# TOADs Digital Interface (DI) & Daughterboard – User Guide

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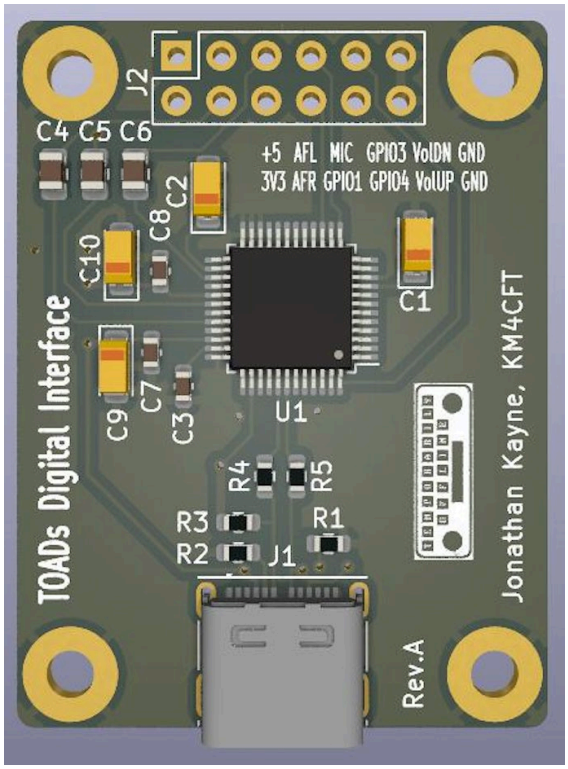
*TOADs DI board by Steve McGrane KM9G (Temporarily Offline) & Jonathan Kayne KM4CFT*




## Contents

## Introduction – TOADs DI

Many radios are fully capable of digital modes like Winlink, FT8, Vara, APRS or even being an allstar node - if only there was a small/easy way to connect them up and make that happen. For some reason radio makers don't seem to know that we want to do anymore than talk on our radios. What if it were easy?

This is the starter board you need - from here you can wire it in yourself, or you can order one of our daughterboards and a cable and you're all plug and play like!

Designed by hams, for hams. This board was conceived by Steve, KM9G and put to PCB by Jonathan, KM4CFT

## Example Applications

- Build a **high-power AllstarLink node** with your radio of choice.
- Create a **VOX-triggered digital interface** with no CAT/PTT cable required (VOX radios only).
- Use with **Direwolf** for APRS I-Gate or Digi setups.

Support is available through the #toads-di channel in the TOADs Discord here – https://discord.gg/97tkMEc

## Overview

The **TOADs Digital Interface (DI)** board is a CM108-based USB audio interface designed for ham radio digital applications. It serves as a modern, no-solder replacement for modifying traditional CM108 USB fobs. Connectivity is via USB-C (to Raspberry Pi/PC) and 12 pin headers (to radio). Size is approx. 40mm (1.57”) x 30mm (1.18”)

The DI board is ideal for:

- **AllstarLink** high-power nodes

- **Direwolf** (APRS, Winlink Gateway and Client, Packet Radio)
- **WSJT-X** and other digital mode software (with VOX-capable radios...for now)

⚠️ **Warning**: This is a *barebones board*. It lacks buffering and isolation components, which are **required** to safely connect to a radio. **Do not connect this board directly to your radio** without appropriate external circuitry. Damage may result. Check back in our store for a daughterboard for your radio if you're not comfortable with tinkering, or join the #toads-di channel on the discord (https://discord.gg/97tkMEc) and we're all here to help!

## Features:

- Based on the **CM108 USB audio chip**
- Stereo **line-out** (Audio Left & Right)
- **Mic Input** (Audio from radio)
- **PTT Output** (GPIO3)
- **COS Input** (VolDn = GPIO2)
- GPIO4 available (can be used for a COS LED indicator)
- 5V and 3.3V header pins
- Fully tested with **AllstarLink**

## Getting Started with AllstarLink

Handy video guides are available on YouTube to help you set up AllstarLink with the TOADs DI board. This board has been tested and works with the HamVOIP image.

