Description

SE1052 is a highly integrated solution for SMPS applications requiring CV (constant voltage) and CC (constant current) modes. It also has built-in LED drivers specifically designed for stand-alone Battery Charging applications. SE1052 integrates three voltage references, three operational amplifiers, and two current sensing circuits together in the same IC. The 1st voltage reference, together with one operational amplifier, controls the output voltage. The 2nd voltage reference, together with another operational amplifier, senses and limits the amount of the current on the low side, hence the overall current at the output. The 3rd voltage reference and operational amplifier senses when the charging current drops to 10% of the programmed value. During charging, SE1052 will turn on Red LED. When the charging is completed, SE1052 will turn on Green LED. The SE1052 is available in SOP8 and DIP8 package.

Features

- Constant Voltage and Constant Current Control
- Low Voltage Operation
- Precision Internal Voltage References
- Low External Component Count
- Current Sink Output Stage
- Easy Compensation
- Low AC Mains Voltage Rejection
- Rugged 1.5KV ESD withstand capability.
- Internal 2 LED drivers
- Available in SOP8 and DIP-8 Package.
- RoHS Compliant and 100% Lead (Pb)-Free

Application

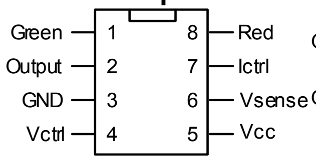
- Adapters
- Digital Camera Chargers.
- Cellphone Chargers.
- Other Battery Chargers

Ordering Information

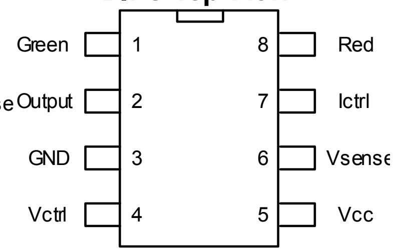
Device	Package	V_{OUT}
SE1052	SOP8 and DIP8 (Lead-free)	Fixed output voltages 1.21V

Pin Configuration

SOP8 Top View



DIP8 Top View



Pin Description

Name	Pin#	Type	Function
Green	1	Driver	Turning on Green LED when the charging is completed.
V_{OUT}	2	Current Sink Output	Output Pin. Sinking Current Only
GND	3	Power Supply	Ground Line. 0V Reference For All Voltages
V_{CTRL}	4	Analog Input	Input Pin of the Voltage Control Loop
V_{CC}	5	Power Supply	Positive Power Supply Line
V_{SENSE}	6	Analog Input	Input Pin of the Current Control Loop
I_{CTRL}	7	Analog Input	Input Pin of the Current Control Loop
Red	8	Driver	Turning on Red LED when the charging is in progress.

Absolute Maximum Rating

Symbol	Parameter	Maximum	Units
V_{CC}	DC Supply Voltage	18	V
V_{IN}	Input Supply Voltage	-0.3~ V_{CC}	V
θ_{JA}	Thermal Resistance Junction to Ambient	250	°C/W
T_J	Operating Junction Temperature Range	0 to 125	°C
T_{STG}	Storage Temperature Range	-40 to 150	°C
T_{LEAD}	Lead Temperature (Soldering 10 Sec)	260	°C

Electrical Characteristic

V_{CC} = 5.0V, T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Total Current Comsuption						
I_{CC}	Total Supply Current - not taking the output sinking current into account	ISINK=0	0.7	1.2	2.5	mA
Voltage Control Loop						
G_{mv}	Transconduction Gain (Vctrl). Sink Current Only[1]	ISINK=0 to 10mA		2.4		mA/mV
V_{REF}	Voltage Control Loop Reference[2]	ISINK=0	1.198	1.21	1.222	V
LR_V	Linear Regulation of Voltage Control Loop Reference	Vcc= 2.5V to 18V		0.6	8	mV
I_{IBV}	Input Bias Current (Vctrl)			70		nA
V_{OL}	Low Output Voltage at 10mA Sinking Current	Vctrl=Vcc, Ictrl=Vsense=GND, ISINK=10mA, G and R Pins Open		250	350	mV
I_{OS}	Output Short Circuit Current. Output to VCC. Sink Current Only	Vctrl=Vout=Vcc, Ictrl=Vsense=GND, G and R Pins Open	15	24	35	mA
Current Control loop						
G_{mi}	Transconduction Gain (Ictrl). Sink Current Only[3]	ISINK=0 to 5mA		7.2		mA/mV
V_{SENSE}	Current Control Loop Reference[4]	ISINK=0	192	200	208	mV
LR_I	Linear Regulation of Current Control Loop Reference	Vcc=2.5V to 18V		0.8	4	mV
I_{IBI}	Current out of pin Ictrl at -200mV			20		uA
V_{OL}	Low Output Voltage at 10mA Sinking Current	Vsense=Vcc, Ictrl=Vctrl=GND, ISINK=10mA, G and R Pins Open		250	350	mV
I_{OS}	Output Short Circuit Current. Output to VCC. Sink Current Only	Vsense=Vout=Vcc, Ictrl=Vctrl=GND, G and R Pins Open	15	24	35	mA

