Consumer Microcircuits Limited

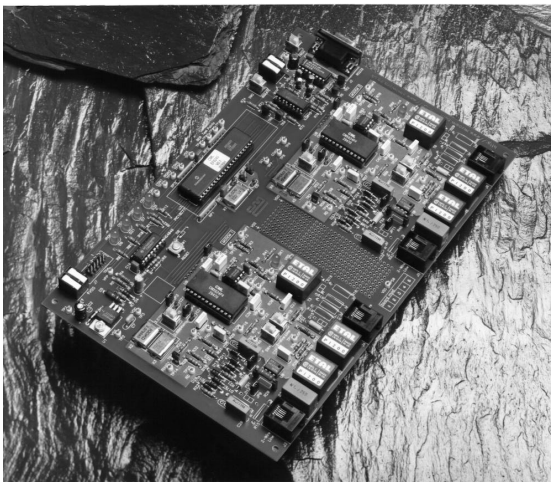
M-I-X-E-D S-I-G-N-A-L S-O-L-U-T-I-O-N-S

EV6240
Evaluation Kit User Manual

UM6240/3 January 1999 Advance Information

1.0 Features

- **CMX624/CMX644A Product Evaluation**
- **Single device Calling and Answer mode tests**
- **Single or Dual device operation for BER tests and general evaluation**
- **2-wire line Ring detect circuitry and OptoMOS Hook relays**
- **Socketed space for optional Telco-specific components**
- **Selectable 2 or 4 wire line interfacing**
- **AT Command compatible firmware controlled via PC terminal emulator**
- **On-Board PIC programming via serial interface and PC software**
- **Socketed components and links for circuit adjustment**
- **Opto-Isolated serial interface capability**



1.1 Brief Description

The EV6240 Evaluation Kit comprises a single board containing two CMX624 or CMX644A devices, line interface components, PIC µC with serial communications port for PC interfacing. A reduced AT command set is used to communicate with the evaluation board via standard terminal emulators.

The board is powered from a single 8-24V dc power supply; an on board regulator and two discrete components set V_{DD} to provide 3.3Volt or 5Volt operation. LED's indicate device interrupts, carrier detect and hook relay status. The CMX6x4 devices may be driven from an external clock, or from their own crystal oscillator. Important signals can be monitored via test points. The CMX6x4 devices are socketed for easy replacement. A user prototyping area is provided.

On-board miniature switches allow the user to select the required line interface and appropriate evaluation device crystal. The CMX6x4 supply currents may be measured by removing jumpers. Where components are telco-specific (line impedance, line protection, etc.) space is provided for the user to add appropriate components.
The EV6240 PCB is suitable for CMX624 and CMX644A evaluation.

© 1999 Consumer Microcircuits Limited

CONTENTS

Section Page

1.0 Features 1

1.1 Brief Description.....1

1.2 Preliminary Information 4
1.2.1 Laboratory Equipment.....4
1.2.2 Handling Precautions 4
1.2.3 Approvals 4

1.3 Quick Start 5
1.3.1 Setting-Up.....5
1.3.2 Adjustments 5
1.3.3 Operation.....5

1.4 Signal Lists 6

1.5 Circuit Schematics and Board Layouts.....11

1.6 Detailed Description.....16
1.6.1 Hardware Description 16
1.6.2 Adjustments and Controls.....18
1.6.3 Firmware Description.....18
1.6.4 Software Description 28
1.6.5 Evaluation Tests.....30
1.6.6 Additional Information.....34

1.7 Performance Specification.....45
1.7.1 Electrical Performance.....45

Note: As this product is still in development, it is likely that a number of changes and additions will be made to this specification. Items marked TBD or left blank will be included in later issues.

© 1999 Consumer Microcircuits Limited

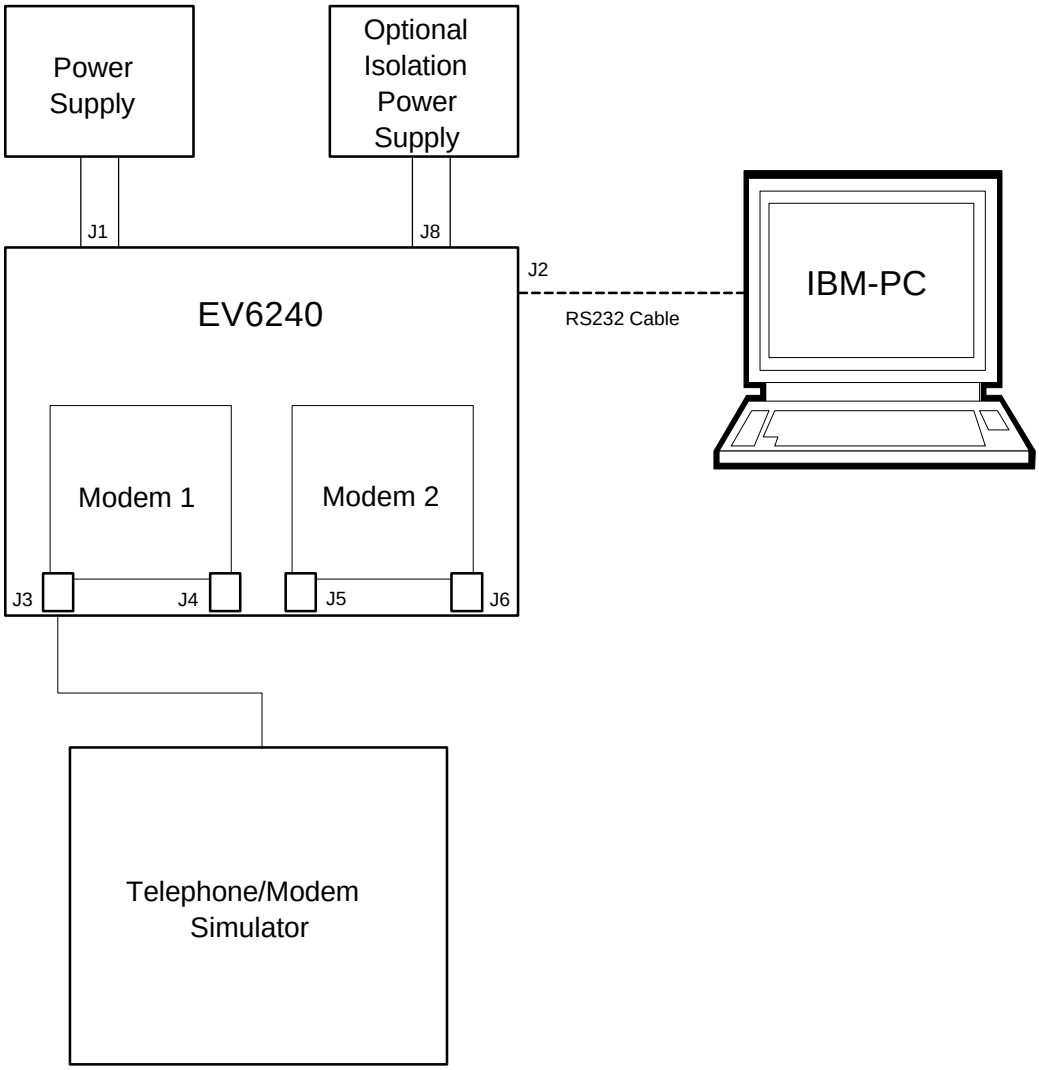


Figure 1 Block Diagram

© 1999 Consumer Microcircuits Limited

1.2 Preliminary Information

1.2.1 Laboratory Equipment

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

1.2.1.1 8-24V dc Power Supply

1.2.1.2 An IBM compatible PC; 66MHz ‘486 or better, running Microsoft Windows™ ’95/NT. The re-programming software supplied (**PICPROGB.EXE**) runs most efficiently under DOS and cannot be used with Windows NT.

1.2.2 Handling Precautions

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

1.2.2.1 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.

1.2.2.2 Contents - Unpacking

Please ensure that you have received all of the items on the separate information sheet (EK6240) and notify CML within 7 working days if the delivery is incomplete.

1.2.3 Approvals

This Evaluation Kit is not approved for direct or indirect connection to any public telecommunication system. Users are advised to observe local statutory requirements which may apply to this product.

© 1999 Consumer Microcircuits Limited

1.3 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.

1.3.1 Setting-Up

THE EV6240 COMES PRE-CONFIGURED WITH TWO CMX624 EVALUATION DEVICES FOR OPERATION AT 5.0 VOLTS OVER A 2-WIRE LINE AND TO BE CONTROLLED VIA A NON-ISOLATED PC INTERFACE.

RJ11 (US style) phone jacks are provided for 2-wire and 4-wire connections. Power is connected via the two-way socket, J1.

Attach the 9-way RS232 cable between connector J2 and the serial port of the PC. Connect a line simulator/external modem via one of the 2-wire line RJ11 connectors.

1.3.2 Adjustments

No board adjustments are required by the user. Telco-specific components may be added, as required.

1.3.3 Operation

Each Modem is provided with an off-hook dc load, R20 (Modem One) and R48 (Modem Two). The factory-fitted value is 2k2Ω so that line simulators know when the modem has gone off hook. This resistor may be removed or an alternative value substituted. Line impedance (ac) matching is provided by T1, R26 (Modem One) and T4, R54 (Modem Two).

The modems are controlled by the AT command set, described in Section 1.6.3, by running a terminal emulator program on the host PC. A suitable emulator is the 'Hyper Terminal' program which operates under Windows '95 or NT systems.

There are two modes of operation for the Evaluation Kit:

Modem Mode allows one of the evaluation board modems to perform calling, answering and simple data transfer with a line simulator or external third party modem (not supplied).

Test Mode allows diagnostic and performance tests to be made on Modem One and/or Modem Two.

© 1999 Consumer Microcircuits Limited

1.4 Signal Lists

CONNECTOR PINOUT				
Connector Ref.	**Connector Pin No.**	**Signal Name**	**Signal Type**	**Description**
J1	1	V_{IN}	Power	+ve power from external power supply.
	2	V_{SS}	Power	0V power from external power supply.
J2	1	DCD	Output	Linked to DTR.
	2	TXD	Output	Connection to PC Receive Data Line (RD).
	3	RXD	Input	Connection to PC Transmit Data Line (TD).
	4	DTR	Input	Connection to PC Data Terminal Ready (DTR).
	5	V_{SS2}	Power	Connection to PC 0V common.
	6	DSR	Output	Linked to DTR.
	7	RTS	Input	Connection to PC Request To Send. (RTS)
	8	CTS	Output	Connection to PC Clear To Send (CTS).
	9	-	-	Not used. No connection needed.
J3	1,2	-	-	MODEM 1 Not used. No connection needed.
	3	A	BI	MODEM 1 Bidirectional 2-wire line (A=TIP)
	4	B	BI	MODEM 1 Bidirectional 2-wire line (B=RING)
	5,6	-	-	MODEM 1 Not used. No connection needed.
J4	1	-	-	MODEM 1 Not used. No connection needed.
	2	TXA	Output	MODEM 1 4-wire line Tx output A.
	3	TXB	Output	MODEM 1 4-wire line Tx output B.
	4	RXA	Input	MODEM 1 4-wire line Rx input A.
	5	RXB	Input	MODEM 1 4-wire line Rx input B.
	6	-	-	MODEM 1 Not used. No connection needed.
J5	1,2	-	-	MODEM 2 Not used. No connection needed.
	3	A	BI	MODEM 2 Bidirectional 2-wire line (A=TIP)
	4	B	BI	MODEM 2 Bidirectional 2-wire line (B=RING)
	5,6	-	-	MODEM 2 Not used. No connection needed.
J6	1	-	-	MODEM 2 Not used. No connection needed.
	2	TXA	Output	MODEM 2 4-wire line Tx output A.
	3	TXB	Output	MODEM 2 4-wire line Tx output B.
	4	RXA	Input	MODEM 2 4-wire line Rx input A.
	5	RXB	Input	MODEM 2 4-wire line Rx input B.
	6	-	-	MODEM 2 Not used. No connection needed.

© 1999 Consumer Microcircuits Limited

CONNECTOR PINOUT				
Connector Ref.	**Connector Pin No.**	**Signal Name**	**Signal Type**	**Description**
J7	1	V_{DD}	Power	V_{DD} connection.
	2	BERT 4	Output	BERT RX DATA clock
	3	RESET	Input	PIC16C77 Reset.
	4	BERT 3	Output	BERT RX DATA
	5	V_{PP}	Input	V_{PP} Programming voltage for PIC16C77.
	6	BERT 2	Output	BERT TX DATA clock
	7	$V_{DD\ ADJ}$	-	V_{DD} Adjustment connection.
	8	BERT 1	Input	BERT Tx DATA
	9	V_{SS}	Power	V_{SS} connection.
	10	-	-	Not used. No connection needed.
J8	1	VIS+	Power	+ve power from isolated external power supply.
	2	VIS-	Power	0V power from isolated external power supply.

