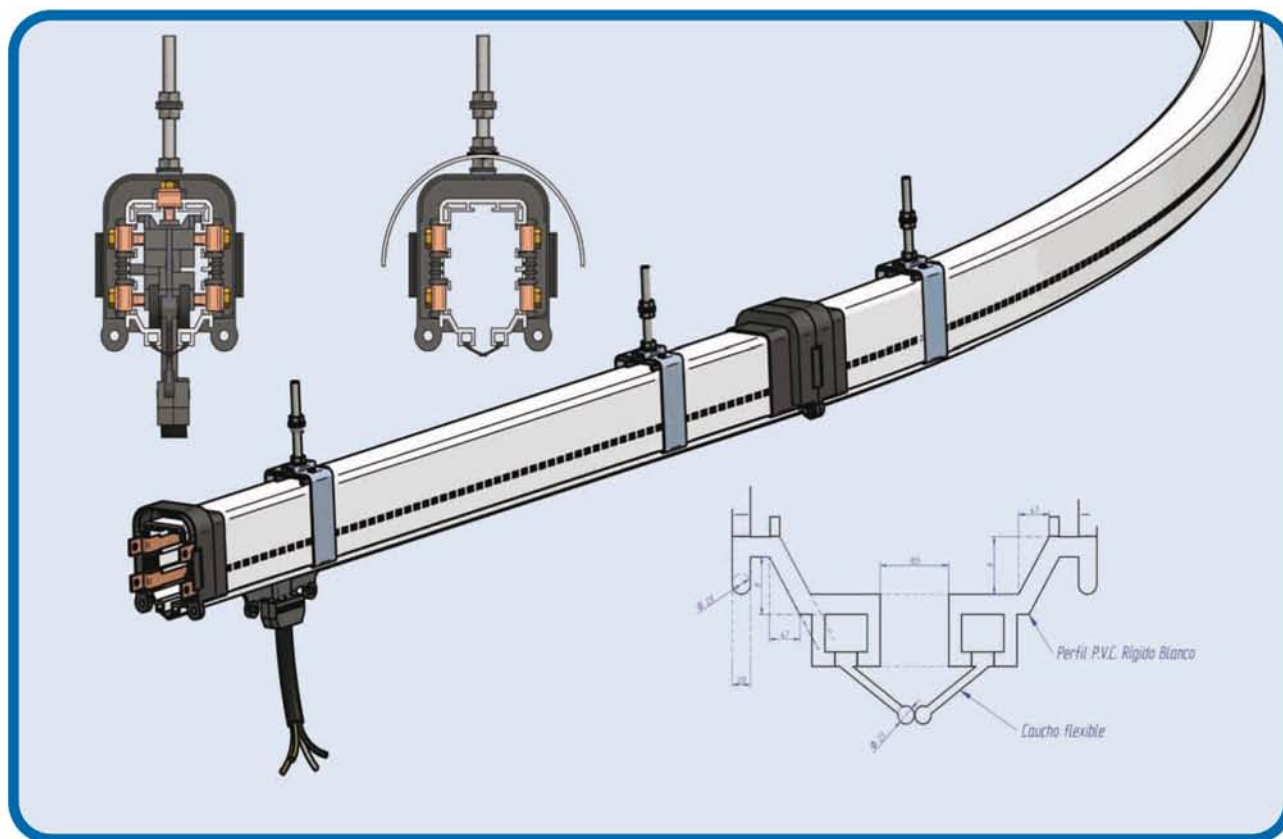
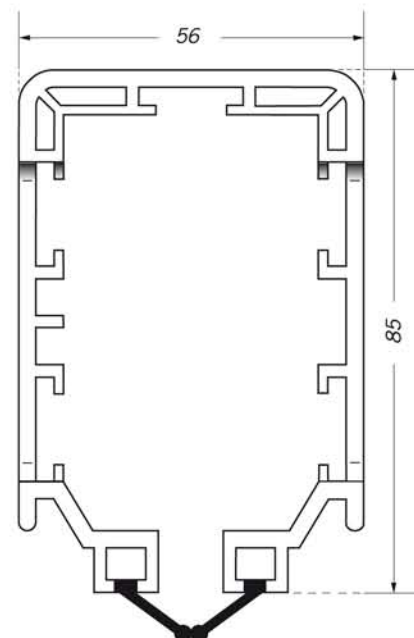


MODUCTOR®

MULTICONDUCTOR MODULAR SYSTEM

- *Own design and production.*
(Registered connection and name)
- *Incorporated rubber sealing strips.*
- *With protecting roof for outdoor installations.*



Ramón Galarza



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More than electrifying

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COMPANY DECLARATION: Ramón Galarza, S.L. Project “Development of MODUCTOR RG enclosed PVC conductor” has been subsidized by European Union through European Development Regional Fund (EDRF) and the Economic Development Agency for La Rioja (ADER).



APPLICATIONS

The MODUCTOR enclosed conductor system is a modern design, accident proof, with moving current collectors, to feed mobile equipments such as: cranes, hoists, conveyors, textiles, chain conveyors, computerized warehouses, etc.

Accomplishing domestic and foreign standards, the MODUCTOR system offers the maximum guarantee against undesirable accidental contacts, allows a fast assembly and a reliable working performance.

The bars are supplied with the copper strip conductors already inserted in the isolated housing to be assembled consecutively. The electric joint of the conductors is made by connecting copper plates locked with bolt-nut. This assembly is covered with an isolated plastic joint.

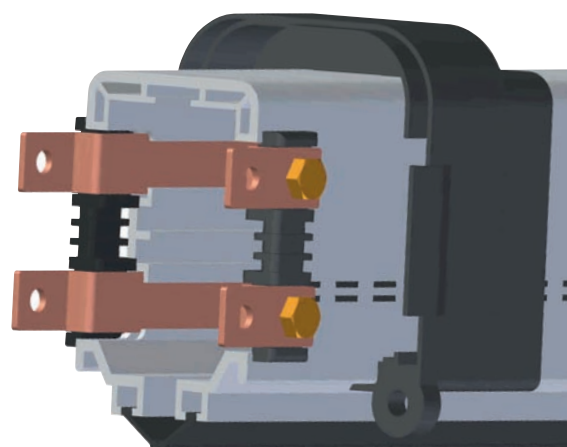
Curved tracks are available upon demand. Send us a sketch indicating radius and angles. Minimum manufacturing radius: 1 metre.

The bars are manufactured, as standard, 4m. length with 4 or 5 copper conductors in five different sections (from 40 Amps. to 140 Amps.). Other lengths upon demand. It is possible to assemble in parallel several tracks, obtaining more than 5 phases and increasing the intensities more than 140 Amps.



