

TL5632C

8-BIT 3-CHANNEL HIGH-SPEED DIGITAL-TO-ANALOG CONVERTER

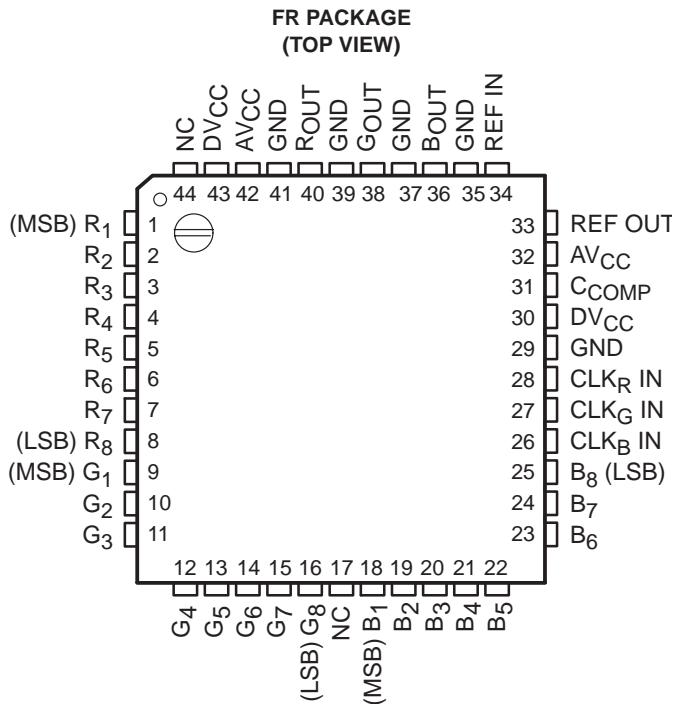
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- **8-Bit Resolution**
- **Linearity . . . $\pm 1/2$ LSB Maximum**
- **Differential Nonlinearity . . . $\pm 1/2$ LSB Maximum**
- **Conversion Rate . . . 60 MHz Min**
- **Nominal Output Signal Operating Range V_{CC} to $V_{CC} - 1$ V**
- **TTL Digital Input Voltage**
- **5-V Single Power Supply Operation**
- **Low Power Consumption . . . 350 mW Typ**

description

The TL5632C is a low-power ultra-high-speed video digital-to-analog converter that uses the Advanced Low-Power Schottky (ALS) process. The device has a three channel I/O; the red, the blue, and the green channel. The red, blue, and green signals are referred to collectively as the RGB signal. An internally generated reference is also provided for the standard video output voltage range. Conversion of digital signals to analog signals can be at a sampling rate of dc to 60 MHz. The high conversion rate makes the TL5632C suitable for digital television, computer digital video processing, and high-speed data conversion.

The TL5632C is characterized for operation from 0°C to 70°C.



NC – No internal connection

FUNCTION TABLE

STEP	DIGITAL INPUT	OUTPUT VOLTAGE
0	LLLLLLLLL	3.980 V
1	LLLLLLLLH	3.984 V
•	•	•
•	•	•
•	•	•
127	LHHHHHHH	4.488 V
128	HLLLLLLL	4.492 V
129	HLLLLLLH	4.996 V
•	•	•
•	•	•
•	•	•
254	HHHHHHHL	4.996 V
255	HHHHHHH	5.000 V

