MX-COM, INC.
COMMUNICATION ICs

CMX602B

DATA BULLETIN

Calling Line Identifier plus Call Waiting (Type II)

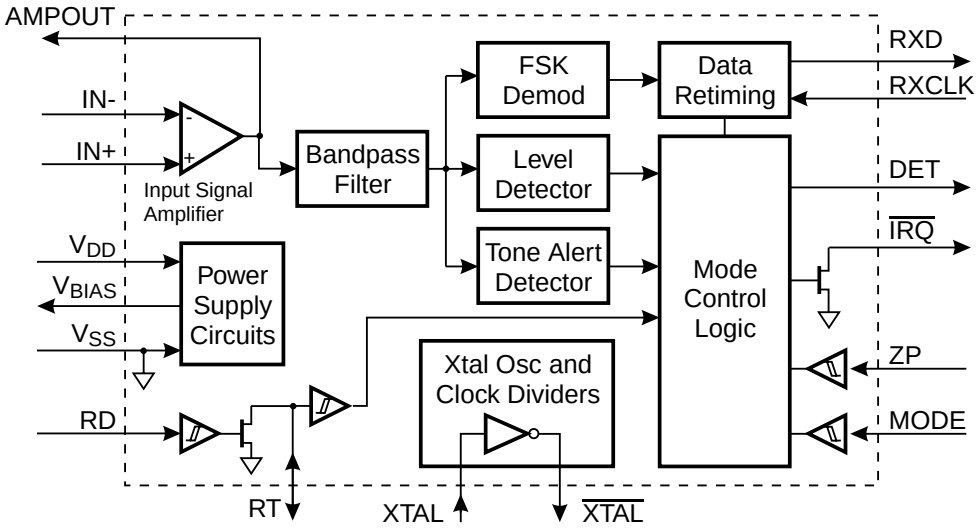
PRELIMINARY INFORMATION

Features

- **Automatic CAS Dual Tone Detector**
  High Sensitivity, Low Falsing
  Automatic CAS Duration Checking
- **1µA max. 'Zero-Power' Ring or Line Polarity Reversal Detector**
- **V23/Bell202 FSK Demodulator with Data Retiming facility**
- **µC Interrupt / Wake-up output to minimize system operating power**
- **Low Power Operation 0.5mA at 2.7V_{DD}**

Applications

- **Caller ID/Caller ID on Call Waiting**
  Telephones
  Adjunct Boxes
- **Bellcore, ETSI, British Telecom, and Mercury Systems**
- **Computer Telephone Integration**
- **Call Logging Systems**
- **Voice Mail Equipment**



The CMX602B is a low power CMOS device used for the reception of physical layer signals in Bellcore's Calling Identity Delivery (CID) and Calling Identity on Call Waiting (CIDCW) systems, British Telecom Calling Line Identification Service (CLIP), the Cable Communications Association's Caller Display Services (CDS), and similar evolving services.

This device includes a 'zero-power' ring or line polarity reversal detector, a dual-tone (2130Hz plus 2750Hz) internally timed CPE Alerting Signal (CAS) detector, and a 1200-baud FSK Bell202/V23 compatible asynchronous data demodulator with data retiming circuitry which removes the need for a UART in the associated µC.

The CMX602B is suitable for use in systems using Bellcore specifications GR-30-CORE and SR-TSV-002476, British Telecom specifications SIN227 and SIN242, CCA TW/P&E/312, ETSI: ETS 300 659 parts 1 and 2 and ETS 300 778 parts 1 and 2, and Mercury Communications MNR 19.

This device may be used with a 2.7V to 5.5V supply and is available in the following packages: 16-pin TSSOP (CMX602BE4), 16-pin SOIC (CMX602BD4) and a 16-pin PDIP (CMX602BP3).

©2000 MX-COM, Inc.
www.mxcom.com tel: 800 638 5577 336 744 5050 fax: 336 744 5054
4800 Bethania Station Road, Winston-Salem, NC 27105-1201 USA
Doc. # 20480204.002
All trademarks an service marks are held by their respective companies.

CONTENTS

Section **Page**

1. Block Diagram 3

2. Signal List 4

3. External Components 5

4. General Description 6

4.1 Mode Control Logic 6
4.2 Input Signal Amplifier 6
4.3 Bandpass Filter 7
4.4 Level Detector 8
4.5 FSK Demodulator 8
4.6 FSK Data Retiming 8
4.7 FSK Data Without Retiming 9
4.8 Tone Alert Detector 10
4.9 Ring or Line Polarity Reversal Detector 10
4.10 Xtal Osc and Clock Dividers 12

5. Application 12

5.1 'On-Hook' Operation 12
5.1.1 Bellcore System 12
5.1.2 British Telecom System 13
5.1.3 Other 'On-Hook' Systems 13
5.2 'Off-Hook' Operation 15

6. Performance Specification 17

6.1 Electrical Performance 17
6.1.1 Absolute Maximum Ratings 17
6.1.2 Operating Limits 17
6.1.3 Operating Characteristics 18
6.2 Packaging 21

MX-COM, Inc. reserves the right to change specifications at any time and without notice.

 All trademarks and service marks are held by their respective companies.

1. Block Diagram

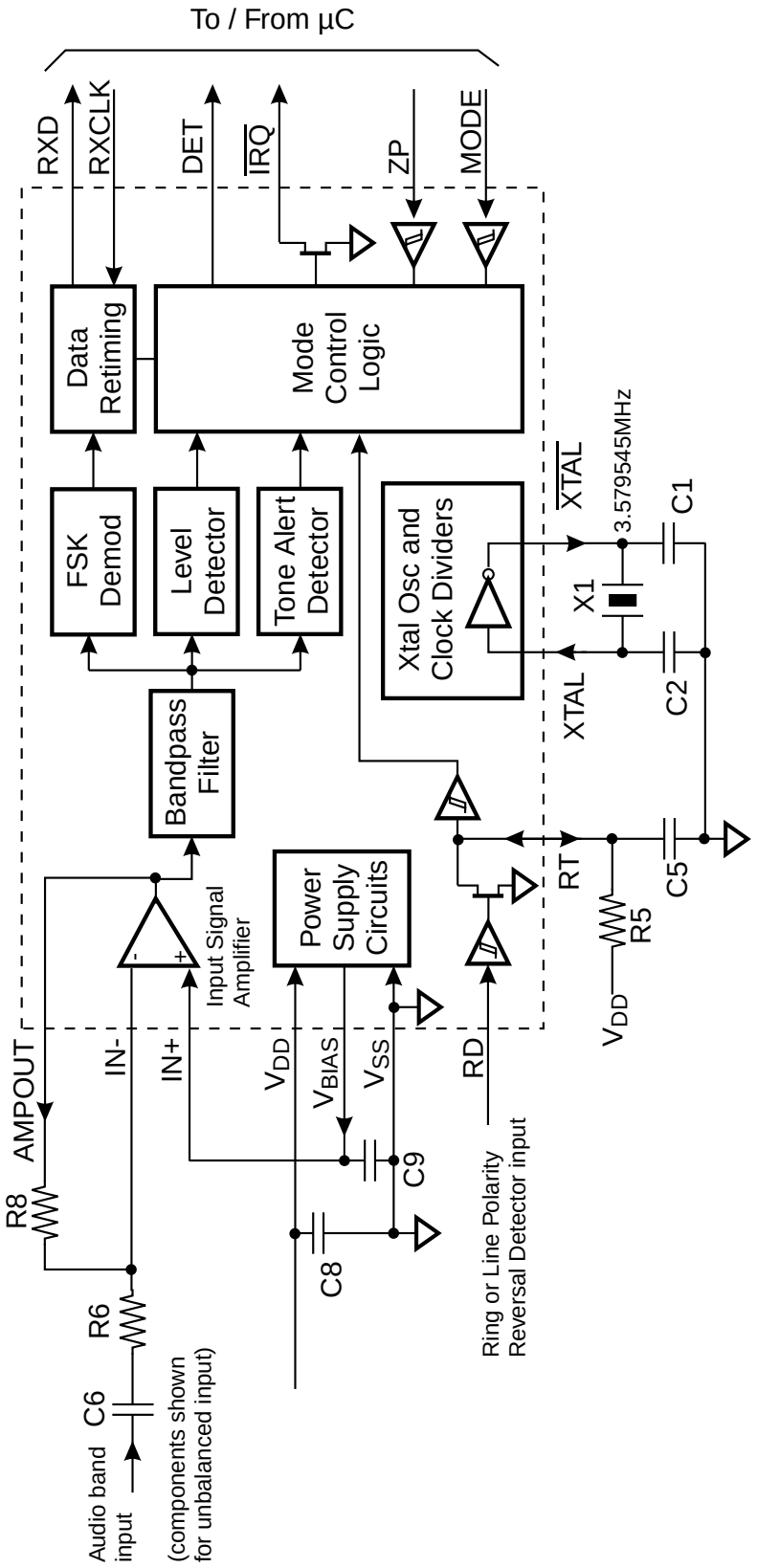


Figure 1: Block Diagram

 All trademarks and service marks are held by their respective companies.

