COMPTEQ
EMBEDDED COMPUTERS ENGINEERING

CE GUIDE

Electronics for the European market, step by step

Directives, EMC and safety testing, technical documentation, manual and rating label. Practical and clear, for electronics manufacturers.

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BASICS · START HERE

What does CE actually mean?

Two letters you will find on a charger, a toy and an industrial computer. What do they really mean, who puts them on the product and why is it not a certificate from a lab?

Reading time **4 minutes**

Short answer: **the manufacturer's declaration that the product meets EU rules**

Short answer

The CE marking says that a product meets **all European rules that apply to it**, for example on electromagnetic compatibility (EMC), electrical safety or radio equipment. It is affixed by the **manufacturer**, who thereby takes responsibility for conformity.

Thanks to CE, the product can be sold freely throughout the European Economic Area without further approval in individual countries. The abbreviation is usually read as the French *Conformité Européenne*, i.e. European conformity.

What CE is not

- **It is not a certificate.** Nobody "issues" CE to you. A lab provides measurements and reports, but the declaration of conformity is drawn up and signed by the manufacturer.
- **It is not a quality mark.** CE does not say that a product is better than another. It only says that it meets the minimum legal requirements.
- **It does not mean "made in Europe".** A product from Asia or the USA must also carry CE if it is sold in the EU.
- **It is not just a sticker.** The marking must be backed by technical documentation and an EU declaration of conformity. Without them, CE on a product is unjustified.

Who affixes CE

The manufacturer, i.e. whoever places the product on the market under their own name or trademark. Before affixing CE, the manufacturer must:

1. identify which rules apply to the product,
2. assess conformity, usually by testing to harmonized standards,
3. compile the technical documentation,
4. draw up and sign the EU declaration of conformity.

For common electronics (EMC, electrical safety, RoHS), manufacturers can do this themselves; no independent notified body is needed. One is required only for certain products, such as some radio equipment or medical devices. More in The path to CE, step by step.

> **Importing or selling someone else's product?**
> Importers and distributors must check that the product carries CE and that a declaration of conformity and instructions in the language of the country of sale exist. Anyone who sells someone else's product under their own brand becomes its manufacturer.

Which products need it

CE is affixed only to products for which a European regulation requires it. For electronics, the most common are:

- **EMC** (2014/30/EU): a device must not disturb its surroundings and must withstand interference.
- **LVD** (2014/35/EU): electrical safety of products rated 50–1000 V AC or 75–1500 V DC.
- **RED** (2014/53/EU): radio equipment with Wi-Fi, Bluetooth, LTE and the like.
- **RoHS** (2011/65/EU): restriction of hazardous substances such as lead or cadmium.

Other rules cover machinery, toys or medical devices, for example. See the overview in Directives made simple.

Watch out

CE must not be affixed to a product that is not covered by any such regulation. That is also a breach of the rules.

Where CE applies

Throughout the European Union and also in Iceland, Liechtenstein and Norway (the European Economic Area). The marking must be visible, legible and indelible, at least 5 mm high and in the prescribed form. If it cannot be placed on the product, it goes on the packaging and in the accompanying documents.

What happens without CE

National market surveillance authorities can ban the sale of a product without CE, or with CE but no supporting documents, order its withdrawal from the market and impose a fine. In practice, however, a customer or a tender issuer asks for the declaration of conformity more often than an authority does.

LEGISLATION · CYBERSECURITY

What is the CRA and does it apply to you?

The Cyber Resilience Act (CRA) adds cybersecurity to the CE marking. It covers almost every piece of electronics with firmware that can be connected to something. And some of the obligations already apply.

Reading time **6 minutes** Fully applies from **11 December 2027**

Short answer

The CRA is **Regulation (EU) 2024/2847**. It says that a product with digital elements may be placed on the EU market only if it is **secure by design** and the manufacturer **takes care of its security throughout the support period**: fixing vulnerabilities, releasing updates and reporting serious issues. Compliance is demonstrated as with other rules: technical documentation, an EU declaration of conformity and the CE marking.

A regulation, not a directive

The CRA applies directly and identically in all EU member states, without national transposition.

Which products it covers

All **products with digital elements**, i.e. hardware and software that can be connected to another device or a network, whether by cable, radio or even USB. Typically:

- control units, industrial and embedded computers, terminals,
- smart devices, sensors and IoT gateways,
- routers, modems, switches,
- firmware and software sold separately.

It **does not cover** products with their own cybersecurity rules, such as medical devices, motor vehicles or aviation equipment, or products developed exclusively for defense and national security. Open source software not supplied in the course of a commercial activity is also out of scope.

What applies when

- **10 December 2024:** the regulation entered into force.
- **11 June 2026:** rules for the conformity assessment bodies that will assess products.
- **11 September 2026 (already applies):** the obligation to report actively exploited vulnerabilities and severe security incidents. This also covers products already on the market.
- **11 December 2027:** full application. New products that do not meet the CRA may no longer be placed on the market.

> **Developing right now?**
> A product you start designing today will most likely reach the market after 11 December 2027. It is therefore wise to address security at the design stage. Retrofitting hardware and firmware costs much more.

What manufacturers must do

During design and before placing on the market:

- Assess the product's cybersecurity risks and design it accordingly.
- Not sell the product with known exploitable vulnerabilities.
- Ship with a secure default configuration, for example no shared default password, and allow a reset to factory state.
- Protect data and access: encryption, authentication, protection against unauthorized firmware modification.
- Minimize the attack surface, i.e. disable unnecessary interfaces and services.

- Compile a software bill of materials (SBOM) as part of the technical documentation.

Throughout the support period:

- Define the support period, usually **at least 5 years** (shorter only for products with a shorter expected lifetime). Customers must know it at the time of purchase.
- Fix vulnerabilities and release security updates, automatically and free of charge where possible.
- Provide a contact for reporting vulnerabilities and a procedure for handling them.
- Report an actively exploited vulnerability or a severe incident: **early warning within 24 hours**, notification within 72 hours and a final report (for a vulnerability within 14 days of the fix, for an incident within one month).

Breaching the essential requirements can result in a fine of up to **EUR 15 million or 2.5% of worldwide annual turnover**, whichever is higher. The market surveillance authority can also order the product to be withdrawn from the market.

