



PRIMELINE[®]
Induction Generator



ISO 9001: 2008 Certified

A Regal Brand

REGAL

PRIMELINE[®]

Induction Generator



General Description Of Product

The PRIMELINE[®] induction generator is a rotating induction machine whose electrical performance has been designed to optimize its performance as a generator. The drip-proof frame construction used throughout is as follows:

NEMA Two Bearing Units:

250 to 320 frame – rolled steel frame with cast iron end brackets.

360 to 510 frame – all cast iron construction.

Single Bearing Units:

360 frame – all cast iron construction.

430 & 570 frame – rolled steel frame with cast iron end brackets.

430 and 570 frame single bearing units are in the same mounting dimension as Marathon's MAGNAPLUS[®] and MAGNAMAX[®] synchronous offering to provide customers with interchangeability and allow for one common rail design.

All rotors are of rugged construction. Regreasable double shielded ball bearings are used throughout. A torsionally engineered SAE engine coupling system is available for a portion of the product which is used in engine driven applications.

The listings described in this brochure are basic standard ratings. There will always be applications that will require specific design. Contact factory for your special requirements.

Generator Basics

The induction generator is similar to any other generator, as it is a device that converts mechanical energy into electrical energy.

An induction generator consists of a rotating element or rotor and a stationary element or stator. The rotor consists of an aluminum or copper 'squirrel cage' within the rotor laminations. The stator consists of insulated copper windings within the stator laminations. Neither an exciter nor voltage regulator is used or required.

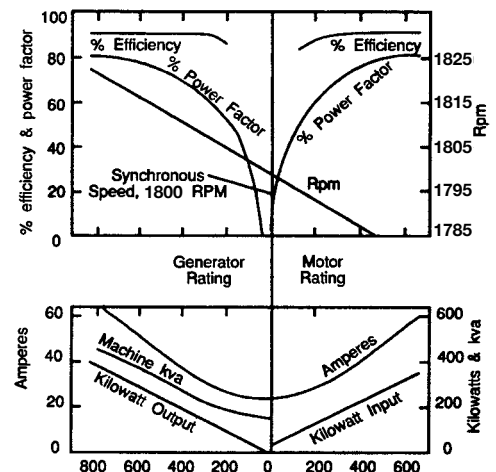
An induction machine (motor or generator) connected to the line power source (excitation) is capable of operating in either mode. If the shaft is allowed to rotate at a speed below synchronous, the machine will attempt to operate as a motor. The rotating magnetic field vector caused by the three phase stator windings will deliver real and reactive power to the rotor as it sweeps around the squirrel cage. If the shaft is forced to rotate at a speed higher than synchronous, a change takes place within the machine. The stator magnetic field vector will continue to deliver reactive power, but now accepts real power induced from the rotor (generator mode). Now the squirrel cage is sweeping the field vector, causing a flux reversal. At synchronous speed, the line supplies reactive power and machine losses, but no torque or power is generated.

There is a practical upper limit to the speed at which an induction generator can be operated above

synchronous and still generate real power efficiently. This speed is typically 2 to 5 percent above synchronous, but below break-away torque. Above the break-away torque speed, the real power generated decays quickly to a low value.

The induction generator and induction motor are in theory similar, but the PRIMELINE[®] induction generator has significant differences from standard motors:

1. The emphasis on the PRIMELINE[®] design is to maximize the efficiency with minimum reduction in power factor.
2. Class F varnish is used in place of the class B varnish that is standard on motors.
3. Additional felt and winding ties are used for coil support to withstand operating conditions that are not experienced by motors.



Applications

There are two types of alternating current generators in commercial use – the synchronous generator and the induction generator. The current role today for the induction generator is for those applications requiring the simplest, lowest total system cost means of converting excess or previously untapped energy into electricity. An induction generator cannot generate electricity in a stand-alone mode.

