Line Impedance Simulation Network type AIP

AIP xxx/3 - fixed impedance
AIP xxx/3/P - programmable impedance
AIP xxx/3/P/JK - programmable impedance including Japanese/Korean standard
AIP xxx/3/P/TPM - programmable impedance including three phase measurement unit
AIP xxx/3/P/JK/TPM three phase measurement unit

The relating standards:

IEC/EN 61000-3-2
IEC/EN 61000-3-3
IEC/EN 61000-3-11
IEC/EN 61000-3-12

Fig. 1: AIP 75/3/P/TPM

The line impedance simulation network AIP is designed for testing according to the IEC/EN 61000-3-11 and IEC/EN 61000-3-12. Available current ranges for the AIP are:

- ***32 A***
- ***75 A***
- ***125 A***
- ***250 A***
- ***375 A***
- ***500 A***

When using the AIP types with 32A or 75A the required impedance is set in the software. When starting the test the user is informed which resistors have to be by-passed by means of the low-ohm plug connectors ($R_{contact}$ <= 60µΩ). The AIP types with 125A, 250A, 375A and 500A have an automated pneumatic switch system and are fully computer controlled.
The adjusted impedance values are displayed in plaintext at the front-panel display. The voltage drop (3% ... 5%) according to IEC/EN 61000-3-11 (section 6.1.1) is intended to be displayed also at the AIP front-panel.

"Harmonics and Flicker emission measurements"

Fig. 2: AIP 125/3/P

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TECHNICAL DATA GENERAL[6]:

Type	All AIP types
Input:	
Input voltage (Harmonic):	AC: 90V_{rms} … 300V_{rms} / DC: 0V … 48V [1]
Input voltage (Flicker):	AC: 40V_{rms} … 504V_{rms} (auto ranging) / DC: 0V … 48V [1]
Input frequency:	45Hz … 65Hz
Power dissipation:	max. total voltage drop at impedance: U_Z > 5% of U_N (depending on adjusted impedance; according to IEC/EN 61000-3-11) Japanese/Korean type: U_Z > 7% of U_N
Protection circuits:	- Overcurrent (circuit breaker) / - Overtemperature (electronically)
Impedance accuracy:	Z: 4% (R + jX) (at X/R relation 0.5 … 0.75 according to IEC/EN 61000-3-11) (calibration cycle: 2 years)
Measuring outputs:	FLI CH1 0V_{rms} ... 300V_{rms} FLI CH2 0V_{rms} ... 300V_{rms} HAR I 0V_p ... 10V_p [2]
Measuring connectors:	4mm laboratory sockets
Interfaces:	IEEE488
Power supply:	230V (±10%) 50Hz … 60Hz
Protection:	2A
Connector:	Safety Plug 16A
Ambient temperature:	0°C up to +40°C
Housing:	19”-plug-in unit, colour light grey (RAL 7035)

Remarks:

1) At DC-voltages >48V switching on/off and changing the operation mode **must be conducted off load!**
2) 3V_{rms} correspond to the upper range value of the current range.
3) Fixed impedance value for AIP 250/3/P/xxx, AIP 375/3/P/xxx and AIP 500/3/P/xxx
4) Fixed impedance value for AIP 125/3/P/xxx
5) Fixed impedance value for AIP 32/3/P/xxx and AIP 75/3/P/xxx
6) All subjects are due to change
7) Impedance values for JK type AIP must be added to the IEC impedance values because of the serial connection of the two impedances

The AIP type glossary:

AIP	xxx	/3	/P	/JK	/TPM
Additional impedance					
Nominal current (A) *32/75/125/250/375/500*					
Number of phases */1 = single phase* */3 = three phase*					
Impedance values are programmable */P = yes* *left out = no*					
Additional Japanese/Korean reference impedance */JK = built-in* *left out = not built-in*					
Measurement option */TPM = simultaneous three phase measurement* *Left out = single phase measurement switchable to all phases*					

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TECHNICAL DATA TYPES AIP 32/3 and AIP 75/3[6)]:

Type	**AIP 32/3**	**AIP 75/3**
Performance:		
Continuous current:	$32A_{rms}$	$75A_{rms}$
Short time current:	$64A_{rms}$	$126A_{rms}$
Internal impedance:		
Phase conductor:	R: 150mΩ X: 150mΩ at 50Hz X: 180mΩ at 60Hz	
Neutral conductor:	R: 100mΩ X: 100mΩ at 50Hz X: 120mΩ at 60Hz	
Max. phase-neutral impedance:	R: 250mΩ X: 250mΩ at 50Hz X: 300mΩ at 60Hz	
Resistor bridging:	No bridging	
Cooling type:	Air cooling	
Size:		
Dimensions:	5U 222x490x500	10U 445x490x600
Weight:	approx. 40kg	approx. 110kg

WIRING DIAGRAM:

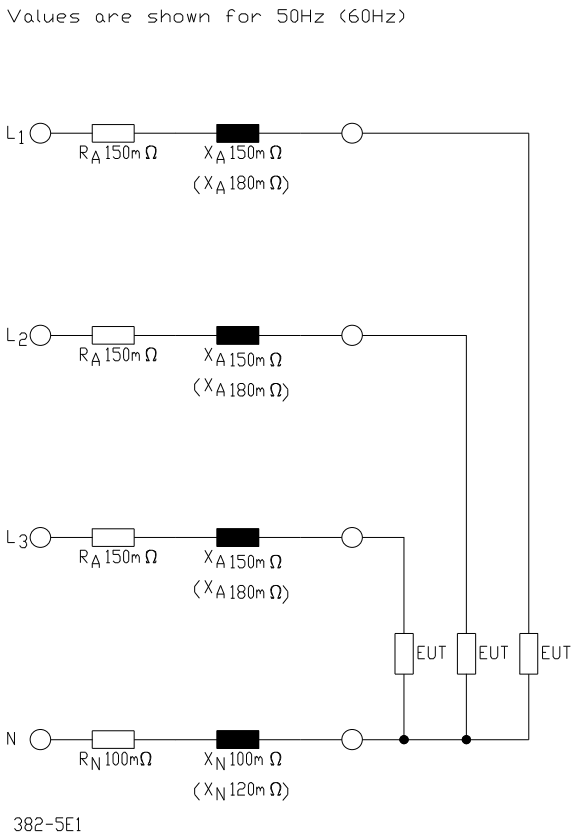

Fig. 3: IEC/EN standard reference impedance 50Hz/(60Hz) values for AIP 32/3 and AIP 75/3

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TECHNICAL DATA TYPES AIP 32/3/P and AIP 75/3/P[6)]:

Type	**AIP 32/3/P**	**AIP 75/3/P**
Performance:[3)]		
Continuous current:	$32A_{rms}$	$75A_{rms}$
Short time current:	$64A_{rms}$	$126A_{rms}$
Internal impedance:	IEC	
Phase conductor:	R: 15mΩ … 240mΩ in 15mΩ - steps X: 9.38mΩ ... 150mΩ in 9.38mΩ - steps at 50Hz X: 11.26mΩ ... 180mΩ in 11.26mΩ - steps at 60Hz	
Neutral conductor:	R: 10mΩ ... 160mΩ in 10mΩ - steps X: 6.25mΩ … 100mΩ in 6.25mΩ - steps at 50Hz X: 7.5mΩ … 120mΩ in 7.5mΩ - steps at 60Hz	
Max. phase-neutral impedance:	R: 400mΩ X: 250mΩ at 50Hz X: 300mΩ at 60Hz	
Resistor bridging:	Software assisted manual bridging	
Cooling type:	Air cooling	
Size:		
Dimensions (mm):	15U 667x490x600	15U 667x490x600
Weight:	approx. 130kg	approx. 155kg

WIRING DIAGRAM:

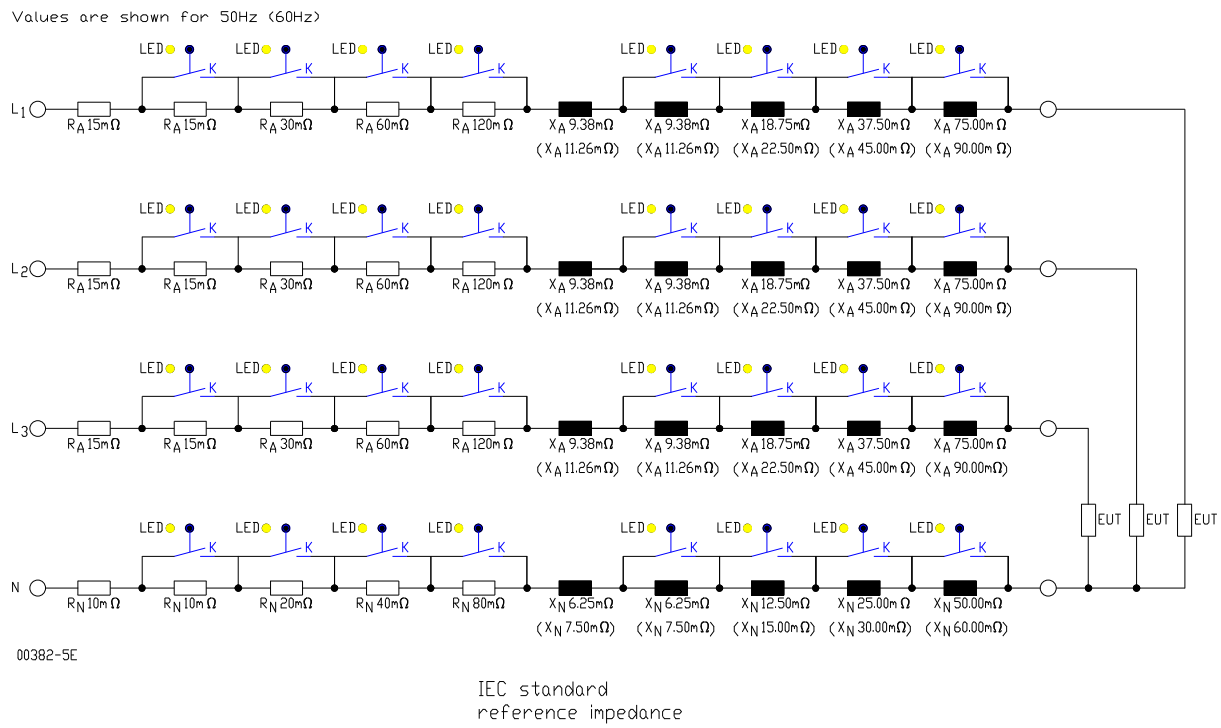

Fig. 4: IEC/EN standard reference impedance 50Hz/(60Hz) values for AIP 32/3/P and AIP 75/3/P

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TECHNICAL DATA TYPE AIP 125/3/P[6]:

Type	**AIP 125/3/P**		
Performance:[3]			
Continuous current:	$125A_{rms}$		
Short time current:	$250A_{rms}$		
Internal impedance:	IEC		
Phase conductor:	R:	7.5mΩ … 240mΩ	in 7.5mΩ - steps
	X:	4.69mΩ ... 150mΩ	in 4.69mΩ - steps at 50Hz
	X:	5.63mΩ ... 180mΩ	in 5.63mΩ - steps at 60Hz
Neutral conductor:	R:	5mΩ ... 160mΩ	in 5mΩ - steps
	X:	3.13mΩ … 100mΩ	in 3.13mΩ - steps at 50Hz
	X:	3.75mΩ … 120mΩ	in 3.75mΩ - steps at 60Hz
Max. phase-neutral impedance:	R:	400mΩ	
	X:	250mΩ at 50Hz	
	X:	300mΩ at 60Hz	
Resistor bridging:	Automated pneumatic bridging *(pressure: 5-10bar, connector ¼" NW 7.2)*		
Cooling type:	Air cooling		
Size:			
Dimensions (mm):	37U 1645x600x600		
Weight:	approx. 650kg		

WIRING DIAGRAM:

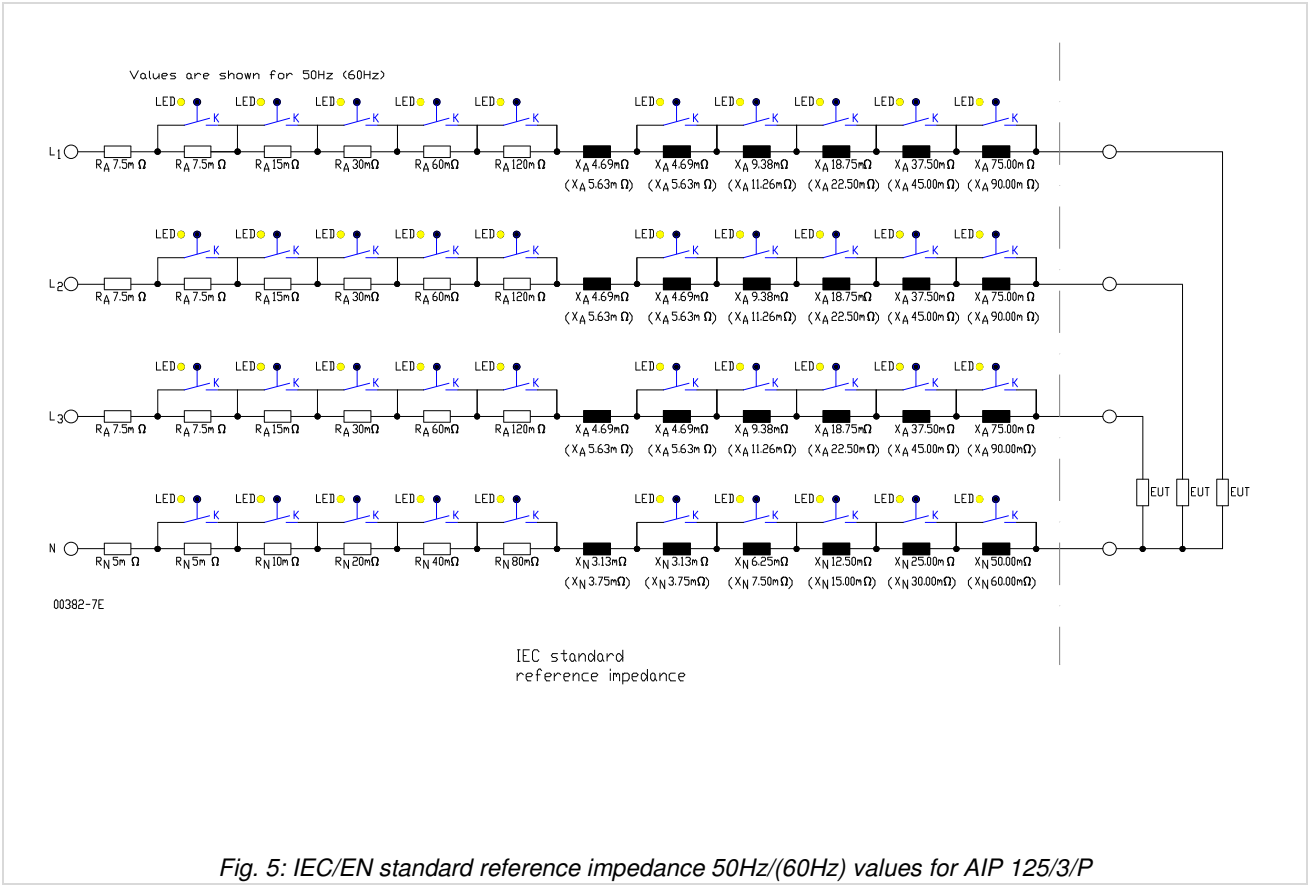

Fig. 5: IEC/EN standard reference impedance 50Hz/(60Hz) values for AIP 125/3/P

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TECHNICAL DATA TYPES AIP 250/3/P, AIP 375/3/P, AIP 500/3/P[6)]:

Type	**AIP 250/3/P**	**AIP 375/3/P**	**AIP 500/3/P**
Performance:[3)]			
Continuous current:	250A_{rms}	375A_{rms}	500A_{rms}
Short time current:	500A_{rms}	500A_{rms}	750A_{rms}
Internal impedance:	IEC		
Phase conductor:	R: 3.75mΩ … 240mΩ X: 2.34mΩ ... 150mΩ X: 2.81mΩ ... 180mΩ	in 3.75mΩ - steps in 2.34mΩ - steps at 50Hz in 2.81mΩ - steps at 60Hz	
Neutral conductor:	R: 2.5mΩ ... 160mΩ X: 1.56mΩ … 100mΩ X: 1.88mΩ … 120mΩ	in 2.5mΩ - steps in 1.56mΩ - steps at 50Hz in 1.88mΩ - steps at 60Hz	
Max. phase-neutral impedance:	R: 400mΩ X: 250mΩ at 50Hz X: 300mΩ at 60Hz		
Resistor bridging:	Automated pneumatic bridging *(pressure: 5-10bar, connector ¼" NW 7.2)*		
Cooling type:	Water cooling *(connector: 1,5")*		
Size:			
Dimensions (mm):	2x37U 1920x1200x1050	3x37U 1920x1800x1050	3x46U 2320x1800x1050
Weight:	approx. 1000kg	approx. 2000kg	approx. 3000kg

