MITSUBISHI FORKLIFT TRUCKS

Service Manual

Controller

FC/MC

FB13PNT EFB21-00011-up

FB15PNT EFB21-50011-up
FB16CPNT EFB22-00011-up
FB18CPNT EFB22-50011-up

FB16PNT EFB23-00011-up
FB18PNT EFB23-50011-up
FB20PNT EFB24-00011-up

FB16CPN EFB27-00011-up
FB18CPN EFB27-50011-up
FB16PN EFB28-00011-up
FB18PN EFB28-50011-up
FB20PN EFB29-00011-up

99759-5M300

FOREWORD

This service manual is a guide for servicing Mitsubishi Forklift Trucks.
The long productive life of your forklift truck(s) depends on regular and proper servicing, servicing consistent with what you will learn by reading this service manual.
Read the respective sections of this manual carefully and familiarize yourself with all of the components before attempting to start a test, repair or rebuild the forklift truck.

The descriptions, illustrations and specifications contained in this manual are for forklift trucks with serial numbers in effect at the time of printing.
Mitsubishi Forklift Trucks reserves the right to change specifications or designs without notice and without incurring obligations. For your convenience the instructions are grouped by systems as an easy reference.

Safety related signs	Meanings
⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or damage to your machine.
NOTE	Indicates a condition that can cause damage to or shorten service life of the machine.

Unauthorized copying and lending are prohibited.

1. Safety

⚠ WARNING

- The proper and safe lubrication and maintenance for these forklift trucks, recommended by Mitsubishi Forklift Trucks, are outlined in the SERVICE MANUAL. Read and understand the SERVICE MANUAL before performing any lubrication or maintenance on these trucks. Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. The serviceman or mechanic may be unfamiliar with many of the systems on this truck. This makes it important to use caution when performing service work.
- Do not operate these trucks unless you have read and understood the instructions in the SERVICE MANUAL. Improper truck operation is dangerous and could result in injury or death.

A knowledge of the system and/or components is important before the removal or disassembly of any component.

Because of the size of some of the truck components, the serviceman or mechanic should check the weights noted in this Manual.
Use proper lifting procedures when removing any components.

Following is a list of basic precautions that should always be observed.

(1) Read and understand all warning plates and decals on the truck before operating, lubricating or repairing the product.

(2) Always wear protective glasses and protective shoes when working around trucks. In particular, wear protective glasses when using a hammer or sledge on any part of the truck or its attachments with a hammer or sledge.
Use welders gloves, hood/goggles, apron and other protective clothing appropriate to the welding job being performed. Do not wear loose fitting or torn clothing. Remove all rings from fingers when working on machinery.

(3) Do not work on any truck that is supported only by lift jacks or a hoist. Always use blocks or jack stands to support the truck before performing any disassembly.

(4) Lower the forks or other implements to the ground before performing any work on the truck. If this cannot be done, make sure the forks or other implements are blocked correctly to prevent them from dropping unexpectedly.

(5) Use steps and grab handles (if applicable) when mounting or dismounting a truck. Clean any mud or debris from steps, walkways or work platforms before using. Always face truck when using steps, ladders and walkways. When it is not possible to use the designed access system, provide ladders, scaffolds, or work platforms to perform safe repair operations.

(6) To avoid back injury, use a hoist when lifting components which weigh 23 kg (51 lb) or more. Make sure all chains, hooks, slings, etc., are in good condition and are of the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.

(7) To avoid burns, be alert of the hot sections and hot fluids in lines, tubes and compartments, even when idle or off.

(8) Be careful when removing cover plates. Gradually remove the last two bolts or nuts located at opposite ends of the cover or device and pry cover loose to relieve any springs or other pressures, before removing the last two bolts or nuts completely.

(9) Be careful when removing filler caps, breathers and plugs on the truck. Wrap a cloth around the cap or plug to prevent being sprayed or splashed by liquids under pressure. Be aware that the danger of being sprayed or splashed is ever greater if it is immediately after stopping the truck, as fluids is very hot.

(10) Use tools well maintained. And use the tools in proper way.

(11) Reinstall all fasteners with same part number. Do not use a lesser quality fastener if replacements are necessary.

(12) If possible, make all repairs with the truck parked on a level, hard surface. Block truck so it does not roll while working on or under truck.

(13) Before starting to work on truck, hang "Do not Operate" tag in the Operator Compartment.

(14) Repairs, which require welding, should be performed only with the appropriate reference information and by personnel adequately trained and knowledgeable in welding procedures. Determine the type of metal and select the correct welding procedure and electrodes, rods or wire to provide a weld metal strength equivalent at least to that of parent metal.

(15) Do not damage wiring during the removal process. Do not reuse the damaged wiring. Reinstall the wiring paying attention not to contact sharp corners or hot parts. Place wiring away from oil pipe.

(16) Be sure all protective devices including guards and shields are properly installed and functioning correctly before starting a repair.
If a guard or shield must be removed to perform the repair work, use extra caution.

(17) Always support the mast and carriage to keep carriage or attachments raised when maintenance or repair work is performed, which requires the mast in the raised position.

(18) Loose or damaged fuel, lubricant and hydraulic lines, tubes and hoses could cause fires. Do not bend or strike high pressure lines or install ones which have been bent or damaged. Inspect lines, tubes and hoses carefully. Do not check for leaks with your hands. Pin hole (very small) leaks could result in a high velocity oil stream that will be invisible close to the hose. This oil could penetrate the skin and cause personal injury. Use cardboard or paper to locate pin hole leaks.

(19) Tighten connections to the correct torque. Make sure that all heat shields, clamps and guards are installed correctly to avoid excessive heat, vibration or rubbing against other parts during operation. Shields that protect against oil spray onto hot exhaust components in event of a line, tube or seal failure, must be installed correctly.

(20) Relieve all pressure in air, oil or water systems before any lines, fittings or related items are disconnected or removed.
Place blocks to prevent a device from falling if it is in the raised position. Release the residual pressure when removing a pressurized device.

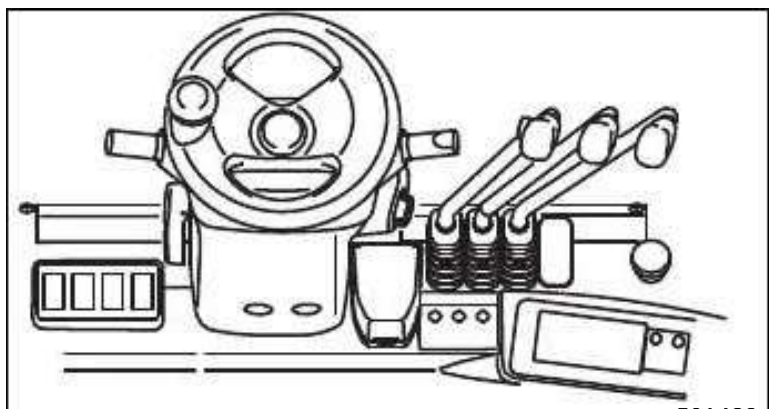
(21) Do not operate a truck if any rotating part is damaged or contacts any other part during operation.
Any high speed rotating component that has been damaged or altered should be checked for balance before reusing.

2. How to Use This Manual

2.1 Truck Model

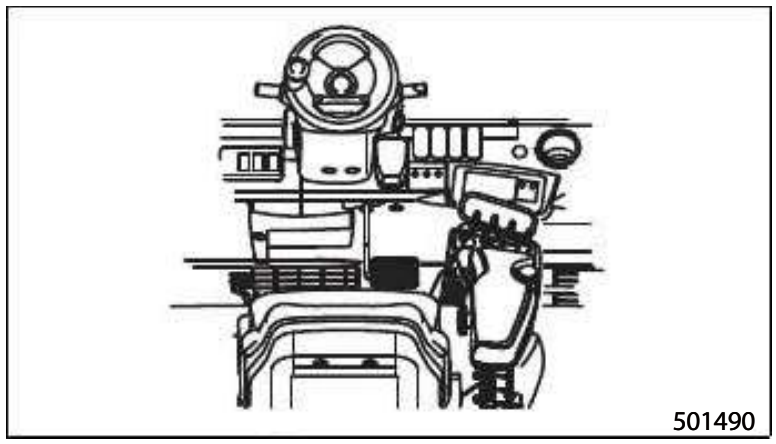
MC Truck (Manual Control System)

Mechanically controlled hydraulic system (conventional lever system)



FC (Fingertip Control System) Truck

This model allows a fingertip operation of lifting and tilting jobs, and may improve the job efficiency with less operation fatigue.



Connector number

A connector number is allocated to each connector.
Refer to the CHAPTER 5 CIRCUIT DIAGRAM or the connector number.

3. Units

- SI Units are used in this manual.
- The following table shows the conversion of SI unit and customary unit.

Item	SI unit	Metric unit	Yard-pound unit
Force	1 N	0.102 kgf	0.225 lbf
Pressure	1 MPa	10.1972 kgf/cm^2	145.038 psi
Torque	1 N·m	0.102 kgf·m	0.7376 lbf·ft
Length	1 mm	-	0.039 in.
	1 m	-	3.281 feet
Weight	1 kg	-	2.205 lb
Temperature	1 ℃	-	°F=1.8 x °C+32
Volume	1 L	-	0.264 US.gal.

Chapter 1 CONTROLLER

Chapter 3 MOTOR

Chapter 4 HOW TO READ CIRCUIT DIAGRAMS

Chapter 5 CIRCUIT DIAGRAM

Chapter 1 CONTROLLER

1. Controller System

1.1 System Layout

Five or seven independent controllers are linked together by the Controller Area Network (CAN) to communicate with each other to control the truck.

The logic unit is the heart of the control system for the lift trucks.
The configuration of the controller system is classified into two types according to the lifting system.

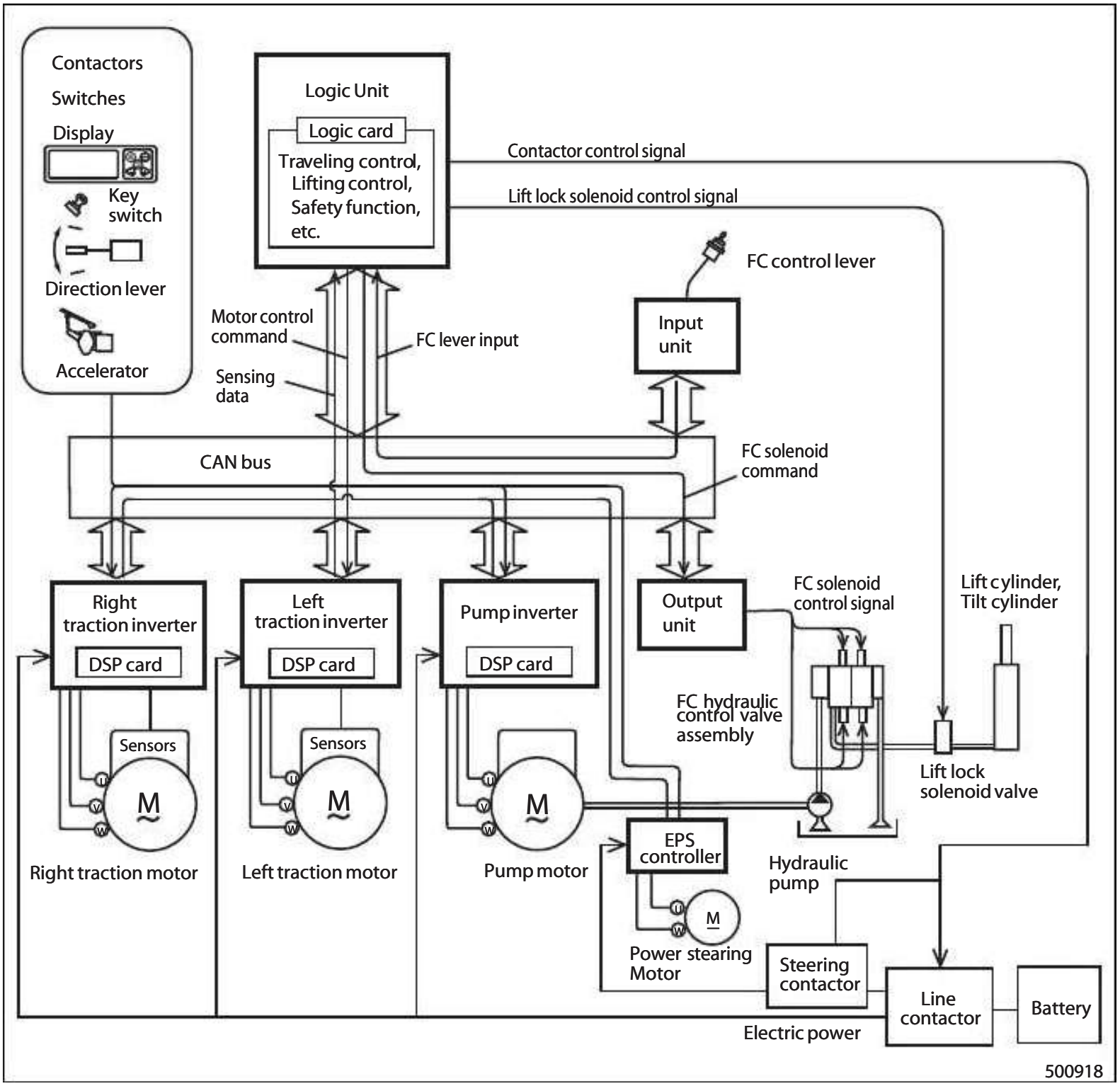
The input unit is connected to the FC control lever.

The output unit is connected to the FC hydraulic control valve assembly.

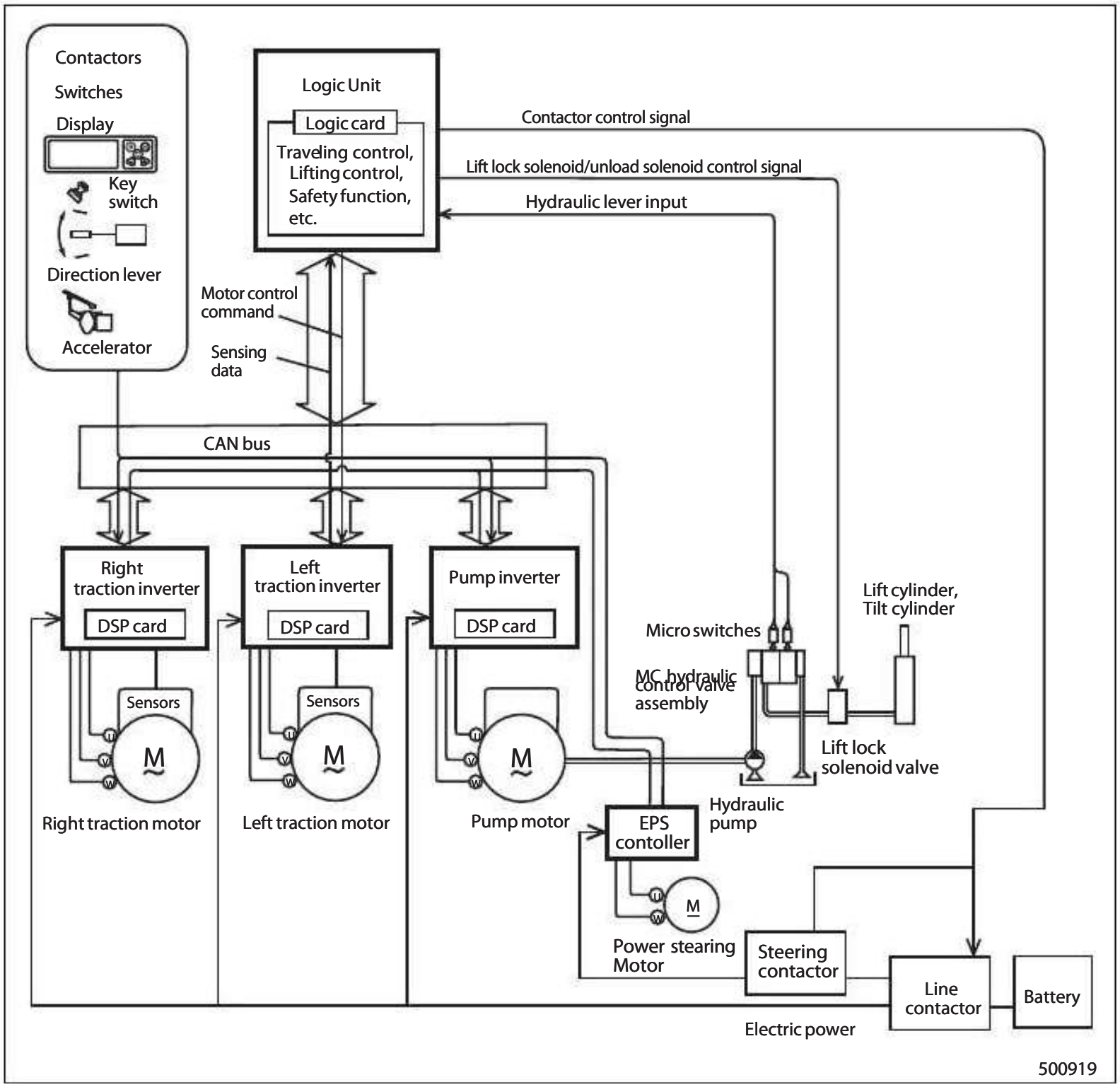
The inverters and EPS controller are connected to the each motor.

The logic unit is connected to the other devices.

System layout for FC type



System layout for MC type



1.2 Controller Area Network (CAN)

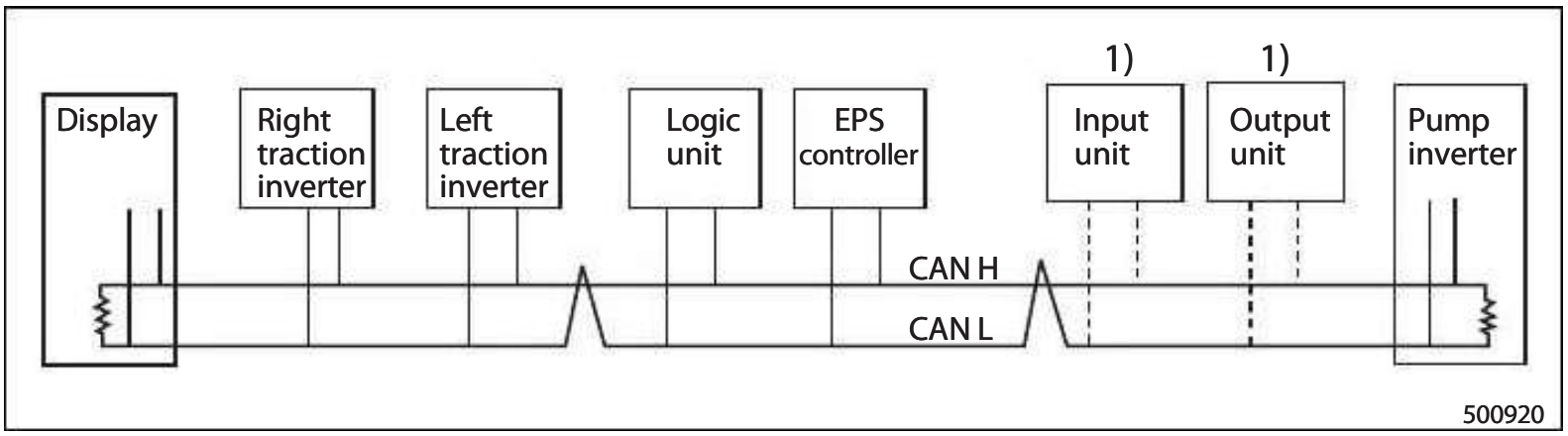
Each controller is linked with the truck harness to form a network as follows.

The terminal resistors are built into the display and the pump inverter.

If the terminal resistors are not properly connected, the communication failure may occur between the logic unit and other controllers.

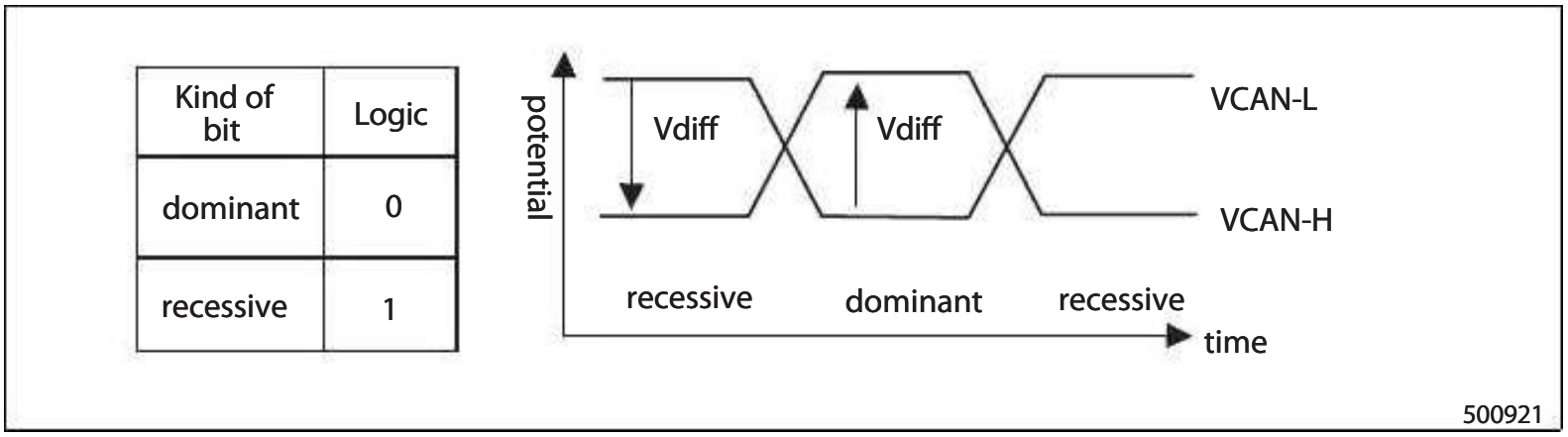
The input unit and output unit are used for FC models only.

For details, see the "Traction Inverter R.H. Fault (63)", "Traction Inverter L.H. Fault (64)" and "Pump Inverter Fault (65)", "EPS Controller fault (71)" in "Troubleshooting for Control Circuits."



1) Input unit and output unit are used for FC model only.

The data are expressed as electric potential difference between high- and low-level signals as follows.
The signals are transferred to each controller through the serial communication protocol.



Main specifications

Item	Specifications	
Communication protocol	CANbus 2.0B passive	Non-Return to Zero method Broadcast communication protocol
Communication line	Dual 2-wire type serial communication	
Communication speed	500 kbps	
Data length	0 to 8 bytes	

1.3 Outline of Logic Unit

This controller includes the power supply card and logic card.

It controls all the jobs for the truck based on the operator's input.

The controller sends a motor control command to the right and left traction inverters from the input of the direction lever or the accelerator pedal. It also monitors malfunctions of the traction system.

The lever input triggers to send the motor control commands to the pump inverter. It also monitors malfunctions in the hydraulic control system. In the FC specifications, this controller sends a control command to the solenoid valves from the output unit by the lever input. A malfunction in the valve control system is also monitored by this controller.

The truck speed and residual battery power are monitored and shown on the display unit.

The logic unit sets its model information and optional default data into internal memory. The information is secured even if the power supply for the logic unit is turned off. This information is set at the factory.

The following table shows the model information. The system will not work properly if the actual controller system is different from the model information.

Model information

Item	Description	SUO No.
Truck type	Model set	#40
Battery voltage	36 V, 48 V	#41
Battery type	Battery type	#42
Hydraulic control selection	FC type, MC type	#43
Mast type	Mast type	#44
Valve section	Number of valves	#45
Battery voltage adjustment	Battery voltage adjustment	#46
Foot direction	Optional equipment	#47
Load meter function	Optional equipment	#48
Tilt horizon function	Optional equipment	#50

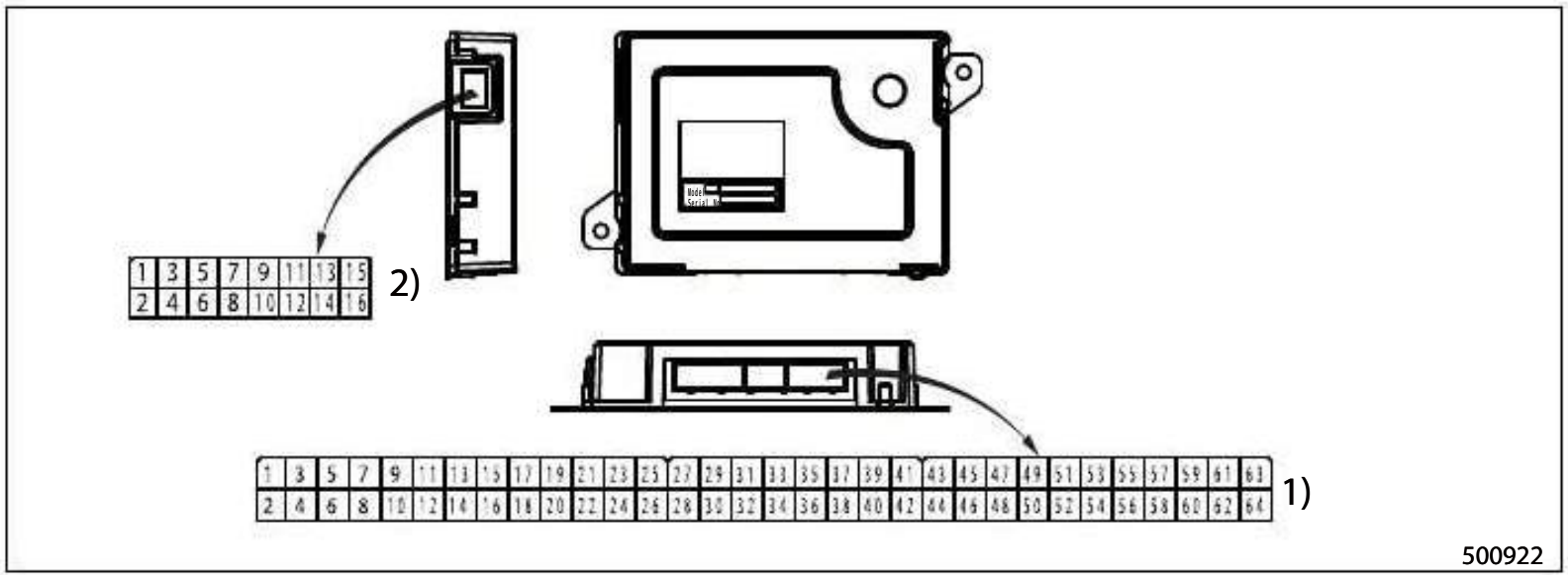
The current information is available to confirm and modify.

Refer to Setup Option on page 1-22 for details and setting procedure.

The model information and various features are set by the Setup Option (SUO).

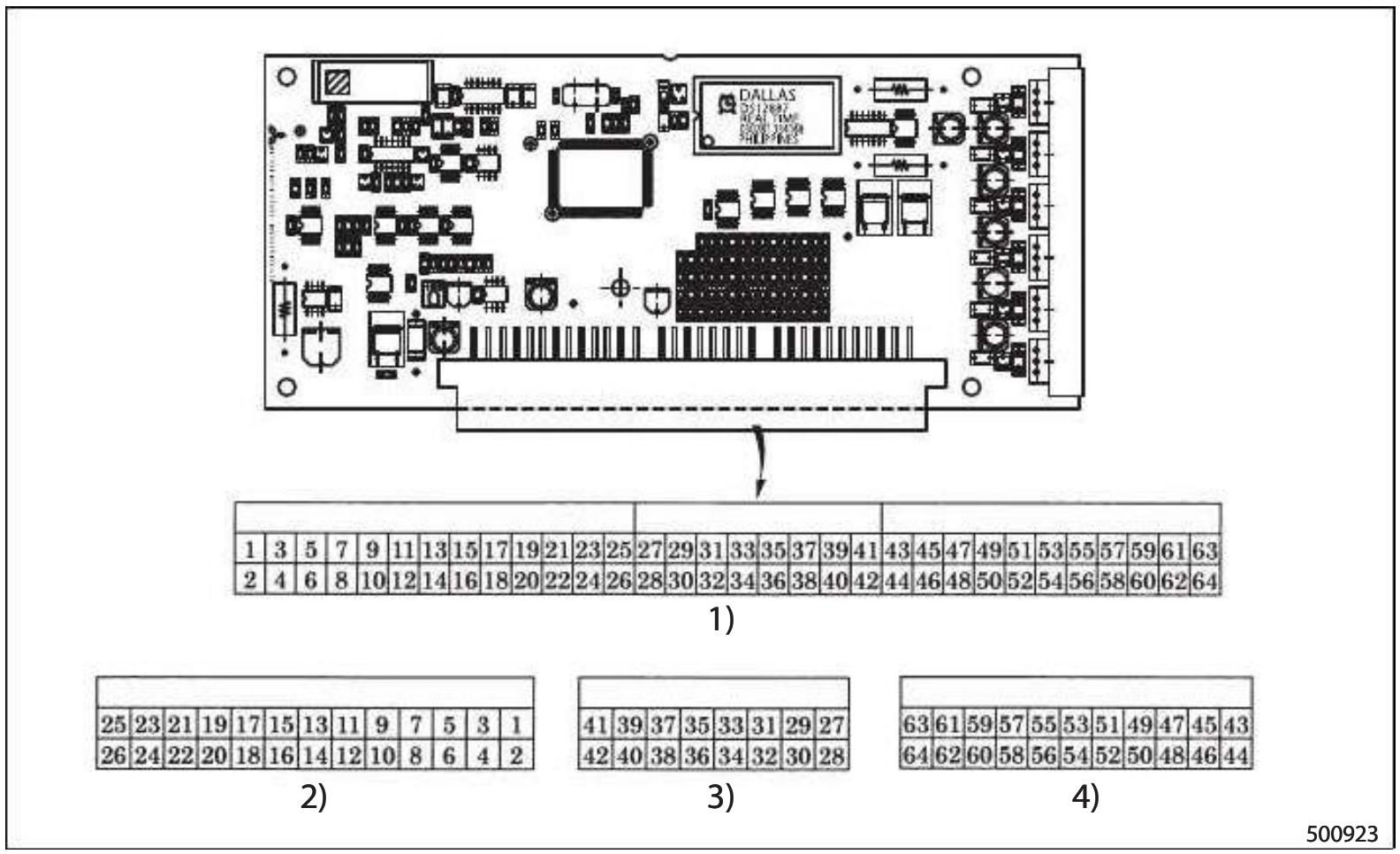
The power supply card changes the battery voltage and supplies power to the logic card and the DSP card.

Logic unit



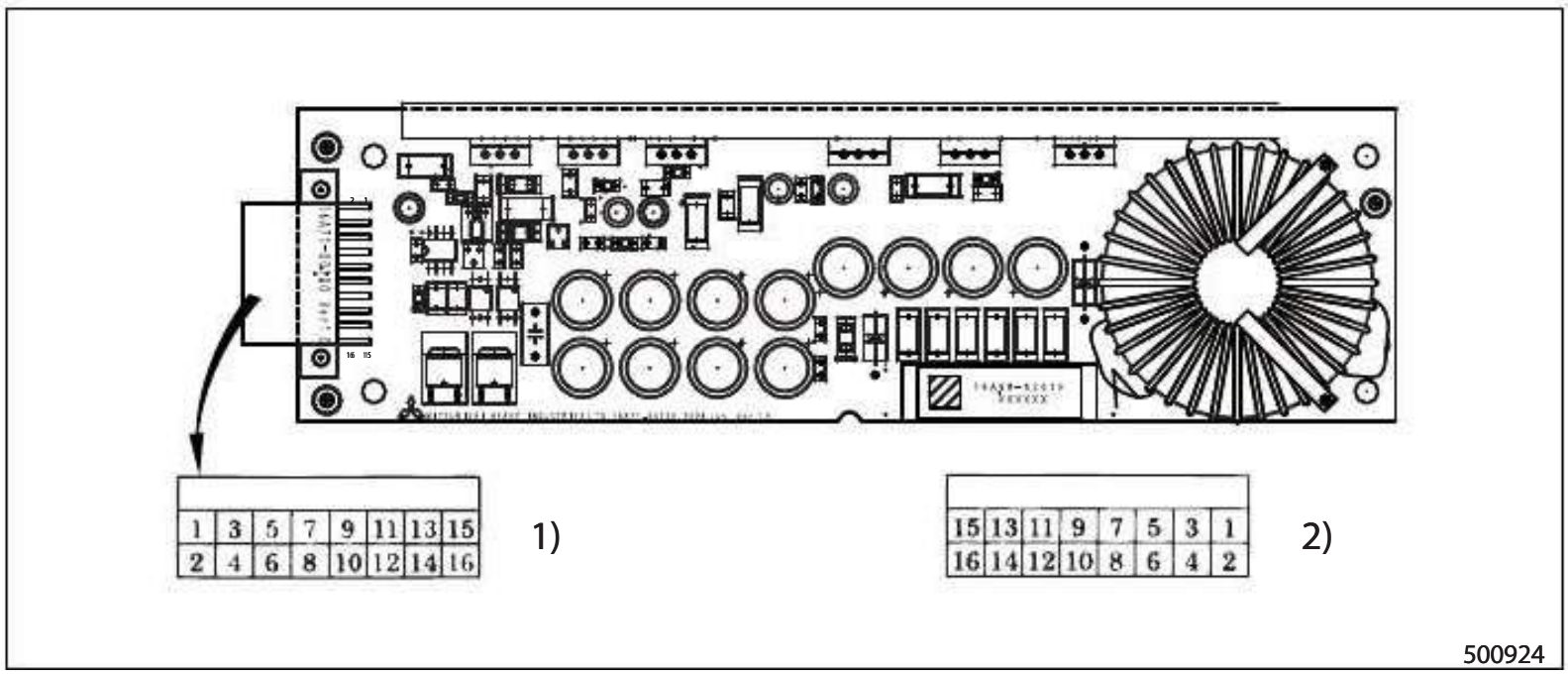
1) Pin location of logic card
2) Pin location of power card

Logic card



1) Logic card side
2) Harness side E-02
3) Harness side E-03
4) Harness side E-04

Power supply card



1) Power supply card side

2) Harness side E-01

1.4 Outline of Inverter

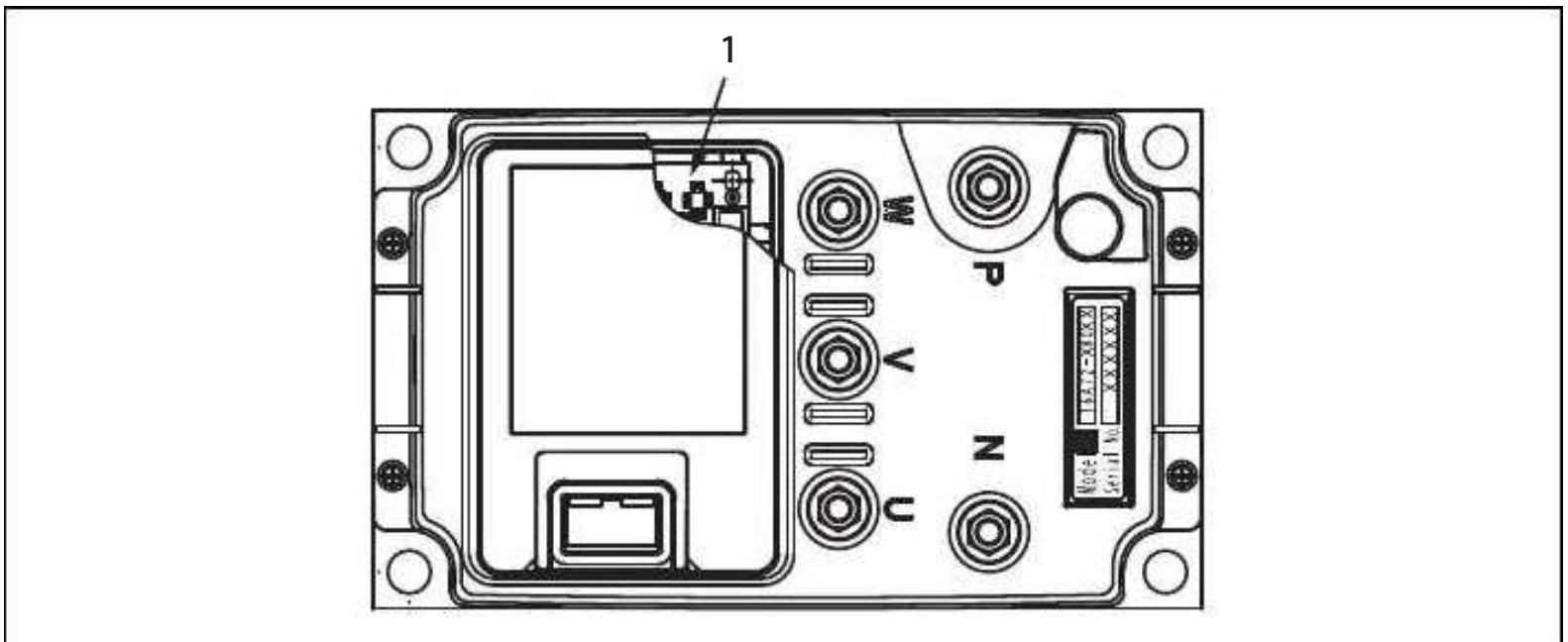
The inverter is a motor drive controller that consists of Digital Signal Processor (DSP) card, Insulated Metal Substrate (IMS) module and their drive boards.

It drives the AC induction motor according to the motor control command from the logic unit. It also monitors malfunctions of the motor and its condition. When a malfunction occurs, it stops the motor and informs to the logic unit.

The DSP card has the DSP chip that enables high-speed calculation and controls the AC induction motor.

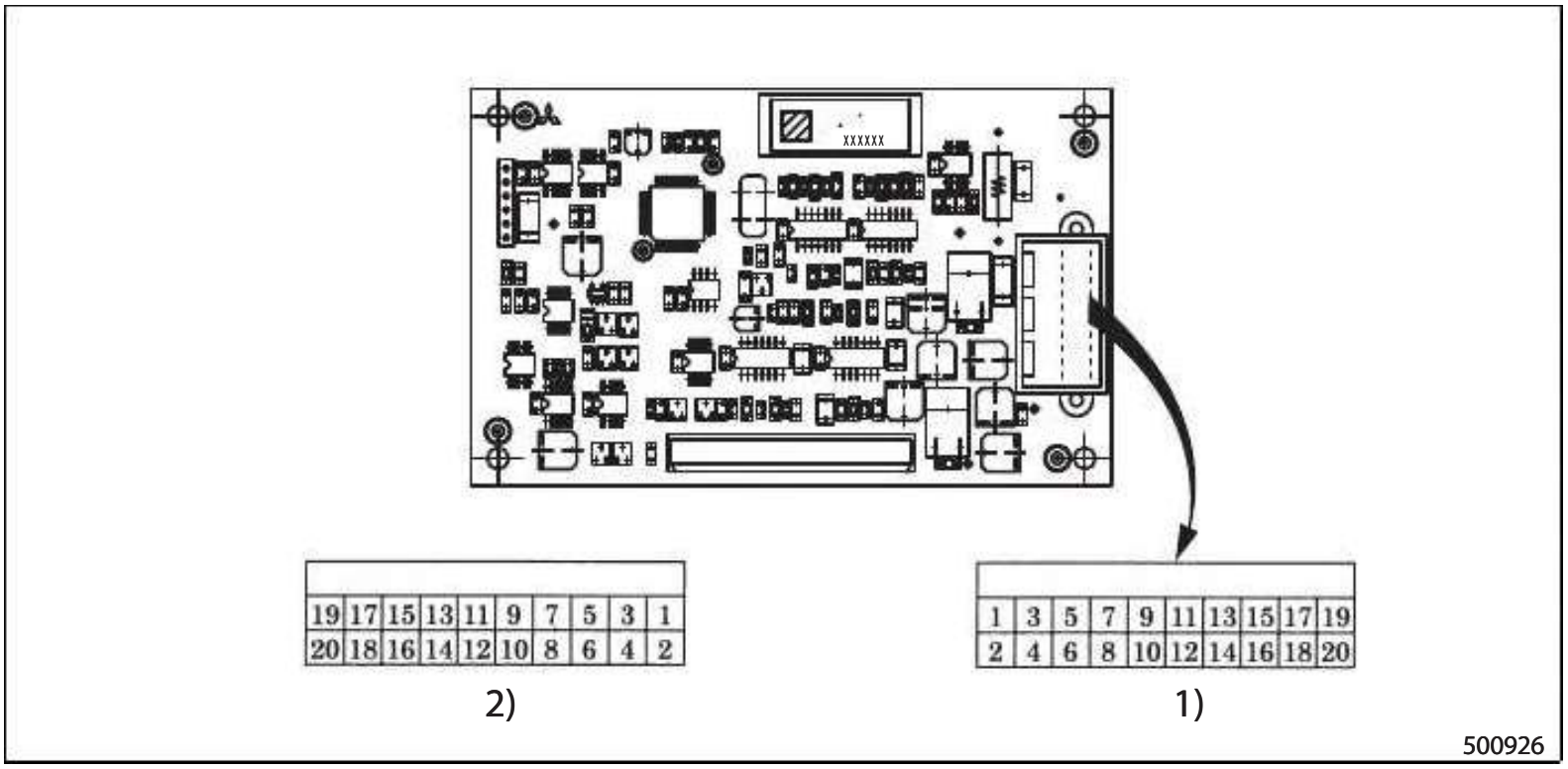
The IMS module has multiple MOS-FET modules which convert battery DC current into AC current for the traction and pump motors.

Traction inverters (right and left) and Pump inverter



1. DSP card

Traction inverter DSP cards (right and left) and Pump inverter DSP card

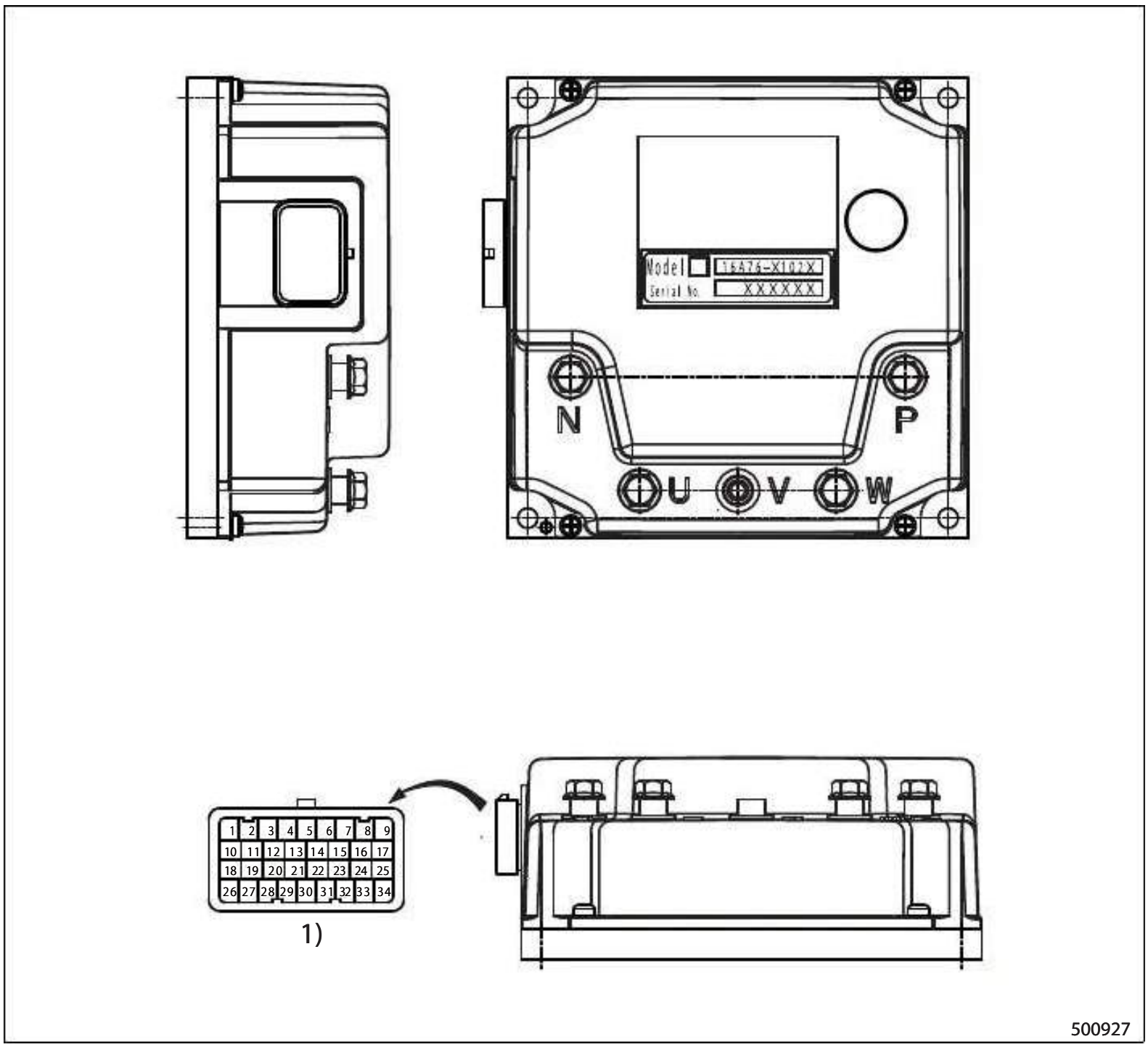


1) Inverter card side

2) Harness side, Traction Right E-07
Harness side, Traction Left E-06
Harness side, Pump E-05

1.5 Outline of EPS Controller

EPS controller is a motor drive controller. It drives the DC motor according to the steering input and tire angle input.
It also monitors malfunctions of motor and its condition. When a malfunction occurs, it stops the motor and informs to the logic unit.

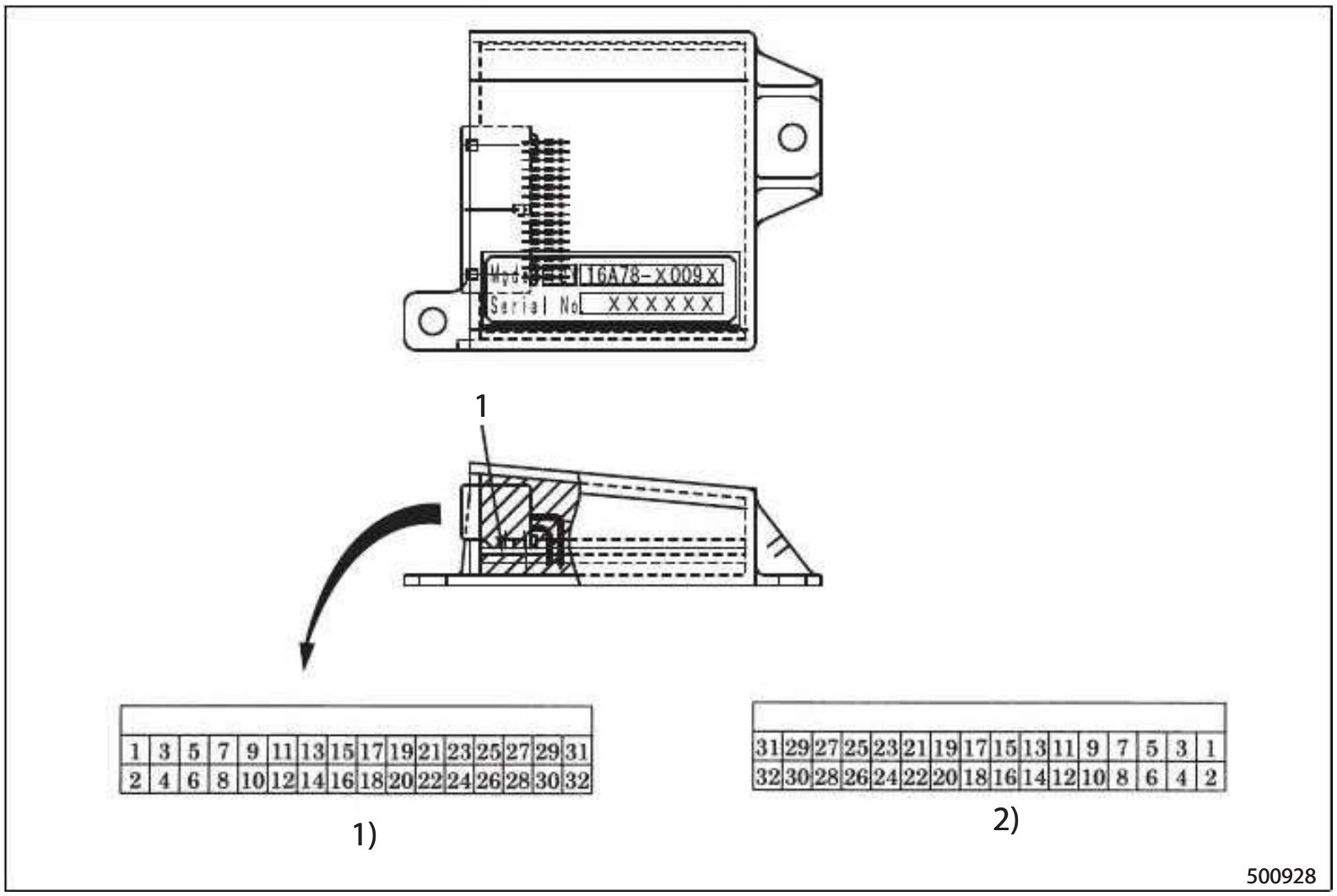


1) CN1

1.6 Outline of Input unit

This input unit is connected to the FC specification model.

It is the dedicated input unit for connecting equipment such as the FC control levers and switches. It monitors for the malfunction of connected equipment and its condition. When a malfunction occurs, it informs to the logic unit.

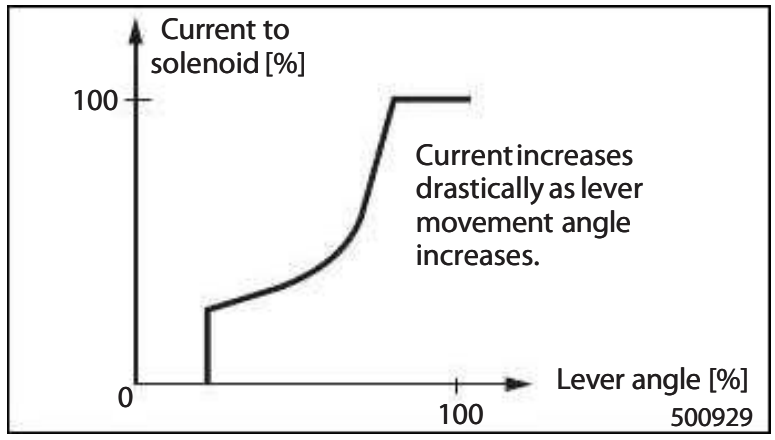


1. Input unit card

1) Input unit card side
2) FC-IN harness side E-12

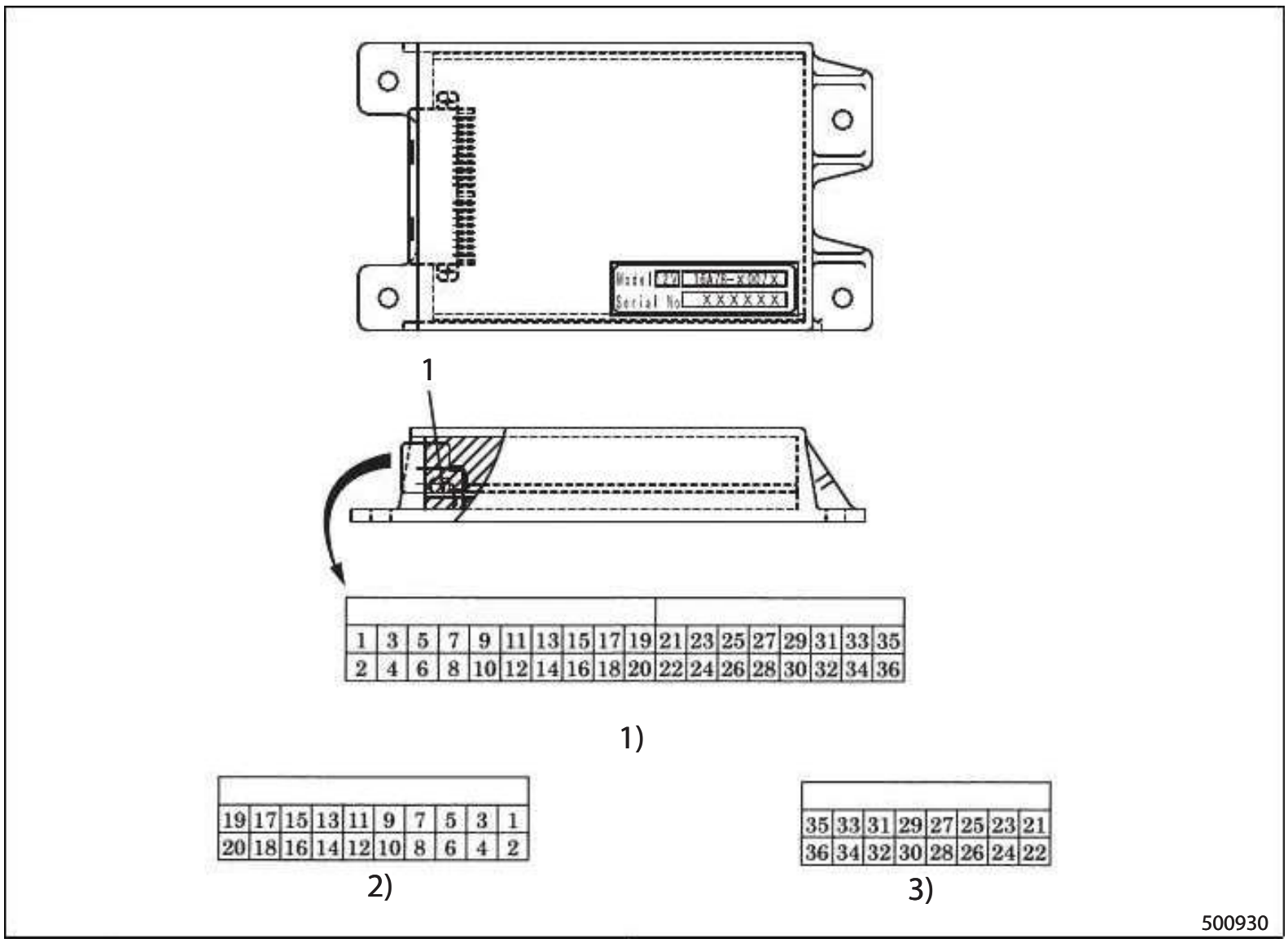
1.7 Outline of Output unit

This output unit is connected to the FC specification model. It is the dedicated output unit for controlling the solenoid valves. It drives the solenoid valves according to the valve control command from the logic unit. It monitors for the malfunction of the solenoid valves and its condition. When a malfunction occurs, it informs to the logic unit.



Current characteristics of proportioning solenoid valve

Output unit



1. Output unit card

1) Output unit card side
2) Harness side E-10
3) FC-OUT harness side E-11

2. Traction Controller Feature

2.1 Modification of traction characteristics

Acceleration power, maximum output power and battery consumption can be set. The following two parameters can be set.

Acceleration rate	Sets acceleration rate.
Traveling power	Selection of the maximum output power changes the amount of battery consumption. It also influences the acceleration rate during loading operation.

Regeneration power and type of regeneration can be set.
There are three types of regeneration and each has availability of setting for regeneration power.

Auto regeneration	Normal deceleration that occurs when the traveling and the direction levers are in the same direction. In case of the setting "1", the regenerative braking does not work when releasing the accelerator pedal.
Brake regeneration	This deceleration occurs while stepping on the brake.
Lever regeneration	The deceleration that occurs when the travel and the direction levers are in the opposite directions.

The lever regeneration starts when the travel direction and the direction lever are in opposite directions. The amount is determined by the pressure on the accelerator pedal.

Setting feature for traction characteristics

		Description	SUO No.
Powering	Acceleration rate	Acceleration of traction	#8
	Traveling power	Max. power, amount of battery consumption	#9
Regeneration	Regen adjustment for accelerator regen	Rate of regeneration at normal slow down	#23
	Regen adjustment for brake regen	Rate of regeneration when stepping on the brake	#21
	Regen adjustment for lever regen	Rate of regeneration when operating two in the opposite direction	#22

Refer to page 1-22 for details and setting procedure of the "Setup Option."

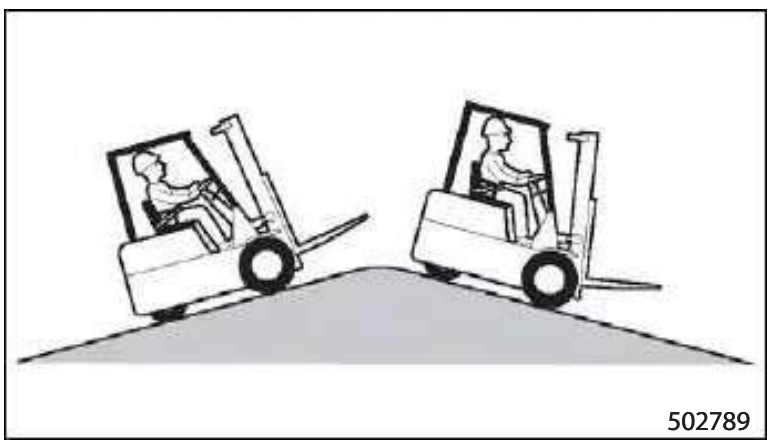
The application preset feature (#1) has the preset setting pattern registered.

2.2 Unti-rollback

When the accelerator pedal is released on a grade, the untiroll-back function will stop the truck.

The descending speed changes with the steepness of grade, the weight of load and value setting of the SUO #23.

Note: When the setting of SUO #23 is "1", the untiroll-back does not work.

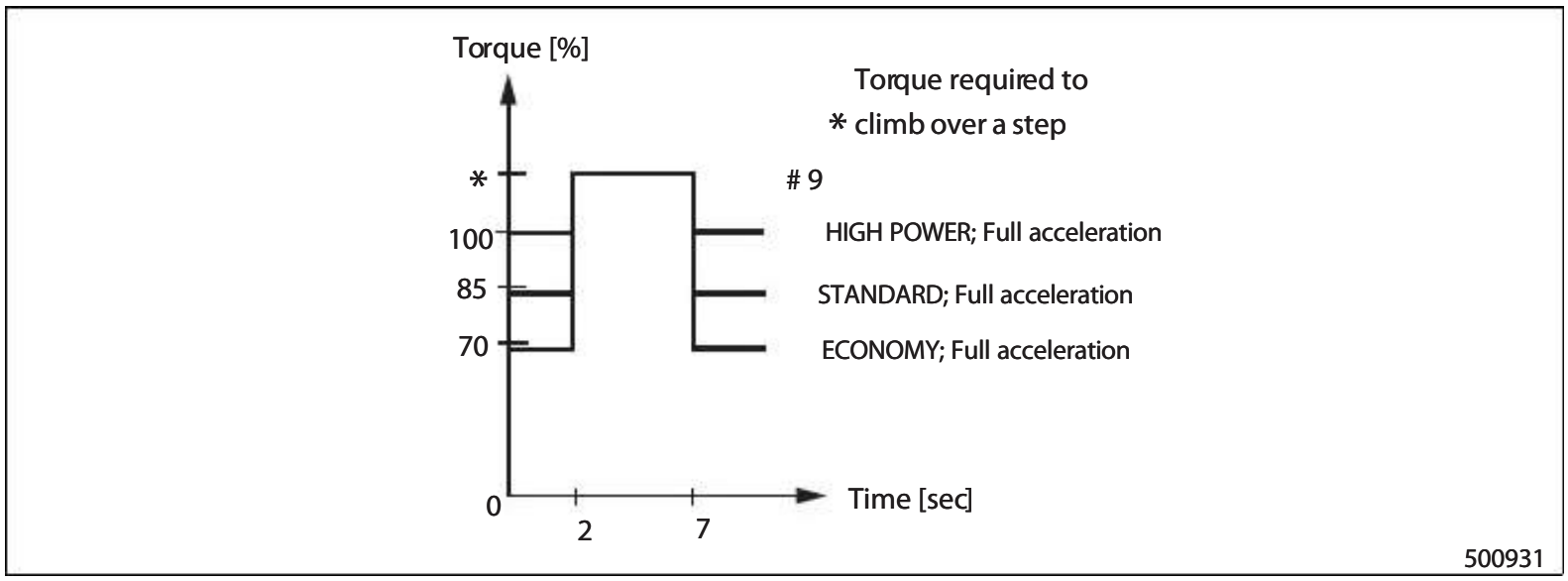


Truck stop accelerator pedal is stops released on a grade.

2.3 Boost

When truck traveling is blocked by a step, the boost function prevents stalling of the truck. Usually the motor maximum torque is set by SUO #9, and this function allows the truck to go over a step regardless of the value setting of the motor maximum torque.

Fully depress the accelerator pedal for 2 seconds. The boost function increases the motor maximum torque for 5 seconds. If the pressure to the accelerator pedal is reduced or the direction lever is moved, the boost function will be cancelled immediately.



Note: When the motor overheats, the boost will not work.
If the stall time setting is small, the motor protection function will be applied during prolonged slow speed traveling.

2.4 Limitation of maximum travel speed

The speed limitation is classified into two major types and available to set each maximum speed.

Type	Description
Normal type	The limitation that functions at all times and is used to keep the speed within the limits. The lamp will glow when the switch is pressed. While the lamp is glowing, the speed is restricted to the speed (km/h) of the display.
Conditional type	The limitation that is triggered from a specific switch input occurrence. Quadruple input signals are selectable, and available to set limit value to each signal.

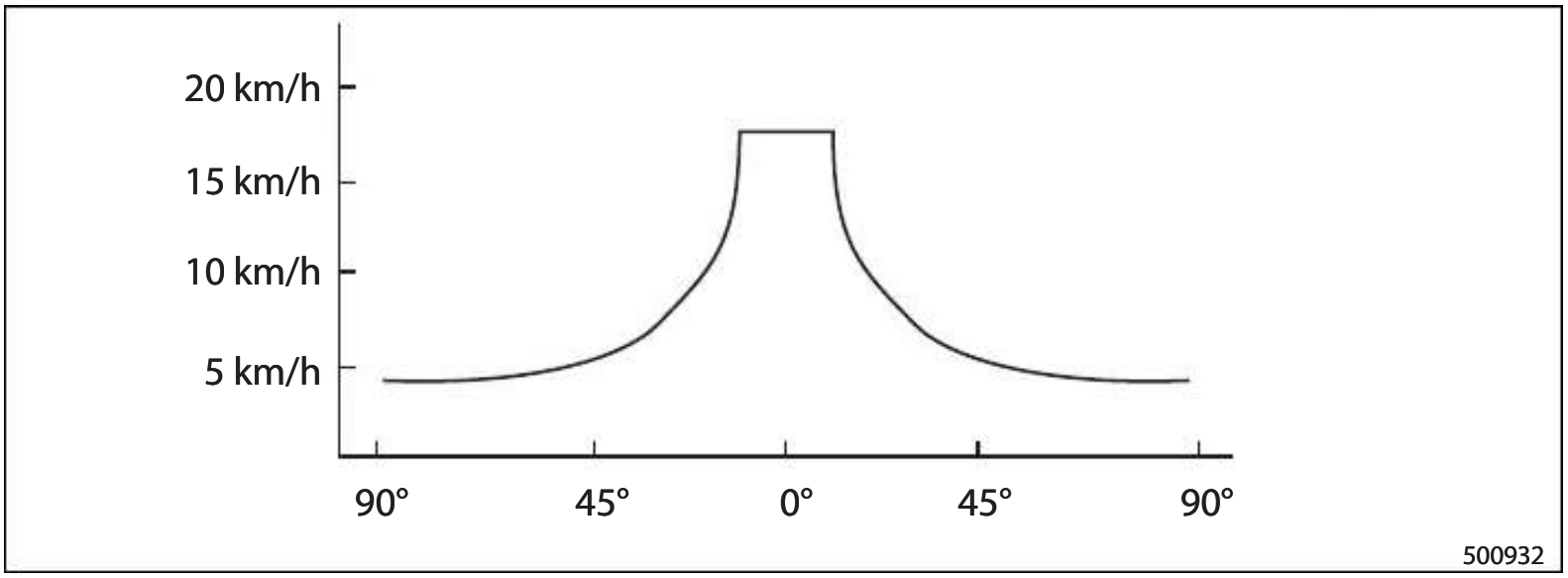
Feature of maximum speed limit

		Description	SUO No.	Harness Pin No.
Normal	Top travel speed limit	Always effective	#7	-
	Turtle SW input setting	Effective when turtle SW is enable.	#30, 31	-
	Travel speed limit of turtle SW			
Conditional	Auxiliary travel speed limit 1	Effective when aux. input 1 close/open	#11, 12	E-03-40
	Auxiliary travel speed limit 2	Effective when aux. input 2 close/open	#14, 15	E-03-41
	Auxiliary travel speed limit 3	Effective when aux. input 3 close/open	#17, 18	E-03-30

2.5 Turning speed limit function

The turning radius is calculated from the tire angle and the speed limit is control by the turning radius to improve the operability during turning.

Item	Description	SUO No.	Harness Pin No
Speed limit for curving	Enable or disable the turning speed limit	#29	-



Note: The turning speed depends on the regen power setting of SUO #21 to 23.

2.6 Miscellaneous features for traction

Miscellaneous features for traction

Item	Description	SUO No.	Harness Pin No
Auxiliary power reduction 1	Effective when aux. input 1 close/open	#11, 13	E-03-30
Auxiliary power reduction 2	Effective when aux. input 2 close/open	#14, 16	E-03-40
Auxiliary power reduction 3	Effective when aux. input 3 close/open	#17, 19	E-03-41
Speed alarm 1	Alarm 1 signal output if speed exceeds set value.	#26	E-04-57, 58
Speed alarm 2	Alarm 2 signal output if speed exceeds set value.	#34	E-11-33, 35

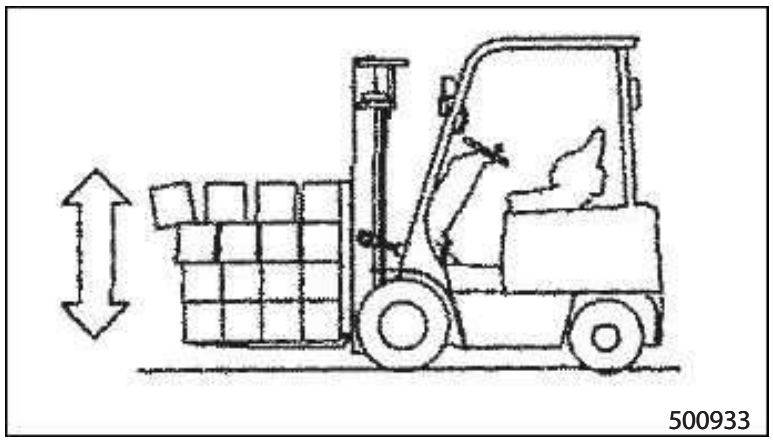
Note: Speed alarm 2 is valid only for models with an output unit.

2.7 Pitching Control (Option)

Pitching control will reduce the vibration of load when traveling over bumps or uneven road.

The loading fluctuation and acceleration are detected by the hydraulic sensor of the load. Then the torque for reducing the load movement is calculated.

Item	Description	SUO No.	Harness Pin No
Pitching control	Enables or disables the pitching control	#39	-



3. Lifting Controller Feature

3.1 Setting and limitation of lift work speed

Each lift work speed can be set. The lift work speed can be limited or stopped when specific switch input occurs.

Triple input signals are selectable and available to set limit value to each signal.

Feature of lifting work speed setting

Item		Description	SUO No.	Harness Pin No.
Normal	Start lift speed	Start lift speed setting	#2	"1" (slow) is strongly recommended.
	Top lift speed	Top lift speed setting	#3	-
	Lowering speed ADJ.	Lowering speed setting	#35	-
	Tilt speed	Tilt speed setting	#4	-
	Auxiliary 1 speed	Attachment 1	#5	-
	Auxiliary 2 speed	Attachment 2	#6	-

Refer to page 1-20 for details and setting procedure of the "Setup Option."

The application preset feature (#1) has the preset setting pattern registered.

3.2 Lift stop

This will stop the lifting operations in progress when the aux. SW input can choose close or open.

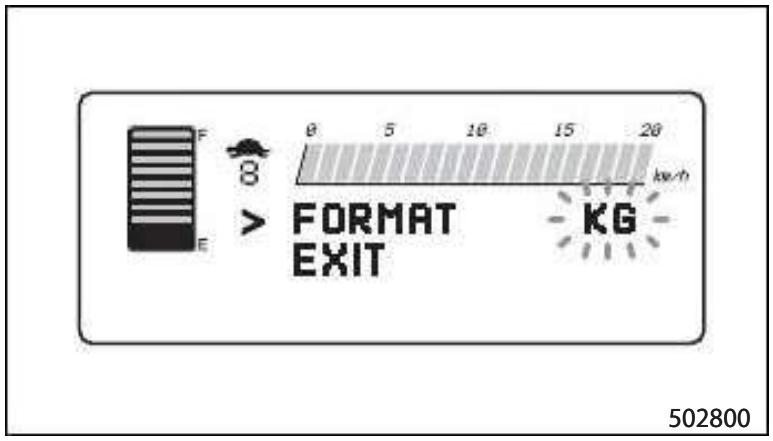
To release the stop function, bring the lever to the neutral position, and start the operation.

Item		Description	SUO No.	Harness Pin No.
Conditional	Auxiliary input for lift 1	Stops lift when aux. input 1 close/open	#11	E-03-40
	Auxiliary input for lift 2	Stops lift when aux. input 2 close/open	#14	E-03-41
	Auxiliary input for lift 3	Stops lift when aux. input 3 close/open	#17	E-03-30

3.3 Load meter (option)

Function

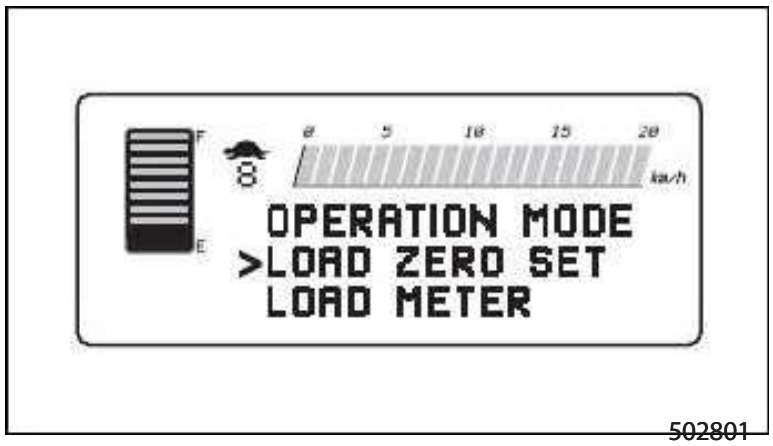
This calculates the live load from the pressure sensor input.
Zero point can be adjusted by the display.
The user can select either "KG" or "LBS" from the display.



502800

Setting (Zero-setting)

(1) Turn on the key switch.
(2) Remove the load from the truck.
(3) Raise the mast slightly off the ground.
(4) Display "LOAD METER ZERO SET" in the Adjustment menu on the display unit.



502801

Note: The load meter indication is affected by the setting of SUO #44. (Mast Type)

⚠ CAUTION

The value of the load meter should be used as a reference only, as it is calculated from an oil pressure converted value. Do not use this value for calculation of the rated load for truck performance.

Item		Description	SUO No.	Harness Pin No.
Conditional	Load meter function	Optional equipment	#48	-
	Load adjustment	Pressure sensor zero point adjustment	#55	-

3.4 Tilt horizon (option)

Function

This will stop the tilting operation when the mast is tilting forward or the mast in the horizontal position.

The status of the load will be detected and if the load is being carried, the tilting operation will not be stopped.

