

TRANSFORMER SERVICE

CoreSense™ M10

Multi-gas sensing for optimal transformer operation

General specifications

Name of manufacturer	Hitachi ABB Power Grids
Models	CoreSense M10 ST for mineral oils (IEC60296) CoreSense M10 SE for synthetic ester (midel 7131) (IEC61099) CoreSense M10 NE for natural ester (Cargil FR3) (IEC62770) CoreSense M10 SL for silicon fluids (IEC60836)
Type	9 gas + moisture multi-gas continuous online DGA analyzer
Color	RAL7035
Oil types	Mineral oils Synthetic Ester – midel 7131 Natural Ester – Cargil FR3 Silicon fluids
Location of manufacturing site	Canada
Standard warranty	3 years full part and labor coverage
Maintenance	Once every 10 years – replace source and pump modules Built in self-diagnostics ensure correct operation
Consumables	Consumable free operation
Calibration	Permanently calibrated at factory – automatic self-check
Data storage	10 years complete data storage in nonvolatile flash memory
Real time clock	Super capacitor power backup for 1 week Network synchronized through SNTP protocol
Firmware upgrades	Upload through web interface or USB key
Manufacturers quality certification	ISO 9001:2015 certified by SGS
Manufacturers environmental certification	ISO 14001:2015 certified by SGS

Warranty statement

The CoreSense™ M10 multi-gas analyzer comes with a full 3-year warranty against any manufacturing defects, malfunctions including software bugs or parts wear. If any of the above should occur Hitachi ABB Power Grids will repair or replace the defective unit and restore it to operation according to published specifications, this is the only remedy that will be offered to the customer.

Maintenance statement

The CoreSense M10 is designed for an effective lifetime of 20 years and requires no recalibration and no consumables, however this does not constitute a warranty that no repairs will be required to maintain correct operation over 20 years. Furthermore, a preventive maintenance is required after 10 year and consists in the replacement of the gas pumps and the infrared source of the analyzer. Hitachi ABB Power Grids also commits to keeping the necessary spare parts to repair or replace any CoreSense M10 analyzer for a period of at least 10 years from the date of purchase of the analyzer.

Gas measurement specifications

Laboratory equivalence	Configurable - IEC60567 with gas temperature of 20°C - ASTM D3612 with gas temperature of 0°C
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Parameter	LOD	Range	Accuracy	Repeatability	Readout speed
Hydrogen (H ₂)	25 ppm 5 ppm option	0 – 5000 ppm	±25 ppm or ±20% ±3 ppm or ±20%	±10%	10 min
Carbon Monoxide (CO)	2 ppm	0 – 5000 ppm	±2 ppm or ±5%	±0.5%	10 min
Carbon Dioxide (CO ₂)	5 ppm	0 – 20000 ppm	±5 ppm or ±5%	±0.5%	10 min
Methane (CH ₄)	1 ppm	0 – 10000 ppm	±1 ppm or ±5%	±0.5%	10 min
Acetylene (C ₂ H ₂)	0.5 ppm	0 – 10000 ppm	±0.5 ppm or ±5% *	±0.5%	10 min
Ethylene (C ₂ H ₄)	2 ppm	0 – 10000 ppm	±2 ppm or ±5%	±0.5%	10 min
Ethane (C ₂ H ₆)	2 ppm	0 – 10000 ppm	±2 ppm or ±5%	±0.5%	10 min
Propene (C ₃ H ₆)	20 ppm	0 – 10000 ppm	±20 ppm or ±5%	±0.5%	10 min
Propane (C ₃ H ₈)	10 ppm	0 – 10000 ppm	±10 ppm or ±5%	±0.5%	10 min
Gas level alarms			User configurable for levels and rate of change Default levels - IEEE C57.104:2019 for mineral oil - IEEE C57.155:2014 for Ester oils - IEEE C57.146:2005 for Silicon fluids		
Gas ranges			Exceed typical IEC ranges for 90% of transformers Exceed typical IEEE ranges for 95% of transformers		

* For FR3 200 to 10,000 ppm (µl/l) ±0.5 ppm or ±30 %

Ranges of 90% typical gas concentration values observed in mineral oil filled power transformers, in µl/l

