**Microcontroller-on-Module**

**STM32 Edition v1 (MoM-S1)**

Board Architecture Specification

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# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Version | Date | Author | Description |
| v0.0 | 07/27/18 | MS | Initial Version |
| v0.1 | 08/03/18 | MS | Updates to Detailed Implementation and Test Points sections |

# Overview

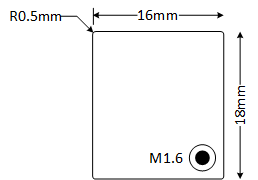
# Functional Description

## Reconfigurable IO

# Detailed Implementation

## Mechanical

The following section describes the mechanical requirements of the MoM-S1 design. An overview of the mechanical features of the MoM-S1 is shown in the figure below:



### Form Factor

The MoM-S1 measures **16mm x 18mm**, or almost a third of the size of an Arduino Nano. A scaled comparison of the two modules is shown in the figure below:



The MoM-S1 module also includes 0.5mm radiused corners.

### Height and Clearance

The maximum component heights are as shown in the following table:

|  |  |
| --- | --- |
| **Maximum Component Height** | |
| Top Side | 1.6mm |
| Bottom Side | 1.5mm – 4mm |

#### Mating Connector Height

The bottom side height requirement is driven by the chosen connector to mate with the interface connector on the MoM-S1 (**DF40C-60DP-0.4V(51)**). The mating connector has a mating height of **1.5mm**, but other variants can be chosen such that the mating height is up to **4mm**.

### Mounting Holes

The MoM-S1 module includes a single **M1.6** mounting hole in the bottom-right corner. This allows a user to secure the module to the mating board and provides mechanical stability when combined with the support from the mating connector.

### Enclosure

The MoM-S1 module was designed to be used in a variety of applications and thus the enclosure will vary by user application.

## Environmental

### Temperature

The MoM-S1 was designed to operate over a temperature range of **-20°C to 80°C**.

### Shock and Vibration

There is no specific shock and vibration requirement for the MoM-S1 module.

### Compliance

The MoM-S1 has not been designed to meet any specific UL, CE, FCC or other standards. Testing should be performed on the user’s specific application to confirm that the required standards are met.

### Reliability

There is no specific reliability requirement for the MoM-S1 module.

### Electromagnetic Interference (EMI)

To limit noise emissions and provide immunity for external noise sources, the MoM-S1 module has been designed to follow all recommended EMC requirements put forth in the specifications for individual components onboard the module. This includes safeguards such as additional filtering of power supply lines and sensitive signals and local decoupling of power supply pins to individual chips.

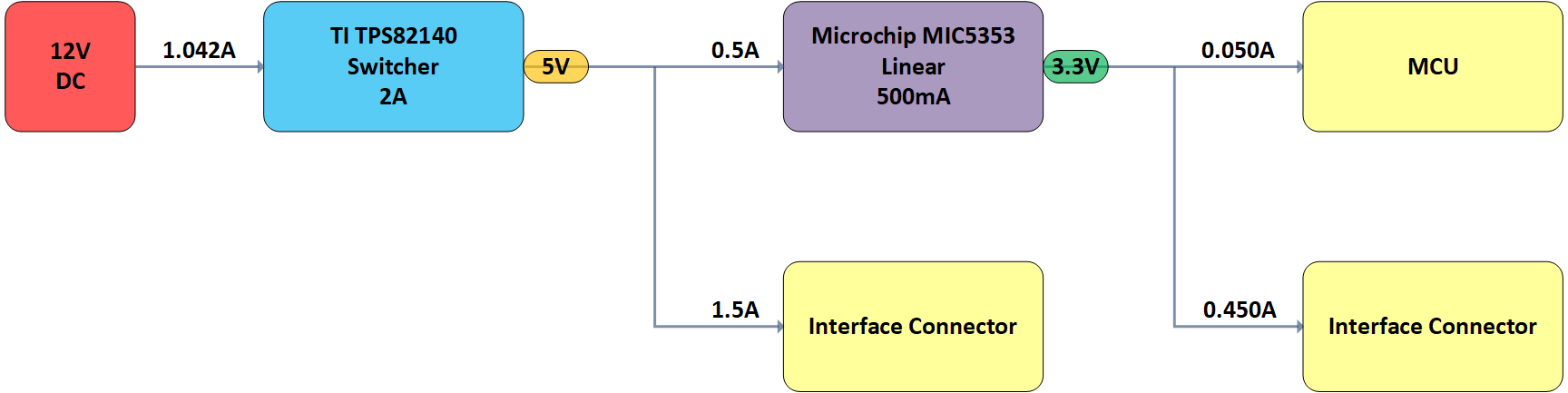
Additional EMI protection in the form of filtering or shielding may be required depending on the user’s application. These measures must be integrated into a user’s custom PCB design as they are not included in the MoM-S1 module.