TEST POINTS		
Test Point Ref.	**Default Measurement**	**Description**
TP1	8-24V	V_{IN} connection
TP2	0V	V_{SS} connection
TP3	5V	V_{DD} connection (3.3V or 5.0V)
TP4	-	V_{PP} programming voltage input for PIC16C77
TP5	0V	V_{SS2} connection
TP6	5V	V_{DD2} connection (3.3V or 5.0V)
TP7	LO	SCLK 'C-BUS' Serial clock.
TP8	-	CDATA 'C-BUS' Command data.
TP9	-	RDATA 'C-BUS' Reply data.
TP10	HI	MODEM 1 CMX6x4 IRQN output, pin 7. A pull up resistor R6 is included on board
TP11	HI	MODEM 1 CMX6x4 CSN input, pin 6
TP12	-	MODEM 1 Line Voltage on 2-wire line.
TP13	-	MODEM 1 DTMF input
TP14	HI	MODEM 1 Ring Stimulus output

© 1999 Consumer Microcircuits Limited

TEST POINTS		
Test Point Ref.	**Default Measurement**	**Description**
TP15	-	MODEM 1 CMX6x4 TXO output, pin 9
TP16	-	MODEM 1 CMX6x4 TXON output, pin 11
TP17	-	MODEM 1 AC coupled CMX6x4 TOP output, pin 8
TP18	-	MODEM 1 Line signal after transformer.
TP19	-	MODEM 1 CMX6x4 RXN input, pin 16
TP20	-	MODEM 1 CMX6x4 RXP input, pin 15 (2-wire line selected)
TP21	-	MODEM 1 CMX6x4 RXO output, pin 17
TP22	-	MODEM 1 CMX6x4 V_{BIAS} output, pin 13
TP23	HI	MODEM 1 CMX6x4 RLYDRV output, pin 14
TP24	-	MODEM 1 CMX6x4 RT bidirectional pin 18
TP25	-	MODEM 1 CMX6x4 RD input pin 19
TP26	HI	MODEM 2 CMX6x4 IRQN output, pin 7. A pull-up resistor R8 is included on board.
TP27	HI	MODEM 2 CMX6x4 CSN input, pin 6
TP28	-	MODEM 2 Line Voltage input on 2-wire line.
TP29	-	MODEM 2 DTMF input
TP30	HI	MODEM 2 Ring Stimulus output
TP31	-	MODEM 2 CMX6x4 TXO output, pin 9
TP32	-	MODEM 2 CMX6x4 TXON output, pin 11
TP33	-	MODEM 2 AC coupled CMX6x4 TOP output, pin 8
TP34	-	MODEM 2 Line signal after transformer.
TP35	-	MODEM 2 CMX6x4 RXN input, pin 16
TP36	-	MODEM 2 CMX6x4 RXP input, pin 15 (2-wire line selected)
TP37	-	MODEM 2 CMX6x4 RXO output, pin 17
TP38	-	MODEM 2 CMX6x4 V_{BIAS} output, pin 13
TP39	HI	MODEM 2 CMX6x4 RLYDRV output, pin 14
TP40	-	MODEM 2 CMX6x4 RT bidirectional, pin 18
TP41	-	MODEM 2 CMX6x4 RD input, pin 19
TP42	-	BERT Tx Data input
TP43	-	BERT Tx Data clock output
TP44	-	BERT Rx Data output
TP45	-	BERT Rx Data clock output
TP46	0V	V_{SS} connection

© 1999 Consumer Microcircuits Limited

TEST POINTS		
Test Point Ref.	**Default Measurement**	**Description**
TP47	0V	V_{SS} connection
TP48	0V	V_{SS} connection
TP49	0V	V_{SS} connection
TP50	0V	V_{SS} connection

JUMPERS			
Link Ref.	**Positions**	**Default Position**	**Description**
JP1	1-2	S/C	Disconnect to supply an external clock to PIC16C77 via pin 1.
JP2	1-2	S/C	Disconnect when supplying external clock to PIC16C77 via JP1 pin 1.
JP3	1-2	S/C	Disconnect when supplying external clock to MODEM 1 evaluation device via JP4 pin 1.
JP4	1-2	S/C	Disconnect to supply an external clock to MODEM 1 evaluation device via pin 1.
JP5	1-2	S/C	Disconnect to measure I_{DD} of MODEM 1 evaluation device.
JP6	1-2	S/C	Disconnect when supplying external clock to MODEM 2 evaluation device via JP7 pin 1.
JP7	1-2	S/C	Disconnect to supply an external clock to MODEM 2 evaluation device via pin 1.
JP8	1-2	S/C	Disconnect to measure I_{DD} of MODEM 2 evaluation device.
JP9	1-2	S/C	Connect to monitor MODEM 1 2-wire line voltage.
JP10	1-2	S/C	Connect to monitor MODEM 1 2-wire line voltage.
JP11	1-2	S/C	Connect to monitor MODEM 2 2-wire line voltage.
JP12	1-2	S/C	Connect to monitor MODEM 2 2-wire line voltage.

Notes: S/C = Short Circuit

© 1999 Consumer Microcircuits Limited

SWITCHES			
Link Ref.	**Positions**	**Default Position**	**Description**
SW1	Open/Closed	Open	PIC16C77 Reset.
SW2	1-2, 6-5/2-3, 4-5	2-3, 4-5	Isolated or non-isolated (default) PC Interface.
SW3	1-2, 6-5/2-3, 4-5	2-3, 4-5	Operating (default) or programming mode.
SW4	1-2, 6-5/2-3, 4-5	2-3, 4-5	MODEM 1 2-wire line (default) or 4-wire line
SW5	1-2, 6-5/2-3, 4-5	1-2, 6-5	MODEM 1 3.5795MHz (default) or 3.6864MHz.
SW6	1-2, 6-5/2-3, 4-5	2-3, 4-5	MODEM 1 2-wire line (default) or 4-wire line.
SW7	1-2, 6-5/2-3, 4-5	2-3, 4-5	MODEM 2 2-wire line (default) or 4-wire line.
SW8	1-2, 6-5/2-3, 4-5	2-3, 4-5	MODEM 2 2-wire line (default) or 4-wire line.
SW9	1-2, 6-5/2-3, 4-5	1-2, 6-5	MODEM 2 3.5795MHz (default) or 3.6864MHz.

