SG29055/55A

Datasheet

Low Dropout Dual Regulator

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Microsemi

a Microchip company

Contents

1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision 2.0

Revision 2.0 was published in July 2018. The following is a summary of changes made in revision 2.0 of this document.

- Corrected a typo in the Features (see page 2) section
- Corrected a typo in the Connection diagram (see page 8)
- The format of the document was updated to the latest template and minor structural edits are done.

1.2 Revision 1.2

Revision 1.2 was published in April 2015. There are no technical content edits in this revision of the document.

1.3 Revision 1.1

Revision 1.1 was published in February 1994. It was the first publication of this document.

2 Product Overview

SG29055/55A is a dual 5 V/5 V positive voltage regulator. One output is a high current (up to 1000 mA) regulator that can be turned on or off by a high impedance low current transistor transistor logic (TTL) compatible switch. The second output or standby output remains ON regardless. The ON/OFF switch not only shuts off the high current output but actually puts the IC in a micropower mode, due to which a low quiescent current becomes possible. This unique characteristic coupled with an extremely low dropout, (0.55 V for output current of 10 mA) makes SG29055/55A appropriate for power systems that require standby memory.

SG29055/55A includes other features that are originally designed for automotive applications. These include protection from reverse battery installations and double battery jumps. The high current regulator has over voltage shutdown to protect both the internal circuitry and the load during line transients, such as load dump (60 V). In addition, the high current regulator design also has built-in protection for short circuit and thermal overload. During these fault conditions of the primary regulator, the standby regulator continues to power its load. SG29055 is the 5 V, ±5% version of a family of dual regulators with a standby output voltage of 5 V. SG29055A also offers an improved output voltage tolerance of ±2%. They are available in the plastic TO–220 power package and are designed to function over the automotive ambient temperature range of –40 °C to 85 °C.

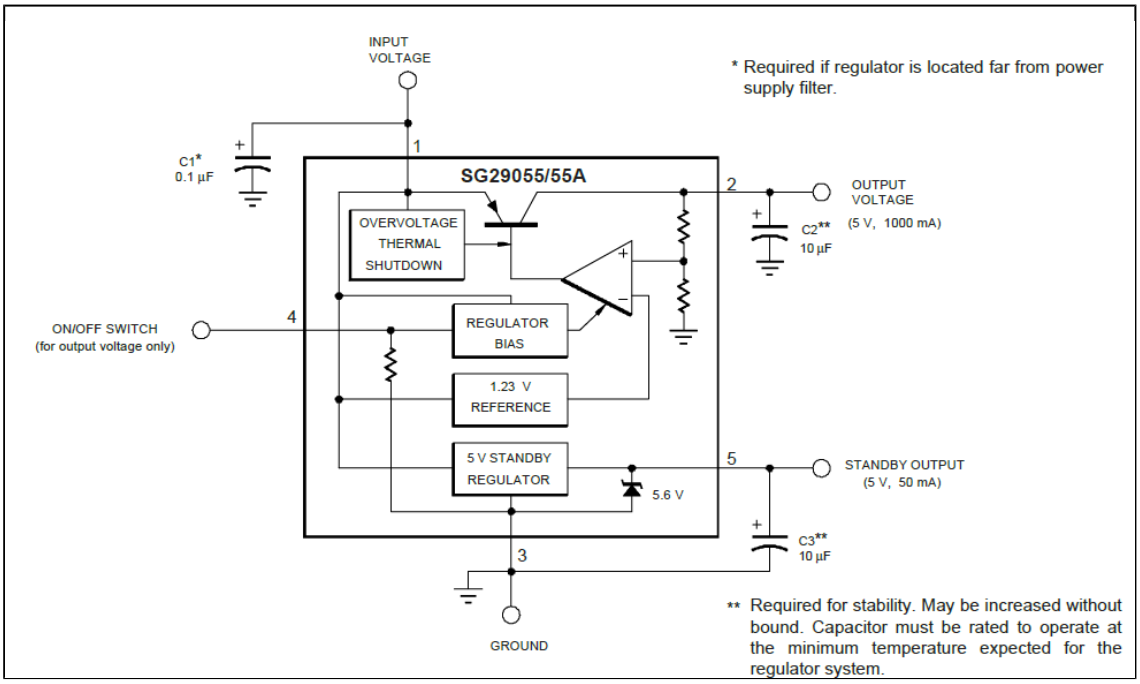
2.1 Features

The major features of the SG29055/55A low dropout dual regulator are as follows.

