Lighting technical guide

How to control and protect lighting circuits?

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[The future of energy]

50%

The required reduction in greenhouse gas emissions to stabilize greenhouse effect by 2050.

30%

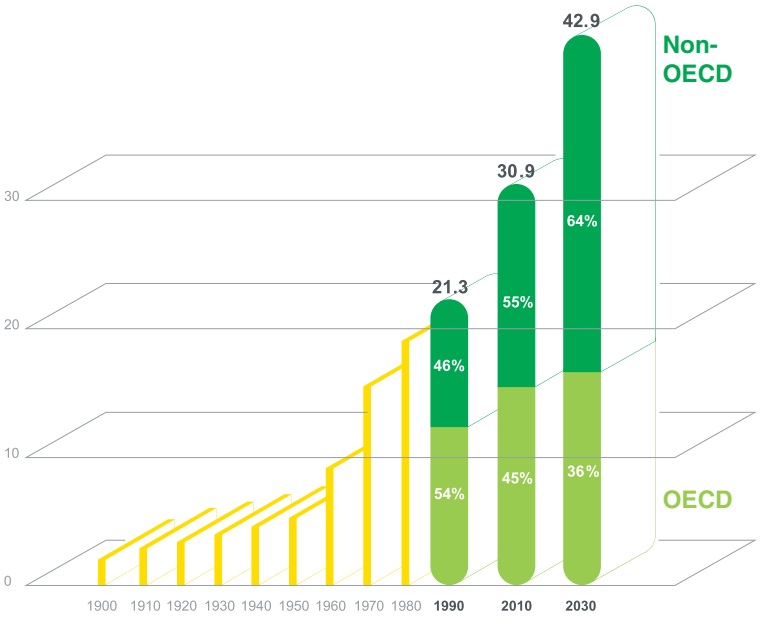
Possible savings using today's technology to reduce emissions or electrify the part of the world that is not yet electrified.

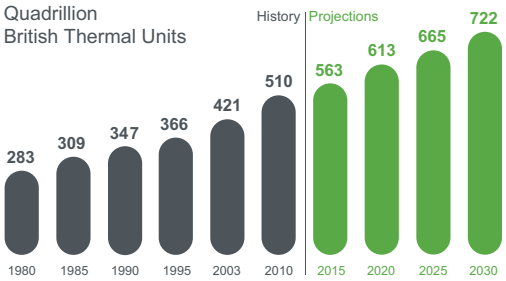
A commitment...

Why the pressure on energy use will not go away

- World energy consumption has risen 45% since 1980. It is projected to be 70% higher by 2030.
- Emerging markets (including China and India) account for more than 75% of new energy demand, placing new pressures on global resources. Meanwhile, mature markets such as North America, Europe and Japan will also face increased demand and limited resources. These mature markets will continue legislating to reduce consumption, shift to alternative energy sources, and improve energy security.
- According to forecasts, increased competition for resources and political instability will cause oil and natural gas prices to remain at or above current levels for the foreseeable future. Coal will continue to be a cheap and plentiful resource, especially in emerging markets. This will maintain the pressure to reduce emissions and will increase the need for global action to mitigate climate change.
- More than ever, global warming is at the top of the agenda. Environmental concerns and public opinion on climate change will drive continued actions by legislators, opinion leaders and special interest groups, forcing industry to respond.

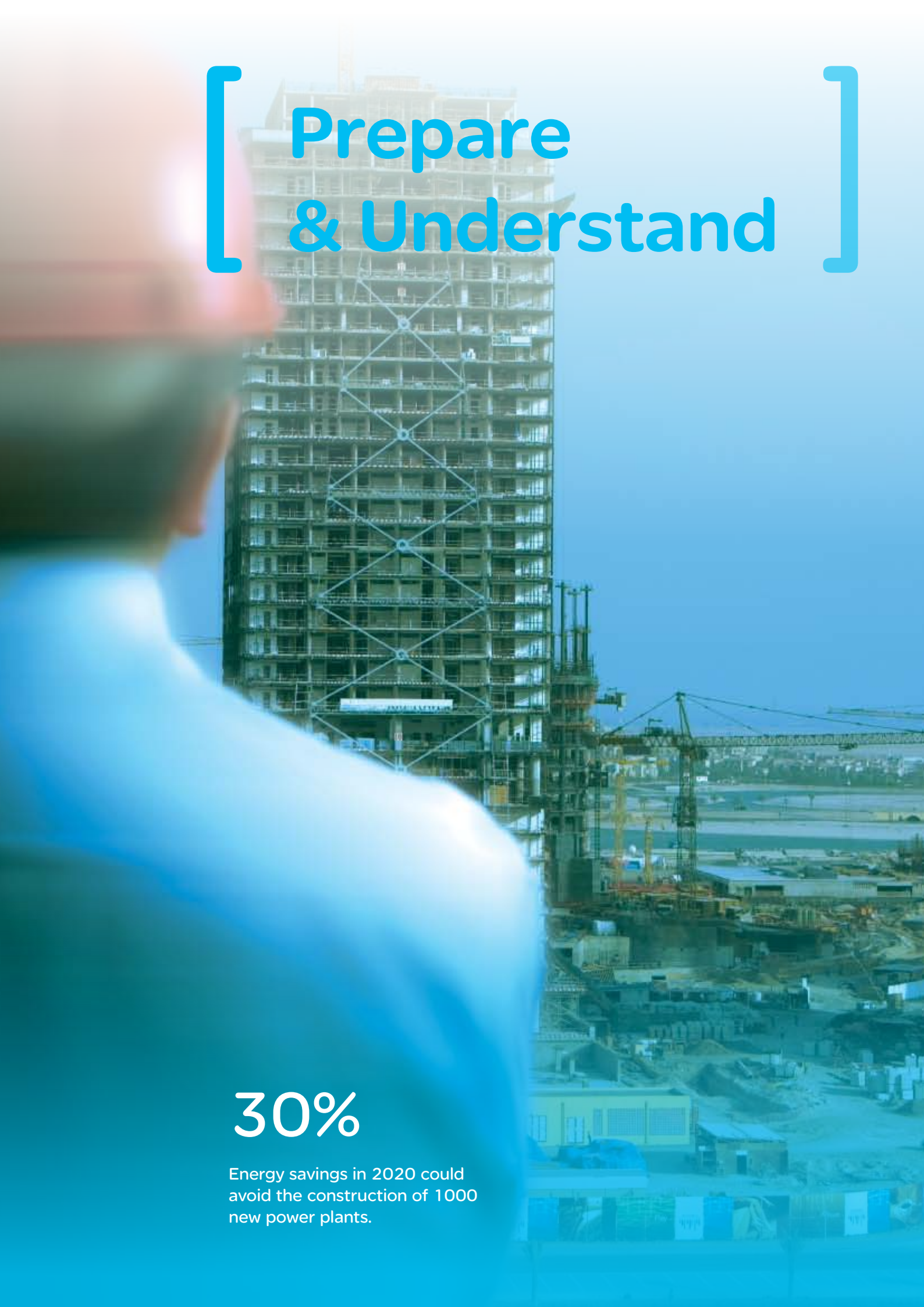
The trends we see now will continue for the next 25 years.





" We must learn to adapt and manage energy consumption, energy costs and pollutant emissions. "

Prepare & Understand



30%

Energy savings in 2020 could avoid the construction of 1000 new power plants.

A commitment...

We can all adapt to the new energy world

Energy use reduction and management will be a continued focus of policy makers. Key targets for future policies will be:

- Limiting final energy consumption in all sectors;
- Measuring and tracking energy use to establish benchmarks and targets;
- Promoting alternative green energy sources and technologies;
- Opening markets to promote emissions trading and a reduction in energy demand.

Building and Industry are the sectors offering the largest and most accessible opportunities for savings.

Make a commitment to understand the environmental impact of your business and opportunities for savings. Energy efficiency is the quickest, cheapest, cleanest way to extend our world's energy supplies.

Industry

- More than 30% of energy consumed.
- Motors account for 60% of electricity consumption.
- A medium-sized facility can reduce its energy consumption by 10% to 20%.

Buildings

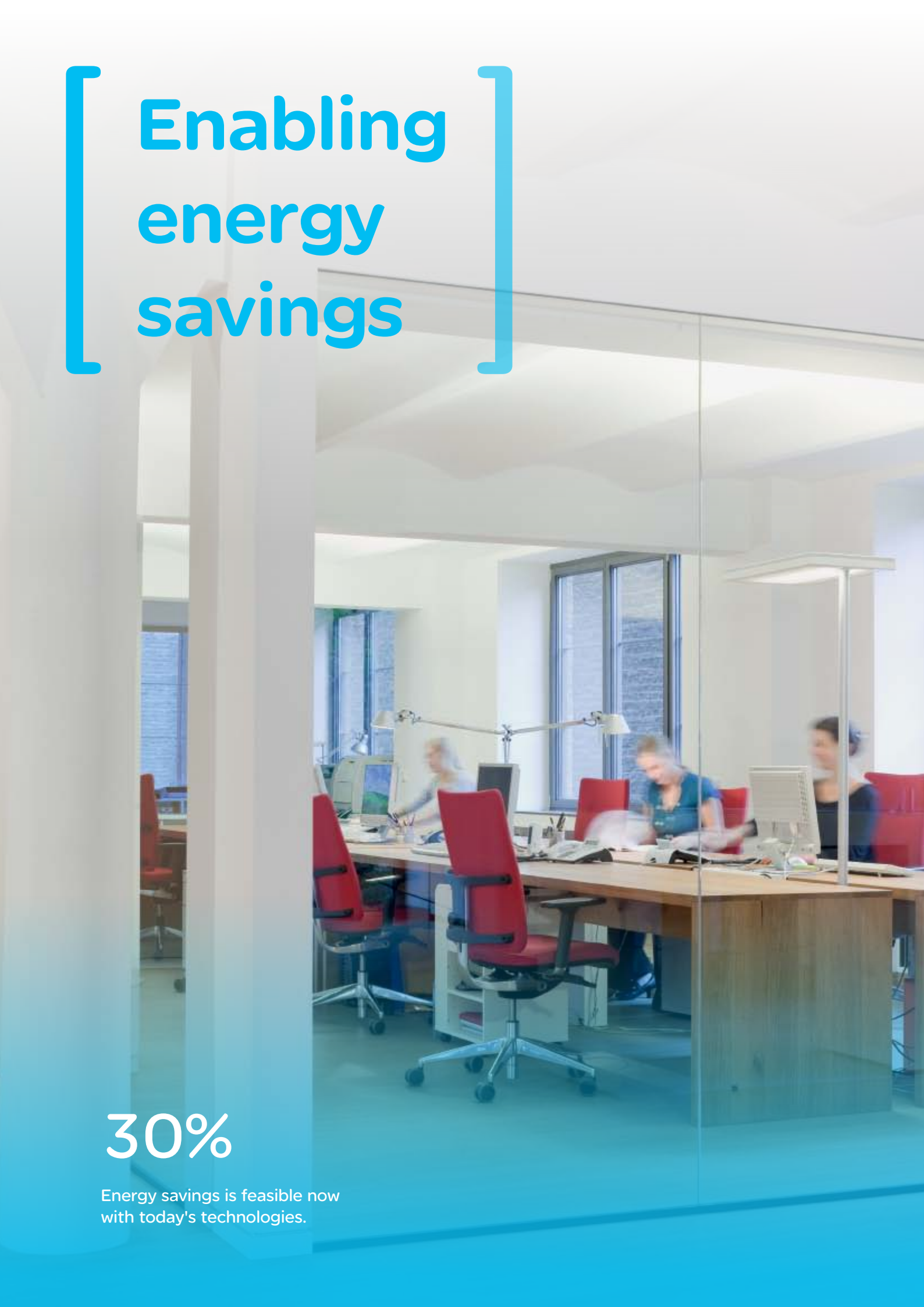
- More than 20% of energy consumed (EU and US).
- 3 key areas: HVAC, lighting & integrated building solutions.
- Technical projects can result in up to 30% energy savings.

Residential

- More than 20% of energy consumed (EU and US).
- Using energy-efficient products may give electricity savings of 10% to 40%.

" Schneider Electric has made this commitment and we can help you. "

Enabling energy savings



30%

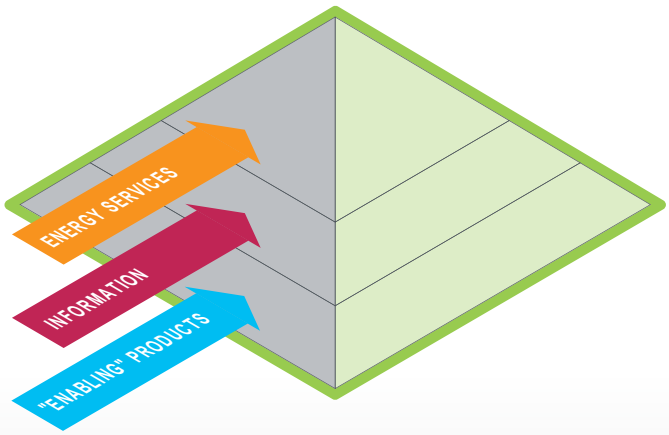
Energy savings is feasible now with today's technologies.

Solutions...

Solutions that enable and sustain energy efficiency

Our products and solutions are on every link in the energy chain, enabling energy savings of 10% to 30% or more to be achieved.

- Technology is crucial to achieving energy efficiency.
Smart innovations in energy will continue to have a significant impact on enabling energy and emissions reduction.
- Information, expertise and knowledge are crucial to apply technologies in practical and economically feasible ways.
- Behavioral and procedural rules facilitate the ability to initiate and sustain all savings.



Help customers make the right decisions to manage energy.
Provide information that allows confident decision making.
Provide technologies and solutions to enable sustainable energy savings.

Solutions & Knowledge

- **HVAC and lighting control and management.**
- **Pump and compressor control, motor control and management.**
- **Power management, critical power solutions.**
- **Facility management, process optimization.**
- **Energy information services, audits and assessments.**
- **Energy services, etc.**

Enabling technology

- Metering, Monitoring & Control, Automation & Sensors.
- Drives and motor control, Lighting control systems.
- Building automation systems, Electrical distribution.
- Power factor correction, power filtering.
- New lighting technology permitting smart management (LED, OLed).
- Uninterruptible Power Systems.
- SCADA, information systems.
- Management tools, etc.

" Schneider Electric helps its customers stand out! "

1 Opportunities...

LED technology: Great prospects to meet the challenges of energy efficiency.

The LED technology, introduced only a few years ago for functional lighting applications, has gradually become established and offers very significant prospects for progress, especially in "smart" control.

The European Commission considers that LED lamps are the sustainable alternative solution to achieve energy saving objectives in the lighting sector.

The prohibition of incandescent light bulbs has boosted new energy-efficient lamp technologies such as compact fluorescent and LED lamps.

This is a major step forward, the first lighting technology suitable for all fields of application (residential, service sector buildings, infrastructures, etc.) providing great energy efficiency and smart management capability.

Constraints to be overcome by manufacturers and installers:

- Potentially very significant current peaks at power up.
- Harmonic pollution generation.
- Overheating at the connection level.
- Radiation in the blue spectrum.

Lamps of the low-consumption compact fluorescent and halogen type remain less expensive but have weak points compared with LEDs:

- Warm-up time before nominal illumination.
- Scintillating light.
- Colors of inferior quality.
- Use of mercury.
- Shorter lifetime.

Intrinsic advantages

- Luminous efficiency.
- Long life.
- Total flexibility of control (variation, hot re-ignition, large number of switching operations).
- Integration through miniaturization, and an extra-low-voltage power supply.
- No heating on the front.
- Mechanical strength (impact and vibration resistance).
- No UV or IR emissions.
- No low- or medium-frequency radiation.
- Contain no mercury.

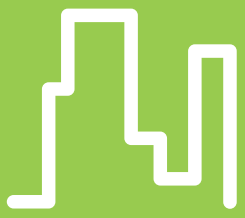
" All the forecasting studies performed by various market players confirm a complete substitution for conventional lighting sources on the 2025-2030 horizon! "

Lighting accounts for a considerable proportion of electricity consumption, whatever the sector.

Residential

40%

Service sector



25% to 50%

Industry

10%

Urban authorities

40% (outdoor lighting)

Careful consideration should therefore be given to the technologies used, in order to strike the best balance between usage and total cost.

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Step-by-step procedure
Introduction

Project specifications and financial constraints

The lighting design depends on:
- The field of application,
- The use of the premises,
- The initial investment,
- Operation and maintenance.

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Type of lamps

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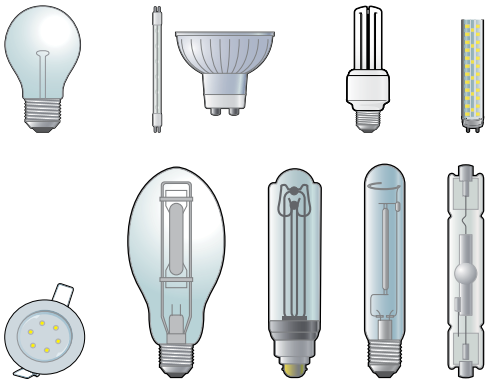
- General characteristics
- Electrical constraints



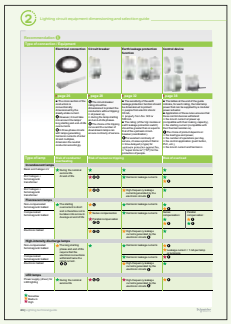
Power supply and control

- Protection
- Single control
- Automatic control
- Remote management

Energy Efficiency

Selection of devices for energy savings and improved comfort.

Recommendations



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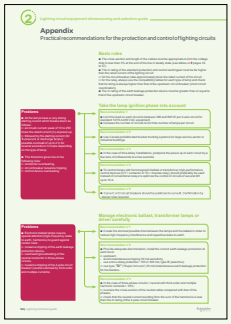
Practical recommendations



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Cables and networks

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• Cable cross section dimensioning factors

• Prefabricated busbar trunking, Canalis type

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Protective devices

• Circuit breakers

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Control devices

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• Impulse relay, Contactor, Relay

• Reflex iC60

• RCA circuit breaker remote control

Dimensioning:
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Management and remote management devices

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• IHP, IC, MIN, etc.

Acti 9 Smartlink, BMS, etc.

Dimensioning:
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Emergency lighting

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Dimensioning:
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Project specifications and financial constraints
Selection criteria

The application

Outdoors

5…70 lux

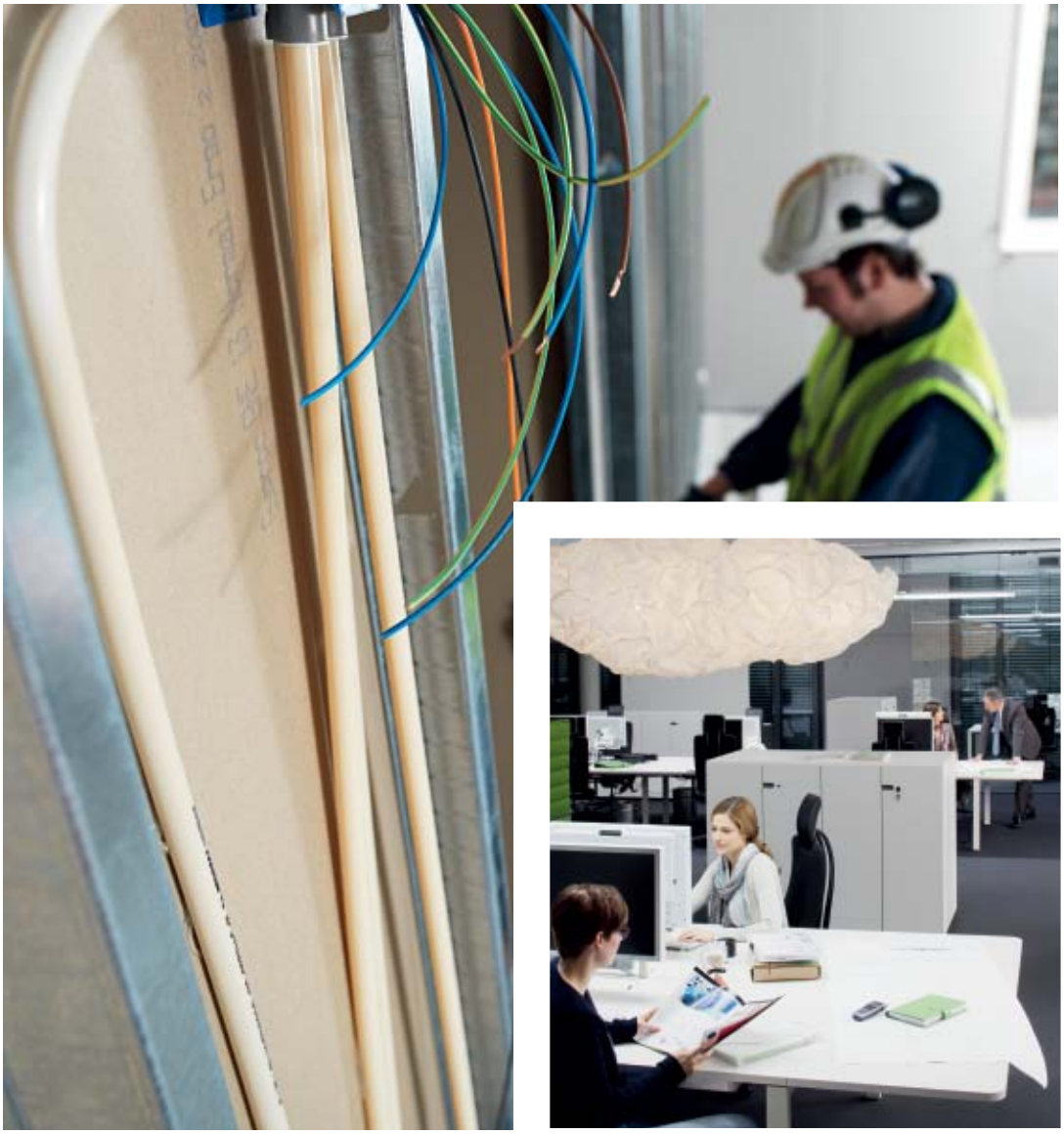
Warehouse

125…300 lux

Home

200 lux

The work of the lighting designer involves creating specific lighting atmospheres using different types of lamps.



Office

400…500 lux

Workshop

300…1000 lux

Shop

500…1000 lux

Studio

2000 lux

Illumination level and quality

Lamp power output

Varies according to the chosen technology and is influenced by the color of the premises and the amount of natural light.

Distance (d) between the lamps and the area to be lit

The illumination level is proportional to $1/d^2$.

Luminaire

The shape and efficiency of the reflector create a more or less focused light beam. For example, a spot lamp has a small angle which generates a stronger but more localized light.

The initial investment

Electrical architecture

The number of lamps used, their output and geographical distribution determine the number of circuits, the cross-section and length of electrical connections, the control and protection devices and the associated lighting components (transformer, ballasts, possible reactive compensation, etc.).

Cost of lamps

The cost varies according to the technology chosen.
Generally, lamps with high lighting efficiency and long-life lamps are expensive, and vice versa.

Cost of luminaires

The luminaire depends mainly on the application.
Other criteria can be used to narrow down the choice: attractiveness, price, climatic conditions, etc.

Operation and maintenance

Consumption

Consumption depends on:
- the lighting efficiency and the output, type and number of lamps used,
- optimization of ignition times.

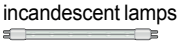
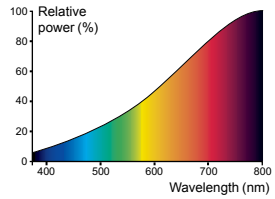
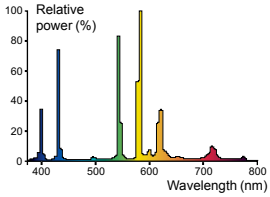
Service life

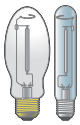
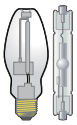
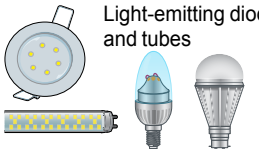
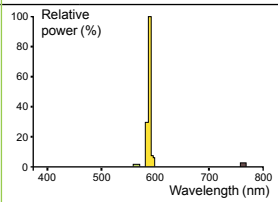
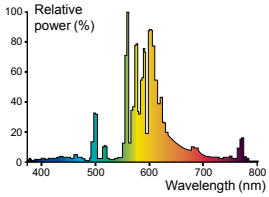
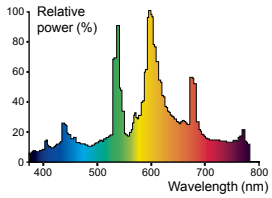
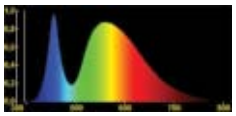
The service life varies according to the chosen technology.
Lamps with a long service life are expensive, but require less frequent maintenance.

Accessibility

Accessibility determines the number of man-hours and whether lifting equipment is required (basket). It must be taken into consideration, depending on the required continuity of service and the operating environment (vehicle traffic, presence of the public, opening hours, etc.).

The various types of lamp
General characteristics

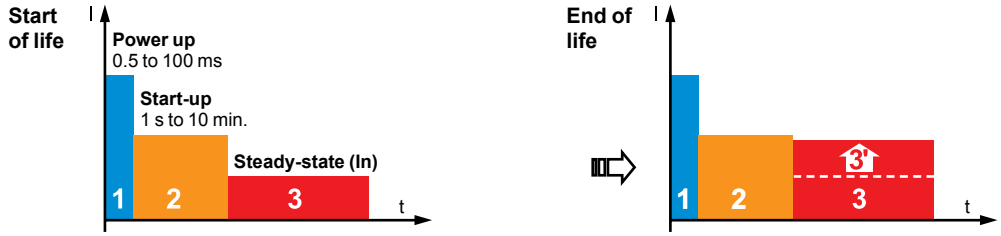
Types of lamps		Incandescent lamps			Fluorescent lamps	
		 Basic lamps	 LV halogen lamps Replacing incandescent lamps 	 ELV halogen lamps 	 Compact fluorescent lamps	 Fluorescent tubes T5, T8
Associated component required for operation		-	-	Electromagnetic or electronic transformer	Integral or external electronic ballast (same as for fluorescent tube)	Ferromagnetic ballast + starter + possibly a capacitor or electronic ballast
The application						
Lamp power output (most common rated powers)		400 to 1000 lm (40 to 100 W)	2000 to 10,000 lm (100 to 500 W)	400 to 1000 lm (20 to 50 W)	300 to 1600 lm (5 W to 26 W)	850 to 3500 lm (14 to 58 W)
Lighting efficiency (lm/W)		5 to 15	12 to 25		45 to 90	40 to 100
Lighting quality	**Lighting spectrum** It determines the quality of the light (the fuller the spectrum, the closer it is to sunlight)					
	Color rendering	★★★★★			★★ or ★★★ according to the price and type of lamp	
	Ambience	Warm			Variable from cold to rather warm	
Installation	**Height**	2 to 19 m	Average	2 to 19 m	Average	19 to 12 m
	Comments		Direct or indirect lighting			Suspended, flush mounted or surface-mounted
Number of switching operations (on/off)		★★★★ (high)			★★ (several times each hour)	
Ignition time		Instantaneous			A few seconds (almost instantaneous with some electronic ballasts)	
Use	**Interior lighting**	■ Homes, shops, restaurants	■ Projector, spotlight, indirect lighting in housing or shops	■ Homes ■ Shops: spotlights, window displays ■ Lighting in humid locations: bathroom, swimming pool	■ Homes ■ Offices, showrooms ■ Shops	■ Offices, schools, clean rooms ■ Industry: warehouses, workshops ■ Large commercial areas: supermarkets, garages, shops, gymnasia
	Exterior lighting				■ Under shelter, at the entrance to buildings	■ Lighting for a pedestrian path on bridges and foot bridges
The initial investment						
The lamp	**Price range** (most common rated powers)	$0.5 to $10 (40 to 100 W)	$5 to $30 (100 to 500 W)	$2 to $50 (20 to 50 W)	$2 to $50 (5 to 26 W)	$2 to $30 (14 to 58 W)
	Max. price	$25	$120	$55	$100	$70
Associated components		-	-	■ Transformer: □ electronic: $10 to $50 □ ferromagnetic: $7 to $20	■ Electronic ballast: from $15 to $200 ■ Ferromagnetic ballast: from $7 to $20 + starter: from $0.5 to $15	
Luminaire	**Price range**	$10 to $30			$15 to $60	
Operation and maintenance						
Service life	**Range**	1000 to 2000 h	2000 to 4000 h		5000 to 20,000 h	7500 to 20,000 h
	Comments	Service life divided by two in the event of overvoltage > 5%			50% longer with external electronic ballasts by comparison with ferromagnetic ballasts	
Average consumption to emit 10,000 lm during 10 h		10 kWh	5 kWh	5 kWh	1.7 kWh	1.7 kWh
Analysis						
Strengths ★ **Weaknesses ★**		★ Instant ignition ★ Frequent switching possibility ★ Lower investment costs ★ Low efficiency, 95% of energy dissipated in the form of heat, which requires good ventilation ★ High consumption ★ High operating cost: frequent maintenance		★ Dimensions of the transformer	★ Low operating cost: little maintenance ★ Energy savings ★ Does not withstand frequent switching ★ Single-tube versions with magnetic ballast and entry-range compact lamps generate visible flicker ★ Useful replacement for basic incandescent lamps	★ Requires numerous luminaires, size ★ Unattractive basic version
Notes		Declining technology. As part of their energy saving programs, some countries and regions (Australia, California, Canada, Cuba, China, Europe, etc.) are planning to phase out the use of incandescent lamps.			Most widely used technology for a large number of uses. Excellent value for money.	

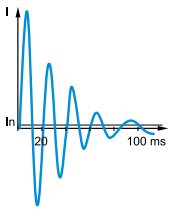
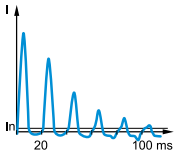
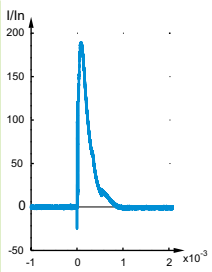
	High-intensity discharge lamps			LED lamps
	 Low-pressure sodium vapor lamps	 High-pressure sodium vapor lamps	 ■ Metal-iodide lamps ■ Metal-halide lamps	 Light-emitting diode lamps and tubes
	Ferromagnetic ballast + starter + possibly a capacitor or electronic ballast (for lamp up to 150 W)			Electronic driver (integrated or non-integrated)
	3900 to 20,000 lm (26 to 135 W)	7000 to 25,000 lm (70 to 250 W)	7000 to 40,000 lm (70 to 400 W)	Low-power LED network or power LEDs (1 to 3 Watts)
	110 to 200	40 to 140	70 to 120	80 to 120 (constantly improving)
				Lighting spectrum defined by the manufacturer 
	★	★★★	★★★★	Numerous color rendering and ambience possibilities
	Monochromatic orange	Dominant yellow	Dominant white	
	-	> 3 m	> 3 m	Appropriate answer to all application cases
	At a height or on the ground			
	★ (several times each day)			★★★★★ (very high)
	Several minutes to reach the nominal illumination level			0.5 s
		■ For white sodium only: shopping malls, warehouses, showrooms	■ Shopping malls, showrooms, gymnasia ■ Factories, workshops ■ Horticulture ■ Theatre, stage	■ Already in the standards: □ road lights, traffic signs, routing □ decoration □ battery-operated handheld or isolated lighting. ■ Replacement solution for most conventional lamps (incandescent, halogen, fluorescent tubes, high-intensity discharge lamps)
	■ Tunnels, motorways ■ Safety lighting ■ Runway lighting	■ Public lighting ■ Roads, monuments ■ Tunnels, airports, docks, car parks, parks	■ Public lighting ■ Pedestrian streets, stadiums ■ Safety lighting ■ Worksite lighting ■ Airports	
	$40 to $150 (26 to 135 W)	$20 to $90 (70 to 250 W)	$30 to $150 (70 to 400 W)	$10 to $1500 The LED is often incorporated in the luminaire
	$170 (180 W)	$290 (1000 W)	$500 to $1000 (2000 W)	
	■ Ferromagnetic ballast: from $20 to $200 (high power: from $80 to $600) + starter: from $15 to $100			Electronic driver, if external: $15 to $200
	$100 to $200			$10 to $200
	12,000 to 24,000 h	10,000 to 22,000 h	5000 to 20,000 h	> 50,000 h
	50% longer with external electronic ballasts by comparison with ferromagnetic ballasts			■ Independent of the switching frequency ■ The quality of the driver influences the overall service life
	0.7 kWh	1 kWh	1 kWh	1 kWh
	★ Low operating cost: little maintenance ★ Energy savings ★ Very powerful lighting ★ High investment cost ★ Long or very long ignition time (2 to 10 minutes)	★ Operate down to -25°C emitting very little heat		★ Very long service life of LED component ★ Impact and vibration resistance ★ Unlimited number of switching operations ★ Instant ignition ★ No ultraviolet or infrared emissions ★ Size of the driver and heat sink for power LEDs ★ Harmonic generation ★ Major inrush current
	Becoming obsolete Good energy efficiency, poor IRC	Most frequently used technology for outdoor public lighting Gradual replacement by LEDs	The trend is to use them as a useful replacement for high-pressure sodium lamps	Technology seeing significant expansion: ■ increased performance ■ fall in prices

The various types of lamp

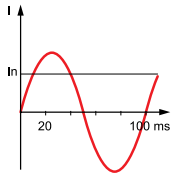
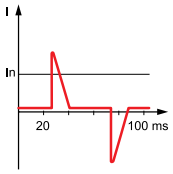
Impacts of selected lamps on the choice of components

Current profile of a lamp in its various phases, over time



Lamp selected	Induced electrical constraints			
Page 18	1 Inrush current at power up			2 Starting current
				All discharge lamps (fluorescent and high intensity) require a phase of gas ionization before ignition which causes higher consumption (starting) Intermediate phase of driver start-up
	Very low resistance of the filament when cold	Initial saturation of ferromagnetic circuits	Initial loading of circuit capacitors	
Incandescent lamps				
Basic and halogen LV	■ 10 to 15 In for 5 to 10 ms			
ELV halogen + ferromagnetic transformer		■ 20 to 40 In for 5 to 10 ms		
ELV halogen + electronic transformer			■ 30 to 100 In for 0.5 ms	
Fluorescent lamps				
Non-compensated ferromagnetic ballast		■ 10 to 15 In for 5 to 10 ms		■ Duration: from a few tenths of a second to a few seconds ■ Amplitude: from 1.5 to 2 times the rated current In
Compensated ferromagnetic ballast			■ 20 to 60 In for 0.5 to 1 ms	
Electronic ballast			■ 30 to 100 In for 0.5 ms	
High-intensity discharge lamps				
Non-compensated ferromagnetic ballast		■ 10 to 15 In for 5 to 10 ms		■ Duration: from 0.5 to 1.5 s ■ Amplitude: from 1.1 to 1.6 times the rated current In
Compensated ferromagnetic ballast			■ 20 to 60 In for 0.5 to 1 ms	
Electronic ballast			■ 30 to 100 In for 0.5 ms	
LED lamps				
Power supply (driver) for LED lighting			■ 30 to 250 In* for 0.1 to 1 ms	■ Duration: from 0.5 to 1.5 s ■ Amplitude: 2 times the rated current In

(*) LED lamps: the disturbance levels (current peaks at power up, harmonics) are highly variable from one manufacturer to another and from one type of LED lamp to another.

	3 Steady-state current		3' End of life	Power factor
	 Non-deformation on passive impedances	 Distortion created by electronic converter rectification / filtering	Higher consumption beyond the nominal service life (time after which 50% of the lamps of a given type are at end of life)	■ Power consumed (W) / apparent power (VA) ■ < 1 in the presence of non-compensated reactive circuits (dominant inductance or capacitance) ■ Determines the rated current of the circuit according to the lamps' power output and losses
	■		Up to two times the rated current	1
	■			Close to 1 at full load
		■		> 0.9
	■		Up to two times the rated current	0.5
	■			> 0.9
		■		> 0.9 with external ballast 0.5 with integral ballast
	■		Up to two times the rated current	0.5
	■			> 0.9
		■		> 0.9
		■ Harmonic* THDI < 20%	Not applicable	> 0.9

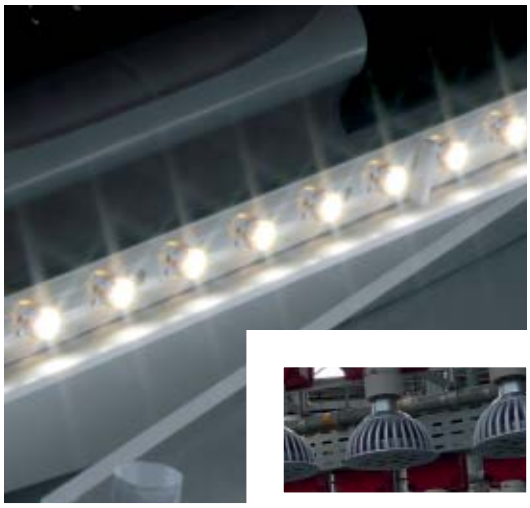
The various types of lamp
LED lighting technology: principles

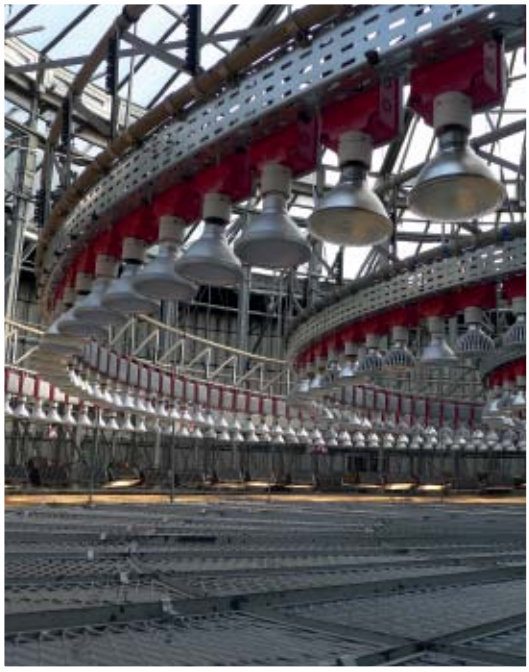
■ Many countries have taken the decision to gradually phase out the most "energy-hungry" lamps.
■ EU countries are not the only ones to have decided to ban incandescent lamps.
■ (Brazil, Venezuela in 2005), Australia, Cuba, (Argentina, Russia, Canada in 2012), the United States (2014), etc. have done likewise.
■ In Europe it is the 2005/32 directive called Energy Using Products (EuP) which specifies phasing out of the least efficient lamps and led to the production of Regulations 244/2009 and 245/2009.

Standard	Year	Disappearance
European Regulation 244/2009	2013	Incandescent lamps > 25 W
	2017	2-pin compact fluorescent lamps
	2018	Eco-halogen lamps
	2018	All lamps having an energy efficiency other than "A"
European Regulation 245/2009	2010	T8 halophosphate tubes
	2012	T10 and T12 tubes of Ra < 80
	2015	High-pressure mercury vapor lamps
	2017	High-pressure sodium vapor lamps to replace mercury vapor lamps
	2017	Metal-iodine lamps < 405 W, the least efficient
	2017	Ferromagnetic ballasts for class B1 and B2 fluorescent lamps

European Regulation 244/2009: ecodesign requirements for non-directional household lamps.

European Regulation 245/2009: ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps.





General characteristics

LED means Light Emitting Diode.
A LED is a diode type semiconductor which emits visible electromagnetic radiation when a current passes through it.

The entity formed by the LED, its substrate and a primary optical unit is called the **LED component**. This LED component provides protection for the semiconductor and dissipates the heat generated.

