ARISO
CONTACTLESS COUPLER

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1. SCOPE

This Specification applies to the Part Numbers of ARISO GPIO listed in the Datasheet DS 116-19004 and presents the validation process for the ARISO M30 GPIO Contactless Coupler.

The primary application for the products is for Factory Automation processes with GPIO interface.

2. APPLICABLE DOCUMENTS

The full set of Specifications describing the product is listed in the Datasheet mentioned in §1.

These Specifications together with the Standards listed in § 2.1 shall be used when performing the tests.

Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the reference document, this document shall take precedence.

All tests shall be performed by using the applicable inspection plans and Product Drawings.

2.1 Overview of the Standards related to the Product

Name of the Standard	Description
EN 55011: 2009	Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
EN 55032: 2015	Electromagnetic compatibility of multimedia equipment - Emission Requirements
EN/IEC 60068-2-31: 2008 Ed. 2	Environmental Testing – Rough handling shocks, primarily for equipment-type specimens
EN/IEC 60068-2-60: 1995 Ed. 2	Environmental Testing – Flowing Mixed Gas Corrosion Test
EN/IEC 60068-2-64: 2008 Ed. 2	Environmental Testing – Vibration, broadband random and guidance
EN/IEC 60512-1-1: 2001 Ed. 1	Connectors for electronic equipment – Visual Examination
EN/IEC 60512-3-1: 2002 Ed. 1	Connectors for electronic equipment – Insulation Resistance
EN/IEC 60512-4-1: 2003 Ed. 1	Connectors for electronic equipment – Voltage Proof
EN/IEC 60512-6-3: 2002 Ed. 1	Connectors for electronic equipment – Shock
EN/IEC 60512-7-2: 2011 Ed. 1	Connectors for electronic equipment – Impact tests (free components)
EN/IEC 60512-11-4: 2002 Ed. 1	Connectors for electronic equipment – Rapid change of temperature
EN/IEC 60512-11-9: 2002 Ed. 1	Connectors for electronic equipment – Dry Heat
EN/IEC 60512-11-10: 2002 Ed. 1	Connectors for electronic equipment – Cold
EN/IEC 60512-11-12: 2002 Ed. 1	Connectors for electronic equipment – Damp Heat, Cyclic
EN/IEC 60512-17-1: 2010 Ed. 1	Connectors for electronic equipment – Cable Clamp Robustness
EN/IEC 60512-17-3: 2010 Ed. 1	Connectors for electronic equipment – Cable Clamp Resistance to Cable Pull
EN/IEC 60529: 2001 Ed. 2.1	Degrees of protection provided by enclosures (IP Code)
EN/IEC 60947-5-2: 2007 + Amendment 1: 2012	Low-Voltage Switchgear and Controlgear: Control circuit devices and switching elements – Proximity switches
EN/IEC 61000-4-2: 2008 Ed. 2	Electromagnetic Compatibility – Electrostatic Discharge Immunity Test
EN/IEC 61000-4-3: 2006 + Amendment 1: 2007 + Amendment 2: 2010	Electromagnetic Compatibility – Radiated, radio-frequency, electromagnetic field immunity test
EN/IEC 61000-4-4: 2012 Ed. 3	Electromagnetic Compatibility – Electrical Fast Transient/Burst Immunity Test
EN/IEC 61000-4-5: 2006	Electromagnetic Compatibility – Surge Immunity Test

Name of the Standard	Description
EN/IEC 61000-4-6: 2013 Ed. 4	Electromagnetic Compatibility – Immunity to Conducted Disturbances, Inducted by Radio Frequency Fields
EN/IEC 61000-4-8: 2001 Ed. 1.1	Electromagnetic Compatibility – Power Frequency Magnetic Field Immunity Test
EN/IEC 61000-6-4: 2007 + Amendment 1: 2011	Electromagnetic Compatibility – Emission Standard for Industrial Environments
EN/IEC 62311: 2007 Ed. 1	Assessment of Electronic and Electrical Equipment related to Human Exposure Restrictions for Electromagnetic Fields (0Hz – 300GHz)
EN 62368-1: 2014 + AC 2015	Audio/video, information and communication technology equipment - Part 1: Safety requirements (IEC 62368-1:2014, modified)
EN 300 440: March 2017 ETSI – V2.1.1	Short Range Devices (SRD); Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Harmonised Standard for access to radio spectrum
EN 301 489-1: March 2017 DRAFT ETSI – V2.2.0	Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU
EN 301 489-3: March 2017 FINAL DRAFT ETSI – V2.1.1	Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU

3. REQUIREMENTS

3.1 Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable Product Drawing of the PN 2287598.