- 2% internally trimmed output
- Two regulated outputs
- Output current in excess of 1000 mA
- Low quiescent current standby
- Regulator
- Input–output differential less than 0.6 V at 0.5 A
- Reverse battery protection
- 60 V load dump protection
- –50 V reverse transient protection
- Short circuit protection
- Internal thermal overload protection
- Available in plastic TO–220
- ON/OFF switch for high current output

The following figure shows the block diagram of SG29055/55A low dropout dual regulator.

Figure 1 • SG29055/55A Block Diagram



The absolute maximum ratings of SG29055/55A regulator are as shown in the following table. Exceeding these values may destroy the parts of SG29055/55A.

Table 1 • Absolute Maximum Ratings

Parameters	Values
Operating input voltage (V_{IN})	26 V
Storage temperature range (T_{STG})	–65 °C to 150 °C
Input voltage (V_{IN}) overvoltage transient	–15 V to 60 V
Operating junction temperature (T_J)	150 °C
ON/OFF switch	–0.3 V to V_{IN}

2.2 Thermal Data

The thermal data of SG29055/55A regulator are as follows.

- Thermal Resistance-Junction to Case, $\theta_{JT} = 4.0$ °C/W*
- Thermal Resistance-Junction to Ambient, $\theta_{JA} = 55$ °C/W
- * = θ_{JT} (junction to case)

Note : Junction temperature calculation: $T_J = T_A + (P_D \times \theta_{JA})$. The above numbers for θ_{Jc}, are maximum values for the limiting thermal resistance of the package in a standard mounting configuration. The θ_{JA} numbers are meant to be guidelines for the thermal performance of the device PC–board system. All of the above assume no ambient airflow.

The recommended operating conditions of SG29055/55A regulator are given in the following table.

Table 2 • Recommended Operating Conditions

Recommended Operating Conditions[1,2]	Values
Input voltage (V_{IN})	6 V to 26 V
Reverse polarity D.C. input voltage (V_{IN}) ($V_O \geq 0.6$ V, 16 Ω load)	– 15 V maximum
ON/OFF threshold voltage	
–Low level, V_{IL} (V_{OUT} is OFF)	0.8 V maximum
–High level, V_{IH} (V_{OUT} is ON)	2.0 V minimum
Reverse polarity transient input voltage (V_{IN}) (1% duty cycle, T ≤ 100 ms, $V_O \geq -9$ V, 16 Ω load)	–50 V maximum
Load current V_{OUT} (with adequate heat sinking)	5 mA to 1000 mA
Output capacitor with ESR of 1 Ω maximum (V_{OUT} to GND and V_{SB} to GND)	10 µF minimum
Maximum line transient (Load dump) $V_{SB} \leq 6$ V	60 V maximum
Input capacitor (V_{IN} to GND)	0.1 µF minimum
Operating ambient temperature range (T_A) for SG29055/55A	– 40 °C to 85 °C

Note:

1. Range over which the device is functional.
2. During 60 V load dump, V_{SB} shall not be less than 4.75 V at I_{OUT} = 10 mA.

2.3 Electrical Characteristics

The following table lists the electrical characteristics for the SG29055/55A regulator. If not mentioned, these specifications apply for the operating ambient temperature of T_A = 25 °C, V_{IN} = 14 V, I_O = 500 mA for V_{OUT} and 10 mA for V_{SB} and are for DC characteristics only. Low duty cycle pulse testing techniques are used; which maintain junction and case temperatures to be equal to the ambient temperature.

