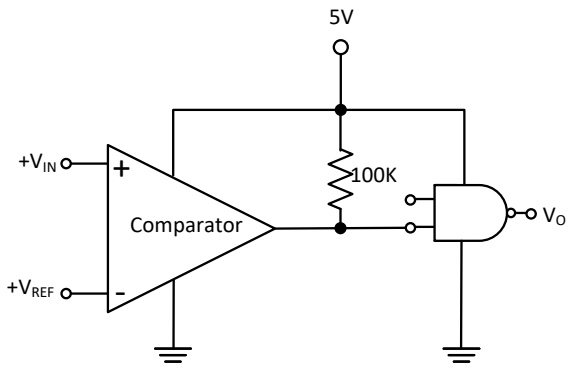
Industry-Standard Comparators

Features

- Wide supply range of 2 V to 36 V
- Faster response time of 1.3 µsec
- Differential input voltage range equal to maximumrated supply voltage: ±36 V
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 25nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Common-mode input voltage range includes ground, enabling direct sensing near ground
- Open Collector Output
  compatibility AECQ-100

Applications

- Vacuum robot
- Single phase UPS
- Server PSU
- Cordless power tool
- Wireless infrastructure
- Applicances
- Building automation
- Factory automation control
- Motor drives
- Infotainment and cluster



Typical Applicaiton

General Description

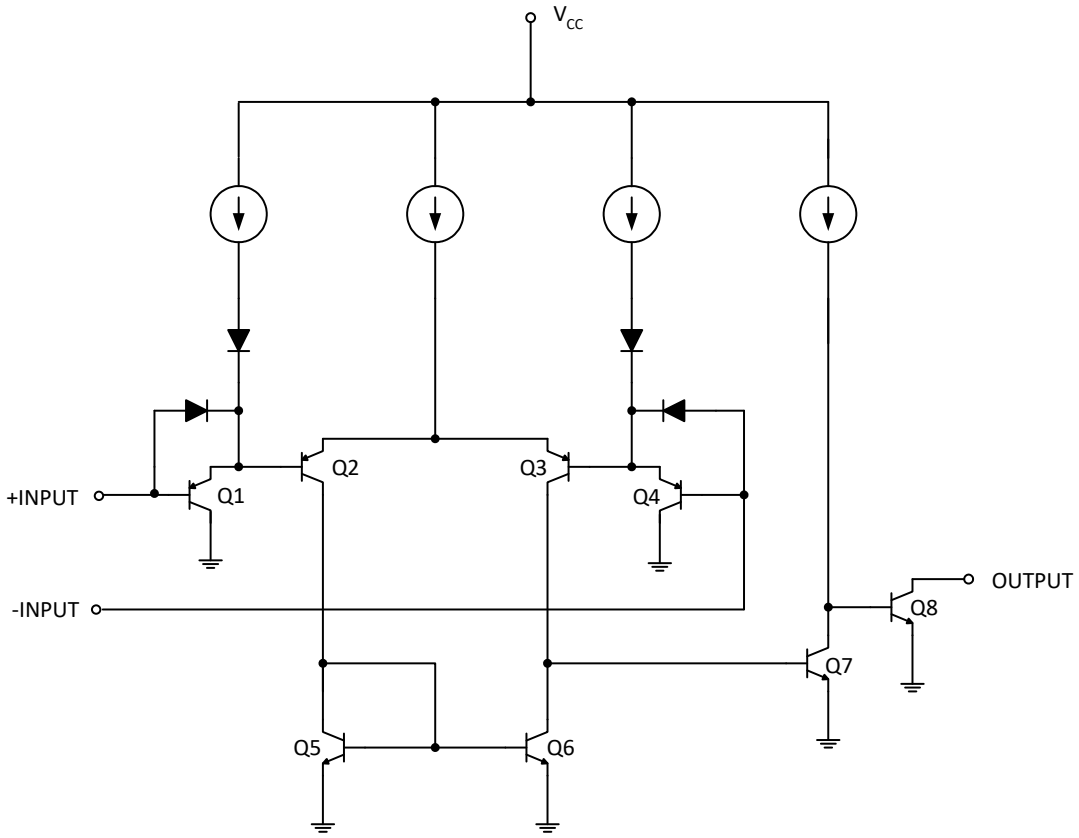
These amplifiers are available in industry standard packages. TheJML331,JML339,JML393,JML2901/and 903 series comparators consist of four and two independent precision voltage comparators with very low input offset voltage specification. They are designed to operate from a single power supply over a wide range of voltages; however operation from split power supplies is also possible. They offer low power supply current independent of the magnitude of the power supply voltage. These comparators family are designed to directly interface with TTL and CMOS. When operating from both plus and minus power supplies, the comparators will directly interface with MOS logic where their low power drain is a distinct advantage over standard comparators.
These amplifiers are available in industry standard packages.

Device Information[1][2]

PART NUMBER	PACKAGE	BODY SIZE(NOM)
JML331	SOT23 (5)	2.90 mm × 1.60 mm
JML393	SOP (8)	3.91 mm × 4.90 mm
	MSOP (8)	3.00 mm × 3.00 mm
JML2903	SOP (8)	3.91 mm × 4.90 mm
	MSOP (8)	3.00 mm × 3.00 mm
JML339	SOP (14)	8.65mm × 3.91mm
	TSSOP (14)	5.00mm × 4.40mm
JML2901	SOP (14)	8.65mm × 3.91mm
	TSSOP (14)	5.00mm × 4.40mm

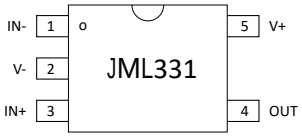
[1] For all available packages,see the orderable addendum at the end of the data sheet.
[2] Package is for preview only.

