Automatic Home Standby Generators

Sizing Guide

Honeywell

Important Notices

This booklet is designed to familiarize estimators and installers with proper sizing guidelines for residential and commercial generators. The information is not comprehensive, nor does it replace or supercede any material contained in any of the written documents shipped with the equipment. This booklet should only be used in conjunction with the Owner's Manual, Installation Manual and other technical documents shipped with each product. Always read all accompanying documentation carefully before attempting to install any generator, transfer switch or related equipment.

HOW TO USE THIS BOOKLET:

Within this booklet, you will find electrical load information, plus an outline of generator surge capability, fuel pipe sizing, liquid propane tank sizing, and UPS / generator compatibility. The worksheet pages can be removed from the book and photocopied to create additional Onsite Estimating Sheets for use with individual jobs.

SAFETY INFORMATION:

Proper sizing of the generator is crucial to the success of any installation and requires a good working knowledge of electricity and its characteristics, as well as the varying requirements of the electrical equipment comprising the load. When analyzing the electrical load, consult the manufacturer's nameplate on each major appliance or piece of equipment to determine its starting and running requirements in terms of watts, amps and voltage. When choosing the generator output for commercial or industrial applications, select a rating that is approximately 20 to 25% higher than the peak load (for example, if the load is about 40 kilowatts, select a 50 kilowatts genset). A higher rated generator will operate comfortably at approximately 80% of its full capacity and will provide a margin of flexibility if the load increases in the future.

For safety reasons, it is recommended that the backup power system be installed, serviced and repaired by a Generator Authorized Service Dealer or a competent, qualified electrician or installation technician who is familiar with applicable codes, standards and regulations.

It is essential to comply with all regulations established by the Occupational Safety & Health Administration (OSHA) and strict adherence to all local, state and national codes is mandatory. Before selecting a generator, check for municipal ordinances that may dictate requirements regarding placement of the unit (setback from building and/or lot line), electrical wiring, gas piping, fuel storage (for liquid propane or diesel tanks), sound and exhaust emissions.

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TABLE 1 Motor Load Reference

AC & Heat Pumps — Running Load — Starting Load

Description	Hp	Running kW	Amps @ 240V 1Ø	Amps @ 208V 3Ø	Amps @ 240V 3Ø	Amps @ 480V 3Ø	LR Amps @ 240V 1Ø	LR Amps @ 208V 3Ø	LR Amps @ 240V 3Ø	LR Amps @ 480V 3Ø
1 Ton (12,000 BTU)	1	1	5	3	3	1	33	22	19	10
2 Ton (24,000 BTU)	2	2	10	7	6	3	67	44	38	19
3 Ton (36,000 BTU)	3	3	15	10	8	4	100	67	58	29
4 Ton (48,000 BTU)	4	4	20	13	11	6	117	78	67	34
5 Ton (60,000 BTU)	5	5	25	16	14	7	145	97	84	42
7.5 Ton (85,000 BTU)	7.5	7.5	37	24	21	11	219	146	126	63
10 Ton* (120,000 BTU)	5 Hp (x2)	10	49	33	28	14	145	97	84	42
10 Ton (120,000 BTU)	10 Hp	10	49	33	28	14	250	167	144	72
15 Ton* (180,000 BTU)	7.5 Hp (x2)	15	74	49	42	21	219	146	126	63
15 Ton (180,000 BTU)	15 Hp	15	74	49	42	21	375	250	217	108
20 Ton* (240,000 BTU)	10 Hp (x2)	20	98	65	57	28	250	167	144	72
20 Ton (240,000 BTU)	20 Hp	20	n/a	65	57	28	500	333	289	144
25 Ton (300,000 BTU)	25	25	n/a	82	71	35	625	416	361	180
30 Ton* (360,000 BTU)	15 Hp (x2)	30	n/a	98	85	42	375	250	217	108
30 Ton (360,000 BTU)	30 Hp	30	n/a	98	85	42	750	500	433	217
40 Ton* (480,000 BTU)	20 Hp (x2)	40	n/a	131	113	57	500	333	289	144
40 Ton (480,000 BTU)	40 Hp	40	n/a	131	113	57	1000	666	577	289
50 Ton* (480,000 BTU)	25 Hp (x2)	50	n/a	163	142	71	625	416	361	180
50 Ton (480,000 BTU)	50 Hp	50	n/a	163	142	71	1250	833	722	361

*** For Multiple motor configurations, sequence starting is assumed.**

Air Conditioning
1 hp per 1 ton
1 ton = 12,000 BTUs

General Residential — Running Load — Starting Load

Description	Hp	Running kW	Amps @ 120V 1Ø	4.9 Amps @ 240V 1Ø	Starting kW	LR Amps @ 120V 1Ø	LR Amps @ 240V 1Ø
Refrigerator pump, sump, furnace, garage opener	0.5	0.5	4.9	2.5	1.5	25	13
Freezer, washer, septic grinder	0.75	0.75	7.4	3.7	2.3	38	19
General 1 Hp	1	1	9.8	4.9	3	50	25
Well & septic lift pump	2	2	19.6	9.8	6	100	50

TABLE 2 Non-Motor Load Reference

Residential

Description	Running Load* kW	Amps at 120V 1ø	Amps at 240V 1ø
Electric heat per 1000 ft^2	12	n/a	50
Heat pump elements per 1000 ft^2	7	n/a	29
Dryer	5.5	n/a	23
Hot tub	10	n/a	50
Range oven/Stove top per burner	8	n/a	30
Electric hot water	4.5	n/a	19
General lighting and receptacles per 1000 ft^2	3	24.9	n/a
Blow dryer	1.25	10.4	n/a
Dishwasher	1.5	12.5	n/a
Microwave	1	8.3	n/a
Toasters	1	8.3	n/a
Home Entertainment Center	1	8.3	n/a
Computer	1	8.3	n/a
Kitchen	1.5	12.5	n/a
Laundry	1.5	12.5	n/a

*Always check data plate for actual running amps.

Commercial

Please refer to equipment data plate and/or billing history for commercial details.

TABLE 3 Surge Capability

Honeywell Generators (Operating at less than 3600 RPM)

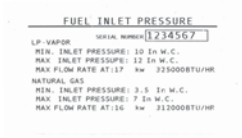
	Rated Output (Running Amps)				Maximum Surge Capability			
Size (kW)	**240V 1Ø**	**208V 3Ø**	**240V 3Ø**	**480V 3Ø**	**240V 1Ø**	**208V 3Ø**	**240V 3Ø**	**480V 3Ø**
25	113	87	75	n/a	265	221	192	n/a
35	146	121	105	52	225	210	182	87
45	188	156	135	68	321	269	233	112
70	292	243	210	105	550	471	408	201
100	417	347	300	150	738	452	426	261
130	542	451	390	195	1088	885	767	419

Honeywell Generators (Operating at 3600 RPM)

	Rated Output (Running Amps)				Maximum Surge Capability			
Size (kW)	**240V 1Ø**	**208V 3Ø**	**240V 3Ø**	**480V 3Ø**	**240V 1Ø**	**208V 3Ø**	**240V 3Ø**	**480V 3Ø**
11	42	n/a	n/a	n/a	92	n/a	n/a	n/a
15	71	n/a	n/a	n/a	130	n/a	n/a	n/a
20	83	n/a	n/a	n/a	185	n/a	n/a	n/a
60	250	208	180	90	350	251	218	136
70	292	243	210	105	550	471	408	201
80	333	278	240	120	550	466	404	212
150	625	520	451	226	1214	1334	1156	624

Note: All nominal ratings based upon LP fuel. Refer to specification sheet for NG ratings and deration adjustments for ambient temperature and altitude.

NATURAL GAS INSTALLATION



Fuel Pipe Sizing Natural Gas

TABLE 4A Natural Gas 5" to 7" of Water Column

(Table values are maximum pipe run in feet.)

	Pipe Size (in)						
kW	**0.75"**	**1"**	**1.25"**	**1.5"**	**2"**	**2.5"**	**3"**
11	20	85	370	800			
15		40	190	425			
20		20	130	305	945		
25			85	203	552		
35			35	95	370	915	
45				50	230	585	
60				25	145	390	1185
70				5	75	225	710
80					65	195	630
100					40	140	460
130						50	215
150						30	150

TABLE 4B Natural Gas 3.5" to 5" of Water Column

(Table values are maximum pipe run in feet.)

