LAN8870/LAN8871/LAN8872

100/1000BASE-T1 Ethernet PHY Transceiver

Highlights

- Single-chip Ethernet physical layer transceiver
- Compliant with IEEE 802.3bp-2016 (1000BASE-T1)
- Compliant with IEEE 802.3bw-2015 (100BASE-T1) (LAN8870 only)
- Media-Independent Interface support
  - LAN8870: RGMII/SGMII MAC interfaces
  - LAN8871: RGMII MAC interface
  - LAN8872: SGMII MAC interface
- Supports RGMII and SGMII MAC interfaces
- 100Mbps/1000Mbps auto-negotiation and force speed mode
- IEEE 1588-2019 and 802.1AS-2020 support
- OPEN Alliance TC10 support / wake-up support
- Ultra low power sleep
- FlexPWR® technology power management
- Advanced Signal Quality Indicator (SQI)
- Over-temperature and under-voltage protection
- Comprehensive status interrupt support
- 1000BASE-T1 Type B support for extended cable reach (LAN8870B only)
- Small footprint 48-pin VQFN (7 x 7 mm) with wettable flanks
- AEC-Q100 automotive product qualification
- Grade 2 Automotive temperature range (-40°C to +105°C)
- Industrial temperature range (-40°C to +85°C)
- Microchip Functional Safety Ready

Target Applications

- Advanced Driver-Assistance Systems (ADAS)
- Infotainment
- Telematics & Smart Antennas
- In-Vehicle Backbone
- Gateways
- Industrial Control
- IIoT

Key Benefits

- High-performance 100BASE-T1/1000BASE-T1 Ethernet PHY (100BASE-T1 LAN8870 only)
  - 100Mbps and 1000Mbps over single balanced twisted pair cable
  - OPEN Alliance TC10 sleep/wake-up support
  - Supports cable lengths up to at least 15m
  - PTP support
  - Fully AVB/TSN compatible
  - Jumbo frame support up to 16KB
  - On-chip termination resistors for balanced UTP cable
  - 25MHz SMI interface for rapid register access
- RGMII (LAN8870/LAN8871) & SGMII (LAN8870/LAN8872) Interfaces
- 25MHz, 50MHz, 125MHz reference clock output
- Low RF Emissions
  - Integrated transmission filtering
  - 125MHz RGMII clock slew rate adjust (LAN8870/LAN8871)
- EtherGREEN™ Energy Efficiency
  - Ultra low-power sleep mode (15µA typical) with local wake-up support (OPEN Alliance TC10)
  - Sleep request recognition
  - IDLE detection on MDI
  - **WAKE_IN** pulse detection wakeup
  - **INH** output for enable/disable of ECU supply
  - Gap free voltage and temperature monitoring
- Resets
  - Pin reset (**RESET_N**)
  - Power-On Reset (POR) with brownout protection
  - Software reset
- Packaging
  - 48-pin (7 x 7 mm) wettable VQFN
- Environmental
  - Grade 2 Automotive temperature range (-40°C to +105°C)
  - Industrial temperature range (-40°C to +85°C)
- Functional Safety
  - For ASIL B and Beyond Applications
  - FMEDA Computation Spreadsheet (Evaluation of Random Hardware Failures Metric)
  - Functional Safety Manual

LAN8870/LAN8871/LAN8872

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An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

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Table of Contents

1.0   INTRODUCTION

1.1   General Description

The Microchip LAN8870/LAN8871/LAN8872 (LAN887x) family of devices provide a compact, cost-effective, single-port 100BASE-T1/1000BASE-T1 Ethernet physical layer transceiver solution compliant with the IEEE 802.3bw-2015 and IEEE 802.3bp-2016 specifications.

The LAN887x provides transmit and receive capability with cable reaches beyond the IEEE 802.3bp standard:

a)   A link segment supporting up to four in-line connectors using a single twisted-pair copper cable for up to at least 15 meters (referred to as link segment type A)

b)   A link segment supporting up to four in-line connectors using a single twisted-pair copper cable for up to at least 40 meters (referred to as link segment type B)

The LAN887x is available in both Industrial grade (-40°C to +85°C) and AEC-Q100 Automotive Grade 2 (-40°C to +105°C) temperature ranges and is optimized for applications such as Industrial Automation, IIoT, Automated Driver-Assistance Systems (ADAS), infotainment, telematics, and in-vehicle backbones.

