CML Microcircuits

COMMUNICATION SEMICONDUCTORS

Application Note
The CMX869x Modem Series
Upgrade Path

1   The CMX869x modem series

The CMX869x modem series provides the functions necessary to implement a V.32 bis automode modem and includes all of the signaling likely to be required within the General Switched Telephone Network, GSTN or PSTN. Some applications normally use a low data rate for regular traffic but require a much higher data rate for occasional traffic. To support such applications the original CMX869 specification has been extended through the CMX869A and CMX869B. There are no pin-out or signal differences between the CMX869x devices so they may be used interchangeably in the same hardware. However, extending the function set required minor register bit re-assignments that affect firmware portability. The aim of this document is to illustrate these changes and to detail the migration of code between devices in the series.

For clarity, this document refers to all autonomous modes as auto mode and all 'manual' modes as QAM, FSK or DPSK manual mode, depending on the selected modulation. See section 4.1 for further information.

2   Migrating code without using new functions

The CMX869x modem series have been engineered to provide a simple upgrade path between devices and this section details the minimal changes that are required in firmware that is to be ported. The impact of using any of the new functions provided by a later generation CMX869x can be assessed from the information in section 3.

2.1   CMX869 to CMX869A

The CMX869A introduces new manual modes and an HDLC disassembler that require changes in the mode selection registers, additional switches to select and de-select the new functions and new flags in the status register.

Code migration
1. *Transmit Mode Register ($E1), b15..12 and Receive Mode Register ($E2), b15..12. Auto mode is reassigned from 1100 to 1111.*
2. *Do not use 1100 and ensure that all register bits described as set to 0 (in the CMX869 data sheet) are set to 0.*

2.2   CMX869 to CMX869B

The CMX869B includes all the changes of the CMX869A, a compatibility mode with the CMX869A and a full HDLC Packet Assembler Disassembler, PAD. This requires further changes in the mode selection registers and additional switches to select and de-select new functions plus extended functionality of the status flags.

Code migration
1. *Transmit Mode Register ($E1), b15..12 and Receive Mode Register ($E2), b15..12. Auto mode is reassigned from 1100 to 1111.*
2. *Do not use 1100 and ensure that all bits described as set to 0 (in the CMX869 data sheet) are set to 0.*

2.3   CMX869A to CMX869B

The CMX869B extends the manual control functions of the CMX869A and provides a full HDLC PAD with some HDLC support signaling. Some unused bits or bit combinations are used to provide these additions and the status bit signaling is extended. There is a back compatibility switch to ensure that CMX869Bs will operate in CMX869A slots.

Code migration
1. *No changes required but ensure that all bits described as set to 0 (in the CMX869A data sheet) are set correctly.*
2. *General Control Register ($E0), b13 = 0 ensures back-compatibility with the CMX869A*

3   Migrating code but using new functions

This section is intended to help identify the impact on legacy code when it is migrated to a newer CMX869x and the new functions are required.

3.1   General Control Register ($E0)

Bit Position	CMX869	CMX869A	CMX869B
15	Reserved (set to 0)	Equaliser	Equaliser
13	Reserved (set to 0)	Reserved (set to 0)	Select enhanced pattern detect mode

Bit 15: In the CMX869A and the CMX869B, this bit is used to enable or disable the fixed compromise equalisers in QAM/DPSK/FSK manual modes. It has no effect in auto mode.

Bit 13: In the CMX869B, this bit enables enhanced pattern detection in QAM/DPSK/FSK manual mode for use in EPOS systems and other systems that use HDLC formatting. Setting this bit to 1 modifies the operation of the Transmit Mode Register and the Status Register. It has no effect in auto mode. When set to 0, this bit ensures back-compatibility with the CMX869A.

