TIMEX sinclair

2068 PERSONAL COLOR COMPUTER PICO INTERFACE

USER MANUAL

TIMEX sinclair

2068 PERSONAL COLOR COMPUTER PICO INTERFACE

USER MANUAL

David Anderson
Author
timexsinclair.com

Evlyn Moreau
Illustrations
www.patreon.com/evlynmoreau

Special Acknowledgements

We would like to acknowledge the people who gave us their feedback, comments and contributions.

The people at Timex Computer Corporation. The Timex Sinclair 2068 made such an impression on us that we are still using it 40 years later.

Johan "Dr Beep" Koelman, whose PC-ZX interface inspired the TS Pico.

The Timex Sinclair community, especially the folks on the Groups.io TS2068 list and attendees of the Zoom meetings, for their encouragement and feedback.

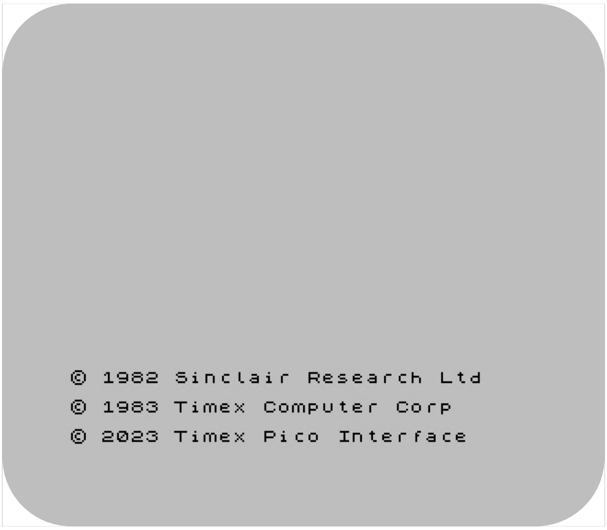
Our families for supporting us during the many late nights and weekends while we developed the TS Pico, hammered out features, squashed bugs and finally got this in your hands.

Printed
Dec 3, 2023

Manual version: 1.1

Table of Contents

General Description and Operation



```
© 1982 Sinclair Research Ltd
© 1983 Timex Computer Corp
© 2023 Timex Pico Interface
```

Thank you selecting the Timex Pico Interface, or the TS Pico, as we like to call it.

This new interface was developed for the Timex Sinclair 2068 computer. It is a user-extensible interface to the Raspberry Pi Pico and a digital file storage solution.

Programmed in MicroPython, the TS Pico allows you to save and load programs from TAP files on an SD card. It features 512k of Flash memory, some of which holds its advanced operating system and some of which is available to you, as well as 512K of static RAM, all of which is available to you.

The TS Pico is difficult, but not impossible, to break. We do not recommend to making electronic or programming modifications if you do not have sufficient technical knowledge. It is possible to cause irreparable damage to the interface or to your computer.

The TS Pico extends standard BASIC SAVE, LOAD, VERIFY and MERGE commands, described in chapter 2. The commands start with *tpi:* and they are only interpreted as extended commands if the TS Pico is connected and operational to the TS-2068.

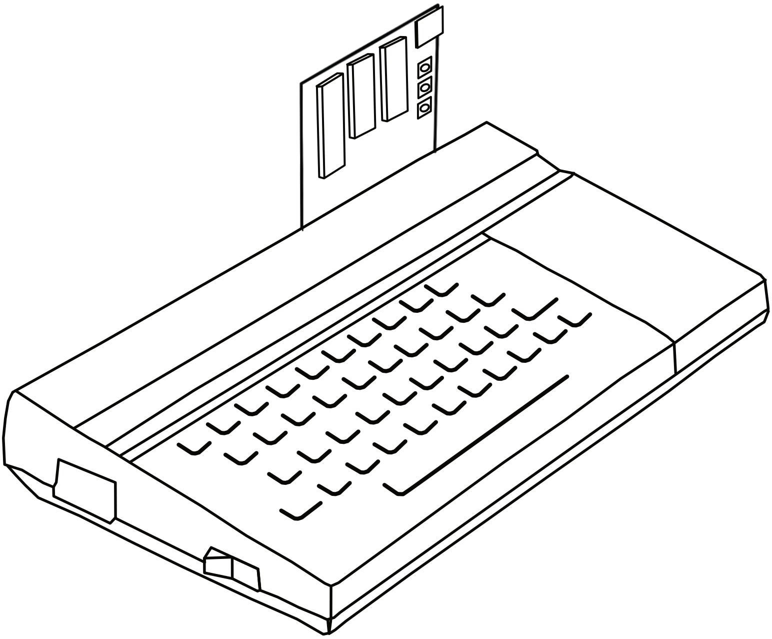
What are TAP Files?

