BROYCE CONTROL

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IMD125/M

(with Modbus communication)

Insulation Monitoring Device for ungrounded DC circuits used in the charging of electric vehicles up to 1250V

Data Sheet/Technical Information

English

Issue 1 – 07/2026

Contents

1. Key Features

- **For integration into Mode 4 high-voltage DC electric vehicle Megawatt Charging Systems (MCS)**
- **Monitors the insulation resistance of the charging station**
- **Selectable charging modes: CCS (Combined Charging System) or CHAdeMO[1]**
- **Insulation monitoring according to IEC 61557-8**
- **Compliant with UL 2231-1 and UL 2231-2**
- **Suitable for network voltages up to 1250VDC**
- **Maximum system leakage capacitance – 25µF**
- **Pre-set measurement levels – Fault 125kΩ , Alarm 625kΩ (factory default[1])**
- **Response time <10s**
- **System voltage monitoring with undervoltage and overvoltage detection**
- **Isolated Modbus RTU connection**
- **Auxiliary power supply – 12-24VDC**
- **2 (SPNO) configurable relay outputs**
- **Failsafe relay operation (factory default = relays de-energise on fault[1])**
- **Local Test and Reset buttons**
- **Option to connect external button for remote Test/Reset triggering**
- **LED indication for status, alarm and fault**
- **DIN Rail mounting – 70mm wide enclosure**

[1] Can be changed via Modbus

2. Overview

The IMD125 is designed for use in unearthed DC (IT) systems to monitor insulation resistance and detect deterioration in the wiring of EV charging equipment. It acts as an early warning system, identifying potential faults and enabling timely maintenance. Supporting both CHAdeMO and CCS requirements, the IMD125 covers system voltages from 50 - 1250VDC.

The IMD is permanently connected to a separate supply, enabling monitoring of both energised and de-energised systems. Supply connection is made via terminals L+, L– and PE. Two relay outputs provide alarm and fault signals, each independently configurable to operate at a pre-set level. The relays can be set to energise or de-energise in response to a fault with the default configuration being de-energise on fault.

Adjustments to the factory default settings are made via Modbus, allowing parameters such as response thresholds, relay logic, and system voltage range to be customised.

3. Principle of Operation

The IMD125 superimposes a voltage measuring signal across the terminals L+/L- and PE. In the event of an insulation fault such as a breakdown between a live conductor and PE protective earth, a measurable current will flow. The IMD continuously monitors this signal and compares it to predefined thresholds. If the measured signal exceeds these thresholds, it indicates an insulation fault and triggers an alarm.

4. CHAdeMO

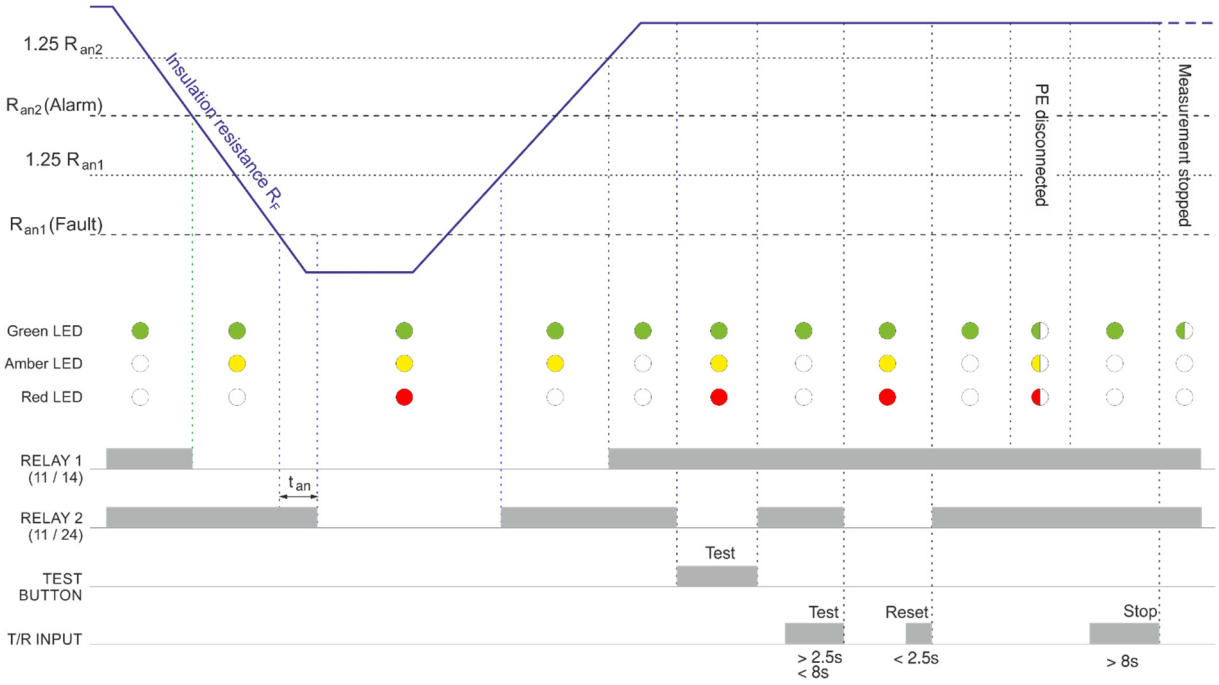
The insulation fault resistance can be calculated for DC systems with a voltage of 50 volts or higher. In CHAdeMO mode* (which can be enabled and mode selected in Modbus register 3023), the resistance fault is determined by the smaller of the double pole fault measurement and single pole fault measurement.