3.2 Materials

Information about the material of the product is specified on the Customer Product Drawing.

3.3 Performance and Test Description

The product is designed to meet the electrical, mechanical and environmental performance requirements specified in paragraph 3.6. All tests are performed at environmental conditions per EN/IEC 60512-1 and EN/IEC 60512-2 series unless otherwise specified.

3.4 Validation Test Requirements and Procedures

3.4.1 Electrical test requirements and procedures of assembled systems

No.	Test	Requirement			Comment
General Inspections					
1.01	Visual and dimensional examination of the system	It meets Product´s Drawing Requirements, including LED functionality			Acc. EN/IEC 60512-1-1 (see §2.1) Test 1a Visual inspection of LED functionality acc. Test Specification.
Electrical Inspections Power Link					
1.02	Power Link Unmated Standby Power	Input Power level at TX < 0.75W			Acc. Test Specification.
1.03	Power Link Mated Standby Power	Input Power level at TX < 4.0W			Acc. Test Specification.
1.04	Power Link Input Voltage Tolerance Sensitivity, Output Voltage Tolerance and Regulation	Output Voltage at RX Supply Output V_{OUT} = 24V ± 5% when Input Voltage at TX side is V_{IN} = 24V ± 10%			Acc. Test Specification. Two edge conditions for the Load at RX Side: No Load (∞) with RX P_{OUT} = 0W Load = 50Ω with RX P_{OUT} = 12W
		Load [Ω]	**V_{IN} [V]**	**Distance [mm]**	
		∞	21.6	0	
		∞	21.6	2	
		∞	21.6	4	
		∞	21.6	5	
		∞	21.6	7	
		∞	26.4	0	
		∞	26.4	2	
		∞	26.4	4	
		∞	26.4	5	
		∞	26.4	7	
		50	21.6	0	
		50	21.6	2	
		50	21.6	4	
		50	21.6	5	
		50	21.6	7	
		50	26.4	0	
		50	26.4	2	
		50	26.4	4	
		50	26.4	5	
		50	26.4	7	
1.05	Power Link Continuous Output Power and Efficiency over distance	**Distance [mm]**	**Power [W]**	**Minimum Efficiency**	Acc. Test Specification.
		0.0	12	75%	
		2.0	12	75%	
		4.0	12	74%	
		5.0	12	74%	
		7.0	12	73%	

