



Service & Maintenance Manual

***Model
AE1932***

PVC 2110

31219132

November 03, 2021 - Rev A

ANSI CE UK CA  AS/NZS MOL 70



INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

GENERAL

This section contains the general safety precautions which must be observed during maintenance of the mobile elevating work platform. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves or others, or damage to the equipment. A maintenance program must be followed to ensure that the machine is safe to operate.

WARNING

Modification or alteration of a mobile elevating work platform shall be made only with written permission from the manufacturer.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

WARNING

Since the machine manufacturer has no direct control over the field inspection and maintenance, safety in this area responsibility of the owner/operator.

MAINTENANCE

WARNING

Failure to comply with safety precautions listed in this section could result in machine damage, personnel injury or death and is a safety violation.

- USE ONLY REPLACEMENT PARTS OR COMPONENTS THAT ARE APPROVED BY JLG. TO BE CONSIDERED APPROVED, REPLACEMENT PARTS OR COMPONENTS MUST BE IDENTICAL OR EQUIVALENT TO ORIGINAL PARTS OR COMPONENTS.
- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICE MANUAL.
- KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.
- USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.
- NEVER WORK UNDER AN ELEVATED SCISSOR UNTIL PLATFORM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR ARM INSPECTION PROP HAS BEEN ENGAGED.
- BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.
- BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

REVISION LOG

DATE	REVISION	DESCRIPTION
November 03, 2021	A	Original Issue

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SECTION 1 SPECIFICATIONS

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Specifications

1.1 OPERATING SPECIFICATIONS

1.1.1 Machine Specifications

DESCRIPTION	AE1932
PLATFORM	
Maximum Platform Height(Elevated) (Ground to Platform Floor)	19 ft. (5.8 m)
Lift Up Time	No Load: 22 - 24 seconds Rated Load: 23 - 25 seconds
Lift Down Time	No Load: 26 - 28 seconds Rated Load: 25 - 27 seconds
Electronic Arm Guards Pause Height (CE/UKCA Only)	54 in. (1.38 m)
DRIVING	
Maximum Allowable Operating Slope (Platform Elevated)	Front to Back: 3.75° (ANSI/CSA/ANSI Export/AUS/CE/UKCA) Side to Side: 1.5° (ANSI/CSA/ANSI Export/AUS/CE/UKCA)
Maximum Drive Speed(FWD/REV) (Seconds to Drive 25 ft (7.62m) Rabbit Mode	Stowed 5.5 ft.: 3.9 - 4.7 seconds(~4.0 mph) 5.5 ft. - 12 ft.(3.66 m): 10.3 - 12.6 seconds(~1.5 mph) 12 ft. - 15ft. (3.66 m- 4.57 m): 18.9 - 15.5 seconds(~1.0 mph) Above 15 ft. (4.57 m): 31 - 38 seconds(~0.5 mph)
Turtle Mode	Stowed 5.5 ft.: 5.2 - 6.3 seconds(~3.0 mph) 5.5 ft. - 12 ft.(3.66 m): 31 - 38 seconds(~0.5 mph) 12 ft. - 15ft. (3.66 m- 4.57 m): 31 - 38 seconds(~0.5 mph) Above 15 ft. (4.57 m): 31 - 38 seconds(~0.5 mph)
Maximum Stowed Travel Grade (Gradeability)	25% (14°)
Maximum Stowed Travel Grade (Side slope)	8.75% (5°)
Turning Radius	Inside: 0 in. (0 cm) (Curbto Curb) Outside: 62.93 in. (159.8 cm)
CHASSIS	
Approximate Gross Machine Weight	3450 lb (1565 kg)
Maximum Tire Load (per wheel)	1540 lb (699 kg)

DESCRIPTION	AE1932
Ground Bearing Pressure	150 psi (10.54 kg/cm ²)
Ground Clearance	PHP Retracted: 2.76 in. (7 cm) PHP Deployed: 0.77 in. (1.95 cm)

1.1.2 Platform Capacities

MACHINE MODEL	Markets	MAXIMUM PLAT- FORM CAPACITY ⁽¹⁾	MAXIMUM CAPACITY ALLOWED ON PLAT- FORM EXTENSION	MAXIMUM PERSONS ALLOWED IN PLAT- FORM ⁽²⁾	MAX. SIDE FORCE (Platform Fully Ex- tended@ Max. Ca- pacity) ⁽²⁾	MAXIMUM OPERAT- ING WIND SPEED
AE1932	ANSI, ANSI Export, CSA, CE/UKCA, JPN, AUS	606 lb (275 kg)	265 lb (120 kg)	Outdoor- 1 Person Indoor- 2 Persons	Outdoor- 45 lb (200 N) Indoor- 90 lb (400 N)	28 mph (12.5 m/s) 0 mph (0 m/s)

NOTE: (1) Maximum Platform Capacity includes platform and platform extension.

NOTE: (2) INDOOR USE is use of a MEWP in areas shielded from wind so that there is no wind. OUTDOOR USE is use of a MEWP in an environment that can be exposed to wind.

1.1.3 Machine Dimensional Data

DESCRIPTION	AE1932
Platform Height - Elevated (Ground to Platform Floor)	19 ft. (5.8 m)
Platform Height - Stowed (Ground to Platform Floor)	38.66 in. (98.2 cm)
Rail Height (Platform Floor to Top of Rail)	39.55 in.(100.45 cm)- Fixed Rails 43.88 in. (111.45 cm)- Folding Rails 43.8 in. (112.5 cm)- Quik Access Rails 44.1 in. (112.01 cm)- Quik-Fold Rails
Overall Height - Fixed Rail (Ground to Top Rail)	78.4 in.(199.13 cm)- Fixed Rails 82.8 in. (210.3 cm)- Folding/ Quik Access Rails 83.2 in. (211.3 cm)- Quik-Fold Rails
Overall Height- Rails Folded (Ground to Mid Rail)	78.4 in. (199.2 cm)- Fixed Rails 64.27 in. (163.2 cm)- Folding Rails 65.2 in. (165.6 cm)- Quik Access Rails 78.2 in. (198.6 cm)- Quik-Fold Rails
Overall Machine Width	31.9 in. (81.02 cm)
Overall Machine Length	68.7 in. (174.5 cm)
Extension Deck Length	33.7 in. (85.6 cm)
Platform Size - Length(Inside)	62.62 in. (159.1 cm)
Platform Size -Width(Inside)	21.71 in. (55.2 cm)
Wheelbase	53.03 in. (134.7 cm)

Specifications

1.1.4 Tires

DESCRIPTION	AE1932
Size (Front and Rear)	12.72 in. x 3.9 in.
	(32.3 cm x10.0 cm)
Wheel Nut Torque	120 ft.lbs. (163 Nm)

1.1.5 Battery

DESCRIPTION	LITHIUM ION
Voltage	24 V
Amp Hour Rating	80 Amp Hour
Energy	2.05 kwh
Weight	39.46 lb (17.9 Kg)

1.1.6 Motors

- Drive Motors**

Type: Electric

Torque: 4425 in. lbs. (500 Nm) - Continuous

8850 in. lbs. (1000 Nm) - Intermittent

- Electric Brake**

Type: Electric Brake

Static Torque: 177 in.lbs (20 Nm)

Voltage: 24 V DC $\pm$ 7%

Power Consumption: 28.8 W $\pm$ 7%

Drop out Voltage: 5.25 V

Pull In Voltage: 16 V

- Electric Motor**

Motor Type: PMAC

Motor Power: 1.19 kW

IP Rating: 65

Motor Voltage: 15 VAC

Thermal Ratings:

60 min: 14.2 in.lbs. (3600 RPM)

2 min: 86.7 in.lbs. (591 RPM)

1.1.7 Electrical System

Table 1. Battery Charger Specifications

DESCRIPTION	AE1932	
Electrical System Voltage (DC)	24V	
Battery Charger:	Delta-Q(650W)	Delta-Q (900W)
Input:		
AC Input Voltage:	85-270VAC	85-270VAC
Nominal AC Input Voltage:	100V AC- 240V ACRMS	100V AC- 240V ACRMS
AC Input Frequency:	50/60 Hz	50/60 Hz

Table 1. Battery Charger Specifications (continued)

DESCRIPTION		AE1932	
Output:	Max. AC Input Current:	7.5 A	10.5 A
	Ingress Protection:	IP66 NEMA4Type4	IP66 NEMA4Type4
	Operating Temperature:	-40°F(-40°C) to 149°F(+65°C)	-40°F(-40°C) to 149°F(+65°C)
	Nominal DC Output Voltage:	24V	24V
	Max. DC Output Voltage:	36V	36V
	Max DC Output Current:	27.1 A	37.5 A
	Max. Interlock Current:	1 A@ 24V	10A@ 24V
Protection:	Output Reverse Polarity:	Electronic Protection - Auto Reset	Electronic Protection - Auto Reset
	Output Short Circuit:	Current Limited	Current Limited
	AC Overload:	Current Limited	Current Limited
	DC Overload:	Current Limited	Current Limited

1.2 LIMIT SWITCH ACTIVATION

1.2.1 Tilt Alarm

Note: When the tilt indicator warning is activated the following functions are affected;

Platform Lowered: Only Drive Allowed.

Platform Raised: Drive and lift up functions are disabled, platform must be fully lowered (stowed) to drive out of tilt condition.

MODELS	TILT SETTING Y-Axis (front to back)	TILT SETTING X-Axis (side to side)	Maximum Platform Elevation	
AE1932	3.75°	3.0° - outdoor	0 - 4.6 m	0 - 15 ft.
		3.0° - indoor		
		2.0° - outdoor	4.6 - 5.2 m	15 - 17 ft.
		2.25° - indoor		
		1.5° - outdoor	5.2 - 5.8 m (Full)	17 - 19 ft.
		1.75° - indoor		

1.2.2 High Drive Speed Cutout Height

High drive speed is cutback when the platform is raised above the preset height per model as follows:

Note: These figures are given with a tolerance of ± 6 to ± 12 in. (0.15 - 0.30 m).

MODEL	HIGH DRIVE SPEED CUTBACK HEIGHT	RABBIT MODE	TURTLE MODE
AE1932	Elevated up to 12 ft (3.66 m)	1.5 mph (2.4 kph)	0.5 mph (0.8 kph)
	12 ft -15 ft (3.66 m - 4.57 m)	1.0 mph (1.6 kph)	

Specifications

MODEL	HIGH DRIVE SPEED CUTBACK HEIGHT	RABBIT MODE	TURTLE MODE
	Above 15 ft (4.57 m)	0.5 mph (0.8 kph)	

1.3 LUBRICATION

1.3.1 Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350°F. Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105.
LAG (Lift Actuator Grease)	Relubrication at an interval of 2 years or after 48000 with 4 g BERUTOX FH 28 EPK II.

1.4 ACTUATOR SPECIFICATIONS

DESCRIPTION	AE1932
Lift Actuator Nominal Voltage	24 V
Lift Actuator Retracted Length	43.75 in. (1111.5 mm)
Lift Actuator Stroke Length	30.51 in. (775 mm)
Steer Actuator Nominal Voltage	24 V DC
Steer Actuator Retracted length	15.7 - 12.5 in. (400 - 320 mm)
Steer Actuator Stroke Length	6.33-6.22 in. (162 -158 mm)

1.5 CRITICAL STABILITY WEIGHTS

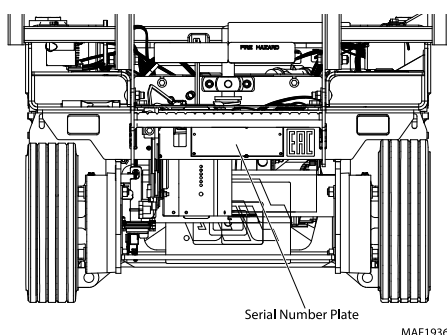
⚠ WARNING

Do not replace items critical to stability, such as battery or solid tires, with items of different weight or specification. Do not modify unit in any way to affect stability.

COMPONENT	AE1932
Wheel and Tire Assembly	21.40 lb (9.7 kg)
Wheel/Tire and Drive Assembly (each)	112.80 lb (51.16 kg)
Battery	58.90 lb (26.7 kg)

1.6 SERIAL NUMBER LOCATION

For machine identification, a serial number plate is affixed to the machine.



1.7 MAJOR COMPONENT WEIGHTS

COMPONENT	AE1932
Platform with Fixed Rails/Extension	353lb (160 kg)
Arm Assembly - (Includes Lift Actuator)	846 lb (383.8 Kg)
Chassis w/Wheel/Tire/Steering/PHP and Drive Assembly	2,251 lb (1,021 Kg)

1.8 TORQUE REQUIREMENTS

Self locking fasteners, such as nylon insert and thread deforming locknut, are not intended to be reinstalled after removal. Always use new replacement hardware when installing locking fasteners.

Note: When maintenance becomes necessary or a fastener has loosened, refer to [Section — Torque Charts, page 16](#) to determine proper torque value.

1.9 THREAD LOCKING COMPOUND

JLG PN	Loctite®	ND Industries	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
1001095650	243™	Vibra-TITE™ 122	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

Note: Loctite® 243™ can be substituted in place of Loctite® 242™. Vibra-TITE™ 122 can be substituted in place of Vibra-TITE™ 121.

Specifications

1.10 TORQUE CHARTS

1.10.1 SAE Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque(Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 111)	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		

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Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque(Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 111)	
					FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque(Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ orVibra-TITE™ 111)	
					FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

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- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

Specifications

SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		

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Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

5000059K

- NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = $\pm 10\%$
3. * ASSEMBLY USES HARDENED WASHER

Specifications

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		

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Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

5000059K

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3. * ASSEMBLY USES HARDENED WASHER

Specifications

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	L B	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		

5000059K

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	L B	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	L B	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

5000059K

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3. * ASSEMBLY USES HARDENED WASHER

Specifications

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Pre-coat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		

5000059K

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Pre-coat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
					FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Pre-coat® 85 K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

5000059K

- NOTES:
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 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = $\pm 10\%$
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Specifications

SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Pre-coat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		

5000059K

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Pre-coat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque		Torque	
							(Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Pre-coat® 85 K=0.16		(Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

5000059K

- NOTES:
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 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = $\pm 10\%$
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Specifications

1.10.2 Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*							
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™)	Torque (Lube)	Torque (Loctite® 262™ or 271™ or Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 141)
		Sq mm	KN	[N.m]		[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

5000059K

- NOTES:
1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = $\pm 10\%$
 3. * ASSEMBLY USES HARDENED WASHER
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAPSCREWS M3 - M5*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.20	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra- TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

5000059K

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Specifications

Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

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Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS, CLASS 12.9 SOCKET HEAD CAPSCREWS M6 AND ABOVE*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra- TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	55
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	222.0	905	850	800
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

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SECTION 2 GENERAL

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2.1 MACHINE PREPARATION INSPECTION AND MAINTENANCE

2.1.1 General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service. With proper care, maintenance and inspections performed per JLG's recommendations with any and all discrepancies corrected, this product will be fit for continued use.

2.1.2 Preparation, Inspection, and Maintenance

It is important to establish and conform to a comprehensive inspection and preventive maintenance program. The following table outlines the periodic machine inspections and maintenance recommended by JLG Industries, Inc. Consult your national, regional, or local regulations for further requirements for mobile elevating work platform. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

2.1.3 Pre-Start Inspection

It is the User's or Operator's primary responsibility to perform a Pre-Start Inspection of the machine prior to use daily or at each change of operator. Reference the Operation and Safety Manual for completion procedures for the Pre-Start Inspection. The Operation and Safety Manual must be read in its entirety and understood prior to performing the Pre-Start Inspection.

2.1.4 Pre-Delivery Inspection and Frequent Inspection

The Pre-Delivery Inspection and Frequent Inspection shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

The Pre-Delivery Inspection and Frequent Inspection procedures are performed in the same manner, but at different times. The Pre-Delivery Inspection shall be performed prior to each sale, lease, or rental delivery. The Frequent Inspection shall be accomplished for each machine in service for 3 months or 150 hours (whichever comes first); out of service for a period of more than 3 months; or when purchased used. The frequency of this inspection must be increased as environment, severity and frequency of usage requires.

Reference the JLG Pre-Delivery and Frequent Inspection Form and the Inspection and Preventative Maintenance Schedule for items requiring inspection during the performance of these inspections. Reference the appropriate areas of this manual for servicing and maintenance procedures.

2.1.5 Annual Machine Inspection

JLG recommends that the Annual Machine Inspection be performed by a Factory-Trained Service Technician on an annual basis, no later than thirteen (13) months from the date of the prior Annual Machine Inspection. JLG Industries, Inc. recognizes a Factory-Trained Service Technician as a person who has successfully completed the JLG Service Training School for the subject JLG product model. Reference the machine Service and Maintenance Manual and appropriate JLG inspection form for performance of this inspection.

Reference the JLG Annual Machine Inspection Form and the Inspection and Preventative Maintenance Schedule for items requiring inspection during the performance of this inspection. Reference the appropriate areas of this manual for servicing and maintenance procedures.

For the purpose of receiving safety-related bulletins, it is important that JLG Industries, Inc. has updated ownership information for each machine. When performing each Annual Machine Inspection, notify JLG Industries, Inc. of the current machine ownership.

2.1.6 Preventative Maintenance

In conjunction with the specified inspections, maintenance shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

Reference the Preventative Maintenance Schedule and the appropriate areas of this manual for servicing and maintenance procedures. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.

NOTICE

JLG Industries, Inc. recognizes a factory-trained service technician as a person who has successfully completed the JLG service training school for the specific JLG product model.

Table 2. Inspection and Maintenance Responsibilities

TYPE	FREQUENCY	PRIMARY RESPONSIBILITY	SERVICE QUALIFICATION	REFERENCE
Pre-Start Inspection	Prior to use each day; or At each Operator change.	User or Operator	User or Operator	Operation and Safety Manual
Pre-Delivery Inspection(see note below)	Prior to each sale, lease, or rental delivery.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Frequent Inspection	In service for 3 months or 150 hours, which ever comes first; or Out of service for a period of more than 3 months; or Purchased used.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Annual Machine Inspection(see note below)	Annually, no later than 13 months from the date of the prior inspection.	Owner, Dealer, or User	Factory-Trained Service Technician (recommended)	Service and Maintenance Manual and applicable JLG inspection form.
Preventative Maintenance	At intervals as specified in the Service and Maintenance Manual.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual

NOTE: Inspection forms are available from JLG. Use the Service and Maintenance Manual to perform inspections.

2.2 PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

The preventive maintenance and inspection checks are listed and defined in the following table. This table is divided into two basic parts, the "AREA" to be inspected and the "INTERVAL" at which the inspection is to take place. Under the "AREA" portion of the table, the various systems along with the components that make up that system are listed. The "INTERVAL" portion of the table is divided into two columns representing the various inspection time periods. The numbers listed within the interval column represent the applicable inspection code for which that component is to be checked.

The checks and services listed in this schedule are not intended to replace any local or regional regulations that may pertain to this type of equipment nor should the lists be considered as all inclusive. Variances in interval times may occur due to climate and/or conditions and depending on the location and use of the machine.

NOTICE

JLG Industries requires that a complete annual inspection be performed in accordance with the "annual machine inspection report" form.

Note: This machine requires periodic safety and maintenance inspections by a qualified JLG mechanic. Notify JLG dealer if inspection is overdue.

General

2.2.1 Maintenance and Inspection Schedule Codes

1. Check for proper and secure: installation, adjustment, or torque.
2. Visual inspection for damage: (cracks, corrosion, abrasions, distortion, excessive wear, broken welds, gouges, chafing and threads showing).
3. Proper operation.
4. Check for proper sealing, signs of leakage and fluid level.
5. Clean and free of debris.
6. Decals installed and legible.
7. Check for proper tolerances, routing, and lubrication.
8. Fully Charged.
9. Verify/Perform.
 - a. Drain, Clean.
 - b. Refill/Replace.
 - c. Lubricate.

Table 3. Preventive Maintenance & Inspection Schedule.

AREA ON MACHINE	INSPECTIONS	
	PRE-DELIVERY ⁽¹⁾ OR FREQUENT ⁽²⁾ INSPECTION	ANNUAL ⁽³⁾ (YEARLY) INSPECTION
Scissor Arms		
Scissor Arms	1, 2	1, 2
Arm Inspection Prop	1, 2	1, 2
Nuts,Bolts,Shafts,Shields,Bearings,and Locking Devices	1, 2	1, 2
Actuator	1,2	1, 2, 9***
Pivot Pin and Attaching Hardware	1,2	1,2
Arm Pads and Sliding Block	1, 2	1, 2
Platform Assembly		
Platform	1	1
Platform Gate Assembly	1, 3	1, 3
Extension Deck and Locks	1, 3	1, 3
Guard Rails and Floor	1, 2	1, 2
Platform Roll Pins and Fold Down Rails	1, 2	1, 2
Lanyard Anchorage Points	1, 2, 6	1, 2, 6
Chassis Assembly		
Wheel Rim Nuts	150	150
Tires	1	1, 2
Steer and Drive Components	1	1, 2, 5
Side-Compartment Door Installation	1, 3, 5	1, 3, 5
Drive Motor	1	1, 4, 5

Table 3. Preventive Maintenance & Inspection Schedule. (continued)

AREA ON MACHINE	INSPECTIONS	
	PRE-DELIVERY ⁽¹⁾ OR FREQUENT ⁽²⁾ INSPECTION	ANNUAL ⁽³⁾ (YEARLY) INSPECTION
Platform Ladder	1, 5	1, 5
Drive Brakes	1	1, 5
Drive Hubs	1	1, 4, 5
Sliding Wear Pads**	1, 2, 5, 7	1, 2, 5, 7
Front Wheel Spindle Nuts/Bolts	1 ⁵⁰	1 ⁵⁰
Functions/Controls		
Control levers, Switches, Gauges, and Instruments	1,3	1,3
Detents, Control Enclosure, and Protective Boots/Guards	1,3	1,3
Emergency Stop Switches at Ground and Platform	1,3	1,3
Lift, Drive, and Speed Cutouts	3	3
Manual Descent Control	3	3
Function Enable System	3	3
Brakes	3	3, 5
Machine Functions	3	3
Joystick/Toggle Return to Neutral/Off When Released	1,3	1,3
Battery	1	3
Battery Charger	1	3
Load Sensing System	3	3,9
ELECTRIC SYSTEM		
Electrical Connections	1, 3	1, 3
Switches, Gauges, Horn, and Lights	1, 3	1, 3
Switches and Controls	1, 3	1, 3
GENERAL		
No Unauthorized Modification or Additions	9	9
Paint and Overall Appearance.	5	5
Operation and Safety Manual	9	9
General Structural Condition and Welds	2	2
Grease and Lubrication Specification	9	9
Function Test of All System	9	9
Notify JLG Change in Machine Ownership	-	9
ANSI Manual of Responsibilities and AEM Safety Manual in Storage Box(ANSI)	9	9
Capacity Decals	9	9
All Decals/Placards	9	9

General

Table 3. Preventive Maintenance & Inspection Schedule. (continued)

AREA ON MACHINE	INSPECTIONS	
	PRE-DELIVERY ⁽¹⁾ OR FREQUENT ⁽²⁾ INSPECTION	ANNUAL ⁽³⁾ (YEARLY) INSPECTION
Annual Machine Inspection	-	9
Safety Publication	9	9
All Fasteners, Pins, Shields, and Covers	1, 2	1, 2
Footnotes: ¹ Prior to each sale, lease, or delivery. ² In service for 3 months; Out of service for 3 months or more; Purchased used. ³ Annually, no later than 13 months from the date of the prior inspection, Includes all daily and quarterly inspections, mandated by regulating body. ⁵⁰ Indicates a 50 hour interval required to perform task after initial use of machine. This only occurs once in machine life. ** Refer to Operation and Safety Manual for machine specific instructions. *** Refer to Section — Relubrication Procedure for a Actuator in Arm Stack, page 106 for proper time interval		

2.3 SERVICE MAINTENANCE COMPONENTS

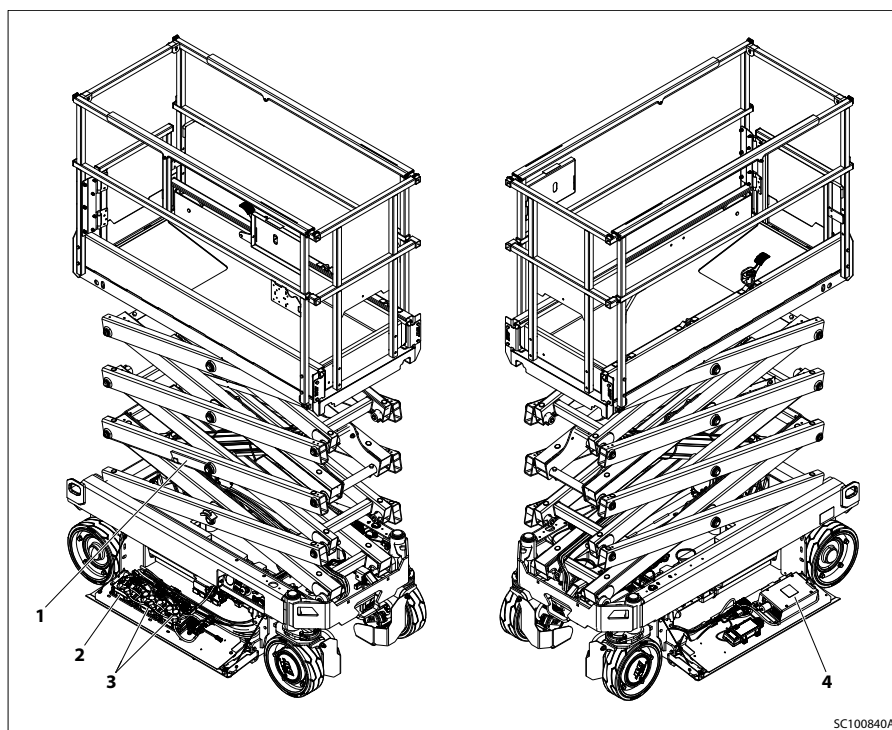


Figure 1. Machine Component Locations

1. Scissor Arm - Inspection Prop	3. Drive Module
2. Lift Module	4. Inverter

2.3.1 Scissor Arm - Inspection Prop

(Refer to *Figure — Scissor Arm - Inspection Prop, page 39.* and *Figure — Scissor Arm - Inspection Prop, page 39.*)

⚠ WARNING

Never work under an elevated platform until it has been restrained from movement with the arm inspection prop, blocking or overhead sling.

⚠ CAUTION

The arm inspection prop must be used whenever maintenance performed on the machine requires the scissor arms to be raised and only with no load in the platform.

Remove all items or unnecessary weight from the platform before engaging the arm inspection prop.

The arm inspection prop is located on the side of the scissor arms on the right side of the machine.

To engage the arm inspection prop:

1. From the Ground Control Station, raise the platform far enough to allow the arm inspection prop to be engaged.
2. Rotate the prop assembly clockwise until it hangs vertically on the side of the scissor arms.
3. Lower the platform until the arm inspection prop rests against the arm inspection prop stop on the arm set below it, stopping all downward movement of the platform/scissor arm assembly.

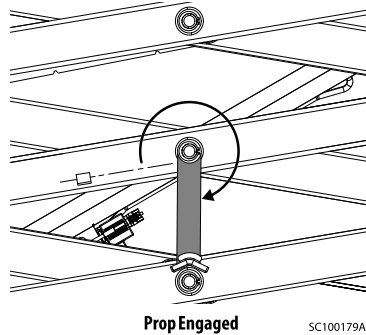


Figure 2. Scissor Arm - Inspection Prop

To disengage the arm inspection prop:

1. Raise the platform enough to release the arm inspection prop off the arm inspection prop stop.
2. Rotate the prop assembly counterclockwise until it is resting on the arm prop holder plate on the side of the scissor arm assembly.

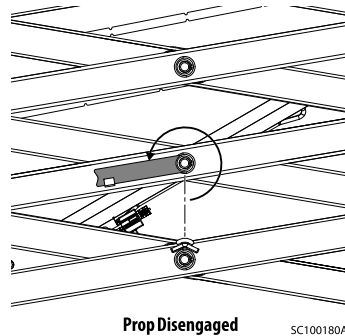


Figure 3. Scissor Arm - Inspection Prop

2.4 SERVICE AND GUIDELINES

2.4.1 General

The following information is provided to assist you in the use and application of servicing and maintenance procedures contained in this book.

2.4.2 Safety and Workmanship

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

2.4.3 Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this by use of shield and covers. These items must be maintained on a scheduled basis in order to function properly
2. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

2.4.4 Components Removal and Installation

1. Use adjustable lifting devices, whenever possible, if mechanical assistance is required. All slings (chains, cables, etc.) should be parallel to each other and as near perpendicular as possible to top of part being lifted.
2. Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90°.
3. If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

2.4.5 Component Disassembly and Reassembly

When disassembling or reassembling a component, complete the procedural steps in sequence. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to assure that nothing has been overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

2.4.6 Pressure-Fit Parts

When assembling pressure-fit parts, use an anti-seize or molybdenum disulfide base compound to lubricate the mating surface.

2.4.7 Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.
2. Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.
3. If bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.
4. Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

2.4.8 Gaskets

Check that holes in gaskets align with openings in the mating parts. If it becomes necessary to hand-fabricate a gasket, use gasket material or stock of equivalent material and thickness. Be sure to cut holes in the right location, as blank gaskets can cause serious system damage.

2.4.9 Bolt Usage and Torque Application

1. Self locking fasteners, such as nylon insert and thread deforming locknuts, are not intended to be reinstalled after removal. Always use new replacement hardware when installing locking fasteners.
2. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
3. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (Refer to [Section — Torque Charts, page 16.](#))

2.4.10 Lubrication

Service applicable components with the amount, type, and grade of lubricant recommended in this manual, at the specified intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

2.4.11 Battery

Clean battery, using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry battery and coat terminals with an anti corrosion compound.

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
 - a. Excessive sloppiness in joints.
 - b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
 - a. Frayed or separated fibers on the liner surface.
 - b. Cracked or damaged liner backing.
 - c. Bearings that have moved or spun in their housing.
 - d. Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
 - a. Detectable wear in the bearing area.
 - b. Flaking, peeling, scoring, or scratches on the pin surface.
 - c. Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
 - a. Housing should be blown out to remove all dirt and debris, bearings and bearing housings must be free of all contamination.
 - b. Bearing / pins should be cleaned with a solvent to remove all grease and oil

Note: Filament wound bearings are dry joints and should not be lubricated.

- c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

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SECTION 3

CHASSIS AND SCISSOR ARMS

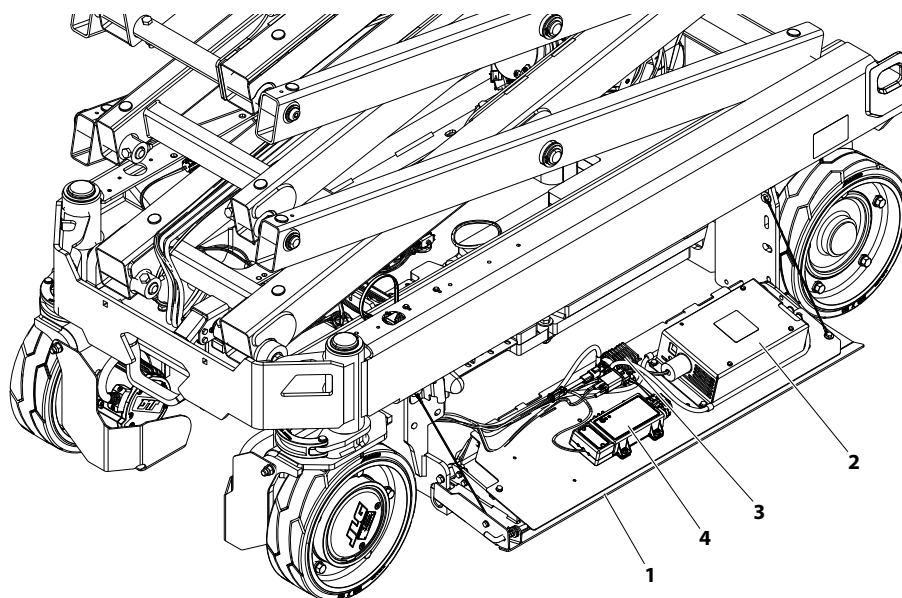
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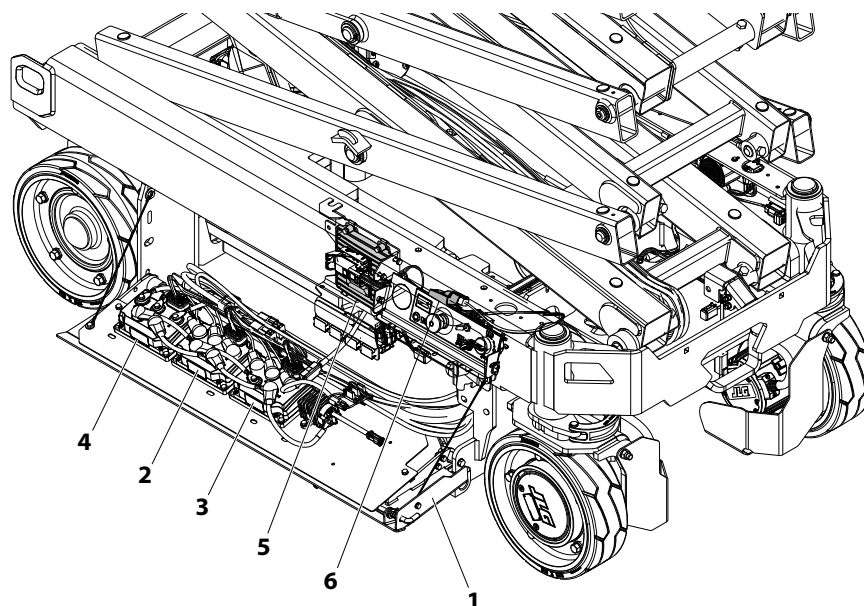
3.1 LEFT AND RIGHT SIDE COMPONENT COMPARTMENTS



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Figure 4. Components on left Side Swing - Down Compartment Door

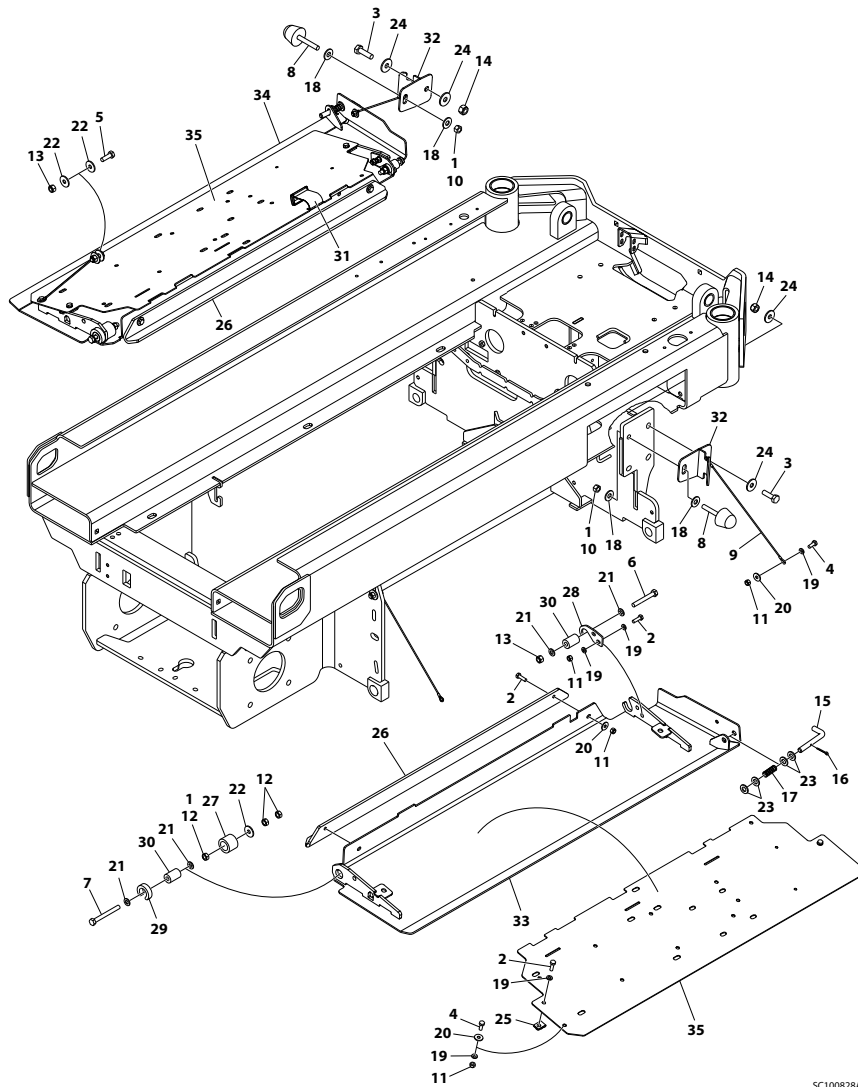
1. Left Side Component Compartment Door	3. Relay (Inverter)
2. Inverter	4. Clearsky Module (Option)



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Figure 5. Components on right Side Swing - Down Compartment Door

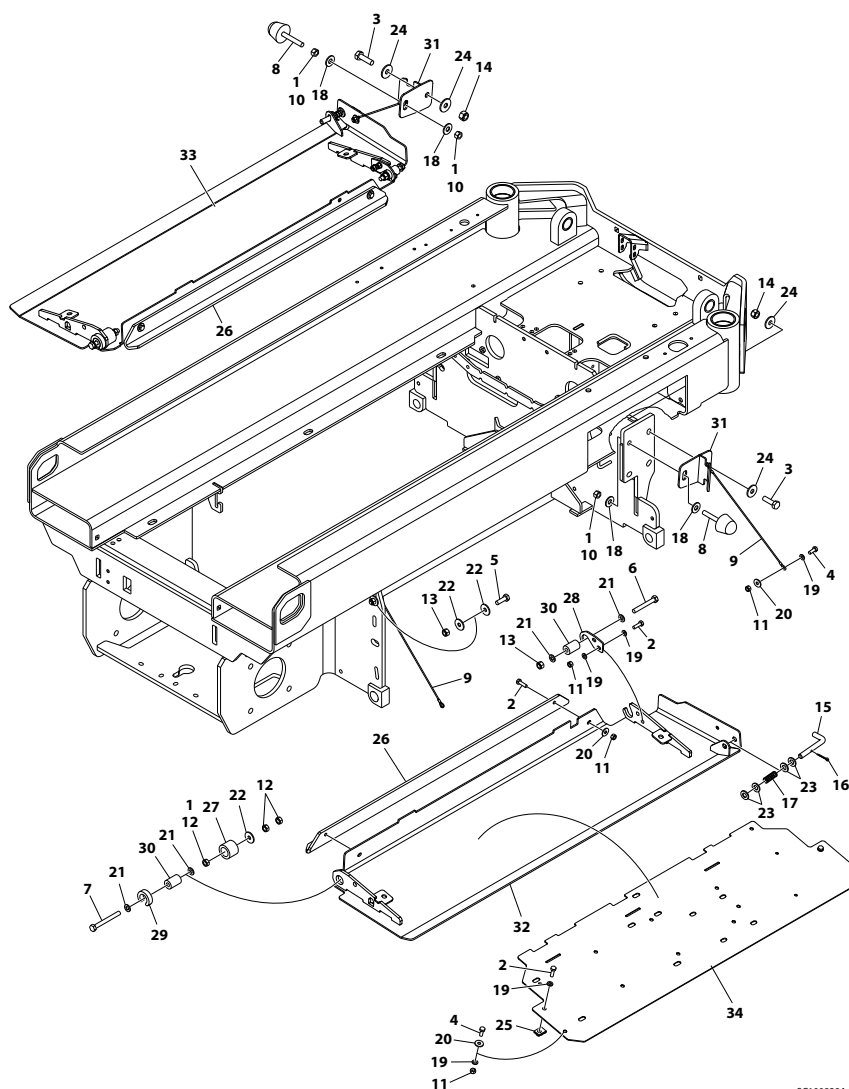
1. Right Side Component Compartment Door	4. Lift Module
2. Drive Module (Left)	5. Logic Control Module Assembly
3. Drive Module (Right)	6. Diagnostics Module



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Figure 6. Side Swing-Down Left/Right Compartment Door Installation

1. Compound, Locking	13. Nut	25. Nut, Tinnerman
2. Bolt	14. Nut	26. Plate, Filler
3. Bolt	15. Pin	27. Sleeve
4. Bolt	16. Pin, Cotter	28. Bracket
5. Bolt	17. Spring	29. Plate, Spacer
6. Bolt	18. Washer	30. Sleeve, Spacer
7. Bolt	19. Washer	31. Strap
8. Bumper	20. Washer	32. Support
9. Lanyard	21. Washer	33. Door (RH)
10. Nut Grd 8	22. Washer	34. Door (LH)
11. Nut	23. Washer	35. Bracket
12. Nut	24. Washer	



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Figure 7. Side Swing-Down Right Compartment Door Installation

1. Compound, Locking	13. Nut	25. Nut, Tinnerman
2. Bolt	14. Nut	26. Plate, Filler
3. Bolt	15. Pin	27. Sleeve
4. Bolt	16. Pin, Cotter	28. Bracket
5. Bolt	17. Spring	29. Plate, Spacer
6. Bolt	18. Washer	30. Sleeve, Spacer
7. Bolt	19. Washer	31. Support
8. Bumper	20. Washer	32. Door (RH)
9. Lanyard	21. Washer	33. Door (LH)
10. Nut Grd 8	22. Washer	34. Bracket
11. Nut	23. Washer	
12. Nut	24. Washer	

3.2 BATTERY SYSTEM MAINTENANCE/TROUBLESHOOTING

3.2.1 Battery Management System (BMS)

The Battery Management System monitors and maintains the health of the battery. It monitors internal cell voltages, temperatures, and calculates the battery State of Charge (SOC); i.e. 100% SOC is a fully charged battery. The BMS controls when the battery can be charged, discharged, and commands the required voltages and currents to the charger during charging. The BMS will prevent charging if the battery temperature is below 32°F (with no Battery Heater) and will prevent discharging (machine use) if the battery temperature is below 0°F.

3.2.2 State of Charge (SOC)

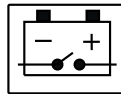
The SOC is a calculated value determine by the BMS Module to estimate the current charge state of the machine.

The battery state of charge (SOC) calculation needs periodic calibration for an accurate measurement. To calibrate the SOC measurement, ensure that you perform a complete charge to 100%. It is advised to charge machine to full 100%, perhaps once per week during frequent usage.

The battery controller calibration helps determine the life of the battery. To calibrate battery controller, it is advised to periodically (approximately every 6month) to complete a charge cycle from 20% to 100%.

3.2.3 Battery Quick-Disconnect

Machines equipped with the battery quick-disconnect allow all machine power to be easily disconnected at the battery without removing battery cables from the battery posts. To disconnect power, locate the RED quick-disconnect connector attached to the positive battery post and pull halves apart.