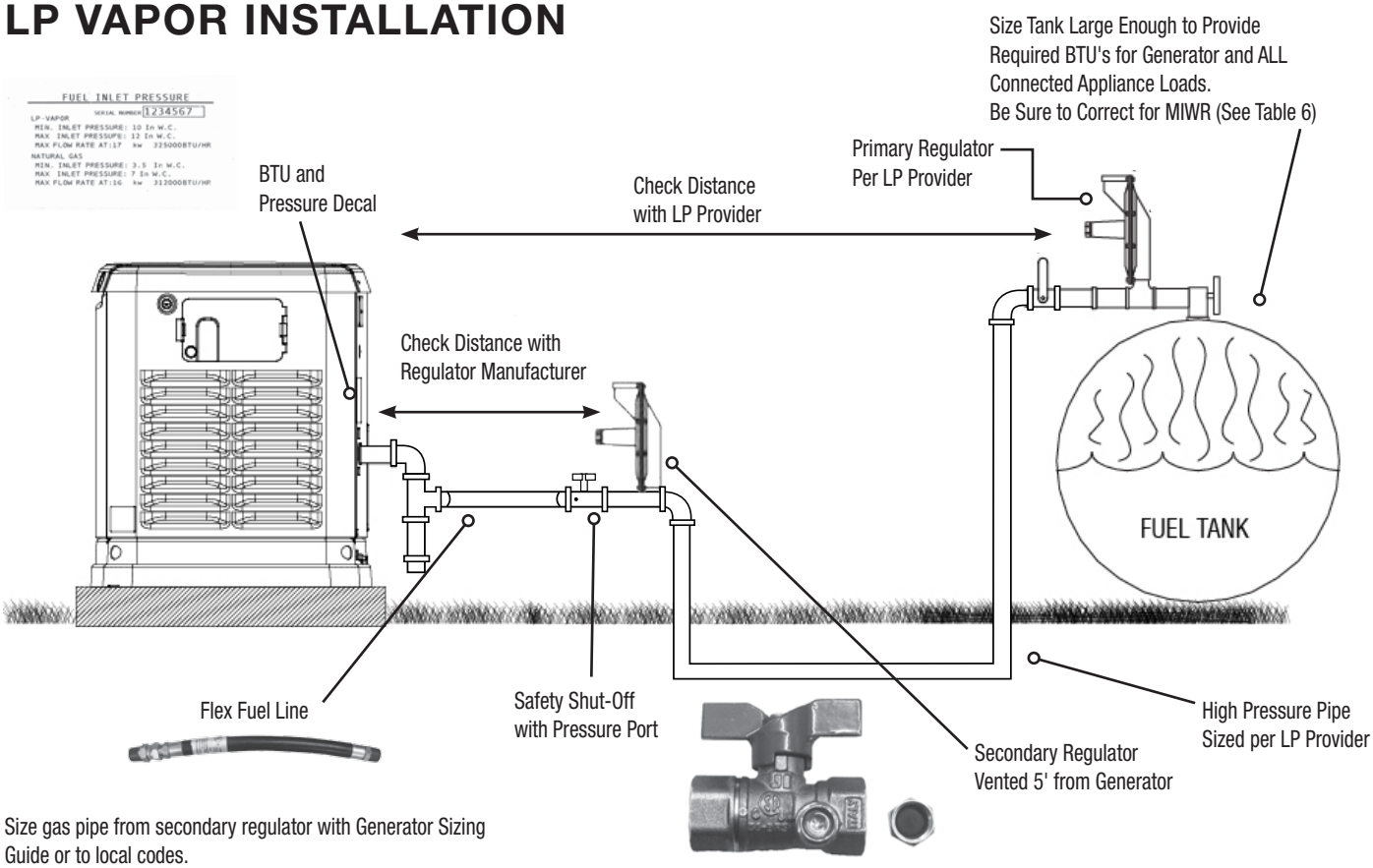
	Pipe Size (in)			
kW	**0.75"**	**1"**	**1.25"**	**1.5"**
11		30	125	200
15–17		10	60	125
20		10	60	125

Natural Gas
1 cubic foot = 1,000 BTU
1 therm = 100,000 BTU
Gas consumption = 13,000-16,000 BTU per kW/hr

Pressure
1 inch mercury = 13.61 inches water column
1 inch Water Column = 0.036 psi
3.5–7 inches water column = 0.126 psi to 0.252 psi

Note:
- Pipe sizing is based on 0.5" H_2O pressure drop.
- Sizing includes a nominal number of elbows and tees.
- Please verify adequate service and meter sizing.
- Tables based on black pipe.

LP VAPOR INSTALLATION



Size gas pipe from secondary regulator with Generator Sizing Guide or to local codes.

TABLE 5 Fuel Pipe Sizing LP Vapor

LP Vapor (LPV) 11" to 14" of Water Column

(Table values are maximum pipe run in feet.)

	Pipe Size (in)						
kW	**0.75"**	**1"**	**1.25"**	**1.5"**	**2"**	**2.5"**	**3"**
11	70	255	1000				
15	25	130	540				
20	15	115	480				
25		55	260	575			
35		20	125	290	1030		
45			70	165	620		
60			45	115	445	1095	
70			20	60	260	660	
80			15	50	230	590	
100				30	165	430	1305
130					70	205	660
150					45	150	490

LP

LPG: 8.55 ft^3/lb., 4.24 lbs./gal., 2500 btu/ft^3

LPG: 36.3 ft^3 = 1 gal.

Pressure

1 inch mercury = 13.61 inches water column

1 inch Water Column = 0.036 psi

11–14 inches water column = 0.396 psi to 0.50 psi

Note:

- Pipe sizing is based on 0.5" H_2O pressure drop.
- Sizing includes a nominal number of elbows and tees.
- Please verify adequate service and meter sizing.
- Tables based on black pipe.

TABLE 6 LP VAPOR (LPV) TANK SIZING Vapor Withdrawal

Tank Capacity Total (Gal.)	Tank Capacity Useable (Gal.)	Minimum Temp (°F)	Tank Capacity (btu/hr.)	Length (Inches)	Diameter (Inches)	Overall Ht. (Inches)
120	72	40	246,240	57	24	33
		20	164,160			
		0	82,080			
150	90	40	293,760	68	24	33
		20	195,840			
		0	97,920			
250	150	40	507,600	94	30	39
		20	338,400			
		0	169,200			
325	195	40	642,600	119	30	39
		20	428,400			
		0	214,200			
500	300	40	792,540	119	37	46
		20	528,360			
		0	264,180			

Gas Required for Common Appliances

APPLIANCE	Approximate Input BTU / Hr
Warm Air Furnace	
Single Family	60,000–120,000
Multifamily, per unit	40,000–60,000
Hydronic Boiler, Space Heating	
Single Family	80,000–140,000
Multifamily, per unit	50,000–80,000
Hydronic Boiler, Space and Water Heating	
Single Family	100,000–200,000
Multifamily, per unit	50,000–100,000
Range, Free Standing, Domestic	50,000–90,000
Built-In Oven or Broiler Unit, Domestic	14,000–16,000
Built-In Top Unit, Domestic	40,000–85,000

Note: Tank BTU capacity and generator run times based upon maintaining a minimum tank fuel level of 20%. Tanks are typically filled to 80% full.
Note: Typical fuel consumption based on a generator 100% loaded.

TABLE 7 GENERATOR FUEL CONSUMPTION

Generator kW Rating		Fuel Consumption at 100% BTU/HR		Fuel Consumption at 50% BTU/HR	
LP	Nat. Gas	LP Vapor	Nat. Gas	LP Vapor	Nat. Gas
8	7	129,000	121,000	79,000	78,000
11	10	175,000	195,000	107,000	124,000
13	13	268,000	255,000	149,000	157,000
14	14	279,000	279,000	168,000	177,000
15	15	260,000	296,000	166,000	185,000
17	16	325,000	312,000	181,000	193,000
20	18	350,000	308,000	189,000	205,000
22	22	313,000	316,000	188,000	190,000
25	25	430,000	430,000	298,000	297,000
27	25	356,000	359,000	195,000	197,000
30	30	493,000	492,000	320,000	320,000
36	35	500,000	503,000	280,000	282,000
45	45	725,000	730,000	378,000	380,000
48	48	755,000	756,000	393,000	392,000
60	60	818,000	862,000	458,000	483,000
70	67	1,028,000	1,020,000	503,000	500,000
80	80	1,163,000	1,154,000	603,000	600,000
100	94	1,268,000	1,260,000	718,000	713,000
130	122	1,798,000	1,786,000	933,000	927,000
150	142	2,075,000	2,061,000	1,078,000	1,070,000

Operating Cost Per Hour
= NG Therms/HR x Cost of NG Therm

UPS - Generator Compatibility

Passive (also referenced as standby or off-line) and Line-Interactive

These technologies are most common for personal workstations and point of sale applications. They are typically single phase equipment with size ranges of 350 VA - 2000 VA for passive and 500 VA to 5000 VA for line-interactive.

Passive UPS's are the simplest type. Under normal conditions AC power passes straight through to the UPS load. When the input power supply goes outside of specifications, the UPS transfers the load from input power to the internal DC to AC power inverter. Passive UPS's do not correct for voltage or frequency deviations under "normal" operation.

Line-interactive is similar to the passive technology except it has circuitry that attempts to correct for standard voltage deviations. Frequency deviations under "normal" power operation are not corrected.

Equipment Notes:

These devices tend to be electrically / harmonically very noisy. A single small UPS is not a significant concern, but applications with multiple UPS's can be problematic.