Functional Block Diagram



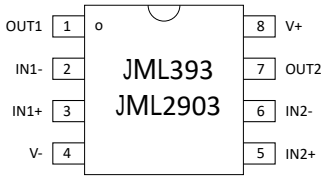
Pin Configuration and Functions

5-Pin SOT-23
(Top View)



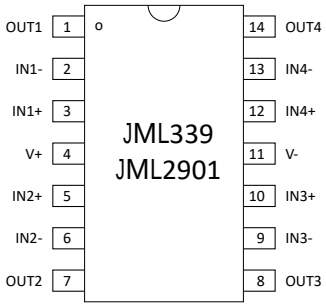
PIN		I/O	DESCRIPTION
NAME	NO.		
IN+	3	I	Noninverting input
IN-	1	I	Inverting input
OUT	4	O	Out
V+	5	—	Positive (highest) power supply
V-	2	—	Negative (low) supply or ground (for single-supply operation)

8-Pin SOP, TSSOP
(Top View)



PIN		I/O	DESCRIPTION
NAME	**NO.**		
IN1–	2	I	Inverting input, channel 1
IN1+	3	I	Noninverting input, channel 1
IN2–	6	I	Inverting input, channel 2
IN2+	5	I	Noninverting input, channel 2
OUT1	1	O	Output, channel 1
OUT2	7	O	Output, channel 2
V+	8	—	Positive (highest) power supply
V-	4	—	Negative (low) supply or ground (for single-supply operation)

14-Pin SOIC, TSSOP
(Top View)



PIN		I/O	DESCRIPTION
NAME	NO.		
IN1–	2	I	Inverting input, channel 1
IN1+	3	I	Noninverting input, channel 1
IN2–	6	I	Inverting input, channel 2
IN2+	5	I	Noninverting input, channel 2
IN3–	9	I	Inverting input, channel 3
IN3+	10	I	Noninverting input, channel 3
IN4–	13	I	Inverting input, channel 4
IN4+	12	I	Noninverting input, channel 4
OUT1	1	O	Output, channel 1
OUT2	7	O	Output, channel 2
OUT3	8	O	Output, channel 3
OUT4	14	O	Output, channel 4
V+	4	—	Positive (highest) power supply
V-	11	—	Negative (low) supply or ground (for single-supply operation)

Specifications

Absolute Maximum Ratings

Over operating ambient temperature (unless otherwise noted)[1]

			MIN	MAX	UNIT
Supply voltage [(V+) – (V–)]			0	40	V
Signal input pins	Voltage	Common-mode	-0.3	40	V
		Differential		40	V
Temperature	Specified, T_A	LM331,LM339,LM393	–40	85	°C
		LM2901, LM2903	–40	125	
	Junction, T_J			150	
	Storage, T_{stg}		-65	150	

[1] Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ESD Ratings

		VALUE	UNIT
All packages			
V_{ESD} Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±500	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101[1]	±1000	

[1] JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process
[2] JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Thermal Information

THERMAL METRIC	SOP-8	TSSOP-8	SOP-14	TSSOP-14	UNIT
$R_{\theta JA}$ Junction-to-ambient thermal resistance	124.7	171	106.9	135.8	°C/W
$R_{\theta JC(top)}$ Junction-to-case (top) thermal resistance	67	69	64	64	

Recommended Operating Conditions

Over operating ambient temperature (unless otherwise noted)

			MIN	MAX	UNIT
V_S	Supply voltage (V_S= [V+] – [V–])		3	36	V
V_{CM}	Common-mode voltage		V–	(V+)-1.5	V
T_A	Operating ambient temperature	LM331,LM339, LM393	–40	85	°C
		LM2901,LM2903	–40	125	

Electrical Characteristics:JML**331**

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	input offset voltage	V_S = 5V to 30V, V_O = 1.4V		2	5	mV
		V_S = 5 V to 30V, V_O = 1.4V, T_A = –40°C to 85°C			7	
INPUT VOLTAGE RANGE						
V_{CM}	Common-mode voltage range	V_S = 5V to 36V,	V–		V+ -1.5	V
	Common-mode voltage range	V_S = 5V to 36V, T_A = –40°C to 85°C	V–		V+ - 2	
INPUT BIAS CURRENT						
I_B	Input bias current	V_{CM}=0		-25	-200	nA
		V_{CM}=0, T_A = –40°C to 85°C			-400	
I_{OS}	Input offset current	V_{CM} = 0		5	50	nA
		V_{CM}=0, T_A = –40°C to 85°C			100	
RESPONSE TIME						
$t_{response}$	Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF, TTL-level input step		0.3		µs
		R_L connected to 5 V through 5.1 kΩ, 100-mV input step with 5 mV overdrive		1.3		
VOLTAGE GAIN						
A_{VD}	Large-signal differential-voltage gain	V_S = 15V, V_O = 1V to 11V, R_L > 15KΩ	50	200		V/mV
OUTPUT						
V_{OL}	Low-level output voltage	I_{OL} = 4 mA, V_{ID} = -1 V		200	400	mV
		I_{OL} = 4 mA, V_{ID} = -1 V, T_A = –40°C to 85°C			700	
I_{OH}	High-level output current	V_{OH} = 5 V, V_{ID} = 1 V	0.1	50		nA
		V_{OH} = 30 V, V_{ID} = 1 V, T_A = –40°C to 85°C			1	µA
I_{OL}	Low-level output current	V_{OL} = 1.5 V, V_{ID} = -1 V	6	16		mA
POWER SUPPLY						
I_Q	Quiescent current	V_S = 5 V		400	1000	µA
		V_S = 5 V, T_A = –40°C to 85°C			2000	
		V_S = 30 V		500	1700	
		V_S = 30 V, T_A = –40°C to 85°C			3000	

