

MT40 Grounding System

for Tank Trucks, Rail Tankers, IBCs, Drums

CE  **IECEX** SIL 

MT40 is a grounding system designed to prevent the accumulation of electrostatic charges which may generate while handling nonconductive liquids, powders and granulates, thus avoiding possible sparks from causing dangerous events in hazardous atmospheres. This is achieved by connecting the tank to earth during the entire loading/ unloading operation, and thanks to a constant monitoring of such a connection. If, for whichever reason, the connection is interrupted, the system generates an alarm so that the operation can be stopped.

By measuring the electric capacitance of the device it is connected to, the MT40 monitor is able to detect whether it is connected to the tank or to some different metal object (piping, stairs, etc.) thus enhancing the level of reliability and safety and preventing possible misuses by the operator.

A typical application is the loading, unloading operation of fuels, chemicals, powders, etc. into tank trucks, railcars, IBCs (intermediate bulk containers).

Thanks to the MT40 grounding system installed in the loading / unloading bay, the vehicle connection to ground is granted at all time. If during the operations the connection is lost for any reason (the operator may disconnect the clamp by mistake, the cable maybe damaged by the truck, etc.) the system allows to stop the process immediately and the operator gets a clear alarm signal, granting the necessary safety conditions.

The system consists of:

- A grounding monitor with a bright LED user interface showing the status of the connection and all the necessary information to the user, for mounting in the loading/unloading area.
- A cable with a clamp, to connect the monitor to the vehicle.

Additional accessories are available, like a tester, to periodically check the setting and the performances of the device "off line", as well as a software toolkit for system diagnostic.



Reference Standards

MT40 monitors the resistance between the mobile tanker (tank truck, railcar, IBC-Intermediate Bulk Container, metal drums) and the earth connection point, checking it does not exceed the threshold resistance of 10Ω according to IEC 60079-32 – (Electrostatic hazards, guidance) and NPFA77 – (Recommended Practice on Static Electricity).

MT40 detects whether the clamp is connected to the tank or to other metal objects, as recommended by IEC 60079-32 – (Electrostatic hazards, guidance).

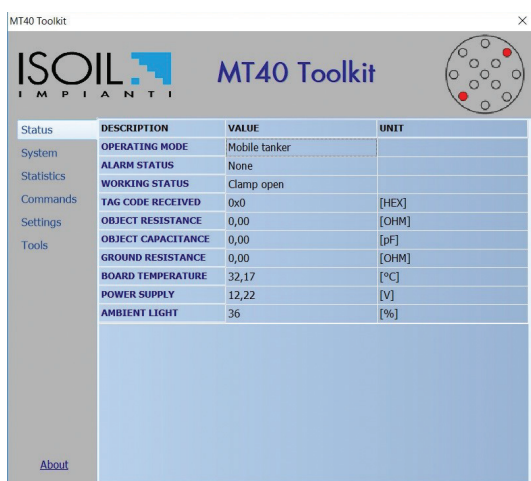
Approvals

MT40 is an approved Safety Device, with SIL2 level (Safety Integrity Level 2), according to:

- Harmonized Standard EN 50495 (Safety devices required for the safe functioning of equipment with respect to explosion risks) under the ATEX Directive 2014/34/EU (Equipment for potentially explosive atmospheres)
- Technical Specification IEC TS 60079-42 (Electrical Safety Devices for the control of potential ignition sources from Ex-Equipment) under international IECEx scheme.
- IEC 61508 (Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems).

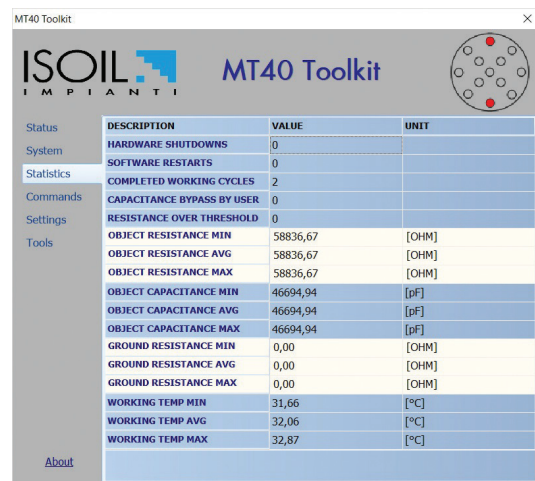
Connectivity

The MT40 monitor is equipped with a serial port RS485 through which the unit can be connected to external devices with ModBus RTU protocol. This allows retrieving diagnostic and statistical information (device status, working cycles, average resistance and capacitance measurements, faults, etc.), useful for optional detailed remote control of the instrument.



