3-Channel Low-Power EDTV/SDTV Video Line Driver With Low-Pass Filters

FEATURES

- **Single Supply: 2.85 V to 5 V**
- **Low Total Supply Current = 4.5 mA (max)**
- **Low Power Mode: 5 μW (max)**
- **Integrated DAC Reconstruction Filters**
- **Video Line Driver Outputs with 6 dB Gain**
- **Rail-to-Rail Output**
- **RoHS Compliant 9-Pin Wafer Scale Package**

APPLICATIONS

- **Personal Media Players**
- **Digital Cameras**
- **Cellular Phone Video Output Buffering**
- **USB/Portable Low Power Video Buffering**

DESCRIPTION

The THS7318 is a very low power single-supply 3 channel device designed to process Y', P'_B, P'_R enhanced definition TV and Y', C', and CVBS standard definition TV signals. It integrates circuitry to perform signal processing commonly required in video output applications.

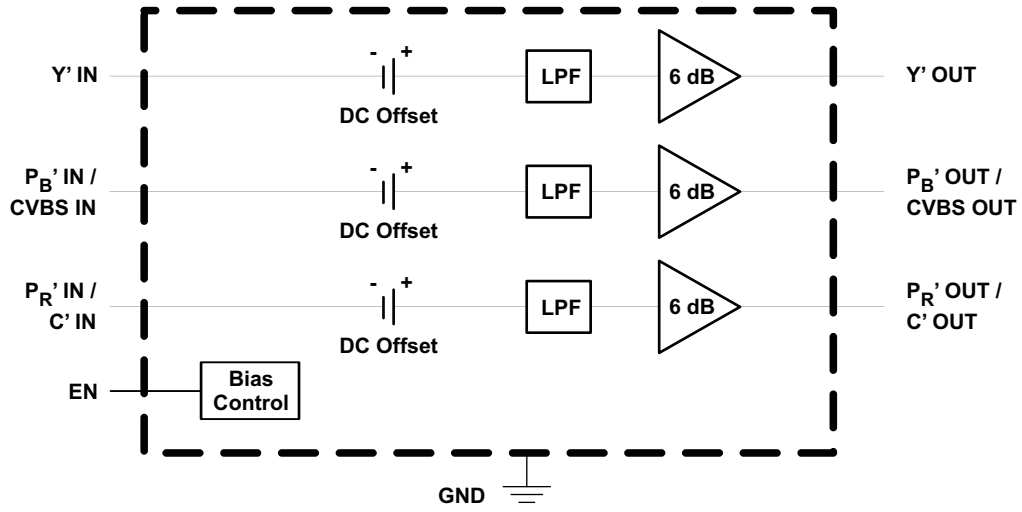
All channels incorporate 3rd-order 20-MHz Butterworth DAC reconstruction filters designed for video systems with 54 MSPS DAC sampling rates like NTSC/PAL 480p/576p EDTV and 480i/576i SDTV video.

Rail-to-Rail output drivers on all channels allow for both ac and dc coupled outputs.

The low quiescent current makes it an excellent choice for USB powered or portable video applications.

The THS7318 is available in a 9-pin NanoFree™ wafer scale package. It is specified for operation from –40°C to +85°C.

THS7318 BLOCK DIAGRAM



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ABSOLUTE MAXIMUM RATINGS

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

			VALUE	UNIT
V_{SS}	Supply voltage, V_{S+} to GND		5.5	V
V_I	Input voltage		–0.4 to V_{S+}	V
I_O	Output current		±100	mA
	Continuous power dissipation		See Dissipation Rating Table	
T_J	Maximum junction temperature	Any condition (2)	150	°C
		Continuous operation, long term reliability(3)	125	°C
T_{stg}	Storage temperature range		–65 to 150	°C
T_A	Ambient operating temperature range		–40 to 85	°C
	ESD ratings	HBM	2000	V
		CDM	1500	V
		MM	200	V

(1) Stresses above 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 degrade device reliability.
(2) The absolute maximum junction temperature under any condition is limited by the constraints of the silicon process.
(3) The absolute maximum junction temperature for continuous operation is limited by the package constraints. Operation above this temperature may result in reduced reliability and/or lifetime of the device.

