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This document is the Functional Safety data sheet of EJX *** A / J, EJA *** E / J.

Certificate

Certificate	
	
No.: 968/FSP 1199.01/17	
Product tested	Pressure Transmitter
Certificate holder	Yokogawa Electric Corporation 2-9-32 Nakacho Musashino-shi Tokyo 180-8750 Japan
Type designation	EJA E Series, EJA J Series, EJX A Series, EJX J Series Details see attached Revision List
Codes and standards	IEC 61508 Parts 1-7:2010
Intended application	Sensors for pressure measurement of liquids and gases. The sensors of the EJA and EJX Series comply with the requirements of the stated standards. They can be used in a safety instrumented system, e.g. in the application area of IEC 61511-1, in a single channel architecture (HFT=0) up to SIL 2 and in a redundant architecture (HFT=1) up to SIL 3. Output currents <3.6mA and >21.6mA have to be considered by the downstream safety device as a failure condition.
Specific requirements	The Operating Instructions and the Safety Manual shall be considered.
Valid until 2022-11-07	
The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1199.01/17 dated 2017-11-07. This certificate is valid only for products which are identical with the product tested.	
TÜV Rheinland Industrie Service GmbH Bereich Automation Funktionale Sicherheit Am Grauen Stein, 51105 Köln	
Köln, 2017-11-07	 Dipl.-Ing. Stephan Häb
<small>Certification Body Safety & Security for Automation & Grid</small>	

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Revision List



Revision List

referred to on Certificate No.: 968/FSP 1199.01/17

Product Tested: Pressure transmitter

EJX A Series and J Series, EJA E Series and J Series



Type Designation	Description	Hardware Revision	Software Revision	Report-No.:	Certification Status
EJX110A, EJX110J, EJA110E, EJA110J, EJX120A, EJX120J, EJA120E, EJA120J, EJX130A, EJX130J, EJA130E, EJA130J, EJX310A, EJX310J, EJA310E, EJA310J	Differential Pressure Transmitters 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Differential Pressure Transmitters 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX115A, EJX115J, EJA115E, EJA115J	Low Flow Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Low Flow Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX118A, EJX118J, EJA118E, EJA118J	Diaphragm Sealed Differential Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Diaphragm Sealed Differential Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX117J, EJA117J	Sanitary Type Differential Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Sanitary Type Differential Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid

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Revision List

referred to on Certificate No.: 968/FSP 1199.01/17

Product Tested: Pressure transmitter

EJX A Series and J Series, EJA E Series and J Series



Type Designation	Description	Hardware Revision	Software Revision	Report-No.:	Certification Status
EJX210A, EJX210J, EJA210E, EJA210J	Flange Mounted Differential Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Flange Mounted Differential Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX213J, EJA213J	Sanitary Type Liquid Level Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Sanitary Type Liquid Level Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX430A, EJX430J, EJA430E, EJA430J, EJX440A, EJX440J, EJA440E, EJA440J	Gauge Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Gauge Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX438A, EJX438J, EJA438E, EJA438J	Diaphragm Sealed Gauge Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Diaphragm Sealed Gauge Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid

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Revision List

referred to on Certificate No.: 968/FSP 1199.01/17

Product Tested: Pressure transmitter

EJX A Series and J Series, EJA E Series and J Series



Type Designation	Description	Hardware Revision	Software Revision	Report-No.:	Certification Status
EJX510A, EJX510J, EJA510E, EJA510J	Absolute Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Absolute Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX530A, EJX530J, EJA530E, EJA530J	Gauge Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Gauge Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX533J, EJA533J	Sanitary Type Gauge Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Sanitary Type Gauge Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX610A, EJA610E	Absolute Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Absolute Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid
EJX630A, EJA630E	Gauge Pressure Transmitter 4mA–20mA output and Integral digital output	1.0	1.04	968/FSP 1199.00/15	Valid
	Gauge Pressure Transmitter 4mA–20mA output	1.1	3.01	968/FSP 1199.00/15	Valid
		1.2	3.01	968/FSP 1199.02/19	Valid

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Revision List

referred to on Certificate No.: 968/FSP 1199.01/17

Product Tested: Pressure transmitter

EJX A Series and J Series, EJA E Series and J Series



Type Designation	Description	Hardware Revision	Software Revision	Report-No.:	Certification Status
EJX910A, EJX930A	Multivariable Transmitter 4mA–20mA output and Integral digital output	1.0	1.02	968/FSP 1199.00/15	Valid
			3.01	968/FSP 1199.00/15	Valid
			4.01	968/FSP 1199.01/17	Valid