TAP files are the digital equivalent of a cassette tape. Like cassette tapes, they can hold one or more individual files.

The advantage of the TAP file format is that it behaves exactly like a tape, so programs written for use with a cassette tape will behave as expected.

Frogger, for instance, is actually several files on a cassette tape: a loader, a screen file that displays while the actual program loads. The Frogger TAP file contains all three of those programs.

Installing the TS Pico



Turn off your TS 2068 before connecting the TS Pico to your computer.

Remove any cartridges from the computer.

The TS Pico comes in two styles: direct connect and expansion bus.

The direct connect style plugs into your computer and will extend horizontally. When you plug it into your computer, line up the key with the key slot on the expansion connector and press the board in until it is firmly attached.

The other style plugs into an expansion bus that is in turn plugged in to your TS 2068.

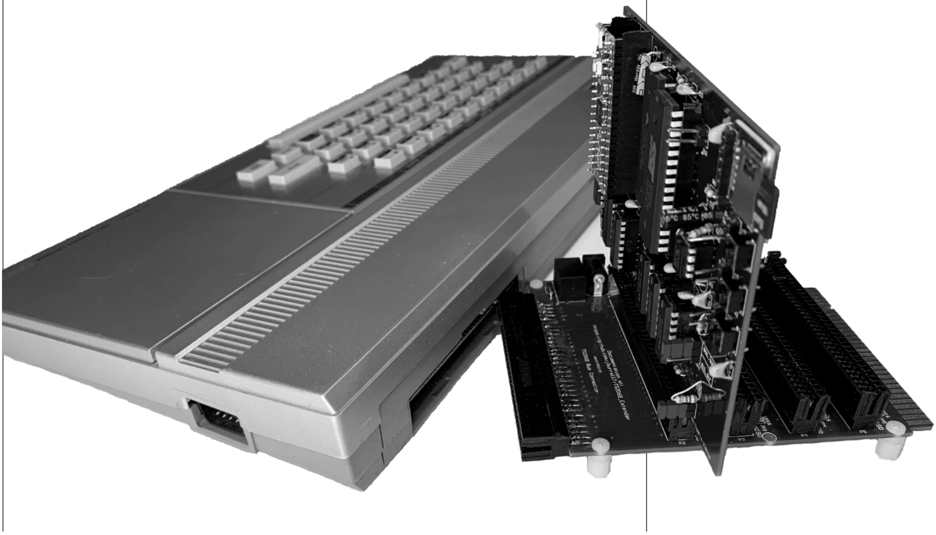
With this style, line up the slot on the TS Pico board with the key in the slot on the expansion bus and press firmly until it is seated in the connector.

Next, plug the expansion bus (which is also keyed) into the TS 2068.

Regardless of which style you have, you'll notice a fair amount of resistance plugging the card into the slot or on to the expansion bus on the back of the computer. This is normal.

In both cases, the TS Pico has a "key" in the appropriate slot to ensure it plugs in correctly.

Turn on your computer and, if the interface is recognized, you will see the normal Sinclair and Timex copyright notices along with a new notice from the TS Pico after a few seconds.



Exploring the TS Pico

The TS Pico has a few hardware features worth exploring before jumping into using it.

First and foremost is the Raspberry Pi Pico, an embedded computer designed to support all kinds of projects. The TS Pico uses a custom MicroPython program, in conjunction with a modified version of the TS 2068 operating system, stored in the Flash ROM, to add features to your TS 2068.