DISSIPATION RATINGS(1)

PACKAGE	θ_{JC} (°C/W)	θ_{JA} (°C/W)	POWER RATING(2) (T_J = 125°C)	
			T_A = 25°C	T_A = 70°C
YZF	38	105	950 mW	428 mW

(1) This data was taken with the JEDEC High-K test PCB.
(2) Power rating is determined with a junction temperature of 125°C. This is the point where distortion starts to substantially increase and long-term reliability starts to be reduced. Thermal management of the final PCB should strive to keep the junction temperature at or below 125°C for best performance and reliability.

RECOMMENDED OPERATING CONDITIONS

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

		MIN	MAX	UNIT
V_{S+}	Supply voltage	2.85	5	V

PACKAGING/ORDERING INFORMATION

PACKAGED DEVICES	PACKAGE TYPE(1)	PART CODE	TRANSPORT MEDIA, QUANTITY
THS7318YZFT	Wafer Scale 9-pin	BYR	Tape and Reel, 250
THS7318YZFR			Tape and Reel, 3000

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at www.ti.com.

NanoFree™ Placement and Removal Procedures

These procedures are generic guidelines to rework NanoFree™ packages assembled on a 0.056-inch thick FR4 board. It's recommended to modify heating profiles for different board thicknesses and equipment used. The assembly process recommended below should be used with a new device. Do not reuse the part after it is removed.

Air-Vac Engineering (www.air-vac-eng.com) has established NanoFree™ reflow profiles for their Hot Gas (convection) rework equipment DRS-24NC. The NMX090DVG nozzle is recommended for use with the YZF package. Customers can use other comparable hot gas (convection) equipment and tooling.

Placement

1. Apply flux paste to component
2. Align device over pads
3. Place device on board. Care must be taken to prevent over-travel during placement which may damage the part or vacuum tip.
4. Raise nozzle 0.05"
5. Preheat board to 90°C, nozzle warming up 20% air flow, 125°C
6. Soak Stage—20% air flow, 225°C, 90 seconds
7. Ramp Stage—20% air flow, 335°C, 30 seconds
8. Reflow Stage—25% air flow, 370°C, 65 seconds
9. Cool down Stage—40% air flow, 25°C, 50 seconds

Removal

1. Apply flux paste to component
2. Align Nozzle over part to be removed
3. Maintain nozzle 0.050"over device. Care must be taken to prevent over-travel of the vacuum tip which may damage the part or vacuum tip when measuring this distance.
4. Preheat board to 90°C, nozzle warming up 20% air flow, 125°C
5. Soak Stage—20% air flow, 225°C, 90 seconds
6. Ramp Stage—20% air flow, 335°C, 30 seconds
7. Reflow Stage—25% air flow, 370°C, 65 seconds
8. Enable Vacuum at the end of the reflow cycle, lower vacuum nozzle, and remove part
9. Cool down Stage—40% air flow, 25°C, 50 seconds
10. Turn off the vacuum and remove part from nozzle.
11. Care should be used if the device is to be returned to TI for failure analysis. Using any metal tweezers or rough handling can damage the part, and render it un-analyzable.

