

## FOUR-, SIX-CHANNEL EMI FILTER WITH ESD PROTECTION FOR LCD DISPLAY

 Check for Samples: [TPD4F202](#), [TPD6F202](#)

### FEATURES

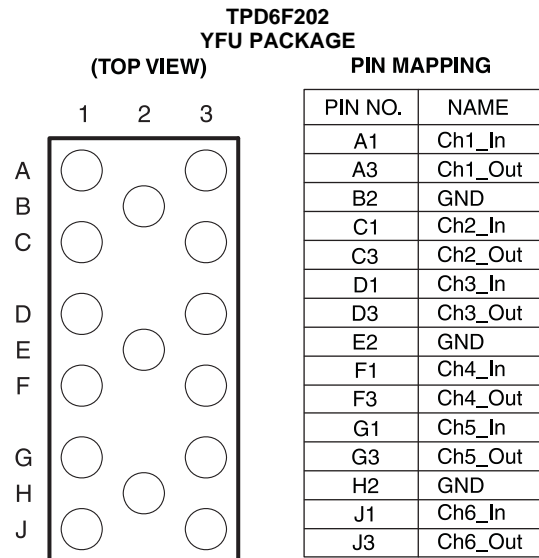
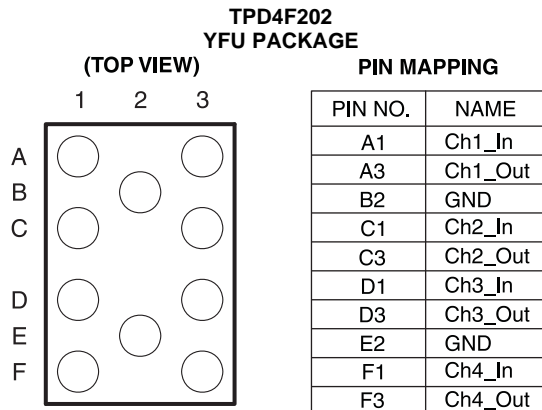
- Four-, Six-Channel EMI Filtering and ESD Protection for Data Lines
- Excellent filter Performance
  - >40dB Attenuation at 1GHz-3GHz
  - -3dB Bandwidth at 108MHz
  - 70 dB Crosstalk Attenuation at 100 MHz
- Exceeds IEC61000-4-2 (Level 4) ESD Protection Requirements
  - ±25-kV IEC 61000-4-2 Contact Discharge
  - ±25-kV IEC 61000-4-2 Air-Gap Discharge
  - ±15-kV Human-Body Model (HBM)
- Pi-Style C-R-C Filter Configuration Offers Symmetric Filter Performance

 (R = 100 Ω, C<sub>TOTAL</sub> = 30 pF)

- Low 10-nA Leakage Current
- Space-Saving WCSP Package and Flow-Through Pin Mapping Provides Optimum Performance in Portable Applications

### APPLICATIONS

- LCD Display Interface
- Memory Interface
- SVGA Video Connections
- Keypad
- Data Lines in Portables



### ORDERING INFORMATION

T <sub>A</sub>	PACKAGE <sup>(1)</sup> (2)	PACKAGE DIMENSION	ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	WCSP – YFU	Length = 2.36 mm, Width = 1.053 mm, Pitch = 0.4 mm, Height = 0.32 mm)	TPD6F202YFUR	YMS5WS
		Length = 1.56 mm, Width = 1.053 mm, Pitch = 0.4 mm, Height = 0.32 mm)	TPD4F202YFUR	YMS57S

- (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](http://www.ti.com).
- (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).



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## DESCRIPTION

The TPDxF202 are four, six-channel EMI filters, designed particularly to suppress EMI noise in the cell phone and other portable applications. These low-pass filters also protect internal core circuitry against system level ESD strikes at the external interface pins. The pi-style C-R-C filter provides symmetric filter performance in the data lines to/ from either side of the filter.