Passive UPS technology typically has normal tolerances of 10-25% on voltage and 3 Hertz on frequency. Minuteman UPS input tolerance is closer to 10-36%. If the input source goes outside of these tolerances, the UPS will switch onto the UPS battery source. Some line-interactive units may have frequency tolerances factory set to 0.5 Hertz. These units will need to have their frequency tolerance increased to a minimum of 2 Hertz. Minuteman UPS products are close to 5 Hertz and not 0.5 Hertz.

Generator Sizing Recommendation:

Limit the total UPS loading to 15% - 20% of the generator capacity.

Double-Conversion

This technology is most common for critical load applications. Double-conversion UPS's constantly rectify AC to DC and then invert the DC back into AC. This configuration results in an output that corrects for voltage and frequency deviations.

There are single and three phase models covering small through large applications. Most UPS applications larger than 5000 VA use double conversion technology. This approach is also the preferred technology for generator applications.

Equipment Notes:

Double-conversion UPS's that are single phase or unfiltered three phase models tend to create a significant level of electrical/ harmonic noise. This is illustrated by harmonic current distortions that are greater than 35%. Minuteman UPS products could have current distortion of 8%. When three phase models are supplied with harmonic filters (current distortion less than 10%), this concern is no longer an issue.

Generator Sizing Recommendation:

Single phase models: limit the total UPS loading to 25% of the generator capacity. Single phase Minuteman UPS models: limit the total UPS loading to 50% of the generator capacity. Three phase models without filters (current distortion > 30%): limit the UPS loading to 35% of the generator capacity. Three phase models with filters (current distortion < 10%): limit the UPS loading to 80% of the generator capacity.

UPS Information

2 x kVA rating for a filtered system

3 – 5 x kVA rating for an unfiltered system

It is recommended you refer to the Honeywell UPS Generator Compatibility sheet (Pg 10) and contact the manufacturer of the UPS system to assist in your installation.

Supplier(s)	Passive (Standby)	Line-Interactive	Double-Conversion
Minuteman UPS	Enspire	Enterprise Plus	Endeavor
APC	Back-UPS Series	Smart-UPS Series	Symmetra Series
Liebert	PowerSure PST & PSP	PowerSure PSA & PSI	UPStation & Nfinity
Powerware	3000 series	5000 series	9000 series

Note: Ferrups and Delta-Conversion UPS technologies not included in discussion

Typical Generator/Transfer Switch Combinations

Current Model - Sync Smart	Current Switch model #	Description
6442		**11 kW Air-Cooled Generator - Aluminum**
	RTG12EZA1H	12 Circuit Pre-wired Transfer Switch
	RTSV100A3	100 amp Normal Sync Smart Switch
	RTSG100A3	100 amp Service Rated Smart Switch
	RTSG150A3	150 amp Service Rated Smart Switch
	RTSV200A3	200 amp Normal Smart Switch
	RTSG200A3	200 amp Service Rated Sync Smart Switch
	RTSE100A3CSA H	100 amp CSA Service Rated Switch
	RTSE200A3CSA H	200 amp CSA Service Rated Switch
6261		**15 kW Air-Cooled Generator - Aluminum**
	RTG12EZA1H	12 Circuit Pre-wired Transfer Switch
	RTSV100A3	100 amp Normal Sync Smart Switch
	RTSG100A3	100 amp Service Rated Sync Smart Switch
	RTSG150A3	150 amp Service Rated Sync Smart Switch
	RTSV200A3	200 amp Normal Sync Smart Switch
	RTSG200A3	200 amp Service Rated Sync Smart Switch
	RTSE100A3CSAH	100 amp CSA Service Rated Switch
	RTSE200A3CSAH	200 amp CSA Service Rated Switch
6262		**20 kW Air-Cooled Generator - Aluminum**
	RTG12EZA1H	12 Circuit Pre-wired Transfer Switch
	RTSV100A3	100 amp Normal Smart Switch
	RTSG100A3	100 amp Service Rated Smart Switch
	RTSG150A3	150 amp Service Rated Sync Smart Switch
	RTSV200A3	200 amp Normal Sync Smart Switch
	RTSG200A3	200 amp Service Rated Sync Smart Switch
	RTSE100A3CSAH	100 amp CSA Service Rated Switch
	RTSE200A3CSAH	200 amp CSA Service Rated Switch

Typical Generator/Transfer Switch Combinations

Current Model - Sync Smart	Current Switch model #	Description
HT02524ANAX		**25 kW Liquid-Cooled Generator, 1 phase - Aluminum**
	RTSV100A3	100 amp Normal Sync Smart Switch
	RTSG100A3	100 amp Service Rated Sync Smart Switch
	RTSG150A3	150 amp Service Rated Sync Smart Switch
	RTSV200A3	200 amp Normal Sync Smart Switch
	RTSG200A3	200 amp Service Rated Sync Smart Switch
	RTSE100A3CSAH	100 amp CSA Service Rated Switch
	RTSE200A3CSAH	200 amp CSA Service Rated Switch
HT03524ANAX		**35 kW Liquid-Cooled Generator - Aluminum**
	RTSV100A3	100 amp Normal Sync Smart Switch
	RTSG100A3	100 amp Service Rated Sync Smart Switch
	RTSG150A3	150 amp Service Rated Sync Smart Switch
	RTSV200A3	200 amp Normal Sync Smart Switch
	RTSG200A3	200 amp Service Rated Sync Smart Switch
	RTSE100A3CSAH	100 amp CSA Service Rated Switch
	RTSE200A3CSAH	200 amp CSA Service Rated Switch
HT04554ANAX		**45 kW Liquid-Cooled Generator - Aluminum**
	RTSG100A3	100 amp Normal Sync Smart Switch
	RTSL100A3	100 amp Service Rated Sync Smart Switch
	RTSG200A3	200 amp Normal Sync Smart Switch
	RTSL200A3	200 amp Service Rated Sync Smart Switch
	RTSE100A3CSAH	100 amp CSA Service Rated Switch
	RTSE200A3CSAH	200 amp CSA Service Rated Switch
	RTSV400A3	400 amp Normal Sync Smart Switch
	RTSG400A3	400 amp Service Rated Sync Switch
HT06024ANAX		**60 kW Liquid-Cooled Generator**
	RTSV100A3	100 amp Normal Sync Smart Switch
	RTSG200A3	100 amp Service Rated Sync Smart Switch
	RTSV200A3	200 amp Normal Sync Smart Switch
	RTSG400A3	200 amp Service Rated Sync Smart Switch
	RTSV400A3	400 amp Normal Sync Smart Switch
	RTSG400A3	400 amp Service Rated Sync Smart Switch
	RTSE100A3CSAH	100 amp CSA Service Rated Switch
	RTSE200A3CSAH	200 amp CSA Service Rated Switch

RTS 100 – 400 amp*	**25–60 kW Liquid-Cooled Generator - 3Ø options**
RTS 100 – 800 amp*	**70–150 kW Liquid-Cooled Generator - 1 & 3Ø options**

NEC (700, 701, 702) Comparison

		Article 700 - Emergency	Article 701 - Standby	Article 702 - Optional Standby
	Scope	Legally required life safety	Legally required critical support (fire fighting, health hazards, etc)	Protect property & facilities
	Equipment Approval	For Emergency / (UL2200)	For Intended Use / (UL2200)	For Intended Use / (UL2200) / Not in 2008
Testing	Witness Testing (on-sight)	At install & periodically	At install	None
Testing	Periodic Testing	Yes	Yes	None
Testing	Battery Maintenance	Yes	Yes	None
Testing	Maintenance Records	Yes	Yes	None
Testing	Load Testing	Yes	Yes	None
	Capacity	All Loads	All loads intended to operate at one time	All loads intended to operate at one time / Not in 2008
	Other Standby Loads Allowed	Yes with load shedding	Yes with load shedding	2008 – Yes with load shedding
	Peak Shaving Allowed	Yes	Yes	Yes
Transfer Switch	Automatic	Yes	Yes	No
Transfer Switch	Equipment Approval	For Emergency / (UL1008)	For Standby / (UL1008)	For Intended Use / (UL1008)
Transfer Switch	Means to Permit Bypass	Yes	No	No
Transfer Switch	Elect. Operated - Mech. Held	Yes	No	No
Transfer Switch	Other loads	No	Yes with load shedding	N/A
Transfer Switch	Max. Fault Current Capable	Yes	Yes	Yes
Signals (Audible & Visual)	Derangement	Yes / Standard common alarm	Yes / Standard common alarm	Yes / Standard common alarm
Signals (Audible & Visual)	Carrying Load	Yes / Displayed at ATS	Yes / Displayed at ATS	Yes / Displayed at ATS
Signals (Audible & Visual)	Battery Charger Failed	Yes	Yes	No
Signals (Audible & Visual)	Ground Fault Indication	Yes (480V & 1000A)	No	No
Signals (Audible & Visual)	NFPA 110 Signaling	Yes / Optional annunciator	Yes / Optional annunciator	No
Signs	At service	Yes / Type & location	Yes / Type & location	Yes / Type & location
Signs	At neutral to ground bonding	Yes (if remote)	Yes (if remote)	Yes (if remote)
	Wiring kept independent	Yes	No	No
	Fire protection (ref 700-9d)	Yes (1000 persons or 75' building)	No	No
	Maximum power outage	10 sec	60 sec	N/A
	Retransfer delay	15 min setting	15 min setting	No
	Automatic starting	Yes	Yes	No
	On-site fuel requirements	2 hours (see NFPA 110)	2 hours	None
	Battery charger	Yes	Yes	No
	Ground Fault	Indication Only	No	No

NEC Comparison Table to be used as a general guideline in determining the proper generator for specific applications. Refer to architectural documents for final selection.

