Huawan Power

Technical Specification of Huawan New Energy

Single-phase overhead transformers

(Revision history)

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Huawan New Energy

Pole Mounted Transformer

Overview

Huawan we manufacture a full range of single-phase pole-mounted distribution transformers in our product line.

In its new energy distribution transformer product line, it provides a full range of single-phase pole-mounted distribution transformer solutions. Our single-phase transformer series includes a variety of specifications and configurations to meet the needs of different application scenarios:

1. Product Series:

Conventional type (5-500kVA)

Fully self-protected type (5-75kVA)

Intelligent circuit breaker protection type (5-167kVA)

2. Technical characteristics:

All products strictly comply with international electrical standards and can be customized according to special industry specifications. The test standard shall be implemented in accordance with IEC 60076-1.

3. Protection configuration:

The fully self-protected transformer integrates the following safety devices: Integrated lightning protection system Secondary side automatic circuit breaker Built-in high voltage fuse

This integrated design significantly simplifies the installation process and effectively reduces overall project costs.

4. Intelligent protection scheme:

Our intelligent circuit breaker protection system provides comprehensive overcurrent protection functions, which can effectively prevent abnormal overload conditions, secondary side fault impact, also supports remote opening and closing operation functions.

Standard Features

Compliance & Efficiency

- Standards: Fully compliant with NTP 370.400, IEC energy efficiency, and ANSI requirements.
- Quality: Manufactured under an ISO 9001 certified quality system.
- Core Design: High-efficiency staggered core (5-75 kVA).

Electrical & Insulation

- Bushings: Wet-process porcelain HV bushings (corona resistant) and polymer LV bushings (5-75 kVA).
- Dielectric Strength: Cover plate rated for a minimum of 8 kV.
- Terminals: Tinned HV/LV terminals compatible with aluminum or copper conductors.
- Insulation: Filled with vegetable or electrical-grade mineral oil.

Mechanical & Safety

- Tank Construction: Enhanced corrosion-resistant coating with a recessed bottom for sliding protection.
- Lifting/Mounting: Heavy-duty lifting eyes and suspension brackets (ANSI compliant).
- Safety Devices: Automatic pressure relief valve and lightning arrester mounts.
- Grounding: Visible cover grounding and dedicated tank grounding device.

Identification & Maintenance

- Markings: Laser-engraved nameplates and permanently stamped secondary leads.
- Monitoring: Internal indicators for precise oil level verification.
- Hardware: Corrosion-resistant cover straps for long-term durability.

Figure 1. Structure of Single-phase pole transformer.

Optional accessories

- Tap: Two options can be configured (upper and lower 2.5% tap or four 2.5% lower taps), NEMA® tap or special tap
- Externally operable tap changer to ensure safe operation
- Multi-voltage primary winding design (applicable to 5-75kVA capacity
- Protection from high corrosion areas using 304 or 409 stainless steel hardware and tanks
- Circuit breakers
- Grounding connection bolt for transformer tank
- Overpressure or gas purging valve
- Nameplate
- Mineral or vegetable oils (when more flame-retardant fluids and superior environmental properties are required)
- Covers with a minimum dielectric strength of 15kV
- High creep-age distance high voltage bushings (up to 150 KV BIL)
- Porcelain low voltage bushings
- Special designs to meet international specifications
- Oil drain/sampling valves
- Pressure and vacuum gauges (limited by tank size)
- Thermometer (limited by tank size)
- Level gauge (limited by tank size)
- High efficiency transformers with efficiencies above NTP standards of 0.05% or higher

Pole Mounted Transformer Ratings

- Pole-mounted transformer ratings vary based on the number of phases and the power requirements of the electrical distribution system. Below are optimized and unique power and voltage ratings for both single-phase and three-phase pole-mounted transformers:
- Single-phase pole-mounted transformer power ratings:
  5kVA,10 kVA,15kVA,20kVA,25 kVA,37.5 kVA, 50 kVA, 100 kVA, 167 kVA, 250 kVA, 333 kVA
- Single-phase pole-mounted transformer voltage ratings:
  2400V, 7200V, 10000V, 10500V, 12470V, 13200V, 13800V, 19070V, 19920V, 22900V, 34500V, 27600V.
- Three-phase pole-mounted transformer power ratings:
  25kVA, 45kVA, 63kVA, 100kVA, 200kVA,315kVA,400kVA and 500kVA.
- Three-phase pole-mounted transformer primary nominal voltage ratings:
  Primary nominal voltage rating from 11kV to 33kV.