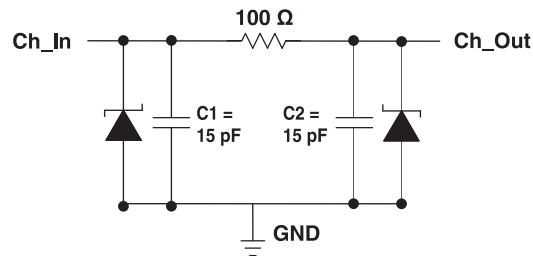
Due to tiny package parasitics of the WCSP package, the TPDxF202 series of filters provide excellent signal attenuation (-40dB at 1GHz) at the typical cell-phone carrier frequency ranges.

The ultra thin (0.3-mm package height, when mounted on board) space saving YFU package enables the TPDxF202 devices to mount on the printed circuit boards where the height is a key constraint.

The TPDxF202 devices offer very robust system level ESD protection specifications at both input and output ports, which eliminates the need for any additional ESD clamp diodes at the external interface pins.

The TPDxF202 devices are specified for -40°C to 85°C operation.

## EQUIVALENT SCHEMATIC REPRESENTATION



## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

		MIN	MAX	UNIT
$V_{IO}$	IO to GND		6	V
	Continuous power dissipation ( $T_A = 70^\circ\text{C}$ )		100	mW
$T_{stg}$	Storage temperature range	-65	150	$^\circ\text{C}$
$T_J$	Junction temperature		150	$^\circ\text{C}$
	Lead temperature (soldering, 10 s)		300	$^\circ\text{C}$

- (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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

$T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (Unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$V_{BR}$	DC breakdown voltage	$I_{IO} = 10 \mu\text{A}$	6		V
R	Resistance		85	100 115	$\Omega$
C	Capacitance (C1 or C2)	$V_{IO} = 3.3 \text{ V}$	15		pF
$I_{IO}$	Channel leakage current	$V_{IO} = 3.3 \text{ V}$	10		nA
$f_C$	Cut-off frequency	$Z_{SOURCE} = 50 \Omega, Z_{LOAD} = 50 \Omega$	108		MHz

- (1) Typical values are at  $T_A = 25^\circ\text{C}$ .

## ESD PROTECTION

PARAMETER	TYP	UNIT
HBM	$\pm 15$	kV
IEC 61000-4-2 Contact Discharge	$\pm 25$	kV
IEC 61000-4-2 Air-Gap Discharge	$\pm 25$	kV

### APPLICATION INFORMATION

Typically, there are multiple EMI filters being utilized in cell phone applications to suppress the EMI interference. This means the total board area consumed by EMI filters are relatively large. One example of space saving innovation is to place the EMI filters right under the connectors so that the main PCB space is not utilized. The YFU packages of the TPDxF202 series offer ultra low-profile package height which enables such innovative component placement in portable applications. Package under-fill is recommended while using the YFU packages in flex boards.

For maximum efficiency of filtering and ESD protection, while doing the board layout, care should be taken to reduce board parasitic from package GND pins to board GND plane. The TPDxF202 devices should be connected to a ground plane with a micro via adjacent to the device GND pad. If this is not possible, the connection to the ground plane should be as direct as possible to minimize the inductance. Due to flow-through pin mapping, the signal pins routing is easily achieved in a single layer.