- **HamVOIP Setup (Ham Radio DX)**
  https://www.youtube.com/watch?v=iCZsMFrVJlM

- **ASL3 Setup (Ham Radio Crusader)**
  https://www.youtube.com/watch?v=aeuj-yI8qrU

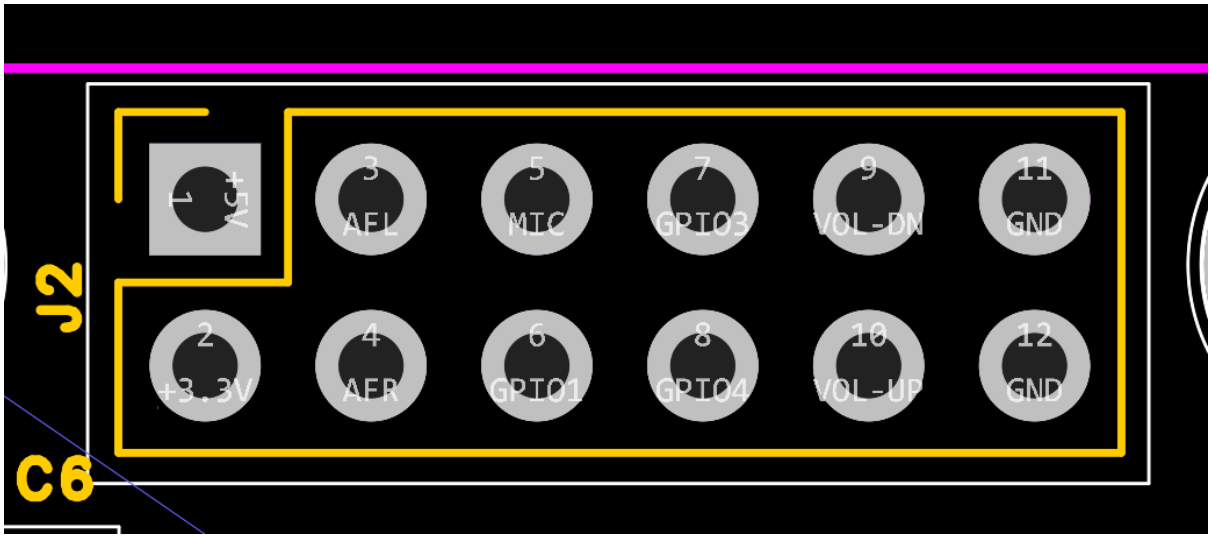
The TOADs DI board has been successfully used in **high-power Allstar nodes** with a variety of user-selected radios.

**Signals required:**

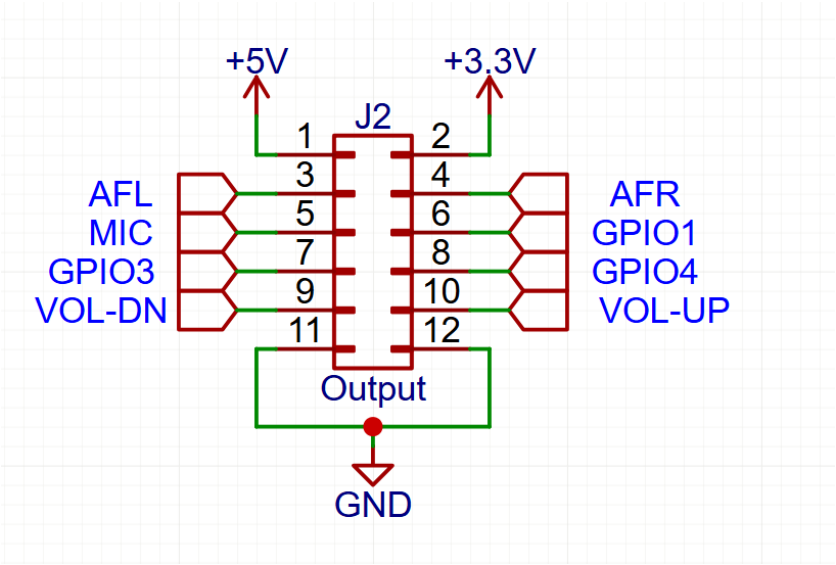
- **Audio In** (from radio to USB)
- **Audio Out** (USB to radio)
- **PTT Output** (GPIO3)
- **COS Input** (VolDn)