	C ₂ H ₂	H ₂	CH ₄	C ₂ H ₄	C ₂ H ₆	CO	CO ₂
All transformers		50-150	30-130	60-280	20-90	400-600	3800-14000
No OLTC	2-20						
Communicating OLTC	60-280						

95% percentile gas concentrations in mineral oil filled transformers as a function of O₂/N₂ and age in µl/l (ppm)

	O ₂ /N ₂ Ratio ≤ 0.2				O ₂ /N ₂ Ratio > 0.2			
	Transformer age in years							
	Transformer age in years				Transformer age in years			
	Unknown	1-9	10-30	≤30	Unknown	1-9	10-30	>30
Hydrogen (H ₂)	200		200		90		90	
Methane (CH ₄)	150	100	150	100	50	60		30
Ethane (C ₂ H ₆)	175	70	175	70	40	30		40
Ethylene (C ₂ H ₄)	100	40	95	175	100	80	125	
Acetylene (C ₂ H ₂)	2		2	4	7		7	
Carbon monoxide (CO)	1100		1100		600		600	
Carbon dioxide (CO ₂)	12500	7000		14000	7000	5000		8000

Note: During the data analysis, it was determined that voltage class, MVA, and volume of mineral oil in the unit did not contribute in significant way to the determination of values provide in the table above

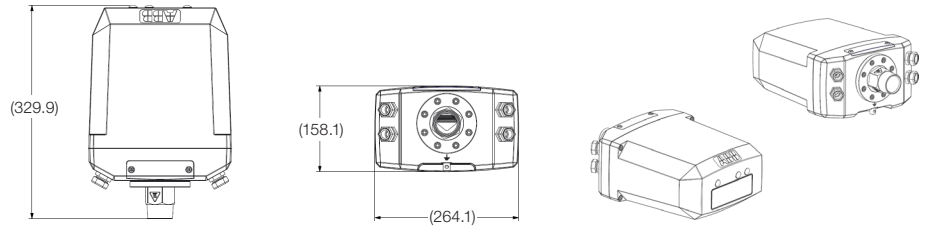
Source IEC: typical gas ranges for 90% of transformers

Moisture measurement specifications

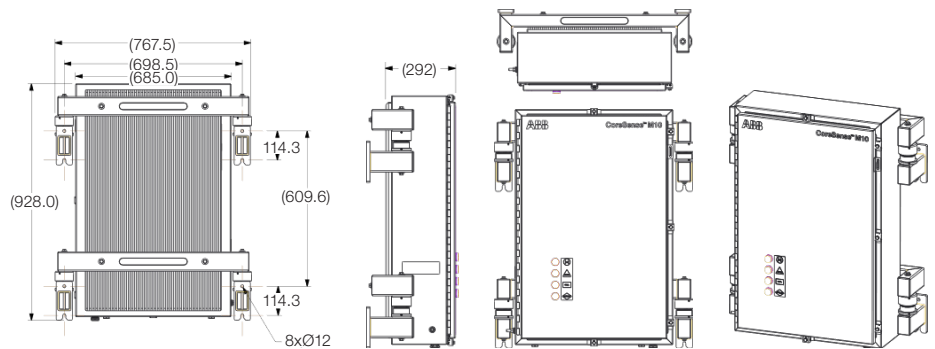
Moisture measurement range	0 to 1 aw (0 to 100% RS)
Moisture measurement accuracy	±0.02 aw (± 2% RS)
Moisture range in ppm	Mineral oil: 0 to 60 ppm @ 25 °C (77 °F) or 0 to 180 ppm @ 55 °C (131 °F) ± 3% Synthetic ester: 0 to 2220 ppm @ 25 °C (77 °F) or 0 to 3490 ppm @ 55 °C (131 °F) ± 3% Natural ester: 0 to 1010 ppm @ 25 °C (77 °F) or 0 to 1780 ppm @ 55 °C (131 °F) ± 3% Silicon fluid: 0 to 300 ppm @ 25 °C (77 °F) or 0 to 590 ppm @ 55 °C (131 °F) ± 3%
Moisture measurement accuracy in ppm	±3%
Temperature measurement accuracy	-40 to +120 ± 0.2 °C (-40 to +248 ± 0.4 °F)