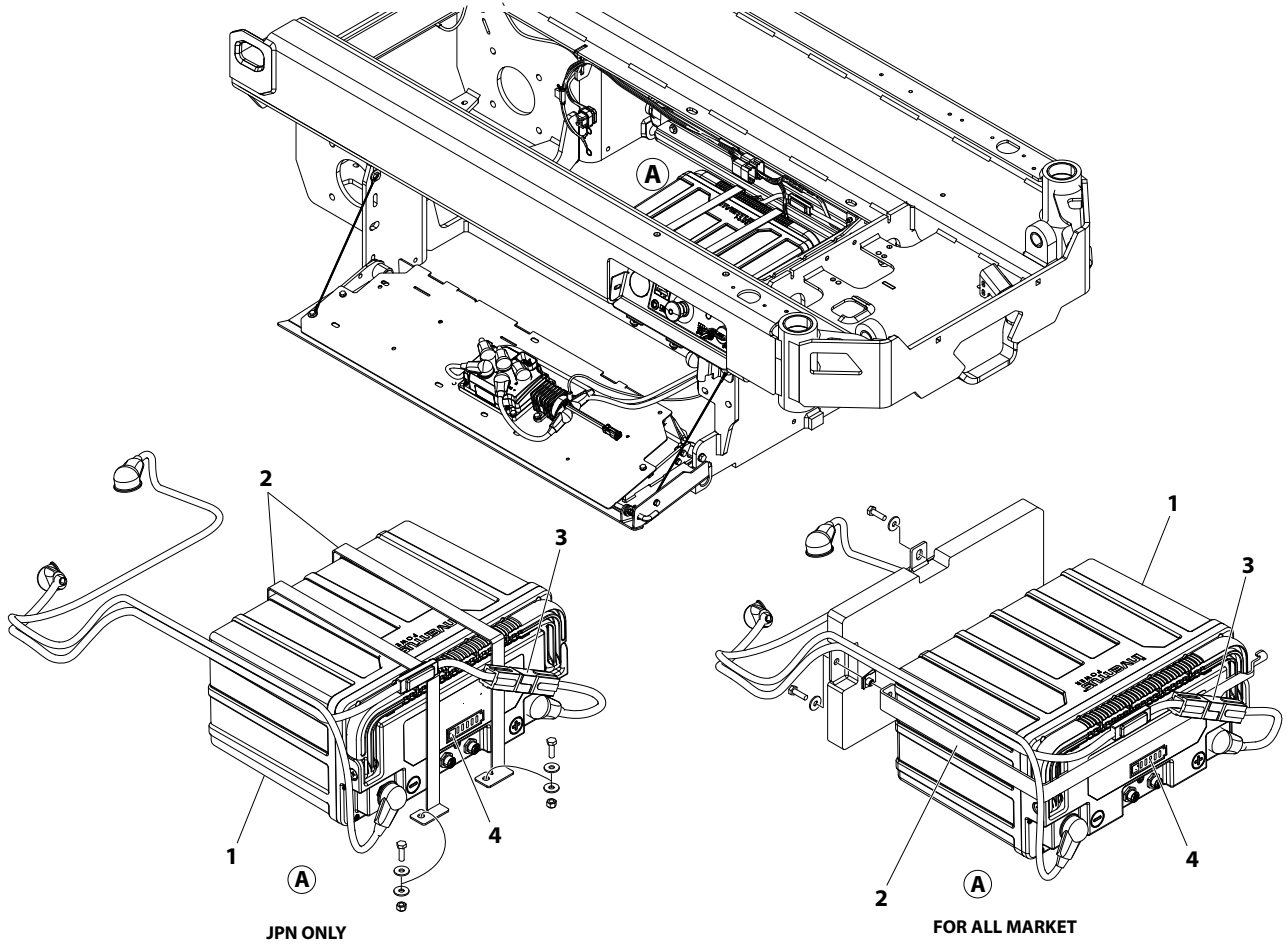
⚠ CAUTION

Before battery removal can begin, ensure that the (+) and (-) battery cables have been properly disconnected.

1. The machine battery is located inside the machine. Release the latch bar at the front of the left side compartment door and open.
2. Once the battery door is open, battery replacement/ maintenance can begin.

Note: Battery weighs approximately 39.5 lb (17.9 Kg)

3. To remove battery from the machine, first disconnect the positive (+) battery cable from the main contactor relay.
4. After any maintenance on the battery or replacement of the battery is complete, reconnect the battery and check for proper operation.
5. Close and latch the left side compartment door.



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Figure 8. Components on right Side Swing - Down Compartment Door

1. Battery	3. Battery Quick Disconnect
2. Bracket	4. Battery Status Indicator (LED)

Chassis and Scissor Arms

3.2.4 Battery Status Indicator (LED)

The chart below describes meaning for the Battery Status Indicator lights blink pattern.

LED Status		Indication	LED Behavior	Module Status/Mode	Resolution
	Flashing Green	Normal Operation	Flashes every 20 seconds	Power saving, not communicating with BMS	N/A
			Flashes every 5 seconds	Active, communicating with BMS	
	Flashing Yellow	Temporary Warning	Flashes every 20 seconds (green once voltage or temperature normalizes)	At least one Cell Bank under voltage	Charge
				At least one Cell Bank over voltage	Discharge
				Cell temp= 60°- 65°C	Allow module to cool
				PCBA temp= 80°- 100°C	
	Flashing Red	Fault	Flashes every 5 seconds (green once voltage is above 3.3V)	Cell voltage< 2.3V	Charge
			Flashes every 5 seconds (remains red when cause for alarm no longer exists)	Cell voltage< 2.3V with charge current> 0.5 A for 1 min	Contact JLG
				Cell voltage> 4.5V	
				Cell temp> 65°C	
				PCBA temp> 100°C	
	Red& Green Flashing alternately	Electronics Fault	Red and green flash alternately	Issue with on board electronics	Contact JLG
	Any Color Remains on	Electronics Fault	Any LED color remains on	Issue with on board electronics	Contact JLG
	Permanently off	Electronics Fault	No LED output	Non-recoverable	Contact JLG

3.3 BATTERY CHARGING

⚠ CAUTION

Only plug the charger into a properly installed and grounded outlet. Do not use ground adaptors or modify plug. Do not touch non-insulated portion of output connector or non-insulated battery terminal.

Do not operate charger if the AC supply cord is damaged or if the charger has received a sharp blow, been dropped, or otherwise damaged in any way.

Always disconnect the charger AC supply before making or breaking the (pos/neg) connections to the battery.

Do not open or disassemble charger.

1. The battery charger AC input plug is located in an opening on the panel at the lower rear of the machine.
2. Connect the charger AC input plug to a grounded outlet using a 3 wire heavy duty extension cord. (Refer to [Table — Battery Charger Specifications, page 12](#) for battery charger AC input specifications.)
3. When powered up the charger will go through a short LED indicator self-test. The battery charger LED indicators on the charger will flash in sequence for two seconds. These LED indicators can be viewed through the opening on the rear panel where the charger AC cord is accessed. See battery charger descriptions following in this sub-section.
4. The battery are fully charged when the green light on the battery charger status panel is illuminated.

Note: If the charger is left plugged in, the charger will automatically restart a complete charge cycle if the battery voltage drops below a minimum voltage or 30 days has elapsed.

3.3.1 Delta-Q - Battery Charger

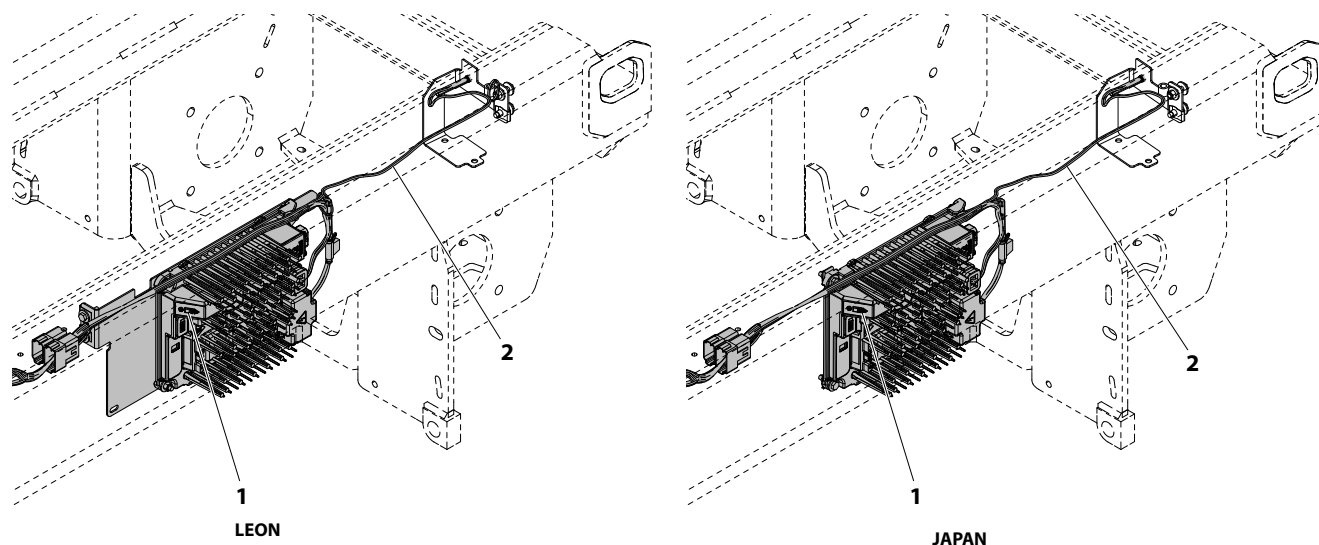


Figure 9. Battery Charger - 650W (LEON & JAPAN)

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1. Charge Indicator LEDs	2. LED Cable
--------------------------	--------------

Note: Some items are removed for illustration purposes only. For charger specifications, Refer to [Table — Battery Charger Specifications, page 12](#).

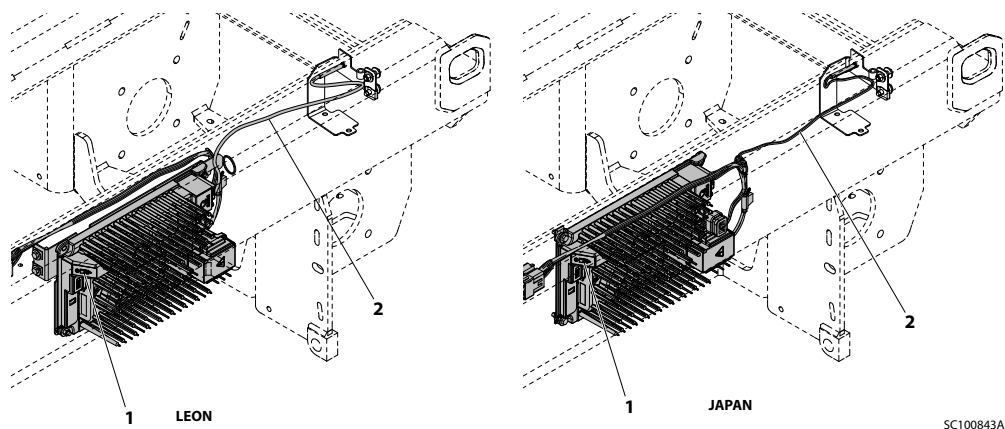


Figure 10. Battery Charger - 900W (LEON & JAPAN)

1. Charge Indicator LEDs	2. LED Cable
--------------------------	--------------

Note: Some items are removed for illustration purposes only. For charger specifications, Refer to [Table — Battery Charger Specifications, page 12.](#)

- **AC Power On:** BLUE LED ON
- **Charging:** Bottom Panel - GREEN LED Flashing; Top Panel - GREEN LED OFF
- **Fault Indicator:** RED LED ON
- **External Error Condition Caution:** AMBER LED Flashing
- **Internal OverTemp Shutdown:** 30 - 90% RED LEDs Blinking

3.3.2 Battery Charger Maintenance

⚠ CAUTION

Use charger only on battery systems with an algorithm selected that is appropriate to the specific battery type. Other usage may cause personal injury and damage.

Study all battery manufacturers' specific precautions such as recommended rates of charge and removing or not removing cell caps while charging.

⚠ CAUTION

Only plug the charger into a properly installed and grounded outlet. Do not use ground adaptors or modify plug. Do not touch non-insulated portion of output connector or non-insulated battery terminal.

Do not operate charger if the AC supply cord is damaged or if the charger has received a sharp blow, been dropped, or otherwise damaged in any way.

Always disconnect the charger AC supply before making or breaking the (pos/neg) connections to the battery. Do not open or disassemble charger.

1. Make sure charger connections to battery terminals are tight and clean.
2. Do not expose charger to oil or to direct heavy water spraying when cleaning vehicle.

Note: Battery charging is a function of the battery cell temperature.

Table 4. Cell Temperature Range

Temperature Range Limits		Li-ion		Li-ion With Heater (opt)	
Temp ° C	Temp ° F	Charge	Discharge	Charge	Discharge
>0	>32	Y	Y	Y	Y
>-15	>5	N	Y*	Y**	Y
>-40	>-40	N	N	N	N

* Battery temperature will raise approximately. 1°F per minute of system operation. In this state, the system can be operated to get the battery back up to charge temperature.

**The battery heater turns on at a cell temperature of -15° C (5° F) and shuts off 1° C (30.2 °F) (If Equipped).

Table 5. Diagnostic Trouble Codes (Delta Q Battery Charger)

DTC	Fault	Solution
E-0-0-1 E-0-2-1	Battery high voltage	Check the battery voltage and cable connections. Check battery size and condition. This error will automatically clear once the condition has been corrected.
E-0-0-2 E-0-2-2	Battery low voltage	Check the battery voltage and cable connections. Check battery size and condition. This error will automatically clear once the condition has been corrected.
E-0-0-3	Charge time out caused by battery pack not reaching required voltage within safe time limit.	Possible causes: Charger output reduced due to high temperatures, poor battery health, very deeply discharged battery and /or poorly connected battery. Possible solutions: Operate at lower ambient temperature. Replace battery pack. Check DC connections. This error will automatically clear once the charger is reset by cycling DC.
E-0-0-4	Battery could not meet minimum voltage	Check for shorted or damaged cells. Replace battery pack. Check DC connections. This error will automatically clear once the charger is reset by cycling DC.
E-0-0-7	Battery amphoter limit exceeded	Possible causes include poor battery health, very deeply discharged battery, poorly connected battery, and / or high parasitic loads on battery while charging. Possible solutions: Replace battery pack. Check DC connections. Disconnect parasitic loads. This error will automatically clear once the charger is reset by cycling DC.
E-0-0-8	Battery temperature is out of range	Possible battery temperature sensor error. Check temperature sensor and connections. Reset charger. This error will automatically clear once the condition has been corrected.
E-0-1-2	Reverse polarity error	Battery is connected to the charger incorrectly. Check the battery connections. This error will automatically clear once the condition has been corrected.
E-0-1-6 E-0-1-8 E-0-2-6	USB operation failed	Software upgrade failure or script operation failure. Ensure the USB flash drive is properly formatted and retry inserting the USB flash drive into the charger.
E-0-2-3	High AC voltage error(>270VAC)	Connect charger to an AC source that provides stable AC between 85 - 270 VAC / 45 - 65 Hz. This error will automatically clear once the condition has been corrected.
E-0-2-4	Charger failed to initialize	The charger has failed to turn on properly. Disconnect AC input and battery for 30 seconds before retrying.
E-0-2-5	Low AC voltage oscillation error	AC source is unstable. Could be caused by undersized generator and /or severely undersized input cables. Connect charger to an AC source that provides stable AC between 85 - 270 VAC / 45-65 Hz. This error will automatically clear once the condition has been corrected.
F-0-0-1, F-0-0-2, F-0-0-3, F-0-0-4, F-0-0-6		Internal charger fault. Remove AC and battery for minimum 30 seconds and retry charger. If it fails again, please contact the manufacturer of your vehicle or machine.
E-0-2-7 E-0-2-8	USB Over Current Fault	USB hardware overcurrent protection has been tripped. Remove and reinsert USB device. If the condition persists then try a different USB device. The selected charging profile is incompatible with the charger software. Update charger software or select a different charging profile. Exiting profile shall remain in use on charger only if trying to change to different algo ID, if trying to upgrade current algo and they see this error then customer needs to contact Delta-Q for a SW Upgrade to run the new algorithm.

Table 5. Diagnostic Trouble Codes (Delta Q Battery Charger) (continued)

DTC	Fault	Solution
E-0-2-9	CANBus error	CANbus network error. Check the physical CAN connector, electrical bus conditions and other CAN modules for correct functioning. For example check termination resistance is approx 60ohms.
E-0-3-0	COMM Battery Module error	CANbus battery module error. Check the CANbus battery module for correct functioning.
E-0-3-1	The Vref for the ADC measurements has triggered an alarm	Internal charger error. Remove AC and battery for minimum 30 seconds and retry charger. If the problem persists contact Delta-Q.
E-0-3-2	CAN Heartbeat Lost	CANbus heartbeat error. Check the networked CANbus device(s) for correct functioning.
E-0-3-3	Target Voltage set is too high, more than the hardware can support.	Configuration issue, the charger configuration is asking for more than the charger can deliver, make sure the target voltage set in platform or ALG is not too low. Recovery possible via USB script to reset the voltage scaling.
E-0-3-4	Battery Capacity is set on platform, but ALG does not support current scale.	Configuration issue, charger platform is configured to run algo with capacity scaling but algo installed does not support this feature, make sure ALG supports current scale based on battery capacity or reset platform configuration using a USB script.
E-0-3-5	Target Voltage set is too low, not even reaching 20% of the charger model nominal voltage.	Configuration issue, the charger configuration is asking for over 20% less than the charger can deliver, make sure the target voltage set in platform or ALG is not too low. Recovery possible via USB script to reset the voltage scaling.
E-0-3-6	Battery Temperature sensor is required by ALG (batt temp compensated ALG) by it is not installed.	check if sensor is connected correctly if alarm is shown or ensure the algo installed does not require temperature compensation.
E-0-3-7	CANOpen reprogramming failed	Re-try CAN Open download or re-program using the USB
E-0-3-8	Fan either has a locked rotor or open circuit	Please inspect fan to make sure the headers are connected and the fan blades are not obstructed.
E-0-3-9	The button is stuck down	Please ensure that the button is functioning correctly.
E-0-4-0	The fan power supply outputs voltage lower than expected	Please ensure that the the FAN is not stuck, or drawing too much current.
E-0-4-6	Invalid PDO Length	Ensure all PDOs are valid length.
E-0-4-7	Platform overvoltage alarm	A battery or some other source has been connected to the charger that exceeds the hardware's design limits.
E-0-4-8	Platform parallel charging found multiple master on the same bus.	check the wiring harness, to ensure only one charger is configured to be parallel charging master. All other chargers are slaves.
E-0-4-9	platform parallel charging alarm, out of resources such as node ID in the ID pool.	Make sure the right number of DQT chargers on the bus, and reset chargers to check if this alarm persist.
E-0-5-0	A Parallel charging disabled unit has received Parallel charging specific CAN messages	Check the configuration of all chargers that are sharing this bus.
E-0-5-1	A Parallel charging enabled slave unit has not detected a Master device on the CAN bus.	Master device may be disconnected or powered down. Check wiring harness. Check configuration of devices.
E-0-5-2	A Parallel charging enabled master has not detected any slaves on the CANbus	Slaves may be disconnected or powered down.
E-0-5-3	A Parallel charging slave has stopped communicating with the master	Check wiring harness and power to slaves. Check to see if slaves are issuing faults of their own.
E-0-5-4	A Parallel charging master has been disconnected from the load. The slaves still appear to beconnected	Check output wiring of the master devices.

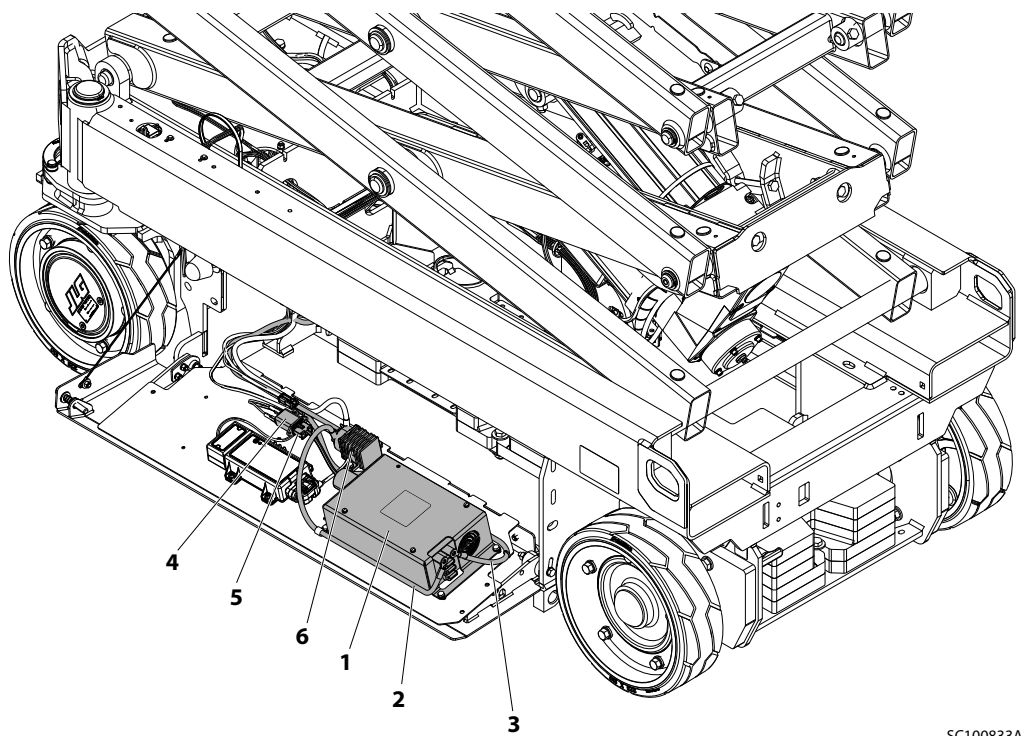
Table 5. Diagnostic Trouble Codes (Delta Q Battery Charger) (continued)

DTC	Fault	Solution
E-0-5-5	A Parallel charging slave has been disconnected from the load. The master still appears to be connected	Check output wiring of the slave devices.
E-0-5-6	A Parallel charging slave has unexpectedly stopped charging but is still in communication with the master.	Check for other Alarms and faults reported by the slave.
E-0-5-7	BMS did not respond to charger	Check CANcabling.
E-0-5-8	Network Management (NM) Down Event; There was an NM messaging error/timeout.	Check CANcabling.
E-0-5-9	Another J1939 device detected with the same address and that device does not comply with the address claim procedures.	Investigate and disconnect non-compliant device from the bus. Alternatively change the charger's configuration to exclude the conflicted address from its allowed range of addresses.
E-0-6-0	An expected RPDO (i.e., has a nonzero timeout) has not been received from the BMS yet, but the charger is ready to start.	Check CAN cabling. Ensure BMS configured to send expected RPDOs.
E-0-6-1 E-0-6-2	BMS sensed current differ from charger sensed current.	Check if the output cable matches the CAN wire harness.
E-0-6-3	Platform parallel charging: The master has detected an incompatible slave on the bus.	Query the master to identify which slave has the bad configuration or interface version.

3.4 DC/AC POWER INVERTER INSTALLATION - OPTION

DESCRIPTION	ALL MACHINES
Electrical System Voltage (DC)	24V
Power Inverter:	Power Bright
DC Input:	
DC Input Voltage:	20 to 30 VDC
Operating Temperature:	-4° F (-20° C) to 113° F (+45° C)
AC Output:	
Output Power (Continuous):	900W
Output Power (Surge):	1800W
Output Power (AC):	7.5A
Output Voltage (AC):	117V +/- 10%
Output Frequency:	60 Hz
Type:	Modified Sine Wave
Protection:	
Output Reverse DC Polarity:	3 X 25A Replaceable Fuse

Set the master power switch on the side of the inverter unit to ON and leave it there. Use the inverter on/off switch at the Ground Control panel (Refer to [Figure — Ground Control Station, page 62](#) item 3) to power the inverter on and off, via the DC power contactor relay (item 6 in illustration below).



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Figure 11. DC/AC Power Inverter - Installation

1. DC/AC Power Inverter	4. AC Filter
2. Inverter Contactor to Inverter+	5. Inverter to AC Filter
3. Battery to Inverter	6. Relay

3.5 LOGIC CONTROL MODULE INSTALLATION

All machine electrical functions are controlled through the logic control module, the logic control module also monitors all the machine’s electrical systems. If a system fault should happen with the logic module or one of the machine’s electrical systems, the logic module will generate a DTC code. Refer to [Section — Diagnostic Trouble Codes \(DTC\), page 134](#), for diagnostic information concerning any DTC code generated by the logic module.

The logic control module is located towards the right side compartment door. It is mounted on a mounting Bracket for easier access to the front panel.

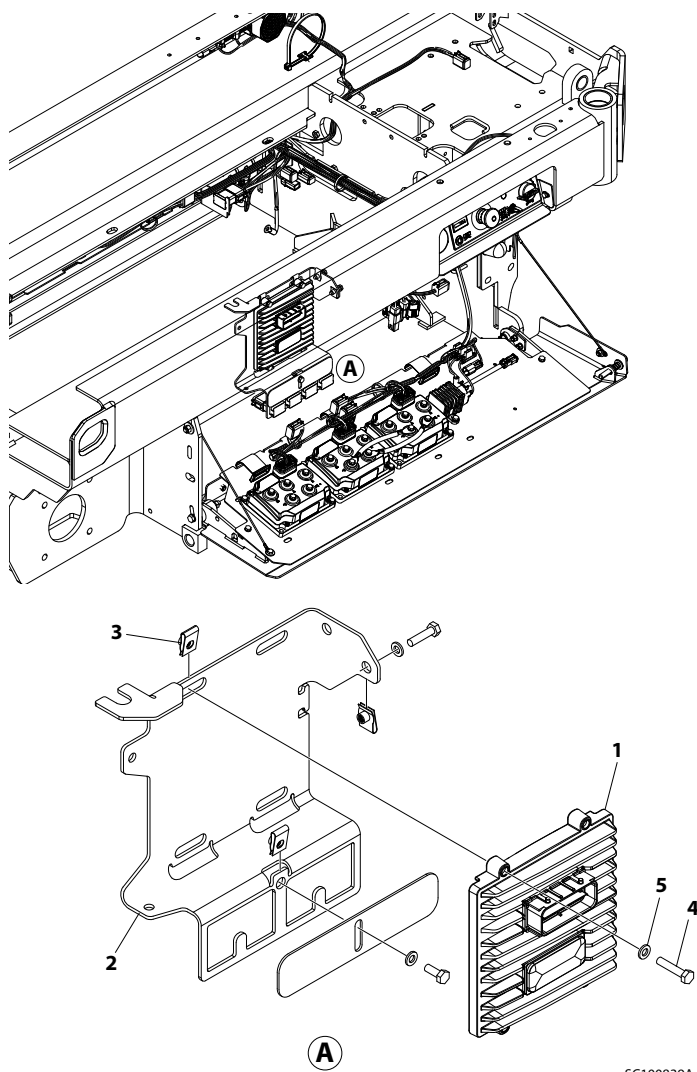


Figure 12. Logic Control Module

1. Logic Control Module	3. Nut	5. Washer
2. Logic Control Module Bracket	4. Bolt	

3.5.1 Removal of Logic Control Module from the machine

1. Turn off the machine power and disconnect the battery.

Note: Mark the wire terminal locations when removing the Logic Control Module.

2. Mark or note the harness connector positions before removing from the module.
3. Disconnect the harness connectors from the front of the module.
4. Remove the bolts, washers and nuts, two on top and two on bottom of module, to remove the module from it's mounting bracket.

Re-install by reversing the above steps.

3.6 DRIVE CONTROL MODULES

The drive control modules are located right side of the door compartment as shown in [Figure — Drive Modules - Installation, page 58](#). below. Use the following instructions when removing and installing the drive module.

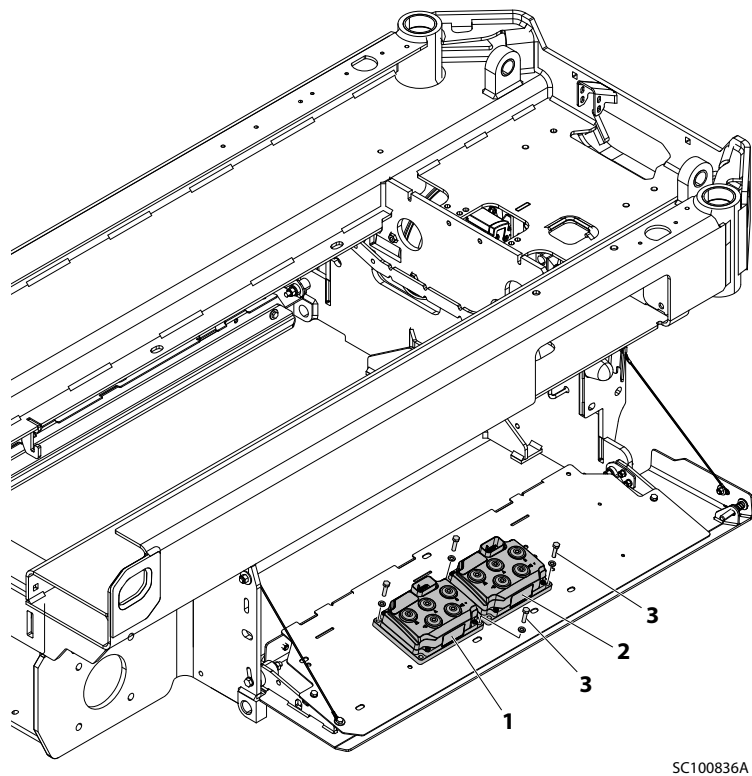


Figure 13. Drive Modules - Installation

1. Drive Module Left	3. Mounting Screws
2. Drive Module Right	

3.6.1 Removal

- 1. Turn off the machine power and disconnect the battery.

Note: Note the wire terminal locations when removing the Drive Module.

- 2. Disconnect all wires from the power module and remove the module mounting bolts, remove module from the machine.

3.6.2 Installation

- 1. Be sure that the terminals are oriented as shown.
- 2. After installing the drive modules, begin connecting the wires back to the controller.

NOTICE

Do not overtighten the terminal bolts, or damage to the unit could occur.

- 3. Torque the terminal bolts to 7 ft lb. (10 Nm).

4. After all connections to the power module are made, the battery can be reconnected.

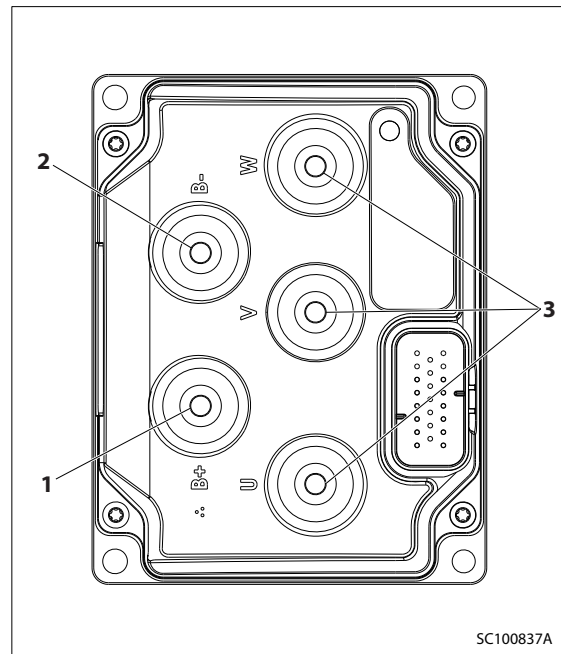


Figure 14. Drive Module Terminals

1. +B - Controller to main line contactor	3. U, V & W - Left and Right Drive Motor
2. -B - Controller to battery negative	

Table 6. Drive Module Specification

Nominal Operating Voltage	24 V
IGN Active Range	9.6 V to 36 V
Normal Operation	12 V to 30 V
Current Cutback	Above 85°C
Voltage	
Under Voltage Cutback	12 V
Under Voltage Cutback Rate	P1 Control
Under Voltage Cutoff	9.6 V
Over Voltage Cutoff	36 V
Main Current Limits	
RMS S2 - 1 Minute	200 A
RMS S2 - 1 HR	67 A
Continuous Current	50 A

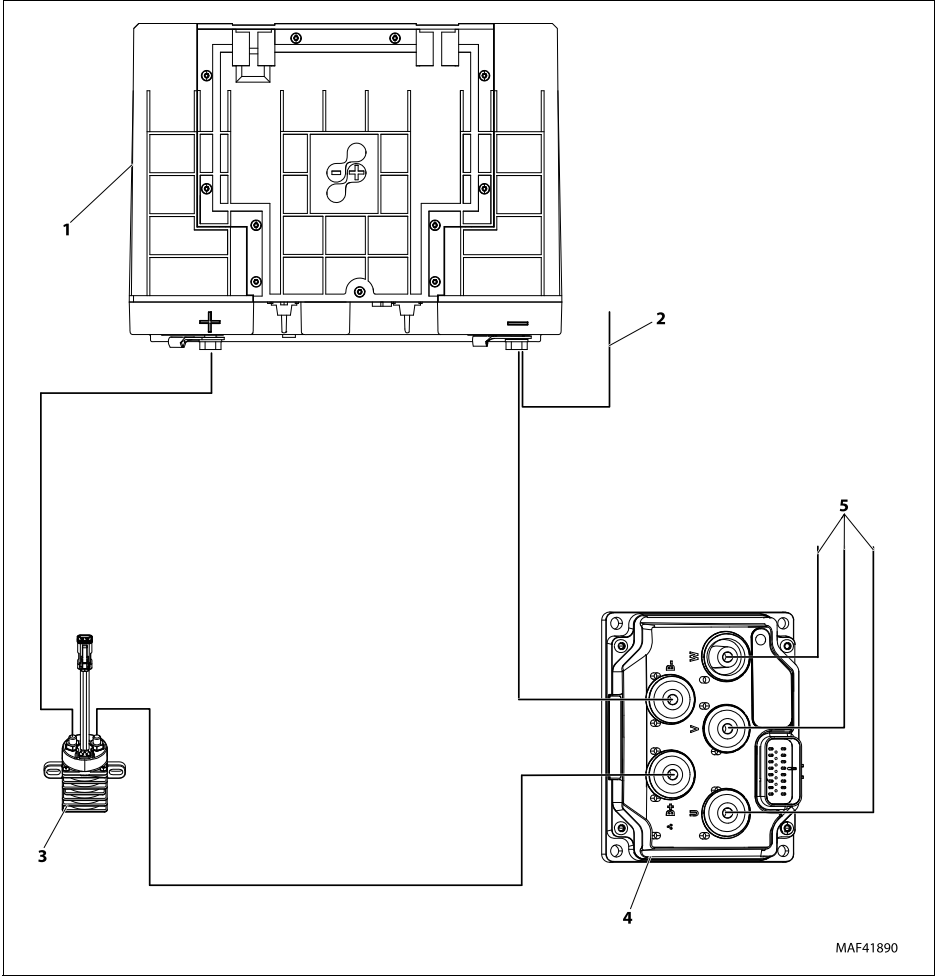


Figure 15. Drive Module Electrical Connections

1. Battery	4. Drive Module
2. To Battery Charger (-)	5. To Left and Right Drive Motor
3. Relay	

3.7 DRIVE MODULE ELECTRICAL EVALUATION

Several basic electrical tests can be performed on the Power Module. Failure of one of these evaluations is significant and may indicate that the device is physically damaged. If a Power Module is suspected to be faulty, thoroughly examine the rest of the system for possible damage.

Refer to [Figure — Resistance Measurement, page 160](#). Disconnect the Main Battery Disconnect and all cables from the Power Module during this analysis. Wait 60 seconds after power is disconnected to allow internal charge to dissipate (risk of hazard, improper readings otherwise).

- 1. **Resistance >100k Ohms All Terminals To Housing**
Ensure that there is an open-circuit between all terminals of the Power Module and the module's aluminum housing. Electronics are insulated from the housing. Place the Black meter lead on the housing and use the red meter load to probe all terminals.
- 2. **Resistance > 100k Ohms between B+ and B-**
Ensure there is open-circuit between the B+ and B- terminals of the Power Module. There should be two diode drops between B+ and B-.

3. **Resistance > 100k Ohms between B+ and each of U, V, and W.**
Ensure there is an open-circuit between the B+ terminal and each of the phase terminals U, V, and W.
4. **Resistance > 100k Ohms between B- and each of U, V, and W.**
Ensure there is an open-circuit between the Bterminal and each of the phase terminals U, V, and W. There should be a diode drop between B- and each of U, V, and W.
5. **Resistance > 10k Ohms between U and V, V and W, and U and W.**
Ensure that there is an open-circuit between each of the U, V, and W terminals.

3.8 DRIVE MOTOR ELECTRICAL EVALUATION

Several basic electrical tests can be performed on the Drive Motors. Failure of one of these evaluations is significant and may indicate that the device is physically damaged.

Refer to [Figure — Resistance Measurement, page 160](#). Disconnect the Main Battery Disconnect and all drive motor cables during this analysis.

1. **Resistance < 2 Ohms Black to White to Green Armature Wires.**
The heavy Black and White and Green conductors are connected to the motor's armature winding. The winding is a very low impedance and should appear to be a short-circuit for an ordinary voltmeter. High resistance can signal corrosion, improper crimps, damaged cabling, worn brushes, a faulty commutator, or an open armature winding.
2. **Resistance 15-25 Ohms Orange to White (Pins 7 & 8) Brake Wires.**
The orange and white wires are connected to the integral brake. Improper resistance can signal corrosion, improper crimps, damaged cabling, or a faulty solenoid.
3. **Resistance > 1 Mega Ohms Black, White, and Green Armature Wires to Motor Housing.**
The armature winding should be electrically isolated from the motor housing. Low resistance may be an indication of a crushed cable, a burned cable, or a burned armature winding. Investigate by disconnecting the drive motor cable from the motor and re-measure resistance (isolation).

Table 7. 8 pin DT04-08PA

Pin	Color	Connection
1	RED	5V
2	YEL	SIN
3	BLU	COS
4	BLK	GND
5	BRN	TEMP
6	N/A	N/C
7	ORG	BRAKE
8	WHT	BRAKE

4. **Resistance 80k-95k Ohms Red to Black (Pins 1 & 4) Power and Ground Wires.**
The red and black wires are connected to the encoders and the temperature sensor. Improper resistance can signal corrosion, improper crimps, or damaged cabling.
5. **Resistance 8k-12k Ohms Red to Yellow (Pins 1 & 2) Phase A (Sin) Encoder Wires.**
The red and yellow wires are connected to the Sin encoder. Improper resistance can signal corrosion, improper crimps, or damaged cabling.
6. **Resistance 90k-105k Ohms Red to Blue (Pins 1 & 3) Phase B (Cos) Encoder Wires**
The red and blue wires are connected to the Cos encoder. Improper resistance can signal corrosion, improper crimps, or damaged cabling.

Chassis and Scissor Arms

7. **Resistance 1000-1500 Ohms Black to Brown (Pins 4 & 5) Temperature Sensor Wires**
The black and brown wires are connected to the temperature sensor. It is a PT1000 sensor.
32°F = 1000 Ohm
70°F = 1082 Ohms
200°F = 1320 Ohms
Improper resistance can signal corrosion, improper crimps or damaged cabling.

3.9 GROUND CONTROL STATION

3.9.1 Components Location

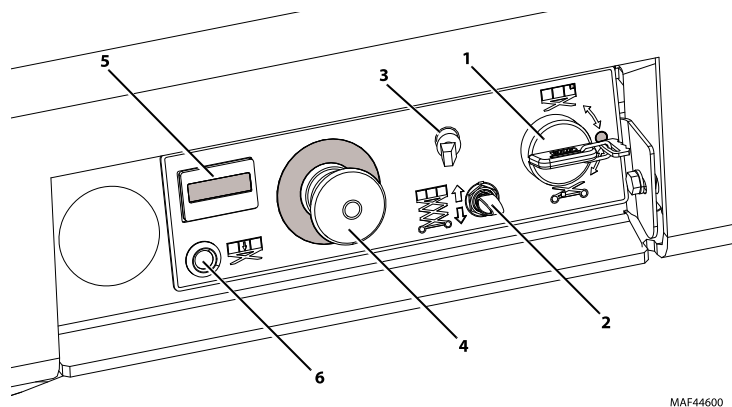


Figure 16. Ground Control Station

1. Ground/Platform/OFF Key Selector Switch	4. Ground Emergency Stop Button
2. Platform Lift/Lower Switch	5. Hour meter Gauge
3. Inverter ON/OFF Switch (If Equipped)	6. Overload Indicator

NOTICE

Disconnect main power from the battery before attempting to service the electrical system. Failure to do so could cause damage to the machines electrical components.

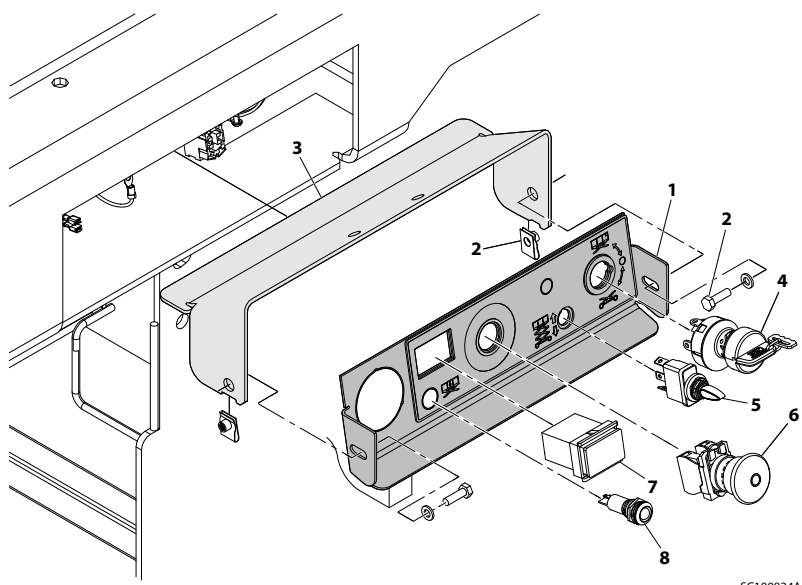
3.9.2 Removal

1. Disconnect main power at the battery.
2. Lift the rear panel cover flap to gain access to the mounting nuts on the control station bracket mounting bolts.
3. Remove the two screws, washers and nuts attaching the ground control panel to the frame.
4. When panel is released, lift and remove protective rear cover and lay aside.
5. Rotate the ground control station and position to unplug or disconnect the desired connectors and remove components on the back of the panel.

3.9.3 Installation

1. Check that all components are installed into the control station panel and connected to the wiring harness on the back of the panel.
2. Insert the control station into position on the machine and align the mounting holes in the panel with the mounting holes in the frame.
3. Attach using the two mounting screws, washers and nuts. Tighten securely.

4. Reconnect the main power at the battery, power machine up and check machine operation.

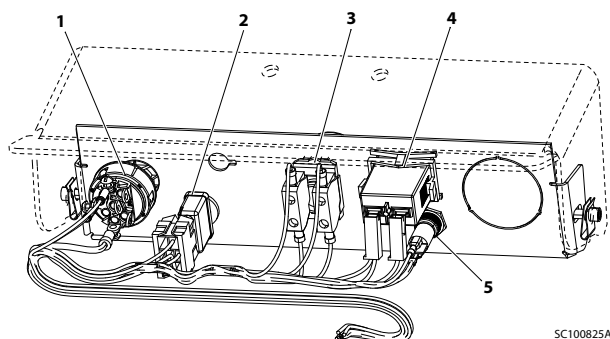


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Figure 17. Ground Control Station Removal

1. Ground Control Housing	5. Platform UP/DOWN Switch
2. Attach Screws, Washers and Nut	6. Emergency Stop Switch
3. Rear Panel Protective Cover	7. Hour Meter
4. Platform/OFF/Ground Select Switch	8. Overload Indicator

Note: Refer to [Section — Electrical Schematics, page 173](#) for wiring connections to switches and gauge.



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Figure 18. Ground Control Station - Rear of Panel

1. Platform/OFF/Ground Selector	4. Hour Meter
2. Platform UP/DOWN Switch	5. Overload Indicator (If LSS Equipped)
3. Emergency Stop Switch	

Note: AE1932 machines are equipped with a platform control station. Refer to [Section — Platform Control Station, page 64](#).

3.10 PLATFORM CONTROL STATION

NOTICE

Power machine down at the ground control station before disconnecting the platform control station.

