CONTROLLER REMOTE ACCESS IDENTIFICATION DEVICE (CRAID) WITH INTEGRATED MICROCONTROLLER, 3D WAKEUP RECEIVER, AND IMMOBILIZER INTERFACE

Check for Samples: TMS37F128

FEATURES

- Wide Supply Voltage Range: 1.8 V to 3.6 V
- Ultralow Power Consumption
  - CPU Active Mode: 200 µA/MHz at 2.2 V
  - Standby Mode (LPM3): 0.7 µA
  - Off Mode (LPM4): 0.1 µA
  - Power-Down Mode: 60 nA
- Microcontroller System and Peripherals
  - 16-Bit RISC Architecture, 125-ns Instruction Cycle Time
  - Wake-Up From Standby Mode in <6 µs
  - Basic Clock Module Configurations
    - Single External Resistor
    - 32-kHz Crystal
    - High-Frequency Crystal
    - Resonator
    - External Clock Source
  - 16-Bit Timer_A With Three Capture/Compare Registers
  - 10-Bit 200-ksps Analog-to-Digital (A/D) Converter With Internal Reference, Sample-and-Hold, and Autoscan
  - 8KB + 256B Flash Memory
  - 256B RAM
  - 133-Byte EEPROM
  - Serial Onboard Programming, No External Programming Voltage Needed
  - Programmable Code Protection by Security Fuse
  - 80-Bit DST80 Security Authentication Coprocessor
  - 17 I/O Ports
- Low-Frequency (LF) Immobilizer Interface
  - Integrated Batteryless Immobilizer Interface
  - Half Duplex (HDX) Immobilizer Communication Achieves up to 4-in (10-cm) Read Range
  - Special Selective Addressing Mode Allows Reliable Learn-In Sequence
  - 80-Bit Authentication Key Length
  - Up to 8-kbit/s LF Uplink Data Rate
  - 5-/3-Byte Challenge/Response Algorithm
  - Fast Authentication Within 42 ms
  - Fast Mutual Authentication Within 65 ms
  - 133-Byte EEPROM
    - 91-Byte Free Available EEPROM User Memory
    - 32-Bit Unique Serial Number
    - High EEPROM Security and Flexibility
    - Write-Only Authentication Keys
    - Pages Are Irreversibly Lockable and Protectable
    - Protected Pages Programmable Only Through Mutual Authentication
  - Battery Check and Charge Functions
  - Each User Page is Lockable
  - Resonant Frequency: 134.2 kHz
  - Integrated Resonant Frequency Trimming
- Low-Frequency 3D Wakeup Receiver
  - Highest Communication Range of More Than Three Meters
    - High Input Sensitivity: 4.2 mV_{pp} (Typ)
    - High Q System
  - Integrated Resonant Circuit Trimming Compensates for Component Offsets
  - Received Signal Strength Indicator (RSSI) Output for Each Channel
  - Resonant Circuit Usable as Clock Reference for Microcontroller (134.2 kHz)
  - Frequency Range: 120 kHz to 140 kHz
  - Ultra-Low Standby Current: 3.9 µA (Typ) With All Three Channels Active for Wake Pattern Detection
  - Interface to up to Three External Antennas
  - Two Different Programmable Wake Patterns
  - Selectable Wake Pattern Length: 0, 4, 8 or 16 Bits
  - Two Separate Adjustable Wake-Up Levels
  - Digital Channel Sensitivity Adjustment for Each Antenna

DESCRIPTION

The Controller Remote Access Identification Device (CRAID) combines three functions in one device:

- Low-power 16-bit microcontroller based on the MSP430F1232 core
- 3D wakeup receiver
- DST80 immobilizer interface

With these three functions, it is ideally suited for state-of-the-art passive entry and passive start applications. The low-power microcontroller MSP430™ core offers a 16-bit RISC architecture, 8KB program memory, and 17 user-accessible I/O ports. The 3D low-frequency (LF) wakeup receiver offers high sensitivity to receive LF signals between 120 kHz and 140 kHz and has several other features such as RSSI measurement and bidirectional LF signaling.