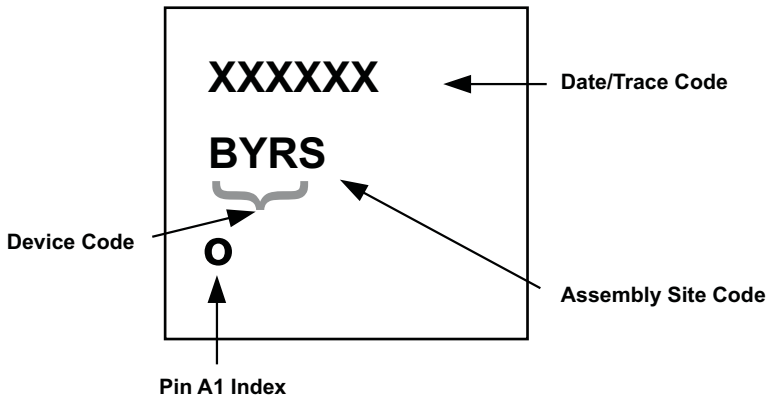
ELECTRICAL CHARACTERISTICS

V_{S+} = 3.3V, 27°C, Y' and P'$_R$ / C' channels: R_L = 150 Ω and C_L = 6.2 pF to GND P'$_B$ / CVBS channel: 75 Ω and C_L = 6.2 pF to GND (unless otherwise noted)

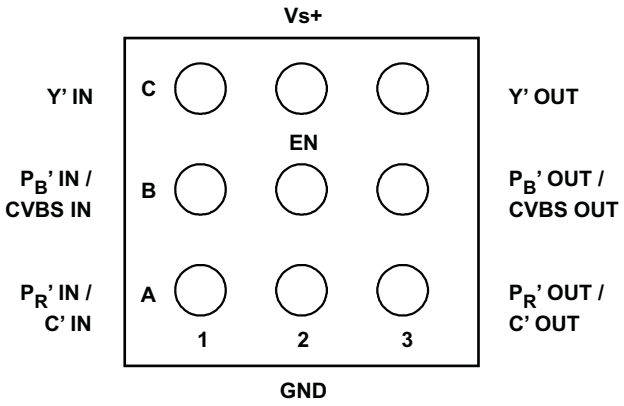
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	TEST LEVEL(1)
DC CHARACTERISTICS							
V_{SS}	Supply voltage range		2.85	3.3	5	V	B
I_Q	Quiescent supply current	EN = High	2.8	3.5	4.5	mA	A
V_{SD}	Shutdown supply current	EN = Low		0.150	<1	µA	A
	Output DC level shift voltage	All channels	110	150	200	mV	A
	Input bias current	Y' and P'$_B$ / CVBS channels	–100	–160	–240	nA	A
		P'$_R$ / C' channel	–170	–280	–415	nA	A
	Input resistance / capacitance			2.4/1		MΩ/pF	C
	Voltage gain		1.98	2	2.02	V/V	A
	Channel to Channel Gain Match	All Channels		±0.14	±1	%	A
PSRR	Power supply rejection	DC	47			dB	A
V_{OH}	Output voltage swing high	Y' and P'$_R$ / C' channel, 150 Ω to GND	2.85	2.96		V	A
		P'$_B$ / CVBS channel, 50 Ω to GND	2.6	2.9		V	A
	P'$_B$ output high minus output offset	At V_{S+} = 3.135 V, P'$_B$ / CVBS channel, 50 Ω to GND	2.3	2.65		V	A
	Output short-circuit current	Y' and P'$_R$ / C' channel		70		mA	C
		P'$_B$ / CVBS channel		100		mA	C
	Max current into EN pin	EN = Low			<1	µA	A
		EN = High			<1	µA	A
	Disable threshold	Low = off			0.6	V	A
	Enable threshold	High = on	2.1			V	A
	Output impedance in shutdown	EN = Low		20		kΩ	C
AC PERFORMANCE							
	0.1 dB Bandwidth	Relative to 1 MHz		11		MHz	C
	±1.0 dB Bandwidth	Relative to 1 MHz	14	17		MHz	A
	–3 dB Bandwidth	Relative to 1 MHz	17	20		MHz	B
	Normalized stop band gain	f = 43 MHz, Relative to 1 MHz		–21	–12	dB	A
	Differential gain	NTSC and PAL		0.05		%	C
	Differential phase	NTSC and PAL		0.03		deg	C
	Group delay variation	f = 11 MHz w/ref to 1 MHz		4		ns	C
	Signal to noise ratio	V_{OUT} = 2-V_{PP} sine wave		62		dB	C
t_r/t_f	Rise / fall time	V_{OUT} = 2-V step		20		ns	C
	Positive/ negative slew rate	V_{OUT} = 2-V step		80		V/µs	C
	THD at 1MHz	At 1MHz, 2 V_{PP}		73		dBc	C

(1) Test levels:
A) 100% tested at 25°C. Over-temperature limits set by characterization and simulation.
B) Limits set by characterization and simulation.
C) Typical value only for information.