Mechanical specifications

Sensor head	Dimensions, weight	393 x 264 x 158 mm (15.5 x 10.4 x 6.2 in), 8 kg (17.6 lbs)
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	Interface to transformer	1.5 NPT male thread or Optional DN50 square flange Single valve installation
	Enclosure	Cast aluminium IP67/NEMA 4X/C4
	Connection to analytical unit	10 m (Armored flexible conduit)
Analytical unit	Dimensions, weight	685 x 863 x 292 mm (27 x 34 x 11.5 in), 65 kg (143.3 lbs)



	Enclosure	Folded aluminium IP66/NEMA 4X/C4
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Electrical specifications

	Voltage input	100 to 240 VAC (50 to 60 Hz)
	Max power consumption	600VA
	Max current	5A
	Line voltage fluctuation	Not to exceed 10% of nominal line voltage
	Power cable	Three (3) conductor configuration with Live, Neutral and Earth connections Max current rating 8A Copper-only wire (stranded WITH FERRULE or solid) AWG #18 to AWG #12 90 °C 600V, UL and CSA type Maximum length 15m (50ft) for AWG#12 Maximum length 10m (33ft) for AWG#18
	Ground strap (mechanical earthing)	AWG #10 to AWG #6 Maximum length 15m (50ft)
Fuse types	Sensor head	1 x 2.0 A/250 V (5 x 20 mm), slow-blow
	Analytical unit	1 x 3.15 A/250 V (5 x 20 mm), slow-blow

Communication specifications

Ultrabright easy-to-read LED		Four color-coded LED system to indicate status
Color touch screen		Integrated color touch screen provides gas concentrations in the field
User interface		Local/remote Web based interface using HTTP over Ethernet TCP/IP Display real time results and historical trends Set warning and alarms Configure analyzer
Digital interfaces	RS485 serial port	Integrated 120Ω terminator Full duplex and half duplex supported 24 AWG cable, 1220m (4003ft) maximum length Settings: 9600baud, 8 data bits, 1 stop bit, no parity, no flow con-trol Protocols: Modbus RTU, DNP 3
	SERVICE RJ45 Ethernet	RJ45 100 base-T Ethernet port Dedicated for local service/field connection Category 5 cable, 3m (10 ft) maximum length Default IP: 10.126.126.126 Protocols: Modbus IP, DNP 3, IEC61850 Integrated HTTP web server, publishes web HMI over Ethernet
	SCADA RJ45 Ethernet	RJ45 100 base-T Ethernet port Port dedicated for customer network and SCADA connection Cannot be used if optical Ethernet in use Category 5 cable, 100m (328 ft) maximum length Default IP: 10.127.127.127 Integrated DHCP client for IP address assignment Protocols: Modbus IP, DNP 3, IEC61850 Integrated HTTP web server, publishes web HMI over Ethernet
	Optical Ethernet	100 base-FX fiber optics Ethernet port Port dedicated for customer network and SCADA connection Cannot be used if SCADA RJ45 Ethernet in use ST-ST full duplex 62.5/125 multi-mode fiber Maximum length 2000m (6562 ft) Default IP: 10.127.127.127 Integrated DHCP client for IP address assignment Protocols: Modbus IP, DNP 3, IEC61850 Integrated HTTP web server, publishes web HMI over Ethernet
	USB	USB type A - Only for use with USB key
Analog interfaces	4-20mA outputs	8 analog outputs for publishing values 4 to 20mA, 24v max, 21 mA signal used to indicate error Copper wire AWG #24 to AWG #26 with ferrule Maximum recommended distance 400m
	4-20mA inputs	4 analog inputs for reading auxiliary values 4 to 20mA, 24v max, 21 mA signal used to indicate error Copper wire AWG #24 to AWG #26 with ferrule Maximum recommended distance 400m
	dry contacts	4 dry contact relays outputs for publishing alarms Copper stranded AWG#18 with ferrule or solid AWG#18 to AWG#14 Output type: normally Closed/Open (SPDT) Rated operational voltage U2 (IEC/EN 60947-01): 250 VAC Switching voltage: min 5V at 100mA, max 400VAC/250VDC Min switching current: 10mA at 10V Rated operational currents (IEC/EN 60947-5-1) AC12 (resistive) 6A AC15 (inductive) 1.5A AC15 (inductive) 3 A DC12 (resistive) 6 A DC13 (inductive) 1 A DC13 (inductive) 0.22 A DC13 (inductive) 0.11 A Max making (inrush) current: 15A at 240VAC Min switching power: 10 mA at 10 V (AgSnO ₂) Max switching (breaking) power (AC1 [resistive]): 1500VA at 250VAC Contact resistance: 100 mΩ (at 1 A/6 V DC) Rated insulation voltage: 250VAC Rated impulse withstand voltage Uimp Between coils and contacts: 4kV for 1min Between open contacts: 1kV for 1min
Digital inputs		2 digital inputs for reading auxiliary alarm/event signals 0 to 24V