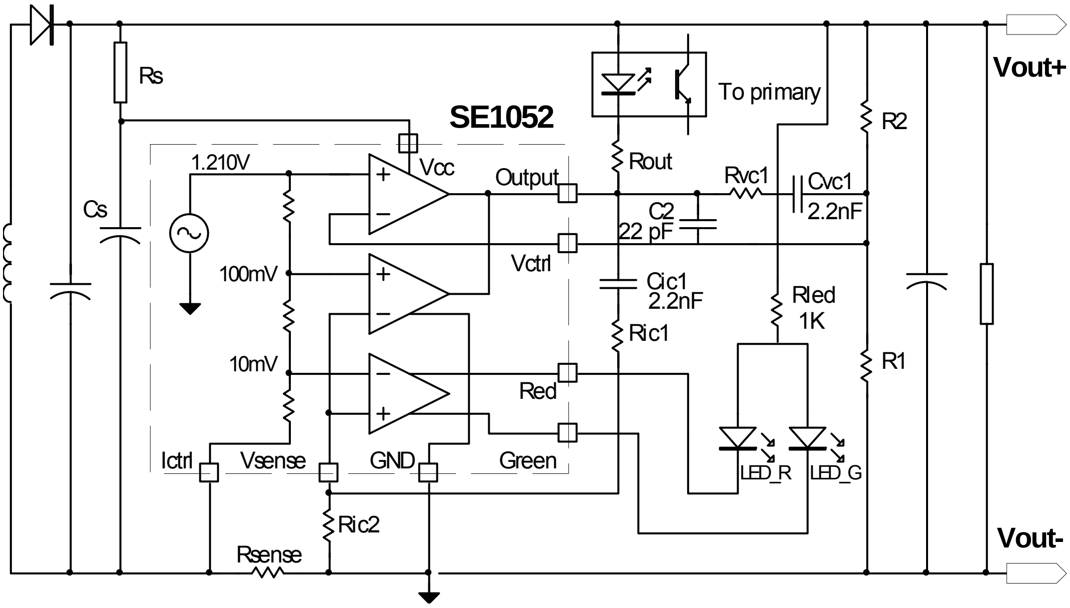
Electrical Characteristic

V_{CC} = 5.0V, T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Current Monitor Loop						
V_{TH}	Threshold Voltage of Turning Red Pin from Low to High			20		mV
H_{ys}	Hysterisis of the comparator in Current Monitor Loop			14		mV

1. If the voltage on V_{CTRL} (the negative input of the amplifier) is higher than the positive amplifier input (V_{REF}=1.210V), and it is increased by 1mV, the sinking current at the output OUT will be increased by 2.4mA.
2. The internal Voltage Reference is set at 1.210V. The internal Voltage Reference is fixed by bandgap, and trimmed to 1% accuracy at room temperature.
3. When the positive input at I_{CTRL} is lower than -200mV, and the voltage is decreased by 1mV, the sinking current at the output OUT will be increased by 2.9mA.
4. The internal current sense threshold is set to -200mV. The current control loop precision takes into account the cumulative effects of the internal voltage reference deviation as well as the input offset voltage of the trans-conduction operational amplifier.

Typical Application



Note：0 ohms of Ric2 is recommended for LED charging indication function.

Application Hints

Voltage Control

The voltage loop is controlled via a first transconductance operational amplifier, the resistor bridge R1, R2, and the optocoupler which is directly connected to the output.
The relation between the values of R1 and R2 should be chosen as written in Equation 1.

R1 = R2 x Vref / (Vout - Vref) Eq1

Where Vout is the desired output voltage. To avoid the discharge of the load, the resistor bridge R1, R2 should be highly resistive. For this type of application, a total value of 100KΩ (or more) would be appropriate for the resistors R1 and R2.
As an example, with R2 = 100KΩ, Vout = 4.10V, Vref = 1.210V, then R1 = 41.9KΩ.
Note that if the low drop diode should be inserted between the load and the voltage regulation resistor bridge to avoid current flowing from the load through the resistor bridge, this drop should be taken into account in the above calculations by replacing Vout by (Vout + Vdrop).