THS7318
(Top View)



THS7318
(Bottom View)



TERMINAL FUNCTIONS

COL.	ROW	PIN NAME	DESCRIPTION
1	C	Y' IN	Luma input
1	B	P_B' IN / CVBS IN	Component video input / composite video input
1	A	P_R' IN / C' IN	Component video input / chroma input
2	C	V_{S+}	Positive power supply input
2	B	EN	Enable input. Logic high enables part. Logic low disables part. To insure proper operation, this pin must be driven and cannot be left floating.
2	A	GND	Ground reference pin for all internal circuitry
3	C	Y' OUT	Luma output
3	B	P_B' OUT / CVBS OUT	Component video output / composite video output
3	A	P_R' OUT / C' OUT	Component video output / chroma output

THS7318 DESCRIPTION

The THS7318 is an integrated analog video processor designed with integrated Butterworth filters and video line driver amplifiers to provide the analog signal conditioning required for EDTV signals in portable video applications.

The device accepts 3 inputs; Y' (Luma), P'_B / CVBS (analog color difference with blue emphasis / composite video) and P'_R / C' (analog color difference with red emphasis / chroma), and provides 3 filtered and amplified outputs; Y', P'_B / CVBS and P'_R / C'.

The following are detailed descriptions of each channel.

CHANNEL DESCRIPTIONS

All channels are comprised of DC offset, 3rd order Butterworth low pass filter, and output buffer amplifier. All channels are same except the Y' and P'_R / C' output amplifiers are designed to drive one doubly terminated 75Ω video line and the P'_B / CVBS output amplifier is designed to drive two doubly terminated 75Ω video lines. Even under the fault condition where one of the video lines is shorted, the P'_B / CVBS output amplifier is capable of full video performance on the properly terminated output.

DC Offset

The DC offset circuit is used to insure the output is not driven into saturation and video signal is not compressed. The nominal output offset caused by this circuit is 150 mV.

3rd Order Butterworth Low Pass Filter

To reduce DAC images that cause aberrations in the video display, a 3rd order Butterworth low pass filter is inserted in the signal path. This DAC reconstruction filter is designed for video systems with 54 MSPS DAC sampling rates like NTSC/PAL 480p/576p EDTV and 480i/576i SDTV video, with nominal 0.1-dB flatness to 11 MHz, -3-dB bandwidth of 20 MHz, and 20 dB attenuation at 43 MHz.

Output Buffer Amplifier

The output buffer amplifiers are designed for a gain of 6 dB. The Y' and P'_R / C' output amplifiers are designed to drive one doubly terminated 75Ω video line and the P'_B / CVBS output amplifier is designed to drive two doubly terminated 75Ω video lines. Even under the fault condition where one of the video lines is shorted, the P'_B / CVBS output amplifier is capable of full video performance on the properly terminated output.

