MR medium rating busbar – 4 conductor (aluminium)
technical data

Complies to :
IEC 61439-6 (BS EN 61439-6)

Suitable for the following climates :
Constant humid climate (IEC 60068 2 – 11)
Cyclical humid climate (IEC 60068 2 – 30)

3L+N+PE (Aluminium)

		160	**250**	**315**	**400**	**500**	**630**	**800**	**1 000**
Rated current	In (A)	160	250	315	400	500	630	800	1 000
Operational voltage	Ue (V)	1 000	1 000	1 000	1 000	1 000	1 000	1 000	690
Insulation voltage	Ui (V)	1 000	1 000	1 000	1 000	1 000	1 000	1 000	690
Frequency	ƒ (Hz)	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Rated shortcircuit current withstand for 3-phase fault (1 s)	I_{cw} (kA)$_{rms}$	15[1]	25[1]	25[1]	25	30	36	36	30
Specific Energy withstand for 3-phase fault	I^2t (M A^{2}s)	23	63	63	625	900	1 296	1 296	900
Peak current	I_{pk} (kA)	30	53	53	53	63	76	76	63
Rated short-time current for single-phase fault Ph-N(1 s)	I_{cw} (kA)$_{rms}$	9[1]	15[1]	15[1]	15	18	22	22	18
Peak current for single-phase fault Ph-N	I_{pk} (kA)	15	30	30	30	36	45	45	36
Rated short-time current single-phase fault Ph-PE (1 s)	I_{cw} (kA)$_{rms}$	9[1]	15[1]	15[1]	15	18	22	22	18
Peak current single-phase fault Ph-PE	I_{pk} (kA)	15	30	30	30	36	45	45	36
Phase resistance at 20°C	R_{20} (mΩ/m)	0·492	0·328	0·197	0·120	0·077	0·060	0·052	0·037
Phase resistance at thermal conditions (I_n; 40°C)	R_t (mΩ/m)	0·665	0·443	0·266	0·163	0·104	0·081	0·070	0·073
Phase reactance (50 Hz)	X (mΩ/m)	0·260	0·202	0·186	0·130	0·110	0·097	0·096	0·076
Neutral resistance at 20°C	Rn_{20} (mΩ/m)	0·492	0·328	0·197	0·120	0·077	0·060	0·052	0·037
Neutral reactance (50 Hz)	Xn (mΩ/m)	0·260	0·202	0·186	0·130	0·110	0·097	0·096	0·076
Resistance of the protective bar	R_{PE} (mΩ/m)	0·341	0·341	0·341	0·283	0·283	0·283	0·283	0·283
Reactance of the protective bar (50 Hz)	X_{PE} (mΩ/m)	0·220	0·220	0·220	0·180	0·180	0·180	0·180	0·180
Resistance of the phase-Pe fault loop	$R_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	1·006	0·784	0·607	0·445	0·387	0·364	0·353	0·336
Reactance of the phase-Pe fault loop (50 Hz)	$XR_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·480	0·414	0·396	0·333	0·333	0·283	0·275	0·273
Resistance of the phase-neutral fault loop	$R_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	1·157	0·771	0·463	0·283	0·181	0·141	0·121	0·093
Reactance of the phase-neutral fault loop (50 Hz)	$XR_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	0·480	0·422	0·406	0·310	0·290	0·277	0·276	0·186
Voltage "k" drop coeff. with distributed load (k)	Δv (V/m/A)10^{-6} cosφ = 0·70	564	394	276	179	131	109	102	90
	Δv (V/m/A)10^{-6} cosφ = 0·75	581	404	279	180	130	108	100	88
	Δv (V/m/A)10^{-6} cosφ = 0·80	596	412	281	180	129	107	98	85
	Δv (V/m/A)10^{-6} cosφ = 0·85	608	418	281	179	127	104	95	82
	Δv (V/m/A)10^{-6} cosφ = 0·90	616	422	277	176	122	100	91	77
	Δv (V/m/A)10^{-6} cosφ = 0·95	617	419	269	169	115	93	83	69
	Δv (V/m/A)10^{-6} cosφ = 1·00	576	384	230	141	90	70	60	46
Losses for the Joule effect at nominal current	P (W/m)	51	83	79	78	78	97	134	160
Fire load	(kWh/m)	1·3	1·3	1·3	1·8	1·8	1·8	1·8	1·8
Weight	(kg/m)	7·4	7·7	8·4	10·7	12·3	13·8	14·7	15·9
Overall dimensions of the busbar	L x H (mm)	75 x 196	75 x 196	75 x 196	135 x 196	135 x 196	135 x 196	135 x 196	135 x 196
Degree of protection (IEC 60529)	IP	52-55	52-55	52-55	52-55	52-55	52-55	52-55	52-55
IK code IEC 60068-2-62	IK	10	10	10	10	10	10	10	10

