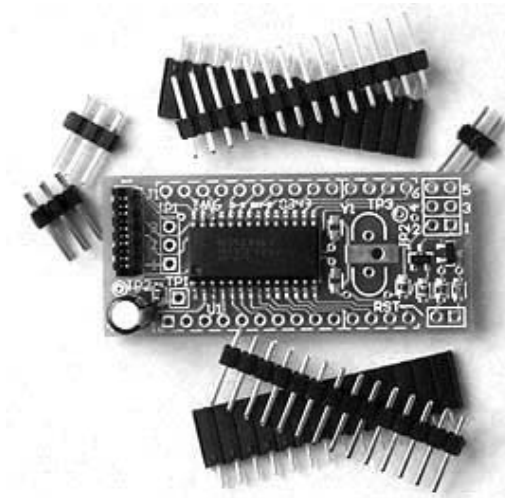


M-SERIES, MSP430F MODULES: Model M-28 and M-20

USER'S GUIDE



Version 1.0

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Section 1

Overview

M-28 and M-20 Module User's Guide

This User's Guide provides general information, functional description, hardware set-up, and operating instructions for EMBEDDEDkits, M-Series, MSP430F-based Modules; M-28 and M-20. The M-28 and M-20 Modules are available in (3) main versions M-28P, M-28O, M-28B, M-20P, M-20O, and M-20B. The information covered in this User's Guide is applicable to all of the M-28 and M-20 versions.

Introduction

Congratulations on your purchase of an M-Series Module. The M-Series Modules were designed to directly interface with EMBEDDEDkits, JT-EASY™; Model JT-E100A or JT-E100K, JTAG Interface Tool for the Texas Instruments, MSP430F family of ultra-low power Microcontrollers.

M28 Module

The M-28 Module's PC-board measures only 2" x 7/8", and depending on the model number may include a pre-installed MSP430F12xx, 28-pin SOIC Microcontroller and other user-installed components. For brevity, user-installed components are included components which, if needed, may be installed by the end-user. All Modules with pre-installed components are factory tested before shipment.

Version M-28P comes with a pre-installed MSP430F12xx Microcontroller and other pre-installed components. It includes user-installed connection headers with mating sockets, operation selection headers with shorting blocks, and a 32.768Khz cylindrical Crystal. The M-28 version is ideal for evaluation and prototyping work, where the user can easily select the Module's functionality via shorting-block jumpers.

The M-28O Module is the OEM version of the M-28P and comes with a pre-installed MSP430F12xx Microcontroller and other pre-installed components. It includes a user-installed FFC/FCP-type JTAG connector and a 32.768Khz cylindrical Crystal. This version is ideal for MSP430F-based end-products, where the module's functionality can be set by wire jumpers, or user provided headers and shorting blocks.

The M-28B version is a blank PC-board, which includes no pre-installed components or user-installed components. The PC-board layout is the same as the M-28P Module. The M-28B is ideal in applications where the actual MSP430F12xx device is selected and installed by the end-product manufacturer. Or it can be used as an inexpensive evaluation or experimenter board, where the user supplies and installs all the needed parts.

M20 Module

The M-20 Module's PC-board measures only 1.9" x 7/8", and depending on the model number may include a pre-installed MSP430F11xxx, 20-pin SOIC Microcontroller and other user-installed components. All Modules with pre-installed components are factory tested before shipment.

Version M-20P comes with a pre-installed MSP430F11xxx Microcontroller and other pre-installed components. It includes user-installed connection headers with mating sockets, operation selection headers with shorting blocks, and a 32.768Khz cylindrical Crystal. The M-20P includes an on-board Test LED which is connected to the Microcontroller I/O port P1.0 via a removable jumper. This feature is convenient for testing the Module or for quick visual demos. The LED connection jumper can be easily removed to allow normal operation of pin P1.0. The M-20P is ideal for evaluation and prototyping work, where the user can easily select the Module's functionality via shorting-block jumpers.

