ARISO M30 General GPIO Contactless Coupler

1. SCOPE

1.1 Content

This specification covers the validation process for the ARISO M30 General GPIO Contactless Coupler. Five different parts are being described in this document:

1) The ARISO M30 Power Transmitter Tx with 2 General Purpose Digital Outputs.
2) The ARISO M30 Power Receiver Rx with 2 General Purpose Digital Inputs.
3) The ARISO M30 Power Transmitter Tx with 8 General Purpose Digital Outputs.
4) The ARISO M30 Power Receiver Rx with 8 General Purpose Digital Inputs, version A
5) The ARISO M30 Power Receiver Rx with 8 General Purpose Digital Inputs, version B

The primary application for this product is for Factory Automation processes with GPIO interface.

1.2 Qualification

The following given specifications and standards shall be used when performing tests. All tests shall be performed by using the applicable inspection plans and product drawings.

2. APPLICABLE DOCUMENTS

The following documents are part of this specification, if they are referenced. In case of conflict between this specification and the product drawing or of conflict between this specification and the referenced documents, this specification shall take precedence.

2.1 TE Documents

A Test Specification, Application Specifications and Data Sheet

109-1: General requirements for test specifications
109-19040: ARISO M30 General GPIO Test Specification
114-19159: ARISO M30 General GPIO Application Specification
116-19004: ARISO M30 general GPIO Data Sheet

B Drawings

C-2287598: M30 ARISO GPIO General Coupler

C Classification

The ARISO M30 General GPIO is classified as a Short Range Device (SRD) and complies with following ETSI documents:

ETSI EN 300 440-1	Receiver Category 2 (table 2)
ETSI EN 300 440-2	
ETSI EN 301 489-1	
ETSI EN 301 489-3	Primary Function Type III (other, table 1), Device Type 2 (table 3).

2.2 Other Documents

1) IEC 11801 Information technology - Generic cabling for customer premises.
2) IEC 60068 Basic environmental testing procedures.
3) IEC 60381 Analogue signals for process control systems.
4) IEC 60512 Connectors for electronic equipment – Test and measurements.
5) IEC 60529 Degrees of protection provided by enclosures (IP Code)
6) IEC 60950 Information technology equipment – Safety.
7) IEC 60801 Electromagnetic compatibility for industrial-process measurement and control equipment.
8) IEC 60947-5-2: Low-Voltage Switchgear and Controlgear – Part 5: Control circuit devices and switching elements, Section 2: Proximity switches.
9) IEC 61000 Electromagnetic compatibility (EMC).
10) IEC 61000-4-2: Testing and measurement techniques – Electrostatic discharge immunity test.
11) IEC 61000-4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
12) IEC 61000-4-8:
13) IEC 61000-6-2: Generic standards – Immunity for industrial environments.
14) IEC 61131-2 Programmable Controllers – Part 2: Equipment requirements and tests
15) EN 55011 / CISPR-11 Industrial, scientific and medical (ISM) radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement
16) EN 55022 / CISPR-22 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
17) EN 62311 Assessment of Electronic and Electrical Equipment related to Human exposure restrictions for Electromagnetic Fields
18) ETSI EN 300 328 V1.8.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission system; data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive.
19) ETSI EN 300 440-1 V1.6.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Part 1: Technical characteristics and test methods.
20) ETSI EN 300 440-2 V1.4.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive.
21) ETSI EN 301 489-1 V1.9.2: Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
22) ETSI EN 301 489-3 V1.6.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic 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.
23) IEC 62479:2010: Assessment of the compliance of low-power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz).
24) DIN 40050-9 Ingress Protection
25) IPC-A-610D Acceptability of Electronic Assemblies
26) 2004/108/EC Electromagnetic Compatibility Directive
27) 2006/95/EC Low Voltage Directive

28) 1999/5/EC R&TTE Directive
29) 2001/95/EC General Product Safety Directive
30) 93/68/EEC CE marking
31) FCC Part 15 Radio Frequency Devices
32) FCC Part 18 Industrial, Scientific, and Medical Equipment

2.3 Notes

-

3. REQUIREMENTS

3.1 Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing (2287598).

3.2 Materials

Information about material is specified on customer drawings (C-2287598).

