



MT25C datasheet and user manual

Membrane keypad, LEDs and capacitive button tester

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MT25C overview

MT25C devices are membrane keypad tester capable of testing up to 25 dome buttons, capacitive buttons or LEDs. MT25C needs to connect to computer for proper operation. A software is provided free of charge to control the MT25C device, display live results and log the history of all testing operations. Alternatively, the user may directly interface with the MT25C hardware via a virtual serial interface, effectively allowing unlimited integration possibilities into existing testing infrastructure.

MT25C are optimized for industrial testing applications, and are highly configurable.



Figure 1: MT25C Membrane keypad tester

MT25C interfaces with the systems under test by the mean of an industry-standard DB25 connector.

Custom software applications can be developed on demand. Contact us (contact@ikalogic.com) for customization requests.

Note: In this document the words “switch” and “button” are used interchangeably without affecting the meaning.

Typical applications

MT25C are typically used to test membrane keypads that include buttons and/or LEDs, but effectively, they can be used for any application that requires the testing of a number of buttons.

The keypad configurations that can be tested are (but not limited to):

- Dome switches with a common line
- Dome switches in a matrix configuration
- Capacitive tactile switches
- Independent unidirectional or bidirectional LEDs (detect LED inversion)
- Unidirectional LEDs with a common line
- Unidirectional LEDs in a matrix configuration

Note 1: It's not possible to test capacitive switches and dome switches simultaneously. It's, however, possible to test capacitive and dome switches separately on the same membrane keypad. **Note 1:** It's not possible to test switch matrix and LED matrix that share the same lines.

Product highlights

- Handle up to 25 contacts, configurable as LEDs, short-circuits, common, or switches.
- Handles matrix configuration for LEDs and switches.
- Detect LED color (using forward voltage drop measurement).
- Automatic detection of membrane insertion and removal (if there is at least 1 LED or 1 common line).
- Training mode to quickly record all valid contacts for a specific membrane keypad.
- Fast operation: Detects all static information (e.g. LEDs, short-circuits) in less than 250ms.
- Versatile, easy to operate and fully documented serial interface allows full control of the MT25C device.

Warning

Read **safety information** section carefully before using this instrument.

Main characteristics

Power requirements

Input power connector	USB (Type B)
Input current (Maximum)	200 mA
Input voltage	5V V $\pm$ 0.25 V
Protection	ESD on all connectors and all contacts

Operating conditions

Room Temperature	10°C to 35°C
Relative humidity	< 80% non condensing
Altitude	< 2000m

Test system

Number of individual test points	25
Maximum LED voltage drop	3V
Contact resistance adjustment	Yes, from 1 Ω to 100 Ω
Contact switch detection times (including communication delay via serial port.)	100ms typical (maximum 250ms)
Capacitive switch detection	Yes, accepts key capacitance from 1pF to 30pF
Capacitive switch calibration time (Needed once after insertion of new membrane keypad.)	1s typical (max 3 seconds)
Capacitive switch detection times (including communication delay via serial port)	100ms typical (maximum 250ms)

MT25C interfaces

MT25C devices connect to a host computer via USB port (type B) on the back panel as shown in the image below.



Figure 2: MT25C Back panel

On the front panel, a standard female DB25 port exposes the 25 test points as well as a status LED.



Figure 3: MT25C Front panel

Interfacing to user keypad.

The user is required to design a specific interface for his application to connect the MT25 to the keypad being tested. A custom DB25 cable can be used for this purpose. It's recommended to limit the length of the wires between the MT25C device and keypad being tested to 150mm. Longer distances are also acceptable but may affect the precision of the measurements.

Special care should be taken when interfacing to capacitive keypads. As with any capacitive switches system, the length of the wires between the capacitive electrodes and the test system are critical and should be reduced as much as possible.

Principle of operation

Serial interface

MT25C is operated via a virtual serial interface (emulated over USB port.)

The user can either use a freely available C++ application to configure and use the MT25C device or design his own test system by sending and receiving serial commands over the serial port.

