

Service Parts



Industrial Generator Sets

Model:

400-800GSW

See Group 701: Literature, inside this manual for
part numbers of engine and accessory parts catalogs

See MP-6009 Parts Catalog Industrial Controllers
for controller parts

Table of Contents

Introduction	1
Numbering System Significance	1
Illustrations	1
How to Find Part Numbers	1
Hardware References	1
Specification Number Index	2
Group 105: Engine	3
Group 107: Nameplate and Decals	3
Group 201: Generator and Mounting	4
Group 301: Control and Harness	8
Group 701: Literature	12
Kit List	13
Fuel System Kits	13
Cooling System Kits	13
Appendix A Abbreviations	A-1
Appendix B Common Hardware Application Guidelines	A-3
Appendix C General Torque Specifications	A-4
Appendix D Common Hardware Identification	A-5
Appendix E Common Hardware List	A-6

Introduction

This manual lists service replacement parts for 400–800 kW generator sets.

At the time of print this manual applied to the generator set specification (spec) numbers listed in the Specification Number Index. On occasion this manual may apply to specs not listed in the Specification Number Index.

Information in this publication represents data available at the time of print. The manufacturer of DDC/MTU Power Generation products reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

This manual includes the following main sections:

Table of Contents. Lists the sections of the manual.

Introduction (and other information sections). Contains introductory material about part numbers, illustrations, and hardware.

Specification Number Index. Lists the generator set specs and groups.

Group Parts Lists. List the part numbers of parts in the groups.

Kit Sections. List modules and accessories and their parts.

Appendices. Include Abbreviations, Common Hardware Application Guidelines, General Torque Specifications, Common Hardware Identification, and Common Hardware List.

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Numbering System Significance

This manual uses the following numbering systems:

Specification Number. The product identification number located on the generator set nameplate. Specification numbers break down into groups.

Group Number. A unique number representing a parts group needed to assemble a generator set function. For example, Group 101 is the Air Intake group.

Variation or Module Number. A group might have several variations. Each variation performs the same function with different parts lists. For example, a 50 Hz generator alternator and a 60 Hz generator alternator both perform the same function; however, with different parts. Each difference requires a group variation or module number.

Part Number. The part number identifies an individual assembly, subassembly, component, or accessory kit.

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Illustrations

Illustrations (or exploded-view drawings) best representing the widest range of variations accompany most groups in this manual. Illustrations do not depict all details and may not show all parts. Do not use illustrations for assembly or disassembly.

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How to Find Part Numbers

Use the following steps to locate a service replacement part.

1. Locate the generator set nameplate to **identify the generator set spec number**.
2. Locate a second generator set nameplate listing accessories to **identify installed modules**. On some models the accessory nameplate is mounted inside the generator junction box.
3. **Turn to the Specification Number Index.** The first column lists the generator set spec numbers. The headings identify the groups of parts that make up the generator set.
4. **Identify the group** most likely to include the service part number.
5. **Find the group variation number** at the intersection of the spec number row and the group column. Note the variation number.
6. **Page forward to locate the group** identified in step 4 or find the appropriate page in the Table of Contents.
7. **Find the part on the illustration** and note the item number of the part or **find the part description in the parts list**.
8. Select the **part number that corresponds to your group variation**. The first column lists the illustration item number. Find the variation identified in the Specification Number Index or the module number found on the generator set nameplate in the appropriate column on the right side of the parts list table. Find the quantity used at the intersection of the item number row and the variation column. A blank space at the intersection means the variation/module does not use that part number.

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Hardware References

Many common hardware items do not appear in parts manuals or will appear as common hardware entries. A common hardware entry lists the size of the hardware. For example, an item that appears as “Hardware, 3/8-16” in the text means that the piece is 3/8-16 size. Obtain common hardware locally or, if contacting the factory, use the Common Hardware List in the appendix to identify the common hardware part number and specifications. See Common Hardware Application Guidelines in the appendix for mating hardware instructions.

Some hardware items require a specific size or some other characteristic. In that case, use the part number listed in the text.

When replacing hardware, do not substitute inferior grade hardware. Replacement hardware grade should be equal to or better than the grade of the manufacturer’s original hardware. Use the Common Hardware List in the appendix to identify the common hardware hardness.

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Specification Number Index

Group Title	Air Intake	Cooling System	Engine	Nameplates and Decals	Skid and Plant Mounting	Generator and Mounting	Controller and Mounting	Literature
Group No.	101	104	105	107	109	201	301	701
Spec No.	Variation Number							
400GSW								
GM22173-GA1S	*	*	⌘	1	*	⌘	†	172
GM22173-GA2S	*	*	⌘	1	*	⌘	†	172
GM22173-GA3S	*	*	⌘	1	*	⌘	†	172
GM22173-GA4S	*	*	⌘	1	*	⌘	†	172
600GSW								
GM22193-GA1S	*	*	⌘	1	*	⌘	†	174
GM22193-GA2S	*	*	⌘	1	*	⌘	†	174
GM22193-GA3S	*	*	⌘	1	*	⌘	†	174
GM22193-GA4S	*	*	⌘	1	*	⌘	†	174
800GSW								
GM22207-GA1S	*	*	⌘	1	*	⌘	†	176
GM22207-GA2S	*	*	⌘	1	*	⌘	†	176
GM22207-GA3S	*	*	⌘	1	*	⌘	†	176
GM22207-GA4S	*	*	⌘	1	*	⌘	†	176

* Cooling system, skid, and air intake modules are supplied by the engine manufacturer.
See engine parts catalog for parts breakdowns.

† Configured group. Refer to the generator set nameplate for the module number.
See controller parts catalog MP-6009 for controller parts lists.

⌘ Configured group. Refer to the generator set nameplate for the module number.
Turn to the respective group on the following pages for parts breakdowns.