The M-200 Module is the OEM version of the M-20P and comes with a pre-installed MSP430F11xxx Microcontroller and other pre-installed components. It includes a user-installed FFC/FCP-type JTAG connector and a 32.768Khz cylindrical Crystal, but does not include the Test LED. The M-200 is ideal for MSP430F-based end-products, where the module's functionality can be set by wire jumpers, or user provided headers and shorting blocks.

The M-20B version is a blank PC-board, which includes no pre-installed components or user-installed components. The PC-board layout is the same as the M-20P Module. The M-20B is ideal in applications where the actual MSP430F11xxx device is selected and installed by the end-product manufacturer. Or it can be used as an inexpensive evaluation or experimenter board, where the user supplies and installs all the needed parts.

M-28 and M-20 connection options

Both the M-28 and M-20 were designed with (2) rows, spaced at 0.7" on-center, of (14) or (10) respectively, of through-hole pads for direct wiring, or for installation of (2), 0.1" pitch, 24mil square post headers. This option allows an easy-connection to your Target Board.

Section 2

Getting Started

Obtaining the latest materials

For the most up-to-date M-Series Modules and JT-EASY information, User's Guide, application notes, and code examples visit EMBEDDEDkits website: www.embeddedkits.com. For MSP430F related information, including device specific user's guide, data sheets, application notes and code examples, visit Texas Instruments website: www.ti.com/sc/msp430.

M-28 and M-20 specifications and features

- Small PC-Board; 2" x 7/8" (M-28), 1.9" x 7/8" (M-20)
- MSP430F12xx, 28-pin SOIC Microcontroller (M-28P/O only)
- MSP430F11xxx, 20-pin SOIC Microcontroller (M-20P/O only)
- Through-hole pads for cylindrical or HC49/US or HC49/U type crystal
- On-board generated RC reset, via jumper
- Jumper selection of source of power-in, or Target Board voltage sense-line output
- On-board generated Enable/Disable line for off-board 3-State buffer
- FFC/FPC, 10-pin JTAG interface connector
- Provision for Test LED, tied to P1.0 via removable jumper (M-20P/O/B only)
- Through-hole pads for direct connection to Target Board, or headers
- 0.7" o.c. headers pads spacing

M-28 and M-20 power requirements

The Module's main device/component is an MSP430F12xx or an MSP430F11xxx Microcontroller, which can operate from 1.8V to 3.6V. Other specification, as listed by Texas Instruments, like "Absolute Maximum Ratings" and "Recommended Operating Conditions" also apply to the operation of the M-28 and M-20 Modules.

For additional MSP430F specific information, consult the actual device specifications available on the Texas Instruments website.

Section 3

M-28/20 Module Operation

User selection of operation modes

The M-28/20 Module operation can be easily configured via installation or removal of “Jumpers” (shorting blocks) to/from jumper headers JP1 and JP2.

Both the M-28P and M-20P are factory shipped with pre-installed jumpers which sets the default operation mode. The default setting is documented in this section and on the Module’s schematic.

NOTE

As a standard practice, to prevent possible damage or operation disruption of the Module or Target Board, it is recommended that the Module power source be turned OFF or be disconnected before installing or repositioning any of the operation-selection jumpers.

Description of the M-28 and M-20, Operation-Selection Jumpers

NOTE

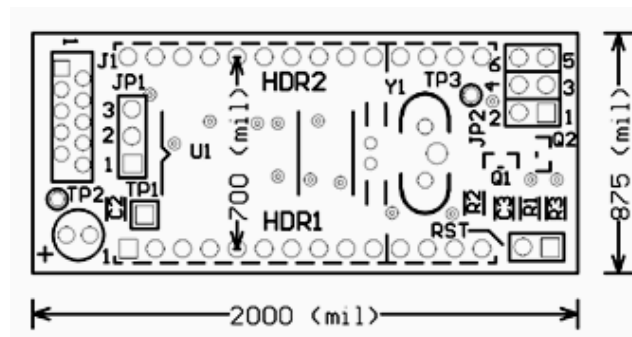
JPn: a-b, denotes installation of jumper onto Jumper Header (n), pin (a) and (b).

