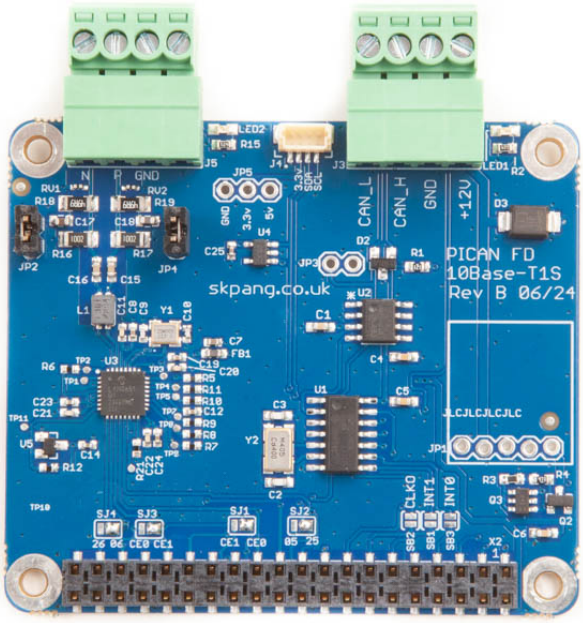

PiCAN FD Board with 10Base-T1S for Raspberry Pi

USER GUIDE V1.0

July 2024

Product name	PiCAN FD Board with 10Base-T1S for Raspberry Pi
Model number	RSP-PICANFD-T1S
Manufacturer	SK Pang Electronics Ltd

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1. Introduction

This board has a 10Base-T1S Single Pair Ethernet (SPE) port and a CAN FD port.

The 10Base-T1S is provided by the Microchip LAN8651 chip. The CAN FD is provided by the Microchip MCP2518FD CAN controller. Connection is via 4 way pluggable terminal.

The improved CAN FD extends the length of the data section to up to 64 bytes per frame and a data rate of up to 8 Mbps.

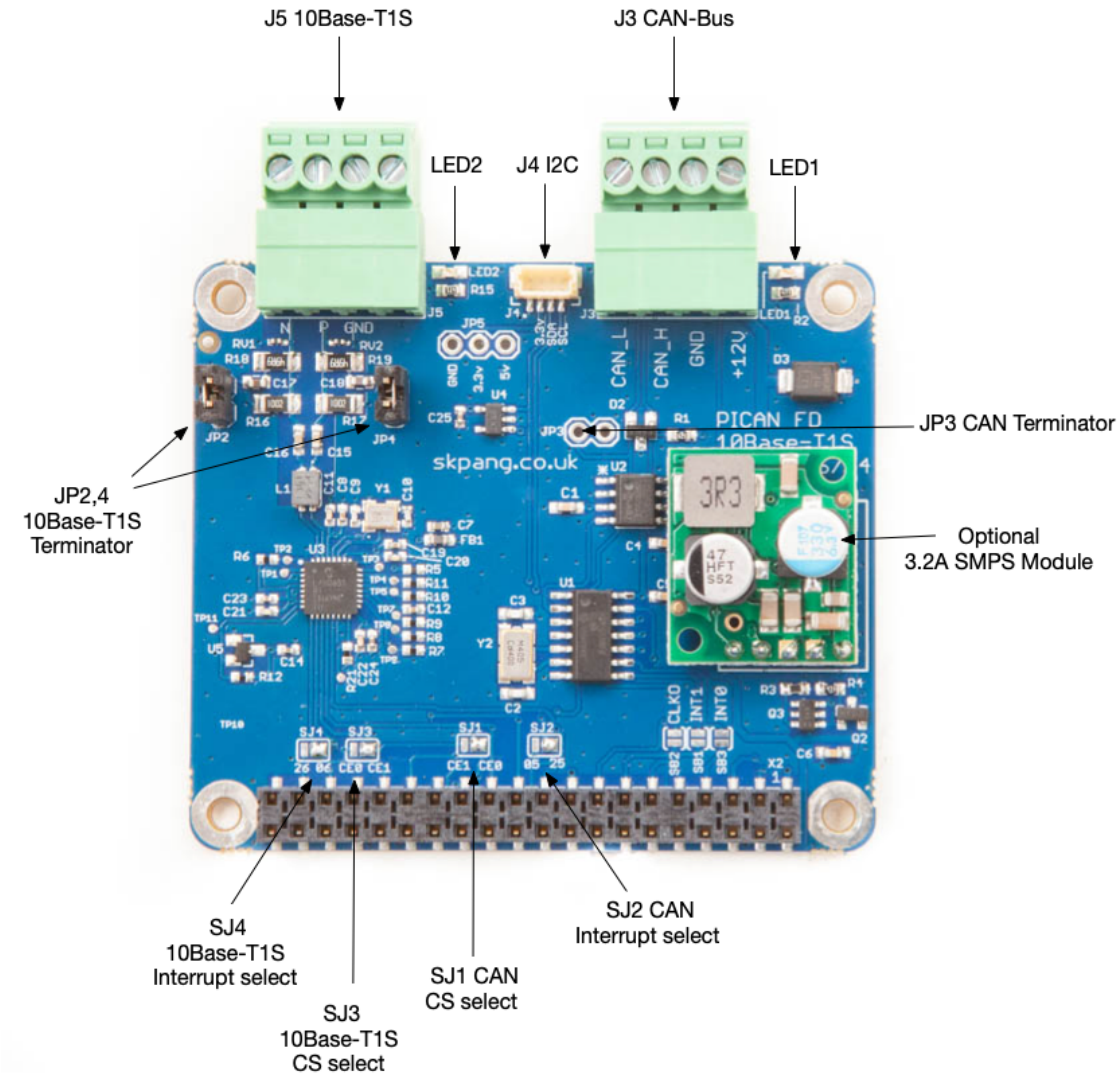
Easy to install SocketCAN driver for CAN applications.

