

MX•COM, INC. MiXed Signal ICs

DATA BULLETIN

MX315A

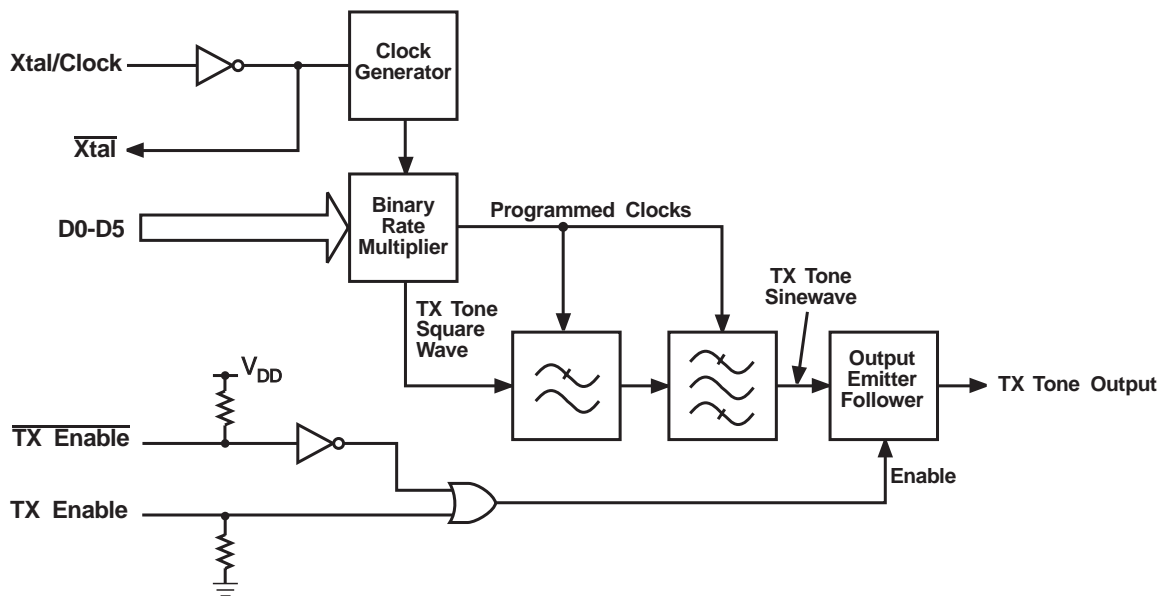
CTCSS Encoder

Features

- Field Programmable Tone Encoder
- 40 CTCSS Frequencies
- Crystal-Controlled Frequency Stability
- Low Distortion Sinewave Output
- Few External Components Required
- CMOS Low Power Requirements

Applications

- Mobile Radio Base Stations & Repeater Stations
- Mobile Radios
- Hand-Held Radios
- Industrial Controls
- Intercom Systems
- Door-Entry Systems



The MX315A is a monolithic CMOS tone encoder for sub-audible tone squelch systems, which provides three additional frequencies over the earlier MX315A. These frequencies are 69.3, 97.4 and 206.5Hz. The tone frequencies are derived from an input reference frequency. An on-chip inverter is provided to drive an external crystal circuit.

Tone selection is achieved through six programming inputs and two control inputs (which allow either a logic "1" or "0" to enable the device). A low distortion sinewave is generated at the TX Tone Output when the MX315A is enabled. The emitter follower output stage can source 1mW directly into a 600Ω load (0dBm).

The MX315A is available in the following package styles: 16-pin SOIC (MX315ADW), 14-pin PDIP (MX315AP) and 14-pin CDIP (MX315AJ).

