Improved Industry Standard Parallel 12-Bit Multiplying DAC

FEATURES

- **Improved Direct Replacement for AD7545A and AD7545**
- **DNL and INL Over Temperature: ±0.5LSB**
- **Gain Error: ±1LSB Maximum**
- 4-Quadrant Multiplication
- Single 5V or 15V Supply
- Low Power Consumption
- **Low Cost**

APPLICATIONS

- Process Control and Industrial Automation
- Software Controlled Gain Adjustment
- Digitally Controlled Filter and Power Supplies
- Automatic Test Equipment

DESCRIPTION

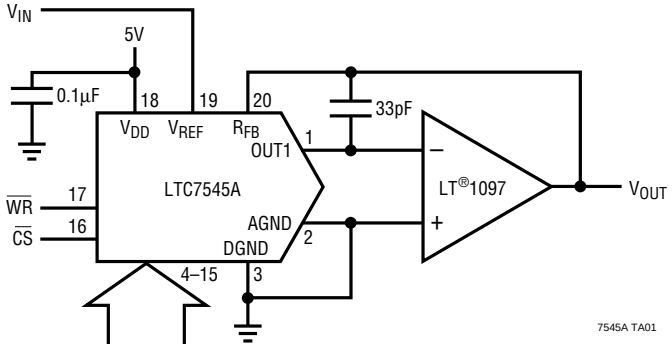
The LTC®7545A is a 12-bit multiplying digital-to-analog converter (DAC) with a microprocessor compatible parallel input. It is a superior pin compatible replacement for the industry standard AD7545A and AD7545. Improvements include better accuracy, better stability over temperature and supply variations and lower sensitivity to output amplifier offset.

This very versatile DAC is useful for 2-quadrant and 4-quadrant multiplying, programmable gain and filtering and single supply noninverting voltage output operation.

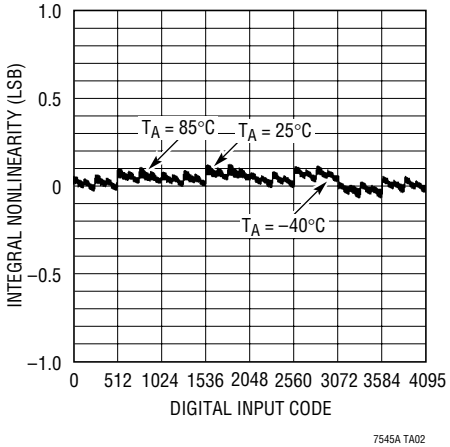
Parts are available in 20-pin PDIP and SO packages and commercial and industrial temperature grades.

TYPICAL APPLICATION

2-Quadrant Multiplying DAC Has Less Than 0.5LSB (Typ) Total Unadjusted Error



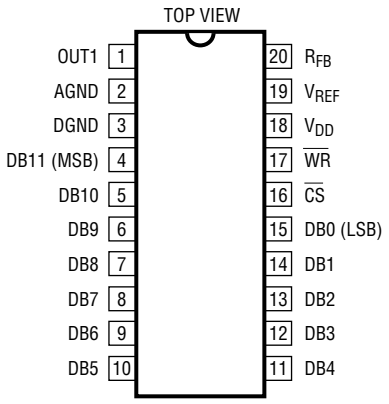
Integral Nonlinearity Over Temperature



ABSOLUTE MAXIMUM RATINGS

V_{DD} to AGND ..... −0.5V to 17V
V_{DD} to DGND .....−0.5V to 17V
AGND to DGND ..... −0.5V to V_{DD} + 0.5V
DGND to AGND ..... −0.5V to V_{DD} + 0.5V
V_{REF} to AGND,DGND ..... ±25V
R_{FB} to AGND,DGND ..... .±25V
Digital Inputs to DGND ..... −0.5V to V_{DD} + 0.5V
V_{OUT1} to AGND, DGND ..... −0.5V to V_{DD} + 0.5V
Maximum Junction Temperature .....150°C
Operating Temperature Range
Commercial (K, L Versions) ..... 0°C to 70°C
Industrial (B, C Versions)..... −40° C to 85°C
Storage Temperature Range ..... −65°C to 150°C
Lead Temperature (Soldering, 10 sec)..... 300°C

