Consumer Microcircuits Limited

COMMUNICATION SEMICONDUCTORS

CMX208
ISDN Dual Telephony Protocol Engine

Features	Applications
• **Supports Incoming and Outgoing Calls**	• **Feature Phones**
• **Independent Port Configuration**	• **Pay-Phones**
• **Flexible B-channel Mapping**	• **PABX Telephones**
• **Supports CTR3 Approval**	• **DECT Cordless Phones**
• *Full API Available*	• *Reference Designs Available*
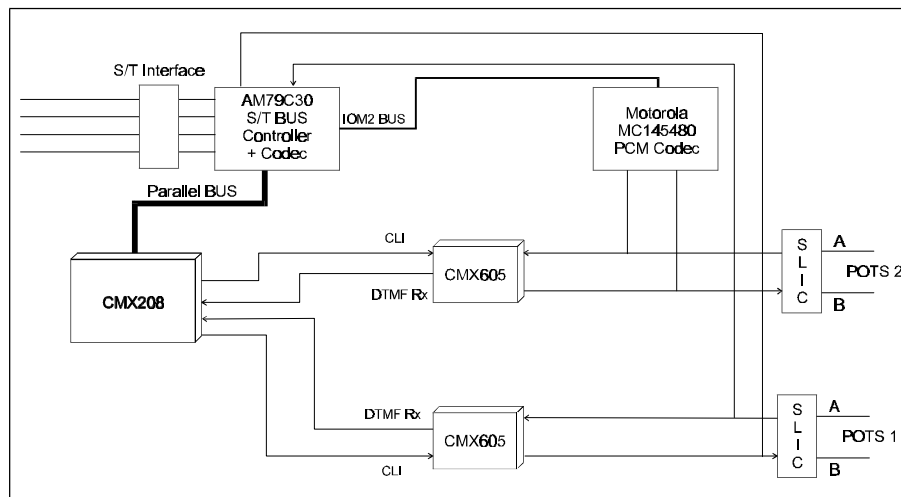
1.1   Brief Description

The CMX208 is an ISDN telephony protocol engine which implements the lower level ISDN interface and communicates with the CMX605 and other standard devices to form a fully integrated ISDN chipset for voice communications. The CMX208 puts all the main data processing elements in a single device. No ISDN software has to be written and simple 'Plug and Play' design results. This reduces development time and provides a highly cost-effective hardware solution. By using proven circuit designs, the designer can move quickly from initial concept through design in to manufacture.

The CMX208 supports two voice ports over the ISDN line, which can be used to provide ISDN telephony services or POTS line interfaces, and has independent keypad-configuration of these services for each port. The CMX208's feature set and architecture allow most analogue systems to be converted to an ISDN equivalent with enhanced features.

The CMX208 is designed to work with the AMD 79C30 S/T bus interface, the Motorola MC145480 PCM codec and the CML CMX605 POTS interface circuit, and also comes complete with embedded applications software. To support the CMX208, CML can also provide licensed reference designs on user request. A flexible Applications Program Interface (API) allows users to customise the features and operation of their own design. The CMX208 comes in a compact 80-pin surface mount package.

CONTENTS

Note: This product is in development: Changes and additions will be made to this specification. Items marked TBD or left blank will be included in later issues.

Information in this data sheet should not be relied upon for final product design.
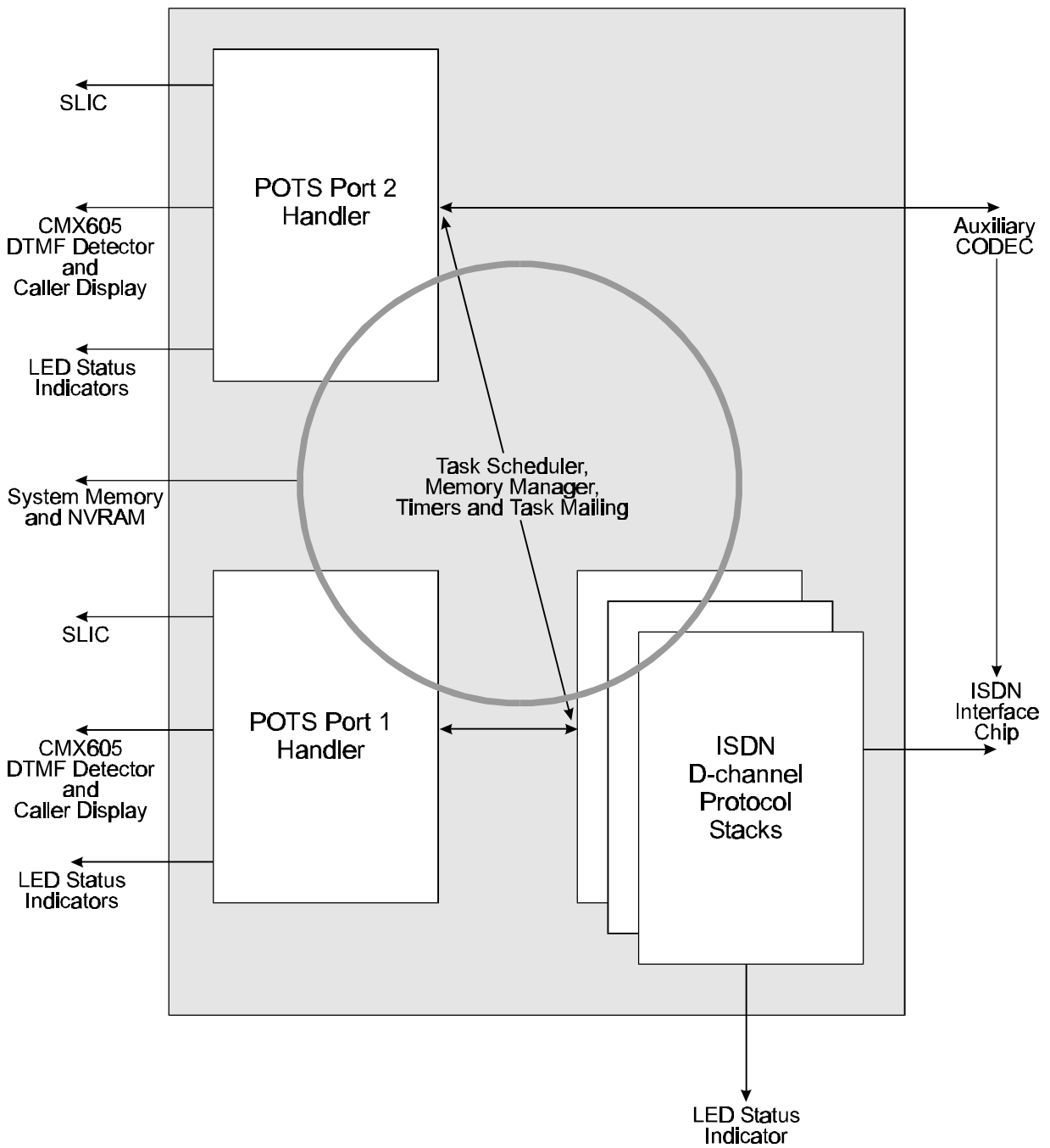
1.2 Block Diagram

