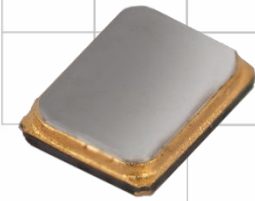


# Model 416W

## IoT Enhanced Quartz Crystal



Part Dimensions:  
1.6 × 1.2 × 0.35mm • 2.51054mg

### Features

- Optimized Design for Low Plating Capacitance and ESR
- Improves Start-Up and Power Savings for Low Energy Applications
- Hermetic Ceramic Surface Mount Package
- Fundamental Crystal Design
- Frequency Range 24 – 52MHz
- Operating Temperature Range to -40°C to +125°C
- Tape and Reel Packaging, EIA-418

Standard Frequencies – see Page 5 for developed frequencies.  
\* Check with factory for availability of frequencies not listed.

### Applications

- Wireless Communications
- Low Power MCUs, SoCs, RF ICs
- M2M Communications
- WiFi, ZigBee, ZigBee RF4CE, Z-Wave
- Bluetooth, Bluetooth Low Energy
- LoRa, LPWAN, 6LowPan, WLAN
- Near Field Communication
- Low Drive Chipsets
- ISM Band Applications

### Description

CTS Model 416W incorporates a high Q quartz resonator and has optimized design parameters for Low ESR and Load Capacitance [C<sub>L</sub>]. M416W is ideal for supporting commercial and industrial IoT applications using low power MCUs, portable RF communication ICs and low drive chipsets.

### Ordering Information

Model	Mode of Oscillation	Frequency Code [MHz]	Tolerance @ +25°C	Temperature Stability	Temperature Range	Load Capacitance	Packaging																																										
416W	F	XXX	3	5	C	D	R																																										
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Notes:

- 1] Refer to document 016-1454-0, Frequency Code Tables. 3-digits for frequencies <100MHz.
- 2] Available with all stability codes.
- 3] Available with stability codes X, 2, Y, 3, 5 and 6.
- 4] Available with stability codes 3, 5 and 6.
- 5] Available with stability codes 5 and 6. Contact factory for availability.

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

This product is specified for use only in standard commercial applications. Supplier disclaims all express and implied warranties and liability in connection with any use of this product in any non-commercial applications or in any application that may expose the product to conditions that are outside of the tolerances provided in its specification.



## Electrical Specifications

### Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Temperature	$T_A$	-	-20		+70	
			-30		+85	
			-40	+25	+85	°C
			-40		+105	
			-40		+125	
Storage Temperature	$T_{STG}$	-	-55	-	+125	°C

### Frequency Stability

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Frequency Range	$f_0$	-		24 - 52		MHz
Frequency Tolerance	$\Delta f/f_0$	@ +25°C		10, 15, 20, 25 or 30		±ppm
Frequency Stability	$\Delta f/f_{25}$	Referenced to +25°C reading		10, 15, 20, 25, 30, 50 or 100		±ppm
Aging	$\Delta f/f_0$	Typical per year @ +25°C	-3	±2	3	ppm

