

10BASE-T1L-MC: 10BASE-T1L to 10BASE-T Media Converter Platform



Version – 6

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1. Document Details

1.1 Revision history

Version	Author		Reviewer		Approver	
	Name	Date (DD-MM-YYYY)	Name	Date (DD-MM-YYYY)	Name	Date (DD-MM-YYYY)
Draft 0.1	Venus Kaurani, Hirenkumar Patel, Sanket Radde,	11-Oct-2021	Ashish Agarwal	12-Oct-2021		
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Draft 0.5	Venus Kaurani	15-Dec-2021	Kalpesh Balar, Mahesh Gohil	16-Dec-2021		
Draft 0.6	Venus Kaurani	17-Dec-2021	Kalpesh Balar	20-Dec-2021		

Version	Description of Change
Draft 0.1	First draft created
Draft 0.2	Updated Product Images and Unboxing Images
Draft 0.3	Updated Unboxing Images, Kit Contents and Daisy Chain Setup Example Diagram
Draft 0.4	Updated the review comments
Draft 0.5	Updated the procedure to connect cable to the terminal block
Draft 0.6	Updated the procedure to remove Harting Cable, added Block Diagram and review comments

1.2 Definition of terms

Definition / Acronym / Abbreviation	Description
AI1L	ADCOE_Industry_4.0_10BASE-T1L
GPIO	General Purpose Input Output
LED	Light Emitting Diode
MC	Media Converter
MDIO	Management Data Input Output
PHY	Physical Layer
RJ45	Registered Jack – type 45

2. Introduction

The 10BASE-T1L-MC is a Media Converter platform which is used for conversion between Standard 10BASE-T Ethernet and 10BASE-T1L PHY.

This document will guide you through the features of Media Converter Device.

2.1 Kit Content

- 10BASE-T1L to 10BASE-T Media Converter Platform
- SPE Harting Cable Assembly (33280101001005)
- CAT5E Ethernet Cable Assembly
- USB type-A to type-C Cable
- Quick Start Guide

Note: * indicates the item is not provided in every kit along with 10BASE-T1L Media Converter Device.

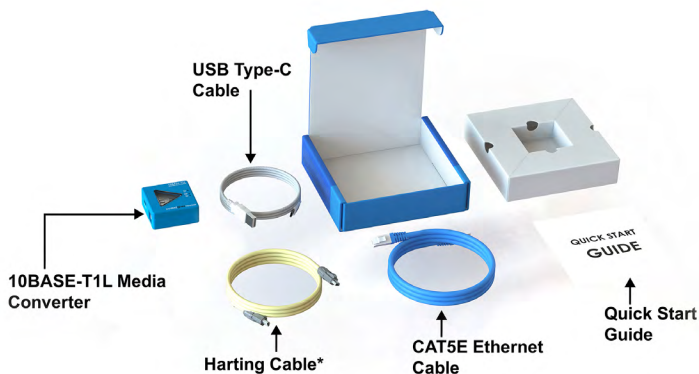


Figure 1 Kit Contents

3. Product Information

3.1 Overview

The media converter ("10BASE-T1L-MC") is a plug and play solution which enables seamlessly interfacing from single twisted pair (SPE) long reach Industrial Ethernet ("10BASE-T1L") to standard Ethernet ("10BASE-T"). The 10BASE-T1L-MC can be used to interface to existing Ethernet connected equipment, such as laptop, PC, Ethernet Switch, Building or Industrial Controller, Test Rigs, among others.

This product enables the testing, debugging of custom prototypes with a 10BASE-T1L Ethernet port and converts the data to standard Ethernet, which is accessible via the RJ45 connector. These devices are hosted in a sleek housing which supports easy side by side placement for multichannel media conversion solutions. Designed to support testing of different SPE cable types, and connectors the 10BASE-T1L-MC is an essential lab tool for anyone looking to develop, debug or test a 10BASE-T1L solution.

The 10BASE-T1L-MC is built using the industry leading PHY technology from Analog Devices ADI Chronous Family, namely the ADIN1100, 10BASE-T1L PHY and the ADIN1200, 10BASE-T PHY. This device is pre-programmed to configure both the PHY ICs in 10Mbps full-duplex auto-negotiation mode.

