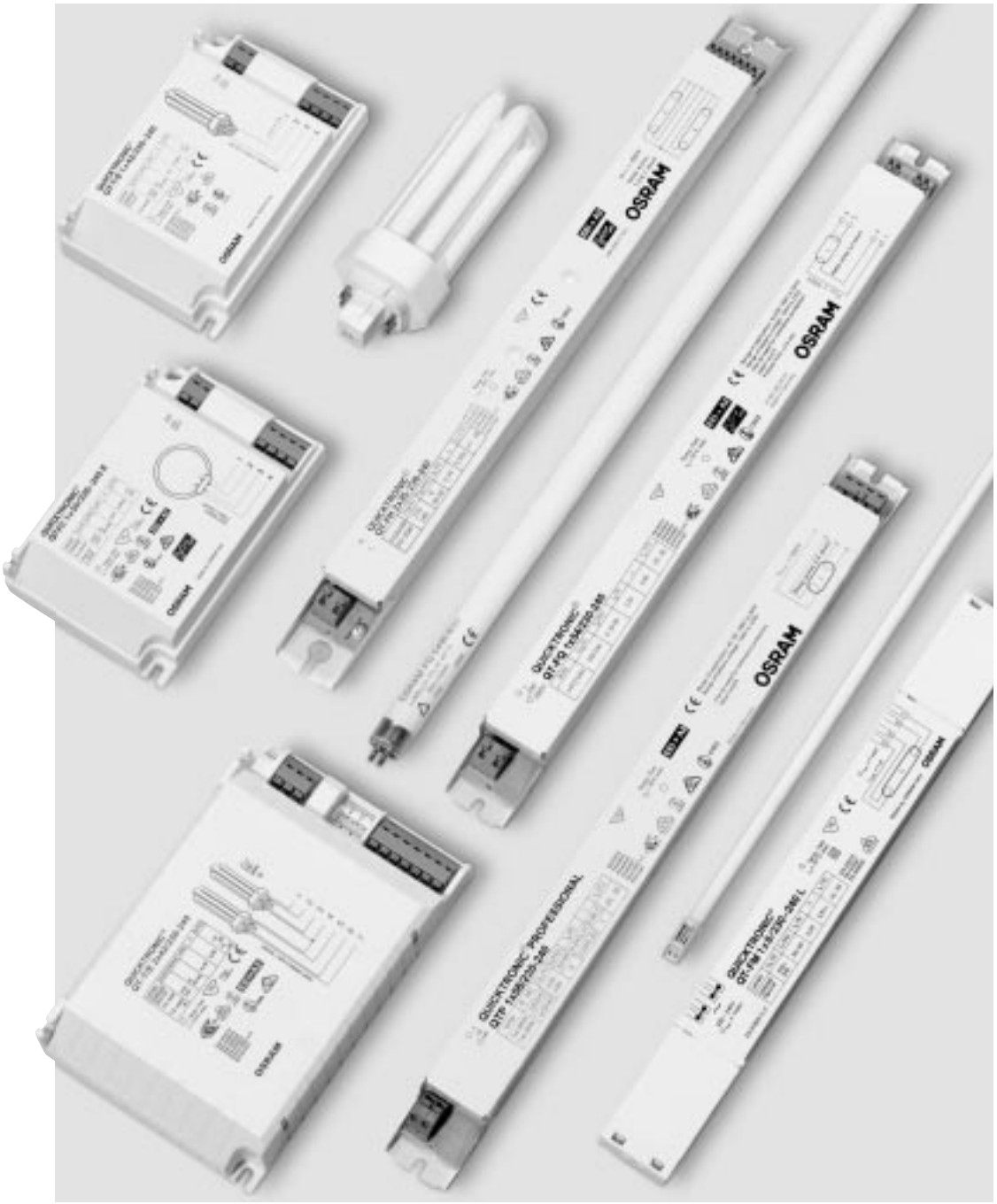
QUICKTRONIC®

Technical Guide **September 2000**

Electronic control gear for fluorescent lamps and compact fluorescent lamps



- Installation in luminaires
- Wiring
- Operation

THERE IS LIGHT. AND THERE IS OSRAM.

OSRAM

Contents

QUICKTRONIC®

QUICKTRONIC® is the name of a range of electronic control gear for operating fluorescent lamps and compact fluorescent lamps.

QUICKTRONIC® control gear offers state-of-the-art technology and unrivalled reliability so that lighting systems can be created with the best possible characteristics in terms of comfort, economy and safety.

With so many different versions in the QUICKTRONIC® range, you are sure to find the right one for your particular application.

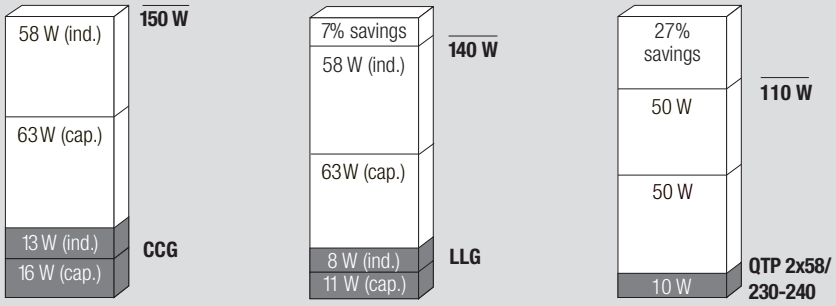
Comfort

- Flicker-free start
- Pleasant, flicker-free light with no stroboscopic effects
- Silent operation with no distracting choke hum
- No flashing of defective or end-of-life lamps
- Automatic restart after lamp change

Economy

- Up to 30 % lower power consumption compared with conventional operation
- Over 50 % longer lamp life compared with conventional/low-loss control gear because the lamp is not exposed to such high stresses
- Low maintenance costs
- Can be used in emergency lighting systems to DIN VDE 0108
- Lower electricity costs for air-conditioning systems and reduced cooling load

Economy



Comparison of connected loads for a 2 x L 58 W two-lamp luminaire

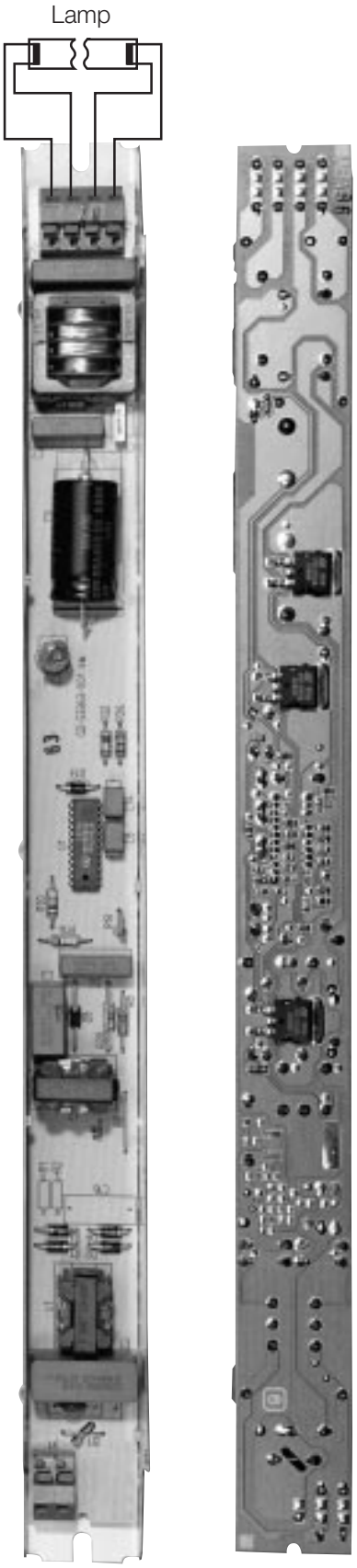
Safety

- Safe shutdown of the power supply to defective lamps
- Compliance with European and international standards for electrical safety, performance and EMC (electromagnetic compatibility)
- Protection against short duration voltage surges (VDE 0160, EN 61000-4-5) and transient overvoltages
- Improved safety because control gear temperatures are lower with QUICKTRONIC®, and luminaires can therefore be constructed to meet the ▽F, ▽F▽F, ▽W and ▽W▽W standards (EN 60598/DIN VDE 0710 and DIN VDE 0711)

Properties of high-quality ECGs

The difference between QUICKTRONIC® and other ECGs can be summed up in two words: quality and reliability.

- Matched to the needs of the lamps
- Electromagnetic compatibility and immunity
- Reliable operation, even in compact luminaires
- Long ECG life



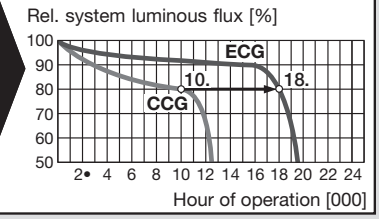
ECG safety

EN 60928
IEC 60928

- Shock protection
- Correct clearances and leakage paths
- ECG shutdown in the event of a fault

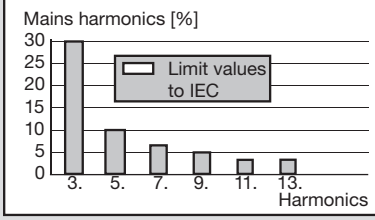
Lamp operation under stand. cond.

EN 60929 (Performance)
IEC 60929



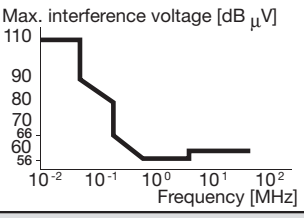
Mains harmonics

IEC 61000-3-2
EN 61000-3-2



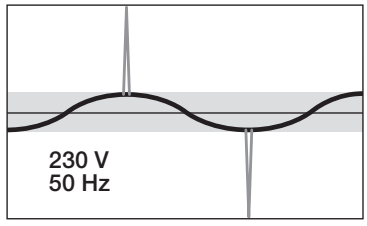
Interference suppression

CISPR 15
EN 55015



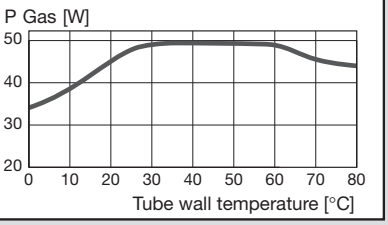
Immunity

EN 61547
IEC 61547



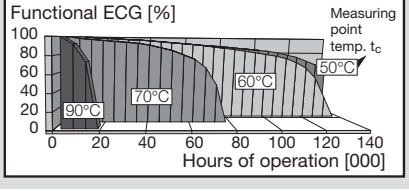
Power reduction

at high ambient temperatures



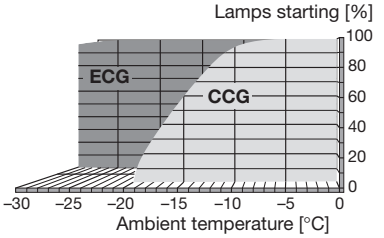
Maximum ECG life

- Long life electrolytic capacitor (50,000h at 70°C at $t_{c\ max.}$)
- Perfected circuit

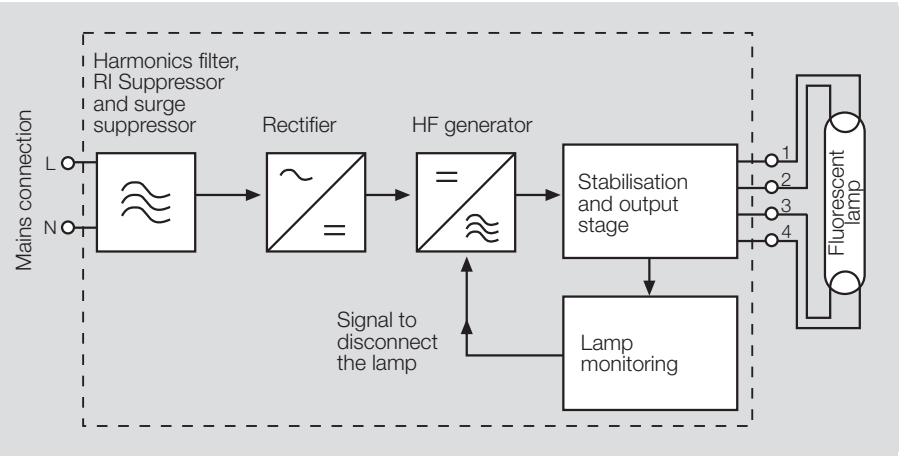


Reliable starting

at low temperatures



Circuit diagram for an ECG



World-wide confidence in OSRAM quality –
Sales 30 million of QUICKTRONIC® units provide the proof

CONTRY		PROJECTS
		DEPARTMENT STORES
D		Tengelmann T • Kaiser's Kaffee
		Coop • Plus • Karstadt
E		El Corte Ingles
I		Euro-Mercato
		INDUSTRY
D		BMW • DAIMLER BENZ • BOSCH • AEG
		Kodak
		Hoechst • Thyssen • Bayer • BASF
		PUBLIC AUTHORITIES
D		Frankfurt airport
I		Ministry of Post and Telecommunications
		St. Raphael hospital
AUS		Sydney Harbour Tunnel
E		Metro Madrid

QUICKTRONIC® range

The QUICKTRONIC® range comprises the following product families:

QTP	QUICKTRONIC® PROFESSIONAL for fluorescent lamps (T8)
QTS	QUICKTRONIC® SHORT for fluorescent lamps (T8)
QTIS	QUICKTRONIC® INSTANT START for fluorescent lamps (T8)
HF … DIM	QUICKTRONIC® DE LUXE DIMMABLE for fluorescent lamps (T8), DULUX L and DULUX F
QT-FM	QUICKTRONIC® for miniature fluorescent lamps FM (T2)
QT	QUICKTRONIC® for DULUX L and DULUX F
QT-D/E[1)]	QUICKTRONIC® for DULUX S/E, D/E and T/E
QT-T/E … DIM[2)]	QUICKTRONIC® DIMMABLE for DULUX D/E and T/E
DT	DULUXTRONIC with integrated lampholder for DULUX S/E, D/E and T/E

1) including QT-S/E…, QT-T/E… 2) including QT-D/E…DIM

1. Product features

1.1. Supply voltage

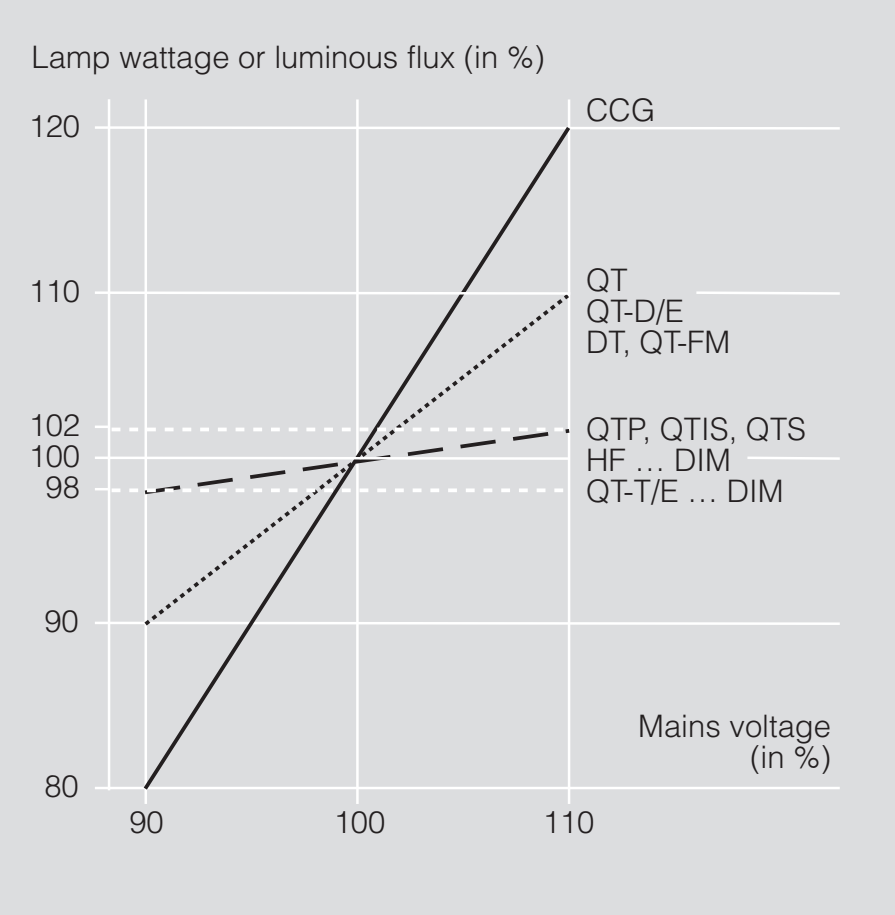
QUICKTRONIC® control gear can be operated on sinusoidal AC voltage and on DC voltage (except QT-FM). The following table shows the recommended voltage ranges and the behaviour of the ECG at overvoltage and undervoltage.

	QTP, QTIS, HF … DIM	QT, QTS, QT-D/E, QT-T/E…DIM, DT	QT-FM
Recommended continuous voltage range			
1. AC voltage	198 V – 254 V	198 V – 254 V	198 V – 254 V
2. DC voltage	154 V – 276 V [1)]	176 V – 254 V [1)]	Not possible
Overvoltage protection			
Continuous overvoltage (approx. 24 h)	Up to 320 V	Up to 280 V	Up to 280 V
Behaviour on exceeding overvoltage limits	1. Up to 350 V dc under 2 hours, no damage to ECG 2. Up to 350 V dc ECG failure possible	Over 280 V ECG failure possible	Over 280 V ECG failure possible
Behaviour at undervoltage:			
1. Voltage drop during operation	Damage to ECG possible at continuous under voltage		
2. Ignition at undervoltage	Under 198 V, lamp start unreliable	Under 198 V, lamp start unreliable; safety shutdown not triggered in the event of lamp fault	Under 198 V, lamp start unreliable; safety shutdown not triggered in the event of lamp fault

1) Voltages below 198 V are permitted only for temporary emergency operation, not for permanent operation

Power consumption – supply voltage variations

QUICKTRONIC® maintains the power consumption of the lamps within tight limits. Changes in power consumption and luminous flux as a function of the supply voltage are smaller than in the case of conventional control gear.

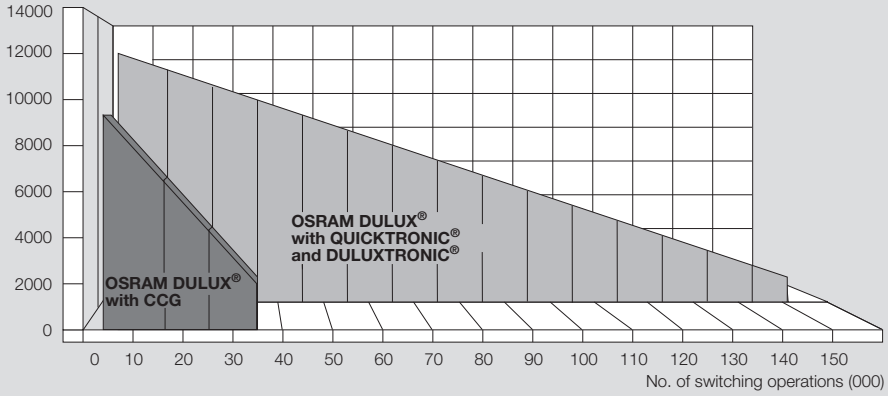


1.2 Start

Most of the models in the QUICKTRONIC® range offer preheat start (except for QUICKTRONIC® INSTANT START which offers instant cold start). With preheat start control gear, the resistance of the lamps to frequent switching is greater. Use of instant cold start control gear is therefore not recommended for applications in which lamps are switched on and off more frequently than about 3 times a day (stairwells in blocks of flats, for example, or in combination with presence detectors).

	QTIS	HF … DIM	QTP	QT, QTS, DT, QT-D/E	QT-T/E … DIM	QT-FM
Start mode	Instant (cold) start	Preheat Start	Preheat Start	Preheat Start	Preheat Start	Preheat Start
Start time for						
a) cold lamp	< 0.3 s	< 0.5 s	< 2 s.	< 2 s	< 2 s	< 2 s
b) warm lamp (after shortoff period < 0.5 s)	approx. 0.3 s	< 0.5 s	< 0.5 s	< 0.5 s	< 2 s	< 0.5 s
Max. no. of switching operations	approx. 10,000 operations	approx. 50,000 operations	approx. 25,000 operations	> 100,000 operations	> 100,000 operations	> 100,000 operations

Switching cycles



OFF time needed for optimum preheat start

After a lamp has been switched off it should remain off for a certain time (depending on the type of control gear) to ensure optimum preheat start.

No OFF time needed	QT 2 x …	QT-T/E 2 x …
(Cathode preheating without PTC thermistor)	QT-T/E 1 x 32	QT-T/E 1 x 42
	HF … DIM	QTP
	QT-FM	QT-T/E … DIM
	QTIS	QT 1 x 40; QT 1 x 55,70
	QTS	
No OFF time needed if the lamps have operated for 1 minute	QT 1 x 36 SE	QT 1x 18 – 24 SE
(With PTC thermistor and relay disconnection)		
OFF time of 2 minutes needed	QT 1 x 18	QT-S/E 1 x 5 – 9
(Cathode preheating with low thermal mass PTC thermistor)	QT 1 x 24	QT-D/E 1 x 9 – 13
	QT 1 x 36	QT-D/E 1 x 18
	DT	QT-D/E 1 x 26

Automatic lamp restart

With all single and twin-lamp OSRAM ECGs (with the exception of QT-FM), automatic restart takes place after a change of lamp (provided the power supply is maintained). (Note: If possible, lamps should not be changed with the power supply switched on).