2. Signal List

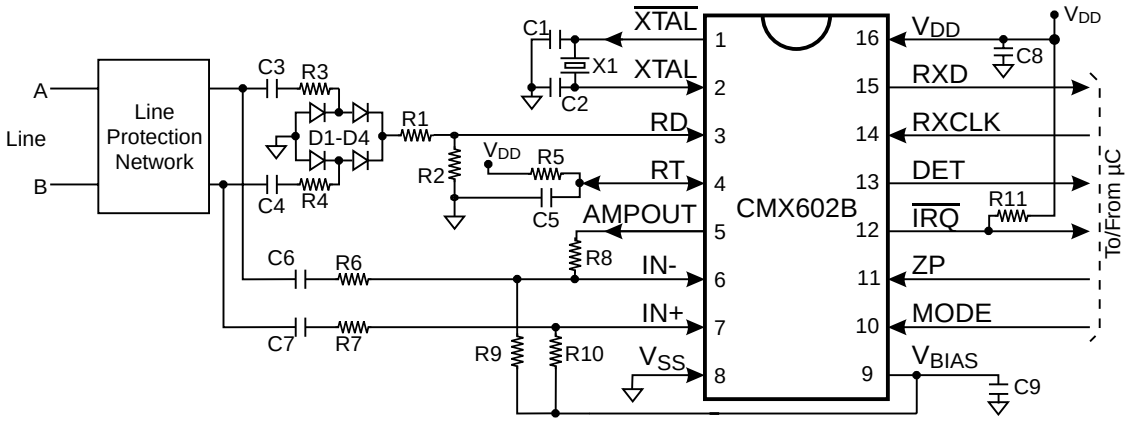
Pin No.	Signal	Type	Description
1	$\overline{XTAL}$	output	Output of the on-chip Xtal oscillator inverter
2	XTAL	input	Input to the on-chip Xtal oscillator inverter
3	RD	input (S)	Input to the Ring or Line Polarity Reversal Detector
4	RT	input / output	Open-drain output and Schmitt trigger input forming part of the Ring or Line Polarity Reversal detector. An external resistor to V_{DD} and a capacitor to V_{SS} should be connected to RT to filter and extend the RD input signal
5	AMPOUT	output	Output of the on-chip Input Signal Amplifier
6	IN -	input	Inverting input to the on-chip Input Signal Amplifier
7	IN +	input	Non-inverting input to the on-chip Input Signal Amplifier
8	V_{SS}	power	Negative supply
9	V_{BIAS}	output	Internally generated bias voltage, held at $V_{DD}/2$ when the device is not in 'Zero-Power' mode. Should be bypassed to V_{SS} by a capacitor mounted close to the device pins.
10	MODE	input (S)	Input used to select the Tone Alert or FSK Level Detection operating mode. See Section 4.1
11	ZP	input (S)	High level on this input selects 'Zero-Power' mode, a low level input enables the V_{BIAS} supply, the Input signal amplifier, the Bandpass Filter , and either the FSK or the Tone alert circuits depending on the MODE input
12	$\overline{IRQ}$	output	Open-drain output (active low) that may be used as an Interrupt Request / Wake-up input to the associated µC. Indicates CAS Dual Tone event of correct duration when device is in Tone Alert Detect Mode. An external pull-up resistor should be connected between this output and V_{DD}.
13	DET	output	Logic level output driven by the Ring or Line Polarity Reversal Detector, the Tone Alert Detector or the FSK Level detect circuits, depending on the operating mode. When device is in Tone Alert Mode, it may be used as a near end voice mute control signal. See Section 4.1
14	RXCLK	input	Logic level input, which may be used to clock, received data bits out of the FSK Data Retiming block. When held high disables FSK Data Retiming block.
15	RXD	output	Logic level output carrying either the raw output of the FSK Demodulator or re-timed 8-bit characters depending on the state of the RXCLK input. See Section 4.6
16	V_{DD}	power	Positive supply. Levels and thresholds within the device are proportional to this voltage. Should be bypassed to V_{SS} by a capacitor mounted close to the device pins.

Notes: input (S) = Schmitt trigger input

Table 1 : Signal List

 All trademarks and service marks are held by their respective companies.

3. External Components



Note: It is recommended that the printed circuit board provide a ground plane in the CMX602B area to provide a low impedance ground connection to the V_{SS} pin and to the bypass capacitors C8 and C9.

Figure 2 : Recommended External Components for Bellcore and/or British Telecom Application

R1		470kΩ	±1%
R2	Note 1		±1%
R3, R4 R5, R6 R7		470kΩ	±1%
R8	Note 2, 3	470kΩ @ 3.3V 680kΩ @ 5.0V	±1%
R9	Note 2	240kΩ @ 3.3V 200kΩ @ 5.0V	±1%
R10		160kΩ	±1%

R11		100kΩ	±20%
C1, C2		18pF	±20%
C3, C4		0.1µF	±20%
C5		0.33µF	±20%
C6, C7		680pF	±20%
C8,C9		0.1µF	±20%
X1	Note 4	3.579545MHz	±0.1%
D1 - D4		1N4004	

Table 2: Recommended External Components

Recommended External Component Notes:

1. See Section 4.8
2. See Section 4.2
3. The recommended values of R8 were selected for applications in both Bellcore and British Telecom Systems. Optimum Bellcore-only operation may be achieved by reducing the value of R8 e.g. to 656kΩ @ 5.0V.
4. 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.
5. It is recommended that the printed circuit board be laid out with a ground plane in the CMX602B area to provide a low impedance ground connection to the V_{SS} pin and to decoupling capacitors C8 and C9.

 All trademarks and service marks are held by their respective companies.

4. General Description

4.1 Mode Control Logic

The CMX602B's operating mode and the source of the DET and $\overline{IRQ}$ outputs are determined by the logic levels applied to the MODE and ZP input pins.

ZP	MODE	Mode	DET output from	$\overline{IRQ}$ output from
0	0	Tone Alert Detect	Tone Alert Signal Detection	Valid 'off-hook' CAS Duration. Ring or Line Polarity Reversal Detector
0	1	FSK Receive	FSK Level Detector	FSK Data Retiming (if enabled). Ring or Line Polarity Reversal Detector.
1	0	Zero-Power	Ring or Line Polarity Reversal Detector	Ring or Line Polarity Reversal Detector.
1	1	Zero-Power	Ring or Line Polarity Reversal Detector	None

In the 'Zero-Power' modes, power is removed from all of the internal circuitry except for the Ring or Line Polarity Reversal Detector and the DET and $\overline{IRQ}$ outputs.

4.2 Input Signal Amplifier

The Input Signal Amplifier is used to convert the balanced FSK and Tone Alert signals received over the telephone line to an unbalanced signal of the correct amplitude for the FSK receiver and Tone Alert Detector circuits.

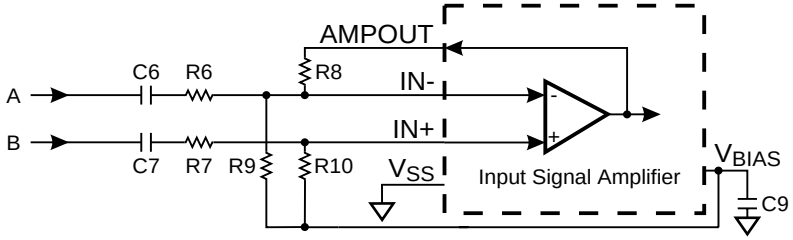


Figure 3: Input Signal Amplifier, balanced input configuration

The design equations for this circuit are:

$$\text{Differential Voltage Gain } \frac{V_{AMPOUT}}{V_{(B-A)}} = \frac{R8}{R6} \qquad R9 = \frac{R8 \times R10}{(R8 - R10)}$$

$$R6 = R7 = 470k\Omega \qquad R10 = 160k\Omega$$

The target differential voltage gain depends on the expected A and B input signal levels and the CMX602B's internal overload and threshold levels, which are proportional to the supply voltage.

The CMX602B has been designed to meet the applicable specifications when R8 = 430kΩ at V_{DD} = 3.0V nominal, rising to 680kΩ at V_{DD} = 5.0V (see note) and R9 = 240kΩ at V_{DD} = 3.0V dropping to 200kΩ at V_{DD} = 5.0V as indicated in Section 3 and as shown in Figure 5. Reference Notes found in Section 3.

 All trademarks and service marks are held by their respective companies.

The Input Signal Amplifier may also be used to allow the CMX602B to operate from an unbalanced signal source as shown in Figure 4. In this unbalanced signal configuration, the values of R6 and R8 are the same as used for the balanced input configuration.

