HIGH-FLEX LV REELING CABLE · RTG / RMG / STS | 3-IN-1 · POWER · CONTROL · FIBRE | 0.6/1 kV | 10 sizes | CSP rubber | 12E9

FC-TCS-M-PF 0.6/1 kV

3-in-1 Power, Control and Fibre-Optic Reeling Cable 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 12 single-mode fibres G.652.D, CSP rubber sheath. 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-TCS-M-PF is a high-flex reeling cable for container terminals and heavy port equipment, rated 0.6/1 kV, with the configuration 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 12 single-mode fibres G.652.D. It has fine-wire class 5 copper conductors, halogen-free EPR/HEPR rubber insulation, a halogen-free inner sheath and an outer sheath of chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil; power cores from 25 – 300 mm². Short-lay stranding makes it suitable for continuous winding on and off a cable reel under tensile and torsional load. The construction is derived from the FC-TPU-M D2X11Y platform with a rubber sheath.

Typical applications

- Cranes with ground-check or pilot-wire protection in addition to power supply
- Remote-controlled and automated cranes that send PLC, video and remote-operation data over single-mode fibre through the reel
- Rubber-tyred gantry (RTG), rail-mounted gantry (RMG) and electrified RTG cranes fed through spring-driven or motor-driven cable reels
- Ship-to-shore (STS) crane auxiliary drives, automated stacking cranes, ship unloaders and bulk-handling machines in terminals
- Outdoor quayside and yard operation with exposure to seawater spray, salt mist, UV radiation and ozone
- Reeling operation at travel speeds up to 60 m/min with repeated tensile and torsional loads

Design

Power cores and split PE conductors combined with two 2.5 mm² pilot cores. The pilot cores form a monitoring loop for earth-continuity (ground-check) relays and protective interlocks, and are larger than standard control cores for higher mechanical robustness on the reel. This is a 3-in-1 design in the DIN VDE 0250 reeling-cable tradition: power cores, pilot cores and optical fibres share one sheath, so one reel, one slip-ring/rotary-joint assembly and one cable route replace three separate cables. The cable contains one optical element (12 single-mode fibres G.652.D). 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	0.6/1 kV	+90 °C	CSP rubber
Cross-section 25 – 300 mm²	Rated voltage U_0/U	Maximum conductor temperature	Sheath: CSP rubber

Key features

- Fine-wire class 5 copper conductors and a very short core lay length for repeated reeling

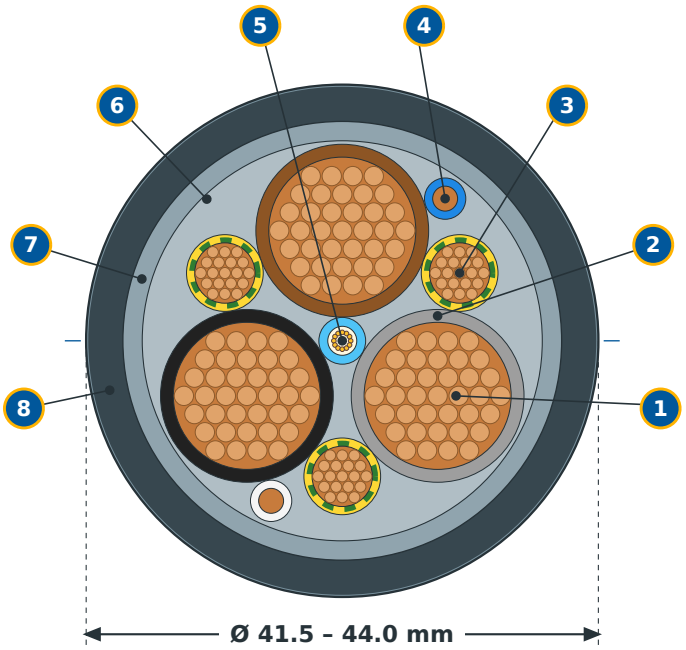
- 3-in-1 design: power, pilot and 12 single-mode fibres G.652.D in a crush-resistant loose-tube element on the cable axis
- Three split PE conductors in the interstices keep the cross-section round and balanced
- Designed for 20 N/mm² continuous tensile load (on the total copper cross-section of the power cores)
- CSP rubber sheath with proven weather, ozone and oil resistance
- Flame retardant to IEC 60332-1-2

02 Construction

FEICHUN · CROSS-SECTION A–A · 0.6/1 kV

FC-TCS-M-PF

Sample size 3×95+3G16+2×2.5+12E9 · Rev 0 · Illustrative, not to scale



No.	Component	Material
1	Conductor	Bare annealed fine-wire copper, class 5 to IEC 60228
2	Insulation	Halogen-free EPR/HEPR rubber
3	Split PE conductor	Class 5 copper, green-yellow insulation, laid in the interstices between the power cores
4	Pilot cores	Class 5 copper, blue and white insulation
5	Optical element	12 single-mode fibres G.652.D; 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	Chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil

The drawing shows size 3×95+3G16+2×2.5+12E9. Other sizes have the same construction with scaled dimensions.

