CH101 and CH201 Ultrasonic Transceiver Handling and Assembly Guidelines

Chirp Microsystems
2560 Ninth Street, Ste 220, Berkeley, CA 94710 U.S.A
+1(510) 640–8155
www.chirpmicro.com

Document Number: AN-000159
Revision: 1.0
Release Date: 11/24/2019

1 INTRODUCTION

This document provides information and general guidelines for handling and assembling boards with CH101 and CH201 ultrasonic transceivers. The goal of the processes outlined herein is to prevent damage of ultrasonic transceivers due to mechanical, vacuum and thermal stress caused by the handling process. Any deviation from the recommendations contained in this Application Note should be reviewed by Chirp Microsystems and thoroughly verified prior to implementation in a production environment.

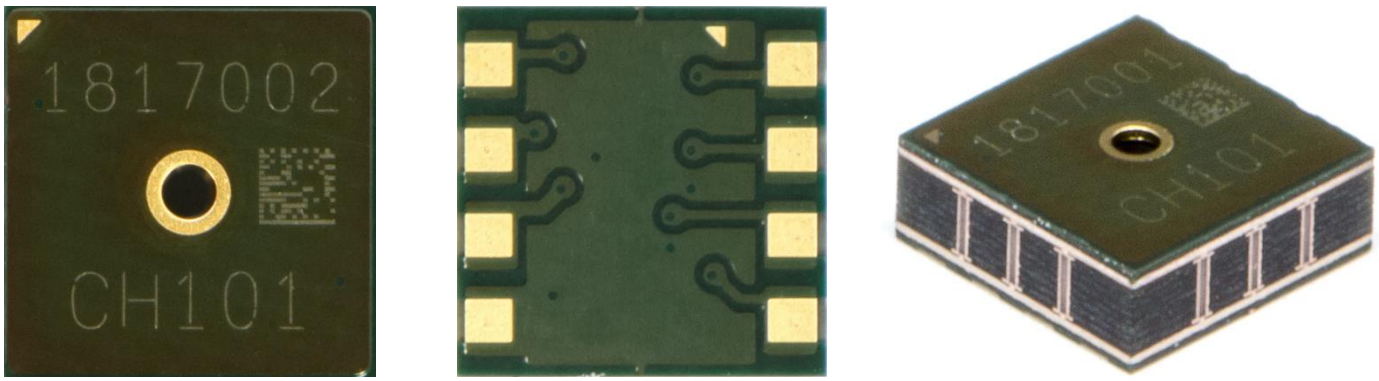

Figure 1. CH101 ultrasonic transceiver

The CH101 and CH201 ultrasonic transceivers are compatible with existing industrial Surface Mount Technology (SMT) processes. An important feature of the ultrasound transceiver is the open acoustic port hole on the top of the package. This exposes the internal MEMS ultrasonic transducer to the external environment. Care must be taken to ensure that no particulates enter this port hole, and there is no damage to the internal MEMS membrane contained in the device.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

2 MANUAL HANDLING

PCB rework, prototyping, manual assembly and manual handling processes:

- Manual soldering should be avoided if possible, as it is difficult to ensure accurate temperature control. It is recommended to start from lowest temperature possible, and the maximum temperature should typically not exceed 230°C.
- All manual processes should be carried out on ESD grounded work stations.
- Sharp objects of any type should not be used to pierce into the transceiver acoustic port hole. In general, the transceiver should only be handled from the side.
- Use static shield bags or ESD bags for transceiver handling and storage. Avoid conductive IC boxes for transceiver storage as loose foam material can get into the transceiver acoustic port hole.
- Pocket-less gel packs with adhesive gel layer are ideal to hold the transceiver in position, care should be taken to remove the dust on the gel surface before using it for transceiver handling and storage.
- Do not board brush, use an air gun or hot air blower directly over the transceiver acoustic port hole during PCB repair or rework of the transceiver or other adjacent components on the board.
- Do not employ chemical board wash or cleaning, as the associated cleaning agents can enter the acoustic port hole and permanently damage the device.
- Do not use physical cleaning and do not expose to ultrasonic cleaning methods or air guns.
- Use of an infra-red rework station is highly recommended for any PCB rework with CH101 and CH201 transceivers as it provides precise control of temperature profile and process repeatability.
- In addition to the general guidelines for IC handing, care should be taken to avoid any vacuum, excessive mechanical stress or contamination entering the transceiver acoustic port hole.

3 AUTOMATED PICK AND PLACE

The Pick and Place (PnP) process often uses vacuum pick up tools for accurate placement of transceivers on the PCB. Drawing a vacuum over the transceiver acoustic port hole may cause damage to the device and so care should be taken to avoid any direct contact or moving the nozzle over the transceiver acoustic port hole.