PACKAGE/ORDER INFORMATION



G PACKAGE
20-LEAD PLASTIC SSOP

N PACKAGE
20-LEAD PDIP

SW PACKAGE
20-LEAD PLASTIC SO WIDE

T_{JMAX} = XXX°C, θ_{JA} = XXX°C/W (G)
T_{JMAX} = 150°C, θ_{JA} = 100°C/W (N)
T_{JMAX} = 150°C, θ_{JA} = 130°C/W (SW)

ORDER PART NUMBER
LTC7545ABG
LTC7545ABN
LTC7545ABSW
LTC7545ACG
LTC7545ACN
LTC7545ACSW
LTC7545AKG
LTC7545AKN
LTC7545AKSW
LTC7545ALG
LTC7545ALN
LTC7545ALSW

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS

V_{DD} = 5V or 15V, V_{REF} = 10V, V_{OUT1} = AGND = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS			LTC7545AK/AB MIN	LTC7545AK/AB TYP	LTC7545AK/AB MAX	LTC7545AL/AC MIN	LTC7545AL/AC TYP	LTC7545AL/AC MAX	UNITS
Accuracy											
	Resolution			●	12			12			Bits
INL	Integral Nonlinearity (Relative Accuracy)	(Note 1)	T_A = 25°C				±0.5			±0.5	LSB
			T_{MIN} to T_{MAX}	●			±0.5			±0.5	LSB
DNL	Differential Nonlinearity	Guaranteed Monotonic	T_A = 25°C				±1			±0.5	LSB
		T_{MIN} to T_{MAX}	T_{MIN} to T_{MAX}	●			±1			±0.5	LSB
GE	Gain Error	(Note 2)	T_A = 25°C				±2			±1	LSB
			T_{MIN} to T_{MAX}	●			±3			±2	LSB
	Gain Temperature Coefficient	(Note 3) ΔGain/ΔTemperature		●		1	5		1	5	ppm/°C
I_{LKG}	OUT1 Leakage Current	(Note 4)	T_A = 25°C				±10			±10	nA
			T_{MIN} to T_{MAX}	●			±50			±50	nA
PSRR	Power Supply Rejection			●			±0.002			±0.002	%/%
Reference Input											
R_{REF}	V_{REF} Input Resistance	(Note 5)		●	8	11	15	8	11	15	kΩ
AC Performance											
	Output Current Settling Time	(Notes 3, 6, 7)		●			1			1	µs
	Propagation Delay	(Notes 3, 6, 8)		●			150			150	ns
	Digital-to-Analog Glitch Impulse	(Notes 6, 9)		●		5			5		nV-sec
	Multiplying Feedthrough Error	V_{REF} = ±10V, 10kHz Sine Wave		●		5			5		mV_{P-P}
Analog Outputs											
C_{OUT}	Output Capacitance (Note 3)	DB0 to DB11 = 0V, WR, CS = 0V	C_{OUT1}	●		30	70		30	70	pF
		DB0 to DB11 = V_{DD}, WR, CS = 0V	C_{OUT1}	●		60	150		60	150	pF

ELECTRICAL CHARACTERISTICS

V_{DD} = 5V, V_{REF} = 10V, V_{OUT1} = AGND = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		ALL GRADES MIN	TYP	MAX	UNITS
Digital Inputs							
V_{IH}	Digital Input High Voltage		●	2.4			V
V_{IL}	Digital Input Low Voltage		●			0.8	V
I_{IN}	Digital Input Current		●		0.001	±1	µA
C_{IN}	Digital Input Capacitance	(Note 3) V_{IN} = 0V	●			8	pF
Timing Characteristics (Note 3)							
t_{CS}	$\overline{CS}$ to $\overline{WR}$ Setup Time		●	100			ns
t_{CH}	$\overline{CS}$ to $\overline{WR}$ Hold Time		●	0			ns
t_{WR}	Write Pulse Width		●	100			ns
t_{DS}	Data Setup Time		●	100			ns
t_{DH}	Data Hold Time		●	5			ns
Power Supply							
V_{DD}	Supply Voltage		●	4.75	5	5.25	V
I_{DD}	Supply Current	All Digital Inputs = V_{IH} or V_{IL}	●			2	mA
		All Digital Inputs = 0V or V_{DD}	●		10	100	µA