## Pinout

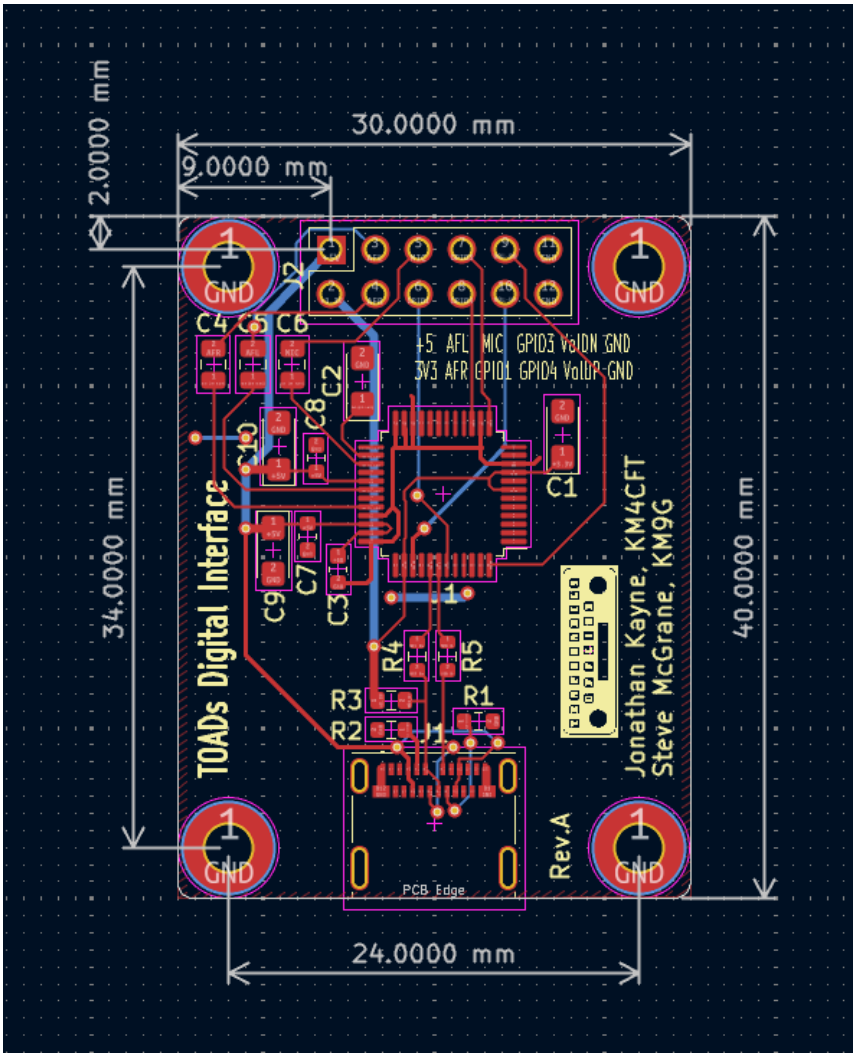
The TOADs DI board features a 12-pin header, with all pins clearly labeled on the silkscreen.




*View is looking from the top of the board down*




*Schematic diagram*




*Board dimensions*

Below is a description of each pin and its function:

| Pin | Label | Function |
|---|---|---|
| 1 | +5V | 5V supply (for external circuits) |
| 2 | +3.3V | 3.3V supply |
| 3 | AFL | Audio Output Left |
| 4 | AFR | Audio Output Right |
| 5 | MIC | Mic Input (audio from radio) |
| 6 | GPIO1 | General-purpose I/O |
| 7 | GPIO3 | PTT Output |
| 8 | GPIO4 | Optional (e.g., COS LED indicator) |

