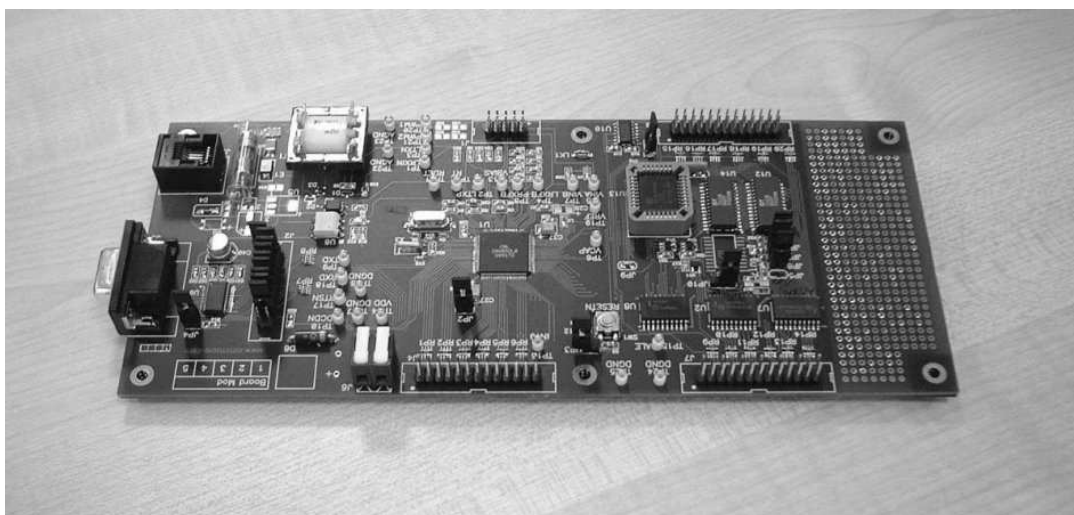


Features

- **CMX850 (contains 80C51) Product Evaluation**
- **Fully Isolated 2-Wire Line Interface with FCC68 or CTR21 DAA**
- **Modem Calling/Answering and CLI Firmware**
- **Full Access to Unused 80C51 Ports**
- **'AT' Command Compatible Firmware**
- **Control via PC Terminal Emulator**
- **Opto-Isolated Ring Detect Circuitry and OptoMOS Hook Relay**
- **Keyboard Encoder (16 x 8 matrix)**
- **8kB Internal RAM, 4Mb External FLASH and 64kB External RAM**
- **On-Board FLASH Reprogramming**
- **Dual Analogue-to-Digital Inputs**
- **Dual Low-Power PWM Outputs**
- **User's Prototyping Area**
- **Space for Optional Telco-Specific Components**



1 Brief Description

The EV8500 Evaluation Kit comprises a single board containing a CMX850 Communications Controller (80C51 core and V.22 bis Modem IC), line interface components and a serial communications port for interfacing to a PC. Firmware is provided to implement a standard 'AT' commands interface which is used to control the evaluation board via a standard terminal emulator. PC software is provided to support serial downloading of firmware updates to the evaluation kit.

The board is powered from a single 3 – 3.6V dc power supply. Removal of jumpers allows the user to measure device current. Important signals can be monitored via test points and header pins.

The evaluation board has a 2-wire line interface to provide line matching and dc isolation. This 2-wire interface is connected to the line using an OptoMOS relay.

Where components are telco-specific (line impedance, line protection, etc.) space is provided for the user to add appropriate components.

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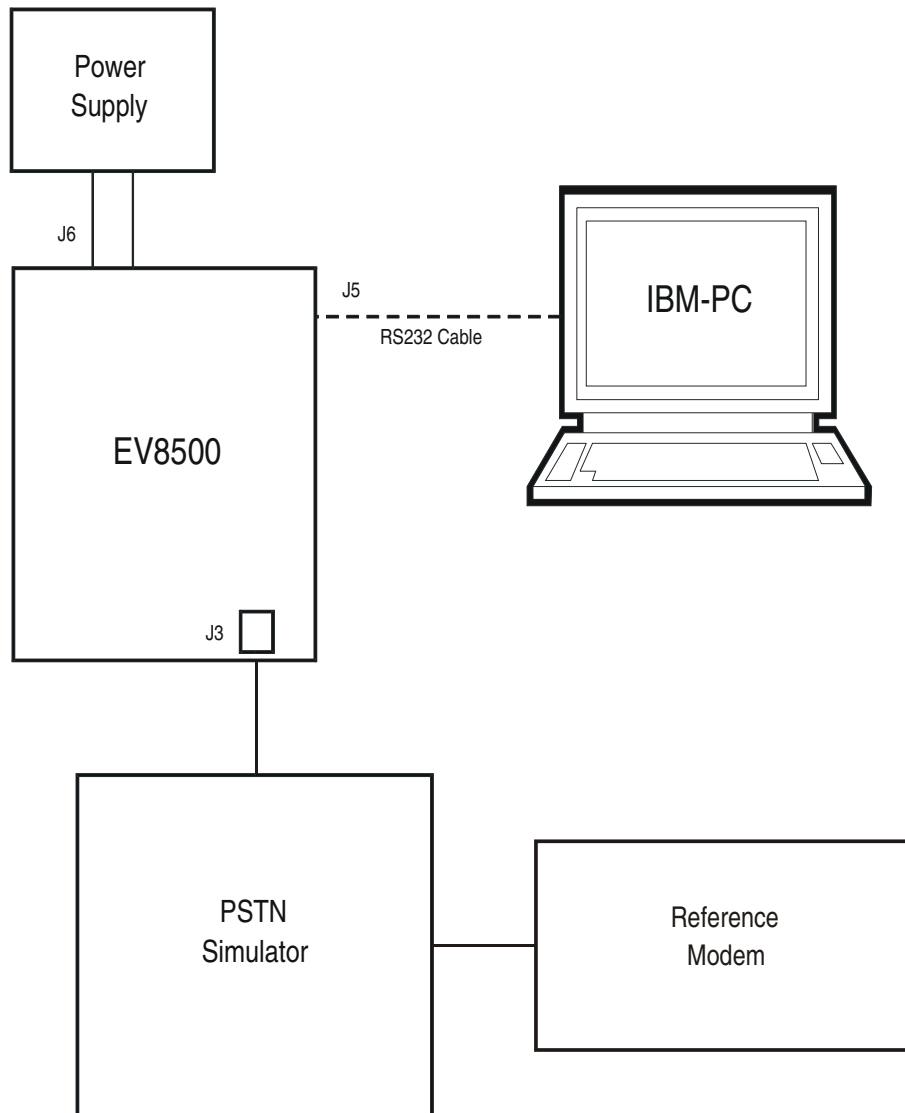


Figure 1 System Block Diagram

2. Preliminary Information

2.1 Laboratory Equipment

The following laboratory equipment is needed to use this evaluation kit:

2.1.1 3 – 3.6V dc Power Supply

2.1.2 An IBM compatible PC; 66MHz '486 or better with a serial communications port, running Microsoft Windows operating systems.

2.2 Handling Precautions

Like most CML evaluation kits, this product is designed for use in office and laboratory environments. The following practices will help ensure its proper operation.

2.3 Static Protection

This product uses low power CMOS circuits which can be damaged by electrostatic discharge. Partially damaged circuits can function erroneously, leading to misleading results. Observe ESD precautions at all times when handling this product.