V_{DD} = 15V, V_{REF} = 10V, V_{OUT1} = AGND = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		ALL GRADES MIN	TYP	MAX	UNITS
Digital Inputs							
V_{IH}	Digital Input High Voltage		●	13.5			V
V_{IL}	Digital Input Low Voltage		●			1.5	V
I_{IN}	Digital Input Current		●			±1	µA
C_{IN}	Digital Input Capacitance	(Note 3) V_{IN} = 0V	●			8	pF
Timing Characteristics (Note 3)							
t_{CS}	$\overline{CS}$ to $\overline{WR}$ Setup Time		●	75			ns
t_{CH}	$\overline{CS}$ to $\overline{WR}$ Hold Time		●	0			ns
t_{WR}	Write Pulse Width		●	75			ns
t_{DS}	Data Setup Time		●	60			ns
t_{DH}	Data Hold Time		●	5			ns
Power Supply							
V_{DD}	Supply Voltage		●	14.25	15	15.75	V
I_{DD}	Supply Current	All Digital Inputs = V_{IH} or V_{IL}	●			2	mA
		All Digital Inputs = 0V or V_{DD}	●		10	100	µA

The ● denotes specificatons which apply over the full operating temperature range.

Note 1: ±0.5LSB = ±0.012% of full scale.

Note 2: Using internal feedback resistor.

Note 3: Guaranteed by design, not subject to test.

Note 4: I_{OUT1} with DAC register loaded to all 0s.

Note 5: Typical temperature coefficient is 100ppm/°C.

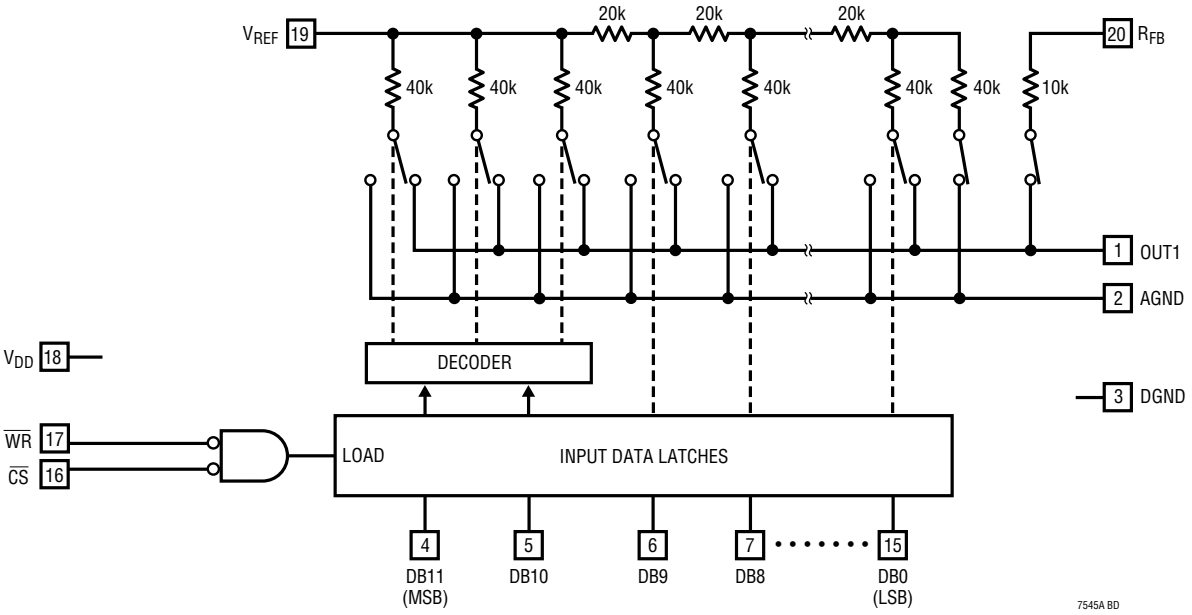
Note 6: OUT1 load = 100Ω in parallel with 13pF.