## Power

The following sections describe the power architecture of the MoM-S1 module.

### Voltage Tree

The figure below shows the voltage tree of the MoM-S1 module:



The current values shown are based on the information provided for the microcontroller, which drove the values available at the interface connector. These are based on the maximum capacity of the power circuitry itself.

A summary of the components chosen can be found in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| **Voltage Regulators** | | | |
| **Voltage Rail** | **Component** | **Designed Capacity** | **Interface Connector Capacity** |
| 5V | TI TPS82140 | 2A @ 5V | 1.5A @ 5V |
| 3.3V | Microchip MIC5353 | 500mA @ 3.3V | 450mA @ 3.3V |

The interface connector values given above assume worst case given the estimated MCU and 3.3V regulator power requirements shown in the figure above.

### Rating

The MoM-S1 module has been designed such that its rated input power requirement is **1.042A @ 12V** and provides the rated output power stated in the section above.

### Sequencing

There are no sequencing requirements for power-on or power-off of the MoM-S1 module.

## Processor

The MoM-S1 module is an STM32-based device (represented by the ‘S’ in the part number). MoM-S1 will use the **STM32F070CBT6** microcontroller (MCU). An overview of the MCU specifications are shown in the table below:

|  |  |
| --- | --- |
| **MCU Specification** | |
| **Flash** | 128KB |
| **SRAM** | 16KB |
| **16-bit Timers** | 8 |
| **Communication Interfaces** | 2x SPI, 2x I2C, 4x UART, 1x USB |
| **ADC Channels** | 12 (10 external, 2 internal) |
| **GPIOs** | 37 |
| **Max CPU Frequency** | 48MHz |
| **Operating Voltage** | 2.4 - 3.6V |
| **Operating Temperature** | -40-85°C (ambient), -40-105°C (junction) |
| **Package** | LQFP48 |

## Configuration

The MoM-S module is programmed via the SWD interface on the MoM daughter board or through a custom board created by the user. The MCU is programmed using the **ST-LINK/V2** programmer. The daughter board utilizes the **ARM20-CTX** adapter and **TC2030-IDC-NL** cable from Tag-Connect for minimum footprint size. An image of the ST-LINK/V2 with the Tag-Connect adapter and cable are shown below:



Test points for the SWD pins (SWCLK/SWDIO) and reset (NRST) are provided if the user wishes to program the MoM-S1 module without additional boards.

## Clocking

The MoM-S1 module uses a 16MHz ceramic resonator with internal capacitors (**CSTCE16M0V53-R0**) to drive the MCU and its peripheral clocks.

## Interfaces

The following section describes the interfaces available on the MoM-S1 module.

### USB

The MCU on the MoM-S1 provides a single USB 2.0 full-speed device peripheral interface that is pinned out through the interface connector (See Interface Connector section below). The data lines (**D+/D-**) are impedance controlled to 90Ω differential as per USB 2.0 requirements.

There is no USB connector or additional hardware for other USB power management, ESD protection or other features (i.e. ID, VBUS) on the MoM-S module. That hardware is located on the MoM daughter board and needs to be implemented on the user’s custom PCB if USB is to be used. Controlled impedance requirements should also be followed when implementing USB on a custom design.