FEATURES

- **Safety:** Due to its external isolation it is a protected line. It is the first protected line manufactured with sealing strips by co-extrusion system.
- **Space:** The MODUCTOR system fit into small spaces in comparison with other conventional electric feeding systems.
- **Expansion-shrink:** Every joint of the system acts as an expansion joint absorbing the differences in length due to the expansion-shrink of the system. So, no “special” expansion joints are required.
- **Enlargements:** As it is a modular system it is possible to enlarge or diminish the installation by adding or removing the modular tracks .
- **Mounting:** It is very easy and quick: in one passing the line is ready to work.
- **Electric feeding:** It can be done at the beginning of the line or at any joint along the installation.
- **Repairs:** If some track is broken it is easy to replace it for a new one without moving the rest of tracks of the line.
- **Voltage:** Up to 600 V.
- **Working temperature:** From -30°C to +55°C.
- **Outdoor installations:** We recommend to place the outdoor roofs Refs. RG 91 and RG 93.
- **Degree of protection:** IP 23. If outdoor roofs are used, then IP 24.



CALCULATIONS

To choose the most suitable line required to accomplish with a determinated amperage and also to define the situation of the feeding point (s), then it will be considered the sum of all the currents from the motors that can work at the same time so as the foreseeable volt drop.

The following chart can be taken as an orientation:

NUMBER OF EQUIPMENTS	MOST POWERFULL MOTOR	2 nd POWERFULL MOTOR	3 rd POWERFULL MOTOR	4 th POWERFULL MOTOR
1	I_A	I_N	-	-
2	I_A	I_N	I_N	-
3	I_A	I_A	-	-
4	I_A	I_A	I_N	-



-Starting current (I_A) or locked rotor current, is measured from the supply line at rated voltage and frequency with the rotor at rest. With NEMA B motors the starting current is 600 – 650% of full-load current. It is a typical data given by the motor manufacturer.

-Nominal current (I_N) is the current at rated horsepower and rated voltage. Its value is determinate using the following formula:

$$I_N = \frac{P}{\sqrt{3} \cdot V \cdot \cos \phi}$$

I_N = Nominal current in Amps.

P = Power in watts

V = Voltage

$\cos \phi$ = Power factor

Power factor or $\cos \phi$ is a “quality electric figure” of the motor. The bigger it is, the less current will be used to get the same power. Its value indicates the “quality” of the motor with regard to its consumption; the maximum value is 1.

Volt drop for three-phase AC is calculated as follows:

$$\Delta U = \sqrt{3} \cdot I \cdot L \cdot Z$$

ΔU = Volt drop in Volts.

I = Current in Amps.

L = Length to be considered.

Z = Impedance of the conductors (Ω / m)

$$\Delta U_{(\%)} = \frac{\Delta U \cdot 100}{U}$$

The value for L (in metres) depends on the place(s) where the feeding point(s) from the supply line are going to be made:

- Feeding point at one end of the line:..... L = Length of the installation.
- Feeding point at the middle of the line: L = Length of the installation / 2
- Feeding points at both ends of the line: L = Length of the installation / 4
- Feeding points at 1/6 of each end of the line: .. L = Length of the installation / 6

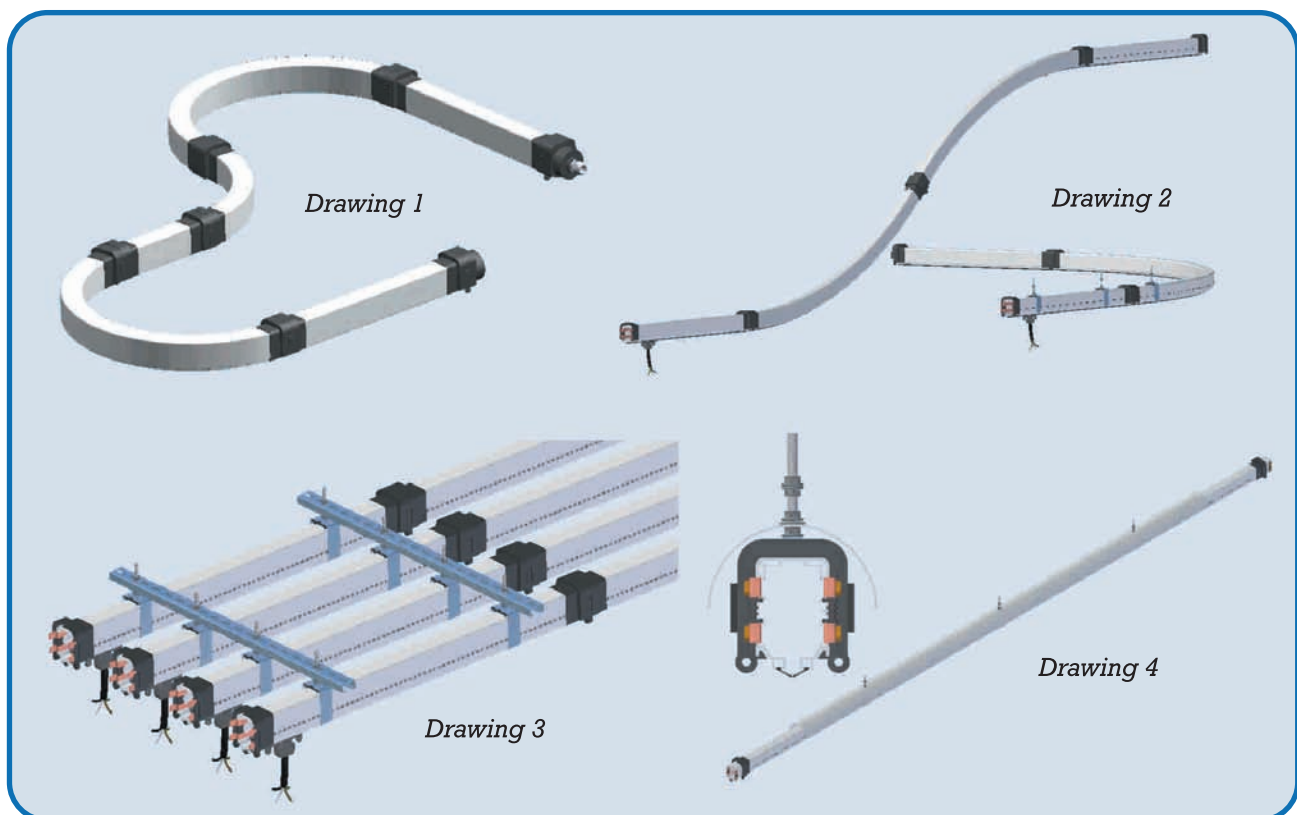
This value decreases when considering the width of the moving machines; it increases when considering the distance between the feeding point and the electrical cupboard (length of the cable).

