



EVB-LAN8870-RGMII

Evaluation Board

User's Guide

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NOTES:

Preface

NOTICE TO CUSTOMERS

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Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXA”, where “XXXX” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the EVB-LAN8870-RGMII Evaluation Board User's Guide. Items discussed in this chapter include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [Warranty Registration](#)
- [The Microchip Web Site](#)
- [Development Systems Customer Change Notification Service](#)
- [Customer Support](#)
- [Document Revision History](#)

DOCUMENT LAYOUT

This document describes how to use the EVB-LAN8870-RGMII Evaluation Board as a development tool for the LAN8870, 1000BASE-T1 Ethernet Transceiver. The manual layout is as follows:

- **Chapter 1. “Overview”** – This chapter shows a brief description of the EVB-LAN8870-RGMII.
- **Chapter 2. “Getting Started”** – This chapter provides information about setup and operation of the EVB-LAN8870-RGMII.
- **Chapter 3. “Hardware Configuration”** - This chapter discusses the hardware Configuration information of the EVB-LAN8870-RMII Evaluation Board
- **Appendix A. “Schematics”** – This appendix shows the EVB-LAN8870-RGMII schematics.
- **Appendix B. “Bill of Materials”** – This appendix includes the EVB-LAN8870-RGMII Bill of Materials.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	<u><i>File>Save</i></u>
Bold characters	A dialog button	Click OK
	A tab	Click the Power tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-Opa+, -Opa-
	Bit values	0, 1
	Constants	0xFF, 'A'
Italic Courier New	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	mcc18 [options] <i>file</i> [options]
Curly brackets and pipe character: { }	Choice of mutually exclusive arguments; an OR selection	errorlevel {0 1}
Ellipses...	Replaces repeated text	var_name [, var_name...]
	Represents code supplied by user	void main (void) { ... }

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The Development Systems product group categories are:

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- **Emulators** – The latest information on Microchip in-circuit emulators. This includes the MPLAB REAL ICE and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit 3 debug express.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART Plus and PIC-kit 2 and 3.

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- Distributor or Representative
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- Field Application Engineer (FAE)
- Technical Support

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Technical support is available through the web site at:

<http://www.microchip.com/support>

DOCUMENT REVISION HISTORY

Revisions	Section/Figure/Entry	Correction
DS50003747A (09-04-24)	Initial release	

Chapter 1. Overview

1.1 INTRODUCTION

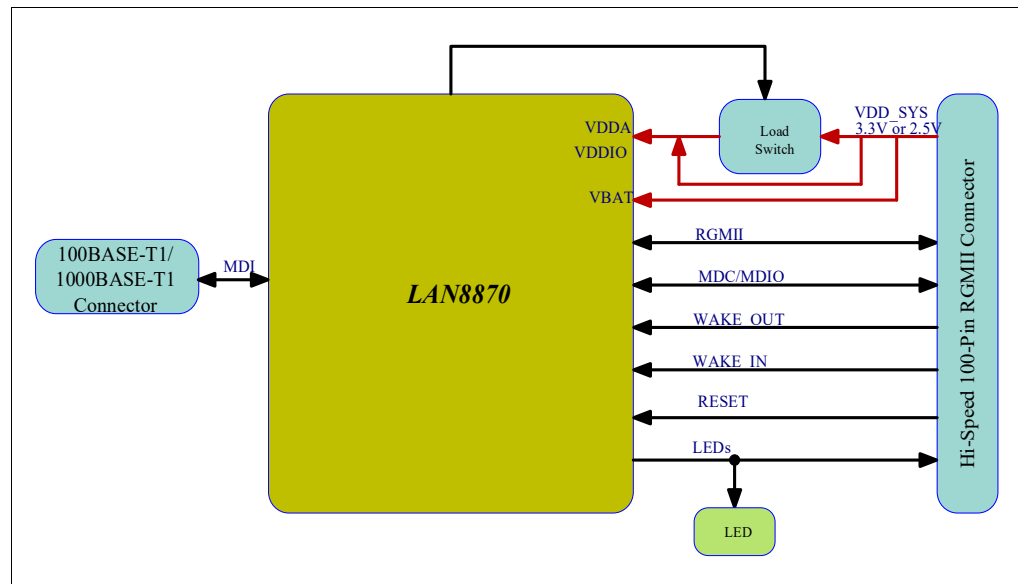
The EVB-LAN8870-RGMII Evaluation Board is a plug-in card that interfaces directly with a mating Microchip host processor controller board, such as the SAMA5D3 Ethernet Development System (EDS) board. It features the LAN8870, a highly integrated networking device that incorporates a 100BASE-T1/1000BASE-T1 physical layer transceiver (PHY). The board's PHY port is connected to an automotive Single-Pair Ethernet (SPE) connector, and the PHY's RGMII connections are brought out to a high-speed multi-pin (HS) connector.