2.4 Contents – Unpacking

Please ensure that you have received all of the items on the separate information sheet (EK8500) and notify CML or your supplier within 7 working days if the delivery is incomplete.

2.5 Approvals

This product is designed to meet CTR21/FCC68 telecom approval requirements. Users are advised to observe all local statutory requirements which may apply to this product before direct or indirect connection to any public telecommunication system.

3. Quick Start

This section provides instructions for users who wish to experiment immediately with the evaluation kit. A fuller description of the kit and its use appears later in this document.

3.1 Setting-Up

The board is powered from a single 3 – 3.6V bench power supply and is pre configured as an FCC68 modem with a pre-programmed FLASH memory.

An RJ11 (US style) phone jack, J3, is provided for 2-wire line connection. Power is connected via the two-way socket, J6.

Attach the 9-way RS232 cable between connector J5 and the serial port of the PC. Connect an external modem/line simulator to the evaluation kit using a suitable RJ11 telephone cable (not supplied).

3.2 Adjustments

The line matching components fitted are suitable for an FCC68 application. The line matching components can be adjusted, as required (refer to CMX850 data sheet and Midcom transformer recommendations). Telco-specific components may be added, as required.

3.3 Operation

The EV8500 evaluation board allows the user to perform calling, answering and simple data transfer with a suitable PSTN simulator and third party modem (these are external to the board and not supplied). The board also allows the user to attach laboratory test equipment to perform simple CMX850 device evaluation tests i.e. current measurement, tone generation and detection.

The board is controlled by the AT command set described in Section 6.3, by running a terminal emulator program on the host PC. A suitable emulator is the 'Hyper Terminal' program which operates under Windows operating systems. The EV8500 AT command set consists of Basic, Extended and CML Specific commands.

The board has three modes of operation:

AT Command Mode

In this mode the command processor firmware is constantly checking to see if the user has typed a valid AT command. When a valid command is received the firmware will execute that command. While the firmware is operating in this mode, the user can instruct it to manually answer a call, originate a call, go on/off hook, read/write to S-registers, issue CML specific AT commands, and perform a number of other AT command functions.

The board always starts in AT Command mode after power is applied and board initialisation is complete.

The CML specific AT commands allow the user to directly control the CMX850 device for evaluation purposes. Note, customer modified CMX850 device registers will be overwritten when Dial and Answer AT commands are executed. See section 6.3 for full details and limitations of the CML specific AT command set.

The Dial and Answer commands will execute the relevant DTMF transmit, call progress tone detection and negotiation (handshaking) firmware routines before a connection to a remote modem can be established. Negotiation may be aborted by using the +++ AT escape sequence.

Note, if the S0 register is modified to a non-zero value during this operating mode, the CMX850 status register will be polled every 20ms to check for ring detect status. If valid ringing is detected the EV8500 Evaluation board will automatically answer the call after the number of ring cycles specified by the contents of the S0 register.

Data Transfer Mode

After gaining a connection (i.e. a successful negotiation) with a remote modem the board will be operating in data transfer mode. In this mode the board will transmit all the data it receives from the RS232 computer terminal to the remote modem via the 2-wire line. Likewise any data received from the remote modem via the 2-wire line will be sent to RS232 computer terminal.

Whilst operating in this mode the data stream from the RS232 computer terminal is monitored for the escape code sequence (defaulted to +++). If this sequence is encountered during data transfer the firmware will revert to on-line AT command mode. Whilst in on-line AT command mode, the board-to-remote modem connection may be aborted by typing ATH0 (instructs modem to go on-hook). Alternatively the user can enter relevant AT commands or return to data transfer mode by using the ATO command.

The modem line speed is much lower than the speed of the RS232 interface (which is running at 19200bps) and the EV8500 firmware only provides a small amount of data buffering. Therefore to prevent the data buffer from overflowing the data flow between the RS232 and CMX850 should be controlled by the RTS/CTS (Request/Clear to Send) hardware handshake lines.

The CMX850 settings used during negotiation and data transfer will be based on the contents of the S-registers when the call was originated or answered. The S-registers are described in Section 6.3. Certain S-register settings (relevant to the CMX850 modem configuration), modified during on-line AT command mode, will only take effect when a new call is originated or answered. For example, new CMX850 Tx gain settings (S25 register) modified in on-line AT command mode will be ignored until the next call.

CLI Type I Detection

The EV8500 firmware will automatically detect a type I CLI message between the first and second rings of an incoming connection. If a valid CLI type I message is detected during this period then the message "CLI I" is displayed.

The contents of the last received CLI message can be viewed using the AT command AT@FC. A simple CLI message when displayed might produce something similar to the following.

```
AT@FC
DL Call Setup, Len 14
Iden: 01621 875500
OK
```

4. Signal Lists

CONNECTOR PINOUT				
Connector Ref.	Connector Pin No.	Signal Name	Signal Type	Description
J1	1	VIN A	Input	CMX850 ADC input A
	2	VIN B	Input	CMX850 ADC input B
	3	HD	Input	Modem Hook detect input
	4	GND	Power	Analogue ground connection
	5	PHONETXP	Output	Non-inverted phone TX output
	6	PHONETXN	Output	Inverted phone TX output
	7	PHONERX	Input	Buffered phone RX input
	8	PWM2	Output	CMX850 PWM output 2
	9	PWM1	Output	CMX850 PWM output 1
	10	GND	Power	Analogue ground connection
J2	---	---	---	Refer to jumpers section
J3	1	n/c	n/c	No connection
	2	n/c	n/c	No connection
	3	RING	BI	Bi-directional 2-wire line
	4	TIP	BI	Bi-directional 2-wire line
	5	n/c	n/c	No connection
	6	n/c	n/c	No connection
J5	1	DCD	Output	RS232 DataCarrierDetect output
	2	RXD	Input	RS232 Receive data input
	3	TXD	Output	RS232 Transmit data output
	4	DTR	Input	RS232 DataTerminalReady output
	5	GND	Power	RS232 ground reference
	6	DSR	Output	RS232 DataSetReady output
	7	RTS	Input	RS232 RequestToSend input
	8	CTS	Output	RS232 ClearToSend output
	9	RI	Output	RS232 RingIndicator output
J6	1	VDD	Power	3 – 3.6 volt supply connection
	2	GND	Power	Ground supply connection

CONNECTOR PINOUT				
Connector Ref.	Connector Pin No.	Signal Name	Signal Type	Description
J4	1	VDD	Power	Power supply connection
	2	KBR0	Input	Keyboard scanner row input
	3	KBR1	Input	Keyboard scanner row input
	4	KBR2	Input	Keyboard scanner row input
	5	KBR3	Input	Keyboard scanner row input
	6	KBR4	Input	Keyboard scanner row input
	7	KBR5	Input	Keyboard scanner row input
	8	KBR6	Input	Keyboard scanner row input
	9	KBR7	Input	Keyboard scanner row input
	10	KBC0	Output	Keyboard scanner column output
	11	KBC1	Output	Keyboard scanner column output
	12	KBC2	Output	Keyboard scanner column output
	13	KBC3	Output	Keyboard scanner column output
	14	KBC4	Output	Keyboard scanner column output
	15	KBC5	Output	Keyboard scanner column output
	16	KBC6	Output	Keyboard scanner column output
	17	KBC7	Output	Keyboard scanner column output
	18	KBC8	Output	Keyboard scanner column output
	19	KBC9	Output	Keyboard scanner column output
	20	KBC10	Output	Keyboard scanner column output
	21	KBC11	Output	Keyboard scanner column output
	22	KBC12	Output	Keyboard scanner column output
	23	KBC13	Output	Keyboard scanner column output
	24	KBC14	Output	Keyboard scanner column output
	24	KBC15	Output	Keyboard scanner column output
	26	GND	Power	Power supply connection