Raspberry Pi Pico

The Raspberry Pi Pico has an LED on it that indicates its status. The LED will blink about once a second when the Pico is idle and waiting for a command.

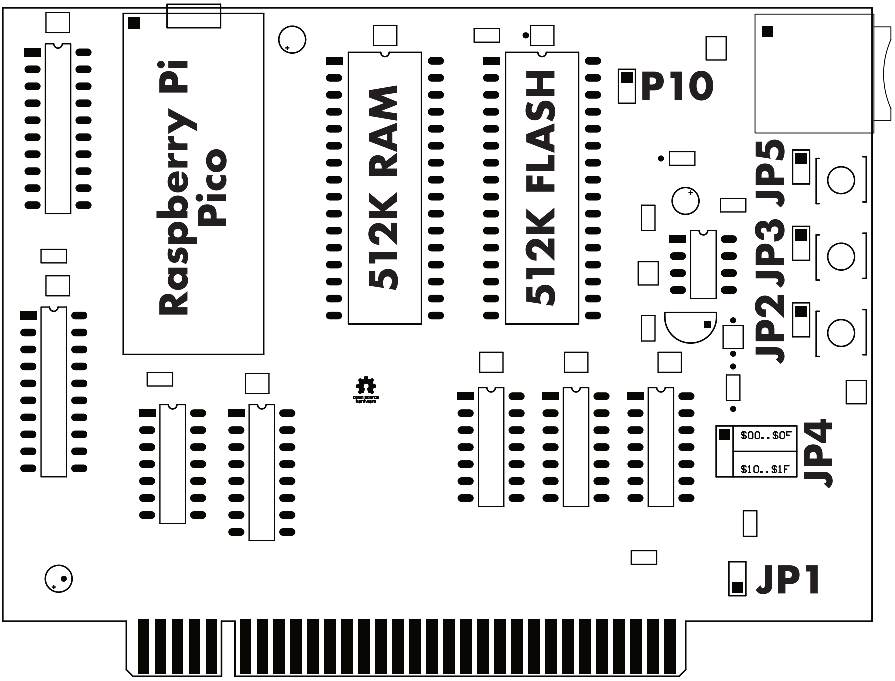
The LED will turn on and stay on when Pico is processing a command or waiting for input from you.

On the off chance the Pico gets confused or a command doesn't perform as expected, the Pico and your computer will appear to pause, for several seconds. Eventually, the watchdog timer in the Pico will cancel the command and reset its buffers. You'll likely see the LED go dark when this happens.

Pushbuttons

There are three pushbuttons on the TS Pico: Pico Reset, TS Reset and NMI.

At the time this manual was written, only the TS Reset button works. Pressing it will reset your TS 2068.



Jumpers

The TS Pico has several jumpers worth noting.

- **JP1** configures how the TS Pico works with other devices when plugged into the expansion bus. When used with the appropriate jumper on the expansion bus, the TS Pico can recognize when a device “behind” it wants to take control of the computer via the /BE signal and will get out of that way of that device.
- **JP2**, **JP3** and **JP5** are optional. They allow you to connect a remote switch for the switches. They’re useful if you want to put your TS Pico and expansion bus in a

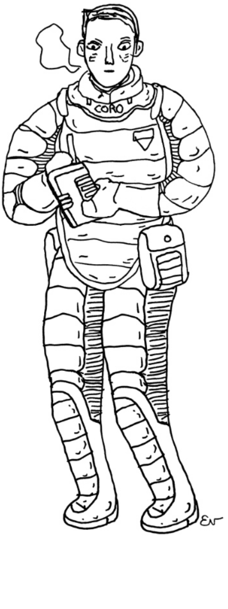
3D-printed enclosure, for instance.

- **JP4** selects the IO port range the TS Pico will recognize. It defaults to port 14 and the $00..$0F range should be jumpered.
- **P10** controls the Write Enable line on the Flash ROM. When there's no jumper on these pins, it's impossible to reprogram the Flash ROM.

