QUICK REFERENCE · TK52

8x8 LED Matrix

Sixty-four LEDs, one MAX7219, five wires. The picture is eight bytes.

VCC goes to 5 V, on every board

The MAX7219 needs 4 to 5.5 V. **5V on an Uno, an ESP32 or an ESP32-S3; VBUS on a Pico. Never 3V3.** Every LED lit at full brightness draws about 330 mA from that pin.

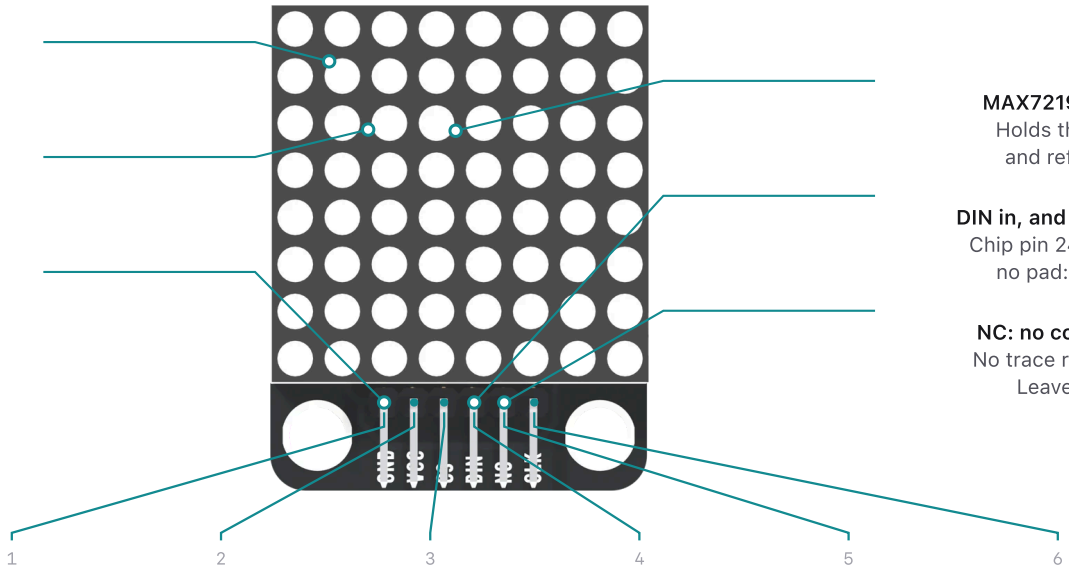
Pins, and which to wire

Matrix up, header at the bottom. There is no square pad: count from GND, printed on both faces. NC is connected to nothing.

1088AS, red
64 LEDs on 16 legs, lit a column at a time.

R7, RSET, under it
10 kΩ: about 40 mA per LED while lit.

GND, no square pad
Then VCC, CS, DIN, NC, CLK.



MAX7219 under it
Holds the picture and refreshes it.

DIN in, and no DOUT
Chip pin 24 reaches no pad: no chain.

NC: no connection
No trace reaches it. Leave it empty.

Front	GND	VCC	CS	DIN	NC	CLK
Back	GND	VCC	CS	DIN	NC	CLK
Wire	GND	VCC	CS	DIN	•	CLK

A register is a column

Register 1 is the left-hand column, bit 0 its top LED. Draw pictures as rows, top first, and let the sketch turn them into columns. If the picture comes out turned, change TURN in the sketch: the column order is worked out from the datasheet, not seen on a lit board.

Three numbers to drive it by

Refresh

800 times a second

One column at a time, 500 to 1300 Hz. Each LED is lit an eighth of the time at most.

Brightness

16 levels, 0 to 15

Time, not current: 1/32 to 31/32 of each column's turn at the same 40 mA.

Current

66 mA, heart at level 4

About 330 mA with all 64 lit at level 15. A model on the datasheet's typical.

Brightness 4 keeps each LED on 9/32 of its turn. Keep register 0x0B at 7, all eight columns: with R7 at 10 kΩ, 3 columns or fewer overloads the chip's column drivers.