Liquid-filled pole-mounted transformers are designed to meet IEC standards and NTP efficiency regulations. They are ideal for single-phase and three-phase distribution in utility applications.

Table 1

Efficiency Parameters for Single-Phase Pole-Mounted Transformers (DOE 2016 Compliant)

Capacity(KVA)	High Voltage (V)	Tapping Ranges	Low Voltage (V)	Loss (W)		Dimension (mm)			DOE2016 Efficiency
				Maximum No Load Losses	Maximum Load Losses	W	D	H	
				(W)	(W)				
5	7620	±2x2.5%	208	49	142	560	590	935	98.65
10	12000		240	68	211				98.73
15	12470		277	86	278	610	625	935	98.82
25	13200		347	103	342	635	975	1035	98.95
37.5	13800		415	120	410	754	840	1035	99.05
50	14400		416	165	608	770	965	1135	99.11
75	19920		480	200	670	795	890	1135	99.19
100	24940		600	225	750				99.25
167	34500		690	235	890				99.33
250									99.39

PROTECTION OPTIONS

- Overcurrent Protection: Secondary circuit breakers with weak links (5-75 kVA) for fault and overload protection.
- Fusing: Primary weak link fuses and current-limiting fuses for high breaking capacity.
- Overvoltage Protection: Primary and secondary distribution-class lightning arresters (internal or external).
- Advanced Safety: Circuit breakers with isolating links or local range current-limiting fuses.
- Fire Safety: Optional high flash point Natural Ester fluid for enhanced fire protection.

QUALITY AND DESIGN EXCELLENCE

- Reliable Core and Coil: Optimized design ensures low field failure rates and high reliability.
- Reinforced Structure: Arched cover and formed cover bands for superior pressure resistance and secure fixation.
- Advanced Sealing: HV bushings designed for maximum gasket protection LV polymer bushings eliminate UV degradation.
- Corrosion Resistance: All external welded parts optimized to prevent moisture entrapment.
- Handling Protection: Recessed tank bottom and stainless-steel cover band ends prevent coating damage.
- Standards Compliance: Coating system fully compliant with IEEE Std C57.12.31-2010.
- Certified Quality: Manufactured under ISO 9001 quality management systems.

INSULATING FLUID OPTIONS

1. Standard Mineral Oil High-quality electrical grade insulating oil (standard configuration).
2. Natural Ester (Vegetable Oil)

- Eco-Friendly: 100% petroleum-free, halogen-free, and non-toxic.
- Superior Biodegradability: Over 98% biodegradation within 28 days (OECD 301).
- Fire Safety: Flame-retardant performance compliant with IEC 61039.
- Electrical Performance: Excellent dielectric properties meeting IEC 60156 and NTP 370.400 standards.

Technical Specifications for Single-Phase Pole-Mounted Distribution Transformers 5-167 kVA

1. Scope

This specification covers the electrical and mechanical characteristics of the Huawan Power Series 5-167 KVA single-phase pole-mounted distribution transformers.

2. Applicable Standards

Except as specifically covered in this specification, all properties, definitions, and terminology shall conform to the latest revisions of the following ANSI®, NTP®, Department of Energy, and NEMA® standards.

- NTP 370.400-2013 - NTP Standard for General Requirements for Liquid-Immersed Distribution, Power, and Voltage-Regulating Transformers NTP
- Std 370.400TM - NTP Standard for Pole-Mounted Distribution Transformers 500KVA and Below: High Voltage 34500V and Below Low Voltage 7970/13800YV and Below NTP
- Std 370.400TM - NTP Standard for Pole-Mounted Equipment - Enclosure Integrity NTP Std
- Std 370.400TM - NTP Standard for Bar Codes for Distribution Transformers and Step Voltage Regulators NTP
- Std 370.400TM - NTP Standard for Test Specifications for Liquid-Immersed Distribution, Power, and Voltage-Regulating Transformers NTP
- Std 370.400TM - NTP Standard for Loading Guidelines for Mineral Oil-Immersed Transformers and Step Voltage Regulators NTP
- Std 370.400TM - NTP NEMA TR 1 (R2000) Standard for the Design, Test, and Application of Liquid-Immersed Distribution, Power, and Voltage-Regulating Transformers Using High-Temperature Insulation Systems and Operating at High Temperatures
- Audible Noise Levels for Transformers, Voltage Regulators, and Reactors