- JP1 – Module Power-in source or Target Board voltage, auto-sense selection
- JP2 – Module Microcontroller TST pin connection and EN or /EN signal selection
- JP3 – Test LED connection (M-20 only)
- RST – Module Microcontroller reset jumper

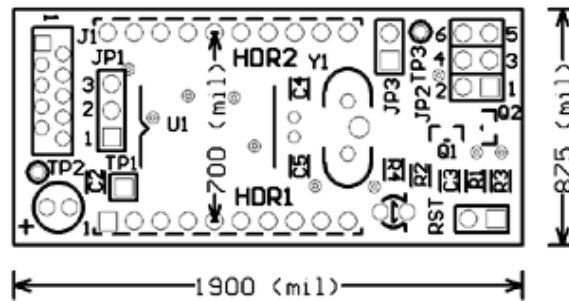
M-28 Jumpers default setting: JP1: 1-2, JP2: 4-6, JP2: 3-5 and RST (open circuit)

M-20 Jumpers default setting: JP1: 1-2, JP2: 4-6, JP2: 3-5, JP4: 1-2 and RST (open circuit)

M-28P/O/B Module



M-20P/O/B Module



Selecting the Module's power-in source

Power to the Module can be supplied via JTAG interface connector (J1) pin-10 by installing JP1: 1-2. In this configuration power from the Target Board to the Module must not be directly connected to header (HDR1) pin-1, or possible damage to the voltage source connected to the JTAG connector may result. If this power-in option is desired, it is recommended that a 2-pin jumper be added on the Target Board, which should be wired in series with header (HDR1) pin-2. In this case the added jumper, in conjunction with JP1: 1-2, can be installed or removed accordingly

When the M-28P/O or M-20P/O is connector to EMBEDDEDkits, JT-EASY; JT-E100A or JT-E100K, the power needed to run the Module and Target Board is supplied by the JT-E100A/K on-board voltage regulator. This voltage level can be adjusted from 2V to 3.6V, as needed.

Target Board voltage level auto-sense feature selection

JT-EASY; JT-E100A and JT-E100K have a built-in, Target Board supply-voltage-level auto-sense feature, that when used, can automatically adjust the JTAG interface outputs voltage-level to that required by the Module and Target Board. This operation mode can be selected by installing JP1: 2-3. For this auto-sense feature, a voltage of 2V to 3.6V must be connected from the Target Board supply to the Module, via header (HDR1) pin-2.

Module's Microcontroller, TST pin connection selection

MSP430F devices with shared I/O, JTAG pins require the connection of a resistor from the TST pin to ground. This resistor is needed to detect if the JTAG fuse is intact, and to enable the internal JTAG buffers. Selection of the Module's Microcontroller TST pin connection to the Module's on-board 22K resistor, or JT-E100A/K 22K on-board resistor, or user Target Board installed resistor is facilitated via JP2.

Install JP2: 4-6 to use the Module's on-board 22K resistor. This configuration is the default setting, which should be used when the Module is not connected to JT-EASY or a compatible JTAG Interface Tool, and the user does not want to install an equivalent resistor on the Target Board.

Install JP2: 2–4 to use the JT–E100A/K, on–board 22K resistor. This setting must be used when the M–28/20 is connected to JT–E100A/K via JTAG connector (J1). If not, the Module MSP430F JTAG interface will not be enabled.

NOTE

When the Module is connected to EMBEDDEDkits, JT–E100A or JT–E100A, JP2: 2–4 must be installed. This is required to enable the MSP430F, internal JTAG interface. The same applies if the M–28 or M–20 is connected (with an appropriate interface cable) to a compatible JTAG Tool like the Texas Instruments, MSP–FET430 FET Tool.

User implemented JTAG Interface

In some cases the user may want to implement his/her own JTAG interface on the Target Board. To facilitate this, all of the JTAG interface lines are made available through header (HDR2). For this option install JP2: 3–4. For proper operation the user must connect a resistor (to terminate the MSP430F, TST pin) from header (HDR1) pin–1, to the Target Board ground. In this configuration JP2: EN or /EN jumper connection is no longer possible.