3.3 Ratings

A	Rated input voltage Tx Rated output voltage Rx	24VDC 24VDC
B	Power Transfer capability	12W @ Rx side, 55 °C ambient temperature, maximum 7 mm distance between Tx and Rx
C	Operating ambient temperature Storage temperature	-20 °C to 55 °C -25 °C to 100 °C
D	Ingress Protection	IP67
E	Dimensions Tx Dimensions Rx	80 mm (excluding cable) 80 mm (excluding cable)
F	EMC	Harmonized ETSI Standards for SRD

3.4 EMI/EMC Certifications Tests

EU

FCC FCC Part 15 and 18
Conducted and Radiated Emission Tests acc. to ANSI C63.4-2003

CISPR CISPR-11 Class A & Group 1

3.5 Safety Certifications

EU

UL/cUL

CSA

FCC

MIC

3.6 Performance and Test Description

The product is designed to meet the electrical, mechanical and environmental performance requirements specified in paragraph 3.8. All tests are performed at ambient environmental conditions per IEC 60512-1/-2 series unless specified otherwise.

3.7 Validation Test Requirements and Procedures

3.7.1 Electrical test requirements and procedures of assembled systems

<table>
<tr><th>No.</th><th>Test Description</th><th>Requirement</th><th>Test Procedure</th></tr>
<tr><td colspan="4">General Inspections</td></tr>
<tr><td>1.01</td><td>Visual and dimensional examination of system</td><td>Meets requirements of product drawing.</td><td>Acc. to IEC 60512-1-1, IEC 60512-1-2.</td></tr>
<tr><td colspan="4">Electrical Inspections
Power Link</td></tr>
<tr><td>1.02</td><td>Power Link Unmated Standby Power</td><td>Input power level at Tx < 0.75 W.</td><td>Acc. to 109-19040, 4.1.2.</td></tr>
<tr><td>1.03</td><td>Power Link Mated Standby Power</td><td>Input power level at Tx < 4.0 W.</td><td>Acc. to 109-19040, 4.1.3.</td></tr>
<tr><td>1.04</td><td>Power Link Input Voltage Tolerance Sensitivity, Output Voltage Tolerance and Regulation</td><td>Output voltage at Rx Supply output should be 24V ± 5% when Vin = 24V ± 10%.</td><td>Acc. to 109-19040, 4.1.4.
<table>
<tr><th>Load (Ω)</th><th>Vin (V)</th><th>Distance (mm)</th></tr>
<tr><td>∞</td><td>21.6</td><td>0</td></tr>
<tr><td>∞</td><td>21.6</td><td>2</td></tr>
<tr><td>∞</td><td>21.6</td><td>4</td></tr>
<tr><td>∞</td><td>21.6</td><td>5</td></tr>
<tr><td>∞</td><td>21.6</td><td>7</td></tr>
<tr><td>∞</td><td>26.4</td><td>0</td></tr>
<tr><td>∞</td><td>26.4</td><td>2</td></tr>
<tr><td>∞</td><td>26.4</td><td>4</td></tr>
<tr><td>∞</td><td>26.4</td><td>5</td></tr>
<tr><td>∞</td><td>26.4</td><td>7</td></tr>
<tr><td>50</td><td>21.6</td><td>0</td></tr>
<tr><td>50</td><td>21.6</td><td>2</td></tr>
<tr><td>50</td><td>21.6</td><td>4</td></tr>
<tr><td>50</td><td>21.6</td><td>5</td></tr>
<tr><td>50</td><td>21.6</td><td>7</td></tr>
<tr><td>50</td><td>26.4</td><td>0</td></tr>
<tr><td>50</td><td>26.4</td><td>2</td></tr>
<tr><td>50</td><td>26.4</td><td>4</td></tr>
<tr><td>50</td><td>26.4</td><td>5</td></tr>
<tr><td>50</td><td>26.4</td><td>7</td></tr>
</table></td></tr>
<tr><td>1.05</td><td>Power Link Continuous Output Power and Power Link Efficiency</td><td>
<table>
<tr><th>Distance (mm)</th><th>Power (W)</th><th>Minimum Efficiency</th></tr>
<tr><td>0.0</td><td>12.0</td><td>75%</td></tr>
<tr><td>2.0</td><td>12.0</td><td>75%</td></tr>
<tr><td>4.0</td><td>12.0</td><td>74%</td></tr>
<tr><td>5.0</td><td>12.0</td><td>74%</td></tr>
<tr><td>7.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>8.0</td><td>1.0</td><td>-</td></tr>
</table></td><td>Acc. to 109-19040, 4.1.5.</td></tr>
</table>