Note 7: To 0.01% for a full-scale change, measured from the falling edge of $\overline{WR}$, $\overline{CS}$ = 0V.

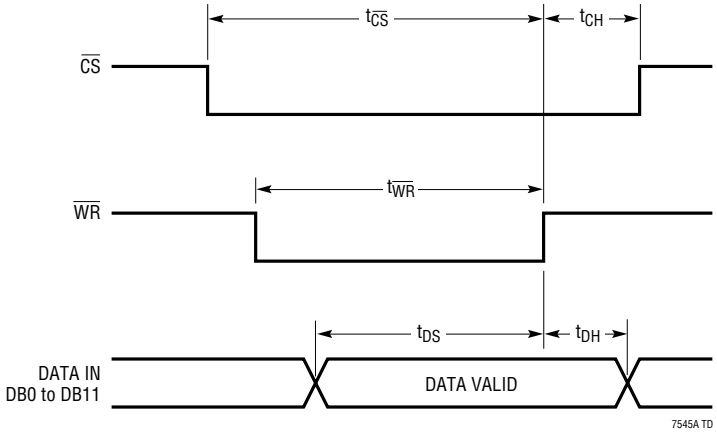
Note 8: From digital input change to 90% of final analog output.

Note 9: V_{REF} = 0V. DAC register contents changed from all 0s to all 1s or all 1s to all 0s.

BLOCK DIAGRAM



TIMING DIAGRAM



TYPICAL APPLICATIONS

Unipolar Operation (2-Quadrant Multiplication)

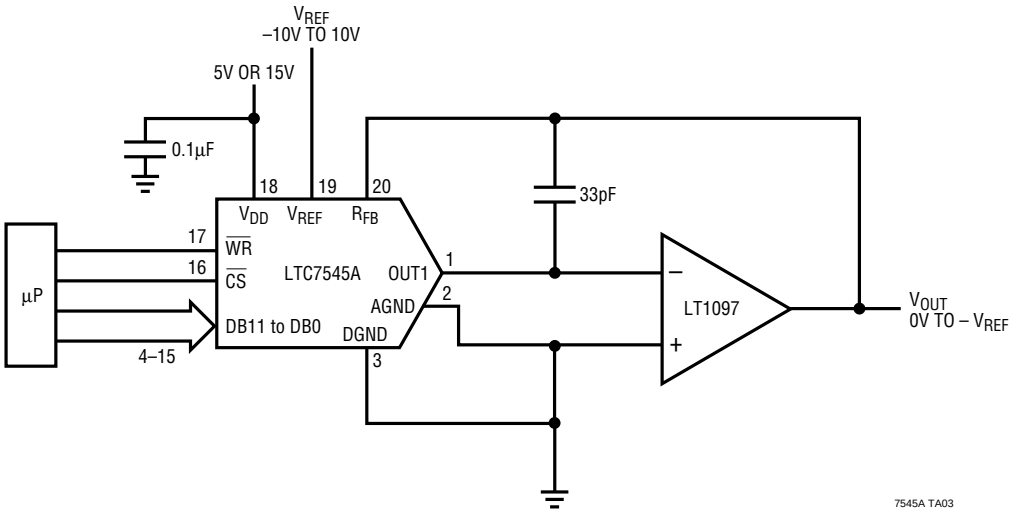


Table 1. Unipolar Binary Code Table

DIGITAL INPUT BINARY NUMBER IN DAC LATCH			ANALOG OUTPUT V_{OUT}
MSB		LSB	
1111	1111	1111	$-V_{REF}$ (4095/4096)
1000	0000	0000	$-V_{REF}$ (2048/4096) = $-V_{REF}/2$
0000	0000	0001	$-V_{REF}$ (1/4096)
0000	0000	0000	0V