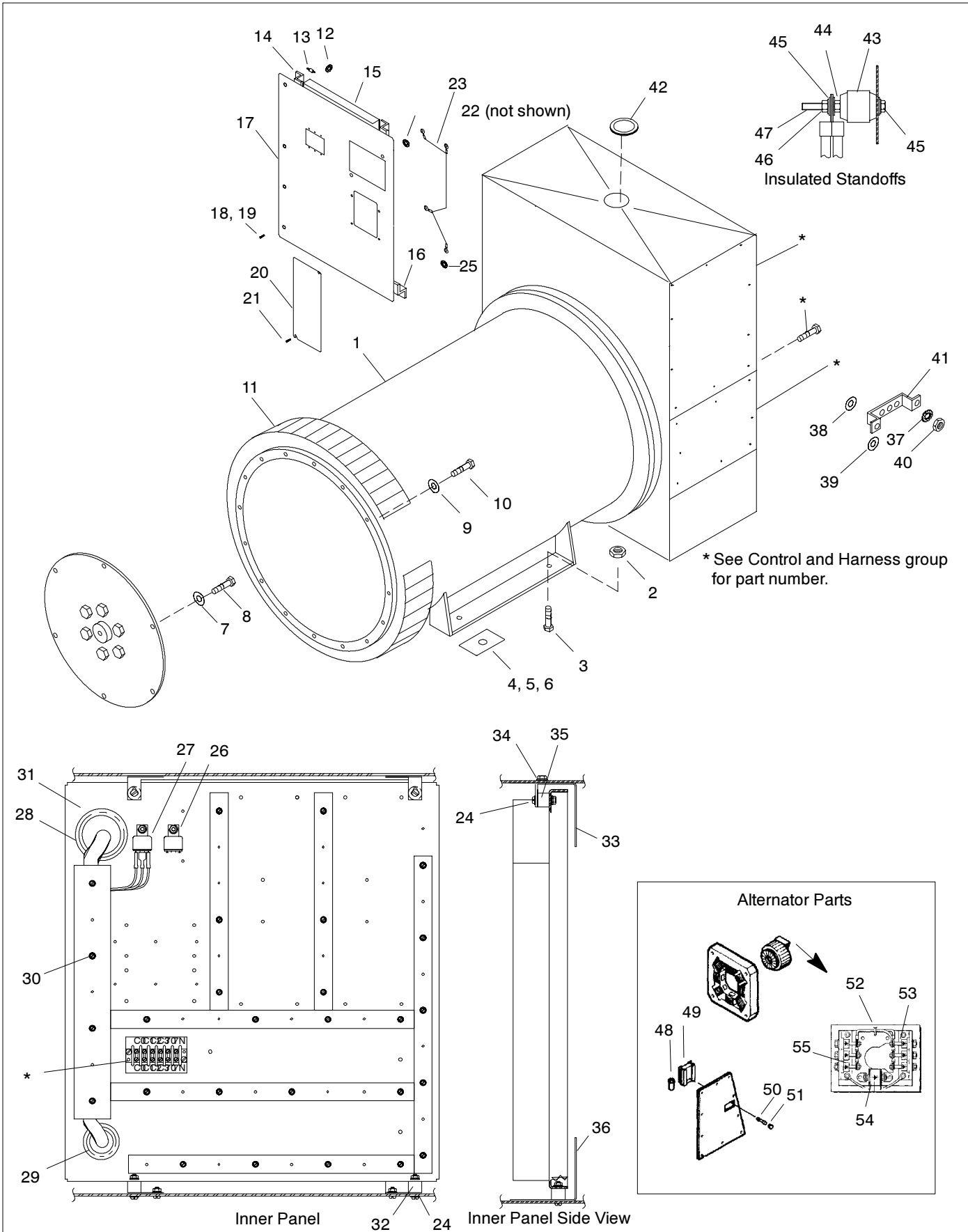
Group 105: Engine

Model (kW)	Engine Description	Spec Number
400	VGf H24GLD Lean-Burn	GM22173-GA1S
400	VGf H24GSID Rich-Burn	GM22173-GA2S
400	VGf H24GLD Lean-Burn, CSA	GM22173-GA3S
400	VGf H24GSID Rich-Burn, CSA	GM22173-GA4S
600	VGf L36GLD Lean-Burn	GM22193-GA1S
600	VGf L36GSID Rich-Burn	GM22193-GA2S
600	VGf L36GLD Lean-Burn, CSA	GM22193-GA3S
600	VGf L36GSID Rich-Burn, CSA	GM22193-GA4S
800	VGf P48GLD Lean-Burn	GM22207-GA1S
800	VGf P48GSID Rich-Burn	GM22207-GA2S
800	VGf P48GLD Lean-Burn, CSA	GM22207-GA3S
800	VGf P48GSID Rich-Burn, CSA	GM22207-GA4S

Group 107: Nameplate and Decals

Item	Part Number	Description	Quantity
			Variation Number
			1
1	238402	Decal, caution positive terminal only	1
2	255822	Decal, caution standby service connect.	1
3	257438	Decal, danger moving rotor	1
4	294520	Decal, danger	1
5	324069	Nameplate, model/ratings, DDC/MTU logo	1
6	347166	Decal, electrical equipment	1
7	GM13227	Decal, warning fan force	1
8	GM13228	Decal, warning lifting support	1
9	X-6301-8	Decal, DDC/MTU logo	1
10	X-6301-2	Decal, DDC/MTU logo	1

Group 201: Generator and Mounting



Group 201: Generator and Mounting

Item	Part Number	Description	Qty. Model		
			400	600	800
1	See chart	Alternator assembly	1	1	1
2	M934-20-80	Nut, hex	4	4	4
3	M933-20055-60	Bolt, hex	4	4	4
4	365410	Shim (16 gauge)	8	8	8
5	365411	Shim (7 gauge)	8	8	8
6	365412	Shim (.010 spring steel)	8	8	8
7	X-801-5	Washer, hardened, .656 ID x 1.06 in. OD	6	12	12
8	X-6021-14	Screw, 5/8-11	6	12	12
9	290945	Washer, hardened, .531 ID x 1.06 in. OD	16	16	16
10	X-129-47	Bolt, hex cap, 1/2-13	16		
10	X-129-56	Bolt, hex cap, 1/2-13		16	16
11	GM22389	Screen	1		
11	328908	Screen		1	1
12	X-22-18	Washer, lock, .172 ID x .595 in. OD	12	12	12
13	282829	Vibromount	6	6	6
14	GM13562	Bracket, door panel mounting, top	2	2	2
15	GM13563	Panel, inner door	1	1	1
16	GM13561	Bracket, door panel mounting, bottom	1	1	1
17	GM13564	Door, junction box	1	1	1
18	X-6217-10	Screw, hex flange machine	14	14	14
19	295009	Retainer	10	10	10
20	GM13565	Cover, access	1	1	1
21	X-50-2	Screw, slotted pan head machine	6	6	6
22	361567	Tie wrap	2	2	2
23	GM21264	Harness, ground	1	1	1
24	X-22-12	Washer, lock, .262 ID x .743 in.	10	10	10
25	X-22-13	Washer, lock, .20 ID x .595 in. OD	1	1	1
26	-	Not used	1	1	1
27	272684	Relay	1	1	1
28	X-634-23	Bushing, 1.968 x 2.50 in. NPT	1	1	1
29	X-634-16	Bushing, 1.312 x 1.50 in. NPT	1	1	1
30	X-67-43	Screw, thread-cutting	27	27	27
31	361186	Panel, junction box, inner	1	1	1
32	229353	Mount, controller	2	2	2
33	GM15336	Bracket, inner panel mounting	1	1	1
34	X-6217-10	Screw, hex flange machine	3	3	3
35	229353	Mount, controller	2	2	2
36	361478	Retainer, inner panel	2	2	2
37	X-22-14	Washer, lock, .391 ID x .975 in. OD	4	4	4
38	X-25-118	Washer, plain, .406 ID x 1 in. OD	4	4	4
39	X-6086-6	Washer, spring, .39 ID x .81 in. OD	2	2	2
40	X-83-7	Nut, hex, zinc, 3/8-16	2	2	2
41	361271	Bus, ground	1	1	1
42	X-634-23	Bushing, 1.968 x 2.50 in. NPT	1	1	1
43	X-6128-29	Insulator, standoff, 3/8-16 x 2 in.	3	3	3
44	X-83-7	Nut, hex, 3/8-16, zinc	6	6	6
45	X-25-118	Washer, plain, .406 ID x 1 in. OD	9	9	9
46	X-6086-6	Washer, spring, .39 ID x .81 in. OD	6	6	6
47	X-6274-7	Rod, threaded	3	3	3
48	347160	Capacitor	1	1	1
49	not used	Voltage regulator, DVR2000	1	1	1
50	279778	Fuse, 5 amp	1	1	1
51	279779	Fuse cap	1	1	1
52	347071	Exciter rectifier assembly	1	1	1
53	279772	Diode, standard polarity	1	1	1
54	279776	Surge suppressor	1	1	1
55	279774	Diode, reversing polarity	1	1	1