1 : Values for 0·1 s

Temperature rating schedule

Mean room temperature (°C)	15	20	25	30	35	40	45	50	55	60
K1 factor	1·15	1·12	1·08	1·05	1·025	1	0·975	0·95	0·93	0·89

Multiplier coefficient of nominal rating for room temperature values different from 40°C

MR medium rating busbar – 4 conductor (copper)
technical data

Complies to :
IEC 61439-6 (BS EN 61439-6)

Suitable for the following climates :
Constant humid climate (IEC 60068 2 – 11)
Cyclical humid climate (IEC 60068 2 – 30)

3L+N+PE (Copper)							
Rated current	In (A)	**250**	**315**	**400**	**630**	**800**	**1 000**
Operational voltage	Ue (V)	1 000	1 000	1 000	1 000	1 000	1 000
Insulation voltage	Ui (V)	1 000	1 000	1 000	1 000	1 000	1 000
Frequency	f (Hz)	50/60	50/60	50/60	50/60	50/60	50/60
Rated shortcircuit current withstand for 3-phase fault (1 s)	I_{cw} (kA)$_{rms}$	25[1]	25[1]	30[1]	36	36	36
Specific Energy withstand for 3-phase fault	I^2t (M A^{2}s)	63	63	90	1 296	1 296	1 296
Peak current	I_{pk} (kA)	53	53	63	76	76	76
Rated short-time current for single-phase fault Ph-N(1 s)	I_{cw} (kA)$_{rms}$	15[1]	15[1]	18[1]	22	22	22
Peak current for single-phase fault Ph-N	I_{pk} (kA)	30	30	36	45	45	45
Rated short-time current single-phase fault Ph-PE (1 s)	I_{cw} (kA)$_{rms}$	15[1]	15[1]	18[1]	22	22	22
Peak current single-phase fault Ph-PE	I_{pk} (kA)	30	30	36	45	45	45
Phase resistance at 20°C	R_{20} (mΩ/m)	0·237	0·180	0·096	0·061	0·040	0·032
Phase resistance at thermal conditions (I_n; 40°C)	R_t (mΩ/m)	0·320	0·243	0·129	0·082	0·053	0·043
Phase reactance (50 Hz)	X (mΩ/m)	0·205	0·188	0·129	0·122	0·122	0·120
Neutral resistance at 20°C	Rn_{20} (mΩ/m)	0·237	0·180	0·096	0·061	0·040	0·032
Neutral reactance (50 Hz)	Xn (mΩ/m)	0·205	0·188	0·129	0·122	0·122	0·120
Resistance of the protective bar	R_{PE} (mΩ/m)	0·336	0·336	0·336	0·279	0·279	0·279
Reactance of the protective bar (50 Hz)	X_{PE} (mΩ/m)	0·220	0·220	0·220	0·180	0·180	0·180
Resistance of the phase-Pe fault loop	$R_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·657	0·579	0·466	0·361	0·332	0·322
Reactance of the phase-Pe fault loop (50 Hz)	$XR_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·425	0·408	0·349	0·302	0·302	0·300
Resistance of the phase-neutral fault loop	$R_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	0·558	0·423	0·225	0·143	0·093	0·074
Reactance of the phase-neutral fault loop (50 Hz)	$XR_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	0·425	0·408	0·349	0·302	0·302	0·300
Voltage "k" drop coeff. with distributed load (k)	Δv (V/m/A)10^{-6} cosφ = 0·70	321	263	158	125	108	100
	Δv (V/m/A)10^{-6} cosφ = 0·75	326	265	158	123	105	96
	Δv (V/m/A)10^{-6} cosφ = 0·80	329	266	157	120	100	92
	Δv (V/m/A)10^{-6} cosφ = 0·85	329	264	154	116	95	86
	Δv (V/m/A)10^{-6} cosφ = 0·90	327	260	149	110	88	79
	Δv (V/m/A)10^{-6} cosφ = 0·95	319	251	141	101	77	68
	Δv (V/m/A)10^{-6} cosφ = 1·00	277	210	112	71	46	37
Losses for the Joule effect at nominal current	P (W/m)	60	72	62	98	103	128
Fire load	(kWh/m)	1·3	1·3	1·3	1·8	1·8	1·8
Weight	(kg/m)	9·3	10·2	13·3	18·2	23·9	27·9
Overall dimensions of the busbar	L x H (mm)	75 x 196	75 x 196	135 x 196	135 x 196	135 x 196	135 x 196
Degree of protection (IEC 60529)	IP	52-55	52-55	52-55	52-55	52-55	52-55
IK code IEC 60068-2-62	IK	10	10	10	10	10	10