Figure 1 Block Diagram

1.3 Signal List

S1 Package 80QFP	Signal		Description
Pin No.	Name	Type	
1	SCL	O/P	EEPROM - Serial Clock
2	SDA	BI	EEPROM - Serial Data
3	ISDNRST	O/P	ISDN S-interface Chip Reset
4	N/C	O/P	Do not make any connection to this pin
5	N/C	O/P	Do not make any connection to this pin
6	N/C	O/P	Do not make any connection to this pin
7	RSTN	I/P	CMX208 Chip Reset (active low)
8	DV_{DD1}	Power	The digital positive supply rail. Levels and voltages are dependent upon this supply. This pin should be decoupled to DV_{SS} by a capacitor
9	XTALN	O/P	The output of the on-chip Xtal oscillator inverter
10	XTAL	I/P	The input to the oscillator inverter from the Xtal circuit
11	DV_{SS1}	Power	The digital negative supply rail (ground)
12	LED1	O/P	POTS Port 1 Off-Hook Indicator (HK1)
13	LED2	O/P	POTS Port 2 Off-Hook Indicator (HK2)
14	N/C	O/P	Do not make any connection to this pin
15	LED4	O/P	POTS Port 2 Call Connected Indicator (CN2)
16	N/C	O/P	Do not make any connection to this pin
17	N/C	O/P	Do not make any connection to this pin
18	N/C	O/P	Do not make any connection to this pin
19	LED8	O/P	ISDN Line Activated Indicator (AR)
20	STN	O/P	Watchdog Timer Stimulus
21	LED9	O/P	POTS Port 1 Call Connected Indicator (CN1)
22	WRN	O/P	Memory Write Access Strobe
23	RDN	O/P	Memory Read Access Strobe
24	A19	O/P	Memory and Peripheral Address Bus
25	A18	O/P	Memory and Peripheral Address Bus
26	A17	O/P	Memory and Peripheral Address Bus
27	A16	O/P	Memory and Peripheral Address Bus
28	A15	O/P	Memory and Peripheral Address Bus

S1 Package 80QFP	Signal		Description
Pin No.	Name	Type	
29	A14	O/P	Memory and Peripheral Address Bus
30	A13	O/P	Memory and Peripheral Address Bus
31	A12	O/P	Memory and Peripheral Address Bus
32	A11	O/P	Memory and Peripheral Address Bus
33	A10	O/P	Memory and Peripheral Address Bus
34	A9	O/P	Memory and Peripheral Address Bus
35	A8	O/P	Memory and Peripheral Address Bus
36	A/D7	BI	Memory and Peripheral Address and Data Bus
37	A/D6	BI	Memory and Peripheral Address and Data Bus
38	A/D5	BI	Memory and Peripheral Address and Data Bus
39	A/D4	BI	Memory and Peripheral Address and Data Bus
40	A/D3	BI	Memory and Peripheral Address and Data Bus
41	A/D2	BI	Memory and Peripheral Address and Data Bus
42	A/D1	BI	Memory and Peripheral Address and Data Bus
43	A/D0	BI	Memory and Peripheral Address and Data Bus
44	ASTB	O/P	Address/Data Bus Strobe (data bus selected if low)
45	DV_{SS0}	Power	The digital negative supply rail (ground)
46	~	I/P	For manufacturer's use only. Connect to DV_{SS} directly
47	N/C	O/P	Do not make any connection to this pin
48	RINGP2	O/P	POTS Port 2 Ringing Generator (low when not ringing)
49	RINGN2	O/P	POTS Port 2 Ringing Generator (high when not ringing)
50	API-RXD	I/P	API/RS232 Port Rx Data (inactive = high)
51	API-TXD	O/P	API/RS232 Port Tx Data (high when inactive)
52	CLIP2	O/P	POTS Port 2 Line Voltage Adjustment (low if sending FSK to a Caller Display unit, as it is intended to make the SLIC present a high impedance to the POTS line)
53	B1/B2N	O/P	B-channel Select (high selects channel B1).
54	ILFI	O/P	ISDN Line Failure Indicator
55	DV_{DD0}	Power	The digital positive supply rail. Levels and voltages are dependent upon this supply. This pin should be decoupled to DV_{SS} by a capacitor

S1 Package 80QFP	Signal		Description
Pin No.	Name	Type	
56	RINGP1	O/P	POTS Port 1 Ringing Generator (low when not ringing)
57	RINGN1	O/P	POTS Port 1 Ringing Generator (high when not ringing)
58	CLIP1	O/P	POTS Port 1 Line Voltage Adjustment (low if sending FSK to a Caller Display unit, as it is intended to make the SLIC present a high impedance to the POTS line)
59	ILINE1	I/P	POTS Port 1 Hook Switch Status Detector (on-hook = low)
60	ILINE2	I/P	POTS Port 2 Hook Switch Status Detector (on-hook = low)
61	REPLY	I/P	CMX605 C-BUS Interface - Reply Data
62	CMD-DATA	O/P	CMX605 C-BUS Interface - Command Data
63	SER-CLK	O/P	CMX605 C-BUS Interface - Serial Clock
64	AV_{DD}	Power	The positive analogue supply rail. Levels and voltages are dependent upon this supply. This pin should be decoupled to AV_{SS} by a capacitor
65	AV_{REF1}	Power	A/D Reference Voltage. Connect to AV_{DD} directly
66	AV_{SS}	Power	The negative analogue supply rail (ground)
67	CSN1	O/P	CMX605 C-BUS Interface (chip select POTS Port 1)
68	CSN2	O/P	CMX605 C-BUS Interface (chip select POTS Port 2)
69	AV_{REF2}	Power	D/A Reference Voltage. Connect to AV_{DD} directly
70	AV_{REF3}	Power	D/A Reference Voltage. Connect to AV_{SS} directly
71	NMI	I/P	For manufacturer's use only. Connect to DV_{SS} directly
72	API-INT	I/P	API Interrupt (inactive = high)
73	IRQN	I/P	CMX605 C-BUS Interface - Interrupt (inactive = high)
74	~	I/P	For manufacturer's use only. Connect to DV_{SS} directly
75	~	I/P	For manufacturer's use only. Connect to DV_{SS} directly
76	~	I/P	For manufacturer's use only. Connect to DV_{SS} directly
77	ISDNINT	I/P	ISDN S-interface Chip Interrupt