CONNECTOR PINOUT				
Connector Ref.	Connector Pin No.	Signal Name	Signal Type	Description
J7	1	GND	Power	Ground supply connection
	2	n/c	n/c	No connection
	3	n/c	n/c	No connection
	4	A0	Output	Address selection output
	5	WEN	Output	Write enable output
	6	E	Output	Enable output (inverted CSN3)
	7	D0	BI	Bi-directional data line
	8	D1	BI	Bi-directional data line
	9	D2	BI	Bi-directional data line
	10	D3	BI	Bi-directional data line
	11	D4	BI	Bi-directional data line
	12	D5	BI	Bi-directional data line
	13	D6	BI	Bi-directional data line
	14	D7	BI	Bi-directional data line
	15	n/c	n/c	No connection
	16	n/c	n/c	No connection
	17	PWM1	Output	CMX850 PWM output 1
	18	PWM2	Output	CMX850 PWM output 2
	19	BNK0	Output	Bank select signal 0
	20	BNK1	Output	Bank select signal 1
	21	BNK2	Output	Bank select signal 2
	22	P0.0	BI	Unassigned control line
	23	P0.1	BI	Unassigned control line
	24	P0.2	BI	Unassigned control line
	25	INT9	Input	Super interrupt input
	26	ALE	Output	Address Latch Enable output

CONNECTOR PINOUT				
Connector Ref.	Connector Pin No.	Signal Name	Signal Type	Description
J8	1	A0	Output	Addressing line
	2	A1	Output	Addressing line
	3	A2	Output	Addressing line
	4	A3	Output	Addressing line
	5	A4	Output	Addressing line
	6	A5	Output	Addressing line
	7	A6	Output	Addressing line
	8	A7	Output	Addressing line
	9	A8	Output	Addressing line
	10	A9	Output	Addressing line
	11	A10	Output	Addressing line
	12	A11	Output	Addressing line
	13	A12	Output	Addressing line
	14	A13	Output	Addressing line
	15	A14	Output	Addressing line
	16	A15	Output	Addressing line
	17	GND	Power	Ground supply connection
	18	GND	Power	Ground supply connection
	19	CSN3	Output	Addressing selection output
	20	CSN2	Output	Addressing selection output
	21	CSN1	Output	Addressing selection output
	22	CSN0	Output	Addressing selection output
	23	WEN	Output	Write enable output
	24	INT1	Input	Interrupt 1 input
	25	T0	Output	Timer 0 output
	26	VDD	Power	Supply connection

TEST POINTS		
Test Point Ref.	Default Measurement	Description
TP1	-	Line receive input signal
TP2	-	Non-inverted line transmit signal
TP3	-	Inverted line transmit signal
TP4	-	Line receive feedback signal
TP5	-	CMX850 ADC input A
TP6	-	CMX850 VCAP signal
TP7	-	CMX850 ADC input B
TP8	-	Phone receive feedback signal
TP9	-	CMX850 serial receive data input
TP10	Hi	CMX850 data carrier detect output
TP11	-	Ring detect, CMX850 RD signal
TP12	-	Ring detect timeout, CMX850 RT signal
TP13	VDD/2	Bias voltage
TP14	-	Power supply positive voltage, VDD signal
TP15	-	Address latch enable output
TP16	-	Interrupt 9 input
TP17	-	CMX850 request to send input
TP18	-	CMX850 serial transmit data
TP19	2.5V	CMX850 reference voltage
TP20	-	CMX850 PWM output 1
TP21	-	CMX850 PWM output 2
TP22-23	0V	Analogue circuit ground reference
TP24-27	0V	Digital circuit ground reference

JUMPERS			
Link Ref.	Positions	Default Position	Description
JP1	Open/Closed	Open	Close to disable multiplexed address and data signals
JP2	Open/Closed	Closed	VDUT breakout for current measurements
JP3	Open/Closed	Open	Close to hold CMX850 in reset state
JP4	Open/Closed	Closed	Close to enable RS232 interface
JP5	Open/Closed	Open	Close to enable internal BootROM.
JP6-8	Open/Closed	Closed	Close to connect normal FLASH bank selection signals
JP9	Open/Closed	Closed	Close to connect FLASH chip enable signal (CSN1)
J2	1-2	Open	No normal function (P5.0 grounded when closed)
	3-4	Closed	Connects Clear To Send signal to serial interface
	5-6	Closed	Connects Data Terminal Ready signal to serial interface
	7-8	Closed	Connects Data Set Ready signal to serial interface
	9-10	Closed	Connects Ring Indicator signal to serial interface
	11-12	Closed	Connects Receive data signal to serial interface
	13-14	Closed	Connects Transmit data signal to serial interface
	15-16	Closed	Connects Request To Send signal to serial interface
	17-18	Closed	Connects Data Carrier Detect signal to serial interface
	19-20	Open	Not connected

Notes: BI = Bi-directional
n/c = No connection

5. Block Diagram, Circuit Schematics and Board Layout

For clarity, the circuit schematics are available as separate, high-resolution files.

