1. 特性

- AEC-Q100 认证
- 出色的 CMRR：
  - 150dB DC CMRR (typ)
- 宽共模电压范围：–6V 至 80V
- 精度：
  - Gain:
    - Gain error: 0.10% (max)
    - Gain drift: 6ppm/°C (typ)
  - Offset:
    - Offset voltage: ±15μV (max)
    - Offset drift: 600nV/°C (max)
- 可供选择的增益：
  - CSA245LQ: 20V/V
  - CSA245MQ: 50V/V
  - CSA245NQ: 100V/V
- 静态电流：1.4mA (typ)

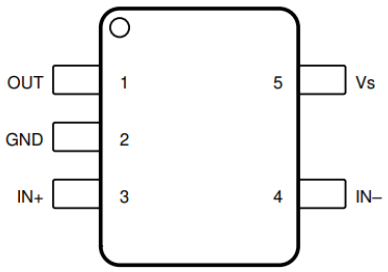
2. 应用

- 电机控制
- 螺线管和阀门控制
- 执行器控制
- 通信设备
- BMS 系统

3. 说明

CSA245Q 器件是一款电压输出的电流检测放大器，在–6V 至 80V 的宽共模电压范围内检测分流电阻器上的压降。CSA245Q 的–6V 共模电压允许器件在地电压以下工作。

该器件采用 2.7V 至 5.5V 单电源供电，典型电源电流为 1.4mA，带宽典型值为 550kHz。CSA245Q 提供三种固定增益：20V/V、50V/V 和 100V/V。其零漂移架构可在分流器上实现低至 10mV 满量程电流检测(典型值)。所有版本均可满足在–40°C 至 125°C 的扩展温度范围内工作，并提供 SOT23-5 封装选择。有关订购信息，请参见 Table 1。



CSA245 PINOUT

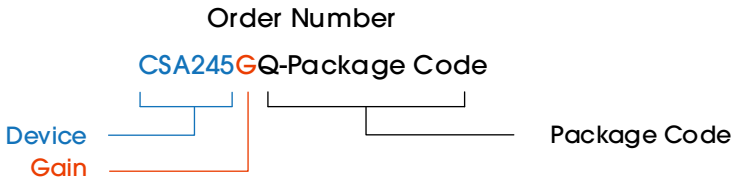
Table 1 lists the order information.

Table 1. Order Information

ORDER NUMBER(1)	PART NUMBER	CH (#)	PACKAGE	V_{CC} (V)	I_Q (TYP) (mA)	GBW (kHz)	GAIN (TYP) (V/V)	OP. TEMP (°C)	RATING	PACKAGE OPTION
CSA245LQASOT235	CSA245LQ	1	SOT23-5_	–6-80V	1.4	550	20	–40-125	Auto	T/R-TBD
CSA245MQASOT235	CSA245MQ	1	SOT23-5	–6-80V	1.4	550	50	–40-125	Auto	T/R-TBD
CSA245NQASOT235	CSA245NQ	1	SOT23-5	–6-80V	1.4	550	100	–40-125	Auto	T/R-TBD

Devices can be ordered via the following two ways:
1. Place orders directly on our website (www.analogysemi.com), or;
2. Contact our sales team by mailing to sales@analogysemi.com.

Note:



4. PIN CONFIGURATION AND FUNCTIONS

Figure 1 illustrates the pin configuration.

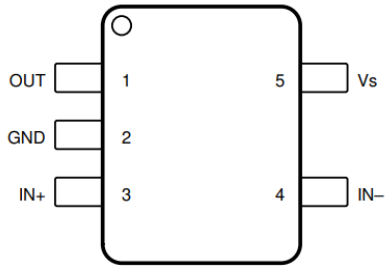


Figure 1. Pin Configuration

Table 2 lists the pin functions.

Table 2. Pin Functions

NAME	TYPE		DESCRIPTION
1	OUT	Analog output	Output voltage
2	GND	Analog	Ground
3	IN+	Analog input	Connect to load side of shunt resistor.
4	IN–	Analog input	Connect to load side of shunt resistor.
5	VS	—	Power supply, 2.7V to 5.5V

5. SPECIFICATIONS

5.1 ABSOLUTE MAXIMUM RATINGS

Table 3 lists the absolute maximum ratings of the CSA245Q. Over operating free-air temperature range, unless otherwise noted.