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1. Block Diagram

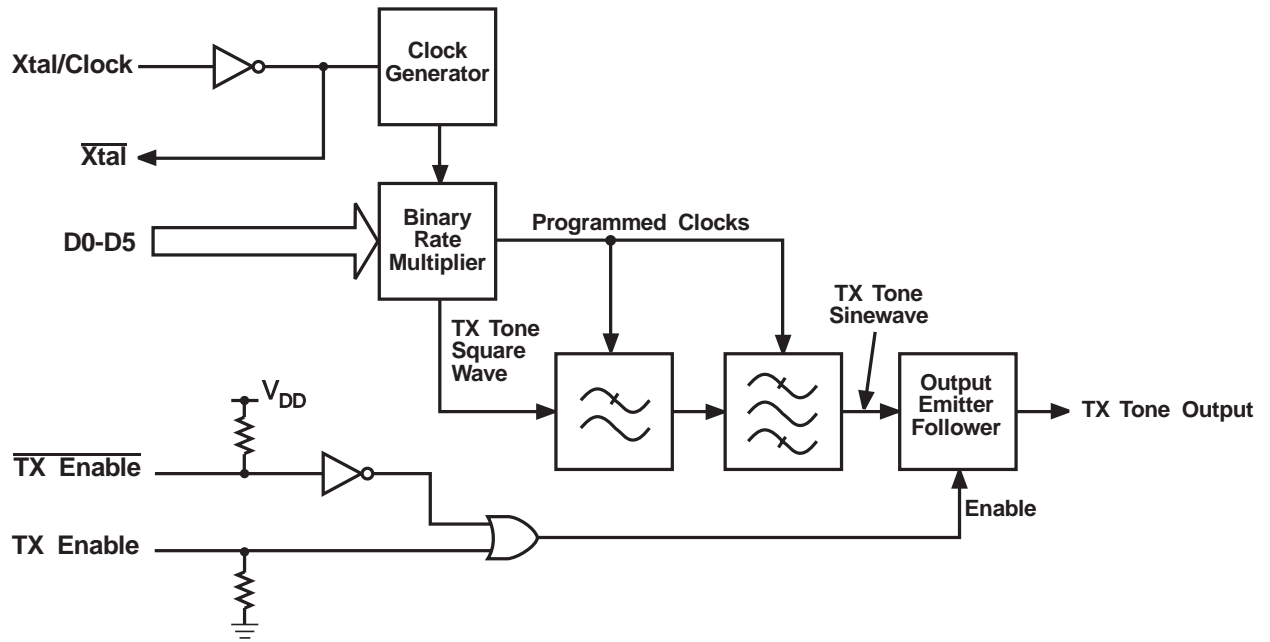


Figure 1: Device Block Diagram

2. Signal List

Pins		Signal		Description
J,P	DW	Name	Type	
1	1	D3	input	D0-D5 are tone select inputs with internal pull-up resistors. The logic combination at these inputs determines the encoded CTCSS tone. See Table 1. The input sequence is not latched and may be changed at any time. A logic "1" will be programmed if the input is open circuit, allowing the use of SPST switches.
2	2	D2	input	
3	3	D1	input	
4	4	D0	input	
5	5	D4	input	
6	6	D5	input	
7	7	V _{SS}	power	Negative Supply Voltage.
8	8	Xtal/Clock In	input	This is the input to the CMOS inverter. It can be used in conjunction with the Xtal output to form the active element in a crystal oscillator circuit. Alternatively, a logic level 1MHz frequency can be injected at this pin. However, the supply voltage should never be applied without the input clock signal.
9	9	$\overline{\text{Xtal}}$ Output	output	This is the output of the CMOS inverter. When used as a crystal oscillator, track lengths and loading of this pin should be minimized.
10	10	Internal Connection		Do not use
	11	N/C		No Connection
	12	N/C		No Connection
11	13	TX Tone Output	output	This is the tone output pin. It includes a low impedance emitter follower stage for sourcing sinusoidal tone. The tone is generated about a DC level of approximately V _{DD} /2. The pin is high impedance when not encoding.
12	14	$\overline{\text{TX Enable}}$ Input	input	This logic input has an internal pull-up resistor. A logic "0" at this pin enables the MX315A.
13	15	TX Enable Input	input	This logic input has an internal pull-down resistor. A logic "1" at this pin enables the MX315A.
14	16	V _{DD}	power	Positive Supply Voltage.