This chapter focuses on the latest scenario, where a user needs to have knowledge low level serial commands to control the operation of the MT25C hardware.

Command construction

A command is composed of several parts described below

Header	Size	Command	Payload	CRC
1 Byte	2 Bytes	1 byte	N Bytes	2 bytes
x55	Size of command, payload and CRC	Command	Payload	16bit CCITT calculated over the command byte and the N payload bytes (the size bytes are not used in CRC calculation).

Each command set by the computer is acknowledged back by MT25C device by sending back a 0 payload packet with the same command to the host computer.

Pin states

Viewed from MT24C device measurement system, and depending on the current measurement context, a pin can have various states as it's summarized in the table below.

Measurement context	Pin state	Pin state value	description
Static measurement	LED-A	0x01	LED Anode
Static measurement	LED-C	0x02	LED Cathode
Static measurement	LED-AC	0x03	Bidirectionnal LED
Static measurement	SHORT	0x04	Short circuit (resistance less than the maximum resistance allowed for a closed switch)
Static measurement	COM	0x05	Pin is common between several other pin pairs. Note: in a matrix configuration, pin are not considered as common.
Mechanical button measurement	BUT0	0x10	Mechanical button released (dome switch or alike).
Mechanical button measurement	BUT1	0x11	Mechanical button pressed (dome switch or alike).
Capacitive button measurement	TCH0	0x20	Capacitive touch released.
Capacitive button measurement	TCH1	0x21	Capacitive touch pressed.

List of serial commands

Request ID

Command name	ID
Command code	0x00
Description	This command is sent by the host computer to identify an MT25C device plugged on the serial port. The MT25C shall respond with the following payload: "MT25C" or the bytes array: {0x4D, 0x54, 0x32, 0x35, 0x43}.
Payload size	0
Payload	N/A

Load configuration

Command name	CFG
Command code	0x01
Description	This command is sent by the host computer to configure the operation of the MT25C device.
Payload size	3
Payload Byte 1	Maximum resistance allowed per closed switch contact (0 to 255, value expressed in ohms)
Payload Byte 2	Capacitive touches threshold (0 to 128, 0 being the most sensitive)
Payload Byte 3	Buzzer volume (0 to 100)

Set insertion detection mode

Command name	DETECT_INSERT
Command code	0x02
Description	This command is sent by the host computer to switch the mode of operation of the MT25C to “insertion detection”. In this mode, the MT25C device will try to detect the insertion of a keypad on the DB25 connector. When an insertion is detected, the ON_INSERT command is sent by the MT25C device
Payload size	0
Payload	N/A

Keypad inserted event

Command name	ON_INSERT
Command code	0x03
Description	This command is sent by the MT25C device to signal that a keypad was inserted. Please note that in some situations, it is impossible to detect the insertion of a keypad. In that situation, other provisions should be taken on the host computer side (via software solutions).
Payload size	0

Payload	N/A
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Request a static measurement

Command name	MES_STATIC
Command code	0x04
Description	This command is sent by the host computer to switch the mode of operation of the MT25C to “static measure” and actually launch the measurement. A static measure relates to all the elements that can be measured without the interventions of a user, that includes: Short circuits, open circuits, and most importantly LEDs. Static measure does not include switches (which are covered by button measurements).
Payload size	0
Payload	N/A

Static measurement event

Command name	ON_STATIC_MES
Command code	0x05
Description	This command is sent by the MT25C device to deliver the result of a static measurement. The measurement is expressed as a number of pairs. Each pair, consists of 6 distinct values: The first pin number, the first pin state, the second pin number, the second pin state and finally the Voltage drop measured in both direction of the current (from first pin to second pin and vice versa). The payload description below is for “1 pair” information, but in theory, much more pairs can be transmitted through this command.
Payload size	Variable (but always multiple of 6 bytes)
Payload byte 1	First pin number (1 to 25)
Payload byte 2	First pin state (see static measurement context in pin functions table)
Payload byte 3	Second pin number (1 to 25)
Payload byte 4	Second pin state (see static measurement context in pin functions table)

Payload byte 5	Voltage drop with current flowing from first to second pin, expressed in 20mV steps.
Payload byte 5	Voltage drop with current flowing from second to first pin, expressed in 20mV steps.