Table 3. Absolute Maximum Ratings

PARAMETER	DESCRIPTION		MIN	MAX	UNITS
Voltage	Supply			6	V
	Analog inputs, V_{IN+}, V_{IN-}(2)	Differential (V_{IN+}) – (V_{IN-}), 1s maximum duration due to package thermal dissipation	–80	80	V
		Common-mode	–6	82	
	Output		GND – 0.3	V_S + 0.3	V
Temperature	Operating free-air, T_A		–40	125	°C
	Junction, T_J			150	°C
	Storage, T_{stg}		–65	150	°C

Note 1: Stresses beyond those listed under Table 3 may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Table 5. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Note 2: V_{IN+} and V_{IN-} are the voltages at the IN+ and IN– pins, respectively.

5.2 ESD RATINGS

Table 4 lists the ESD ratings of the CSA245Q.

Table 4. ESD Ratings

PARAMETER	SYMBOL	DESCRIPTION	VALUE	UNITS
Electrostatic Discharge	$V_{(ESD)}$	Human-body model (HBM), per AEC-Q100	TBD	V
		Charged-device model (CDM), per AEC-Q100	TBD	

5.3 RECOMMENDED OPERATING CONDITIONS

Table 5 lists the recommended operating conditions for the CSA245Q.

Table 5. Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	NOM	MAX	UNITS
Common-Mode Input Voltage	V_{CM}	–6		80	V
Operating Supply Voltage	V_S	2.7		5.5	V
Operating Free-Air Temperature	T_A	–40		125	°C

5.4 THERMAL INFORMATION

Table 6 lists the thermal information for the CSA245Q.

Table 6. Thermal Information

PARAMETER	SYMBOL	SOT23-5	UNITS
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$		°C/W
Junction-to-Case (Top) Thermal Resistance	$R_{\theta JC(top)}$		°C/W
Junction-to-Board Thermal Resistance	$R_{\theta JB}$		°C/W
Junction-to-Top Characterization Parameter	ψ_{JT}		°C/W
Junction-to-Board Characterization Parameter	ψ_{JB}		°C/W

5.5 ELECTRICAL CHARACTERISTICS

Table 7 lists the electrical characteristics of the CSA245Q. T_A = 25°C, V_S = 5V, V_{SENSE} = V_{IN+} – V_{IN-}, V_{CM} = 12V , unless otherwise noted.

Table 7. Electrical Characteristics

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT						
Common-Mode Input Range	V_{CM}	V_{IN+} = –6V to 80V, V_{SENSE} = 0mV, T_A = –40°C to 125°C	–6		80	V
Common-Mode Rejection Ratio	CMRR	V_{IN+} = –6V to 80V, V_{SENSE} = 0mV, T_A = –40°C to 125°C		150		dB
Offset Voltage, Input-Referred	V_{OS}	V_{SENSE} = 0mV		±20		μV
Offset Voltage Drift	dV_{OS}/dT	V_{SENSE} = 0mV, T_A = –40°C to 125°C		±200		nV/°C
Power-Supply Rejection Ratio	PSRR	V_S = 2.7V to 5.5V, V_{SENSE} = 0mV, T_A = –40°C to 125°C		±0.2		μV/V
Input Bias Current	I_B	I_{B+}, I_{B-}, V_{SENSE} = 0mV		10		nA
OUTPUT						
Gain	G	CSA245LQ		20		V/V
		CSA245MQ		50		
		CSA245NQ		100		
Gain Error		GND + 50mV ≤ V_{OUT} ≤ V_S – 200mV		±0.05%		
		T_A = –40°C to 125°C		±6		ppm/°C
Non-Linearity Error		GND + 10mV ≤ V_{OUT} ≤ V_S – 200mV		±0.01%		
Maximum Capacitive Load		No sustained oscillation		2		nF
VOLTAGE OUTPUT(2)						
Swing to V_S Power-Supply Rail		R_L = 10kΩ to GND, T_A = –40°C to 125°C	V_S – 0.015	V_S – 0.005		V
Swing to GND		R_L = 10kΩ to GND, V_{SENSE} = 0mV, V_{REF1} = V_{REF2} = 0V, T_A = –40°C to 125°C		V_{GND} + 1	V_{GND} + 15	mV
FREQUENCY RESPONSE						
Bandwidth	BW	All gains, –3dB bandwidth		550		kHz
Settling Time - Output Settles to 0.5% of Final Value		CSA245LQ		5		μs
Slew Rate	SR			1.5		V/μs
NOISE (INPUT REFERRED)						
Voltage Noise Density				90		nV/√Hz
POWER SUPPLY						
Operating Voltage Range	V_S	T_A = –40°C to 125°C	2.7		5.5	V
Quiescent Current	I_Q	V_{SENSE} = 0mV		1.4	1.8	mA
		I_Q vs. temperature, T_A = –40°C to 125°C			2	
TEMPERATURE RANGE						
Specified Range			–40		125	°C

Note 1: See the INPUT SIGNAL BANDWIDTH section for more details.
Note 2: See Figure 8.