There are a number of marked differences between the application of synchronous generators and induction generators. In most induction generator applications, power factor correction in the form of capacitance will be required to raise the induction generator's operating power factor up to the area of 0.90 to 0.95 lagging. (Power factor correction information is available from companies that supply industrial capacitor banks.) The kVA of capacitor correction applied should not exceed the no-load, or magnetizing kVA of the induction generator. Excessive capacitance has the potential to cause the generator to go into a self-exciting mode should the utility fail even momentarily. This self excited mode will typically have voltage and frequency deviations sufficient to cause damage to the generator, and perhaps even to the connected load.

When an engine driven synchronous generator is operated in parallel with a source much larger than itself, the throttle controls the real power (kilowatts) generated and the voltage regulator controls the reactive power (kilovars) generated. The speed of the generator does not change over the controllable range. In an induction generator, the throttle controls the real power generated; there is no control of the reactive power. Note that the synchronous concept of parallel operation has no counterpart with induction operation. The frequency of the induction generator does not change over the controllable range from synchronous to perhaps 2 to 5 percent above synchronous speed. Changes in the bus voltage

by the utility source cause reactive power changes in the synchronous generator and real power changes in the induction generator.

When an induction generator or any driven load is connected to an engine, the torsional analysis must be performed on the connected system to assure that vibration resonances do not cause premature failure of any bearings or major drive change components.

The factors that are most critical to torsional vibration are contained in the design of the engine. The engine-generator set manufacturer, his representative, or buyer shall be responsible for the torsional analysis and approval of the engine-generator combination. Marathon Electric shall submit for approval, rotor weight and WK squared information, along with such other data as it deems necessary when approval has not already been obtained on a specific diesel-generator combination.

Generator Protection

Protective devices that should be used in induction generator applications include contactors, overload sensors and circuit breakers. These devices are applied with an induction generator in the same way as with a motor. Additional protection can be provided by the use of meters, over current sensors, voltage balance sensors, over/under voltage controls, and temperature detectors.

To prevent the induction generator from reaching the pushover point, overspeed protection should be placed on the prime mover. This protection can be in the form of governors, speed switches, etc.

Reverse power relays are used to sense direction of power flow and to disconnect the induction generator when it begins to operate as a motor. A reverse power relay is recommended for all applications.

All protective devices used must be coordinated throughout the complete system.

Advantages Over AC Synchronous Generators

When compared to a synchronous generator, the induction generator has several advantages:

- No voltage regulator is required. Voltage and frequency are controlled by the utility.
- Excitation is provided by the utility.
- Simple construction; no brushes, diodes, or collector rings.
- No synchronizing circuit for paralleling to the utility.
- Lower maintenance costs.
- Large power swings do not pull the generator out of synchronization with the system.

Application Considerations

1. Three phase or single phase
2. Voltage
3. Synchronous RPM
4. Maximum kW output at a specified temperature rise.
5. Prime mover (engine or turbine) characteristics
6. Ambient temperature
7. Altitude
8. Will the unit ever be operated as a motor?
9. Coordinate with the utility for capacity to supply the excitation required by the induction generator
10. Will the machine be subjected to adverse environmental conditions?
11. Dripproof construction
12. Special full load speed requirements
13. Special efficiency and/or power factor
14. Special temperature rise requirements
15. Special shaft requirements
16. Flange mounting
17. Direct drive or belted (if belted, furnish complete drive details)
18. Thrust load (which direction?)
19. Is engineering information required for torsional approval?
20. Other special electrical or mechanical requirements
21. Induction generator cannot supply reactive power for motor starting?