Who assesses the product

- **Default products** (the majority): the manufacturer assesses conformity alone, just as for EMC.
- **Important products, class I**, such as routers, modems, switches or microcontrollers with security functions: self-assessment only when harmonized standards are applied, otherwise a notified body.
- **Important products, class II**, such as firewalls: always a third party.
- **Critical products**, such as smart cards or hardware security modules: a third party or European certification.

The exact classification is set out in Annexes III and IV of the regulation. If you are not sure, we are happy to go through it with you.

The CRA and radio equipment

For internet-connected devices with Wi-Fi, Bluetooth or LTE, the cybersecurity requirements of the RED have applied since 1 August 2025 (Regulation (EU) 2022/30 , EN 18031 standards). From 11 December 2027 they will be replaced by the CRA. If you meet EN 18031 today, you are well on your way to the CRA, but the CRA asks for more, mainly vulnerability handling and updates throughout the support period.

How to get started

1. **Check whether the CRA applies to you.** Does the product have firmware and some data interface? Then almost certainly yes.
2. **Do a risk assessment.** What can be done to the product, what would it cause and how do you prevent it.
3. **Review the design:** secure boot, signed updates, default passwords, unnecessary interfaces and debug ports.
4. **Set up a process:** who monitors vulnerabilities in the libraries you use, how updates are released and who reports an incident within 24 hours.
5. **Plan the support period** and factor it into the product price.

We have been designing embedded hardware and firmware for over 25 years, so we know how to build security into the design from the start. We also pre-test radio equipment to EN 18031. An overview of the other rules is in Directives made simple.

BASICS · STEP BY STEP

The path to CE, step by step

The CE marking is not a certificate someone issues to you. It is your declaration that the product meets European rules. We show what leads to it, what you can do yourself and where we save you time.

Reading time **7 minutes** **9 steps**

The **manufacturer** is responsible for CE, i.e. whoever places the product on the market under their own name. A lab, a notified body or a parts supplier will not do it for you. They can, however, provide evidence and save you a lot of work.

You can do it yourself **Where we help**

1 Identify which rules apply to the product

For electronics, these are most often the EMC Directive (2014/30/EU), the LVD for electrical safety (2014/35/EU), the RED for radio equipment (2014/53/EU) and RoHS (2011/65/EU). Depending on the type of product, others are added, such as machinery rules.

> **You can do it yourself:** Write down what the product does, how it is powered, which interfaces it has and whether it contains a radio.

> **Where we help:** Our EMC and CE calculator identifies the rules and standards in a few minutes. EMC and CE calculator →

2 Choose the conformity assessment procedure

For EMC, LVD and RoHS, conformity is usually assessed by the manufacturer alone (module A, internal production control). A notified body is needed only in some cases, e.g. for radio equipment where harmonized standards have not been applied in full.

> **You can do it yourself:** Decide who will be the manufacturer, i.e. under

whose name the product will be placed on the market.

Where we help: We advise whether your own assessment is enough.

3 Find the harmonized standards

Directives say WHAT the product must meet. Harmonized standards say HOW to verify it. If you meet them, the presumption of conformity applies and you have the strongest evidence.

You can do it yourself: Check whether a dedicated product standard exists for your type of product.

Where we help: We select the standards and build a test plan from them.

4 Assess the risks

Describe the hazards the product may present (electric shock, overheating, interference) and how you prevent them. The risk assessment is part of the technical documentation.

You can do it yourself: You know this best. A table is enough: hazard, measure, verification.

Where we help: We check that the assessment matches the standards.

5 Verify the product by testing

Measurements to the standards: EMC, electrical safety, and climatic or IP protection tests where relevant. The results are the main part of the technical documentation.

You can do it yourself: Prepare the sample, cables and a description of the operating modes.

Where we help: Pre-compliance testing in our own EMC chamber, usually available within a week. If something fails, we help fix it. Preparation checklist →

6 Compile the technical documentation

Product description, schematics and drawings, list of applied standards, test reports, risk assessment and the user manual. It is kept for 10 years after the last unit is placed on the market and the market surveillance authority may request it.

You can do it yourself: Most of it: description, schematics, drawings, manual and documents from your parts suppliers (declarations of conformity, RoHS).

Where we help: We provide the test reports and input for the technical documentation.

7 Draw up the EU declaration of conformity

A single document in which the manufacturer declares that the product meets all applicable rules. It contains identification of the product and manufacturer, the list of rules and standards, place, date and signature.

You can do it yourself: The declaration is drawn up and signed by the manufacturer, i.e. you.

Where we help: We prepare the input and check that nothing is missing.

8 Mark the product and include the manual

The CE marking must be visible, legible and indelible, at least 5 mm high. The product must bear a type or serial number and the manufacturer's name and contact address. The manual and safety information must be in the language of the country where the product is sold.

You can do it yourself: The label, manual and translations.

Where we help: We check the marking and the manual against the product standard.

9 Keep an eye on the product after placing it on the market

When you change the product (a different board, power supply, firmware with a new radio) or the standards change, reassess whether the declaration of conformity still holds.

You can do it yourself: Keep a record of product changes and follow updates to the standards.

Where we help: Quick retesting of the modified version. The calculator shows the price up front.

Mind cybersecurity

Since 1 August 2025, cybersecurity requirements apply to internet-connected radio equipment (Regulation (EU) 2022/30, EN 18031 standards). The Cyber Resilience Act (CRA) will gradually apply to other products with digital elements. If this concerns you, address it at the design stage.

Wondering whether an assembly of parts that are already CE marked needs CE too? The answer is in The parts are CE marked. Does the assembly need CE too?

LEGISLATION · OVERVIEW

Directives made simple: EMC, LVD, RED, RoHS and CRA

The five rules you meet most often with electronics. For each one, we explain who it applies to, what it requires and how to comply. At the top, you can select which ones apply to your product.

Reading time **6 minutes** **3 questions** to select the rules

Which rules apply to your product?

How is the product powered?

- (●) From the mains or another voltage above 50 V AC / 75 V DC
- ( ) By batteries or an external low-voltage adapter

Does it have a radio (Wi-Fi, Bluetooth, LTE, LoRa, GNSS, RFID)?

- ( ) Yes
- (●) No

Does it have firmware or software and connect to another device or a network?

- (●) Yes
- ( ) No

Most likely applies to you:

- EMC – electromagnetic compatibility
- LVD – electrical safety
- RoHS – hazardous substances
- CRA – cyber resilience (from 11 December 2027)

An indicative selection. The EMC and CE calculator, or we, will determine the exact rules and standards.