6. TYPICAL CHARACTERISTICS

T_A = 25°C, V_S = 5V, V_{CM} = 12V, and V_{REF} = V_S / 2, unless otherwise noted.

Figure 2. Input Offset Voltage Production Distribution

Figure 3. Offset Voltage vs. Temperature

Figure 4. Common-Mode Rejection Production Distribution

Figure 5. Common-Mode Rejection Ratio vs. Temperature

Figure 6. Gain Error Production Distribution

Figure 7. Gain Error vs. Temperature

Figure 8. Gain vs. Frequency

Figure 9. Power-Supply Rejection Ratio vs. Frequency

Figure 10. Common-Mode Rejection Ratio vs. Frequency

Figure 11. Input Bias Current vs. Common-Mode Voltage

Figure 12. Quiescent Current vs. Temperature

Figure 13. Input-Referred Voltage Noise vs. Frequency

Figure 14. 0.1Hz to 10Hz Voltage Noise

Figure 15. Step Response

Figure 16. Common-Mode Voltage Transient Response

7. 详细说明

7.1 概述

CSA245Q 是一款宽共模、零漂移、超高共模抑制比(CMRR)的精密电流检测放大器，CSA245Q 带宽可达 550kHz 并提供多个增益版本选择：20V/V、50V/V 和 100V/V，研发人员可根据应用中预期的目标电流范围优化所需的满量程输出电压。

7.2 功能模块框图

TBD

Figure 17. Functional Block Diagram

7.3 特性描述

7.3.1 输入信号

CSA245Q 带宽由器件内部电流检测放大器的–3dB 带宽定义：典型值 550kHz，请参见 ELECTRICAL CHARACTERISTICS 表。器件带宽提供快速检测和处理过流事件所需的快速吞吐量和快速响应。在缺乏足够带宽的情况下，保护电路可能没有足够的响应时间，并且可能会对受监控的应用程序或电路造成损坏。

7.4 芯片功能模式

8. 应用和实现

注

以下应用部分中的信息不是 AnalogySemi 组件规范的一部分，AnalogySemi 不保证其准确性或完整性。AnalogySemi 的客户有责任确定组件是否适合他们的用途。客户应验证和测试他们的设计实施以确认系统功能。

8.1 典型应用

CSA245Q 在多种应用场景中的优势体现为：

- 高共模范围和出色的 CMRR 可实现直接在线感应
- 超低偏移和漂移消除了校准的必要性
- 宽电源范围可实现与大多数微处理器的直接接口

典型应用如下文所示。

8.1.1 电机相电流检测应用

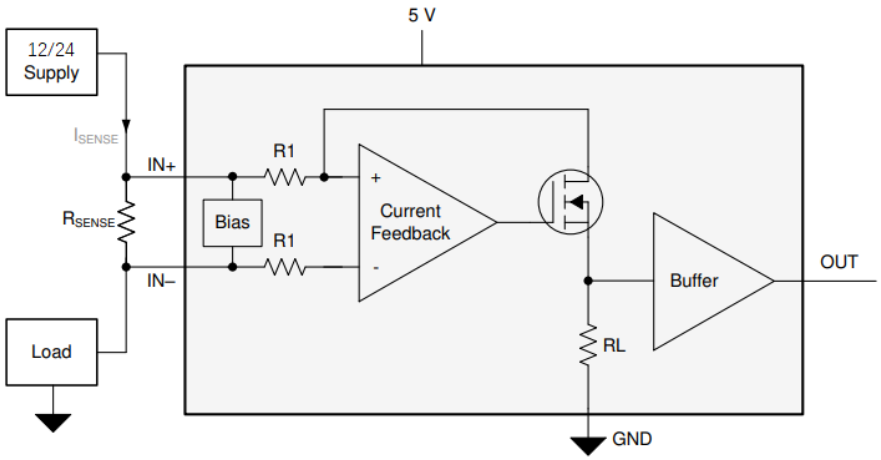


Figure 18. **典型应用**

8.2 设计建议

8.2.1 高精度应用

对于高精度应用，通过以下方式验证放大器的准确性和稳定性：

8.2.2 电流检测电阻的开尔文连接

为提供准确的电流测量，请验证电流检测电阻器和放大器之间的布线是否使用开尔文连接。在器件布局期间使用 Figure 19 和 LAYOUT 部分中提供的信息。

TBD

Figure 19. Shunt Connections to the CSA245Q

9. 电源供电推荐

CSA245Q 系列可在连接的电源电压(V_S)之外进行精确测量，因为输入(IN+和 IN–)可在–6V 至 80V 之间的任意电压下运行，与 V_S 无关。例如，V_S 电源等于 5V，被测分流器的共模电压可高达 80V。