TYPICAL APPLICATIONS

Bipolar Operation (4-Quadrant Multiplication)

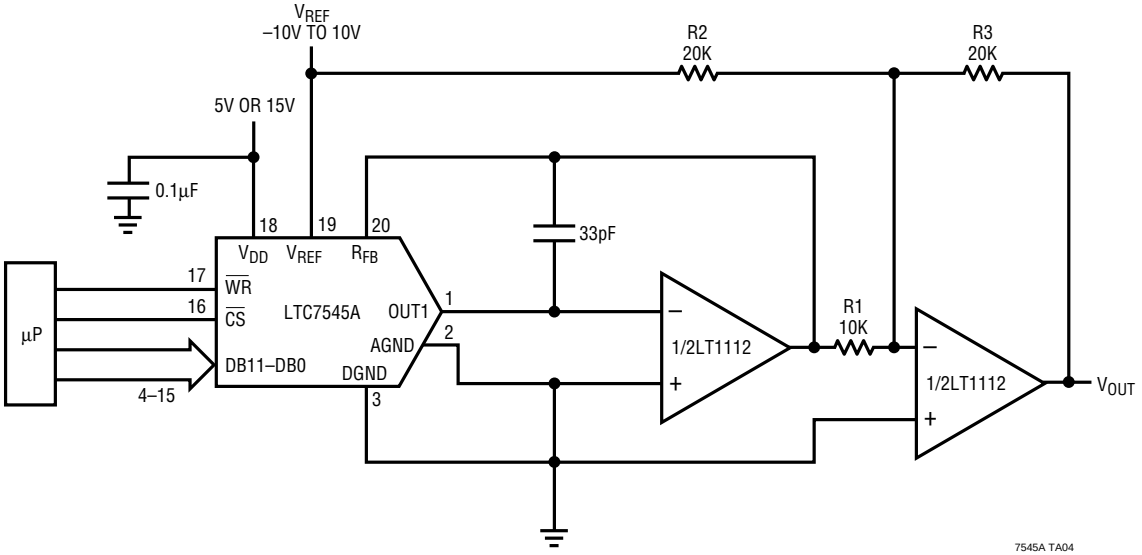
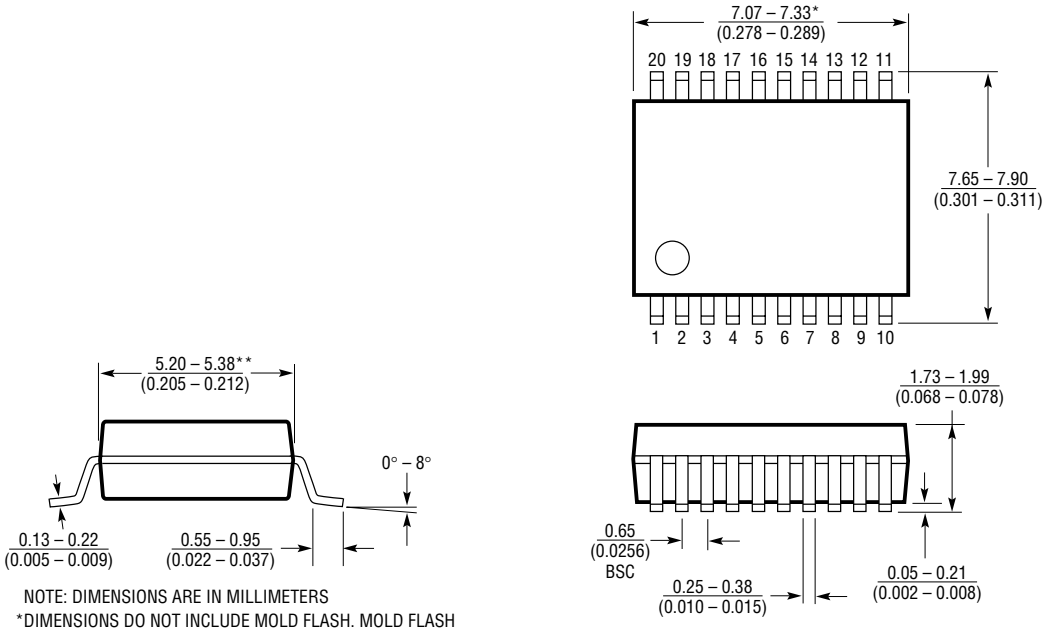