Electrical Formulas

TO FIND	KNOWN VALUES	1-PHASE	3-PHASE
KILOWATTS (kW)	Volts, Current, Power Factor	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73 \times PF}{1000}$
KVA	Volts, Current	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73}{1000}$
AMPERES	kW, Volts, Power Factor	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times 1.73 \times PF}$
WATTS	Volts, Amps, Power Factor	Volts x Amps	E x I x 1.73 x PF
NO. OF ROTOR POLES	Frequency, RPM	$\frac{2 \times 60 \times Frequency}{RPM}$	$\frac{2 \times 60 \times frequency}{RPM}$
FREQUENCY	RPM, No. of Rotor Poles	$\frac{RPM \times Poles}{2 \times 60}$	$\frac{RPM \times Poles}{2 \times 60}$
RPM	Frequency, No. of Rotor Poles	$\frac{2 \times 60 \times Frequency}{Rotor\ Poles}$	$\frac{2 \times 60 \times Frequency}{Rotor\ Poles}$
kW (required for Motor)	Motor Horsepower, Efficiency	$\frac{HP \times 0.746}{Efficiency}$	$\frac{HP \times 0.746}{Efficiency}$
RESISTANCE	Volts, Amperes	$\frac{E}{I}$	$\frac{E}{I}$
VOLTS	Ohms, Amperes	I x R	I x R
AMPERES	Ohms, Volts	$\frac{E}{R}$	$\frac{E}{R}$

E = VOLTS I = AMPERES R = RESISTANCE (OHMS) PF = POWER FACTOR

U.S. WEIGHTS AND MEASURES

LINEAR MEASURE

			1	INCH	=	2.540 CENTIMETERS
12	INCHES	=	1	FOOT	=	3.048 DECIMETERS
3	FEET	=	1	YARD	=	9.144 DECIMETERS
5.5	YARDS	=	1	ROD	=	5.029 METERS
40	RODS	=	1	FURLONG	=	2.018 HECTOMETERS
8	FURLONGS	=	1	MILE	=	1.609 KILOMETERS

MILE MEASUREMENTS

1	STATUTE MILE	=	5,280	FEET
1	SCOTS MILE	=	5,952	FEET
1	IRISH MILE	=	6,720	FEET
1	RUSSIAN VERST	=	3,504	FEET
1	ITALIAN MILE	=	4,401	FEET
1	SPANISH MILE	=	15,084	FEET

OTHER LINEAR MEASUREMENTS

1	HAND	= 4	INCHES	1	LINK	= 7.92	INCHES
1	SPAN	= 9	INCHES	1	FATHOM	= 6	FEET
1	CHAIN	= 22	YARDS	1	FURLONG	= 10	CHAINS
				1	CABLE	= 608	FEET

SQUARE MEASURE

144	SQUARE INCHES	=	1	SQUARE FOOT
9	SQUARE FEET	=	1	SQUARE YARD
30¼	SQUARE YARDS	=	1	SQUARE ROD
40	RODS	=	1	ROOD
4	ROODS	=	1	ACRE
640	ACRES	=	1	SQUARE MILE
1	SQUARE MILE	=	1	SECTION
36	SECTIONS	=	1	TOWNSHIP

CUBIC OR SOLID MEASURE

1	CU. FOOT	= 1728	CU. INCHES
1	CU. YARD	= 27	CU. FEET
1	CU. FOOT	= 7.48	GALLONS
1	GALLON (WATER)	= 8.34	LBS.
1	GALLON (U.S.)	= 231	CU. INCHES OF WATER
1	GALLON (IMPERIAL)	= 277¼	CU. INCHES OF WATER

METRIC SYSTEM

PREFIXES:

A.	MEGA	=	1,000,000	E.	DECI	=	0.1
B.	KILO	=	1,000	F.	CENTI	=	0.01
C.	HECTO	=	100	G.	MILLI	=	0.001
D.	DEKA	=	10	H.	MICRO	=	0.000001

LINEAR MEASURE:

(THE UNIT IS THE METER = 39.37 INCHES)

1	CENTIMETER	= 10	MILLIMETERS	=	0.3937011	IN.
1	DECIMETER	= 10	CENTIMETERS	=	3.9370113	INS.
1	METER	= 10	DECIMETERS	=	1.0936143	YDS.
				=	3.2808429	FT.
1	DEKAMETER	= 10	METERS	=	10.936143	YDS.
1	HECTOMETER	= 10	DEKAMETERS	=	109.36143	YDS.
1	KILOMETER	= 10	HECTOMETERS	=	0.62137	MILE
1	MYRIAMETER	= 10,000 METERS				

SQUARE MEASURE:

(THE UNIT IS THE SQUARE METER = 1549.9969 SQ. INCHES)

1	SQ. CENTIMETER	= 100	SQ. MILLIMETERS	= 0.1550	SQ. IN.
1	SQ. DECIMETER	= 100	SQ. CENTIMETERS	= 15.550	SQ. INS.
1	SQ. METER	= 100	SQ. DECIMETERS	= 10.7639	SQ. FT.
1	SQ. DEKAMETER	= 100	SQ. METERS	= 119.60	SQ. YDS.
1	SQ. HECTOMETER	= 100	SQ. DEKAMETERS		
1	SQ. KILOMETER	= 100	SQ. HECTOMETERS		

(THE UNIT IS THE "ARE" = 100 SQ. METERS)

1	CENTIARE	= 10	MILLIARES	=	10.7643	SQ. FT.
1	DECIARE	= 10	CENTIARES	=	11.96033	SQ. YDS.
1	ARE	= 10	DECIARES	=	119.6033	SQ. YDS.
1	DEKARE	= 10	ARES	=	0.247110	ACRES
1	HEKTARE	= 10	DEKARES	=	2.471098	ACRES
1	SQ. KILOMETER	= 100	HEKTARES	=	0.38611	SQ. MILE

CUBIC MEASURE:

(THE UNIT IS THE "STERE" = 61,025.38659 CU. INS.)

1	DECISTERE	= 10	CENTISTERES	=	3.531562	CU. FT.
1	STERE	= 10	DECISTERES	=	1.307986	CU. YDS.
1	DEKASTERE	= 10	STERES	=	13.07986	CU. YDS.

METRIC SYSTEM

CUBIC MEASURE:

(THE UNIT IS THE METER = 39.37 INCHES)

1	CU. CENTIMETER	= 1000	CU. MILLIMETERS	=	0.06102	CU. IN.
1	CU. DECIMETER	= 1000	CU. CENTIMETERS	=	61.02374	CU. IN.
1	CU. METER	= 1000	CU. DECIMETERS	=	35.31467	CU. FT.
		= 1	STERE	=	1.30795	CU. YDS.
1	CU. CENTIMETER (WATER)			=	1	GRAM
1000	CU. CENTIMETERS (WATER)	= 1	LITER	=	1	KILOGRAM
1	CU. METER (1000 LITERS)			=	1	METRIC TON

MEASURES OF WEIGHT:

(THE UNIT IS THE GRAM = 0.035274 OUNCES)

1	MILLIGRAM	=		=	0.015432	GRAINS
1	CENTIGRAM	=	10 MILLIGRAMS	=	0.15432	GRAINS
1	DECIGRAM	=	10 CENTIGRAMS	=	1.5432	GRAINS
1	GRAM	=	10 DECIGRAMS	=	15.4323	GRAINS
1	DEKAGRAM	=	10 GRAMS	=	5.6438	DRAMS
1	HECTOGRAM	=	10 DEKAGRAMS	=	3.5274	OUNCES
1	KILOGRAM	=	10 HECTOGRAMS	=	2.2046223	POUNDS
1	MYRIAGRAM	=	10 KILOGRAMS	=	22.046223	POUNDS
1	QUINTAL	=	10 MYRIAGRAMS	=	1.986412	CWT.
1	METRIC TON	=	10 QUINTAL	=	2,204.6223	POUNDS
1	GRAM	=	0.56438 DRAMS			
1	DRAM	=	1.77186 GRAMS			
		=	27.3438 GRAINS			
1	METRIC TON	=	2,204.6223 POUNDS			

MEASURES OF CAPACITY:

(THE UNIT IS THE LITER = 1.0567 LIQUID QUARTS)

1	CENTILITER	=	10 MILLILITERS	=	0.338	FLUID OUNCES
1	DECILITER	=	10 CENTILITERS	=	3.38	FLUID OUNCES
1	LITER	=	10 DECILITERS	=	33.8	FLUID OUNCES
1	DEKALITER	=	10 LITERS	=	0.284	BUSHEL
1	HECTOLITER	=	10 DEKALITERS	=	2.84	BUSHELS
1	KILOLITER	=	10 HECTOLITERS	=	264.2	GALLONS

NOTE: $\frac{\text{KILOMETERS}}{8} \times 5 = \text{MILES}$ or $\frac{\text{MILES}}{5} \times 8 = \text{KILOMETERS}$

METRIC DESIGNATOR AND TRADE SIZES

METRIC DESIGNATOR												
12	16	21	27	35	41	53	63	78	91	103	129	155
⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
TRADE SIZE												

U.S. WEIGHTS & MEASURES / METRIC EQUIVALENT CHART

	In.	Ft.	Yd.	Mile	Mm	Cm	M	Km
1 Inch =	1	.0833	.0278	1.578×10^{-5}	25.4	**2.54**	.0254	2.54×10^{-3}
1 Foot =	12	1	.333	1.894×10^{-4}	304.8	**30.48**	.3048	3.048×10^{-4}
1 Yard =	36	3	1	5.6818×10^{-4}	914.4	91.44	**.9144**	9.144×10^{-4}
1 Mile =	63,360	5,280	1,760	1	1,609,344	160,934.4	1,609.344	**1.609344**
1 mm =	**.03937**	.0032808	1.0936×10^{-3}	6.2137×10^{-7}	1	0.1	0.001	0.000001
1 cm =	**.3937**	.0328084	.0109361	6.2137×10^{-6}	10	1	0.01	0.00001
1 m =	39.37	3.28084	**1.09361**	6.2137×10^{-4}	1000	100	1	0.001
1 km =	39,370	3,280.84	1,093.61	**0.62137**	1,000,000	100,000	1,000	1

In. = Inches Ft. = Foot Yd. = Yard Mi. = Mile Mm = Millimeter Cm = Centimeter M = Meter Km = Kilometer

EXPLANATION OF SCIENTIFIC NOTATION:

Scientific Notation is simply a way of expressing very large or very small numbers in a more compact format. Any number can be expressed as a number between 1 & 10, multiplied by a power of 10 (which indicates the correct position of the decimal point in the original number). Numbers greater than 10 have positive powers of 10, and numbers less than 1 have negative powers of 10.

Example: $186{,}000 = 1.86 \times 10^{5}$ $0.000524 = 5.24 \times 10^{-4}$

USEFUL CONVERSIONS / EQUIVALENTS

1	BTU	Raises 1 LB. of water 1°F
1	GRAM CALORIE	Raises 1 Gram of water 1°C
1	CIRCULAR MIL	Equals 0.7854 sq. mil
1	SQ. MIL	Equals 1.27 cir. mils
1	MIL	Equals 0.001 in.

To determine circular mil of a conductor:

ROUND CONDUCTOR .....CM = (Diameter in mils)²

BUS BAR .....CM = $\frac{\text{Width (mils)} \times \text{Thickness (mils)}}{0.7854}$

NOTES: 1 Millimeter = 39.37 Mils 1 Cir. Millimeter = 1550 Cir. Mils
1 Sq. Millimeter = 1974 Cir. Mils

Selected Circuit Load Calculator

Contractor_____ Email _____

Phone_____ Fax _____

Job Name _____

Date_____ Location _____

VOLTAGE ☐ 120/240 1Ø ☐ 120/208 3Ø ☐ 120/240 3Ø ☐ 277/480 3Ø

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 150 Amp ☐ 200 Amp ☐ 300 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Contacting local authorities prior to installation is recommended.

LOADS: Look for heavy building loads such as refrigeration, air conditioning, pumps or UPS systems. Use the following for sizing and determining generator kW.

Applications

The HT Series does not meet the necessary requirements for the following applications:

NEC 695	Fire Pumps
NEC 700	Emergency Systems
NFPA 20	Fire Pumps
NFPA 99	Healthcare
NFPA 110	Emergency Systems

Reference Codes

Related Codes and Standards:

NEC 225	Branch Circuits and Feeders
NEC 240	Overcurrent Protection
NEC 250	Grounding
NEC 445	Generators
NEC 700	Emergency Systems
NEC 701	Legally Required Standby
NEC 702	Optional Standby
NFPA 37	Installation & Use of Stationary Engines
NFPA 54	National Fuel Gas Code
NFPA 58	LP Gas Code

TABLE 8 — Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] Starting kW for HP < 7.5 starting kW = HP x 3
Starting kW for HP > 7.5 starting kW = HP x 2
Starting kW for loading with no listed HP, calculate HP based on running amps in the chart on the right

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

TABLE 9 — Motor Load Table (refer to Table 1)

Device		Amps	kW

UPS Information

2 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system
It is recommended you refer to the Honeywell UPS Generator Compatibility sheet (Pg 10) and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

RTSG – 100, 150, 200, 300 and 400 Amp service rated
RTSZ – 100–800 3ø and 600-800 1ø Amp
RTSV – 100, 150, 200, 300 and 400 Amp

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

1. Suggested concrete pad minimum thickness of 4" with 6" overhang on all sides. Composite pad included with air-cooled products.
2. Consult manual for installation recommendations.
3. Consult local authority having jurisdiction for local requirements.

Generator Sizing Instructions:

There is not a single correct sizing solution. Following are several methods that, when mixed with good judgement, should result in an appropriately sized generator. Remember to consider load growth, seasonality, and effects of starting motors.

As municipalities and states adopt the new 2011 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which code cycle will affect your install.

Never add amps when sizing a generator. Convert amps to kW and add kW to determine the required generator size. Power factors for various motor loads vary widely. Adding amps without properly accounting for the power factor and/or mixing voltages will result in improperly sizing the generator.

When motors start, they create a current surge that step loads the generator and creates a voltage dip. After selecting a generator, reference the generator's surge capability using **table 3**. Verify that voltage dip is adequate for the application. Most commercial applications should be limited to about 15% voltage dip and residential applications should be limited to a 30% voltage dip.

Some applications utilize an uninterruptible power supply (UPS) to back up critical loads. Please read sizing guide for this load type.

Measurement Method

Use a clamp-on amp meter or power analyzer to measure facility load levels. Clamp each leg separately and take the measurement during peak usage levels.

240V 1ø Applications: To determine peak usage in kW, add the highest amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

Size the generator 10 to 20% larger than the peak measured load.

3ø Applications: Add the peak amp readings from all three legs and divide by 3 to determine peak amps. Multiply peak Amps by volts, multiply the result by 1.732 (square root of 3), then divide by 1000 to convert amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

Size the generator 20 to 25% larger than the peak measured load.

Peak amps = _____ Peak kW= _____

Determining Existing Loads/Billing History Method 220.87 NEC 2011

Many customers have a utility rate structure that has a peak demand charge. Using a year's worth of electric bills, size the generator 25% larger than the largest peak demand.

Verify motor and UPS load compatibility. Peak Demand = _____

Load Summation Method

1) Enter running kW for all motor loads (except the largest) expected to run during peak load levels into **table 6**. Refer to **table 1** for typical motor load sizes and electrical requirements.
2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.
3) Add the running motor load kW, non-motor load kW, and the starting kW of the largest motor load.

Motor load running total (minus largest motor): _____ kW (ref. table 8)
Non-motor load total: _____ kW (ref. table 9)
Starting load from largest cycling motor: _____ kW (ref. table 8)
Total electrical loads: = _____ kW

Select generator: Commercial (add 20 to 25% to total kW)
Residential (add 10 to 20% to total kW)

4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).
5) Confirm UPS compatibility (see page 6).