1 : Values for 0·1 s

Temperature rating schedule										
Mean room temperature (°C)	15	20	25	30	35	40	45	50	55	60
K1 factor	1·15	1·12	1·08	1·05	1·025	1	0·975	0·95	0·93	0·89

Multiplier coefficient of nominal rating for room temperature values different from 40°C

MR medium rating busbar – five conductor (aluminium)
technical data

Complies to :
IEC 61439-6 (BS EN 61439-6)

Suitable for the following climates :
Constant humid climate (IEC 60068 2 – 11)
Cyclical humid climate (IEC 60068 2 – 30)

3L+N 100% +PE 100% (Aluminium)

Rated current	In (A)	**160**	**250**	**315**	**400**	**500**	**630**	**800**	**1 000**
Operational voltage	Ue (V)	1 000	1 000	1 000	1 000	1 000	1 000	1 000	690
Insulation voltage	Ui (V)	1 000	1 000	1 000	1 000	1 000	1 000	1 000	690
Frequency	f (Hz)	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Rated shortcircuit current withstand for 3-phase fault (1 s)	I_{cw} (kA)$_{rms}$	15[1]	25[1]	25[1]	25	30	36	36	30
Specific Energy withstand for 3-phase fault	I^2t (M A^{2}s)	23	63	63	625	900	1 296	1 296	900
Peak current	I_{pk} (kA)	30	53	53	53	63	76	76	63
Rated short-time current for single-phase fault Ph-N(1 s)	I_{cw} (kA)$_{rms}$	9[1]	15[1]	15[1]	15	18	22	22	18
Peak current for single-phase fault Ph-N	I_{pk} (kA)	15	30	30	30	36	45	45	36
Rated short-time current single-phase fault Ph-PE (1 s)	I_{cw} (kA)$_{rms}$	9[1]	15[1]	15[1]	15	18	22	22	22
Peak current single-phase fault Ph-PE	I_{pk} (kA)	15	30	30	30	36	45	45	45
Phase resistance at 20°C	R_{20} (mΩ/m)	0·492	0·328	0·197	0·120	0·077	0·060	0·052	0·039
Phase resistance at thermal conditions (I_n; 40°C)	R_t (mΩ/m)	0·665	0·443	0·266	0·163	0·104	0·081	0·070	0·053
Phase reactance (50 Hz)	X (mΩ/m)	0·260	0·202	0·186	0·130	0·110	0·097	0·096	0·093
Neutral resistance at 20°C	Rn_{20} (mΩ/m)	0·492	0·328	0·197	0·120	0·077	0·060	0·052	0·039
Neutral reactance (50 Hz)	Xn (mΩ/m)	0·260	0·202	0·186	0·130	0·110	0·097	0·096	0·093
Resistance of the protective bar	R_{PE} (mΩ/m)	0·202	0·167	0·125	0·084	0·060	0·050	0·044	0·034
Reactance of the protective bar (50 Hz)	X_{PE} (mΩ/m)	0·119	0·105	0·101	0·075	0·068	0·063	0·063	0·061