Electrical Characteristics:JML339

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	input offset voltage	V_S = 5V to 30V, V_O = 1.4V		2	5	mV
		V_S = 5 V to 30V, V_O = 1.4V, T_A = –40°C to 85°C			7	
INPUT VOLTAGE RANGE						
V_{CM}	Common-mode voltage range	V_S = 5V to 36V,	V–		V+ -1.5	V
	Common-mode voltage range	V_S = 5V to 36V, T_A = –40°C to 85°C	V–		V+ - 2	
INPUT BIAS CURRENT						
I_B	Input bias current	V_{CM}=0		-25	-200	nA
		V_{CM}=0, T_A = –40°C to 85°C			-400	
I_{OS}	Input offset current	V_{CM} = 0		5	50	nA
		V_{CM}=0, T_A = –40°C to 85°C			100	
RESPONSE TIME						
$t_{response}$	Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF, TTL-level input step		0.3		µs
		R_L connected to 5 V through 5.1 kΩ, 100-mV input step with 5 mV overdrive		1.3		
VOLTAGE GAIN						
A_{VD}	Large-signal differential-voltage gain	V_S = 15V, V_O = 1V to 11V, R_L > 15KΩ	50	200		V/mV
OUTPUT						
V_{OL}	Low-level output voltage	I_{OL} = 4 mA, V_{ID} = -1 V		200	400	mV
		I_{OL} = 4 mA, V_{ID} = -1 V, T_A = –40°C to 85°C			700	
I_{OH}	High-level output current	V_{OH} = 5 V, V_{ID} = 1 V	0.1	50		nA
		V_{OH} = 30 V, V_{ID} = 1 V, T_A = –40°C to 85°C			1	µA
I_{OL}	Low-level output current	V_{OL} = 1.5 V, V_{ID} = -1 V	6	16		mA
POWER SUPPLY						
I_Q	Quiescent current	V_S = 5 V		850	1990	µA
		V_S = 5 V, T_A = –40°C to 85°C			2990	
		V_S = 30 V		1150	2490	
		V_S = 30 V, T_A = –40°C to 85°C			3490	

Electrical Characteristics:JML393

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	input offset voltage	V_S = 5V to 30V, V_O = 1.4V		2	5	mV
		V_S = 5 V to 30V, V_O = 1.4V, T_A = –40°C to 85°C			7	
INPUT VOLTAGE RANGE						
V_{CM}	Common-mode voltage range	V_S = 5V to 36V,	V–		V+ -1.5	V
	Common-mode voltage range	V_S = 5V to 36V, T_A = –40°C to 85°C	V–		V+ - 2	
INPUT BIAS CURRENT						
I_B	Input bias current	V_{CM}=0		-25	-200	nA
		V_{CM}=0, T_A = –40°C to 85°C			-400	
I_{OS}	Input offset current	V_{CM} = 0		5	50	nA
		V_{CM}=0, T_A = –40°C to 85°C			100	
RESPONSE TIME						
$t_{response}$	Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF, TTL-level input step		0.3		µs
		R_L connected to 5 V through 5.1 kΩ, 100-mV input step with 5 mV overdrive		1.3		
VOLTAGE GAIN						
A_{VD}	Large-signal differential-voltage gain	V_S = 15V, V_O = 1V to 11V, R_L > 15KΩ	50	200		V/mV
OUTPUT						
V_{OL}	Low-level output voltage	I_{OL} = 4 mA, V_{ID} = -1 V		200	400	mV
		I_{OL} = 4 mA, V_{ID} = -1 V, T_A = –40°C to 85°C			700	
I_{OH}	High-level output current	V_{OH} = 5 V, V_{ID} = 1 V	0.1	50		nA
		V_{OH} = 30 V, V_{ID} = 1 V, T_A = –40°C to 85°C			1	µA
I_{OL}	Low-level output current	V_{OL} = 1.5 V, V_{ID} = -1 V	6	16		mA
POWER SUPPLY						
I_Q	Quiescent current	V_S = 5 V		620	1000	µA
		V_S = 5 V, T_A = –40°C to 85°C			1990	
		V_S = 30 V		700	1750	
		V_S = 30 V, T_A = –40°C to 85°C			2990	

Electrical Characteristics:JML2901

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	input offset voltage	V_S = 5V to 30V, V_O = 1.4V		2	7	mV
		V_S = 5 V to 30V, V_O = 1.4V, T_A = –40°C to 125°C			15	
INPUT VOLTAGE RANGE						
V_{CM}	Common-mode voltage range	V_S = 5V to 36V,	V–		V+ -1.5	V
	Common-mode voltage range	V_S = 5V to 36V, T_A = –40°C to 125°C	V–		V+ - 2	
INPUT BIAS CURRENT						
I_B	Input bias current	V_{CM}=0		-25	-250	nA
		V_{CM}=0, T_A = –40°C to 125°C			-400	
I_{OS}	Input offset current	V_{CM} = 0		5	50	nA
		V_{CM}=0, T_A = –40°C to 125°C			200	
RESPONSE TIME						
$t_{response}$	Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF, TTL-level input step		0.3		µs
		R_L connected to 5 V through 5.1 kΩ, 100-mV input step with 5 mV overdrive		1.3		
VOLTAGE GAIN						
A_{VD}	Large-signal differential-voltage gain	V_S = 15V, V_O = 1V to 11V, R_L > 15KΩ	50	200		V/mV
OUTPUT						
V_{OL}	Low-level output voltage	I_{OL} = 4 mA, V_{ID} = -1 V		200	400	mV
		I_{OL} = 4 mA, V_{ID} = -1 V, T_A = –40°C to 85°C			700	
I_{OH}	High-level output current	V_{OH} = 5 V, V_{ID} = 1 V	0.1	50		nA
		V_{OH} = 30 V, V_{ID} = 1 V, T_A = –40°C to 85°C			1	µA
I_{OL}	Low-level output current	V_{OL} = 1.5 V, V_{ID} = -1 V	6	16		mA
POWER SUPPLY						
I_Q	Quiescent current	V_S = 5 V		850	1990	µA
		V_S = 5 V, T_A = –40°C to 125°C			2990	
		V_S = 30 V		1150	2490	
		V_S = 30 V, T_A = –40°C to 125°C			3490	