*There are two modes available:

CHAdeMO 1 monitors for both single pole and 2-pole faults
CHAdeMO 2 monitors for single pole faults only, i.e. L+ to PE or L- to PE

Please also note that in CHAdeMO mode, the maximum capacitance of the network is limited to 1.6uF per conductor.

5. Function Diagram



Note: Factory default assignment of relays is shown in the diagram above.

6. LED & Relay Status

System status	Green LED	Amber LED	Red LED	Relay 1 (Alarm)**	Relay 2 (Fault)**
Normal operation ($R_F > R_{an2}$)	On	Off	Off	EN	EN
Alarm condition ($R_{an2} > R_F > R_{an1}$)	On	On	Off	DE-EN	EN
Fault condition ($R_F \leq R_{an1}$)	On	On	On	DE-EN	DE-EN
Waiting for user to reset after fault ($R_F \geq 1.25\ R_{an1}$) [1]	On	Off	On	DE-EN	DE-EN
Under voltage [2]	On	Flashing	Off	Set via Modbus	
Over voltage [2]	On	Off	Flashing		
PE disconnected [3]	Flashing simultaneously*			EN	EN
Measurement stopped	Flashing*	Off	Off	EN	EN
Test mode	On	On	On	EN	DE-EN

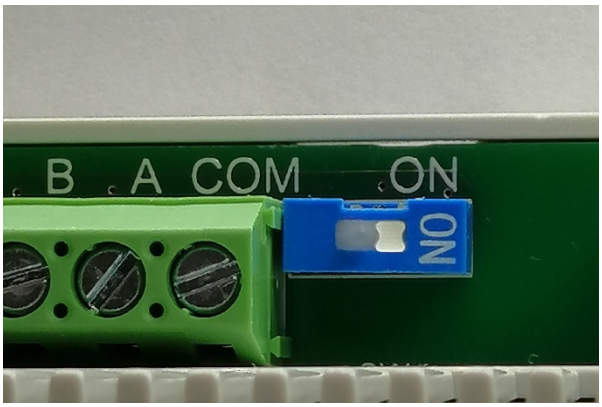
* Flash rate 2Hz
** Factory default assignment of relays
[1] this state only applies if automatic reset is disabled
[2] under/over voltage detection is disabled by default
[3] it is possible to assign the relays to respond to a PE disconnection (see page 14)

Key to relay abbreviations:
EN = Relay Energised
DE-EN = Relay De-Energised

7. Installation

Installation work must be carried out by qualified personnel.