Environmental specifications

Operating ambient temperature	-50°C to +55°C (-58°F to +131°F)
Operating electronics temperature	-40°C to +80°C (-40°F to +176°F)
Cold start min temperature	-40°C (-40°F)
Survival temperature	-60°C to +100°C (-76°F to +212°F)
Shipping/storage temperature	-40°C to +70°C (-40°F to +158°F)
Operating ambient humidity	5% to 95% RH non condensing
Operating altitude	-610m to 3000m (-2001ft to 9843ft)
Pollution degree	4 (outdoor use), 2 (internal)
Operational oil temperature at valve	-20°C to +120°C (-4°F to +248°F)
Survival oil temperature at valve	-60°C to +150°C (-76°F to +302°F)
Oil pressure at valve	0 to 1000 kPa/0 to 10 bar/0 to 145 psi

Certifications

European approval (electrical safety)	CE mark	
North American approval (electrical safety)	cCSAus mark	
Electrical safety – with US and Canadian deviations	IEC/EN 61010	
Electrical safety – International deviations	CBScheme	
Safety of products containing a laser	IEC60825-1 2nd edition, 2007	
Cybersecurity	Compliant with ABB cybersecurity standards IEEE 1676 cybersecurity assessment	
FCC part 15 – with Canadian equivalent	FCC	
Ingress protection rating	Analytical cabinet	IP66 – IEC/EN 60529 NEMA 4X – NEMA standard 250 Class C4 – ISO12944-2
	Sensor head	IP67 – IEC/EN 60529 NEMA 4X – NEMA standard 250 Class C4 – ISO12944-2
Directive limiting use of heavy metals	ROHS 2011/65/EU ROHS – China	
Electronics recycling directive	WEEE 2012/19/EU	
Hazardous chemicals directive	REACH EC1907/2006	
Regulation on substances that deplete ozone layer	EC2037/2000	
Ordinance on the Use of Particularly Dangerous Substances, Preparations, and Articles	SR814.81	
Regulations on chemicals threatening health and environment from Union of European rail industries	UNIFE	
Regulation on persistent organic pollutants	EC850/2004	
Electrical equipment for measurement, control and laboratory use	IEC61326-1 Industrial levels, class A equipment & industrial locations	
Electromagnetic immunity	IEC/EN 61000-6-2	
Emission standard for industrial environments	IEC/EN 61000-6-4	
Electrostatic discharge immunity	IEC/EN 61000-4-2 level 4 (8kV contact, 15kV through air)	
Radiated, radio-frequency, electromagnetic field immunity	IEC/EN 61000-4-3	
Electrical fast transient/burst immunity	IEC/EN 61000-4-4	
Surge immunity	IEC/EN 61000-4-5	
Immunity to conducted disturbances, induced by radio-frequency fields	IEC/EN 61000-4-6	
Power frequency magnetic field immunity	IEC/EN 61000-4-8	
Pulsed magnetic field immunity	IEC/EN 61000-4-9	
Damped oscillatory magnetic field	IEC/EN 61000-4-10	
Voltage dips, short interruptions and voltage variations immunity	IEC/EN 61000-4-11	
Ring wave immunity	IEC/EN 61000-4-12	
Common mode disturbances 0-150 kHz	IEC/EN 61000-4-16	
Harmonics emissions	IEC/EN 61000-3-2	
voltages changes, voltage fluctuations and flicker	IEC/EN 61000-3-3	
Conducted emissions	EN55011, CISPR 11, conducted group 1 class A	
Radiated emissions	EN55011, CISPR 11, radiated group 1 class A	
Random vibrations category 4	IEC/EN 60068-2-64	
Shock	IEC/EN 60068-2-27	
Damp heat cyclic with 95% relative humidity	IEC/EN 60068-2-30	
Sinusoidal vibrations	IEC/EN 60068-2-6 Test extended to 150-180Hz range	