Electrical Characteristics:JML2903

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	input offset voltage	V_S = 5V to 30V, V_O = 1.4V		2	7	mV
		V_S = 5 V to 30V, V_O = 1.4V, T_A = –40°C to 125°C			15	
INPUT VOLTAGE RANGE						
V_{CM}	Common-mode voltage range	V_S = 5V to 36V,	V–		V+ -1.5	V
	Common-mode voltage range	V_S = 5V to 36V, T_A = –40°C to 125°C	V–		V+ - 2	
INPUT BIAS CURRENT						
I_B	Input bias current	V_{CM}=0		-25	-250	nA
		V_{CM}=0, T_A = –40°C to 125°C			-400	
I_{OS}	Input offset current	V_{CM} = 0		5	50	nA
		V_{CM}=0, T_A = –40°C to 125°C			200	
RESPONSE TIME						
$t_{response}$	Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF, TTL-level input step		0.3		µs
		R_L connected to 5 V through 5.1 kΩ, 100-mV input step with 5 mV overdrive		1.3		
VOLTAGE GAIN						
A_{VD}	Large-signal differential-voltage gain	V_S = 15V, V_O = 1V to 11V, R_L > 15KΩ	50	200		V/mV
OUTPUT						
V_{OL}	Low-level output voltage	I_{OL} = 4 mA, V_{ID} = -1 V		200	400	mV
		I_{OL} = 4 mA, V_{ID} = -1 V, T_A = –40°C to 85°C			700	
I_{OH}	High-level output current	V_{OH} = 5 V, V_{ID} = 1 V	0.1	50		nA
		V_{OH} = 30 V, V_{ID} = 1 V, T_A = –40°C to 85°C			1	µA
I_{OL}	Low-level output current	V_{OL} = 1.5 V, V_{ID} = -1 V	6	16		mA
POWER SUPPLY						
I_Q	Quiescent current	V_S = 5 V		400	1000	µA
		V_S = 5 V, T_A = –40°C to 125°C			1990	
		V_S = 30 V		650	1750	
		V_S = 30 V, T_A = –40°C to 125°C			2990	

Typical Characteristics

at T_A = 25°C, V_S = 5 V, R_{PULLUP} = 5.1kΩ, and V_{OUT} = 0 V (unless otherwise noted)

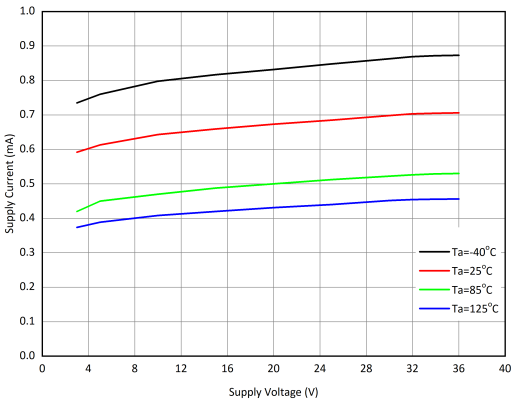


Figure 1: Supply Current vs. Power Supply (JML2903 and LM393)

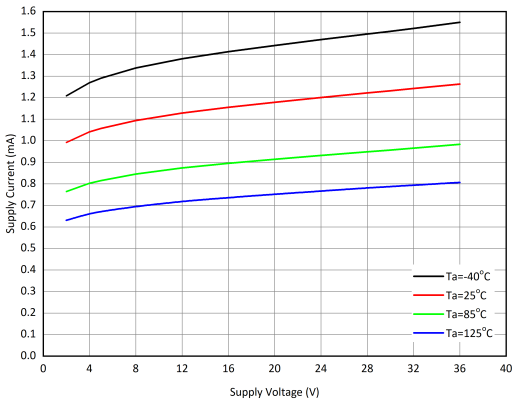


Figure 2: Supply Current vs. Power Supply (JML2901 and LM339)

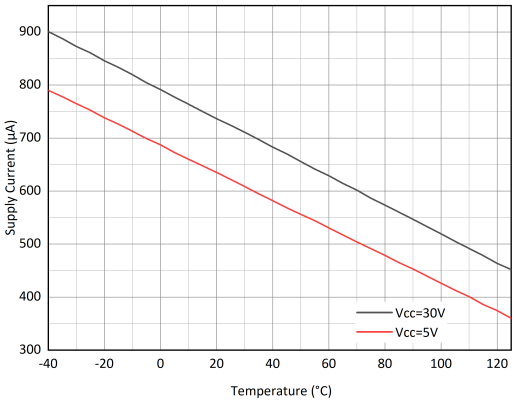


Figure 3: Supply Current vs. Temperature (JML2903 and LM393)

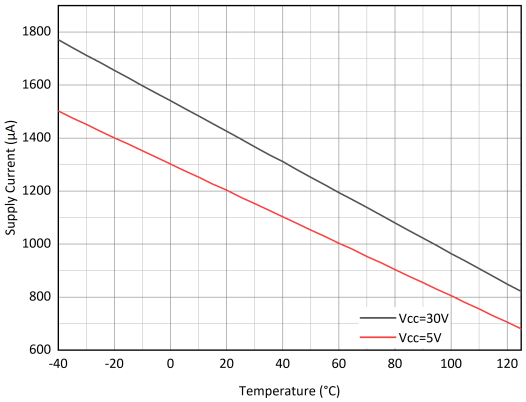


Figure 4: Supply Current vs. Temperature (JML2901 and LM339)