AVAILABLE OPTIONS

T _A	PACKAGE
0°C to 70°C	TL5632CFR

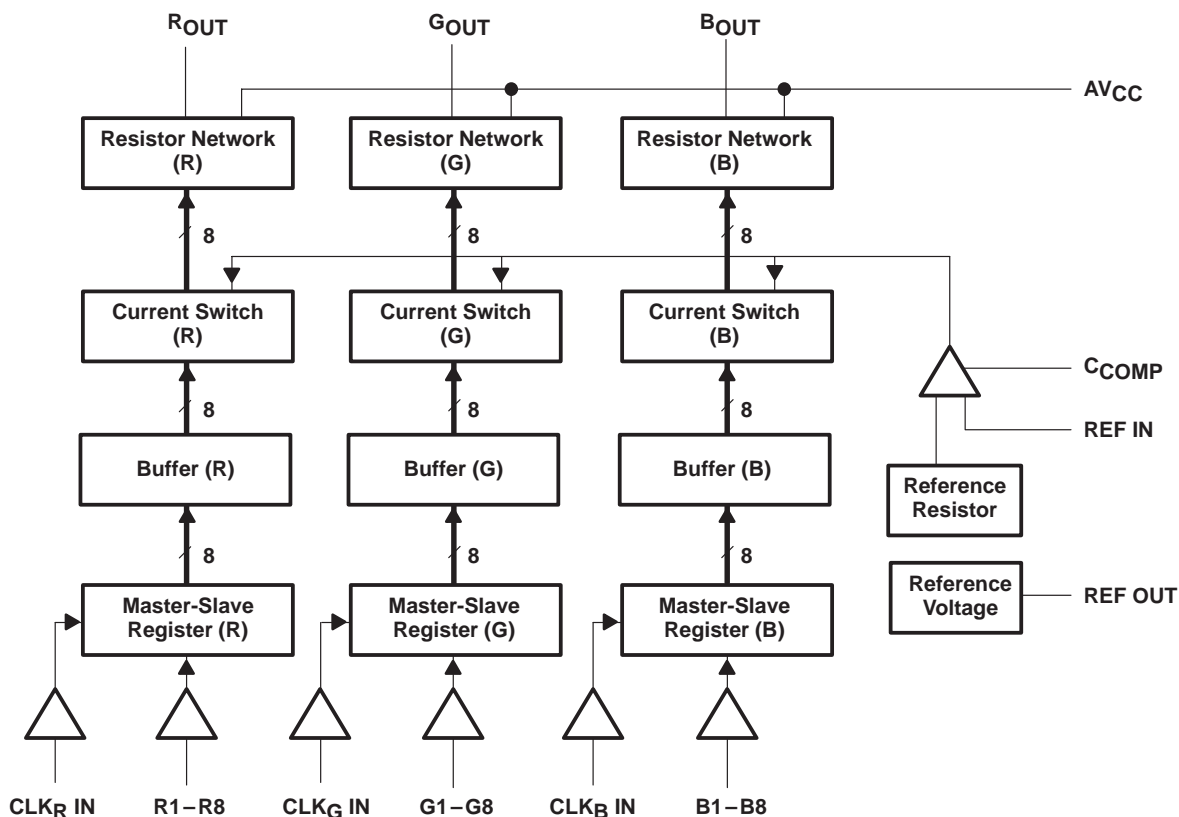
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



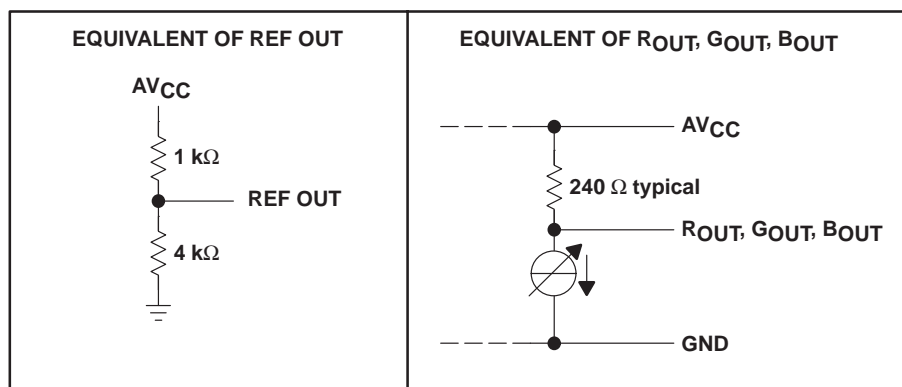
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functional block diagram



