

Introduction

All products, which have an intrinsic function, are required to meet European Directives for Electromagnetic Compatibility (EMC). Crompton Instrument's products normally form part of an installation or system, which also has to meet these EMC Directives. In order to comply with the Directives, Crompton products are now marked CE. In order to achieve optimum performance, Crompton products should be installed to a good code of practice for EMC.

This technical sheet has been produced to aid the installer or system designer to incorporate Crompton instrument products in the finished apparatus in a manner, which will allow the apparatus to achieve the EMC performance required for its operational environment. **Advice is available through our networks of Sales and Service centres to help with situations not covered by this guide.**

Electromagnetic Compatibility

The essential requirements of the Directives for protection of an apparatus can be broken down into two parts:

- The electromagnetic disturbance it generates does not exceed a level preventing radio and telecommunications equipment and other apparatus to operate as intended.
- The apparatus has a level of intrinsic immunity, which is adequate to enable it to operate as intended when it is properly installed and maintained.

This does not mean that the apparatus has to be designed to meet all contingencies. It has to provide protection to a level that can reasonably be expected to be present.

The level of intrinsic immunity required will depend upon the application and environment. In particular the designer or installer should pay attention to the following:

- The level of performance reasonably expected of the final apparatus having regard to its intended function.
- A specification for an acceptable level of degradation of performance provided to the end user.
- The consequence of degradation of performance.

However nothing should authorise a level of interference which could permit the operation of the apparatus to be dangerous in any reasonably foreseeable circumstances.

To aid the designer of the apparatus to meet these requirements, this technical note will examine the various phenomena, furnish background information on the likely levels and sources, detail the effect upon Crompton Instruments products and provide details of possible protection measures.

Electromagnetic Emissions

The intrinsic performance of Crompton Instruments products allows them to meet all existing Directives and Standards, as regards emissions to industrial standards.

Electromagnetic Immunity

When looking at the immunity from interference, due consideration must be given not only to the origin of the source but also its nature, location and impact. For example, radio frequency interference (RFI) from a mobile telephone operated in front of a panel could produce the effects of fields in excess of 10 Volts per meter behind the panel. The field from the telephone, penetrating through apertures, can have unpredictable effects due to console and cable resonance. It is not sufficient to specify a particular level of immunity of an instrument, as the immunity of the device is effectively degraded by these effects.

A good way of combating EMI effects is through design to a code of practice for Electromagnetic Compatibility. Crompton has devised installation codes to aid in this practice. In order to further understand the effect of EMI on Crompton Instrument's products the following sections lists the electromagnetic interference by the type of phenomena.

1. Conducted low-frequency phenomena:**a) Slow variations of supply voltage:**

These are supply variations of up to +/- 10% of the nominal voltage. Crompton products are designed to operate with immunity from these disturbances but if safety is put at risk in critical applications then Crompton's advise the use of secure auxiliary supplies.

b) Harmonics and interharmonics:

This type of interference is generated by noisy loads such as fluorescent lighting, switch-mode power supplies and drives. Harmonic distortion can be tolerated by all products, but accuracy can be degraded. Specify instruments with true RMS detectors to obtain satisfactory results in these operational conditions.

c) Voltage fluctuations and interruptions:

Commonly known as brown-outs and drop-outs. These are defined in standards (EN 61000-4-11) as 30% fluctuations over 60 ms, 10% over 100 ms or <90% over 5 seconds. Crompton products can tolerate these fluctuations although an error in the output could occur during the fluctuation. Protection should be provided for safety critical applications by using a secure auxiliary supply.

Guide to Achieving Electromagnetic Compatibility

- d) **Voltage unbalance:**
This is caused in three phase systems by unbalanced loads. The result can be large neutral currents. Accuracy can be affected in 3 wire systems, if this disturbance must be tolerated then 4 wire system design is recommended.
- e) **Power-frequency variations:**
These variations usually occur in applications involving Gensets due to their speed governing characteristics. Crompton Instruments products can tolerate these variations. However, variations outside the product specification could result in errors in output.
- f) **Induced low-frequency voltages:**
These are caused by common mode pick-up on signal lines by cross coupling and stray pick-up. Careful segregation of leads and screening is very effective in overcoming these effects.
2. **Radiated low frequency phenomena:**
- a) **Magnetic fields (continuous or transient):**
Magnetic fields can be generated by currents in bus-bars with high peak values under fault conditions. Crompton Instruments products are designed to meet those encountered in the industrial environment without degradation of function.
- b) **Electric fields:**
Strong electric fields can be generated by high voltage distribution networks. These have not been known to effect Crompton Instrument products.
3. **Conducted high frequency phenomena:**
- a) **Induced continuous wave (CW) voltage or currents:**
The source of this type of interference is usually radio stations where the signal from the transmitter is coupled into the mains distribution network. In addition, if the transmitter is in close proximity to the installation, the RF can couple on to internal system signal leads. Installation configurations can result in RF currents flowing in cable harnesses well in excess of the equivalent to 10 volts per metre, the Industrial Standard for apparatus. The effect of these currents is difficult to predict. Therefore satisfactory operation of Crompton Instruments products depend upon installation techniques. The codes of practice for the design of the installation should therefore include the practices advised in the product installation sheet.
- b) **Unidirectional transients:**
High energy surges can be caused by contactors, tap changers and reactive switching etc. These transients (spikes or glitches) are short in duration (less than a few milliseconds) and can be up to several thousand volts. All Crompton products are designed to withstand up to 2 kV as recommended in the Standard IEC 1000-4-5. In situations where transients can be in excess of 2kV external transient suppressors should be fitted, if possible at the source of the interference i.e. across contractor coils and inductive loads etc. Crompton Instruments advise that specialist advice is sought from suppression device suppliers for the correct approach if a problem is likely to exist.
For further information on the nature of these surges see IEC 1000-4-5.
4. **Radiated high frequency phenomena:**
- a) **Magnetic fields:**
A magnetic field (H field) is generated around a conductor carrying a current. The field is measured in amps per meter and is proportional to the current divided by the distance from the conductor.
- b) **Electric fields:**
An electric field (E field) is generated between two conductors at different potentials. The field is measured in volts per meter and is proportional to the applied voltage divided by the distance between the conductors.
- c) **Electromagnetic fields:**
Electromagnetic fields (E & H fields as above) are, for industrial environments, rated at 10 volts per meter but, within consoles and depending upon internal wiring antenna effects, environments in excess of this can be generated. Crompton products can operate satisfactorily in these environments when installation practices are followed as advised on the product installation sheet. See IEC 1000-4-3 Annex for clarification of environments.
5. **Electrostatic discharge (ESD):**
A person walking across an insulated floor can develop a charge up to many thousands of volts, on coming into contact with a metal object such as an instrument console, a discharge will occur resulting in a high current pulse circulating through the instruments. Crompton products are type tested to withstand 8kV discharge levels from in-service operations without degradation of performance.
ESD precautions must be taken at all times when handling Crompton Instruments products during shipping and installation. See British Standard BS 5783 or its international equivalent for more details.