Together, the EVB-LAN8870-RGMII Evaluation Board and either the EVB-LAN7801-EDS or the EVB-LAN7431-EDS provide a highly-flexible platform for evaluation of basic PHY features via static Control-Status Registers (CSR).

The scope of this document is meant to describe the EVB-LAN8870-RGMII Evaluation Board setup and its user interface features. A simplified block diagram of the board is shown in [Figure 1-1](#).

1.2 BLOCK DIAGRAM

FIGURE 1-1: BLOCK DIAGRAM



1.3 REFERENCES

Concepts and materials available in the following documents may be helpful when reading this document. Visit www.microchip.com for the latest documentation.

- *LAN8870 Data Sheet*
- LAN8870 Schematics
- *EVB-LAN7431-EDS Board User's Guide*
- *EVB-LAN7801-EDS Board User's Guide*
- *MIC94060 Data Sheet*
- *MIC1726 Data Sheet*
- *VXM7-9013 Data Sheet*

Chapter 2. Getting Started

2.1 INTRODUCTION

The EVB-LAN8870-RGMII Evaluation Board is designed as a plug-in card to interface directly with a mating Microchip host processor or controller board, such as the EVB-LAN7431-EDS Board, that supplies full power and provides full register access and configuration via MDIO/MDC bus management.

2.2 DEFAULT JUMPER SETTINGS

The EVB-LAN8870-RGMII ships with the necessary jumpers installed for basic operation. These are:

- J4: shunt installed between pins [1-2]
- J5: shunt installed between pins [1-2]
- J13: shunt installed between pins [2-3]
- J15: shunt installed between pins [2-3]
- J17: shunt installed between pins [2-3]
- J18: shunt installed between pins [2-3]
- J20: shunt installed between pins [2-3]
- J21: shunt installed between pins [1-2]
- J22: shunt installed between pins [1-2]

See [Figure 3-1](#) for an image of these default shunt installations.

See [Section 3.4 “Connectors”](#) for a full list of connector/header descriptions and directions for use.

2.3 POWER SOURCE

The EVB-LAN8870-RGMII can be completely bus-powered from its mating Microchip host processor or control board. Alternatively, the EVB-LAN8870-RGMII can be powered with an external 3.3V supply.

Refer to [Figure 3-1](#) and the board schematics in [Figure A-1](#) for details.

2.3.1 EDS-Powered Operation

For EDS-powered operation:

- J18 needs a jumper on either pins [1-2] for 2.5V operation or pins [2-3] for 3.3V operation.
- Either one of the following two options but not both options:
 - J13 [2-3] and J20 [2-3] for normal operation
 - J13 [1-2] and J20 [1-2] for TC10 application where INH controls non-VBAT Power Supplies

2.3.2 External-Powered Operation

For external-powered operation:

- VDDA: Apply 2.5V or 3.3V to J20, pin 2 (center pin)
- VDDIO: Apply 1.8V, 2.5V or 3.3V to J13, pin 2 (center pin)

2.4 CLOCK

The EVB-LAN8870-RGMII utilizes a 25 MHz crystal to generate input reference clock for the LAN8870 device. Refer to [Figure A-1](#) for details.

2.5 RESET CIRCUIT

2.5.1 Power-On Reset—EDS Reset

The EVB-LAN7801-EDS or EVB-LAN7431-EDS can provide the LAN8870 Reset when a jumper is placed on EVB-LAN8870-RGMII, J15 pins [2-3] (EDS Reset).

2.5.2 Manual Reset

The EVB-LAN8870-RGMII SW1 can be pressed and released to provide LAN8870 Reset after device power-up. The EVB-LAN8870-RGMII J18 must have a jumper between pins [1-2] (Onboard) to utilize this manual Reset.