Table 3 • Electrical Description

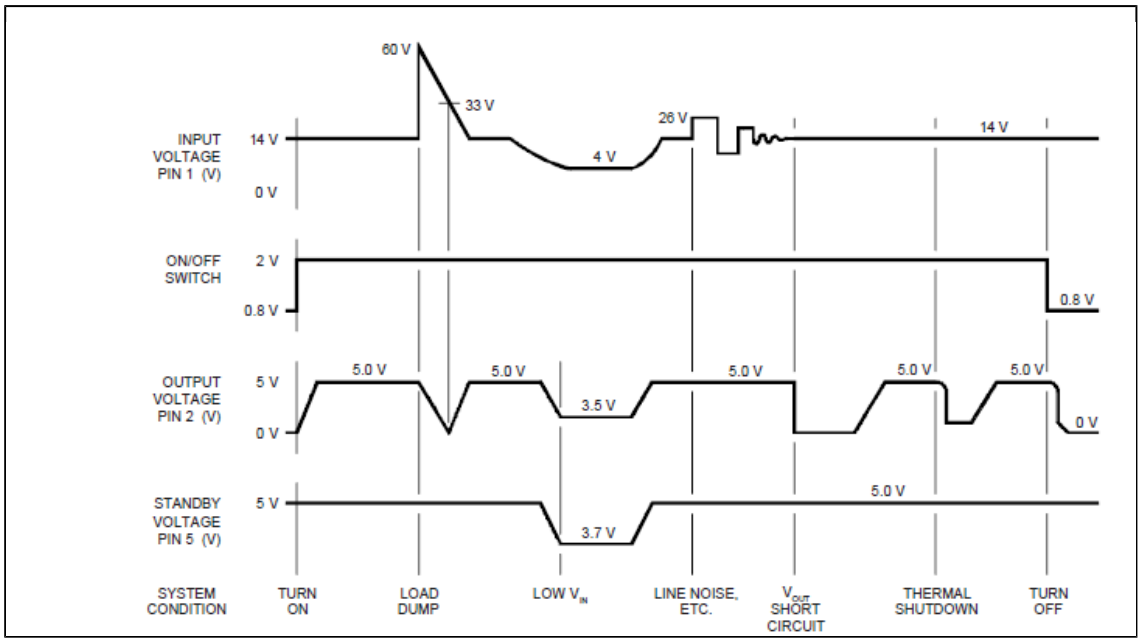
Parameter	Test Conditions	SG29055/55A			Units
		Min	Typical	Max	
Voltage Output (V_{OUT})					
Output voltage[3]	6 V ≤ V_{IN} ≤ 26 V, I_O ≤ 1000 mA, –40°C ≤ T_A ≤ 85°C				
	SG29055	4.75	5.00	5.25	V
	SG29055A	4.90	5.00	5.10	V
Line regulation	6 V ≤ V_{IN} ≤ 16 V, I_O = 5 mA		4	25	mV
	6 V ≤ V_{IN} ≤ 26 V, I_O = 5 mA		10	50	mV
Load regulation	5 mA ≤ I_O ≤ 1000 mA		10	50	mV
Output impedance	500 mA_{DC} and 10 mA_{RMS}, 100 Hz to 10 kHz		200		mΩ
Quiescent current	I_O ≤ 10 mA, No load on standby		2		mA
	I_O = 500 mA, No load on standby		40	100	mA
	I_O = 750 mA, No load on standby		90		mA
	I_O = 220 mA, I_{SB} = 10 mA, V_{IN} = V_{OUT} – 200 mV		15	25	mA
Output noise voltage	10 Hz to 100 kHz		100		μV_{RMS}
Long term stability			20		mV /1000hr

Ripple rejection	F_O = 120 Hz		66		dB
Dropout voltage	I_O = 500 mA		0.45	0.6	V
	I_O = 1000 mA	0.7		1.2	V
Current limit		1.0	1.8	2.5	A
Maximum operational input voltage	Double battery	26.5	31		V
Maximum line transient	$V_O \leq 5.5$ V	60	70		V
ON/OFF switch (I_{IH})	I_O = 10 mA, Pin 4 = 2.4 V			50	µA
ON/OFF switch (I_{IL})	I_O = 10 mA, Pin 4 = 0.4 V	–10			µA
Standby Output (V_{SB})					
Output voltage[3]	6 V ≤ V ≤ 26 V, $I_O \leq 50$ mA, –40°C ≤ $T_A \leq$ 85°C	4.75	5.0	5.25	V
Tracking	V_{OUT} (Standby output voltage)		50	200	mV
Line regulation	6 V ≤ $V_{IN} \leq$ 26		4	50	mV
Load regulation	1 mA ≤ $I_O \leq$ 35 mA		10	25	mV
	1 mA ≤ $I_O \leq$ 50 mA		25	50	mV
Output impedance	1 mA_{DC} and 1 mA_{RMS}, 100 Hz to 10 kHz		1		Ω
Quiescent current	$I_O \leq$ 0 mA, V_{OUT} OFF		1.2	3	mA
Output noise voltage	10 Hz to 100 kHz		300		µV RMS
Long term stability			20		mV /1000hr
Ripple rejection	F_O = 120 Hz		66		dB
Dropout voltage	$I_O \leq$ 50 mA		0.55	0.7	V
Current limit			100		mA
Maximum operational input voltage	4.75 V ≤ $V_O \leq$ 6 V		70		V

Note:
3. The temperature extremes are guaranteed but not 100% production tested.