No.	Test	Requirement			Comment
1.06	Power Link Sensitivity to XYZ and Tilt Misalignment	**Z-Distance / XY-misalignment [mm] / Tilt [°]**	**Power [W]**	**Minimum Efficiency**	Acc. Test Specification.
		0.0 / ±5.0 / 0.0	12.0	73%	
		2.0 / ±5.0 / 0.0	12.0	73%	
		2.0 / 0.0 / 7.5	12.0	73%	
		2.0 / ±5.0 / 8.5	12.0	73%	
		4.0 / ±5.0 / 0.0	12.0	73%	
		4.0 / 0.0 / 15.0	12.0	73%	
		4.0 / ±5.0 / 17.5	12.0	73%	
		5.0 / ±3.0 / 0.0	12.0	73%	
		5.0 / 0.0 / 20.0	12.0	73%	
		5.0 / ±3.0 / 22.5	12.0	73%	
		7.0 / ±2.0 / 0.0	12.0	73%	
		7.0 / 0.0 / 25.0	12.0	73%	
		7.0 / ±2.0 / 32.5	12.0	73%	
1.07	Power Link Output Short Circuit Protection and Reverse Polarity Protection	Maximum RX Output Current: 0.72A ± 10% Normal Operation Output is expected once short circuit is removed or Input Polarity is correct.			Acc. Test Specification.
1.08	Power Link Rotational Freedom	No variation of Output Voltage and Efficiency. No change in performance of Power Link.			Acc. Test Specification. No XY misalignment, no tilt, TX fixed. RX rotating at 1250rpm.
1.09	Power Link Operational Readiness	RX V_{OUT} stable within 160ms after powering TX. Both power and data are ready (*Data* Readiness measured at TX Outputs).			Acc. Test Specification.
1.10	Power Link Inter Coupler Distance	No change in Power Link Performance of both couplers. Drop in efficiency ≤ 1% with respect to the situation without another coupler pair in close proximity.			Acc. Test Specification. For both coupler pairs no misalignment between TX and RX.
1.11	Power Link Metal Clearance	No change in Power Link Performance. Drop in efficiency ≤ 3% with respect to the situation without metal nearby.			Acc. Test Specification. RX and TX inserted in a Copper (Cu) tube with inner diameter of 60mm and in an Iron (Fe) tube of 65mm. All symmetry axes aligned.
1.12	Power Link Vibrational Performance	No change in Power Link Performance. Drop in efficiency ≤ 3% with respect to the situation without vibration.			Acc. Test Specification.
1.13	Power Link Temperature Cycling (operational)	No change in Power Link Performance. Drop in efficiency ≤ 3%.			Acc. Test Specification.

No.	Test	Requirement	Comment
1.14	Power Link OTP (Over Temperature Protection) Threshold	Threshold level of OTP ≥ 55°C at rising temperature. At falling temperature, the threshold level of OTP should be between 55°C and the threshold level at rising temperature.	Acc. Test Specification. The product is free hanging, in an ambient with forced convection.
1.15	Power Link Foreign Object Detection (FOD)	TX switched to Standby in case Input Power exceeds 19W. Input Power < 4W if space between TX and RX is covered by more than 40% with metal.	Acc. Test Specification. Iron or Copper sheet inserted between TX and RX.
1.16	Power Link Temperature Rating	1st: Maximum Temperature Rise Values after 1 hour Metal Housing ΔT_{MAX}: 20°C Front End Cap ΔT_{MAX}: 35°C 2nd: Maximum Power "P" Values as function of the Ambient Temperatures "T_{amb}": P(50°C) = 12.0W P(55°C) = 12.0W P(60°C) = 12.0W P(65°C) = 6.0W	Acc. Test Specification.
1.17	Power Link Operational Robustness	The under-voltage or over-voltage lockout circuits don´t turn off the product, there are no hang-ups or infinite loops during any operational condition. Output Voltage Change and Efficiency within 5% when Vin = 24.0 V ± 10% at ambient temperature ≤ 55°C and no metal plate is present between TX and RX. Power Link should start-up without instabilities when parameters are within normal operating conditions.	Acc. Test Specification. Note: Temporary reduction or switch-off of the power transfer allowed.
1.18	Power Link Inrush Current	TX Supply Input Inrush Current ≤ 2.0A	Acc. Test Specification.
1.19	Power Link Output Ripple and Noise. Load Variation Regulation	RX Supply Output Ripple and Noise ≤ 480mV Step Load Variation ≤ 2.4V The device can handle an Inrush Current < 200µA/s	Acc. Test Specification. Mating distance Δz = 4.0mm and 7.0mm, RX load switched from no-load to 10Ω / 2.4Ω (resistive) during 100µs / 20µs.
1.20	Power Link Stress Test	No change in performance of Power Link (during or after test)	Acc. Test Specification. Input Over-Voltage Test. Efficiency at maximum Input Voltage. Input Short Circuit Test. Input File Test between Power Supply and Power Input. Input File Test between Power Input and Ground.