3. Rated parameters

3.1 Transformers shall be designed in accordance with this specification and meet any of the following temperature rise standards: 55°C, 55/65°C, 65°C, 65/75°C, 75°C

The applicable AWR rating shall be specified in the inquiry.

3.2 The transformer shall be designed in accordance with this specification and have one of the following kVA ratings: 5, 10, 15, 25, 37.5, 50, 75, 100, 167.

The applicable kVA rating shall be specified in the enquiry.

3.3 The primary voltage and basic insulation level (BIL) shall comply with Table 2.

Table 2

Single-phase transformer rating (single ratio)

	Primary voltage (kV)	Primary voltage (kV)	BIL (kV)	AC （kV）
Transformer high voltage	10	12	75	28
	10.5	12	75	28
	13.2	17.5	95	38
	13.8	17.5	95	38
	19.07	24	125	50
	22.9	24	125	50
	10-22.9	24	125	50
	10-33	36	150	70
	33-22.9	36	150	70
Minimum kVA rating, for low voltage ratings	0.231	1.0	7.5	2.5
	0.46-0.23	1.0	7.5	2.5
	0.40-0.231	1.0	7.5	2.5

3.3.1. Low voltage ratings of 120/240 V or 240/480 V are for series, parallel or three-wire service.

3.3.2. Applicable to star-connected systems where grounding conditions allow the use of 18-kV arresters.

3.3.3 Applicable to star-connected systems where grounding conditions allow the use of 27-kV lightning arresters.

3.3.4 When specifying 125KV BIL, adequate grounding and surge protection studies should be carried out.

3.3.5 Rated regulation range of high-voltage tap changer: ±2×2.5%

Applicable voltage rating should be specified in enquiry

Transformers with GrdY high voltage (eg: 12470GrdY/7200) will be equipped with one (1) high voltage bushing. Transformers with Y high voltage (eg: 7200/12470Y) will be equipped with two (2) high voltage bushings. The bushings are made of porcelain insulating material, with a minimum creepage distance of 25 mm/kV.The transformer shall have a dual voltage primary capable of being reconnected by an externally operable, de-energized switch. The voltages provided and the Basic Insulation Level (BIL) shall be in accordance with Table 3.

Table 3

Ratings of single-phase transformers

Transformer high voltage		Minimum kVA rating , for low voltage ratings:	
Rated value (V)	BIL (kV)	120/240 (V)	277 or 240/480 1 (V)
2400/4160Y x 7200/12470Y	95 x 95	5	5
4160GrdY/2400 x 12470GrdY/7200	95 x 95	5	5
2400/4160 Y x 7620/13200Y	95 x 95	5	5
4160GrdY/2400x 13200GrdY/7620	95 x 95	5	5
4800/8320Y x 7200/12470Y	95 x 95	5	5
8320GrdY/4800x 12470GrdY/7200	95 x 95	5	5
4800/8320Y x 7620/13200Y	95 x 95	5	5
8320 GrdY /4800 x 13200 GrdY /7620	95 x 95	5	5
7200/12470Y x 14400/24940Y	125 x 125	5	5
12470GrdY/7200 x 24940GrdY/14400	125 x 125	5	5
7620/13200Y x 14400/24940Y	125 x 125	5	5
13200GrdY/7620 x 24940GrdY/14400	125 x 125	5	5

3.4 The secondary voltage shall be one of the following and the Basic Insulation Level (BIL) of the secondary voltage shall be 30 KV.

120/240 (5-100kVA-3 bushings, 167kVA-4 bushings)

240/480 (5-100kVA-3 bushings, 167kVA-4 bushings)

120 (2 bushings)

277 (2 bushings)

The applicable secondary voltage shall be specified in the enquiry.