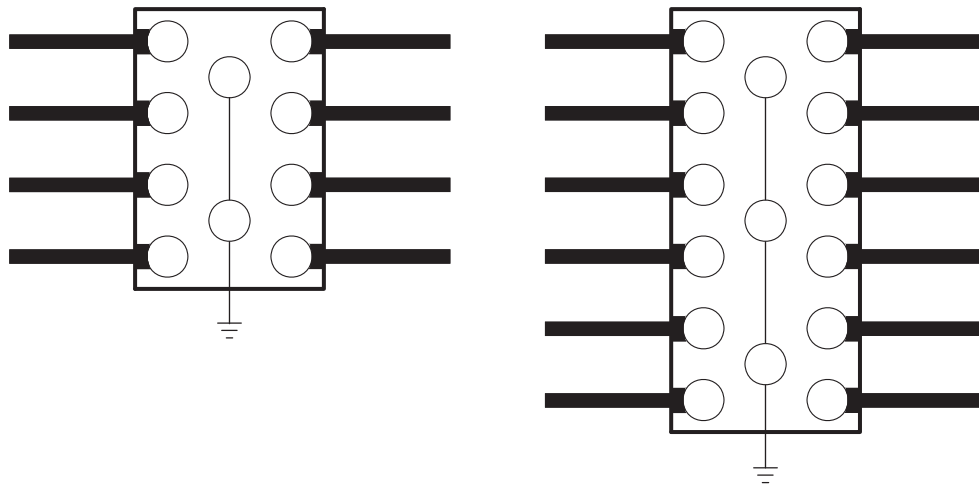


Figure 1. Board Layout with TPDxF20

TYPICAL CHARACTERISTICS

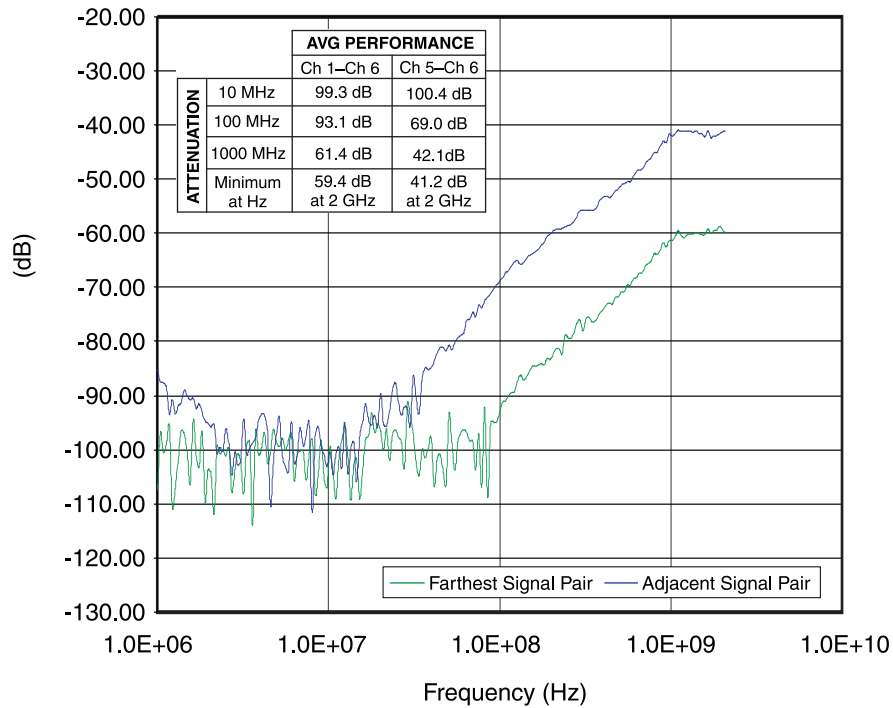