S1 Package 80QFP	Signal		Description
Pin No.	**Name**	**Type**	
78	~	I/P	For manufacturer's use only. Connect to DV_{SS} directly
79	~	I/P	For manufacturer's use only. Connect to DV_{SS} directly
80	N/C	O/P	Do not make any connection to this pin

Notes: I/P = Input
O/P = Output
BI = Bidirectional

1.4 External Components

Figure 2 CMX208 Pinout
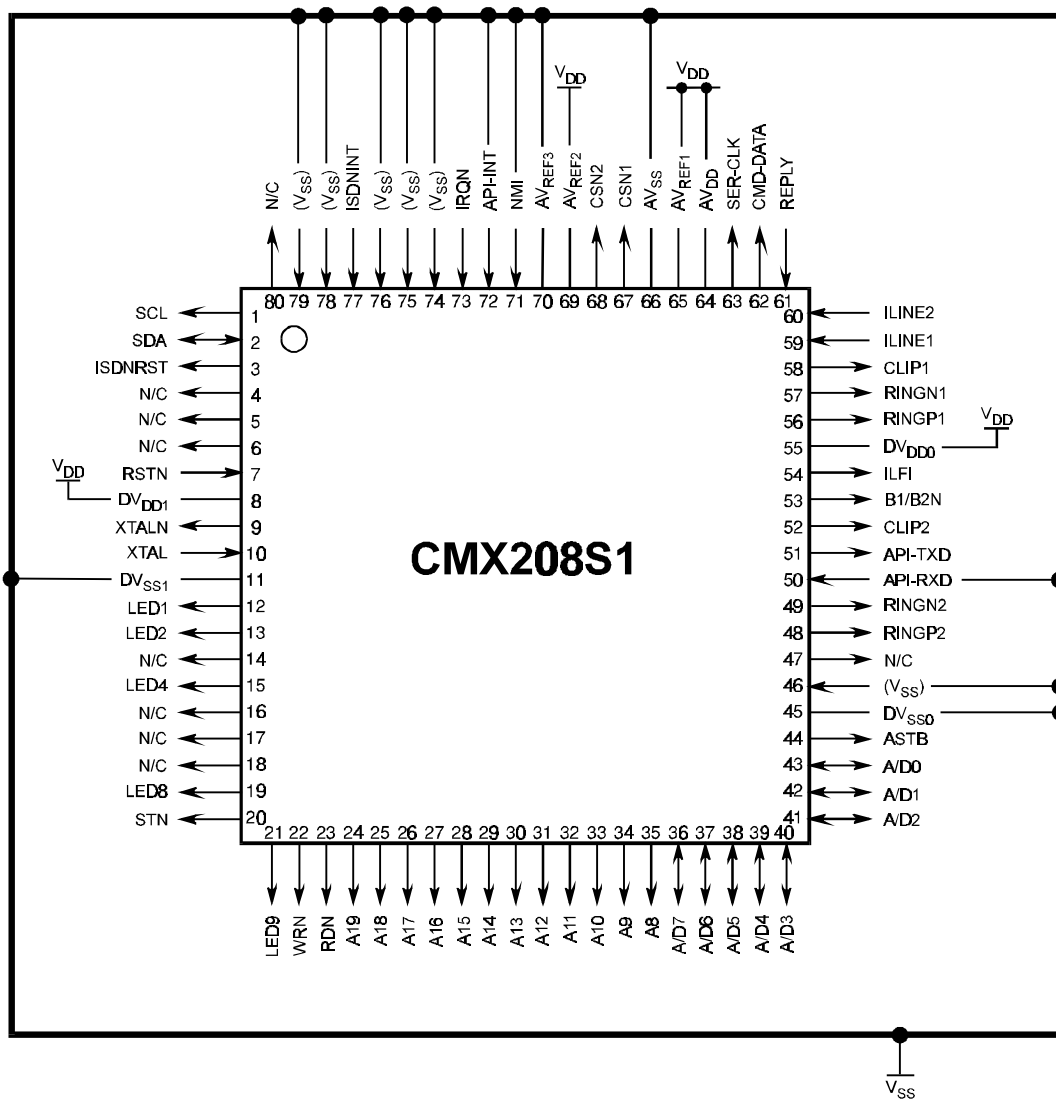
Note: This product is to be used as part of a chip-set. Please refer to the Applications Section (section 1.6) for details of the recommended chip-set.

1.5   General Description

The CMX208 is a single-chip data processor which has been mask programmed with firmware to implement an ISDN protocol stack. This enables the CMX208 to provide two analogue (POTS) ports with an ISDN S-bus network connection. Key variables are stored in an external EEPROM and the user can provide additional features by adding external ROM and RAM. Access to the firmware Application Programmer's Interface (API) facilitates the seamless integration of the user's additional features with the pre-programmed ISDN to POTS interfaces.

The CMX208 is intended for use as part of an ISDN chipset and all descriptions in this data sheet refer to this implementation, which is shown diagrammatically in Figure 3. The use of alternative chipsets is not supported.

The firmware supports connection to an ISDN S-bus network interface via the AMD AM79C30 ST controller with integral PCM codec for a single POTS port. An auxiliary Motorola MC145480 PCM codec will need to be added for the second POTS port.

The CMX208 interfaces with up to two CMX605 Tone Generator and DTMF Receiver chips, which decode incoming DTMF tones and generate call progress signals (eg busy tone) normally originating from an analogue telephone exchange. The firmware translates the CMX605 data into ISDN D-channel commands and vice versa to support both incoming and outgoing calls. For the ISDN interface, D-channel commands sufficient for standard telephony applications are implemented. With the aid of a small amount of discrete circuitry, exchange battery voltage, ringing current, line reversal and off-hook detection are also supported, to complete the POTS interface. The CMX208 has dedicated outputs for visible indicators (LEDs) which can be used to provide information on the call status. Support for Multiple Subscriber Numbering is also included in the firmware.

The CMX208 can be configured by means of keypad programming via either POTS port. Configuration parameters allow the user to change (for example) the format and cadence of the ringing signal, so as to facilitate use of the CMX208 in different countries. Each POTS interface is able to configure the variables relevant to its own use.

An Application Programmer's Interface (API) is available and is described separately in section 1.5.6. Further details are available on completion of a Non-Disclosure Agreement. Please contact CML Sales directly for further details.

The firmware and finite state machine embedded in the CMX208 have been used in products which have gained ETSI CTR3 approval.