1.1. CAN FD Features

- Arbitration Bit Rate upto 1Mbps
- Data Bit Rate up to 8Mbps
- CAN FD Controller modes
- Mixed CAN2.0B and CANFD mode
- CAN2.0B mode
- Conforms to ISO11898-1:2015
- High speed SPI Interface
- CAN connection via 4 way pluggable terminal
- 120Ω terminator ready
- LED indicator
- Four fixing holes, comply with Pi Hat standard
- SocketCAN driver, appears as can0 to application
- Interrupt RX on GPIO25

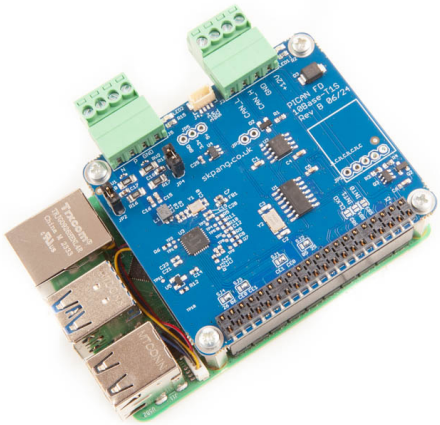
1.2. 10Base-T1S Features

- Microchip LAN8651 MAC/PHY controller
- PHY designed to IEEE Std. 802.3cgTM-2019
- 10 Mbit/s over a single balanced pair
    - Half-duplex multidrop mixing segments up to at least 25m with up to at least 8 PHYs
    - Half-duplex point-to-point link segments upto at least 15m
- Physical Layer Collision Avoidance (PLCA)
    - Burst mode for transmission of multiple packets • for latency-sensitive applications
    - Minimize latency for time-sensitive applications by assigning multiple PLCA IDs per node
- Carrier Sense Multiple Access / Collision Detection (CSMA/CD) media access control
- Application Controlled Media Access (ACMA) for implementation of collision-free Time-Division Multiple Access (TDMA) methods
- Industry standard Serial Peripheral Interface (SPI), designed to the OPEN Alliance 10BASE-T1x MAC-PHY Serial Interface specification, V1.1
- Unique 48-bit MAC address provided by 24AA02E48 IC



2. Hardware Installation

Before installing the board make sure the Raspberry is switched off. Carefully align the 40way connector on top of the Pi. Use spacer and screw (optional items) to secure the board.



