CML Microcircuits

COMMUNICATION SEMICONDUCTORS

EV8500
Evaluation Kit User Manual

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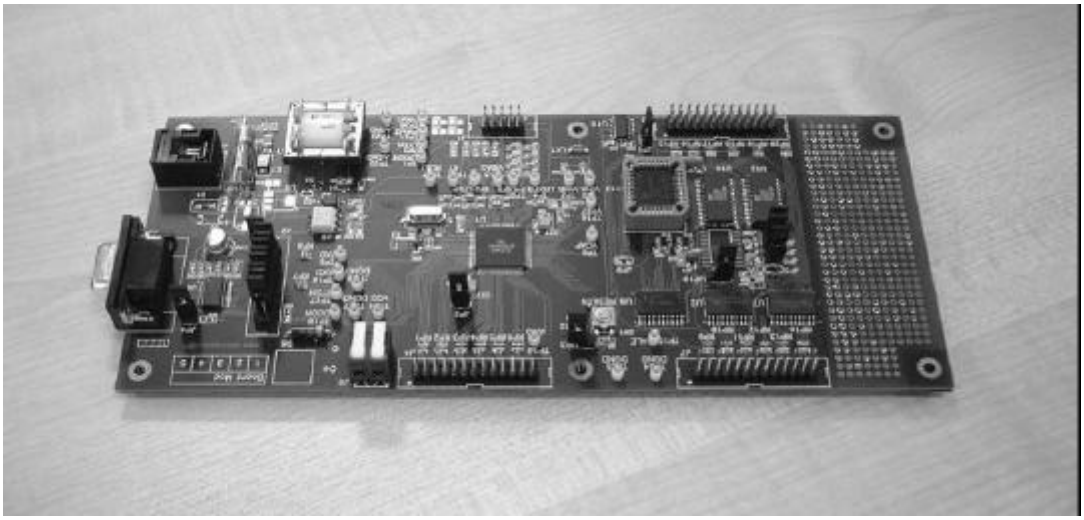
Features

- **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.