Item		Description	SUO No.	Harness Pin No.
Conditional	Tilt horizon function	Optional equipment	#50	E-04-57 E-03-28
	Tilt horizon adjustment	Tilt angle sensor adjustment	#51	-

4. Other Feature

4.1 PDS (Presence Detection System) feature

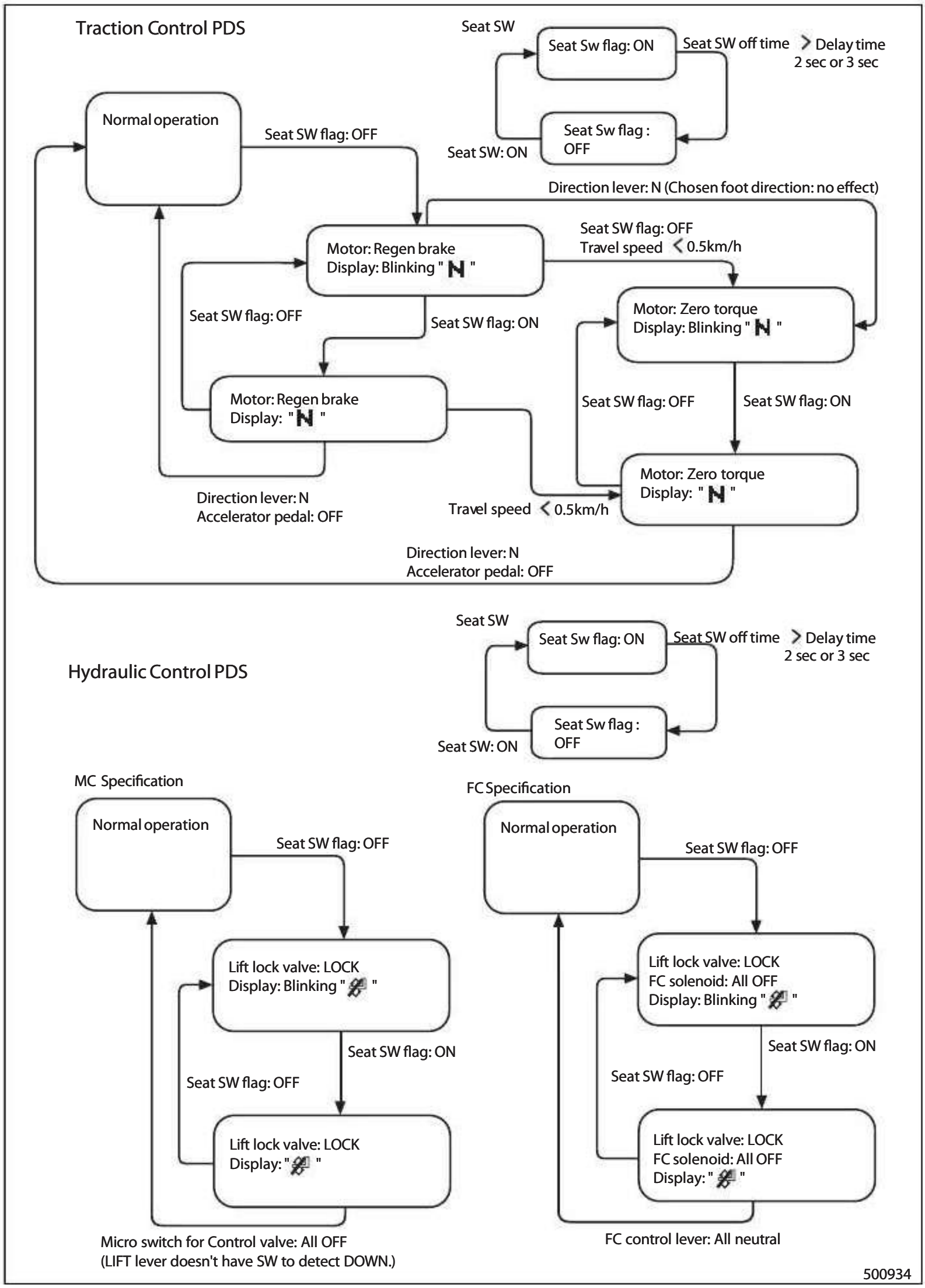
This controller is part of the "Presence Detection System" (PDS) of the truck. This system features an enhanced, integral computer based feed back system which provides "certain product intelligence" to the operator. The table shows processes for traction and lifting. Refer to the Status Transfer Chart for details.

PDS features

Item		Protect condition		Result	Release method
Traction control		Seat	Sit ➡ Leave	Slowdown and Stop	Sit and Direction lever: N Accelerator pedal: Release
		Direction lever	F or R		
Hydraulic control	MC	Seat	Sit ➡ Leave	Stop	Sit and Control valve SW: All open
	FC				Sit and FC control lever: All neutral

CHAPTER 1 CONTROLLER

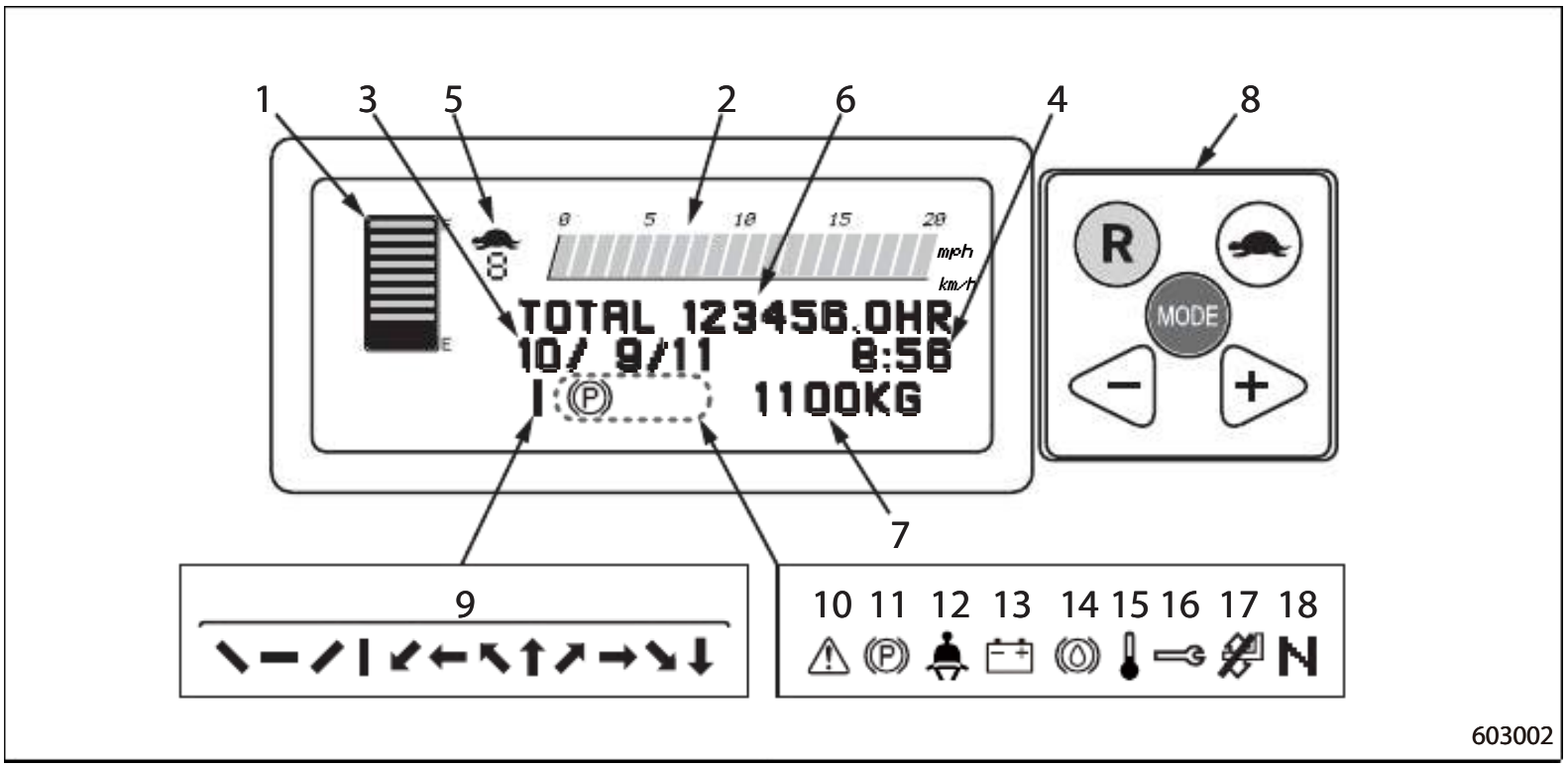
PDS Status transfer chart



Note: In the initial state, E, H1, H2, H3 or H4 may appear.

4.2 Display function

Main monitor



1. Battery discharge indicator
2. Speedometer
3. Calendar
4. Clock
5. Slow speed mode monitor (Turtle mark)
6. Hour meter
7. Load meter (option)
8. Mode select switch
9. Wheel indicator
10. Error warning
11. Parking brake warning
12. Seat belt warning
13. Battery warning
14. Brake fluid warning
15. Overheat warning
16. Service indicator
17. Mast lock
18. Neutral lock

See the Chassis & Mast Service Manual for details.

Adjustment

(1) To display the adjustment screen, push "M" button.

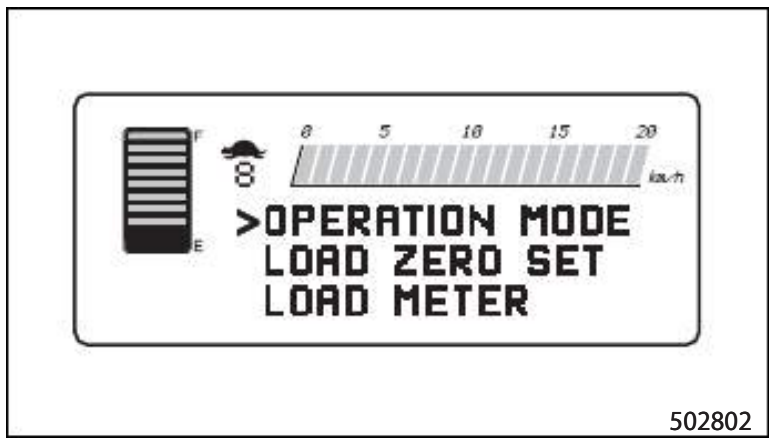
(2) Select the item you want to adjust using ◁ or ▷ button, and push "R" button to execute.

(3) Cancel the screen being displayed with "M" button.

The following items is adjustable:

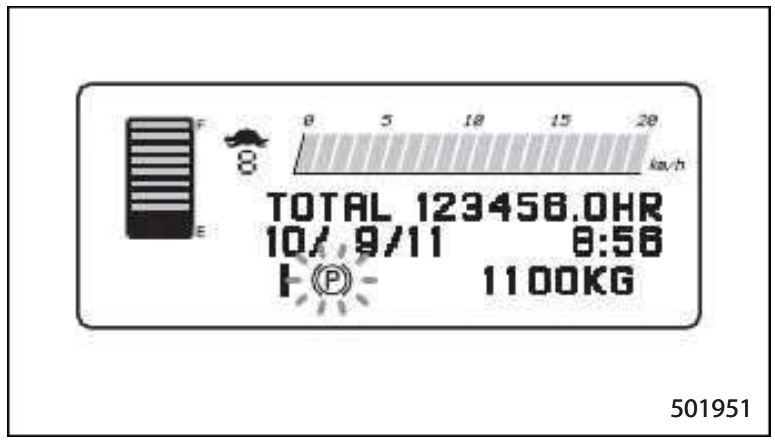
- Operation Model Select
- Load Zero Set*
- Load meter*
- Speed meter
- Date
- Clock
- Contrast

The items marked with * are available only on the truck equipped with load meter option.



4.3 Parking Brake Interlock

The parking brake (PKB) interlock will be activated and "P" on the display blinks if the operator leaves the seat when the key switch is in ON position and the PKB switch is in OFF position. Also the PKB interlock will be applied when the key switch is turned OFF with the PKB switch in OFF position.
To release the PKB interlock, apply the parking brake, then release it.



4.4 BDI (Battery discharge indicator) display features

This feature shows with 11 levels (BDI 0 to BDI 10) of remaining battery capacity of the current battery voltage.

Set SUO No. #41 or #42 depends on installed battery type and voltage.

See the Chassis & Mast Service Manual for details.

Warning buzzer features

The buzzer sounds when the key switch is turned off or the operator leaves the operator's seat with the parking brake SW is turnd off.

4.5 Miscellaneous features

The table shows miscellaneous features.

Miscellaneous features

Item	Description	SUO No.
Service indicator	Shows or warns maintenance time.	#10
Display unit	Speed, error code, hour-meter, date, clock, SW, BDI, etc. are shown.	-

4.6 Hour Meter

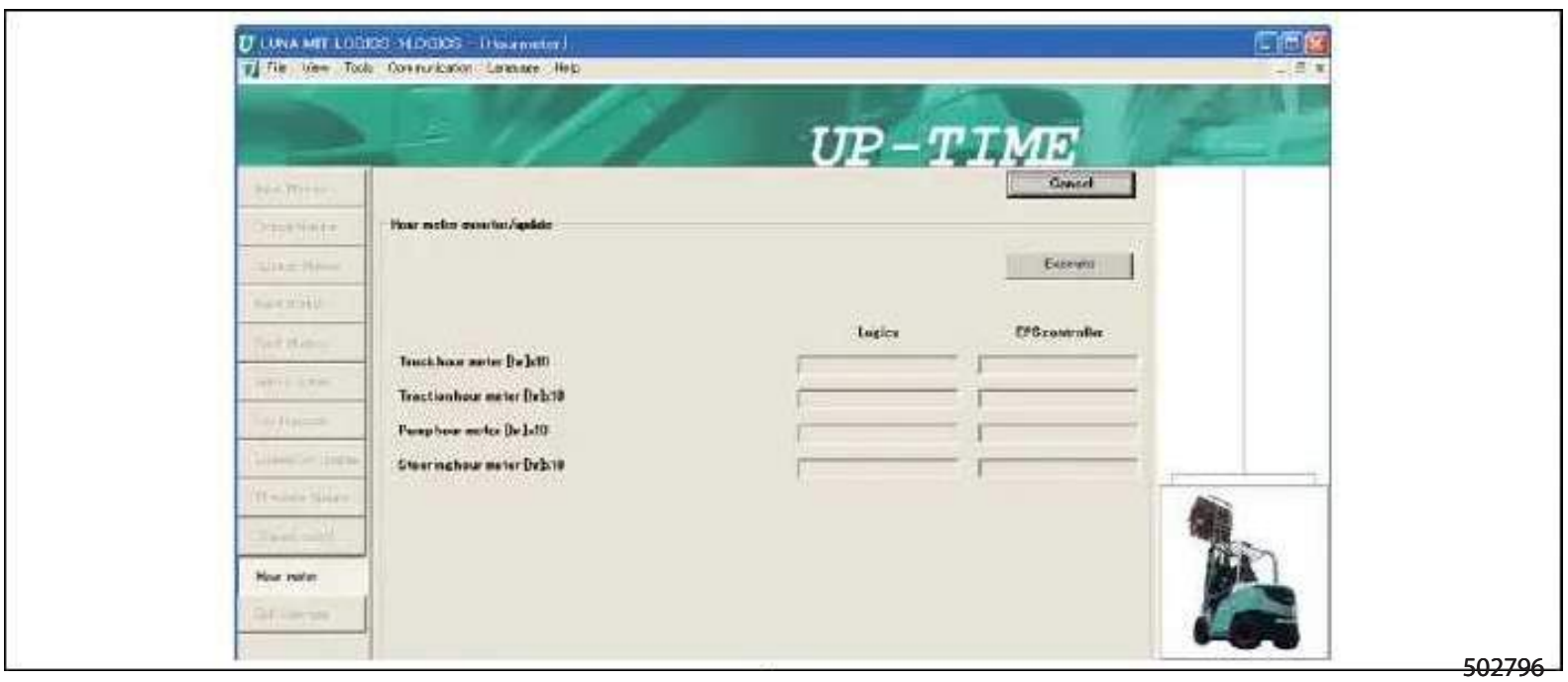
The truck hour meter reading is indicated on the display.

Also, the traveling/load, handling/steering hour meter readings can be confirmed using service tool.

When a difference of the hour meter reading between the logistics and EPS controller exceeds 1 hour, “HR NG” will be indicated on the display.

Upon receiving a request of hour meter adjustment from the service tool, the smaller hour meter reading will be rewritten to longer service hour reading so that the hour meter readings between the logics and EPS controller will be matched.

501134



502796

5. Setup Option

5.1 Outline

The logic unit is equipped with a memory module that retains recorded data even if the main power is turned off.

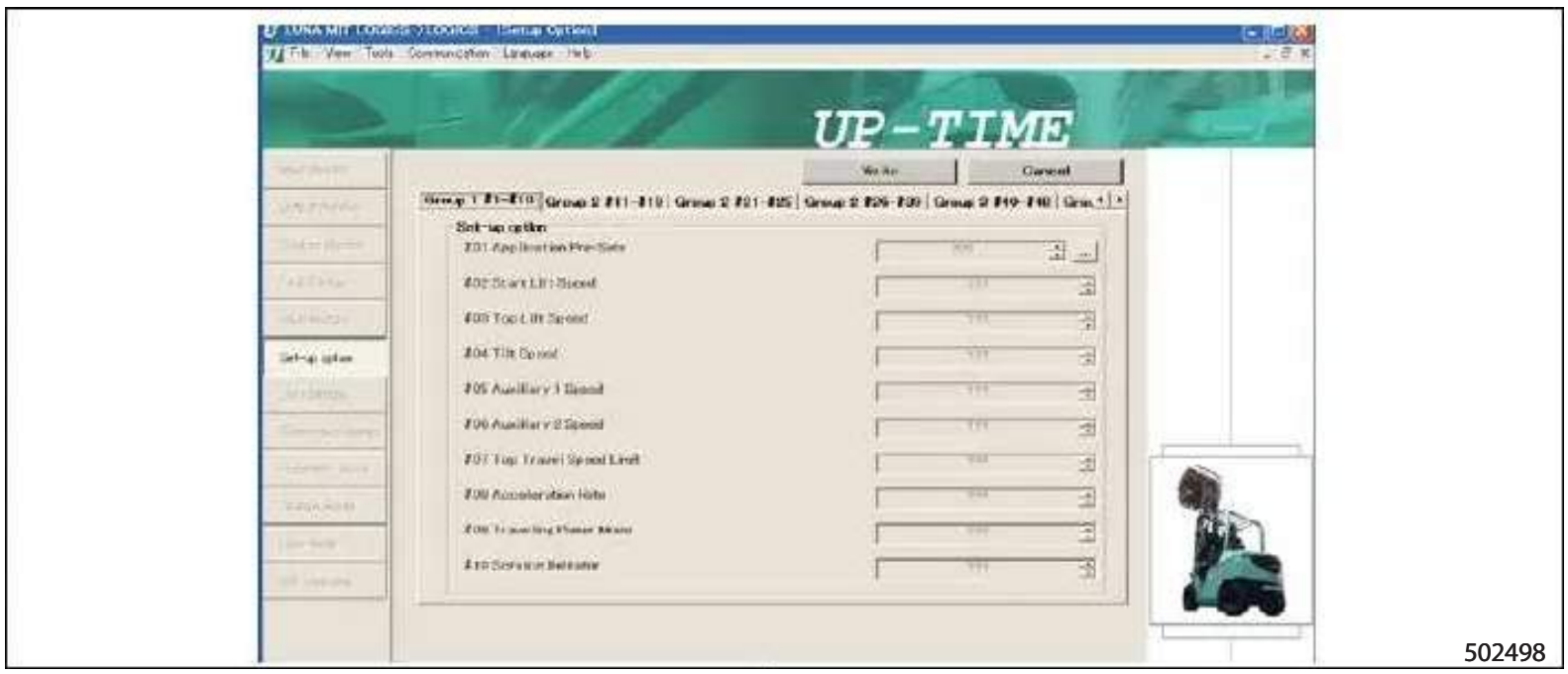
The model information and various features are set before factory shipment.

The setup options are categorized from Group 1 to Group 3 according to the feature levels.

Setup group

Group	Description
Group 1	Basic function (#1 to #10)
Group 2	Detailed function (#11 to #39)
Group 3	Model information (#40 to #55)

The Group 1 and 2 are available to set the default value in a one-step operation and can be customized in accordance with applications. Since the Group 3 is for model information, it is required to be set to the same value as actual control system. It will not work properly if the model information is different.
When setting the setup option data for the first time after the assembly is completed or the logic card is replaced, be sure to set Group 3 data first, then the default data of Group 1 and 2, with the "service tool" in each setup mode.



502498

5.2 Details of Setup Options (Group-1)

#1 Application Pre-Sets (Truck Operation Mode)

Truck mode can be selected from 1 to 5, each with preset values shown in the below table.

These 10 settings are automatically set by changing the PRESET number of the setting.

PRESET values for each setting are as follows.

							SUO#
Feature/ Application		**PRESET 1**	**PRESET 2**	**PRESET 3**	**PRESET 4**	**PRESET 5**	**1**
Characteristic	Lift	Slow	Medium	Medium	Medium	Fast	
	Tilt	Medium	Medium	Medium	Medium	Medium	
	Auxiliary	Slow	Slow	Slow	Slow	Slow	
	Vehicle Speed	Slow	Medium	Medium	Fast	Fast	
	Acceleration	Slow	Slow	Medium	Medium	Fast	
	Power	Economy	Economy	Standard	Powerful	Powerful	
	Regeneration	Medium	Medium	High	High	High	
Default value	Start Lift Speed	1	1	1	1	1	2
	Top Lift Speed	4	7	7	7	10	3
	Tilt Speed	4	4	4	6	6	4
	Auxiliary 1 Speed	3	3	3	3	3	5
	Auxiliary 2 Speed	1	1	1	1	1	6
	Top Travel Speed Limit	10	15	15	16	16	7
	Acceleration Rate	3	3	5	7	9	8
	Traveling Power Mode	1	1	2	3	3	9
	Regen Adjustment for Brake Regen	7	8	10	10	10	21
	Regen Adjustment for Accelerator Regen	7	8	10	10	10	23

You can modify these 10 settings afterwards individually.

Note: Value "1" is strongly recommended.

#2 Start Lift Speed

This setting affects pump speed when you start lifting operation.

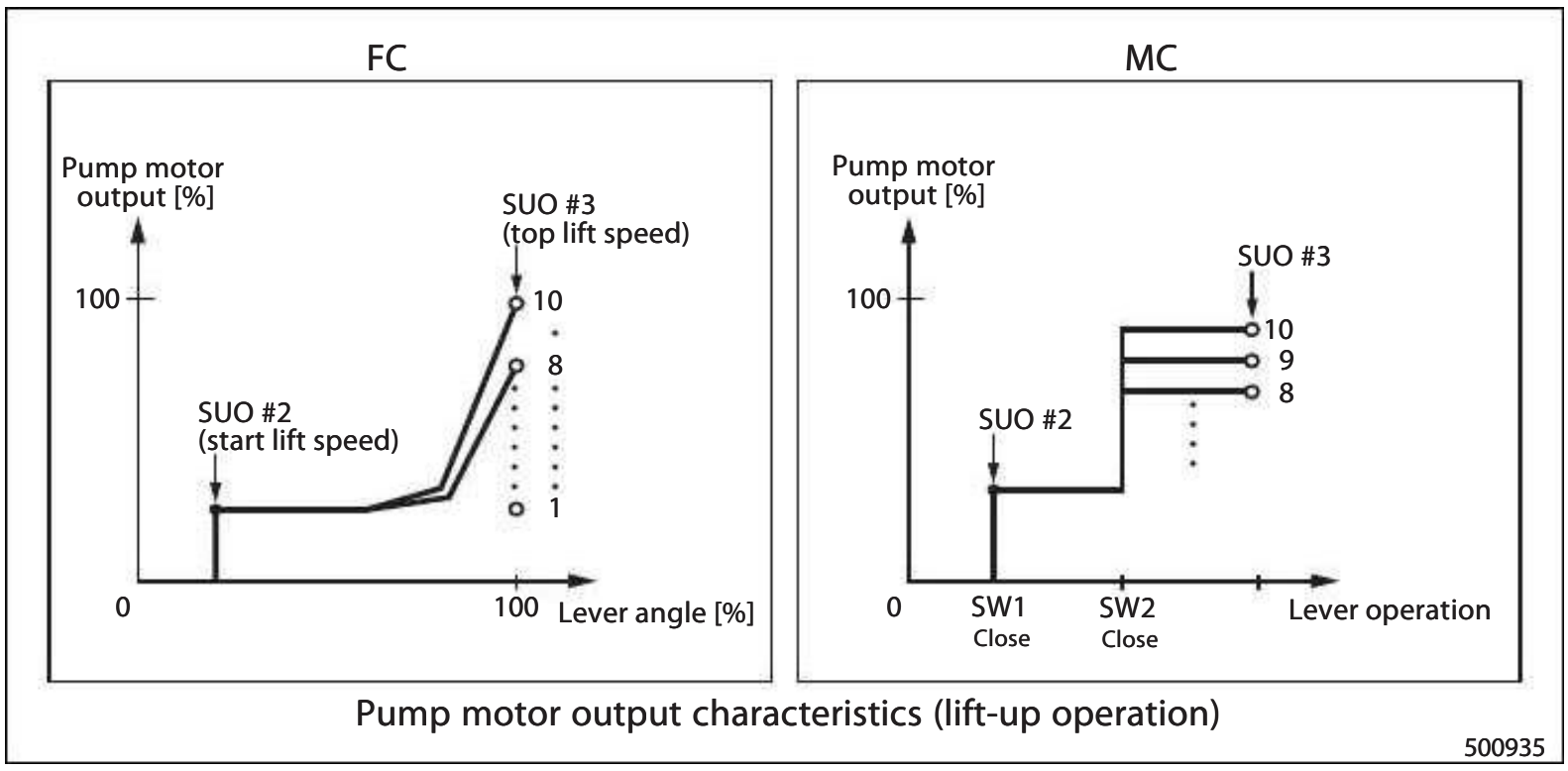
FC spec: speed when the lift lever is slightly pulled.
MC spec: speed when lift switch 1 is turned on.
Lift speed in the rise direction will become faster if the setting value is increased.

The setting range is 1 to 10.

#3 Top Lift Speed

This setting affects pump speed and FC solenoid current when you pull the lift lever. If you set a smaller value than #2, then the #2 setting will be ignored.

FC spec: speed when the lift lever is pulled.
MC spec: speed when lift switch 2 is turned on.
Lifting speed will become faster if the value setting is increased.
The setting range is 1 to 10.



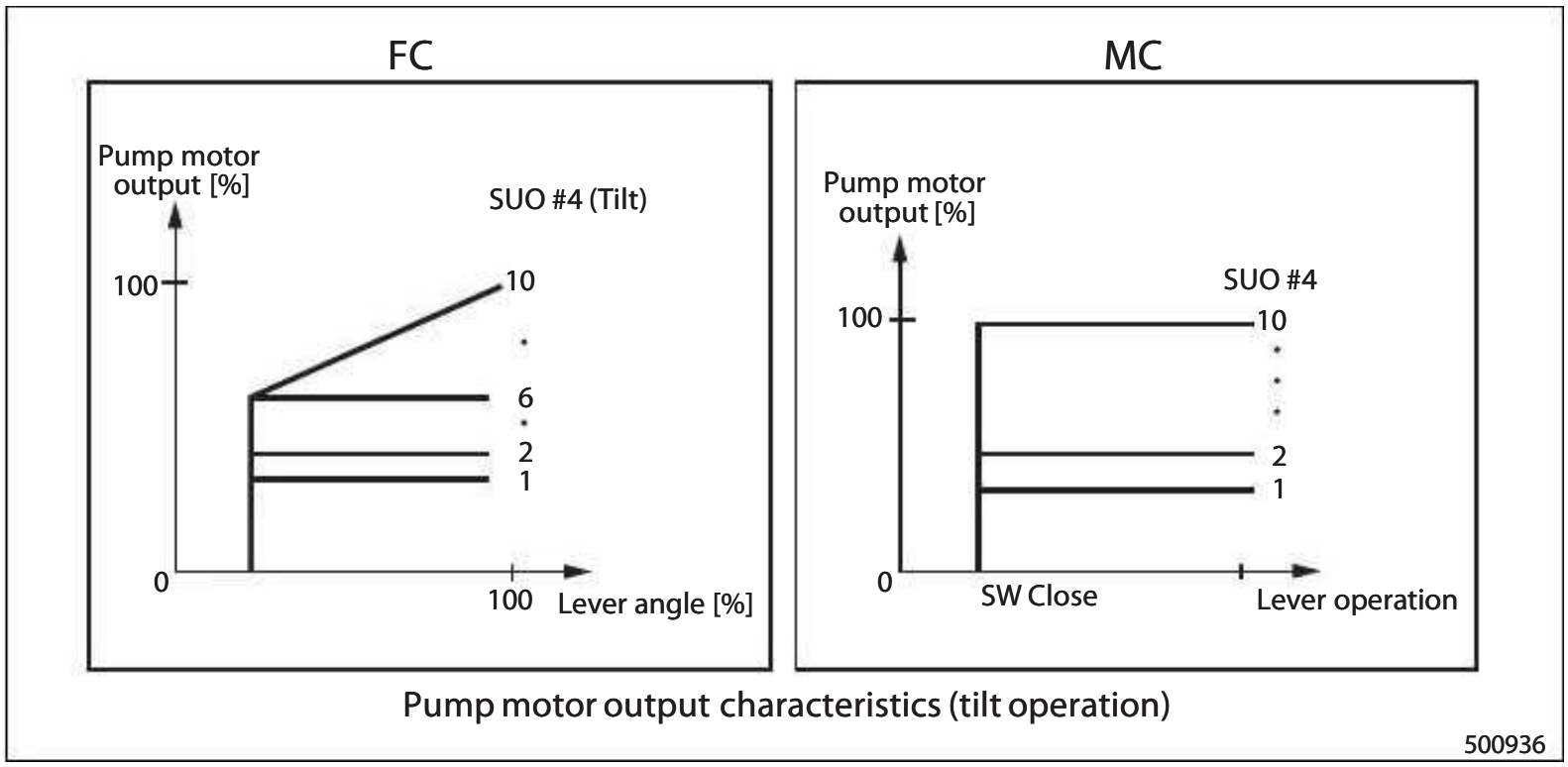
Pump motor output characteristics (lift-up operation)

500935

#4 Tilt Speed

This setting affects pump speed and FC solenoid current when you operate the tilt lever or tilt switch. Tilt speed will be faster if the value setting is increased. The setting range is 1 to 10.

Tilt speed has priority over lifting speed, when the two levers are operated simultaneously.



Pump motor output characteristics (tilt operation)

500936

#5 Auxiliary 1 Speed

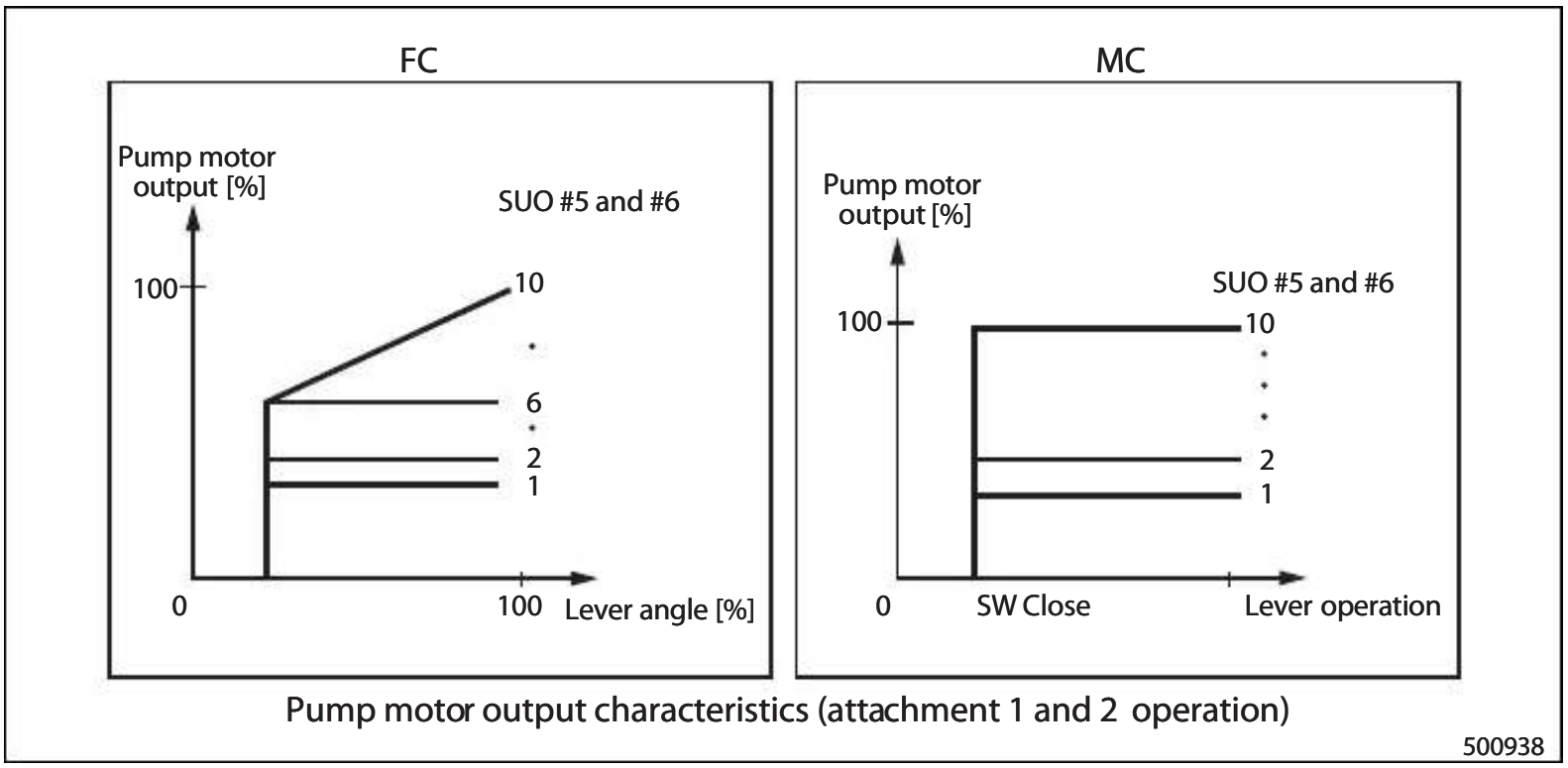
This setting affects pump speed and FC solenoid current when you operate the attachment 1 lever or attachment 1 switch.

Attachment 1 speed will become faster if the value setting is increased. The setting range is 1 to 10.

#6 Auxiliary 2 Speed

This setting affects pump speed and FCC solenoid current when you operate the attachment 2 lever or attachment 2 switch.

Characteristic is almost the same as auxiliary 1.
Attachment 2 speed will become faster if the value setting is increased. The setting range is 1 to 10.



Pump motor output characteristics (attachment 1 and 2 operation)

500938

#7 Top Travel Speed Limit

This setting affects maximum traveling speed without load. Traveling speed with load will be less than this setting. This setting affects top speed, and does not affect gradability or acceleration.

The setting range is for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

#8 Acceleration Rate

This setting affects response time to calculate required torque from accelerator pedal position.

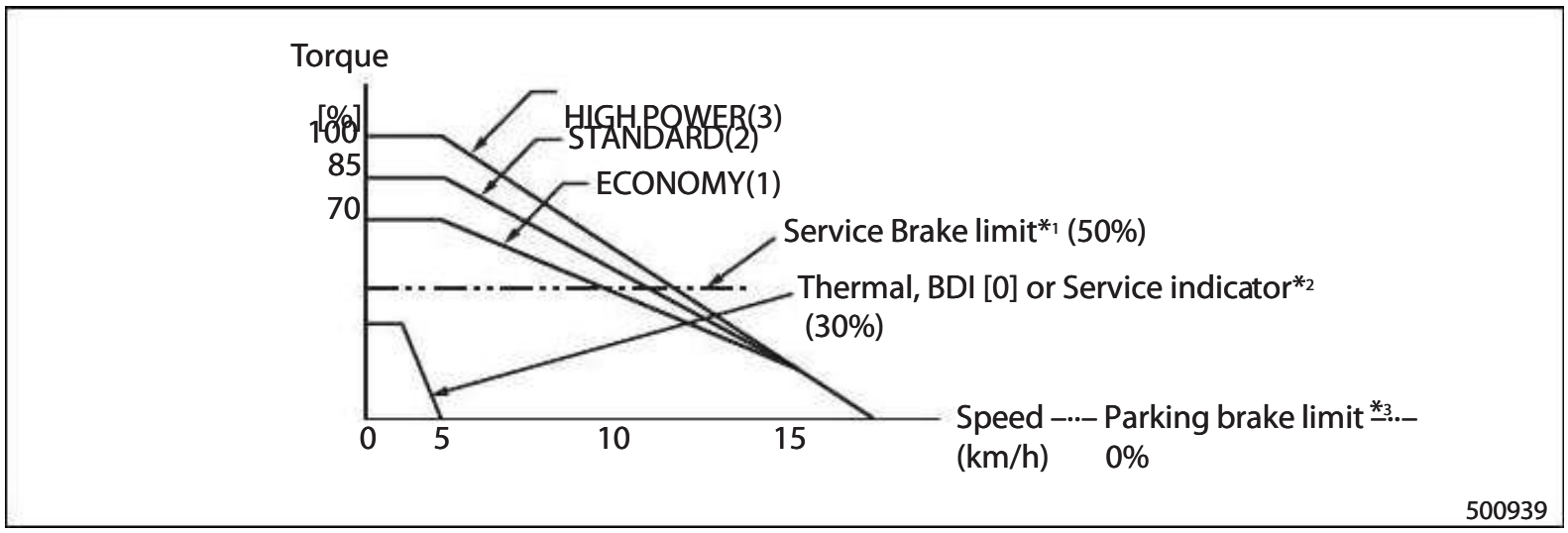
Acceleration of trucks becomes faster if the value setting is increased. The setting range is 1 to 10.

#9 Traveling Power Mode

This setting affects the required torque which is calculated from accelerator pedal position.

The values are selected from three types: ECONOMY, STANDARD and HIGH POWER.

The figure shows the torque characteristic to the time.



*1 Service brake limit: Torque value resulting from reduction in current when the service brake is applied.

*2 Thermal: BDI [0] or Service indicator: Curve of limited torque under a condition of overheating or battery voltage low or maintenance time over.

*3 Parking brake limit: When the parking brake SW is enabled, the torque becomes zero.

#10 Service Indicator

This setting sets the maintenance time. The time set here is added to the truck's hour meter and that value is stored in memory as the "maintenance time."

When the truck's hour meter reaches maintenance time, the service reminder LED turns on.

It will flash 20 hours before the time.

You can reduce the truck power when the LED flashes by setting the service indicator selection. You can also set the demo-mode, which shows the service Indicator function in a short period of time.

The setting value is as follows.

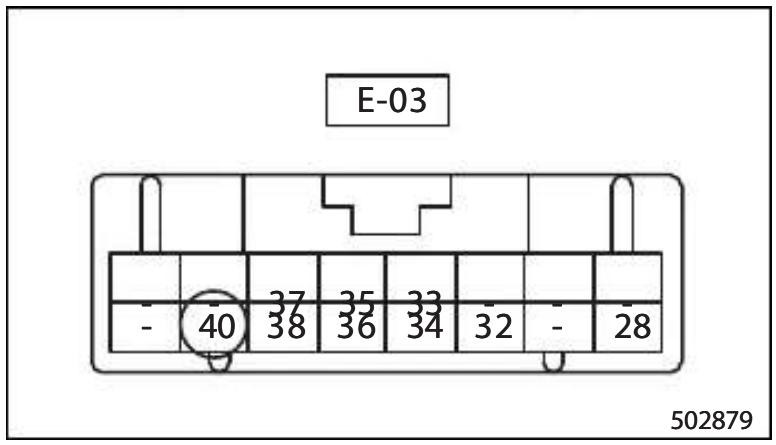
Maintenance time [hour]		**-**	**6 min (test)**	**100**	**150**	**In increments of 50**	**950**	**1000**
Set data on display	Invalid	0						
	Only warning		0.1	100	150	-----	950	1000
	Torque limit		=0.1	=100	=150	-----	=950	=1000

5.3 Details of Setup Options (Group-2)

#11 Aux Input for Lift/Drive Speed 1
(Harness pin No. E-03-40)

This setting defines the function of "Auxiliary 1" switch. This value has an effect on #12 and #13 when 2, 3, 5 or 6 is selected.

The setting value is as follows.



Value	Lift	Travel
0	–	–
1	Stop lift *1 (switch closed)	–
2	–	Speed limit (switch opened)
3	–	Power reduction (switch closed)
4	Stop lift *1 (switch opened)	–
5	–	Speed limit (switch opened)
6	–	Power reduction (switch closed)

*1 Place the lever in neutral. Lift moves by operating the lever again.

#12 Aux Travel Speed Limit 1
(Harness pin No. E-03-40)

This setting defines maximum speed when the "Auxiliary 1" switch is closed or opened.

The setting range for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

Effective when the data of #11 is 2 or 5.

#13 Aux Power Reduction Rate 1
(Harness pin No. E-03-40)

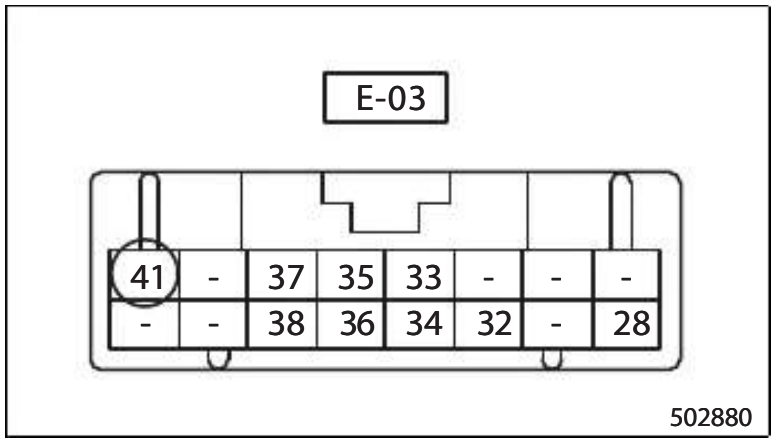
This setting defines traction power reduction when the "Auxiliary 1" switch is closed or opened.

The setting range is 0 to 100 [%]. Effective when the data of #11 is 3 or 6.

#14 Aux Input for Lift/Drive Speed 2
(Harness pin No. E-03-41)

This setting defines the function of "Auxiliary 2" switch. This value has an effect on #15 and #16 when 2, 3, 5 or 6 is selected.

The setting value is the same as that of #11.



#15 Aux Travel Speed Limit 2
(Harness pin No. E-03-41)

This setting defines maximum speed when the "Auxiliary 2" switch is closed or opened.

The setting range for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

Effective when the data of #14 is 2 or 5.

#16 Aux Power Reduction Rate 2
(Harness pin No. E-03-41)

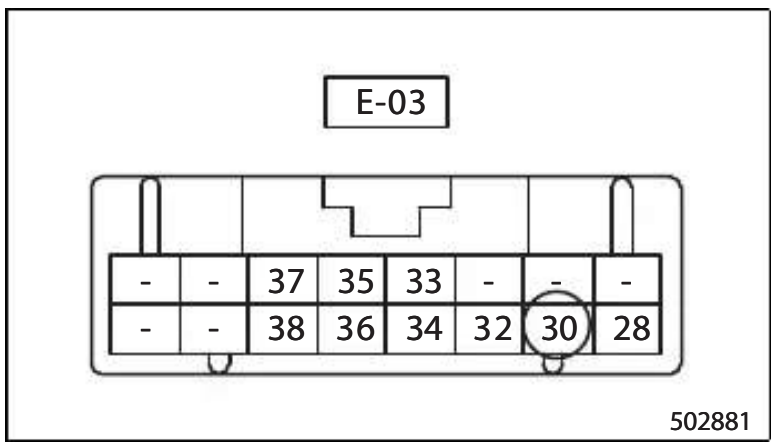
This setting defines traction power reduction when the "Auxiliary 2" switch is closed or opened.

The setting range is 0 to 100 [%]. Effective when the data of #14 is 3 or 6.

#17 Aux Input for Lift / Drive Speed 3
(Harness pin No. E-03-30)

This setting defines the function of "Auxiliary 3" switch. This value has an effect on #18 and #19 when 2, 3, 5 or 6 is selected.

The setting value is the same as that of #11.



#18 Aux Travel Speed Limit 3
(Harness pin No. E-03-30)

This setting defines maximum speed when the "Auxiliary 3" switch is closed or opened.

The setting range for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

Effective when the data of #17 is 2 or 5.

#19 Aux Power Reduction Rate 3
(Harness pin No. E-03-30)

This setting defines traction power reduction when the "Auxiliary 3" switch is closed or opened.

The setting range is 0 to 100 [%]. Effective when the data of #17 is 3 or 6.

#21 Regen Adjustment for Brake Regen

This works when the brakes are applied.

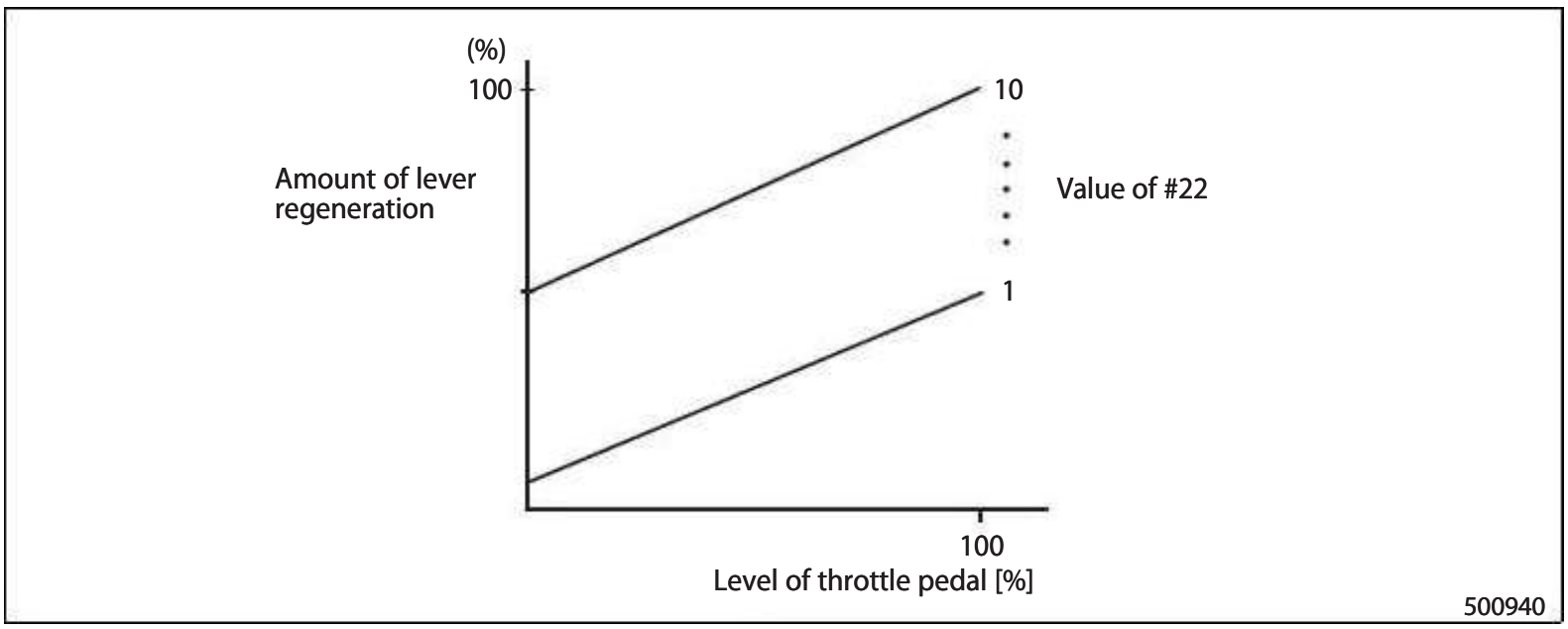
When the setting value is higher than "#23" , regenerative power will increase by stepping on the brake.

When the setting value is lower than "#23", the regenerative rate will be the same as the "#23."

#22 Regen Adjustment for Lever Regen

This setting defines the "Lever regen" characteristic.

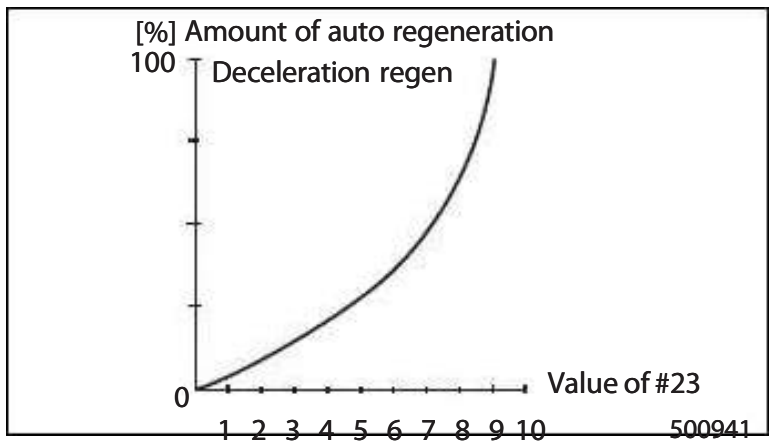
When the direction lever is shifted into the position opposite to the truck's traveling direction, the "Lever regen" function is activated. The "Lever regen" characteristic is shown in this diagram. The setting range is 1 to 10.

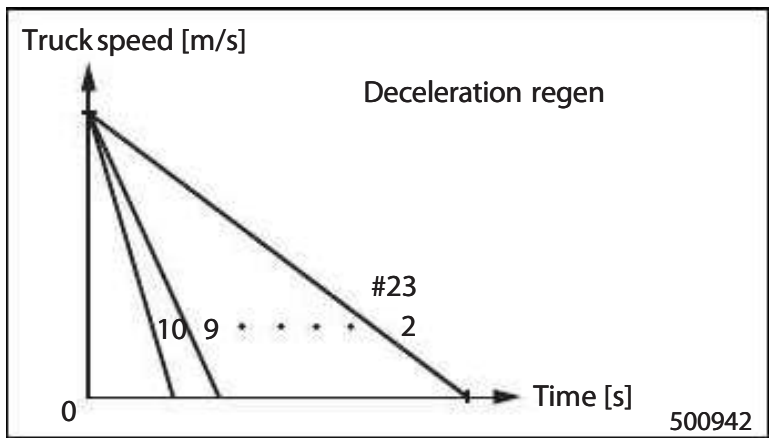


#23 Regen Adjustment for Auto Regen

This setting defines amount of deceleration when "Auto regen" is activated. This setting defines the amount of deceleration when "Auto regen" is activated. (Setting "10") The setting range is 1 to 10.

Note: With "1" setting, regeneration will not work except when going downhill.





Note: *When the setting is "1", the regenerative braking is not be generated, thus the time for truck to stop is spontaneous.

#25 Steering brake force

Setting of maximum steering brake force when the steering angle is not proportional to the steering force during normal operation of the steering wheel.

Setting is available in 3 steps: strong, medium, and weak

#26 Speed Alarm 1
(Harness Pin No. E-04-57, 58)

This setting defines speed of turning on the "Speed alarm 1" light.

The setting range for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

#28 Steering range

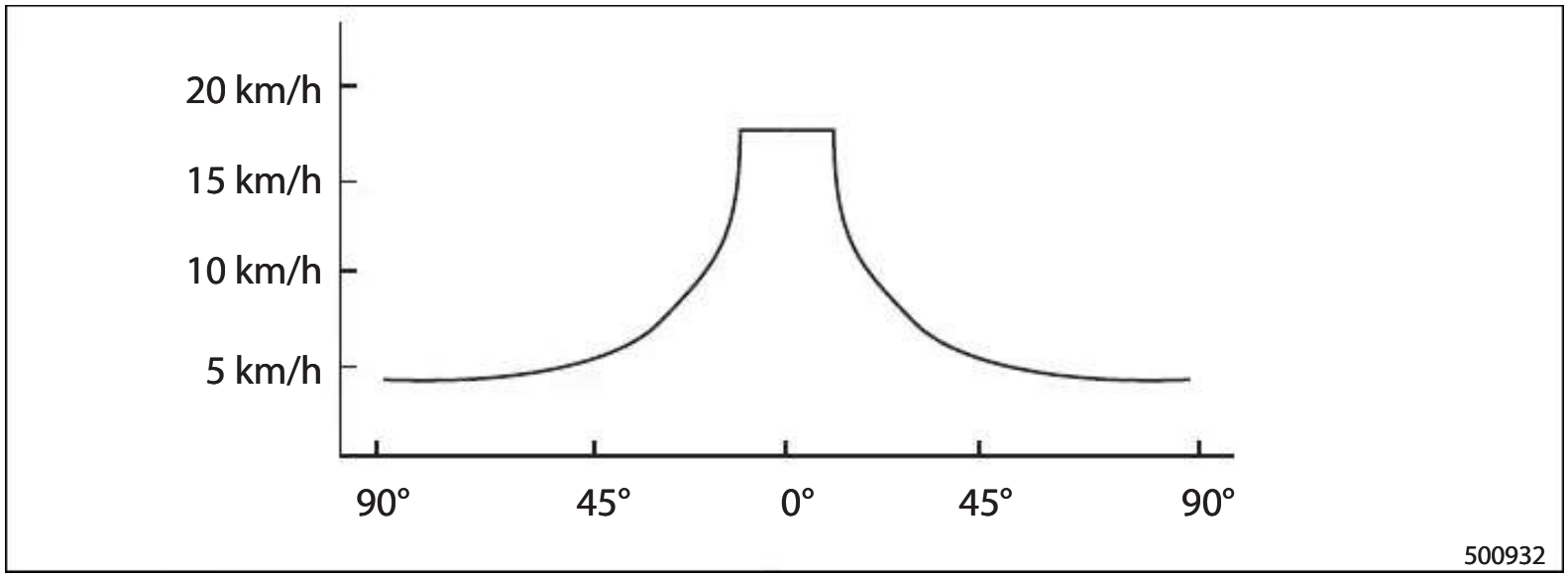
Currently this setting is not availabe.

#29 Speed limit curving

When this setting is enable, the truck speed can be restricted by the turning angle.

0 : Disable
1 : Enable

The speed will be decreased according to the regenerative rate of #21 to 23.



#30 Turtle Switch Input Setting

This setting defines the function of "Speed Limit" Turtle switch.

According to the combination of #30, #31 you can reduce travel speed.

Value	Travel speed
0	Disable
1	Enable

#31 Travel Speed Limit of Turtle SW
(Harness Pin No. E-03-31)

This setting defines the maximum travel speed when the speed limit function is activated by #30.

The range setting for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

#34 Speed Alarm 2
(Harness Pin No. E-11-33, 35)

This setting defines speed of turning on the "Speed alarm 2" light.

The setting range for 3-Wheel model is 5 to 16 [km/h] and for 4-Wheel model is 5 to 17 [km/h].

#35 Lowering Speed ADJ.

This setting is for adjustment of the maximum lowering speed.

In case the lowering speed is higher than the specification as mentioned in the service manual, it can be adjusted. When lowering the setting, the current to the solenoid will be reduced, but this does not mean it affects the lowering speed immediately due to tolerance in oil flow and oil characteristics. Further lowering of the setting may be required.

This setting is applicable to the FC models only.

#39 Pitching Control

This enables the pitch control that suppresses the risk of the carrying load to fall down or unbalanced.

To use this function, an oil pressure sensor is required.
0: disable, 1: enable

5.4 Details of Setup Options (Group-3)

#40 Truck Type

This setting defines the type of truck.
The setting value is 3-Wheel or 4-Wheel model.

⚠ CAUTION

If the truck type setting is incorrect, unexpected movement of the truck may occur.

#41 Battery Voltage

This setting defines the voltage of battery installed in the truck.
The setting value is 36 or 48 [v].
No setting shows "ll ll ll ll ll."

#42 Battery Type

This setting defines the type of battery installed in the truck.

The setting value is 1, 2 or 3.

1: Normal 2: Tubular 3: Gel

Select an appropriate BDI table from the followings according to the battery type.

Normal BDI

BDI#	36V	48V
0	- 34.4	- 45.9
1	34.5 - 34.8	46.0 - 46.4
2	34.9 - 35.2	46.5 - 46.9
3	35.3 - 35.6	47.0 - 47.4
4	35.7 - 36.0	47.5 - 47.9
5	36.1 - 36.4	48.0 - 48.4
6	36.5 - 36.7	48.5 - 48.9
7	36.8 - 37.0	49.0 - 49.8
8	37.1 - 37.3	49.4 - 49.7
9	37.4 - 37.6	49.8 - 50.1
10	37.7 -	50.2 -

Tubular BDI

BDI#	36V	48V
0	- 35.2	- 46.9
1	35.3 - 35.5	47.0 - 47.3
2	35.6 - 35.8	47.4 - 47.7
3	35.9 - 36.1	47.8 - 48.1
4	36.2 - 36.4	48.2 - 48.5
5	36.5 - 36.7	48.6 - 48.9
6	36.8 - 37.0	49.0 - 49.2
7	37.1 - 37.2	49.3 - 49.5
8	37.3 - 37.4	49.6 - 49.8
9	37.5 - 37.6	49.9 - 50.1
10	37.7 -	50.2 -

Gel BDI

BDI#	36V	48V
0	- 32.9	- 43.8
1	33.0 - 33.5	43.9 - 44.7
2	33.6 - 34.0	44.8 - 45.4
3	34.1 - 34.5	45.5 - 46.1
4	34.6 - 35.0	46.2 - 46.7
5	35.1 - 35.5	46.8 - 47.3
6	35.6 - 35.9	47.4 - 47.8
7	36.0 - 36.2	47.9 - 48.3
8	36.3 - 36.5	48.4 - 48.7
9	36.6 - 36.7	48.8 - 48.9
10	36.8 -	49.0 -

#43 Hydraulic Control Selection

This setting defines the type of hydraulic control.

0: FC system 1: MC system

#44 Mast Type

This setting defines the type of the mast.
2-FF: 2-stage full-free

3-FF: 3-stage full-free
2-SP: 2-stage panorama

#45 Valve Section

This setting defines the number of valve sections.

1: 3-way (lift, tilt, attachment 1)

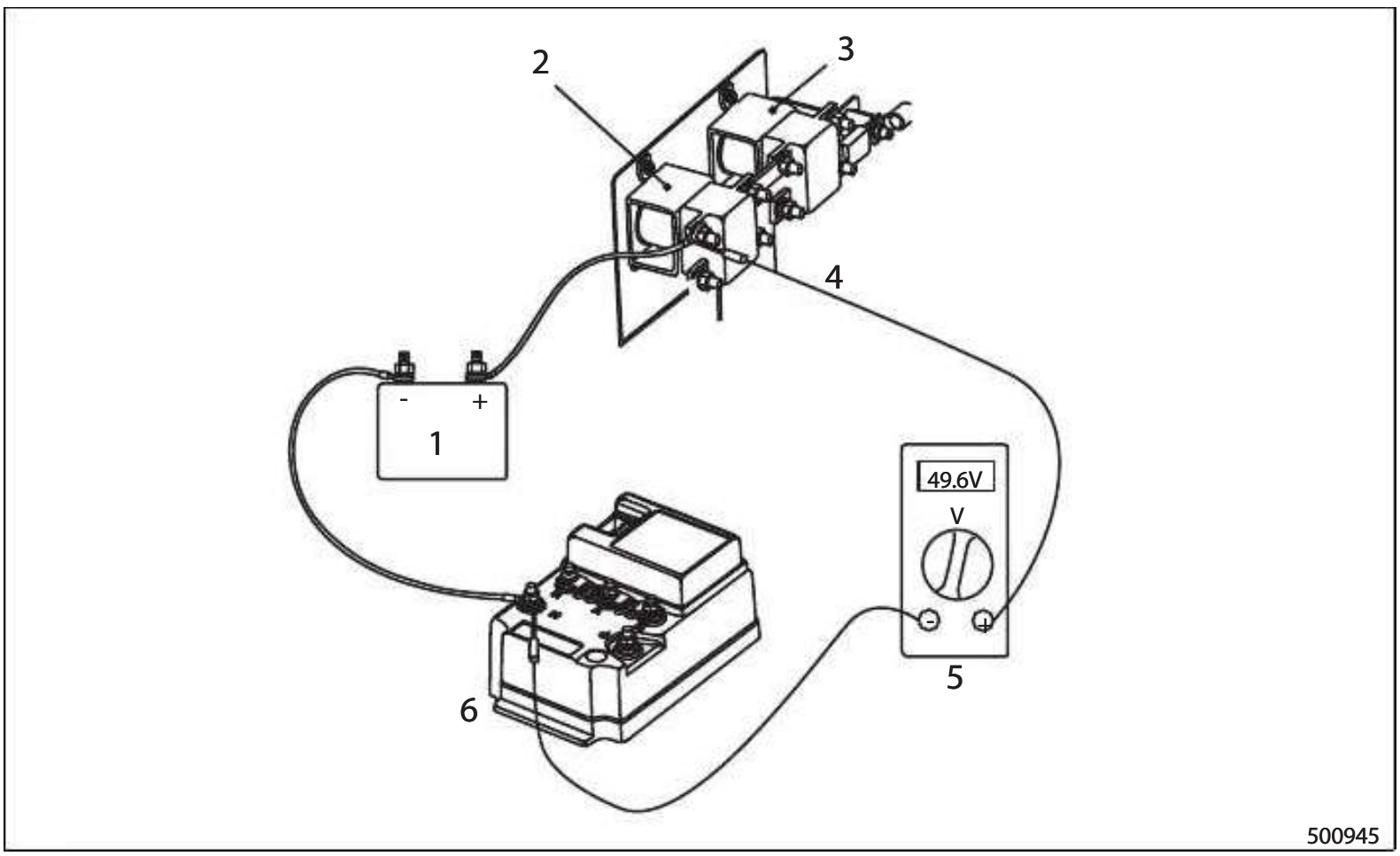
2: 4-way (lift, tilt, attachment 1, 2)

#46 Battery Voltage Adjust

This setting corrects the difference between the actual battery voltage and controller-recognized battery voltage. The display shows battery voltage which the controller recognizes.

Measure actual battery voltage using a tester (or a multi-meter) and operate service tool.

Refer to the "Measurement of battery voltage" below.



1. Battery
2. Pump contactor
3. Line contactor
4. Contactor
5. Tester or Multi-meter
6. Right traction inverter

#47 Foot Direction

This setting defines the foot direction control.

1: Standard direction lever

2: Foot Direction Control (FoDiCo)

3: Armrest FNR

#48 Load Meter Function (E-03-28)

Enable or disable the load meter option.

0: Disable
1: Enable

To use this function, an oil pressure sensor is required. Units are selectable between KG and LBS from the display.

A different method of calculation is used based on the #44 Mast type. On the truck with 2-FF or 3-FF, when the mast is positioned in the first stage, the value displayed on the load meter is valid, however, when the mast is in the second stage, the load meter does not show the correct value.

⚠ CAUTION

The value of the load meter should be used as a reference only, as it is calculated from an oil pressure converted value. Do not use this value for calculation of the rated load for truck performance.

#50 Tilt Horizon Function (E-04-57, E-03-28)

Enable or disable the tilt horizon function.

0: Disable
1: Enable

To use this function, ALS switch, tilt angle sensor and oil pressure sensor are required.

For MC trucks, prepare the output unit and tilt lock valve for this job.
To stop the mast in a horizontal position during empty load or when the mast is tilting forward, press the ALS switch.

See the table below for the movement when ALS switch is pressed.

Loaded or empty	Tilt lever operation	Status of mast (angle)	Mast movement
Empty load	Backward tilt	Forward tilt/backward tilt	Will be tilted backward.
	Forward tilt	Backward tilt	Will be tilted forward.
		Forward tilt	Will not be tilted forward.
Loaded	Backward tilt	Forward tilt/backward tilt	Will not be tilted backward. (On Mc model, will be tilted backward.)
	Forward tilt	Forward tilt/backward tilt	Will not be tilted forward.

#51 Tilt Horizon Adjustment

Tilt angle sensor horizontal value setting

Zero point should be set up with the normal tilt angle kept in horizontal position.

#55 Load Meter Adjustment

Load meter zero point setting

Zero point setting is also available from the display.

#-- Tire Adjustment

Tire angle sensor straight position setting

Straight position should be set up.
The zero set is done at the moment you press the "<<" button without pushing the "write" button.

5.5 Setup Options (Group 1)

Option #	Title of Option	Description	Range	Default Value
#1	Application Pre-Sets (Truck Operation Mode) *1	The value setting of the following 10 items are registered on shipping. Top travel speed, Acceleration rate, Traveling power, Brake Regeneration, Automatic Regeneration, Start lift speed, Top lift speed, Tilt speed, Auxiliary 1 Speed, and Auxiliary 2 Speed. Refer to the explanation for details.	1 to 5	3
#2	Start Lift Speed	Speed setting for start lift speed Start lift speed cannot exceed top lift speed.	1 to 10 (1: SLOW to 10: FAST)	1
#3	Top Lift Speed	Lift speed when operating the lever at maximum	1 to 10 (1: SLOW to 10: FAST)	7
#4	Tilt Speed	Speed setting for tilt	1 to 10 (1: SLOW to 10: FAST)	4
#5	Auxiliary 1 Speed	Speed setting for attachment 1	1 to 10 (1: SLOW to 10: FAST)	3
#6	Auxiliary 2 Speed	Speed setting for attachment 2	1 to 10 (1: SLOW to 10: FAST)	3
#7	Top Travel Speed Limit	Maximum travel speed	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	15
#8	Acceleration Rate	Choice of acceleration rate	1 to 10 (1: SLOW to 10: FAST)	5
#9	Traveling Power Mode	Choice of power characteristic	1, 2, 3 (1: ECONOMY, 2: STANDARD, 3: HIGH POWER)	2
#10	Service Indicator	This function notifies service personnel that the maintenance interval is approaching or has passed. It means the lapsed time when setting up. Approached: !LED flashes (20 hour) Passed : !LED turn on and power reduction (selected) (2) Refer to the explanation for details.	0, 0.1, 100, 150, ...950, 1000, =0.1 (6 min.), =100, =150, =950, =1000 (In increments of 50 [hour]) "=": power reduction 0: no action	0

*1 Before changing, when parameter data are different from the values of the selected mode, the truck mode indicator (1 to 5) flashes.
When the truck mode is changed, all parameter data is replaced by the set values of the selected mode.

5.6 Setup Options (Group 2)

Op-tion#	Title of Option	Description	Range	Default Value	Harness Pin No.
#11	Aux Input for Lift/ Drive Speed 1	When the auxiliary input 1 signal is on, travel speed or lift speed is limited to the set value. The maximum speed is defined at #12. The amount of power reduction is defined at #13.	0: Disable 1: Disable lift (switch closed) 2: Speed limit (switch closed) 3: Power reduction (switch closed) 4: Disable lift (switch opened) 5: Speed limit (switch opened) 6: Power reduction (switch opened)	0	E-03-40
#12	Aux Travel Speed Limit 1	Travel speed limit for #11	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	12	E-03-40
#13	Aux Power Reduction Rate 1	Traction power reduction ratio for #11	0 to 100 [%]	70	E-03-40
#14	Aux Input for Lift/ Drive Speed 2	When the auxiliary input 2 signal is on, travel speed or lift speed is limited to set value. The maximum speed is defined at #15. The amount of power reduction is defined at #16.	Same as #11	0	E-03-41
#15	Aux Travel Speed Limit 2	Travel speed limit for #14	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	12	E-03-41
#16	Aux Power Reduction Rate 2	Traction power reduction ratio for #14	0 to 100 [%]	70	E-03-41
#17	Aux Input for Lift/ Drive Speed 3	When the auxiliary input 3 signal is on, travel speed or lift speed is limited to set value. The maximum speed is defined at #18. The amount of power reduction is defined at #19.	Same as #11	0	E-03-30
#18	Aux Travel Speed Limit 3	Travel speed limit for #17	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	12	E-03-30
#19	Aux Power Reduction Rate 3	Power reduction ratio for #17	0 to 100 [%]	70	E-03-30
#21	Regen Adjustment for Brake Regen	10 steps for regen power on brake regen	1 to 10 (1: SLOW to 10: FAST)	5	–
#22	Regen Adjustment for Lever Regen	10 steps for regen power on lever regen	1 to 10 (1: SLOW to 10: FAST)	7	–

<table>
<tr><th>Op-tion#</th><th>Title of Option</th><th>Description</th><th colspan="6">Range</th><th>Default Value</th><th>Harness Pin No.</th></tr>
<tr><td>#23</td><td>Regen Adjustment for Accelerator Regen</td><td>10 steps for regen power on accelerator regen</td><td colspan="6">1 to 10
(1: SLOW to 10: FAST)</td><td>5</td><td>–</td></tr>
<tr><td rowspan="5">#25</td><td rowspan="5">Steering handle force</td><td rowspan="5">Setting of constant steering reaction force and deviation force.
The setting should be in accordance with the table shown on the right.</td><td colspan="2" rowspan="2"></td><td colspan="4">Constant reaction force strength</td><td rowspan="5">8</td><td rowspan="5">–</td></tr>
<tr><td>Weak</td><td>Medium</td><td>Strong</td></tr>
<tr><td rowspan="3">Eccentric reaction force strength</td><td>Weak</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Medium</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Strong</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>#26</td><td>Speed Alarm 1</td><td>Sets speed for turning on alarm 1 light.</td><td colspan="6">5 to 16 [km/h] (3-Wheel model)
5 to 17 [km/h] (4-Wheel model)</td><td>12</td><td>E-04-57, 58</td></tr>
<tr><td>#28</td><td>Steering range selection</td><td>Sets the lock-to-lock range of steering.</td><td colspan="6">0 to 10: From small to large (Currently, the same range at any value)</td><td>5</td><td>–</td></tr>
<tr><td>#29</td><td>Turning speed limit</td><td>Turnting speed limit setting</td><td colspan="6">0: Disable
1: Enable</td><td>1</td><td>–</td></tr>
<tr><td>#30</td><td>Turtle SW Input Setting</td><td>This setting defines the function of “Speed Limit” W switch.
According to the combination of #30, #31 you can reduce travel speed.</td><td colspan="6">0: Disable
1: Enable</td><td>1</td><td>button</td></tr>
<tr><td>#31</td><td>Travel Speed Limit of Turtle SW</td><td>This option determines the maximum travel speed limit of #30.</td><td colspan="6">5 to 16 [km/h] (3-Wheel model)
5 to 17 [km/h] (4-Wheel model)</td><td>12</td><td>button</td></tr>
<tr><td>#34</td><td>Speed Alarm 2</td><td>Sets speed for turning on alarm 2 light.</td><td colspan="6">5 to 16 [km/h] (3-Wheel model)
5 to 17 [km/h] (4-Wheel model)</td><td>12</td><td>E-03-33, 35</td></tr>
<tr><td>#35</td><td>Lowering Speed ADJ. *1</td><td>In this option, the display shows value for lowering speed adjustment.</td><td colspan="6">0 to 15
(0: SLOW to 15: FAST)</td><td>0</td><td>–</td></tr>
<tr><td>#39</td><td>Pitching control</td><td>Enabling the pitch control that suppresses the risk of the carrying load to fall down or unbalanced.</td><td colspan="6">0: Disable
1: Enable</td><td>0</td><td>–</td></tr>
</table>

*1: This setting is applicable to the FC models only.

5.7 Setup Options (Group 3)

Option #	Title of Option	Description	Range	Default Value
#40	Truck Type	This option is used to set the type of the truck.	0: 3-Wheel model 1: 4-Wheel model	–
#41	Battery Voltage	This option is used to set the voltage of the battery.	36, 48 [V]	–
#42	Battery Type	This option is used to set the type of the battery. The electric discharge characteristic of a battery changes with battery type.	0: Normal BDI 1: Tubular BDI 2: Gel BDI	–
#43	Hydraulic Control Selection	This option is used to set the type of the hydraulic control	0: FC specification 1: MC specification	–
#44	Mast Type	This option is used to set the type of the mast.	2FF: 2-stage full-free 3FF: 3-stage full-free 2SP: 2-stage panorama	–
#45	Valve Section	This option is used to set the number of valve sections.	1: 3 ways (lift, tilt, attachment 1) 2: 4 ways (lift, tilt, attachment 1,2)	–
#46	Battery Voltage Adjustment	This setting corrects the gap of the battery voltage which the controller recognizes, and actual battery voltage. Measure actual battery voltage and operate the direction lever in order to adjust the value which is shown on the service tool actual battery voltage.	5.0 to 120.0 [V]	–
#47	Foot Direction	This option is used to enable the function for foot direction option. Armrest FNR	1: Standard direction lever 2: Foot Directional Control (FoDiCo) 3: Armrest FNR	–
#48	Load Meter Function	This option is used to enable/disable the load meter.	0: Disable 1: Enable	
#50	Tilt Horizon Function	This option is used to enable/disable the tilt horizon function.	0: Disable 1: Enable	
#51	Tilt Horizon Adjustment	When the #50 "Tilt horizon function" is enabled, this option is used to store the analog value when the mast is positioned horizontally.	0 to 255	
#55	Load Adjustment	When the #48 "Load Meter" is enabled, this option is used to store the analog value when the live load is zero.	0 to 255	

Note:

(1) The data of a group 3 has no default value, but it needs to set data by the actual truck type. If the value and the truck model aren't in agreement, the truck does not operate normally.