Request a mechanical buttons measurements

Command name	MES_BUTTON_MECH
Command code	0x06
Description	This command is sent by the host computer to switch the mode of operation of the MT25C to “mechanical buttons measurement” and scans the keypad for any buttons being pressed. When a button is pressed or released, an event command is sent to host PC. MT25C stays in this mode until the mode is changed.
Payload size	0
Payload	N/A

Mechanical button measurement event

Command name	ON_BUTTON_MECH
Command code	0x07
Description	This command is sent by the MT25C device to the host computer when a mechanical button is pressed or released.
Payload size	6
Payload byte 1	First pin number (1 to 25)
Payload byte 2	First pin state (see mechanical button measurement context in pin functions table)
Payload byte 3	Second pin number (1 to 25)
Payload byte 4	Second pin state (see mechanical button measurement context in pin functions table)
Payload byte 5	Voltage drop with current flowing from first to second pin, expressed in 20mV steps.

Payload byte 6	Voltage drop with current flowing from second to first pin, expressed in 20mV steps.
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Request a capacitive buttons measurement

Command name	MES_BUTTON_CAP
Command code	0x08
Description	This command is sent by the host computer to switch the mode of operation of the MT25C to “capacitive buttons measurement” and scans the keypad for any capacitive button being touched. When a button is touched or released, an event command is sent to host PC. MT25C stays in this mode until the mode is changed.
Payload size	0
Payload	N/A

Capacitive button measurement event

Command name	ON_BUTTON_CAP
Command code	0x09
Description	This command is sent by the MT25C device to the host computer when a capacitive pad is touched or released.
Payload size	4
Payload byte 1	First pin number (1 to 25)
Payload byte 2	First pin state (see capacitive button measurement context in pin functions table)
Payload byte 3	Second pin number (1 to 25)
Payload byte 4	Second pin state (see capacitive button measurement context in pin functions table)

Set removal detection mode

Command name	DETECT_REMOVE
Command code	0x0A
Description	This command is sent by the host computer to switch the mode of operation of the MT25C to “removal detection”. In this mode, the MT25C device will try to detect the removal of a keypad on the DB25 connector. When removal is detected, the ON_REMOVE command is sent by the MT25C device. If this mode is set after a keypad was removed, the ON_REMOVE event will be generated immediately.
Payload size	0
Payload	N/A

Keypad inserted event

Command name	ON_REMOVE
Command code	0x0B
Description	This command is sent by the MT25C device to signal that a keypad was removed. Please note that in some situations, it is impossible to detect the removal of a keypad (for example, if the keypad has no any LEDs or short circuits). In that situation, other provisions should be taken on the host computer side to detect removal (via software solutions).
Payload size	0
Payload	N/A

What's in the box

MT25C series is shipped with the following items:

1. MT25C test device.
2. USB 2 cable (Type C to A)

Unpacking and first usage

We recommend the user to start by identifying all the different components that are provided. To turn ON the MT25C device, connect it to a free USB port of your computer using the provided USB cable¹. The LED should glow according to the table in the “Status LEDs behavior” section. To switch off the device, simply disconnect the USB cable.

Status LEDs behavior

Status led can be in one of 3 states:

Status LED	Meaning
Red fix	Device is booting (this should last maximum 0.5 seconds after being powered up)
Green fix	Device ready.
Fushia	Waiting for keypad to be connected or disconnected
Blue	Performing static measurements
Blue blinking	Waiting for button activity
Red blinking	Device hardware fault.

Software Quick Start guide (MT25C Interface)

A simple utility is provided to allow MT25C device to be used without any programming skills.

