

XTR11x 4-20mA 电流环路变送器

1 特性

- 低静态电流：200μA
- 用于外部电路的 5V 稳压器
- 用于传感器激励的 V_{REF} ：
 - XTR115：2.5V
 - XTR116：4.096V
- 低量程误差：0.05%
- 低非线性误差：0.003%
- 宽环路电源电压范围：7.5 V 至 36 V
- SO-8 封装

2 应用

- 2 线 4-20mA 电流环路
- 发送器
- 智能变送器
- 工业过程控制
- 测试系统
- 与 HART 调制解调器兼容
- 电流放大器
- 电压转电流放大器

3 说明

XTR115 和 XTR116 (XTR11x) 是精密电流输出转换器，设计用于通过业界通用电流环路传输模拟 4mA 至 20mA 信号。这些器件提供精确的电流调节和输出电流限制功能。

片上稳压器 (5V) 可用于为外部电路供电。精密片上 V_{REF} (XTR115 为 2.5V，XTR116 为 4.096V) 可用于激励传感器或使其偏移。电流回路引脚 (I_{RET}) 可检测外部电路中使用任何电流，以精确控制输出电流。

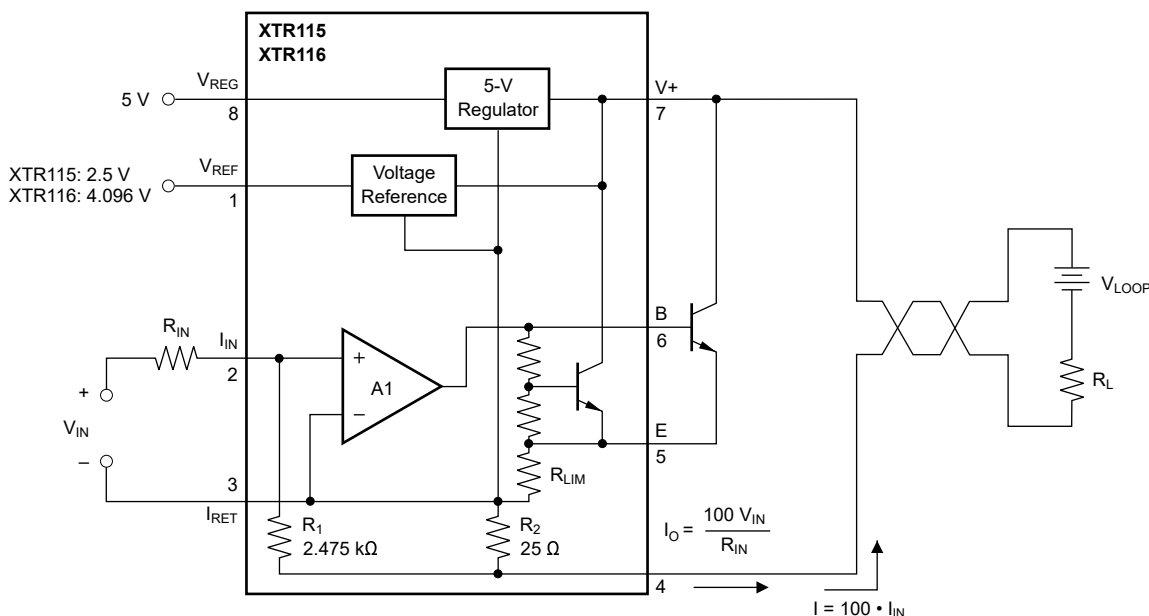
XTR11x 是使用 4mA 至 20mA 电流传输的智能传感器的基本构建块。

XTR11x 的工业级工作温度范围为 -40°C 至 $+85^{\circ}\text{C}$ 。

器件信息

器件型号	片上 V_{REF}	封装 ⁽¹⁾
XTR115	2.5V	D (SOIC, 8)
XTR116	4.096V	

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。



典型应用



Table of Contents

1 特性	1	7.3 Feature Description	8
2 应用	1	8 Application and Implementation	9
3 说明	1	8.1 Application Information.....	9
4 Revision History	2	9 Device and Documentation Support	13
5 Pin Configuration and Functions	3	9.1 Device Support.....	13
6 Specifications	4	9.2 Documentation Support.....	13
6.1 Absolute Maximum Ratings.....	4	9.3 接收文档更新通知.....	13
6.2 Recommended Operating Conditions.....	4	9.4 支持资源.....	13
6.3 Thermal Information.....	4	9.5 Trademarks.....	13
6.4 Electrical Characteristics.....	5	9.6 静电放电警告.....	13
6.5 Typical Characteristics.....	6	9.7 术语表.....	13
7 Detailed Description	7	10 Mechanical, Packaging, and Orderable Information	13
7.1 Overview.....	7		
7.2 Functional Block Diagram.....	7		

4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision A (November 2003) to Revision B (March 2022)	Page
• 更新了整个文档中的表格、图和交叉参考的编号格式.....	1
• 添加了引脚功能、ESD 等级、热性能信息、建议运行条件和电气特性表以及详细说明、概述、功能方框图、特性说明、应用和实施、器件和文档支持和机械、封装和可订购信息部分.....	1
• Added <i>Pin Functions</i> table.....	3
• Changed operating temperature minimum value from -55°C to -40°C in <i>Absolute Maximum Ratings</i>	4
• Deleted thermal resistance, θ_{JA} specification of 150°C/W from <i>Electrical Characteristics</i> ; added a <i>Thermal Information</i> table, with $R_{\theta JA} = 128.2^{\circ}\text{C/W}$ and other detailed thermal parameters.....	4
• Changed span error test condition from: $I_{IN} = 250\ \mu\text{A}$ to $25\ \text{mA}$ to: $I_{OUT} = 250\ \mu\text{A}$ to $25\ \text{mA}$ in <i>Electrical Characteristics</i>	5
• Changed V_{REF} voltage accuracy vs load typical value from $\pm 100\ \text{ppm/mA}$ to $\pm 200\ \text{ppm/mA}$ in <i>Electrical Characteristics</i>	5
• Changed bias current vs temperature typical value from $150\ \text{pA}/^{\circ}\text{C}$ to $300\ \text{pA}/^{\circ}\text{C}$ in <i>Electrical Characteristics</i>	5
• Changed <i>Basic Circuit Connections</i> application diagram.....	9
• Changed <i>External Transistor</i> applications information section to incorporate additional guidance regarding transistor power dissipation and thermal concerns.....	10
• Added <i>Circuit Stability</i> application information section.....	12

