



Traction cable

Current rating for single core cables

RADOX 4 GKW-AX 1800V + 9 GKW-AX 3600V

1. Scope :

This document provides guidelines for the selection of cable cross-sections with regard to the current rating for continuous operation.

2. Definitions :

Current load :	current passed through the cable during operation
Continuous operation :	an operation with constant current whose duration is at least long enough to allow the system to reach thermal equilibrium, but may then go on indefinitely
Current rating :	maximum permissible current under determined operation conditions
Permissible operating temperature :	maximum permissible conductor temperature during continuous operation

3. General remarks :

- 3.1 The current rating of a cable depends on the conductor cross-section, on the cable design, on the characteristics of the insulation materials, on the installation conditions and, for larger cross-sections, on the frequency (skin and proximity effects). Also, additional heating effects due to higher ambient temperatures, due to heating elements and due to bunching of cables have to be taken into account.
- 3.2 The conductor cross-section has to be selected in such a way that the actual current load does not exceed the current rating, i.e. the conductor temperature does not exceed the permissible operating temperature. The determining factor is the appropriate, most unfavourable operating condition, encountered during operation over the whole length of the cable.

4. Current rating under service conditions :

$$I = I_N \cdot f_1 \cdot f_2 \cdot f_3 \cdot f_4$$

- I [A] : Current rating for continuous operation under service conditions
 I_N [A] : Current rating for continuous operation under standard conditions
 f_1 : Reduction factor for increased ambient temperature (see # 4.2)
 f_2 : Reduction factor for deviated conductor temperature (see # 4.3)
 f_3 : Reduction factor for increased frequency (see # 4.4)
 f_4 : Reduction factor for bunched cables (see tables on pages 4 and 5)

4.1 Standard conditions for current rating :

- 4.1.1 The tabled values for the current rating were calculated according to IEC 60287 for the following standard conditions:
- continuous operation
 - single circuit for 3-phase current, single conductor for 1-phase current
 - 30°C ambient temperature and sufficiently large and ventilated spaces, whose ambient temperature is not appreciably increased by the heat coming from the cables.
 - 120°C conductor temperature
 - frequency up to 200 Hz

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4.1.2 Installation in air, unrestricted heat dissipation, means that the following installation conditions are observed :

- distance of the cables from the wall, from the floor, from the ceiling > cable diameter
- distance between two adjacent power circuits > 2 x cable diameter
- vertical distance between power circuits laid one upon another for individual cables > 2 x cable diameter and for layers of cables > 200 mm
- perforated tray with a perforation > 30 % of the total surface

4.1.3 Open trays are continuous supports with vertical sides, but without cover. A possible perforation accounts for < 30% of the total surface.

4.1.4 Closed ducts are entirely closed. Pipes belong to this category also.
The max. filling degree is 60%.

4.1.5 Due to the skin effect at higher frequencies (higher than 200 Hz) the current ratings for conductors can be reduced (see # 4.4).

4.2 Reduction factors for increased ambient temperature :

Ambient temperature [°C]	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
Reduction factor f_1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.78	0.75	0.71	0.67	0.62	0.58	0.53	0.47	0.41	0.33	0.22

4.3 Reduction factors for different permissible conductor temperature :

Conductor temperature [°C]	120	110	100	90	80
Reduction factor f_2	1	0.96	0.91	0.85	0.79



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4.4 Reduction factors for increased frequency :

Frequency [Hz] *	400	600	800	1000	2000	3000	4000	5000	10000
Conductor size mm ²	factors f_3								
0.5	1	1	1	1	1	1	1	1	1
0.75	1	1	1	1	1	1	1	1	1
1.0	1	1	1	1	1	1	1	1	1
1.5	1	1	1	1	1	1	1	1	1
2.5	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	0.98
6	1	1	1	1	1	1	1	0.99	0.93
10	1	1	1	1	1	1	0.96	0.93	0.82
16	1	1	1	1	1	0.95	0.91	0.87	0.76
25	1	1	1	1	0.94	0.88	0.83	0.80	0.69
35	1	1	1	0.98	0.89	0.82	0.77	0.74	0.64
50	1	1	0.97	0.94	0.83	0.76	0.72	0.69	0.59
70	1	0.95	0.91	0.88	0.77	0.71	0.67	0.63	0.54
95	0.98	0.93	0.88	0.84	0.73	0.67	0.63	0.60	0.51
120	0.94	0.88	0.84	0.80	0.69	0.64	0.60	0.57	0.48
150	0.90	0.85	0.80	0.77	0.66	0.61	0.57	0.54	0.46
185	0.88	0.82	0.77	0.74	0.64	0.58	0.54	0.52	0.44
240	0.85	0.77	0.72	0.69	0.60	0.54	0.51	0.48	0.41
300	0.79	0.73	0.69	0.66	0.57	0.52	0.48	0.46	0.39
400	0.75	0.69	0.65	0.63	0.54	0.49	0.46	0.44	0.37