The Two Big Chips

Right next to the Raspberry Pi Pico are two large chips. The chip in the middle is 512K of static RAM; it is soldered directly to the circuit board.

The chip further right is the Flash ROM. It's in a socket. If upgrades to the Flash ROM become available, you'll be able to remove this chip from the TS Pico and reprogram it yourself or replace it with another programmed Flash ROM chip.



The SD Card Slot

At the upper right corner of the TS Pico is the SD card slot. This is where your TAP files are stored.

You should always have a card in this slot, especially when you turn the computer on. The TS Pico will attempt to mount and get a directory of files on the SD card when the computer is powered on.

Using the TS Pico

Your TS Pico uses extended versions of the TS 2068 LOAD and SAVE commands to perform its operations.

All TS Pico commands are prefixed with *tpi:*, to signal that a command will follow.

LOAD: The Basics

The TS Pico uses the LOAD command to perform the following operations:

- Load (“mount”) a TAP file
- Print the contents of the current working directory
- Print the contents of a mounted TAP file
- Print the path to the current working directory

SAVE: Sending Commands

The TS Pico uses the SAVE command for instructions that aren’t directly related to loading files:

- Changing the working directory
- Creating a new subdirectory
- Deleting a subdirectory
- Navigate through files in a TAP file
- Unmounting a TAP file
- Switch between physical tape and TS Pico

LOAD: Mount a TAP File

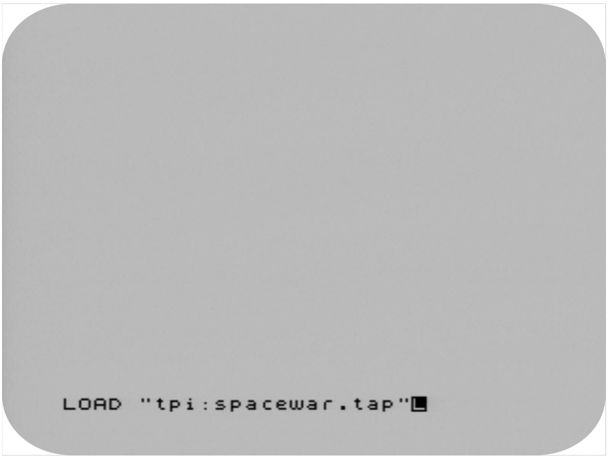
LOAD “tpi:filename.tap”

The first and most basic thing you can do with your TS Pico is to LOAD a TAP file.

This command instructs the TS Pico to “mount” the TAP file. It is the equivalent of inserting a cassette tape into your tape player.

To mount a TAP file, enter:
LOAD “tpi:filename.tap” and press Enter.

Replace *filename.tap* with the name of the TAP file to mount. Filenames *are* case-sensitive: frogger.tap and Frogger.tap are different files.



```
LOAD "tpi:spacewar.tap"L
```

If the TS Pico finds the TAP file in the current working directory, it will load the file and report `0 OK, 0:1`.

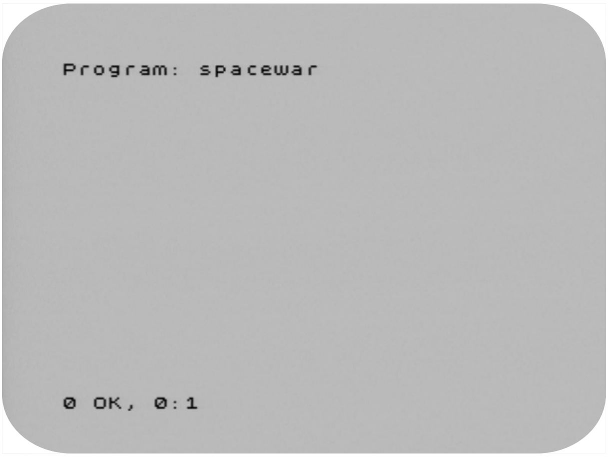
Once you’ve mounted the TAP file, you can

load any file or program in the TAP file with the appropriate commands.

To load the first file in the TAP file, type:

LOAD “”

Your TS 2068 will load the first file within the TAP file and report the type and its filename, just as if it were loading from actual tape, only loads faster.

