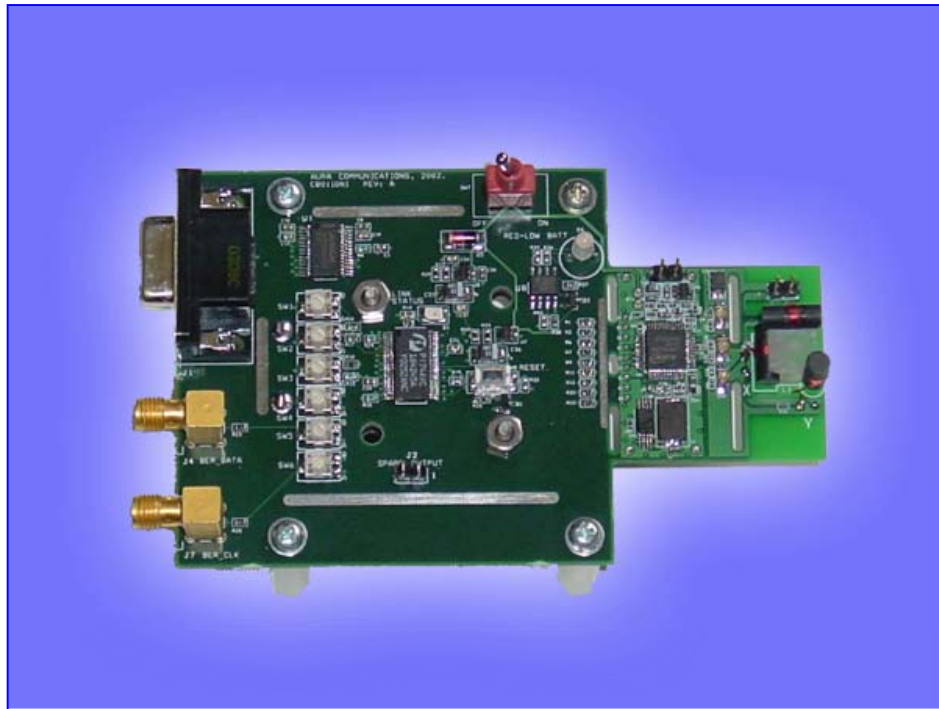


Aura Communications

LibertyLink



Near-Field Magnetic Wireless Data Evaluation System Hardware Manual



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I. Introduction

This document describes Aura's Near-Field Magnetic Wireless Data evaluation kit that consists of a pair of demonstration data module Printed Circuit Boards (PCBs). The demonstration system provides bi-directional data transmission capability to be used as part of a user's system for the wireless transmission of data. This evaluation kit provides customized operating firmware for the LibertyLink™ Application Specific Integrated Circuit (ASIC) along with the data modules. Each data module contains a small LibertyLink™ transceiver and RS-232 interface. The transceiver can be later removed from the interface for insertion into user's prototype system.

II. Overview

- This evaluation kit demonstrates the feasibility of using Aura's Near-Field Magnetic link technology to provide a low power non-RF replacement for a wireless RS232 application.

A summary description for the evaluation kit is contained in the following table

Demonstration System Description

Parameter	Value
Communication Technology	Magnetic Induction
Operating Frequency	13.56 MHz
Operating Range	BER = 10^{-4} at 0.8 meters
Operating Voltage	9V Battery or 6V DC Supply
Data Rate	9.6K Baud symmetrical (-101 configuration) 57.6K Baud symmetrical (-102 configuration)
Data Format	1 Start, 8 Data, 1 Stop, No Parity
Data Interface	RS-232 (+/- 9 V Support Module) RS-232 (0 to 2V LibertyLink™ Module)
Remote Size Goal	Min. consistent with above performance
Base Size Goal	Min. consistent with above performance
Power Consumption (not including RS-232)	15ma @ 1 m Typical

III. LibertyLink™ Data Module Description

A modular approach permits both computer-based demonstrations as well as portable form factor demonstrations. As shown in Figure 1, the left hand section is fully compatible with standard computer RS-232 interfaces. A small (2.0 X 3.4 X 0.4 cm) separable LibertyLink™ Transceiver Sub-module provides 2 volt RS-232 data I/O for small form-factor demonstrations. A third Antenna Sub-module provides a stable antenna-mounting surface.

