Low Power, Low Noise, Low Temperature Drift, High Precision Voltage Reference

1 Features

- Low temperature drift:
  - 15 ppm/°C (max)
- High accuracy:
  - 0.1% (max)
- Low noise: 10μVpp/V
- Excellent long-term stability:
  - 100ppm (typical) first 1000 hours
  - 50ppm (typical) after 1000 hours
- High output current: ±10mA
- Low quiescent current 30μA (typical)
- Output voltage: 2.048V, 2.5V, 3V, 3.3V, 4.096V, 5V
- Temperature range: −40°C to 125°C

2 Application

- Portable Devices
- Medical Devices
- Data Acquisition System
- Test Equipment

3 Description

The GD30VR1000 is a family of low power, low noise, low drift, high precision voltage references. These references support both current sinking and current sourcing and have excellent line and load regulation.

Proprietary design techniques are used to achieve excellent temperature drift and high accuracy. These features, combined with very low noise, make the GD30VR1000 series an ideal choice for high-precision data acquisition systems.

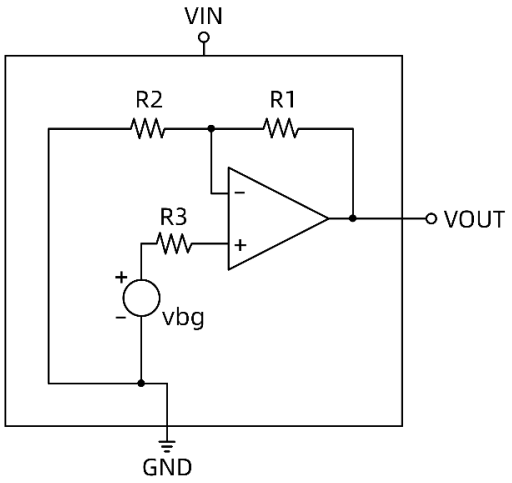
Available in a SOT23-3 leaded package, it is specified over the −40°C to 125°C temperature range.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
GD30VR1000	SOT23-3	2.90mm x 1.30mm

1. For packaging details, see *Packaging Information* section .

Block Diagram



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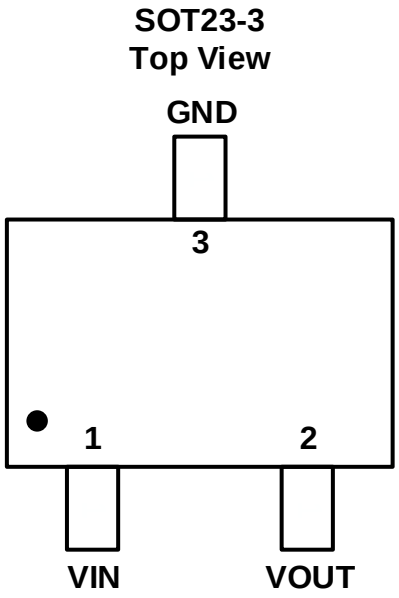
4 Device Overview

4.1 Pinout and Pin Assignment



4.2 Pin Description

PIN NUMBER		PIN TYPE[1]	FUNCTION
NAME	SOT23-3		
VIN	1	P	Supply voltage
VOUT	2	O	Reference voltage output
GND	3	G	Ground

1. O = Output, P = Power, G = Ground.

5 Parameter Information

5.1 Absolute Maximum Ratings

Over free-air operating temperature range (unless otherwise stated)[1].

PARAMETER	MIN	MAX	UNIT
Input voltage (V_{IN})	−0.2	7	V
Output short circuit to ground	0	30	mA
Output voltage range	−0.2	5.5	V
Operating temperature (T_A)	−55	125	°C
Junction Temperature (T_J Max)		150	°C
Storage temperature (T_{stg})	−65	150	°C

1. Stresses exceeding these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only and functional operation of the device at these or any other conditions beyond those specified is not implied.

