HIGH-FLEX LV REELING CABLE · RTG / RMG / STS | 3-IN-1 · POWER · CONTROL · FIBRE | 0.6/1 kV | 10 sizes | CSP rubber | 2×12E9

FC-TCS-M-PF2 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 + 24 single-mode fibres G.652.D in two elements, 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-PF2 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 + 24 single-mode fibres G.652.D in two elements. 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 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	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

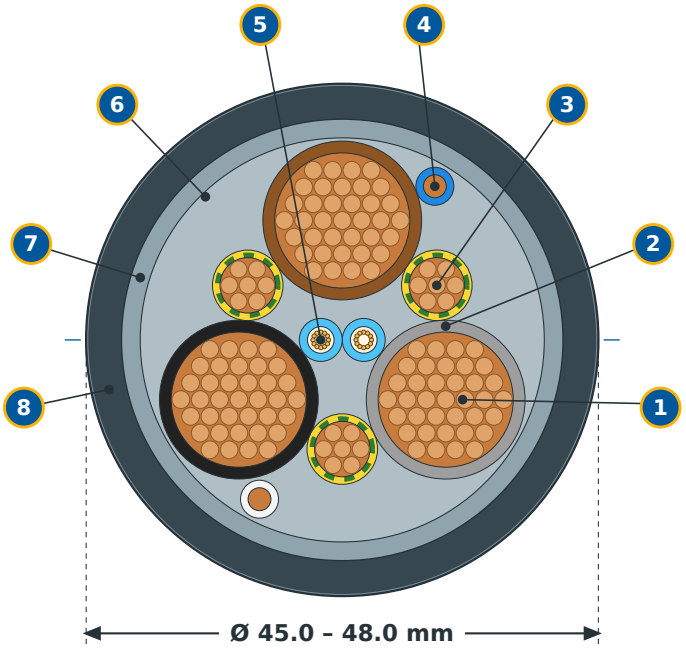
- Fine-wire class 5 copper conductors and a very short core lay length for repeated reeling
- 3-in-1 design: power, pilot and 24 single-mode fibres G.652.D in two elements in a crush-resistant loose-tube element on the cable axis
- Three split PE conductors in the interstices keep the cross-section round and balanced
- Designed for 20 N/mm² continuous tensile load (on the total copper cross-section of the power cores)
- 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-PF2

Sample size 3×95+3G16+2×2.5+2×12E9 · 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	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	Chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil

The drawing shows size 3×95+3G16+2×2.5+2×12E9. 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	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	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+2×12E9	FC-LV094-001	6.2	25.5	27.0	216	1,290	1,500	0.780	131	3.58
3×35+3G6+2×2.5+2×12E9	FC-LV094-002	7.8	30.0	32.0	256	1,760	2,100	0.554	162	5.00
3×50+3G10+2×2.5+2×12E9	FC-LV094-003	9.6	34.5	36.5	292	2,470	3,000	0.386	202	7.15
3×70+3G16+2×2.5+2×12E9	FC-LV094-004	11.1	40.0	42.0	336	3,480	4,200	0.272	250	10.01
3×95+3G16+2×2.5+2×12E9	FC-LV094-005	12.6	45.0	48.0	384	4,110	5,700	0.206	302	13.59
3×120+3G25+2×2.5+2×12E9	FC-LV094-006	14.8	48.5	51.5	412	5,240	7,200	0.161	350	17.16
3×150+3G25+2×2.5+2×12E9	FC-LV094-007	16.0	54.0	57.5	460	6,290	9,000	0.129	402	21.45
3×185+3G35+2×2.5+2×12E9	FC-LV094-008	17.7	58.0	61.5	492	7,900	11,100	0.106	459	26.45
3×240+3G50+2×2.5+2×12E9	FC-LV094-009	20.2	65.5	69.5	556	10,300	14,400	0.0801	540	34.32
3×300+3G50+2×2.5+2×12E9	FC-LV094-010	22.4	71.0	75.5	604	12,310	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+2×12E9	27.0	216	432	870	129.0	105	80	64	54
3×35+3G6+2×2.5+2×12E9	32.0	256	512	1,140	176.0	130	99	79	66
3×50+3G10+2×2.5+2×12E9	36.5	292	584	1,640	247.0	162	123	99	83
3×70+3G16+2×2.5+2×12E9	42.0	336	672	2,340	348.0	200	152	122	102
3×95+3G16+2×2.5+2×12E9	48.0	384	768	3,000	411.0	242	184	148	124
3×120+3G25+2×2.5+2×12E9	51.5	412	824	3,910	524.0	280	214	172	144
3×150+3G25+2×2.5+2×12E9	57.5	460	920	4,710	629.0	322	245	197	165
3×185+3G35+2×2.5+2×12E9	61.5	492	984	5,910	790.0	367	280	225	188
3×240+3G50+2×2.5+2×12E9	69.5	556	1,112	7,780	1,030.0	432	329	265	221
3×300+3G50+2×2.5+2×12E9	75.5	604	1,208	9,380	1,231.0	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-PF2 covers 10 sizes. The smallest, 3×25+3G6+2×2.5+2×12E9, has an outer diameter of up to 27.0 mm and weighs about 1,290 kg/km; the largest, 3×300+3G50+2×2.5+2×12E9, has an outer diameter of up to 75.5 mm and weighs about 12,310 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 216 mm to 604 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+2×12E9 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+2×12E9 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+2×12E9	72.6	125.2	5,795
3×35+3G6+2×2.5+2×12E9	89.8	154.9	4,085
3×50+3G10+2×2.5+2×12E9	112.0	193.1	3,045
3×70+3G16+2×2.5+2×12E9	138.6	239.0	2,120
3×95+3G16+2×2.5+2×12E9	167.4	288.7	1,660
3×120+3G25+2×2.5+2×12E9	194.0	334.6	1,415
3×150+3G25+2×2.5+2×12E9	222.8	384.3	1,040
3×185+3G35+2×2.5+2×12E9	254.4	438.8	935
3×240+3G50+2×2.5+2×12E9	299.3	516.3	620
3×300+3G50+2×2.5+2×12E9	344.2	593.7	535

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-PF2 [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-PF2	FeiChun series and sheath system
Core configuration	3×95+3G16+2×2.5+2×12E9	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-PF2 3×95+3G16+2×2.5+2×12E9 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-PF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 24 single-mode fibres G.652.D in two elements, PUR
- FC-TCS-M-KF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + 24 single-mode fibres G.652.D in two elements, 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-PF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 24 single-mode fibres G.652.D in two elements, PUR low-temp
- FC-TCS-M-F2 0.6/1 kV – 3 power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, 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-PF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 24 single-mode fibres G.652.D in two elements, CPE rubber
- FC-TCS-M-NSF2 0.6/1 kV – 3 power cores + 3 split PE conductors + overall screen + 24 single-mode fibres G.652.D in two elements, CSP rubber

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

Frequently asked questions

What is FC-TCS-M-PF2 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+2×12E9?
The outer diameter is 45.0 to 48.0 mm and the minimum bending radius in moving or reeling operation is 384 mm (8 × D).

What minimum reel core diameter is needed for 3×95+3G16+2×2.5+2×12E9?
At least 768 mm, which is twice the minimum bending radius of 384 mm. A larger core diameter extends cable life.

What current rating applies to 3×95+3G16+2×2.5+2×12E9 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-PF2 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).

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-PF2: 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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Technical and commercial contacts

Anhui FeiChun Special Cable Co., Ltd.
International Business Department
Park No. 1, Private Science and Technology Park, Hefei National Economic and Technological Development Zone, Hefei, Anhui, China
Technical support: Tech@feichuncables.com
Mining and heavy industry: mining@feichuncables.com
Zihao Yang, Global Sales Manager: zihao.yang@feichuncables.com
WhatsApp: +86 138 5512 3218
Web: www.feichuncables.com

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