- Avoid using excessive force in the PnP process
- As a starting point for setting up the PnP process, it is recommended that the nozzle size to handle 0603 components or smaller can be used for CH101 and CH201 ultrasonic transceivers

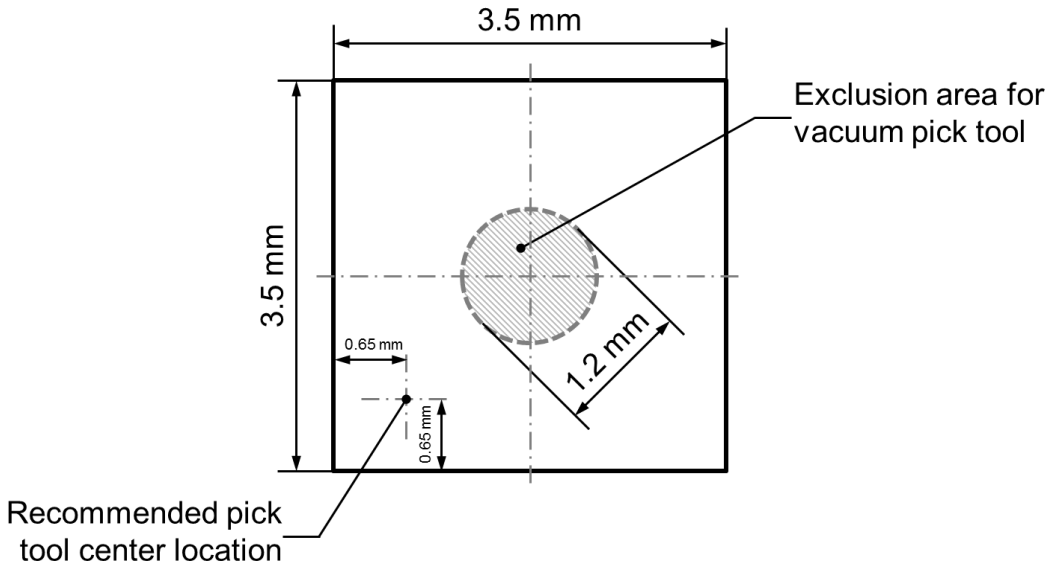

Figure 2. Vacuum pick up point for Pick and Place

4 PCB DESIGN GUIDELINES

PCB layout should adhere to the following guidelines:

- PCB design should be as symmetrical as possible
  - Since the transceiver has very low power consumption, large Vdd and Gnd traces are not required
  - Do not place vias or traces within the transceiver footprint (Figure 3)
- PCB land and connecting traces should be symmetrical
- PCB land height and width should be equal the transceiver pad height and width (Figure 4)
- Solder mask opening should exceed PCB land height and width by 0.1mm (Figure 4)
- Placement of the transceiver on the PCB should avoid locations close to hot spots such as microprocessors and points of mechanical stress such as pushbuttons and screws

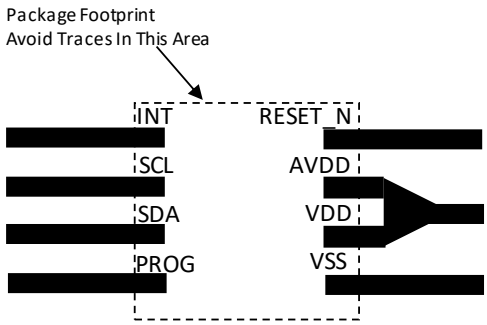

Figure 3. Recommended trace layout

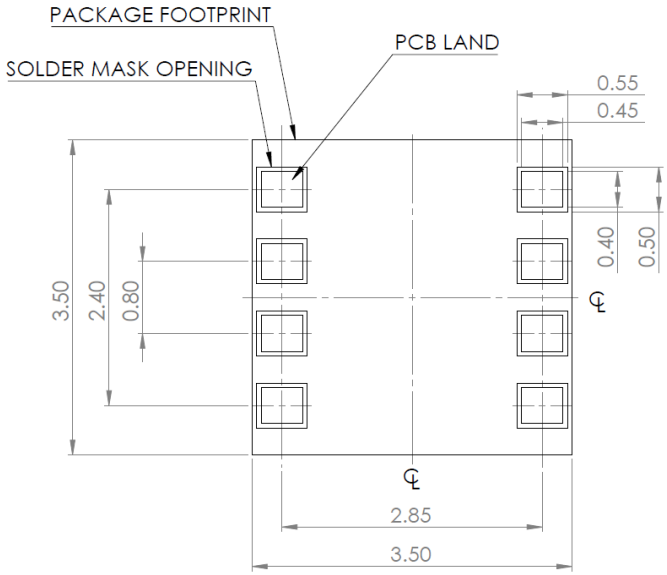

Figure 4. Recommended land and solder mask design

5 STENCIL DESIGN AND SOLDER PASTE APPLICATION

The thickness and the pattern of the soldering paste are important for the proper transceiver mounting process.