3.2 Features

- Features Analog Devices 10BASE-T1L PHY the ADIN1100 and Standard 10BASE-T PHY the ADIN1200
- Operates on +5V \pm 10%, 500mA USB supply over type-C connector
- Screwless terminal block to connect all types of 10BASE-T1L SPE cable
- SPE connector supporting IEC63171-6, one of the SPE connector standards.
- Shielded RJ45 connector with LEDs to access 10BASE-T
- Both the PHYs supports 10Mbps full-duplex auto-negotiation mode.
- 10BASE-T1L supports cable length up to 1000m
- Harting IEC63171-6 connector/ terminal block to connect 10BASE-T1L port
- Terminal block supports 16 AWG to 22 AWG cable
- Supports 1V/2.4V Tx level for 10BASE-T1L
- 10BASE-T1L port supports 10 Mbps full-duplex, auto-negotiation mode
- Shielded RJ45 connector with LEDs to access 10BASE-T
- 10BASE-T port supports 10Mbps full-duplex auto-negotiation mode
- LED indication for power, link-status, and activity, Tx Voltage level for 10BASE-

3.3 Product Details

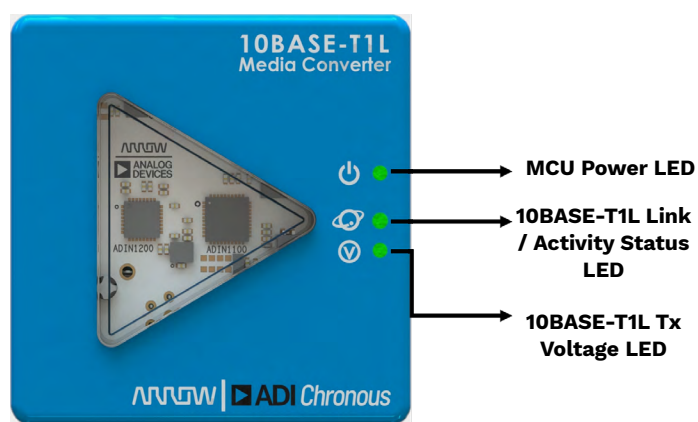


Figure 2 Top View of 10BASE-T1L MC

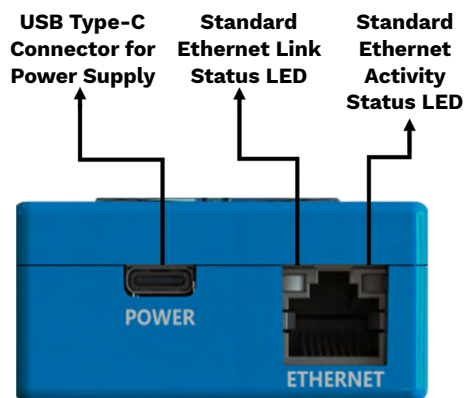


Figure 3 Side View of 10BASE-T1L MC

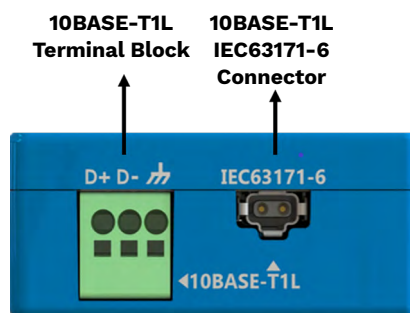


Figure 4 Side View of 10BASE-T1L MC

Product Unboxing

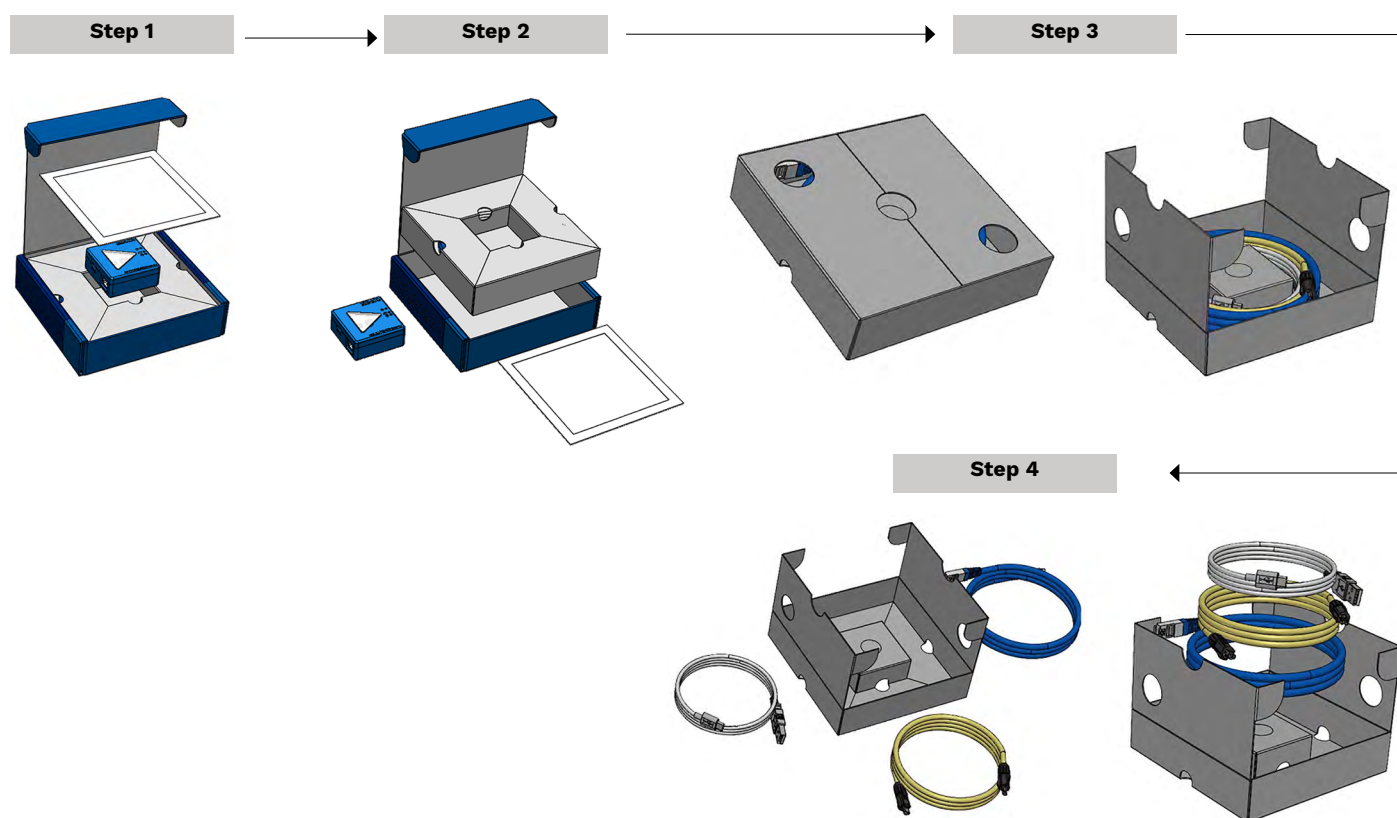


Figure 5 Unboxing Steps

4. 10BASE-T1L Kit Setup

4.1 Hardware requirements

- Link partner with 10BASE-T interface