(2) When you set up for the first time, set up the group 3 first, and then set default data of group 1 and 2.
(3) If SUO data is not set, the error code "62" is displayed.

(4) This value was adjusted at the time of LOGIC CARD inspection. Adjust the value if the value shown on the service tool is different from actual battery voltage.

6. Diagnostics

6.1 Outline

The controller monitors status of various input/output equipment to allow diagnostics of truck's malfunction.
There is a diagnostics called Self Diagnostics, which performs equipment check during maintenance.

Diagnostics

Mode		Description
Diagnostics	Self diagnostics	Checks function of electrical systems.

Self diagnostics that exclusively checks the power steering system is also available.

6.2 Operation Procedure

Turn on the key switch and enter the diagnostics mode using service tool.
Perform diagnostics by following the procedure below.

Preparatory operations (excluding steering)

(1) Place the parking brake lever in the locked position.
(2) Turn OFF the key switch.
(3) Disconnect the battery plug.
(4) Discharge all inverters. See page 1-53.
(5) Place the direction lever in the N position.
(6) Remove the line fuse (500 A) and steering fuse (100 A).
(7) Connect the battery plug.

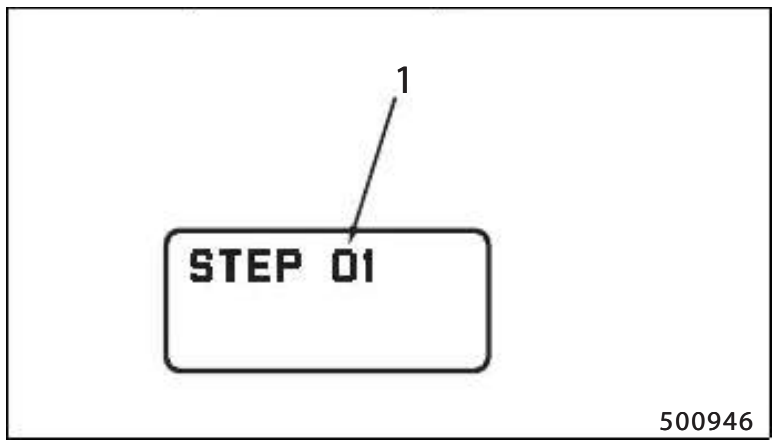
Diagnostics procedure

Perform the procedure using the Self-Diagnostics table in accordance with the following guide.

(1) Start diagnostics with the Step 0 in the table. Without sitting in the seat, turn ON the key switch according to the instruction in the "Do this" box on the Step 0 line. If the item passes the check without any problem, the next step number "01" appears on the display.
If the item involves any problem and fails in the check, "dd" is shown on the display. The display also shows "dd" when diagnostics is started without removing the fuse. In this case, diagnostics is prohibited from going even to the first step.

(2) When the Step 0 has passed the check, diagnostics may advance to the Step 1 item (seat switch). Cycle the seat switch OFF ➡ ON ➡ OFF according to the instruction in the "Do this" box on the Step 1 line. If the item passes the check, the next step number "02" appears on the display.
Do likewise for the succeeding items, following the instructions in the "Do this" column boxes. If the step fails in the check, diagnostics does not advance automatically. In this case, diagnostics can be forcibly advanced to the next step by pressing the R button on the display or the next button on the service tool.

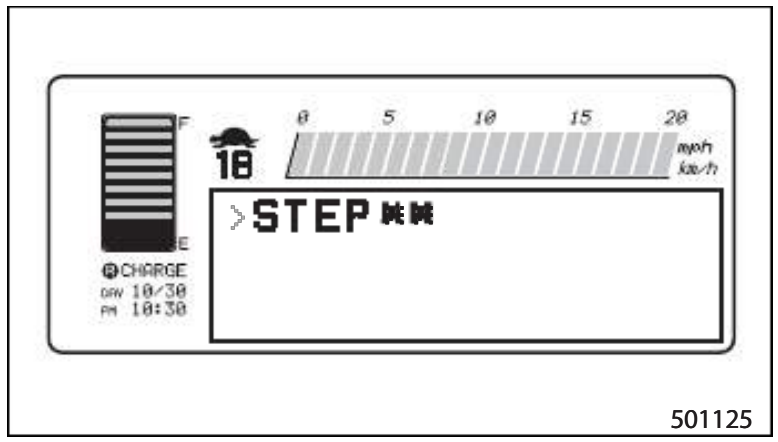
*Diagnostic items can be skipped by pressing the Skip button on the service tool.



1. Diagnostics result indication

(3) When all the steps have been checked through, turn OFF the key switch. Be sure to reinstall the 500 A line fuse and 100 A steering fuse.

- Turn OFF the key switch to exit from the diagnostics mode.
- Repair all faults found immediately after diagnostics.



501125

Follow the instructions in the diagnostics procedure guide above as well as those in the applicable boxes in the “Do this” column.

6.3 Self-Diagnostics

Step	Diagnosis item	Do this	Controller check this	Result	Display	Contactor operation
0	Line voltage	Remove fuse.	Close line contactor and check power line voltage.	Pass	01	Contactor closes and opens.
				Pass	16 (see 1-42)	
				Fail	dd	
1	Seat SW	Release, press and release seat SW.	Input OFF - ON - OFF	Pass	02	
				fail	01	
2	Direction change SW	Cycle direction lever. N - R - N - F - N	Input N - R - N - F - N	Pass	03	
				Fail	02	
3	Parking brake SW	Apply and release parking brake SW.	Input ON - OFF- ON	Pass	04	
				Fail	03	
4	Service brake SW	Release and press service brake SW.	Input OFF - ON - OFF	Pass	05	
				Fail	04	
5	Accel	Press and release accelerator. And see display.		Pass	Note (1)	
				Fail	-	
		Push R button on meter panel.		-	06	
6	Handle , Tire angle sensor	See display.		Pass	Note (2)	
				Fail	-	
		Push R button on meter panel.		-	07	
7	Battery voltage	Automatic	Check battery voltage.	Pass	08	
				Fail	07	
8	Lift lever (up)	Pull and release lift lever.	Input OFF - ON - OFF	Pass	09	
				Fail	08	
9	Tilt lever	Pull and release tilt lever.	Input OFF - ON - OFF	Pass	10	
				Fail	09	
10	Attach 1 lever	Pull and release attachment 1 lever.	Input OFF - ON - OFF	Pass	11	
				Fail	10	
11	Attach 2 lever	Pull and release attachment 2 lever.	Input OFF - ON - OFF	Pass	12	
				Fail	11	
12	Pump speed	Pull any lever and see display.		Pass	Note (3)	
				Fail	-	
		Push R button on meter panel.		-	13	
13	Line contactor	See line contactor close.		Pass	14	Contactor closes.
				Fail	13	Contactor dose not closes.
		Push R button on meter panel.		-	14	

Step	Diagnosis item	Do this	Controller check this	Result	Display	Contactor operation
14	Steering contactor	See steering contactor close.		Pass	14	Contactor closes.
				Fail	13	Contactor dose not closes.
		Push R button on meter panel.		-	14	
15	Seat belt	Release, fasten and release seat belt.	Input OFF - ON - OFF	Pass	OK	
				Fail	15	

Note:

(1) Input (ON / OFF) to the accelerator switch and travel of the accelerator pedal (0 to 100 percent) appears.
(2) The steering wheel angle is displayed on the upper window and the wheel angle on the lower window.
(3) Setting of hydraulic speed (0 to 10) appears when any lever is pulled.

6.4 Power Steering Diagnostics

Perform power steering diagnostics using the following procedure.

Preparatory operations

(1) Place the parking brake lever in the locked position.
(2) Turn OFF the key switch.
(3) Disconnect the battery plug.
(4) Discharge all inverters. See page 1-53.
(5) Place the direction lever in the N position.
(6) Remove the line fuse (500 A). (Do not remove steering fuse)
(7) Connect the battery plug.

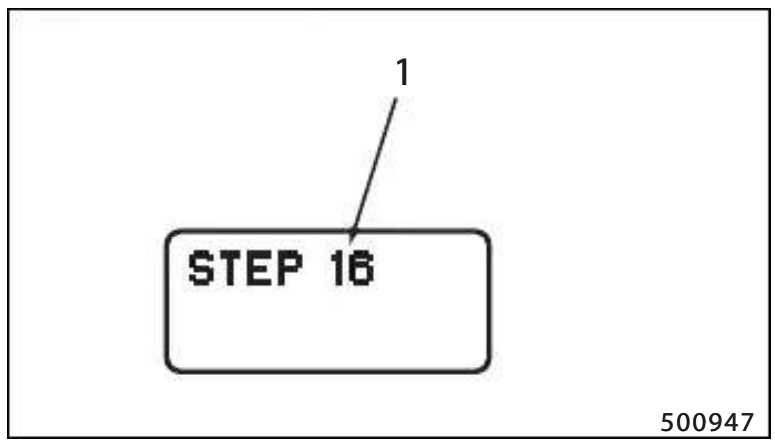
Diagnostics procedure

Perform the procedure using the Self-Diagnostics (Power steering system) table in accordance with the following guide.

(1) Start diagnostics with the Step 0 in the table. Turn ON the key switch according to the instruction in the "Do this" box on the Step 0 line. If the item passes the check without any problem, the next step number "16" appears on the display. If the item involves any problem and fails in the check, "dd" is shown on the display. The display also shows "dd" when diagnostics is started without removing the fuse. In this case, diagnostics is prohibited from going even to the first step.

(2) When the Step 0 has passed the check, diagnostics may advance to the Step 16 item (steering). Check the steering sensor according to the instruction in the "Do this" box on the Step 16 line.
(3) When all the steps have been checked through, turn OFF the key switch.
Be sure to reinstall the line fuse.

- Turn OFF the key switch to exit from the diagnostics mode.
- Repair all faults found immediately after diagnostics.



1. Diagnostics result indication

Follow the instructions in the diagnostics procedure guide above as well as those in the applicable boxes in the "Do this" column.

Self-Diagnostics (Power steering system)

Step	Diagnosis item	Do this	Controller check this	Result	Display	Contactor operation
0	Line voltage	Remove steering fuse.	Close line contactor and check power line voltage.	Pass	16	Contactor closes and opens.
				Pass	01 (see 1-41)	
				Fail	dd	
16	Steering	Operate steering and see display.		Pass	Note (1)	
				Fail	-	

Note: The steering wheel angle is displayed on the upper window and the wheel angle on the lower window.

6.5 Run Time Diagnostics

Availability of operation:
○: Yes, ×: No, △: Partially operable, *: Applicable

Error Code	Fault	Error condition	Display: I CON: Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation	Fault history record	Steering operation	Lift by wering	Restriction	To return to normal
E0	Traction Motor R.H., Overheating	Motor (145°C [293°F]or higher, -25°C [-13°F] or lower)			*				*	○	○	Driving power reduction	Cool
E1	Traction Motor L.H., Overheating	Motor (145°C [293°F] or higher, -25°C [-13°F] or lower)			*				*	○	○	Driving power reduction	Cool
E2	Pump Motor, Overheating	Motor (145°C [293°F] or higher, -25°C [-13°F] or lower)			*				*	○	○	Pump power reduction	Cool
E5	Traction Inverter R.H. Overheating	MOSFET (100°C [212°F] or higher, -25°C [-13°F] or lower) Capacitor (110°C [230°F] or higher, -25°C [-13°F] or lower)			*				*	○	○	Driving power reduction	Cool
E6	Traction Inverter L.H., Overheating	MOSFET (100°C or higher, -25°C [-13°F] or lower) Capacitor (110°C [230°F]or higher, -25°C [-13°F] or lower)			*				*	○	○	Driving power reduction	Cool
E7	Pump Inverter, Overheating	MOSFET (100°C [212°F] or higher, -25°C [-13°F] or lower) Capacitor (110°C [230°F] or higher, -25°C [-13°F] or lower)			*				*	○	○	Pump power reduction	Cool
		MOSFET (105°C [221°F] or higher), Capacitor (115°C [239°F] or higher)			*				*	○	○	Control power reduction (Loadhandling restricted to 1s)	Cool
E9	PS Controller Overheating	Thermistor (IMS 100°C [230°F], -25°C [-13°F] , Capacitor 110°C [230°F], -25°C [-13°F])			*				*	○	○	Driving power reduction	Cool
		MOSFET (105°C [221°F] or higher) Capacitor (115°C [239°F] or higher)			*			*	*	○	○	Normal stop	Turn key off
14	Traction Motor Current Sensor R.H. Fault	Current sensor offset mean value is ±120A or more						*	*	○	○	Normal stop	Turn key off
15	Traction Motor R.H., Over-current	Current value exceeding 586Arms in 1.6 mm sec. , or exceeding 631 Arms in 1 m sec., or exceeding 781 Arms instantaneously.						*	*	○	○		Turn key off

Error Code	Fault	Error condition	Display						Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
			I CON										
			Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation					
16	Traction Motor R.H., Stall Timer	Stall condition exceeds 7 sec. (estimated time to the boost stop)						*	*	○	○	Normal stop	Turn key off
24	Traction Motor L.H. Current Sensor Fault	Current sensor offset mean value is ± 120A or more.						*	*	○	○	Normal stop	Turn key off
25	Traction Motor L.H., Over-current	Current value exceeding 586 Arms in 1.6 mm sec. , or exceeding 631 Arms in 1 m sec., or exceeding 781 Arms instantaneously.						*	*	○	○	Normal stop	Turn key off
26	Traction Motor L.H., Stall Timer	Stall condition exceeds 7 sec. (estimated time to the boost stop)						*	*	○	○	Normal stop	Turn key off
34	Pump Motor Current Sensor Fault	Current sensor offset mean value is ± 120 A or more.						*	*	○	○	Normal stop	Turn key off
35	Pump Motor Over-current	Current value exceeding 586 Arms in 1.6 mm sec. , or exceeding 631 Arms in 1 m sec., or exceeding 781 Arms instantaneously.						*	*	○	○	Normal stop	Turn key off
40	Line Contactor Fault	The difference in voltage between battery and inverter is 7 V DC or more.						*	*	○	○	Normal stop	Turn key off
41	Steering Contactor Fault	The difference in voltage between battery and power steering controller is 7 V DC or more.						*	*	×	○	Steering emergency stop	Turn key off
45	Traction Motor R.H. Open	Traction motor disconnected when the power is turned on.						*	*	○	○	Normal stop	Turn key off
46	Traction Motor L.H. Open	Traction motor disconnected when the power is turned on.						*	*	○	○	Normal stop	Turn key off
47	Pump Motor Open	Pump motor disconnected when the power is turned on.						*	*	○	○	Normal stop	Turn key off
49	PS Motor Open	PS motor disconnected when the power is turned on.						*	*	×	○	Steering emergency stop	Turn key off
50	Tire Angle Sensor Fault	Tire angle sensor output 0.2 V or lower, or 4.8 V or higher, or inconsistent data.						*	*	○	○	Driving power reduction	Turn key off
		Tire angle sensor output 0.2 V or lower, or 4.8 V or higher, or						*	*	×	○	Steering emergency	Turn key off

		inconsistent data.										stop	

Error Code	Fault	Error condition	Display						Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
			I CON										
			Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation					
51	Accelerator Sensor Fault	Compensation of accelerator pedal 1 or 2 is 4.9 V or more, or the difference between both data is 0.5 or more.						*	*	○	○	Normal stop	Turn key off
52	Traction Motor RH Pulse Input Fault	Rotational speed exceeds 6000 rpm for 2 seconds.						*	*	○	○	Normal stop	Turn key off
53	Traction Motor LH Pulse Input Fault	Rotational speed exceeds 6000 rpm for 2 seconds.						*	*	○	○	Normal stop	Turn key off
54	FC Lever Fault (FC model only)	Lever input voltage is 0.1 V or less, or 4.95 V or more, or the difference in data between original and duplicate is large.						*	*	○	△	Corresponding working implement stop	Turn key off
55	Output Unit Solenoid Fault (FC model only)	Carrying a current of 0.16A or less, or 1.9A or more.						*	*	○	△	Corresponding working implement stop	Turn key off
56	Output Unit Solenoid Current Leak (FC model only)	Current is 0.18A or more when current is not applied.						*	*	○	△	Normal stop	Turn key off
60	Display Communication Fault	Display failure or communication line disconnection.						*	*	○	○		Turn key off
61	Logic Card Initialize Failure	No setting of Setup Gr3, or no setting of default.						*	*	×	○	Immediate stop	Turn key off
62	Logics Fault	Setup data parity check, ROM, RAM sum check						*	*	×	×	Immediate stop	Turn key off
63	Traction Inverter R.H. Fault	Traction inverter ROM/ EEPRROM/RAM failure						*	*	×	○	Immediate stop	Turn key off
		Traction inverter CAM communication is interrupted.						*	*	○	○	(Waiting for CAN recovery)	Recover communica-tion
64	Traction Inverter L.H. Fault	Traction inverter ROM/ EEPRROM/RAM failure						*	*	×	○	Immediate stop	Turn key off
		Traction inverter CAM communication is interrupted.						*	*	○	○	(Waiting for CAN recovery)	Recover communica-tion

Error Code	Fault	Error condition	Display						Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
			I CON										
			Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation					
65	Pump Inverter Fault	Pump inverter ROM/ EEPRROM/RAM failure						*	*	×	○	Immediate stop	Turn key off
		Pump inverter CAM communication is interrupted.						*	*	○	○	(Waiting for CAN recovery)	Recover communication
67	Input Unit Fault (FC model only)	Input unit ROM/EEPRROM/ RAM failure						*	*	×	×	Immediate stop	Turn key off
		Input unit cam communication is interrupted.						*	*	○	×	(Waiting for CAN recovery)	Recover communication
68	Output Unit Fault (FC model only)	Output unit ROM/EEPRROM/ RAM failure						*	*	×	×	Immediate stop	Turn key off
		Output unit CAM communication is interrupted.						*	*	○	×	(Waiting for CAN recovery)	Recover communication
71	EPS Inverter Fault	EPS controller ROM/ EEPRROM/RAM failure						*	*	×	○	Immediate stop	Turn key off
		EPS controller CAM communication is interrupted.						*	*	○	○	(Waiting for CAN recovery)	Recover communication
		ON or OFF of life signal continues 60 ms or more.						*	*	○	○	(Waiting for life signal recovery)	Recover communication
		Both CAN and life signal are abnormal.						*	*	×	○	Steering emergency stop	Turn key off
72	Contactor Coil Fault	Line contactor short circuit protection is activated.						*	*	○	○	Normal stop	Turn key off
		Steering contactor short circuit protection is activated.						*	*	×	○	Steering emergency stop	Turn key off
74	Hydraulic Lock Solenoid Fault (FC model only)	Lift lock valve short circuit protection is activated.						*	*	○	×	Corresponding working implement stop	Turn key off
		Carrying a current of 0.16A or less, or 1.9 A more when current is being applied to the tilt lock, or carrying a current of 0.18 A or more when current is not being applied.						*	*	○	×	Corresponding working implement stop	Turn key off

75	Parking Brake Solenoid	Parking brake short-circuit detected.						*	*	○	○	Normal stop	Turn key off

Error Code	Fault	Error condition	Display: I CON: Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation	Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
76	PDS Buzzer Fault	PDS buzzer short-circuit protection is activated.						*	*	○	○	(Only error display and buzzer stoppage)	Turn key off
78	Battery Voltage Too Low	Battery voltage is less than the value below after 120 msec from the time the power is applied. Battery voltage 36 V truck: Error threshold: 30 V. Battery voltage 48 V truck: Error threshold: 42 V.						*	*	×	○	Immediate stop	Turn key off
79	Battery Voltage Too High	Battery voltage is less than the value below after 120 msec from the time the power is applied. Battery voltage 36 V truck: Error threshold: 42 V. Battery voltage 48 V truck: Error threshold: 60 V.						*	*	×	○	Immediate stop	Turn key off
80	Tilt Angle Sensor Fault	0.1 V or less or 4.9 V or more of sensor input voltage continues 400 ms or more.						*	*	○	○	(Tilt stop only when ALS SW is ON)	Turn key off
81	Load Sensor Fault	When the truck is stopped, 0.1 V or less, or 4.9 V or more of load sensor input voltage continues 400 ms or more.						*	*	○	○	(Pitch control OFF)	Turn key off
82	Handle Angle Sensor Fault	steering angle input cycle 1 and 2.						*	*	○	○	Driving power reduction	Turn key off
		Steering angle input signal cycle 1 and 2 sensors error. Inconsistent 1 and 2 sensors.						*	*	×	○	Steering emergency stop	Turn key off
96	PS PWM1 Fault	PS controller LIFE signal short-circuit protection is activated.						*	*	×	○	Steering emergency stop	Turn key off
		PS controller LIFE signal short-circuit protection is activated.						*	*	×	○	Steering emergency stop	Turn key off
-	Battery Consumption Much	Battery voltage is low (25V or less)								○	○	Driving power reduction	Charge battery
Lo	Battery Consumption Too Much	Battery voltage is low (22 V or less)	*					*	*	○	○	Normal stoppage	Turn key off

Error Code	Fault	Error condition	Display						Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
			I CON										
			Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation					
EE	FNR Lever Fault	All the FNR signals are OFF or more than one point is ON.						*	*	○	○	(Neutral)	Turn key off
-	Brake Oil, Low Lever	Brake fluid low level SW is ON.		*						○	○		Turn key off
-	RTC Battery Low	Battery voltage for calendar IC is low.								○	○	Hour meter blinking	Turn key off
E	FNR Lever or Accelerator, Faulty Setting	Turned the power on when the FNR lever/accelerator is not in neutral position.						*		×	○	Waiting for recovery to travel.	FNR Neutral Accel open Seat SW close
		Seated while operating the FNR lever/accelerator.					*			○	○	(PDS function)	FNR Neutral Accel open Seat SW close
-	Seat Switch, Faulty Setting for Traction	Leaving the seat.					*			○	○	(PDS function)	FNR Neutral Accel open Seat SW close
-	Seat Switch, Faulty Setting for Pump	Leaving the seat.				*				○	○	(PDS function)	FNR Neutral Accel open Seat SW close
H1	Lift Lever, Faulty Setting	Turned the power on when the lift lever is ON.						*		×	×	Waiting for recovery to handle the load.	Lever off/ Neutral Seat SW close
		Seated when the lift lever is ON.				*					×	(PDS function)	Lever off/ Neutral Seat SW close
H2	Tilt Lever, Faulty Setting	Turned the power on when the tilt lever is ON.						*		×	○	Waiting for recovery to handle the load.	Lever off/ Neutral Seat SW close
		Seated when the tilt lever is ON.				*					○	(PDS function)	Lever off/ Neutral Seat SW close

Error Code	Fault	Error condition	Display: I CON: Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation	Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
H3	Attachment 1 Lever, Faulty Setting	Turned the power on when the attach 1 lever is ON.						*		×	○	Waiting for recovery to handle the load.	Lever off/ Neutral Seat SW close
		Seated when the attach 1 lever is ON.				*					○	(PDS function)	Lever off/ Neutral Seat SW close
H4	Attachment 2 Lever, Faulty Setting	Turned the power on when the attach 2 lever is ON.						*		×	○	Waiting for recovery to handle the load.	Lever off/ Neutral Seat SW close
		Seated when the attach 2 lever is ON.				*					○	(PDS function)	Lever off/ Neutral Seat SW close
A4	EPS Motor Current Sensor Fault	Current sensor offset mean value is ± 16 A or more.						*	*	×	○	Steering emergency stop	Turn key off
A5	EPS Motor Over-current	EPS motor current : 115.7 A (Instantaneous) 112.6 A (1 ms) 111.9 A (1.6 ms)						*	*	×	○	Steering emergency stop	Turn key off
A7	EPS Handle Brake Fault	Command value > 0.2A, FB current is less than 0.16A when short-circuit protection is activated.						*	*	○	○	Driving power reduction	Turn key off
A8	Battery Side Way Exchange Interlock	Battery side way SW OFF condition continues 400 ms.						*	*	○	○	Normal stop	Turn key off

Note:

(1) E0-E7 don't appear on the display, but are stored in the history folder.
(2) E, (E), (L), H1-H5, and Lo appear on the display, but not stored in the history folder. (E) means flashing.
(3) "Line contactor off(*)" means that the contactor will open immediately when a fault is detected.
"Line contactor off" means that the contactor will open when a current gets to 0.
(4) Contactor "hold" means "no change." When the error occurs while the contactor is turned on, it keeps on.

6.6 Fail-Safe Restriction List

Availability of operation:
○: Yes, ×: No, △: Partially operable

Classification	Restriction	Description	Contactor		Parking brake	Servo			Lift lock valve	Availability of operation		
			Line	Steering		Drive	Load handling	Steering		Drive	Load handling (Excluding lowering)	Steering
Failure *1	Immediate stop	Failure detected by initial power-up testing	OFF	OFF	Lock	OFF	OFF	OFF	ON	×	×	×
	Normal stop	When a failure is detected, speed command 0 is sent to traction and pump inverters and the servo is turned off.	ON	ON	Auto	OFF	OFF	ON	ON	×	×	○
	Emergency stop	Line and steering contactors are turned off upon detection of a failure.	OFF	OFF	Lock	OFF	OFF	OFF	ON	×	×	×
	Steering emergency stop	Line and steering contactors are turned off upon detection of a failure.	OFF	OFF	Lock	OFF	OFF	OFF	ON	×	×	×
Partial failure *1	Corresponding working implement stop *2	Working implement where failure detected is disabled. (Working implements without any problem can be operable.)	ON	ON	Auto	ON	ON	ON	ON *3	○	○	○
Degeneracy *1	Driving power reduction	Driving power is reduced.	ON	ON	Auto	ON	ON	ON	ON	○	○	○
	Pump power reduction	Power for handling load is reduced.	ON	ON	Auto	ON	ON	ON	ON	○	○	○
	Waiting for recovery to drive	The operator is not seated, or seated with the accelerator OFF and the travel direction placed in a position other than the neutral.	ON	ON	Auto	OFF	ON	ON	ON	×	○	○
	Waiting for recovery to handle the load	The operator is not seated, or seated and turned the power on when the control lever is not in the neutral position.	ON	ON	Auto	ON	OFF	ON	ON	○	×	○

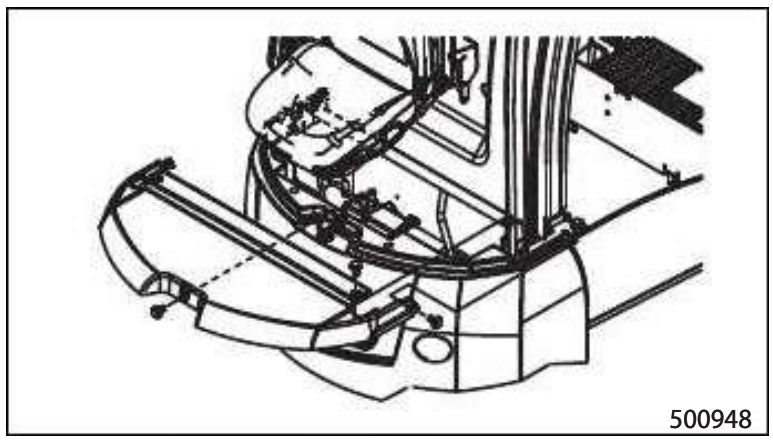
*1 The function will not be recovered in case of failure and partial failure unless the power is turned off. For degeneracy, the function will be recovered when the condition is removed. The fail-safe is considered to be a normal for partial failure and degeneracy.
*2 For MC model, only lifting operation can be disabled.
*3 If error 74 (Hydraulic Lock Solenoid Fault) of lift lock valve coil failure occurs, the lift lock valve is turned OFF.

7. Removal and Installation

7.1 Inverter Discharging Procedure

Discharge the inverters by using the following procedure.

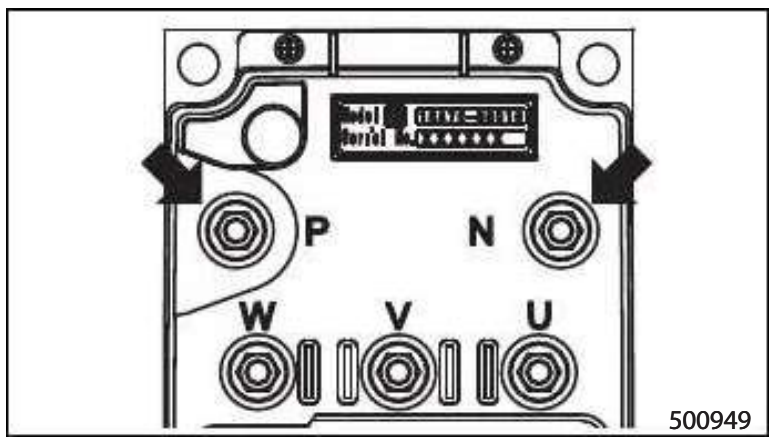
(1) Turn off the key switch.
(2) Disconnect the battery plug.
(3) Remove the rear cover.


500948

⚠ CAUTION

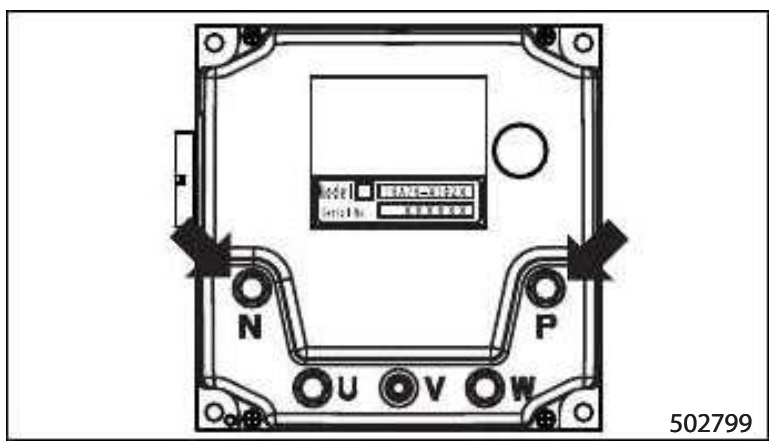
Be careful not to be pinched yourself between the head guard and seat.

(4) Place a 150 /25 W resistor between P and N terminals in the right traction inverter to discharge the inverter.
(5) After touching the resistor to the P and N terminals for approx. five seconds, measure the voltage between the terminals with a multimeter and confirm a reading of 5 V or less.
(6) Perform the same procedure for the left traction inverter, pump inverter, and EPS controller in order to discharge all inverters.



500949

Check whether the resistance between + and - of the battery plug on the truck side is 1 kΩ or more when connecting the battery plug for the first time after maintenance. (Discharge all inverters completely before measuring. Longer measurement time reduces resistance value.)



502799

7.2 Replacing Inverter

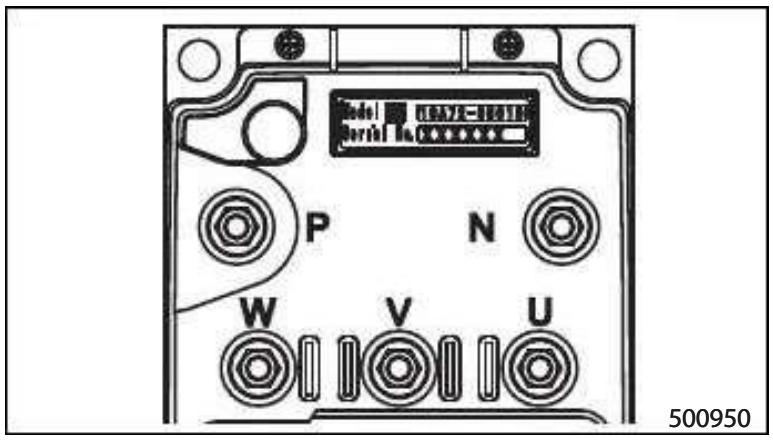
Removal

(1) Perform steps (1) to (6) in Inverter Discharging Procedure.

⚠ CAUTION

Be sure to discharge all inverters.

(2) Disconnect all five power cables from P, N, U, V and W terminals.



⚠ CAUTION

When disconnecting the connector, hold the connector housing and plug, and unlock the connector.

Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

(3) Remove M10 bolts (four places) fixing the inverter, then remove the inverter.

Installation

(1) Wipe off the dirt and thermal paste from the inverter mounting surface and remove dirt from the mounting surface and the aluminum base plate of the inverter.
(2) Apply thermal paste approx. 1 mm (0.04 in.) thick to the area where the aluminum base plate of the inverter comes into contact with the truck body.

⚠ CAUTION

Apply thin and even thermal paste since it works to release generated heat from the inverter to the truck body.

(3) Fix the inverter with M10 bolts.
(4) Connect the power cables to P, N, U, V and W terminals.

⚠ CAUTION

Use the correct power cables and terminate marked cable ends to the correct terminals marked on the motor.

Cables terminated at the wrong terminals on the motor may cause the motor to rotate in the opposite direction when activated.

Item		Tightening torque
M8 nut	P, N U, V and W terminals	16 ± 1.0 N·m {1.63 ± 0.10 kgf·m} [11.80 ± 0.74 lbf·ft]

(5) Connect the main harness connector to the inverter.

⚠ CAUTION

Forcibly pressing of the connector may cause damage to the DSP card. Hold the connector housing and press the connector, if required.

7.3 Replacing DSP (Digital Signal Processor) Card

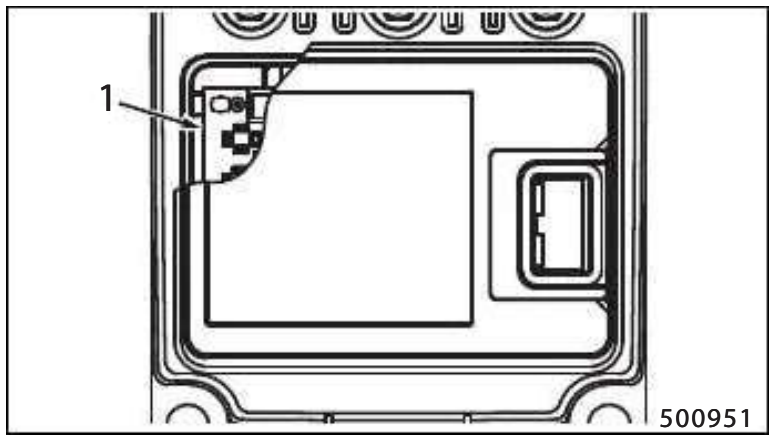
Removal

(1) Perform steps (1) to (6) in Inverter Discharging Procedure.

⚠ CAUTION

Be sure to discharge inverters before working on the electrical system.

(2) Disconnect the connector.



1. DSP Card

⚠ CAUTION

When disconnecting the connector, hold the connector housing and plug, and unlock the connector.

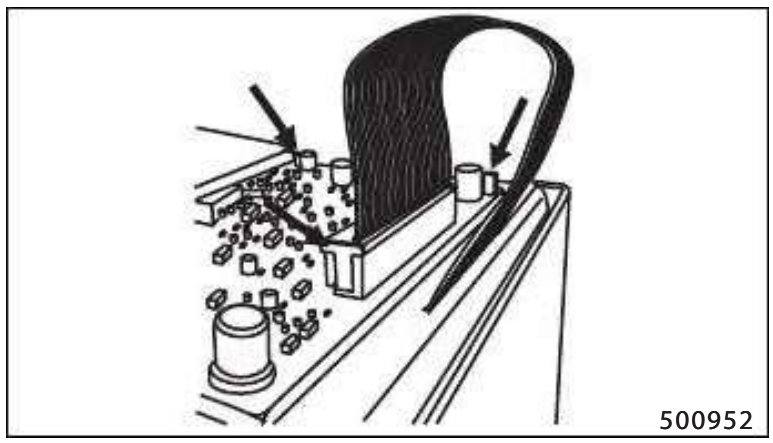
Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

(3) Push and lift up at the four corners of the card cover to remove the cover.

(4) Unlock the connector that is connected to the flat cable.
Hold the both ends of the white part of the connector and pull it straight up.

(5) Pull the flat cable connector to disconnect it.
If it cannot be disconnected smoothly, raise the lock again to unlock.

(6) Pinch the plastic spacers at the four corners of the DSP card with pliers to unlock and remove the card.



⚠ CAUTION

Be careful not to damage mounted parts with the pliers since the card has a number of fragile parts.

Installation

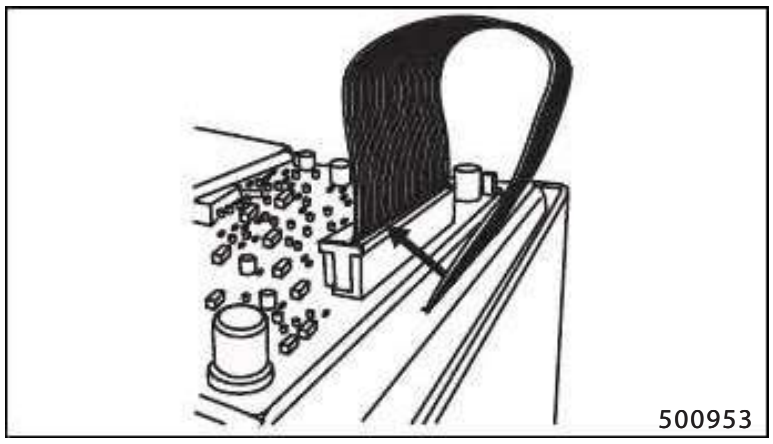
(1) Align the four mounting holes of the new DSP card with the plastic spacer positions and press it into place.

⚠ CAUTION

Press at the card edges.

Make sure that the spacer lock works completely and the card is secure.

(2) Verify that the flat cable connector is unlocked by raising the connector lock.
(3) Insert the flat cable into the connector. Press down the connector lock.



⚠ CAUTION

Do not forcibly bend the flat cable. Insert its conductive surface in the direction shown in the illustration.

Verify that the cable is inserted squarely into the connector.

(4) Install the cover while pushing the flat cable toward the card side slightly.

⚠ CAUTION

Do not force the flat cable into the inverter cover.

Do not forcibly bend the flat cable. Make sure that the cable will not be pinched underneath the cover.
Verify that the cover is completely locked.

(5) Connect the main harness connector to the inverter.

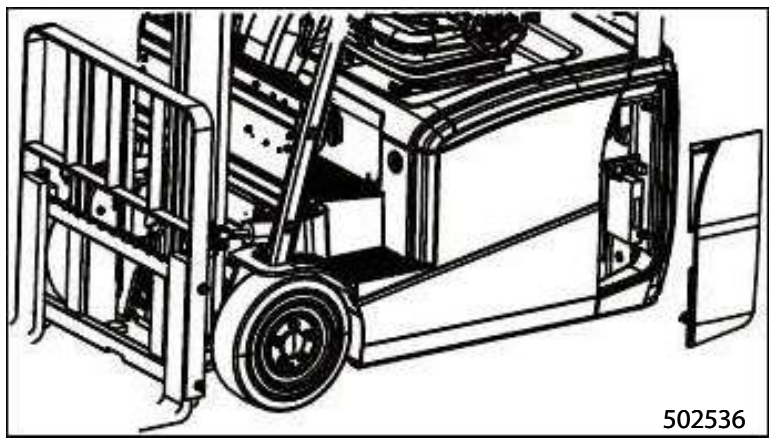
⚠ CAUTION

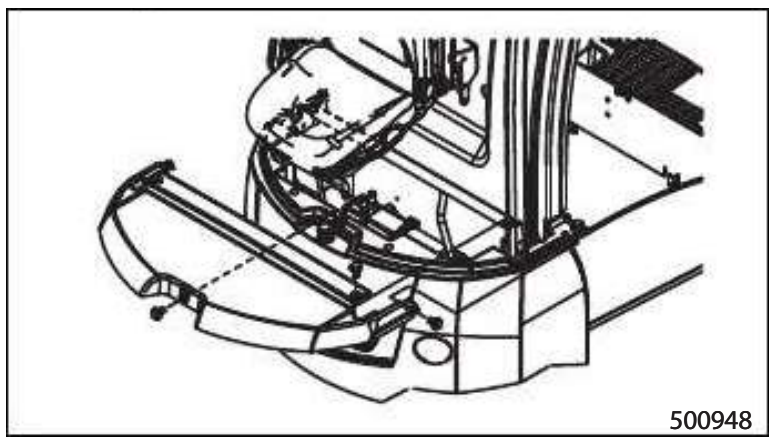
Forcibly pressing of the connector may cause damage to the DSP card. Hold the connector housing and press the connector, if required (for the card with vertical type connector).

7.4 Replacing Logic Unit

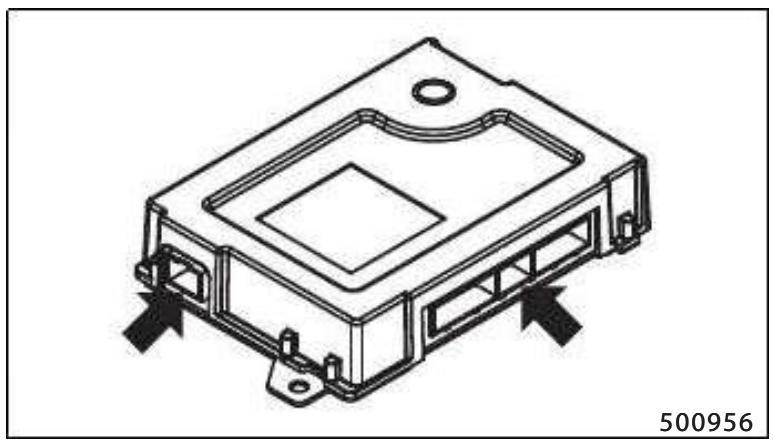
Removal

(1) Turn off the key switch.
(2) Disconnect the battery plug.
(3) Remove the side cover. (3-Wheel model)
Remove the rear cover. (4-Wheel model)


502536


500948

(4) Disconnect the connector from the logic card and power supply card.


500956

⚠ CAUTION

When disconnecting the connector, hold the connector housing and plug, and unlock the connector.

Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

(5) Remove M8 bolts (two places) and remove the logic unit.

Installation

Follow the removal sequence in reverse.

7.5 Replacing EPS Controller

Removal

(1) Perform steps (1) to (6) in Inverter Discharging Procedure.

⚠ CAUTION

Be sure to discharge all inverters.

(2) Disconnect all four power cables from P, N, U, and W terminals.

Installation

Follow the removal sequence in reverse.

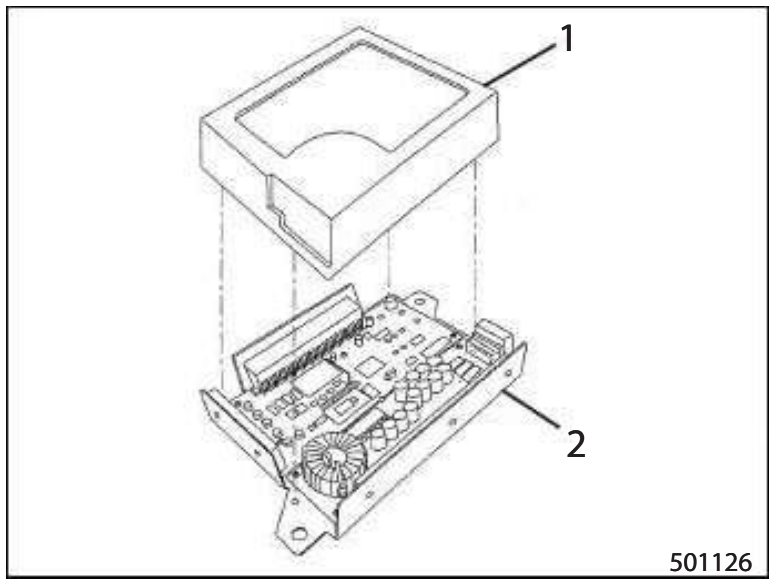
Item	Tightening torque
M6 nut	4.00 ± 0.50 N·m {0.41 ± 0.05 kgf·m} [2.95 ± 0.37 lbf·ft]

7.6 Replacing Logic Card

Note: When replacing the logic card, it is recommended to replace the logic unit as an assembly.
When the cover is removed from the logic unit case, its tapped holes may get damaged.
Replace the cover if the tapped holes of the cover are damaged.

Removal

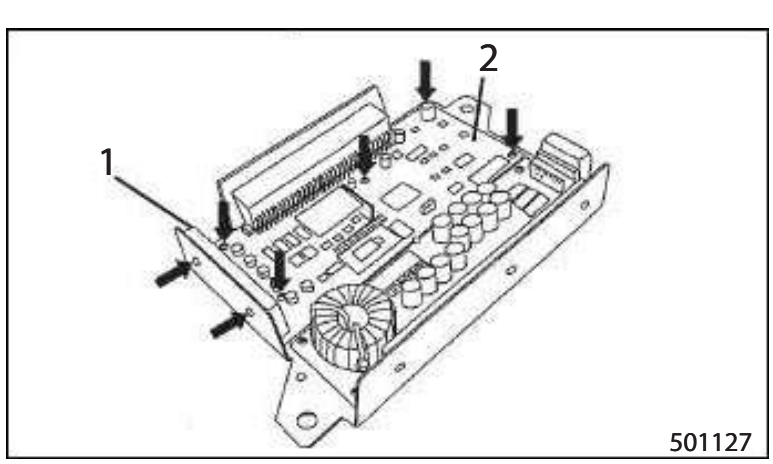
(1) Perform steps (1) to (5) in Replacing Logic Unit.
(2) Remove M3 flat head screws (two places) from the bottom of the logic unit to remove the cover.
(3) Remove M3 screws (four places) fixing the logic card to the logic unit case to remove the logic card.
(4) Remove the grommet from the logic card.



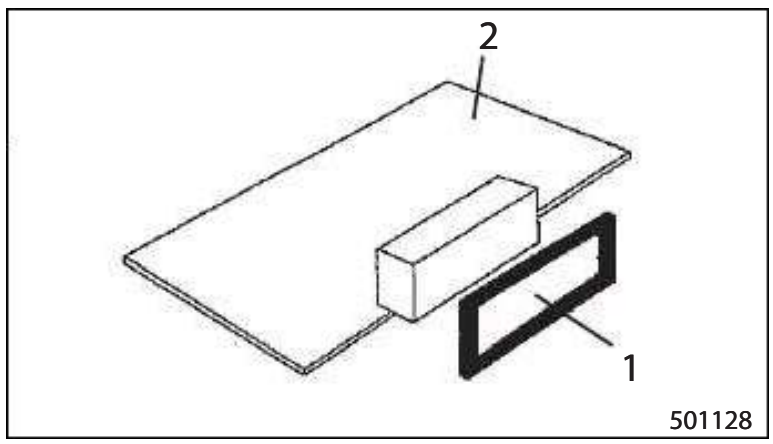
1. Cover 2. Logic unit case

Installation

Follow the removal sequence in reverse.



1. Heat sink 2. Logic card



1. Grommet 2. Logic card

⚠ CAUTION

When installing the logic card onto the logic unit case, carefully tighten the logic card and heat sink fixing screws to the specified torque to avoid excessive stresses. Fix the heat sink first.

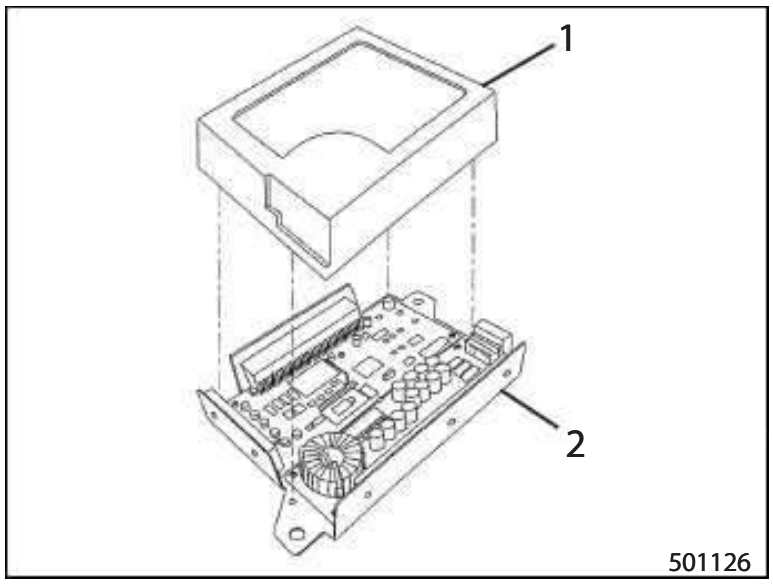
Item	Tightening torque
M3 screw	0.98 ± 0.20 N·m {0.10 ± 0.02 kgf·m} [0.72 ± 0.15 lbf·ft]
M3 flat head screw	0.30 ± 0.10 N·m {0.03 ± 0.01 kgf·m} [0.22 ± 0.074 lbf·ft]

7.7 Replacing Power Supply Card

Note: When replacing the power supply card, it is recommended to replace the logic unit as an assembly.
When the cover is removed from the logic unit case, its tapped holes may get damaged.
Replace the cover if the tapped holes of the cover are damaged.

Removal

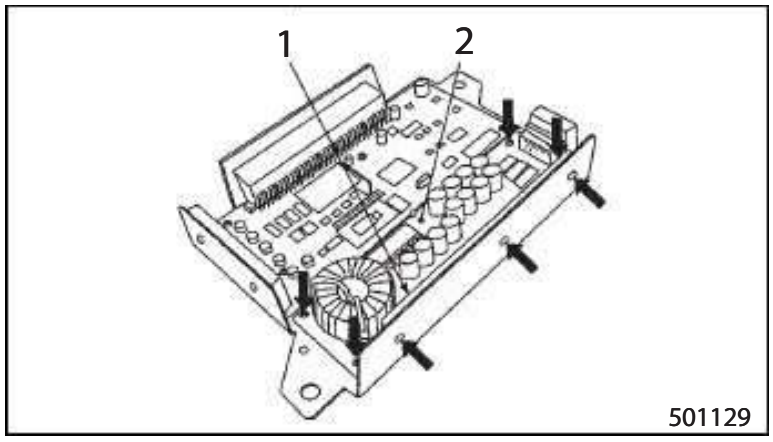
(1) Perform step (1) to (5) in Replacing Logic Unit.
(2) Remove M3 flat head screws (four places) from the bottom of the logic unit to remove the cover.
(3) Remove M3 screws (seven places) fixing the power supply card to the logic unit case to remove the power supply card.
(4) Remove the grommet from the power supply card.



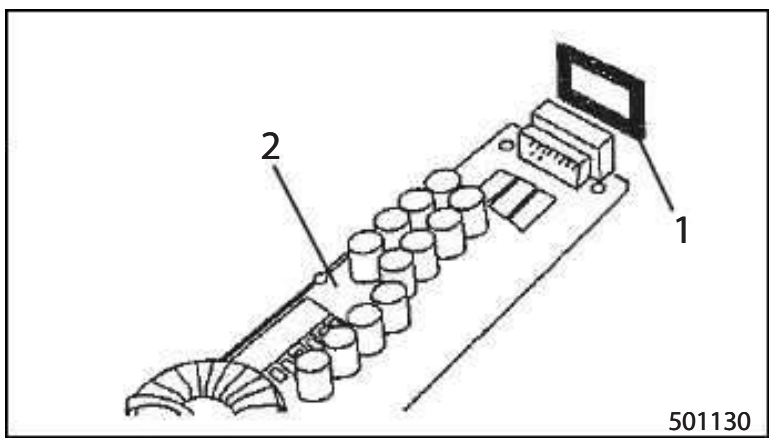
1. Cover 2. Logic unit case

Installation

Follow the removal sequence in reverse.



1. Heat sink 2. Power supply card



1. Grommet 2. Power supply card

⚠ CAUTION

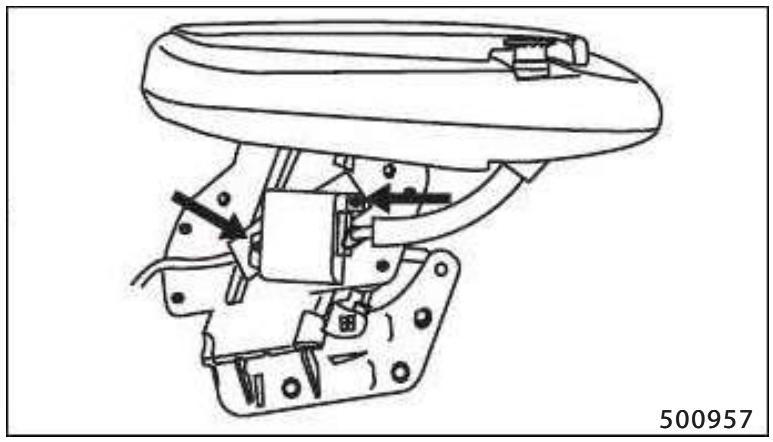
When installing the power supply card onto the logic unit case, carefully tighten the power supply card and heat sink fixing screws to the specified torque to avoid excessive stresses. Fix the heat sink first.

Item	Tightening torque
M3 screw	0.98 ± 0.20 N·m {0.10 ± 0.02 kgf·m} [0.72 ± 0.15 lbf·ft]
M3 flat head screw	0.30 ± 0.10 N·m {0.03 ± 0.01 kgf·m} [0.22 ± 0.074 lbf·ft]

7.8 Replacing Input Unit (FC MODEL ONLY)

Removal

(1) Turn off the key switch.
(2) Disconnect the battery plug.
(3) Disconnect the input unit connector.



⚠ CAUTION

When disconnecting the connector, hold the connector housing and plug, and unlock the connector.

Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

(4) Remove M6 screws (two places) to remove the input unit.

Installation

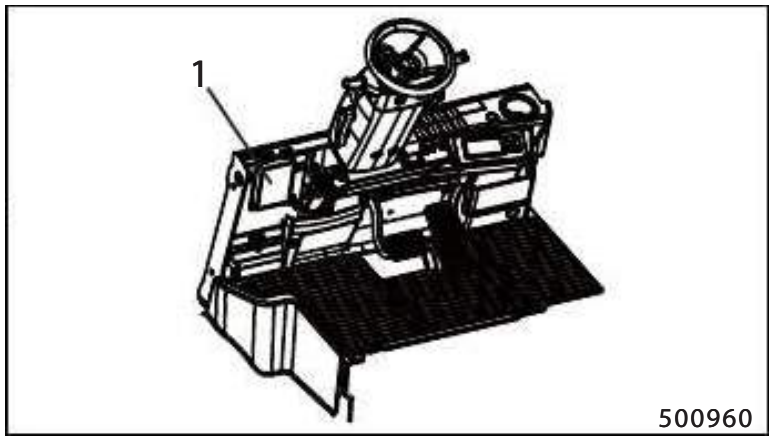
Follow the removal sequence in reverse.

Item	Tightening torque
M6 screw	2.90 ± 0.58 N·m {0.30 ± 0.06 kgf·m} [2.14 ± 0.43 lbf·ft]

7.9 Replacing Output Unit (FC MODEL ONLY)

Removal

(1) Turn off the key switch.
(2) Disconnect the battery plug.
(3) Disconnect the output unit connector.



1. Output Unit

⚠ CAUTION

When disconnecting the connector, hold the connector housing and plug, and unlock the connector.

Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

(4) Remove M6 bolts (four places) to remove the output unit.

Installation

Follow the removal sequence in reverse.

Item	Tightening torque
M6 bolt	6.90 ± 1.38 N·m {0.70 ± 0.14 kgf·m} [5.09 ± 1.02 lbf·ft]

8. Basic Check

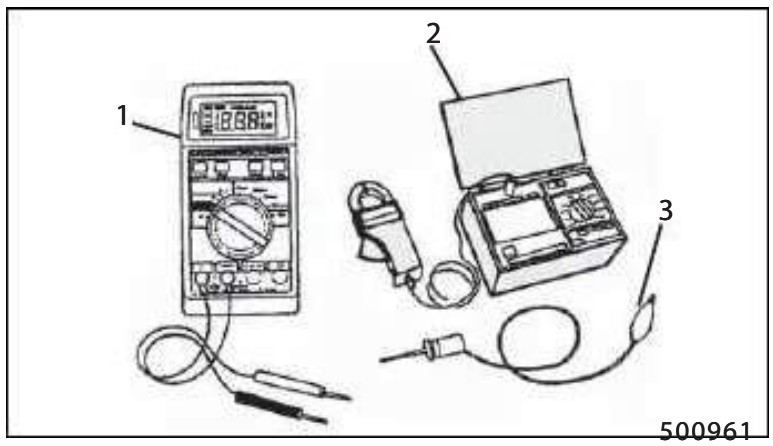
Always follow basic troubleshooting steps.

- Talk to the operator.
- Confirm the operator's description of the problem with an operational check.
- Visually inspect cables, connectors, contactor tips, etc.
- Perform basic battery cables to frame resistance test. (at least 20 k ohm)
- Check battery condition.

Always check each option and write down the reading.

8.1 Testing Tools

Note: The illustrations show digital multimeters. In these multimeters, the positive (+) terminal is applied with positive charge, and the negative (-) terminal with negative charge. It should be noted that the terminals must be connected inversely when using an analog meter.



1. Multimeter
2. Clamp meter
3. IC clip

⚠ WARNING

Disconnect the battery plug before inspecting or adjusting the controller.

8.2 Measurement of Card Voltage

⚠ WARNING

To prevent accidental movement of the truck, place wood blocks under the truck to lift the front wheels off the ground. Stay away from the front wheels.

(1) Tilt the mast fully backward. Place blocks under the mast, and tilt the mast forward to raise the front end of the truck.

(2) Turn the key switch off.
(3) Disconnect the battery plug. Remove the cover.
(4) Reconnect the battery plug.
(5) Turn the key switch on. Connect the negative terminal of the multimeter to the V GND terminal of the card.
(6) Set the multimeter to the 100 VDC range.
(7) Connect the positive terminal of the multimeter to each pin of connectors detailed on the following pages.

Note: Be careful not to short-circuit pins. For the normal voltage value, refer to the card voltage chart on the following pages.

Logic card voltage chart

CN1

No.	Name	Note
1	GND-L	thick
2	+VL	thick
3	GND-L	thick
4	+5V-L	thick
5	CANH	thick
6	CANL	thick
7	BOOT	
8	FWE	
9	GND	
10		
11		
12		
13		
14		
15	KEY-OFF	
16		
17	GSE-TxD	
18	GSE-RxD	
19	POS VOLTAGE	
20	ACCEL ANGLE 1	
21	ACCEL ANGLE 2	
22		
23	GND	thick
24	+5V	thick
25	GND	thick
26	+5V	thick
27		
28	LIFT PRESSURE	
29	TILT ANGLE	
30	AUX SW3	
31		
32	SEAT BELT SW	
33	SEAT SW	
34	PARK BRAKE SW	

No.	Name	Note
37	FORWARD SW	
38	BRAKE FLUID SW	
39		
40	AUX SW 1	
41	AUX SW 2	
42		
43	GND	thick
44	PDS BUZZER	thick
45		
46		
47		
48	ATTACH 2 SW	
49	ATTACH 1 SW	
50	TILT SW	
51	LIFT 2 SW	
52	LIFT 1 SW	
53	PS LIFE SIGNAL	
54	ALS SW (MC)	
55	INSPECTION MODE	
56	BATTERY SIDE WAY EXCHANGE IL	
57	SPEED ALARM 1+	
58	SPEED ALARM 1-	
59	LINE CONTACTOR CON	
60	PKB 1	
61	LIFT LOCK	thick
62	PKB 2	thick
63	CON VE	thick
64	STEERING CONTACTOR CON	thick

35	SERVICE BRAKE SW	
36	REVERSE SW	

Power supply card voltage chart

CN1

No.	Name	Voltage	Note
1	+12V	12V	
2	GND	0V	
3	+VL	13.0 to 16.0V	DSP
4	+8V	8V	DSP
5	+VG	12V	DSP
6	GND	0V	DSP
7	+VE-L	Vbatt	
8	+VE-L	Vbatt	
9	+VL	13.0 to 16.0V	Logic
10	+5V-L	5V	Logic
11	GND	0V	Logic
12	GND	0V	Logic
13	V POW	Vbatt	Input
14	V POW	Vbatt	Input
15	V GND	0V	Input
16	V GND	0V	Input

DSP card voltage chart of inverters

CN2

No.	Name	Stand-by voltage	Active voltage	Note
1	MOTOR THERMAL +	0 to 5V	0 to 5V	
2	MOTOR THERMAL -	0 to 5V	0 to 5V	
3	CANH	0 to 5V	0 to 5V	Do not measure the voltage between CAN and Logic GND terminal.
4	CANL	0 to 5V	0 to 5V	
5	ROTARY SENSOR +12V	12V	12V	
6	ROTARY SENSOR A+	0 to 5V	0 to 5V	
7	ROTARY SENSOR B+	0 to 5V	0 to 5V	
8	MODE 1	11.5V	0V	
9	MODE 2	11.5V	0V	
10	BOOT	11.5V	0V	
11	GND	0V	0V	
12	TxD (GSE)	-	-	
13	RxD (GSE)	-	-	
14	CANR+	-	-	
15	CANR-	-	-	
16	+VG	12V	12V	
17	+VL	13.0 to 16.0V	13.0 to 16.0V	
18	+8V	8V	8V	
19	GND	0V	0V	
20	GND	0V	0V	

EPS controller voltage chart

NO	NAME	NOTE	TYPE	Stand-by voltage	Active voltage
1	+8V (POWER IN)		POWER IN	8V	8V
2			POWER OUT		
3		NPN	DI		
4		NPN	DI		
5	BOOT		COMMUNICATION	11.5V	0V
6	TIRE ANGLE 2		AI	0 to 5V	0 to 5V
7	STEERING ANGLE 1		AI	11.5V	0V
8	PS LIFE SIGNAL	Suction	DO	11.5V	0V
9		Suction	DO		
10	+VG (POWER IN)		POWER IN	12V	12V
11		Steering wheel sensor			
12		NPN	DI		
13		NPN	DI		
14	TIRE ANGLE 1		AI	0 to 5V	0 to 5V
15	STEERING ANGLE 2		AI	11.5V	0V
16	GND		GND	0V	0V
17	HNDLE BRAKE COIL +	Discharge	DO	0 to V battery	
18	+VL (POWER IN)		POWER IN	13 to 16V	
19			AI		
20		Steering wheel sensor	DI		
21	CAN-H		COMMUNICATION	0 to 5V	0 to 5V
22	RxD		COMMUNICATION	-	-
23	GND		GND	0V	0V
24	GND		GND	0V	0V
25	GND (POWER IN)		GND	0V	0V
26	+5V	Contact/Non-contact	POWER OUT	5V	5V
27		Steering wheel sensor	POWER OUT		
28		Steering wheel sensor	DI		
29			COMMUNICATION		
30	CAN-L		COMMUNICATION	0 to 5V	0 to 5V
31	TxD		COMMUNICATION	-	-
32	GND (POWER IN)		GND	0V	0V
33	HNDLE BRAKE COIL -	Discharge (Current FB)	DO	0V	0V
34	CON VE		POWER IN	V battery	

Input unit card voltage chart

CN1

No.	Name	Stand-by voltage	Active voltage	Note
1	GND	0V	0V	
2	+VL	13.0 to 16.0V	13.0 to 16.0V	
3	-			
4	RS-232 Tx	0 to 12V	0 to 12V	
5	RS-232 Rx	0 to 12V	0 to 12V	
6	RS-232 GND	0V	0V	
7	CAN H	0 to 5V	0 to 5V	
8	CAN L	0 to 5V	0 to 5V	
9	CAN R+	-	-	
10	CAN R	-	-	
11	BOOT MODE	-	-	
12	-			
13	-			
14	GND	0V	0V	
15	-	13.0 to 16.0V		
16	-			
17	-	13.0 to 16.0V	0V	
18	PI 4	0 to 15V	0V	FORWARD (ARMREST)
19	PI 5	0 to 15V	0V	NEUTRAL (ARMREST)
20	PI 6	0 to 15V	0V	REVERSE (ARMREST)
21	PI 7	0 to 15V	0V	ALS-SW (FC)
22	-			
23	+5V	5V	5V	
24	GND	0V	0V	
25	AI 1	2.3 to 2.7V	0.1 to 4.9V	LIFT JOYSTICK 1
26	AI 2	2.3 to 2.7V	0.1 to 4.9V	LIFT JOYSTICK 2
27	AI 3	2.3 to 2.7V	0.1 to 4.9V	TILT JOYSTICK 1
28	AI 4	2.3 to 2.7V	0.1 to 4.9V	TILT JOYSTICK 2
29	AI 5	2.3 to 2.7V	0.1 to 4.9V	ATTACH 1 JOYSTICK 1
30	AI 6	2.3 to 2.7V	0.1 to 4.9V	ATTACH 1 JOYSTICK 2
31	AI 7	2.3 to 2.7V	0.1 to 4.9V	ATTACH 2 JOYSTICK 1
32	AI 8	2.3 to 2.7V	0.1 to 4.9V	ATTACH 2 JOYSTICK 2

Output unit card voltage chart

CN3

No.	Name	Stand-by voltage	Active voltage	Note
1	GND	0V	0V	
2	GND	0V	0V	
3	VE	Vbatt	Vbatt	
4	VE	Vbatt	Vbatt	
5	NODE 0	-	-	
6	NODE 1	-	-	
7	GND	0V	0V	
8	GND	0V	0V	
9	GND	0V	0V	
10	RS-232 Tx	0 to 12V	0 to 12V	
11	RS-232 Rx	0 to 12V	0 to 12V	
12	RS-232 GND	0V	0V	
13	CAN H	0 to 5V	0 to 5V	
14	CAN L	0 to 5V	0 to 5V	
15	CAN R+	-	-	
16	CAN R-	-	-	
17	RBOOT MODE	-	-	
18	-			
19	GND	0V	0V	
20	+VL	13.0 to 16.0V	13.0 to 16.0V	
21	SOL PWM 1+	0V	0 to Vbatt	LIFT VALVE A
22	SOL PWM 2+	0V	0 to Vbatt	LIFT VALVE B
23	SOL PWM 1-/2-	0V	0 to 0.5V	LIFT VALVE -
24	SOL PWM 3+	0V	0 to Vbatt	TILT VALVE A
25	SOL PWM 4+	0V	0 to Vbatt	TILT VALVE B
26	SOL PWM 3-/4-	0V	0 to 0.5V	TILT VALVE -
27	SOL PWM 5+	0V	0 to Vbatt	ATTACH 1 VALVE A
28	SOL PWM 6+	0V	0 to Vbatt	ATTACH 1 VALVE B
29	SOL PWM 5-/6-	0V	0 to 0.5V	ATTACH 1 VALVE -
30	SOL PWM 7+	0V	0 to Vbatt	ATTACH 2 VALVE A
31	SOL PWM 8+	0V	0 to Vbatt	ATTACH 2 VALVE B
32	SOL PWM 7-/8-	0V	0 to 0.5V	ATTACH 2 VALVE -
33	SOL PWM 9+	0V	0 to Vbatt	SPEED ALARM +
34	SOL PWM 10+	0V	0 to Vbatt	

35	SOL PWM 9-/10-	0V	0 to 0.5V	SPEED ALARM -
36	-			

8.3 Checking Contactor Coil

⚠ CAUTION

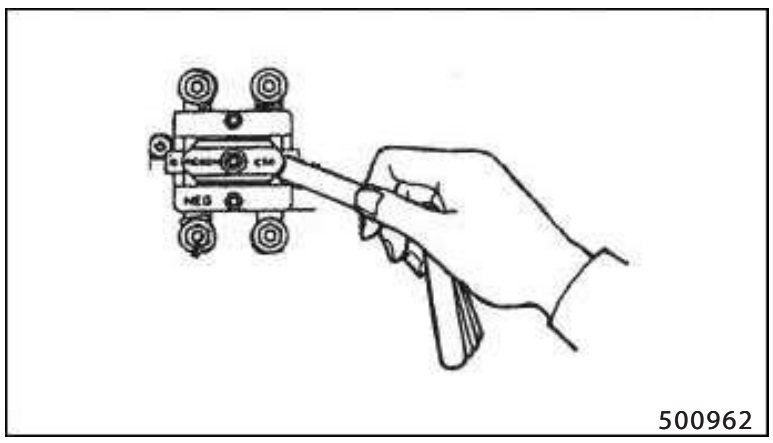
Disconnect the battery plug and discharge the inverters before working on the electrical system.

(1) Disconnect the lead wire of coil.
(2) Set the multimeter to the 200 ohm range.
(3) Measure coil resistance.
The resistance must be between 44 ohm at -30 °C (-22 °F) and 65 ohm at 80 °C (176 °F).
- If the measured value deviates from the above range, replace the contactor assembly.

(4) With the lead wire of contactor coil connected, set the multimeter to the 200 VDC range.
(5) Connect the negative (-) terminal of the multimeter to the negative-side coil terminal (small multimeter terminal) and the positive (+) terminal of the multimeter to the positive-side coil terminal (large terminal).
(6) Connect the battery, and operate the control device that activates the contactor.
(7) The multimeter should indicate about 24 V after the contactor operates. When the contactor is found normal in the coil resistance test, but measured voltage is not this value, replace the logic card.

8.4 Checking Contactor Tips

(1) Visually inspect the contactor tips for melting, adhesion, heat seizure and pitting corrosion.
(2) To check for interference, press the tips and release them.
(3) Visually inspect the contactor assembly. Make sure there is no foreign material that could interfere with contactor movement.
(4) Measure the gap at the contactor tips using a thickness gauge.
[It must be 3 ± 0.5 mm (0.12 ± 0.02 in.)]
- If you find any trouble, replace or repair the contactor.

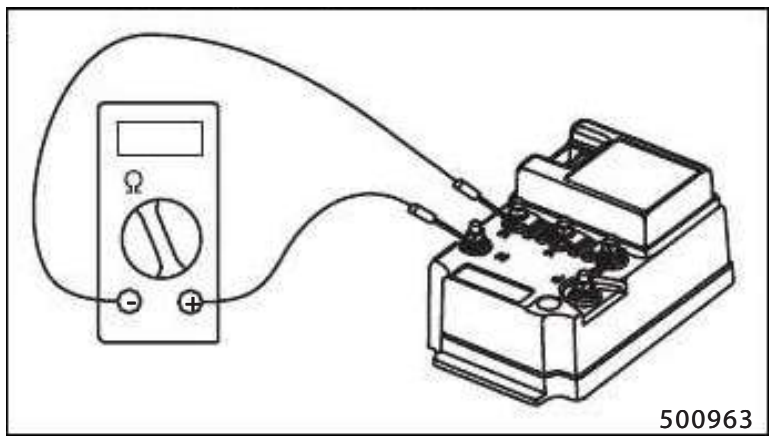


8.5 Checking Inverter

⚠ CAUTION

Disconnect the battery plug and discharge the inverters before working on electrical system.

(1) Disconnect all five power cables from P, N, U, V and W terminals.
(2) Check the resistance between the terminal as shown in the following table.



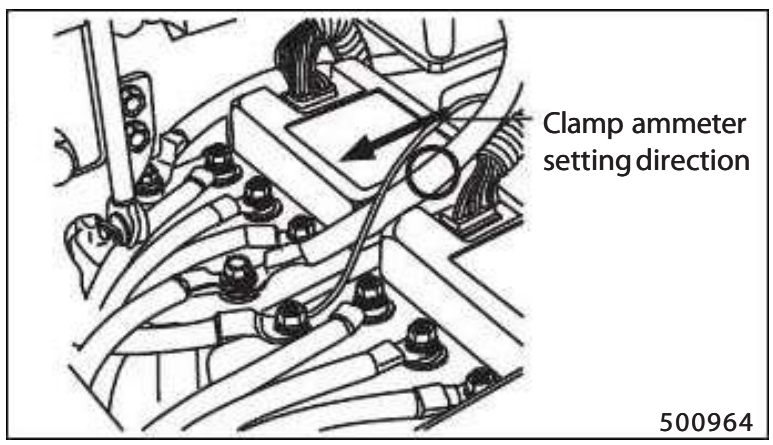
Positive probe	Negative probe	Resistance (ohm)
N	U	1 k to ∞
	V	
	W	
U	P	
V		
V		

Note: Short- or open-circuits of the inverter MOSFET can be determined with this check. Other internal faults cannot be determined with this check.

