CML Semiconductor Products

Application Information

Getting the Best from Your CMX602A

Introduction

The CMX602A will support Calling Line ID subscriber line protocols based on either the Bell 202 or CCITT V23 1200 baud FSK signalling for on-hook (type 1) and off-hook (type 2) data transmission.

Calling Identity Delivery on Call Waiting (CIDCW) Applications

Within the above protocols the most difficult aspect of designing CIDCW equipment is that of correctly detecting the CAS CPE Alerting Signal in the presence of speech signals, as required within the Bellcore specification.

This application note provides some guidance, suggestions and an example circuit design to incorporate the CXM602A within a telephone unit.

Bellcore report SR-TSV-002476 includes a test plan for CPE Alerting Signal detectors, which defines three categories of tests:

1. Signal recognition tests without speech present.

2. Talkdown tests - missed signals in the presence of speech.

3. Talkoff tests - false detections caused by speech.

The CMX602A will meet the requirements of (1) without any problem. However it will not meet the requirements of (2) and (3) if connected directly across tip and ring of the 2-wire telephone line because of the relatively high level of locally generated (near end) speech. (SR-TSV-002476 says that the average level of near end speech is 9dB higher than the average level of far end speech when both are measured at tip and ring of the CPE.)

These high near end speech levels can be too great to allow successful detection of the CAS signals, and are more likely to give rise to false detections.

A 2 to 4-wire hybrid is therefore needed to reduce the level of near end speech appearing at the CMX602A's input when it is in CAS detect mode, ideally this should provide about 16dB rejection of the near end speech although significant performance gains can be achieved with as little as 7dB.

Glossary of terms used within this Application Note	
CAS	Dual-tone CPE Alerting Signal as defined in SR-TSV-002476.
CID	Calling Identity Delivery System (Bellcore)
CIDCW	Calling Identity Delivery on Call Waiting, see Bellcore documents GR-30-CORE and SR-TSV-002476
CLIP	Calling Line Identity Presentation (BT).
CPE	Customer Premises Equipment i.e. the telephone set.
dBm	Signal level measurement, as used here 0dBm = 775mVrms
Hook Switch	The switch in a telephone which is operated when the handset is placed on the cradle.
On-Hook	The condition when the CPE is not being used i.e. the telephone handset is placed on the cradle, operating the hook switch
Off-Hook	The condition when the CPE is in use i.e. the telephone handset is removed from the cradle, releasing the hook switch

Feature Phones

Hardware

Any Feature Phone design will include circuitry to perform the normal telephone functions of dialling, AC and DC line terminations, microphone signal amplification and - most importantly for CIDCW applications - a 2/4-wire hybrid which can be used to drive a CMX602A as illustrated below in Figure 1.

Fig.1 CMX602A Application in a Feature Phone

This circuit uses two-thirds of a 4053B CMOS triple 2-channel analog multiplexer to switch the CMX602A analogue input to the tip and ring lines or to the receive (earpiece) output of the phone circuits. The control line 'Tipring' should be low when the CMX602A is being used to look for a CAS signal in off-hook mode, and should be high at all other times i.e. when receiving on-hook or off-hook FSK signals and when looking for the tone alert signal in a BT on-hook CLID application.

The values of RX and CX depend on the characteristics of the phone circuits used, and can be calculated on the following basis;

> If G is the received signal voltage at point A for a 1Vrms signal applied between tip and ring, then making RX equal to G * 470k will ensure that the CMX602A has the same sensitivity for signals coming via the Phone circuits as for those taken directly from the tip and ring lines. However, the CAS detection performance in off-hook applications can be improved slightly by reducing the CMX602A's sensitivity by 6dB, changing the 'will detect' level from -41dBm to -35dBm per tone.
> Thus the optimum values of RX and CX are given by:

$$RX = 2 * G * 470 \quad k\Omega$$

$$CX = 680 * 470k / RX \quad pF \text{ (the value is not critical)}$$

Note that the Microphone Mute input of the phone circuits is driven by the 602A's DET as required by the 'off-hook' control algorithm given in section 1.6.2 of the CMX602A Data Sheet. If the particular circuits used do not have a Microphone Mute input, then this function could be implemented by using the spare switch in the 4053B.

