

AS1101, AS1102, AS1103, AS1104

Low-Dropout LED Drivers

Data Sheet

1 General Description

The AS110x family are LED drivers providing matched current source bias for any color LED, including white and blue. LED current is programmable using an external resistor.

The AS1101 LED currents are typical $460 \times I_{SET}$ (per LED) at an LED cathode voltage of 150mV and typical $650 \times I_{SET}$ at an LED cathode voltage of 1V.

The AS1102, AS1103, and AS1104 LED currents are typical $230 \times I_{SET}$ (per LED) at an LED cathode voltage of 150mV and typical $325 \times I_{SET}$ at an LED cathode voltage of 1V where I_{SET} is the current through the external resistor connected to the CTRL pin.

The AS110x family can drive up to 4 high-current LEDs. The AS1101, AS1102, and AS1104 incorporate a chip-enable feature via pin ON. When the devices are disabled, the supply current drops to less than $1\mu\text{A}$.

The devices are pin-to-pin compatible to the FAN5611, FAN5612 and FAN5614.

The AS1101, AS1102, and AS1103 are available in a 6-pin SC70 package; the AS1104 is available in a 8-pin MSOP package.

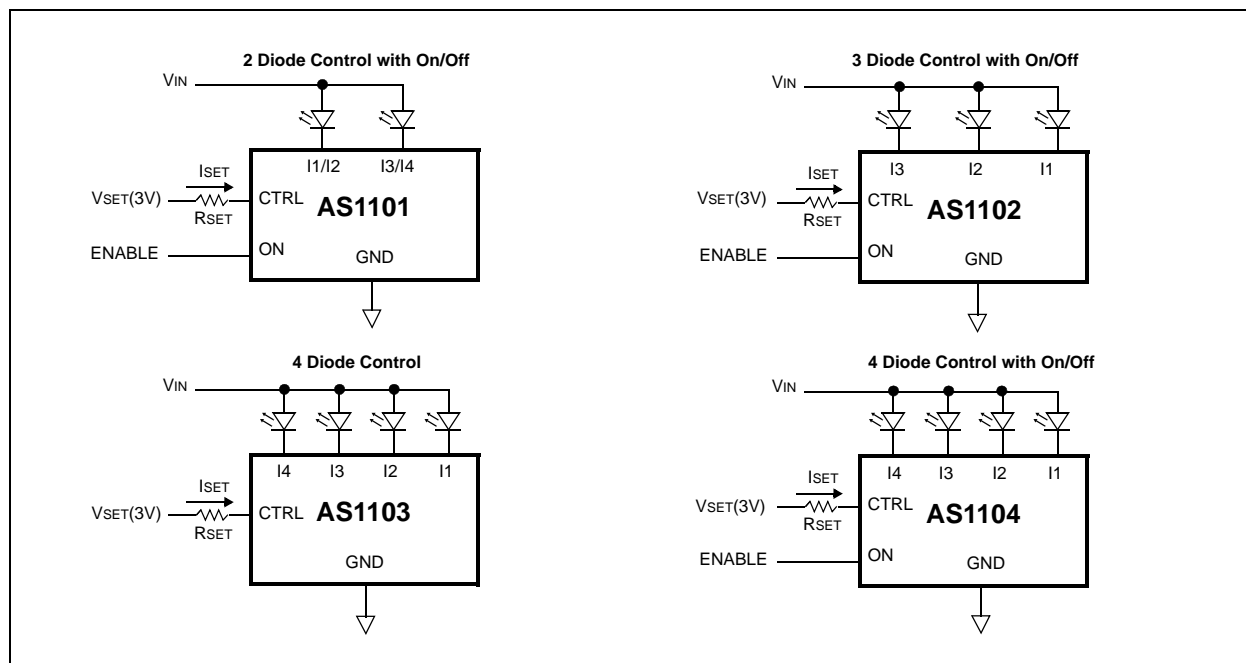
2 Key Features

- LED Drivers for Parallel-Connected LEDs
- Ultra-Low Voltage Drop: Less Than 150mV (for Li-ion Battery Support)
- Analog and PWM Brightness Control
- Up to 80mA per LED (AS1101)
- Up to 40mA per LED (AS1102, AS1103, AS1104)
- No Electromagnetic Interference, No Switching-Noise
- Current-Matching Requires No External Components
- Active-Low Shutdown Mode (AS1101, AS1102, and AS1103)
- Low Shutdown-Current: Less Than $1\mu\text{A}$
- SC70-6 Package (AS1101, AS1102, and AS1103)
- MSOP-8 Package (AS1104)
- Pin-to-Pin Compatible to FAN5611, FAN5612, and FAN5614

3 Applications

The AS110x devices are ideal for LED displays and keyboard backlights, as well as lighting management units for battery powered audio devices such as MP3 and CD players, mobile and cordless phones, PDAs, portable DVD players, and consumer electronics.