Table 1: Signal List

3. External Components

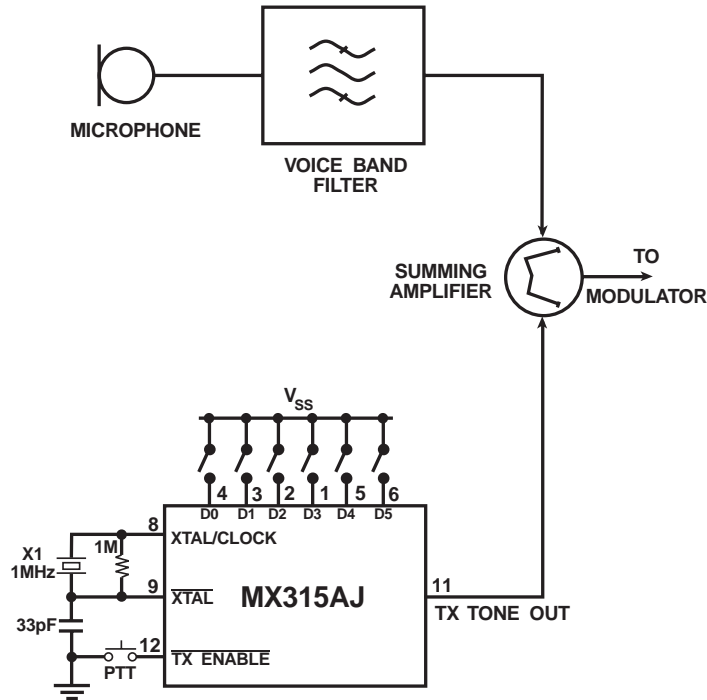


Figure 2: External Components

R1	Note 1	1M	±20%
C1		33pF	±20%
X1	Note 2, 3	1MHz	±0.19%

Table 2: Recommended External Components

Notes:

1. The 1M Ω resistor is used to bias the internal CMOS inverter into its linear mode. A tolerance of $\pm 20\%$ is acceptable.
2. "X1" is a parallel resonant crystal. A reference frequency of 1MHz $\pm 0.19\%$ is required to maintain a tone accuracy within 0.5%.
3. For best results, a crystal oscillator design should drive the clock inverter input with signal levels of at least 40% of V_{DD} , peak to peak. Tuning fork crystals generally cannot meet this requirement. To obtain crystal oscillator design assistance, consult your crystal manufacturer.

4. Application

The MX315A is dedicated to Continuous Tone-controlled Squelch Systems (CTCSS) in radio applications. However, it can be used wherever encoding of low-frequency tones is required, such as intercoms, door-entry systems and various industrial applications.

The performance of a CTCSS system can be degraded if speech frequencies in the signaling spectrum are not removed prior to transmission. This can be accomplished by filtering the microphone signals to attenuate frequencies below 250 Hz. Figure 2 illustrates the addition of TX Tone Output to the filtered microphone signals prior to modulation. Figure 3 illustrates the TX Tone Output sequence and a typical spectral analysis.

Where two or more circuits are required to use a single oscillator (i.e. repeater applications), the signal at $\overline{\text{Xtal}}$ can be used to drive one additional Xtal/Clock input. Any further circuits can be driven from the buffered $\overline{\text{Xtal}}$ output of the second device.

The program code can be set on the D0-D5 inputs by hardwired logic levels or SPST switches to V_{SS} , as illustrated in Figure 2 (allowing the internal pull-up resistors to program a logic "1").

The MX315A provides both a $\overline{\text{TX Enable}}$ input and a TX Enable input. Either input can be used to enable the tone output, with the unused pin left open circuit (internal resistors establish a valid logic level and prevent damage). Any configuration of PTT switch or TX signal can therefore be interfaced.

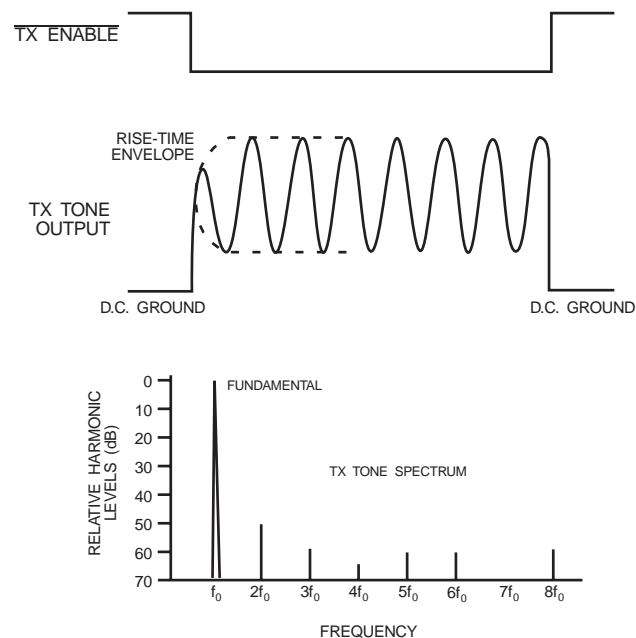


Figure 3: Tone Encoding Sequence and Spectral Response

4.1 Interfacing and Electromagnetic Capability

The MX315A requires a clock of 1MHz, which is internally converted to logic level square waves. Consideration should therefore be given to possible interference problems with RF or IF circuitry caused by 1MHz or its harmonics.