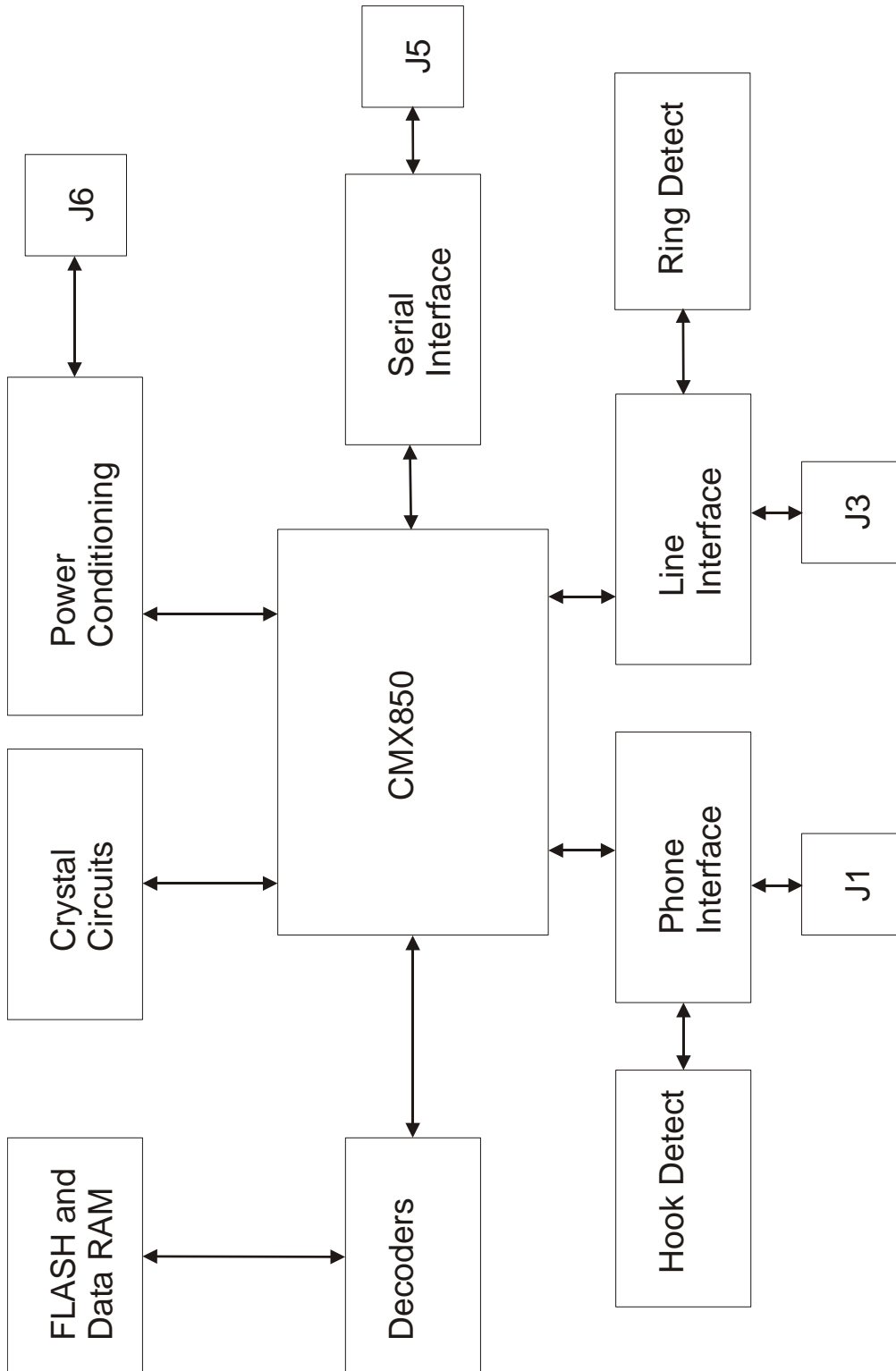


Figure 2 Block Diagram

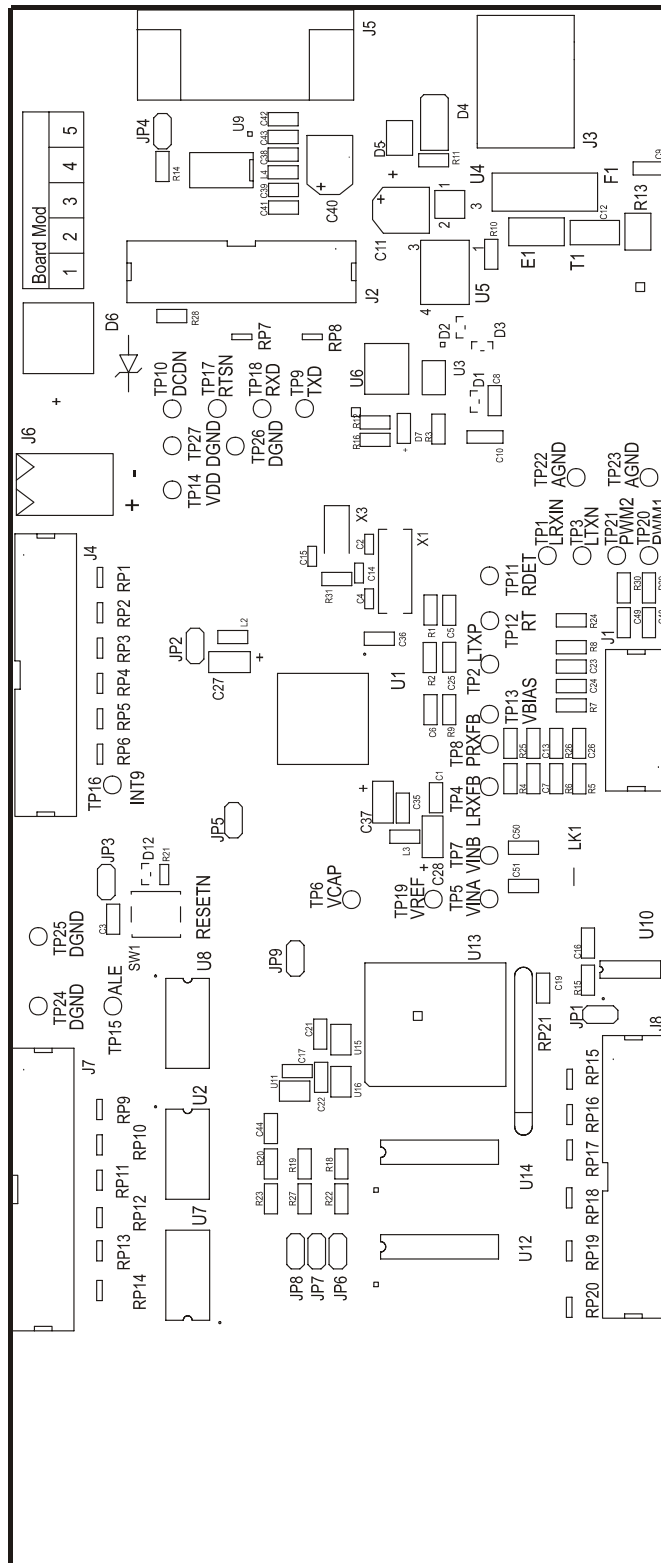


Figure 3 Evaluation Board - Layout

6. Detailed Description

6.1 Hardware Description

6.1.1 IDD Measurement

The evaluation device IDD may be measured by removing jumper JP2 and replacing it with a multimeter.

6.1.2 On Hook Caller ID

This function provides a high impedance, on-hook AC path for the routing of Caller ID signals to the CMX850, allowing the Type I Caller ID protocols to be implemented.

6.1.3 Line Protection

Line protection is provided by the Sidactor component E1. Sidactor is the trade name for a type of Transient Voltage Suppressor (TVS) manufactured by Teccor Electronics.

6.1.4 Simplified European FCC68 Approvable DAA, as Shipped

The values of R4, R6, R7, R8, R9, C8 and C24 are optimal values with respect to the Midcom 82111 transformer. Parts C10 and D4 are not required for this simplified design but are replaced with 0Ω links.

6.1.5 CTR21 Approvable DAA

The following components may be fitted to provide a 60mA current limit as required by CTR21.

Component Identifier	Component Type or Value
R10	33kΩ
R11	11R5Ω
C11	10μF, 50V
D4	33v, 600W
D5	CBRHD-02
U4	BC846ALT1
U5	FZT605

An alternative transformer, the Midcom 82107, must be fitted and the components C8, C10, C24, and R6 changed. This is to match the characteristics of the Midcom 82107 transformer and the CTR21 reference impedance. The required component values are as specified below.

	FCC68	CTR21
T1	Midcom 82111	Midcom 82107
C8	33nF	100nF
C10	0RΩ	2.2μF
C24	39pF	180pF
R6	100kΩ	91kΩ

6.1.6 Isolated Ring detect

Ring Detection is provided by an opto-isolated circuit whose response time is set by components R1 and C5 and whose detect threshold is approximately 20V_{RMS}.

6.2 Adjustments and Controls

Various line interface signals can be accessed via test points and breakout connectors. A user's prototyping area is also provided.

6.3 Firmware Description

The 80C51 microcontroller core internal to the CMX850, which is fitted on the EV8500 evaluation kit, runs the latest firmware. This is programmed into the 4 Megabit FLASH (U13) by CML before shipment. Please check the CML web site for firmware status and updates. The latest source code and programming files (EF8500xx.Hex, where xx represents the version number) can be downloaded from the CML web site.