Figure 1. Typical Application Diagrams



4 Absolute Maximum Ratings

Stresses beyond those listed in Table 1 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those listed in Table 2 is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 1. Absolute Maximum Ratings

Parameter	Min	Max	Unit	Comment
V _{I1} , V _{I2} , V _{I3} , V _{I4} , CTRL and ON Voltage to GND	-0.3	5	V	
Power Dissipated by Device at T _{AMB} = 85°C		200	mW	SC70-6
		250	mW	MSOP-8
I ₁ , I ₂ , I ₃ , I ₄ Steady State Current		100	mA	
Package Body Temperature †		260	°C	
Junction Temperature		150	°C	
Storage Temperature	-65	150	°C	
Electrostatic Discharge Protection (ESD) Level	2		kV	Human Body Model; Norm: MIL-STD883E 3015 methods.

† The reflow peak soldering temperature (body temperature) is specified according to IPC/JEDEC J-STD-020C "Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices".

4.1 Operating Conditions

Table 2. Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit	Comments
LED Cathode Voltage	0.15	0.6	3.6	V	
Enable Voltage ON Mode †	2.2	3.0	3.6	V	
Enable Voltage OFF Mode †	0	0.2	0.5	V	
Ambient Temperature	-40	25	85	°C	

† Not applicable to AS1103.

5 DC Electrical Characteristics

5.1 Electrical Characteristics – AS1101

Conditions: $T_{AMB} = 25^{\circ}\text{C}$ (unless otherwise noted).

Table 3. Electrical Characteristics – AS1101

Parameter	Symbol	Conditions	Min	Typ	Max	Units
ISET Range	ISET	$V_{ON} = 3\text{V}$	25		150	μA
Output Current Multiplication Ratio	OCMR	$I_{SET} = 25\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$	350	500	650	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 40\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$	315	450	585	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 75\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$	295	420	545	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 25\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$	435	620	805	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 40\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$	425	610	795	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 75\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$	415	590	765	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 25\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$	470	670	870	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 40\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$	460	660	860	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 75\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$	440	630	820	
LED-to-LED Current Matching	Match	$V_{ON} = 3\text{V}$	-3		3	%
ISET in OFF Mode	$I_{SET,OFF}$	$V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$		0.1	1	μA
IIN in OFF Mode	$I_{IN,OFF}$	$V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$, $T_{AMB} = 25^{\circ}\text{C}$		0.1	1	μA
		$V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$			4	
Peak Efficiency [†]	EFF	$V_{IN} = 3\text{V}$, $V_{ON} = 3\text{V}$	95			%

[†] Efficiency = $(V_{IN} - V_{SAT}) / V_{IN}$. Information parameter, guaranteed by design.

5.2 Electrical Characteristics – AS1102, AS1103, AS1104

Conditions: $T_{AMB} = 25^{\circ}\text{C}$ (unless otherwise noted).