3.10.1 Overview of Control Station Components

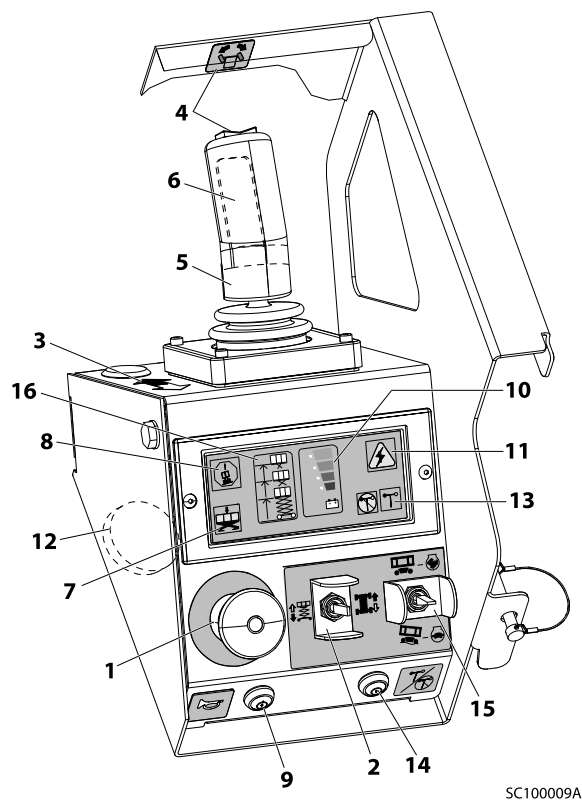


Figure 19. Platform Control Station Components - External (LED)

1. Emergency Stop Switch	9. Horn Button
2. Drive and Lift Select Switch	10. Battery Charge Indicator
3. Forward/Reverse/Lift/Lower Direction Decal	11. System Fault Indicator
4. Steer Control Switch and Decal	12. Alarm
5. Drive and Lift Joystick Control	13. Indoor/Outdoor Operation Indicator
6. Trigger (Enable) Switch	14. Indoor/Outdoor Operation Mode Switch
7. Overload Indicator	15. Speed Select Switch
8. Machine Tilt Indicator	16. Variable Tilt - Platform Restricted Height Indicator

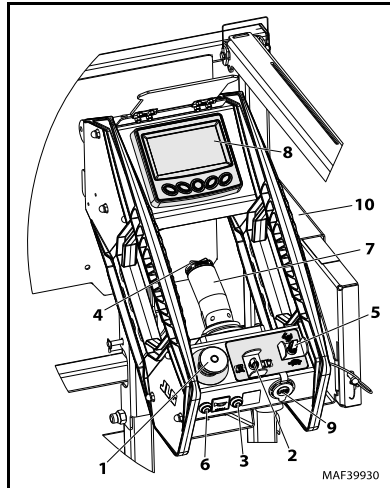


Figure 20. Platform Control Station Components - External (LCD)

1. Emergency Stop Switch	6. Horn Button
2. Drive and Lift Select Switch	7. Joy Stick
3. Indoor/Outdoor Operation Mode Switch	8. LCD Display
4. Steer Control Switch	9. USB Port
5. Drive and Lift Joystick Control	10. Mount Adapter

3.10.2 Installation/Removal

1. Disconnect the platform control station harness (1) from the round connector on front of the control station.

Chassis and Scissor Arms

- 2. Remove the mounting pin (2) securing the control station to the platform station mount, lift up and swing tab out of slot in mount, remove control station from the machine.

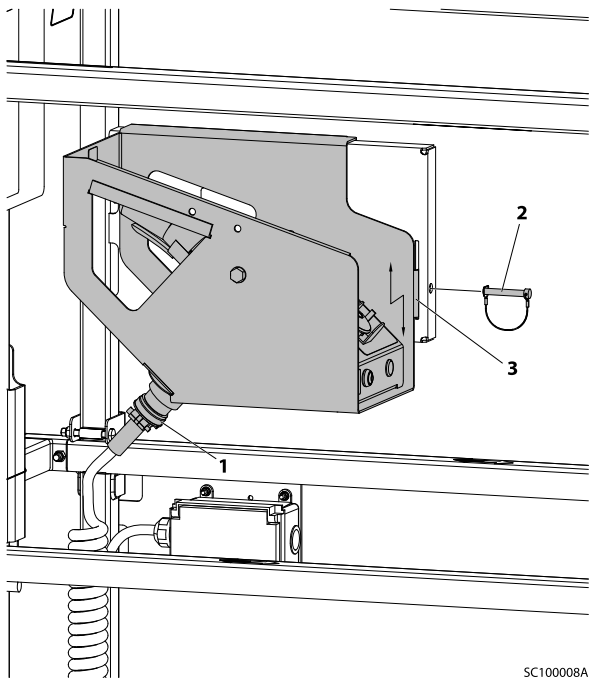


Figure 21. Platform Control Station Installation (LED)

1. Harness Connector	3. Lift and Remove
2. Mounting Pin	

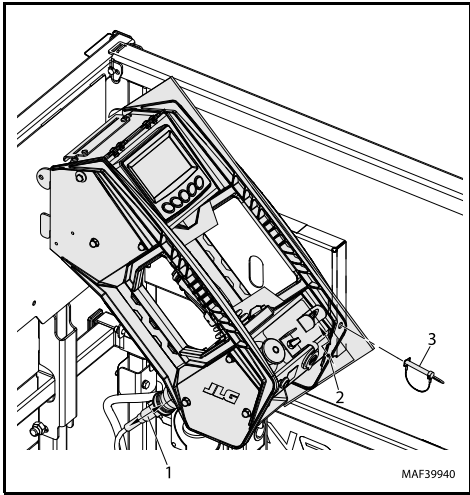


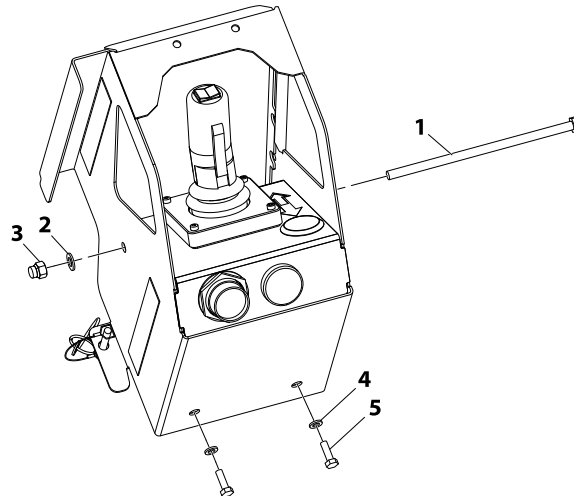
Figure 22. Platform Control Station Installation (LCD)

1. Harness Connector	3. Lift and Remove
2. Mounting Pin	

- 3. To install, reverse steps 1 and 2 above.

3.10.3 Control Station Disassembly

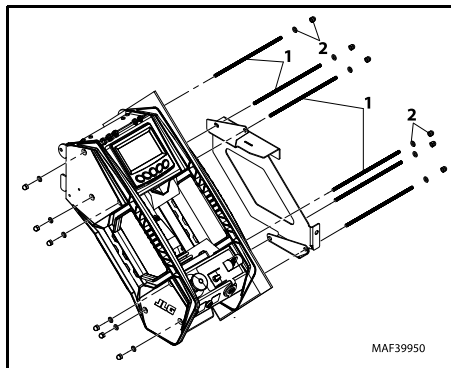
1. Place the platform control station assembly on a suitable work bench.
2. Remove the main body from the mount, by removing the hardware as shown in [Figure — Platform Control Station Disassembly \(LED\)](#), page 67. and [Figure — Platform Control Station Disassembly \(LCD\)](#), page 67.



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Figure 23. Platform Control Station Disassembly (LED)

1. Bolt	4. Washers
2. Washer	5. Rear Edge Bolts
3. Cap-nut	



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Figure 24. Platform Control Station Disassembly (LCD)

1. Stud	2. Nut and Washer
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Chassis and Scissor Arms

3. To install, reverse steps 1 and 2 above.

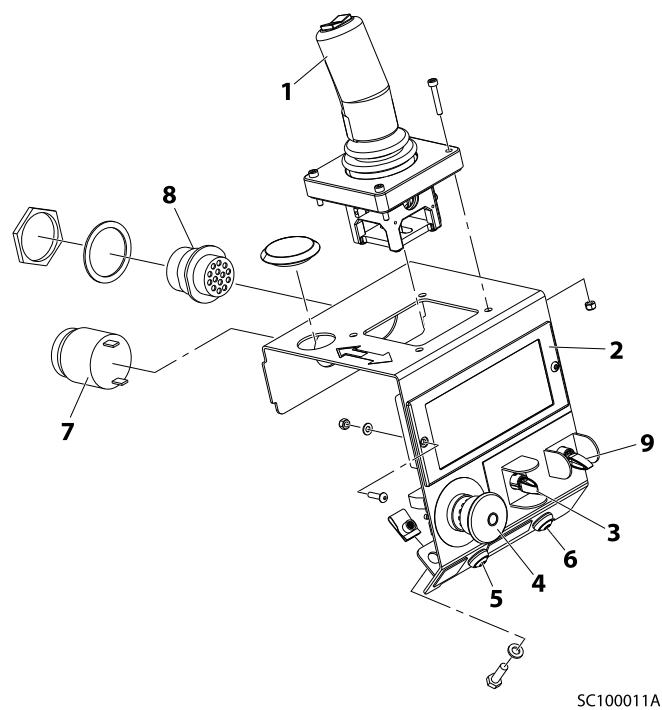


Figure 25. Platform Control Station Components - Internal (LED)

1. Drive, Lift and Steer Joystick Control	6. Indoor/outdoor operation switch
2. Indicator Panel Module	7. Alarm
3. Drive and Lift Select Switch	8. Main Harness Connector
4. Emergency Stop Switch	9. Speed Select Switch
5. Horn Button Switch	

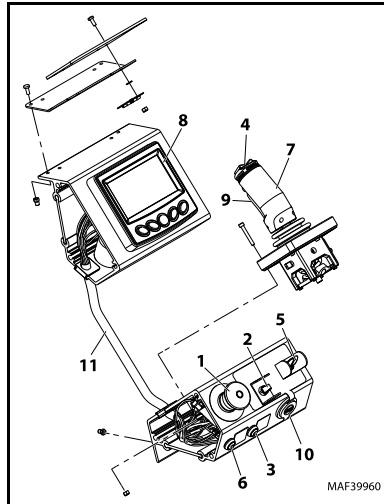


Figure 26. Platform Control Station Components - Internal (LCD)

1. Emergency Stop Switch	7. Joystick
2. Drive and Lift Select Switch	8. LCD Display
3. Indoor/Outdoor Operation Mode Switch	9. Toggle Switch
4. Steer Control Switch	10. USB Port
5. Drive and Lift Joystick Control	11. Platform Harness
6. Horn Button	

3.10.4 Joystick Controller

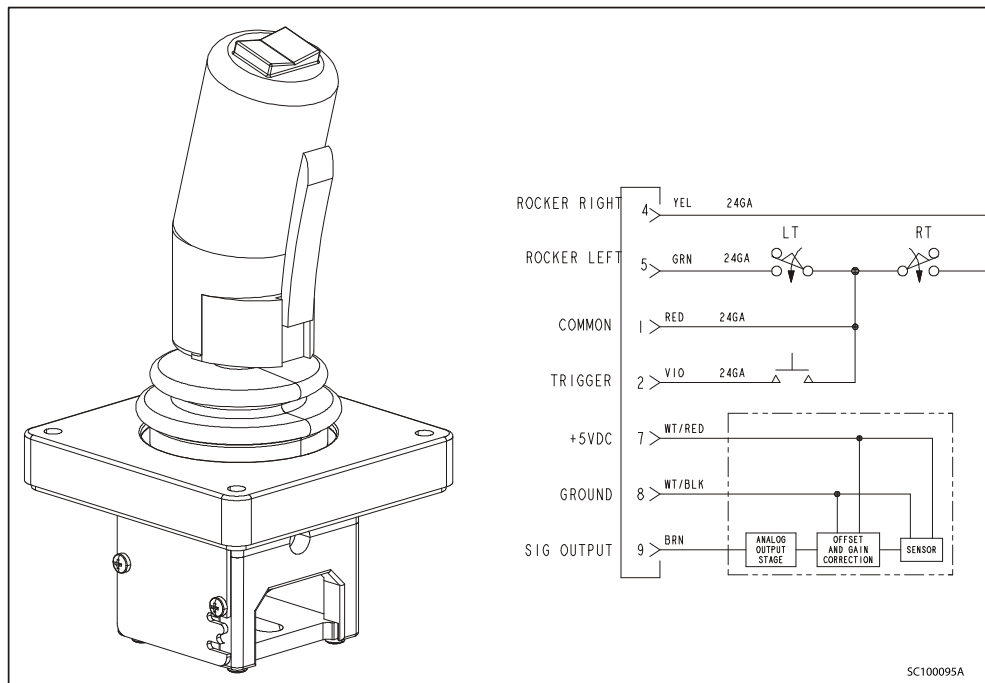


Figure 27. Joystick

Chassis and Scissor Arms

Table 8. Joystick Specifications

Input Voltage	+5 (± 0.1)VDC
Current Consumption	10 mA@ 12VDC
Output: Handle Centered	2.5 (± 0.1)VDC
Output: Full Positive (Reverse) Deflection	4 (± 0.1)VDC
Output: Full Negative(Forward) Deflection	1 (± 0.1)VDC

Table 9. Connector Chart

CONNECTOR PINOUT		
Term	Color	Function
1	RED	HANDLECOM
2	VIOLET	TRIGGERN.O.
3	—	SPARE
4	YELLOW	ROCKERRT
5	GREEN	ROCKERLT
6	—	SPARE
7	WHITE/RED	+5VDC
8	WHITE/BLACK	GROUND
9	BROWN	SIGOUTPUT

3.11 TILT SENSOR INSTALLATION

The tilt sensor is located inside the left side machine compartment door on mounting plate towards front of machine.

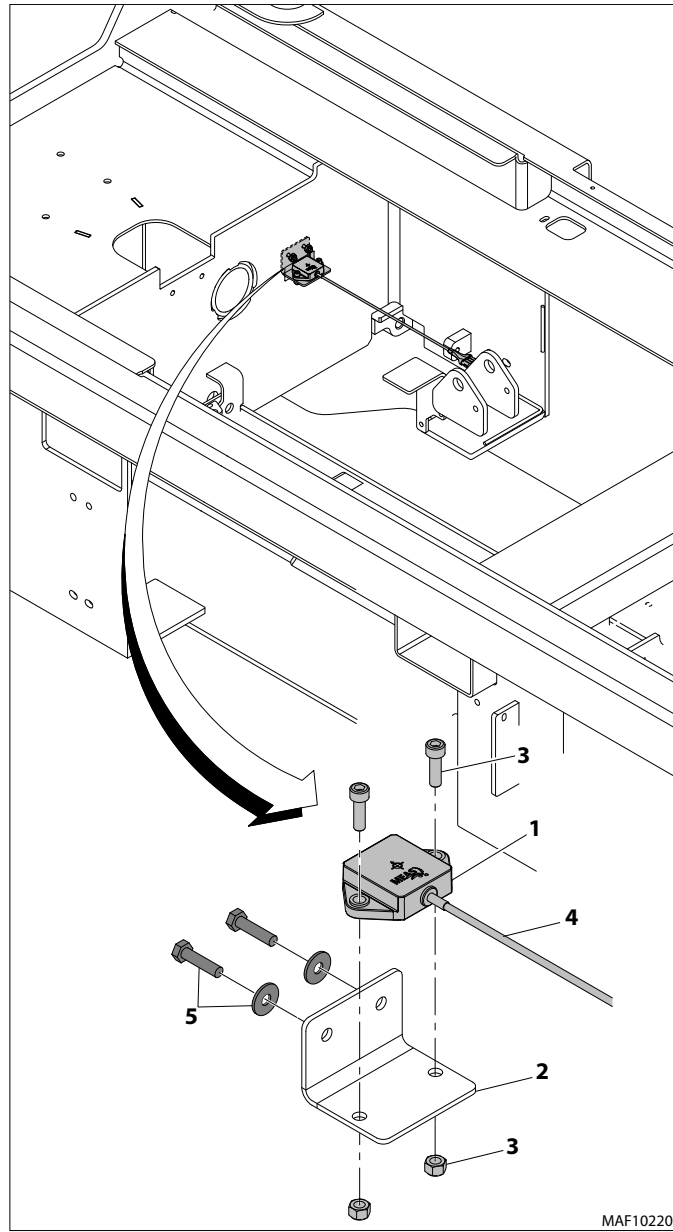


Figure 28. Tilt Sensor Installation

(pothole bar removed for clarity)

1. Tilt Sensor	4. Wire Harness Connector
2. Mounting Plate	5. Mounting Plate Hardware (Apply Medium Strength Threadlocking Compound to bolts before installation)
3. Mounting Hardware	

Chassis and Scissor Arms

3.11.1 Tilt Sensor Removal

1. Open right side compartment door, disconnect the battery power from the machine.
2. Locate the tilt sensor on the frame mounting plate next to the right side compartment door hinge assembly. Unplug the tilt sensor harness connector.
3. Remove two mounting bolts and locknuts attaching the sensor to the mounting plate.
4. Remove two mounting bolts, washer and nuts attaching mounting plate to the base frame.

3.11.2 Tilt Sensor Installation

1. Before mounting the mounting plate, tilt sensor to the base frame, check the mating surfaces of the sensor, mounting plate and base are free from debris or burrs to prevent flush mount.
2. Install mounting plate onto base frame with bolts, washer and nuts.
3. When mounting the tilt sensor onto the mounting plate, mount with the wiring harness pointing to the rear of the machine. Align the two mounting holes of the sensor with the holes of the mounting plate.
4. Secure tilt sensor onto mounting plate with mounting hardware. Torque to 9 ft.lbs. (12 Nm).
5. Plug the wire harness connector into the tilt sensor.
6. Reconnect the battery power to the machine.
7. Start the machine and check tilt sensor calibration with mobile device. Refer to [Section — JLG Control System, page 110](#) for tilt sensor calibration procedure.

Table 10. Tilt Sensor Wiring Pin Assignment

Pin	Function	Wire Color	Description
1	Vcc	WHT	+8To 30 V (32 V Max)
2	GND	YEL	Ground
3	CANH	GRN	CAN HIGH LINE
4	CANL	BRN	CAN LOW LINE

3.12 SCISSOR ARM - ROTARY ANGLE SENSOR

This machine is equipped with a scissor arm rotary angle sensor switch. This sensor communicates with the machine control module to determine platform height.

On LSS equipped machines this sensor works in tandem with the lift actuator pressure switch to accurately determine platform load for any given platform height.

There is no adjustment to the angle sensor switch, just install in the proper orientation and calibrate.

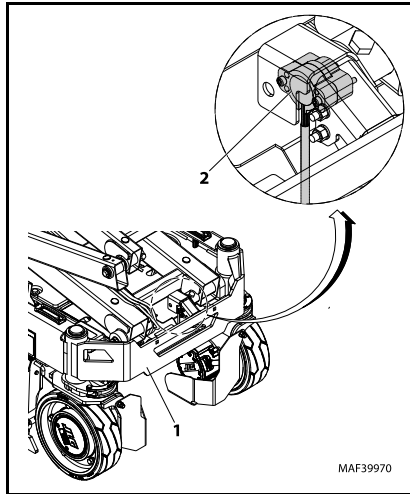


Figure 29. Scissor Arm Rotary Angle Sensor - Location

1. Front of Machine	2. Rotary Angle Sensor
---------------------	------------------------

3.12.1 Rotary Angle Sensor Installation

(Refer to [Figure — Scissor Arm Rotary Angle Sensor - Installation, page 74.](#))

1. Install angle sensor to mounting bracket with wire lead pointing away from bend in mounting bracket. Secure with bolts, locknuts and washers.
2. Insert key into slot in the scissor arm pin with the narrow end pointing away from the pin.
3. With the Angle sensor and bracket oriented as shown (1) in ([Figure — Scissor Arm Rotary Angle Sensor - Installation, page 74.](#)) gently slide slot in angle sensor over protruding tab of key.
4. Gently rotate sensor and bracket to load sensor spring until holes in the bracket line up with slots on frame mounting plate (2) ([Figure — Scissor Arm Rotary Angle Sensor - Installation, page 74.](#)). Rotation is approximately 120°, or 1/3 of a turn.
5. Secure mounting bracket to frame with bolts, locknuts and washers. Care should be taken to maintain alignment between rotating sensor slot and key so they can freely rotate together when arm stack is elevated. Secure all hardware.
6. Calibrate the sensor after installation. Refer to [Section — New Software Calibration, page 120](#) for tilt sensor calibration.

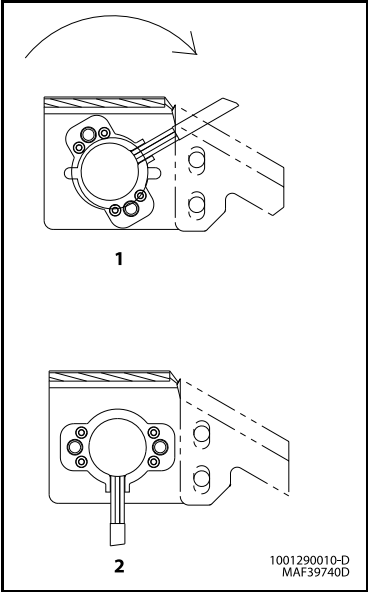


Figure 30. Scissor Arm Rotary Angle Sensor - Installation

1. Pre-Load Installation Angle	2. Final Position Installation
--------------------------------	--------------------------------

3.13 POT-HOLE PROTECTION SYSTEM COMPONENTS

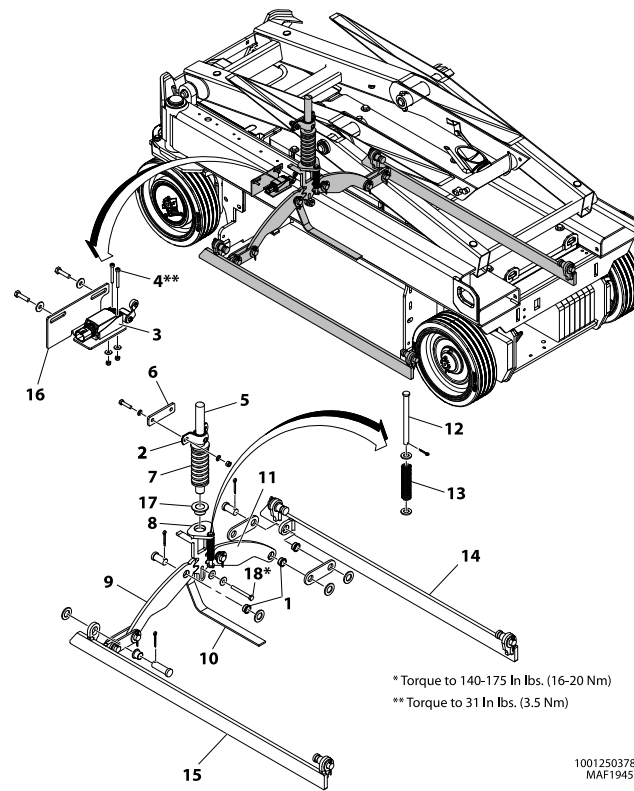


Figure 31. Pot-hole Protection Assembly

1. Bearing	7. Spring	13. Spring
2. Bearing Bracket	8. Lower Actuator	14. Bar (LH)
3. Limit switch	9. Pinion Plate	15. Bar (RH)
4. Limiting switch mounting screw	10. Anti-Static Strap	16. Sensor Mounting Plate
5. Upper Actuator	11. Link	17. Bearing
6. Mounting Plate	12. Pin	18. Bolt

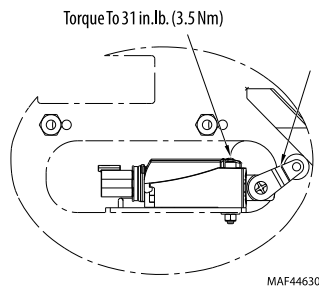
! WARNING

Never work under an elevated platform until it has been restrained from movement with blocking, or overhead sling.

1. Install flange bearings into the frame holes with the flange side facing outside of frame against pothole bar hinge.

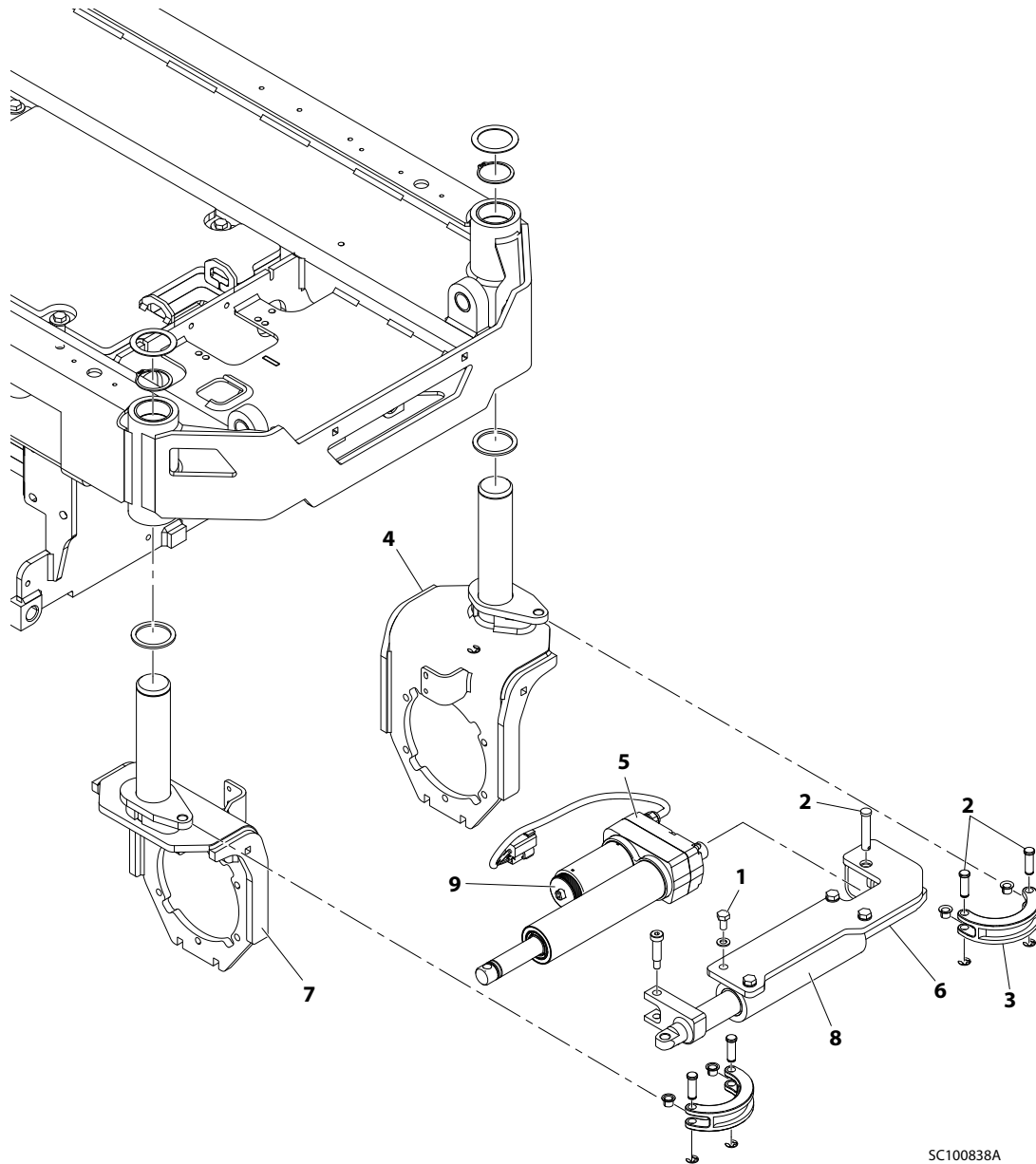
Chassis and Scissor Arms

2. PHP Bearing Adjustment - If reassembling or replacing PHP components, PHP bars may not store at same height due to manufacturing tolerances of parts. Adjustment may be needed after assembly:
 - a. Completely lower the platform and compress the actuator assembly to raise the PHP bars, check to see if only one PHP bar is raised against the frame.
 - b. If Yes, elevate the platform to release the actuator assembly and deploy the PHP bars. The actuator bearing bracket (2) allows for some side to side adjustment, mark the current position of the actuator bearing bracket (2) on the frame.
 - c. Loosen and move the actuator bearing bracket slightly towards the PHP bar that will not raise completely, and re-tighten bracket down.
 - d. Compress the actuator assembly again to stow the PHP bars and check bar ground clearance. Repeat steps (a) through (c) above until both PHP bars achieve maximum ground clearance. (Refer to [Section — Operating Specifications, page 10](#)).
3. Do not tighten limit switch mounting screws beyond 31 in. lb. (3.5 Nm).



4. PHP Limit Switch Adjustment - When the platform is raised and PHP bars fully DOWN, adjust the switch until it lightly contacts the ramp on the lower actuator.

3.14 STEER ACTUATOR AND SPINDLE ASSEMBLY COMPONENTS



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Figure 32. Steer Actuator and Spindle Assembly

1. Apply Medium Strength Threadlocking Compound to bolt threads before tightening. Torque to 40.56 ft. lbs. (55 Nm).	6. Drag Link
2. Pin	7. Spindle (RH)
3. Steering Lug	8. Bushing Bracket Weldment
4. Spindle (LH)	9. Manual Override
5. Steering Actuator	

3.14.1 Drive Motor Covers Installation

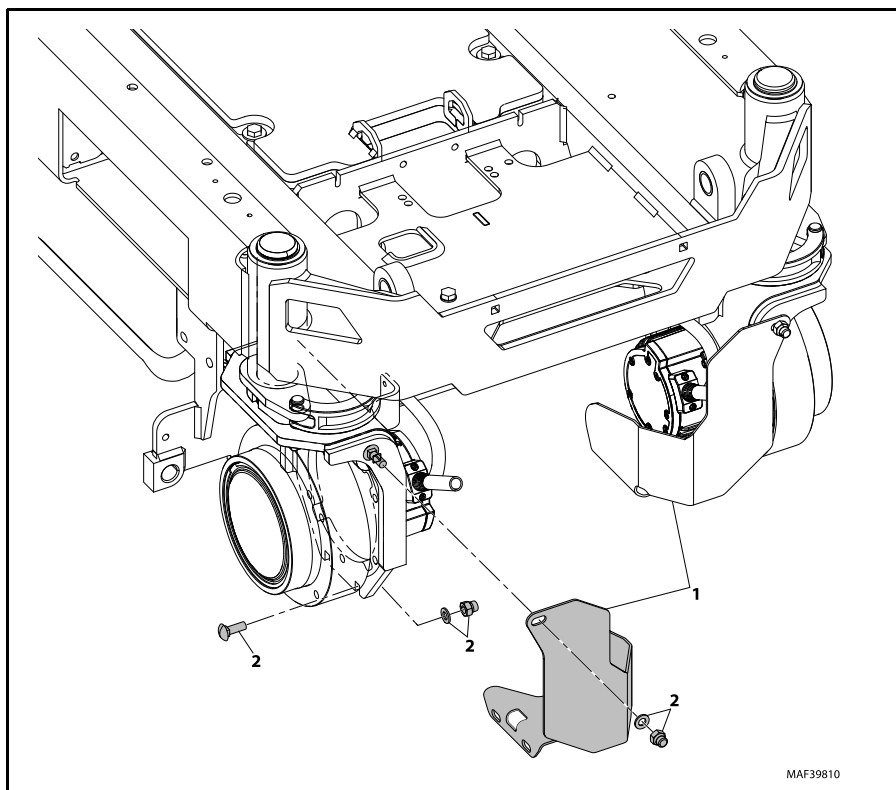


Figure 33. Drive Motor Cover Installation - Option

Note: Cover installation same for both sides.

1. Drive Motor Cover	2. Cover carriage bolts, self-locking nuts, and washers
----------------------	---

3.14.2 Tire Wear and Damage

The tire and rim assemblies installed on machines have been approved by the tire manufacturer for applications in which those products are intended to be used. The tire and rims installed on each product model have been designed for stability requirements, which consist of track width, tire compound, and load capacity. Tire changes such as rim width, centerpiece location, larger or smaller diameter, tire compound, etc., without written manufacturers approval, could result in an unsafe condition regarding stability.

The tires and rims installed on machines are to be inspected daily as part of the daily walk-around inspection. JLG requires that the daily walk-around inspection be performed at each operator change during a shift and at each shift change.

3.14.3 Wheel and Tire Replacement

JLG recommends that any replacement tire be the same size and brand as originally installed on the machine or offered by JLG as an approved replacement. Please refer to the JLG Parts Manual for the part number of the approved tires for a particular machine model.

If any of the following is discovered during tire inspection, measures must be taken to remove the JLG product from service immediately. Arrangements must be made for replacement of the tire(s) or tire assembly(s). Both tires/ wheels on the same axle must be replaced:

- If the overall diameter of the tire is less than one of the following:
100 x 323 Tire – 12.25 in. (311mm) minimum
- If any uneven wear is discovered.
A tire with significant damage in the tread area or sidewall requires immediate evaluation before placing the machine into service. If a cut, tear, chunk, or other discrepancy exceeds any one or more of the following dimensions, the tire must be replaced:
3.0 in. (76 mm) long
0.75 in. (19 mm) wide

0.75 in. (19 mm) deep

- If the metal wheel is visible at any point through the tread area of the tire.
- If more than one discrepancy exists in any quadrant of the wheel (within 90 degrees of one another).

3.14.4 Wheel Installation

It is extremely important to apply and maintain proper wheel mounting torque.

⚠ WARNING

Wheel slotted nuts must be installed and maintained at the proper torque to prevent loose wheels, a broken nut, and possible separation of wheel from the axle.

Tighten the slotted nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the slotted nuts. The proper procedure for attaching wheels is as follows:

1. Install wheel (1) onto hub (2).
2. Start mounting bolts (3) by hand to prevent cross threading. DO NOT use a lubricant on threads.
3. Tighten bolts in stages. Following the recommended sequence, tighten bolts per wheel torque of 163 Nm (120 ft.lb.).
4. Wheel mounting bolts should be torqued after the first hours of operation and after each wheel removal. Check torque every 3 months or 150 hours of operation.

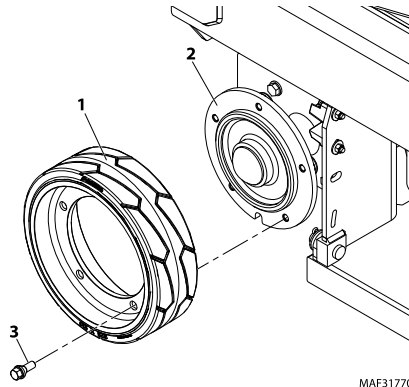


Figure 34. Wheel Installation

1. Wheel	3. Mounting Bolts
2. Hub	

3.15 ARMS AND PLATFORM POSITIONING AND SUPPORT

WARNING

Never work under an elevated platform until it has been restrained from movement with blocking or overhead sling.

The arm stack can be supported by using an overhead crane, Refer to [Figure — Arms and Platform Positioning with Overhead Support](#). If an overhead crane is not available the stack may also be lifted by using a fork-truck using the following instructions:

1. With the forks on the fork-truck slid close together, enter from the front of the machine and place the forks on the cross tube of the second arm assembly below the platform.
2. Slowly lift the arm stack with the fork-truck while the manual descent valve is being engaged (this allows the oil to drain back into the tank).
3. Place machine on arm inspection prop and leave the fork truck in place.
4. At this point the lift actuator removal may begin. (Refer to [Section — Lift Actuator, page 98](#)).

If removal of the platform becomes necessary use the above procedure to stabilize the platform for pin and platform removal.

3.16 PLATFORM REMOVAL

Note: [Figure — LSS and Platform Assembly - Installation/Removal - Sheet 1 of 4](#); [Figure — LSS and Platform Assembly - Installation/Removal - Sheet 2 of 4](#); [Figure — LSS and Platform Assembly - Installation/Removal - Sheet 3 of 4](#) and [Figure — LSS and Platform Assembly - Installation/Removal - Sheet 4 of 4](#)

1. Support the platform using an overhead crane with straps capable of lifting at least 500 lb (227 kg). Refer to [Figure — Arms and Platform Positioning with Overhead Support](#).
2. Disconnect and remove the platform control station and wiring harness at the platform. Disconnect AC receptacle cable if applicable. Route the cables out through the hole at the right-rear of the platform to free platform of any constraints when lifting.
3. Remove the bolts attaching the pins and slide blocks at each corner to the arm stack. Carefully remove the four pins attaching the platform to the arm stack.
4. Lift the platform from the arm stack and set aside.

Note: When attaching platform back onto scissor arm assembly, follow removal procedures in reverse order.

3.17 SCISSOR ARMS REMOVAL

1. Remove platform (Refer to [Section — Platform Removal, page 80](#)).
2. Disconnect all wiring and cables attached to scissor arm assembly.
3. The scissor arms can be removed as a complete unit or individually.

NOTICE

Care should be taken when setting the arms down as the lift actuator protrudes out of the bottom of the stack and could get damaged if the weight of the arm stack is setting directly on the actuator assembly.

3.17.1 Removing Scissor Arm Assembly as a Complete Unit

1. Support the scissor arms with adequate capacity Overhead Crane and Straps.
2. Remove the rotary angle sensor.
3. Remove the ladder from the frame.
4. Remove the pins attaching the bottom scissor arms to the front of the frame by removing the pin attach bolts.
5. Place two straps around each end of the entire scissor arm assembly. Using an overhead crane, slowly and carefully move the arm stack backwards so that slide blocks at rear of machine slide out the rear of the slide channel on the frame.

Note: Overhead crane and straps must be capable of lifting at least 2000 lb (907 kg).

6. Once slide blocks are clear of machine, the scissor stack can be moved to a more desirable location for further arm disassembly.

3.17.2 Removing/installing Scissor Arms Individually

Note: Refer to [Figure Scissor Arm Assembly, page 89](#) and [Figure — Scissor Arm Assembly - Pin Configuration, page 90](#).

1. If reusing the pins, number each pin and journal before removing, so the pin can be reinstalled back in same location. Odd numbers on one side and even numbers on other side.
2. With the platform removed, start with the top arms (closest to platform).
3. Secure each arm section being removed using an overhead crane with suitable lifting straps.
4. Remove the bolts securing the connecting pins in place.
5. Remove the pins from the arms.
6. Remove the arm section from the machine using the overhead crane.
7. Repeat previous steps for remaining arm sections.

Note: When attaching scissor arm assembly back onto frame, follow removal procedures in reverse order.

Self locking fasteners, such as nylon insert and thread deforming locknuts, are not intended to be reinstalled after removal. Always use new replacement hardware when installing locking fasteners.