3.2 Transmit Mode Register ($E1)

Bit Positions	CMX869	CMX869A	CMX869B
b15-12	Tx Mode	Tx Mode	Tx Mode
1111	*Reserved*	*Auto mode*	*Auto mode*
1110	*Reserved*	*Reserved*	*Reserved*
1101	*Reserved*	*V.22 bis high-band manual mode*	*V.22 bis high-band manual mode*
1100	*Auto mode*	*V.22 bis low-band manual mode*	*V.22 bis low-band manual mode*
1011	*Reserved*	*V.22 high-band manual mode*	*V.22 high-band manual mode*
1010	*Reserved*	*V.22 low-band manual mode*	*V.22 low-band manual mode*
b2-0	Tx Modem Data (Special modes)	Tx Modem Data (Special modes)	Tx Modem Data (Special modes)
110	*Reserved*	*Reserved*	*Select HDLC mode*
101	*Reserved*	*Reserved*	*Send HDLC Abort (13 x 1s)*
001	*1010..*	***1010.. (FSK manual mode)*** *S1 (DPSK manual mode)*	***1010.. (FSK manual mode)*** *S1 (DPSK manual mode)*

Bits 15-12 control the transmit mode in all three CMX869x devices but there has been some re-assignment to allow the QAM manual modes to be added. Note that auto mode requires a different bit combination between the CMX869 and the CMX869A/B.

Bits 2-0 control the transmission of bit patterns that are normally used during the training sequence. The S1 pattern (110011..) was added to the CMX869A to permit modem training in V.22 bis manual mode. Note that the modem is running at 1200bps at this time and hence S1 can only be selected in DPSK manual mode.
Adding an HDLC PAD to the CMX869B required a new UART receive mode and the ability to handle an abort sequence.
There are no migration issues for HDLC mode because previously unassigned bit combinations (CMX869/CMX869A) are used to control the new features (CMX869B) and S1 transmission is automatically selected if DPSK mode is enabled in transmit.

3.3 Receive Mode Register ($E2)

Bit Positions	CMX869	CMX869A		CMX869B	
b15-12	Rx Mode	Rx Mode		Rx Mode	
1111	*Reserved*	*Auto mode*		*Auto mode*	
1110	*Reserved*	*Reserved*		*Reserved*	
1101	*Reserved*	*V.22 bis high-band manual mode*		*V.22 bis high-band manual mode*	
1100	*Auto mode*	*V.22 bis low-band manual mode*		*V.22 bis low-band manual mode*	
1011	*Reserved*	*V.22 high-band manual mode*		*V.22 high-band manual mode*	
1010	*Reserved*	*V.22 low-band manual mode*		*V.22 low-band manual mode*	
b8	Reserved (set to 0)	Auto-equaliser		Auto-equaliser	
1	-	*Enabled*		*Enabled*	
0	-	*Freeze (QAM manual mode)* *Disabled (DPSK manual mode)*		*Freeze (QAM manual mode)* *Disabled (DPSK manual mode)*	
b7-6	Reserved (set to 0)	Descrambler	64 x 1s Detect	Descrambler	64 x 1s Detect
11	-	*Enabled*	*Enabled*	*Enabled*	*Enabled*
10	-	*Enabled*	*Disabled*	*Enabled*	*Disabled*
01	-	*Reserved*		*Reserved*	
00	-	*Disabled*	*Disabled*	*Disabled*	*Disabled*
b5-3	Data format	Data format		Data format	
101	*Reserved*	*Rx Start/Stop mode +1% overspeed*		*Rx Start/Stop mode +1% overspeed*	
100	*Reserved*	*Rx Start/Stop mode +2.3% overspeed*		*Rx Start/Stop mode +2.3% overspeed*	
b2-0	Data bits & Parity (Special modes)	Data bits & Parity (Special modes)		Data bits & Parity (Special modes)	
110	*Reserved*	*Select HDLC mode*		*Select HDLC mode*	

Bits 15-12 control the receive mode in all three CMX869x devices but there has been some re-assignment to allow the QAM manual modes to be added. Note that auto mode requires a different bit combination as described for the transmit mode above.