TYPICAL APPLICATION CIRCUITS

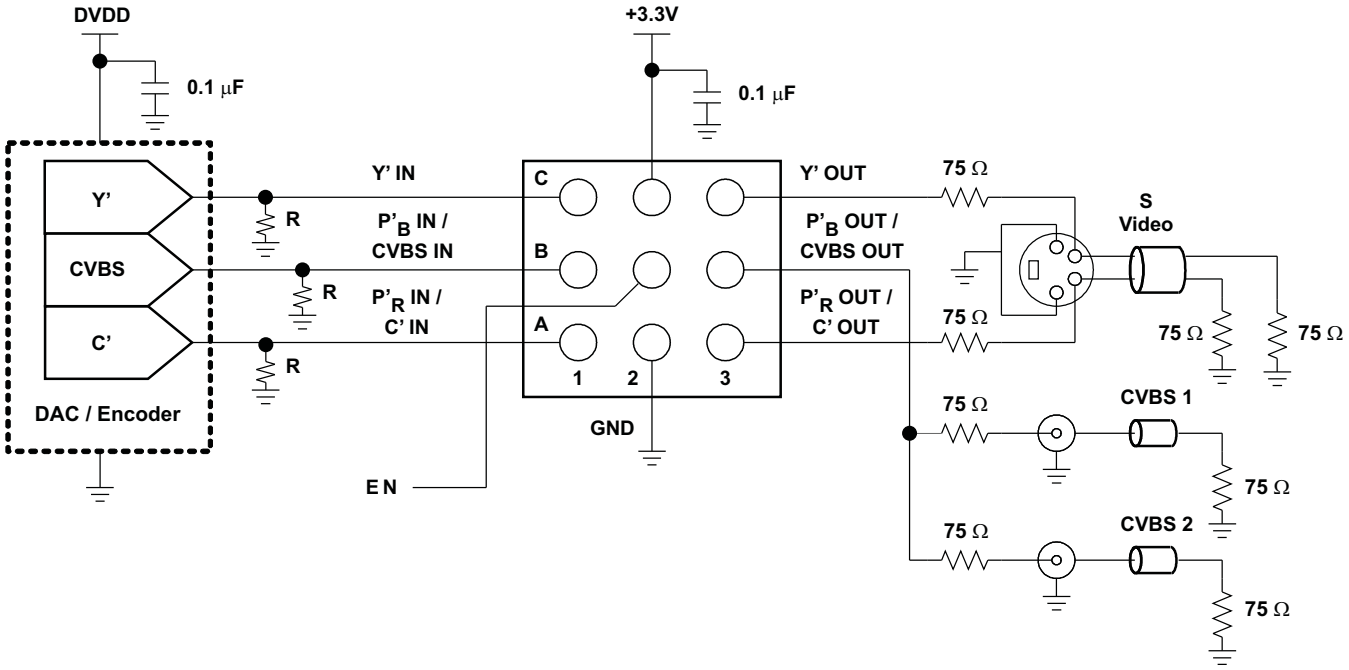


Figure 1. Application Drawing