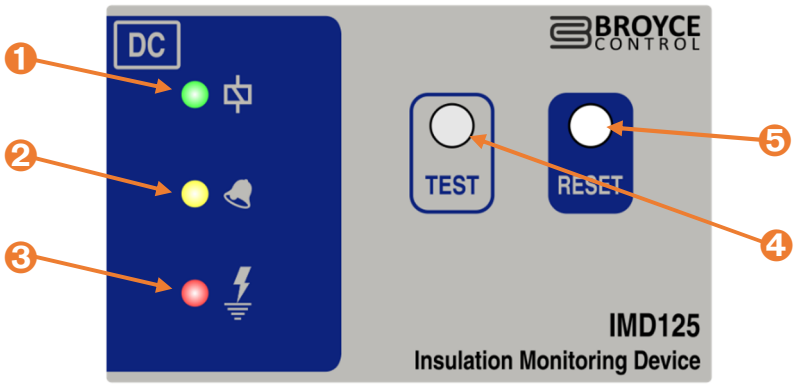
- BEFORE INSTALLATION, **ENSURE ALL SUPPLIES ARE ISOLATED.**
- It is recommended that the unit is mounted horizontally to allow air to flow vertically through the cooling slots in the housing. Avoid blocking these slots.
- Connect the unit as shown in the diagram on page 13 (N.B. certain features may not be required and therefore do not need to be connected).
- Ensure the Auxiliary supply voltage to be connected to terminals A1 and A2 matches the rating of the product.
- If the device is intended to be connected to Modbus and is last in the chain, the slide switch (shown below) that connects the internal 120Ω resistor should be set to “ON”.



- To satisfy regulations, it is recommended that the device be tested periodically to ensure correct operation.

8. Front Panel Description

1. Power on LED indication (Green)
2. "Alarm" LED indication (Amber)
3. "Fault" LED indication (Red)
4. "Test" button
5. "Reset" button



9. Operation

- The unit is supplied with factory default settings. There are no user adjustments on the product itself.

The following assumes factory default settings.

Applying power.

- Apply power and the green "power on" LED ❶ will illuminate. Both output relays will energise.

Insulation fault.

- In the event of an insulation fault, relay 1 (RLY1) will de-energise first if the fault level is less than the response value R_{an2}. The amber "alarm" LED ❷ will illuminate.
- If the insulation fault becomes less than the response value R_{an1} for greater that the response time t_{an} relay 2 (RLY2) will then de-energise. The red "fault" LED ❸ will also illuminate.
- Once the fault has cleared (fault level > 1.25 R_{an1}), the red LED ❸ will extinguish and RLY2 will return to its energised state.
- The amber LED ❷ will remain lit until the fault level increases to 1.25 R_{an2}. RLY1 will also re-energise.

Fault simulation (Test mode).

Local Test

- The unit can be placed into a fault condition by pressing and holding the "Test" button ❹ on the front of the unit. RLY2 will de-energise and remain in this state.
- Release the button to revert to normal operation. RLY2 will re-energise.

Remote Test (if fitted)

- The remote (T/R) button must be closed for between 2.5s and 8s (then released) to enter the Test mode.
- Press the button again (<2.5s) to revert to normal operation.

Stop mode.

- Press and hold the remote (T/R) button for >8s to enter stop mode and pause measurements.
- Release the button to resume operation.

Troubleshooting.

- If the unit fails to operate correctly, check that all wiring and connections are good.

10. Factory Reset

- There are two possible Factory Reset procedures that can be carried out on the unit:

    1. Reset Modbus parameters only
    2. Reset ALL user parameters including Modbus

Entering Factory Reset mode.

- Connect the auxiliary power supply. Within 30s after applying power, press and hold the “Reset” button ❺ for >5s.
- The front green, amber and red LED’s will light in sequence to signify the Factory Reset mode has been entered.
- Release the “Reset” button.

Note:
1. There is a 30s window at power up whereby the “Reset” button must have been pressed for >5s to enter this mode.
2. If no button is pressed within 5s, the unit will revert to normal operation with the last saved parameters.

Resetting Modbus parameters

- Press and hold the “Reset” button ❺ for >2s.
- The front LED’s will change to alternating just the green and amber.
- Wait for a further 5s to allow the parameters to reset to the factory defaults (see: page 10).
- The LED’s will stop alternating once the defaults have been restored.

Resetting ALL user parameters

- Press and hold both the “Test” ❹ and “Reset” buttons ❺ simultaneously for >2s.
- The front LED’s will change to alternating just the green and red.
- After 5s, the unit will automatically restart resetting all user parameters to the factory defaults (see: page 10).
- The LED’s will stop alternating once the defaults have been restored.