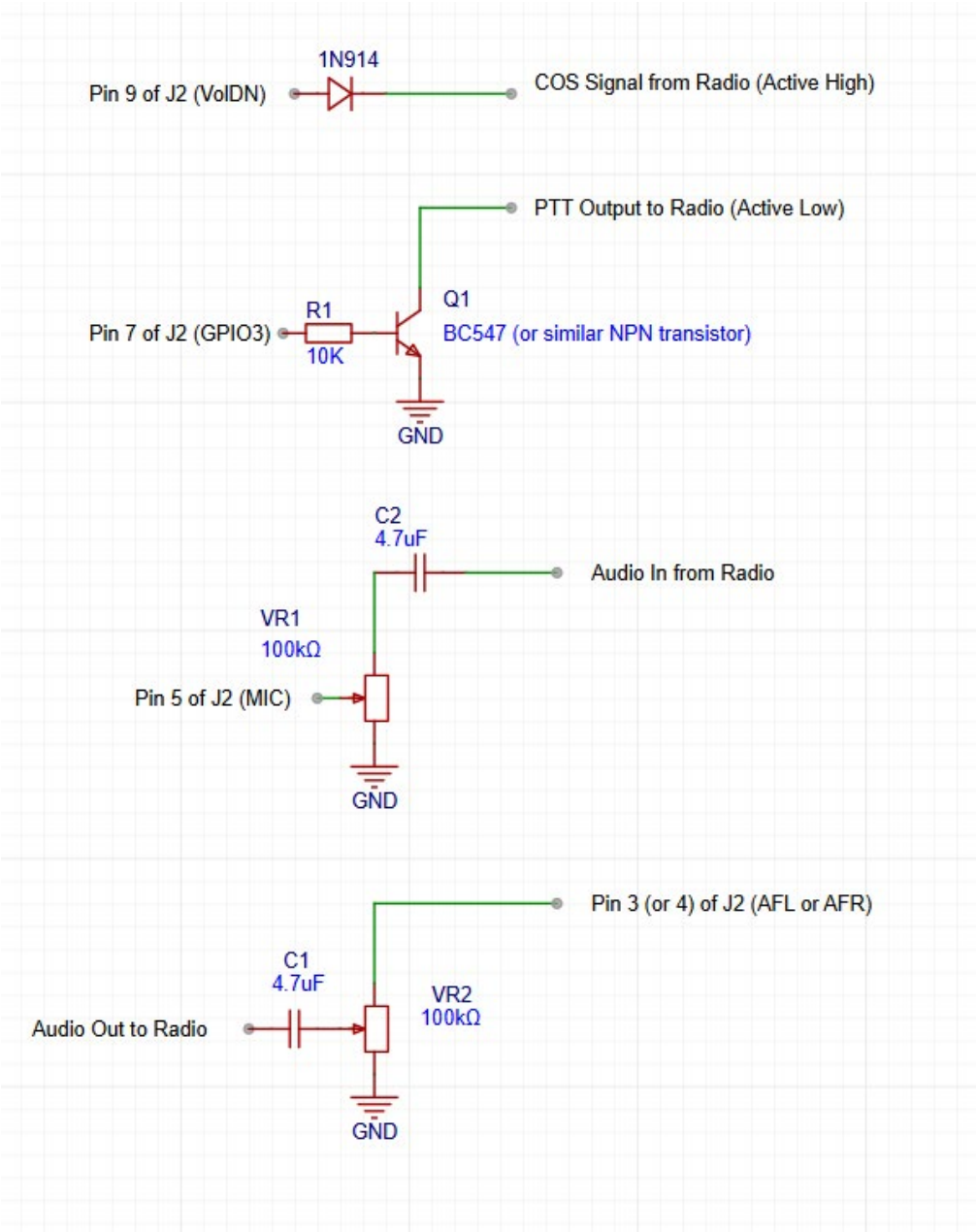
| Pin | Label | Function |
|---|---|---|
| 9 | VolDn | COS Input (Carrier/Squelch detect) |
| 10 | VolUp | Unused |
| 11 | GND | Ground |
| 12 | GND | Ground |

🔧 **Note**: COS (squelch) signal is received via the **VolDn** line (GPIO2), clearly marked on the board. It's HIGHLY RECOMMENDED that this be active high logic signalling.

## Setup with AllstarLink

Interfacing to AllstarLink is reasonably straightforward. All that is required are a few extra components to DIY your own solution for your particular radio. The author has had this running on Philips PRM80 and Kenwood TM-D710 radios, however any radio with the required signals should work just fine.