Current Control

The current loop is controlled via the second trans-conductance operational amplifier, the sense resistor Rsense, and the optocoupler.
The control equation is:
Rsense x I-limit = Vsense Eq2
Rsense = Vsense / I-limit Eq3

where I-limit is the desired current limit, and Vsense is the threshold voltage for the current control loop.
As an example, with I-limit = 1A, Vsense = -200mV, then Rsense = 200mΩ.
Note that the Rsense resistor should be selected with the consideration of the Maximum Power in full load operations (P-limit).
P-limit = Vsense x I-limit. Eq4

As an example, with I-limit = 1A, and Vsense =-200mV, P-limit = 200mW.
Consequently, for most adapter and battery charger applications, a quarter-watt resistor to make the current sensing function is sufficient.
Vsense threshold is achieved internally by a resistor bridge tied to the Vref voltage reference. Its middle point is tied to the positive input of the current control operational amplifier, and its foot is to be connected to lower potential point of the sense resistor as shown on the following figure. The resistors of this bridge are matched in layout to provide the best precision possible.

The current sinking outputs of the two trans-conductance operational amplifiers are connected together. This makes an ORing function which ensures that whenever the current or the voltage reaches too high values, the optocoupler is activated.
The relation between the controlled current and the controlled output voltage can be described with a square characteristic as shown in the following V/I output-power graph.

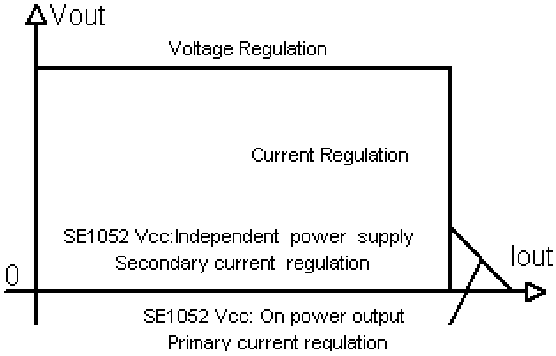


Fig.2 Output voltage versus output current

Compensation

The voltage-control trans-conductance operational amplifier can be fully compensated. Both of its output and negative input are directly accessible for external compensation components.
An example of a suitable compensation network is shown in Fig.1. It consists of a capacitor Cvc1=2.2nF and a resistor Rcv1=470KΩ in series, connected in parallel with another capacitor Cvc2=22pF.
The current-control trans-conductance operational amplifier can also be fully compensated. Both of its output and negative input are directly accessible for external compensation components.
An example of a suitable compensation network is shown in Fig.1. It consists of a capacitor Cic1=2.2nF and a resistor Ric1=22KΩ in series.
When the Vcc voltage reaches 12V it could be interesting to limit the current coming through the output in the aim to reduce the dissipation of the device and increase the stability performances of the whole application.
An example of a suitable Rout value could be 330Ω in series with the opto-coupler in case Vcc=12V.

Driving LED

SE1052 provides direct driving pins to Red and Green LED's for charging applications. During charging, SE1052 will turn on Red LED. When the charging is completed, SE1052 will turn on Green LED.

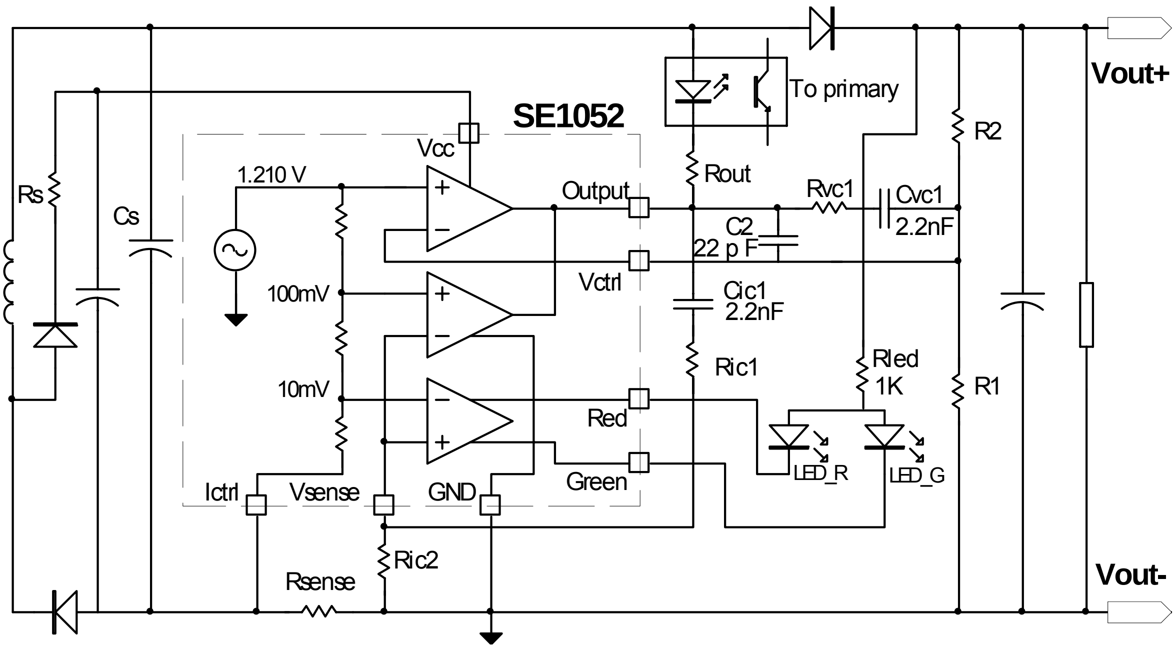
Start Up and Short Circuit Conditions

Under start-up or short-circuit conditions the SE1052 does not have a high enough supply voltage. This is due to the fact that the chip has its power supply line in common with the power supply line of the charger system. Consequently, the current limitation can only be ensured by the primary PWM module, which should be designed accordingly.