Numbers from HGSEMI's MAX7219/MAX7221 datasheet (2018 AUG), the maker of the fitted MAX7219M, and Toplite's 1088AS drawing. The current is a model, not a measurement. A 3.3 V board's HIGH is under the chip's 3.5 V minimum and usually works.

A heart, no library

Arduino IDE · Board: your board · ESP32-S3: USB CDC On Boot: Enabled

```
const int CS_PIN = 10, DIN_PIN = 11, CLK_PIN = 13;  // Uno
const int TURN = 0;  // 1 to 3 if it comes out turned

const uint8_t HEART[8] = {0x00, 0x66, 0xFF, 0xFF,
                          0xFF, 0x7E, 0x3C, 0x18};

void send(uint8_t reg, uint8_t data) {
  digitalWrite(CS_PIN, LOW);
  shiftOut(DIN_PIN, CLK_PIN, MSBFIRST, reg);
  shiftOut(DIN_PIN, CLK_PIN, MSBFIRST, data);
  digitalWrite(CS_PIN, HIGH);          // takes effect here
}

bool lit(const uint8_t *pic, int x, int y) {
  for (int t = 0; t < TURN; t++) { int s = x; x = y; y = 7 - s; }
  return pic[y] & (0x80 >> x);
}

void show(const uint8_t *pic) {        // register d + 1 = column d
  for (int d = 0; d < 8; d++) {
    uint8_t col = 0;
    for (int b = 0; b < 8; b++) if (lit(pic, d, b)) col |= 1 << b;
    send(1 + d, col);
  }
}

void setup() {
  pinMode(CS_PIN, OUTPUT); pinMode(DIN_PIN, OUTPUT);
  pinMode(CLK_PIN, OUTPUT); digitalWrite(CS_PIN, HIGH);
  send(0x0F, 0); send(0x09, 0); send(0x0B, 7);  // test off, raw, 8
  send(0x0A, 4); send(0x0C, 1);                 // level 4, wake
  show(HEART);
}

void loop() {}
```

`A red heart, the point at the header end.`

Nothing printed. Dark: VCC on 5V? Garbage: DIN and CLK swapped? All lit: display test left on.

Wiring

	FRONT	UNO	ESP32	S3	PICO
1	GND	GND	GND	GND	GND
2	VCC	5V	5V	5V	VBUS
3	CS	D10	GPIO 5	GPIO 10	GP17
4	DIN	D11	GPIO 23	GPIO 11	GP19
5	NC				
6	CLK	D13	GPIO 18	GPIO 12	GP18

Hole 1 is GND, at the left with the matrix up; there is no square pad. VCC is 5 V on every board. Any three output pins work for CS, DIN and CLK; these are each board's SPI pins.

In MicroPython

On an ESP32, ESP32-S3 or Pico, the same sixteen bits by hand: `cs(0)`, then for each bit from 15 down to 0 set `din` and pulse `clk` high and low, then `cs(1)`. Pins: ESP32 5, 23, 18; ESP32-S3 10, 11, 12; Pico 17, 19, 18 (CS, DIN, CLK).

When it does not work

Dark, sketch running

Register 0x0C must be written 1: it powers up asleep. Then check VCC is on 5V, not 3V3.

Every LED on, full blast

Display test, register 0x0F, is on. Write 0 to it.

The picture is on its side

Set TURN to 1, 2 or 3. For a mirror image, reverse the column order.

Random dots

DIN and CLK swapped. DIN is the fourth pin, CLK the sixth, NC between them.

Only one column lights

Register 0x0B is 0. Write 7 to it; never fewer than four columns.

Board resets on a big picture

All 64 at level 15 is about 330 mA from its 5V pin. Lower the level.

Specifications

Driver	MAX7219 (HGSEMI MAX7219M), SOP-24	**Display**	1088AS, 8 × 8 red, 32 mm
Supply	4 to 5.5 V: 5 V on every board	**Logic HIGH**	3.5 V minimum
Clock	10 MHz maximum	**LED current**	about 40 mA while lit (R7, 10 kΩ)
Supply current	about 330 mA all lit, 150 µA asleep	**Board**	32 × 41 mm, no DOUT