CML Microcircuits

COMMUNICATION SEMICONDUCTORS

EV9900A
Evaluation Kit
User Manual
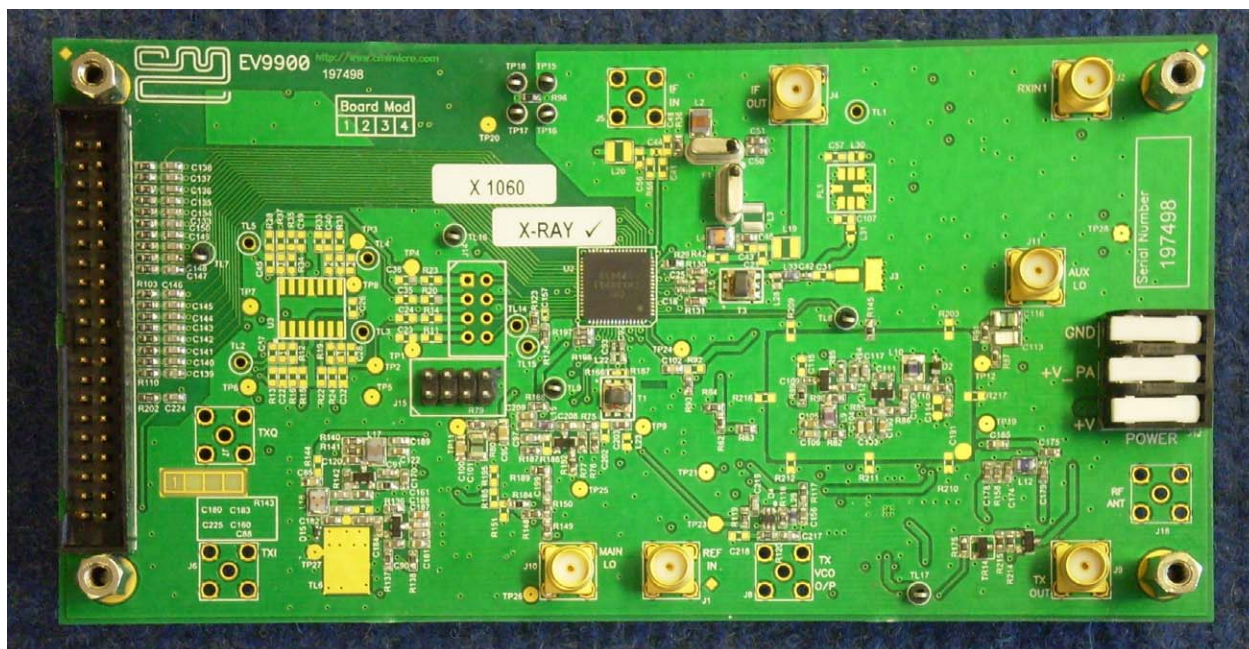
Features

- **Complete 400 MHz Transceiver (Initial Configuration for 410 - 430MHz Tx / 410 - 430MHz Rx)**

- **Configurable for 800 MHz (e.g. 819 - 825MHz Tx / 864 - 870MHz Rx Transceiver)**

- **Test Access for Important Signals**

- **14.4MHz Reference for 9600bps / 8000bps / 4800bps etc. data rates**

- **Parallel Interface to a µC**

1   Brief Description

The EV9900A allows evaluation of the CMX990 Baseband and RF Modem IC. The design is a flexible platform to allow users to configure and evaluate the CMX990 for various applications and frequency bands. Initial configuration is for 410-430MHz operation with 25kHz channel spacing and 9600bps. A number of RF circuits, such as VCO's, PA and LNA, are provided on the EV9900A to facilitate easy evaluation. The PA and LNA are configurable for different operating bands through component value changes (contact CML for further information).

*Serial numbers 198189 - 198203 are supplied configured for external Auxiliary LO operation - please refer to the "*Addendum*" at the end of the document for further information.*
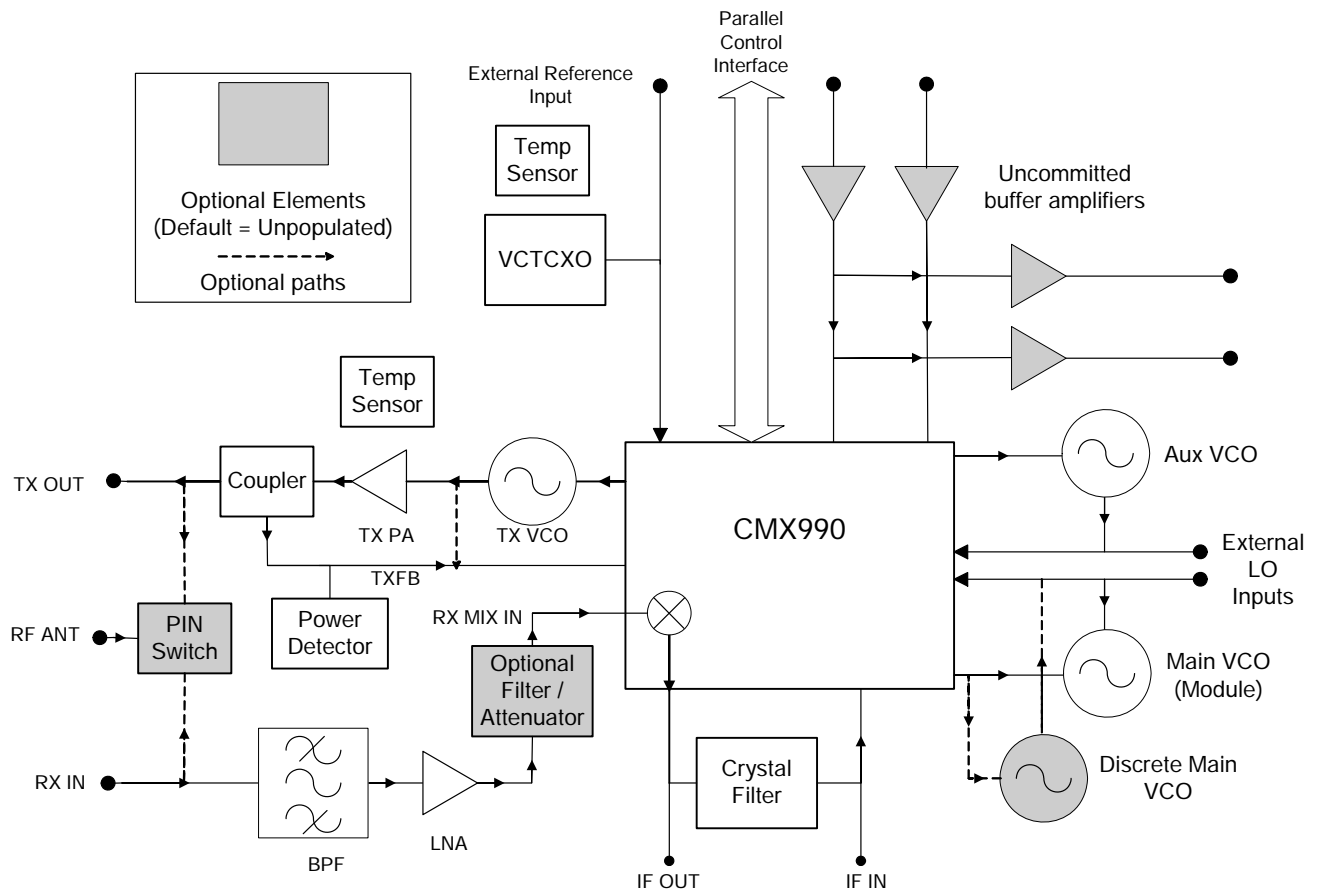
Parallel
Control
Interface

