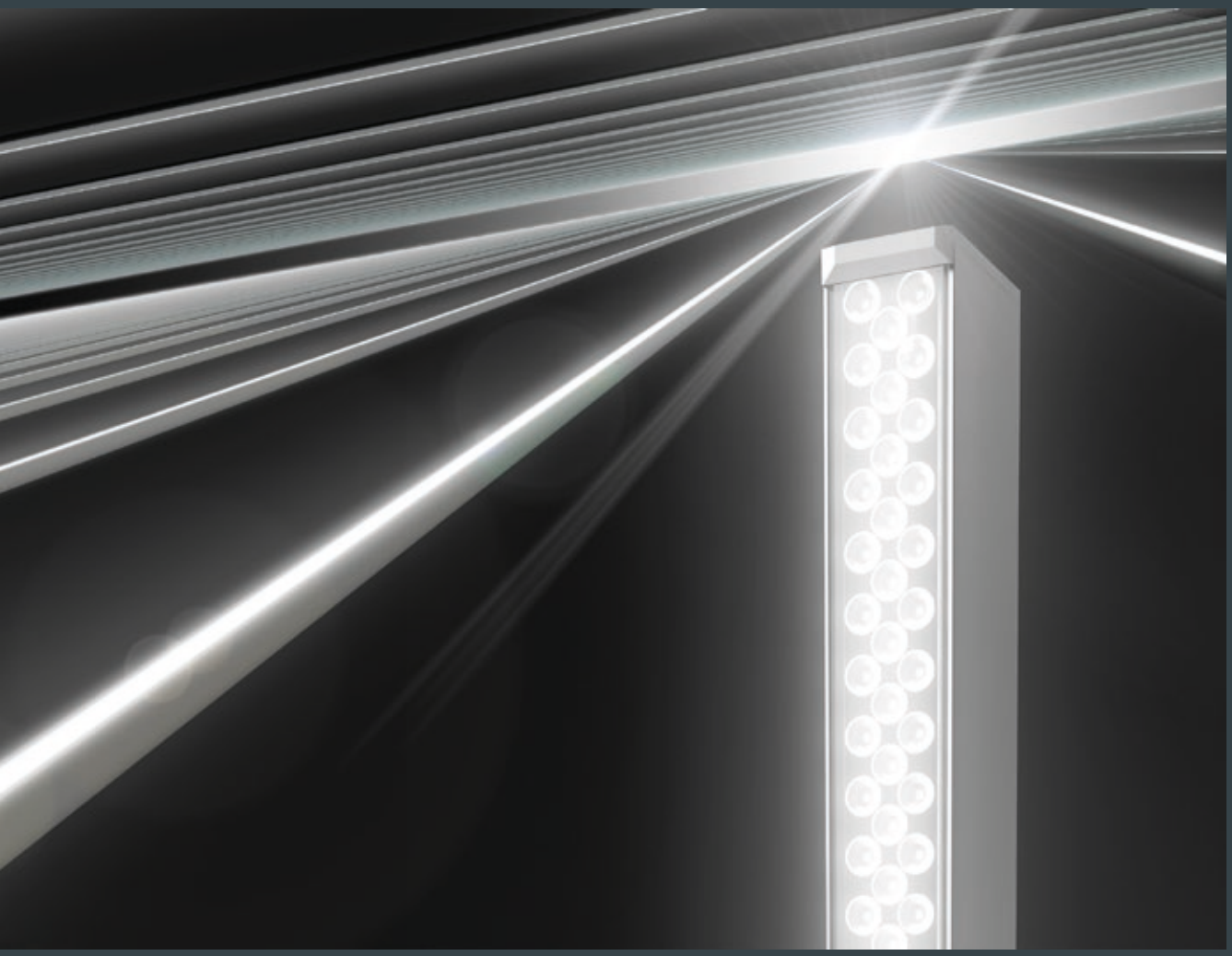


LENGTH PLANNING FOR CONTINUOUS-LINE LUMINAIRES

Q: How long can a continuous-line luminaire be?

$$l = R * A / \rho$$

Q: Sorry, what?

A: This formula is used to calculate the maximum permissible length of the protective conductor.

Q: What do I need that for?

A: According to EN 60528-1, the protective conductor resistance of a continuous-line luminaire, between the feed point and the last touchable metal part, must never exceed a value of 0.5 Ω. With this formula, you can calculate the maximum possible cable length.

Q: And what does that mean for my continuous-line luminaire system?