Feature Phones ......

Software

Figure 2 below shows a successful CIDCW transaction using the circuit of Figure 1 and the 'off-hook' control algorithm described in the current CMX602A Data Sheet.
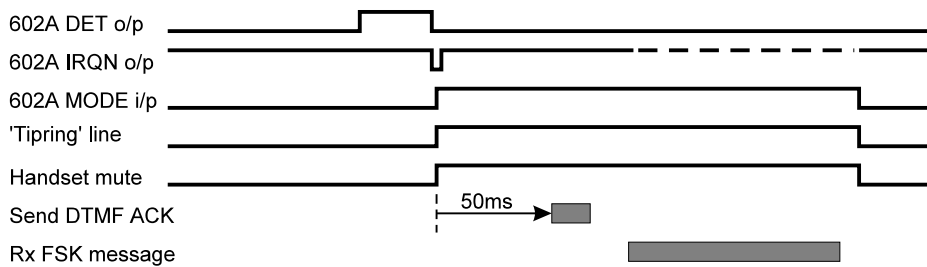

Fig.2 Successful CIDCW Transaction Using Circuit of Figure 1

While looking for a CAS signal, the CMX602A is running in Tone Detect mode (MODE i/p low), with its input connected to the Rx Speech output of the phone circuits (Tipring low). In this state the CMX602A's DET output directly controls the Microphone Mute line as required by the Data Sheet algorithm. The DET output serves no other purpose at this stage.

CAS signal detection is indicated by the CMX602A's IRQN output going low. When this happens the μC should:

1. Set the CMX602A to FSK mode by taking the MODE pin high (this will also clear the IRQN output).
2. Completely mute the local handset and keypad.
3. Set the Tipring line high, so that the CMX602A is connected directly across tip and ring (as the Rx Speech output of the phone circuits will now be muted).
4. Start a 50ms timer.

In the 50ms period between setting the CMX602A into FSK mode and sending the ACK signal, the CMX602A's DET output should be monitored and the transaction terminated if the line goes high during this time, as described in the Data Sheet algorithm.
At the end of the 50ms period, a DTMF ACK should be sent, after which the FSK message containing the waiting caller's ID will be received by the CMX602A. At the end of the message, the μC should set the CMX602A back into the 'looking for CAS' mode by taking the MODE and Tipring lines low and removing the local handset and keypad mute.

Other Aspects

Printed Circuit Layout

The CMX602A is capable of detecting and decoding small amplitude signals. To achieve this VDD and VBIAS decoupling are very important.

It is recommended that the decoupling capacitors are placed so that connections between them and the device pins are as short as practicable and via a printed circuit ground plane, which can also be laid out to shield the receive path from interfering signals.

High Frequency Interfering Signals

The CMX602A input filter uses switched capacitor technology running at 57.7kHz and is therefore sensitive to input signals at multiples of this frequency.

A linear anti-alias filter is included on chip between the output of the Input Signal Amplifier and the input to the switched capacitor filter, and this should provide adequate attenuation of out of band signals for most applications. Additional attenuation may be added if necessary by adding a 22pF capacitor in parallel with the input amplifier feedback resistor R8.

If the Ring Detect Circuit is Not Used

The RD pin should be connected to VSS and RT to VDD.

Common Mode Interference

The interface circuits between the telephone line and the CMX602A shown in the CMX602A Data Sheet have been designed to reduce the effects of common mode noise voltages appearing between the line and the CMX602A's ground connection (the VSS pin). However excessive levels of common mode noise can cause problems with the detection of the ringing signal or the line polarity reversal, with reception of CAS, the Tone Alert signal used in BT's CLIP system, and FSK data signals.

The extent of the problem depends mainly on the power supply used for the CMX602A and the connection (if any) between this supply and the tip and ring lines.