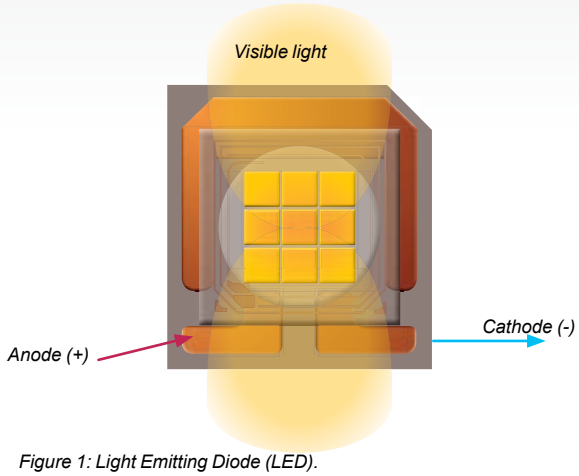


Figure 1: Light Emitting Diode (LED).

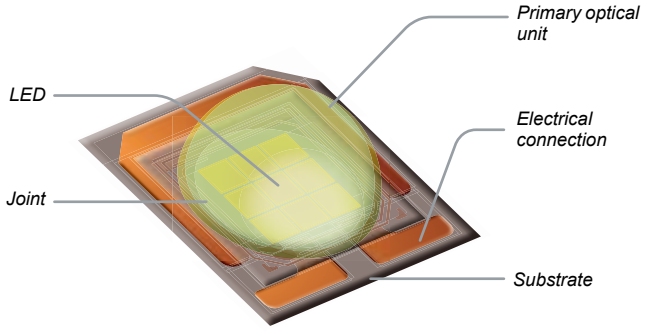


Figure 2: LED component.

It is also possible to obtain from LED suppliers **printed circuit boards** on which several LED components are already mounted.

The **LED module** is the assembly of one or more LED components with optical, mechanical and thermal elements.

A **driver** is an electronic device which can convert the electric power of a low-voltage AC electrical network into electric power appropriate for the LED luminaire (direct voltage and current).
The driver may be external or integral with the luminaire.
A driver can power one or more luminaires.

A **LED luminaire** is a complete system consisting of a LED module, a housing, an optical reflector, wiring, connectors, joints and a heat dissipation system (heat sink or fan).

Figure 3: Printed circuit board with pre-fitted LEDs.

Figure 4: LED module.

Figure 5: Driver.

Figure 6: LED industrial luminaire.

LED lighting technology: Electrical characteristics

At power up, a variable current is demanded by the luminaires during the first second, and the current stabilizes as soon as rated operating conditions are reached.
For luminaire starting, three transient states have been identified:

- State 1: inrush current.
- State 2: driver starting.
- State 3: powering the LED load.

These states are numbered on Figure 7. State 4 corresponds to steady-state operating conditions.

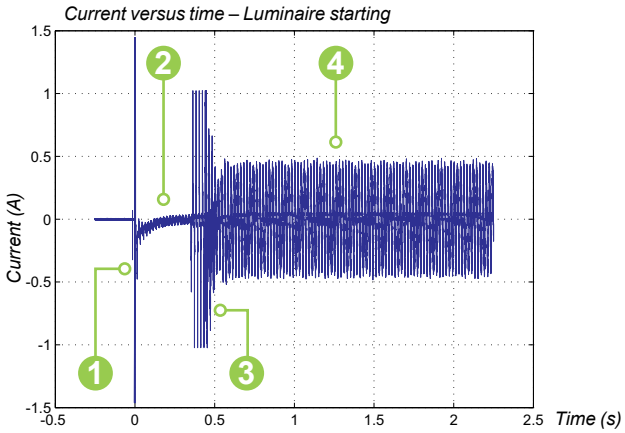


Figure 7: Current versus time.

In the initial moments following luminaire power up, a significant transient current appears (up to about 250 times the rated current). The duration of this current due to the capacitors present in the driver is less than 1 ms for a single luminaire.

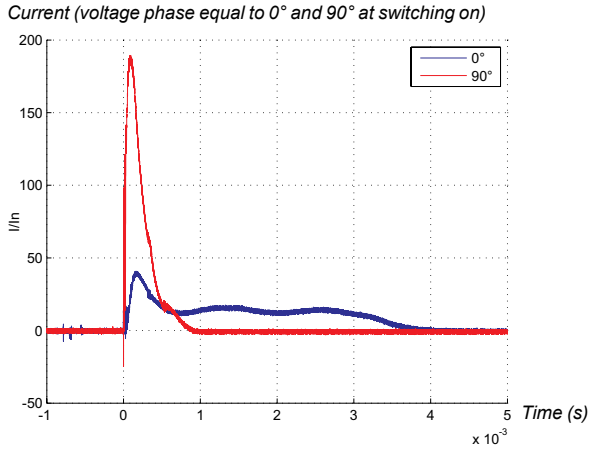


Figure 8: Current at switching on.

Recommendation 1

Type of connection / Equipment

	Electrical connection	Circuit breaker	Earth leakage protection function	Control device
				
	page 26	page 28	page 32	page 38
	■ The cross section of the conductors is conventionally dimensioned by the steady-state current. (A) However, it must take into account the lamps' long starting and end-of-life overcurrents. (B) In three-phase circuits with lamps generating harmonic currents of order 24 and multiples, dimension the neutral conductor accordingly.	(C) The circuit breaker rating should be dimensioned to protect the conductors without tripping: □ at power up, □ during the lamp starting and end-of-life phases. (D) The choice of its tripping curve and the number of downstream lamps can ensure continuity of service.	■ The sensitivity of the earth leakage protection function should be dimensioned to protect: □ people from electric shock: 30 mA, □ property from fire: 300 or 500 mA. ■ The rating (of the Vigi module or earth leakage protection switch) should be greater than or equal to that of the upstream circuit breaker (coordination). (E) For excellent continuity of service, choose a product that is: □ time-delayed (s type) for upstream protection against fire, □ "super immune" ("*SI*") for the protection of people.	■ The tables at the end of the guide indicate, for each rating, the total lamp power that can be supplied by a modular power actuator. ■ Application of these rules ensures that these control devices withstand: □ the inrush current at power up (compatible with their making capacity), □ the starting current (compatible with their thermal resistance). (F) The choice of product depends on: □ the load type and power, □ the number of operations per day, □ the control application (push button, PLC, etc.), □ the inrush current and harmonic.

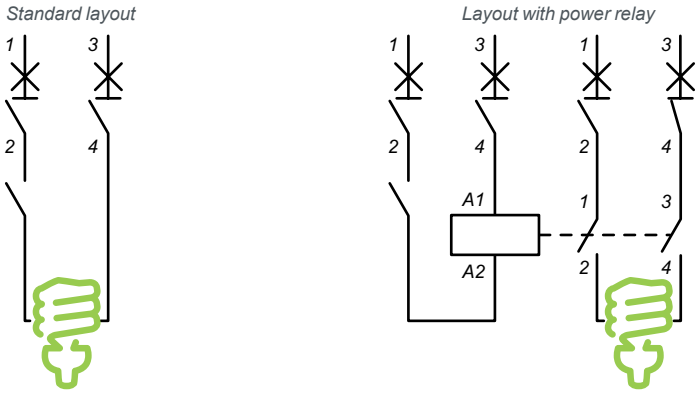
Type of lamp	Risk of conductor overheating	Risk of nuisance tripping		Risk of overload	
Incandescent lamps					
Basic and halogen LV	★ During the nominal service life. At end of life	★	★	★	
ELV halogen + ferromagnetic transformer		★ (C) (D)	★ Harmonic leakage currents	★ ★ (F)	
ELV halogen + ferromagnetic transformer		★ (C) (D)	★ High-frequency leakage currents generated by the electronic circuits (E)	★	
Fluorescent lamps					
Non-compensated ferromagnetic ballast	★ The starting overcurrent is short and is therefore not to be taken into account. Average at end of life	★ (C)	★ Harmonic leakage currents	★ ★ (F)	
Compensated ferromagnetic ballast		★ Series compensation ★ Parallel compensation (C) (D)	★ Harmonic leakage currents	Series compensation: ★ ★ (F)	Parallel compensation: ★ (F) ★ (F)
Electronic ballast		★ (C) (D)	★ High-frequency leakage currents generated by the electronic circuits (E)	★	
High-intensity discharge lamps					
Non-compensated ferromagnetic ballast	★ The long starting phase and end of life require that the electrical connections withstand twice the rated current. (A) (B)	★	★ Harmonic leakage currents	★ (F) ★ Leakage current < 1 mA per lamp or luminaire	
Compensated ferromagnetic ballast			★ Harmonic leakage currents	★ (F)	
Electronic ballast			★ High-frequency leakage currents generated by the electronic circuits (E)	★	
LED lamps					
Power supply (driver) for LED lighting	★ During the nominal service life	★ (C) (D)	★ High-frequency leakage currents generated by the electronic circuits (E)	★ (F)	

★ None/low
★ Medium
★ High

Recommendation 2

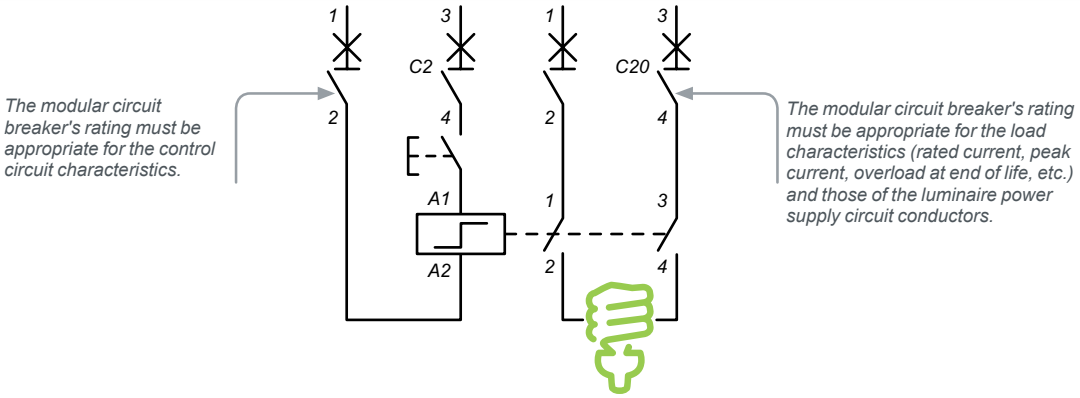
A lighting circuit can be powered up/down with a simple wall- or panel-mounted switch.
Very often this switch will not be appropriate or sufficient:
- Powering up of high-power lighting loads.
- Distribution with cables of large cross section up to the control circuit apparatus.
- Three-phase distribution.
- Control with a safety voltage.
- Multiple controls above 2 control points.
- Need for automatic management control.

To meet these needs, circuit control by a power relay (contactor or impulse relay) is necessary.



Recommendation 3

Separation of protection from the control circuit.
It should be ensured that the control circuit protection is appropriate for the circuit's characteristics and specific features:
- Conductor cross section.
- Permissible rated current for control functions (switch, PLC output, push button, etc.).



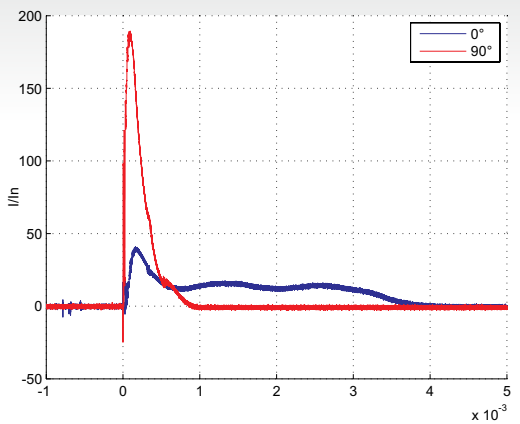
- Generally, the two circuits should be protected separately, with appropriate circuit breaker ratings and curves.
- The control circuits for several lighting feeders can be protected by the same circuit breaker.

Recommendation 4

In case of:
- Potential risks of overcurrents generated by the loads at power up which could cause tripping.
- Proven tripping of protective devices due to an excessive current peak generated by the loads.

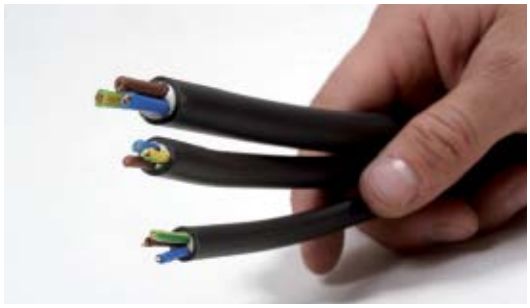
And
- Impossibility of changing the protection characteristics (rating, curve, etc.).

One solution is to use a contactor or impulse relay with closing controlled by zero voltage, of the iTL+ or iCT+ type (▸ page 38)**.**
In addition, this product can limit overvoltage.



Selection of electrical distribution systems

Principles for selection of cables and prefabricated busbar trunking



Power connections

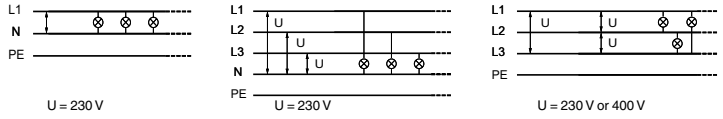
■ The electrical power connections have the role of transporting energy from the electrical switchboard to the lighting loads.
■ They can be formed of cables or prefabricated busbar trunking.
■ Where large areas have to be lit, they comprise a main circuit and branch circuits to the luminaires.
■ Their selection depends on various constraints:
□ safety (insulation, little overheating, mechanical strength, etc.),
□ efficiency (limited voltage drop, etc.),
□ installation environment (location, installation procedure, temperature, etc.),
□ investment cost.

Cable cross section dimensioning factors

Rated current of circuits

■ The total circuit power must be analyzed and calculated:
□ lamp power consumption,
□ any lamp ballast or transformer losses.
■ Depending on the type of load and any compensation, a power factor must be applied. A poor power factor, for example, can double the current flowing through the circuits.
■ For electrical connection dimensioning, one should allow for the fact that the lamps consume 1.5 to 2 times their rated current:
□ at end of life for all lamps,
□ during the long starting phase for high-intensity discharge lamps.

Single-phase or three-phase distribution with or without neutral



In most buildings used for tertiary or commercial purposes, the lighting system is distributed via a single-phase circuit. To optimize the cabling, especially for high-power applications over large areas, three-phase distribution is sometimes used: 230 V between phase and neutral or between phases, or 400 V between phases for high-power lamps (2000 W).

Length of electrical connections

The cable resistance causes a voltage drop proportional to the cable length and the current. It can cause malfunctions when the lamps are switched on or reduce the luminosity in steady state. The length of the circuits and the distributed power require an appropriate cable cross section.

Conductive material

Copper is less resistive but more expensive than aluminum.
The use of aluminum is reserved for high-current electrical connections.

Installation procedure

Buried or otherwise, on cable trays or embedded, etc.

Mutual interference in the case of adjacent circuits

Type of insulating material

Ambient temperature

1% to 2% derating per °C above the nominal temperature.

Derating factors to prevent overheating of electrical connections

Loaded neutral correction factor

In the case of three-phase circuits supplying discharge lamps with electronic ballasts, harmonic currents of the third order and multiples of three are generated. They flow through the phase conductors and combine in the neutral cable, possibly causing an overload. The circuit must therefore be sized according to this harmonic content.

Conductor cross section

Cables: fast dimensioning ▸ page 34

Optimized calculation: ▸ "CanBrass" software

Usual values

■ Power output per phase of a lighting circuit:
□ common values: 0.3 to 0.8 kW,
□ maximum values:
- 110 V: up to 1 kW,
- 220 to 240 V: up to 2.2 kW.
■ Power factor: > 0.92 (compensated circuit or electronic ballast).
■ Maximum permissible voltage drop (ΔU) in steady state:
□ 3% for circuits of less than 100 m,
□ 3.5% tolerated above 200 m.
■ Cable cross section:
□ most commonly (< 20 m): 1.5 or 2.5 mm^2,
□ very long (> 50 m) high-power circuit, to limit voltage drops: 4 to 6 mm^2, or even 10 mm^2 (> 100 m).

Type of electrical connections	Cables	Canalis busbar trunking
		
Criteria to be taken into account for selection		
Installation procedure (generating possible overheating)	■	
Mutual interference in the case of adjacent circuits	■	
Ambient temperature	■	■
Type of electric insulating material	■	
Loaded neutral correction factor (three-phase circuit with high harmonic distortion factor)	■	■
Conductive material	■	
Length of electrical connection	■	■
Rated current of circuits	■	■ Simplified selection according to the type of lamp
Halogen-free material	■	

Canalis prefabricated busbar trunking

These systems meet the needs of all applications in commercial, tertiary and industrial buildings.

Canalis: Fast dimensioning ▸ page 34

Optimized calculation: ▸ "CanBrass" software

Advantages in every stage in the life of a building

Design

■ Simplified electrical circuit diagram.
■ Direct selection of the model according to the type and number of lamps.
■ Direct correspondence between the circuit breaker rating and that of the duct (example at 35°C: KDP 20 A > 20 A .).
■ Guaranteed performance irrespective of the installation (in accordance with the IEC 604279-2 standard).
■ Suitable for all environments: IP55 standard, in conformity with sprinkler tests.
■ Protects the environment: RoHS.
■ No halogen: releases no toxic fumes in case of fire.

Implementation

■ Ease of installation: no risk of wiring error.
■ Can be installed by unskilled personnel (connection by connectors, polarizing, etc.).
■ Reduction in worksite time, control of completion times.
■ Prefabricated, pretested: operates immediately on commissioning.

Operation and maintenance

■ Quality of contacts of clamp type active conductors.
■ Long service life, maintenance-free (up to 50 years).
■ Continuity of service and safety: servicing can be performed on live lines.
■ Significant reduction in radiated electromagnetic fields.

Changes in the building

■ Modular, hence dismountable and reusable.
■ Refitting of premises and their light fittings facilitated by the branch connections available at regular intervals.
■ Legibility of the installation for servicing operations and upgrades.

		Canalis KDP	Canalis KBA	Canalis KBB
				
Installation	Type	Flexible	Rigid	Very rigid
	Installation procedure	■ Installed in suspended ceiling or raised flooring ■ Attached to the building structure (installation spacing up to 0.7 m)	■ Suspended (installation spacing up to 3 m)	■ Suspended (installation spacing up to 5 m)
Luminaire attachment to the duct		No	Yes	Yes
Power circuits	Quantity	1	1	1 or 2
	Type	■ Single-phase ■ Three-phase	■ Single-phase ■ Three-phase	■ Single-phase ■ Three-phase ■ Single-phase + single-phase ■ Single-phase + three-phase ■ Three-phase + three-phase
Single-phase: 2 conductors + PE *Three-phase: 4 conductors + PE*				
Lighting control circuit (0-10 V, Dali)		-	Optional	Optional
Rating		20 A	25 or 40 A	25 or 40 A
Protection by fuses		With tap-off KBC 16DCF..	With tap-off KBC 16DCF..	With tap-off KBC 16DCF..
Tap-off spacing		1.2 - 1.35 - 1.5 - 2.4 - 2.7 – 3 m	No tap-off or 0.5 - 1 - 1.5 m	No tap-off or 0.5 - 1 - 1.5 m

Selection of protection systems
Circuit breaker selection principles

iC60N / DPN circuit breakers *Reflex iC60*

■ Protective devices are used to:
□ guard against fires that might be caused by a faulty electric circuit (short-circuit, overload, insulation fault),
□ protect the workforce against electric shock in the event of indirect contact.
■ The choice of protective devices must be optimized to provide absolute protection while ensuring continuity of service.
■ Although the protective devices are sometimes used as lighting circuit control units, it is recommended to install:
□ separate control devices (switch, contactor, impulse relay ▸ page 38)
□ or an integrated control circuit breaker designed for lighting applications (Reflex iC60 ▸ page 39) which withstands a larger number of switching operations.

Protection of electrical connections
against short circuits and overloads

Choice of breaking capacity

■ The breaking capacity must be greater than or equal to the presumed short-circuit current upstream of the circuit breaker.
■ However, in the event of use in combination with an upstream circuit breaker limiting the current, this breaking capacity can possibly be reduced (cascading).

Choice of rating

■ The rating (In) is chosen above all to protect the electrical connection:
□ for cables: it is chosen according to the cross section,
□ for Canalis prefabricated busbar trunking: it must be simply less than or equal to the rating of the busbar trunking.
■ Generally, the rating should be greater than the rated current of the circuits. But in the case of lighting circuits, to ensure excellent continuity of service, it is recommended that this rating correspond to **about twice the rated current** of the circuit (see section opposite), by limiting the number of lamps per circuit.
■ The rating of the upstream circuit breaker must always be less than or equal to that of the control device located downstream (on-off switch, residual current circuit breaker, contactor, impulse relay, etc.).

Choice of tripping curve

■ Electricians always use the same curve for lighting circuits: B or C depending on habits.
■ However, to prevent nuisance tripping, it may be advisable to choose a less sensitive curve (2) (e.g. go from B to C)

Continuity of service
Safety measures to guard against nuisance tripping

Nuisance tripping can be generated by:
■ the inrush current which could be very high during circuit closing with LED luminaires,
■ the overload current during the lamp starting phase,
■ and sometimes the harmonic current flowing through the neutral of three-phase circuits (1).

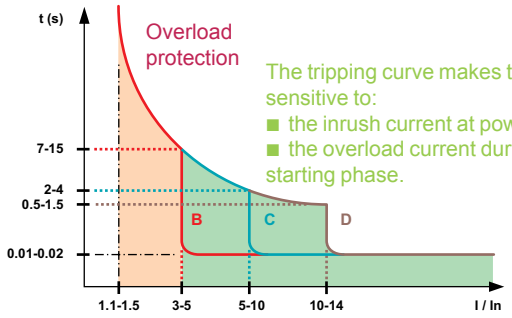
Three solutions

■ **Choose a circuit breaker with a less sensitive curve:** change from B curve to C curve or from C curve to D curve (2).
■ **Reduce the number of lamps per circuit**
■ **Start up the circuits successively,** using time delay auxiliaries on the control relays (▸ page 46 and example ▸ page 47).

Under no circumstances may the circuit breaker rating be increased, as the electrical connections would then no longer be protected.

Reflex iC60

The Reflex iC60 devices (▸ page 39) are integrated control circuit breakers which combine the following main functions in a single device:
■ circuit breaker for cable protection,
■ remote control by latched and/or impulse-type order,
■ remote indication of product status,
■ interface compatible with Acti 9 Smartlink and programmable logic controller (remote control and indications).



The tripping curve makes the protection more or less sensitive to:
■ the inrush current at power up;
■ the overload current during the short (< 1 s) lamp starting phase.

Usual values

Circuit breaker: fast dimensioning ▸ page 34

Optimized calculation: ▸ "My Ecodial" software

■ Circuit breaker rating: value equal to twice the rated current of the circuit (6, 10, 13, 16 or 20 A)
■ Curve: B or C depending on habits.

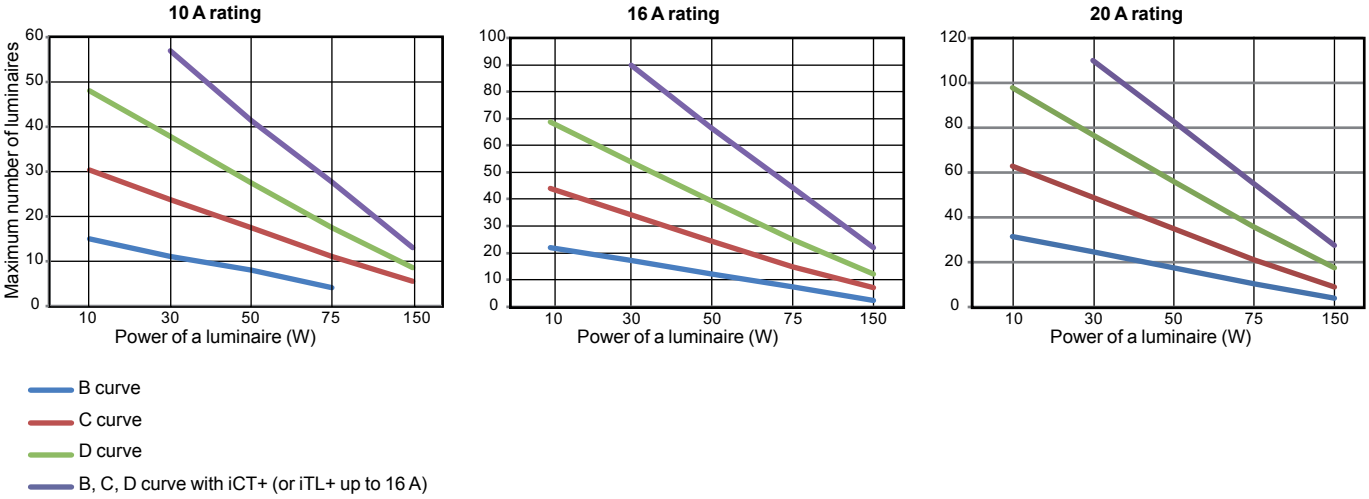
(1) In the particular case of three-phase circuits supplying discharge lamps with electronic ballasts, harmonic currents of the third order and multiples of three are generated and combined in the neutral conductor. The neutral cable must be sized to prevent it from overheating. However, the current flowing through the neutral cable may become greater than the current of each phase and cause nuisance tripping.
(2) In the case of installations with very long cables in a TN or IT system, it may be necessary to add differential protection to protect human life. In all cases, the choice of curve must be confirmed by a design note.

Number of lamps according to the circuit breaker rating and curve

A - Led technology

Use of circuit breakers

■ The new lighting technologies with electronic interfaces (ballasts, drivers) cause a large transient inrush current at power up which could result in circuit breaker tripping.
■ These phenomena are especially significant with LED lighting.
■ Coordination curves between the number of LED luminaires and circuit breaker rating:



Maximum number of luminaires according to the circuit breaker rating and curve

	Circuit breaker rating	10 A				16 A				20 A			
Unit power of the luminaire (W)	**Curve**	**B**	**C**	**D**	**B, C, D with iCT+ or iTL+**	**B**	**C**	**D**	**B, C, D with iCT+ or iTL+**	**B**	**C**	**D**	**B, C, D with iCT+**
10		15	30	48	-	22	44	69	-	32	63	98	-
30		11	24	38	57	17	34	54	90	25	49	77	110
50		8	17	27	41	12	25	39	66	18	35	56	83
75		4	11	17	28	7	15	25	44	11	21	36	55
150		-	5	9	13	2	7	12	22	4	9	18	28
250		-	3	5	8	-	4	7	13	-	5	10	16
400		-	1	4	5	-	2	6	8	-	3	9	10

Depending on the control device used, the transient current peak may:
■ require derating of the circuit breaker according to the coordination curves between the number of luminaires and the circuit breaker rating, when using conventional control devices: CT, TL (electromechanical control device),
■ be reduced by using the following technologies:
□ softStart: implemented by a control integrated in the driver or by variable speed controller,
□ controlled-action control contactor (iTL+, iCT+) (closing on zero crossing by the voltage, only derating is linked to the lighting circuit's power factor.

These technologies make it possible to use the circuit breakers without derating due to the lamp technology.
Example:
Circuit rated power = 230 V AC x circuit breaker rating x power factor.

Number of lamps according to the circuit breaker rating and curve

B - Other technologies

The table is produced for C-curve circuit breakers:
- for B-curve circuit breakers, the number of lamps should be reduced by 50%,
- for D-curve circuit breakers, the number of lamps should be increased by 50%.

Maximum number of lamps according to the circuit breaker rating and curve

Products			Circuit breaker (C curve)				
Type of lamp			10 A	16 A	25 A	40 A	63 A
Standard incandescent lamps, LV halogen lamps, replacement mercury vapor lamps (without ballast)							
	40 W		28	46	70	140	207
	60 W		23	36	55	103	152
	75 W		29	31	46	80	121
	100 W		15	23	33	60	88
ELV 12 or 24 V halogen lamps							
Ferromagnetic transformer	**20 W**		11	19	27	50	75
	50 W		8	12	19	33	51
	75 W		7	10	14	27	43
	100 W		5	8	10	22	33
Electronic transformer	**20 W**		47	74	108	220	333
	50 W		19	31	47	92	137
	75 W		15	24	34	64	94
	100 W		12	20	26	51	73
Fluorescent tubes with starter and ferromagnetic ballast							
1 tube without compensation (1)	15 W		16	26	37	85	121
	18 W		16	26	37	85	121
	20 W		16	26	37	85	121
	36 W		15	24	34	72	108
	40 W		15	24	34	72	108
	58 W		9	15	21	43	68
	65 W		9	15	21	43	68
	80 W		8	12	19	36	58
	115 W		6	9	12	24	38
1 tube with parallel compensation (2)	15 W	5 µF	11	19	24	48	72
	18 W	5 µF	11	19	24	48	72
	20 W	5 µF	11	19	24	48	72
	36 W	5 µF	11	19	24	48	72
	40 W	5 µF	11	19	24	48	72
	58 W	7 µF	8	12	19	36	51
	65 W	7 µF	8	12	19	36	51
	80 W	7 µF	8	12	19	36	51
	115 W	16 µF	4	7	9	17	24
2 or 4 tubes with series compensation	2 x **18 W**		23	36	56	96	148
	4 x **18 W**		12	20	29	52	82
	2 x **36 W**		12	20	29	52	82
	2 x **58 W**		8	12	20	33	51
	2 x 65 W		8	12	20	33	51
	2 x 80 W		7	11	15	26	41
	2 x 115 W		5	8	12	20	31
Fluorescent tubes with electronic ballast							
1 or 2 tubes	**18 W**		56	90	134	268	402
	36 W		28	46	70	142	213
	58 W		19	31	45	90	134
	2 x **18 W**		27	44	67	134	201
	2 x **36 W**		16	24	37	72	108
	2 x **58 W**		9	15	23	46	70

(1) Circuits with non-compensated ferromagnetic ballasts consume twice as much current for a given power output. This explains the small number of lamps in this configuration.

(2) The total capacitance of the power factor capacitors in parallel on a circuit limits the number of lamps that can be controlled by a contactor. The total downstream capacitance of a modular contactor of rating 16, 25, 40 or 63 A should not exceed 75, 100, 200 or 300 µF respectively. Allow for these limits to calculate the maximum acceptable number of lamps if the capacitance values are different from those in the table.

Maximum number of lamps according to the circuit breaker rating and curve (cont.)

Products			Circuit breaker (C curve)				
Type of lamp			10 A	16 A	25 A	40 A	63 A
Compact fluorescent lamps							
External electronic ballast	**5 W**		158	251	399	810	Infrequent use
	7 W		113	181	268	578	
	9 W		92	147	234	463	
	11 W		79	125	196	396	
	18 W		49	80	127	261	
	26 W		37	60	92	181	
Integral electronic ballast (replacing incandescent lamps)	**5 W**		121	193	278	568	859
	7 W		85	137	198	405	621
	9 W		71	113	160	322	497
	11 W		59	94	132	268	411
	18 W		36	58	83	167	257
	26 W		25	40	60	121	182
Low-pressure sodium vapor lamps with ferromagnetic ballast and external ignitor							
Without compensation [1]	**35 W**		4	7	11	17	29
	55 W		4	7	11	17	29
	90 W		3	4	8	11	23
	135 W		2	3	5	8	12
	180 W		1	2	4	7	10
With parallel compensation [2]	**35 W**	20 µF	3	4	7	12	19
	55 W	20 µF	3	4	7	12	19
	90 W	26 µF	2	3	5	8	13
	135 W	40 µF	1	2	3	5	9
	180 W	45 µF	0	1	2	4	8
High-pressure sodium vapor lamps Metal-iodide lamps							
Ferromagnetic ballast with external ignitor, without compensation [1]	35 W		12	19	28	50	77
	70 W		7	11	15	24	38
	150 W		3	5	9	15	22
	250 W		2	3	5	10	13
	400 W		0	1	3	6	10
	1000 W		0	0	1	2	3
Ferromagnetic ballast and external ignitor, with parallel compensation [2]	35 W	6 µF	14	17	26	43	70
	70 W	12 µF	8	9	13	23	35
	150 W	20 µF	5	6	9	14	21
	250 W	32 µF	3	4	5	10	14
	400 W	45 µF	2	3	4	7	9
	1000 W	60 µF	0	1	2	4	7
	2000 W	85 µF	0	0	1	2	3
Electronic ballast	35 W		15	24	38	82	123
	70 W		11	18	29	61	92
	150 W		6	9	14	31	48

Note:
High-pressure sodium vapor lamps
For the 10 A and 16 A B-curve ratings, the number of lamps should be reduced by 10% to limit unwanted magnetic tripping.

Selection of protection systems
Earth leakage protection device selection principles

iID

iC60N + Vigi iC60

■ Earth leakage protection devices are used to:
□ guard against fires that might be caused by an electric circuit with an insulation fault,
□ protect the workforce against electric shock (direct or indirect contact).
■ The choice of protective devices must be optimized to provide absolute protection while ensuring continuity of service.
■ The implementation of earth leakage protection on lighting circuits varies according to standards, the earthing system and installation customs.

Protecting the installation
against fires generated by a cable insulation fault

Protecting people
against electric shock

Choice of sensitivity
■ For protection against fire only: 300 mA.
■ For protection against electric shock: 30 mA.

Choice of rating
■ The rating must be greater than or equal to the total consumption of the circuit. This consumption can be as much as twice the rated current of the lamps:
□ in the case of discharge lamps, due to the long starting time (several minutes),
□ higher consumption by lamps that have exceeded their nominal service life.
■ The rating of the earth leakage protection function (Vigi module or earth leakage protection switch) should always be greater than or equal to the rating of the upstream circuit breaker.

Continuity of service
Safety measures to guard against nuisance tripping

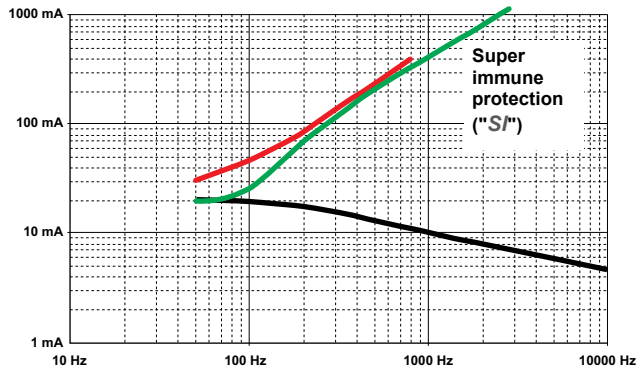
Choice of time delay
Protective device discrimination
■ For a two-level earth leakage protection system, the following are recommended:
□ upstream time-delayed earth leakage protection with sensitivity greater than or equal to three times the downstream protection (for example, 100 or 300 mA Ⓢ type protection),
□ one or more instantaneous 30 mA earth leakage protection devices downstream.

Super immune protection
"*SI*" type super immune protection
■ Compact fluorescent lamps and high-intensity discharge lamps with electronic ballast generate high-frequency currents (several kHz) that flow between conductors and earth in the ballast input filters and through stray capacitance in the installation.
■ These currents (up to several mA per ballast) can trip standard earth leakage protection devices.
■ **To avoid such problems and maintain excellent continuity of service, "*SI*" type earth leakage protection is recommended.**

"*SI*" type technology

■ Red curve ▬ : international standard IEC 479 determines the limit current for earth leakage protection tripping according to the frequency. This limit corresponds to the current that the human body is capable of withstanding without any danger.
■ Black curve ▬ : standard earth leakage protection devices are more sensitive to high-frequency currents than to 50/60 Hz.
■ Green curve ▬ : "*SI*" type "super immune" protection devices are less sensitive to high-frequency disturbance while ensuring personal safety.

Tripping curve of a 30 mA earth leakage protection function



Selection of protection systems
Principle for selection of surge protective devices


PRF1 Master


iPRD


iQuick PRD

■ Load protective devices are used to:
□ prevent fires which could be generated by the destruction of loads due to the effects of lightning,
□ ensure the continuity of service of the most sensitive loads.
■ The choice of protective devices must be optimized to provide absolute protection while ensuring continuity of service.
■ Implementation: surge protective devices are used at all levels of the electrical installation, and on communication networks.

Choice of the type of surge protective device

Type 1
Installed in the main electrical switchboard when the building is equipped with a lightning protection system. For more effective protection of loads, it should be combined with a type 2 surge protective device to absorb residual overvoltages.

Type 2
Installed in the main electrical switchboard, it is designed to discharge the currents generated by indirect lightning strokes and causing induced or conducted overvoltages on the power distribution network.

Type 3
Installed to complement the Type 2 surge protective device if the distance between the surge protective device and the load is >10 m.

Choice of surge protective device dimensioning

Type 1
The discharge capacity is Iimp = 12.5 kA or 25 kA depending on building risk analysis.

Type 2
There are different discharge capacities for each of these categories (Imax = 20, 40, 65 kA (8/20 µs); this choice depends mainly on the exposure zone (moderate, average, high).

Type 3
They are designed to reduce overvoltage across the terminals of sensitive equipment.

Choice of breaking capacity

The surge protective device should be combined with a "circuit breaker or fuse" short-circuit protective device. This device will be chosen according to the installation's short-circuit current.

The use of surge protective devices with an integrated disconnect circuit breaker ensures good coordination of the circuit breaker and surge protective device.

Exterior lighting

Given the widespread use of electronics in luminaires, it is recommended to establish a type 3 fine protection system at the level of each luminaire.

Continuity of service

Precaution against nuisance tripping:

In a TT system, a residual current device of the "***SI***" type or delayed "Ⓢ" type should be installed upstream of the surge protective device. This type of device is immune to the risks of unwanted tripping due to lightning. The other solution is to install the residual current device downstream of the surge protective device.

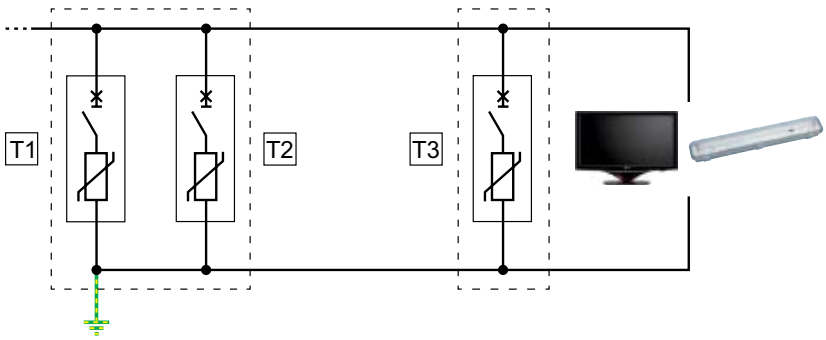
Coordination between the protection system and the surge protective device

Good coordination between the protection system and the surge protective device can prevent tripping on lightning waves and ensure isolation for the installation network at its end of life.

Surge protective device cascading

Terminal protection and fine protection

■ To effectively protect an electrical installation, the discharge capacity of the surge protective devices to be installed should be determined according to the characteristics of the installation.
■ Protection should be provided at the installation terminal (terminal protection) and, if necessary, near sensitive equipment (fine protection).
■ The terminal protection system protects the whole installation, whereas the fine protection system protects only the loads with which it is associated.



Quick dimensioning of electrical distribution and protec
Cable cross-section, circuit breaker rating

From the main characteristics of the installation (lighting power, distance from electrical switchboard), these tables can be used to determine:
- the cross-section of the conductors on the power supply line for a voltage drop less than 3% at the lamps, whatever the installation method and insulating material used for the conductors,
- the circuit breaker rating for protection and continuity of service with a safety margin, whatever the type of lamps.

230 V AC single-phase copper cable

Infrequently used
Recommended
Acceptable
Not recommended (high inrush currents)
Risk of overheating/overloading the cable
Example described at bottom of page

(1) If the voltage or power factor is different, the lighting power and the cable length must be recalculated (the value of the rated current does not change):
- for a voltage of 110-115 V: divide the values by 2.
- for a different power factor,

see the table below:

Cos φ	Multiplying factor to be applied for	
	Power	**Length**
0.85	0.895	1.118
0.5	0.526	1.9

(2) Maximum values not to be exceeded to guarantee cable protection.