The embedded DST80 immobilizer interface offers a high level of security through its hardware encryption coprocessor and can also handle mutual authentication schemes. The immobilizer interface operates without battery support. Power management features include battery charge and check as well as a battery backup function allowing operation of all functions (including the microcontroller) with low or even no battery as long as there is sufficient energy from the LF field.

The passive entry device manages the immobilizer communication, push-button interaction, and LF wake reception. The special high-Q design achieves communication ranges up to 3 m for the passive entry link with outstanding low standby current on the receiver side. The front end offers flexible configuration of two different wake patterns lengths of 0, 4, 8, or 16 bits. Each channel can be adjusted in sensitivity and resonance frequency, which results in reproducible system designs. By sensing the pressing of a push button, the device wakes up and controls an external UHF transmitter or transceiver. Security keys and rolling codes can be stored in the integrated EEPROM memory. This memory is accessible over the LF interface without support from the battery in the keyfob. The passive entry device offers a special battery backup mode to operate the microcontroller without battery support. The external resonant circuit with an LF coil and a resonant capacitor can be trimmed to the correct resonant frequency with the integrated trimming capability, eliminating part tolerances.

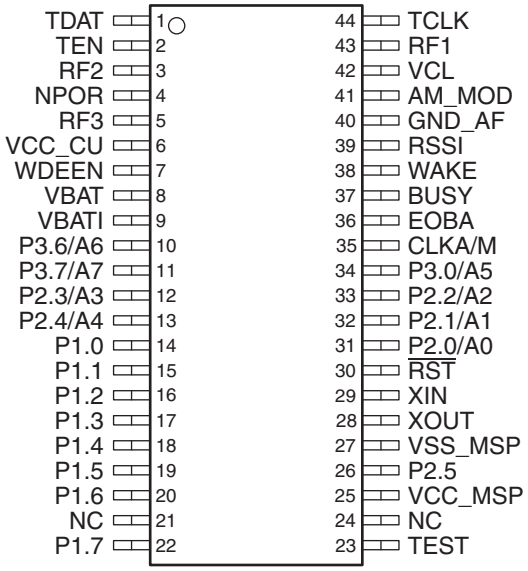
Ordering Information(1)

T_A	PACKAGE(2)	ORDERABLE PART NUMBER
–40°C to 85°C	TSSOP – DBT	TMS37F128D3IDBTRG4

(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.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

DBT PACKAGE
(TOP VIEW)