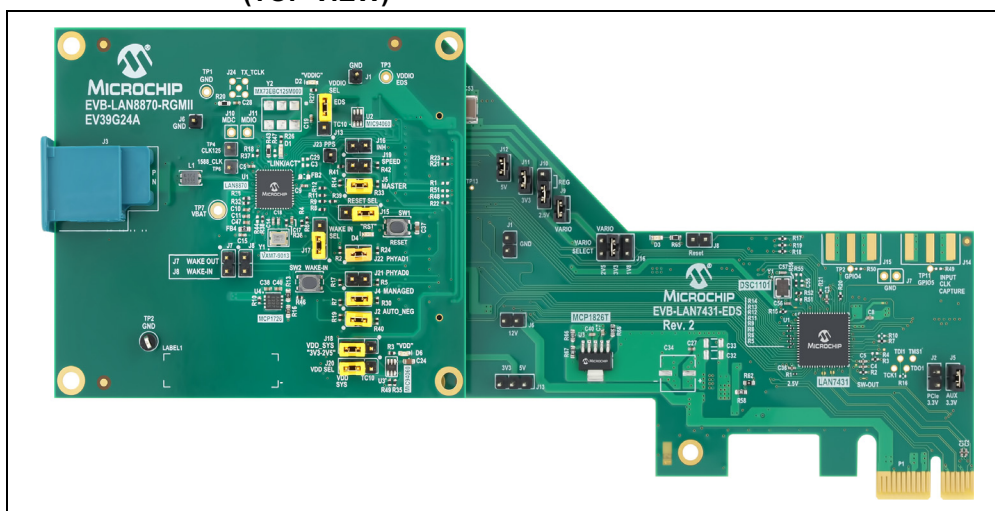
2.6 USING THE EVB-LAN8870-RGMII

2.6.1 With EVB-LAN7431-EDS

For EVB-LAN7431-EDS to work with the EVB-LAN8870-RGMII, a specific LAN7431 EEPROM image should be programmed onto the EVB-LAN7431-EDS baseboard. This EEPROM is on the LAN7431 product page, and this EEPROM is also preprogrammed on the EVB-LAN7431-EDS board. This is necessary to ensure that RGMII TXC and RXC delay settings are appropriately configured, and the LAN7431's 125 MHz clock source is enabled.

All LAN8870 registers are accessible via MDIO/MDC bus management from the EVB-LAN7431-EDS (through both Windows® and Linux®), enabling full evaluation.

FIGURE 2-1: EVB-LAN8870-RGMII AND EVB-LAN7431-EDS BOARDS (TOP VIEW)



2.6.2 With EVB-LAN7801-EDS

For EVB-LAN7801-EDS to work with the EVB-LAN8870-RGMII, a specific LAN7801 EEPROM image should be programmed onto the EVB-LAN7801-EDS baseboard. This EEPROM is on the LAN7801 product page and preprogrammed on the EVB-LAN7801-EDS board. This is necessary to ensure that RGMII TXC and RXC

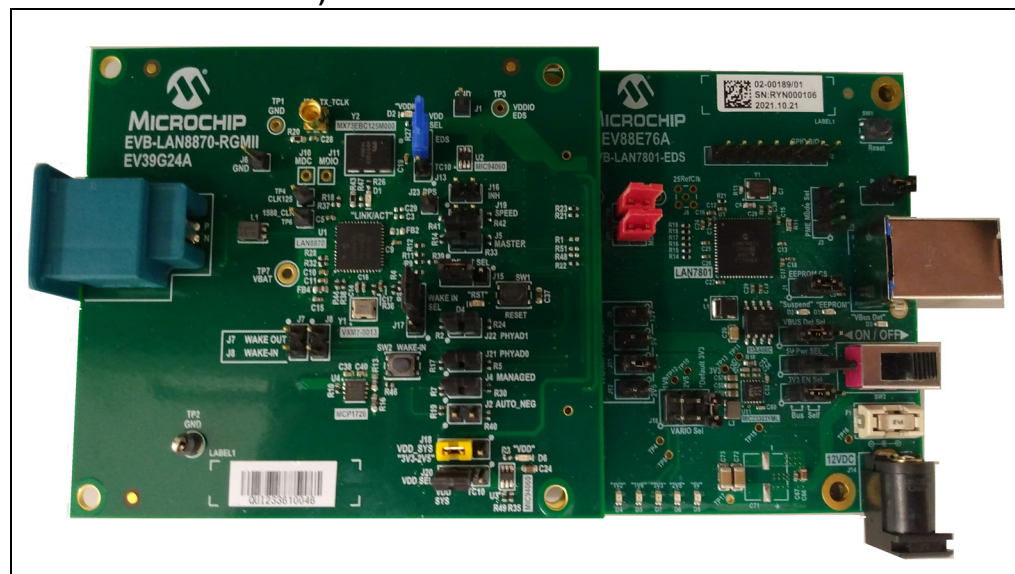
delay settings are appropriately configured and that the LAN7801's 125 MHz clock source is enabled.

All LAN8870 registers are accessible via MDIO/MDC bus management, enabling full LAN8870 evaluation through either of these methods:

- EVB-LAN7801-EDS with Windows or Linux
 - Populate EVB-LAN7801-EDS J15 (MDC).
 - Populate EVB-LAN7801-EDS J16 (MDIO).
- EVB-LAN8870-RGMII
 - Do not populate EVB-LAN7801-EDS J15 (MDC).
 - Do not populate EVB-LAN7801-EDS J16 (MDIO).

EVB-LAN8870-RGMII headers J10 (MDC) and J11 (MDIO) are provided for local LAN8870 evaluation with a Serial Management Interface (SMI) tool.