**Three Phase
Induction
Generators**

**240 or 480 Volts
208 or 416 Volts
480 Volts**

NEMA Class F Insulation
40°C Ambient

PRIMELINE® 4-Pole, One Bearing Dripproof Induction Generators

240 or 480 Volts, 1800 RPM

Base Model	Net Wt. (lbs.)	No. of Leads	Continuous kW 80°C R/R
364TTDS17033❶	725	3	60
365TTDS8771	850	9	80
431ASL1415	1600	9	150
431ASL1417	1600	12	200
431ASL1414	1750	9	220
431ASL1421❶	1750	3	250
431ASL1420	1750	9	265
431ASL1418	1750	9	300
572ASL1418	2650	9	350
572ASL1413	2650	9	400
572ASL1414	2950	12	450

208 or 416 Volts, 1800 RPM

Base Model	Net Wt. (lbs.)	No. of Leads	Continuous kW 80°C R/R
365TTDS8771	850	9	80
431ASL1419	1600	12	150
431ASL1416	1750	12	160
431ASL1420	1750	9	200
572ASL1413	2650	9	350

❶ 480 V ONLY.

PRIMELINE® Two Bearing Dripproof Induction Generators

4-Pole, 480 Volts, 1800 RPM

Frame	Net Wt. (lbs.)	No. of Leads	Continuous kW	
			80°C R/R	105°C R/R
254	161	3	12	14
256	233	3	17	19
284	346	3	25	28
286	354	3	29	34
324	401	3	35	40
326	430	3	50	57
364	720	3	65	75
365	815	3	72	85
404	1040	3	100	110
405	1112	3	110	120
444	1335	3	130	157
445	1450	3	150	175
447	2064	6	275	315
505	2150	6	275	320
508	3050	12	400	425
510	3850	12	450	500

6-Pole, 480 Volts, 1200 RPM

Frame	Net Wt. (lbs.)	No. of Leads	Continuous kW	
			80°C R/R	105°C R/R
284	346	3	14	17
286	354	3	18	21
324	401	3	22	24
326	430	3	25	29
364	720	3	40	46
365	815	3	50	55
404	1040	3	65	75
405	1112	3	80	88
444	1335	3	90	100
445	1450	3	110	125
447	1792	6	180	200
505	2100	6	190	220
508	2850	12	325	350
510	3750	12	400	440

**PRIMELINE® Induction Generators
are now CSA Certified!**



Specifications

General – all standard Marathon Electric induction generators are manufactured to NEMA dimensions. All testing is performed on a motoring dynamometer as an induction generator.

kW Rating 12 - 500
Voltage 208/416, 240/480, 480
Hertz 60
RPM 1800, 1200
Frame Sizes 254T-510U, 431, 572
Enclosure Open, Dripproof
Mounting Rigid base - horizontal foot mounted
Insulation Class F, 100% solids varnish, epoxy overcoat
Bearings Double shielded ball bearings
Shaft Dimension NEMA Standard
Shaft Material Hot rolled steel
Grease Polyrex EM

Windings All copper
Hardware Corrosion resistant
Nameplate Stainless steel
Standard Ambient 40°C
Standard Altitude 3300 ft.

Options

- Special shaft dimensions
- C-Flange, D-Flange, Vertical Mounting
- Single phase designs
- Space heaters
- SAE close coupled
- Premium efficiency
- Thermal protection
- Belt Drive
- 431 and 572 Frame Double Bearing
- TEFC (254-510 Double Bearing)
- Encoder options

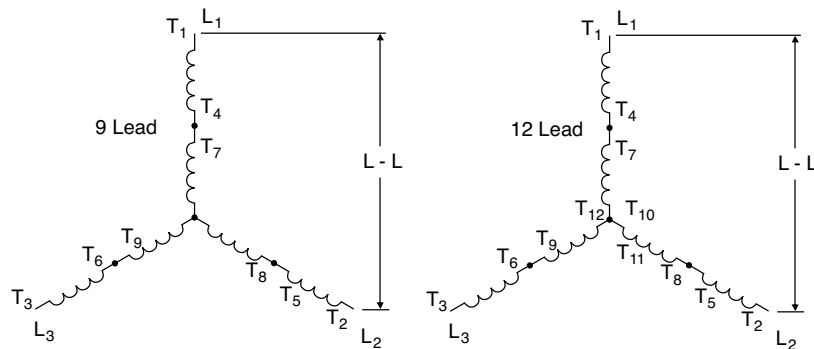
Induction Generator Connections

The electrical connections in the conduit box should be made in accordance with the appropriate connection diagram.

