

Quick reference of the STEVAL-IHM022V1 STM32 dual motor drive evaluation board and software demo application

Introduction

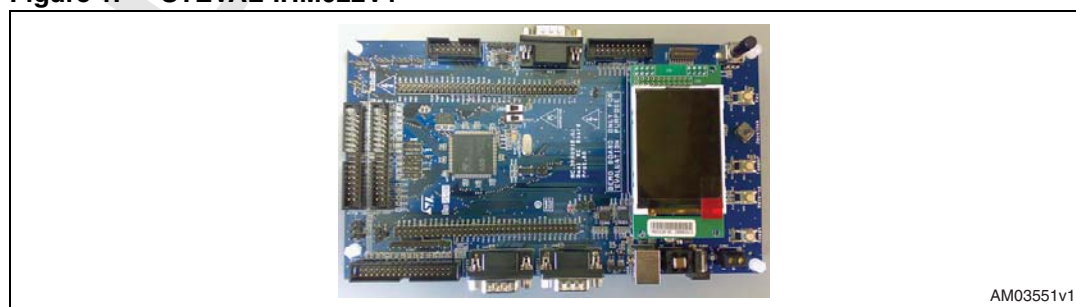
The STEVAL-IHM022V1 demonstration board is designed as dual and triple motor control development platform for STMicroelectronic's ARM Cortex-M3 core-based STM32F103Z microcontroller. It does include full speed USB2.0, CAN2.0A/B compliant interface, 2 channels I²S, 2 channels I²C, 5 channels USART, 3 channels SPI, 2 channels DAC, internal 64 KB SRAM and 512KB Flash, JTAG&SWD debugging support. The demonstration board is thought to implement multiple motor control (three MC connectors are present) and, other than above listed peripherals support, it offers an advanced user I/O interface (LCD QVGA display and joystick key). Extension headers make it possible to easily connect a daughter board or wrapping board for your specific application.

Use STEVAL-IHM022V1 as order code for ordering this demonstration board.

Features

- Four 5 V power supply sources: 2-way screw connector, power jack, USB connector or daughter board
- Boot from user flash or system memory
- 64 Mbit serial Flash included
- Two RS232 channels with RTS/CTS handshake support on one channel
- USB2.0 full speed connection
- CAN2.0A/B compliant connection
- Two motor control connectors full featured for field oriented control plus PFC support on one connector
- JTAG, SWD and trace debug support
- 240x320 TFT color LCD
- Joystick with 4-direction control and selector
- Reset, wakeup, tamper and user button
- 4 LEDs
- Extension connectors for daughter board or wrapping area board.

Figure 1. STEVAL-IHM022V1



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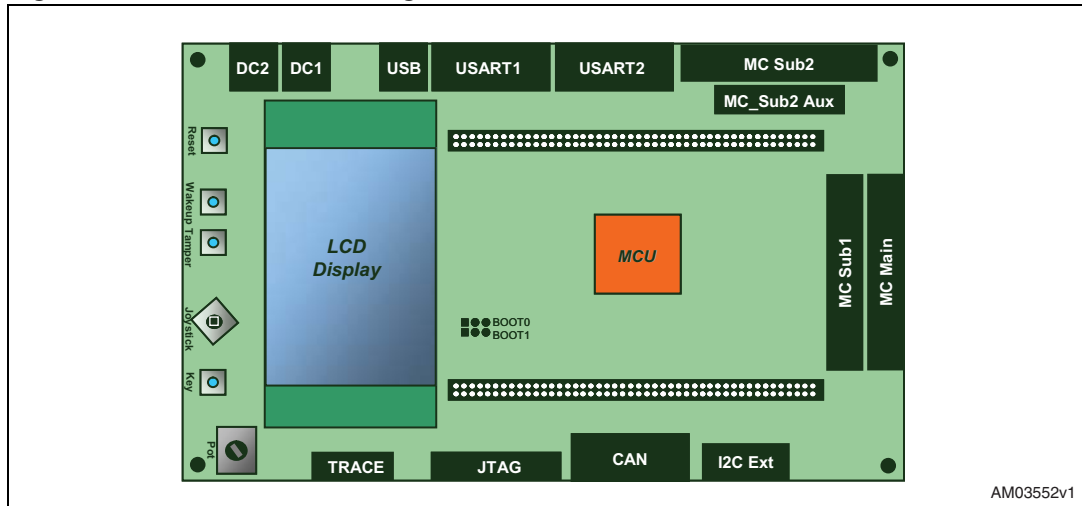
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1 Hardware features