<table>
<tr><td>1.06</td><td>Power Link Sensitivity to XYZ and Tilt Misalignment</td><td>
<table>
<tr><th>Z-Distance, XY-mis-alignment (mm), Tilt (°)</th><th>Power (W)</th><th>Minimum Efficiency</th></tr>
<tr><td>0.0 / ±5.0 / 0.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>2.0 / ±5.0 / 0.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>2.0 / 0.0 / 7.5</td><td>12.0</td><td>73%</td></tr>
<tr><td>2.0 / ±5.0 / 8.5</td><td>12.0</td><td>73%</td></tr>
<tr><td>4.0 / ±5.0 / 0.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>4.0 / 0.0 / 15.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>4.0 / ±5.0 / 17.5</td><td>12.0</td><td>73%</td></tr>
<tr><td>5.0 / ±3.0 / 0.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>5.0 / 0.0 / 20.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>5.0 / ±3.0 / 22.5</td><td>12.0</td><td>73%</td></tr>
<tr><td>7.0 / ±2.0 / 0.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>7.0 / 0.0 / 25.0</td><td>12.0</td><td>73%</td></tr>
<tr><td>7.0 / ±2.0 / 32.5</td><td>12.0</td><td>73%</td></tr>
<tr><td>8.0 / ±1.0 / 0.0</td><td>1.0</td><td>-</td></tr>
<tr><td>8.0 / 0.0 / 30.0</td><td>1.0</td><td>-</td></tr>
<tr><td>8.0 / ±1.0 / 38.0</td><td>1.0</td><td>-</td></tr>
</table>
</td><td>Acc. to 109-19040, 4.1.6.</td></tr>
<tr><td>1.07</td><td>Power Link Output Short Circuit Protection and Reverse Polarity Protection</td><td>Maximum output current at Rx should be 0.72A ± 10%.

Normal operation output should appear once short circuit is removed or input polarity is normal.</td><td>See 109-19040, 4.1.7.</td></tr>
<tr><td>1.08</td><td>Power Link Rotational Freedom</td><td>No variation of output voltage and efficiency (variations less than 1%).

No change in performance of Power Link.</td><td>Acc. to 109-19040, 4.1.8.

Mating distance Δz = 7.0 mm, no XY misalignment, no tilt, Tx fixed, Rx rotated over 0, 90, 180 and 270 degrees.

Mating distance Δz = 7.0 mm, no XY misalignment, no tilt, Tx fixed, Rx rotating with 1250 rpm.</td></tr>
<tr><td>1.09</td><td>Power Link Operational Readiness</td><td>Output voltage Rx stable within 160 ms after powering Tx</td><td>Acc. to 109-19040, 4.1.9.

Mating distance Δz = 7.0 mm, 50Ω load at Rx.</td></tr>
<tr><td>1.10</td><td>Power Link Inter Coupler Distance</td><td>No change in performance of Power Link of both couplers.
Drop in efficiency ≤ 1 % with respect to situation without coupler pair in close proximity.</td><td>Acc to 109-19040, 4.1.10.

For both coupler pairs:
Mating distance Δz = 7.0 mm, 50Ω load at Rx. Distance between central axis of both pairs 60 mm, no misalignment.</td></tr>
<tr><td>1.11</td><td>Power Link Metal Clearance</td><td>No change in performance of Power Link.
Drop in efficiency ≤ 3 % with respect to situation without metal environment.</td><td>Acc. to 109-19040, 4.1.11.

Mating distance Δz = 7.0 mm, 50Ω load at Rx. Rx and Tx inserted in a Copper (Cu) tube with inner diameter of 60 mm and in an Iron (Fe) tube of 65 mm. All symmetry axes aligned.</td></tr>
</table>

<table>
<tr><td>1.12</td><td>Power Link Vibration Performance</td><td>No change in performance of Power Link

Drop in efficiency ≤ 3 % with respect to situation without vibration.</td><td>Acc. to 109-19040, 4.1.12.

Mating distance Δz = 7.0 mm, 50Ω load at Rx. Sine with 2 mm amplitude in X, Y and Z directions, 10Hz.</td></tr>
<tr><td>1.13</td><td>Power Link Temperature cycling operational</td><td>No change in performance of power link.

Drop in efficiency ≤ 3 % with respect to situation without vibration.</td><td>Acc. to 109-19040, 4.1.13.</td></tr>
<tr><td>1.14</td><td>Power Link OTP Threshold</td><td>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.</td><td>Acc. to 109-19040, 4.1.14.