Bit 8 enables/disables the auto-equaliser in DPSK manual mode or enables/freezes it in QAM manual mode (CMX869A/B). This allows the auto-equaliser to be disabled at the beginning of training sequences as is normally required. The auto-equaliser can be frozen in QAM mode to enable faster training times.
There are no migration issues with the auto-equaliser control bit because a previously unassigned bit (CMX869) is used to enable the new features (CMX869A/B).

Bits 7-6 enables/disables both the descrambler and the 64 x 1s detector. The descrambler is normally enabled toward the end of a training sequence and then enabled until reception ends or an error is encountered, but its use is not considered mandatory by the ITU. The 64 x 1s detector is used to simplify the detection of continuous 1s toward the end of a training sequence but may not be required in some systems, e.g. EPOS where continuous 1s are replaced by HDLC flags.
There are no migration issues when using the scrambler or 64 x 1s detector because previously unassigned bit combinations (CMX869) are used to control the new features (CMX869A/B).

Bits 5-3 allow a receive speed adjustment to be made in Start/Stop (asynchronous) mode as specified in the ITU V.14 recommendation.
There are no migration issues when using this feature because previously unassigned bit combinations (CMX869) are used to control the new features (CMX869A/B).

Bits 2-0 Enables synchronous receive mode on the CMX869 and transparent synchronous or HDLC mode on the CMX869A/B.
There are no migration issues when using this feature because previously unassigned bit combinations are used to control the new features.

3.4   Status Register ($E6)

Bit Positions	CMX869	CMX869A	CMX869B
b10 = 1	*In-band energy detected (all manual modes)* *Always 0 (auto mode)*	*In-band energy detected (all manual modes)* *Always 0 (auto mode)*	*In-band energy detected (all manual modes)* *Always 0 (auto mode)*

Bit 10 signals energy detection in the FSK modes on the CMX869, which are the only manual modes available on this device. This signaling is extended to include the QAM/DPSK modes of the CMX869A/B (these modes are not available on the CMX869).
There are no migration issues when using this feature because the bit function is only extended (CMX869A/B) to modes not present in the CMX869.

Bits 9-7. In the table below note that bits 9-7 have different meanings depending on the modem mode selected. Figure 1 shows how the meanings of the bit combinations are expanded depending on the device and mode selected.
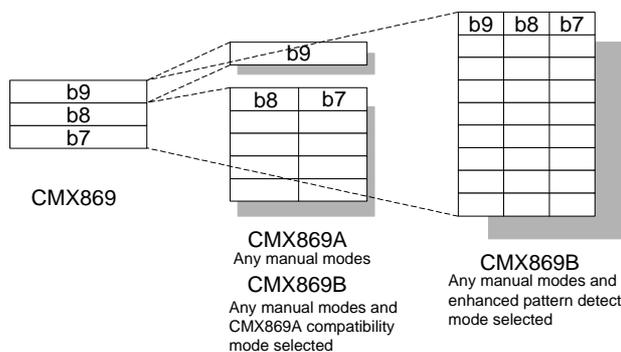

Figure 1.
Bits are used in combination to define enhanced status signaling on the CMX869A. The method is extended further on the CMX869B.

Bit Positions	CMX869	CMX869A and CMX869A compatible mode on the CMX869B	
b9-7	Manual modes (FSK modes are the only manual modes on the CMX869)		
b9 = 1	*1010.. detected (All manual modes)*	*Bit fields are used in combination for enhanced signaling on the CMX869A/B (See following entries)*	
b8 = 1	*Continuous 0s detected (All manual modes)*		
b7 = 1	*Continuous 1s detected (All manual modes)*		
b9		DPSK/FSK manual modes only	
b9 = 1	*Not applicable*	*1010.. detected (All FSK modes) S1 detected (DPSK manual mode)*	
b8-7		QAM/DPSK Synchronous manual modes only	
		De-Scrambler Off	De-Scrambler On
11	*Not applicable*	*No detection*	*Scrambled 1s detected*
10	*Not applicable*	*Unscrambled 0s detected*	*Scrambled 0s detected*
01	*Not applicable*	*Unscrambled 1 detected*	*Unscrambled 1s detected*
00	*Not applicable*	*No detection*	*No detection*
b8-7		QAM/DPSK Asynchronous manual modes only	
b8 = 1	*Not applicable*	*'Break' signal detected*	
b7 = 1	*Not applicable*	*0*	