The LAN887x supports communication with an Ethernet MAC via standard RGMII/SGMII interfaces (see Table 1-1 for device specific interface breakdown). An optional 25MHz, 50MHz, or 125MHz reference clock output is provided. An integrated SMI interface provides rapid register access and configuration.

The LAN887x is Time Sensitive Networking (TSN) ready, supporting IEEE802.1AS-2020 and IEEE1588-2019 Precision Clock Synchronization Protocol for real time Ethernet networking.

Microchip's LAN887x EtherGREEN™ energy efficient technology provides low-power 1000BASE-T1/100BASE-T1 PHY operation along with OPEN Alliance TC10 ultra low-power remote sleep and wake-up support. FlexPWR® variable I/O and core power supply voltages provide flexible design options and further power saving opportunities.

Advanced PHY diagnostics provide the user with troubleshooting capabilities such as cable defect detection of shorts or opens, a receiver Signal Quality Indicator (SQI), over-temperature, under-voltage protection, comprehensive status interrupt support, and various loopback and test modes.

The Microchip LAN887x family includes the following devices:

• LAN8870
• LAN8870B
• LAN8871
• LAN8872

Device specific features that do not pertain to the entire LAN887x family are called out independently throughout this document. Table 1-1 provides a summary of the feature differences between family members:

TABLE 1-1:   LAN887X FAMILY FEATURE MATRIX

Part Number	Package	1000BASE-T1	100BASE-T1	Auto-Negotiation	RGMII Support	SGMII Support	125MHz Reference Clock Output	Precision Time Protocol (PTP)	Internal Core Voltage Regulator Disable Option	INH Pin Support	WAKE_IN Pin Support	AEC-Q100 -40° To 105°C	Industrial Grade -40° To +85°C	I1000BASE-T1 Type B Extended Reach
LAN8870	48-VQFN	X	X	X	X	X	X	X	X	X	X	X	X	
LAN8870B	48-VQFN	X	X	X	X	X	X	X	X	X	X	X	X	X
LAN8871	48-VQFN	X		X	X		X	X	X	X	X	X	X	
LAN8872	48-VQFN	X		X		X	X	X	X	X	X	X	X	

LAN8870/LAN8871/LAN8872

A system-level block diagram is shown in Figure 1-1. An internal block diagram of the LAN887x is shown in Figure 1-2.

