Technical Report

Testing Laboratory
Product Safety


Applicant: Weidmüller Interface GmbH & Co. KG
Klingenbergstr. 16
32758 Detmold

Device under test: Safe power feeding I/O-module

Test principles: Series UR20-PF-O-SIL
EN 61508:2010 Parts 1-7; Requirements according SIL3
EN ISO 13849-1:2008 Category 4 / Performance Level e
EN 61131-2:2007

Order no.: 8000429670

Test engineer: Alexander Struß


Place of testing: TÜV NORD CERT, Testing Laboratory Product Safety,
Am TÜV 1, 30519 Hannover, Germany

The report consists of 7 pages
Directory

1. General ................................................................. 3
2. Technical description .................................................... 3
3. Submitted files .......................................................... 4
4. Related files ............................................................. 5
5. Conducted test .......................................................... 5
6. List of test equipment .................................................... 7
7. Test result ............................................................... 7
1. General

The company Weidmüller Interface GmbH & Co. KG ordered the examination of the power-feed modules PF-O-xDI-SIL. The safety I/O-modules are part of the Weidmüller UR20 I/O-system.

2. Technical description

The u-remote safe power-feed modules PF-O-xDI-SIL are intended for connecting safety-related equipment. The PF-O-xDI-SIL modules are controlled using contact-based safety transducers and/or safety transducers with OSSD inputs.

The safety function consists of the safe disconnection of 24 V outputs the safe state of which is "24 V switched off" (current path for outputs and the OSSD output is switched off).

Each PF-O-xDI-SIL module safely switches off all following modules that are supplied by the output current path and thus creates a safety segment. A survey of the switchable modules is shown at the end of this section. The safety segment extends either to the next PF-O module or to the end of the station. A safety-related input circuit together with pulsed inputs is used for detecting broken wires and short circuits.

In the u-remote system, three types of PF-O-xDI-SIL modules are available:
- UR20-PF-O-1DI-SIL (one safe input)
- UR20-PF-O-2DI-SIL (two safe inputs)
- UR20-PF-O-2DI-DELAY-SIL (two safe inputs, delayed switching off possible)

With PF-O-xDI-SIL modules, the following safety functions can be implemented:
- Up to two dual-channel safety circuits (AND linked), e.g. for emergency stop switch, safety door contacts and safety light curtain
- A range of output modules within a u-remote station is safely supplied with power via the switched +24 V OSSD output.
- PF-O-xDI-SIL modules can be cascaded.

Realisation of the safety function

Input for an OSSD device or emergency stop signal is connector CN1 and CN2. Monitored are two n.c. contacts at each connector (Line EmStop). The UR20-PF-O-SIL detects short circuits in the input path. Therefore the supply (Line Pulse 1.1 / 1.2 / 2.1 / 2.2) of the single input paths are switched in short pulses to ground (OSSD signal).

The monitoring of the input signals and the pulsing is done by two microcontrollers type STM32F (U300A and U301A).

The safety output (line 24V_OSSD_O, connector CN4 PIN42 and connector PWR PIN +OUT) is switched by two parallel paths with three transistors in each path. The two microcontrollers switch and read back the status of the semiconductor outputs (line Enable, Q101 – Q106). Each output path is tested cyclically while the other output path operates normally. Thus the
OSSD test pulses only occur internally while the external output signal remains unaffected by the test activity.

**Internal power supply**

The modules are supplied by an external power supply unit with 24VDC. Internal is a switching power supply (U10, L50). Each of the two microcontrollers is supplied by their own voltage regulator (U16, U17) with 2,5VDC. Both supplies are monitored by the microcontroller and switches off the output in case of a detected failure. Under voltage is monitored by RESET ICs (U302, U303) and active direct the reset input of the microcontroller.

**Separation from field side to system side at standard-modules**

The output modules and the linked periphery of the standard-I/O modules are powered by a safety supply unit with the voltage line 24V_O. The module PF-O-xDI-SIL contains a galvanic separation between the logic and the data bus (SNAP+ bus) to avoid systematic failures in the safety relevant part. The bus communication is not relevant for the safety function. The galvanic separation is safe up to 2,5kV.

