

TX7164 3-Level, 64-Channel Transmitter with On-Chip Beamformer, T/R Switch

1 Features

- Transmitter supports:
 - 64-channel 3-level pulser and active transmit/receive (T/R) switch
- 3-level pulser:
 - Maximum output voltage: $\pm 100\text{V}$
 - Minimum output voltage: $\pm 1\text{V}$
 - Maximum output current: 0.5A
 - Maximum clamp current: 0.75A
 - True return to zero to discharge output to ground
 - Second harmonic of -40dBc at 2.5MHz
 - -3dB Bandwidth with $400\Omega \parallel 125\text{pF}$ load
 - 11MHz for a $\pm 100\text{V}$ supply
 - Very low receive power: 0.1 mW/ch
- Active transmit/receive (T/R) switch with:
 - Turn on resistance of 21Ω
 - Turn on and Turn off time: 100ns
 - Transient glitch: 10mV_{PP}
- On-chip beam former with:
 - Channel based T/R switch on and off controls
 - Delay resolution: half beamformer clock period, minimum 2.5ns
 - Maximum delay: 2^{14} beamformer clock period
 - Maximum beamformer clockspeed: 200MHz
 - On-Chip RAM for pattern and delay profile
 - One 512×32 memory to store beam-former pattern and delay for a group of 4 channels
 - Global repeat feature present, enabling long duration patterns
- High-speed (400MHz maximum), 2-lane LVDS serial programming interface.
 - Low programming time: $\approx 1 \mu\text{s}$ for delay profile update
 - 32-bit Checksum to detect wrong SPI writes
- Supports CMOS serial programming interface (50MHz maximum)
- High reliability features:
 - Internal temperature sensor and automatic thermal shutdown
 - No specific power sequencing requirement
 - Error flag register to detect faulty conditions
 - Integrated passives for the floating supplies and bias voltages
 - Small package: FC-BGA-196 (12mm $\times$ 12mm) with 0.8mm pitch

2 Applications

- Ultrasound imaging system
- Piezoelectric driver
- In-probe ultrasound imaging

3 Description

TX7164 is a highly integrated, high-performance transmitter device for ultrasound imaging system. The device has total 64 pulser circuits, 64 transmit/receive switches (referred as T/R or TR switches) and supports on-chip beamformer (TxBF). The device also integrates on-chip floating power supplies that reduce the number of required high voltage power supplies.

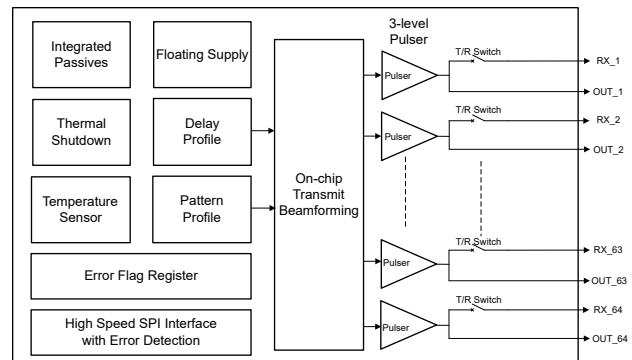
TX7164 has a pulser circuit that generates three-level high voltage pulses (up to $\pm 100\text{V}$) that is used to excite multiple channels of an ultrasound transducer. The device supports total 64 outputs. The maximum output current is 0.5A.

Device can be used as a transmitter design resource for many applications like ultrasound imaging, non-destructive testing, SONAR, LIDAR, marine navigation system, brain imaging systems and so on.

Package Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE (NOM) ⁽²⁾
TX7164	FC-BGA-196	12.0mm $\times$ 12.0mm

- (1) For all available packages, see the orderable addendum at the end of the data sheet.
- (2) The package size (length $\times$ width) is a nominal value and includes pins, where applicable



Simplified Block Diagram



4 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

4.1 Documentation Support

Abbreviation	Comment
PRT	Pulse Repetition Time. Represent TR_BF_SYNC period
PRF	Pulse Repetition Frequency. Represent TR_BF_SYNC frequency
Receive Mode	Duration in which T/R switch of all the channels are in ON state
High Voltage Supplies	AVDDP_HV and AVDDM_HV are collectively referred as high voltage supplies
Low Voltage Supplies	AVDDP_5, AVDDM_5, and AVDDP_1P8 supplies are collectively referred as low voltage supplies
SPI	Serial program interface

4.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

4.3 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

4.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

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4.5 Electrostatic Discharge Caution



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.