11. Anti-tamper Lock

To comply with UL 2231, the Anti-tamper lock must be set to prevent un-authorised changes to the user settings.

1. Locking

To set the Anti-tamper lock, first check if Modbus field/register is set to 0xAA55. If register 8010 is already set to 0xAA55 then the unlock procedure must be followed (see "2. Un-locking").

Correct setting of the anti-tamper lock requires that registers 8010-8013 must be written as a consecutive pattern (write multiple registers – Modbus function code 16):

8010 = 0xAA55
8011 = BCD passcode digit 1 (0-9)
8012 = BCD passcode digit 2 (0-9)
8013 = BCD passcode digit 3 (0-9)

Once the lock has been set, any attempts to change any of the settings will result in a Modbus "Illegal Function" response code (01).

2. Un-Locking

To remove the Anti-tamper lock, registers 8010-8013 must be written as a consecutive pattern of words (write multiple registers – Modbus function code 16):

8010 = 0x1122
8011 = BCD passcode digit 1 (0-9)
8012 = BCD passcode digit 2 (0-9)
8013 = BCD passcode digit 3 (0-9)

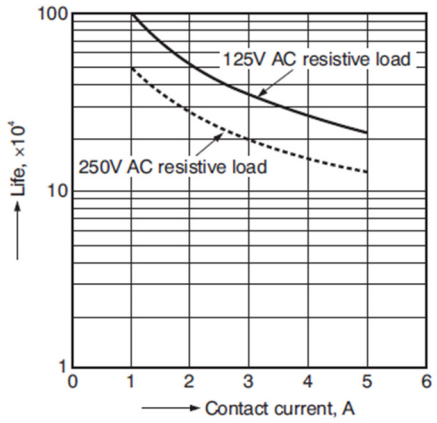
If the correct pattern is written, no exception code will be indicated in the response and the device will be unlocked. In the event of incorrect passcode, Modbus exception code "Illegal Data Value (03)" will be set, and the unit will not be unlocked.

12. Technical Specification

Auxiliary Power Supply (A1, A2)			
Voltage rating (U_s):			12 - 24V DC
Supply variation:			85 - 115% of U_s
Auxiliary supply is galvanically isolated from the monitored DC supply			
Overvoltage category:			III (IEC 60664)
Power consumption (max.):			2W
1.25A (T) rated fuse should be installed in line with terminal A1			
Monitored input (using terminals, L+, L-, PE1 & PE2)			
Monitoring principle:			Insulation between L+/L- and PE1/PE2
Monitored DC supply voltage (U_n):			50V - 1250VDC
Max. permanently admissible voltage (U_{fg}):			1375V DC
Maximum system leakage capacitance (C_e):			25uF *(1.6uF per conductor in CHAdeMO mode)*
Max. system leakage capacitance (C_e) according to UL 2231-1/-2:			≤ 10uF
Specified response value (R_{an}):			R_{an1} = 125kΩ (Fault) R_{an2} = 625kΩ (Alarm) *Assuming 1250VDC nominal charger output*
Response level accuracy:			±15%, ±2kΩ
Fault hysteresis level:			125% of R_{an1} (125kΩ)
Alarm hysteresis level:			125% of R_{an2} (625kΩ)
Response time (t_{an}):			≤ 10s typ. *(≤1s in CHAdeMO 1 mode)* *Response time measured with C_e = 1uF*
Response value for break/disconnection of PE1/PE2 conductors:			> 500Ω
Measuring voltage (U_m):			±43V approx.
Internal DC resistance:			Typ. >375KΩ
Measuring current:			≤ 250µA peak @ Rf = 0Ω
Reset time:			< 1s (from supply interruption)
LED indication *(refer also to function diagram for LED diagnostic information)*			
Power Supply		Green x1	*LED is usually permanently lit but will flash if measurement stops**
Alarm		Amber x1	*Illuminates during alarm condition**
Tripped		Red x1	*Illuminates during fault condition**
** LED also flashes when PE is disconnected*			
Manual Test and Reset			
		Front push buttons	**Remote N.O. push button (T/R, PE1)**
"Test" method *(assuming unit is in the non-tripped state)*		Press "TEST" once to trip the unit	Press and hold button between 2.5s and 8s, then release to trip unit
"Reset" method *(assuming unit is in the tripped state and fault cleared)*		Press "RESET" once to clear fault indication only	Press button <2.5s to reset the unit
Auto-reset			
Allows for unit to return to normal operation automatically			Enabled *(factory default)* ***To comply with UL 2231, "Auto-reset" must be set to "Disabled"***