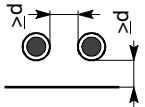
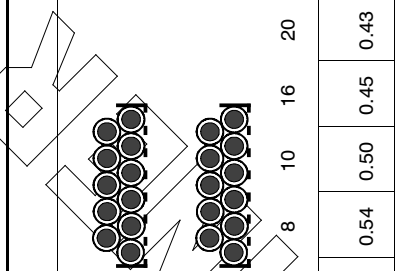
* For frequencies above 800 Hz and cross-sections higher than 25 mm² special conductor-constructions are recommended (waveguide tubes).



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Continuous current rating
Conductor temperature 120 °C
Ambient temperature 30 °C

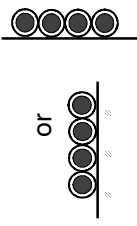
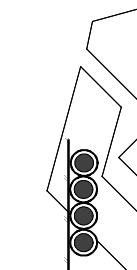
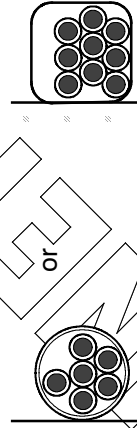
Installation method		1. Cables in free air or perforated trays																									
Number of simultaneous loaded conductors on each tray																											
		1	2	3	4	6	8	10	16	20	4	6	8	10	16	20	4	6	8	10	16	20					
Reduction factor f4	1	0.87	0.81	0.78	0.75	0.74	0.73	0.72	0.71	0.71	0.62	0.57	0.53	0.47	0.45	0.67	0.59	0.54	0.50	0.45	0.43	0.71	0.58	0.52	0.48	0.41	0.38
Conductor size mm²		Current rating in [A]																									
0.5	20	17	16	16	15	15	15	14	14	14	12	11	11	9	9	13	12	11	10	9	9	14	12	10	10	8	8
0.75	25	22	20	20	19	19	18	18	18	18	16	14	13	12	11	17	15	14	13	11	11	18	15	13	12	10	10
1.0	30	26	24	23	22	22	22	21	21	21	19	17	16	14	14	20	18	16	15	14	13	21	17	16	14	12	11
1.5	37	32	30	29	28	27	27	26	26	26	23	21	20	17	17	25	22	20	19	17	16	26	21	19	18	15	14
2.5	50	44	41	39	38	37	37	36	36	36	31	29	27	24	23	34	30	27	25	23	22	36	29	26	24	21	19
4	68	59	55	53	51	50	50	49	48	48	42	39	36	32	31	46	40	37	34	31	29	48	39	35	33	28	26
6	87	76	70	68	65	64	64	63	62	62	54	50	46	41	39	58	51	47	44	39	37	62	50	45	42	36	33
10	123	107	100	96	92	91	90	89	87	87	76	70	65	58	55	82	73	66	62	55	53	87	71	64	59	50	47
16	168	146	136	131	126	124	123	121	119	119	104	96	89	79	76	113	99	91	84	76	72	119	97	87	81	69	64
25	225	196	182	176	169	167	164	162	160	160	140	128	119	106	101	151	133	122	113	101	97	160	131	117	108	92	86
35	280	244	227	218	210	207	204	202	199	199	174	160	148	132	126	188	165	151	140	126	120	199	162	146	134	115	106
50	355	309	288	277	266	263	259	256	252	252	220	202	188	167	160	238	209	192	178	160	153	252	206	185	170	146	135
70	446	388	361	348	335	339	326	321	317	317	277	254	236	210	201	299	263	241	223	201	192	317	259	232	214	183	169
95	530	461	429	413	398	392	387	382	376	376	329	302	281	249	239	355	313	286	265	239	228	376	307	276	254	217	201
120	626	545	507	488	470	463	457	451	444	444	388	357	332	294	282	419	369	338	313	282	269	444	363	326	300	257	238
150	728	633	590	568	546	539	531	524	517	517	451	415	386	342	328	488	430	393	364	328	313	517	422	379	349	298	277
185	831	723	673	648	623	615	607	598	590	590	515	474	440	391	374	557	490	449	416	374	357	590	482	432	399	341	316
240	1000	870	810	780	750	740	730	720	710	710	620	570	530	470	450	670	590	540	500	450	430	710	580	520	480	410	380
300	1160	1009	940	905	870	858	847	835	824	824	719	661	615	545	522	777	684	626	580	522	499	824	673	603	557	476	441
400	1420	1235	1150	1108	1065	1051	1037	1022	1008	1008	880	809	753	667	639	951	838	767	710	639	611	1008	824	738	682	582	540