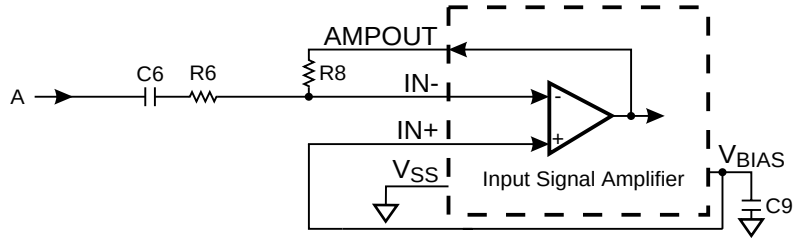


Figure 4: Input Signal Amplifier, unbalanced input configuration

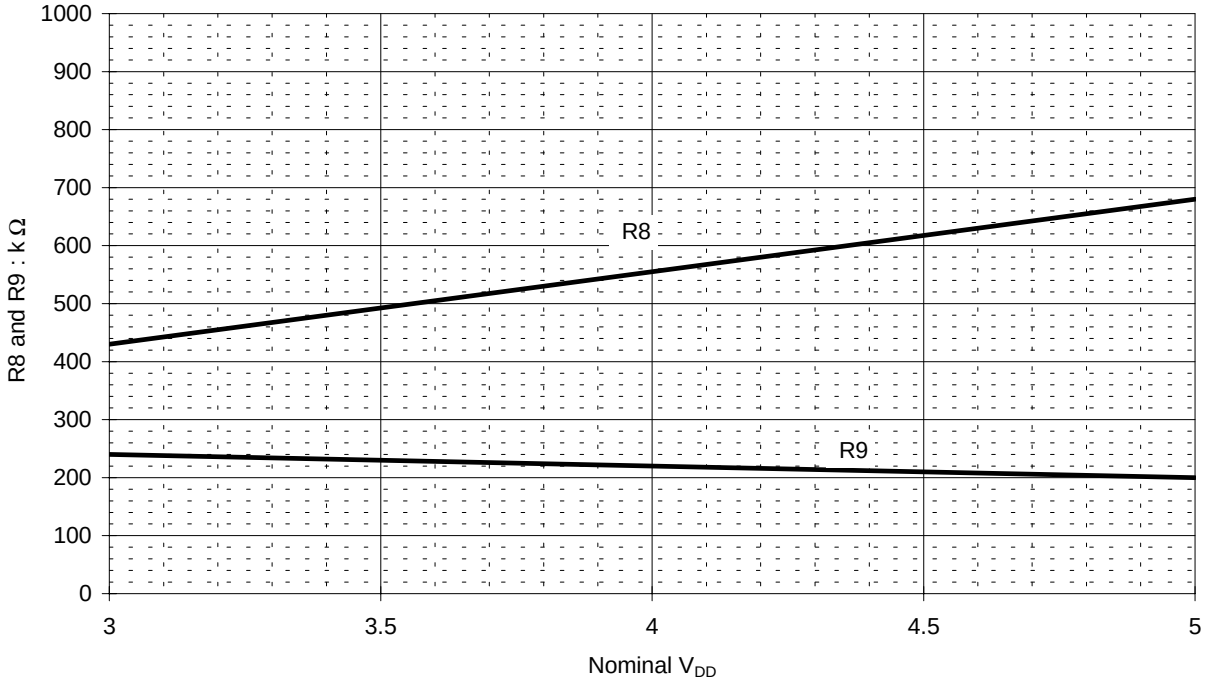


Figure 5: Input Signal Amplifier, Optimum Values of R8 and R9 vs. V_{DD}

4.3 Bandpass Filter

The Bandpass Filter is used to attenuate out of band noise and interfering signals from reaching the FSK Demodulator, Tone Alert Detector and Level Detector circuits. The characteristics of this filter differ between FSK and Tone Alert modes. Switched Capacitor filter stages clocked at 57.7kHz provide primary filtering. If the input signal is band limited to below 28.85kHz then external anti-aliasing filtering is not required.

 All trademarks and service marks are held by their respective companies.

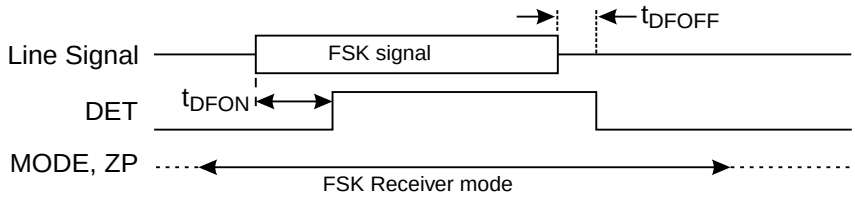
4.4 Level Detector

The Level Detector block operates by measuring the level of the signal at the output of the Bandpass Filter. It then compares it against a threshold, which depends on whether FSK Receive or Tone Alert Detect mode has been selected.

In Tone Alert Detect mode the output of the Level Detector block provides an input to the Tone Alert Signal Detector.

In FSK Receive mode the CMX602B DET output will be set high when the level has exceeded the threshold for a sufficient duration. Amplitude and time hysteresis are used to reduce chattering of the DET output in marginal conditions.

Note: In FSK Receive mode, this circuit may also respond to non-FSK signals such as speech.



See Section 6.1 for definitions of t_{DFON} and t_{DFOFF}

Figure 6: FSK Level Detector Operation

4.5 FSK Demodulator

The FSK Demodulator block converts the 1200 baud FSK input signal to a digital data stream which is output via the RXD pin as long as the Data Retiming function is not enabled (Holding RXCLK continuously high). The RXD output does not depend on the state of the FSK Level Detector output.

Note: In the absence of a valid FSK signal, the demodulator may falsely interpret speech or other extraneous signals as data.

4.6 FSK Data Retiming

The Data Retiming block extracts the 8 data bits of each character from the received asynchronous data stream and presents them to the µC under the control of strobe pulses applied to the RXCLK input. The timing of these pulses is not critical, and they may easily be generated by a simple software loop. This facility removes the need for a UART in the µC without incurring an excessive software overhead.

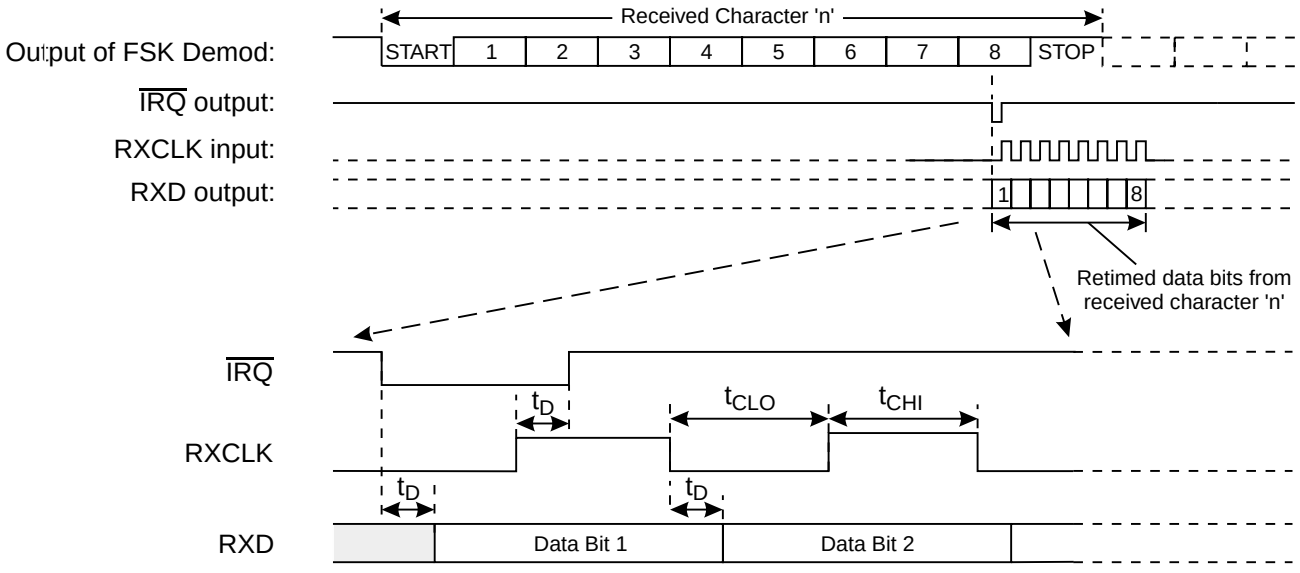
The block operates on a character by character basis by first looking for the mark to space transition which signals the beginning of the start bit. Using this transition as a timing reference, the block samples the output of the FSK Demodulator in the middle of each of the following 8 received data bits and stores the results in an internal 8-bit shift register.

When the eighth data bit has been clocked into the internal shift register, the CMX602B examines the RXCLK input. If RXCLK input is low, then the $\overline{IRQ}$ output will be pulled low, thereby sending the first of the stored data bits to the RXD output pin. Upon detecting that the $\overline{IRQ}$ output has gone low, the µC should pulse the RXCLK pin high 8 times. The high to low transition at the end of the first 7 of these pulses will be used by the CMX602B to shift the next data bit from the shift register onto the RXD output. At the end of the eighth pulse, the FSK Demodulator output will be reconnected to the RXD output pin. The $\overline{IRQ}$ output will be cleared the first time the RXCLK input goes high.

Thus to use the Data Retiming function, the RXCLK input should be kept low until the $\overline{IRQ}$ output goes low; if the Data Retiming function is not required the RXCLK input should continuously be kept high.

The only restrictions on the timing of the RXCLK waveform are those shown in Figure 7 and the need to complete the transfer of all eight bits into the µC within 8.3ms (to empty the buffer before the next character is received and put into the buffer).

 All trademarks and service marks are held by their respective companies.



t_D = Internal CMX602B delay (max 1µS); t_{CLO} = RXCLK low time (min 1µS); t_{CHI} = RXCLK high time (min 1µS)

Figure 7: FSK Operation with Data Retiming

Note: If enabled, the Data Retiming block will interpret the FSK Channel Seizure signal (a sequence of alternating mark and space bits) as valid received characters, with values of 55 (hex). Similarly it may interpret speech or other signals as random characters.

4.7 FSK Data Without Retiming

If the Data Retiming facility is not required, the RXCLK input to the CMX602B should continuously be kept high. The asynchronous data from the FSK Demodulator is then connected directly to the RXD output pin and the $\overline{IRQ}$ output will not be activated by the FSK signal. This case is illustrated in Figure 8.