In the below chart there are indicative values for the nominal current (I_N) in Amps. for three-phase motors AC as per NF C63-110.2001 standard:

POWER		NOMINAL CURRENT			RATIO I_A / I_N	CURRENT
CV	KW	220 V	380 V	500 V		
3	2,2	8,7	5	3,8	5	40 A
4	3	11,5	6,6	5	5	
5,5	4	14,5	8,5	6,5	5,2	
7,5	5,5	20	11,5	9	5,4	
10	7,5	27	15,5	12	5,4	60 A
13,3	10	35	20	15	5,6	80 A
15	11	39	22	17	5,8	
20	15	52	30	23	5,8	
25	18,5	64	37	28,5	6	
30	22	75	44	33	6	100 A
40	30	103	60	45	6,2	140 A
50	37	126	72,5	55	6,8	
60	45	147	85	65	6,8	
75	55	182	105	80	6,8	

SPECIAL INSTALLATIONS

- **Lines with curve tracks:** *It is advisable to send us a sketch of the line indicating radius, angles and lengths of the straight tracks. Minimum bending radius: 1 m. (See drawing 1)*
- **Curves:** *It is possible to supply horizontal and/or vertical curves. (See drawing 2)*
- **Lines in parallel:** *For those lines with consumption over 140 Amps. or more than five conductors, the assembly of two or more lines in parallel is done. (See drawing 3).*
- **Aggressive environments:** *Such as humidity, acidity, etc it is recommended to place stainless steel hardware and metallic components galvanized + epoxy coating. In outdoors installations is it advisable to place the roofs Refs. RG 91 y RG 93. (See drawing 4) to protect the line from rain and solar heating and radiations.*
- **Electric lines with isolating sections:** *Whenever it is necessary to interrupt the current in a line it is necessary to place an isolating section Ref. RG 12 and a double current collector. (i.e. to create a repairing area for cranes in the same runaway).*



ISOLATED HOUSING

MATERIAL

Rigid self-extinguishing PVC (UNE 20.672.83.AP2-1) and synthetic rubber sealing lips coextruded.

ELECTRICAL FEATURES

Dielectric strength 25 KV/mm

Transversal resistivity $1 \times 10^{16} \Omega/m$

MECHANICAL FEATURES

Flexural strength 750 Kg/cm²

Torsional strength (ISO R 527) 430 kg/cm²

Breaking load (ISO R 527) > 430 kg/cm²

Impact strength (DIN 53453) No rupture

WORKING TEMPERATURE

From -30°C to +55°C (-22°F +131°F)

5 kg.VICAT degree (ISO R 306) 80°C (176°F)

RESISTANCE TO CHEMICAL AGENTS

Oils and mineral greases Yes

Solvents Yes, except those aromatics, cetonics and chlorated ones.

Hydrochloric No

Concentrated sulphuric acid No

50% Diluted sulphuric acid Yes

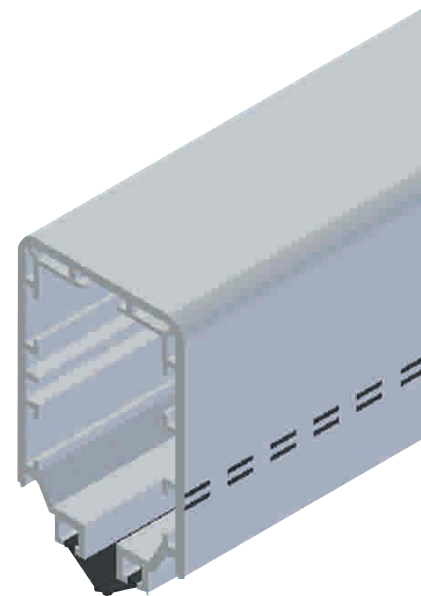
50% Caustic soda Yes, less than 40°C (104°F)

SPECIFIC WEIGHT (ISO 1183) 1,44 g./cm³

LINEAR EXPANSION COEFF. 0,05 mm/m/°C

INFLAMMABILITY (UL 94) VO

WATER ABSORPTION Not detectable, < 0,07%



ELECTRICAL CONDUCTORS

MATERIAL

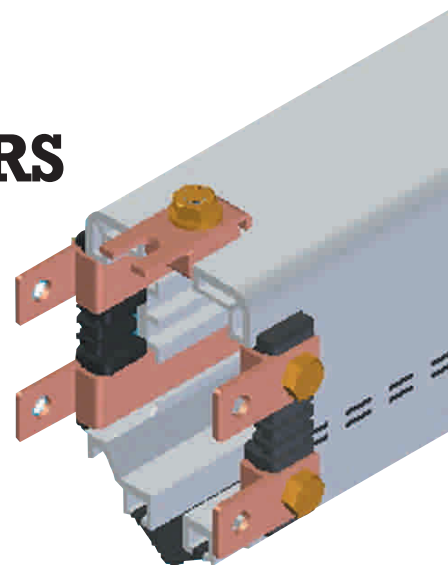
Electrolytic copper strips as per DIN 1787/17670/40500 standards and certified CU-ETP type.

LINEAR EXPANSION COEFFICIENT 0,0165 mm/m/°C

RESISTIVITY 0,0172 $\Omega/m/mm^2$

SPECIFIC WEIGHT 8,9 g./cm³

IACS CONDUCTIVITY 100



CURRENT (Amps.)	VOLTAGE (V)	IMPEDANCE (Ω /m)	SECTION (mm^2)	VOLT DROP (V/m /Amps.)	WEIGHT (g./m.)
40	500	$2 \cdot 10^3$	9,3	0,00346	82,77
60	500	$1,75 \cdot 10^3$	12,4	0,00303	110,36
80	500	$1,18 \cdot 10^3$	17,05	0,00204	151,74
100	500	$1 \cdot 10^3$	21,7	0,00173	193,13
140	500	$0,75 \cdot 10^3$	31	0,00123	275,90

Volt drop values considered at 20°C (68°F) $\cos. \varphi = 1$ y E.D. 80% three-phase AC.

- For temperature of 30°C (86°F) apply corrective factor 1,04.
- For temperature of 40°C (104°F) apply corrective factor 1,08.
- For temperature of 50°C (122°F) apply corrective factor 1,12.

If E.D. 60%, apply corrective factor 0,77.

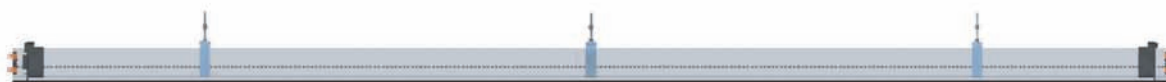
MODUCTOR COMPONENTS



● BAR OF 40 AMP. OR 60 AMP.

Standard lenght: 4 m. Includes two sliding supports RG 01 and one joint RG 04.

Description	Ref.	Weight/m.
Bar with 4 conductors 40 Amp.	RG 4x40 A	1,84 kg.
Bar with 5 conductors 40 Amp.	RG 5x40 A	1,92 kg.
Bar with 4 conductors 60 Amp.	RG 4x60 A	1,95 kg.
Bar with 5 conductors 60 Amp.	RG 5x60 A	2,06 kg.



● BAR OF 80 AMP., 100 AMP. OR 140 AMP.

