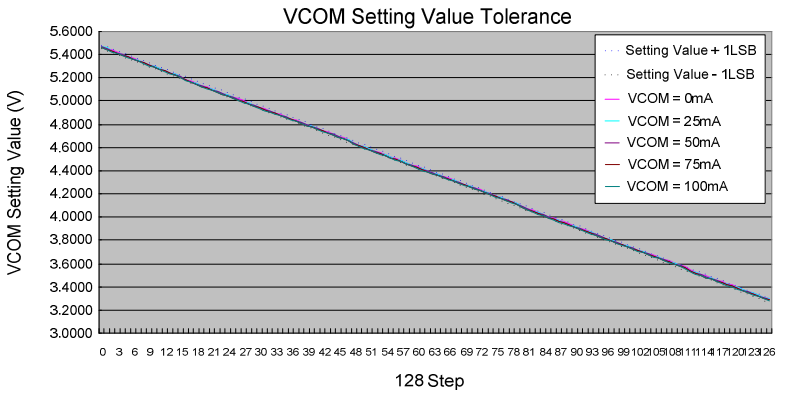
VCOM Setting Value Tolerance



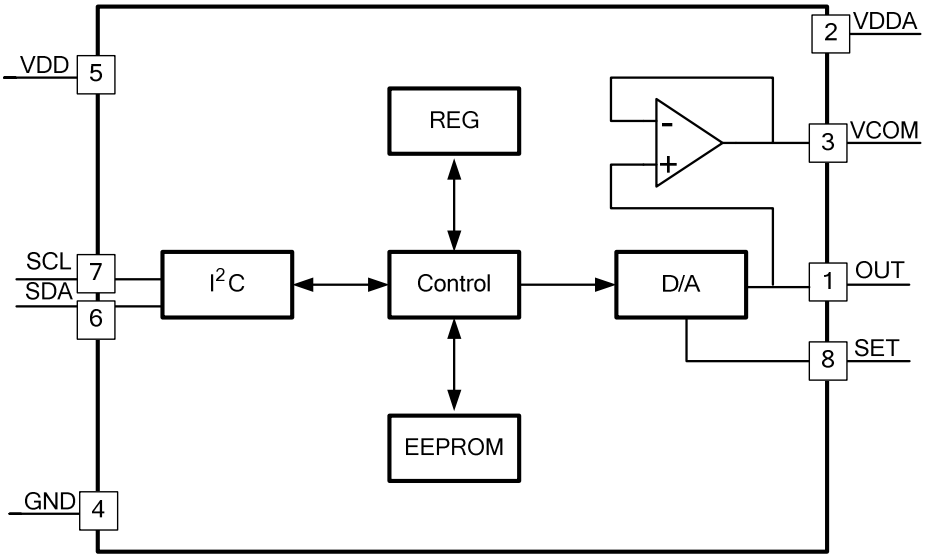
Line Regulation



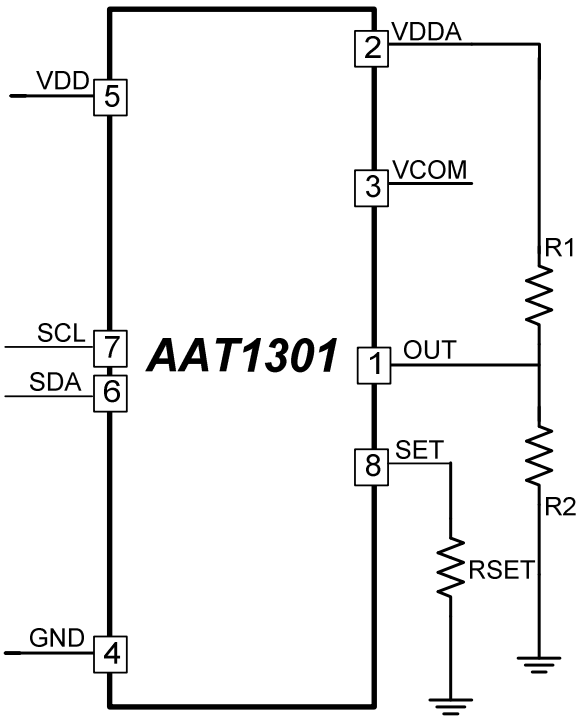
Load Regulation



FUNCTION BLOCK DIAGRAM



TYPICAL APPLICATION CIRCUIT



DETAILED DESCRIPTION

The AAT1301 adjusts output voltage by sinking current. Users may easily calculate output voltage by using the following equation:

$$V_{OUT} = VDDA * \frac{R2}{R1+R2}\left(1-\frac{(SETTING+1)*R1}{20*128*R_{SET}}\right)$$

"SETTING" represents the 7-Bit D/A converter setting value in above equation. It can be read or written by the I^2C interface. The I^2C interface protocol is shown in Figure 2.