WIRING DIAGRAM:

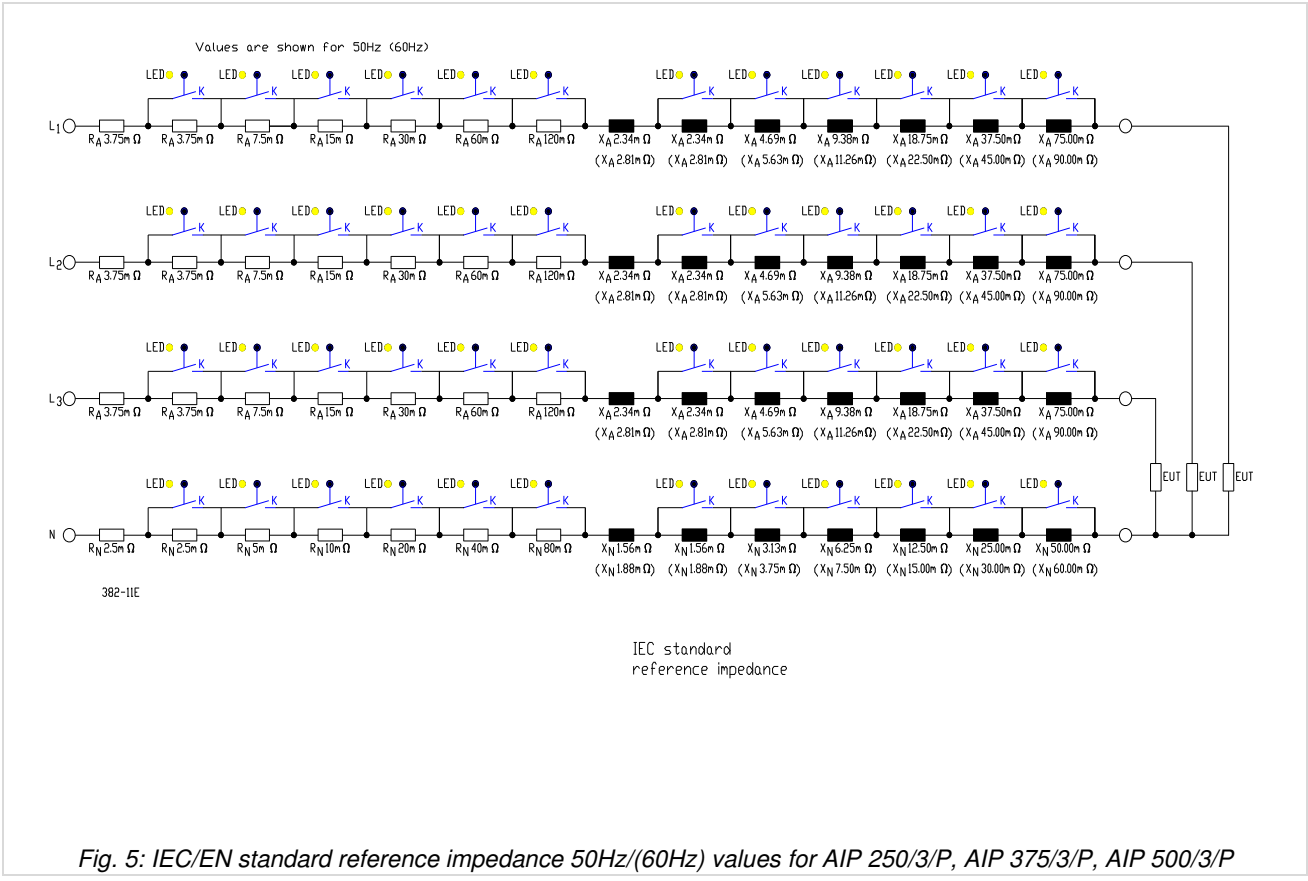

Fig. 5: IEC/EN standard reference impedance 50Hz/(60Hz) values for AIP 250/3/P, AIP 375/3/P, AIP 500/3/P

