

Islamic Republic of Iran
Vice Presidency for Strategic Planning and Supervision

**General Technical Specification and
Execution Procedures for Transmission
and Subtransmission Networks
Coupling Equipment at HV Substations**

NO: 478

**Office of Deputy for Strategic Supervision
Bureau of Technical Execution System
<http://tec.mporg.ir>**

**Energy Ministry - Tavanir Co.
Power Industry Technical Criteria
Project
www.tavanir.ir**

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Technical Specifications of Coupling Equipment



1- General Requirements

This specification covers the requirements for the design, manufacturing and factory testing testing of the power line carrier coupling equipment.

Coupling device for PLC shall be designed, manufactured and tested in accordance with the requirements of this specification and latest revision of IEC 60481 and 60663. All amendments and reference publications listed within the above standard should be applied.

Coupling device, which will be inserted between the low voltage terminals of the coupling capacitor and the carrier terminal equipment shall consist of a line coupling unit which matches the impedance of the line side to the PLC terminals, protection unit providing protection for the carrier terminal equipment against over voltage surges, balancing unit, hybrid transformer and separation filter.

The equipment shall be designed for outdoor and to operate in specified service conditions.

The equipment should be so designed that prevent overvoltage on carrier terminals in normal service condition and over voltage which may occur on transmission line.

2- Line Matching Unit

The line matching unit shall suitable for outdoor duty and are to be mounted on the steel framework which supports the coupling capacitors. All equipment parts of the line coupling unit shall be enclosed in metal box of IP54 with hinged, front access.

The coupling unit shall include, but shall not be limited to the following coupling and protective devices:

- A tuned and replaceable coupling transformer which, together with the coupling capacitor shall form a broadband high pass filter arrangement which shall match the output impedance of the power line over the range of frequencies to be transmitted and received.
- A disconnect and grounding switch, shall be used to ground the coupling capacitor output lead. The open and close condition of this switch should be visible.
- A primary high voltage discharge arrester which shall be set to conduct when a potential is applied across its terminals. The arrester shall be capable of protecting the coupling unit even under the rare case where the coupling capacitor may become shorted.
- A drain coil which shall be connected to the output lead of the coupling capacitor to provide a low impedance path to ground for the 50 Hz component of incoming voltage and current. It shall not attenuate the incoming/ outgoing carrier signal level by an amount greater than 0.5 dB over the usable carrier frequency range and should withstand over voltages.
- A fuse which shall limit the current allowed to flow in the coaxial cable connecting the coupling unit to the power line carrier equipment. This fuse shall have sufficient breaking capacity so that there is no risk of flashover between its terminals, after fusion of the fuse wire.

- A secondary low voltage discharge arrester.
- Earth terminal of coupling device which is intended to be connected directly to the local station earth.
- Primary terminal of coupling device which is intended to be connected to the low- voltage terminal of the coupling capacitor.
- Secondary terminal of coupling device which is intended to be connected to the coaxial cable.
- Anti- condensation heater.

3- Coaxial cable

Coaxial cable will be used to connect the outdoor coupling equipment to the indoor carrier set. The characteristic impedance of the cable shall match with the nominal equipment side impedance of the coupling device and PLC terminal impedance and shall have specified loss.

4- Coaxial cable connecting unit

The coaxial cable connecting unit shall be provided for the joining of the outdoor coaxial cable to the indoor coaxial cable which is connected to the PLC terminal equipment.

The coaxial cable connecting unit must provide the following:

- Adequate screening of the inner conductor.
- Protection against electrical danger caused by exposed terminals and armoring for protection against mechanical damage.
- Negligible mismatch of the line.
- Solid earthing for the outdoor coaxial cable.
- Provision for connecting a load equal to line impedance for test.

5- Overall requirements of the line coupling equipment

The coupling equipment shall effectively transmit to and receive from the line, without undue loss. Frequencies to be used at the line are specified. The manufacturer of the line coupling unit shall be responsible for checking the overall attenuation between the carrier input/ output terminals of the line coupling unit at end of transmission line over the frequency range of the coupling equipment. These end to end frequency response curves shall be submitted to the engineer.

The coupling device shall be designed and built to ensure that a fault on the power line shall not in general cause a permanent interruption in the functioning of the coupling device.

The coupling device shall be so designed that the impedance at power frequency between the primary terminal and the earth terminal be as low as possible and in no case in excess of 20 Ω . This low impedance should be provided by drain coil and / or matching transformer.

The composite loss shall be the least possible compatible with the bandwidth and design requirements called for by safety considerations and shall be not greater than specified value over the whole of the available bandwidth of the coupling device.

In certain cases, other values for return loss may require to be accepted, subject to agreement between manufacturer and purchaser.

The nominal line- side impedance for phase- to- earth or phase- to- phase coupling shall lie in the specified ranges.

The level of individual distortion and intermodulation products arising within the coupling device shall be at least 80 dB below the level corresponding to the peak- envelope power.