### Crystal Parameters

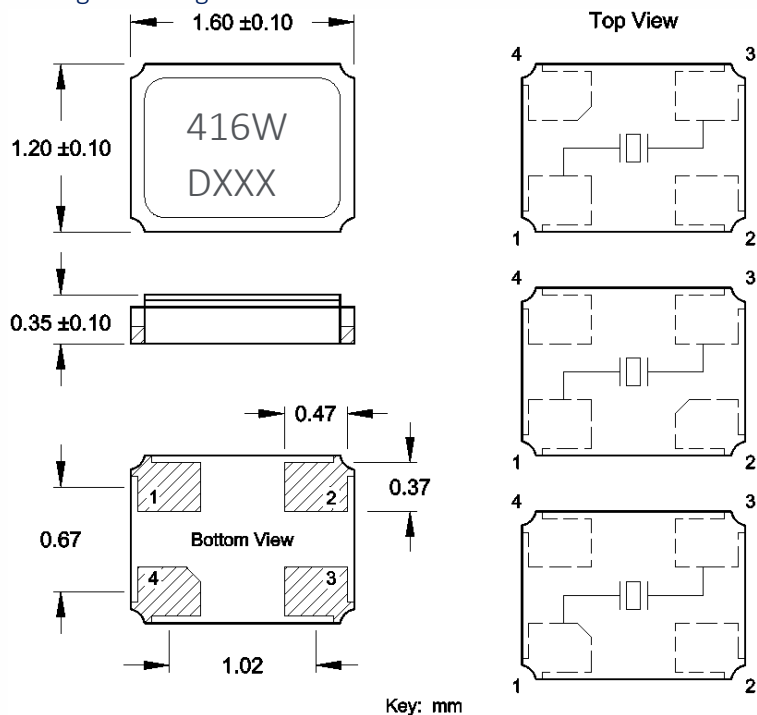
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Mode	-	-		Fundamental		-
Crystal Cut	-	-		AT-Cut Strip		-
Load Capacitance	$C_L$	-		See Ordering Information		pF
Shunt Capacitance	$C_0$	-	-	1.0	<3.0	pF
Series Resistance						
Fundamental	$R_1$	24MHz - <32MHz	-	90	150	Ω
		32MHz - <37MHz	-	80	100	
		37MHz - 52MHz	-	60	80	
Drive Level	DL	-	-	10	100	μW
Insulation Resistance	$R_i$	+100Vdc ±15Vdc	500	-	-	MΩ

$\Delta f/f_0$  - Frequency deviation referenced to nominal frequency.

$\Delta f/f_{25}$  - Frequency deviation over operating temperature range, referenced to +25°C frequency.

## Mechanical Specifications

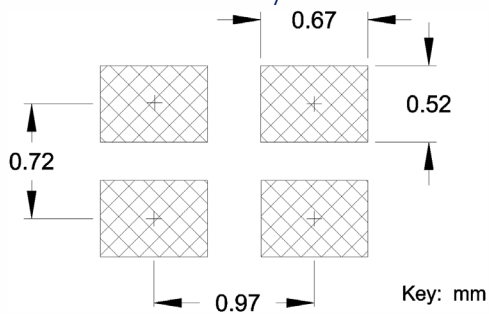
### Package Drawing



### Marking Information

1. M416 – CTS Model series.
2. D – Date code. See Table I for codes.
3. XXX – Frequency code, 3-digits for frequencies below 100MHz.  
[See document 016-1454-0, Frequency Code Tables].

### Recommended Pad Layout



### Notes

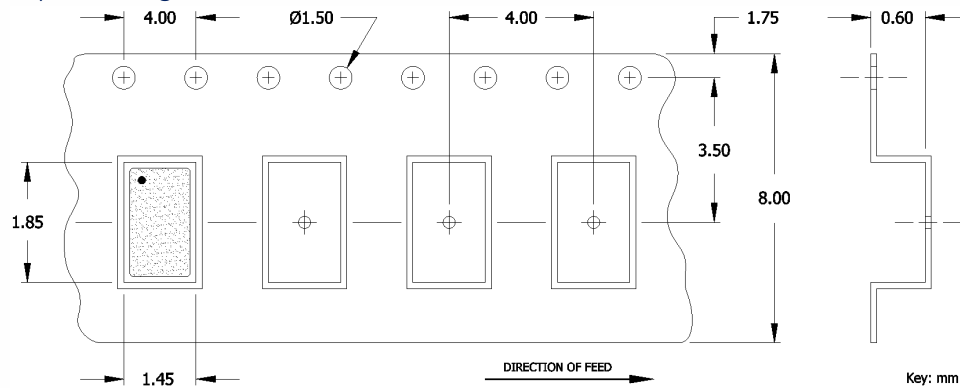
1. JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
2. Terminations #2, #4 and the metal lid are connected internally. End user may connect these pins to circuit ground for EMI suppression.
3. Due to package variability, the pad chamfer on the bottom could be located on Pin 1, 2 or 4 in a given lot. Layout orientation should be based on the top view [marking side], as indicated in package drawing. The chamfer location does not affect the electrical performance of the device.
4. Reflow conditions per JEDEC J-STD-020; +260°C maximum, 20 seconds.
5. MSL = 1.