Characteristics of the installation
at 40°C, 230 V AC, Cos φ = 0.95 **(1)**

Lighting power (kW) including any ballast losses	**Rated current (A)**	**Maximum cable length (m)** for a 3% voltage drop (the value shown is the average distance between the electrical switchboard and the lamps)						
0.2	1	294	489	783				
0.4	2	147	245	391	587			
0.7	3	98	163	261	391	652		
1.3	6	49	82	130	196	326	522	
2.2	10	29	49	78	117	196	313	489
3.5	16	18	31	49	73	122	196	306
4.4	20		24	39	59	98	157	245
5.5	25			31	47	78	125	196
7.0	32			24	37	61	98	153
8.7	40				29	49	78	122
10.9	50					39	63	98
13.8	63						50	78
Cable								
Cross section of each conductor (mm²)		**1.5**	**2.5**	**4**	**6**	**10**	**16**	**25**
Circuit breaker								
Rating (A)	**Recommended**	Twice the rated current of the lighting circuit						
			2 x 6 A = **13** or **16 A**					
	Maximum (2)							
	Cable with PVC type insulation	13	16	25	32	40	50	63
	Other insulating material more efficient at high temperature.	16	20	32	40	50	63	80

Example of an open-plan office

Characteristics of the installation
- 30 luminaires with 2 x 18 W 230 V single-phase fluorescent lamps.
- Power factor (Cos φ): 0.95.
- Average distance from the switchboard: 60 m.

Calculations
- Lamp power: 340 x 2 x 18 = 1080 W.
- Ballast losses, estimated at 10% of the lamp power: i.e. 108 W.
- Lighting power (P): 1080 + 108 = 1188 W = 1.2 kW; the next highest value in the table, i.e. **1.3 kW**, is selected.
- Corresponding rated current (I = P/U Cos φ): = 1188 W/(230 V x 0.95) = 5.4 A. The next highest value in the table, i.e. **6 A**, is selected.
- Average distance from luminaires: 60 m; the next highest value in the table, i.e. **82 m**, is selected.

Cable and protection values selected
- The recommended cable cross-section so as not to exceed a 3% voltage drop at the end of the line is therefore: **2.5 mm²**
- Minimum recommended circuit breaker rating: 2 x 6 A = 12 A, equivalent to the next highest normalized value of **13 A** or **16 A**. This rating is effectively less than or equal to the maximum authorized rating (16 or 20 A) to ensure that the cable is protected.

230 V AC three-phase copper cable between phase and neutral or 400 V AC between phases

Infrequently used
Recommended
Acceptable
Not recommended (high inrush currents)
Risk of overheating/overloading the cable

Example described at bottom of page (with correction of the values in the table taking into account a power factor of 0.85)

(1) If the voltage or power factor is different, the lighting power and the cable length must be recalculated (the value of the rated current does not change):
■ for a different voltage, multiply the lighting power and the cable length by:
□ 0.577 for a voltage of 230 V between phases,
□ 0.5 for a voltage of 110-115 V between phase and neutral.
■ for a different power factor, see the table below:

Cos φ	Multiplying factor to be applied for	
	Power	**Cable length**
0.85	0.895	1.118
0.5	0.526	1.9

(2) Maximum values not to be exceeded to guarantee cable protection.

Characteristics of the installation

Balanced three-phase circuit, at 40°C, Cos φ = 0.95
230 V AC between phase and neutral or 400 V AC between phases **(1)**

Lighting power per phase (kW) including any ballast losses	**Rated current per phase (A)**	**Maximum cable length (m)** for a 3% voltage drop (the value shown is the average distance between the electrical switchboard and the lamps)						
0.2	1	587	978	1565				
0.4	2	294	489	783	1174			
0.7	3	196	326	522	783	1304		
~~1.3~~ **x 0.895 = 1.2**	6	~~98~~ **110**	~~163~~ **182**	261	391	652	1044	
2.2	10	59	98	157	235	391	626	978
3.5	16	37	61	98	147	245	391	611
4.4	20		49	78	117	196	313	489
5.5	25			63	94	157	250	391
7.0	32			49	73	122	196	306
8.7	40				59	98	157	245
10.9	50					78	125	196
13.8	63						99	155
Cable Neutral conductor cross-section equal to the phase cable cross-section								
Cross section of each conductor (mm²)		**1.5**	**2.5**	**4**	**6**	**10**	**16**	**25**
Circuit breaker								
Rating (A)	**Recommended**	Twice the rated current of the lighting circuit						
			2 x 6 A = **13** or **16 A**					
	Maximum (2)							
	Cable with PVC type insulation	13	16	25	32	40	50	63
	Other insulating material more efficient at high temperature	16	20	32	40	50	63	80

Example of a warehouse

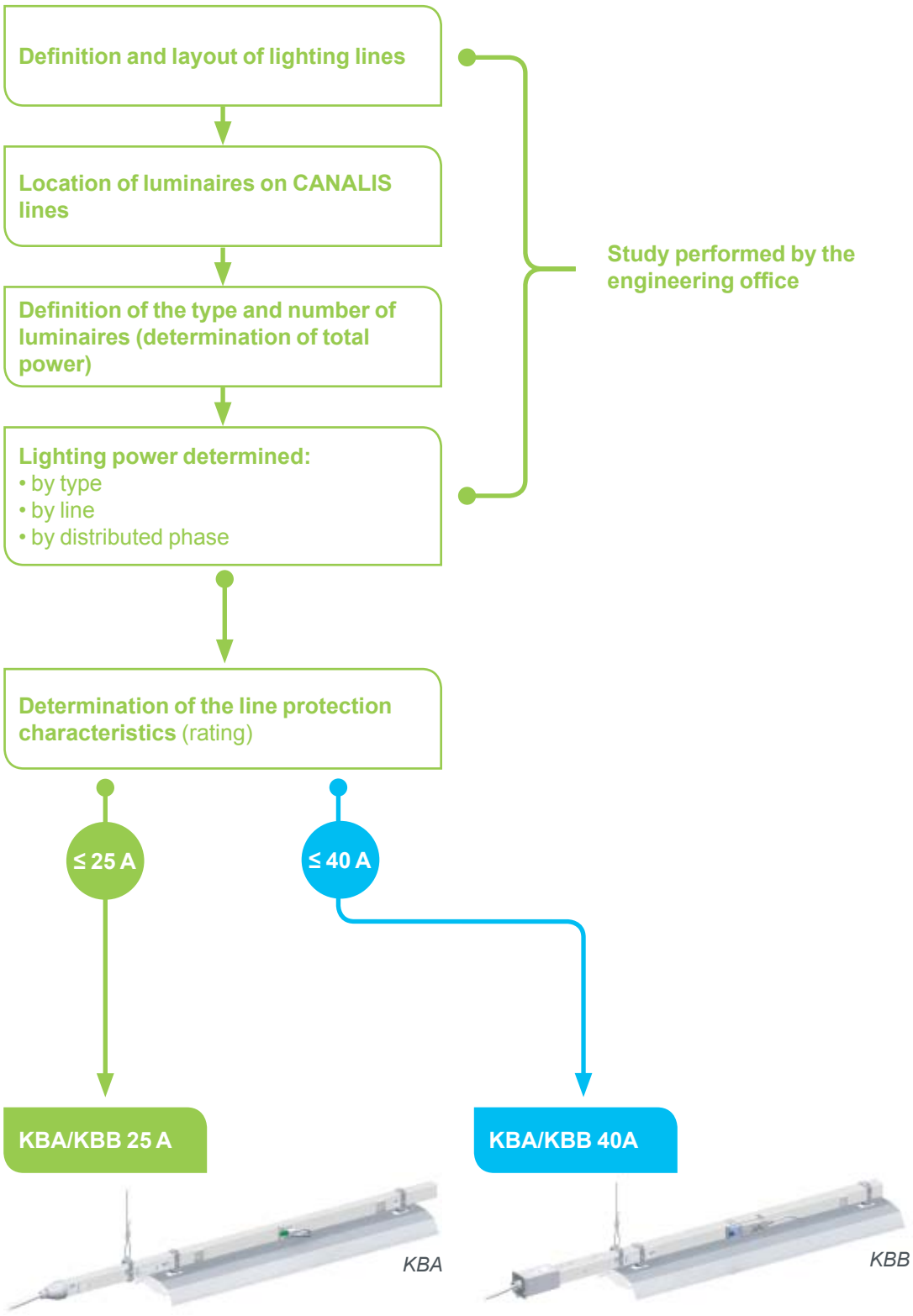
Characteristics of the installation
■ 39 x 70 W 230 V sodium vapor lamps with compensation, connected to a three-phase circuit between phase and neutral.
■ Power factor (Cos φ): 0.85.
■ Average distance from the switchboard: 120 m.

Calculations
■ Lamp power per phase: (39 x 70)/3 = 910 W.
■ Ballast losses per phase, estimated at 10% of the lamp power: i.e. 91 W.
■ Lighting power per phase (P): 910 + 91 = 1001 W = 1 kW.
■ Corresponding current (I = P/U Cos φ): = 1001 W/(230 V x 0.85) = 5.1 A.
The next highest value in the table, i.e. **6 A**, is selected.
■ Correction of the values in the table for the maximum cable length to take into account the power factor:
□ 98 x 1.118 = 110 m,
□ 163 x 1.118 = 182 m
The next highest corrected value in the table after 120 m, i.e. **182 m**, is selected.

Cable and protection values selected
■ The recommended cable cross-section per phase so as not to exceed a 3% voltage drop at the end of the line is therefore: **2.5 mm².**
■ Minimum recommended circuit breaker rating: twice 6 A, i.e. **13 A** or **16 A** as a normalized value.
This rating is effectively less than or equal to the maximum authorized rating (16 or 20 A) to ensure that the cable is protected.

Quick dimensioning of electrical distribution and protec
Type of Canalis, circuit breaker rating

Step 1: choice of busbar trunking rating



Step 2: confirmation of the busbar trunking rating according to the length of the circuit and to the choice of circuit breaker rating

Single-phase Canalis 230 V AC busbar trunking

Characteristics of the installation
at 35°C, Cos φ = 0.95 **(1)**

Lighting power (kW) including any ballast losses	**Rated current (A)**	**Maximum busbar trunking length (m)** for a voltage drop < 3% at the end of the busbar trunking. Lamps evenly spaced along the busbar trunking (most common case)		
0.2	1			
0.4	2			
0.7	3	330	375	
1.3	6	165	188	384
2.2	10	99	113	231
3.5	16	62	70	144
4.4	20	49	56	115
5.5	25		45	92
7.0	32			72
8.7	40			58
10.9	50	Overloaded busbar trunking		
13.8	63			
Prefabricated busbar trunking				
Type of busbar trunking		Flexible (KDP)	Rigid (KBA or KBB)	
Rating (A)		20	25	40
Circuit breaker				
Rating (A)	**Recommended**	Twice the rated current of the lighting circuit		
	Max.	20	25	40

Three-phase 230 V AC Canalis busbar trunking between phase and neutral or 400 V AC between phases

Characteristics of the installation
at 35°C, Cos φ = 0.95
230 V AC between phase and neutral or 400 V AC between phases **(2)**

Lighting power per phase (kW) including any ballast losses	**Rated current per phase (A)**	**Maximum busbar trunking length (m)** for a voltage drop < 3% at the end of the busbar trunking. Lamps evenly spaced along the busbar trunking (most common case)		
0.2	1			
0.4	2			
0.7	3	661	751	
1.3	6	330	375	769
2.2	10	198	225	461
3.5	16	124	141	288
4.4	20	49	113	231
5.5	25		90	184
7.0	32			144
8.7	40			115
10.9	50	Overloaded busbar trunking		
13.8	63			
Prefabricated busbar trunking				
Type of busbar trunking		Flexible (KDP)	Rigid (KBA or KBB)	
Rating (A)		20	25	40
Circuit breaker				
Rating (A)	**Recommended**	Twice the rated current of the lighting circuit		
			2 x 6 A = **13** or **16 A**	
	Max.	20	25	40

- Infrequently used
- Recommended
- Acceptable
- Not recommended (high inrush currents)
- Risk of overheating/overloading the cable

(1) If the voltage or power factor is different, certain values in the table are to be recalculated (the value of the rated current does not change):
- for a voltage of 110-115 V: divide the values by 2,
- for a different power factor, see the table below:

Cos φ	Multiplying factor to be applied for	
	Power	**Busbar trunking length**
0.85	0.895	1.118
0.5	0.526	1.9

(2) If the voltage or power factor is different, the lighting power and the busbar trunking length must be recalculated (the value of the rated current does not change):
- for a different voltage, multiply the lighting power and the busbar trunking length by:
  - 0.577 for a voltage of 230 V between phases,
  - 0.5 for a voltage of 110-115 V between phase and neutral.
- for a different power factor, see the table below:

Cos φ	Multiplying factor to be applied for	
	Power	**Busbar trunking length**
0.85	0.895	1.118
0.5	0.526	1.9

Control devices
Principles for selection of modular remote control equipment

Control devices

- Their role is to control luminaire switching on and off.
- Their technology allows a very large number of switching operations to be performed without adversely affecting their performance, in normal operating conditions.
- The installation of a control relay (impulse relay, contactor) allows:
  - remote control of a high-power lighting circuit,
  - easy performance of sophisticated functions (central control, timer, programming, etc.),
  - control of three-phase circuits.
- The iCT+ and iTL+ are especially suitable for lamps with a high inrush current (LED lighting, lamps with electronic ballast).

Choice of control relay

		Impulse relay			Modular contactor	
						
		iTL	*iETL*	*iTL+*	*iCT*	*iCT+*
Type of power circuit architecture (modular/monobloc)		■ Circuit protection is provided by a separate circuit breaker. ■ The control and power circuits are separate. They can also relay the management devices (▸ page 50), which often have a limited switching capacity and do not allow multi-polar switching (phase/neutral or three-phase).				
Installation		In enclosure and panel				
Control	Number of points	Multiple		Multiple	Single (as standard) or multiple (with auxiliary)	Single
	Type	Impulse-type, by push button			Latched-type by switch (as standard) or impulse-type by push button (with auxiliary)	
	Consumption	0		1 VA	1 to 2 VA	1 VA
Remote status indication	Protections	Auxiliary on circuit breaker				
	Control	Auxiliary on contactor or impulse relay		–	Auxiliary on contactor or impulse relay	–
Control circuit	Push button, selector switch	12 to 230 V AC		230 V AC	12, 24, 48, 110, 230 V AC	230 V AC
	PLC	6 to 130 V DC		–	24 V AC, 24 V DC by TI24 iACT interface and iATL 24 V DC	–
Remote reclosing of the protective device		–		–	–	–
Number of switching cycles per day (on average)		< 100		< 1000	< 100	< 1000
Flexibility of control		By combining auxiliaries		With relay circuitry	By combining auxiliaries	With relay circuitry
Additional functions		Many functions due to the use of auxiliaries: ■ time delay ■ illuminated push-button control ■ step-by-step control ■ signaling ■ latched-type control ■ centralized multi-level control ■ control by PLC		–	Many functions due to the use of auxiliaries: ■ time delay ■ illuminated push-button control ■ step-by-step control ■ signaling ■ latched-type control ■ centralized multi-level control ■ control by PLC	–
Rating (commonest values in bold)		**16** or 32 A		16 A	16, **25**, **40**, 63 A	20 A
Controlled power		Several kW				
Type of circuit controlled		Single-phase (1 or 2 P) or three-phase (3 or 4 P monobloc or in conjunction with iETL extension)		Single-phase (1P) Conducting neutral	Single-phase (1 or 2 P) or three-phase (3 or 4 P)	Single-phase (1P) Conducting neutral
Number of lamps controlled		▸ pages 42 and 45		No derating: ■ 16 A cos φ in steady-state conditions	▸ pages 42 and 45	No derating: ■ 20 A cos φ in steady-state conditions
Favorite applications		■ Residential ■ Service sector and industrial buildings (offices, corridors, shops, workshops, etc.)		■ Residential ■ Service sector buildings (hotels, hospitals)	■ Service sector and industrial buildings (offices, open-space offices, warehouses, supermarkets, indoor car parks, etc.) ■ Infrastructure (tunnels, outdoor car parks, public lighting, etc.)	■ Residential ■ Service sector buildings (hotels, hospitals)

Reflex iC60

Solution for lighting control and protection applications
- Total safety of the installation.
- Easy wiring.
- Reduced consumption and heating in the switchboard.
- Bistable solution.
- Ready for interfacing with an Acti 9 Smartlink interface or integrated PLC.

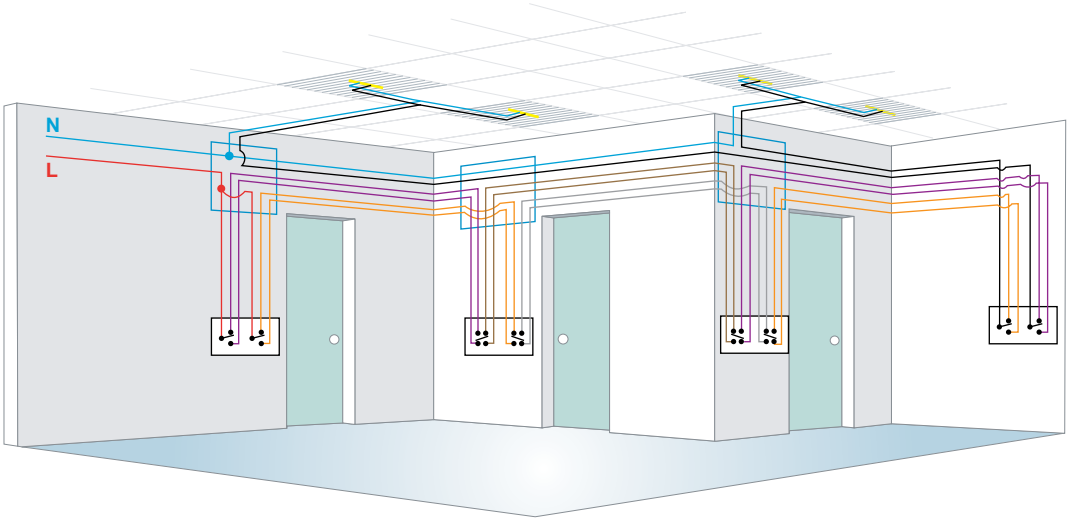
	Reflex iC60 integrated-control circuit breaker	RCA iC60 remote control
		
	Reflex iC60	*RCA iC60*
	Monobloc The circuit protection and power switching functions are incorporated in a single device	**Monobloc** The circuit breaker combined with the RCA performs the circuit protection and power switching functions
	In enclosure and panel	In enclosure and panel
	Multiple	Multiple
	Pulse or latched	Pulse or latched
	5 VA	1 VA
	Incorporated	■ Incorporated ■ By MCB auxiliary
	Incorporated	■ Incorporated ■ By MCB auxiliary
	230 V AC 24/48 V AC/DC with iMDU auxiliary	230 V AC 24/48 V AC/DC with iMDU auxiliary
	24 V DC with Ti24 interface	24 V DC with Ti24 interface
	–	Yes
	<10	1 to 2 on average
	Integrated auxiliary functions	Integrated auxiliary functions
	Numerous functionalities incorporated: ■ choice of control order interpretation mode ■ control and indication interface compatible with 24 V DC programmable logic controller standards ■ compatibility with Vigi iC60 residual current protection auxiliaries ■ control orders time delayed by time delay relays or PLCs	Numerous functionalities incorporated: ■ remote reclosing possible, following an electrical fault ■ choice of control order interpretation mode ■ control and indication interface compatible with 24 VDC programmable logic controller standards ■ control orders time delayed by time delay relays or PLCs ■ compatibility with the auxiliaries of the iC60 and Vigi protection product offering (iOF, iSD indications and iMN, iMX tripping, etc.)
	10, 16, 25, 40, 63 A	1 to 63 A
	Several kW	Several kW
	Single-phase (2P) or three-phase (3 or 4P)	Single-phase (1 or 2P) or three-phase (3 or 4P)
	▶ pages 42 and 45	▶ page 34
	■ Service sector and industrial buildings (offices, open-space offices, warehouses, supermarkets, indoor car parks, etc.) ■ Infrastructure (tunnels, outdoor car parks, public lighting, etc.)	■ Infrastructure (tunnels, indoor/outdoor car parks, public lighting, etc.)

Control devices
Example

Simplification of the conventional cabling by using an impulse relay

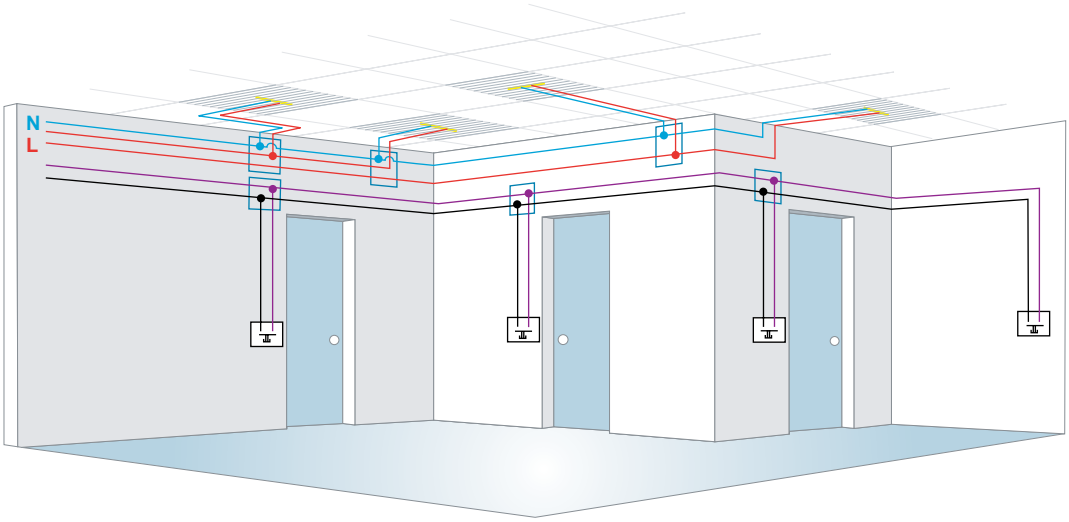
Without control device

■ Conventional cabling with two-way switches and changeover switch(es).



With impulse relay or impulse control device: Reflex iC60, RCA

■ **Lower investment costs:**
□ fewer cables,
□ small control circuit cross section,
□ faster installation (simplified cabling).
■ **Upgradeable circuits:**
□ easy to add a control point,
□ potential for adding auxiliaries (time delay, timer, centralized multi-level control, etc. ▸ page 46) and management functions.
■ **Energy savings:**
□ no power consumption in the control circuit (impulse relay)
□ automated management of switching on/off (movement detector, programmable time switch, dusk-to-dawn switch, etc., ▸ page 50).



Control devices
Choice of rating

iTL

iCT

Reflex iC60

RCA iC60

iTL+

iCT+

Ventilation spacer

■ The rating printed on the front of the products never corresponds to the rated current of the lighting circuit.
■ The standards that determine the ratings do not take into account all the electrical constraints of the lamps due to their diversity and the complexity of the electrical phenomena that they create (inrush current, starting current, end-of-life current, etc.).
■ Schneider Electric regularly conducts numerous tests to determine, for each type of lamp and each lamp configuration, the maximum number of lamps that a relay with a given rating can control for a given power.

iTL impulse relays and iCT contactors

■ The rating should be chosen according to the tables on the following pages.
■ The rating of the iTL and iCT must be equal to or greater than the protective device's rating.

Reflex iC60 and RCA iC60

■ The rating is determined by the cable characteristics in the same way as for the circuit breaker.
■ The switching capacity is defined in the following tables.

Thermal dissipation

■ **Modular contactors,** due to their operating principle, constantly dissipate heat (several watts) due to:
□ coil consumption,
□ power contact resistance.
Where several modular contactors are installed side by side in a given enclosure, it is therefore recommended to insert a side ventilation spacer at regular intervals (every 1 or 2 contactors). Heat dissipation is thus facilitated. If the temperature inside the enclosure exceeds 40°C, apply to the rating a derating factor of 1% per °C above 40°C.
■ **The impulse relays, Reflex iC60 and RCA,** can usefully replace the modular contactors:
□ they consume less energy and dissipate less heat (no permanent current in the coil). They require no spacer,
□ depending on the application, they allow a more compact installation with less wiring.

Control devices

Rating performance according to the type and number of lamps

General comments

Modular contactors and impulse relays do not use the same technologies. Their rating is determined according to different standards and does not correspond to the rated current of the circuit.
For example, for a given rating, an impulse relay is more efficient than a modular contactor for the control of luminaires with a strong inrush current, or with a low power factor (non-compensated inductive circuit).

Relay rating

- The tables below show the maximum number of lamps for each relay, according to the type, power and configuration of the lamp in question. As an indication, the total acceptable power is also mentioned.
- These values are given for a 230 V circuit with two active conductors (single-phase phase/neutral or two-phase phase/phase). For 110 V circuits, divide the values in the table by 2.

Selection table

Products			iCT contactors								iCT+ contactors
Type of lamp			Maximum number of lamps for a single-phase circuit and maximum power output per circuit								
			16 A		25 A		40 A		63 A		20 A
Standard incandescent lamps, LV halogen lamps, replacement mercury vapor lamps (without ballast)											
	40 W		38	1550 W to 2000 W	57	2300 W to 2850 W	115	4600 W to 5250 W	172	6900 W to 7500 W	4660 W x Cos phi
	60 W		30		45		85		125		
	75 W		25		38		70		100		
	100 W		19		28		50		73		
ELV 12 or 24 V halogen lamps											
Ferromagnetic transformer	**20 W**		15	300 W to 600 W	23	450 W to 900 W	42	850 W to 1950 W	63	1250 W to 2850 W	
	50 W		10		15		27		42		
	75 W		8		12		23		35		
	100 W		6		8		18		27		
Electronic transformer	**20 W**		62	1250 W to 1600 W	90	1850 W to 2250 W	182	3650 W to 4200 W	275	5500 W to 6000 W	
	50 W		25		39		76		114		
	75 W		20		28		53		78		
	100 W		16		22		42		60		
Fluorescent tubes with starter and ferromagnetic ballast											
1 tube without compensation [1]	15 W		22	330 W to 850 W	30	450 W to 1200 W	70	1050 W to 2400 W	100	1500 W to 3850 W	
	18 W		22		30		70		100		
	20 W		22		30		70		100		
	36 W		20		28		60		90		
	40 W		20		28		60		90		
	58 W		13		17		35		56		
	65 W		13		17		35		56		
	80 W		10		15		30		48		
	115 W		7		10		20		32		
1 tube with parallel compensation [2]	15 W	5 µF	15	200 W to 800 W	20	300 W to 1200 W	40	600 W to 2400 W	60	900 W to 3500 W	
	18 W	5 µF	15		20		40		60		
	20 W	5 µF	15		20		40		60		
	36 W	5 µF	15		20		40		60		
	40 W	5 µF	15		20		40		60		
	58 W	7 µF	10		15		30		43		
	65 W	7 µF	10		15		30		43		
	80 W	7 µF	10		15		30		43		
	115 W	16 µF	5		7		14		20		
2 or 4 tubes with series compensation	2 x **18 W**		30	1100 W to 1500 W	46	1650 W to 2400 W	80	2900 W to 3800 W	123	4450 W to 5900 W	
	4 x **18 W**		16		24		44		68		
	2 x **36 W**		16		24		44		68		
	2 x **58 W**		10		16		27		42		
	2 x 65 W		10		16		27		42		
	2 x 80 W		9		13		22		34		
	2 x 115 W		6		10		16		25		
Fluorescent tubes with electronic ballast											
1 or 2 tubes	**18 W**		74	1300 W to 1400 W	111	2000 W to 2200 W	222	4000 W to 4400 W	333	6000 W to 6600 W	
	36 W		38		58		117		176		
	58 W		25		37		74		111		
	2 x **18 W**		36		55		111		166		
	2 x **36 W**		20		30		60		90		
	2 x **58 W**		12		19		38		57		

■ To obtain the equivalent values for the entire 230 V three-phase circuit, multiply the number of lamps and the maximum power output:
□ by √3 (1.73) for circuits with 230 V between phases without neutral,
□ by √3 for circuits with 230 V between phase and neutral or 400 V between phases.

Note: the lamp power ratings most commonly used are shown in bold.
For power ratings not mentioned, use a proportional rule with the nearest values.

Reflex iC60

Solution for lighting control and protection applications
■ Total safety of the installation.
■ Easy wiring.
■ Reduced consumption and heating in the switchboard.
■ Bistable solution.
■ Ready to be connected with an Acti 9 Smartlink or a PLC.

	iTL impulse relays				iTL+ impulse relays	Reflex iC60								
	Maximum number of lamps for a single-phase circuit and maximum power output per circuit													
	16 A		32 A		16 A	10 A		16 A		25 A		40 A		63 A	
	40	1500 W	106	4000 W	3680 W x Cos phi	28	1120 W	46	1840 W	70	2800 W	140	5600 W	207	8280 W
	25	to	66	to		23	to	36	to	55	to	103	to	152	to
	20	1600 W	53	4200 W		29	2175 W	31	2600 W	46	3600 W	80	6800 W	121	9800 W
	16		42			15		23		33		60		88	
	70	1350 W	180	3600 W		11	220 W	19	380 W	27	540 W	50	1000 W	75	1500 W
	28	to	74	to		8	to	12	to	19	to	33	to	51	to
	19	1450 W	50	3750 W		7	500 W	10	800 W	14	1050 W	27	2200 W	43	3300 W
	14		37			5		8		10		22		33	
	60	1200 W	160	3200 W		47	940 W	74	1480 W	108	2160 W	220	4400 W	333	6660 W
	25	to	65	to		19	to	31	to	47	to	92	to	137	to
	18	1400 W	44	3350 W		15	1200 W	24	2000 W	34	2600 W	64	5100 W	94	7300 W
	14		33			12		20		26		51		73	
	83	1250 W	213	3200 W		16	244 W	26	390 W	37	555 W	85	1275 W	121	1815 W
	70	to	186	to		16	to	26	to	37	to	85	to	121	to
	62	1300 W	160	3350 W		16	647 W	26	1035 W	37	1520 W	85	2880 W	121	4640 W
	35		93			15		24		34		72		108	
	31		81			15		24		34		72		108	
	21		55			9		15		21		43		68	
	20		50			9		15		21		43		68	
	16		41			8		12		19		36		58	
	11		29			6		9		12		24		38	
	60	900 W	160	2400 W		11	165 W	19	285 W	24	360 W	48	720 W	72	1080 W
	50		133			11	to	19	to	24	to	48	to	72	to
	45		120			11	640 W	19	960 W	24	1520 W	48	2880 W	72	4080 W
	25		66			11		19		24		48		72	
	22		60			11		19		24		48		72	
	16		42			8		12		19		36		51	
	13		37			8		12		19		36		51	
	11		30			8		12		19		36		51	
	7		20			4		7		9		17		24	
	56	2000 W	148	5300 W		23	828 W	36	1296 W	56	2016 W	96	3456 W	148	5328 W
	28		74			12	to	20	to	29	to	52	to	82	to
	28		74			12	1150 W	20	1840 W	29	2760 W	52	4600 W	82	7130 W
	17		45			8		12		20		33		51	
	15		40			8		12		20		33		51	
	12		33			7		11		15		26		41	
	8		23			5		8		12		20		31	
	80	1450 W	212	3800 W		56	1008 W	90	1620 W	134	2412 W	268	4824 W	402	7236 W
	40	to	106	to		28	to	46	to	70	to	142	to	213	to
	26	1550 W	69	4000 W		19	1152 W	31	1798 W	45	2668 W	90	5336 W	134	8120 W
	40		106			27		44		67		134		201	
	20		53			16		24		37		72		108	
	13		34			9		15		23		46		70	

Control devices

Rating performance according to the type and number of lamps (cont.)

Selection table (cont.)

Products			iCT contactors								iCT+ contactors
Type of lamp			**Maximum number of lamps for a single-phase circuit and maximum power output per circuit**								
			16 A		**25 A**		**40 A**		**63 A**		**20 A**
Compact fluorescent lamps											
External electronic ballast	**5 W**		210	1050 W to 1300 W	330	1650 W to 2000 W	670	3350 W to 4000 W		Non testé	4660 W x Cos phi
	7 W		150		222		478				
	9 W		122		194		383				
	11 W		104		163		327				
	18 W		66		105		216				
	26 W		50		76		153				
Integral electronic ballast (replacing incandescent lamps)	**5 W**		160	800 W to 900 W	230	1150 W to 1300 W	470	2350 W to 2600 W	710	3550 W to 3950 W	
	7 W		114		164		335		514		
	9 W		94		133		266		411		
	11 W		78		109		222		340		
	18 W		48		69		138		213		
	26 W		34		50		100		151		
Low-pressure sodium vapor lamps with ferromagnetic ballast and external ignitor											
Without compensation (1)	**35 W**		5	270 W to 360 W	9	320 W to 720 W	14	500 W to 1100 W	24	850 W to 1800 W	
	55 W		5		9		14		24		
	90 W		3		6		9		19		
	135 W		2		4		6		10		
	180 W		2		4		6		10		
With parallel compensation (2)	**35 W**	20 µF	3	100 W to 180 W	5	175 W to 360 W	10	350 W to 720 W	15	550 W to 1100 W	
	55 W	20 µF	3		5		10		15		
	90 W	26 µF	2		4		8		11		
	135 W	40 µF	1		2		5		7		
	180 W	45 µF	1		2		4		6		
High-pressure sodium vapor lamps Metal-iodide lamps											
Ferromagnetic ballast with external ignitor, without compensation (1)	35 W		16	600 W	24	850 W to 1200 W	42	1450 W to 2000 W	64	2250 W to 3200 W	
	70 W		8		12		20		32		
	150 W		4		7		13		18		
	250 W		2		4		8		11		
	400 W		1		3		5		8		
	1000 W		0		1		2		3		
Ferromagnetic ballast and external ignitor, with parallel compensation (2)	35 W	6 µF	12	450 W to 1000 W	18	650 W to 2000 W	31	1100 W to 4000 W	50	1750 W to 6000 W	
	70 W	12 µF	6		9		16		25		
	150 W	20 µF	4		6		10		15		
	250 W	32 µF	3		4		7		10		
	400 W	45 µF	2		3		5		7		
	1000 W	60 µF	1		2		3		5		
	2000 W	85 µF	0		1		2		3		
Electronic ballast	35 W		24	850 W to 1350 W	38	1350 W to 2200 W	68	2400 W to 4000 W	102	3600 W to 600 W	
	70 W		18		29		51		76		
	150 W		9		14		26		40		
LED lamps											
With driver LED	**10 W**		48	500 W to 1400 W	69	700 W to 1950 W	98	1000 W to 3000 W	200	2000 W to 6200 W	
	30 W		38		54		77		157		
	50 W		27		39		56		114		
	75 W		17		25		36		73		
	150 W		9		12		18		37		
	200 W		7		9		15		31		

(1) Circuits with non-compensated ferromagnetic ballasts consume twice as much current for a given power output. This explains the small number of lamps in this configuration.
(2) The total capacitance of the power factor capacitors in parallel on a circuit limits the number of lamps that can be controlled by a contactor. The total downstream capacitance of a modular contactor of rating 16, 25, 40 or 63 A should not exceed 75, 100, 200 or 300 µF respectively.
Allow for these limits to calculate the maximum acceptable number of lamps if the capacitance values are different from those in the table.

iTL impulse relays				iTL+ impulse relays	Reflex iC60								
Maximum number of lamps for a single-phase circuit and maximum power output per circuit													
16 A		32 A		16 A	10 A		16 A		25 A		40 A		63 A	
240	1200 W to 1450 W	630	3150 W to 3800 W	3680 W x Cos phi	158	790 W to 962 W	251	1255 W to 1560 W	399	1995 W to 2392 W	810	4050 W to 4706 W	Infrequently used	
171		457			113		181		268		578			
138		366			92		147		234		463			
118		318			79		125		196		396			
77		202			49		80		127		261			
55		146			37		60		92		181			
170	850 W to 1050 W	390	1950 W to 2400 W		121	605 W to 650 W	193	959 W to 1044 W	278	1390 W to 1560 W	568	2840 W to 3146 W	859	4295 W to 4732 W
121		285			85		137		198		405		621	
100		233			71		113		160		322		497	
86		200			59		94		132		268		411	
55		127			36		58		83		167		257	
40		92			25		40		60		121		182	
Not tested, infrequently used					4	153 W to 253 W	7	245 W to 405 W	11	385 W to 792 W	17	595 W to 1198 W	29	1015 W to 2070 W
					4		7		11		17		29	
					3		4		8		11		23	
					2		3		5		8		12	
					1		2		4		7		10	
38	1350 W	102	3600 W		3	88 W to 169 W	4	140 W to 270 W	7	245 W to 450 W	12	420 W to 720 W	19	665 W to 1440 W
24		63			3		4		7		12		19	
15		40			2		3		5		8		13	
10		26			1		2		3		5		9	
7		18			0		1		2		4		8	
Not tested, infrequently used					12	416 W to 481 W	19	400 W to 750 W	28	980 W to 1350 W	50	1750 W to 2500 W	77	2695 W to 4000 W
					7		11		15		24		38	
					3		5		9		15		22	
					2		3		5		10		13	
					0		1		3		6		10	
					0		0		1		2		3	
34	1200 W to 1350 W	88	3100 W to 3400 W		14	490 W to 800 W	17	595 W to 1200 W	26	910 W to 2200 W	43	1505 W to 4400 W	70	2450 W to 7000 W
17		45			8		9		13		23		35	
8		22			5		6		9		14		21	
5		13			3		4		5		10		14	
3		8			2		3		4		7		9	
1		3			0		1		2		4		7	
0		1			0		0		1		2		3	
38	1350 W to 2200 W	87	3100 W to 5000 W		15	525 W to 844 W	24	840 W to 1350 W	38	1330 W to 2100 W	82	2870 W to 4650 W	123	4305 W to 7200 W
29		77			11		18		29		61		92	
14		33			6		9		14		31		48	
69	700 W to 1950 W	98	1000 W to 3000 W		30	300 W to 850 W	44	450 W to 1250 W	71	700 W to 2000 W	108	1050 W to 3050 W	146	1450 W to 4150 W
54		77			24		34		55		83		113	
39		56			17		25		40		61		83	
25		36			11		15		24		37		50	
12		18			5		7		11		17		23	
9		15			-		6		10		15		20	

Note: **Reflex iC60**
High-pressure sodium vapor lamps
For the 10 A and 16 A B-curve ratings, the number of lamps should be reduced by 10% to limit unwanted magnetic tripping.
LED lamps
B curve, the number of lamps should be reduced by 50%.
D curve, the number of lamps should be increased by 50%.

iCT+, iTL+ !

Cos φ	Pc (W)	
	iTL+	iCT+
0.95	3500	4420
0.85	3120	3960
0.5	1840	2330

Where the standard contactors or impulse relays can only control a very limited number of lamps, the iCT+ and iTL+ are an alternative to be considered. They are especially suitable for lamps with a high inrush current consuming up to 16 A (iTL+) or 20 A (iCT+) in steady state (for example: lamps with ballast or ferromagnetic transformer). The following table shows the controllable power **Pc** according to the power factor. For high-intensity discharge lamps divide the power by 2 (long starting current).

Example: how many compensated 58 W fluorescent tubes (power factor of 0.85) with ferromagnetic ballast (10% loss) can be controlled with a 20 A iCT+? Number of lamps N = controllable power **Pc**/(power output of each lamp + loss of ballast), i.e. in this case **N** = 3900/(58 + 10%) = 61. By comparison, a 16 A iCT is limited to 10 x 58 W tubes, a 25 A iCT to 15 lamps, and a 63 A iCT to 43 lamps.

Control auxiliaries
Overview

iATEt iACT24 iRTA iATLc+s Mounting clips

Control auxiliaries

■ These auxiliaries can perform a great variety of functions:
□ from the simplest (signaling, timer, illumination delay, etc.),
□ to the most sophisticated (centralized multi-level control, step-by-step control, etc.).
■ Moreover, some auxiliaries make it possible to overcome electrical disturbance which may detract from satisfactory switching operation.
■ Schneider Electric has the most comprehensive and coherent product offering in the market.
All the auxiliaries in a family (modular contactor or impulse relay) are compatible with all the devices in that family.
■ They are very easy to install thanks to their integral mounting clips which simultaneously provide electrical and mechanical connection.