The serial communications firmware supplied in the CMX850 assumes the following serial configuration: 8 data bits, no parity, 1 stop bit and 19,200 baud with hardware flow control support.

The firmware routine run at start-up and reset performs the following important tasks:

- Peripheral Interrupt Initialisation
- CMX850 ports and I/O direction initialisation
- Serial Communication Interface (SCI) initialisation
- Loads factory profile 0
- Resets CMX850 peripherals

The message EF8500 Vx.x, will be displayed in the terminal emulator window when these tasks have been completed, or an error message will be displayed

The firmware only supports DTMF dialling.

AT command echoing is an option available in the firmware and involves echoing the received characters sent by the PC. The firmware also provides the option of sending result codes to the PC. These responses can be in either an alpha or numeric form.

The AT command set for the EV8500 Evaluation kit is tabulated below. These commands can be entered on a PC running Windows terminal emulator software, such as the 'Hyper Terminal' program supplied with Windows operating systems. AT commands should be typed in uppercase only.

The extended AT command set (AT!x) allows access to the internal features of the 80C51 core of the CMX850 and is provided in the monitor.c, monitor.h, CMX850sfr.asm and CMX850breakpoint.asm files for inclusion into customer projects.

The 'Hyper Terminal' Send Text File facility is useful for data transfer i.e. when the EV8500 has established a connection with a remote modem. This terminal emulator facility can also be used for sending long AT command scripts to the EV8500. These scripts should consist of a single line multiple AT command, for example.

ATH1@REO=4929@RE6?@RE1=4567<CR>

Please note that the S-register contents are not transferred into the C-BUS registers of the modem until a call is made or received (ATA, ATD or ATZn command is executed).

Basic EV8500 AT Commands

Command	Description
A	<p>Answer Command The modem will go off-hook and attempt to establish a connection with a remote modem.</p> <p>Syntax: ATA<CR></p>
A/	<p>Re-Execute Previous Command Line Re-executes the last issued command line. This command does not require the AT prefix or a carriage return.</p> <p>Syntax: A/</p>
Bn	<p>Select Communications Standard Selects the communications standard specified by the parameter n.</p> <p>Syntax: ATBn<CR></p> <p>Modifier Usage</p> <p>n=0 Selects ITU-T V.22bis at 2400bps QAM (default). n=1 Selects ITU-T V.22 at 1200bps DPSK. n=2 Selects ITU-T V.23 with Tx 75bps and Rx 1200bps FSK. n=3 Selects ITU-T V.23 with Tx 1200bps and Rx 75bps FSK (NYI). n=4 Selects ITU-T V.21 at 300bps FSK (NYI). n=5 Selects Bell 202 with Tx 150bps and Rx 1200bps FSK (NYI). n=6 Selects Bell 202 with Tx 1200bps and Rx 150bps FSK (NYI). n=7 Selects Bell 103 at 300bps FSK.</p> <p>Protocol code n saved into S register 27.</p>
Dn	<p>Dial Command This command directs the modem to go off-hook, dial according to the string entered and attempt to establish a connection with a remote modem. The n represents an ASCII string composed of dial digits and dial modifiers and must not exceed the 15 character buffer limit. The DTMF tone dialling digits include 0 through 9, A, B, C, D, and the symbols # and *.</p> <p>Syntax: ATDn<CR></p> <p>For example: ATD9,01621875500<CR></p> <p>Modifier Usage</p> <p>n=L Re-dial last number. n=, Delay dial sequence (pause setting contained in S-Register S8). n= 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, #, * Dial the DTMF tone associated with each character.</p>

Command	Description
En	Echo Command Characters Syntax: ATEn<CR> Modifier Usage n=0 Disables the echoing of commands to the screen. n=1 Enables echoing of commands to the screen (default). Setting saved into S register 14 bit 0.
Hn	Hook Switch Control Syntax: ATHn<CR> Modifier Usage n=0 Instructs the modem to go on-hook (disconnect). n=1 Instructs the modem to go off-hook.
In	Identification Requests the modem to return its product identification information. Syntax: ATIn<CR> Modifier Usage n=0 Displays the firmware version number. n=1 Displays Target Selection Designation (i.e. EV8500 eval board).
Nn	Modulation Fallback Option Syntax: ATNn<CR> Modifier Usage n=0 When originating or answering, modem negotiates only at the specified communications standard (default). n=1 When originating or answering, falls back from higher to lower transfer rate where possible. Setting saved into S register 24 bit 3.
O	Return to Data Transfer Mode Used during on-line AT command mode, this command allows the user to return to data transfer mode. Note, this command does not initiate any retrain sequence. Syntax: ATO<CR>

Command	Description
Qn	Enable/Disable Modem Responses Syntax: ATQn<CR> Modifier Usage n=0 Enables result codes to be issued to the screen (default). n=1 Disables result codes to be issued to the screen. Setting saved into S register 14 bit 1.
Sn?	S-Register Read Command for displaying the contents of an S-Register (See S-Register Table). Syntax: ATSn?<CR> where n is the S-Register to be interrogated (decimal). Value returned is either in decimal (default) or hex format depending on the setting of the AT&Hn command (S register 14 bit 3).
Sn=x	S-Register Write Command for writing to an S-Register (See S-Register Table). Syntax: ATSn=x<CR> where n is the S-Register (decimal) and x is the value to be written in decimal or hex format depending in the setting of the AT&Hn command (S register 14 bit 3).
Vn	Result Code Format Syntax: ATVn<CR> Modifier Usage n=0 Instructs the modem to display result codes as numbers. n=1 Instructs the modem to display result codes as words (default). Setting stored into S register 14 bit 2.

Command	Description
Xn	<p>Calling Characteristics Determines which set of responses and calling characteristics are used.</p> <p>Syntax: ATXn<CR></p> <p>Modifier Usage n=0 The modem will ignore dial tones and busy tones. The modem returns a CONNECT result code when a connection is established. n=1 The modem will ignore dial tones and busy tones. The modem returns a CONNECT xxxx result code when a connection is established, where xxxx is the Tx/Rx line speed (default). n=2 The modem will ignore busy tones, but waits for a dial tone before dialling. If a dial tone is not detected within 5 seconds, a NO DIAL TONE result code is returned. The modem returns a CONNECT xxxx result code when a connection is established, where xxxx is the Tx/Rx line speed. n=3 The modem will ignore dial tones. If a busy tone is detected, a BUSY result code is returned. The modem returns a CONNECT xxxx result code when a connection is established, where xxxx is the Tx/Rx line speed. n=4 If a dial tone is not detected within 5 seconds, a NO DIAL TONE result code is returned. If a busy tone is detected, a BUSY result code is returned. The modem returns a CONNECT xxxx result code when a connection is established, where xxxx is the Tx/Rx line speed.</p> <p>Setting stored into S register 22 bits 0-2. Note that wait for dial and wait for busy actions are not yet implemented.</p>
Zn	<p>Modem Reset Instructs the software to reset the Modem device and then reload the factory default S-Register settings (See S-Register Table).</p> <p>Syntax: ATZn<CR></p> <p>Modifier Usage n=0 Reset Modem device and restore factory profile 0. n=1 Reset Modem device and restore factory profile 1.</p>

Extended EV8500 AT Commands

Command	Description
&Fn	Recall Factory Defaults Instructs the modem to reload the factory S-Register settings (See S-Register Table). Syntax: AT&Fn<CR> Modifier Usage n=0 Recalls factory profile 0. n=1 Recalls factory profile 1.
&Gn	Guard Tone Select Selects the Guard tone to be transmitted with the high band QAM or DPSK. Syntax: AT&Gn<CR> Modifier Usage n=0 Disable guard tone (default). n=1 Enable 1800Hz guard tone. n=2 Enable 550Hz guard tone. Setting stored into S register 23.
&Hn	Number Base Select Selects the number base used by AT commands and responses. Syntax: AT&Hn<CR> Modifier Usage n=0 Decimal number base (default). n=1 Hexadecimal number base. Setting stored into S register 14 bit 3.