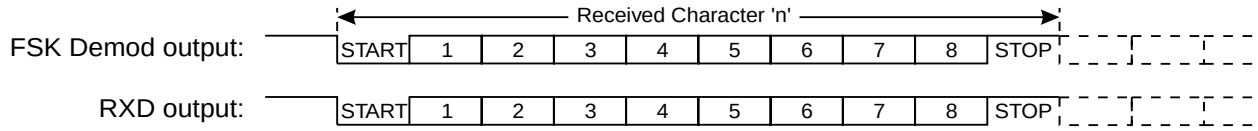


Figure 8: FSK Operation without Data Retiming (RXCLK always high)

 All trademarks and service marks are held by their respective companies.

4.8 Tone Alert Detector

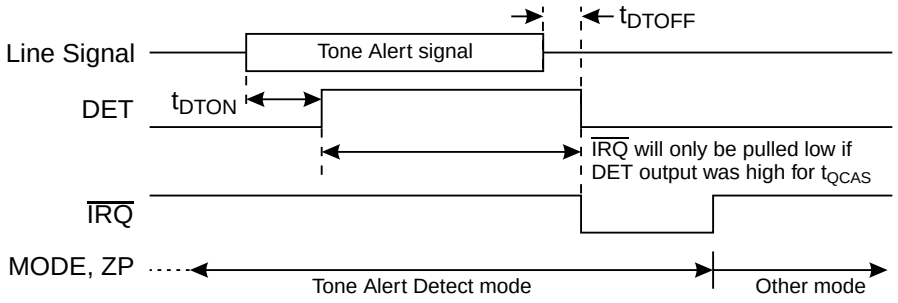
The Tone Alert Detector block is enabled when the CMX602B is set to Tone Alert Detector operating mode. It then monitors the received signal for the presence of simultaneous 2130Hz and 2750Hz tones of sufficient level and duration.

Two digital bandpass filters, centered around 2130Hz and 2750Hz, are used within the block to provide additional rejection of interfering signals.

The CMX602B DET output will be set high while Tone Alert signal is detected.

When DET goes low at the end of the Tone Alert signal, the $\overline{IRQ}$ output will be pulled low, only if DET was high for a period of time falling within the CAS qualifying time (t_{QCAS}) limits (See Section 6.1). $\overline{IRQ}$ will remain low until the CMX602B is switched out of Tone Detect mode. This $\overline{IRQ}$ falling transition indicates a valid CAS dual-tone has occurred.

Note: The t_{QCAS} timing has been optimized for the detection of 75 to 85ms CPE Alert Signals (CAS) used in off-hook applications. The longer (88ms to 110ms) Tone Alert signal employed by British Telecom for on-hook applications will not necessarily cause $\overline{IRQ}$ to go low.



See Section 6.1 for definitions of t_{DTON}, t_{DTOFF} and t_{QCAS}

Figure 9: Tone Alert Detector Operation

4.9 Ring or Line Polarity Reversal Detector

These circuits are used to detect the Line Polarity Reversal and Ringing signals associated with the Calling Line Identification protocol. Figure 10 illustrates their use in a typical application.

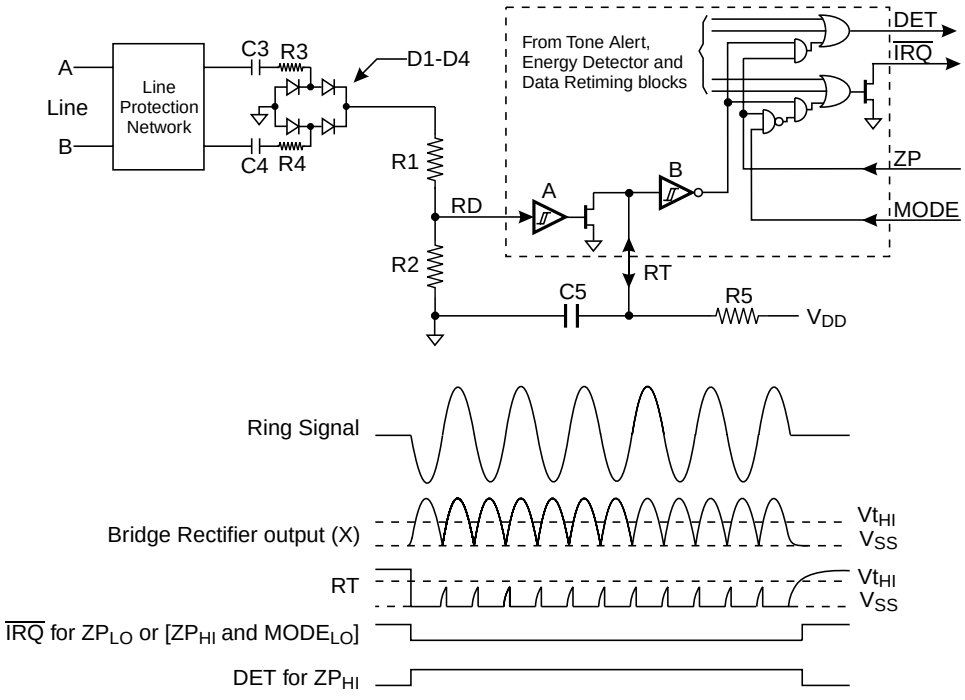


Figure 10: Ring or Line Polarity Reversal Operation

 All trademarks and service marks are held by their respective companies.

When no signal is present on the telephone line, RD will be at V_{SS} and RT pulled to V_{DD} by R5 so the output of the Schmitt trigger 'B' will be low.

The ring signal is usually applied at the subscriber's exchange as an ac voltage. The ring signal is inserted in series with one of the telephone wires and will pass through either C3 and R3 or C4 and R4 to appear at the top end of R1 in a rectified and attenuated form.

The signal prior to R1 will be further attenuated by the potential divider formed by R1 and R2 before being applied to the CMX602B input RD. If the amplitude of the signal appearing at RD is greater than the input threshold (Vt_{HI}) of Schmitt trigger 'A' then the N transistor connected to RT will be turned on, pulling the voltage at RT to V_{SS} by discharging the external capacitor C5. The output of the Schmitt trigger 'B' will then go high, activating the DET and/or $\overline{IRQ}$ outputs depending on the states of the MODE and ZP inputs.

The minimum amplitude ringing signal that is certain to be detected is:

$$\left(0.7 + Vt_{HI}\frac{(R1+R2+R3)}{R2}\right)(0.707V_{RMS})$$

Where Vt_{HI} is the high-going threshold voltage of the Schmitt trigger A (see Section 6.1).

With R1, R3 and R4 all 470kΩ as indicated in Figure 2, then setting R2 to 68kΩ will guarantee detection of ringing signals of $40V_{RMS}$ and above for V_{DD} = 2.7 to 5.5V.

A line polarity reversal may be detected using the same circuit but there will be only one pulse at RD. The British Telecom specification SIN242 indicates that the circuit must detect a +15V to -15V reversal between the two lines slewing in 30ms. For a linearly changing voltage at the input to C3 (or C4), then the voltage appearing at the RD pin will be

$$\frac{dV}{dt}C3\left(1-e^{-\frac{t}{T}}\right)R2$$

$$\text{where } T = C3(R1+R2+R3) \text{ and } \frac{dV}{dt} \text{ is the input slew rate.}$$

For dV/dt = 500V/sec (15V in 30ms), R1, R3 and R4 all 470kΩ and C3, C4 both 0.1µF as indicated in Figure 2, then setting R2 to 390kΩ will guarantee detection at V_{DD} = 5.5V.

If the time constant of R5 and C5 is large enough then the voltage on RT will remain below the threshold of the 'B' Schmitt trigger keeping the DET and/or $\overline{IRQ}$ outputs active for the duration of a ring cycle

The time for the voltage on RT to charge from V_{SS} towards V_{DD} can be derived from the formula

$$V_{RT} = V_{DD}\left(1-e^{-\frac{t}{R5C5}}\right)$$

As the Schmitt trigger high-going input threshold voltage (Vt_{HI}) has a minimum value of 0.56 x V_{DD}, then the Schmitt trigger 'B' output will remain high for a time of at least 0.821 x R5 x C5 following a pulse at RD.

Using the values provided in Figure 2 (470kΩ and 0.33µF) gives a minimum time of 100ms (independent of V_{DD}), which is adequate for ring frequencies of 10Hz or above.

If necessary, the µC can distinguish between a ring and a reversal by timing the length of the $\overline{IRQ}$ or DET output.

 All trademarks and service marks are held by their respective companies.

4.10 Xtal Osc and Clock Dividers

A 3.579545MHz clock present at the XTAL pin determines frequency and timing accuracy of the CMX602B. This may be generated by the on-chip oscillator inverter using the external components C1, C2, and X1 of Figure 2, or may be supplied from an external source to the XTAL input, in which case C1, C2, and X1 should not be fitted.

The oscillator is turned off in the 'Zero-Power' modes.

If the clock is provided by an external source which is not always running, then the ZP input must be set high when the clock is not available. Failure to observe this rule may cause a significant rise in the supply current drawn by CMX602B as well as generating undefined states of the RXD, DET, and $\overline{IRQ}$ outputs.

5. Application

5.1 'On-Hook' Operation

The systems described in this section operate when the telephone set is not in use (on-hook) to display the number of a calling party before the call is answered. System specific descriptions are provided as well as a flowchart for on-hook applications (Figure 13).