**See the basic wiring diagram on the next page to interface to your radio. This is a bare minimum setup and you can customize to your liking.**




- From top to bottom, we use a 1N914 or 1N4148 signalling diode wired with the anode toward the TOADs DI board and the cathode toward the radio for logic isolation.
- Pin 7 of the TOADs DI Board (GPIO3) is the PTT output. This is active high. Drive a NPN transistor such as a BC547, 548 etc via a 10K resistor. Connect the collector of the transistor to your radio and the emitter to ground.

You can use variable resistors (up to 500kΩ) on the audio input and output lines to make hardware-level adjustments to audio levels. Additional fine-tuning can be done using the SimpleUSB Tune software tool. The 4.7uF capacitors are DC blocking caps. You can use any value in your parts bin from 1uF to 10uF. **Use non-polarity caps or wire the + side toward the radio.**

⚠️ **Tip**: Set your audio levels with a signal generator and/or deviation meter if possible using a 1KHz tone and 3 KHz of deviation for proper audio levels. Further information on setting audio levels is available here: https://wiki.allstarlink.org/wiki/Calibrating_Audio_Levels

You can also make use of the parrot Allstarlink node 55553 which will repeat back your audio for testing.

## Config Example

In your /etc/asterisk/simpleusb.conf file, ensure that carrierfrom=usb and invertptt=0

```
; SimpleUSB configuration
;
; Shown for two nodes. Second node commented out.
;
[general]

[usb]

eeprom=0

rxboost=1   ; 0 = 20db attenuator inserted, 1= 20db attenuator removed
                        ; Set to 1 for additonal gain if using a low-level receiver output

carrierfrom=usb         ; no,usb,usbinvert
                        ; no - no carrier detection at all
                        ; usb - from the COR line on the modified USB sound fob
                        ; usbinvert - from the inverted COR line on the modified USB sound fob

ctcssfrom=no            ; no,usb,usbinvert
                        ; no - CTCSS decoding, system will be carrier squelch
                        ; usb - CTCSS decoding using input from USB FOB
                        ; usbinvert - from the inverted CTCSS line on the modified USB sound fob

invertptt=0   ; Invert PTT 0 = ground to transmit, 1 = open to transmit
                        ; This is the collector lead of the 2n4401 on the modified
                        ; usb sound fob.
                        ; please refer to the howto for the procedure to do this.

; Only uncomment following two lines if necessary for your installation
```

IMPORTANT: The above configuration will need changing if you are using the daughterboard with the TOADs DI. Please see the below sections for more information.

## Additional Notes

- **GPIO4 (Pin 8)** can optionally be used to drive an **LED indicator** for COS activity.

  To enable the active high signal from GPIO4 edit your rpt.conf file in /etc/asterisk:

  1. Verify that there is a statement near line 159 which says events=eventsXXXXX where XXXX is your node number.
  2. If there is a semi-colon in front of it, remove it.
  3. Verify that there is a statement near line 906 which reads [eventsXXXXX] where XXXXX is your node number.
  4. If there is a semi-colon in front of it, remove it.
  5. Look for two lines below the [eventsXXXXX] which state cop,62,GPIO4:1 = c|t|RPT_RXKEYED cop,62,GPIO4:0 = c|f|RPT_RXKEYED
  6. They will probably have semi-colons in front of them. If so, remove them.

  Save rpt.conf and reboot. Transmit to your node and this pin should go active high when receiving a signal.

- You can purchase a **custom daughterboard** that connects to the header for convenient interfacing with various radios.
- No warranty or liability is expressed or implied. **Use at your own risk.**

