TRANSFORMER SERVICE

CoreSense™

Gas sensing for optimal transformer operation

General specifications

Name of manufacturer	Hitachi ABB Power Grids
Models	CoreSense ST for mineral oils (IEC60296) CoreSense SE for synthetic ester (midel 7131) (IEC61099) CoreSense NE for natural ester (Cargil FR3) (IEC62770) CoreSense SL for silicon fluids (IEC60836)
Type	Hydrogen + moisture single-gas 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	Solid state maintenance free – expected lifetime 15 years Built in self-diagnostics ensure correct operation
Consumables	Consumable free operation
Calibration	Permanently calibrated at factory – automatic self-check
Data storage	1 year 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™ single-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 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 is designed for an effective lifetime of 15 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 15 years. Hitachi ABB Power Grids also commits to keeping the necessary spare parts to repair or replace any CoreSense 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

Parameter	LOD	Range	Accuracy	Repeatability	Readout speed
Hydrogen (H2)	25 ppm 5 ppm option	0 – 5000 ppm	±25 ppm or ±20% ±3 ppm or ±20%	±10%	1 min
Gas level alarms			User configurable for levels and rate of change Default levels set according to IEEE C57		
Gas ranges			Exceed typical IEC ranges for 90% of transformers Exceed typical IEEE ranges for 95% of transformers		

Ranges of 90% typical gas concentration values observed in power transformers, in µl/l							
	C_2H_2	H_2	CH_4	C_2H_4	C_2H_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						

Source IEEE: typical gas ranges for 95% of transformers

95% percentile gas concentrations as a function of O_2/N_2 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			
		Unknown	1-9	10-30	≤30	Unknown	1-9	10-30	>30
Gas	Hydrogen (H_2)	200	200			90	90		
	Methane (CH_4)	150	100	150	100	50	60		30
	Ethane (C_2H_6)	175	70	175	70	40	30	40	
	Ethylene (C_2H_4)	100	40	95	175	100	80	125	
	Acetylene (C_2H_2)	2	2		4	7	7		
	Carbon monoxide (CO)	1100	1100			600	600		
	Carbon dioxide (CO_2)	12500	7000	14000		7000	5000	8000	

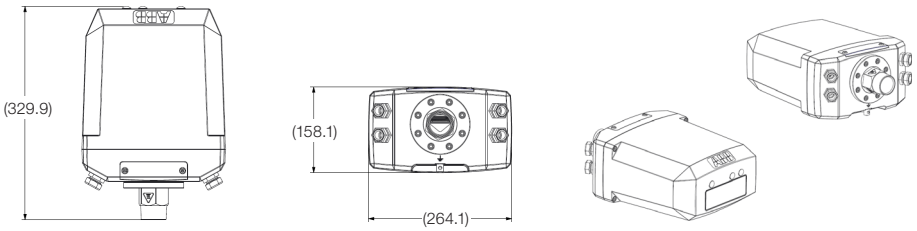
Note: During the data analysis, it was determined that voltage class, MVA, and volume of mineral oil in the unit did not contribute in significant way to the determination of values provide in the table above
Source IEC: typical gas ranges for 90% of transformers

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

Dimensions, weight	393 x 264 x 158 mm (15.5 x 10.4 x 6.2 in), 8 kg (17.6 lbs)



Interface to transformer	1.5 NPT male thread Optional DN50 square flange Single valve installation
Enclosure	Cast Aluminium IP67/NEMA 4X/C4

Electrical specifications

Voltage input	100 to 240 VAC (50 to 60 Hz)
Max power consumption	150VA
Max current	1A
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 type	1 × 1.0 A/250 V (5 × 20 mm), slow-blow (IEC60127 type T)

Communication specifications

Ultrabright easy-to-read LED		Three color-coded LED system to indicate status
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 control 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: 172.16.100.1 (DHCP server will set client) 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: DHCP dynamic address (fixed address can be configured) 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: DHCP dynamic address (fixed address can be configured) 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	2 analog outputs for publishing values 3 to 20mA, 24v max, 21 mA signal used to indicate error Copper wire AWG #24 to AWG #26 with ferule Maximum recommended distance 400m
	4-20mA inputs	3 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 ferule Maximum recommended distance 400m
	dry contacts	3 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

Environmental specifications

Operating ambient temperature	-50°C to +60°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 noncondensing
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
Cybersecurity	Compliant with Hitachi ABB Power Grids cybersecurity standards IEEE 1676 cybersecurity assessment
FCC part 15 – with Canadian equivalent	FCC
Ingress protection	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