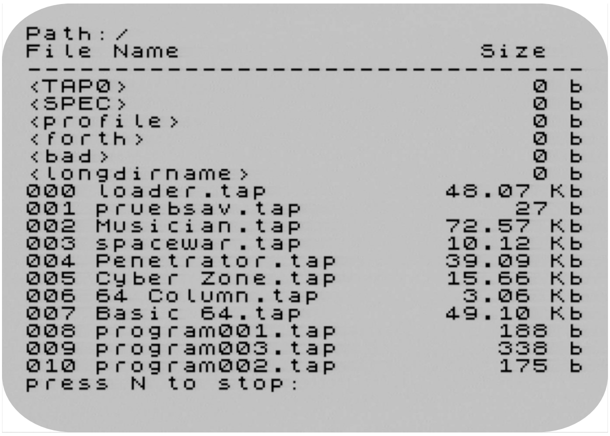


```
Program: spacewar




0 OK, 0:1
```

DIR: Get a Directory



```
Path:/
File Name                 Size
--------------------------------
<TAP0>                       0 b
<SPEC>                       0 b
<profile>                    0 b
<forth>                      0 b
<bad>                        0 b
<longdirname>                0 b
000 loader.tap          48.07 Kb
001 pruebsav.tap            27 b
002 Musician.tap        72.57 Kb
003 spacewar.tap        10.12 Kb
004 Penetrator.tap      39.09 Kb
005 Cyber Zone.tap      15.66 Kb
006 64 Column.tap        3.06 Kb
007 Basic 64.tap        49.10 Kb
008 program001.tap         188 b
009 program003.tap         338 b
010 program002.tap         175 b
press N to stop:
```

LOAD "tpi:dir"

Chances are good that you won't remember all the TAP files on your SD card. That's where the *tpi:dir* command comes in handy.

When you send the directory request to the TS Pico, it'll scan the current working directory and report its contents back to you.

If there are more than 20 files in the directory, you'll see a prompt at the bottom of the screen to *Press N to stop:*

If you press any other key, the directory will continue to scroll through the items until all have been displayed.

Interpreting the Directory Output

The directory listing starts by printing the current working directory, or Path.

Subsequent lines display an index number for the file, the file name and file size.

Subdirectories are enclosed in <>. In the example to the left, <TAP0>, <SPEC>, <profile>, <forth> and <bad> are subdirectories.

PATH: Display the Path

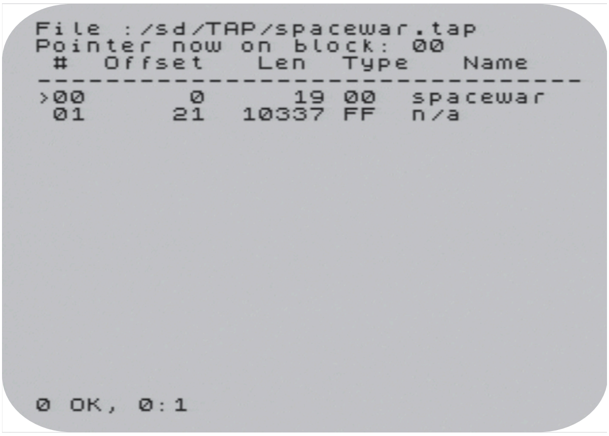
```
LOAD "tpi:path"
```

When you turn your TS 2068 on, the TS Pico will mount the /TAP folder on the SD card as the root, or base, folder.

Using the CD command, you can navigate to child directories.

While you can use DIR to see the current working directory and its files, there may be times when you only want to know what directory you are in. The PATH command will display just the current working directory.

TAPDIR: List files inside a TAP



```
File :/sd/TAP/spacewar.tap
Pointer now on block: 00
 #   Offset    Len   Type    Name
--------------------------------
>00       0      19  00   spacewar
 01      21   10337  FF   n/a




0 OK, 0:1
```

LOAD “tpi:tapdir”

Once you’ve mounted a TAP file with LOAD ”tpi:filename.tap”, you can use TAPDIR to see the files inside it.