Mated condition, Δz = 7.0 mm distance, 50Ω load at Rx, free hanging with forced convection.</td></tr>
<tr><td>1.15</td><td>Power Link Foreign Object Detection</td><td>Tx switched to standby in case input power exceeds 19W.
Input power < 4 W if space between Tx and Rx is covered by more than 40% with metal.</td><td>Acc. to 109-19040, 4.1.15.

Mating distance Δz = 7.0 mm
Iron and Copper sheet of 0.5 mm thickness inserted between Tx and Rx, 50Ω load at Rx.</td></tr>
<tr><td>1.16</td><td>Power Link Temperature Rating</td><td>1st: Temperature rise max 20 °C for the metal housing and 35 °C for the plastic Front End after 1 hour. Both for Horizontal and Vertical positions.

2nd: Maximum power as function of temperature:
<table>
<tr><th>Ambient Temperature (°C)</th><th>Power (W)</th></tr>
<tr><td>50</td><td>12.0</td></tr>
<tr><td>55</td><td>12.0</td></tr>
<tr><td>60</td><td>12.0</td></tr>
<tr><td>65</td><td>6.0</td></tr>
</table></td><td>Acc. to 109-19040, 4.1.16.

1st: Mated condition, Δz = 7.0 mm distance, 50Ω load at Rx, free hanging, forced convection.

2nd: Mated condition, Δz = 7.0 mm distance, free hanging, forced convection.</td></tr>
<tr><td>1.17</td><td>Power Link Operational Robustness</td><td>No under-/over-voltage lockouts, hang-ups, infinite loops during any operational condition. Output voltage change and efficiency within 5 % when Vin = 24.0 V ± 10%, ambient temperature is ≤ 55 °C and no metal plate between Tx and Rx.

Power link should start-up without instabilities when parameters are within normal operation conditions.</td><td>Acc. to 109-19040, 4.1.17.

Mating distance Δz = 7.0 mm, 50Ω load.
1. Decrease input voltage from 24.0 V down to 21.0 V in 10s.
Increase input voltage from 21.0 V up to 26.4 V in 20s.
Decrease input voltage from 26.4 V down to 24.0V in 10 s.
2. Increase mating distance from 1 to 20 mm in 10 s.
Decrease mating distance from 20 to 1 mm in 10 s.
3. Increase mating distance from 1 to 20 mm within 1 s and wait 5 s.
Decrease mating distance from 20 to 1 mm within 1 s and wait 5 s.
4. Repeat 3 without waiting in between.
5. Insert iron sheet of 0.5 mm thickness inserted between Tx and Rx and remove it after 10 s.

Note: Temporary reduction or switch-off of the power transfer allowed.</td></tr>
</table>