Construction details

Conductor	Bare annealed fine-wire copper, class 5 to DIN EN 60228 / IEC 60228 / VDE 0295
Insulation	Halogen-free EPR/HEPR rubber to IEC 60502-1, maximum conductor temperature 90 °C
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
Pilot cores	Two pilot cores 2 × 2.5 mm² (blue, white) laid in the free space between the power cores
Optical element	One element: 12 single-mode fibres G.652.D, 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	Chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil

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 chlorosulfonated polyethylene (CSP) rubber sheath is a proven reeling-cable material for open-air cranes: excellent resistance to weather, ozone and mineral oil, good mechanical robustness and low-temperature flexibility to −30 °C in motion. CSP 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	0.6/1 kV AC
Test voltage	2.5 kV AC (power cores); 2 kV AC (control cores)
Maximum operating voltage, DC	0.9/1.8 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	−30 °C to +90 °C
Minimum bending radius	4 × D fixed; 8 × D on a cable reel (DIN VDE 0298-3)
Maximum tensile load	20 N/mm² continuous, on the total copper cross-section of the power cores
Maximum torsional load	±50 °/m
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 (CSP 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 – 0.6/1 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+2×2.5+12E9	FC-LV093-001	6.2	24.0	25.5	204	1,250	1,500	0.780	131	3.58
3×35+3G6+2×2.5+12E9	FC-LV093-002	7.8	27.5	29.5	236	1,660	2,100	0.554	162	5.00
3×50+3G10+2×2.5+12E9	FC-LV093-003	9.6	31.5	33.5	268	2,330	3,000	0.386	202	7.15
3×70+3G16+2×2.5+12E9	FC-LV093-004	11.1	36.5	38.5	308	3,260	4,200	0.272	250	10.01
3×95+3G16+2×2.5+12E9	FC-LV093-005	12.6	41.5	44.0	352	3,910	5,700	0.206	302	13.59
3×120+3G25+2×2.5+12E9	FC-LV093-006	14.8	45.0	47.5	380	5,020	7,200	0.161	350	17.16
3×150+3G25+2×2.5+12E9	FC-LV093-007	16.0	50.5	53.5	428	6,050	9,000	0.129	402	21.45
3×185+3G35+2×2.5+12E9	FC-LV093-008	17.7	54.0	57.5	460	7,600	11,100	0.106	459	26.45
3×240+3G50+2×2.5+12E9	FC-LV093-009	20.2	61.5	65.5	524	9,950	14,400	0.0801	540	34.32
3×300+3G50+2×2.5+12E9	FC-LV093-010	22.4	67.0	71.5	572	11,910	18,000	0.0641	621	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+2×2.5+12E9	25.5	204	408	870	125.0	105	80	64	54
3×35+3G6+2×2.5+12E9	29.5	236	472	1,140	166.0	130	99	79	66
3×50+3G10+2×2.5+12E9	33.5	268	536	1,640	233.0	162	123	99	83
3×70+3G16+2×2.5+12E9	38.5	308	616	2,340	326.0	200	152	122	102
3×95+3G16+2×2.5+12E9	44.0	352	704	3,000	391.0	242	184	148	124
3×120+3G25+2×2.5+12E9	47.5	380	760	3,910	502.0	280	214	172	144
3×150+3G25+2×2.5+12E9	53.5	428	856	4,710	605.0	322	245	197	165
3×185+3G35+2×2.5+12E9	57.5	460	920	5,910	760.0	367	280	225	188
3×240+3G50+2×2.5+12E9	65.5	524	1,048	7,780	995.0	432	329	265	221
3×300+3G50+2×2.5+12E9	71.5	572	1,144	9,380	1,191.0	497	379	304	255

Reel design guidance

- Minimum reel core diameter = 2 × minimum bending radius = 16 × 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-TCS-M-PF covers 10 sizes. The smallest, 3×25+3G6+2×2.5+12E9, has an outer diameter of up to 25.5 mm and weighs about 1,250 kg/km; the largest, 3×300+3G50+2×2.5+12E9, has an outer diameter of up to 71.5 mm and weighs about 11,910 kg/km, 9.5 times as much. Across the range the rated current in free air rises from 131 A to 621 A at 30 °C, and the minimum bending radius from 204 mm to 572 mm.

Example 1. A drive draws 128 A continuously, the cable is wound in 2 layers on the reel and the ambient temperature is 40 °C. Required table current = 128 / (0.61 × 0.91) = 231 A. The smallest suitable size is 3×70+3G16+2×2.5+12E9 with 250 A.