## Order From:

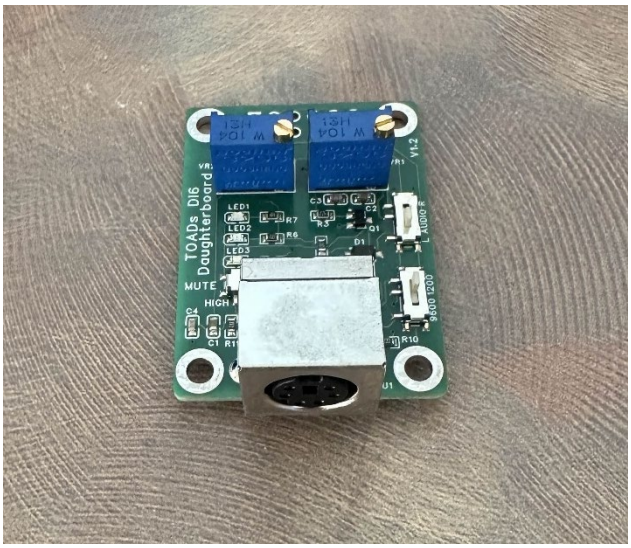
US: https://temporarilyoffline.com/

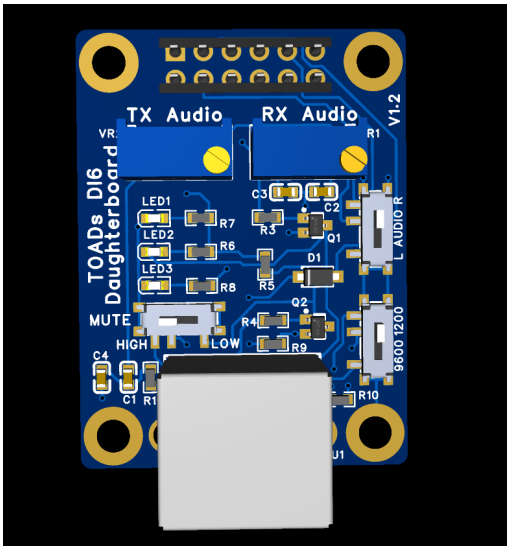
AU/NZ: https://shop.hamradiodx.net

UK: https://shop.m0jsx.radio

# DI6 Daughterboard

The TOADs DI6 is a compact and powerful daughterboard designed to interface directly with the TOADs Digital Interface. It provides seamless connectivity to radios that feature a standard 6-pin Mini DIN data port (commonly used for packet, APRS, and digital voice modes).






**Radio Compatibility:** Fits radios with a 6-pin Mini DIN DATA connector

**Selectable Switches:**

- *MUTE Control:* Choose between High or Low mute logic (see notes about logic below)
- *Audio Source (RX):* Select between the radio's DATA (audio) output source of 1200 bps or 9600 bps
- *Audio Source (TX):* Route audio from either the Left or Right channel of the CM108 sound interface.

**Precision Audio Control:**

- Two 30-turn trimpots for fine adjustment of transmit and receive audio levels—ensuring optimal performance and clean audio for digital modes.

# Headers & Wiring to TOADs DI

Some soldering of headers is required to interface with the TOADs DI board. Solder 2.54mm 2x6 **pin headers** to the top of the TOADs DI board. Solder 2x6 pin socket to the bottom of the daughterboard. You can use standoffs to support the boards if required.

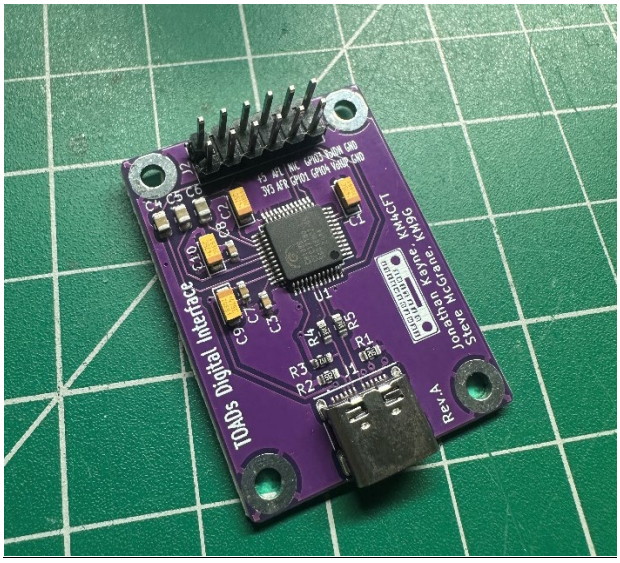
You can obtain these cheaply from AliExpress or any other electronic store/Amazon