Solder paste	Type 4- alloy composition – Sn/Ag 3.0/Cu 0.5, no clean solder paste
Flux	Use No Clean Flux to avoid board cleaning

Table 1. Typical soldering recommendations

- Stainless steel stencils are recommended for solder paste application
- A stencil thickness of 90 - 150 µm (3.5 - 6 mils) is recommended for screen printing
- The openings of the stencil for the signal pads should be between 70% and 90% of the PCB pad area
- The final volume of soldering paste applied to each PCB land is recommended to be within 20% among (all) the PCB land pads
- Optionally, for better solder paste release, the aperture walls should be trapezoidal, and the corners rounded
- The fine pitch of the IC leads requires accurate alignment of the stencil to the printed circuit board. The stencil and printed circuit assembly should be aligned to within 25 µm (1 mil) prior to application of the solder paste

6 GENERAL GUIDELINES FOR SOLDERING

The following best practices for PCB design and assembly should be followed when mounting CH101 and CH201 ultrasonic transceivers:

- Solder paste should be as thick as possible to minimize stress between the PCB to the transceiver and to avoid the PCB solder mask from touching the transceiver
- Solder paste thickness must be as uniform to avoid uneven stress

CH101 and CH201 are compliant to standard solder reflow processes as specified in JEDEC standard J-STD-020, as shown in Figure 5 and specified in Table 2.

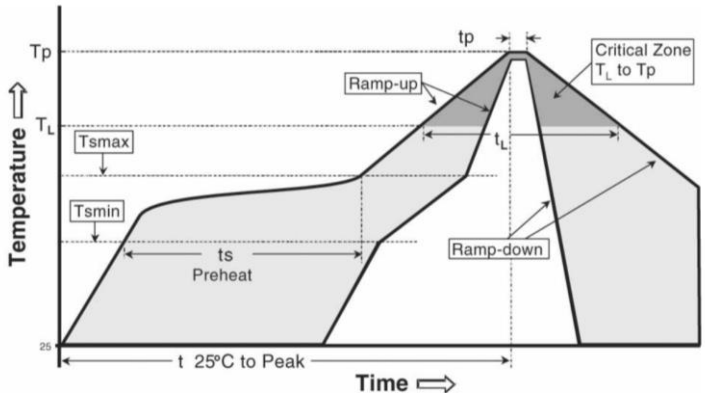

Figure 5. Solder reflow profile

- Maximum ramp up rate should not be exceeded to allow for uniform temperature distribution, avoid component damage and soldering defects
- Maximum peak temperature should not be exceeded to avoid changes in transceiver performance parameters
- A pre-heat zone at 200 °C for 60 to 120 seconds can be added before heating to the peak temperature to enhance uniform temperature distribution
- Allocate the transceivers to the last reflow soldering operation.
- Do not employ chemical board wash or cleaning, as the associated cleaning agents can enter the port hole and permanently damage the transceiver
- Do not use physical cleaning and do not expose to ultrasonic cleaning methods or air guns
- Do not use Vapor Phase Re-flow process for CH101 and CH201 transceivers, as the vapor can damage the transceiver through the port hole

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (Tsmax to Tp)	3° C/second max.	3° C/second max.
Preheat - Temperature Min (Ts_{min}) - Temperature Max (Ts_{max}) - Time (Ts_{min} to Ts_{max}) (ts)	 100 °C 150 °C 60-120 seconds	 150 °C 200 °C 60-180 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	 183 °C 60-150 seconds	 217 °C 60-150 seconds
Peak Temperature (Tp)	240 +0/-5 ˚C	260 ˚C
Time within 5°C of actual Peak Temperature $(tp)^2$	10-30 seconds	20-40 seconds
Ramp-down Rate	6 °C/second max.	6 °C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Note 1: All temperatures refer to topside of the package, measured on the package body surface.
Note 2: Time within 5 °C of actual peak temperature (tp) specified for the reflow profiles is a "supplier" minimum and "user" maximum.

Table 2. Recommended solder profile parameters

7 REVISION HISTORY

Revision Date	Revision	Description
11/24/2019	1.0	Release with CH101 and CH201

TDK Chirp Microsystems