1.5.1   Glossary

ACCM	Asynchronous Control Character Map
API	Application Programmer's Interface
CIDCW	Caller Identification During Call Waiting
CLI	Calling Line Identification
CRC	Cyclic Redundancy Check
CTS	Clear to Send
DCD	Data Carrier Detect
DDI	Direct Dialling Inwards
DTE	Data Terminal Equipment
DTMF	Dual Tone Multiple Frequency
DTR	Data Terminal Ready
HDLC	High Level Data Link Control
IA5	International Alphabet No 5
IE	Information Element
ILFI	ISDN Line Failure Indicator
ISDN	Integrated Services Digital Network
LAPB	Link Access Procedure - Balanced
LAPD	Link Access Procedure on the D-Channel
LCGN	Logical Channel Group Number
LED	Light Emitting Diode
LLI	Logical Link Identifier
MFO	Multiple Frame Operation
MSN	Multiple Subscriber Numbering
NU	Number Unobtainable
NUA	Network User Address
NUI	Network User Identification
PAD	Packet Assembler/Disassembler
PC	Personal Computer
PCM	Pulse Code Modulation
POTS	Plain Old (Analogue) Telephone Service
PPP	Point to Point Protocol
PVC	Permanent Virtual Circuit
RI	Ring Indication
RNR	Receiver Not Ready
RR	Receiver Ready
RTS	Ready to Send
SABM	Set Asynchronous Balanced Mode
SABME	Set Asynchronous Balanced Mode Extended
SLIC	Subscriber Line Interface Circuit
SPM	Subscriber Pulse Metering
SVC	Switched Virtual Circuit
TEI	Terminal Endpoint Identifier

1.5.2   Initialisation

On power-up, the CMX208 assumes its default values, which are factory programmed into the firmware. It then performs a self-test, during which all of the LED pins and the ILFI pin are held high for 3s. If the test is unsuccessful, the CMX208 remains in this condition.

If the test is successful, the CMX208 reads its preset values from the attached EEPROM and examines the state of the ISDN link (ie Layer 1) before commencing normal operation. On power-up, the ISDN link is de-activated, the POTS ports are assumed to be on-hook and ringing is disabled.

1.5.3   ISDN Interface

Two simultaneous voice calls are possible. Incoming calls are firstly checked for other calls present, then the MSN is checked for validity, then the channel mapping, so that responses will be handled accordingly.

When channel mapping is enabled, outgoing calls will request the channel enabled. When not enabled, a request for any channel is made. If no free channels are available for outgoing calls, a locally generated busy tone is returned to the analogue port.

1.5.3.1 Activation

Activation occurs in the following circumstances:
- The ISDN network activates.
- The device connected to the analogue port goes off hook.

The Terminal Endpoint Identifier (TEI) is negotiated. Line powering of the CMX208 is not supported.

The 'AR' indicator (LED8) toggles between high and low states when the CMX208 is powered up, and remains constantly low once the CMX208 identifies an activated ISDN line.

ISDN line power detection is not implemented and the CMX208 will negotiate a new TEI on any new network activation.

1.5.3.2 De-activation or Line Disconnection

De-activation or line disconnection causes the TEI to be removed. Upon re-connection the CMX208 will only be re-activated and request a new TEI when one of the conditions in the above section is met.

1.5.3.3 Line Failure Detection

If the line failure detection parameter is enabled (via either POTS port) the CMX208 will check that Layer 2 communications are active every sample period of 30 seconds. If Layer 2 communications are not active, the CMX208 will attempt to activate them. If they remain inactive for 2 sample periods, the line is deemed to have failed, so then the ILFI pin is set high and both RINGP1 and RINGN1 pins (port 1 only) are set low. The CMX208 continues to attempt to activate the line and if it becomes active and stays active for 2 sample periods, then the ILFI pin is set low and both RINGP1 and RINGN1 pins (port 1 only) are restored to their default settings.

1.5.3.4 Incoming Calls

Incoming voice calls and calls from analogue lines are directed to the analogue ports and all other incoming calls are rejected with a Cause Information Element set to 'Incompatible Destination'.

1.5.3.5 Multiple Subscriber Numbering

Multiple Subscriber Numbering (MSN) enables each POTS port of the CMX208 to have its own telephone number. Up to 23 digits can be saved as the MSN for each port.

All incoming SETUP messages will be checked for the presence of a Called Party Number Information Element (IE). If one is present it is compared with the saved MSN number (if present), starting with the last digit of both numbers. Comparison continues until there are no more numbers in the MSN saved number or the incoming Called Party Number or there is a difference between the numbers. The MSN is said to match if the saved MSN and the incoming calls' Called Party Number are the same for the duration of the shorter number (ie if the digit '1' is saved and the received Called Party Number is 654321, then the MSN matches). If there is no saved MSN, the Called Party Number is ignored and call processing continues.

When there is a saved MSN and the Calling Party Number transmit is enabled, all outgoing call SETUP messages will contain a Calling Party Number Information Element.

Note 1: When a CMX208 with MSN saved and Calling Party Number transmit enabled is connected to some exchanges, no dial tone is heard when going off-hook.

Note 2: Disabling the Calling Party Number transmit will mean that the called party may not receive the Calling Line Identification (CLI), or if they do receive a CLI it will probably be the base number and not the number specific to the calling telephone.

1.5.3.6 Channel Mapping

It is possible to configure the CMX208 so that the analogue ports will only originate calls to and respond to calls from a specific ISDN B-channel. This is a useful feature if, for example, you wish to have a hunt group on your ISDN line (ie to select the next available channel) and only want one voice port to ring on an incoming call.

1.5.4   POTS Configuration

1.5.4.1 Configuration and Control via DTMF Keypad

Configuration can be carried out at any time by causing the POTS port to go off-hook and then immediately entering a configuration sequence of DTMF tones. The sequence signalled to the CMX208 will determine the configuration to be performed, as shown in the following table.