**Technical Ratings:**

| Nominal Voltage: | 24VDC +20 %/-15 % |
| Current consumption: | 35mA |
| Output current: | 8A |
| Protection degree: | IP20 |
| Over voltage category: | II |
| Dimension | 120 x 11,5 x 76mm |
| Temperature Range: | -20°C ... +60°C |

3. **Submitted files**

   Software V1.12
   bRK_A022_v00.01_DOC_Glossary V00.01 2012-05-21
   bRK_A075_v01.01_FSMP_UR20-PF-SIL V01.01 2014-05-22
   bRK_A026_v01.06_PRS_UR20-PF-SIL V01.06 2014-05-22
   bRK_A089_v01.00_PFTS_UR20-PF-SIL V01.00 2014-08-15
   bRK_A042_v01.04_SC_UR20-PF-SIL V01.04 2014-05-22
   bRK_A081_v01.09_ARF_Analyse_Rueckwirkungsfreiheit V01.09 2013-01-24
   bRK_A077_v01.00_FAM_UR20-PF-SIL V01.00 2013-10-28
   bRK_A076_v01.01_PVP_UR20-PF-SIL V01.01 2014-05-22
   bRK_A054_v01.00_TAD_FW_Toolchain_UR20-PF-SIL V01.00 2013-10-28
   bRK_A055_v01.00_TAD_FW_Code-Analysis_UR20-PF-SIL V01.00 2013-10-28
   bRK_A056_v01.00_TAD_FW_Module-Test_UR20-PF-SIL V01.00 2013-10-28
   bRK_A264_v01.00_ASR_UR20-PF-SIL V01.00 2013-10-28
   bRK_A052_v01.03_FRS_UR20-PF-O-SIL V01.03 2014-05-22
   bRKA089v01.00PFTSUR20-PF-SIL V01.00 2014-08-15
   bRKA260v01.00FTUR20-PF-SIL V01.00 2014-04-29
   bRK_A161_v01.03_FDD_UR20-PF-SIL V01.03 2014-08-27
4. Related files

Checklist EN ISO 13849-1 2014-09-02
Checklist EN 61508 2014-09-11
Checklist EN 62061 2014-09-11
FMEDA 8000402500 2013-11-14
Laboratory Report Weidmüller No. 18597 2014-08-07
Laboratory Report Weidmüller No. 18639F 2014-06-16
Laboratory Report Weidmüller No. 18660E 2014-08-07
Laboratory Report Weidmüller EN 61131-2:2007 2014-09-16

5. Conducted test

Tests according to the test principles were conducted. Detailed reports are held in the laboratories files.

Test of the functional safety

To verify the functional safety function tests, error simulation and review of the documentation are done.

Parameter EN ISO 13849-1

MTTF₀ > 100 years
DCₑᵥₑ_avg = 96.64%
Category 4
Performance Level e

For details see checklist EN ISO 13849-1 and the FMEDA 8000402500.

Parameter EN 61508

PFH = 6.27·10⁻⁹ 1/h  
SFF = 98,58%  
Structure = 1oo2D  
β = 2%, β₀ = 1%  
SIL3

For details see checklist EN 61508 and the FMEDA 8000402500.

Parameter EN 62061

PFH = 1,35·10⁻⁹ 1/h  
SFF = 98,58%  
HFT = 1  
β = 2%  
SIL3

For details see checklist EN 62061 and the FMEDA 8000402500.

**EMC Tests**

Tests are performed by the DAkkS accredited test laboratory of Weidmüller in Detmold. The emission was tested according IEC 61131-2 and IEC 61000-6-4, the immunity according IEC 61131-2, IEC 61326-3-1 and IEC 61000-6-2. For details see laboratory report No. 18597.

**Environmental and electrical tests**

Several tests to avoid systematic failures are done by the DAkkS accredited test laboratory of Weidmüller in Detmold.

**Overview most relevant tests and used standards**

<table>
<thead>
<tr>
<th>Test</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation resistance</td>
<td>EN 50178</td>
</tr>
<tr>
<td>Temperature tests</td>
<td>IEC 60068-2-2</td>
</tr>
<tr>
<td>Vibration</td>
<td>IEC 60068-2-6</td>
</tr>
<tr>
<td>Shock</td>
<td>IEC 60068-2-27</td>
</tr>
<tr>
<td>High voltage test</td>
<td>EN 61131-2</td>
</tr>
<tr>
<td>Clearance and Creepage Distances</td>
<td>EN 50178, EN 61131-2</td>
</tr>
</tbody>
</table>

For details and all performed tests see laboratory report No. 18639E, No. 18660 and EN 61131-2:2007.
6. List of test equipment

A list of test equipment is available in the project file.

7. Test result

The referenced units are in compliance with the above requirements.

A. Struß

Expert