Functional Block Diagram

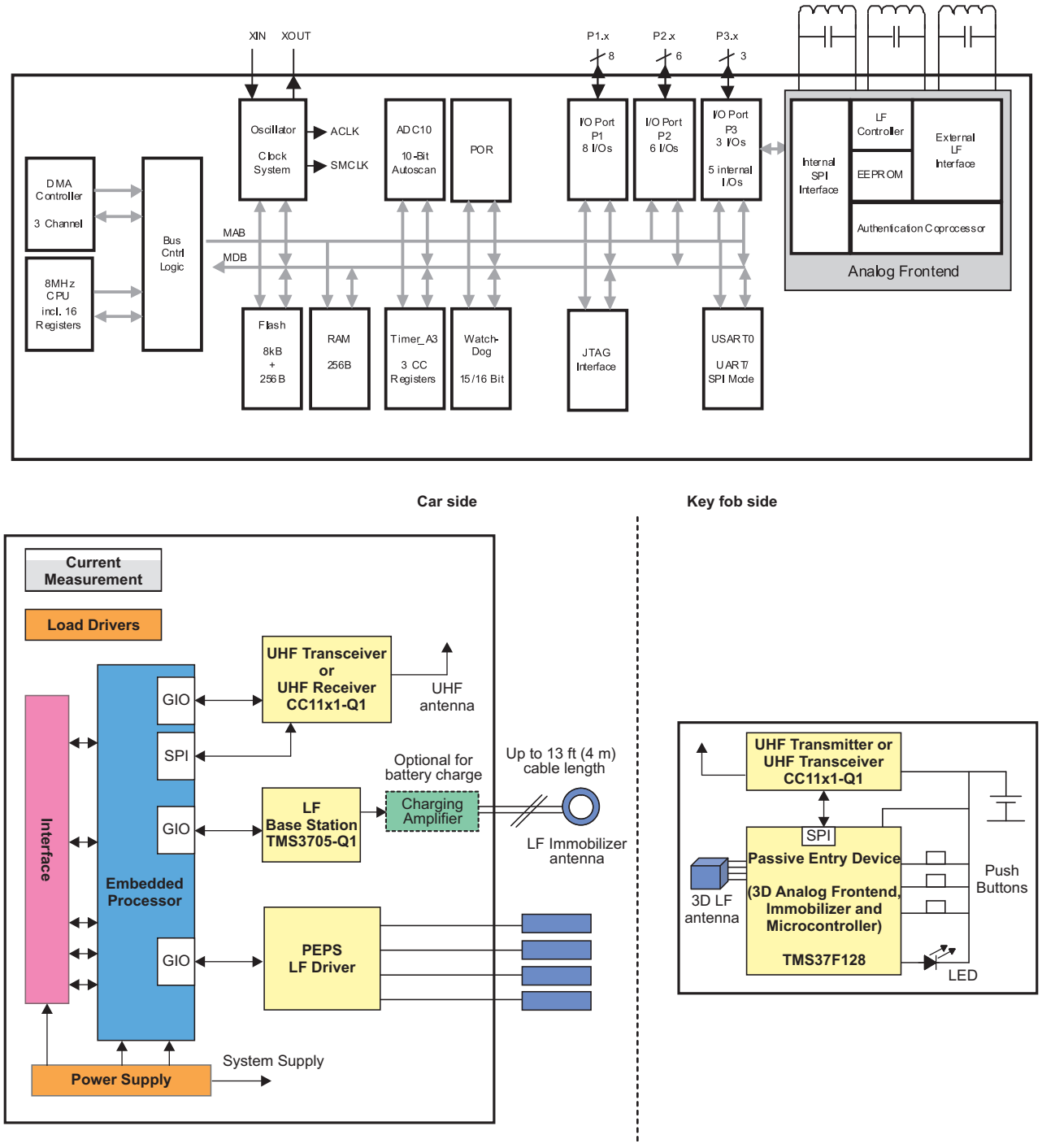


Figure 1. Application Diagram

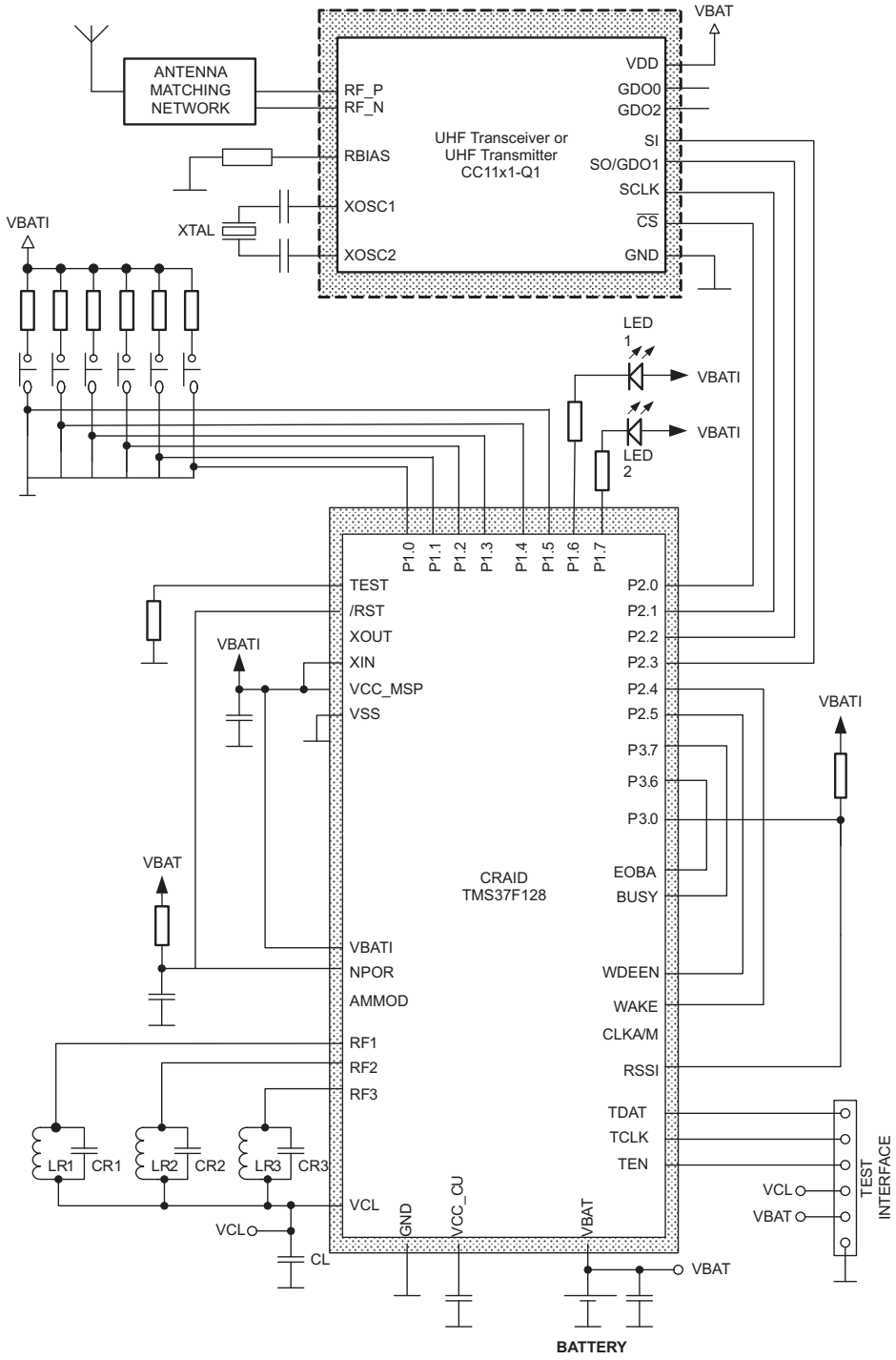


Figure 2. Application Schematic

Operating Characteristics

Part Number	**TMS37F128D3IDBTRG4**	
Features	Immobilizer plus microcontroller with integrated power management	
DST80 authentication logic	80-bit key length, 5-byte challenge, 3-byte signature	
DST80 authentication time	Mutual authentication: 65 ms Fast authentication: 42 ms	
Microcontroller	16-bit RISC ultra-low power based on MSP430F1232 core	
Supply voltage (VBAT)	1.8 V to 3.6 V	
Active current consumption	300 µA (typ) (V_{CC} = 2.2 V, f_{osc}= 1 MHz, microcontroller active)	
Standby current consumption	3.9 µA (typ) (three channels wake pattern active, microcontroller in LPM4, V_{CC} = 3 V, T_A = 25°C)	
Transponder		
Transmission Principle	HDX (half-duplex telegram protocol)	
Operating Frequency	134.2 kHz Integrated resonant frequency trimming capability via LF or Test interface	
Security	Challenge/response, mutual authentication	
Downlink	100% AM, PPM Bit coding with 2 kbit/s (typ)	
Uplink	FSK modulation with 7.9 kbit/s (typ)	