Configuration Sequence	Name	Description	Default
♠02♠#	Test watchdog	Puts the CMX208 into a permanent loop, not updating the external watchdog counter, so after 2s it should reset.	n/a
♠81♠#	Disable CLI delivery on port	Inhibits CLI delivery on the analogue POTS port	n/a
♠81♠1n#	Use V23 FSK for CLI delivery	Configures modem standard to be used for CLI delivery. n = alert mode 0 = FSK follows ring burst as per ETS 300 659-1 para. 6.1.1 1 = FSK follows dual tone alert as per ETS300 659-1 para. 6.1.2.a 2 = FSK follows ringing pulse alert as per ETSI 300 659-1 para. 6.1.2.b 3 = FSK follows line reversal and tone alert as per ETSI 300 659-1 para. 6.1.2.c and BT SIN227.	Disabled
♠81♠2#	Use Bell 202 FSK for CLI delivery	Configures modem standard to be used for CLI delivery. FSK follows ring burst as per Bellcore GR-30-CORE and SR-TSV-002476	Disabled
♠90♠#	Clear MSN	Clears any saved digits	n/a
♠90♠n#	Save Multiple Subscriber Number (MSN)	n = MSN (up to 23 digits)	Clear
♠93♠#	Clear country code	Country code is set to UK by default	n/a

♠93♠n#	Change country code	n = country code
		    0 = UK
		    1 = Belgium
		    2 = Rest of Europe
			UK

♠94♠#	Clear channel mapping	Incoming calls on any channel are accepted (provided other parameters are valid eg MSN).	n/a
♠94♠n#	Enable channel mapping	Where n = 1 or 2 for the appropriate channel.	No channel map

Configuration Sequence	Name	Description	Default
♠95♠#	Disable Calling Party No. transmit	Outgoing call SETUP messages do not contain any Calling Party Number Information Elements.	n/a
♠95♠1#	Enable Calling Party No. transmit	Outgoing call SETUP messages contain Calling Party Number Information Element with number set to saved MSN (if a number is present).	Enabled
♠96♠#	Disable DDI transmit	Prevents digits being transmitted to the POTS port upon call connection.	n/a
♠96♠1#	Enable DDI transmit	Upon connection of a call on POTS port 1 only, if there was a Called Party Number Information Element present in the incoming call setup message, the digits are sent as DTMF tones to the POTS port.	Disabled
♠97♠#	Disable line failure detection	Once the CMX208 is de-activated it stays de-activated until the network re-activates it or an outgoing call needs to be made.	n/a
♠97♠1#	Enable line failure detection	The CMX208 checks to see if the ISDN line is activated and Layer 2 communications can be made. It then sets the ILFI pin accordingly.	Disabled
♠9♠♠1234567890#	Initialise all configurations.	Resets all of the configuration variables back to their default values.	n/a

Of the above configurations, MSN and Channel Mapping are saved on a per port basis. The rest are saved on a system-wide basis, the last details entered at either port being the configuration saved.

The extent to which full CLI information is delivered to the POTS port will depend upon the CLI facilities which have been implemented on the ISDN network.

Once the '♠' has been recognised, each digit pressed is then checked for validity as a configuration sequence. If any digit pressed is not a valid configuration digit, all digits pressed so far will be transmitted to the network in INFORMATION messages as Keypad Information Elements, until a '#' is entered (with the exception of '♠#' being entered, see Keypad Operation below). If the first four digits received are a valid configuration sequence then the configuration mode is entered. When a valid configuration has been completed the CMX208 will send a single DTMF tone to the POTS port. If a valid configuration sequence is received but subsequent digits are invalid, then subsequent digits entered will be ignored and two DTMF tones will be sent to the POTS port.

If the port goes on-hook part way through configuration, it will cause any digits received so far to be ignored. Configurations can be performed consecutively with the exception of the test function (where the attached handset must be replaced immediately after the configuration has been audibly signalled to the POTS port). All configurations entered will be retained after a power-down as they are stored in the external EEPROM.

1.5.5 POTS Operation

1.5.5.1 Keypad Operation

The CMX208 supports ISDN keypad messages for control of Network Supplementary services either before or during call establishment. When dialling a number (ie off-hook and dial tone audible on POTS port), or if a call has been disconnected by the network but the POTS port has not yet gone on-hook, any keypad string entered will be sent to the network as 'Keypad Information Elements' within INFORMATION messages. Keypad strings are defined as the following sequences of digits, with the exception of the configuration strings defined in the previous section:

> ♠...#
> ♠#...#
> #...#

When a call is connected, pressing the recall key results in all subsequent key presses being sent to the network as 'Keypad Information Elements' within INFORMATION messages, until the handset is replaced. The tones generated by the key presses are also passed down the B-channel, so the remote user will be able to hear them.

1.5.5.2 Incoming POTS Calls

An incoming POTS call is identified by the Bearer Capability Information Element of the SETUP message being set to 'Speech' or '3.1 kHz Audio'. The call will be routed to either (or both) of the POTS ports which satisfy the following three conditions:

- The port is on-hook.
- The MSN saved for the port matches the Called Number in the incoming SETUP message, or no MSN is specified for the port, or there is no Called Number in the SETUP message. See section 1.5.3.5 for details of POTS port MSN selection.
- The ISDN B-channel on which the call is placed (as indicated in the SETUP message) is compatible with the channel mapping configuration for the port. See section 1.5.3.6 for details of POTS port channel mapping selection.

When the call is routed to a port, the ringing signal for that port will be applied by means of the RINGP1 and RINGN1 (or RINGP2 and RINGN2) pins.

The call is answered when either of the ports with ringing signal goes off-hook. The ringing signal is then stopped and the ISDN call is connected to that port.

1.5.5.3 Outgoing POTS Calls

Outgoing calls are initiated when a POTS port goes off-hook. An ISDN SETUP message is sent to the network with the Bearer Capability Information Element set to 'Speech'. The dial tone presented by the network on that ISDN B-channel which was selected by channel mapping (see section 1.5.3.6), will be routed to the POTS port initiating the call.

When DTMF tones are received from the POTS port, they are sent to the network either as Called Party Number or Keypad Information Elements. Keypad Information Elements are discussed in section 1.5.5.1.

Receipt of a valid DTMF tone will prompt its conversion to IA5 coded digits, as shown in the following table (IA5 hex digits are in brackets). If the first valid digit to be received is a '♠' then the configuration mode is entered and subsequent digits will be monitored and saved as indicated in section 1.5.4.1. If the first tone received is not a '♠' or '#' (see section 1.5.5.1) that digit and all subsequent digits will be passed to the network in an INFORMATION message as a Called Party Number Information Element.

Digits received before the network has returned the SETUP ACK message are saved. Upon receipt of the SETUP ACK any saved digits will be transmitted.

The DTMF tone mapping is as shown below:

Low Group (Hz)	High Group (Hz)			
	1209	1336	1477	1633
697	1 (31)	2 (32)	3 (33)	A (not used)
770	4 (34)	5 (35)	6 (36)	B (not used)
852	7 (37)	8 (38)	9 (39)	C (not used)
941	♠ (2A)	0 (30)	# (23)	D (not used)

Once the network has indicated that the full number has been received, no further digits will be sent to the network. All tones and announcements from the network (eg ringing, NU, busy etc) and audio (if the call is connected) will be routed to the POTS port initiating the call, until that port goes on-hook.

1.5.5.4 Connected Calls

Once a call is connected to an analogue port, whether it was incoming or outgoing, a port-specific LED indicator pin is set high to indicate that the call is connected. See section 1.5.9.1 for details of the LED indicator pins. Once the call is disconnected, either by receipt of a DISCONNECT message from the network or an on-hook indication, the ports' LED indicator pin is set low.