CONTENTS

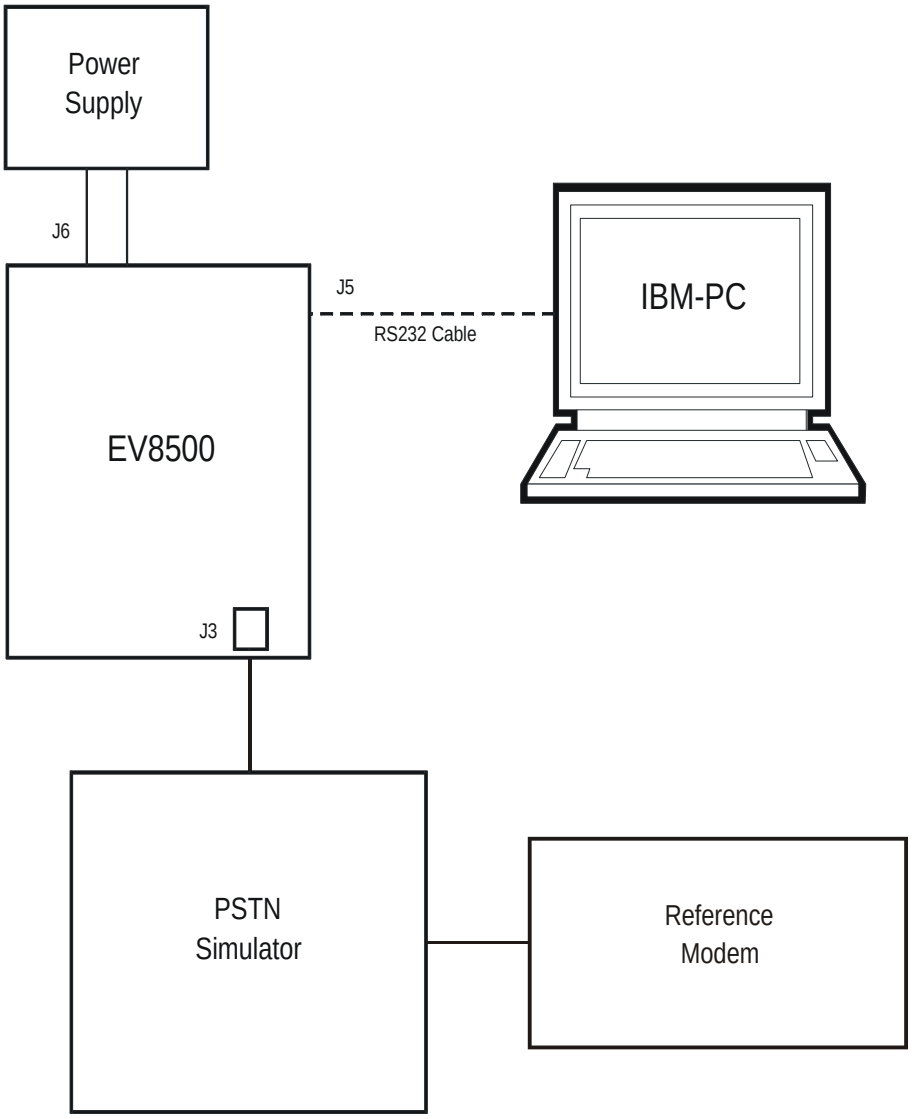


Figure 1 System Block Diagram

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 two 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 and II 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 EV8500 firmware can also detect a type II CLI message. As this applies to phone rather than modem systems a special ‘feature phone’ mode has been added (S register 14, bit 0). The EV8500 firmware with ‘feature phone’ enabled (AT command AT@F9) does not attempt a modem connection when going off-hook but instead waits to detect a type II CLI message. If a valid type II CLI message is detected then the message “CLI II” is displayed.
The contents of the last received CLI message can be viewed using the AT command AT@F6. A simple CLI message when displayed might produce something similar to the following.

AT@F6
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.

