QUICK REFERENCE · TK89

1.8-inch TFT Display

128 × 160 in colour over SPI, 3.3 V only, with a backlight that waits for BL.

3.3 V only, on every pin

3V3 and all six signals go straight to the panel: no regulator, no level shifter. Its inputs take nothing over 3.6 V. **ESP32, ESP32-S3, Pico: wire straight across. A 5 V Uno goes through a TK97 logic level converter**, and 3V3 never comes from a 5V pin.

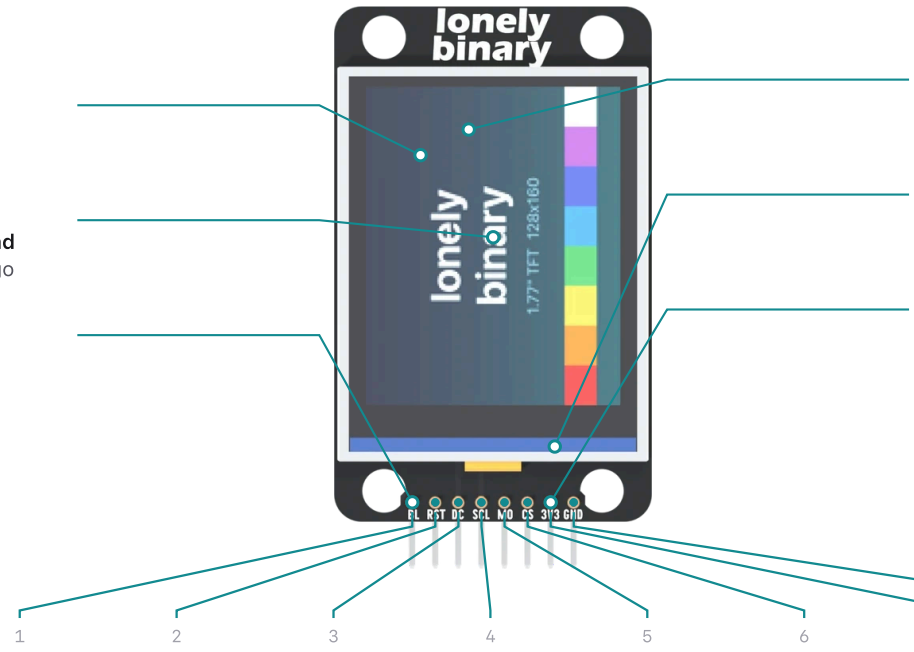
Pins, and which to wire

Drawn stood up, the header along the bottom: **BL, RST, DC, SCL, MO, CS, 3V3, GND**. No pad is square; the back prints the names in full. All eight are wired as shipped.

1.77-inch panel
128 × 160, ST7735S. Sold as 1.8 inch.

Ribbon socket, behind
12 contacts. Signals go straight in, unshifted.

BL switches the light
10 kΩ holds it off: dark until BL is HIGH.



BL-3V3 jumper, behind
Open as shipped. Bridged: always lit, BL unwired.

CS-GND jumper, behind
Open as shipped. Bridged: alone on its SPI bus.

3V3 in, 3.3 V only
No regulator on the board: never 5V here.

Front	BL	RST	DC	SCL	MO	CS	3V3	GND
Back	BACKLIGHT	RST	DC	SCL	MOSI	CS	3V3	GND
As shipped	BL	RST	DC	SCK	MOSI	CS	3V3	GND
BL-3V3 bridged	•	RST	DC	SCK	MOSI	CS	3V3	GND
CS-GND bridged	BL	RST	DC	SCK	MOSI	•	3V3	GND

A black screen is usually BL

The backlight is switched by a BSS138 whose gate is BL, with 10 kΩ to GND. Unwired or LOW, the backlight is off and a perfectly drawn picture is invisible. Set BL HIGH first thing in setup(); it takes 0.33 mA from the pin. PWM on BL dims it.

What a frame costs, on the wire

One frame

40,960 bytes

128 × 160 pixels, two bytes each, all sent again for every full redraw.

Rated clock

15 MHz

The sheet's 66 ns write cycle. Libraries often run faster; it usually works.

Whole screen

21.8 ms at least

At 15 MHz, before any drawing. Longer than a 60 Hz frame.

Clearing the screen every loop shows as flicker: for 22 ms or more there is nothing on the glass. Draw what never changes once, then paint numbers over the old ones with a background colour and fill only the part of a bar that moved.