Choice of auxiliaries

or pre-auxiliary control devices

Function		Pre-auxiliary impulse relay or impulse relay + auxiliary	Modular contactor + auxiliary	Reflex iC60 integrated-control circuit breaker	RCA iC60 remote control
Centralized control	Centralized control (1 level) for a group of circuits while maintaining separate control of each of them. Example: control of a whole storey or room by room	iTLc or iTL + auxiliary iATLc	-	Integrated	Integrated
	Centralized control (1 level) + signaling	iTL + auxiliary iATLc+s	-	Integrated	Integrated
	Centralized control (2 levels) Example: control of a whole storey, a zone or room by room	iTL + auxiliary iATLc+c	-	Via PLC	Via PLC
	Impulse-type local control + latched-type centralized control	-	iCT + auxiliary iACTc	Integrated	Integrated
Interface with PLC	Allows control from Acti 9 Smartlink or a PLC	Auxiliary iATL24	Auxiliary iATL24	Reflex iC60 Ti24 version	Reflex iC60 Ti24 version
Signaling	Remote signaling of lamp status (lit or extinguished)	iTLs or iTL + auxiliary iATLs	iCT + auxiliary iACTs	Integrated	Integrated
Timer	Return to rest position after an adjustable time delay	Auxiliary iATEt + iTL	Auxiliary iATEt + iTL	Time delay relays (iRT) + PLC	Time delay relays (iRT) + PLC
Step-by-step control	Allows control of 2 circuits with a single control unit	Auxiliary iATL4 + 2 impulse relays iTL	Via PLC	Via PLC	Via PLC
Illuminated push button compensation	Allows fault-free control by illuminated push buttons	1 or more iATLz auxiliaries for each iTL	-	Max. leakage current: 1.35 mA on Y2 input	Max. leakage current: 1.35 mA on Y2 input
Change in type of control	Operates on latched orders coming from a changeover contact (selector switch, time switch, etc.)	iTLm or iTL + auxiliary iATLm	Standard operation	Yes	Yes
	Impulse-type local control + latched-type centralized control	Standard operation without auxiliary	Auxiliary iACTc + iCT	Integrated	Integrated
Time delay	Illumination delay (see example on ▶ page 47). Allows the inrush current at the head of the network to be limited by powering the circuits in succession	Auxiliary iATEt + iTL	Auxiliary iATEt + iCT	Time delay relays (iRT) + Reflex iC60	Time delay relays (iRT) + RCA iC60
Disturbance suppressor	Can prevent disturbance generated on the electrical network at power off	Not applicable	1 iACTp auxiliary per iCT	Not applicable	Not applicable
Voltage adaptation for control	Allows 24 V or 48 V AC/DC control	Possible in V AC and V DC	■ Possible in V AC ■ With auxiliary iMDU in V DC	Possible with an auxiliary iMDU	

Example
Dimensioning an installation

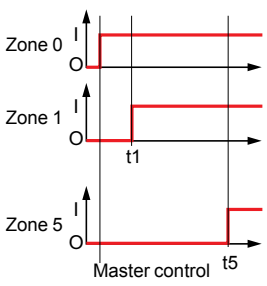
Supermarket: main lighting circuits



Requirement	General lighting			Product enhancement			Car park lighting		
Circuit	Three-phase + neutral 230/400 V AC			Single-phase 230 V AC			Single-phase 230 V AC		
Number of lines	18 (1 per department)			3 (1 per display)			10		
Number of lamps per line	45 luminaires with 56 W LED lamps			Four 150 W metal-iodide lamps with ferromagnetic ballast and parallel compensation			Nine 70 W high-pressure sodium vapor lamps with ferromagnetic ballast and parallel compensation		
Electrical connections									
Main lines	18 60-m lines with Canalis KBA 25 A (2 conductors + PE)			Three 20-m lines with Canalis KBA 25 A			10 buried lines of 100 m with 10 mm² cables		
Branch to each luminaire	1 m of cables of 1.5 mm²			-			5 m of cables of 1.5 mm²		
Monitoring/Control									
Protection									
Residual current circuit breaker	4P - 40 A - 300 mA - *"SI"* type 1 per group of 5 lines			2P - 25 A - 300 mA 1 for all the 3 lines			2P - 40 A - 300 mA 1 per group of 2 lines		
Possible solutions	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Circuit breaker	4P 16 A C curve 1 per line	4P 16 A C curve 1 per line	Reflex iC60 4P 16 A C curve 1 per line The auxiliary centralized control (Y3) and indication (OF, SD) functions are integrated	2P 16 A C curve 1 per line	2P 16 A C curve 1 per line	Reflex iC60 2P 16 A C curve 1 per line The auxiliary centralized control (Y3) and indication (OF, SD) functions are integrated	2P 16 A B curve 1 per line	2P 16 A B curve 1 per line	Reflex iC60 2P 16 A B curve 1 per line The auxiliary centralized control (Y3) and indication (OF, SD) functions are integrated
Control devices									
Impulse relay, contactor or integrated-control circuit breaker	Impulse relay ITL 2P 32 A 1 per line	Contactor iCT 1P 40 A 1 per line		Impulse relay ITL 2P 16 A 1 per line	Contactor iCT 2P 16 A 1 per line		Impulse relay ITL 1P 16 A 1 per line	Contactor iCT 2P 25 A 1 per line	
Control auxiliaries									
Signaling in the control panel	1 iATLs per impulse relay	1 iACTs per contactor		1 iATLc+s per impulse relay	1 iACTs per contactor		1 iATLc+s per impulse relay	1 iACTs per contactor	
Centralized control	-				1 iACTc per contactor			1 iACTc per contactor	
Inrush current limited by successive illumination of groups of lines	1 ATEt on 6 groups of 3 lines with a time delay of 2 s between each group		Via PLC	-			-		
Management devices									
Servo control by outside luminosity, timetable and calendar	-			-			1 light sensitive switch IC2000P+		

Successive illumination of 6 zones

Use of one iATEt per group of lines to limit the inrush current.

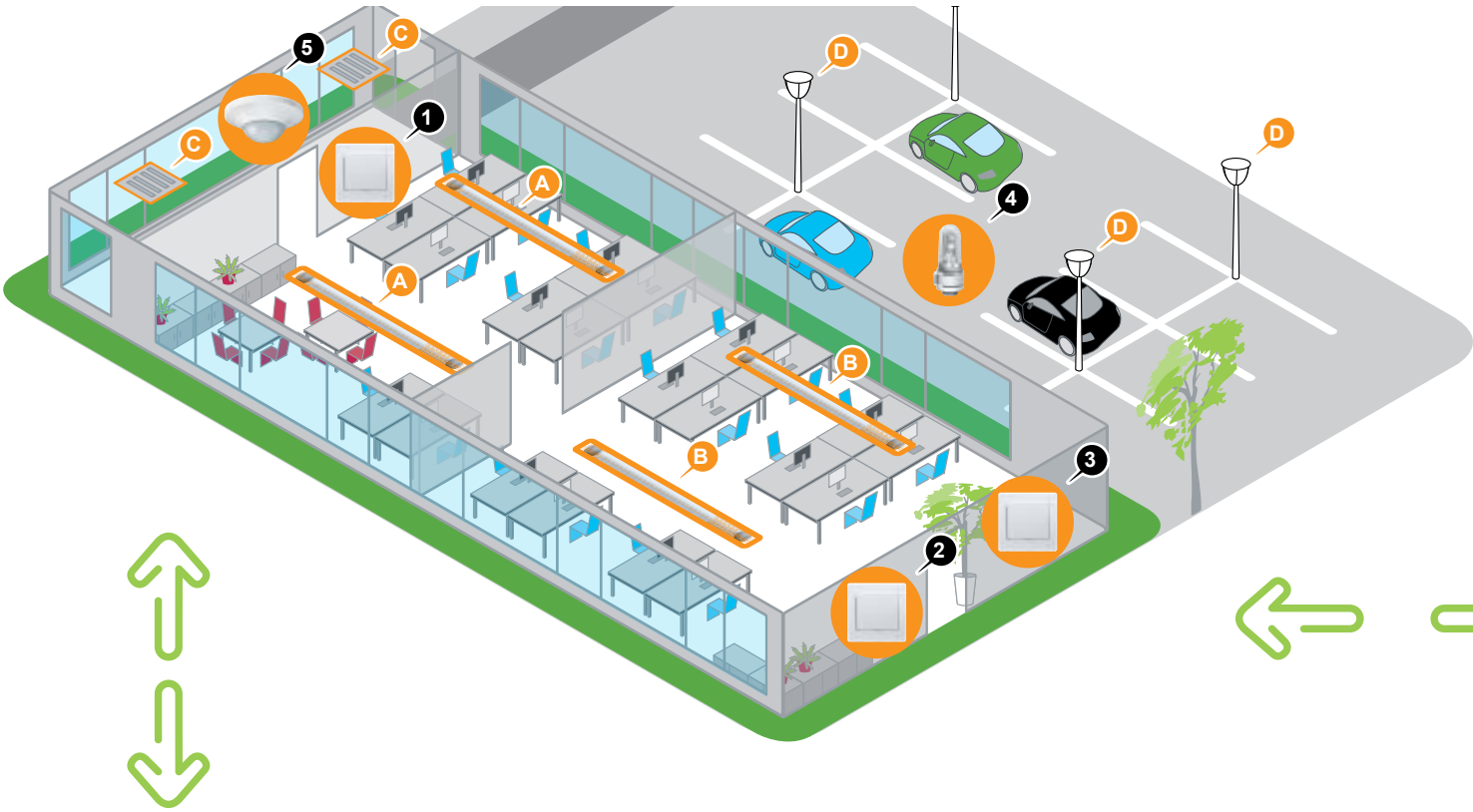


Canalis KBB with DALI system

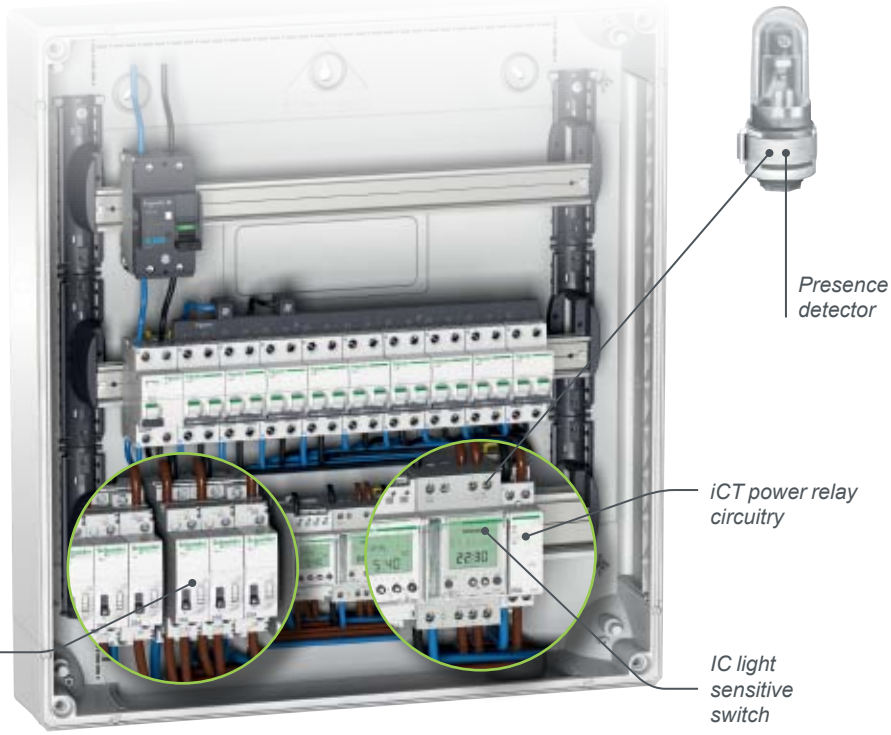
The winning solution for controlling and supplying power for supermarket lighting.

Example

Lighting management, a simple solution or a remote management solution



Simple solution

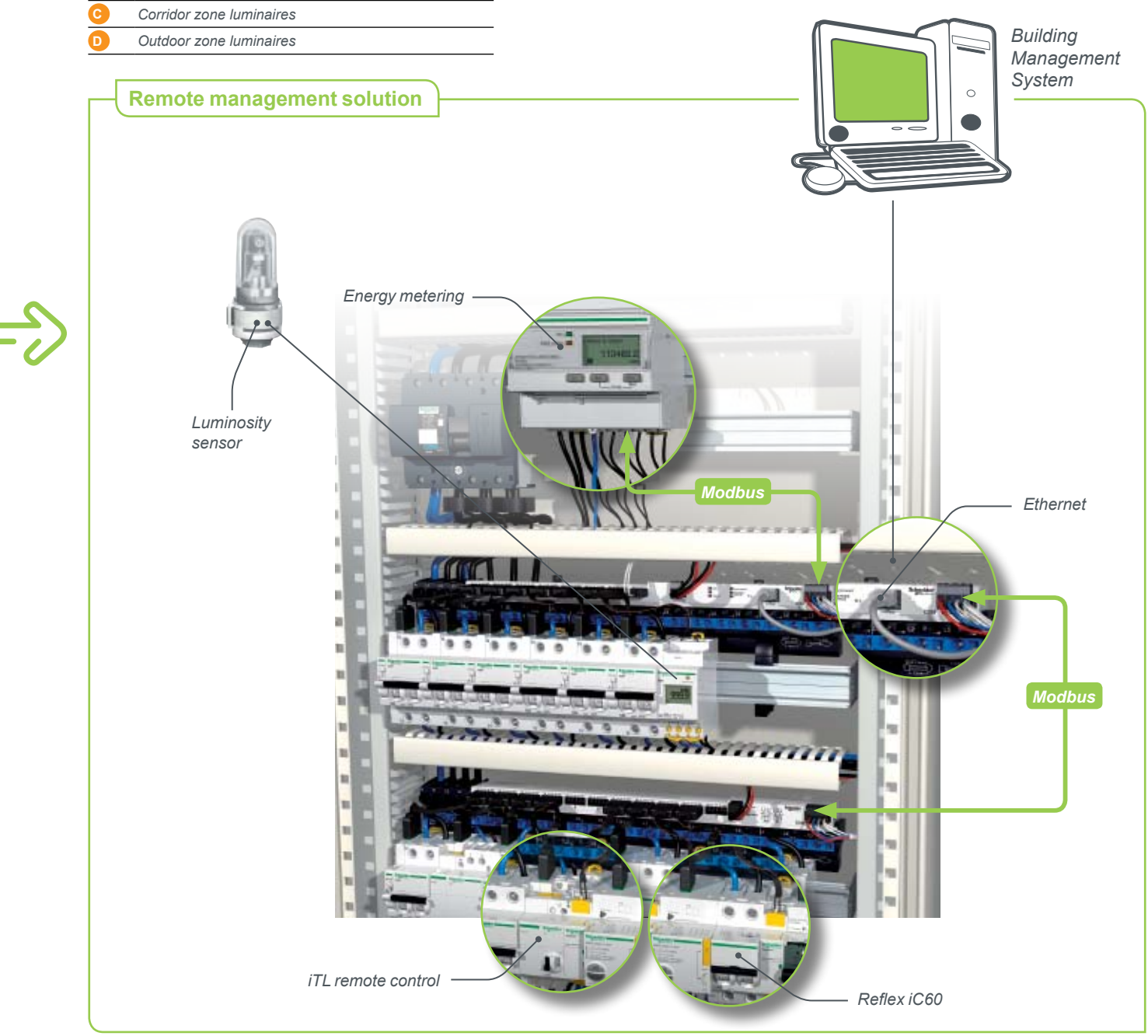


Zones	Contracting authorities	Power relays	Type of lamp
Passageways	Automatic by movement detector	-	LED
Offices	Manual by local push button	Impulse relay	Fluorescent T5
Car parks	Automatic control by detection of the luminosity level and time programming	Contactor	High pressure sodium

1. *Zone 1 local lighting control*
2. *Zone 2 local lighting control*
3. *Centralized control of zone 1 and zone 2*
4. *Automatic control of outdoor lighting by presence detection*
5. *Automatic control by movement detection*

A. *Zone 1 luminaires*
B. *Zone 2 luminaires*
C. *Corridor zone luminaires*
D. *Outdoor zone luminaires*

Remote management solution



Zones	Contracting authorities	Power relays	Type of lamp
Passageways	Automatic by movement detector	-	LED
Offices	Manual by local push button	Impulse relay with remote management	Fluorescent T5
Car parks	Automatic control by detection of the luminosity level and time programming	Reflex iC60 with remote management interface	High pressure sodium
Additional functions			
	• Remote display of satisfactory operation (state of circuit breakers, contactors, etc.)		
	• Fault indication		
	• Luminaire operating time		
	• Number of switching operations performed by power relays		

Management devices


IHP


IC2000


MIN

■ These devices chiefly make it possible to optimize power consumption by managing lighting control according to various parameters:
□ time, day or date,
□ a given limited duration,
□ movement or the presence of personnel,
□ level of luminosity,
□ the amount of natural light.
■ They can also improve everyday comfort through:
□ automation of the tasks of switching on/off,
□ manual or automatic adjustment of the illumination level.

Choice of management devices

for energy savings and improved comfort

Products	Potential energy savings	Functions	Compatibility			
			Incandescent lamps	**Fluorescent lamps**	**High-intensity discharge lamps**	**LED lamps (unit power 2 to 8 W)**
IH Electromechanical time switches	**50%**	■ Hourly, daily or weekly ■ 1 or 2 circuits ■ With or without power reserve (operation in the event of mains failure)	1000 W	600 to 700 W	See Note	15 to 50 W
IHP Digital programmable time switches	**50%**	■ Daily, weekly or annual ■ 1 or 2 circuits ■ With or without conditional input ■ Switching interval: at least 1 min.	1000 to 2600 W	1000 to 2300 W		20 to 180 W
IC Light sensitive switch	**30%**	■ Controlled by: □ astronomical clock (automatic sunrise and sunset calculation) □ luminosity detection (adjustable from 2 to 2000 Lux) ■ With or without programmable clock function	2300 to 3600 W	2300 to 3600 W		55 to 160 W
MIN Timer	**30%**	■ 30 s to 1 h ■ 50% reduction of luminosity before extinction of incandescent lamps with PRE auxiliary	2300 to 3600 W	2300 to 3600 W Not recommended for time delays of less than a few minutes	Not recommended for time delays of less than one hour	55 to 150 W

Note: **IH/IHP/IC**
To control lighting loads, whenever the power is significant and the type of lamp generates major inrush stress, it is recommended to combine a power actuator with each circuit:
- a contactor
- an impulse relay with its latched-type control auxiliary
- a Reflex iC60
or
- a RCA iC60 (low rate of switching)

Emergency lighting

Evacuation unit

Anti-panic unit

■ Emergency lighting is designed to eliminate or minimize public panic in the event of a serious problem such as a fire or an earthquake, and even merely a power cut.
■ Suitable for all types and sizes of buildings (schools, hotels, shopping centers, hospitals, offices, shops, museums, etc.), Schneider Electric emergency lighting is essential to occupants' safety.
■ The anti-panic devices give out a light that enables people to see where they are and avoid obstacles, while the signage units clearly show the way out of the premises. These products are mostly installed at a height.

Various technologies and characteristics

■ These luminaires have a light source consisting mainly of fluorescent lamps and LEDs, a battery to supply power in the event of a mains failure, and an electronic circuit board. These products are selected according to their luminous flux, IP, IK and battery life, illuminated continuously or only in the event of a power cut.
■ They are also chosen for their maintainability:
□ standard units: tests are carried out manually or via a remote control,
□ Activa/self-test units: they are tested automatically and indicate their operating state by means of colored LEDs,
□ Dardo/addressable units: they self-test and send the result over a pair of wires to a centralizing control device.

Deactivating the luminaires

■ To prevent the batteries discharging when the installation is not used or in the event of mains failure, the luminaires can be deactivated via:
□ a remote control (TBS) for Standard and Self-test units,
□ the Dardo Plus control unit for Addressable units.

The installation rules and diagrams are given for information only. They vary according to the country.
Only the rules in force in each country must be observed.

Installation of evacuation BAES (signage)
Install 1 emergency lighting unit (BAES) at each exit and each emergency exit, for each obstacle and change of direction to make it easier to evacuate the buildings safely.

■ Maximum spacing between each unit on the routes according to the size of the evacuation pictogram.
■ At a minimum height (out of reach of the public; generally 2 m).
■ Affix warning signs to the units.
■ Minimum luminous flux requirement.
■ Autonomy requirement in the event of mains failure (generally 1 h).
■ Required on all public premises.

Installation of anti-panic/ambience BAES
■ Min. lighting density (in lumens) per m^2.
■ Even distribution throughout the premises. Often with a minimum number of units per room.
■ Autonomy requirement in the event of mains failure (generally 1 h).
■ Required on all public premises.

Appendix

Practical recommendations for the protection and control of lighting circuits

Basic rules

■ The cross-section and length of the cables must be appropriate to limit the voltage drop to less than 3% at the end of the line in steady state (see tables on ▸ pages 34 to 37).
■ The In rating of the standard protection and control switchgear must be far higher than the rated current of the lighting circuit:
□ for the circuit breaker, take approximately twice the rated current of the circuit,
□ for the relay, always use the compatibility tables for each type of lamp and check that its rating is always higher than that of the upstream circuit breaker (short circuit coordination).
■ The In rating of the earth leakage protection device must be greater than or equal to that of the upstream circuit breaker.

Take the lamp ignition phase into account

Problems

■ All the lamps have a very strong starting current which breaks down as follows:
□ an inrush current: peak of 10 to 250 times the rated current (In) at power up,
□ followed by the starting current (for fluorescent or discharge lamps): possible overload of up to 2 In for several seconds or minutes depending on the type of lamp.

■ This therefore gives rise to the following risks:
□ conductor overheating,
□ circuit breaker nuisance tripping,
□ control device overloading.

Recommendation 1

■ Limit the load on each circuit to between 300 and 800 W per 2-wire circuit for standard 10/16 A 230 V AC equipment.
■ Increase the number of circuits to limit the number of lamps per circuit.

Recommendation n°2

■ Use Canalis prefabricated busbar trunking systems for large service-sector or industrial buildings.

Recommendation n°3

■ In the case of time-delay installations, postpone the power up of each circuit by a few tens of milliseconds to a few seconds.

Recommendation n°4

■ To control lamps with ferromagnetic ballast or transformer, high-performance control devices (iCT+ contactor or iTL+ impulse relay) should preferably be used instead of conventional relays to optimize the control of circuits of several kW up to 16 A.

Recommendation n°5

■ Curve C or D circuit breakers should be preferred to curve B. Confirmation by design note required.

Manage electronic ballast, transformer lamps or driver carefully

Problems

■ Electronic ballast lamps require special attention (high-frequency leaks to earth, harmonics) to guard against certain risks:
□ nuisance tripping of the earth leakage protection device,
□ overheating/overloading of the neutral conductor in three-phase circuits,
□ nuisance tripping of the 4-pole circuit breaker (neutral overload by third-order and multiple currents).

Recommendation n°1

■ Create the shortest possible links between the lamps and the ballast in order to reduce high-frequency interference and capacitive leaks to earth.

Recommendation n°2

■ Provide adequate discrimination, install the correct earth leakage protection at each level:
□ upstream:
- avoid instantaneous tripping 30 mA sensitivity,
- use a time-delay protection: 100 or 300 mA, type Ⓢ (selective).

□ use type ***"SI"*** ("Super immune") 30 mA instantaneous earth leakage protection for the feeders.

Recommendation n°3

■ In the case of three-phase circuits + neutral with third-order and multiple harmonic contents > 33%:
□ oversize the cross-section of the neutral cable compared with that of the phases,
□ check that the neutral current resulting from the sum of the harmonics is less than the In rating of the 4-pole circuit breaker.

Save energy without increasing maintenance costs

Problems

■ Discharge lamps significantly reduce energy consumption but create additional problems both for the user and with respect to their management:
□ ignition is not instantaneous due to their starting time (a few seconds for fluorescent lamps to several minutes for high-intensity discharge lamps);
□ repeated switching accelerates ageing by a factor of 3 to 5,
□ their higher investment cost requires careful management.

Recommendation n°1

■ To meet an instantaneous and/or temporary lighting requirement, an additional circuit with halogen or LED lamps may be useful for premises lit by discharge lamps.

Recommendation n°2

■ To limit the ageing of fluorescent lamps: set the timers or presence detectors to a minimum value of 5 to 10 minutes.

Recommendation n°3

■ Use LED lamps for frequent switching or when hot re-ignition is needed.

Recommendation n°4

■ Set the lighting to remain on continuously in corridors and offices at peak times rather than use presence detectors that will switch it on and off repeatedly.

Recommendation n°5

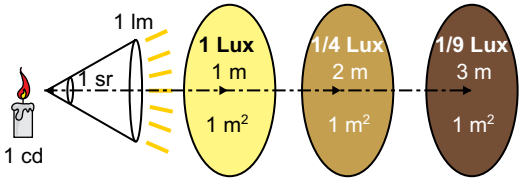
■ Regularly, at the end of the lamps' average service life, replace all the lamps and their ignitor for a given area to reduce maintenance costs.

Recommendation n°6

■ Use the impulse relay or Reflex iC60 rather than the contactor to prevent energy losses in the coils (a few Watts/relay).

Appendix
Definition of light-related units

Candela (cd)
- Old definition: luminous intensity (luminosity) of 1 candle.
- Modern definition (standard international unit): luminous intensity of light at a wavelength of 555 nm over 1.46 10^{-3} W/steradian.

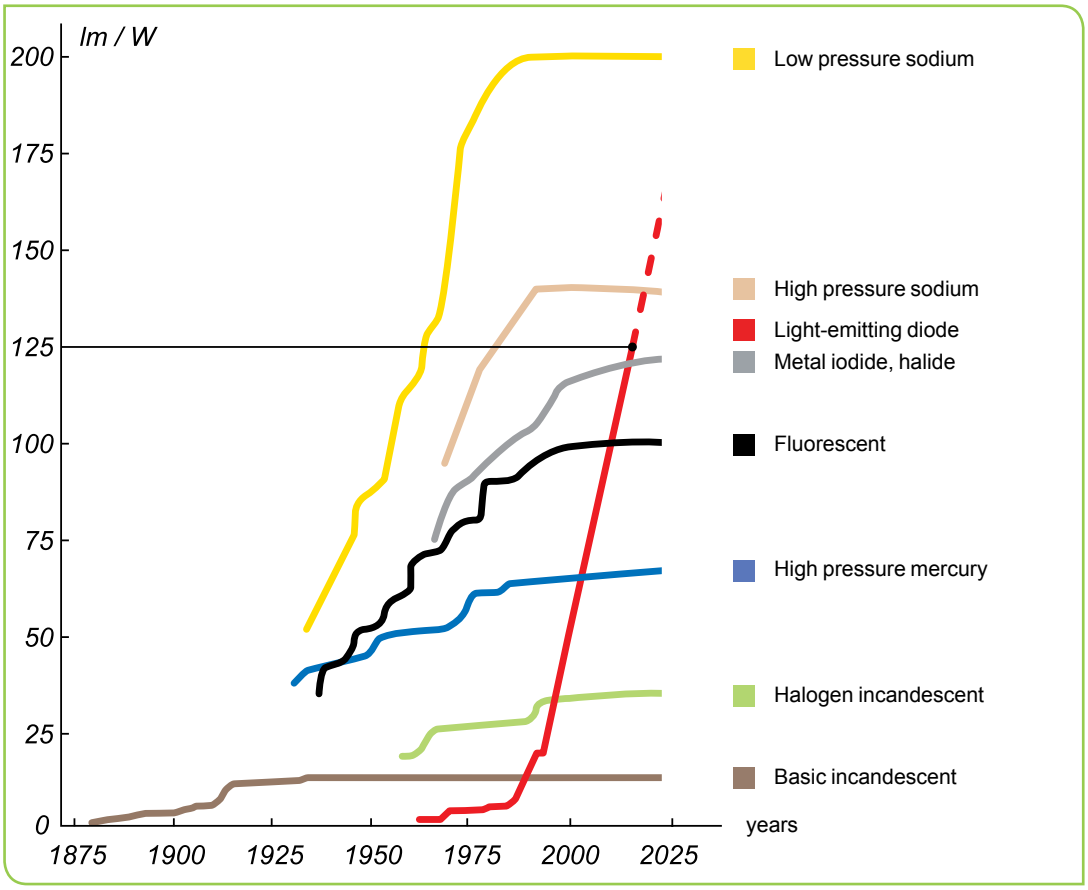


Lumen (lm)
Luminous flux of 1 cd in a 1 steradian cone (1 sphere/4π).

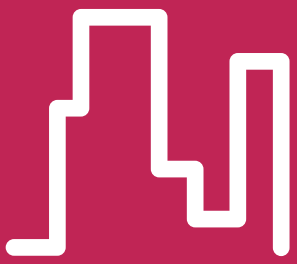
Lux (lx)
Illumination (quantity of light/m²) of 1 lumen/m².

Lighting efficiency (lm/W)
Ratio of the luminous flux emitted to the electrical power consumed. The energy that is not converted into light is dissipated in the form of heat.
The lighting efficiency decreases by 30% to 70% towards the end of the life of the lamp.

Progress in the performance of each technology over time
The graph below illustrates:
- the low efficiency of incandescent lamps despite the halogen technology,
- the obsolescence of the mercury technology, usefully replaced by sodium or metal iodide,
- the good performance of fluorescent lamps,
- the constant progress of light-emitting diodes, with a regular increase in performance (power LED, luminous efficiency, CRI, etc.).



Energy savings with Lighting Control



Lighting can represent

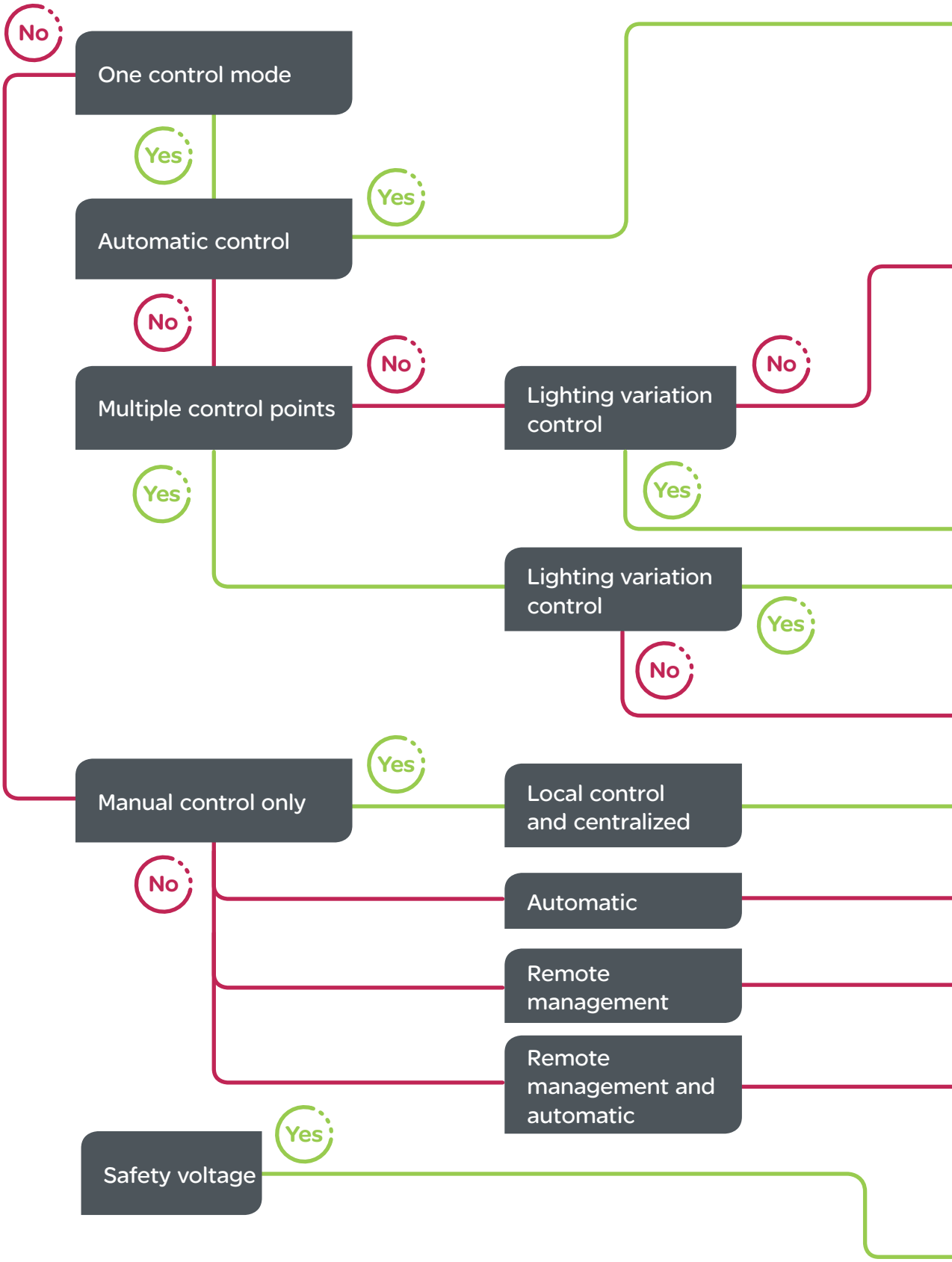
25% to 50%

of energy consumption in buildings depending on the business.

"Smart" lighting control is **one way** of quickly cutting the energy bill **without detracting from essential comfort**!

Lighting Control simple solutions

Content



"Check that the types of protection (1P, 1P+N, 2P... and earth leakage protection) conform to the installation regulations in force in the country concerned"

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Emergency lighting

Management of the lighting period and bells in a school

Customer needs

- The engineering departments want to optimize the operating costs of the local body's educational institutions by achieving savings on lighting, and also achieve automatic actuation of the school bells at the appropriate time.
- Override control of the lighting may be performed for maintenance or servicing purposes.

Proposed solution

- The use of the ITA makes it possible to:
  - limit the use of lighting by programming its operation at times during which the classrooms and common areas must be lit,
  - program bell ringing times,
  - have override control of the lighting by push button.
- Duplication of the program in each educational institution is performed by using a programming kit and the duplicate is transferred by means of a memory cartridge.

User/customer benefits

- **Ease of programming**: changes in time switch programming in case of special events or holiday periods can be made using the programming tool on a computer; a memory cartridge allows the changes to be duplicated simply in each educational institution.
- **Reduced maintenance**: thanks to GPS time reception and automatic summer time/winter time changing.
- **Lighting override control**: a remote push button allows override control of the lighting for maintenance or servicing operations.

Zoom on

ITA

Efficiency at your fingertips!

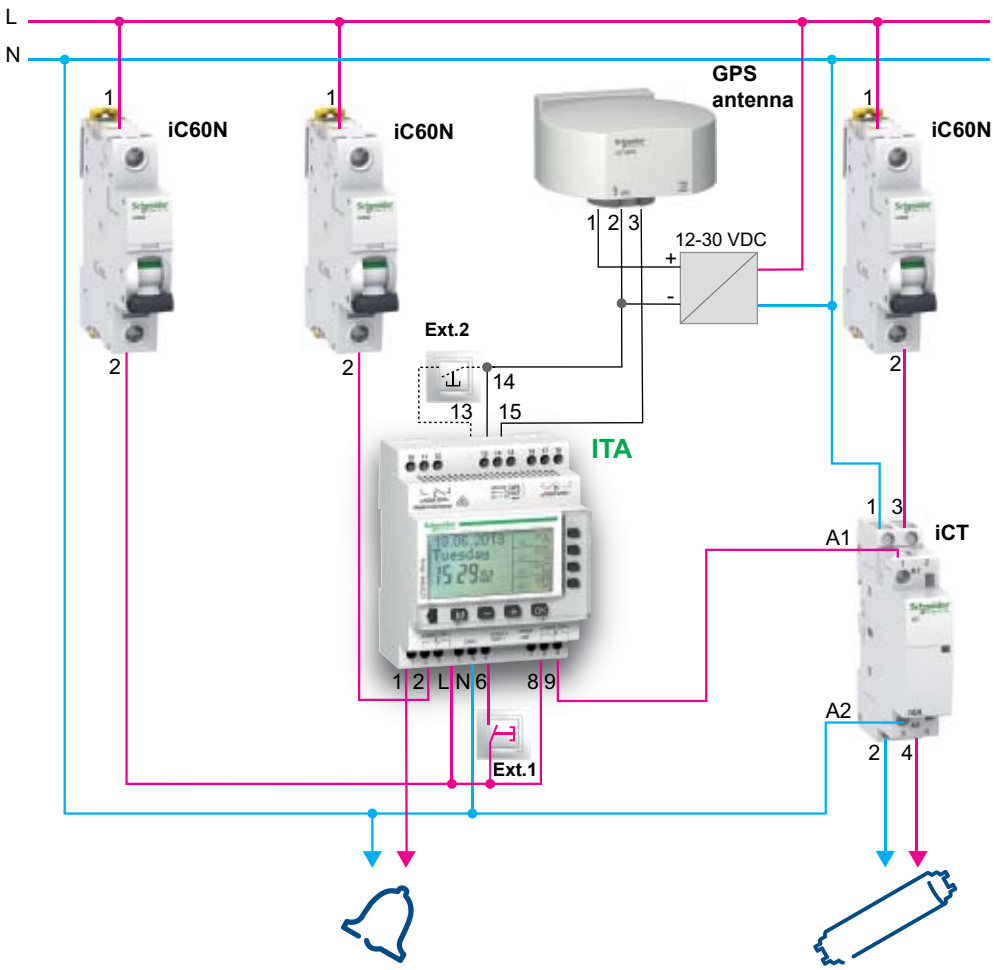
Favorite applications:

- offices and educational institutions,
- hotels,
- industry,
- housing,
- etc.

100% Responsible

> Time programming + GPS time reception = lighting and bell sounding at the right time

Diagram of the solution



Text for specifications

- The lighting and bell will be activated by a programmable time switch.
- A programming key and programming kit will be used to create and copy the program to another time switch, or save it.
- No deviation from timetable thanks to synchronization performed by GPS clock.
- Override control of the lighting will be performed via a switch or push button.

> Products used

Product	Description	Unit	Reference
ITA 4c	Yearly programmable time switch, 4 channels	1	CCT15940
GPS or DCF	GPS or DCF antenna (optional)	1	CCT15970 or CCT15960
Programming kit and key	Programming kit for PC and memory key (optional)	1 +1	CCT15950 and CCT15955
iC60N	MCB 1P	3	
iCT	Modular contactor 2P	1	

Managing the lighting of a convenience store or superette

Customer needs

- The manager of a convenience store wants to automate its lighting system.
- His store comprises two separate lighting areas: storage and sales.
- The lighting must be reduced: one luminaire out of three during delivery, after closing and at cleaning time, while full lighting must be ensured during opening hours.
- The layout of the shelves in the sales area could be reorganized, and the relocation of luminaires should be performed without works.

Proposed solution

- The system chosen is 25 A KBA Canalis busbar trunking.
- The luminaires shall be installed directly under Canalis KBA by means of KBA40ZFUW fasteners.
- An IHP+ 2c clock combined with contactors ensures lighting scripting.
- Manual override control of the lighting will be performed from the electrical switchboard.
- Alteration of the installation during reorganization of the shelves will be simplified by the modularity and extreme ease of assembly and disassembly of the Canalis components.

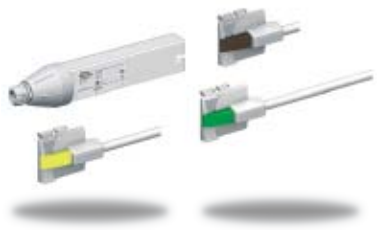
User/customer benefits

- **Simplicity and speed of execution**: from design to installation, no constraints, "Canalis" adapts to all store configurations.
- **Attractiveness**: the white-colored (RAL 9003) Canalis components ensure consistency with the colors of the luminaires.
- **Cost saving**: automation of the installation reduces electricity consumption.
- **Flexibility**: no works required when reorganizing the store or changing the sales area.