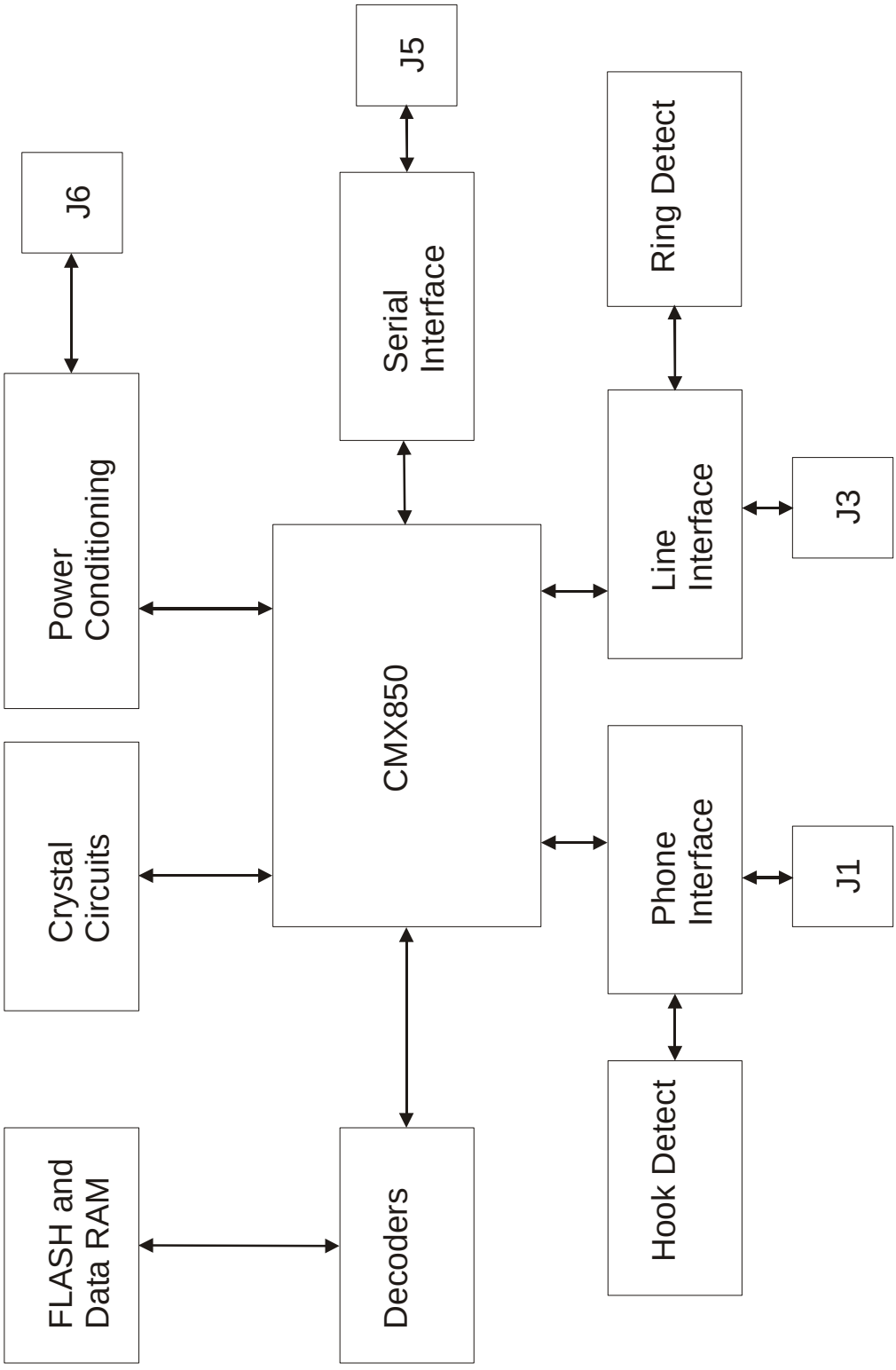


Figure 2 Block Diagram

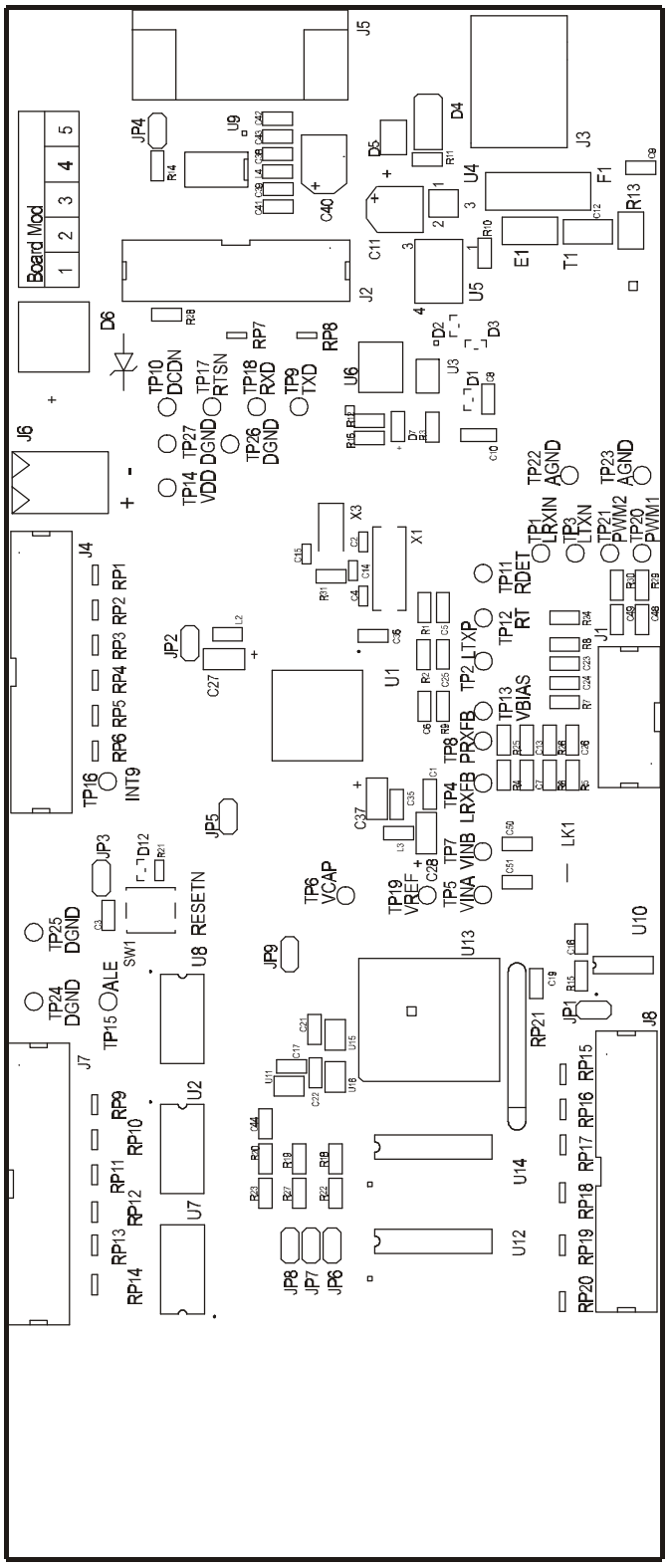


Figure 3 Evaluation Board - Layout

6. Detailed Description

6.1 Hardware Description

6.1.1 I_{DD} Measurement

The evaluation device I_{DD} may be measured by removing jumper JP2 and replacing it with a multimeter.

6.1.2 On and Off Hook Caller ID (Type I and II)

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 0 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	33k
R11	11R5
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	0R	2.2µF
C24	39pF	180pF
R6	100k	91k

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.Hnn, where xx represents the version number and nn the code bank 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, sfr.asm and breakpoint.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@RE224=4929@RE230?@RE225=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*

ATA **Answer**

The EV8500 will go off-hook and attempt to establish a remote connection.

Syntax: **ATA**<*CR*>

A/ **Repeat previous command line**

Repeat the previously entered command line.
Note: *This command string does not terminate with a carriage return.*

Syntax: **A/**

ATBn **Select communication standard**

Select the communication standard specified by the parameter n

Syntax: **ATBn**<*CR*>

Parameter usage:

n=0 ITU-T V.22bis at 2400bps QAM (default)
n=1 ITU-T V.22 at 1200bps DPSK
n=2 ITU-T V.23 with Tx 75bps and Rx 1200bps FSK
n=3 ITU-T V.23 with Tx 1200 bps and Rx 75bps FSK (Not implemented)
n=4 ITU-T V.22 at 600bps DPSK (Not implemented)
n=5 ITU-T V.21 at 300bps FSK (Not implemented)