© 1999 Consumer Microcircuits Limited

1.5 Circuit Schematics and Board Layouts

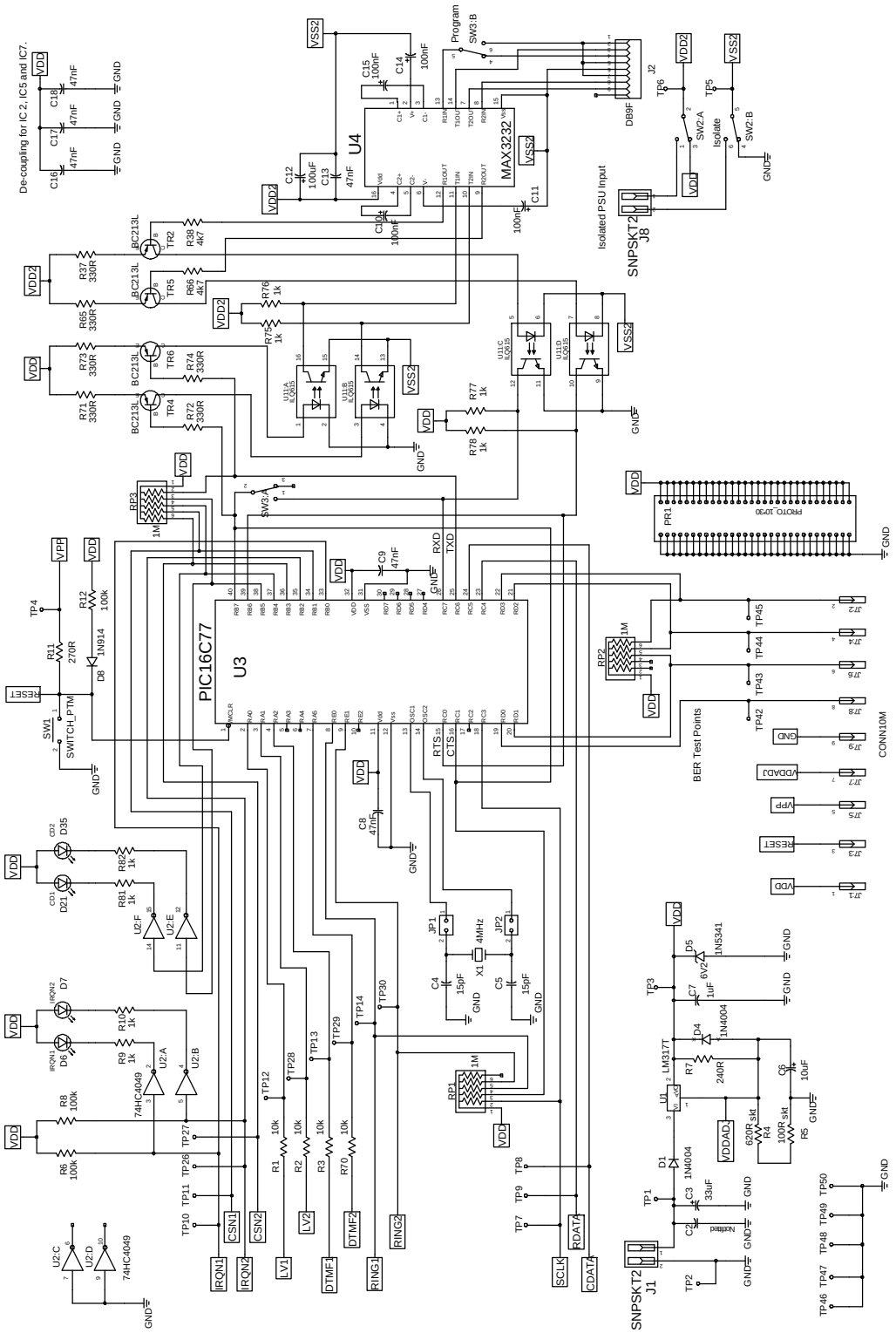


Figure 2 Control Section

© 1999 Consumer Microcircuits Limited

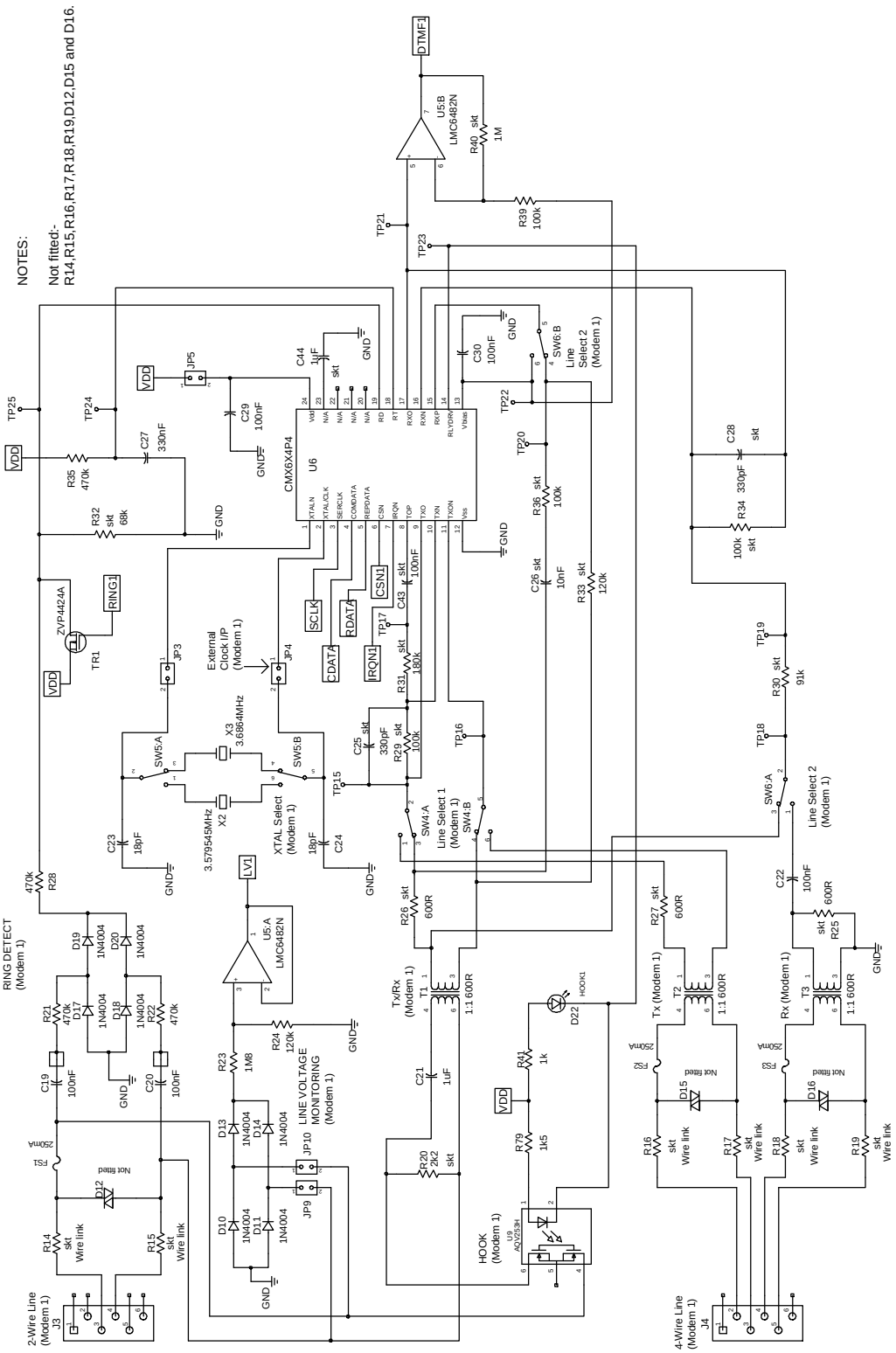


Figure 3 Modem One Section

© 1999 Consumer Microcircuits Limited

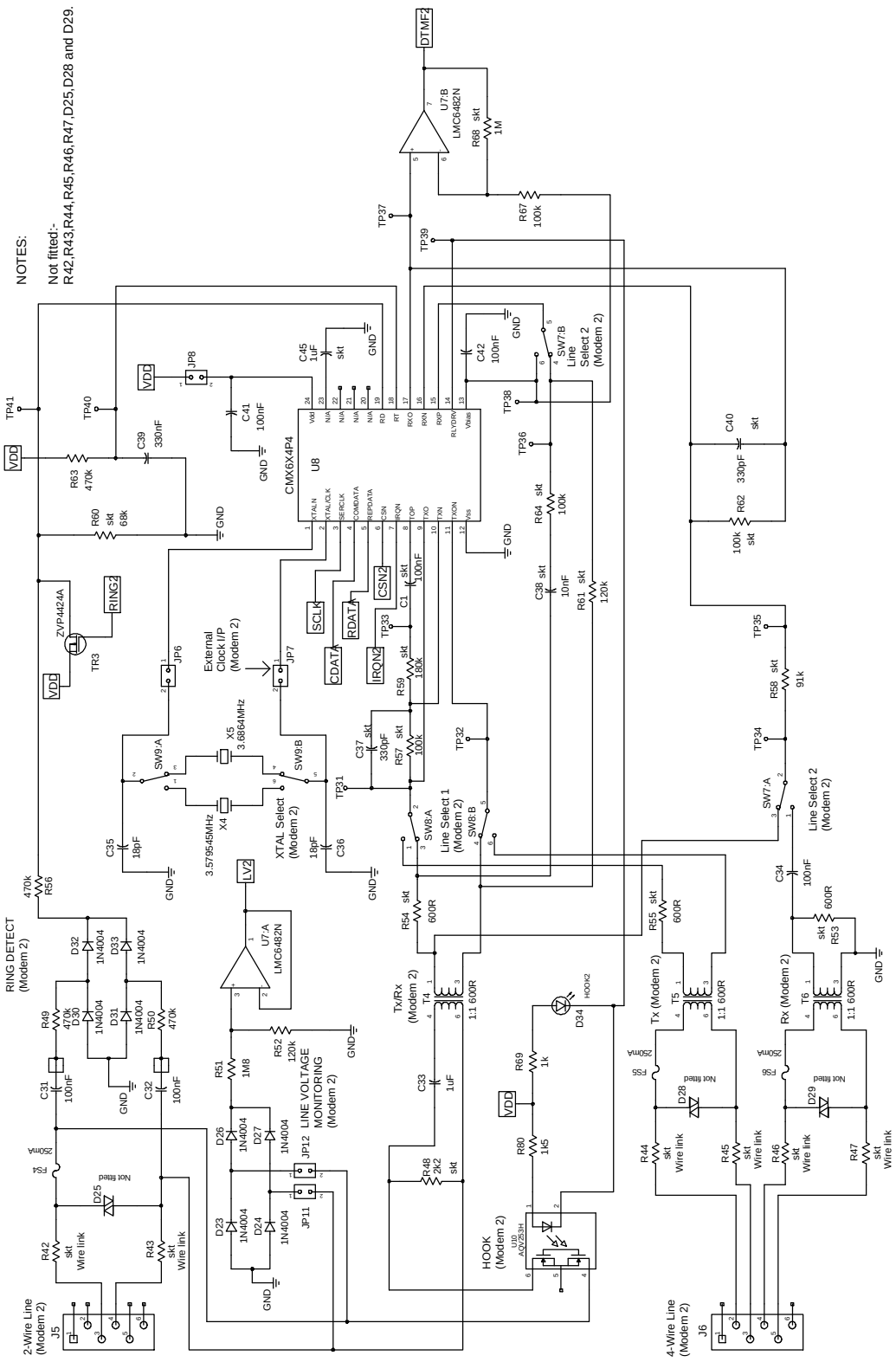


Figure 4 Modem Two Section

© 1999 Consumer Microcircuits Limited

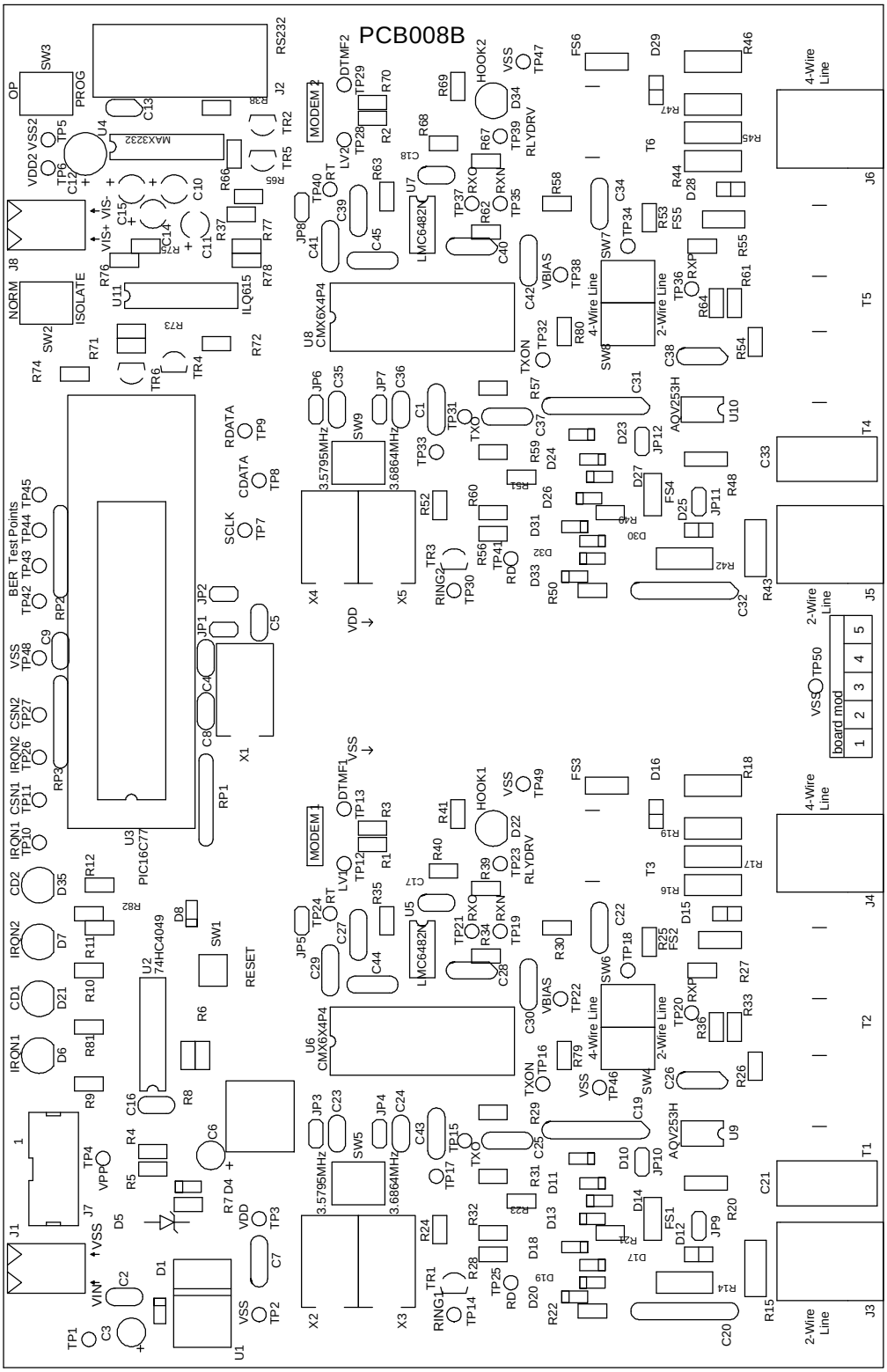


Figure 5 Evaluation Board Layout

© 1999 Consumer Microcircuits Limited

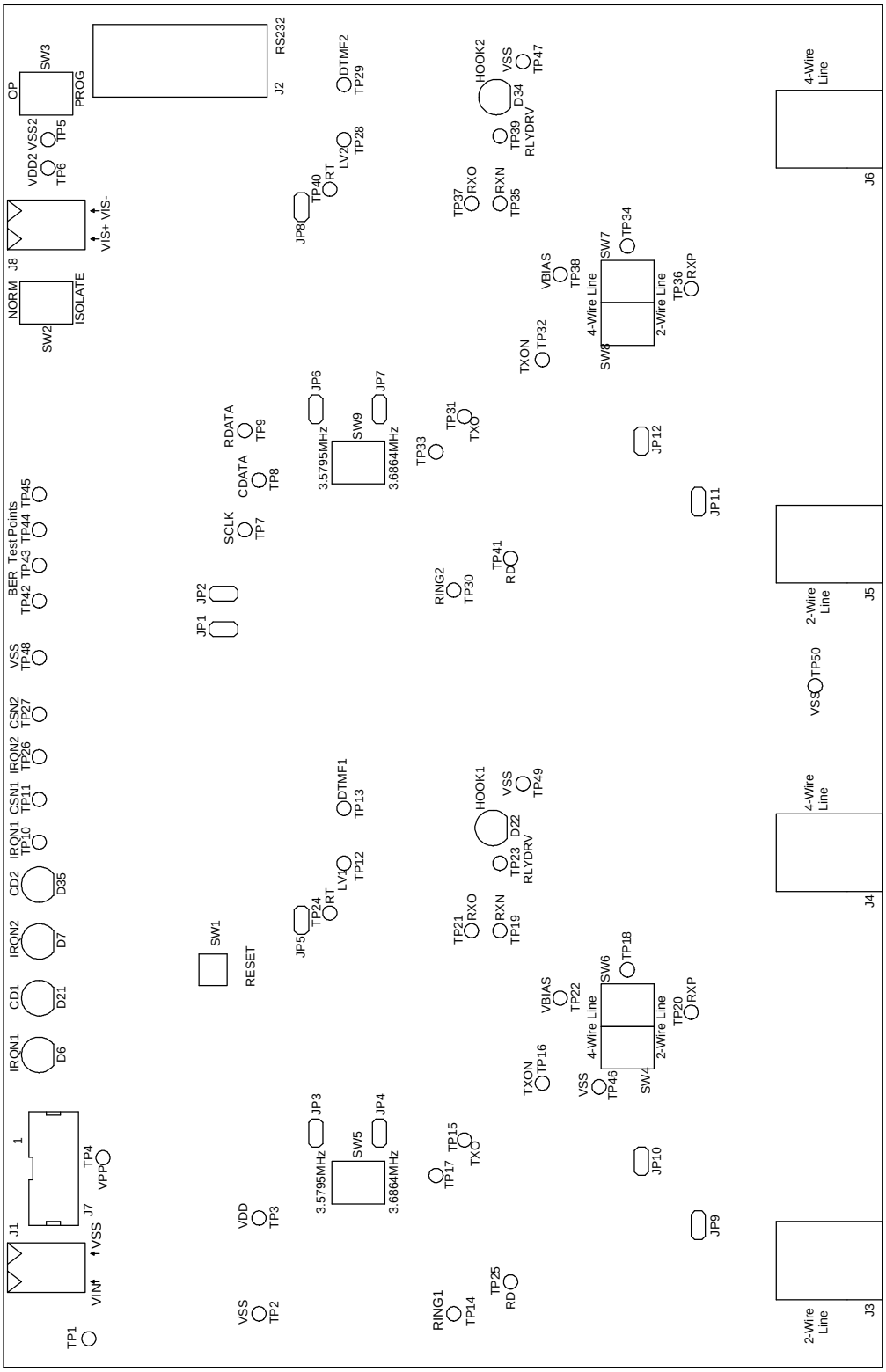


Figure 6 Evaluation Board Inputs, Outputs and Test Points

© 1999 Consumer Microcircuits Limited

1.6 Detailed Description

1.6.1 Hardware Description - Evaluation Board

1.6.1.1 Line Protection.

Line protection is provided for each Modem on both line interfaces by R14-R19 (47Ω), R42-R47 (47Ω), D12, D15, D16, D25, D28 and D29 (Phillips BR211 series 140V). These components are not fitted, but suitable values for UK applications are suggested in brackets. Wire links which bypass R14-R19 (Modem One) and R42-R47 (Modem Two) will need to be removed if these resistors are fitted.