Group 201: Generator and Mounting, continued

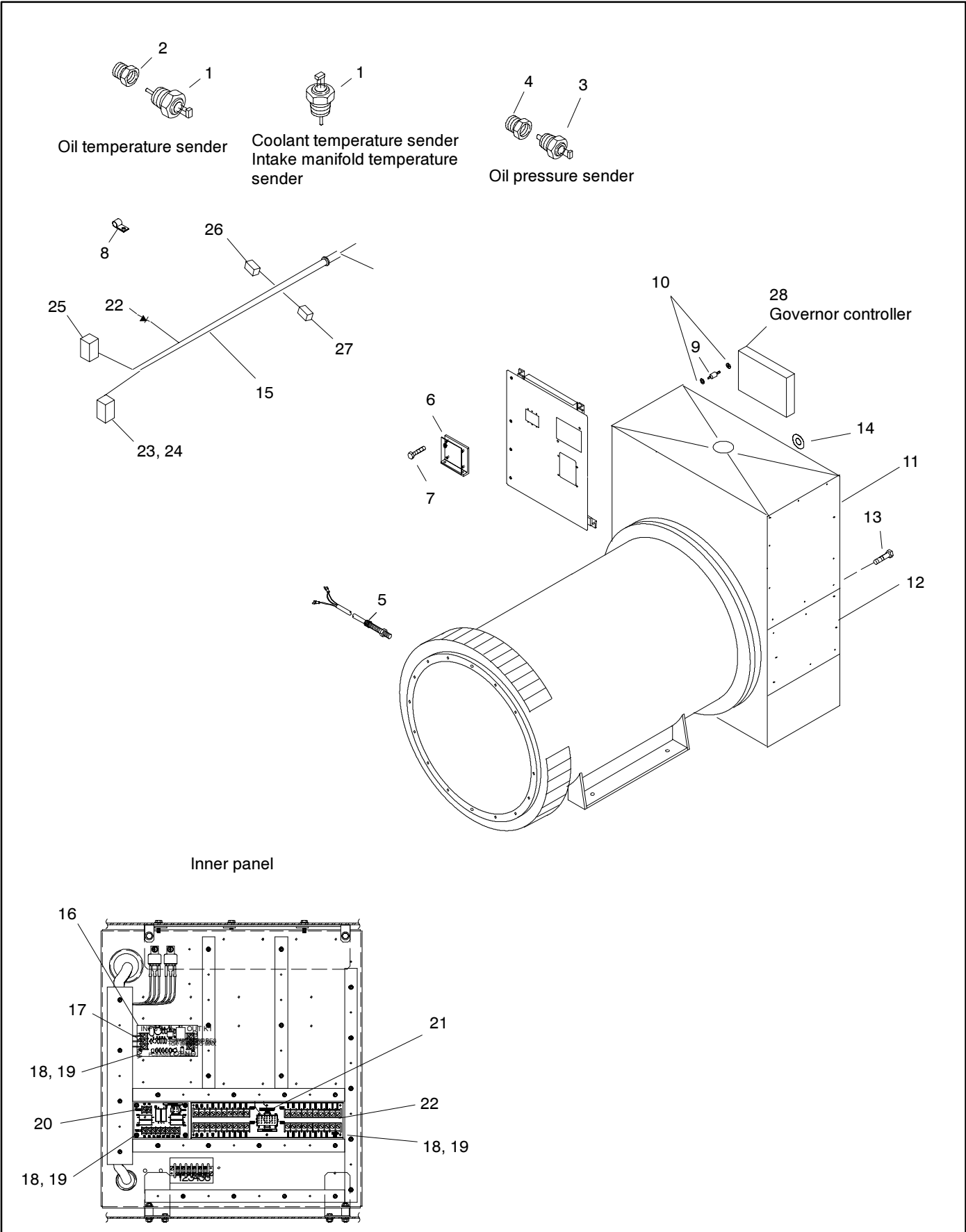
Alternator Part Number and Mount Type

Use this table to identify the module number's alternator part number (item 1).

Module Number	Alternator Description	Alternator Part Number
GM22154-MA1	5M4024	GM22139
GM22154-MA2	5M4028	GM22314
GM22154-MA3	5M4160	GM22145
GM22154-MA4	5M4162	GM22146
GM22154-MA5	5M4270	GM22149
GM22154-MA6	5M4272	GM22315
GM22154-MA7	5M4032	GM22140
GM22154-MA8	5M4034	GM22141
GM22154-MA9	5M4164	GM22147
GM22154-MA10	5M4166	GM22148
GM22154-MA11	5M4274	GM22150
GM22154-MA12	5M4276	GM22151
GM22154-MA13	5M4036	GM22142
GM22154-MA14	5M4038	GM22143
GM22154-MA15	5M4044	GM22144
GM22154-MA16	5M4166	GM22152
GM22154-MA17	5M4280	GM22153
GM22154-MA18	5M4168	GM22344