The transceiver establishes bi-directional wireless transmission of data between two RS-232 devices. To operate the wireless link all that is required for each of the two boards of the data link is a 9V transistor radio battery and the connection to an RS-232 device. Under certain circumstances, it may be necessary to detach the antenna module. If so, please contact Aura and we will evaluate your needs and execute a defined plan to meet your requirements. Antenna leads must be twisted and lengths longer than 25mm are not recommended. It is also recommended that the antenna supplied be used at all times.

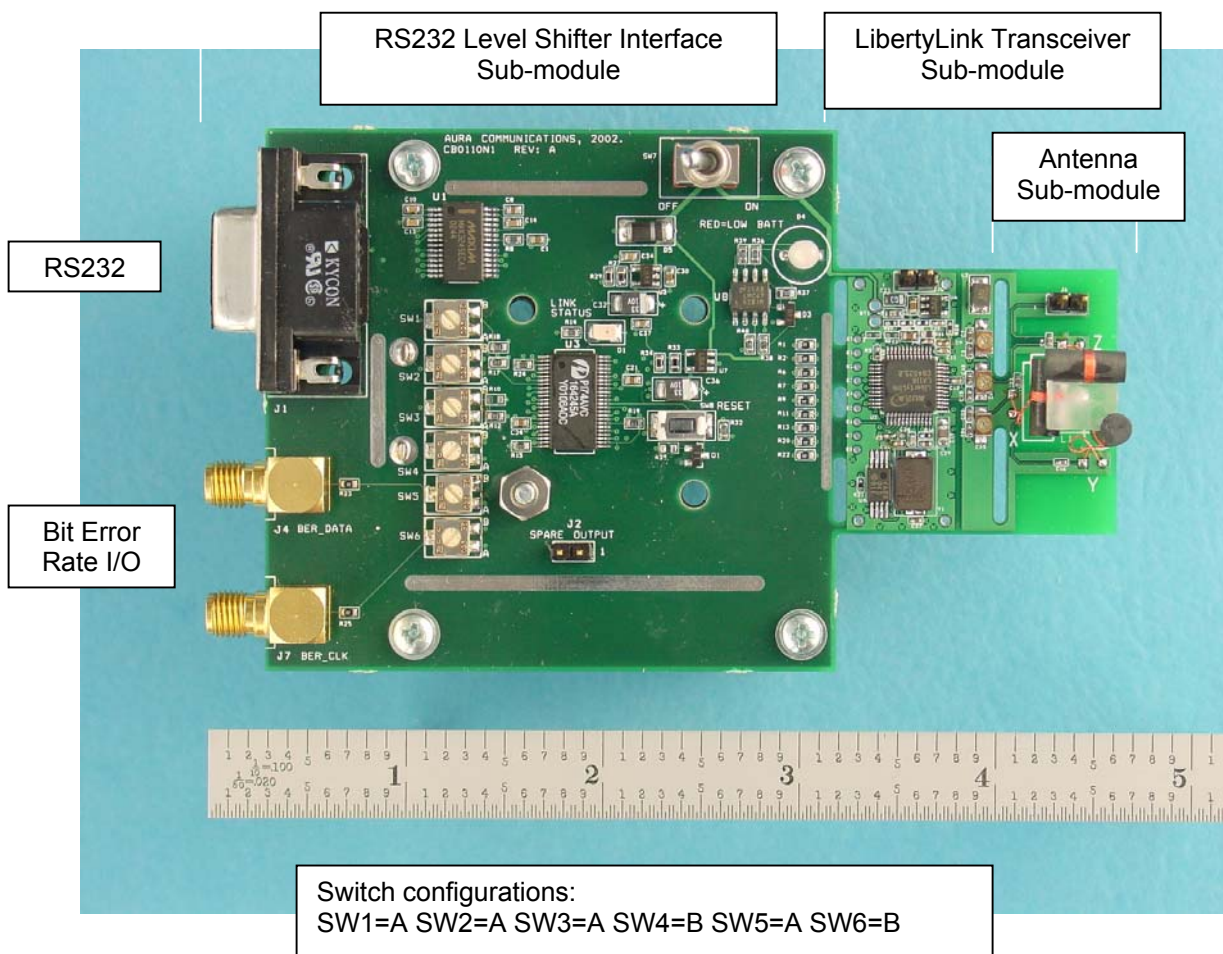


Figure 1. The Data Board provides RS-232 Interface I/O, Transceiver, and Antenna sub-modules