No.	Test	Requirement		Comment
Electrical Inspections Data Link				
2.01	Digital Data Link Functionality	GPIO-1 to GPIO-8 (1) channels: Connections, Voltage Levels and Bit Error Rate (BER) < 0.1%		Acc. Test Specification.
2.02	Digital Data Link, Latency and Jitter	GPIO-1 to GPIO-8 (1) channels: Latency + Jitter < 800µs		Acc. Test Specification. Between rising/falling edges at GPIO input and rising/falling edges at GPIO output, single channel.
2.03	Digital Data Link Sensitivity to XYZ and Tilt Misalignment	**Z-Distance / XY-misalignment [mm] / Tilt [°]**	**Maximum Bit Error Rate (BER)**	Acc. Test Specification.
		0.0 / ±5.0 / 0.0	10^{-3}	
		2.0 / ±5.0 / 0.0	10^{-3}	
		2.0 / 0.0 / 7.5	10^{-3}	
		2.0 / ±5.0 / 8.5	10^{-3}	
		4.0 / ±5.0 / 0.0	10^{-3}	
		4.0 / 0.0 / 15.0	10^{-3}	
		4.0 / ±5.0 / 17.5	10^{-3}	
		5.0 / ±3.0 / 0.0	10^{-3}	
		5.0 / 0.0 / 20.0	10^{-3}	
		5.0 / ±3.0 / 22.5	10^{-3}	
		7.0 / ±2.0 / 0.0	10^{-3}	
		7.0 / 0.0 / 25.0	10^{-3}	
		7.0 / ±2.0 / 32.5	10^{-3}	
2.04	Digital Data Link Output Short Circuit Protection and Output Impedance	Sum of all output currents at GPIO-1 to GPIO-8 (1) channels should be less than 0.35A. Normal output operation should appear once short circuit is removed. Output Impedance ≤ 4Ω.		Acc. Test Specification.
2.05	Digital Data Link Rotational Freedom	No change in performance of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).		Acc. Test Specification. No XY misalignment, no tilt, TX fixed. RX rotating at 1250rpm.
2.06	Digital Data Link Operational Readiness	Output at TX side 1st: GPO-1 to GPO-8 (1) channels stable within 160ms after TX is powered 2nd: GPi-1 to GPI-8 (1) channels stable within 10ms after mating and RX Output Power is stable.		Acc. Test Specification. TX powered, RX moved from Δz = 20.0mm to Δz = 7.0mm
2.07	Digital Data Link Inter Coupler Distance	No change in BER of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).		Acc. Test Specification. For both coupler pairs no misalignment between TX and RX.

No.	Test	Requirement	Comment
2.08	Digital Data Link Metal Clearance	No change in BER of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).	Acc. Test Specification. RX and TX inserted in a metal tube with inner diameter of 60 mm. Metal tube should be made from Copper (Cu) and Iron (Fe). All symmetry axes aligned.
2.09	Digital Data Link Vibrational Performance	No change in BER of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).	Acc. Test Specification.
2.10	Digital Data Link Temperature Cycling (operational)	No change in BER of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).	Acc. Test Specification.
2.11	Digital Data Link Operational Robustness	Stable setup of data link after mating.	Acc. Test Specification.
2.12	Digital Data Link Output Status	All GPI Input Level = High 1st: GPO-1 to GPO-8 (1) Low NOK (2) status High 2nd: GPO-1 to GPO-8 (1) High NOK (2) status Low 3rd: GPO-1 to GPO-8 (1) High → Low. NOK (2) status Low → High	Acc. Test Specification. 1st: measure output level of GPIO-1 to GPIO-8 channels after powering TX, unmated. 2nd: measure output level of GPIO-1 to GPIO-8 channels after powering TX, mated with RX 3rd: measure output level of GPIO-1 to GPIO-8 channels after slow un-mating.
2.13	Digital Data Link Salt Water	No change in BER of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).	Acc. Test Specification.
2.14	Digital Data Link Stress Test	No change in BER of GPIO-1 to GPIO-8 (1) channels (acc. test 2.01).	Acc. Test Specification.