3.5 Tap Configuration Options

Transformers may be equipped with full capacity high voltage taps. Tap changers shall be clearly marked to reflect that the transformer must be de-energized before operating the tap changer in accordance with IEEE Std C57.12.20. For transformers with dual voltage primary, the tap changer shall be operable only at the higher voltage. Units shall have one of the following tap configurations:

- No taps
- Two ±2.5% taps above and below rated voltage (split taps)
- Four -2.5% taps below rated voltage
- Taps (14400, 13800, 13200, 12780.12540)
- The applicable tap configuration shall be specified in the enquiry.

4. Structural Requirements

4.1 The core and coils shall be vacuum treated to ensure maximum penetration of the dielectric fluid into the coil insulation system. The transformer shall be filled with preheated, filtered, degassed dielectric fluid under vacuum. The core shall be made of burr-free, grain-oriented silicon steel and precisely laminated to eliminate gaps in corner joints and fixed with cold-annealed pressing plates. The coils are made of electrolytic copper conforming to ASTM B 187 standard Class E insulating material is adopted and shall be insulated with B-stage, epoxy-coated, diamond-patterned insulating paper and
heat cured under pressure to ensure proper bonding of the conductor and paper

4.2 The dielectric coolant shall be a listed flame-retardant liquid that meets the International Electrotechnical Commission (IEC) Requirements. The dielectric coolant should be non-toxic, non-bioaccumulate, and easily and completely biodegradable according to EPA OPPTS 835.3100. It has excellent environmental, fire safety, chemical and electrical properties. This insulating oil does not contain any petroleum, halogen, silicone or other harmful substances, and can be quickly and completely biodegraded in soil and water environments. Tests have shown that natural ester insulating oil can
achieve 98% degradation within 28 days.

4.3 Transformers up to 75KVA should be manufactured with interleaved windings to provide superior surge suppression (above 75kVA superior surge suppression can be provided without interleaved windings as the voltage per turn is higher at higher kVA).

4.4 All transformer components shall be certified to industry standards when tested in Envirotemp FR3TM fluid.
Certification test reports for each transformer component shall be available upon request.

4.5 The tank is made of rolled steel with a coating thickness of not less than 6 mils on the surface and shall include a pressure relief device as a means of relieving pressure in excess of normal operating pressure. Venting and sealing

- Characteristics shall be as follows:
- Opening Pressure: 10 psig ± 2 psig
- Reseal Pressure: 6 psig minimum
- No leakage from reseal pressure to -8 psig
- Flow at 15 psig: 35 SCFM minimum

4.6 The tank cover and tank body are connected by bolts, lock washers and galvanized iron nuts.

4.7 The oil tank shall have an internal marking indicating the correct oil level in accordance with IEEE Std C57.12.20TM.

4.8 The tank shall be provided with mild steel cover rings with stainless steel cover band rings and stainless-steel bolts.
Bronze nuts shall also be provided to eliminate corrosion problems and avoid galling.

4.9 The fuel tank shall be equipped with an anodized aluminum laser engraved nameplate. The nameplate shall comply with IEEE Std C57.12.00TM, Nameplate A.

4.10 The tank shall include arrester mounting brackets, grounding devices, ANSI® support ears (hanging brackets) and lifting rings.
The quantity of suspension brackets (one or two sets) should be specified in the enquiry.

4.11 High Pressure Bushings and Terminals

4.11.1 The high-pressure bushings provided shall comply with Table 4 regulations.

4.11.2

Table 4 Electrical characteristics of bushing

Bushing Insulator	Rated Voltage (kV)	Maximum Voltage of the Material (kV)	Power-Frequency Withstand Voltage (kV)	Impulse Withstand Voltage 1.2/50 μs (kVp)	Altitude (m)
HT	10	17.5	38	95	0 - 4,500
	10.5	17.5	38	95	0 - 4,500
	13.2	24	50	125	0 - 4,500
	13.8	24	50	125	0 - 4,500
	19.07	36	70	170	0 - 4,500
	22.9	36	70	170	0 - 4,500
	10-22.9	36	70	170	0 - 4,500
	33-10	52	95	250	0 - 4,500
	33-22.9	52	95	250	0 - 4,500
BT	0.231	1.0	3	10	0 - 4,500
	0.46-0.23	1.0	3	10	0 - 4,500
	0.40-0.231	1.0	3	10	0 - 4,500
Note: In accordance with IEC 60815, the minimum creepage distance shall be 25 mm/kV under all circumstances. To determine the minimum creepage distance of the primary insulator, the nominal voltage or the specified voltage shall be taken into account. The design altitude of the transformer has been standardized at 4500 meters. Therefore, the technical characteristics of the standardized insulators in this table have been verified to be suitable for operation at this altitude.					