5 Pin Configuration and Functions

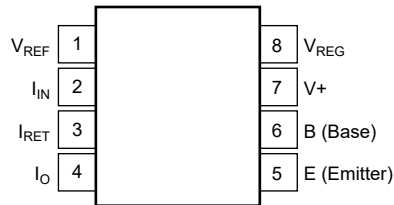


图 5-1. D Package, SOIC-8 (Top View)

表 5-1. Pin Functions

PIN		TYPE	DESCRIPTION
NO.	NAME		
1	V _{REF}	Output	Reference voltage output (2.5 V for XTR115, 4.096 V for XTR116)
2	I _{IN}	Input	Current input pin
3	I _{RET}	Input	Local ground return pin for V _{REG} and V _{REF}
4	I _O	Output	Regulated 4-mA to 20-mA current-loop output
5	E (Emitter)	Input	Emitter connection for external transistor
6	B (Base)	Output	Base connection for external transistor
7	V+	Power	Loop power supply
8	V _{REG}	Output	5-V regulator voltage output

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

		MIN	MAX	UNIT
V+	Power supply (referenced to I _O pin)		40	V
	Input voltage (referenced to I _{RET} pin)	0	V+	V
	Output current limit	Continuous		
	V _{REG} , short-circuit	Continuous		
	V _{REF} , short-circuit	Continuous		
T _A	Operating temperature	–40	125	°C
T _J	Junction temperature		165	°C
T _{stg}	Storage temperature	–55	125	°C
	Lead temperature (soldering, 10 s)		300	°C

- (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability.

6.2 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V+	Power supply voltage	7.5	24	36	V
T _A	Specified temperature	–40		85	°C

6.3 Thermal Information

THERMAL METRIC ⁽¹⁾		XTR11x	UNIT
		D (SOIC)	
		8 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	128.2	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	68.2	°C/W
R _{θJB}	Junction-to-board thermal resistance	75.7	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	15.5	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	74.9	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC package thermal metrics](#) application report.

6.4 Electrical Characteristics

at $T_A = 25^\circ\text{C}$, $V_+ = 24\text{ V}$, $R_{IN} = 20\text{ k}\Omega$, and TIP29C external transistor (unless otherwise noted)

PARAMETER		TEST CONDITIONS	XTR115U, XTR116U			XTR115UA, XTR116UA			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT									
I _O	Output current equation		I _O = I _{IN} × 100			I _O = I _{IN} × 100			
	Output current, linear range		0.25 25			0.25 25			mA
I _{LIM}	Overscale limit		32			32			mA
I _{MIN}	Underscale limit	I _{REG} = 0, I _{REF} = 0	0.2 0.25			0.2 0.25			mA
SPAN									
S	Span (current gain)		100			100			A/A
	Error ⁽¹⁾	I _{OUT} = 250 mA to 25 mA	±0.05 ±0.2			±0.05 ±0.4			%
	vs Temperature	T _A = −40°C to +85°C	±3 ±20			±3 ±20			ppm/°C
	Nonlinearity	I _{IN} = 250 mA to 25 mA	±0.003 ±0.01			±0.003 ±0.02			%
INPUT									
V _{OS}	Offset voltage (op amp)	I _{IN} = 40 mA	±100 ±250			±100 ±500			μV
	vs Temperature	T _A = −40°C to +85°C	±0.7 ±3			±0.7 ±6			μV/°C
	vs Supply voltage, V+	V+ = 7.5 V to 36 V	±0.1 ±2			±0.1 ±2			μV/V
I _B	Bias current		−35			−35			nA
	vs Temperature		300			300			pA/°C
e _n	Noise: 0.1 Hz to 10 Hz		0.6			0.6			μVp-p
DYNAMIC RESPONSE									
	Small signal bandwidth	C _{LOOP} = 0, R _L = 0	380			380			kHz
	Slew rate		3.2			3.2			mA/μs
V _{REF} ⁽²⁾									
	XTR115		2.5			2.5			V
	XTR116		4.096			4.096			V
	Voltage accuracy	I _{REF} = 0	±0.05 ±0.25			±0.05 ±0.5			%
	vs Temperature	T _A = −40°C to +85°C	±20 ±35			±20 ±75			ppm/°C
	vs Supply voltage, V+	V+ = 7.5 V to 36 V	±1 ±10			±1 ±10			ppm/V
	vs Load	I _{REF} = 0 mA to 2.5 mA	±200			±200			ppm/mA
	Noise	0.1 Hz to 10 Hz	10			10			μVp-p
	Short-circuit current		16			16			mA
V _{REG} ⁽²⁾									
	Voltage		5			5			V
	Voltage accuracy	I _{REG} = 0	±0.05 ±0.1			±0.05 ±0.1			V
	vs Temperature	T _A = −40°C to +85°C	±0.1			±0.1			mV/°C
	vs Supply voltage, V+	V+ = 7.5 V to 36 V	1			1			mV/V
	vs Output current		See Typical Characteristics			See Typical Characteristics			
	Short-circuit current		12			12			mA
POWER SUPPLY, V+									
	Quiescent current		200 250			200 250			μA
		T _A = −40°C to +85°C	240 300			240 300			μA

(1) Does not include initial error or TCR of R_{IN} .

(2) Voltage measured with respect to I_{RET} pin.

6.5 Typical Characteristics

At $T_A = 25^\circ\text{C}$, $V_+ = 24\text{ V}$, $R_{IN} = 20\text{ k}\Omega$, and TIP29C external transistor (unless otherwise noted)