Ordering matrix

				Transformer Interface		Environment	Hydrogen Sensor		Software		Warranty	
Article No. (TCS Reference)	**Product code**	**Product CoreSense Hydrogen and Moisture (CSHM)**	**Transformer Fluid ST - Mineral Oil NE - Nat. Ester Fluid SE - Synth. Ester Fluid SL - Silicone Fluid**	**1.5 inch NPT Interface (1,5)**	**DN50 Interface (50 CM) (N50)**	**Industrial Areas, Moderate Spray (C4)**	**Standard Performance (SH)**	**High Performance (HH)**	**Standard (STD)**	**IEC61850 Publishing (850)**	**3 year**	**5 year**
1ZBG000091	For master drawing											
1ZBG000092	CSHM-ST-1,5-C4-SH-STD-3Y	CSHM	ST	■		■	■		■		■	
1ZBG000093	CSHM-ST-1,5-C4-SH-STD-5Y	CSHM	ST	■		■	■		■			■
1ZBG000094	CSHM-ST-1,5-C4-SH-850-3Y	CSHM	ST	■		■	■			■	■	
1ZBG000095	CSHM-ST-1,5-C4-SH-850-5Y	CSHM	ST	■		■	■			■		■
1ZBG000096	CSHM-ST-N50-C4-SH-STD-3Y	CSHM	ST		■	■	■		■		■	
1ZBG000097	CSHM-ST-N50-C4-SH-STD-5Y	CSHM	ST		■	■	■		■			■
1ZBG000098	CSHM-ST-N50-C4-SH-850-3Y	CSHM	ST		■	■	■			■	■	
1ZBG000099	CSHM-ST-N50-C4-SH-850-5Y	CSHM	ST		■	■	■			■		■