EMC

Electromagnetic compatibility

Directive 2014/30/EU

WHO IT APPLIES TO

Almost all electronics. The exception is radio equipment, where EMC is covered under the RED.

WHAT IT REQUIRES

The product must not cause excessive interference and must withstand normal interference from its surroundings.

HOW TO COMPLY

Usually assessed by the manufacturer alone (module A). The evidence is testing to standards such as EN 55032 and EN 55035.

LVD Electrical safety (low voltage)

Directive 2014/35/EU

WHO IT APPLIES TO

Equipment rated 50–1000 V AC or 75–1500 V DC. Typically anything plugged straight into a wall outlet.

WHAT IT REQUIRES

The product must not endanger people or property: electric shock, overheating, fire, mechanical hazards.

HOW TO COMPLY

Always assessed by the manufacturer; no notified body is involved. Standards such as EN 62368-1 or EN 61010-1 are used.

RED Radio equipment

Directive 2014/53/EU

WHO IT APPLIES TO

Anything that intentionally transmits or receives radio waves: Wi-Fi, Bluetooth, LTE, LoRa, GNSS receiver, RFID.

WHAT IT REQUIRES

Safety (with no lower voltage limit), EMC, efficient use of the spectrum and, since 1 August 2025, cybersecurity for internet-connected devices (Regulation (EU) 2022/30 , EN 18031 standards).

HOW TO COMPLY

Self-assessment by the manufacturer when harmonized standards are applied in full, otherwise with a notified body. A radio module with its own assessment helps a

lot.

RoHS Hazardous substances

Directive 2011/65/EU

WHO IT APPLIES TO

Electrical and electronic equipment, including cables and spare parts.

WHAT IT REQUIRES

Restricts 10 substances: lead, mercury, cadmium, hexavalent chromium, PBB, PBDE and four phthalates.

HOW TO COMPLY

Manufacturers demonstrate compliance mainly with documentation from parts suppliers according to EN IEC 63000. Lab analysis only when in doubt.

CRA Cyber resilience

Regulation (EU) 2024/2847

WHO IT APPLIES TO

Products with digital elements that can be connected to a device or a network: firmware, applications, connected electronics.

WHAT IT REQUIRES

Secure design, vulnerability handling and updates throughout the support period. From 11 September 2026, actively exploited vulnerabilities must be reported within 24 hours.

HOW TO COMPLY

The main obligations and CE under the CRA apply from 11 December 2027. If you are developing now, address it at the design stage.

One declaration for everything

> When several rules apply to a product, you draw up one combined EU declaration of conformity. A template is in Technical documentation and the declaration of conformity.

Other rules not to forget

- **Machinery**, when the product contains moving parts driven by a motor.
- **Medical devices** have their own, stricter rules.
- **Electronic waste (WEEE) and batteries**: obligations when placing on the market, e.g. take-back and marking.
- **Automotive**: vehicles and their components are approved under UNECE regulations, e.g. R10 for EMC.

If you are not sure, write to us. We reply within 24 hours.

LEGISLATION · COMMON QUESTION

The parts are CE marked. Does the assembly need CE too?

Are you building a device from purchased parts, such as a computer, a control cabinet or a terminal, and every part has its own CE? Unfortunately, that is not enough for the assembly. We explain why, where this is written and how you can save work.

Reading time **5 minutes** Short answer: **yes, the assembly is a new product**

Short answer

Yes. Anyone who sells an assembly of parts as a single product under their own name is its **manufacturer** under European rules. They must assess the conformity of the whole assembly, keep technical documentation, draw up an EU declaration of conformity and affix the CE marking.

> **Good news**
>
> Documentation from your parts suppliers saves you a large part of the work. You do not have to retest every part; the assessment focuses mainly on what results from combining them.

Who the manufacturer is

The manufacturer is not only someone who makes something from scratch. It is anyone who **places the product on the market under their own name or trademark**, even if they bought all the parts. They sign the declaration of conformity and they are liable for the product's conformity.

Why CE on the parts is not enough

CE on a part applies to the part itself and only under the conditions for which its manufacturer assessed it. In your assembly, several things come together at once:

- **Cabling** between the parts and out of the enclosure often acts as an antenna.
- **The enclosure** may shield, or have openings through which interference escapes.
- **The power supply** and its load are different from the part's test setup.
- **The parts interfere with each other.** Each passes on its own, but not together.

That is why the assembly is assessed as a new product.

Where this is written

- **EMC:** Directive 2014/30/EU. It treats a combination of parts sold as a single functional unit as "apparatus".
- **Electrical safety:** Directive 2014/35/EU (LVD). It applies to supply voltages of 50–1000 V AC or 75–1500 V DC.
- **Radio:** if the assembly has Wi-Fi, Bluetooth or LTE, Directive 2014/53/EU (RED) applies, and EMC and safety are then assessed under it. Since 1 August 2025, this also includes cybersecurity (Regulation (EU) 2022/30, EN 18031 standards).
- **Hazardous substances:** Directive 2011/65/EU (RoHS).
- **Framework:** the manufacturer's obligations are described in Decision 768/2008/EC and in the European Commission's interpretive "Blue Guide" (2022, section 3.1).

To be fair

The law does not require a lab test. It requires conformity to be assessed and demonstrated. For EMC and safety, manufacturers usually do this themselves. The most reliable evidence, however, is testing to harmonized standards, because it gives the presumption of conformity. An analysis without measurements is unlikely to stand up to an inspection for an assembly with its own cabling and power supply.

Without a declaration of conformity, the market surveillance authority may ban the sale or order the product to be withdrawn from the market and impose a fine. In addition, customers and tender issuers routinely ask for the declaration of conformity.

How to save time and money

1. **Collect documentation from your suppliers.** The parts' EU declarations of conformity and their RoHS declarations. Without them, you cannot demonstrate RoHS for the assembly.
2. **Use the parts as their manufacturer prescribes.** A radio module with its own assessment, connected according to its instructions (antenna, power), saves you a large part of the radio tests.
3. **Buy a CE-marked power supply.** An external CE-marked adapter greatly simplifies the electrical safety assessment.
4. **Several variants?** Not every one has to be tested. Comparative measurements identify the worst case, and full tests are done only on that one.
5. **Do pre-compliance testing first.** You find out whether the assembly passes and make any changes (ferrites, a filter, shielding) before you pay for full testing.

When it is different

- **Powered from an external adapter below 75 V DC:** the LVD does not apply to the assembly itself (the adapter has its own CE). EMC still applies.
- **You sell the parts separately** and the customer assembles them: the customer is then the manufacturer of the assembly.