Dual Voltage

High Wye

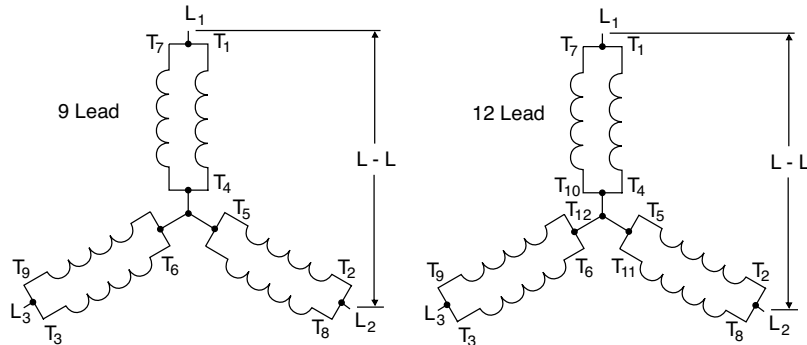
Voltage	
HZ	L-L
60	480



Dual Voltage

Low Wye

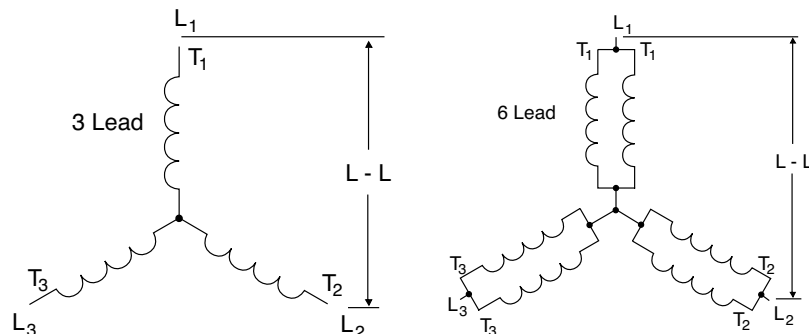
Voltage	
HZ	L-L
60	208 240



Single Voltage

Wye

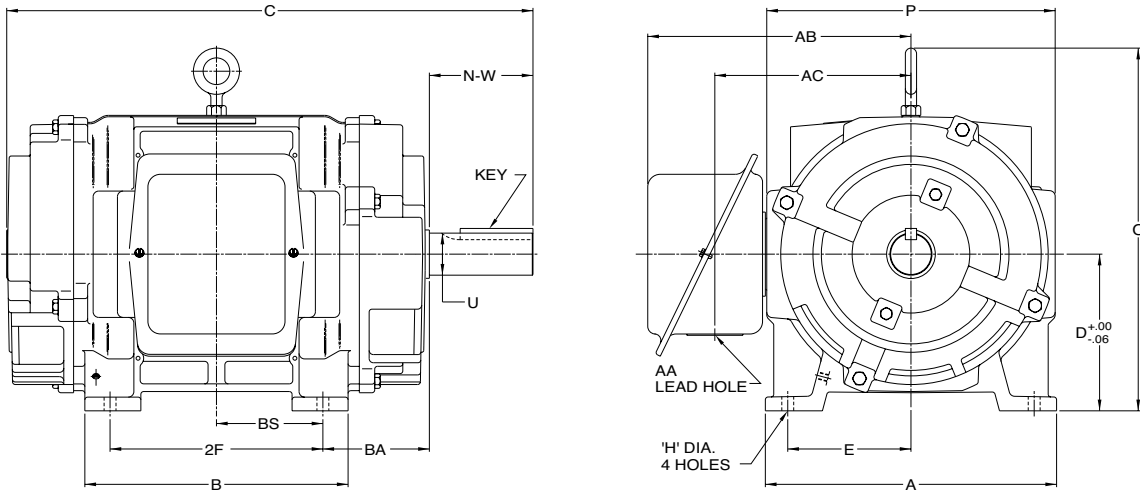
Voltage	
HZ	L-L
60	480



PRIMELINE®

Induction Generator

Standard Two Bearing Mounting



FRAME	A	B	C	D	E	2F	H	N-W	O	P	U	AA	AB	AC	BA	BS	KEY
254T	10.38	11.24	20.57	6.25	5.00	8.25	.53	4.00	12.03	9.50	1.625	1.75	8.15	6.65	4.25	7.69	.38x.38x2.88
256T	10.38	11.24	22.32	6.25	5.00	10.00	.53	4.00	12.03	9.50	1.625	1.75	8.15	6.65	4.25	9.43	.38x.38x2.88
284T	13.00	11.75	23.49	7.00	5.50	9.50	.53	4.62	16.31	12.88	1.875	1.50	11.75	8.75	4.75	4.75	.50x.50x3.25
284TS	13.00	11.75	22.06	7.00	5.50	9.50	.53	3.25	16.31	12.88	1.625	1.50	11.75	8.75	4.75	4.75	.50x.50x1.88
286T	13.00	13.25	24.99	7.00	5.50	11.00	.53	4.62	16.31	12.88	1.875	1.50	11.75	8.75	4.75	5.50	.50x.50x3.25
286TS	13.00	13.25	23.56	7.00	5.50	11.00	.53	3.25	16.31	12.88	1.625	1.50	11.75	8.75	4.75	5.50	.50x.50x1.88
324T	14.62	13.00	26.00	8.00	6.25	10.50	.66	5.25	18.06	14.62	2.125	2.00	12.69	9.69	5.25	5.25	.50x.50x3.88
324TS	14.62	13.00	24.50	8.00	6.25	10.50	.66	3.75	18.06	14.62	1.875	2.00	12.69	9.69	5.25	5.25	.50x.50x2.00
326T	14.62	13.25	27.50	8.00	6.25	12.00	.66	5.25	18.06	14.62	2.125	2.00	12.69	9.69	5.25	6.00	.50x.50x3.88
326TS	14.62	13.25	26.00	8.00	6.25	12.00	.66	3.75	18.06	14.62	1.875	2.00	12.69	9.69	5.25	6.00	.50x.50x2.00
364T	17.75	13.25	28.62	9.00	7.00	11.25	.66	5.88	21.50	18.62	2.375	3.62	16.38	12.19	5.88	5.62	.62x.62x4.25
364TS	17.75	14.25	26.50	9.00	7.00	11.25	.66	3.75	21.50	18.62	1.875	3.62	16.38	12.19	5.88	5.62	.50x.50x2.00
365T	17.75	14.25	29.62	9.00	7.00	12.25	.66	5.88	21.50	18.62	2.375	3.62	16.38	12.19	5.88	6.12	.62x.62x4.25
365TS	17.75	15.00	27.50	9.00	7.00	12.25	.66	3.75	21.50	18.62	1.875	3.62	16.38	12.19	5.88	6.12	.50x.50x2.00