External Reference
Input

Temp
Sensor

VCTCXO

Optional Elements
(Default = Unpopulated)
--------►
Optional paths

Uncommitted
buffer amplifiers

Temp
Sensor

Coupler

TX OUT

TX PA

TX VCO

CMX990

Aux VCO

Power
Detector

TXFB

RX MIX IN

External
LO
Inputs

PIN
Switch

RF ANT

Optional
Filter /
Attenuator

Main VCO
(Module)

BPF

LNA

Crystal
Filter

Discrete Main
VCO

RX IN

IF OUT

IF IN

Figure 1 – Block Diagram

CONTENTS

It is always recommended that you check for the latest product datasheet version from the Datasheets page of the CML website: [www.cmlmicro.com].

2.   Preliminary Information

The EV9900A provides a platform for the evaluation of the CMX990. To use the EV9900A, a separate micro-controller or PC, for example, is required to program the CMX990 via its parallel interface. This controlling device is not included on the EV9900A, however a CML product is available to provide the controlling functionality: the EV9902.

2.1   Laboratory Equipment

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

- Dual Power Supply
- Spectrum Analyzer
- RF Attenuator
- RF Signal Generator

For more detailed design or investigation work the other RF test equipment may be required.

2.1.1   Power Supply

The supply input voltage to the PCB, for all circuits except the PA, is 7.2V (5.25V to 7.6V acceptable). On board regulators are provided to generate all voltage rails used on the PCB (3V and 5V rails are used).

The supply to the PA is directly connected to the PA: a voltage of 3.6V is recommended.

The 7.2V supply should be rated at 1A and the 3.6V supply rated at 2A.

NOTE: Care should be exercised with the supplies as they are not protected for reverse polarity. For optimum RF performance, the PA supply is connected directly to the RF5110G device so care is required to ensure the RF5110G manufacturer's ratings are not exceeded.

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.

2.2.1   Static Protection

This product uses low power CMOS circuits that 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.

2.2.2   Contents - Unpacking

Please ensure that you have received all of the items on the separate information sheet (EK9900A) and notify CML within 7 working days if the delivery is incomplete.

2.3   Approvals

This product is not approved to any EMC or other regulatory standard. Users are advised to observe local statutory requirements, which may apply to this product and the radio frequency signals that may emanate from it.

3.   Quick Start

This section provides instructions for users who wish to experiment immediately with the evaluation kit. A more complete description of the kit and its use appears later in this document. The EV9900A includes a CMX990 device that is described in its own, separate, datasheet. Accordingly, the user should read the CMX990 datasheet before using the EV9900A.

3.1   Setting-Up

The following procedure is recommended:

1. Connect test leads as required, including the host µController to parallel interface J13.
2. The power amplifier output should be connected to a suitable 50Ω load.
    THE USE OF AN EXTERNAL 50Ω LOAD IS ESSENTIAL TO PREVENT POSSIBLE DAMAGE TO THE PA STAGE.
3. Power should be applied to the main supply (7.2V nominal).
4. The CMX990 device should be reset by issuing a RESET task to the host µController parallel interface (using the TASK bits (b3 - b0) of the Command register [address $01]).
5. Power should be applied to the power amplifier supply connector (3.5V).