1.6.1.2 Operating Voltage

The operating voltage (V_{DD}) is set to 5.0V. This may be altered by changing components R4 and R5 which are socketed. To select 3.3 Volts set R4 = 360Ω and R5 = 33Ω. The formula for calculating the values of R4 and R5 is as follows:

$$R4 + R5 = \frac{240\ (V_{DD} - 1.25)}{1.25}$$

Where 240 is the value of R7 in ohms and V_{DD} is the required supply voltage.

1.6.1.3 Clock/Oscillator

The CMX6x4 evaluation devices may use either an external clock or their own xtal oscillators. Two on-board xtals, 3.5795MHz (CMX624) and 3.6864MHz (CMX644A), are provided for each Modem for the latter method. A single switch for each Modem is provided to select between the on-board xtals, SW5 (Modem One) and SW9 (Modem Two). Two jumpers for each Modem (JP3 and JP4 for Modem 1 and JP6 and JP7 for Modem 2), which are normally fitted, can be removed to allow for an external clock. The external clock may be supplied to JP4 pin 1 (Modem One) and/or JP7 pin 1 (Modem Two) once the jumpers have been removed.

The PIC16C77 may be provided with an external clock in the same way by removing jumpers JP1 and JP2. Note that PICs programmed by CML are only configured for use with the on-board 4MHz crystal.

1.6.1.4 Line Interface

Each Modem is provided with 2-wire and 4-wire line interfaces. The interfaces for each Modem are selected using two miniature switches, SW4 and SW6 (Modem One) and SW7 and SW8 (Modem Two).
The line interface switches should be the same as the settings in the S27 registers.

The majority of the line interface components are fitted in sockets for adjustment purposes. These values should be calculated based on the evaluation device, operating voltage and line conditions, see the evaluation device data sheet for more information. The 2-wire ac line impedance matching is provided by T1, R26 (Modem One) and T4, R54 (Modem Two) which are factory fitted to suit a 600Ω line.

The line transformers used on the EV6240 board have an insertion loss of approximately 1.2dB over the operating frequency range.

The dc line resistors, R20 (Modem One) and R48 (Modem Two) should be removed when connecting the on-board Modems together via the 2-wire line.

Note: for correct operation ensure the TXON output of the CMX6x4 device is enabled whilst performing evaluation tests.

© 1999 Consumer Microcircuits Limited

1.6.1.5 Ring Detection

Modem One Ring detection on the 2-wire line is provided by components C19, C20, R21, R22, R28 and R32, plus D17-D20. The response time is set by components R35 and C27.
Modem Two Ring detection on the 2-wire line is provided by components C31, C32, R49, R50, R56 and R60, plus D30-D33. The response time is set by components R63 and C39.
The evaluation board has been fitted with suitable components for UK applications. See CMX624/CMX644A data sheets for further details.

1.6.1.6 Ring Stimulus

Ring stimulus can be applied to each Modem via the PIC µC and TR1 (Modem One) or TR3 (Modem Two). This feature is activated when the user enters the ring stimulus command.

1.6.1.7 I_{DD} Measurement

The evaluation device I_{DD} may be measured for each Modem by removing jumper JP5 (Modem One) or JP8 (Modem Two) and replacing it with a multimeter.

1.6.1.8 Line Voltage Monitoring

An indication of the level of voltage on the 2-wire lines for each Modem are provided at Bit 0 (Pin 2) and Bit 1 (Pin3) of the PIC µC Port A. For a 48 Volt dc line the level at this point is ≈ 3.0V dc. These µC pins can be re-configured as ADC inputs and, with appropriate firmware, be used to monitor the line voltage. Note that this feature is not used by the current firmware revision.

The line voltage monitoring circuitry can be disabled by removing jumpers, J9 and JP10 (Modem One) or JP11 and JP12 (Modem Two).

When the line voltage monitoring jumpers (JP9 to JP12) are removed, the line interface will not be referenced to V_{SS}.

1.6.1.9 Optional Opto-Isolated Serial Interface.

To avoid potential common mode interference problems when operating over the 2-wire line, the line interface is referenced to V_{SS}(line voltage monitoring jumpers fitted).
However, this 2-wire line referencing scheme will cause the line to become unbalanced when the evaluation kit is connected to a telephone simulator that employs a ground referenced line interface. Therefore the EV6240 is provided with an optional opto-isolated serial interface to overcome this problem. The optional interface will also minimise noise from the host PC.
To operate with the opto-isolated serial interface set switch, SW2, to the 'ISOLATE' position and connect a second power supply or battery via the two-way socket, J8. This second power supply should be set to the same voltage as the on-board regulated supply, (V_{DD}) either 3.3V or 5V.

1.6.1.10 Serial Interface

On the evaluation board the RS232 DCD (Data Carrier Detect) and DSR (Data Set Read) handshaking lines are linked to the PC DTR (Data Terminal Ready) line.

For evaluation purposes these handshaking lines are not toggled in the same fashion as a standard PC Modem. During normal operation and V22/V23 handshaking sequences the PIC µC only uses the TXD (Transmit Data) and RXD (Receive Data) lines together with the CTS (Clear to Send) and RTS (Request to Send) handshaking lines to communicate with the PC via the serial interface.

© 1999 Consumer Microcircuits Limited

1.6.1.11 DTMF Decoding

An indication of the DTMF signal levels on either the 2 or 4 wire lines for each Modem are provided at Bit 2 (Pin 4) and Bit 5 (Pin 7) of the PIC µC Port A. These µC pins can be re-configured as ADC inputs and, with appropriate firmware, be used to decode the DTMF signal.

The DTMF signal level at the PIC µC inputs can be adjusted by changing components R40 (Modem One) or R68 (Modem Two). The components R40 and R68 have been fitted with values to provide a 20dB voltage gain with respect to the signal level at RXO.

Note that this feature is not used by the current firmware revision.

1.6.2 Adjustments and Controls

Various line interface components around the evaluation devices are socketed to allow for user adjustments. Discrete component sockets are also provided for Telco-specific components.
Miniature control switches are provided to select the required line interfaces (2-wire or 4-wire), on-board crystals (3.5795MHz or 3.6864MHz), mode (operating or program) and serial interface (normal or isolated).

1.6.3 Firmware Description

The source code for the PIC firmware is supplied as the file EF6240XX ASM.

Please note that there are two modes of operation for the Evaluation Kit.

Modem Mode allows one of the evaluation board modems to perform calling, answering and simple data tests with a line simulator or external third party modem (not supplied).

Test Mode allows diagnostic and performance tests to be made on Modem One and/or Modem Two.

The firmware supplied in the PIC µC assumes the following configuration; 8 data bits, no parity, 1 stop bit and 19,200 baud with hardware handshake but without CR → CR/LF conversion.

The firmware only supports DTMF dialling.

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

Peripheral Interrupt Initialisation
µC ports and I/O direction initialisation
Serial Communication Interface (SCI) initialisation
Serial Peripheral Interface (SPI) initialisation
Loads Modem One and Modem Two with factory profile 0
Resets Modem One and Modem Two evaluation devices.

The message EF6240 Vx.x (where x.x represents the version number), will be displayed in the terminal emulator window when these tasks have been completed.

AT command echoing is an option available in the firmware and involves echoing the received characters sent by the PC. When echoing is enabled the firmware will send a LF character directly after a CR character to ensure the terminal emulator display is legible.

The firmware also provides the option of sending result codes to the PC. These responses can be in either an alpha or numeric (hex) form.

Simple data transfer using the terminal emulator involves the user entering text via the keyboard. Downloading data may be achieved using the terminal emulator send text file facility. The µC firmware does not support any send or receive data transfer protocols.

© 1999 Consumer Microcircuits Limited

The send text file facility can also be used for AT Command Scripts.

Note: 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

The following AT commands can be entered on a PC running Windows terminal emulator software, such as the 'Hyper Terminal' program supplied with Windows '95 or NT systems.

Basic AT Commands

Command	*Description*
A	**Answer Command** The modem will go off-hook, transmit the answer tone, and wait for a carrier from the remote modem. Syntax: **ATA<CR>**
A/	**Re-Execute Previous Command Line** Re-executes the last issued command line. This command does not require the AT prefix or a carriage return. Syntax: **A/**
Bn	**Select Communications Standard** Selects the communications standard specified by the parameter n. Syntax: **ATBn<CR>** ***Modifier Usage*** **n=0** Selects ITU-T Standard (default). **n=1** Selects Bell Standard.
Dn	**Dial Command** This command directs the modem to go off-hook, dial according to the string entered and attempt to establish a connection. Number of DTMF digits entered cannot exceed 16. Syntax: **ATDn1n2n3…….n16<CR>** ***Modifier Usage*** **n1..16=0-9, *, #, A-D** DTMF digits. **n1=L** Re-dial last number.
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**)**.

© 1999 Consumer Microcircuits Limited

Fn **Select Line Modulation**
Selects the line modulation specified by the parameter n.

Syntax: **ATFn<CR>**

Modifier Usage
n=0 Selects the CMX624 for V.23 or Bell 202 line modulation (default).
n=1 Selects the CMX644A for V.22 or Bell 212A line modulation.
n=2 Reserved.

Hn **Switch Hook 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 name and version number.
n=1 Displays Product Name.
n=2 Displays CML UK sales information.
n=3 Displays South East Asia sales information.
N=4 Displays NAFTA sales information.

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

Sn? **S-Register Read**
Command for displaying the contents of an S-Register.

Syntax: **AT@Sn?<CR>**

where **n** is the S-Register to be interrogated (decimal).
Value returned will be in hexadecimal format.

Sn=x **S-Register Write**
Command for writing to an S-Register. (See list of S-Registers later on)

Syntax: **AT@Sn=x<CR>**

where **n** is the S-Register (decimal) and **x** is the value to be written (decimal, 0-255).

© 1999 Consumer Microcircuits Limited

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).

Xn Calling Characteristics
Determines which set of responses and calling characteristics are used.

Syntax: **ATXn<CR>**

Modifier Usage
n=0 The modem will ignore dial tones and busy tones. Dial tone wait time is zero, and blind dialling is enabled. The modem returns a CONNECT result code when a connection is established.
n=1 The modem will ignore dial tones and busy tones. Dial tone wait time is zero, and blind dialling is enabled. 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. Blind dialling is enabled. 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.

Zn Modem Reset
Instructs the modem to reset the evaluation device and then reload the factory S-Register settings.

Syntax: **ATZn<CR>**

Modifier Usage
n=0 Reset CMX6x4 device and restore factory profile 0.
n=1 Reset CMX6x4 device and restore factory profile 1.