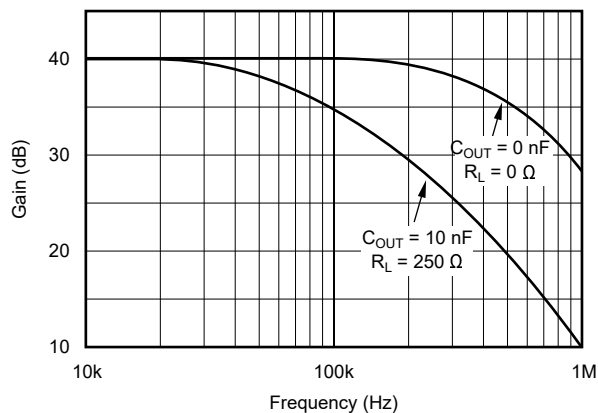


图 6-1. Current Gain vs Frequency

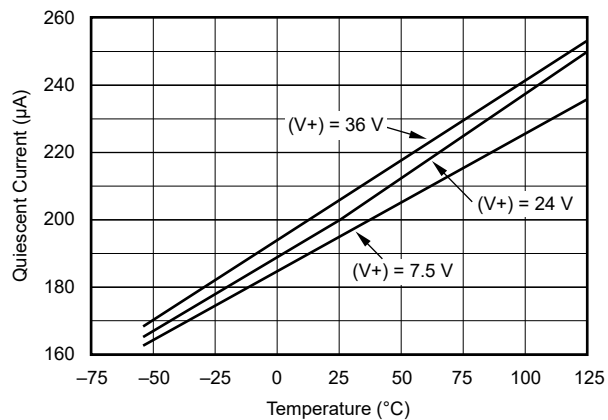


图 6-2. Quiescent Current vs Temperature

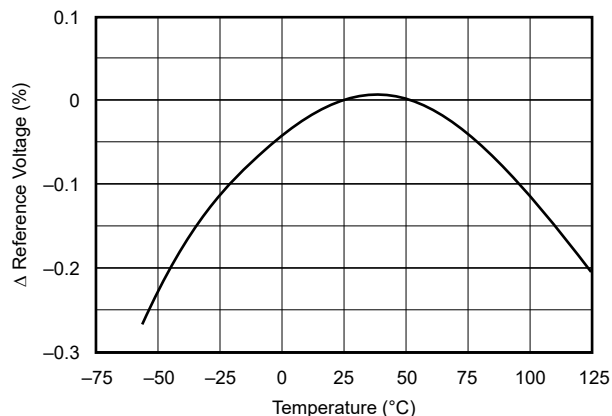


图 6-3. Reference Voltage vs Temperature

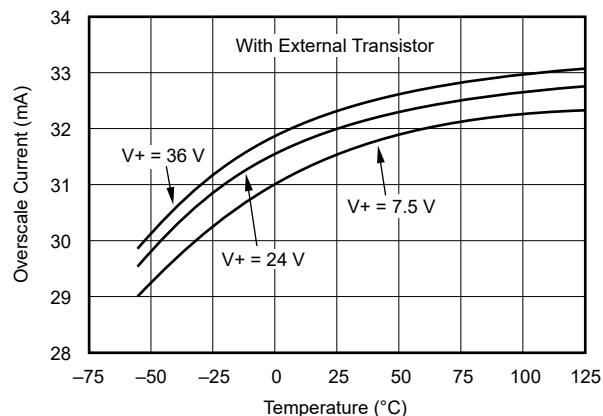


图 6-4. Overscale Current vs Temperature

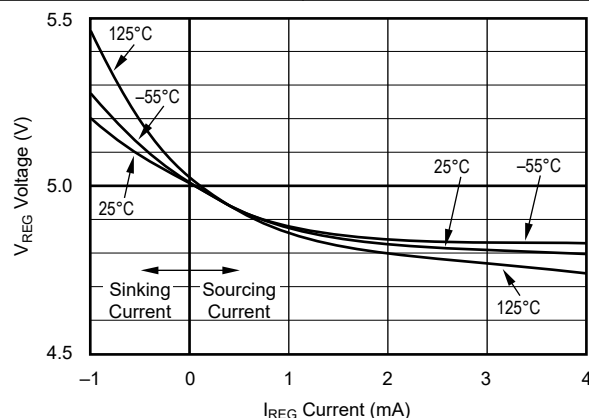


图 6-5. V_{REG} Voltage vs V_{REG} Current

7 Detailed Description

7.1 Overview

The XTR115 and XTR116 are precision current output converters designed to transmit analog 4-mA-to-20-mA signals over an industry standard current loop. The regulator and reference voltages power a sensor, such as a bridge as shown in 图 7-1. The sensor output, as a current signal I_{IN} , is gained up and transmitted over the loop to be read by a receiver.

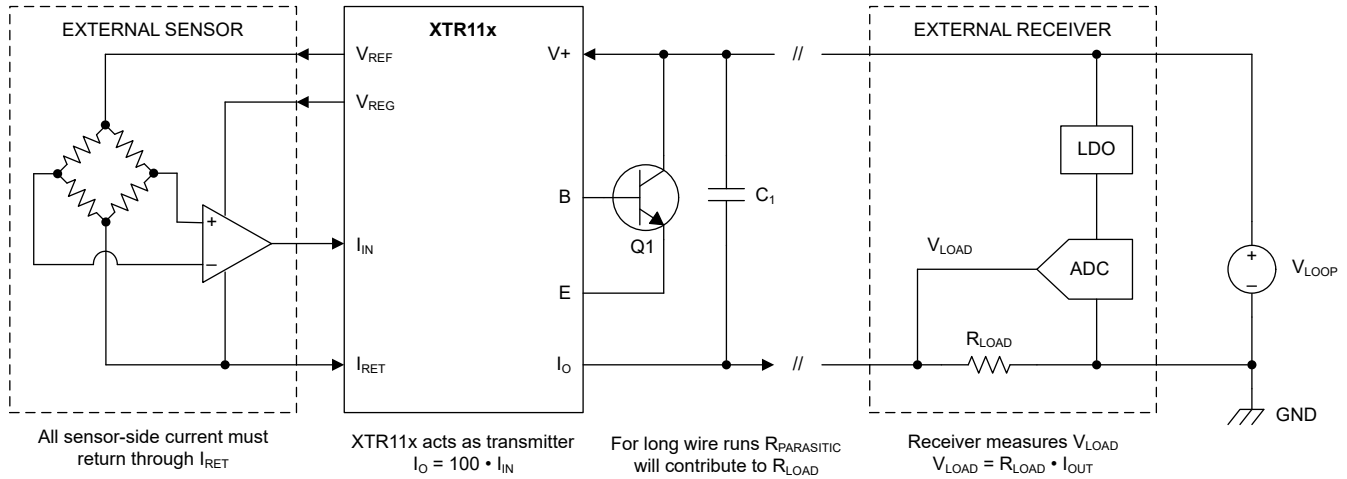
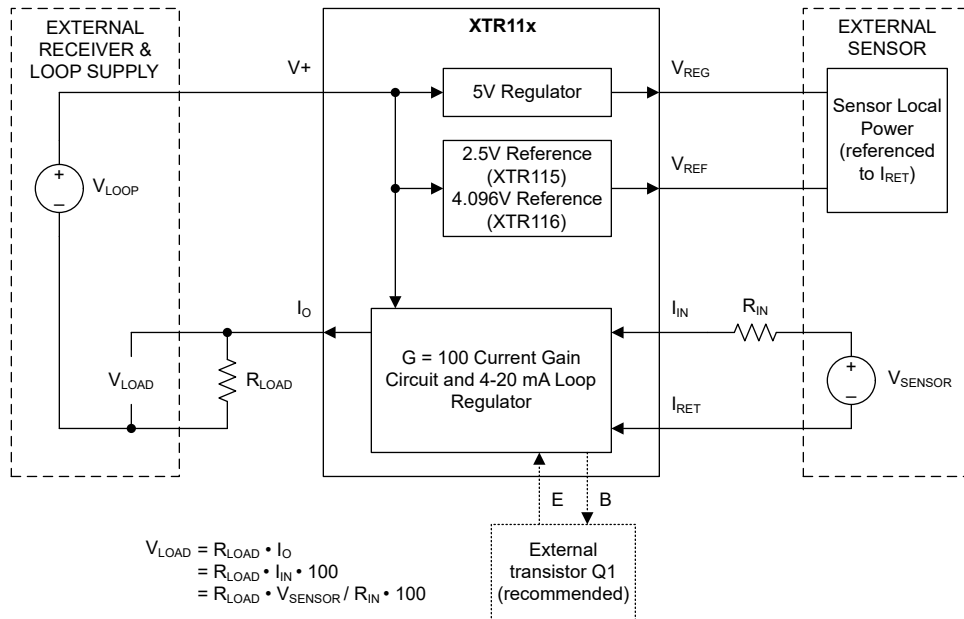