The following figure shows the typical circuit waveform of the SG29055/55A regulator.

Figure 2 • Typical Circuit Waveform



2.4 Advantages of SG29055

The advantages of using a low dropout regulator such as SG29055/55A is the need for less headroom for full regulation, and the inherent reverse polarity protection provided by the PNP output device.

A typical NPN regulator design requires an input to output differential of minimum 2 volts. This is due to the *2Vbe + Vcesat* of the NPN Darlington used in the output, coupled with the voltage drop across the current limit resistor. In contrast, the PNP regulator uses a single series pass transistor with its single Vcesat, thus lowering the input to output voltage differential or dropout voltage. In addition to a low dropout voltage, an important advantage of the SG29055/55A series is low quiescent current in the standby mode. When the high current or primary regulator is shut off, the regulator enters a micro power mode. Here, all but the most essential circuitry to power the standby output is deactivated; that allows the lowest possible quiescent current (typical around 1.2 mA). This is a vital factor when used in a battery powered system. In some applications the regulator output voltage is used not only as a power supply but also as a voltage reference for control systems. In such cases, not just the temperature stability of the output is important but also the initial accuracy. SG29055/55A meets this need as the internal band gap reference is trimmed; allowing a typical output voltage tolerance of ±1%.

2.5 Application Details

The following sections give details of SG29055/55A low-dropout regulator application modules and their functionalities.

2.5.1 External Capacitors

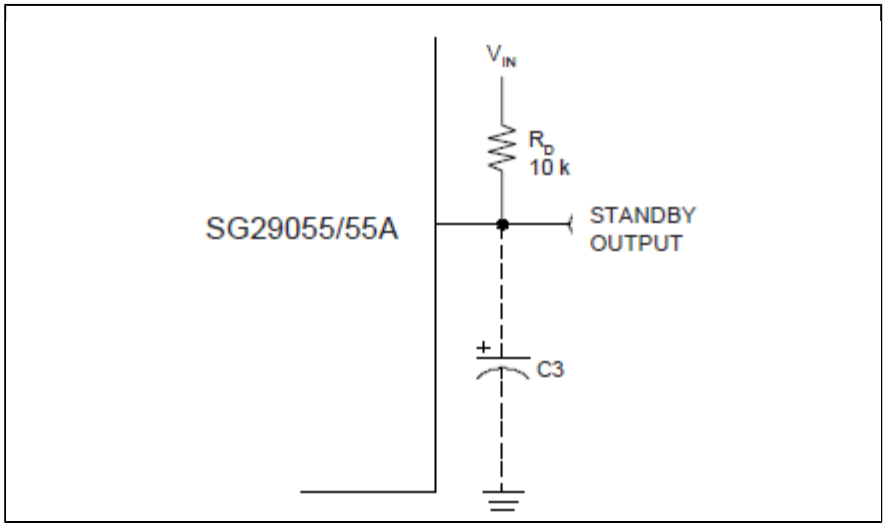
External capacitors are required t o stabilize the outputs and prevent oscillation . The minimum recommended value for the output capacitors is 10 µF. Although, the actual size and type likely varies according to the particular application, for example, it may vary based on operating temperature range and load. Another consideration is the effective series resistance (ESR) of the capacitor. Capacitor ESR varies with manufacturer. Consequently, some evaluation may be required to determine the minimum value of the output capacitors. Generally, the worst case scenario happens at the maximum load and the minimum ambient temperature. The size of the output capacitor can be increased to any value above the minimum. One possible advantage of this would be to maintain the output voltage during brief periods of negative input transients.

The output capacitors chosen should be rated for the full range of ambient temperature over which the circuit will be exposed and expected to operate. For example, many aluminum type electrolytic capacitors freeze at –30°C. The effective capacitance is reduced to zero in such a situation. Capacitors rated for – 40°C operation must be used in order to maintain regulator stability at that temperature. Tantalum capacitors satisfy this requirement.