Our measurements and test report serve as the basis for your declaration of conformity. The declaration is drawn up and signed by the manufacturer, i.e. you.

TESTING · OVERVIEW

What EMC tests measure

EMC has two sides. The product must not disturb its surroundings (emissions) and the surroundings must not disturb the product (immunity). We go through the individual tests: what happens during them, why they exist and where products fail most often.

Reading time **8 minutes** **9 tests** in our lab

Emissions and immunity

Which tests apply to your product and at what severity is determined by the standard for that type of product and the environment where it will be used. An office computer is tested differently from a control unit for a factory.

Emissions

The product does not disturb its surroundings. We measure what it emits into space and into cables.

Immunity

The surroundings do not disturb the product. We expose the product to interference and watch whether it works.

Residential or industrial?

Stricter emission limits apply to residential and office environments (class B), while industrial environments use higher disturbance levels in immunity tests. The standards are chosen accordingly.

Emissions: what the product emits

Radiated emissions

`30 MHz – 6 GHz`

What happens: How much electromagnetic interference the product emits into its surroundings. An antenna in the EMC chamber measures the spectrum and compares it with the limit line.

Why: So that the product does not disturb broadcast radio, mobile networks, Wi-Fi or neighboring equipment.

Why products fail: Harmonics of clock frequencies, switch-mode power supplies, unfiltered cables acting as antennas, and slots in the shielding.

EN 55032, EN 55011

Conducted emissions

150 kHz – 30 MHz

What happens: Interference the product sends into power and data cables. Measured through an artificial mains network (LISN) or, for data ports, through an ISN.

Why: The mains and cables would carry the interference to other appliances in the building.

Why products fail: A switch-mode power supply without an input filter, or with a filter that is poorly grounded or placed far from the connector.

EN 55032, EN 55011

Harmonic currents and flicker

mains up to 16 A

What happens: How much the product distorts the current drawn from the mains and whether it causes voltage fluctuations (flickering lights).

Why: Distorted current loads the grid and affects other consumers.

Why products fail: Power supplies without power factor correction (PFC) and power loads that switch in fast cycles.

EN 61000-3-2, EN 61000-3-3

Immunity: what the product withstands

Electrostatic discharge (ESD)

criterion B

What happens: We simulate a discharge from a human hand into metal parts, buttons, connectors and the surroundings of the product.

Level: typically ±4 kV contact, ±8 kV air

Why products fail: Processor reset or freeze, unprotected connectors and controls without protection diodes.

EN 61000-4-2

Radiated RF field

criterion A

What happens: We expose the product in the chamber to an RF field, similar to a nearby transmitter or mobile phone.

Level: 3 V/m residential, 10 V/m industrial (chamber up to 12 V/m)

Why products fail: Sensitive analog inputs and sensors, long unshielded cables, measured values “drifting”.

EN 61000-4-3

Electrical fast transients (burst)

criterion B

What happens: Bursts of short pulses, such as those generated when relays, contactors and motors switch.

Level: e.g. ±1 kV on residential mains, ±2 kV industrial

Why products fail: No input filtering, grounding through long wires, firmware hangs on a communication error.

EN 61000-4-4

Surge

criterion B

What happens: A strong but slower pulse, like after a lightning strike on a line or switching in the grid. On data ports only for cables longer than 30 m.

Level: e.g. ±1 kV line to line, ±2 kV line to ground

Why products fail: No surge protection (varistor, TVS diode), or protection rated for too little energy.

EN 61000-4-5

Conducted RF disturbance

criterion A

What happens: We inject RF disturbance directly into the cables, because below 80 MHz it enters the product mainly through them.

Level: 3 V residential, 10 V industrial, 150 kHz – 80 MHz

Why products fail: Unfiltered inputs, analog signals routed over long cables, missing ferrites.

EN 61000-4-6

Voltage dips and short interruptions

criterion B / C

What happens: We simulate short outages and dips of the mains voltage.

Level: short outages and dips on the AC mains

Why products fail: The product does not restart properly, loses its settings or corrupts data in memory.

EN 61000-4-11

Depending on the type of product, we add further tests, such as bulk current injection (BCI) for vehicles and defense, or radio equipment tests to ETSI EN 301 489. The EMC and CE calculator shows exactly what applies to your product.

Performance criteria A, B, C

Immunity tests are not just about whether the product “survives”. The standard defines how it may behave:

- **A:** it works normally during the test, with no noticeable change.
- **B:** performance may degrade temporarily and recovers by itself once the disturbance stops.
- **C:** the function may be interrupted and is restored by the operator, e.g. by a restart.

You describe what “works normally” means for your product. More on this in How to prepare for EMC testing.

How to pass first time

1. **Think about EMC at the design stage.** An input filter, connector protection and a solid ground plane on the board cost little at design time and a lot afterwards.
2. **Watch the cables.** Where they run, how long they are and whether they are shielded. Most emission problems start with them.
3. **Do pre-compliance testing.** You find the problem before you pay for full testing or order production.
4. **Keep an engineer at hand.** If something fails, our engineers propose a fix directly in the schematic or the board.

PREPARATION · CHECKLIST

How to prepare for EMC testing

An hour in the EMC chamber costs money. Most time, however, is not lost measuring but looking for a cable, switching firmware or agreeing what the product is actually supposed to do. You can prepare all of this in advance.

Reading time **6 minutes** Printable checklist, **18 items**

Why preparation pays off

EMC testing is paid by the hour. A well-prepared sample is measured quickly and the result is meaningful. An unprepared sample means extra hours, or even a new appointment.

EUR 100/h
EMC chamber, excl. VAT. Every hour saved counts.

within a week
is when we can usually test. No waiting for months.

18 GHz
upper limit of our chamber (from 30 MHz) for radiated emissions

Our testing is pre-compliance. It shows whether the product will pass and, if not, why. You then have time to fix it before you pay for a certification test or start production.

Operating modes and performance criteria

The product is measured in the mode in which it “interferes” the most, and at the same time we need to know how to tell that it has *withstood* interference. Only you can answer these two questions.

Worst case for emissions

Turn everything on at once: all interfaces communicating, the display on, the motor running, the processor at full clock. Best of all is test firmware that cycles through the functions by itself. Then nobody has to go into the chamber to switch modes.