The screenshot shows the MT40 Toolkit software interface. The top bar includes the ISOIL IMPIANTI logo and the title 'MT40 Toolkit'. A sidebar on the left lists categories: Status, System, Statistics, Commands, Settings, and Tools. The main area displays a table with the following data:

DESCRIPTION	VALUE	UNIT
OPERATING MODE	Mobile tanker	
ALARM STATUS	None	
WORKING STATUS	Clamp open	
TAG CODE RECEIVED	0x0	[HEX]
OBJECT RESISTANCE	0,00	[OHM]
OBJECT CAPACITANCE	0,00	[pF]
GROUND RESISTANCE	0,00	[OHM]
BOARD TEMPERATURE	32,17	[°C]
POWER SUPPLY	12,22	[V]
AMBIENT LIGHT	36	[%]



The screenshot shows the MT40 Toolkit software interface with the Statistics and Tools sections expanded. The main area displays a table with the following data:

DESCRIPTION	VALUE	UNIT
HARDWARE SHUTDOWNS	0	
SOFTWARE RESTARTS	0	
COMPLETED WORKING CYCLES	2	
CAPACITANCE BYPASS BY USER	0	
RESISTANCE OVER THRESHOLD	0	
OBJECT RESISTANCE MIN	58836,67	[OHM]
OBJECT RESISTANCE AVG	58836,67	[OHM]
OBJECT RESISTANCE MAX	58836,67	[OHM]
OBJECT CAPACITANCE MIN	46694,94	[pF]
OBJECT CAPACITANCE AVG	46694,94	[pF]
OBJECT CAPACITANCE MAX	46694,94	[pF]
GROUND RESISTANCE MIN	0,00	[OHM]
GROUND RESISTANCE AVG	0,00	[OHM]
GROUND RESISTANCE MAX	0,00	[OHM]
WORKING TEMP MIN	31,66	[°C]
WORKING TEMP AVG	32,06	[°C]
WORKING TEMP MAX	32,87	[°C]

The Freeware Toolkit app for Windows platform, can be used for diagnostic purpose via RS485 serial line, and for maintenance purpose via practical USB link.

Working Modes

MODE 1: RESISTIVE/CAPACITIVE (ROAD TANKERS)

When in MODE 1 for Road Tankers application, the MT40 monitor is able to detect whether it is connected to the tank (or earth connection point) or to some different metal object (piping, stairs, etc.), which may be electrically isolated from the container, thanks to an accurate capacitance measurement system of the tank.

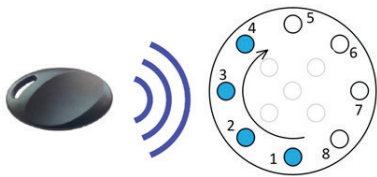
After the bipolar clamp is connected to the tank, and the correct capacitance is detected, the MT40 monitor performs ground connection by means of a dedicated internal relay.

Once the correct grounding is successfully verified, it activates a circuit which monitors that during the entire operation the resistance value does not exceed 10Ω , as recommended by the reference standards.

The specific relay output allows enabling or stop of the operation in compliance with functional safety, according to the monitoring status of the resistive threshold.

Sensibility Level Setting

The default capacitance threshold is set to 1 nF (lev. 6), according to the average typical value recovered from empirical field tests. The capacitance could vary according to the shape and size of the tanker; the monitor allows to change the sensibility level by using an RF-ID tag (supplied with the instrument).



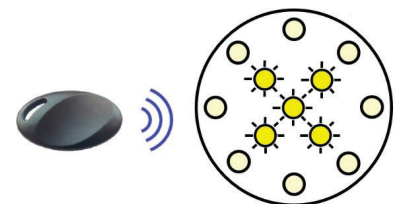
Just place the tag in the center of the display when MT40 is in stand-by mode: the sensibility level increases step by step, until the desired level is reached.

Level (number of blue LEDs)	1	2	3	4	5	6	7	8
Capacitance values	32 nF	16 nF	8 nF	4 nF	2 nF	1 nF	500 pF	250 pF

By-pass

The capacitance measurement in exceptionally high humidity conditions (due to rain or fog), could sometime result in lower than typical values. In these cases, the tank truck recognition may fail, and MT40 goes into the pending authorization phase.