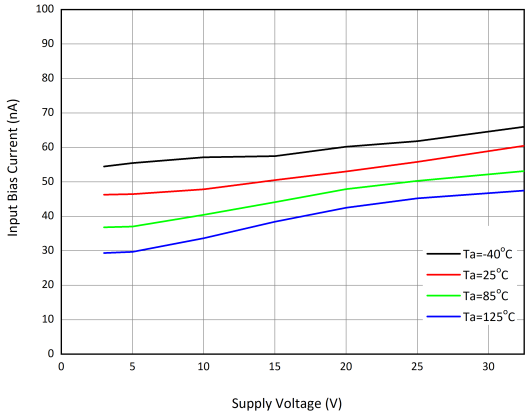


Figure 5: Input Bias Current vs. Supply Voltage

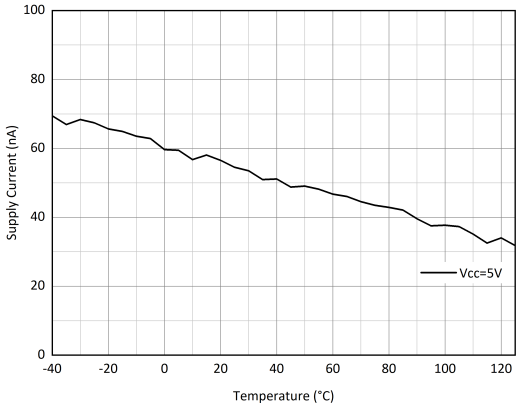


Figure 6: Input Bias Current vs. Temperature

Typical Characteristics (continued)

at T_A = 25°C, V_S = 5 V, R_{PULLUP} = 5.1kΩ, and V_{OUT} = 0 V (unless otherwise noted)