CVBS and S Video

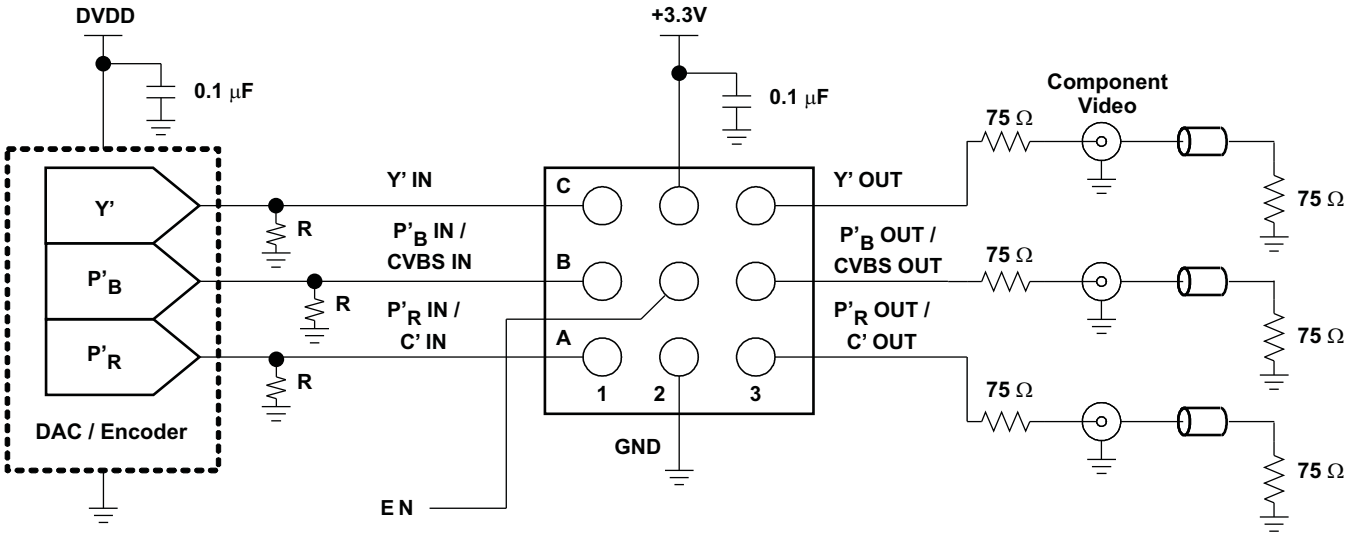
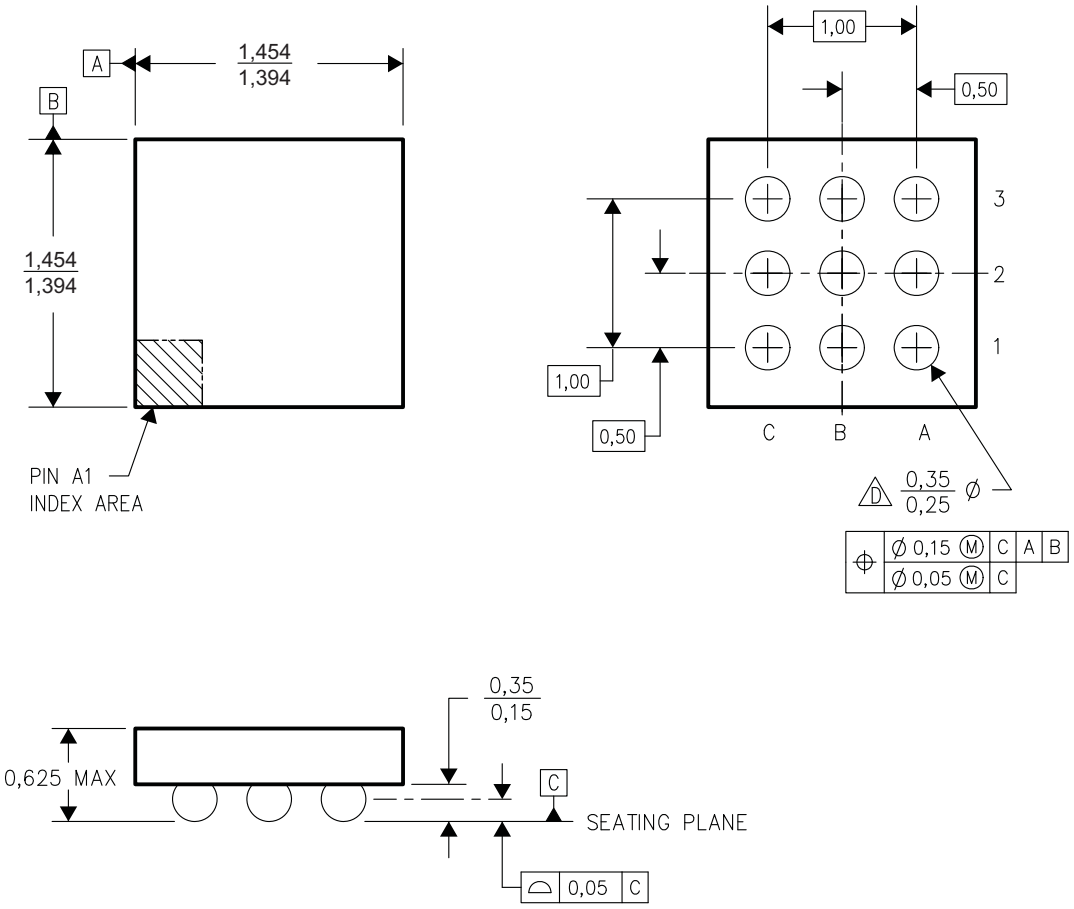


