MX•COM, INC. MX003

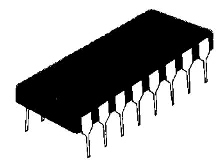
SELECTIVE CALL TONE DECODER

FEATURES

- CMOS Low Power Requirements
- No External Prefilters Needed
- 0dB Signal to Noise Performance
- >30dB Dynamic Range
- 25 ms Typical Response Time
- Quadradecimal Throughput
- Automatic Repeat Tone Translation

APPLICATIONS

- MX003QA: Metropage** - USA
- MX003QC: CCIR - International
- MX003QE: EEA - United Kingdom
- MX003QZ: ZVEI - West Germany



MX003*
16-pin hybrid

* specify Metropage (QA), CCIR (QC), EEA (QE), or ZVEI (QZ) tonesets.

Description

The MX003 Selective Call Tone Decoder converts the toneset of one of four international sequential tone signaling conventions into binary data. On-chip programs accommodate the individual frequencies and bandwidths specified by each convention. Each device type (QA, QC, QE, QZ) is pin-for-pin compatible.

Unlike conventional sequential tone decoders that must detect tones in a specified order, the MX003Q offers a random, 1 of 15 tone decode capability. This ability to detect tones in random order makes the MX003Q a key component in the advanced Hexadecimal Sequential Coding (HSC) system. HSC selective calling address code transmissions may have data and/or control instructions appended to improve communication system efficiency. For example, in addition to a transmitted voice message, a caller's telephone number or "emergency" code can be digitally displayed on a pocket pager.

Crosscode falsing is avoided by dedicating certain tones and/or data codes to the purpose of system control. Thus, "E" and "F" codes perform important functions: F denotes the beginning and end of a transmission, while E flags a sequentially repeated character. Data may therefore be entered as written and read digitally in the same manner. During transmission, the E coded tone is substituted for a sequentially repeated data entry.

The full benefit of HSC operation is achieved by use of the following additional MX-COM CMOS IC building blocks:

MX103Q Address Selector
MX313/323Q MUX/Display Driver
MX403Q Address Transponder
MX503Q Sequential Tone Transmitter

Operation in the limited manner of conventional systems is not compromised. The MX003Q/MX103Q combination is directly compatible with the signaling conventions of older systems.

**Metropage is a trademark of Motorola, Inc.

Device Operation

Tone detection is accomplished by a complex autocorrelation algorithm that ensures accurate tone channel bandwidths, equalized response times, and full spec. decoding under high noise signaling conditions. No external signal conditioning or filtering is required, and signals of full dynamic range are processed.

A total of sixteen code states are processed by the MX003 -- 15 tones and a NOTONE logic state. Fourteen of these tones are directly usable for data transmission.

A Strobe pulse of 1 ms duration signals each change in the output code and may be used with the HOLD input to establish handshake routines. Alternatively, it can be used to externally add a duration control to the signaling program, as required in some tone signaling conventions.

The MX003's decode response time is typically 25 ms.

Master clocks for the digital filter stages are derived from an on-chip oscillator and external 560kHz ceramic resonator. The decode channel bandwidth has worst-case tolerances calculated to include the specified resonator tolerance. A 23.3 kHz auxiliary clock output can be used to drive other HSC operating components.

PIN FUNCTION CHART

Pin	Function
1	23.33 kHz Clock O/P: This output operates ancillary components such as the MX103Q Address Selector, MX313/323Q MUX/Display Driver and MX403Q Address Transponder.
2	$\overline{\text{Clock}}$: Output from on-chip inverter clock at 560kHz. May be connected to the Clock In line of an MX503Q Sequential Tone Transmitter to operate multiple devies from a common resonator.
3	Clock In: Input to on-chip inverter clock at 560kHz.
4	V_{SS}: Negative Supply (GND).
5	$\overline{\text{Hold}}$: A LO on this line sustains the Strobe and Data Output lines in a coded true state. Hold must be switched HI momentarily for new data to be processed.
6	Power-up Reset: Connects to an external R-C network to prevent invalid data from being output upon application of power.
7	Internal Connection. Do Not use.
8	Data Strobe: A 1 ms pulse lags the input of valid data by 20 to 25 ms.
9	Q3 Data Output: Binary weight = 8
10	Q2 Data Output: Binary weight = 4
11	Q1 Data Output: Binary weight = 2
12	Q0 Data Output: Binary weight = 1
13	V_{DD}: Positive Supply
14	Signal Input: A high-impedance (1 MΩ) for signal tones in the 30mV to V_{DD}-V_{SS} peak-peak range. Signals may be sine or square wave. These pins should be D.C. blocked externally from the signal source.
15	Signal Bias: See signal input.
16	Internal Connection. Do Not use.