schematics of outputs



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Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
B ₁ – B ₈	18 – 25	I	B-channel digital input (B ₁ = MSB)
B _{OUT}	36	O	B-channel analog output
C _{COMP}	31		Phase compensation capacitance. A 1 μF capacitor is connected from C _{COMP} to GND.
CLK _B IN	26	I	B-channel clock input
CLK _G IN	27	I	G-channel clock input
CLK _R IN	28	I	R-channel clock input
G ₁ – G ₈	9 – 16	I	G-Channel digital input (G ₁ = MSB)
GND	29, 35, 37, 39, 41		Ground. All GND terminals are connected internally; however, all GND terminals should be connected externally to a ground plane or equivalent low impedance ground return.
G _{OUT}	38	O	G-channel analog output
NC	17, 44		No connection internally
R ₁ – R ₈	1 – 8	I	R-channel digital input (R ₁ = MSB)
R _{OUT}	40	O	R-channel analog output
AV _{CC}	32, 42		Analog power supply voltage
DV _{CC}	30, 43		Digital power supply voltage
REF IN	34	I	Reference voltage input. REF IN accepts the reference voltage on REF OUT. An external reference can also be applied consistent with Note 1.
REF OUT	33	O	Reference voltage output. An internal voltage divider generates the voltage level (see schematics of outputs, page 2).

NOTE 1: $V_{CC} - V_{ref} \leq 1.2 \text{ V}$

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Power supply voltage range, AV _{CC} , DV _{CC} (see Note 2)	–0.3 V to 7 V
Digital input voltage range, V _I	–0.3 V to DV _{CC}
Analog output voltage range, R _{OUT} , G _{OUT} , B _{OUT} , C _{COMP} (externally applied)	–0.3 V to AV _{CC} + 0.3 V
Reference input range, REF IN	–0.3 V to AV _{CC} + 0.3 V
Reference output range, REF OUT	–0.3 V to AV _{CC} + 0.3 V
Operating free-air temperature range, T _A	0°C to 70°C
Storage temperature range	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

† 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.

NOTE 2: All voltage values are with respect to GND.



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recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC} , DV_{CC}	4.75	5	5.25	V
High-level input voltage, V_{IH}	2			V
Low-level input voltage, V_{IL}			0.8	V
Reference voltage, V_{ref} (see Note 1)	3.8	4	4.2	V
Setup time, data before $CLK\uparrow$, t_{su1}	10			ns
Hold time, data after $CLK\uparrow$, t_{h1}	3			ns
Pulse duration at high level, t_{w1}	8.3			ns
Pulse duration at low level, t_{w2}	8.3			ns
External phase compensation capacitance, C_{COMP}	1			μF
Operating free-air temperature, T_A	0		70	$^{\circ}C$

NOTE 1: $V_{CC} - V_{ref} \leq 1.2 V$

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Resolution				8	Bit
I_{IH}	High-level input current $V_{CC} = 5.25 V, V_{IH} = 2.7 V$			20	μA
I_{IL}	Low-level input current $V_{CC} = 5.25 V, V_{IH} = 2.7 V$	-400			μA
I_{ref}	Reference input current REF IN = 4 V			10	μA
V_{ref}	Reference output voltage $V_{CC} = 5 V, \text{ With internal reference}$	3.8	4	4.2	V
V_{FS}	Full-scale analog output voltage $V_{IH} = 2 V, \text{ REF IN} = 4 V$	$AV_{CC} - 15$	AV_{CC}	$AV_{CC} + 15$	mV
V_{ZS}	Zero-scale analog output voltage $V_{IL} = 0.8 V, \text{ REF IN} = 4 V$	3.9	3.98	4.05	V
RGB full-scale ratio		0%	4%	8%	
z_o	Output impedance	200	240	280	Ω
I_{CC}	Supply current		70	90	mA

operating characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
E_L	Linearity error End point, REF IN = 4 V			± 0.5	LSB
E_D	Differential linearity error REF IN = 4 V			± 0.5	LSB
f_c	Maximum conversion rate		60		MHz
t_{PLH}	Propagation delay time, low-to-high level		10		ns
t_{PHL}	Propagation delay time, high-to-low level		10		
t_r	Rise time		5		ns
t_f	Fall time		5		

† All typical values are at $V_{CC} = 5 V, T_A = 25^{\circ}C$.