1.1 Demonstration board architecture

The STEVAL-IHM022V1 demonstration board is designed around the STM32F103Z in 144-pin TQFP package. A block diagram of the demonstration board is shown in [Figure 2](#); it illustrates the connections between STM32 MCU and the supported connectors.

Figure 2. Hardware block diagram



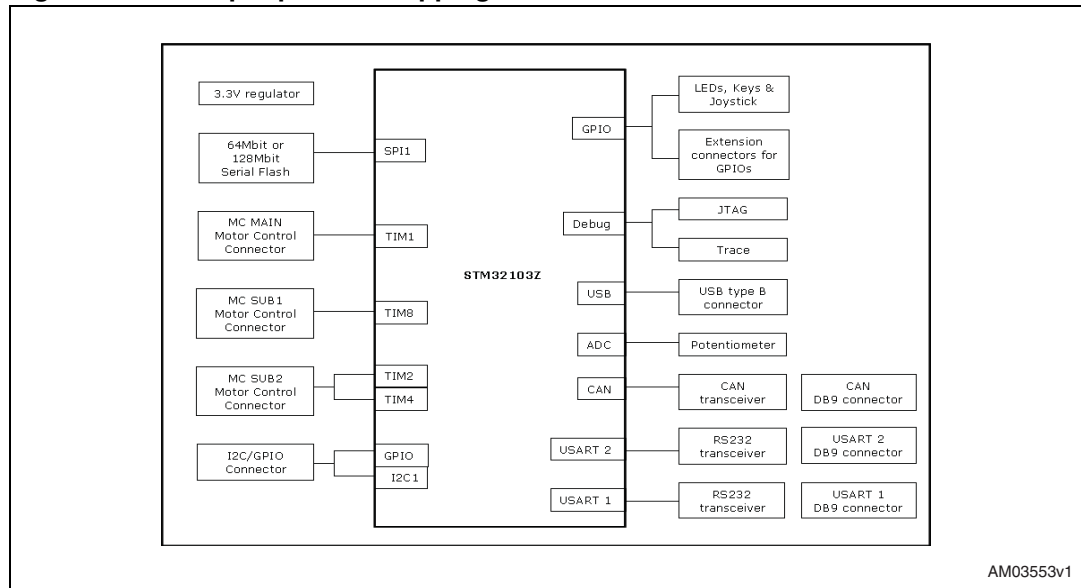
In particular, it can be noticed:

- 3 motor control connectors for supporting up to three 3 phase motor control operations
- 2xUSART, CAN, I²C, USB connectors for external interfacing
- JTAG/SWD and Trace connectors for debugging and developing applications
- Embedded user interface constituted by an LCD TFT display and 5-ways joystick key (plus one additional user defined key).

1.2 STM32 peripherals mapping on STEVAL-IHM022V1

The block diagram in [Figure 3](#) illustrates the connection between STM32F103Z peripherals and the connectors present in the demonstration board.

Figure 3. MCU peripherals mapping



1.3 Multiple motor control operations

STEVAl-IHM022V1 demonstration board supports up to three 3-phase brushless motor control via three 34-pins connectors named MC_Main, MC_Sub1, MC_Sub2, each one providing all required control and feedback signals to and from a motor power-driving board.

MC_Main and MC_Sub1 connectors include emergency stop, motor speed feedback (Tacho, Encoder and/or hall sensor), motor currents, DC bus voltage and heatsink temperature sensing, 6 complementary PWM channels going to the motor driving circuit. As far as the third motor control connector MC_Sub2 is concerned, the 6 PWM channels can be derived either by using two general purpose timers working in synchronism or by using one GP timer plus additional external circuitry for complementary PWM signals generation. An auxiliary connector (MC_Sub2 Aux) is present on the board for plugging a daughter board in for this aim.