If the install is on the Raspberry Pi 5 with a fan fitted then this height extender is required:

https://www.skpang.co.uk/products/raspberry-5-header-extender-kit

1.3. CAN Bus connection

The CAN bus connection is on connector J3.

J3 pin no.	Function
1	CAN_L
2	CAN_H
3	GND
4	+12v

Note : The +12v In is only used on the board with SMPS option fitted.

1.4. 10Base-T1S Connection

The 10Base-T1S connection is on connector J5.

J5 pin no.	Function
1	N
2	P
3	GND
4	

1.5. CAN Bus 120Ω Terminator

There is a 120Ω fitted to the board. To use the terminator solder a 2way header pin to JP3 then insert a jumper.

1.6. 10Base-T1S Terminator

There are two 10Base-T1S terminators fitted on the board. JP2 and JP4. Remove the jumpers if terminator is not required.

1.7. LED Indicators

There are two red LEDs fitted to the board. These are user programmable via GPIOs.

LED1 connected to GPIO22.

LED2 connected to GPIO19.

1.8. Optional 3.2A SMPS

Switch mode power supply module, this is an optional 5v module that can power the Pi. It has an input voltage range of 8v to 26v. The total power drawn by the Pi and any other connected peripherals must be less then 3.2A

3. Software Installation

It is best to start with a brand new Raspbian image. Download the latest from:

https://www.raspberrypi.org/downloads/raspbian/

After first time boot up, do an update and upgrade first.

```
$ sudo apt-get update
$ sudo apt-get upgrade
$ sudo reboot
```

Add the overlays by:

```
$ sudo nano /boot/firmware/config.txt
```

Add these lines to the end of file:

```
dtparam=spi=on
dtparam=i2c_arm=on
dtoverlay=lan865x
dtoverlay=mcp251xfd,spi0-0,interrupt=25
```

Reboot Pi:

```
$ sudo reboot
```

1.9. Installing CAN Utils

Install the CAN utils by:

```
$ sudo apt-get install can-utils
```

1.10. Bring Up the Interface

You can now bring the CAN interface up with CAN 2.0B at 500kbps:

```
$ sudo /sbin/ip link set can0 up type can bitrate 500000
```

or CAN FD at 500kpbs / 2Mbps. Use copy and paste to a terminal.

```
$ sudo /sbin/ip link set can0 up type can bitrate 500000 dbitrate 2000000 fd on
sample-point .8 dsample-point .9
```

Connect the PiCAN2 to your CAN network via screw terminal or DB9.

To send a CAN 2.0 message use :

```
$ cansend can0 7DF#0201050000000000
```

This will send a CAN ID of 7DF. Data 02 01 05 – coolant temperature request.

To send a CAN FD message with BRS use :

```
$ cansend can0 7df##15555555555555555
```

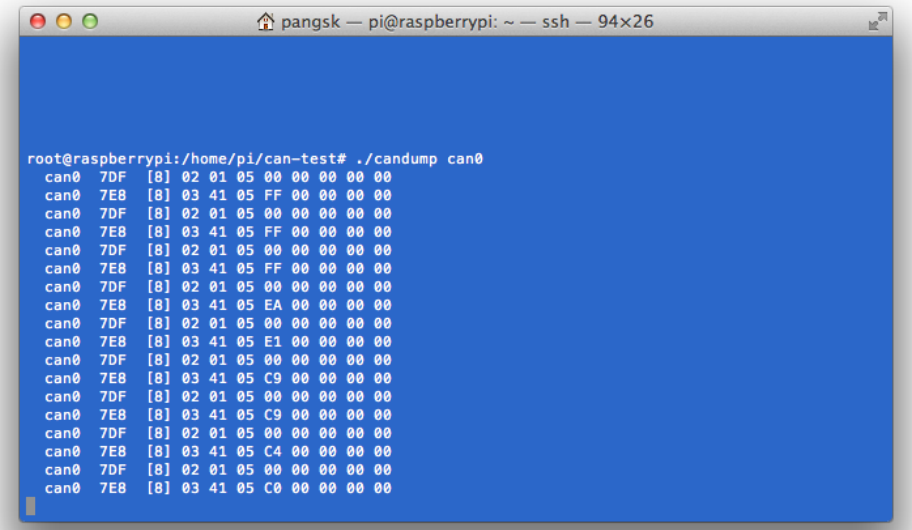
To send a CAN FD message with no BRS use :

```
$ cansend can0 7df##05555555555555555
```