‡ C_L includes probe and jig capacitances.

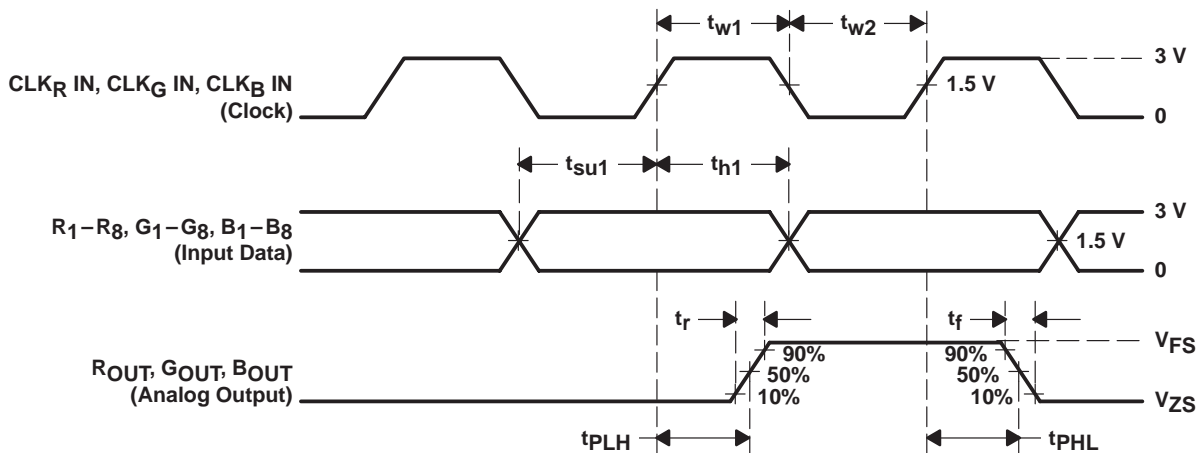


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PARAMETER MEASUREMENT INFORMATION