8.6 Regeneration Check

The AC motor uses a common circuit for current flow in both loading and regeneration. The following procedure will check the regeneration operation.

(1) Place the clamp ammeter onto the cable connected to the inverter's
(1) terminal (use DC current range). This is positive direction as current flows from the battery to the inverter.
(2) Run the truck forward. With the direction lever shifted in F position, release the accelerator pedal. Then perform a full-reverse operation.
(3) The clamp ammeter should show a negative value. This value becomes the regeneration current.



Energy is generated when a motor is rotated by an external force. The regeneration power is produced when this energy is larger than the one that is consumed by the controller and motor. This means that the regeneration current is not measured if the speed or load changes gradually.

9. AC Motor System Basics

9.1 Feature of AC motor

The AC motor model trucks covered by this manual use AC motors (three-phase induction motors) as the traction motor and pump motor. AC motors have the following advantages over DC motors:

(1) AC motors are simple in construction. Since they do not have friction parts like brushes and commutators, daily maintenance is significantly reduced.

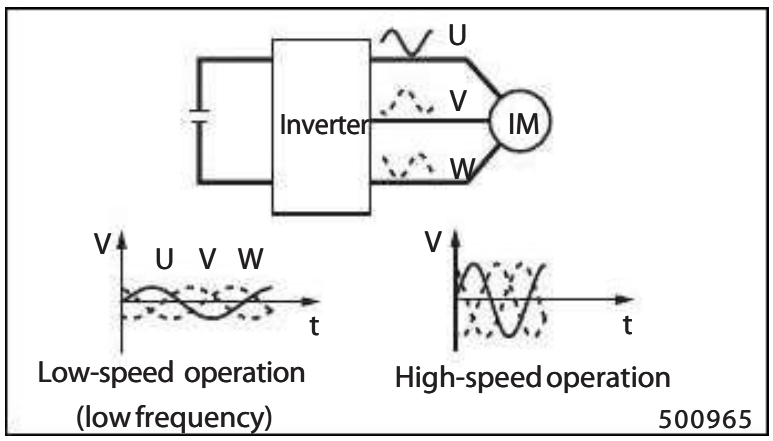
(2) AC motors are compatible with high-speed operation.
(3) An AC motor of a certain size produces higher power than a DC motor of the same size.

9.2 Speed control of induction motors

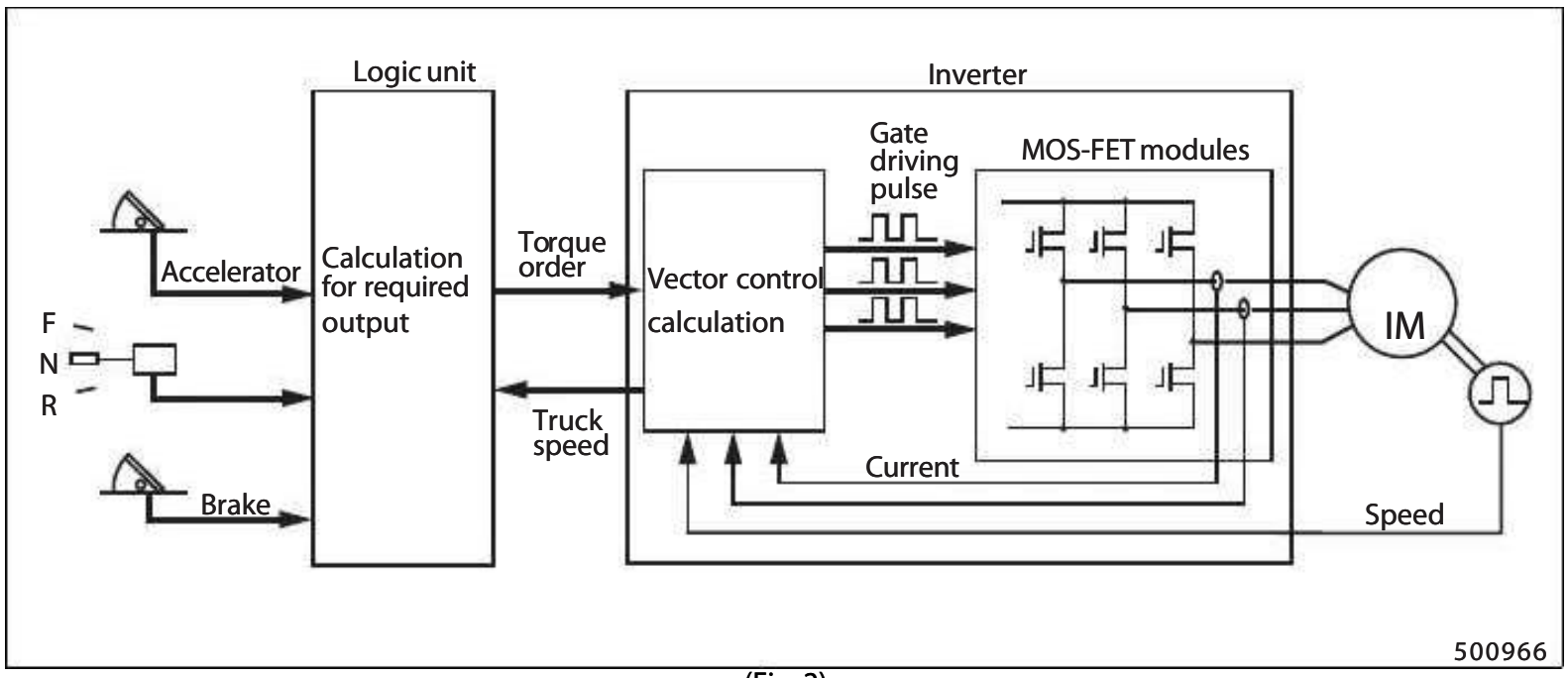
Speed control of DC motors depends on regulation of the field and armature current amounts, while that of AC motors basically depends on adjustment of the frequency of the alternating current power supply. The speed of an AC motor is determined by the frequency of the power supply AC current and the load on the motor.

In addition, the voltage and current to the motor must be controlled properly so that the motor operates in its optimum characteristic range. (Fig. 1)

The frequency and voltage can be controlled in a variety of methods including the "vector control method" employed in the AC motor model trucks. This method provides highly responsive control according to ever changing truck-operating conditions through a high-speed calculation of huge amount of data. The vector control calculation is performed by the inverter. (Fig. 2)



(Fig. 1)



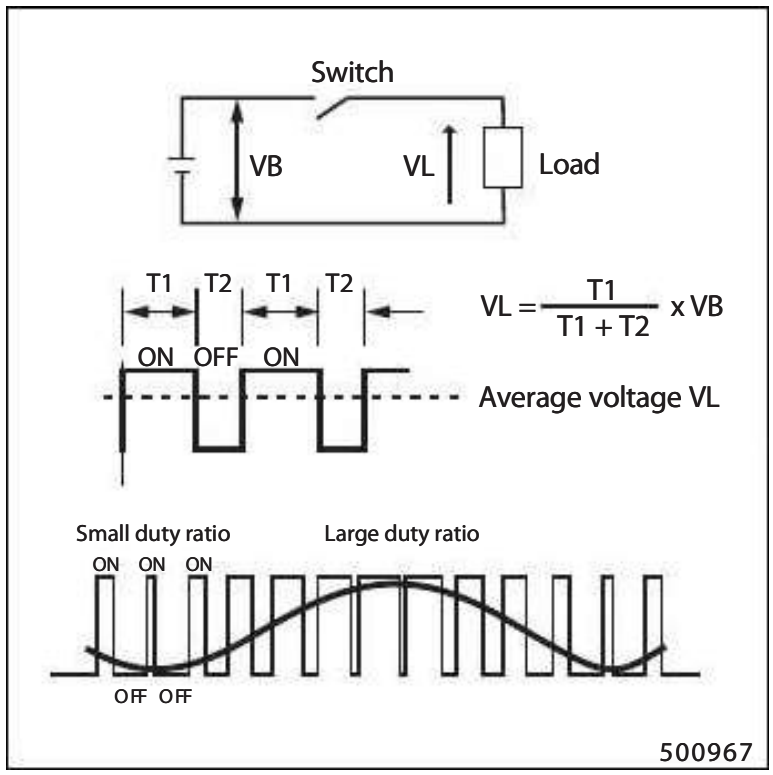
(Fig. 2)

9.3 Inverter

The truck battery delivers DC current, so the current must be converted into AC current to drive an AC motor. The device that converts direct current into alternating current is generally called an "inverter." The processes involved in creating AC current from DC current are described below.

(1) Changing DC voltage cyclically

If the switch in a circuit like a one shown in Fig. 3 is turned on for time T1 and then turned off for time T2 and this on-off operation is repeated many times, the average of the voltage applied to the load is determined by the ratio between T1 and T2. Varying the ratio, therefore, results in varying voltage. The ratio between T1 and T2 is called "duty ratio." By changing the duty ratio cyclically, it is possible to obtain cyclically changing DC voltage shown in Fig. 3.

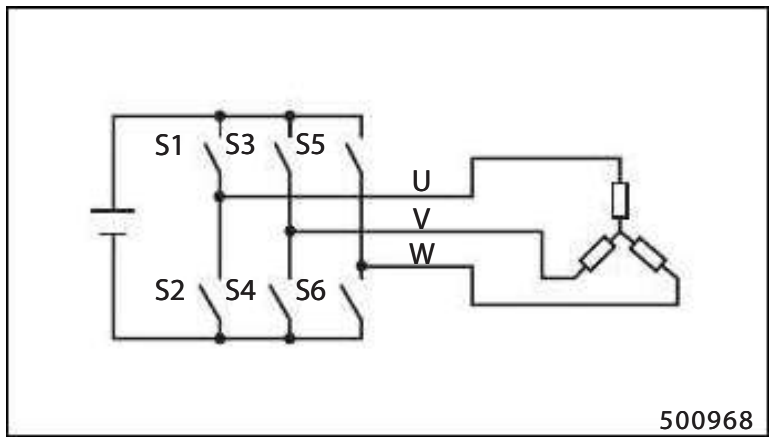


(Fig. 3)

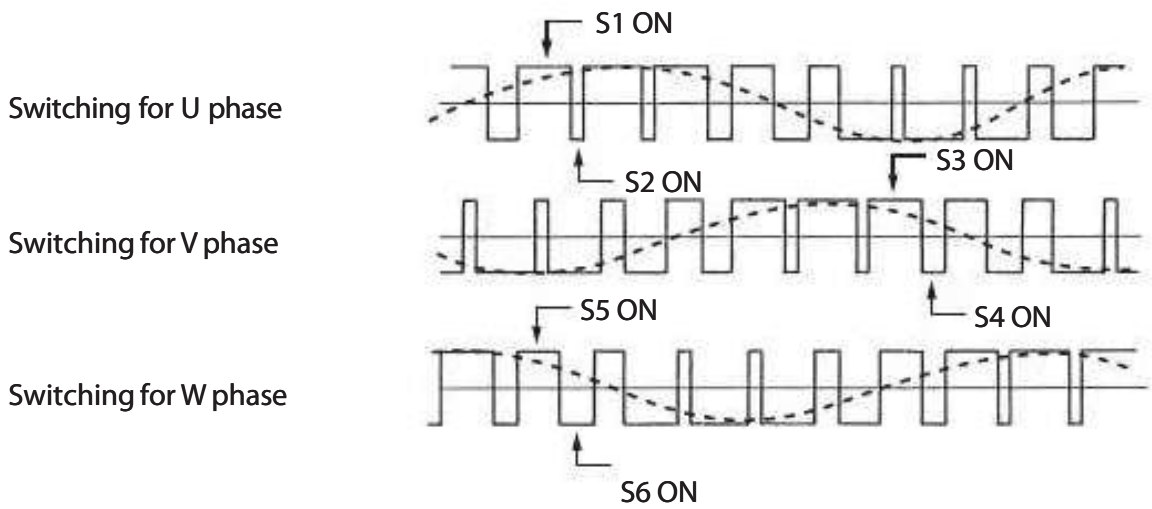
(2) Converting DC power into AC power

Driving a three-phase AC motor using battery delivered power requires creating three phase outputs (U, V, W) of an identical waveform that differ in phase by 120° using a circuit with six switches S1 to S6 that are arranged as shown in Fig. 4. The outputs thus created forms a three-phase alternating current. Fig. 5 shows on-off condition of each switch (arm) and output voltage variation.

Functioning as switches in the inverter of the AC motor trucks are MOS-FET transistors. The MOS-FET transistors can switch at very high speeds, thus creating smooth waveforms of alternating current.



(Fig. 4)



500969

(Fig. 5)

Chapter 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

1. General Information

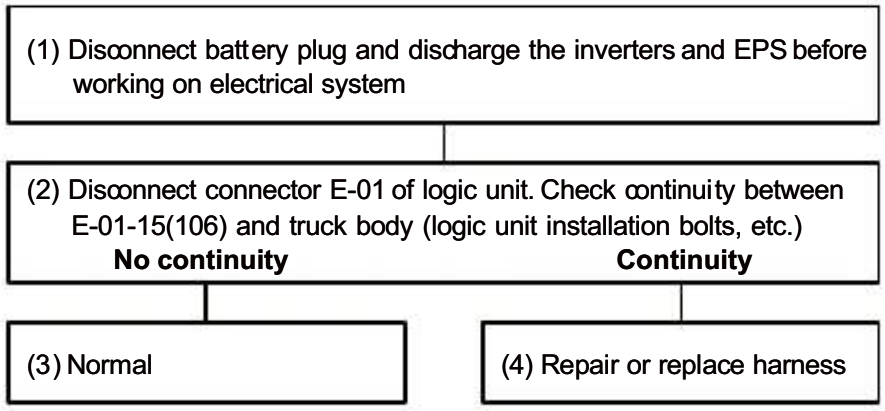
1.1 Before replacing devices

Do not replace devices casually even if replacement is required as a result of troubleshooting. Be sure to check the following items before replacing devices (logic unit, logic card, power supply card, inverters, inverter DSP cards, EPS, input unit and output unit).

- Loose battery connectors
- Abnormal wire harness connections
- Loose connectors
- Broken, bent or loose connector pins
- Dirty connectors

If connectors are dirty, remove the connector and clean connectors.
See "How to clean harness connectors and system components" on page 2-2.

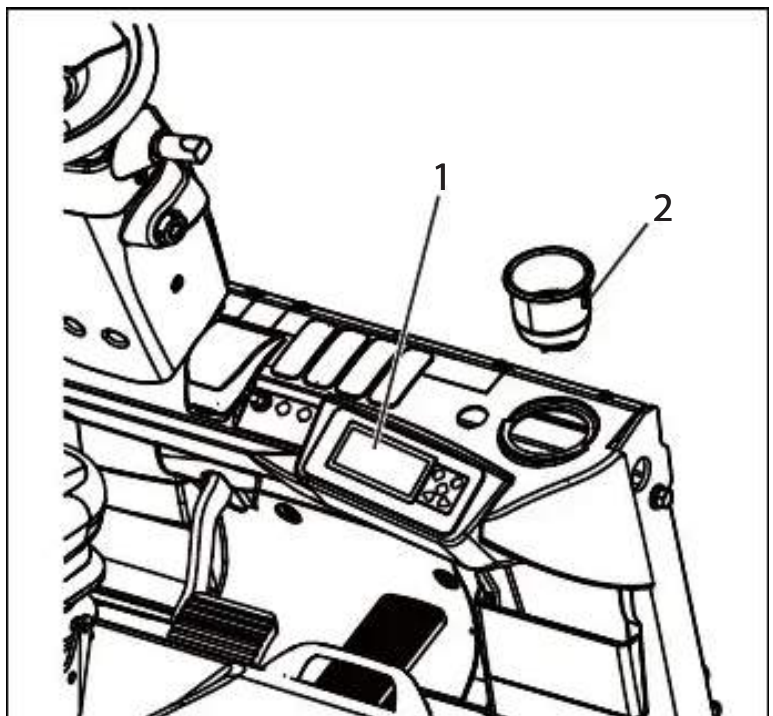
- Ensure that the main harness is not short-circuited to the truck body by using the following procedures.



If any of these items (above items) is a source of the trouble, the device will be damaged even if it is replaced with a new one. Be sure to check the above items and replace carefully.

1.2 Connection of the service tool

(1) Turn off the truck power.
(2) Remove cup holder.
(3) Find the connector E-09 to the service tool.
(4) Remove the cover and connect the PC as shown.
(5) Turn on the truck power.
(6) Start the service tool software.

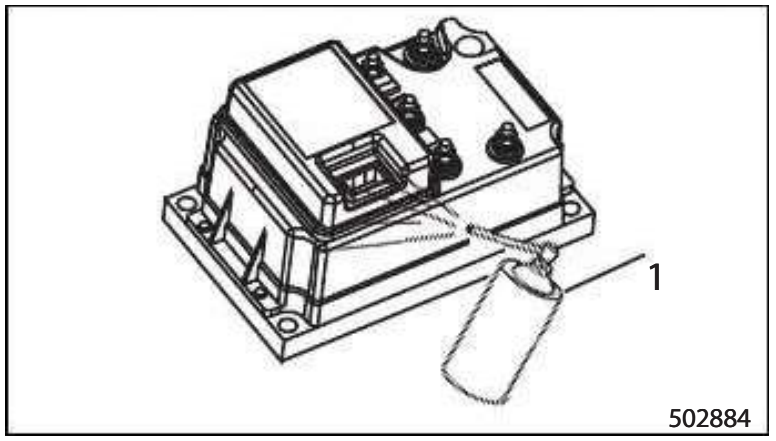


1. Error code display 2. Cup holder

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

1.3 How to clean harness connectors and system components

(1) Open-circuits are often caused by dirty harness connectors and components. Dust together with greasy matter forms grime which, in time, penetrates electrical connections, resulting in loose metal-to-metal contact or, in the worst case, electrical separation of surfaces in contact. For this reason, it is essential that the connectors and components be cleaned at each periodic inspection and at when servicing the truck. Instead of a commonly used solvent, use electronic parts cleaner (in the manner illustrated on the right).

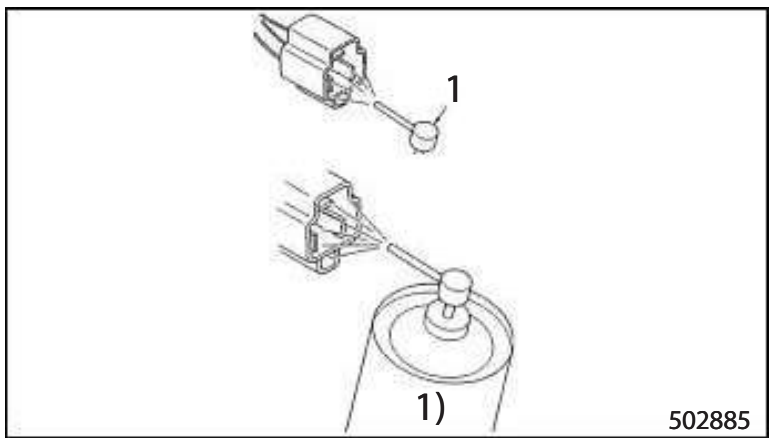


1. Electronic parts cleaner

Electronic parts cleaner
Three Bond 29B

Note: The cleaner liquid is volatile (evaporates by itself).
All that is required is to throughly wash off the grime with the spray.
No need to wipe off the sprayed liquid.

(2) After checking the connector for continuity, wash it as shown. Then, uncouple the connector and spray contact surface activator onto contact surfaces. Install and remove the connector several times to wet the surfaces thoroughly with the activator liquid. After coupling up the connector, check to be sure that it is in locked state.



1) Contact surface activator 1. Electronic parts cleaner

Contact surface activator
Three Bond 2501S (aerosol)

Note: Do not spray too much liquid into the connector.
Cleaner liquid reacts differently with some resins (plastic materials).

2. List of Error Codes

Error code	Error name
E0	Traction Motor R.H.,Overheating
E1	Traction Motor L.H.,Overheating
E2	Pump Motor,Overheating
E5	Traction Inverter R.H., Overheating
E6	Traction Inverter L.H., Overheating
E7	Pump Inverter, Overheating
E9	PS Controller, Overheating
14	Traction Moter Current Sensor R.H., Fault
15	Traction Motor R.H., Over-current
16	Traction Moter R.H., Stall Timer
24	Traction Moter Current Sensor L.H., Fault
25	Traction Motor L.H., Over-current
26	Traction Moter L.H., Stall Timer
34	Pump Motor Current Sensor Fault
35	Pump Motor Over-current
40	Line Contactor Fault
41	Steering Contactor Fault
45	Traction Motor R.H., Open
46	Traction Motor L.H., Open
47	Pump Motor Open
49	PS Motor Open
50	Tire Angle Sensor Fault
51	Accelerator Sensor Fault
52	Traction Motor R.H., Pulse Input Fault
53	Traction Motor L.H., Pulse Input Fault
54	FC Lever Fault
55	Output Unit Solenoid Fault
56	Output Unit Solenoid Current Leak
E	FNR Lever or Accelerator, Faulty Setting
(E)	Seat Switch, Faulty Setting For Traction
H1	Lift Lever, Faulty Setting

Error code	Error name
H2	Tilt Lever, Faulty Setting
H3	Attach1 Lever, Faulty Setting
H4	Attach2 Lever, Faulty Setting
(L)	Seat Switch, Faulty Setting For Hydraulic
EE	FNR Lever Fault
60	Display Communication Fault
61	Logic Card Initialize Failure
62	Logics Faul
63	Traction Inverter R.H., Fault
64	Traction Inverter L.H., Fault
65	Pump Inverter Fault
67	Input Unit Fault
68	Output Unit Fault
71	EPS Controller Fault
72	Contactor Coil Fault
74	Hydraulic Lock Solenoid Fault
75	Parking Brake Fault
76	PDS Buzzer Fault
78	Battery Voltage Too Low
79	Battery Voltage Too High
(Lo)	Battery Consumption Too Much
80	Tilt Angle Sensor Fault
81	Load Sensor Fault
82	Handle Sensor Fault
A4	PS Motor Current Sensor Fault
A5	PS Motor Over-current
A7	PS Handle Brake Fault
A8	Battery Side Way Exchange Interlock
None	Battery Consumption Much
None	Brake Oil, Low Level
None	RTC Battery Low

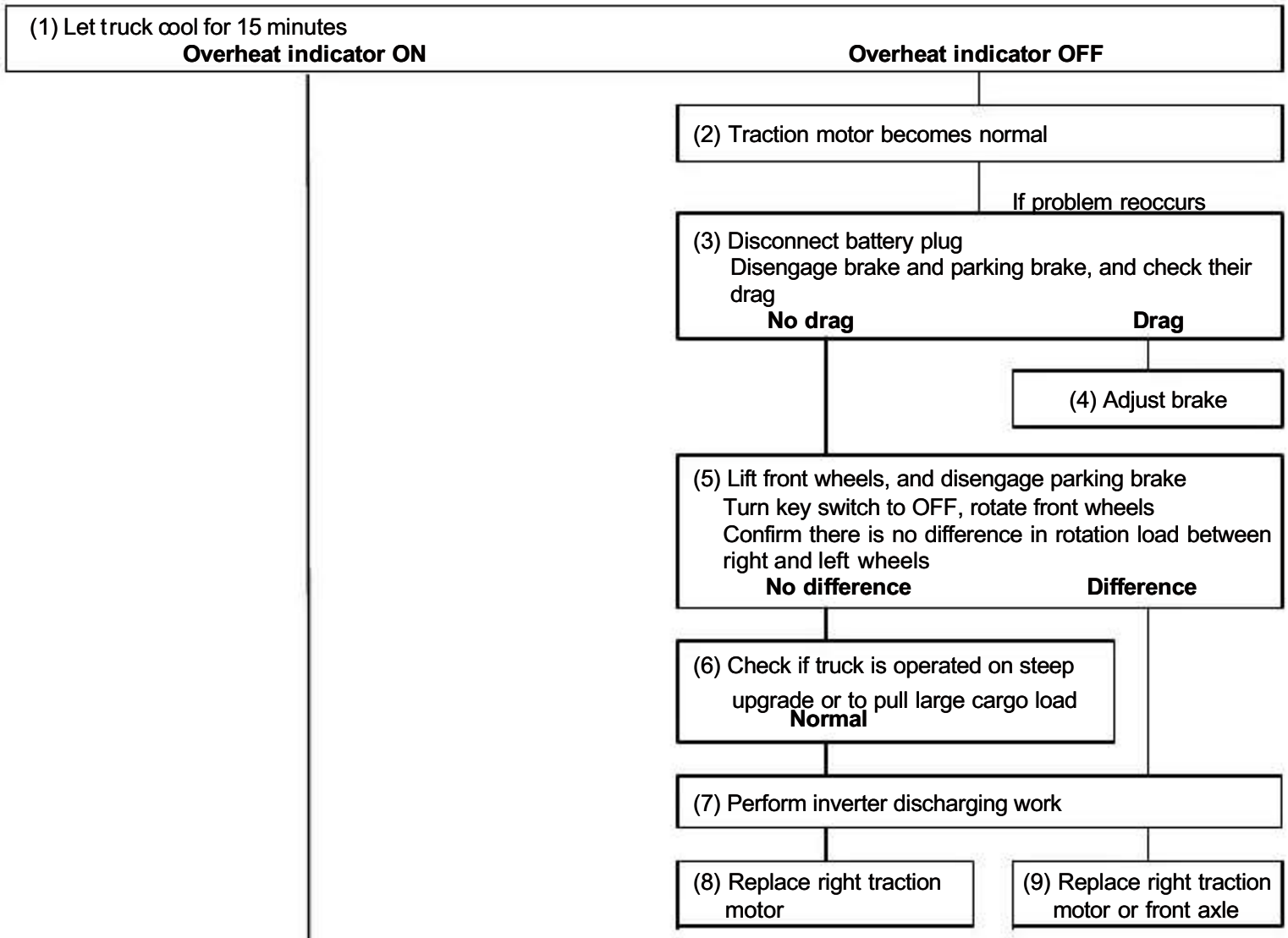
CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

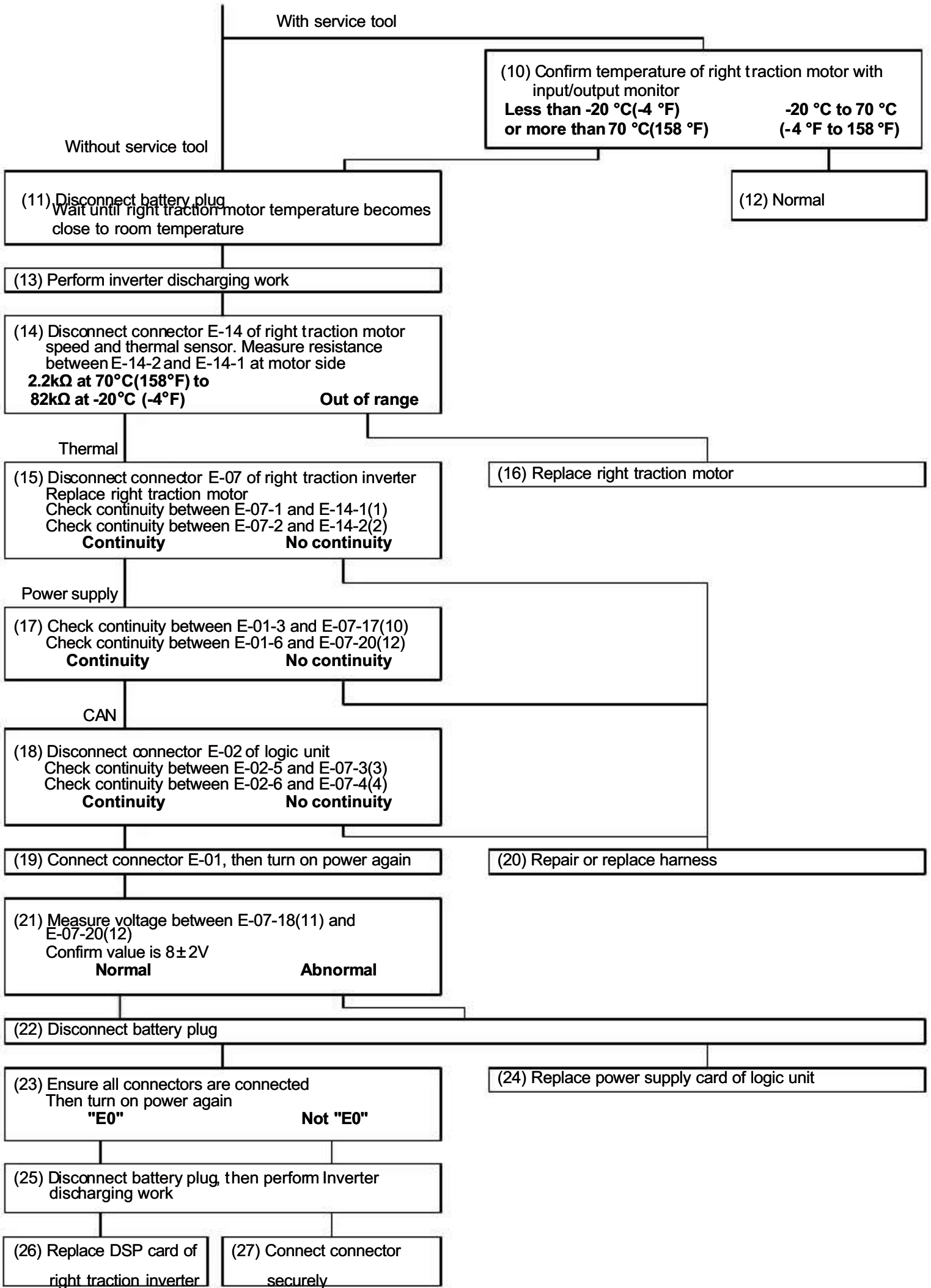
3. Troubleshooting

3.1 Traction Motor R.H.,Overheating (E0)

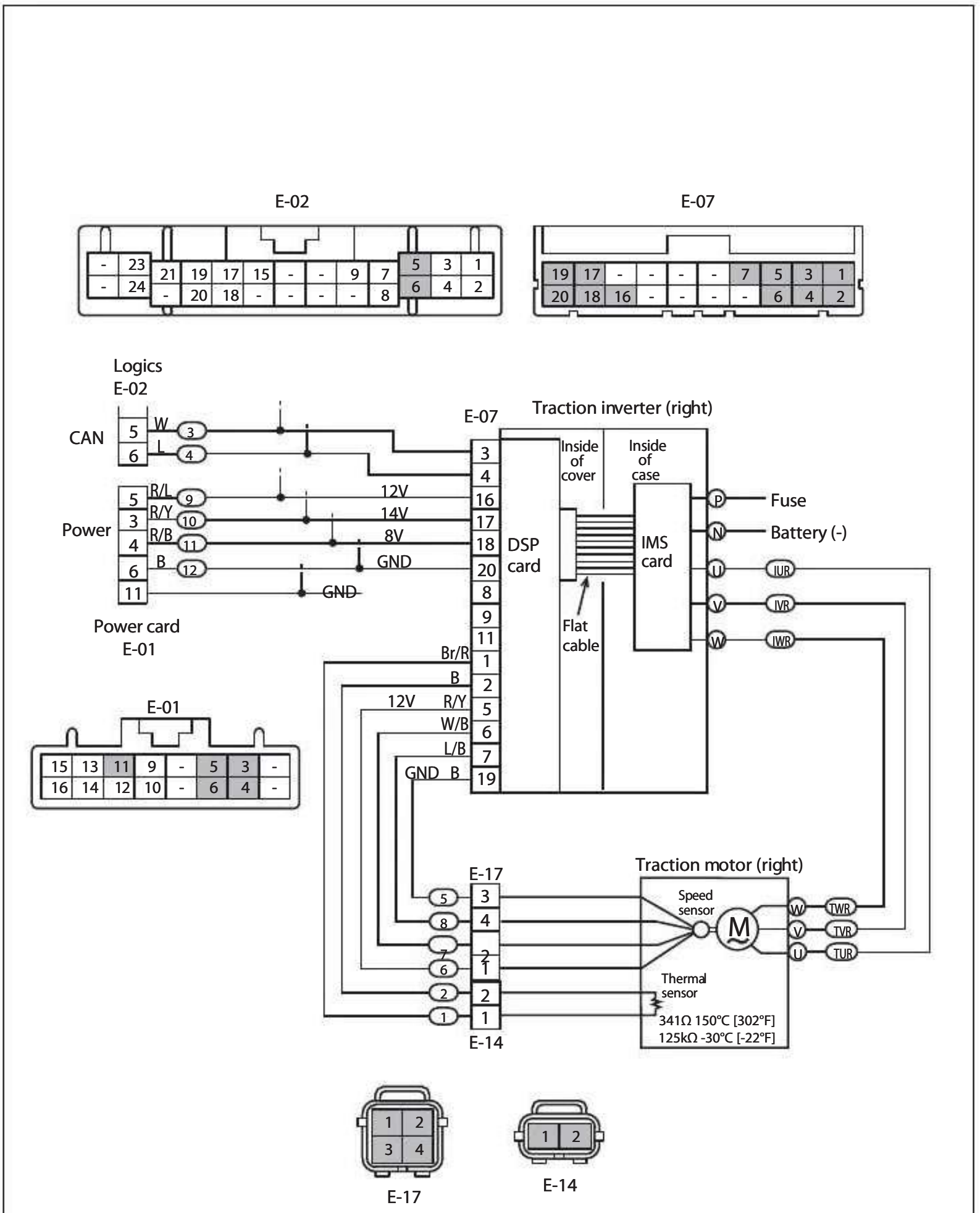
Error code: E0	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor and power steering operations. Service tool "Alarm status" and "E0" displayed.
Possible cause	Overheating of right side traction motor, faulty right side traction motor or thermal sensor, faulty or open harness wiring, faulty right traction inverter DSP card, abnormal power supply of logic unit, brake or parking brake drag, abnormality in front axle, faulty display unit.
Trigger of the error code	Motor temperature is out of range of -25 °C to 145 °C (-13 °F to 293 °F). Recovers when motor temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks




With service tool
(10) Confirm temperature of right traction motor with input/output monitor
Less than -20 °C(-4 °F) or more than 70 °C(158 °F)
-20 °C to 70 °C (-4 °F to 158 °F)
Without service tool
(11) Disconnect battery plug
Wait until right traction motor temperature becomes close to room temperature
(12) Normal
(13) Perform inverter discharging work
(14) Disconnect connector E-14 of right traction motor speed and thermal sensor. Measure resistance between E-14-2 and E-14-1 at motor side
2.2kΩ at 70°C(158°F) to 82kΩ at -20°C (-4°F)
Out of range
Thermal
(15) Disconnect connector E-07 of right traction inverter
Replace right traction motor
Check continuity between E-07-1 and E-14-1(1)
Check continuity between E-07-2 and E-14-2(2)
Continuity
No continuity
(16) Replace right traction motor
Power supply
(17) Check continuity between E-01-3 and E-07-17(10)
Check continuity between E-01-6 and E-07-20(12)
Continuity
No continuity
CAN
(18) Disconnect connector E-02 of logic unit
Check continuity between E-02-5 and E-07-3(3)
Check continuity between E-02-6 and E-07-4(4)
Continuity
No continuity
(19) Connect connector E-01, then turn on power again
(20) Repair or replace harness
(21) Measure voltage between E-07-18(11) and E-07-20(12)
Confirm value is 8±2V
Normal
Abnormal
(22) Disconnect battery plug
(23) Ensure all connectors are connected
Then turn on power again
"E0"
Not "E0"
(24) Replace power supply card of logic unit
(25) Disconnect battery plug, then perform Inverter discharging work
(26) Replace DSP card of right traction inverter
(27) Connect connector securely

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

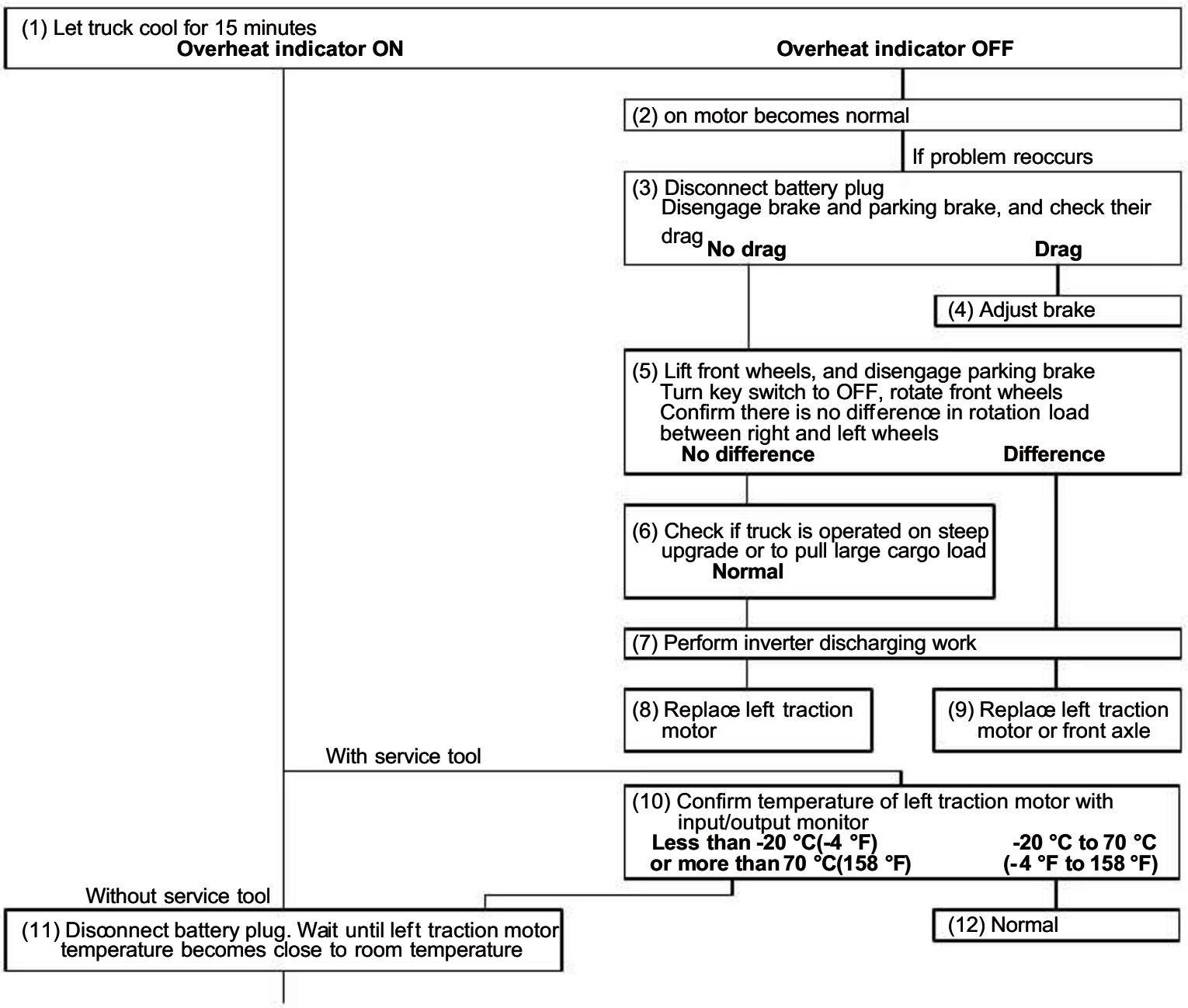


501135

3.2 Traction Motor L.H., Overheating (E1)

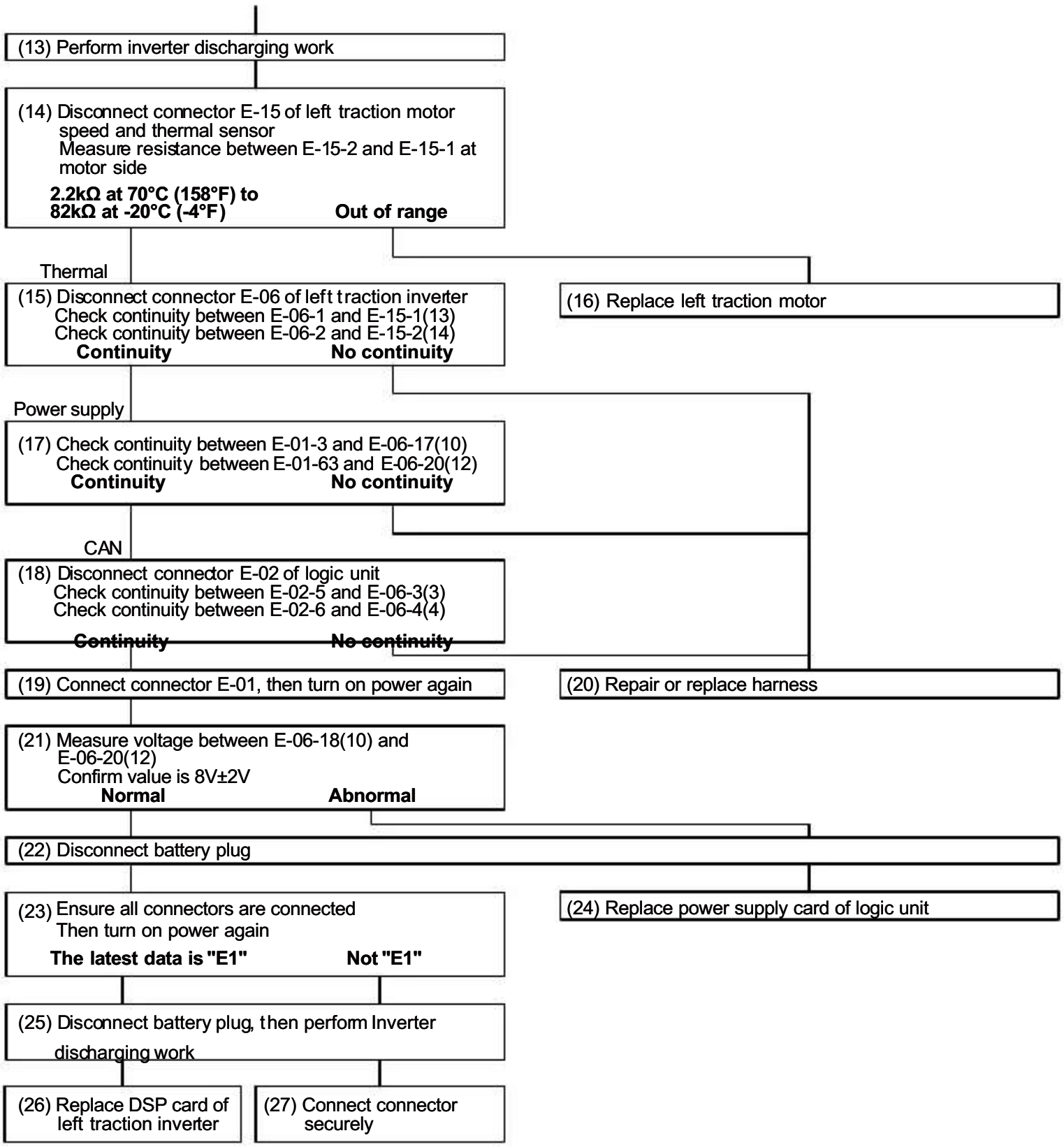
Error code: E1	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor and power steering operations. Service tool "Alarm status" and "E1" displayed.
Possible cause	Overheating of left traction motor, faulty left traction motor or thermal sensor, faulty or open harness wiring, faulty left traction inverter DSP card, abnormal power supply of logic unit, brake or parking brake drag, abnormality in front axle, faulty display unit
Trigger of the error code	Motor temperature is out of range of -25 °C to 145 °C (-13 °F to 293 °F). Recovers when motor temperature is in range of -20 to 70 °C (-4 to 158 °F).

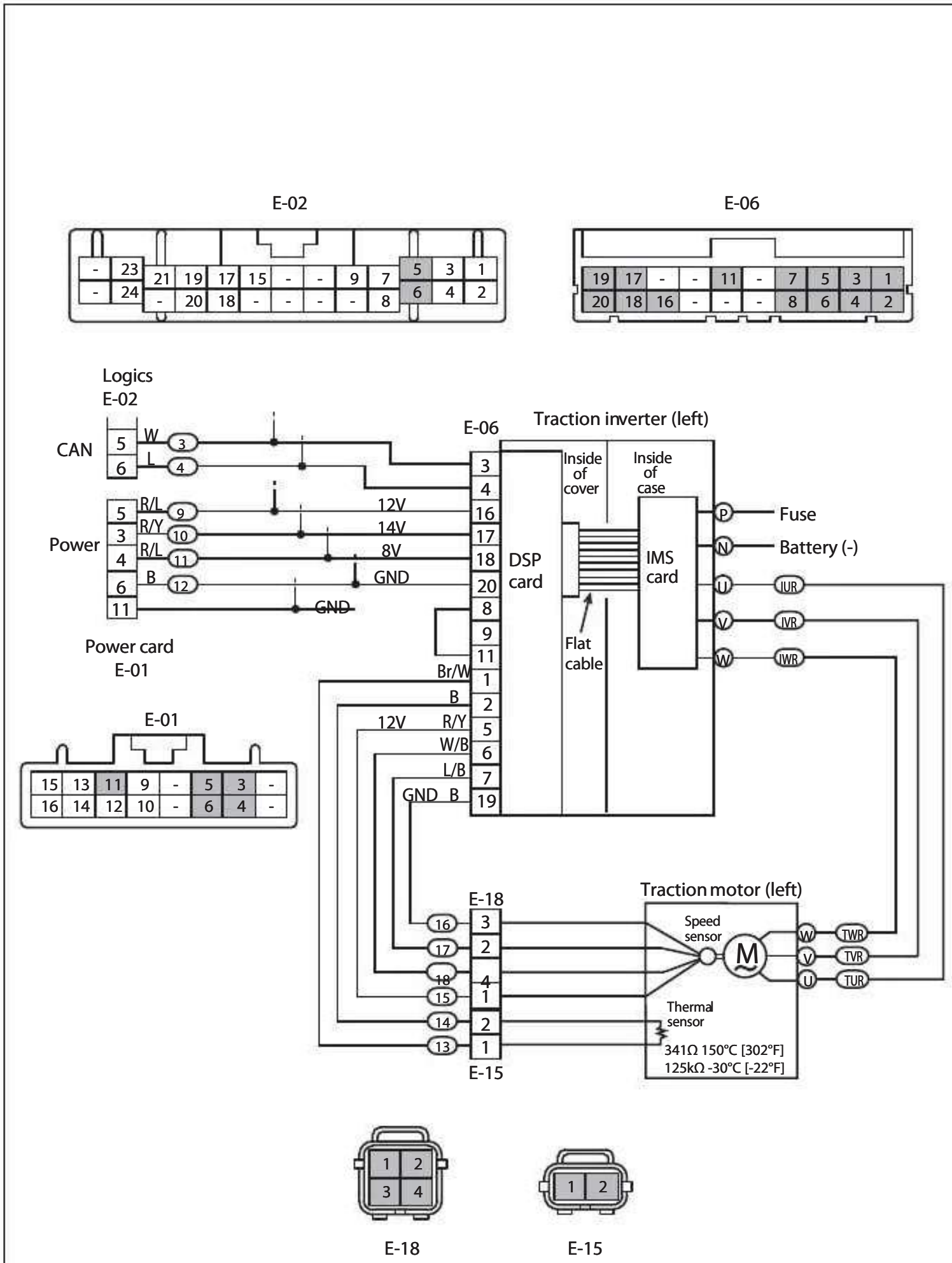
Checks



502805

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

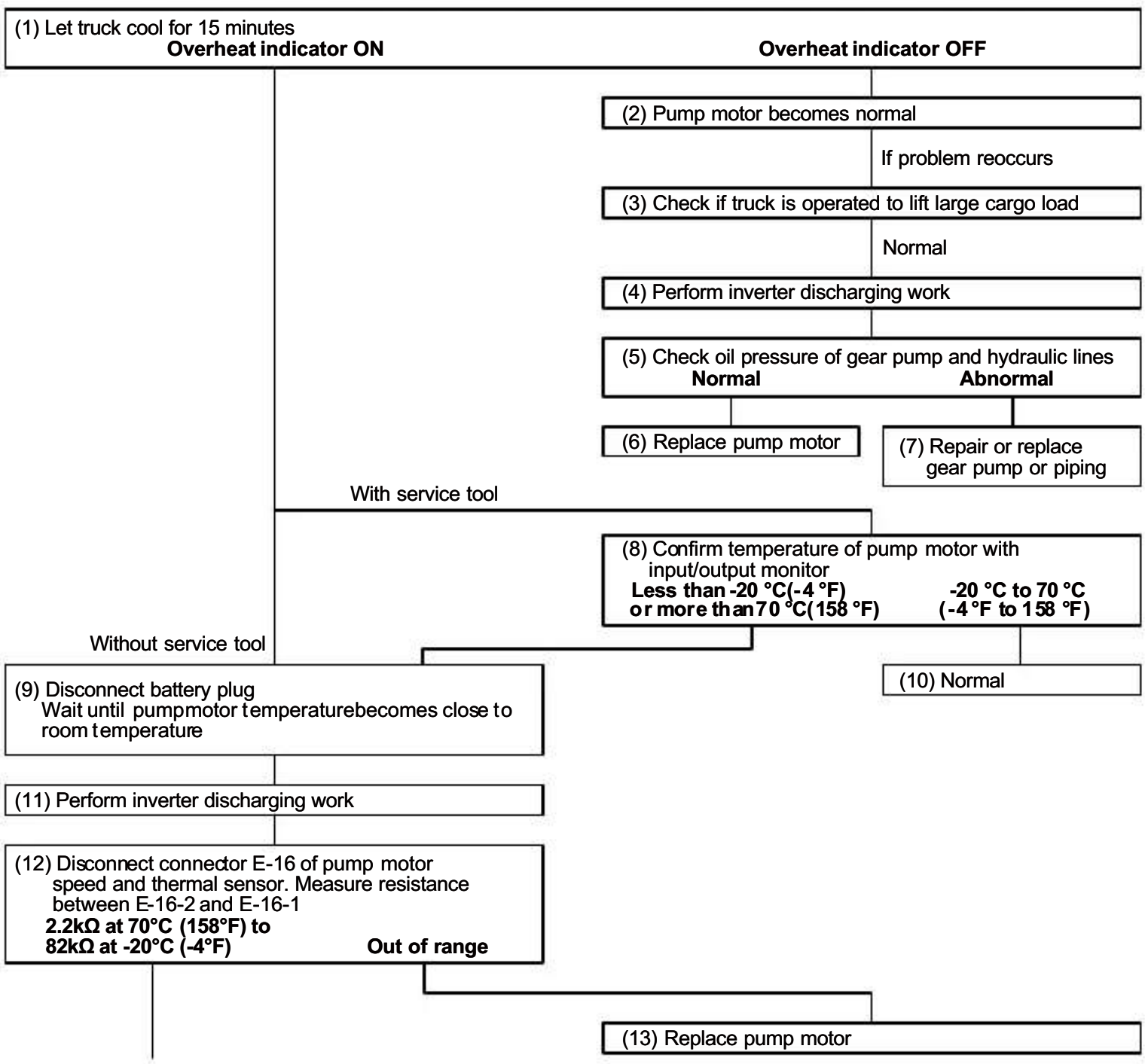


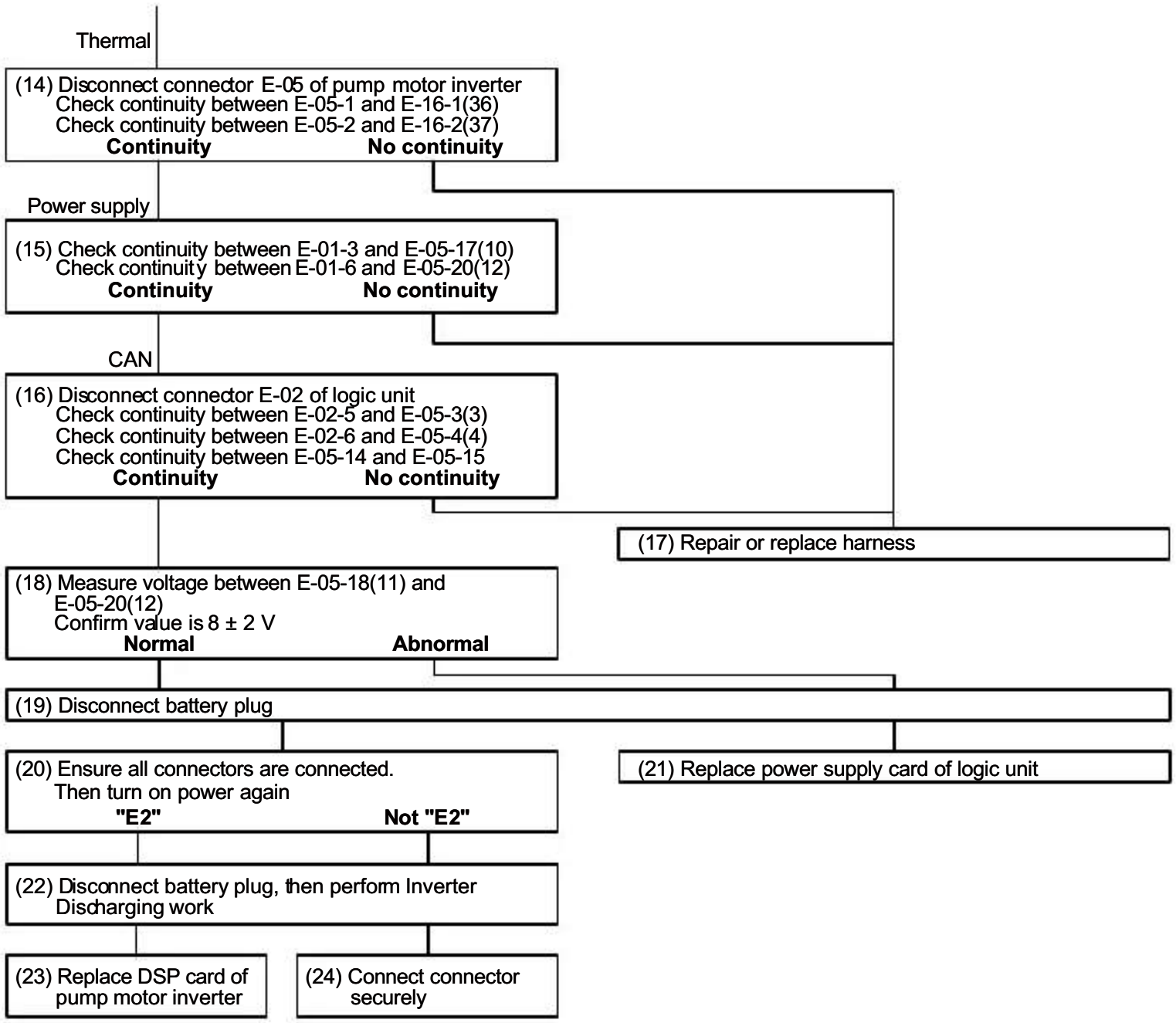

E-02
E-06
Logics
E-02
CAN
Power
Power card
E-01
E-01
Traction inverter (left)
E-06
DSP card
IMS card
Inside of cover
Inside of case
Flat cable
Fuse
Battery (-)
IUR
IVR
IWR
Br/W
B
12V
R/Y
W/B
L/B
GND B
E-18
E-15
Traction motor (left)
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
TWR
TVR
TUR
E-18
E-15

3.3 Pump Motor,Overheating(E2)

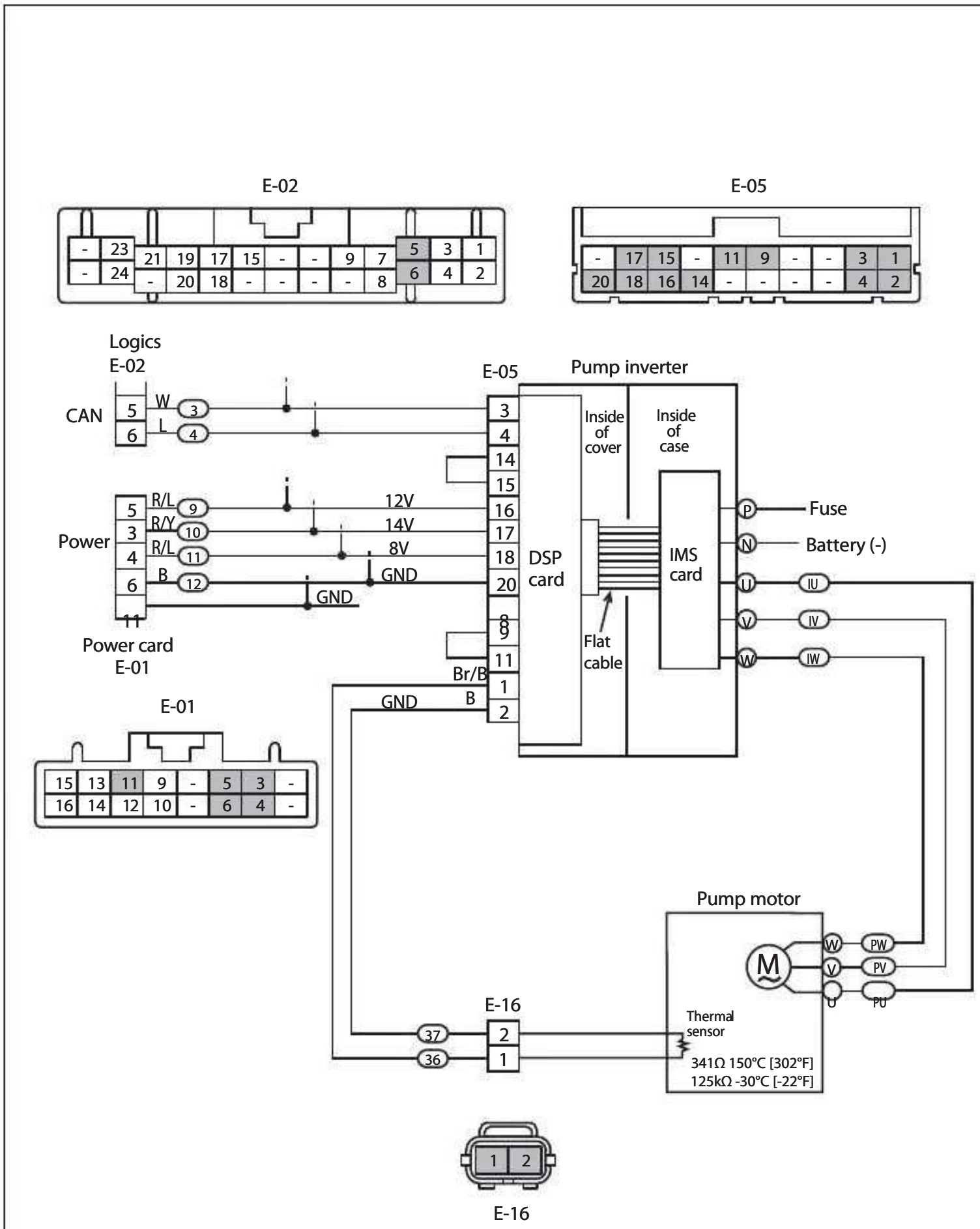
Error code: E2	
Situation	Controller/motor overheat indicator ON. Lifting speed slower than normal. Normal traction motorand power steering operations. Service tool "Alarm status" and "E2" displayed.
Possible cause	Overheating of pump motor, faulty pump motor or thermal sensor, faulty or open harness wiring, faulty pump motor inverter DSP card, abnormal power supply of logic unit, abnormal oil pressure of gear pump or hydraulic lines, faulty display unit.
Trigger of the error code	Motor temperature is out of range of -25 °C to 145 °C (-13 °F to 293 °F). Recovers when motor temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks




Thermal
(14) Disconnect connector E-05 of pump motor inverter
Check continuity between E-05-1 and E-16-1(36)
Check continuity between E-05-2 and E-16-2(37)
Continuity
No continuity
Power supply
(15) Check continuity between E-01-3 and E-05-17(10)
Check continuity between E-01-6 and E-05-20(12)
Continuity
No continuity
CAN
(16) Disconnect connector E-02 of logic unit
Check continuity between E-02-5 and E-05-3(3)
Check continuity between E-02-6 and E-05-4(4)
Check continuity between E-05-14 and E-05-15
Continuity
No continuity
(17) Repair or replace harness
(18) Measure voltage between E-05-18(11) and E-05-20(12)
Confirm value is 8 ± 2 V
Normal
Abnormal
(19) Disconnect battery plug
(20) Ensure all connectors are connected.
Then turn on power again
"E2"
Not "E2"
(21) Replace power supply card of logic unit
(22) Disconnect battery plug, then perform Inverter Discharging work
(23) Replace DSP card of pump motor inverter
(24) Connect connector securely

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

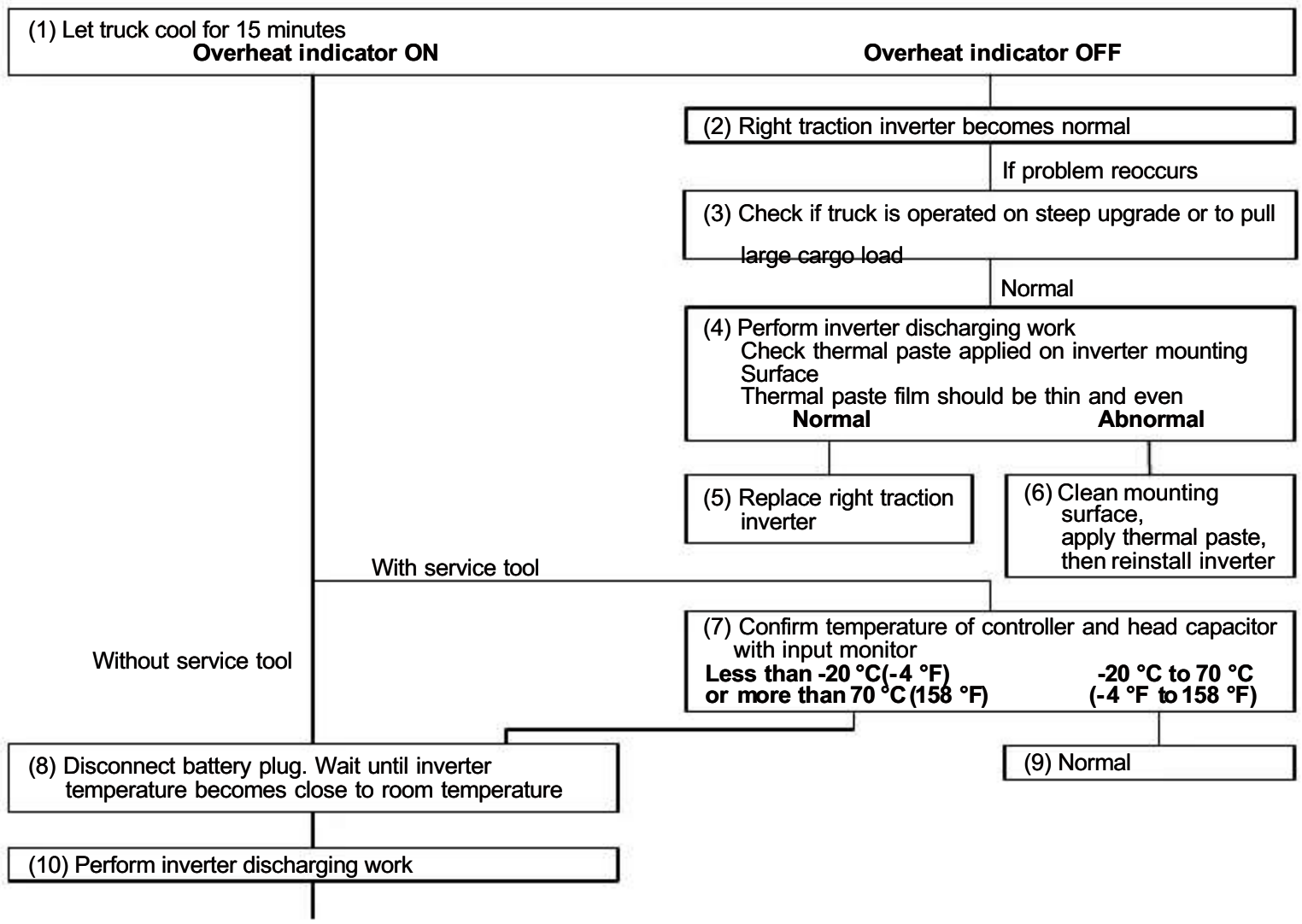


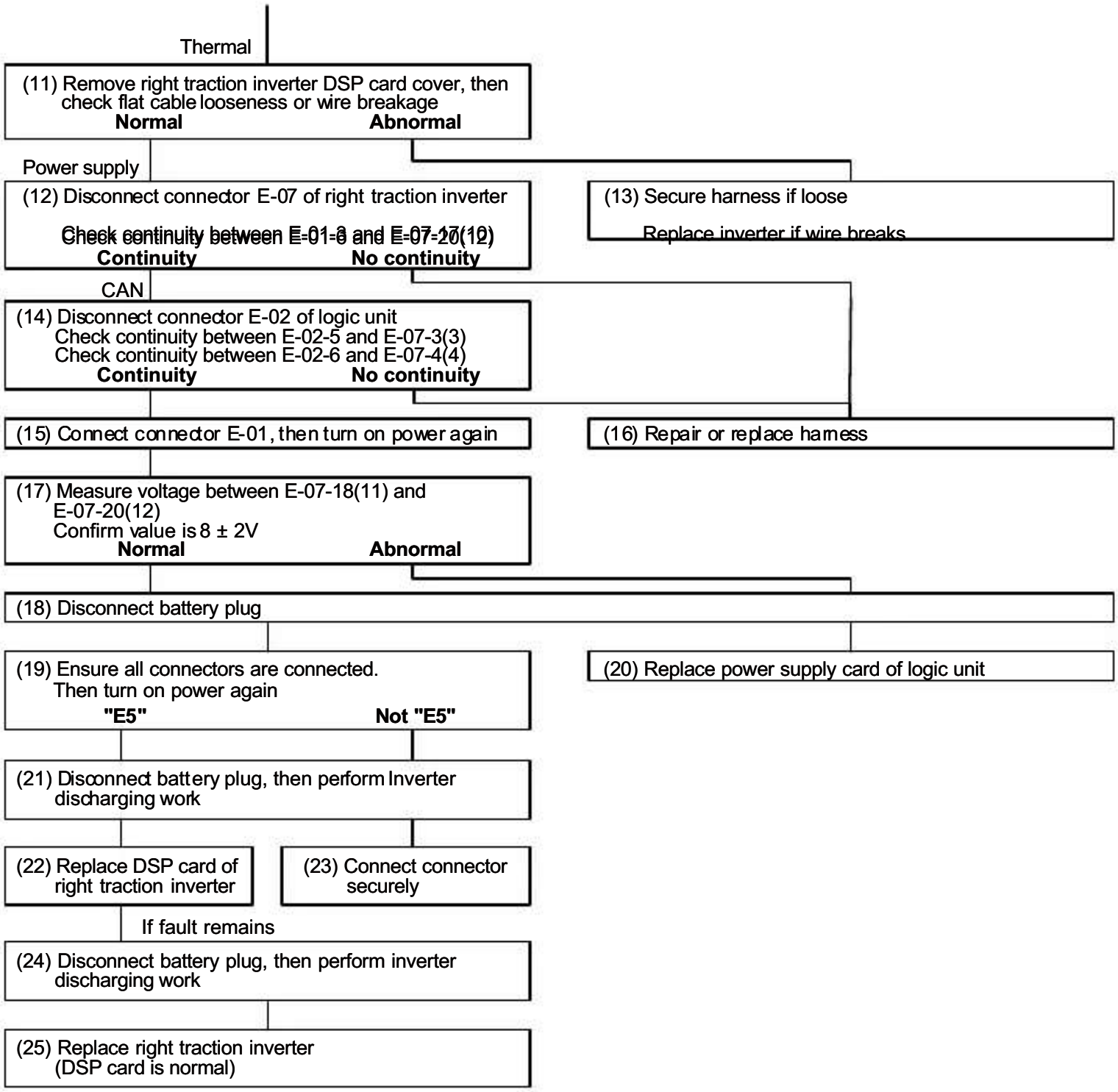
501137

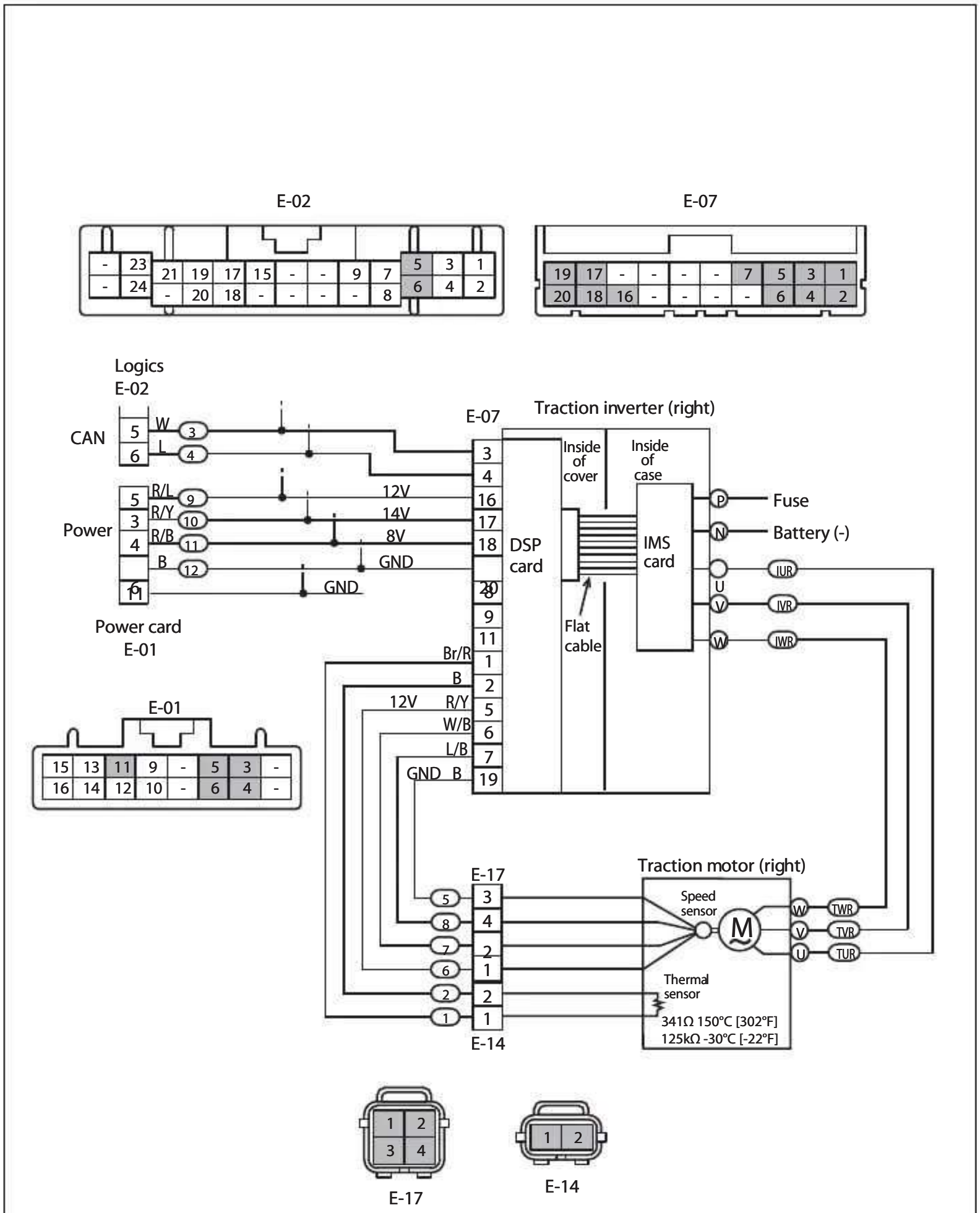
3.4 Traction Inverter R.H., Overheating (E5)