n=6 Bell 212A at 1200bps DPSK (Not implemented)
n=7 Bell 202 with Tx 150bps and Rx 1200bps FSK (Not implemented)
n=8 Bell 202 with Tx 1200bps and Rx 150bps FSK (Not implemented)
n=9 Bell 103 and 300bps FSK

ATDn **Dial command**

Commands the modem to go off-hook, dial according to the entered parameter and attempt to establish a connection. The maximum length of the dial string is 23 characters excluding the ATD prefix.

Syntax: **ATD9,01621875500**<*CR*> or
ATDL<*CR*>

Parameter usage:

n=L Repeat dial of last number
n=, Delay dialing sequence (duration defined in 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

ATEn **Echo command characters**

Syntax: **ATEn**<*CR*>

Parameter usage:

n=0 Disable echoing of command characters
n=1 Enable echoing of command characters

Command	*Description*

ATHn **Hook switch control**

Set the current state of the modem hook switch.

Syntax: **ATHn**<*CR*>

Parameter usage:

n=0 Force the modem on-hook (disconnect)

n=1 Force the modem off-hook

ATIn **Identification**

Instruct the modem to return product information

Syntax: **ATIn**<*CR*>

Parameter usage:

n=0 Display the firmware name and version number

n=1 Display the product name and CML web site information

ATNn **Modulation fallback options**

Syntax: **ATNn**<*CR*>

Parameter usage:

n=0 When originating or answering the modem handshakes only at the specified communications standard (default)

n=1 When answering the modem falls back from V.22bis and V.22 to Bell 212A, V.21, Bell 103 or V.23 as required and where implemented.

ATO **Return to online mode**

Returns the modem to online data transfer mode.