It’s important to note that TAP files can contain a number of individual files, but the minimum is usually two. TAP files are organized in blocks.

Almost every TAP file contains two files per program or data file within it: the header and the file itself. This format duplicates how the TS 2068 actually stores files on cassette tape.

The header holds information about the program or data file, including the file name, if there is one. The header is usually 19 bytes long and has a type of 00.

The program or data file does not have a filename, so you’ll see “n/a” in the filename column. It will have a variable file length and the type will be FF.

Some programs used “headerless” files as a way of copy protection, so you may see a program or data file that does not have a header file listed before it.

TAPDIR will tell you which block the “pointer” is on in a message and with a > next to the block. The pointer is where the next LOAD command will start.

CD: Change Working Directory

SAVE “tpi:cd path”

The TS Pico supports subdirectories on your SD card. We recommend using subdirectories to manage your TAP files, especially if you have a lot.

The CD command will tell the TS Pico to change to that directory.

The TS Pico will check if the directory exists before changing. It will ignore the command if the directory does not exist.

You can move “back up” to the parent directory with:

SAVE “tpi:cd ..”

You can only move up one directory level at a time. The TS Pico will not let you move above the root directory.

You can move to the root (top level) directory with:

SAVE “tpi:cd /”

MD: Create a Subdirectory

```
SAVE “tpi:md directory”
```

The MD command will tell the TS Pico to create a subdirectory in the current working directory.

Directory names are limited to 10 characters.

The TS Pico will check if the directory already exists before creating a directory. It will ignore the command if the directory exists.

You can create a subdirectory with the same name as a TAP file without harm.

You can move “back up” to the parent directory with:

```
SAVE “tpi:cd ..”
```

You can only move up one directory level at a time. The TS Pico will not let you move above the root directory.

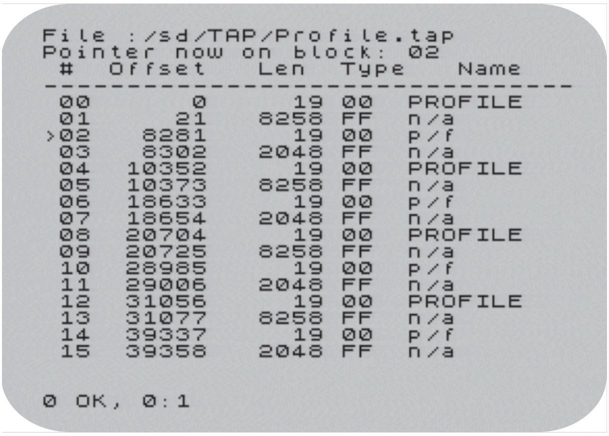
RM: Remove a Subdirectory

```
SAVE “tpi:rm directory”
```

The RM command will tell the TS Pico to remove a subdirectory in the current working directory.

The TS Pico will check if the directory already exists before creating a directory. It will ignore the command if the directory does not exist.

FFW and REW



```
File :/sd/TAP/Profile.tap
Pointer now on block: 02
 #   Offset    Len   Type    Name
-------------------------------
 00       0     19  00   PROFILE
 01      21   8258  FF   n/a
>02    8281     19  00   p/f
 03    8302   2048  FF   n/a
 04   10352     19  00   PROFILE
 05   10373   8258  FF   n/a
 06   18633     19  00   p/f
 07   18654   2048  FF   n/a
 08   20704     19  00   PROFILE
 09   20725   8258  FF   n/a
 10   28985     19  00   p/f
 11   29006   2048  FF   n/a
 12   31056     19  00   PROFILE
 13   31077   8258  FF   n/a
 14   39337     19  00   p/f
 15   39358   2048  FF   n/a

0 OK, 0:1
```

SAVE "tpi:ffw"
SAVE "tpi:rew"

Once you've mounted a TAP File, you can use the tpi:ffw and tpi:rew commands to move the LOAD pointer to different blocks in the TAP file.

In most cases, you'll want to simply LOAD the contents of a TAP file. Sometimes, you may want to skip ahead an load a specific file.