<table>
<tr><td>1.18</td><td>Power Link Inrush Current</td><td>Tx Supply Input Inrush Current ≤ 2.0 A</td><td>Acc. to 109-19040, 4.1.18.
Mating distance Δz = 7.0 mm, 50Ω load at Rx.</td></tr>
<tr><td>1.19</td><td>Power Link Output Ripple and Noise and Load Variation Regulation</td><td>Rx Supply Output Ripple and Noise ≤ 480 mV.
Step load variation ≤ 2.4V.
Inrush current handling capability > 200 µAs</td><td>Mating distance Δz = 4.0 and 7.0 mm, no load and 50Ω load at Rx. Measurement based upon JEITA-RC9131A Ripple & Noise Test Set-Up.
Mating distance Δz = 4.0 and 7.0 mm, Rx load switched from no-load to 50Ω (resistive) and from 50Ω to no-load.
Mating distance Δz = 4.0 and 7.0 mm, Rx load switched from no-load to 10Ω / 2.4Ω (resistive) during 100µs / 20µs.</td></tr>
<tr><td>1.20</td><td>Power Link Stress Test</td><td>No change in performance of power link (during or after test).</td><td>Acc. to 109-19037 4.1.20
Input over-voltage test.
Efficiency at max. input voltage.
Input Short Circuit test.
Input file test between power supply and power input.
Input file test between power input and ground.</td></tr>
<tr><td colspan="4">Electrical Inspections
Data Link</td></tr>
<tr><td>2.01</td><td>Digital Data Link Functionality</td><td>GPIO-1 to GPIO-8 channels: Connections, Voltage levels and Bit Error Rate < 0.1 %.</td><td>Acc. to 109-19040, 4.2.1
Mating distance Δz = 7.0 mm.</td></tr>
<tr><td>2.02</td><td>Digital Data Link Latency and Jitter</td><td>GPIO-1 to GPIO-8 channels:
Delay > 50 µs
Delay + Jitter < 350 µs</td><td>Acc. to 109-19040, 4.2.3.
Between rising/falling edge at GPIO input (TBIL) and rising/falling at GPIO output, single channel.</td></tr>
<tr><td>2.03</td><td>Digital Data Link Sensitivity to XYZ and Tilt Misalignment</td><td>
<table>
<tr><th>Z-Distance, XY-mis-alignment (mm), Tilt (°)</th><th>Max. BER</th></tr>
<tr><td>0.0 / ±5.0 / 0.0</td><td>10^{-3}</td></tr>
<tr><td>2.0 / ±5.0 / 0.0</td><td>10^{-3}</td></tr>
<tr><td>2.0 / 0.0 / 7.5</td><td>10^{-3}</td></tr>
<tr><td>2.0 / ±5.0 / 8.5</td><td>10^{-3}</td></tr>
<tr><td>4.0 / ±5.0 / 0.0</td><td>10^{-3}</td></tr>
<tr><td>4.0 / 0.0 / 15.0</td><td>10^{-3}</td></tr>
<tr><td>4.0 / ±5.0 / 17.5</td><td>10^{-3}</td></tr>
<tr><td>5.0 / ±3.0 / 0.0</td><td>10^{-3}</td></tr>
<tr><td>5.0 / 0.0 / 20.0</td><td>10^{-3}</td></tr>
<tr><td>5.0 / ±3.0 / 22.5</td><td>10^{-3}</td></tr>
<tr><td>7.0 / ±2.0 / 0.0</td><td>10^{-3}</td></tr>
<tr><td>7.0 / 0.0 / 25.0</td><td>10^{-3}</td></tr>
<tr><td>7.0 / ±2.0 / 32.5</td><td>10^{-3}</td></tr>
<tr><td>8.0 / ±1.0 / 0.0</td><td>10^{-3}</td></tr>
<tr><td>8.0 / 0.0 / 30.0</td><td>10^{-3}</td></tr>
<tr><td>8.0 / ±1.0 / 38.0</td><td>10^{-3}</td></tr>
</table>
</td><td>Acc. to 109-19040, 4.2.4.</td></tr>
</table>

2.04	Digital Data Link Output Short Circuit Protection and Output Impedance	Sum of all output currents at GPIO-1 to GPIO-8 channels should be less than 0.35 A. Normal operation output should appear once short circuit is removed. Output impedance ≤ 4 Ω.	Acc. to 109-19040, 4.2.5.
2.05	Digital Data Link Rotational Freedom	No change in performance of GPIO-1 to GPIO-8 channels (acc. to 2.01). No change in performance of GPIO-1 to GPIO-8 channels (acc. to 2.01).	Acc. to 109-19040, 4.2.6. Mating distance Δz = 7.0 mm, no XY misalignment, no tilt, Tx fixed, Rx rotated over 0, 90, 180 and 270 degrees. Mating distance Δz = 7.0 mm, no XY misalignment, no tilt, Tx fixed, Rx rotating with 1250 rpm.
2.06	Digital Data Link Operational Readiness	Output of GPIO-1 to GPIO-8 channels at Tx side stable within 25 ms after Rx output power is stable.	Acc. to 109-19040, 4.2.7. Tx powered, Rx moved from Δz = 20.0 mm to Δz = 7.0 mm, 50Ω load at Rx.
2.07	Digital Data Link Inter Coupler Distance	No change in BER of GPIO-1 to GPIO-8 channels (acc. to 2.01)	Acc. to 109-19040, 4.2.8. For both coupler pairs: Mating distance Δz = 7.0 mm, 50Ω load at Rx. Distance between central axis of both pairs 60 mm, no misalignment.
2.08	Digital Data Link Metal Clearance	No change in BER of GPIO-1 to GPIO-8 channels (acc. to 2.01)	Acc. to 109-19040, 4.2.9. Mating distance Δz = 7.0 mm, 50Ω load at Rx. Rx and Tx inserted in a metal tube with inner diameter of 60 mm. Metal tube should be made from Cu and from Fe. All symmetry axes aligned.
2.09	Digital Data Link Vibration Performance	No change in BER of GPIO-1 to GPIO-8 channels (acc. to 2.01)	Acc. to 109-19040, 4.2.10. Mating distance Δz = 7.0 mm, 50Ω load at Rx. Sine with 2 mm amplitude in X, Y and Z directions, 10Hz.
2.10	Digital Data Link Temperature cycling operational	No change in BER of GPIO-1 to GPIO-8 channels (acc. to 2.01)	Acc. to 109-19040, 4.2.11.
2.11	Digital Data Link Operational Robustness	Stable setup of data link after mating.	Acc. to 109-19040, 4.2.12.
2.12	Digital Data Link Output Status	All GPI input level = High 1st: GPO-1 to GPO-8 LOW. 2rd: GPO-1 to GPO-8 High. 3rd: GPO-1 to GPO-8 High → Low.	Acc. to 109-19040, 4.2.13. 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 Test	No change in BER of GPIO-1 to GPIO-8 channels (acc. to 2.01)	Acc. to 109-19040, 4.2.14. Mating distance Δz = 7.0 mm, 50 Ω load at Rx. Rx and Tx submerged in salt water.
2.14	Data Link Stress Test	No change in BER of GPIO-1 to GPIO-8 channels (acc. to 2.01)	Acc. to 109-19037 4.2.15. Voltage level above 24V. Prolonged maximum load test. Prolonged short circuit test.