Example 2. A drive draws 284 A continuously, the cable is wound in 1 layer on the reel and the ambient temperature is 35 °C. Required table current = 284 / (0.80 × 0.96) = 370 A. The smallest suitable size is 3×150+3G25+2×2.5+12E9 with 402 A.

Type designation cores × mm²	Apparent power at 400 V kVA (1 layer)	Apparent power at 690 V kVA (1 layer)	Winding capacity m
3×25+3G6+2×2.5+12E9	72.6	125.2	6,570
3×35+3G6+2×2.5+12E9	89.8	154.9	4,680
3×50+3G10+2×2.5+12E9	112.0	193.1	3,585
3×70+3G16+2×2.5+12E9	138.6	239.0	2,615
3×95+3G16+2×2.5+12E9	167.4	288.7	1,970
3×120+3G25+2×2.5+12E9	194.0	334.6	1,725
3×150+3G25+2×2.5+12E9	222.8	384.3	1,265
3×185+3G35+2×2.5+12E9	254.4	438.8	1,040
3×240+3G50+2×2.5+12E9	299.3	516.3	825
3×300+3G50+2×2.5+12E9	344.2	593.7	590

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 60502-1	Insulation compound, power cables up to 1 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 0298-300	Core identification
DIN VDE 0250-814	Design reference for flexible reeling and trailing cables (NSHTÖU type)
ITU-T G.652.D / IEC 60793-2-50	Single-mode optical fibres
IEC 60794-1-21	Optical cables – mechanical test methods
IEC 60811-404	Mineral oil immersion test

Routine and type tests

- AC voltage test on every reel length (routine test): 2.5 kV AC (power cores); 2 kV AC (control cores)
- 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 (16 × 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 (±50 °/m) 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.
- Suitable for wet conditions; consult FeiChun for continuous immersion.

Sheath marking

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FEICHUN FC-TCS-M-PF [cross-section] 0.6/1 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-TCS-M-PF	FeiChun series and sheath system
Core configuration	3×95+3G16+2×2.5+12E9	Number × cross-section (mm²) of the power cores, split PE conductors (G) and control or optical elements
Rated voltage	0.6/1 kV	U_0/U, AC
Length and packing	500 m, steel reel	Delivery length in one piece; reel type on request

Order example: FC-TCS-M-PF 3×95+3G16+2×2.5+12E9 0.6/1 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.

The CE, EAC and UKCA certificates listed in datasheet FC-TDS-TMP-2026-9238-EN apply to the FC-TPU-M D2X11Y product group. Confirm with FeiChun that the certificate scope covers this construction before quoting it in a tender.

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-TPU-M D2X11Y-PF 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 12 single-mode fibres G.652.D, PUR
- FC-TCS-M-KF 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + 12 single-mode fibres G.652.D, CSP rubber
- FC-TCS-M-P 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm², CSP rubber
- FC-TPU-MA D2X11Y-PF 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 12 single-mode fibres G.652.D, PUR low-temp
- FC-TCS-M-F 0.6/1 kV – 3 power cores + 3 split PE conductors + 12 single-mode fibres G.652.D, CSP rubber
- FC-TCS-M-PF6 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 6 single-mode fibres G.652.D, CSP rubber
- FC-TRB-M-PF 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 12 single-mode fibres G.652.D, CPE rubber
- FC-TCS-M-NSF 0.6/1 kV – 3 power cores + 3 split PE conductors + overall screen + 12 single-mode fibres G.652.D, CSP rubber

Overview of all datasheets: Low-Voltage Port Reeling Cables 0.6/1 kV

Frequently asked questions

What is FC-TCS-M-PF used for?
Typical applications include cranes with ground-check or pilot-wire protection in addition to power supply.

What are the outer diameter and minimum bending radius of 3×95+3G16+2×2.5+12E9?
The outer diameter is 41.5 to 44.0 mm and the minimum bending radius in moving or reeling operation is 352 mm (8 × D).

What minimum reel core diameter is needed for 3×95+3G16+2×2.5+12E9?
At least 704 mm, which is twice the minimum bending radius of 352 mm. A larger core diameter extends cable life.

What current rating applies to 3×95+3G16+2×2.5+12E9 on a cable reel?
The rated current in free air at 30 °C ambient is 302 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-TCS-M-PF contain?
12 single-mode fibres G.652.D. 1 Gbit/s and 10 Gbit/s Ethernet up to 10 km (1000BASE-LX, 10GBASE-LR).

Why choose a 3-in-1 reeling cable?
One cable carries power, pilot-wire monitoring and data, so the crane needs one reel channel, one slip-ring assembly with a fibre-optic rotary joint and one cable route. This saves reel space and weight and reduces the number of terminations to maintain.

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 CSP 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-TCS-M-PF: 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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