Selection of EN or /EN signal

One of the potential problem of a shared JTAG interface architecture is the possible contention or unwanted interference between the MSP430F shared JTAG lines and external I/O lines connections, while JTAG exchanges take place. To get around this situation EMBEDDEDkits has implemented on–board circuitry which can be selected by installing a jumper. The on–board circuitry derives an active–high Enable (EN) and an active–low Enable (/EN) signal from the JTAG interface, TST line. This signal can in turn be used to control an external, 3–State buffer. In this case, the /EN signal can be used to control an external 74HC125, or the EN signal can be used to control an external 74HC126. To select the EN signal, install JP2: 1–3, to select the /EN signal, install JP2: 3–5. The selected signal is made available at (HDR1) pin–1. If this functionality is not needed, JP2: 1–3 or 3–5 can be removed, or the connection from the Target Board to (HDR1) pin–1 can be omitted.

Manually resetting the Module’s Microcontroller

A 2–pin header RST is provided to facilitate a hardware reset. To initiate a reset, momentarily short out RST. To do this, it is recommended that you use a shorting block instead of a screwdriver or other metallic object.

The infamous “Mr. Blinky”

For simple testing or for quick visual demos, EMBEDDEDkits has equipped the M–20P Module with an on–board, jumper–selected Test LED. This LED can be controlled through I/O port P1.0 pin. To allow LED control, install JP3: 1–2.

M-28/20 Module to JT-EASY, 10-pin Flat Flex Cable (FFC) connection

NOTE

As a standard practice, to prevent possible damage or operation disruption of the Module or Target Board, it is recommended that the Module or Target Board power source be turned OFF or be disconnected before making any cable connections.

To prevent unwanted bending of the FFC grasp it near the exposed end-fingers, or the hard-plastic backing. It is best to partially insert one corner of the FFC end into the connector first, before squaring the edge to complete the insertion.

Insert one end of the FFC into JT-EASY, 10-pin FFC (J3) connector, and the other into the Module (J1) connector. EMBEDDEDkits uses FFC dual-contact type connectors on both JT-EASY and the M-Series Modules, so the orientation (facing up or down) of the cable exposed end-fingers is not important, as long as both ends of the cable are facing the same way. We generally prefer to insert the cable with the exposed end-fingers facing up.

NOTE

EMBEDDEDkits, JT-EASY is equipped with both an FFC-type and a 14-pin header for the JTAG Interface connection. To prevent unwanted noise pick-up, only one cable connection should be made to one of the JT-EASY, JTAG Interface connectors.

Section 4

User Installed Components

Installing the connection headers and operation selection headers

NOTE

Installing in this case means inserting the header or component in the designated location and soldering its' leads. A Soldering Iron (25 to 45W) with a 1/16" (max) tip along with 60/40, or equivalent, solder should be sufficient for this task.

If needed, install headers HDR1 and HDR2 in their designated location. The same applies for JP1, JP2, JP3 (M-20 only) and RST headers.

Installing the low frequency, cylindrical-type Crystal

Both the M-28P/O and the M-20P/O are supplied with a 32.768Khz, cylindrical-type Crystal. Through-hole pads are provided for installing this crystal. It is recommended that the crystal case be soldered to the PC-Board rectangular ground pad, to minimize spurious noise pick-up. The MSP430Fxxxxx family of devices have internal, selectable, 12pF capacitors, so in most cases it will not be necessary to add external loading-capacitors. This feature needs to be selected by writing to the appropriate SFR. Consult the Texas Instruments MSP430F manual for additional information.

Installing the HC49/US or HC49/U high frequency Crystal

Both the M-28 and the M-20 have through-hole pads for installing a high-frequency crystal. Most of the high-frequency crystals will require external loading-capacitors for proper operation. Pads for soldering the (2) surface mount capacitors C4 and C5 (case size 0603 or 0805) are located near the crystal case outline. Consult the Texas Instruments MSP430F manual for proper selection of the crystal and recommended loading capacitors value. In most cases this value is around 12 to 22pF. The crystal case should be soldered to the PC-Board rectangular ground pad.