404T	19.75	15.00	32.50	10.00	8.00	12.25	.81	7.25	23.50	20.62	2.875	4.12	19.00	13.69	6.62	6.12	.75x.75x5.62
404TS	19.75	16.50	29.50	10.00	8.00	12.25	.81	4.25	23.50	20.62	2.125	4.12	19.00	13.69	6.62	6.12	.50x.50x2.75
405T	19.75	16.50	34.00	10.00	8.00	13.75	.81	7.25	23.50	20.62	2.875	4.12	19.00	13.69	6.62	6.88	.75x.75x5.62
405TS	19.75	17.00	31.00	10.00	8.00	13.75	.81	4.25	23.50	20.62	2.125	4.12	19.00	13.69	6.62	6.88	.50x.50x2.75
444T	21.75	17.00	37.75	11.00	9.00	14.50	.81	8.50	25.50	22.50	3.375	4.12	19.88	14.62	7.50	7.25	.88x.88x6.88
444TS	21.75	17.00	34.00	11.00	9.00	14.50	.81	4.75	25.50	22.50	2.375	4.12	19.88	14.62	7.50	7.25	.62x.62x3.00
445T	21.75	19.00	39.75	11.00	9.00	16.50	.81	8.50	25.50	22.50	3.375	4.12	19.88	14.62	7.50	8.25	.88x.88x6.88
445TS	21.75	19.00	36.00	11.00	9.00	16.50	.81	4.75	25.50	22.50	2.375	4.12	19.88	14.62	7.50	8.25	.62x.62x3.00
447T	21.75	22.50	43.25	11.00	9.00	20.00	.81	8.50	25.50	24.25	3.375	4.62	21.44	17.00	7.50	10.00	.88x.88x6.88
447TS	21.75	22.50	39.50	11.00	9.00	20.00	.81	4.75	25.50	24.25	2.375	4.62	25.81	19.19	7.50	10.00	.62x.62x3.00
449T	21.75	27.50	48.25	11.00	9.00	25.00	.81	8.50	25.50	24.25	3.375	4.62	21.44	17.00	7.50	12.50	.88x.88x6.88
449TS	21.75	27.50	44.50	11.00	9.00	25.00	.81	4.75	25.50	24.25	2.375	4.62	25.81	19.19	7.50	12.50	.62x.62x3.00
505U	25.00	20.50	44.88	12.50	10.00	18.00	.94	10.12	29.50	27.00	3.875	4.62	22.12	17.62	7.50	9.00	1.00x1.00x9.00
505US	25.00	20.50	39.50	12.50	10.00	18.00	.94	4.75	29.50	27.00	2.375	4.62	22.12	17.62	7.50	9.00	.62x.62x3.25
508U	25.00	27.50	53.38	12.50	10.00	25.00	.94	11.62	29.62	27.12	4.125	6.62	26.38	19.81	7.50	12.50	1.00x1.00x9.00
508US	25.00	27.50	48.50	12.50	10.00	25.00	.94	6.75	29.62	27.12	3.375	6.62	26.38	19.81	7.50	12.50	.88x.88x5.00
510U	25.00	34.50	60.38	12.50	10.00	32.00	.94	11.62	29.62	27.12	4.125	6.62	26.38	19.81	7.50	16.00	1.00x1.00x9.00
510US	25.00	34.50	55.50	12.50	10.00	32.00	.94	6.75	29.62	27.12	3.375	6.62	26.38	19.81	7.50	16.00	.88x.88x5.00