5.1.1 Bellcore System

Figure 11 illustrates the line signaling and CMX602B input and output signals for the Bellcore 'On-Hook' Caller ID system as defined in Bellcore documents GR-30-CORE and SR-TSV-002476 and also in ETS 300 659-1 Section 6.1.1.

As for the British Telecom system, the 'Chan Seize' signal is a '1010…' FSK bit sequence. The Bellcore specifications do not require AC or DC line terminations while the FSK data is being received, however ETS 300 659-1 allows for the possibility of an AC termination begin applied.

Note: For simplicity of presentation, the Data Retiming function is not used in Figure 11 (RXCLK is kept high).

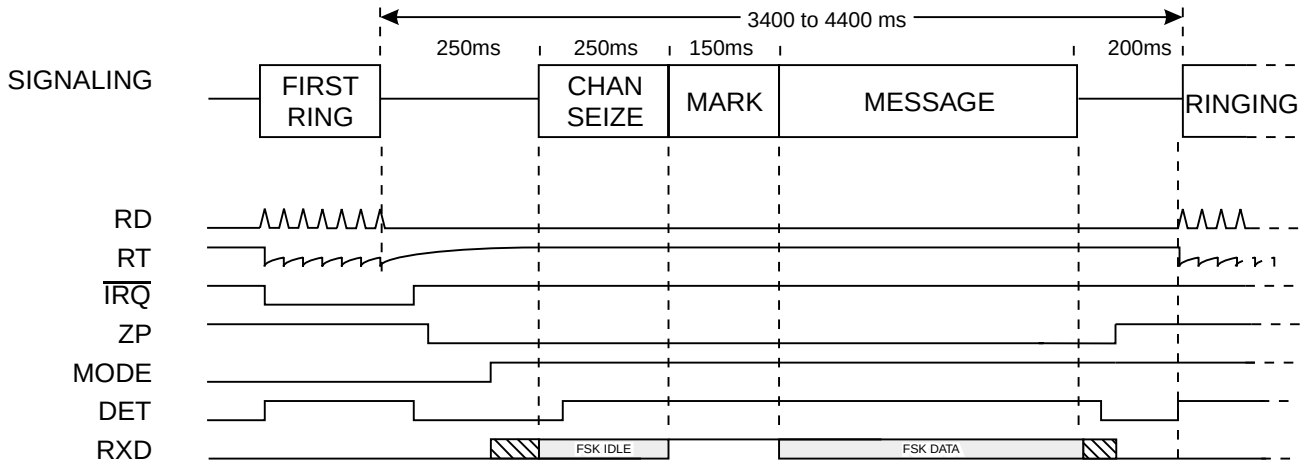


Figure 11: Bellcore On-hook System Signals

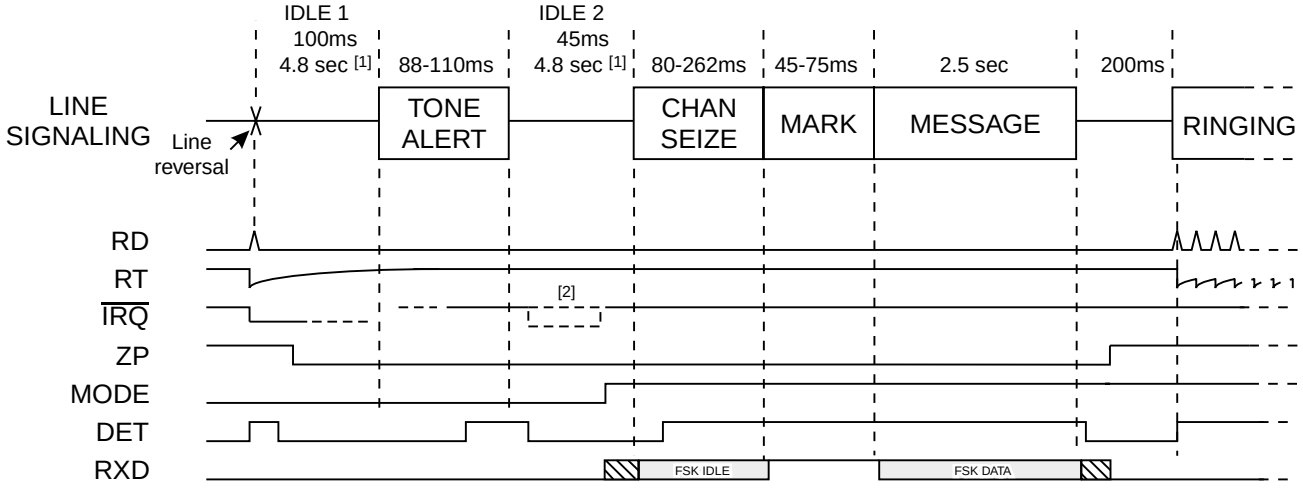
 All trademarks and service marks are held by their respective companies.

5.1.2 British Telecom System

Figure 12 illustrates the line signaling and CMX602B input and output signals for the British Telecom 'On-Hook' Caller ID system as defined in the British Telecom specifications SIN227 and SIN242 part 1. A similar system is described in ETSI 300 659-1 Section 6.1.2c.

The Tone Alert signal consists of simultaneous 2130Hz and 2750Hz tones. The 'Chan Seize' signal consists of a '1010..' FSK bit sequence. Not shown are the requirements for AC and DC loads, including a short initial Current Wetting Pulse, to be applied to the line 20ms after the end of the Tone Alert signal and to be maintained during reception of the FSK signal.

Note: For simplicity of presentation, the Data Retiming function is not used in Figure 12 (RXCLK is kept high).



[1] IDLE 1 + IDLE 2 5 sec.

[2] $\overline{IRQ}$ may go low at end of DET high period, but this is not guaranteed.

Figure 12: British Telecom System Signals

5.1.3 Other 'On-Hook' Systems

ETS 300 659-1 also allows for systems where the FSK transmission is preceded by a Dual Tone Alert signal similar to that used by British Telecom but without line reversal (ETS 300 659-1 Section 6.1.2a) or by a Ringing Pulse alerting Signal (ETS 300 659-1 Section 6.1.2b).

The U.K. CCA (Cable Communications Association) specification TW/P&E/312 precedes the FSK signals by a 200 to 450ms ring burst. AC and DC line terminations during FSK reception are optional.

Mercury Communications Ltd. Specification MNR 19 allows for either the British Telecom system or that specified by CCA.

As these are all slight variants on the Bellcore and British Telecom systems, they can also be supported by the CMX602B.

 All trademarks and service marks are held by their respective companies.