图 7-1. Typical Schematic

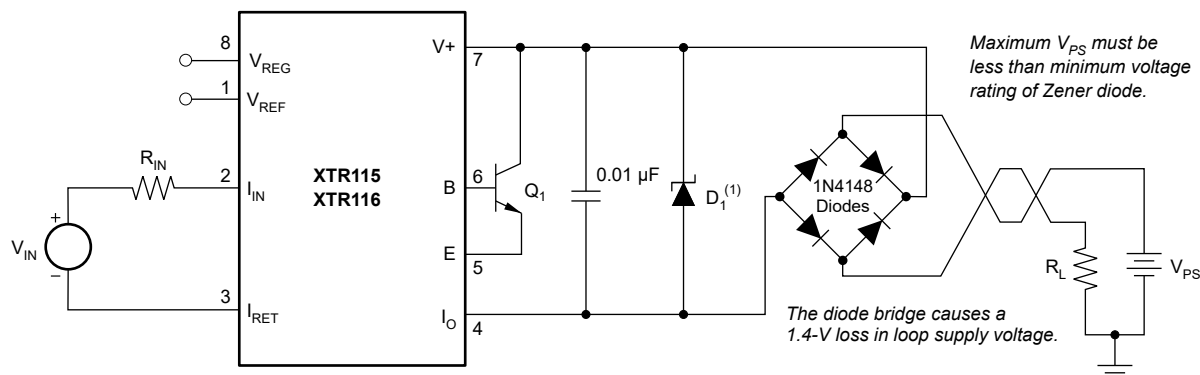
7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Reverse-Voltage Protection

The XTR11x low compliance voltage rating (7.5 V) permits the use of various voltage protection methods without compromising the operating range. Figure 7-2 shows a diode bridge circuit that allows normal operation even when the voltage connection lines are reversed. The bridge causes a two-diode drop (approximately 1.4 V) loss in loop supply voltage. This loss results in a compliance voltage of approximately 9 V—satisfactory for most applications. A diode can be inserted in series with the loop supply voltage and the V+ pin to protect against reverse output connection lines with only a 0.7-V loss in loop supply voltage.



(1) Zener Diode 36 V: 1N4753A or Motorola P6KE39A. Use lower-voltage Zener diodes with loop power-supply voltages less than 30 V for increased protection; see Section 7.3.2.

Figure 7-2. Reverse Voltage Operation and Overvoltage Surge Protection

7.3.2 Overvoltage Surge Protection

Remote connections to current transmitters can sometimes be subjected to voltage surges. Best practice is to limit the maximum surge voltage applied to the XTR11x to as low as practical. Various Zener and surge clamping diodes are specially designed for this purpose. Select a clamp diode with as low a voltage rating as possible for best protection. For example, a 36-V protection diode provides proper transmitter operation at normal loop voltages, and also provides an appropriate level of protection against voltage surges. Characterization tests on several production lots showed no damage with loop supply voltages up to 65 V.

Most surge protection Zener diodes have a diode characteristic in the forward direction that conducts excessive current, possibly damaging receiving-side circuitry if the loop connections are reversed. If a surge protection diode is used, also use a series diode or diode bridge for protection against reversed connections.

8 Application and Implementation

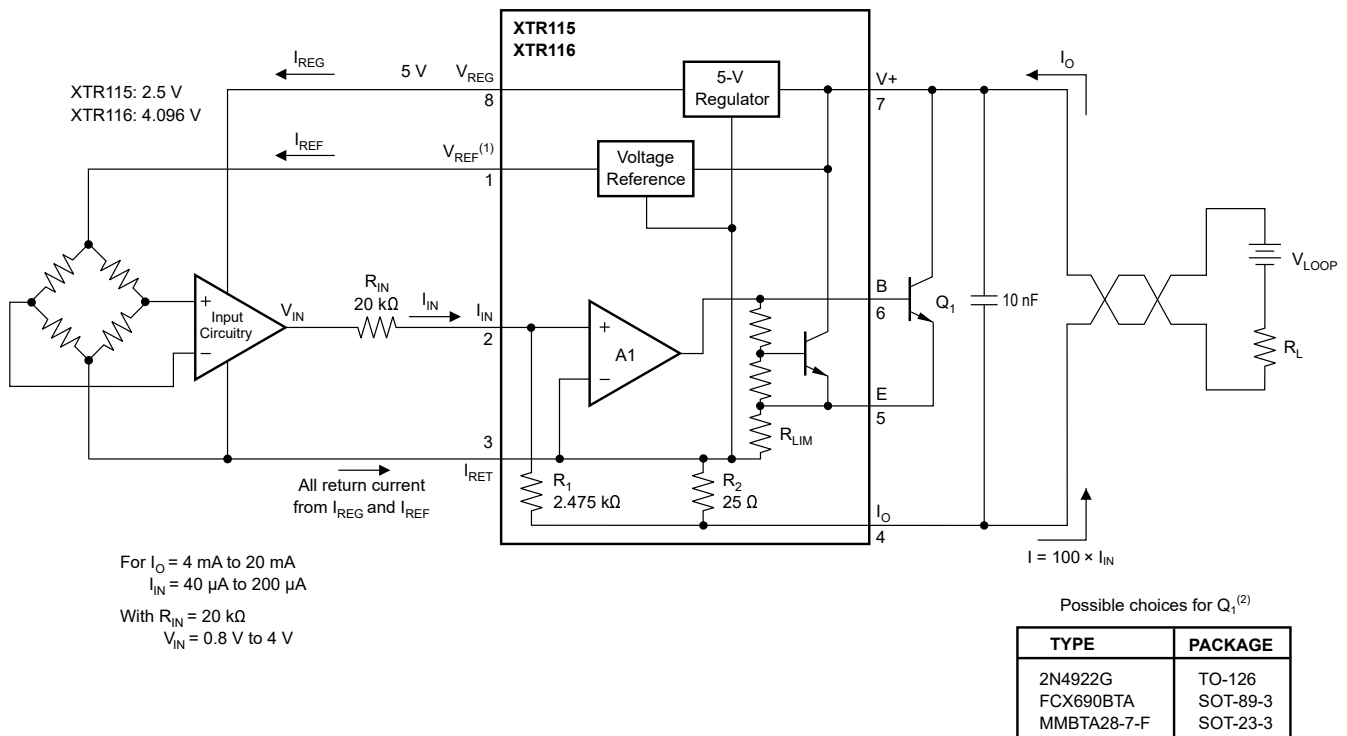
备注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information