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TECHNICAL DATA TYPE JK (JAPANESE/KOREAN STANDARDS) [6) 7)]:

Type	**AIP 32/3/P/JK**	**AIP 75/3/P/JK**	**AIP 125/3/P/JK**
Performance:[3)]			
Continuous current:	$32A_{rms}$	$75A_{rms}$	$125A_{rms}$
Short time current:	$64A_{rms}$	$126A_{rms}$	$250A_{rms}$
Internal impedance:	Japanese/Korean standard		
Phase conductor:	R: 0mΩ / 15mΩ / 50mΩ / 55mΩ / 90mΩ X: 0mΩ / 34.37mΩ / 66.67mΩ / 101.04mΩ at 50Hz X: 0mΩ / 41.25mΩ / 80mΩ / 121.25mΩ at 60Hz		
Neutral conductor:	R: 0mΩ / 10mΩ / 190mΩ X: 0mΩ / 8.33mΩ / 33.33mΩ / 41.67mΩ at 50Hz X: 0mΩ / 10mΩ / 40mΩ / 50mΩ at 60Hz		
Max. phase-neutral impedance:	R: 680mΩ X: 393mΩ at 50Hz X: 471mΩ at 60Hz		
Resistor bridging:	Automated pneumatic bridging *(pressure: 5-10bar, connector ¼" NW 7.2)*		
Cooling type:	Air cooling		
Size:			
Dimensions (mm):	23U 1022x490x600	23U 1022x490x600	37U 1645x1200x600
Weight:	approx. 210kg	approx. 250kg	approx. 1100kg

WIRING DIAGRAM:

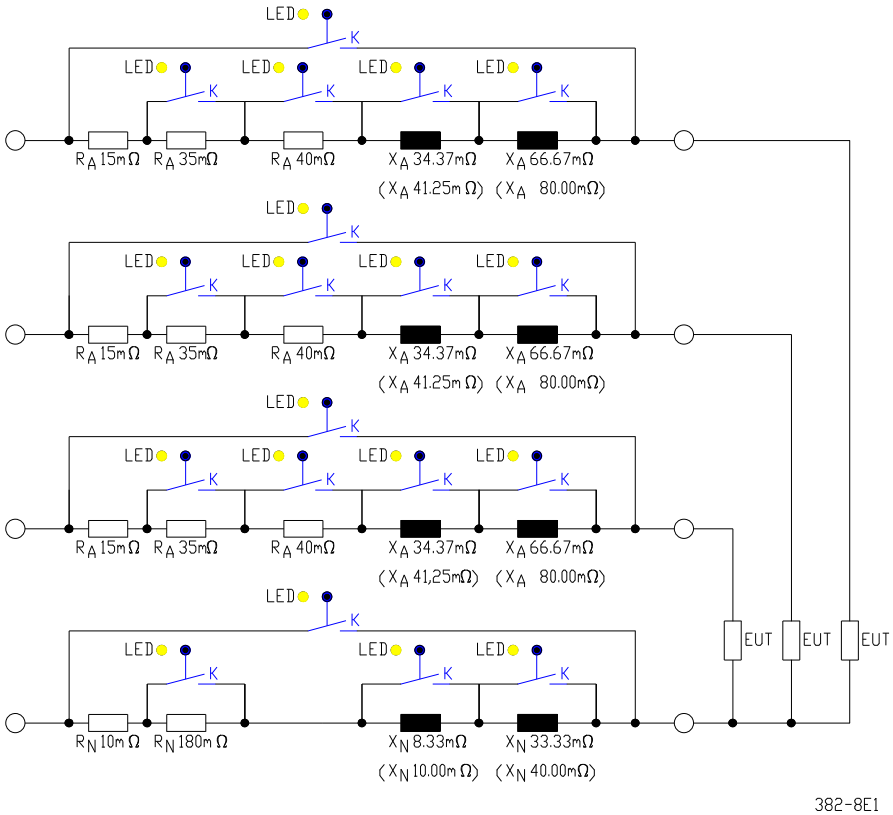

Fig. 6: Japanese/Korean standard reference impedance 50Hz/(60Hz) values for all AIP xxx/3/P/JK