After visually verifying that the clamp has actually been connected to the vehicle, the authorized operator can enable the MT40 monitor to carry out the subsequent grounding operations.



MODE 2: LOOP-RESISTIVE (TANK TRAIN, IBC, METALLIC DRUMS)

In configuration MODE 2, after identifying that the bipolar clamp has been connected to a metal object, the MT40 grounding monitor performs ground connection by means of a dedicated internal relay.


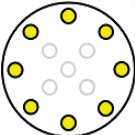
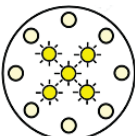
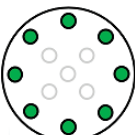

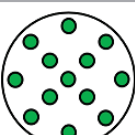
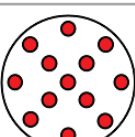
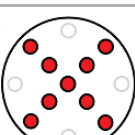
If grounding is correct, MT40 activates the circuit that has to monitor that the resistance remains below 10Ω during the entire operation, as recommended by the reference standards.

The specific relay output allows enabling or stop of the operations, in compliance with functional safety, according to the monitoring status of the resistive threshold.

Display



The LED matrix display, through conventional shapes and colors, provides the operator with a clear and immediate perception of the operating status.

DISPLAY	MEANING	MODE 1	MODE 2
	STAND-BY MT40 waiting for clamp connection.	✓	✓
	TANKER RECOGNITION Clamp connected. MT40 is performing resistive and capacitive measurements to verify proper connection to a road tanker.	✓	
	TANKER NOT RECOGNIZED Capacitive value not consistent with set level or MT40 has failed to make any measurement (wet road tanker). Grounding not possible unless with BY-PASS.	✓	
	GROUNDING CHECK Valid measurement or bypass made by the Operator. MT40 earths the clamp by using an internal relay. It then checks correct connection to the ground potential.	✓	✓
	GROUNDING NOT CORRECT Ground connection corresponds to a resistive value higher than that required by the standards. Loading/unloading is interrupted.	✓	✓
	LOADING / UNLOADING ENABLED Successful grounding. MT40 allows loading / unloading by activating the output relay (connector X2). The unit keeps monitoring the specific safety conditions.	✓	✓
	GROUNDING LOOP FAULT Grounding has not been successful. MT40 denies consent to the loading / unloading operations.	✓	✓
	SIL SAFETY CIRCUIT FAULT Grounding is successful but there is an inconsistency in the safety circuit. MT40 denies consent to loading / unloading.	✓	✓

Technical Specifications - Monitor

ENVIRONMENTAL CHARACTERISTICS

Ambient Working Temperature:	-40°C to +55°C (233°K to 328°K)
Ambient Storage Temperature:	-40 °C to +65°C (233°K to 338°K)
Humidity:	5 to 95 % UR

ENCLOSURE PROTECTION

ATEX-IECEX:	II 2 (1) GD Ex db [ia Ga] IIB T6 Gb Ex tb [ia Da] IIIC T85°C Db
Mechanical Protection:	IP66 (according IEC 60529), outdoor use

MECHANICAL CHARACTERISTICS

Enclosure Material:	Aluminium
Dimensions:	200 x 220 x 60 mm
Weight:	5 kg approximately
Mounting:	On wall using the due holes (n°4) 8,5mm On panel with n°4 threaded holes M6x12mm
Cable Entries:	n° 4 holes threaded ½" NPT (ANSI ASME B1.20.1)

RF-ID TAG CHARACTERISTICS

Frequency:	125Khz (TAG compatibility: Q5 in configuration RF/64 ASK Manchester)
Dimensions:	50 x 35 x 7 mm

ELECTRICAL CHARACTERISTICS

Main Power Supply:	AC Version: 115 / 230 V~ (-15 ÷ +10%) 50 - 60 Hz DC Version: 10 ÷ 30 VDC
Maximum Power Consumption:	3W
Output Relay:	Free Contact: C (Common), NO (Normally Open) Max. Current: 5A Max. Working Voltage: 250V~, 30 VDC Max. Power Loading: 2000 VA, 150 W Minimum Load: 5 VDC, 10 mA
Serial Line Communication:	N° 1 RS 485 (2 wires)
Intrinsically Safe Parameters x4 Clamp Connector:	Uo: 14,2 V Io: 212 mA Po: 624 mW Co: 4,39 µF Lo: 3.16 mH