Start by downloading the latest version of MT25C Interface software (www.ikalogic.com) and then follow instructions to install both software and provided drivers. It is recommended to restart your computer after the software and drivers have been installed.

MT25C Interface demonstrates all the features of the MT25C device, and can be used in a production and testing environment.

¹Do not connect SP1000G device to anything else than a computer's USB port. Never connect the SP1018G to a USB charging adaptor.

Mechanical data

MT25C devices casing are manufactured from anodized aluminum, able to withstand heavy duty usage in various harsh environments.

Weight: 200 gm $\pm$ 10 gm

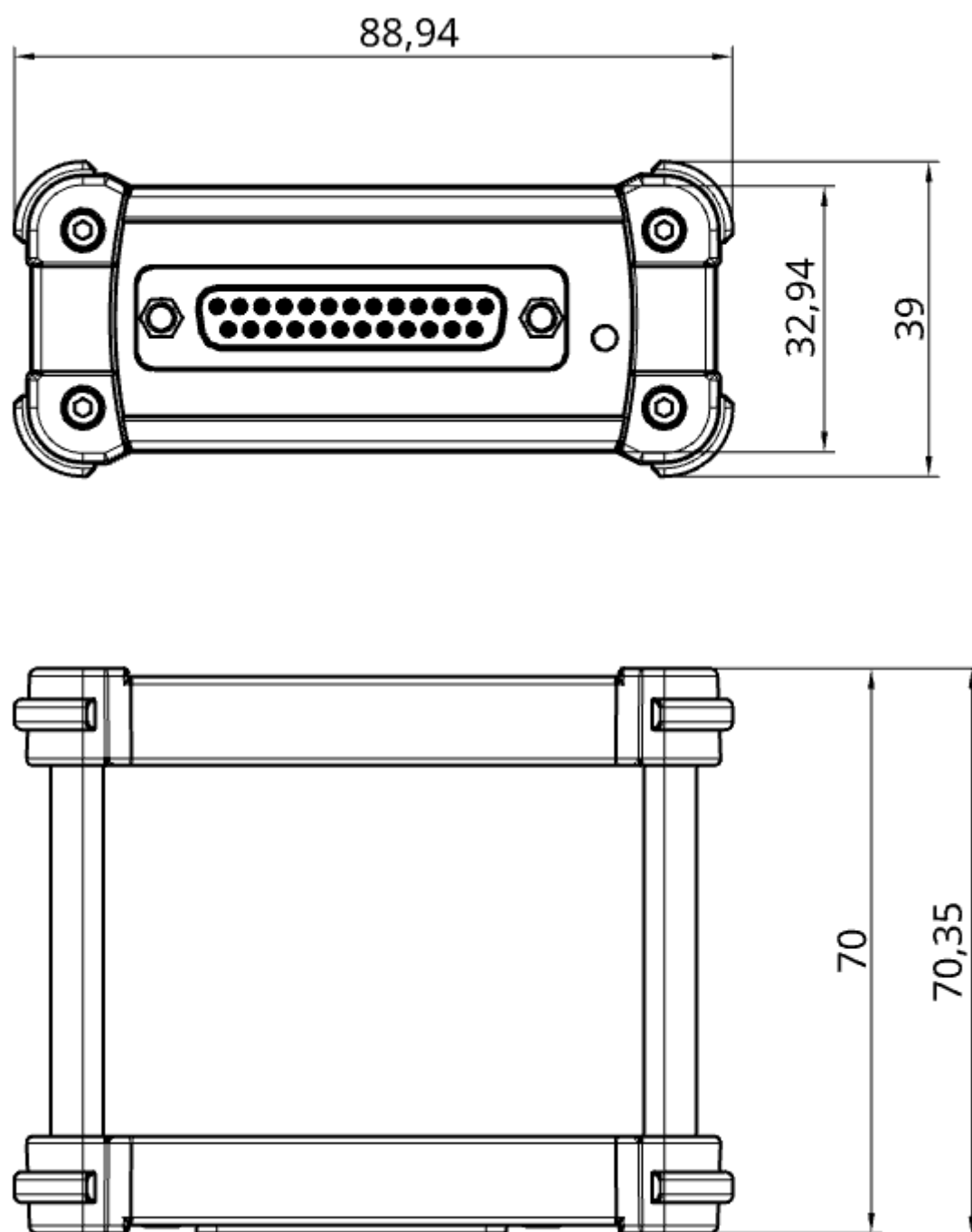


Figure 4: MT25C dimensions (mm)