Error code: E5	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor and power steering operations. Service tool "Alarm status" and "E5" displayed.
Possible cause	Overheating of right traction inverter, faulty right traction inverter thermal sensor, open harness wiring, faulty right traction inverter PC board, abnormal power supply of logic unit, faulty radiation of right traction inverter, faulty display unit.
Trigger of the error code	Controller temperature is out of range of -25 °C to 100 °C (-13 °F to 21 2 °F). Capacitor temperature is out of range of -25 °C to 110 °C (-13 °F to 230 °F). Recovers when temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks




Thermal
(11) Remove right traction inverter DSP card cover, then check flat cable looseness or wire breakage
Normal
Abnormal
Power supply
(12) Disconnect connector E-07 of right traction inverter
Check continuity between E-01-8 and E-07-17(10)
Check continuity between E-01-6 and E-07-20(12)
Continuity
No continuity
(13) Secure harness if loose
Replace inverter if wire breaks
CAN
(14) Disconnect connector E-02 of logic unit
Check continuity between E-02-5 and E-07-3(3)
Check continuity between E-02-6 and E-07-4(4)
Continuity
No continuity
(15) Connect connector E-01, then turn on power again
(16) Repair or replace harness
(17) Measure voltage between E-07-18(11) and E-07-20(12)
Confirm value is 8 ± 2V
Normal
Abnormal
(18) Disconnect battery plug
(19) Ensure all connectors are connected.
Then turn on power again
"E5"
Not "E5"
(20) Replace power supply card of logic unit
(21) Disconnect battery plug, then perform Inverter discharging work
(22) Replace DSP card of right traction inverter
(23) Connect connector securely
If fault remains
(24) Disconnect battery plug, then perform inverter discharging work
(25) Replace right traction inverter (DSP card is normal)

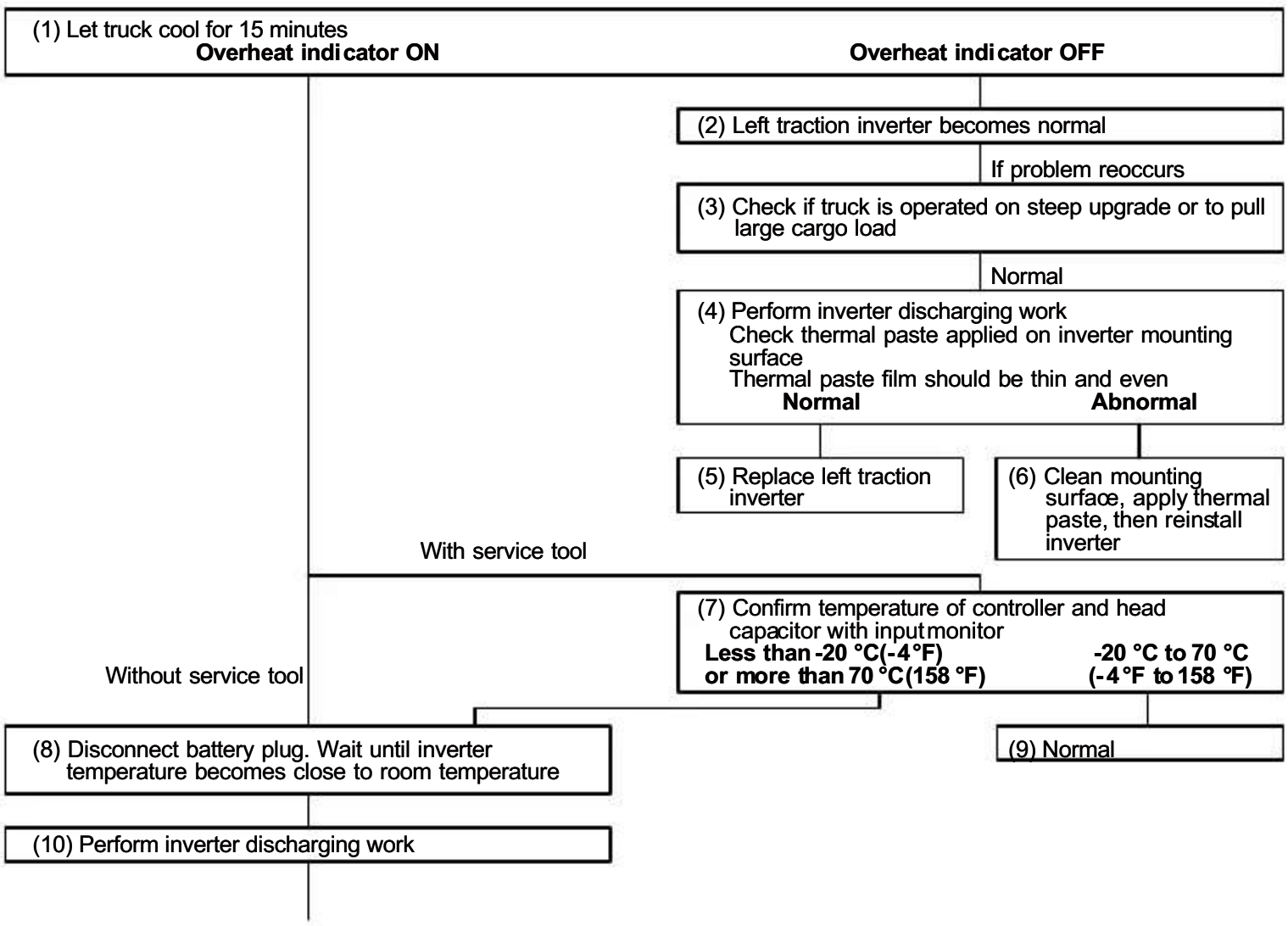

E-02
E-07
Logics
E-02
CAN
Power
Power card
E-01
E-07
Traction inverter (right)
Inside of cover
Inside of case
Flat cable
IMS card
DSP card
Fuse
Battery (-)
E-01
E-17
E-14
Traction motor (right)
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]

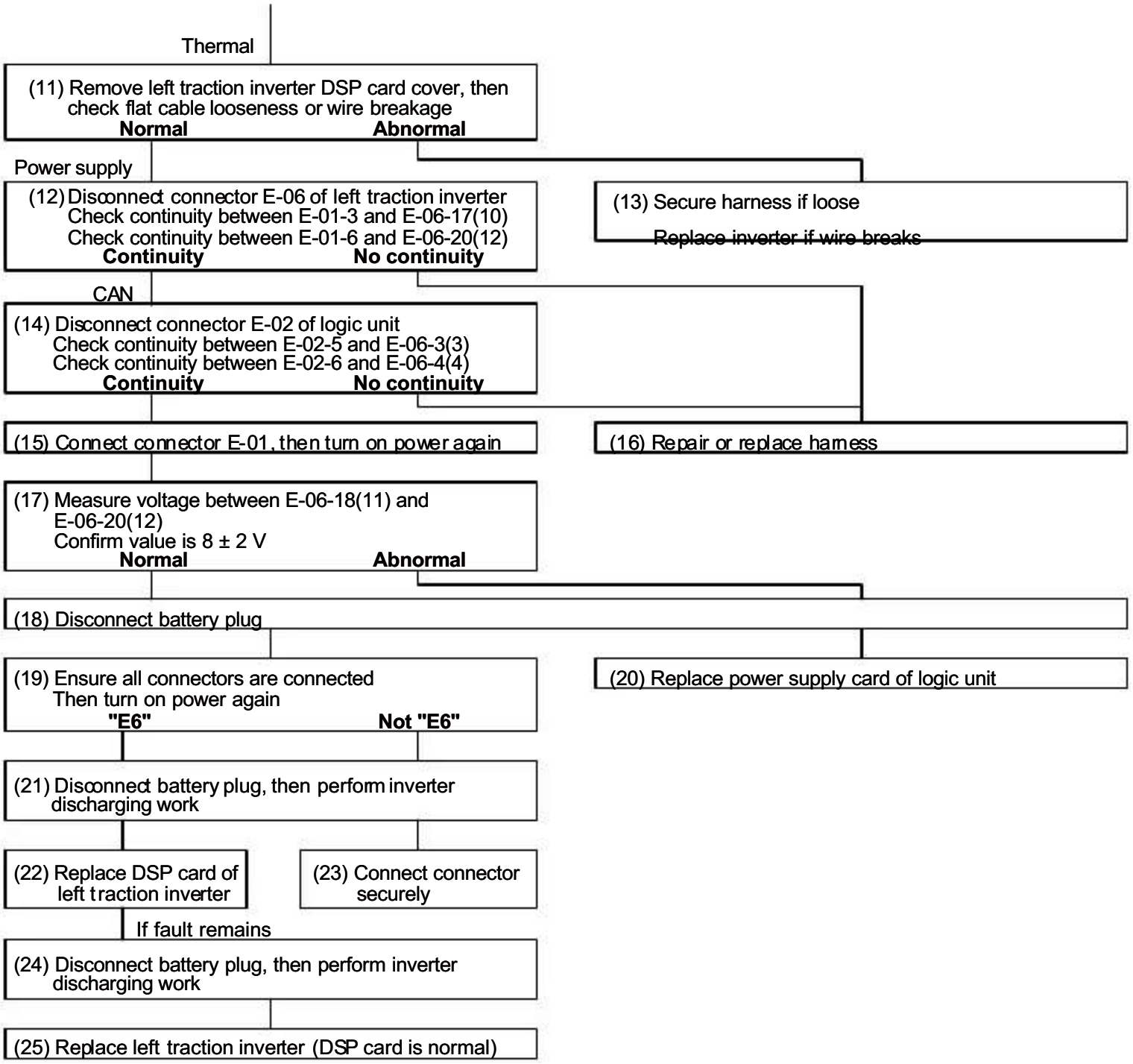
501135

3.5 Traction Inverter L.H., Overheating (E6)

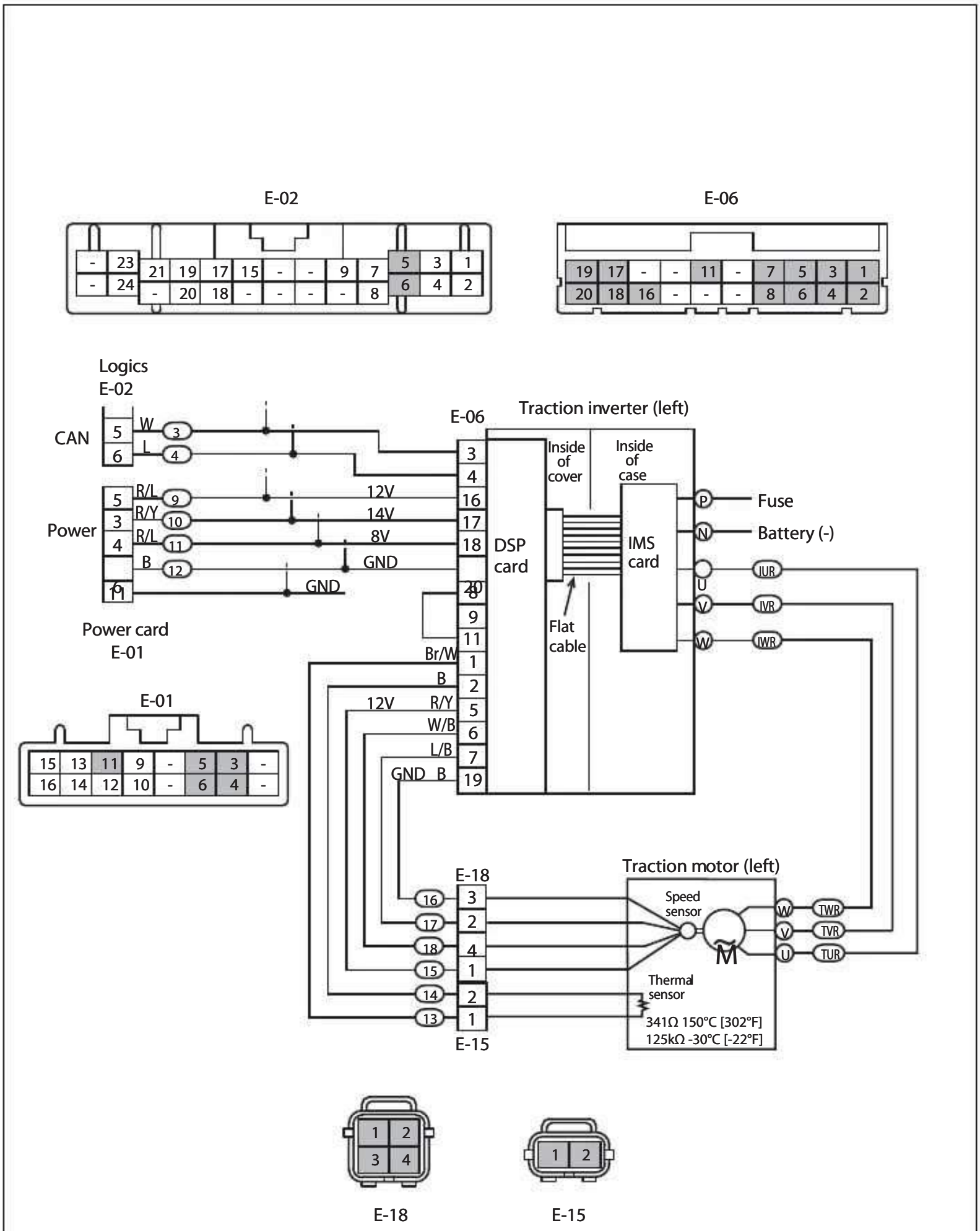
Error code: E6	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor and power steering operations. Service tool "Alarm status" and "E6" displayed.
Possible cause	Overheating of left side traction inverter, faulty left side traction inverter thermal sensor, open harness wiring, faulty left traction inverter PC board, abnormal power supply of logic unit, faulty radiation of left side traction inverter, faulty display unit.
Trigger of the error code	Controller temperature is out of range of -25 °C to 100 °C (-13 °F to 212 °F). Capacitor temperature is out of range of -25 °C to 110 °C (-13 °F to 230 °F). Recovers when temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks




Thermal
(11) Remove left traction inverter DSP card cover, then check flat cable looseness or wire breakage
Normal
Abnormal
Power supply
(12) Disconnect connector E-06 of left traction inverter
Check continuity between E-01-3 and E-06-17(10)
Check continuity between E-01-6 and E-06-20(12)
Continuity
No continuity
(13) Secure harness if loose
Replace inverter if wire breaks
CAN
(14) Disconnect connector E-02 of logic unit
Check continuity between E-02-5 and E-06-3(3)
Check continuity between E-02-6 and E-06-4(4)
Continuity
No continuity
(15) Connect connector E-01, then turn on power again
(16) Repair or replace harness
(17) Measure voltage between E-06-18(11) and E-06-20(12)
Confirm value is 8 ± 2 V
Normal
Abnormal
(18) Disconnect battery plug
(19) Ensure all connectors are connected
Then turn on power again
"E6"
Not "E6"
(20) Replace power supply card of logic unit
(21) Disconnect battery plug, then perform inverter discharging work
(22) Replace DSP card of left traction inverter
(23) Connect connector securely
If fault remains
(24) Disconnect battery plug, then perform inverter discharging work
(25) Replace left traction inverter (DSP card is normal)

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

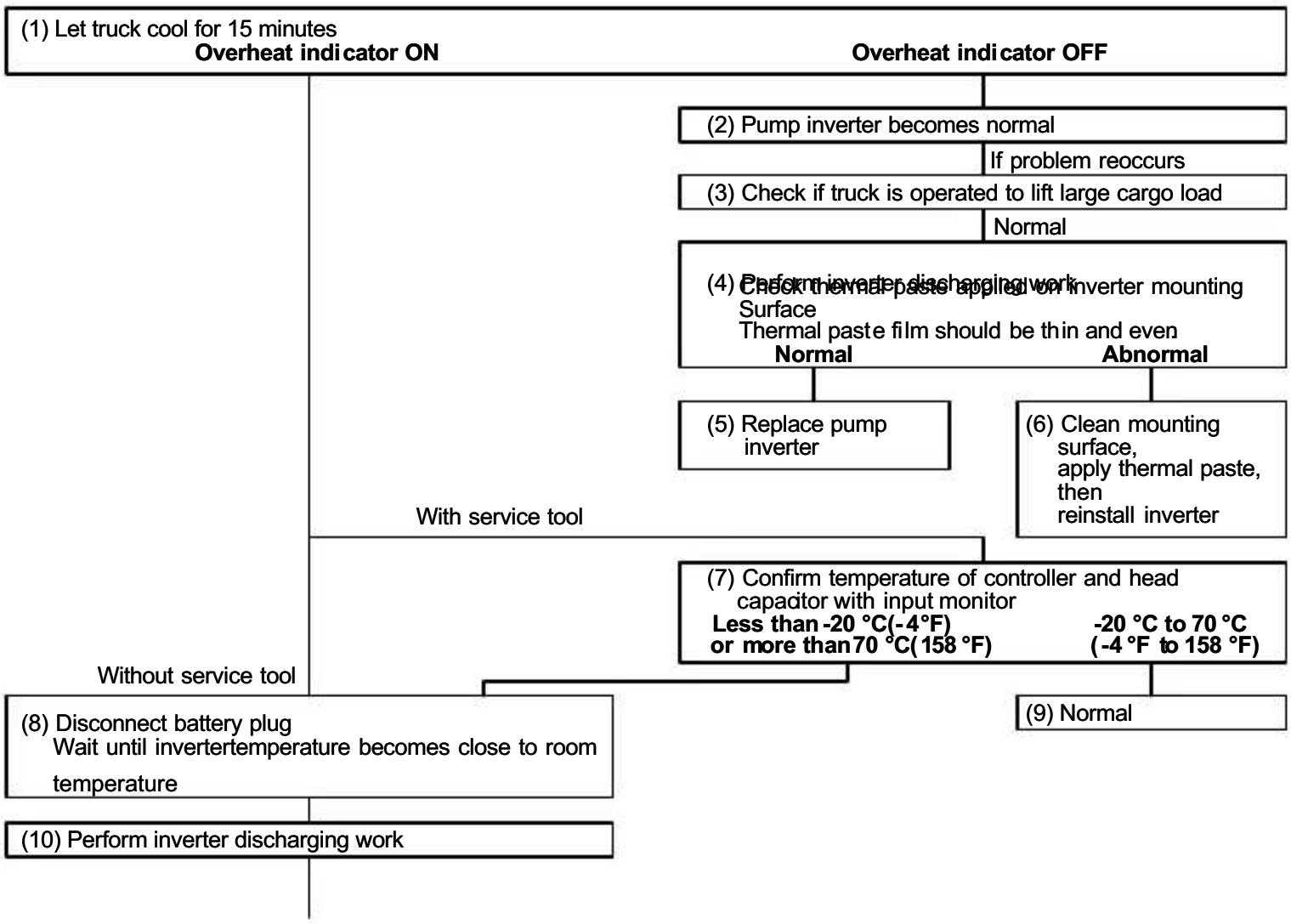


501136

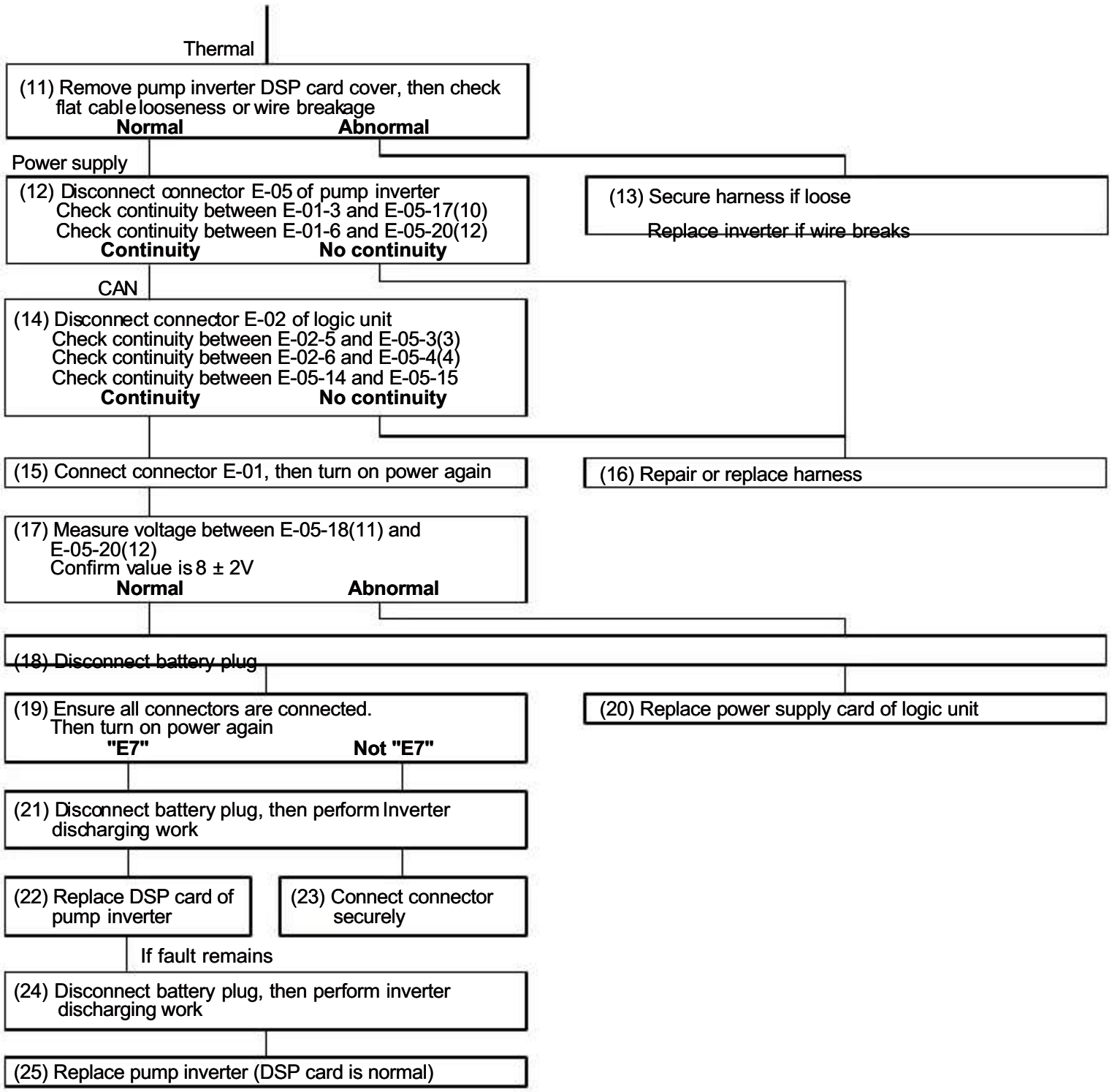
3.6 Pump Inverter, Overheating (E7)

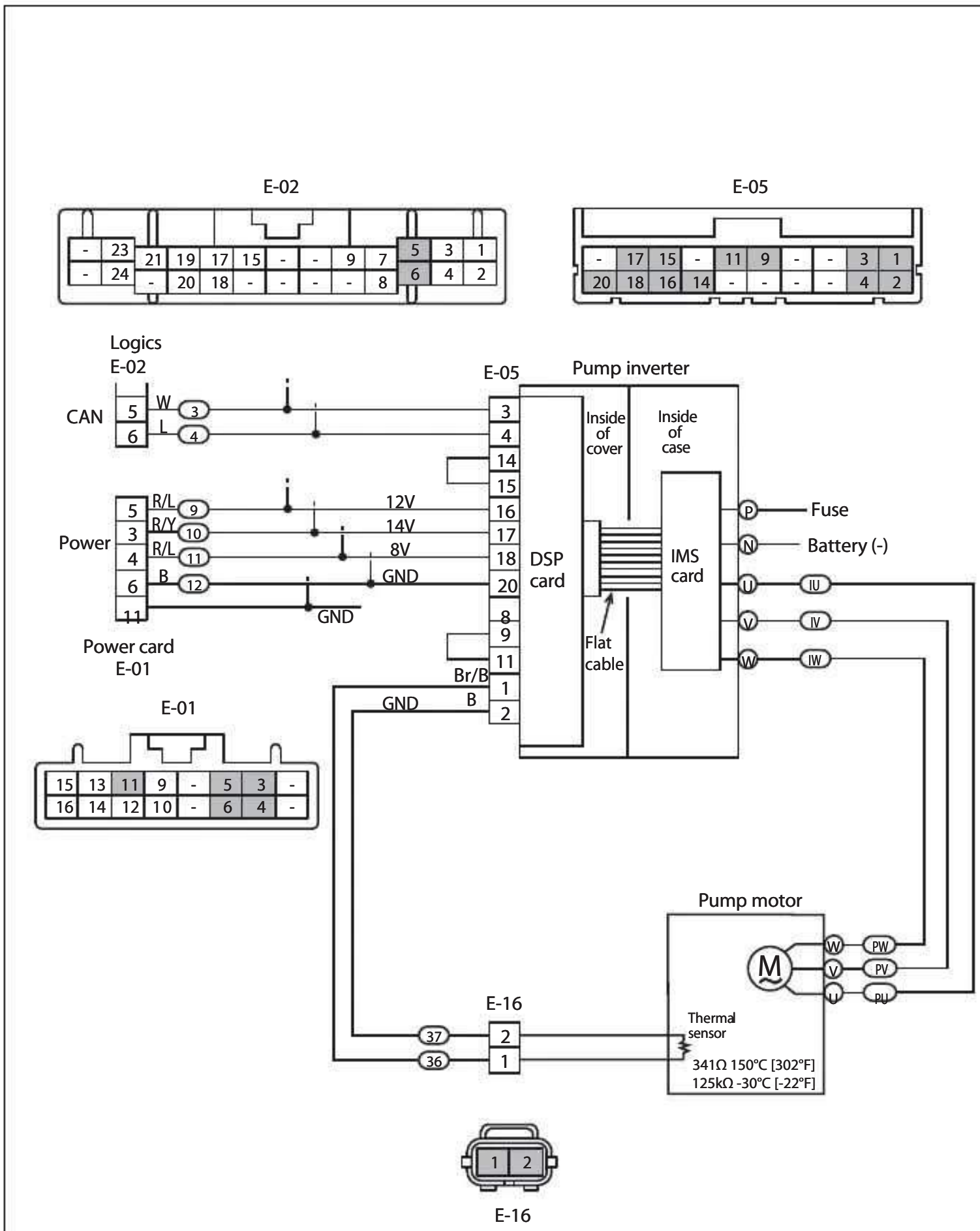
Error code: E7	
Situation	Controller/motor overheat indicator ON. Lifting speed slower than normal. Normal traction motor and power steering operations. Service tool "Alarm status" and "E7" displayed.
Possible cause	Overheating of pump inverter, faulty pump inverter thermal sensor, open harness wiring, faulty pump inverter PC board, abnormal power supply of logic unit, faulty radiation of pump inverter, faulty display unit.
Trigger of the error code	Controller temperature is out of range of -25 °C to 100 °C (-13 °F to 212 °F). Capacitor temperature is out of range of -25 °C to 110 °C (-13 °F to 230 °F). Recovers when temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks



CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS



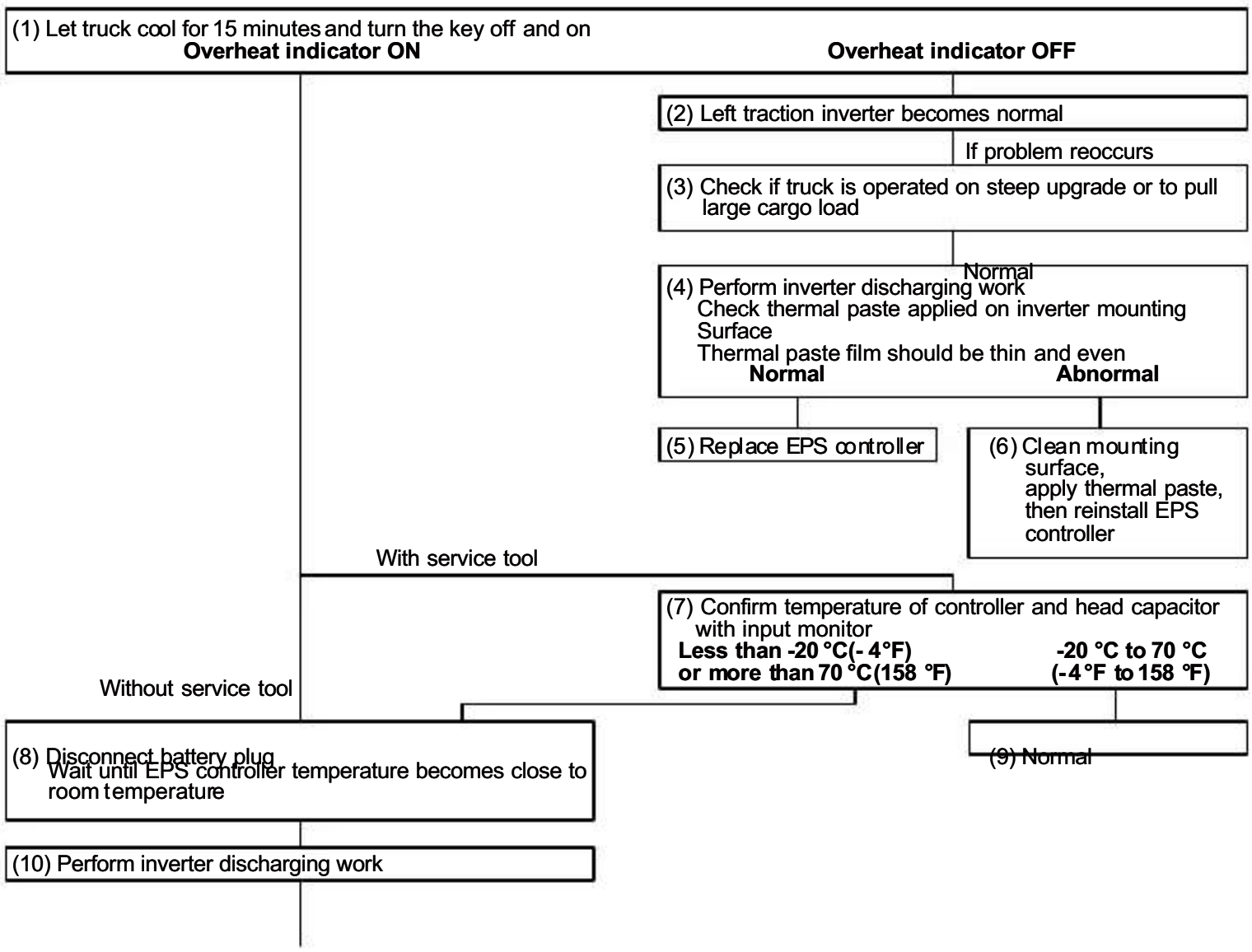

E-02
E-05
Logics
E-02
CAN
W
L
E-05
Pump inverter
Inside of cover
Inside of case
DSP card
IMS card
Flat cable
Power
R/L
R/Y
R/L
B
12V
14V
8V
GND
GND
Power card
E-01
Br/B
B
GND
Fuse
Battery (-)
E-01
Pump motor
PW
PV
PU
E-16
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
E-16

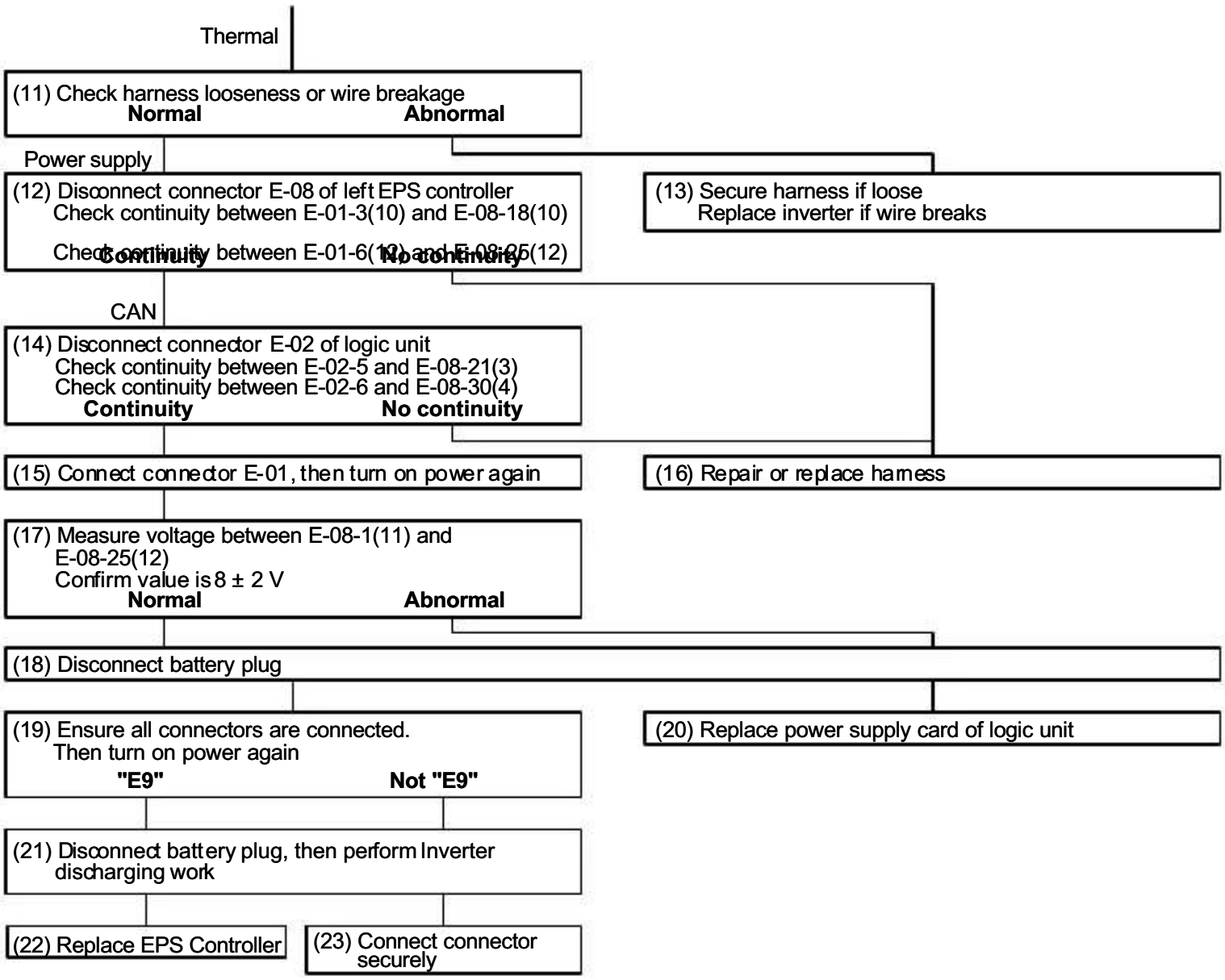
501137

3.7 PS Controller, Overheating (E9)

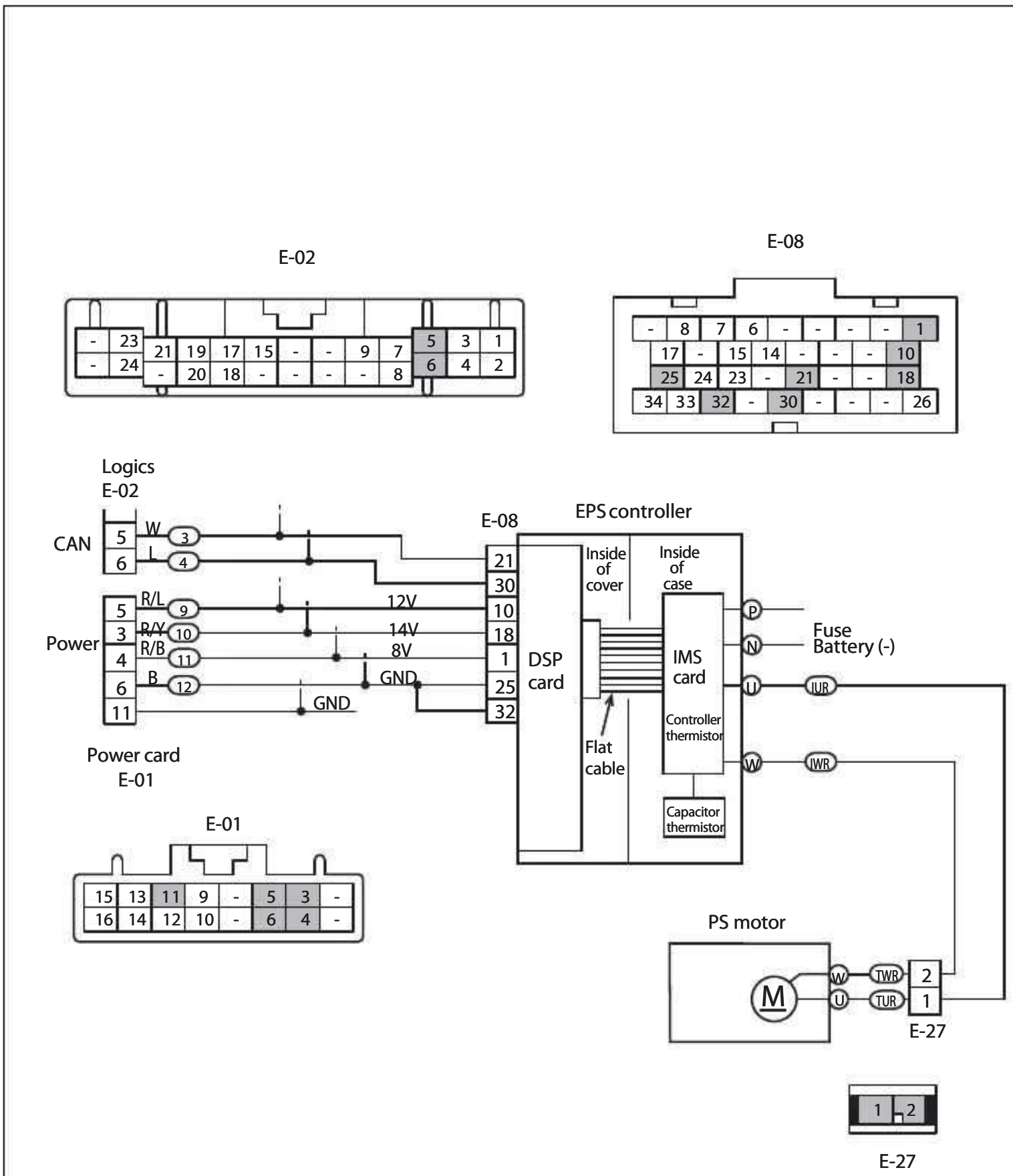
Error code: E9	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor. Service tool "Alarm status" and "E9" displayed.
Possible cause	Overheating of PS controller, faulty PS controller thermal sensor, open harness wiring, faulty PC board, abnormal power supply of logic unit, faulty radiation of left traction inverter, faulty display unit.
Trigger of the error code	Controller temperature is out of range of -25 °C to 100 °C (-13 °F to 212 °F). Capacitor temperature is out of range of -25 °C to 110 °C (-13 °F to 230 °F). Recovers when temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks




Thermal
(11) Check harness looseness or wire breakage
Normal
Abnormal
Power supply
(12) Disconnect connector E-08 of left EPS controller
Check continuity between E-01-3(10) and E-08-18(10)
Check continuity between E-01-6(12) and E-08-25(12)
Continuity
No continuity
(13) Secure harness if loose
Replace inverter if wire breaks
CAN
(14) Disconnect connector E-02 of logic unit
Check continuity between E-02-5 and E-08-21(3)
Check continuity between E-02-6 and E-08-30(4)
Continuity
No continuity
(15) Connect connector E-01, then turn on power again
(16) Repair or replace harness
(17) Measure voltage between E-08-1(11) and E-08-25(12)
Confirm value is 8 ± 2 V
Normal
Abnormal
(18) Disconnect battery plug
(19) Ensure all connectors are connected.
Then turn on power again
"E9"
Not "E9"
(20) Replace power supply card of logic unit
(21) Disconnect battery plug, then perform Inverter discharging work
(22) Replace EPS Controller
(23) Connect connector securely

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

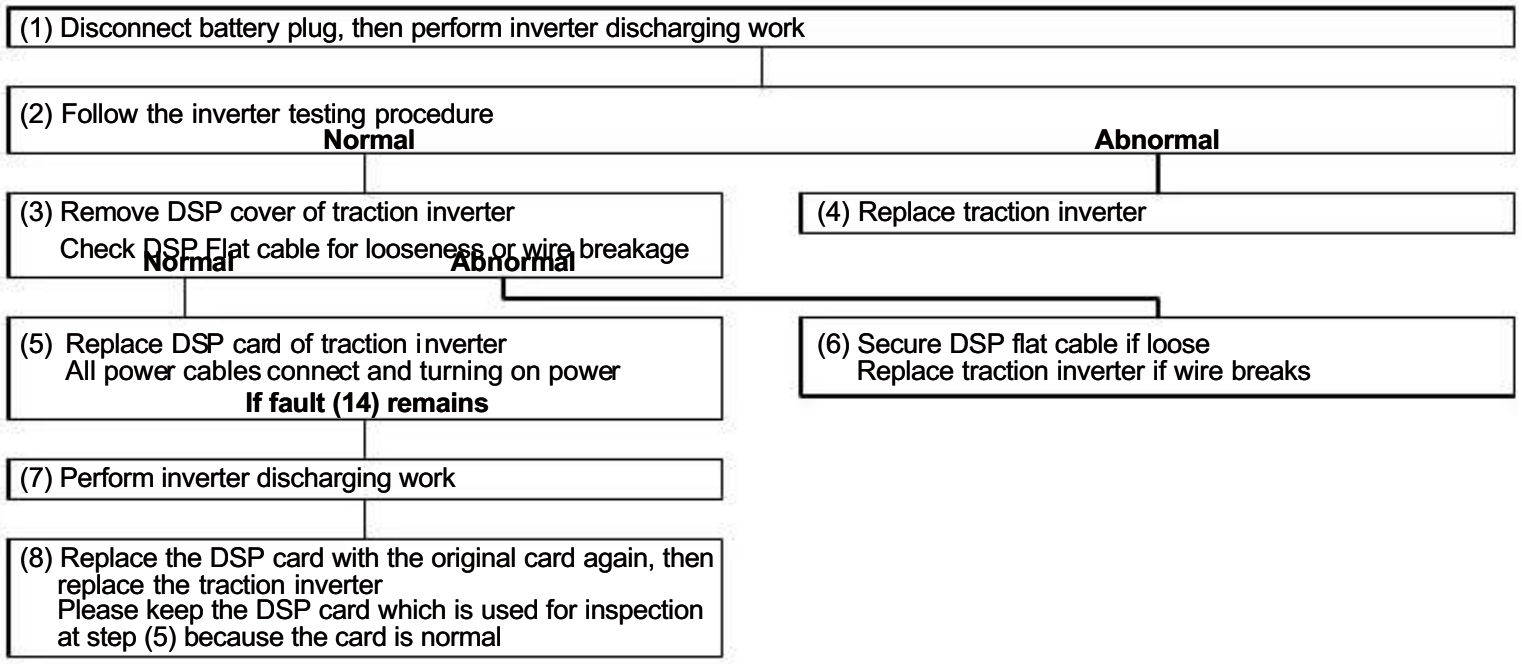


501138

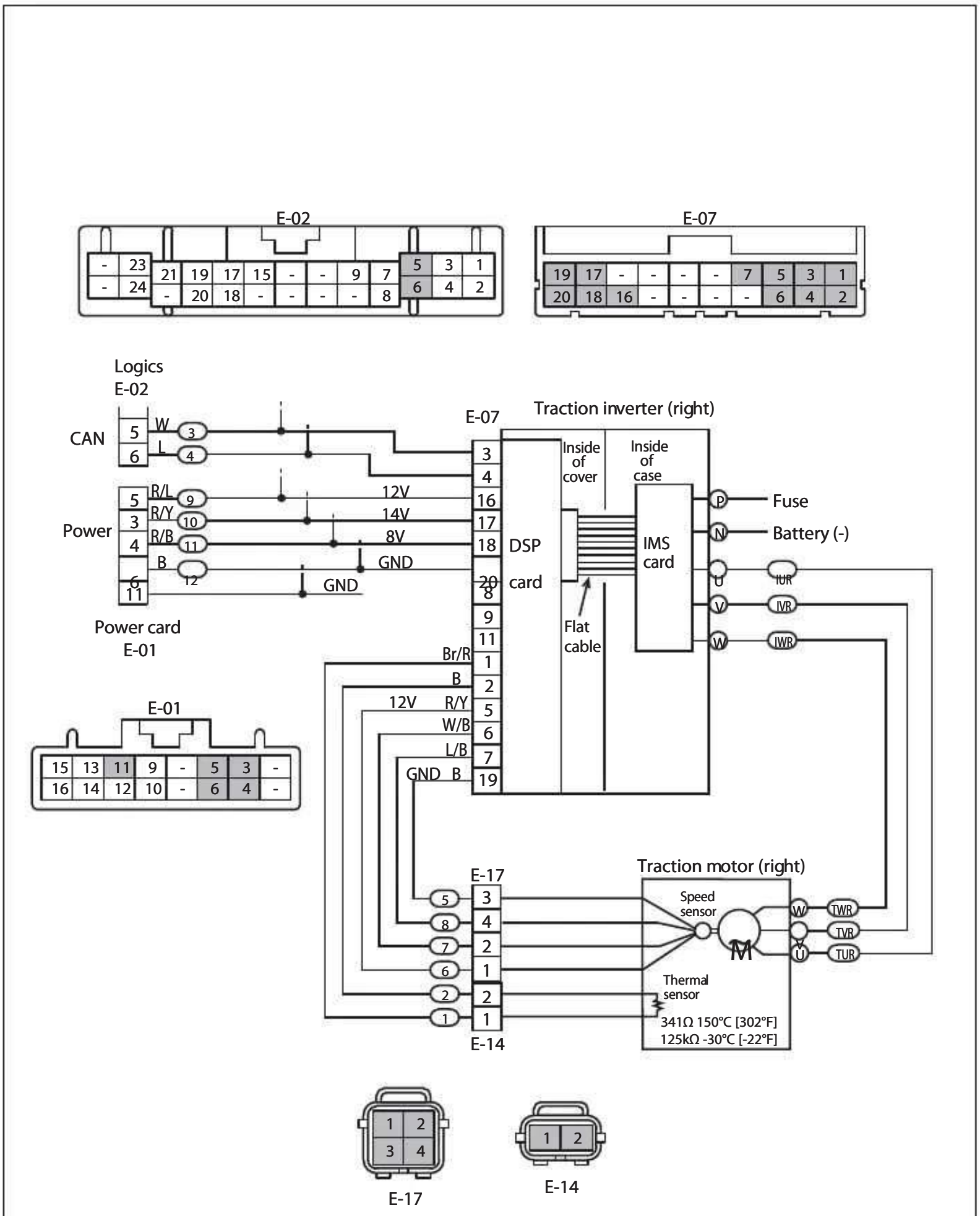
3.8 Traction Motor Current Sensor R.H., Fault (14)

Error code: 14	
Situation	Display: "14". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty traction inverter. (U, V current sensor in traction inverter) Faulty DSP card of traction inverter. Faulty contact or wire breakage of DSP flat cable in traction inverter.
Trigger of the error code	When turning on power, current sensor value is out of -120 A to 120 A .

Checks



CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

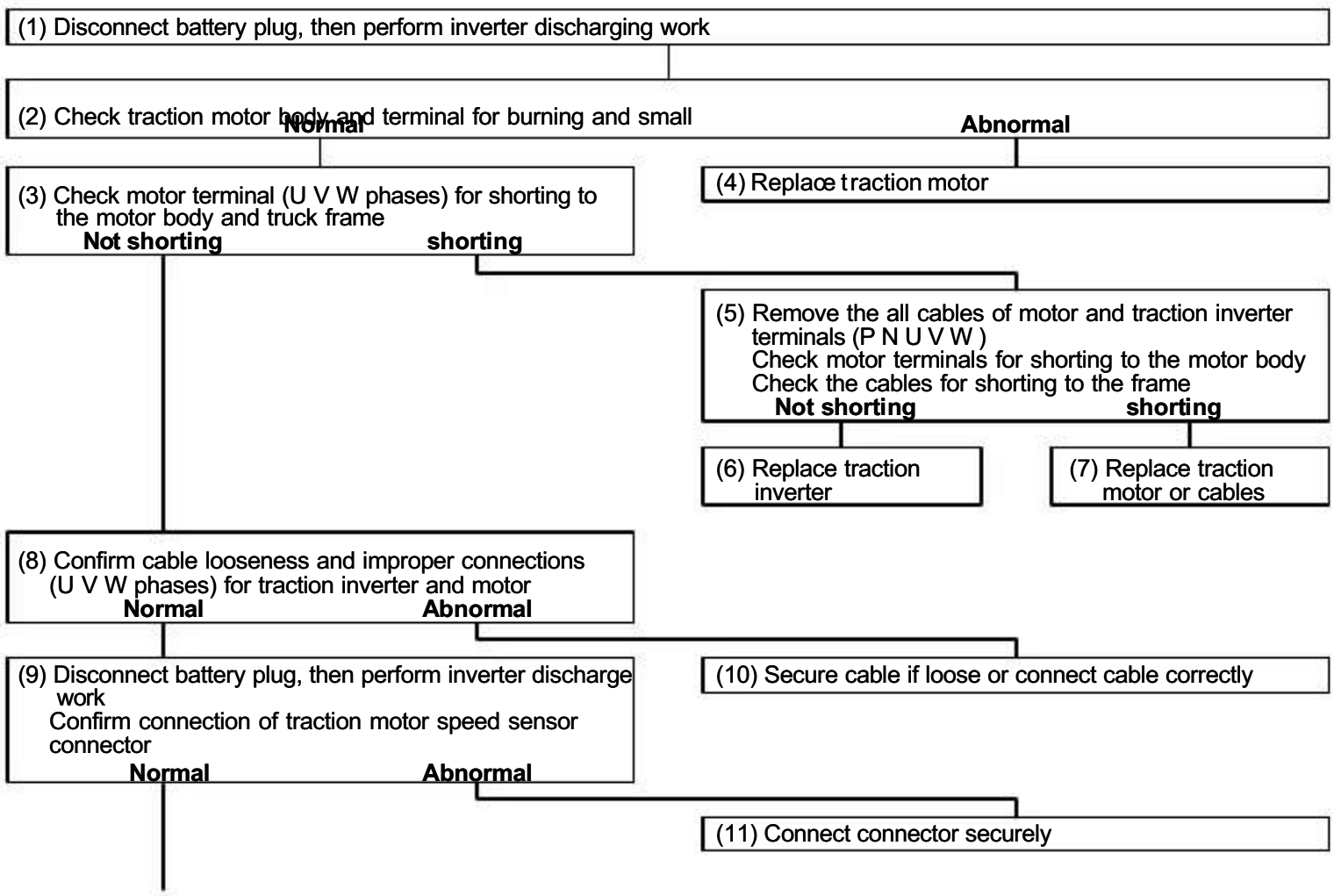


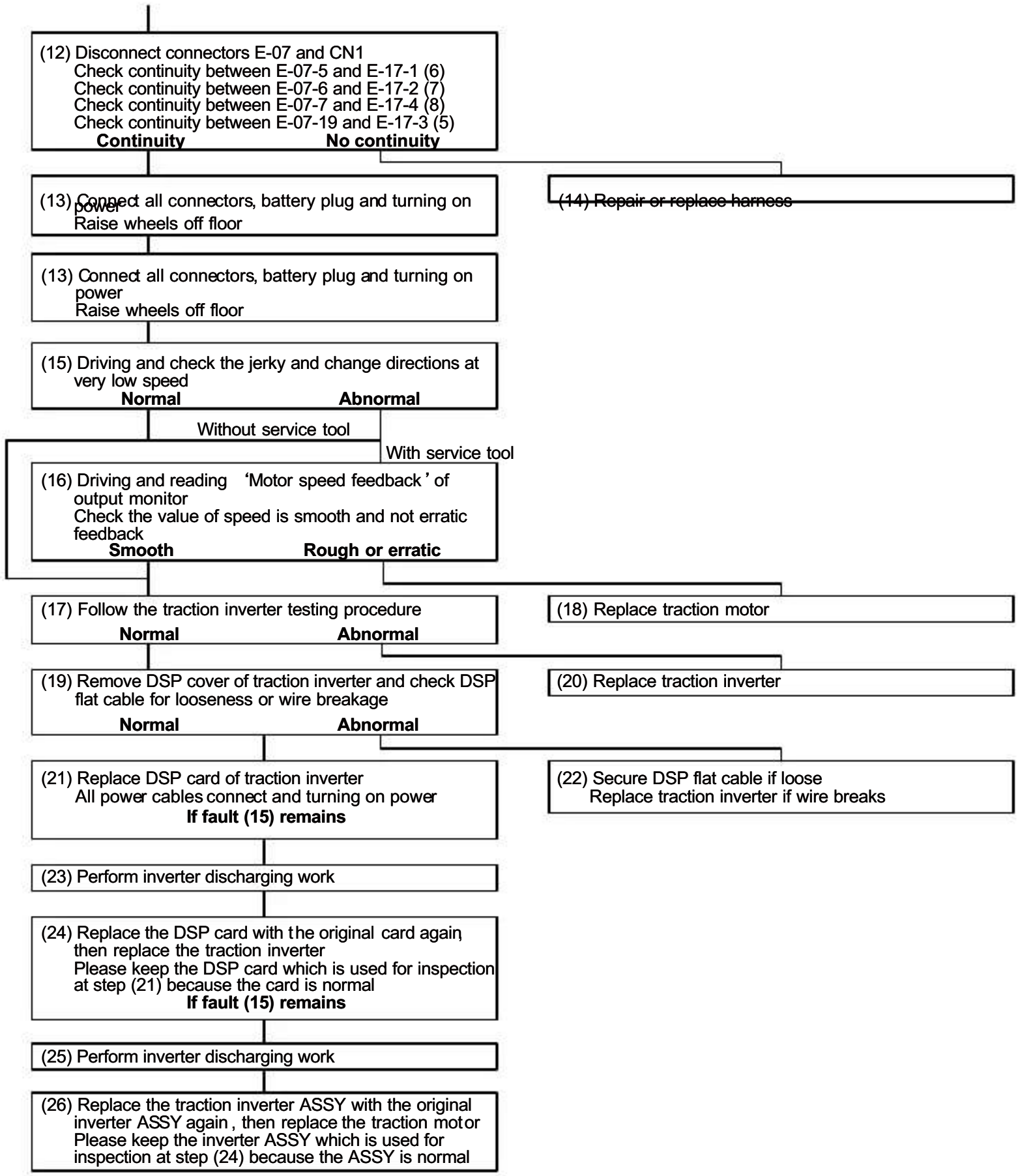
501135

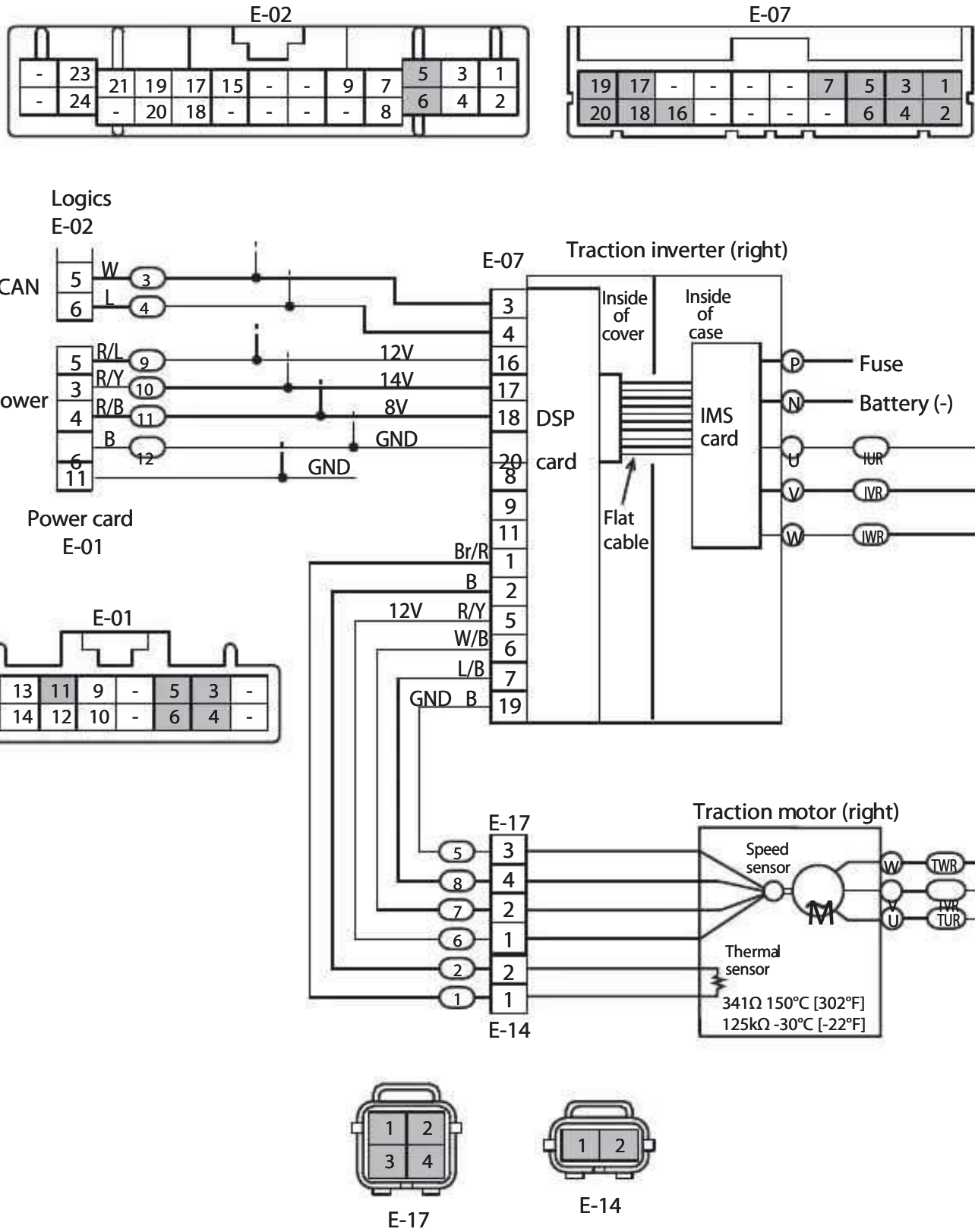
3.9 Traction Motor R.H., Over-current (15)

Error code: 15	
Situation	Display: "15". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited.If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty traction motor. (Contain the bearing sensor) Faulty contact or wire breakage of traction motor speed sensor harness. Faulty traction inverter. Faulty contact or wire breakage of DSP flat cable in traction inverter. Faulty DSP card of traction inverter. Faulty main harness.
Trigger of the error code	Motor current is more than 1105 A (Moment) or 893 A (1 mS) or 829 A (1.6 mS).

Checks




(12) Disconnect connectors E-07 and CN1
Check continuity between E-07-5 and E-17-1 (6)
Check continuity between E-07-6 and E-17-2 (7)
Check continuity between E-07-7 and E-17-4 (8)
Check continuity between E-07-19 and E-17-3 (5)
Continuity
No continuity
(13) Connect all connectors, battery plug and turning on power
Raise wheels off floor
(14) Repair or replace harness
(13) Connect all connectors, battery plug and turning on power
Raise wheels off floor
(15) Driving and check the jerky and change directions at very low speed
Normal
Abnormal
Without service tool
With service tool
(16) Driving and reading 'Motor speed feedback' of output monitor
Check the value of speed is smooth and not erratic feedback
Smooth
Rough or erratic
(17) Follow the traction inverter testing procedure
Normal
Abnormal
(18) Replace traction motor
(19) Remove DSP cover of traction inverter and check DSP flat cable for looseness or wire breakage
Normal
Abnormal
(20) Replace traction inverter
(21) Replace DSP card of traction inverter
All power cables connect and turning on power
If fault (15) remains
(22) Secure DSP flat cable if loose
Replace traction inverter if wire breaks
(23) Perform inverter discharging work
(24) Replace the DSP card with the original card again, then replace the traction inverter
Please keep the DSP card which is used for inspection at step (21) because the card is normal
If fault (15) remains
(25) Perform inverter discharging work
(26) Replace the traction inverter ASSY with the original inverter ASSY again, then replace the traction motor
Please keep the inverter ASSY which is used for inspection at step (24) because the ASSY is normal

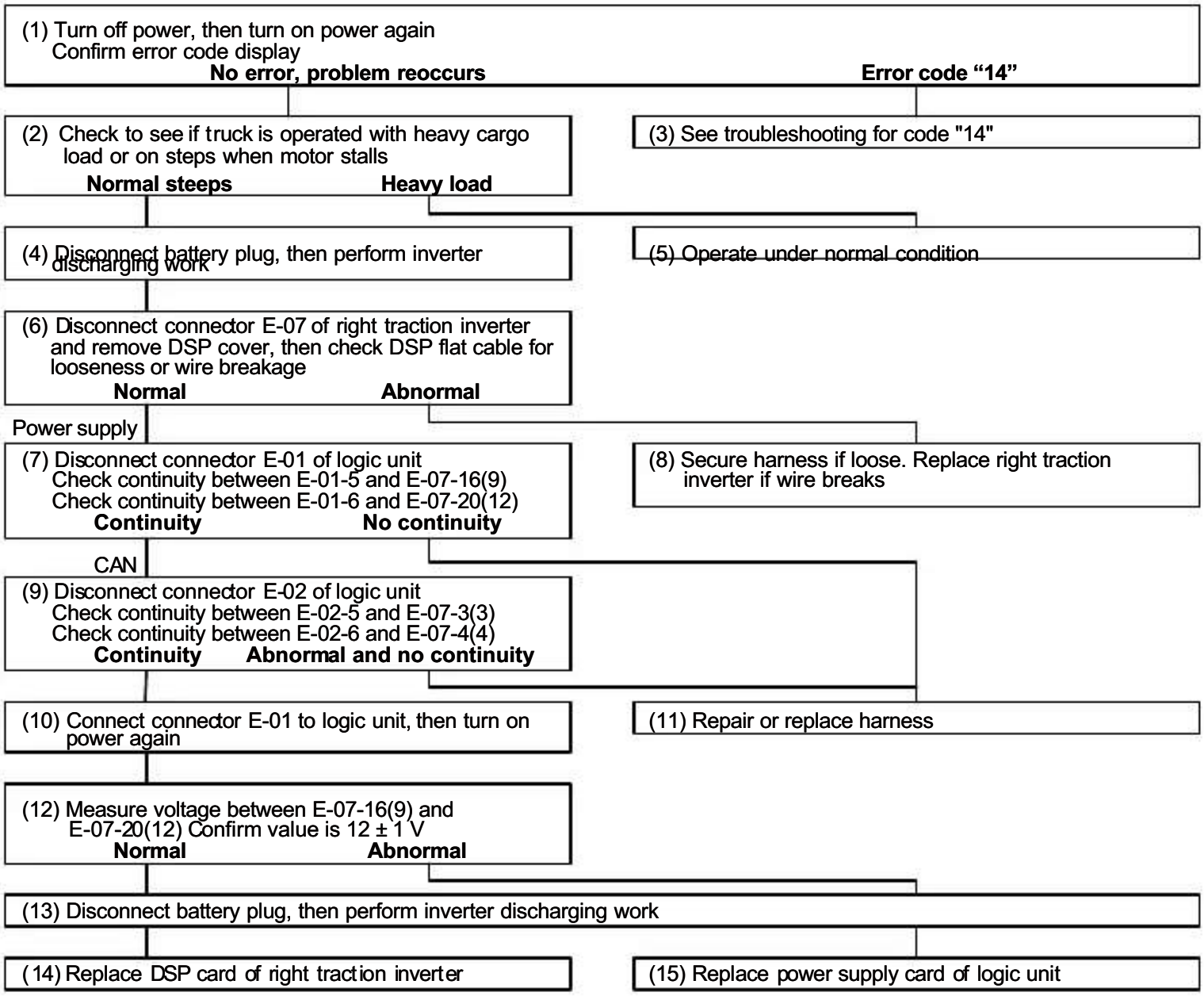

E-02
E-07
Logics
E-02
Traction inverter (right)
E-07
CAN
Power
Power card
E-01
Inside of cover
Inside of case
IMS card
DSP card
Flat cable
Fuse
Battery (-)
12V
14V
8V
GND
GND
Br/R
B
12V R/Y
W/B
L/B
GND B
E-01
E-17
E-14
Traction motor (right)
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
E-17
E-14

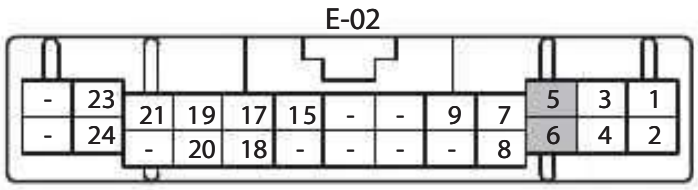
501135

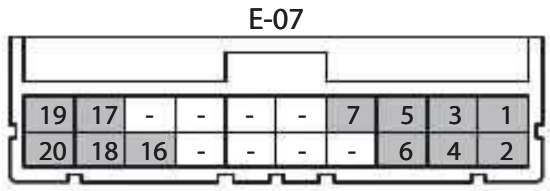
3.10 Traction Motor R.H., Stall Timer (16)

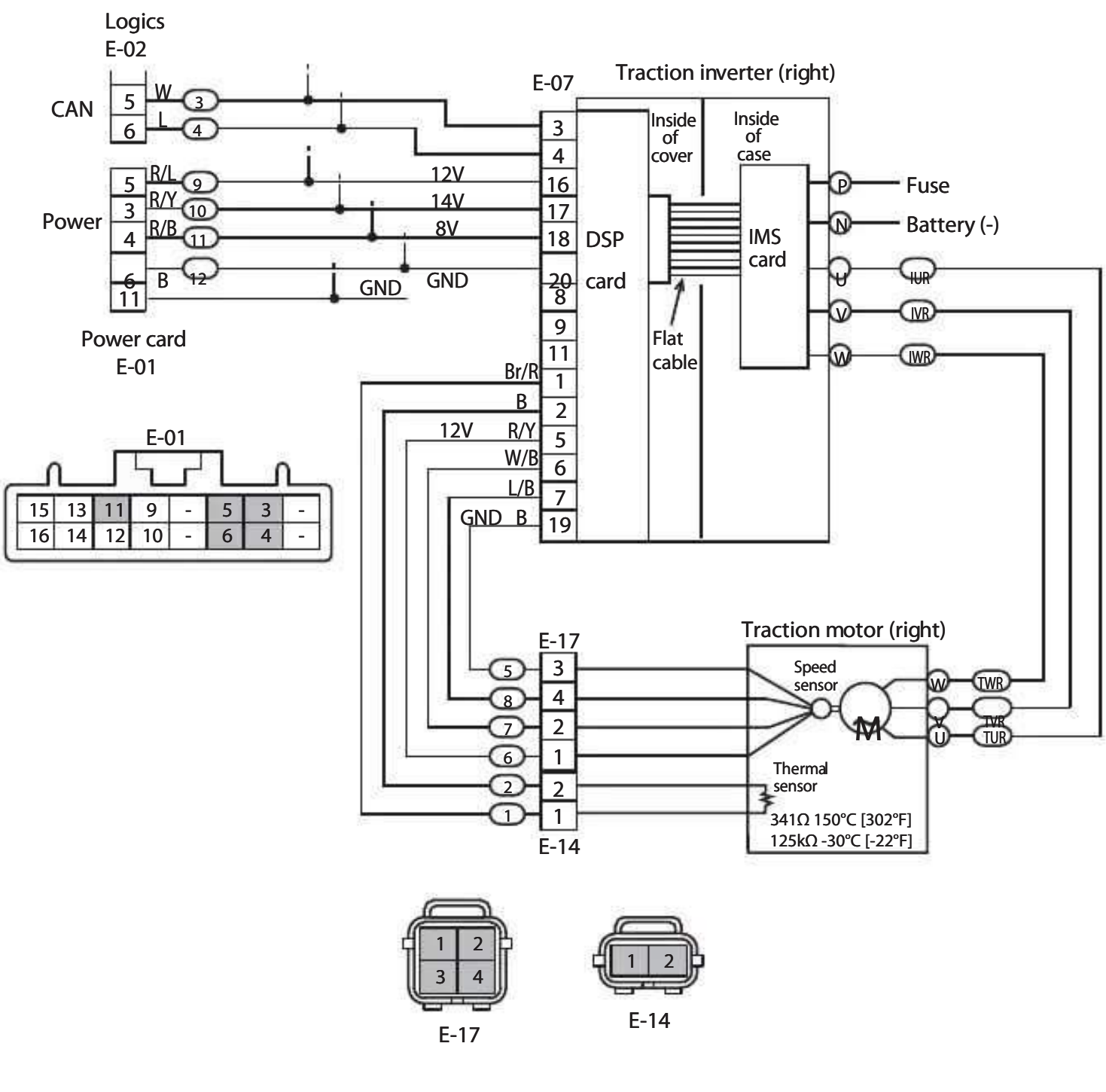
Error code: 16	
Situation	Display: "16". Traction motor and pump motor operation inhibited. LINE contactor HOLD and ST contactor HOLD
Possible cause	Stall current flowed more than 7s right traction motor, faulty right traction inverter current sensor, shorted harness wiring, faulty right traction inverter DSP card, faulty logic unit.
Trigger of the error code	7s is measured while stalling.

Checks




E-02
- 23
- 24
21 19 17 15 - - 9 7
- 20 18 - - - - 8
5 3 1
6 4 2


E-07
19 17 - - - - 7 5 3 1
20 18 16 - - - - 6 4 2


Logics
E-02
CAN
5 W 3
6 L 4
Power
5 R/L 9
3 R/Y 10
4 R/B 11
6 B 12
11
Power card
E-01
12V
14V
8V
GND
GND
E-07
Traction inverter (right)
3
4
16
17
18 DSP
20 card
8
9
11
1
2
5
6
7
19
Inside of cover
Inside of case
IMS card
Flat cable
P Fuse
N Battery (-)
U IUR
V IVR
W IWR
Br/R
B
12V R/Y
W/B
L/B
GND B
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
E-17
5 3
8 4
7 2
6 1
2 2
1 1
E-14
Traction motor (right)
Speed sensor
W TWR
V TVR
U TUR
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
1 2
3 4
E-17
1 2
E-14

501135

3.11 Traction Motor Current Sensor L.H., Fault (24)

Error code: 24	
Situation	Display: "24". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty traction inverter. (U, V current sensor in traction inverter) Faulty DSP card of traction inverter. Faulty contact or wire breakage of DSP flat cable in traction inverter.
Trigger of the error code	When turning on power, current sensor value is out of -120 A to 120 A .