Relay operational mode *(assuming factory default settings used)*		
Status:	**RLY1 (Alarm)**	**RLY2 (Fault)**
Normal:	Energised	Energised
Alarm:	De-Energised	Energised
Fault:	De-energised	De-energised

Temperature rating	
Operating:	-40 to +70°C
Storage:	-40 to +85°C
Relative humidity:	+95% max.

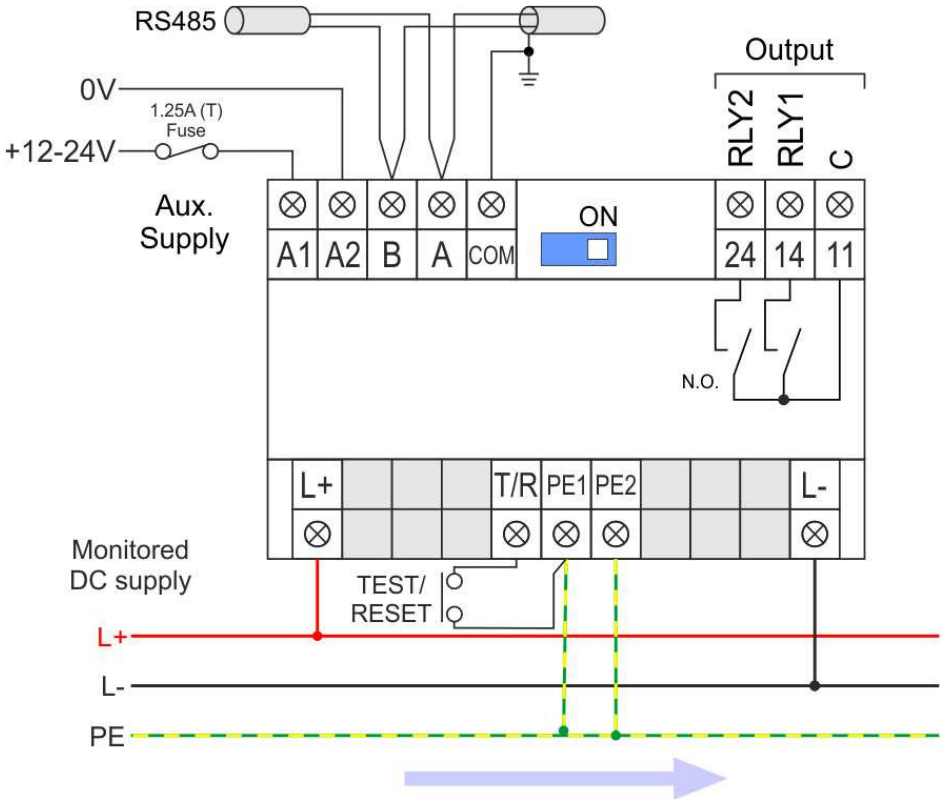
Output		
	Relay 1 (RLY1)	Relay 2 (RLY2)
Terminals:	**11, 14**	**11, 24**
Contact arrangement:	1 x SPNO	1 x SPNO
AC1 (250V)	5A (1250VA)	5A (1250VA)
DC1 (25V)	5A (125W)	5A (125W)
Electrical life:		

Modbus (A, B, COM)	
Connections:	Tx+, Tx-, 0V
Baud rate:	Selectable *(factory default: 9600)*
Parity:	Selectable *(factory default: none)*
Stop bit:	Selectable *(factory default: 1)*
Device address:	Selectable *(factory default: 003)*
Termination method:	120R resistor built in. Set slide switch to “ON” to enable (see: section 7)