4.11.3 Sleeve terminals provided shall be tin-plated to accommodate aluminum and copper conductors. The dimensions of these terminals shall conform to Table 5.

Table 5

Single -phase transformer high voltage terminal size

Terminal opening size Inches mm	The terminal can accommodate the conductor AWG Size	kVA High voltage rating range: 5KV and Below 7.2 kV to 34.5 kV
5/16	8 Number solid center to 2 No. 6 stranded wire	10-167
5/8		10-500
7.9	Number solid to 4/0-19 Stranded wire	250-500
15.9		--

4.11.4 The color of the bushing shall match Light Grey No. 70 (Munsell Notation 5BG7.0/0.4).

The number of high voltage bushings (one or two) shall be specified in the enquiry.

4.12 Low Pressure Bushings and Terminals

4.12.1 The low-voltage bushings provided shall comply with Table 5 regulations.

4.12.2 The provided bushing terminals must be tinned, to accommodate aluminum and copper conductors. The terminal size should comply with Table 6. regulations.

Table 6

Low voltage terminal size of single-phase transformer

		Transformer Low Voltage Rating (Volts)		
Terminal opening size Inches mm	The terminal can accommodate the conductor AWG Size	120/240	240/480	277
5/16 7.9	8 Number solid center to 2 Stranded wire	-	-	-
5/8 15.9	6 Number solid to 4/0-19 Stranded wire	10-15	10-25	10-25
13/16 20.6	2 Solid to 350 kcmil -19 stranded wire	25-50	37 1/2-100	37 1/2-100
15/16 23.8	None 1/0 Solid to 500 kcmil -37 twist Wire	75	-	-
1-1/4 31.8	No 2/0 Solid 100 okcmil — 61 Stranded wire	100	-	-
Spade H	---	167-250	167-500	167-250

4.12.3 Internal secondary leads shall be permanently stamped with the letters A, B, C, and D in accordance with IEEE Std C57.12.00TM and IEEE Std C57.12.20TM. This marking can be used to locate these leads relative to each other when reconnecting them internally.

5. Labeling

A temporary bar code label shall be affixed to the outside of the transformer in accordance with IEEE Standard C57.12.35™.

6. Surface performance requirements

6.1 Transformers shall be painted Munsell Notation 5BG7.0/0.4, ANSI 70 Gray. The coating system shall meet or exceed the standard coating system requirements for pole mounted equipment in IEEE Std C57.12.31TM, including the following performance tests:

- ASTM B117/D1654 Salt spray test
- ASTM D3359 Cross-cut Adhesion Test
- ASTM D523 Gloss Test
- ASTM D2247 Humidity Test
- ASTM G154/D523 Ultraviolet Accelerated Weathering (QUV) Test

- ASTM D4060/B1117 Abrasion resistance Taber abrasion test

6.2 Certified test data available upon request.

7. Production Testing

7.1 All equipment must undergo the following tests:

- No-load loss at rated current
- Total losses at rated current
- Impedance percentage at rated current
- Excitation current (100% voltage) test
- Ratio test polarity and phase relationship test using all tap settings
- Inductive withstand voltage test

No-load losses will be reported at either 95°C or 20°C for 75°C AWR units, 85°C or 20°C for 65°C and 65/75°C AWR units, and 75°C or 20°C for 55°C and 55/65°C AWR units.

Total loss and impedance values will be reported at 95°C for 75°C AWR units, 85°C for 65°C AWR units, and 75°C for 55°C AWR units.

7.2 The manufacturer shall provide the guaranteed average no-load and loaded losses when specified. These losses shall be subject to the tolerances given in Table 7.

Table 7

Transformer loss tolerance

No-load loss (%)	Total loss (%)
10	6

8. Approved Manufacturers

Anhui Huawan New Energy Co., Ltd.