Table 4. Electrical Characteristics – AS1102, AS1103, AS1104

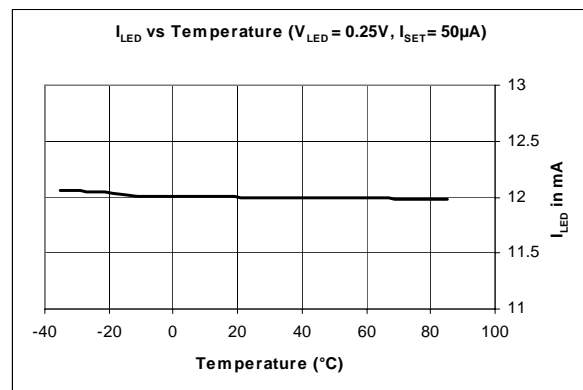
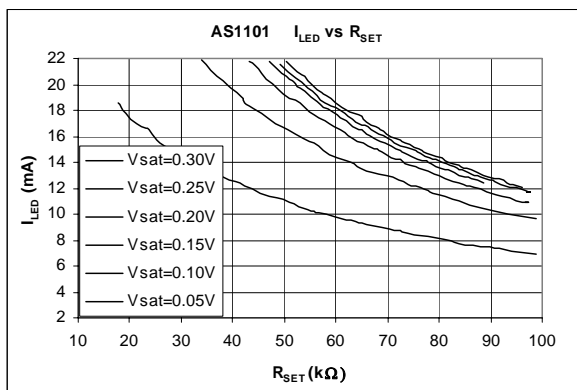
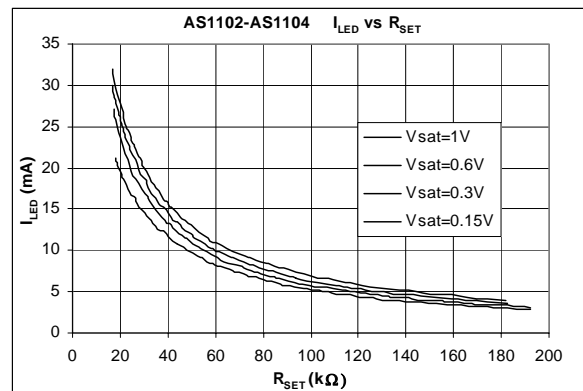
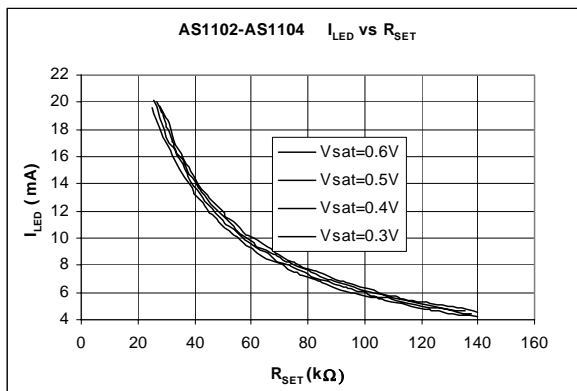
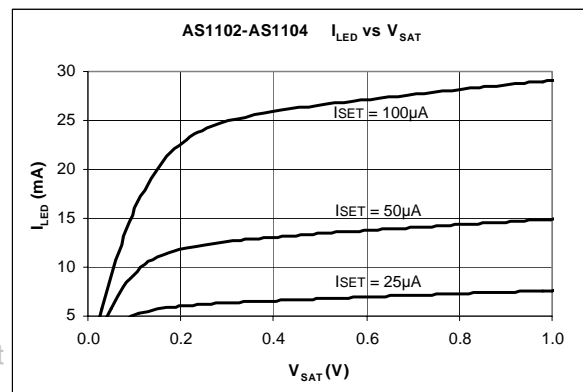
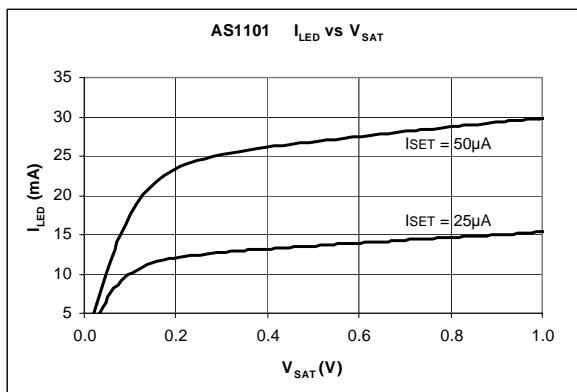
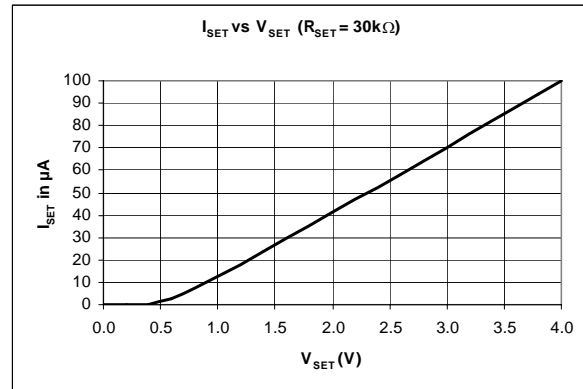
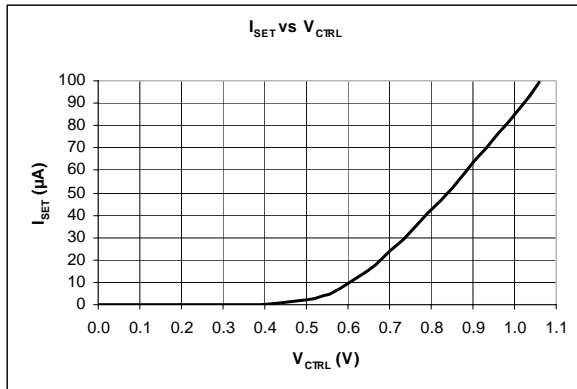
Parameter	Symbol	Conditions	Min	Typ	Max	Units
ISET Range	ISET	$V_{ON} = 3\text{V}$	25		150	μA
Output Current Multiplication Ratio	OCMR	$I_{SET} = 25\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$	175	250	325	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 40\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$	170	240	310	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 75\mu\text{A}$, $V_{SAT} = 150\text{mV}$, $V_{ON} = 3\text{V}$	145	210	275	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 25\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$	215	310	405	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 40\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$	215	305	395	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 75\mu\text{A}$, $V_{SAT} = 600\text{mV}$, $V_{ON} = 3\text{V}$	205	295	385	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 25\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$	235	335	435	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 40\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$	230	330	430	
Output Current Multiplication Ratio	OCMR	$I_{SET} = 75\mu\text{A}$, $V_{SAT} = 1000\text{mV}$, $V_{ON} = 3\text{V}$	220	315	410	
LED-to-LED Current Matching	Match	$V_{ON} = 3\text{V}$	-3		3	%
ISET in OFF Mode ¹	$I_{SET,OFF}$	$V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$		0.1	1	μA
IIN in OFF Mode ²	$I_{IN,OFF}$	$V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$, $T_{AMB} = 25^{\circ}\text{C}$		0.1	1	μA
		$V_{CTRL} = 3\text{V}$, $V_{SAT} = 3\text{V}$, $V_{ON} = 0\text{V}$			2	
Peak Efficiency ³	EFF	$V_{IN} = 3\text{V}$, $V_{ON} = 3\text{V}$	95			%