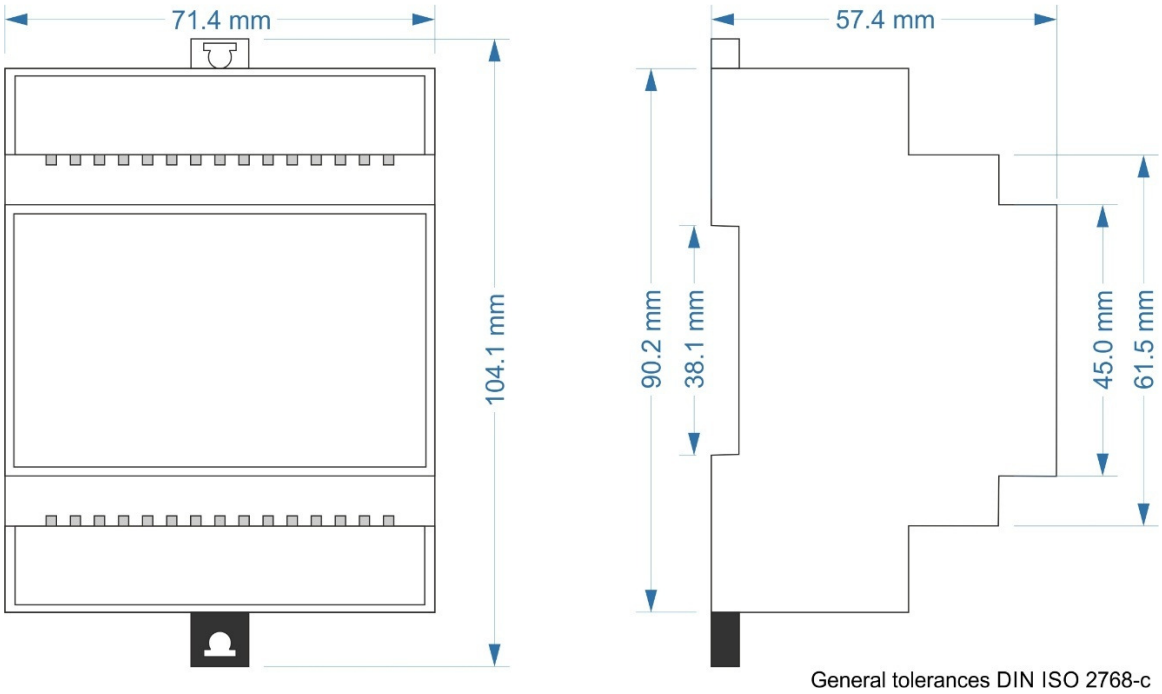
Rated Impulse Withstand Voltage		
Definitions:	**SC** (Supply circuit)	A1, A2
	OC (Output circuit)	11, 14, 24
	BC (Modbus circuit)	A, B, COM
	CC (Control circuit)	T/R, PE1, PE2
	MC (Monitored circuit)	L+/L-
Ratings:	**SC/BC:**	Galvanically isolated <100V
	OC/(SC, MC):	8kV
	OC/CC:	8kV
	CC/(SC, BC):	8kV
	MC/(SC, BC):	8kV
	MC/OC:	8kV

Housing	
Material:	Grey flame-retardant polycarbonate UL94 V0
Weight:	120g approx.
Mounting:	Horizontally on to 35mm symmetric DIN rail to BS EN 60715
Pollution degree:	2
Terminal conductor size	
Cable type:	Solid or stranded
Nominal cross section:	0.2 – 2.5mm^2 (12 – 22/24 AWG)
Stripping length:	7mm ±1mm
Tightening torque:	0.4 Nm
Standards	
Product:	IEC 61851-1, IEC 61851-23, IEC 61557-8, UL 2231-1, UL 2231-2
EMC:	IEC 61326-2-4, IEC 61000-4
General Compliance:	CE, UKCA and RoHS Compliant. RCM (Australia / New Zealand)

13. Connection Diagram



14. Product Dimensions



15. Modbus Register Set

15.1 Modbus measured values registers (read only)

Register	Function	Channel description (last two bytes)
1000-1003	Insulation measurement	71 = no fault 1 = alarm or fault 102 = PE disconnection
1004-1007	Reserved	
1008-1011	Under/over voltage	76 = no fault 77 = undervoltage 78 = overvoltage
1012-1015	Not implemented	
1016-1019	Voltage PE to L+	76 = no fault
1020-1023	Voltage PE to L-	76 = no fault
1024-1027	Not implemented	
1028-1031	Not implemented	
1032-1035	Device status	1022 = Measured value update counter 115 = Device error

15.1.1 Measured values register configuration

The measured values registers are configured as shown below (register 1000-1003 is shown as an example).