Data Board Design

The goal was to provide a transceiver printed circuit assembly (PCA) that had a small enough form factor to be useful for product demonstrations. In addition, it was necessary to enable standard RS-232 interface connectivity to various instruments. Aura's solution to these seemingly contradictory requirements is a modular transceiver board that can be demonstrated through the RS-232 connection and subsequently removed from the interface support circuitry for miniature form-factored demonstration products. This LibertyLink™ Module, can be further size-reduced when the actual configuration requirements are defined. Figure 1 shows a photograph of the PCA. Figure 2 clarifies the function of the major components visible in Figure 1 and subsequent sections provide additional information about each of the most significant portions of the PCA. The three sub-modules are supplied as a single six-layer printed circuit board with slots between them to allow for easy detachment. Please refer to schematic document in appendix I.

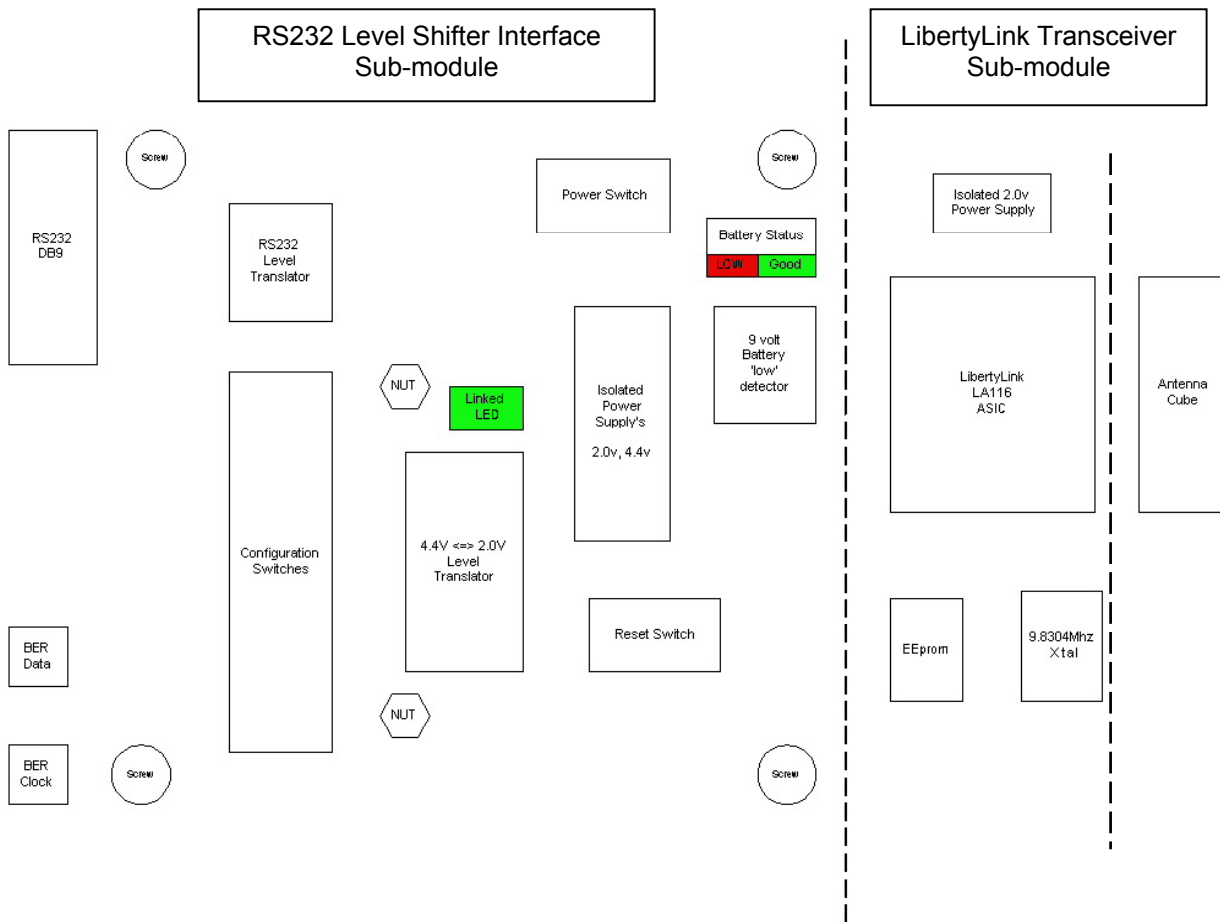


Figure 2. The entire board assures full RS-232 functionality. A separable module includes all the LibertyLink™ functionality for low power RS-232 format communication.

System Characteristics (Typical)

RS232 Level Shifter/Computer Interface Sub-module

Parameter	Value
Supply Voltage	4.5 to 9VDC, *Low Battery detect set at 5.0VDC for 9VDC supply.
Control Switches	On/Off, Mode Select (6), Reset.
Indicators	Low Battery, Link Status.
Interface/Control Lines	RS-232{DCE: TX(2)/RX(3);Port Speed up to 223Kbaud} BER_Data, BER_Clock.
Dimensions	74 X 70 X 24 mm.

LibertyLink™ Transceiver Sub-module

Parameter	Value
Supply Voltage	2.1 to 9.0 VDC
Supply Current	10 to 15 mA-DC
Interface/Control Lines	9 Lines, 0 to 2VDC
Antenna Interface	4 Lines, 0 to 2VDC
Dimensions	34 X 19 X 2.4 mm

Antenna Sub-module

Parameter	Value
Number of Antennae (Base)	3
Number of Antennae (Remote)	1
Coil Inductance	1.7 +/- 0.1 UH
Dimensions	34 X 14 X 10 mm
Antenna Block Dimensions	1 X 1 X 1 cm

RS232 Level Shifter/Computer Interface

Input/Output (I/O)