Figure 2. Channel-to-Channel Crosstalk

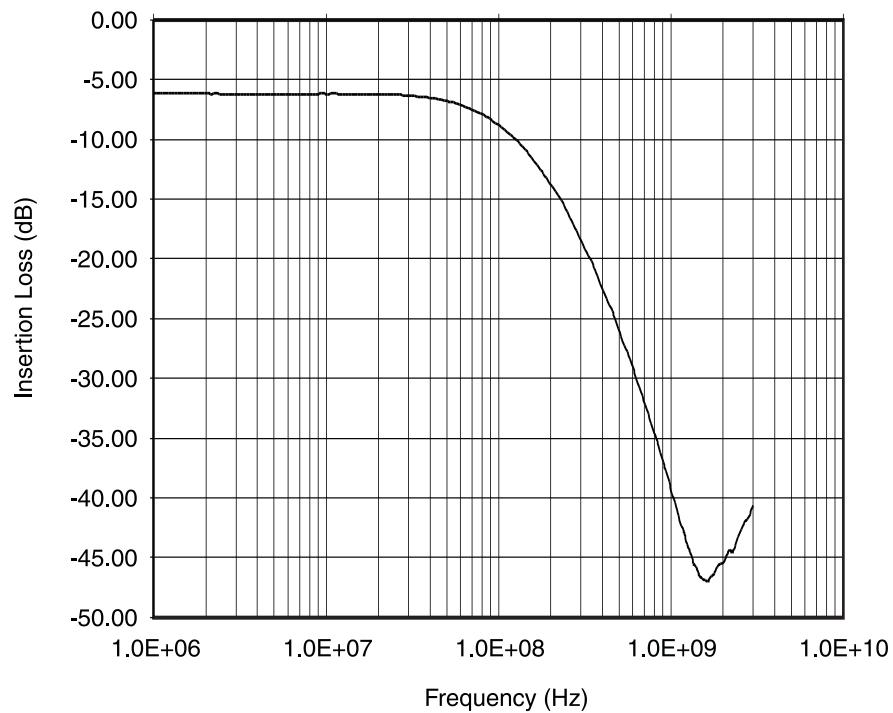
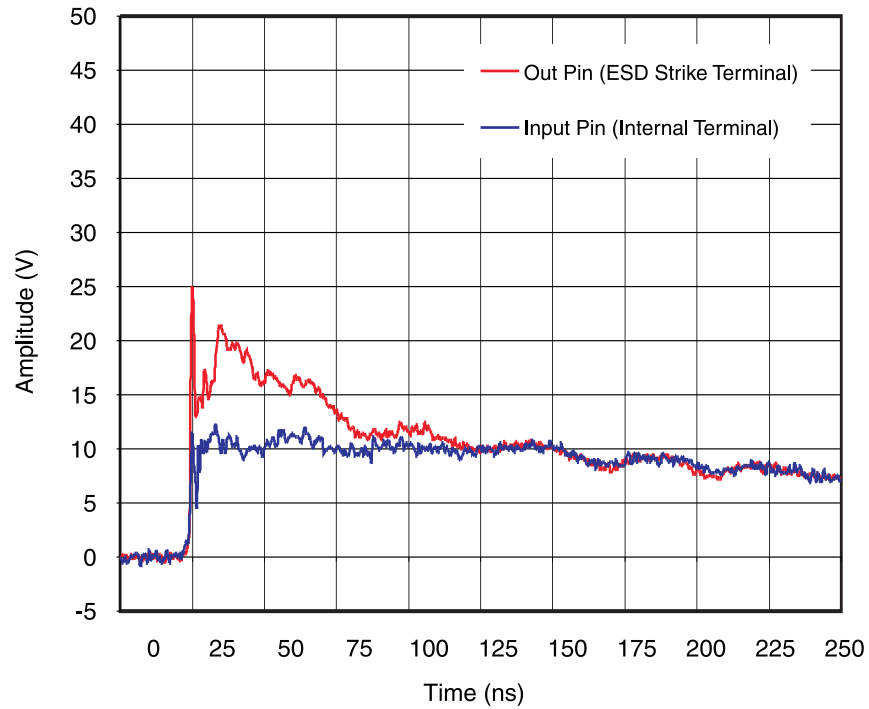
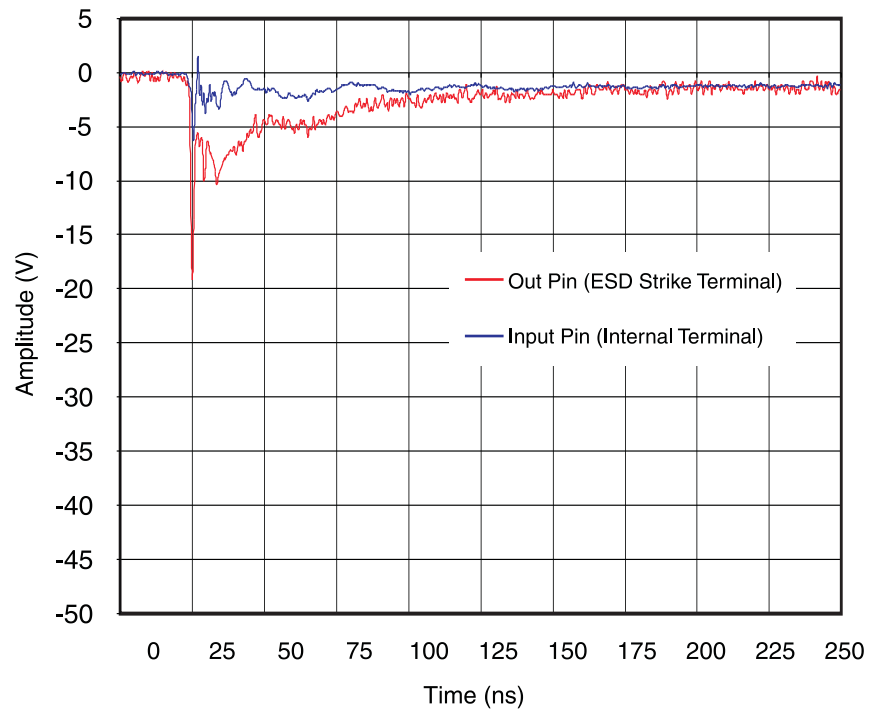