$ AT Command Online Help
Displays all AT Commands

Syntax: **AT$<CR>**

© 1999 Consumer Microcircuits Limited

Extended AT Commands

Command	*Description*
&Fn	**Recall Factory Defaults** Instructs the modem to reload the factory S-Register settings. Syntax: **AT&Fn<CR>** ***Modifier Usage*** **n=0** Recalls factory profile 0. **n=1** Recalls factory profile 1.
&Gn	**Guard Tone Select in ITU-T Mode** Guard tones are always disabled in the U.S.A. Syntax: **AT&Gn<CR>** ***Modifier Usage*** **n=0** Disable guard tone (default). **n=1** Select a 550Hz guard tone. **n=2** Select a 1800Hz guard tone.
&Ln	**Select Line Interface** Selects the line interface specified by the parameter n. On-board miniature switches must also be switched to required position. Syntax: **AT&Ln<CR>** ***Modifier Usage*** **n=0** Selects the 2-Wire line interface (default). **n=1** Selects the 4-Wire line interface.
&$	**Extended AT Command Online Help** Displays all Extended AT Commands Syntax: **AT&$<CR>**

© 1999 Consumer Microcircuits Limited

CML Specific AT Commands

Command	*Description*

@Bn **Ring Detection**

Instructs PIC to detect BT or Bell ringing on a modem's Ring Detect Line.

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

Modifier Usage
n=0 BT ring detection (default).
n=1 Bell ring detection.

@En **Evaluation Mode**

Informs PIC which mode we will be operating in.

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

Modifier Usage
n=0 Selects Modem Mode (default).
n=1 Selects Test Mode.

@Fn **Test Functions**

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

Modifier Usage
n=0 Return the status of the following digital inputs:-
IRQN1 (Bit 0), LV1 (Bit 1), IRQN2 (Bit 4), and LV2 (Bit 5).
n=1 BER measurement. (Not available in the current firmware revision).
n=2 BER Test points (Returns status of input and sets outputs high).
n=3 BER Test points (Returns status of input and sets outputs low).
n=4 CD LED On.
n=5 CD LED Off.
n=6 Simulate Ring Burst.
n=7 Simulate Ring Silence.

@Mn **Modem Focus**

Informs PIC which modem should have the AT Command focus. All subsequent AT Commands are directed at the modem with the focus.

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

Modifier Usage
n=0 Directs all subsequent AT Commands to Modem One (default).
n=1 Directs all subsequent AT Commands to Modem Two.

@RR **CMX6x4 Device Reset**

Resets the CMX6x4 device for the modem with focus.

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

© 1999 Consumer Microcircuits Limited

@Rn? **CMX6x4 Register Read**
Command for displaying the contents of a CMX6x4 device register

Syntax: **AT@Rn?<CR>**

where **n** is the CMX6x4 register address (hexadecimal).
Value returned is in hexadecimal format.

@Rn=x **CMX6x4 Register Write**
Command for writing to a CMX6x4 device register.

Syntax: **AT@Rn=x<CR>**

where **n** is the CMX6x4 register address (hexadecimal) and **x** is the value to be written (decimal, 0-255).

@Tn **BER Measurement Set Up**
Informs PIC which modem is transmitting and receiving during BER measurement.

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

Modifier Usage
n=0 Selects Modem One Tx/Rx (default).
n=1 Selects Modem One Tx and Modem Two Rx.
n=2 Selects Modem Two Tx and Modem One Rx.
n=3 Selects Modem Two Tx/Rx.

@$ **CML Specific AT Command Online Help**
Displays all CML Specific AT Commands

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

AT Command Summary

1) Commands must be typed in upper case.
2) The maximum command length is 32 characters, including the AT prefix but excluding the carriage return.
3) 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 to the PIC.
4) Every command except for A/ and the escape sequence must begin with the AT prefix and be entered by pressing a carriage return.

© 1999 Consumer Microcircuits Limited

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.

S- Register				*Factory Profiles*	
Reg	***Range***	***Units***	***Description***	***'0' (Default at Power up)***	***'1'***
S0	0-255	Rings	**Automatic answer** - The number of rings until automatic answer. If the register is set to zero, modem does not answer.	0	5
S1	0-255	Rings	**Count incoming rings** - This register is read only and contains the number of rings detected by the modem.	0	0
S2	0-127	ASCII Decimal	**Escape character value** - This register defines an ASCII decimal value of the escape character. The default setting is an ASCII + and the escape sequence is +++. A value over 127 disables the escape sequence.	43	43
S3	0-127	ASCII Decimal	**Carriage return character** - Contains the ASCII decimal value of the character used to send a carriage return. This character ends both commands and result codes.	13	13
S4	0-127	ASCII Decimal	**Line feed character** - Contains the ASCII decimal value of the character used to send a line feed. The modem sends the line feed character after a carriage return only when word responses are sent.	10	10
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

© 1999 Consumer Microcircuits Limited

S-Register				Factory Profiles	
Reg	**Range**	**Units**	**Description**	**'0'**	**'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	5-255	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** - Controls the time required before typing escape sequence codes.	20	20
S14	0-255	Decimal	**General options** - provides the following functions: Bit 0 - Reserved Bit 1 - Echo command character, 0 Disables echoing (ATE0), 1 Enables echoing (ATE1) Bit 2 - Result code display, 0 Send responses (ATQ0), 1 Do not send responses (ATQ1) Bit 3 - Word or number responses, 0 Send number responses (ATV0), 1 Send word responses (ATV1) Bit 4,5,6 - Reserved Bit 7 - Answer/originate operation, 0 Answer (ATA), 1 Originate (ATD)	138	128
S18	0-255	s	**General Purpose Timer** - Used for various firmware functions.	5	5

© 1999 Consumer Microcircuits Limited

S-Register				Factory Profiles	
Reg	**Range**	**Units**	**Description**	**'0'**	**'1'**
S22	0-255	Decimal	**Bit Mapped register** - Provides the following functions: Bit 0,1,2,3,7 - Ignored Bit 4,5,6 - Calling Characteristics, 000 (ATX0), 100 (ATX1), 101 (ATX2), 110 (ATX3), 111 (ATX4)	64	64
S23	0-255	Decimal	**Bit Mapped register** - Provides the following functions (Not applicable to CMX624): Bit 0,1,2,3,4,5 - Ignored Bit 6,7 - Guard tones, 00 None (AT&G0), 01 550Hz (AT&G1), 10 1800Hz (AT&G2)	0	0
S27	0-255	Decimal	**General mode selection** - Provides the following functions: Bit 0,1,3,4,5- Ignored Bit 2 - Line interface control, 0 Two wire line interface (AT&L0), 1 Four wire line interface (AT&L1) Bit 6 - Bell/ITU-T select, 0 ITU-T standard (ATB0), 1 Bell standard (ATB1) Bit 7 - Ring detection select, 0 BT (AT@B0), 1 Bell (AT@B1).	0	0

Note: For correct Firmware operation the S2, S3 and S4 settings must be the same for both board modems.

Modem Result Codes

Numeric Response (Hex)	*Alpha Response*
00	**OK**
01	**CONNECT**
02	**RING**
03	**NO CARRIER**
04	**ERROR**
05	**CONNECT 1200**
06	**CONNECT 1200/75**
07	**CONNECT 1200/150**
08	**CONNECT 75/1200**
09	**CONNECT 150/1200**
0A	**NO DIAL TONE**
0B	**BUSY**
0C	**UNDEFINED**
0D	**UNDEFINED**
0E	**PIC RX ERROR**
0F	**PIC RX BUFFER OVERFLOW**

© 1999 Consumer Microcircuits Limited

1.6.4 Software Description

1.6.4.1 Terminal Emulator

Users will need to run a suitable terminal emulator on their PC in order to communicate with the PIC µC on the Evaluation Kit. 'Hyper Terminal', which is supplied with the Windows '95 and NT installations, is suitable for this purpose.

Hyper Terminal Setup
Emulation VT100
ASCII Character set
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

1.6.4.2 In-circuit re-programming of PIC16C77

In order that the PIC16C77 µC may be re-programmed the existing program must be erased by placing the device in a UV-Eraser for approximately 15 minutes.

TO ENTER PROGRAMMING MODE

(a) Remove power from board.
(b) Set switch, SW3, to 'PROG' and switch, SW2, to 'NORM'.
(c) Re-apply power to board. (V_{DD} = 5.0V).
(d) Connect the programming voltage (V_{PP} = 12.5V to 13.5V) power supply between test point TP4 (+ve) and V_{SS} (-ve).
(e) Ensure the PIC µC programming utility **PICPROGB.EXE** is loaded into the PC under DOS and the PC is connected to the evaluation kit.
(f) Reset the EV6240 board by momentarily pressing switch SW1.

USING THE SOFTWARE - PICPROGB

This is supplied on disk as a self-documented executable file **PICPROGB.EXE** for a PC running DOS (either directly or as a DOS window in Windows 3.11 or '95). It is not recommended for use on Windows NT systems. Please note that this programming software does not meet the Arizona Microchip Technology verification requirements for a "production quality" programmer. Also, it does not support the programming of ID.

© 1999 Consumer Microcircuits Limited

The user interface consists of two windows. The top window contains the operating instructions and status information. The bottom window contains prompting and progress information plus user input. When the top window first appears the user will be prompted to enter the number of the serial communications port to which the EV6240 board is connected, and then, which device is to be programmed. For the EV6240 board select option 2, PIC16C77. Once the user has entered this information, the following commands may be selected:

Press F to load file

Press C to configure device.

Press B to check target device is blank.

Press P to program target device.

Press V to verify target device.

Press R to read target device.

Press A to view contents of program data array.

Press Esc to return to DOS.

A new function from the above table can be selected whenever the **>ok** prompt appears in the bottom window.

Notes:

a) Assembler output files must be in the Intel hex format **(.HEX)** in order to be usable by this programming software.

b) The PIC µC supplied has a Configuration Word which is preset **3FB1H**. This selects the crystal oscillator, disables the watch dog timer, enables the power up timer and disables code protection. The programming software currently defaults to **3FB1H.** Consult Arizona Microchip Technology for more information on the Configuration Word.

c) The “blank check” command **(B)** only looks at the first location. A programmed device will always have data in this location as it is the program start address.

d) For each of the commands **B,P,R** and **V** the user will be prompted to manually reset the target µC, by pressing the RESET switch (SW1) on the EV6240 Evaluation Board. This is because PIC programming always starts from location **0000** and the program counter can only be incremented.

e) Pressing **A** will display the program data in the bottom window, formatted in pages of 48 consecutive locations. Use the **<PageUp>** and **<PageDown>** keys to scroll through the data. Pressing **<Esc>** will return the user to the **>ok** prompt.

f) Programming the EV6240 PIC16C77 using the PICPROGB software takes approximately 2 minutes.

TO LEAVE PROGRAMMING MODE

a) Remove power from board (including the programming voltage, V_{PP}).
b) Set switch, SW3, to ‘OP’.
c) Power up board as described in previous sections for normal operation.

© 1999 Consumer Microcircuits Limited

1.6.5 Evaluation Tests

1.6.5.1 BER Measurement (Not available in the current firmware revision).

To allow the user to perform Bit Error Rate Testing (BERT) the EF6240 firmware contains a BERT routine. This facility requires the user to put the evaluation board into Test Mode (AT@E1) and modify the BER Measurement Set Up (AT@Tn) to the appropriate configuration. The BERT routine can be configured to operate in one of two ways; with a single on-board Modem connected to an external simulator/modem, via the 2 or 4-wire line interfaces; or simply by connecting the two on-board Modems together via the 2 or 4-wire line interfaces.

Note, the BERT routine is performed in synchronous mode and uses a preamble and sync byte when it begins to allow the µC firmware to synchronise with the start of the bit stream. When the configuration set up is complete BERT can commence by entering the AT@F1 command. The BER Tester should be started before the user enters the AT@F1 command to ensure bit synchronisation is achieved.

Hardware Setup
This function enables connection to BER Testers as follows:

TP42 (PIC16C77 µC Pin 19) to BER Tester Tx Data O/P
TP43 (PIC16C77 µC Pin 20) to BER Tester Tx Data Clock I/P
TP44 (PIC16C77 µC Pin 21) to BER Tester Rx Data I/P
TP45 (PIC16C77 µC Pin 22) to BER Tester Rx Data Clock I/P

The tester must be able to operate from an external clock. The timings of the clock provided from the Evaluation board µC are as follows:

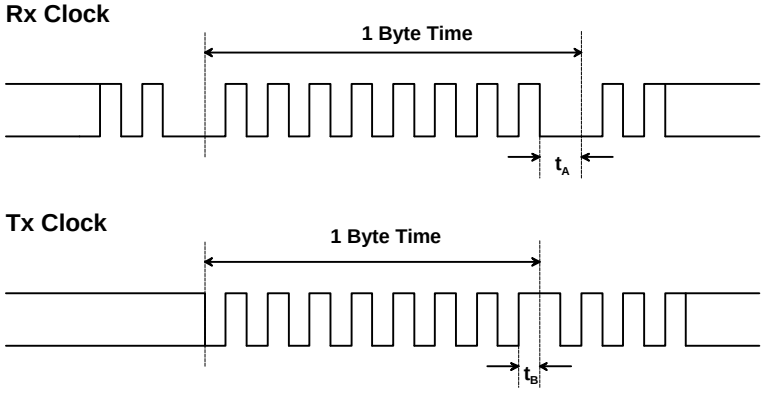


Figure 7 Evaluation board µC clock outputs

Times t_A and t_B vary as the clocks are adjusted to fit the exact byte periods of the evaluation devices.