For QT 2 x 18, QT 2 x 24, QT 2 x 36 and QT-T/E 2 x 1… automatic lamp restart takes place only if the lamp at terminals 1,2 is the last to be inserted.

In most cases, it is not possible to see from the outside which lampholders are assigned to which terminals, so if you insert lamps and they fail to start automatically you should take out the first lamp again and refit it. Both lamps should then light.

1.3 Behaviour in response to lamp defects

For twin-lamp ECGs the question is whether the 2nd lamp will continue to operate if one lamp is faulty or has been removed.

In the case of all twin-lamp ECGs, any lamp fault that causes the safe shut-down circuit to operate will lead to the shutdown of both lamps. One lamp will therefore never continue to burn by itself.

What happens when one lamp is removed will depend on the type of circuit (series or parallel).

Parallel circuit:	QTP, QT 2 x 40, QT 2x 55,70
	HF … DIM
	QT-T/E … DIM
Series circuit:	other twin-lamp QUICKTRONIC® units

For units with a **parallel circuit** (except DIM ECGs) the remaining lamp will continue to operate (at rated output) if the other is removed.
Note that in this mode the lamp is operated with cold start. Applications with frequent switching (> 3 time a day) should therefore be avoided.

For ECGs with **series circuits** and the twin-lamp DIM units, removal of one lamp will lead to the shutdown of the other lamp.

1.4 Luminous ripple

Light fluctuation is a measure of how much the instantaneous value of the luminous flux varies above and below the average luminous flux of a lamp. High-frequency operation with QUICKTRONIC® reduces luminous ripple to 5% (compared with 40% to 60% in the case of conventional control gear). The underlying 100 Hz modulation of the light is so small that possible stroboscopic effects cannot be perceived by the human eye.

$$\text{Light fluctuation} = \frac{\Phi\ \text{max} - \Phi\ \text{min}}{\Phi\ \text{average}} \quad (\text{where } \Phi \text{ is luminous flux})$$

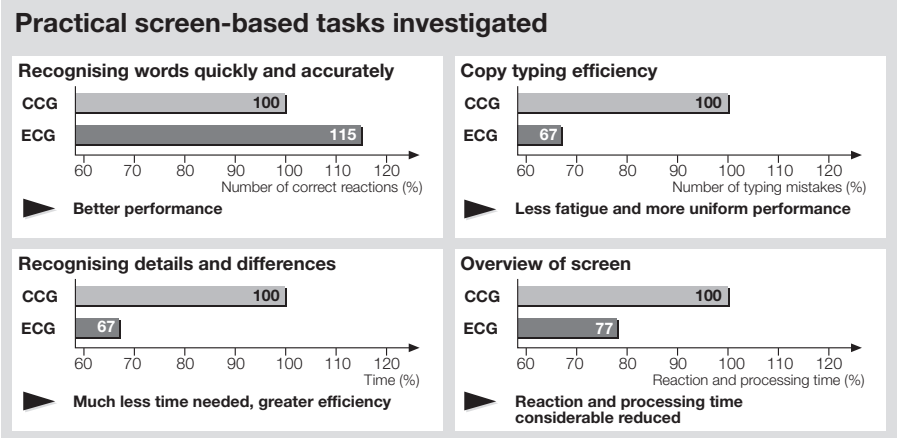
For video, television and film recording, for example, the extremely small fluctuation means that the light is virtually constant with respect to time. Even objects that move very quickly or rotate in synchronism with the mains frequency can be clearly observed, recorded and transmitted.

Some technical applications with exacting requirements (such as optical inprocess inspection using CCD cameras) may call for even less luminous ripple. In such cases, it is best to operate the ECG on direct current. To all intents and purposes, the residual ripple is then zero (depending on the residual ripple of the dc voltage).

In addition to economic and ecological aspects of the use of ECGs, there are extremely positive effects of high-frequency light on the working environment. Recent studies in ergonomics, such as the comparative study undertaken by the Christian Bartenbach Engineering Office in Innsbruck, Austria, provide ample confirmation.

Latent flickering of the light (CCG operation) is a load factor that affects a person's work performance, particularly if the person is viewing a computer screen. The consequences are rapid fatigue, lack of concentration and a greater number of errors in word processing and other such tasks. In contrast to lamps operated with conventional control gear, fluorescent lamps with ECGs produce flicker-free light. Practical screen-based tasks have shown that the benefits are considerable, not only for the people themselves but also for the quality of their work.

Greater efficiency with ECG light



1.5 Dimming

Special dimmable ECGs are needed to dim fluorescent lamps. These units (HF … DIM, QT … DIM and QT D/E … DIM) are identified by the letters DIM at the end of their product reference. Their technical properties, control options via a 1–10 V interface, instructions for installing in luminaires, etc. are described in detail in the QUICKTRONIC® DIMMABLE user guide.

Lighting levels cannot be regulated with Control gear designed to provide constant luminous flux.

1.6 Noise

Fluorescent lamps operated at high frequency with QUICKTRONIC® control gear are virtually silent. QUICKTRONIC® units themselves are so quiet that even in very quiet surroundings they cannot be heard by the human ear. They are therefore ideal for sound-sensitive areas such as radio and recording studios. The limit of the frequency-dependent sound pressure curve is based on the audibility threshold (in other words, a person with normal hearing will not be able to detect the noise generated by an ECG in the same room).

The factors affecting the sound pressure level are the sound power level of the ECG, the absorption properties of the room, characterised by its volume and reverberation time, and the number of ECGs.

In mains supplies with a high level of distortion in which the mains voltage wave form deviates significantly from a sine wave, a “chirping” may be heard from the reactance coils in the input section of the ECG.

1.7 Power factor

For an electrical load, the power factor λ is the ratio of effective power (P_{eff} = voltage x effective current) to apparent power (P_{app} = voltage x current). This value is affected both by the phase displacement cosj between current and voltage and also by the current wave form distortion e (non-sinusoidal wave form).

$\lambda = P_{eff}/P_{app} = \varepsilon \cos\varphi$.

In contrast to conventional control gear (inductive, 50 Hz), there is hardly any phase displacement with electronic control gear (high frequency), which means that capacitor correction is not required. However slight distortions in the current sine-wave curve occur during operation of electronic control gear. In general these distortions are characterized by integer multiples of the mains frequency (harmonics).

The harmonic content of the mains current is controlled by national and international regulations (IEC 61000-3-2, EN 61000-3-2). OSRAM ECGs have built-in active electronic harmonic filters for this purpose which guarantee a value for ε of more than 0.95 and hence a power factor λ greater than 0.95 (DT: $\lambda > 0.85$, QT-FM: $\lambda > 0.9$).

QUICKTRONIC® ECGs have been tested by VDE for mains current harmonic content in accordance with EN 61000-3-2 and carry the VDE EMC symbol of approval (see 4.1).

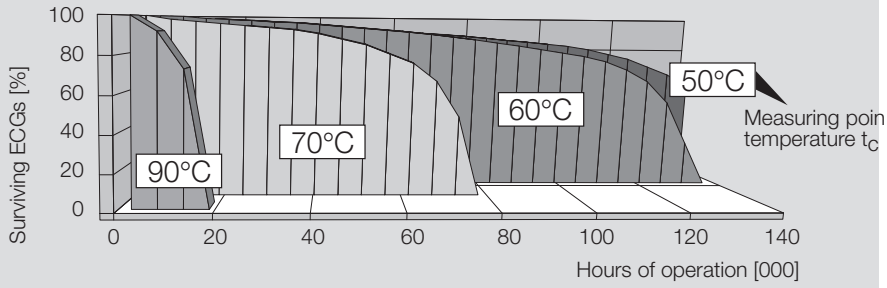
1.8 Service life

The service life of an ECG depends on the operating temperature and failure rate of the electronic components. Overheating can destroy electronic components and cause the ECG to fail. To avoid this, a temperature measuring point and the maximum permissible measuring point temperature tc (70 ºC to 75 ºC depending on the model) is printed on the case of every QUICKTRONIC® unit. The tc temperature is therefore the main criterion in assessing whether a particular ECG should be installed in a particular luminaire (for more details see Section 2.3).

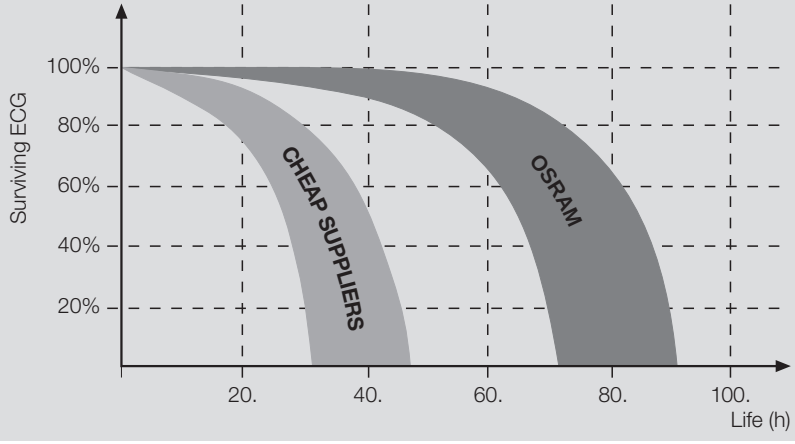
The tc temperature is tied directly to the component temperature and the service lives of individual components and therefore of the unit as a whole. All QUICKTRONIC® units are designed so that **at t_c a failure rate of fewer than 2 per thousand per 1000 hours of operation** can be expected. This corresponds to **an ECG life of 50,000 h at a percentage component failure of less than 10%.** Because of the exponential relationship between the temperature and failure rate of a component, the service life of an ECG is reduced considerably if this maximum permissible t_c temperature is exceeded. Conversely, operating the ECG below the limit temperature will lead to a disproportionate increase in its service life. As a general guide, the service life of a QUICKTRONIC® unit will double if the temperature is maintained at 10 ºC below the t_c temperature.

OSRAM defines the service life of QUICKTRONIC® units on the basis of a failure rate of 10%. Some other manufacturers are not as stringent and base their figures on higher failure rates. In any objective assessment of reliability and service life, it is the correlation between the measuring point temperature, service life and failure rate that is of prime importance. Simply indicating the measuring point temperature and the service life does not provide any meaningful basis for comparison.

Maximum ECG service life



ECG service life – expected values
(70°C at the measuring point on the top of the case)



2. ECG installed in luminaire: Installation and operating instructions

2.1 Wiring instructions

2.1.1 Cable types and cable cross-sections

Both single core and multi-core cables may be used with the terminals of QUICKTRONIC® ECGs.

a) Single-core cables

- These should have a cross-section of 0.5 mm^2 at least and 1.5 mm^2 at most (except for QT-FM:1.0 mm^2 max.). The minimum cross-section for the lamp cables is 0.3 mm^2.
- Single core cables with a cross-section of 0.75 mm^2 to 1.5 mm^2 can be inserted into the terminals without operating the release tabs.
- In the case of single core cables with a cross-section of 0.3 mm^2 to 0.75 mm^2, the tab has to be pressed down to insert the conductor in the terminal

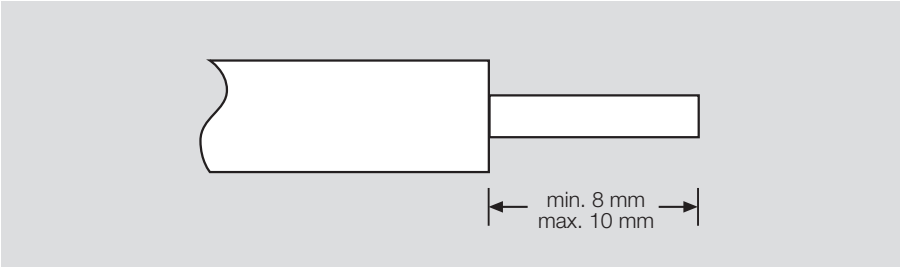
b) Multi-core cables

- These should have a cross-section of 0.5 mm^2 at least and 1 mm^2 at most.
- Multi-core cables can be inserted directly into the terminals.
- Multi-core cables must not be soldered, particularly in the case of screw terminals (QT-FM … LB, for example). Solder will distort under pressure in the course of time and the reliability of the contact diminishes significantly.
- Ferrules may be used but they are not essential.
- Multi-core cables can only be inserted into the terminals while the release tab is pushed down.

An adapter terminal block may be required in the luminaire to accommodate the different conductor cross-sections.

Insulation

For QUICKTRONIC® terminal blocks, about 8 to 10 mm of insulation should be stripped from the ends of both single core and multi-core cables.



2.1.2 Cable routing

To ensure good radio interference suppression and maximum safety and reliability, the following rules for cable routing should be observed:

1. Cables between ECGs and lamps (HF cables) should be kept as short as possible (to reduce electromagnetic interference).
2. Mains and lamp cables should never be routed in parallel. Keep HF cables and mains cables as far away from one another as possible (e.g. 5 to 10 cm). This avoids mutual interference between mains and lamp cables.
3. Lay HF cables away from earthed metal surfaces (if possible several cm away) to reduce capacitative interference.
4. If long HF cables are unavoidable (e.g. with tubular fluorescent lamps or in master/slave circuits) they should be twisted together to reduce HF emission.
5. Keep mains cables in the luminaire as short as possible to reduce interference.
6. Do not lay mains cables too close to the ECG or the lamps (this applies in particular to through-wiring).
7. Avoid crossing mains cables and lamp cables; if this is not possible, they should cross at right angles (to reduce mains and HF interference).
8. Lamp cables at high potential (see Section 2.1.3 “Hot wires”) must be kept as short as possible, particularly with tubular lamp luminaires.

Wiring must comply with the latest versions of the relevant national standards.

Cable entry through metal components should never be left unprotected but should be fitted with additional insulation (sleeve, grommet, edge protector, etc.).

The body of the luminaire or parts thereof must never be employed as a conductor or in any way come into contact with mains or lamp cable conductors (as a result, for example, of bare cables, too much insulation stripped away, screws protruding through insulation, or sharp metal edges). There is a serious risk that a person may be electrocuted and the control gear damaged beyond repair.

If you are wiring a number of luminaires from a 3 mains supply in a loop (with 5-core cable, for example), you must also ensure that are **never** connected two phases to the ECG mains terminals instead of the group phase, the neutral conductor and the PE conductor. Otherwise the ECG may fail immediately or within a short time (see also Section 7, Troubleshooting).

L and N interchangeable (e.g. for mobile luminaires)?

- **yes (case labelling: ≂)**
  All ECGs in plastic cases, HF … DIM, QTIS, QTP, QT 1 x 40, QT 2 x 40, QT 1 x 55, 70, QT 2 x 55,70)
- **no (case labelling: L, N)**
  QT, QTS

2.1.3 Permissible cable lengths

The table below shows the maximum recommended cable lengths between the ECG and the lamp. The additional information contained in this table is discussed elsewhere in this section.

These maximum recommended cable lengths must be adhered to in order not to overload the ECG and to ensure that the system will start reliably even under adverse conditions (low ambient temperatures, high humidity levels, aged lamps).

	QTIS	HF … DIM	QTP	QT, QTS, QT-D/E	DT	QT–T/E … DIM	QT–FM
Max. permissible cable length between ECG and lamp	< 3 m	< 2 m	< 3 m	< 3 m	not applicable	< 1 m	< 1 m
"Hot wires"	< 1,5 m	< 1,5 m	< 1,5 m	< 1,5 m	not applicable	< 0,8 m	< 0,8 m
Master/slave circuit	recommended	not recommended	recommended	recommended	not applicable	not recommended	not applicable
"Hot wires" (see below)							
1-lamp:	1	3, 4	3, 4	3, 4	not applicable	3, 4	3, 4
2-lamp:	1	1 – 3	4 – 7	see table	not applicable	5, 6	not applicable

In order to comply with radio interference suppression limits, the instructions in Section 2.1.2 must be followed. If the maximum recommended cable lengths for operating an ECG/lamp system are fully exploited, additional radio interference suppression measures may be needed (e.g. shielding or separate filters). Because there are so many different interference factors involved (see Section 2.2), it is not possible to specify a maximum cable length for an ECG/lamp system below which radio interference suppression limits are guaranteed not to be exceeded.

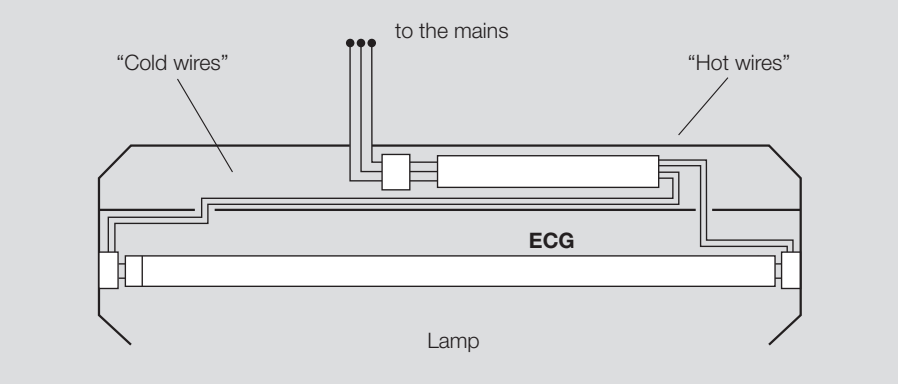
"Hot wires"

The following table indicates the "hot wires" (high potential). By this we mean the lamp cables which are at the highest potential with respect to circuit earth or protective earth. The other lamp cables are "cold wires" and have a correspondingly lower potential with respect to earth.

ECG	Pin
QT-D/E 2 x 10 – 13	6, 7
QT-T/E 2 x 18	6, 7
QT-T/E 2 x 26	6, 7
QT-T/E 2 x 32	6, 7
QTS 2 x …	5, 6
QT 2 x 18	5, 6
QT 2 x 24	5, 6
QT 2 x 36	5, 6
QT 2 x 40	4 – 7
QT 2 x 55,70	4 – 7

The "hot wires" of all the other units are shown in Table 2.1.3. In addition, the "hot wires" are labelled on the case ("Keep wires … short").

For reasons of radio interference suppression and reliable starting, the “hot wires” must be kept as short as possible. In other words, you should install the ECG to one side in the luminaire, making the low-potential cables longer so that the length of the high-potential cables can be reduced. This type of installation is to be preferred to central mounting (see diagram below).



In luminaires equipped with more than one ECG (systems with 3, 4 or more lamps), the ECG and its associated lamp(s) should be assigned to one another. For reasons of radio interference suppression and reliable starting we do not recommend splitting the luminaire into centralised lamps and decentralised ECGs. For the reasons given above we also advise against splitting the ECGs into units located in the luminaire and units located outside the luminaire (e.g. on the back of the luminaire) if this means much longer cables between the ECGs and the lamps.

In the case of dimmable ECGs, the length and arrangement of the control cables also play a significant role. Please refer to the QUICKTRONIC® DIMMABLE guide.

Switching between lamp and ECG

In some special applications it may be necessary to disconnect or incorporate a switch the cables between the ECG and the lamp(s).

Depending on the way in which the units are connected, this may lead to faults in the ECG (safe shutdown or even failure of the ECG). For this reason, this secondary side switching is generally not permitted.

For QTP, QT 2 x 40 and QT 2 x 55,70 single-lamp operation is possible (but there is the drawback of reduced lamp life) if the lamp cable at terminal 4 or 6 is disconnected. (Note: in single-lamp mode the lamp cold starts rather than warm starts; maximum of 10,000 switching operations; the remaining lamp operates at rated wattage). The switch or relay used must be capable of with-standing ignition voltage (it must be insulation resistant to at least 1600 V) and, in the case of a changeover switch, must be of the break-before-make type. In general, we advise against including switches in the lamp cables.

If changeover units are used (emergency lighting modules with internal switching) which supply the lamp directly from an emergency supply and interrupt the system circuit between the ECG and the lamp, the following must be observed:

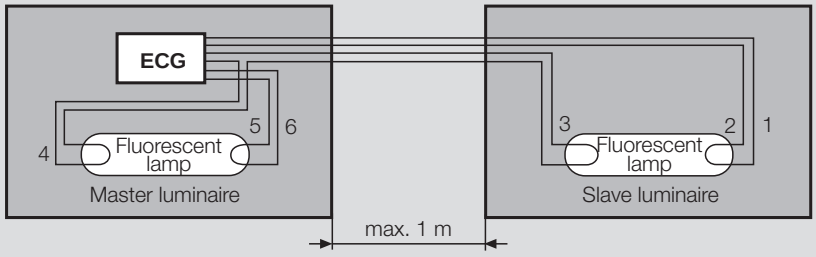
- Changeover or disconnection of the lamps from the ECG to the external unit must be on all terminals.
- When switching back from the external supply to ECG operation, the lamp(s) must first be connected at all terminals to the ECG before the ECG is supplied with power again, otherwise the cutout in the ECG will operate.
- Many of these emergency lighting units available on the market do not comply with the normal operating conditions of the lamp and will therefore damage it. In such cases, OSRAM cannot guarantee that the lamp will last as long as indicated.