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POSSIBLE IMPEDANCE COMBINATIONS AIP AT 50Hz:

(Without additional Japanese/Korean standard values):
Fixed values displayed in red colour

No.	R_A [mΩ]	R_N [mΩ]	R_{total} [mΩ]	ratio X_{total} / R_{total}	X_A [mΩ]	X_N [mΩ]	X_{total} [mΩ]	AIP with 32A 75A	AIP with 125A	AIP with 250A 375A 500A
1[3]	3.75	2.5	**6.25**	0.625	2.34	1.56	**3.9**	×	×	✓
2[4]	7.5	5	**12.5**	0.625	4.69	3.13	**7.82**	×	✓	✓
3	11.25	7.5	**18.75**	0.625	7.03	4.69	**15.63**	✓	✓	✓
4[5]	15	10	**25**	0.625	9.38	6.25	**15.63**	✓	✓	✓
5	18.75	12.5	**31.25**	0.625	11.72	7.81	**19.53**	×	×	✓
6	22.5	15	**37.5**	0.625	14.07	9.38	**23.45**	×	✓	✓
7	26.25	17.5	**43.75**	0.625	16.41	10.94	**27.35**	×	×	✓
8	30	20	**50**	0.625	18.75	12.5	**31.25**	✓	✓	✓
9	33.75	22.5	**56.25**	0.625	21.09	14.06	**35.15**	×	×	✓
10	37.5	25	**62.5**	0.625	23.44	15.63	**39.07**	×	✓	✓
11	41.25	27.5	**68.75**	0.625	25.78	17.19	**42.97**	×	×	✓
12	45	30	**75**	0.625	28.13	18.75	**46.88**	✓	✓	✓
13	48.75	32.5	**81.25**	0.625	30.47	20.31	**50.78**	×	×	✓
14	52.5	35	**87.5**	0.625	32.82	21.88	**54.7**	×	✓	✓
15	56.25	37.5	**93.75**	0.625	35.16	23.44	**58.6**	×	×	✓
16	60	40	**100**	0.625	37.5	25	**62.5**	✓	✓	✓
17	63.75	42.5	**106.25**	0.625	39.84	26.56	**66.4**	×	×	✓
18	67.5	45	**112.5**	0.625	42.19	28.13	**70.32**	×	✓	✓
19	71.25	47.5	**118.75**	0.625	44.53	29.69	**74.22**	×	×	✓
20	75	50	**125**	0.625	46.88	31.25	**78.13**	✓	✓	✓
21	78.75	52.5	**131.25**	0.625	49.22	32.81	**82.03**	×	×	✓
22	82.5	55	**137.5**	0.625	51.57	34.38	**85.95**	×	✓	✓
23	86.25	57.5	**143.75**	0.625	53.91	35.94	**89.85**	×	×	✓
24	90	60	**150**	0.625	56.25	37.5	**93.75**	✓	✓	✓
25	93.75	62.5	**156.25**	0.625	58.59	39.06	**97.65**	×	×	✓
26	97.5	65	**162.5**	0.625	60.94	40.63	**101.57**	×	✓	✓
27	101.25	67.5	**168.75**	0.625	63.28	42.19	**105.47**	×	×	✓
28	105	70	**175**	0.625	65.63	43.75	**109.38**	✓	✓	✓
29	108.75	72.5	**181.25**	0.625	67.97	45.31	**113.28**	×	×	✓
30	112.5	75	**187.5**	0.625	70.32	46.88	**117.2**	×	✓	✓
31	116.25	77.5	**193.75**	0.625	72.66	48.44	**121.1**	×	×	✓