The board is now ready for operation. An example of typical connections to the EV9900A is shown in *Figure 2*.
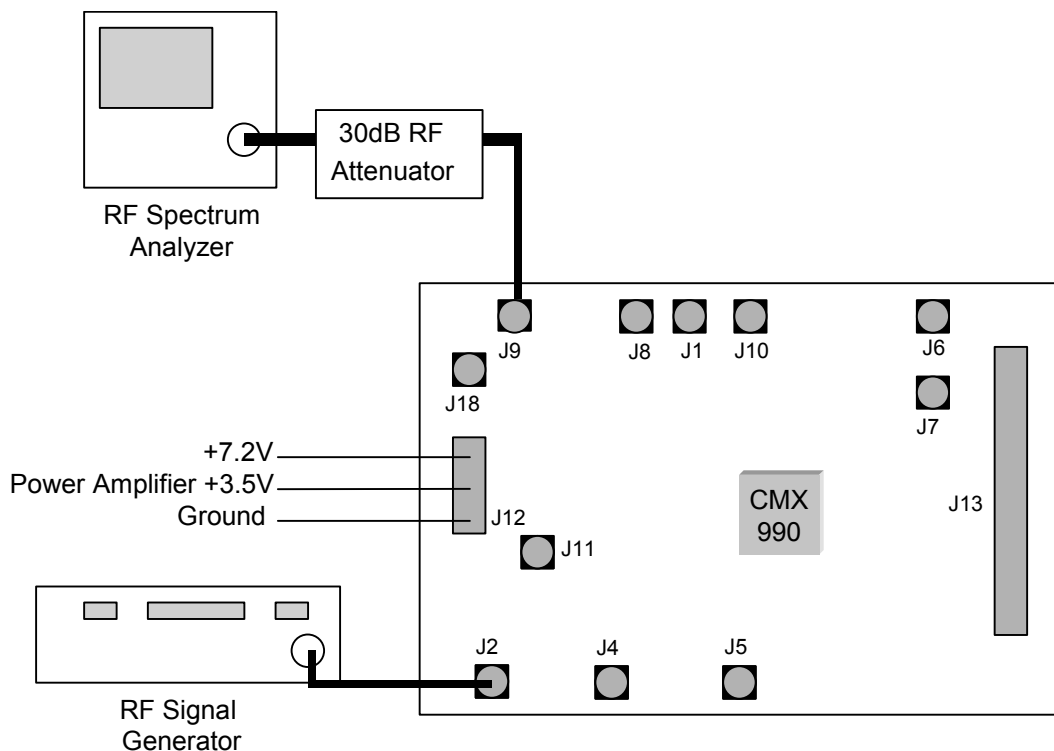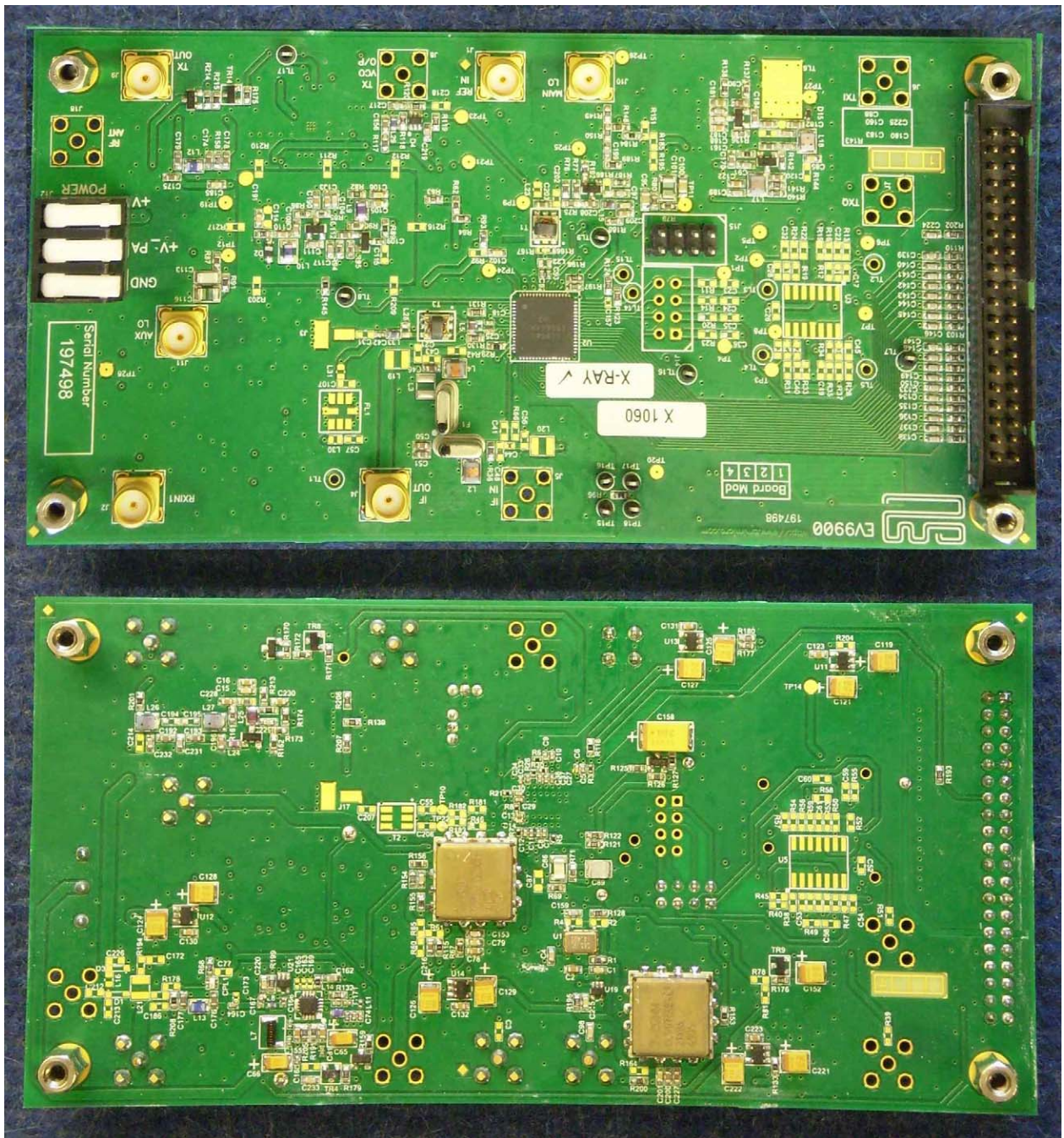

Figure 2 – Typical Connections for EV9900A

Figure 3 EV9900A top and bottom views

3.2   Adjustments

None.

3.3   Operation

The CMX990 is a complex RF and Baseband Modem IC. It is recommended that the user familiarise themselves with the datasheet of this device prior to attempting to use the EV9900A.

To use the EV9900A the user will need a mechanism to send and receive data and commands via the 8-bit parallel host µController interface on the CMX990, which is brought out on connector J13 on the EV9900A. The CMX990 datasheet gives details of the registers and commands. To operate the CMX990, some typical command sequences are given below:

Data Rate

The default data rate with a 14.4MHz reference is 6000bps. Data rates can be configured using the clock control register in the CMX990 (C-BUS address $29). The following example C code shows a typical configuration for common data rates:

```
register_write(CLOCK_CONTROL, 0x45);        //9600 bps e.g. 25kHz channel

register_write(CLOCK_CONTROL, 0x85);        //4800 bps e.g. 12.5kHz channel

register_write(CLOCK_CONTROL, 0x46);        //8000 bps e.g. 12.5kHz channel
```

Receive Mode

The following example C code shows a typical configuration for reception.

```
register_write(POWER_UP_2, 0x08);    //Reset
register_write(POWER_UP_2, 0x01);    //Vbias on
register_write(POWER_UP_1, 0xEE);    //Clock+BB+Vreg,+Rx:on & Opamps+Tx:off
register_write(POWER_UP_2, 0xF1);    //DACs on
register_write(AUX_DAC_1_MSB,169);   //AFC to mid rail (1.65V)

//Set up synths:

set_main_synth(0x8480,0x807530);     //750MHz, low side, Rx Freq=420.1MHz
                                     //(assuming ref 14.4MHz & comp 12.5kHz)

set_aux_synth(0x8090,0x870C);             //180.4MHz (for 45.1MHz IF)
                                     //(assuming ref 14.4MHz & comp100kHz)

register_write(CONTROL, 0xE9);       //AGC max gain & run, IQ offset fine,
                                     //AFC Slow, PLL Narrow

register_write(MODE, 0xD2);          //IRQ enabled, scrambler enabled,
                                     //INV bit enabled, Main ADC enabled, Rx mode

register_write(POWER_UP_2,0xF5);     //Turn LNA on.

register_write(COMMAND, 0x60);       //Acquire DC offset & AFC
                                     //DelayBy(90000);
                                     //Wait for Offset to complete
```

Following the above routines the user may initiate reception of data using the modem task commands in Command register ($01).