The XTR115 and XTR116 are identical devices except for the reference voltage output, pin 1. This voltage is available for external circuitry and is not used internally. Further discussions that apply to both devices refer to the XTR11x.

图 8-1 shows basic circuit connections with representative simplified input circuitry. The XTR11x is a two-wire current transmitter. The device input signal (pin 2) controls the output current. A portion of this current flows into the V+ power supply, pin 7. The remaining current flows in Q₁. External input circuitry connected to the XTR11x can be powered from VREG or VREF. Current drawn from these terminals must be returned to IRET, pin 3. This IRET pin is a *local ground* for input circuitry driving the XTR11x.



(1) Also see 图 8-4.

(2) See 节 8.1.1.

图 8-1. Basic Circuit Connections

The XTR11x is a current-input device with a gain of 100. A current flowing into pin 2 produces $I_O = 100 \cdot I_{IN}$. The input voltage at the I_{IN} pin is zero (referred to the I_{RET} pin). A voltage input is created with an external input resistor, as shown. Common full-scale input voltages range from 1 V and upward. Full-scale inputs greater than 0.5 V are recommended to minimize the effect of offset voltage and drift of A1.

8.1.1 External Transistor

The external transistor, Q_1 , conducts the majority of the full-scale output current. Power dissipation in this transistor can approach 0.8 W with high loop voltage (40 V) and 20 mA of output current. The XTR11x is designed to use an external transistor to avoid on-chip, thermal-induced errors. Heat produced by Q_1 still causes ambient temperature changes that can affect the XTR11x. To minimize these effects, locate Q_1 away from sensitive analog circuitry, including the XTR11x. Mount Q_1 so that heat is conducted to the outside of the transducer housing and away from the XTR11x.

The XTR11x is designed to use virtually any NPN transistor with sufficient voltage, current, and power rating. Case style and thermal mounting considerations often influence the choice for any given application. Several possible choices are listed in [Figure 8-1](#). A MOSFET transistor does not improve the accuracy of the XTR11x and is not recommended. Although the XTR11x can be used without an additional external transistor, this configuration is not always practical at higher loop voltages and currents because of self-heating concerns.

8.1.2 Minimum Scale Current

The quiescent current of the XTR11x (typically 200 μ A) is the lower limit of the device output current. Zero input current ($I_{IN} = 0$ A) produces an I_O equal to the quiescent current. Output current does not begin to increase until $I_{IN} > I_Q / 100$. Current drawn from V_{REF} or V_{REG} adds to this minimum output current. This means that more than 3.7 mA is available to power external circuitry while still allowing the output current to go below 4 mA.

8.1.3 Offsetting the Input

A low scale of 4 mA is produced by creating a 40- μ A input current. This low-scale offset can be created with the proper value resistor from V_{REF} (as shown in [Figure 8-2](#), or by generating offset in the input drive circuitry.

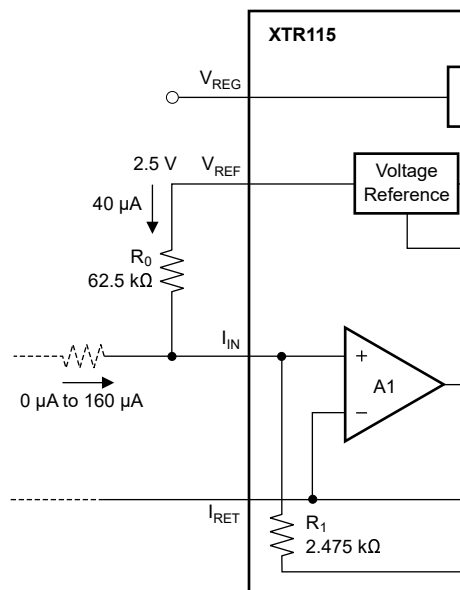


图 8-2. Creating Low-Scale Offset

8.1.4 Maximum Output Current

The XTR11x provide accurate, linear output up to 25 mA. Internal circuitry limits the output current to approximately 32 mA to protect the transmitter and loop power or measurement circuitry.

Extending the output current range of the XTR11x is possible by connecting an external resistor from pin 3 to pin 5 to change the current limit value.

CAUTION

All output current must flow through internal resistors; therefore, damage is possible with excessive current. Output currents greater than 45 mA can cause permanent damage.

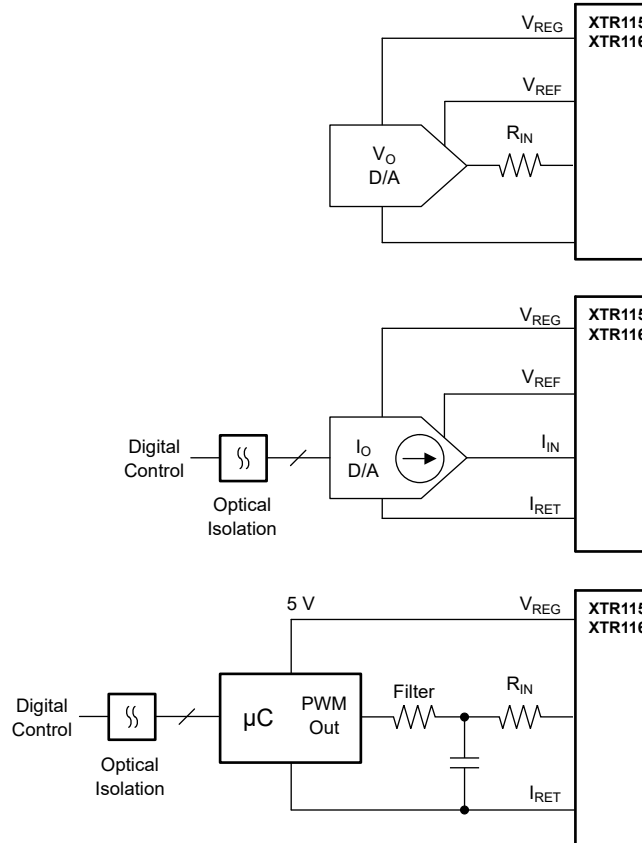


图 8-3. Digital Control Methods

8.1.5 Radio Frequency Interference

The long wire lengths of current loops invite radio frequency interference (RF). RF can be rectified by the input circuitry of the XTR11x or preceding circuitry. This RF generally appears as an unstable output current that varies with the position of loop supply or input wiring. Interference can also enter at the input pins. For integrated transmitter assemblies with short connection to the sensor, the interference more likely comes from the current-loop connections.