FIGURE 1-1: LAN887X FAMILY SYSTEM-LEVEL BLOCK DIAGRAM

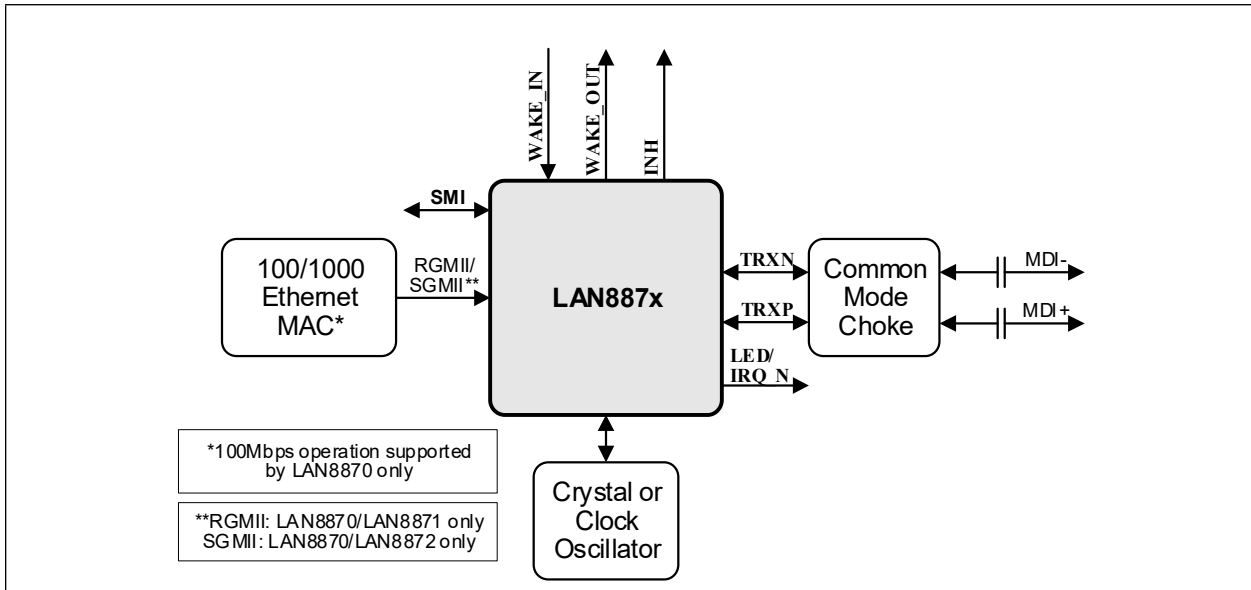