Standard connectors have been provided for laboratory equipment.

1. J1 – RS-232(DCE), DB9 female connector. Supported signals: RX, TX, RTS, CTS, DTR, DSR. For connection to an RS-232 device, use a male to female, 9-conductor cable with a 'straight through' wiring configuration with +/- 9-volt levels.
2. J4 - BER Data In/Out, SMB connector, Digital Input/Output of BER (Bit Error Rate) Test Data Pattern. Direction of data flow is dependant upon the switch matrix settings. **(Not Currently Used)**
3. J7 - BER Clock Out, SMB connector. Digital Output of BER (Bit Error Rate) Test Data Pattern, reference clock. Data Output is valid on the rising edge of this clock signal. Data Input is required to be valid 10nsec prior to the rising edge (setup time) of the reference clock. **(Not Currently Used)**

System Configuration

To provide flexibility for known and future variations, the system can be configured with combinations of switches and jumpers.

1. SW1 – SW6 – Configuration Switch Matrix. To enable future test capabilities without driving PCB design changes, a 1 X 6 switch Matrix has been provided.

Switch Configuration:

	SW1	SW2	SW3	SW4	SW5	SW6
Normal Mode	A	A	A	B	A	B
Test Mode	B	B	A	B	A	B

2. J5 – LibertyLink configuration Jumper. Short jumper pins 1 & 2 only to configure the system for 'Base' operation. Short jumper pins 2 & 3 only to configure the system for 'Remote' operation. **NEVER** short pins 1, 2, & 3 together!

Level Translation

To change the RS-232 signals from the 0 to 2 volts required for low power consumption on the Transceiver Module to levels compatible with computer interfaces, level translation is required.

1. U3 performs level translation between the LibertyLink hardware (2.0 volts) and the external digital signals (4.4 volts).
2. U1 is the RS-232 transceiver chip. It performs level translation between the 4.4V digital I/O and the RS-232 levels driven to/from the RS-232 device. An onboard voltage doubler/inverter generates +/- 8.8volts from a single 4.4-volt supply.

Power Supply (9 volt battery BT2)

A single 9-volt battery is used to supply the power requirements.