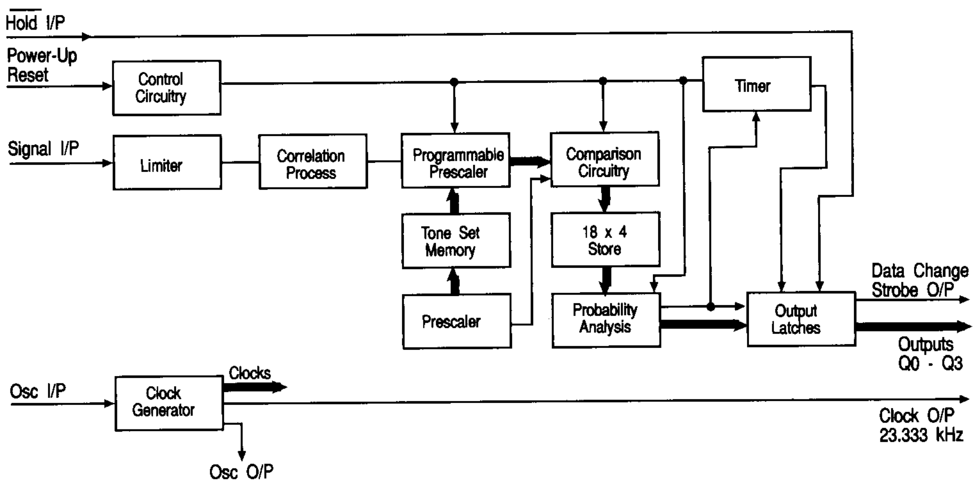


Figure 1 - Internal Block Diagram

MX003Q(*) Tone Table

Input Tone Frequencies (f_0 in Hz)				Binary Coded Output				Quadradecimal Data Character
MX003QA	MX003QC	MX003QE	MX003QZ	D3	D2	D1	D0	
600	1981	1981	2400	0	0	0	0	0
741	1124	1124	1060	0	0	0	1	1
882	1197	1197	1160	0	0	1	0	2
1023	1275	1275	1270	0	0	1	1	3
1164	1358	1358	1400	0	1	0	0	4
1305	1446	1446	1530	0	1	0	1	5
1446	1540	1540	1670	0	1	1	0	6
1587	1640	1640	1830	0	1	1	1	7
1728	1747	1747	2000	1	0	0	0	8
1869	1860	1860	2200	1	0	0	1	9
2151	2400	1055	2800	1	0	1	0	A
2435	930	930	810	1	0	1	1	B
2007	2247	2247	970	1	1	0	0	C
2295	991	991	886	1	1	0	1	D
459	2110	2110	2600	1	1	1	0	E
NOTONE	NOTONE	NOTONE	NOTONE	1	1	1	1	F

Table 1 - MX003 Tone Table

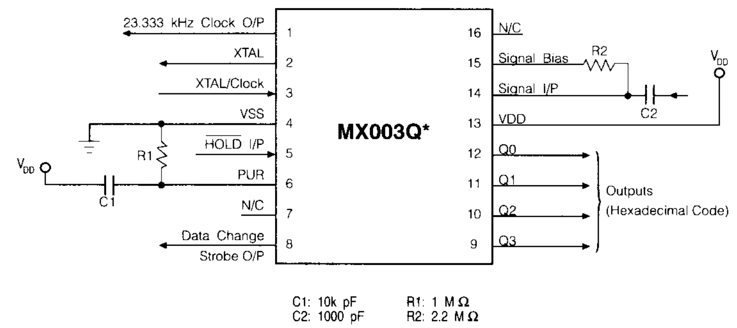


Figure 2 - External Component Connections

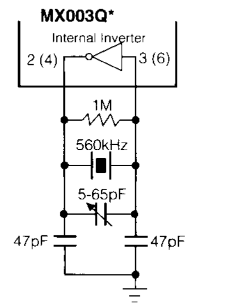
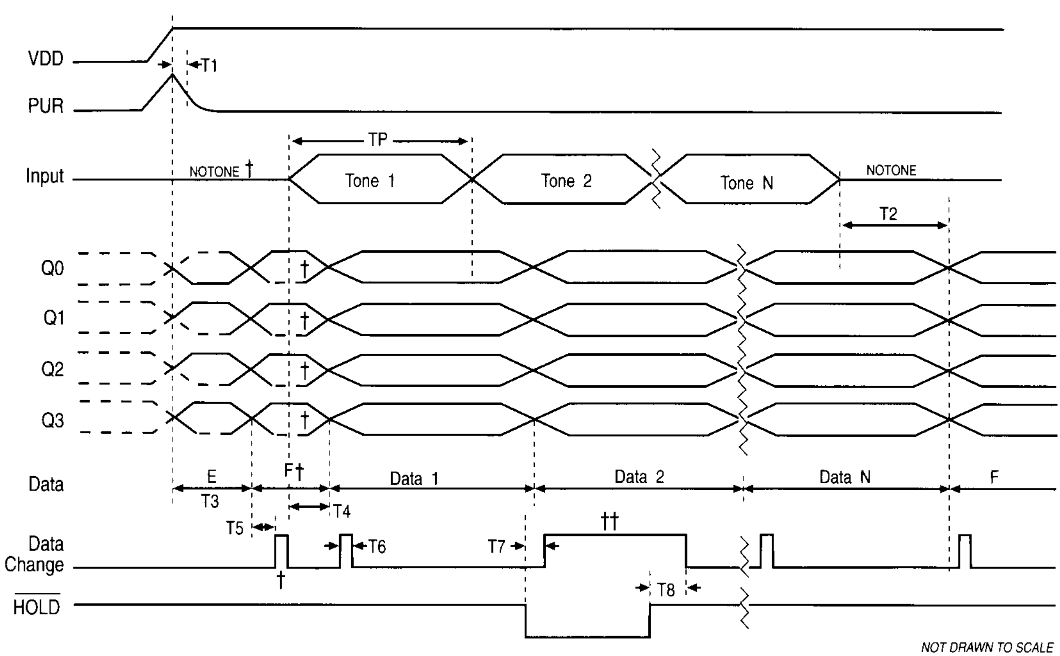


Figure 3 - 560kHz Resonator Circuit

Timing



T1 Logic 1, >2ms
T2 >33 ms & <50 ms
T3 33 ms (Data E)
T4 20 ms min. (Tp max.)
T5 0.5 - 1.0 ms (Data Change)
T6 1.0 ms (Data Change Pulse Duration)
T7 >50 μs
T8 < 120 μs

† Q0 - Q3 will represent the input frequency present during and after PUR (Shown as F (NOTONE) in this example).

†† After application of HOLD the next Data Change pulse will stay high until HOLD is removed according to the timing shown.

Figure 4 - Timing Diagram

SPECIFICATIONS

OPERATING LIMITS

All devices were measured under the following conditions unless otherwise noted. Characteristics are valid for all tones unless otherwise stated.

V_{DD}=5.0V

-30°C ≤ T_{AMB} ≤ +85°C

Xtal/Clock f_0 = 560 kHz

Characteristics	See Note	Min.	Typ.	Max.	Unit
Static Values					
Supply Voltage (V_{SS}=0V)		3.3	5	5.5	V
Supply Current		-	1.2	5	mA
Logic "1" Output					
1 Source = 1 mA		4.5	-	-	V
Logic "0" Output					
1 Sink = 1 mA		-	-	0.5	V
Logic "1" Input Level		3.5	-	-	V
Logic "0" Input Level		-	-	1.5	V
Signal Input Range	1	0.1	-	V_{DD}	Vp-p
Dynamic Values					
Signal Input Range		35	-	$V_{DD}/2$	mVrms
Must-Decode Bandwidth when P>0.995	2				
QA		±20	-	-	Hz
QC		±1	-	-	%
QE		±1	-	-	%
QZ		±2	-	-	%
Must-Not-Decode Bandwidth (all conditions of inputs SNR and amplitude P≤0.03)	3				
QA		-	-	±60	Hz
QC		-	-	±3	%
QE		-	-	±3	%
QZ		-	-	±4.5	%
Noise Response Rate	4,5				
QA		-	0.15	-	hour
QC		-	40.0	-	hours
QE		-	40.0	-	hours
QZ		-	1.0	-	hour
Decode Response Time:					
Notone to tone (F - F)	6	20	25	Tp	ms
Tone to notone, Tf (F - F)	6	33	-	50	ms
Min. intertone gap for "F"	7	15	-	28	ms

Notes:

1) AC coupled sine/square.
2) With minimum tone period (Tp) specified for toneset. P = Decode Probability.
3) With maximum Tp specified for toneset.
4) Corresponds to 1-digit code falsing rate. F=random single character.
5) Hours per F - F - F single character response, Gaussian Input noise, BW 6kHz @ max. input level.
6) Delay from change of input (tone applied/removed) to change at Q0-Q3 outputs (see Figure 4).
7) Minimum tone gap requirement for "notone" recognition. Outputs = F after delay (see Figure 4).