- Link partner with 10BASE-T1L interface
- 5V \pm 10%, 500mA USB power supply over USB Type-A to Type-C Cable.

4.2 Setup steps

- Remove the 10BASE-T1L Media Converter Board carefully from antistatic bag
- Connect 5V USB power source using USB type-C to type-A cable
- Power LED will glow, once board is powered on
- Connect 10BASE-T link partner with CAT5E ethernet cable
- Green LED on RJ45 connector will glow after 10BASE-T link is established
- Connect 10BASE-T1L link partner using either IEC63171-6 (Harting) cable on IEC63171-6 connector or shielded twisted pair cable on terminal block corresponding to the other end device
 - For terminal block D+, D- and shield ground indications are mentioned on the outer case
- 10BASE-T1L Link Status/Activity LED will glow continuously once 10BASE-T1L link is established
- Based on 10BASE-T1L link partner advertised capability the PHY works on either 2.4 V pk or 1 V pk-pk

- In the case where the link is set to 2.4 V Tx voltage level, Tx level LED will glow continuously on
- Media converter device is ready for communication
- On data activity, yellow LED on RJ-45 and 10BASE-T1L link status/activity will blink

* To disconnect the Harting cable IEC63171-6, squeeze the connector between the thumb on top and the index finger underneath the connector. Then pull the connector out.