Safety Manual / User documentation

Document No.	Description	Report-No.:	Certification Status
IM 01C25T01-06EN, 6th Edition IM 01C25R02-01E, 7th Edition	Safety manual, Safety Instrumented Systems Installation for EJX A Series and J Series, EJA E Series and J Series	968/FSP 1199.00/15	Valid
IM 01C25R02-01E, 8th Edition	Safety manual, Safety Instrumented Systems Installation for EJX A Series and J Series, EJA E Series and J Series (Only for EJX910A and EJX930A with Software Revision of 4.01)	968/FSP 1199.01/17	Valid
IM 01C25T01-06EN, 7th Edition TI 01C25A05-01EN, 1st Edition	Safety manual, Safety Instrumented Systems Installation for EJX A Series and J Series, EJA E Series and J Series	968/FSP 1199.02/19	Valid

Document Revision:

Date	Rev.	Description / Changes	Author
2015-11-30	1.0	Initial creation, based on Report-No.: 968/FSP 1199.00/15	TRJ-yn
2017-11-07	2.0	Information added, based on Report-No.: 968/FSP 1199.01/17	TRJ-yn
2019-02-21	3.0	Information added, based on Report-No.: 968/FSP 1199.02/19	TRJ-yn

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Table. 1 Functional Safety Data

Certificate/Reg.-No.	968/FSP 1199.01/17
Revision List No.	968/FSP 1199.01/17_RL_2019_02_21
Product Category	Pressure Transmitter
Type Designation	EJX A Series, EJX J Series, EJA E Series, EJA J Series Details see attached Revision List
Codes and Standards	IEC 61508 Parts 1-7:2010
Valid Until	2022-11-07
Scope and Result	Sensors for pressure measurement of liquids and gases. The sensors of the EJX and EJA Series comply with the requirements of the stated standards and can be used in a safety-related system with a hardware fault tolerance HFT=0 up to SIL 2 and under consideration of the minimum required hardware fault tolerance HFT=1 in a redundant structure up to SIL 3. Output currents 21.6mA have to be considered by the downstream safety device as failure condition.
Safety-related output signal	4-20 mA
Safety Manual	IM01C25T01-07EN Appendix 1
SIL	2(3)
Type	B
HFT	0(1)
Mode of operation	Low demand mode
λ SD	103 FIT (*1)
λ SU	123 FIT (*1)
λ DD	171 FIT (*1)
λ DU	31 FIT (*1)
SFF	92.7%
PFDaverage (*2)	1.37×10^{-4}
MTBF	267 years
Recommended proof test interval	1 year

*1 This number is representative of EJX-A (Except 900 Series), EJX-J, EJA-E, EJA-J series. Refer to Table 3 for details.

*2 PFDaverage is calculated by $T = 8760 (H) = 1 \text{ year}$, Single channel architecture (HFT = 0).

In order to judge the failure behavior of the EJX / EJA transmitter, define the failure of the device.

Table. 2 Failure Categories Description

Safe state	Safe state is indicated by outside of normal output range for output signal. Normal output range is defined as 3.6 – 21.6mA(Safety accuracy 2%).
Dangerous state	Dangerous state is the output signal shows a measurement error exceeding 2%.
λ SD	Failure rate for safe detected failures (*1)
λ SU	Failure rate for safe undetected failures (*2)
λ DD	Failure rate for dangerous detected failures (*3)
λ DU	Failure rate for dangerous undetected failures (*4)
No effect	Failure of a component that is part of the safety function but that has no effect on the safety function. (*5)

*1 There is a malfunction that transitions the output signal to Safe state due to a failure of the diagnostic circuit.

*2 There is a breakdown in which the transmitter does not start up.
Failure diagnosis is impossible with the transmitter itself, but it can be diagnosed as a Safe state with a logic solver.

*3 It is a failure of the sensor circuit and the AMP circuit.
It is a dangerous fault but a fault detected by automatic diagnosis.
The output signal becomes Safe State with diagnostic function.