Transmit Mode

The following example 'C' code shows a configuration for the CMX990 transmitter.

```
register_write(POWER_UP_2, 0x08);    //Reset
register_write(POWER_UP_2, 0x01);    //Vbias on
register_write(POWER_UP_1, 0xE0);    //Clock, BB, Vreg:on & Opamps+Tx+Rx:off

register_write(COMMAND, RESET);      //give modem reset command

register_write(CONTROL, 0x00);       //
register_write(MODE, 0xB1);          //IRQ, Tx Mode, Scrambler & Main DAC enabled
```

The user should also ensure that the synthesisers are set to appropriate frequencies and enabled. The transmitter is now ready to start transmission but the offset loop is unlikely to lock without modulation being generated. To achieve lock, write task TSO (Transmit Scrambler Output), which will result in a continuous sequence of random data being generated by the baseband modem. The transmitter is enabled by setting the TxIFRF bit in POWER_UP_1 register.

```
register_write(COMMAND, TSO);        //Transmit Scrambler Output
register_write(POWER_UP_1,0xE1);     //Clock, BB, Vreg, Opamps off , Tx RFIF on
```

The above sequence just enables the transmitter. The power amplifier can now be enabled using the DAC0 Output. This DAC has an automatic ramping circuit to allow an accurate power ramping profile to be applied to the power amplifier.

```
register_write(AUX_DAC_0_MSB,0x39);          //Turn PA on at minimum power to all
lock
```

For some operating frequencies the free-running frequency of the Tx VCO needs to be within certain limits of the desired Tx frequency (as described in the datasheet). On the EV9900A this can be achieved using the pre-charge facility as follows:

```
Register_write(0x24,0x11);           //Enable Tx VCO Charge
Delay(1000);                         //Wait while VCO tunes
Register_write(0x24,0x01);           //Disable Tx VCO Charge
```

The power amplifier may now be either ramped up or, for basic testing, enabled to the required power. An output power of ~1W is generally achieved with a DAC0 value of 0xb0.

```
register_write(AUX_DAC_0_MSB,0xb0);          //PA output approx 1W
```

4.   Signal Lists

CONNECTOR PINOUT				
Connector Ref.	Connector Pin No.	Signal Name	Signal Type	Description
J1	N/A	REFIN	RF / Clock	Clock input / output. By selecting coupling capacitors (C3 / C4) this port may be used to monitor the on-board 14.4MHz reference or the external reference input.
J2	N/A	RXIN1	RF	Input to receiver LNA.
J3	N/A	RXIN2	RF	By selecting components this port may be used as an LNA output or input to the receiver mixer. *NB: This port is a test port (solder pads) designed to allow connection of a coax cable.*
J4	N/A	IFOUT	RF	1st Mixer Output or input to IF filter (F2).
J5	N/A	IF IN	RF	Output of IF filter (F2) or input to CMX990 receiver IF stages.
J6	N/A	TXI	BASEBAND	EV9900A is not configured to use this port.
J7	N/A	TXQ	BASEBAND	EV9900A is not configured to use this port.
J8	N/A	TX VCO O/P	RF	Monitor point for Tx VCO feedback signal.
J9	N/A	TXOUT	RF	400MHz / 800MHz transmitter output.
J10	N/A	MAIN LO	RF	Input or output / monitor for main local oscillator.
J11	N/A	AUX LO	RF	Input or output / monitor for auxiliary (180MHz) local oscillator (normally not connected).
J12	3	+7.2V	DC	7.2V power supply input.
J12	2	+3.5V	DC	3.5V power supply for RF power amplifier.
J12	1	GND	DC	Power supply ground.
J13	1 – 40	HOST INTERFACE	LOGIC	8 bit parallel interface from CMX990 to host / controller or PC. See schematics and CMX990 datasheet for details.
J14	1 – 8	TX/RX/I/Q	BASEBAND	EV9900A is not configured to use this port.
J15	1,3,5,7	TX/RX/I/Q	BASEBAND	EV9900A is not configured to use these pins.
J15	2	DAC3	BASEBAND	DAC3 output.
J15	4	DAC2	BASEBAND	DAC2 output.
J15	6	ADC5	BASEBAND	ADC5 input.
J15	8	ADC4	BASEBAND	ADC4 input.
J16	VOID	VOID	N/A	Void
J17	N/A	N/A	N/A	EV9900A is not configured to use this connector.
J18	N/A	RF_ANT	RF	TX / RX Switch Output (Default configuration of EV9900A does not use this connector).

Table 1 – Signal List

CONNECTOR PINOUT for J13			
Connector Pin No.	Signal Name	Signal Type	Description
1	GNDD	POWER	Connection to digital ground.
2	GNDD	POWER	Connection to digital ground.
3	ADDRESS5	I/P	CMX990 Address (A5).
4	ADDRESS4	I/P	CMX990 Address (A4).
5	ADDRESS3	I/P	CMX990 Address (A3).
6	ADDRESS2	I/P	CMX990 Address (A2).
7	ADDRESS1	I/P	CMX990 Address (A1).
8	ADDRESS0	I/P	CMX990 Address (A0).
9	GNDD	POWER	Connection to digital ground.
10	GNDD	POWER	Connection to digital ground.
11	READN	I/P	CMX990 read strobe.
12	WRITE	I/P	CMX990 write strobe.
13	CSN	I/P	CMX990 chip select input.
14	IRQN	O/P	CMX990 open-drain Interrupt output. 10k pull-up resistor to 3.3V (R193) fitted on PCB.
15	GNDD	POWER	Connection to digital ground.
16	GNDD	POWER	Connection to digital ground.
17	DATA7	BI	CMX990 Data (D7).
18	DATA6	BI	CMX990 Data (D6).
19	DATA5	BI	CMX990 Data (D5).
20	DATA4	BI	CMX990 Data (D4).
21	DATA3	BI	CMX990 Data (D3).
22	DATA2	BI	CMX990 Data (D2).
23	DATA1	BI	CMX990 Data (D1).
24	DATA0	BI	CMX990 Data (D0).
25	GNDD	POWER	Connection to digital ground.
26	GNDD	POWER	Connection to digital ground.
27	TX_ON	I/P	TX Enable for PIN switch, high = TX, low = RX (default configuration does not use this signal).
28	~	~	Spare pin. Leave unconnected.
29, 30	~	~	Spare pin. Leave unconnected.
31, 32	~	~	Spare pin. Leave unconnected.
33, 34	~	~	Spare pin. Leave unconnected.
35, 36	~	~	Spare pin. Leave unconnected.
37, 38	~	~	Spare pin. Leave unconnected.
39, 40	~	~	Spare pin. Leave unconnected.