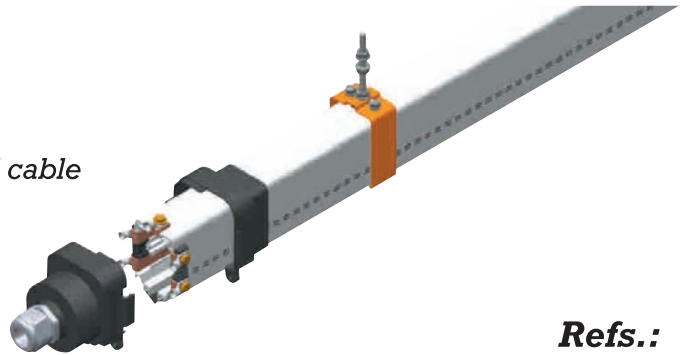
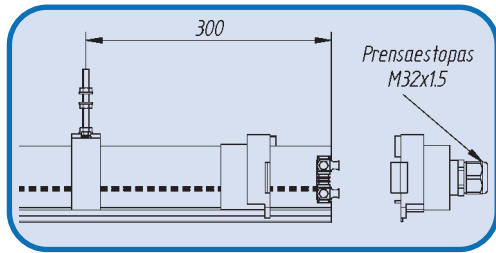
Standard lenght: 4 m. Includes three sliding supports RG 01 and one joint RG 04.

Description	Ref.	Weight/m.
Bar with 4 conductors 80 Amp.	RG 4x80 A	2,15 kg.
Bar with 5 conductors 80 Amp.	RG 5x80 A	2,31 kg.
Bar with 4 conductors 100 Amp.	RG 4x100 A	2,32 kg.
Bar with 5 conductors 100 Amp.	RG 5x100 A	2,51 kg.
Bar with 4 conductors 140 amp.	RG 4x140 A	2,65 kg.
Bar with 5 conductors 140 Amp.	RG 5x140 A	2,93 kg.



● END FEED

To feed the line at the end of it.
 Manufactured in insulating plastic material.
 Supplied including connecting terminals and cable gland M32x1,5 for round cable.
 It is fitted to the joint by meanings of two press flanges (click system)
 And two bolt-nuts placed at the inner side of it. Weight: 140 g.

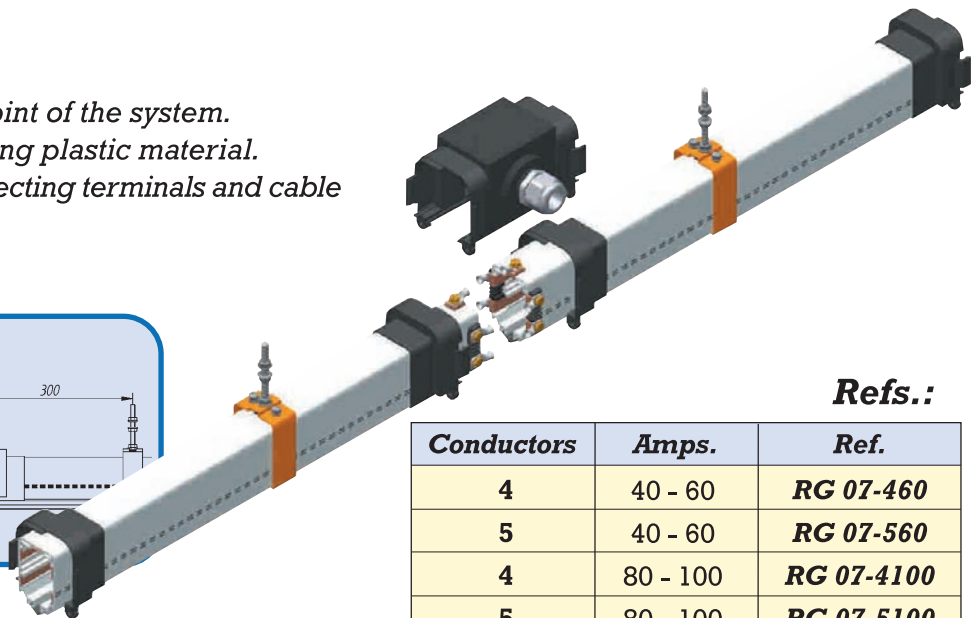
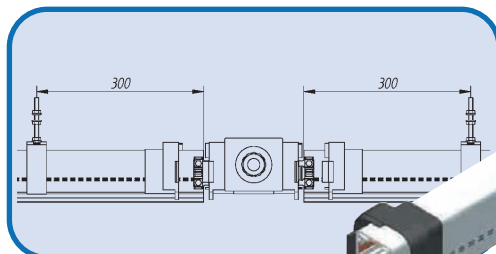


Refs.:

Conductors	Amps.	Ref.
4	40 - 60	RG 03-460
5	40 - 60	RG 03-560
4	80 - 100	RG 03-4100
5	80 - 100	RG 03-5100
4	140	RG 03-4140
5	140	RG 03-5140

● LINE FEED

To feed the line at any joint of the system.
 Manufactured in insulating plastic material.
 Supplied including connecting terminals and cable gland for round cable.
 Weight: 265 g.

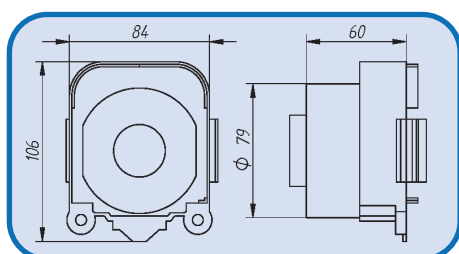


Refs.:

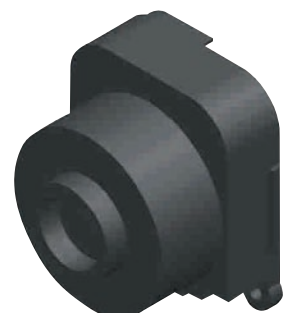
Conductors	Amps.	Ref.
4	40 - 60	RG 07-460
5	40 - 60	RG 07-560
4	80 - 100	RG 07-4100
5	80 - 100	RG 07-5100
4	140	RG 07-4140
5	140	RG 07-5140

● END CAP

Ref. RG 04



It ensures and protects the closure of the line at the end/s of it.
 Manufactured in insulating plastic material.
 It is fitted to the joint by meanings of two press flanges (click system) and two bolt-nuts placed at the inner side of it. Weight: 95 g.



● CURRENT COLLECTOR 4x35 A

Ref. RG 14



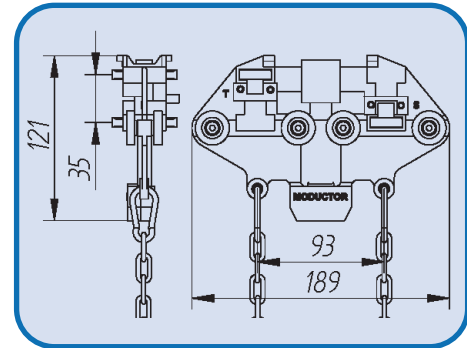
Body manufactured in insulating plastic material and four carbon shoes made of metal-graphite N-51, including springs inox AISI302.