EEPROM memory	133 bytes	91-byte free available EEPROM user memory
		32-bit unique serial number
EEPROM endurance	200 000 cycles (T_A = 25°C) (min)	
Clock reference for microcontroller	Resonant circuit can be used as clock reference for the microcontroller	
Battery charge	Integrated battery charge functionality	
Key learn-in	Special selective addressing to provide secure learn-in procedure	
3D Wakeup Receiver		
Sensitivity	4.2 mV_{pp} (typ), 2.7 mV_{pp} (min), 5.1 mV_{pp} (max) (V_{CC} = 2.8 V, T_A = 25°C)	
Sensitivity tuning	Separate for each channel and each wake pattern	
Operating frequency	120 kHz to 140 kHz	
Resonant frequency trimming	Separate for each channel	
Wake pattern	Two independent wake patterns with selectable length: 0, 4, 8 or 16 bits	
Microcontroller		
Memory	8KB program memory, 256-byte RAM	
User data flash memory	256-byte information memory	
Flash program and erase endurance	100 000 cycles (typ) (T_A = 25°C)	
Flash data retention	10 years (min) (T_A = 25°C)	
Program, erase, read supply voltage	2.7 V (min)	
I/O ports	17	
Operating temperature	-40°C to 85°C	
Package	44-pin TSSOP (DBT)	