4.6 Glossary

TI Glossary

This glossary lists and explains terms, acronyms, and definitions.

5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
October 2026	*	Initial Release

6 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

6.1 Package Option Addendum

Packaging Information

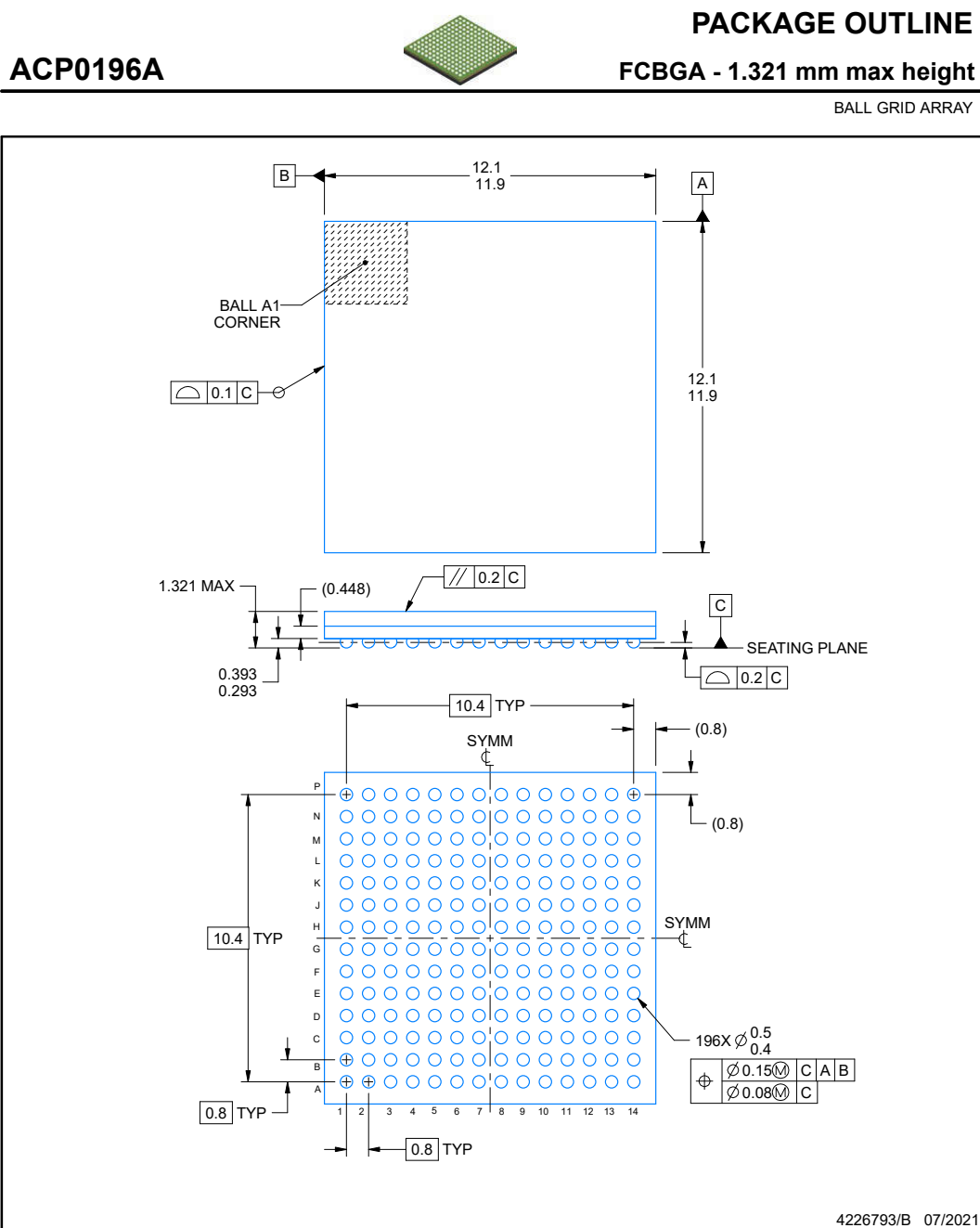
Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish ⁽⁶⁾	MSL Peak Temp ⁽³⁾	Op Temp (°C)	Device Marking ⁽⁴⁾⁽⁵⁾
TX7164ACP	ACTIVE	FCCSP	ACP	196	189	RoHS & Green	SNAGCU	Level-3-260C-1 68 HR	0°C to 70°C	TX7164