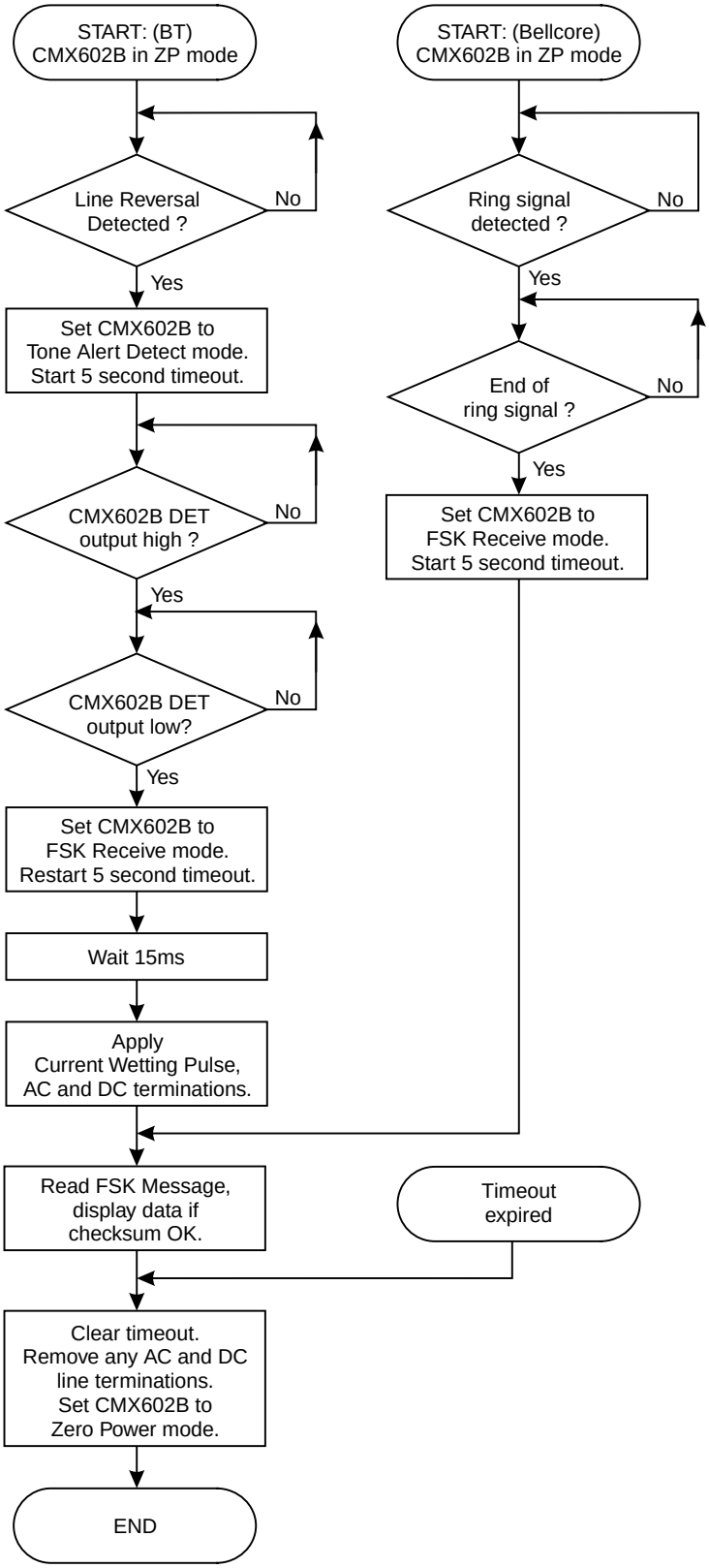


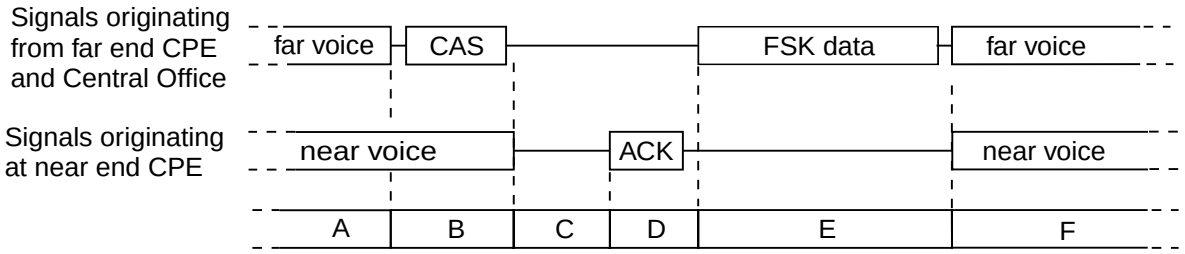
Figure 13: Flow Chart for 'On-Hook' Operation of CMX602B

 All trademarks and service marks are held by their respective companies.

5.2 'Off-Hook' Operation

The CIDCW (Calling Identity on Call Waiting) system, as described in this section, operates when the telephone set is in use (off-hook) to display the number of a waiting caller without interrupting the current call.

Bellcore documents GR-30-CORE and SR-TSV-002476, British Telecom specifications SIN227 and SIN242 part 2 and ETS 300-659-2 all describe similar systems in which a successful CIDCW transaction consists of a sequence of actions between the near end CPE (Customer Premises Equipment - e.g. a telephone) and the Central Office as indicated in Figure 14.



A. Normal conversation with both near and far voice present.
B. Central Office mutes far end voice, emits CAS, and becomes silent.
C. CPE recognizes CIDCW initiation and mutes near end voice and keypad.
D. CPE emits DTMF ACK to Central Office to signal its readiness to receive Caller ID data stream.
E. Central Office recognizes ACK and emits FSK Data stream of Caller ID data which is received and decoded by CPE.
F. CIDCW transaction is complete. CPE unmutes near end voice and Central Office unmutes far end voice returning to normal conversation with both near and far voice present.

Figure 14 CIDCW Transaction From Near End CPE Perspective

The CAS signal is transmitted by the Central Office to initiate a CIDCW transaction and consists of an 80ms burst of simultaneous 2130Hz and 2750Hz tones.

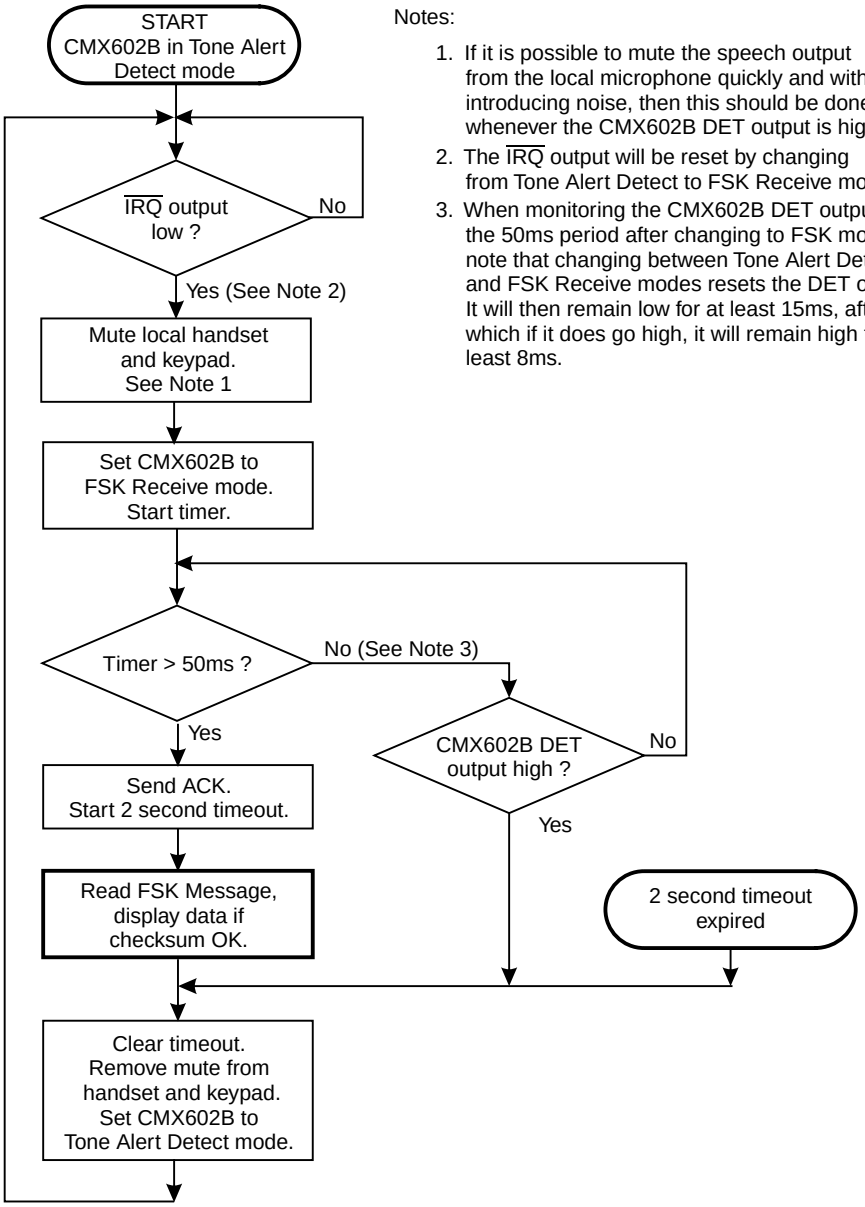
CAS detection is very important because a 'missed' signal causes Caller ID information to be lost and a false signal detection produces a disruptive tone which is heard by the far end caller. Because the CAS signals must be detected in the presence of conversations, which both mask and masquerade as the tone signals, this function is difficult to accomplish correctly.

Because the number of false responses (Talk-offs) and missed signals (Talk-downs) are related to the speech levels at the CMX602B input, the level of near end speech from the local handset is normally greater than that of far end speech coming from the Central Office. A further improvement in overall performance can be obtained by taking the CMX602B's audio input from the receive side of the telephone set hybrid where this is possible.

The internal algorithms used by the CMX602B to drive the DET and $\overline{IRQ}$ outputs in Tone Alert Detect mode have been optimized for the detection of off-hook CAS signals in the presence of speech when used according to the following principles:

1. If it is possible to mute the local speech from the microphone rapidly (within 0.5ms) without introducing noise (i.e. where the CIDCW equipment is built into the telephone set), then this muting should be done whenever the CMX602B is in Tone Alert Detect mode and the DET output is high. Doing this will markedly reduce the number of false responses generated by local (near end) speech. Note that the DET output is not used for any other purpose in an off-hook application when the CMX602B is set to Tone Alert Detect mode.
2. When the $\overline{IRQ}$ output goes low in Tone Alert Detect mode, this indicates that a CAS has been detected. The local handset and keypad should then be muted as required by the Bellcore specification and the CMX602B switched to FSK Receive mode to be ready to receive the FSK data. Doing this will also clear the $\overline{IRQ}$ output.
3. The CMX602B's DET output should be monitored for a period of 50ms after changing to FSK Receive mode and before sending the ACK signal. The transaction should be abandoned if the DET output goes high during this time, which would be the case if a false CAS detect had been caused by far end speech.

 All trademarks and service marks are held by their respective companies.



Notes:

1. If it is possible to mute the speech output from the local microphone quickly and without introducing noise, then this should be done whenever the CMX602B DET output is high.
2. The $\overline{IRQ}$ output will be reset by changing from Tone Alert Detect to FSK Receive mode.
3. When monitoring the CMX602B DET output for the 50ms period after changing to FSK mode note that changing between Tone Alert Detect and FSK Receive modes resets the DET output. It will then remain low for at least 15ms, after which if it does go high, it will remain high for at least 8ms.

Figure 15, Flow Chart for 'Off-Hook' Operation of CMX602B

 All trademarks and service marks are held by their respective companies.