Figure 2. Application Drawing Component Video

MECHANICAL DATA



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.
D. Reference Product Data Sheet for array population.
3 x 3 matrix pattern is shown for illustration only.
E. This package contains lead–free balls.
Refer to YEF (Drawing #4204181) for tin–lead (SnPb) balls.

Figure 3. YZF Ball Grid Array Package Dimensions (in mm)

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
THS7318YZFR	ACTIVE	DSBGA	YZF	9	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	BYR	Samples
THS7318YZFT	ACTIVE	DSBGA	YZF	9	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	BYR	Samples

(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.

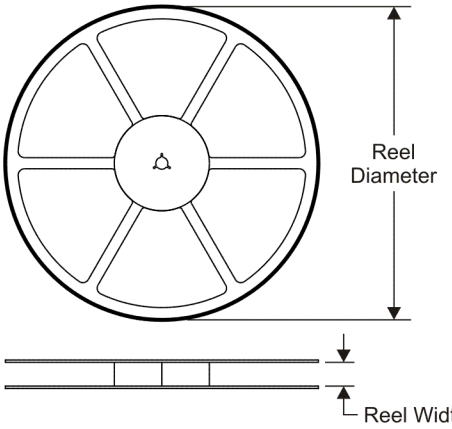
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been 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.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
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.

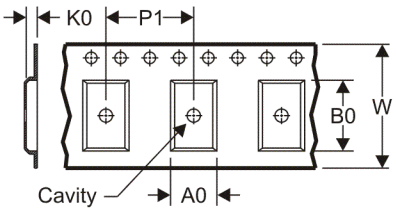
(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

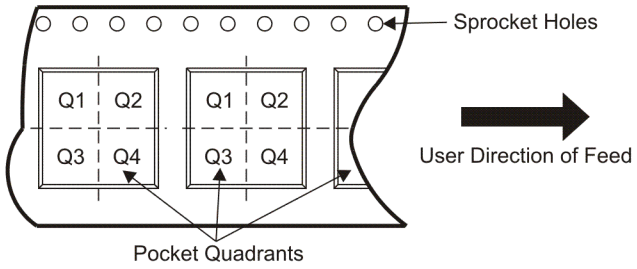


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

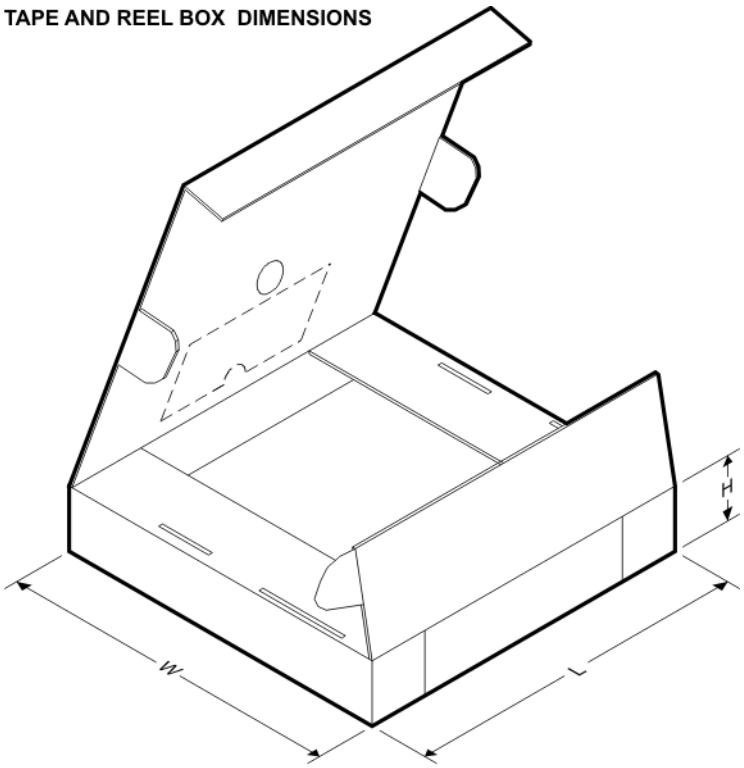
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
THS7318YZFR	DSBGA	YZF	9	3000	180.0	8.4	1.65	1.65	0.81	4.0	8.0	Q1
THS7318YZFT	DSBGA	YZF	9	250	180.0	8.4	1.65	1.65	0.81	4.0	8.0	Q1