8.1.6 Circuit Stability

The 4-20 mA control-loop stability must be evaluated for any XTR11x design. A 10-nF decoupling capacitor between $V+$ and I_O is recommended for most applications. As this capacitance appears in parallel with the load resistance R_{LOAD} from a stability perspective, the capacitor and resistor form a filter corner that can limit the bandwidth of the system. Therefore, for HART applications, use a bypass capacitance of 2 nF to 3 nF instead.

For applications with EMI and EMC concerns, use a bypass capacitor with sufficiently low ESR to decouple any ripple voltage from the V_{LOOP} supply. Otherwise, the ripple voltage couples onto the 4-mA to 20-mA current source, and appears as noise across R_{LOAD} after the current-to-voltage conversion.

Additionally, stability concerns apply to the V_{REF} reference buffer when driving capacitive loads. 图 8-4 shows that two filtering capacitors are required, one C_{HF} of 10 pF to 0.5 μ F and another C_{LF} of 2.2 μ F to 22 μ F. Either a series isolation resistance R_{ISO} or a snubber R_{COMP} is used, depending on application requirements.

If capacitive loading must be placed on the V_{REF} pin, use one of the following compensation schemes to maintain stable operation. Values of capacitance must remain within the given ranges.

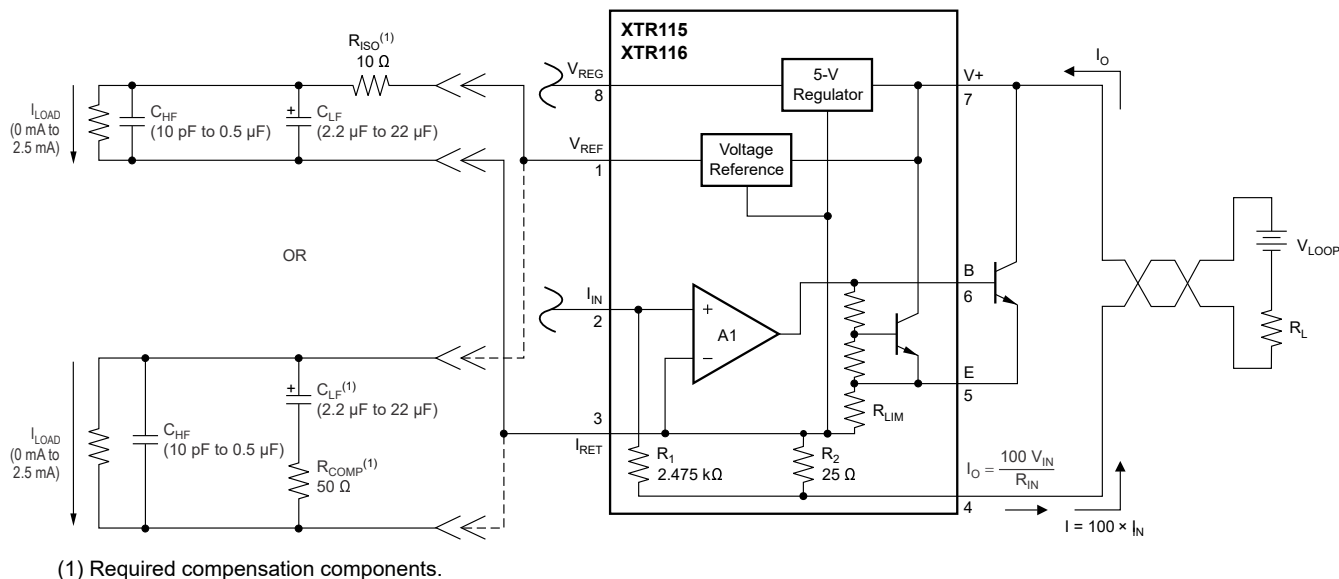


图 8-4. Stable Operation With Capacitive Load on V_{REF}

9 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

9.1 Device Support

9.2 Documentation Support

9.2.1 Related Documentation

For related documentation see the following:

- Texas Instruments, [Special Function Amplifiers: TI Precision Labs introduction video on Current Loop Transmitters](#)
- Texas Instruments, [TIPD190 2-wire, 4-20mA Transmitter, EMC/EMI Tested Reference Design](#) with the XTR116

9.3 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](#) 上的器件产品文件夹。点击 [订阅更新](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

9.4 支持资源

TI E2E™ [支持论坛](#) 是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《[使用条款](#)》。

9.5 Trademarks

TI E2E™ is a trademark of Texas Instruments.
所有商标均为其各自所有者的财产。

9.6 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

9.7 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
XTR115U	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-40 to 85	XTR 115U
XTR115U/2K5	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	Call TI Nipdau	Level-3-260C-168 HR	-40 to 85	XTR 115U
XTR115UA/2K5	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU NIPDAU	Level-3-260C-168 HR	-40 to 85	XTR 115U A
XTR116U	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-40 to 85	XTR 116U
XTR116U/2K5	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	Call TI Nipdau	Level-3-260C-168 HR	-40 to 85	XTR 116U
XTR116UA	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-40 to 85	XTR 116U A
XTR116UA/2K5	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	XTR 116U A