5.2 Recommended Operation Conditions

PARAMETER	MIN	MAX	UNIT
Input voltage (V_{IN})[1]	V_{OUT}+0.2	5.5	V
Output Current (I_{OUT})	−10	10	mA

1. Except GD30VR1000-I20, V_{IN} (min) = 2.5V.

5.3 Electrical Sensitivity

SYMBOL	CONDITIONS	VALUE	UNIT
$V_{ESD\ (HBM)}$	Human Body Model (HBM) , compliant with ANSI/ESDA/JEDEC JS-001[1]	±3000	V
$V_{ESD\ (CDM)}$	Charged Device Model (CDM) , compliant with JEDEC specification JESD22-C101[2]	±1000	V

1. JEDEC Document JEP155 states: 500V HBM Can be realized in standard ESD Safe production under controlled process.
2. JEDEC Document JEP157 states: 250V CDM Can be realized in standard ESD Safe production under controlled process.

5.4 Thermal Resistance

SYMBOL[1]	CONDITIONS	SOT23-3	UNIT
Θ_{JA}	Junction to ambient thermal resistance	297.3	°C/W
Θ_{JB}	Junction to board thermal resistance	91.7	°C/W
$\Theta_{JC\ (top)}$	Junction to case (top) thermal resistance	128.5	°C/W
Ψ_{JB}	Junction-to-Board Characterization Parameters	90.3	°C/W
Ψ_{JT}	Junction to Top Characteristic Parameters	12.8	°C/W

1. Thermal characteristics are based on simulation, and meet JEDEC document JESD51-7.

5.5 Electrical Characteristics

Unless otherwise noted, at T_A = 25°C, I_{LOAD} = 0, C_L = 1μF, V_{IN} = 5V.

PARAMETER	CONDITION	MIN	TYP	MAX	UNIT
OUTPUT VOLTAGE					
V_{OUT} output voltage	GD30VR1000-I20		2.048		V
	GD30VR1000-I25		2.5		
	GD30VR1000-I30		3.0		
	GD30VR1000-I33		3.3		
	GD30VR1000-I40		4.096		
	GD30VR1000-I50		5.0		
Initial accuracy	All voltage options[1]	−0.1		0.1	%
NOISE					
Output voltage noise	f = 0.1Hz to 10Hz		10		μV_{PP}/V
OUTPUT VOLTAGE TEMPERATURE DRIFT					
δV_{OUT} / dT			3	15	ppm/°C
LINE REGULATION					
δV_O (δV_I) linear adjustment	V_{IN} = (V_{OUT} + 0.2) to 5.5V, T_A = –40°C to 125°C[2]		30		ppm/V
LOAD REGULATION					
δV_O (δIL) Load Regulation	−10mA < I_{LOAD} < 10mA, T_A = –40°C to 125°C		20		ppm/mA
SHORT CIRCUIT CURRENT					
I_{SC} short circuit current			25		mA
THERMAL HYSTERESIS					
dT Thermal hysteresis			90		ppm
LONG-TERM STABILITY					
SOT23-3	0 to 1000 hours		100		ppm/1000 hours
SOT23-3	1000 to 2000 hours		50		ppm/1000 hours
POWER SUPPLY					
Vs supply voltage	See Notes	V_{OUT} + 0.2		5.5	V
Quiescent Current I_Q			30		μA
	T_A = −40°C to 125°C			60	μA
TEMPERATURE RANGE					
Specified range			−40	125	°C
Working scope			−55	125	°C

1. For V_{OUT} ≤ 2.5V, the minimum supply voltage is 2.5V.
2. Except GD30VR1000-I20, its V_{IN} = 2.5V to 5.5V.

5.6 Typical Characteristics

Unless otherwise noted, I_{LOAD} = 0, V_{IN} = 5V, at T_A = 25°C.