Notes

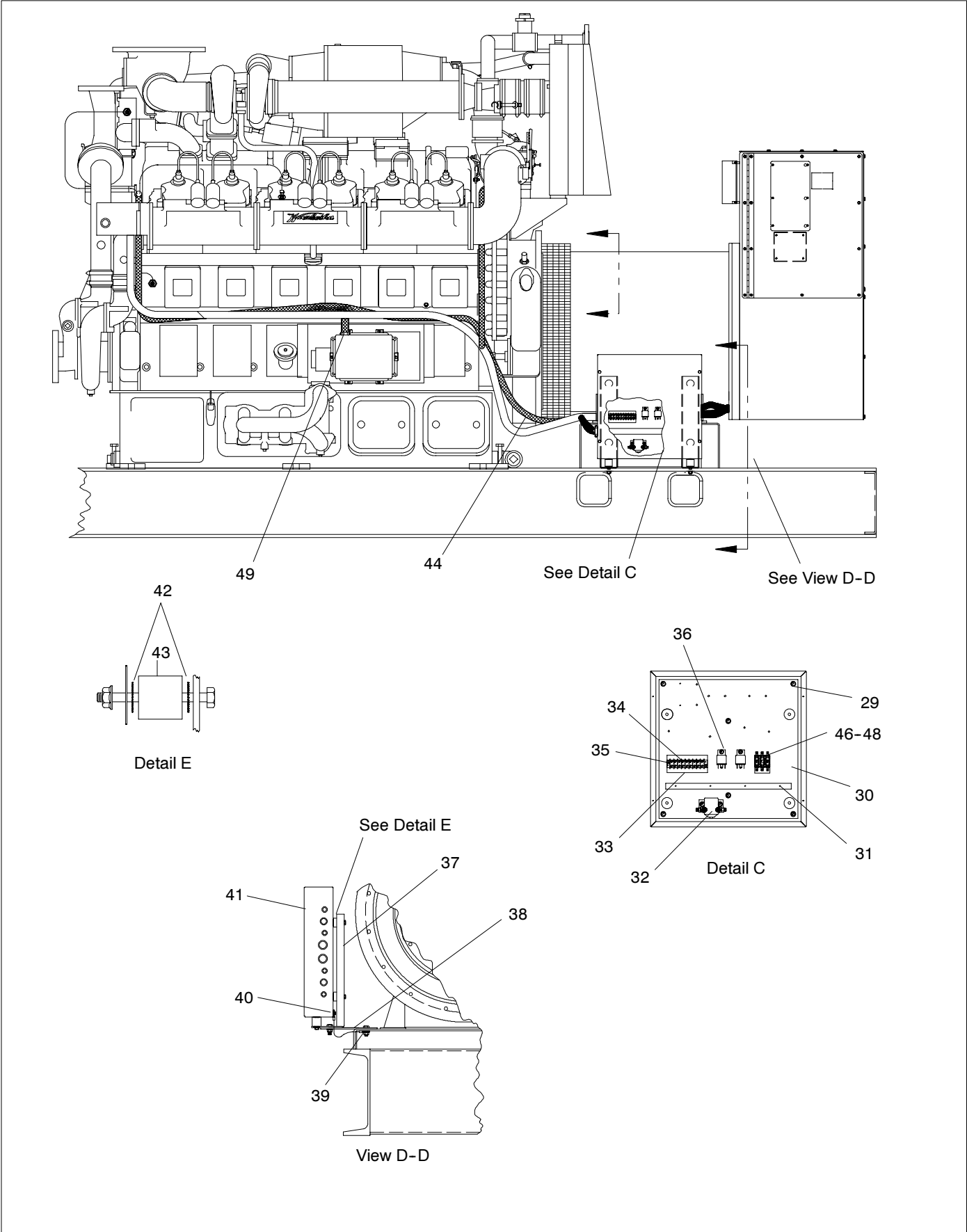
Group 301: Control and Harness



Group 301: Control and Harness

Item	Part Number	Description	Quantity	
			Model/Module Number	
			400	600/800
			GM22216-MA1S	GM22217-MA1S
1	GM16787	Sensor, temperature	3	3
2	361286	Adapter bushing	1	
2	X-202-41	Bushing, reducer (1/2 x 3/4 in. NPT)		1
3	GM16788	Sensor, pressure	1	1
4	361916	Adapter bushing	1	
4	X-202-29	Bushing, reducer (1/8 x 1/2 in. NPT)		1
5	226529	Pickup, magnetic	1	2
6	GM11718	PCB assembly, Marathon excitation interface	1	1
7	M965A-06012-20	Screw, pan head machine	4	4
8	X-672-37	Clamp	1	
9	282829	Vibromount	4	4
10	X-22-18	Washer, lock	8	8
11	361184	Panel, junction box, front	1	1
12	328901	Cover, louvered (bottom)	1	1
13	X-6217-10	Screw, hex flange machine	24	24
14	243488	Grommet, round	1	1
15	GM22244	Harness, engine	1	
15	GM22245	Harness, engine		1
16	C-294301	PCB assembly, 1-relay dry contact	1	1
17	GM10186	Harness, dry contact	1	1
18	X-70-12	Nut, hex machine screw, 8-32	14	14
19	X-712-9	Spacer, .25 OD, .5 in.	14	14
20	GM13980	PCB assembly, CT burden resistor	1	1
21	GM16753	Harness, wiring dry contact	1	1
22	GM13984	Assembly, customer connection	1	1
23	233959	Diode, 6 A	6	6
24	292800	Connector, cable	1	1
25	295145	Connector, 24-position	1	1
26	337131	Connector, plug, 6-position	1	1
27	GM15493	Connector	4	4
28	-	Governor controller (supplied with engine)	1	
28	X-6119-40	Governor controller		1
29	X-400-28	Spacer, .282 ID x .5 OD x .531 in.	6	6
30	GM23566	Panel, inner	1	1
31	X-67-43	Screw, slotted hex washer, threadcutting	4	4
32	272713	Solenoid	1	1
33	273781	Marker, strip	1	1
34	295313	Terminal block	1	1
35	X-51-11	Screw, cross recess round machine	2	2
36	272684	Relay	1	2
37	GM23567	Bracket, mounting	2	2
38	GM23862	Plate, mounting	1	1
39	X-22-15	Washer, lock, .456 ID x 1.058 in. OD	1	1
40	X-22-12	Washer, lock, .262 ID x .743 in. OD	1	1
41	GM23565	Box, Nema 1 pull (includes cover)	1	1
42	X-22-16	Washer, lock, .326 ID x .883 in. OD	12	12
43	292834	Vibromount	6	6
44	GM23554	Harness, engine sensor 400kW Waukesha	1	
44	GM23555	Harness, engine sensor 600-800kW Waukesha		1
45	292821	Fuse holder	1	1
46	239298	Fuse, 5 A, 250 V	1	1
47	343601	Strip, marker	1	1
48	X-49-26	Screw, slotted pan head machine	1	1
49	X-567-1	Coupling, non-metallic	1	1

Group 301: Control and Harness, continued



Group 301: Control and Harness, continued

Item	Part Number	Description	Quantity	
			Model/Module Number	
			400	600/800
			GM22216-MA1S	GM22217-MA1S
1	GM16787	Sensor, temperature	3	3
2	361286	Adapter bushing	1	
2	X-202-41	Bushing, reducer (1/2 x 3/4 in. NPT)		1
3	GM16788	Sensor, pressure	1	1
4	361916	Adapter bushing	1	
4	X-202-29	Bushing, reducer (1/8 x 1/2 in. NPT)		1
5	226529	Pickup, magnetic	1	2
6	GM11718	PCB assembly, Marathon excitation interface	1	1
7	M965A-06012-20	Screw, pan head machine	4	4
8	X-672-37	Clamp	1	
9	282829	Vibromount	4	4
10	X-22-18	Washer, lock	8	8
11	361184	Panel, junction box, front	1	1
12	328901	Cover, louvered (bottom)	1	1
13	X-6217-10	Screw, hex flange machine	24	24
14	243488	Grommet, round	1	1
15	GM22244	Harness, engine	1	
15	GM22245	Harness, engine		1
16	C-294301	PCB assembly, 1-relay dry contact	1	1
17	GM10186	Harness, dry contact	1	1
18	X-70-12	Nut, hex machine screw, 8-32	14	14
19	X-712-9	Spacer, .25 OD, .5 in.	14	14
20	GM13980	PCB assembly, CT burden resistor	1	1
21	GM16753	Harness, wiring dry contact	1	1
22	GM13984	Assembly, customer connection	1	1
23	233959	Diode, 6 A	6	6
24	292800	Connector, cable	1	1
25	295145	Connector, 24-position	1	1
26	337131	Connector, plug, 6-position	1	1
27	GM15493	Connector	4	4
28	-	Governor controller (supplied with engine)	1	
28	X-6119-40	Governor controller		1
29	X-400-28	Spacer, .282 ID x .5 OD x .531 in.	6	6
30	GM23566	Panel, inner	1	1
31	X-67-43	Screw, slotted hex washer, threadcutting	4	4
32	272713	Solenoid	1	1
33	273781	Marker, strip	1	1
34	295313	Terminal block	1	1
35	X-51-11	Screw, cross recess round machine	2	2
36	272684	Relay	1	2
37	GM23567	Bracket, mounting	2	2
38	GM23862	Plate, mounting	1	1
39	X-22-15	Washer, lock, .456 ID x 1.058 in. OD	1	1
40	X-22-12	Washer, lock, .262 ID x .743 in. OD	1	1
41	GM23565	Box, Nema 1 pull (includes cover)	1	1
42	X-22-16	Washer, lock, .326 ID x .883 in. OD	12	12
43	292834	Vibromount	6	6
44	GM23554	Harness, engine sensor 400kW Waukesha	1	
44	GM23555	Harness, engine sensor 600-800kW Waukesha		1
45	292821	Fuse holder	1	1
46	239298	Fuse, 5 A, 250 V	1	1
47	343601	Strip, marker	1	1
48	X-49-26	Screw, slotted pan head machine	1	1
49	X-567-1	Coupling, non-metallic	1	1