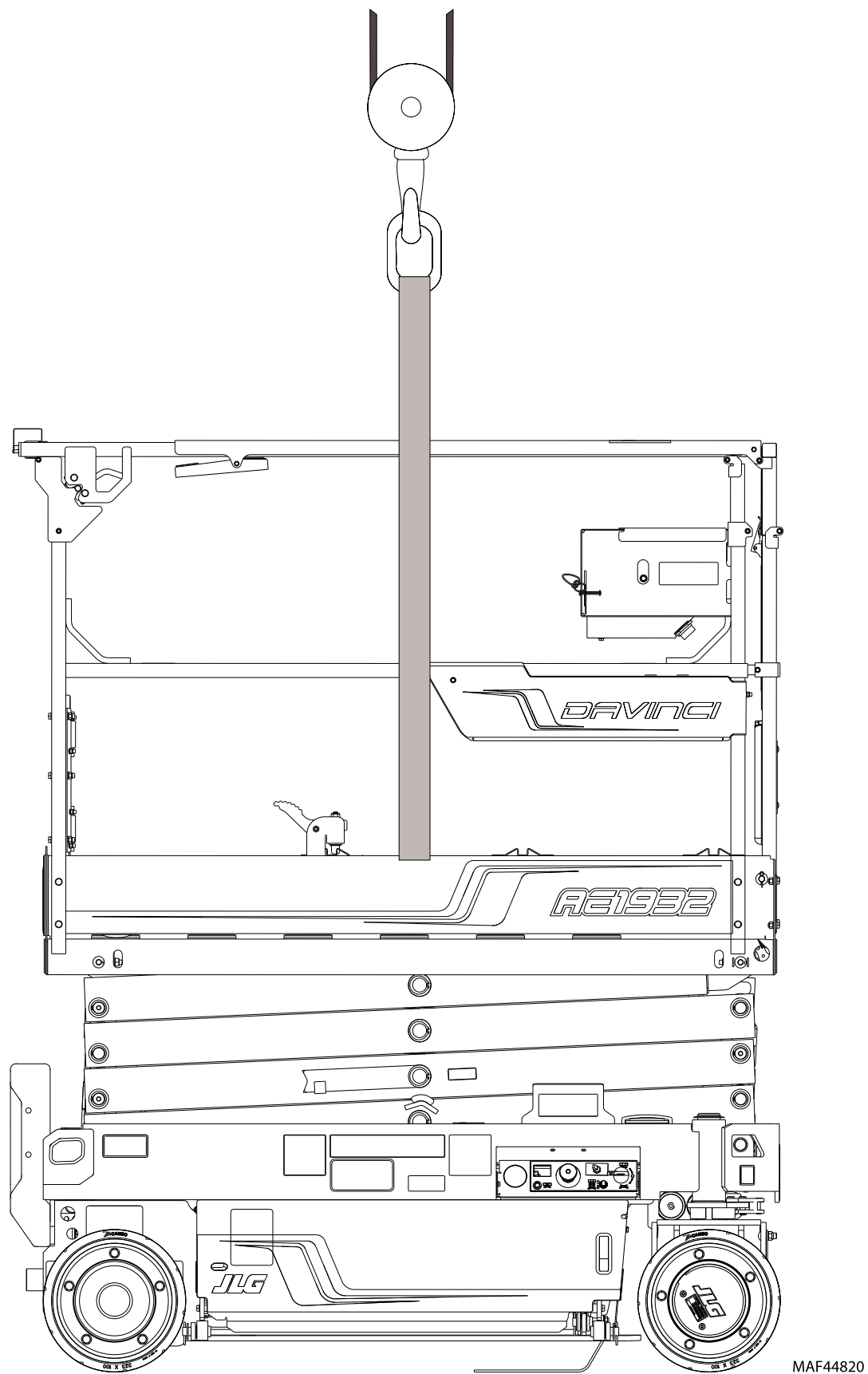


Figure 35. Arms and Platform Positioning with Overhead Support

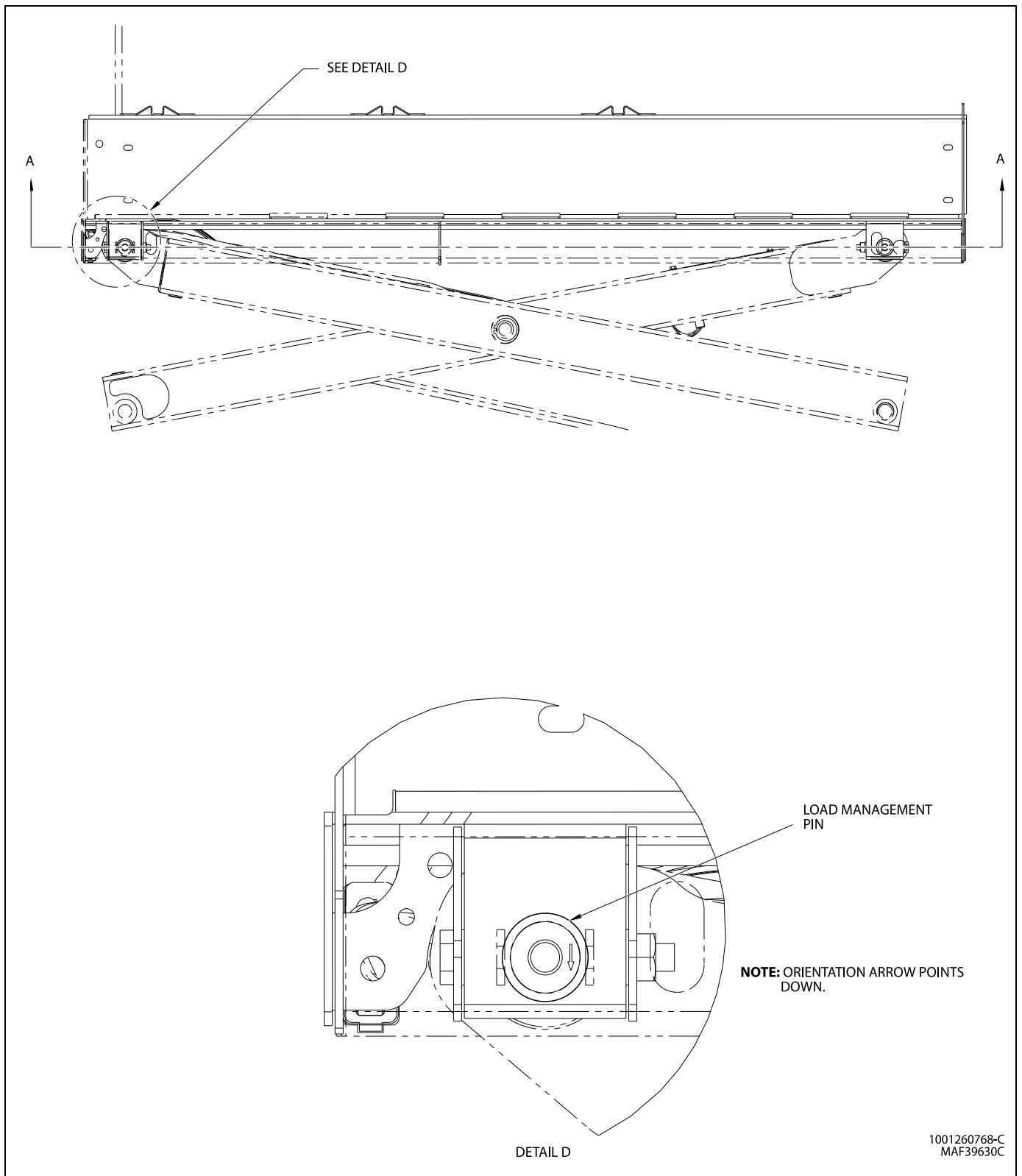


Figure 36. LSS and Platform Assembly - Installation/Removal - Sheet 1 of 4

Chassis and Scissor Arms

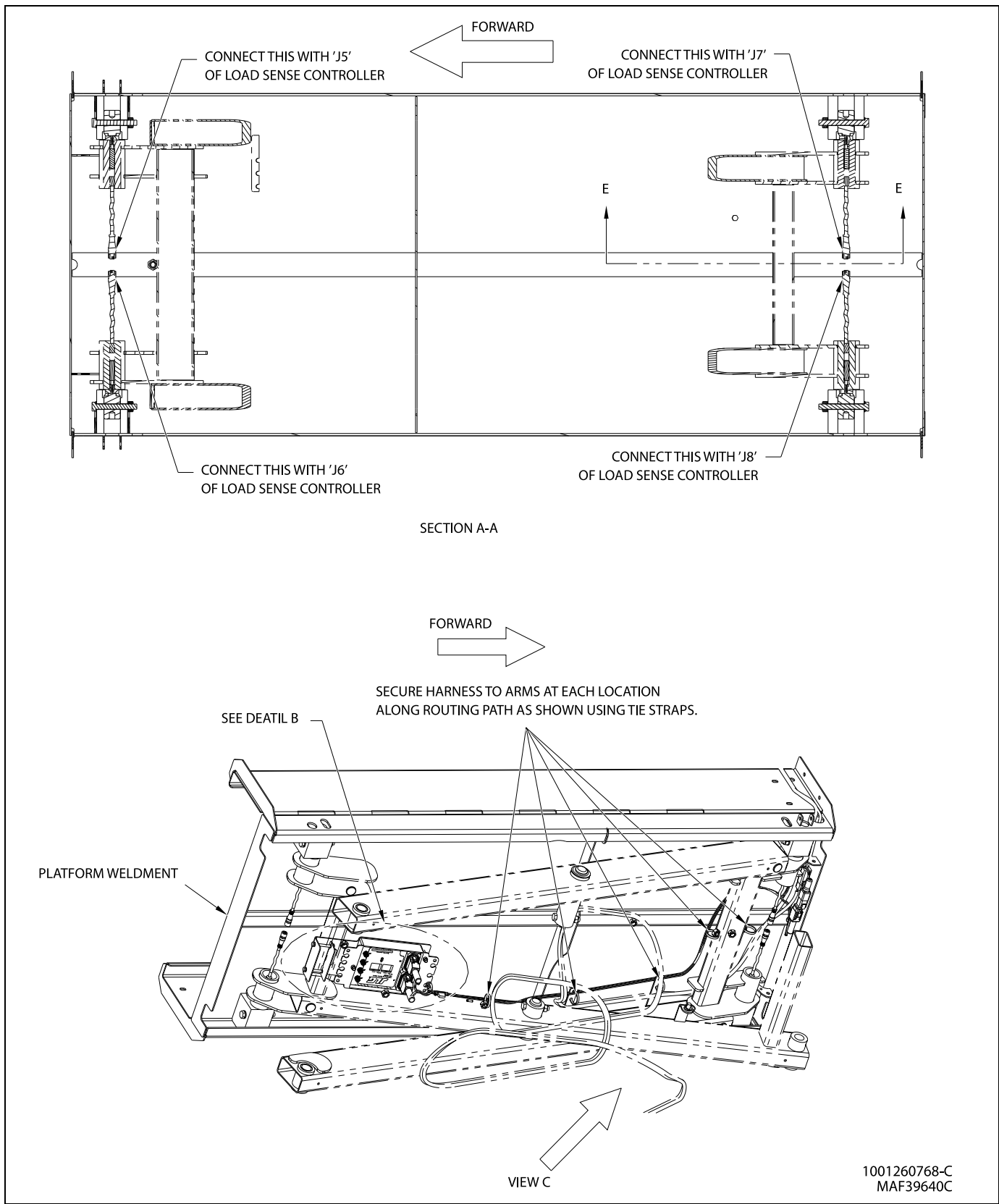
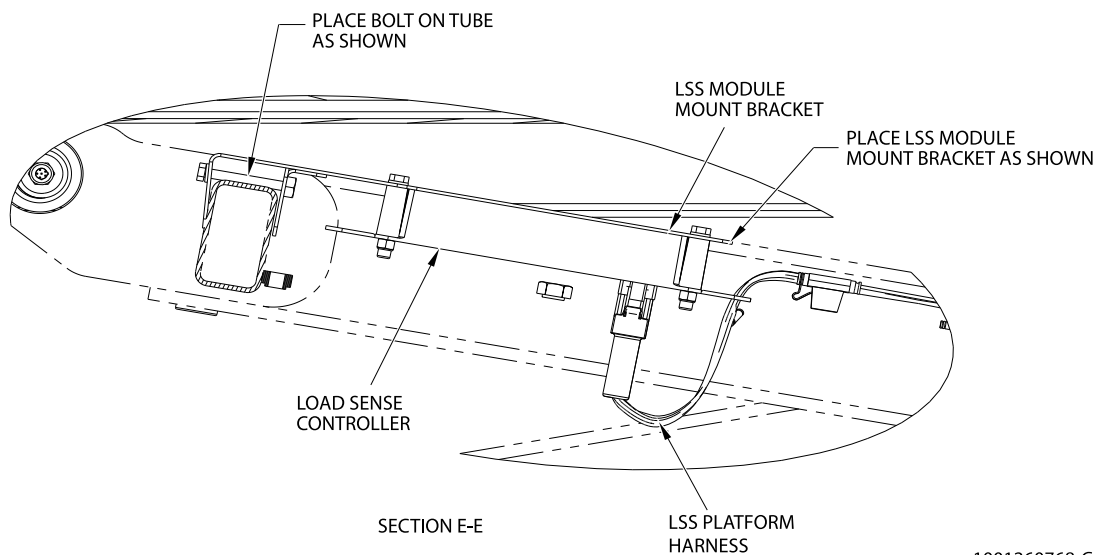
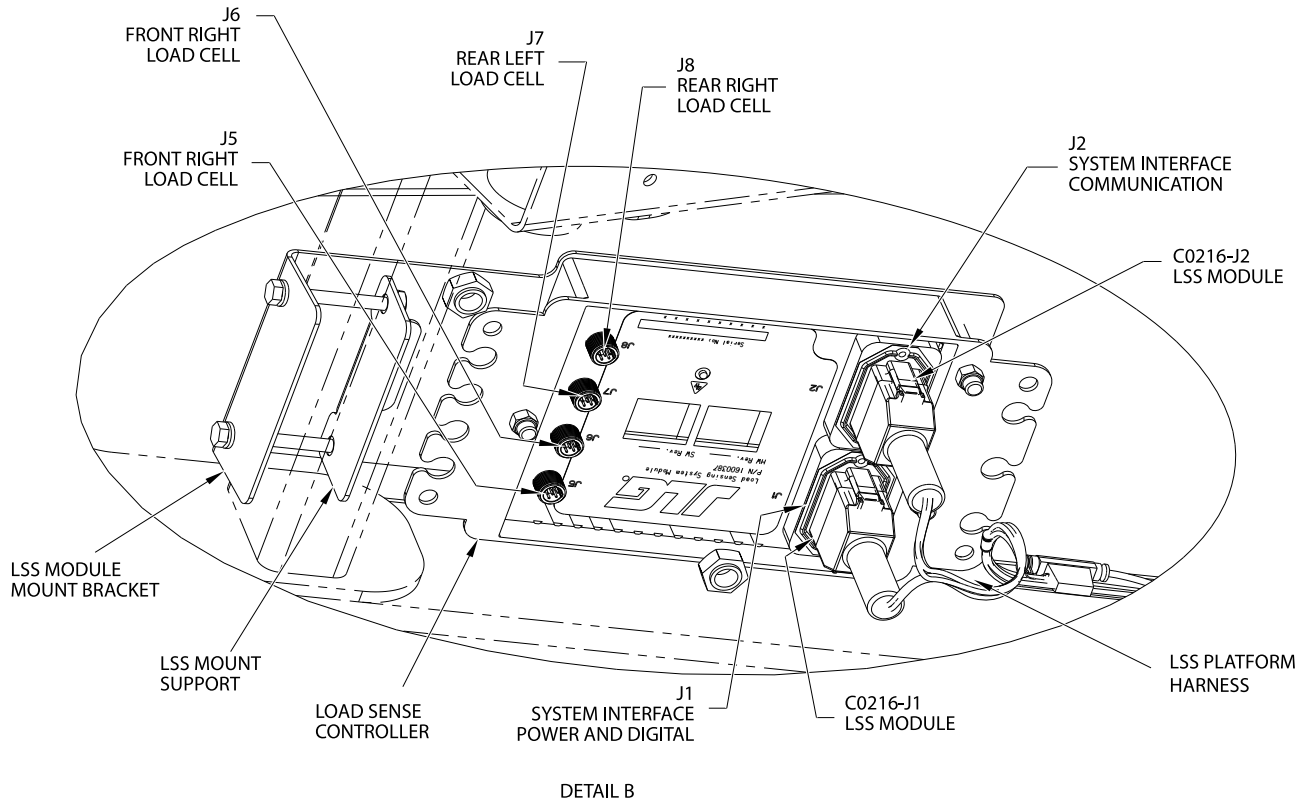


Figure 37. LSS and Platform Assembly - Installation/Removal - Sheet 2 of 4



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Figure 38. LSS and Platform Assembly - Installation/Removal - Sheet 3 of 4

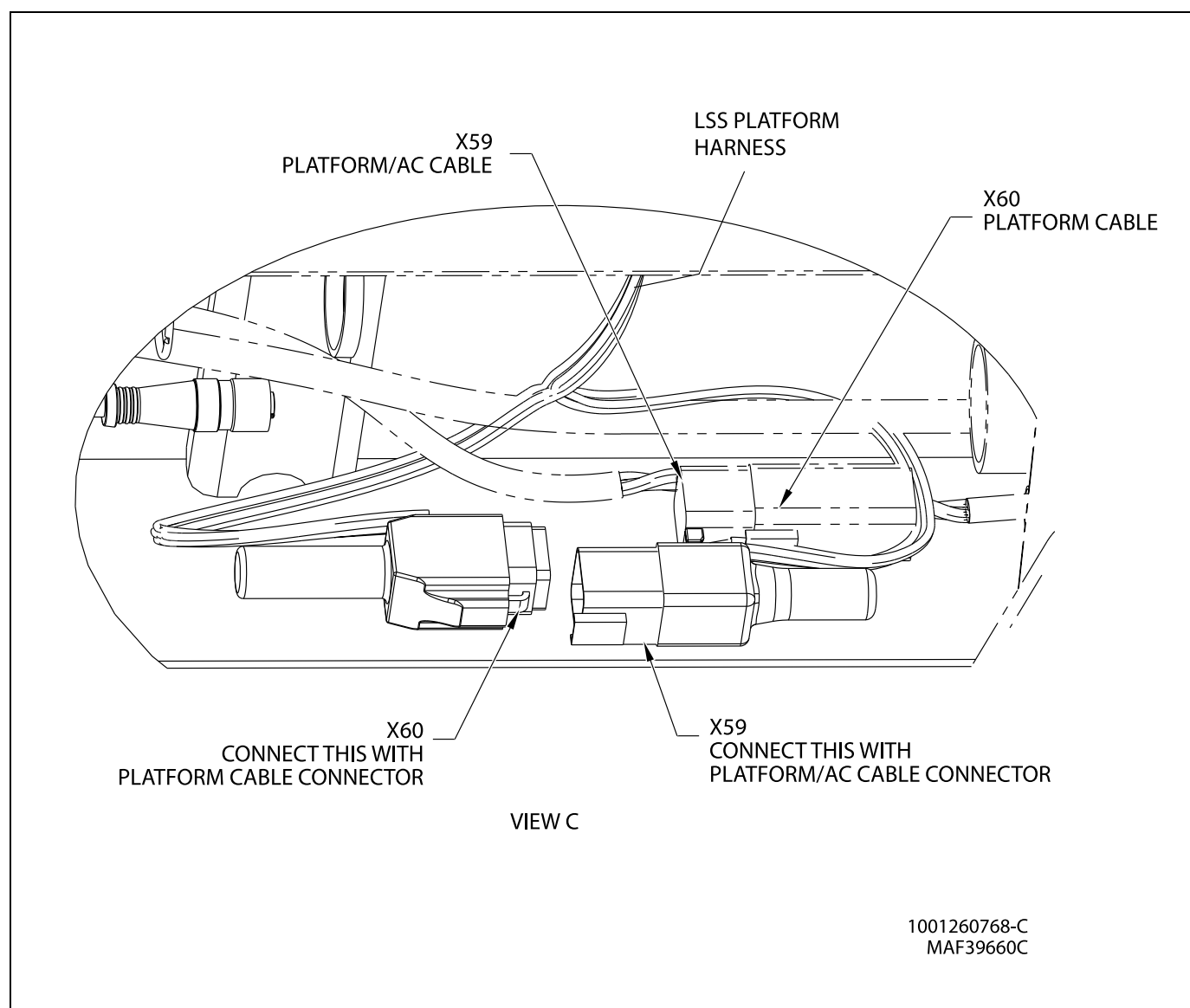


Figure 39. LSS and Platform Assembly - Installation/Removal - Sheet 4 of 4

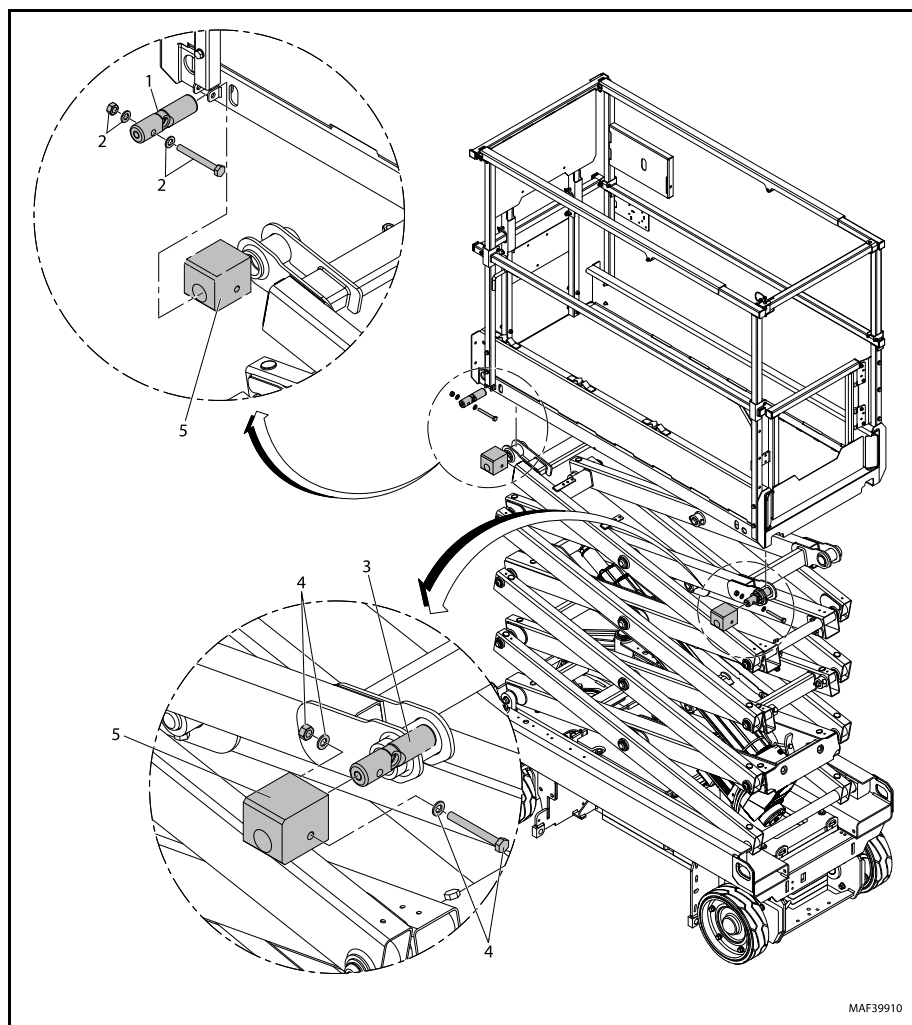
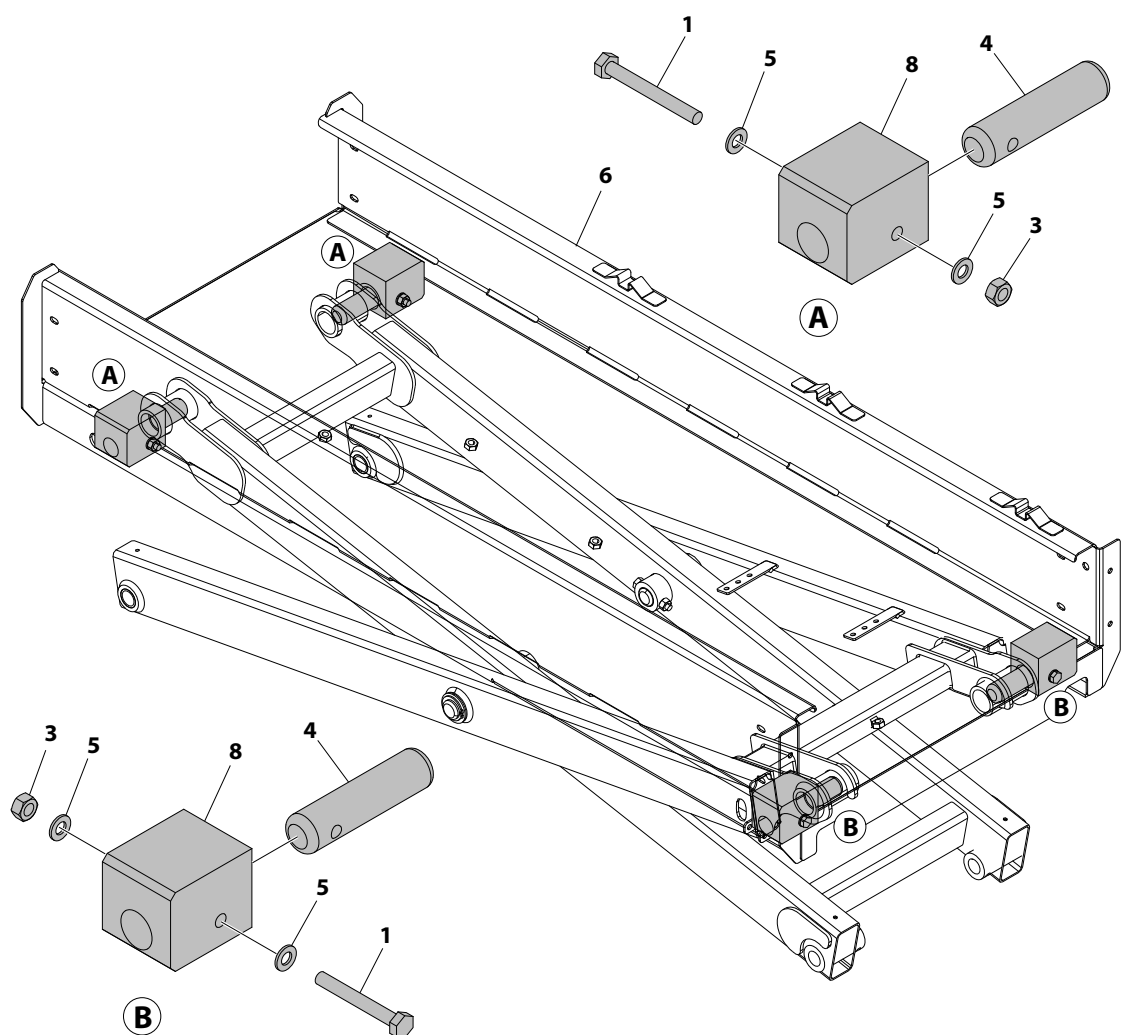


Figure 40. Platform Assembly (with LSS) - Installation/Removal

1. Front Platform to Arm Attach Pin	4. Pin Screw, Lock Nut and washers
2. Pin Screw, Washers and Lock Nut	5. Slide Block (Install with thick section above hole)
3. Rear Platform to Arm Attach Pin	

Note: Parts same for both sides of machine.



SC100830A

Figure 41. Platform Assembly (without LSS) (JAPAN) - Installation/Removal

1. Capscrew	4. Platform Attach Pin	7. Block, Upper Rear Slide
2. Capscrew	5. Washer	8. Block, Upper Front Slide
3. Locknut	6. Platform Weldment	

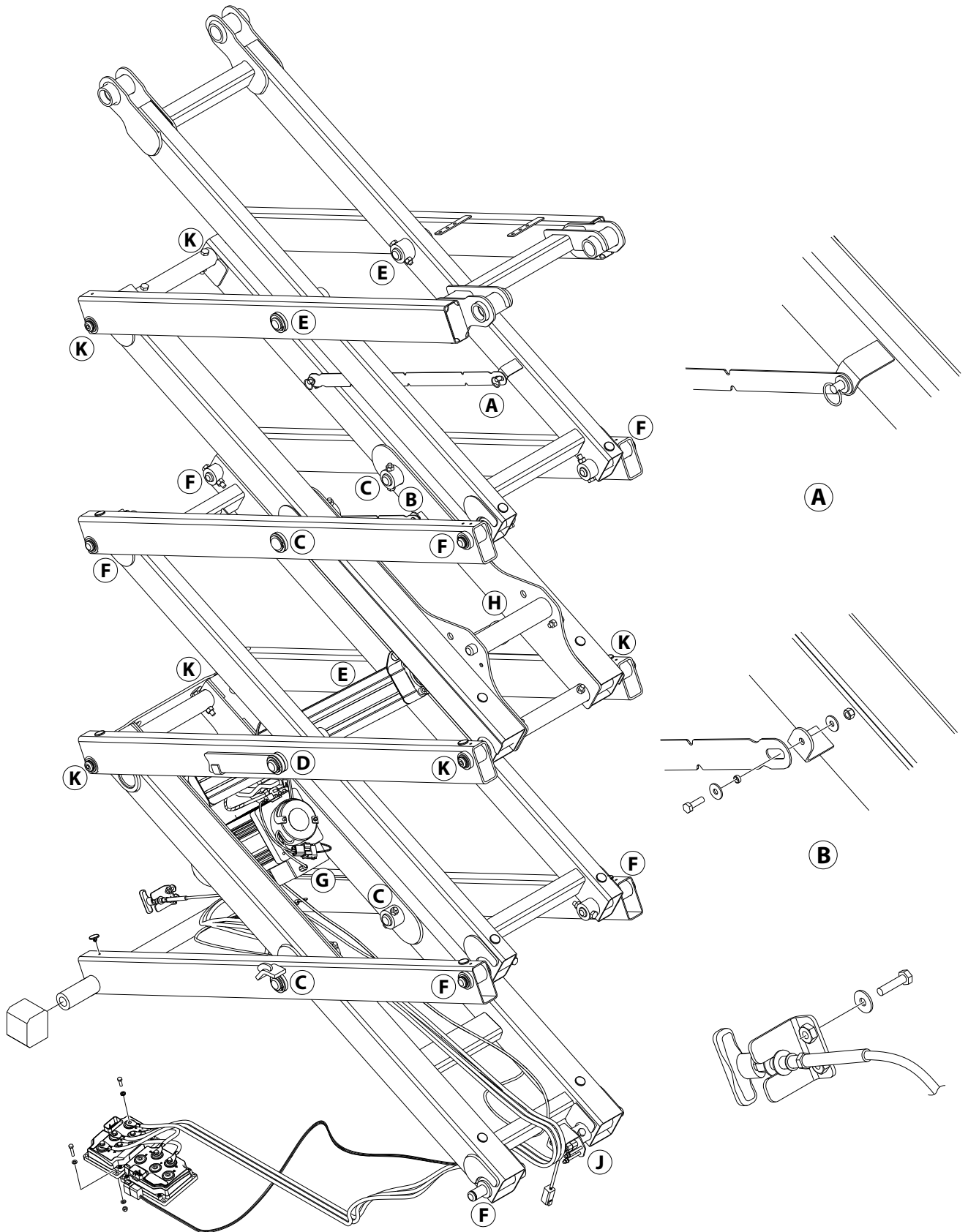


Figure 42. Scissor Arm Assembly

SC100834A

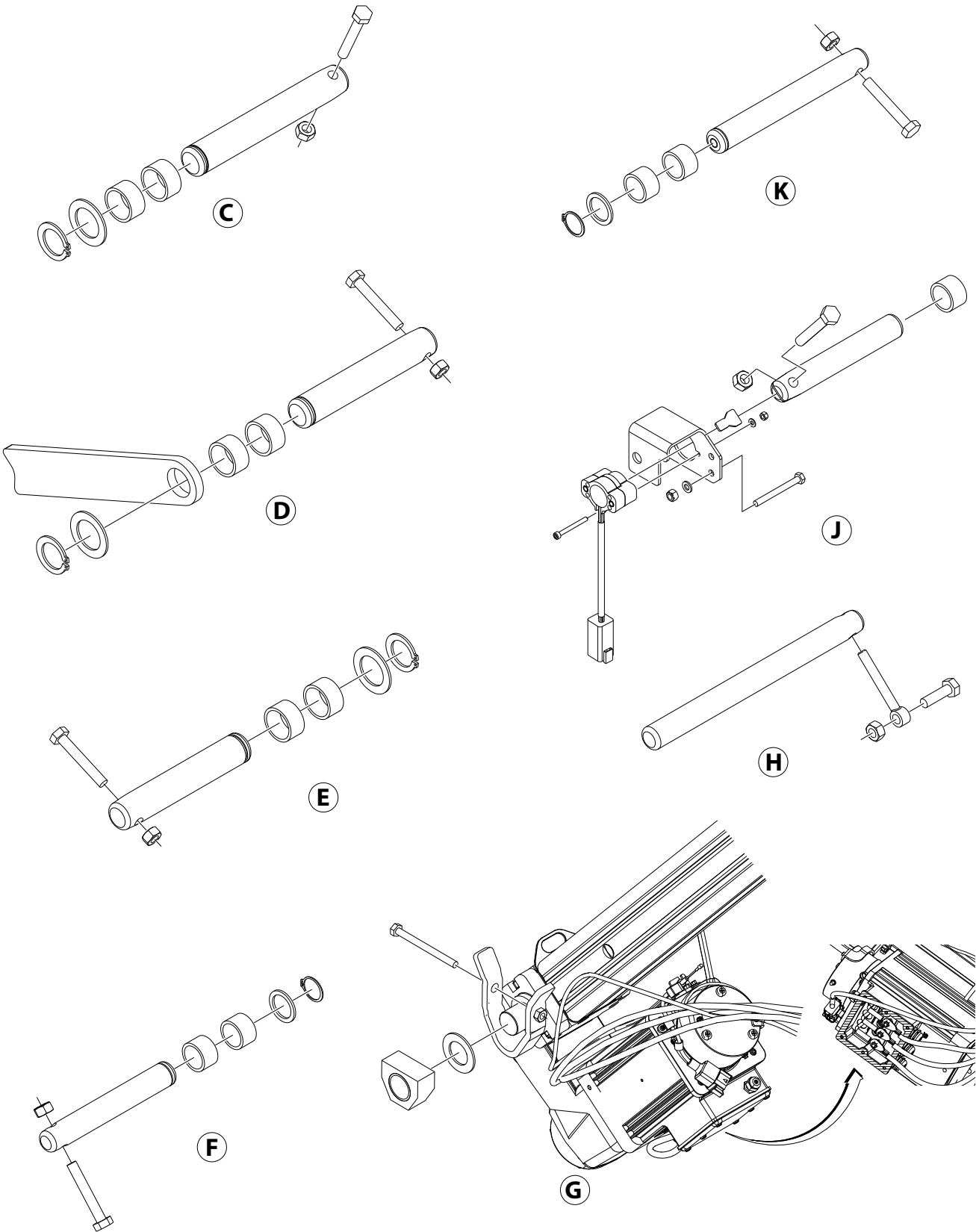
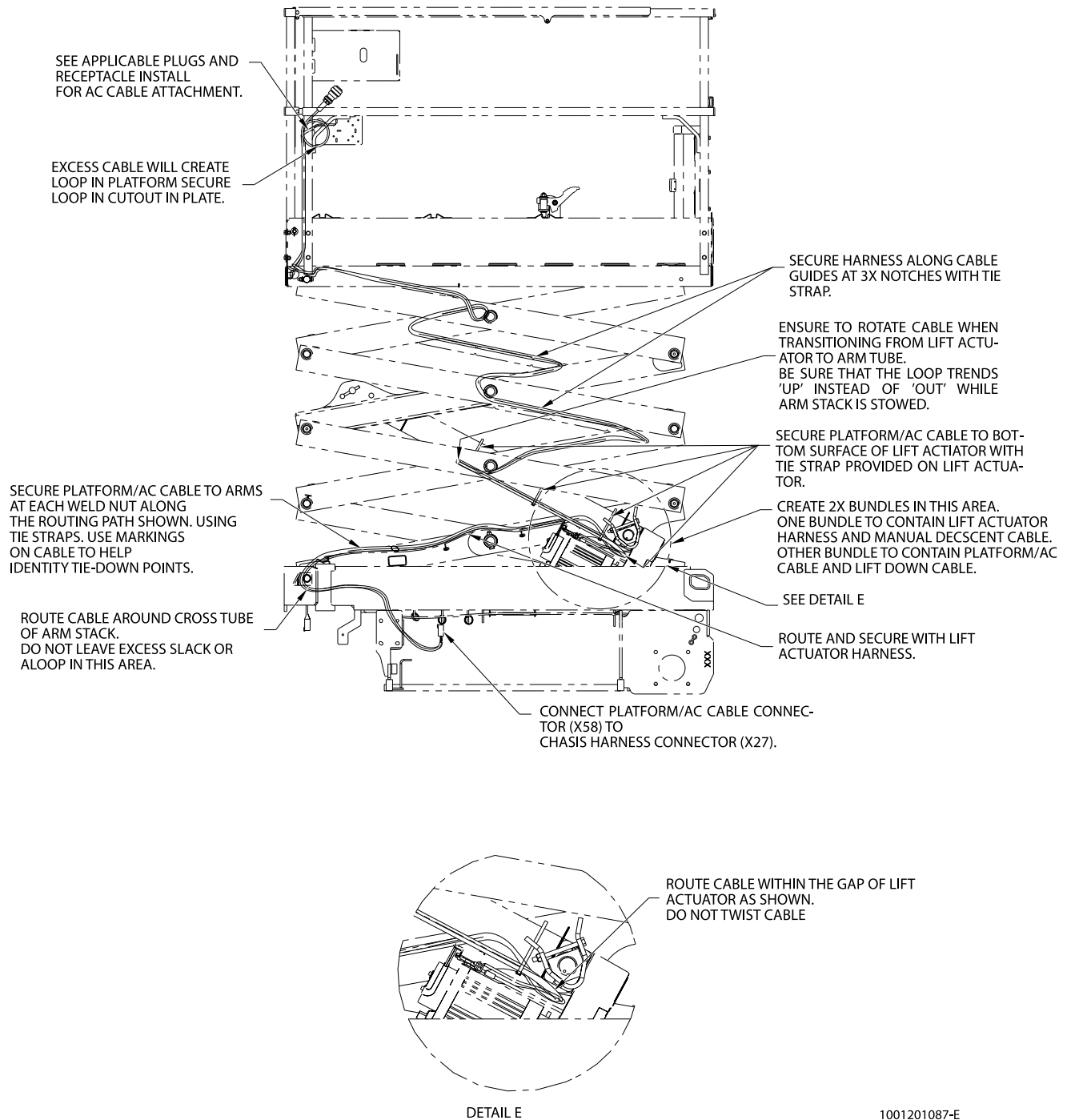


Figure 43. Scissor Arm Assembly - Pin Configuration

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Figure 44. Scissor Arm Assembly - Cable Routing

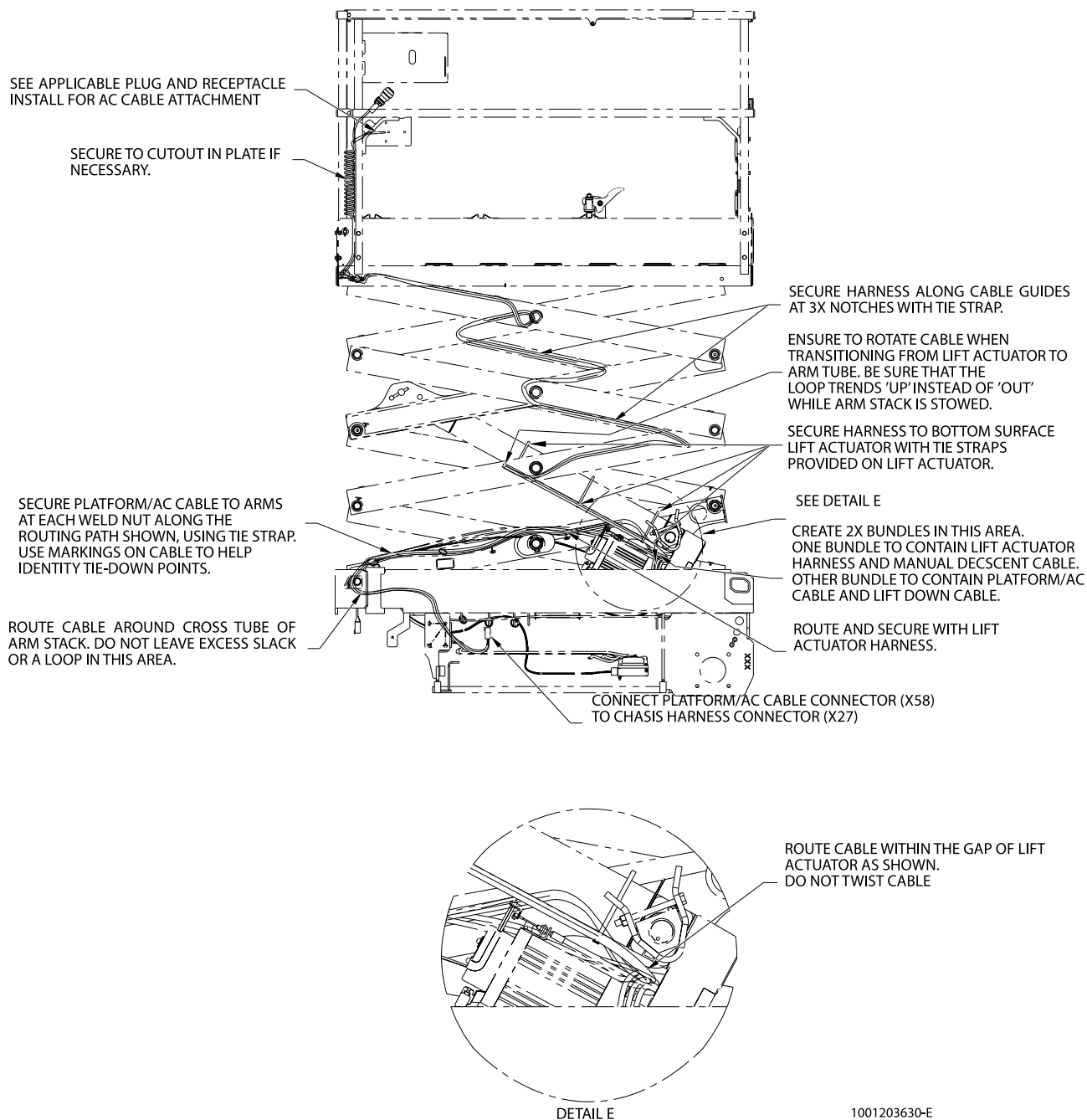
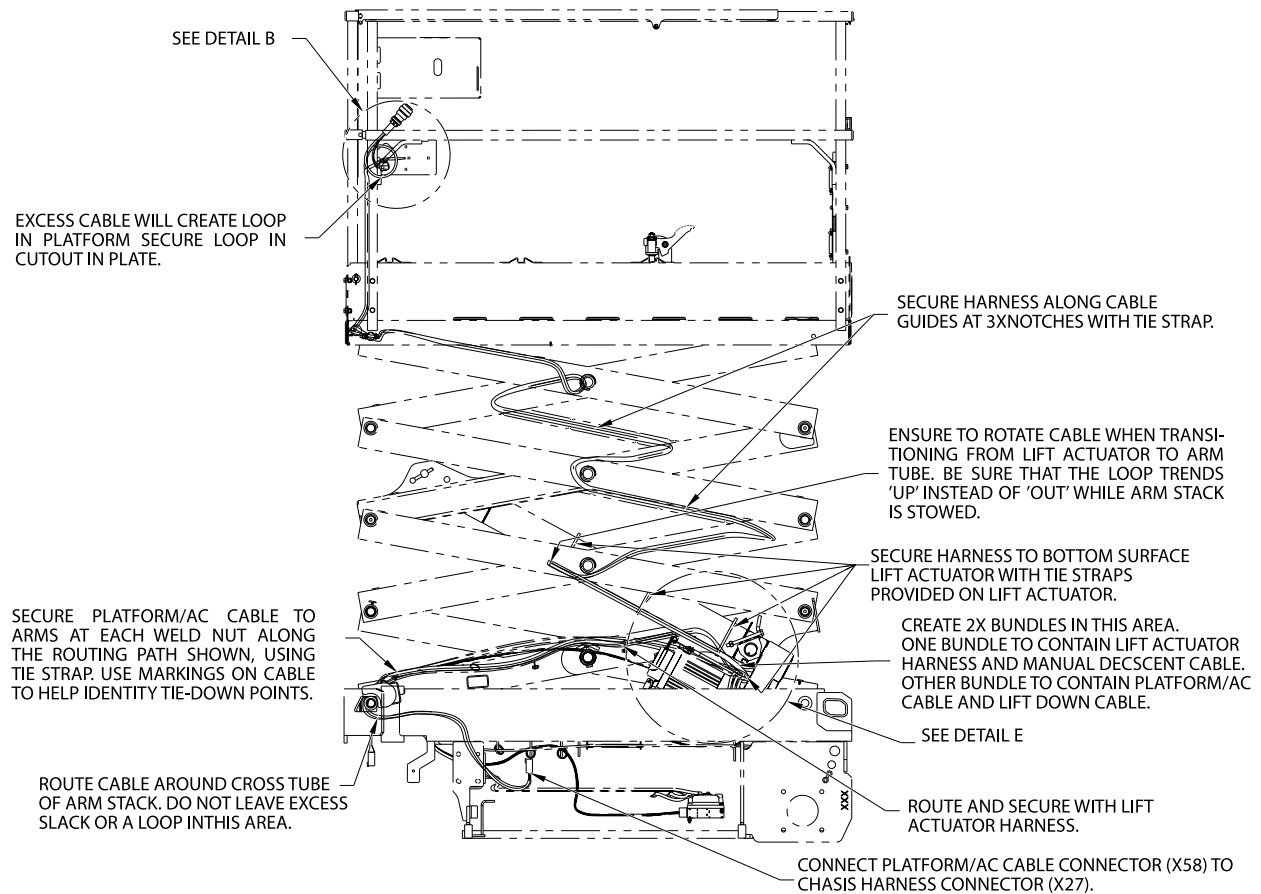
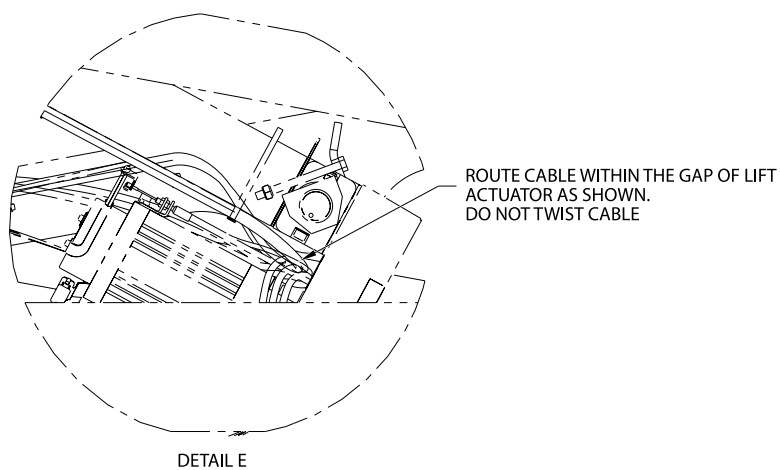
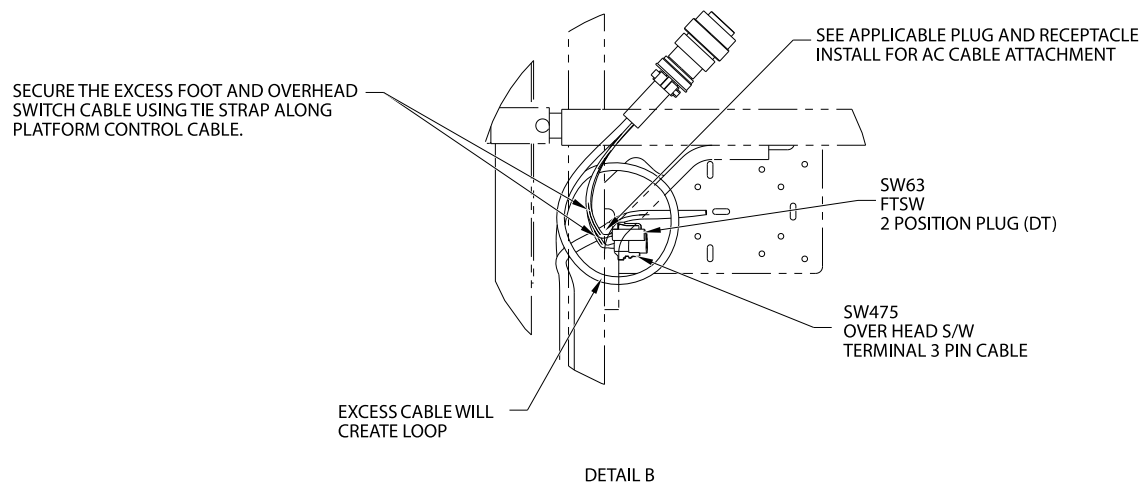