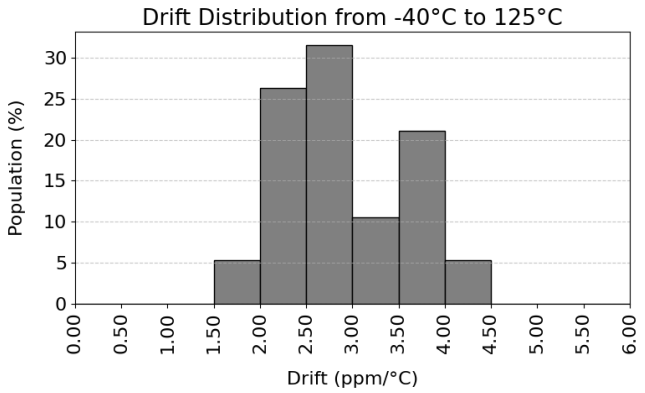


Figure 1. -40 ~ 125°C Temperature Drift

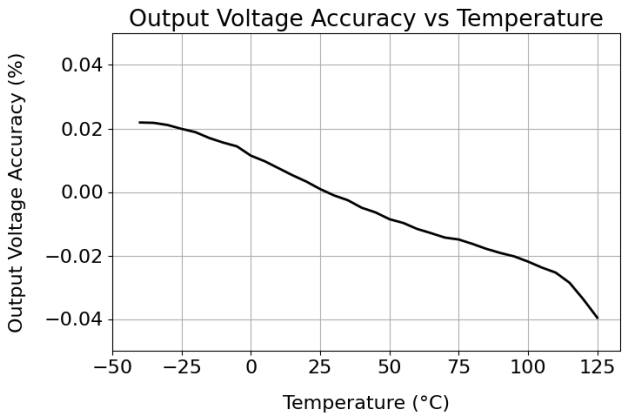


Figure 2. Output Voltage Accuracy vs. Temperature

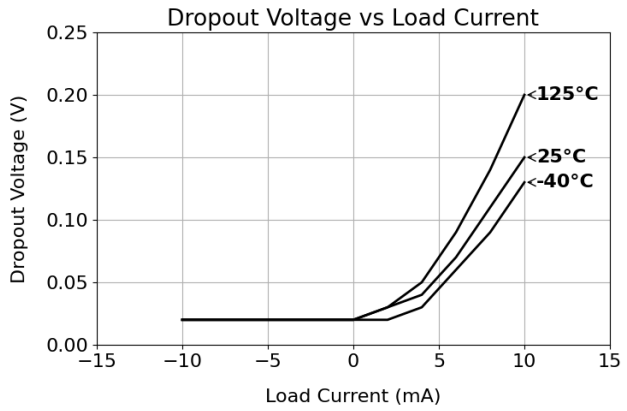


Figure 3. Drop Voltage vs. Load Current

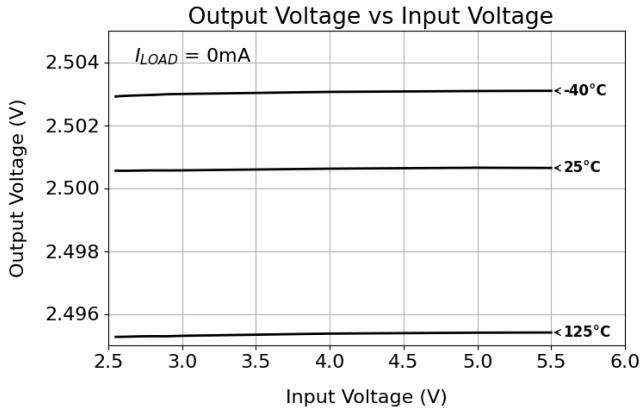


Figure 4. Output Voltage vs. Input Voltage

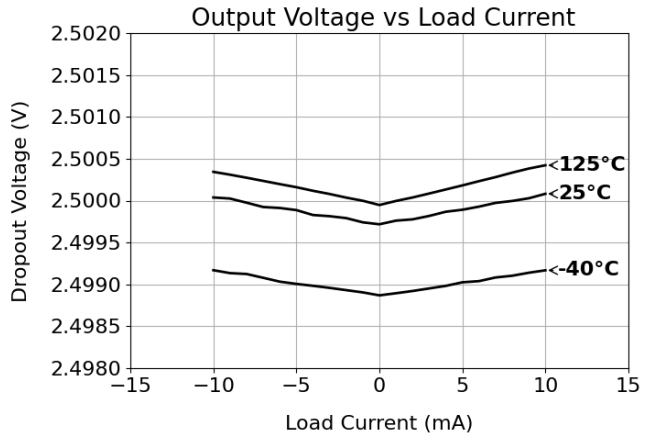


Figure 5. Output Voltage vs. Load Current

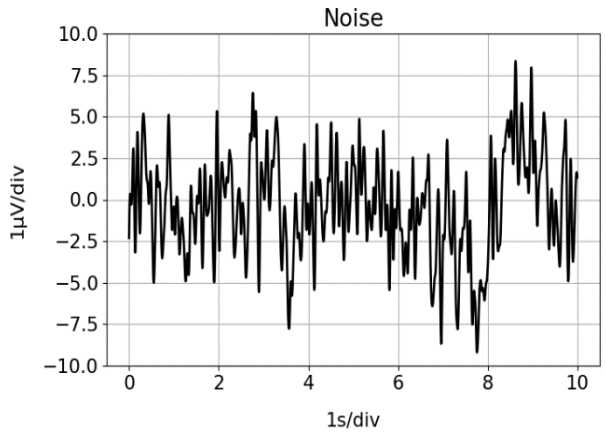


Figure 6. 0.1 Hz to 10 Hz noise

Typical Characteristics(Continued)

Unless otherwise noted, at T_A = 25°C, I_{LOAD} = 0, V_{IN} = 5V, V_{OUT} = 2.5V.