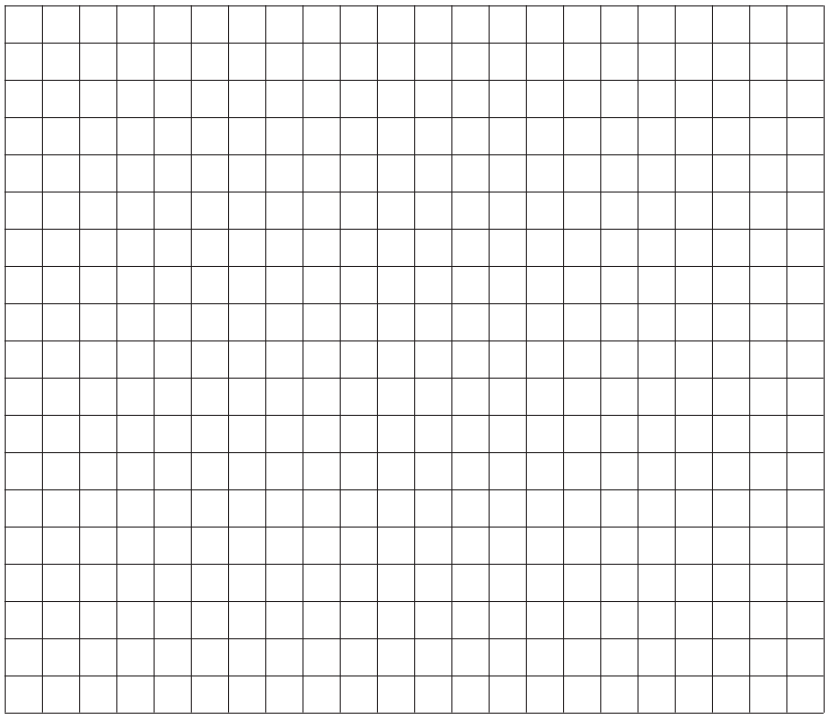
System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2011 NEC Code, you may be required to use this step. Article 702 of the 2011 NEC includes a new requirement for sizing (702.4). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

PMM Load Control Module 702.4 (B) (2) (a) NEC 2011

The PMM Load Control Module is a 50 amp contact housed in a NEMA 3R enclosure for indoor and outdoor installation applications. Through the use of the PMM Modules in conjunction with any of the 100–400 amp Sync Smart Switches, household or business loads can be intelligently managed enabling the use of a smaller, more efficient generator system. Up to four PMM Modules can be used with a single switch.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .34 = _____ kW

Estimate based on square footage

Fast food, convenience stores, restaurants, grocery stores: kW = 50 kW + 10 watts/sq. ft.

Other commercial applications: kW = 30 kW + 5 watts/sq. ft.

Square footage = _____ Estimated kW = _____

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2011, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	NFC REFERENCE
SECTION CAN BE USED FOR DWELLING UNITS	**220.82 (A)**
Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater the calculated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61 . (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	**220.82 (A)**
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	**220.82 (C)**
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
-If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units@ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS	
General Lighting Load	$3VAxft^2$
• Small Appliance & Laundry Circuits	+ 1500 VA per circuit
• General Appliances & Motors (1 00% rated load)	+ Total general appliances
• Sum of all General Loads	= Total General Load (VA)
APPLY DEMAND FACTORS	
- First 10 kVA@ 100%	= 10,000 VA
- Remainder of General Loads @ 40%	(Total VA -10,000) x .40
	= Calculated General Load (VA)
• HEAT I A-C LOAD@ 100%	Largest Heat or A-Q Load (VA)
	= TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2011, 220 Part IV					
Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					
GENERAL LOADS					
• 1st 10 kW of General Loads 100% kW			100%	kW	
• Remaining General Loads 40% kW			40%	kW	
CALCULATED GENERAL LOAD kW					kW
LARGEST HEAT / A-C LOAD 100% kW					kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)					kW

Selected Circuit Load Calculator

Contractor_____ Email _____

Phone_____ Fax _____

Job Name _____

Date_____ Location _____

VOLTAGE ☐ 120/240 1Ø ☐ 120/208 3Ø ☐ 120/240 3Ø ☐ 277/480 3Ø

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 150 Amp ☐ 200 Amp ☐ 300 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Contacting local authorities prior to installation is recommended.

LOADS: Look for heavy building loads such as refrigeration, air conditioning, pumps or UPS systems. Use the following for sizing and determining generator kW.

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NFPA 110	Emergency Systems

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NEC 702	Optional Standby
NFPA 37	Installation & Use of Stationary Engines
NFPA 54	National Fuel Gas Code
NFPA 58	LP Gas Code

TABLE 8 — Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

[1] Starting kW for HP < 7.5 starting kW = HP x 3
Starting kW for HP > 7.5 starting kW = HP x 2
Starting kW for loading with no listed HP, calculate HP based on running amps in the chart on the right

TABLE 9 — Motor Load Table (refer to Table 1)

Device		Amps	kW

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2 x kVA rating for a filtered system

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It is recommended you refer to the Honeywell UPS Generator Compatibility sheet (Pg 10) and contact the manufacturer of the UPS system to assist in your installation.

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RTSG – 100, 150, 200, 300 and 400 Amp service rated

RTSZ – 100–800 3ø and 600-800 1ø Amp

RTSV – 100, 150, 200, 300 and 400 Amp

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

1. Suggested concrete pad minimum thickness of 4" with 6" overhang on all sides. Composite pad included with air-cooled products.
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When motors start, they create a current surge that step loads the generator and creates a voltage dip. After selecting a generator, reference the generator's surge capability using **table 3**. Verify that voltage dip is adequate for the application. Most commercial applications should be limited to about 15% voltage dip and residential applications should be limited to a 30% voltage dip.

Some applications utilize an uninterruptible power supply (UPS) to back up critical loads. Please read sizing guide for this load type.

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Use a clamp-on amp meter or power analyzer to measure facility load levels. Clamp each leg separately and take the measurement during peak usage levels.

240V 1ø Applications: To determine peak usage in kW, add the highest amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

Size the generator 10 to 20% larger than the peak measured load.

3ø Applications: Add the peak amp readings from all three legs and divide by 3 to determine peak amps. Multiply peak Amps by volts, multiply the result by 1.732 (square root of 3), then divide by 1000 to convert amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

Size the generator 20 to 25% larger than the peak measured load.

Peak amps = _____ Peak kW= _____

Determining Existing Loads/Billing History Method 220.87 NEC 2011

Many customers have a utility rate structure that has a peak demand charge. Using a year's worth of electric bills, size the generator 25% larger than the largest peak demand.

Verify motor and UPS load compatibility. Peak Demand = _____

Load Summation Method

1) Enter running kW for all motor loads (except the largest) expected to run during peak load levels into **table 6**. Refer to **table 1** for typical motor load sizes and electrical requirements.
2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.
3) Add the running motor load kW, non-motor load kW, and the starting kW of the largest motor load.

Motor load running total (minus largest motor): _____ kW (ref. table 8)
Non-motor load total: _____ kW (ref. table 9)
Starting load from largest cycling motor: _____ kW (ref. table 8)
Total electrical loads: = _____ kW

Select generator: Commercial (add 20 to 25% to total kW)
Residential (add 10 to 20% to total kW)

4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).
5) Confirm UPS compatibility (see page 6).

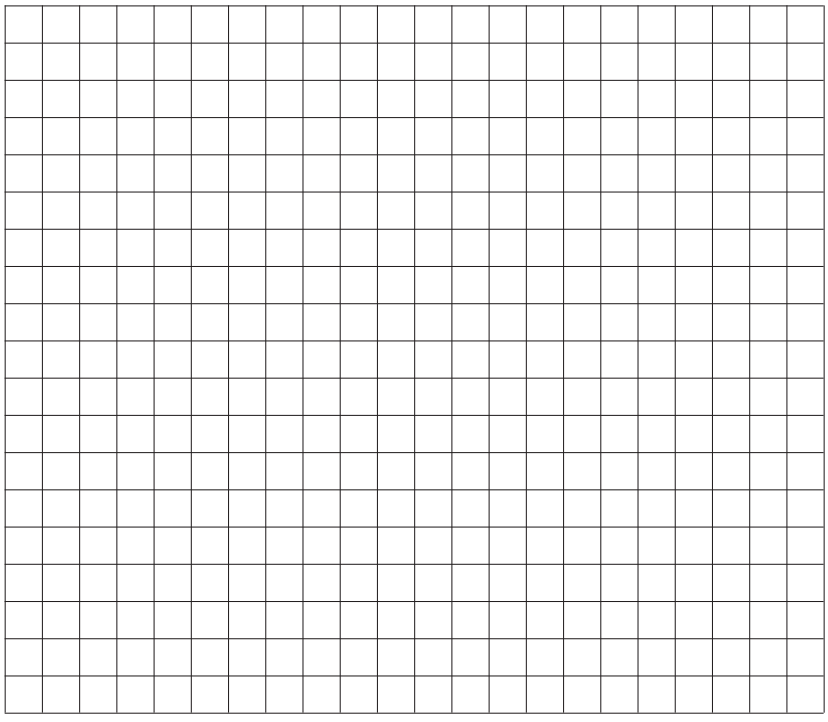
System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2011 NEC Code, you may be required to use this step. Article 702 of the 2011 NEC includes a new requirement for sizing (702.4). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

PMM Load Control Module 702.4 (B) (2) (a) NEC 2011

The PMM Load Control Module is a 50 amp contact housed in a NEMA 3R enclosure for indoor and outdoor installation applications. Through the use of the PMM Modules in conjunction with any of the 100–400 amp Sync Smart Switches, household or business loads can be intelligently managed enabling the use of a smaller, more efficient generator system. Up to four PMM Modules can be used with a single switch.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .34 = _____ kW

Estimate based on square footage

Fast food, convenience stores, restaurants, grocery stores: kW = 50 kW + 10 watts/sq. ft.