				Transformer Interface		Environment	Hydrogen Sensor		Software		Warranty	
Article No. (TCS Reference)	Product code	Product CoreSense Hydrogen and Moisture (CSHM)	Transformer Fluid ST - Mineral Oil NE - Nat. Ester Fluid SE - Synth. Ester Fluid SL - Silicone Fluid	1.5 inch NPT Interface (1,5)	DN50 Interface (50 CM) (N50)	Industrial Areas, Moderate Spray (C4)	Standard Performance (SH)	High Performance (HH)	Standard (STD)	IEC61850 Publishing (850)	3 year	5 year
1ZBG000100	CSHM-ST-1,5-C4-HH-STD-3Y	CSHM	ST	■		■		■	■		■	
1ZBG000101	CSHM-ST-1,5-C4-HH-STD-5Y	CSHM	ST	■		■		■	■			■
1ZBG000102	CSHM-ST-1,5-C4-HH-850-3Y	CSHM	ST	■		■		■		■	■	
1ZBG000103	CSHM-ST-1,5-C4-HH-850-5Y	CSHM	ST	■		■		■		■		■
1ZBG000104	CSHM-ST-N50-C4-HH-STD-3Y	CSHM	ST		■	■		■	■		■	
1ZBG000105	CSHM-ST-N50-C4-HH-STD-5Y	CSHM	ST		■	■		■	■			■
1ZBG000106	CSHM-ST-N50-C4-HH-850-3Y	CSHM	ST		■	■		■		■	■	
1ZBG000107	CSHM-ST-N50-C4-HH-850-5Y	CSHM	ST		■	■		■		■		■
1ZBG000108	CSHM-NE-1,5-C4-SH-STD-3Y	CSHM	NE	■		■	■		■		■	
1ZBG000109	CSHM-NE-1,5-C4-SH-STD-5Y	CSHM	NE	■		■	■		■			■
1ZBG000110	CSHM-NE-1,5-C4-SH-850-3Y	CSHM	NE	■		■	■			■	■	
1ZBG000111	CSHM-NE-1,5-C4-SH-850-5Y	CSHM	NE	■		■	■			■		■
1ZBG000112	CSHM-NE-N50-C4-SH-STD-3Y	CSHM	NE		■	■	■		■		■	
1ZBG000113	CSHM-NE-N50-C4-SH-STD-5Y	CSHM	NE		■	■	■		■			■
1ZBG000114	CSHM-NE-N50-C4-SH-850-3Y	CSHM	NE		■	■	■			■	■	
1ZBG000115	CSHM-NE-N50-C4-SH-850-5Y	CSHM	NE		■	■	■			■		■
1ZBG000116	CSHM-NE-1,5-C4-HH-STD-3Y	CSHM	NE	■		■		■	■		■	
1ZBG000117	CSHM-NE-1,5-C4-HH-STD-5Y	CSHM	NE	■		■		■	■			■
1ZBG000118	CSHM-NE-1,5-C4-HH-850-3Y	CSHM	NE	■		■		■		■	■	
1ZBG000119	CSHM-NE-1,5-C4-HH-850-5Y	CSHM	NE	■		■		■		■		■
1ZBG000120	CSHM-NE-N50-C4-HH-STD-3Y	CSHM	NE		■	■		■	■		■	
1ZBG000121	CSHM-NE-N50-C4-HH-STD-5Y	CSHM	NE		■	■		■	■			■
1ZBG000122	CSHM-NE-N50-C4-HH-850-3Y	CSHM	NE		■	■		■		■	■	
1ZBG000123	CSHM-NE-N50-C4-HH-850-5Y	CSHM	NE		■	■		■		■		■
1ZBG000124	CSHM-SE-1,5-C4-SH-STD-3Y	CSHM	SE	■		■	■		■		■	
1ZBG000125	CSHM-SE-1,5-C4-SH-STD-5Y	CSHM	SE	■		■	■		■			■
1ZBG000126	CSHM-SE-1,5-C4-SH-850-3Y	CSHM	SE	■		■	■			■	■	
1ZBG000127	CSHM-SE-1,5-C4-SH-850-5Y	CSHM	SE	■		■	■			■		■
1ZBG000128	CSHM-SE-N50-C4-SH-STD-3Y	CSHM	SE		■	■	■		■		■	
1ZBG000129	CSHM-SE-N50-C4-SH-STD-5Y	CSHM	SE		■	■	■		■			■
1ZBG000130	CSHM-SE-N50-C4-SH-850-3Y	CSHM	SE		■	■	■			■	■	
1ZBG000131	CSHM-SE-N50-C4-SH-850-5Y	CSHM	SE		■	■	■			■		■
1ZBG000132	CSHM-SE-1,5-C4-HH-STD-3Y	CSHM	SE	■		■		■	■		■	
1ZBG000133	CSHM-SE-1,5-C4-HH-STD-5Y	CSHM	SE	■		■		■	■			■
1ZBG000134	CSHM-SE-1,5-C4-HH-850-3Y	CSHM	SE	■		■		■		■	■	
1ZBG000135	CSHM-SE-1,5-C4-HH-850-5Y	CSHM	SE	■		■		■		■		■
1ZBG000136	CSHM-SE-N50-C4-HH-STD-3Y	CSHM	SE		■	■		■	■		■	
1ZBG000137	CSHM-SE-N50-C4-HH-STD-5Y	CSHM	SE		■	■		■	■			■
1ZBG000138	CSHM-SE-N50-C4-HH-850-3Y	CSHM	SE		■	■		■		■	■	
1ZBG000139	CSHM-SE-N50-C4-HH-850-5Y	CSHM	SE		■	■		■		■		■
1ZBG000140	CSHM-SL-1,5-C4-SH-STD-3Y	CSHM	SL	■		■	■		■		■	
1ZBG000141	CSHM-SL-1,5-C4-SH-STD-5Y	CSHM	SL	■		■	■		■			■
1ZBG000142	CSHM-SL-1,5-C4-SH-850-3Y	CSHM	SL	■		■	■			■	■	
1ZBG000143	CSHM-SL-1,5-C4-SH-850-5Y	CSHM	SL	■		■	■			■		■
1ZBG000144	CSHM-SL-N50-C4-SH-STD-3Y	CSHM	SL		■	■	■		■		■	
1ZBG000145	CSHM-SL-N50-C4-SH-STD-5Y	CSHM	SL		■	■	■		■			■
1ZBG000146	CSHM-SL-N50-C4-SH-850-3Y	CSHM	SL		■	■	■			■	■	
1ZBG000147	CSHM-SL-N50-C4-SH-850-5Y	CSHM	SL		■	■	■			■		■
1ZBG000148	CSHM-SL-1,5-C4-HH-STD-3Y	CSHM	SL	■		■		■	■		■	
1ZBG000149	CSHM-SL-1,5-C4-HH-STD-5Y	CSHM	SL	■		■		■	■			■
1ZBG000150	CSHM-SL-1,5-C4-HH-850-3Y	CSHM	SL	■		■		■		■	■	
1ZBG000151	CSHM-SL-1,5-C4-HH-850-5Y	CSHM	SL	■		■		■		■		■
1ZBG000152	CSHM-SL-N50-C4-HH-STD-3Y	CSHM	SL		■	■		■	■		■	
1ZBG000153	CSHM-SL-N50-C4-HH-STD-5Y	CSHM	SL		■	■		■	■			■
1ZBG000154	CSHM-SL-N50-C4-HH-850-3Y	CSHM	SL		■	■		■		■	■	
1ZBG000155	CSHM-SL-N50-C4-HH-850-5Y	CSHM	SL		■	■		■		■		■

Hitachi ABB Power Grids Ltd

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