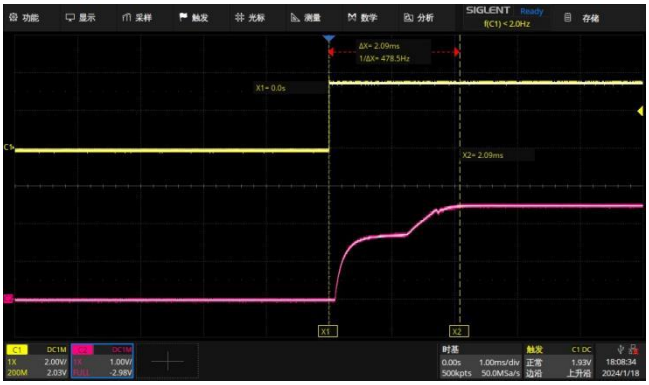


Figure 7. CL =1uF Power-On

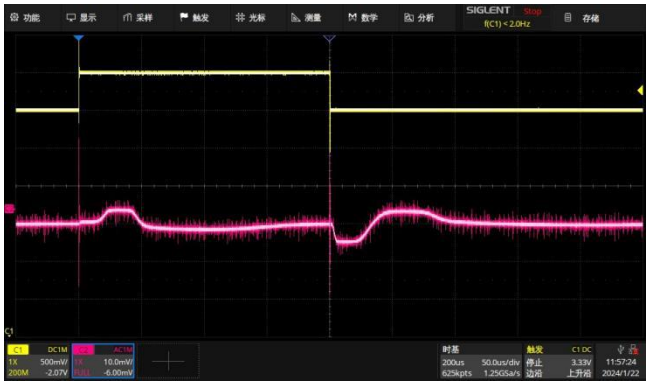


Figure 8. CL=1uF Linear Dynamic Response

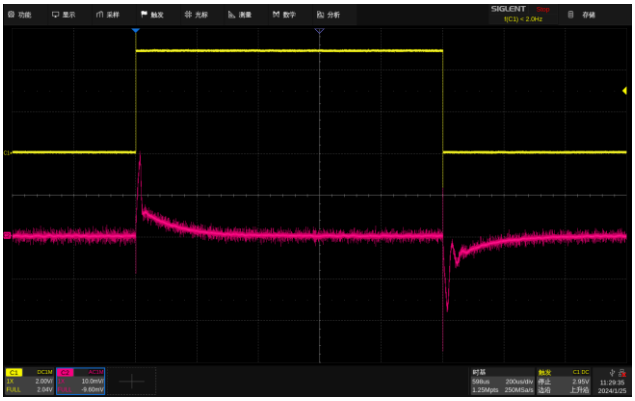


Figure 9. CL = 1uF, IOUT = 1mA Dynamic Load Response

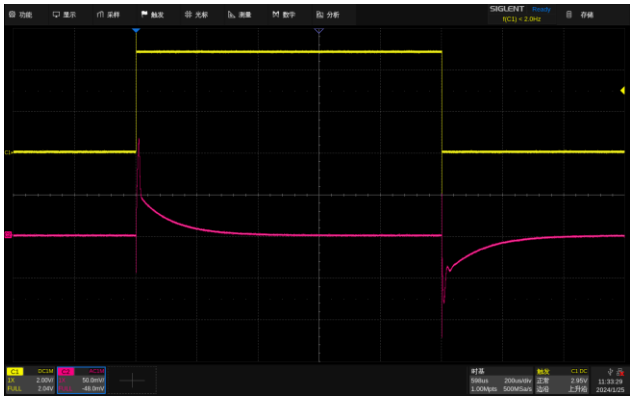


Figure 10. CL = 1uF, IOUT = 10mA Dynamic Load Response

6 Functional Description

6.1 Overview

The GD30VR1000 is a family of low noise, precision bandgap voltage reference products designed for excellent initial voltage accuracy and drift. See the figure below for a simplified block diagram of the GD30VR1000.

6.2 Block Diagram

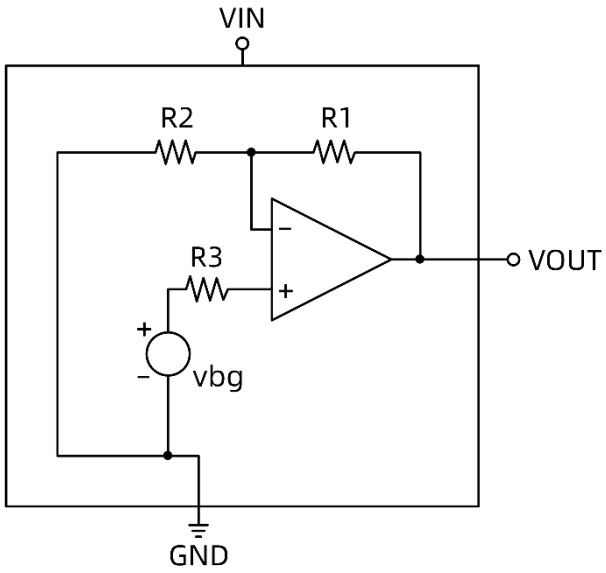


Figure 11. GD30VR1000 Functional Block Diagram

6.3 Features

6.3.1 Overview

6.3.2 Temperature Drift

The GD30VR1000 is designed for minimum drift error, which is defined as the change in output voltage with temperature. The temperature drift is calculated using the logic box method, as described in Equation (1).

$$Drift = \left(\frac{V_{OUTMAX} - V_{OUTMIN}}{V_{OUT} \times TempRange}\right) \times 10^6 (ppm) \quad (2)$$

The maximum drift coefficient of GD30VR1000 is 15ppm/°C.

6.3.3 Thermal Hysteresis

The GD30VR1000 is defined as the change in output voltage after the device is operated at 25°C, cycled through the specified temperature range, and returned to 25°C. Thermal hysteresis can be expressed as Equation (3):

$$V_{HYST} = \left(\frac{V_{PRE} - V_{POST}}{V_{NOM}}\right) \times 10^6 (ppm) \quad (4)$$

- V_{HYST} = Thermal hysteresis (in ppm)
- V_{NOM} = specified output voltage
- V_{PRE} = Output voltage measured during a 25°C warm-up cycle
- V_{POST} = Device starts at 25°C − Output voltage measured after cycling through the rated temperature range of 40°C to 125°C and returning to 25°C

6.4 Device Functional Mode

6.4.1 Basic Connections

The following figure shows the typical connections for the GD30VR1000. The recommended range for the power supply bypass capacitor is 1μF to 10μF. A 1μF to 50μF output capacitor (CL) must be connected from Connect VOUT to GND.