You can do that either by specifying the name of the file within the TAP file or by moving the LOAD pointer to a specific block.

Keep in mind that your TS 2068 wants load a file starting with the header, so in most cases, you'll want to FFW or REW to a header block (type 00; header blocks also show the file name).

CLOSE: Unmount a TAP File

```
SAVE “tpi:close”
```

You must close, or unmount, the TAP file before you mount another TAP file.

Also, if you’d like to remove the SD card from your TS Pico, you should first close any open TAP files.

Once you get the “ok” from the TS 2068, you can safely mount another TAP file or remove the SD card.

TAPE: Use the Cassette

```
SAVE “tpi:tape”
```

Use this command to route SAVE/LOAD commands to the TS 2068’s cassette interface ports (EAR/MIC).

You can use this command to load a file from a physical tape into memory or save the current memory contents to tape.

SDCARD: Use the TS Pico

SAVE “tpi:sdcard”

If you’ve switched to the physical tape interface, use this command to switch back to using the TS Pico.

You can use this command to save a program you’ve loaded from tape to the TS Pico or to save a program loaded from the TS Pico to tape.

TP_MODE System Variable

TP_MODE, a variable at 26686 (683Eh), controls whether SAVE/LOAD/VERIFY/MERGE commands go to cassette or the TS Pico.

SAVE “tpi:tape” sets TP_MODE to 0
SAVE “tpi:sdcard” sets TP_MODE to 1

You can read this variable via PEEK and use it in your programs.

LOADing and SAVEing Files

The TS Pico recognizes the standard TS 2068 BASIC LOAD, SAVE, VERIFY and MERGE commands.

LOADing Files

```
LOAD “”
LOAD “filename”
LOAD “filename” CODE 65000,255
```

Once you’ve mounted a TAP file, you can use the LOAD command with any of the files in the TAP file.

Do not include the “tpi:” prefix when loading a file.

You can use any of the LOAD command options as documented in the TS 2068 manual.

SAVEing Files

```
SAVE “filename”
SAVE “filename” LINE 10
SAVE “filename” CODE 65000,255
```

Similar to the LOAD command, the TS Pico recognizes TS 2068 standard SAVE commands and options.

Note: As of this writing, SAVE will create a new TAP file with the file name provided. The TS Pico does not yet SAVE to a mounted TAP file.

VERIFY and MERGE

The TS Pico recognizes and performs both VERIFY and MERGE commands. Refer to the TS 2068 manual for details on how to use these commands.

File and Directory Management

The TS 2068 has less on-screen display space than some other computers of the same time. As a result, we recommend the following file and directory management practices.

File Management

We recommend using your personal computer to manage files on the SD card.

Consistent with the TS 2068 filename restrictions, limit TAP filenames to 10 characters or less, not including the .TAP extension.

Directory Management

While there's no enforced limit on the number of files you can have in a directory, it's a good practice to not overload the directory.

Instead, use subdirectories to manage your TAP files. Use whatever organization method that makes sense for you. Keep in mind how subdirectories will affect the display of the directory listing.

Troubleshooting

It’s bound to happen. You type in a command and the TS Pico or your TS 2068 throws up its digital hands and says “what the heck?”

While we’ve tried to make the TS Pico as bulletproof as possible, it’s a community project and we’re still learning.

If you encounter an error message, try the directory command to see if the TS Pico is still fully there:

```
LOAD “tpi:dir”
```

If you get a response, chances are you can just keep going.

If not, try:

```
SAVE “tpi:close”
```

If it takes a long time to respond, the watchdog timer in the TS Pico is waiting and will eventually do a soft reset. It’ll clear some internal variables and try to get back to a usable state.

We can’t guarantee that always works, so next try the TS Reset button. It pulls the RESET line on the Z80 down, causing a restart of the computer. You’ll see the three copyright messages and you should be able to continue.

And if that doesn’t work, turn your computer off and back on. That will definitely clear any issues and restore everything back to working order.

What Next?

Upgrades!