TYPICAL CHARACTERISTICS

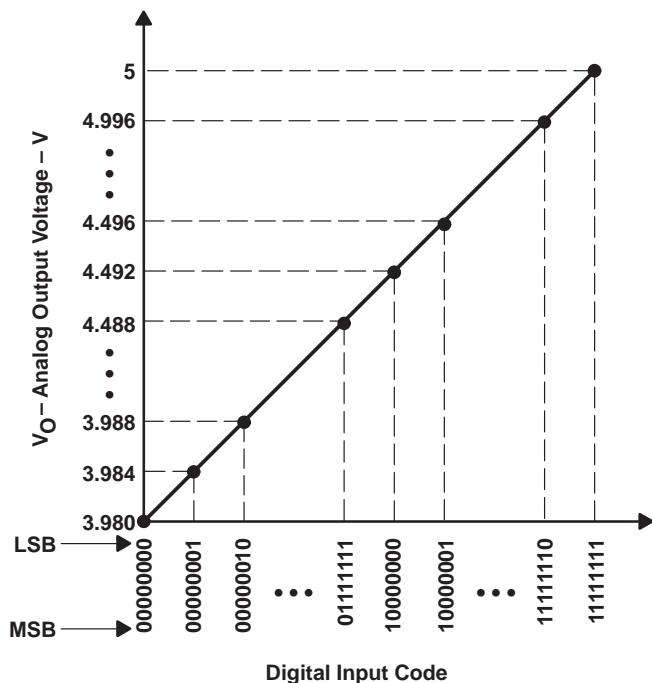


Figure 1. Ideal Conversion Characteristics

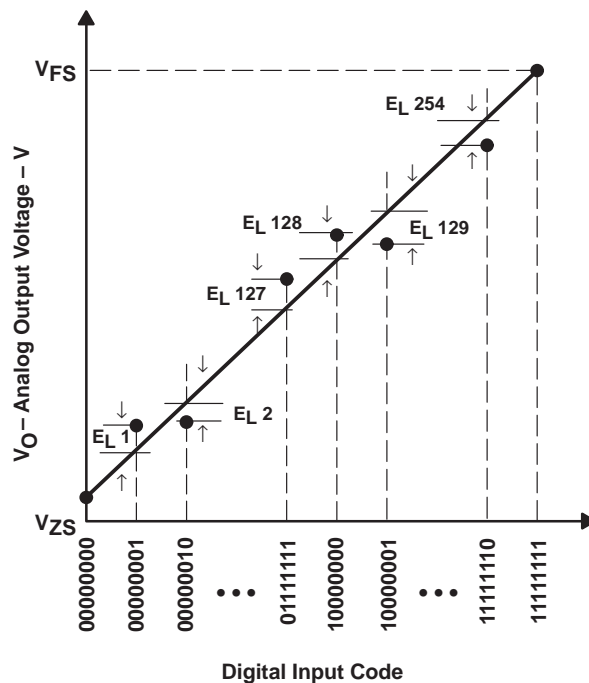


Figure 2. End-Point Linearity Error

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APPLICATION INFORMATION

The following design procedures should be used for optimum operation.

- External analog and digital circuitry should be physically separated and shielded as much as possible to reduce system noise.
- RF breadboarding or RF printed-circuit-board (PCB) techniques should be used throughout the evaluation and production process.
- Wide ground leads or a ground plane should be used on the PCB layouts to minimize parasitic inductance and resistance. A ground plane is the better choice for noise reduction.
- AV_{CC} and DV_{CC} are also separate internally, so they must be connected externally. These external PCB leads should also be made as wide as possible. A ferrite bead or equivalent inductance should be placed in series with AV_{CC} and the decoupling capacitor before the AV_{CC} and DV_{CC} leads are connected together on the board. It is critical that the supply voltage applied to AV_{CC} be as noise free and ripple free as possible. Ripple and noise rejection should be a minimum of 60 dB below the full-scale output range of 1 V peak-to-peak.
- AV_{CC} to GND and DV_{CC} to GND should be decoupled with 3.3- μ F and 0.1- μ F capacitors, respectively, as close as possible to the appropriate device terminals. A ceramic chip capacitor is recommended for the 0.1- μ F capacitor.
- The phase compensation capacitor should be connected between C_{COMP} and GND with as short a lead-in as possible.
- The no-connection (NC) terminals on the small-outline package should be connected to GND.
- AV_{CC} , DV_{CC} , and R_{OUT} , G_{OUT} , and B_{OUT} should be shielded from the high-frequency terminals $CLK_R IN$, $CLK_G IN$, and $CLK_B IN$ and the input data terminals. GND traces should be placed on both sides of the R_{OUT} , G_{OUT} , and B_{OUT} traces on the PCB to the following signal processing stage. These output traces should be as short as possible.

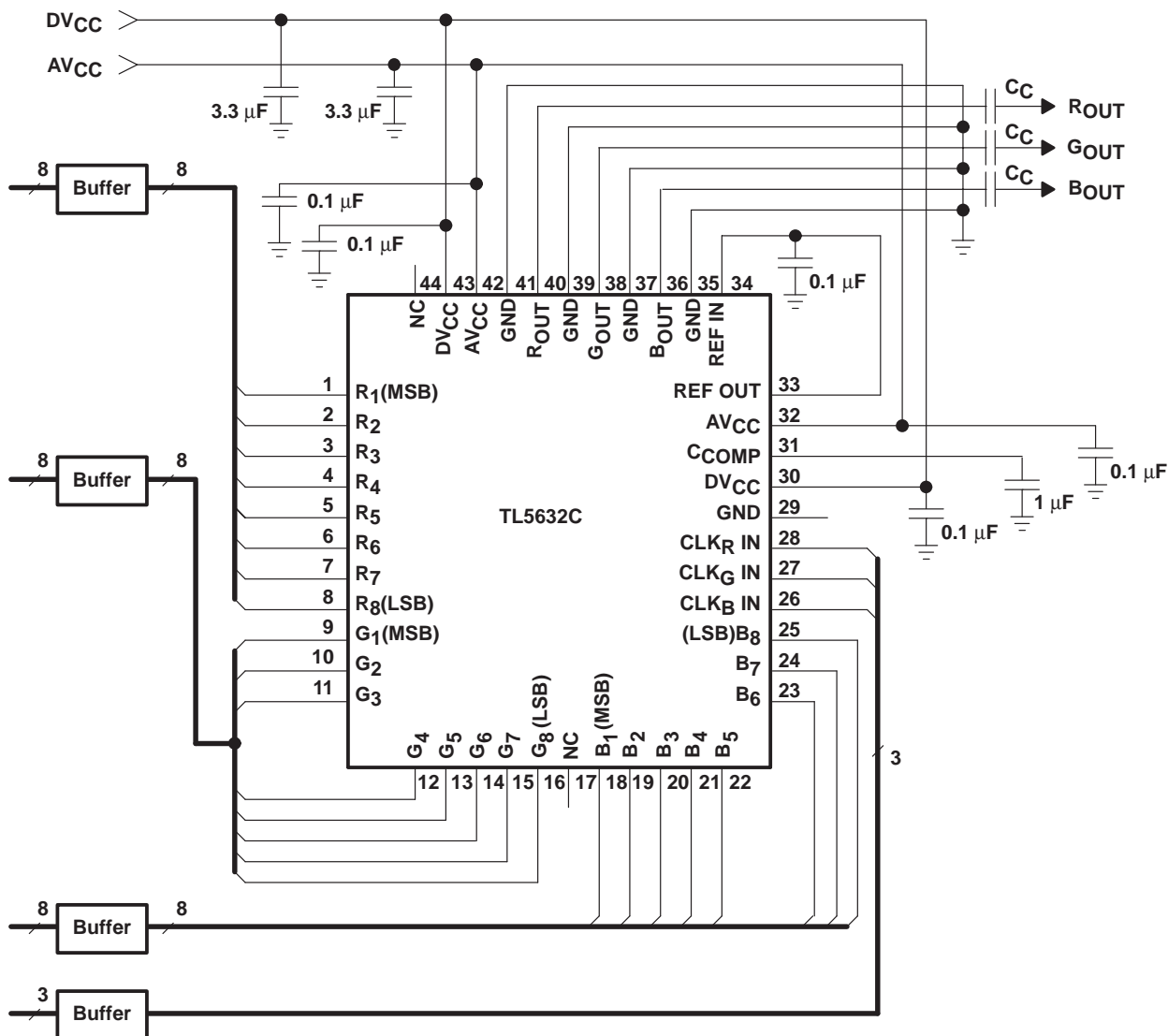


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APPLICATION INFORMATION



- NOTES: A. Buffers are SN74AS244 or equivalent.
 B. 0.1 µF capacitors should be placed as close to the device terminals as possible.
 C. The coupling capacitor (C_C) value is application specific and selectable by the user.