2.1.4 Master/slave circuit for two-lamp luminaires

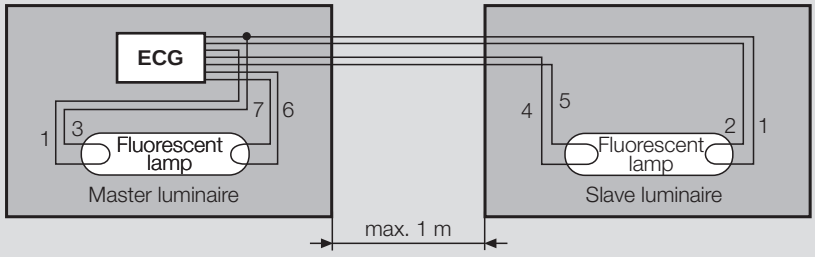
An additional single lamp “slave luminaire” can be supplied from a two-lamp ECG installed in a single lamp “master luminaire”.

This requires a 4-core connecting cable between the two luminaires and, in general, different cable lengths between the ECG and the lamp in the “master luminaire” and between the ECG and the lamp in the “slave luminaire”. Depending on the type of circuit, this can lead to asymmetrical operation and malfunctions in one or both luminaires. For this reason, master/slave operation is not recommended for two-lamp dimmable HF … DIM and QT-T/E … DIM. For reliable starting, master/slave operation is recommended only for indoor applications.

The following requirements apply to the physical arrangement of the two lamps:



ECG with 6-pin terminal



ECG with 7-pin terminal

Instructions on cable routing (2.1.2) and the maximum recommended cable lengths (2.1.3) must be observed.

For reasons of electrical safety and radio interference suppression, it is best to earth the body of the slave luminaire. The connecting cables should also have as low a resistance as possible (i.e. plug-socket connections) and should never be laid together with mains cables otherwise radio interference may be a problem.

2.1.5 Connecting the PE conductor for protection class I luminaires

Exposed metal parts of luminaires of protection class I must be reliably and permanently connected to a PE conductor.

For QUICKTRONIC® units in metal housings the fastening screws are used for grounding (except for QT 1 x 18, QT 1 x 24 and QT 1 x 36 which have a separate PE conductor terminal). Serrated washers must be used.

In the case of QUICKTRONIC® units in plastic housing, these earthing measures for the ECG are not needed since these units have been designed for optimum safety and radio interference suppression. Grounding would be superfluous. However some ECGs (QT-T/E … DIM) have a ground terminal to suppress radio interference.

To obtain good radio interference suppression, the PE conductor and the line mains cables should not be laid parallel to the lamp cables or alongside the ECG. This applies equally to both ECGs in plastic housings and ECGs in metal housings.

2.2 EMC standards

The abbreviation **EMC** stands for **e**lectro**m**agnetic **c**ompatibility. EMC specifications define a series of different test criteria. The most important in connection with electronic control gear are **radio interference suppression** (noise), **harmonic content** (up to the 39th harmonic) and **immunity to interference.**

	IEC, international	European standard	VDE Germany
Radio interference suppression*	CISPR 15	EN 55015	VDE 0875 T2
Harmonic content	IEC 61000-3-2	EN 61000-3-2	
Immunity to interference	IEC 61547	EN 61547	VDE 0839 T82-1, -2

* For frequencies up to 30 MHz

The CE and VDE EMC symbols on OSRAM units indicate compliance with immunity to interference, harmonic content and radio interference suppression requirements. Since immunity to interference and harmonic content are determined exclusively by the ECG, these measurements are no longer necessary on luminaires with OSRAM ECGs, which all carry the **VDE EMC symbol** (cost savings for the luminaire manufacturer; see also 4.1).

2.2.1 Harmonic limit values to EN 61000-3-2

Lighting equipment is subject to restrictions on harmonics. The maximum permissible threshold values are defined for two classes of equipment:

- Class C: Effective input power (system wattage) > 25 W
- Class D: Effective input power < 25 W

The requirements for Class D equipment must be met by January 1, 2000 at the latest.

Harmonic number	Proportion in % of the mains current of the fundamental wave (50 Hz)
2	2
3	30 x power factor (λ)*
5	10
7	7
9	5
11 < n < 39	3

* The power factor l is indicated on all units. On our units with their excellent mains current compensation it assumes values between 0.9 and 0.99.

The specified values apply to Class C ECGs.

OSRAM ECGs typically exhibit values well below the threshold values. Most QUICKTRONIC® units have a total harmonic distortion (THD) of less than 10%.

2.2.2 Radio interference suppression

Compliance with the limit values for radio interference suppression is also a requirement for the **VDE EMC approval.**

The ECGs are measured in a reference luminaire.

However, the interference level depends not only on the ECG but also on the arrangement of the lamp and ECG, the luminaire design and in particular the wiring (see also Section 2.1.2). To obtain approval, compliance with the limit values has to be checked for each luminaire (by the VDE for example). This is discussed in more detail below:

Causes of radio interference

Radio interference refers to both the radiated and the mains-borne influences of an electrical load on other units connected to the same mains supply and/or in the immediate vicinity.

To ensure that the various electrical loads can operate simultaneously and trouble free, each unit must not exceed certain radio interference values.

A distinction is made here between mains-borne disturbances on the power supply side and atmospheric disturbances due to electromagnetic fields in the vicinity of the luminaires.

Conducted disturbances

These disturbances are caused by non-linear components and the high-frequency operation.

By using complex input filters it is possible to reduce these disturbances to a level well below the limits prescribed by the relevant standards. Each and every OSRAM ECG complies with these standards. The way in which an ECG is installed in a luminaire, however, can have a considerable influence, which is why some important information is included on installing ECGs in Section 2.2.3. These instructions must be followed when designing and constructing luminaires otherwise there can be problems obtaining approval.

Disturbances due to fields

These disturbances are caused by clocked high-frequency operation in conjunction with non-linear components (diodes, coils, etc.).

Owing to the various dynamic electrical and physical processes in the ECG/lamp system, there is always an electromagnetic field around the luminaire. In defining its effects, a distinction is made between electric and magnetic components.

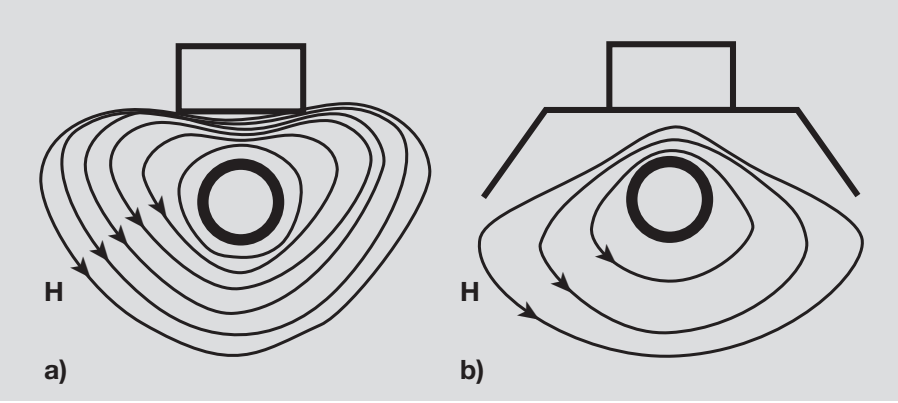
a) Electrical fields
Because of the high-frequency output voltage the lamp and lamp wiring generate an electrical field. This is attenuated to a level well below that prescribed in the relevant standards by filtering on the output side and by suitable circuit design. What applies to an individual ECG does not always automatically apply to the entire system once the ECG has been installed in the luminaire (see 2.2.3).

b) Magnetic fields
The magnitude of this field is determined solely by the lamp and the geometrical arrangement of the entire system, particularly by the areas enclosed by the lamp, ECG and wiring. The only recommendation that can be made here is to aim for a self-enclosed structure as far as possible and to comply with the wiring instructions set out in Section 2.2.3.

In practice, the field strength of the magnetic field does not play a major role. It is measured with a frame antenna with a diameter greater than 2 m. The measured values are well below the threshold values.

Selective shielding

The following diagrams show the magnetic lines of force for two simple linear luminaires a) without reflector and b) with a metal reflector.



The resulting magnetic field strength in the near field and hence the effect on the environment is reduced in b) by a current induced in the reflector. It is important here for the surface of the reflector to have good electrical conductivity. It is not necessary to earth it.

To shield the electrical field, which is always radial around the lamp, it is necessary for the reflector (or its surface) to be as conductive as possible and for the connection to earth or to protective earth to be of the lowest possible resistance.

Based on these two requirements, the solution here is to have a reflector (or reflector and diffuser) with excellent conductivity connected at lowest possible resistance to the ECG earth(PC I) or the PE conductor connection of the luminaire (for ECGs without a PE conductor terminal).

2.2.3 Installation instructions for avoiding disturbance

The following diagrams show examples of correct and incorrect wiring.

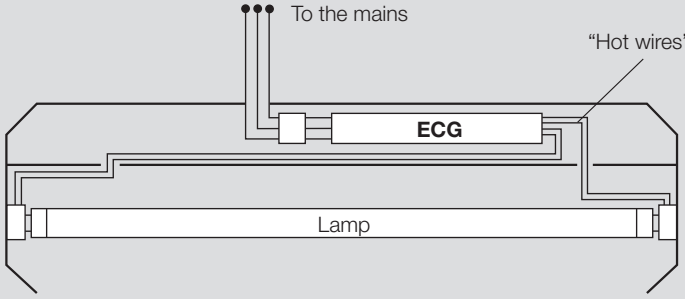
1. a) Long-run luminaire with reflector

To avoid interference on the lamp cable, the mains cable should be routed to the outside immediately at the luminaire terminal. The lamp cables should be laid in accordance with the criteria specified in Section 2.1. The reflector is used here for shielding and should therefore made of metal and be attached permanently with a high quality plug connector (must have low resistance) to the luminaire body which in turn is connected to control gear earth.

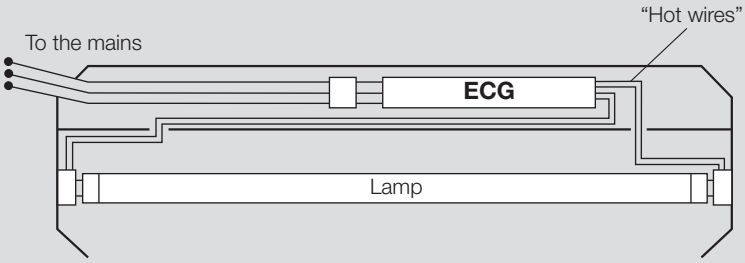
1. b) Bad example

Mains and lamp cables that run in parallel over long distances. This leads inevitably to interaction and therefore to higher energy in the radiated electro-magnetic field. Serious problems can occur if, as described in Section 2.1, the lamp cables that have high potential with respect to earth (hot wires) are not kept as short as possible by connecting them to the nearest lampholder.

1a) Correct



1b) Incorrect



The following diagrams apply to both recessed and surface-mounted luminaires.

2. a) Asymmetrical installation of ECGs in the luminaires

Cables should be laid close to the body of the luminaire. ECG and reflector need a low resistance earth. Wiring complies with the recommendations in Section 2.1. The luminaire design provides effective shielding of the electro-magnetic field.

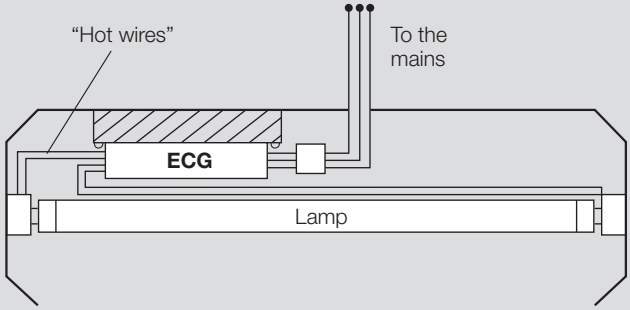
2. b) Alternative asymmetric installation

This option is equally suitable.

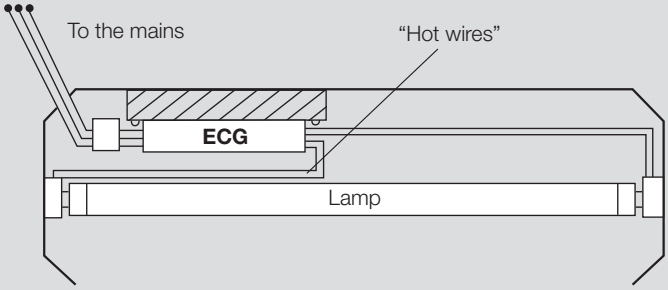
2. c) Bad example

The electrical connection between the ECG and the luminaire is poor where unnecessary crossovers have been created leading to poorer and therefore higher resistance connection with earth. This arrangement is also poor from a thermal point of view.

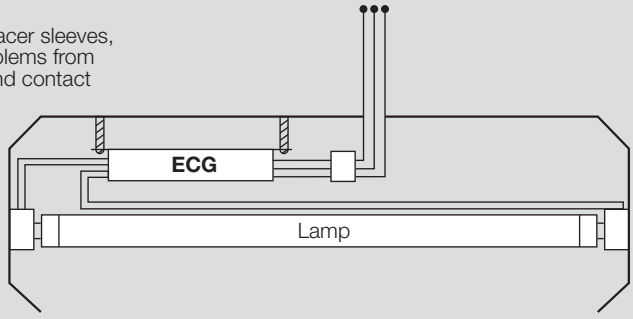
2. a) Correct
1st version;
Full-surface ECG installation



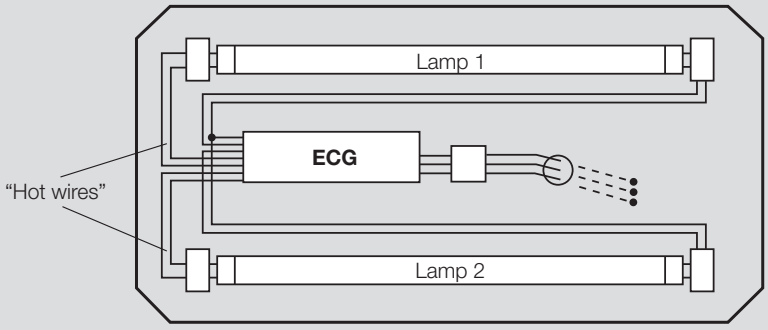
2. b) Correct
2nd version;
Full-surface ECG installation



2. c) Incorrect
ECG mounted on spacer sleeves, possible thermal problems from high-resistance ground contact



3. a) Good wiring arrangement for 2-lamp luminaires

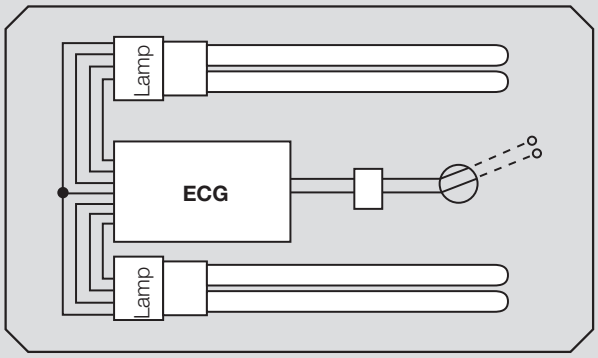


4. a) Diagram of a compact fluorescent lamp luminaire

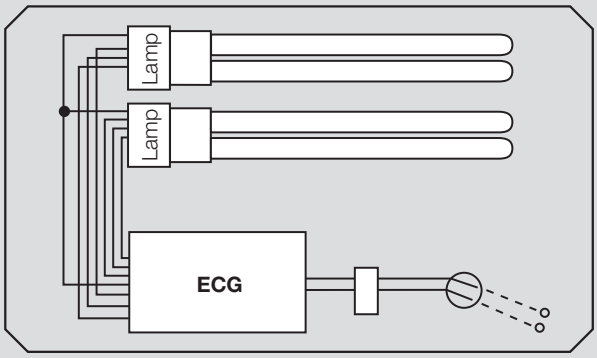
As far as grounding and wiring are concerned, the same requirements apply here as to linear luminaires.

To keep lamp cables as short as possible, the ECG should be installed between the two lamps and **not as shown in diagram 4. b).**

4. a) Correct (symmetrical cable routing)



4. b) Incorrect (some cables too long)



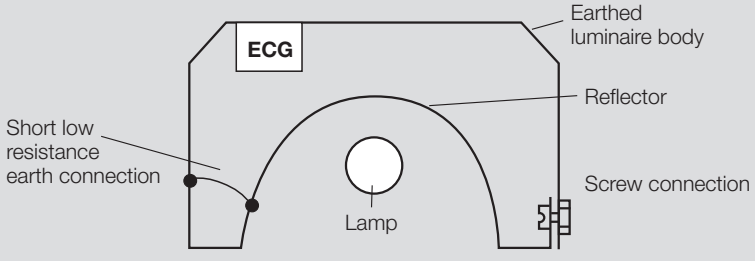
5. Luminaires with reflector and/or specular louvres

These parts must be made of metal or at least have a surface with excellent electrical conductivity.

5. a) The reflector acts as an effective shield

Provided the reflector has a very good connection to the central earthing point, the lamp is effectively shielded and there can be no interaction with the ECG and the wiring. Electromagnetic fields are also effectively shielded.

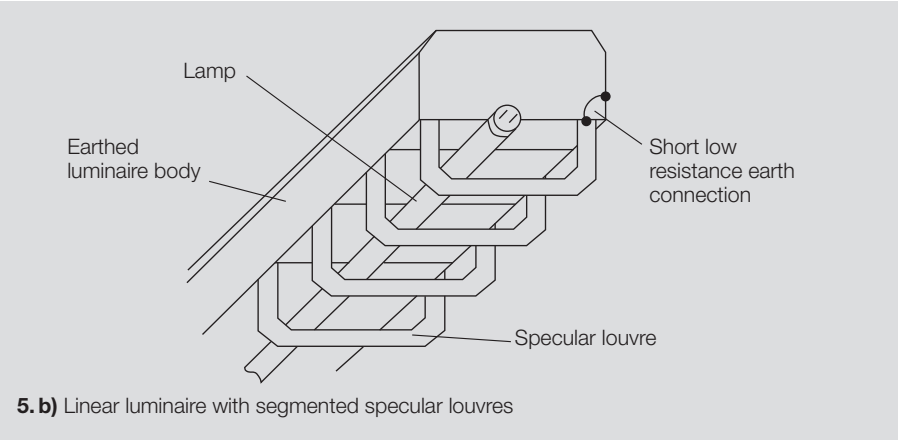
The reflector should be connected by a short cable or screw connection to the body. A poor contact or loss of contact at this point would have an adverse effect on the EMC behaviour of the complete luminaire and could also impair starting.



5. a) Linear luminaire (screw connection or clamp connection)

5. b) The same applies to louvres as to the reflector

Louvres also have to be good electrical conductors and be connected to luminaire earth.

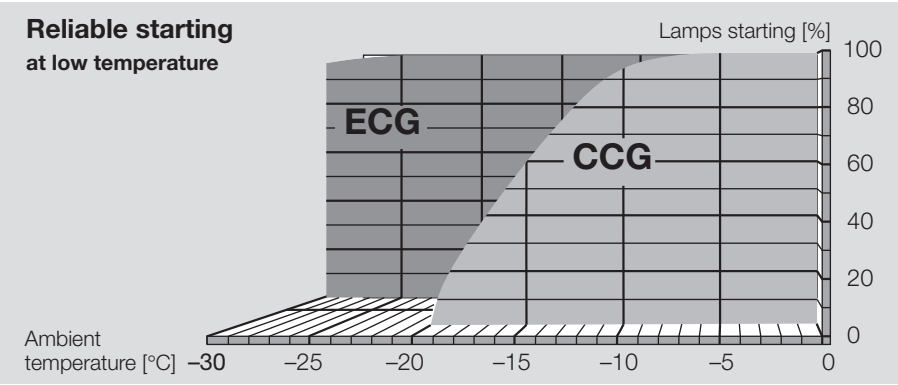


5. b) Linear luminaire with segmented specular louvres

2.3 Temperature ranges

The temperature must be assessed separately for the two system components (ECG and lamp). In the case of the lamp, there are physical laws that restrict the temperature range, whereas in the case of the ECG fixed limits must be set in order to ensure reliable operation. Apart from this, there are external factors such as the reciprocal influences of ECG, lamp and luminaire and the selected installation site which all of which have an influence.

Compliance with the specified limits and hence the guarantee of operational reliability are the responsibility of the relevant luminaire or system manufacturer.



2.3.1 Lamp temperature

The maximum values specified in the lamp documentation for cold-spot temperature are important operating criteria for the lamp and must not be exceeded under any circumstances.

Fluorescent lamps are generally optimised for a tube wall temperature of around 40ºC, whereas compact fluorescent lamps because of their higher luminance are optimised for a tube wall temperature of around 50ºC to 60ºC (in free burning applications, this corresponds in both cases to an ambient temperature of 25ºC). At these temperatures the lamps have their nominal electrical properties and their highest luminous efficacy. Even relatively small changes in temperature will have an effect on their electrical and photometric characteristics.