3.7.2 Mechanical and environmental test requirements and procedures of assembled system

No.	Test Description	Requirement	Test Procedure
		Basic Function Tests	
3.01	Functional Test	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.
		Environmental Inspections	
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.	According to IEC 60512-6-3: 1. Non-Operating, place DUT on shock simulator machine. 2. Half-sine. 3. Peak acceleration: 50g • Corresponding duration of the nominal pulse: 11ms • Axis: ±X, ±Y, ±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.	According to IEC 60512-6-4 1. Non-Operating, place DUT on vibration simulator machine. 2. Vibration Frequency: 20~500 Hz. 3. P.S.D.: 0.01G²/Hz (2.2 Grms). 4. Axis: X,Y, Z 3 axis 5. Test Duration: 30 min / each axis.
3.04	Free Fall Test	No functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60512-5 Test condition: 1. Height 1000 mm. 2. Free fall from vertical position. 3. Free fall from horizontal position.

3.05	Thermal/Humidity Cycle Test	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60068-2-38 Simultaneous temperature and humidity cycles: 5h @ -20°C / 0-10% RH. 9h @ +85°C / 85% RH. 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.	According to IEC 60512-11-12. Lower air temp.: 25±3 °C. Upper air temp.: 55±2 °C. 90-100% RH. Number of cycles: 21. Duration of cycles: 12+12 hrs.
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.	According to IEC 60512-11-9. Temperature: 100 °C. Duration: 120h.
3.08	Cold storage	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60512-11-10 Temperature: -25 °C. Duration: 24h.
3.09	Rapid change of temperature	No physical damage and no functional failures after stress test, such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60068-2-14 Na. Ta = -25 °C Tb = 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.	According to IEC 60512-11-7. Relative humidity: 75%. Temperature: 25 °C. Duration: 21 days. 0,2 ppm SO_2 0,01 ppm H_2S 0,2 ppm NO_2 0,01 ppm Cl_2
		EMI / EMC	
4.01	Electrostatic Discharge Immunity (ESD) Test	Severity Level: 3 Air Discharge: 8kV Contact Discharge: 4kV Pass Criteria: B	According to IEC 61000-4-2. 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 >1 second. Air discharge shall be applied to non-conductive surfaces of the DUT: At least ten 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 (RF Immunity)	Test Level: 2 Field Strength: 10V/m Freq. Range: 80-1000MHz Field Strength: 3V/m Freq. Range: 1.4-2.0GHz Field Strength: 1V/m Freq. Range: 2.0-2.7GHz Pass Criteria: A	According to IEC 61000-4-3. The DUT including supporting equipment is placed 0.8m above ground within an anechoic test chamber. Distance antenna to DUT: 3m
4.03	Fast Transient (Burst) Immunity Test	Signal, data and control lines: ±1kV DC Power Supply lines: ±2kV Tr/Th: 5/50ns Repetition rate: 5kHz Duration: > 1 min. Pass Criteria: B	According to IEC 61000-4-4: Signal lines: Only if longer than 3m, capacitive coupling clamp (50-200pF). Supply lines: Injection via coupling network (33nF). Both positive and negative polarity discharges shall be applied.
4.04	Immunity to Conducted Disturbances	Voltage: 10 Vrms Pass Criteria: A	According to IEC 61000-4-6. 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 1.5x 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. Test is applicable for all DC supply lines and for signal lines longer than 3m. Coupling method: coupling / decoupling network (CDN) preferred.
4.05	Power Frequency Magnetic Field Immunity Test	Field Strength: 30 A/m (50Hz and 60Hz). Pass Criteria: A	According to IEC 61000-4-8. The equipment cabinets 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.1 meter of all cables used shall be exposed to the magnetic field (induction coil size 1m x 1m).
4.06	EMC - Immunity for Industrial Environments	See Test Items 2.01-2.07	According to EN61000-6-2. Ensured by single tests 2.01-2.07.
4.07	EMC – Emission Standard for Industrial Environments	Conducted emission limits (Quasi-Peak): <79 dBµV @ 0.15-0.5 MHz <73 dBµV @ 0.5-30MHz	According to EN61000-6-4. Conducted emission: The DUT is placed 0.8 meters from the horizontal ground plane with DUT being connected to the power mains through a line