Syntax: **ATO**<*CR*>

ATQn **Configure modem responses**

Syntax: **ATQn**<*CR*>

Parameter usage:

n=0 Enable result codes to the terminal (default)

n=1 Disable result codes to the terminal

ATSn **S-Register read and write command**

Command to read and display the contents of an S register (first syntax) or write the value of an S register (second syntax). See S register table for register usage.

Syntax: **ATSn?**<*CR*> or
ATSn=v<*CR*>

Parameter usage:

n=0-29 S register address

v=0-255 Write value

Command	*Description*

ATVn **Result code format**

Syntax: **ATVn**<*CR*>

Parameter usage:
n=0 Display modem result codes as numbers (see table for meanings)
n=1 Display modem result codes as text (default)

ATXn **Calling characteristics**
Select which set of calling characteristics are to be used.

Syntax: **ATXn**<*CR*>

Parameter usage:
n=0 Modem ignores dial tones and busy tones. Dial tone wait time is zero and blind dialing is disabled. Modem returns a connect result code when connection is established.
n=1 Same as above except modem returns a connect result code containing the connected line speed

ATZn **Modem reset**
Reset the modem using one of the provided factory profiles.

Syntax: **ATZn**<*CR*>

Parameter usage:
n=0 Reset the CMX850 using factory profile 0
n=1 Reset the CMX850 using factory profile 1

Extended EV8500 AT Commands

Command	*Description*

AT&Fn **Recall Factory Defaults**
Load one of the provided factory profiles without resetting the CMX850 hardware.

Syntax: **AT&Fn**<*CR*>

Parameter usage:
n=0 Load factory profile 0
n=1 Load factory profile 1

AT&Gn **Guard tone selection**
Select the guard tone to be transmitted in high band QAM or DPSK modes.

Syntax: **ATZn**<*CR*>

Parameter usage:
n=0 Disable guard tone (default)
n=1 Select a 550Hz guard tone
n=2 Select a 1800Hz guard tone

CML Specific EV8500 AT Commands

Command	*Description*

AT@AC **Set RTC alarm value or clear the current alarm**

Set value of the RTC alarm time (first syntax) or clear the current alarm time if set (second syntax). When the alarm time is reached the message "RTC Alarm" will be displayed and the alarm cleared.

Syntax: **AT@Addddd,hh,mm,ss**<*CR*>
AT@AC<*CR*>

Parameter usage:

ddddd=0-49710	Number of days in the alarm time
hh=0-24	Number of hours in the alarm time
mm=0-59	Number of minutes in the alarm time
ss=0-59	Number of seconds in the alarm time

AT@Bn **BER test duration**

Set the duration of the next BER test originated.

Syntax: **AT@Bn**<*CR*>

Parameter usage:

n=0-7 Length of bit error rate test is 10En (1-10,000,000) bits

AT@CS **Control the Analogue to Digital Converter**

Set the value of the lower ADC threshold (first syntax), or the upper ADC threshold (second syntax). Start continuous readings from input A or B at the specified rate (third and fourth syntax). Stop continuous reading if started (fifth syntax) and display current ADC reading value (sixth syntax).

Syntax: **AT@CLnnn**<*CR*>
AT@CUnnn<*CR*>
AT@CSAr<*CR*>
AT@CSBr<*CR*>
AT@CS<*CR*>
AT@CR<*CR*>

Parameter usage:

nnn=0-255	Threshold value, compared against upper eight bits of ADC result
r=0-4	Continuous reading rate, 552/8832/4416/2208 or 1104 per second

AT@E **Equaliser settings**

Set the equaliser setting for the receive auto equaliser (first syntax) or the fixed receive and transmit path equaliser (second syntax)

Syntax: **AT@ERn**<*CR*> or
AT@EFn<*CR*>

Parameter usage:

n=0	Disable equaliser
n=1	Enable equaliser

Command	*Description*

AT@Fn **Test Functions**

Syntax: **AT@Fn**<*CR*>

Parameter usage:

n=0 Force modem on-hook and un-assert modems DCD line
n=1 Force modem off-hook and assert modems DCD line
n=2 Delay for 100 ms
n=3 Delay for 1 second
n=4 Initiate BER test as Rx (answering) modem
n=5 Initiate BER test as Tx (originating) modem
n=6 Display data from last received CLI packet
n=7 Reads and displays the contents of the CMX850 modem status register when an interrupt occurs. This function times out after 30 seconds.
n=8 Reserved function
n=9 Switch to 'feature phone' mode
n=A Display 5 ADC readings/sec forever

AT@Hn **Modem response number base**

Syntax: **AT@Hn**<*CR*>

Parameter usage:

n=0 Display modem responses in decimal (default)
n=1 Display modem responses in hex

AT@RR **CMX850 hardware reset**

Reset the CMX850 hardware.