FIGURE 2-2: EVB-LAN8870-RGMII AND EVB-LAN7801-EDS BOARD (TOP VIEW)



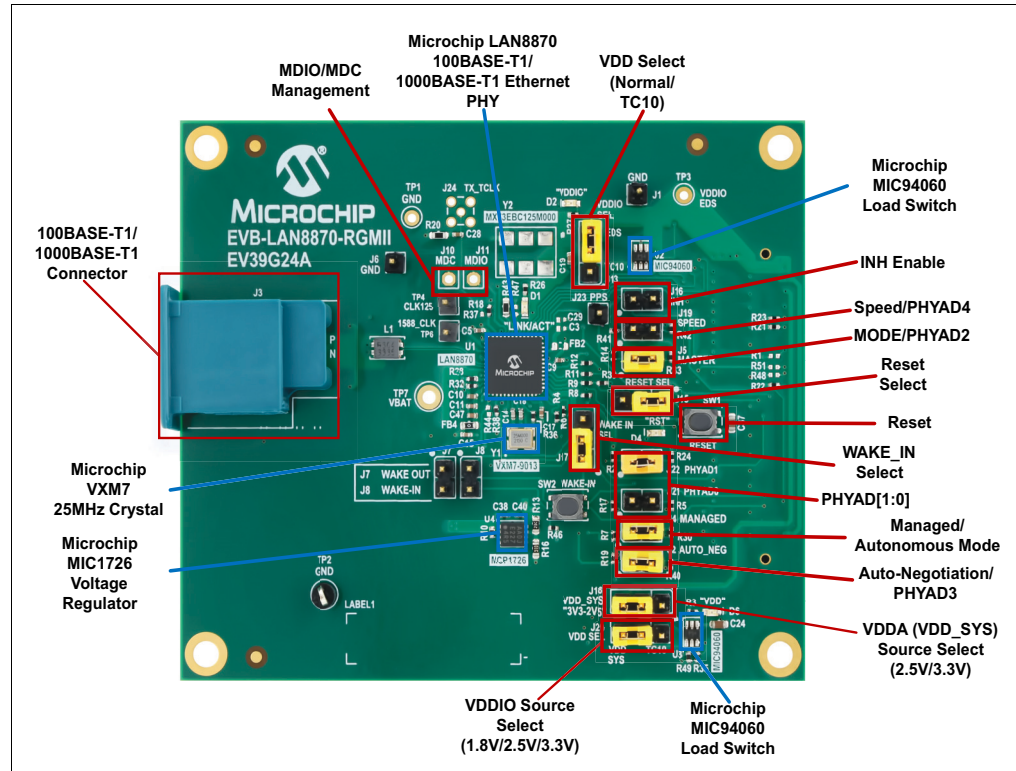
NOTES:

Chapter 3. Hardware Configuration

3.1 HARDWARE CONFIGURATION OPTIONS

Figure 3-1 shows the top view of the EVB-LAN8870-RGMII.

FIGURE 3-1: EVB-LAN8870-RGMII TOP VIEW WITH CALLOUTS



3.2 PHY PORT

PHY port (J13) supports 100BASE-T1/1000BASE-T1 operation.

3.3 TEST POINTS

Table 3-1 lists the test points on the EVB-LAN8870-RGMII:

TABLE 3-1: TEST POINTS

Test Point	Description
J1	GND
J6	GND
TP1	GND
TP2	GND
TP3	VDDIO EDS
TP4	CLK125

TABLE 3-1: TEST POINTS (CONTINUED)

Test Point	Description
TP6	1588_CLK
TP7	VBAT
J23	PPS

3.4 CONNECTORS

Table 3-2 lists the connectors on the EVB-LAN8870-RGMII:

TABLE 3-2: CONNECTORS

Connector Reference Designator	Function	Options
J2	Auto-Negotiation Enable (J4 Open - Autonomous mode)	Closed: LAN8870 Auto-Negotiation Disabled Open: LAN8870 Auto-Negotiation Enabled
	PHYAD3 (J4 Closed - Managed mode)	Closed: PHYAD3 = 0 Open: PHYAD3 = 1
J3	100BASE-T1/1000BASE-T1 Connector	N/A
J4	MANAGED Mode Selection	Closed: LAN8870 is in Managed mode. Open: LAN8870 is in Autonomous mode.
J5	MASTER Mode Selection (J4 Open - Autonomous mode)	Closed: LAN8870 configured as leader. Open: LAN8870 configured as follower.
	PHYAD2 (J4 Closed - Managed mode)	Closed: PHYAD2 = 1 Open: PHYAD2 = 0
J7	WAKE OUT Jumper	Closed: Allows LAN8870 WAKE_OUT access to MAC through J14 RGMII connector Open: LAN8870 WAKE_OUT isolated from MAC
J8	WAKEIN Jumper	Closed: Allows LAN8870 WAKE_IN access to MAC through J14 RGMII Connector Open: LAN8870 WAKE_IN isolated from MAC
J10	MDC Header	N/A
J11	MDIO Header	N/A
J13	VDDIO SEL Select	Shunt pins [1-2]: VDDIO can be turned off in LAN8870 TC10 Sleep State. Shunt pins [2-3]: VDDIO is always enabled. (See Note 1.)
J14	RGMII Connector	N/A

Note 1: A shunt must be placed on either [1-2] or [2-3] for LAN8870 power.