Figure 3. Frequency Response Data (0 V Bias)

**TYPICAL CHARACTERISTICS (continued)**



**Figure 4. IEC Clamping Waveforms +8 kV Contact**



**Figure 5. IEC Clamping Waveforms -8 kV Contact**

TYPICAL CHARACTERISTICS (continued)

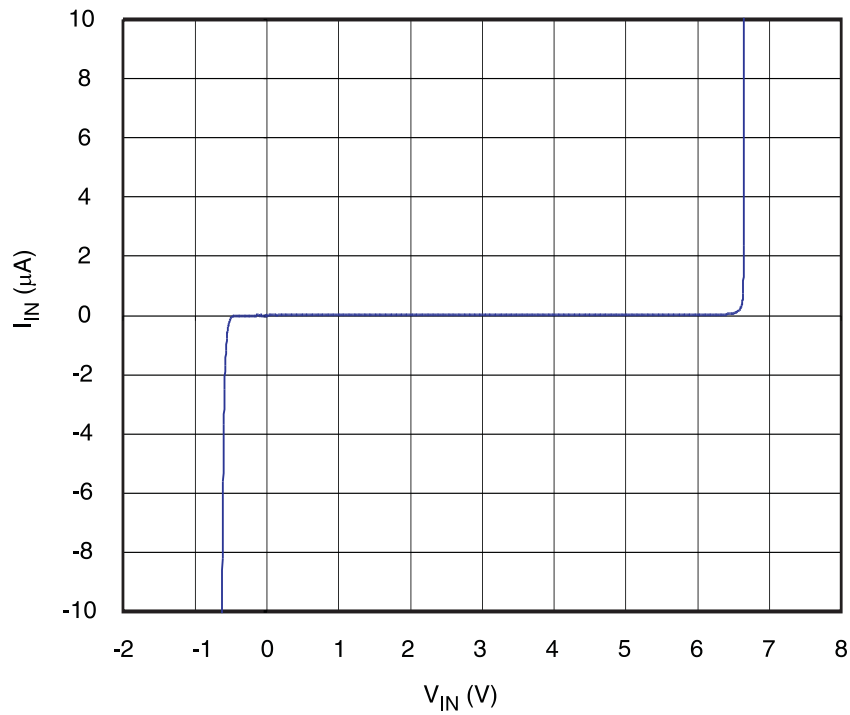


Figure 6. DC Characteristics ( $I_{IN}$  vs.  $V_{IN}$ ),  $T_A = 25^\circ C$

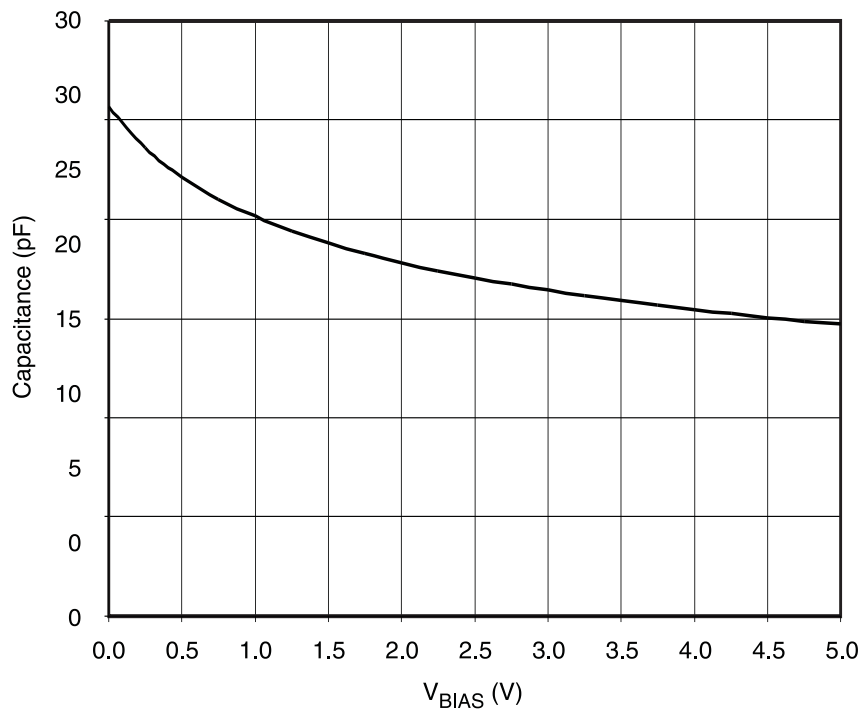


Figure 7. C1 or C2 Capacitance vs.  $V_{BIAS}$

**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
TPD4F202YFUR	ACTIVE	DSBGA	YFU	10	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	57S	<a href="#">Samples</a>