Resistance of the phase-Pe fault loop	$R_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·866	0·611	0·391	0·247	0·164	0·131	0·113	0·087
Reactance of the phase-Pe fault loop (50 Hz)	$XR_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·379	0·307	0·287	0·205	0·178	0·160	0·159	0·154
Resistance of the phase-neutral fault loop	$R_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	1·157	0·771	0·463	0·283	0·181	0·141	0·121	0·093
Reactance of the phase-neutral fault loop (50 Hz)	$XR_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	0·520	0·404	0·372	0·260	0·220	0·194	0·192	0·186
Voltage “k” drop coeff. with distributed load (k)	Δv (V/m/A)10^{-6} cosφ = 0·70	564	394	276	179	131	109	102	90
	Δv (V/m/A)10^{-6} cosφ = 0·75	581	404	279	180	130	108	100	88
	Δv (V/m/A)10^{-6} cosφ = 0·80	596	412	281	180	129	107	98	85
	Δv (V/m/A)10^{-6} cosφ = 0·85	608	418	281	179	127	104	95	82
	Δv (V/m/A)10^{-6} cosφ = 0·90	616	422	277	176	122	100	91	77
	Δv (V/m/A)10^{-6} cosφ = 0·95	617	419	269	169	115	93	83	69
	Δv (V/m/A)10^{-6} cosφ = 1·00	576	384	230	141	90	70	60	46
Losses for the Joule effect at nominal current	P (W/m)	51	83	79	78	78	97	134	160
Fire load	(kWh/m)	1·3	1·3	1·3	1·8	1·8	1·8	1·8	1·8
Weight	(kg/m)	7·6	8·0	8·9	11·4	13·5	15·2	16·4	17·9
Overall dimensions of the busbar	L x H (mm)	75 x 196	75 x 196	75 x 196	135 x 196	135 x 196	135 x 196	135 x 196	135 x 196
Degree of protection (IEC 60529)	IP	52-55	52-55	52-55	52-55	52-55	52-55	52-55	52-55
IK code IEC 60068-2-62	IK	10	10	10	10	10	10	10	10

1 : Values for 0·1 s

Temperature rating schedule

Mean room temperature (°C)	15	20	25	30	35	40	45	50	55	60
K1 factor	1·15	1·12	1·08	1·05	1·025	1	0·975	0·95	0·93	0·89

Multiplier coefficient of nominal rating for room temperature values different from 40°C

MR medium rating busbar – five conductor (copper)
technical data

Complies to :
IEC 61439-6 (BS EN 61439-6)

Suitable for the following climates :
Constant humid climate (IEC 60068 2 – 11)
Cyclical humid climate (IEC 60068 2 – 30)

3L+N 100% +PE 100% (Copper)

