GENERAL

mksap 16 board basics 3

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Introduction

When you first dive into the world of 3D printing, the choice of controller board can feel overwhelming. The **MKSAP 16 board** has carved out a niche among hobbyists and professionals alike, thanks to its robust design, flexible firmware support, and a wide array of compatible components. This guide is the third installment in a comprehensive series on **mksap 16 board basics 3**, and it will walk you through the advanced configuration, feature integration, and troubleshooting techniques that will help you unlock the full potential of your printer.

Whether you're building a new machine from scratch, upgrading an existing setup, or simply looking to refine your firmware, this article will give you the knowledge you need to confidently configure, maintain, and optimize your **MKSAP 16 board**. We'll cover everything from hardware connections to firmware tweaks, ensuring that you can tailor the board to your specific printing needs.

1. Overview of the MKSAP 16 Board

1.1 Hardware Specifications

The **MKSAP 16**is a feature-packed 32 bit controller that supports up to 16 stepper drivers, making it ideal for complex, multi-axis machines. Key specifications include:

- CPU: 32 bit ARM Cortex M4 running at 168 /MHz
- Memory: 512 /KB Flash, 64 /KB SRAM
- Connectivity: USB, UART, SPI, I2C, and an SD card slot
- Display: 2.4 inch SPI LCD with touch support
- Power: 12 /V or 24 /V input, 5 /V regulator for peripherals
- Stepper drivers: 16 dedicated outputs, compatible with A4988, DRV8825, TMC2130, and TMC5160

These specifications give the board a versatile foundation for a wide range of 3D printers, from simple Cartesian setups to more advanced Delta or CoreXY machines.

1.2 Design and Compatibility

The board's architecture is designed to accommodate a broad selection of stepper drivers and sensors. Its 3.3 V logic level is compatible with most microcontrollers, and the board's robust power distribution ensures stable operation even under heavy loads.

Compatibility extends to popular firmware families, such as Marlin, RepRapFirmware, and Klipper. The open source nature of the board's design also means that you can find a wealth of community resources, including schematic overlays, custom PCB layouts, and firmware patches.

2. Setting Up the MKSAP 16 Board

2.1 Power Supply and Basic Connections

Before you start soldering, make sure you have the following components:

1. 12 /V or 24 /V regulated power supply

2. Step by step driver modules (A4988, DRV8825, TMC2130, etc.)
3. Thermistors (NTC 100 /k:’ &V6öÖÖVæFVB `or the hotend and heated bed)
4. Extruder and heated bed fans
5. LCD screen and touch panel (if using the 2.4 inch display)

Connect the power supply to the board’s main power terminals. Be sure to observe correct polarity to avoid damaging the board. Next, attach the stepper drivers to the dedicated outputs, ensuring that each driver’s enable pin is correctly routed to the board’s enable lines.

2.2 Stepper Driver Configuration

Each stepper driver can be configured for microstepping, current limits, and driver type. For example, if you’re using DRV8825 drivers, you’ll set the microstepping pins to match the desired resolution (e.g., 1/16 or 1/32). Current limits should be set to match your stepper motors’ rated current to prevent overheating while maximizing torque.

2.3 Thermistor and Temperature Sensor Setup

Attach the thermistors to the board’s designated temperature input pins. The board supports a range of thermistor types, but the NTC 100 k:• is the most common for hotends and heated beds. Verify the wiring with a multimeter to ensure continuity and correct pin assignments.

2.4 LCD and Touch Panel Wiring

For the 2.4 inch display, connect the LCD’s SPI interface to the board’s dedicated SPI pins. If you’re using a capacitive touch panel, wire the touch controller’s I2C or SPI pins accordingly. Once connected, you can power on the board and verify that the display initializes correctly.

3. Firmware Configuration

3.1 Installing Marlin Firmware

Marlin remains the most popular firmware for 3D printers, and it offers extensive support for the **MKSAP 16 board**. To install Marlin:

1. Download the latest Marlin source from the official GitHub repository.
2. Open the Marlin/Configuration.h file in a text editor.
3. Set the #define MOTHERBOARD 128 to match the board’s identifier.
4. Enable the drivers you’re using, e.g., #define DRIVER_X TMC2130 for a TMC2130 driver on the X axis.
5. Configure the stepper driver parameters such as microstepping, current limits, and motor directions.
6. Set the temperature sensor types: #define TEMP_SENSOR_0 1 for the hotend and #define TEMP_SENSOR_BED 1 for the heated bed.
7. Adjust the LCD and touch panel settings, ensuring the correct pins are assigned.
8. Compile the firmware using Arduino IDE or PlatformIO.
9. Upload the compiled binary to the board via USB.

Once the firmware is uploaded, power on the printer and use the LCD interface to test basic movements, temperature readings, and fan controls.

3.2 Fine Tuning Stepper Drivers

With the TMC drivers, you can take advantage of features such as stealthChop, spreadCycle, and coolStep. For example, to enable stealthChop on a TMC2130, add the following lines to Configuration.h:

#define TMC2130_X_CS 10

```
#define TMC2130_X_ENABLE_PIN 9
#define TMC2130_X_CS 10
#define TMC2130_X_EN 9
#define TMC2130_X_M0 8
#define TMC2130_X_M1 7
#define TMC2130_X_M2 6
#define TMC2130_X_SGTHRS 30
#define TMC2130_X_CHOPCONF 0x00000000
#define TMC2130_X_PWMCONF 0x00000000
```

Adjust the SGTHRS value to fine tune the stall guard threshold, which helps the driver detect load changes and reduce noise.

3.3 Configuring Auto Bed Leveling (ABL)

Many users opt for a BLTouch or inductive sensor for ABL. To configure a BLTouch:

1. Set the sensor pin: #define BLTOUCH_PIN 42.
2. Enable the sensor: #define BLTOUCH.
3. Configure the probe height and offsets.
4. In the Configuration_adv.h file, enable the AUTO_BED_LEVELING_BLINE or AUTO_BED_LEVELING_GAUSS algorithm.

After configuring, run the ABL routine via the LCD menu to generate a mesh and calibrate the bed.

4. Advanced Features

4.1 Filament Sensor Integration

Adding a filament sensor can prevent failed prints caused by filament runs out. The MKSAP 16 board supports both mechanical and optical sensors. To integrate a mechanical sensor:

1. Connect the sensor to a free digital input pin.
2. Define the sensor pin in Configuration.h with #define FILAMENT_SENSOR_PIN 53.
3. Enable the filament sensor in Configuration_adv.h with #define FILAMENT_SENSOR.

Once enabled, the printer will pause automatically when the sensor detects a break in the filament feed.

4.2 Power Loss Recovery

Power loss recovery is a critical safety feature that ensures your printer can resume a print after a blackout. The MKSAP 16 board can store the current position and layer information in EEPROM. To enable this feature:

1. In Configuration_adv.h, enable POWER_LOSS_RECOVERY.
2. Set the recovery timeout and the number of retries.
3. Configure the board’s power monitoring circuit (e.g., a voltage divider on the power input).

After configuration, the printer will automatically resume from the last saved position once power is restored.

4.3 Advanced Motion Planning

The MKSAP 16 board’s 32 bit CPU

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