Connect the PiCAN to a CAN-bus network and monitor traffic by using command:

```
$ candump can0
```

You should see something like this:



4. Python Installation and Use

Ensure the driver for PiCAN FD is installed and working correctly first.

Clone the pythonCan repository by:

```
$ git clone https://github.com/hardbyte/python-can
```

```
$ cd python-can
```

```
$ sudo python3 setup.py install
```

Check there is no error been displayed.

Bring up the can0 interface:

```
sudo /sbin/ip link set can0 up type can bitrate 500000 dbitrate 2000000 fd on sample-point .8 dsample-point .8
```

Now start python3 and try the transmit with CAN FD and BRS set.

```
$ python3
```

```
import can
```

```
bus = can.interface.Bus(channel='can0', bustype='socketcan',fd = True)
```

```
msg = can.Message(arbitration_id=0x7de,is_fd = True, bitrate_switch =
True,data=[0,0,0,0,0,0x1e,0x21,0xfe, 0x80, 0, 0,1,0])
```

```
bus.send(msg)
```

```
pi@raspberrypi:~/python-can $ python3
Python 3.5.3 (default, Jan 19 2017, 14:11:04)
[GCC 6.3.0 20170124] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import can
>>> bus = can.interface.Bus(channel='can0', bustype='socketcan_native',fd = True)
>>> msg = can.Message(arbitration_id=0x7de,extended_id=False,is_fd = True, bitrate
_switch = True,data=[0,0,0,0,0,0x1e,0x21,0xfe, 0x80, 0, 0,1,0])
>>> bus.send(msg)
>>>
```

To received messages and display on screen type in:

```
notifier = can.Notifier(bus, [can.Printer()])
```

```
pi@raspberrypi:~/python-can $ python3
Python 3.5.3 (default, Jan 19 2017, 14:11:04)
[GCC 6.3.0 20170124] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import can
>>> bus = can.interface.Bus(channel='can0', bustype='socketcan_native',fd = True)
>>> msg = can.Message(arbitration_id=0x7de,extended_id=False,is_fd = True, bitrate_switch = True,data=[0,0,0
,0,0,0x1e,0x21,0xfe, 0x80, 0, 0,1,0])
>>> bus.send(msg)
>>> notifier = can.Notifier(bus, [can.Printer()])
>>> Timestamp: 1521407261.782672         ID: 0123    S          DLC: 5    01 22 33 44 04
Timestamp: 1521407262.494297         ID: 0123    S          DLC: 5    01 22 33 44 04
Timestamp: 1521407263.006066         ID: 0123    S          DLC: 5    01 22 33 44 04
Timestamp: 1521407263.406438         ID: 0123    S          DLC: 5    01 22 33 44 04
Timestamp: 1521407265.154456         ID: 07df    S          DLC: 8    23 41 23 41 34 23 04 00
Timestamp: 1521407265.746158         ID: 07df    S          DLC: 8    23 41 23 41 34 23 04 00
Timestamp: 1521407266.226386         ID: 07df    S          DLC: 8    23 41 23 41 34 23 04 00
Timestamp: 1521407307.873616         ID: 0123    S     F    DLC: 12    01 22 33 44 04 00 00 00 00 00 00 00
Timestamp: 1521407308.385764         ID: 0123    S     F    DLC: 12    01 22 33 44 04 00 00 00 00 00 00 00
Timestamp: 1521407308.816160         ID: 0123    S     F    DLC: 12    01 22 33 44 04 00 00 00 00 00 00 00
>>>
```