6. Performance Specification

6.1 Electrical Performance

6.1.1 Absolute Maximum Ratings

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

	Min.	Max.	Units
Supply (V_{DD} - V_{SS})	-0.3	7.0	V
Voltage on any pin to V_{SS}	-0.3	V_{DD} + 0.3	V
Current into or out of V_{DD} and V_{SS} pins	-30	30	mA
Current into or out of any other pin	-20	20	mA
D4 / P3 Package			
Total Allowable Power Dissipation at T_{AMB} = 25°C		800	mW
Derating above 25°C°		13	mW/°C above 25°C
Storage Temperature	-55	125	°C
Operating Temperature	-40	85	°C
E4 Package			
Total Allowable Power Dissipation at T_{AMB} = 25°C		300	mW
Derating above 25°C°		5	mW/°C above 25°C
Storage Temperature	-55	125	°C
Operating Temperature	-40	85	°C

6.1.2 Operating Limits

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

	Notes	Min.	Max.	Units
Supply (V_{DD} - V_{SS})	1	2.7	5.5	V
Operating Temperature	1	-40	85	°C
Xtal frequency	2	3.575965	3.583125	MHz

Operating Limits Notes:

1. Operating temperature range –10°C to 60°C at V_{DD} < 3.0V.

2. A Xtal frequency of 3.579545MHz ±0.1% is required for correct Tone Alert and FSK detection.

 All trademarks and service marks are held by their respective companies.

6.1.3 Operating Characteristics

For the following conditions unless otherwise specified:

V_{DD} = 2.7V at T_{AMB} = 10°C to 60°C and V_{DD} = 3.0V to 5.0V at T_{AMB} = -40°C to 85°C
Xtal Frequency = 3.579545MHz ± 0.1%, 0dBV corresponds to 1.0V_{RMS}

	Notes	Min.	Typ.	Max.	Units
DC Parameters					
I_{DD} (ZP input high) at V_{DD} = 5.0V	1,2		0.02	1.0	µA
I_{DD} (ZP input low) at V_{DD} = 3.0V	1		0.5	1.0	mA
I_{DD} (ZP input low) at V_{DD} = 5.0V	1		1.0	2.0	mA
Logic 1 input level (RXCLK and XTAL inputs)		70%			V_{DD}
Logic 0 input level (RXCLK and XTAL inputs)				30%	V_{DD}
Logic input leakage current (V_{IN} = 0 to V_{DD}) excluding XTAL input		-1.0		1.0	µA
Output logic 1 level (I_{OH} = 360µA)		V_{DD} - 0.4			V
Output logic 0 level (I_{OL} = 360µA)				0.4	V
$\overline{IRQ}$ output 'off' state current (V_{OUT} = V_{DD})				1.0	µA
Schmitt Trigger input thresholds (Figure 16)					
High going (Vt_{HI})		(0.56)(V_{DD})		(0.56)(V_{DD}) + 0.6	V
Low going (Vt_{LO})		(0.44)(V_{DD}) - 0.6		(0.44)(V_{DD})	V
Tone Alert Detector					
'Low' tone nominal frequency			2130		Hz
'High' tone nominal frequency			2750		Hz
Start of Tone Alert signal to DET high time (t_{DTON} Figure 9)			55.0		ms
End of Tone Alert signal to DET and $\overline{IRQ}$ low time (t_{DTOFF} Figure 9)		0.5		10.0	ms
DET high time to ensure $\overline{IRQ}$ goes low (t_{QCAS} see Figure 9)		8.0		45.0	ms
To ensure detection:	3				
'Low' tone frequency deviation from nominal				±0.5	%
'High' tone frequency deviation from nominal				±0.5	%
Tone level of each simultaneously applied tone	4	-40.0		-2.2	dBV
2750Hz tone level with respect to 2130Hz tone level		-6.0		6.0	dB
Signal to Noise ratio	5	20.0			dB
Dual Tone Burst Duration for DET output		75			ms
Dual Tone Burst Duration to ensure $\overline{IRQ}$ goes low		75		85	ms

 All trademarks and service marks are held by their respective companies.

	Notes	Min.	Typ.	Max.	Units
To ensure non-detection:	6				
'Low' tone frequency deviation from nominal		±75			Hz
'High' tone frequency deviation from nominal		±95			Hz
Level (total)	4			-46.0	dBV
Dual Tone Burst Duration				45.0	ms
FSK Receiver					
Transmission rate		1188	1200	1212	Baud
V23 Mark (logic 1) frequency		1280	1300	1320	Hz
V23 Space (logic 0) frequency		2068	2100	2132	Hz
Bell202 Mark (logic 1) frequency		1188	1200	1212	Hz
Bell202 Space (logic 0) frequency		2178	2200	2222	Hz
Valid input level range	4	-40.0		-8.0	dBV
Acceptable twist (mark level with respect to space level)					
V23		-6.0		6.0	dB
Bell202		-10.0		10.0	dB
Acceptable Signal to Noise ratio					
V23	5	20.0			dB
Bell202	5	30.0			dB
Level Detector 'on' threshold level	4			-40.0	dBV
Level Detector 'off' to 'on' time (t_{DFON} Figure 6)				25.0	ms
Level Detector 'on' to 'off' time (t_{DFOFF} Figure 6)		8.0			ms
Input Signal Amplifier					
Input impedance	7	10.0			MΩ
Voltage gain			500		V/V
XTAL Input					
'High' pulse width	8	100			ns
'Low' pulse width	8	100			ns

Operating Characteristics Notes:

1. At 25°C, not including any current drawn from the CMX602B pins by external circuitry other than X1, C1, and C2.
2. RD, MODE, RXCLK inputs at V_{SS}, ZP input at V_{DD}. See Figure 17.
3. All conditions must be met to ensure detection.
4. For V_{DD} = 3.3V with equal level tones and with the input signal amplifier external components as shown in Section 3. The internal threshold levels are proportional to V_{DD}. For other supply voltages or different signal level ranges the voltage gain of the input signal amplifier should be adjusted by selecting the appropriate external components as described in Section 4.2
5. Flat Noise in the 300Hz-3400Hz band for V23 and 200Hz-3200Hz for Bell202.
6. Meeting any of these conditions will ensure non-detection.
7. Open loop, small signal, low frequency measurements.
8. Timing for an external input to the XTAL pin.

 All trademarks and service marks are held by their respective companies.

