



Model TSX

Temperature Sensing Crystal

Features

- Crystal unit with built in Thermistor
- Ultra Compact and Low Profile
- Hermetic Ceramic Surface Mount Package
- Fundamental Crystal Design
- Frequency Range 16 – 285MHz*
- Operating Temperature Range to -40°C to +105°C
- Tape and Reel Packaging, EIA-481



Part Dimensions:
 1.6 × 1.2 × 1.00mm • 4.825mg
 2.0 × 1.6 × 0.65mm • 6.825mg
 2.5 × 2.0 × 0.65mm • 16.310mg

Applications

- Wireless Communications
- Low Power MCUs, SoCs, RF ICs
- M2M Communications
- 5G, Wi-Fi, ZigBee, Z-Wave
- Bluetooth, Bluetooth Low Energy
- LoRa, LPWAN, 6LowPan, WLAN
- LTE, NB-IoT, GPS, MCU, FPGA
- Low Drive Chipsets
- Wearable Devices

Description

CTS Model TSX integrates Thermistor into a Crystal Unit to eliminate space in circuit design. Frequency temperature compensation is improved compared to the conventional crystal unit as crystal element and a temperature sensing Thermistor are mounted in the same package.

Ordering Information

Model	Package Size	Tolerance @25°C	Temperature Stability	Temperature Range	Load Capacitance	Frequency ⁴
<u>TSX</u>	<u>25</u>	<u>2</u>	<u>3</u>	<u>C</u>	<u>A</u>	<u>xxxMxxxxx</u>

Code	Dimension	Code	Tolerance	Code	Stability	Code	Temp range	Code	Value	Code	Value
16	1.6x1.2 mm	1	±10ppm	1	±10ppm	C	-20 to +70°C ¹	T	6 pF	B	13 pF
20	2.0x1.6 mm	X	±15ppm	X	±15ppm	I	-40 to +85°C ²	V	7 pF	C	16 pF
25	2.5x2.0 mm	2	±20ppm	2	±20ppm	G	-40 to +105°C ³	K	8 pF	D	18 pF
				3	±30ppm			J	9 pF	E	20 pF
				5	±50ppm			A	10 pF	G	30 pF
								L	12 pF	S	Series

Notes:

- 1] Available with all stability codes.
- 2] Available with stability codes X, 2, 3, and 5 only.
- 3] Available with stability codes 3 and 5 only.
- 4] See Table 2, Page 5 for developed frequencies.
 [Format - 3 characters, M, 5 characters; Examples: 16.000MHz = 016M00000, 156.25MHz = 156M25000]
 *Check factory availability for frequencies not listed.

Part number example:
TSX2523CA019M20000

Not all performance combinations and frequencies may be available.
 Contact your local CTS representative or CTS Customer Service for availability



Electrical Specifications

Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Temperature			-20		+70	°C
			-40		+85	
			-40		+105	
Storage Temperature	T _{STG}	-	-55	-	+125	°C

Frequency Stability

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Frequency Range ¹	f ₀	-		16 - 285		MHz
Frequency Tolerance	Δf/f ₀	@ +25°C		10, 15, 20, or 30		±ppm
Frequency Stability	Δf/f ₂₅	Referenced to +25°C reading		10, 15, 20, 30 or 50		±ppm
Aging	Δf/f ₀	Typical per year @ +25°C	-2	-	2	ppm

Crystal Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Mode	-	-		Fundamental		-
Crystal Cut	-	-		AT-Cut Strip		-
Load Capacitance	C _L	-		See Ordering Information		pF
Shunt Capacitance	C ₀	-	-	-	3.0	pF
Series Resistance [TSX16, TSX20]						
Fundamental	R ₁	24MHz - <32MHz	-	-	200	Ω
		32MHz - <38MHz	-	-	100	
		38MHz - <80MHz	-	-	80	
		80MHz - <285MHz	-	-	60	
Series Resistance [TSX25]						
Fundamental	R ₁	16MHz - <27MHz	-	-	60	Ω
		27MHz - <285MHz	-	-	40	
Drive Level	D _L	-	-	10	200	μW
Insulation Resistance	R _i	+100Vdc ±15Vdc	500	-	-	MΩ
Thermistor B-Constant [25~50°C]					4,250	K

Note 1: Pls refer to Series Resistance Parameter section for frequency range of different package sizes.