Where:

Bit 1~7: Slave Address 1001111

Bit 8: = 1 Reading Command

= 0 Writing Command

Bit 9, 18: Slave Acknowledgement

Bit 10 ~ 16: SETTING Value

Bit 17: In Slave Writing Command (Bit 8 = 0),

"Bit17 = 1" Write Data into REG

"Bit17 = 0" Write Data into EEPROM.

In Reading Operation (Bit 8 = 1),

Bit 17 can be 1 or 0.

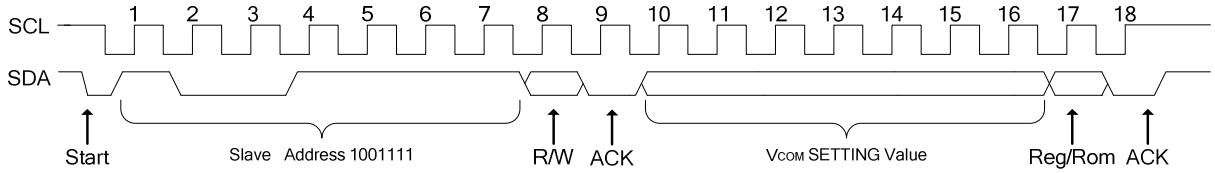


Figure 2. The I^2C Interface Protocol

DESIGN PROCEDURE

One of many important functions of AAT1301 is to minimize flicker in TFT-LCD panels by adjusting VCOM voltage. AAT1301 is attached to an external resistive voltage-driver to sink a programmable current (IOUT), which determines the VCOM voltage. Eq. 1 and Eq.2 can be used to calculate the output current (IOUT) and output voltage (VCOM).

$$IOUT = \frac{(SETTING+1)}{128} * \frac{VDDA}{20(R_{SET})} \quad \text{.....Eq. 1}$$

$$VCOM = VDDA * \frac{R2}{R1+R2}\left(1-\frac{(SETTING+1)}{128} * \frac{R1}{20(R_{SET})}\right) \quad \text{.....Eq. 2}$$

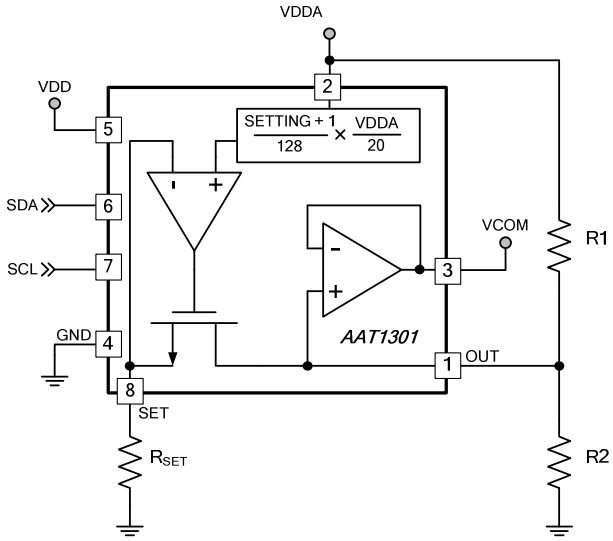


Figure 3. Application Circuit

Table 1 shows calculated value of VCOM under following condition:

AVDD = 10V, R1 = 200kΩ, R2 = 243kΩ, and R_{SET} = 24.9kΩ.

Table 1. VCOM Setting Value

SETTING VALUE	VCOM(V)
0	5.4681
10	5.2960
20	5.1239
30	4.9518
40	4.7797
50	4.6076
60	4.4355
70	4.2634
80	4.0913
90	3.9192
100	3.7471
110	3.5750
127	3.2824

LAYOUT CONSIDERATION

Power Supply Bypassing and PCB Layout

AAT1301 performs stable gain at high frequency. Users of this device are highly recommended to use ground plane construction. To reduce oscillation, lead lengths should be as short as possible and the power supply pins must be well bypassed.