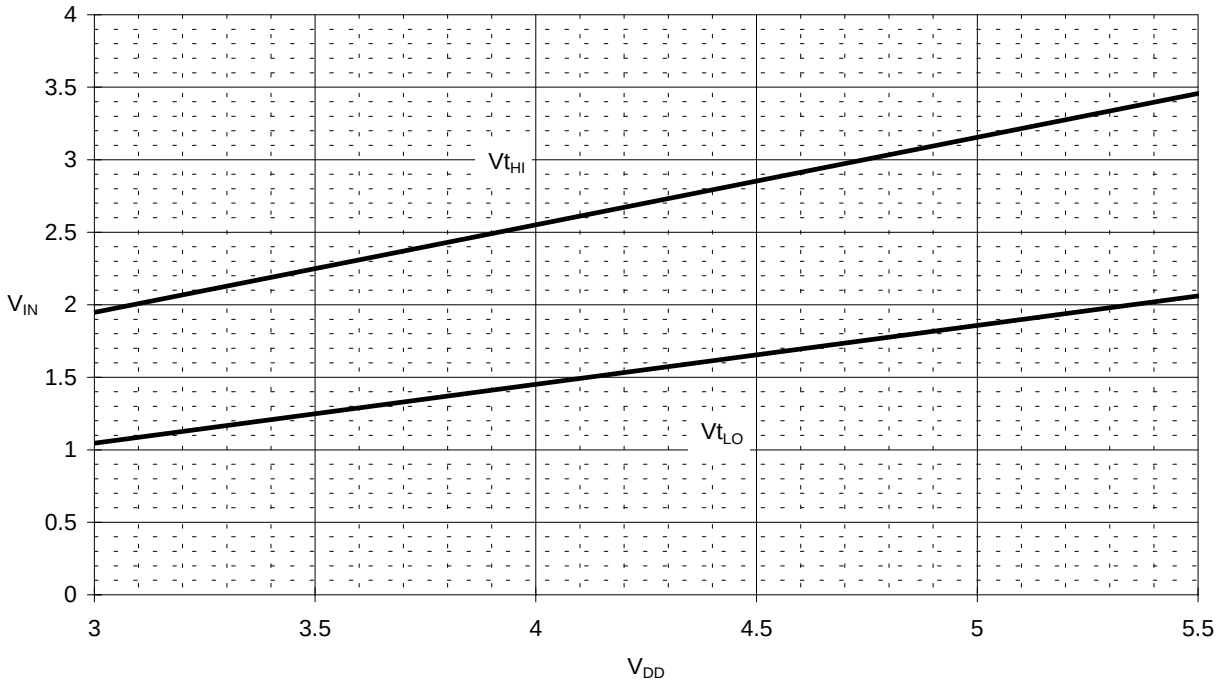


Figure 16: Schmitt Trigger typical input voltage thresholds vs. V_{DD}

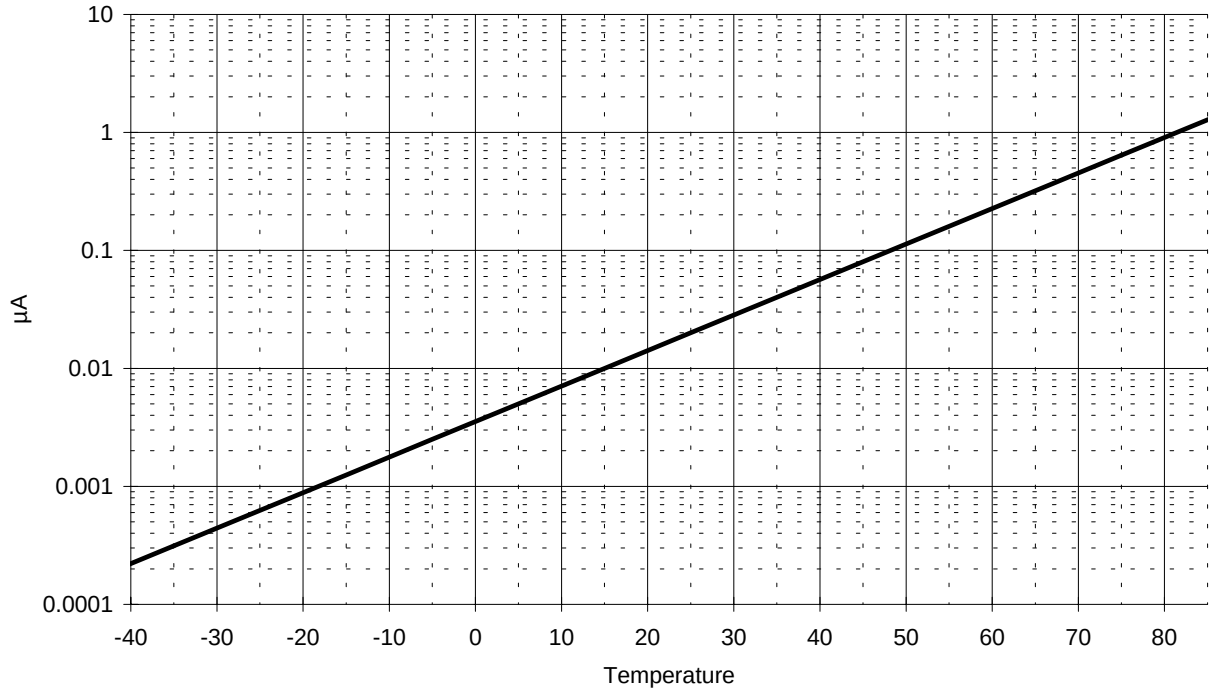
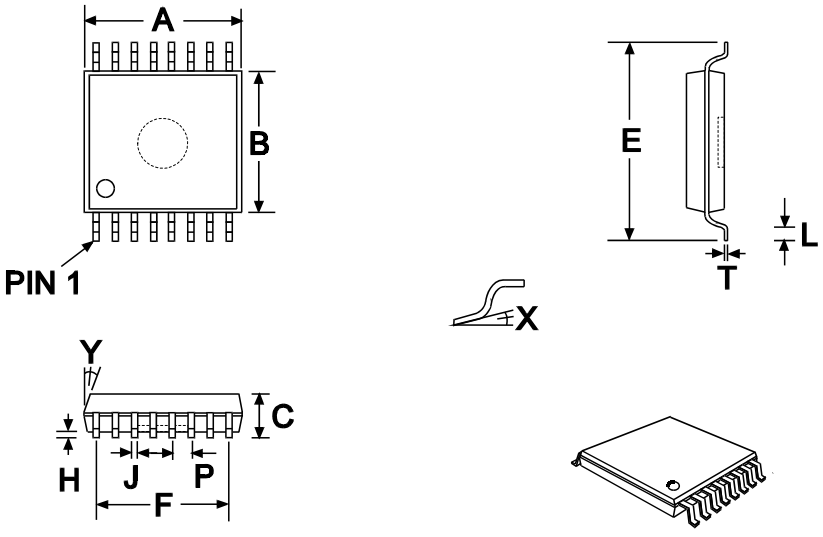


Figure 17: Typical 'Zero-Power' I_{DD} vs. Temperature (V_{DD} = 5.0V)

 All trademarks and service marks are held by their respective companies.

6.2 Packaging



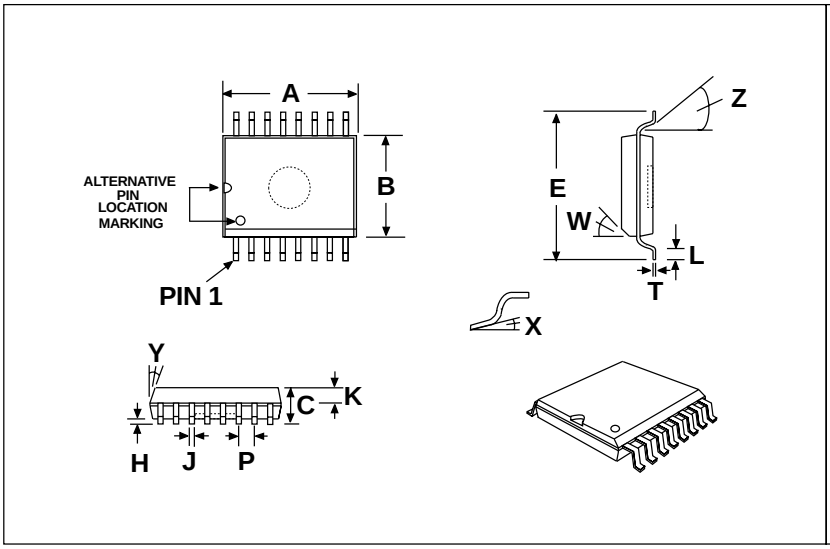
DIM.	MIN.	TYP.	MAX.
* A	0.193 (4.90)		0.201 (5.10)
* B	0.169 (4.30)		0.177 (4.50)
C	--------		0.047 (1.20)
E	0.248 (6.30)		0.256 (6.50)
F		0.179 (4.55)	
H	0.002 (0.05)		0.006 (0.15)
J	0.007 (0.17)		0.012 (0.30)
L	0.020 (0.50)		0.030 (0.75)
P		0.026 (0.65)	
T	0.003 (0.08)		0.008 (0.20)
X	0°		7°
Y		12°	

NOTE :

* A & B are reference data and do not include mold deflash or protrusions.

All dimensions in inches (mm.)
Angles are in degrees

Figure 18: 16-pin TSSOP Mechanical Outline: *Order as part no. CMX602BE4*



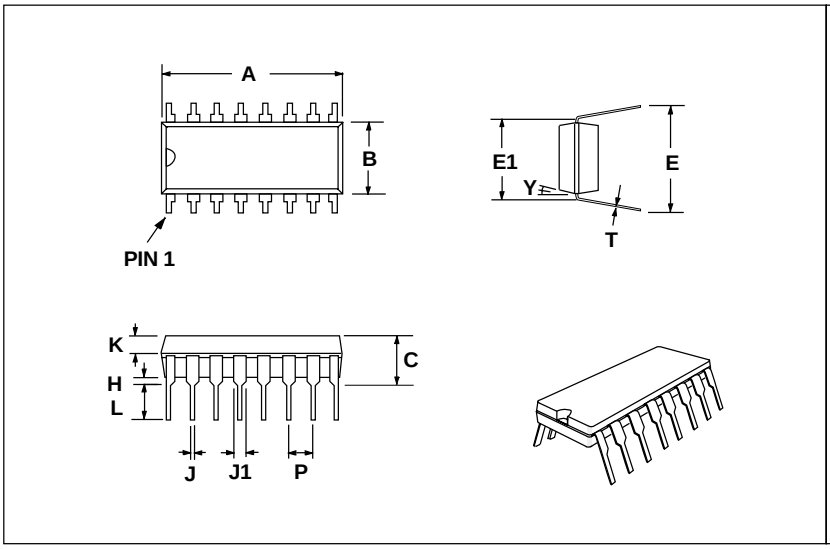
Package Tolerances

DIM.	MIN.	TYP.	MAX.
A	0.395 (10.03)		0.413 (10.49)
B	0.286 (7.26)		0.299 (7.59)
C	0.093 (2.36)		0.105 (2.67)
E	0.390 (9.90)		0.419 (10.64)
H	0.003 (0.08)		0.020 (0.51)
J	0.013 (0.33)		0.020 (0.51)
K		0.041 (1.04)	
L	0.016 (0.41)		0.050 (1.27)
P		0.050 (1.27)	
T	0.009 (0.23)		0.0125 (0.32)
W		45°	
X	0°		10°
Y	5°		7°
Z		5°	

NOTE : All dimensions in inches (mm.)
Angles are in degrees

Figure 19: 16-pin SOIC Mechanical Outline: *Order as part no. CMX602BD4*

 All trademarks and service marks are held by their respective companies.



Package Tolerances

DIM.	MIN.	TYP.	MAX.
A	0.740 (18.80)		0.810 (20.57)
B	0.240 (6.10)		0.262 (6.63)
C	0.135 (3.43)		0.200 (5.06)
E	0.300 (7.62)		0.390 (9.91).
E1	0.290 (7.37)		0.325 (8.26)
H	0.015 (0.38)		0.070 (1.77)
J	0.014 (0.35)		0.023 (0.58)
J1	0.040 (1.02)		0.065 (1.65)
K	0.056 (1.42)		0.064 (1.63)
L	0.121 (3.07)		0.150 (3.81)
P		0.100 (2.54)	
T	0.008 (0.20)		0.015 (0.38)
Y		7°	

NOTE : All dimensions in inches (mm.)
Angles are in degrees

Figure 20: 16-pin PDIP Mechanical Outline: *Order as part no. CMX602BP3*

 All trademarks and service marks are held by their respective companies.