- (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.
PRE_PROD Unannounced device, not in production, not available for mass market, nor on the web, samples not available.
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 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) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device markings will be inside parentheses. Only one Device 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 Device Marking for that device.
- (6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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6.2 Mechanical Data

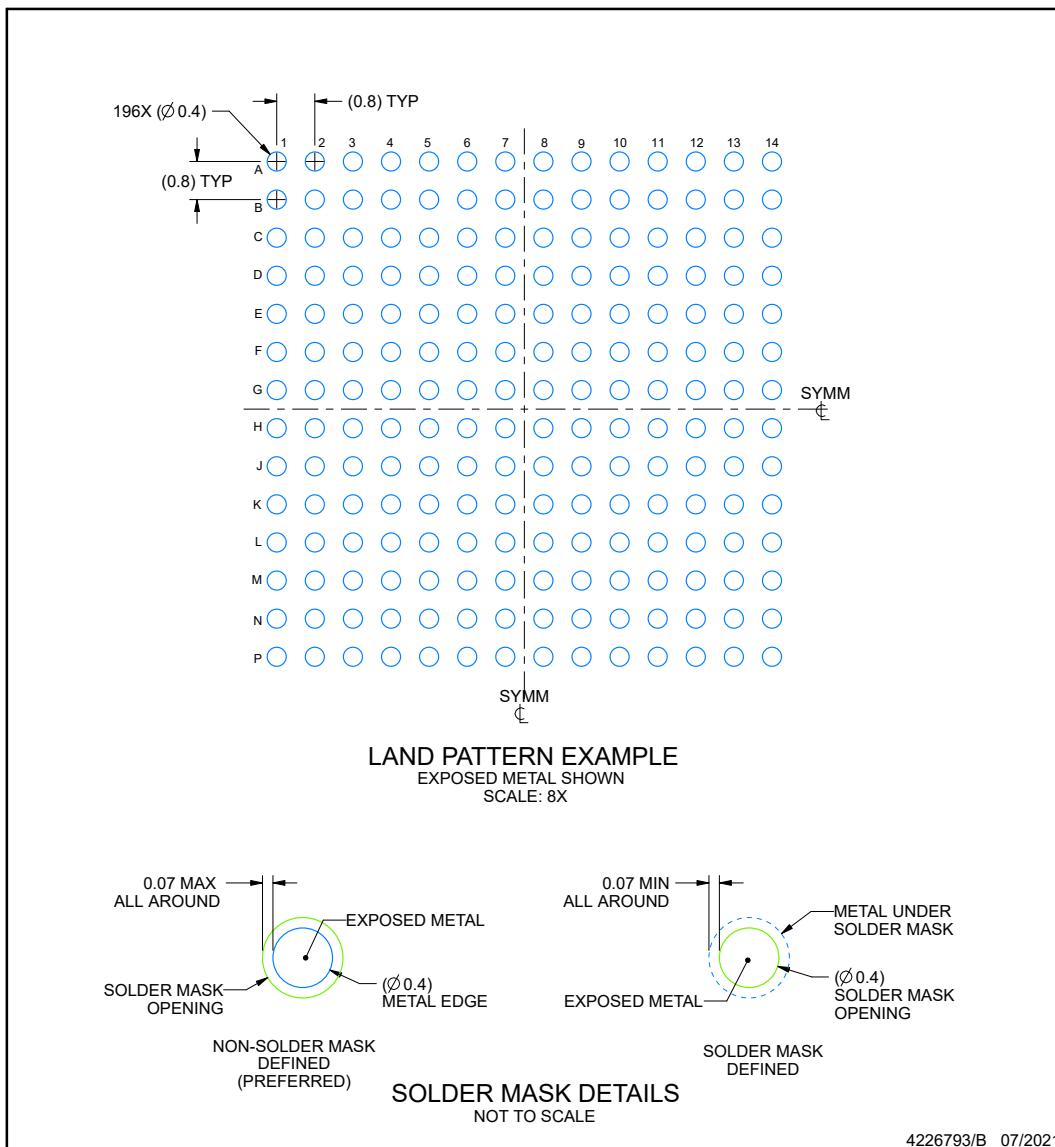


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT**ACP0196A****FCBGA - 1.321 mm max height**