The Information contained in these installation instructions is for use only by installers trained to make electrical power installations and is intended to describe the correct method of installation for this product. However, Tyco Electronics has no control over the field conditions, which influence product installation. It is the user's responsibility to determine the suitability of the installation method in the user's field conditions. Tyco Electronics' only obligations are those in Tyco Electronics' standard Conditions of Sale for this product and in no case will Tyco Electronics be liable for any other incidental, indirect or consequential damages arising from the use or misuse of the products. Crompton is a trade mark.



Tyco Electronics UK Limited
Crompton Instruments

Freebournes Road, Witham, Essex, CM8 3AH, UK
Phone: +44 1376 509 509 Fax: +44 1376 509 511

<http://energy.tycoelectronics.com>

Ref: T96/336 – Rev 3 – March 02

Guide to Achieving Electromagnetic Compatibility

Installation Codes

In general the following practices can be used as a guide when installing Crompton Instruments products. Table 1 allows the designer to select the appropriate codes for a product based upon the environment identified in the previous section. In safety critical applications, products must be installed to the code listed in table 1 or on the installation sheet for the product.

PRODUCT GROUP	Low level	Moderate	Severe
DC Analogue meters	C	C	C
AC Rectified meters	D	D	D
Meters incorporating active discrete electronics	C	D	F
Meters incorporating microprocessors	C	D	F, G
Protectors	C	D	F
Transducers	C	D	F, G
Integra	C	D	F, G

Installation codes recommended per product group - Table 1

- CODE A** "General" Cable routing
Control and signal cables should be segregated from power cables to avoid common mode pick-up, and their lengths made as short as possible.
- CODE B** "General" Shielding
Route cables along the surface of existing metal work to take advantage of inherent shielding effects.
- CODE C** Twisted pair
Twisted cables should be used to provide protection from transient energy surges and RF currents. If cables are routed separately then protection measures against differential interference might be required. Routing cables along existing metal work can be of additional benefit but the effectiveness depends upon the impedance of the earth bonds.
- CODE D** Shielded twisted pair
To provide protection from RF fields screened twisted leads should be used on all signal and low level control leads. If possible the screen should be earthed at the product end of the cable only, ideally with a 360 degree cable clamp. Due to cable antenna effects experimentation with cable routing and earthing points might be necessary to achieve optimum results. If it is not possible to use screened leads, see Code E.
- CODE E** - Low level RFI filtering (RF 10-150MHz and line transients)
RF interference from mobile telephones, inverters and switch mode power supplies could cause a malfunction in an instrument depending upon the installation configuration and cable antenna effects. Ferrite Absorber sleeves are useful retrofit components where segregation from interference sources, screened leads and optimum earthing points are not possible. The absorbers should be positioned as close as possible to the product for RF suppression and at the source of the interference if it can be identified. For severe cases of interference see Code F.
- CODE F** - Instrument enclosure for severe or unpredictable levels of interference
In severe interference environments where portable transceivers and mobile phones are used within 20 meters of the equipment or in heavy industrial environments. Electronic products should be installed in a metal enclosure that provides protection from radiated and conducted interference.
- CODE G** - Transient suppression
Unless a disturbance of function can be tolerated instruments must be protected using transient and surge arrestors that limit peak amplitudes to below 1kV. It is always best to fit transient and surge arrestors at the interference source, i.e. across relay and contractor coils and inductive loads etc.

The Information contained in these installation instructions is for use only by installers trained to make electrical power installations and is intended to describe the correct method of installation for this product. However, Tyco Electronics has no control over the field conditions, which influence product installation. It is the user's responsibility to determine the suitability of the installation method in the user's field conditions. Tyco Electronics' only obligations are those in Tyco Electronics' standard Conditions of Sale for this product and in no case will Tyco Electronics be liable for any other incidental, indirect or consequential damages arising from the use or misuse of the products. Crompton is a trade mark.



Tyco Electronics UK Limited Crompton Instruments

Freebournes Road, Witham, Essex, CM8 3AH, UK
Phone: +44 1376 509 509 Fax: +44 1376 509 511

<http://energy.tycoelectronics.com>