A decoupling capacitor can be used to reduce ripple on the power supply. This will reduce the level of superimposed noise on the supply caused by internal switching transients (particularly at 1MHz and f_0).

4.2 CTCSS Programming

Tone			Programming Inputs						
Nominal Frequency (Hz)	MX315A Freq. (Hz)	Δf_o (%)	D5	D4	D3	D2	D1	D0	Hex
67.0	67.06	+ .10	1	1	1	1	1	1	3F
69.3	69.37	+ .10	1	1	1	0	0	1	39
71.9	71.84	- .08	0	1	1	1	1	1	1F
74.4	74.33	- .10	1	1	1	1	1	0	3E
77.0	76.99	- .02	0	0	1	1	1	1	0F
79.7	79.65	- .06	1	1	1	1	0	1	3D
82.5	82.50	0.0	0	1	1	1	1	0	1E
85.4	85.34	- 0.7	1	1	1	1	0	0	3C
88.5	88.62	+ .14	0	0	1	1	1	0	0E
91.5	91.38	- .13	1	1	1	0	1	1	3B
94.8	94.88	+ .08	0	1	1	1	0	1	1D
97.4	97.46	+ .06	1	1	1	0	1	0	3A
100.0	99.87	- .13	0	0	1	1	0	1	0D
103.5	103.39	- .11	0	1	1	1	0	0	1C
107.2	107.17	- .03	0	0	1	1	0	0	0C
110.9	110.85	- .04	0	1	1	0	1	1	1B
114.8	114.80	0.0	0	0	1	0	1	1	0B
118.8	118.60	- .17	0	1	1	0	1	0	1A
123.0	123.12	+ .10	0	0	1	0	1	0	0A
127.3	127.50	+ .16	0	1	1	0	0	1	19
131.8	131.67	- .10	0	0	1	0	0	1	09
136.5	136.69	+ .14	0	1	1	0	0	0	18
141.3	141.48	+ .13	0	0	1	0	0	0	08
146.2	145.96	- .16	0	1	0	1	1	1	17
151.4	151.45	+ .03	0	0	0	1	1	1	07
156.7	156.59	- .07	0	1	0	1	1	0	16
162.2	162.10	- .06	0	0	0	1	1	0	06
167.9	168.01	+ .07	0	1	0	1	0	1	15
173.8	173.43	- .21	0	0	0	1	0	1	05
179.9	180.21	+ .17	0	1	0	1	0	0	14
186.2	186.46	+ .14	0	0	0	1	0	0	04
192.8	193.16	+ .19	0	1	0	0	1	1	13
203.5	202.88	- .31	0	0	0	0	1	1	03
206.5	206.78	+ .14	1	1	1	0	0	0	38
210.7	210.84	+ .07	0	1	0	0	1	0	12
218.1	217.96	- .07	0	0	0	0	1	0	02
225.7	225.58	- .05	0	1	0	0	0	1	11
233.6	233.75	+ .07	0	0	0	0	0	1	01
241.8	242.54	+ .31	0	1	0	0	0	0	10
250.3	250.06	+ .10	0	0	0	0	0	0	00
Test	4032	0.0	1	1	0	0	1	1	*33

* - or any invalid address

Table 3: CTCSS Tones

5. Performance Specification

5.1 Electrical Performance

5.1.1 Absolute Maximum Ratings

Exceeding these maximum ratings can result in damage to the device.

General	Min.	Max.	Units
Supply Voltage	-0.3	7.0	V
J / P /DW Packages			
Total Allowable Device Dissipation at T _{AMB} = 25°C		800	mW
Derating above 25°C		10	mW/°C above 25°C
Operating Temperature	-30	+85	°C
Storage Temperature	-55	+125	°C

5.1.2 Operating Limits

Correct operation of the device outside these limits is not implied.