A: That the length of a line is limited by the internal resistance of the protective conductor. Taking the case of a 2.5 mm^2 copper conductor over a calculated 70 m length at +20°C – after deducting the contact resistances of the connectors, approx. 60 m remain.

Q: Does that apply to all continuous-line luminaires, regardless of the manufacturer?

A: Of course: that's physics.

Q: Is this protective conductor resistance really so important?

A: Definitely. In protection class I devices, the protective conductor connects all touchable conductive parts to the electrical earth. In the event of a voltage applied to the housing (e.g. due to an insulation fault), the protective conductor would dissipate the current on contact and possibly trigger the fuse or the residual current circuit breaker (RCD). If the resistance of the protective conductor is too high, this function and therefore safety in case of contact is no longer guaranteed, since the residual current seeks the path of least resistance and could leak through the human body.

R	[Ω]	resistance
ρ	[Ω*mm^2/m]	specific resistance
l	[m]	cable length
A	[mm^2]	cable cross-section

The specific resistance of copper
is 0,0171 - 0,0178 Ω*mm^2/m

Q: And what if I need a longer continuous-line luminaire?

A: Then you can feed in multiple times. With a central feed, a length of up to 120 m can be planned, since two separate protective conductors can be created in this case. The two lines must be electromechanically separated in the feeder. This way, you can plan even longer lines.

Q: Are there any other factors that need to be considered?

A: Under certain circumstances, you'll need to take the leakage currents into account. LINEDO modules have leakage currents < 0.7 mA. When protected by an RCD, installations with too many modules with a common leakage current of 15 mA can trigger a 30 mA RCD at switch-on (leakage current peak) due to tolerances. In other words, the residual current leaks out. Here, too, distribution over several feeds with separate circuits helps.

Q: Does that apply to all continuous-line luminaires?

A: Of course: that's electrical engineering.

Q: Anything else?

A: Yes. The permissible number of luminaires on each circuit breaker must be observed. In a continuous-line luminaire, the individual modules are counted as separate luminaires. The maximum number for category-B and -C circuit breakers with 10 A and 16 A are specified in the luminaire's data sheet and instructions. With a symmetrical distribution of the luminaire modules to the three phases (plugs for phase selection) of the continuous-line luminaire, the modules' total load can be distributed to up to three circuit breakers.

These three factors

can limit the length of a continuous-line luminaire:

1. The resistance of the protective conductor

According to EN 60528-1, the protective conductor resistance of a continuous-line luminaire, between the feed point and the last touchable metal part, must never exceed a value of 0.5 Ω.
The resistance of the copper cable can be calculated with the formula R=ρ*l/A.
The connectors' contact resistances must be added to the line resistance. For LINEDO, that is approx. 4 mΩ per terminal contact.

Sample calculation for a 60-metre-long continuous-line luminaire:

Resistance of a 60-m-long copper cable with dia. 2.5 mm^2:

R = 0,0178 Ω*mm^2/m * 60 m / 2,5 mm^2 = 0,427 Ω

plus the contact resistances of the connectors:

13 x 4,529 mm continuous-line luminaire module + 1 x electrical feed = 13 contacts @ 4 mΩ = 0,052 Ω

together results in a protective conductor resistance of **0.479 Ω -> -> which is still permissible.**