CML Specific EV8500 AT Commands

Command	Description																
@Ac	<p>ADC control and interrogation commands These functions allow the ADC to be controlled and readings taken from the AT command line.</p> <p>Syntax: AT@Ac<CR></p> <p>Modifier Usage c=A Select ADC input channel A c=B Select ADC input channel B c=Lnnn Set value of lower ADC threshold (0-255 range) c=R Display ADC reading for selected channel c=Unnn Set value of upper ADC threshold (0-255 range)</p>																
@C	<p>Real Time Clock and Alarm control commands</p> <p>Syntax: AT@CC<CR> Syntax: AT@Cdddd, hh, mm, ss<CR></p> <p>The first syntax clears and disables the alarm system. The second syntax sets the alarm value to the specified days (dddd), hours (hh) minutes (mm) and seconds (ss).</p> <p>Parameter Usage</p> <table border="0"> <tr> <td>dddd</td> <td>= 0</td> <td>- 49710</td> <td>number of days</td> </tr> <tr> <td>hh</td> <td>= 0</td> <td>- 23</td> <td>number of hours</td> </tr> <tr> <td>mm</td> <td>= 0</td> <td>- 59</td> <td>number of minutes</td> </tr> <tr> <td>ss</td> <td>= 0</td> <td>- 59</td> <td>number of seconds</td> </tr> </table>	dddd	= 0	- 49710	number of days	hh	= 0	- 23	number of hours	mm	= 0	- 59	number of minutes	ss	= 0	- 59	number of seconds
dddd	= 0	- 49710	number of days														
hh	= 0	- 23	number of hours														
mm	= 0	- 59	number of minutes														
ss	= 0	- 59	number of seconds														
@Dn	<p>DTMF Tone Transmit Modem will constantly transmit the specified DTMF tone dialling digit.</p> <p>Syntax: AT@Dn<CR>X</p> <p>Modifier Usage n = 0-9, A, B, C, D, * or # The DTMF dialling digit to be transmitted. X = Any key, terminates the command.</p>																

Command	Description
@Fn	<p>Test Functions</p> <p>Syntax: AT@Fn<CR></p> <p>Modifier Usage</p> <p>n=0 Set DCD and RI inactive, go on hook, clear test port bits if present. n=1 Set DCD and RI active, go off hook, set test port bits if present. n=2 Delay 100ms. n=3 Delay 1s. n=4 Reserved n=5 Reserved n=6 Modem status register continuous monitor function. Read and display the status register contents with an update rate configured by the S19 register setting in 10ms steps. The function is aborted by pressing any key on the terminal window. n=7 Modem status register interrupt monitor function. Displays the contents of the status register when an interrupt occurs. Error message is returned after 30 seconds if interrupt does not go active. User must enable interrupt with the desired IRQ masks bit before executing this command. n=C Display last received CLI packet information.</p>
@RR	<p>Modem CBUS Reset</p> <p>Sends the CBUS General Reset Command to the Modem device.</p> <p>Syntax: AT@RR<CR></p>
@Rn?	<p>Modem CBUS Register Read</p> <p>Command for displaying the contents of a Modem device CBUS register</p> <p>Syntax: AT@Rn?<CR></p> <p>where n is a valid Modem CBUS register address (hexadecimal). Value returned is either in decimal (default) or hex format depending on the setting of the AT&Hn command (stored in S register 14 bit 3). For write-only registers, value returned is last value written to that address.</p>
@Rn=x	<p>Modem CBUS Register Write</p> <p>Command for writing to a Modem device CBUS register.</p> <p>Syntax: AT@Rn=x<CR></p> <p>where n is a valid Modem CBUS register address (hexadecimal) x is the value to be written in decimal (default) or hexadecimal format depending on the setting of the AT&Hn command (stored in S register 14 bit 3). 8-bit register values should be in the range 0-255 (0-FF) and 16-bit register values should be in the range 0-65535 (0-FFFF). CBUS Read registers cannot be written.</p>

Command	Description
@Tn	DTMF Twist setting – Selects the required DTMF twist setting.

Modifier Usage**n=0** +2.0dB**n=1** +1.0dB**n=2** +1.5dB**n=3** +2.5dB**n=4** +3.0dB**n=5** +3.5dB**n=6** +4.0dB**n=7** +4.5dB

Settings saved into S register 28.

EV8500 Specific Extended AT Commands

Command	Description
AT!D	<p>Read and write internal 8051 core data memory Inspect or set the contents of the internal memory area.</p> <p>Syntax: AT!Da<CR> AT!Da=n<CR></p> <p>Parameter usage: 0≤a≤255 Address of internal memory 0≤n≤255 Data to set into specified location</p>
AT!P	<p>Read and write 8051 core special function memory Inspect and set the contents of the special function memory area.</p> <p>Syntax: AT!Pa<CR> AT!Pa=n<CR></p> <p>Parameter usage: 0≤a≤255 Address of special function memory 0≤n≤255 Data to set into specified location</p>
AT!X	<p>Read and write 8051 core extended data memory Inspect and set the contents of the extended memory area.</p> <p>Syntax: AT!Xa<CR> AT!Xa=n<CR></p> <p>Parameter usage: 0≤a≤65535 Address of extended data memory 0≤n≤255 Data to set into specified location</p>
AT!R	<p>Reset the CMX850 firmware Performs a warm boot operation</p> <p>Syntax: AT!R<CR></p>
AT!S	<p>Displays the current remaining stack space The result is an estimate of the peak stack usage.</p> <p>Syntax: AT!S<CR></p>
AT!T	<p>Display the current RTC time value Display the current time value in the form Dddd:Hhh:Mmm:Sss<CR>. Where dddd is in days elapsed, hh is in hours elapsed, mm is in minutes elapsed and ss is in seconds elapsed. Note: Use the AT@C command to set alarms using the RTC clock.</p> <p>Syntax: AT!T<CR></p>

S-Registers

The following table gives a description of the available S-registers, their functions and bit usage. Valid register value range, applicable units and factory profiles default values are also listed.