MC_Main connector features additional sensing signals (AC 50/60 Hz mains and rectified input current) for managing a digital power factor control, whose software executes in the same STM32 microcontroller used for multiple motor control.

1.4 Connect STEVAL-IHM022V1 to inverter power stage boards

For simultaneous multiple motor operations, STEVAL-IHM022V1 has to be connected to three phases inverter power stages through the MC Main, MC Sub1 and MC Sub2 34-pins connectors.

In our application demo, dual motor control driving has been implemented and two power stages, MB459 and STEVAL-IHM011V1, available from STMicroelectronics have been connected to control stage. They can be ordered via ST regional sales offices.

2 Software demonstrator

2.1 General description

The demonstration firmware running on STEVAL-IHM022V1 demonstration board is able to perform dual motor control operations in simultaneous mode. Up to two motors can be driven in field oriented control (FOC), single shunt resistor and in sensorless mode (no speed sensor needed).

Dual motor control firmware uses the FOC routines implemented on STM32 PMSM library ver. 2.0 firmware package and, hence, shares same principles for configuring the motor drive with user parameters.

Moreover, the architecture of the software has been extended to treat each motor drive as an independent element, allowing to set the drive and motor parameters in a completely independent way.

2.2 Embedded user interface and debug mode

An embedded UI (LCD TFT 320x240 display and 5 positions joystick) allows the user to set a lot of motor control parameters in real time during motors operations. Basically, the UI is made of:

- TFT LCD graphical display
- Micro joystick key with five position
- One dedicated key for starting/stopping the motors

The user can set all relevant motor drive and control parameters by means a set of screen views shown on the LCD display.

Debug functionality allows selecting which motor control variables have to be sent via DAC outputs (2 channels).

2.3 Memory size and CPU workload

Dual motor control software is provided for demonstration purposes and it is not fully featured as the STM32 FOC motor control library v. 2.0 from whose it has been derived. In [Section 3](#) the allowed configurations are described in more details. Here follows some figures about memory size and CPU workload:

Table 1. Dual motor control firmware performances

| Firmware configuration ⁽¹⁾ | Flash memory occupation | CPU load (estimation) |
|-------------------------------------------------------|-------------------------|-----------------------|
| Standard dual motor control (no UI + sensorless mode) | 20 kB | ~45% |
| Standard dual motor control (no UI + encoder sensing) | 18.5 kB | N.A. |

Table 1. Dual motor control firmware performances (continued)

| Firmware configuration ⁽¹⁾ | Flash memory occupation | CPU load (estimation) |
|------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| Advanced dual motor control (no UI + sensorless mode + advanced motor driving techniques) | 22.5 kB | N.A. |
| Full dual motor control (UI + sensorless mode + advanced motor driving techniques + debug functionalities) | 45.5 kB | N.A. |

1. All this configurations refer to single shunt mode and repetition counter = 3

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3 Demo configuration parameters

3.1 FOC Drive parameters and configuration files

The values listed in [Table 1](#) have been calculated in the following conditions:

- CPU clock @ 72 MHz
- Motor control PWM frequency: 12 kHz
- Max modulation index: 96%
- Current control loop speed: 6 kHz (repetition counter = 3)
- Speed loop sampling time: 500 Hz
- Each motor current sensed over 1 single shunt resistor.

All these settings (together with other ones) are provided through parameters configuration files, the one that in its filename have the suffix `_param`.

3.2 Demo scope and limitations

As stated in this document, the software program provided with the dual MC board is only for demo purposes and it is tuned to run a particular model of low voltage motor. This limitation must be taken into account when the user will try to modify all operating parameters listed in [Section 3.1](#). We strongly suggest to refer to UM0492 (STM32F103xx permanent-magnet synchronous motor FOC software library V2.0) or to UM0683 for having full knowledge on this subject before performing any customization in this software.

4 References

Detailed information on STEVAL-IHM022V1 demonstration board and software demo provided with this hardware can be retrieved in the following documents downloadable from www.st.com:

- UM0686 user manual
- UM0683 user manual.

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5 Revision history

Table 2. Document revision history

| Date | Revision | Changes |
|-------------|----------|------------------|
| 25-Mar-2009 | 1 | Initial release. |

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