Table 2. Bipolar Offset Binary Code Table

DIGITAL INPUT BINARY NUMBER IN DAC LATCH			ANALOG OUTPUT V_{OUT}
MSB		LSB	
1111	1111	1111	V_{REF} (2047/2048)
1000	0000	0001	V_{REF} (1/2048)
1000	0000	0000	0V
0111	1111	1111	$-V_{REF}$ (1/2048)
0000	0000	0000	$-V_{REF}$ (2048/2048) = $-V_{REF}$

PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

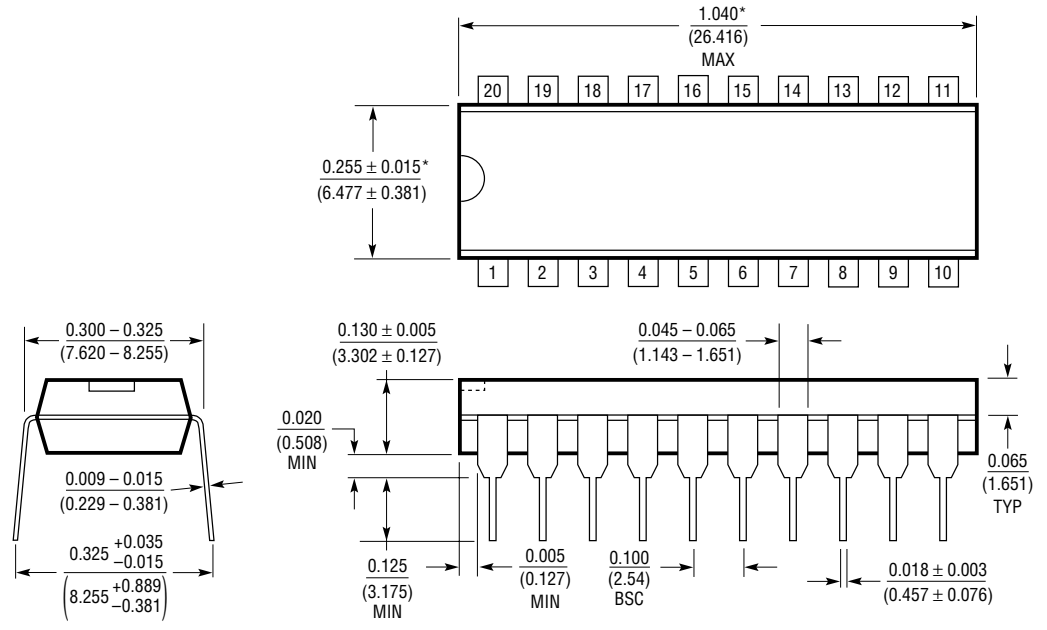
G Package
20-Lead Plastic SSOP (0.209)
(LTC DWG # 05-08-1640)



NOTE: DIMENSIONS ARE IN MILLIMETERS
*DIMENSIONS DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.152mm (0.006") PER SIDE
**DIMENSIONS DO NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.254mm (0.010") PER SIDE

G20 SSOP 1098

N Package
20-Lead PDIP (Narrow 0.300)
(LTC DWG # 05-08-1510)