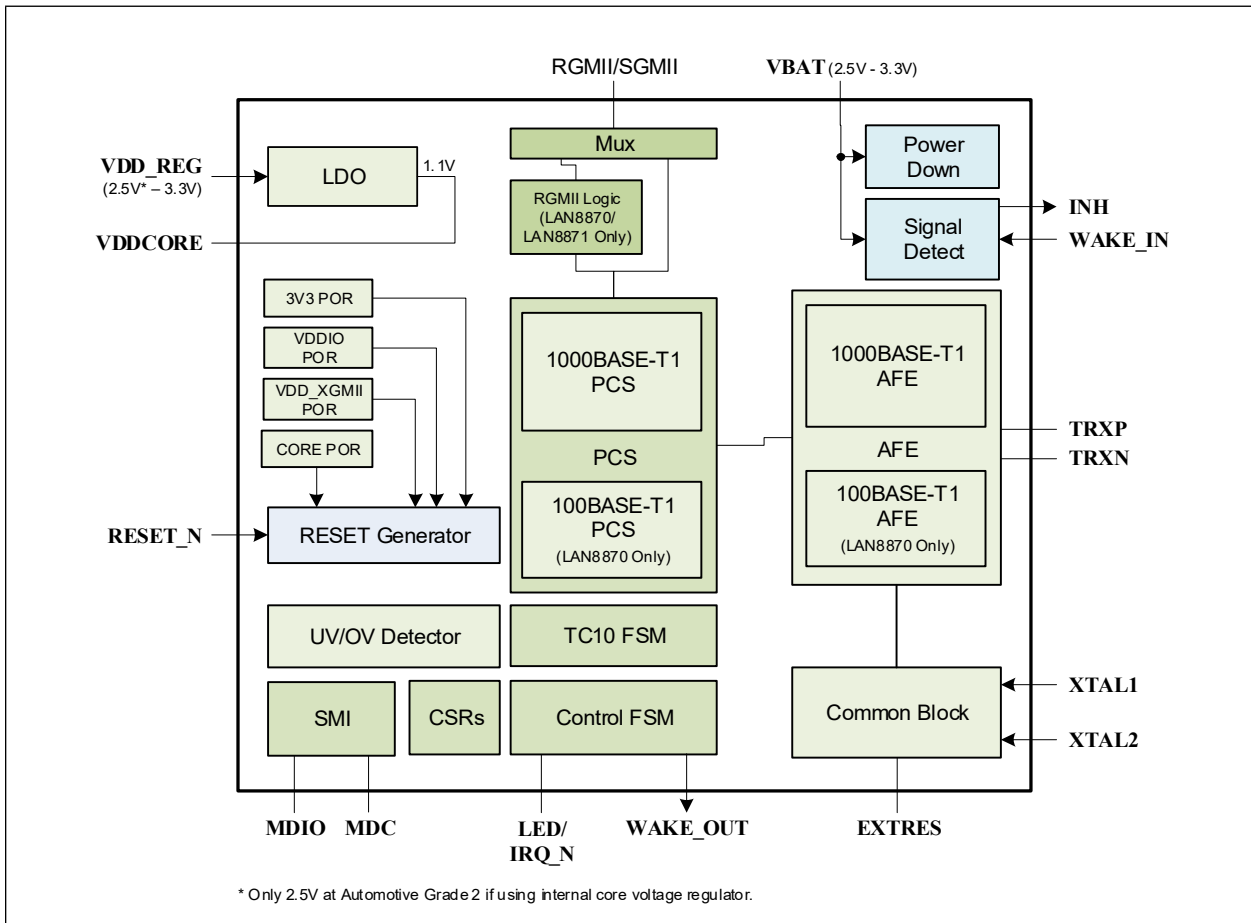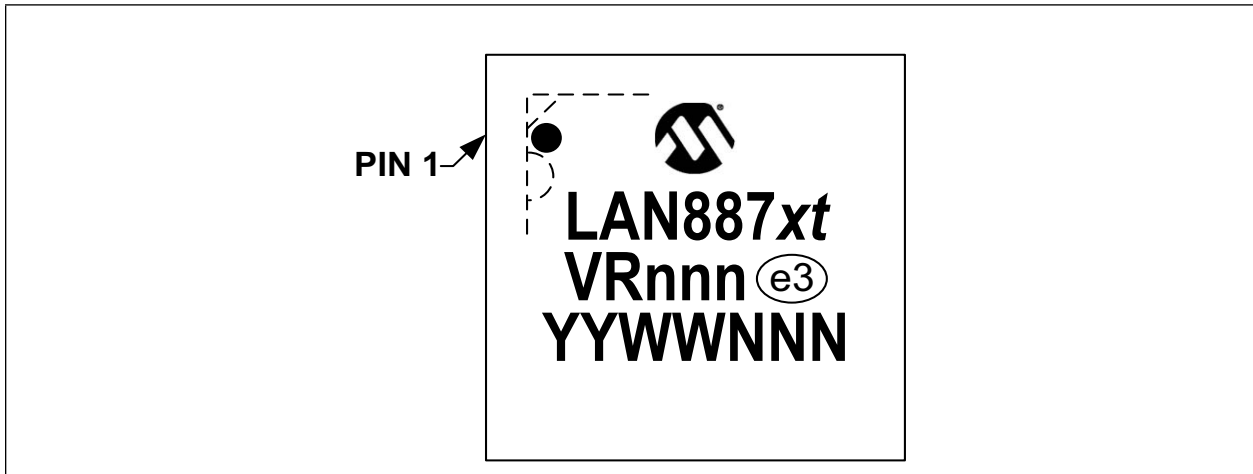**FIGURE 1-2:** LAN887X INTERNAL BLOCK DIAGRAM