During a call, if a Recall (ie a line break of appropriate length) is received from a POTS port, the CMX208 will start to look for DTMF tones received on that POTS port. Any tones received will then be sent to the network in ISDN INFORMATION messages, as Keypad Information Elements.

1.5.5.5 Call Clearing

The call is cleared either by the port going on-hook or by the ISDN network. Note that the ISDN B-channel which was being used is not released until the POTS port which was in use has gone on-hook.

1.5.6   Application Programmer's Interface

Details of this will be supplied to customers under a Non-Disclosure Agreement.

The following Memory Map indicates the main code areas used on the CMX208:

Function	Start Hex Address	End Hex Address
Code Space	000 000	01F FFF
External RAM	020 000	03F FFF
API area	0C0 000	0EF FFF
AMD79C30 ISDN Interface Chip	0F0 000	0F0 0FF
PSB21525 HDLC Driver Chip	0F0 100	0F0 1FF
Reserved	0F0 200	0FF FFF

1.5.7   Hardware Description

1.5.7.1 LED Status Indicators (LED1 to LED9, and ILFI)

LED1 (HK1) is low when analogue port 1 is off-hook, high when on-hook.

LED2 (HK2) is low when analogue port 2 is off-hook, high when on-hook.

LED4 (CN2) is high when analogue port 2 is connected to the ISDN network, low when not connected.

LED8 (AR) is pulsed high and low until the ISDN line is activated, when it remains low constantly.

LED9 (CN1) is high when analogue port 1 is connected to the ISDN network, low when not connected.

ILFI is high when an ISDN Link Failure is Indicated, low when the link is operational.

The functions of the LED and ILFI indicators are set out in the table below:

Pin No.	Designation	POTS port 1	POTS port 2
12	LED1	Off-Hook	~
13	LED2	~	Off-Hook
15	LED4	~	Call Connected
19	LED8	ISDN Line Activated	ISDN Line Activated
21	LED9	Call Connected	~
54	ILFI	ISDN Line Failure Indicator	ISDN Line Failure Indicator

1.6   Application Notes

1.6.1   General

The CMX208 is intended for use as part of an ISDN chipset. The CML recommended hardware implementation contains the following elements (refer to Figure 3):

       'S' bus interface via RJ45 socket.
       RJ11 analogue telephone sockets and analogue circuitry.
       ISDN line transformer.
       AMD79C30 S-interface controller.
       Auxiliary Motorola MC145480 PCM codec.
       64K bytes external RAM.
       16K Non-volatile memory.
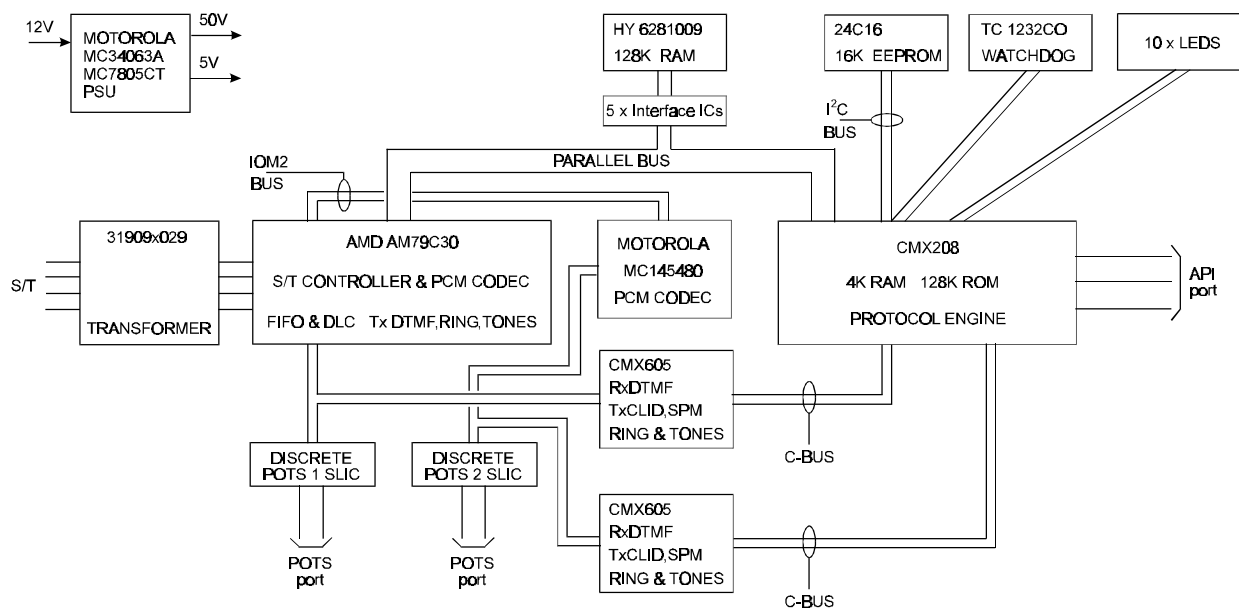   Six processor controlled LED indicator signals.

Figure 3 Application Block Diagram

1.6.2   Approvals

The firmware and finite state machine embedded in the CMX208 have been used in products which have gained ETSI CTR3 approval.

1.7   Performance Specification

1.7.1   Electrical Performance

1.7.1.1 Absolute Maximum Ratings
Exceeding these maximum ratings can result in damage to the device.

	Min.	Max.	Units
Supply (AV_{DD} - AV_{SS}), (DV_{DD0} - DV_{SS0}), (DV_{DD1} - DV_{SS1})	-0.3	7.0	V
Voltage on any pin to AV_{SS}, DV_{SS0} or DV_{SS1}	-0.3	V_{DD} + 0.3	V
Current into or out of any V_{DD} or V_{SS} pin	-30	+100	mA
Current into or out of any other pin	-20	+10	mA

S1 Package (QFP)	Min.	Max.	Units
Total Allowable Power Dissipation at Tamb = 25°C		1300	mW
... Derating		17	mW/°C
Storage Temperature	-55	+125	°C
Operating Temperature	-40	+85	°C

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

	Notes	Min.	Max.	Units
Supply: (AV_{DD} - AV_{SS}), (DV_{DD0} - DV_{SS0}), and (DV_{DD1} - DV_{SS1})		2.7	5.5	V
Operating Temperature		-40	+85	°C
32 MHz Xtal Frequency Tolerance		-100	+100	ppm

1.7.1.3 Operating Characteristics

Details in this section represent design target values and are not currently guaranteed.