Syntax: **AT@RR**<*CR*>

AT@REn **CMX850 C-BUS register access**

Command to read and display the contents of a C-BUS register (first syntax) or write the value of a C-BUS register (second syntax). See CMX850 datasheet for register definitions.

Syntax: **AT@REn?**<*CR*> or
Syntax: **AT@REn=v**<*CR*>

Parameter usage:

n=0-255 The value of n specifies the C-BUS register to read or write
v=0-255 The value to write to the C-BUS register (8-bit registers)
=0-65535 The value to write to the C-BUS register (16-bit registers)

AT@Xn **Modem crystal selection**

Syntax: **AT@Xn**<*CR*>

Parameter usage:

n=0 Select 12.2880MHz crystal
n=1 Select 11.0592MHz crystal (default)

CML Specific Extended EV8500 AT Commands

Note all arguments to and results from these commands are in hexadecimal format.

Command	*Description*

AT!D **Read and write internal data memory**

Inspect or set the contents of the internal memory area.

Syntax: **AT!Daa**<*CR*>
AT!Daann<*CR*>

Parameter usage:

aa=0-FF	Address of internal memory
nn=0-FF	Data to set into specified location

AT!P **Read and write special function memory**

Inspect and set the contents of the special function memory area.

Syntax: **AT!Paa**<*CR*>
AT!Paann<*CR*>

Parameter usage:

aa=0-FF	Address of internal memory
nn=0-FF	Data to set into specified location

AT!X **Read and write extended data memory**

Inspect and set the contents of the special function memory area.

Syntax: **AT!Paa**<*CR*>
AT!Paann<*CR*>

Parameter usage:

aa=0-FF	Address of internal memory
nn=0-FF	Data to set into specified location

AT!R **Reset the CMX850 software**

Performs a warm boot operation

Syntax: **AT!R**<*CR*>

AT!S **Displays the current remaining stack space**

The result is an estimate of the peak stack usage.

Syntax: **AT!S**<*CR*>

AT!T **Display the current RTC time value**

Display the current time value in the form Ddddd:Hhh:Mmm:Sss<*CR*>.
Where dddd is in hours elapsed, hh is in hours elapsed, mm is in minutes elapsed and ss is in seconds elapsed.
Note: Use the AT@A command set alarms using the RTC clock.

Syntax: **AT!T**<*CR*>

Command	*Description*

AT!B **Setup or clear a breakpoint**

Breakpoints are a debugging facility which is provided for simple project debugging. It does not support operation with a banked project or compiler.
To setup a breakpoint (first syntax) at the specified address (aaaa), this operation overwrites the contents of bank seven of the FLASH memory and copies the contents of bank 0 with a breakpoint jump into it. Execution then resumes from bank seven until the breakpoint is reached.
The command has no effect if a breakpoint is currently active.

Syntax: **AT!Baaaa**<*CR*>
AT!B0000<*CR*>

AT!C **Continue from an active breakpoint**

Continue from an active breakpoint, this command has no effect if a breakpoint is not active.

Syntax: **AT!C**<*CR*>

S-Registers

The following table gives a brief description of the available S-registers and their functions. Register range, units and factory profiles are also listed. Factory profile 0 is the default at system power up.