BALL GRID ARRAY



NOTES: (continued)

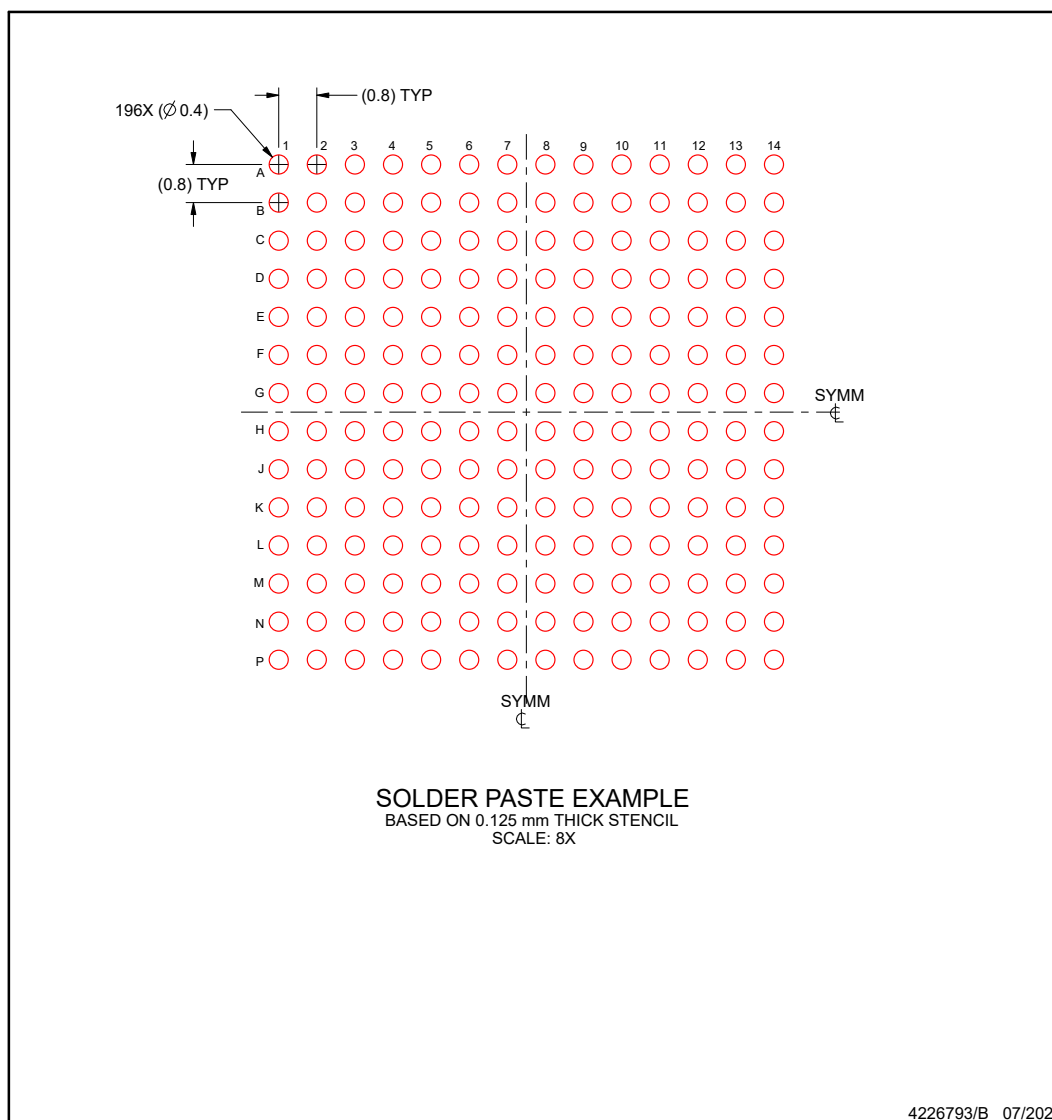
3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
For information, see Texas Instruments literature number SPRAA99 (www.ti.com/lit/spraa99).

EXAMPLE STENCIL DESIGN

ACP0196A

FCBGA - 1.321 mm max height

BALL GRID ARRAY



NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TX7164ACP	Active	Production	null (null)	160 JEDEC TRAY (5+1)	-	Call TI Snagcu	Level-3-260C-168 HR	0 to 70	TX7164

- (1) **Status:** For more details on status, see our [product life cycle](#).
- (2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- (4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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