For the following conditions unless otherwise specified:

Xtal Frequency = 32MHz $\pm$ 100ppm, $AV_{DD} = DV_{DD0} = DV_{DD1}$ = 3.0V to 5.0V, Tamb = - 40°C to +85°C.
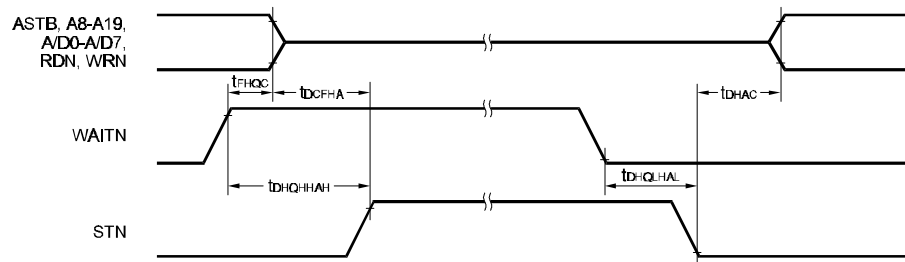
	Notes	Min.	Typ.	Max.	Units
DC Parameters					
I_{DD} (total, operational)	1	–	25.0	45.0	mA
I_{DD} (total in HALT mode)	1	–	13.0	26.0	mA
I_{DD} (total in IDLE mode)	1	–	–	12.0	mA
Digital Interface					
Input logic "1" level		70%	–	–	V_{DD}
Input logic "0" level		–	–	30%	V_{DD}
Input leakage current (Vin = 0 to DV_{DD})		-10.0	–	+10.0	µA
Output logic "1" level (I_{OH} = -2mA)		V_{DD} -1.0	–	–	V
Output logic "0" level (I_{OL} = 2mA)		–	–	400	mV
Input or Output leakage current (Vout = V_{DD})		–	–	10	µA
Xtal/Clock Input					
'High' pulse width (t_{WXH})	2	10	–	125	ns
'Low' pulse width (t_{WXL})	2	10	–	125	ns
Risetime (t_{XR})	2	–	–	10	ns
Falltime (t_{XF})	2	–	–	10	ns
Period (t_{CYK})	2, 3	31.2468	–	31.2531	ns

Notes: 1. Not including any current drawn by external circuitry.
2. Timing for an external input to the XTAL pin.
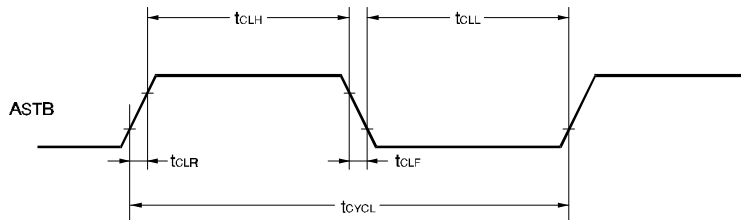3. A fundamental cut crystal is recommended.

1.7.1.3 Operating Characteristics (continued)

Timing Diagrams

(1) Read operation

(2) Write operation

Figure 4 External Memory Access Timing
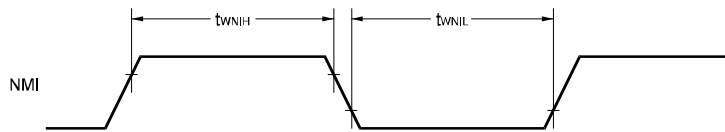
Timing Diagrams (continued)

(3) Hold operation

Figure 5 Bus Hold Timing
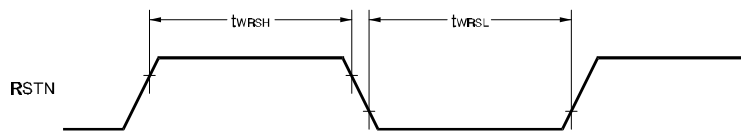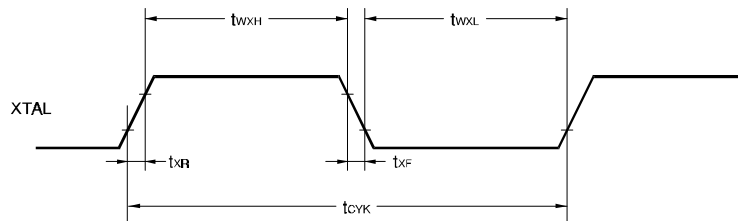
CLOCK OUTPUT TIMING

INTERRUPT INPUT TIMING

RESET INPUT TIMING

EXTERNAL CLOCK TIMING

Figure 6 Miscellaneous Timing

AC Timing Parameters (continued)

For the following conditions unless otherwise specified:
Xtal Frequency = 32MHz, $AV_{DD} = DV_{DD0} = DV_{DD1} = 3.0V$ to $5.0V$, Tamb = - 40°C to +85°C.

Read/Write operation (1/2)

Parameter	Symbol	Conditions	Min.	Max.	Units
Address setup time	t_{SAST}	V_{DD} = +5.0V ± 10%	(0.5 + a) T - 15	–	ns
			(0.5 + a) T - 31	–	ns
ASTB high-level width	t_{WSTH}	V_{DD} = +5.0 V ± 10%	(0.5 + a) T - 17	–	ns
			(0.5 + a) T - 40	–	ns
Address hold time to (ASTB↓)	t_{HSTLA}	V_{DD} - +5.0 V ± 10%	0.5T - 24	–	ns
			0.5T - 34	–	ns
Address hold time (to RD↑)	t_{HRA}		0.5T - 14	–	ns
Delay from address to RD↓	t_{DAR}	V_{DD} = +5.0V ±10%	(1 + a) T - 9	–	ns
			(1 + a) T - 15	–	ns
Address float time (to RD↓)	t_{FRA}		–	0	ns
Delay from address to data input	t_{DAID}	V_{DD} = +5.0V ±10%	–	(2.5 + a + n) T - 37	ns
			–	(2.5 + a + n) T - 52	ns
Delay from ASTB↓ to data input	t_{DSTID}	V_{DD} = +5.0V ± 10%	–	(2 + n) T - 40	ns
			–	(2 + n) T - 60	ns
Delay from RD↓ to data input	t_{DRID}	V_{DD} = +5.0 V ± 10%	–	(1.5 + n) T - 50	ns
			–	(1.5 + n) T - 70	ns
Delay from ASTB↓ to RD↓	t_{DSTR}		0.5T - 9	–	ns
Data hold time (to RD↑)	t_{HRID}		0	–	ns
Delay from RD↑ to address active	t_{DRA}	V_{DD} = +5.0 V ± 10%			
		After program is read	0.5T - 8	–	ns
		After program is read V_{DD} = +5.0 V ± 10%	0.5T - 12	–	ns
		After data is read	1.5T - 8	–	ns
		After data is read	1.5T - 12	–	ns
Delay from RD↑ to ASTB↑	t_{DRST}		0.5T - 17	–	ns
RD low-level width	t_{WRL}	V_{DD} = 5.0 V ± 10%	(1.5 + n) T - 30	–	ns
			(1.5 + n) T - 40	–	ns
Address hold time (to WR↑)	t_{HWA}		0.5T - 14	–	ns
Delay from address to WR↓	t_{DAW}	V_{DD} = +5.0V ± 10%	(1 + a) T - 5	–	ns
			(1 + a) T - 15	–	ns
Delay from ASTB↓ to data output	t_{DSTOD}	V_{DD} = +5.0V ± 10%	–	0.5T + 19	ns
			–	0.5T + 35	ns
Delay from WR↓ to data output	t_{DWOD}		–	0.5T - 11	ns
Delay from ASTB↓ to WR↓	t_{DSTW}		0.5T - 9	–	ns