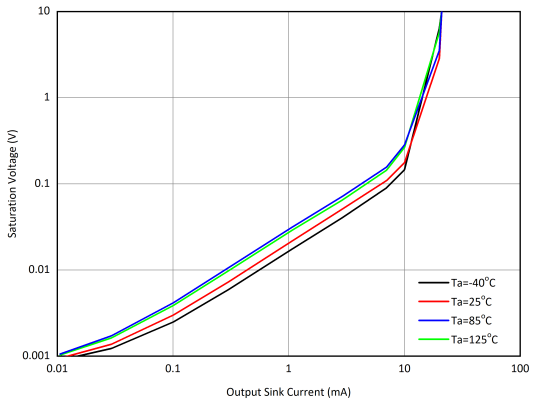


Figure 7: Output Sink Current vs. Saturation Voltage

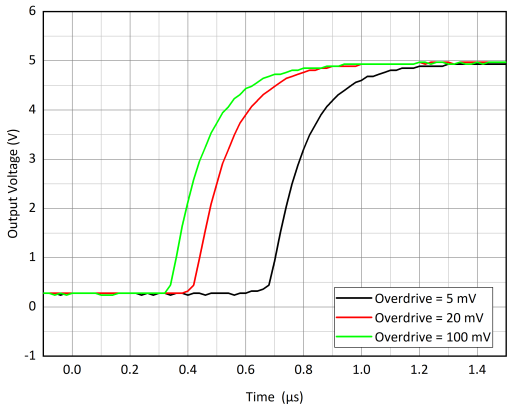


Figure 8: Response Time for Various Overdrives Positive Transition

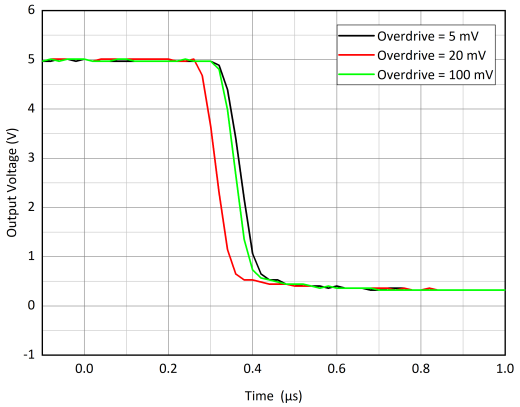


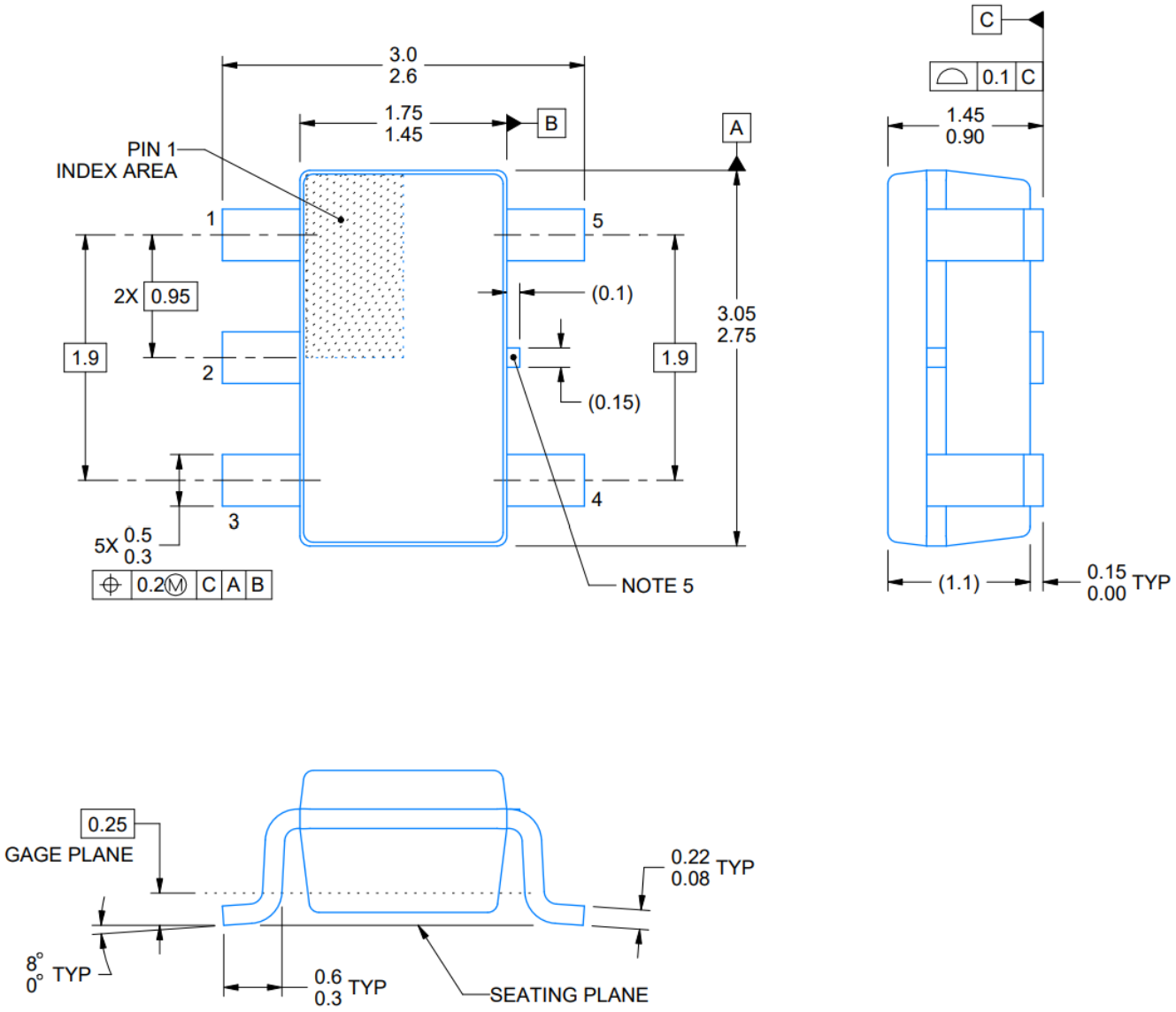
Figure 9: Response Time for Various Overdrives Negative Transition

Packaging Infromation

Orderable Device	Status	Package Type	Pins	Package Qty	Eco Plan	Op Temp(°C)	Marking
JML331DBVR	ACTIVE	SOT-23	5	4000	RoHS Green	-40 to 85	331
JML393DGKR	ACTIVE	MSOP	8	4000	RoHS Green	-40 to 85	393DGK
JML393DR	ACTIVE	SOP	8	4000	RoHS Green	-40 to 85	393D
JML2903DGKR	ACTIVE	MSOP	8	4000	RoHS Green	-40 to 125	2903DGK
JML2903DR	ACTIVE	SOP	8	4000	RoHS Green	-40 to 125	2903D
JML339DR	ACTIVE	SOP	14	2500	RoHS Green	-40 to 85	339D
JML339PWR	ACTIVE	TSSOP	14	2500	RoHS Green	-40 to 85	339PW
JML2901DR	ACTIVE	SOP	14	2500	RoHS Green	-40 to 125	2901D
JML2901PWR	ACTIVE	TSSOP	14	2500	RoHS Green	-40 to 125	2901PW

Package Outline Dimension

SOT23-5



NOTE:

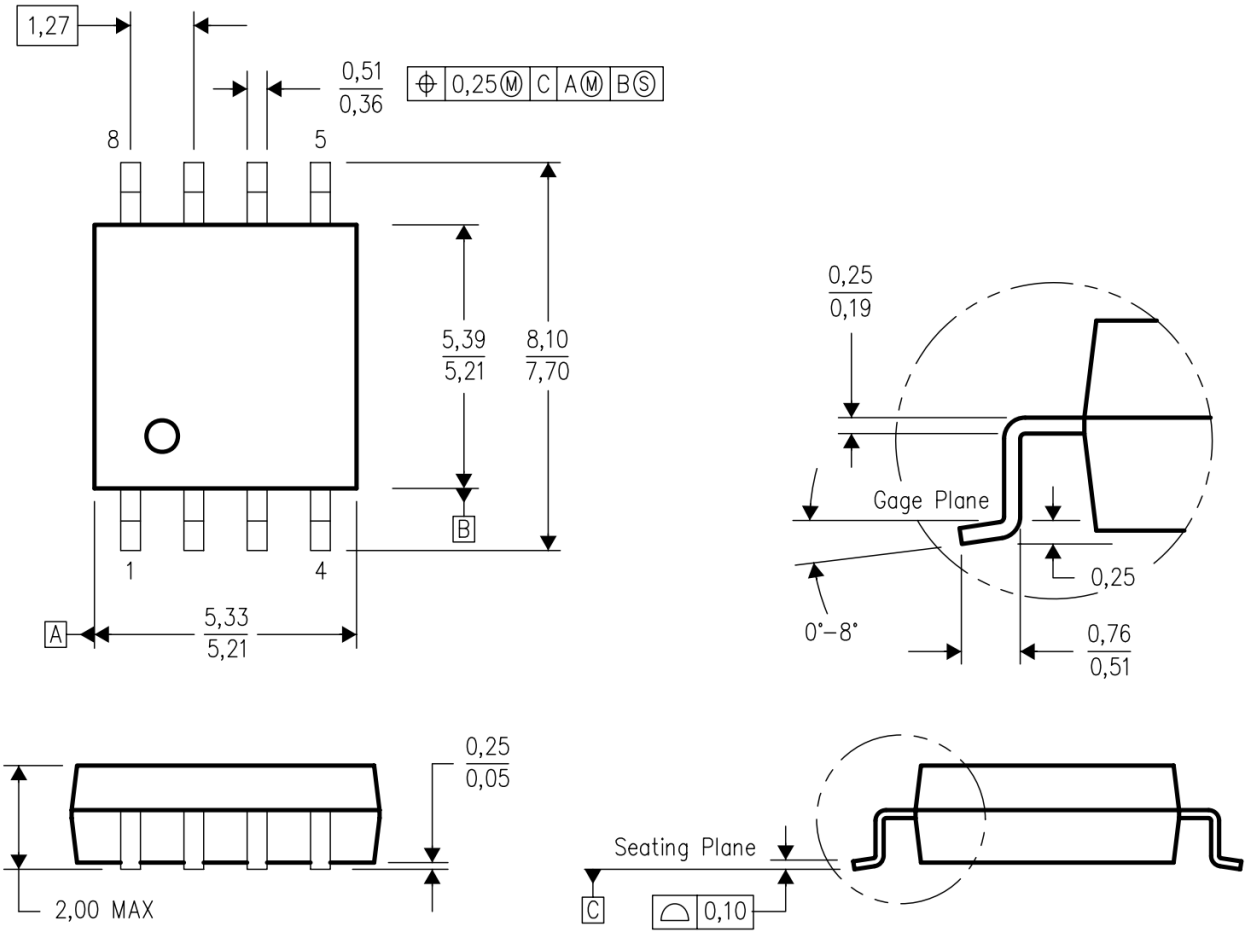
1.All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only.