		Radiated emission limits: <40 dBµV/m @ 30-230MHz <47 dBµV/m @ 230-1000MHz	impedance stabilization network (LISN). Radiated emission: The measuring distance of at 10 m shall be used for measurements at frequency up to 1GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
4.08	Magnetic Field Emission	Radiated emission (150-200 kHz) E-field < 30 V/m H-field < 1 H/m	According to EN 62311. Radiated emission measured at 10 cm distance of the product.
4.09	Surge	10 µs / 700 µs pulse with 500V peak applied to Power Supply input (single polarity). Pass Criteria: B.	Acc. to 109-19037 4.3.1.
		Miscellaneous Inspections	
5.01	Voltage withstand between shield and signal paths	Value and nature of test voltage: 1500V_{rms} @ 50…60Hz or 2250 V_{DC} No insulation breakdown during test	According to DIN IEC 60512-4-1, test 4a, test duration: 60s,
5.02	Insulation resistance	Each signal contact and screen to all others: min. 500MOhm	Acc. to IEC 60512-3-1, test 3a, method A.
5.03	Ingress Protection	No function failure during stress test, such as power loss or increased Bit Error Rate.	Acc. to IP-67. 7 days submerged in water at 1 m depth. See IEC60529.
5.04	Cap impact test	No function failures after test, such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60512-7-2, height 1000mm, 5 dropping cycles. The cable shall be extended to meet the length as specified.
5.05	Cable pull test	At and after cable pull no physical damage and no function failures such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60512-17-3 / IEC 60947-5-2. Applied force: 50N, 1 minute
5.06	Cable exit bend test	At and after cable bend no physical damage and no function failures such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60512-17-1 / IEC 60947-5-2 Applied force: 30N.
5.07	Cable torque test	At and after cable torque no physical damage and no function failures such as power loss, lower efficiency or increased Bit Error Rate.	According to IEC 60947-5-2. Applied force: 0.1Nm (max. 360 degrees) at 100 mm from exit, 1 minute.
5.08	Cable exit push test	At and after cable push no physical damage and no function failures such as power loss, lower efficiency or increased BER.	According to IEC 60947-5-2. Applied force: 20N, 1minute.

3.8 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 SN29500 and the following set of application data:

- Ambient temperature 0 - 55 °C
- Rx Power Load 12W (50 Ω)
- Loads at all digital outputs 10 kΩ
- Component temperatures According measured VI mapping data
- Operating duty cycle 75% for Tx and 50% for Rx
- Mechanical Stress (vibration) 10-150 Hz / 0.35 mm (50 m/s^2), Typical environment for equipment in industrial environment according to IEC60068-2-6

Aside of the MTTF calculation, sample products will be put on lifetime testing according to SN29500.

Calculated figures are 200kHours for Tx and 400kHours for Rx.

3.9 Qualification and Requalification Tests Sequence

3.9.1 Test sequences for electrical tests of assembled systems

No.	Test	Test Group (1)									
		1	2	3	4	5	6	7	8	9	10
		Test Sequence (2)									
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 Misalignment	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 Vibration 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									
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 Vibration 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									

(1) See paragraph 4.1 A
(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									
No.	**Version description**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
V1	GPIO	4									