*4 There are faults that are not diagnosed by automatic diagnosis due to dangerous faults.
- Failure that takes 5 sec or more to transit to safe state in case of failure
- Failure within normal output range at failure
- Failure to output in the direction different from the direction set in the burnout direction at the time of failure
However, the above fault can be detected by proof test.

For the calculation of safety related parameters such as SFF, PFDaverage etc., the above fault is included as λ DU.

*5 It is indicator malfunction or failure of the protection circuit. It is not included in the failure rate calculation due to a failure that does not affect the output signal.

Table. 3 Safety Related Parameter(Ambient Temperature 40°C)

Device	HW Rev.	SW Rev.	$\lambda_{SD}(FIT)$	$\lambda_{SU}(FIT)$	$\lambda_{DD}(FIT)$	$\lambda_{DU}(FIT)$	SFF(%)	PFDaverage	MTBF
EJX100/EJA100 4-20mA output	1.0	1.04	0	195	277	27	94.6	1.18×10^{-4}	229
	1.1	3.01	0	54	331	39	90.8	1.71×10^{-4}	269
	1.2	3.01	103	123	171	31	92.7	1.37×10^{-4}	267
EJX100/EJA100 digital output	1.0	1.04	0	215	260	31	93.9	1.36×10^{-4}	226
EJX900 4-20mA output (Difference Pressure)	1.0	1.02 3.01 4.01	0	142	245	25	93.9	1.10×10^{-4}	277
EJX900 4-20mA output (Temperature)	1.0	1.02 3.01 4.01	0	116	211	24	93.2	1.05×10^{-4}	325
EJX900 4-20mA output (Mass flow)	1.0	1.02 3.01 4.01	0	153	295	35	92.8	1.53×10^{-4}	236
EJX900 digital output (Difference Pressure)	1.0	1.02 3.01 4.01	0	169	227	30	93.0	1.31×10^{-4}	268
EJX900 digital output (Temperature)	1.0	1.02 3.01 4.01	0	143	193	29	92.1	1.27×10^{-4}	313
EJX900 digital output (Mass flow)	1.0	1.02 3.01 4.01	0	181	276	40	92.0	1.75×10^{-4}	230
EJX900 using external RTD 4-20mA output (Temperature)	1.0	1.02 3.01 4.01	0	116	250	30	92.4	1.31×10^{-4}	288
EJX900 using external RTD 4-20mA output (Mass flow)	1.0	1.02 3.01 4.01	0	153	334	41	92.2	1.80×10^{-4}	216
EJX900 using external RTD digital output (Temperature)	1.0	1.02 3.01 4.01	0	143	232	35	91.5	1.53×10^{-4}	278
EJX900 using external RTD digital output (Mass flow)	1.0	1.02 3.01 4.01	0	181	315	46	91.5	2.01×10^{-4}	211

PFDaverage is calculated by $T = 8760 (H) = 1$ year, Single channel architecture (HFT = 0).

Table. 4 Term Definition

HFT	Hardware Fault Tolerance
SFF	Safe Failure Fraction
PFDaverage	Average Probability of dangerous Failure on Demand
MTBF	Mean Time Between Failures

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Table. 1 Functional Safety Data

Certificate/Reg.-No.	968/FSP 1199.01/17
Revision List No.	968/FSP 1199.01/17_RL_2019_02_21
Product Category	Pressure Transmitter
Type Designation	EJX A Series, EJX J Series, EJA E Series, EJA J Series Details see attached Revision List
Codes and Standards	IEC 61508 Parts 1-7:2010
Valid Until	2022-11-07
Scope and Result	Sensors for pressure measurement of liquids and gases. The sensors of the EJX and EJA Series comply with the requirements of the stated standards and can be used in a safety-related system with a hardware fault tolerance HFT=0 up to SIL 2 and under consideration of the minimum required hardware fault tolerance HFT=1 in a redundant structure up to SIL 3. Output currents 21.6mA have to be considered by the downstream safety device as failure condition.
Safety-related output signal	4-20 mA
Safety Manual	IM01C25T01-07EN Appendix 1
SIL	2(3)
Type	B
HFT	0(1)
Mode of operation	Low demand mode
λ SD	103 FIT (*1)
λ SU	123 FIT (*1)
λ DD	171 FIT (*1)
λ DU	31 FIT (*1)
SFF	92.7%
PFDaverage (*2)	1.37×10^{-4}
MTBF	267 years
Recommended proof test interval	1 year