Checks

(1) Disconnect battery plug, then perform inverter discharging work

(2) Follow the inverter testing procedure

Normal → (3) Remove DSP cover of traction inverter
Check DSP Flat cable for looseness or wire breakage

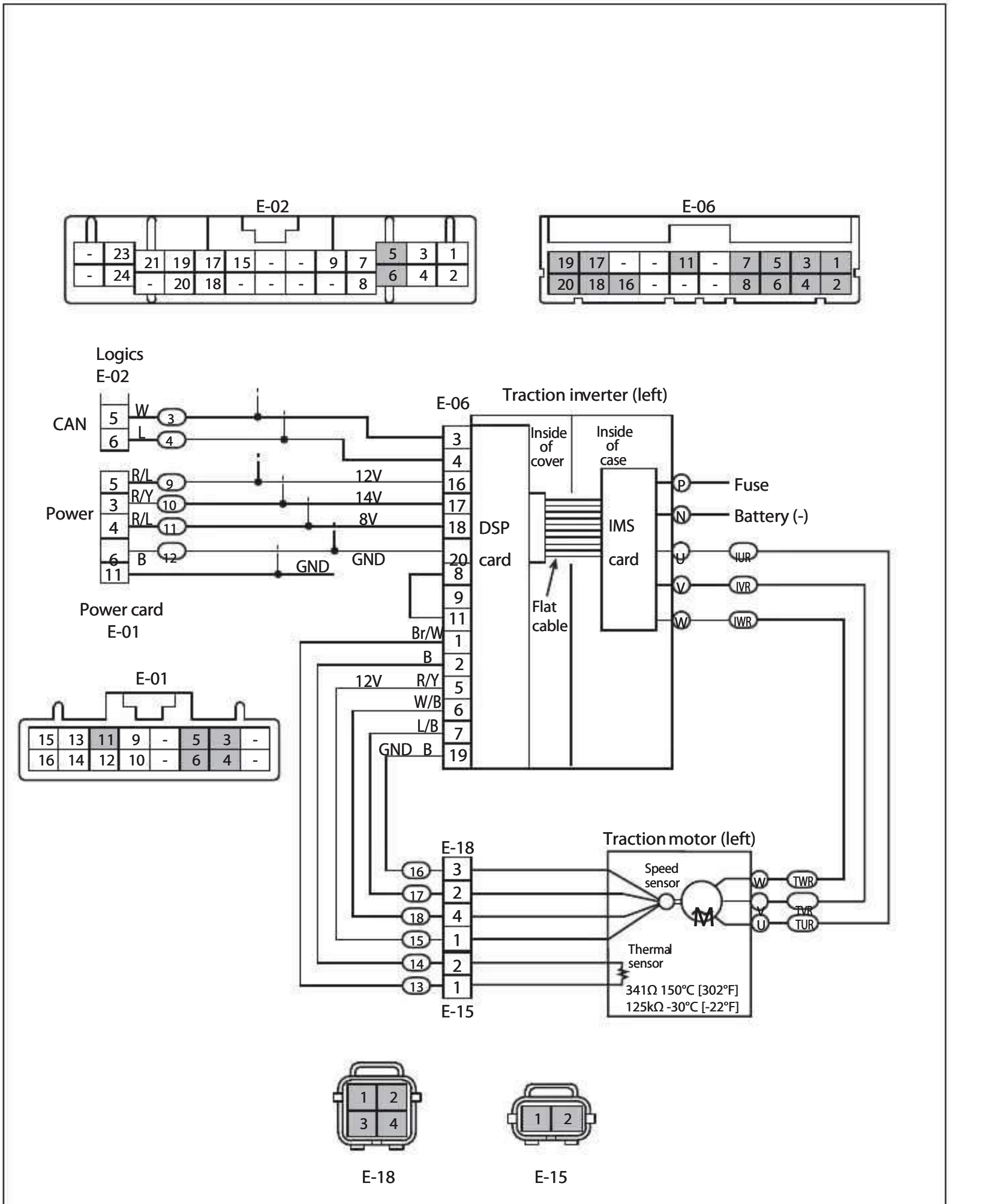
Normal → (5) Replace DSP card of traction inverter
All power cables connect and turning on power
If fault (24) remains

(7) Perform inverter discharging work

(8) Replace the DSP card with the original card again, then replace the traction inverter
Please keep the DSP card which is used for inspection at step (5) because the card is normal

Abnormal → (4) Replace traction inverter

Abnormal → (6) Secure DSP flat cable if loose
Replace traction inverter if wire breaks

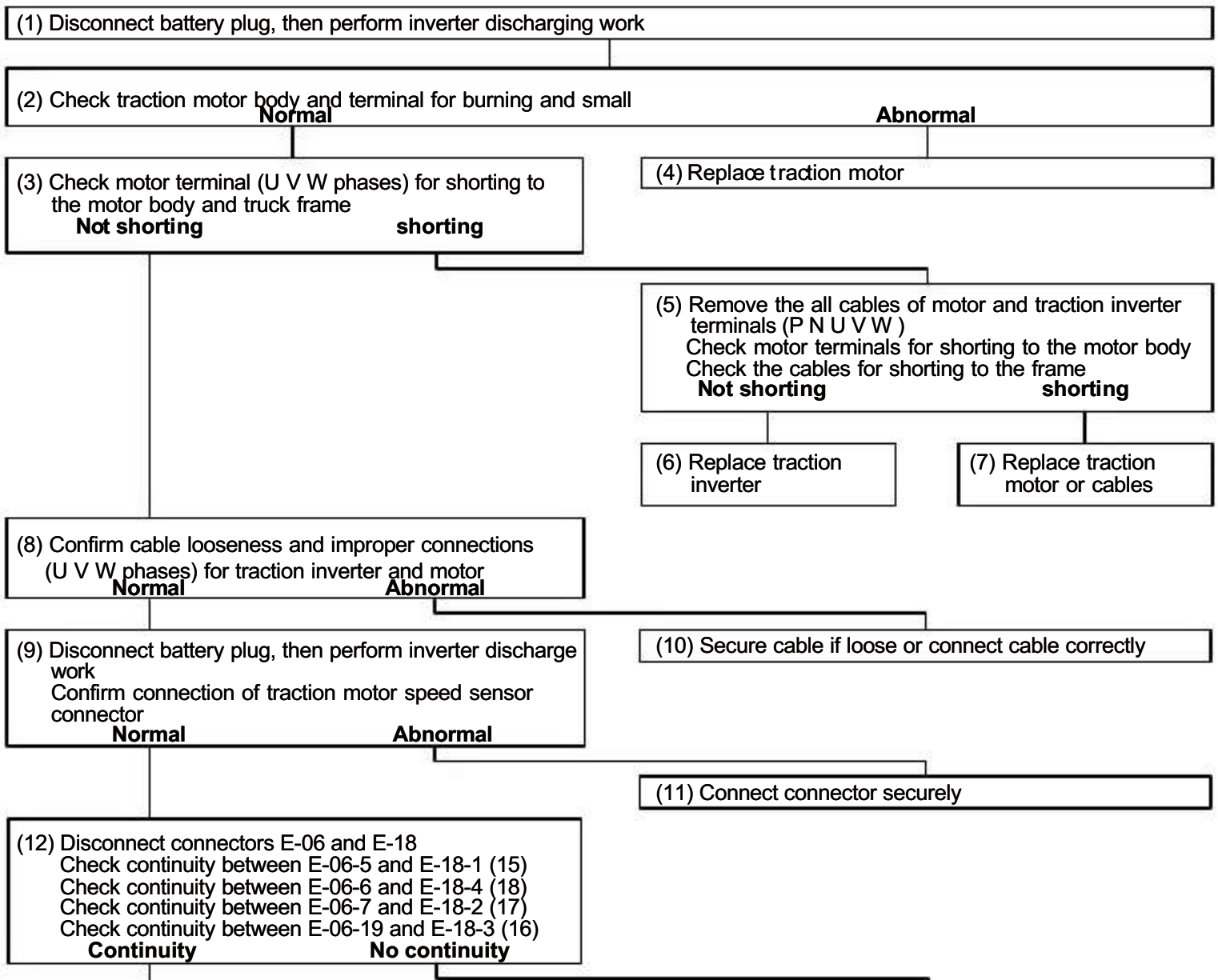

E-02
- 23
- 24
21 19 17 15 - - 9 7
- 20 18 - - - - 8
5 3 1
6 4 2
E-06
19 17 - - 11 - 7 5 3 1
20 18 16 - - - 8 6 4 2
Logics
E-02
CAN
5 W 3
6 L 4
Power
5 R/L 9
3 R/Y 10
4 R/L 11
6 B 12
11
12V
14V
8V
GND
GND
Power card
E-01
E-06
Traction inverter (left)
3
4
16
17
18
20
8
9
11
1
2
5
6
7
19
DSP
card
Inside
of
cover
Inside
of
case
IMS
card
Flat
cable
P Fuse
N Battery (-)
U IUR
V IVR
W IWR
Br/W
B
12V R/Y
W/B
L/B
GND B
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
E-18
16 3
17 2
18 4
15 1
14 2
13 1
E-15
Traction motor (left)
Speed
sensor
W TWR
V TVR
U TUR
Thermal
sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
1 2
3 4
E-18
1 2
E-15

501136

3.12 Traction Motor L.H., Over-current (25)

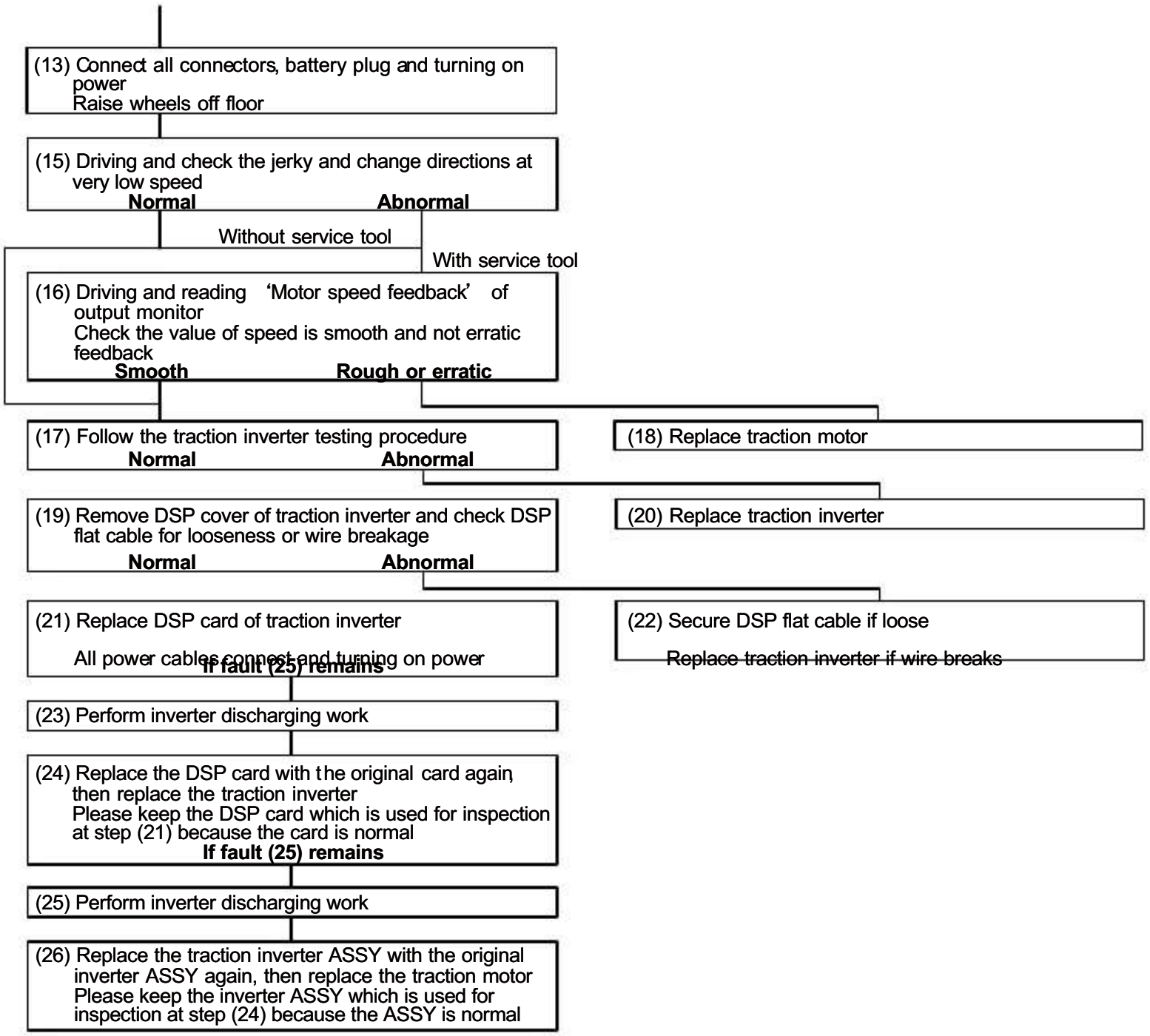
Error code: 25	
Situation	Display: "25". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty traction moter. (Contain the bearing sensor) Faulty contact or wire breakage of traction motor speed sensor harness. Faulty traction inverter. Faulty contact or wire breakage of DSP flat cable in traction inverter. Faulty DSP card of traction inverter. Faulty main harness.
Trigger of the error code	Motor current is more than 1105 A (Moment) or 893 A (1 mS) or 829 A (1.6 mS).

Checks

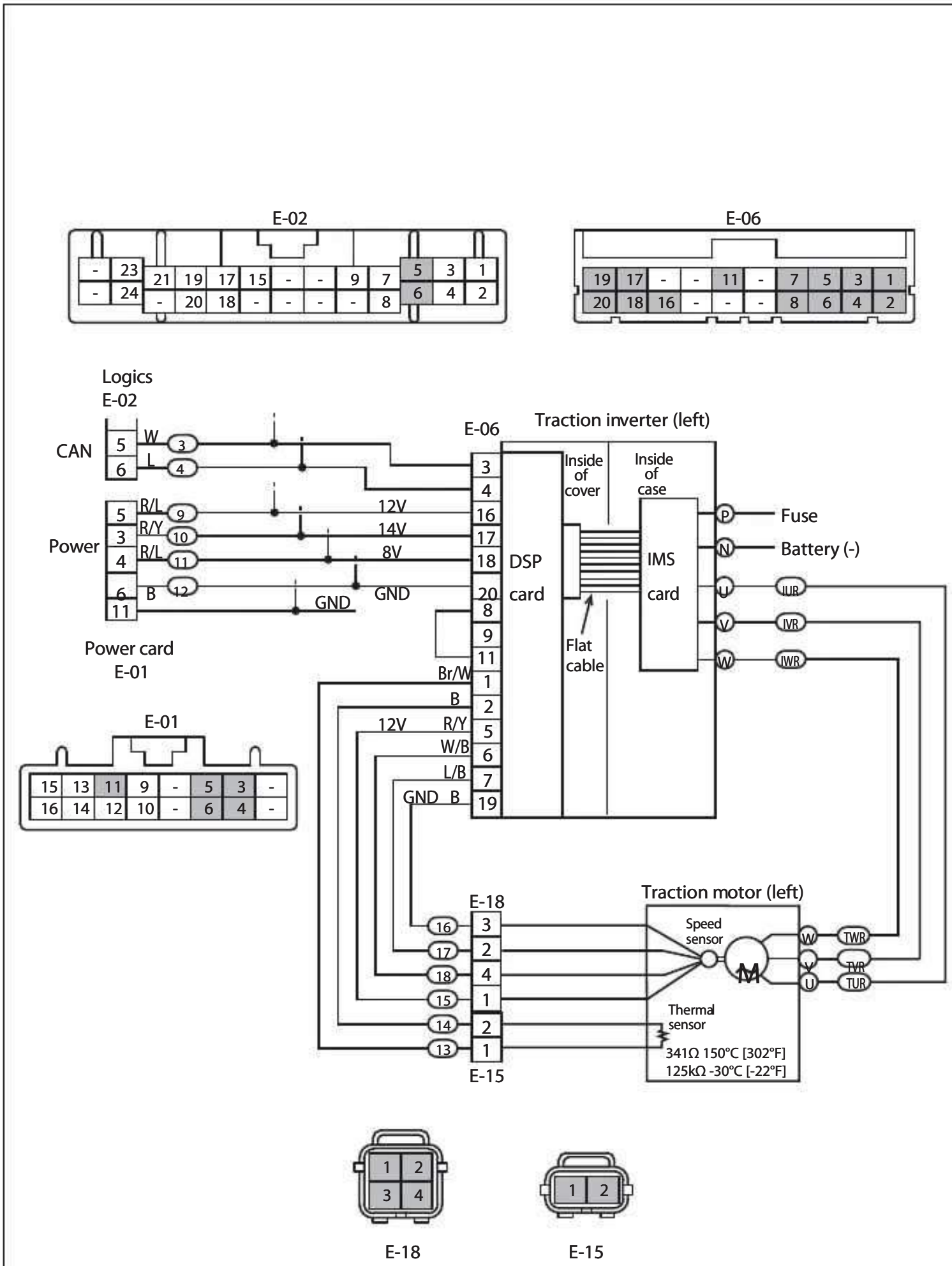


(14) Repair or replace harness

502822



CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

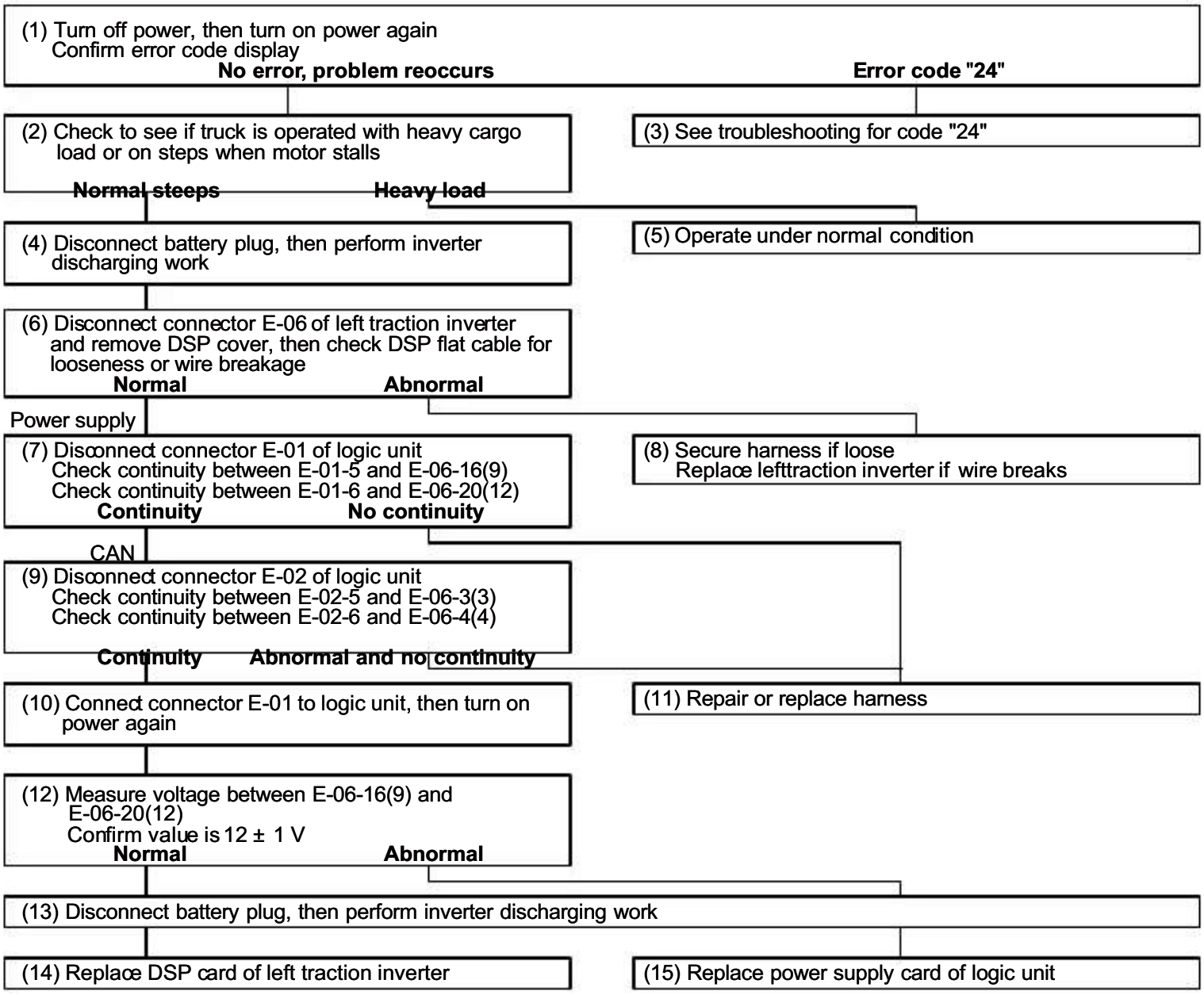


501136

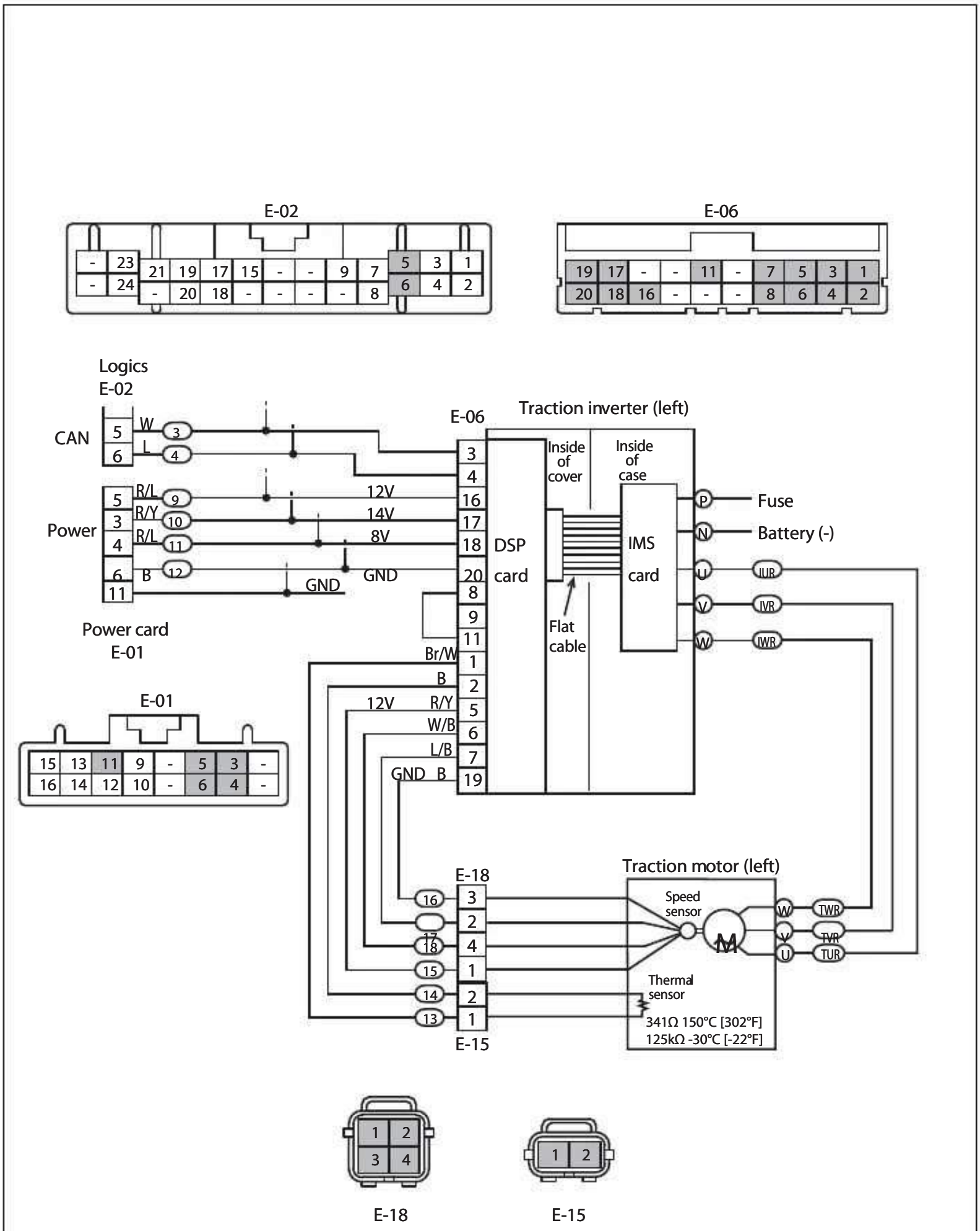
3.13 Traction Motor L.H., Stall Timer (26)

Error code: 26	
Situation	Display: "26". Traction motor and pump motor operation inhibited. Line contactor HOLD and ST contactor HOLD
Possible cause	Stall current flowed more than 7s right traction motor, faulty right traction inverter current sensor, shorted harness wiring, faulty right traction inverter DSP card, faulty logic unit.
Trigger of the error code	7s is measured while stalling.

Checks



CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

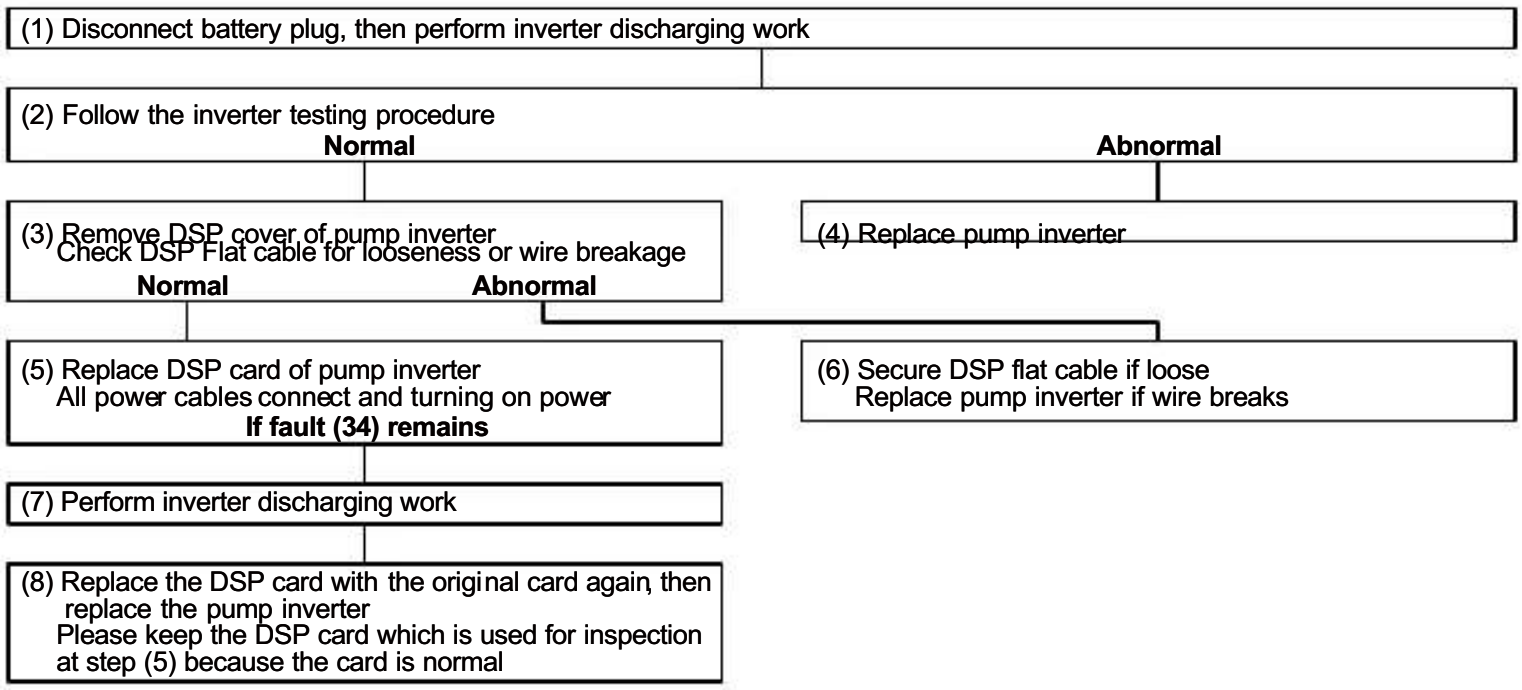


501136

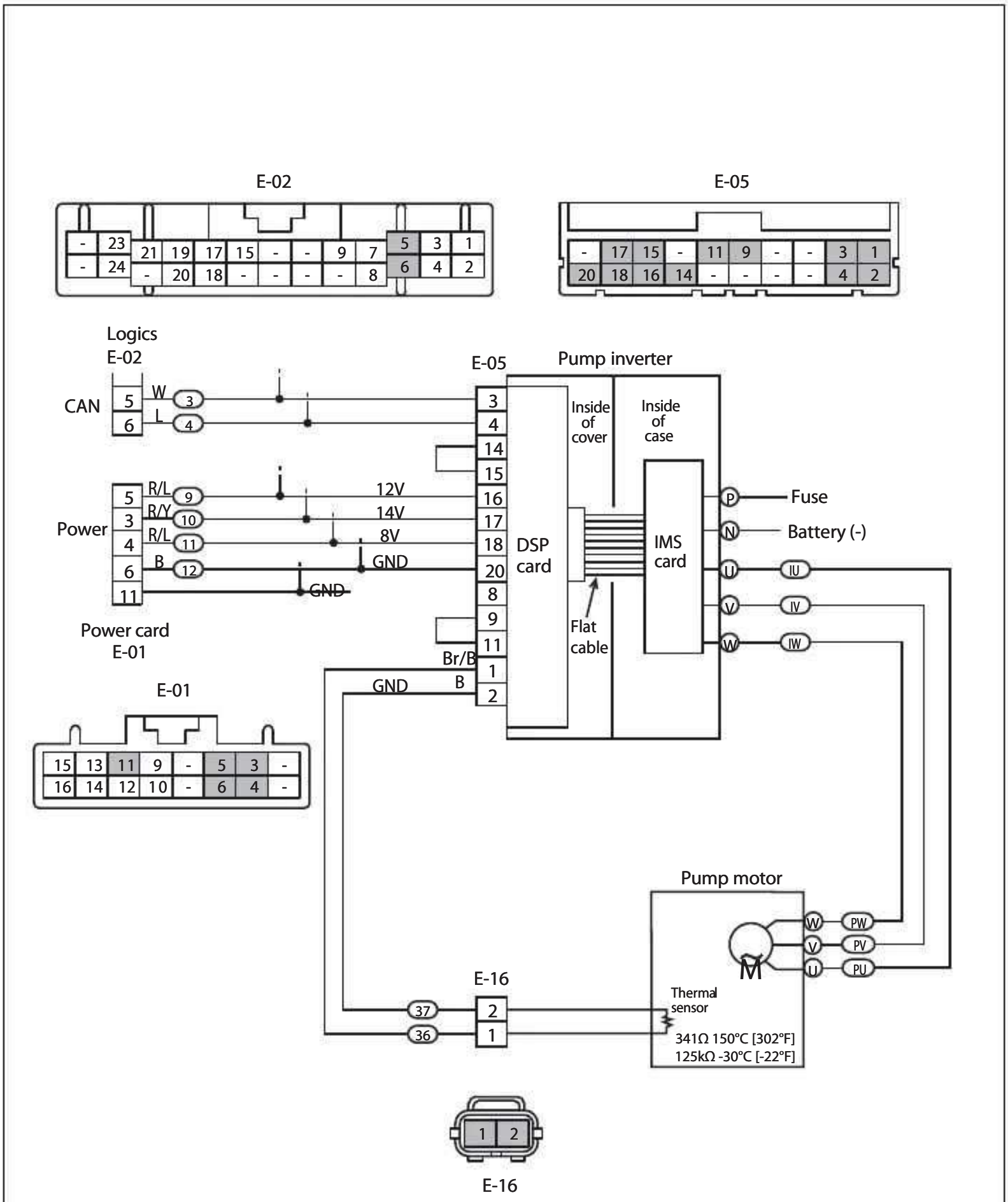
3.14 Pump Motor Current Sensor Fault (34)

Error code: 34	
Situation	Display: "34". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty pump inverter. (U, V current sensor in pump inverter) Faulty DSP card of pump inverter. Faulty contact or wire breakage of DSP flat cable in pump inverter.
Trigger of the error code	When turning on power, current sensor value is out of -120 A to 120 A .

Checks



CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

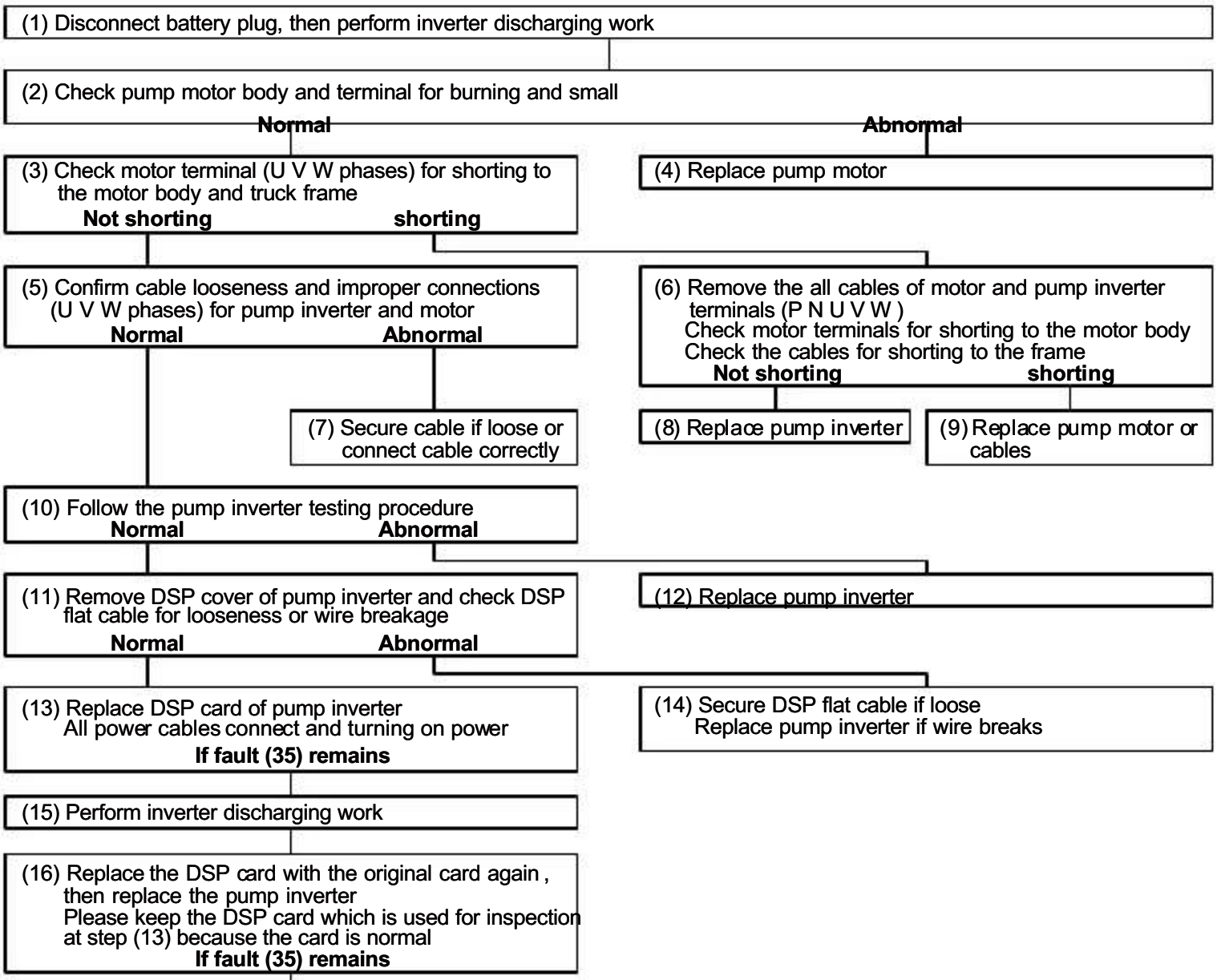


501137

3.15 Pump Motor Over-current (35)

Error code: 35	
Situation	Display: "35". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty pump motor. (Contain the bearing sensor) Faulty pump inverter. Faulty contact or wire breakage of DSP flat cable in pump inverter. Faulty DSP card of pump inverter. Faulty main harness.
Trigger of the error code	Motor current is more than 1105 A (Moment) or 893 A (1 mS) or 829 A (1.6 mS).

Checks

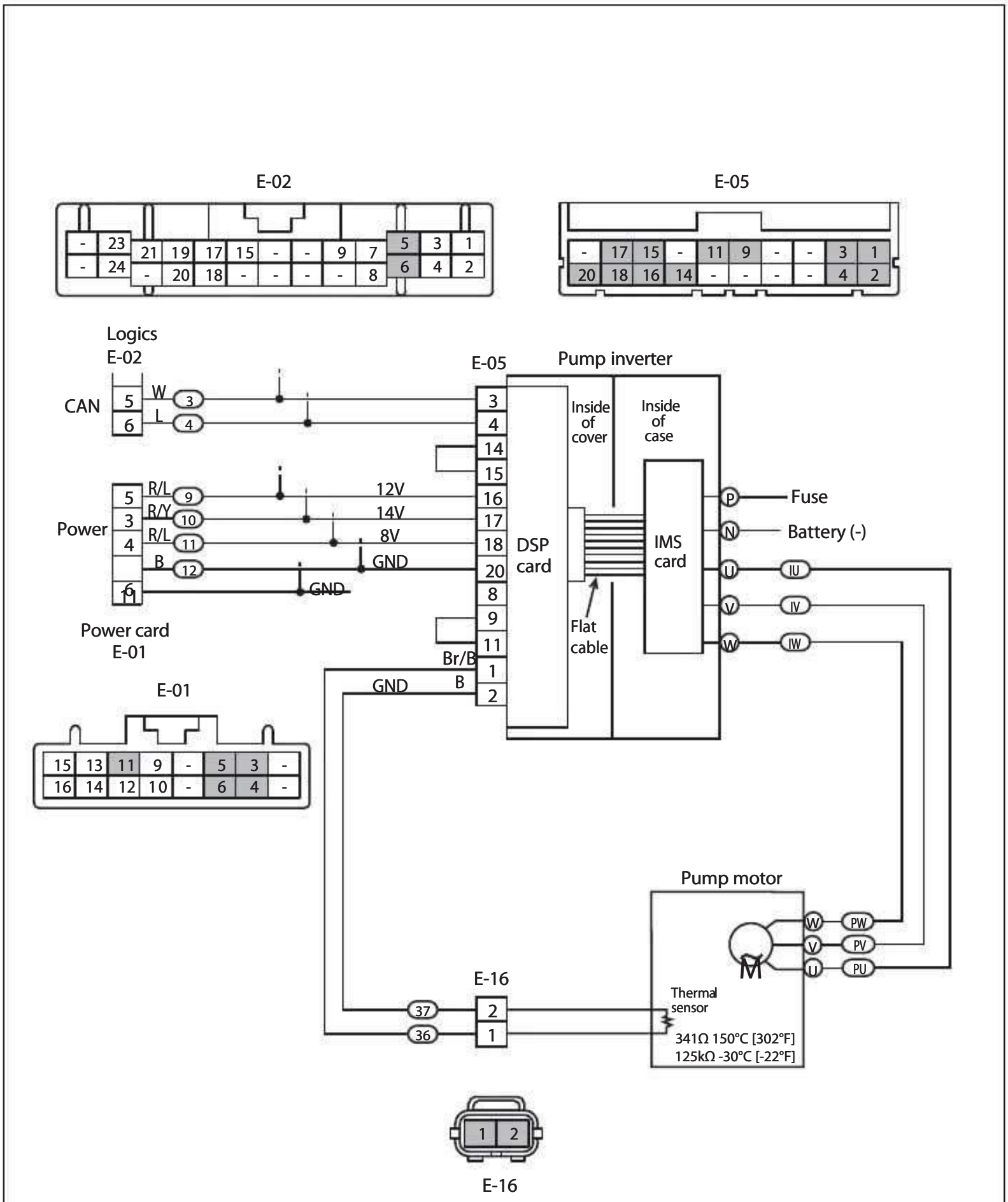


(17) Perform inverter discharging work

(18) Replace the pump inverter ASSY with the original inverter ASSY again, then replace the pump motor Please keep the inverter ASSY which is used for inspection at step (16) because the ASSY is normal

502826

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

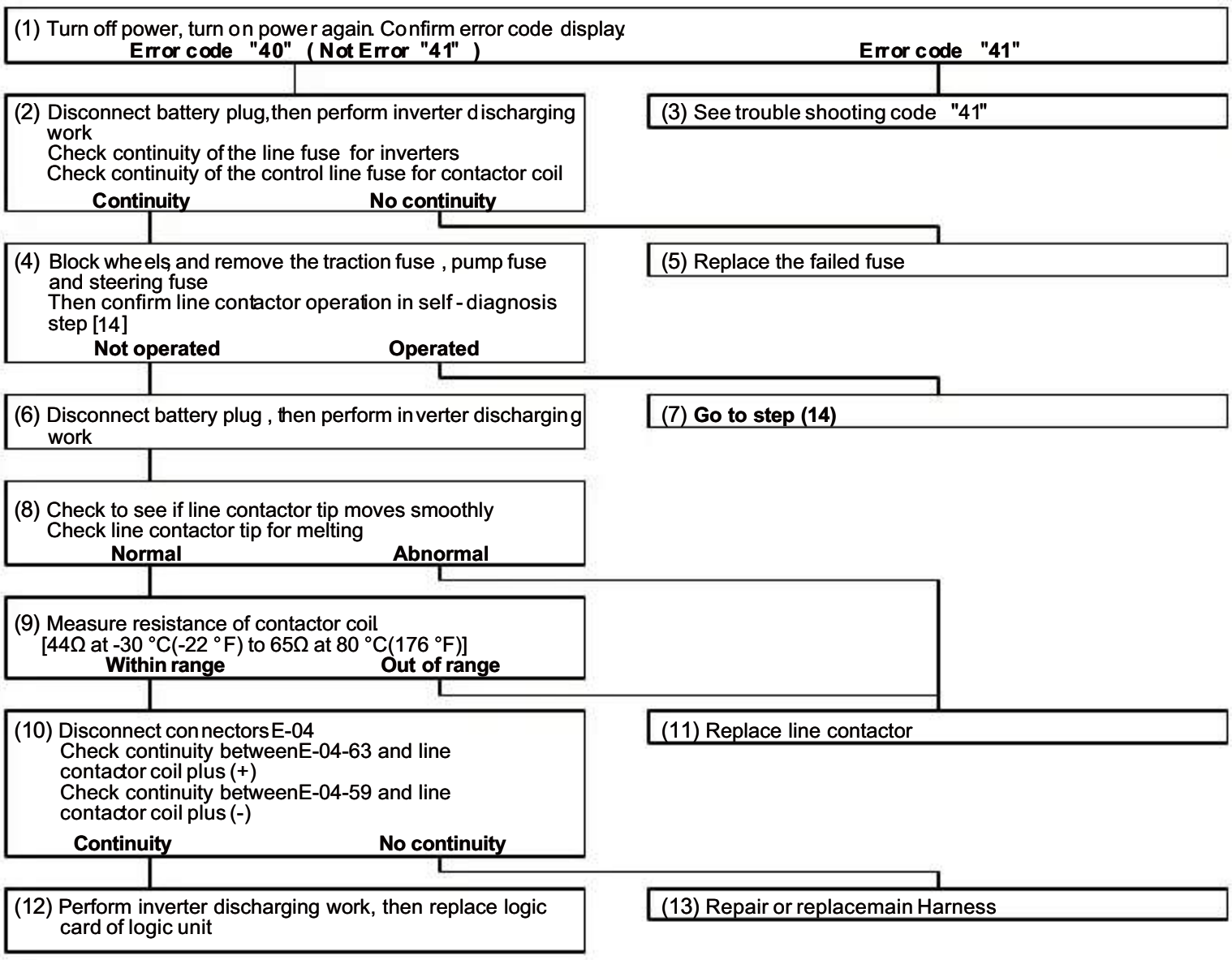


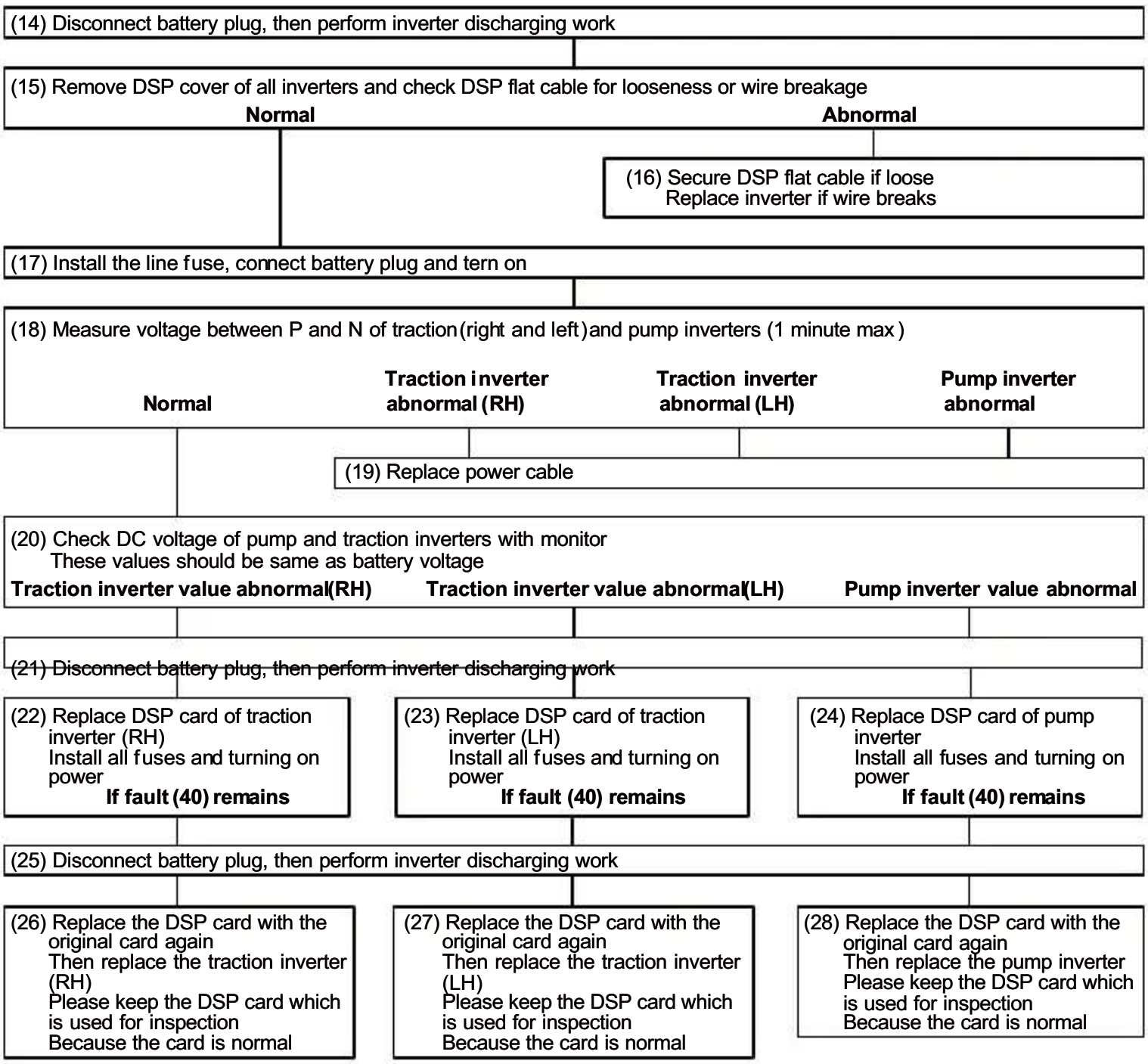
501137

3.16 Line Contactor Fault (40)

Error code: 40	
Situation	Display: "40". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Break of line fuse. Faulty line contactor. Faulty right, left traction inverter or pump inverter. Faulty DSP card in right, left traction inverter. Faulty main harness. Faulty logic unit.
Trigger of the error code	Inverter voltage data is checked when contactor is closed (400 ms).

Checks




(14) Disconnect battery plug, then perform inverter discharging work
(15) Remove DSP cover of all inverters and check DSP flat cable for looseness or wire breakage
Normal
Abnormal
(16) Secure DSP flat cable if loose
Replace inverter if wire breaks
(17) Install the line fuse, connect battery plug and tern on
(18) Measure voltage between P and N of traction (right and left) and pump inverters (1 minute max)
Normal
Traction inverter abnormal (RH)
Traction inverter abnormal (LH)
Pump inverter abnormal
(19) Replace power cable
(20) Check DC voltage of pump and traction inverters with monitor
These values should be same as battery voltage
Traction inverter value abnormal (RH)
Traction inverter value abnormal (LH)
Pump inverter value abnormal
(21) Disconnect battery plug, then perform inverter discharging work
(22) Replace DSP card of traction inverter (RH)
Install all fuses and turning on power
If fault (40) remains
(23) Replace DSP card of traction inverter (LH)
Install all fuses and turning on power
If fault (40) remains
(24) Replace DSP card of pump inverter
Install all fuses and turning on power
If fault (40) remains
(25) Disconnect battery plug, then perform inverter discharging work
(26) Replace the DSP card with the original card again
Then replace the traction inverter (RH)
Please keep the DSP card which is used for inspection
Because the card is normal
(27) Replace the DSP card with the original card again
Then replace the traction inverter (LH)
Please keep the DSP card which is used for inspection
Because the card is normal
(28) Replace the DSP card with the original card again
Then replace the pump inverter
Please keep the DSP card which is used for inspection
Because the card is normal

E-07

19	17	-	-	-	-	7	5	3	1
20	18	16	-	-	-	-	6	4	2

E-06

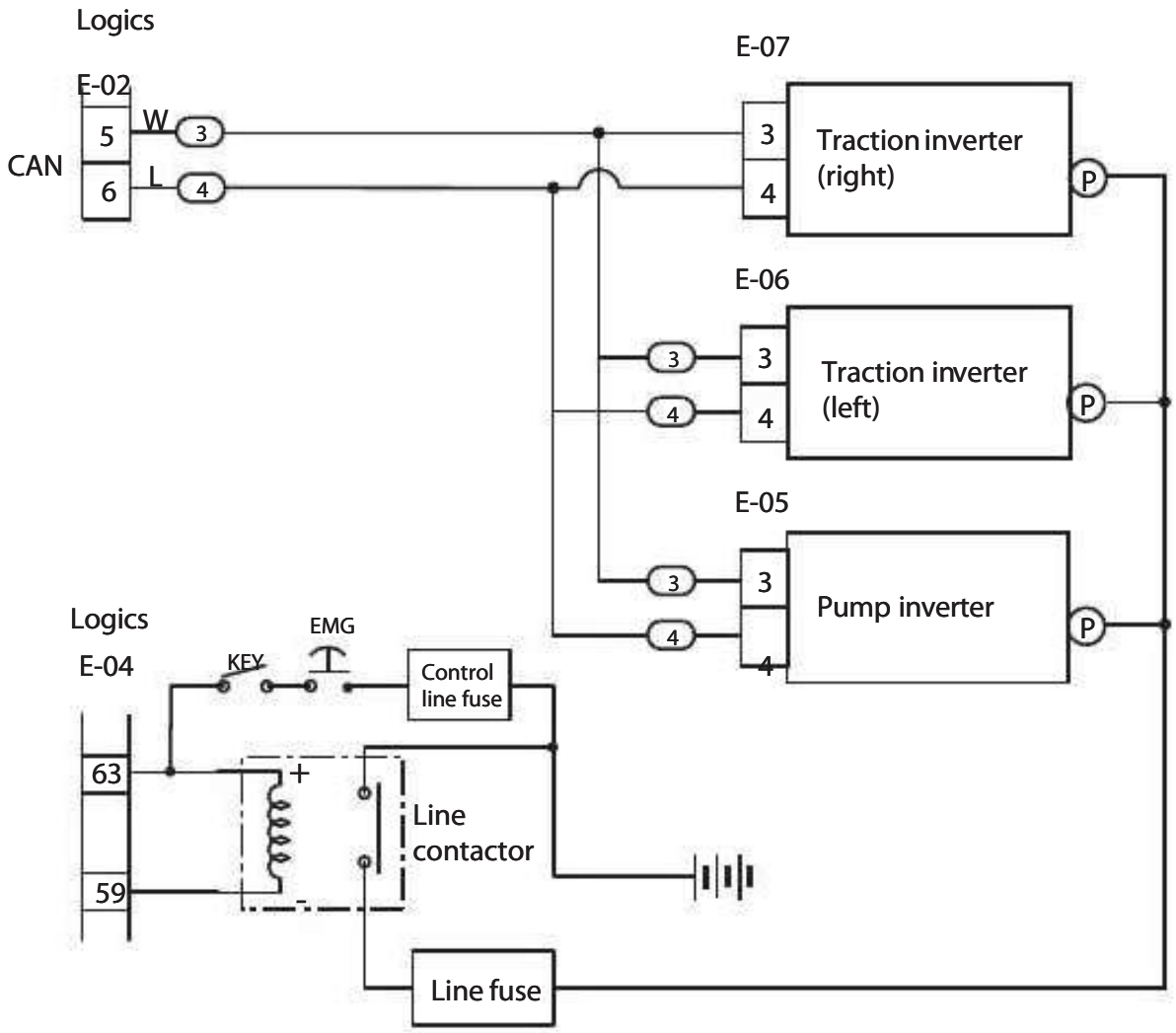
19	17	-	-	11	-	7	5	3	1
20	18	16	-	-	-	8	6	4	2

E-02

-	23	21	19	17	15	-	-	9	7	5	3	1
-	24	-	20	18	-	-	-	-	8	6	4	2

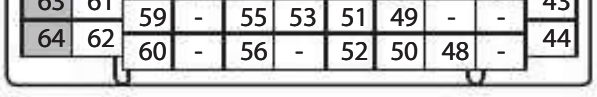
E-05

-	17	15	-	11	9	-	-	3	1
20	18	16	14	-	-	-	-	4	2



E-04

63	61	59	57	55	53	51	49	47	45	43	41	39	37	35	33	31	29	27	25	23	21	19	17
64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18



501142

3.17 Steering Contactor Fault (41)

Error code: 41	
Situation	Display: "41". All truck operations inhibited. Line contactor OPEN and steering contactor OPEN.
Possible cause	Faulty steering contactor, faulty main harness, faulty logic unit.
Trigger of the error code	Inverter voltage data is checked when contactor is closed (400 mS).

Checks

(1) Turn off power, then turn on power again. Confirm error code display
If fault (41) remains

(2) Disconnect battery plug, then perform inverter discharging work
Check continuity of the steering fuse
Check continuity of the control line fuse for contactor coil
Continuity — **No continuity**

(3) Block wheels and remove the traction fuse,pump fuse, steering fuse
Then confirm pump contactor operation in self-diagnostics step [15]
Not operated — **Operated**

(4) Replace steering fuse

(5) Disconnect battery plug, then perform inverter discharging work

(6) Check to see if steering contactor tip moves smoothly
Check steering contactor tip for melting
Normal — **Abnormal**

(7) **Go to step (13)**

(8) Measure resistance of contactor coil
[61Ω at -30 °C(-22 °F) to 91Ω at 80 °C(176 °F)]
Within range — **Out of range**

(9) Disconnect connectors E-04
Check continuity between E-04-63 and Steering contactor coil plus(+)
Check continuity between E-04-64 and steering contactor coil minus(-)
Continuity — **No continuity**

(10) Replace steering contactor

(11) Perform inverter discharging work, then replace logic card of logic unit

(12) Repair or replace main harness

(13) Install the steering fuse, connect battery plug and tern on

(14) Measure voltage between P and N of EPS controller (1 minute may)
Normal — **Abnormal**

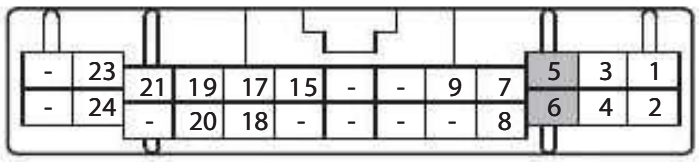
(15) Disconnect battery plug, then perform inverter discharging work

(16) Replace power cable

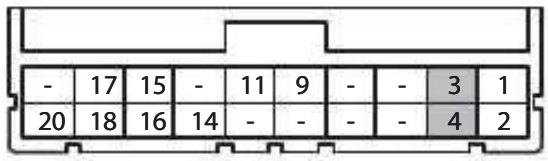
(17) Replace EPS controller

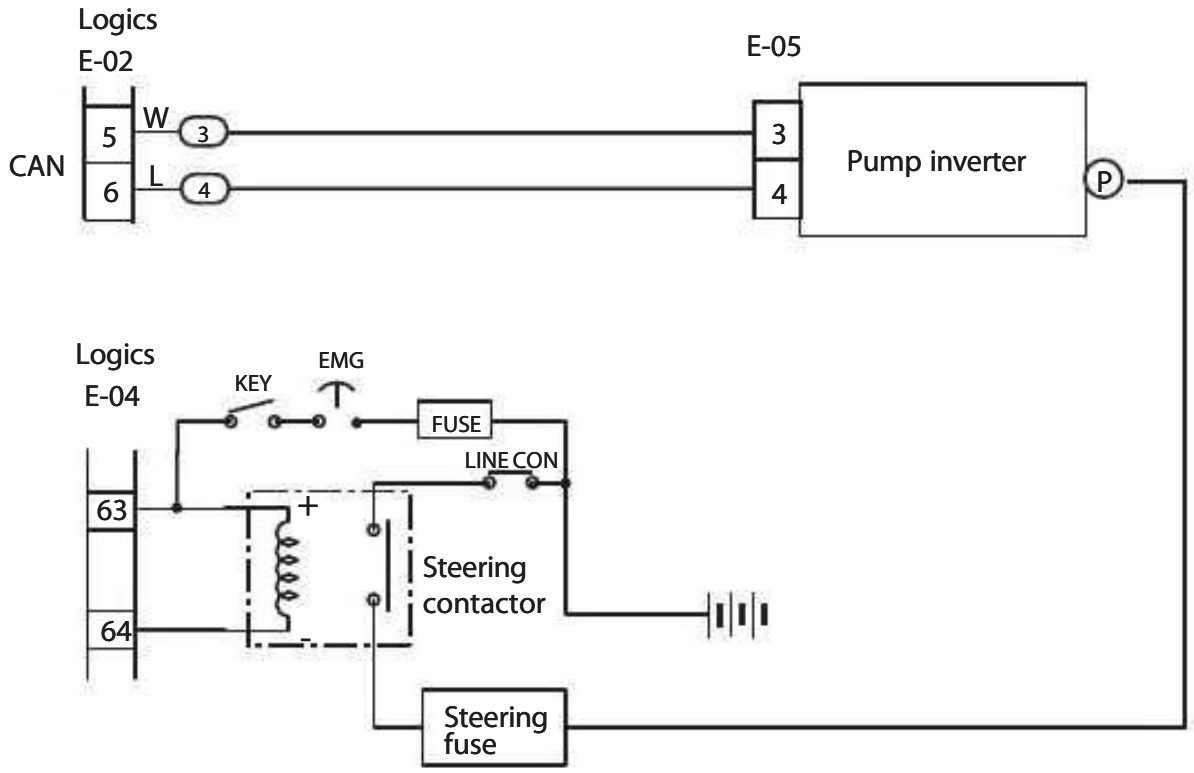
502829

E-02

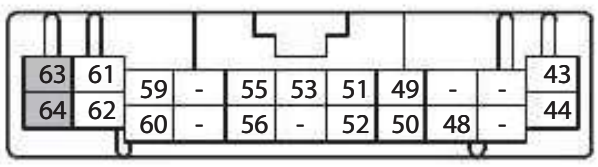


E-05





E-04

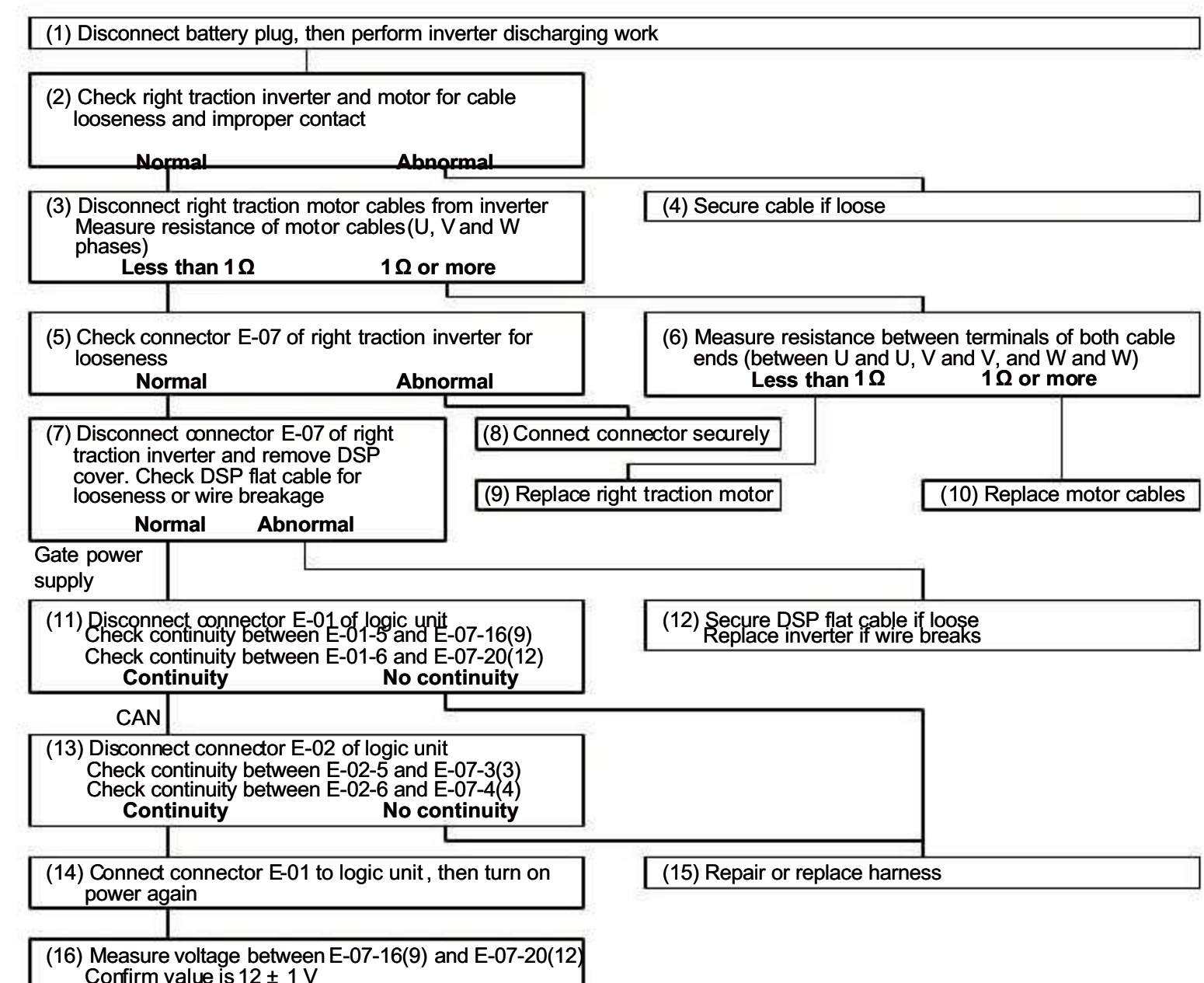


501143

3.18 Traction Motor R.H., Open (45)

Error code: 45	
Situation	Display: "45". Traction motor operation inhibited. Pump motor and power steering operations inhibited if this fault occurs before pump contactor CLOSE, and both operable if it occurs after pump contactor CLOSE. Line contactor OPEN and pump contactor CLOSE or OPEN.
Possible cause	Faulty contact or wire breakage of right side traction motor cable, faulty right side traction motor, faulty contact or wire breakage of right side traction inverter connector, faulty contact of DSP flat cable in right side traction inverter, wire breakage of main harness, faulty power supply card of logic unit, faulty DSP card of right side traction inverter, faulty right side traction inverter, when restarting after motor shorted.
Trigger of the error code	Motor voltage is abnormal when power is turned on. Current does not flow when torque instruction is requested.

Checks



Normal | Abnormal

(17) Disconnect battery plug, then perform inverter discharging work

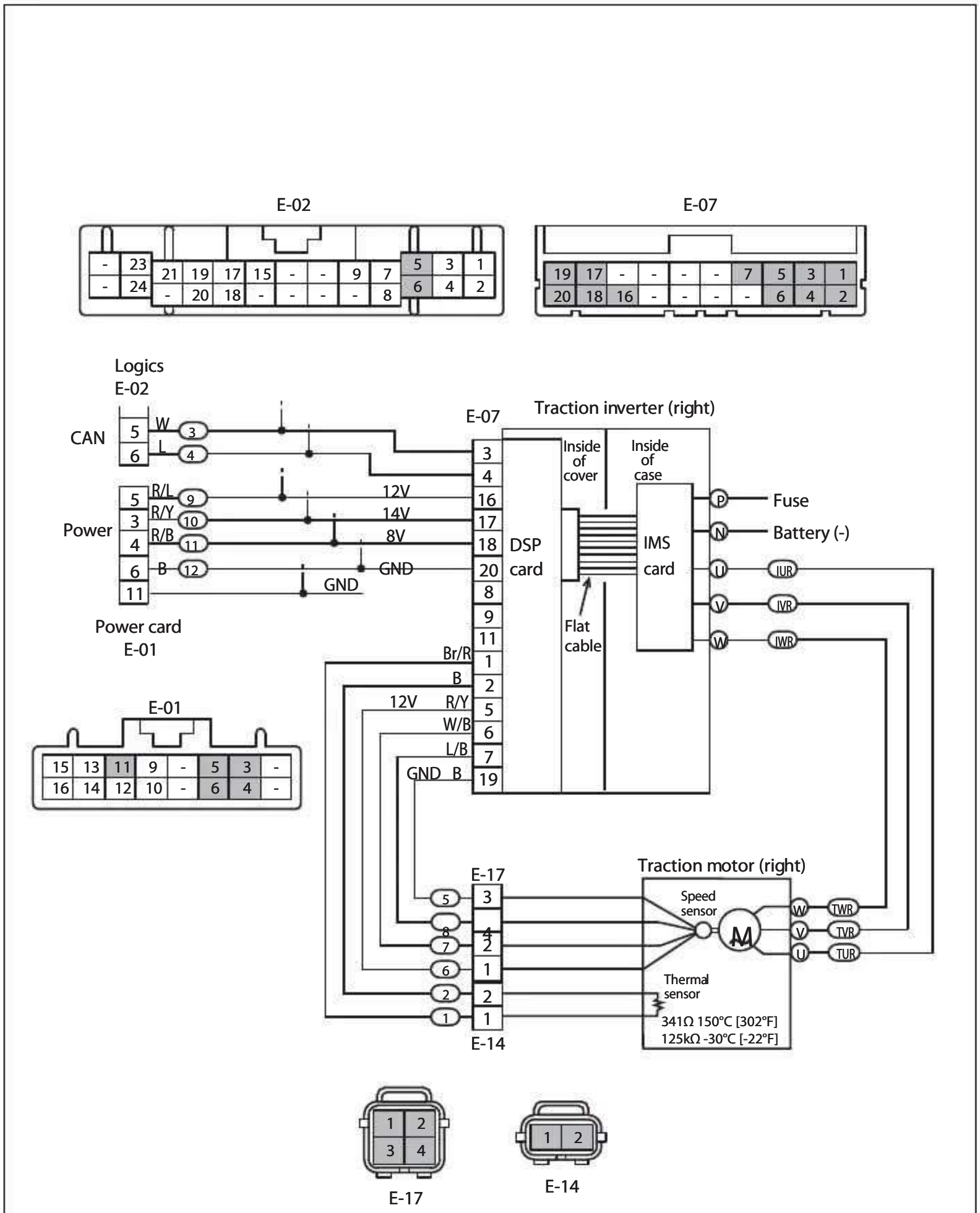
(18) Replace DSP card of right traction inverter

(19) Replace power supply card of logic unit

If fault remains

(20) Perform inverter discharging work, then replace right traction inverter (DSP card is normal)

502830

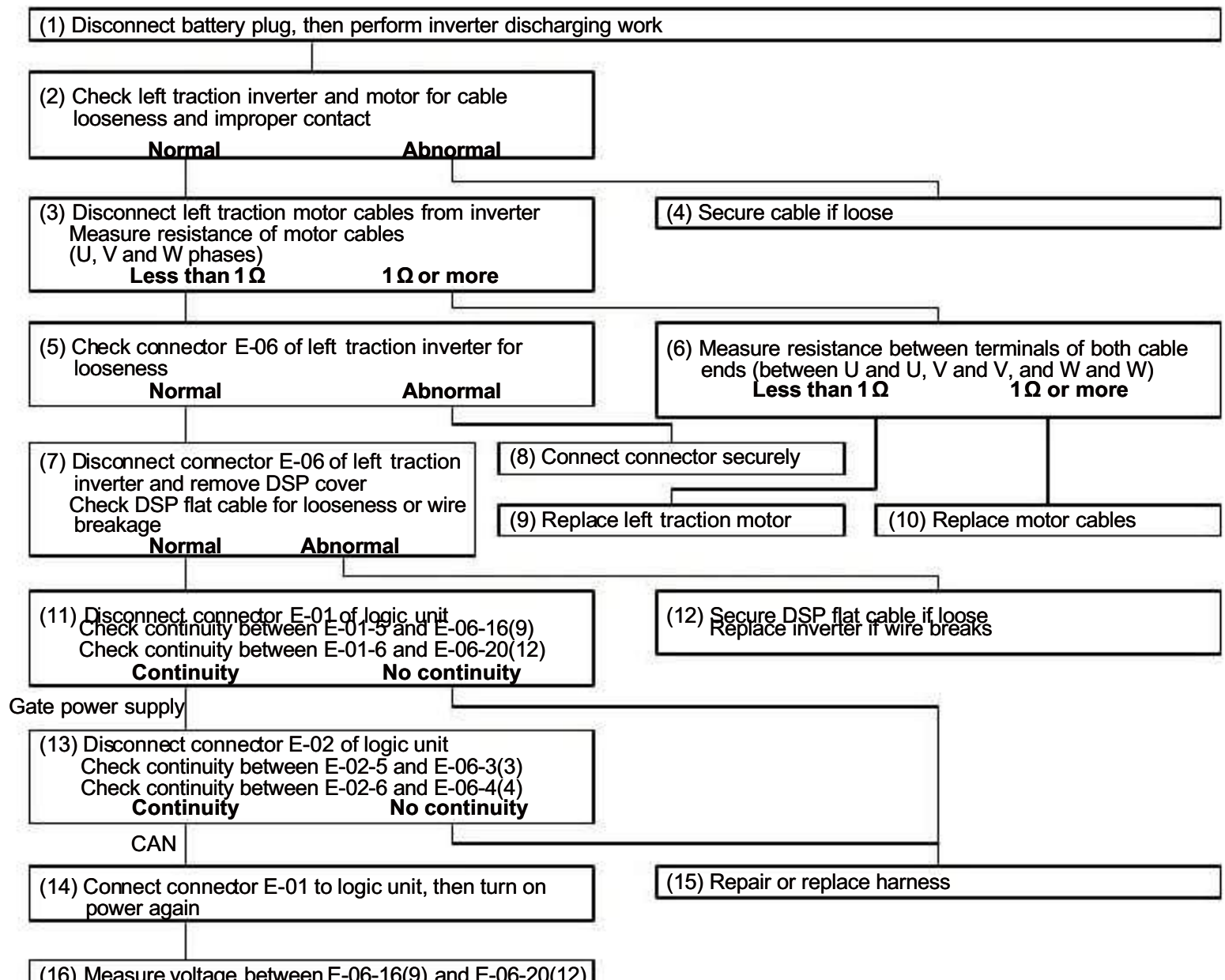


501135

3.19 Traction Motor L.H., Open (46)

Error code: 46	
Situation	Display: "46". Traction motor operation inhibited. Pump motor and power steering operations inhibited if this fault occurs before pump contactor CLOSE, and both operable if it occurs after pump contactor CLOSE. Line contactor OPEN and pump contactor CLOSE or OPEN.
Possible cause	Faulty contact or wire breakage of left side traction motor cable, faulty left side traction motor, faulty contact or wire breakage of left side traction inverter connector, faulty contact of DSP flat cable in left side traction inverter, wire breakage of main harness, faulty power supply card of logic unit, faulty DSP card of left side traction inverter, faulty left side traction inverter, when restarting after motor shorted
Trigger of the error code	Motor voltage is abnormal when power is turned on. Current does not flow when torque instruction is requested.