尽管输入的共模电压可以超出电源电压，但 CSA245Q 系列的输出电压范围受限于电源电压。

将电源旁路电容器放置在尽可能靠近电源和接地引脚的位置。旁路电容建议不得小于 10nF，一般建议使用 0.1μF。可以添加额外的去耦电容来补偿噪声或高阻抗电源。

10. 布局

电流检测电阻布线不当会导致放大器输入引脚之间产生额外的电阻。任何额外的高电流承载阻抗都会导致严重的测量误差，因为电流电阻器的欧姆值非常低。使用开尔文或 4 线连接连接到器件输入引脚。这种连接技术可确保仅检测输入引脚之间的电流检测电阻器阻抗。

11. PACKAGE INFORMATION

The CSA245Q is available in the SOT23-5 package. Figure 20 shows the package view.

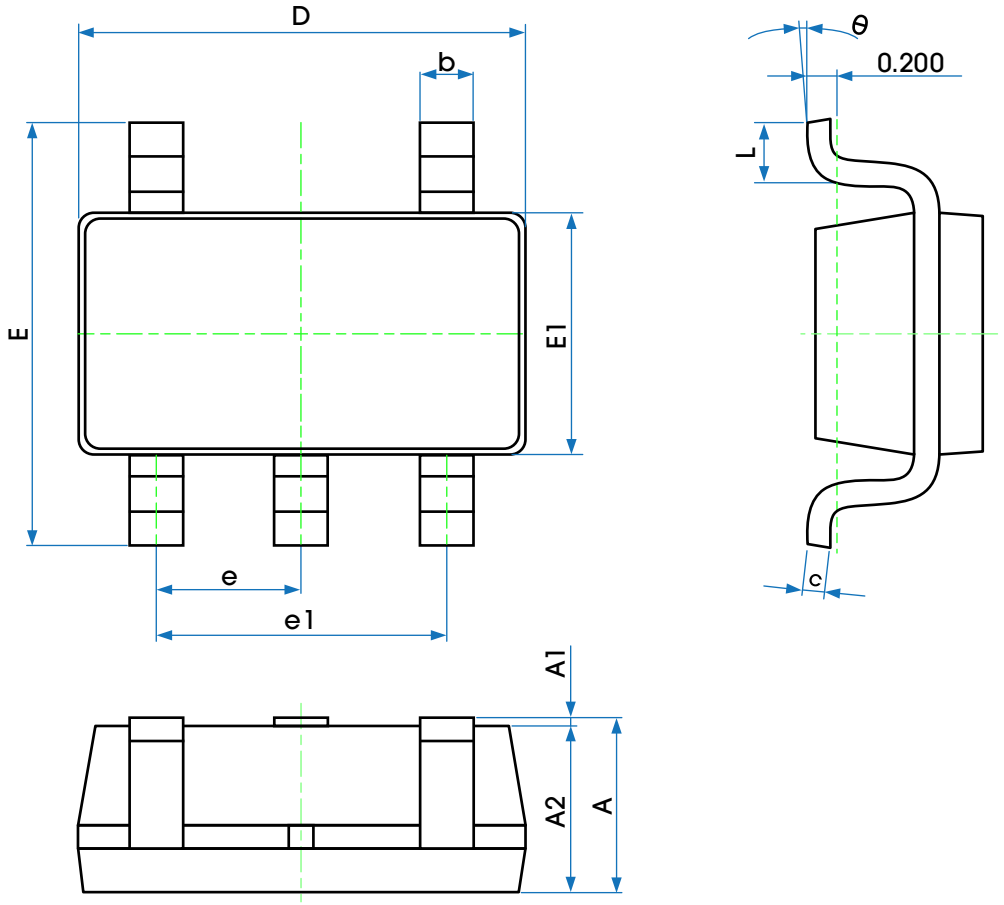


Figure 20. Package View

Table 8 provides detailed information about the dimensions.

Table 8. Dimensions

SYMBOL	DIMENSIONS IN MILLIMETERS		DIMENSIONS IN INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	2.650	2.950	0.104	0.116
E1	1.500	1.700	0.059	0.067
e	0.950 (BSC)		0.037 (BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600REF		0.024REF	
θ	0°	8°	0°	8°

12. TAPE AND REEL INFORMATION

REVISION HISTORY

REVISION	DATE	DESCRIPTION
Rev 0.1	07 February 2023	Rev A release.
Rev 0.5	24 February 2023	Updated Figure 27.
Rev 0.8	22 April 2023	1. Updated table 5.5