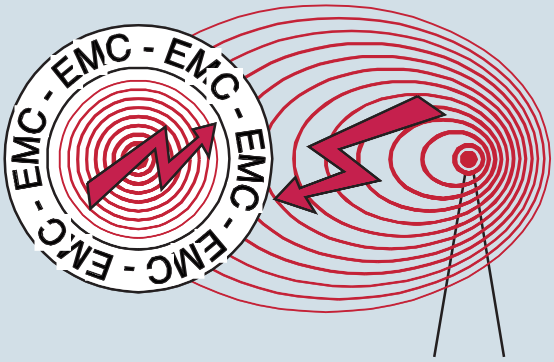
Connectors and electromagnetic compatibility (EMC) Directives and standards.

The concept of **Electromagnetic Compatibility** (EMC) is the reversal in the positive sense of what was until recently known as **Electromagnetic Interference** (EMI): ***we have electromagnetic compatibility*** between a device and the environment (including surrounding equipment) when there is no reciprocal electromagnetic interference or when this is within tolerable limits.
In other words, ***to obtain electromagnetic compatibility,*** measures must be adopted aimed at bringing the electrical or electronic equipment to levels of **emission** and electromagnetic **immunity** against electromagnetic interference such that it continues to function properly without causing disturbance to other equipment present in the surrounding environment.



In the electrical equipment of industrial machines, rectangular multipole connectors with their metallic enclosures are widely used due to their high standards of safety, reliability, mechanical robustness and resistance to corrosion and pollution.

These connectors are passive electromechanical components: they do not generate electromagnetic interference and are not disturbed in their function. Taken by themselves, therefore, they fall outside the scope of Directive 89/336/EEC on electromagnetic compatibility and the CE mark is therefore not required for EMC aspects: it still applies, however, under the Low Voltage Directive.

It is rather the devices and industrial equipment mentioned above, in which the connectors are for the most part used (e.g. on-board electric panels) which, taken as a whole, must be CE marked also for EMC aspects, having to meet the fundamental safety requirements of the EMC Directive.
For EMC in industrial environments two European standards are in force, not intended for specific equipment, which regulate the emissions and immunity of devices. These are therefore generic standards, one for emissions (EN 50081-2 (1993), class. IEC 110-13, 1994, IEC CISPR 26 project) and one for immunity (EN 50082-2 (1995), class. IEC 110-25, 1995, IEC 61000-6-2) project[1].
These apply in the absence of provisions in the particular EMC product standards or in the total absence of the latter. For industrial equipment, when appliances are not intentionally designed to generate radio frequencies[2], the latter case applies (no particular standards).
In European standards for electrical panels (EN 60947-1) and in those for electrical equipment of machines (EN 60204-1) emission and immunity limits have for some time been in the process of being issued, as well as their verification, if necessary, with reference to above-mentioned industrial environment EMC standards.

EMC testing should not be performed on individual components, but rather on the entire apparatus, at times not without inconsiderable logistical difficulties due to the size, reproducing as far as possible their operation in real operating conditions.
It is therefore incorrect to assign limits of electromagnetic emission and immunity imposed on the equipment on, for example, connectors present as components of the equipment.

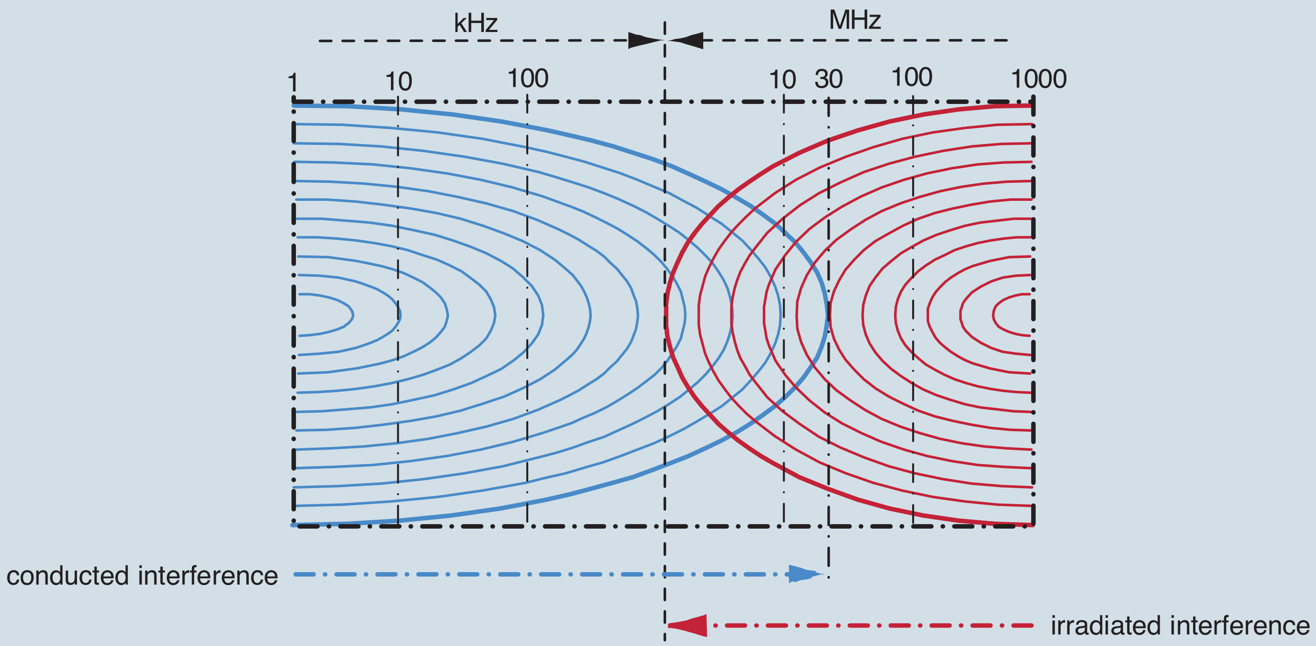
1) there are two similar for the other standardized environment, defined as residential, commercial and light industrial environment, respectively EN 50081-1 (1992), class. IEC 110-7, 1992 for emissions (IEC CISPR 27 project) and EN 50082-1 (1992), class. IEC 110-8, 1992 for immunity (IEC 61000-6-1 project).
2) in which case for such devices, called ISM (industrial, scientific, medical) EN 55011 standard for emission of radio interference would apply.

Electromagnetic interference and ILME connectors.

The entry into force of the EMC Directive, with requirement for electrical and electronic equipment to comply with the levels of electromagnetic pollution dictated by the standards, brought renewed interest in all the appropriate steps to mitigate the effects of electromagnetic interference.

Electromagnetic interference can occur in two forms: **conducted or radiated**. With reference to connectors, **conducted interference** transmitted on conductors wired to the connectors, is, for example: harmonic, superimposed on the voltage of the power supply at 50 Hz, caused by withdrawal of biased current or by electromechanical or electronic switches, or radio frequency interference noise which is inductively or capacitively coupled with the cable, overlapping transported signals.
This is characterized by frequency and amplitude (intensity) and can be filtered to some extent, both in the outgoing (emission) and incoming (immunity) direction, only via in-line passive electrical filters, which the designer of the electrical equipment must foresee since he is the only one with a knowledge of all the terms of the problem[3].

Radiated interference, transmitted in the form of electromagnetic waves, is characterized by the values of amplitude of associated electric (V/m) and magnetic fields and with the frequency or frequency band (rarely is this located on a single frequency, more often it occupies a band). This may come from inside the device: in this case it is necessary to mitigate emissions. Or from the outside, in which case it is necessary to raise immunity.



By test convention, **interference with frequency up to 30 MHz** is considered to be conducted and **irradiated with frequency above 30 MHz up to 1 GHz**.

3) For example, for trapezoidal Sub-D type connectors for digital data transmission, there are connectors on the market which incorporate "general purpose" filters for any conducted interference.

The sources of electromagnetic interference are classified as intentional and unintentional. The first (e.g. radio-telecommunication antennas, mobile phones) use high frequency electromagnetic fields for functional reasons. For the second (e.g. ignition of internal combustion engines, electric arc furnaces) they are a by-product.

In most industrial applications, compared to the overall EMC issues of a device, connectors (inserts + enclosures), taken by themselves, are not the priority concern of the designer.
The enclosures of the low-frequency industrial connectors, taking shape as a barrier to a “shell”, are implicitly a “peripheral” aspect: the designer of electrical equipment / electronics will take care first of all the “core” of the EMC problem, that of the active components to ‘inside of your system by limiting the emissions and enhance immunity.
In fact, to have significant problems due to radiation through the opening constituted by a connector enclosure on a control panel, there must be a particularly “efficient” radiofrequency source inside the panel. Essentially, significant design errors must have been committed regarding the EMC of the entire equipment.

In certain cases the coupling of connectors may constitute the weak link in the chain, for example where it is not possible for functional reasons to further reduce interference of the electronics inside the control panel. In these cases one must rely on the efficiency of the shield. Even if the equipment manufacturer uses shielded fabrication and high quality shielded cables, continuity and homogeneity of such shielding could be significantly degraded precisely in the passage between mobile connector and panel.
In dealing with electromagnetic compatibility of electrical equipment of an industrial machine, a second aspect to be addressed as a priority is the presence of large quantities of interface cabling.
In these cases, the significant attenuation of the shield necessary for the cables must not be jeopardised by the connector enclosures due to imperfect earthing of the cable shield.

It should nevertheless be pointed out that increasing shielding may not be sufficient to solve possible problems and should be considered as a complementary choice.

Electromagnetic shielding of connectors: fundamental principles.

To considering electromagnetic compatibility of an electrical/electronic device in the final verification rather than in the design phase almost always leads to a substantial increase in overall development time and costs.

The designer who deals with electromagnetic compatibility issues should use the same rules and the same precautions regardless of whether the equipment is subsequently shielded. Numerous products meet electromagnetic compatibility standards without the use of shielding. However, when all other limiting interventions are impossible or uneconomical, recourse to increased efficiency of the electromagnetic shield is the only answer.

An **electromagnetic shield** is a barrier to the transmission of electromagnetic fields. To generalise the concept to include conducted emissions, a filter can be considered as a shield. We will restrict ourselves here to considering a shield as a barrier to radiated emissions.
The metallic containers which completely enclose an electrical/electronic device or a part thereof ***constitute an electromagnetic shield***, with the task of preventing the emissions of electrical/electronic devices or a part thereof to radiate outside the equipment container itself.
A cable connected to a device is part of the same for the purposes of electromagnetic compatibility. A flexible multicore cable is shielded by surrounding the insulated conductors with a conductive metal mesh.
An electromagnetic shield is characterized by a parameter which measures its efficiency.
Attenuation of the shield is the ratio between the radiated power generated inside a device and the residual radiated power outside the unit. Attenuation introduced by a shield can be measured by comparing the absence and presence of the shield. ***Shielding attenuation is measured*** in dB (decibels). 20 dB is equivalent to an order of magnitude, i.e. attenuation of a factor of 10, 40 dB = attenuation of a factor of 100, etc.

To obtain large shielding attenuation values (e.g. 100 dB) the shield must completely enclose the electronic device and not have any means of access from the outside, such as openings, joints, cracks or cables. Any means of access through a shield, if not properly treated, can drastically reduce the efficiency of the shield.
The passage of a cable through a shield must be properly considered. One common method is to place filters on the cable at which it crosses the shield. Another is to use shielded cables, with their shields connected for the entire perimeter to the equipment shield.
To reduce radiated emissions of a cable, the cable shield must be connected to a point with zero potential (an ideal ground therefore, not a logical ground of an electronic circuit).

To achieve electromagnetic shielding conductive materials (metals) are used. Shielding attenuation depends mainly on the electrical conductivity of the material and thickness of the shield.

Rectangular or square connectors - special case - intrinsically anisotropic, are more difficult to shield and less predictable in behaviour than circular connectors (isotropic geometry) used, not by accident, with coaxial terminations for RF applications.
Connector enclosures are typically made of aluminium alloy, excellent metal for shielding electric fields because it is an excellent conductor. It is also better than steel in shielding phenomena of an impulsive nature (typical example is electrostatic discharge) which cause interference in the high frequency spectrum and is among the most insidious and dangerous.
It is important to ensure electrical continuity along the boundary of the enclosure, not only to ensure high shielding attenuation but also to avoid accumulation of static electricity.
It is important not to “economically” tip the balance of a screening system which is only as effective as its weakest component.

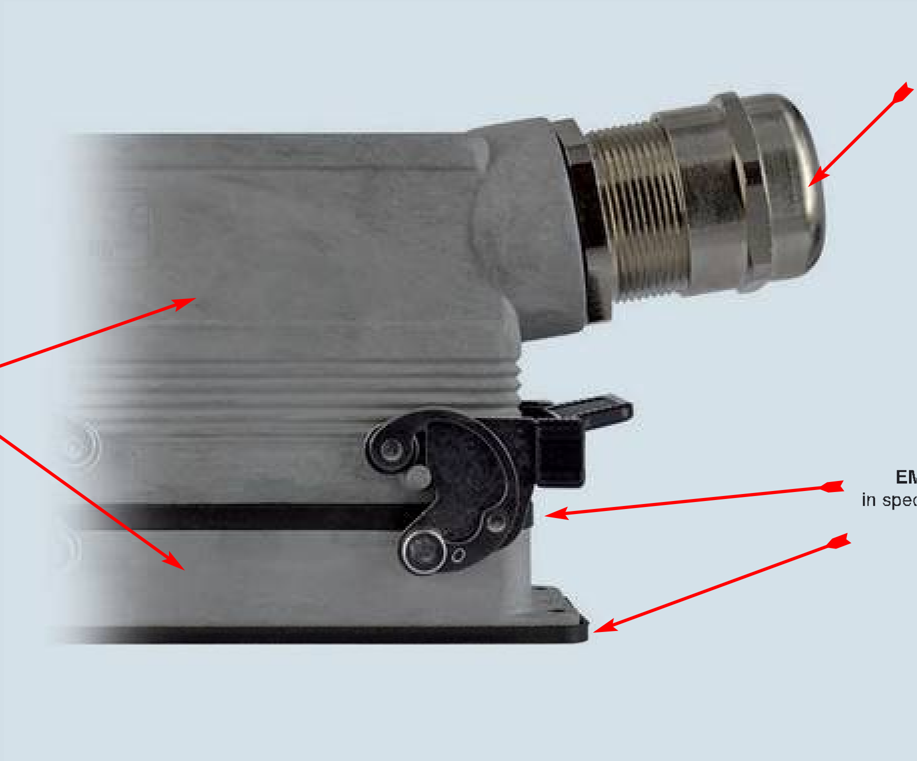
A good shielded cable has a shield attenuation greater than that attributable to the connector, but only for very small lengths of cable (e.g. one metre). When the length of the shielded cable increases, shield attenuation is significantly reduced.
This indicates that it is much more important to improve the shield quality of cables, which are mainly responsible for radiated interference emissions and in an electrical system are often present in considerable quantity, before that of the connector.

What dramatically increases the efficiency of shielding is the quality of its connection to the conductor: EMC cable glands create a very homogeneous and continuous contact between the cable shield and connector enclosure.

EMC connector enclosures and accessories

In light of the foregoing, ILME has developed for designers of the electrical/electronic machine equipment the new series of EMC connector enclosures and accessories.
Available in bulkhead mounting housings and hood versions in the various sizes 06/10/16/24, they maintain the robustness and reliability of standard types whilst possessing increased high frequency shielding characteristics.
In the development of EMC enclosures recourse to geometrical modifications compared to the standard versions has been avoided so as not to affect their dimensional compatibility with the latter: in using EMC enclosures the equipment designer need not foresee any changes in layout due to increased dimensions and need not renounce the convenience of the traditional lever closures.
The increase in shielding attenuation is achieved primarily by providing a homogeneous and as uniform as possible electrical continuity of earthing to the cable shield in the connection between cable and hood and between hood and enclosure.
At the contact between the bulkhead mounting housings and fixing surface a special conductive gasket is foreseen.