	Notes	Min.	Typ.	Max.	Units
V _{DD}		4.5	5.0	5.5	V
Operating Temperature		-30		85	°C
Clock	Note 1		1		MHz

Operating Limits Note:

1. "X1" is a parallel resonant crystal. A reference frequency of 1 MHz ±0.19% is required to maintain a tone accuracy within 0.5%.

5.1.3 Operating Characteristics

For the following conditions unless otherwise specified:

V_{DD} = 5.0V , T_{AMB} = 25°C, Xtal Frequency = 1MHz

	Notes	Min.	Typ.	Max	Units
Supply Current (operating)			1.5	4.5	mA
Input Impedance	1		500		kΩ
Input Impedance	2		10		MΩ
Logic Input "1"		3.5			V
Logic Input "0"				1.5	V
TX Output EMF	3	550	775		mV _{RMS}
TX Risetime			1		ms
TX Tone Output Load Current				5	mA
TX Distortion	3		2	5	%
Variation in Output Level Between Tones	3		0.1		dB

Operating Characteristics Notes:

1. Refers to D0, D1, D2, D3, D4, D5, TX Enable and $\overline{\text{TX Enable}}$ inputs
2. Refers to Xtal/Clock input
3. Any program tone and R_L = 600Ω, C_L = 15pF. THD measurements are taken in the 0-6 kHz bandwidth.