SAFETY CHARACTERISTICS (SIL)

Assessment Type:	FMEDA Assessment according IEC61508:2010
SIL Eligibility:	SIL 2
λ _{du} :	976.3 FIT
λ _{dd} :	119.8 FIT
λ _s :	11256.3 FIT
SFF:	92.1 %
PFD _{avg} , T _{proof} = 1 Year (8760 Hours)	4.30 x 10 ⁻³ (SIL2)
Response Time:	< 1 Sec

Technical Specifications - Accessories

CR-02

Cable Reel with cable and SSC clamp



SSC Clamp



CST

Coiled Cable with SSC clamp



CR-02 Cable Reel

REEL

Material:	Aluminium alloy
Temperature Range:	-25°C to +65 °C
Protection Degree:	IP42
Weight:	11 Kg
Temperature Range:	-25°C to +65 °C

CABLE

Cable Length:	14 m (10 m wounded, 3 m un-rolled on the monitor side, 1 m on the clamp side)
Conductors:	2 x 1.5 mm ²
Sheath:	Blue polyurethane, oil and water resistant, flame retardant
Temperature range:	-30°C to +80 °C
Resistance:	13.3 Ω/Km
Capacitance:	190 pF/m
Inductance:	0.57 mH/Km

Clamp SSC

Poles:	2
Teeth Material:	Stainless Steel 304
Body Material:	Stainless Steel 304
Opening Range:	3 to 25 mm
Temperature Range:	-40 °C to +65°C
ATEX Marking:	Ex II 2 GD - Ex h IIB T6 Gb Ex h IIIC T85°C Db

Coiled Cable

Length:	1.5 m (10 m extended)
Conductors:	2 x 1.5 mm ²
Sheath:	Blue polyurethane, oil and water resistant, flame retardant
Temperature range:	-30°C to +70°C
Resistance:	13.3 Ω/Km
Capacitance:	190 pF/m
Inductance:	0.57 mH/Km

Tester/T

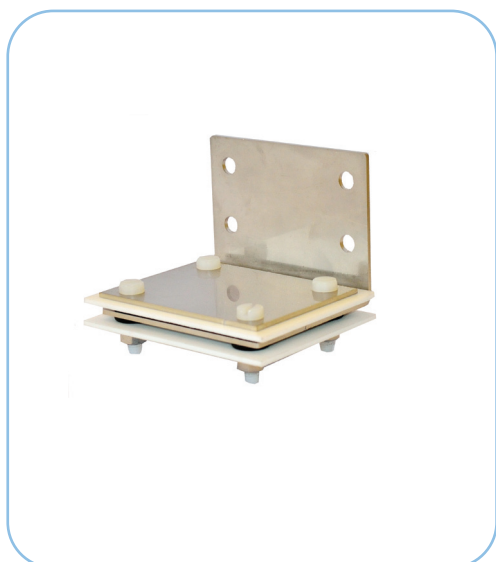


The MT40 Tester allows immediate and easy check of the grounding system working condition, and the verification of the capacitance measurement circuit.

In case MT40 is part of a SIL Safety System, this tester is useful to perform the periodical 'proof test'.

Tester	
Materials:	ABS, Stainless Steel
Dimensions:	130x80x80 mm
Ground cable length:	1 m
Temperature range:	-25°C to +55°C
Resistance levels:	Pass, Fail
Capacitance levels:	2, 4, 6, 8

SI-1 Insulated Support

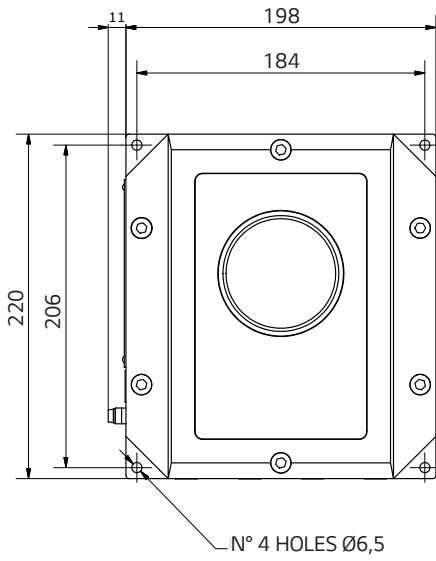


The SI-1 insulated support is designed to park the earthing clamp when not in use. When the clamp is hooked up to this support there is no electrical continuity between the clamp poles thanks to the insulating plate. The MT40 grounding system identifies the clamp as disconnected from the tank truck/railcar.