Note (1): the number of GPIO Lines depends on the product´s type
Note (2): the presence of NOK (Not OK) status depends on the product´s type

3.4.2 Mechanical and Environmental Test Requirements and Procedures for the Assembled System

No.	Test	Requirement	Comment
Basic Functional Tests			
3.01	Functional	These tests shall ensure proper function of all features. Values, given in the individual product drawings (such as throughput rate) shall be met.	Passing tests 1.01, 1.02, 1.03, 1.04, 1.05 and 2.01.
Inspections with regard to Environmental Conditions			
3.02	Mechanical Shock	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-6-3 (see §2.1) Test 6c 1. Non-Operating, place DUT (Device Under Test) on shock simulator machine. 2. Half-sine. 3. Peak acceleration: 50g Corresponding nominal pulse duration: 11ms Axes: ±X, ±Y and ±Z (6 directions).
3.03	Mechanical Vibration	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60068-2-64 (see §2.1) Test Fh 1. Non-Operating, place DUT on vibrational simulator machine. 2. Vibration Frequency: from 20Hz up to 500Hz. 3. Acceleration Spectral Density (ASD): $0.01g^2/Hz$ ($2.2g_{RMS}$). 4. Axes: X,Y, Z 5. Test Duration: 30 min/axis.
3.04	Free Fall	No functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60068-2-31 (see §2.1) Test conditions: 1. Height 1m. 2. Free fall from vertical position. 3. Free fall from horizontal position.
3.05	Thermal/Humidity Cyclic	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-11-12 (see §2.1) Test 11m Simultaneous temperature and humidity cycles: 5h at -20°C and 0-10% Relative Humidity. 9h at +85°C and 85% Relative Humidity. Transition time: 1,5h. Duration: 3 cycles (Total 52,5h)
3.06	Damp Heat, cyclic	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. IEC 60512-11-12, Test 11m (see §2.1) Lower Air Temperature: 25°C ± 3°C. Upper Air Temperature: 55°C ± 2°C. 90-100% Relative Humidity. Number of cycles: 21. Duration of cycles: 12+12 hours.
3.07	Dry Heat	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-11-9, Test 11i (see §2.1) Temperature: 100°C. Duration: 120h.

No.	Test	Requirement	Comment
3.08	Cold	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-11-10, Test 11j (see §2.1) Temperature: -25°C. Duration: 24h.
3.09	Rapid Temperature Change	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-11-4 (see §2.1) Test 11d. T_A = -25°C T_B = 80°C. ta = 60 min tb = 60 min. Number of cycles: 25.
3.10	Flowing Mixed Gas Corrosion	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60068-2-60, Test Ke, method 3 (see §2.1) Relative humidity: 75%. Temperature: 25°C. Duration: 21 days. 0,01 ppm H_2S 0,2 ppm NO_2 0,01 ppm Cl_2
EMI / EMC (Electromagnetic Interference / Electromagnetic Compatibility)			
4.01	Electrostatic Discharge (ESD) Immunity	Severity Level: 3 Air Discharge: 8kV Contact Discharge: 4kV Pass Criterion: B	Acc. EN/IEC 61000-4-2 (see §2.1) Contact discharge shall be applied to conductive surfaces and coupling planes of the DUT. The test shall be performed with single discharges. Recovery time between single discharges is >1s. Air discharge shall be applied to non-conductive surfaces of the DUT: at least 10 single discharges with positive and negative at the same selected point. The ESD test shall not be applied to open I/O lines, Power Supply Lines or Communication Lines.
4.02	Radiated Electromagnetic Field Immunity	Test Level: 2 Field Strength: 10V/m Freq. Range: 80-1000MHz Field Strength: 3V/m Freq. Range: 1.0-6.0GHz Pass Criterion: A	Acc. EN/IEC 61000-4-3 (see §2.1) The DUT (Device Under test) including supporting equipment is placed 0.8m above ground within an anechoic test chamber. Distance Antenna to DUT: 3m
4.03	Electrical Fast Transient/Burst Immunity	Signal, data and control lines: ±1kV DC Power Supply lines: ±2kV Trise/Threshold (T_r/T_h): 5/50ns Repetition frequency: 5kHz Testing time for each polarity: 1 min Pass Criterion: B	Acc. EN/IEC 61000-4-4 (see §2.1) Supply lines: Power Injected via Coupling Network (33nF). Both positive and negative polarity discharges shall be applied.