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Continuous current rating
Conductor temperature 120 °C
Ambient temperature 30 °C

Installation method	2. on floor or wall													3. fixed on a ceiling or under floor													4. in conduit in a void or in a pipe												
Number of simultaneous loaded conductors per installation																																							
	1	2	3	4	1	2	3	4	5	6	7	8	≥ 9	1	2	3	4	5	6	7	8	9	10	12	14	16	20												
	Reduction faktor f4	0.85	0.79	0.75	0.75	0.95	0.81	0.72	0.68	0.66	0.64	0.63	0.62	0.61	1	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.45	0.43	0.41	0.38											
Conductor size mm²	Current rating in [A]																																						
0.5	17	15	14	13	16	14	12	12	11	11	11	11	10	14	11	10	9	9	8	8	7	7	7	6	6	6	5												
0.75	21	18	17	16	20	17	15	14	14	14	13	13	13	17	14	12	11	10	10	9	9	8	8	7	7	7													
1.0	26	22	20	19	24	21	19	17	17	16	16	16	16	20	16	14	13	12	12	11	11	10	10	9	9	8	8												
1.5	35	30	28	26	33	28	25	24	23	22	22	22	21	28	22	20	18	17	16	15	15	14	13	12	12	11													
2.5	48	41	38	36	45	39	34	32	32	31	30	30	29	38	31	27	25	23	22	21	20	19	18	17	16	15													
4	65	55	51	48	61	52	47	44	43	41	41	40	39	52	41	36	34	31	29	28	27	26	25	23	22	21													
6	83	70	65	62	79	67	60	56	55	53	52	51	50	66	53	46	43	40	38	36	34	33	32	30	28	27													
10	117	99	92	88	111	95	84	79	77	75	74	72	71	93	75	65	61	56	53	50	49	47	45	42	40	38													
16	160	136	126	120	152	129	115	109	105	102	101	99	97	128	102	89	83	77	73	69	66	64	61	57	55	52													
25	214	182	169	160	203	173	154	145	141	137	135	133	130	171	137	120	111	103	97	92	89	86	82	77	74	70													
35	266	226	210	200	253	215	192	181	176	170	168	165	162	213	170	149	138	128	121	115	111	106	102	96	92	87													
50	337	287	266	253	320	273	243	229	223	216	212	209	206	270	216	189	175	162	154	146	140	135	130	121	116	111													
70	424	360	335	318	403	343	305	288	280	271	267	263	258	339	271	237	220	203	193	183	176	169	163	153	146	139													
95	504	428	398	378	478	408	363	342	332	322	317	312	307	403	322	282	262	242	230	218	209	201	193	181	173	165													
120	595	505	470	446	565	482	428	404	393	381	375	369	363	476	381	333	309	285	271	257	247	238	228	214	205	195													
150	692	588	546	519	657	560	498	470	456	443	436	429	422	553	443	387	360	332	315	299	288	277	266	249	238	227													
185	789	671	624	592	750	639	568	537	521	505	497	489	482	632	505	442	411	379	360	341	328	316	303	284	272	259													
240	950	808	751	713	903	770	684	646	627	608	599	589	580	760	608	532	494	456	433	410	395	380	365	342	327	312													
300	1102	937	871	827	1047	893	793	749	727	705	694	683	672	882	705	617	573	529	503	476	458	441	423	397	379	361													
400	1349	1147	1066	1012	1282	1093	971	917	890	863	850	836	823	1079	863	755	701	648	615	583	561	540	518	486	464	442													