Figures from Sitronix's ST7735S data sheet V1.1, 2011-11-21: logic supply 1.65 to 3.7 V, HIGH from 2.31 V on 3.3 V, reset at least 10 µs. Panel figures from its mechanical drawing. Times count the bytes only. The sketch compiles for an Uno, an ESP32 and an ESP32-S3; not bench-tested.

First light, on an ESP32-S3

Arduino IDE · Board: ESP32S3 Dev Module · USB CDC On Boot: Enabled · Library: Adafruit ST7735 and ST7789

```
#include <Adafruit_GFX.h>
#include <Adafruit_ST7735.h>
#include <SPI.h>

// SCL and MO go to the S3's SPI pins, 12 and 11.
const int TFT_CS = 10, TFT_DC = 2, TFT_RST = 42, TFT_BL = 41;
Adafruit_ST7735 tft(TFT_CS, TFT_DC, TFT_RST);

void panel(uint16_t colour, const char *name, uint16_t ink) {
  tft.fillScreen(colour);
  tft.setTextColor(ink);
  tft.setTextSize(2);
  tft.setCursor(8, 8);
  tft.print(name);        // a name on the wrong colour: see below
  delay(1500);
}

void setup() {
  pinMode(TFT_BL, OUTPUT);
  digitalWrite(TFT_BL, HIGH);  // the backlight first
  tft.initR(INITR_BLACKTAB);
  // tft.invertDisplay(true);  // if BLACK shows as white
  tft.setRotation(1);          // landscape, 160 x 128
}

void loop() {
  panel(ST77XX_RED, "RED", ST77XX_WHITE);
  panel(ST77XX_GREEN, "GREEN", ST77XX_BLACK);
  panel(ST77XX_BLUE, "BLUE", ST77XX_WHITE);
  panel(ST77XX_BLACK, "BLACK", ST77XX_WHITE);
}
```

RED → GREEN → BLUE → BLACK

Each colour for a second and a half with its name on it. BLACK on white: take the // off invertDisplay. RED on blue: try INITR_REDTAB.

Wiring

	FRONT	S3	ESP32	PICO	UNO+TK97
1	**BL**	41	32	GP2	D7
2	**RST**	42	4	GP3	D8
3	**DC**	2	2	GP4	D9
4	**SCL**	12	18	GP18	D13
5	**MO**	11	23	GP19	D11
6	**CS**	10	15	GP5	D10
7	**3V3**	3V3	3V3	3V3(OUT)	TK97
8	**GND**	GND	GND	GND	GND

The ESP32 columns are GPIO numbers. Hole 1 is BL, the left-hand pin with the header along the bottom; no pad is square. SCL is the SPI clock, not I2C: SCL and MO go to each board's hardware SPI clock and data out; CS, DC, RST and BL any outputs. On an Uno all six signals pass through the TK97. D7 cannot dim: move BL to D6 for PWM.

The two jumpers

Both open as shipped. **BL-3V3** bridged: the backlight is on whenever there is power, and BL must stay unwired, since driving it LOW shorts 3V3. **CS-GND** bridged: always selected, CS unwired (pass -1), and the display must be alone on its SPI bus. MicroPython: boochow's ST7735.py driver; the sketches in the block's folder pick the pins by board.

When it does not work

Plain white

The controller took no setup: check RST, DC, SCL and MO against the table and the sketch.

Black, nothing at all

BL unwired, on another pin, or never set HIGH. Then check 3V3 and GND.

Dim, readable at an angle

The picture is there, the backlight is not: BL again.

Black shows as white

The panel wants inverted colours: tft.invertDisplay(true).

Red shows as blue

Colour order: INITR_REDTAB in place of INITR_BLACKTAB.

Noise through a TK97

Short wires, then a slower clock: tft.setSPISpeed(4000000).

Specifications

Panel	1.77 in, sold as 1.8 in; 35.04 × 28.03 mm	**Pixels**	128 × 160, 16-bit colour (RGB565)
Controller	Sitronix ST7735S, SPI, write-only	**Clock**	About 15 MHz rated for writes
Supply	3.3 V on 3V3; no regulator	**Logic**	3.3 V; HIGH from 2.31 V, never over 3.6 V
Backlight	BSS138 on BL, 10 kΩ holds it off	**Board**	56.7 × 35.0 mm, V3, four 4.8 mm holes