Figure 3. Typical Bypass, Buffer, and Output Configuration

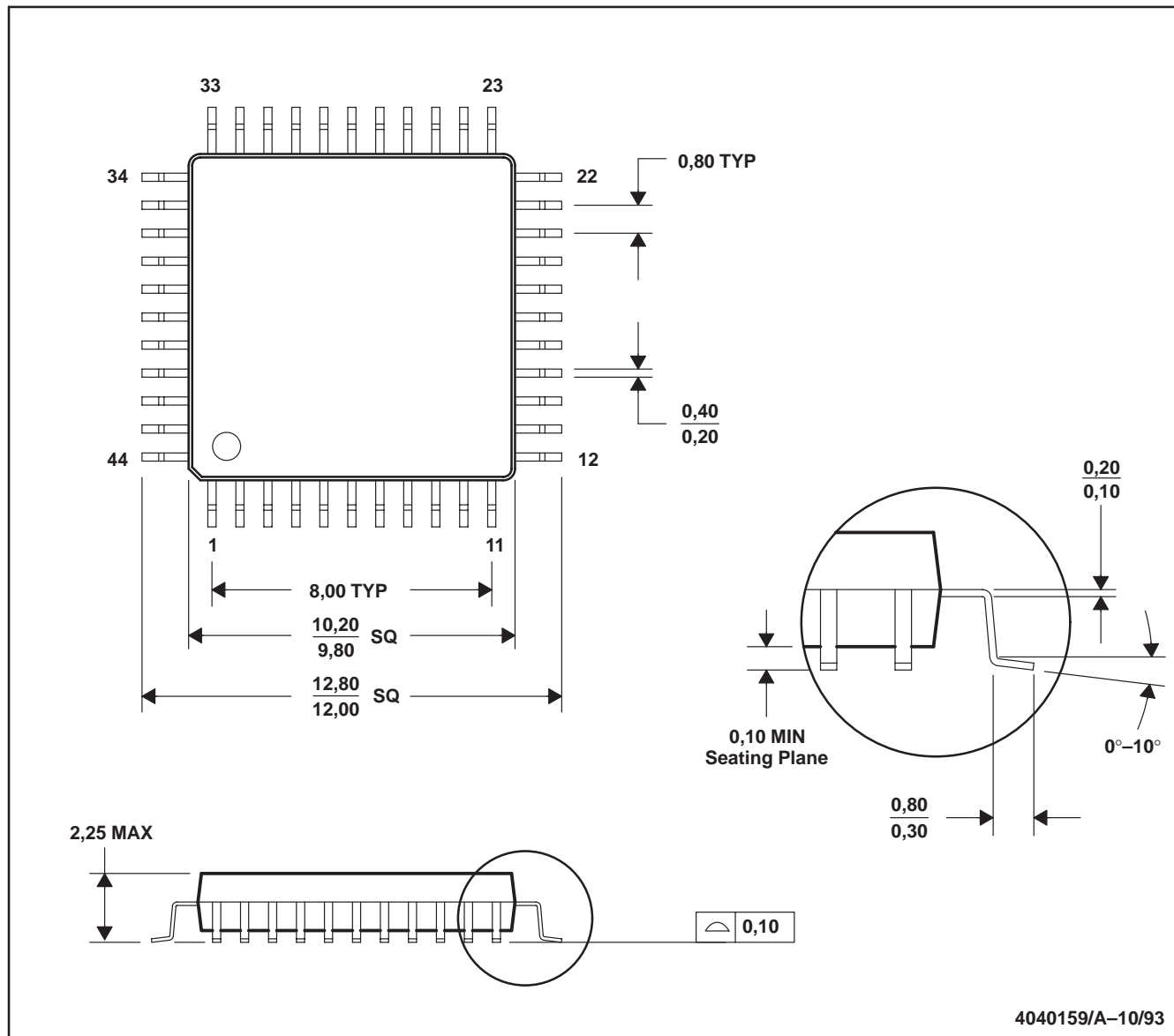
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MECHANICAL DATA

FR/S-PQFP-G44

PLASTIC QUAD FLATPACK



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TL5632CFR	OBSOLETE	QFP	FR	44		TBD	Call TI	Call TI

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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