Performance criteria for immunity

Immunity standards distinguish what may happen during the disturbance:

- **A:** the product works normally throughout.
- **B:** performance may degrade temporarily but recovers by itself once the disturbance stops.
- **C:** the function may be interrupted and is restored by the operator, e.g. by a restart.

The standard determines which criterion applies to which test. But what “works normally” means for your particular product is something you must describe. For example, “data is transferred without errors” or “the value on the display does not change by more than 1%”.

> **Tip**
>
> Make sure the function can be monitored from outside: a blinking LED, output to a laptop or a value on a display that we can see by camera from the control room.

Cables and accessories

For most products, the cables radiate more than the electronics itself. So bring the cables your customer will use, in the same length and type. A shielded cable instead of an unshielded one, or vice versa, changes the result completely.

Do not forget the power supply you will ship with the product and everything the product needs for normal operation: sensors, loads, the other end of the communication.

Documents to send us in advance

A few lines of text are enough. They let us prepare the test before you arrive, so no time is lost in the chamber.

- **Where the product is used.** Residential and office, or industrial? This determines the limits, e.g. class B (stricter) or class A.
- **Ports and cables.** Each port is tested separately, so their number affects the duration and price of testing.
- **Highest frequency in the product.** It determines up to which frequency radiated emissions are measured.
- **Standards, if you know them.** If not, you can find them with the EMC and CE calculator.

Checklist: ready for testing

Sample

- [ ] **Sample in its final form**
  Enclosure, covers, screws, shielding and cable glands as on a production unit. Without the cover, you measure something other than what you will sell.
- [ ] **A second unit as a spare**
  Immunity tests (e.g. surges or discharges) may damage the sample. A spare unit saves a trip and a new appointment.
- [ ] **Frozen firmware**
  One version that you have written down. The results apply to that specific version.
- [ ] **Dimensions and weight**
  So we know how to place the sample. The turntable in our chamber carries up to 500 kg and is 1.2 m in diameter.

Operating modes

- [ ] **List of operating modes**
  E.g. standby, normal operation, full power, charging, communication.
- [ ] **“Worst case” mode**
  All interfaces active, maximum load and highest clock. Ideally test firmware that cycles through the functions by itself.

- [ ] **How we can tell the product works correctly**
  Performance criteria for immunity tests: what may and may not happen during and after the disturbance. For example, an LED blinks, data flows without errors, the display shows a value.

- [ ] **How to monitor the function**
  A laptop with service software, an LED, a display or a monitoring output that can be watched from the control room by camera.

Cables and accessories

- [ ] **Cables of the length your customer will use**
  Cables are often the main “antenna”. Length and type (shielded or unshielded) affect the result.

- [ ] **Power supply or adapter**
  The one you will ship with the product. Send us the voltage, frequency and current draw in advance.

- [ ] **Counterparts and loads**
  Sensors, motors, bus simulators, a router. Anything needed for the product to run as in real operation.

Documents

- [ ] **A short description of the product and its use**
  Where it will be used (residential, industrial, vehicle, healthcare). This determines the standards and limits, e.g. class A or B.

- [ ] **List of ports and interfaces**
  Power, Ethernet, USB, RS-485, CAN, radio modules and their cable lengths.

- [ ] **Highest frequency in the product**
  Clock of the processor, memories, FPGA or radio. It determines up to which frequency radiated emissions are measured (up to 6 GHz under EN 55032).

- [ ] **Block diagram**
  A simple one is enough. It helps find the source of a problem quickly if something fails.

- [ ] **List of standards, if you have one**
  If not, no problem. You can find it with our EMC and CE calculator, or we will determine it together.

If you want to debug on site

- [ ] **An engineer with a laptop and tools**
  Whoever knows the circuit finds and verifies a fix fastest.
- [ ] **Small materials for fixes**
  Ferrite rings, an assortment of capacitors, copper tape, a soldering iron. A quick experiment often shows the way forward.

What a test day at our lab looks like

1. **Arrival and setup.** Together we place the sample on the table or turntable, connect the cables and check that it runs.
2. **Emissions.** We measure what the product radiates and what it sends into cables. You see the results on screen right away, with the limit line.
3. **Immunity.** We expose the product to disturbance and watch whether it works according to the criteria we agreed on.
4. **If something fails,** we look for the cause on site and propose a fix. Our engineers can work it straight into the schematic or the board.
5. **The test report** with results and recommendations is delivered after testing.

TESTING · TROUBLESHOOTING

Failed EMC. What now?

A peak above the limit or a reset during a discharge is not the end of the project. Most problems are solved by inexpensive changes if you know where to look. We go through the fixes from the simplest to a design change.

Reading time **7 minutes** **6 levels** of fixes

Short answer

First find out **what** interferes and **where from**. Then try fixes starting with the quickest and cheapest: cabling, grounding, ferrites and filters, firmware. Only when that is not enough, change the enclosure or the board design. Retest after every change.

> **The earlier, the cheaper**
>
> Changing a cable takes minutes. A new board revision takes weeks and costs money for manufacturing. That is why it pays to test the prototype, not only the finished product before certification.

Find the cause first

Randomly adding ferrites sometimes helps, but often just moves the problem elsewhere. The test report and a few simple experiments usually show where to look:

- **Narrow peaks at regular intervals** are usually multiples (harmonics) of some clock. Find which crystal or bus they correspond to.
- **A broad “hill”** in the spectrum is often caused by a switch-mode power supply or a DC/DC converter.
- **Conducted emissions** (up to 30 MHz) usually point to the power input and its filtering.

- **If a peak changes when a cable is disconnected or rerouted,** that cable is the main radiator.
- **For immunity** (ESD, fast transients, surges), what matters is where the disturbance enters and what exactly fails: a reset, a communication dropout or damage.

We then pinpoint the exact spot on the board with a near-field probe. It shows which component or trace radiates the most.

Fixes from the cheapest

The order is indicative. Only testing shows what helps your particular device.

1. Cabling

`effort: low`

Cables are the most common antenna. Current flowing along them in the same direction there and back (common-mode current) radiates even when the device itself is fine. A cable also brings interference inside, for example during the fast transient test.

- Shorten cables and route them close to the chassis, not loosely in the air.
- Use twisted pairs for signals and power.
- Terminate the cable shield around the full circumference of the connector, not with a pigtail.
- Separate power and signal wires; do not run them in one bundle.

2. Chassis bonding and grounding

`effort: low`

Shielding and filters only work if they have somewhere to divert the interference. A long, thin wire to the chassis has high impedance at high frequencies and hardly helps.