EMC connector



The enclosure surfaces are treated to make them extremely conductive while maintaining the necessary corrosion resistance.
The bulkhead mounting housing has a special conductive gasket. For best results the surface underneath the gasket should be conductive.
Since the use of this enclosure system presupposes the use of shielded cables, the hood should comprise a special cable gland with anchoring device for the cable shield.
These metal cable glands ensure IP65 protection rating, are resistant to corrosion and equipped internally with a contact element with geometry that ensures uniform earthing of the cable conductor shield on the metal shell of the hood.
Even with standard enclosures (not EMC), the contact with an EMC cable gland between the cable shield and the connector enclosure, permanently earthed to the insert inside, produces an attenuation of electromagnetic interference on average higher (by approx. 6 ÷ 15 dB up to 600 MHz, corresponding to a factor of 2 ÷ 5.6) than the attenuation achieved by connecting the shield mesh directly to the earth terminal of the connector insert.

The reasons for this are:
- the uniform 360° contact via the contact device of the EMC cable gland avoids what instead happens when the shield mesh is earthed to the earth terminal of the connector, i.e. the discontinuity of the shield which necessarily opens precisely around the connector;
- more efficient distribution of induced current circulating on the shield mesh;
- directly involving the metal shell constituted by the enclosure avoids transmitting interference to the connector, as happens when the shield is connected to the earth terminal of the connector.

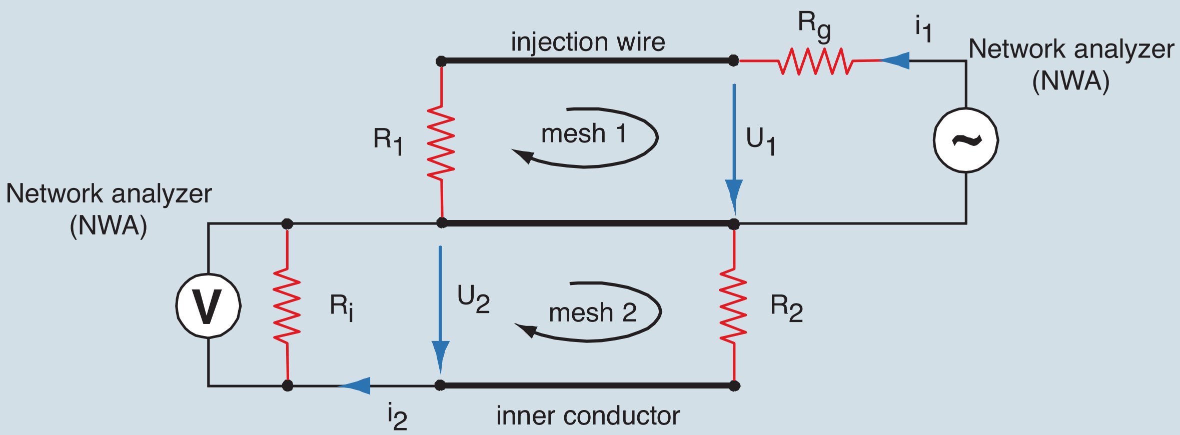
EMC - overview

Experimental tests

Tests for measurement of the shielding of ILME special EMC enclosures for multipole rectangular connectors for industrial use were conducted at the CESI EMC Laboratory in Milan, national notified body for certification under the EMC Directive.
Shielding attenuation of a component is defined as the ratio of the power radiated within the component and the maximum interference power outside the component in the room (VG 95214-11).
For a connector it can be expressed, in analogy with cables, as a function of transfer impedance, which is the ratio between the voltage induced in the shield and the current flowing outside the same. The transfer impedance measurement is a widely used and accepted method to determine shielding attenuation of coaxial cables and connectors. Only recently, due to the increase in digital data transmission speeds and the increase in frequencies of transmitted signals, the issue of identifying efficient and repeatable methods for measuring shielding efficiency, also for connectors traditionally considered low frequency, has been addressed at a regulatory level.

An experimental method for determining surface transfer impedance of coupled low frequency connectors is still being studied by IEC.

The method chosen by ILME for verification of its system of EMC enclosures and accessories is the **line injection method** based on German military standards **VG 95214-10** and **VG 95214-11.**



Legend:

R_g = output impedance of the signal generator (NWA port1)
R_1 = termination resistance of the generator circuit (mesh 1)
R_i = input impedance of the measuring instrument (NWA port 2)
R_2 = termination resistance of the generator circuit (mesh 2)

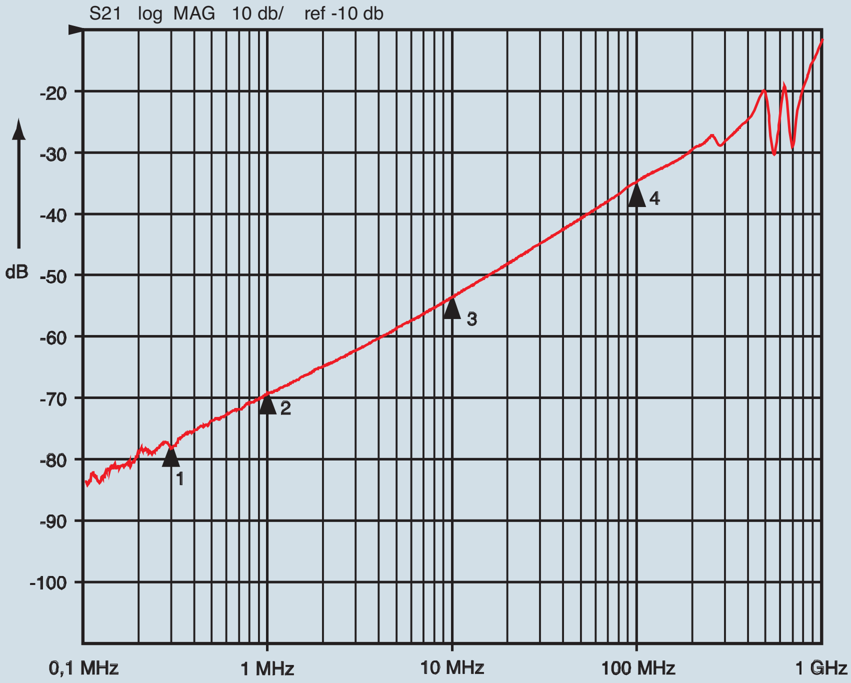
A signal with a frequency of 0.1 MHz and 1000 MHz generated by port 1 of the measuring device (network analyzer with 75 Ω output impedance) circulates in mesh 1 consisting of an insulated conductor (injection wire) resting on the surface of two coupled enclosures (shield), terminating on a calibrated (and shielded) resistance of 75 Ω. As a result of the current i_1 injected in mesh 1, an induced voltage U_2 is generated in mesh 2, consisting of an inner pick-up conductor connected to two contacts at the center of the connector inserts, terminated on another calibrated resistance of 75 Ω (shielded), in turn earthed on the coupled enclosures which act as a shield. The voltage is measured on port 2 of the measuring device for S parameters (scattering parameters). The network analyzer sees the device under test as a filter and calculates the measurement providing a graph illustrating the shielding attenuation (measured in dB) as a function of frequency in MHz

The tests were performed on:

- coupled standard enclosures
- coupled EMC enclosures

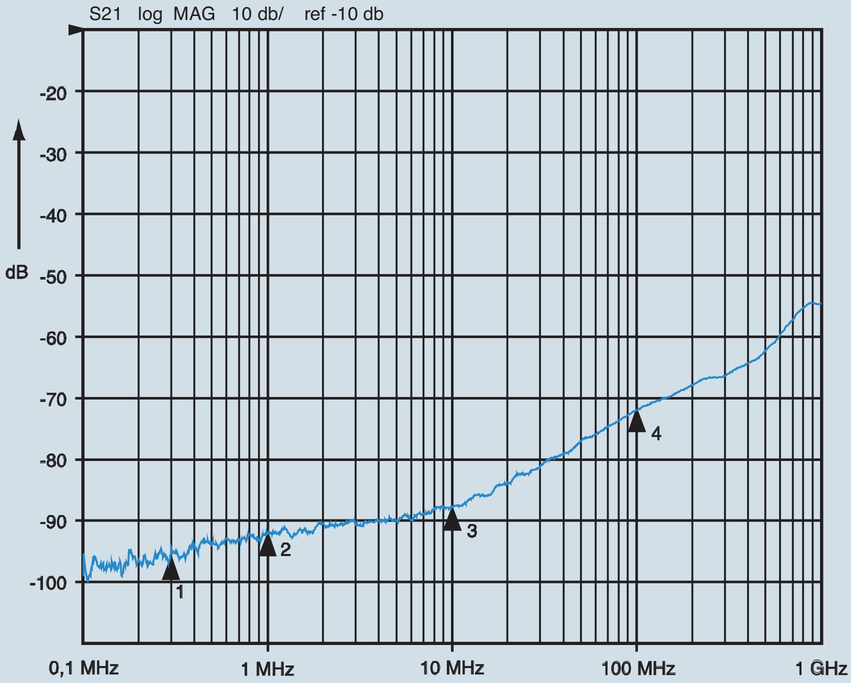
The results are summarized in the diagrams below.

Standard enclosure diagram



1_:-78.167	dB
300	kHz
2_:-69.369	dB
1	MHz
3_:-53.543	dB
10	MHz
4_:-34.719	dB
100	MHz

EMC enclosure diagram



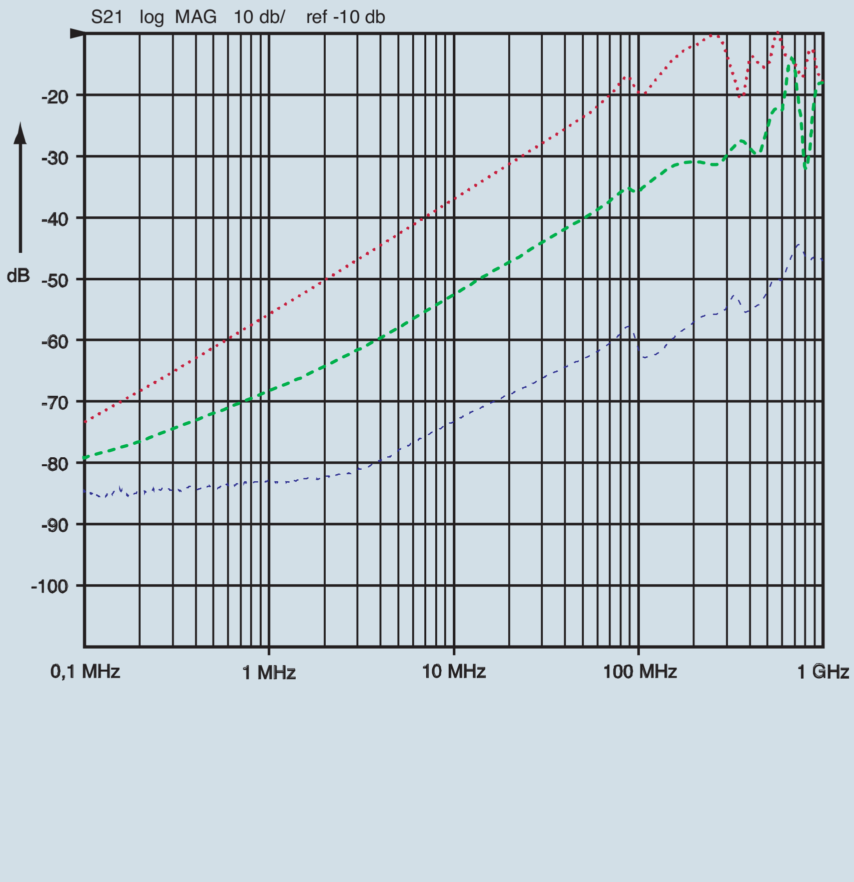
1_:-93.988	dB
300	kHz
2_:-91.86	dB
1	MHz
3_:-87.557	dB
10	MHz
4_:-71.649	dB
100	MHz

EMC - overview

To highlight the influence of the cable gland the shielding attenuation measurements were repeated on:

- coupled standard enclosures with standard cable gland and cable shield earthed to the earth terminal of the connector see curve A
- coupled standard enclosures with EMC cable gland and cable shield earthed to the cable gland see curve B
- coupled EMC enclosures with EMC cable gland and cable shield earthed to the cable gland see curve C

The results are summarized in the diagrams below.



Conclusions

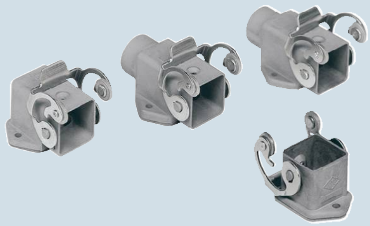
The measurements suggest the following considerations:

- standard enclosures already provide good levels of shielding attenuation;
- when used with EMC cable glands, standard enclosures clearly increase their shielding attenuation;
- EMC enclosures, with better shielding attenuation values, provide further improvements.

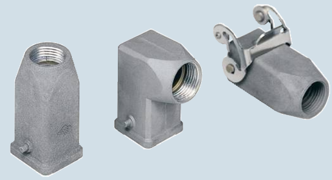
inserts:

insert dimensions:
21 x 21 mm

straight and angled bulkhead mounting housings

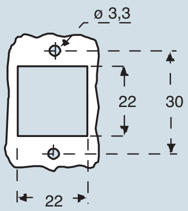


hoods



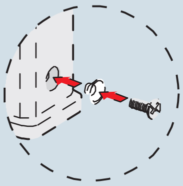
description	part no. (entry - Pg 11)	part no. (entry - M 20)	part no. (entry - Pg 11)	part no. (entry - M 20)
with stainless steel lever	**CKAXS 03 I**			
without cable gland, stainless steel lever	**CKAXS 03 IA**			
with cable gland, stainless steel lever	**CKAXS 03 IAP**	**MKAXS IAP20**		
with cable gland entry, stainless steel lever, bulkhead hole closed	**CKAXS 03 AP**	**MKAXS AP20**		
with pegs, top entry			**CKAS 03 V**	**MKAS V20**
with pegs, side entry			**CKAS 03 VA**	**MKAS VA20**
with stainless steel lever, top entry			**CKAXS 03 VG**	**MKAXS VG20**
gasket and screw kit for IP66/IP67 1) for CK, CQ 05, CKS inserts	**CKR 65**		**CKR 65**	
gasket and screw kit for IP66/IP67 1) for CD 08 inserts	**CKR 65 D**		**CKR 65 D**	

panel cut-out for enclosures, in mm



1) To obtain the protection rating IP66/IP67 a kit is provided that includes a gasket to fit under the insert fixing screws supplied with the kit (see illustrative example)

Note:
CQ 12 inserts are already supplied with a gasket and screw which ensure IP66/IP67 protection rating.



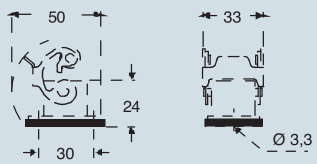
Type 12
Type 4/4X only
with CKR 65 (D)

IP66/IP67 with CKR 65 (D) 1)

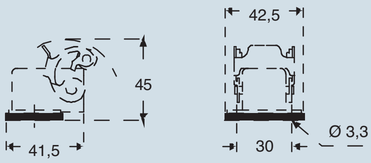
dimensions shown are not binding
and may be changed without notice

dimensions in mm

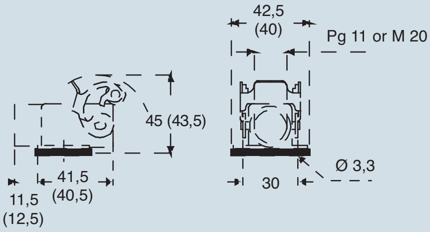
CKAXS I



CKAXS IA

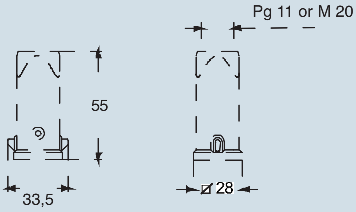


CKAXS IAP (CKAXS AP) and
MKAXS IAP (MKAXS AP)

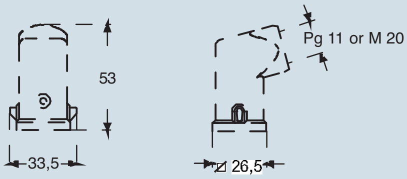


dimensions in mm

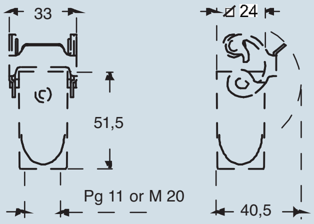
CKAS V and **MKAS V**



CKAS VA and **MKAS VA**



CKAXS VG and **MKAXS VG**



EMC - size 21.21

inserts: page

- metallic insulating enclosures

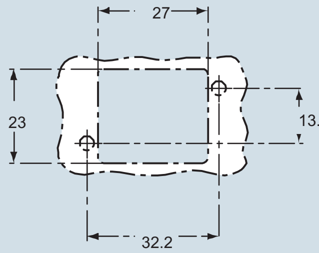
bulkhead mounting housing with single lever

hood with 2 pegs

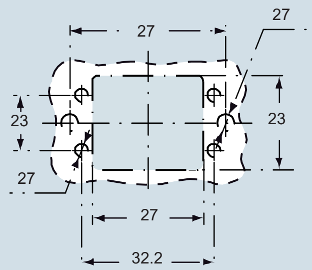
description	part no.	entry Pg	part no.	entry Pg
with lever	**CQS 08 I**			
without cable gland entry, angled, with lever	**CQS 08 IA**			
with cable gland entry, angled, with lever	**CQS 08 IAP**	21		
with pegs, side entry **			**CQS 08 VA**	16
with pegs, top entry **			**CQS 08 V**	21

** Pg male thread on enclosure exterior

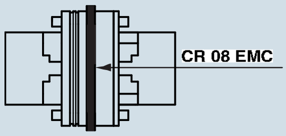
panel cut-out for CQS I enclosure, in mm



panel cut-out for CQS IA - CQS IAP enclosure, in mm



Note:
when using series “CQS 08” enclosures, replace the gasket provided with male inserts with the conductive gasket “**CR 08 EMC**”.

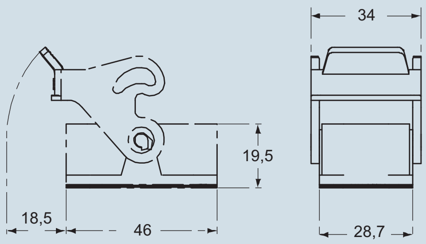


Type 12

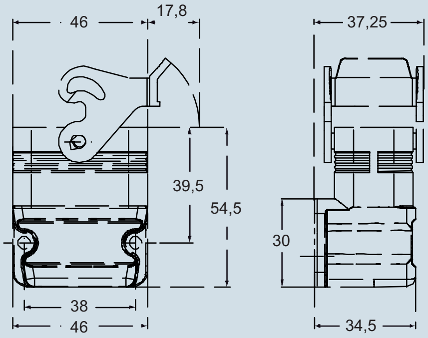
dimensions shown are not binding and may be changed without notice

dimensions in mm

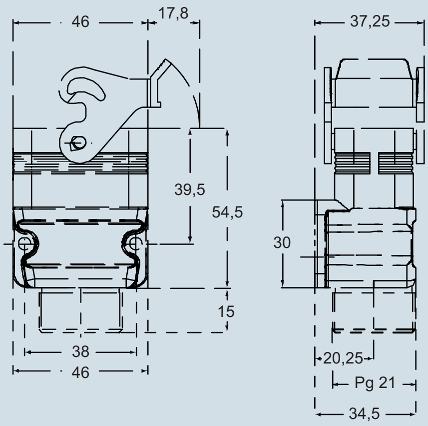
CQS I



CQS IA

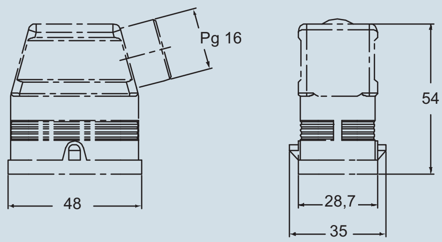


CQS IAP

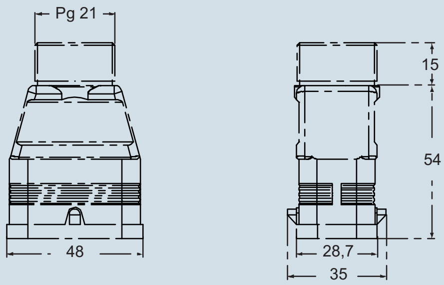


dimensions in mm

CQS VA



CQS V



EMC - size 32.13

inserts: page

- metallic insulating enclosures

hood with 1 lever

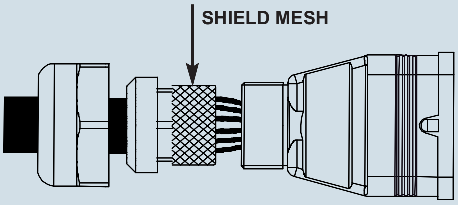
conductive gasket for CQM male inserts
thermoplastic resin cable glands

description	part no.	entry Pg	part no.
with lever, top entry **	**CQS 08 VG**	21	
conductive gasket for CQM male inserts			**CR 08 EMC**
cable gland head and gasket for CQS 08 VA enclosure			**CRQ 16**
cable gland head and gasket for CQS 08 V enclosure VG and IAP			**CRQ 21**

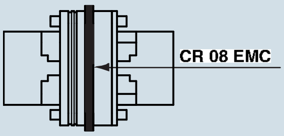
** Pg male thread on enclosure exterior

cable diameters for cable glands:
- CRQ 16: 10 - 14.5 mm (4 - 7 mm on request)
- CRQ 21: 14 - 18 mm (7 - 10 mm on request)

place the cable shield mesh between the CRQ cable gland gasket and the seat of the gasket itself.



when using series "CQS 08" enclosures, replace the gasket provided with male inserts with the conductive gasket "**CR 08 EMC**".

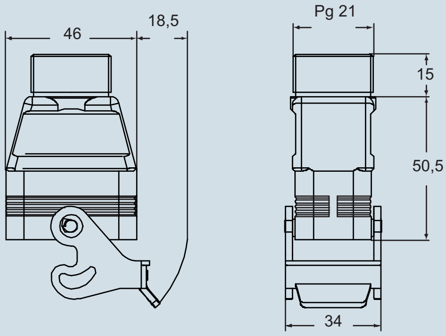


Type 12

dimensions shown are not binding
and may be changed without notice

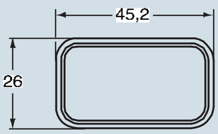
dimensions in mm

CQS VG

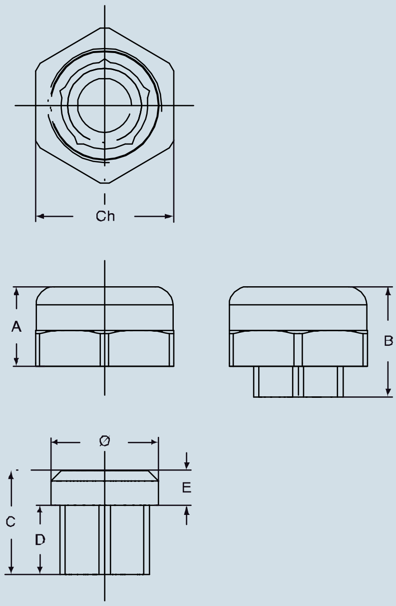


dimensions in mm

CR 08 EMC



CRQ 16 e CRQ 21



no.	A	B	C	D	E	Ø	Ch
CRQ 16	15.5	21.5	20.25	13.5	6.75	21	27
CRQ 21	18.2	27.5	25	15.5	9	26.5	33

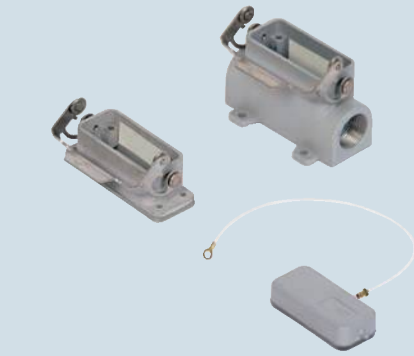
EMC - size 32.13

inserts: page

CD	15	poles + ⊕	47
CDA	10	poles + ⊕	72
CDC	10	poles + ⊕	73
MIXO	1	module	156÷195

Cover versions L and LG cannot be used together with coding pins. If this application is required, please contact ILME SpA.

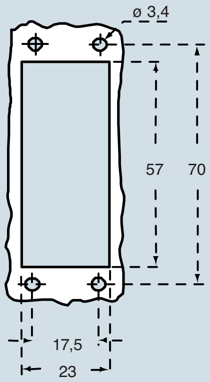
housings and cover for electromagnetic compatibility



hoods and cover for electromagnetic compatibility

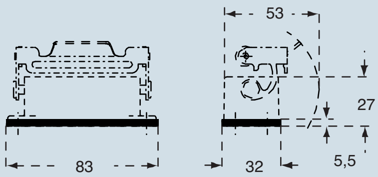
description	part no.	entry Pg	part no.	entry M	part no.	entry Pg	part no.	entry M
bulkhead mounting housing with lever	**CZIS 15 L**	—-						
surface mounting housing with lever	**CZPS 15 L2**	16 x 2	**MZPS 15 L225**	25 x 2				
cover with pegs (for 1 lever enclosures)	**CZCS 15 L**							
enclosure with pegs, side entry					**CZOS 15 L**	16	**MZOS 15 L20**	20
enclosure with pegs, side entry							**MZOS 15 L25**	25
enclosure with pegs, side entry, high construction					**CZAOS 15 L21**	21	**MZAOS 15 L25**	25
enclosure with pegs, top entry					**CZVS 15 L**	13.5	**MZVS 15 L20**	20
enclosure with pegs, top entry, high construction					**CZAVS 15 L21**	21	**MZAVS 15 L25**	25
cover with lever (for enclosures with pegs)					**CZCS 15 LG**			

panel cut-out for bulkhead mounting housings in mm

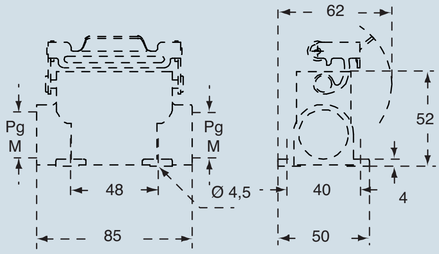


dimensions in mm

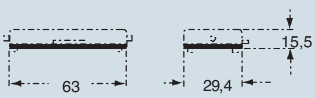
CZIS L



CZPS L and **MZPS L**

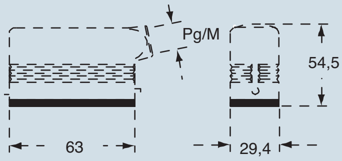


CZCS L

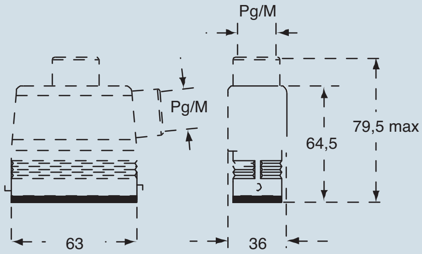


dimensions in mm

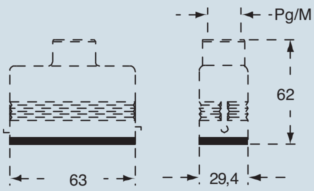
CZOS L and **MZOS L**



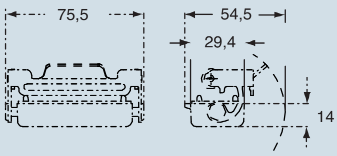
CZAOS L - MZAOS L and **CZAVS L - MZAVS L**



CZVS L and **MZVS L**



CZCS LG



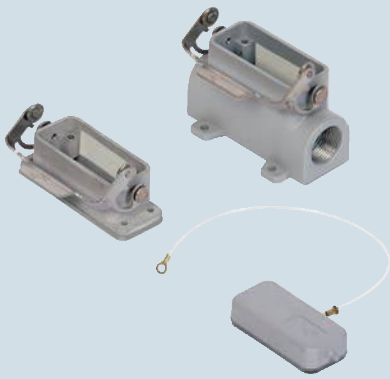
Type 4/4X/12

dimensions shown are not binding and may be changed without notice

inserts: page

Cover versions L and LG cannot be used together with coding pins. If this application is required, please contact ILME SpA.

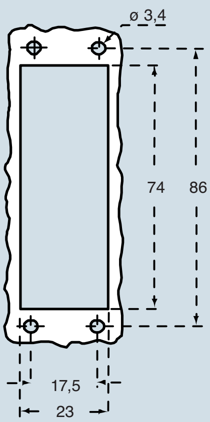
housings and cover for electromagnetic compatibility



hoods and cover for electromagnetic compatibility

description	part no.	entry Pg	part no.	entry M	part no.	entry Pg	part no.	entry M
bulkhead mounting housing with lever	**CZIS 25 L**	—-						
surface mounting housing with lever, high construction	**CZAPS 25 L2**	16 x 2	**MZAPS 25L225**	25 x 2				
cover with pegs (for 1 lever enclosures)	**CZCS 25 L**							
enclosure with pegs, side entry					**CZOS 25 L**	16	**MZOS 25 L20**	20
enclosure with pegs, side entry							**MZOS 25 L25**	25
enclosure with pegs, side entry, high construction					**CZAOS 25 L21**	21	**MZAOS 25 L25**	25
enclosure with pegs, top entry					**CZVS 25 L**	16	**MZVS 25 L20***	20
enclosure with pegs, top entry, high construction					**CZAVS 25 L21**	21	**MZAVS 25 L25**	25
cover with lever (for enclosures with pegs)					**CZCS 25 LG**			

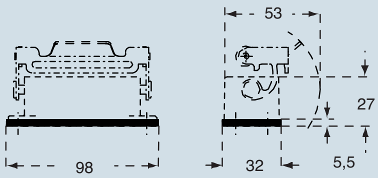
panel cut-out for bulkhead mounting housings in mm



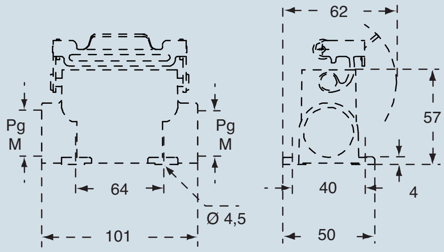
* can only be used with cable gland (to be purchased separately).