1. Voltage Regulator U6 generates a 2.0 volt supply that exclusively powers the LibertyLink ASIC, U2, and the EEPROM U4
2. Voltage Regulator U5 generates a 2.0-volt supply that powers the 'low voltage' side of level translator U3.
3. Voltage Regulator U7 generates a 4.4 volt supply that powers the 'high voltage' side of level translator U3, and the RS-232 transceiver U1

Test and Measurement

Future testing capability has been designed in for Bit Error Rate (BER) measurements that would provide a quantitative measure of the integrity of the link and the effectiveness of the transfer.

1. J4 - BER Data In/Out. Digital Input/Output of BER (Bit Error Rate) Test data pattern. Direction of data flow is dependant upon the switch matrix settings. **(Not Currently Used)**
2. J7 - BER Clock Out. Digital Output of BER (Bit Error Rate) Test Data Pattern, reference clock. Data Output is valid on the rising edge of this clock signal. Data Input is required to be valid 10nsec prior to the rising edge (setup time) of the reference clock. **(Not Currently Used)**
3. J8 – Current Monitor Jumper. Provides a means of measuring the current draw of the LibertyLink ASIC U2, and the companion EEPROM U4. For normal operation, insert jumper J8. To monitor current draw, remove Jumper J8 and measure the voltage drop across a 1-Ω resistor R26.

Visual Indicators

Visual status indicators provide important continuous “health checks” of the system and aid set-up and troubleshooting.

1. D1 – Green, Link Status LED. LED flashes at a rate of 500msec on/500msec off when an active link has been established. The optional BER firmware will flash the led when BER Data Out becomes active.
2. D4 – Bi-Color, Battery Status LED. LED glows green to indicate a ‘good’ battery. LED glows red to indicate a ‘low’ battery. 9-volt battery, BT2, MUST be replaced when the LED glows Red. The ‘low’ threshold trips when the battery falls below 5 volts. Comparators U8, and zener diode D3 form the level detection circuit.

LibertyLink™ Transceiver Sub-module

U2 is the LibertyLink ASIC, Y1 is the master clock crystal running @ 9.8304MHz. L1 is the antenna ‘cube’ which holds (1) coil for a ‘remote’ configuration and (3) coils for a ‘base’ configuration. LibertyLink firmware is uploaded, after reset, from the 8Kx8 EEPROM U4. Nine solder connections provide access to all the 2V RS-232 signals, +2.2V to +3.3V power and ground to permit this module to operate as part of an integrated, wearable demonstration product.

IV. Firmware Operation Description

Firmware is customer and application specific. Firmware operation guidelines will be provided with the evaluation kit.

V. Data Rate Selections

Two data rates are available, 9.6K and 57.6K baud. The data rate is configurable by changing resistor values as shown in the table:

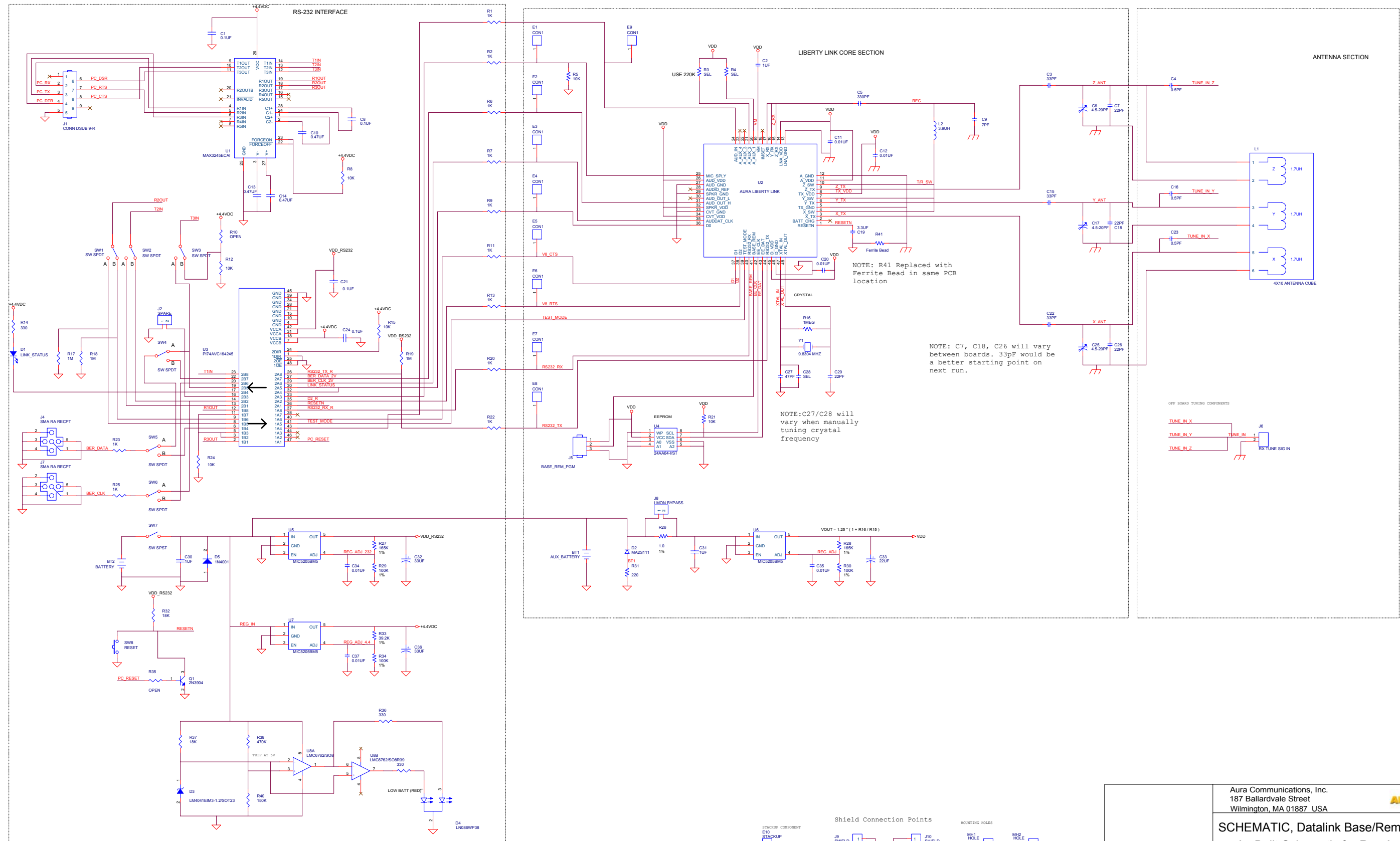
Resistor	9.6K Baud Rate (1304-101 configuration.)	57.6K Baud Rate (1304-102 configuration.)
R3	OPEN	OPEN
R4	OPEN	220K ohm