Metallic wheels with ball-bearings.

To avoid any mistake when connecting the phases the trolley fits only in one position in the housing: there is an anti-reverse rib. It is supplied already connected to the carbon shoes by means of a round cable 4G4 mm². It incorporates chains to be fitted to the towing arm.

Maximum speed: 160m/min. In curved tracks: 90m/min.

To be fitted to towing arm ref. RG 06. Weight: 738 g.



● CURRENT COLLECTOR 5x35 A

Ref. RG 15

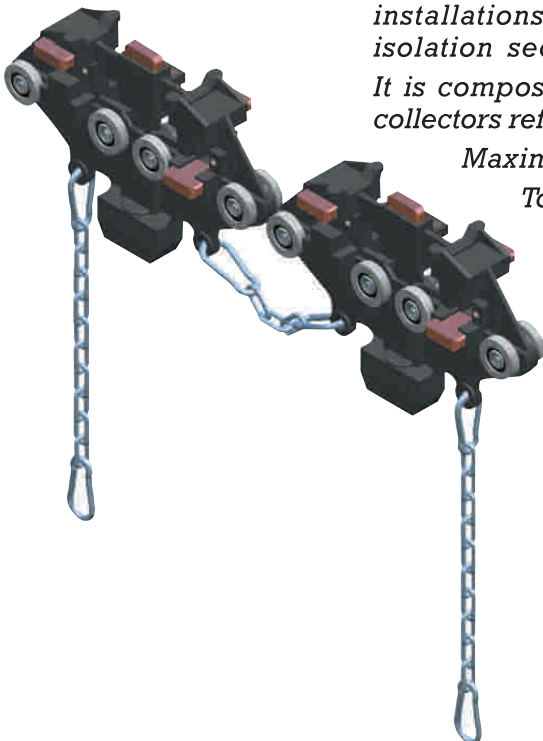
Same features than current collector ref. RG 14 but, in this case with 5 carbon shoes.

Connected with round cable 5G4 mm².

Weight: 820 g.

● DOUBLE CURRENT COLLECTOR 2 (4x35 A) WITH JOINT

Ref. RG 24



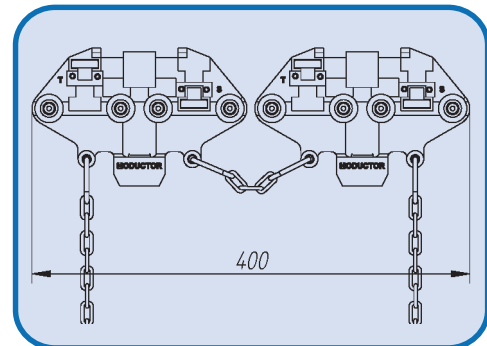
Necessary for currents between 35 and 70 Amps.

It is also necessary in those installations where there are isolation sections ref. RG 12.

It is composed by two current collectors ref. RG 14 joined by a chain.

Maximum speed: 130m/min. In curved tracks: 70m/min.

To be fitted to towing arm ref. RG 08. Weight: 1.526 g.



● DOUBLE CURRENT COLLECTOR 2 (5x35 A) WITH JOINT

Ref. RG 25

It is composed by two current collectors ref. RG 15 joined by a chain.

Maximum speed: 130m/min. In curved tracks: 70m/min.

To be fitted to towing arm ref. RG 08.

Weight: 1.690 g.

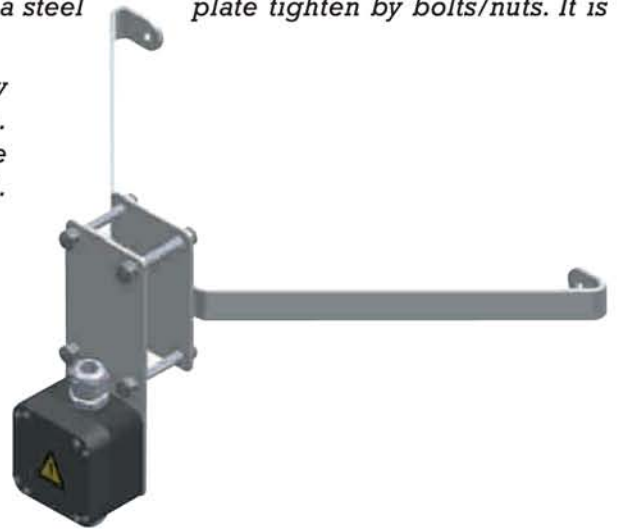
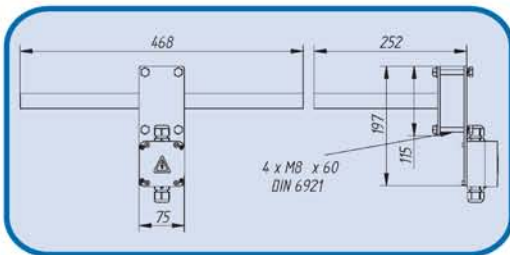


● TOWING ARM FOR CURRENT COLLECTOR 35 AMPS. + CONNECTING BOX Ref. RG 06

Made of galvanized steel. It is advised to make the towing movement of the current collector (ref. RG 14 or RG 15) along the line. To be fitted by means of a steel plate tighten by bolts/nuts. It is important to center and align it with the line.

It is fitted to the current collectors by chains which allow deviations in horizontal and vertical along the installation. Includes a connecting box with terminals and two cable glands (one for entering the cable and one for exit it).

Weight: 1.600 g

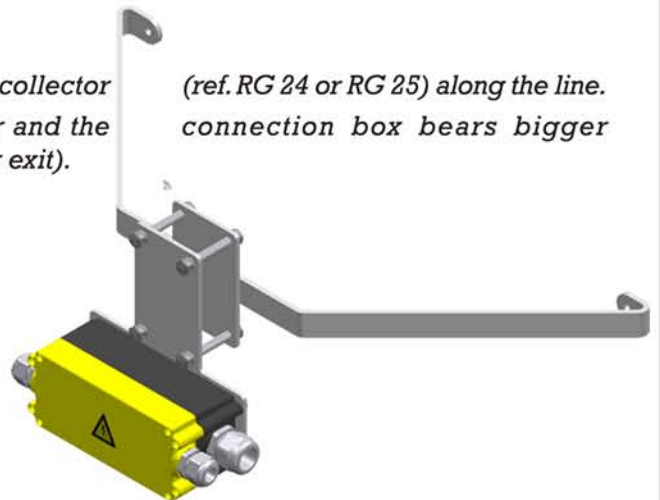
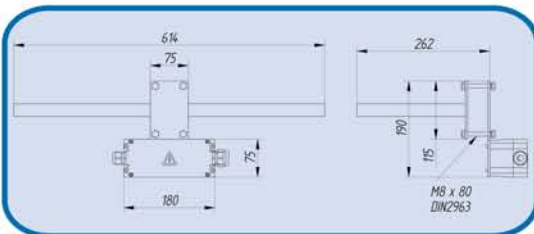


● TOWING ARM FOR DOUBLE CURRENT COLLECTOR 70 AMPS. + CONNECTING BOX Ref. RG 08

Advised to make the towing movement of the current collector (ref. RG 24 or RG 25) along the line. Same features than towing arm RG 06 but, it is larger and the terminals and three cable glands (two for entry, one for exit).