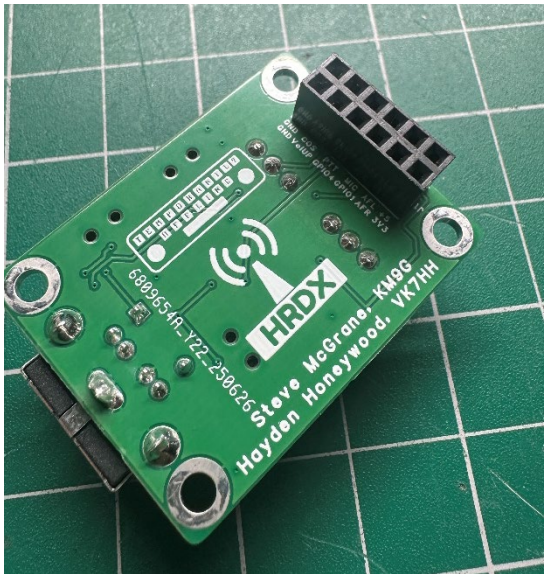
**Make sure they are 2.54mm 0.1” - 2x6 pins**

https://s.click.aliexpress.com/e/_oERUqYI

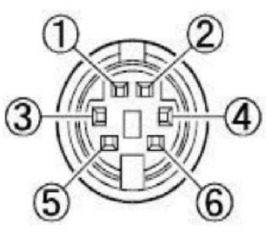
https://s.click.aliexpress.com/e/_onTwcMq

Wires can be used to solder between the boards however this is generally **not recommended.**



# DB6 Mini DIN Wiring Notes




| Pin | Label | Note |
|---|---|---|
| 1 | PKD (DATA IN) | Packet Data Input<br>*Impedance*: 10 kΩ,<br>*Maximum Input Level*: 40 mV p-p for 1200 bps<br>2.0 Vp-p for 9600 bps |
| 2 | GND | Signal Ground |
| 3 | PTT | Gound to Transmit |
| 4 | RX9600 | 9600 bps Packet Data Output<br>*Impedance*: 10 kΩ, *Maximum Output*: 500 mV p-p |
| 5 | RX1200 | 1200 bps Packet Data Output<br>*Impedance*: 10 kΩ, *Maximum Output*: 300 mV p-p |
| 6 | PKS (SQL) | Squelch Control<br>*Squelch Open*: +5 V, *Squelch Close*: 0 V |

Wiring diagram as viewed from rear panel of radio

⚠️ **IMPORTANT: Understanding "DATA" vs. "Audio" Terminology**

**Radio manufacturers often use the term "DATA" to refer to connections intended for TNCs or packet modems. In reality, these are audio lines, not digital data lines. For clarity throughout this guide, you can interpret "DATA" as "Audio". Baud rates (1200/9600) referenced below relate to audio filtering and are explained in more detail later.**

6-Pin Mini DIN Connector Overview

The diagram above shows the pinouts for the standard 6-pin Mini DIN connector found on the rear of many Yaesu, Icom, and Kenwood mobile radios.

⚠️ IMPORTANT: It is the user's responsibility to verify compatibility and correct wiring for their specific radio. Refer to your radio's manual for exact details.

**DB6 Pinout Description:**

- **Pin 1 – DATA IN (Audio Input)**
  This is the audio input to the radio. Radios typically allow the user to select between:
- **Processed Mic Audio** (commonly labeled "1200 baud")
- **Flat Audio Input** (commonly labeled "9600 baud")
  Flat audio usually requires a higher drive level.

**Examples:**

- Yaesu FT-8900: Menu #26 (PCKT S)

- Kenwood TM-D710: Menu #518 (EXT.Data Speed)
  Consult your radio's manual for exact configuration.

  In most cases, using **1200 baud (processed audio)** works reliably.