- Bond to the chassis short and wide (strap, direct contact), not with a long wire.
- Ensure conductive contact between the cover and the enclosure; remove paint at contact points.
- Connect metal connectors and their shields directly to the chassis.

- Check where the electronics ground connects to the chassis and whether unnecessary loops are formed.

3. Ferrites and filters

effort: low to medium

A ferrite ring on a cable suppresses common-mode current. It usually helps in the range of tens to hundreds of MHz. A filter on the power input reduces conducted emissions from switch-mode supplies and improves immunity.

- Ferrite rings or clamp-on ferrites on the cables where peaks showed up.
- An AC or DC filter on the power input.
- Fill capacitors and chokes into unpopulated positions on the board.
- For immunity, add surge and ESD protection (e.g. TVS diodes) on the interfaces.

4. Firmware tuning

effort: medium

A lot of interference comes from clocks and fast signal edges. Some of it can be reduced by configuration alone, without touching the hardware. Firmware also helps with immunity: the device recovers by itself after a disturbance.

- Enable spread-spectrum clocking if the interfaces tolerate it.
- Slow down output edges (GPIO and bus slew-rate settings).
- Disable unused peripherals, clock outputs and buses.
- Move switching and communication frequencies out of problematic bands.
- For immunity: watchdog, communication checks and retries, safe return to operation.

5. Enclosure and shielding

effort: medium to higher

A metal enclosure shields only as well as its parts are bonded together. Long slots and seams radiate like antennas themselves. A plastic enclosure does not shield at all.

- Conductive gaskets or spring contacts between the cover and the enclosure, more screws.

- Several small openings instead of one long slot.
- A shielding can over the problematic part of the board.
- For plastic, a conductive coating inside the housing or internal shielding.

6. Electronics design

`effort: high`

When the board or the circuit is the cause, other measures only mitigate the consequences. A design change means a new board revision, but it solves the problem at the root.

- A PCB stackup with a solid ground plane under fast signals.
- Short current loops in switch-mode supplies and decoupling capacitors.
- Placement: fast circuits away from connectors and board edges.
- Filtering and protection right at the connectors.
- Choosing components with slower edges or lower emissions.

Mind safety

Filters with capacitors to the chassis (Y capacitors) increase leakage current. For mains-powered equipment, it is limited by the electrical safety standards. A fix for EMC must not compromise safety.

How we handle it

1. **We measure** the device in our EMC chamber and show you where and by how much it exceeds the limit.
2. **We look for the cause** right at the chamber, together with you: rerouting cables, near-field probing, disconnecting parts.
3. **We try fixes on site** (ferrites, bonding, temporary shielding, firmware settings) and retest immediately.
4. **You get the result** with before-and-after charts and a recommendation on what to implement in production.

When the problem lies in the board or enclosure design, our engineering team proposes a fix and we retest the next revision right away. We can usually offer testing within a week.

How to prevent it next time

- **Think about EMC at the design stage:** board stackup, ground plane, filtering at the connectors, enclosure bonding.
- **Do pre-compliance testing on the prototype** while changes are cheap.
- **Prepare for testing** with our checklist, so chamber time is not wasted.

DOCUMENTATION · TEMPLATE

Technical documentation and the EU declaration of conformity

You can prepare most of the CE documentation yourself, because you know the product best. We show what belongs in it, and you can fill in the declaration of conformity template right here.

Reading time **5 minutes** Template for **Word and PDF**

What the technical documentation is for

The technical documentation is the evidence that the product meets the rules. It is not sent anywhere, but you must have it ready. If a market surveillance authority requests it, you must provide it.

10 years

you keep the documentation after the product is placed on the market

you

as the manufacturer are responsible for it and issue the declaration

1 declaration

for all rules that apply to the product

What belongs in the technical documentation

Each directive defines the exact content. For electronics, this is what usually recurs:

1. **Product description.** What the product does, variants and versions, photos. Identification of the type and of the hardware and firmware versions.
2. **Schematics and drawings.** Electrical schematics, board and mechanical drawings, list of main parts.
3. **Explanations.** A short description of how to read the schematics and drawings and how the product works.

4. **List of rules and standards.** Which directives and harmonized standards you applied, or which other solutions you used and why.
5. **Risk assessment.** Hazards, measures and their verification. For EMC, an electromagnetic compatibility assessment.
6. **Calculation and test results.** Reports from EMC, safety and other tests.
7. **Supplier documentation.** Declarations of conformity for the modules and power supplies used, RoHS declarations.
8. **Manual and safety information.** In the language of the country of sale. What it must contain is covered in our article on the manual and rating label.
9. **Copy of the EU declaration of conformity.** The signed declaration that you issue as the manufacturer.

> **Where you save**
>
> You already have the description, schematics, drawings, manual and supplier documentation from development. You just need to put them together. From us, you mainly need the test reports and possibly a check that nothing is missing.

EU declaration of conformity

A short document in which the manufacturer declares, under its sole responsibility, that the product meets all rules. If several directives apply to the product, **one combined declaration** is issued. It must contain:

- Product identification: name, type or model, and serial numbers or batch where relevant.
- Name and address of the manufacturer or its authorized representative.
- A statement that the declaration is issued under the sole responsibility of the manufacturer.
- The list of EU rules the product conforms with.
- Harmonized standards or other specifications, including their date of issue.
- Where applicable, details of the notified body and its certificate.
- Place and date of issue, name and function of the signatory, and the signature.

EU DECLARATION OF CONFORMITY

1. Product: ……, type ……

2. Manufacturer: ……, ……

3. This declaration of conformity is issued under the sole responsibility of the manufacturer.

4. Object of the declaration: the product identified in point 1.

5. The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

- Directive 2014/30/EU of the European Parliament and of the Council – electromagnetic compatibility (EMC)
- Directive 2011/65/EU of the European Parliament and of the Council – restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

6. References to the relevant harmonised standards used:

- ……

7. Additional information: –

Signed for and on behalf of: ……
……, 17 November 2026
……, ……

_____
signature

Common mistakes

- **The year of the standard is missing.** Without it, it is not clear which version you assessed the product against.
- **Both EMC and RED are listed.** Radio equipment falls under the RED, and EMC is then assessed under it. The EMC Directive is not listed in the declaration.
- **The lab signs the declaration.** It does not. The lab provides the test report; the manufacturer issues the declaration.
- **A declaration for a different version.** After changing the board, power supply or radio module, conformity must be reassessed.