2.5.2 Standy Output

SG29055/55A differs from the most fixed voltage regulators. It is equipped with two regulator outputs instead of one. The additional output is intended for use in systems requiring standby memory circuits. While the high current regulator output can be controlled with the ON/OFF pin described in this section, the standby remains ON under all conditions as long as sufficient input voltage is applied to the IC. Thus, memory and other circuits powered by this output remain unaffected by positive line transients, thermal shutdown, and so on. The standby regulator circuit is designed so that the quiescent current to the IC is very low (< 1.5 mA) when the other regulator output is OFF. If the standby output is not required, it can be disabled. This is accomplished by connecting a resistor from the standby output to the supply voltage, thereby also eliminating the requirement for a more expensive output capacitor to prevent unwanted oscillations. The resistor value depends upon the minimum input voltage expected for a given system. Since the standby output is shunted with an internal 5.6 V Zener, the current through the external resistor should be sufficient to bias internal resistors up to this point. Approximately, 60 mA is sufficient, that results in a 10 k external resistor for most applications (see the following figure).

Figure 3 • Disabling Standby Output to Eliminate C3



2.5.3 High Current Output

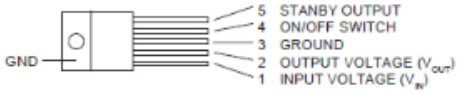
The high current regulated output features fault protection against over voltage and has a thermal shutdown feature as well. If the input voltage rises above 33 V (load dump), the high current output shuts down automatically. The internal circuitry is thus protected and the IC is able to survive higher voltage transients than what is expected. The thermal shutdown of the high current output effectively guards against overheating of the die since this section of the IC is the principle source of power dissipation on the chip.

2.5.4 On/Off Switch

The ON/OFF pin is a high impedance low current switch that controls the main output voltage (pin 2). This is directly compatible with all 5 volt logic families. For use with open collector logic outputs, a 50 k resistor from this pin to a 5 V supply (such as pin 5) is required. The SG29055/55A also has an internal pull-down resistor on pin 2 to ground. This resistor, approximately 90 kW in value, ensures the high current switched output remains OFF unless actively pulled high.

The following table gives the ordering information and the connection diagrams of the respective packages.

Table 4 • Connection Diagrams and Ordering Information

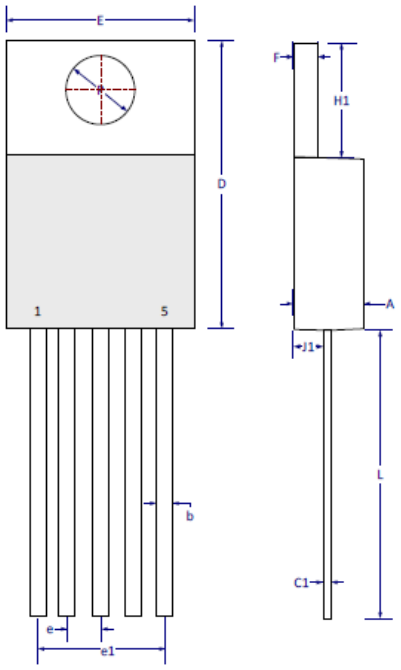
Package	Part No.	Ambient Temperature Range	Connection Diagram
5-PIN TO-220 PLASTIC PACKAGE	SG29055P	–40 °C to 85 °C	
	SG29055AP	–40 °C to 85 °C	

Note: All parts are viewed from the top.

3 Package Dimensions

This following figure shows the 5-pin plastic TO–220 package dimensions. The controlling dimensions are in inches. The metric equivalents are shown for general information.

Figure 4 • 5-Pin Plastic TO-220 Package Dimensions



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	3.56	4.82	0.140	0.190
b	0.46	1.04	0.018	0.040
C1	0.31	1.14	0.012	0.045
D	14.22	16.51	0.560	0.650
E	9.66	10.66	0.380	0.420
e	0.67 TYP		1.70 TYP	
e1	6.80 TYP		0.268 TYP	
F	1.14	1.40	0.045	0.055
H1	5.85	6.85	0.230	0.270
J1	2.04	2.92	0.080	0.115
P	3.56	4.06	0.140	0.160
L	12.70	14.73	0.500	0.580

Note:

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage.

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