2.0   PACKAGE INFORMATION

> **Note:** For the most current package drawings, see the Microchip Packaging Specification at: http://www.microchip.com/packaging.

2.1   Top Marking

PIN 1 →

LAN887*xt*
VRnnn (e3)
YYWWNNN

Legend:

x	Part number (0, 1, or 2)
t	Temperature range designator *(i* = industrial, *v* = automotive)
V	Automotive indicator
R	Product revision
nnn	Internal code
e3	Pb-free JEDEC® designator for Matte Tin (Sn)
YY	Year code (last two digits of calendar year)
WW	Week code (week of January 1 is week '01')
NNN	Alphanumeric traceability code

> **Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information

2.2   48-VQFN

FIGURE 2-1:   **48-VQFN PACKAGE (DRAWING)**

Microchip Technology Drawing C04-1263 Rev F Sheet 1 of 2
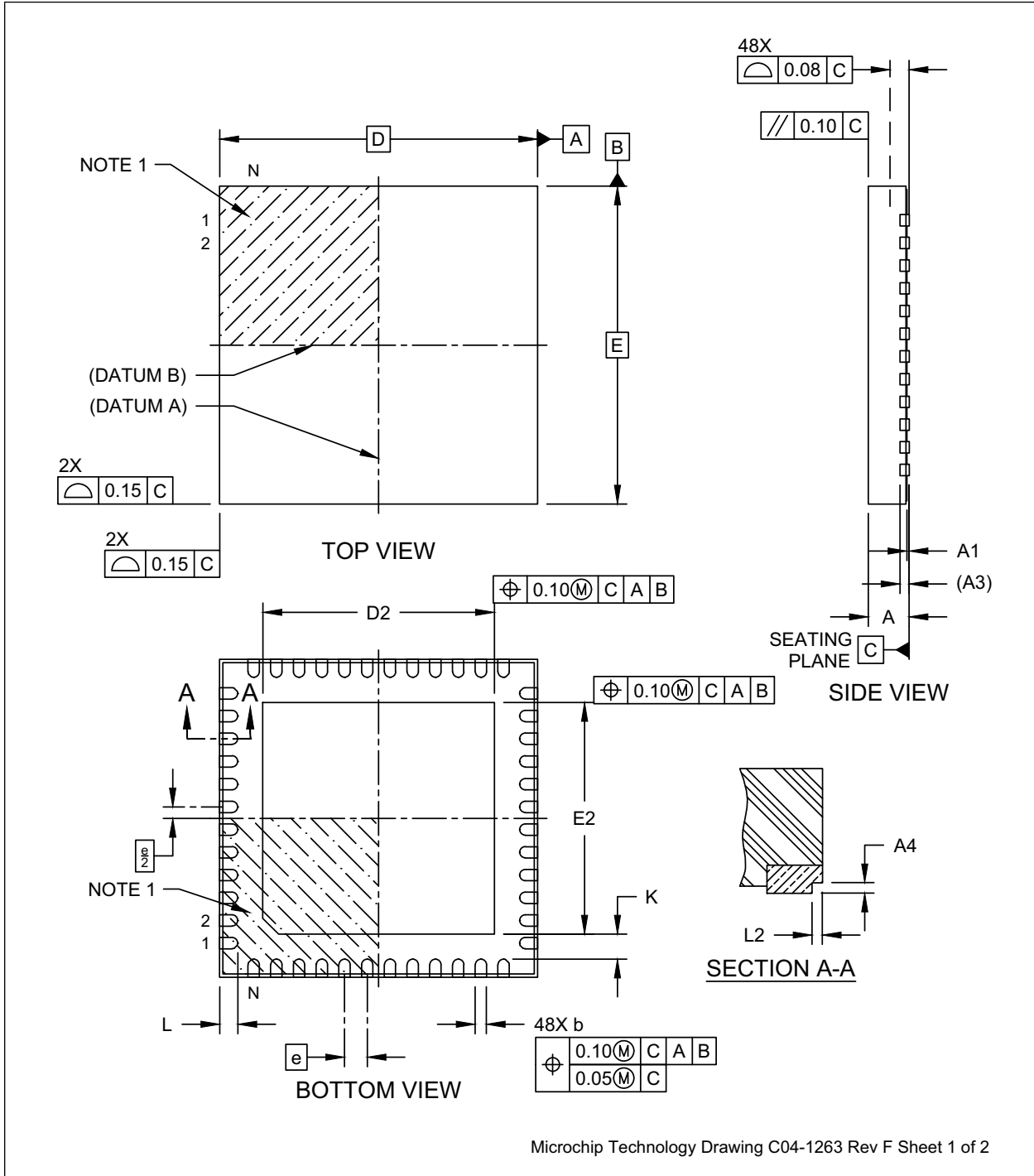
FIGURE 2-2: **48-VQFN PACKAGE (DIMENSIONS)**
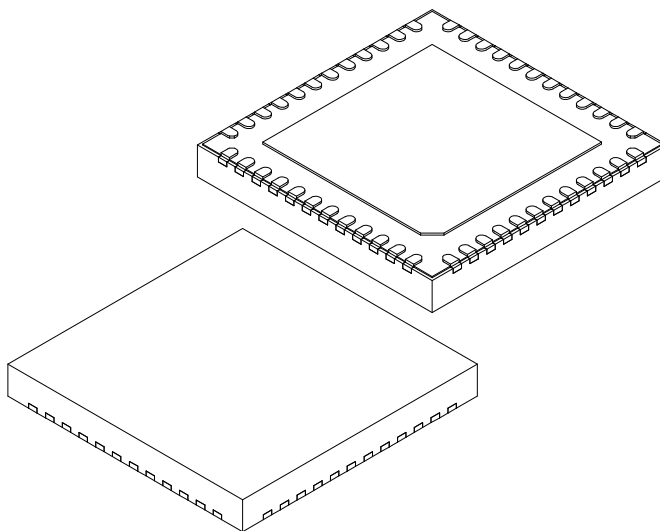
Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		48	
Pitch	e		0.50 BSC	
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.00	0.035	0.05
Terminal Thickness	A3		0.203 REF	
Overall Length	D		7.00 BSC	
Exposed Pad Length	D2	4.90	5.05	5.20
Overall Width	E		7.00 BSC	
Exposed Pad Width	E2	4.90	5.05	5.20
Terminal Width	b	0.20	0.25	0.30
Terminal Length	L	0.35	0.40	0.45
Terminal-to-Exposed-Pad	K	0.20	-	-
Step Cut Height	A4	0.075	-	-
Step Cut Length	L2	-	-	0.075
Alternate Stepped Wettable Flank Dimensions				
Step Cut Height	A4	0.10	-	0.19
Step Cut Length	L2	-	-	0.085