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32	120	80	**200**	0.625	75	50	**125**	✓	✓	✓
33	123.75	82.5	**206.25**	0.625	77.34	51.56	**128.9**	×	×	✓
34	127.5	85	**212.5**	0.625	79.69	53.13	**132.82**	×	✓	✓
35	131.25	87.5	**218.75**	0.625	82.03	54.69	**136.72**	×	×	✓
36	135	90	**225**	0.625	84.38	56.25	**140.63**	✓	✓	✓
37	138.75	92.5	**231.25**	0.625	86.72	57.81	**144.53**	×	×	✓
38	142.5	95	**237.5**	0.625	89.07	59.38	**148.45**	×	✓	✓
39	146.25	97.5	**243.75**	0.625	91.41	60.94	**152.35**	×	×	✓
40	150	100	**250**	0.625	93.75	62.5	**156.25**	✓	✓	✓
41	153.75	102.5	**256.25**	0.625	96.09	64.06	**160.15**	×	×	✓
42	157.5	105	**262.5**	0.625	98.44	65.63	**164.07**	×	✓	✓
43	161.25	107.5	**268.75**	0.625	100.78	67.19	**167.97**	×	×	✓
44	165	110	**275**	0.625	103.13	68.75	**171.88**	✓	✓	✓
45	168.75	112.5	**281.25**	0.625	105.47	70.31	**175.78**	×	×	✓
46	172.5	115	**287.5**	0.625	107.82	71.88	**179.7**	×	✓	✓
47	176.25	117.5	**293.75**	0.625	110.16	73.44	**183.6**	×	×	✓
48	180	120	**300**	0.625	112.5	75	**187.5**	✓	✓	✓
49	183.75	122.5	**306.25**	0.625	114.84	76.56	**191.4**	×	×	✓
50	187.5	125	**312.5**	0.625	117.19	78.13	**195.32**	×	✓	✓
51	191.25	127.5	**318.75**	0.625	119.53	79.69	**199.22**	×	×	✓
52	195	130	**325**	0.625	121.88	81.25	**203.13**	✓	✓	✓
53	198.75	132.5	**331.25**	0.625	124.22	82.81	**207.03**	×	×	✓
54	202.5	135	**337.5**	0.625	126.57	84.38	**210.95**	×	✓	✓
55	206.25	137.5	**343.75**	0.625	128.91	85.94	**214.85**	×	×	✓
56	210	140	**350**	0.625	131.25	87.5	**218.75**	✓	✓	✓
57	213.75	142.5	**356.25**	0.625	133.59	89.06	**222.65**	×	×	✓
58	217.5	145	**362.5**	0.625	135.94	90.63	**226.57**	×	✓	✓
59	221.25	147.5	**368.75**	0.625	138.28	92.19	**230.47**	×	×	✓
60	225	150	**375**	0.625	140.63	93.75	**234.38**	✓	✓	✓
61	228.75	152.5	**381.25**	0.625	142.97	95.31	**238.28**	×	×	✓
62	232.5	155	**387.5**	0.625	145.32	96.88	**242.2**	×	✓	✓
63	236.25	157.5	**393.75**	0.625	147.66	98.44	**246.1**	×	×	✓
64	240	160	**400**	0.625	150	100	**250**	✓	✓	✓

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ADDITIONAL IMPEDANCE COMBINATIONS JAPANESE/KOREAN STANDARD:

No.	R_A [mΩ]	R_N [mΩ]	R_{total} [mΩ]	ratio X_{total} / R_{total}	X_A [mΩ]	X_N [mΩ]	X_{total} [mΩ]	
1	15	10	**25**	0.625	9.38	6.25	**15.63**	*= Fixed value*
2	35	180	**215**	0.625	34.37	8.33	**42.70**	
3	40		**40**	0.625	66.67	33.33	**100.00**	
4	330	350	**680**	0.625	251	142	**393**	*= Japanese/Korean standard values*

Note: When using the AIP xxx/P/JK version the additional JK impedance can be disabled. The remaining AIP impedance is then the adjusted IEC impedance value. The minimum impedance value is the fixed impedance value of the according AIP version.

TECHNICAL INFORMATION TYPES AIP xxx/3/P/TPM[6)]:

The AIP unit with Three Phase Measurement capability (TPM) reduces the total testing time for three-phase EUTs. Whilst the non TPM versions of AIP require a sequential phase by phase test, the TPM version enables the system to measure the EUTs phase lines simultaneously.
To perform an automated test it is strongly recommended to use also an ARS TPM version.

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