Refer to Appendix 3 for component placement

VI. Appendix

- 1) Schematic
- 2) Bill of Materials
- 3) PCB Component Placement

Appendix1: Schematic



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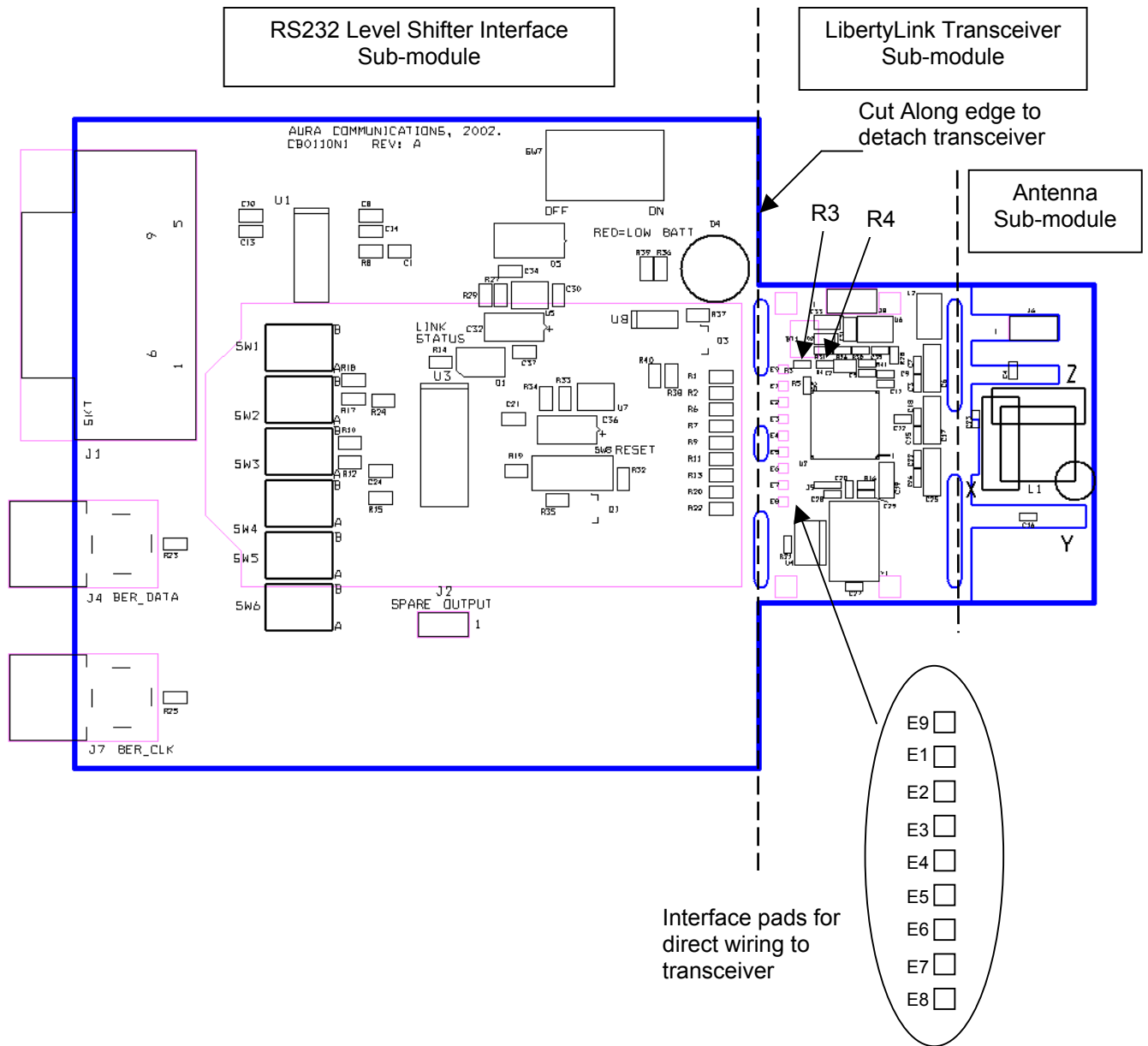
		Aura Communications, Inc. 187 Ballardvale Street Wilmington, MA 01887 USA		
		SCHEMATIC, Datalink Base/Remote As-Built Schematic for Rev A		
Drawn By: D.F. Terranova		Size	D	DWG NO 1273-CB (CB0110N1 old#)
ECO # Release	Rev A			
Date: Friday, May 16, 2003		Sheet 1 of 1		