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
TMS37F128D3IDBTRG4	ACTIVE	TSSOP	DBT	30		Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	

(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.
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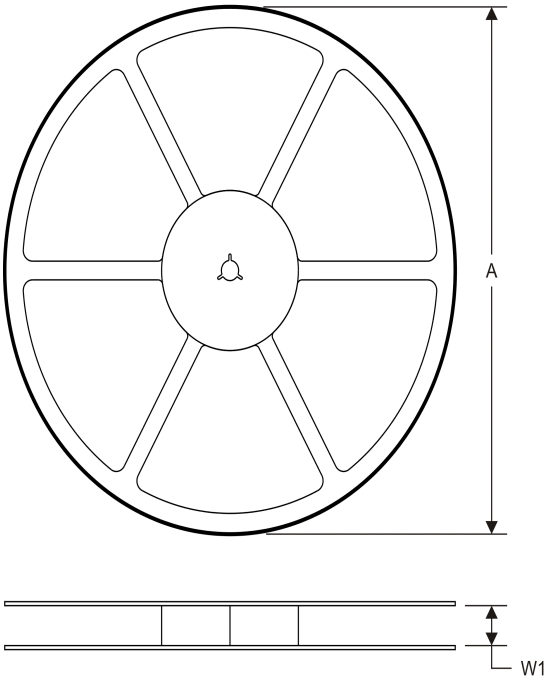
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & 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)

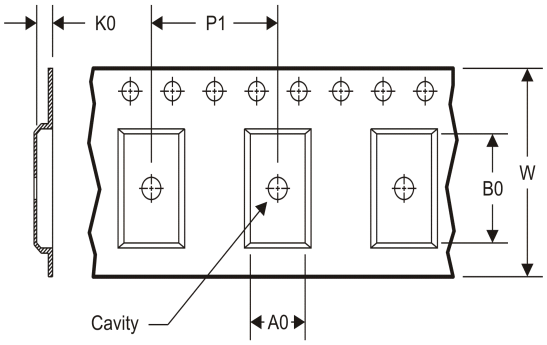
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