Table 2 – Host µController Interface

TEST LOOPS		
Test Loop Ref.	**Default Measurement**	**Description**
TL1		LNAON control line from CMX990
TL2		EV9900A is not configured to use this port
TL3		EV9900A is not configured to use this port
TL4		EV9900A is not configured to use this port
TL5		EV9900A is not configured to use this port
TL6		EV9900A is not configured to use this port
TL7		Control port chip select line (This pin is useful to trigger measurements on command inputs to the CMX990 registers)
TL8		DAC 0 (PA Ramping)
TL9		DAC 1 (AFC)
TL10		Void
TL11		Void
TL12		Void
TL13		Void
TL14		Test point for differential amplifier 2 output
TL15		Test point for differential amplifier 2 inverting input
TL16	2.5V	+2.5V power supply
TL17		Power amplifier control voltage

Table 3 – Test Loops

TEST POINTS		
Test Point Ref.	**Default Measurement**	**Description**
TP1		EV9900A is not configured to use this signal
TP2		EV9900A is not configured to use this signal
TP3		EV9900A is not configured to use this signal
TP4		EV9900A is not configured to use this signal
TP5		EV9900A is not configured to use this signal
TP6		EV9900A is not configured to use this signal
TP7		EV9900A is not configured to use this signal
TP8		EV9900A is not configured to use this signal
TP9		Transmitter PLL VCO control line
TP10		EV9900A is not configured to use this signal
TP11		Main PLL VCO control line
TP12		Auxiliary PLL VCO control line
TP13	2.5V	2.5V regulator output
TP14	5.0V	5.0V regulator output for digital baseband
TP15	0V	Analogue ground
TP16	0V	Analogue ground
TP17	0V	Digital ground
TP18	0V	Digital ground
TP19	5.0V	5.0V regulator output for analogue baseband
TP20	3.3V	3.3V regulator output
TP21	3.3V	3.3V regulator output for VCO
TP22		EV9900A is not configured to use this signal
TP23		PA output power detector voltage
TP24		PA Temperature sensor voltage
TP25		AFC Temperature sensor voltage
TP26	5.0V	5.0V regulator output for VCO

Table 4 – Test Points

JUMPERS			
Link Ref.	Positions	Default Position	Description
J14		Open	EV9900A is not configured to use this port
J15		Open	EV9900A is not configured to use this port

Table 5 – Jumpers

Notes: I/P   =   Input
O/P   =   Output
BI   =   Bidirectional
TL   =   Test Loop
TP   =   Test Point

5.   Circuit Schematics and Board Layouts

For clarity, circuit schematics are available as separate high-resolution files. The layout on each side is shown in *Figure 4*, below:
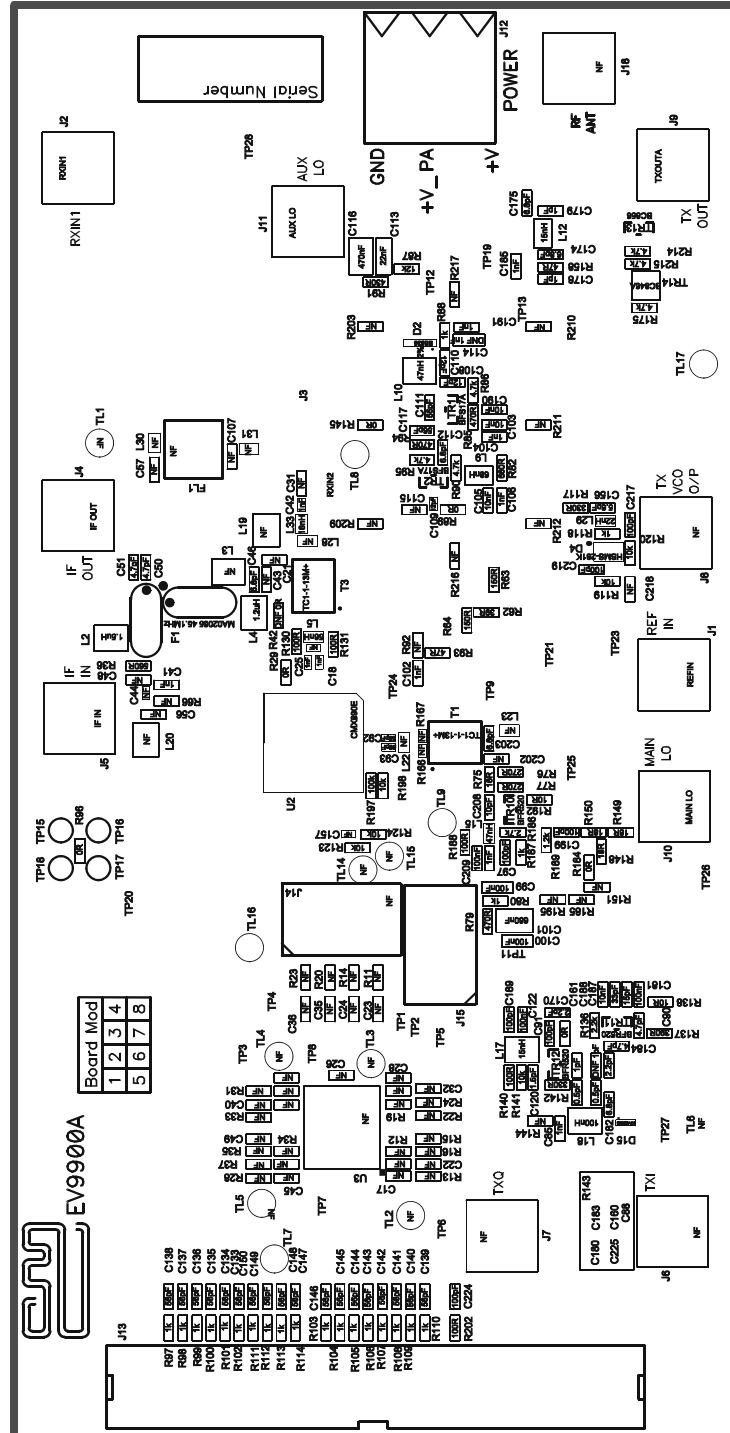
Figure 4a - PCB Layout: top
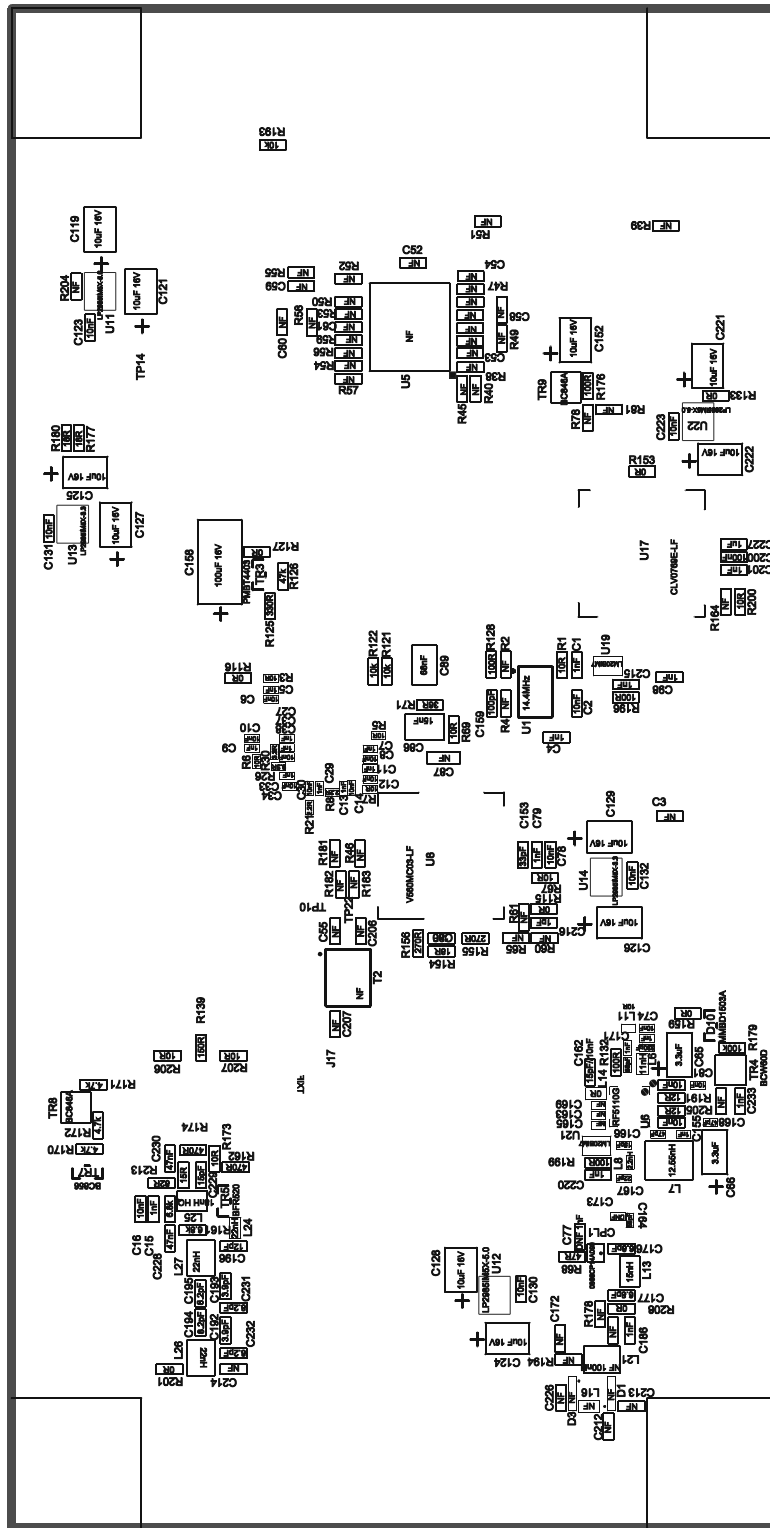
Figure 4b – PCB Layout: bottom