Figure 45. Scissor Arm Assembly - Cable Routing (Coil)



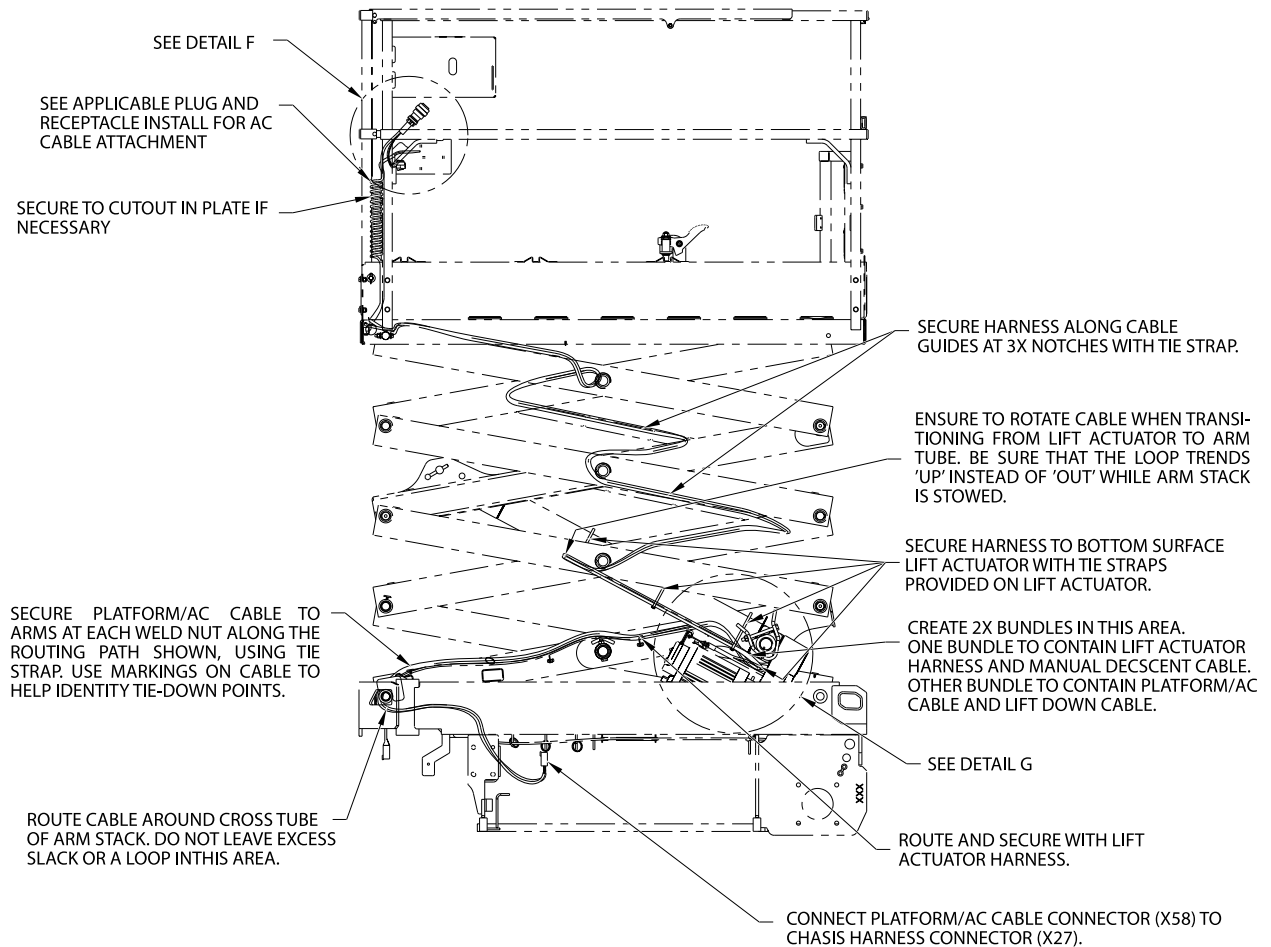
1001201129-F
MAF39590F

Figure 46. Scissor Arm Assembly - Cable Routing (FTSW) (Overhead) - Sheet 1 of 2



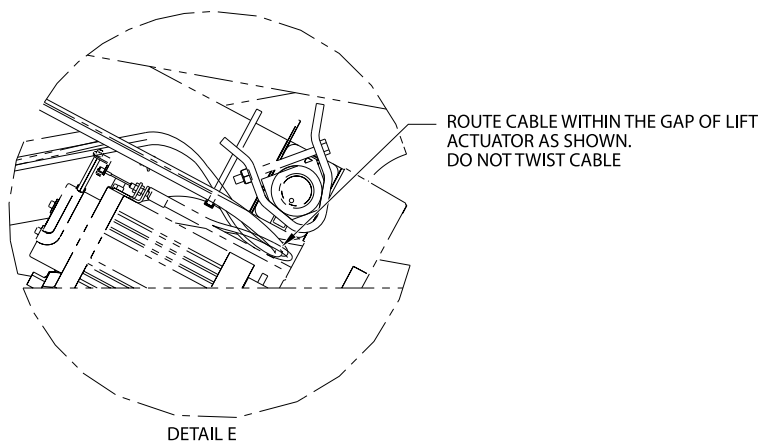
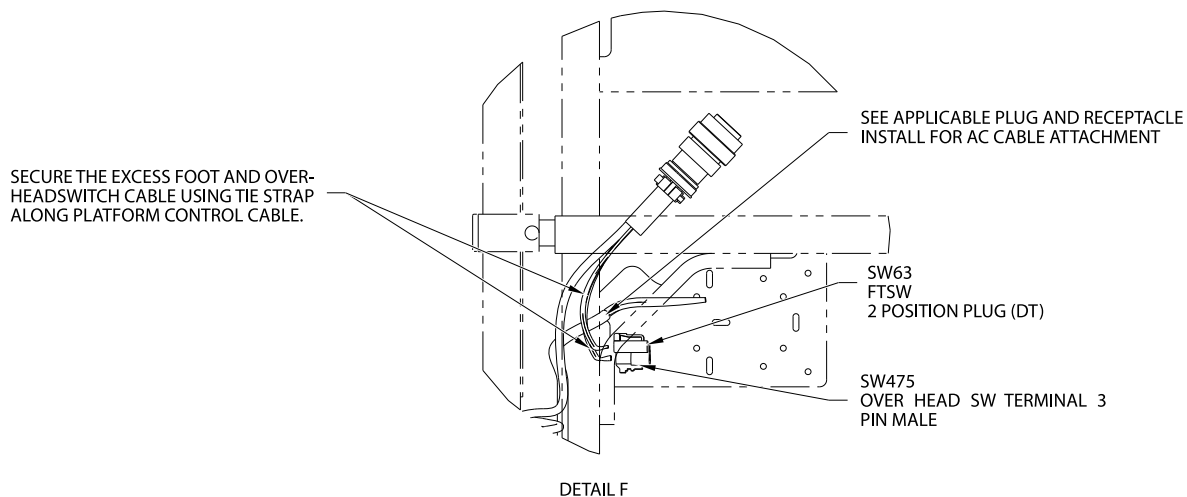
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MAF39600F

Figure 47. Scissor Arm Assembly - Cable Routing (FTSW) (Overhead) - Sheet 2 of 2



1001203631-F
MAF39610F

Figure 48. Scissor Arm Assembly - Cable Routing (FTSW) (Overhead) (Coil) - Sheet 1 of 2



1001203631-F
MAF39620F

Figure 49. Scissor Arm Assembly - Cable Routing (FTSW) (Overhead) (Coil) - Sheet 2 of 2

SECTION 4 ACTUATORS

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4.1 LIFT ACTUATOR

4.1.1 Removal

Note: If lifting with crane or fork truck the manual descent cable must be pulled to release the parking brake on the motor to allow the actuator to extend. Refer to [Figure — Arms and Platform Positioning with Overhead Support](#).
If machine/actuator is inoperable refer to [Section — Lift Actuator Manual Override, page 101](#) procedure to remove the lift actuator.

WARNING

Never work under an elevated platform until it has been restrained from movement with blocking, or overhead slings.

Self-locking fasteners, such as nylon insert and thread deforming locknuts, are not intended to be reinstalled after removal. Always use new replacement hardware when installing locking fasteners.

1. Use fork lift or strap to support the platform and scissor arms before removal of the lift actuator. Refer to [Figure — Arms and Platform Positioning with Overhead Support](#).
2. Cut any wire ties that attach any cables to the lift actuator.

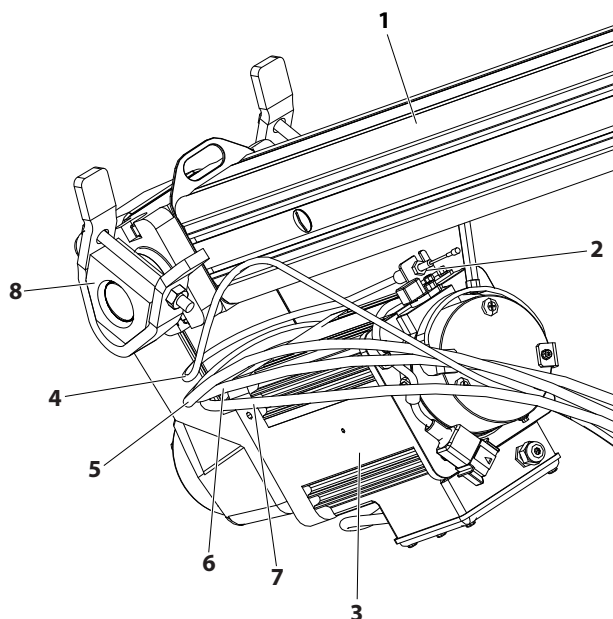
NOTICE

Disconnect main power from the battery before removing any components from the lift actuator assembly.

3. Remove three cables and the manual descent cable from the actuator.

Note: To avoid having to readjust the manual descent, remove the large nut located behind the manual descent bracket as shown.

4. Ensuring that the platform and scissor arms are properly secure, support the lift actuator and remove the top lift actuator pin and rest the top of the actuator on the arm cross tube directly below the actuator.



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Figure 50. Lift Actuator Assembly

1. Actuator	5. Lift Cable (W)
2. Nut	6. Lift Cable (V)
3. Motor	7. Lift Cable (U)
4. Manual Descent Cable	8. Trunnion

5. Remove the bolt from the actuator trunnion and have someone assist you in lifting the actuator from the scissor arms.
6. Place the actuator assembly into a suitable holding fixture.
7. Remove motor, brake, gear box and coupling assembly (If necessary). Refer to [Section — Motor, page 101](#); [Section — Actuator Brake, page 103](#); [Section — Coupling, page 102](#) and [Section — Gearbox, page 105](#).

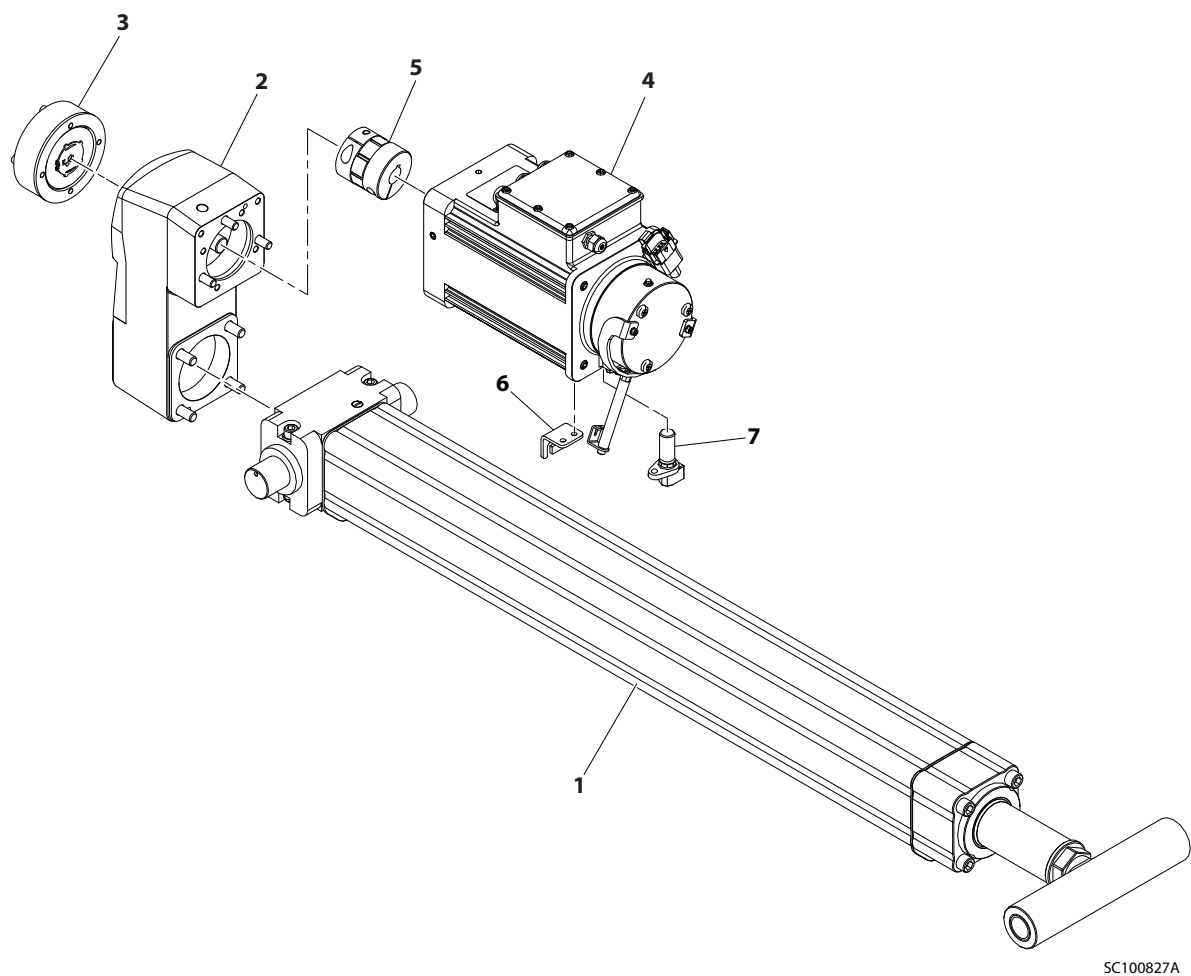


Figure 51. Lift Actuator

SC100827A

1. Actuator	5. Coupling
2. Gear Box	6. Manual Descent Bracket
3. Actuator Brake	7. Speed Sensor
4. Motor	

4.1.2 Installation

1. Install motor, brake, gear box and coupling assembly to actuator. Refer to [Section — Motor, page 101](#); [Section — Actuator Brake, page 103](#); [Section — Coupling, page 102](#) and [Section — Gearbox, page 105](#).
2. Place the actuator assembly into a suitable holding fixture.
3. Install trunnion block to actuator and place into trunnion mounts of lower weldment.
4. Remove actuator assembly from the holding fixture. Use suitable lifting device to support the actuator assembly.
5. Install hardware to the lower actuator and top actuator pin and secure the actuator assembly.
6. Connect three cables and the manual descent cable to the actuator. Tie the cables to actuator.

4.1.3 Lift Actuator Manual Override

In case of power failure to manual override the machine follow below process

Note: If lifting with crane or fork truck the manual descent cable must be pulled to release the parking brake on the motor to allow the actuator to extend. Refer to [Figure — Arms and Platform Positioning with Overhead Support](#).

1. Use fork lift or strap to support the platform and scissor arms before removal of the lift actuator. Refer to [Figure — Arms and Platform Positioning with Overhead Support](#).
2. Remove cap at the rear of the gearbox and install M8 allen wrench and connect to a power drill.
3. With the help of a second person pull the manual descent cable (To release parking brake) and simultaneously power the drill clockwise to extend. Once platform is at it's desired height release the manual descent cable to engage the parking brake.
4. Remove the bolt from the actuator trunnion and have someone assist you in lifting the actuator from the scissor arms.
5. Place the actuator assembly into a suitable holding fixture.
6. Remove motor, brake, gear box and coupling assembly (If necessary). Refer to [Section — Motor, page 101](#); [Section — Actuator Brake, page 103](#); [Section — Coupling, page 102](#) and [Section — Gearbox, page 105](#).

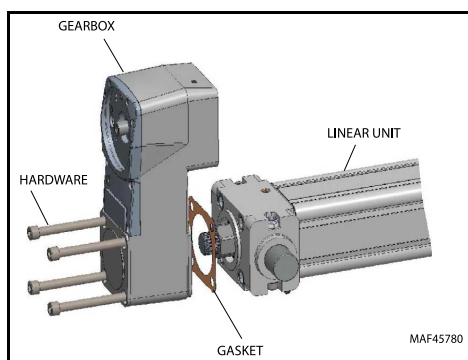
4.2 LINEAR UNIT

4.2.1 Disassembly

1. Support the lift actuator and Remove the hardware from gearbox assembly.
2. Remove linear unit and gasket from lift actuator.

4.2.2 Assembly

1. Install gasket onto linear unit.
2. Install gearbox onto linear unit with adequate support with hardware. Torque to 29.5 ft.lb. (40 Nm).
3. Make sure the holes of the gasket and gearbox align with the holes in the linear unit.



4.3 MOTOR

4.3.1 Disassembly

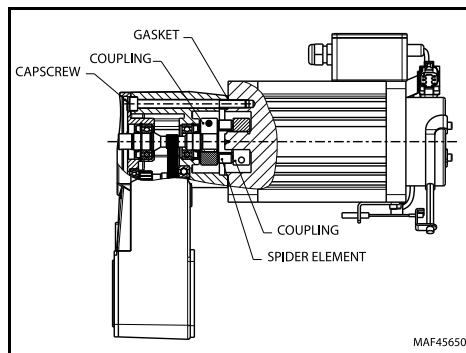
1. Support the motor assembly with adequate lifting device.
2. Remove the hardware attached to gearbox to the brake assembly.
3. Remove gasket and coupling from the motor shaft.

Actuators

4. Remove cap from the access hole in the motor.

4.3.2 Assembly

1. Install Coupling on to motor shaft and install spider element onto coupling on motor shaft.
2. Install gasket onto motor and make sure that holes in the gasket align with the threaded holes in the motor flange.
3. Align coupling by turning on the input shaft of the gearbox and install motor to gearbox with hardware. Torque to 29.50 ft. lb. (40Nm).



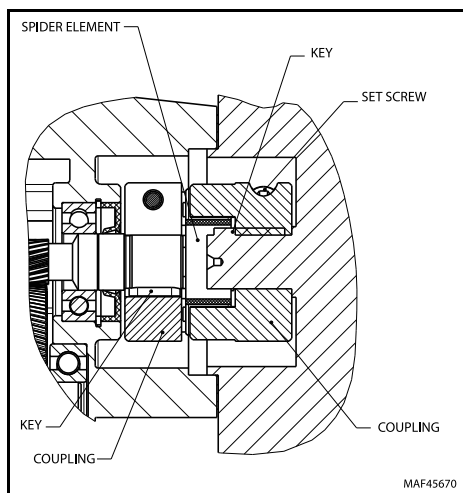
4.4 COUPLING

4.4.1 Disassembly

1. Remove centrifugal and motor brake from gear box. Refer to [Section — Motor, page 101](#) and [Section — Actuator Brake, page 103](#).
2. Remove cap and release EM-brake with the manual lever to gain access to the coupling.
3. Remove key, coupling and spider element from motor shaft.
4. Remove setscrew from gearbox to gain access to coupling and remove coupling from gearbox input shaft.
5. Remove key from gearbox input shaft.

4.4.2 Assembly

1. Install key and coupling on motor shaft.
2. Rotate motor shaft to gain access and install setscrew. Torque to 11 ft.lb. (15Nm). Close access hole with cap.
3. Install key and coupling onto gearbox input shaft.
4. Rotate input shaft to gain access and install setscrew. Torque to 11 ft.lb. (15Nm). Close access hole with setscrew.
5. Install spider element onto one of the couplings.
6. Install motor and centrifugal brake to gear box. Refer to [Section — Motor, page 101](#) and [Section — Actuator Brake, page 103](#).



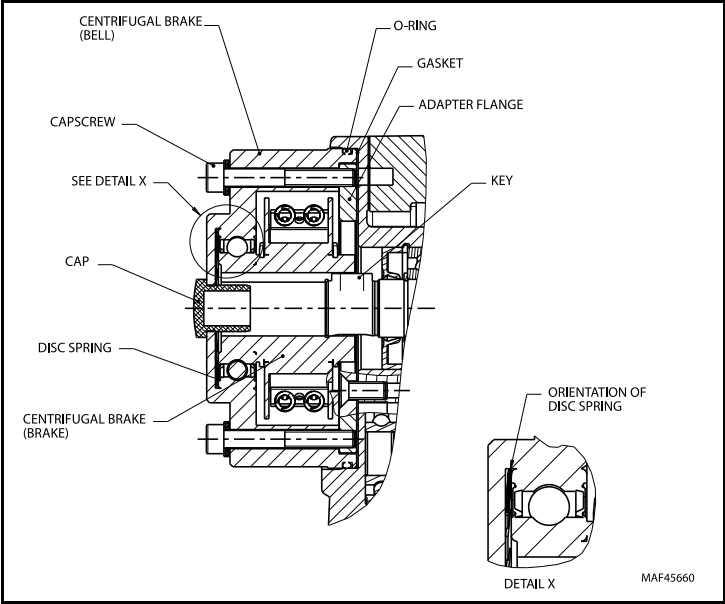
4.5 ACTUATOR BRAKE

4.5.1 Disassembly

1. Remove the hardware securing centrifugal brake bell to gearbox.
2. Remove and discard o-ring and disc spring from centrifugal brake bell.
3. Remove centrifugal brake from input shaft along with adapter flange and gasket.
4. Remove key from gearbox input.

4.5.2 Assembly

1. Insert key into key hole in gearbox input shaft.
2. Install gasket and adapter flange on gear box.
3. Install centrifugal brake on gearbox input shaft.
4. Install o-ring and disc spring into centrifugal brake bell.
5. Place centrifugal brake bell onto centrifugal brake and gearbox. Make sure that the o-ring does not get squeezed or damaged during installation.
6. Secure centrifugal brake bell to gearbox with hardware. Torque to 3.68 ft.lb. (5 Nm).
7. Make sure sealing rings are pressed equally. If not, replace the sealing washer.
8. Install cap into centrifugal brake bell.



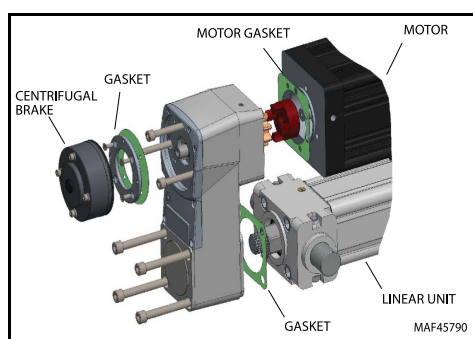
4.6 GEAR BOX

4.6.1 Disassembly

1. Remove centrifugal brake assembly. Refer to [Section — Actuator Brake, page 103](#).
2. Remove motor assembly. Refer to [Section — Actuator Brake, page 103](#).
3. Remove linear unit assembly. Refer to [Section — Linear Unit, page 101](#).

4.6.2 Assembly

1. Install linear unit to actuator. Refer to [Section — Linear Unit, page 101](#).
2. Install motor assembly to gearbox. Refer to [Section — Motor, page 101](#).
3. Install Centrifugal brake assembly to gearbox. Refer to [Section — Actuator Brake, page 103](#).



4.7 STEER ACTUATOR

4.7.1 Removal

Note: Refer to [Figure — Steer Actuator and Spindle Assembly, page 77](#).

NOTICE

Disconnect all the connections from the actuator before removing any components from the spindle assembly.

Note: If machine/actuator is inoperable refer to Section , Steer Actuator Manual Override procedure to extract, retract or rotate the rod.

1. Remove spindle assembly from the chassis.

Note: Steer actuator approximately weighs 10.8 lb (5 kg).

2. Support the actuator assembly and remove the hardware attached steer lugs to the actuator assembly.
3. Remove the hardware attached to the actuator assembly and remove the actuator from bracket.

4.7.2 Installation

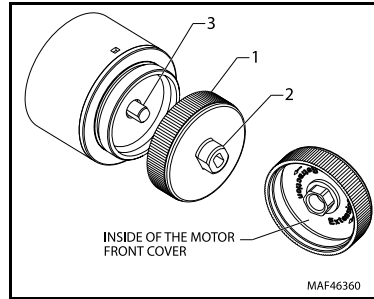
1. Secure actuator assembly to the bracket by installing the hardware.
2. Support the actuator assembly and secure actuator assembly to the steer lugs by installing the hardware.
3. Use suitable lifting device to lift the chassis assembly and secure spindle assembly to the chassis.

Actuators

4.7.3 Steer Actuator Manual Override

In case of power failure to manual override the machine follow below process.

1. Support the actuator assembly and remove the hardware attached steer lugs to the actuator assembly.
2. Remove the hardware attached to the actuator assembly and remove the actuator from bracket.
3. Release the motor cover (1) and use slot (2) to rotate the motor shaft (3) in proper direction to extract, retract or rotate the rod.



4.8 RELUBRICATION PROCEDURE FOR ACTUATOR IN ARM STACK

Note: 4gram is the max amount of grease to apply during re-lubrication. Actuator nut should be re-greased every three years.

⚠ WARNING

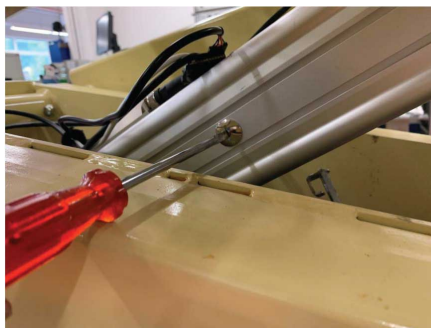
Never work under an elevated platform until it has been restrained from movement with blocking, or overhead slings.

1. Park the machine on a firm level surface.
2. Lift the scissor arm to gain access to the actuator port.



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3. Remove the hardware from port with screw driver.



SC100410A



SC100411A

4. Use manual or automatic grease pump to fill the grease to the port.



SC100412A

Actuators

5. Align the nozzle to the port and press firmly on port so no grease gets spilled off from the port.



SC100413A

WARNING

Actuator nut should be re-greased for every 3 years and 4g is the maximum amount of grease to apply during lubrication.

6. Secure the lubrication port with hardware. Torque to 1.45 ft.lb. (2 Nm).



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SECTION 5

JLG CONTROL SYSTEM

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5.1 MOBILE DIAGNOSTIC DEVICE

To Connect Mobile Device to machine download DaVinciGO application.

Note: IQANgo App can also be used as Mobile Diagnostic device.

5.1.1 Download DaVinciGO App

IOS:

The DaVinciGO App can be downloaded from the App Store.

Search "DaVinciGO" in the app store. Refer to [Figure — DaVinciGO Icon, page 110](#).

Download and install the "DaVinciGO" app on the mobile device/iPad.

ANDROID:

The DaVinciGO App can be downloaded from the Google Play Store.

Search "DaVinciGO" in the app store. Refer to [Figure — DaVinciGO Icon, page 110](#).

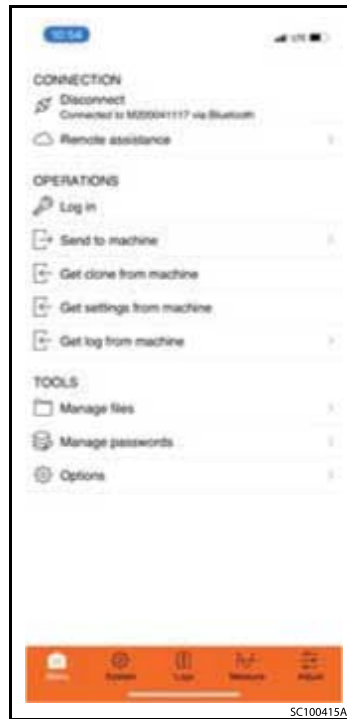
Download and install the "DaVinciGO" app on the mobile device/iPad.



Figure 52. DaVinciGO Icon

5.1.2 Connect Mobile Device To Machine

After downloading the mobile application the home screen will look as shown below,



For detailed information refer to [Table — Main Landing Screen Description, page 111](#).

Table 11. Main Landing Screen Description

Interface	Symbols	Features	Response
MENU		Connection, Operations and Tools	N/A
CONNECTION		Connect	Communication Interface established between machine and APP.
		Disconnect	Communication Interface between Machine and APP is Disconnected.
OPEARTION		Remote Assistance	Contains Read only Information of Machine ID, IQANCONNECT KEY, Data transferred and Connection of Internet and Machine.
		Log In	Credentials will be required to enter the required level of access depending upon the nature of work performed.
		Logout	Logout of the access level.
		Send to machine	Required machine settings can be modified and send to machine.
		Get clone from machine	Clone file of current machine settings including with or without the logs can be obtained.
		Get settings from machine	The current machine settings can be obtained from machine
		Get logs from machine	The Logs can be obtained from the machine.
TOOLS		Manage Files	Contains the Saved log information of the scissor that includes system, Module logs. And they can be shared with Mail.

Table 11. Main Landing Screen Description (continued)

Interface	Symbols	Features	Response
		Manage passwords	This feature provides Ability to request, Manage and delete password. Prompt message for request password through mail.
		Options	Provides ability to configure Password save prompt methods with toggle switch option. Read Only Version Information for Current versions of App and Firmware.
SYSTEM		System Read only Signals	Displays communication status of modules on CANbus.
LOGS		Logs of Ground Module	When logged into service mode show machine usage information.
MEASURE		Recorded Measure item calibration graph data	Used for viewing live data from machine. DTC's and system test are also included here for troubleshooting. Log into Service Mode for additional measurements
ADJUST		Adjust items of signals	Used to update machine personalities and perform calibrations .Service Mode login required to make any machine adjustments

5.1.3 Machine Power on Setting

1. Move the Key selector switch on the machine to Ground Control / Platform Control.
2. Pull the EMERGENCY button out.
3. Wait for the beep sound and let LED blink on the machine Ground control Panel.

Note: Check Diagnostic Module on the Left-side compartment is connected and indicating its signal through flashing LED.

5.1.4 Connect to Machine Via Bluetooth

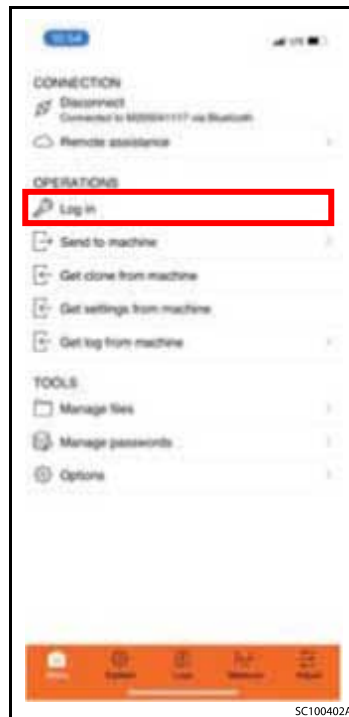
1. Power on the machine.
2. Click on connect option and turn on the bluetooth.
3. Select the machine from the listed display and connect the machine.

Note: Drag the screen downward to refresh the list.



5.1.5 Login to Access Level

1. Click on the Login option.

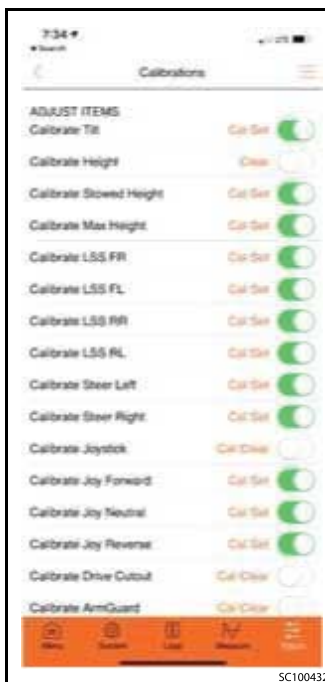


2. Enter User name "Service" and Password "33271" to gain access to the service level.



5.1.6 Calibration Adjustment

1. Power on the machine and connect to machine via bluetooth.
2. Log into service Mode. Refer to [Section — Login to Access Level, page 113](#).
3. Machine should be in ground mode to perform all calibrations except Steer (platform mode).
4. Click on the Adjust menu and select calibration option.
5. Refer to [Section — Machine Configuration, page 118](#) for more details.



6. Toggle the indicator pin to perform a calibration operation.
If indicator toggled to left side, calibration is not done for particular operation and if indicator toggled to right side (Green), calibration is done for particular operation.

5.2 UPDATING SOFTWARE

Software updates are available via OLE (Online Express). Navigate to the website and follow the instructions for to download software updates.

5.2.1 Downloading Software

1. Open browser and search onlineexpress.jlg.com.
2. Login using OLE password to access Service tab and control software.
3. Click on service tab drop down option and select control software.
4. Select brand as "JLG Scissor lift" and model as "AE1932". Click on "Download this file" hyperlink.
5. Read all terms and condition to download the software and Click on "Accept" button to download.
6. To move the file to DaVinciGO app using different browser follow below process.
 - a. **iOS**

Safari:

- Go to downloaded file location and long press the file, select "Move" option from the dropdown to move the file to DaVinciGO app.
- Software will be in manage file section on Menu page.

Chrome:

- Click on the downloaded file.
- Scroll to open in DaVinciGO app.
- Software will be in manage file section on Menu page.

b. **Android**

Chrome:

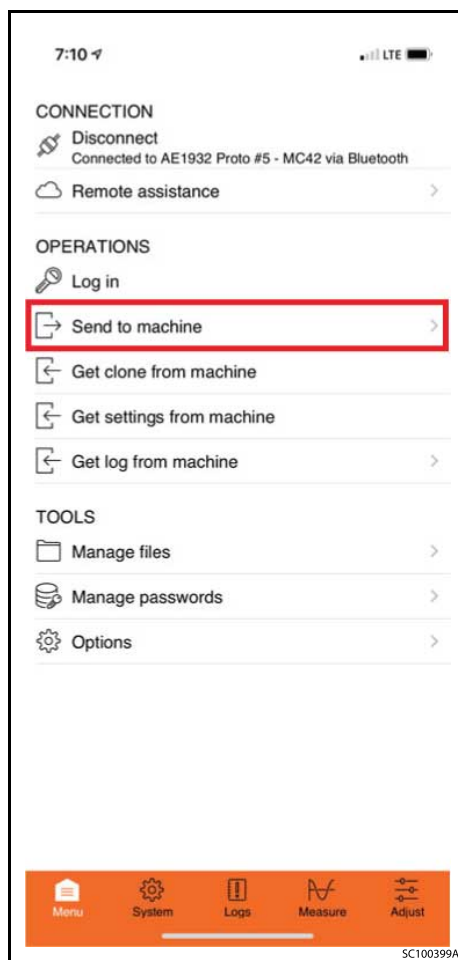
- Go to downloads and share downloaded file to DaVinciGO folder in goggle drive.
- Open the uploaded file with "Zip Extractor" to unzip the file.
- Download the unzipped file and move the file to DaVinciGO app.
- Software will be in manage file section on Menu page.

7. Refer to [Section — Remote Assistance, page 125](#) for alternate way to update software.

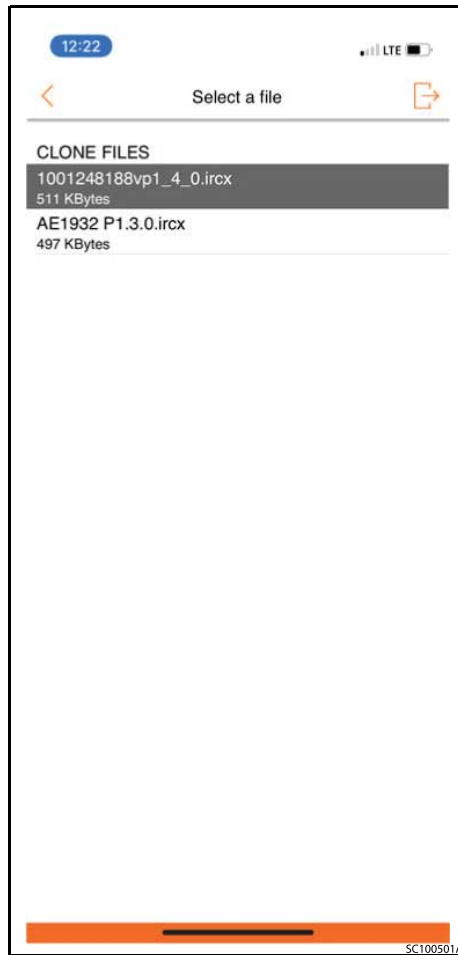
5.2.2 Installing Software

1. Power on the machine and connect to machine via bluetooth.
2. Click on the Menu tab.
3. Log into service mode. Refer to [Section — Login to Access Level, page 113](#).

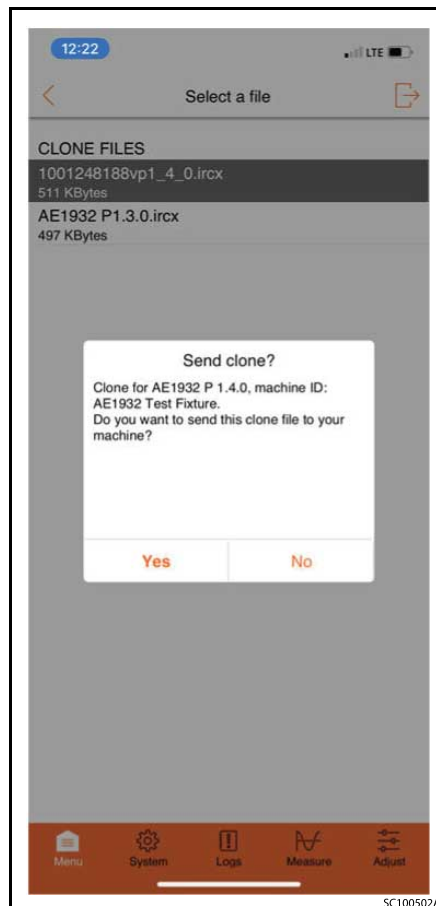
- Click on send to machine tab.



5. Select the appropriate clone file (software) to send to machine and Click on send icon at the top right corner.



6. Ensure and click on "Yes" when new software installation pop up on screen.



7. Enter the password "33271" to confirm the software updation.
8. After successful installation of software, finalization screen will appear and alarm will sound to inform the completion of machine setup and calibration process. Refer to [Section — Machine Configuration, page 118](#) for more details.

5.3 MACHINE CONFIGURATION

Machine configuration is needed when new software is installed followed by a full machine calibration.

1. Log into service mode. Refer to [Section — Login to Access Level, page 113](#).
2. Go to Adjust tab and click on Market tab.
3. Select a particular model.
4. Market will be auto selected based on [Table — Machine Configuration Programming Information \(Software Version P1.3.0\), page 119](#).

Note:

1. When configuring a scissor machine, the machine configuration programming must be completed before any personality settings can be changed, Refer to [Table — Machine Model Adjustment \(Personality Settings\) \(Software Version P1.3.0\), page 123](#) Changing the personality settings first and then changing the model number of the machine configuration will cause the personality settings to return to default value.
2. Solid shaded entries are not available for the selected Market.
3. Select Market as CE for UKCA specification machine on analyzer.

Table 12. Machine Configuration Programming Information (Software Version P1.3.0)

Configuration Digit	Setting	Description	Market Default Setting					
			1	2	3	4	5	6
MODEL	1	AE1932	1	1	1	1	1	1
MARKET	1	ANSI USA						
	2	ANSI EXPORT						
	3	CSA	1	2	3	4	5	6
	4	CE						
	5	JAPAN						
	6	AUS						
DRIVE CUTOUT	1	NO-Vehicle is not configured with Drive cutout when elevated.	1	1	1	1	1	1
	2	YES-Vehicle is configured with Drive cutout when elevated.						
CHARGER INTERLOCK	1	DRIVE ONLY- Drive motion prevented while vehicle is charging.	1	1	1	1	1	1
	2	DRIVE AND LIFT UP - Drive and lift up motions are prevented while vehicle is charging.						
GROUND ALARM	1	MOTION- Ground Alarm sounds during Lift Up, Lift Down, Drive Forward, or Drive Reverse.						
	2	HORN ONLY- Ground Alarm only sounds when user presses Platform Horn button.	1	1	1	2	1	1
	3	DESCENT- Ground Alarm sounds during Lift Down.						
LOAD	1	NO- Load Sensing System(LSS) is not fitted to the vehicle.						
	2	CUTOUT PLATFORM - Load Sensing System (LSS) is fitted, and Platform Controls are prevented in the even to fan Overload. Ground Controls remain functional.	2	2	2	3	2	2
	3	CUTOUT ALL - Load Sensing System (LSS) is fitted. Platform and Ground Controls are prevented in the even to fan Overload.						
BEACON	1	YES- Optional beacon is present.	2	2	2	1	2	2
	2	NO- Optional beacon not present.						
WHITE NOISE ALARM	1	NO-Vehicle does not have the white noise alarm.	1	1	1	1	1	2
	2	YES-Vehicle has the white noise alarm.						
PHP ALARM	1	NO-Vehicle is not configured with PHP Alarm when Pothole bar is blocked.	1	1	1	1	1	1
	2	YES - Vehicle is configured with PHP Alarm when Pothole bar is blocked.						
FORCE CHARGER OFF	1	CHARGER OFF - Force Charger Off.	2	2	2	2	2	2
	2	CHARGER AUTO - Charger Automatic Mode						
CONTACTOR TIME OUT ENABLE	1	TRUE - Machine will enter Safe Mode after Set Time	1	1	1	1	1	1
	2	FALSE - Machine will not enter Safe Mode						
INACTIVITY BEEP ENABLE	1	TRUE - Vehicle will beep after a period of inactivity.	1	1	1	1	1	1
	2	FALSE - Vehicle will not beep after a period of inactivity.						

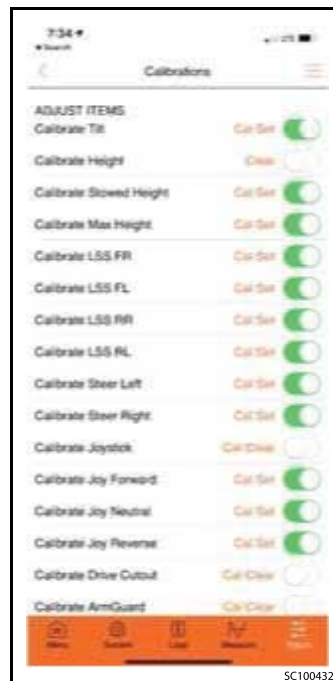
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5.3.1 New Software Calibration

Note: Machine alarm will sound until calibration process is complete.

1. Machine to be in a ground mode.
2. Login to service access mode. Refer to [Section — Login to Access Level, page 113](#).
3. Go to adjust tab and click on market tab.
 - a. Set model to AE1932.
 - b. Select appropriate market (scroll if needed).
 - c. Leave remaining setting as auto market unless additional accessories are equipped on machine.

4. Follow the calibration process order as in the calibration tab.



a. **Tilt**

- Ensure the machine is on firm and level ground surface.
- Toggle the "Calibrate Tilt" pin to calibrate (Green).

b. **Elevation Height**

- Machine to be in stowed state and toggle the "Calibrate Height" pin to calibrate (Green).

⚠ CAUTION

Upper slide block need to stop approximately 2 inch before rib on bottom of platform.

- Elevate the machine to full height and once reached desired position toggle to calibrate icon (green).
- Lower the machine to stowed position and toggle the "Calibrate Height" icon to lock calibration (Grey).

c. **LSS**

- Elevate the arms so there is about 2 in. (50 mm) gap between arms.
- Toggle all 4 pins of LSS to calibrate (Green).
- Once all 4 pins are calibrated ground alarm will stop sounding.

d. **Steer**

- Switch machine to platform mode.
- Turn all the way left and toggle to calibrate (Green).

Note: Steer actuator will run at half speed until calibration is complete.