S-Register				*Factory Profiles*	
Reg	***Range***	***Units***	***Description***	***'0'***	***'1'***
S0	0-255	Rings	**Automatic answer** – This register defines the number of rings before the modem automatically answers. If the register value is zero then automatic answer is disabled.	0	5
S1	0-255	Rings	**Count incoming rings** – This register is read-only and indicates the number of incoming rings detected by the modem	0	0
S2	0-128	ASCII	**Escape character** – This register defines the ASCII value of the escape character. The default value is ASCII + giving an escape sequence of +++ and a value of 128 disables the escape sequence.	43	43
S3	0-127	ASCII	**Carriage return character** – This register defines the ASCII character used to terminate AT commands and sent at the end of response lines.	13	13
S4	0-127	ASCII	**Line feed character** – This register defines the ASCII character accepted by the modem and used when word responses are enabled.	10	10
S5	0-127	ASCII	**Backspace character** – This register defines the ASCII character recognised as a backspace.	8	8
S6	2-255	Seconds	**Wait time for blind dialing** - This register defines the delay between the EV8500 going off hook and dialing the first digit of the telephone number	2	2

S-Register				Factory Profiles	
Reg	**Range**	**Units**	**Description**	**'0'**	**'1'**
S7	1-255	Seconds	**Wait time for carrier after dialing** – This register defines the time the modem waits for a carrier before returning on-hook	50	50
S8	0-255	Seconds	**Pause time for comma dial character** – This register defines the time to pause for each comma (,) character found in the telephone number.	2	2
S9	0-255	n/a	**Reserved**	0	0
S10	1-255	100ms	**Lost carrier to hang-up delay time** – This register defines the time between the loss of carrier and the modem returning on-hook. This allows the modem to ignore any momentary breaks in the connection.	7	7
S11	5-255	10ms	**DTMF tone duration** – This register defines the duration of DTMF dialing tones and the pause between each dialled tone.	10	20
S12	0-255	50ms	**Escape code guard time** – The register defines the time before an escape sequence can be entered and the time between each character of the escape sequence.	20	20
S13	0-255	n/a	**Reserved**	0	0
S14	0-255	n/a	**General options (bit assignment)** – The register defines the following functions. Bit 0 - Feature Phone Mode Select, 0 run the modem in its normal operating mode, 1 run with pseudo feature phone features. Bit 1 - Echo command character, 0 Disables echoing (ATE0), 1 Enables echoing (ATE1) Bit 2 - Results code display, 0 displays results (ATQ0), 1 suppress results (ATQ1) Bit 3 - Text or numeric responses, 0 number responses (ATV0), 1 text responses (ATV1) Bit 4 - Decimal of Hex responses, 0 decimal responses (AT@H0), 1 Hex responses (AT@H1) Bit 5 - Receive auto equaliser setting, 0 disable auto equaliser (AT@ER0), 1 enable auto equaliser (AT@ER1) - *see note below* Bit 6 - Fixed equaliser setting, 0 enable fixed equaliser (AT@EF1), 1 disable fixed equaliser (AT@EF0) - *see note below* Bit 7 - Answer or originate, 0 answer (ATA), 1 originate (ATD) *NOTE: For V.22 the default settings are - auto equaliser off, fixed equaliser on* *For V.22bis the default settings are - auto equaliser on, fixed equaliser on* *Otherwise the default settings are - auto equaliser off, fixed equaliser off*	138 0x8A	128 0x80