Other commercial applications: kW = 30 kW + 5 watts/sq. ft.

Square footage = _____ Estimated kW = _____

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2011, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	NFC REFERENCE
SECTION CAN BE USED FOR DWELLING UNITS	**220.82 (A)**
Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater the calculated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61 . (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	**220.82 (A)**
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	**220.82 (C)**
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
-If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units@ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS	
General Lighting Load	3VAxft^2
• Small Appliance & Laundry Circuits	+ 1500 VA per circuit
• General Appliances & Motors (1 00% rated load)	+ Total general appliances
• Sum of all General Loads	= Total General Load (VA)
APPLY DEMAND FACTORS	
- First 10 kVA@ 100%	= 10,000 VA
- Remainder of General Loads @ 40%	(Total VA -10,000) x .40
	= Calculated General Load (VA)
• HEAT I A-C LOAD@ 100%	Largest Heat or A-Q Load (VA)
	= TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2011, 220 Part IV					
Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					
GENERAL LOADS					
• 1st 10 kW of General Loads 100% kW			100%	kW	
• Remaining General Loads 40% kW			40%	kW	
CALCULATED GENERAL LOAD kW					kW
LARGEST HEAT / A-C LOAD 100% kW					kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)					kW

Selected Circuit Load Calculator

Contractor_____ Email _____

Phone_____ Fax _____

Job Name _____

Date_____ Location _____

VOLTAGE ☐ 120/240 1Ø ☐ 120/208 3Ø ☐ 120/240 3Ø ☐ 277/480 3Ø

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 150 Amp ☐ 200 Amp ☐ 300 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Contacting local authorities prior to installation is recommended.

LOADS: Look for heavy building loads such as refrigeration, air conditioning, pumps or UPS systems. Use the following for sizing and determining generator kW.

Applications

The HT Series does not meet the necessary requirements for the following applications:

NEC 695	Fire Pumps
NEC 700	Emergency Systems
NFPA 20	Fire Pumps
NFPA 99	Healthcare
NFPA 110	Emergency Systems

Reference Codes

Related Codes and Standards:

NEC 225	Branch Circuits and Feeders
NEC 240	Overcurrent Protection
NEC 250	Grounding
NEC 445	Generators
NEC 700	Emergency Systems
NEC 701	Legally Required Standby
NEC 702	Optional Standby
NFPA 37	Installation & Use of Stationary Engines
NFPA 54	National Fuel Gas Code
NFPA 58	LP Gas Code

TABLE 8 — Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] Starting kW for HP < 7.5 starting kW = HP x 3
Starting kW for HP > 7.5 starting kW = HP x 2
Starting kW for loading with no listed HP, calculate HP based on running amps in the chart on the right

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

TABLE 9 — Motor Load Table (refer to Table 1)

Device		Amps	kW

UPS Information

2 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system
It is recommended you refer to the Honeywell UPS Generator Compatibility sheet (Pg 10) and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

RTSG – 100, 150, 200, 300 and 400 Amp service rated
RTSZ – 100–800 3ø and 600-800 1ø Amp
RTSV – 100, 150, 200, 300 and 400 Amp

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

1. Suggested concrete pad minimum thickness of 4" with 6" overhang on all sides. Composite pad included with air-cooled products.
2. Consult manual for installation recommendations.
3. Consult local authority having jurisdiction for local requirements.

Generator Sizing Instructions:

There is not a single correct sizing solution. Following are several methods that, when mixed with good judgement, should result in an appropriately sized generator. Remember to consider load growth, seasonality, and effects of starting motors.

As municipalities and states adopt the new 2011 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which code cycle will affect your install.

Never add amps when sizing a generator. Convert amps to kW and add kW to determine the required generator size. Power factors for various motor loads vary widely. Adding amps without properly accounting for the power factor and/or mixing voltages will result in improperly sizing the generator.

When motors start, they create a current surge that step loads the generator and creates a voltage dip. After selecting a generator, reference the generator's surge capability using **table 3**. Verify that voltage dip is adequate for the application. Most commercial applications should be limited to about 15% voltage dip and residential applications should be limited to a 30% voltage dip.

Some applications utilize an uninterruptible power supply (UPS) to back up critical loads. Please read sizing guide for this load type.

Measurement Method

Use a clamp-on amp meter or power analyzer to measure facility load levels. Clamp each leg separately and take the measurement during peak usage levels.

240V 1ø Applications: To determine peak usage in kW, add the highest amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

Size the generator 10 to 20% larger than the peak measured load.

3ø Applications: Add the peak amp readings from all three legs and divide by 3 to determine peak amps. Multiply peak Amps by volts, multiply the result by 1.732 (square root of 3), then divide by 1000 to convert amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

Size the generator 20 to 25% larger than the peak measured load.

Peak amps = _____ Peak kW= _____

Determining Existing Loads/Billing History Method 220.87 NEC 2011

Many customers have a utility rate structure that has a peak demand charge. Using a year's worth of electric bills, size the generator 25% larger than the largest peak demand.

Verify motor and UPS load compatibility. Peak Demand = _____

Load Summation Method

1) Enter running kW for all motor loads (except the largest) expected to run during peak load levels into **table 6**. Refer to **table 1** for typical motor load sizes and electrical requirements.
2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.
3) Add the running motor load kW, non-motor load kW, and the starting kW of the largest motor load.

Motor load running total (minus largest motor): _____ kW (ref. table 8)
Non-motor load total: _____ kW (ref. table 9)
Starting load from largest cycling motor: _____ kW (ref. table 8)
Total electrical loads: = _____ kW

Select generator: Commercial (add 20 to 25% to total kW)
Residential (add 10 to 20% to total kW)

4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).
5) Confirm UPS compatibility (see page 6).

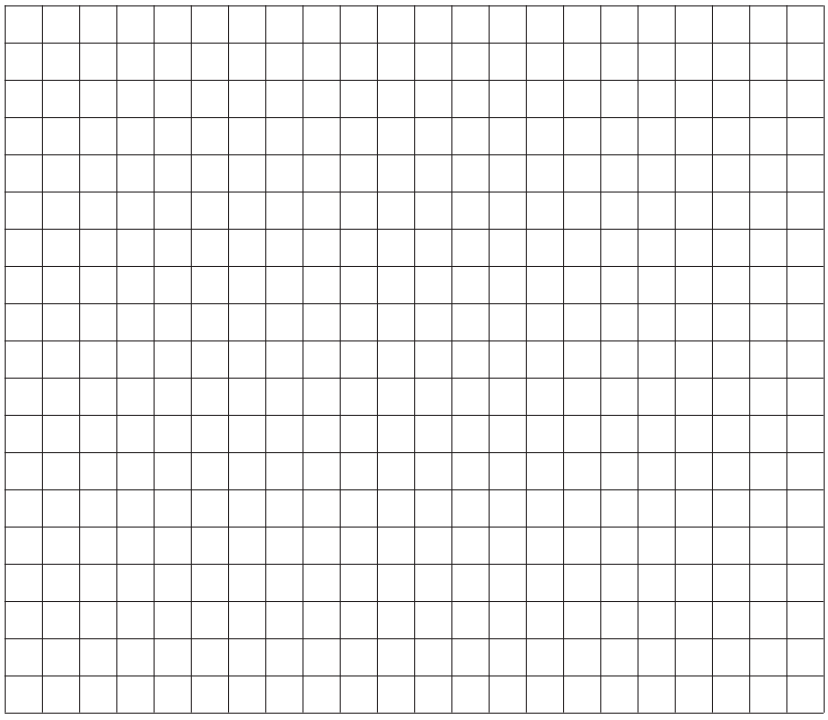
System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2011 NEC Code, you may be required to use this step. Article 702 of the 2011 NEC includes a new requirement for sizing (702.4). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

PMM Load Control Module 702.4 (B) (2) (a) NEC 2011

The PMM Load Control Module is a 50 amp contact housed in a NEMA 3R enclosure for indoor and outdoor installation applications. Through the use of the PMM Modules in conjunction with any of the 100–400 amp Sync Smart Switches, household or business loads can be intelligently managed enabling the use of a smaller, more efficient generator system. Up to four PMM Modules can be used with a single switch.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .34 = _____ kW

Estimate based on square footage

Fast food, convenience stores, restaurants, grocery stores: kW = 50 kW + 10 watts/sq. ft.

Other commercial applications: kW = 30 kW + 5 watts/sq. ft.