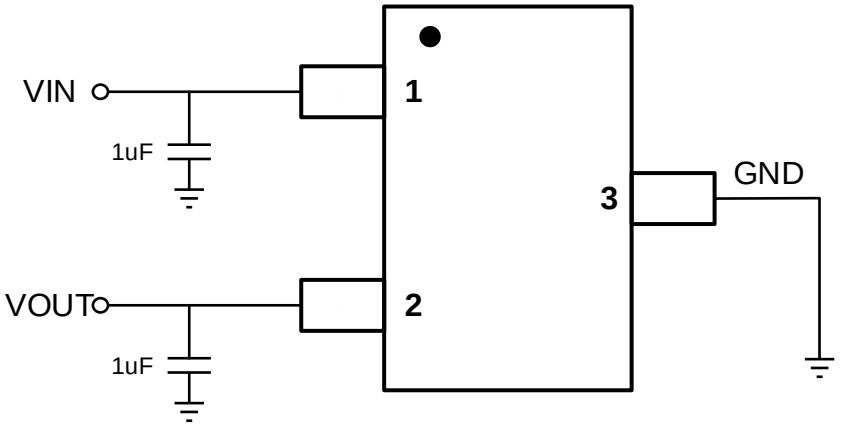


Figure 12. Basic Connections

6.4.2 Supply Voltage

GD30VR1000 product family feature extremely low dropout voltages. Except for the GD30VR1000 which has a minimum supply requirement of 2.5V, these references can operate from supplies that exceed the output voltage by 200mV under no-load conditions.

7 Layout Guides and Example

7.1 Layout Guides

Place the power supply bypass capacitors as close to the power supply and ground pins as possible. The recommended value for this bypass capacitor is 1μF to 10μF. If necessary, additional decoupling capacitors can be added to compensate for noisy or high impedance power supplies.

must be decoupled with a 1μF to 50μF capacitor. Adding a resistor in series with the output capacitor is optional. For better noise performance, a high-frequency, 1μF capacitor can be placed in parallel between the output and ground to filter the noise and act as a load switch for the data converter.

7.2 Layout Example

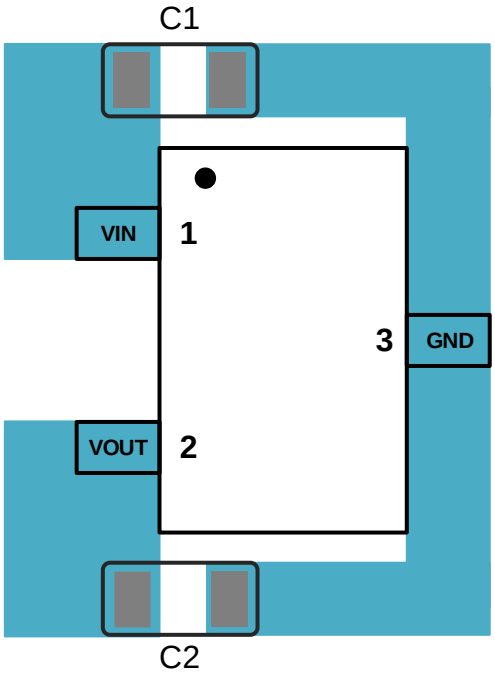


Figure 13. Layout Example

7.3 Power Dissipation

G D30VR1000 product family provides a current load of ±10mA over the specified input voltage range. The temperature of the device rises according to Equation (5):

$$T_J = T_A + P_D \times \theta_{JA} \quad (6)$$

in:

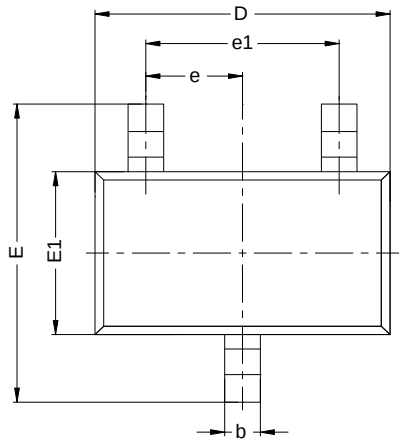
- T_J = Junction temperature (°C)
- T_A = ambient temperature (°C)
- PD = Power dissipated (W)
- θ_{JA} = junction-to-ambient thermal resistance (°C/W)

The GD30VR1000 junction temperature must not exceed the absolute maximum rated temperature of 150°C.