1. Not applicable to AS1103.

2. Not applicable to AS1103.

3. Efficiency = $(V_{IN} - V_{SAT}) / V_{IN}$. Information parameter, guaranteed by design.

6 Typical Performance Characteristics



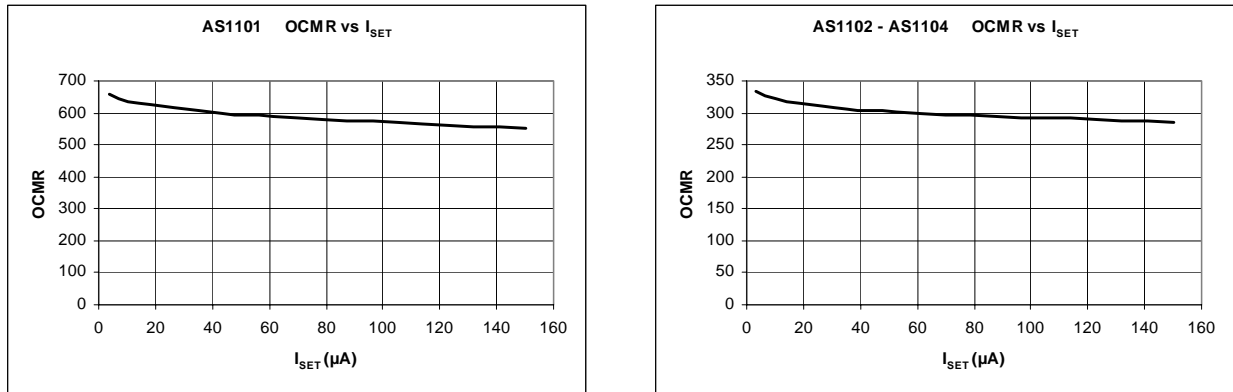


Figure 2. Control Voltage Transient Response

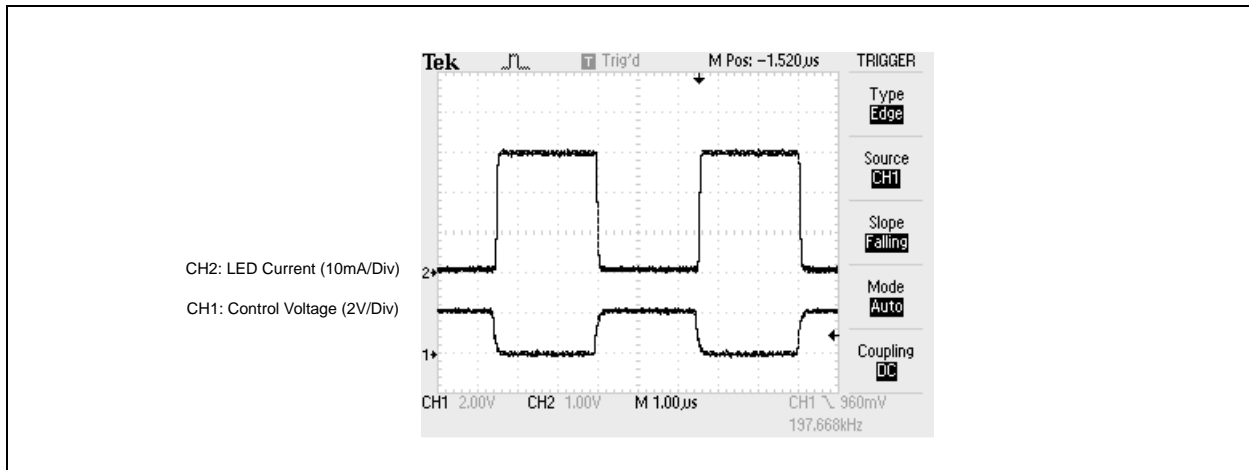
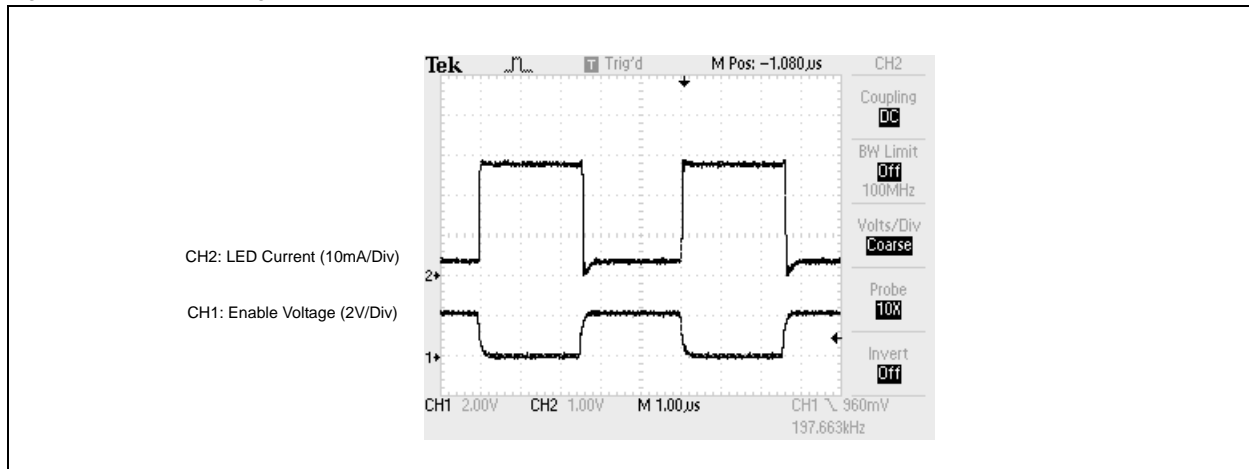