6- Rating plate of the coupling device

The coupling device shall be provided with a rating plate of weather- proof material, fitted so that it is readily visible. The inscriptions shall be indelibly marked. The rating plate shall give the following data:

- Manufacturer's name
- Type
- Manufacturer's serial number
- Nominal peak- envelope power
- Capacitance of coupling capacitor to which the carrier- frequency requirement of the coupling device are referred.
- Nominal line- side and equipment- side impedances
- Available bandwidth or carrier- frequency working rang

7- Tests

7-1- Type tests

- Composite loss measurement
- Return loss measurement

- Distortion and intermediation test
- Impulse voltage test
- Tests on arresters
- Power frequency voltage tests
- Tests on drain coil or matching transformer winding

7-2- Sampling tests

Some, or all, of the type tests may be repeated as sampling tests if specially agreed between manufacturer and purchaser

7-3- Routine tests

- Composite loss measurement
- Return loss measurement
- Power frequency voltage test

8- Drawing and documents

8-1- Documents to be given by tenderer

- Filled line coupling equipment schedule (II)
- Catalog and technical pamphlets
- Detailed summary of exceptions to tender specification
- Dimensional drawings
- Spare part and special tool lists

8-2- Documents to be given by contractor/ supplier

The electrical and mechanical design, fabrication, factory testing, working and packing, transportation, erection, site test, operation and maintenance drawings, documents and manuals shall be submitted not limited to the followings:

- Necessary calculations for sufficiency proving of the equipments of any aspects
- Dimensional drawings, detail specification of circuit, terminals and cross sections

- Assembly drawing
- Packaging details
- Test reports and certifications
- Drawings of rating plates
- Shipping, warehousing, assembly, erection, commissioning, operating, repairing and maintenance instruction manuals
- List of equipment
- Drawings list
- Required test sheet in the location of the substation

SCHEDULE (I)
RATING AND CHARACTERISTIC OF COUPLING EQUIPMENT

ITEM	DESCRIPTION	Technical Specification for Systems With Following Nominal Voltages				
		63/66 kV	132 kV	230 kV	400 kV	
1	System characteristic					
1-1	Nominal system voltage	kV	63/66	132	230	400
1-2	Min. system voltage	kV	72.5	145	245	420
1-3	Nominal system frequency	Hz	50			
1-4	Number of phases		3			
2	Service conditions					
2-1	Max. ambient temperature	°C	40/45/50/55			
2-2	Min. ambient temperature	°C	-40/-35/-30/-25			
2-3	Average value of daily Temperature	°C	*			
2-4	Altitude above sea level	m	1000/1500/2000/2500			
2-5	Pollution level		Low/medium/high/ Very high/ special			
2-6	Solar radiation	w/m	*			
2-7	Max. wind velocity	m/s	30/40/45			
2-8	Wind velocity at ice condition	m/s	20			
2-9	Ice coating thickness	mm	5/10/20/25			
2-10	Seismic acceleration	m/s ²	0.2/0.25/0.3/0.35			
2-11	Relative humidity	%	90/95/greater than 95			

SCHEDULE (I)
RATING AND CHARACTERISTIC OF COUPLING EQUIPMENT

ITEM	DESCRIPTION	Technical Specification for Systems With Following Nominal Voltages			
		63/66 kV	132 kV	230 kV	400 kV
3	<u>COUPLING DEVICE</u>				
3-1	Type of coupling		Phase to phase/ phase to earth		
3-2	Max. composite loss		2		
3-3	Min. return loss	db	12		
3-4	Carrier frequency rage	KHZ	30-500		
3-5	Line impedance	Ω	200-400		
3-6	Input impedance				
3-6-1	Balance	Ω	150		
3-6-2	Unbalance	Ω	25/50/75		
3-7	Impulse bolt age insulation between output terminals on the coupling capacitor and earth	KV	4		
3-8	Discharge current of surge arrester	KV	5		
4	Coaxial cable				
4-1	Type		RG11		
4-2	Max. loss	db	0.15 per 100 meters at 10 KHZ		
4-3	Max. power dissipation	W	400		
5	Value of coupling capacitor	PF	*		

* These will be specified by engineer

**SCHEDULE (II)
GARUNTEED TECHNICAL INFORMATION OF COUPLING EQUIPMENT**

ITEM	DESCRIPTION	Technical Specification for Systems With Following Nominal Voltages			
		63/66 kV	132 kV	230 kV	400 kV
1	Type designation				
2	Manufacturer				
3	Type of coupling (phase to phase/ phase to earth/ three phase)				
4	Withstand current/time of disconnect and grounding switch				
5	Fuse breaking capacity current				
6	residual voltage of primary arrester				
7	residual voltage of secondary arrester				
8	Loss of coaxial cable				
9	Impedance of coupling device				
10	Band width				
11	Input impedance:				
11-1	Balance				
11-2	Unbalance				
12	Return loss				
13	Composite loss				
14	Acceptable level of carrier signal distortion				
15	Wiring diagram and sketch of complete equipment Showing all accessories and connections to be enclosed				
16	Diagram for coupling type changing is provided				