Zoom on

KBA

Rigid busbar trunking!



Canalis KBA

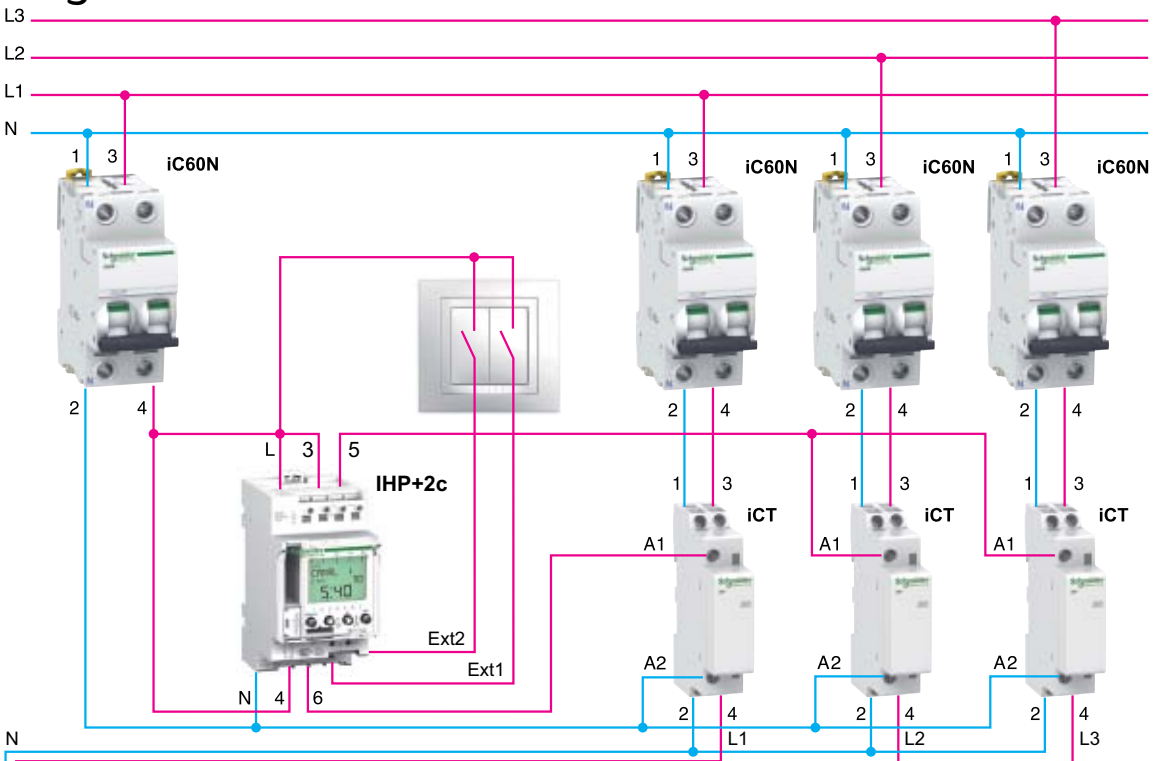
Favorite applications:

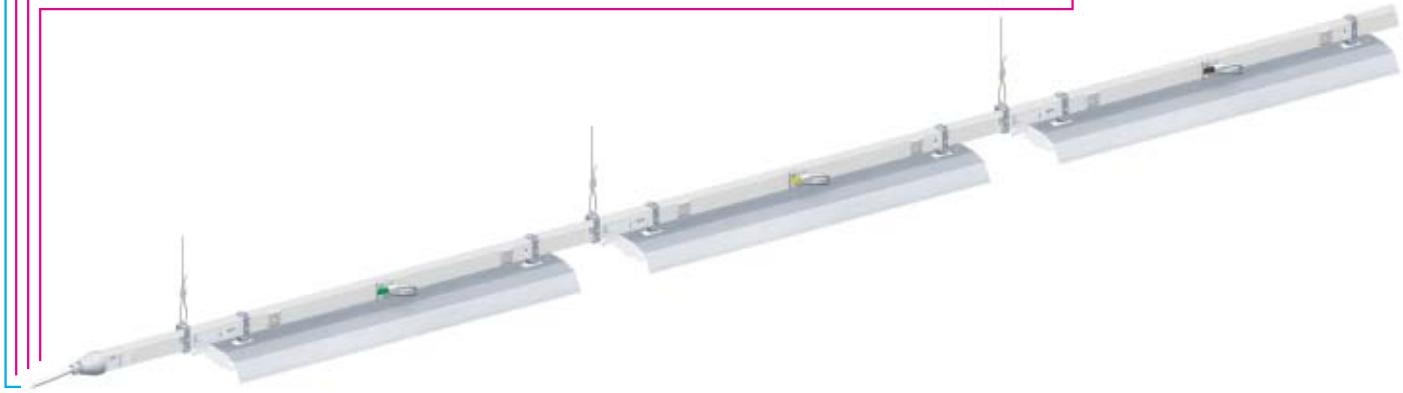
- small stores,
- superettes,
- etc.

100% Efficient

> Pre-cabling + time programming = lighting in the right place + lighting at the right time

Diagram of the solution





Text for specifications

- The use of a decentralized lighting electrical distribution architecture (prefabricated).
- Being able to reorganize the lighting layout without altering the electrical installation.

> Products used

Product	Description	Unit	Reference
Canalis KBA	25 A straight element		KBA25ED4303W
Canalis KBA	25 A power supply box	1	KBA25ABG4W
Canalis KBA	Fasteners		KBA40ZFUW
Canalis busbar trunking	Tap-off connectors		KBC10DCS101, 201, 301
iC60N	C2 A 2P circuit breaker	1	
IHP+ 2c	Programmable time switch with 2 output contacts	1	CCT15853
iC60N	C16 A 2P circuit breaker	3	
iCT	25 A 2P contactor	3	

Lighting management for a car park of a large tertiary site

Customer needs

- Automate the lighting system of an outdoor car park for a technology park according to the time and the position of the sun, without connecting a light sensor.
- For cost saving reasons, after a certain time, only one lamp post out of two will remain lit.
- The lighting system shall be programmed to operate only on working days.
- Possibility of remote override control of the lighting if necessary for maintenance operations.

Proposed solution

- Use of the "IC Astro 2C" astronomical light-sensitive switch allows:
  - car park lighting according to the position of the sun,
  - control of 2 independent lighting circuits,
  - programming of lighting days and times,
  - the possibility of override control of the lighting via a simple push button.

User/customer benefits

- **Maintenance-free**: the IC Astro light-sensitive switch offers the same functions as a regular light-sensitive switch except that it does not require a light sensor. Accordingly, maintenance operations of cleaning, adjustment or replacement due to vandalism are unnecessary.
- **Energy savings**: the lighting is switched on only during the period of activity of the site when the luminosity makes lighting of the car park necessary. The fact that there is no sensor prevents nonconforming lighting times due to fouling, damage to a sensor or the presence of plants.

Zoom on

IC Astro 2C

The programmable astronomical light-sensitive switch!

IC Astro 2C

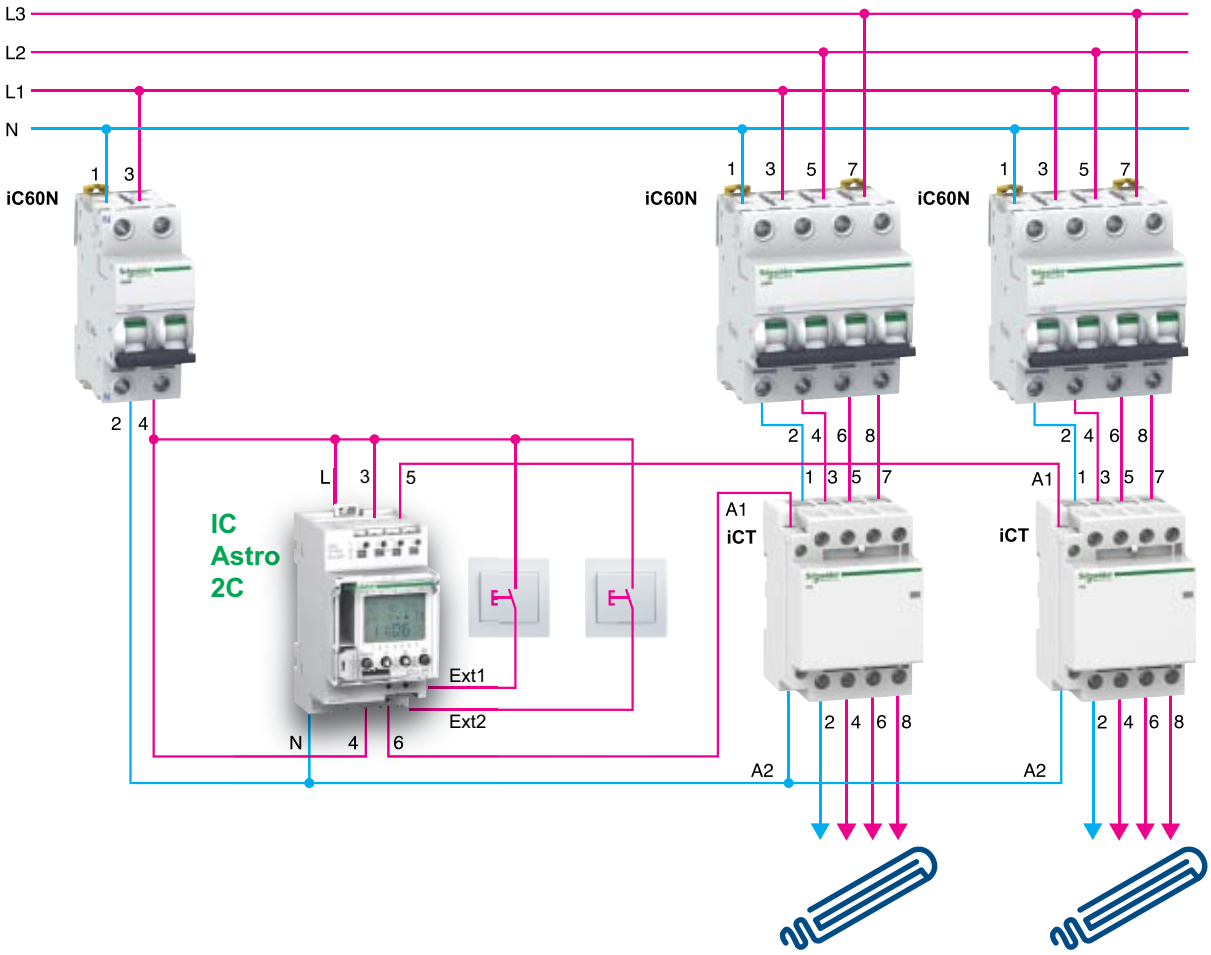
Favorite applications:

- public lighting,
- outdoor car parks,
- etc.

100% Efficient

> Astronomical clock + programming = guarantee of lighting duration

Diagram of the solution



Text for specifications

- The outdoor lighting system is controlled by a time switch which allows for sunrise and sunset times and which requires no light sensor. The lighting system may be inhibited on certain days.

> Products used

Product	Description	Unit	Reference
iC60N	C10 A 1P+N circuit breaker	1	
IC Astro 2C	Programmable astronomical light-sensitive switch with 2 output contacts	1	CCT15243(1), CCT15244(2)
iC60N	C63 A 3P+N circuit breaker	2	
iCT	63 A 4P contactor	2	

(1) English, French, Spanish, Portuguese, Hungarian, Polish, Romanian, Czech, Slovak, Bulgarian, Greek, Slovenian, Serbian, Croatian.
(2) English, French, Italian, German, Swedish, Dutch, Finnish, Danish, Russian, Ukrainian, Latvian, Lithuanian, Estonian, Turkish.

Automatic control of public lighting according to sunrise and sunset times

Customer needs

- The mayor of the local body wants improved operating dependability of public lighting in order to:
  - improve the comfort and safety of his constituents,
  - be able to control the lighting operating period.
- He also wants to reduce the lighting level by 50% so as to achieve energy savings from midnight to 5 am.

Proposed solution

- The use of an IC Astro 2C programmable astronomical light-sensitive switch allows automatic switch-on and switch-off of the lighting according to sunrise and sunset times.
- Two channels are used to be able to reduce the number of luminaires powered from midnight to 5 am (energizing of 1 or 2 phases).
- Override control for each channel is provided by push buttons.
- Given the installed capacity, relaying is provided by contactors.

User/customer benefits

- **Intuitive programming**: the IC Astro 2C incorporates a backlit LCD screen display allowing everyday programming to be performed.
- **Program backup**: internal backup of the program in the event of failure of the mains power supply.
- **Use of a key via a PC** for saving and the duplication of settings and programs in the various cabinets.
- **Simplified maintenance**: no need of a luminosity detector, hence improved operating dependability.
- **Easier installation**: screwless terminals for easy, fast connection.

Zoom on

IC Astro 2C

The programmable astronomical light-sensitive switch!

IC Astro 2C

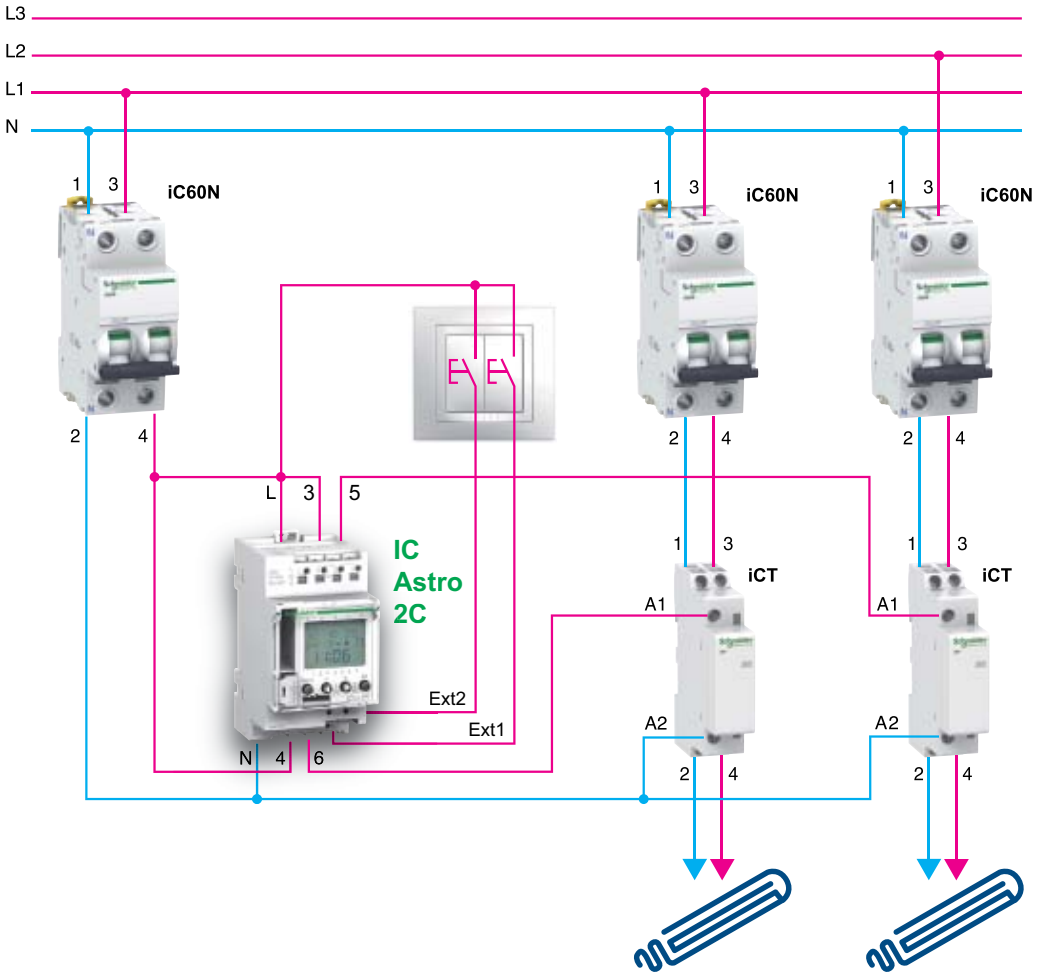
Favorite applications:

- public lighting,
- outdoor car parks,
- etc.

100% Responsible

> Astronomical clock + 2 programmable channels = -30% on the energy bill

Diagram of the solution



Text for specifications

- Use of an astronomical light-sensitive switch with 2 independent channels, allowing automatic switch-on and switch-off of the lighting according to sunrise and sunset times and geographic location, and without a luminosity detector.
- Program backup and duplication is performed on a programming key.
- Possibility of manual override control of the lighting for each channel by means of push buttons (or switches).

> Products used

Product	Description	Unit	Reference
iC60N	C2 A 2P circuit breaker	1	
iC60N	C20 A 2P circuit breaker	2	
IC Astro 2C	Programmable astronomical light-sensitive switch with 2 output contacts	1	CCT15243(1), CCT15244(2)
iCT	25 A 2P contactor	2	A9C20732

(1) English, French, Spanish, Portuguese, Hungarian, Polish, Romanian, Czech, Slovak, Bulgarian, Greek, Slovenian, Serbian, Croatian.
(2) English, French, Italian, German, Swedish, Dutch, Finnish, Danish, Russian, Ukrainian, Latvian, Lithuanian, Estonian, Turkish.

Lighting for a hotel lobby

Customer needs

- Ensure lighting for people's movement if the luminosity is insufficient.
- The lighting should automatically be extinguished after a certain time, once the people have left.
- It must be possible to switch on the lighting by remote override control to be able to check the condition of the lamps in daytime.

Proposed solution

- **The Argus 360** allows detection of people in movement. In the event of insufficient luminosity, the lighting comes on automatically for a given period.
- Relaying by a contactor makes it possible to increase the control power.
- A two-position wall switch, located at the reception desk for example, can be used to switch on the lighting by override control if necessary.

User/customer benefits

- **Energy savings**: lighting is ensured in the event of low luminosity and the presence of persons, and this can optimize power consumption while ensuring the safe movement of people. It is also possible to adjust the time during which the lighting will remain lit after the last detection of a movement.
- **Comfort**: automatic switching on without having to look for the lighting control.

Zoom on

Argus

Movement detection

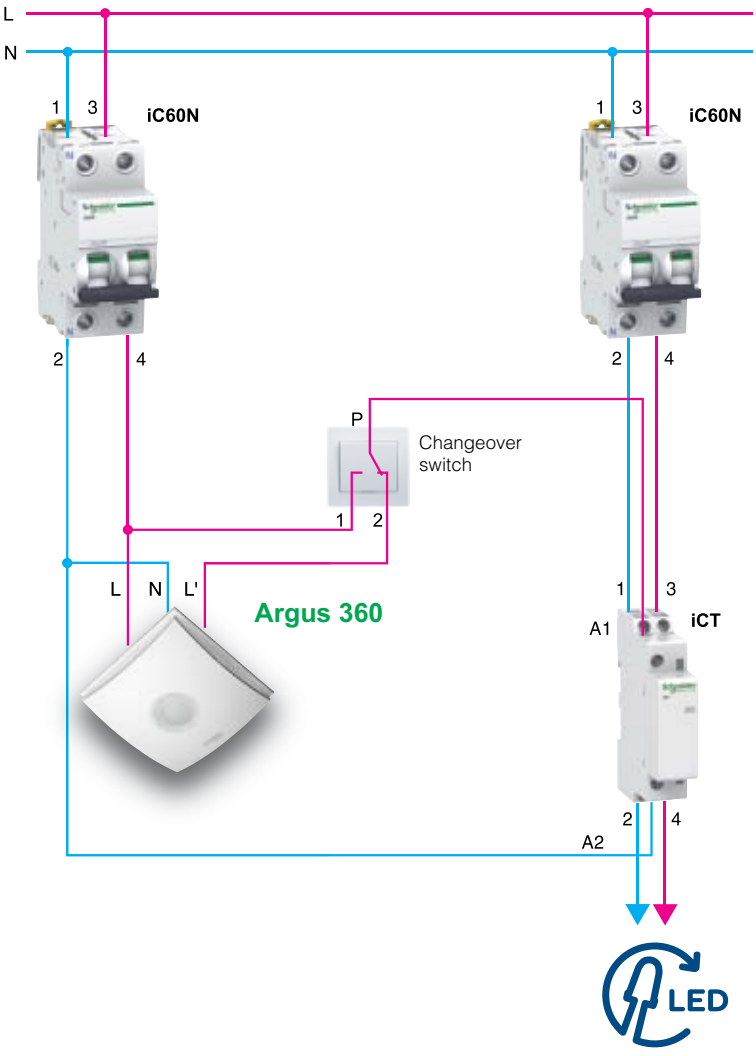
Argus 360

Favorite applications:

- hotels,
- residential buildings,
- etc.

> Movement detection + luminosity measurement = safe movement

Diagram of the solution



Text for specifications

- The lighting system for an area is activated by movement detection and according to the luminosity.
- If necessary, the lighting can be switched on continuously by a remote control.

> Products used

Product	Description	Unit	Reference
iC60N	C2 A 1P+N circuit breaker	1	
iC60N	C16 A 1P+N circuit breaker	1	
Argus 360	360° movement detector	1	CCT56P002
iCT	25 A 1P+N contactor	1	A9C20732

Lighting management for an office space

Customer needs

- The manager of an office space needs to organize the lighting layout for this space.
- He also wants to achieve energy savings by implementing automatic switch-on or switch-off of the lighting according to the presence of people and the luminosity level.
- Automatic extinguishing of each office shall be performed after a time delay in the absence of people.
- The installation must be easily modifiable during rearrangement of the offices.

Proposed solution

- The system chosen is Canalis busbar trunking incorporating a DALI architecture without programming.
- Automatic lighting is provided by master and slave DALI presence detectors, and adjustment of the constant luminosity level office by office is an integral function of the master Argus detectors.
- These detectors are fastened directly to the busbar trunking or are simply connected to it according to the layout of the offices.
- Information is transferred uniformly to all the ballasts connected to the master detector network.
- Override control of the lighting is performed by push buttons connected to the (master) DALI detector.
- Alteration of the installation will be easy thanks to the modularity and extreme ease of assembly and disassembly of the Canalis components.

User/customer benefits

- **Fewer cables**: a single duct incorporates the power and the DALI communication buses for the master and slave Argus detectors and DALI ballast (option T of the KBA product ranges).
- Communication between the master and slave Argus devices and override control push buttons uses the power supply conductor (power line carrier).
- The prefabricated lighting electricity distribution system allows flexibility of installation for arrangement or rearrangement of space, without altering the electrical structure.

Zoom on

KBA

Rigid busbar trunking!

Canalis KBA

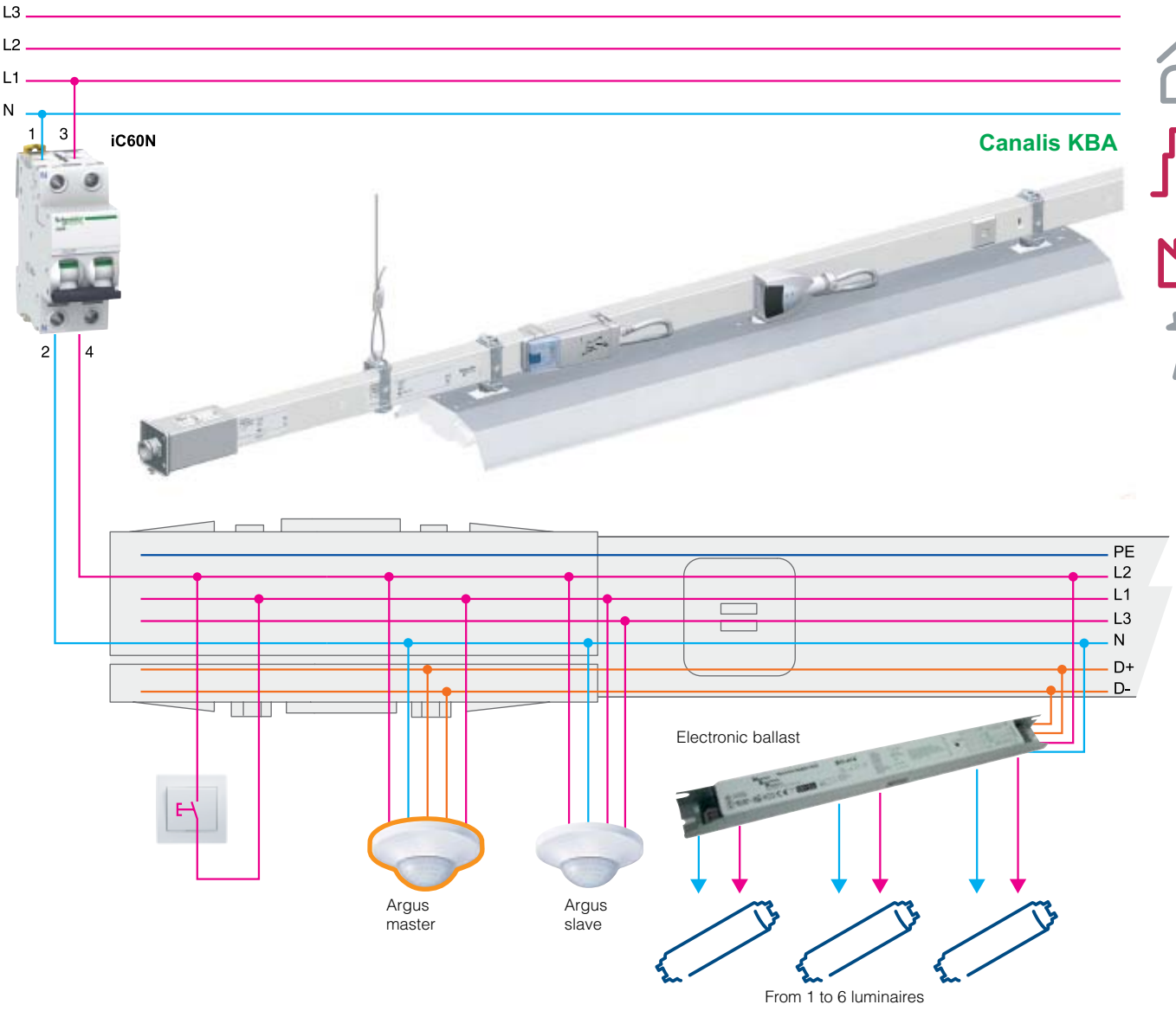
Favorite applications:

- small stores,
- superettes,
- etc.

100% Efficient

> Pre-cabling + presence detection = lighting in the right place + appropriate lighting

Diagram of the solution



Text for specifications

- Decentralized DALI lighting system without programming.
- Simplification of office rearrangement.

Products used

Product	Description	Unit	Reference
Canalis KBA	40 A straight element (with communication bus)		KBA40ED4303TW
Canalis KBA	40 A power supply box	1	KBA40ABG4TW
Canalis KBA	Fasteners		KBA40ZFUW
Canalis busbar trunking	Tap-off connectors	1	KBC16DCB21+KBC16ZT1
Canalis busbar trunking	Connectors for Argus master detector	1	KBC16DCB40+KBC16ZT1
Canalis busbar trunking	Connectors for Argus slave detector	1	KBC10DCB40
iC60N	C16 A 1P+N circuit breaker	1	

Optimizing lighting for the car park of a hotel

Customer needs

- The hotel manager wants to optimize lighting for a car park with a simple solution ensuring sufficient lighting irrespective of the natural luminosity level.

Proposed solution

- The use of an IC100 light-sensitive switch allows automatic control of the car park lighting according to the level of outside luminosity and the threshold set on the light-sensitive switch.

User/customer benefits

- **Customer safety**: lighting is ensured in the event of low luminosity.
- **Energy savings**: precise setting of the lighting tripping threshold on the IC100 light-sensitive switch can optimize the lighting period.
- **Easy access to settings** on the light-sensitive switch located in the electrical distribution switchboard.

Zoom on

IC100

Light comes with the night!

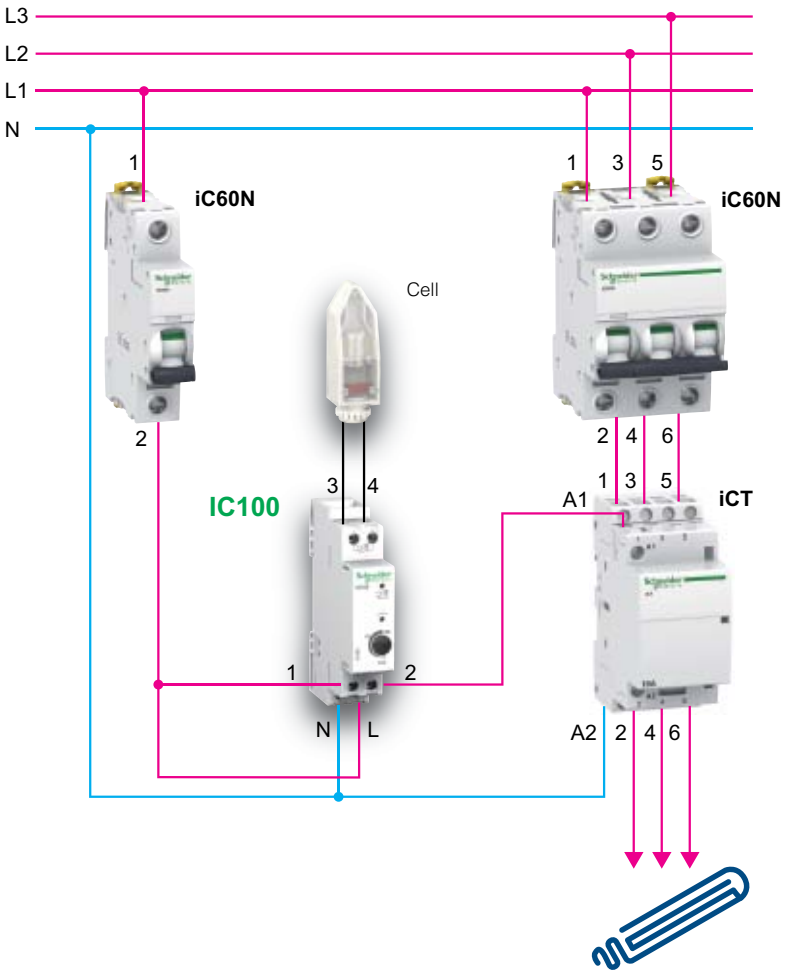
IC100

Favorite applications:

- hotel,
- educational institution,
- offices,
- etc.

> Luminosity measurement = sufficient lighting in all circumstances

Diagram of the solution



Text for specifications

- Car park lighting is activated according to the luminosity. The light-sensitive switch must be combined with a wall cell.
- Power consumption exceeds 2300 W.

> Products used

Product	Description	Unit	Reference
IC100	Light-sensitive switch (supplied with a wall cell)	1	15482
iC60N	C2 A 1P circuit breaker	1	
iC60N	C25 A 3P circuit breaker	1	
iCT	40 A 3P contactor	1	

Optimizing the lighting of a shop window

Customer needs

- The owner of the shop, set up in a shopping mall, wants to light his shop window automatically when luminosity is low.
- Also, he wants to achieve energy savings by automatic extinguishing of this lighting at closing time, and on non-working days.

Proposed solution

- The use of an IC2000P+ programmable light-sensitive switch makes it possible to automatically control lighting of the shop window according to the level of outside luminosity and opening hours.
- Non-working days can be programmed to inhibit lighting.
- Remote override control possible by simple switch.

User/customer benefits

- **Ease of installation**: thanks to intuitive configuration.
- **Flexibility of settings**: has a luminosity level adjustable from 2 to 2100 Lux and an adjustable time delay to prevent unwanted switch-on of the lighting in the event of a brief change in luminosity.
- **Ease of use**: override control of lighting by remote control switch. Automatic summer time/winter time changing.

Zoom on

IC

Light comes with the night!

IC2000P+

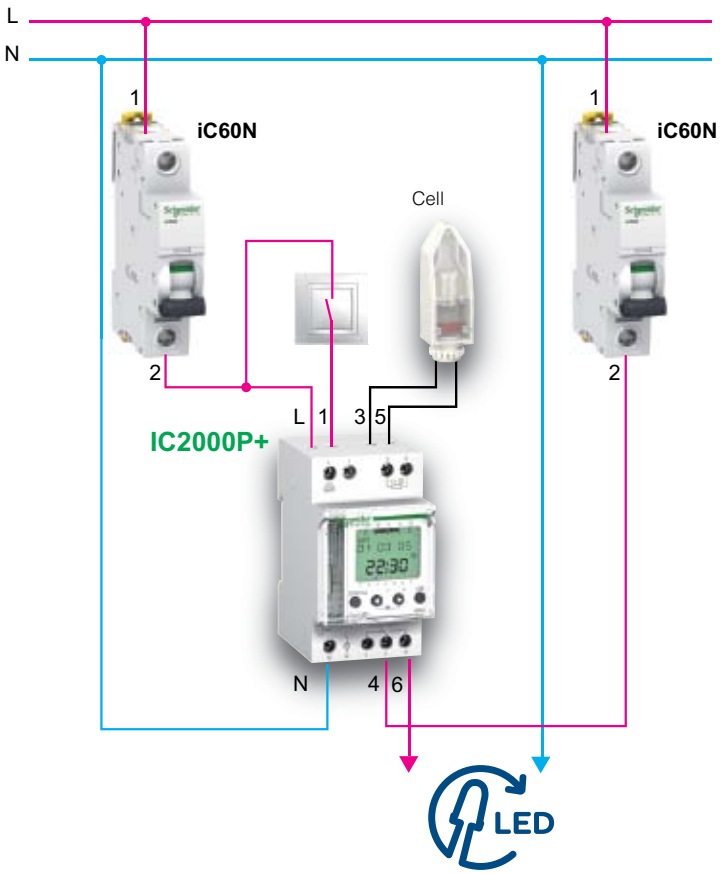
Favorite applications:

- housing,
- shops,
- etc.

100% Efficient

> Luminosity measurement + time programming = value creation + savings

Diagram of the solution



Text for specifications

- The light-sensitive switch must be combined with a wall cell.
- The operating period settings must be configured according to the shopping mall's opening hours.
- It must be possible to adjust the lighting tripping threshold according to the level of outside luminosity, from 2 to 2100 lux.
- It must be possible to override the lighting settings by remote control.

> Products used

Product	Description	Unit	Reference
IC2000P+	Programmable light-sensitive switch (supplied with a wall cell)	1	15483
iC60N	C2 A 1P circuit breaker	1	
iC60N	C16 A 1P circuit breaker	1	

Improving management of a public lighting system in a town

Customer needs

- The quality of lighting is of prime importance for a town. This installation provides management of public lighting and a power supply for the power sockets distributed over the public space to allow the holding of special events (markets, street entertainment).
- The objective is to ensure the following functions by remote management:
  - switching public lighting on and off,
  - energizing or de-energizing a power socket circuit,
  - information on equipment operating states, so as to plan repair operations,
  - remote restarting following an electrical fault.
- In the event of a remote management failure, a function designed to ensure improved dependability of service is performed by a local PLC for switching the public lighting on and off.

Proposed solution

- The functional units are installed in street cabinets along the roads, or in equipment rooms located near the area to be powered.
- The RCA control device allows the PLC to switch off the power supply by actuating the iC60 device.
- Each cabinet has a local automatic control system interfacing with the central system.
- The RCA remote control is configured in 1-A mode to give priority to the management PLC and enable reclosing of the circuit breaker following a fault.

User/customer benefits

- **Simplicity**: automated, secure solution for switching the power supply on and off, indications on the front panel of the product and remote signaling.
- **Safety**: padlocking possible without any additional accessory.
- **Continuity of service**: enabling of automatic reclosing upon an electrical fault.
- **Energy efficiency**: no permanent consumption because the RCA iC60 remote control is a bistable actuator.

Zoom on

RCA iC60

Remote control!

With Ti24 interface

RCA iC60

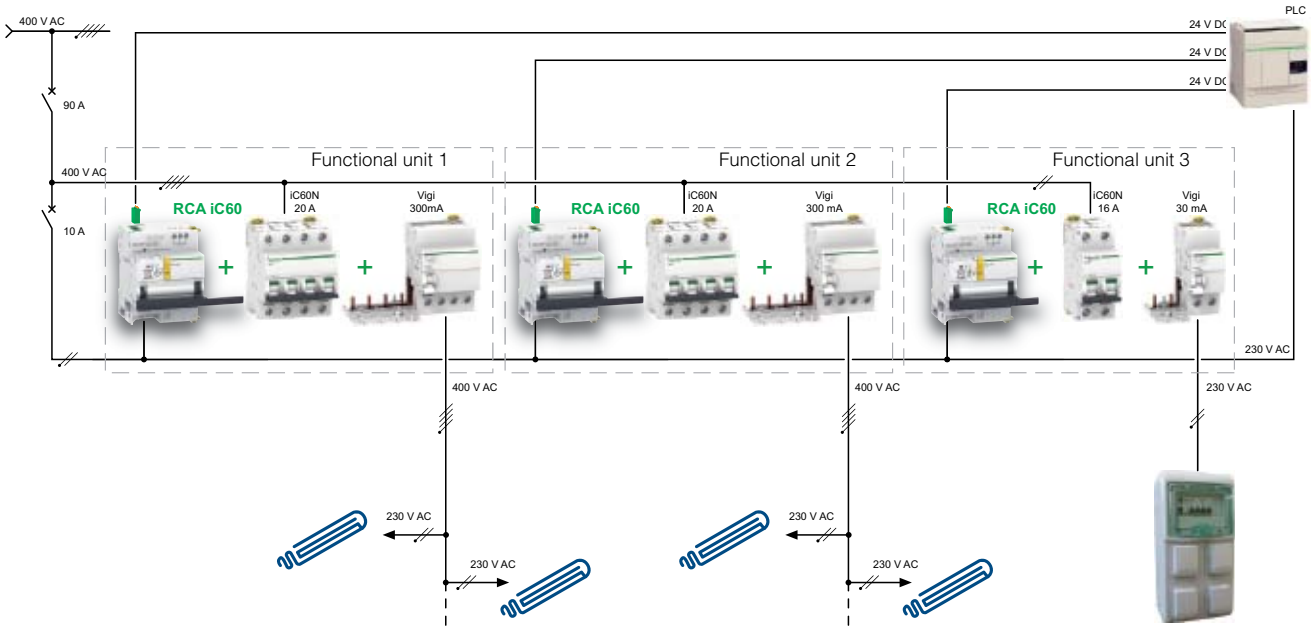
Favorite applications:

- infrastructure,
- industry, large tertiary,
- public lighting,
- power distribution,
- circuit load shedding,
- etc.

100% Responsible

> Remote management + automatic control = quality of service + savings

Diagram of the solution



Text for specifications

- The lighting and power socket feeders must be powered by a modular circuit breaker combined with a remote control and an earth leakage protection auxiliary.
- This circuit breaker is remote controlled automatically via a connection with a PLC without any additional interface.
- The state of the circuit breaker (open/closed) and the presence of an electrical fault must be indicated at the PLC level.
- After tripping of the protective device, remote reclosing is enabled.

> Products used

Product	Description	Unit	Reference
RCA iC60	230 V AC 50 Hz remote control with Ti24 4P interface	2	A9C70124
iC60N	C20 A 4P circuit breaker	2	-
Vigi iC60	300 mA 4P earth leakage protection device	2	-
RCA iC60	230 V AC 50 Hz remote control with Ti24 2P interface	1	A9C70122
iC60N	C16 A 2P circuit breaker	1	-
Vigi iC60	30 mA 2P earth leakage protection device	1	-

Improve the reliability of LED street lighting system (single-phase network)

Customer needs

- When switching from conventional lighting technology to LED technology, the town hall technical department wants to have a solution that is compatible with all the light units on the market.
- The solution must minimize maintenance operations through increased reliability and it must be possible to interface it with existing installations.