4.3 Example setup

Two media converters in daisy chain:

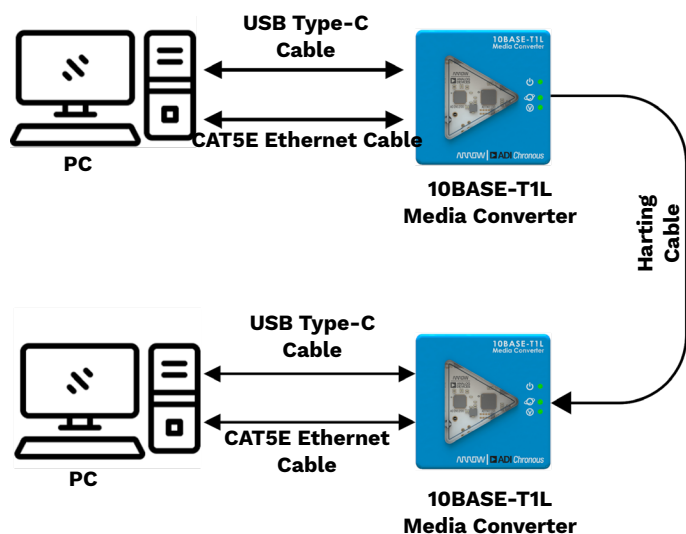


Figure 6 Example Daisy chain Setup of two 10BASE-T1L MC

Note: This setup is used for illustration purposes to provide an example usecase. 10BASE-T1L can be connected to any device with ethernet peripheral as per the application requirement for the conversion of media between the devices.

This setup has been used for testing purpose as a reference example. In this setup 2 10BASE-T1L media converter and 2 PCs are required. A media converter is connected with a PC through standard ethernet cable, and both the media conversion devices are connected together through the 10BASE-T1L cable. The ADIN1100 and ADIN1200 PHYs on the media converter device have been configured by default for auto-negotiation mode, full-duplex, and speed of 10Mbps. Also note that ADIN1100 (10BASE-T1L) does not support half duplex mode so the link partner chosen should be in full-duplex mode because both PHYs work in auto-negotiation mode.

The example setup has been created as show in the connection sequence below:

PC-1 <==> ADIN1200 <==> ADIN1100 <== 10BASE-T1L Cable Link ==> ADIN1100 <==> ADIN1200 <==> PC-2

The setup is functioning correctly, if the link is established over both PHYs and the devices communicate or transfer the data, as indicated by the LED's.

4.4 Cable Connection to 10BASE-T1L Terminal and IEC63171-6 Connector

How to use Single Pair Cable to connect with Terminal block of device:

Setup Requirement

- Single Pair Cable (in case of long length ~1KM cable requirement, select the cable as per the IEEE802.3cg standard to meet the signal specification)

Connection Setup

- Single Pair Cable contains two signal wire and a shield
- Media converter device contains Push to connect terminal block connector also to connect other 10Base T1L device using custom wire assembly
- Connect the cable wires to D+ and D- of connector. Cable shield can be connected based on assembly requirement or can be left as NC.

Below reference images shown the connection information:

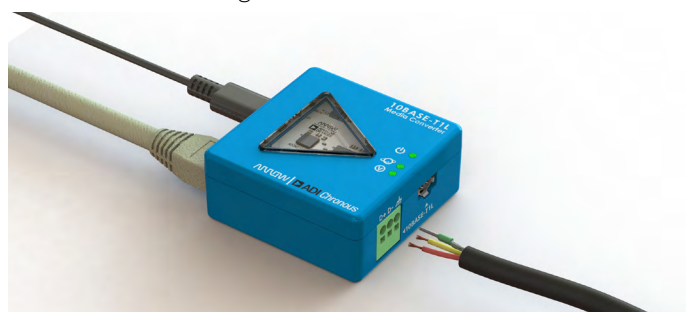


Figure 7 Connecting Shielded Wire with MC

Note: In 10BASE-T1L MC, at a time only single connector, Harting or Terminal Block can be used based on the application