Group 701: Literature

Item	Part Number	Description	Quantity		
			Model/Variation Number		
			400 172	600 174	800 176
1	MP-5374	Warranty, 1 Year Limited	1	1	1
2	TP-5578	O/I/S/M Marathon Alternator Magna DVR	1	1	1
3	TP-5579	O/I/S/M Marathon Voltage Regulator DVR	1	1	1
4	MP-5583	S/M 350-1600 kW	1	1	1
5	MP-5700	I/M Industrial	1	1	1
6	MP-5708	P/C Accessories, Gas	1	1	1
7	MP-6009	P/C Controller, Industrial	1	1	1
8	MP-6083	O/M Digital 550 Controller	1	1	1
9	MP-6140	O/I/M Controller Setup & Application, 550 Controller	1	1	1
10	TP-6147	O/M Waukesha F18/H24/L36/P48	1	1	1
11	TP-6152	S/M Waukesha F18/H24	1		
11	TP-6153	S/M Waukesha L36		1	1
12	MP-6154	P/C 400-800GSW, Industrial	1	1	1
13	MP-6155	W/D 400-800GSW	1	1	1
14	TP-6156	P/C Waukesha F18/H24	1		
14	TP-6157	P/C Waukesha L36/P48		1	1

Kit List

This section lists the part numbers of modules/kits not listed in the group parts lists. Refer to the generator set nameplate or the list below to identify the module/kit number installed on your generator set. See the sections following this page for the parts list of the module/kit.

Model		
	400	600/800
Controllers		
See Parts Catalog MP-6009 for parts lists.		
Cooling Systems		
See engine parts catalog for cooling system parts lists.		
Block Heater Hardware	GM24684-KA1	GM24684-KA2
Fuel Systems		
See engine parts catalog for gas regulator parts lists.		
Gas solenoid valve	GM23200-KP1	GM23201-KP1
Optional Kits		
See Parts Catalog MP-5708 for parts lists.		
Paint and Miscellaneous Parts		
Paint, gray	All models use 221331 spray can, 221332 gallon, GM19491 touch-up	

Block Heater Hardware Kits

Qty.	Description	Part No.
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Block Heater Hardware (400 kW) GM24684-KA1

Note: Block heater is supplied and installed by Waukesha

1	Strip, terminal	292940
1	Harness, block heater 400 kW Waukesha	GM23556
1	Relay	GM23560
1	Strip, marker 4-position	GM23564
4	Screw, pan head machine	M7985A-05020-20
4	Nut, hex 5mm	M934-05-50
4	Washer, lock, .20 ID x .373 in. OD	X-22-9
1	Coupling, non-metallic	X-567-1
2	Nut, hex machine screw, 10-32	X-70-3

Block Heater Hardware (600/800 kW) GM24684-KA2

Note: Block heater is supplied and installed by Waukesha

1	Strip, terminal	292940
1	Harness, block heater 600-800 kW Waukesha	GM23557
1	Relay	GM23560
1	Strip, marker 4-position	GM23564
4	Screw, pan head machine	M7985A-05020-20
4	Nut, hex 5mm	M934-05-50
4	Washer, lock, .20 ID x .373 in. OD	X-22-9
1	Coupling, non-metallic	X-567-1
2	Nut, hex machine screw, 10-32	X-70-3

Fuel System Kits

Qty.	Description	Part No.
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Gas Solenoid Valve (400 kW) GM23200-KP1

1	Solenoid	343055
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Gas Solenoid Valve (600/800 kW) GM23201-KP1

1	Valve, solenoid (gas)	GM23199
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Notes

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere	CG	center of gravity	fglass.	fiberglass
ABDC	after bottom dead center	CID	cubic inch displacement	FHM	flat head machine (screw)
AC	alternating current	CL	centerline	fl. oz.	fluid ounce
A/D	analog to digital	cm	centimeter	flex.	flexible
ADC	analog to digital converter	CMOS	complementary metal oxide substrate (semiconductor)	freq.	frequency
adj.	adjust, adjustment			FS	full scale
ADV	advertising dimensional drawing	cogen.	cogeneration	ft.	foot, feet
AHWT	anticipatory high water temperature	Com	communications (port)	ft. lbs.	foot pounds (torque)
AISI	American Iron and Steel Institute	conn.	connection	ft./min.	feet per minute
ALOP	anticipatory low oil pressure	cont.	continued	g	gram
alt.	alternator	CPVC	chlorinated polyvinyl chloride	ga.	gauge (meters, wire size)
Al	aluminum	crit.	critical	gal.	gallon
ANSI	American National Standards Institute (formerly American Standards Association, ASA)	CRT	cathode ray tube	gen.	generator
		CSA	Canadian Standards Association	genset	generator set
AO	anticipatory only	CT	current transformer	GFI	ground fault interrupter
API	American Petroleum Institute	Cu	copper	GND, ⊕	ground
approx.	approximate, approximately	cu. in.	cubic inch	gov.	governor
AR	as required, as requested	cw.	clockwise	gph	gallons per hour
AS	as supplied, as stated, as suggested	CWC	city water-cooled	gpm	gallons per minute
ASE	American Society of Engineers	cyl.	cylinder	gr.	grade, gross
ASME	American Society of Mechanical Engineers	D/A	digital to analog	GRD	equipment ground
assy.	assembly	DAC	digital to analog converter	gr. wt.	gross weight
ASTM	American Society for Testing Materials	dB	decibel	H x W x D	height by width by depth
ATDC	after top dead center	dBA	decibel (A weighted)	HC	hex cap
ATS	automatic transfer switch	DC	direct current	HCHT	high cylinder head temperature
auto.	automatic	DCR	direct current resistance	HD	heavy duty
aux.	auxiliary	deg., °	degree	HET	high exhaust temperature
A/V	audiovisual	dept.	department	hex	hexagon
avg.	average	dia.	diameter	Hg	mercury (element)
AVR	automatic voltage regulator	DI/EO	dual inlet/end outlet	HH	hex head
AWG	American Wire Gauge	DIN	Deutsches Institut für Normung e. V. (also Deutsche Industrie Normenausschuss)	HHC	hex head cap
AWM	appliance wiring material	DIP	dual inline package	HP	horsepower
bat.	battery	DPDT	double-pole, double-throw	hr.	hour
BBDC	before bottom dead center	DPST	double-pole, single-throw	HS	heat shrink
BC	battery charger, battery charging	DS	disconnect switch	hsg.	housing
BCA	battery charging alternator	DVR	digital voltage regulator	HVAC	heating, ventilation, and air conditioning
BCI	Battery Council International	E, emer.	emergency (power source)	HWT	high water temperature
BDC	before dead center	EDI	electronic data interchange	Hz	hertz (cycles per second)
BHP	brake horsepower	EFR	emergency frequency relay	IC	integrated circuit
blk.	black (paint color), block (engine)	e.g.	for example (<i>exempli gratia</i>)	ID	inside diameter, identification
blk. htr.	block heater	EG	electronic governor	IEC	International Electrotechnical Commission
BMEP	brake mean effective pressure	EGSA	Electrical Generating Systems Association	IEEE	Institute of Electrical and Electronics Engineers
bps	bits per second	EIA	Electronic Industries Association	IMS	improved motor starting
br.	brass	EI/EO	end inlet/end outlet	in.	inch
BTDC	before top dead center	EMI	electromagnetic interference	in. H ₂ O	inches of water
Btu	British thermal unit	emiss.	emission	in. Hg	inches of mercury
Btu/min.	British thermal units per minute	eng.	engine	in. lbs.	inch pounds
C	Celsius, centigrade	EPA	Environmental Protection Agency	Inc.	incorporated
cal.	calorie	EPS	emergency power system	ind.	industrial
CARB	California Air Resources Board	ER	emergency relay	int.	internal
CB	circuit breaker	ES	engineering special, engineered special	int./ext.	internal/external
cc	cubic centimeter	ESD	electrostatic discharge	I/O	input/output
CCA	cold cranking amps	est.	estimated	IP	iron pipe
ccw.	counterclockwise	E-Stop	emergency stop	ISO	International Organization for Standardization
CEC	Canadian Electrical Code	etc.	et cetera (and so forth)	J	joule
cfh	cubic feet per hour	exh.	exhaust	JIS	Japanese Industry Standard
cfm	cubic feet per minute	ext.	external	k	kilo (1000)
		F	Fahrenheit, female	K	kelvin
				KA	kiloampere
				KB	kilobyte (2 ¹⁰ bytes)