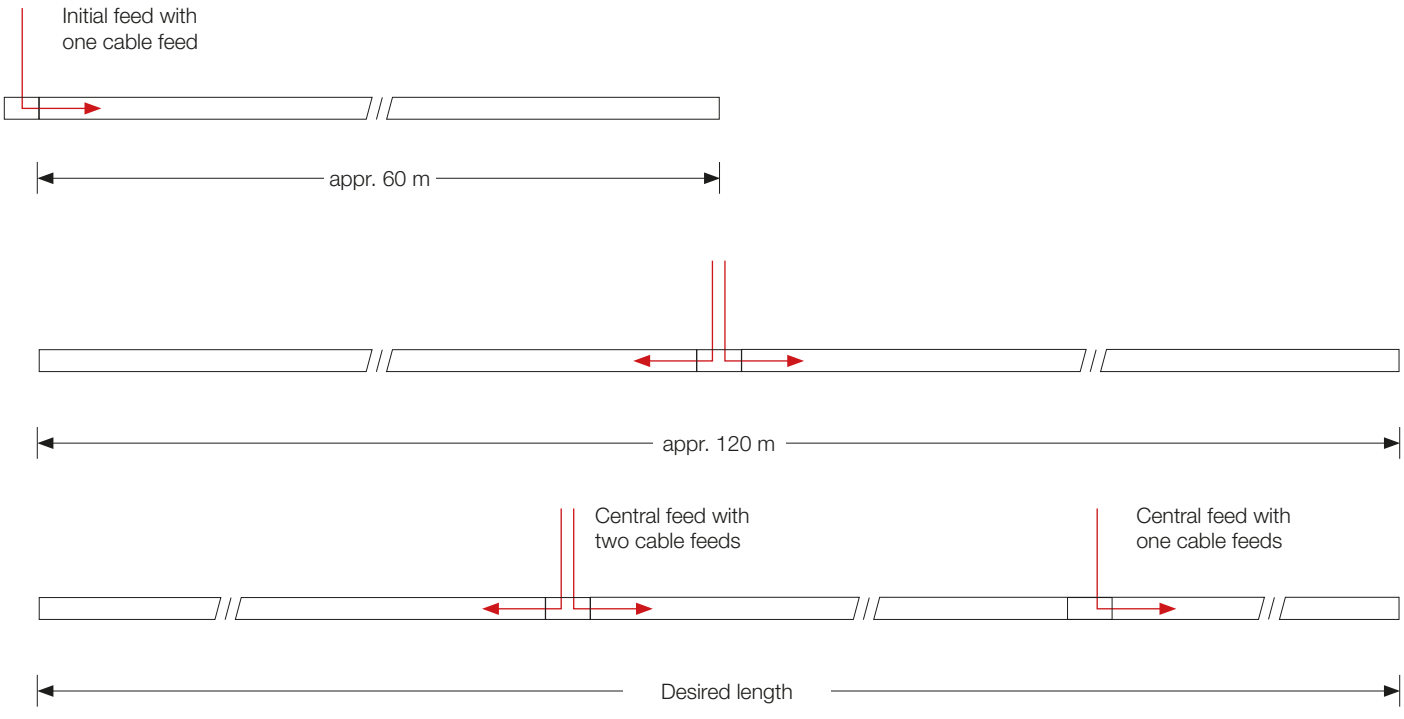
For 2273-mm-long modules, this results in 26 contact points = 0.1040 Ω and a total resistance of 0.531 Ω – which would no longer be permissible: the strip should only be 54.5 m long.

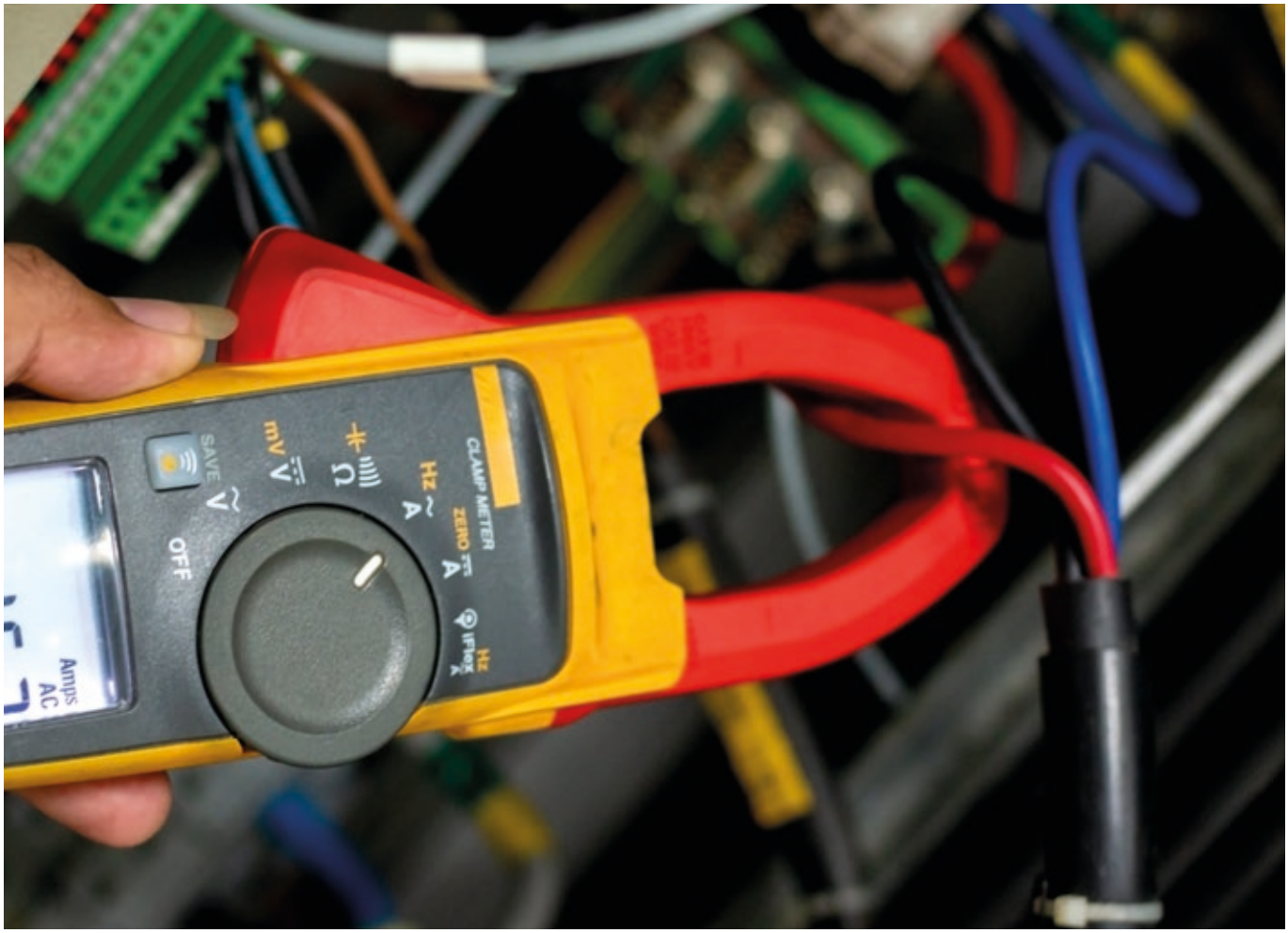
According to DIN VDE 0100, the electrician is obliged to measure this value after installation and to make any necessary changes if it is exceeded. This can be avoided by careful planning.
Please note that an ambient temperature of +20°C is assumed for these calculations. If a higher ambient temperature is expected, this must be taken into account during planning.