Checks



Confirm value is 12 ± 1 V

Normal **Abnormal**

(17) Disconnect battery plug, then perform inverter discharging work

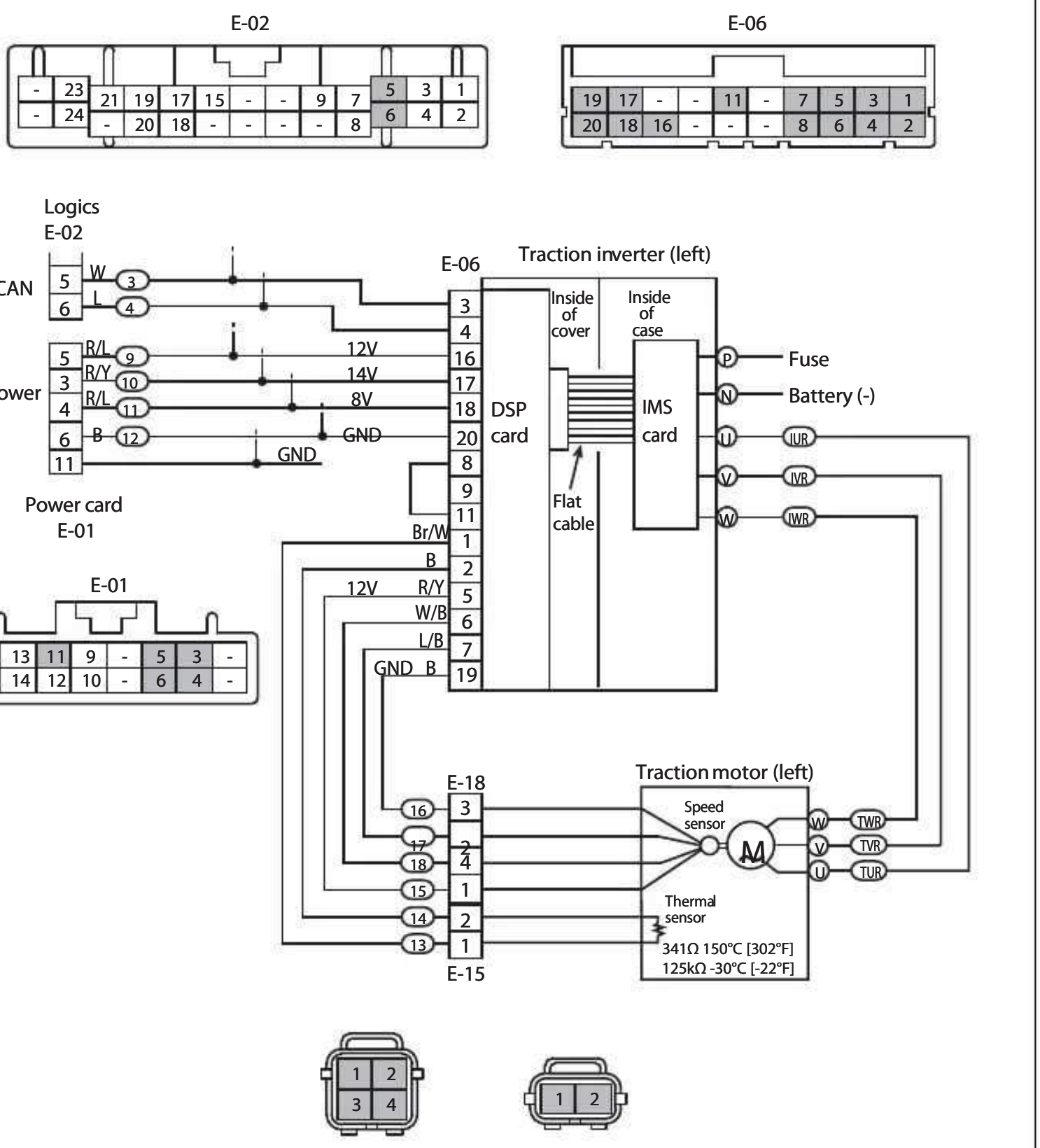
(18) Replace DSP card of left traction inverter

(19) Replace power supply card of logic unit

If fault remains

(20) Perform inverter discharging work, then replace left traction inverter (DSP card is normal)

502831



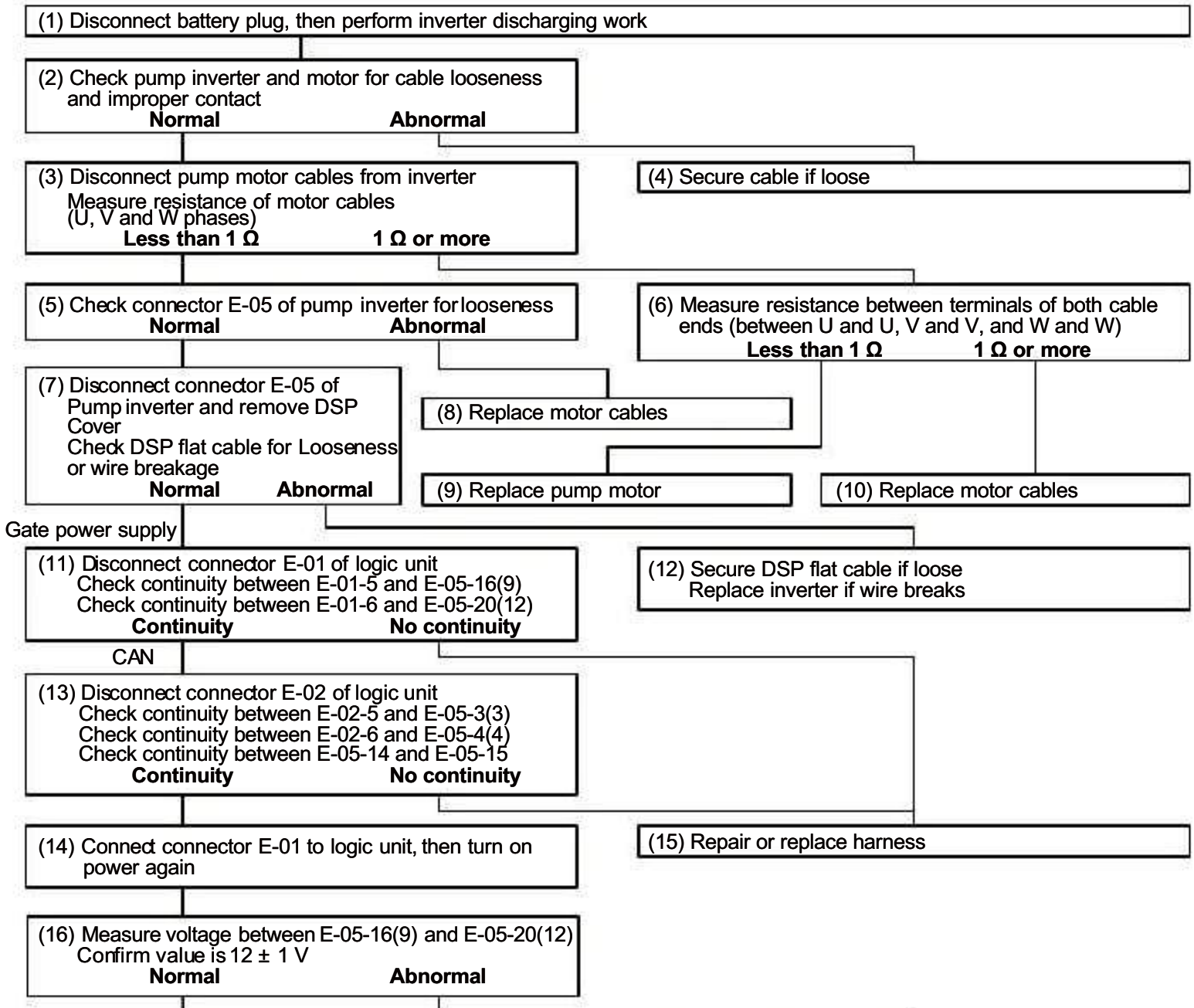
L-18 L-15

501136

3.20 Pump Motor Open (47)

Error code: 47	
Situation	Display: "47". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty contact or wire breakage of pump motor cable, faulty pump motor, faulty contact or wire breakage of pump inverter connector, faulty contact of DSP flat cable in pump inverter, wire breakage of main harness, faulty power supply card of logic unit, faulty DSP card of pump inverter, faulty pump inverter, when restarting after motor shorted.
Trigger of the error code	Motor voltage is abnormal when power is turned on. Current does not flow when rotational speed instruction is requested.

Checks



(17) Disconnect battery plug, then perform inverter discharging work

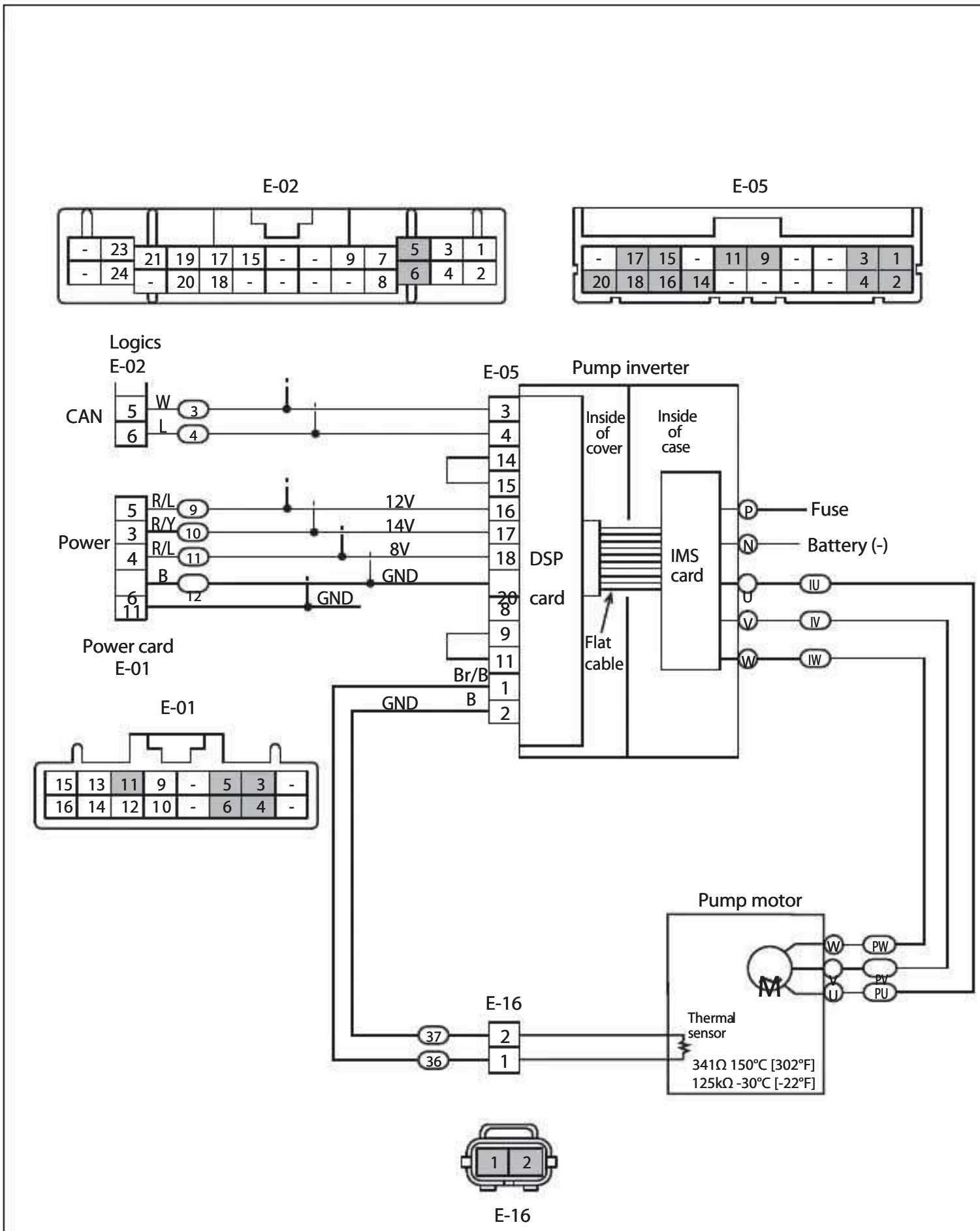
(18) Replace DSP card of pump inverter

(19) Replace power supply card of logic unit

If fault remains

(20) Perform inverter discharging work, then replace pump inverter (DSP card is normal)

502832

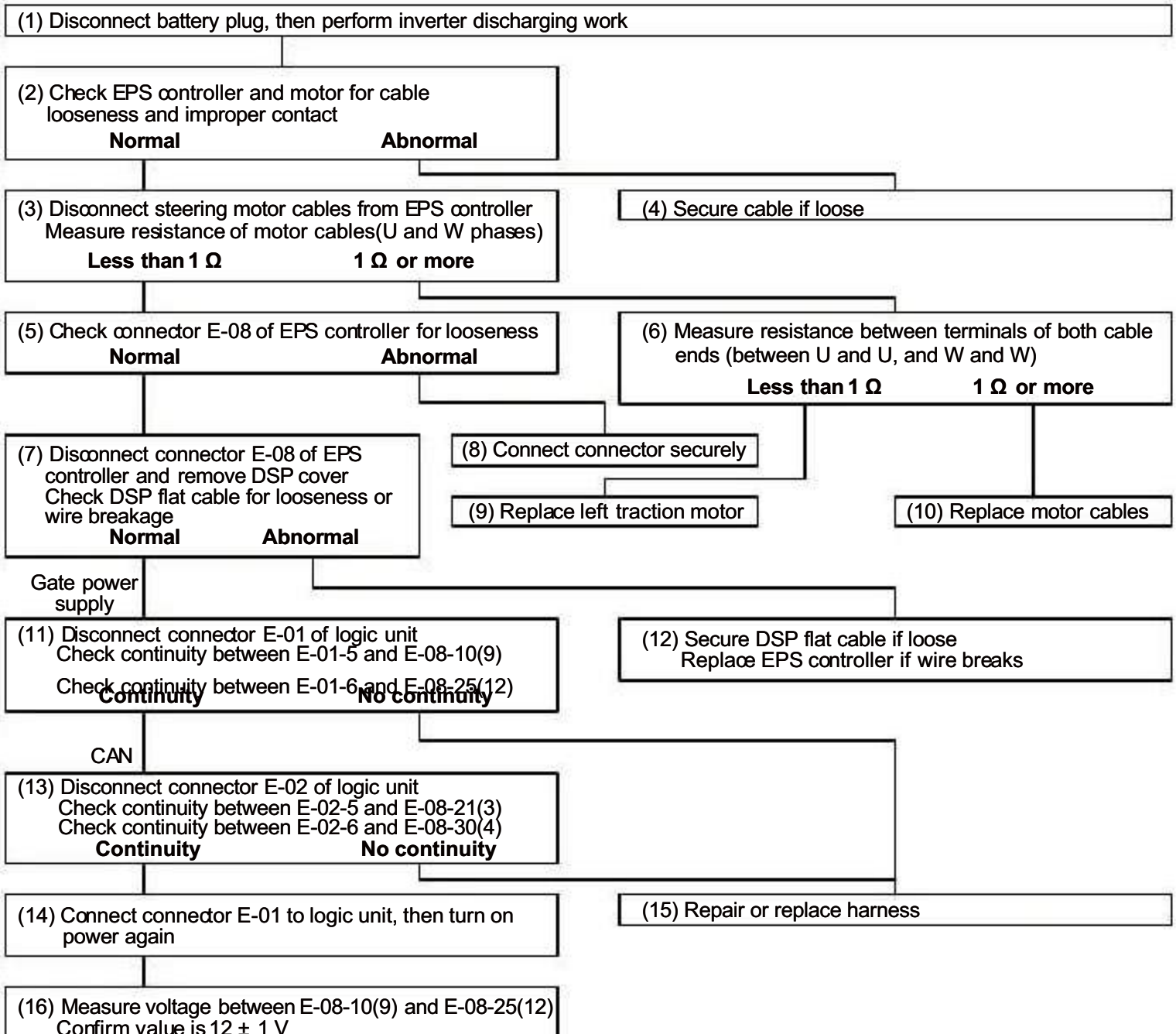


501137

3.21 PS Motor Open (49)

Error code: 49	
Situation	Display: "49". All operations inhibited except mast lowering operation. Line steering contactor OPEN.
Possible cause	Faulty contact or wire breakage of ST motor cable, faulty ST motor, faulty contact or wire breakage of left PS controller connector, wire breakage of main harness, faulty power supply card of logic unit, when restarting after motor shorted
Trigger of the error code	Motor voltage is abnormal when power is turned on. Current does not flow when torque instruction is requested.

Checks



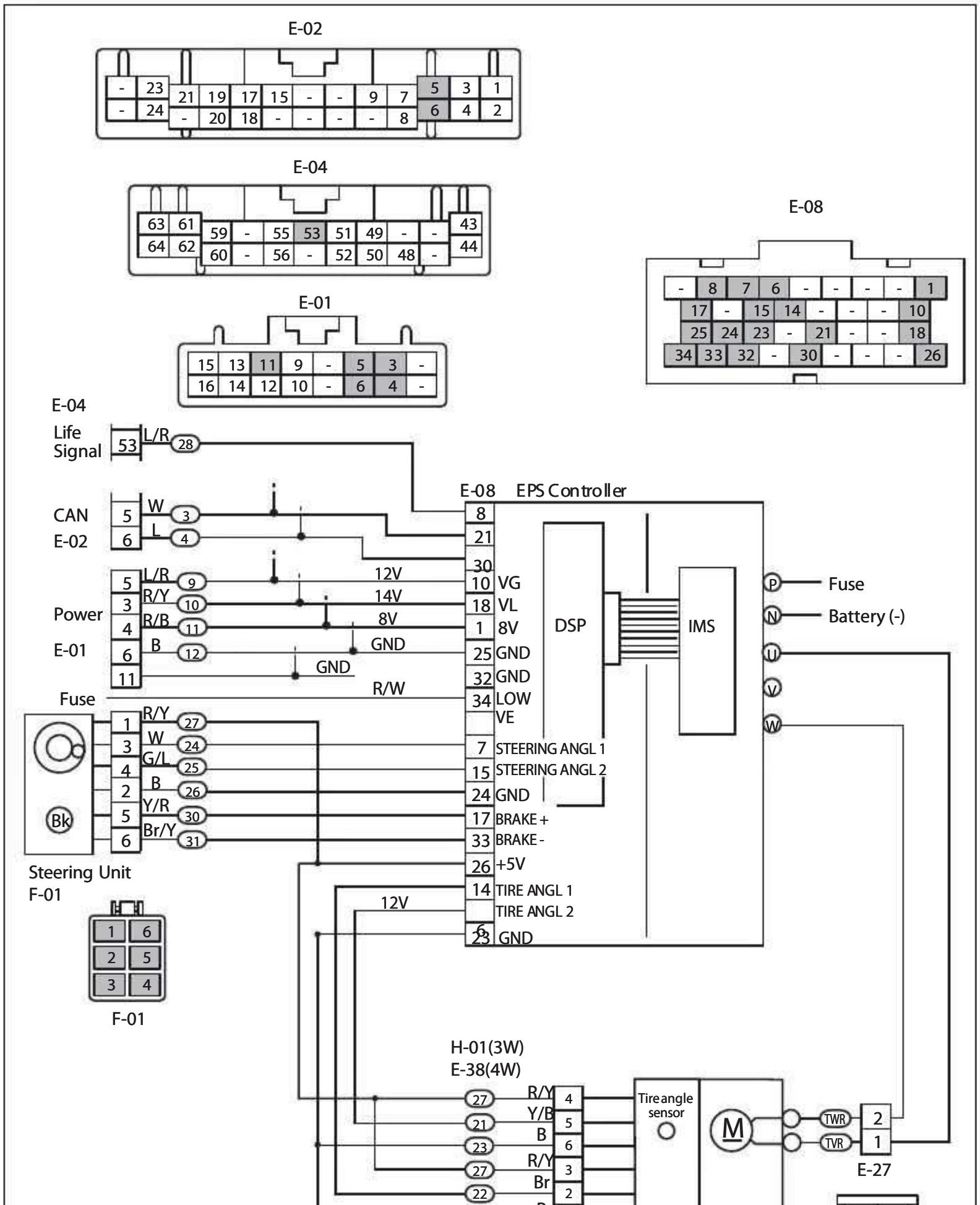
Normal	Abnormal

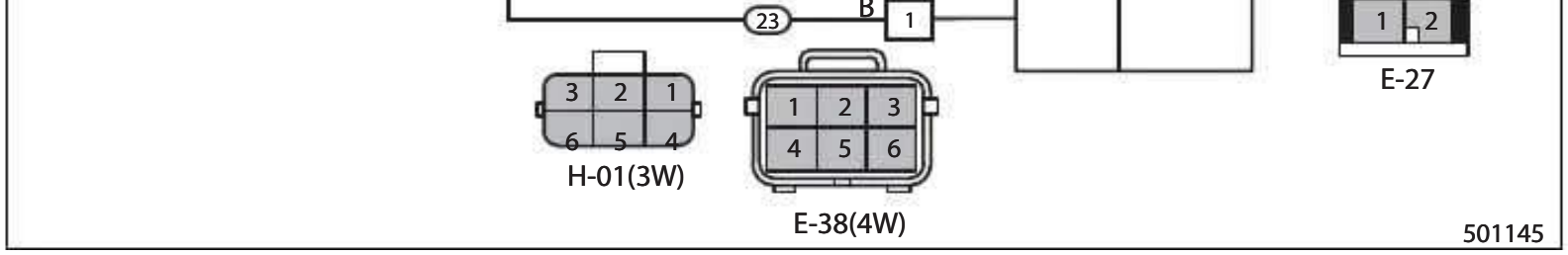
(17) Disconnect battery plug, then perform EPS controller discharging work

(18) Replace EPS controller

(19) Replace power supply card of logic unit

502833





3.22 Tire Angle Sensor Fault (50)

Error code: 50	
Situation	Display: "50". All operations inhibited except mast lowering operation. Line and steering contactor OPEN. Or travelling speed limited to 5 km/h.
Possible cause	Faulty steering sensor, faulty main harness, faulty PS controller.
Trigger of the error code	Voltage 4.8 or more, or 0.2 or less 12°of phase difference between A and B 36°of fluctuation for 10 ms

Checks

(1) Disconnect battery plug

(2) Disconnect connecter E-08 and H-01(3W), E-38(4W)
Check continuity between E-08-26 and H-01(3W) E-38(4W)-3, E-08-26 and E-01(3W) E-38(4W)-4 (Sensor voltage)
Continuity — **No continuity** → (6) Replace harness

(3) Check continuity between E-08-14 and H-01(3W) E-38(4W)-2
Check continuity between E-08-6 and H-01(3W) E-38(4W)-5 (Signal)
Continuity — **No continuity** → (6) Replace harness

(4) Check continuity between E-08-23 and H-01(3W) E-38(4W)-1, E-08-23 and H-01(3W) E-38(4W)-6(GND)
Continuity — **No continuity** → (6) Replace harness

(5) Connect logic connector and connect battery plug.
Turn on power
Check voltage between H-01(3W) E-38(4W)-3(Power) and (GND) and check voltage between H-01(3W) E-38(4W)-4(Power) and 6(GND)
5 V ± 10 % — **Outside the specified range** → (8) Replace logic power board

(7) Turn off power, turn off battery, and discharge
Check steering wheel angle sensor linkage
Normal — **Abnormal** → (10) Repair linkage

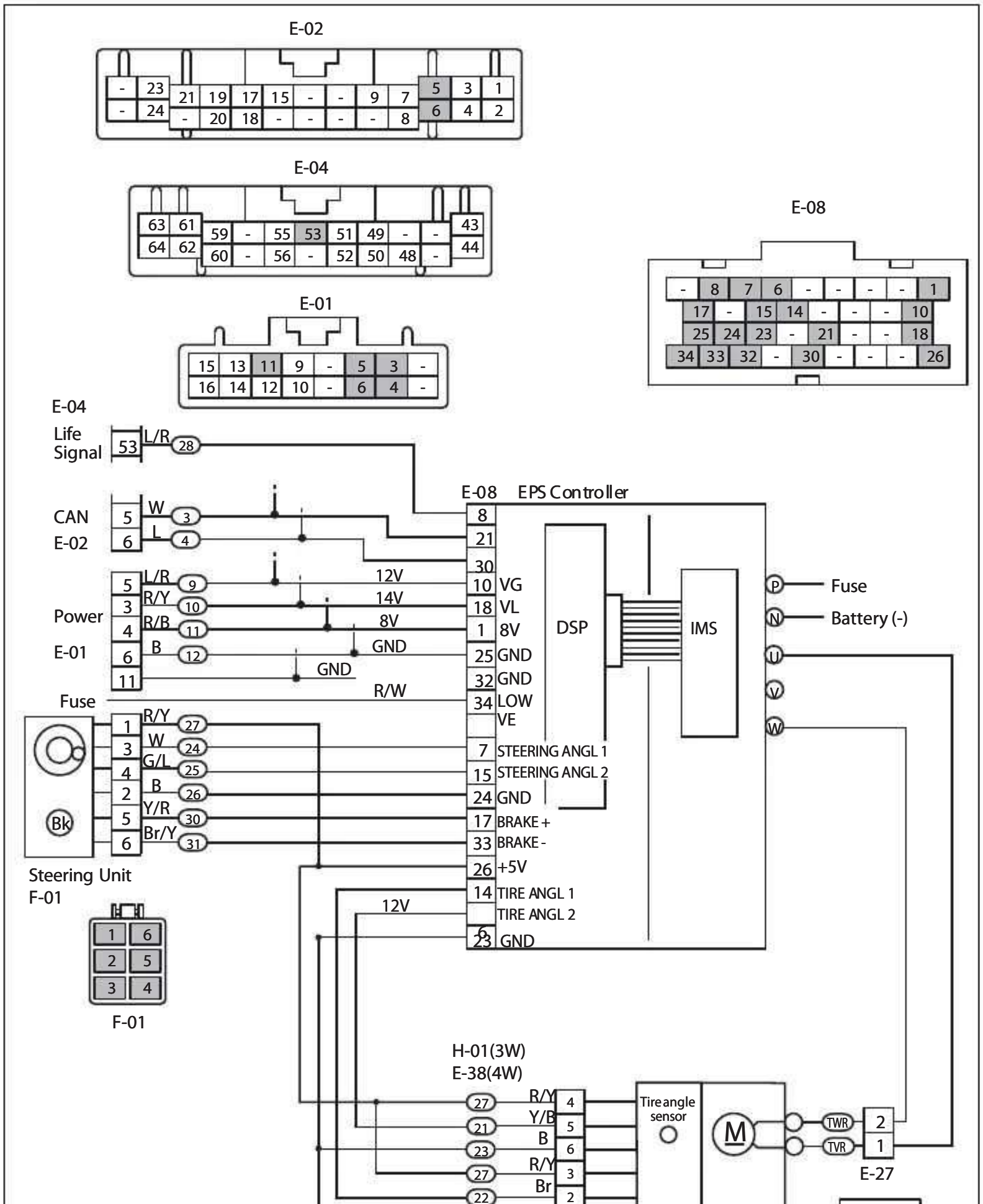
(9) Replace steering wheel angle sensor

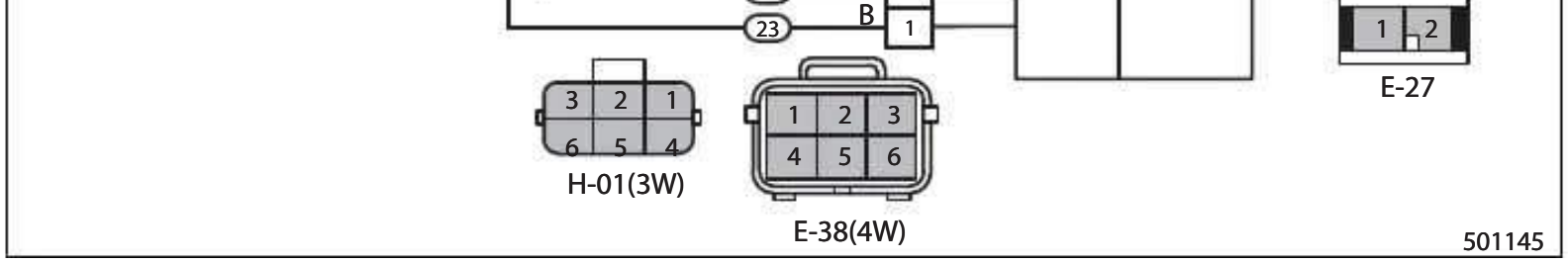
If fault remains

(11) Reinstall steering wheel angle sensor just has been

replaced
Replace EPS controller

502834

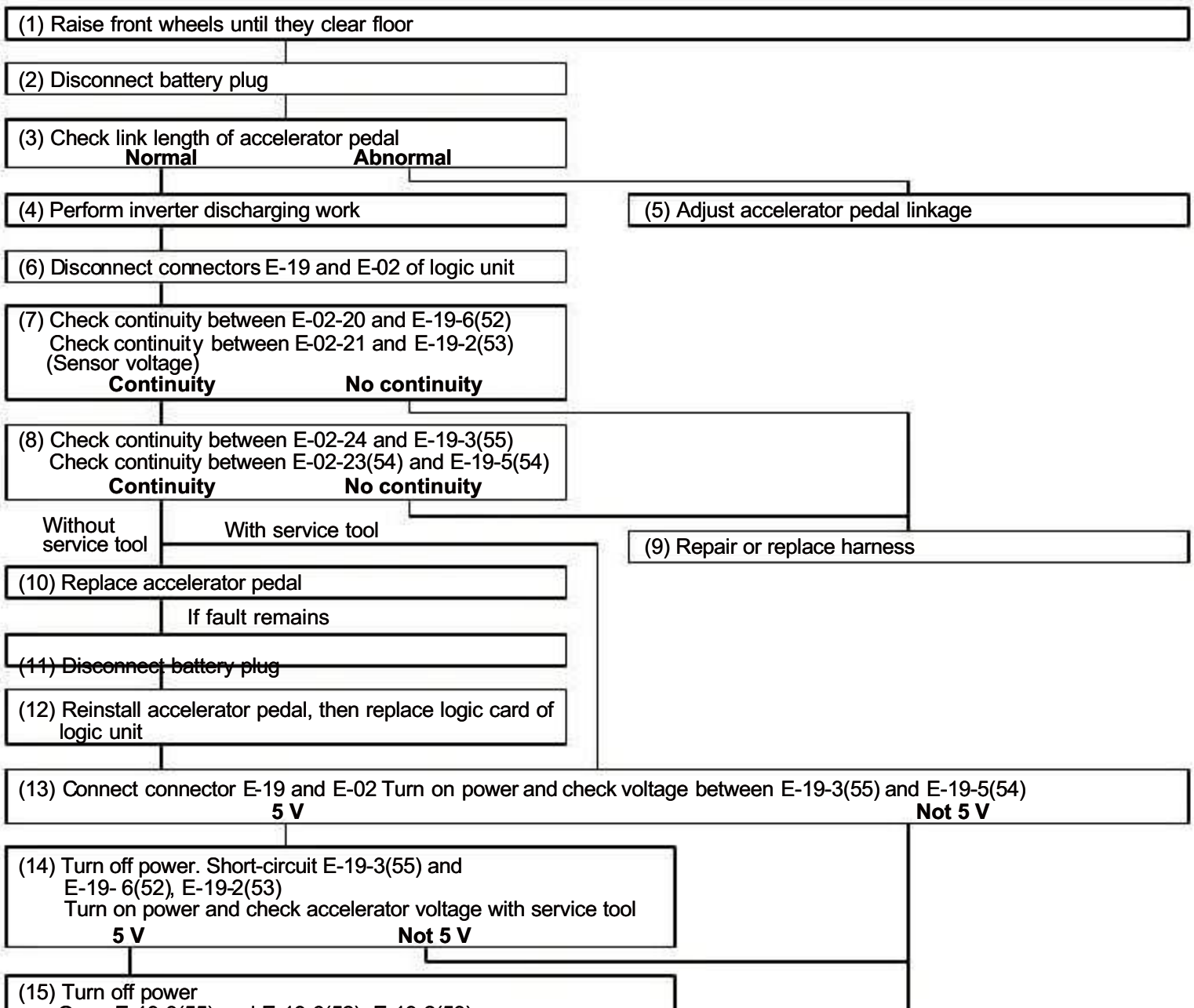




3.23 Accelerator Sensor Fault (51)

Error code: 51	
Situation	Display: "51". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Improper accelerator pedal linkage, faulty accelerator sensor, faulty main harness, faulty logic unit.
Trigger of the error code	Sensor 1 or 2 output is 0.2 V or lower, or 4.8 V or higher. Difference in output between sensors 1 and 2 is 0.5 V or more.

Checks



Open E-19-3(55) and E-19-6(52), E-19-2(53)
Short-circuit E-19-5(54) and E-19-6(52), E-19-2(53)
Turn on power and check accelerator voltage with service tool

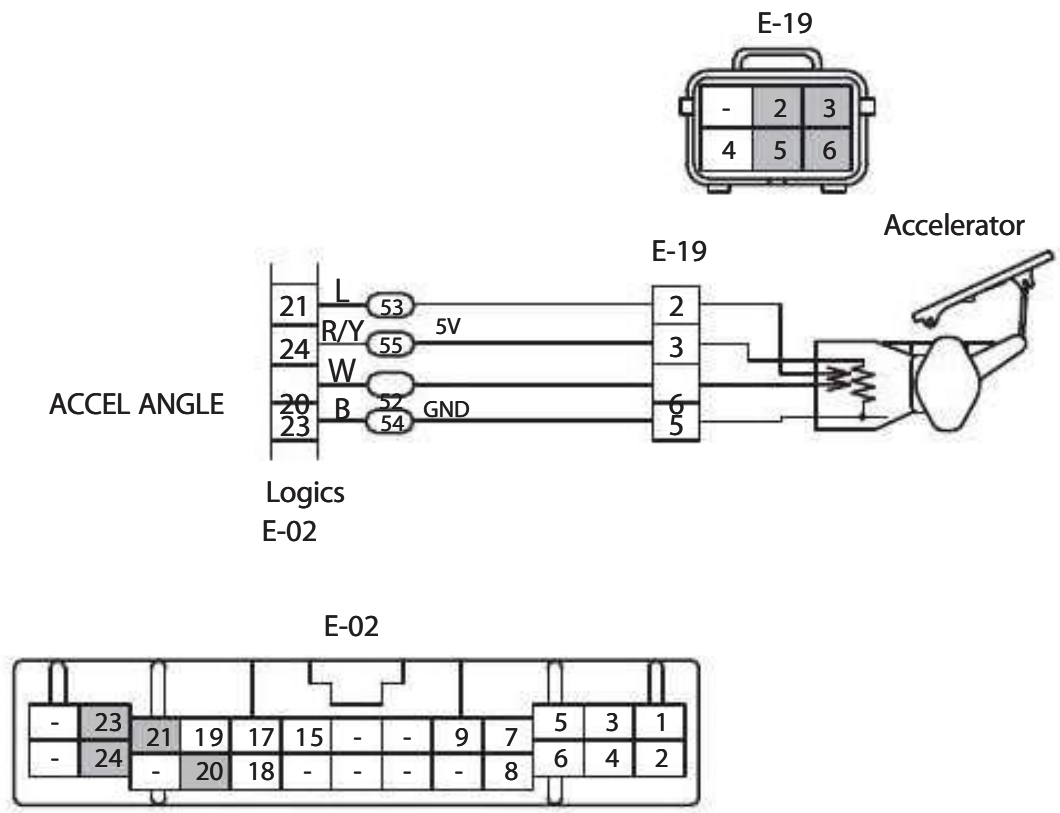
0 V | **Not 0 V**

(16) Replace accelerator pedal

(17) Disconnect battery plug

(18) Replace logic card of logic unit

502835

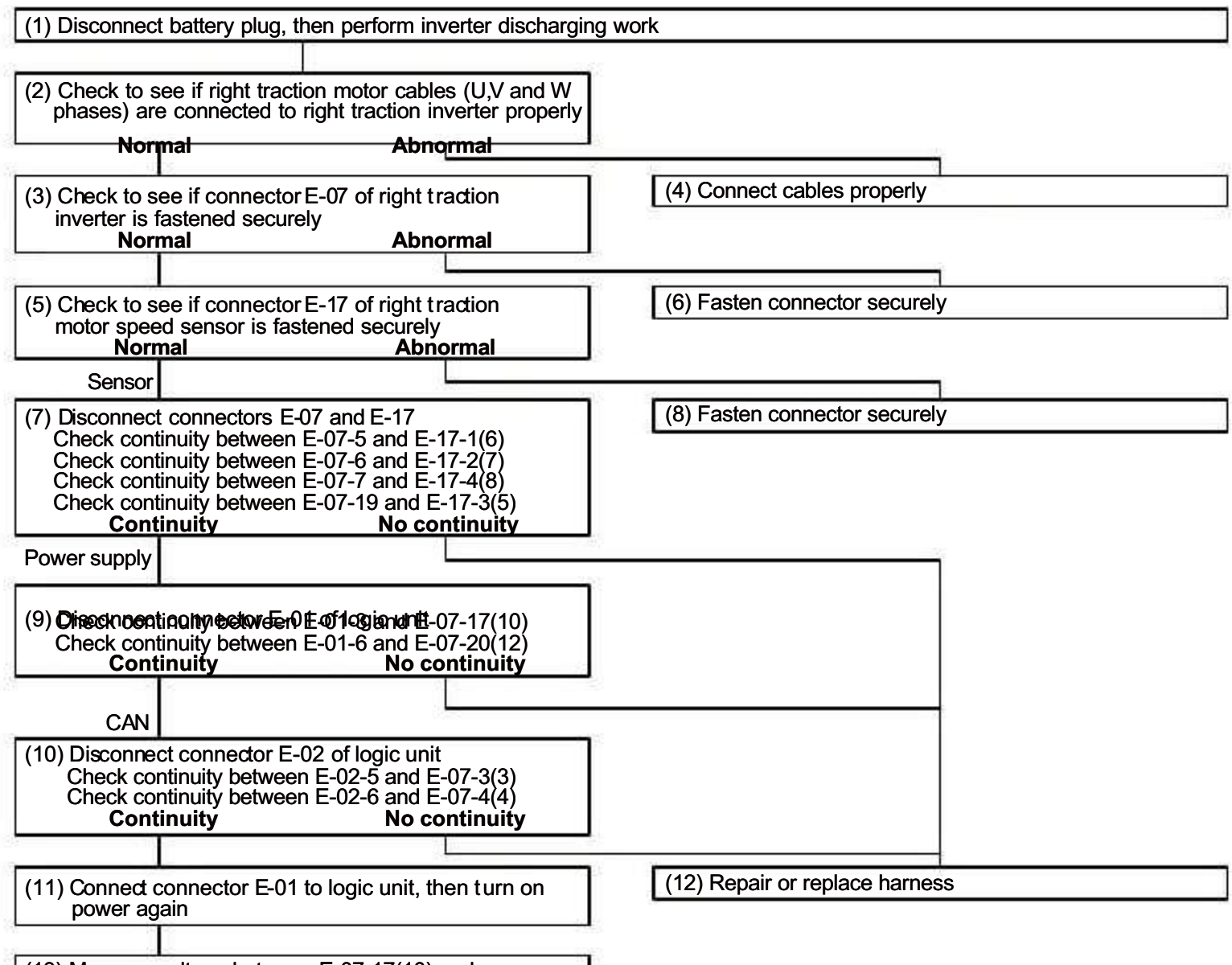


501144

3.24 Traction Motor R.H., Pulse Input Fault (52)

Error code: 52	
Situation	Display: "52". Traction motor operation inhibited. Pump motor and power steering operations inhibited if this fault occurs before pump contactor CLOSE, and both operable if it occurs after pump contactor CLOSE. Line contactor OPEN and pump contactor CLOSE or OPEN.
Possible cause	Faulty contact of right side traction inverter connector, faulty connection of right side traction motor connector and cable, faulty 12V input voltage of right side traction inverter, faulty contact or wire breakage of right side traction motor speed sensor harness, faulty DSP card of right side traction inverter, faulty right side traction motor speed sensor.
Trigger of the error code	Motor rotation speed is more than 6000 rpm.

Checks



(13) Measure voltage between E-07-17(10) and E-07-20(12) Confirm value is 14 ± 2 V

Normal **Abnormal**

(14) Disconnect battery plug, then perform inverter discharging work

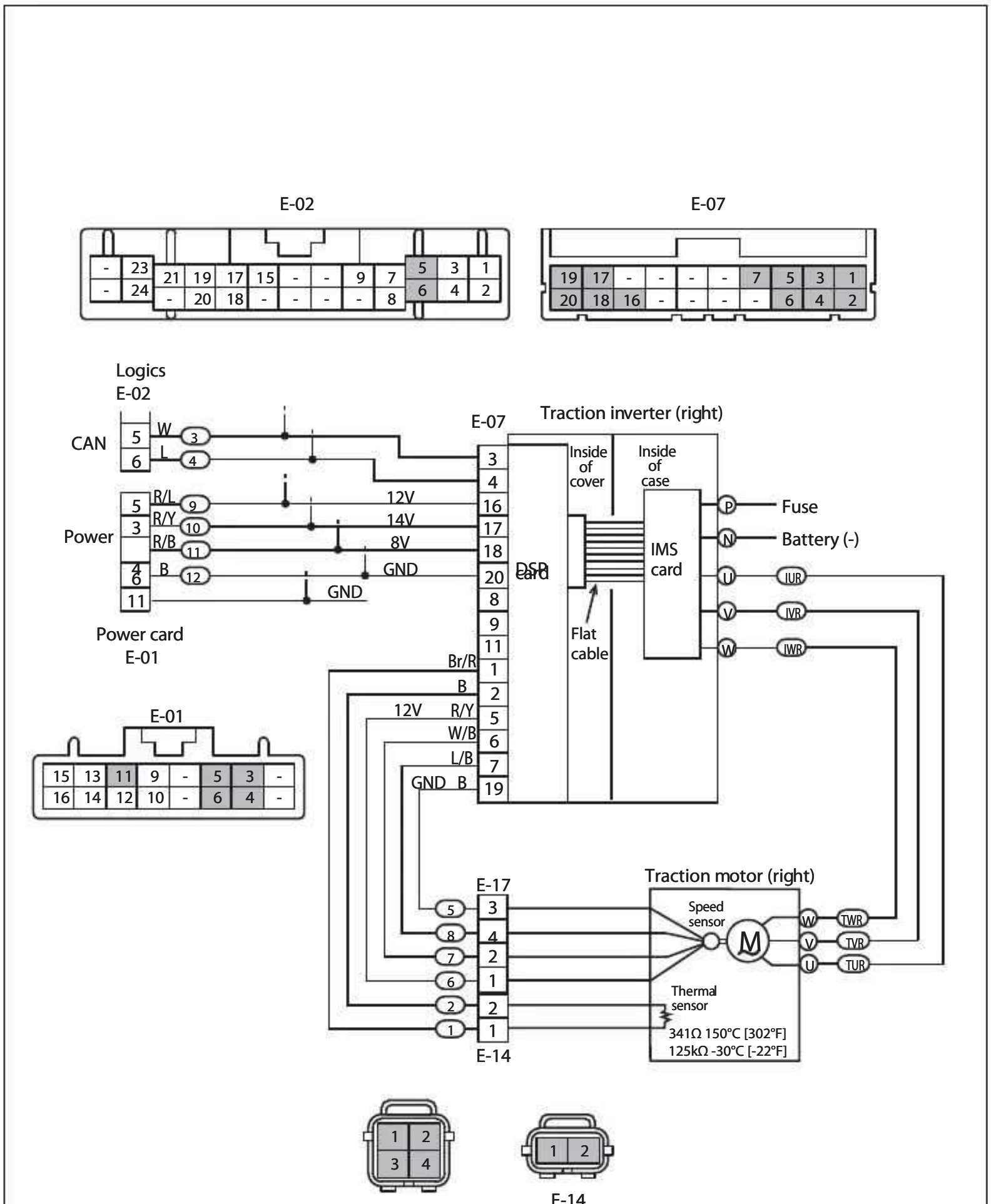
(15) Replace DSP card of right traction inverter

(16) Replace power supply card of logic unit

If fault remains

(17) Perform inverter discharging work, then replace Right traction motor (DSP card is normal)

502836



E-17

501135

3.25 Traction Motor L.H., Pulse Input Fault (53)

Error code: 53	
Situation	Display: "53". Traction motor operation inhibited. Pump motor and power steering operations inhibited if this fault occurs before pump contactor CLOSE, and both operable if it occurs after pump contactor CLOSE. Line contactor OPEN and pump contactor CLOSE or OPEN.
Possible cause	Faulty contact of left side traction inverter connector, faulty connection of left side traction motor connector and cable, faulty 12V input voltage of left side traction inverter, faulty contact or wire breakage of left side traction motor speed sensor harness, faulty DSP card of left side traction inverter, faulty left side traction motor speed sensor.
Trigger of the error code	Motor rotation speed is more than 6000 rpm.

Checks

(1) Disconnect battery plug, then perform inverter discharging work

(2) Check to see if left traction motor cables (U, V and W phases) are connected to left traction inverter properly
Normal **Abnormal**

(4) Connect cables properly

(3) Check to see if connector E-06 of left traction inverter is fastened securely
Normal **Abnormal**

(6) Fasten connector securely

(5) Check to see if connector E-18 of left traction motor speed sensor is fastened securely
Normal **Abnormal**

Sensor

(8) Fasten connector securely

(7) Disconnect connectors E-06 and E-18
Check continuity between E-06-5 and E-18-1(15)
Check continuity between E-06-6 and E-18-4(18)
Check continuity between E-06-7 and E-18-2(17)
Check continuity between E-06-19 and E-18-3(16)
Continuity **No continuity**

Power supply

(9) Disconnect connector E-01 of logic unit
Check continuity between E-01-3 and E-06-17(10)
Check continuity between E-01-6 and E-06-20(12)
Continuity **No continuity**

CAN

(10) Disconnect connector E-02 of logic unit
Check continuity between E-02-5 and E-06-3(3)
Check continuity between E-02-6 and E-06-4(4)
Continuity **No continuity**

(12) Repair or replace harness

(11) Connect connector E-01 to logic unit, then turn on power again

(13) Measure voltage between E-06-17(10) and E-06-20(12) Confirm value is 14 ± 2 V

Normal **Abnormal**

(14) Disconnect battery plug, then perform inverter discharging work

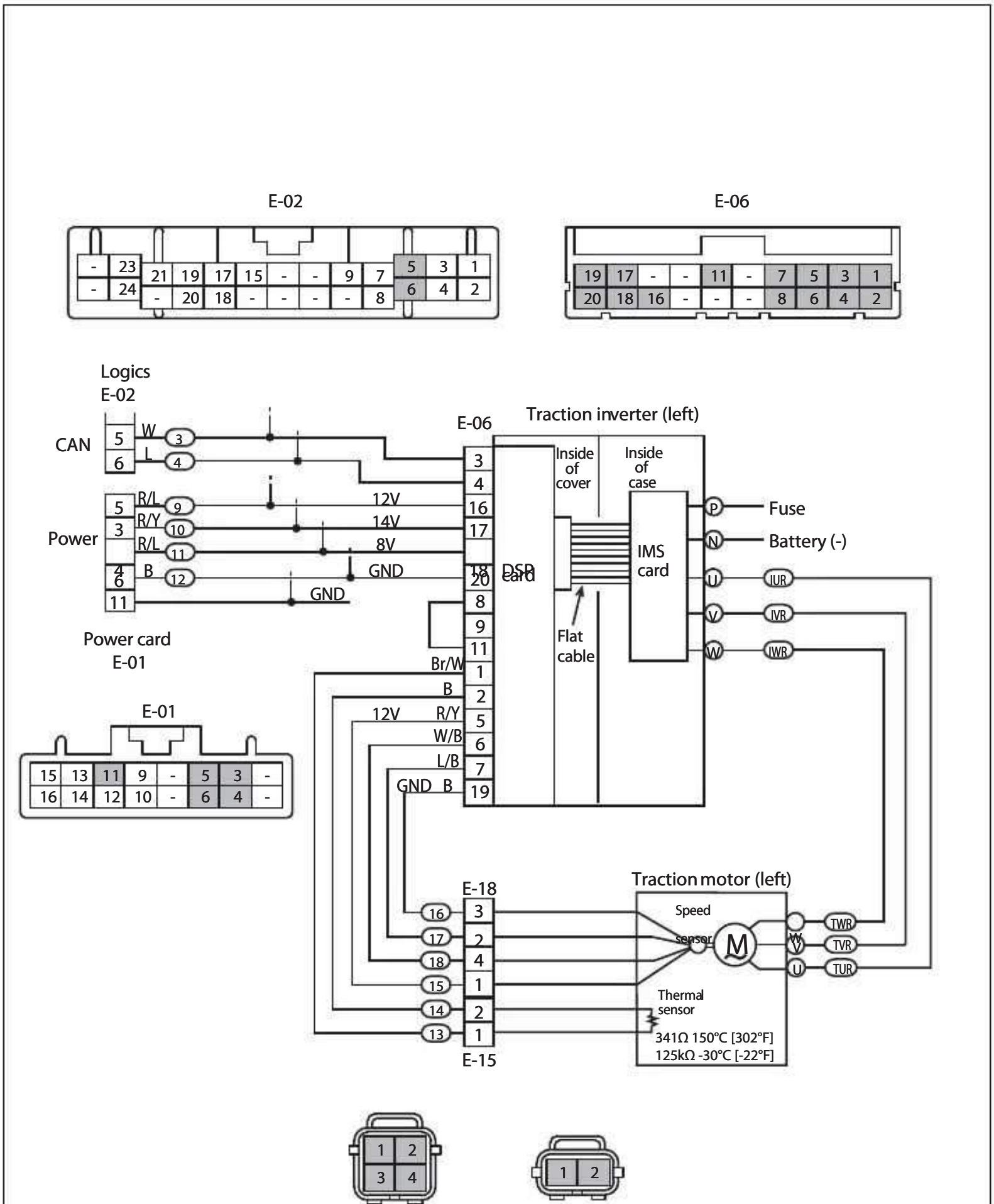
(15) Replace DSP card of left traction inverter

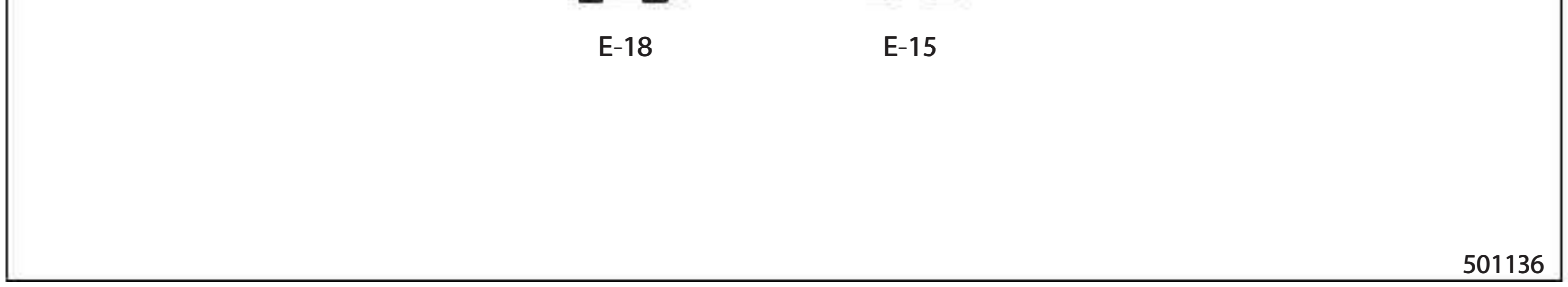
(16) Replace power supply card of logic unit

If fault remains

(17) Perform inverter discharging work, then replace left traction motor (DSP card is normal)

502837





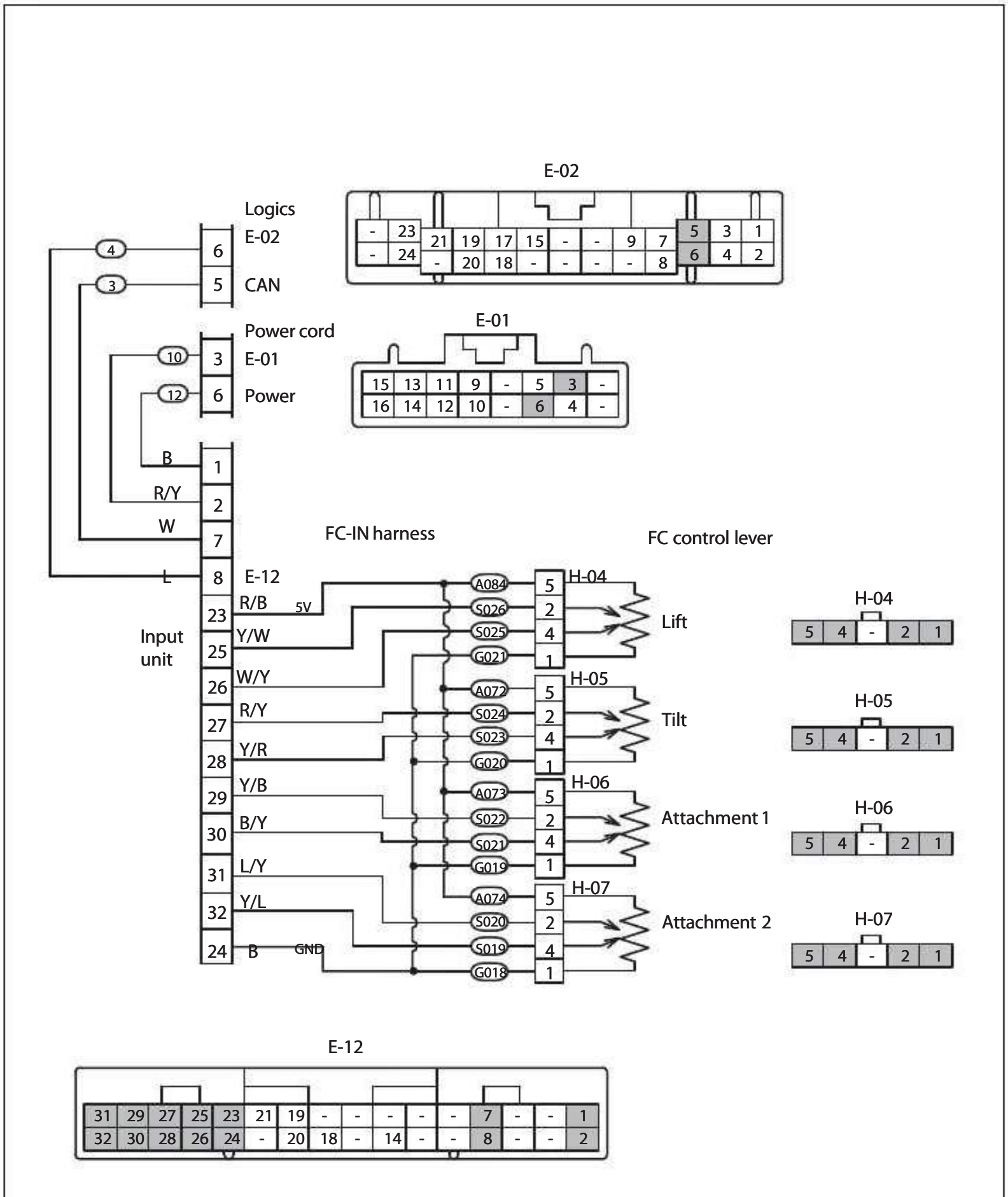
3.26 FC Lever Fault (54)

Error code: 54	
Situation	Display: "54". Related lever operation inhibited. Normal traction motor and power steering operations.
Possible cause	Faulty lift FC control lever, faulty tilt FC control lever, faulty attachment 1 and 2 FC control levers, faulty main harness, faulty input unit.
Trigger of the error code	FC control lever voltage is out of range of 0.1 V to 4.9 V.

Checks

(14) Reinstall input unit and replace harness (FC-IN harness)

502838

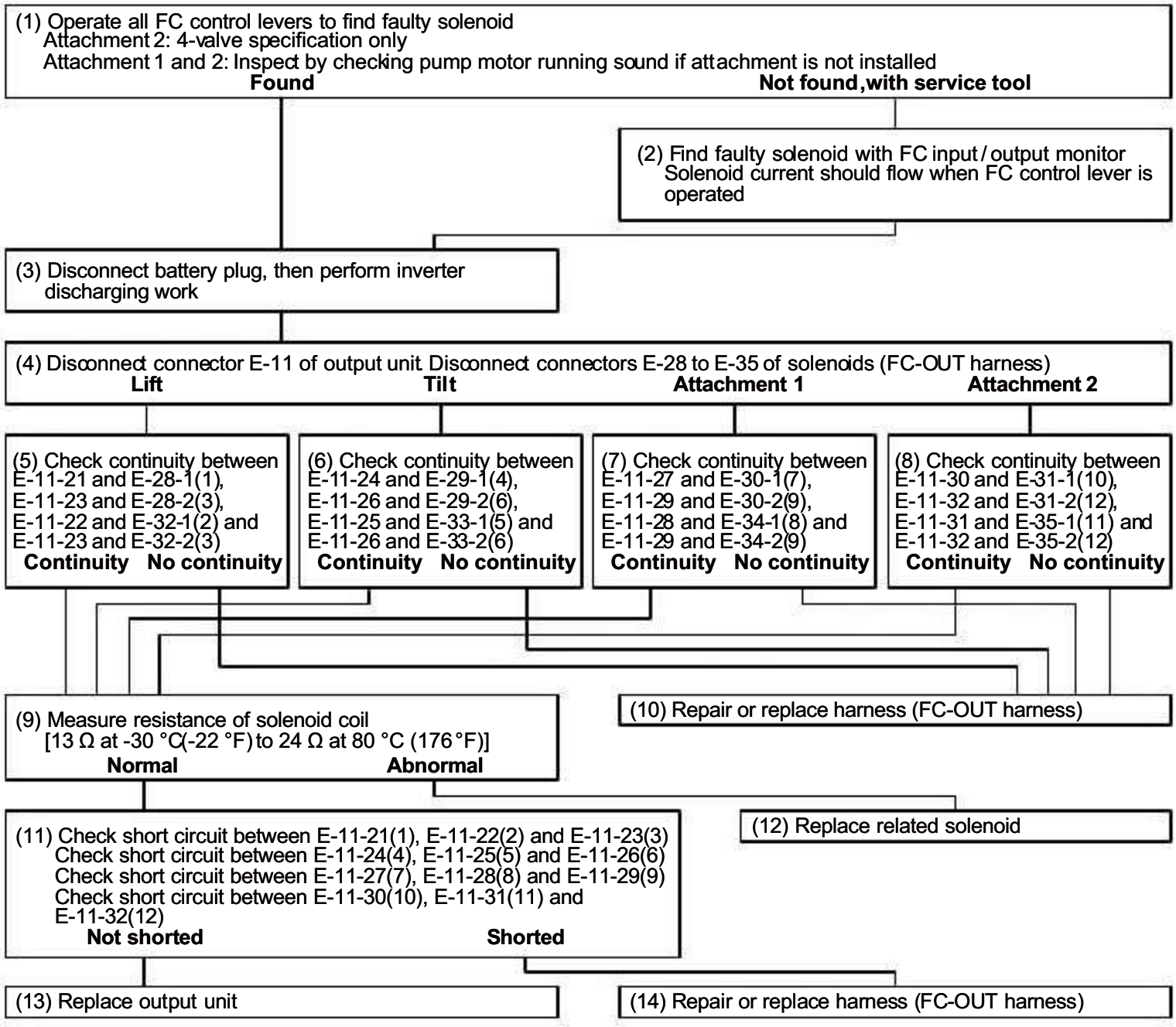


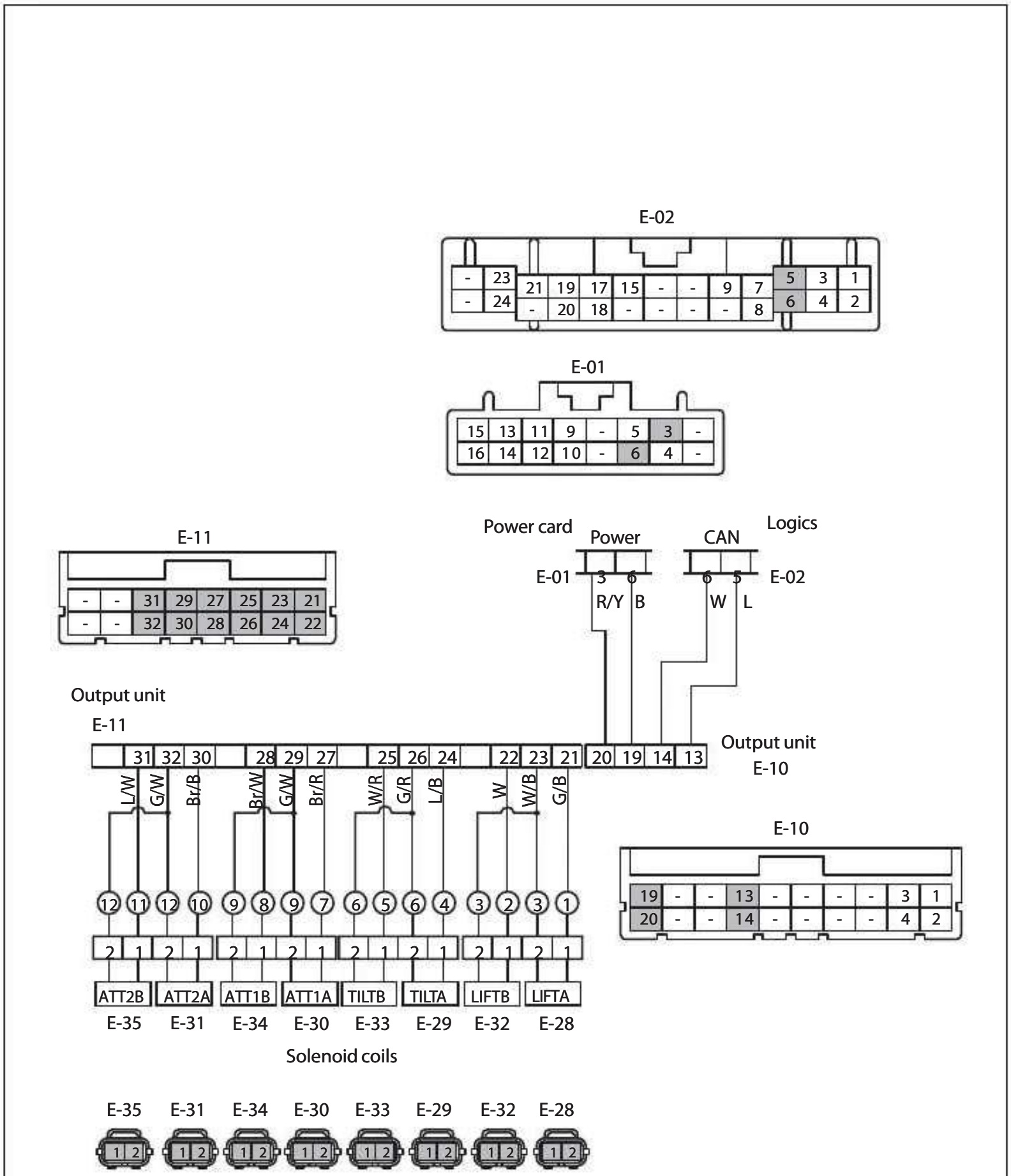
501147

3.27 Output Unit Solenoid Fault (55)

Error code: 55	
Situation	Display: "55". Related lever operation inhibited. Normal traction motor and power steering operations.
Possible cause	Faulty lift solenoid, faulty tilt solenoid, faulty attachment 1 and 2 solenoids, faulty main harness, faulty output unit.
Trigger of the error code	When signal is outputted, current is out of range of 0.16 A to 1.9 A.

Checks



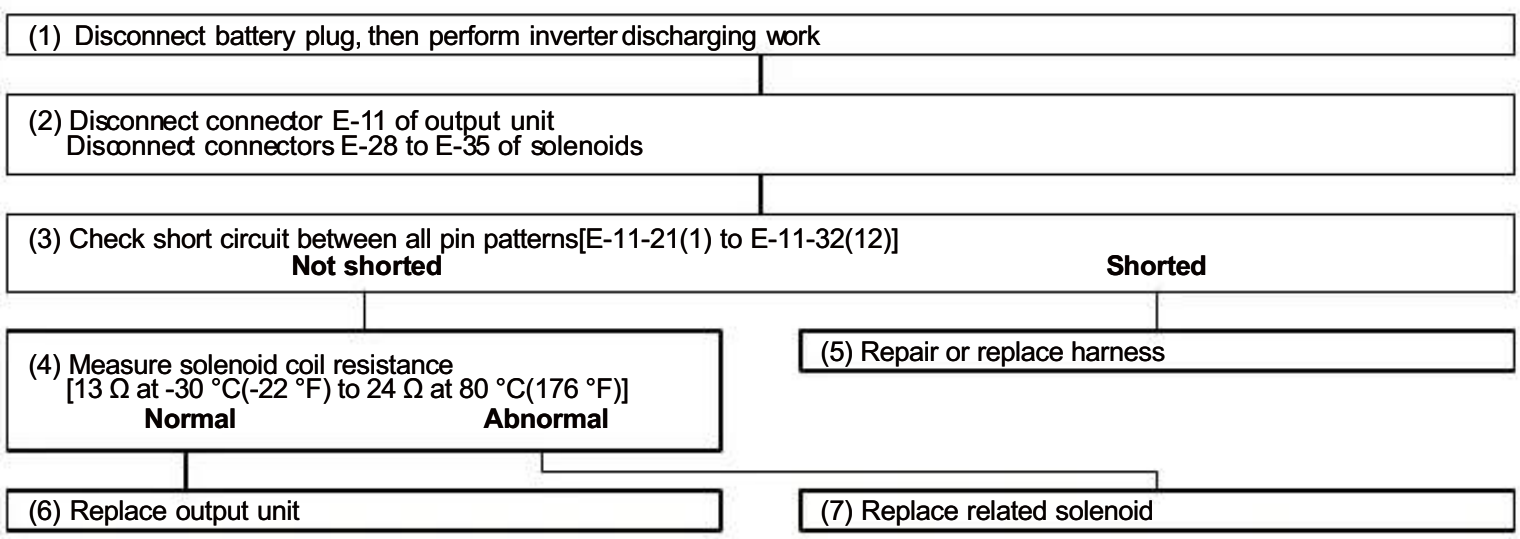

E-02
- 23 21 19 17 15 - - 9 7 5 3 1
- 24 - 20 18 - - - - 8 6 4 2
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
E-11
- - 31 29 27 25 23 21
- - 32 30 28 26 24 22
Power card
Power
CAN
Logics
E-01
3 6
R/Y B
6 5
W L
E-02
Output unit
E-11
31 32 30 28 29 27 25 26 24 22 23 21 20 19 14 13
Output unit
E-10
L/W G/W Br/B Br/W G/W Br/R W/R G/R L/B W W/B G/B
12 11 12 10 9 8 9 7 6 5 6 4 3 2 3 1
2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
ATT2B ATT2A ATT1B ATT1A TILTB TILTA LIFTB LIFTA
E-35 E-31 E-34 E-30 E-33 E-29 E-32 E-28
Solenoid coils
E-10
19 - - 13 - - - - 3 1
20 - - 14 - - - - 4 2
E-35 E-31 E-34 E-30 E-33 E-29 E-32 E-28
1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2

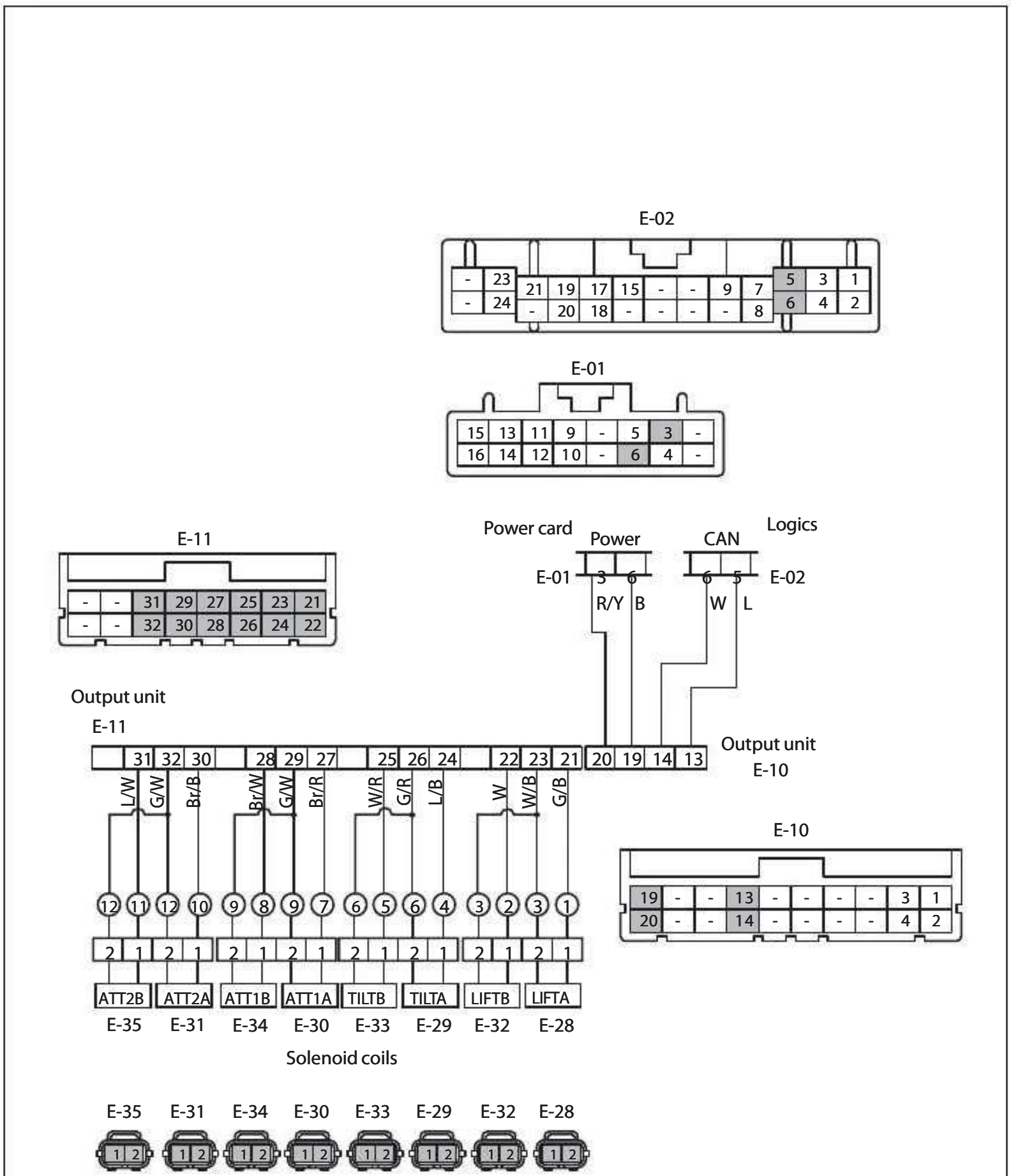
501150

3.28 Output Unit Solenoid Current Leak (56)

Error code: 56	
Situation	Display: "56". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty lift solenoid, faulty tilt solenoid, faulty attachment 1 and 2 solenoids, faulty main harness, faulty output unit.
Trigger of the error code	When signal is not outputted, current is more than 0.18 A.