Proposed solution

- iCT+ allows peak current to be reduced at power up and circuit breakers to be used without derating. The amount of wear on the switchgear is therefore limited and its service life maximized.
- iQuick PRD surge arresters protect power circuits.
- iPRI surge arresters protect communication systems that are sensitive to overvoltages.

Users / customer benefits

- **Designers:** complete, simple, integrated, upgradeable solution.
- **Ease of installation:** this solution allows existing facilities to be refurbished, has smaller physical dimensions, is simple to install and easier to implement.
- **Optimized maintenance:** protection against the effects of lightning.
- **Maximized return on investment** by opting for the best technico-economic solution.

Zoom on

iQuick PRD

Surge arrester with integrated disconnector

iQuick PRD

iCT+

Zero voltage contactor

iCT+

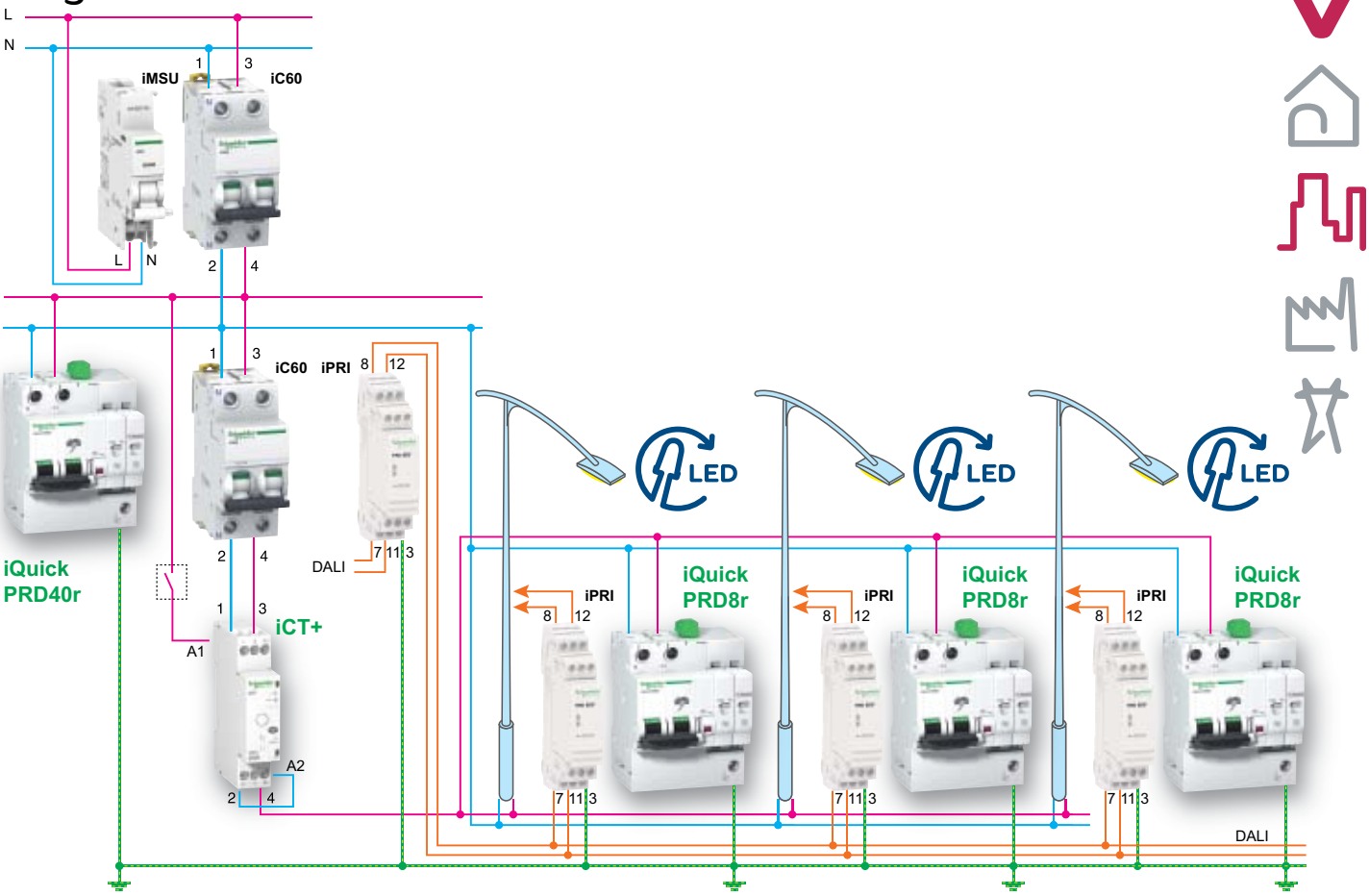
Preferred application:

- street lighting,
- car parks,
- supermarkets,
- ....

100% Efficient

> Overvoltage protection + zero voltage contactor = reduced maintenance + longer service life

Diagram of the solution



Specifications

- A zero voltage contactor must be provided to limit the inrush current when the light units are powered up.
- An overvoltage relay must provide protection against temporary industrial frequency overvoltages.
- Energy network surge arresters that are coordinated and fitted with disconnectors must be installed in the distribution enclosure and in the base of each pole.
- Communication network surge arresters must be installed in the distribution enclosure and in the base of each pole.

> Products used

Produit	Description	Unité	Référence
iQuick PRD40r (*)	1P+N withdrawable surge arrester (Type 2)	1	A9L16292
iQuick PRD8r	1P+N withdrawable surge arrester (Type 2)	3	A9L16298
iC60N	1P+N C40 A circuit breaker	2	-
iCT+	1P+N 20 A contactor with manual control	1	A9C15031
iPRI	Surge arrester for communication network	4	A9L16339
iMSU	Voltage threshold release	1	A9A26500

(*) If lightning arrestor present: Type 1 + Type 2 surge arrester, iPRF1 12.5r A9L16632 + associated disconnector

Improve the reliability of LED street lighting system (three-phase network)

Customer needs

- When switching from conventional lighting technology to LED technology, the town hall technical department wants to have a solution that is compatible with all the light units on the market.
- The solution must minimize maintenance operations through increased reliability and it must be possible to interface it with existing installations.

Proposed solution

- iCT+ allows peak current to be reduced at power up and circuit breakers to be used without derating. The amount of wear on the switchgear is therefore limited and its service life maximized.
- iQuick PRD surge arresters protect power circuits.
- iPRI surge arresters protect communication systems that are sensitive to overvoltages.

Users / customer benefits

- **Designers:** complete, simple, integrated, upgradeable solution.
- **Ease of installation:** this solution allows existing facilities to be refurbished, has smaller physical dimensions, is simple to install and easier to implement.
- **Optimized maintenance:** protection against the effects of lightning.
- **Maximized return on investment** by opting for the best technico-economic solution.

Zoom on

iQuick PRD

Surge arrester with integrated disconnector

iQuick PRD

iCT+

Zero voltage contactor

iCT+

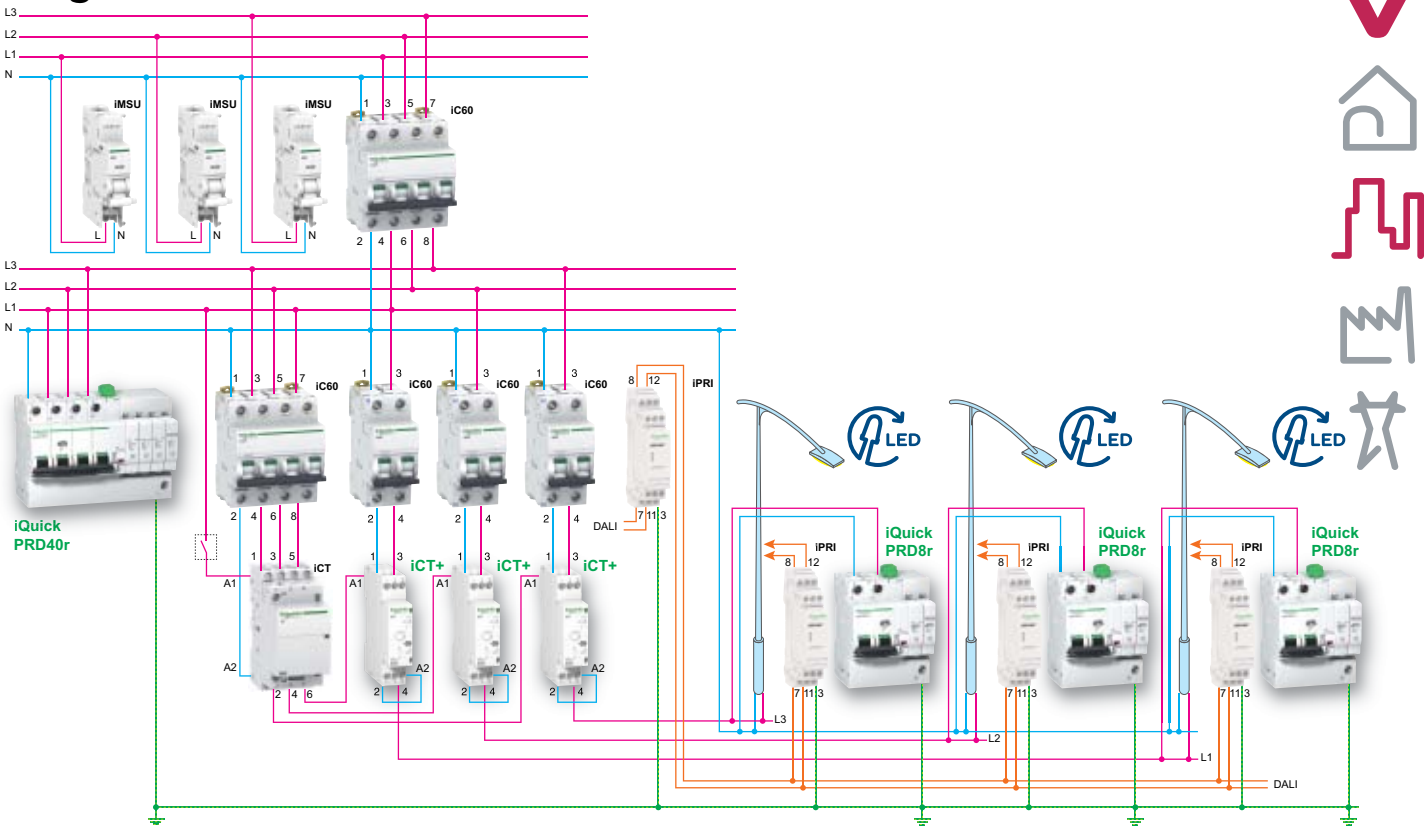
Preferred application:

- street lighting,
- car parks,
- supermarkets,
- ....

100% Efficient

> Overvoltage protection + zero voltage contactor = reduced maintenance + longer service life

Diagram of the solution



Specifications

- Zero voltage contactors must be installed to limit the inrush current when the light units are powered up.
- Overvoltage relays must provide protection against temporary industrial frequency overvoltages.
- Energy network surge arresters that are coordinated and fitted with disconnectors must be installed in the distribution enclosure and in the base of each pole.
- Communication network surge arresters must be installed in the distribution enclosure and in the base of each pole.

> Products used

Produit	Description	Unité	Référence
iQuick PRD40r (*)	3P+N withdrawable surge arrester (Type 2)	1	A9L16294
iQuick PRD8r	1P+N withdrawable surge arrester (Type 2)	3	A9L16298
iC60N	3P+N C40 A circuit breaker	2	-
iC60N	1P+N C40 A circuit breaker	3	-
iCT+	1P+N 20 A contactor with manual control	3	A9C15031
iCT	3P 25 A contactor	1	A9C20833
iPRI	Surge arrester for communication network	4	A9L16339
iMSU	Voltage threshold release	3	A9A26500

(*) If lightning arrestor present: Type 1 + Type 2 surge arrester, iPRF1 12.5r A9L16634 + associated disconnector

Functional lighting for a hypermarket

Customer needs

- The Maintenance Department of a hypermarket is to replace the T12 fluorescent tubes of the functional lighting system with far more efficient LED luminaires.
- The customer does not wish to change the distribution architecture or the type of protection (long cable length), or increase the number of feeders in the electrical switchboard.
- For a given illumination level, the installed capacity with LEDs is far smaller, but the current peaks generated at power up could possibly cause unwanted tripping of the B-curve protective circuit breakers.

Proposed solution

- Replace the standard contactors with iCT+ controlled-action control contactors (switching at zero voltage phase angle).
- Keep the protective circuit breakers with the same characteristics (ratings, curves).

User/customer benefits

- **Reduction of current peaks** within a ratio of 4 to 5 at power up, thanks to the use of iCT+ contactors, which will make it possible to:
  - keep the protection system,
  - eliminate the risk of nuisance tripping,
  - limit the level of overvoltage generated at power up and "stress" the LED drivers less (Soft Start concept).

Zoom on

iCT+

The contactor!

iCT+

Favorite applications:

- hypermarkets,
- shops,
- offices,
- etc.

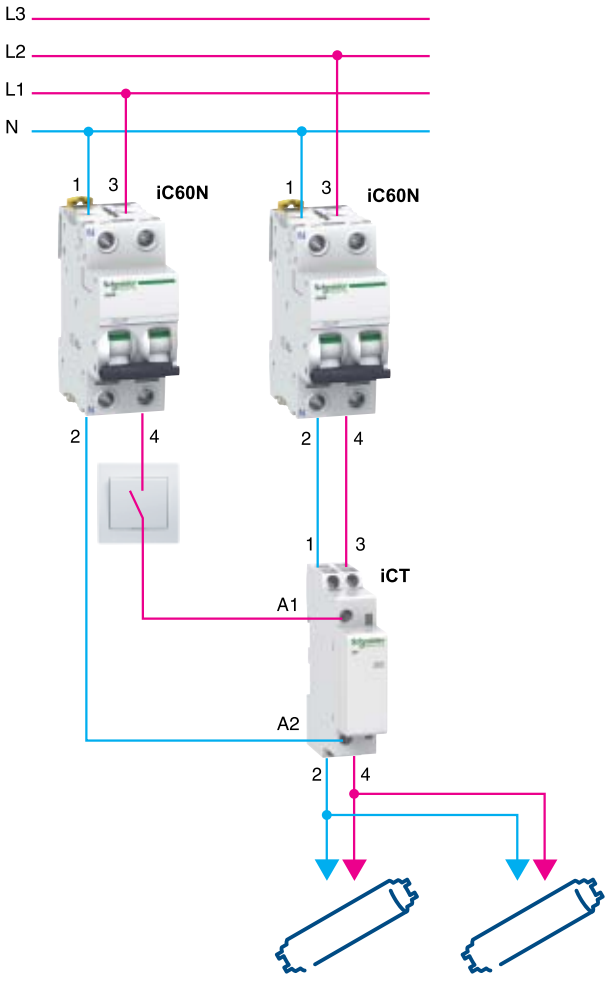
100% Efficient

> LED lighting + controlled-action control = limited capital cost + operating savings

Diagram of the solution

Before

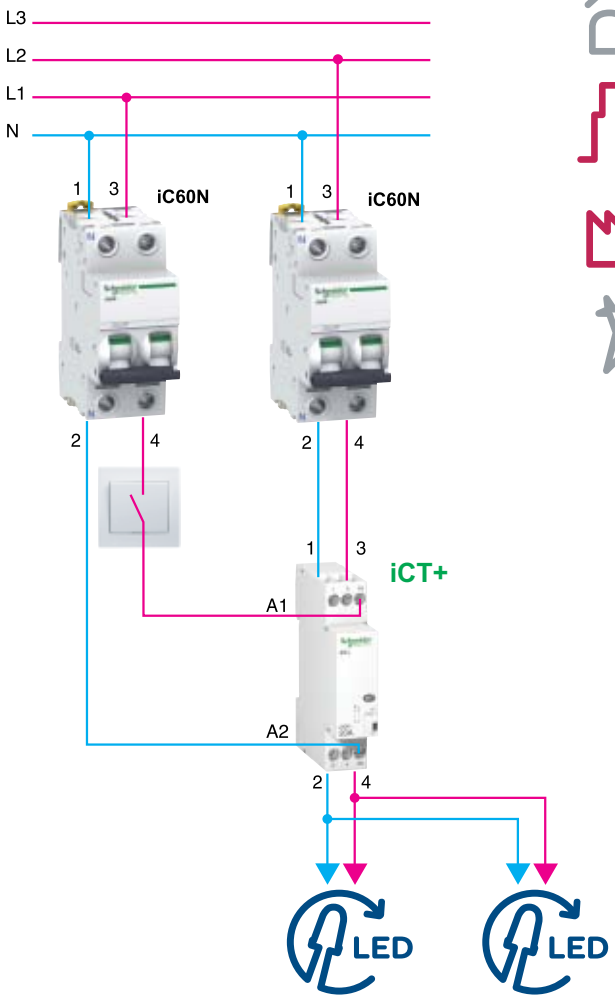
Old installation with CT and fluorescent tubes



2 kW fluorescent tubes

After

New installation with iCT+ and LED lamps



0.8 kW LED lamps

Text for specifications

- The replacement of the T12 fluorescent tube lighting system must not require:
  - a change of architecture,
  - a change in the characteristics of protective devices,
  - additional space in the electrical distribution switchboard.

> Products used

Product	Description	Unit	Reference
iC60N	C10 A 1P+N circuit breaker	1	
iC60N	C16 A 1P+N circuit breaker	1	
iCT+	Silent contactor	1	A9C15030

Lighting for a storage warehouse

Besoins clients

- **Lighting control must be ensured by a simple switch.**
- **Obtain feedback** on the lighting circuit state (ON or OFF).
- **The lighting power may be significant depending on the case.**

Proposed solution

- **The latched-control impulse relay iTLm** is a bistable relay that can be controlled by means of a changeover switch.
- The iTLm opens or closes its contact according to the application of a voltage to the ON or OFF terminal. The voltage can be applied via a changeover contact of a simple switch, a time switch, etc.

User/customer benefits

- **Reduced consumption and heating in the switchboard**: use of the impulse relay avoids permanent consumption by the coil of a contactor.
- **Simplified control**: the latched-control impulse relay makes it possible to use a simple switch.
- **Lighting override control**: the controls on the front panel of the product can be used to switch the lighting on or off by override control for specific needs.

Zoom on

iTLm

The impulse relay!

iTLm iTL iATLm

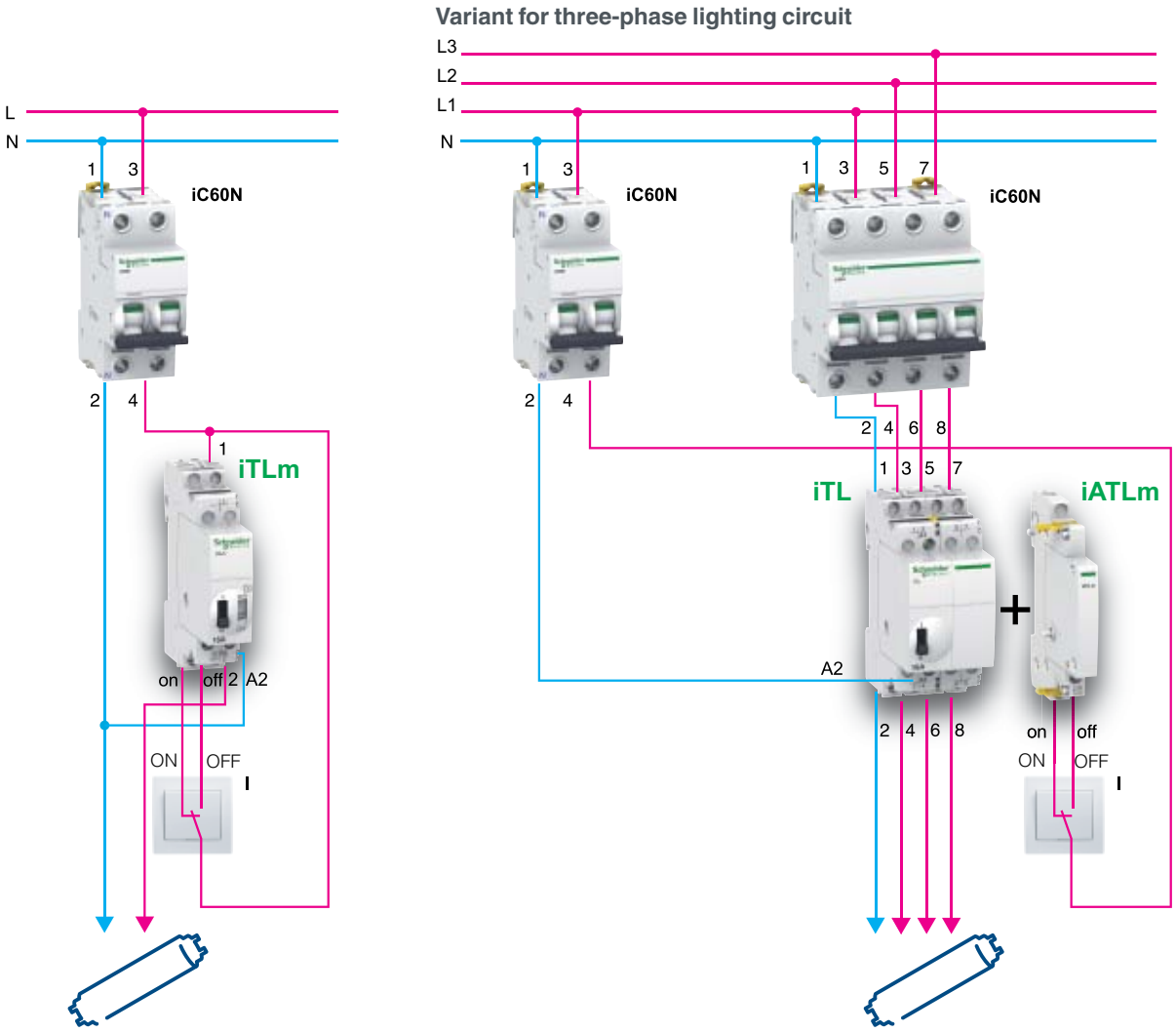
Favorite applications:

- educational institutions,
- hotels,
- industry,
- infrastructure,
- etc.

100% Efficient

> Impulse remote control + switch = visibility of lighting status

Diagram of the solution



Text for specifications

- The lighting system for an area is activated by an impulse relay controlled by a simple two-position switch. Lighting remote control must be able to be inhibited easily.

Products used

Product	Description	Unit	Reference
iC60N	C16 A 1P+N circuit breaker	1	
iTLm	Impulse relay with integral latched function	1	A9C34411
Variant for three-phase circuit			
iC60N	1P+N C2 A circuit breaker	1	
iC60N	3P+N C16 A circuit breaker	1	
iTL	4P impulse relay	1	A9C30814
iATLm	Impulse relay auxiliary with latched function	1	A9C15414

Lighting for a meeting room with remote reporting

Customer needs

- The meeting room's lighting must be able to be controlled from several points.
- The receptionist must be able to check switch-off when the room is not in use, to avoid any waste of energy if users have forgotten to turn off the light.

Proposed solution

- The iTL, iTLs impulse relay closes or opens the circuit whenever a control pulse is applied. The pulse is generated by pressing one of the push buttons. All the push buttons are connected in parallel.
- For the purpose of remote signaling, a lighting status report is produced by the signaling function of the iTLs.

User/customer benefits

- **Space saving**: the iTLs impulse relay saves space due to integration of the remote signaling function. The total width is still 18 mm.
- **Reduced consumption and heating**: a "bistable" solution, which consumes no energy to hold the lighting circuit in closed position.
- **Comfort**: the impulse relay offers continuous, silent operation compared with similar applications using contactors. The distribution board can be installed in bedrooms, offices, etc. without any discomfort for the users.

Zoom on

iTL

The impulse relay!

iTL iTLs

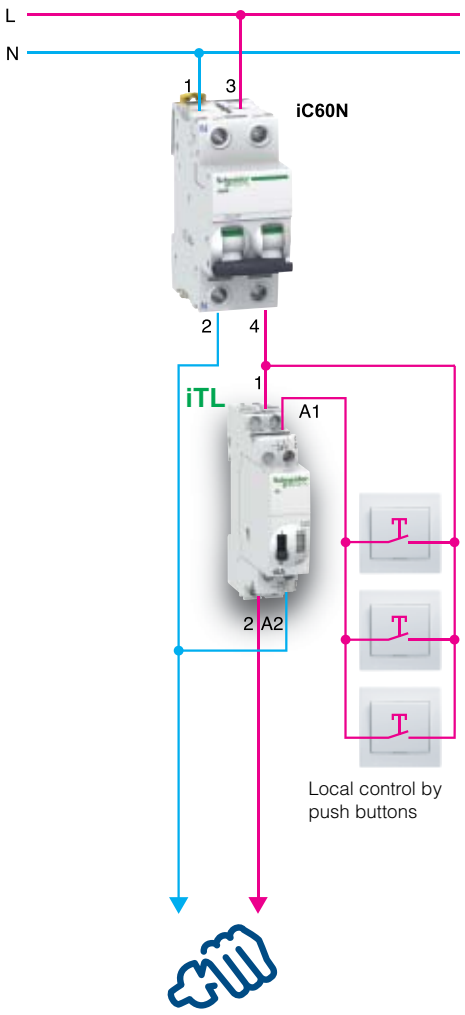
Favorite applications:

- housing,
- offices,
- hotels,
- etc.

> Impulse remote control + signaling = visibility of lighting status

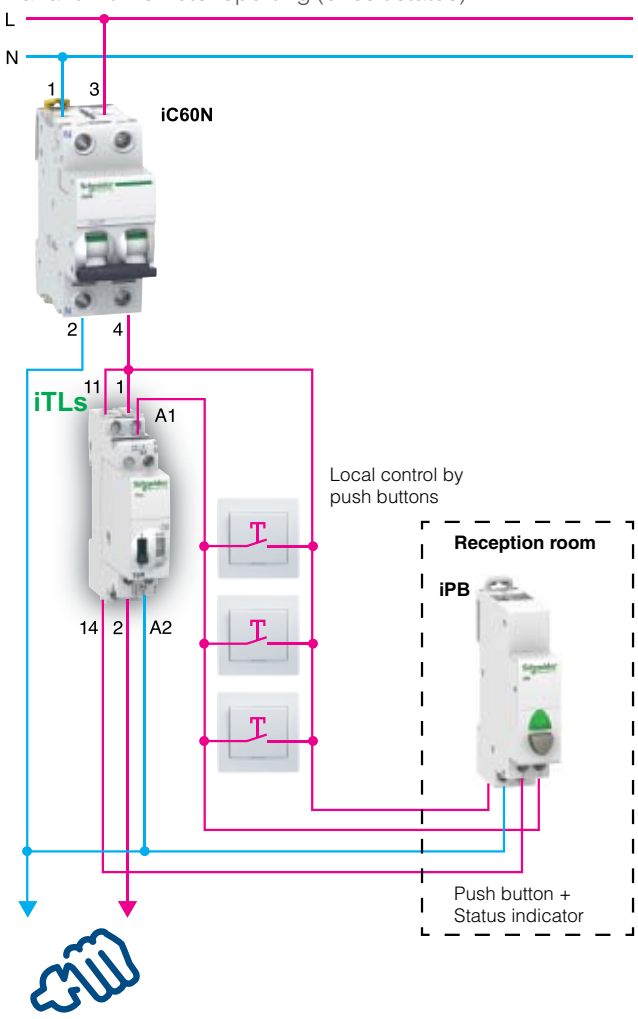
Diagram of the solution

Lighting for a meeting room



Lighting for a meeting room

Variant with remote reporting (circuit status)



Text for specifications

- The lighting system for an area is activated locally via several push buttons. Override setting of the lighting to ON or OFF for maintenance purposes must be able to be performed easily from the distribution board.
- On option, it must be possible to remotely indicate the circuit status.
- Depending on the rating of the power circuit protection circuit breaker, additional protection for the control circuit may be necessary.

> Products used

Product	Description	Unit	Reference
iC60N	C16 A 1P+N circuit breaker	1	
iTL	16 A impulse relay	1	A9C30811
iTLs	16 A impulse relay with remote indication	1	A9C32411
iPB	Push button + green indicator	1	A9E18036

Lighting control for the exhibition halls of a museum

Customer needs

- Control the main lighting system for three exhibition halls separately and also by centralized actuation.
- It must be possible to adjust the lighting so as to be able to lower the luminosity level and adapt lighting consumption to the needs.
- A minimum of two lighting levels must be feasible in a simple manner.

Proposed solution

- The lighting system consists of fluorescent tubes provided with electronic ballasts with 1-10 V control.
- The solution is to separate the exhibition halls into three different thematic areas.
- The use of three SCU10-SAE remote control dimmers will ensure centralized control of the three areas and allow memorizing of two lighting levels.

User/customer benefits

- **Ease of use**: a single press on the external push buttons can call up the two lighting levels memorized in the remote control dimmer.
- **Clear indications on the front of the remote control dimmer**: the indicator lamp on the control push button on the front displays its status: in operation or in fault mode.
- **Reliability**: the remote control dimmers are provided with electronic protective devices.
- **Energy savings**: a mere 25% light variation can generate 20% energy savings.

Zoom on

SCU

Light is under your control!

SCU10

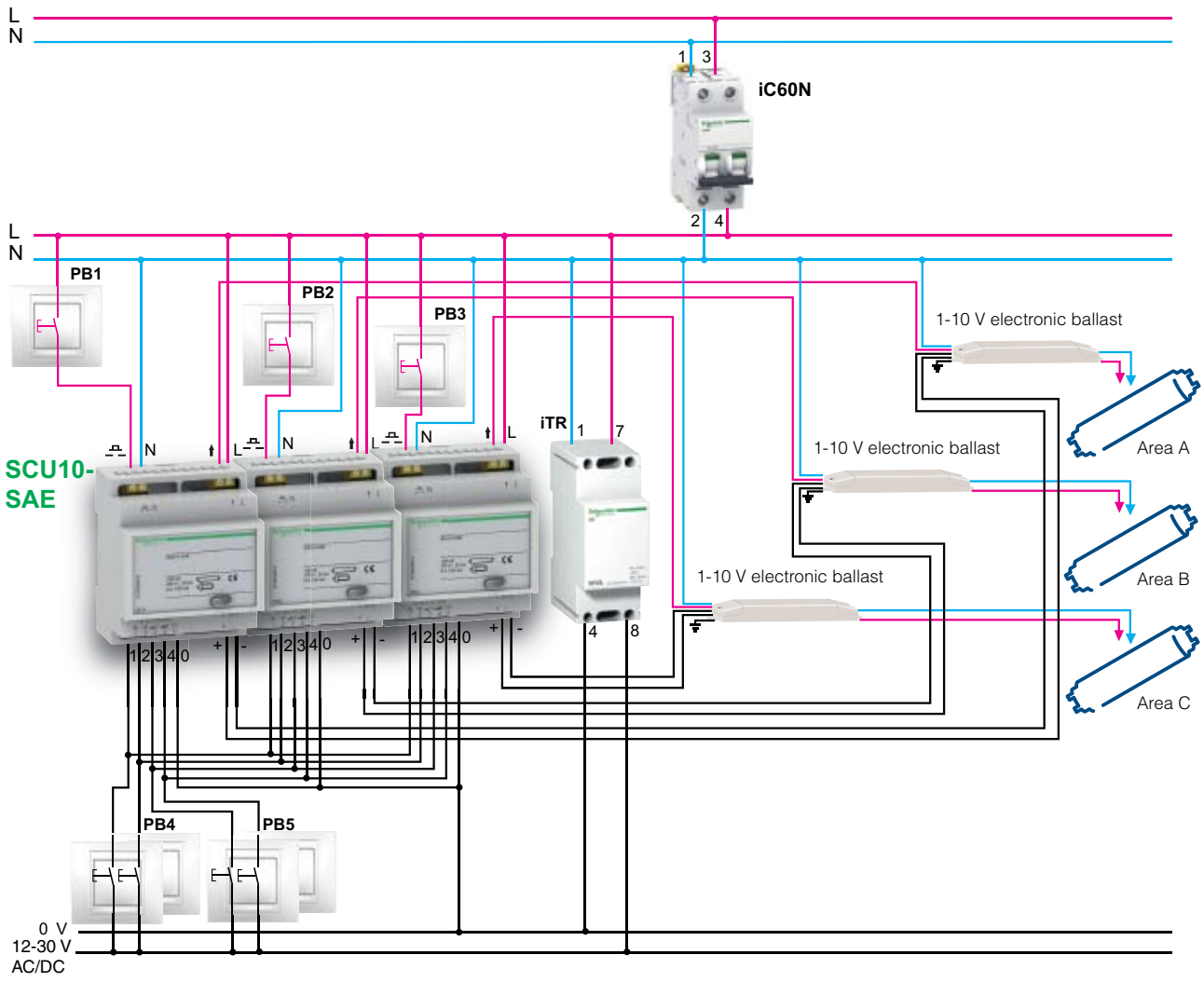
Favorite applications:

- offices and educational institutions,
- hotels,
- industry,
- housing,
- etc.

100% Responsible

> Variation + central control = quality of lighting and operating comfort

Diagram of the solution



Text for specifications

- The lighting system is implemented by fluorescent tubes with 1-10 V electronic ballasts.
- The system consists of several lighting areas, and each area can be switched on or off separately, with the possibility of variation in the luminosity level. These operations shall be performed via simple push buttons.
- Master control by push buttons shall ensure: memorizing of two lighting scenarios, master control of switching on/off and luminosity variation for all the areas.

> Products used

Product	Description	Unit	Reference
SCU10-SAE	1-10 V remote control dimmer with card having four digital inputs	3	CCTDD20012
iC60N	C16 A 1P+N circuit breaker	1	
iTR	230 V AC / 8-12 V AC – 4 VA transformer	1	A9A15213

Lighting management for a house

Customer needs

- **The lighting system must be able to be turned on locally, by the residents.**
- It must be possible to switch off all the lighting areas by means of a centralized control in a single action, to ensure extinguishing of the whole house.
- For practical reasons, all the lighting areas can also be switched on in a single action.

Proposed solution

- The use of **iTLc impulse relays** allows both local control of each room and centralized control of the whole house.
- Centralized control is provided by ON/OFF push buttons, remote from all the rooms to be managed.

User/customer benefits

- **Energy savings**: centralized control allows extinguishing of all the rooms in the house to prevent leaving rooms lit when there are no residents.
- **Comfort**: all the rooms in the house can also be switched on in a single action.
- **Ease of installation**: the small size (18 mm) of the iTLc is equivalent to that of a simple impulse relay.

Zoom on

iTLc

The impulse relay!

iTLc

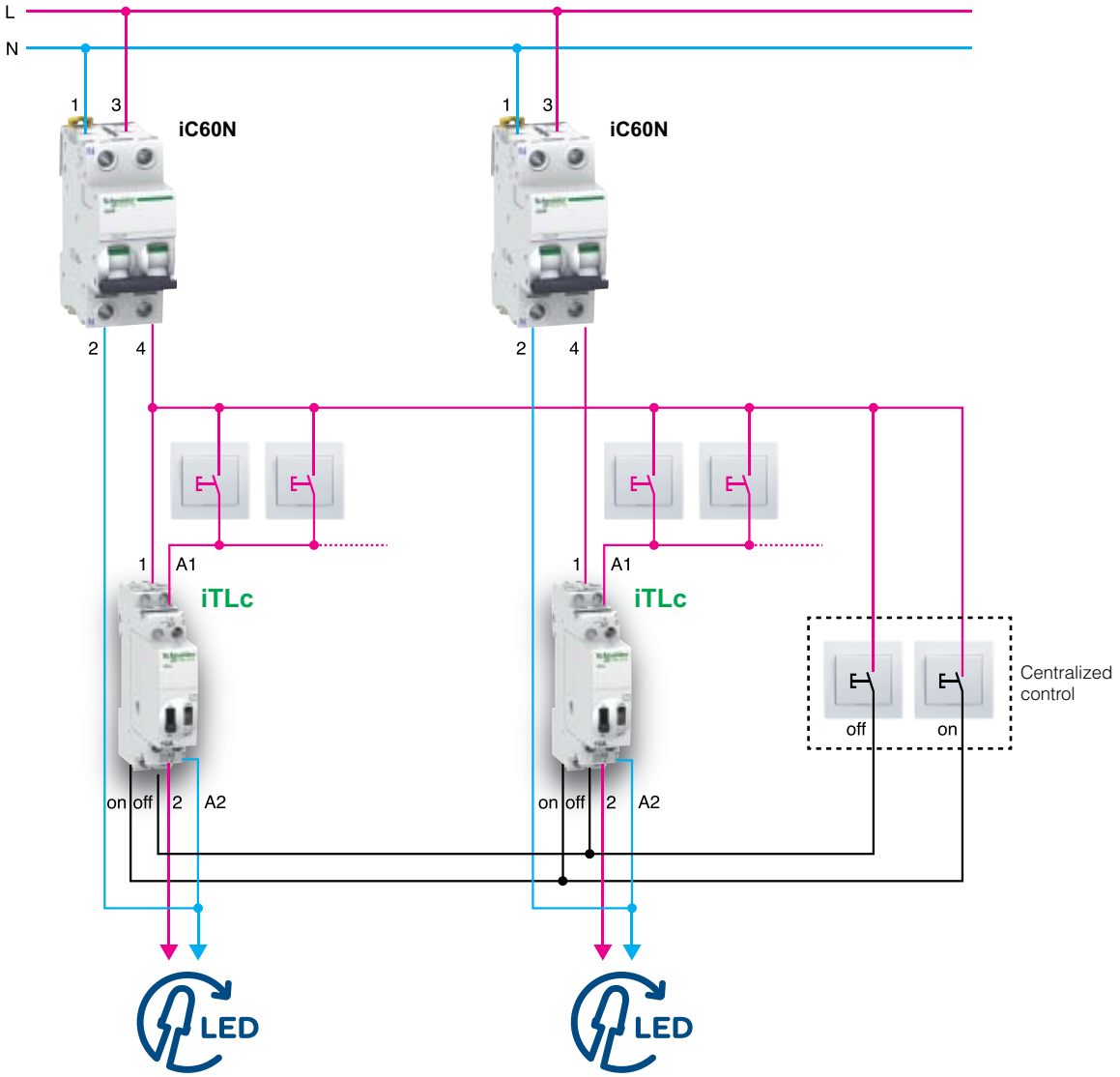
Favorite applications:

- housing,
- offices,
- etc.

100% Efficient

> Impulse remote control + central control = energy savings + user comfort

Diagram of the solution



Text for specifications

- Each lighting circuit is controlled locally via push buttons.
- All the lighting in the house is switched off via a single push button.
- All the lighting in the house is switched on via a single push button.

> Products used

Product	Description	Unit	Reference
iC60N	1P+N C16 circuit breaker	2	
iTLc	Centralized-control impulse relay	2	A9C33811

Renovation of the lighting for a Town Council

Customer needs

- In order to optimize the existing lighting of a Town Council and achieve savings, the engineering department wants to upgrade the installation, while keeping the local controls in place.
- They also want to have a centralized control, located by the Town Council's reception desk, allowing all the offices, the Council meeting room and the reception to be extinguished in a single action.

Proposed solution

- For each office an iTLc will be used for lighting control via push buttons.
- For lighting control in the lobby and meeting rooms, for reasons of installed capacity, a 32 A impulse relay combined with an iATLc remote control auxiliary is necessary.
- The iTLc and iATLc allow centralized control via a push button installed by the reception desk which extinguishes all the building's lighting.

User/customer benefits

- **Energy savings and safety**: the lighting for each area can be activated and deactivated locally by the users.
A push button located at the reception is connected to each iATLc auxiliary module for iTL and directly to each iTLc impulse relay. Result: all the impulse relays can respond simultaneously to central control orders.
- **Ease of connection**: thanks to its integral centralized control function, the iTLc impulse relay allows savings of wiring and space. The total width is still 18 mm.
The iATLc centralized control auxiliary is compatible with the standard iTL impulse relay to upgrade the existing installations. iATLc + iTL is equivalent to iTLc.