TABLE 3-2: CONNECTORS (CONTINUED)

Connector Reference Designator	Function	Options
J15	RESET Select	Shunt pins [1-2]: Reset comes from local Reset button (SW1). Shunt pins [2-3]: Reset comes from MAC (EDS) device.
J16	INH	Closed: Allows LAN8870 INH access to MAC through J14 RGMII Connector Open: LAN8870 INH isolated from MAC
J17	100BASE-T1 Ethernet Connector	N/A
J18	VDD_SYS Select	Shunt pins [1-2]: Selects 2.5V for VDD Shunt pins [2-3]: Selects 3.3V for VDD (See Note 1 .)
J19	SPEED Selection (J4 Open - Autonomous Mode)	Closed: LAN8870 is in 100BASE-T1 speed. Open: LAN8870 is in 1000BASE-T1 speed.
	PHYAD4 (J4 Closed - Managed Mode)	Closed: PHYAD4 = 0 Open: PHYAD4 = 1
J20	VDD SEL Select	Shunt pins [1-2]: VDD can be turned off in LAN8870 TC10 Sleep State. Shunt pins [2-3]: VDD is always enabled. (See Note 1 .)
J21	PHYAD0	Closed: PHYAD0 = 0 Open: PHYAD0 = 1
J22	PHYAD1	Closed: PHYAD1 = 0 Open: PHYAD1 = 1

Note 1: A shunt must be placed on either [1-2] or [2-3] for LAN8870 power.

NOTES:

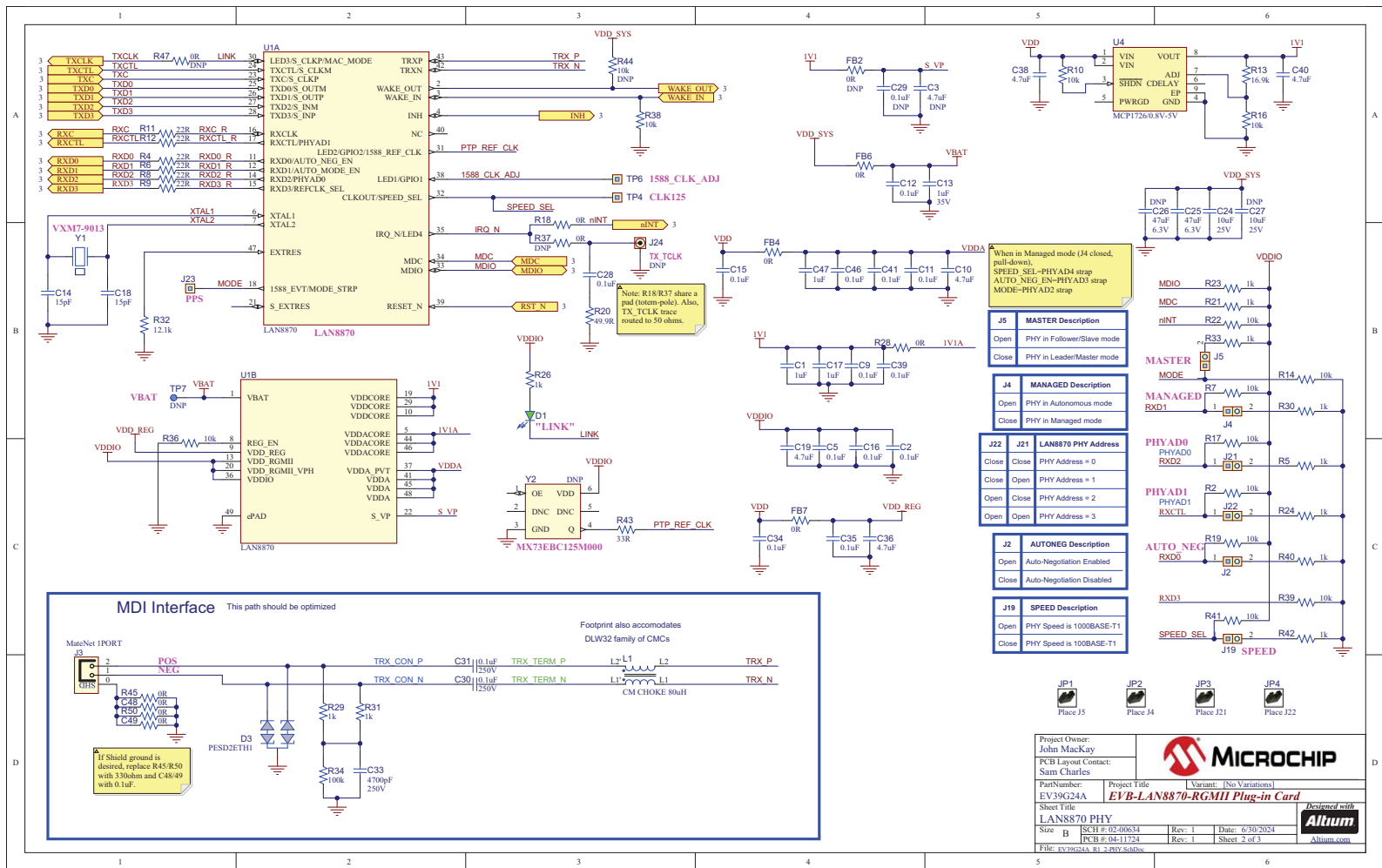


Appendix A. Schematics

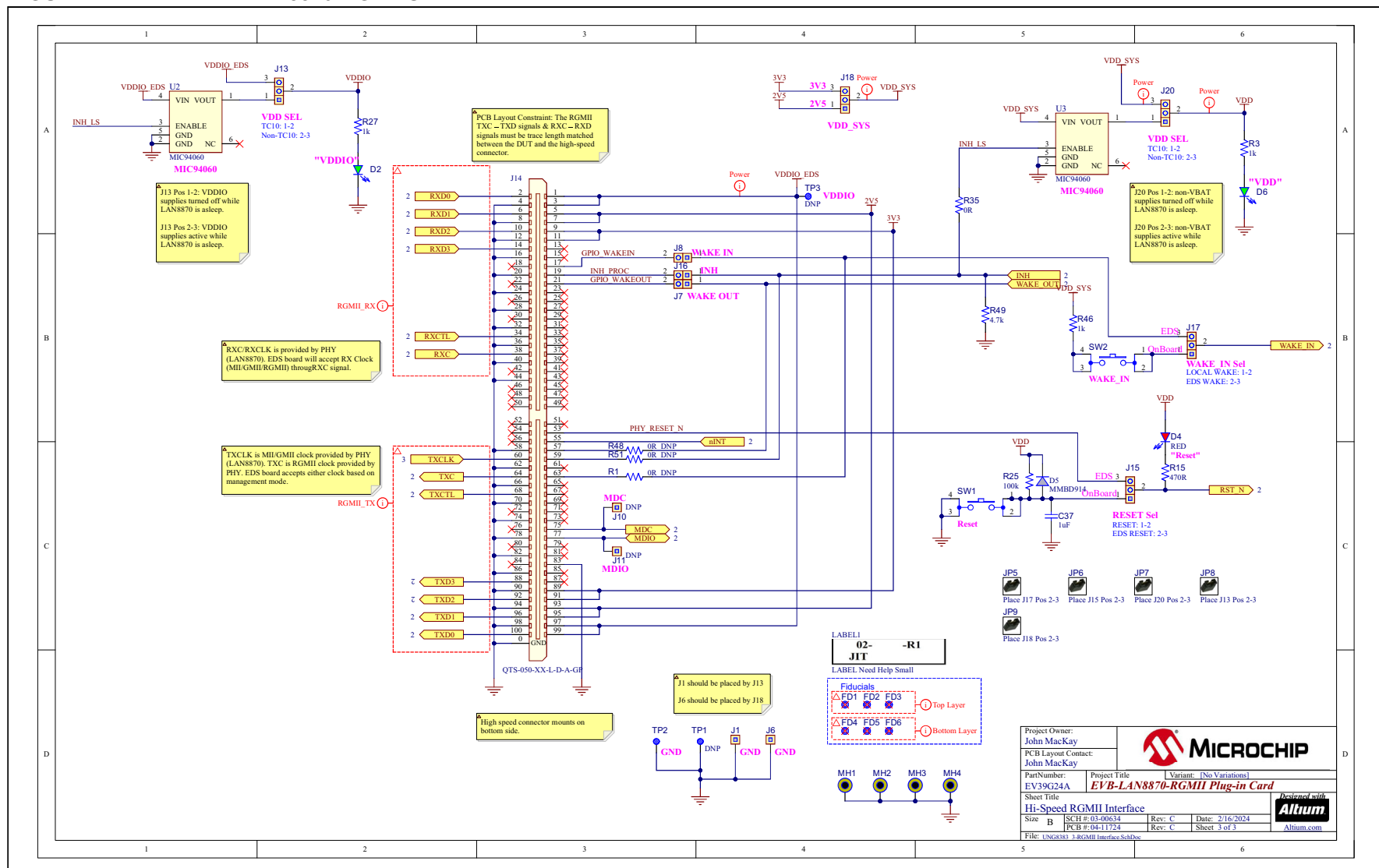
A.1 INTRODUCTION

This appendix shows the EVB-LAN8870-RGMII schematics.