No.	Test	Requirement	Comment
4.04	Immunity to Conducted Disturbances	Voltage: 10 V_{RMS} Pass Criterion: A	Acc. EN/IEC 61000-4-6 (see §2.1) The Frequency range shall be swept from 150kHz to 80MHz, with the signal modulated with a 1kHz sine wave (AM 80%). The rate of sweep does not exceed 1.5 x 10^{-3} decade/s. The dwell time at each frequency shall be not less than the time necessary for the DUT to be able to respond. Coupling method: Coupling / Decoupling Network (CDN) preferred.
4.05	Power Frequency Magnetic Field Immunity	Field Strength: 30A/m, 50Hz and 60Hz. Pass Criterion: A	Acc. EN/IEC 61000-4-8 (see §2.1) The switchgears shall be connected to the safety earth directly on the ground plane via the earth terminal of the DUT. The cables supplied or recommended by the equipment manufacturer shall be used. One meter of all cables used shall be exposed to the magnetic field (induction coil size 1m x 1m).
4.06	EMC – Emission Standard for Industrial Environments	Radiated emission limits: < 40 [dB(µV/m)] from 30MHz up to 230MHz < 47 [dB(µV/m)] from 230MHz up to 1GHz	Acc. EN/IEC 61000-6-4 (see §2.1) Conducted emission: the DUT is placed 0.8 meters from the horizontal ground plane with DUT connected to the power mains through a Line Impedance Stabilization Network (LISN). Radiated emission: the measuring distance of 3m shall be used for measurements at frequency up to 1GHz. The rotational plate was rotated 360 degrees to determine the position of the highest radiation.
4.07	Electro-Magnetic Field Emission	Radiated emission (150-200 kHz) from measured values: E-field < 30 V/m H-field < 1 A/m	Acc. EN 62311 (see §2.1) Radiated emission measured at 10 cm distance from the product.
4.08	Surge Immunity	Tr/Th: 1.2µs/50µs (8µs/20µs) pulse with ±0.5kV line to ground and line to line. Pass Criterion: B.	Acc. EN/IEC 61000-4-5 (see §2.1) Test carried out at ±2kV from line to ground.
4.09	Effective Radiated Power	Effective radiated peak for generic use max 10mW between 2400MHz and 2483.5MHz	Acc. ETSI EN 300 440, §4.2.2 (see §2.1)
4.10	Permitted Change of Operating Frequencies	2400MHz – 2483.5MHz	Acc. ETSI EN 300 440, §4.2.3 (see §2.1) Acc. ERC Recommendation 70-03, Annex 1, brand h
4.11	Duty Cycle	$Duty\ Cycle = \frac{T_{on\_cum}}{T_{obs}} = \frac{0.00301s}{0.00602s} = 50\%$	Acc. ETSI EN 300 440, §4.2.5 (see §2.1) T_{obs} = Observation Time T_{on_cum} = Cumulative Transmission Time in T_{obs}

No.	Test	Requirement				Comment
4.12	Transmitter Unwanted Spurious Emission	**State**	**[MHz]** 47-74 87.5-118 174-230 470-864	**Other < 1GHz**	**All > 1GHz**	Acc. ETSI EN 300 440, §4.2.4 (see §2.1)
		Operating	4nW	250nW	1µW	
		Standby	2nW	2nW	20nW	
4.13	Conducted Disturbances	No signals other than the intended signal exceeds the limit line				Acc. ETSI EN 301 489-1 (see §2.1) Acc. EN 55032 Class B (see §2.1)