Software technical requirements

Serial port API

Any machine with USB support and capable of emulating a serial port over USB can be used to communicate with MT25C device.

MT25C Interface software

MT25C Interface software was tested to work on these platforms:

- Windows 7/8/10
- Mac OS
- Ubuntu

Ordering information

Valid ordering code is [MT25C](#)

For purchasing, please check for nearest distributor on www.ikalogic.com or contact us for any inquiry at contact@ikalogic.com.

Accessories, maintenance and customer support

Accessories and maintenance services (probes replacement) are available on our website: www.ikalogic.com or by contacting customer support (support@ikalogic.com).

Certifications and regulations

This device complies with the following applicable European Directives: Electromagnetic Compatibility (EMC) Directive 2004/108/EC, Low-Voltage Directive 2006/95/EC, IEC 61326-2.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CAN ICES-3 (B) / NMB-3 (B)

RoHS Compliant 2011/65/EC. This device does not contain any of the substances in excess of the maximum concentration values ("MCVs") defined in the EU RoHS Directive.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



Safety information

This product complies with safety standards IEC NF/EN 61010-1: 2010, IEC NF/EN 61010-2-030 and UL 61010-1: 2015 To prevent possible electrical shock, fire, personal injury, or damage to the product, read all safety information before you use the product. The following international symbols are used on the product and in this manual.

Symbols definitions



Figure 5: Risk of Danger. Important information. See Manual.



Figure 6: WEEE logo. This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 Do not dispose of this product as unsorted municipal waste.



Figure 7: CE Logo. Conforms to European Union directives.

Important safety notes



Warning, to avoid electrical shock or fire:

- Carefully read all instructions.
- Use the product only as specified, otherwise the protection supplied by the product can be compromised.

- Do not use the product if it operates incorrectly.
- Before use, inspect device casing, probes, test leads and accessories for mechanical damage and replace if damaged.
- Never attempt to repair a defective device. Contact after-sale service.
- Do not use the product or its accessories in case of any damage.
- Remove all probes, test leads and accessories that are not in use.
- Never use the device for measuring mains circuits.
- Never use the device for measuring circuits which are not isolated from mains.
- Do not touch electrical wires with bare hands.
- Keep away from children's sight or from animals.
- Do not expose to water, heat or moisture.
- The device's ground connection through the USB cable is for measurement purposes only. The logic analyzer does not have a protective safety ground.
- Ensure there is no significant voltage between device ground and the point to which you intend to connect it.
- Do not apply more than the rated voltage ($\pm 25V$), between the terminals or between each terminal and ground.
- Do not apply input voltages above the rating of the instrument ($\pm 25V$).
- Measure a known voltage first to make sure that the product operates correctly.
- Do not work alone.
- Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame resistant clothes) to prevent shock.
- Do not use the device in wet or damp conditions, or around explosive gas or vapor.
- Do not operate the product with covers removed or the case open. Hazardous voltage exposure is possible.
- Do not use in a system in which the failure of the product might result in personal injury.

Limited warranty & limitation of liability

Each Ikalogic product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is three years for the test tool and two year for its accessories. This warranty extends only to the original buyer or end-user customer of an Ikalogic authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Ikalogic's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation or handling.

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES,

EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IKALOGIC SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, WHETHER ARISING FROM BREACH OF WARRANTY OR BASED ON CONTRACT, TORT, RELIANCE OR ANY OTHER THEORY. Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

Document Revisions

10-March-2022	Initial release of this document.
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