### User IO

The MoM-S1 module provides **27 IOs** from the MCU to the interface connector. These may be used from any purpose. Some examples include serial interfaces (SPI, I2C, etc…), analog pins or generic IO.

An additional 2 IOs from MCU are available via test point only. See the Test Points section below for more information.

### LEDs

Two user-defined LEDs are provided on the MoM-S1 module. There is one blue LED (**USER\_LED0**) and one green LED (**USER\_LED1**) that can be controlled. Both are active-high (sending a high signal or ‘1’ from the MCU turns the LED on).

## Connectors

The following section describes the connectors available on the MoM-S1 module.

### Interface Connector

The interface connector provides the main connection between the MoM-S1 module and the custom PCB that it connects to. A table with the pinout of the connector (provided as two sections) along with a key is provided below:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2** | **4** | **6** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **26** | **28** | **30** |
| **12V** | **12V** | **GND** | **GND** | **5V** | **5V** | **GND** | **GND** | **GND** | **3V3** | **GND** | **NRST** | **GND** | **GND** | **D-** |
| **1** | **3** | **5** | **7** | **9** | **11** | **13** | **15** | **17** | **19** | **21** | **23** | **25** | **27** | **29** |
| **12V** | **12V** | **GND** | **GND** | **5V** | **5V** | **5V** | **GND** | **GND** | **3V3** | **GND** | **CLK** | **DIO** | **GND** | **D+** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **32** | **34** | **36** | **38** | **40** | **42** | **44** | **46** | **48** | **50** | **52** | **54** | **56** | **58** | **60** |
| **GND** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **HW\_VER** |
| **31** | **33** | **35** | **37** | **39** | **41** | **43** | **45** | **47** | **49** | **51** | **53** | **55** | **57** | **59** |
| **GND** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** | **IO** |

|  |  |
| --- | --- |
| **GND** |  |
| **12V** |  |
| **5V** |  |
| **3V3** |  |
| **SWD** |  |
| **USB** |  |
| **MCU** |  |
| **HW\_VER** |  |

### Filtering and ESD Protection

Both filtering and ESD protection of IOs has been left off the MoM-S1 module. If required, these features should be located close to the connectors on the user’s custom PCB to off noise reduction and ESD protection prior to signals reaching the MoM-S1 module.

## Debug

Debug options onboard the MoM-S1 module are limited to the test points provided (See *Test Points* section below), which includes the SWD programming interface. Additional debug methods, such as UART or USB, must be configured in the MCU and pinned out either on the MoM daughterboard or user’s custom PCB.

# Test Points

The following section explains the test points available onboard the MoM-S1 module.

Test points are provided for bring-up, programming and debugging potential issues. The following table provides a list of signals and their associated test points on the MoM-S1 module:

|  |  |  |
| --- | --- | --- |
| **Test Points** | | |
| **Signal** | **Description** | **Designator(s)** |
| 12V0 | 12V Power Input | TP1 |
| 5V0 | 5V Power Output | TP3 |
| 3V3 | 3.3V Power Output | TP5 |
| GND | Ground | TP7, TP9, TP11 |
| MCU\_NRST | MCU Reset | TP2 |
| MCU\_SWCLK | SWD Clock | TP4 |
| MCU\_SWDIO | SWD Data | TP6 |
| MCU\_USB\_D\_P | USB Data (+) | TP8 |
| MCU\_USB\_D\_N | USB Data (-) | TP10 |
| MCU\_IO0 | User IO 0 | TP12 |
| MCU\_IO1 | User IO 1 | TP13 |
| MCU\_IO2 | User IO 2 | TP14 |
| MCU\_IO3 | User IO 3 | TP15 |
| MCU\_IO4 | User IO 4 | TP16 |
| MCU\_IO27 | User IO 27 | TP17 |
| MSU\_IO28 | User IO 28 | TP18 |

HW\_VER?

...

# Bring-up and Testing Procedures

TBD

# Future Revisions

TBD

# Appendix A: Glossary of Terms

# Appendix B: Calculations