kg	kilogram	MW	megawatt	rms	root mean square
kg/cm ²	kilograms per square centimeter	mW	milliwatt	rnd.	round
kgm	kilogram-meter	μF	microfarad	ROM	read only memory
kg/m ³	kilograms per cubic meter	N, norm.	normal (power source)	rot.	rotate, rotating
kHz	kilohertz	NA	not available, not applicable	rpm	revolutions per minute
kJ	kilojoule	nat. gas	natural gas	RS	right side
km	kilometer	NBS	National Bureau of Standards	RTV	room temperature vulcanization
kOhm, kΩ	kilo-ohm	NC	normally closed	SAE	Society of Automotive Engineers
kPa	kilopascal	NEC	National Electrical Code	scfm	standard cubic feet per minute
kph	kilometers per hour	NEMA	National Electrical Manufacturers Association	SCR	silicon controlled rectifier
kV	kilovolt	NFPA	National Fire Protection Association	s, sec.	second
kVA	kilovolt ampere	Nm	newton meter	SI	<i>Système international d'unités</i> , International System of Units
kVAR	kilovolt ampere reactive	NO	normally open	SI/EO	side in/end out
kW	kilowatt	no., nos.	number, numbers	sil.	silencer
kWh	kilowatt-hour	NPS	National Pipe, Straight	SN	serial number
kWm	kilowatt mechanical	NPSC	National Pipe, Straight-coupling	SPDT	single-pole, double-throw
L	liter	NPT	National Standard taper pipe thread per general use	SPST	single-pole, single-throw
LAN	local area network	NPTF	National Pipe, Taper-Fine	spec, specs	specification(s)
L x W x H	length by width by height	NR	not required, normal relay	sq.	square
lb.	pound, pounds	ns	nanosecond	sq. cm	square centimeter
lbm/ft ³	pounds mass per cubic feet	OC	overcrank	sq. in.	square inch
LCB	line circuit breaker	OD	outside diameter	SS	stainless steel
LCD	liquid crystal display	OEM	original equipment manufacturer	std.	standard
ld. shd.	load shed	OF	overfrequency	stl.	steel
LED	light emitting diode	opt.	option, optional	tach.	tachometer
Lph	liters per hour	OS	oversize, overspeed	TD	time delay
Lpm	liters per minute	OSHA	Occupational Safety and Health Administration	TDC	top dead center
LOP	low oil pressure	OV	overvoltage	TDEC	time delay engine cooldown
LP	liquefied petroleum	oz.	ounce	TDEN	time delay emergency to normal
LPG	liquefied petroleum gas	p., pp.	page, pages	TDES	time delay engine start
LS	left side	PC	personal computer	TDNE	time delay normal to emergency
L _{wa}	sound power level, A weighted	PCB	printed circuit board	TDOE	time delay off to emergency
LWL	low water level	pF	picofarad	TDON	time delay off to normal
LWT	low water temperature	PF	power factor	temp.	temperature
m	meter, milli (1/1000)	ph., ∅	phase	term.	terminal
M	mega (10 ⁶ when used with SI units), male	PHC	Phillips head crimplite (screw)	TIF	telephone influence factor
m ³	cubic meter	PHH	Phillips hex head (screw)	TIR	total indicator reading
m ³ /min.	cubic meters per minute	PHM	pan head machine (screw)	tol.	tolerance
mA	milliampere	PLC	programmable logic control	turbo.	turbocharger
man.	manual	PMG	permanent-magnet generator	typ.	typical (same in multiple locations)
max.	maximum	pot	potentiometer, potential	UF	underfrequency
MB	megabyte (2 ²⁰ bytes)	ppm	parts per million	UHF	ultrahigh frequency
MCM	one thousand circular mils	PROM	programmable read-only memory	UL	Underwriter's Laboratories, Inc.
MCCB	molded-case circuit breaker	psi	pounds per square inch	UNC	unified coarse thread (was NC)
meggar	megohmmeter	pt.	pint	UNF	unified fine thread (was NF)
MHz	megahertz	PTC	positive temperature coefficient	univ.	universal
mi.	mile	PTO	power takeoff	US	undersize, underspeed
mil	one one-thousandth of an inch	PVC	polyvinyl chloride	UV	ultraviolet, undervoltage
min.	minimum, minute	qt.	quart	V	volt
misc.	miscellaneous	qty.	quantity	VAC	volts alternating current
MJ	megajoule	R	replacement (emergency) power source	VAR	voltampere reactive
mJ	millijoule	rad.	radiator, radius	VDC	volts direct current
mm	millimeter	RAM	random access memory	VFD	vacuum fluorescent display
mOhm, mΩ	milliohm	RDO	relay driver output	VGA	video graphics adapter
MOhm, MΩ	megohm	ref.	reference	VHF	very high frequency
MOV	metal oxide varistor	rem.	remote	W	watt
MPa	megapascal	RFI	radio frequency interference	WCR	withstand and closing rating
mpg	miles per gallon	RH	round head	w/	with
mph	miles per hour	RHM	round head machine (screw)	w/o	without
MS	military standard	rly.	relay	wt.	weight
m/sec.	meters per second			xfrm	transformer
MTBF	mean time between failure				
MTBO	mean time between overhauls				
mtg.	mounting				

Appendix B Common Hardware Application Guidelines

Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure 1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.

Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spirallock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

See Appendix C, General Torque Specifications, and other torque specifications in the service literature.

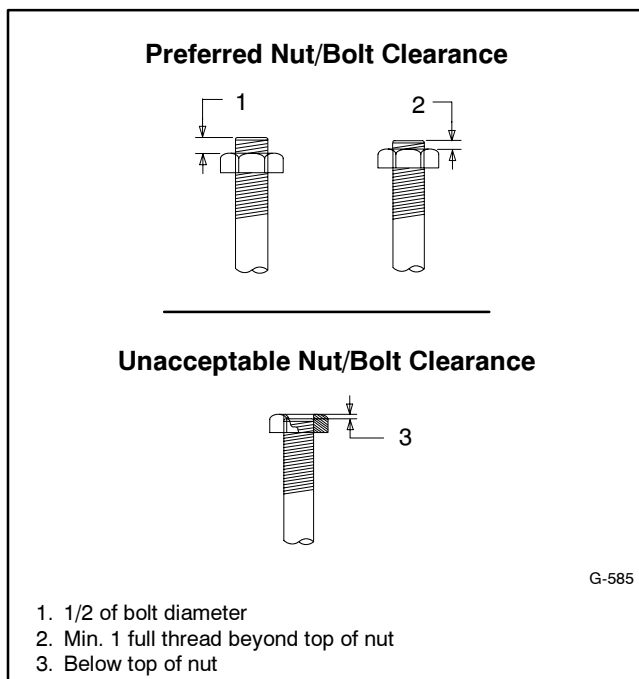


Figure 1 Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter can take a properly torqued whiz nut or spirallock nut. See Figure 2.