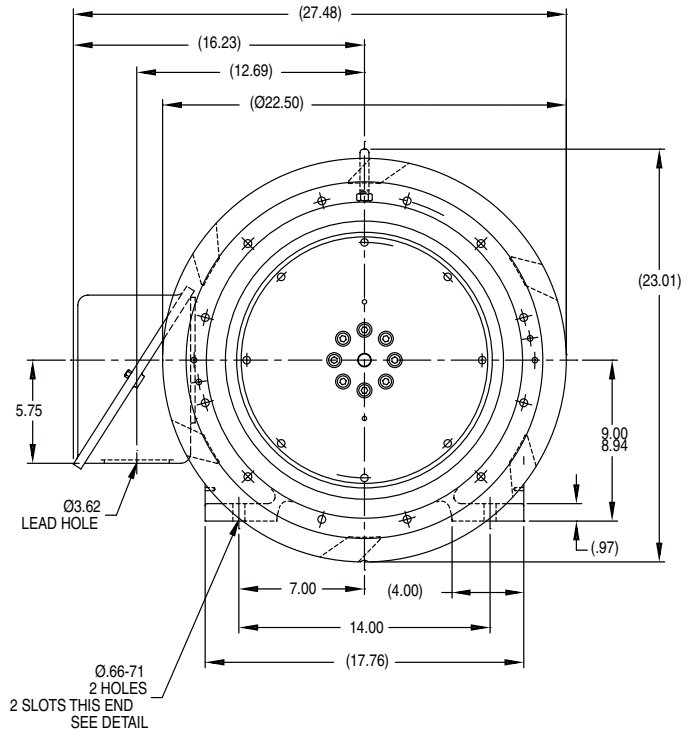
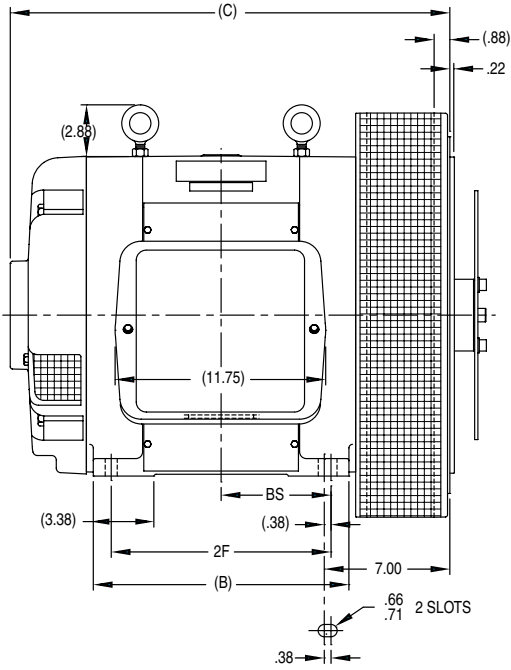
All dimensions are approximate.
 Certified prints available on request.
 For reference only, not for construction.

PRIMELINE®

Induction Generator

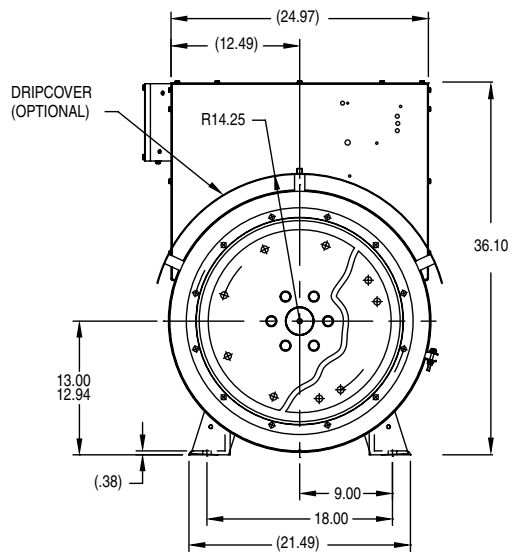
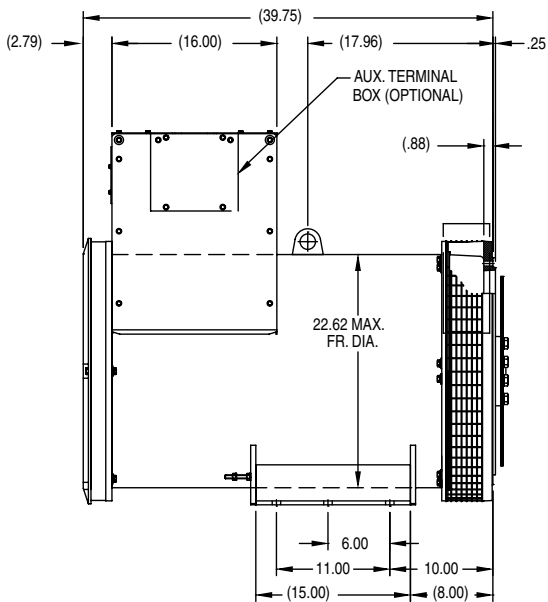
Standard Single Bearing Mounting