Appendix 2: Bill of Materials

Item	Qty.	Reference	Part	P/N	MANUF
1	1	BT1	AUX_BATTERY		
2	1	BT2	BATTERY	1294	KEYSTONE
3	4	C1,C8,C21,C24	0.1UF	ECJ-1VB1C104K	PANASONIC
4	3	C2,C30,C31	1UF	ECJ-1VF1A105Z	PANASONIC
5	3	C3,C15,C22	33PF	ECJ-0EC1H330J	PANASONIC
6	3	C4,C16,C23	0.5PF	ECJ-0EC1H0R5C	PANASONIC
7	1	C5	330PF	ECJ-1VC1H331J	PANASONIC
8	3	C6,C17,C25	4.5-20PF	GKP20066	SPRAGUE
9	4	C7,C18,C26,C29	22PF	ECJ-0EC1H220J	PANASONIC
10	1	C9	7PF	ECJ-0EC1H070J	PANASONIC
11	3	C10,C13,C14	0.47UF	ECJ-1VF1C474Z	PANASONIC
12	4	C11,C12,C20,C35	0.01UF	ECJ-1VB1H103K	PANASONIC
13	1	C19	3.3UF	ECJ-2YB0J335K	PANASONIC
14	1	C27	47PF	ECJ-1VC1H470J	PANASONIC
15	1	C28	SEL		PANASONIC
16	2	C32,C36	33UF	ECS-T1AX336R	PANASONIC
17	1	C33	22UF	ECS-T0GZ226R	PANASONIC
18	2	C34,C37	0.01UF	ECJ-1VB1H103K	PANASONIC
19	1	D1	LINK_STATUS	LN1351C-(TR)	PANASONIC
20	1	D2	MA2S111	MA2S111	PANASONIC
21	1	D3	LM4041EIM3-1.2/SOT23	LM4041AIM3-1.2	NATIONAL
22	1	D4	LN086WP38	LN086WP38	PANASONIC
23	1	D5	1N4001	DL4001	DIODES
24	9	E1,E2,E3,E4,E5,E6, E7,E8,E9	CON1		
25	1	E10	STACKUP		
26	1	J1	CONN DSUB 9-R	KF22HT-E9S-N	KYCON
27	1	J2	SPARE	PTC36SANC	SULLINS
28	2	J4,J7	SMA RA RECPT	901-143-6-RFX	AMPHENOL
29	1	J5	BASE_REM_PGM		
30	1	J6	RX TUNE SIG IN		
31	1	J8	I MON BYPASS	PTC36SANC	SULLINS
32	4	J9,J10,J11,J12	SHIELD	SHIELD	
33	1	L1	4X10 ANTENNA CUBE		
34	1	L2	3.9UH	S1210-392K	DELEVAN
35	4	MH1,MH2,MH3,MH4	HOLE	HOLE	
36	1	Q1	2N3904	MMBT3904	MOTOROLA
37	11	R1,R2,R6,R7,R9,R11,R13, R20,R22, R23,R25	1K	ERJ-3GEYJ102V	PANASONIC
38	2	R3,R4	SEL	ERJ-3GSYJ103	PANASONIC
39	2	R5,R21	10K	ERJ-2GEJ103X	PANASONIC
40	3	R8,R15,R24,R12	10K	ERJ-3GEYJ103V	PANASONIC
41	1	R10, R35	OPEN		
42	3	R14,R36,R39	330	ERJ-3GEYJ331V	PANASONIC

Item	Qty.	Reference	Part	P/N	MANUF
43	1	R16	1MEG	ERJ-2GEJ105X	PANASONIC
44	3	R17,R18,R19	1M	ERJ-3GEY105V	PANASONIC
45	1	R26	1	ERJ-2GEJ1R0X	PANASONIC
46	1	R27	165K	ERJ-3EKF1653V	PANASONIC
47	1	R28	165K	ERJ-2RKF1653X	PANASONIC
48	2	R29,R34	100K	ERJ-3EKF1003V	PANASONIC
49	1	R30	100K	ERJ-2RKF1003X	PANASONIC
50	1	R31	220	ERJ-2GEJ221X	PANASONIC
51	2	R37,R32	18K	ERJ-3GEYJ183V	PANASONIC
52	1	R33	39.2K	ERJ-3EKF3922V	PANASONIC
53	1	R38	470K	ERJ-3GEYJ474V	PANASONIC
54	1	R40	150K	ERJ-3GEYJ154V	PANASONIC
55	1	R41	Ferrite Bead	BLM18HG471SN1D	MURATA
56	6	SW1,SW2,SW3, SW4,SW5,SW6	SW SPDT	7814G	BOURNS
57	1	SW7	SW SPST	T101SHCQE	C&K
58	1	SW8	RESET	EVQ-PJS05K	PANASONIC
59	1	U1	MAX3245ECAI	MAX3245ECAI	MAXIM
60	1	U2	AURA LIBERTY LINK	LIBERTYLINK	AURA
61	1	U3	PI74AVC164245	PI74AVC164245	PERICOM
62	1	U4	24AA64-I/ST	24AA64-I/ST	MICROCHIP
63	3	U5,U6,U7	MIC5205BM5	MIC5205BM5	MICREL
64	1	U8	LMC6762/SO8	LMC6762	NATIONAL
65	1	Y1	9.8304 MHZ	ECS-98.3-20-18-TR	ECS

Appendix 3: PCB Component Placement



PCB Notes:

- 1) Transceiver interface pads intended for direct wire only. Not a connector mount.
- 2) No mounting holes for transceiver board support. Recommend edge support.
- 3) No metal surface should be placed beneath transceiver or antenna sub-modules.
- 4) Consult Aura Communications before detaching antenna sub-module.



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