Rated current	In (A)	**250**	**315**	**400**	**630**	**800**	**1 000**
Operational voltage	Ue (V)	1 000	1 000	1 000	1 000	1 000	1 000
Insulation voltage	Ui (V)	1 000	1 000	1 000	1 000	1 000	1 000
Frequency	f (Hz)	50/60	50/60	50/60	50/60	50/60	50/60
Rated shortcircuit current withstand for 3-phase fault (1 s)	I_{cw} (kA)$_{rms}$	25[1]	25[1]	30[1]	36	36	36
Specific Energy withstand for 3-phase fault	I^2t (M A^{2}s)	63	63	90	1 296	1 296	1 296
Peak current	I_{pk} (kA)	53	53	63	76	76	76
Rated short-time current for single-phase fault Ph-N(1 s)	I_{cw} (kA)$_{rms}$	15[1]	15[1]	18[1]	22	22	22
Peak current for single-phase fault Ph-N	I_{pk} (kA)	30	30	36	45	45	45
Rated short-time current single-phase fault Ph-PE (1 s)	I_{cw} (kA)$_{rms}$	15[1]	15[1]	18[1]	22	22	22
Peak current single-phase fault Ph-PE	I_{pk} (kA)	30	30	36	45	45	45
Phase resistance at 20°C	R_{20} (mΩ/m)	0·237	0·180	0·096	0·061	0·040	0·032
Phase resistance at thermal conditions (I_n; 40°C)	R_t (mΩ/m)	0·320	0·243	0·129	0·082	0·053	0·043
Phase reactance (50 Hz)	X (mΩ/m)	0·205	0·188	0·129	0·122	0·122	0·120
Neutral resistance at 20°C	Rn_{20} (mΩ/m)	0·237	0·180	0·096	0·061	0·040	0·032
Neutral reactance (50 Hz)	Xn (mΩ/m)	0·205	0·188	0·129	0·122	0·122	0·120
Resistance of the protective bar	R_{PE} (mΩ/m)	0·139	0·117	0·075	0·050	0·035	0·028
Reactance of the protective bar (50 Hz)	X_{PE} (mΩ/m)	0·106	0·101	0·081	0·073	0·073	0·072
Resistance of the phase-Pe fault loop	$R_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·460	0·360	0·204	0·132	0·088	0·071
Reactance of the phase-Pe fault loop (50 Hz)	$XR_{Ph\text{-}Pe\ fault\ loop}$ (mΩ/m)	0·311	0·289	0·210	0·195	0·195	0·192
Resistance of the phase-neutral fault loop	$R_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	0·558	0·423	0·225	0·143	0·093	0·074
Reactance of the phase-neutral fault loop (50 Hz)	$XR_{Ph\text{-}N\ fault\ loop}$ (mΩ/m)	0·311	0·289	0·210	0·195	0·195	0·192
Voltage “k” drop coeff. with distributed load (k)	Δv (V/m/A)10^{-6} cosφ = 0·70	321	263	158	125	108	100
	Δv (V/m/A)10^{-6} cosφ = 0·75	326	265	158	123	105	96
	Δv (V/m/A)10^{-6} cosφ = 0·80	329	266	157	120	100	92
	Δv (V/m/A)10^{-6} cosφ = 0·85	329	264	154	116	95	86
	Δv (V/m/A)10^{-6} cosφ = 0·90	327	260	149	110	88	79
	Δv (V/m/A)10^{-6} cosφ = 0·95	319	251	141	101	77	68
	Δv (V/m/A)10^{-6} cosφ = 1·00	277	210	112	71	46	37
Losses for the Joule effect at nominal current	P (W/m)	60	72	62	98	103	128
Fire load	(kWh/m)	1·3	1·3	1·3	1·8	1·8	1·8
Weight	(kg/m)	10·0	11·1	14·9	20·8	27·9	32·9
Overall dimensions of the busbar	L x H (mm)	75 x 196	75 x 196	135 x 196	135 x 196	135 x 196	135 x 196
Degree of protection (IEC 60529)	IP	52-55	52-55	52-55	52-55	52-55	52-55
IK code IEC 60068-2-62	IK	10	10	10	10	10	10

1 : Values for 0·1 s

Temperature rating schedule

Mean room temperature (°C)	15	20	25	30	35	40	45	50	55	60
K1 factor	1·15	1·12	1·08	1·05	1·025	1	0·975	0·95	0·93	0·89

Multiplier coefficient of nominal rating for room temperature values different from 40°C

MR medium rating busbar

determining the operating current of a busbar

In order to determine the correct busbar rating, the current must be established using the following criteria :