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M
    BSC: Basic Dimension. Theoretically exact value shown without tolerances.
    REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1263 Rev F Sheet 2 of 2

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FIGURE 2-3: **48-VQFN PACKAGE (LAND-PATTERN)**

THE USER MAY MODIFY THE PCB LAND
DIMENSIONS BASED ON THEIR EXPERIENCE
AND/OR PROCESS CAPABILITY

LAND PATTERN DIMENSIONS			
SYMBOL	MIN	NOM	MAX
GD/GE	6.00	-	6.10
D2'/E2'	-	4.10	-
X	-	0.28	0.28
Y	-	0.69	0.69
e		0.50	

PCB LAND PATTERN
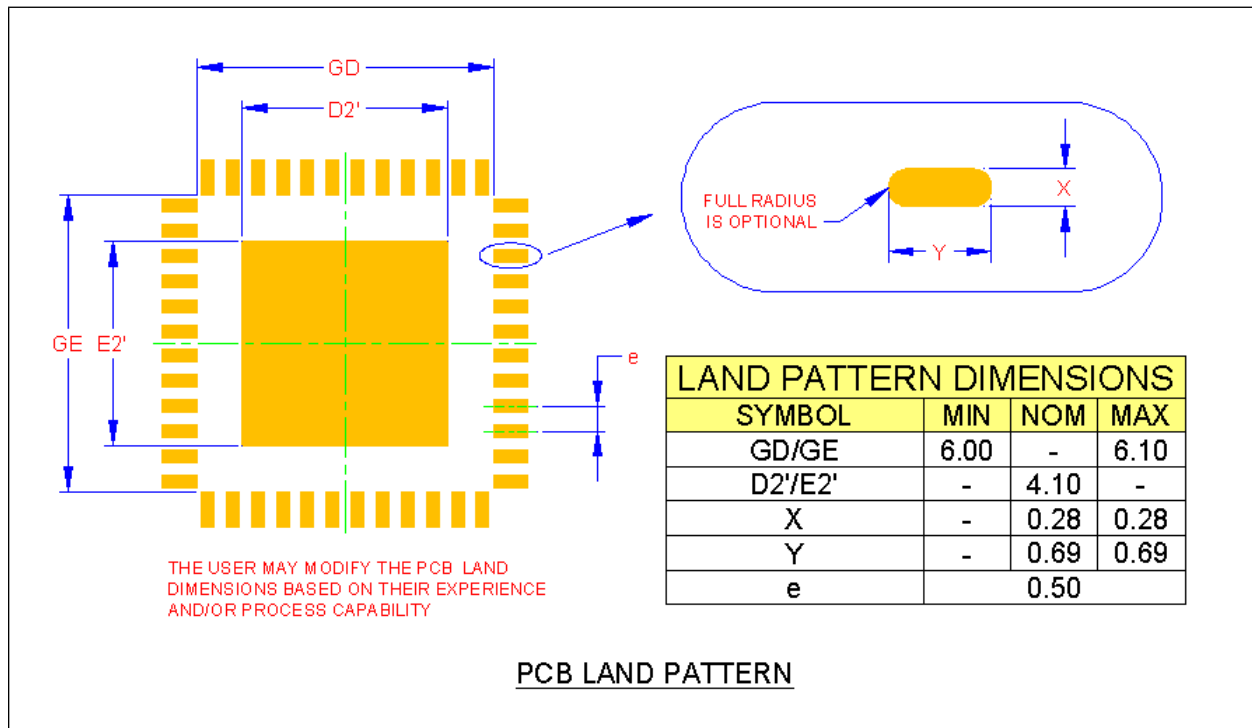
APPENDIX A: PRODUCT BRIEF REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision Level & Date	Section/Figure/Entry	Correction
DS00004469B (06-24-24)	Features	Removed RGMII drive strength adjust (LAN8870/LAN8871)
		Sleep change max 20uA changed to 15uA typical
	Throughout Document	Added information/features regarding part numbers LAN8871/LAN8872
	Throughout Document	Removed support for 3.3 V for SGMII operation. Added notes advising +3.3 V is for RGMII operation only.
	Throughout Document	"VDD11" name changed to "VDDCORE". "VDD11A" name changed to "VDDACORE".
	Throughout Document	References to "1.1V" internal power supply have been renamed to "core".
	Highlights, Top Marking, Product Identification System	Added information for LAN8870B product configuration.
	N/A	Removed Pin Descriptions chapter, as this is now featured in LAN887x Datasheet (DS00004828).
	Section 2.1, Top Marking	Added "V" automotive indicator. Product revision variable indicator updated from "A" to "R".
DS00004469A (03-16-22)	All	Initial Release

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	[X]⁽¹⁾	- X	/ XXX	XXX
Device	Tape and Reel Option	Temperature Range	Package	Automotive Code

Device:
LAN8870 = 100/1000Mbps, RGMII/SGMII Interface
LAN8871 = 1000Mbps, RGMII Interface
LAN8872 = 1000Mbps, SGMII Interface

Extended Cable Reach Option:
Blank = 1000BASE-T1 Type A (up to at least 15m)
B = 1000BASE-T1 Type B (up to at least 40m)
Note: Type-B option is only available with LAN8870

Tape and Reel Option:
Blank = Standard packaging (tray)
T = Tape and Reel (Note 1)

Temperature Range:
V = -40°C to +105°C (AEC-Q100 Grade 2 Automotive)
I = -40°C to +85°C (Industrial Grade)

Package:
PUA = 48-pin VQFN

Automotive Code:
Vxx = 3 character code with "V" prefix, specifying automotive product.

Examples:

a) LAN8870B-V/PUAVAO
Extended Cable Reach,
Tray, -40°C to +105°C, 48-pin VQFN
b) LAN8870BT-V/PUAVAO
Extended Cable Reach,
Tape & reel, -40°C to +105°C, 48-pin VQFN
c) LAN8870-V/PUAVAO
Tray, -40°C to +105°C, 48-pin VQFN
d) LAN8870T-I/PUA
Tape & reel, -40°C to +85°C, 48-pin VQFN
e) LAN8871-I/PUA
Tray, -40°C to +85°C, 48-pin VQFN
f) LAN8871T-V/PUAVAO
Tape & reel, -40°C to +105°C, 48-pin VQFN
g) LAN8872-I/PUA
Tray, -40°C to +85°C, 48-pin VQFN
h) LAN8872T-V/PUAVAO
Tape & reel, -40°C to +105°C, 48-pin VQFN

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

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