Reg	Range	Units	S-Register Description	Factory Profiles	
				'0' (Default at Power up)	'1'
S0	0-255	Rings	Automatic answer - Number of rings until automatic answer. If the register is zero the modem will not automatically answer.	0	5
S1	0-255	Rings	Count incoming rings - Contains the number of rings detected by the modem.	0	0
S2	0-127	ASCII	Escape character value - This register defines an ASCII decimal value of the escape character. The default setting is an ASCII + giving an escape sequence of +++. A value over 127 disables the escape sequence.	43	43
S3	0-127	ASCII	Terminator character - Contains the ASCII value of the character recognised as the command line terminator. This character will also be sent at the end of result codes.	13 '\r'	13 '\r'
S4	0-127	ASCII	Line feed character - Contains the ASCII value of the character recognised by the modem as the line feed. The modem sends the line feed character after a carriage return only when word responses are sent.	10	10
S5	0-127	ASCII	Backspace character - Contains the ASCII value of the character recognised as the backspace.	8	8
S6	2-255	s	Wait time for blind dialling - Sets the length of time to pause after the modem goes off the hook before the modem dials the first digit of the telephone number.	2	2
S7	1-255	s	Wait for carrier after dial - Sets the length of time the modem waits for a carrier before returning on-hook.	50	50
S8	0-255	s	Pause Time for Comma Dial Modifier - Specifies the number of seconds to pause for each comma (,) encountered in a dial string.	2	2
S9	1-255	Decimal	Reserved	0	0

S-Register				Factory Profiles	
Reg	Range	Units	Description	'0' (Default at Power up)	'1'
S10	1-255	100ms	Lost carrier to hang up delay - Sets the length of time that the modem waits before hanging up after the loss of a carrier. This allows the modem to distinguish between disturbances that momentarily break the connection and the remote modem hanging up.	7	7
S11	5-25	10ms	DTMF tone duration - Defines the duration of DTMF tones for tone dialling. The length of pause between each DTMF tone is the same as this duration time.	10	20
S12	0-255	50ms	Escape code guard time - Specifies the minimum time before entry of the escape sequence. This value also dictates the acceptable entry speed (inter-character delay) for each escape character.	2	2
S13	0-255	Decimal	Reserved	0	0
S14	0-255	Decimal	General options - provides the following functions: Bit 0 - Echo command character, 0 Disables echoing (ATE0), 1 Enables echoing (ATE1) Bit 1 - Result code display, 0 Send responses (ATQ0), 1 Do not send responses (ATQ1) Bit 2 - Word or number responses, 0 Send number responses (ATV0), 1 Send word responses (ATV1) Bit 3 - Format for command value entry. 0 select decimal (AT&H0), 1 select hexadecimal (AT&H1) Bit 4, 5, 6 - Reserved Bit 7 - Answer/originate operation, 0 Answer (ATA), 1 Originate (ATD)	133 (0x85)	128 (0x80)
S15	0-7	5ms steps	CLI window width setting - specifies the window width setting for CLI CAS tone detect. 0=100, 7=135.	0	0
S16	0-255	Decimal	Reserved	0	0
S17	0-255	Decimal	Reserved	0	0
S18	0-255	s	Wait for carrier after answer - Sets the length of time the modem waits for a carrier before returning on-hook.	30	30
S19	2-255	10ms	Modem status register monitor polling time. - Specified the time between status register polls for AT@F6 command.	2	2

S-Register				Factory Profiles	
Reg	Range	Units	Description	'0' (Default at Power up)	'1'
S20	0-255	10ms	V.22bis S1 Pattern Detect Timeout – The detect timeout value for the S1 pattern detect action in the V.22bis handshake sequence. Specified in 10ms steps, 0 defaults to 270ms.	0	0
S21	0-255	Decimal	Reserved	0	0
S22	0-7	Decimal	Calling mode selection - Provides the following configuration bits: Bit 0 - Wait for Dial Tone, ignore dial tones if 0, wait for 5 seconds if 1. Bit 1 - Wait for busy tones, ignore busy tones if 0. Bit 2 - Report connect speed, report CONNECT only if 0, report line connection speed if 1.	1 (0x01)	0 (0x00)
S23	0,2,3	Decimal	Guard tone selection – Specified the required guard tone (DPSK/QAM high band operation only). 0= no guard tone (AT&G0), 2=1800Hz (AT&G1) and 3=550Hz (AT&G2).	0	0
S24	0-255	Decimal	Modem configuration - Provides the following configuration bits: Bit 0 – Modem crystal Frequency selection, 0=12.288MHz, 1=11.0592MHz Bit 1 – Modem transmit and receive fixed compromise equaliser setting (used during negotiation and data transfer), 0 Enable, 1 Disable Bit 2 – Modem auto equaliser (DPSK operating modes only, always enabled during V22bis QAM operation), 0 Disable, 1 Enable Bit 3 – Fallback configuration, 0=Disable (ATN0), 1=Enable (ATN1). Bit 4, 5, 6, 7 – Reserved	1 (0x01)	3 (0x03)

S-Register				Factory Profiles	
Reg	Range	Units	Description	'0' (Default at Power up)	'1'
S25	0-255	Decimal	Transmit format and attenuation - Provides the following configuration bits: Bit 0, 1, 2 – Modem transmit attenuation in dB (used during negotiation and data transfer). 111=0, 110=-1.5, 101=-3.0, 100=-4.5, 011=-6, 010=-7.5, 001=-9.0, 000=-10.5 Bit 3, 4, 5 – Modem transmit data/stop bit settings (used during data transfer). 111 8/2 bits, 110 8/1 bits, 101 7/2 bits, 100 7/1 bits, 011 6/2 bits, 010 6/1 bits, 001 5/2 bits, 000 5/1 bits Bit 6, 7 – Modem transmit start stop mode setting (used during data transfer). 00 Odd parity, 01 Even parity, 10 No parity, 11 Synchronous.	176 (0xB0)	176 (0xB0)
S26	0-255	Decimal	Receive format and attenuation - Provides the following configuration bits: Bit 0, 1, 2 – Modem receiver attenuation in dB (used during negotiation and data transfer). 111=0, 110=-1.5, 101=-3.0, 100=-4.5, 011=-6, 010=-7.5, 001=-9.0, 000=-10.5 Bit 3, 4, 5 - Modem receiver data and parity bit settings (used during data transfer). 111 8 data + parity, 110 8 data, 101 7 data + parity, 100 7 data, 011 6 data + parity, 010 6 data, 001 5 data + parity, 000 5 data Bit 6, 7 - Modem receiver USART setting (used during data transfer). 00 2.3% overspeed, 01 1% overspeed, 10 No overspeed, 11 Synchronous.	48 (0x30)	176 (0xB0)
S27	0-255	Decimal	Bit Negotiation protocol selection – Specifies the selected protocol for negotiation, for 'ATBn', S27 = n.	0	0
S28	0-7	Decimal	DTMF twist settings - Provides the following configuration bits (AT@Tn command): Bit 0, 1, 2 – CMX868 DTMF Twist level, 000 +2.0dB, 001 +1.0dB, 010 +1.5dB, 011 +2.5dB, 100 +3.0dB, 101 +3.5dB, 110 +4.0dB, 111 +4.5dB Do not use +4.5dB setting in conjunction with the 0dB transmit attenuation setting.	0	0

S-Register				Factory Profiles	
Reg	Range	Units	Description	'0' <i>(Default at Power up)</i>	'1'
S29	0-255	Decimal	Reserved – Contains handshake failure state information.	0	0

Modem Result Codes

Numeric Response (Decimal)

00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
21
22
24
25
26

Alpha Response

OK
CONNECT
RING
NO CARRIER
ERROR
NO DIAL TONE
BUSY
CONNECT 2400
CONNECT 1200
CONNECT 600
CONNECT 300
CONNECT 1200/75
CONNECT 75/1200
CONNECT 1200/150
CONNECT 150/1200
NYI
ALARM
CLI
ADC NOT READY
INVALID CHANNEL
NO CLI

(Not Yet Implemented)
Not all target selections
Not all target selections

At Command Summary

- 1) The maximum command length is 48 characters, excluding the AT prefix and carriage return.
- 2) A user defined escape sequence (usually +++) is required to revert the modem from on-line (data transfer mode) to the command mode, to allow the user to issue AT commands.
- 3) Every command except for A/ and the escape sequence must begin with the AT prefix and be completed by sending a carriage return.
- 4) When the default command echoing and word result codes are enabled the firmware will send a LF character directly after a CR character to ensure the terminal emulator display is legible.
- 5) Commands which are not yet implemented will return the result code 'NYI' (Not Yet Implemented).
- 6) Do not send AT commands to the Demonstration board until the previous result code (if enabled) has been received as this may overflow the input buffers.