(ref. RG 24 or RG 25) along the line. connection box bears bigger

Weight: 2.050 g.



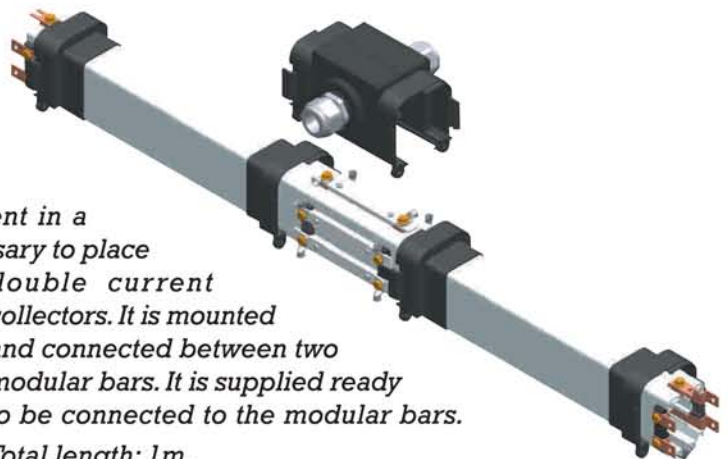
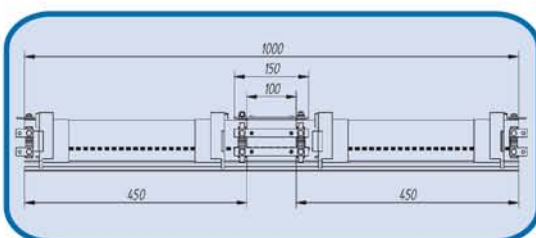
● ISOLATION SECTION Ref. RG 12

Advised to interrupt, at discretion, the current in a determined area of the installation. It is necessary to place

double current collectors. It is mounted and connected between two modular bars. It is supplied ready to be connected to the modular bars.

Total length: 1m.

Weight: variable depending on the number and section of the conductors (to be indicated when ordering).

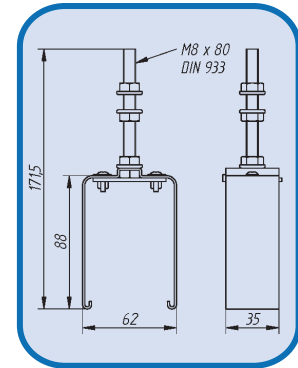
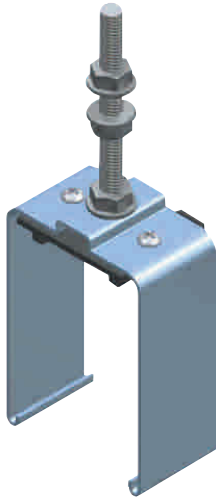


● SLIDING SUPPORT

Ref. RG 01

It is the hanger of the conductors bars allowing its displacement when expanding or shrinking due to the changes in ambient temperature. Made of galvanized steel incorporating a plastic runner screw together to the steel plate in order to prevent the going out of the bar. It is supplied pre-mounted in the conductor bar. Lines of 40 Amps. and 60 Amps. mounted every 2 m. Lines of 80 Amps., 100 Amps. and 140 Amps. mounted every 1,33 m.

Mounted to the structure, being regulated in height, by a bolt M8 and its corresponding nuts. Weight: 157 g.

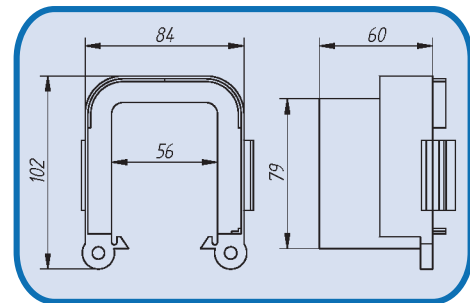
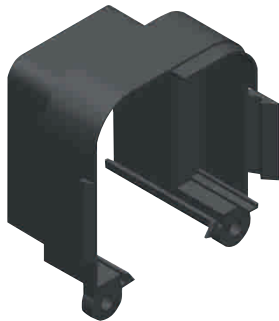


● JOINT

Ref. RG 02

Made of insulating plastic material to protect and isolate the connections from the copper conductors. It is supplied pre-mounted in the conductor bars (one half at each end).

Slide both halves till the hinges are joined together (click noise). For special applications or just for having a double security it is possible to fit two bolts and their corresponding nuts in the inner side of the joint. Weight: 117 g.



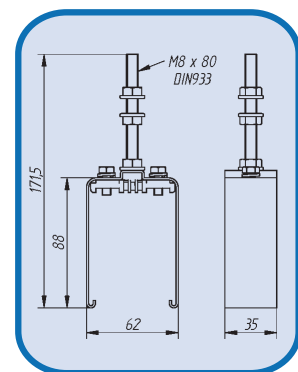
● FIXED POINT CLAMP

Ref. RG 05

It is necessary to avoid displacements of the line assuring its fixation to the structure thus orienting the expansions of the system.

Manufactured in galvanized steel + epoxy coating orange colour (RAL 2004).

When mounting, assure its fixation to the PVC housing tightening the two bolts M6. Weight: 168 g.

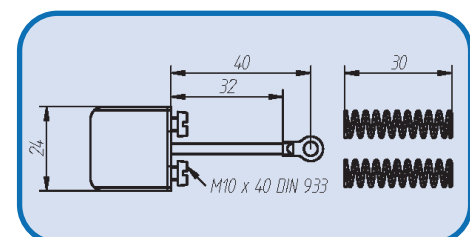
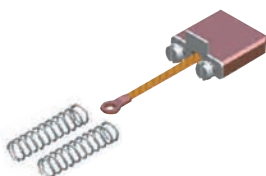


● CARBON SHOE 35 A

Ref. RG 11

Made of graphite and copper, quality N 51; they press against the copper conductors by means of a couple of springs made of stainless steel AISI 302.

It is supplied together with the springs. Weight : 24 g.

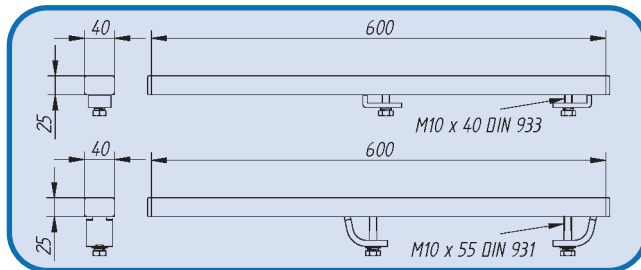




● UNIVERSAL SUPPORTS

Ref. SU-600 (for flange <10 mm)

Ref. SUG-600 (for flange >10 mm)



It is an option to install the supports RG 01 and fixed Point clamp RG 05.

Eliminates welding works and allows a correct alignment of the system.

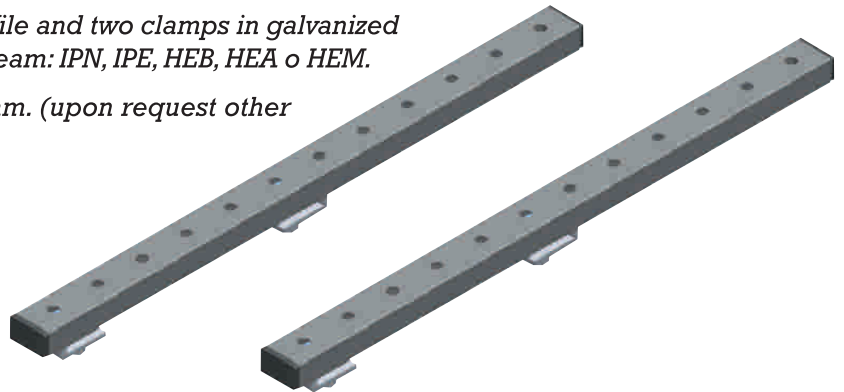
Can be recovered in case of new lay-out of the installation.

Composed by a steel galvanized profile and two clamps in galvanized steel fixed by bolts. They fit in any I-beam: IPN, IPE, HEB, HEA o HEM.

Standard lenght of the profile: 600 mm. (upon request other lengths are available)

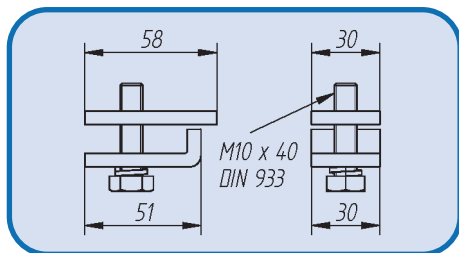
Weight SU-600: 1.292 g.

Weight SUG-600: 1.432 g



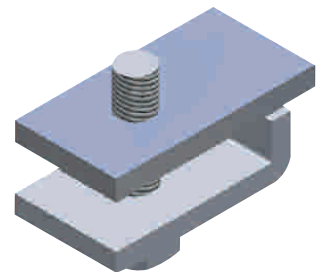
● BEAM CLAMP FOR FLANGE <10 mm.

Ref. RG 8025



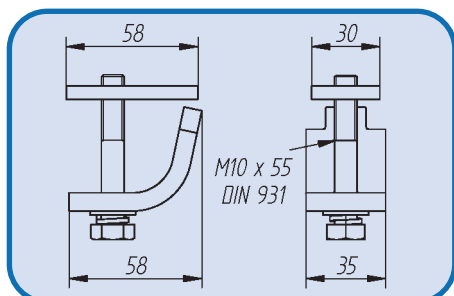
It is a component for the universal support SU-600. Composed by two galvanized steel plates (one flat and other curved), a bolt M10 and a grower washer. Advised for flange thickness up to 10 mm.

Weight: 205 g.



● BEAM CLAMP FOR FLANGE >10 mm.

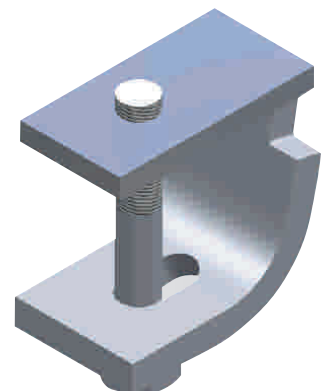
Ref. RG 8030



It is a component for the universal support SUG-600.

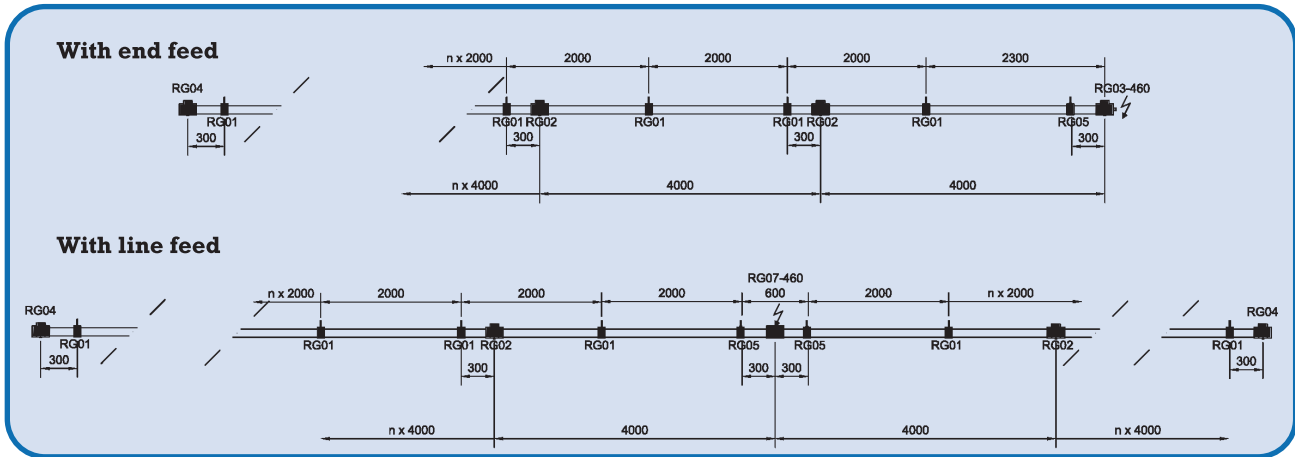
Composed by two galvanized steel plates (one flat and other curved), a bolt M10 and a grower washer. Advised for flange thickness from 10 mm.

Weight: 275 g.

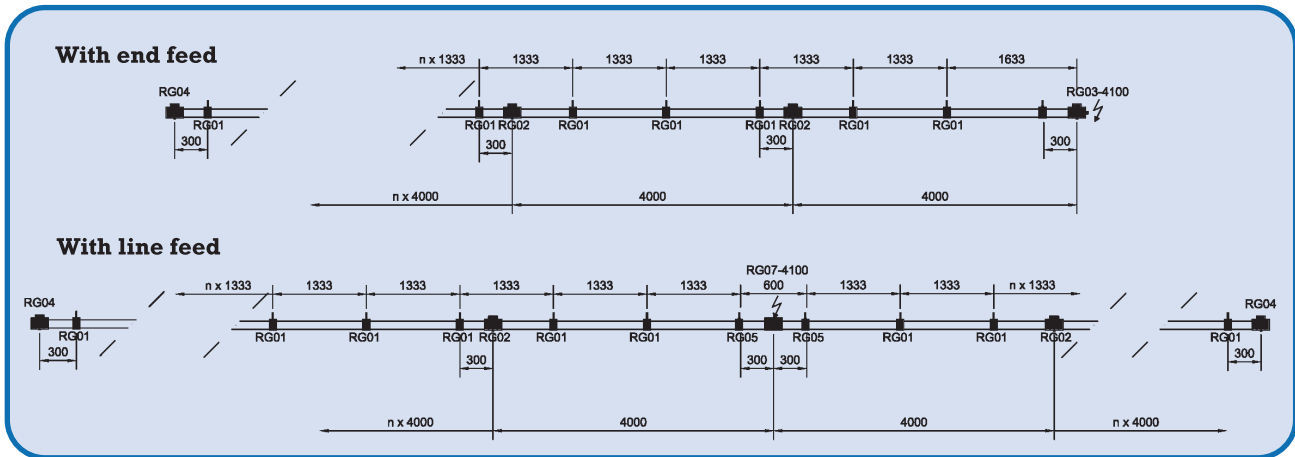


MODUCTOR MOUNTING ARRANGEMENTS

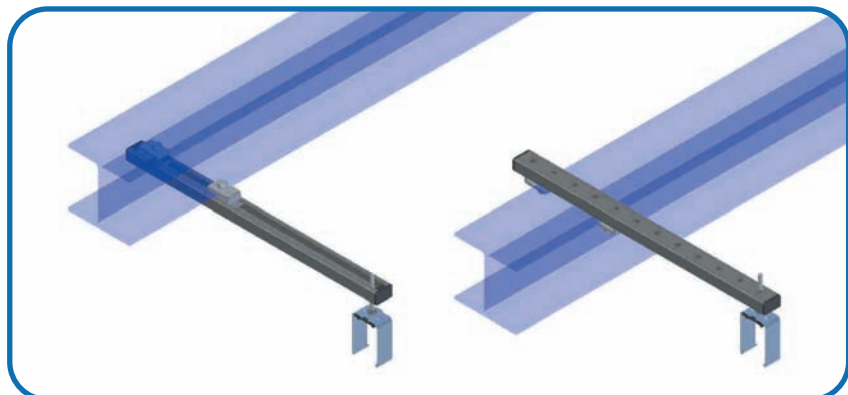
● For 40 Amps. AND 60 Amps. LINES: (supports every 2 m.)



● FOR 80 Amps., 100 Amps. AND 140 Amps. LINES: (supports every 1,33 m.)



● MOUNTING ARRANGEMENTS FOR UNIVERSAL SUPPORTS:





MODUCTOR MOUNTING INSTRUCTIONS

1.- Get ready the universal supports, or other ones, with all their components pre-assembled before fitting them to the structure. (picture 1)

2. - Fit to the structure the universal supports or other ones (picture 2) to fix the sliding hangers RG 01 as per mounting instructions:

- Every 2 m. for lines 40 and 60 Amps.
- Every 1,33 m. for lines 80, 100 and 140 Amps.

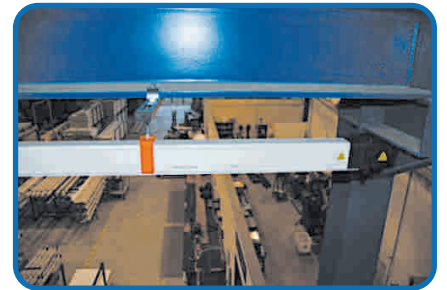
Also to fix the fixed point clamp (the orange one) RG 05 closed to the feeding point. (pictures 3 & 4)



Picture 1

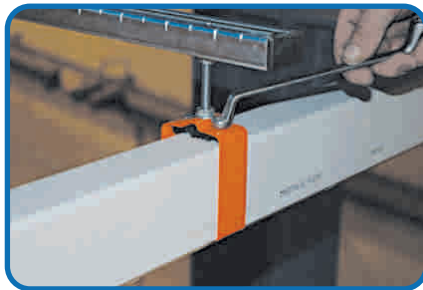


Picture 2

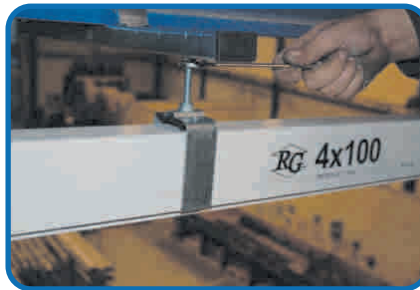


Picture 3

3. - Place the PVC housing and tighten the sliding hangers to the universal supports (picture 5) placing all the bars **IN THE SAME POSITION** (earth line and “RG” sticker continuously); the other side is just white colour. The inner shape of the housing is assymetric, so that the current collector can only be fitted in one position avoiding possible short-circuits.



Picture 4



Picture 5



Picture 6

4. - Press, by hand, the carbon shoes and then place the current collector into the PVC housing having a look to the anti-reverse rib to fit it correctly: “earth” carbon shoe in the same side than earth line and “RG” sticker of the PVC housing. (picture 6)

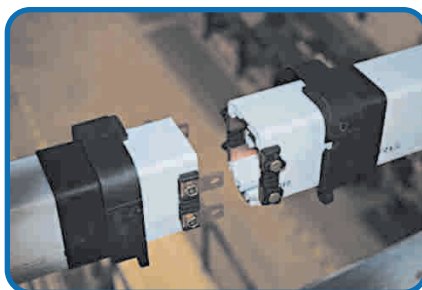
5. - When joining two consecutive housings (pictures 8 & 9) connect phase by phase the strip copper conductors using the copper plates in connection with the bolt – nut supplied. Once the electrical joint has been made, check the good functioning of the current collector passing it, by hand, along the joint and testing that it is made smoothly. (picture 7)

The difference in length between PVC housing and copper conductors allows to compensate the difference in expansion-shrinks between both materials.

6. - To cover the electrical joint, now, slide both halves corresponding to the joint RG 02 till a “click” noise is made (pictures 11 & 12). For outdoor installations it is advisable to place a couple of M6 bolt-nuts in the inner part of the joint.



Picture 7



Picture 8



Picture 9

7. - Once all the bars have been connected, then place at the end/s the cap RG 04. (picture 13)



Picture 10



Picture 11



Picture 12

8. - Place the towing arm and fit it to the current collector considering an alignment with the central axle of the bars and slightly underneath the collector (picture 14). The current collector feeding cable has to be placed making a sufficient loop in order to prevent possible torsional forces affecting it. (picture 15)

9. - Make the electrical connection of the above feeding cable to the connecting box placed in the towing arm. Then connect it to the crane electric cupboard or hoist to be fed.

10. - Finally connect the installation using the end or line feeds foreseen in each case.

Test the line is isolated and also check the good functioning of the current collector along the whole length.



Picture 13



Picture 14



Picture 15