Figure 3. Enable Voltage Transient Response



7 Application Information

Figure 4. Typical Application Diagrams

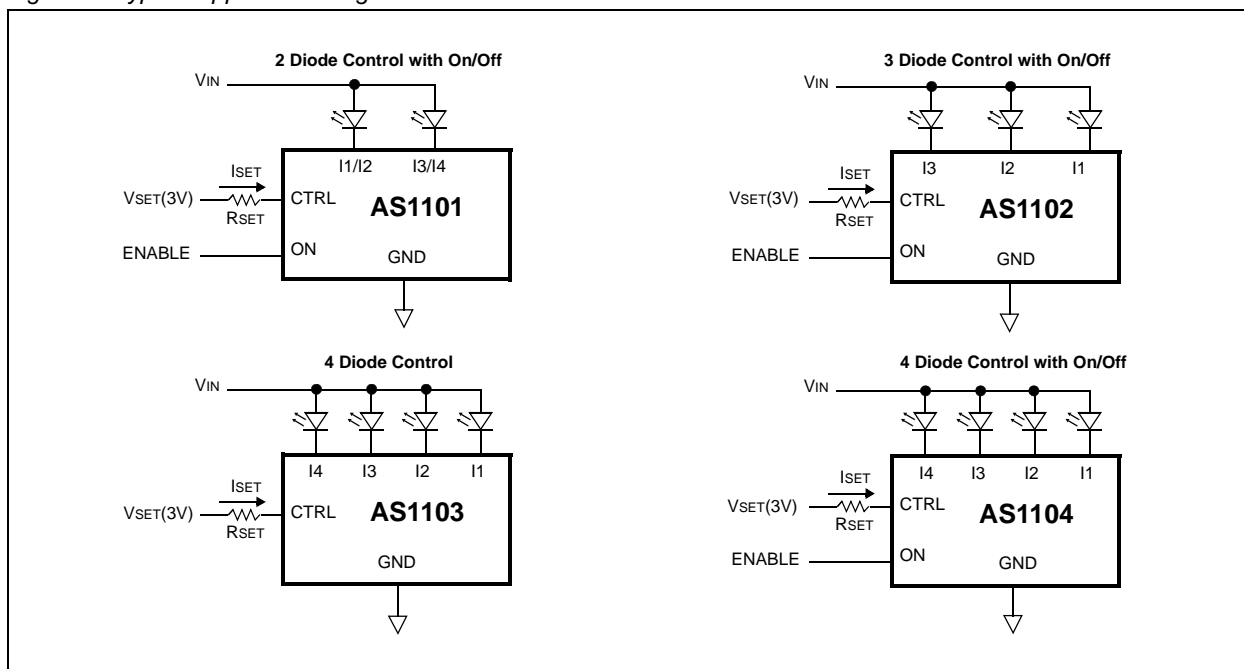
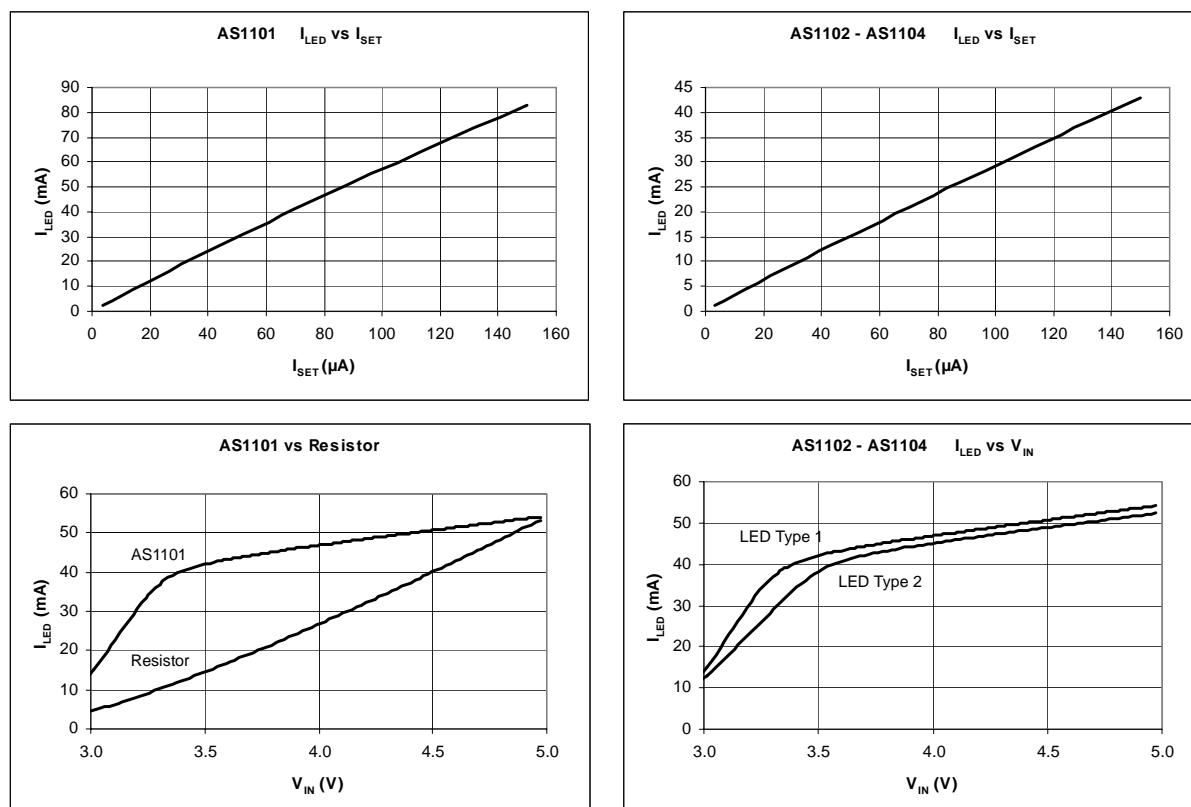


Figure 5. Performance Characteristics

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7.1 Setting the LED Current

The current going into the LEDs is approximately OCMR times greater than the current ISET. LED current is controlled by VSET and RSET (see Figure 4) according to the formula:

$$I_{LED} = OCMR \times \frac{(V_{SET} - V_{CTRL})}{R_{SET}} \quad (EQ 1)$$

For $V_{SET} = 3V$ and a specific LED current, the R_{SET} value can be determined using the diagram shown in Section 6 Typical Performance Characteristics on page 5. For any other option, the value of ISET can be determined using the graph "ISET vs. VCTRL" on page 7.

LED Brightness can also be adjusted by driving pin ENABLE or pin CTRL with a PWM signal.