6.   Detailed Description

The CMX990 datasheet (not included but available at www.cmlmicro.com) should be referred to for a detailed description of the CMX990 device.

The EV9900A functionality includes:

- Demonstration of the CMX990 RF functionality at ≈400MHz (or ≈800MHz by component changes. Please contact CML for further information.)
- Demonstration of EN 300 113 receive performance.
- Interfaces that allow the card to be connected to a host µController, to allow real-time control, or to a PC (a separate interface may be required)
- An interface allowing the connection of an external reference clock

In summary, the EV9900A allows the user to create experiments to investigate all aspects of the CMX990 device. The EV9900A is designed to allow user modification, to support detailed investigation of each user's specific and different applications.

6.1   Hardware Description

Front End LNA

The PCB includes a 400MHz discrete bipolar LNA using TR5, which is designed for 410-430MHz and to meet EN 300 113 requirements. The LNA includes some front-end band-pass filtering (L26, L27, C186, C187, C188, C189, C192, C193 and C194). This can be re-configured for operation on other bands with value changes. A 1.8dB Pi attenuator (R162, R173, R174) follows the LNA output.

SAW Image Filter

By fitting or not fitting certain components the user is able to select either a SAW filter (FL1) or additional T attenuation (R206, R207, R139) to simulate the typical system loss of such a filter. As built, the SAW filter is not fitted, with the attenuator values fitted to give around 3dB loss.

Mixer Input

The signal from the LNA and filter is then applied to the differential input of the CMX990 RX mixer via a balun transformer T3. The input is matched for the particular band of interest (L5, L33, L28).

IF Filter

The IF filter (F1A, F1B) is a 45.1MHz 4-pole crystal filter. The pass-band of the filter fitted to the EV9900A is approximately +/-7.5kHz, designed for 25kHz channel spacing, however other filters are available in the same package outline, offering different bandwidths (e.g. +/-3.75kHz for 12.5kHz channel spacing). Correct matching of the filter is necessary to achieving optimum performance.

Reference Oscillator

A 14.4MHz VCTCXO is provided on the PCB (U1). If U1 is disabled (lifting R1), C4 is removed, and C3 fitted, an alternative clock source can be applied to J1.

Transmitter

The transmitter provides at least +30dBm in the default configuration (410-430MHz). The 420MHz PA is tuneable (by component changes) over the range 150 to 900MHz, however lower output power is available over 750MHz. The transmit VCO (U8) also has very broad tuning range typically from below 400MHz to above 450MHz with a 3.3V charge pump. U8 would need to be changed for operation on other bands, for example 800MHz (contact CML for further information).

The CMX990 RAM DAC output (DAC 0) is connected to the PA control line via a diode and transistor (D10 and TR4) to provide sufficient current to the PA control pin.

Local Oscillators

VCO's are provided for the main and aux synthesizers. The aim is to cover the frequency bands of 410-430MHz (Rx and Tx).