3. Follow these SAE washer rules after determining exit hole type:
 - a. Always use a washer between hardware and a slot.
 - b. Always use a washer under a nut (see 2 above for exception).
 - c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to Figure 2, which depicts the preceding hardware configuration possibilities.

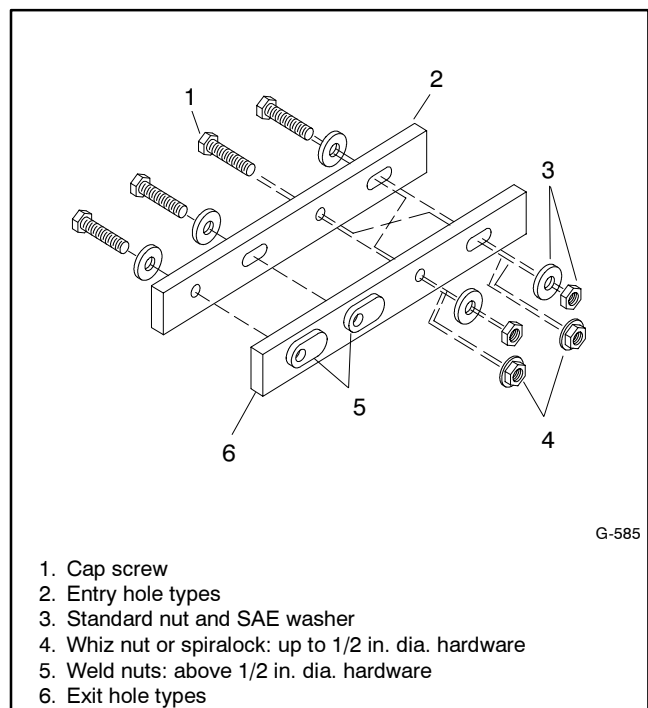


Figure 2 Acceptable Hardware Combinations

Appendix C General Torque Specifications

Use the following torque specifications when service literature instructions give no specific torque values. The charts list values for new plated, zinc phosphate, or

oiled threads. Increase values by 15% for nonplated threads. All torque values are +0%/-10%.

American Standard Fasteners Torque Specifications					
Size	Torque Measurement	Assembled into Cast Iron or Steel			Assembled into Aluminum Grade 2 or 5
		Grade 2	Grade 5	Grade 8	
8-32	Nm (in. lb.)	1.8 (16)	2.3 (20)	—	1.8 (16)
10-24	Nm (in. lb.)	2.9 (26)	3.6 (32)	—	2.9 (26)
10-32	Nm (in. lb.)	2.9 (26)	3.6 (32)	—	2.9 (26)
1/4-20	Nm (in. lb.)	6.8 (60)	10.8 (96)	14.9 (132)	6.8 (60)
1/4-28	Nm (in. lb.)	8.1 (72)	12.2 (108)	16.3 (144)	8.1 (72)
5/16-18	Nm (in. lb.)	13.6 (120)	21.7 (192)	29.8 (264)	13.6 (120)
5/16-24	Nm (in. lb.)	14.9 (132)	23.1 (204)	32.5 (288)	14.9 (132)
3/8-16	Nm (ft. lb.)	24.0 (18)	38.0 (28)	53.0 (39)	24.0 (18)
3/8-24	Nm (ft. lb.)	27.0 (20)	42.0 (31)	60.0 (44)	27.0 (20)
7/16-14	Nm (ft. lb.)	39.0 (29)	60.0 (44)	85.0 (63)	—
7/16-20	Nm (ft. lb.)	43.0 (32)	68.0 (50)	95.0 (70)	—
1/2-13	Nm (ft. lb.)	60.0 (44)	92.0 (68)	130.0 (96)	—
1/2-20	Nm (ft. lb.)	66.0 (49)	103.0 (76)	146.0 (108)	—
9/16-12	Nm (ft. lb.)	81.0 (60)	133.0 (98)	187.0 (138)	—
9/16-18	Nm (ft. lb.)	91.0 (67)	148.0 (109)	209.0 (154)	—
5/8-11	Nm (ft. lb.)	113.0 (83)	183.0 (135)	259.0 (191)	—
5/8-18	Nm (ft. lb.)	128.0 (94)	208.0 (153)	293.0 (216)	—
3/4-10	Nm (ft. lb.)	199.0 (147)	325.0 (240)	458.0 (338)	—
3/4-16	Nm (ft. lb.)	222.0 (164)	363.0 (268)	513.0 (378)	—
1-8	Nm (ft. lb.)	259.0 (191)	721.0 (532)	1109.0 (818)	—
1-12	Nm (ft. lb.)	283.0 (209)	789.0 (582)	1214.0 (895)	—

Metric Fasteners Torque Specifications, Measured in Nm (ft. lb.)				
Size (mm)	Assembled into Cast Iron or Steel			Assembled into Aluminum Grade 5.8 or 8.8
	Grade 5.8	Grade 8.8	Grade 10.9	
M6 x 1.00	5.6 (4)	9.9 (7)	14.0 (10)	5.6 (4)
M8 x 1.25	13.6 (10)	25.0 (18)	35.0 (26)	13.6 (10)
M8 x 1.00	21.0 (16)	25.0 (18)	35.0 (26)	21.0 (16)
M10 x 1.50	27.0 (20)	49.0 (35)	68.0 (50)	27.0 (20)
M10 x 1.25	39.0 (29)	49.0 (35)	68.0 (50)	39.0 (29)
M12 x 1.75	47.0 (35)	83.0 (61)	117.0 (86)	—
M12 x 1.50	65.0 (48)	88.0 (65)	125.0 (92)	—
M14 x 2.00	74.0 (55)	132.0 (97)	185.0 (136)	—
M14 x 1.50	100.0 (74)	140.0 (103)	192.0 (142)	—
M16 x 2.00	115.0 (85)	200.0 (148)	285.0 (210)	—
M16 x 1.50	141.0 (104)	210.0 (155)	295.0 (218)	—
M18 x 2.50	155.0 (114)	275.0 (203)	390.0 (288)	—
M18 x 1.50	196.0 (145)	305.0 (225)	425.0 (315)	—

Appendix D Common Hardware Identification

Screw/Bolts/Studs	
Head Styles	
Hex Head or Machine Head	
Hex Head or Machine Head with Washer	
Flat Head (FHM)	
Round Head (RHM)	
Pan Head	
Hex Socket Head Cap or Allen™ Head Cap	
Hex Socket Head or Allen™ Head Shoulder Bolt	
Sheet Metal Screw	
Stud	
Drive Styles	
Hex	
Hex and Slotted	
Phillips®	
Slotted	
Hex Socket	

Nuts	
Nut Styles	
Hex Head	
Lock or Elastic	
Square	
Cap or Acorn	
Wing	
Washers	
Washer Styles	
Plain	
Split Lock or Spring	
Spring or Wave	
External Tooth Lock	
Internal Tooth Lock	
Internal-External Tooth Lock	

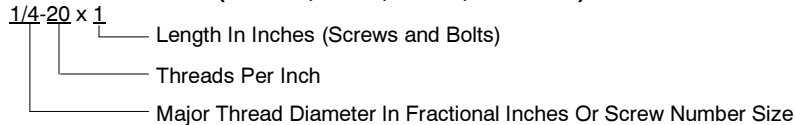
Hardness Grades	
American Standard	
Grade 2	 
Grade 5	 
Grade 8	
Grade 8/9 (Hex Socket Head)	
Metric	
Number stamped on hardware; 5.8 shown	

Allen™ head screw is a trademark of Holo-Krome Co.