*1 この数値は EJX-A(Except 900 Series), EJX-J, EJA-E, EJA-J series の代表値です。詳細は Table.3 参照のこと。

*2 PFDaverage は $T=8760(H)=1\text{year}$, Single channel architecture(HFT=0) で算出している。

EJX/EJA 伝送器の故障動作を判断するために、デバイスの故障に関する定義をしています。

Table.2 Failure Categories Description

Safe state	安全状態は、出力信号が通常出力範囲外で示されます。 通常出力範囲は 3.6 ~ 21.6mA(安全確度 2%)と定義しています。
Dangerous state	危険な状態は、出力信号が 2%を超える測定誤差を示す状態です。
λSD	検出された安全な故障の故障率 (*1)
λSU	検出されなかった安全な故障に対する故障率 (*2)
λDD	検出された危険な故障の故障率 (*3)
λDU	検出されなかった危険な故障に対する故障率 (*4)
No effect	安全機能の一部であるが安全機能に影響を及ぼさないコンポーネントの故障 (*5)

*1 診断回路の故障で出力信号を Safe state へ状態遷移する故障があります。

*2 伝送器が起動しない故障があります。

伝送器自身で故障診断不可ですが、ロジックソルバーで Safe state であると診断可能です。

*3 センサー回路や AMP 回路の故障です。危険な故障ですが自動診断によって検出される故障です。
診断機能で出力信号が Safe State になります。

*4 危険な故障で自動診断により診断されていない故障があります。

・故障時、安全状態に遷移するまで 5sec 以上かかる故障

・故障時、正常出力範囲内となる故障

・故障時、バーンアウト方向で設定した方向と異なる方向へ出力する故障

ただし、上記故障はプルーフトテストで検出することが可能です。

SFF, PFDaverage 等の安全関連パラメータの算出には上記故障を λDU として含んでおります。

*5 表示器の故障や保護回路の故障です。出力信号へ影響しない故障のため、故障率計算に含んでおりません。

Table.3 Safety Related Parameter (周囲温度 40°C)

Device	HW Rev.	SW Rev.	λ_{SD} (FIT)	λ_{SU} (FIT)	λ_{DD} (FIT)	λ_{DU} (FIT)	SFF (%)	PFDaverage	MTBF
EJX100/EJA100 4-20mA output	1.0	1.04	0	195	277	27	94.6	1.18×10^{-4}	229
	1.1	3.01	0	54	331	39	90.8	1.71×10^{-4}	269
	1.2	3.01	103	123	171	31	92.7	1.37×10^{-4}	267
EJX100/EJA100 digital output	1.0	1.04	0	215	260	31	93.9	1.36×10^{-4}	226
EJX900 4-20mA output (Difference Pressure)	1.0	1.02 3.01 4.01	0	142	245	25	93.9	1.10×10^{-4}	277
EJX900 4-20mA output (Temperature)	1.0	1.02 3.01 4.01	0	116	211	24	93.2	1.05×10^{-4}	325
EJX900 4-20mA output (Mass flow)	1.0	1.02 3.01 4.01	0	153	295	35	92.8	1.53×10^{-4}	236
EJX900 digital output (Difference Pressure)	1.0	1.02 3.01 4.01	0	169	227	30	93.0	1.31×10^{-4}	268
EJX900 digital output (Temperature)	1.0	1.02 3.01 4.01	0	143	193	29	92.1	1.27×10^{-4}	313
EJX900 digital output (Mass flow)	1.0	1.02 3.01 4.01	0	181	276	40	92.0	1.75×10^{-4}	230
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EJX900 using external RTD 4-20mA output (Mass flow)	1.0	1.02 3.01 4.01	0	153	334	41	92.2	1.80×10^{-4}	216
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EJX900 using external RTD digital output (Mass flow)	1.0	1.02 3.01 4.01	0	181	315	46	91.5	2.01×10^{-4}	211

PFDaverage は $T=8760(H)=1$ year, Single channel architecture(HFT=0) で算出している。

Table.4 Term Definition

HFT	Hardware Fault Tolerance
SFF	Safe Failure Fraction
PFDaverage	Average Probability of dangerous Failure on Demand
MTBF	Mean Time Between Failures

Revision Information

Title : Functional Safety Data Sheet

Manual number : TI 01C25A05-01EN

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- New publication