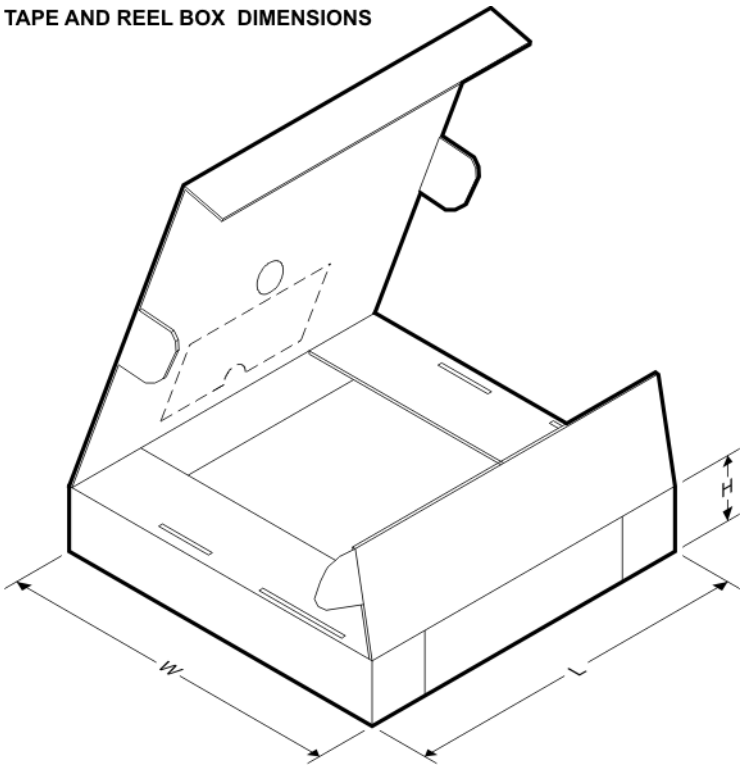
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
TMS37F128D3IDBTRG4	TSSOP	DBT	30	0	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1

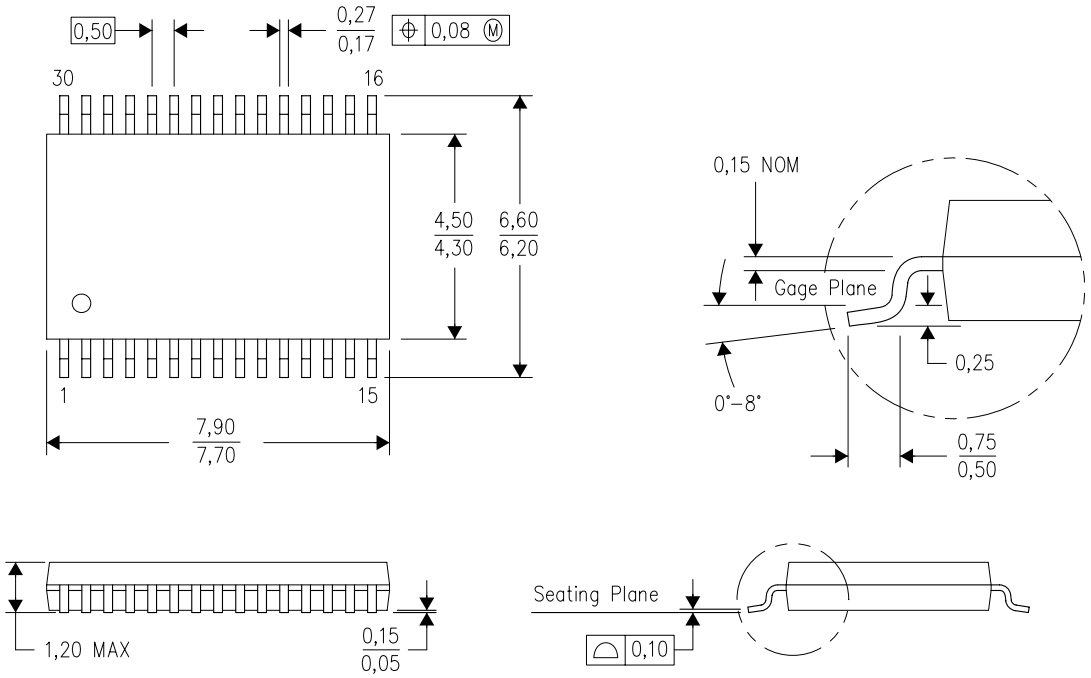
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TMS37F128D3IDBTRG4	TSSOP	DBT	30	0	367.0	367.0	45.0

DBT (R–PDSO–G30) PLASTIC SMALL OUTLINE



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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. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–153.

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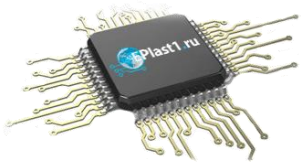

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