S-Register				Factory Profiles	
Reg	**Range**	**Units**	**Description**	**'0'**	**'1'**
S15	0-7	n/a	**CLI Type II Window** – This register defines the CLI CAS tone detection window where: 0 = 65-100ms 1 = 65-105ms 2 = 65-110ms 3 = 65-115ms 4 = 65-120ms 5 = 65-125ms 6 = 65-130ms 7 = 65-135ms	0	0
S16	0-255	n/a	**Reserved**	0	0
S17	0-255	n/a	**Reserved**	0	0
S18	0-255	Seconds	**Modem handshake timeout** – This register defines the time before an answering modem aborts a handshaking action.	30	30
S19	0-255	n/a	**Reserved**	0	0
S20	0-255	n/a	**Reserved**	0	0
S21	0-255	n/a	**Bit error rate test setup (bit assignment)** – Bit 2,1,0 - Duration of test where the value selected gives 10En (1-10,000,000) bits (AT@Bn) Bit 7-3 - Start delay in seconds (0-31)	5	5
S22	0-1	n/a	**Calling characteristics** – This register defines the calling characteristics of the modem where 0=ATX0 and 1=ATX1	1	0
S23	0-2	n/a	**Guard tone setting** – This register defines the guard tone setting where: 0 = None (AT&G0) 1 = 550Hz (AT&G1) 2 = 1800Hz (AT&G2)	0	0
S24	0-1	n/a	**Crystal selection** – This register defines the CMX850 main crystal frequency, 0 12.2880MHz (AT@X0), 1 11.0592MHz (AT@X1)	1	1
S25	0-255	n/a	**Transmitter setup (bit assignment)** – Bit 2,1,0 - Transmit attenuation setting where: 0 (000) = -10.5 dB 1 (001) = -9.0 dB 2 (010) = -7.5 dB 3 (011) = -6.0 dB 4 (100) = -4.5 dB 5 (101) = -3.0 dB 6 (110) = -1.5 dB 7 (111) = 0.0 dB Bit 3 - Stop bit setting where: 0 is one stop bit and 1 is two stop bits Bit 5,4 - Data bits setting where: 0 (00) = 5 data bits 1 (01) = 6 data bits 2 (10) = 7 data bits 3 (11) = 8 data bits	183 0xB7	176 0xB0

S-Register				Factory Profiles	
Reg	**Range**	**Units**	**Description**	**'0'**	**'1'**
			Bit 7,6 - Start-stop mode where: 0 (00) = Odd parity 1 (01) = Even parity 2 (10) = No parity		
S26	0-255	n/a	**Receiver setup (bit assignment)** – Bit 2,1,0 - Receive attenuation setting, as S25 Bit 3 - Stop bit setting, as S25 Bit 5,4 - Data bits setting, as S25 Bit 7,6 - Overspeed setting where: 0 (00) = 2.3 % overspeed 1 (01) = 1.0% overspeed 2 (10) = No overspeed	183 0xB7	176 0xB0
S27	0-9	n/a	**Communication standard** – This register defines the modems communication standard where values 0 to 9 are selected by ATB0-9	0	0
S28	0-255	n/a	**Reserved**	0	0
S29	0-255	n/a	**Reserved**	0	0

Modem Result Codes

Numeric Response (Decimal)	*Alpha Response*
00	**OK**
01	**CONNECT**
02	**RING**
03	**NO CARRIER**
04	**ERROR**
05	**NO DIAL TONE**
06	**BUSY**
07	**CONNECT 2400**
08	**CONNECT 1200**
09	**CONNECT 600**
10	**CONNECT 300**
11	**CONNECT 1200/75**
12	**CONNECT 75/1200**
13	**CONNECT 1200/150**
14	**CONNECT 150/1200**
15	**NYI**

AT Command Summary

1) The maximum command length is 47 characters, excluding the AT prefix and carriage return.
2) A user defined escape sequence (defaulted to +++) is required to revert the modem from on-line (data transfer mode) to AT 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 with a carriage return.
4) Commands which are not fully implemented will return the result code 'NYI' (Not Yet Implemented).
5) Do not send AT commands to the Evaluation Kit until the previous result code (if enabled) has been received.

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. *(Enable if modem not echoing)*	
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 complier 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 complied 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 or files. The Keil compiler suite produces multiple files for code banked projects with the file extension “.Hnn”. Selecting a file with the extension .H00 automatically loads the other banked files with the same name. Each .Hnn file will be loaded into the code bank specified by the numeric value in the files extension e.g. .H03 would be loaded into code bank three.

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.

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
Storage Temperature	-10	+70	°C
Operating Temperature	+10	+35	°C

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
Operating Temperature		+10	+35	°C

7.1.3 Operating Characteristics

For the following conditions unless otherwise specified:

Evaluation Device Xtal Frequency = 11.0592MHz or 12.288MHz ±0.01% (100ppm)
V_{DD} = 3.3V, Tamb = +25°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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For FAQs see: www.cmlmicro.com/products/faqs/

For a full data sheet listing see: www.cmlmicro.com/products/datasheets/download.htm

For detailed application notes: www.cmlmicro.com/products/applications/

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