Insulated Support SI-1	
Wall Mounting Plate:	Stainless Steel
Clamp Hook Up Plate:	Stainless Steel
Isolating Plate:	Teflon
Screws:	Teflon
Washers:	Stainless Steel

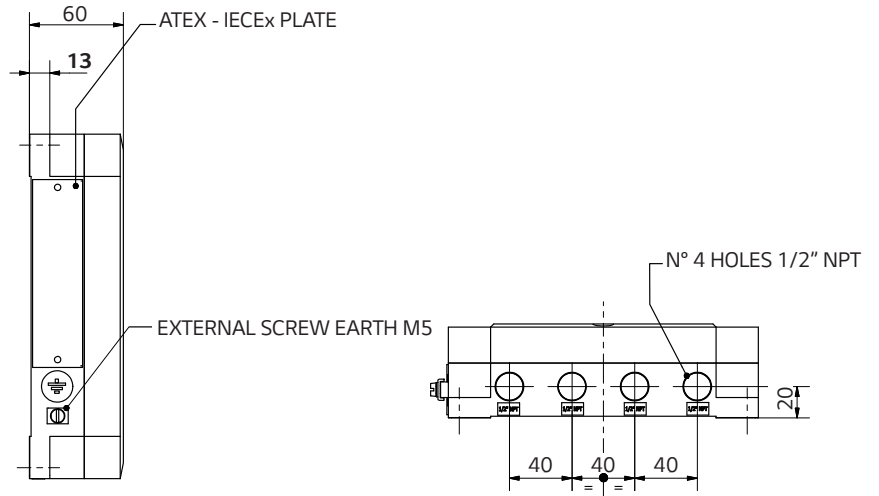
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Dimensions

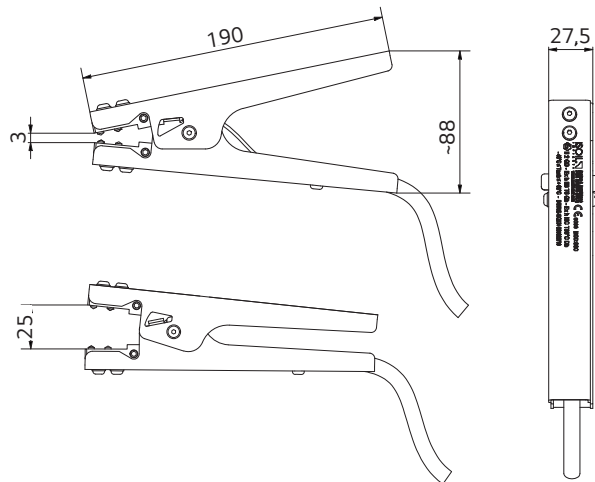
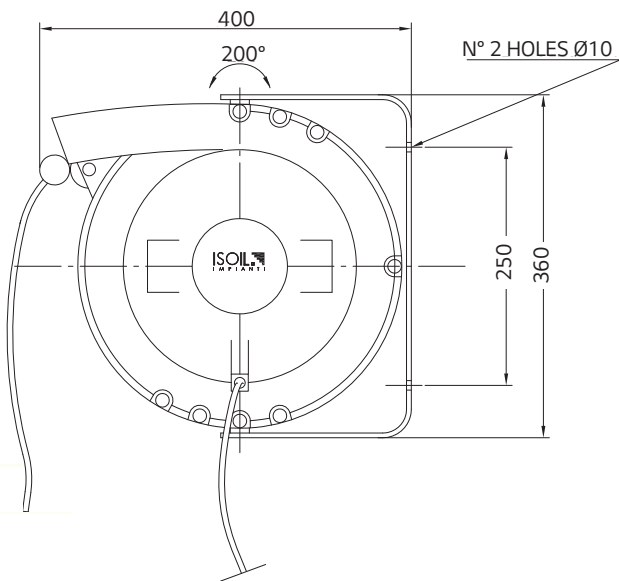


CR-02 Cable Reel

MT40 Grounding Monitor



SSC Clamp



Ordering Code

Grounding System Version	MT40	X	T	0	0
Power Supply 115/230 V		1			
Power Supply 10÷30 VDC		2			
Mode Mobile Tank (loop with threshold @10 Ohm)			T		
Fixed Fields				0	0