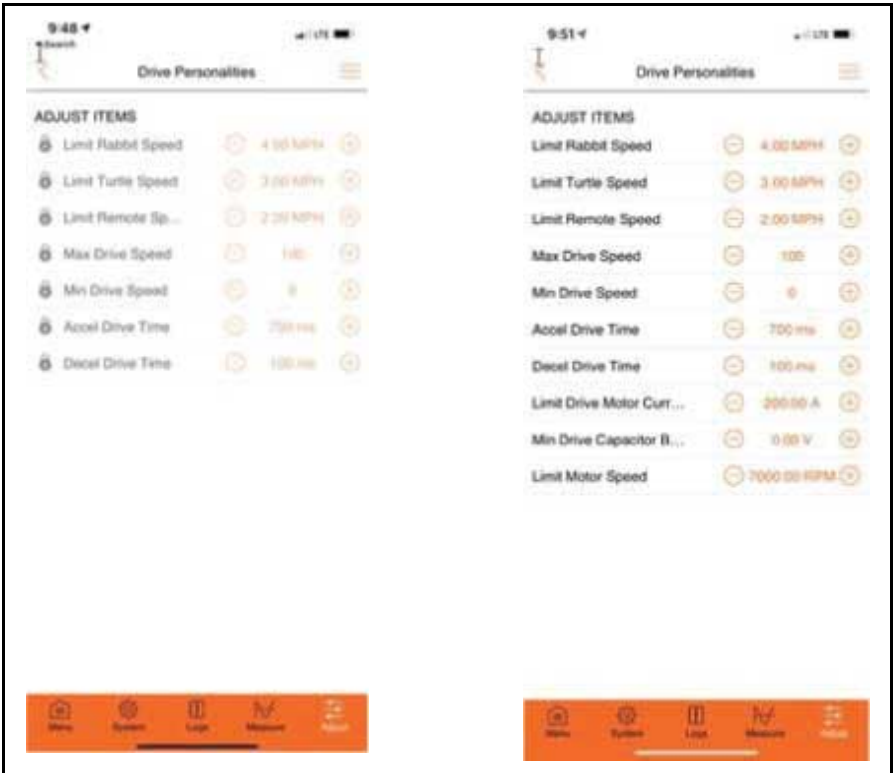
- Turn all the way right and toggle to calibrate (Green).

- 5. Machine calibration Completed. Additional calibration can be done but are not required during a new software installation.

5.4 MACHINE ADJUSTMENT PERSONALITIES

- 1. Power on the machine.
- 2. Open DaVinciGO app and connect to machine. Refer to [Section — Connect to Machine Via Bluetooth, page 112](#).
- 3. Click Login and enter Service mode. Refer to [Section — Login to Access Level, page 113](#).
- 4. Navigate to adjust tab.

Note: All adjustments are locked (Grey) when logged out of service mode and unlocked when logged in to service mode.



Service Mode Logged Out

Service Mode Log In

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Table 13. Machine Model Adjustment (Personality Settings) (Software Version P1.3.0)

Adjustment	Adjustment Range	AE1932
Model		
Horn	1 to 100	94
Ground Alarm	1 to 100	25
Lift Personalities		
Service Override Lift Down Speed	-26000 to 0 rpm	-13000 rpm
Max Lift Down Speed	-26000 to- 650 rpm	-26000 rpm
Service Override Lift Up Speed	0 to 26000 rpm	-13000 rpm
Max Lift Up Speed	650 to 26000 rpm	26000 rpm
Limit Lift Down Torque	5 to 25 Nm	10 Nm
Arm Guard Calibration	Cal Clear /Cal Set	Cal Clear
Arm Guard Lift On Delay	N/A	1500 ms
Arm Guard Calibrated	50 to 228 Inches	50 Inches
Lift Motor Temp	N/A	150 Inches
Max Lift Controller Temp	N/A	95°C
Min Motor Temp Sensor	N/A	-100°C
Limit Lift Motor Speed	4000 to 7000 rpm	4000 rpm
Limit Lift Motor Current	4000 to 7000 rpm	200 A
Min Lift Capacitor Bank	0 to 24 V	0 V
Drive Personalities		
Limit Rabbit Speed	0.0-4.0 mph	4.0 mph
Limit Turtle Speed	0.0-3.0 mph	3.0 mph
Limit Remote Speed	0.0-2.0 mph	2.0 mph
Max Drive Speed	25 to 100	100
Min Drive Speed	0 to 25	0
Accel Drive Time	100 to 5000 ms	700 ms
Decel Drive Time	100 to 2000 ms	100 ms
Limit Drive Motor Current	50 to 250 A	200 A
Max Drive Controller Temp	N/A	95°C
Max Drive Motor Temp	N/A	120°C
Max Motor Temp Sensor	N/A	300°C
Min Motor Temp Sensor	N/A	-100°C
Min Drive Capacitor Bank	0 to 24 V	0 V
Limit Lift Motor Speed	4000 to 7000 rpm	7000 rpm
Height Pothole Deployment	N/A	70 Inches

Table 13. Machine Model Adjustment (Personality Settings) (Software Version P1.3.0) (continued)

Adjustment	Adjustment Range	AE1932
Steering Personalities		
Accel Time Steer	0-5000 ms	10 ms
Accel Tim eSteer	0-1000 ms	5 ms
Calibrate Steer Left	Cal Clear /Cal Set	Cal Clear
Cal Steer Left Voltage	0.5 to 45 V	410 V
Calibrate Steer Right	Cal Clear/Cal Set	Cal Clear
Cal Steer Right Voltage	0.5 to 4.5 V	1.50 V
Tilt		
Tilt Calibration	Cal Clear/Cal Set	Cal Clear
TILTX Calibration	N/A	20°C
TILTY Calibration	N/A	20°C
Load Sensing System (LSS)		
Rated Load	N/A	606 lbs
Weight Accy	0 to 150 lbs	0 lbs
Calibrate FR	Cal Clear/Cal Set	Cal Clear
Calibrate FL	Cal Clear/Cal Set	Cal Clear
Calibrate RR	Cal Clear/Cal Set	Cal Clear
Calibrate RL	Cal Clear/Cal Set	Cal Clear
Cal FR Weight	N/A	0 lbs
Cal FL Weight	N/A	0 lbs
Cal RR Weight	N/A	0 lbs
Cal RL Weight	N/A	0 lbs
Time Overload Debounce	0 to 5000 ms	600 ms
Time Overload Hold	0 to 5000 ms	5000 ms
Elev Height		
Calibrate Height	Clear/Set	Clear
Calibrate Stowed Height	Cal Clear/Cal Set	Cal Clear
Cal Stowed Height	0.5-2.0 V	0.55 V
Calibrate Max Height	Cal Clear/Cal Set	Cal Clear
Cal Max Height	3-4.5 V	3V
TransportHtVal	N/A	70 Inches
MaxHeight	N/A	228 Inches
Calibrate Drive Cutout	True/False	False
Battery / Charger		
Max Battery Charge Temp	N/A	60°C

Table 13. Machine Model Adjustment (Personality Settings) (Software Version P1.3.0) (continued)

Adjustment	Adjustment Range	AE1932
Limit Current High Temp	N/A	15 A
Limit Temp Cutback	N/A	50°C
Joystick Personalities		
Calibrate Joystick	False/True	False
Calibrate Joy Forward	False/True	False
Calibrate Joy Neutral	False/True	False
Calibrate Joy Reverse	False/True	False
CalJoy Forward	N/A	1.40 V
CalJoy Neutral	N/A	2.55 V
Cal Joy Reverse	N/A	4.00 V
Line Contactor		
Min Battery SOC	N/A	10%
Inactivity Beep Delay	0 to 3600 Sec	600 Sec
Inactivity Beep Enable	False/True	True
Service Mode		
Lift Override Service Mode	False/True	False

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Note: These settings may change in order to achieve optimal performance.

5.5 REMOTE ASSISTANCE

5.5.1 Overview

The remote assistance feature enables the JLG call-center specialist to access real-time data on the machine from a remote location. To enable this feature, turn the machine on and open the DaVinciGO app. On the main menu screen click Remote Assistance. Communicate the IQAN connect key to the JLG call-center specialist. They will enter the IQAN connect key into their software which will give them the ability to see DTC's, see real-time data from machine (Measures tab), adjust machine personalities (Adjust tab), perform calibrations, install software, and any other features within the DaVinciGO app. The JLG call-center specialist will not be able to operate the machine. They will rely on the person local to machine to perform any lift, drive, steer operations during troubleshooting.

5.5.2 Working

The end user or service technician who is near to the machine makes a wireless Bluetooth connection to machine using DaVinciGO app. The JLG call center specialist is able to connect the DaVinciGO app when the IQAN connect key is given to the JLG specialist. The DaVinciGO app acts as a modem to connect the machine to the internet so remote support can be enabled.

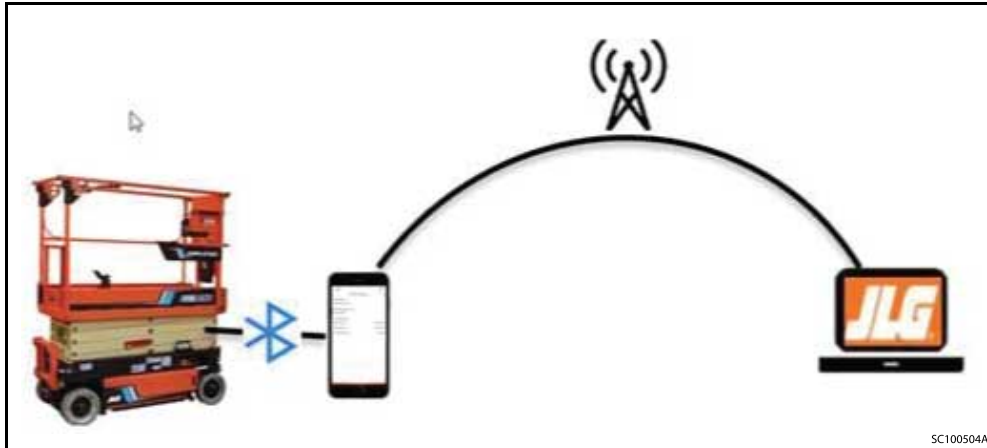
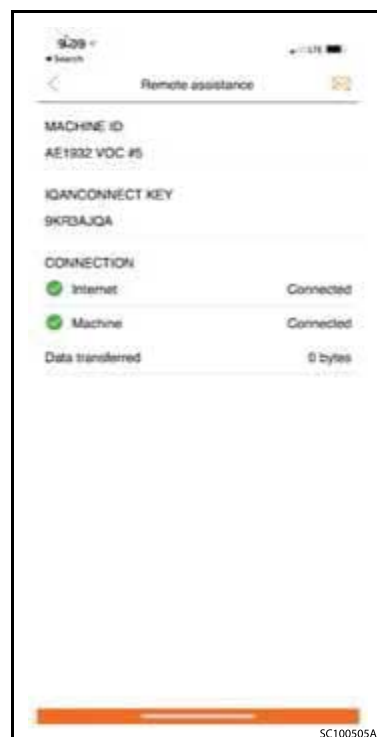


Figure 53. Remote Assistance Connection

5.5.3 Connection

1. Power on the machine.
2. Open DaVinciGO app and connect to machine. Refer to [Section — Connect to Machine Via Bluetooth, page 112](#).
3. Click on Remote assistance and enables the remote assistance feature using IQAN connect key given to the JLG call-center specialist.

Note: Once Connection is made with machine, Do not leave the Remote Assistance screen or connection will be lost. Connection (IQAN Key) is valid for 24hr per machine. Switching between the platform mode and ground mode will disconnect the connection.



SECTION 6

LOAD SENSING SYSTEM (LSS)

CONTENTS

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LOAD SENSING SYSTEM (LSS)

6.1 LOAD SENSING SYSTEM (LSS)

The Load Sensing System (LSS) is designed to monitor the load of persons and tools in the platform. There are four CAN based Load Pins at platform corners measuring force. The CAN based load pins allow the Ground Module to monitor the amount of load in the platform.

When the rated capacity is exceeded or there is a fault related to LSS, both the platform (if in platform mode) and ground overload LED's will flash in a 500mS ON, 500mS OFF pattern. An acoustic warning accompanies the visual indicator to alert the operator that the weight limit has been exceeded. All platform controls, except lift down are disabled, when LSS is in this state/condition. The Ground Controls, Platform Controls, and the manual descent system can be used to lower the platform.

To remove the overload condition and resume normal operation, the operator must remove weight from the platform until the overload condition does not exist. Both the platform and ground visual indicators can be used as load reduction verification.

The LSS can be calibrated to maximum accuracy without the need of test weights. Accessories mounted in the platform have an impact on the LSS capacity limit. The control system will manage accessories properly when the accessory personalities setting are adjusted prior to LSS calibration according to the documentation furnished with the factory-provided accessories. See calibration section for more details.

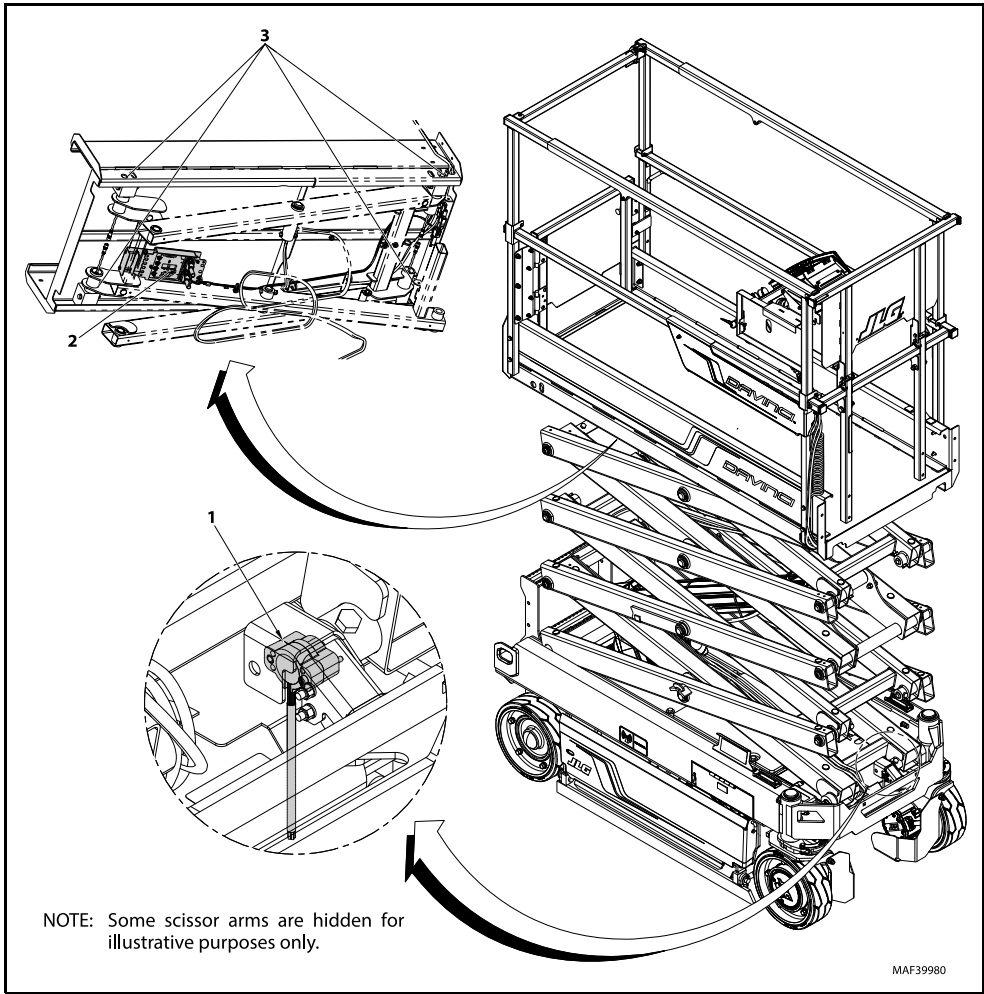
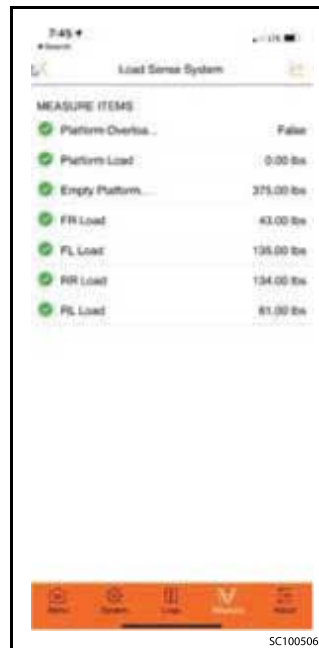


Figure 54. LSS Component Locations

1. Elevation Angle Sensor	3. Load Pins
2. LSS Module	

6.1.1 Diagnostic Menu

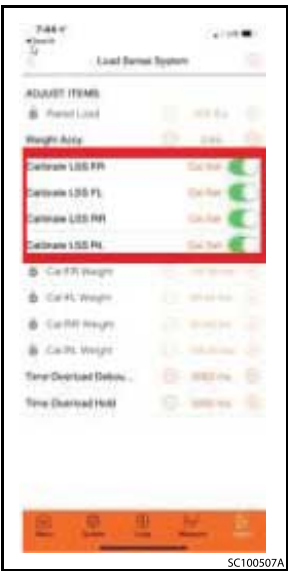
1. Power On the machine.
2. Connect the DaVinciGO app to machine. Refer to [Section — Connect to Machine Via Bluetooth, page 112](#).
3. Login to Access level. Refer to [Section — Login to Access Level, page 113](#).
4. Click on the measure tab and click on load sense system tab.
5. The value show for Platform Load is control systems calculation for platform load which controls LSS response. The "Platform Load" can be refined by performing an LSS calibration.



6.1.2 Calibration

If machine has factory JLG accessories enter in the accessory weight before completing rest of calibrations process.

1. Power On the machine.
2. Connect the DaVinciGO app to machine. Refer to [Section — Connect Mobile Device To Machine, page 110](#).
3. Login to Access level. Refer to [Section — Login to Access Level, page 113](#).
4. Set key switch to Ground Mode.
5. Click on the adjustment menu and click on load sense system option.
6. Enter the weight of the accessory parameter (lb) (if no accessories value should be 0).
7. Elevate the arms so there is about 2 in. (50 mm) gap between arms.
8. Toggle all 4 pins to calibrate (Green).
9. Once all 4 pins are calibrated navigate back to Measure screen and check platform load parameter.



6.1.3 Testing

The following procedure should be executed to test LSS. The test confirms the LSS does not trigger when the platform carries 100% rated load, and the LSS continuously triggers when the platform carries 120% rated load. Refer to the troubleshooting section of this manual if the Load Sensing System fails to meet these guidelines.

1. Install and connect the DaVinciGO app to machine. Refer to [Section — Download DaVinciGO App, page 110](#).
2. Note the current setting of MACHINE SETUP ' LOAD and then adjust it to CUTOFF ALL. This will allow LSS interlocks to work from Ground Mode.
3. Place weight corresponding to 100% of the vehicle's rated load in the center of the platform. Refer to the LSS Testing Weight Table below.

Table 14. Platform 100% Calibration Weight

MACHINE	CALIBRATION WEIGHT	
	ANSI-USA ANSI-EXPORT JAPAN CSA	CE/UKCA GB AUS
AE1932	607 lb (275 Kg)	607 lb (275 Kg)

4. Lift up to maximum elevation using the ground controls. LSS should not prevent motion and the Ground Overload Indicator should not illuminate.
5. Lift down to the stowed position using the ground control. LSS should not prevent motion and the Ground Overload Indicator should not illuminate.
6. Place weight corresponding to 120% of the vehicle's rated load in the center of the platform. Refer to the LSS Testing Weight Table above.

Table 15. Platform 120% Calibration Weight

MACHINE	CALIBRATION WEIGHT	
	ANSI-USA ANSI-EXPORT JAPAN CSA	CE/UKCA GB AUS
AE1932	728 lb (331 Kg)	728 lb (331 Kg)

- Lift up using the ground controls. LSS should prevent motion within 15% of maximum platform height, the Ground Overload Indicator should flash, and the alarm should sound.

6.1.4 LSS Troubleshooting

For LSS Troubleshooting, Refer to [Section — DTC Check Tables, page 134](#).

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SECTION 7

DIAGNOSTIC TROUBLE CODES

CONTENTS

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7.1.1	System Fault/DTC Indication	134
7.2	DIAGNOSTIC TROUBLE CODES (DTC)	134
7.3	DTC CHECK TABLES.....	134

Diagnostic Trouble Codes

7.1 INTRODUCTION

This section provides a reference for Diagnostic Trouble Codes (DTC) read from the DaVinciGO. For more information on any sensors or indicators, refer to the appropriate manual section. Many of the checks below require configuring and using a multimeter. Refer to [Section — General Electrical Information and Schematics, page 173](#) for multimeter basics. To troubleshoot multiple DTCs, start with the DTC with the higher first two digits. The machine is powered by one 24 Volt battery to the control system. Some procedures below refer to this nominal voltage (VMN) as 24V. Actual voltage measurements may differ based on the charge of the battery. **If a correction is made during a check, conclude the check by cycling the machine power, using the emergency stop switch.** It may also be helpful to run a system test, DaVinciGO -> SYSTEM TEST for intermittent or difficult problems.

7.1.1 System Fault/DTC Indication

In addition to the DTC codes being displayed on the DaVinciGO, DTC codes are indicated by the number of flashes and pauses of the System Fault indicator on the face of the platform control box as shown below:



7.2 DIAGNOSTIC TROUBLE CODES (DTC)

The DTC tables following are sorted in groups by the first two digits, these digits represent the number of flashes the system distress indicator lamp will flash on the platform indicator panel when a fault occurs.

For example: a **212** - Keyswitch would be indicated by 2 flashes, a pause, then 1 flash, a pause, then would keep repeating until the fault is cleared.

The more detailed three digit code numbers in the DTC column of the following tables are only indicated on a DaVinciGO.

To troubleshoot multiple DTCs, start with the DTC with the higher first two digits. **If a correction is made during a check, conclude the check by cycling the machine power off then back on, using the emergency stop switch.**

7.3 DTC CHECK TABLES

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
3	ALARM SOUNDING-TILTED & ABOVE ELEVATION	PF:Continuous	None	No Motion restrictions	Platform is elevated and chassis is not level {MACHINE SETUP->TILT CUTOUT =NO} AND Transport State = FALSE AND Tilted State= TRUE
4	DRIVING AT CUTBACK-ABOVE ELEVATION	None	None	Drive State= CREEP	Platform is elevated and the machine is in the drive mode of operation In Platform Mode, Transport State= FALSE AND Move State= DRIVE
5	DRIVE & LIFT UP PREVENTED TILTED& ELEVATED	PF:Continuous	None	- Drive State= PRE-VENTED - Lift Up State= PREVENTED	Driving and lift up are not possible since the platform is elevated and the chassis is not level. In Platform Mode, Transport State= FALSE AND Tilted State= TRUE AND {MACHINE SETUP->TILT CUTOUT = YES}.
7	DRIVING AT CUTBACK-POTHOLE STILL ENGAGED	None	None	Drive State= CREEP	While stowed, drive speed is reduced(due to lower ground clearance) since the control system detected that the pothole protection mechanism is deployed (failed to retract). Clear the obstacle blocking the pothole protection mechanism, repair the mechanical problem, re-adjust the pothole limit switches, or repair the wiring to correct the problem. Alternately, there may be difficulty with the Elevation Angle Sensor that causes the Control System to improperly believe the platform is stowed. Applicable only in Platform Mode, and Move State= DRIVE.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
					Transport State= TRUE AND the Pothole State= BLOCKED or EXTENDED
8	FUNCTIONS LOCKED OUT- SYSTEM POWERED DOWN	None	None	- Enter SafeMode - After successfully going to SafeMode, Disable GM_IGNITION_OUT	A period of time elapsed without activity and the Control System entered a low-power state to preserve battery charge and disarm controls. Note: AE vehicles can turn completely off whereas R vehicles can only drop to SafeMode. Triggers: 45 minutes without Drive Forward, Drive Reverse, LiftUp, LiftDown, Steer Left, or SteerRight in Platform Mode. 10 minutes without LiftUp or LiftDown in Ground Mode. - Timer resets if user changes Platform Mode/Ground Mode - Fault not available in modes other than Platform Mode or Ground Mode Cycle the Ground EMS in Ground Mode or the Platform EMS in Platform Mode to re-enable the vehicle.
9	DRIVE PREVENTED-ELEVATED ABOVE DRIVE CUTOUT HEIGHT	None	None	Drive State= PREVENTED	The Drive Cutout functionality is enabled, and the Platform is Elevated above the calibrated Cutout Height. (Refer to Drive Cutout Functionality) {MACHINE SETUP-> DRIVE CUTOUT= YES} AND the Platform Height Value Drive Cut Value
52	LIFTUP PREVENTED-MAX HEIGHT REACHED	None	None	LiftUp State= PRE-VENTED-	The vehicle has reached the maximum height allowed by the Indoor/Outdoor selection and further lift up motion is not possible. Platform Height Value Max Height Allowed Value
61	AUXILIARY MODE	None	None	No Motion restrictions	Machine is in Auxiliary Mode
212	KEY SWITCH FAULTY	None	2_1	Force to Ground Mode	Both the Ground Select and Platform Select signals are energized, which means there is an issue with the keyswitch or one of the lines are shorted to battery. PF_SEL and GRND_SEL are energized simultaneously.
221	FUNCTION PROBLEM-HORN PERMANENTLY SELECTED	None	2_2	Horn Prevented	Horn Switch in the Platform Control Box was closed during power-up. Release or repair the switch to clear the message. In Platform Mode and HORN is Energized during Platform Mode Start up. Retained until HORN is momentarily De-energized.
222	FUNCTION PROBLEM-INDOOR/OUTDOOR PERMANENTLY SELECTED	None	2_2	Previously selected Indoor/Outdoor Mode maintained	Indoor/Outdoor Switch in the Platform Control Box was closed during power-up. Release or repair the switch to clear the message. In Platform Mode, the IN/OUT switch is energized during Platform Mode Startup. Retained until IN/OUT is momentarily De-energized. Only applicable if {MACHINE SETUP-> MARKET = CSA, CE/UKCA, AUSTRALIA, or GB}
223	FUNCTION PROBLEM-DRIVE & LIFT ACTIVE TOGETHER	None	2_2	- Move State= LIFT - Drive State= PREVENTED - LiftUp State= PREVENTED	The Drive -Lift Selector Switch indicates that both functions are selected simultaneously. Repair the wiring or switch to clear the message. In Platform Mode and DRIVE_SEL and LIFT_SEL are energized at the same time. Retained until either is momentarily open circuit.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
				LiftDown State=MAX	
224	FUNCTION PROBLEM-STEER LEFT PERMANENTLY SELECTED	None	2_2	Drive State=PRE- VENTED	Steer Left Switch in the Platform Control Box was closed during power-up. Release or repair the switch to clear the message. In Platform Mode, the STEER_L_SW is Energized during Platform Mode Startup. Retained until Digital Input is momentarily De-energized.
225	FUNCTION PROBLEM-STEER RIGHT PERMANENTLY SELECTED	None	2_2	Drive State=PRE- VENTED	Steer Right Switch in the Platform Control Box was closed during power-up. Release or repair the switch to clear the message. In Platform Mode, the STEER_R_SW is Energized during Platform Mode Startup. Retained until momentarily De-energized.
226	ACCELERATOR FAULTY-WIPER OUT OF RANGE	None	2_2	- Drive State=PREVENTED - LiftUp State=PREVENTED - LiftDown State=PREVENTED	The joystick (accelerator) wiper signal input is outside the acceptable voltage range. The wiper wire may be off, shorted to +B, or shorted to -B (ground) to cause this difficulty. In Platform Mode, JOY_SIG is >4.50V OR <0.50V. Retained until the EMS is cycled.
227	STEER SWITCHES FAULTY	None	2_2	Drive State=PRE- VENTED	Both the Steer Left and Steer Right Inputs are closed as the same time. A short in the Steer Switch wiring or a failed Steer Switch can cause this difficulty. In Platform Mode, the STEER_L_SW is Energized AND STIER_R_SW is Energized. Retained until the EMS is cycled.
228	FUNCTION LOCKED OUT-ACCELERATOR NOT CENTERED	None	2_2	- Drive State=PREVENTED - LiftUp State=PREVENTED - LiftDown State=PREVENTED	Selected function (Drive or Lift) is not allowed because the joystick (accelerator) was not centered at power-up. Return joystick to center momentarily. In Platform Mode, the JOY_SIG must be 0% and Stable (within +/-0.05 V change) for 1000 mS after Power-up or this fault will be issued. Recovery permitted once the conditions are met(EMS re-cycle not necessary).
229	FUNCTION PROBLEM-TRIGGER PERMANENTLY CLOSED	None	2_2	- Drive State=PRE- VENTED - LiftUp State=PRE- VENTED - LiftDown State=PREVENTED	Trigger Switch in the Platform Control Box was closed at power-up. Release switch or repair the switch/wiring to clear the difficulty. In Platform Mode, the TRIGGER is Energized during Platform Mode Startup. Cleared once TRIGGER is momentarily De-energized.
231	FUNCTION PROBLEM-LIFT PERMANENTLY SELECTED	None	2_3	In Ground Mode then - LiftUp State=PREVENTED - LiftDown State=PREVENTED	Lift Switch (Up or Down) in the Ground Control Box was closed during power-up. Release or repair the switch to clear the message. - In Ground Mode, [LIFT_UP_SW OR LIFT_DN_SW is Energized] during Ground Mode Startup. Retained until the respective Digital Input is momentarily De-energized. - This fault should not become active in Platform Mode.
232	GROUND LIFT UP/ DOWN ACTIVE TOGETHER	None	2_3	In Ground Mode then LiftUpState=PREVENTED	In Ground Mode, the control system has detected the LiftUp and Down are active simultaneously. Check the Lift Switch and associated wiring in the Ground Control Box.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
				LiftDown State = PREVENTED	- In Ground Mode, LIFT_UP_SW is Energized AND LIFT_DN_SW is Energized. Retained until the EMS is cycled. - This fault should not become active in Platform Mode.
233	FUNCTION PROBLEM- BRAKE RELEASE PERMANENTLY SELECTED	None	2_3	In Ground Mode only Brake Release State= FALSE (Brake Release Option is not allowed to disengage brakes)	In Ground Mode, the Manual Brake Release Digital Input is energized at power-up. Retained until the respective Digital Input is momentarily de-energized.
241	AMBIENT TEMPERATURE SENSOR-OUT OF RANGE LOW	PF: Continuous	2_4	Drive and Lift Restrictions	The temperature as communicated by the temperature/tilt sensor is less than -40 degrees Celsius. - If Transport State= FALSE, then set Drive State =CREEP, LiftDown State= CREEP LiftUp State =PREVENTED. The platform alarm shall continuously sound. - If Transport State= TRUE, then set Drive State= MAX, LiftDown State = CREEP, and LiftUp State= PREVENTED, the platform alarm shall continuously sound.
242	AMBIENT TEMPERATURE SENSOR- OUT OF RANGE HIGH	PF: Continuous	2_4	Drive and Lift Restrictions	The temperature as communicated by the temperature/tilt sensor is greater than +85 degrees Celsius. - If Transport State = FALSE, then set Drive State= CREEP, LiftDown State= MAX. and LiftUp State= PREVENTED. The platform alarm shall continuously sound. - If Transport State= TRUE, then set Drive State= MAX, LiftDown State= MAX. and LiftUp State= PREVENTED, the platform alarm shall continuously sound.
251	ELEVANGLE SENSOR FAULTY- VOLTAGEOUT OF RANGE	None	2_5...	- LiftUp State= PRE- VENTED - Platform Height-Value assumed to be Full Elevation for the purposes of other interlocks - Arm Guard Functionality shall be disabled - Overload State= TRUE if {MACHINE SETUP-> LOAD= CUTOUT PLT Mor CUTOUT ALL}	The input voltage from the sensor that measures lower arm motion is outside acceptable range. This may be caused by difficulty with the sensor wiring, or a faulty sensor. Check mounting, review sensor wiring against the electrical schematic, or replace the sensor to clear the message. Fault should be triggered for any of the following conditions: - Elevation 1Raw Value >45V or <0.5V - Elevation 2Raw Value >45V or < 0.5V and {MACHINE SETUP-> LOAD= CUTOUT PLTM or CUTOUT ALL}
252	ELEVANGLE SENSOR HAS NOT BEEN CALIBRATED	None	2_5	LiftUpState=PRE-VENTED	Successfully calibrate the Elevation Angle Sensor in the Stowed Position using the calibration procedure to clear the message.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
				- Platform Height-Value assumed to be Full Elevation for the purposes of other interlocks - OverloadState= TRUEif {MACHINE SETUP->IDAD;1: NO}	- The Elevation Sensor's Calibration EEPROM is set to the signature implanted by the In-Circuit Test Fixture(has never been calibrated by the factory). Retained until Calibration EEPROM is over-written by a valid calibration. - Need to recheck this setting for the redundant sensors as well if MACHINE SETUP->LOAD =NO
253	DRIVE PREVENTED-CHARGER CONNECTED	None	2_5	Drive State= PRE- VENTED	Driving is not possible since the vehicle is charging. In Platform Mode, the Charge Interlock State= TRUE AND Move State= Drive.
254	DRIVE & LIFTUP PREVENTED-CHARGER CONNECTED	None	2_5	- DriveState= PRE- VENTED - LiftUpState= PRE- VENTED	Driving and Lifting are not possible since the vehicle is charging and it is configured to prevent all motion. Charge Interlock State= TRUE AND {MACHINE SETUP-> CHARGE INTER- LOC= DRV & LIFTUP}.
255	PLATFORM OVERLOADED	PF:5000msON/ 2000ms OFF- GND:5000msON/ 2000ms OFF	2_5	- DriveState= PRE- VENTED if {MACHINE SETUP-> MARKET ;1: JAPAN} AND {TRANSPORT STATE=FALSE} - DriveState= CREEP if {MACHINESETUP->MARKET= JAPAN - LiftUpState= PRE- VENTED if {(Platform Mode=TRUE} OR (Ground Mode= TRUEAND MACHINE SETUP-> LOAD= CUTOUT ALL}	Triggers when Overload State= TRUE Clears when Overload State= FALSE While the Load Sensing System is enabled, the Platform Load measured by the Load Sensing System is excessive. Functions from Platform Control Station are prevented, and functions from Ground Control may be prevented, depending on machine configuration (Markets other than Japan). For the Japanese Market, only Lift Up is prevented and Drive (at creep speed) is allowed in the stowed position. Refer to LSS functionality for Lift and Drive restrictions. This fault shall be suppressed if technician navigates to the CALIBRATIONS menu of the ANALYZER.
256	DRIVE PREVENTED-POT-HOLE NOT ENGAGED	If {MACHINE SETUP->PHP ALARM= YES}PF:500ms on/ 500ms Off GND:500ms On/500msOff	2_5	DriveState= PRE- VENTED	While elevated, driving is not possible since the control system detected that the pot-hole protection mechanism failed to deploy. Clear the obstacle blocking the pot-hole protection mechanism, repair the mechanical problem, re-adjust the pot-hole limit switches, or repair the wiring to correct the problem. Alternately, there may be difficulty with the Elevation Angle Sensor that causes the Control System to improperly believe the platform is elevated. - In Platform Mode AND Move State= DRIVE AND Transport State= FALSE AND AND Platform Height Value>Pothole Not Engaged Value AND Pot- hole State= BLOCKED or RETRACTED. - Platform and Ground alarm shall only sound if {MACHINE SETUP->PHP ALARM=YES} and this DTC is active

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
258	DRIVE & LIFT PREVENTED-BRAKES ELECTRICALLY RELEASED FOR TOWING	MotionAlarm	2_5	- DriveState= PRE-VENTED - LiftUpState= PRE-VENTED - LiftDownState= PREVENTED	- Brake Release Digital Input is Energized for 1000mS and Ground Mode is Selected. - Charger not connected to wall power - Brake Release Digital Input is not re-energized after initial activation
311	OPEN CIRCUIT LINE CONTAC-TOR	None	3_1	- DriveState= PRE-VENTED - LiftUpState= PRE-VENTED	The vehicle's MainLineContactor did not dose when energized. Check the line contactor coil and the associated power wiring. - The Power Module detected an open-circuit for the line contactor coil; alternately, the Negative Main Contactor driver was activated, but the line contactor did not provide voltage to the B+ terminal on the controller. - Power Module returns MainLine Contactor Open Fault Curtis Code 39: Main Contactor Did Not Close Set: With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+ Effect: Shutdown Motor, Shutdown Main Contactor, Shutdown EM Brake, Shutdown Throttle, Full Brake, Shutdown Pump Possible Cause: - Main contactor did not dose - Main contactor tips are oxidized, burned, or not making good contact. - External load on capacitor bank (B+ terminal connection) that prevents capacitor bank from charging. - Blown B+ fuse.
321	LINE CONTACTOR WELDED OR MISWIRED	None	3_2	- DriveState = PRE-VENTED - LiftUpState = PRE-VENTED	The Line contactor is off, but the Power Module is being energized. The line contactor's coil or power interconnect may be miswired. Alternately, the line contactor is faulty (welded or stuck). - The Power Module did not activate the Negative Main Contactor driver, but battery voltage was detected on the B+ terminal of the controller. Curtis Code 38: Main Contactor Welded Set: Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and voltage did not discharge. Effect: Shutdown Motor, Shutdown Main Contactor, Shutdown EM Brake, Shutdown Throttle, Full Brake, Shutdown Pump Possible Cause: - Main contactor tips are welded closed. - Motor phase U or Vis disconnected or open - An alternate voltage path (such as an external pre-charge resistor) is providing a current to the capacitor bank (B+ connection terminal)
426	MASTER MODULE TEMPERATURE OUT OF RANGE	None	4_2	Normal operation	The Ground Module's internal temperature sensor is out of range. (<40C or >150C) - Flag Error to show that analog input readings are not being temperature compensated, and allow normal operation. - Not having temperature compensation affects Elevation sensor accuracy and Pressure transducer accuracy

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
443	L. SSBATTERYVOLTAGE TOO HIGH	None	4_4	Overload State= TRUE	While the Load Sensing System is enabled, the Load Sensing System Module measured Battery Voltage >34.0Vdc, which may compromise ability to predict weight. This may be due to improper battery charging or incorrect voltage battery being used. {MACHINE SETUP-> LOAD NO} AND {MACHINE SETUP-> LOAD UG= LOAD CELL} - LSS Module Message- Status Message (0X81) is reporting MBATT TOO HIGH" AND [Machine Setup's LOAD is set to 1=CUTOUT PLTOR 2=CUTOUT ALU. Refer to CANbus documentation for Load Sensing System Module.
444	LSS BATTERY VOLTAGE TOO LOW	None	4_4	Overload State= TRUE	While the Load Sensing System is enabled, the Load Sensing System Module measured Battery Voltage <9.0Vdc, which may compromise ability to predict weight. With a low battery charge, this can occur during heavy current demand due to Drive, Steer, or Lift Up. Recharge battery or check for damaged battery. {MACHINE SETUP-> LOAD= NO} AND {MACHINE SETUP-> LOAD CFG= LOAD CELL} - LSS Module Message- Status Message (0x81) is reporting eATT TOO LOW.. AND [Machine Setup's LOAD is set to 1=CUTOUT PLTOR 2=CUTOUT ALL]. Refer to CANbus documentation for Load Sensing System Module.
446	LOGIC SUPPLY VOLTAGE OUT OF RANGE LOW	None	4_4	- Drive State= PRE-VENTED - Lift Up State= PRE-VENTED	The Ground Module's VSW voltage was measured to be out of range on an AE vehicle by the Ground Module. This may be caused by loose battery terminal, severely discharged battery, a damaged battery, or an improper wire harness connection. This fault shall be suppressed if DTC 441 is active.
447	VOLTAGE REFERENCE OUT OF RANGE	None	4_4	- Drive State= PRE-VENTED - Lift Up State= PRE-VENTED	The Ground Modules SV supply voltage was measured to be out of range (<45V or >5.5V). This may be caused by loose battery terminal, severely discharged battery, a damaged battery, or an improper wire harness connection.
448	VOLTAGE REFERENCE OUT OF RANGE	None	4_4	- Lift Up State= PRE-VENTED - Drive State= PRE-VENTED	The Ground Modules 3.3V supply voltage was measured to be out of range (<3.135V or >3.465V). This may be caused by issues with the 3.3V supply or the VSP0 reference supply on the Ground Module.
662	CANBUS FAILURE-PLATFORM MODULE	None	6_6	All Platform functions Prevented. Normal operation from Ground Mode	In Platform Mode, the control system failed to receive messages from the Platform Module. Check wiring at the Platform Box. Check wiring along scissor arms leading up to Platform. - Digital Input Message- Motion (0X00) not received for 250mS AND Platform Mode selected - This error shall be suppressed any time that VSW is De-energized or if unit is in Safe Mode
663	CANBUS FAILURE-LOAD SENSING SYSTEM MODULE	None	6_6	Overload State= TRUE	With the Load Sensing System enabled AND [Machine Setup's LOAD CFG is set to LOAD CELL], the control system failed to receive messages from the Load Sensing System Module.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
811	TILTSENSOR NOTCALIBRATED	None	8_1	TiltedState=TRUE (+20.0°X, +20.0°Y); Max DriveSpeed-Value=Worst-Case Slope Descent Functionality for both Forward and Reverse	- The ChassisTiltSensor has never been calibrated so the control system assumes that the vehicle is tilted. Drive speed is reduced since a valid tilt reading is not available. Calibrate the Tilt Sensor using the calibration procedure to clear the message. - The Tilt Sensors calibration EEPROM is set to the signature implanted by the In-Circuit Test Fixture. Retained until Calibration EEPROM is overwritten by a valid calibration.
821	I5SCCELL#1 ERROR	None	8_2	Overload State=TRUE	LSS Module Message-Status Message (0x81) is reporting cm1 ERROR AND [MachineSetup's LOAD is set to 1=CUTOUT PLT OR 2=CUTOUT ALL] AND [MachineSetup's LOADCFG is set to LOADCELL]. Refer to CANbus documentation for Load Sensing System Module.
822	I5SCCELL#2 ERROR	None	8_2	Overload State=TRUE	LSS Module Message-Status Message (0x81) is reporting cELL2ERROR AND [MachineSetup's LOAD is set to 1=CUTOUT PLT OR 2=CUTOUT ALL] AND [MachineSetup's LOADCFG is set to LOADCELL]. Refer to CANbus documentation for Load Sensing System Module.
823	L5SCCELL#3 ERROR	None	8_2	Overload State=TRUE	LSS Module Message-Status Message (0x81) is reporting muERROR AND [MachineSetup's LOAD is set to 1=CUTOUT PLT OR 2=CUTOUT ALL] AND [MachineSetup's LOADCFG is set to LOADCELL]. Refer to CANbus documentation for Load Sensing System Module.
824	L5SCCELL#4 ERROR	None	8_2	Overload State=TRUE	LSS Module Message-Status Message (0x81) is reporting cELL4ERROR AND [MachineSetup's LOAD is set to 1=CUTOUT PLT OR 2=CUTOUT ALL] AND [MachineSetup's LOADCFG is set to LOADCELL]. Refer to CANbus documentation for Load Sensing System Module.
825	L5SHAS NOTBEENCALIBRATED	None	8_2	Overload State=TRUE	Only applicable when MACHINESETUP-> LOAD is CUTOUT PLT M or CUTOUT ALL. The Load Sensing System has never been calibrated, previous vehicle model LSS calibration does not match current model, or previous LSS calibration version is different from current version. Follow the calibration procedure to clear the message.
991	L5SWATCHDOG RESET	None	9_9	No Motion Interlocks	The Watchdog Timer on Load Sensing System Module's microprocessor was triggered by exposure to excessive electrical noise, or by a hardware difficulty. - Re-cycle power to clear difficulty. {MACHINESETUP-> LOAD NO} AND {MACHINESETUP-> LOAD CFG = LOADCELL} - LSS Module Message-Status Message (0x81) is reporting-WATCHDOG RST AND [MachineSetup's LOAD is set to 1=CUTOUT PLT OR 2=CUTOUT ALL]. Refer to CANbus documentation for Load Sensing System Module. Retained until power is re-cycled.
992	L5SEEPROM ERROR	None	9_9	Overload State=TRUE	Memory used to retain settings on Load Sensing System Module has been corrupted. Re-calibrate and verify the Load Sensing System. Alternately, this may indicate an LSS Module malfunction. {MACHINESETUP-> LOAD NO} AND {MACHINESETUP-> LOAD CFG = LOADCELL}