At significantly lower or higher temperatures than the specified temperature the electrical properties of the lamps change drastically and there is a marked reduction in luminous flux. In normal cases, the shutdown mechanism in the ECG will operate. In extreme cases there may be damage to the electronic control gear (cf. 7.3: Draughts, Hg depletion).

If the lamp temperature is too low it may be difficult to start and the luminous flux may be too low. Selecting a different site for installation generally helps here, or using an outer tube to conserve the heat of the lamp.

These requirements lead to the following restrictions:

The ambient temperature for starting time must not be less than the lower temperature limit indicated on the associated ECG. During operation, the tube wall temperature should not exceed 40ºC (for fluorescent tubes) or 50ºC to 60ºC (for compact fluorescent lamps) even in onerous situations (high ambient temperature and or supply voltage). If necessary, the luminaire design must be improved (see Section 2.3.3).

If fluorescent tubes or compact fluorescent lamps are operated in conjunction with dimmers, there are certain special requirements with respect to temperature limits. Detailed information can be found in the QUICKTRONIC® DIMMABLE guide.

2.3.2 Control gear temperature

Always operate within temperature ranges indicated on the units otherwise reliable operation cannot be guaranteed. As a general rule, operating temperatures below the upper limit will extend the life of the ECG (cf. 1.8).

For installing ECGs in luminaires, the measuring point temperature $\mathbf{t_c}$ on the case is of major importance in any thermal analysis. The maximum recommended value specified for the unit and marked on the housing must not be exceeded.

Measuring point temperature t_c

According to EN 60598, $\mathbf{t_c}$ (c stands for case) is the maximum recommended temperature that may occur at a indicated point on the ECG ($\mathbf{t_c}$ measuring point) during normal operation at rated voltage or at the maximum value in the rated voltage range.

In practice, the temperature rise of the housing results from the self-heating of the unit, which in turn results from the power loss, and the ambient temperature of the ECG. This is influenced by the position of the lamp and the design of the luminaire and is consequently always higher than the ambient temperature of the luminaire.

Exceeding the maximum recommended tc temperature by a few degrees drastically reduces the expected service life of the unit. If the temperature is exceeded by more than 10ºC, a 50% reduction in service life can be expected. At 20ºC or more above the maximum recommended temperature the unit is likely to fail very quickly. The limit temperatures of various electronic components, such as capacitors, are primarily responsible for this.

If, however, the temperature at the $\mathbf{t_c}$ point is permanently 10ºC or more below the maximum, the expected service life of the unit will be approximately doubled (cf. 1.8).

Ambient temperature t_a

According to EN 60598-1, $\mathbf{t_a}$ (a stands for ambient) is the maximum value of the steady state temperature at which, during normal operation, limit temperature $\mathbf{t_c}$ is not exceeded at the measuring point.

Also according to EN 60598-1, there are precisely defined testing and measuring requirements for both surface mounted luminaires (fixed and pendant) and portable luminaires (floor standing).

Temperature ranges

	QTP, QTIS	QT, DT	QTS	QT-D/E	HF ... DIM	QT-T/E ... DIM QT-FM
Min. recommended ambient temperature	– 25°C	– 20°C	– 20°C	– 15°C	0°C (5°C for DULUX L)	+ 5°C
Max. recommended ambient temperature t_a	Depends on how the ECG is installed in the lamp To ensure long ECG life, the maximum measuring point temperature marked on the ECG cover must not be exceeded. Additional cooling fins around the ECG reduce the temperature at the measuring point and allow higher ambient luminaire temperatures.					
Max. recommended temperature at the measuring point t_c	+ 70°C	+ 70°C	+ 75°C (1-lamp: 70°C)	+ 70°C	+ 70°C	+ 70°C
ECG behaviour outside the recommended temperature limits						
Temperature too low	Lamps do not ignite; ECG shuts down; mains reset required for lamp restart; no damage to ECG or lamps					
Temperature too high	ECG life shortened; high ECG failure rate					

Important:

These limit temperatures apply even if the units are not in operation or are in storage.

The very low thermal output of OSRAM control gear (producing typically 10º to 20ºC temperature rise), allows a very wide ambient temperature range which in almost all cases this range is perfectly adequate. If not, suitable measures must be taken in the luminaire or at the site of installation to improve the thermal balance of the luminaire (see also Section 2.3.3).

If the limit temperature is expected to be breached for only short periods (less than one hour per day, as may be the case in outdoor installations in direct sunlight), but most of the entire time the operating temperature is below the maximum recommended value (at night-time, for example), a certain balance between reduction and extension of service life may be expected. However, there is no guarantee that this will be the case.

The temperature at the tc point must never be exceeded by more than 20ºC, otherwise the unit is very likely to suffer permanent damage.

ECGs may also suffer permanent damage if they are operated below the specified minimum temperature. As already mentioned, if the lamps are also too cold, there will be problems with starting, low luminous flux and a shift towards the red end of the spectrum (see the table entitled “Temperature ranges”).

2.3.3 Recommendations for Installation

It is important to ensure that the lamp and the ECG are positioned in the luminaire so that they do not mutually heat one another and that the ECG power loss can be properly dissipated even at the maximum expected ambient temperature and/or supply voltage.

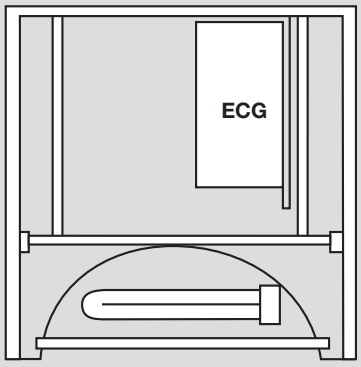
The temperature at the measuring point on the ECG must not be exceeded during operation even at the maximum expected ambient temperature and supply voltage. Under “normal” ambient conditions the temperature must be at the ECG measuring point should be at least 5°C to 10ºC below the specified maximum value so that there is a safety margin to allow for extreme situations.

It may be necessary to split lamp and ECG (with, say, the lamp in the luminaire and the ECG in the stand or luminaire support) such that in the absence of special measures the lamp and ECG would not mutually heat each other if arranged in close proximity, leading to excessive temperatures of the lamp and/or the ECG. Obviously, in such arrangements ensure that the maximum cable length between the ECG and the lamp(s) is not exceeded and that the wiring instructions in Section 3.5.3 are followed.

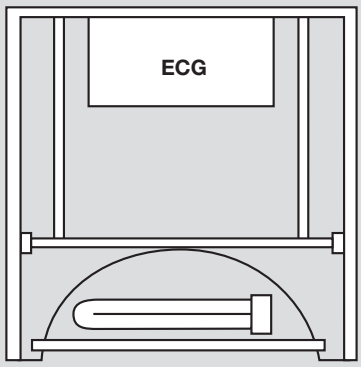
Suggestions for ideal thermal operation of the ECG

From these recommendations, the following summary applies:

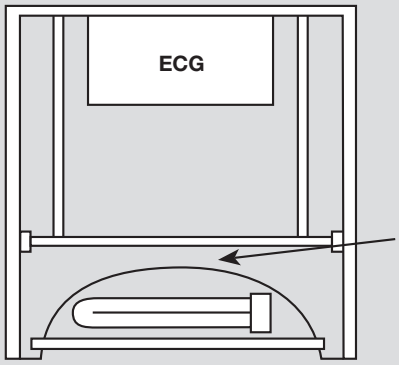
1. The lamp and the ECG should be thermally isolated from one another as far as possible in the luminaire (for example by placing the ECG outside the luminaire, by selecting a thermally non-critical location for the ECG in the luminaire (provided the luminaire is large enough) or by introducing additional measures to dissipate the heat (see diagrams 1a to 1d below for examples of a downlighter for compact fluorescent lamps).



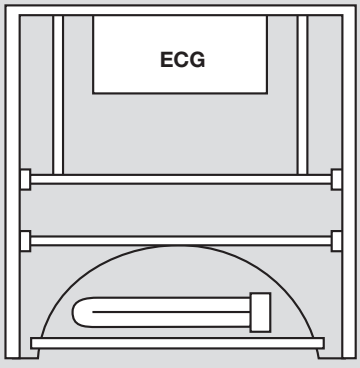
1 a) Siting the ECG on a metal bracket



1 b) Siting the ECG on the back wall



1 c) Additional separation of the reflector

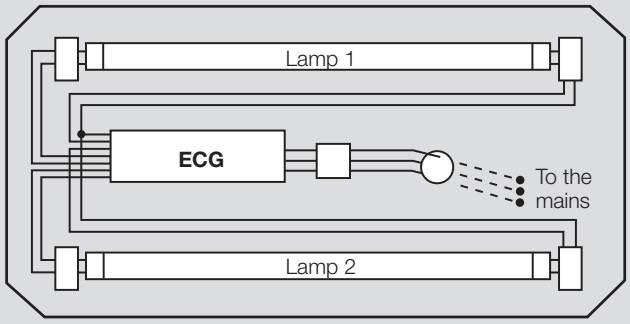


1 d) Incorporating a partition

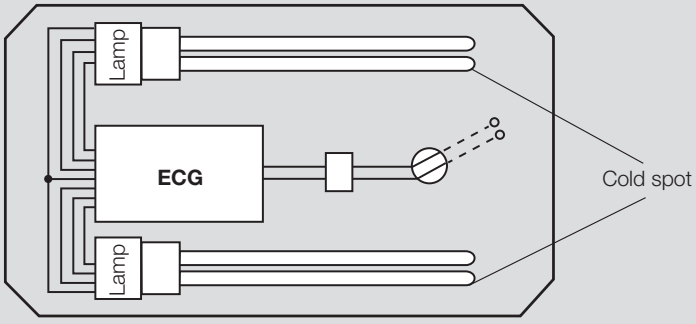
2. In two-lamp arrangements, particularly with compact fluorescent lamps, always ensure that the lamps cannot mutually heat one another. The following options should be considered (see diagram 2). In multi-lamp compact fluorescent lamp luminaires, all the lamps must be similarly aligned (i.e. all the bases of the lamps must be on the same side).

   For OSRAM DULUX® L compact fluorescent lamps in particular, the arrangement shown in diagram 2 c) must be avoided since the cathodes of one lamp will heat the cold spot of the other lamp to extreme levels (90 to 100 °C instead of 50 to 60 °C). The resultant higher lamp currents (up to 50% higher) coupled with the drastic reduction in luminous flux can destroy the ECG.

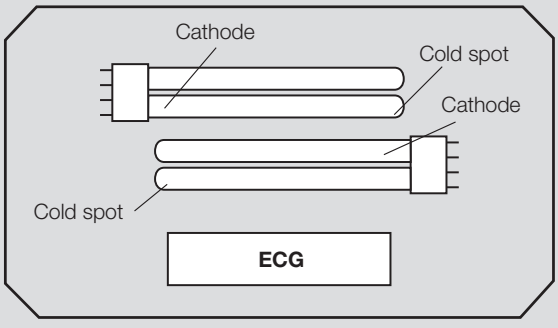
   If such an arrangement cannot be avoided suitable separators must be placed between the electrode and the cold spot on the other lamp to provide thermal isolation.



2 a) Fluorescent lamps (correct arrangement)



2 b) Compact fluorescent lamps (correct arrangement)



2 c) Compact fluorescent lamps (incorrect arrangement)

3. Thermal dissipation due to convection must not be restricted in any way and should be encouraged (for example by providing suitable inlet and outlet holes in the luminaire housing.

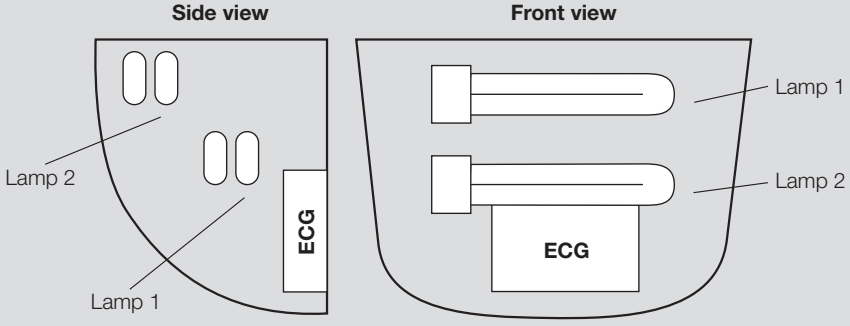
   In ideal conditions, freely circulating air can reduce the temperature of the control gear by as much as 15ºC.

   Make sure that fluorescent tubes are cooled along their entire length and not at any one point, and that all the lamps in a multi-lamp system are cooled to the same extent, otherwise dark areas (known as cold spots) will appear on the lamps or the lamps will appear to operate at different brightness levels. This applies in particular to air-handling luminaires which are subjected to forced cooling, and to luminaires that are sited close to air-conditioning outlets, fans or other air-circulating equipment.

   In the case of luminaires fitted with compact fluorescent lamps, on the other hand, it can be very beneficial for luminaire efficiency to intentionally ventilate the cold spots of the lamps (by air circulation, for example, through an opening in the reflector close to the cold spot). The cold spot of a compact fluorescent lamp is always at the corner of the bends in the tube (see also the OSRAM DULUX® guide).

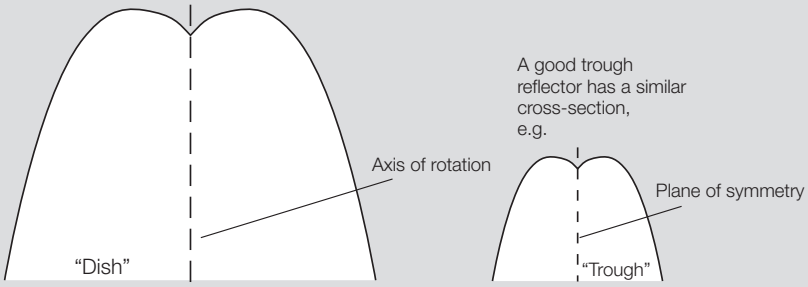
4. If the lamp(s) and control gear are arranged vertically, the temperature will progressively rise from component to component towards the ceiling as heat rises. This may lead to different brightness levels in the lamps or, in extreme cases, to thermal overloading of the lamps and/or ECG. A considerable reduction in luminous flux will be apparent and there is a possibility that the unit will be damaged. Temperature analysis and measurement should therefore be conducted with particular care for these luminaires.

   If the luminaire is large enough, the following arrangement of components is recommended (Fig. 3)



3) Uplighter

5. With suitable deformation in the centre of the reflector its geometry should prevent heat from being reflected directly back to the lamp (see the example of a downlight in Fig. 4). For the same reason, a structured reflector (hammer finish) should be preferred to a smooth reflector.



4) Parabolic ellipsoid or "trough" reflector

6. If the luminaire is installed in a suspended ceiling, there must be adequate free space above the luminaire (in the insulating material for example) and there must be adequate provision for heat to be dissipated to the immediate surroundings. In addition, luminaires should not be installed in the vicinity of heat sources (heaters, radiators, heating system pipes, and so on).

For reasons of safety, reliability and thermal integrity, if a number of lamps are arranged in one plane and in conjunction with two-lamp control gear, there should be a minimum clearance of 5 cm between the lamps (important particularly if dimming control gear is used) and at least 1.5 cm between a lamp and an earthed metal reflector (this latter requirement also applies to single lamp arrangements).

2.3.4 Measuring the temperature

The simplest way to measure the relevant temperatures on the lamp (especially at the cold spot, see also special product literature such as the OSRAM DULUX® guide) and on the ECG (tc point) is with thermocouples fixed to the lamp/ECG and a suitable measuring instrument. Make sure the adhesive used is neutral in terms of its thermal, electrical and photometric properties.

To measure the ECG temperature it is convenient to have a thermocouple permanently attached to a housing cover exchange this for the original cover.

The temperature values should only be measured when the steady-state temperature has been reached (in other words, when there has been no significant change in temperature for some time). The supply voltage should be held constant at least throughout the entire measuring cycle at the rated voltage of the lamp.

The following procedure is recommended for the thermal analysis of the output, taking into account the design requirements specified in EN 60598-1:

1. Thermal situation in the luminaire **without** control gear heat

   Luminaire in measurement setup according to EN 60598-1 in standard mounting position, equipped with ECG and lamp and fitted with thermo-couples. The lamp is supplied from external control gear, and not from the built-in control gear.

   In this way the temperature rise in the entire set-up resulting only from the lamp can be measured and the thermal “link” to the environment can be optimised.

2. Thermal situation in the luminaire **with** control gear heat

   Arrangement as described in 1., but the lamp is supplied from internal control gear. By comparison with the measured values obtained already, the additional heat generated by the ECG can now be assessed. In this way it is easier to follow the installation instruction given in Section 2.3.3 properly.

2.4 Luminaire wiring test for two-lamp luminaires

2.4.1 Testing with lamps

a) To prevent two-lamp luminaires with the following ECGs (7-pin terminal)

QTP, QT 2 x 40 and QT 2 x 55,70

being incorrectly wired, the following simple wiring test is recommended:

1. Apply mains voltage to the empty luminaire (lamps not fitted)
2. Insert one lamp in the luminaire. The lamp must light.
3. Remove this lamp and insert it in the second position in the luminaire. The lamp must again light.
4. Insert another lamp (2nd lamp) in the unused position.
5. If both lamps operate correctly, the lampholders are correctly wired.

   This final luminaire test eliminates unwelcome wiring faults, particularly those which allow the lamps to light but cause them to fail prematurely owing to overheated electrodes.

a) To prevent two-lamp dimmable luminaires with the following ECGs (7-pin terminal)

HF…DIM

being incorrectly wired, the following simple wiring test is recommended:

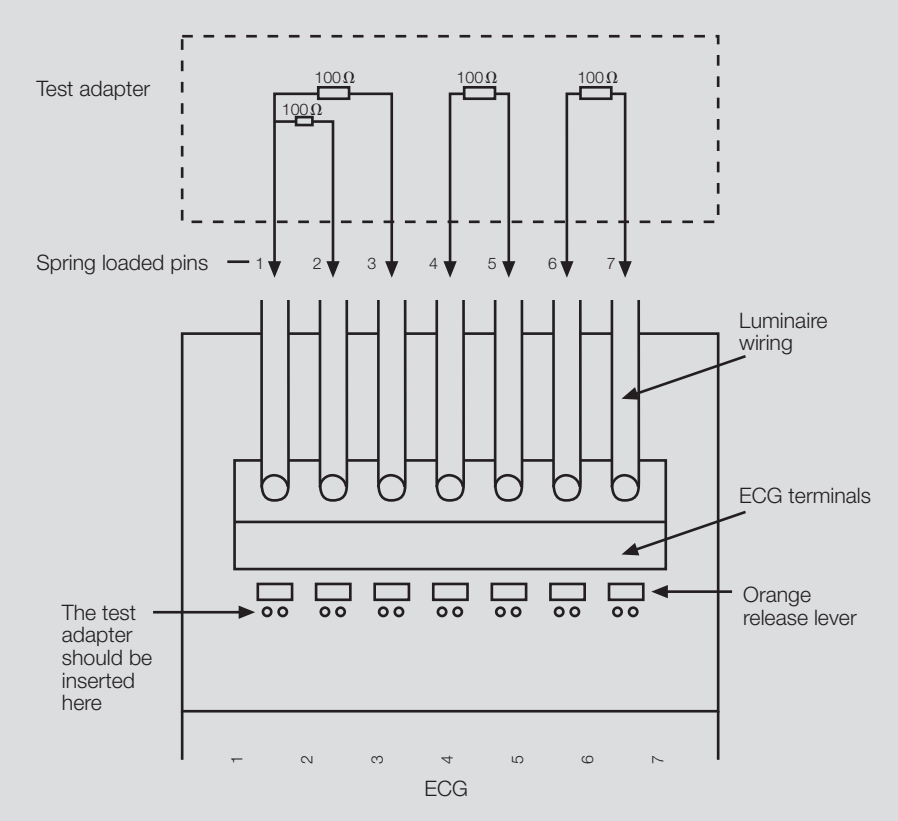
1. Apply mains voltage to the equipped luminaire (luminaire with lamps fitted), with the 1-10V control input open.
2. Dim the luminaire by short-circuiting the 1-10V control input at the luminaire terminal. The short-circuit is achieved with the aid of a diode (mains voltage diode type 1 N 4007, polarised in the forward direction).
3. This will dim the lamps to 1%. If this is not the case, the positive and negative terminals of the 1-10V control line have been incorrectly connected.

c) In the case of QT 2 x 18, QT 2 x 24 and QT 2 x 36 (two-lamp ECG with 6-pin terminal) and all single-lamp QUICKTRONIC® control gear, the lamps will not light if the wiring is incorrect.