2.This drawing is subject to change without notice.

3.Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.

4.Support pin may differ or may not be present.

SOP8



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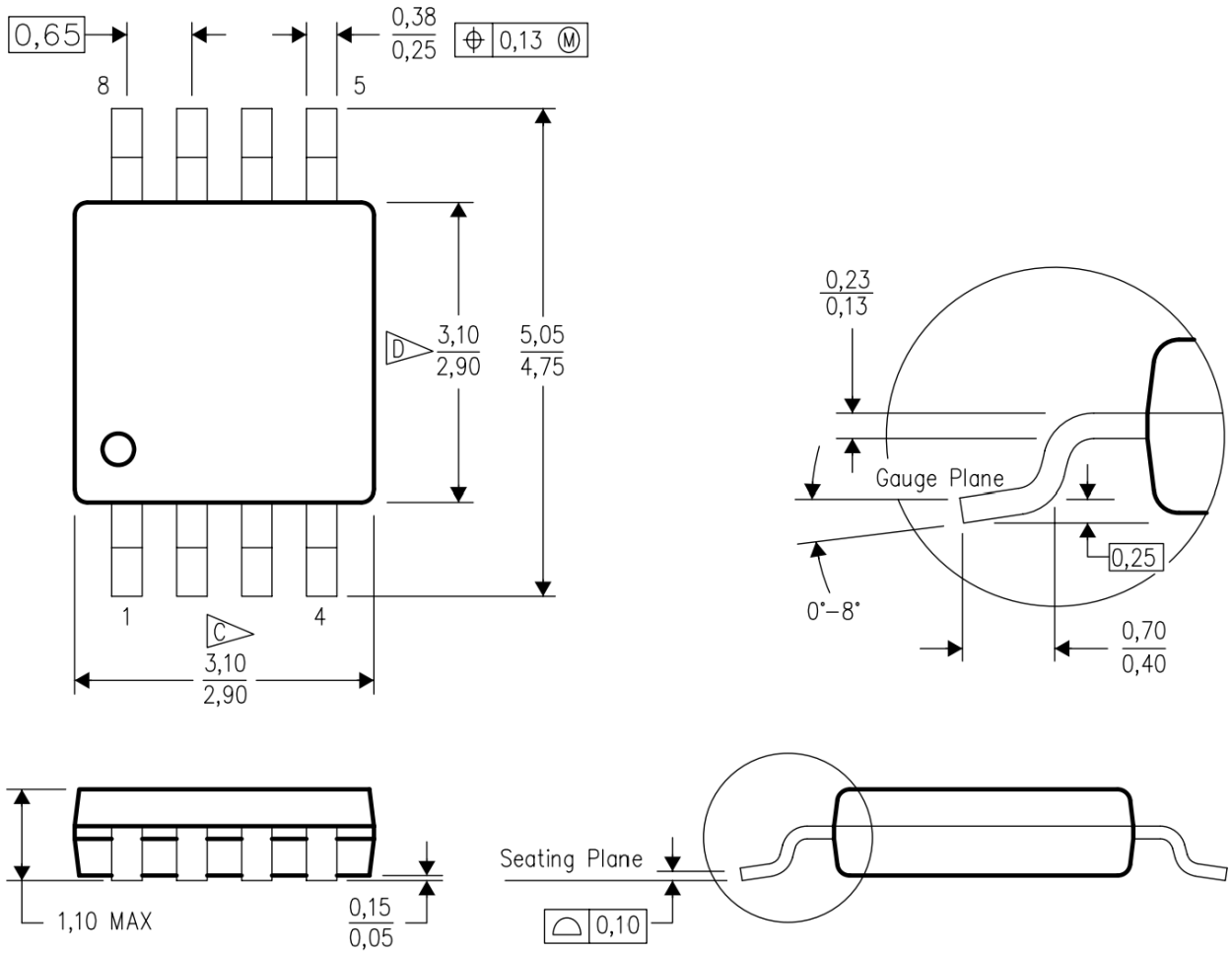
MSOP8