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
					LSSModule Message-Status Message (0x81) is reporting #EEPROM ERROR AND [MachineSetup's LOADissetto 1=CUTOUT PLTOR2=CUTOUT ALL]. Referto CANbus documentation for LoadSensingSystem Module. Retained until power is re-cycled.
993	LSSINTERNAL ERROR- PINEXCITATION	None	9_9	Overload State= TRUE	The Excitation Voltage for the Load Sensors < 415V. These sensors may be excessively loading the Excitation Supply due to wiring damage, or the LoadSensingSystem Module may have hardware difficulty. {MACHINESETUP-> LOAD7:NO} AND {MACHINESETUP-> LOAD CFG = LOADCELL} - LSSModuleMessage- Status Message (0x81) is reporting INTERNAL ERROR- PINEXCITATION < 4Jsv AND [MachineSetup's LOADissetto 1=CUTOUT PLTOR2=CUTOUT ALL]. Referto CANbus documentation for LoadSensingSystem Module. Retained until power is re-cycled.
994	LSSINTERNAL ERROR- DRDYMISSING FROM A/D	Latched	Latched	Overload State= TRUE	The DRDYInterrupt from the LoadSensingSystem Module's A/D Converter is missing. This may indicate LoadSensingSystem Module hardware difficulty. {MACHINESETUP-> LOAD7:NO} AND {MACHINESETUP-> LOAD CFG = LOADCELL} - LSSModuleMessage- Status Message (0x81) is reporting INTERNAL ERROR-DRDYINTERRUPTFROM A/D. AND [MachineSetup's LOADissetto 1=CUTOUT PLTOR2=CUTOUT ALL]. Referto CANbus documentation for LoadSensingSystem Module. Retained until power is re-cycled.
2210	TRIGGERCLOSED- TOO LONG WHILE IN NEUTRAL	None	2_2	- Trigger State= FALSE therefore - DriveState= PRE-VENTED - LiftUpState= PRE-VENTED - LiftDown State= PREVENTED	Trigger Switch in the Platform Control Box was closed for more than five seconds while the Joystick (accelerator) was in the neutral position (centered). Releaseswitch or repair the switch/wiring to clear the difficulty. In Platform Mode, the TRIGGER input was Energized for 5,000mS AND Joystick Command is 0% and Stable (within +/- 0.05V change). Retained until the TRIGGER input is momentarily De-energized.
2232	FUNCTION PROBLEM- DRIVE&LIFT BOTH OPEN	None	2_2	- MoveState= LIFT - DriveState= PRE-VENTED - LiftUpState= PRE-VENTED - LiftDownState= MAX	In Platform Mode, the Drive- Lift Selector Switch indicates that neither function is selected. Repair the wiring or switch to clear the message. In Platform Mode, the DRIVE_SEL and LIFT_SEL are open circuit at the same time. Retained until either is momentarily energized.
2512	ELEVATION SENSOR NOT DETECTING CHANGE	None	2_5	- LiftUpState= PREVENTED - Platform Height-Value assumed to be Full Elevation	The input voltage from the Elevation Angle Sensor that measures lower acceleration did not respond properly while the vehicle is lifting up. Check mounting, review sensor wiring against the electrical schematic, or replace the sensor to clear the message. This fault is not required for the redundant elevation angle sensor fitted for pressure-based LSS systems. - Elevation Raw Value does not change more than 0.3 degrees of elevation for 5000mS or decreases while lifting up - Platform HeightValue < (PhysicalMin HeightValue + 95 % Platform Height Range)

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
					- DTC251 ELEVANGLESENSORFAULTY-VOLTAGEOUT OF RANGE not active - DTC252 ELEVANGLESENSOR HASNOT BEEN CALIBRATED notactive - MACHINESETUP-> LOAD=NONE
3214	EXTERNALMODULE ENABLE DRIVERPERMANENn- YON	None	3_2	- DriveState= PRE- VENTED - LiftUpState=PRE- VENTED	The VSWsignalisshorted toBattery duringstartuppriorto enablingtheVSWswitch. VSW> 14VwhenVSWswitdl isintheoffstate.
3371	GROUND ALARM- SHORT TO GROUND	None	3_3	Disableoutput	ShorttoGroundwasdetectedonWN_ALARM Only applicableif{MACHINESETUP->WHITE NOISEALARM=YES}
3379	HOURLMETER- SHORTTOGROUND	None	3_3	Disableoutput	ShorttoGroundwasdetectedonHOUR_MTR
3 80	HOURLMETER-OPEN CIR- CUil	None	3_3	Disableoutput	Open Circuitwasdetectedon HOUR_MTR EmergencyMessagefromOK>.7=21 62
3381	HOURLMETER- SHORTTOBATTERY	None	3_3	Disableoutput	Shortto Batterywas detectedon HOUR_MTR
4210	RIGHTDRIVEMOTOR- TOOHOT-PLEASEWAIT	None	4_2	DriveState= PRE- VENTED	CurtisCode: 87 73-Motor Hot 72-TempSensorFault PossibleCauses:Motor characterizationfailed duringdlaracterization processes. FaultActions: Shutdown Motor,Shutdown MainContactor,Shutdown EMBrake, Shutdown Throttle,FullBrak clear: Reset Controller
4211	LEFTDRIVEMOTORTOO- HOT-PIEASEWAIT	None	4_2	DriveState= PRE- VENTED	CurtisCode: 87 73-Motor Hot 72-TempSensorFault PossibleCauses:Motor characterizationfailed duringdlaracterization processes. FaultActions: Shutdown Motor,Shutdown MainContactor,Shutdown EMBrake, Shutdown Throttle,FullBrak clear: Reset Controller
4212	RIGHTDRIVE MOTORTEM-PERATIURE- OUTOF RANGE	None	4_2	DriveState= PRE- VENTED	CurtisCode: 29 PossibleCauses: Motorthermistor isnotconnectedproperly,Sensor polar-ityisinmrrct. motortempandsensor parametersare misadjustedFault Actions: MaxSpeed reduced,motortempcutback disabled Clear: Bringmotorthermistorinputvoltage withinrange
4213	LEFT DRIVEMOTORTEM- PERATIURE-OUT OFRANGE	None	4_2	DriveState= PRE- VENTED	CurtisCode: 29 PossibleCauses: Motorthermistor isnotconnectedproperly,Sensor polar-ityisinmrrct. motortempandsensor parametersare misadjustedFault Actions: MaxSpeed reduced,motortempcutback disabled Clear: Bringmotorthermistorinputvoltage withinrange
4221	FRONT LEFTMODULETOO HOT- PLEASEWAIT	None	4_2	DriveState= PRE- VENTED	CurtisCode: 16 Possiblecauses: Controller operatingin extremeenvironment,Excessive loading,improper mountingofcontrollerFault Actions: Shutdown Motor, Shutdown MainContactor,Shutdown EMBrake,Shutdown Throttle, FullBrakeClear: Bringheatsinktemp below95°C,reset controller
4222	FRONT RIGHTMODULETOOHOT- PLEASEWAIT	None	4_2	DriveState= PRE- VENTED	CurtisCode: 16 Possiblecauses: Controller operatingin extremeenvironment,Excessive loading,improper mountingofcontrollerFaultActions: Shutdown Motor, Shutdown MainContactor,ShutdownEM- Brake,Shutdown Throttle, FullBrakeClear: Bringheatsinktemp below95°C,reset controller

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
4239	LIFTMODULETOOHOT- PLEASEWAIT	None	4_2	- LiftUp State= PRE- VENTED - LiftDown State = PREVENTED	CurtisCode: 16 Possiblecauses: Controller operatingin extremeenvironment,Excessive loading,improper mountingofcontrollerFault Actions: Shutdown Motor, Shutdown MainContactor,Shutdown EMBrake,Shutdown Throttle, FullBrakeClear: Bringheatsinktemp below95°C,reset controller
4240	STEERMODULETOOHOT- PLEASEWAIT	None	4_2	DriveState= PRE- VENTED	CurtisCode: EM22 or EM24.
4241	LIFTMOTORTOOHOT -PLEASEWAIT	None	4_2	- LiftUp State= PRE- VENTED - LiftDown State = PREVENTED	CurtisCode: 87 73-Motor Hot 72-TempSensorFault PossibleCauses:Motor characterizationfailed duringdlaacterization processes. FaultActions: Shutdown Motor,Shutdown MainContactor,Shutdown EMBrake, Shutdown Throttle,FullBrak clear: Reset Controller
4242	LIFTMOTORTEMPERA- TURE-OUTOFRANGE	None	4_2	- LiftUp State= PRE- VENTED - LiftDown State = PREVENTED	CurtisCode: 29 PossibleCauses: Motorthermistorisnotconnected properly,Sensorpolar- ity is incorrect, motortempandsensorparameters aremisadjusted FaultActions: MaxSpeed reduced,motortempcutback disabledaear: Bringmotorthernistorinputvoltagewithinrange
4244	BMS- BATTERYCHARGE- TEMPIDW-CHARGESUS- PEND POSSIBLE	None	4_2	- Enable Heater - If<1 ° C, Charge State= PREVENTED	BMSFault: UnderTemperature ChargeState=WARNING System shouldruntheheaterto bringthesystemoutofWARN INGandinto CLEAR.System shouldrunasidealalgorithm inthe hostGMtoensuretemp staysabove 1°CmincelltempforChargeState= ALLOWED. Iftempfalls below 1°C,ChargeState= PREVENTED.Runheater. Heaterwill either bringbackabove hostthreshold,orfail todoso.Ifheater brings tempback,allowchargingagain.Ifitdoesn't, ChargeState= PREVENTED untilconditions improve. Note:IfBMS istakenoutof'ChargeMode' over CANbus,itwillnotsourcean alarmstateiftempdropstoo low.
4245	BMS- BATTERYCHARGE- TEMPIDW-CHARGE NGSUS- PENDED	None	4_2	- ChargeState =PRE- VENTED - DisableHeater (onlyifBMSgener- atedfault)	InternalAlgorithm: MinCellTemp <1°C (not latched andrecoverable)BMSFault UnderTemperature ChargeState= ALARM (latched,unrecov- erable) ifalarmthreshold doesoccur,wewill needto resetthe BMS toclear.Until we reset,the BMSwill disallow chargingbecauseitopens contactorwhile ALARM is latched. Wecouldstill bedischarging,butnotchargingduring anALARM.DoNOTrunheater ifALARM occurs becausewecannotcharge untilareset anyway.RESETcanonlyhappen ifhostswitches offignition or estop ispressed &thechargerisOFF. Oncewereset,the Hostalgorithm can takeovert to keepoutofchargemode,tumonheater,maybe recover-0th- eiwise havetowaitforconditionstoimprove.
4246	BMS- BATTERYDISCHARGE- TEMPIDW-SYSTEM SUS- PEND POSSIBLE	None	4_2	None	BMSFault: UnderTemperature Discharge State=WARNING Display OTC,based on BMSwaming,topromotedischargeofthe module toselfwarnorwaitforambienttemprise. Usercanoperatethrougha warning.
4247	BMS- BATTERYDISCHARGE- TEMPIDW-SYSTEM SUS- PENDED	None	4_2	- Safemode- Disable GM_ IGNITION_OUT - ChargeState =PRE- VENTED - OpenContactors	BMSFault: UnderTemperature Discharge State=ALARM Donotdischarge moreenergy. Open contactors,show DTC. There is1°C marginbetween alarmandshutdown,so mayonlybeabletomakeuser awareforshorttime.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
4248	BMS-BATTERYOVER-VOLT-AGE- LIMITED FUNCTIONAL- ITY	None	4_2	- ChargeState =PREVENTED - LiftDownState= CUTBACK - DriveState= CUT- BACK	BMSFault: OverVoltage State=WARN ING BMSwillissue warningmessageat3.9VandAlarm at4.0V.Charge control intheBMS issetto3.8V limitinorder toavoidafaultcondition.If faultis thrown, somethinginternaltothe BMSmaybewrong or regen currents pushedvoltage toohigh. System shouldSTOP chargingtoavoidfurther OV.System shouldalsomanage regencapacityaroundthisissue-which mayinvolve cutback performanceonlift/drive. Discharge maybeallowed toattempttoclearfault. Possiblecauses maybecharger is notputtingout expectedvoltage andcurrentset points-disconnect charger andmeasure outputs. Chargingcontactor maybeweldedorfailedshut
4249	BMS- BATTERYOVER-VOLT-AGE-SYSTEM SUSPENDED	None	4_2-	- ChargeState= PRE-VENTED - LiftDown State = PREVENTED - DriveState= PRE- VENTED - OpenContactors	BMSFault OverVoltageState= ALARM Expect alarmconditiontobeavoided ifchargingisstopped.IfAlarm occurs, contactors willopen,suspend vehide operation. Needtoresetsys- ternandBMSfor alarmtoclear.
4250	BMS- BATTERYTEMP HIGH-SYSTEMCUTBACK	None	4_2	- DriveState =CUT- BACK - LiftUpState =CUT- BACK - ChargeState =PRE- VENTED	BMSFault OverTemperature State=WARNING; PCBA OverTempera- ture= WARNING Cutback lift/drive/steerfuncti onalityto consume lessmachinepower. Operate machineatreduced power untiltemperature improvesoralarm level is reached.
4251	BMS- BATTERYTEMP HIGH- SYSTEMSUSPENDED	None	4_2-	- DriveState =PRE- VENTED - LiftUpState =PRE- VENTED - ChargeState =PRE- VENTED - Open Contactor	BMSFault: OverTemperature State= ALARM; PCBAOverTemperature= ALARM Disablemachineoperation,open contactors. Clear alarmtorestorefunc- tionality.Alarm canbeclearedbyresettingBMSafter conditions improve.
4252	BMS- BATTERYTERMINAL- TEMP-CREEP; CHECK BAT- TERY CONNECTIONS	None	4_2	- DriveState =CUT- BACK - LiftUpState =CUT- BACK - ChargeState =PRE- VENTED	BMSFault ModuleTenninalOverTemperature State=WARNING Usercanoperatethroughawarningwithcutback function. Check battery terminallugsfortorque/tightness.
4253	BMS- BATTERYTERMINAL- TEMP-SYSTEMSUS- PENDED;CHECK BATTERY CONNECTIONS	None	4_2-	- DriveState= PRE- VENTED - LiftUpState= PRE- VENTED - Charge State= PREVENTED	BMSFault ModuleTenninalOverTemperature State=ALARM Check batteryterminallugsfortorque/tightness. Reset System and BMS toclearthe ALARM.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
				• Open Contactor	
4254	BMS- BATTERY UNDER-VOLTAGE-CHARGE BATTERY IMMEDIATELY	None	4_2	• DriveState= CUT-BACK (DEPENDENT ON STATE OF CHARGE) • LiftUpState= CUT-BACK (DEPENDENT ON STATE OF CHARGE)	BMS Fault: UnderVoltageState= WARNING BMS will issue warning message at 2.8V if a cell reaches these low levels. The DTC should be issued at the WARNING level to avoid the alarm. System should operate at cutback to slow current drain from battery module but allow user to move to or prepare for charging. Once the system has charged to clear this fault, normal operation can be restored. Charge the battery to relieve fault.
4255	BMS- BATTERY UNDER-VOLTAGE-SYSTEM SUSPENDED, CHARGE BATTERY	None	4_2	• DriveState= PRE-VENTED • LiftUpState= PRE-VENTED • Open Contactor	BMS Fault: UnderVoltageState= WARNING BMS will issue alarm message at 2.35V if a cell reaches these low levels. The DTC should be issued at the ALARM level to avoid the alarm. Once the system has charged to clear this fault, normal operation can be restored. Charge the battery to relieve fault and reset the system and BMS to restore operation.
4256	BMS- FULL CHARGE CYCLE REQUIRED	None	4_2	No Action	Triggered by internal algorithm A timer/counter on the host module has detected it has been TBD charge cycles without completing a 'well balanced' indication. Issue DTC to make user aware of charging need. Allow operation through this DTC until internal algorithm reaches a more severe number of charge cycle counts.
4257	BMS- FULL CHARGE CYCLE REQUIRED- OPERATION SUSPENDED	None	4_2	• DriveState= PRE-VENTED • LiftUpState= PRE-VENTED • Open Contactor	Triggered by internal algorithm. A timer/counter on the host module has detected it has been TBD charge cycles without completing a 'well balanced' indication. This count is above/ beyond the warning version of this DTC. Prevent vehicle operation to encourage user to charge through to a full well balanced status. Once well balanced, reset the counter/timer. Restore operation.
4258	BMS-MODULE CELL REVERSAL - OPERATIONS SUSPENDED, REPLACE BATTERY	None	4_2	• Safemode-Disable GM_IGNITION_OUT • ChargeState= PRE-VENTED • Open Contactor	BMS Fault: Cell Reversal warning= TRUE If this warning is active at any time, disallow vehicle use forever- Battery Module is potentially unfit for use. Replace battery module to reinstate function.
4259	BMS- OVERCURRENT CHARGE- CHARGE SUSPENDED	None	4_2	Scissors may choose to show DTC or not show DTC. Take steps to stop or back down charge current setpoint to alleviate WARNING before timeout	BMS Fault: OverCurrentCharge= WARNING, timeout style fault (240s warning, 120s alarm, 60s shutdown) Scissors should take system action to stop charging upon receiving the warning. Scissors may choose to show DTC to operator indicate charging is suspended.
4260	BMS- OVERCURRENT CHARGE- SYSTEM SUSPENDED	None	4_2	• ChargeState= PRE-VENTED • DriveState= PRE-VENTED • LiftUpState= PRE-VENTED	BMS Fault: OverCurrentCharge= ALARM, timeout style fault (240s warning, 120s alarm, 60s shutdown) Upon alarm for charge overcurrent, command charger to OV/OA output, open charge contactor, open discharge contactor, suspend operation. Check communication between charger and Host. Check communication between BMS and Host. Reset charger (unplug, plug in). Reset/Reprogram Host module. To clear alarm, reset the BMS/System.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
				OpenContactor	
4261	BMS-OVERCURRENTD IS-CHARGE-SYSTEM CUTBACK	None	4_2	- DriveState=CUT- BACK - LiftUpState =CUT- BACK	- BMSFault OverCurrent Discharge=WARNING, timeoutstylefault (255swarning,120salar, 60sshutdown) - Issue DTCatwarninglevelofovercurrent dischargefault. Usercanoperate throughthefault, butcommunicatecutback status. Cutbackissystem response to lowerdischarge current Clearfault and restorefull operation ifconditions clear.
4262	BMS-OVERCURRENTD IS-CHARGE-SYSTEM SUS- PENDED	None	4_2	- DriveState= PRE- VENTED - LiftUpState=PRE- VENTED - OpenContactor	- BMSFault: OverCurrentDi scharge= ALARM, timeoutstylefault (255swarning,120salar, 60sshutdown) - System detectstoo muchcurrentdrawfrombattery. Checkfor overload, STB/STG insystem,unsanctioned loads(tamperi ng).
4263	BMS- CELLBANKDELTATEMP- SYSTEMSUSPENDED	None	4_2	- DriveState =PRE- VENTED - LiftUpState =PRE- VENTED - ChargeState =PRE- VENTED - Open Contactor	BMSFault:Cell DeltaTemperature State= ALARM Note: IfCellBank DeltaTempisinaWARNINGstate,disablethe heater. Thisfau ltistypicallycausedby useofanexternal heater. Ifdisablingheaterdoes not resolve issue, andfault reachesalarm state, disablemachineoperation untilconditions improve. Resetsystem/bms to dear ALARM.
4421	LOGICSUPPLYVOLTAGE- OUT OFRANGEHIGH	None	4_4	- Enter SafeMode - LiftDownState= MAX	TheGround Module'sVSWvoltagewasmeasured tobemorethan 32V. Thismay becaused byloose batteryterminal,severely discharge battery,a damaged battery,oran improperwireharness connection.
4478	GROUNDMODULE- OVER-CURRENT	None	4_4	- Enter SafeMode - LiftDownState= MAX	Thecurrent beingmeasuredthroughtheGround Moduleistoo high. The GroundModule measurmorethan 8Ampsthrough theVSWswitch.
6649	CANBUSFAILURE-TILT/ TEMPSENSOR	None	6_6	TiltedState= TRUELowTemp- Cut=TRUEif {MACHINESETUP- >TEMPCUTOUT= YES}	Thecontrolsystem failed to receive messagesfrom the tiltsensor. - TiltSensorCANcommuni cationnotreceivedfor1000ms - TempSensor consideredto beunhealthy iflowTemperature Cutoutcon- figured
6652	CANBUS FAILURE- FRONTLEFTMODULE	None	6_6	DriveState =PRE- VENTED	CurtisCode: 72 Possiblecauses: CAN PDOmessagedelayexceeds PDOTimeout Period Fault Actions:Shutdown ThrottleClear: ReceiveCANNMTmessage,orreset controller
6653	CANBUS FAILURE- FRONT RIGHTMODULE	None	6_6	DriveState =PRE- VENTED	CurtisCode: 72 Possiblecauses: CAN PDOmessagedelayexceeds PDOTimeout Period Fault Actions: Shutdown ThrottleClear: ReceiveCANNMTmessage,orreset controller
7776	LEFTMOTORWIRING- ISSUE	None	7_7	- Enter SafeMode - DriveState =PRE- VENTED	CurtisCode: 12 Possiblecauses: Possibleshort ofphase U,V,orW; Encoder noise;motor parameters mistuned;defective controller Fault Actions: Shutdown Motor, ShutdownMainContactor,ShutdownEM- Brake,ShutdownTHrottle, FullBrakeClear: ResetController CurtisCode: 37

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
					Possible causes: Motor phase open; Bad crimps or wiring Fault Actions: Shutdown EM Brake; Shutdown Throttle; Shutdown Motor; Shutdown Main Contactor; Full Brake Clear: Cycle KSI Curtis Code: 13 Possible causes: Leakage to frame from U,V, or W; Controller defective Fault Actions: Shutdown EM Brake; Shutdown Throttle; Shutdown Motor; Shutdown Main Contactor; Full Brake Clear: Cycle interlock or Reset controller
7777	RIGT MOTOR WIRING-ISSUE	None	7_7	- Enter Safe Mode - Drive State = PRE-VENTED	Curtis Code: 12 Possible Causes: Possible short of phase U,V, or W; Encoder noise; motor parameters mistuned; defective controller Fault Actions: Shutdown Motor, Shutdown Main Contactor, Shutdown EM-Brake, Shutdown Throttle, Full Brake Clear: Reset Controller Curtis Code: 37 Possible Causes: Motor phase open; Bad crimps or wiring Fault Actions: Shutdown EM Brake; Shutdown Throttle; Shutdown Motor; Shutdown Main Contactor; Full Brake Clear: Cycle KSI Curtis Code: 13 Possible Causes: Leakage to frame from U,V, or W; Controller defective Fault Actions: Shutdown EM Brake; Shutdown Throttle; Shutdown Motor; Shutdown Main Contactor; Full Brake Clear: Cycle interlock or Reset controller
7778	LIFT MOTOR WIRING-ISSUE	None	7_7	- Enter Safe Mode - Lift Up State = PRE-VENTED - Lift Down State = PREVENTED	Curtis Code: 12 Possible Causes: Possible short of phase U,V, or W; Encoder noise; motor parameters mistuned; defective controller Fault Actions: Shutdown Motor, Shutdown Main Contactor, Shutdown EM-Brake, Shutdown Throttle, Full Brake Clear: Reset Controller Curtis Code: 37 Possible Causes: Motor phase open; Bad crimps or wiring Fault Actions: Shutdown EM Brake; Shutdown Throttle; Shutdown Motor; Shutdown Main Contactor; Full Brake Clear: Cycle KSI Curtis Code: 13 Possible Causes: Leakage to frame from U,V, or W; Controller defective Fault Actions: Shutdown EM Brake; Shutdown Throttle; Shutdown Motor; Shutdown Main Contactor; Full Brake Clear: Cycle interlock or Reset controller
7779	STEER MOTOR WIRING-ISSUE	None	7_7	Drive State = PRE-VENTED	Curtis Code: EM18 or EM19.
7781	LIFT POWER MODULE-CAPACITOR BANK FAULT	None	7_7	Lift Up State = PRE-VENTED	Curtis Code: 14 1-Abort 2- Energy limit Exceeded 3-Time Limit Exceeded Possible Causes: External loading on cap bank Fault Actions: Shutdown Motor; Shutdown Main Contactor; Shutdown EM Brake; Shutdown Throttle; Full Brake Clear: Cycle Interlock, reset controller
7783	FRONT LIFT MODULE-CAPACITOR BANK FAULT	None	7_7	Drive State = PRE-VENTED	Curtis Code: 14 1-Abort 2- Energy limit Exceeded 3-Time Limit Exceeded Possible Causes: External loading on cap bank Fault Actions: Shutdown Motor; Shutdown Main Contactor; Shutdown EM Brake; Shutdown Throttle; Full Brake Clear: Cycle Interlock, reset controller
7784	FRONT RIGHT MODULE-CAPACITOR BANK FAULT	None	7_7	Drive State = PRE-VENTED	Curtis Code: 14 1-Abort 2- Energy limit Exceeded 3-Time Limit Exceeded

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
					PossibleCauses: Externalloadingon capbankFaultActions: Shutdown Motor;Shutdown MainContactor; Shutdown EMBrake; Shutdown Throttle; FullBrakeae:ar: Cycle Interlock,resetcontroller
7785	BACK-UPNUT-WARNING	None	7_7	No motionrestrictions	LiftUp/DownTorque exceeded limitwith specific platform load.
7786	BACK-UPNUT-WARNING2	None	7_7	LiftUpStlItte =CREEP LiftDnStlItte =CREEP	LiftUp/DownTorque exceeded limitwith specific platform load.
7787	BACK-UPNUT-FAIWRE	None	7_7	LiftUpState =PRE-VENTED LiftDnStlItte =PRE- VENTED	LiftUp/DownTorque exceeded limitwith specific platform load.
9911	FUNCTIONSIDCKEDOUT-LSSMODULESOFTWARE VERSION IMPROPER	Latched	Latched	OverloadState= TRUE	Thecontrolsystemwill notfunctionbecause the LSSModuleSoftwareVersion isnotcompatiblewiththerestofthe system. Re-programorreplace withaVersion7.xxmodule {MACHINESETUP-> LOAD NO} AND {MACHI NESETUP-> !DADCFG = LDADCELL} - MachineSetup's LDAD=1or2ANDthe LSSModulereported aSoftware MajorVersion thatwas notequalto'7 Thecontrolsystemmayresume operationoncethedifficulty hasbeencorrected.
9949	MACHINECONFIGURATION OUTOF RANGE-CHECKALL SETTINGS	Continuosly	9_9	- DriveState =PRE-VENTED - LiftUpState =PRE- VENTED - LiftDownState= PREVENTED	Ground Moduledetectsoneoftheseissues: - MachineSetupparameterorPersonalityi soutofrange - MachineSetupchecksum improper
22103	STEERCALIBRATIONNOT COMPLETED	None	2_2	DriveState =MAX limitallowed steer-ingrango topreset. minimized rangeof motion	ThisDTCis activewhenverthe steering calibration isnotvalid or notcompleted. Promptusertocompleteasteeringcal. Once complete, automaticallydearthe OTC.
moo	LIRUPSWITCH-INVALID SIGNAL	None	2_3	LiftUpState =PRE- VENTED	InGround Modeandthe Ground Moduledetects aredundancy disagreementonthe LIFT_UP_SWinputfor500ms. Ignorethisfault inPlatform Mode.
23201	unDOWN SWITCH-INVALIDSIGNAL	None	2_3	- LiftUpState=PRE-VENTED - LiftDownState= PREVENTED	InGround Modeandthe Ground Moduledetects aredundancydisagreementonthe LIR_DN_SW inputfor500ms. Ignorethis fault inPlatform Mode.
23202	POTHOLEPREVENTIONS-WITCH 1-INVALIDSIGNAL	None	2_3	PotHoleState= BIDCKED	The GroundModuledetectsaredundancydisagreementon the PHP_SW1inputfor500ms.ThiserrorisvalidinbothGround Modeand Platform Mode.
23203	POTHOLEPREVENTIONS-WITCH2-INVALIDSIGNAL	None	2_3	PotHole State= BIDCKED	The Ground Moduledetectsaredundancy disagreementonthe PHP_SW2inputfor500ms.ThiserrorisvalidinbothGround Modeand Platform Mode.
23205	ELEVATIONSSENSORS-INVALIDSIGNAL	None	2_3	LiftUpState=PRE-VENTED	Thecontrolsystem hasdetected a disagreement between Elevation Sen-sor 1and ElevationSensor 2. Checkthe Elevation Sensorsandassociated wiring.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
				- Platform Height-Value assumed to be Full Elevation-for the purposes of other interlocks - OverLoadState= TRUE	- Only Valid if {MACHINESETUP->LOAD ; t: NO} AND ROTS1_SIG and ROTS2_SIG are not +/- .25V of the normalized voltage. - This fault shall be suppressed if the DTC252 ELEVATIONSENSORS NOT CALIBRATED fault is active.
23238	ELEVATION ANGLE SENSOR MAX ELEVATION-NOT CALIBRATED	None	2_3	OverloadState = TRUE if {MACHINE SETUP->LOAD: t: NO}	Successfully complete the SETMAX ELEVATION calibration procedure to clear the message. The Elevation Sensor was not calibrated at max elevation
25103	OPERATION RESTRICTED-PLATFORM RAILS FOLDED	None	2_5	- LiftUpState= PREVENTED - DriveState = CREEP if {TransportState= TRUE} - DriveState= PREVENTED if {TransportState= FALSE}	If Machine is configured for CE Market and the QuikFold Platform switch is de-energized.
33209	HORN SHORT TO GROUND	None	3_3	Disable Output	Short to Ground was detected on GRND_ALARM_SIG. Short to ground output shall be STG when the following conditions are present: A2D counts are >= 200 while PWM output is greater than 25% (Constant Data). Conditions must be present for 500 ms (Constant Data)
33383	BEACON LIGHT-OPEN CIRCUIT	None	3_3	- Disable output - No motion restrictions	Open Circuit was detected on BEACON AND {MACHINE SETUP-> BEACON= YES}.
33384	BEACON LIGHT-SHORT TO GROUND	None	3_3	- Disable output - No motion restrictions	Short to Ground was detected on BEACON AND {MACHINE SETUP-> BEACON= YES}.
33387	OVERLOAD INDICATOR-SHORT TO GROUND	None	3_3	- Disable output - No motion restrictions	Short to Ground was detected on OVERLOAD INDICATOR GRND Emergency Message from OKA7=21 60
33388	OVERLOAD INDICATOR-OPEN CIRCUIT	None	3_3	- Disable output - No motion restrictions	Open Circuit was detected on OVERLOAD INDICATOR GRND Emergency Message from OKA7=21 60
33562	BEACON LIGHT-SHORT TO BATTERY	None	3_3	- Disable output - No motion restrictions	Short to Battery was detected on BEACON AND {MACHINE SETUP-> BEACON= YES}. NOTE: This will only be able to trigger when ARM GUARD is active and the short to battery occurs under the Arm guard limit.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
33674	PLATFORM POWER-SHORT TO BATTERY	None	3_3-	- Force Ground Mode - Disable output	Short to Battery was detected on the PLATFORM_PWR digital output
33675	PLATFORM POWER-OPEN CIRCUIT	None	3_3	N/A	Team decided to ignore this fault for following reasons. N/A in Ground Mode No diagnostic value in Platform Mode, would only increase startup time.
33676	PLATFORM POWER-SHORT TO GROUND	None	3_3-	- Platform Mode Pre-vented - Disable output	Short to Ground was detected on the PLATFORM_PWR digital output
33816	LEFT POWERMODULE BRAKE WIRING-ISSUE	None	3_3	DriveState =PRE-VENTED	Curtis Fault: 32 1 - Driver Short 2 - Driver Overcurrent 3 - Open/Short (High, should be low) 4 - Open/Short (Low, should be high) 5 - Open Wire Possible Causes: Open or short on driver load, Dirty connector pins at controller or contactor coil Fault Actions: Shutdown EM Brake, Shutdown Throttle, Full Brake Clear: Restore/repair any external wiring or device-coil to their correct state, Reset Controller
33817	RIGHT POWERMODULE BRAKE WIRING-ISSUE	None	3_3	DriveState =PRE-VENTED	Curtis Fault: 32 1 - Driver Short 2 - Driver Overcurrent 3 - Open/Short (High, should be low) 4 - Open/Short (Low, should be high) 5 - Open Wire Possible Causes: Open or short on driver load, Dirty connector pins at controller or contactor coil Fault Actions: Shutdown EM Brake, Shutdown Throttle, Full Brake Clear: Restore/repair any external wiring or device-coil to their correct state, Reset Controller
33818	LIFT POWERMODULE-BRAKE WIRING-ISSUE	None	3_3	Lift: UpState =PRE-VENTED	Curtis Fault: 32 1 - Driver Short 2 - Driver Overcurrent 3 - Open/Short (High, should be low) 4 - Open/Short (Low, should be high) 5 - Open Wire Possible Causes: Open or short on driver load, Dirty connector pins at controller or contactor coil Fault Actions: Shutdown EM Brake, Shutdown Throttle, Full Brake Clear: Restore/repair any external wiring or device-coil to their correct state, Reset Controller
33825	LEFT POWERMODULE MOTOR CURRENT-OUT OF RANGE	None	3_3	DriveState =PRE-VENTED	Curtis Code: Motor Current > 200A
33826	RIGHT POWERMODULE MOTOR CURRENT-OUT OF RANGE	None	3_3	DriveState =PRE-VENTED	Curtis Code: Motor Current > 200A
33827	STEER MODULE MOTOR CURRENT-OUT OF RANGE	None	3_3	DriveState =PRE-VENTED	Curtis Code: EM20A

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
33828	LIFTPOWER MODULEMOTORCUR- RENT-OUTOF RANGE	None	3_3	Lift: UpState =PRE- VENTED	CurtisCode:MotorCurrent> 200A
33837	STEER IGNITION- SHORTTOGROUND	None	3_3	Disableoutput	ShorttoGroundwasdetectedonSTEERCONT ACTOR
33838	STEER IGNITION-OPEN CIR-CUII	None	3_3	Disableoutput	Open Grcuitdetected on STEER CONTACTOR
44136	BATTERY CHARGER- FAULT(Exxx)	None	4_4	ChargeState =PRE- VENTED	DeltaQFaults. Display (Exxx:) ascorrespondingerrorpresent ontheCAN-bus. ActionsCheck cableconnections between batteryandcharger for opens. Check Batteryconnectionstocharger.Checkharnessconnecti onsareto propersources. [E013, E047]Thiswillshow upifthe GMsendsunexpected! incorrect setpointstothe charger.Reprogramthe GMorreplacecharger [E015]-DisconnectACand batteryfor30seconds. Retry.Ifpersists,contact JLG /Delta-Q [E024]-DisconnectACand batteryfor30seconds. Retry.Inspect pushbuttonon charger Ulfordamageorstuck. Ifpersists,contactJLG/Delta-Q [E031, E039,E041,E042]ReplaceCharger [F001,F002,F003,F004,F005, F006,F007]
44137	BATTERY CHARGER- HIGHBATTERYVOLTAGE ERROR	None	4_4	ChargeState =PRE- VENTED	DeltaQIC640 Charger Fault: E001 Check battery sizeandcableconnections. Checkbatterycondition. Error clearswhencondition hasbeencorrected.
44138	BATTERY CHARGER- BAT-TERYVOLTAGETO LOWFOR CHARGE	None	4_4	ChargeState =PRE- VENTED	DeltaQIC640 Charger Fault: E002 Check battery sizeandcableconnections. Checkbatterycondition. Error clearswhencondition hasbeencorrected.
44143	BATTERY CHARGER- BAT-TERYVOLTAG EPOLAIRTY REVERSED	None	4_4	ChargeState =PRE- VENTED	DeltaQIC650 Charger Fault: E012 Check cableconnections between batteryandchargerforopens. Check Batteryconnectionstocharger.Checkharnessconnecti onsareto propersources.
44147	BATTERY CHARGER- ACSUPPLYVOLTAGETO HIGH	None	4_4	ChargeState =PRE- VENTED	DeltaQIC650 Charger Fault: E023 Connectchargerto anACsourcethat istablebetween85V-270VAC;45- 65Hz.
44148	BATTERY CHARGER- ACSUPPLYVOLTAGETO LOW	None	4_4	ChargeState =PRE- VENTED	DeltaQIC650 Charger Fault: E025 caused byundersizedgenerator and/or undersized cables.Connect charger to ACsourcethat providesstableACbetween85-270VAC; 45-65Hz.
44150	BATTERY CHARGER- BAT-TERY DISCONNECTED	None	4_4	ChargeState =PRE- VENTED	DeltaQ IC650 Charger Fault: E045 Check cableconnections between batteryandchargerfor opens. Check Batteryconnectionstocharger. Checkharnessconnecti onsareto propersources.
44151	LEFT POWERMODULEVOLT- AGETOLOW-MODULE SHUTDOWN	None	4_4	- Enter Safe Mode - LiftDown State = MAX	Curtis Code: 17 Possible Causes: Non-Controller system drain on circuit wiring, Resistance in low power circuit is too high, KSI disconnected while driving, Blown fuse Fault Actions: none Clear: Bring KSI voltage above Brownout threshold
44152	RIGHTPOWERMODULE- VOLTAGETO LOW- MOD- ULESHUTDOWN	None	4_4	- Enter Safe Mode - LiftDown State = MAX	Curtis Code: 17 Possible Causes: Non-Controller system drain on circuit wiring, Resistance in low power circuit is too high, KSI disconnected while driving, Blown fuse Fault Actions: none Clear: Bring KSI voltage above Brownout threshold
44153	LIFT POWERMODULEVOLT- AGETOLOW-MODULE SHUTDOWN	None	4_4	Enter SafeMode	Curtis Code: 17 Possible Causes: Non-Controller system drain on circuit wiring, Resistance in low power circuit is too high, KSI disconnected while driving, Blown fuse Fault Actions: none Clear: Bring KSI voltage above Brownout threshold

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
44154	STEER POWERMODULEVOLTAGE TOO LOW- MODULESHUTDOWN	None	4_4	DriveState =PRE-VENTED	CurtisCode: EMUor EM27orEM28
44181	BATTERYHEATER-SHORTTOGROUND	None	4_4	Disableoutput	ShorttoGroundwasdetectedonHEATERPWMOUTPUT
44182	BATTERY HEATER-OPENCIRCUIT	None	4_4	Disable output	Open Circuitdetected onHEATER PWMOUTPUT
46167	LEFTMOTORSPEEDSENSOR-INVALIDREADING	None	4_6	DriveState =PRE-VENTED	CurtisCode: EM2234
46168	RIGHTMOTORSPEED-SEN-SOR- INVALID READING	None	4_6	DriveState =PRE-VENTED	CurtisCode: EM2234
46169	LIFTMOTORSPEED SENSOR-INVALID READING	None	4_6	- LiftUpState =PRE- VENTED - LiftDownState=PREVENTED	CurtisCode: EM2234
46170	LEFTMOTORSPEEDSENSOR-NOTRESPONDING	None	4_6	DriveState =PRE-VENTED	Curtis Code: 73 Possible Causes: Stalled Motor, Encoder Failure, Bad crimp/wiring, Encode power supply issue Fault Actions: Shutdown EMBrake, Shutdown Throttle, Shutdown Motor, Control Mode to LOS Clear: Reset Controller
46171	RIGHTMOTORSPEED-SEN-SOR-NOTRESPONDING	None	4_6	DriveState =PRE-VENTED	Curtis Code: 73 Possible Causes: Stalled Motor, Encoder Failure, Bad crimp/wiring, Encode power supply issue Fault Actions: Shutdown EMBrake, Shutdown Throttle, Shutdown Motor, Control Mode to LOS Clear: Reset Controller
46172	LIFTMOTORSPEEDSENSOR-NOTRESPONDING	None	4_6	- LiftUpState =PRE- VENTED - LiftDownState=PREVENTED	Curtis Code: 73 Possible Causes: Stalled Motor, Encoder Failure, Bad crimp/wiring, Encode power supply issue Fault Actions: Shutdown EMBrake, Shutdown Throttle, Shutdown Motor, Control Mode to LOS Clear: Reset Controller
46173	LEFTMOTORSPEEDSENSOR-WRONG DIRECTION	None	4_6	DriveState =PRE-VENTED	CurtisCode: EM2234
46174	RIGHTMOTORSPEED-SEN-SOR-WRONG DIRECTION	None	4_6	DriveState =PRE-VENTED	CurtisCode: EM2234
46175	LIFTMOTORSPEEDSENSOR-WRONG DIRECTION	None	4_6	LiftUpState=PRE-VENTED	CurtisCode: EM2234
46176	FRONT LEFTMOTORSPEED-TOO HIGH	None	4_6	DriveState =PRE-VENTED	Curtis Code: 19 Possible Causes: Motor Speed detected exceeding the limit set by the Max Speed Supervisor, Misadjusted Max Speed Supervisor parameter Fault actions: Shutdown Interlock, Shutdown EMBrake Clear: Reset controller
46177	FRONT RIGHTMOTORSPEED-TOO HIGH	None	4_6	DriveState =PRE-VENTED	Curtis Code: 19

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
					Possible Causes: Motor Speed detected exceeding the limit set by the Max Speed Supervisor, Misadjusted Max Speed Supervisor parameter Fault actions: Shutdown Interlock, Shutdown EMBrake Clear: Reset controller
46178	LIFTMOTORSPEED-TOOHIGH	None	4_6	- LiftUpState=PRE- VENTED - LiftDownState=PREVENTED	Curtis Code: 19 Possible Causes: Motor Speed detected exceeding the limit set by the Max Speed Supervisor, Misadjusted Max Speed Supervisor parameter Fault actions: Shutdown Interlock, Shutdown EMBrake Clear: Reset controller
66100	CANBUS FAILURE-BATIERYCHARGER	None	6_6	ChargeState=PREVENTED	DeltaQIC650 Charger Fault: 29,32,43,58Check CANconnectorsonGMand Charger,Verifytermination resistanceis 120ohms,Check cablingcondition.
66102	CANBUS FAILURE-LIFTMODULE	None	6_6	- LiftUpState=PRE- VENTED - LiftDownState=PREVENTED	CurtisCode: 72PossibleCauses: CANPDOmessagedelayexceeds PDOTimeout Period FaultActions: ShutdownThrottleaear: ReceiveCANNMtmessage,or resetcontroller
66103	CANBUS FAILURE-STEERMODULE	None	6_6	DriveState =PRE- VENTED	No Heartbeat
66105	BMS-BATIERYMODULECOM-MUNICATIONLOST	None	6_6	- DriveState= PRE- VENTED - LiftUpState= PRE- VENTED - OpenContactor - ChargeState =PRE- VENTED	BMSFault: Module LostAlarm,ModuleExist,ModuleLostState=ALARMCheck connection between BMSand BatteryModule. Otherwise,replace BMSand Module.Rags: ModulelostAlarm,ModulelostState,ModuleExist.Caused by BMSlosingcontactwith1+batterymodulesunderitscontrol. Timeout periodforfaultsarewarning7s,alarm 15s,shutdown 20s. Donothingonwarninglevel.Ifitisconnectionissue,unlikelyanythingcan bedone intimeperiodbetween warningandalarmtimeout. Display OTC atalarm level.
66106	BMS-HOSTTIMEOUTFAIL-URE-OPERATIONSUS-PENDED	None	6_6	- DriveState= PRE- VENTED - LiftUpState= PRE- VENTED - OpenContactor	BMSFault: HostTimeout=TRUEBMSHas lost CANconnectionfrom HOSTfor 10+seconds andpresumes HOSTisdown,butBMSisstillfunctional.Stop operation. Checkconnec- tionsbetween BMSand Host Resetsystem/BMS toclearalarm.NOTE: NEEDSTOBEADDEDTO BMSCONFIGFILE-TALKTO LithiumWorks
66110	COMMUNICATINFAI-LURE- POWERMODULEMISSING	None	6_6	- DriveState =PRE- VENTED - LiftUpState =PRE- VENTED - LiftDnState =PRE- VENTED	Ground Moduledidnotdetectall 3power modulesontheCANbusat Start-up
86154	STEERSENSOR-OUTOFRANGE	None	8_6	DriveState =CREEP	Steering angleislessthan 0.5Vorgreaterthan 4.5V
99342	LEFT POWERMODULEFAI L-URE -INTERNALERROR	None	9_9	DriveState =PRE- VENTED	CurtisCode: 46(1,2,3,4),87,Reprogram

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
99343	RIGHTPOWERMODULE FAIWRE -INTERNALERROR	None	9_9	• DriveState =PRE- VENTED	CurtisCode: 46(1,2,3,4),87, Reprogram
99344	LIFT POWERMODULEFAIL- URE -INTERNALERROR	None	9_9	• LiftUpState =PRE- VENTED • LiftDownState= PREVENTED	CurtisCode: 46(1,2,3,4),87,Reprogram
99345	STEER POWERMODULEFAI- LURE -INTERNALERROR	None	9_9	• DriveState =PRE- VENTED	CurtisCode: EM7or EM16or EM29orEM32
99346	LEFT POWERMODULEFAI L- URE -INTERNALERROR	None	9_9	• DriveState =PRE- VENTED	CurtisCode: 77,79,83,42,92,36,410,Replace
99347	RIGHTPOWERMODULE- FAIWRE -INTERNALERROR	None	9_9	• DriveState =PRE- VENTED	CurtisCode: 77,79,83,42,92,36,410,Replace
99348	LIFT POWERMODULEFAIL- URE -INTERNALERROR	None	9_9	• LiftUpState =PRE- VENTED • LiftDownState= PREVENTED	CurtisCode: 77,79,83,42,92,36,410,Replace
99349	STEER POWERMODULE FAILURE -INTERNALERROR	None	9_9	• DriveState =PRE- VENTED	CurtisCode: EM15
99358	BMS-INTERNAL ERROR	None	9_9.	• DriveState =PRE- VENTED • LiftUpState =PRE- VENTED • ChargeState =PRE- VENTED • Open Contactor	BMS Fault: Configuration Information Missing, Serial Number Missing, Internal System Error Bit, Current Sense Warning, System Internal Error Code, BMS Main Code Version, BMS Main Code Revision BMS not properly configured, assigned improper serial number, or other internal error. Look for additional modules on the bus (tampering). Otherwise requires replacement.