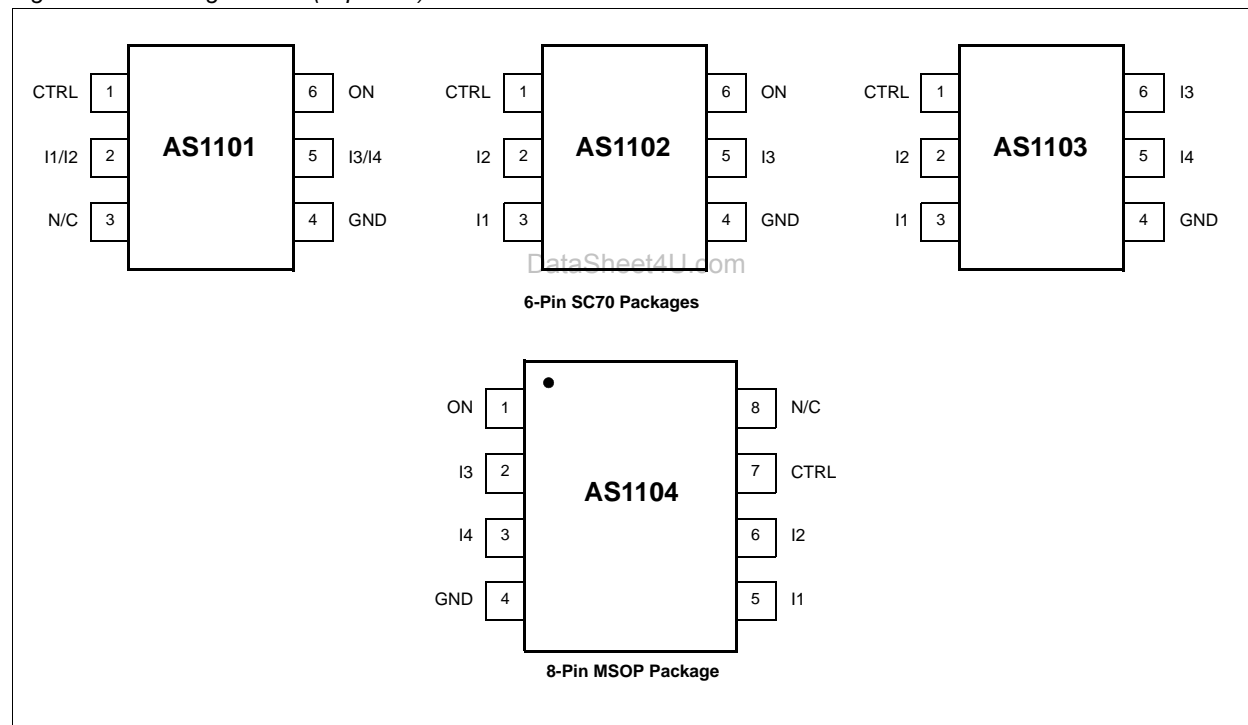
8 Pinout and Packaging

8.1 Pin Descriptions and Assignments

Table 5. Pin Descriptions

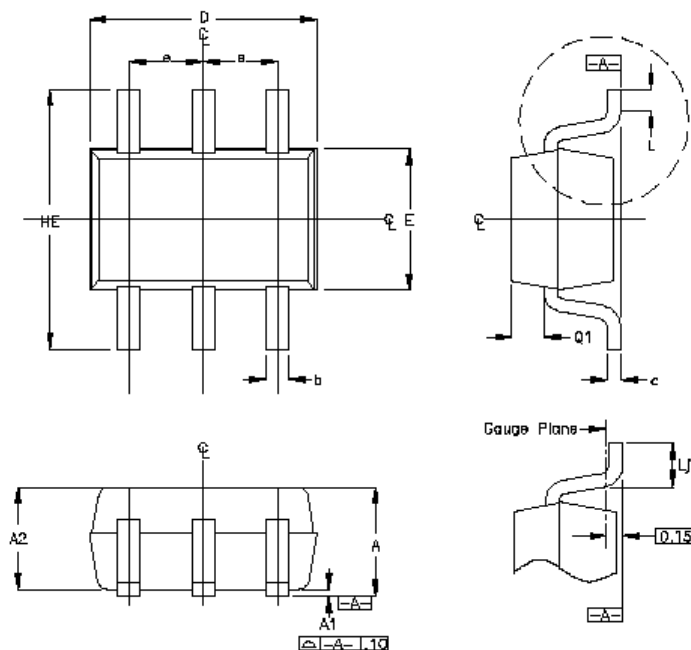
Pin (See Figure 6)	Name	Description
	CTRL	Sets LED current; connect to external resistor.
	I1	Connect to cathode of LED.
	I2	Connect to cathode of LED.
	I3	Connect to cathode of LED.
	I4	Connect to cathode of LED.
	GND	Ground
	ON	Device Enable Input.