No.	Test Description	Requirement	Comment
	Miscellaneous Inspections		
5.01	Voltage withstand between shield and signal paths	Value and frequency of test voltage: 1500V_{RMS} from 50Hz up to 60Hz or 2250 V_{DC} No insulation breakdown during test	Acc. EN/IEC 60512-4-1 (see §2.1) Test 4a, Test Duration: 60s.
5.02	Insulation Resistance	Each signal contact and screen to all others: min. 500MΩ	Acc. EN/IEC 60512-3-1 (see §2.1) Test 3a
5.03	Degrees of protection provided by enclosures (IP Code)	No functional failures during stress test, such as power loss or increased Bit Error Rate.	Acc. EN/IEC 60529 (see §2.1) Acc. Datasheet.
5.04	Impact – Cap	No functional failures after test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-7-2 (see §2.1) Height 1m, 5 dropping cycles. The cable shall be extended to meet the length as specified.
5.05	Cable Pull	No physical damage and no functional failures at and after test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-17-3 (see §2.1) Applied force: 50N, 1 minute.
5.06	Cable Bend – Retaining Ring	No physical damage and no functional failures at and after test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60512-17-1 (see §2.1) Applied force: 30N.
5.07	Cable Torque	No physical damage and no functional failures at and after test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60947-5-2 (see §2.1) Applied moment of force: 0.1N·m (max. 360 degrees) at 100mm from exit, 1 minute.
5.08	Cable Push – Retaining Ring	No physical damage and no functional failures at and after test, such as power loss, lower efficiency or increased Bit Error Rate.	Acc. EN/IEC 60947-5-2 (see §2.1) Applied force: 20N, 1minute.

3.7 Mean Time To Failure (MTTF)

The Mean Time To Failure is the inverse of the annual failure rate assuming that the failure rate is constant. It has been calculated for this product based upon Siemens SN 29500: 1996 Standard and the following set of application data:

Ambient temperature	0°C - 55°C
RX Power Load	12W (50Ω)
Loads at all digital outputs	10kΩ
Component temperatures	According measured VI mapping data
Operating duty cycle	75% for TX and 50% for RX
Mechanical Stress (Vibration)	From 10Hz up to 150Hz, 0.35mm (50m/s^2). Typical environment for equipment in industrial environment acc. EN/IEC 60068-2-6: 1995 Ed. 6.

Aside of the MTTF calculation, sample products will be put on lifetime testing according to SN 29500: 1996.

Results: MTTF of the TX ≈ 204 years and MTTF of the RX ≈ 366 years.

3.8 Qualification and Requalification Tests Sequence

3.8.1 Test sequence for electrical tests of assembled system

No.	Test	Test Group (1)
		1
		Test Sequence (2)(3)
1.01	Visual and dimensional examination of System	1
1.02	Power Link Unmated Standby Power	2
1.03	Power Link Mated Standby Power	3
1.04	Power Link Input Voltage Tolerance Sensitivity, Output Voltage Tolerance and Regulation	6
1.05	Power Link Continuous Output Power and Power Link Efficiency	7
1.06	Power Link Sensitivity to XYZ and Tilt Misalignments	8
1.07	Power Link Output Short Circuit Protection and Reverse Polarity Protection	9
1.08	Power Link Rotational Freedom	10
1.09	Power Link Operational Readiness	11
1.10	Power Link Inter Coupler Distance	12
1.11	Power Link Metal Clearance	13
1.12	Power Link Vibrational Performance	14
1.13	Power Link Temperature Cycling (Operational)	15
1.14	Power Link OTP Threshold	16
1.15	Power Link Foreign Object Detection	17

No.	Test	Test Group (1)
		1
		Test Sequence (2)(3)
1.16	Power Link Temperature Rating	18
1.17	Power Link Operational Robustness	19
1.18	Power Link Inrush Current	20
1.19	Power Link Output Ripple and Noise	21
1.20	Power Link Stress Test	22
2.01	Digital Data Link Functionality	4
2.02	Digital Data Link Latency and Jitter	5
2.03	Digital Data Link Sensitivity to XYZ and Tilt Misalignment	9
2.04	Digital Data Link Output Short Circuit Protection and Output Impedance	10
2.05	Digital Data Link Rotational Freedom	11
2.06	Digital Data Link Operational Readiness	12
2.07	Digital Data Link Inter Coupler Distance	13
2.08	Digital Data Link Metal Clearance	14
2.09	Digital Data Link Vibrational Performance	15
2.10	Digital Data Link Temperature Cycling (Operational)	16
2.11	Digital Data Link Operational Robustness	23
2.12	Digital Data Link Output Status	24
2.13	Digital Data Link Salt Water Test	25
2.14	Data Link Stress Test	26