2.4.2 Testing with a test adapter and dummy lamps

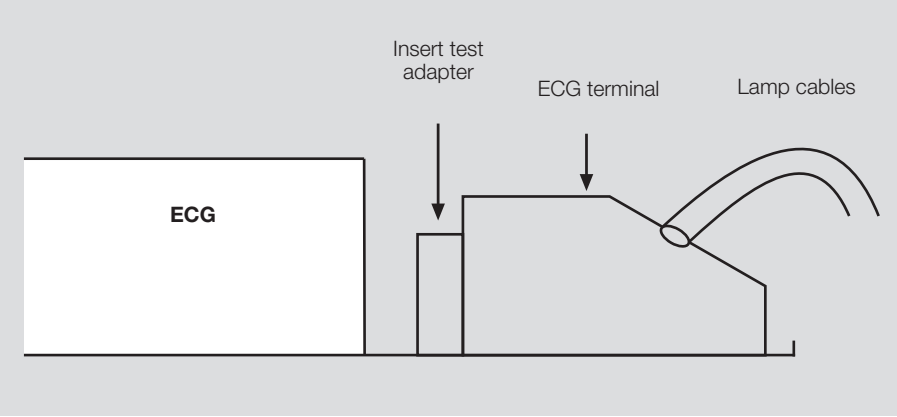
A more precise wiring test for two-lamp luminaires than the one described in a) above can be performed with a test adapter (own design with the resistors shows in the diagram) and a sample tube (dummy lamp with sockets for measuring the resistance). This test can be used for two-lamp luminaires equipped with the following ECGs:

QTP, QT 2 x 40, QT 2 x 55,70

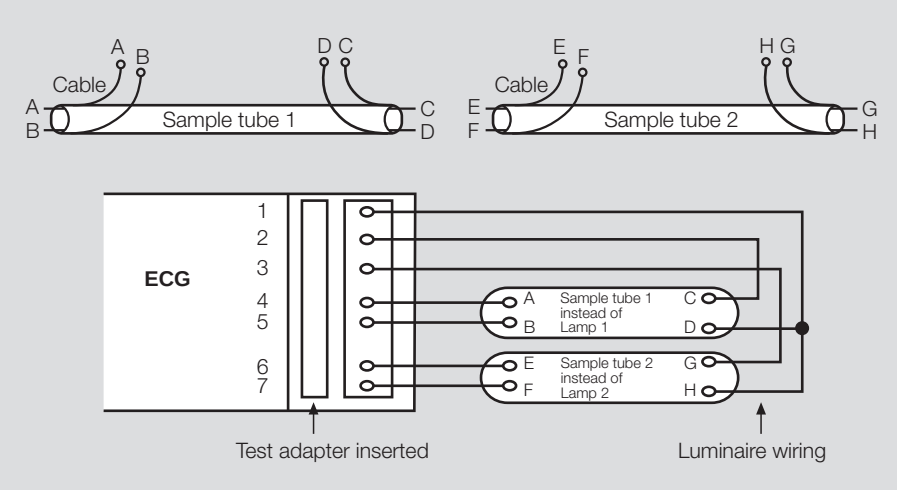


The test is performed on the wired luminaire without mains voltage and without lamps.

1. The test adapter is inserted in the test sockets behind the orange release lever.



2. Instead of the lamps the two dummy lamps are inserted in the lampholders in the empty luminaire.



3. Measure the resistance between A and B and between C and D.
   The resistance between A and B and between C and D should be 100 W.
4. Measure the resistance between E and F and between G and H in the same way.

If the measured resistance is not 100 W, the wiring is incorrect.

2.5 ECG operation for luminaires of protection classes I and II

In accordance with EN 60598, luminaires are grouped into protection classes according to the measures taken against contact with high voltages.

In the case of **protection class I** luminaires, all accessible parts which may become live as a result of a fault must have a good conductive connection to the PE conductor. The conductive link between the luminaire and the ECG must not be provided by the PE conductor connection of the ECG but by appropriate mechanical design features (such as using of serrated edge washers or serrated head bolts).

In the case of **protection class II** luminaires, live parts must be provided with reinforced or double insulation. Protection class II luminaires do not therefore have an earth connection.

ECGs approved for installation in luminaires are **"built-in devices".** Almost all QUICKTRONIC® units and other ECGs on the market are "built-in devices" and are not assigned to a protection class since protection classes are defined only for end products (such as luminaires) and not for components.

Stand-alone ECGs from OSRAM (DT, QT-FM) are protection class II devices and are already approved as luminaires in compliance with EN 60598. They carry the ⓐ and ⧈ symbols (see also Section 4.3).
Lamps operated with stand-alone ECGs can therefore be used without further luminaire approval. The appropriate electrical wiring regulations must of course be met.

All QUICKTRONIC® and DULUXTRONIC® units (except HF…DIM) are suitable for operation in protection class I and protection class II luminaires, unless otherwise indicated in the latest edition of the Lighting Programme catalogue. Radio interference suppression values and temperatures must be checked in each case however.

For enclosed luminaires of protection class II (such as damp-proof luminaires), QTS ($t_{c\ max.}$ = 75 °C) is recommended because of its extremely low power loss.

As a general rule, we can say that the thermal properties in open metallic luminaires (typically protection class I luminaires) are normally better than in enclosed plastic luminaires (typically protection class II luminaires) because of the good thermal conductivity of metal (heat sink effect) and better convection possibilities in the luminaire.

2.6 Insulation distances in luminaires

The use of luminaires is subject to a series of regulations governing electrical safety (shock protection) and operational reliability in wet, dusty, corrosive, flammable and explosive conditions. European standard EN 60598 applies to the electrical safety of luminaires.

To guarantee the electrical safety of luminaires, special attention must be paid to clearances and tracking distances. These terms are defined as follows in EN 60598-1-11 for the mains terminal of the luminaire:

"Tracking distances at the mains terminal shall be measured between the active parts in the terminal and any exposed metal part. Clearance shall be measured between the incoming mains cable and exposed metal parts (i.e. from the bare end from which the insulation has been stripped the furthest to the metal part that is exposed. On the side of the terminal to which the internal wires are connected, the clearance shall be measured between the active parts of the terminal and exposed metal parts."

The specified minimum values for tracking distance and clearance for sinusoidal AC voltages up to 250 V (50 Hz or 60 Hz) are shown in the following table.

Tracking distance		
Basic insulation	PTI ≥ 600	1.7 mm
	PTI < 600	2.5 mm
Additional insulation	PTI ≥ 600	3.6 mm
	PTI < 600	3.6 mm
Reinforced insulation		7 mm
Clearances		
Basic insulation		1.7 mm
Additional insulation		3.6 mm
Reinforced insulation		7 mm

PTI (proof tracking index) is defined in IEC 112.

The values for materials with PTI ≥ 600 apply to all materials (irrespective of their actual PTI values) for tracking distances

– that are not impaired by dust or moisture
– that are exposed to working voltage for a period of less than 60 s and
– from non-conducting parts or to parts that are not designed to be earthed and to which leakage currents cannot flow.

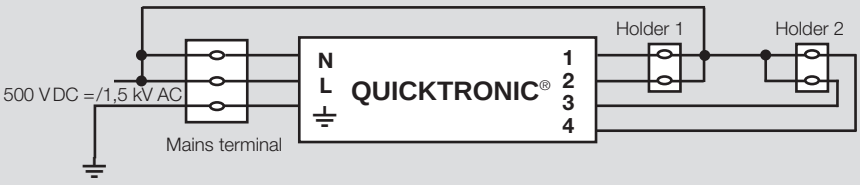
For further information, please refer to luminaire standard EN 60598.

2.7 Insulation test

Luminaires must be subjected to insulation and high-voltage testing (in accordance with EN 60598, VDE 0711, PM 395). Proceed as follows:

– All the input and output terminals of the ECG (except the PE conductor terminal) must be connected conductively with one another.
– Conduct insulation test at 500 V DC; the leakage current should not exceed 0.25 mA
– Carry out high voltage test at 1.5 kV AC/50 Hz. This voltage must be maintained for 1 s without flash-over (i.e. leakage current < 10 mA)

The following are recommended alternatives for the luminaire manufacturers(PM 333, PM 395):
– 100% high voltage testing (insulation testing may be omitted) or
– 100% insulation testing and 1 – 2% high-voltage testing or
– testing by agreement with the testing authority (such as VDE or SEV)



Test voltage between connecting cable and earth or metallic housing if ECG is not earthed

2.8 Dielectric resistance in lighting systems

Dielectric resistance in lighting systems (> 0.5 MΩ) can be measured in accordance with DIN VDE 0100 Part 600 Section 9 between:

a) the outer conductors (L1, L2, L3) and the protective earth (PE) conductor

b) the neutral conductor (N) and the protective earth (PE) conductor

c) the outer conductors (L1, L2, L3) among themselves

d) the outer conductors (L1, L2, L3) and the neutral conductor (N)

The insulation test is performed at 500 V DC.

Measuring the dielectric resistance between N and L

Tests c) and d) are performed only on new installations. **When the dielectric resistance is measured, the loads (e.g. luminaires) must not be connected** because at a dielectric resistance of less than 0.5 MΩ) MΩ) the test is invalid.

Measuring the dielectric resistance between N and PE or L and PE

Tests a) and b) are performed on new installations and existing installation. In existing installations the tests may be carried out without isolating the luminaire (approx. every two or three years). There must be no electrical connection between the neutral conductor and the PE conductor. **In this insulation measurement (500 V DC with respect to PE), the neutral conductor isolating terminal should only be disconnected if mains voltage is disconnected. Make sure the connection is secure before reapplying mains voltage.** Failure to observe these instructions may lead to destruction of all the ECGs in the system due to an unbalanced load and resultant overvoltage.

Recommendation: 500 V DC / max. 1 mA measurement current

Measurement procedure:

- The ECG appears momentarily to have low resistance (charging of the capacitors in the interference suppression filter)
- The ECG then appears to have high resistance An insulation fault in the lamp circuit does not affect the ECG.

The ECG will not be damaged by tests a), b), c) or d), provided a maximum measurement current of 1 mA is not exceeded (the measuring equipment must be designed as a current source with an internal resistance of 500 kW).

Important:

Before using the lighting system, check for correct N conductor connections (cf. 2.12) . While the lighting system is in operation, never interrupt the neutral conductor.

2.9 Starting current/automatic circuit breakers

When an ECG is switched on, a starting current pulse of very short duration (< 1 ms) occurs as the storage capacitors responsible for internal power supply charge up. If a large number of ECGs are switched on simultaneously (particularly if they are switched on at peak rated voltage) a starting current will flow that will reduce the recommended number of ECGs per automatic circuit breaker below that which would apply if we were to consider only their rated currents. All switching equipment and protection devices must therefore be selected according to their current carrying capacity.

Maximum permissible number of ECGs
for operating OSRAM DULUX® D or OSRAM DULUX® D/E 10 W, 13 W, 18 W, 26 W and 32 W with an N automatic circuit breaker, single-pole, type B (made by SIEMENS) with conventional control gear or **QUICKTRONIC® and DULUXTRONIC® for DULUX® D/E and T/E**

Rated current of circuit breaker	**Fluorescent lamp**	**CCG 1-lamp**		**CCG 2-lamp**	**QUICKTRONIC® 1-lamp**	**2-lamp**
		uncorrected p.f.	p.f. correctec	DUO		
10 A	DD/E 10 W	44	80	–	32	20
	DD/E 13 W	44	80	–	32	20
	DD/E 18 W	38	55	30	26	20
	DT/E 18 W					
	DD/E 26 W	26	40	22	26	20
	DT/E 26 W					
	DT/E 32 W	–	–	–	20	10
	DT/E 42 W	–	–	–	12	7
16 A	DD/E 10 W	70	118	–	48	28
	DD/E 13 W	70	118	–	48	28
	DD/E 18 W	60	88	50	32	28
	DD/E 26 W	42	66	36	32	28
	DT/E 32 W	–	–	–	28	16
	DT/E 42 W	–	–	–	18	12
20 A	DD/E 10 W	88	150	–	60	34
	DD/E 13 W	88	150	–	60	34
	DD/E 18 W	76	110	62	48	34
	DD/E 26 W	52	82	46	48	34
	DT/E 32 W	–	–	–	34	20
	DT/E 42 W	–	–	–	22	14

Maximum permissible number of ECGs
for operating OSRAM DULUX® L with an N automatic circuit breaker, single-pole, type B (made by SIEMENS) with **QUICKTRONIC® for DULUX® L and DULUX® F**

Rated current of circuit breaker	**Fluorescent lamp**	**CCG 1-lamp**		**CCG 2-lamp**	**QUICKTRONIC® 1-lamp**	**2-lamp**
		uncorrected p.f.	p.f. correctec	DUO		
10 A	DL 18 W	27	32	23	26	26
	DL 24 W	25	32	23	26	26
	DL 36 W	23	32	23	26	26
	DL 40 W	–	–	–	18	8
	DL 55 W	–	–	–	18	8
16 A	DL 18 W	43	51	37	32	32
	DL 24 W	40	51	37	32	32
	DL 36 W	37	51	37	32	32
	DL 40 W	–	–	–	26	12
	DL 55 W	–	–	–	26	12
20 A	DL 18 W	53	64	46	48	48
	DL 24 W	49	64	46	48	48
	DL 36 W	46	64	43	48	48
	DL 40 W	–	–	–	33	16
	DL 55 W	–	–	–	33	16

Maximum permissible number of ECGs
for operating OSRAM DULUX® S or OSRAM DULUX® S/E 5 W, 7 W, 9 W and 11 W with an N automatic circuit breaker, single-pole, type B (made by SIEMENS) with **QUICKTRONIC® and DULUXTRONIC® for DULUX® S/E**

Rated current of circuit breaker	**Fluorescent lamp**	**CCG 1-lamp**		**CCG 2-lamp**	**QUICKTRONIC® 1-lamp**	**2-lamp**
		uncorrected p.f.	p.f. correctec	DUO		
10 A	DS/E 5 W	50	90	–	32	–
	DS/E 7 W	50	90	–	32	–
	DS/E 9 W	55	90	–	32	20
	DS/E 11 W	50	90	–	32	20
16 A	DS/E 5 W	80	130	–	48	–
	DS/E 7 W	80	130	–	48	–
	DS/E 9 W	90	130	–	48	28
	DS/E 11 W	100	130	–	48	28
20 A	DS/E 5 W	100	165	–	60	–
	DS/E 7 W	100	165	–	60	–
	DS/E 9 W	110	165	–	60	34
	DS/E 11 W	120	165	–	60	34

Maximum permissible number of ECGs
for operating fluorescent lamps with an N automatic circuit breaker, single-pole, type B (made by SIEMENS) with **HF…DIM, QTP, QTIS, QTS**

Rated current of circuit breaker	**Fluorescent lamp**	**CCG 1-lamp**		**CCG 2-lamp**	**QUICKTRONIC® 1-lamp**	**2-lamp**
		uncorrected p.f.	p.f. correctec	DUO		
10 A	L 18 W	27	32	23	25	17
	L 36 W DULUX L 36 W	23	32	23	25	17
	L 38 W	–	32	21	25	17
	L 58 W DULUX L 55 W	15	20	15	17*)	8
16 A	L 18 W	43	51	37	41	28
	L 36 W DULUX L 36	37	51	37	41	28
	L 38 W	37	51	34	41	28
	L 58 W DULUX L 55	24	33	24	28*)	13
20 A	L 18 W	53	64	46	51	35
	L 36 W DULUX L 36 W	46	64	46	51	35
	L 38 W	46	64	43	51	35
	L 58 W DULUX L 55 W	30	41	30	35*)	16

*) exception: QTS 1 x 55 – 58 like QTS 2 x 55 – 58

Maximum permissible number of ECGs
for operating **QTEC 3 x 18 or QTEC 4 x 18**

10 A	7
16 A	12
20 A	14

When using the values given in these tables please note the following:

- In ECG operation the load data relates to starting at peak rated voltage (i.e. at the most onerous time as far as the current is concerned).
- The specified load from fluorescent lamps and the associated control gear applies to N automatic circuit breakers (Siemens type 5 SN I-2 and 5 SX) with B characteristics. If the above circuit breakers types with C characteristics are used the number of permitted luminaires doubles with ECG operation.
- The specified load applies to single-pole automatic circuit breakers. If multi-pole automatic circuit breakers are used (2-pole, 3-pole) the permitted number is reduced by 20%.
- For CCG operation, the specified load applies to group starting of the relevant number of luminaires. For ECGs, it applies to the maximum number of ECGs that can be switched simultaneously.
- The specified values apply for a line impedance of 800 mW. This corresponds to a 15 m length of 1.5 mm2 cable from the distribution board to the first luminaire and a further run of 20 m to the middle of the lighting circuit. At 400 mW, the permitted values are reduced by 10%, and at 200 mW by 20%.

2.10 RCDs/fault currents

In the case of ECGs with protective earth (PE) connections, both the high short duration starting current and the small continuous current through the interference suppression capacitors in the ECG can trip the residual current detector (see also Table 2.11).

The following solutions may be considered:
– Divide the luminaires into three phases and use three-phase RCDs
– Use surge-current-resistant, short-delay RCDs
– Use 30 mA RCDs (if possible)

2.11 Leakage current

In protection class I luminaires, the internal HF filter in an ECG with PE conductor connection produces a 50 Hz leakage current through the earth conductor (< 0.25 mA per QUICKTRONIC®). This 50 Hz leakage current limits the number of ECGs that can be operated on an RCD. The values in the table below are intended for guidance only.

Maximum number of ECGs on a Siemens RCD

RCD		10 mA 2-pole 1-phase	30 mA 2-pole 1-phase	30 mA 4-pole 1-phase[1]	30 mA 4-pole 2-phase[2]	30 mA 4-pole 3-phase
QTP, QTS	1-lamp	25	50	50	50	50
	2-lamp	25	50	50	29	29[2] 50[3]
HF... DIM	1-lamp	25	50	50	50	50
	2-lamp[4]	25	33	33	33	33
QT	1-lamp	8	30	30	30	30
	2-lamp	4	30	30	20	20[2] 30[3]

1) Unbalanced 2) If phases are switched individually 3) balanced 4) 2 x 18 W as for 1-lamp

ECGs without PE connections such as QT-D/E … do not have 50 Hz leakage currents. Consequently, any number of these ECGs can be operated on RCDs.

The maximum values specified in the table and in the text apply only if surge-current-resistant, short-delay RCDs are used since they will not be tripped by the starting current surge (see Section 2.9).

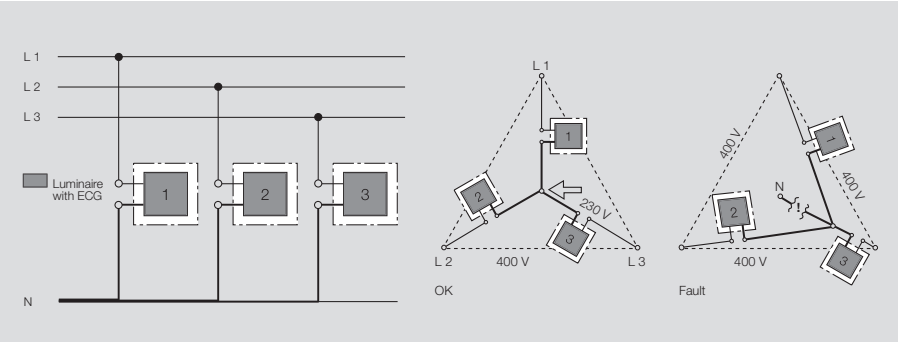
The leakage current is measured on an instrument that has an input resistance of 1.5 kW and is bridged at 0.15µF (to EN 60598).

2.12 ECGs in three-phase operation

1. Check whether the mains voltage is within the application range of the ECG (DC/AC range from 198 V to 254 V).
2. The mains connection on the installation side may only be made to the luminaire terminal. For luminaires or luminaire groups in 3-phase circuits.
3. Make absolutely sure that the neutral conductor is correctly connected to all the ECG luminaires and that it is making proper contact.
4. Cables may only be disconnected or connected when no voltage is present.
5. For 3 x 230/240 V supply networks in triangular circuit arrangements, protection by way of common disconnection of the phase conductor is necessary.

Important:

- In new systems the loads must not be connected when the insulation resistance is measured with 500 V DC, since according to VDE 0100 T600 Section 9 the test voltage is also applied between the neutral conductor (N) and all three external lines (L1, L2, L3). In existing systems it is sufficient to carry out an insulation test between the external lines (L1, L2, L3) and the protective earth without disconnecting the loads. The neutral conductor (N) and the protective earth (PE) may not be electrically connected in any way when this is done. For this insulation measurement (500 V DC to earth) the neutral conductor disconnection terminal may only be opened with the mains voltage switched off.
- Before the equipment is put into operation, make sure that the N conductor is correctly connected.
- During operation do not disconnect the N conductor on its own or first.



The diagram above shows the wiring for luminaires or luminaire groups in 3-phase circuits and with a common neutral conductor. If the common neutral conductor is interrupted in a 3-phase star configuration and voltage is present, then luminaires or groups of luminaires operated with electronic control gear may be exposed to unacceptably high voltages and the ECG itself may be destroyed.

3. Special applications

3.1 Outdoor ECGs

If you intend using electronic control gear in outdoor luminaires, it is important to remember that, depending on of the design of the luminaire, it may be exposed to moisture and/or humidity.

The level of ingress protection of the luminaire (IP … to DIN 40050/IEC 529) determines whether standard or special ECGs can be installed.

1. In luminaires of ingress protection type 5 (protected against water jets: IP 65 for example) standard ECGs can be used since dampness cannot penetrate this type of luminaire so there is no risk of the ECG being corroded.
2. In the case of luminaires of protection type 3 (protected against splash water, IP 43 for example), it is possible that water droplets will penetrate and cause corrosion. We therefore recommend using a protective housing (OUT KIT) over the ECGs for these luminaires (see below). The two corrosion-proof units QT 1 x 18-24 SE and QT 1 x 36 SE are also suitable.