Diagnostic Trouble Codes

DTC	HELP Message	ALARM	FLASH CODE	ACTION	TRIGGER
99359	BMS- INTERNAL MODULEERROR	None	9_9	• DriveState =PRE- VENTED • LiftUpState =PRE- VENTED • ChargeState =PRE- VENTED • Open Contactor	BMS Fault: Temp Sensor Failure, Voltage Sensor Failure, Module Fault, Fault Module Sanity Error, ADC Measurement Error, Voltage Measurement Error, Flash Error, Oscillator Error, Program Checksum Error, Event Log, Non- Used Interrupt Called. No serviceable actions. Reboot the system, if fault persists check system for unsanctioned battery loads/tampering, replace Battery Module. Can be caused by several issues: Module Cell polarity reversal, Internal Temp sensor failure, Internal voltage sensor failure, internal current sensor error, Any module fault, module sanity error, ADC measurement error, Voltage measurement error, flash error, oscillator error, program checksum error, event log is full, non-used interrupt called.
99360	BMS- SYSTEMCONFIGERROR- OPERATIONSUS- PENED	None	9_9	• DriveState =PRE- VENTED • LiftUpState =PRE- VENTED • ChargeState =PRE- VENTED • Open Contactor	BMS Fault: Number of Modules in Communication, Too Many Modules Flag System is detecting more than the assigned number of modules present in the system, system may have been incorrectly been tampered with or is reporting incorrectly. Action: Open main contoactor, look for additional modules or tampering with the battery system. Otherwise, replace the BMS and Module.

SECTION 8

GENERAL ELECTRICAL INFORMATION AND SCHEMATICS

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8.1 GENERAL

This section contains schematics to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

NOTICE

It is a good practice to avoid pressure-washing electrical/ electronic components. Should pressure-washing be utilized to wash areas containing electrical/electronic components, JLG Industries, Inc. recommends a maximum pressure of 750 psi (52 bar) at a minimum distance of 12 inches (30.5 cm) away from these components. If electrical/ electronic components are sprayed, spraying must not be direct and be for brief time periods to avoid heavy saturation.

8.2 MULTIMETER BASICS

A wide variety of multimeters or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. A digital meter with reasonable accuracy (within 7%) is recommended for the measurements in these procedures. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

8.2.1 Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the voltage source.

8.2.2 Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

8.2.3 Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

8.2.4 Polarity

Finding a negative voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly. Also check that the lead on the "COM" port goes to the ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

8.2.5 Scale

M = Mega = 1,000,000 * (Displayed Number)

k = kilo = 1,000 * (Displayed Number)

m = milli = (Displayed Number) / 1,000

μ = micro = (Displayed Number) / 1,000,000

Example: 1.2 kΩ = 1200 Ω

Example: 50 mA = 0.05 A

8.2.6 Voltage Measurement

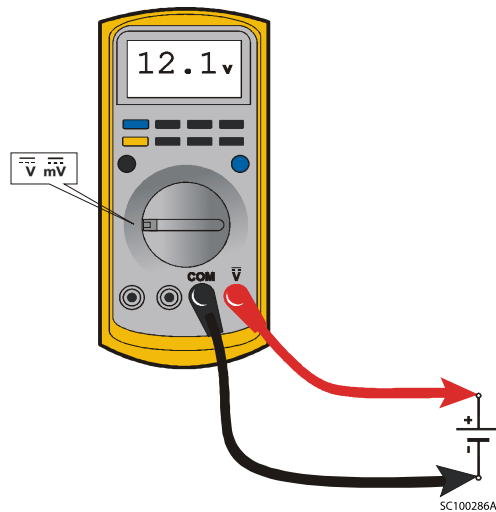


Figure 55. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual).
- Use firm contact with meter leads.

8.2.7 Resistance Measurement

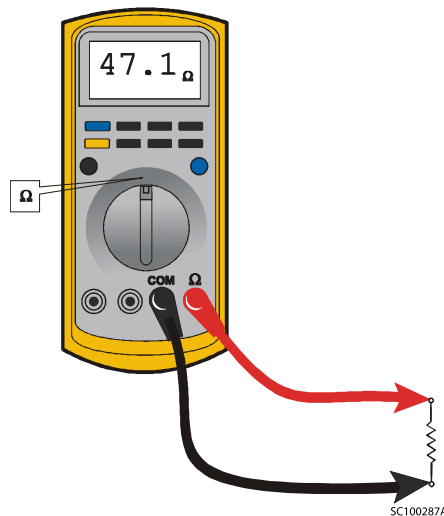


Figure 56. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit (very low resistance).
- Circuit power must be turned OFF before testing resistance.
- Disconnect component from circuit before testing.
- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual).
- Use firm contact with meter leads.

8.2.8 Continuity Measurement

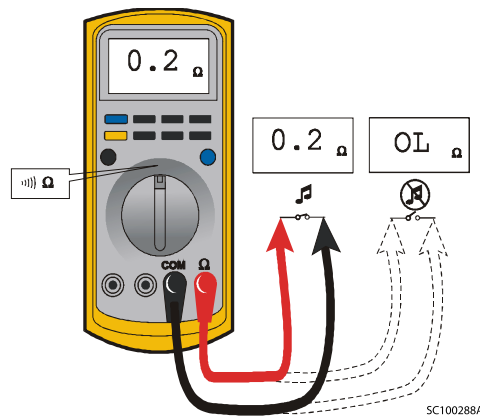


Figure 57. Continuity Measurement

- Some meters require a separate button press to enable audible continuity testing.
- Circuit power must be turned OFF before testing continuity.
- Disconnect component from circuit before testing
- Use firm contact with meter leads.
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity.

8.2.9 Current Measurement

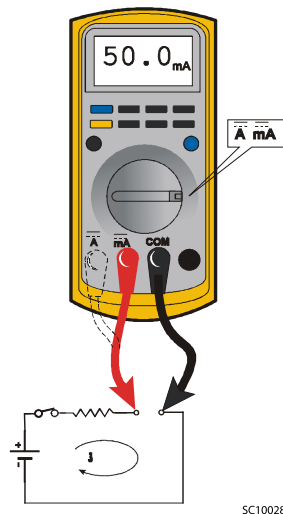


Figure 58. Current Measurement (DC)

- Set up the meter for the expected current range.
- Be sure to connect the meter leads to the correct jacks for the current range you have selected.
- If meter is not auto ranging, set it to the correct range (See multi meter's operation manual).
- Use firm contact with meter leads.

8.2.10 Continuity Measurement Over Long Distances

When trying to determine continuity of a harness or wire, longer than the reach of standard instrument leads, is possible to perform the check without excessively long leads. Using the other wires in the harness one can determine the condition of a particular wire in the harness.

General Electrical Information and Schematics

8.2.11 Requirements:

- Harness with at least three separate wires including the wire under test.
- These wires must be able to be isolated from other wires, etc.
- Jumper or method to connect contacts on one side of harness.
- Meter that can measure resistance or continuity.

8.2.12 Procedure

Test multimeter leads resistance. Subtract this value from the measured resistance of the wires to get a more accurate measurement.

Consult the circuit schematic to determine which wires to use in addition to wire under test, here called wire #1 and wire #2, and how to isolate these wires. These wires should appear in the same connectors as the wire under test or are within reach of the jumper.

1. Disconnect all connections associated with the wire under test and the two additional wires. If harness is not completely isolated disconnect battery terminals also, as a precaution.
2. Measure continuity between all three wires, the wire under test, wire #1 and wire #2. These should be open. If not, repair the shorted wires or replace the harness.
3. On one side, jumper from contact of wire #1 and wire #2.
4. Measure continuity between wire #1 and wire #2. If there is continuity, both wires are good and can be used for this test. If there is not continuity, either wire could be bad. Check connections and measurement setup. Redo measurement. If still no continuity, repair wires or consult schematic for other wires to use for test.
5. Jumper from wire under test to wire #1.
6. Measure continuity. If there is continuity, the wire under test is good. Resistance of a wire increases as the length increases and as the diameter decreases.

One can find the continuity of two wires, here #1 and #2, at once by following steps 1 through 4. If there is a problem the third wire is used to troubleshoot the other wires.

To find the problem, start at step 1 and use the entire procedure.

8.3 APPLYING SILICONE DIELECTRIC COMPOUND TO AMP CONNECTORS

Silicone Dielectric Compound must be used on the AMP connections for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors.

1. To prevent oxidation and low level conductivity, silicone dielectric grease must be packed completely around male and female pins on the inside of the connector after the mating of the housing to the header. This is easily achieved by using a syringe to fill the header with silicone dielectric compound, to a point just above the top of the male pins inside the header. When assembling the housing to the header, it is possible that the housing will become air locked, thus preventing the housing latch from engaging.
2. Pierce one of the unused wire seals to allow the trapped air inside the housing to escape.
3. Install a hole plug into this and/or any unused wire seal that has silicone dielectric compound escaping from it.

8.4 DIELECTRIC GREASE APPLICATION

Dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Non-waterproof connectors benefit from the application of dielectric grease.

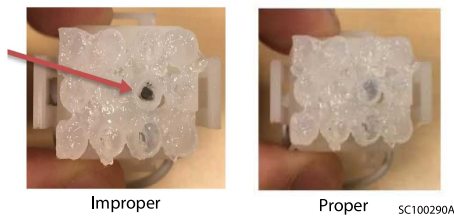
8.4.1 Installation

The following is general guidance for the installation of dielectric grease in a connector system.

- Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
- Apply dielectric grease to plug/male connector housing which typically contains sockets contact/female terminals.
- Leave a layer of dielectric grease on the mating face of the connector, completely covering each connector terminal hole. Refer the pictures shown below.
- Assemble the connector system immediately to prevent moisture ingress or dust contamination.
- The following connector systems are specifically addressed because of their widespread use at JLG. However, this guidance may be applied to similar devices.

8.4.2 AMP Mate-N-Lok

This connector system is widely used inside enclosures for general-purpose interconnect. Follow the general guidance for installation.



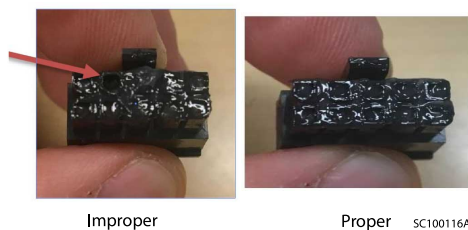
8.4.3 AMP Faston

This connector system is typically used on operator switches at JLG. Follow the general guidance for installation.



8.4.4 AMP Micro-Fit

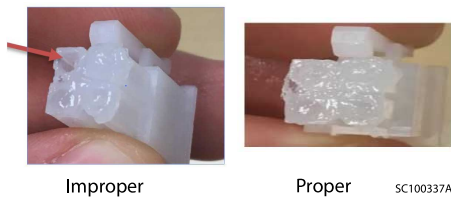
This connector system is typically used on control modules at JLG. Follow the general guidance for installation.



8.4.5 AMP Mini Fit Jr

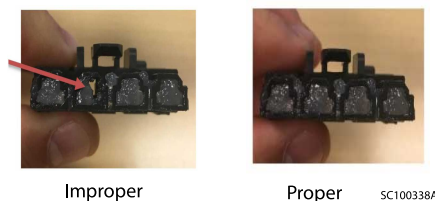
This connector system is typically used on control modules at JLG. Follow the general guidance for installation.

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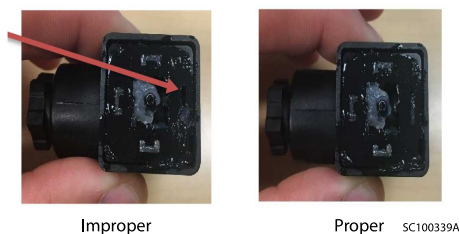
8.4.6 Mini Fit Sr

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.



8.4.7 DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.



8.4.8 Exceptions

Some waterproof connector applications do benefit from dielectric grease, and some non waterproof connectors do not benefit from dielectric grease.

In the exceptions below, we have found dielectric grease is not needed for some applications, and in some cases can interfere with the intended connection. Dielectric grease shall be used as an exception in other applications.

8.4.9 Enclosures

Application of dielectric grease is not required in properly sealed enclosures. To meet criteria, the enclosure must be rated to at least IP56 (dust protected; protected from powerful jets of water).

8.4.10 Carling Switch Connectors

Carling switches may experience high impedance, or discontinuity, due to silicone dielectric grease ingress when switching inductive loads. Therefore, dielectric grease shall not be applied to Carling switch mating connectors unless specifically noted.

8.4.11 Scissor Platform Cable at the Platform Control



8.5 AMP CONNECTOR

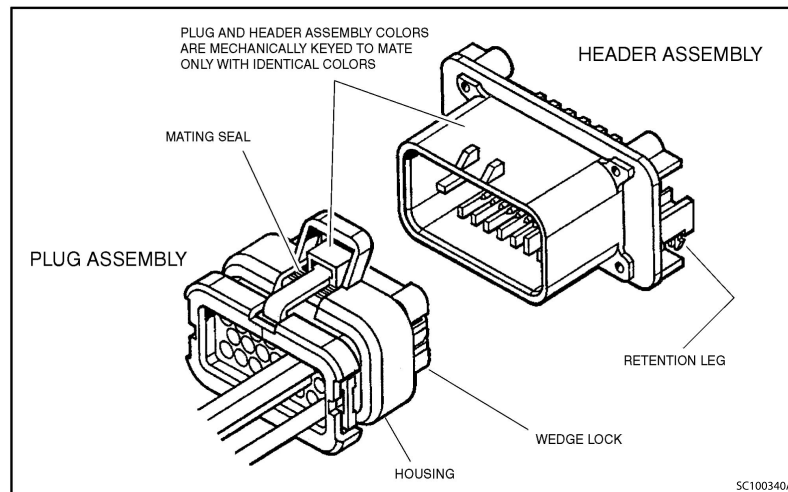


Figure 59. AMP Connector

8.5.1 Assembly

Check to be sure the wedge lock is in the open, or asshipped, position (Refer to [Figure — Connector Assembly \(1 of 4\), page 165](#)). Proceed as follows:

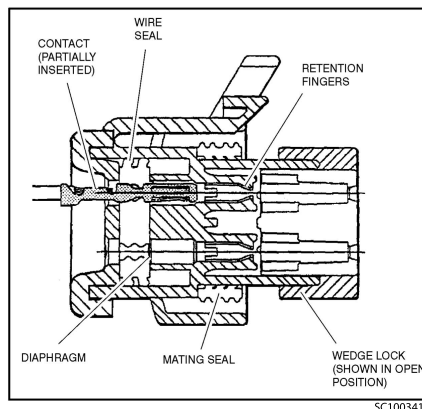


Figure 60. Connector Assembly (1 of 4)

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (Refer to [Figure — Connector Assembly \(2 of 4\), page 166](#)).

General Electrical Information and Schematics

2. Pull back on the contact wire with a force of 1 or 2 lb. to be sure the retention fingers are holding the contact (Refer to [Figure — Connector Assembly \(2 of 4\), page 166](#)).

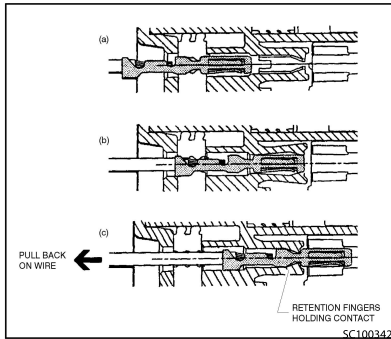


Figure 61. Connector Assembly (2 of 4)

3. After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward (Refer to [Figure — Connector Assembly \(3 of 4\), page 166](#)).

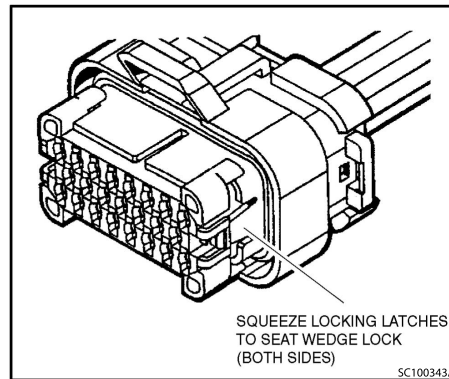


Figure 62. Connector Assembly (3 of 4)

4. Slide the wedge lock into the housing until it is flush with the housing (Refer to [Figure — Connector Assembly \(4 of 4\), page 166](#)).

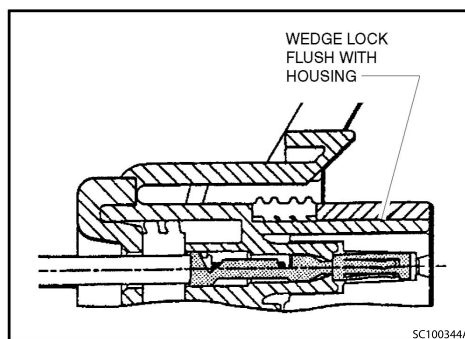


Figure 63. Connector Assembly (4 of 4)

8.5.2 Disassembly

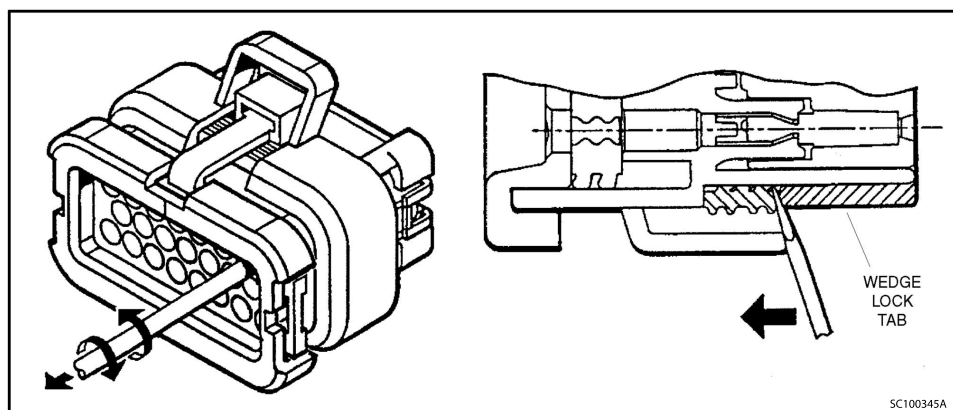


Figure 64. Connector Disassembly

1. Insert a 4.8 mm (3/16 in.) wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
2. Pry open the wedge lock to the open position.
3. While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.

Note: The wedge lock should never be removed from the housing for insertion or removal of the contacts.

8.5.3 Wedge Lock

The wedge lock has slotted openings in the forward, or mating end. These slots accommodate circuit testing in the field, by using a flat probe such as a pocket knife. DO NOT use a sharp point such as an ice pick.

8.5.4 Service - Voltage Reading

⚠ CAUTION

Do not pierce wire insulation to take voltage readings.

It has been common practice in electrical troubleshooting to probe wires by piercing the insulation with a sharp point. This practice should be discouraged when dealing with the AMPSEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

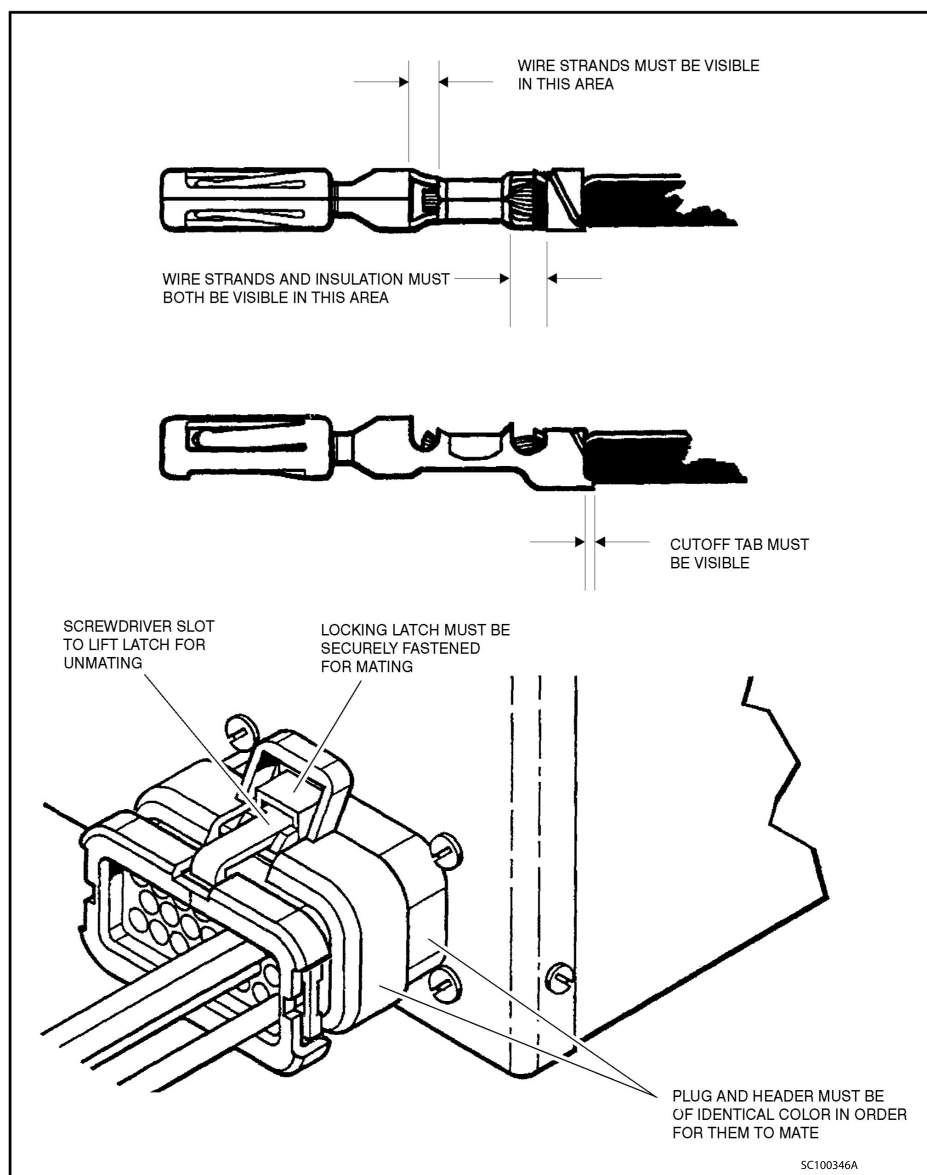


Figure 65. Connector Installation

8.6 WORKING WITH DEUTSCH CONNECTORS

8.6.1 DT/DTP Series Assembly

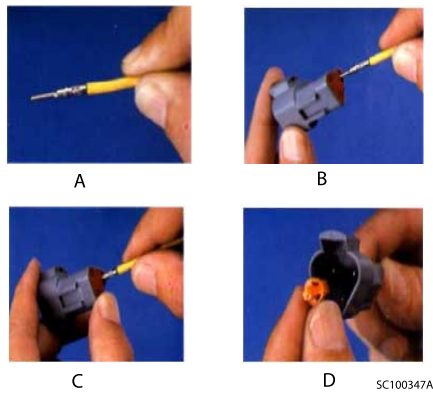


Figure 66. DT/DTP Contact Installation

1. Grasp crimped contact about 25mm behind the contact barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.
4. Once all contacts are in place, insert wedge lock with arrow pointing toward exterior locking mechanism. The wedge lock will snap into place. Rectangular wedges are not oriented. They may go in either way.

Note: The receptacle is shown - use the same procedure for plug.

8.6.2 DT/DTP Series Disassembly

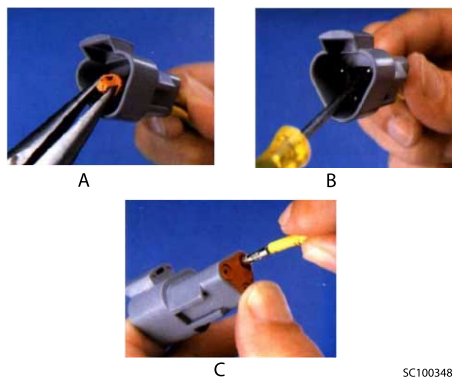


Figure 67. DT/DTP Contact Removal

1. Remove wedge lock using needle nose pliers or a hook shaped wire to pull wedge straight out.
2. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.
3. Hold the rear seal in place, as removing the contact may displace the seal.

8.6.3 HD30/HDP20 Series Assembly

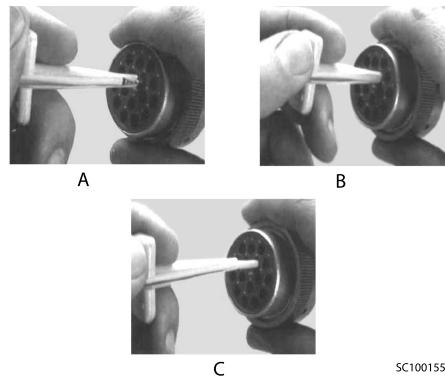


Figure 68. DT/DTP Contact Removal

1. Grasp contact about 25mm behind the contact crimp barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a positive stop is felt. A slight tug will confirm that it is properly locked in place.

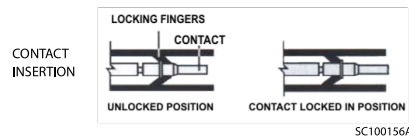


Figure 69. HD/HDP Locking Contacts Into Position

Note: For unused wire cavities, insert sealing plugs for full environmental sealing.

8.6.4 HD30/HDP20 Series Disassembly

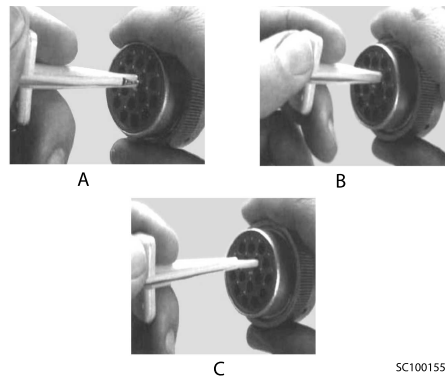


Figure 70. DT/DTP Contact Removal

1. With rear insert toward you, snap appropriate size extractor tool over the wire of contact to be removed.
2. Slide tool along into the insert cavity until it engages contact and resistance is felt.
3. Pull contact-wire assembly out of connector.

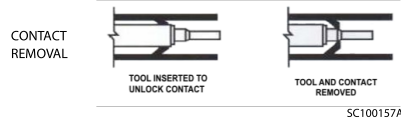


Figure 71. HD/HDP Unlocking Contacts

Note: Do Not twist or insert tool at an angle.

8.7 SWITCHES

8.7.1 Basic check

The following check determines if the switch is functioning properly, not the circuit in which the switch is placed. A switch is functioning properly when there is continuity between the correct terminals or contacts only when selected.

1. De-energize the circuit.
2. Isolate the switch from the rest of the circuit if possible. If not possible, keep in mind it may affect readings.
3. Access the terminals to the switch.
4. If the switch has two terminals:
 - a. Measure resistance across the terminals.
 - b. Change the switch position.
 - c. Measure resistance again with the leads in the same positions. If the meter was reading short, it should read an open. If the meter was reading open it should read short.
5. If the switch has more than two terminals, consult the schematic or switch diagram to determine what terminals will be connected. The test is similar to testing a switch with two terminals.
 - a. Place one meter lead on the common contact and the other on a different contact in the same circuit.
 - b. Cycle through all positions of the switch. The meter should read short only when the switch connects the two terminals and open otherwise.
 - c. If the switch has more than one common contact repeat the process for that circuit.

8.7.2 Limit Switches

Limit switches are used to control movement or indicate position. Mechanical limit switches are just like manually operated switches except that the moving object operates the switch. These switches can be tested the same way as a standard switch by manually operating the sensing arm.

Another type of limit switch used by JLG is the inductive proximity switch, also referred to as a "prox switch". Inductive proximity switches are actuated only by ferrous metal that contains Iron, such as steel) near the switch. They do not require contact, and must be energized to actuate. These types of switches can be used to detect boom or platform position, for example. These switches have a sensing face where the switch can detect ferrous metal close to it. To find the sensing face, take note how the switch is mounted and how the mechanisms meet the switch. Test this type of switch as follows:

1. Remove prox switch from its mount.
2. Reconnect harness if it was disconnected for step a, and turn on machine.
3. Hold switch away from metal and observe switch state in the control system diagnostics using the Analyzer. See vehicle or control system documentation on how to do this.
4. Place sensing face of switch on the object to be sensed by the switch. If that is not available, use a piece of ferrous metal physically similar to it. The switch state in the control system diagnostics should change.
5. When reinstalling or replacing switch be sure to follow mounting instructions and properly set the gap between the switch and object sensed.

8.7.3 Automatic Switches

If the switch is actuated automatically, by temperature or pressure for example, find a way to manually actuate the switch to test it. Do this either by applying heat or pressure, for example, to the switch. These switches may need to be energized to actuate.

1. Connect instrumentation to monitor and/or control the parameter the switch is measuring.
2. Observe switch state in control system with the Analyzer. See vehicle or control system documentation on how to do this.
3. Operate system such that the switch actuates. This could be going over a certain pressure or temperature, for example. The state indicated in the control system should change.

8.7.4 Switch Wiring - Low Side, High Side

When controlling a load, a switch can be wired between the positive side of the power source and the load. This switch is called a "high side" switch. The switch supplies the power to the load. When a switch is wired between the negative side of the power source and the load, it is a "low side" switch. The switch provides the ground to the load.

A low side switch will allow voltage to be present on the load. No power is applied because the switch is stopping current flow. This voltage can be seen if the measurement is taken with one test lead on the load and the other on the battery negative side or grounded to the vehicle. What is actually being measured is the voltage drop across the switch. This could mislead a technician into thinking the load is receiving power but not operating. To produce an accurate picture of power or voltage applied to the load, measure voltage across the load's power terminals. Also, the technician can measure the voltage at both power terminals with respect to battery ground. The difference between those two measurements is the voltage applied to the load.

8.8 ELECTRICAL SCHEMATICS



Figure 72. Electrical Schematic - Sheet 1 of 4

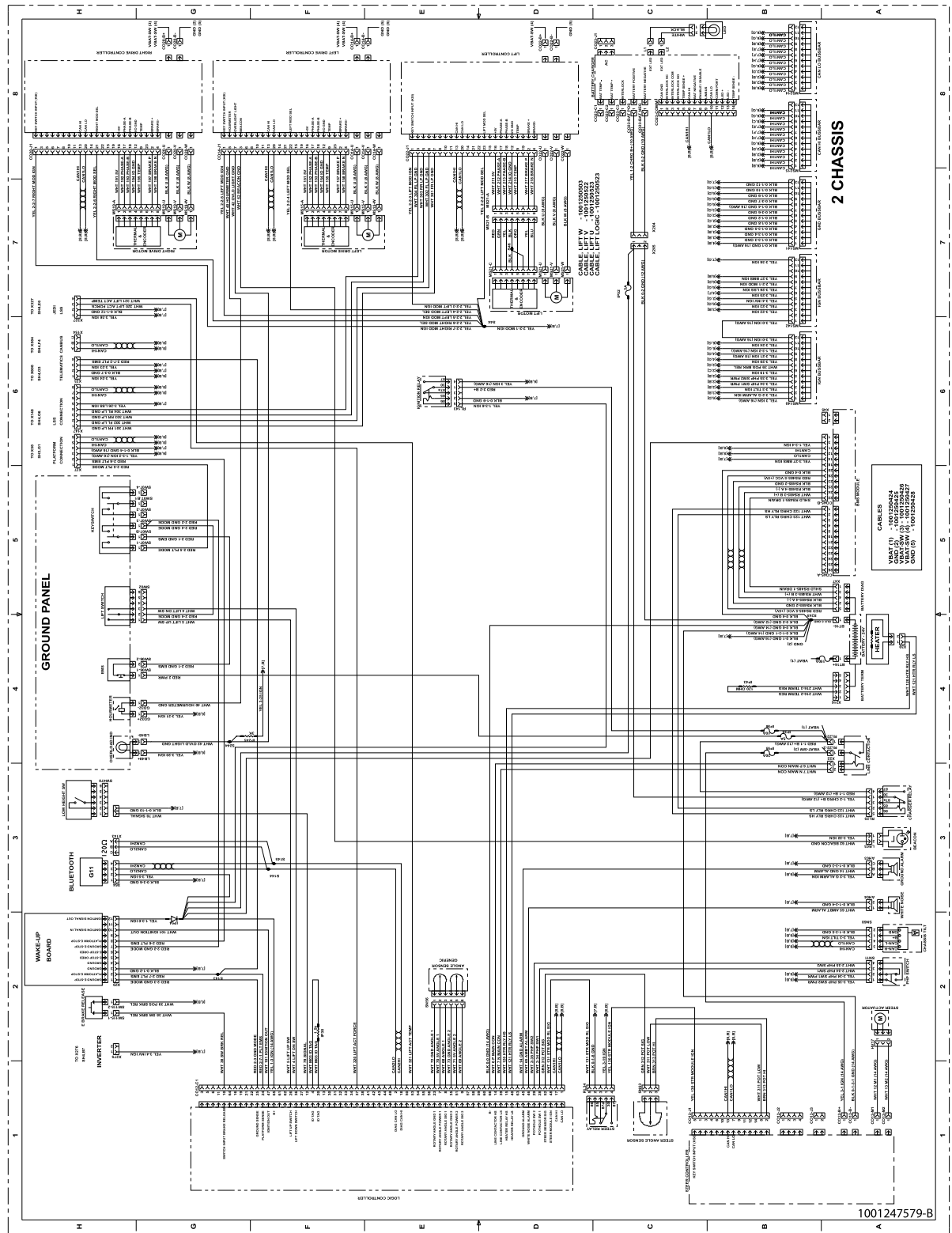


Figure 73. Electrical Schematic - Sheet 2 of 4

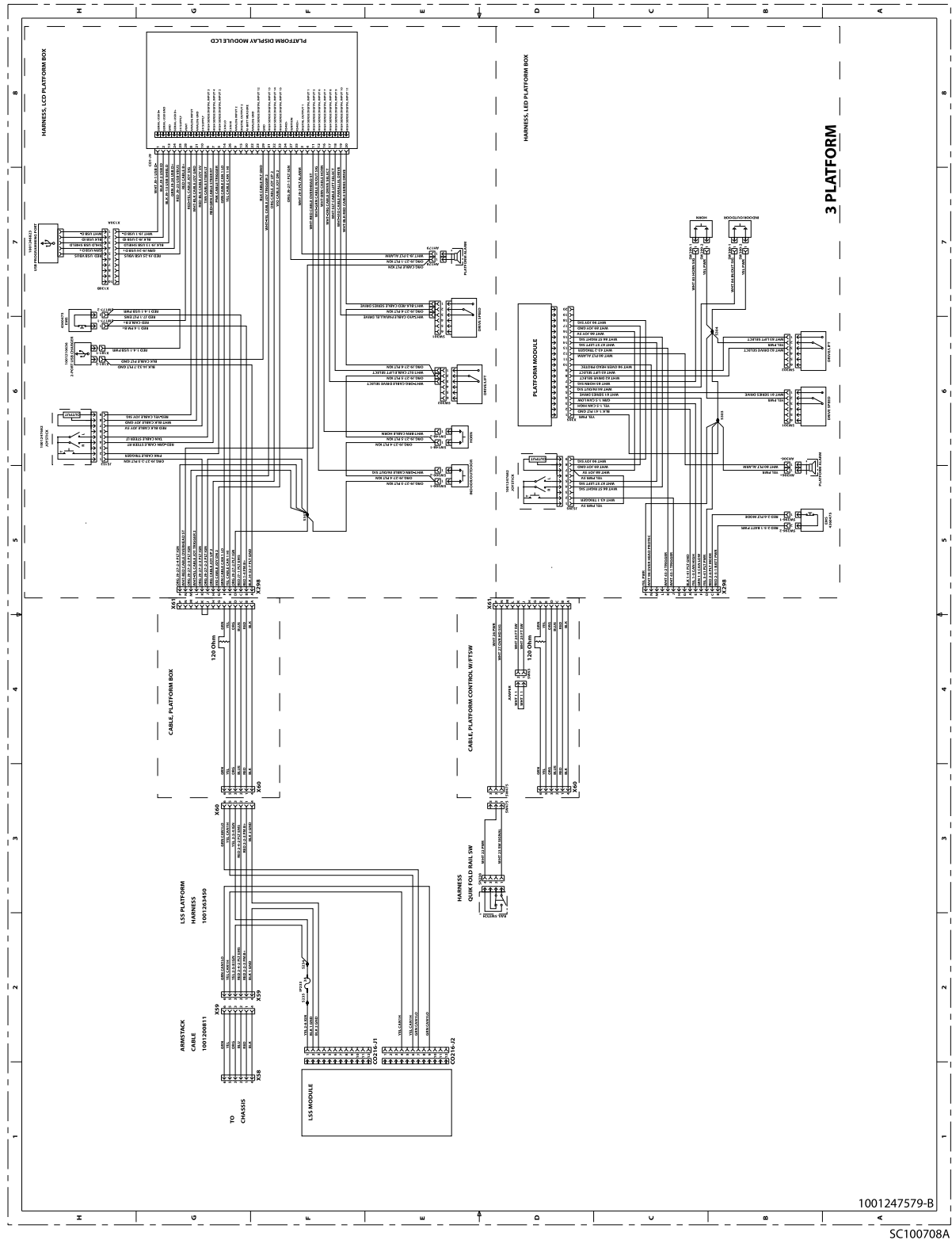


Figure 74. Electrical Schematic - Sheet 3 of 4

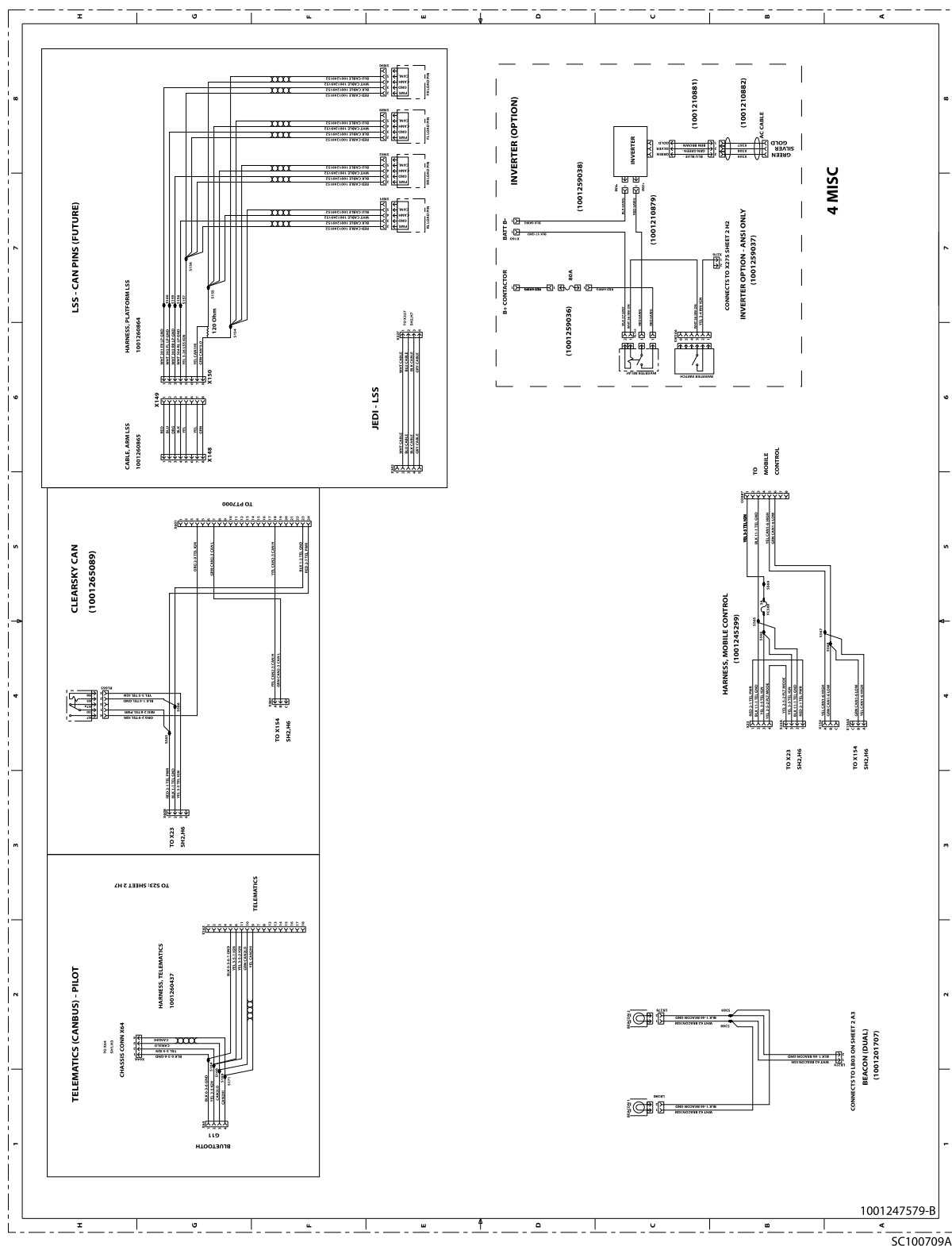


Figure 75. Electrical Schematic - Sheet 4 of 4



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