Table I - Date Code

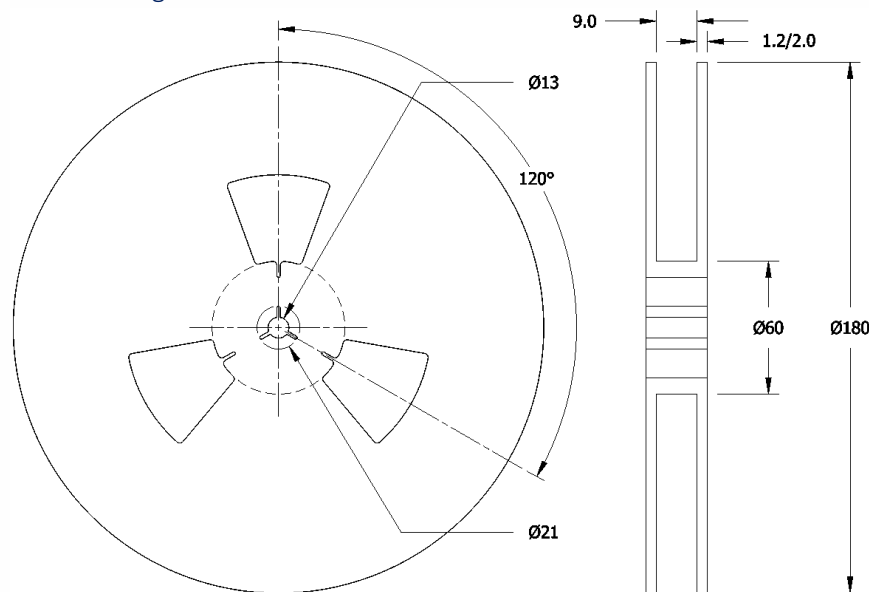
YEAR		MONTH					JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		2001	2005	2009	2013	2017												
2001	2005	2009	2013	2017		A	B	C	D	E	F	G	H	J	K	L	M	
2002	2006	2010	2014	2018		N	P	Q	R	S	T	U	V	W	X	Y	Z	
2003	2007	2011	2015	2019		a	b	c	d	e	f	g	h	j	k	l	m	
2004	2008	2012	2016	2020		n	p	q	r	s	t	u	v	w	x	y	z	

### Packaging - Tape and Reel

#### Tape Drawing



#### Reel Drawing



#### Notes

1. Device quantity is 1k pieces minimum and 3k pieces maximum per 180mm reel.
2. Complete CTS part number, frequency value, date code and manufacturing site code information must appear on reel and carton labels.



## Addendum

### Common Frequencies and Frequency Codes – MHz

Common Wireless Frequencies		Additional Frequencies					
FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE
24.000000	240	24.305000	243	33.333300	33A		
25.000000	250	24.545400	24F	33.868800	338		
26.000000	260	24.545454	24G	35.328000	353		
27.120000	271	24.553500	24B	36.000000	360		
30.000000	300	24.576000	24C	38.000000	380		
32.000000	320	25.000625	25A	38.880000	388		
37.400000	374	26.041660	26F	39.062500	39A		
38.400000	384	27.000000	270	41.600000	41C		
40.000000	400	28.224000	282	44.000000	440		
48.000000	480	28.322000	28C	45.000000	450		
52.000000	520	28.375000	283	49.152000	491		
		28.636360	286	50.000000	500		
		29.491200	29B	54.000000	540		
		30.400000	304				
		30.720000	307				
		31.250000	312				
		32.768000	327				
		33.000000	330				
		33.330000	333				
		33.333000	33E				