FIGURE A-1: EVB-LAN8870-RGMII SCHEMATIC 1



Schematics



NOTES:



Appendix B. Bill of Materials

B.1 INTRODUCTION

This appendix contains the EVB-LAN8770-RMII Evaluation Board evaluation board Bill of Materials (BOM).

TABLE B-1: EVB-LAN8870-RGMII BILL OF MATERIALS

Item	Quantity	Designator	Description	Populated	Manufacturer	Manufacturer Part Number
1	4	C1, C13, C17, C47	CAP CER 1uF 35V 10% X5R SMD 0402	YES	Murata Electronics North America	GRM155R6YA105KE11D
2	12	C2, C5, C9, C11, C12, C15, C16, C34, C35, C39, C41, C46	CAP CER 0.1uF 35V 10% X7R SMD 0402	YES	TDK Corporation	CGA2B3X7R1V104K050BB
3	5	C10, C19, C36, C38, C40	CAP CER 4.7uF 6.3V 20% X5R SMD 0402	YES	Murata	GRM155R60J475ME47D
4	2	C14, C18	CAP HiQ 15pF 50V 5% NP0 2.32GHz SMD 0402	YES	Johanson Technology Inc	500R07S150JV4T
5	2	C24	CAP CER 10uF 25V 20% X5R SMD 0603	YES	Murata Electronics North America	GRM188R61E106MA73D
6	1	C25	CAP CER 47uF 6.3V 20% X5R SMD 0805v	YES	Taiyo Yuden	JMK212BJ476MG-T
7	1	C28	CAP CER 0.1uF 16V 10% X7R SMD 0402	YES	Murata	GRM155R71C104KA88D
8	2	C30, C31	CAP CER 0.1uF 250V 10% X7T SMD 0805	YES	TDK Corporation	C2012X7T2E104K125AA
9	1	C33	CAP CER 4700pF 250V 10% X7R SMD 0805	YES	KEMET	C0805C472KARACAUTO
10	1	C37	CAP CER 1uF 16V 10% X5R SMD 0603	YES	AVX	0603YD105KAT2A
11	7	C48, C49, FB4, FB6, FB7, R45, R50	RES TKF 0R 1/10W SMD 0603 AEC-Q200	YES	Panasonic Electronic Company	ERJ-3GEY0R00V
12	3	D1, D2, D6	DIO LED GREEN 2V 30mA 35mcd Clear SMD 0603	YES	Lite-On Inc	LTST-C191KGKT
13	1	D3	DIO TVS ARRAY PESD2ETH100-TR 24V SMD SOT-23-3	YES	Nexperia	PESD2ETH100-TR
14	1	D4	DIO RED 2V 20mA 54mcd CLEAR SMD 0603	YES	Lite-On Inc	LTST-C191KRKT
15	1	D5	DIO RECT MMBD914LT1G 1V 10mA 100V SMD SOT-23-3	YES	ON Semiconductor	MMBD914LT1G
16	5	J1, J6, J23, TP4, TP6	CON HDR-2.54 Male 1x1 Gold 5.84MH TH VERT	YES	TE Connectivity	5-146280-1
17	9	J2, J4, J5, J7, J8, J16, J19, J21, J22	CON HDR-2.54 Male 1x2 Gold 5.84MH TH VERT	YES	FCI	68001-202HLF
18	1	J3	CON HDR-1.8 MALE 1X2 TIN SHROUD 7MH TH R/A	YES	TE Connectivity	9-2304372-9
19	5	J13, J15, J17, J18, J20	CON HDR-2.54 Male 1x3 Gold 5.84MH TH VERT	YES	FCI	68000-103HLF
20	1	J14	CON STRIP High Speed Stacker 5mm Male 2x50 SMD VERT	YES	Samtec	QTS-050-01-L-D-A-GP
21	1	L1	CM CHOKE 2.4R@100kHz 80uH SMD 3.2X2.5MM AEC-Q200	YES	ACT1210G-800-2P-TL10	DLW43MH201XK2L
22	11	R2, R7, R10, R14, R17, R19, R22, R36, R38, R39, R41	RES TKF 10k 1% 1/10W SMD 0402	YES	Panasonic	ERJ-2RKF1002X
23	12	R3, R5, R21, R23, R24, R26, R27, R30, R33, R40, R42, R46	RES TKF 1k 5% 1/16W SMD 0402	YES	Yageo	RC0402JR-071KL
24	6	R4, R6, R8, R9, R11, R12	RES TKF 22R 1% 1/16W SMD 0402	YES	Yageo	RC0402FR-0722RL
25	1	R13	RES TKF 16.9k 1% 1/10W SMD 0603 AEC-Q200	YES	Stackpole Electronics Inc	RMCF0603FT16K9
26	1	R15	RES TKF 470R 1% 1/16W MF 0402	YES	Yageo	RC0402FR-07470RL
27	1	R16	RES TF 10k 1% 1/16W SMD 0603	YES	TE Connectivity Passive Product	CPF0603F10KC1
28	4	R18, R28, R35	RES TKF 0R SMD 0402 AEC-Q200	YES	Panasonic	ERJ-2GE0R00X
29	1	R20	RES TKF 49.9R 1% 1/10W SMD 0603	YES	Panasonic	ERJ-3EKF49R9V
30	1	R25	RES TF 100k 1% 1/10W SMD 0603	YES	Yageo	RC0603FR-07100KL
31	2	R29, R31	RES TF 1k 1% 1/2W SMD 1206	YES	Stackpole Electronics Inc	RNCP1206FTD1K00