1000		1001		1002		1003	
High byte	Low byte	High byte	Low byte	High byte	Low byte	High byte	Low byte
Measured value				Alarm Type & Test (AT&T)	Range & unit (R&U)	Channel description	

15.1.2 Measured value (4 bytes)

Values are in floating point format according to IEEE 754 (S = sign, E = exponent, M = mantissa):

WORD	0x0000															
BYTE	High byte								Low byte							
BIT	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	S	E	E	E	E	E	E	E	E	M	M	M	M	M	M	M
WORD	0x0001															
BYTE	High byte								Low byte							
BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

15.1.3 Alarm Type and Test (AT&T) byte

Bit	Description	7	6	5	4	3	2	1	0
Alarm type	No fault	X	X	X	X	X	0	0	0
	Alarm	X	X	X	X	X	0	0	1
	Device error	0	0	X	X	X	0	1	0
	Reserved	X	X	X	X	X	0	1	1
	Warning	X	X	X	X	X	1	0	0
	Fault	X	X	X	X	X	1	0	1
	Reserved	X	X	X	X	X	1	1	0
	Reserved	X	X	X	X	X	1	1	1
Test	No test	0	0	X	X	X	X	X	X
	Internal test	0	1	X	X	X	X	X	X
	External test	1	0	X	X	X	X	X	X

15.1.4 Range and Unit (R&U) byte

Bit	Description	7	6	5	4	3	2	1	0
Unit	Invalid	-	-	-	0	0	0	0	0
	No unit	-	-	-	0	0	0	0	1
	Ω	-	-	-	0	0	0	1	0
	A	-	-	-	0	0	0	1	1
	V	-	-	-	0	0	1	0	0
	%	-	-	-	0	0	1	0	1
	Hz	-	-	-	0	0	1	1	0
	Baud	-	-	-	0	0	1	1	1
	F	-	-	-	0	1	0	0	0
	H	-	-	-	0	1	0	0	1
	°C	-	-	-	0	1	0	1	0
	°F	-	-	-	0	0	0	1	1
	Second	-	-	-	0	1	1	0	0
	Minute	-	-	-	0	1	1	0	1
	Hour	-	-	-	0	1	1	1	0
	Day	-	-	-	0	1	1	1	1
	Month	-	-	-	1	0	0	0	0
Range of validity	Actual value	0	0	X	X	X	X	X	X
	Value is lower	0	1	X	X	X	X	X	X
	Value is higher	1	0	X	X	X	X	X	X
	Invalid value	1	1	X	X	X	X	X	X

15.1.5 Channel description (2 bytes)

Value (dec)	Measured value description	Comments
0		
1	Insulation fault	
71	Insulation fault	Insulation resistance R_F in Ω
76	Voltage	Measured value in V
77	Undervoltage	
78	Overvoltage	
101	System connection	
102	PE disconnection	
115	Device error	
129	Device error	
145	Own address	

15.2 Modbus parameter registers

RO = read only, WO = write only, RW = read/write

Register	Property	Description	Format	Unit	Value range
999	RO	Number of Modbus measured value registers with alarm or fault	UINT16	---	0..3
3000	RO	Test status	UINT16	---	0 = None 1 = Self Test 2 = Relay
3001-3004	RW	Reserved	---	---	---
3005	RW	Insulation resistance Alarm value (R_{an2})	UINT16	kΩ	R_{an1}...625
3006	RW	Reserved	---	---	---
3007	RW	Insulation resistance Fault value (R_{an1})	UINT16	kΩ	1...R_{an2}
3008	RW	Undervoltage detection enabled / disabled	UINT16	---	0=disabled, 1=enabled Default = 0
3009	RW	Undervoltage detection level “U<”	UINT16	V	30...U>
3010	RW	Overvoltage detection enabled / disabled	UINT16	---	0=disabled, 1=enabled Default = 0
3011	RW	Overvoltage detection level “U>”	UINT16	V	U< ... 1150

Continued….