Zoom on

iTLc

Centralized control!

iTLc iTL + iATLc

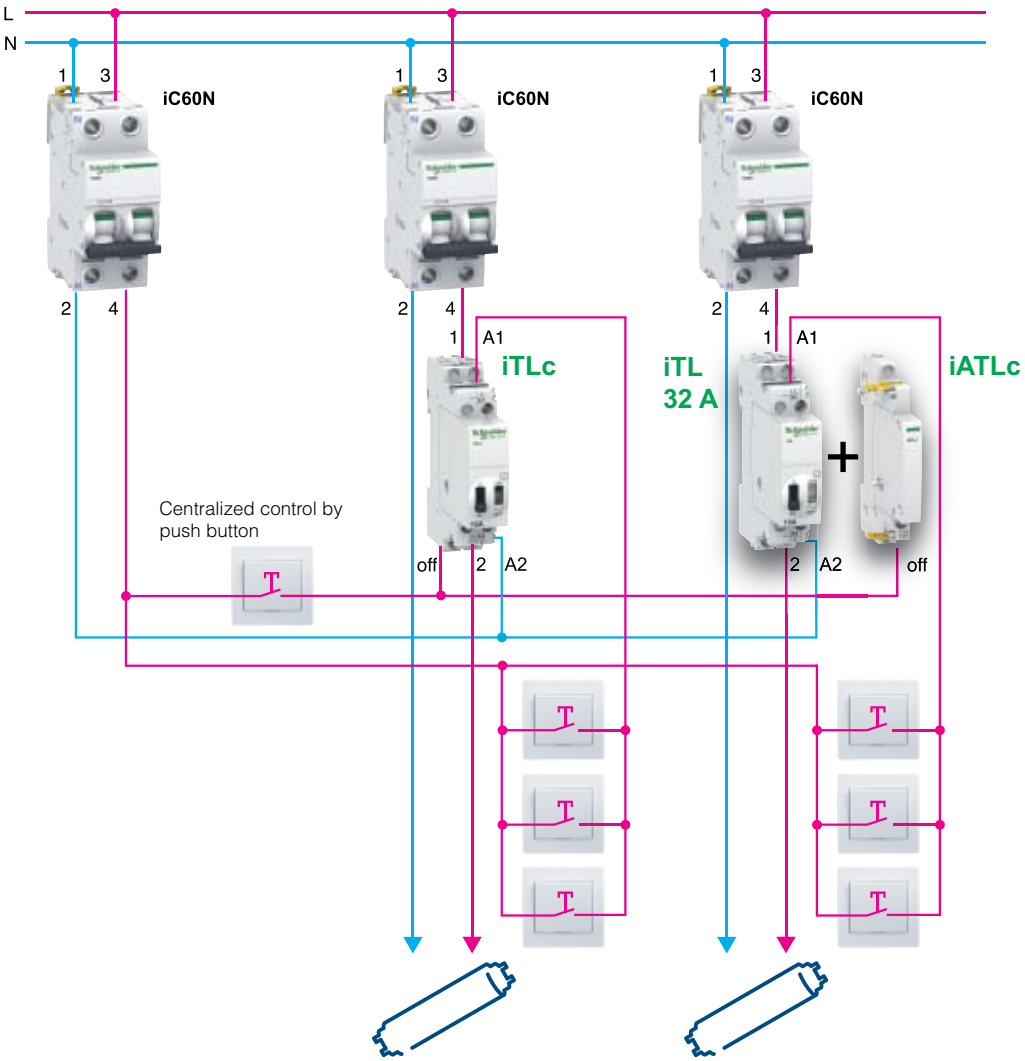
Favorite applications:

- housing,
- offices,
- educational institutions,
- etc.

100% Efficient

> Impulse remote control + local and central control = energy savings + ease of use

Diagram of the solution



Text for specifications

- A single push button must be able to extinguish all the building's lighting.
- The "centralized control" function must be compatible with the volume available in the existing switchboard (additional space requirements limited insofar as possible).

> Products used

Product	Description	Unit	Reference
iC60N	C2 A 2P+N circuit breaker	1	
iC60N	2P+N C10 A circuit breaker	2	
iC60N	2P+N C20 A circuit breaker		
iTL	32 A impulse relay	1	A9C30831
iTLc	Centralized-control impulse relay	1	A9C33811
iATLc	Centralized control auxiliary	1	A9C15404

Lighting management for a solicitor's office

Customer needs

- **Energy savings, safety**: the lighting for each area can be switched on or off locally by office workers.
- The receptionist can switch all the lighting areas on (or off) from a central control, to prevent any waste of energy if users have forgotten to switch off the light.
- Signaling of the lighting status is necessary for the reception desk (indicator lit if one of the offices is illuminated).

Proposed solution

- The combination **of iATLc+s auxiliaries** for iTL impulse relays allows both local control of each office, centralized control, and signaling of the lighting status.
- Centralized control is provided by ON/OFF push buttons, remote from all the offices to be managed.
- Signaling is achieved by mounting in series the auxiliary signaling contact of each impulse relay.

User/customer benefits

- **Energy savings**: centralized remote control allows all the office and meeting room lights to be extinguished and prevents leaving the lighting on in rooms when closing the solicitor's office.
- **Comfort**: an indicator lamp can indicate that an office or meeting room is lit. Local push buttons actuate impulse relays individually for each lighting circuit.

Zoom on

iATLc+s

Centralized control!

iTL+iATLc+s

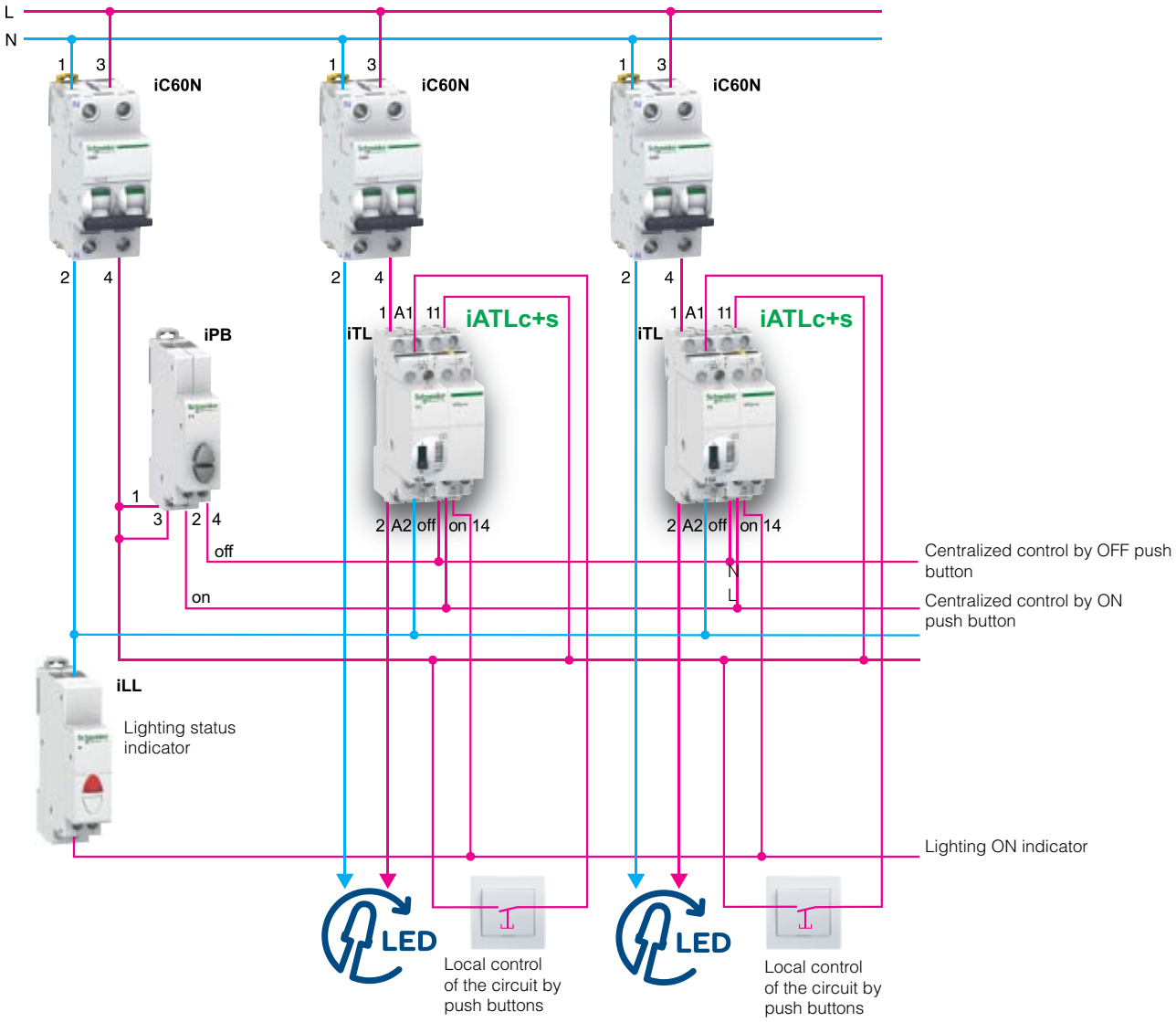
Favorite applications:

- offices,
- educational institutions,
- hotels,
- etc.

100% Responsible

> Impulse remote control + central control = energy savings + ease of use

Diagram of the solution



Text for specifications

- Each lighting circuit is actuated by local push buttons and via common switch-on and switch-off orders by push buttons located at the reception level where a review of the situation is provided by a status indicator.

> Products used

Product	Description	Unit	Reference
iC60N	C2 A 1P+N circuit breaker	1	
iC60N	C10 A 1P+N circuit breaker	2	
iTL	Impulse relay	2	A9C30811
iATLc+s	Centralized control + signaling	2	A9C15409
iIL	Indicator lamp	1	A9E18320
iPB	Double push button	1	A9E18035

Lighting management for a university

Customer needs

- There is a need to achieve savings on lighting consumption for a university building of several stories.
- Each room will be lit or extinguished separately.
- Manual extinguishing shall be feasible for each story.
- The building will be switched off automatically when the university is closed.
- The lighting in one room can be switched on again during the period when the building is closed. It will remain switched on until the next extinguishing order sent by the time switch.

Proposed solution

- The use of an iTLc impulse relay ensures control of a lighting circuit via dedicated push buttons for each classroom.
- It also makes it possible to receive a lighting extinguishing control order for the story.
- **One iATLc+c auxiliary** for each story allows extinguishing of all the building's lighting.
- The IHP+ 1c ensures automatic extinguishing of the entire building by impulse control.

User/customer benefits

- **Ease of installation**: the centralized function incorporated in the impulse relay can reduce the space requirement in the switchboard.
- **Simple automatic control solution**: the IHP+ 1c programmable time switch has a user-friendly interface, an impulse control mode and a large number of possible switching operations.

Zoom on

iATLc+c

The auxiliary centralized control module for impulse relays!

iATLc+c

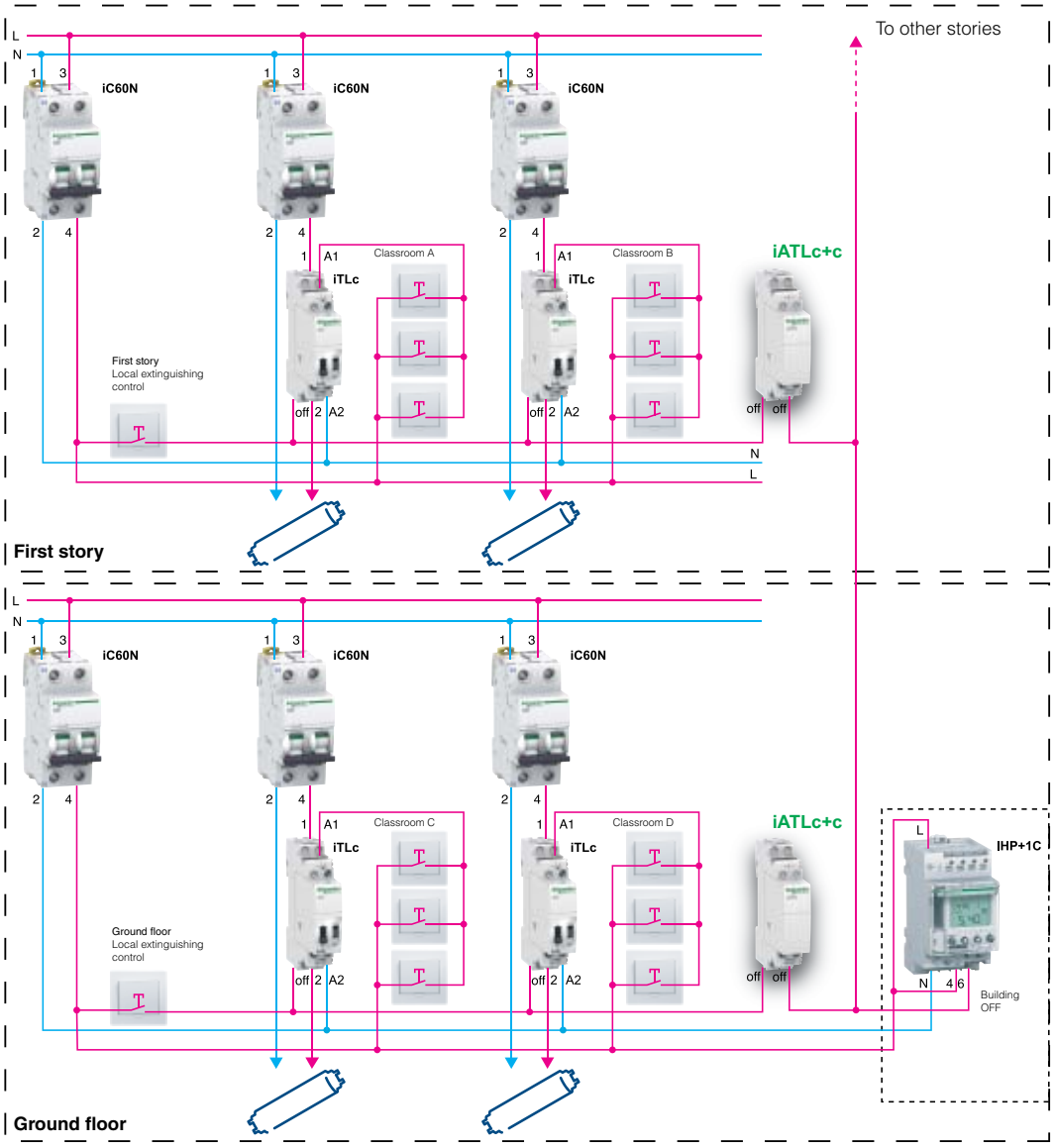
Favorite applications:

- office buildings,
- educational institutions,
- etc.

100% Responsible

> Area control + time programming = energy savings + flexibility of use

Diagram of the solution



Text for specifications

- The solution must be optimized in terms of space requirements, with no programming requiring special skills.
- An automatic impulse control order for overall extinguishing must be generated when the building is closed and then repeated every half-hour.

> Products used

Product	Description	Unit	Reference
iC60N	C2 A 1P+N circuit breaker	2	
iC60N	C10 A 1P+N circuit breaker	4	
iATLc+c	Multiple-level centralized control auxiliary	2	A9C15410
iTLc	16 A centralized-control impulse relay	1	A9C33411
IHP+ 1c	Programmable time switch	2	CCT15851

Ensuring the satisfactory functioning of loads critical for human safety

Customer needs

- In an underground car park, ventilation and lighting are critical for human safety.
- Any malfunction must immediately alert the surveillance personnel.
- They must be able to diagnose the equipment and restore it to operation very rapidly, remotely whenever possible, or by going to the site.
- In the event of a malfunction of the automatic control system which manages them, these loads must continue to operate without interruption.

Proposed solution

- Thanks to Acti 9 Smartlink, all the final distribution boards are connected directly to the site surveillance network.
- The circuit breaker auxiliaries iOF+SD24 report any tripping and any deliberate opening.
- The contactors and impulse relays receive switch-on and switch-off orders and report their status.
- Selector switches on the front panel of the switchboards allow maintenance personnel to take over control of the automatic system to manage the contactors and impulse relays via push buttons. In that case, the position of the inhibition selector switch is sent over the Modbus network via the Acti 9 Smartlink interface.

User/customer benefits

- **Fast, reliable installation**: the appliances are connected to the Modbus network via Acti 9 Smartlink communication interfaces and entirely prefabricated connector systems:
  - wiring is performed quickly, without risk of error (inversion of cables, etc.),
  - during maintenance operations, "thin wire" connections inside the switchboard are identifiable immediately. They can be handled without any tools thanks to plug-in connectors.
- A single RS485 link connects the various switchboards to the PLCs and the supervision system.
- **Reliability of data and indications:**
  - low-level iOF+SD24 signaling contacts complying with IEC 60947-5-4,
  - high level of electromagnetic compatibility of the Acti 9 Smartlink modules.
- Integrated in Acti 9 Smartlink, the counting of protective device tripping actions and hours' operation of luminaires can be used to plan preventive maintenance.

Zoom on

Acti 9 Communication System!

Acti 9 Smartlink
iOF+SD24
iACT24

Acti 9 Smartlink

Prefabricated cables

iOF+SD24

iACT24

iATL24

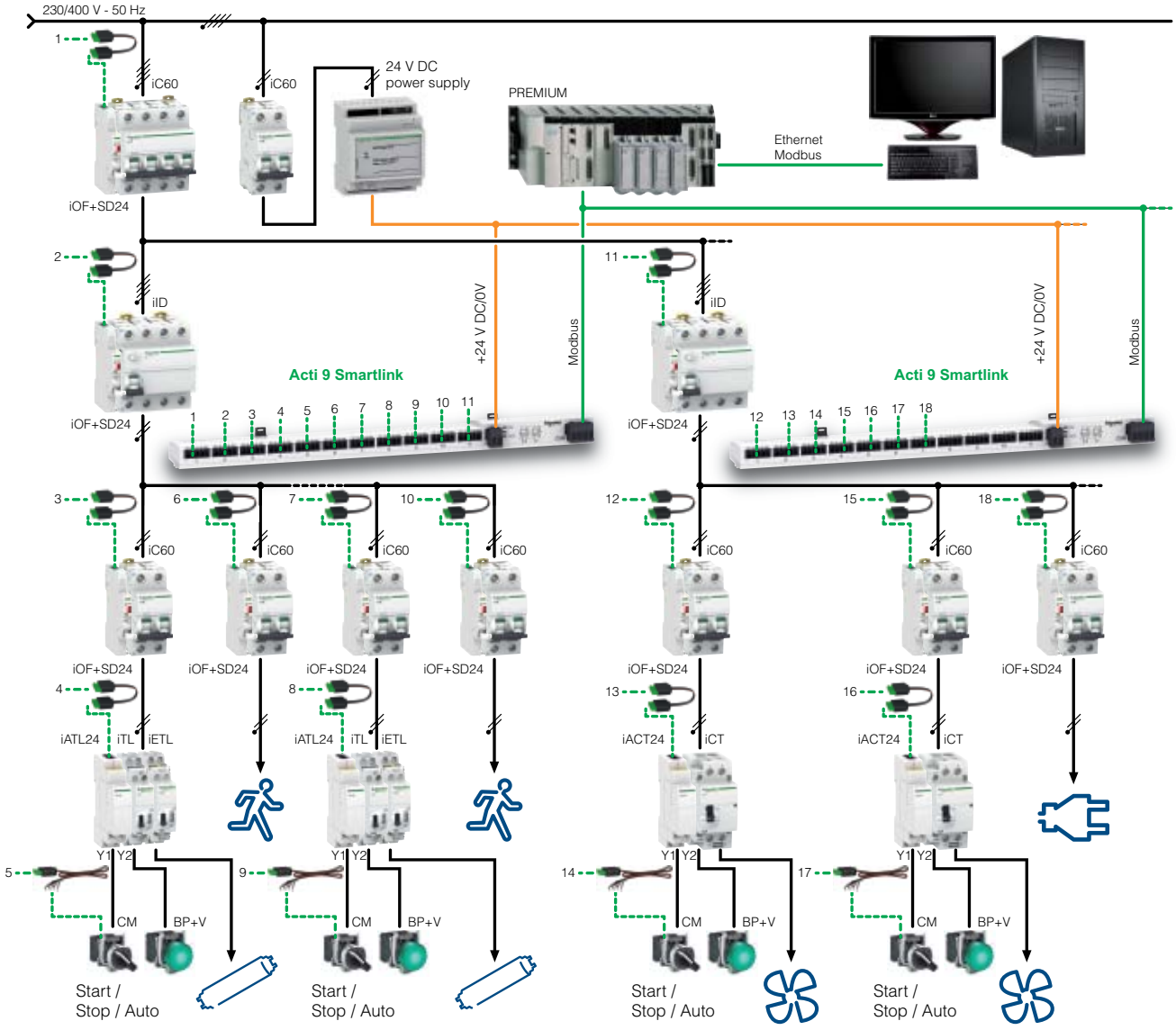
Favorite applications:

- commercial and industrial buildings,
- etc.

100% Responsable

> Remote management + manual control = easy operation + continuity of service

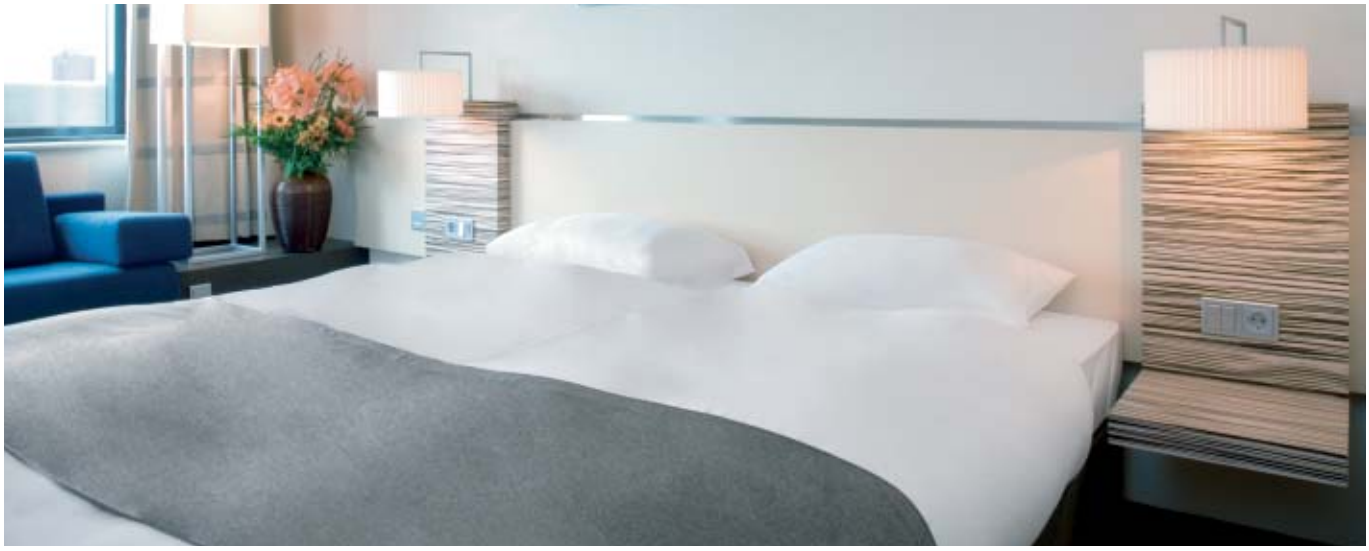
Diagram of the solution



> Products used

Product	Description	Unit	Reference
Acti 9 Smartlink	Communication interface		A9XMSB11
iOF+SD24	24 V DC circuit breaker auxiliaries		A9A26897
iACT24	24 V DC contactor auxiliaries		A9C15924
iATL24	24 V DC impulse relay auxiliaries		A9C15424
Prefabricated cables (set of 6)	Short: 100 mm		A9XCAS06
	Medium: 160 mm		A9XCAM06
	Long: 870 mm		A9XCAL06
	Long semi-prefabricated: 870 mm		A9XCAU06
Ti24 connectors	Set of 12		A9XC2412
Power supply	24 V DC		ABL8-MEM24006
Premium	Programmable logic controller		

Lighting management for a hotel room



Customer needs

- For the hotel manager, his need is to control the energy consumption of his hotel while ensuring the comfort and safety of his customers.
- The lighting and electrical equipment other than refrigerators should be switched off when there is no occupant in the room.

Proposed solution

- By using a keycard switch combined with an iRTC time delay relay, when the occupant of the room is absent, those electrical circuits that are not indispensable can be switched off after a time delay.
- The iTL 32 A impulse relay combined with the latched control function (iATLm) switches off all the room's various electrical circuits.
- The iTL16 A impulse relays combined with push buttons allow 3 of each lighting circuit.

User/customer benefits

- **Safety and comfort**: the electrical equipment is switched off automatically at the end of a time delay which begins when the keycard is removed from its slot. This offers the advantage of being able to cast a last glance in the room before leaving, or being able to retrieve a forgotten object.
- **A simple and economical solution**: automatic switching off of the room's non-priority circuits allows energy savings to be achieved.

Zoom on

iRTC

The time delay relay!

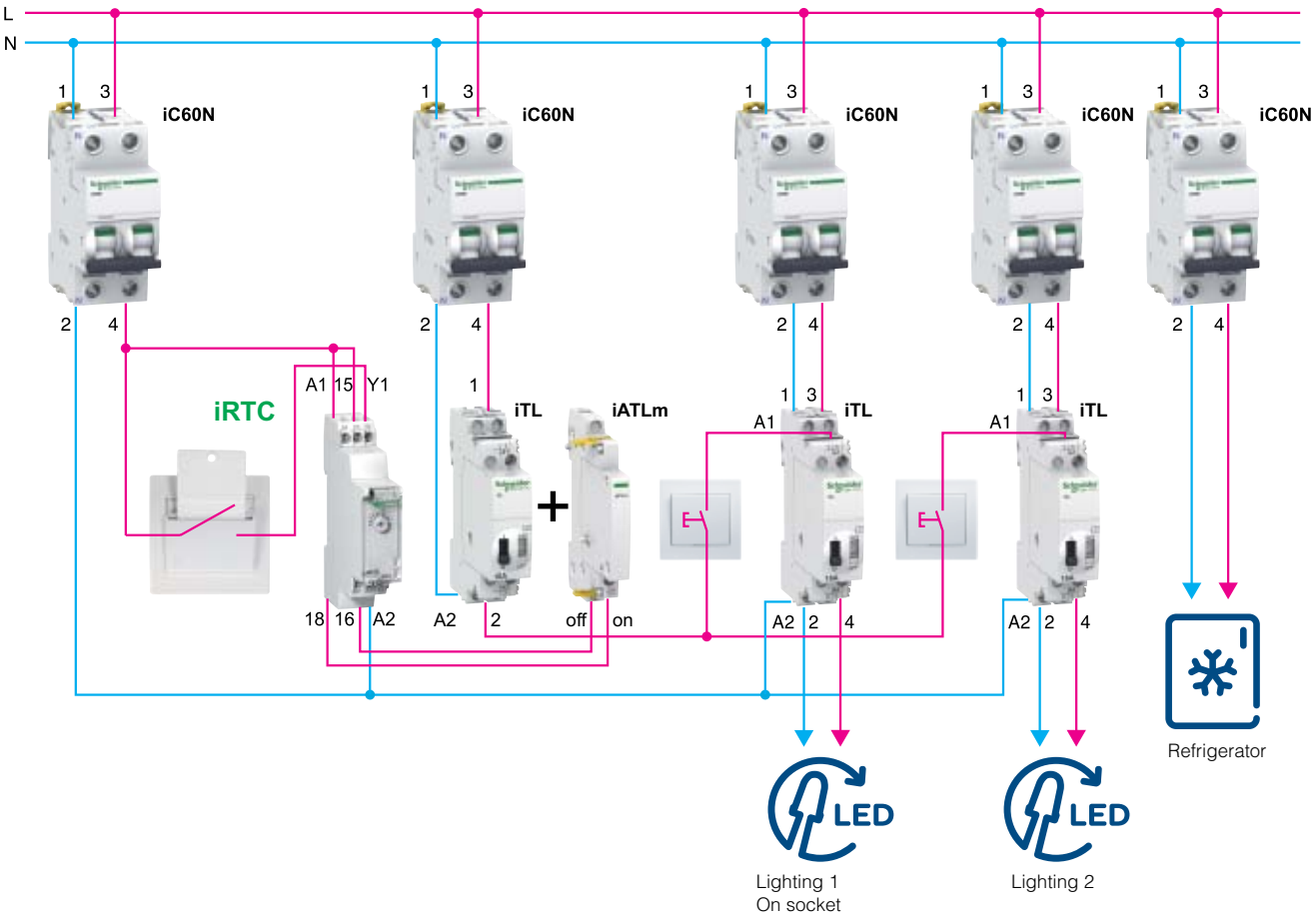
iRTC

Keycard switch

Favorite applications:

- hotel rooms,
- student residences,
- old people's homes,
- self-catering cottages,
- mobile homes,
- etc.

Diagram of the solution



Text for specifications

- The room's lighting and power sockets are activated when the keycard is detected. After removing the keycard, deactivation takes place after a predetermined time delay.

Products used

Product	Description	Unit	Reference
iC60N	C2 A 1P+N circuit breaker	1	
iC60N	C16 A 1P+N circuit breaker	4	
iRTC	Time delay relay	1	A9E16067
iTL	32 A 1P impulse relay	1	A9C30831
iTL	16 A 2P impulse relay	2	A9C30812
iATLm	Impulse relay auxiliary for latched control	1	

Controlling power off for a hotel room by keycard

Customer needs

- A hotel room is a private space yet remains under the responsibility of the operator. Ensuring customer safety and comfort while optimizing profitability are the main concerns of a hotel manager.
- To limit electrical risks during periods of non-occupancy of the room and reduce electricity consumption, the proposed system allows all the electrical circuits used by the customer (power sockets, lighting) to be powered off except for the facilities that must be left powered up for reasons of comfort (refrigerator, air conditioning).

Proposed solution

- The room's power supply is provided by a distribution board fastened horizontally in the false ceiling at the room entrance. This arrangement does not allow the use of a modular contactor.
- A Reflex iC60 integrated-control circuit breaker can switch off the circuits' power supply when the keycard has been removed from its reader located at the entrance to the room.
- Customer presence and electrical fault information is reported to the room's PLC without any additional interface. This information is then transmitted to the supervision room via a communication bus.

User/customer benefits

- **Safety**: no unwanted temperature rise, which allows installation in a false ceiling.
- **Energy efficiency**: no permanent consumption because the Reflex iC60 is a bistable product.
- **Efficiency**: no undesirable noise in steady-state conditions, unlike a contactor.
- **Simplicity**: simplicity of the control circuit thanks to the Ti24 interface which provides a direct link with the room's PLC.

Zoom on

Reflex iC60

Integrated-control circuit breaker!

With Ti24 interface

Reflex iC60

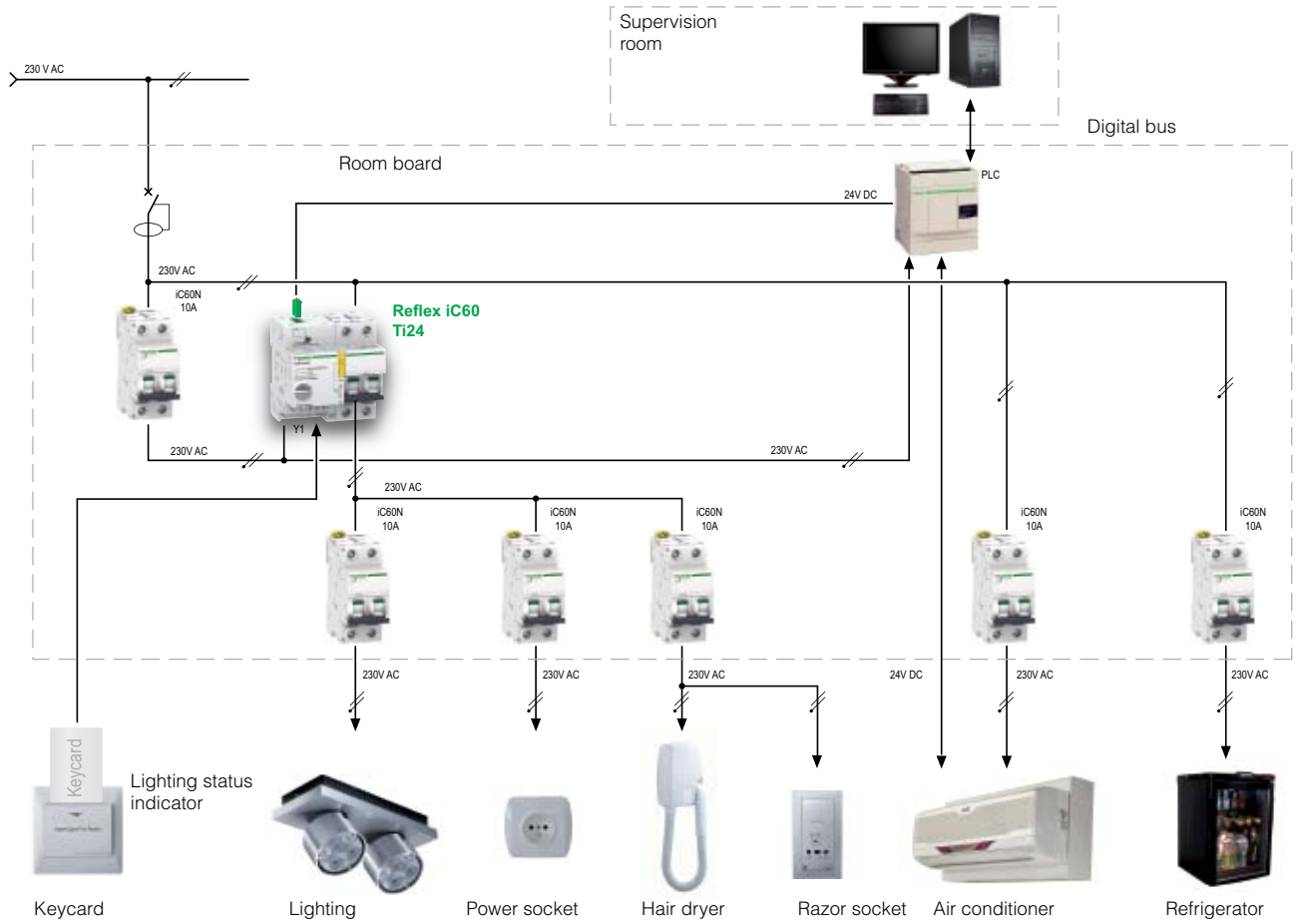
Favorite applications:

- hotels,
- supermarkets,
- factories,
- universities,
- offices,
- etc.

100% Efficient

> Remote management + presence = customer comfort + safety

Diagram of the solution



Text for specifications

- The non-priority loads must be powered via an integrated-control circuit breaker which should be able to operate in all positions to allow installation in a false ceiling.
- The integrated-control circuit breaker can be controlled by the presence of the keycard in its reader.
- The circuit breaker state (open/closed) shall be indicated at the PLC level.
- The solution must generate no noise or unwanted temperature rise.

> Products used

Product	Description	Unit	Reference
Reflex iC60N	2P C-curve 25 A 230 V 50 Hz integrated-control circuit breaker with Ti24 interface	1	A9C62225
iC60N	C10 A 2P circuit breaker	5	-
iC60N	C16 A 2P circuit breaker	1	-

Lighting management for an archive room

Customer needs

- Have an assurance that the lighting will be systematically switched off following a more or less long period of activity.
- Personnel must have independence to switch off or extend the duration of lighting from several control points.

Proposed solution

- The use of an iATEt timer combined with an iCT contactor allows:
  - setting of the lighting duration,
  - extinguishing the lighting at any time (operation unauthorized on a timer),
  - possible restarting of a lighting cycle.
- The contactor allows high-powered control.

User/customer benefits

- **Flexibility of use**: the time delay can be set at up to 10 hours. Possibility of extinguishing the lighting at any time. No minimum duration of lighting.
- **Ease of installation**: the iCT, iATEt combination is executed without connection, by clips.

Zoom on

iATEt

The multifunction auxiliary timer!

iATEt

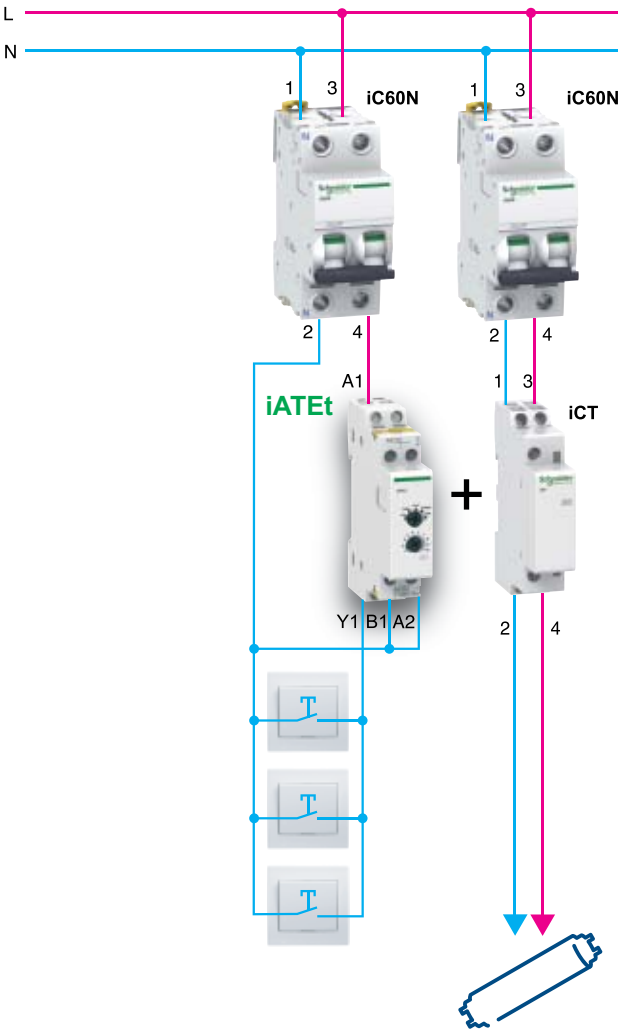
Favorite applications:

- workshops,
- hotels,
- offices,
- etc.

100% Efficient

> Manual stoppage + automatic stoppage = guarantee of extinguishing

Diagram of the solution



Text for specifications

- The lighting is switched on manually from several push buttons. It should go out automatically after an adjustable time of maximum duration 10 hours. The time delay must be reset by each press on a push button. The lighting may be extinguished at any time.

> Products used

Product	Description	Unit	Reference
iC60N	C10 A 1P+N circuit breaker	1	
iC60N	1P+N C25 A circuit breaker	1	
iATEt	Multifunction time delay auxiliary	1	A9C15419
iCT	25 A 2P contactor	1	A9C20731

Lighting management in a stairway, a corridor or a lobby

Customer needs

- The building manager wants to achieve savings on energy expenses related to lighting, while maintaining customer comfort.

Proposed solution

- The use of a MIN timer makes it possible to:
  - adjust the lighting period very finely, from one or more control points,
  - automatically extinguish the lighting,
  - override the timer settings if permanent lighting is needed.
- LED luminaires shall be preferred to compact fluorescent lamps, to provide a longer service life and energy savings.

User/customer benefits

- **Energy savings**: automatic management of the lighting period makes it possible to precisely optimize the light ON time.
- **Easier operation**: the maintenance personnel have access to permanent lighting by means of a selector switch on the front of the timer or can restart the time delay by simply pressing one of the lighting push buttons.

Zoom on

MIN

Just the light that is needed!