Protective conductor resistance for 2,273 mm modules				
Continuous-line length [m]	Number of contact points [pcs]	Copper resistance [Ω]	Contact-point resistance [Ω]	Protective conductor resistance [Ω]
40	17	0.285	0.0680	0.353
50	22	0.356	0.0880	0.444
60	26	0.427	0.1040	0.531
70	30	0.498	0.1200	0.618

Protective conductor resistance for 4529 mm modules				
Continuous-line length [m]	Number of contact points [pcs]	Copper resistance [Ω]	Contact-point resistance [Ω]	Protective conductor resistance [Ω]
40	9	0.285	0.0360	0.321
50	11	0.356	0.0440	0.400
60	13	0.427	0.0520	0.479
70	16	0.498	0.0640	0.562

If a longer continuous-line luminaire is required, this can be realised using central feeds with electromechanically separated cable feeds:





2. Leakage currents

A certain leakage current flows in every luminaire. In Europe, 3.5 mA are permissible per luminaire. In a fully fitted LINEDO continuous-line luminaire module, there are just 0.68 mA.
Too high leakage currents can cause a residual current circuit breaker (RCD) to trip if one is installed. The leakage currents of all modules on an RCD have to be added together, and the tripping tolerance of the RCD has to be considered.
If functional modules such as projector inserts, light-management inserts, etc. are used, the leakage currents may increase.

Sample calculation for a 60-metre-long continuous-line luminaire:

13 * 0,68 mA = 8,84 mA < < triggering tolerance of the RCD (15 mA) -> everything is fine

If critically high leakage currents are determined, a distribution over several feeds with separate circuits on separate RCDs is needed here, too. The leakage currents must also be checked by an electrician during installation as standard.

3. Circuit breakers

The permissible number of luminaires on each circuit breaker must be observed.
In a continuous-line luminaire, the individual modules are counted as separate luminaires.
The maximum number for category-B and -C circuit breakers with 10 A and 16 A are specified in the luminaire‘s data sheet and instructions.

With a symmetrical distribution of the luminaire modules to the three phases (plugs for phase selection) of the continuous-line luminaire, the modules’ total load can be distributed to up to three circuit breakers

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Electrical	
Control gear	Converter
Voltage	220 - 240 V / 0 Hz, 50 - 60 Hz
Luminaires on B10A fuse	8
Luminaires on B16A fuse	13
Luminaires on C10A fuse	16
Luminaires on C16A fuse	25
Inrush current / inrush current duration	82 A / 124 µs
System power	80 W
Luminaire efficacy	170 lm/W

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