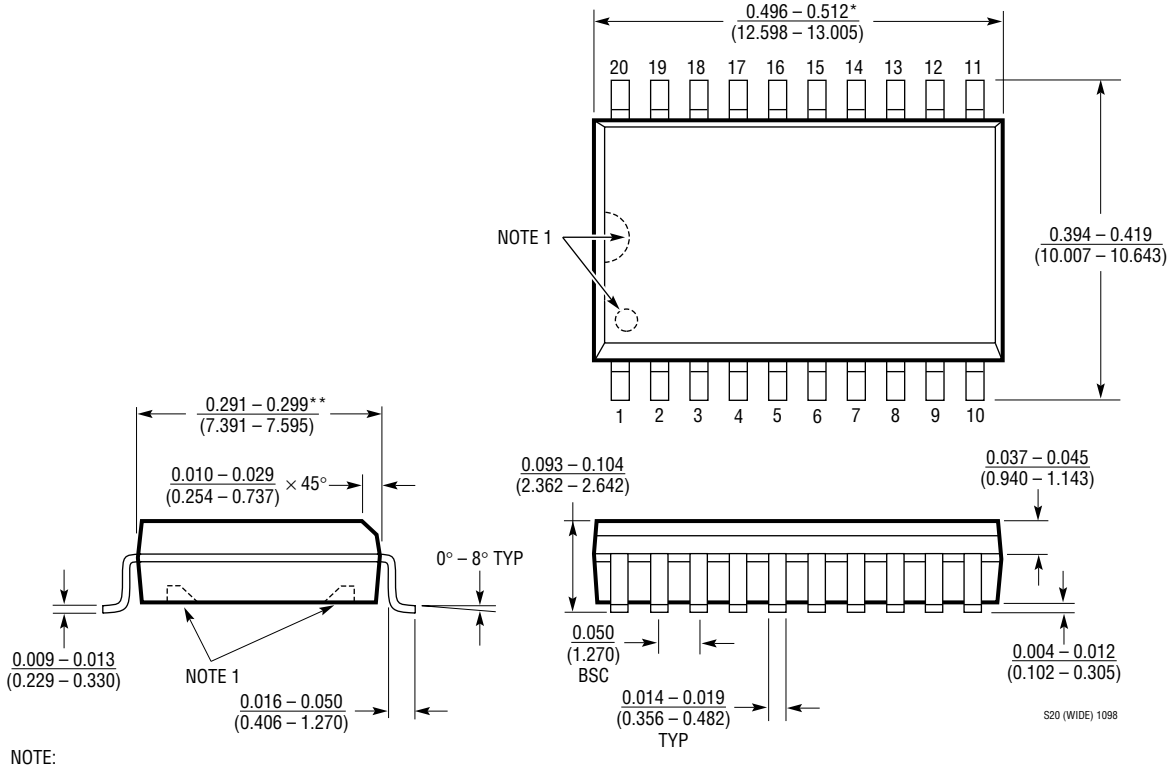


*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

N20 1098

PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

SW Package
20-Lead Plastic Small Outline (Wide 0.300)
(LTC DWG # 05-08-1620)



NOTE:
1. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS

*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

RELATED PARTS

PART NUMBER	DESCRIPTON	COMMENTS
LTC1257	Complete Serial I/O V_{OUT} 12-Bit DAC	5V to 15V Single Supply in 8-Pin SO and PDIP
LTC1450/LTC1450L	Complete Parallel Input V_{OUT} 12-Bit DACs	Rail-to-Rail V_{OUT}, 3V/5V Single Supply, 12-Bit or (8 + 4) Bit Loading
LTC1451/LTC1452/LTC1453	Complete Serial I/O V_{OUT} 12-Bit DACs	Rail-to-Rail V_{OUT}, 3V/5V Single Supply in 8-Pin SO and PDIP
LTC7541A	Parallel I/O Multiplying I_{OUT} 12-Bit DAC	12-Bit Wide Parallel Input
LTC7543/LTC8143	Serial I/O Multiplying I_{OUT} 12-Bit DACs	Clear Pin and Serial Data Output (LTC8143)
LTC8043	Serial I/O Multiplying I_{OUT} 12-Bit DAC	8-Pin SO and PDIP

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