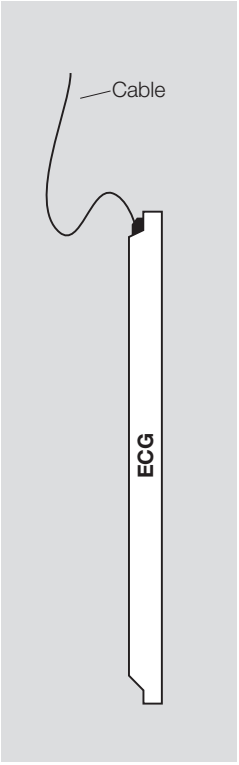
Typical applications include lighting systems for car washes, petrol stations, outdoor advertising displays and swimming pools.

Installation instructions

The same installation and wiring instructions apply to these units as to the standard units, with the following additions:

- The mains connection terminals on the ECGs should point downwards. In other words, the control gear should be installed vertically or upside down with the base of the ECG uppermost, otherwise horizontally with a slight incline (5 to 10º). This will prevent condensate from collecting inside the unit and causing short-circuits on the printed circuit board and tripping the RCD as a result of leakage currents.
- All ECG terminals that are not protected by vertical or upside down installation should be covered by arched metal plates or plastic (better from the point of view of corrosion) so that spray water and condensate cannot drip into the terminals and therefore into the ECG.

- Place ECGs on spacers to protect them from dripping water/ condensation.
- To prevent water entering the control gear through the terminals along the incoming or outgoing cables, it is best to kink the cables ahead of the terminals (to provide a water pocket or drip point). To ensure success, the lowest point of the kink should lie below the level of the terminal inlet.
- A small opening at the lowest point on the luminaire is also recommended so that condensation can escape. However, this opening should be protected so that rain and spray cannot enter.



In summary, we can say that the ECG should be installed in such a way that spray, water drops and condensation cannot enter the ECG and that moisture that condenses inside the ECG can run out.

An ECG can withstand condensation for short periods but long-term exposure to moisture should be avoided. The ECG must be operated for at least 30 minutes each day so that condensation inside the ECG can evaporate.

The luminaire casing should not be hermetically sealed. Instead, it should be ventilated so that the condensate that forms during the cool-down period as a result of the change in temperature (a luminaire is switched on, say, at –10ºC, warms up during operation to +30ºC and then cools down again to -10ºC after it has been switched off) is not trapped inside the unit and can evaporate safely.

OUT KIT

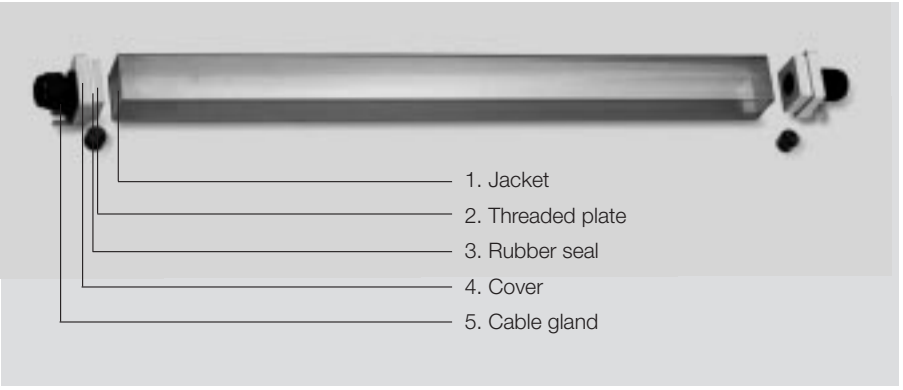
Weatherproof housing for electronic control gear in humid applications

Areas of application

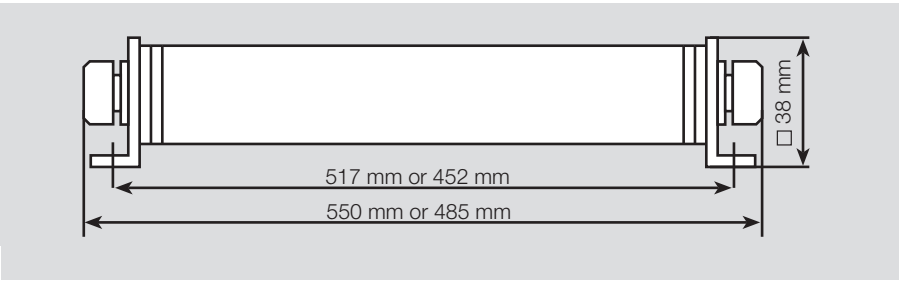
Outdoor lighting applications in which the ECG requires a high level of protection against moisture, such as outdoor lighting, petrol stations, advertising panels and all high-humidity applications.

Product characteristics

- Type of protection: IP 67
- Self-heating: only 5 K higher than an open ECG
- Earthing: the ECG need not be earthed (neither lamp starting nor radio interference suppression require the ECG housing to be earthed)
- Two models:
  OUT KIT SHORT for QTIS and QTP 1x… (ECG dimensions: 360 x 30 x 30 mm)
  OUT KIT LONG for QTP 2x… (ECG dimensions: 423 x 30 x 30 mm)
- Scope of supply: OUT KIT without ECG and without wiring, three rubber seal inserts for cable wires



Geometrical data



Installation instructions

These housings can accommodate electronic control gear with 30 x 30 mm cross-sections. They have been designed primarily for OSRAM 1 and 2-lamp QUICKTRONIC® INSTANT START units.

Each housing comprises the following:

Cable gland M16/1.5	2x	
Cover	2x	
Rubber seal	4x	
Threaded plate	2x	
Jacket	1x	
Seal inserts	3x	(supplied loose in the jacket)

The housing is supplied preassembled. Connecting cables are required for further assembly.

The ECG can be connected with individual wires or with special cables.

Using individual wires

1. Open the cable gland with a suitable tool, jaw size 22, and remove the locking unit.
2. Cut the wires to length (outer diameter min. 2.0, max. 2.7), strip the insulation 8 to 10 mm from the ends and connect to the ECG, making sure to check the colour coding.
3. Push the ECG and wires into the centre of the jacket.
4. Loosen the nut from the cable gland and remove the plastic seal.
5. Insert the wires through the locking unit, push the locking unit on to the jacket as far as it will go and screw tight. Check for proper fit.
6. Fit the wires in the appropriate seal insert push the seal insert into the cable gland as far as it will go.
7. Place the nut over the wires and screw tightly to the cable gland.

Using special cable

The leak test was carried out using an Ölflex 540 P cable manufactured by U.I.Lapp, Stuttgart.

The recommended types of cable are chemically resistant cables with high UV stability. In conjunction with the cable glands used these cables provide a high degree of leak-tightness. If other types of cable are used we cannot guarantee the leak-tightness of the unit.

Primary connection	2-wire control cable, type Ölflex 540 P 2 x 0.75 from U.I.Lapp, Stuttgart.
Secondary connection	– 3-wire control cable for 1-lamp QTIS ECG, type Ölflex 540 P 4 x 0.5 or 4 x 0.75 from U.I.Lapp, the wires are colour-coded
	– 4-wire control cable for 2-lamp QTIS ECG, type Ölflex 540 P 4 x 0.5 or 4 x 0.75 from U.I.Lapp, the wires are colour-coded

a) Preassembling the cables

- Cut the cables to length + approx. 6 cm (for 2-lamp ECGs) or 4.5 cm (for 1-lamp ECGs) for routing within the housing
- Remove the sheath, making sure not to cut through the insulation round the wires
- Strip the insulation from the wires, min. 8 mm, max. 10 mm

b) Connecting the cables

- Open the cable gland by unscrewing the nut on the casing with a spanner or special pliers.
- Remove the locking unit.
- Connect the cable on both sides to the ECG by fixing the wires to the ECG terminals, making sure the colour codes or numbers on the wires match up to the terminals on the ECG.
- Push the ECG and cables into the centre of the jacket.
- Insert the cable ends through the loosened locking units.
- Push the locking unit on to the jacket as far as it will go. Check for proper fit.
- Tighten the screw with a spanner or pliers and then tighten the nut to lock the cable in place. Make sure the cable does not twist in the process.

Tools

The tools needed to install an OUT KIT must have a jaw size of 22.

Spanners, sockets or special pliers such as SKINMATIC RZ from U.I.Lapp may be used.

Special applications

An OUT KIT is also recommended for indoor applications with extremely high levels of humidity (e.g. swimming pools, terrariums, aquariums and tropical houses) or for applications with constant changes of temperature in which condensation is readily formed in the luminaire/control gear (e.g. climatic testing chambers).

It also makes sense to use the OUT KIT in luminaires installed in corrosive atmospheres (sea air, chemical industry, stables).

3.2 ECGs in sound studios

If electronic control gear is to be used in areas in which noise and electromagnetic interference (see Section 2.2) are important factors there are special requirements that have to be met when installing the ECGs and the luminaires.

Noise and how to avoid it

Generally speaking, noise is generated in electronic circuits (as a “hum” at 50 Hz or 100 Hz or as higher frequency interference), in inductances (chokes and transformers) and in capacitors.

Compared with conventional control gear (chokes), electronic control gear with their high-frequency mode of operation (in which inductance values are much lower) generate appreciably lower noise levels and are a problem only in highly sensitive environments (such as sound studios for CD quality recordings). The fully electronic control gear offered by OSRAM is much quieter than the heavier single-part or two-part units.

In luminaires, control gear (conventional or electronic) functions as a vibration source and is capable of exciting adjacent metallic or plastic components so that they act as resonators, amplifying the actual noise considerably and increasing its range. To develop luminaires that are as quiet as possible, it is therefore essential to insulate the control gear and chassis or luminaire holder (e.g. with Conti rubber-metal anti-vibration mounting type 25326/A, 15 mm diameter, 15 mm height). In other words, there should be clearance below the ECG with the ECG mounted on point supports on the luminaire chassis or on rubber absorbers as used for conventional control gear. This type of mounting may, however, lead to thermal problems in certain circumstances (maximum recommended measuring point temperature can be exceeded, see Section 2.3) since the best way to dissipate the power loss to the environment is to have the ECG in full contact with the chassis.

Solving this problem with an appropriate housing design and/or type of installation for the luminaire (forced cooling, increased convection effect) has a further advantage in reducing the interference noise level and should therefore be seriously considered.

Experiments have shown that the amount of noise generated is closely linked to the operating temperature of the ECG. This is a particularly important factor if the unit has been installed in accordance with the recommendations given above. In extreme cases, it will not be possible to dispense with any additional heat sink.

As the noise level increases disproportionately as the temperature of the ECG rises. It is therefore best to operate the control gear at a temperature below the maximum recommended value (see Section 2.3). In practice, this means that the amount of noise generated is less, the lower the measuring point temperature. A combination of acoustic insulation of the ECG and reduced operating temperature represents the best technical solution.

In general, the following applies:

Electronic control gear from OSRAM is so quiet that even in very quiet surroundings they cannot be decerned by the human ear. They are therefore ideal for sound-sensitive areas such as radio studios with CD quality recordings. If necessary, random samples should be used to determine whether, given the local parameters (volume in the studio, reverberation time and number of ECGs), insulation as described above is needed from an acoustic point of view or whether standard products could equally be used.

3.3 Treatment rooms, operating theatres

Electrodes may be placed on a patient's body to obtain electro-cardiogram or electro-encephalogram recordings. To eliminate interference from magnetic fields, DIN VDE 0107 defines the maximum recommended inductance strengths. Luminaires fitted with QUICKTRONIC® control gear easily fall within these limit values at distances of 0.75 m and greater.

Because of their magnetic field strengths, conventional control gear is often not suitable and has to be placed at least 3 m away.

Electromagnetic interference

Fluorescent lamps are not point light sources and cannot be adequately focused, which means they are not considered suitable for operating theatre lighting. Dichroic (halogen) lamps are used almost exclusively. But even the room lighting has to meet very stringent requirements in terms of radiated magnetic fields. Sensitive patient monitoring systems, in the operating theatre and intensive care wards, must not be exposed to leakage magnetic fields.

It is neccessary to comply with the maximum recommended interference levels and minimum installation distances for the luminaires as defined in VDE 0107/6.81. Important and useful information on this subject is in Section 2.2 of this Guide.

It is virtually impossible for conventional control gear (chokes) to meet these high standards. This is where electronic control gear opens up a whole new range of applications. Thanks to their electronic mode of operation, ECGs generate only very weak leakage magnetic fields and hence interference levels that are five to ten times smaller than their conventional counterparts – a fact that is crucial particularly in electro-cardiogram and electro-encephalogram measurement rooms.

Whereas conventional control gear has to be installed separately from the luminaire in a central switching cabinet far enough away from the treatment area, ECGs can, in most cases, be installed directly in the luminaire without any problem. The actual interference levels generated by luminaires fitted with ECGs are generally lower than those generated by the connecting cables between the luminaire and the choke for a conventional separate arrangement.

The electrical safety requirements correspond to those for installations in humid locations. In other words, protection class II luminaires should be used. For precise information on the minimum level of protection for the luminaire see DIN 40050/IEC 529.

Because of their low field strengths ECGs are unlikely to affect electronic equipment. There has been no known incidence of a heart pacemaker being affected.

Interference from infrared transmission equipment

Fluorescent lamps emit energy in wavelength bands that are also used for infrared transmission. These emissions cannot be changed at the lamp. Since IR receivers are often not selective and operate with wide wavebands, the IR equipment may be triggered inadvertently if light from the lighting system enters the receiver. The light emitted from the fluorescent lamp is modulated at twice the operating frequency (40 to 80 kHz depending on the ECG). Interference may occur if the useful signal also operates in this frequency range.

Interference is likely in cases in which the useful signal falls in the frequency range of the light emitted from the fluorescent lamp. Operating at higher frequencies (400 to 1500 kHz) or using optical filters in front of the infrared receivers (absorption filters) may remedy the situation. Shielding the infrared receiver from direct light (with a tube, for example) may also help.

The carried signal for sound transmission used to be around 95 kHz or higher, which meant that the 3rd, 5th and 7th harmonics of the ECG operating frequency ranges (30 to 45 kHz in normal operation and up to 100 kHz in dimmer mode) led to considerable interference in transmission. Headphone manufacturers shifted to higher frequencies, such as 2.3 MHz and 2.8 MHz

to remedy the problem.
For simultaneous interpreting systems, which also operate in the 95 to 250 kHz frequency range, we recommend not using the first six transmission channels, particularly channel 1, of the total of 32 transmission channels because these are affected, as described above, by the harmonics of the basic ECG frequencies.

Electronic tagging

Many department stores and shops now use electronic tagging systems to protect their merchandise (such as CDs and clothes) against theft. These systems typically operate with resonance frequencies in the kHz range (an emitted pulse will cause an amorphous metal in the tag to resonate). One major supplier operates its security system at 58 kHz.

In certain circumstances these systems may malfunction if the operating frequency is between 30 kHz and 150 kHz. It may be possible to eliminate the problem by increasing the distance between the luminaires and the transmitter/receiver.

3.4 Emergency lighting

Luminaires with QUICKTRONIC® can be operated on either AC or DC voltage (except for QT-FM which can only operate on AC voltage). This means that with appropriate wiring, the same luminaires can be used for both normal and emergency lighting. Safety lighting from systems with high illuminances (for example in high-risk workplaces) can be achieved economically using the high luminous efficacy of compact fluorescent lamps operated with QUICKTRONIC® control gear.

The following electro-technical regulations apply to emergency and safety lighting systems installed in Germany.

VDE 0100	Regulations governing the installation of power systems with rated voltages up to 1000 V
VDE 0170	Installing and testing electrical installations in medical rooms
VDE 0108	**Installing and operating power systems in buildings for gatherings of people and safety lighting at work**
VDE 0165	Installing electrical systems in hazardous areas
VDE 0510	Regulations governing accumulators and battery systems

In addition, there are various lighting standards that have to be observed. In view of the number involved, we have selected just a couple by way of example. The full list can be obtained from Beuth Verlag (Publishers) in Berlin.

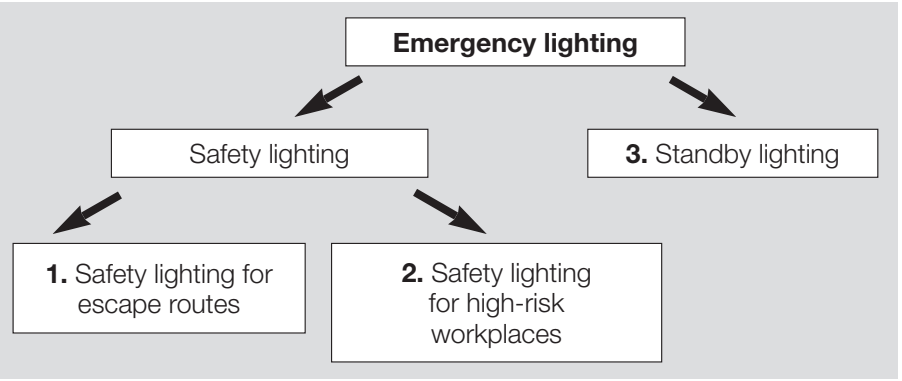
DIN 4844	Safety labelling
DIN 5035, Part 1 to Part 6	Interior lighting with artificial light

The above-mentioned standards apply to Germany. Other standards apply in other countries. Please contact the appropriate national approvals authority.

Definition of emergency lighting

According to DIN 5035, Part 5, emergency lighting is lighting which comes into effect as soon as there is a fault in the power supply to the normal lighting system.

Types of emergency lighting



Recommended start-up and changeover delays

An important aspect of the emergency lighting requirements is the start-up delay and the delay in change-over from the normal lighting system to the emergency lighting system and vice versa. Three different time delays are defined in the standards:

	1. Safety lighting for escape routes		2. Safety lighting for high-risk workplaces	3. Standby lighting
Recommended start-up and changeover delay	15 seconds	1 seconds	0.5 seconds	any time
	For escape routes e.g. in workplaces	For theatres, etc. and department stores	For high-risk workplaces	There are no binding regulations; the user is free to decide (e.g. in shops for continuing to trade)
Standby circuit	All QUICKTRONIC® units	HF … DIM, QTIS	HF … DIM, QTIS	All QUICKTRONIC® units
Dauerschaltung	All QUICKTRONIC® units	All QUICKTRONIC® units	All QUICKTRONIC® units	All QUICKTRONIC® units

To these changeover times for the ECGs the typical relay switching time of 0.5 s max. should be added.

QT-FM is not suitable at present for DC operation.

DC supply

Luminaires for emergency lighting are switched to battery supply only in the event of a power failure. In mains operation, the luminaires are powered by the normal supply. The mains and emergency lighting switchover arrangement must reliably separate mains operation from emergency lighting operation; it must be a break-before-make arrangement.

A deep discharge protection system must be provided for battery systems. This effectively prevents the batteries discharging too much and suffering damage as a result and also prevents possible damage to the ECG.

If QUICKTRONIC® DIMMABLE is used is emergency lighting installations, suitable measures must be taken to interrupt the control cable at the positive pole in the event of an emergency. It is necessary to use changeover converters which supply a predefinable control voltage to the dimmable ECG and therefore enable emergency lighting to be provided at less than 100% luminous flux to save the batteries.

Note that some accessory components (such as signal amplifier DIM SA and DIM ICM-10) are not approved for battery operation. Suitable arrangements must therefore be made to ensure that these components are never connected to a DC source. In such cases, the signal amplifier, for example, represents a fixed resistance which is connected to the control line. The dimmer setting of an ECG is then about 20%, or correspondingly higher if there are more.

General

Switchover from mains supply to emergency supply and vice versa must take place in a break-before-make arrangement. In this discrete switching sequence there is a period (the length of which depends on the design of the emergency monitoring system) in which current does not flow or at least the supply voltage falls considerably below its minimum recommended value. These switching times must comply with the limits already mentioned and specified in DIN 5035.

In accordance with VDE 0108, the battery units must be designed for rated operation of at least three hours. If the ECG is supplied with a rectified AC voltage, this voltage should have as small a residual ripple as possible. The AC voltage component must be less than 5%.

If changeover units are used (emergency lighting modules with internal switching) which supply the lamp directly from an emergency supply and interrupt the system circuit between the ECG and the lamp, the following must be observed:

- Changeover or disconnection of the lamps from the ECG to the external unit must be on all terminals.
- When switching back from the external supply to ECG operation, the lamp(s) must first be connected at all terminals to the ECG before the ECG is supplied with power again, otherwise the cutout in the ECG will operate.
- Many of these emergency lighting units available on the market do not comply with the normal operating conditions for the lamps and therefor damage them. In such cases, OSRAM cannot guarantee that the life of the lamps.