We've designed the TS Pico so you can upgrade it with your PC, Mac or Linux computer. We have plans for many enhancements and will share upgrade files on the TS Pico Github site, here:

https://github.com/TS-Pico-dev/TS-Pico

You Can Do Your Own Thing

The TS Pico is a general purpose interface to a powerful processor, the Raspberry Pi Pico. We've built in some features, like the RAM, Flash ROM and SD card interface. We encourage you write your own extensions or even your own operating system for the TS Pico.

Source code and programming details can be found at:

https://github.com/TS-Pico-dev/TS-Pico

You can download files to make your own TS Pico boards here:

https://github.com/jburrell7/TSPICO

And files for the expansion bus here:

https://github.com/jburrell7/TS2068_Extender

The TS Pico Team

The TS Pico sprung from the fertile mind of Argentinian Ricardo Calcagno in 2021. Ricardo had long been interested in a modern file storage solution and the global COVID-19 pandemic gave him the time to learn MicroPython programming on the Raspberry Pi Pico.

Ricardo quickly enlisted Gustavo Pane, a fellow Argentinian, to help develop the operating system that drives the TS Pico. Gustavo developed the “tpi” system in 1985 and adapted it to work with the TS Pico interface.

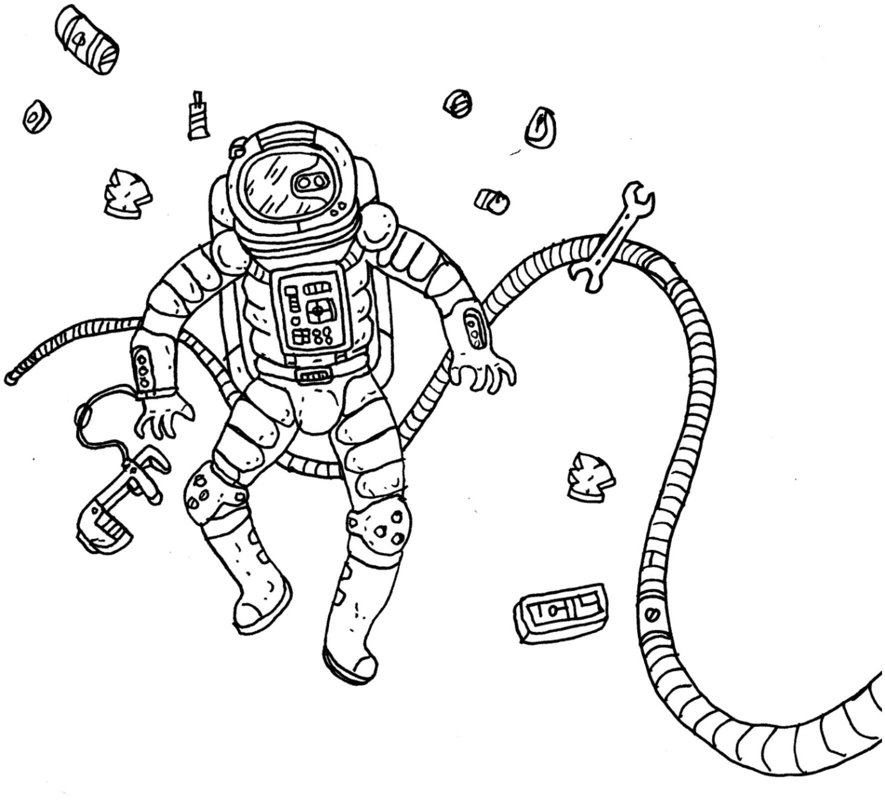
In 2022, Ricardo reached out to David Anderson, the person behind *timexsinclair.com*. David had been hosting international Zoom meetings for Timex Sinclair fans and connected Ricardo with Tim H (in New Zealand) and Jeff Burrell (in the US).

Tim and Jeff brought their considerable hardware product design experience to the project and the TS Pico advanced to the product you have today.

David, in addition to coordinating weekly, international project meetings, wrote the manual.

We are thrilled to share this project and product with you and look forward to many more fun years with our TS 2068 computers.

Ricardo, Gustavo, Tim, Jeff and David



TS-Pico.com