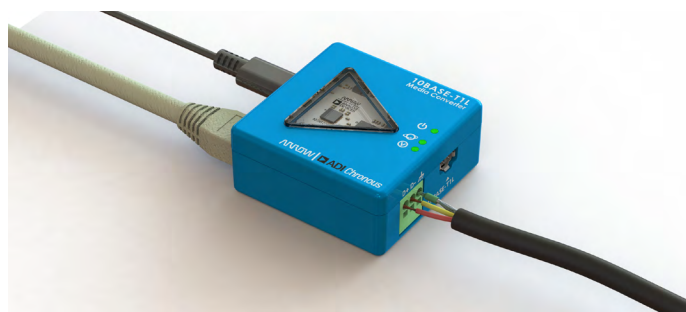


Figure 8 Connected the Wire using PUSH in the Terminal Block

How to use Harting Cable to connect with the IEC63171-6 connector

- Connection of Harting cable requires pushing the cable inside the IEC63171-6 connector directly.
- For removing the cable, it requires to push the cable inside and the press the plug on upper side to take it out from the connector mounted the device.



Figure 9 Removing the Harting Cable

4.5 10BASE-T1L LED Pattern List

LED	Color	Activity	Description
Power (MCU Health)	Green	On	Media converter working
		Off	Media Converter MCU Power UP Failure/ No Power Input to Media Converter
		Blinking (80% Duty Cycle for 500ms duration)	ETH / 10BASE-T1L Config fault
Act/ Link Status		On	10BASE-T1L Link Detected
		Off	10BASE-T1L Link Down (no Energy detected/ auto negotiation fail)
		Blinking	Data is being transmitted over the 10BASE-T1L
10BASE-T1L Tx Voltage Level Status		On	2.4 V pk-pk 10BASE-T1L Connection
		Off	1.0 V pk-pk 10BASE-T1L Connection
		Blinking	Reserved for Future Use
Link Status over RJ45 connector		On	Ethernet Link Detected
		Off	When the ethernet cable is not connected
		Blinking	Reserved for Future Use
Activity Status over RJ45 connector	Yellow	On	Reserved for Future Use
		Off	No activity over ethernet or the cable is not connected
		Blinking	Activity over the ethernet

Note: If Green LED of RJ45 is kept on even without connecting ethernet cable, it indicates configuration fault of ADIN1200 (Default Settings in RJ45)