Data is assumed to be clocked in and out of the Tester on the rising edge of either Rx or Tx clock.

© 1999 Consumer Microcircuits Limited

1.6.5.2 Modem Two Automatically Answering a V22 Call from an External Simulator/Modem

Modem Two configured to auto-answer on 10 consecutive BT rings via the 2-wire line.

The CMX644A will be configured to operate with 8 data bits, 1 stop bit and no parity.

Example assumes the evaluation board is powered up with CMX644A target devices inserted and with the line select switches set to 2-wire and the crystal select switches set to 3.6864MHz.

1. Select CMX644A target devices for V22 or Bell 212A line Modulation.
   Command : ATF1<CR>

2. Set Focus to Modem Two.
   Command : AT@M1<CR>

3. Write to CMX644A UART MODE register, 8 Data Bits and 1 Stop Bit. UART MODE register Bit 5 (SYNC/ASYNC) will be overwritten during handshaking and data transfer.
   Command : AT@RE4 = 8<CR>

4. Set Automatic Answer S-Register (S0) to 10 rings.
   Command : ATS0=10<CR>

Modem Two will begin the EV6240 Answering Modem Handshaking Sequence when 10 consecutive BT rings have been successfully detected on the 2-wire line.

1.6.5.3 Modem Two Manually Answering a V23 Call from an External Simulator/Modem

External Simulator/Modem sets up a call to Modem Two of the EV6240 evaluation board via the 2-wire line.

Depending on the test set up a ringing signal will be present on the line or the Calling External Simulator/Modem will be waiting for the 2100Hz Answer Tone.

The CMX624 will be configured to operate with 7 data bits, 2 stop bits and no parity.

Example assumes the evaluation board is powered up with CMX624 target devices inserted and with the line select switches set to 2-wire and the crystal select switches set to 3.5795MHz.

1. Set Focus to Modem Two.
   Command : AT@M1<CR>

2. Write to CMX624 SETUP register, 7 Data Bits and 2 Stop Bits.
   All other SETUP register bit settings will be overwritten during handshaking and data transfer.
   Command : AT@RE0=9<CR>

3. Manually Answer V23 Call.
   Command : ATA<CR>

Modem Two will go off-hook and begin the EV6240 Answering Modem Handshaking Sequence via the 2-wire line. This will start with a 2 second billing delay before transmitting the 2100Hz Answer Tone.

© 1999 Consumer Microcircuits Limited

1.6.5.4 Modem Two Originating a Bell 202 Call to an External Simulator/Modem

Modem Two configured to dial out and detect Call Progress tones via the 2-wire line with DTMF tone durations of 150ms.

Example assumes the evaluation board is powered up with CMX624 target devices inserted and with the line select switches set to 2-wire and the crystal select switches set to 3.5795MHz.

1. Set Focus to Modem Two.
   Command : AT@M1<CR>

2. Select Bell communications standard for Bell 202.
   Command : ATB1<CR>

3. Set calling characteristic to detect dial tones and busy tones.
   Command : ATX4<CR>

4. Set DTMF Tone Duration S-Register (S11) to 150ms.
   Command : ATS11=15<CR>

5. DTMF Dial.
   Command : ATD0176432198<CR>

Modem Two will begin the EV6240 Calling (Originate) Modem Handshaking Sequence when the dial tone has been detected, DTMF tones transmitted and no busy tone is detected.

The OK result code returned to the PC after dialling indicates the handshaking sequence has begun. NO DIAL TONE or BUSY result codes returned to the PC indicate that the dialling stage has failed and the handshaking sequence has not been attempted.

1.6.5.5 Modem Two Transmitting Low Band PSK in Test Mode via a 2-Wire Line

Example assumes the evaluation board is powered up with CMX644A target devices inserted and with the line select switches set to 2-wire and the crystal select switches set to 3.6864MHz.

1. Select CMX644A target devices for V22 or Bell 212A line Modulation.
   Command : ATF1<CR>

2. Select Test Mode for simple diagnostic purposes.
   Command : AT@E1<CR>

3. Set Focus to Modem Two.
   Command : AT@M1<CR>

4. Write to CMX644A SETUP register (Relay Drive and 3.6864MHz xtal)
   Command : AT@RE0=65<CR>

5. Write to CMX644A GAIN BLOCKS register (0dB Tx Gain)
   Command : AT@RE2=240<CR>

6. Write to CMX644A TX PSK MODE register (TXON, Low Band and PSK Tx enabled)
   Command : AT@RE7=66<CR>

© 1999 Consumer Microcircuits Limited

1.6.5.6 Modem One Originating a V23 Call to an External Simulator/Modem

Modem One configured to dial out via the 2-wire line using a blind dialling method (blind dial wait time of 5 seconds) with DTMF tone durations of 200ms.

Example assumes the evaluation board is powered up with CMX624 target devices inserted and with the line select switches set to 2-wire and the crystal select switches set to 3.5795MHz.

1. Set Wait Time for Blind Dialling S-Register (S6) to 5 seconds.
   Command : ATS6=5<CR>

2. Set DTMF Tone Duration S-Register (S11) to 200ms.
   Command : ATS11=20<CR>

3. DTMF Dial.
   Command : ATD0176432198<CR>

Modem One will begin the EV6240 Calling Modem Handshaking Sequence when the DTMF tones have been transmitted.

The OK result code returned to the PC after dialling indicates the handshaking sequence has begun.

© 1999 Consumer Microcircuits Limited

1.6.6 Additional Information

1.6.6.1 CMX624 Optional Connection Settings

The CMX624 data format can be modified by the user before a Modem mode connection is attempted. This can be achieved using the AT@RE0=x command (where x is the decimal register setting).

At power up the CMX624 SETUP register defaults to 0 which corresponds to 8 bit data, no parity and 1 stop bit.

The Rx Equaliser and Tx level control bit settings are also optional and should be enabled if required before a connection is attempted.

1.6.6.2 CMX644A Optional Connection Settings

The CMX644A Tx/Rx gain is controlled by the user. The settings in the GAIN BLOCKS register will only be used during handshaking and data transfer if the Tx gain control bits (TG0-TG3) are not equal to zero (o/p off). If a connection is attempted and the Tx gain control bits are zero the firmware will modify the Tx gain control bits of the GAIN BLOCKS register to give a Tx gain of 0dB.

The Tx/Rx Equaliser control bit settings are also optional and should be enabled if required before a connection is attempted.

1.6.6.3 V23/Bell 202 Handshaking Sequence for an EV6240 Calling Modem via a 2-Wire Line

Figure 8 is a flowchart illustrating the firmware handshaking sequence performed when an on-board CMX624 modem originates a call to an external V23/Bell 202 simulator/modem.

The firmware assumes the external equipment has been configured to answer the call using the appropriate protocol.

The states shown in the diagram are as follows:

Calling Modem Entry Point

On entry the Modem will be off-hook, DTMF dialling and the required call progress monitoring completed.

State 1

Start the Wait for Carrier after Dial Timer (setting stored in S7).

Check Communications Standard selected by user (Bell or ITU-T).

If Bell

Goto State 4.

State 2

Set up CMX624 to detect 2100Hz Answer tone.

Start transmitting the 1300Hz calling tone (Cadence 0.6s on and 1.5s off).

If the 2100Hz Answer tone is detected then start Validation Timer (setting stored in S18).

If the 2100Hz Answer tone is detected for 1s stop transmitting the 1300Hz Calling tone then goto State 3.

If the Wait for Carrier after Dial Timer expires then Hang Up and Exit.

© 1999 Consumer Microcircuits Limited

State 3
When Rx Energy flag is clear start 60ms Silence Timer

If Validation Timer expires the 2100Hz Answer tone has been present for too long so Hang Up and Exit.

State 4
Set up CMX624 to detect High Band FSK.

Wait until the Rx Energy flag is set then goto State 4b.

If the Wait for Carrier after Dial Timer expires before the Rx Energy flag is set then Hang Up and Exit.

State 4b
Check Communications Standard selected by user (Bell or ITU-T).

```
If Bell
        Goto State 4c.
Else
        If 60ms Silence Timer has not expired Hang Up and Exit.
```

State 4c
Restart Validation Timer (setting stored in S18).

Whilst the Rx Energy flag (currently detecting High Band FSK) is set the Rx data is monitored to ensure 95% of 1's (marks) are detected for 160ms.

```
If 95% of High Band FSK 1's are detected for 160ms
        Turn on Modem CD LED.
        Start a 450ms Timer
        Goto State 5.
```

If Validation Timer expires before 95% of High Band FSK 1's detected then Hang Up and Exit.

State 5
Wait until 450ms Timer expires then set up the CMX624 to Tx Low Band FSK 1's.

Start a 320ms Timer

State 6
Wait until 320ms Timer expires then goto Data Transfer Mode.

© 1999 Consumer Microcircuits Limited

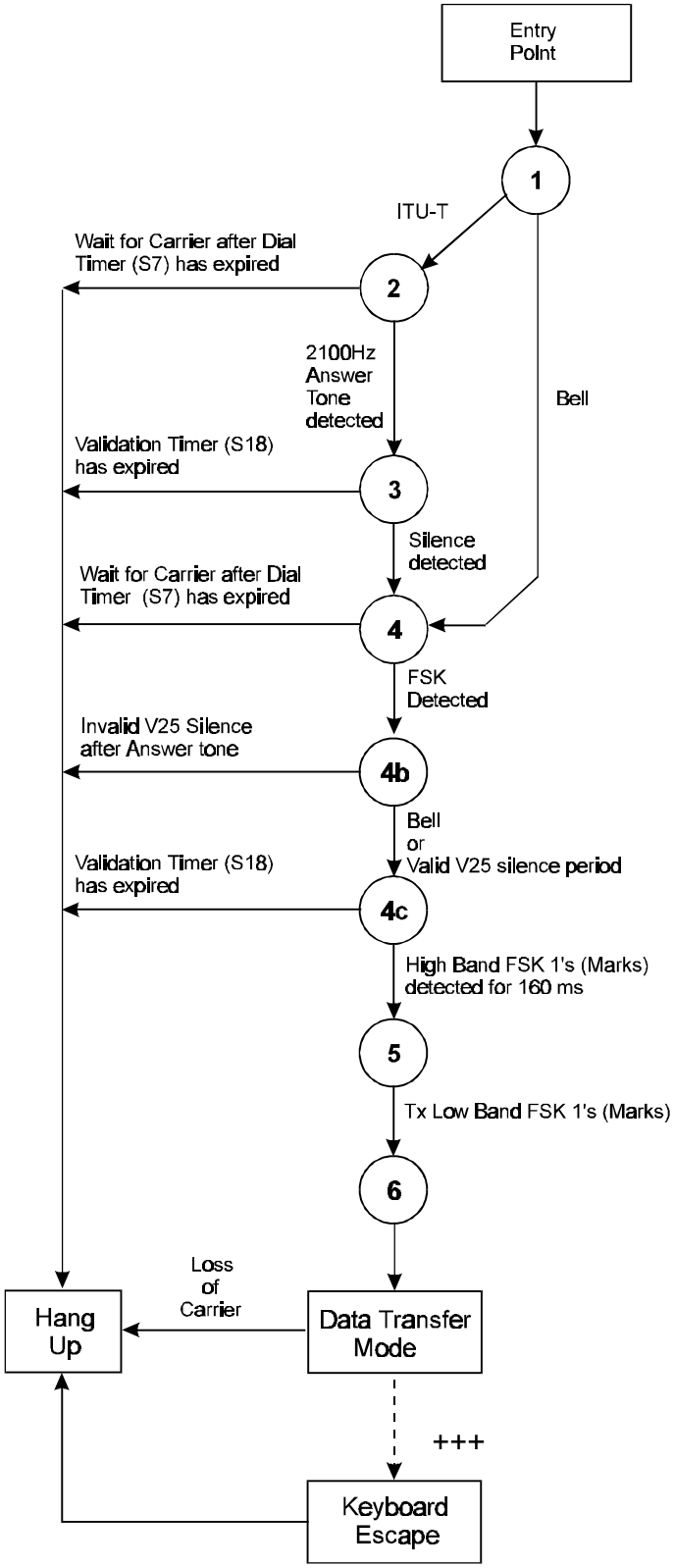


Figure 8 V23/Bell 202 Handshaking Sequence for an EV6240 Calling Modem via a 2-Wire Line

© 1999 Consumer Microcircuits Limited

1.6.6.4 V23/Bell 202 Handshaking Sequence for an EV6240 Answering Modem via a 2-Wire Line

Figure 9 is a flowchart illustrating the firmware handshaking sequence performed when an on-board CMX624 modem answers a call from an external V23/Bell 202 simulator/modem.