Register	Property	Description	Format	Unit	Value range
3012	RW	Unit latches on fault condition	UINT16	---	0=disabled, 1=enabled Default = 0
3013	RW	Operating mode of RLY1	UINT16	---	0=N.O, 1=N.C (default = 1)
3014	RW	Operating mode of RLY2	UINT16	---	0=N.O, 1=N.C (default = 1)
3015	RW	Bus address	UINT16	---	0..247 (0=Broadcast) Default = 3
3016	RW	Baud rate	UINT16	---	1=1.2k 2=2.4k 3=4.8k 4=9.6k (default) 5=19.2k 6=38.4k 7=57.6k 8=115.2k
3017	RW	Parity	UINT16	---	0=8N1 (default) 1=8O1 2=8E1 3=8N2
3018	RW	Startup delay “t” during service start	UINT16	S	0..10 (default = 0)
3019	RW	Response delay “ton” for relays 1 & 2	UINT16	S	0..99 (default = 0)
3020	RW	Delay on release “toff” for relays 1 & 2	UINT16	S	0..99 (default = 0)
3021	RW	Repetition period for automatic self-test	UINT16	S	0=OFF (default) 1=1h 2=24h
3022	RW	Reserved	---	---	---
3023	RW	Monitoring mode	UINT16	---	0=CCS/DC 1=CHAdeMO 1 2=CHAdeMO 2
3026	RW	Request stop mode	UINT16	---	0=Stop, 1=Enable
3027	RW	Function assignment for RLY1	UINT16	---	Bit 15...Bit 0 – see 11.2.1 (default = 0x0004)
3028	RW	Function assignment for RLY2	UINT16	---	Bit 15...Bit 0 – see 11.2.1 (default = 0x0010)
8003	WO	Factory setting for all parameters, including Modbus comms parameters	UINT16	---	0x6661 “fa”
8004	WO	Factory setting for user parameters only (no comms parameter change)	UINT16	---	0x4653 “FS”

Continued….

Register	Property	Description	Format	Unit	Value range
8005	WO	Start device test	UINT16	---	0x5445 “TE”
8006	WO	Clear all alarm and fault indications	UINT16	---	0x434C “CL”
8010	RW	Lock / unlock			Set anti-tamper lock. 0xAA55 = lock Writing to following 3 registers sets passcode 0x1122 = unlock request Following 3 registers must form correct passcode to unlock settings.
8011	WO	Passcode digit 1	UINT16		0-9
8012	WO	Passcode digit 2	UINT16		0-9
8013	WO	Passcode digit 3	UINT16		0-9 Writing this register will activate the lock if locking requested in register 10000. If unlocking requested, and passcode is correct then device will be unlocked.
9800-9809	RO	Device name:	UINT16 - ASCII		BROYCE CONTROL IMD125 2 characters per word, low byte is first character
9820	RO	Software ID number	UINT16	---	
9821	RO	Software version #	UINT16	---	
9822	RO	Software version: year	UINT16	---	
9823	RO	Software version: month	UINT16	---	
9824	RO	Software version: day	UINT16	---	
9825	RO	Modbus driver version	UINT16	---	

15.2.1 Relay function assignments

Bit	Indication	Description
0	Reserved	0 when read
1	All LEDs flashing	Device error / PE connection failure
2	Yellow and Green LEDs ON	PE/L+ insulation resistance < R_{an2}
3	Yellow and Green LEDs ON	PE/L- Insulation resistance < R_{an2}
4	All LEDs ON	PE/L+ insulation resistance < R_{an1}
5	All LEDs ON	PE/L- insulation resistance < R_{an1}
6	Green LED ON, Amber LED flashing	Undervoltage warning
7	Green LED ON, Red LED flashing	Overvoltage warning
8	All LEDs ON	Manually started self-test
9	-	-
10	Reserved	0 when read
11	Reserved	0 when read
12	Reserved	0 when read
13	Reserved	0 when read
14	Reserved	0 when read
15	Reserved	0 when read

16. Ordering Information

Part number to be quoted when ordering.

Part Number	Part Description
99-7030	IMD125/M wtih Modbus communication

Links to PDF copy of document

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HS Code: 85364900

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