Figure 6. Pin Assignment – (Top View)



8.2 Package Drawings and Markings

Figure 7. SC70-6 Package



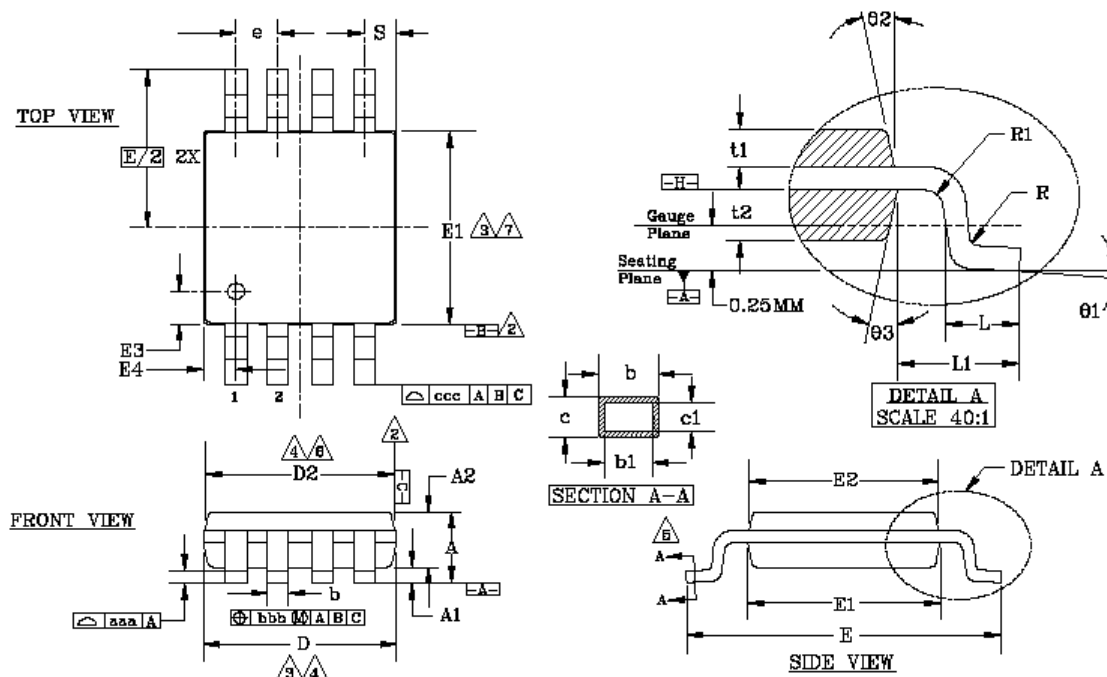
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Notes:

1. All dimensions are in millimeters.
2. Dimensions are inclusive of plating.
3. Dimensions are exclusive of mold flash and metal burrs.
4. All specifications comply with JEITA SC88 and JEDEC-MO-203.

Symbol	Min	Max
e	0.65 BSC	
D	1.80	2.20
b	0.15	0.30
E	1.15	1.35
HE	1.80	2.40
Q1	0.10	0.40
A2	0.80	1.00
A1	0.00	0.10
A	0.80	1.10
c	0.10	0.18
L	0.10	0.30
L1	0.26	0.46

Figure 8. MSOP-8 Package

**Notes:**

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1. All dimensions are in millimeters (angles in degrees), unless otherwise specified.
2. Datums B and C to be determined at datum plane H.
3. Dimensions D and E1 are to be determined at datum plane H.
4. Dimensions D2 and E2 are for top package; dimensions D and E1 are for bottom package.
5. Cross section A-A to be determined at 0.18 to 0.22mm from the leadtip.
6. Dimension D and D2 does not include mold flash, protrusions, or gate burrs.
7. Dimension E1 and E2 does not include inter-lead flash or protrusion.

MSOP-8 Package Outline					
Symbol	Millimeters	± Tolerance	Symbol	Millimeters	± Tolerance
A	1.10	Max	b	0.33	+0.07 to -0.08
A1	0.10	±0.05	b1	0.30	±0.05
A2	0.86	±0.05	c	0.18	±0.05
D	3.00	±0.10	c1	0.15	+0.03 to -0.02
D2	2.95	±0.10	theta1	3.0	±3.0
E	4.90	±0.15	theta2	12.0	±3.0
E1	3.00	±0.10	theta3	12.0	±3.0
E2	2.95	±0.10	L	0.55	±0.15
E3	0.51	±0.13	L1	0.95 BSC	-
E4	0.51	±0.18	aaa	0.10	-
R	0.15	+0.15 to -0.08	bbb	0.08	-
R1	0.15	+0.15 to -0.08	ccc	0.25	-
t1	0.31	±0.08	e	.5 BSC	-
t2	0.41	±0.08	S	.525 BSC	-

9 Ordering Information

Part Number	Package Type	Delivery Form	Description
AS1101	SC70-6	Tape and Reel Tube	Dual LED driver with enable.
AS1102			Triple LED driver with enable.
AS1103			Quad LED driver.
AS1104	MSOP-8		Quad LED driver with enable.

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