Documentation for python-can can be found at :

```
$ https://python-can.readthedocs.io/en/stable/index.html
```

More examples in github:

```
$ https://github.com/skpang/PiCAN-FD-Python-examples
```

5. 10Base-T1S Driver Install

On the Raspberry Pi, at the prompt type in:

```
$ git clone https://github.com/skpang/10Base-T1S_tools.git

$ cd 10Base-T1S_tools/

$ sudo cp lan865x.dtbo /boot/overlays/

$ chmod +x ethtool
```

```
$ unzip lan865x-linux-driver-0v4.zip

$ cd lan865x-linux-driver-0v4/

$ sudo apt-get --assume-yes install build-essential cmake subversion
libncurses5-dev bc bison flex libssl-dev python3

$ sudo wget https://raw.githubusercontent.com/RPi-Distro/rpi-
source/master/rpi-source -O /usr/local/bin/rpi-source && sudo chmod +x
/usr/local/bin/rpi-source && /usr/local/bin/rpi-source -q --tag-update

$ make

$ cp microchip_t1s.ko ../

$ cp lan865x_t1s.ko ../

$ sudo reboot

$ cd 10Base-T1S_tools
```

For Raspberry Pi 5, type in:

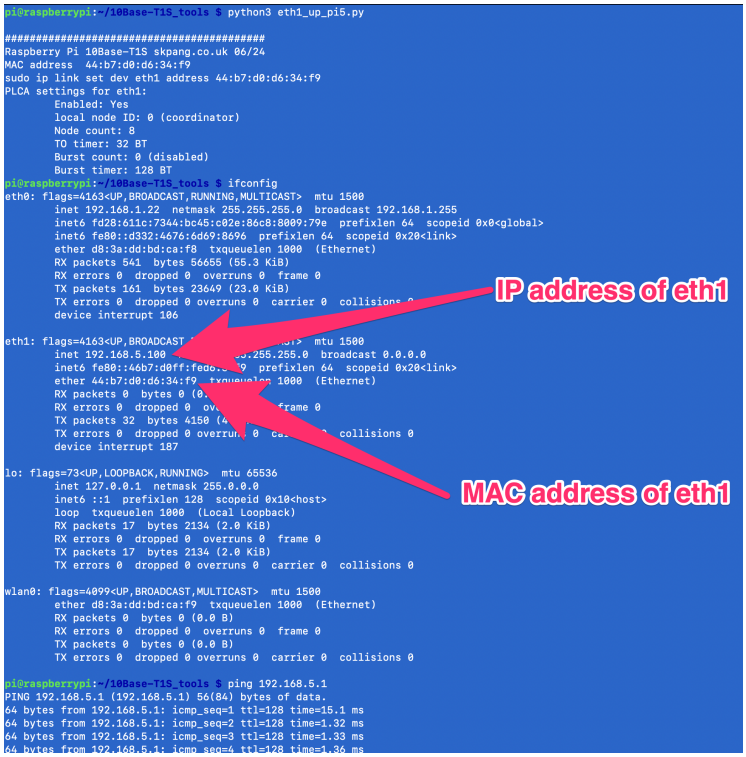
```
$ python3 eth1_up_pi5.py
```

For Raspberry Pi 4, type in:

```
$ python3 eth1_up_pi4.py

$ ifconfig
```

You should see something like this:



This shows eth1 is up.

Using a twisted pair wire, connect to J5 and the other end to a Microchip EVB-LAN8670-USB. Install the Windows driver and Wireshark software.

On the Raspberry Pi, at the prompt type in:

```
$ python3 10Base-T1S_UDP_demo.py
```

On the Windows machine start Wireshark software and select the EVB-LAN8670-USB interface. You should see something like this: