HIGH-FLEX MV REELING CABLE · PORT CRANES | FIBRE-OPTIC HYBRID | 3.6/6 kV | 10 sizes | PCP rubber | 2×12E9

FC-PMR (N)TSCGEWÖU-F2 3.6/6 kV

MV Power and Fibre-Optic Hybrid Reeling Cable 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PCP (polychloroprene) rubber sheath 5GM5. Complete technical data sheet: construction, dimensions, weights, current ratings, standards and installation guidance for 10 sizes.

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01 Application and Product Overview

FC-PMR (N)TSCGEWÖU-F2 is a high-flex medium-voltage reeling cable rated 3.6/6 kV for ship-to-shore cranes, rail-mounted gantry cranes and electrified port equipment, with the configuration 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements. Each power core has a class 5 copper conductor, semi-conductive layers, EPR insulation 2.5 mm thick and its own tinned-copper braid screen; inner and outer sheaths are polychloroprene (PCP/CR) rubber compound 5GM5 to DIN VDE 0207-21, flame-retardant, resistant to oil, weather and ozone. Power cores from 25 – 300 mm².

Typical applications

- Medium-voltage supply of ship-to-shore (STS) cranes and rail-mounted gantry cranes through motor-driven cable reels
- Remote-controlled and automated cranes that send PLC, video and remote-operation data over single-mode fibre through the reel
- Shore connections and mobile equipment powered from the terminal MV network
- Stackers, reclaimers, ship loaders and open-cast mining machines travelling on rails with a cable reel
- Outdoor operation with seawater spray, salt mist, UV radiation and ozone
- MV supply of ship-to-shore cranes, shore connections and electrified yard equipment through a cable reel

Design

Three individually screened power cores and three split PE conductors in the interstices. Each core has an inner and outer semi-conductive layer and its own tinned-copper braid screen, so the electric field stays inside the core insulation and the cores can be terminated with standard MV accessories. The cable contains two optical elements (24 single-mode fibres G.652.D in two elements). Single-mode fibres carry the crane data, video and remote-operation links over the full length of the terminal with very low attenuation, so a single reel cable can connect the crane to the terminal operating system without intermediate repeaters.

10 sizes	3.6/6 kV	+90 °C	PCP rubber
Cross-section 25 – 300 mm²	Rated voltage U_0/U	Maximum conductor temperature	Sheath: PCP rubber

Key features

- Fine-wire class 5 copper conductors and a very short core lay length for repeated reeling
- 24 single-mode fibres G.652.D in two elements in a crush-resistant loose-tube element on the cable axis
- Three split PE conductors in the interstices keep the cross-section round and balanced
- Designed for 20 N/mm² continuous tensile load (on the total copper cross-section of the power cores)

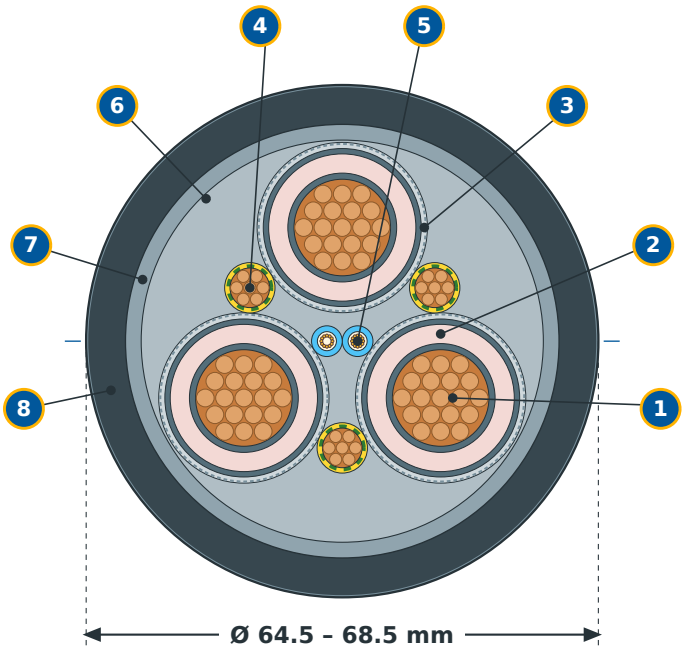
- PCP rubber sheath with proven weather, ozone and oil resistance
- PCP rubber sheath 5GM5 in the DIN VDE 0250 (N)SHTÖU / (N)TSCGEWÖU tradition
- Flame retardant to IEC 60332-1-2

02 Construction

FEICHUN · CROSS-SECTION A-A · 3.6/6 kV

FC-PMR (N)TSCGEWÖU-F2

Sample size 3×95+3G16+2×12E9 · Rev 0 · Illustrative, not to scale



No.	Component	Material
1	Conductor	Bare annealed fine-wire copper, class 5 to IEC 60228 (tinned on request)
2	Semi-conductive layers and insulation	Inner and outer semi-conductive compound with EPR insulation, extruded in one pass
3	Core screen	Tinned-copper wire braid, coverage ≥ 80 %
4	Split PE conductor	Class 5 copper, green-yellow insulation, laid in the interstices between the power cores
5	Optical element	24 single-mode fibres G.652.D in two elements; gel-filled loose tube, aramid strength members
6	Filler and binder tape	Halogen-free compound, polyester tape
7	Inner sheath	Halogen-free polymer compound
8	Outer sheath	Polychloroprene (PCP/CR) rubber compound 5GM5 to DIN VDE 0207-21, flame-retardant, resistant to oil, weather and ozone

The drawing shows size 3×95+3G16+2×12E9. Other sizes have the same construction with scaled dimensions.

Construction details

Conductor	Bare annealed fine-wire copper; tinned on request, class 5 to DIN EN 60228 / IEC 60228 / VDE 0295
Insulation	Halogen-free EPR/HEPR rubber to IEC 60502-2, maximum conductor temperature 90 °C
Core screen	Semi-conductive layers extruded together with the EPR insulation; tinned-copper wire braid screen, coverage ≥ 80 %
Core identification	Power cores brown, black, grey to DIN VDE 0298-300
Protective conductor	Three PE conductors (3G), green-yellow, 16 mm² each, laid in the interstices between the power cores
Optical element	Two elements: 24 single-mode fibres G.652.D in two elements, located at the centre of the cable
Stranding	Power cores, split PE conductors and control or optical elements are stranded together with a very short lay length
Inner sheath	Halogen-free polymer compound, extruded tightly over the stranded cores
Outer sheath	Polychloroprene (PCP/CR) rubber compound 5GM5 to DIN VDE 0207-21, flame-retardant, resistant to oil, weather and ozone

Optical fibre data

Fibre type	Single-mode E9/125 µm, ITU-T G.652.D / IEC 60793-2-50 B-652.D, low water peak
Attenuation, cabled	≤ 0.40 dB/km at 1310 nm; ≤ 0.30 dB/km at 1550 nm
Mode-field diameter	9.2 ± 0.4 µm at 1310 nm
Typical link reach	1 Gbit/s and 10 Gbit/s Ethernet up to 10 km (1000BASE-LX, 10GBASE-LR)
Optical element	Gel-filled loose tube with aramid strength members and a crush-resistant TPU element sheath, placed on the cable axis where bending strain is lowest
Fibre colours	IEC 60304 / DIN VDE 0888 colour sequence; tube and element marked for identification
Fibre strain, reeling	≤ 0.25 % at the rated tensile load of the cable
Optical test	Attenuation of every fibre measured by OTDR after cabling; values recorded in the test certificate

Sheath material

The polychloroprene (PCP/CR) rubber outer sheath, compound type 5GM5 to DIN VDE 0207-21, is the classic sheath of DIN VDE 0250 reeling and trailing cables of the (N)SHTÖU and (N)TSCGEWÖU type. It is heavy-duty, flame-retardant and highly resistant to weather, ozone, UV radiation and mineral oil, and keeps its elasticity on the reel down to −25 °C in motion. Polychloroprene contains halogen; where halogen-free cables are specified, select the HFFR rubber or PUR version of the same construction.

03 Electrical, Thermal and Mechanical Characteristics

Electrical data

Rated voltage U_0/U	3.6/6 kV AC
Test voltage	9 kV AC, 5 min
Maximum operating voltage, DC	5.4/10.8 kV
Current-carrying capacity	To DIN VDE 0298-4 at 30 °C ambient; the table gives rated design values
Conductor resistance	Maximum at 20 °C, class 5 to IEC 60228

Thermal and mechanical data

Maximum conductor temperature	+90 °C
Maximum temperature at short circuit	+250 °C
Ambient temperature, fixed installation	−40 °C to +90 °C
Ambient temperature, in motion	−25 °C to +90 °C
Minimum bending radius	6 × D fixed; 12.5 × D on a cable reel
Maximum tensile load	20 N/mm² continuous, on the total copper cross-section of the power cores
Maximum torsional load	To be agreed with FeiChun for the specific reel design
Maximum travelling speed	60 m/min on a cable reel; higher speeds on request
Flame propagation	IEC 60332-1-2 / DIN EN 60332-1-2
Halogen-free	No (PCP rubber sheath)
UV and ozone resistance	Resistant
Mineral oil resistance	Resistant, IEC 60811-404
Optical element, temperature in operation	−40 °C to +70 °C

Sheath material comparison

Property	PUR	PUR low-temp	CSP rubber	CPE rubber	PCP rubber	HFFR rubber
Abrasion resistance	Excellent	Excellent	Good	Good	**Very good**	Good
Cut and tear resistance	Excellent	Excellent	Good	Good	**Very good**	Good
Mineral oil resistance	Very good	Very good	Very good	Very good	**Very good**	Good
Weather, UV and ozone resistance	Very good	Very good	Excellent	Very good	**Excellent**	Very good
Cold flexibility (moving)	−30 °C	−40 °C	−30 °C	−30 °C	**−25 °C**	−25 °C
Halogen-free (IEC 60754-1/-2)	Yes	Yes	No	No	**No**	Yes

The column of the sheath used in this cable is highlighted. Ratings are qualitative; ask FeiChun for test data on a specific requirement.

04 Dimensions, Weights and Rated Data – 3.6/6 kV (10 sizes)

Type designation cores × mm²	FeiChun article no.	Conductor Ø max mm	Outer Ø min mm	Outer Ø max mm	Min. bend radius mm	Weight approx. kg/km	Max. pull force N	R_{20} max Ω/km	Rated current A	I_k (1 s) kA
3×25+3G6+2×12E9	FC-MV116-001	6.2	51.0	54.5	682	3,380	1,500	0.780	121	3.58
3×35+3G6+2×12E9	FC-MV116-002	7.8	54.0	57.0	712	3,880	2,100	0.554	149	5.00
3×50+3G10+2×12E9	FC-MV116-003	9.6	57.0	60.5	756	4,660	3,000	0.386	186	7.15
3×70+3G16+2×12E9	FC-MV116-004	11.1	61.0	64.5	806	5,680	4,200	0.272	230	10.01
3×95+3G16+2×12E9	FC-MV116-005	12.6	64.5	68.5	856	6,710	5,700	0.206	278	13.59
3×120+3G25+2×12E9	FC-MV116-006	14.8	68.0	72.5	906	7,940	7,200	0.161	322	17.16
3×150+3G25+2×12E9	FC-MV116-007	16.0	72.0	76.5	956	9,110	9,000	0.129	370	21.45
3×185+3G35+2×12E9	FC-MV116-008	17.7	75.5	80.5	1,006	10,680	11,100	0.106	422	26.45
3×240+3G50+2×12E9	FC-MV116-009	20.2	81.0	86.0	1,076	13,100	14,400	0.0801	497	34.32
3×300+3G50+2×12E9	FC-MV116-010	22.4	86.5	91.5	1,144	15,270	18,000	0.0641	571	42.90

Current-carrying capacity: rated design values to DIN VDE 0298-4 for flexible cables, free air, 30 °C ambient; for other ambient temperatures, grouping or layered winding on a reel, apply the factors below. Pull force = 20 N/mm² × total copper cross-section of the power cores. Diameters, dimensions and weights are nominal design values and vary within manufacturing tolerances; confirm critical dimensions before dimensioning reels, guides or festoon systems. Other sizes and configurations are produced to order.

Ambient temperature factors (conductor 90 °C)

°C	20	25	30	35	40	45	50
Factor	1.08	1.04	1.00	0.96	0.91	0.87	0.82

Short-circuit current rating

I_k = 0.143 kA/mm² × cross-section of the power core (conductor 90 °C → 250 °C). For another short-circuit duration t: $I_{k,t} = I_{k,1s} / \sqrt{t}$ (0.1 s ≤ t ≤ 5 s).

Derating on a cable reel (DIN VDE 0298-4)

1 layer: 0.80 · 2 layers: 0.61 · 3 layers: 0.49 · 4 layers: 0.41. Permissible current = table current × layer factor × temperature factor.

05 Reeling Performance and Reel Design Data

The values below support the dimensioning of the cable reel: minimum reel core diameter, copper weight for earthing and loop-resistance calculations, cable weight, and the rated current for the number of layers wound on the reel.

Type designation cores × mm²	Outer Ø max mm	Min. bend radius on reel, mm	Min. reel core Ø mm	Copper weight kg/km	Cable weight kg/100 m	Current, 1 layer A	2 layers A	3 layers A	4 layers A
3×25+3G6+2×12E9	54.5	682	1,364	1,180	338.0	97	74	59	50
3×35+3G6+2×12E9	57.0	712	1,424	1,480	388.0	119	91	73	61
3×50+3G10+2×12E9	60.5	756	1,512	2,020	466.0	149	113	91	76
3×70+3G16+2×12E9	64.5	806	1,612	2,750	568.0	184	140	113	94
3×95+3G16+2×12E9	68.5	856	1,712	3,460	671.0	222	170	136	114
3×120+3G25+2×12E9	72.5	906	1,812	4,410	794.0	258	196	158	132
3×150+3G25+2×12E9	76.5	956	1,912	5,240	911.0	296	226	181	152
3×185+3G35+2×12E9	80.5	1,006	2,012	6,490	1,068.0	338	257	207	173
3×240+3G50+2×12E9	86.0	1,076	2,152	8,410	1,310.0	398	303	244	204
3×300+3G50+2×12E9	91.5	1,144	2,288	10,070	1,527.0	457	348	280	234

Reel design guidance

- Minimum reel core diameter = 2 × minimum bending radius = 25 × D (outer diameter D).
- Spring reels suit short travel and low tensile load; motor-driven reels with torque control keep the cable under constant, low tension.
- Fit a guide or level-wind that keeps the cable parallel to the reel axis to prevent crossing turns.
- Rated current falls with the number of layers on the reel because heat is not dissipated; see the layer factors below.

06 Selection Guide and Sizing Aid

FC-PMR (N)TSCGEWÖU-F2 covers 10 sizes. The smallest, 3×25+3G6+2×12E9, has an outer diameter of up to 54.5 mm and weighs about 3,380 kg/km; the largest, 3×300+3G50+2×12E9, has an outer diameter of up to 91.5 mm and weighs about 15,270 kg/km, 4.5 times as much. Across the range the rated current in free air rises from 121 A to 571 A at 30 °C, and the minimum bending radius from 682 mm to 1,144 mm.

Example 1. A drive draws 117 A continuously, the cable is wound in 2 layers on the reel and the ambient temperature is 40 °C. Required table current = 117 / (0.61 × 0.91) = 211 A. The smallest suitable size is 3×70+3G16+2×12E9 with 230 A.

Example 2. A drive draws 261 A continuously, the cable is wound in 1 layer on the reel and the ambient temperature is 35 °C. Required table current = 261 / (0.80 × 0.96) = 340 A. The smallest suitable size is 3×150+3G25+2×12E9 with 370 A.

Type designation cores × mm²	Apparent power at 6 kV MVA (1 layer)	Winding capacity m
3×25+3G6+2×12E9	1.01	970
3×35+3G6+2×12E9	1.24	840
3×50+3G10+2×12E9	1.55	720
3×70+3G16+2×12E9	1.91	510
3×95+3G16+2×12E9	2.31	405
3×120+3G25+2×12E9	2.68	310
3×150+3G25+2×12E9	3.08	235
3×185+3G35+2×12E9	3.51	230
3×240+3G50+2×12E9	4.13	145
3×300+3G50+2×12E9	4.75	65

Apparent power S = √3 × U × I × 0.80 (one layer on the reel, 30 °C). Winding capacity is an indicative value for a reel with 2,500 mm flange diameter, 1,000 mm traverse width, core diameter equal to the minimum reel core diameter and 90 % fill; it is not a substitute for the reel manufacturer’s calculation.

07 Standards and Testing

Standard	Scope
DIN EN 60228 / IEC 60228 / VDE 0295	Conductors, class 5
IEC 60502-2	Power cables with extruded insulation, 6 kV to 30 kV
DIN VDE 0298-3	Application of cables – bending radii and tensile loads
DIN VDE 0298-4	Application of cables – current-carrying capacity
DIN EN 60332-1-2 / IEC 60332-1-2	Flame propagation, single cable
DIN VDE 0250-813	Reference construction of MV reeling cables
ITU-T G.652.D / IEC 60793-2-50	Single-mode optical fibres
IEC 60794-1-21	Optical cables – mechanical test methods
DIN VDE 0207-21	Sheath compound 5GM5 (polychloroprene)
IEC 60811-404	Mineral oil immersion test

Routine and type tests

- AC voltage test on every reel length (routine test): 9 kV AC, 5 min
- Partial-discharge test of the MV power cores to IEC 60502-2
- Conductor resistance and checks of dimensions, insulation thickness and sheath thickness
- Continuity of conductors and protective earth
- Bending, tensile and reeling torsion tests (type test)
- Flame propagation (IEC 60332-1-2)
- Optical attenuation of every fibre by OTDR after cabling (routine test); reeling and torsion tests with optical monitoring (type test)

Test documentation: every delivery is accompanied by a test certificate from FeiChun's own laboratory. Third-party witnessed tests can be arranged at the buyer's cost.

08 Installation, Marking and Delivery

Installation guidance

- Use a spring-driven or motor-driven cable reel with a core diameter of at least twice the minimum bending radius (25 × D).
- Unwind from the shipping reel tangentially; never pull the cable over the flange of the drum, and avoid loops and kinks.
- Keep torsion within the permitted limit and tensile load within the value in the table.
- Guide the cable so that it is not run over by vehicles or crushed; inspect the sheath regularly.
- Connect all parts of the split PE conductor at both ends of the cable.
- Use terminations and joints that are approved for individually screened cores; do not cut back the semi-conductive layers unless instructed by the accessory manufacturer.

Sheath marking

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FEICHUN FC-PMR (N)TSCGEWÖU-F2 [cross-section] 3.6/6 kV [year] [serial no.] [metre mark]
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Packing and delivery

Reel	Steel or fumigated wooden reels; cable ends sealed with heat-shrink caps
Delivery length	As ordered, in one continuous length without joints
Lead time	2–3 weeks after technical approval
Warranty	1 year, covering failures not caused by human factors
Reel label	Type, cross-section, length, gross/net weight, batch no., reel no.

Ordering information

Field	Example	Meaning
Series code	FC-PMR (N)TSCGEWÖU-F2	FeiChun series and sheath system
Core configuration	3×95+3G16+2×12E9	Number × cross-section (mm²) of the screened power cores, split PE conductors (G) and pilot or optical elements
Rated voltage	3.6/6 kV	U_0/U, AC
Length and packing	500 m, steel reel	Delivery length in one piece; reel type on request

Order example: FC-PMR (N)TSCGEWÖU-F2 3×95+3G16+2×12E9 3.6/6 kV – 500 m on one steel reel. When requesting a quotation, state the cable type, configuration, cross-section, voltage, length per piece, required standards and installation conditions.

09 Certification and Quality

All cable is subject to FeiChun's quality control, with routine testing over 100 % of the delivered length. Certificates, type tests and third-party tests (for example partial discharge or compatibility with cable accessories) are provided per project requirement; copies of the records are available on request.

10 Related Datasheets

Variants of this cable that differ in one attribute – sheath, configuration, optical fibres or voltage. All datasheets are in PDF format.

- FC-MRT-P-F2 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PUR
- FC-PMR (N)TSCGEWÖU-PF2 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 24 single-mode fibres G.652.D in two elements, PCP rubber
- FC-PMR (N)TSCGEWÖU 3.6/6 kV – 3 screened power cores + 3 split PE conductors, PCP rubber
- FC-PMR (N)TSCGEWÖU-F2 1.8/3 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PCP rubber
- FC-MRT-PA-F2 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PUR low-temp
- FC-PMR (N)TSCGEWÖU-F6 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 6 single-mode fibres G.652.D, PCP rubber
- FC-PMR (N)TSCGEWÖU-F2 6/10 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PCP rubber
- FC-MRT-C-F2 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, CSP rubber

Overview of all datasheets: Medium-Voltage Port Reeling Cables 1.8/3 – 20/35 kV

Frequently asked questions

What is FC-PMR (N)TSCGEWÖU-F2 used for?
Typical applications include medium-voltage supply of ship-to-shore (STS) cranes and rail-mounted gantry cranes through motor-driven cable reels.

What are the outer diameter and minimum bending radius of 3×95+3G16+2×12E9?
The outer diameter is 64.5 to 68.5 mm and the minimum bending radius in moving or reeling operation is 856 mm (12.5 × D).

What minimum reel core diameter is needed for 3×95+3G16+2×12E9?
At least 1,712 mm, which is twice the minimum bending radius of 856 mm. A larger core diameter extends cable life.

What current rating applies to 3×95+3G16+2×12E9 on a cable reel?
The rated current in free air at 30 °C ambient is 278 A. Multiply it by 0.80 for one layer on the reel, 0.61 for two layers, 0.49 for three layers and 0.41 for four layers (DIN VDE 0298-4), and by the ambient temperature factor.

Which optical fibres does FC-PMR (N)TSCGEWÖU-F2 contain?
24 single-mode fibres G.652.D in two elements. 1 Gbit/s and 10 Gbit/s Ethernet up to 10 km (1000BASE-LX, 10GBASE-LR).

How are the fibres connected on the reel?
Through a fibre-optic rotary joint (FORJ) on the reel axis, normally combined with the power slip-ring assembly. Match the number of FORJ channels to the number of fibres in use and keep spare fibres for later expansion.

Is this cable halogen-free?
No. The PCP rubber sheath contains halogen. If halogen-free cables are required, select the HFFR rubber or PUR version of the same construction.

Which cross-sections are available?
FC-PMR (N)TSCGEWÖU-F2: 25, 35, 50, 70, 95, 120, 150, 185, 240, 300 mm². Other sizes and special designs can be produced to order.

11 Trademark Notice and Intellectual Property

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