3.9.2 Test sequences for mechanical and environmental tests

No.	**Test**	**Test Group (1)**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		Test Sequence (2)									
3.01	Functional Test	1,4, 6	1,5, 7,9, 11, 14	1,3	1,3	1,3, 5,7, 9,11, 13,15, 17,19	1,3	1,3, 5,7,9, 11			
3.02	Mechanical Shock	2									
3.03	Mechanical Vibration	3									
3.04	Free Fall Test	5									
3.05	Thermal/Humidity Cycle Test		4								
3.06	Damp Heat, cyclic		6								
3.07	Dry Heat		8								
3.08	Cold Heat		10								
3.09	Rapid Temperature change			2							
3.10	Flowing mixed gas corrosion				2						
4.01	Electrostatic Discharge (ESD) Immunity Test					2					
4.02	Radiated Electromagnetic Field Immunity Test (RF Immunity)					4					
4.03	Fast Transient Immunity Test (Burst Immunity)					6					
4.04	Immunity to Conducted Disturbances					8					
4.05	Power Frequency Magnetic Field Immunity Test					10					
4.06	EMC – Immunity for Industrial Environment					12					
4.07	EMC – Emission Standard for Industrial Environment					14					
4.08	Magnetic Field Emission					16					
4.09	Surge					18					

5.01	Voltage withstand between shield and signal paths		2,12								
5.02	Insulation Resistance		3,13								
5.03	Ingress Protection						2				
5.04	Cap impact test							2			
5.05	Cable pull test							4			
5.06	Cable exit bend test							6			
5.07	Cable torque test							8			
5.08	Cable push test							10			

(1) See paragraph 4.1 A
(2) Numbers indicate sequence in which tests are performed.

		Number of described samples in test groups									
No.	**Version description**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
V2	GPIO	4	4	4	4	4	4	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 (Transmitter and Receiver pair).

B Test sequence

Qualification inspection shall be verified by testing samples as specified in paragraph 3.7.

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

When product failure occurs, corrective action shall be taken and samples are resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

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. APPENDIX

Electrical Wiring

5.1 4 pos connector Tx side (ARISO TXM030S012PNP2A)

Pos number	Power Transmitter (Tx) / Data Receiver
1	+24Vdc
2	GPO-1
3	Ground
4	GPO-2

5.2 12 pos connector Tx side (ARISO TXM030S012PNP8A)

Pin number	Wire color	Power Transmitter (Tx) / Data Receiver
1	**Brown**	**+24Vdc**
2	**Blue**	**Ground**
3	**White**	**GPIO-1**
4	**Green**	**GPIO-2**
5	**Pink**	**GPIO-3**
6	**Yellow**	**GPIO-4**
7	**Black**	**GPIO-5**
8	**Gray**	**GPIO-6**
9	**Red**	**GPIO-7**
10	**Violet**	**GPIO-8**
11	**Gray-Pink**	**FOD**
12	**Red-Blue**	**Status_NOK**

5.3 4 pos connector Rx side (ARISO RXM030S012PNP2A)

Pos number	Power Reciever (Tx) / Data Transmitter
1	+24Vdc
2	GPI-1
3	Ground
4	GPI-2

5.4 12 pos connector Rx side, A version (ARISO RXM030S012PNP8A)

Pin number	Wire color	Power Receiver (Rx) / Data Transmitter	Comment
1	**Brown**	**+24Vdc**	
2	**Blue**	**Ground**	
3	**White**	**GPIO-1**	**S1 Socket 1**
4	**Green**	**GPIO-2**	**S1 Socket 2**
5	**Pink**	**GPIO-3**	**S1 Socket 5**
6	**Yellow**	**GPIO-4**	**S1 Socket 3**
7	**Black**	**GPIO-5**	**S1 Socket 7**
8	**Gray**	**GPIO-6**	**S1 Socket 4**
9	**Red**	**GPIO-7**	**S1 Socket 6**
10	**Violet**	**GPIO-8**	**S1 Socket 8**
11	**Gray-Pink**	**N.C.**	
12	**Red-Blue**	**N.C.**	

5.5 12 pos connector and wire color Pinning Rx side, B version (ARISO RXM030S012PNP8B)

Pin number	Wire color	Power Receiver (Rx) / Data Transmitter	Comment
1	Brown	+24Vdc	
2	Blue	Ground	
3	White	GPIO-1	S1 Socket 1
4	Green	GPIO-2	S1 Socket 2
5	Pink	GPIO-3	S1 Socket 5
6	Yellow	GPIO-4	S1 Socket 3
7	Black	N.C.	
8	Gray	GPIO-5	S1 Socket 4
9	Red	GPIO-6	S1 Socket 6
10	Violet	N.C.	
11	Gray-Pink	GPIO-7	S2 Socket 1
12	Red-Blue	GPIO-8	S2 Socket 2