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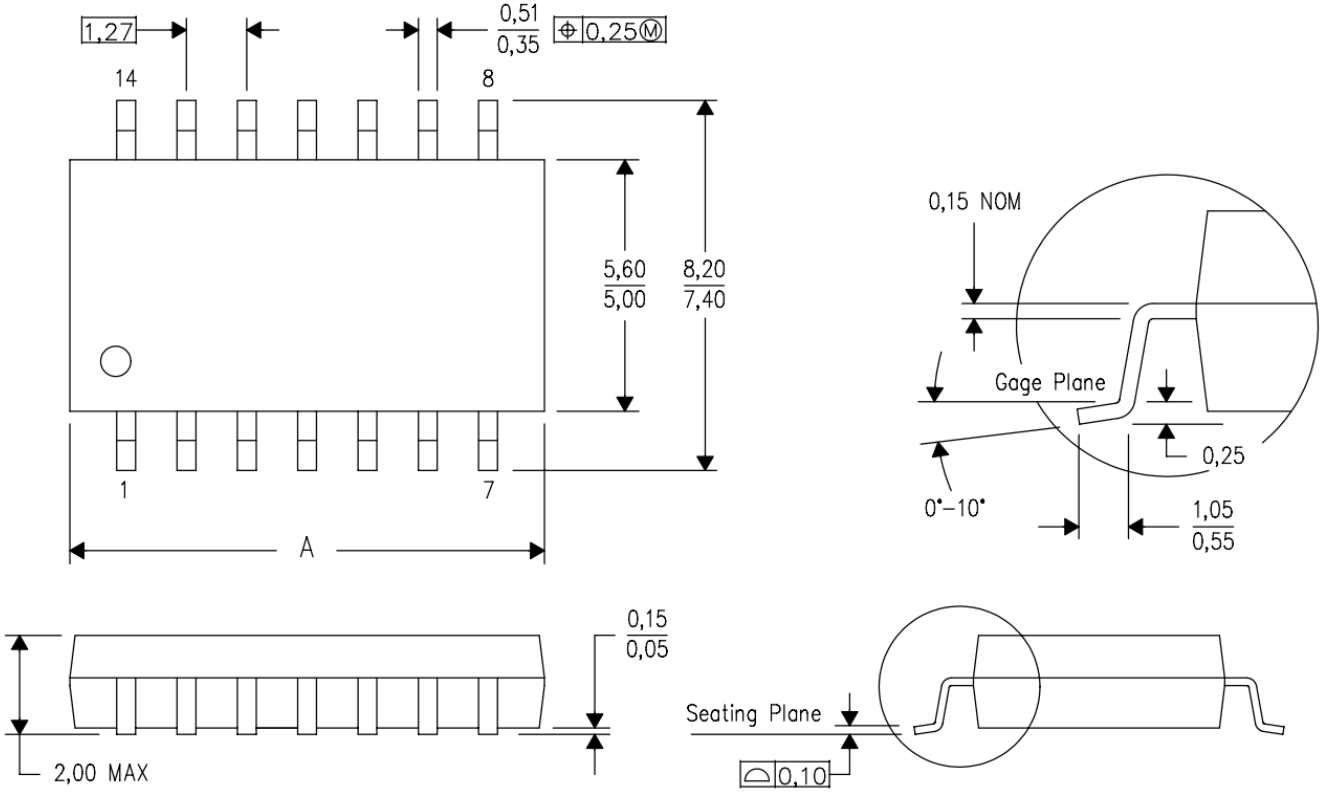
SOP14



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

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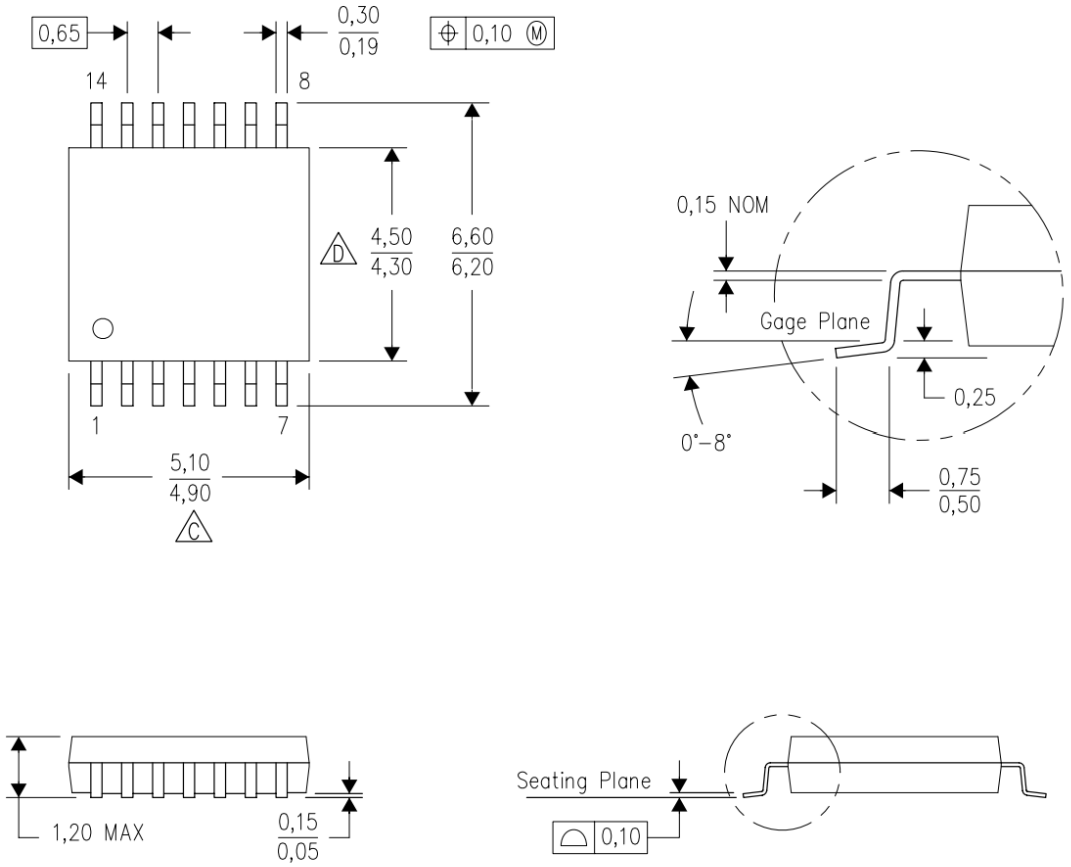
TSSOP14



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