(1) See paragraph 4.1A
(2) Numbers indicate sequence in which tests are performed.
(3) Note that some tests can / will be done in parallel.

3.8.2 Test sequences for mechanical and environmental tests

No.	Test	Test Group (1)						
		2	3	4	5	6	7	8
		Test Sequence (2)(3)						
3.01	Functional	1, 4, 6	1, 5, 7, 9, 11, 14	1, 3	1, 3	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29	1, 3	1,3, 5,7,9, 11
3.02	Mechanical Shock	2						
3.03	Mechanical Vibration	3						
3.04	Free Fall	5						
3.05	Thermal/Humidity Cycle		4					
3.06	Damp Heat, cyclic		6					
3.07	Dry Heat		8					
3.08	Cold		10					
3.09	Rapid Temperature Change			2				
3.10	Flowing Mixed Gas Corrosion				2			
4.01	Electrostatic Discharge (ESD) Immunity					2		
4.02	Radiated Electromagnetic Field Immunity (RF Immunity)					4		
4.03	Electrical Fast Transient/Burst Immunity					6		
4.04	Immunity to Conducted Disturbances					8		
4.05	Power Frequency Magnetic Field Immunity					10		
4.06	EMC – Emission Standard for Industrial Environment					12		
4.07	Electro-Magnetic Field Emission					14		
4.08	Surge Immunity					16		
4.09	Effective Radiated Power					18		
4.10	Permitted Range of Operating Frequencies					20		
4.11	Duty Cycle					26		
4.12	Transmitter Unwanted Spurious Emission					22		
4.13	Conducted Disturbances					24		
5.01	Voltage withstand between shield and signal paths		2, 12					
5.02	Insulation Resistance		3, 13					

No.	Test	Test Group (1)						
		2	3	4	5	6	7	8
		Test Sequence (2)(3)						
5.03	Degrees of protection provided by enclosures (IP Code)						2	
5.04	Impact – Cap							2
5.05	Cable Pull							4
5.06	Cable Bend – Retaining Ring							6
5.07	Cable Torque							8
5.08	Cable Push – Retaining Ring							10

(1) See paragraph 4.1A
(2) Numbers indicate sequence in which tests are performed.
(3) Note that some tests can / will be done in parallel.

	Number of described samples in test groups							
Version description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
M30 GPIO 8 Channels	4	4	4	4	4	2	4	4
M30 GPIO 2 Channels	4	0	0	0	0	0	0	4

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification Testing

A Sample selection

The samples shall be prepared in accordance with product drawings and application specification.

They shall be selected at random from current production.

Test groups consist of 4 samples (two couplers made of one Transmitter and one Receiver each).

B Test sequence

Qualification inspection shall be verified by testing samples as specified in paragraph 3.6.

4.2 Requalification Testing

If changes affecting significantly form, fit or function are made to the product or to the manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality, and reliability engineering.

4.3 Acceptance

Acceptance is based on verification that the product meets the requirements of paragraph 3.4.

Failures attributed to equipment, test setup, or operator deficiencies shall not disqualify the product.

When product failure occurs, corrective actions shall be taken and samples are resubmitted for qualification.

Testing to confirm corrective action is required before resubmission.

4.4 Quality Conformance Inspection

The applicable TE quality inspection plan will specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.

5. OTHERS

The product described herein has not been fully tested to ensure conformance to the requirements outlined above.

TE makes no representation or warranty, expressed or implied, that the product or design will comply with these requirements. Further, TE may change these requirements based on the results of additional testing and evaluation. Contact TE Engineering for further details.