5. Detailed Specifications

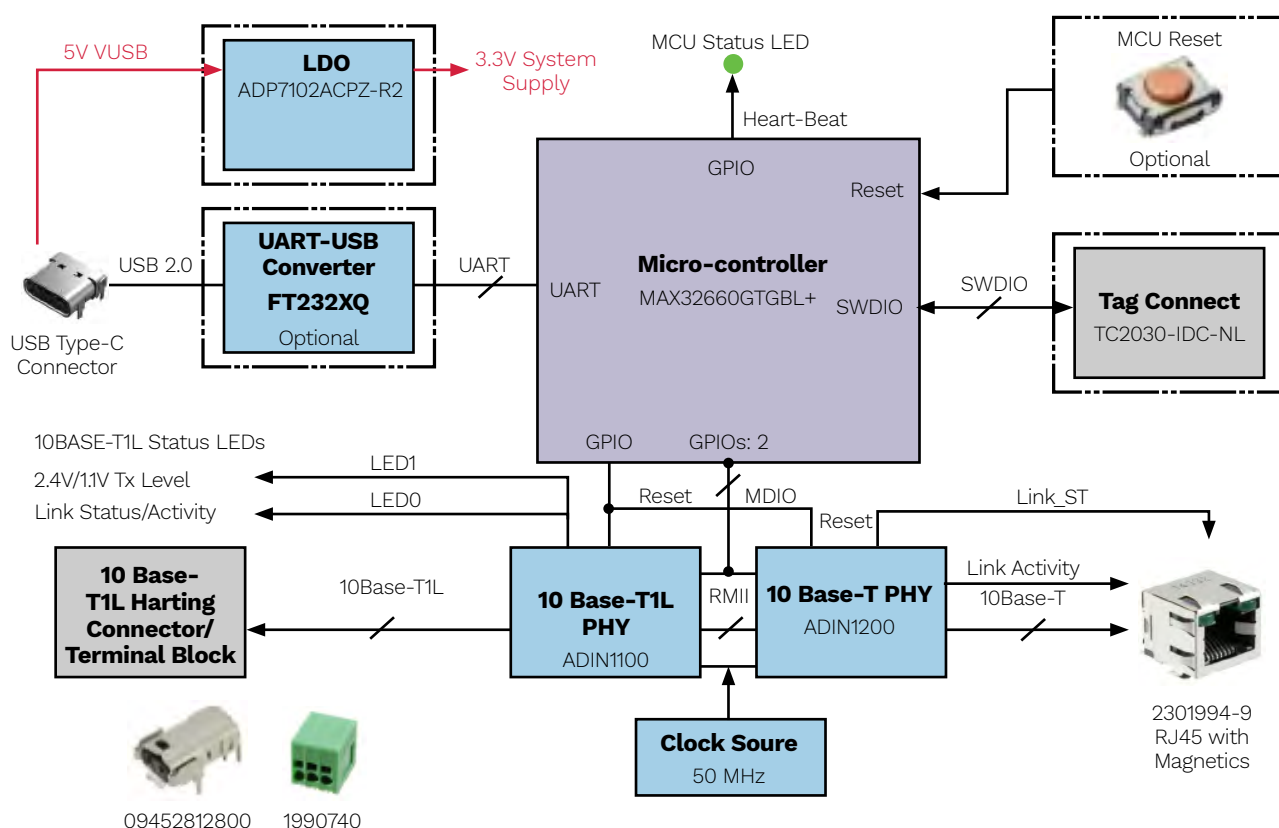


Figure 10 10BASE-T1L Media Converter Hardware Architecture

Table 8. Default Hardware Configuration Modes

Hardware Configuration Pin Function	Default Mode
PHY address	0x0
Software PD mode after reset	PHY in software PD after reset
Master / Slave selection	Prefer slave
Transmit amplitude	1.0V pk-pk/2.4 V pk-pk
MAC interface selection	RMII

Controller
 IC
 Connector

The block diagram illustrates the design of the 10BASE-T1L-MC Platform. The diagram provides an understanding of the signal and power chain for the Media Converter device. It shows the interconnections of all the major components including the Max microcontroller, the 10BASE-T1L PHY and the 10BASE-T PHY. Supporting power solutions from ADI are also included, namely the ADP7102 LDO. For application specific developments, the schematic, layout and Gerber files including the microcontroller software code are all available on GitHub. [Link to the Development Documents](#)

5.1 Featured Products:

[MAX32660GTGBL+:](#)

- Ultra-Low Power Arm Cortex-M4 with FPU-Based Microcontroller
- Highly integrated 32-bit microcontroller designed for battery-powered devices and wireless sensors
- 256KB Flash Memory • 96KB SRAM
- [Data Sheet](#)

[10BASE-T1L \(ADIN1100\):](#)

- ADIN1100 communicates over RMII back- back mode.
- ADIN1100 is configured over Clause-45 MDIO.
- Auto-negotiation mode speed as 10 Mbps Voltage level as 2.4 V pk-pk and full duplex mode
- Both the PHYs advertises its states to link partner
- LED indication for the link status, activity status for both PHYs and 2.4 V/ 1.0 V pk-pk transfer voltage level for ADIN1100
- [Data Sheet](#)

[10BASE-T \(ADIN1200\):](#)

- ADIN1200 is configured over Clause-22 MDIO
- ADIN1100 communicates over RMII back- back mode.
- Auto-negotiation mode, speed as 10BASE-T, voltage level as 2.4V pk-pk and full duplex mode.
- LED indication for the link status, activity status and voltage level for ADIN1200 over the RJ45 connector mounted on the Media Converter device.
- [Data Sheet](#)

[LDO \(ADP7102ACPZ-5.0-R7\):](#)

- Low dropout linear regulator that operates from 3.3 V to 20 V and provides up to 300 mA of output current
- High input voltage LDO is ideal for regulation of high-performance analog and mixed signal circuits operating from 19 V to 1.22 V rails
- [Data Sheet](#)