If the primary current limitation is considered not to be precise enough for the application, then a sufficient supply for the SE1052 has to be ensured under any condition. It would then be necessary to add some circuitry to supply the chip with a separate power line. This can be achieved in numerous ways, including an additional winding on the transformer.

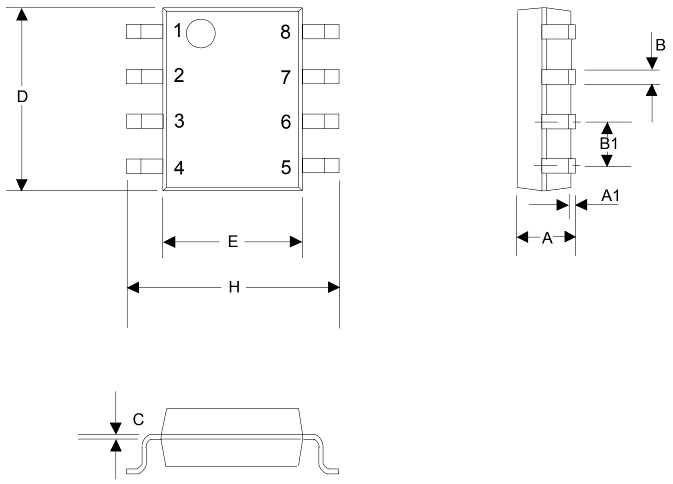
The following schematic shows how to realize a low-cost power supply for the SE1052 (with no additional windings).

Please pay attention to the fact that in the particular case presented here, this low-cost power supply can reach voltages as high as twice the voltage of the regulated line. Since the Absolute Maximum Rating of the SE1052 supply voltage is 18V, this low-cost auxiliary power supply can only be used in applications where the regulated line voltage does not exceed 9V.



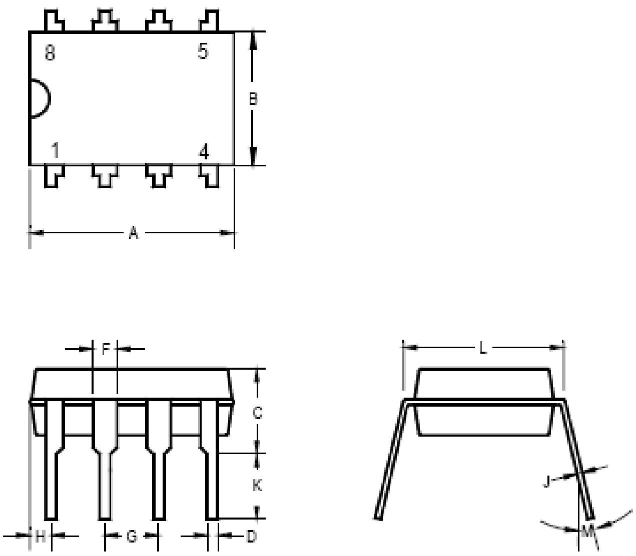
Note：0 ohms of Ric2 is recommended for LED charging indication function.

OUTLINE DRAWING SOP-8



DIMENSIONS				
DIM[N]	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.0532	0.0688	1.35	1.75
A1	0.0040	0.0098	0.10	0.25
B	0.0130	0.0200	0.33	0.51
B1	0.050 BSC		1.27 BSC	
C	0.0075	0.0098	0.19	0.25
D	0.1890	0.1968	4.80	5.00
H	0.2284	0.2440	5.80	6.20
E	0.1497	0.1574	3.80	4.00

OUTLINE DRAWING DIP-8



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.355	0.365	0.400	9.02	9.27	10.16
B	0.240	0.250	0.280	6.10	6.35	7.11
C	-	-	0.210	-	-	5.33
D	-	0.018	-	-	0.46	-
F	-	0.060	-	-	1.52	-
G	-	0.100	-	-	2.54	-
H	0.050	-	0.090	1.27	-	2.29
J	0.008	-	0.015	0.20	-	0.38
K	0.115	0.130	0.150	2.92	3.30	3.81
L	0.300 BSC.			7.62 BSC.		
M	-	7º	15º	-	7º	15º

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