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

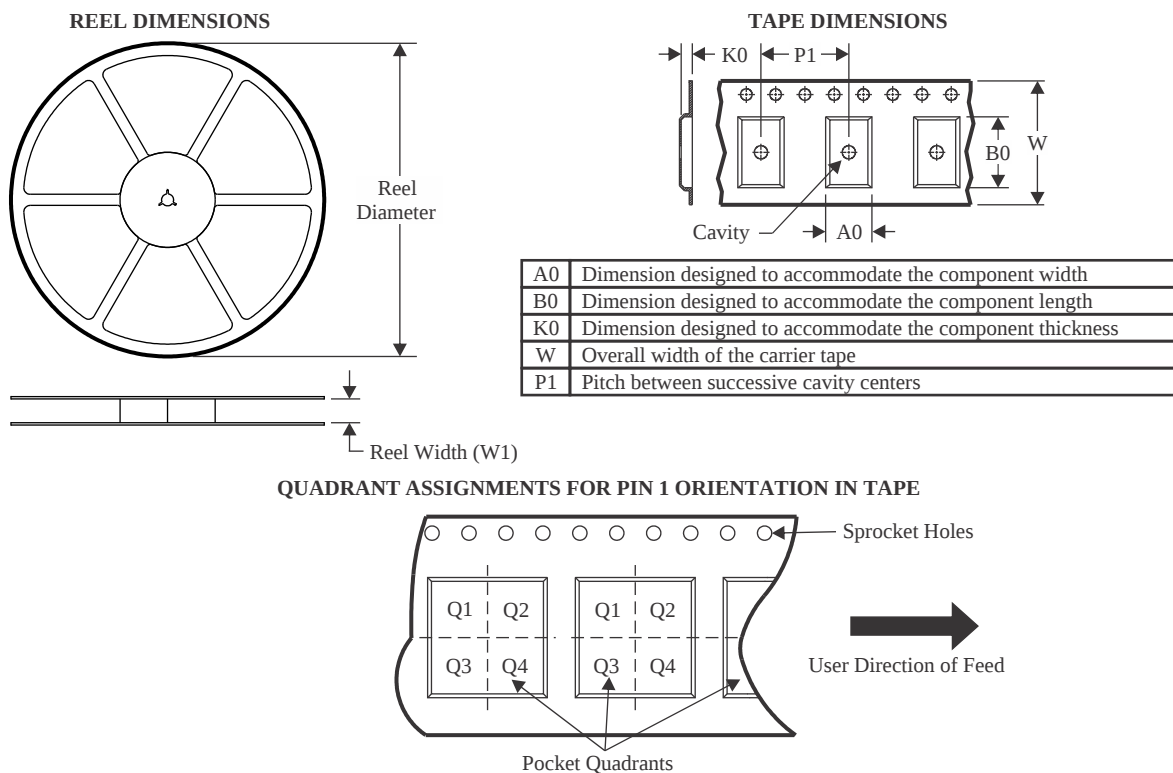
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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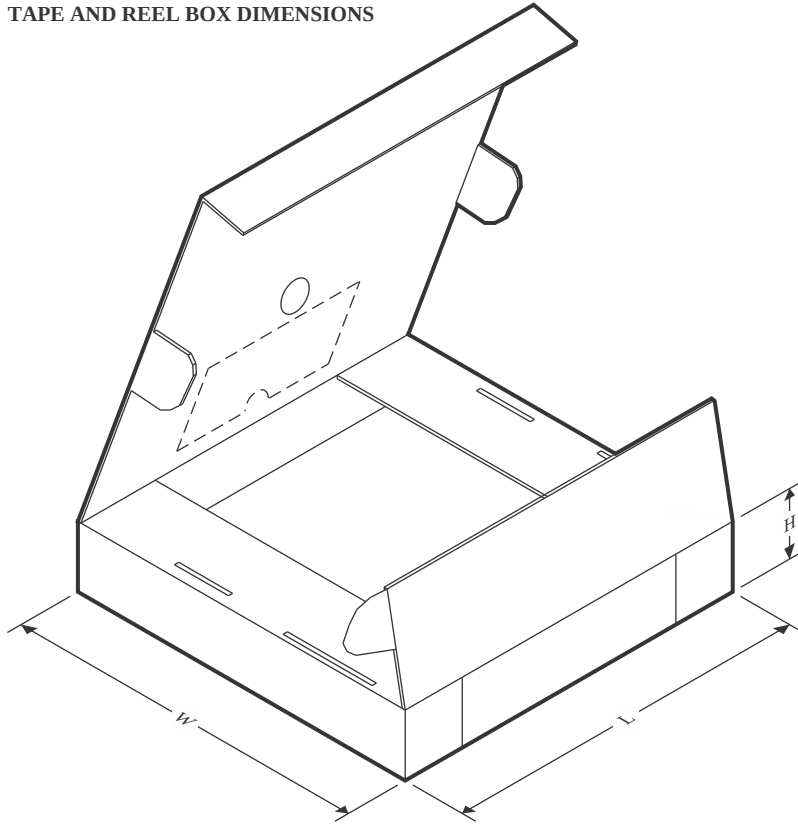
TAPE AND REEL INFORMATION



*All dimensions are nominal

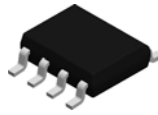
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
XTR115U/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR115U/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR115UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR115UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR116U/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR116U/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR116UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
XTR116UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
XTR115U/2K5	SOIC	D	8	2500	356.0	356.0	35.0
XTR115U/2K5	SOIC	D	8	2500	356.0	356.0	35.0
XTR115UA/2K5	SOIC	D	8	2500	356.0	356.0	35.0
XTR115UA/2K5	SOIC	D	8	2500	356.0	356.0	35.0
XTR116U/2K5	SOIC	D	8	2500	356.0	356.0	35.0
XTR116U/2K5	SOIC	D	8	2500	353.0	353.0	32.0
XTR116UA/2K5	SOIC	D	8	2500	356.0	356.0	35.0
XTR116UA/2K5	SOIC	D	8	2500	353.0	353.0	32.0