6.4 Terminal Emulator

Users will need to run a suitable terminal emulator on their PC in order to communicate with the CMX850 on the Evaluation Kit. 'Hyper Terminal', which is supplied with the Windows operating systems, is suitable for this purpose.

Hyper Terminal Setup

Emulation:	VT100
Character Set:	ASCII
ASCII Sending:	Echo typed characters locally. <i>(Enable if modem not echoing)</i>
ASCII Receiving:	Wrap lines that exceed terminal width.
COM Port Settings:	
	Bits per second: 19,200
	Data bits: 8
	Parity: None
	Stop bits: 1
	Flow Control: Hardware (or None, see note)

Note: The flow control can be set to none and still allow communication with the CMX850 evaluation board but buffer overrun problems may occur in data transfer mode.

6.5 Compiling new firmware with the Keil compiler

The EV8500 evaluation kit comes complete with the full firmware source code. This code is produced and compiled using the Keil compiler version 6.02 (not supplied as part of this kit). The Keil project files for the firmware are also included with the source code.

The Keil target options (Project menu, Options for Target) are default except for the following:
 Target tab: Xtal frequency 11.0592MHz, Memory Model; Compact, Code ROM size; Large, Off chip code memory; 0-10000, Off chip XDATA memory; 0-10000.
 A51 tab: Macro processor; Standard and MPL checked.

The EV8500 contains hardware to support code banking and the evaluation code is by default configured to support this. To enable code banking support in your project include the modified L51_bank.asm source file and set the following compiler options:
 Target tab: Code banking checked, Banks; 8, Bank area; 0-FFFF.
 A51 tab (for L51_bank.asm only): Macro processor; MPL unchecked.

Note that the breakpoint AT commands AT!B and AT!C are provided with the standard firmware but cannot be used with the code banking scheme active. To use the breakpoint commands the standard firmware must be compiled with banking removed (see settings above) and download to the EV8500.

6.6 Reprogramming the FLASH ROM

The EV8500 board supports in-situ programming of the onboard FLASH memory using the serial interface and internal BootROM.

To enter FLASH programming mode remove the power from the EV8500 board and close jumper JP5. Connect the serial interface (J5) to a PC able to run the FLASH programming application (ESFLASH_xx.EXE) and reconnect the power to the EV8500 board.

The FLASH programming application is provided to allow the user to download new program data to the FLASH memory on the EV8500 board. To program the FLASH memory on an EV8500 board enter FLASH programming mode as described above.

Start the FLASH programming application and select a "Target type selection" of "EV8500 Evaluation board". Click "Load File" and select a "fat stub download" HEX file which matches the flash memory type fitted to the attached EV8500 evaluation board. (The board is normally fitted with AM29LV040B 70ns FLASH memory). Click "Load File" and select the required FLASH data download file. The Keil compiler suite produces a single file for code banked projects with the file extension ".Hex".

Select the PC communications resource which is connected to the EV8500 evaluation board. Press the "Program FLASH" button to start the download sequence to the EV8500 evaluation board. The dialog controls will be greyed and a progress counter will start. If the program prompts with the message "Automatically include 'thin' stub code bank in 1 ?" then click the No button.

The first pass of the progress counter is the download of the 'fat' stub to control access to the FLASH memory. The second pass of the progress bar is the download of the FLASH program data. Once both passes of the progress bar are complete the EV8500 FLASH application will inform the user that the download is complete. Remove jumper JP5 and reset the board.

6.7 Negotiation and Data Transfer

During modem negotiation (handshaking) and data transfer mode the user can revert to on-line AT command mode by typing the escape code sequence (+++). The escape code guard time (based on S12) must have expired to successfully access this mode. Whilst in on-line AT command mode the board to remote modem connection may be aborted by typing ATH0 (instructs modem to go on-hook). Alternatively the user can enter relevant AT commands or return to data transfer mode by using the ATO command.

The firmware only supports asynchronous data transfer.

Receiver USART overspeed settings specified in S-Register, S26, only apply to DPSK/QAM operating modes.

Transmitter Guard Tone settings specified in S-Register, S23, only apply to DPSK/QAM answering modes.

If the carrier is lost (during data transfer) or negotiation is aborted by the user, the firmware will send the General Reset Command to the CMX850 device modem section. This action will cause the EV8500 demonstration board to hang up.

The data transfer firmware does not contain any retrain code. This process is sometimes performed by modems when signal distortion or line noise is detected which may threaten data integrity.

The receive auto equalizer function can be enabled via the S24 register. This S24 register setting only applies to DPSK modes of operation. The EV8500 firmware for V.22 bis always enables the receive auto equalizer half way through the negotiation phase.

6.8 Troubleshooting

Care must be taken to get the correct settings for address and data multiplexing using JP1 and JP5 to JP7. If JP1 is shorted then JP5 to JP7 must be open to allow correct non-multiplexed operation and the firmware modified to support this mode of operation.

Some terminal emulators have been found not to support full hardware flow control when transferring text files. This could result in data loss when using this facility. If this problem is experienced users should try using a different terminal emulator

To ensure successful negotiation and data transfer between the EV8500 and third party modems, users should ensure their third party modem is configured to the correct protocol (see third party AT command documentation).

Note that any sudden loss of the 2-wire line during data transfer will result in loss of carrier and therefore the demonstration board will hang up and display the NO CARRIER message. However, due to the lost carrier to hang up delay (S10), a short burst of corrupt characters (noise generated) will be observed on the HyperTerminal window before the NO CARRIER message is displayed. These corrupt characters can sometimes match control characters and therefore modify HyperTerminal's behaviour. The user is advised to restart HyperTerminal if this happens.

7. Performance Specification

7.1 Electrical Performance

7.1.1 Absolute Maximum Ratings

Exceeding these maximum ratings can result in damage to the Evaluation Kit.

	Min.	Max.	Units
Supply ($V_{DD} - V_{SS}$)	-0.3	3.9	V
Voltage on any connector pin to V_{SS}	-0.3	$V_{DD} + 0.3$	V
Current into or out of V_{IN} and V_{SS} pins	0	+1.5	A
Current into or out of any other connector pin	-20	+20	mA

7.1.2 Operating Limits

Correct operation of the Evaluation Kit outside these limits is not implied.

	Notes	Min.	Max.	Units
Supply ($V_{DD} - V_{SS}$)		3.0	3.6	V

7.1.3 Operating Characteristics

For the following conditions unless otherwise specified:

Evaluation Device Xtal Frequency = 11.0592MHz or 12.288MHz \pm 0.01% (100ppm)
 $V_{DD} = 3.3V$, $T_{amb} = +25^{\circ}C$.

	Notes	Min.	Typ.	Max.	Units
DC Parameters					
I_{DD} ((evaluation board - idle))	1		100		mA

Notes: 1. Hook relay off.




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