This requires the following local oscillator frequencies, based on the following frequency plan:

Rx Band / MHz	Tx Band / MHz	Tx IF / MHz	Rx IF / MHz	LO Range / MHz
410-430			45.1	729.8-769.8
	410-430	45		730-770

Table 6 – Local Oscillator Frequencies

The VCOs are packaged parts from Z-Communications, who provide a range of VCO's in the same package outline, so that the user can evaluate other frequency bands if required. These VCOs have some performance limitations and are marginal for EN 300 113 adjacent channel requirements for transmitter and receiver.

The facility to use a discrete, high performance, low phase noise VCO circuit, is also provided (TR11, TR12 and coaxial resonator TL6), However this is not enabled in the default configuration. This may be re-tuned by component changes if required by the user.

The aux VCO is a discrete design operating at around 180MHz. Again this may be re-tuned by component changes if required by the user.

Differential Amplifiers

Simple circuits are provided to allow evaluation of the differential amps on the CMX990 (R117, R118, R119, R120, R121, R122, R123, R124, C156 and C157).

Temperature Sensors

Two temperature sensors are provided, one (U21) adjacent to the PAs and the other (U19) adjacent to the VCTCXO. These are connected to the CMX990 Aux ADC inputs 0 and 1 respectively.

Tx/Rx Switch

Although not configured in the default EV9900A build, circuits are provided to implement a Tx / Rx switch using PIN diodes. (See section 6.2.1)

Interface

The EV9900A provides access to the CMX990 parallel interface via connector J13.

The EV9900A has test pins to allow measurement of aux DAC outputs and test pins that allow the user to apply test signals to the aux ADC inputs.

All RF connectors are SMA type.

The power connector provides two separate power connections: one for the power amplifier and the other to supply all other circuits.

6.2   Adjustments and Controls

The user has the ability to configure the EV9900A for a number of different operational scenarios.

6.2.1   Tx/Rx Switch

The following modifications need to be implemented on the EV9900A (PCB546F) evaluation board to enable a classical series-shunt RX/TX switch.

Ref Des	410-430MHz value
R194	100R
C172	1n0
C94	1n0
L21	100nH 1008CS
C212	1n0
L16	15nH 0603CS
C213	6p8
C226	6p8

The receiver path components (L16, C213, C226) form a lumped quarter wave section and will need to vary dependent upon the users' operating band. L21 would also require a value change. The switch will give less than 1dB insertion loss.

The main consequence with this topology is that only one control line is required and the logic is as follows; TX_ON = 3V (HIGH) => TX mode, TX_ON = 0V (LOW) => RX mode. This signal is buffered by TR13 and TR14 due to the current required for low transmit through loss.

6.2.2   External Local Oscillator

To evaluate the performance of the CMX990 it is recommended that a low noise external oscillator be used for the main LO. This is particularly important when performing blocking and adjacent channel tests. An external main LO can be supplied via J10. The following changes are recommended:

- Remove R78, R81, R164 and R200 (supplies to on-board VCO's).
- Ensure C98 (1nF) and R149 (18Ω) are fitted.

6.2.3   Intermediate Signal Connections

The EV9900A allows a user to connect signals at various points in the signal path of the IC. Details can be found on the schematic and in the list of connectors. Users can choose appropriate matching and configurations to suit their requirements. Note that just connecting test equipment to the ports may not give the expected results – correct RF matching arrangements are required.

6.3   Firmware Description

The EV9900A has no embedded firmware.

6.4   Software Description

CML products DE9901 and EV9902 (not included) can be used with the EV9900A and include related software.

6.5   Application Information

6.5.1   TX Loop Operating Power Levels

The range of input powers to the feedback port (TxFB) of the offset loop is designed to allow operation over an 65dB range (approximately +8 to –57dBm). This is to permit the loop to lock prior to commencing power ramping.

6.6   Evaluation Tests

The EV9900A is intended to allow evaluation of CMX990 RF and baseband performance. The following is a list of typical tests from radio modem standards (e.g. EN300113). Some guidance notes on likely EV9900A performance at 410-430MHz are provided.

Frequency Error

Compliant, based on a selected 14.4MHz VCTCXO.

Adjacent Channel Power (ACP)

60dB adjacent channel power can be demonstrated for 12.5kHz channels with G(M)FSK, B_t = 0.27 and 8kbit/s. To achieve this an external LO is required and a TxIF of 45MHz selected.

70dB adjacent channel power can be demonstrated for 25kHz channels with GMSK, B_t = 0.5 and 9.6kbit/s.

Compliance with FCC 47CFR90.210 emission mask D can also be demonstrated using the on-board Main VCO module, as shown in the following plot. A 45MHz TXIF was used. This is a 12.5kHz channel mask and requires a change in baud rate to 8kbit/s (register $29, 46h) and BT to 0.3.
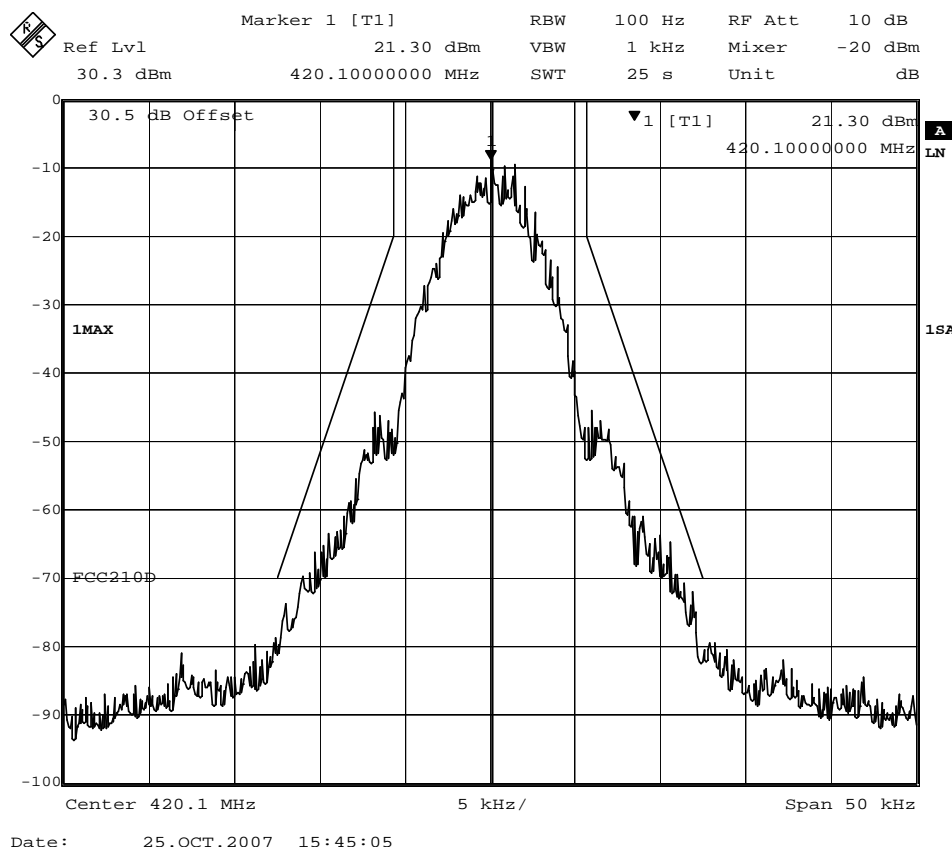
Figure 5 – FCC 47CFR90.210 emission mask D

Spurious Emissions

EV9900A is not designed to be compliant with spurious emissions limits as transmitter filtering is not included.