MIN

Favorite applications:

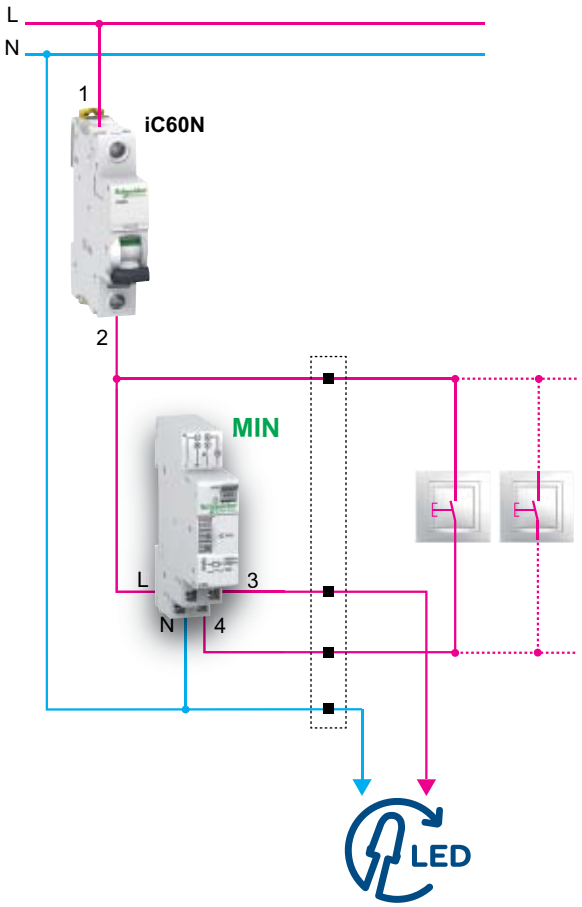
- hotels,
- residential buildings,
- educational institutions,
- etc.

100% Efficient

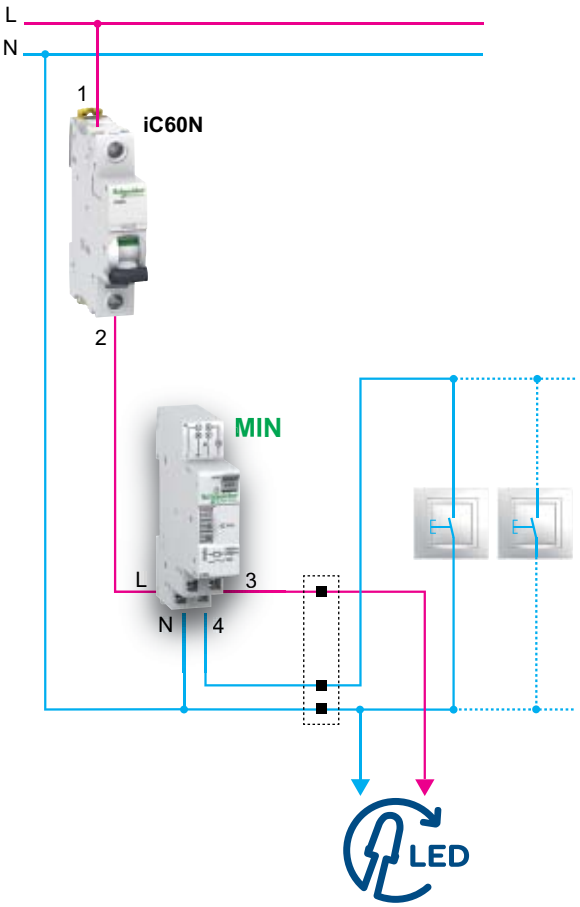
> Programmed lighting period = energy savings

Diagram of the solution

Connection to 4-conductor riser pipe



Connection to 3-conductor riser pipe



Text for specifications

- Be compatible with existing 3- or 4-conductor installations without altering the installation, via a selector on the product.
- Have an extinguishing time delay setting of between 1 and 7 minutes, without prior notice of lighting extinguishing, and be able to override the installation's settings to permanent lighting.
- A press on a control push button restarts the preset time delay.

> Products used

Product	Description	Unit	Reference
MIN	Electromechanical timer	1	15363
iC60N	C16 A 1P circuit breaker	1	

Lighting management in a basement

Customer needs

- The basement lighting must be able to be controlled by several lighting points and extinguished automatically in case someone forgets.
- This lighting must also be able to be extinguished by manual control.
- The installation must be able to have a long time delay for maintenance and a permanent lighting function for works.

Proposed solution

- The use of a MINt timer makes it possible to:
  - set the lighting period to a minimum and have prior notice of extinguishing,
  - extinguish the lighting by pressing one of the push buttons (impulse relay function),
  - have two lighting override control modes:
    - either permanent by actuation on the front of the device,
    - or for a period of one hour, by pressing one of the installation's push buttons for 2 seconds.

User/customer benefits

- **Energy savings**: automatic control of lighting extinguishing in case someone forgets can generate significant savings.
- **Flexibility**: the integral impulse relay function allows manual extinguishing of the lighting by pressing one of the installation's push buttons.
- **Easier operation**: two override control modes are available (permanent, long-term), making it possible to cover the basement's various operating needs (cleaning, tidying, etc.).

Zoom on

MINt

Just the light that is needed!

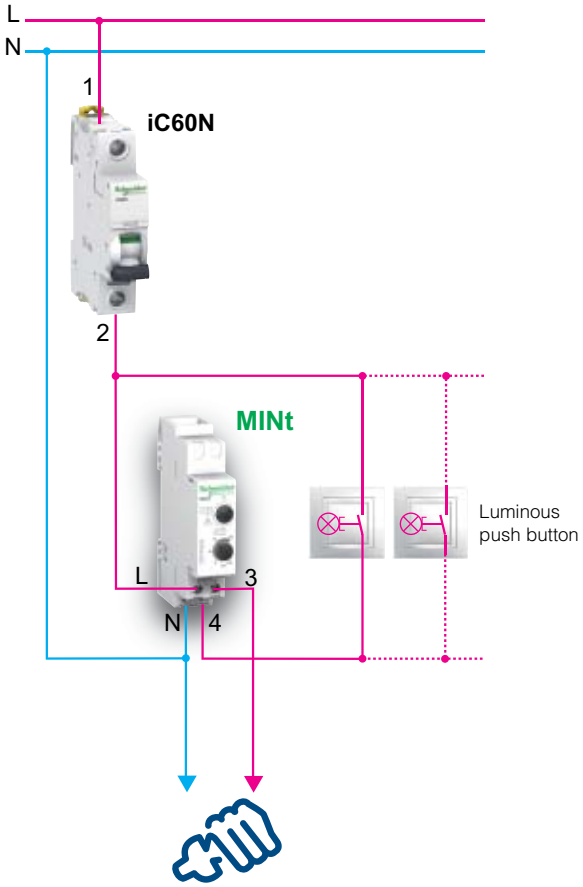
MINt

Favorite applications:

- housing,
- archive rooms,
- etc.

> Manual stoppage + automatic stoppage = guarantee of extinguishing

Diagram of the solution



Text for specifications

- Have an extinguishing time delay setting of between 0.5 and 20 minutes, with prior notice of lighting extinguishing, and be able to override the installation's settings to permanent lighting.
- Extinguishing the lighting remains possible throughout the period of the time delay.
- Pressing a control push button for more than 2 s causes the start of a fixed time delay of one hour; a second long press allows extinguishing.

> Products used

Product	Description	Unit	Reference
MINt	Electronic timer with impulse relay function	1	CCT15234
iC60N	C16 A 1P circuit breaker	1	
Push button	Wall-mounted luminous push button		

How to modernize the entrance of an apartment building

Customer needs

- Automatically limit the lighting period on an existing installation equipped with a simple impulse relay.
- Reduce the cost of lighting by preventing the lighting from being left constantly lit.
- Notify the user of imminent extinguishing.
- Give remote access to a longer lighting time for a removal or for maintenance work without adding extra controls.

Proposed solution

- The use of a MINp timer makes it possible to:
  - set the lighting period to a minimum in corridors, stairs, the lobby, etc. using a timer to switch on one or more lamps from one or more control points,
  - warn, through flickering of the lamps' light, that the lighting will soon be extinguished,
  - have two lighting override control modes, either permanent by actuation on the front of the device, or for a period of one hour, by pressing one of the installation's push buttons for 2 seconds.

User/customer benefits

- **Energy savings**: automatic management of the lighting period allows significant energy savings to be achieved.
- **User safety** is improved by the function of switch-off warning of lighting extinguishing (the warning consists of flickering of the lamps' light).
- **Ease of installation**: the MINp is compatible with cabling of the 3- or 4-conductor type without altering the installation.
- **User comfort**: two override control modes are available (permanent, long-term). They can cover the various customary needs of the building entrance (cleaning, tidying, etc.).

Zoom on

MINp

Just the light that is needed!

MINp

Favorite applications:

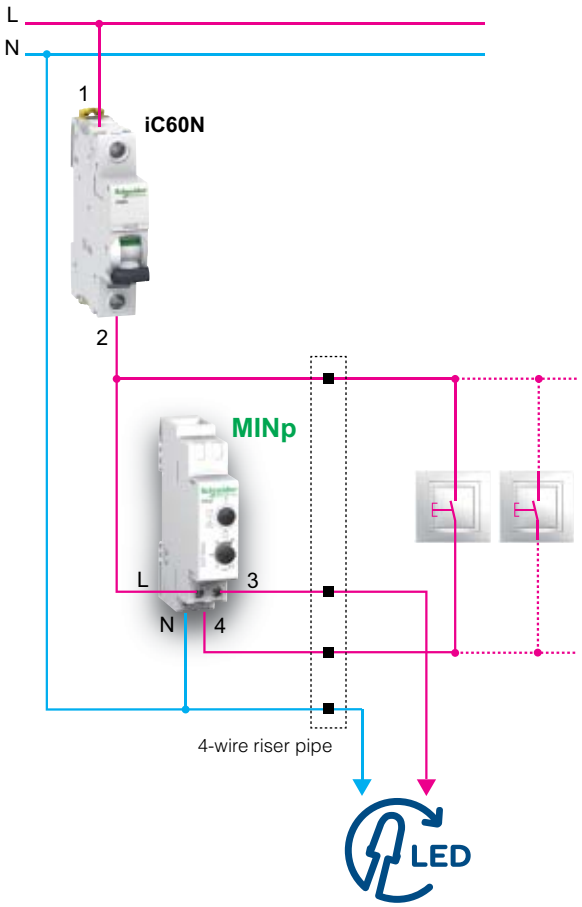
- hotels,
- residential buildings,
- educational institutions,
- etc.

100% Responsible

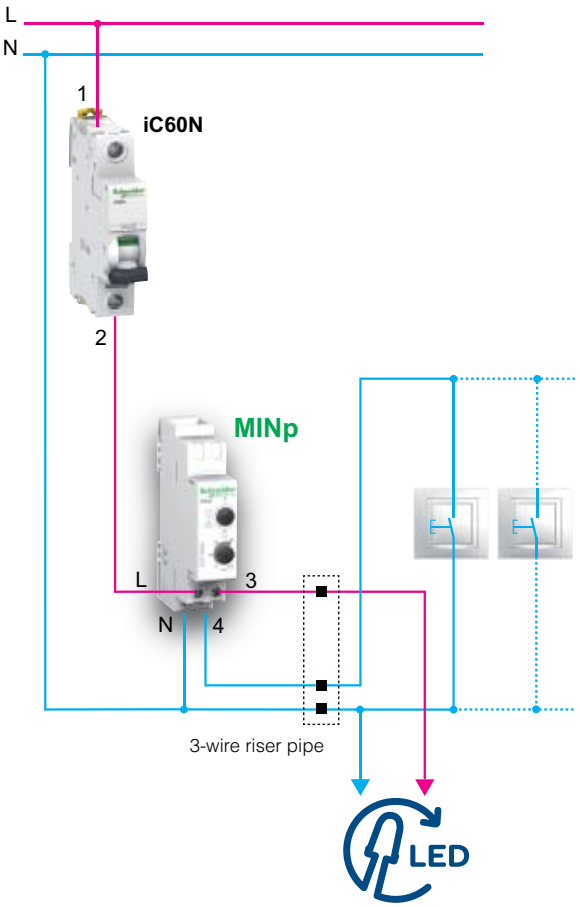
> Automatic stoppage + prior notice = guarantee of extinguishing + safety of movement

Diagram of the solution

Connection to 4-conductor riser pipe



Connection to 3-conductor riser pipe



Text for specifications

- Be fully compatible with existing 3- or 4-conductor installations without altering the installation.
- Have an extinguishing time delay setting of between 0.5 and 20 minutes, with prior notice of lighting extinguishing, and be able to override the installation's settings to permanent lighting.
- Pressing a control push button for more than 2 s causes the start of a fixed time delay of one hour; a second long press allows extinguishing.

> Products used

Product	Description	Unit	Reference
MINp	Electronic timer with switch-off warning	1	CCT15233
iC60N	C16 A 1P circuit breaker	2	

Optimizing the lighting of open office spaces

Customer needs

- On average, over one-third of the total energy consumed in office buildings is used for lighting.
- In this type of building, occupied mainly during the daytime, undeniable energy savings can be achieved by optimizing luminaire lighting times.
- This installation can manage extinguishing of the lighting at the desired times, while allowing users to control the luminaires outside of the programmed period.

Proposed solution

- Lighting circuits are switched on and off by office users by means of ambience control push buttons located in each zone.
- An IHP time switch sends to the Reflex iC60 protection and control devices orders for extinguishing according to the building's operating requirements.
- The Reflex integrated-control circuit breakers are configured in mode 1 to allow local restarting of the lighting.

User/customer benefits

- **Energy efficiency**: optimization of lighting times allows energy savings of up to 30%.
- **Simplicity**:
  - automated and secure lighting management solution,
  - indications on the front of the product.
- **Safety**: padlocking possible without any additional accessory.
- **Continuity of service**: the Reflex iC60 is a bistable actuator which does not change state in the event of a power outage.

Zoom on

Reflex iC60

Integrated-control circuit breaker!

Reflex iC60

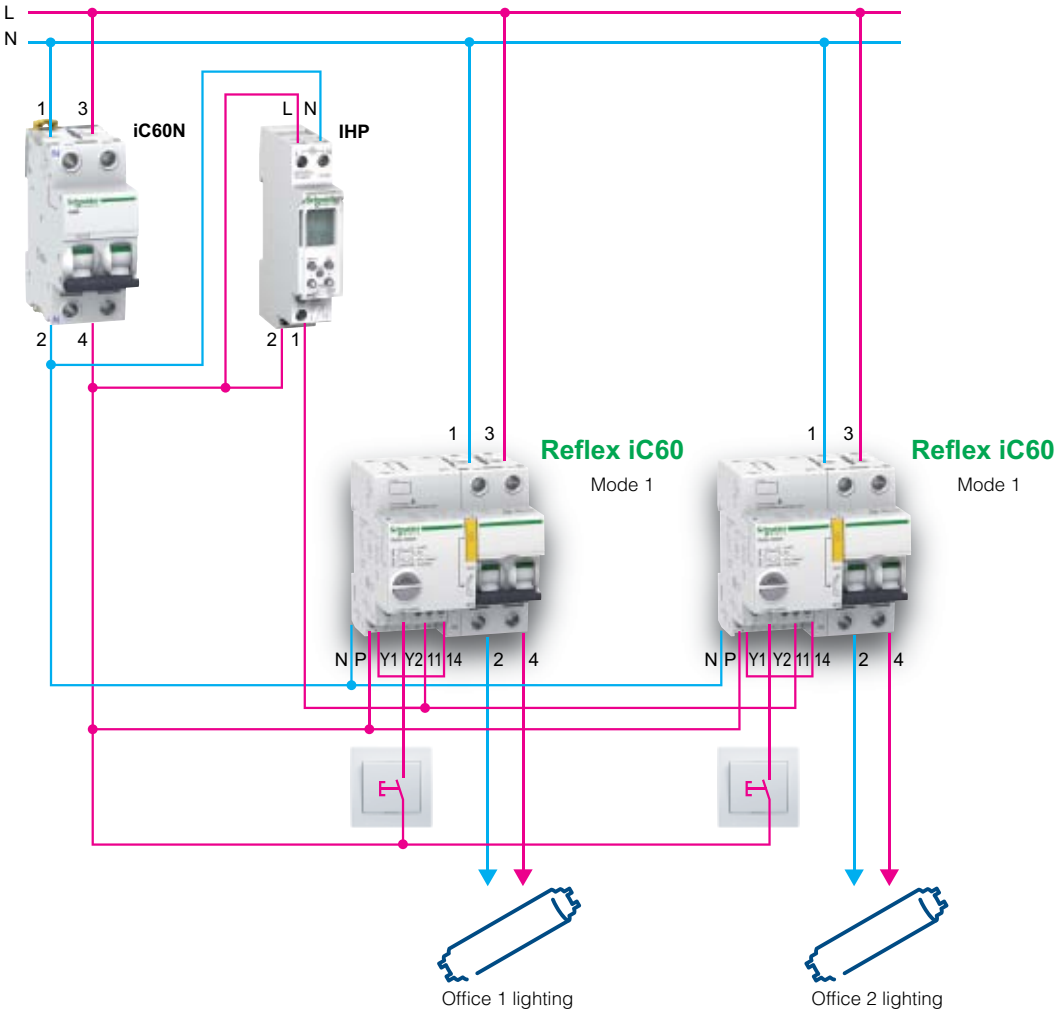
Favorite applications:

- offices,
- educational institutions,
- industry,
- retail trade,
- etc.

100% Efficient

> Automatic stoppage + local control = guarantee of extinguishing + user comfort

Diagram of the solution



Text for specifications

- The lighting loads must be powered via an integrated-control circuit breaker.
- Lighting circuits are switched on and off by the users of the premises by means of ambience control push buttons.
- Centrally controlled extinguishing of lighting circuits must be able to be programmed by means of a time switch.
- It must be possible for the occupants to restart the lighting outside of the programmed lighting times.

> Products used

Product	Description	Unit	Reference
iC60N	C10 A 1P+N circuit breaker	1	-
Reflex iC60N	25 A C-curve 2P integrated-control circuit breaker	2	A9C52225
IHP	Weekly programmable time switch	1	15854

Management of a large office building

Customer needs

- Automate the lighting of a large office building, while retaining the possibility of local control.
- Manage energy consumption, and luminaire maintenance.
- Adapt the lighting according to:
  - a timer program,
  - the presence of people,
  - the level of natural light based on several areas.
- Perform override control of lighting by area.
- Rapidly reallocate a work area.

Proposed solution

- The choice made is a KNX type Building Management System, connected to a "Canalis KBB" busbar trunking architecture, DALI-compatible, performing the functions of lighting management, measuring and monitoring.
- The use of DALI detectors located in each area makes it possible to maintain a constant luminosity level in the presence of employees, for optimal working conditions.
- Override setting of the lighting for each area is performed by KNX switches.
- Fault information is sent by the ballasts via the DALI communication network.
- By rearrangement, it is easy to allocate new monitoring points for an office or group luminaires.

User/customer benefits

- **Fast installation**: Canalis busbar trunking, formed of prefabricated elements, can be installed rapidly and safely. Connections require no tools and are designed to prevent any risk of incorrect connection.
- Reallocation of the various offices.
- **Simplified maintenance**: no preventive maintenance campaign (renewal of the lamps according to their service life).
- Simple lighting management and cost saving scenarios.

Zoom on

KBB

Rigid busbar trunking!

Canalis KBB

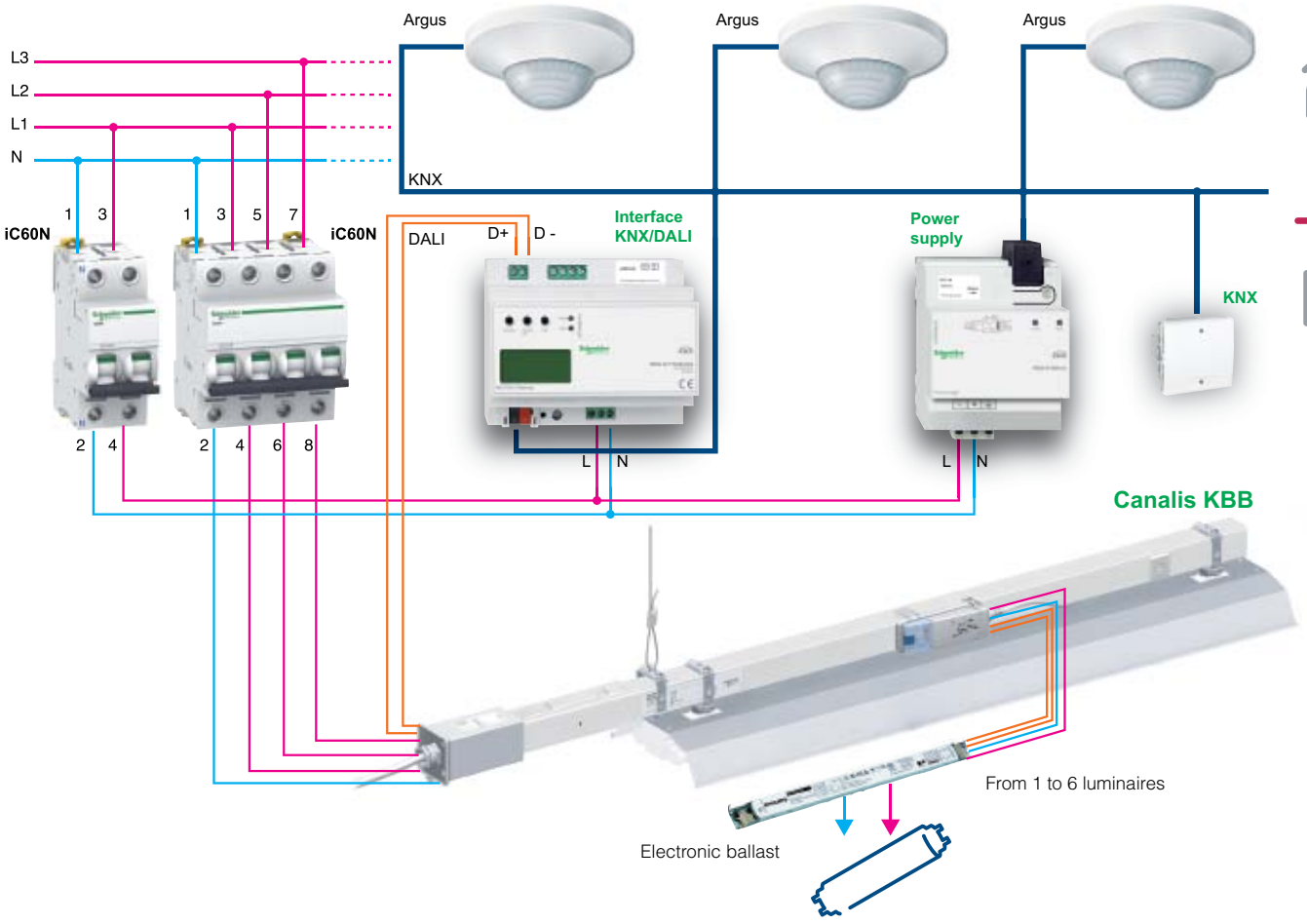
Favorite applications:

- offices,
- educational institutions,
- etc.

100% Efficient

> Pre-cabling + communication network = easy reallocation + control of energy consumption

Diagram of the solution



Text for specifications

- The lighting management system used consists of a decentralized distribution system incorporating a DALI communication bus connected to a Building Management System. It performs control of the luminaires by area, and allows the creation of lighting scenarios according to the occupants' hours of presence and the extinguishing of unoccupied areas.
- Formed of prefabricated elements with tap-offs, it offers great flexibility of installation and is completely scalable.
- Connections require no tools and can prevent any risk of a connection error.

> Products used

Product	Description	Unit	Reference
Canalis KBB	40 A straight element (with communication bus)		KBB40ED4303TW
Canalis KBB	40 A power supply box	1	KBB40ABG4TW
Canalis busbar trunking	Fasteners		KBA40ZFUW
Canalis busbar trunking	Tap-off connectors		KBC16DCB21+KBC16ZT1
KNX	KNX local switch	1	
KNX	KNX power supply		
KNX	DALI/KNX gateway		
Argus	Argus presence detector	3	
iC60N	1P+N C6 A circuit breaker	1	
iC60N	3P+N C40 A circuit breaker	1	

Automating the lighting for an industrial workshop

Customer needs

- The lighting of an industrial workshop is of prime importance to ensure employee safety and good productivity at work stations.
- To optimize consumption, it is advantageous to automate luminaire lighting times according to work periods.
- For safety reasons, employees must not be able to switch off the luminaires. However, it is necessary to allow local override control for performing maintenance operations (change of lamps or night work in the workshop, for example).
- This installation allows the operator to choose an automated or manual mode for the control of each lighting circuit.

Proposed solution

- The lighting loads are powered by an integrated-control Reflex iC60 protective device.
- The Building Management System (BMS) sends to the Reflex switch-on and switch-off orders according to the building's operating requirements.
- The Reflex integrated-control circuit breaker is configured in mode 3 in order to allow override setting of the lighting to ON or OFF to be performed by the operator.
- The light switch-on/switch-off data and electrical faults are transmitted to the facility's supervision room.

User/customer benefits

- **Simplicity**: no LV power interface between the Reflex and the Building Management System (BMS), lower cabling costs, up to 50% fewer connections, indications on the front of the product and remote indications.
- **Flexibility**: possibility of manual override control.
- **Safety**: padlocking possible without any additional accessory.
- **Continuity of service**: the Reflex iC60 is a bistable actuator which does not change state in the event of a power outage.

Zoom on

Reflex iC60

Integrated-control circuit breaker!

Reflex iC60N with Ti24 interface

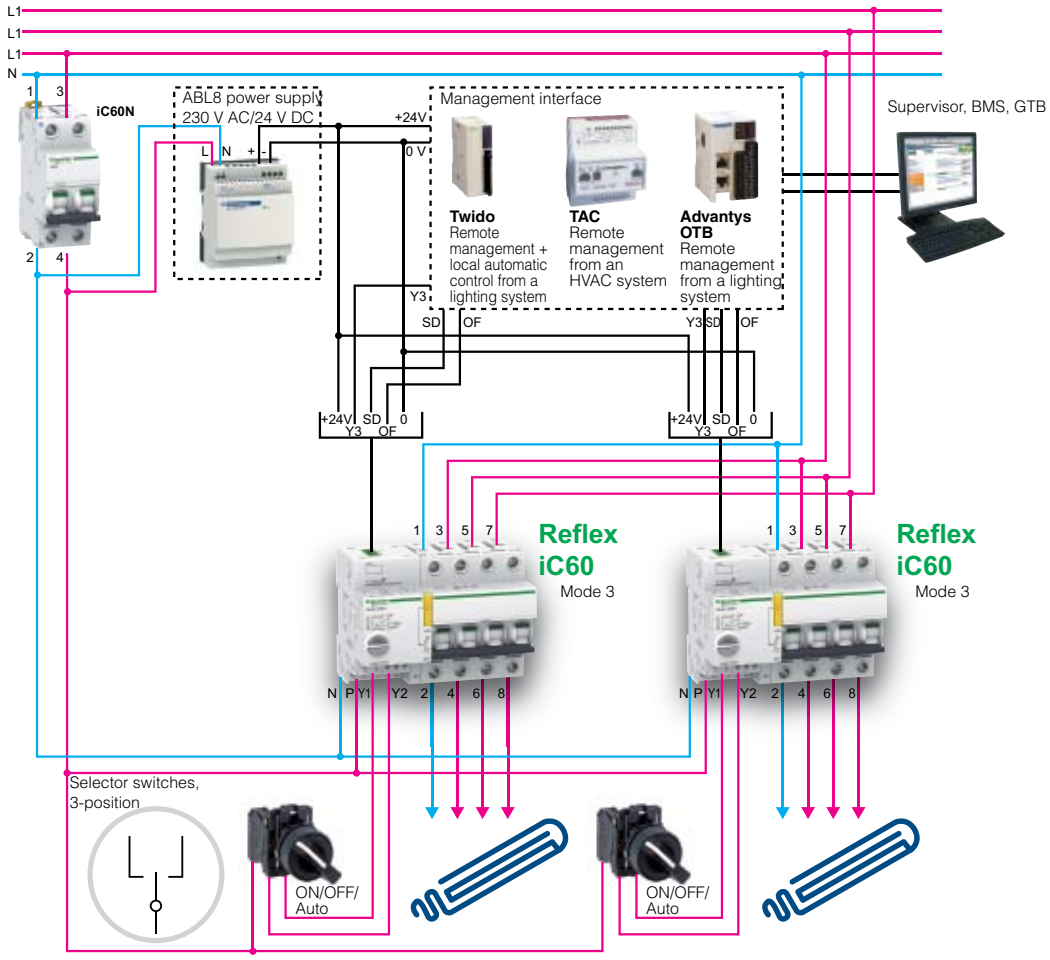
Favorite applications:

- industrial workshop,
- conference room,
- station platform,
- airport hall,
- supermarket,
- etc.

100% Efficient

> Remote management + manual control = continuity of service + savings

Diagram of the solution



Text for specifications

- The lighting loads must be powered via an integrated-control circuit breaker.
- ON/OFF control of lighting circuits must be supervised by a management PLC connected to a BMS.
- Manual override setting of the lighting to ON or OFF can be performed by a selector switch on the front of the electrical distribution switchboards.
- The light switch-on/switch-off data and electrical faults are transmitted to the supervision system, without any additional LV power interfaces.

> Products used

Product	Description	Unit	Reference
iC60N	C10 A 1P+N circuit breaker	1	-
Reflex iC60N	C25 A 4P integrated-control circuit breaker with Ti24 interface (mode 3 setting)	2	A9C62425
Harmony K series	3-position selector switch, dia. 22 mm	2	-

Lighting for a humid room

Customer needs

- **Be able to control lighting in a humid room, while ensuring personnel safety, taking into account sanitary requirements and the floor and wall cleaning operations performed each day.**

Proposed solution

- **The iTL impulse relay** with 24 V coil, together with a power supply via iTR safety transformer, ensures a level of isolation between the mains voltage and the control voltage.
- All guarantees must be taken (sealed push button, use of SELV, earth leakage protection) to ensure personnel safety and protect it from electrical hazards.

User/customer benefits

- **Ease of installation**: the control terminal connection capacity allows the use of cable of cross section up to 4 mm^2.
- **Safety**: the 4 kV isolation level between the coil and the power contacts can meet the requirements of a Safety Extra Low Voltage (SELV) installation.

Zoom on

iTL

The impulse relay!

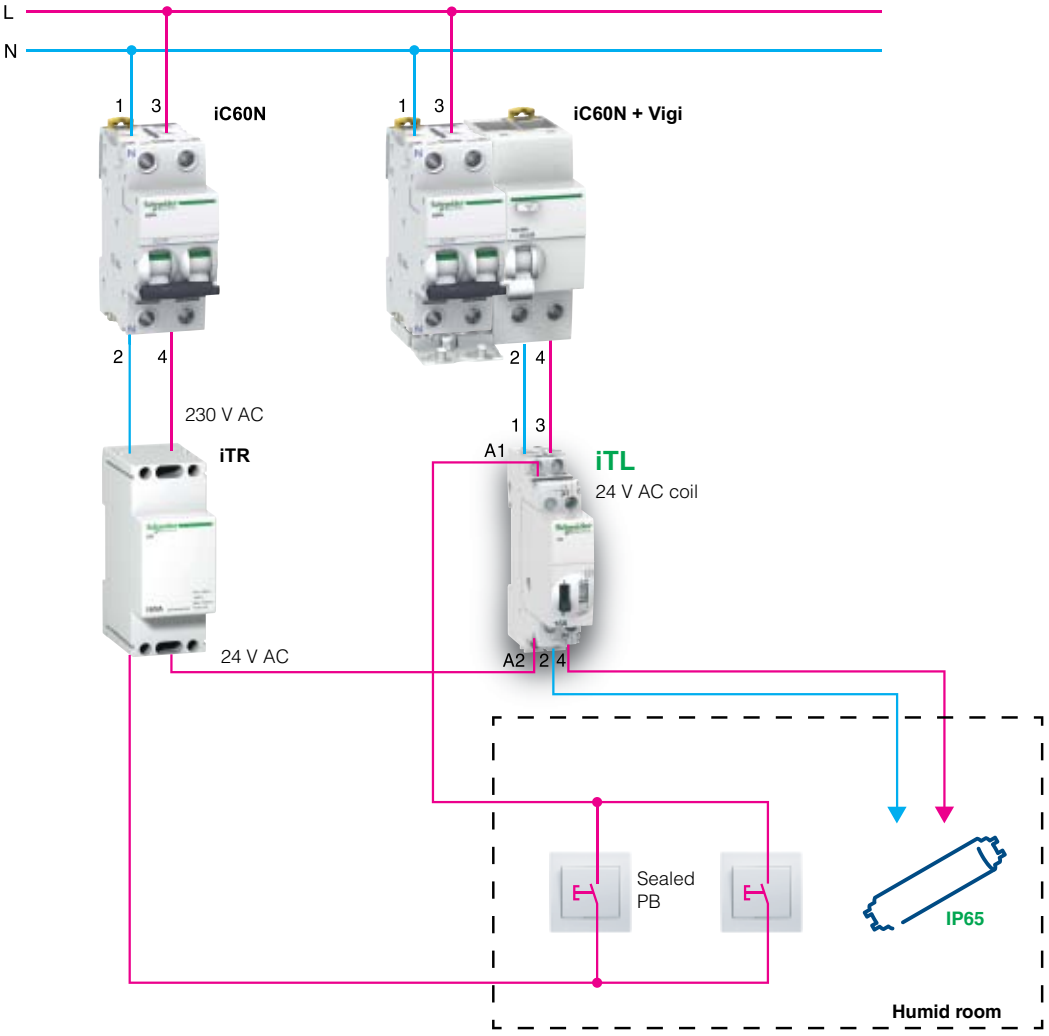
iTL

Favorite applications:

- educational institutions,
- hotels,
- industry,
- infrastructure,
- etc.

> Safety Extra Low Voltage + impulse remote control = personnel protection

Diagram of the solution



Text for specifications

- The impulse relay must have a performance level in compliance with the regulatory requirements for a "Safety Extra Low Voltage" (SELV) electrical installation.

> Products used

Product	Description	Unit	Reference
iC60N	C2 A 1P+N circuit breaker	1	
iC60N + Vigi iC60	C16 A 1P+N circuit breaker + 30 mA Vigi earth leakage protection module	1	
iTL	16 A, 24 V AC 2P impulse relay	1	A9C30112
iTR	16 VA, 12-24 V AC safety transformer	1	A9C15918

Emergency lighting in a public building: junior high school

Customer needs

- Produce an emergency lighting installation in compliance with the regulations allowing signage and ambient lighting to reach the emergency exits in case of evacuation of the institution during a power cut.
- The equipment installed must be unremovable with conventional tools, and that installed in cloakrooms and sports rooms shall be reinforced to prevent damage.
- The self-contained emergency lighting units ("BAES") installed shall be able to indicate their operating condition.
- In the event of a deliberate power cut, the units must be idled to prevent them from discharging.

Proposed solution

- The use of anti-panic emergency lighting units and signage can:
  - reduce the risk of panic,
  - make evacuation paths and obstacles visible.
- The range has accessories: tamper-proof screws and wire guards.
- They are "self-testable" and perform regular checks on their operating condition.
- The TBS 50 remote control prevents the batteries from discharging in the event of a deliberate mains power cut.

User/customer benefits

- **Easy, fast installation**: the emergency lighting units are designed to simplify the work of the installer: numerous handling operations are performed without tools. Numerous mounting possibilities. Simplified markings, quick connectors, cable glands, accessories.
- **Lower maintenance costs**: provided with integral self-control, they make regular checks on the light source, the battery and the electronic module. The results are indicated by multicolored LEDs.
- **Extended service life**: the LED technology reduces power consumption and increases the degree of reliability and service life of the installation.

Zoom on

BAES

Emergency lighting unit!

Evacuation BAES

Anti-panic/ambient BAES

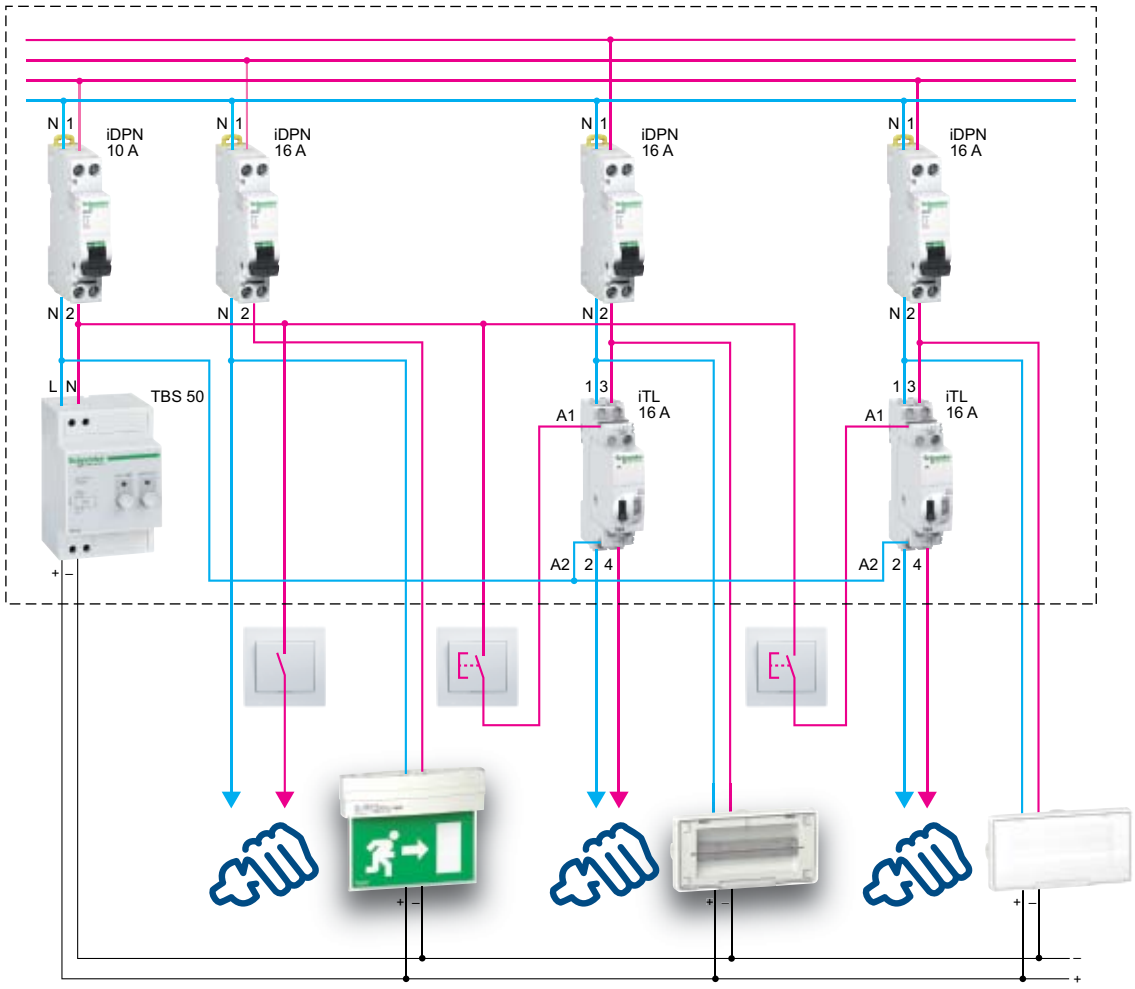
Favorite applications:

- offices and educational institutions,
- hotels,
- industry,
- retail trade,
- infrastructure,
- etc.

> Good marks for purchasing and maintenance costs:

> The combined cost of purchase and maintenance of the LED versions is far less expensive than the purchase and maintenance of fluorescent tube units (no change of fluorescent tubes).

Diagram of the solution



Text for specifications

- The installation shall be executed with self-testable anti-panic emergency lighting and ambient lighting units.
- The installation shall be stopped in the event of a deliberate power supply cutoff.

> Products used

Product	Description	Unit	Reference
iDPN	C16 A 1P+N circuit breaker	3	
iDPN	C10 A 1P+N circuit breaker	1	
TBS 50	Remote control for emergency units (max. 50 units)	1	
iTL	16 A impulse relay	1	A9C30812
BAES	Evacuation unit	1 or more	
BAES	Anti-panic/ambient lighting unit	1 or more	

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