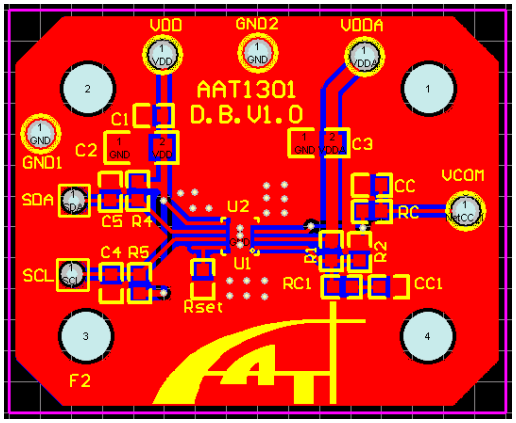


Figure 4. TOP Layer

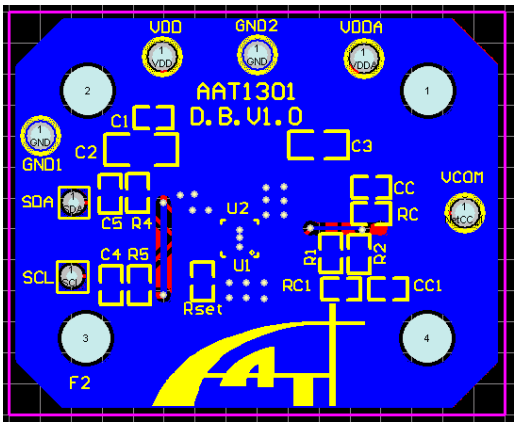
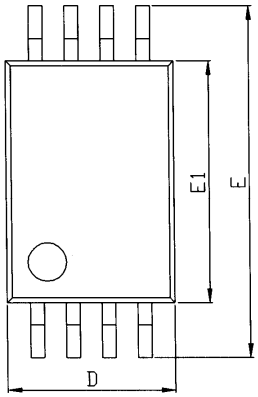
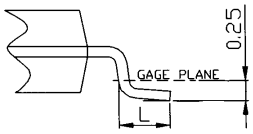


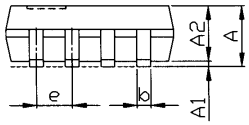
Figure 5. Bottom Layer

PACKAGE DIMENSION

TSSOP8



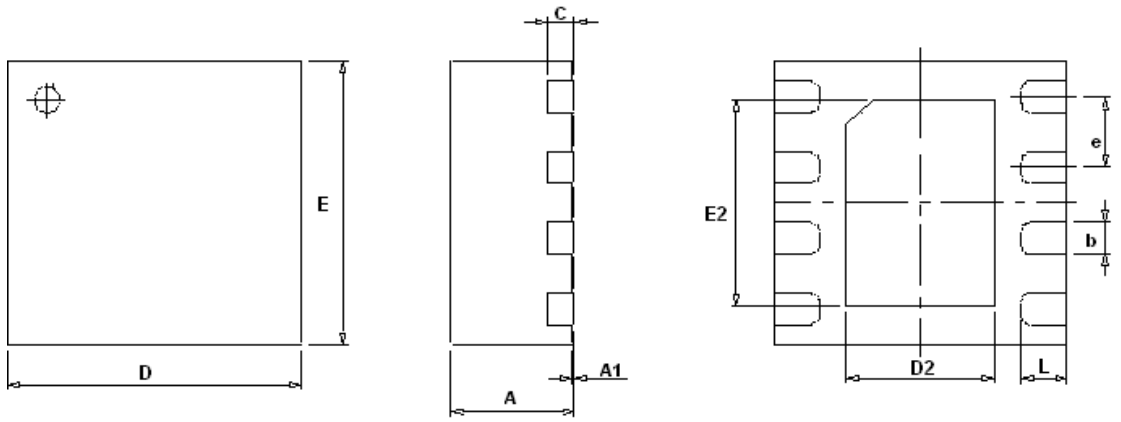




Symbol	Dimensions In Millimeters		
	MIN	TYP	MAX
A	1.05	1.10	1.20
A1	0.05	0.10	0.15
A2	0.80	1.00	1.05
b	0.19	-----	0.30
D	2.90	3.05	3.10
E	6.2	6.4	6.6
E1	4.3	4.4	4.5
e	-----	0.65	-----
L	0.40	0.60	0.75

PACKAGE DIMENSION

VSON8L-3x3



Symbol	Dimensions In Millimeters		
	MIN	TYP	MAX
A	0.8	0.9	1.0
A1	0	0.02	0.05
b	0.25	0.30	0.35
C	0.19	0.20	0.25
D	2.9	3.0	3.1
D2	1.65	1.70	1.75
E	2.9	3.0	3.1
E2	1.95	2.00	2.05
e	------	0.65	------
L	0.30	0.35	0.40
y	0	------	0.076