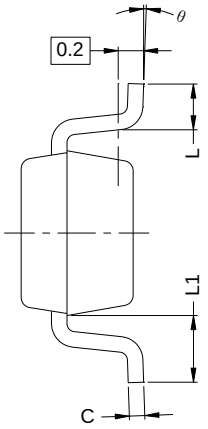
8 Packaging Information

8.1 Outline Dimensions

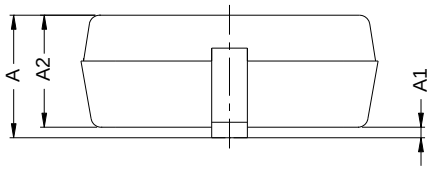
SOT23-3 Package Outline



TOP VIEW



SIDE VIEW



FRONT VIEW

Note:

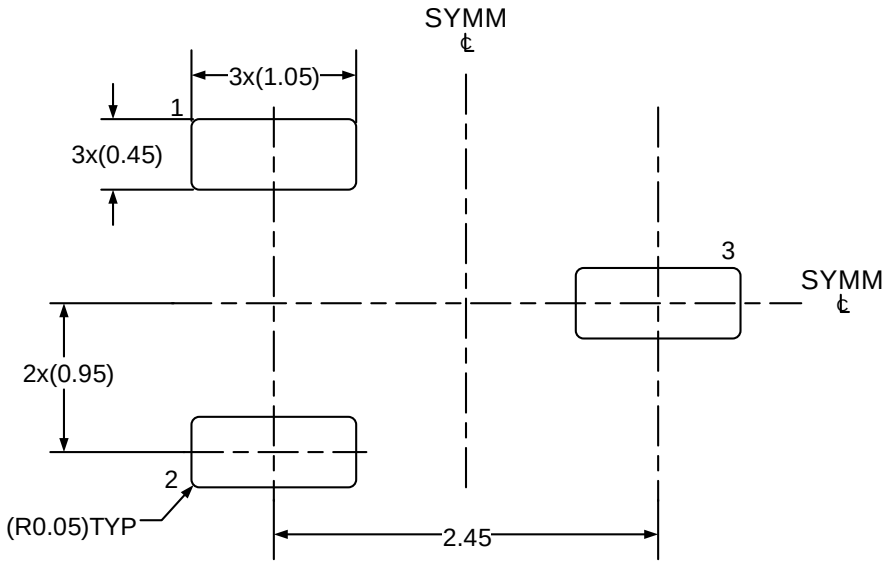
1. All dimensions in millimeters
2. Package dimensions does not include mold flash, protrusions, or gate burrs.
3. Refer to Table 1. *SOT23-3 Dimensions (mm)*

Table 1. SOT23-3 Dimensions (mm)

SYMBOL	MIN	NOM	MAX
A	0.89		1 .12
A1	0.01		0.10
A2	0.88	0.95	1.02
b	0.36		0.50
c	0.14		0.20
D	2.80	2.90	3.00
E	2.35	2.50	2.64
E1	1.20	1.30	1.40
e	0.90	0.95	1.00
e1	1.90 BSC		
L	0.40	0.45	0.50
L1	0.60 REF		
θ	0°		8°

8.2 Recommended Land Pattern

SOT23-3 Land Pattern Example



Note:

1. Refer to the IPC-7351 can also help you complete the designs.
2. Exposed metal shown.
3. Drawing is 20X scale.

9 Ordering Information

Ordering Code	Output Voltage	Package Type	Packaging Type	MOQ	OP Temp(°C)
GD30VR1000BSTR-I20	2.048V	SOT23-3	Tape & Reel	3000	−40°C to +125°C
GD30VR1000BSTR-I25	2.5V	SOT23-3	Tape & Reel	3000	−40°C to +125°C
GD30VR1000BSTR-I30	3.0V	SOT23-3	Tape & Reel	3000	−40°C to +125°C
GD30VR1000BSTR-I33	3.3V	SOT23-3	Tape & Reel	3000	−40°C to +125°C
GD30VR1000BSTR-I40	4.096V	SOT23-3	Tape & Reel	3000	−40°C to +125°C
GD30VR1000BSTR-I50	5.0V	SOT23-3	Tape & Reel	3000	−40°C to +125°C

10 Revision History

REVISION NUMBER	DESCRIPTION	DATE
1.0	Initial release and device details	2024

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