9. Attachments

9.1 The following selected attachments shall be provided:

- 15 kV insulation cover
- Non-PCB decals
- Sub voltage mark
- Secondary voltage marking
- Stainless steel hardware
- Stainless steel water tank
- Stainless steel cover
- Stainless steel cover band
- Internal fault detector
- Vacuum pressure gauge

- Liquid level gauge
- thermometer
- Drain valve with sampling device
- Tank ground connector
- Ground strap

Any additional accessories will be stated at the time of enquiry.

10. Shipping

The unit should be adequately lashed or secured to the wooden pallet.

Figure 2. Packaging of Single-phase pole transformer.

11. Services

The supplier provides Tier 1-Tier 3 technical support:

- Tier 1 (primary): remote diagnosis (email/work order system, response within 4 hours)
- Tier 2 (Intermediate): Video conferencing guidance (Microsoft Teams/Zoom, providing screen sharing and AR assistance)
- Tier 3 (Advanced): Expert consultation

Table 8

Technical Performance for Single-phase Transformers (Rated Voltage ≤ 17.5 kV)

Single-phase transformer with capacity of 5–50 kVA

AT ≤ 17.5 kV y BT ≤ 1.0 kV						
Item#	**Transforme r Power**	**Maximum No Load Losses**	**Maximum Load Losses**	**No-Load Current**	**Short-Circuit Voltage**	**Total Loss**
1	kVA	W	W	% of In	% of Un	% of Pn
2	5	49	142	2.95	$2.75 \pm 10\%$	3.82
3	10	68	211	2.6	2.75 ±10%	2.79
4	15	86	278	2.4	2.75 ±10%	2.43
5	20	103	342	2.25	2.75 ±10%	2.23
6	25	120	410	2.1	2.75 ±10%	2.12
7	37.5	165	608	2.05	2.75 ±10%	2.06
8	50	199	776	1.95	2.75 ±10%	1.95

Table 9

Technical Performance for Single-phase Transformers (17.5 kV < Rated Voltage ≤ 36 kV)

17.5 < AT ≤ 36 kV y BT ≤ 1.0 kV						
Item#	**Transforme r Power**	**Maximum No Load Losses**	**Maximum Load Losses**	**No-Load Current**	**Short-Circuit Voltage**	**Total Loss**
1	kVA	W	W	% of In	% of Un	% of Pn
2	5	62	144	3.54	$3.25 \pm 10\%$	4.12
3	10	81	233	3.21	$3.25 \pm 10\%$	3.14
4	15	101	319	2.98	$3.25 \pm 10\%$	2.80
5	20	125	388	2.85	$3.25 \pm 10\%$	2.57
6	25	150	469	2.6	$3.25 \pm 10\%$	2.48
7	37.5	196	629	2.35	$3.25 \pm 10\%$	2.20
8	50	240	793	2.3	$3.25 \pm 10\%$	2.07

Description:	**Single-phase overhead transformers**
Transformer capacity	5-100kVA
Phase	Single phase
Manufacturing standard	IEC 60076-1
Cooling class	ONAN
Connection Symbol	LI0/LI6
Insulating fluid	Mineral oil
Frequency	60 Hz
Winding temperature rise Top-oil temperature rise	65K 60K
Impedance voltage	2.75±10%
rated noise level	< 55dB
Primary bushings	2.4-34.5kV Cover mount (Qty:2)
Primary voltage	3.6-52kV
BIL	22-250kV
AC withstand	10-95kV
Secondary bushings	0.23-0.46kV Secondary bushing(Qty:3)
Secondary volitage	1kV
BIL	10kV
AC withstand	3kV
Arresters	Optional
CSP protection	Optional
Overload alarm indicator	Optional
Installation location	Coastal area, highland area or jungle area
Operating altitude	4500m

PERFORMANCE DATA:	
Fluid Weight	As per product model
Total Weight	As per product model
Fluid Volume	As per product model
Tank Diameter	As per product model
Overall Height	As per product model
Overall Width	As per product model
Overall Depth	As per product model
Outside Tank Height Height	As per product model
Cover Tank	As per product model
Primary Conductor Material	Copper
Secondary Conductor Material	Copper