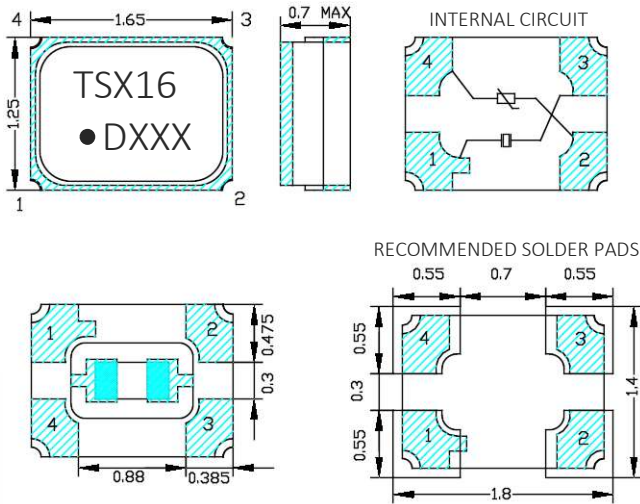
Δf/f₀ - Frequency deviation referenced to nominal frequency.

Δf/f₂₅ - Frequency deviation over operating temperature range, referenced to +25°C frequency.

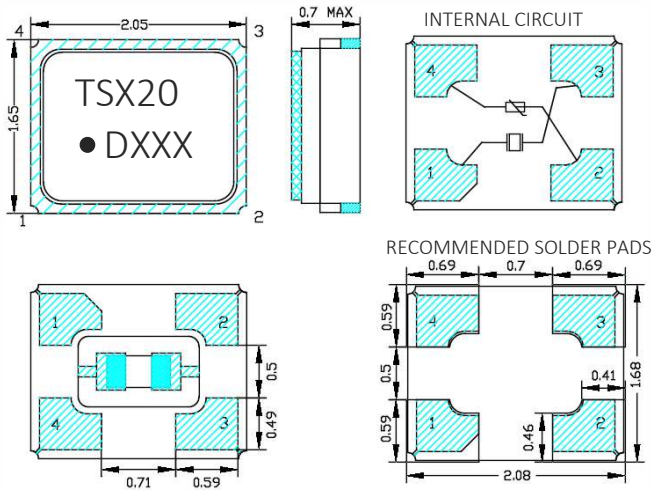
Mechanical Specifications

Package Drawing

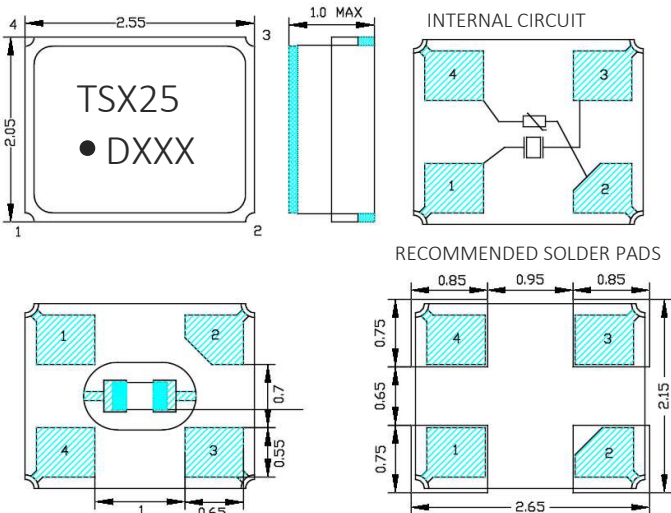
TSX16



TSX20



TSX25



Marking Information

TSX16

1. TSX16 – Model series.
 2. D – Date Code. See Table 1 for codes.
 3. ● - Pin 1 indicator.
 4. xxx – Frequency Code.
3-digits, frequencies below 100MHz
4-digits, frequencies 100MHz or greater
- [See document 016-1454-0, Frequency Code Tables.]

TSX20

1. TSX20 – Model series.
 2. D – Date Code. See Table 1 for codes.
 3. ● - Pin 1 indicator.
 4. xxx – Frequency Code.
3-digits, frequencies below 100MHz
4-digits, frequencies 100MHz or greater
- [See document 016-1454-0, Frequency Code Tables.]

TSX25

1. TSX25 – Model series.
 2. D – Date Code. See Table 1 for codes.
 3. ● - Pin 1 indicator.
 4. xxx – Frequency Code.
3-digits, frequencies below 100MHz
4-digits, frequencies 100MHz or greater
- [See document 016-1454-0, Frequency Code Tables.]

Notes

1. JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
2. Reflow conditions per JEDEC J-STD-020; +260°C maximum, 20 seconds.
3. MSL = 1.