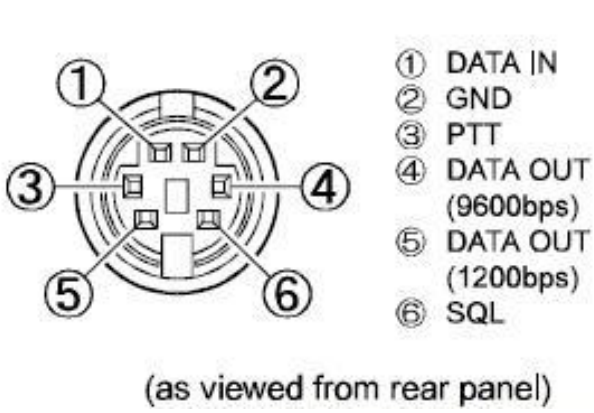
- **Pin 2 – GND**

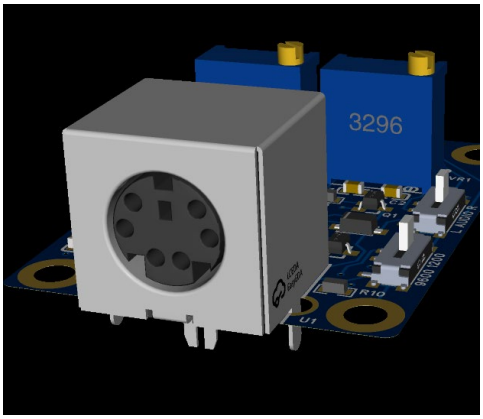
  **Pin 3 – PTT (Push-To-Talk)**
  Pull to ground to activate transmit.

  **Pin 4 – DATA OUT (RX9600)**
  Unprocessed, flat receive audio (no de-emphasis).

  **Pin 5 – DATA OUT (RX1200)**
  Processed receive audio (with de-emphasis).

  **Pin 6 – PKS / Squelch Logic**
  Mute/squelch indication logic, active high or low (selectable – see below)




⚠️ **NOTE**: The connector on the DI6 board is reversed (flipped upside down) compared to the wiring diagram. Ensure you double-check your cable orientation before connecting.

**Cable Options**

You can use a straight-through Male to Male Mini DIN 6-pin cable, available from online sources like **AliExpress** or **Amazon**, to connect the TOADs DB6 board to most compatible radios. Shielded is best.

Amazon: https://geni.us/PAQBkW8

AliExpress: https://s.click.aliexpress.com/e/_oBUGS7y

Alternatively, you may DIY your own cable, provided the following connections are available on your radio:

- Mic Audio In
- Receive Audio Out
- Ground
- PTT (pull to GND)
- Mute/Squelch (active high or low; selectable via onboard switch)

🔒 **DISCLAIMER**: No warranty or liability is expressed or implied. Use at your own risk.

## DI6 Audio Adjustment, Onboard Switches & LEDs

The DB6 board includes two 30-turn trimpots for fine-tuning audio levels:

- **RX Audio** – Adjusts the level **from** the radio to the TOADs DB6 board.
- **TX Audio** – Adjusts the level from the TOADs DB6 board **to** the radio.

Additionally, there are three onboard switches for customizing operation:

- **COS** – Selects either **high** or **low** logic for squelch indication (see below note)
- **1200/9600** – Chooses between **processed** (Pin 5) or **flat** (Pin 4) audio output from the radio.
- **L / R AUDIO** – Selects whether to use the **left** or **right** audio channel from the CM108 chip on the DB6 board.

There are three onboard LED's to indicate Power (Green), PTT (Red) and COS (Blue or White). If a LED is too bright, use a sharpie/permanent marker across the LED to dim it down a touch.

## IMPORTANT: COS Input

On daughterboards with a version number 1.2 or lower there is a switch to select either active high or active low signalling depending on the output from your radio. As the DI6 was designed for radios that use active-high signalling this is the HIGHLY recommended option. The ASL notes also recommend active-high signalling. https://wiki.allstarlink.org/wiki/Radio_Connections

Using active-low will work, however you may run into a problem. If the radio is switched OFF – this then sends an "active-low" signal to the CM108 and it thinks the node is "keyed". If you have AllstarLink remote nodes connected – they will lock up on transmit and timeout!!

**Note - this only applies to radios using active-low logic and those that use active high are not affected.**

**An alternative to active-low radios (to avoid the above) is to not use COS at all and instead potentially use the USBRadio driver instead of simpleusb which uses DSP to detect carrier.**

**https://wiki.allstarlink.org/wiki/USBRadio_Channel_Driver**

## Document Changes:

V1.0

v.1.1 – Updated errata referencing CM108 PTT to the wrong pin in example wiring diagram

v1.2 – Added  dimensions image

v1.3 – Added TOADs DB6 daughterboard information

v1.4 – minor corrections and formatting

v1.5 – corrections and updates related to the daughterboard mute logic lines

v.1.6 – Updated COS Input notes