Frame 364T/365T



FRAME	B	C	2F	BS
364T	13.25	23.50	11.25	5.62
365T	14.25	24.50	12.25	6.12

Frame 431

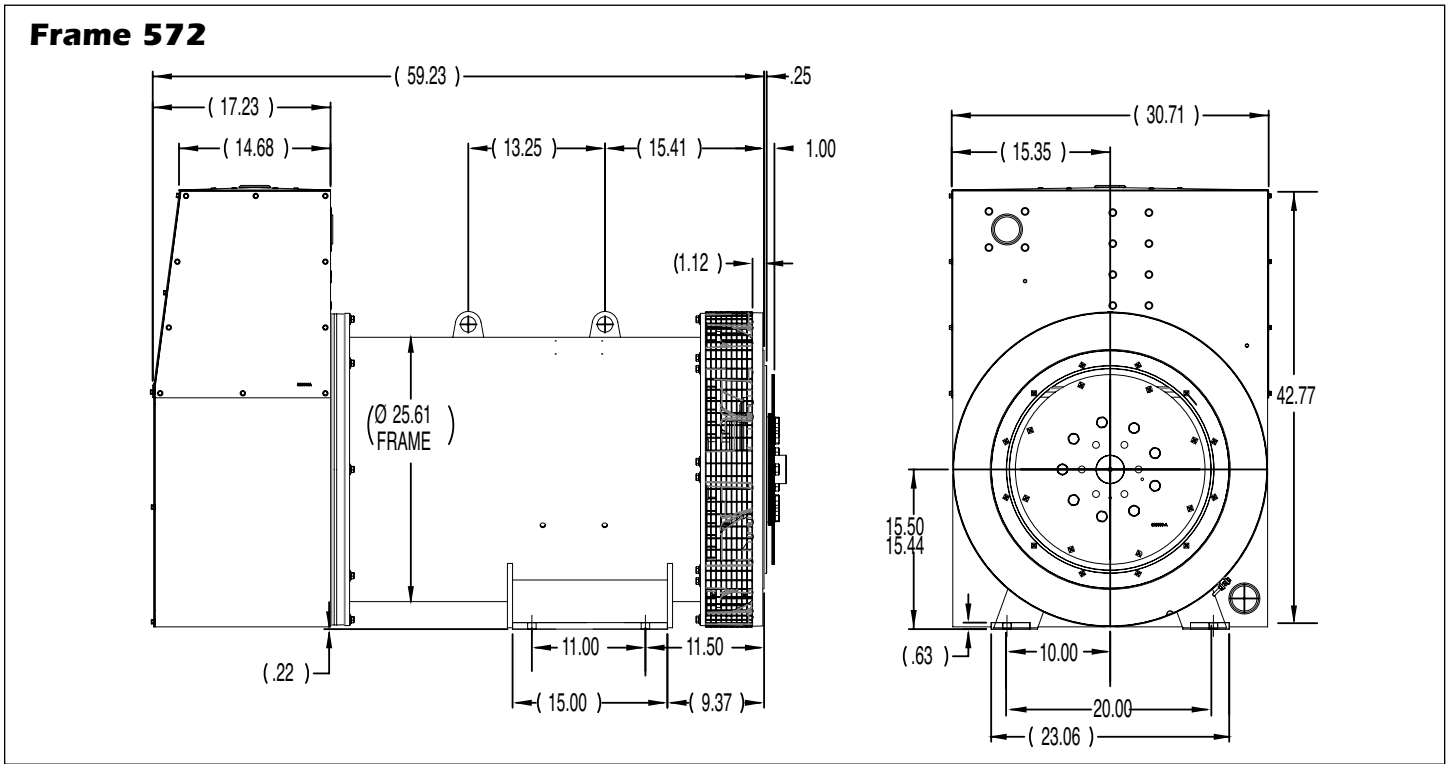


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PRIMELINE[®]

Induction Generator

Standard Single Bearing Mounting (cont.)



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