3.5. Portable luminaires

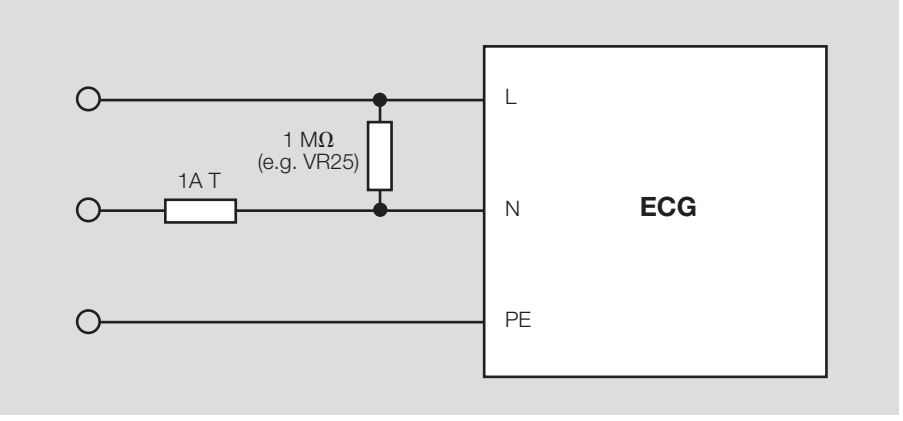
Portable ECG luminaires of protection class I (i.e. with earth terminals) require a fuse in both the L conductor and on the N conductors of the mains supply.

If VDE approval documents for ECGs state “for permanently installed luminaires” then only the L side is fuse-protected. The N side must be fused in the luminaire if the ECG is to be used also suitable for portable luminaires. The following OSRAM ECGs belong in this category:

- QTS
- QT (with the exception of QT for DULUX L 40 and DULUX L 55)

These units are labelled “L” and “N” instead of ⏦ .

The additional fuse on the N side must be designed for mains voltage, suitable for the system input current and be of the “anti-surge” type.



For all other QUICKTRONIC® units there is no need for an in-phase mains connection (cf. 2.1.3).

Portable ECGs luminaires of protection class II (i.e. luminaires without a earth connection) do not need an additional fuse in the N side.

Various approval authorities assess the residual or decay voltage at the two connector terminals (not PE conductor) which remains for a certain time (perhaps 1 second) after disconnection from the mains and which may constitute a hazard if touched. To ensure that this voltage is always below the required threshold value irrespective of the type of control gear and tripping moment, a 1 MW (discharge) resistor capable of withstanding the currents and voltages involved should be placed across the N and L terminals (see circuit diagram above).

3.6 FM (T2) luminaires

Triple safe shutdown plays an important role in luminaires with FM miniature fluorescent lamps. Please note the following to ensure reliable trouble-free operation of this lighting system:

Installing the ECG

- The ECG cables on the mains side and on the lamp side must not be twisted or laid together (to avoid high-frequency interference).
- The distance between the ECG and the lamp should be no more than 1 m.
- The lamp-side connections made at the internal lamp-side ECG terminals should generally be kept shorter than the lamp cables attached to the external ECG terminals.
- Lamp cables for different ECGs should not be routed together with the lamp cables of neighbouring ECGs. Lamp cables for one ECG should be grouped together with cable ties or laid in separate cable ducts.
- If ore than on ECG is installed there should be a distance of at least 2 cm between the ECGs.
  In the event of a fault or when the lamp reaches the end of its life the ECG safe shutdown circuit will trip. A mains reset is needed once the lamp has been replaced (i.e. the mains needs to be switched off and on again).

Installing the holder

- The lamp base with its delicate contact wires is not and rugged as normal commercially available fluorescent lamp bases so special care must be taken when installing and removing the lamp.
- The lamp bases are rotated with respect to one another by up to 3 degrees (according to IEC 81 a rotation of + 6° is permissible). The lamp holders should therefore be installed only on a torsionally rigid support otherwise there is no guarantee of reliable electrical contact.
- Length tolerances: maximum value (catalogue value) – 2 mm
- In addition, the specifications of the holder manufacturers with respect to the distance between holders, generally **less than 0.3 mm,** must be adhered to exactly (e.g. measured with a gauge). Special holders have to be used in mobile applications to absorb vibration.

4. Standards and approvals

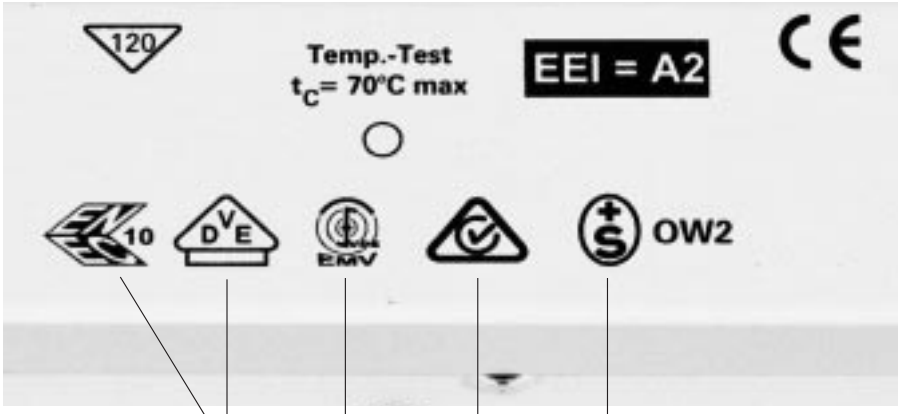
4.1 Standards for safety, operation and EMC

QUICKTRONIC® units have been designed and manufactured to reflect the latest state of the art. All units comply with national and international standards governing safety, operation and EMC and carry national and international approval marks to confirm that they have been tested by recognised independent test authorities.

Current standards

EN 60928	Safety in AC mode
EN 60924	Safety in DC mode
EN 60929	Performance
EN 55015	Radio interference suppression
EN 61000-3-2	Harmonics
EN 61547	Immunity to interference
EN 60598	Safety of luminaires (for independent ECGs only)

Approval marks



Radio interference suppression, harmonics, immunity to interference

(for Switzerland) Safety, Radio interference suppression, harmonics

Safety, Performance

(for Australia) Safety EMC

VDE EMC mark

Harmonics and radio interference suppression are determined exclusively by the quality of the ECG. The wiring the luminaire plays a role only in the case of mains-borne interference.

The advantages for luminaire manufacturers of using OSRAM ECGs with the VDE EMC mark are therefore as follows:

- Only radio interference suppression has to be checked as part of luminaire testing. There is no need to test for harmonics or immunity to interference, so the cost of testing luminaires can be reduced by approx. 80%
- The time taken for testing is reduced because there are fewer individual tests to be performed and the waiting times for individual tests are in some cases shorter, i.e. throughput time for luminaire testing is reduced

4.2 CE labelling

The CE symbol on is a conformity mark that indicates compliance with the basic requirements of certain European Union directives.

The CE symbol on QUICKTRONIC® units and the conformity declarations indicate compliance with the Low-Voltage Directive guidelines (safety requirements in accordance with EN 60928) and the guidelines relating to electromagnetic compatibility (harmonic limits in accordance with EN 61000-3-2, radio interference suppression with EN 55015 and immunity to interference with EN 61547).

The situation can be summarised as follows:

- The CE symbol is targeted primarily at administrative authorities, not at end consumers.
- The CE symbol is obligatory in the EU for the sale of products that can be used independently.
- It is only an administrative label, not a safety mark or mark of quality.
- The CE symbol is based on a declaration made by the manufacturer and for which the manufacturer is responsible, not on testing by a recognised independent test authority.
- There is no obligation to include the CE label on ECGs that are installed as components in luminaires.

4.3 Energy Efficiency Index EEI

The Energy Efficiency Index (EEI), also known as the Energy Label, is a classification system for the lamp/ECG combination (it does not relate to luminaires).

The EEI was devised by CELMA (Committee of EU Luminaires Manufacturers Association).

The seven classes, set out below, are defined by certain limit values in system performance.

A1: Dimmable ECGs
A2: ECGs with low loss
A3: ECGs with higher losses
B1: Good low-loss control gear
B2: Poor low-loss control gear
C: Conventional control gear
D: Poor conventional control gear

OSRAM QUICKTRONIC® units are typically assigned to classes A1 and A2. It is worth remembering that energy efficiency is just criteria for assessing the quality of an ECG. In most cases, radio interference suppression, reliability and service life are more important.

4.4 Other marks

There are a number of symbols printed on QUICKTRONIC® units in addition to the marks mentioned above:

Luminaires with M M symbols are furniture luminaires for incandescent lamps or for discharge lamps with built-in control gear. These are for mounting in or on furniture which is made from materials of unknown flammability. If M M luminaires develop a fault, the temperatures on the mounting surface or on adjacent surfaces should remain below 115ºC.

The 110 symbol indicates a thermally protected unit. This means that the ECG contains a device to protect against overheating so that its housing temperature never exceeds the limit value indicated in the triangle (in this case 110ºC), even in abnormal operation. All units labelled with 115 or a lower temperature therefore automatically meet the requirements for M M luminaires.

The ⓐ symbol indicates an independent ECG that is suitable for use outside luminaires without the need for an additional cover. Luminaire approval is not needed if independent ECGs are used since these ECGs are designed and approved in accordance with the EN 60598 safety standard for luminaires. This symbol is used on some DULUXTRONIC units and on QT-FM 1 x…L units, which are fitted with cable clamping devices.

Independent ECGs with the ⧈ symbol are equipped with double or reinforced insulation and do not have a PE conductor connection. These units therefore meet the requirements of protection class II.

5. Lamp/ECG combinations

5.1 Recommended combinations

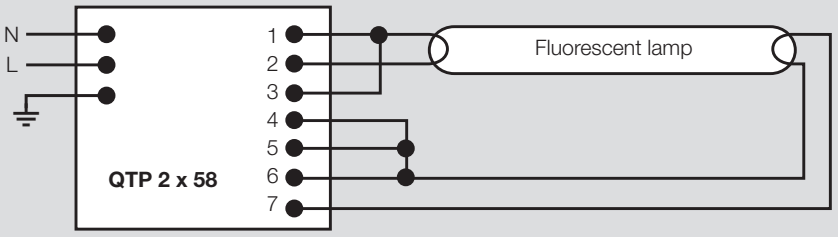
Recommended combinations of lamps and ECGs are listed in current edition of OSRAM's "Lighting Programme" catalogue.
Combinations that are not expressly recommended must not be used (risk of damage to the lamp and/or ECG).

5.2 Recommended special combinations

Germicidal lamps	ECG
HNS 30 W	QTP 1 x 36
2 x HNS 30 W	QTP 2 x 36

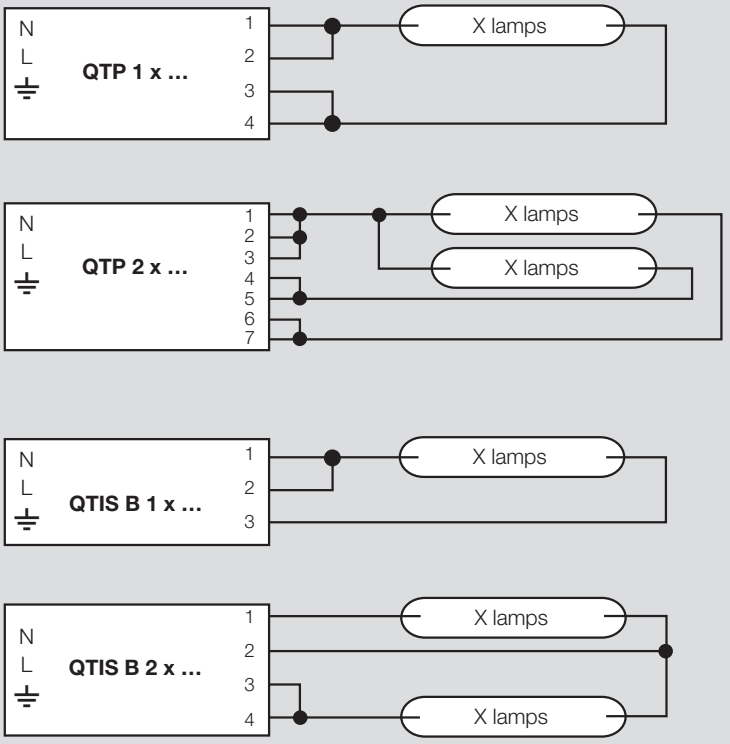
UV-A fluorescent lamps	ECG
L 80 W/79	QTP 2 x 58
L 80 W/78 R	QTP 2 x 58
L 80 W/79 R	QTP 2 x 58
L 100 W/79	QTP 2 x 58
L 100 W/78 R	QTP 2 x 58
L 100 W/79 R	QTP 2 x 58

Circuit diagram for L 80 W/… and L 100 W/… with HF 450-2



Circuit diagram for single pin X lamps

X lamps	ECG
L 18 X (ø 26 mm)	QTP … x 18, QTIS B … x 18
L 36 X (ø 26 mm)	QTP … x 36, QTIS B … x 36
L 58 X (ø 26 mm)	QTP … x 58, QTIS B … x 58



Note: automatic lamp restart does not work with these combinations.

5.3 Combinations not recommended

A selection of non-recommended combinations of lamps and ECGs is given in the current edition of OSRAM's "Lighting Programme" catalogue.
In view of the large number of these, it is impractical to provide a complete list.

6. Upgrading from conventional to electronic control gear

The following rules apply to upgrading existing luminaires from conventional to electronic control gear.

All conversion work must be undertaken by qualified electricians.

The relevant national regulations (such as DIN VDE 0701, Part 1, 10/86 “Repair, modification and testing of electrical equipment” in Germany) apply to upgrading existing luminaires.

Safety approval/ approval marks

If a luminaire with conventional control gear has been approved by a testing authority, the drawing approval granted to the luminaire manufacturer for the original version of the luminaire ceases to be valid as soon as the upgrade is made.

The VDE symbol or other approval mark on the type plate or otherwise displayed on the luminaire must be made unrecognisable (by removal or masking) or the luminaire must be resubmitted to the approval authority.

A luminaire upgraded with an ECG complies with the relevant standards
a) if it complies with the above-mentioned VDE or equivalent regulations
b) if it complies with the following instructions and safety requirements.

Wiring

The ECGs must be wired in accordance with their type plates; in most cases the existing cables can be reused. The following points must also be observed:

a)
- in the case of solid conductors, the cross-sections of both mains and lamp cables must be between 0.5 mm^2 and 1.5 mm^2.
- for multi-core cables see 2.1.1.

b) The starter must be removed and replaced by a conductive connection between the two terminals in the starter holder. The short-circuit connection must be protected against contact and have an adequate cross-section (a wire cross-section of at least 0.5 mm^2.

c) Correct clearances and leakage paths as defined in EN 60598 must be maintained.

d) Detailed wiring instructions can be found in Section 2.1

- Cables between the ECG and the lamp must be as short as possible, direct paths must be used and there must be no cable loops (shorten the original cables if necessary). Always ensure that the “hot wires” take the shortest path to the lampholder.
- Provide a PE conductor connection to the terminal on the ECG housing; for protection class I luminaires the ECG housing may also be grounded with a fastening screw and serrated edge washer.
- The mains connection may only be made directly at the luminaire and not at the ECG.

Radio interference suppression

As already indicated in Section 2.2, the ECG meets the necessary conditions for luminaires to comply with the radio interference suppression requirements of EN 55015.

However, the radio interference suppression (EMC) properties of a luminaire fitted with electronic control gear depend not only on the control system used but also on the type, design and wiring of the luminaire. The information given in Section 2.1 must be observed.

Temperature

To ensure adequate heat dissipation, the ECG must be installed flush on the mounting surface. Problems may occur particularly as a result of the often raised mounting holes in the base plate for taking the chokes. A temperature measurement (see 2.3) will provide information on the operational reliability of the system.

It is also important to ensure that the surface on which the ECG is mounted and surfaces that are in contact with the sides of the ECG are not heated from the outside as this would prevent the heat of the ECG from being dissipated.

Starting

Make sure that the neutral conductor is correctly connected and makes good contact in the luminaire, in the system (particularly in the case of 5-core through-wiring) and in the distribution board (see 2.12).

Additional notes

a) Because the starting current of an ECG is higher than the operating current, it is important that
   - surge current resistant, short-delay RCDs are used
   - the maximum permissible number of luminaires per cutout is not exceeded (see also Section 2.9)

b) Upgrading of protection classes II luminaires with ECGs having earth connections (all units with metal housings) is not recommended since much more stringent requirements have to be met with respect to insulation for clearances and tracking distances and level of I. P. rating. Radio interference suppression (EMC) is often not adequate owing to the lack of a PE conductor.

c) Upgrading tightly enclosed luminaires to ECG operation is not recommended if ambient temperatures and/or supply voltages are high because the service life of the ECG may well be reduced and system reliability may also be impaired.

7. Troubleshooting tips

7.1 General

1. ECGs in constant operation (24 hours)

Recommendation: Systems with ECGs operating 24 hours a day should be switched off each day for a few minutes.

Reason: When a lamp comes to the end of its life there is an increase in lamp voltage that may overload the ECG. When the ECG is switched off and then on again all the relevant values of the lamps are checked and “critical” values can be detected.

2. Wiring of multiple ECGs

Recommendation: Lamp cables from different ECGs should not be routed together.

Reason: Mutual interference may lead to problems with starting and/or normal operation (the lamps may automatically disconnect).

3. Wiring of dimmable ECGs

Recommendation: Lamp cables in a luminaire with dimmable ECGs should be kept as short as possible and not routed together.

Reason: Mutual interference may affect dimmer performance.

4. New lamps in dimmable systems

Recommendation: Lamp in systems with dimmable ECGs should be burnt in at maximum wattage for around 50 hours.

Reason: Only after this burn-in time will the lamps have the stable operating values needed to ensure optimum dimming performance.

5. Coding of the lamp cables

To speed up troubleshooting in luminaires and luminaire systems it is extremely useful for the lamp cables to be uniquely coded (colour coded or numbered). This applies especially to two-lamp ECGs and even more so to three and four-lamp ECGs since the large number of cables increases the risk of connecting incorrectly.

6. Terminal blocks (2, 3, 4, 6 and 7 positions)

These terminal blocks are used with the majority of OSRAM ECGs.
Note that only single core cables with a cross-section of 0.75 mm^2 to 1.5 mm^2 can be inserted without pressing the release tab. Larger cross-sections are not recommended; the release tab has to be pressed down for insertion of smaller cross-sections, as with all multi-core cables (2.1.1).

7. UV-resistant materials

Fluorescent lamps always emit a certain amount of UV radiation. For this reason, the housing material (particularly the plastics, transparent or coloured) as well as the surface coatings on metallic parts have been selected so that they resist ageing and have good thermal stability.

7.2 Equipment behaviour on overvoltage/undervoltage

Appearance of the lighting system:

- Lamps of different brightness (phase-to-phase)
  Restriction: different brightness levels for ECGs with constant output and only above 300 V

Depending on the type of unit, the internal shutdown circuit will operate at voltages above 280 V. In the event of a fault, the lamp generator will be disconnected. The mains input circuit and various other sub-circuits, however, continue to be supplied with this high voltage. If the mains voltage increases further there will be changes in the operating characteristics of the unit. In most cases, this will lead to damage or destruction of the overvoltage-sensitive varistor/protective diode, which in turn will cause the unit fuse to trigger and damage to the unit.

If the system fault is corrected and the mains voltage has returned to the specified tolerance range without damage to the unit, the unit can continue to operate normally after an interruption in the mains supply and a recovery time (typically 20 s). If the mains voltage continues to be high, the unit will once again go into protection mode as soon as power flows to it. Over short periods of time, this state does not usually damage the unit.

If an ECG is operated over long periods on a supply voltage greater than 280 V it may fail as a result of overheating.

At a supply voltage greater than 350 V, all QUICKTRONIC® ECGs would be expected to fail. In such cases, damage to the ECG may comprise one or more of the following:

- destruction of the varistor, tripping of the fuse
- overheating of the transistors (insulating foil melted, transistor tarnished or desoldered)
- swelling of both windings at one or both mains filter chokes
- overheating of the lamp choke(s) (discoloration of the winding or board material under the choke(s))
- failure of other components

Some of the damage mentioned may, however, be caused by factors other than significant mains overvoltage. For this reason, it is difficult to draw any conclusions from a single failed unit. The situation becomes clearer the more defective ECGs there are to be analysed.

If some ECGs appear to be fully operational when the rest exhibit the above mentioned features, a neutral conductor break causing vastly different loads on the individual phases is the most likely the cause (because of these different loads, certain units on one phase will have been overloaded on the mains side while other units will have been under loaded on a low-load phase and will therefore not have been able to operate the lamps).

Important

In the case of ECGs with constant power, significant undervoltage may also lead to failure. Because of the control characteristics of these units, the mains current into the unit increases as the supply voltage falls. Below the specified minimum supply voltage, this response leads to a current overload at the mains filter chokes. The first sign is a discoloration of the varnished copper wire of the inductance coils and the board beneath them. If the overload persists, both windings on one or both of the filter chokes will swell. This leads to interlayer or interwinding faults.

With all other fluorescent lamp and compact fluorescent lamp ECGs, the lamps will go out when the supply voltage falls below a particular threshold during operation or will not start if the voltage is too low at the moment of switching. Damage to the ECG is not expected, provided the lamp is operating correctly. If the lamp is deactivated at the end of its life (i.e. the emitter is depleted) the automatic safety shutdown device in the ECG may not operate below the specified minimum voltage. The ECG will be damaged as a result.

7.3 Application faults

1. Wiring faults on the lamp side

All single-lamp QUICKTRONIC® ECGs and units with 6-pole output terminals

If there is a wiring fault the lamp will not operate or will cold start.
In particularly serious cases there is a risk that the ECG will be destroyed.