TPD6F202YFUR	ACTIVE	DSBGA	YFU	15	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	5WS	<a href="#">Samples</a>

(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.

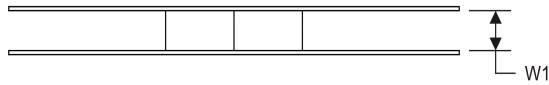
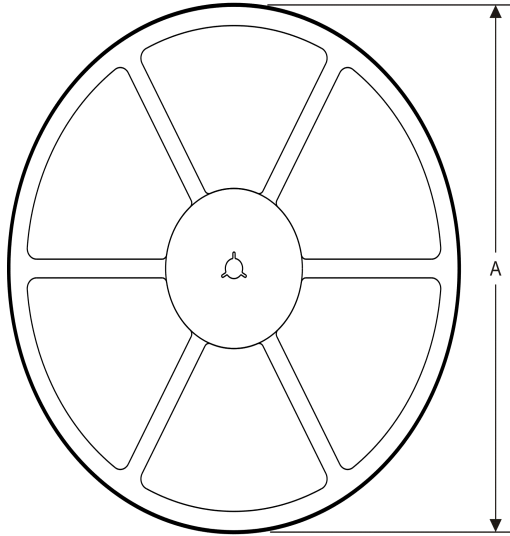
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**TAPE AND REEL INFORMATION**

**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

**TAPE AND REEL INFORMATION**

\*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
TPD4F202YFUR	DSBGA	YFU	10	3000	178.0	9.2	1.21	1.72	0.45	4.0	8.0	Q1
TPD6F202YFUR	DSBGA	YFU	15	3000	178.0	9.2	1.19	2.5	0.45	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS

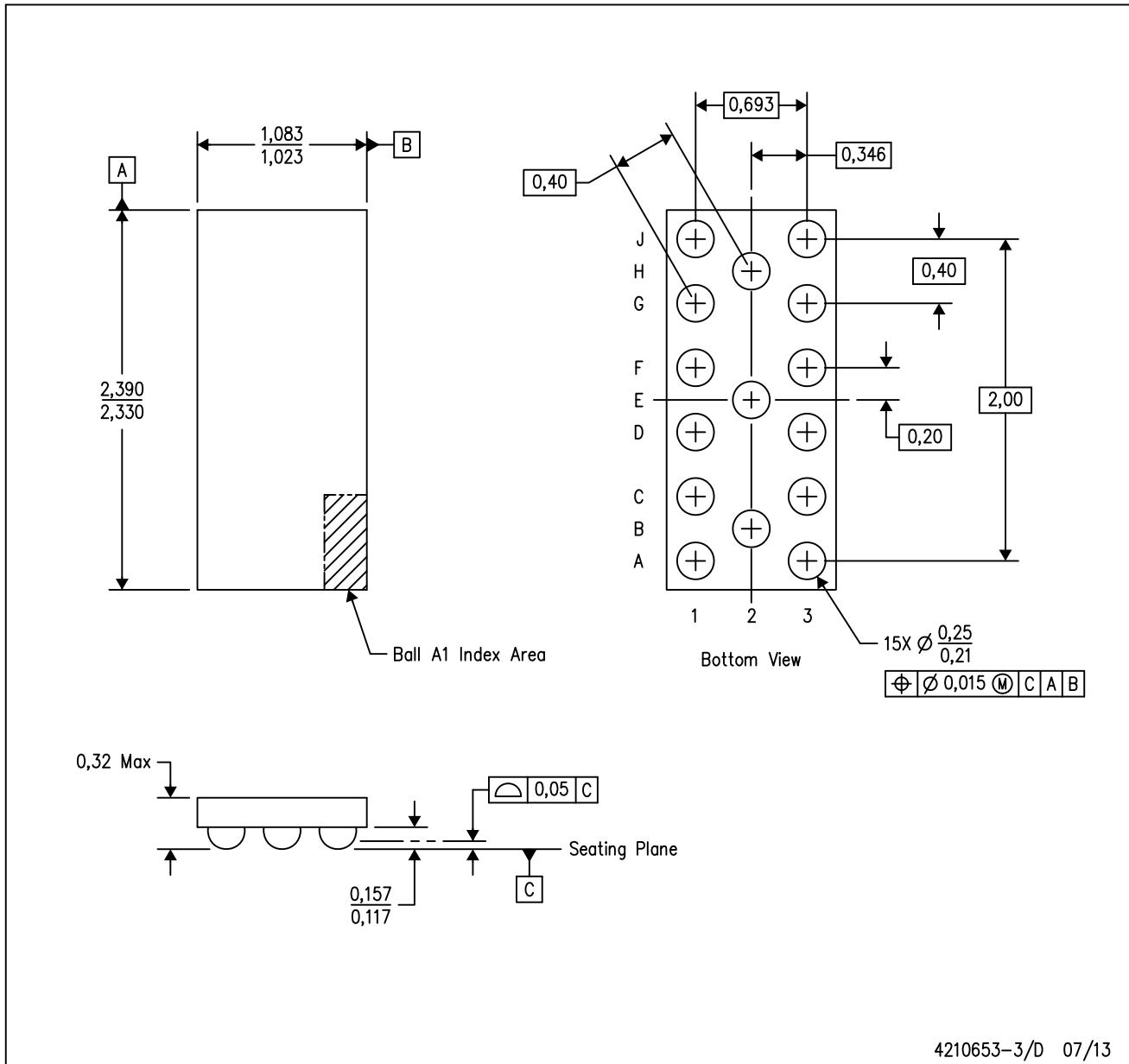


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPD4F202YFUR	DSBGA	YFU	10	3000	220.0	220.0	35.0
TPD6F202YFUR	DSBGA	YFU	15	3000	220.0	220.0	35.0

YFU (R-XBGA-N15)