Maximum Usable Sensitivity

Typically –117dBm for 1% BER (9.6kbit/s, B_t = 0.5).

Co-channel Rejection

With an interferer on the same frequency this is typically 7dB for 25kHz channel spacing operation (9.6kbit/s).

Adjacent Channel Rejection (ACR)

ACR performance is limited by local oscillator phase-noise.

Typically, 72dB ACR can be demonstrated for 25kHz channels with GMSK, B_t = 0.5 and 9.6kbit/s using the on-board VCO. Enhanced performance can be achieved using an external, low noise, main LO.

Intermodulation

Typically greater than >65dB tested as EN 300 113.

Spurious Response Rejection

A front-end SAW filter is not provided on the default configuration EV9900A so spurious response rejection is not guaranteed. However the option to fit a filter to reject such responses (type selected by user) is available. The resulting performance will depend upon the operating band used and the particular rejection characteristics of the chosen filter.

Blocking or Desensitisation

Blocking performance is approx. 86dB.

6.7   Troubleshooting

The CMX990 is a complex RF and Baseband system. If incorrectly programmed or modified, results will be at variance from datasheet performance. Please study the datasheet, this manual and the associated schematics and layout drawings carefully when troubleshooting.

This section provides some suggestions to help users resolve application issues they might encounter.

6.7.1   Receiver Operation

Error Observed	Possible Cause	Remedy
No packets are received, however synthesisers are locked and the receiver otherwise appears to be operating correctly.	'INV' bit incorrectly set. Incorrect baud rate set.	Invert current setting of 'INV' bit. Select correct clock control register value.
Receiver sensitivity is 30dB less than anticipated.	'Sign' bit is incorrectly set.	Invert current setting on 'Sign' bit
Degraded receiver performance.	Incorrect DC offset correction.	Ensure DC offset correction sequence has been executed.
Degraded receiver sensitivity and/or imbalance in adjacent channel power in the transmitter (i.e. ACP high is much better than ACP low or vice versa)	There is a frequency offset between EV9900A reference oscillator and the test equipment. (Note: EV9900A requires an approximate AFC value to be programmed into the DAC1. A value of 0x95 in register 0x0B is a good starting point.)	To check if a frequency error exists measure the frequency of the main local oscillator either using the measuring equipment in question or compare results from EV9900A with those from the measurement equipment. To overcome a frequency error either: a) Use a external reference for the EV9900A b) Tune to control voltage on the AFC output (DAC1).
Poor sensitivity on some channels or BER results variable.	The main Tx VCO is not powered down and can drift into the Rx band.	In a normal modem design the Tx VCO (U18) would be powered down during Rx mode. This is not implemented on EV9900A. To overcome the problem the Tx VCO should be disabled during Rx BER testing. This can be done by removing R67.

6.7.2 Transmitter Operation

Error Observed	Possible Cause	Remedy
Transmitter loop does not lock	No modulation is present.	Ensure the transmitter is outputting data. The TSO command can be used to continuously send data for testing. Note also the modem needs to be in transmit mode and main DAC enable (register $03)
Transmitter loop does not lock	The PA is not turned on.	Check the feedback coupling level to the CMX990. Ensure the correct coupler for the band of interest is selected.
Poor modulation spectrum in transmit.	An incorrect filter has been chosen for the selected Tx IF.	Select the correct filter using bits 5 and 6 of the Aux PLL M div MSB register ($26).

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 Voltage (V_{IN} - V_{SS})	0.0	7.6	V
Supply Voltage (V_{PA} - V_{SS})	0.0	4.0	V
Current into or out of V_{IN} V_{PA} and V_{SS} pins	0	+2.0	A
Current into or out of any other connector pin	-20	+20	mA

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

	Notes	Min.	Max.	Units
Supply Voltage (V_{IN} - V_{SS})		5.25	7.6	V
Supply Voltage (V_{PA} - V_{SS})		3.0	3.6	V
Xtal/External Clock Frequency			24	MHz

7.1.3   Operating Characteristics

For the following conditions unless otherwise specified:

Evaluation Device Xtal Frequency = 14.4MHz, Bit Rate = 9.6k bits/sec,
V_{IN} - V_{SS} = 7.2V, V_{PA} - V_{SS} = 3.6V, Tamb = +25°C.

	Notes	Min.	Typ.	Max.	Units
DC Parameters (Excluding PA Supply)					
I_{DD} (CMX990 powersaved)	1		135		mA
I_{DD} (Tx)	1		200		mA
I_{DD} (Rx CMX990 internal mixer; LNA enabled)	1		260		mA
AC Parameters					
Tx Output					
Tx output impedance			50		Ω
TX output power			30		dBm
Rx Input					
Rx input impedance			50		Ω
Rx Sensitivity	2		-112		dBm
Maximum Input Level without damage				0	dBm
Xtal/Clock Input					
Reference Clock Frequency			14.4		MHz
Reference Clock Level	3	1			Vp-p
µC Interface					
See CMX990 Datasheet					

Notes: 1.   PCB current consumption, not current consumption of the CMX990.
2.   1% BER
3.   Typically clipped sine wave

7.1.3   Operating Characteristics - Timing Diagrams

Please refer to CMX990 Datasheet for details.

Addendum

EV9900A PCB serial numbers 198189 to 189203 are supplied configured as follows:

R82 (680R), R85 (470R) and R89 (0R) have been removed to disable the on-board Auxiliary VCO,
R92 has been fitted (0R) to allow an external Auxiliary LO to be applied via J11.

This is due to a problem with the PCB construction that has caused unreliable operation of the Auxiliary VCO when in transmit using a 90MHz IF. The problem can be avoided by using an external source for the AUX LO. EV9900A PCB's with other serial numbers are unaffected.

This does not affect the user's ability to evaluate the CMX990 IC.

The user should apply 180.4MHz at –3dBm for receive and 180MHz at –3dBm for transmit operation to J11.

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