QUICKTRONIC DIMMABLE
and all two-lamp ECGs in plastic housings

In addition to wiring faults which prevent the lamps from starting, there are faults which may result in behaviour that will damage the lamp.

Flickering lamps, lamps with extremely bright or deep blue gas discharge at one or both ends, and blackening of the cathode area at one end generally indicate wiring faults of this nature.

In such cases, it is particular important to connect the double terminal of the ECG correctly (terminal 1 or terminal 4).

It is essential for the wiring to be checked particularly with uncoded lamp cables (see also Sections 2.5 and 7.1).

Correct connection of the control cables is also important for dimmable units. The main point here is to ensure correct polarity at the control terminals (see 2.5.1).

2. Short-to-ground at the output of QUICKTRONIC® ECGs

If there is a short-circuit-to earth at one or more of the connecting cables between the ECG and the lamp, the ECG will fail.

Damage to the ECG:

- Melting and swelling of only one winding on one or both input filter chokes
- Breakdown of one or two rectifier diodes, irrespective of whether they are discrete or integrated components

There are, however, other causes of these major faults. Generally, as a consequence, consequential damage occurs at other components and this damage need not be unique in character.

3. Effects of moisture (see also 3.1)

Rust at the edges of metal housings may indicate the effects of moisture. If the printed circuit board and/or various components are tarnished, it can be assumed that there has been a serious moisture ingress. There will be short-circuits between neighbouring component connections or solder points with high potential difference, resulting in failure of the ECG. Symptoms of serious faults are indicated by a “tidemark” inside the housing.

4. Installing luminaires in draughty locations

Depending on the location of the fluorescent lamp in the draught, the lamp will cool down in certain areas of the bulb. This leads to local depletion of mercury and to a darkening of the lamp in these areas because there is no mercury available to generate UV radiation.

This can be remedied by installing a thermal tube in the luminaire. The effect always or nearly always occurs in the area of the luminaire where the ECG is not located. This is due to the power loss of the ECG which provides partial local warming of the lamp. The lamp on the ECG side of the luminaire will always be slightly warmer for the same reason.

Caution: Mercury depletion leads to a reduction in lamp voltage and to an increase in discharge current. This may result in damage to the ECG or, in extreme cases to failure of the ECG.

7.4 Troubleshooting

Problem	Possible Cause	Remedy
1. Lamp does not start (with two-lamp ECGs both lamps fail to start), no visible glow shortly after start-up. Same behaviour even after being off for 1 minute (internal reset) and restart.	■ RSD or other protective device in the installation has operated	Check the wiring on the mains side or insulation resistance. Has the max. recommended number of ECGs on one phase in a 3-phase system been exceeded? Make sure that the neutral conductor is connected properly to all the luminaires and makes good contact. Check that moisture has not penetrated the luminaire?
	■ Fault in the wiring on the mains side	Check whether the mains voltage is in the required range for the ECG. Make sure that the neutral conductor is connected properly to all the luminaires and makes good contact. Check that the cables sit correctly in the terminals.
	■ At least one lamp has reached the end of its life owing to a cathode break or increase in lamp voltage.	Replace the lamp (for two-lamp ECGs we recommend replacing both lamps at the same time to keep maintenance time and costs to a minimum).
	■ The „fail-safe" overload protection device in the ECG has responded (the ECG is permanently damaged)	Check whether the lamp(s) operate at other positions. If not, check whether the mains voltage is within the permissible range. Make sure that the neutral conductor is connected properly to all the luminaires and makes good contact. Replace the ECG and lamp.
2. Lamp does not start but there is a brief glimmer from one or both lamps (i.e. the protective circuit in the ECG has responded at start-up).	■ At least one lamp has reached the end of its life owing to a cathode break or increase in lamp voltage.	Replace the lamp (for two-lamp ECGs we recommend replacing both lamps at the same time to keep maintenance time and costs to a minimum).
Same behaviour even after being off for one minute (internal reset) and restart	■ Wiring faulty between ECG and lamp (output terminals not used or reversed; contact problems in the holder or the terminals (e.g. wire cross-section too small or too large)	Check the lamp-side wiring for correct contact. Has the lamp connection been wired according to the wiring diagram on the ECG? For two-lamp ECGs in particular, check that the common or external connection is correctly wired.
	■ A lamp with the wrong wattage has been installed or, in the case of two-lamp ECGs, only one lamp is installed or there are lamps of different wattages	The wattage and type of lamp must correspond to the wattage and type indicated on the ECG or the lamp/ECG combination should be in line with OSRAM's Indoor and Outdoor Lighting brochure. ECGs designed for two-lamp operation must be operated with two lamps.
	■ The mains voltage lies outside the limit values indicated on the ECG or in the data sheet	Check the voltage at the ECG and at source; check the wiring on the mains side.
	■ The temperature at the measuring point of the ECG is too high (for a brief description of the temperature at the ECG and lamp see end of text)	The luminaire or site of installation should be modified to ensure that the maximum recommended temperature is not exceeded even in onerous conditions (high ambient temperature and/or high supply voltage).
	■ Changeover times and voltage levels are outside recommended tolerances for emergency lighting systems with changeover between AC and DC.	Measure the DC supply voltage and check the switchover properties, or consult the equipment manufacturers.

Problem	Possible Cause	Remedy
	■ Non-sinusoidal mains voltage or DC voltage with high residual ripple (e.g. operation with fully electronic leading edge phase control dimmer switch or artificial mains network/ emergency generating set)	Check whether the mains voltage is in the required range for the ECG and the wave form or residual ripple in DC operation is within the specified limit values. Dimming is not recommended unless the ECG is expressly approved for dimming, in which case the prescribed controls (special accessories) must be used.
	■ At least one lamp has reached the end of its life owing to an increase in lamp voltage.	Replace the lamp (for two-lamp ECGs we recommend replacing both lamps at the same time to keep maintenance time and costs to a minimum).
3. The lamp goes out during operation (at least one lamp in the case of two-lamp units)	■ The reversible protection device in the ECG has responded during operation. The reason may be an intensive transient mains fault (mains voltage falls below the minimum voltage specified on the ECG for longer than permissible). Pulses of exceptional energy (transients) are superimposed on the mains voltage. The value of the mains voltage exceeds the maximum recommended value (e.g. because of a fault in the supply unit). Slow increase in mains voltage following neutral conductor break (unbalanced load, depending, among other things, on the mains load).	Disconnect the ECG or luminaire from the mains then check the supply voltage. If such problems occur sporadically, we recommend recording the mains voltage and/or using an oscilloscope or memory voltmeter. The electricity supplier may have to be consulted. Make sure that the neutral conductor is connected properly to this luminaire and makes good contact.
	■ The temperatures at the measuring point on the ECG or at the cool spot on the lamp(s) are exceeded (for a brief description of the temperature at the ECG and lamp see end of text).	The luminaire or site of installation should be modified to ensure that the maximum recommended temperature is not exceeded even in onerous conditions circumstances (high ambient temperature and/or high supply voltage).
4. Luminous output too low compared with other luminaires. Different brightness levels for the two lamps in two-lamp luminaires. Different brightness levels at the lamp ends.	■ Typical maintenance behaviour of a fluorescent lamp at the end of its life.	Replace the lamp (for two-lamp ECGs we recommend replacing both lamps at the same time to keep maintenance time and costs to a minimum).
	■ Lamps of different wattages colour appearance or incorrect wattage	The lamp wattage must match the wattage indicated on the ECG. The colour appearance should be homogeneous within an application.
	■ Incorrect wiring between ECG and lamp (output terminals not used or reversed; contact problems)	Check the lamp-side wiring for correct contact. Has the lamp connection been wired according to the wiring diagram on the ECG? For two-lamp ECGs in particular, check that the common or external connection is correctly wired. Pay particular attention in the case of special combinations.
	■ Lamps are “force cooled” by draughts	Find the cause of the draught and either eliminate the draught or protect the lamps accordingly.

Problem	Possible Cause	Remedy
5. Fault in other electrical equipment, particularly radio and television receivers, or problems in master/slave arrangements for 2-lamp ECGs	■ Wiring problems	Lamp cables should be short, far enough away (> 5 cm) from earthed metallic parts and, if possible, not laid parallel to mains cables (particularly in the luminaire). If cross-overs are needed they must be at right angles. The mains cables must also be as short as possible. In master/slave arrangements the maximum length of the cable to the daughter luminaire must not be exceeded.
	■ Electrical equipment, radios and televisions are inadequately immunity to interference.	Increase the distance between the luminaire and the equipment; if necessary, contact the manufacturer.
	■ The IR remote control signals for TV operate at a similar frequency to the ECG	Move the IR receiver on the TV out of the radiation field of the lamp or disable it.
6. Humming or “chirping” from the ECG	■ Non-sinusoidal AC voltage	Eliminate sources of interference; if necessary, in consultation with the electricity supplier.

Notes on the temperature at the ECG measuring point and on the cool spot of the lamp:

The maximum values for the cool spot temperature specified in the lamp documentation are an important criterion for operating the lamp and must not be exceeded in any circumstances. Make sure that the lamp and the ECG do not heat each other up in the luminaire and that the heat loss from the ECG can be properly removed even at the maximum ambient temperature expected. The temperature at the ECG measuring point is another important factor. Under no circumstances should this exceed the maximum temperature indicated on the type plate or in the data sheet. Any increase above this maximum temperature will shorten the life of the ECG and may cause damage in applications in which the surface temperature is significant (e.g. in the case of furniture luminaires). If the maximum temperatures are exceeded the general result is that there is a reduction in luminous flux and therefore also in system efficiency, and an increase in the temperature of the entire system. In extreme cases this can destroy the lamp and/or the ECG.

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8. Appendix

8.1 Voltage reductions in lighting systems

Information on the principle and the effects on lamps and luminaires

For more than 10 years components for lighting systems that promise significant energy savings have been offered on the free market. “At least 17 %” or “up to 30 %” are typical of these promises. The savings are to be achieved with equipment integrated in the circuits and connected on the mains side of various groups of luminaires. The major players in the electrical industry do not offer such equipment for discharge lamps. The following descriptions of the way in which this equipment works and the effects they have on lamps and luminaires will convince you why this is the case.

The following systems are used to “optimise light”, as manufacturers like to claim:

The electronic principle:

- phase control on the leading, edge, trailing edge or mid-signal

The transformer principle:

- Pure compensator transformers
- Variable transformers
- wired transformers

Phase control on the leading, edge, trailing edge or mid-signal

The principle here is based on the deformation of the sinusoidal AC voltage. The result is a reduction in the rms value. Power consumption is reduced considerably. For discharge lamps, only phase-control systems that do not extend the time of zero crossing are practicable. The voltage differs appreciably from a sinusoidal form. Harmonic content is inevitably increased. The system no longer operates within the specified tolerances.

Pure compensator transformers

Pure compensator transformers reduce the voltage level in the lighting circuit to around 200 V in the simplest of ways in a constant ratio to the mains voltage. The secondary voltage remains sinusoidal. The lamps are started at a reduced voltage, which means that starting is not as reliable. If the mains voltage is too low, or if there is loss of voltage on the feeder cable or if there are fluctuations in the voltage it may not be possible to start the lamps at all.

Variable transformers

Variable transformers ensure that the lamps will start at mains voltage. A variable tapping mechanism using sliding contacts steadily reduces the voltage in the closed circuit after a certain delay to around 190 V (or less) with no interruption to the circuit. This is possible after the lamps start but it is not possible to connect individual luminaires later to this circuit. This principle is more costly than pure compensator transformers and mechanical in its approach.

Wired transformers

These have the same properties as variable transformers but without the mechanics; instead they have switching elements with contacts. Auxiliary relays/contactors are needed to prevent interruptions when switching from high to low voltage, otherwise as soon as the luminaires were switched to reduced voltage they would try to start again at this reduced voltage.
The purpose of all the systems presented here is to reduced the output of high-pressure and low-pressure discharge lamps (i.e. fluorescent lamps, HQL, HQI and NAV) and pay for themselves through energy savings. In actual practice, however, their use is restricted essentially to fluorescent lamps. The following comments therefore relate to fluorescent lamps.

Effect of the phase control principle

The rms value of the feed voltage is reduced. Power consumption is therefore also reduced. Luminous flux is reduced disproportionately. Efficiency and luminous efficacy also drop. The result is a considerable loss of illuminance, at a higher percentage than the energy savings. This principle cannot be used for discharge lamps in compensated luminaires. The principle is familiar from dimmer switches for incandescent lamps, but here the emphasis is not so much on energy saving as on reducing brightness to change the mood or to suit some other specific purpose.

Effect of the transformer principle

Energy savings: Energy savings of between 15 and 30 % are achieved at the luminaire depending on the specific conditions in the system (type of control, combination of low-loss gear/starter, mains voltage and cabling). What is often overlooked however is that if a low-quality transformer is used there may be a power loss of up to 10 % of rated wattage.

Loss of luminous flux: Loss of luminous flux is not negligible in modern three-band fluorescent lamps. If the voltage is reduced from 230 V to 200 V (on 220 V conventional control gear), power consumption will be reduced by around 20 % and luminous flux by around 15 %. The actual savings are therefore just the difference between the two, and then the transformer losses have to be deducted as well. In some systems the overall balance is negative because there are also no-load losses. And this may be the case 24 hours a day unless the transformers are isolated on the mains side. Unless the lighting system was over-dimensioned from the outset, this reduction in voltage will lead to an excessive loss of illuminance. This in turn may mean that the minimum working conditions prescribed by law are not being met.

Liability and warranty: The lighting system is no longer being operated in accordance with VDE regulations and is outside the voltage tolerances approved by the lamp manufacturer. Claims under liability and warranty obligations can no longer be made against lamp and luminaire manufacturers.

Apparent power: In uncompensated luminaires the transformers must be designed for almost twice the apparent power. This means higher investment costs and higher power losses. Energy savings remain unchanged.

Lead-lag circuit: In lead-lag compensated luminaires (standard practice) a reduced operating voltage leads to a considerable and problematical difference in brightness between the two lamps. The inductive branch is reduced appreciably more than the capacitive branch.

Labelling: The transformers available on the market are often not adequately labelled. In many cases the labels simply state that the units are manufactured to VDE 0550 for miniature transformers. In most cases they do not carry the VDE approval mark.

Reliable starting: Flickering or repeated unsuccessful attempts at starting are not uncommon if there are long cables with small cross-sections. There is a risk of overheating and fire.

High-speed safety starters: In some cases, high-speed safety starters cannot be used. Because of the low voltage level they either fail to start or switch off.

Life: Increased lamp life cannot be expected. In modern 26 mm fluorescent lamps the operating currents are optimised at 230 V for filament heating. These are the conditions under which the lamps achieve their maximum life. If the feed voltage is too low the filaments will not be heated adequately. This may have an adverse effect on lamp life.

ECG operation: Because of their output and luminous flux behaviour, Electronic control gear is only marginally dependent on feed voltage. Measures to reduce voltage therefore have only a small effect in terms of energy savings.

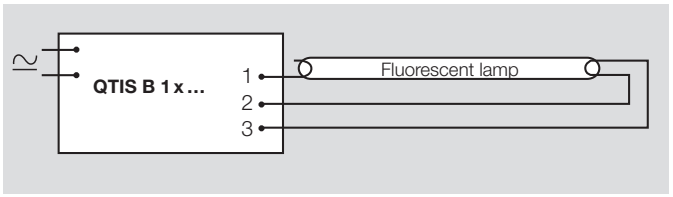
Voltage reduction in fluorescent lamps at a glance:

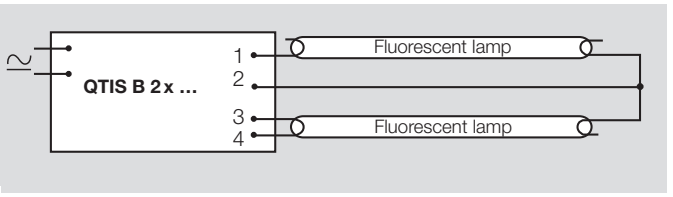
- Only has a marginal effect with electronic control gear
- With conventional technology there are energy savings but there are associated problems
- Transformer losses are often not taken into account
- In modern 26 mm fluorescent lamps there is a considerable loss of illuminance
- Non-compliant operation (loss of warranty and manufacturer's liability) must be taken into consideration
- In the case of lead-lag circuits there are visible differences in brightness
- Increased life cannot be expected
- Problems starting the lamps and flickering cannot be ruled out
- In uncompensated luminaires the transformer has to be dimensioned for much higher apparent power

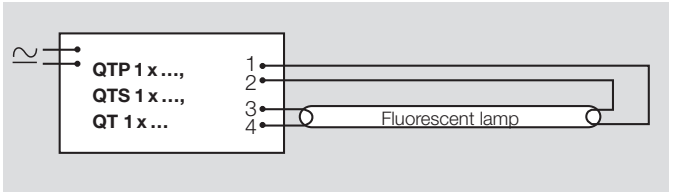
8.2 Wiring

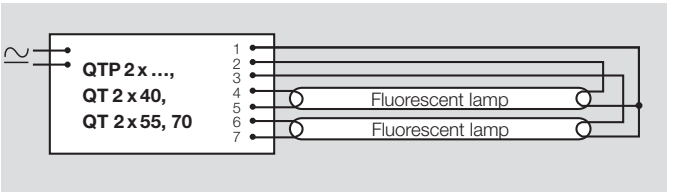
The wiring diagrams on the units themselves shall apply in all cases.

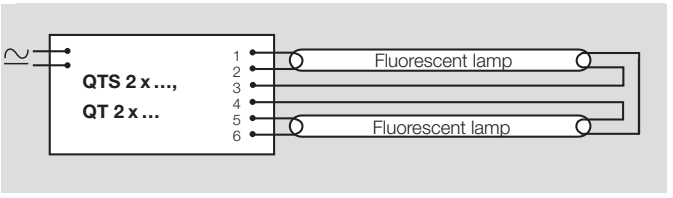
▪ QUICKTRONIC® in metal housing

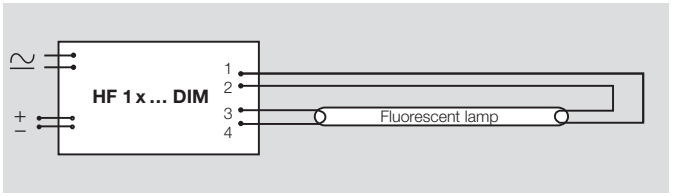


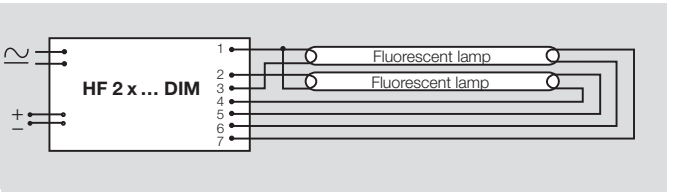




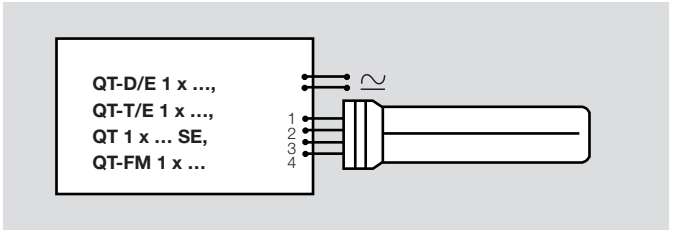


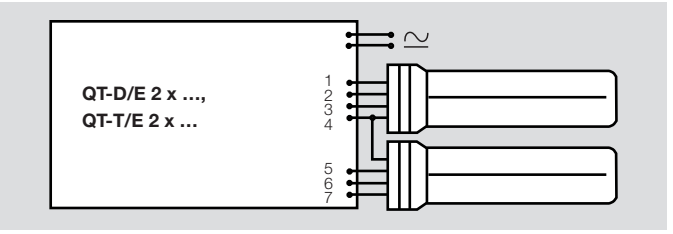


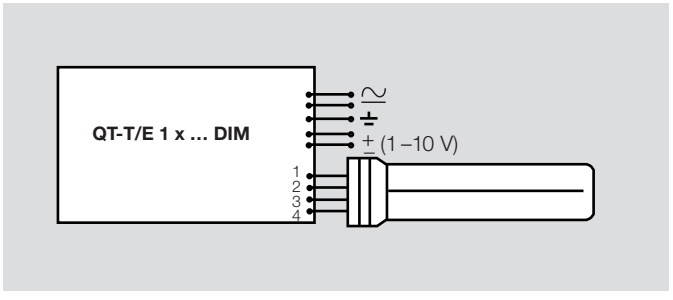


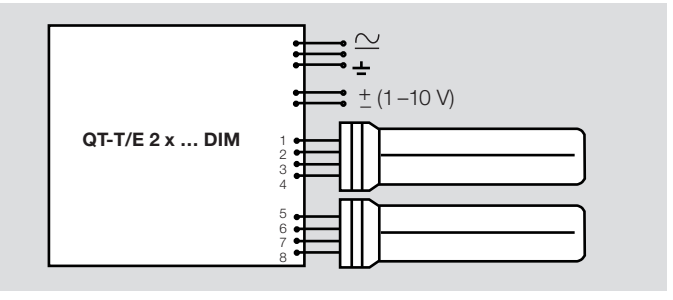


▪ QUICKTRONIC® in plastic housing









9. Index

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