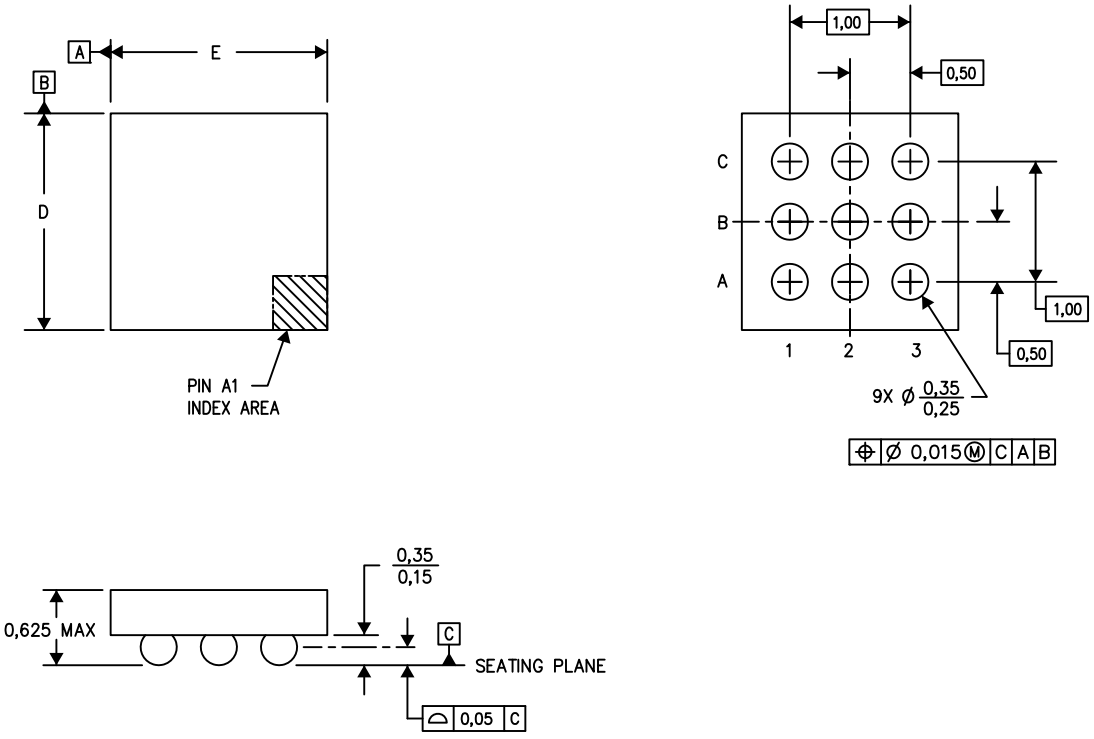
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
THS7318YZFR	DSBGA	YZF	9	3000	220.0	220.0	34.0
THS7318YZFT	DSBGA	YZF	9	250	220.0	220.0	34.0

YZF (S–XBGA–N9) DIE–SIZE BALL GRID ARRAY



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NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.

NanoFree is a trademark of Texas Instruments.

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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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