TABLE B-1: EVB-LAN8870-RGMII BILL OF MATERIALS (CONTINUED)

Item	Quantity	Designator	Description	Populated	Manufacturer	Manufacturer Part Number
32	1	R32	RES TKF 12.1k 1% 1/16W SMD 0402	YES	Vishay	CRCW040212K1FKEDC
33	1	R34	RES TKF 100k 1% 1/4W SMD 0603	YES	Vishay	CRCW0603100KFKEAHP
34	2	SW1, SW2	SWITCH TACT SPST-NO 16V 0.05A PTS810 SMD	YES	C&K Components	PTS810 SJM 250 SMTR LFS
35	1	TP2	CON TP LOOP Black 3.18x5.59 TH	YES	Keystone Electronics	5006
36	1	U1	MCHP INTERFACE ETHERNET LAN8870 VQFN-48 AEC-Q100	YES	Microchip Technology	LAN8870-V/PUAVAO
37	2	U2, U3	MCHP ANALOG HIGH-SIDE LOAD SWITCH 2A MIC94060 SC70-6	YES	Microchip Technology	MIC94060YC6-TR
38	1	U4	MCHP ANALOG LDO 0.8V-5V MCP1726T-ADJE/MF DFN-8	YES	Microchip Technology	MCP1726T-ADJE/MF
39	1	Y1	MCHP CRYSTAL 25Mhz 10pF SMD L3.2W2.5H0.8	YES	Microchip Technology	VXM7-9013-25M0000000
40	1	C3	CAP CER 4.7uF 6.3V 20% X5R SMD 0402	DNP	Murata	GRM155R60J475ME47D
41	1	C26	CAP CER 47uF 6.3V 20% X5R SMD 0805	DNP	Taiyo Yuden	JMK212BJ476MG-T
42	1	C27	CAP CER 10uF 25V 20% X5R SMD 0603	DNP	Murata Electronics North America	GRM188R61E106MA73D
43	1	C29	CAP CER 0.1uF 35V 10% X7R SMD 0402	DNP	TDK Corporation	CGA2B3X7R1V104K050BB
44	1	FB2	RES TKF 0R 1/10W SMD 0603 AEC-Q200	DNP	Panasonic Electronic Components	ERJ-3GEY0R00V
45	2	J10, J11	CON HDR-2.54 Male 1x1 Gold 5.84MH TH VERT	DNP	TE Connectivity	5-146280-1
46	1	J24	CON RF Coaxial MMCX Female 2P TH VERT	DNP	Cinch Connectivity Solutions Johnson	135-3701-211
47	1	R1, R47, R48, R51	RES TKF 0R SMD 0402 AEC-Q200	DNP	Panasonic	ERJ-2GE0R00X
48	1	R37	RES TKF 0R <0.01R 1/5W SMD 0402	DNP	Vishay	CRCW04020000Z0EDHP
49	1	R44	RES TKF 10k 1% 1/10W SMD 0402	DNP	Panasonic	ERJ-2RKF1002X
50	2	TP1, TP3	MISC, TEST POINT MULTI PURPOSE MINI BLACK	DNP	Keystone	5001
51	1	TP7	CON TP LOOP Black 3.18x5.59 TH	DNP	Keystone Electronics	5006
52'	1	Y2	MCHP CLOCK OSCILLATOR SINGLE 125Mhz MX573EBC125M000 LGA-6	DNP	Microchip Technology	MX573EBC125M000-TR

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