DIE-SIZE BALL GRID ARRAY

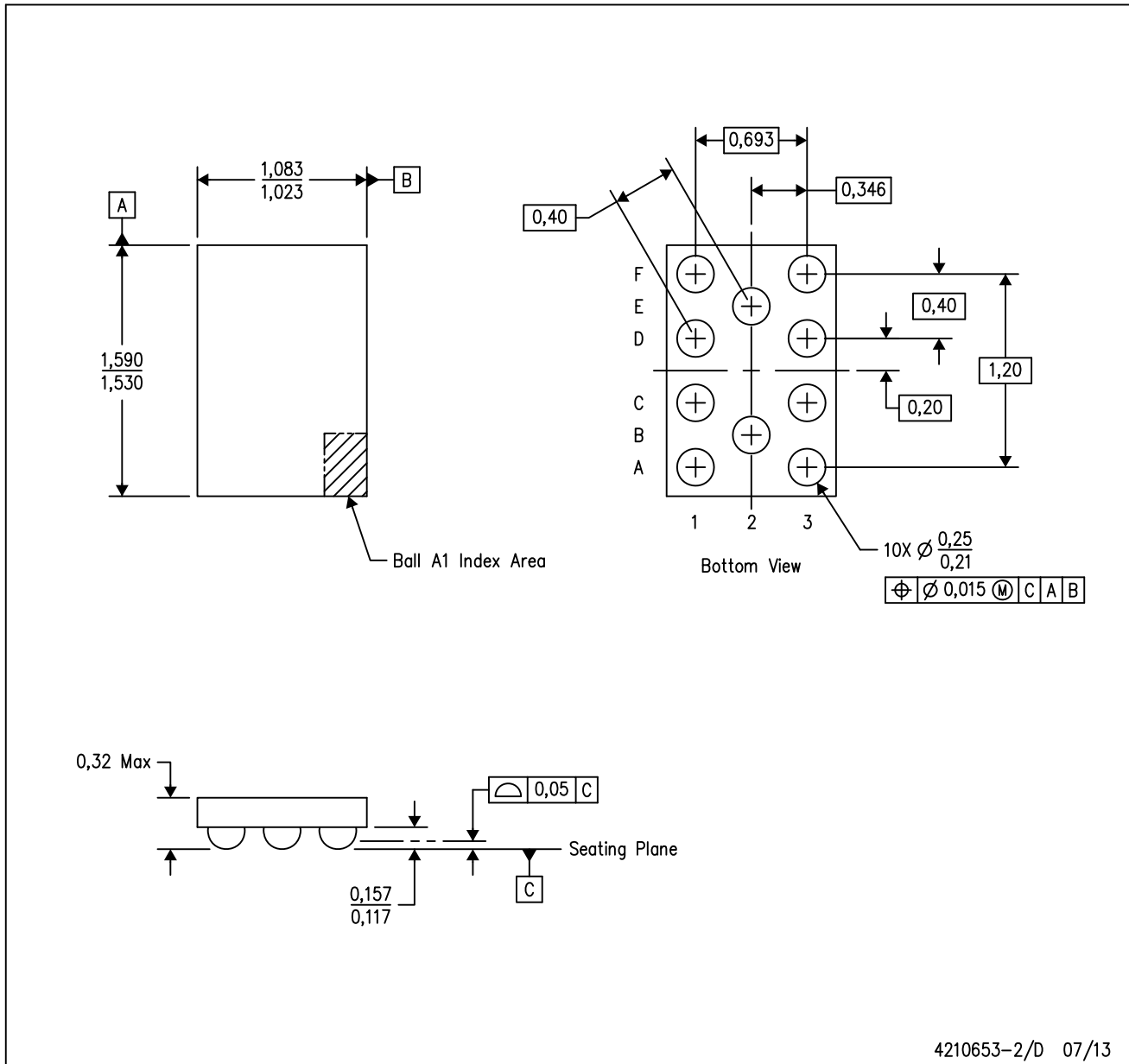


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.

NanoFree is a trademark of Texas Instruments.

YFU (R-XBGA-N10)

DIE-SIZE BALL GRID ARRAY



4210653-2/D 07/13

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
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