The firmware assumes the external equipment has been configured to originate the call using the appropriate protocol.

The states shown in the diagram are as follows:

Answering Modem Entry Point
On entry the Modem will have manually answered a call using the ATA command or auto-answered via the ring detect circuitry. In both cases the Modem will be off-hook.

Start 2 second Billing Delay Timer

State 10
Wait for Billing Delay Timer to expire.

Check Communications Standard selected by user (Bell or ITU-T).
If Bell goto State 14.

State 11
Set up CMX624 to Tx 2100Hz Answer tone.

Start 3.3 second Answer Tone Timer.

State 12
Wait for Answer Tone Timer to expire.

Turn off Tone o/p (silence).

Start 80ms Silence Timer.

State 13
Wait for Silence Timer to expire.

State 14
Set up the CMX624 to Tx High Band FSK 1's (marks)

State 15
Set up CMX624 to detect Low Band FSK.

Start Validation Timer (setting stored in S18).

When the Rx Energy flag is set the Rx data is monitored to ensure 95% of 1's are detected for 160ms.

If 95% of Low Band FSK 1's are detected for 160ms
Turn on Modem CD LED.
Goto Data Transfer Mode.

If Validation Timer expires before 95% of Low Band FSK 1's detected then Hang Up and Exit.

© 1999 Consumer Microcircuits Limited

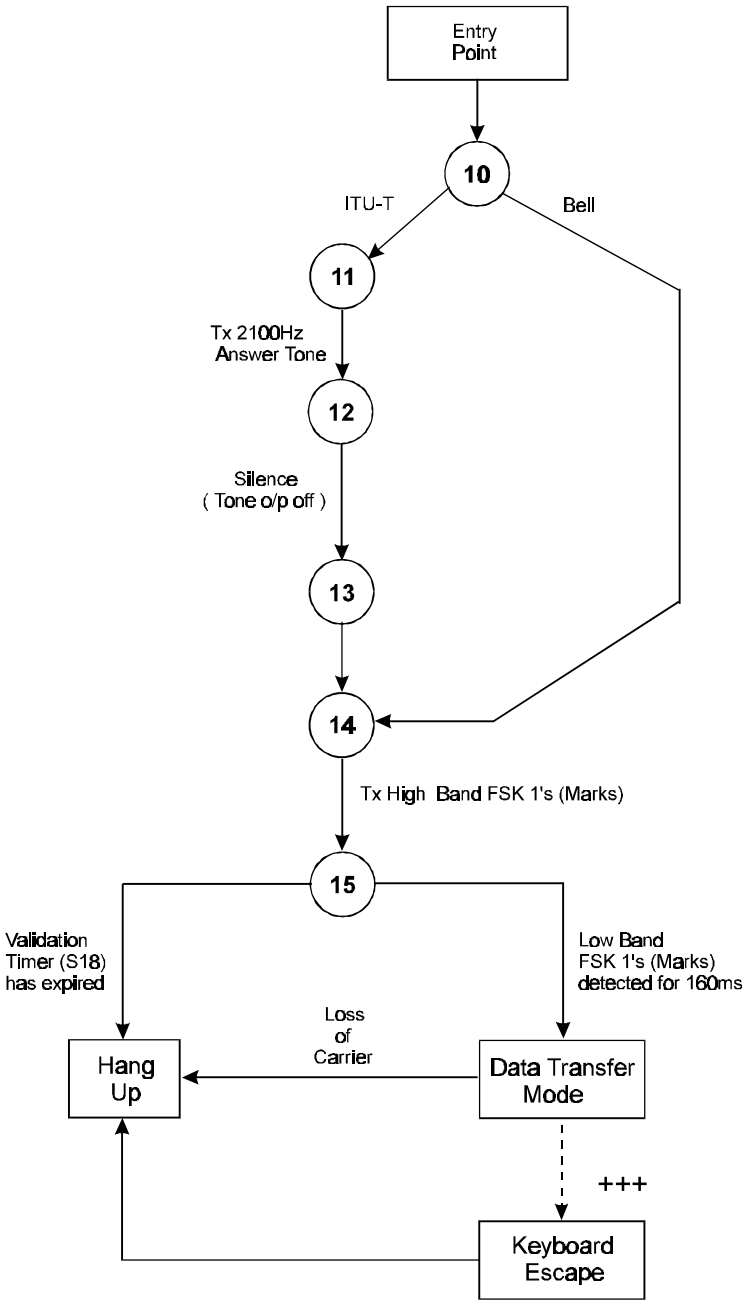


Figure 9 V23/Bell 202 Handshaking Sequence for an EV6240 Answering Modem via a 2-Wire Line

© 1999 Consumer Microcircuits Limited

1.6.6.5 V22/Bell 212A Handshaking Sequence for an EV6240 Calling Modem via a 2-Wire Line

Figure 10 is a flowchart illustrating the firmware handshaking sequence performed when an on-board CMX644A modem originates a call to an external V22/Bell 212A simulator/modem.

The firmware assumes the external equipment has been configured to answer the call using the appropriate protocol.

The states shown in the diagram are as follows:

Calling Modem Entry Point
On entry the Modem will be off-hook, DTMF dialling and the required call progress monitoring completed.

State 1
Start the Wait for Carrier after Dial Timer (setting stored in S7).

Check Communications Standard selected by user (Bell or ITU-T).
If Bell
Set up CMX644A to detect 2225Hz Answer tone.
Goto State 6.

State 2
Set up CMX644A to detect 2100Hz Answer tone.

Start transmitting the 1300Hz Calling tone (Cadence 0.6s on and 1.5s off).

State 3
If the 2100Hz Answer tone is detected then start Validation Timer (setting stored in S18).

If the 2100Hz Answer tone is detected for 1s stop transmitting the 1300Hz Calling Tone then goto State 4.

If the Wait for Carrier after Dial Timer expires then Hang Up and Exit.

State 4
Wait until silence occurs (2100Hz Answer tone not detected)
Start a 60ms Timer.
Set up CMX644A to detect 2225Hz Answer tone (set up will allow for frequency detection of either the 2225Hz Answer tone or High Band Unscrambled PSK 1's (marks))
Goto State 5.

If Validation Timer expires the 2100Hz Answer tone has been present for too long so Hang Up and Exit.

© 1999 Consumer Microcircuits Limited

State 5
Wait until 2225Hz Answer tone or High Band Unscrambled PSK 1's (marks) frequency has been detected.

If 60ms Timer has expired.
Goto State 6a.
Else
Silence period is too short so Hang Up and Exit.

If the Wait for Carrier after Dial Timer expires then Hang Up and Exit.

State 6
Wait until 2225Hz Answer tone is detected then goto State 6a.

If the Wait for Carrier after Dial Timer expires then Hang Up and Exit.

State 6a
Start a 160ms Timer.

If 160ms Timer expires goto State 7.

If 2225Hz Answer tone is not detected then goto State 6.

State 7
Disable 2225Hz Answer tone detection.

Check Communications Standard selected by user (Bell or ITU-T).
If Bell
Start a 550ms Timer.
Else
Start a 450ms Timer.

State 8
Wait until 450ms or 550ms Timer expires

Set up the CMX644A to Tx Low Band Scrambled PSK 1's (marks).

Restart Validation Timer (setting stored in S18).

Set up CMX644A to detect High Band Scrambled PSK.

State 9
When the PSK Carrier Detect flag is set the Rx data is monitored to ensure 95% of 1's are detected for 270ms.

If 95% of High Band Scrambled PSK 1's are detected for 270ms
Turn on Modem CD LED.
Start a 770ms Timer.
Goto State 10.

If Validation Timer expires before 95% of High Band Scrambled PSK 1's detected then Hang Up and Exit.

State 10
Wait until 770ms Timer expires then goto Data Transfer Mode.

© 1999 Consumer Microcircuits Limited

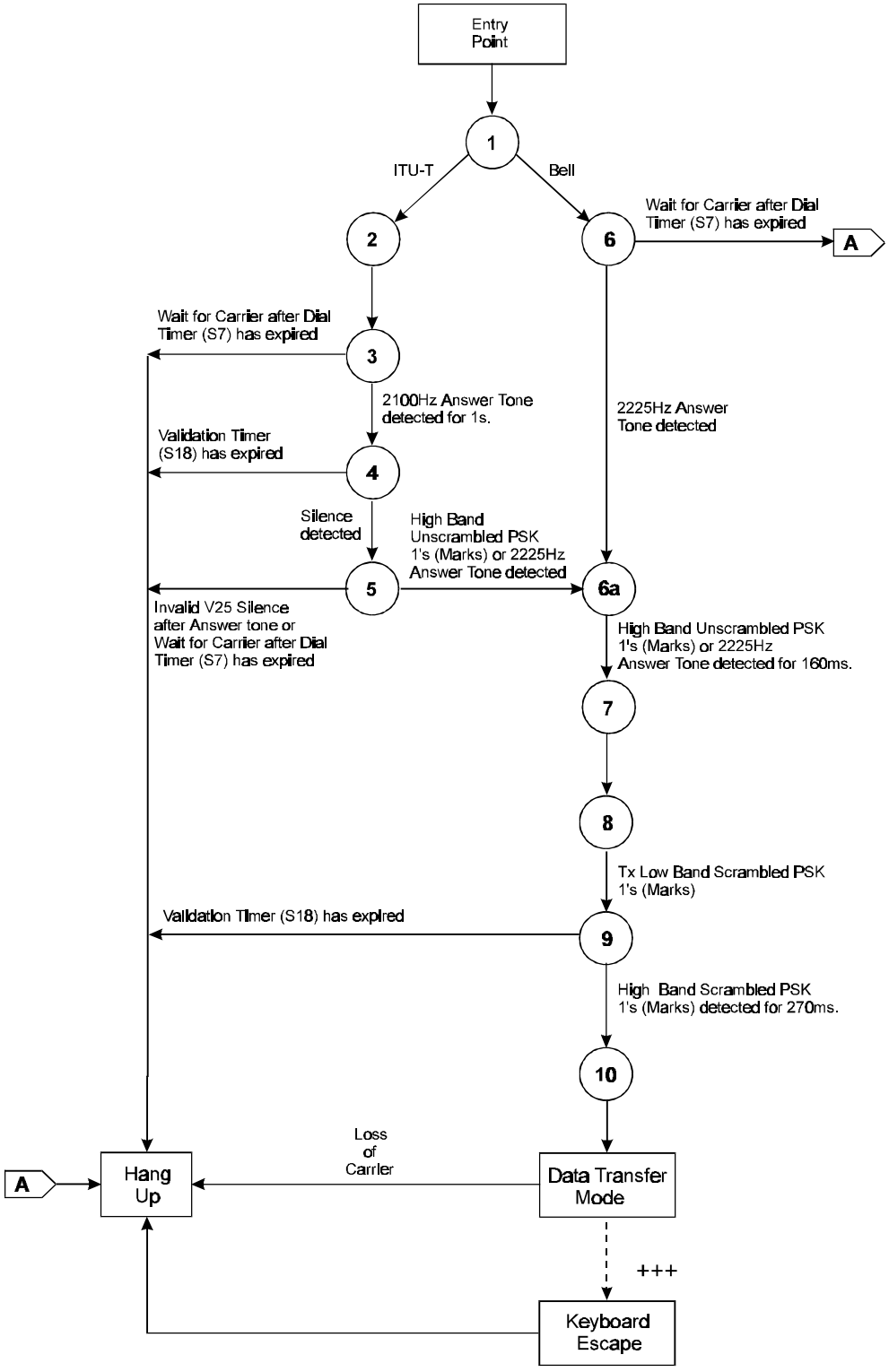


Figure 10 V22/Bell 212A Handshaking Sequence for an EV6240 Calling Modem via a 2-Wire Line

© 1999 Consumer Microcircuits Limited

1.6.6.6 V22/Bell 212A Handshaking Sequence for an EV6240 Answering Modem via a 2-Wire Line

Figure 11 is a flowchart illustrating the firmware handshaking sequence performed when an on-board CMX644A modem answers a call from an external V22/Bell 212A simulator/modem.