Square footage = _____ Estimated kW = _____

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2011, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	NFC REFERENCE
SECTION CAN BE USED FOR DWELLING UNITS	**220.82 (A)**
Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater the calculated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61 . (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	**220.82 (A)**
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	**220.82 (C)**
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
-If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units@ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS	
General Lighting Load	$3VAxft^2$
• Small Appliance & Laundry Circuits	+ 1500 VA per circuit
• General Appliances & Motors (1 00% rated load)	+ Total general appliances
• Sum of all General Loads	= Total General Load (VA)
APPLY DEMAND FACTORS	
- First 10 kVA@ 100%	= 10,000 VA
- Remainder of General Loads @ 40%	(Total VA -10,000) x .40
	= Calculated General Load (VA)
• HEAT I A-C LOAD@ 100%	Largest Heat or A-Q Load (VA)
	= TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2011, 220 Part IV					
Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					
GENERAL LOADS					
• 1st 10 kW of General Loads 100% kW			100%	kW	
• Remaining General Loads 40% kW			40%	kW	
CALCULATED GENERAL LOAD kW					kW
LARGEST HEAT / A-C LOAD 100% kW					kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)					kW

Selected Circuit Load Calculator

Contractor_____ Email _____

Phone_____ Fax _____

Job Name _____

Date_____ Location _____

VOLTAGE ☐ 120/240 1Ø ☐ 120/208 3Ø ☐ 120/240 3Ø ☐ 277/480 3Ø

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 150 Amp ☐ 200 Amp ☐ 300 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Contacting local authorities prior to installation is recommended.

LOADS: Look for heavy building loads such as refrigeration, air conditioning, pumps or UPS systems. Use the following for sizing and determining generator kW.

Applications

The HT Series does not meet the necessary requirements for the following applications:

NEC 695	Fire Pumps
NEC 700	Emergency Systems
NFPA 20	Fire Pumps
NFPA 99	Healthcare
NFPA 110	Emergency Systems

Reference Codes

Related Codes and Standards:

NEC 225	Branch Circuits and Feeders
NEC 240	Overcurrent Protection
NEC 250	Grounding
NEC 445	Generators
NEC 700	Emergency Systems
NEC 701	Legally Required Standby
NEC 702	Optional Standby
NFPA 37	Installation & Use of Stationary Engines
NFPA 54	National Fuel Gas Code
NFPA 58	LP Gas Code

TABLE 8 — Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] Starting kW for HP < 7.5 starting kW = HP x 3
Starting kW for HP > 7.5 starting kW = HP x 2
Starting kW for loading with no listed HP, calculate HP based on running amps in the chart on the right

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

TABLE 9 — Motor Load Table (refer to Table 1)

Device		Amps	kW

UPS Information

2 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system
It is recommended you refer to the Honeywell UPS Generator Compatibility sheet (Pg 10) and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

RTSG – 100, 150, 200, 300 and 400 Amp service rated
RTSZ – 100–800 3ø and 600-800 1ø Amp
RTSV – 100, 150, 200, 300 and 400 Amp

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

1. Suggested concrete pad minimum thickness of 4" with 6" overhang on all sides. Composite pad included with air-cooled products.
2. Consult manual for installation recommendations.
3. Consult local authority having jurisdiction for local requirements.

Generator Sizing Instructions:

There is not a single correct sizing solution. Following are several methods that, when mixed with good judgement, should result in an appropriately sized generator. Remember to consider load growth, seasonality, and effects of starting motors.

As municipalities and states adopt the new 2011 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which code cycle will affect your install.

Never add amps when sizing a generator. Convert amps to kW and add kW to determine the required generator size. Power factors for various motor loads vary widely. Adding amps without properly accounting for the power factor and/or mixing voltages will result in improperly sizing the generator.

When motors start, they create a current surge that step loads the generator and creates a voltage dip. After selecting a generator, reference the generator's surge capability using **table 3**. Verify that voltage dip is adequate for the application. Most commercial applications should be limited to about 15% voltage dip and residential applications should be limited to a 30% voltage dip.

Some applications utilize an uninterruptible power supply (UPS) to back up critical loads. Please read sizing guide for this load type.

Measurement Method

Use a clamp-on amp meter or power analyzer to measure facility load levels. Clamp each leg separately and take the measurement during peak usage levels.

240V 1ø Applications: To determine peak usage in kW, add the highest amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

Size the generator 10 to 20% larger than the peak measured load.

3ø Applications: Add the peak amp readings from all three legs and divide by 3 to determine peak amps. Multiply peak Amps by volts, multiply the result by 1.732 (square root of 3), then divide by 1000 to convert amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

Size the generator 20 to 25% larger than the peak measured load.

Peak amps = _____ Peak kW= _____

Determining Existing Loads/Billing History Method 220.87 NEC 2011

Many customers have a utility rate structure that has a peak demand charge. Using a year's worth of electric bills, size the generator 25% larger than the largest peak demand.

Verify motor and UPS load compatibility. Peak Demand = _____

Load Summation Method

1) Enter running kW for all motor loads (except the largest) expected to run during peak load levels into **table 6**. Refer to **table 1** for typical motor load sizes and electrical requirements.
2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.
3) Add the running motor load kW, non-motor load kW, and the starting kW of the largest motor load.

Motor load running total (minus largest motor): _____ kW (ref. table 8)
Non-motor load total: _____ kW (ref. table 9)
Starting load from largest cycling motor: _____ kW (ref. table 8)
Total electrical loads: = _____ kW

Select generator: Commercial (add 20 to 25% to total kW)
Residential (add 10 to 20% to total kW)

4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).
5) Confirm UPS compatibility (see page 6).

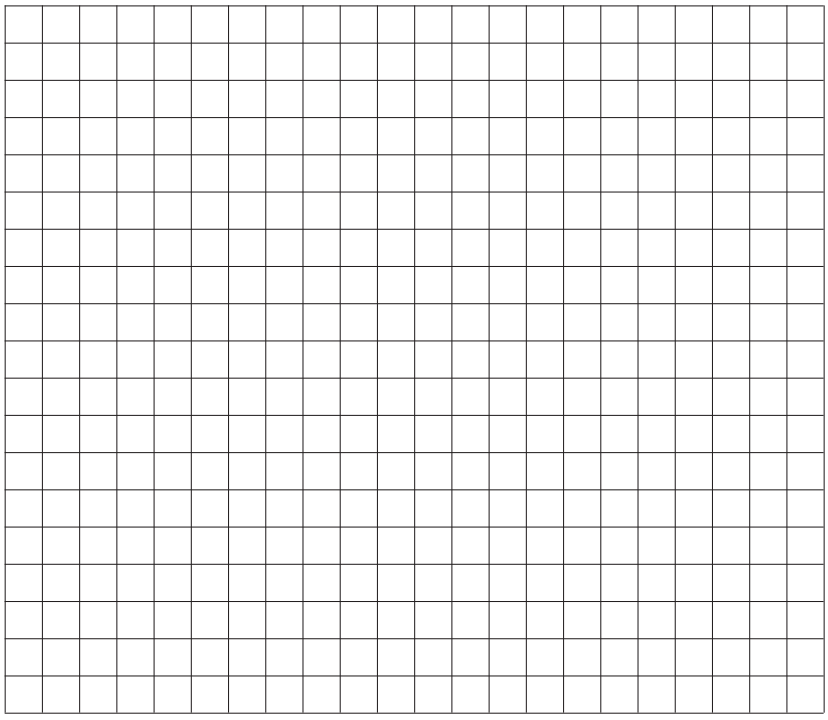
System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2011 NEC Code, you may be required to use this step. Article 702 of the 2011 NEC includes a new requirement for sizing (702.4). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

PMM Load Control Module 702.4 (B) (2) (a) NEC 2011

The PMM Load Control Module is a 50 amp contact housed in a NEMA 3R enclosure for indoor and outdoor installation applications. Through the use of the PMM Modules in conjunction with any of the 100–400 amp Sync Smart Switches, household or business loads can be intelligently managed enabling the use of a smaller, more efficient generator system. Up to four PMM Modules can be used with a single switch.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .34 = _____ kW

Estimate based on square footage

Fast food, convenience stores, restaurants, grocery stores: kW = 50 kW + 10 watts/sq. ft.

Other commercial applications: kW = 30 kW + 5 watts/sq. ft.

Square footage = _____ Estimated kW = _____

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2011, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	NFC REFERENCE
SECTION CAN BE USED FOR DWELLING UNITS	**220.82 (A)**
Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater the calculated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61 . (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	**220.82 (A)**
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	**220.82 (C)**
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
-If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units@ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS	
General Lighting Load	$3VAxft^2$
• Small Appliance & Laundry Circuits	+ 1500 VA per circuit
• General Appliances & Motors (1 00% rated load)	+ Total general appliances
• Sum of all General Loads	= Total General Load (VA)
APPLY DEMAND FACTORS	
- First 10 kVA@ 100%	= 10,000 VA
- Remainder of General Loads @ 40%	(Total VA -10,000) x .40
	= Calculated General Load (VA)
• HEAT I A-C LOAD@ 100%	Largest Heat or A-Q Load (VA)
	= TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2011, 220 Part IV					
Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					
GENERAL LOADS					
• 1st 10 kW of General Loads 100% kW			100%	kW	
• Remaining General Loads 40% kW			40%	kW	
CALCULATED GENERAL LOAD kW					kW
LARGEST HEAT / A-C LOAD 100% kW					kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)					kW

Notes

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0194900HWL Revised July 2013

Honeywell