Bit Positions	CMX869	CMX869A	CMX869B
b9-7	All manual modes (enhanced pattern detection mode) CMX869B only		
	Not applicable	*Not applicable*	*See data sheet for table expansion*
b9-7	Auto mode		
	See data sheet for table expansion	*No change from CMX869*	*No change from CMX869*

Bits 9-7 are expanded in the CMX869A to allow the manual modes and HDLC packet disassembly to be supported. They are further expanded in the CMX869B to fully support an HDLC PAD.
There are no issues porting from the CMX869 to the CMX869A/B because the expanded signaling is only available when new modes are selected but the effect of the expansion should be checked in legacy code.
There are no issues porting from the CMX869A to the CMX869B because a backward compatibility switch is provided, General Control Register ($E0) b13 = 0.

Bit Positions	CMX869	CMX869A	CMX869B
b4 = 1	*Rx UART framing error*	*Rx UART framing error HDLC FCS error*	*Rx UART framing error HDLC FCS error*
b3 = 1	*Rx even parity detected (1st character)*	*Rx even parity detected (1st character) End of HDLC packet received*	*Rx even parity detected (1st character) End of HDLC packet received*
b2 = 1	*Rx even parity detected (2nd character)*	*Rx even parity detected (2nd character)*	*Rx even parity detected (2nd character) HDLC abort detected*

Bits 4-2 are expanded in the CMX869A/B to provide HDLC support.
There are no issues porting from the CMX869 to the CMX869A/B because the expanded signaling is only available when new modes are selected.

4 Useful Questions and Answers

4.1 What modes are available?

An automatic or semi-autonomous mode is available, known in this document as the 'auto mode' (see below for a more complete description). Alternatively, more control of the modem is available through the 'manual' mode. This mode is subdivided into other modes, i.e. DPSK manual mode, depending on the type of modulation used. These modes are known by different names in the various CMX869x documents so the following table should help clarify most instances.

Mode in this document (Applicable modulation)	Mode Names used in Respective Data Sheets		
	CMX869	CMX869A	CMX869B
Auto (V.32 bis, V.32, V.22 bis, V.22)	QAM modem	QAM AUTO modem	QAM Automodem
QAM manual (V.22 bis)	-	QAM manual modem	QAM manual modem
DPSK manual (V.22)	-	DPSK manual modem	DPSK manual modem
FSK manual (V.21, Bell 103, V.23, Bell 202)	FSK modem	FSK modem	FSK modem and FSK manual modem

4.2 What is an automode modem?

The ITU recommendation for a V.32 bis modem includes the possibility of interworking with V.22 and V.22 bis modems. A V.32 bis modem that provides this facility is known as an automode modem.

4.3 Why make some training sequences automatic?

The handshake process that modems go through to train and synchronise gets increasingly complex as the data rate increases and it is convenient if this is managed by the modem. The ITU defines the handshake process for each modem type but some vendors have found these to be too constraining or they want a proprietary handshake to restrict competitor access. For example, many financial institutions are connected directly to their peers, via the GSTN, using modems that communicate only to a limited number of predetermined destinations so the line quality can be measured and guaranteed. These modems do not need to cope with widely varying conditions so the training processes that condition the modems can be reduced or eliminated. For these reasons it is convenient if an automatic mode is included for the higher data rates but a manual mode is also included to allow proprietary protocols to be supported.

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