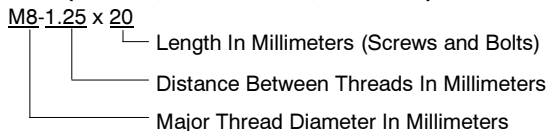
Phillips® screw is a registered trademark of Phillips Screw Company.

Sample Dimensions

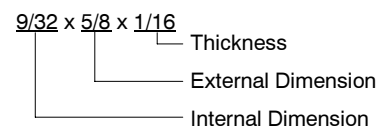
American Standard (Screws, Bolts, Studs, and Nuts)



Metric (Screws, Bolts, Studs, and Nuts)



Plain Washers



Lock Washers



Appendix E Common Hardware List

The Common Hardware List lists part numbers and dimensions for common hardware items.

American Standard

Part No.	Dimensions	Part No.	Dimensions	Part No.	Dimensions	Type
Hex Head Bolts (Grade 5)		Hex Head Bolts, cont.		Hex Nuts		
X-465-17	1/4-20 x .38	X-6024-5	7/16-14 x .75	X-6009-1	1-8	Standard
X-465-6	1/4-20 x .50	X-6024-2	7/16-14 x 1.00	X-6210-3	6-32	Whiz
X-465-2	1/4-20 x .62	X-6024-8	7/16-14 x 1.25	X-6210-4	8-32	Whiz
X-465-16	1/4-20 x .75	X-6024-3	7/16-14 x 1.50	X-6210-5	10-24	Whiz
X-465-18	1/4-20 x .88	X-6024-4	7/16-14 x 2.00	X-6210-1	10-32	Whiz
X-465-7	1/4-20 x 1.00	X-6024-11	7/16-14 x 2.75	X-6210-2	1/4-20	Spiralock
X-465-8	1/4-20 x 1.25	X-6024-12	7/16-14 x 6.50	X-6210-6	1/4-28	Spiralock
X-465-9	1/4-20 x 1.50	X-129-15	1/2-13 x .75	X-6210-7	5/16-18	Spiralock
X-465-10	1/4-20 x 1.75	X-129-17	1/2-13 x 1.00	X-6210-8	5/16-24	Spiralock
X-465-11	1/4-20 x 2.00	X-129-18	1/2-13 x 1.25	X-6210-9	3/8-16	Spiralock
X-465-12	1/4-20 x 2.25	X-129-19	1/2-13 x 1.50	X-6210-10	3/8-24	Spiralock
X-465-14	1/4-20 x 2.75	X-129-20	1/2-13 x 1.75	X-6210-11	7/16-14	Spiralock
X-465-21	1/4-20 x 5.00	X-129-21	1/2-13 x 2.00	X-6210-12	1/2-13	Spiralock
X-465-25	1/4-28 x .38	X-129-22	1/2-13 x 2.25	X-6210-15	7/16-20	Spiralock
X-465-20	1/4-28 x 1.00	X-129-23	1/2-13 x 2.50	X-6210-14	1/2-20	Spiralock
X-125-33	5/16-18 x .50	X-129-24	1/2-13 x 2.75	X-85-3	5/8-11	Standard
X-125-23	5/16-18 x .62	X-129-25	1/2-13 x 3.00	X-88-12	3/4-10	Standard
X-125-3	5/16-18 x .75	X-129-27	1/2-13 x 3.50	X-89-2	1/2-20	Standard
X-125-31	5/16-18 x .88	X-129-29	1/2-13 x 4.00	Washers		
X-125-5	5/16-18 x 1.00	X-129-30	1/2-13 x 4.50	Part No.	ID	OD
X-125-24	5/16-18 x 1.25	X-463-9	1/2-13 x 5.50			Thick.
X-125-34	5/16-18 x 1.50	X-129-44	1/2-13 x 6.00			Bolt/ Screw
X-125-25	5/16-18 x 1.75	X-129-51	1/2-20 x .75	X-25-46	.125	.250
X-125-26	5/16-18 x 2.00	X-129-45	1/2-20 x 1.25	X-25-9	.156	.375
230578	5/16-18 x 2.25	X-129-52	1/2-20 x 1.50	X-25-48	.188	.438
X-125-29	5/16-18 x 2.50	X-6021-3	5/8-11 x 1.00	X-25-36	.219	.500
X-125-27	5/16-18 x 2.75	X-6021-4	5/8-11 x 1.25	X-25-40	.281	.625
X-125-28	5/16-18 x 3.00	X-6021-2	5/8-11 x 1.50	X-25-85	.344	.687
X-125-22	5/16-18 x 4.50	X-6021-1	5/8-11 x 1.75	X-25-37	.406	.812
X-125-32	5/16-18 x 5.00	273049	5/8-11 x 2.00	X-25-34	.469	.922
X-125-35	5/16-18 x 5.50	X-6021-5	5/8-11 x 2.25	X-25-26	.531	1.062
X-125-36	5/16-18 x 6.00	X-6021-6	5/8-11 x 2.50	X-25-15	.656	1.312
X-125-40	5/16-18 x 6.50	X-6021-7	5/8-11 x 2.75	X-25-29	.812	1.469
X-125-43	5/16-24 x 1.75	X-6021-12	5/8-11 x 3.75	X-25-127	1.062	2.000
X-125-44	5/16-24 x 2.50	X-6021-11	5/8-11 x 4.50			
X-125-30	5/16-24 x .75	X-6021-10	5/8-11 x 6.00			
X-125-39	5/16-24 x 2.00	X-6021-9	5/8-18 x 2.50			
X-125-38	5/16-24 x 2.75	X-6239-1	3/4-10 x 1.00			
X-6238-2	3/8-16 x .62	X-6239-8	3/4-10 x 1.25			
X-6238-10	3/8-16 x .75	X-6239-2	3/4-10 x 1.50			
X-6238-3	3/8-16 x .88	X-6239-3	3/4-10 x 2.00			
X-6238-11	3/8-16 x 1.00	X-6239-4	3/4-10 x 2.50			
X-6238-4	3/8-16 x 1.25	X-6239-5	3/4-10 x 3.00			
X-6238-5	3/8-16 x 1.50	X-6239-6	3/4-10 x 3.50			
X-6238-1	3/8-16 x 1.75	X-792-1	1-8 x 2.25			
X-6238-6	3/8-16 x 2.00	X-792-5	1-8 x 3.00			
X-6238-17	3/8-16 x 2.25	X-792-8	1-8 x 5.00			
X-6238-7	3/8-16 x 2.50					
X-6238-8	3/8-16 x 2.75					
X-6238-9	3/8-16 x 3.00					
X-6238-19	3/8-16 x 3.25					
X-6238-12	3/8-16 x 3.50					
X-6238-20	3/8-16 x 3.75					
X-6238-13	3/8-16 x 4.50					
X-6238-18	3/8-16 x 5.50					
X-6238-25	3/8-16 x 6.50					
X-6238-14	3/8-24 x .75					
X-6238-16	3/8-24 x 1.25					
X-6238-21	3/8-24 x 4.00					
X-6238-22	3/8-24 x 4.50					

Hex head bolts are hardness grade 8.8 unless noted.

Appendix A-7



DDC/MTU Power Generation
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ddcmtupowergeneration.com