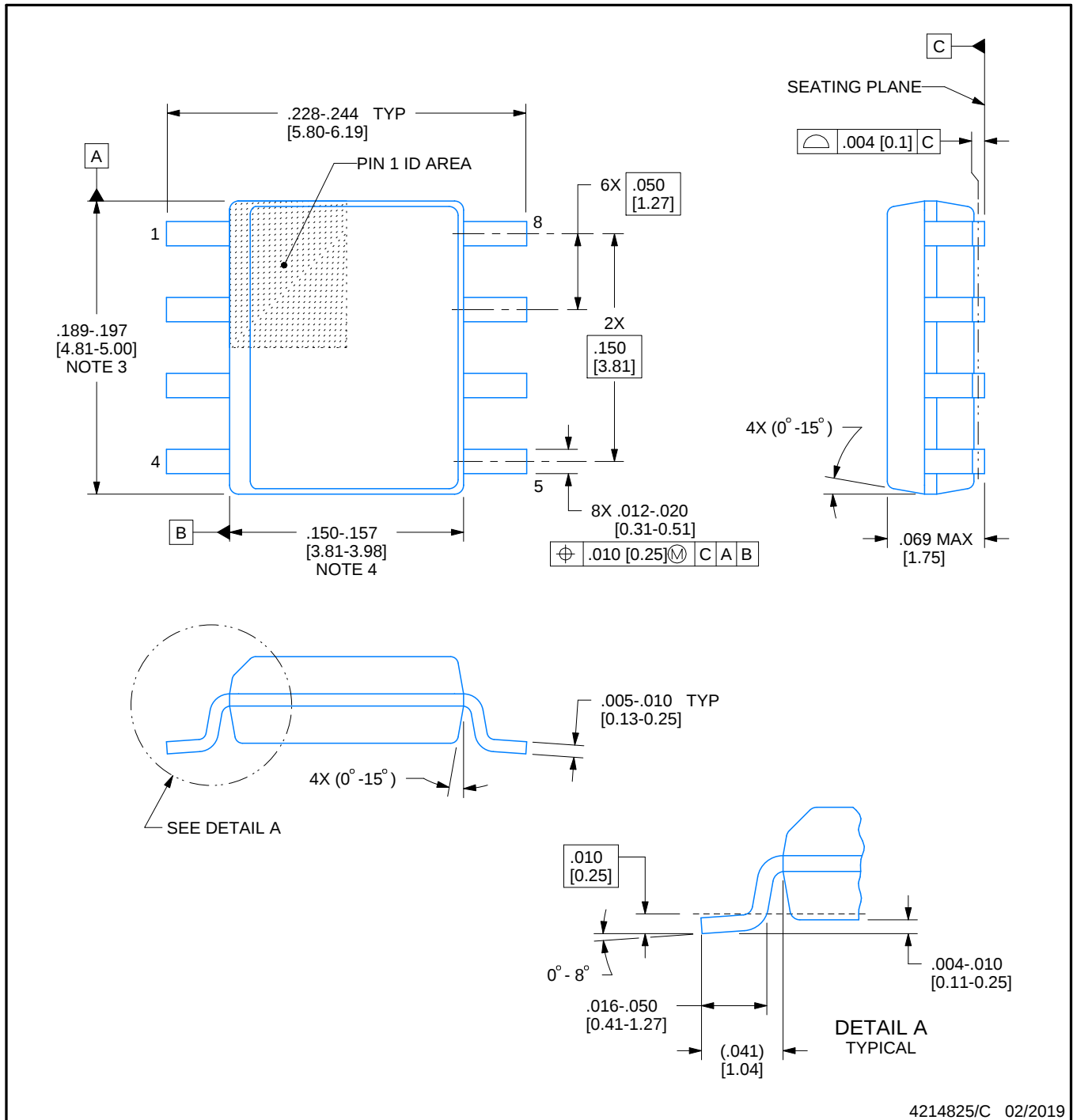


D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

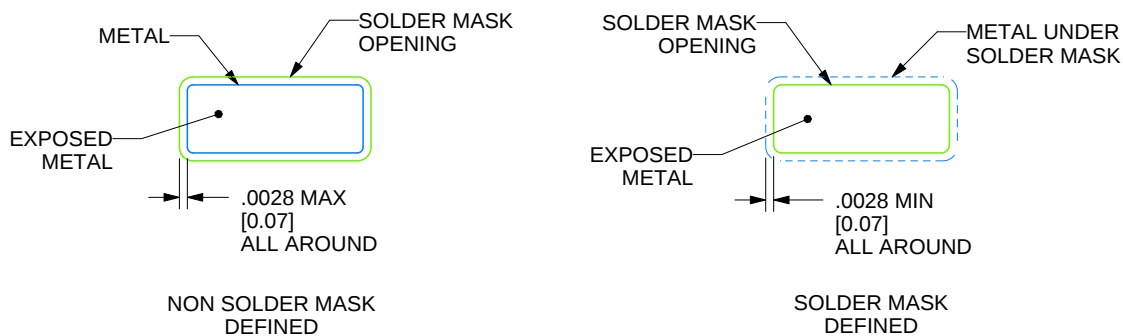
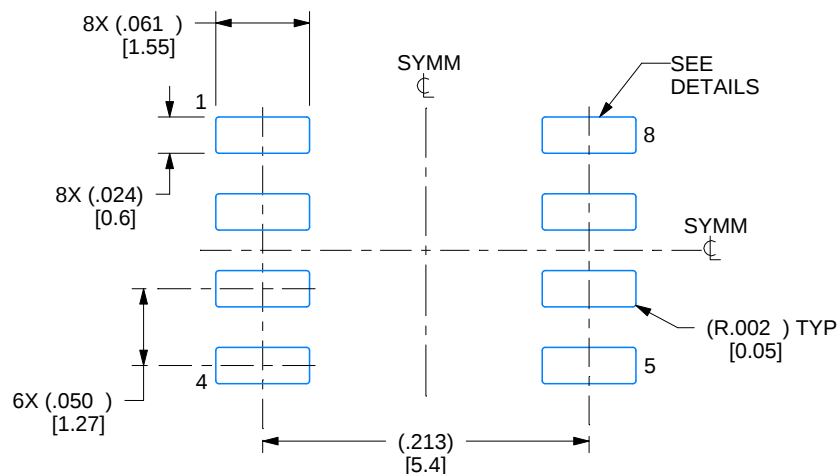
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

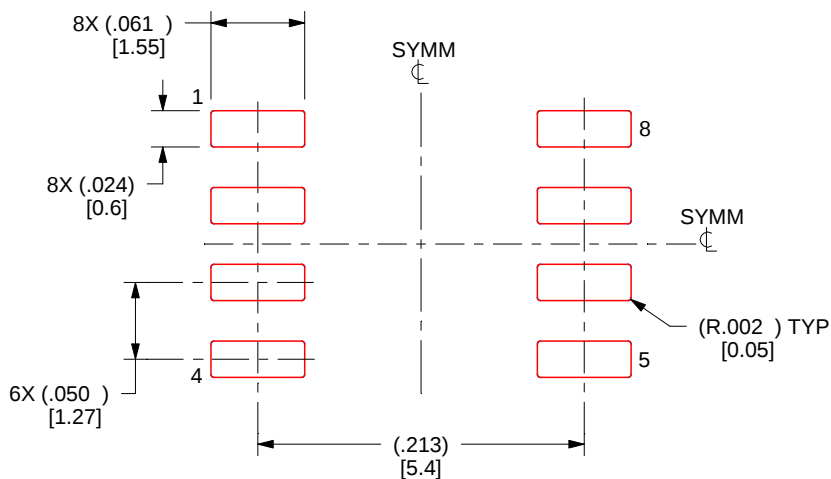
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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