dimensions in mm

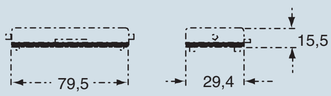
CZIS L



CZAPS L and **MZAPS L**

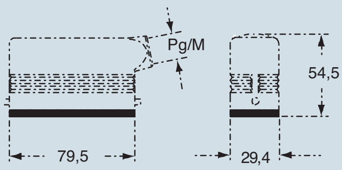


CZCS L

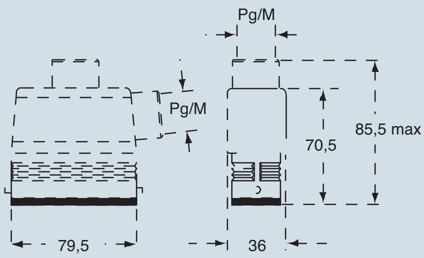


dimensions in mm

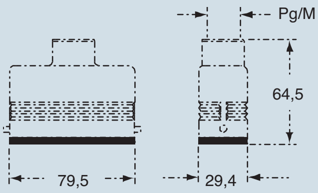
CZOS L and **MZOS L**



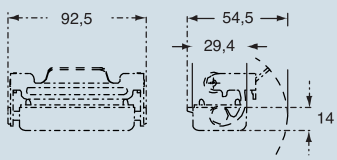
CZAOS L - MZAOS L and **CZAVS L - MZAVS L**



CZVS L and **MZVS L**



CZCS LG



c US Type 4/4X/12

EN 60529 IP66 IEC 60529

dimensions shown are not binding and may be changed without notice

EMC - size 66.16

inserts:

			page
CDD	24	poles + ⊕	59
CQE	10	poles + ⊕	80
CSH	6	poles + ⊕	88
CCE	6	poles + ⊕	94
CNE, CSE, JCNE, JCSE	6	poles + ⊕	95 and 106
CSS	6	poles + ⊕	118
CT, CTE, CTSE *)	6	poles + ⊕	126 and 130
MIXO	2	modules	156÷195

insert centre distance:
44 x 27 mm

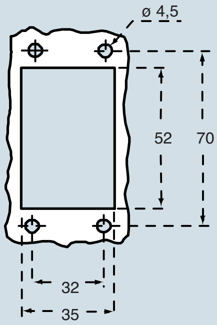
***) only for enclosure CHIS 06 L**

housings and cover for electromagnetic compatibility

hoods and cover for electromagnetic compatibility

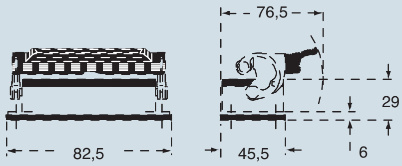
description	part no.	entry Pg	part no.	entry M	part no.	entry Pg	part no.	entry M
bulkhead mounting housing with lever	**CHIS 06 L**	—-						
surface mounting housing with lever, high construction	**CAPS 06 L**	21	**MAPS 06 L32**	32				
cover with pegs (for 1 lever enclosures)	**CHCS 06 L**							
enclosure with pegs, side entry, high construction					**CAOS 06 L21**	21	**MAOS 06 L32**	32
enclosure with pegs, top entry, high construction					**CAVS 06 L21**	21	**MAVS 06 L32**	32
cover with lever (for enclosures with pegs)					**CHCS 06 LG**			

panel cut-out for bulkhead mounting housings in mm

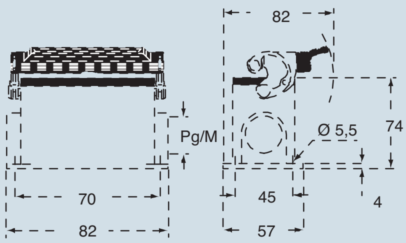


dimensions in mm

CHIS L



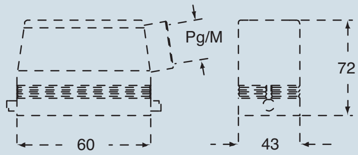
CAPS L and **MAPS L**



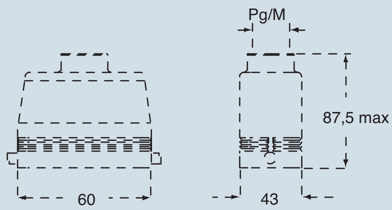
CHCS L

dimensions in mm

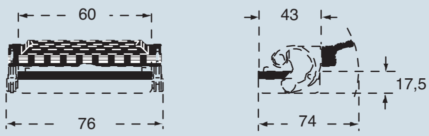
CAOS L and **MAOS L**



CAVS L and **MAVS L**



CHCS LG



c UL us Type 4/4X/12

EN 60529 IP66 IEC 60529

dimensions shown are not binding and may be changed without notice

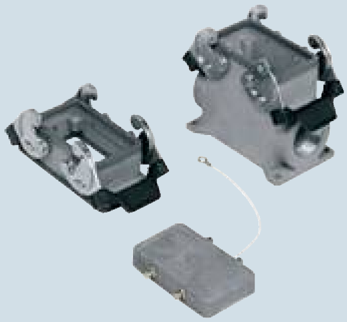
CH - CA and MH - MA enclosures   size “57.27”   EMC version

inserts: page

insert centre distance:
57 x 27 mm

***) only for enclosure CHIS 10**

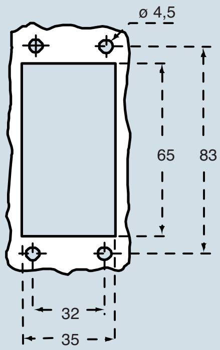
housings and cover for electromagnetic compatibility



hoods and cover for electromagnetic compatibility

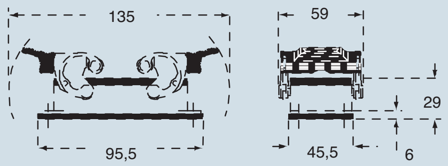
description	part no.	entry Pg	part no.	entry M	part no.	entry Pg	part no.	entry M
bulkhead mounting housing, with levers	**CHIS 10**	—-						
surface mounting housing, with levers, high construction	**CAPS 10.21**	21	**MAPS 10.32**	32				
cover with 4 pegs (for enclosures with 2 levers)	**CHCS 10**							
enclosure with pegs, side entry, high construction					**CAOS 10.21**	21	**MAOS 10.32**	32
enclosure with pegs, top entry, high construction					**CAVS 10.21**	21	**MAVS 10.32**	32
cover with 2 levers (for enclosures with 4 pegs)					**CHCS 10 G**			

panel cut-out for bulkhead mounting housings in mm

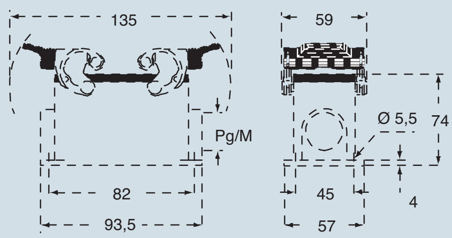


dimensions in mm

CHIS



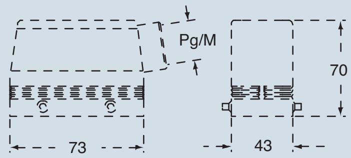
CAPS and **MAPS**



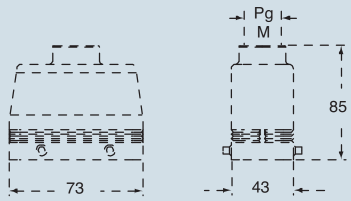
CHCS

dimensions in mm

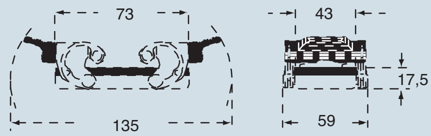
CAOS and **MAOS**



CAVS and **MAVS**



CHCS G



Type
4/4X/12

EN 60529
IP66
IEC 60529

dimensions shown are not binding
and may be changed without notice

EMC - size 57.27

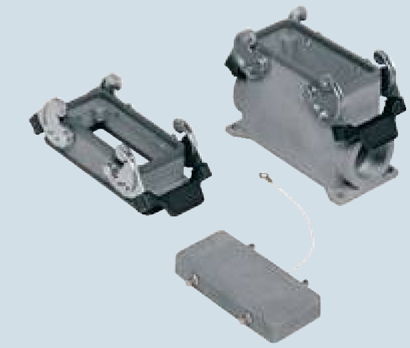
inserts:

			page
CD	40	poles + ⏚	49
CT, CTS *) (10A)	40	poles + ⏚	56
CDD	72	poles + ⏚	62
CQE	32	poles + ⏚	82
CSH	16	poles + ⏚	90
CCE	16	poles + ⏚	98
CNE, CSE, JCNE, JCSE	16	poles + ⏚	99 and 108
CSS	16	poles + ⏚	120
CT, CTE, CTSE *) (16A)	16	poles + ⏚	128 and 132
CMSE	6+2 (aux)	poles + ⏚	137
CMCE	6+2 (aux)	poles + ⏚	136
CP..............................	6	poles + ⏚	149
CX................	6/36 and 12/2	poles + ⏚	152 and 153
CX	4/0 and 4/2	poles + ⏚	154
MIXO	4	modules	156÷195

insert centre distance:
77.5 x 27 mm

***) only for enclosure CHIS 16**

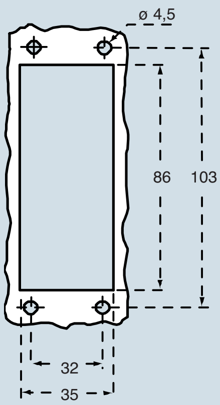
housings and cover for electromagnetic compatibility



hoods and cover for electromagnetic compatibility

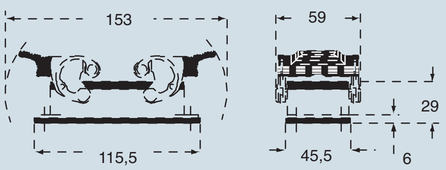
description	part no.	entry Pg	part no.	entry M	part no.	entry Pg	part no.	entry M
bulkhead mounting housing with levers	**CHIS 16**	—-						
surface mounting housing, with levers, high construction	**CAPS 16.21**	21	**MAPS 16.32**	32				
cover with 4 pegs (for enclosures with 2 levers)	**CHCS 16**							
enclosure with pegs, side entry					**CHOS 16**	21	**MHOS 16.25**	25
enclosure with pegs, side entry							**MHOS 16.32**	32
enclosure with pegs, side entry, high construction					**CAOS 16.29**	29	**MAOS 16.32**	32
enclosure with pegs, side entry, high construction							**MAOS 16.40**	40
enclosure with pegs, top entry					**CHVS 16**	21	**MHVS 16.25**	25
enclosure with pegs, top entry							**MHVS 16.32**	32
enclosure with pegs, top entry, high construction					**CAVS 16.29**	29	**MAVS 16.32**	32
enclosure with pegs, top entry, high construction							**MAVS 16.40**	40
cover with 2 levers (for enclosures with 4 pegs)					**CHCS 16 G**			

panel cut-out for bulkhead mounting housings in mm

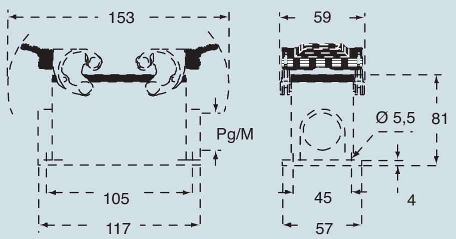


dimensions in mm

CHIS



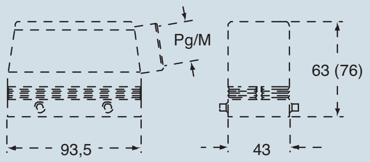
CAPS and **MAPS**



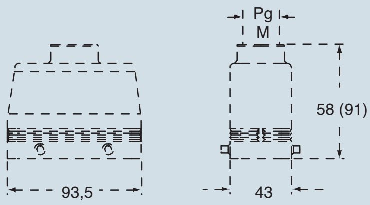
CHCS

dimensions in mm

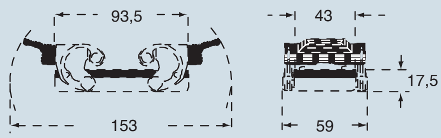
CHOS (CAOS) and **MHOS (MAOS)**



CHVS (CAVS) and **MHVS (MAVS)**



CHCS G



c UL us Type 4/4X/12

IP66 EN 60529 IEC 60529

dimensions shown are not binding
and may be changed without notice

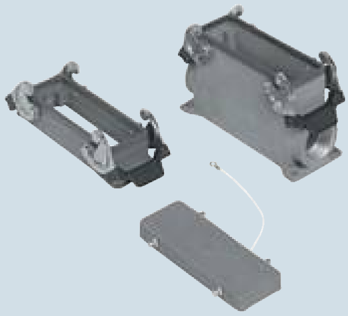
EMC - size 77.27

inserts: page

insert centre distance:
104 x 27 mm

***) only for enclosure CHIS 24**

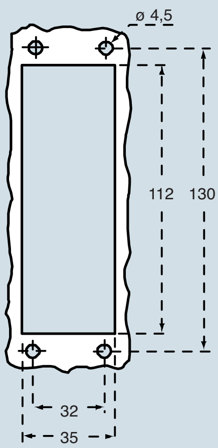
housings and cover
for electromagnetic compatibility



hoods and cover
for electromagnetic compatibility

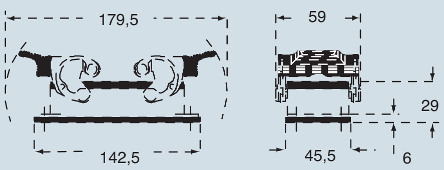
description	part no.	entry Pg	part no.	entry M	part no.	entry Pg	part no.	entry M
bulkhead mounting housing with levers	**CHIS 24**	—-						
surface mounting housing with levers, high construction	**CAPS 24.21**	21	**MAPS 24.32**	32				
cover with 4 pegs (for enclosures with 2 levers)	**CHCS 24**							
enclosure with pegs, side entry					**CHOS 24**	21	**MHOS 24.25**	25
enclosure with pegs, side entry							**MHOS 24.32**	32
enclosure with pegs, side entry, high construction					**CAOS 24.29**	29	**MAOS 24.32**	32
enclosure with pegs, side entry, high construction							**MAOS 24.40**	40
enclosure with pegs, top entry					**CHVS 24**	21	**MHVS 24.25**	25
enclosure with pegs, top entry							**MHVS 24.32**	32
enclosure with pegs, top entry, high construction					**CAVS 24.29**	29	**MAVS 24.32**	32
enclosure with pegs, top entry, high construction							**MAVS 24.40**	40
cover with 2 levers (for enclosures with 4 pegs)					**CHCS 24 G**			

panel cut-out for bulkhead mounting housings in mm

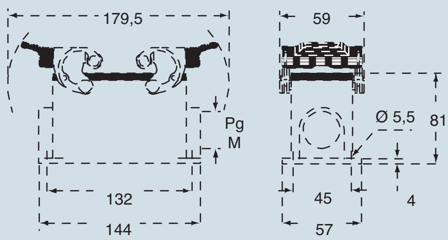


dimensions in mm

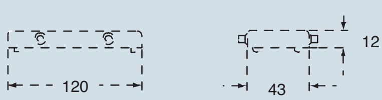
CHIS



CAPS and **MAPS**

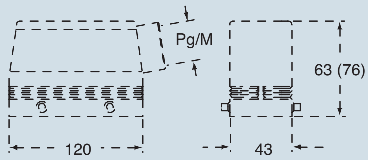


CHCS



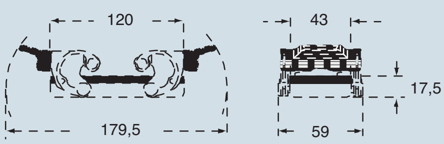
dimensions in mm

CHOS (CAOS) and **MHOS (MAOS)**



CHVS (CAVS) and **MHVS (MAVS)**

CHCS G



Type
4/4X/12

EN 60529
IP66
IEC 60529

dimensions shown are not binding
and may be changed without notice

EMC - size 104.27