DOCUMENTATION · TEMPLATES

User manual and rating label: what must be on them

The label and the manual are the first things a customer and an inspector see. We show which information is mandatory, and you can prepare a label template and a manual outline right here.

Reading time **6 minutes** Templates: **SVG label, Word manual**

Why it matters

A product can pass every test and still be withdrawn from sale by the market surveillance authority because of a missing address on the label or a manual in the wrong language. The label and manual are part of the technical documentation and are assessed as strictly as the measurements.

5 mm
minimum height of the CE marking

local language
manual and safety information for each country of sale

1 address
where the manufacturer can be reached, not just a website

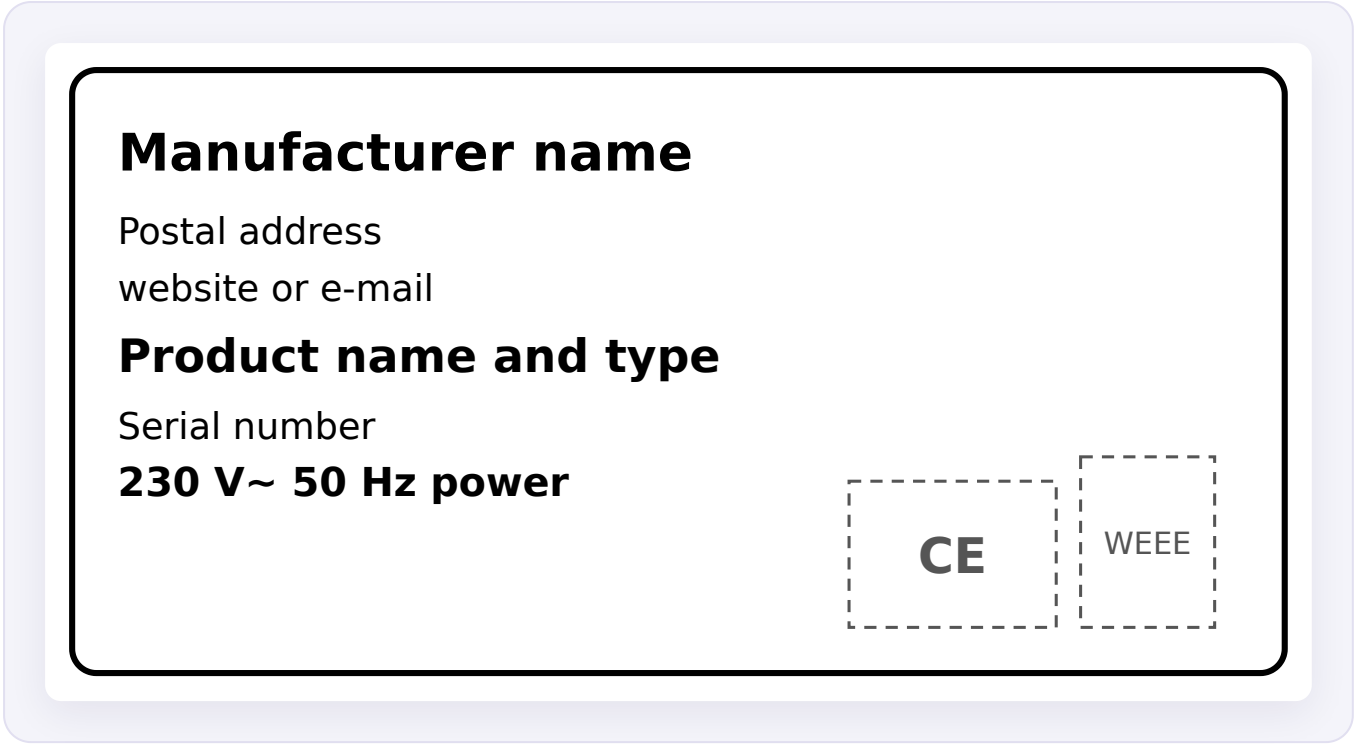
What must be on the rating label

The label information is required by the directives under which you CE mark the product and by the safety standard for your product. For electronics, it usually comes down to this:

ITEM	WHAT AND WHY	RULE
CE marking	Visible, legible and indelible, at least 5 mm high, in the prescribed proportions. The notified body number follows the marking only when the notified body is involved in production control.	Regulation 765/2008, Annex II
Type and serial or batch number	So that the product can be traced unambiguously. If it does not fit on the product, put it on the packaging or in the accompanying documents.	EMC Art. 7, LVD Art. 6, RED Art. 10
Manufacturer and postal address	Name, registered trade name or trademark and an address where you can be contacted. For consumer products, also an e-mail address or website.	EMC Art. 7, LVD Art. 6, RED Art. 10, GPSR Art. 9
Importer	If you import the product from outside the EU, add the importer's name and address.	EMC, LVD, RED – obligations of importers
Electrical ratings	Rated voltage, frequency and current or power. The exact scope is set by the safety standard for your product.	e.g. EN 62368-1, EN 61010-1, EN 60598-1
Protection class symbol	The double square for products with double insulation (class II). The IP rating, if you declare one.	product safety standard
Crossed-out wheeled bin	The product must not be disposed of with mixed waste. A bar or the date of placing on the market goes under the symbol.	WEEE 2012/19/EU, EN 50419

Small product?

If the information does not fit on the product, the directives allow the manufacturer's address to be given on the packaging or in the accompanying documents. The CE marking, type and serial number should, however, stay on the product itself where possible.



What must be in the user manual

A manual must always accompany the product, even industrial equipment. For electronics, these parts must not be missing:

1. **Language.** The manual and safety information must be in a language easily understood by users in the country of sale.
2. **Intended use.** What the product is for, where it may be used and what it may not be used for.
3. **Safety warnings.** The risks and how to avoid them. Specific warnings are prescribed by the product safety standard.
4. **Installation and connection.** How to connect, ground and mount the product correctly.
5. **EMC measures.** If conformity depends on installation, say so: shielded cables, ferrites, cable length, grounding. A class A product must carry a warning that it may cause interference in a residential environment.
6. **Technical data.** Power supply, power consumption, operating temperatures, IP rating, dimensions and weight.
7. **Maintenance and cleaning.** What the user may do and what only service may do.

8. **Radio equipment.** Frequency bands and maximum transmitted power. Include a copy of the EU declaration of conformity or a simplified declaration with a link to the full text.
9. **Disposal.** That the product belongs to the electrical equipment take-back scheme and where to return it.
10. **Manufacturer contact.** The same details as on the label; for consumer products, also an e-mail address or website.