Where: T = t_{CYK} (system clock cycle time)
      a = 1 (during address wait), otherwise, 0
      n = Number of wait states (n = 2)

Read/Write operation (2/2)

Parameter	Symbol	Conditions	Min.	Max.	Units
Data setup time (to WR↑)	t_{SODW}	V_{DD} = +5.0 V ± 10%	(1.5 + n) T - 30	–	ns
			(1.5 + n) T - 40	–	ns
Data hold time (to WR↑) Note 1	t_{HWOD}	V_{DD} = +5.0V ± 10%	0.5T - 5	–	ns
			0.5T - 25	–	ns
Delay from WR↑ to ASTB↑	t_{DWST}		0.5T - 12	–	ns
WR low-level width	t_{WWL}	V_{DD} = +5.0V ± 10%	(1.5 + n) T - 30	–	ns
			(1.5 + n) T - 40	–	ns

Note 1: Hold time includes the time during which V_{OH1} and V_{OL1} are held under the load conditions of C_L = 50 pF and R_L = 4.7 kΩ.

Bus Hold timing

Parameter	Symbol	Conditions	Min.	Max.	Units
Delay from WAITN↑ to float	t_{FHQC}		–	(6 + a + n) T + 50	ns
Delay from WAITN↑ to STN↑	$t_{DHQHHAH}$	V_{DD} = +5.0 V ± 10%	–	(7 + a + n) T + 30	ns
			–	(7 + a + n) T + 40	ns
Delay from float to STN↑	t_{DCFHA}		–	1T + 30	ns
Delay from WAITN↑ to STN↓	$t_{DHQLHAL}$	V_{DD} = +5.0 V ± 10%	–	2T + 40	ns
			–	2T + 60	ns
Delay from STN↓ to active	t_{DHAC}	V_{DD} = +5.0 V ± 10%	1T - 20	–	ns
			1T - 30	–	ns

Miscellaneous timing

Parameter	Symbol	Conditions	Min.	Max.	Units
ASTB cycle time	t_{CYCL}		nT	–	ns
ASTB low-level width	t_{CLL}	V_{DD} = +5.0 V ± 10%	0.5 t_{CYCL} - 10	–	ns
			0.5 t_{CYCL} - 20	–	
ASTB high-level width	t_{CLH}	V_{DD} = +5.0 V ± 10%	0.5 t_{CYCL} - 10	–	ns
			0.5 t_{CYCL} - 20	–	
ASTB rise time	t_{CLR}	V_{DD} = +5.0 V ± 10%	–	10	ns
			–	20	
ASTB fall time	t_{CLF}	V_{DD} = +5.0 V ± 10%	–	10	ns
			–	20	ns
NMI low-level width	t_{WNIL}		10	–	µs
NMI high-level width	t_{WNIH}		10	–	µs
RSTN low-level width	t_{WRSL}		10	–	µs
RSTN high-level width	t_{WRSH}		10	–	µs

Where: T = t_{CYK} (system clock cycle time)
           a = 1 (during address wait), otherwise, 0.
           n = Number of wait states (n = 2).

1.7.2   Packaging
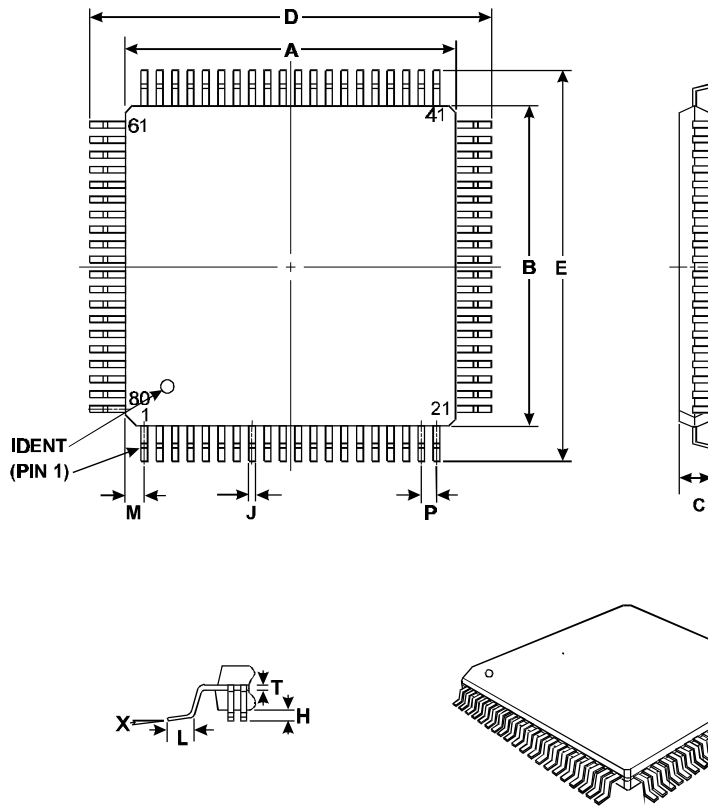
DIM.	MIN.	TYP.	MAX.
* A	0.543 (13.8)		0.560 (14.2)
* B	0.543 (13.8)		0.560 (14.2)
C			0.067 (1.70)
D	0.669 (17.0)		0.685 (17.4)
E	0.669 (17.0)		0.685 (17.4)
H	0.002 (0.05)		0.008 (0.20)
J	0.010 (0.26)		0.015 (0.38)
L	0.023 (0.60)		0.040 (1.00)
M		0.032 (0.825)	
P		0.026 (0.65)	
T	0.004 (0.10)		0.008 (0.20)
X	0°		10°

NOTES : All dimensions In Inches (mm.)

Angles In degrees

*

Each lead centerline Is located within 0.13 mm (0,005 inch) of its true position (T.P.) at maximum material condition

IDENT
(PIN 1)

Figure 7 QFP Mechanical Outline: *Order as part no. CMX208S1*