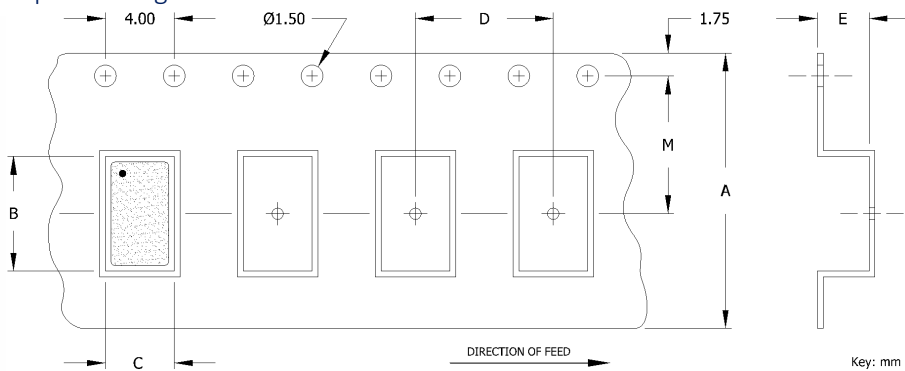
Mechanical Specifications

Table 1 - Date Code, Beginning year 2021

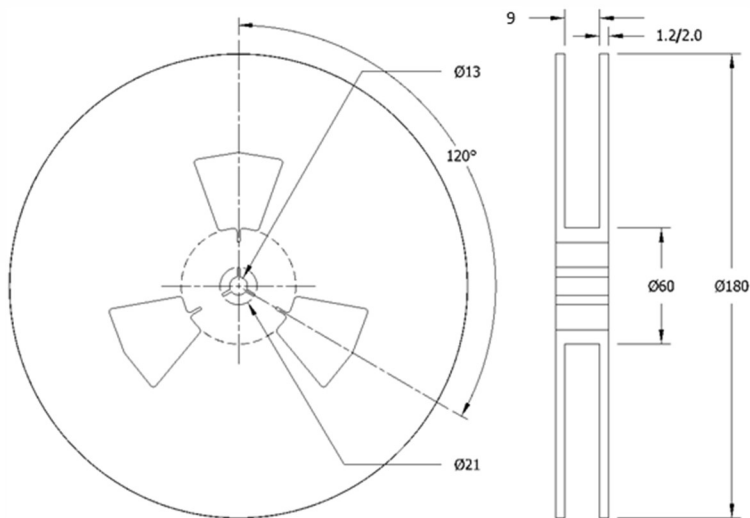
MONTH					JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR																
2021	2025	2029	2033	2037	A	B	C	D	E	F	G	H	J	K	L	M
2022	2026	2030	2034	2038	N	P	Q	R	S	T	U	V	W	X	Y	Z
2023	2027	2031	2035	2039	a	b	c	d	e	f	g	h	j	k	l	m
2024	2028	2032	2036	2040	n	p	q	r	s	t	u	v	w	x	y	z

Packaging - Tape and Reel

Tape Drawing



Reel Drawing



Notes:

1. Complete CTS part number, frequency value and date code information must appear on reel and carton labels.

Tape Dimensions [mm]

PACKAGE	A	B	C	D	E	M	QUANTITY
TSX16	8.00	1.85	1.45	4.00	0.90	3.50	3000
TSX20	8.00	2.40	2.00	4.00	0.90	3.50	3000
TSX25	8.00	2.70	2.25	4.00	1.15	3.50	3000



Addendum Product Frequency Codes

Table 2 - Common Frequencies and Frequency Codes – MHz

TSX16 Available Frequencies [MHz]

FREQUENCY	FREQUENCY MARKING CODE	FREQUENCY	FREQUENCY MARKING CODE
38.400000	384		
52.000000	520		
76.800000	768		

TSX20 Available Frequencies [MHz]

FREQUENCY	FREQUENCY MARKING CODE	FREQUENCY	FREQUENCY MARKING CODE
38.400000	384		
52.000000	520		

TSX25 Available Frequencies [MHz]

FREQUENCY	FREQUENCY MARKING CODE	FREQUENCY	FREQUENCY MARKING CODE
19.200000	192		
26.000000	260		

Common Frequencies and Applications

Frequency	Reference ICs	Common Domains
19.2 MHz	Qualcomm, u-blox, Quectel, Broadcom, Espressif, Nordic	Cellular, GNSS, Wi-Fi/BT, IoT
26.0 MHz	Qualcomm, MediaTek, HiSilicon, Broadcom, STM32, Realtek	LTE/5G basebands, GNSS, Wi-Fi, MCU
38.4 MHz	Quectel BG96, u-blox GNSS, ESP32, Qualcomm Wi-Fi	Cellular, GNSS, IoT
52.0 MHz	Qualcomm MSM, MediaTek, Broadcom Wi-Fi, STM32H7	LTE, Wi-Fi, MCU, Ethernet
76.8 MHz	TI AWR/IWR radar, ADI ADRV9008/9009, FPGAs	Radar, RF, high-speed data

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