The firmware assumes the external equipment has been configured to originate the call using the appropriate protocol.

The states shown in the diagram are as follows:

Answering Modem Entry Point
On entry the Modem will have manually answered a call using the ATA command or auto-answered via the ring detect circuitry. In both cases the Modem will be off-hook.

Start 2 second Billing Delay Timer

State 11
Wait for Billing Delay Timer to expire.

Check Communications Standard selected by user (Bell or ITU-T).
If Bell goto State 15.

State 12
Set up CMX644A to Tx 2100Hz Answer tone.

Start 3.3 second Answer Tone Timer.

State 13
Wait for Answer Tone Timer to expire.

Turn off Tone o/p (silence).

Start 80ms Silence Timer.

State 14
Wait for Silence Timer to expire.

Set up the CMX644A to Tx High Band Unscrambled PSK 1's (marks) with Guard Tone if selected.

State 15
Set up CMX644A to Tx 2225Hz Answer tone.

State 16
Set up CMX644A to detect Low Band Scrambled PSK.

Start Validation Timer (setting stored in S18).

When the PSK Carrier Detect flag is set the Rx data is monitored to ensure 95% of 1's are detected for 270ms.

If 95% of Low Band Scrambled PSK 1's are detected for 270ms then goto State 17.

If Validation Timer expires before 95% of Low Band Scrambled PSK 1's detected then Hang Up and Exit.

© 1999 Consumer Microcircuits Limited

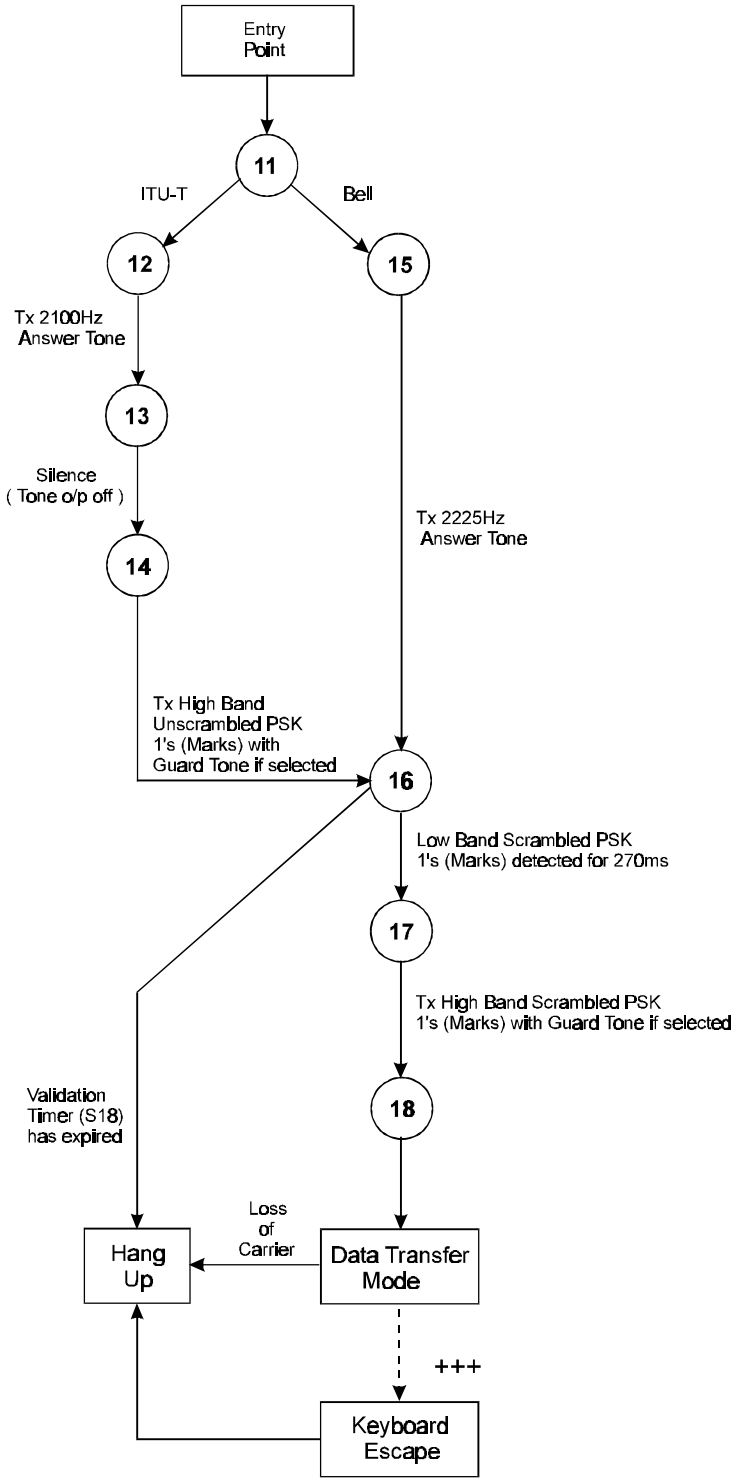


Figure 11 V22/Bell 212A Handshaking Sequence for an EV6240 Answering Modem via a 2-Wire Line

© 1999 Consumer Microcircuits Limited

State 17
Set up the CMX644A to Tx High Band Scrambled PSK 1's (marks) with Guard Tone if selected.

Start a 770ms Timer.

State 18
Wait until 770ms Timer expires then turn on Modem CD LED and goto Data Transfer Mode.

Note:

Handshaking sequences are only performed when the EV6240 evaluation board is operated in the default Evaluation Mode (Modem Mode, AT@E0).

To ensure successful handshaking and data transfer between the EV6240 and third party modems, users should ensure their third party modem is configured to the correct protocol (see third party AT command documentation).

The EV6240 ITU-T handshaking firmware incorporates the V25 calling and answering procedures.

The EV6240 ITU-T handshaking firmware will only allow the Calling Modem to connect with a modem that is using the V25 answering sequence.

After dialling, the ITU-T calling modem will pulse the 1300Hz calling tone (0.6s on and 1.5s off) until the 2100Hz answer tone has been detected. This V25 calling procedure is not shown on Figures 8 and 10.

Handshaking sequences may be aborted by pushing any key prior to entering data transfer mode. Whilst in data transfer mode the user can return to AT Command mode by typing the escape code sequence (+++). The escape code guard time must have expired to successfully return to the AT Command mode.

The CD(Carrier Detect) LED's are only used during the Modem Mode handshaking sequences and data transfer.

1.6.6.7 Use of CMX644A with early EV6240 Kits

Early (Rev A) EV6240 kits were designed for evaluating the CMX644: They can be easily modified to evaluate the CMX644A.

(a) Connect capacitor C44 (1.0µF ceramic) between U6 pin 23 and Ground (0v).
(b) Connect capacitor C45 (1.0µF ceramic) between U8 pin 23 and Ground (0v).
(c) Reprogram the PIC µC (U3) with the latest revision of firmware.

Rev B (and later) versions of the EV6240 kit do not require hardware modification for use with the CMX644A, although a later version of firmware, (available on the CML web site) may need to be programmed into the PIC µC. The CMX644 can still be evaluated on modified EV6240 kits, providing an earlier version of firmware is used. Please contact CML for details.

© 1999 Consumer Microcircuits Limited

1.7 Performance Specification

1.7.1 Electrical Performance

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

	Min.	Max.	Units
Supply (V_{IN} - V_{SS})	-0.3	40.0	V
Supply (V_{DD} - V_{SS})	-0.3	7.0	V
Voltage on any 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 pin	-20	+20	mA
Storage Temperature	-	+70	°C
Operating Temperature	+10	+35	°C

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

	Notes	Min.	Max.	Units
Supply (V_{IN} - V_{SS})		8.0	24.0	V
Supply (V_{DD} - V_{SS})		3.0	5.5	V
Operating Temperature		+10	+35	°C
External Clock Frequency for CMX624		3.575965	3.583125	MHz
External Clock Frequency for CMX644A		3.686031	3.686769	MHz
External Clock Frequency (for µC at 5.0V V_{DD})		0.1	20.0	MHz
External Clock Frequency (for µC at 3.3V V_{DD})		0.1	4.0	MHz

Operating Characteristics
For the following conditions unless otherwise specified:
CMX624 Evaluation Device and Xtal Frequency = 3.579545MHz, µC = 4.00MHz
CMX644A Evaluation Device and Xtal Frequency = 3.6864MHz, µC = 4.00MHz
V_{DD} = 3.3V to 5.0V, Tamb = +25°C.

	Notes	Min.	Typ.	Max.	Units
DC Parameters					
I_{DD} (evaluation board - idle)	1	-	50.0	-	mA
AC Parameters					
Xtal/Clock Input to Evaluation Device					
'High' pulse width	2	100	-	-	ns
'Low' pulse width	2	100	-	-	ns
OSC1 Input to PIC µC					
'High' pulse width		50.0	-	-	ns
'Low' pulse width		50.0	-	-	ns

Notes: 1. Relays not energised.
2. Timing for an external input to the CLOCK/XTAL pin.

Operating Characteristics - Timing Diagrams
For CMX624/CMX644A timing information, refer to current CML CMX624/CMX644A Data Sheets.

© 1999 Consumer Microcircuits Limited

CML does not assume any responsibility for the use of any circuitry described. No IPR or circuit patent licences are implied. CML reserves the right at any time without notice to change the said circuitry and this evaluation kit specification. Evaluation kits are supplied for the sole purpose of demonstrating the operation of CML products and are supplied without warranty. They are intended for use in a laboratory environment only and are not for re-sale, end-use or incorporation into other equipments. Operation of evaluation kits outside a laboratory environment is not permitted within the European Community. All software is supplied "as is" and is without warranty. It forms part of the evaluation kit and is licensed for use only in this kit, for the purpose of demonstrating the operation of CML products. Whilst all reasonable efforts are made to ensure that software contained in this product is virus free, CML accepts no responsibility whatsoever for any contamination which results from using this software and the onus for checking that the software is virus free is placed on the purchaser of this evaluation kit.

Consumer Microcircuits Limited
M-I-X-E-D S-I-G-N-A-L S-O-L-U-T-I-O-N-S

1 WHEATON ROAD
WITHAM - ESSEX
CM8 3TD - ENGLAND

Telephone: +44 1376 513833
Telefax: +44 1376 518247
e-mail: sales@cmlmicro.co.uk
http://www.cmlmicro.co.uk

CML Microcircuits

COMMUNICATION SEMICONDUCTORS

CML Product Data

In the process of creating a more global image, the three standard product semiconductor companies of CML Microsystems Plc *(Consumer Microcircuits Limited (UK), MX-COM, Inc (USA) and CML Microcircuits (Singapore) Pte Ltd)* have undergone name changes and, whilst maintaining their separate new names *(CML Microcircuits (UK) Ltd, CML Microcircuits (USA) Inc and CML Microcircuits (Singapore) Pte Ltd*), now operate under the single title **CML Microcircuits**.
These companies are all 100% owned operating companies of the CML Microsystems Plc Group and these changes are purely changes of name and do not change any underlying legal entities and hence will have no effect on any agreements or contacts currently in force.

CML Microcircuits Product Prefix Codes

Until the latter part of 1996, the differentiator between products manufactured and sold from MXCOM, Inc. and Consumer Microcircuits Limited were denoted by the prefixes MX and FX respectively. These products use the same silicon etc. and today still carry the same prefixes. In the latter part of 1996, both companies adopted the common prefix: CMX.

This notification is relevant product information to which it is attached.

Company contact information is as below:

CML Microcircuits (UK) Ltd
COMMUNICATION SEMICONDUCTORS

Oval Park, Langford, Maldon,
Essex, CM9 6WG, England
Tel: +44 (0)1621 875500
Fax: +44 (0)1621 875600
uk.sales@cmlmicro.com
www.cmlmicro.com

CML Microcircuits (USA) Inc.
COMMUNICATION SEMICONDUCTORS

4800 Bethania Station Road,
Winston-Salem, NC 27105, USA
Tel: +1 336 744 5050,
0800 638 5577
Fax: +1 336 744 5054
us.sales@cmlmicro.com
www.cmlmicro.com

CML Microcircuits (Singapore) Pte Ltd
COMMUNICATION SEMICONDUCTORS

No 2 Kallang Pudding Road, 09-05/
06 Mactech Industrial Building,
Singapore 349307
Tel: +65 7450426
Fax: +65 7452917
sg.sales@cmlmicro.com
www.cmlmicro.com

D/CML (D)/1 February 2002