Class A products

Class A products under EN 55032 are intended for industrial environments. Their manual must include a warning that they may interfere with radio and TV reception in a residential environment. The EMC Directive also requires any restrictions of use to be clearly stated in the manual and, where appropriate, on the packaging.

USER MANUAL

product name and type

1. Intended use

The product is intended for what it is for. Any other use is not intended and may be dangerous.

✎ *Where the product may be used (indoor / outdoor) and what it may not be used for.*

2. Safety warnings

The product is mains powered. Disconnect it from the power supply before opening the cover or changing the wiring. Installation may only be carried out by a person with appropriate electrical qualifications.

✎ *Warnings according to the product safety standard (e.g. EN 62368-1, EN 61010-1).*

3. Installation and connection

✎ *Mounting procedure, connection, grounding, fuse and cable requirements.*

4. Commissioning and operation

✎ *Switching on, controls, status indicators, settings.*

5. Technical data

Power supply: ...
Power consumption: ...
Operating temperature: ...
IP rating: ...
Dimensions and weight: ...

6. Maintenance and cleaning

✎ *What the user may do and what only service may do. Cleaning, replacing a fuse or battery.*

7. Disposal

A product marked with the crossed-out wheeled bin symbol must not be disposed of with mixed waste. Return it to a collection point for electrical equipment.

8. Manufacturer

manufacturer name
postal address
website or e-mail

Common mistakes

- **Only a website on the label.** A postal address where the manufacturer can be reached is mandatory. A website or e-mail is added on top.
- **A CE marking drawn by eye.** It has prescribed proportions and a minimum height of 5 mm. Use the official artwork.
- **A manual in one language only.** The manual and safety information must be in the language of each country where the product is sold.
- **Missing class A warning.** An industrial product without a warning about interference in residential environments will not pass a documentation review.
- **The label peels off or wears away after testing.** The information must be durable. Test it against the abrasion and temperatures the product will be exposed to.

LUMINAIRES · COMMON QUESTION

Making lamps? What you need for the CE marking

A 3D-printed table lamp, an E27 lampholder, a cord with a switch and an LED bulb. It looks simple, but even such a lamp is an electrical product. We show which rules apply, what is tested and what you can do yourself.

Reading time **5 minutes** Main topic: **electrical safety**

Short answer

Whoever sells the lamp under their own name is its **manufacturer**. They must assess conformity, compile technical documentation, draw up an EU declaration of conformity and affix the CE marking to the lamp. For luminaires, the manufacturer does this **alone**, without a notified body.

> **Good news**
>
> If you use CE-marked parts (lampholder, cord, switch, bulb), you take over a large part of the documentation from your suppliers. The assessment focuses mainly on what results from combining them: construction, heat and fastening.

Which rules apply

- **Electrical safety:** Directive 2014/35/EU (LVD). It applies to every mains-powered lamp. The main standards are EN 60598-1 and, for table and floor lamps, EN 60598-2-4.
- **Hazardous substances:** Directive 2011/65/EU (RoHS). You demonstrate it with declarations from your parts suppliers.
- **Electromagnetic compatibility:** Directive 2014/30/EU (EMC). Whether it applies to you depends on the electronics. See the next section.

Is EMC needed?

It depends on whether the lamp has **its own electronics**.

- **Without electronics** (just a lampholder, a mechanical cord switch and a replaceable bulb with its own CE): EMC tests are usually not needed. Emissions and immunity are handled by the bulb, which has its own declaration. You briefly justify this in the technical documentation.
- **With electronics** (built-in LED module or strip with a driver, dimmer, touch switch, USB charging): EMC is tested. Emissions to EN IEC 55015, immunity to EN 61547 and, for mains power, also harmonics and flicker to EN IEC 61000-3-2 and EN 61000-3-3.

Watch out for cheap LED drivers

Built-in LED modules and dimmers are the most common reason a luminaire fails EMC. If you plan to use them, do pre-compliance testing on the lamp before series production.

What is tested for safety

The EN 60598 standard covers the whole luminaire. For a simple lamp, these are the main points:

- **Temperature rise:** how hot the lamp gets with the highest permitted bulb wattage and whether the plastics and cord can withstand it.
- **Plastics, heat and fire:** parts that hold live parts must resist heat and must not ignite easily.
- **Cord:** anchorage against pulling and twisting, a cord entry without sharp edges.
- **Insulation and electric strength:** a lamp with a cord without a protective earth conductor must have double insulation (protection class II).
- **Stability:** a portable lamp must not tip over easily.
- **Marking and manual:** manufacturer, type, voltage, maximum bulb wattage and instructions in the language of the country of sale.

Watch out with 3D printing

Common 3D printing materials soften at low temperatures: PLA from about 60 °C, PETG from about 80 °C. For a lamp, therefore, watch:

- **The distance between the shade and the bulb.** The closer it is, the hotter the plastic gets.
- **The maximum wattage on the label.** A classic 60 W incandescent bulb, which gets much hotter than an LED, also fits an E27 lampholder. So state on the label and in the manual the type and maximum wattage with which you assessed the lamp.
- **Keep live parts inside certified components.** A printed part should only hold the lampholder, not replace its insulation.

Several variants, one assessment

Same electrical parts and different shade shapes? You do not have to test every variant. The **worst case** is tested: the shade closest to the bulb (highest temperature) and the least stable shape. You then describe all variants in one technical file and one declaration of conformity.

What you can do yourself and where we help

You can do it yourself

- Collect the EU declarations of conformity and RoHS declarations from the suppliers of the lampholder, cord, switch and bulb.
- A description of the lamp, photos, drawings and a parts list.
- The label, manual and EU declaration of conformity. Our declaration of conformity template helps.

Where we help

- Analysis of the EN 60598 requirements for your specific lamp and a review of your documentation.
- Electrical safety tests in our own lab. If you need a report from an accredited test lab, we arrange it with a partner.

- For lamps with electronics, EMC testing in our own chamber. We can usually offer testing within a week.

What manufacturers forget

- **Take-back:** luminaires are electrical equipment. Manufacturers must meet the national WEEE obligations (Directive 2012/19/EU) in each country where they sell, usually through a collective compliance scheme.
- **Identification on the product:** the manufacturer's name or trademark, postal address and type or batch number.
- **Instructions and safety information in the language of the country of sale**, including the maximum bulb wattage.