5.2 Packaging

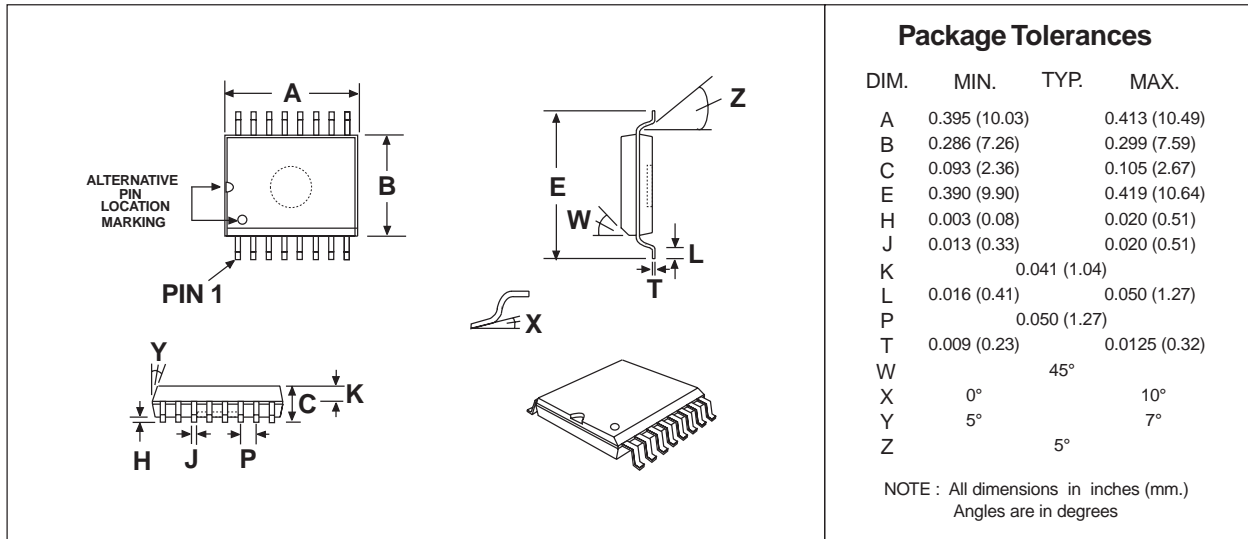


Figure 4: 16-pin SOIC Mechanical Outline: Order as part no. MX315ADW

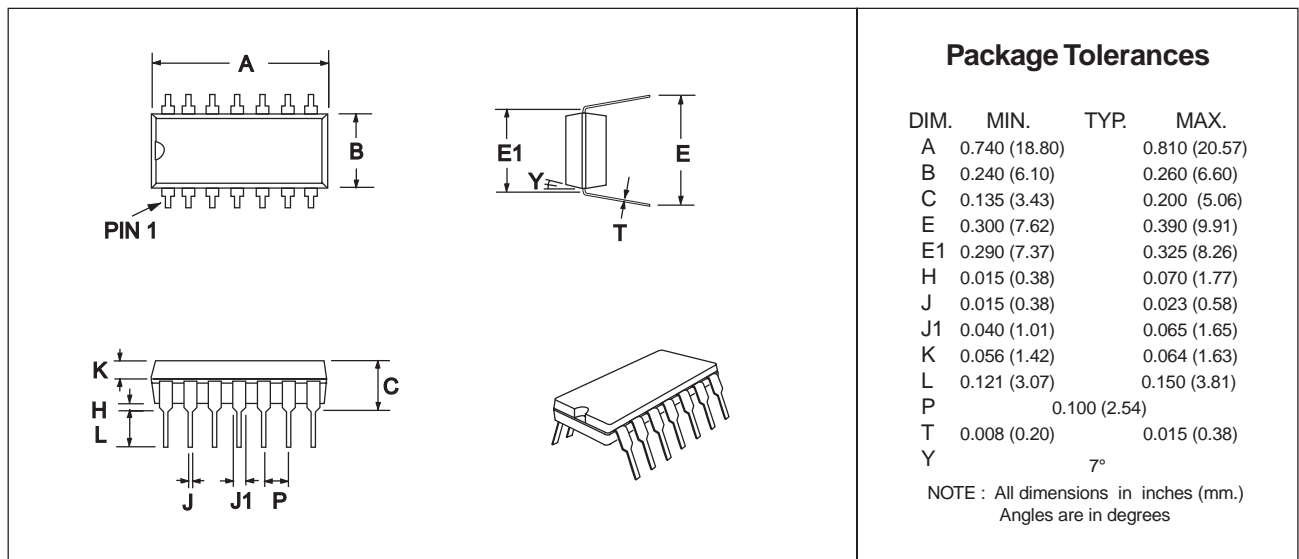


Figure 5: 14-pin PDIP Mechanical Outline: Order as part no. MX315AP

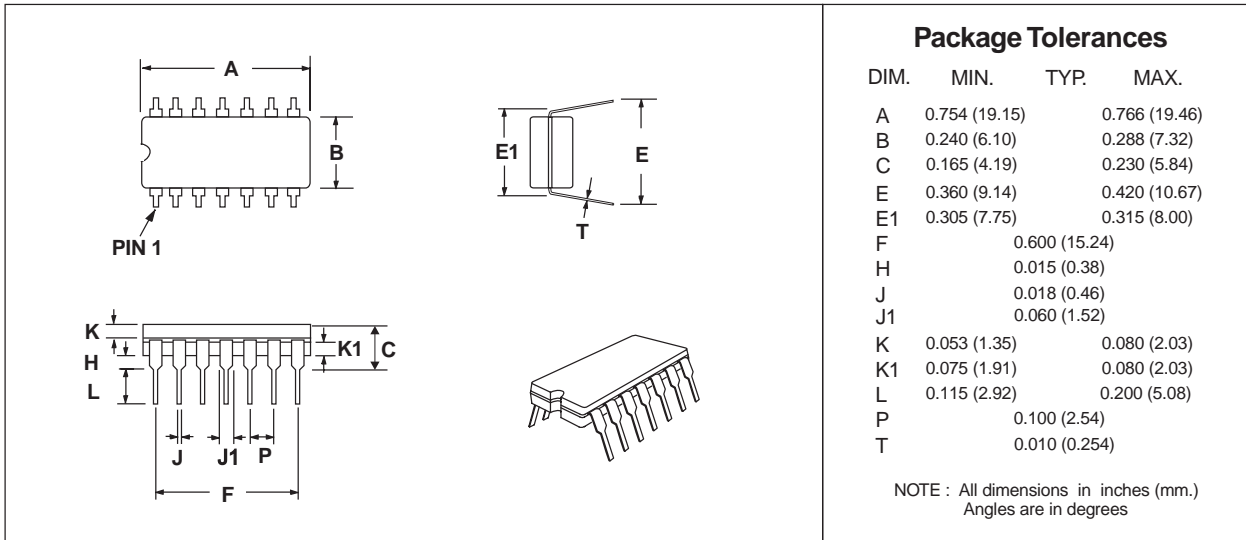


Figure 6: 14-pin CDIP Mechanical Outline: Order as part no. MX315AJ