- type of load inputs – three phase or single-phase
- type of circuit input – from one end, from both ends, central input, etc.
- nominal input voltage
- number, power and cosφ of loads which are to be fed by the busbar
- load diversity factor
- load use nominal factor
- assumed short circuit current at the input point
- room temperature
- type of busbar installation (edgeways, flat or vertical)

When using a three phase power supply, the operating current is determined by the following formula :

$$I_b = \frac{PTOT \cdot \alpha \cdot \beta \cdot d}{\sqrt{3} \cdot Ue \cdot \cos\varphi_{\ medium}} (A)$$

Where :

I_b	operating current (A)
α	load diversity factor (.)
β	load use factor (.)
d	feed factor (.)
P_{TOT}	sum of the total active power of installed loads (W)
Ue	operating voltage (V)
$\cos\varphi_{\ medium}$	average load power factor (.)

The 'd' input factor has a value of 1 when the busbar is fed from one end only. The value is $^1/_2$ if fed from the centre or if it is fed from each end

Once the operating current has been determined, choose the busbar with a rated current immediately higher than the one calculated

All Zucchini products have been designed and tested for an average room temperature of 40°C; should they be installed in rooms with average daily temperatures different from 40°C, the rated current of the busbar should be multiplied by a k1 factor that is greater than the unit for temperatures lower than 40°C, and lower than the unit if the room temperature is higher than 40°C

Room temperature (°C)	15	20	25	30	35	40	45	50	55	60
k, thermal correction factor (.)	1·15	1·12	1·08	1·05	1·025	1	0·975	0·95	0·93	0·89

Finally, the following should be considered for the most appropriate busbar choice :

$$I_{nt} \geq I_b \Rightarrow I_{nt} = k_1 \cdot I_n$$

where I_{nt} represents the maximum current loaded by a busbar for an indefinite time at the specified room temperature

Voltage drop

If the length of the line is particularly long (>100m) it is necessary to check the voltage drop (hereinafter specified as v.d.). If the installation is a three phase system and the power factor is not lower than cos = 0.7 the v.d. may be calculated with the coefficients of the voltage drop specified in the technical data table

$$\Delta v\% = 2b \cdot \frac{k \cdot I_b \cdot L}{Vn} \cdot 100$$

Defined :

I_b	= the current that supplies the busbar (A)
Vn	= the voltage power supply of the busbar (V)
L	= the length of the busbar (m)
Δv%	= the voltage drop percentage
b	= the distribution factor of the current
k	= corresponding voltage drop factor a cosφ (V/m/A) (see technical data table, p. 52-55)

The current distribution factor "b" depends on how the circuit is fed and on the distribution of the electric loads along the busbar :

b = 1	Supplies at one end and load at the end of the line
b = ½	Supplies at one end and with load evenly distributed
b = ¼	Supplies at both ends and with load evenly distributed
b = ¼	Central supply with loads at both ends
b = ⅛	Central supply with load distributed evenly

Example : MR 400 A Al for riser mains feed

I_b	= 315 A operating current
b = 1	= supply from one end
k = 179	= see technical data table, p. 52-55
Cosφ	= 0·85
L	= 30 m line length
Vn	= 400 V operating voltage

$$\Delta v\% = 1x \frac{179 \cdot 10^{-6} \cdot 315 \cdot 30}{400} x100 = 0{\cdot}42\%$$

Short circuit current

The short circuit current value I_{CW} that can be supported by Zucchini busbar trunking systems allows for both electrodynamic stress and thermal energy dissipated during the fault

The busbars must be able to sustain the short circuit current for the entire duration of the fault – i.e. for the time required for the protective device (circuit breaker) to start operating, cutting off the metal continuity and extinguishing the electric arc

Joule effect losses

Losses due to the Joule effect are essentially caused by the electrical resistance of the busbar. Lost energy is transformed into heat and contributes to the heating of the conduit

Three phase rating

$P = 3 \cdot R_t \cdot I_b^2 \cdot 10^{-3} (W/m)$

Single phase rating

$P = 2 \cdot R_t \cdot I_b^2 \cdot 10^{-3} (W/m)$