Checks



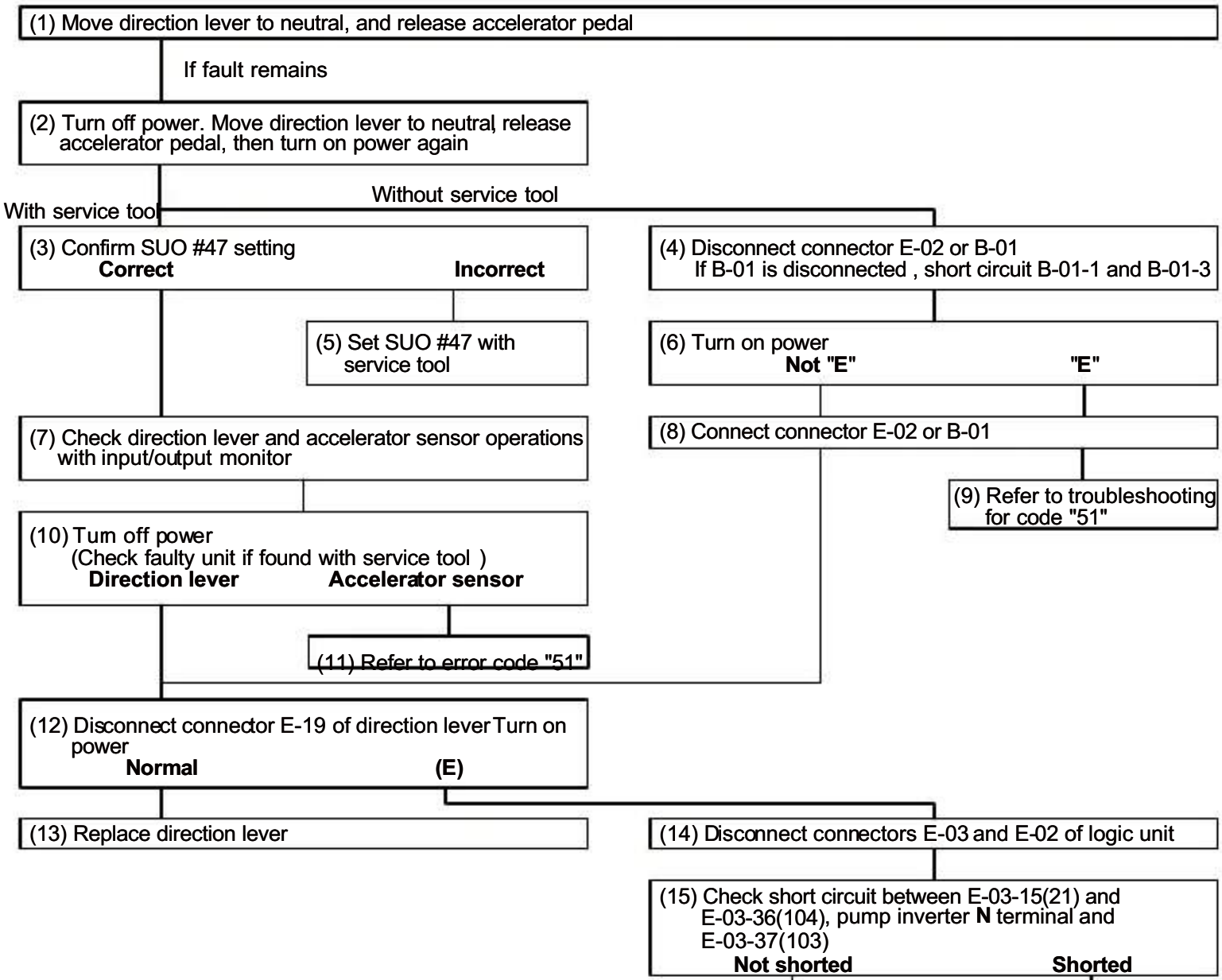

E-02
- 23 21 19 17 15 - - 9 7 5 3 1
- 24 - 20 18 - - - - 8 6 4 2
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
E-11
- - 31 29 27 25 23 21
- - 32 30 28 26 24 22
Power card
Power
CAN
Logics
E-01
3 6
R/Y B
6 5
W L
E-02
Output unit
E-11
31 32 30 28 29 27 25 26 24 22 23 21 20 19 14 13
Output unit
E-10
L/W G/W Br/B Br/W G/W Br/R W/R G/R L/B W W/B G/B
E-10
19 - - 13 - - - - 3 1
20 - - 14 - - - - 4 2
12 11 12 10 9 8 9 7 6 5 6 4 3 2 3 1
2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
ATT2B ATT2A ATT1B ATT1A TILTB TILTA LIFTB LIFTA
E-35 E-31 E-34 E-30 E-33 E-29 E-32 E-28
Solenoid coils
E-35 E-31 E-34 E-30 E-33 E-29 E-32 E-28
1 2

501150

3.29 FNR Lever or Accelerator, Faulty Setting (E)

Error code: E	
Situation	Display: "E". Traction motor operation inhibited. Normal pump and power steering operations. Line contactor OPEN.
Possible cause	Key switch turned on while direction lever was either in forward or reverse position, key switch turned on while accelerator pedal was depressed, seat switch turned off during running, faulty direction lever switch, faulty accelerator sensor, faulty main harness, faulty logic unit.
Trigger of the error code	Detects following signal when turning on power. Direction lever: F or R Accelerator sensor voltage: More than 0.9 V

Checks

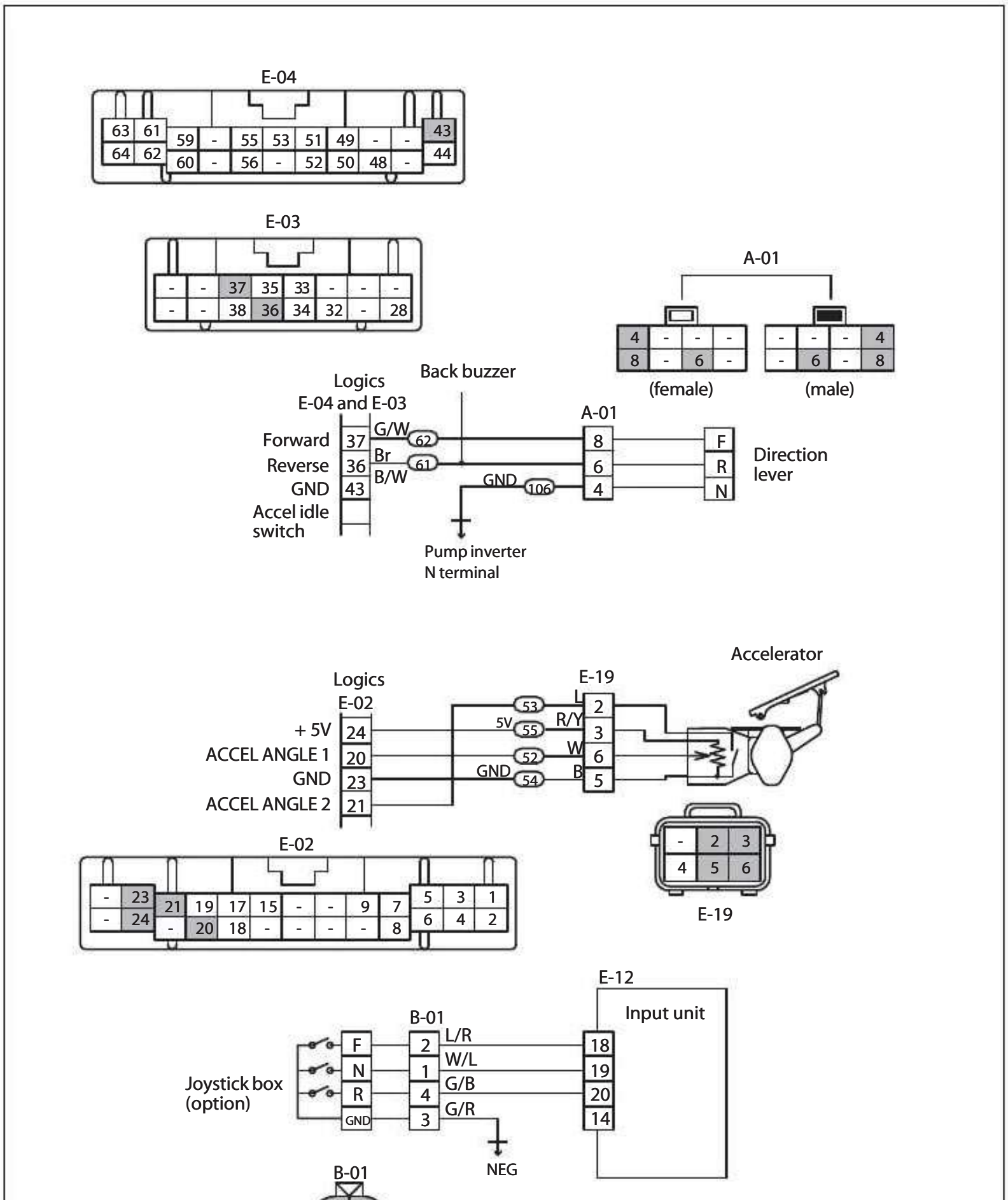


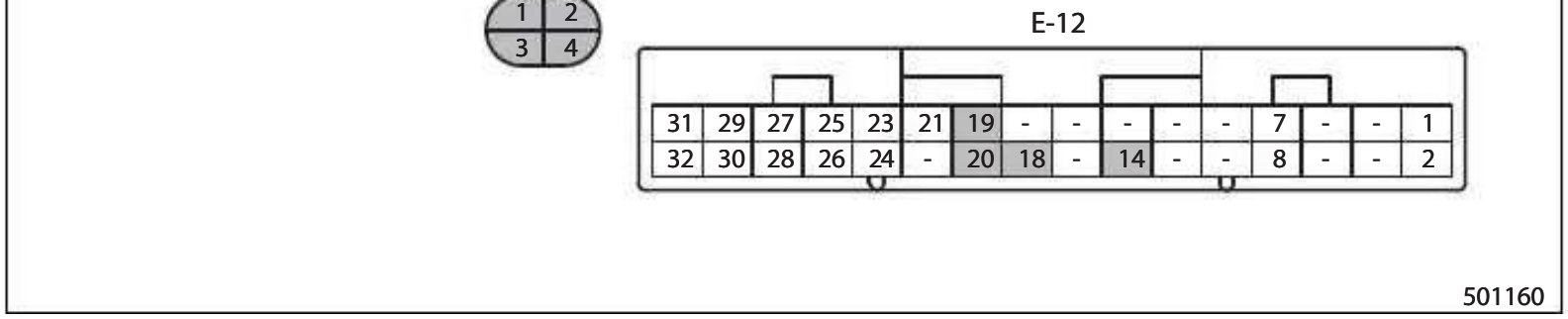
(16) Disconnect battery plug

(17) Repair or replace main harness

(18) Replace Logic card of logic unit

502841

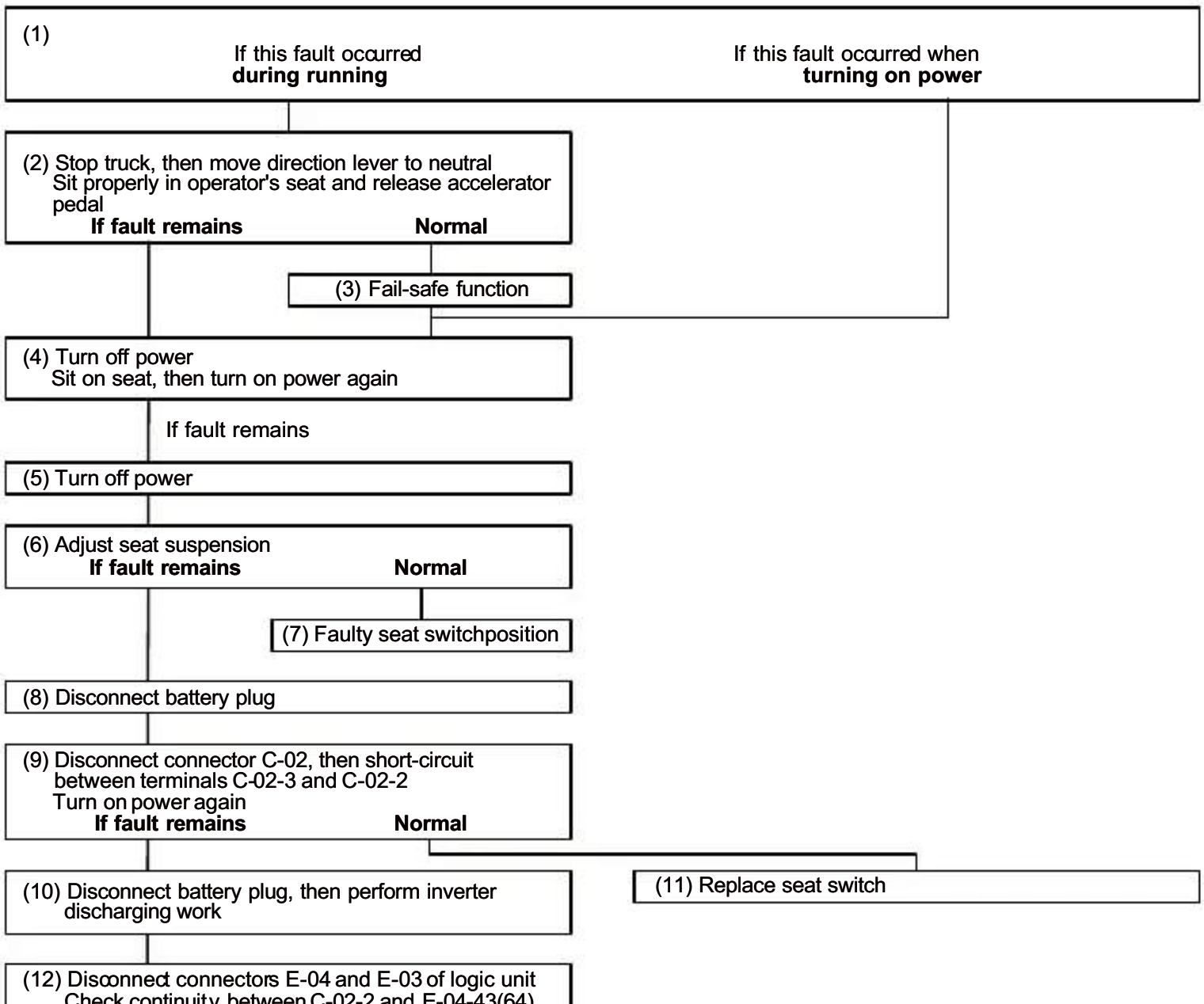




3.30 Seat Switch, Faulty Setting for Traction ((E))

Error code: (E)	
Situation	Display: "(E)" flashes. Traction motor operation inhibited. Normal pump and power steering operations. Line contactor OPEN.
Possible cause	Operator is not seated, seat switch turned off during running, improper seat suspension adjustment, faulty seat switch, faulty main harness, faulty logic unit.
Trigger of the error code	Detects seat switch opening when turning on power or during running.

Checks



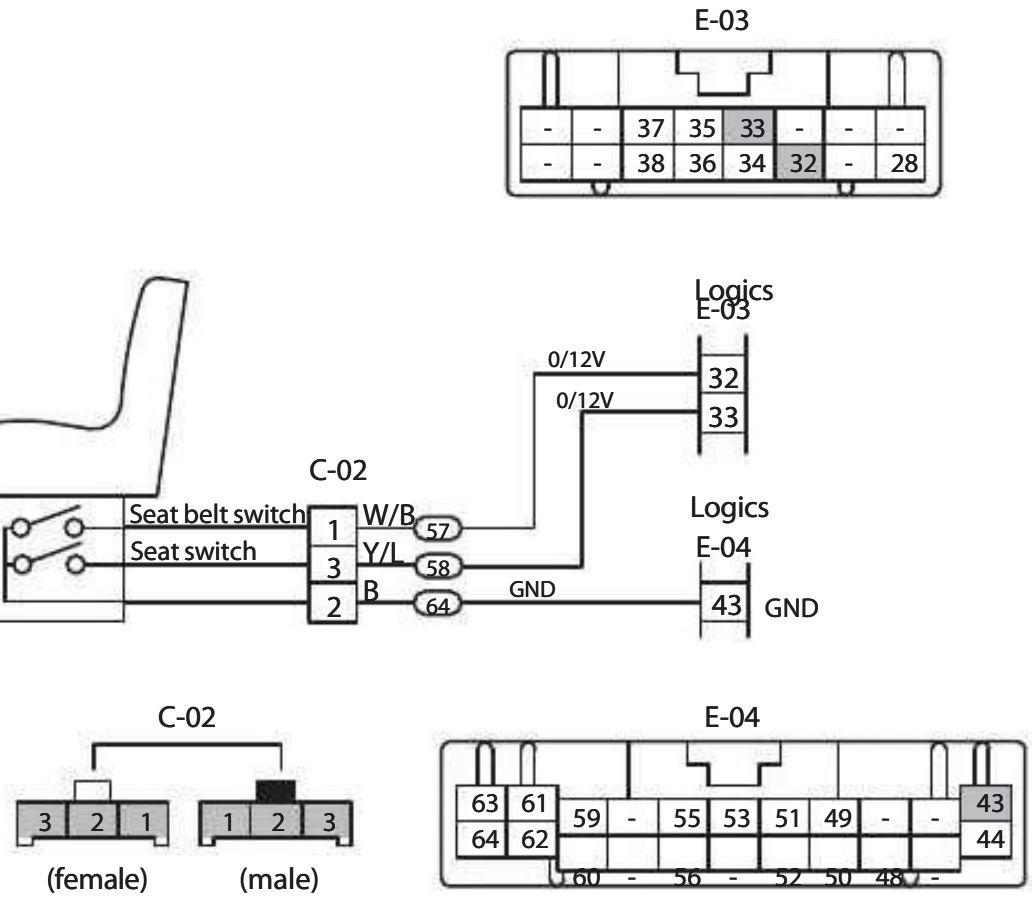
Check continuity between C-02-3 and E-03-33(58)

Continuity | **No continuity**

(13) Replace logic card of logic unit

(14) Repair or replace main harness

502842

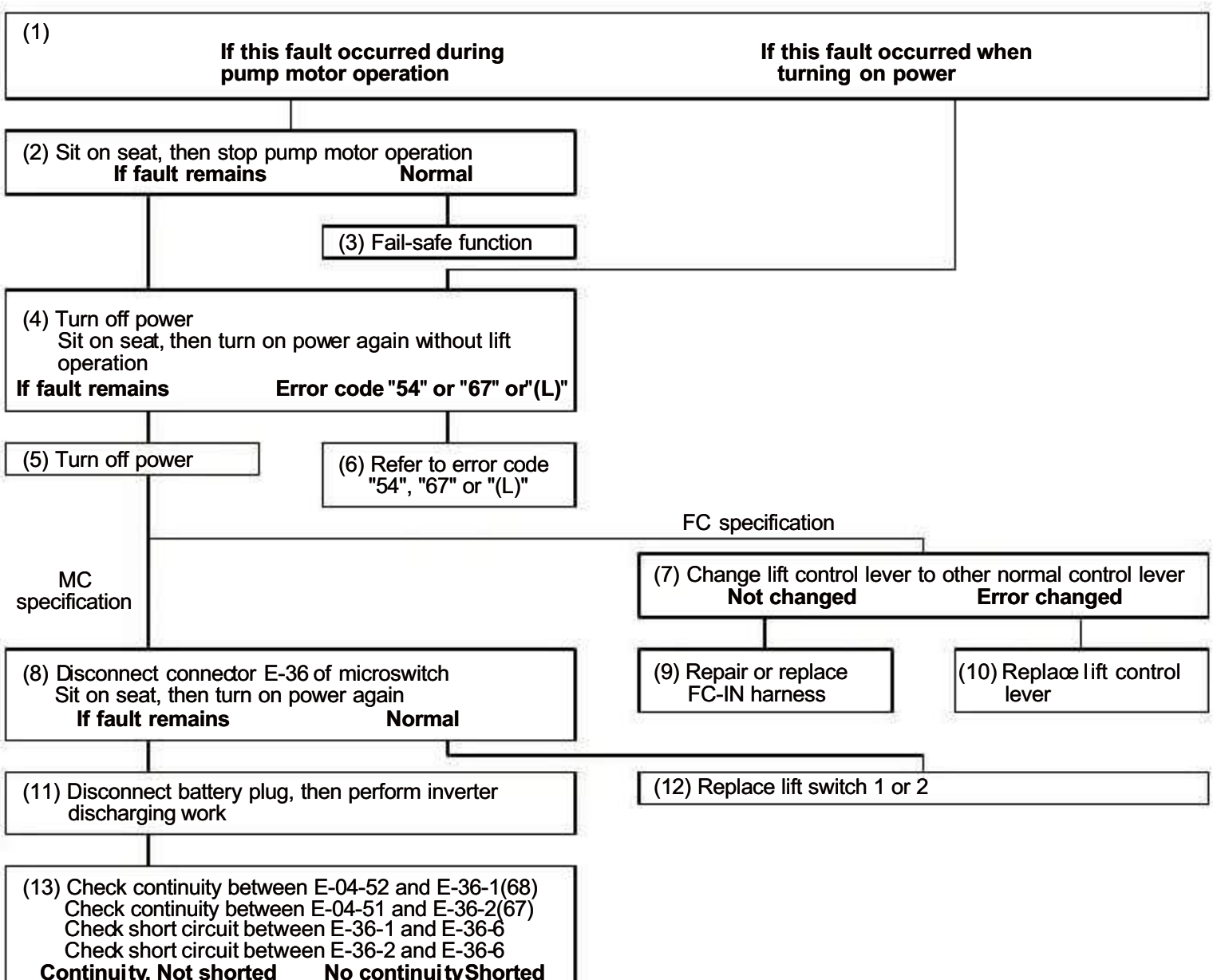


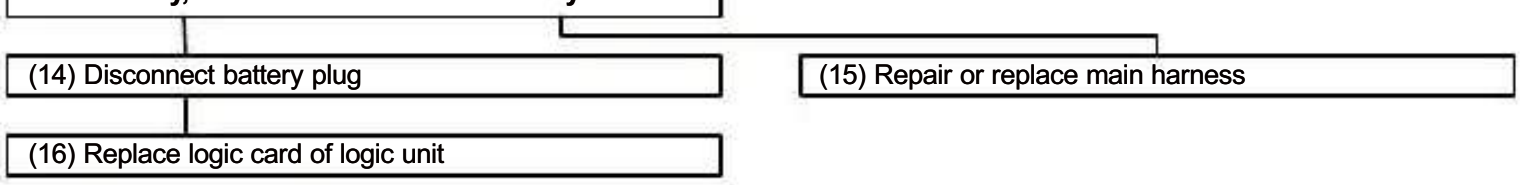
501161

3.31 Lift Lever, Faulty Setting (H1)

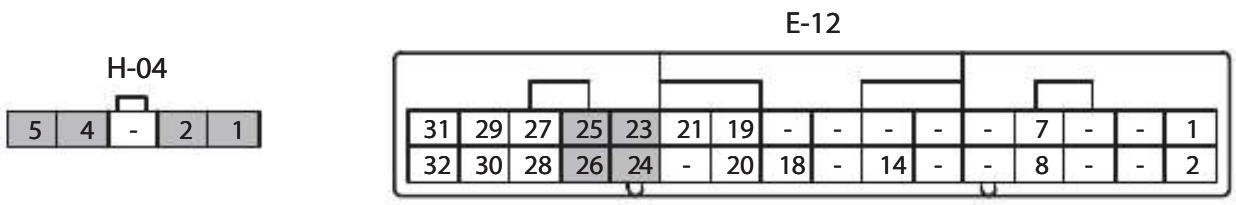
Error code: H1	
Situation	Display: "H1" flashes. Pump motor and power steering operations inhibited. Pump contactor OPEN if this fault occurs when turning on power. Pump contactor CLOSE if this fault occurs during pump operation and then OPEN if truck stops.
Possible cause	Key switch turned on while operating lift lever, faulty lift control lever or lift switches 1 and 2, faulty main harness, faulty logic unit, faulty input unit.
Trigger of the error code	Detects lift control lever signal of CAN when turning on power (FC specification). Detects lift microswitch 1 or 2 when turning on power (MC specification).

Checks

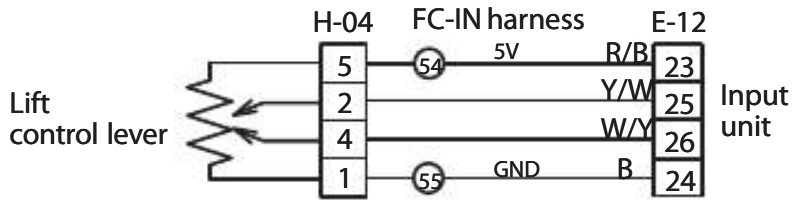




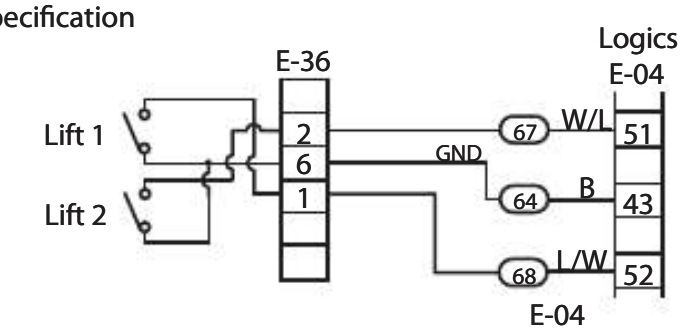
502843

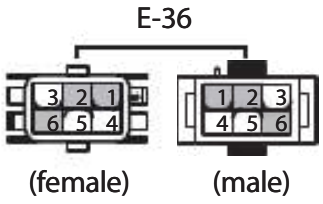


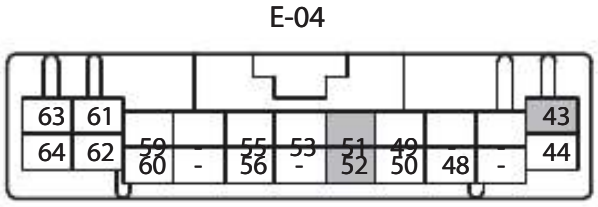
FC specification



MC specification





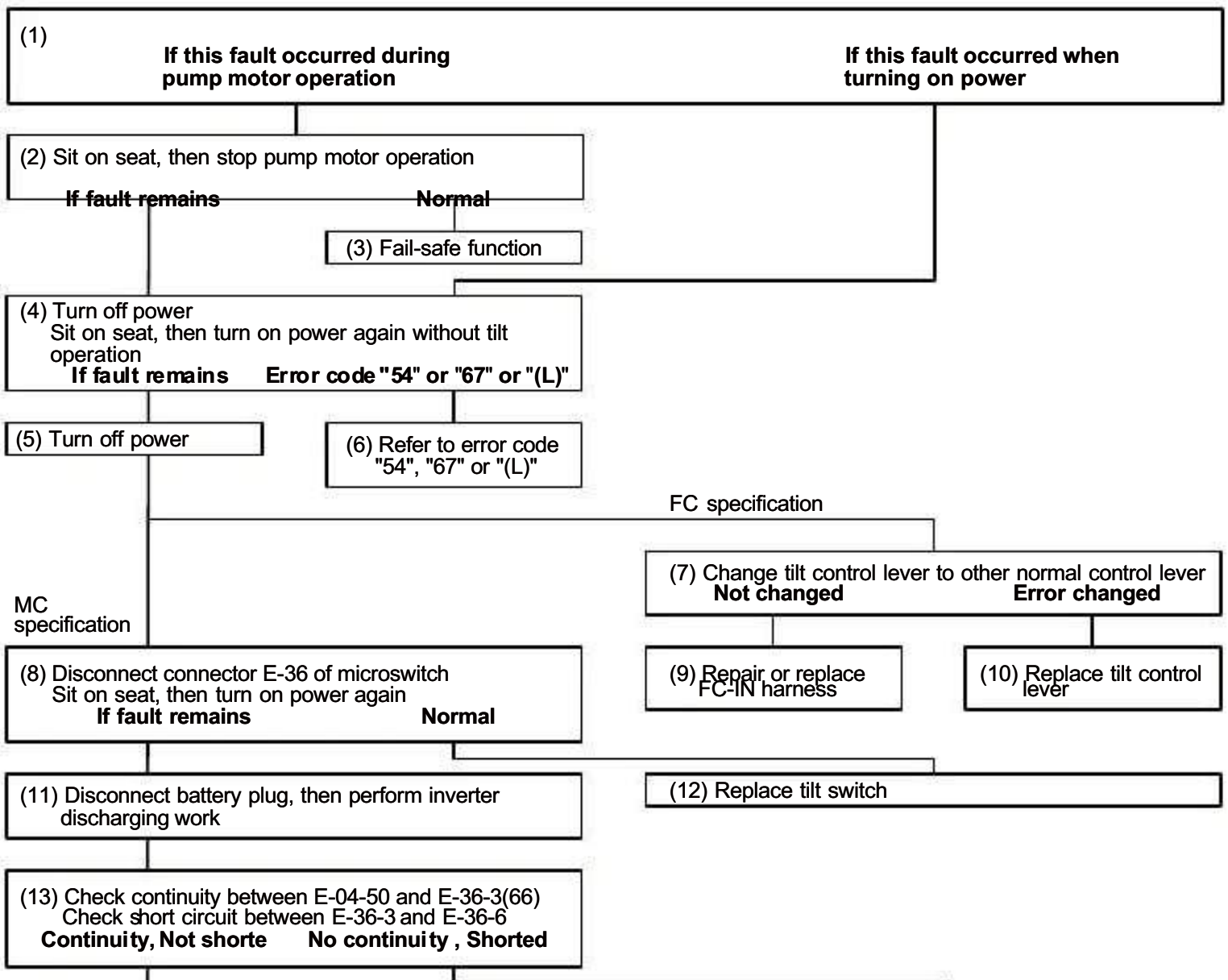


501162

3.32 Tilt Lever, Faulty Setting (H2)

Error code: H2	
Situation	Display: "H2" flashes. Pump motor and power steering operations inhibited. Pump contactor OPEN if this fault occurs when turning on power. Pump contactor CLOSE if this fault occurs during pump operation and then OPEN if truck stops.
Possible cause	Key switch turned on while operating tilt lever, faulty tilt control lever or tilt switch, faulty main harness, faulty logic unit, faulty input unit.
Trigger of the error code	Detects tilt control lever signal of CAN when turning on power (FC specification). Detects tilt microswitch when turning on power (MC specification).

Checks



(14) Disconnect battery plug

(15) Repair or replace main harness

(16) Replace logic card of logic unit

502844

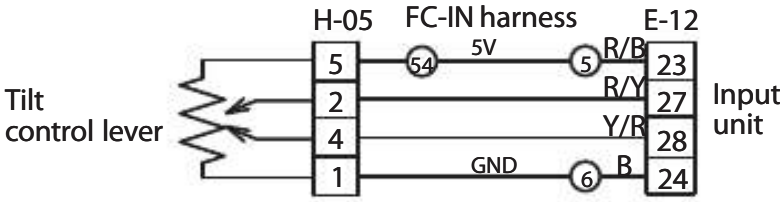
H-05

5	4	-	2	1

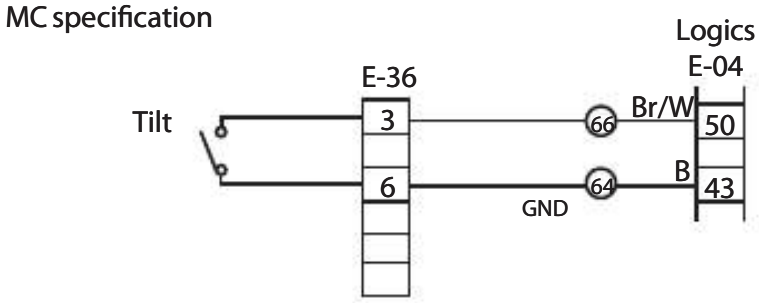
E-12

31	29	27	25	23	21	19	-	-	-	-	-	7	-	-	1
32	30	28	26	24	-	20	18	-	14	-	-	8	-	-	2

FC specification

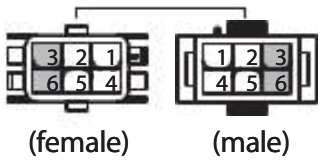


MC specification



E-04

63	61	59	-	55	53	51	49	-	-	43
64	62	60	-	56	-	52	50	48	-	44

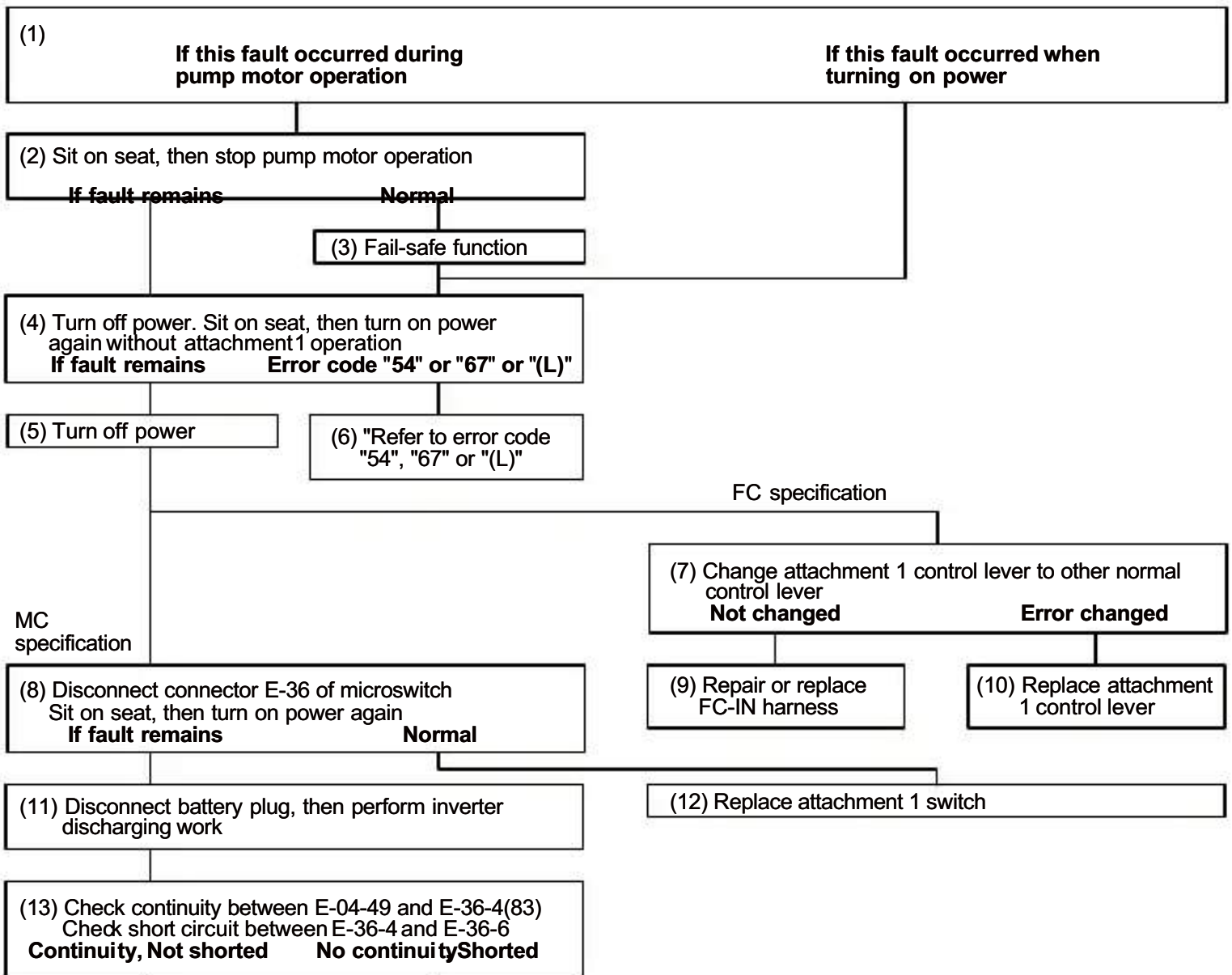


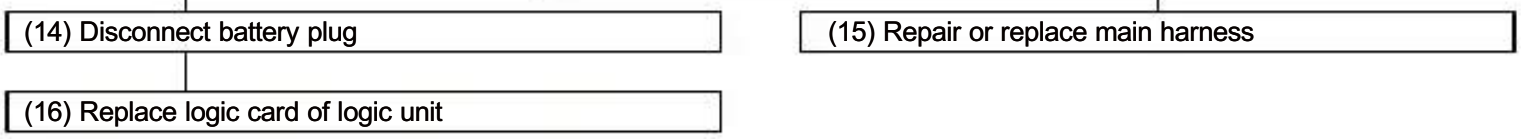
501163

3.33 Attachment 1 Lever, Faulty Setting (H3)

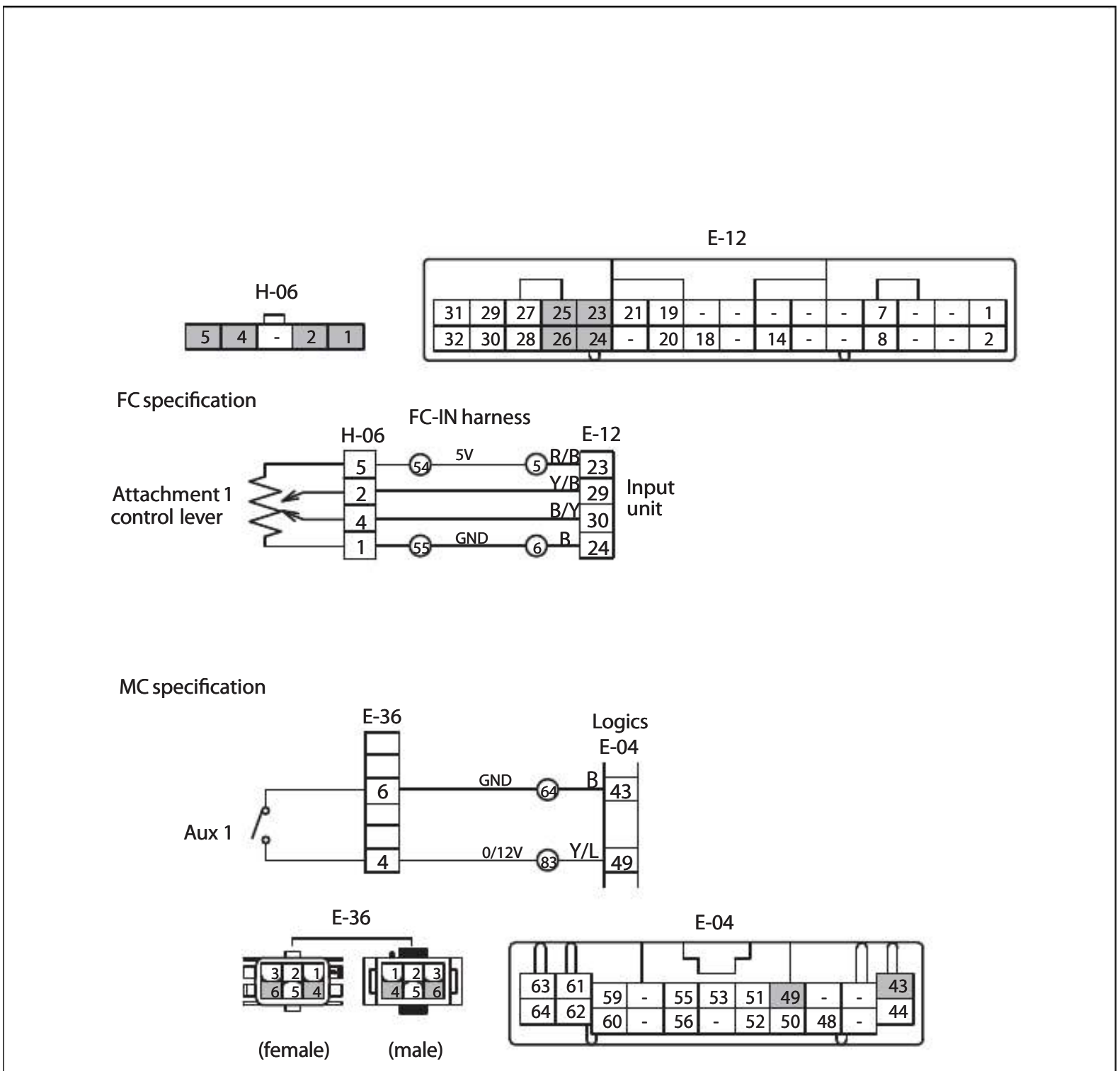
Error code: H3	
Situation	Display: "H3" flashes. Pump motor and power steering operations inhibited. Pump contactor OPEN if this fault occurs when turning on power. Pump contactor CLOSE if this fault occurs during pump operation and then OPEN if truck stops.
Possible cause	Key switch turned on while operating attachment 1 lever, faulty attachment 1 control lever or attachment 1 switch, faulty main harness, faulty logic unit, faulty input unit.
Trigger of the error code	Detects attachment 1 control lever signal of CAN when turning on power (FC specification). Detects attachment 1 microswitch when turning on power (MC specification).

Checks




(14) Disconnect battery plug
(15) Repair or replace main harness
(16) Replace logic card of logic unit

502845

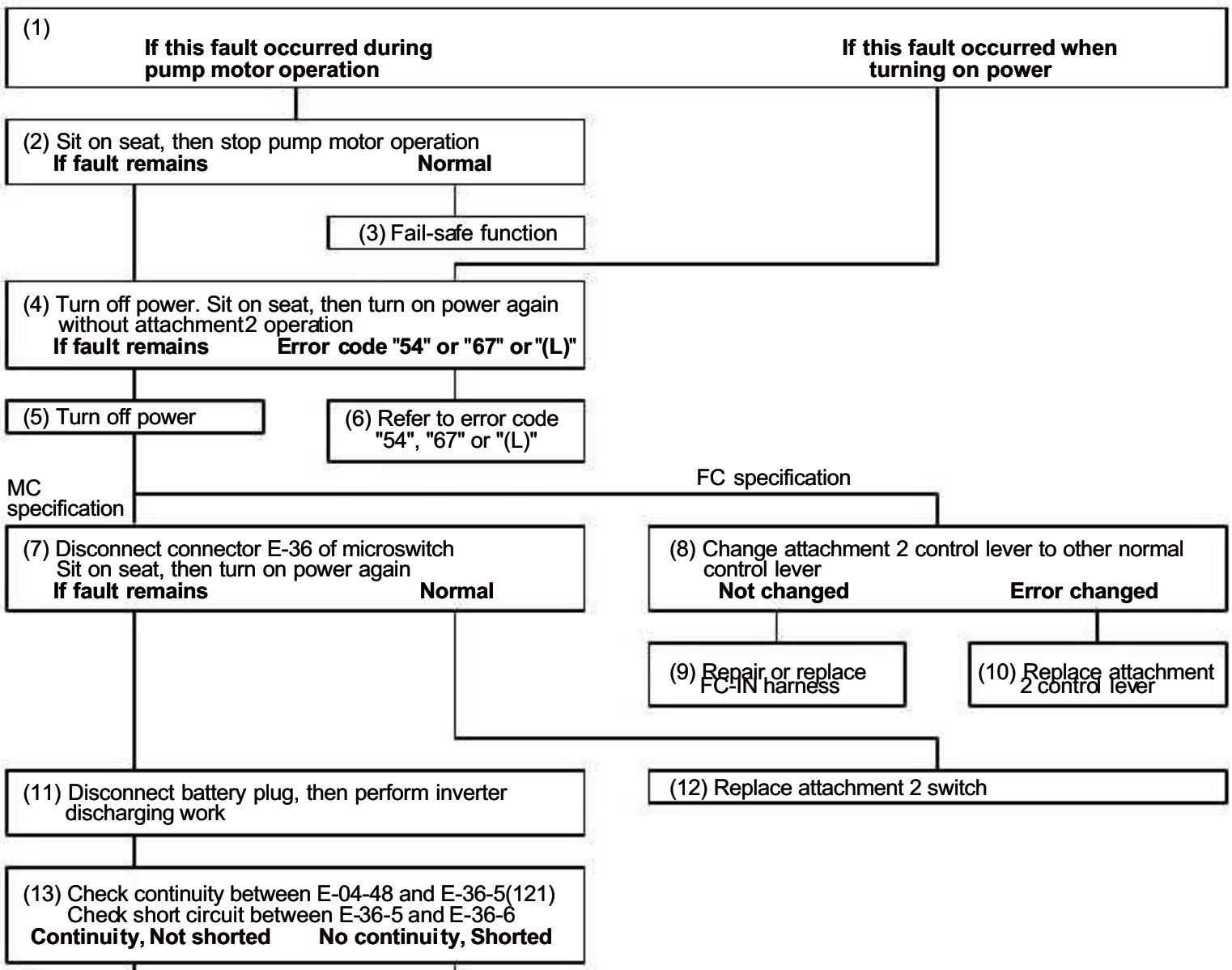

H-06
5 4 - 2 1
E-12
31 29 27 25 23 21 19 - - - - - 7 - - 1
32 30 28 26 24 - 20 18 - 14 - - 8 - - 2
FC specification
FC-IN harness
H-06
E-12
Attachment 1 control lever
5
2
4
1
54
55
5V
GND
5
6
R/B
Y/B
B/Y
B
23
29
30
24
Input unit
MC specification
E-36
Logics E-04
Aux 1
6
4
GND
64
0/12V
83
B
Y/L
43
49
E-36
3 2 1
6 5 4
1 2 3
4 5 6
(female)
(male)
E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44

501164

3.34 Attachment 2 Lever, Faulty Setting (H4)

Error code: H4	
Situation	Display: "H4" flashes. Pump motor and power steering operations inhibited. Pump contactor OPEN if this fault occurs when turning on power. Pump contactor CLOSE if this fault occurs during pump operation and then OPEN if truck stops.
Possible cause	Key switch turned on while operating attachment 2 lever, faulty attachment 2 control lever or attachment 2 switch, faulty main harness, faulty logic unit, faulty input unit.
Trigger of the error code	Detects attachment 2 control lever signal of CAN when turning on power (FC specification). Detects attachment 2 microswitch when turning on power (MC specification).

Checks

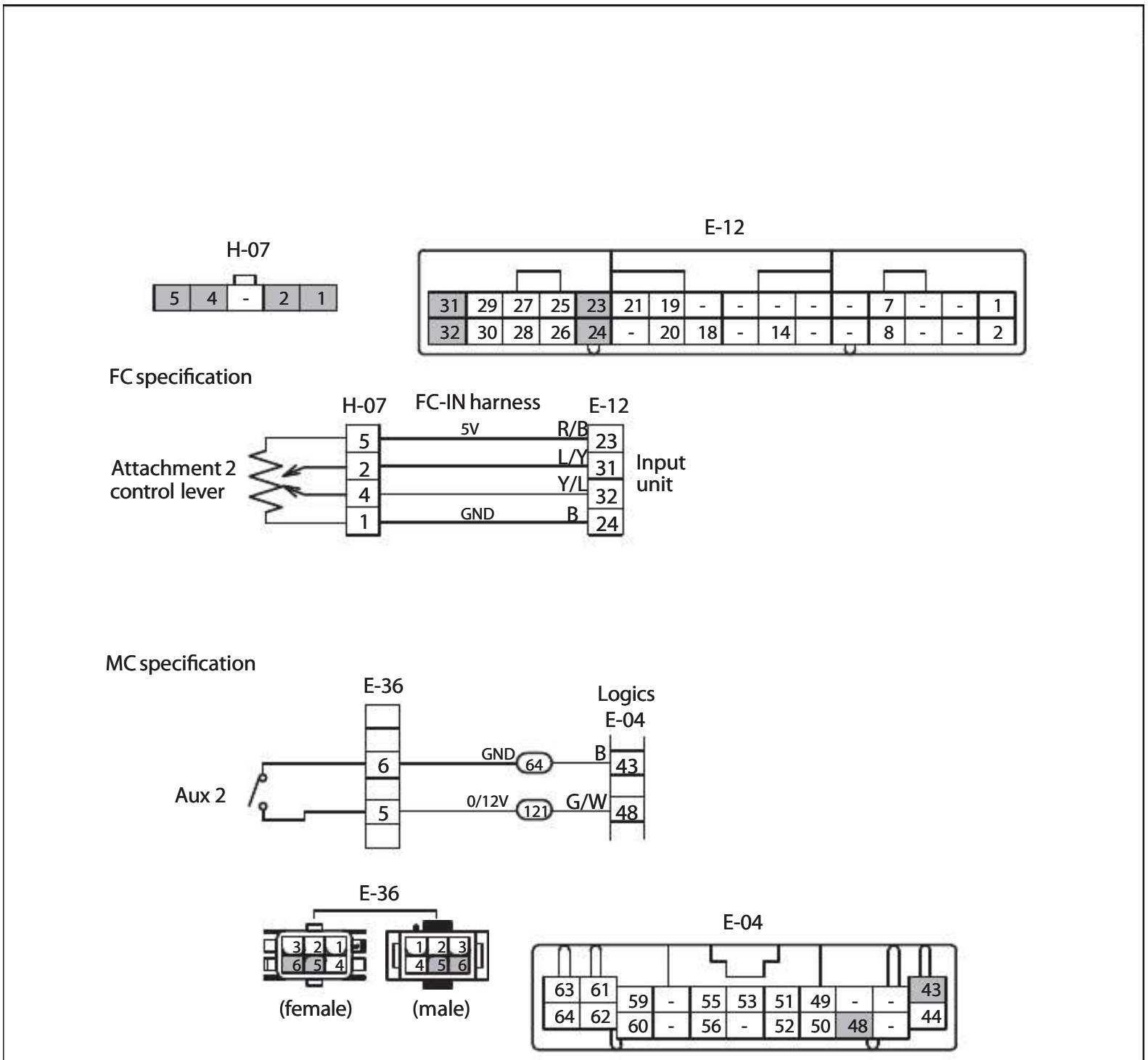


(14) Disconnect battery plug

(15) Replace logic card of logic unit

(16) Repair or replace main harness

502846

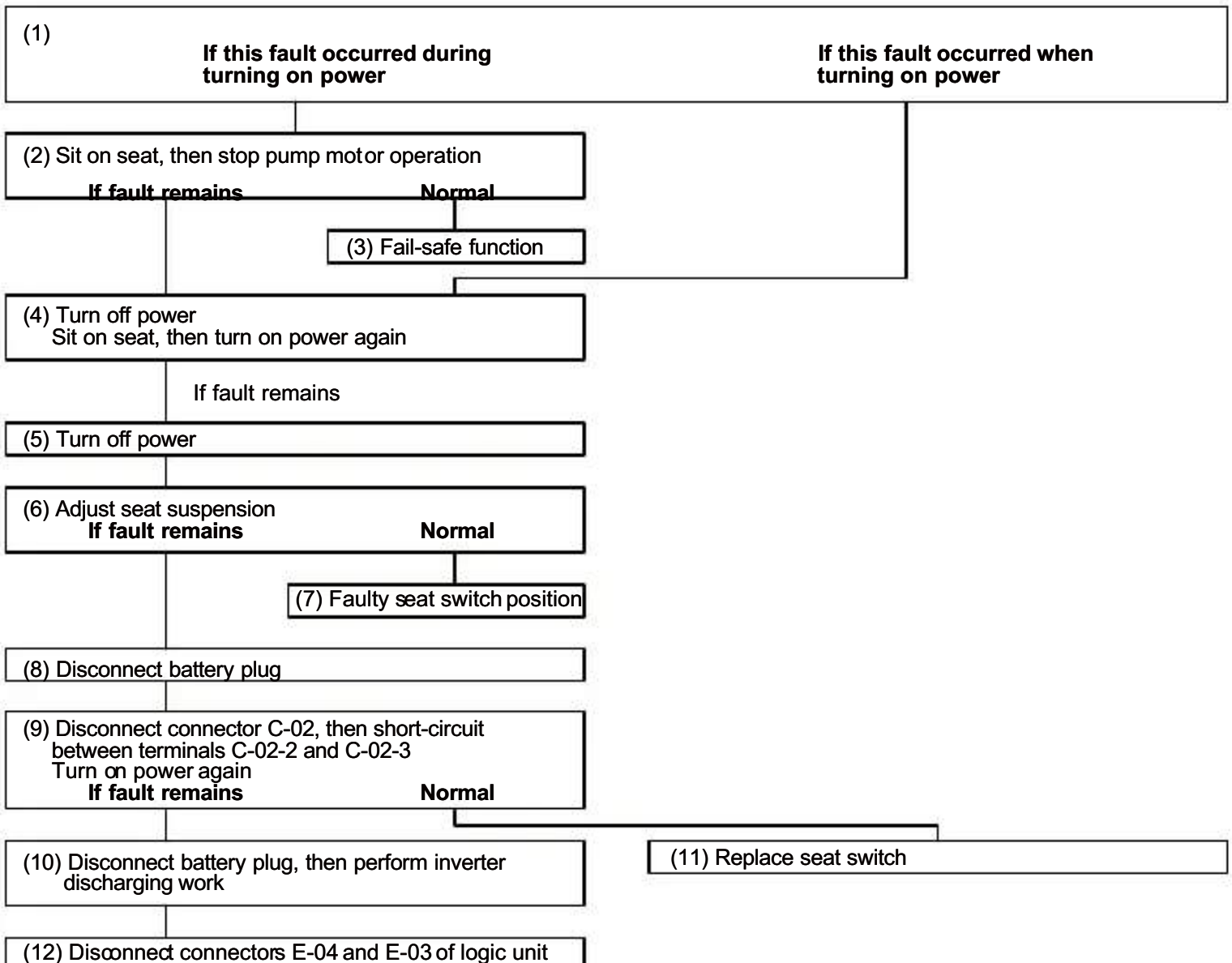


501165

3.35 Seat Switch, Faulty Setting for Hydraulic ((L))

Error code: (L)	
Situation	Display: "L" flashes. Pump motor and power steering operations inhibited. Pump contactor OPEN if this fault occurs when turning on power. Pump contactor CLOSE if this fault occurs during pump operation and then OPEN if truck stops.
Possible cause	Operator not seated, seat switch turned off during pump motor operation, improper seat suspension adjustment, faulty seat switch, faulty main harness, faulty logic unit.
Trigger of the error code	Detects seat switch opening when turning on power or during pump operation.

Checks

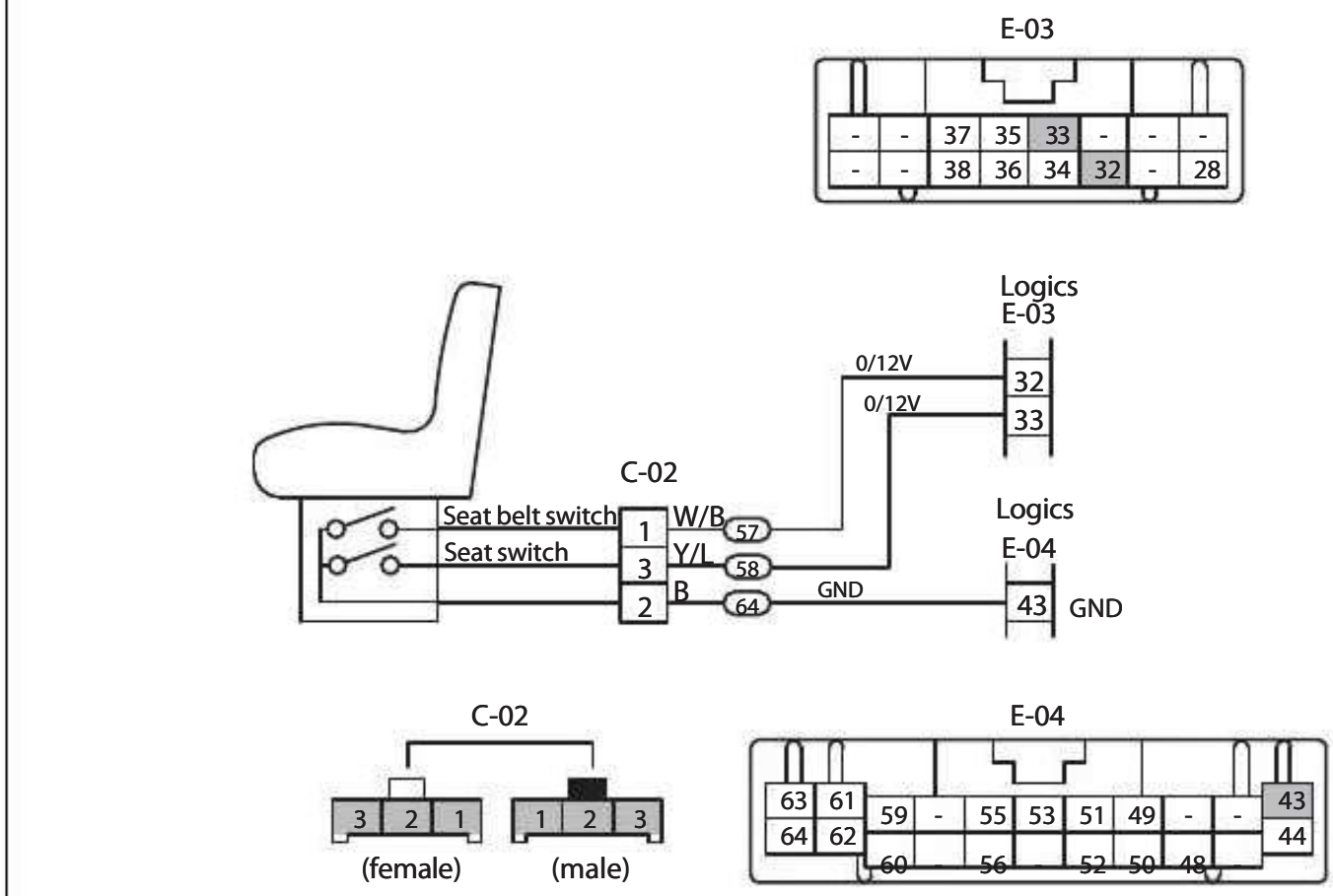


Check continuity between C-02-2 and E-04-43(64)
Check continuity between C-02-3 and E-03-33(58)
Continuity **No continuity**

(13) Replace logic card of logic unit

(14) Repair or replace main harness

502847



501161

3.36 FNR Lever Fault (EE)

Error code: EE	
Situation	Gear of lever changes to neutral statusl, thus traveling inhibited.
Possible cause	Lever fault, harness fault, logic unit fault
Trigger of the error code	All FNRs are ON (armrest FNR) All FNRs are OFF Both FRs are ON (normal or foot direction)

Checks

Other than armrest FNR

(1) Disconnect battery plug and discharge

(2) Disconnect E-03, E-04, and A-01 harnesses
Place FNR lever in neutral.
Check continuity between E-04-43 and E-03-37
Check continuity between E-04-43 and E-03-36
Check continuity between E-03-36 and E-03-37
Open **shprt**

(3) Connect A-01
Check continuity between E-04-43 and E-03-37
Check continuity between E-04-43 and E-03-36
Check continuity between E-03-36 and E-03-37
Open **short**

(4) Replace harness

(5) Replace logic card of login unit

(6) Replace FNR lever

Armrest FNR

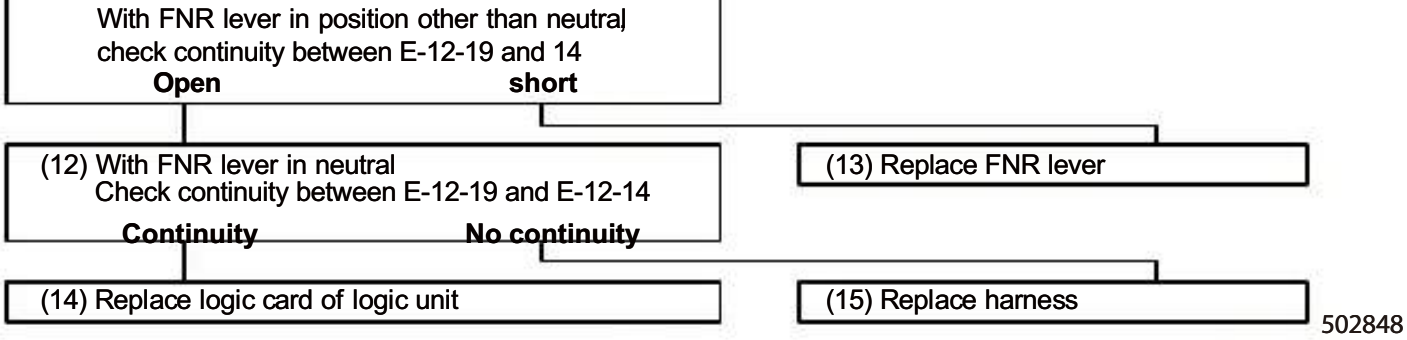
(7) Disconnect battery plug and discharge

(8) Disconnect E-12 and B-01
Place FNR lever in neutral
With tester, check continuity between:
E-12-18 and E-12-14
E-12-19 and E-12-14
E-12-20 and E-12-14
Open **short**

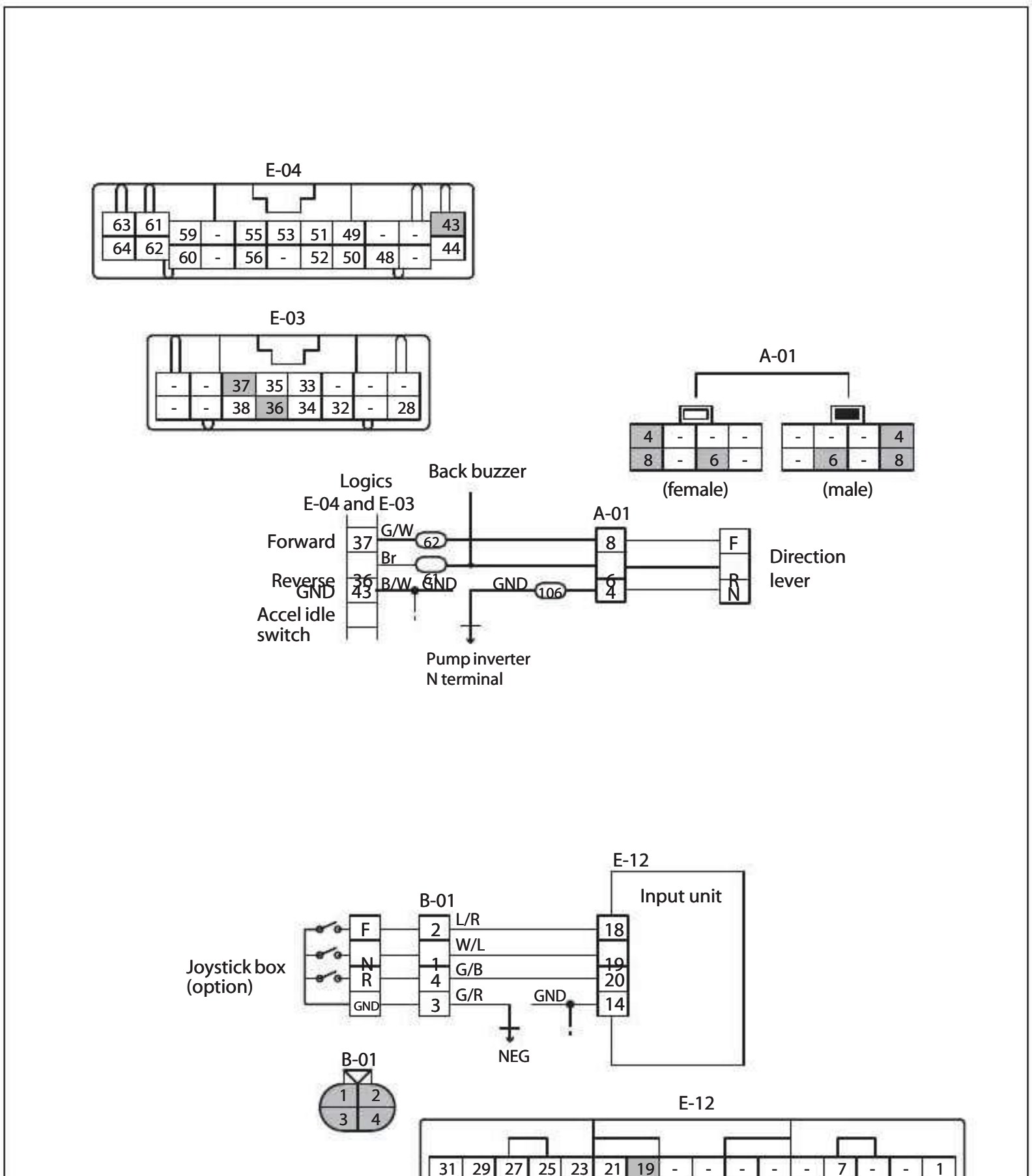
(9) Check continuity between B-01-1 and E-12-19
Continuity **No continuity**

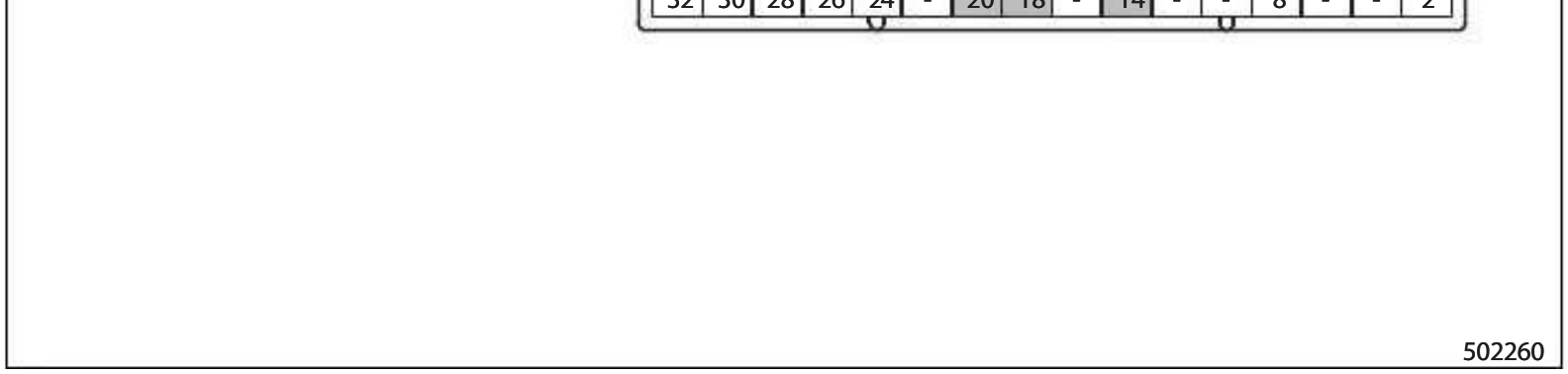
(10) Connect B-01
With FNR lever in neutral,
check continuity between E-12-18 and E-12-14 and
check continuity between E-12-20 and E-12-14

(11) Replace harness


With FNR lever in position other than neutral
check continuity between E-12-19 and 14
Open
short
(12) With FNR lever in neutral
Check continuity between E-12-19 and E-12-14
Continuity
No continuity
(13) Replace FNR lever
(14) Replace logic card of logic unit
(15) Replace harness

502848


E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44
E-03
- - 37 35 33 - - -
- - 38 36 34 32 - 28
A-01
4 - - - 8 - 6 -
- - - 4 - 6 - 8
(female)
(male)
Logics
E-04 and E-03
Back buzzer
A-01
Forward
Reverse
GND
Accel idle switch
37
36
43
G/W
Br
B/W
62
61
GND
GND
106
8
6
4
F
R
N
Direction lever
Pump inverter
N terminal
E-12
Input unit
B-01
Joystick box (option)
F
N
R
GND
2
1
4
3
L/R
W/L
G/B
G/R
18
19
20
14
GND
NEG
B-01
1 2
3 4
E-12
31 29 27 25 23 21 19 - - - - - 7 - - 1
32 30 28 26 24 - 20 18 - 14 - - 8 - - 2



3.37 Display Communication Fault (60)

Error code: 60		
Situation	Display: "60".	
	Normal truck operation	All truck operations inhibited
Possible cause	Faulty main harness, faulty display unit, faulty logic unit.	Faulty logic unit
Trigger of the error code	Communication is impossible. Hour meter data of display unit is abnormal.	Communication is impossible.

Checks

(1) Disconnect battery plug, then perform inverter discharging work

(2) Check connection of display connector

CAN

(3) Disconnect connector E-02 and H-03
Check continuity between E-02-5 and H-03-9(3)
Check continuity between E-02-6 and H-03-10(4)
Continuity — **No continuity** → (5) Replace harness

(4) Connect E-02
Measure resistance between H-03-9 and10 (harness side)
120Ω ± 5% — **Not** → (7) See troubleshooting for code E"65"

(6) Measure resistance between H-03-9 and 10 (displace side)
120Ω ± 5 % — **Not** → (9) Replace display

(8) Connect H-03 and disconnect E-02
Measure resistance between E-02-5 and 6
(harness side)
60Ω ± 5 % — **Not** → (11) Replace harness

(10) Check to see if these are shorted to other signal cables
Not shorted — **Shorted**

(12) Replace display unit

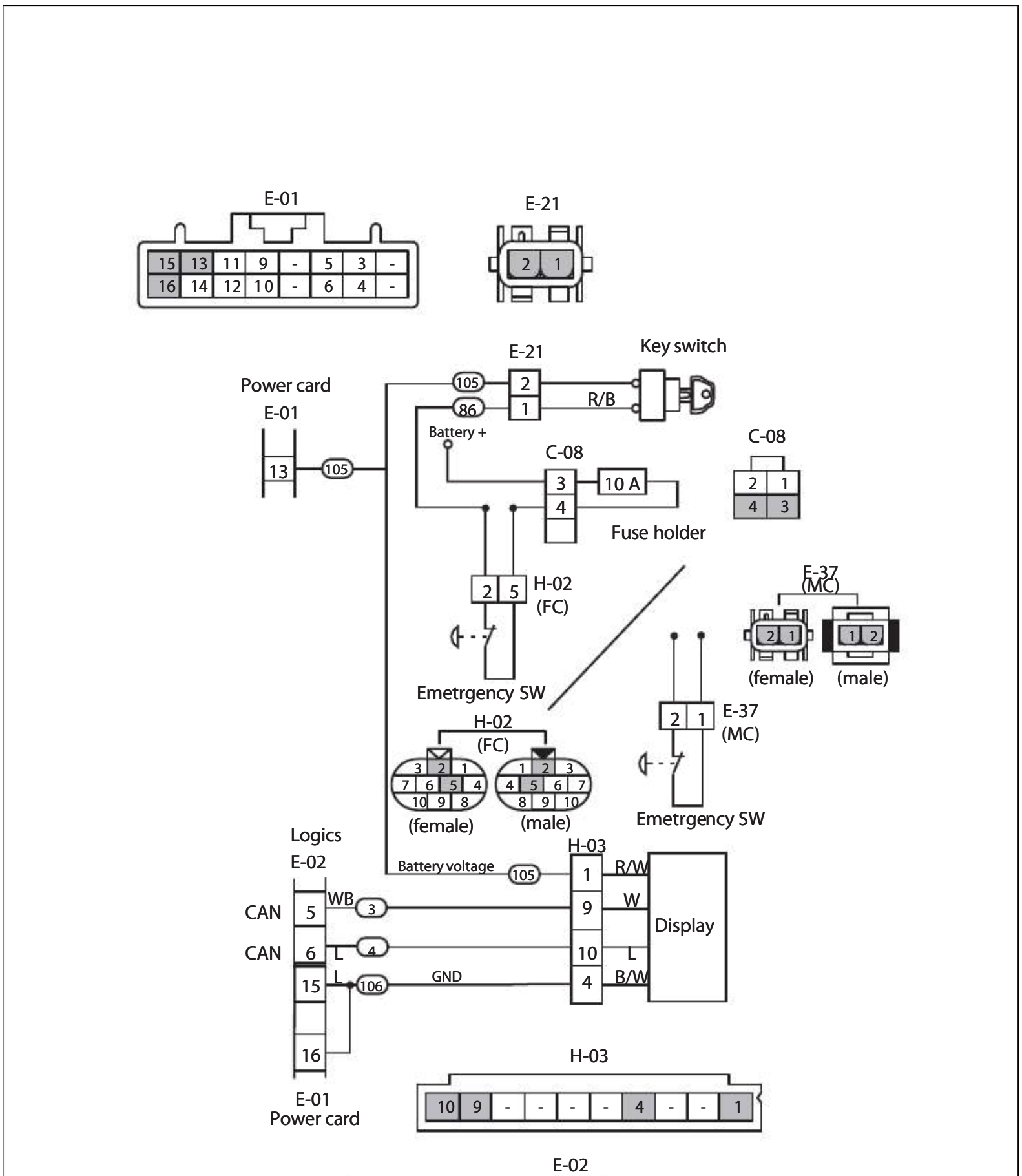
If fault remains

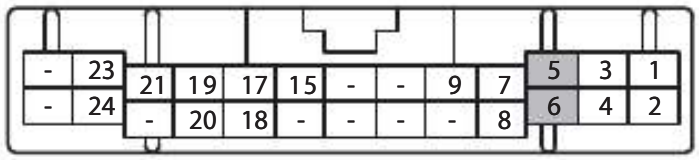
(13) Disconnect battery plug, then perform inverter discharging work

(15) Replace logic card of logic unit

(14) Repair or replace harness

502849





501151

3.38 Logic Card Initialize Failure (61)

Error code: 61	
Situation	Display: "61". All truck operations inhibited. Line contactor OPEN and ST contactor OPEN.
Possible cause	Setup Option Group 3 data not set, Setup Option Group 1 and 2 default data not set, faulty Setup Option data, faulty logic unit.
Trigger of the error code	Setup Option data is in abnormal setting range. MC specification is set at #43 while CAN data is received from input unit or output unit.

Checks

(1) Turn off power, then turn on power in Setup Option Group3 setting

(2) Set Setup Option Group 3 data
Confirm that SUO#43 and 50 have been set up correctly and their combination with output unit and input unit is correct

(3) Set Setup Option default data

(4) Turn on power

If fault remains

(5) With service tool, set Setup Option Group 3 data

(6) With service tool, set Setup Option default data

If fault remains

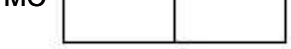
(7) Disconnect battery plug

(8) Replace logic card of logic unit

(9) With service tool, set Setup Option Group 3 data

(10) With service tool, set Setup Option default data

	Tilt horizon Function Enable	Disable
FC	Input output	Input output
MC	output	-

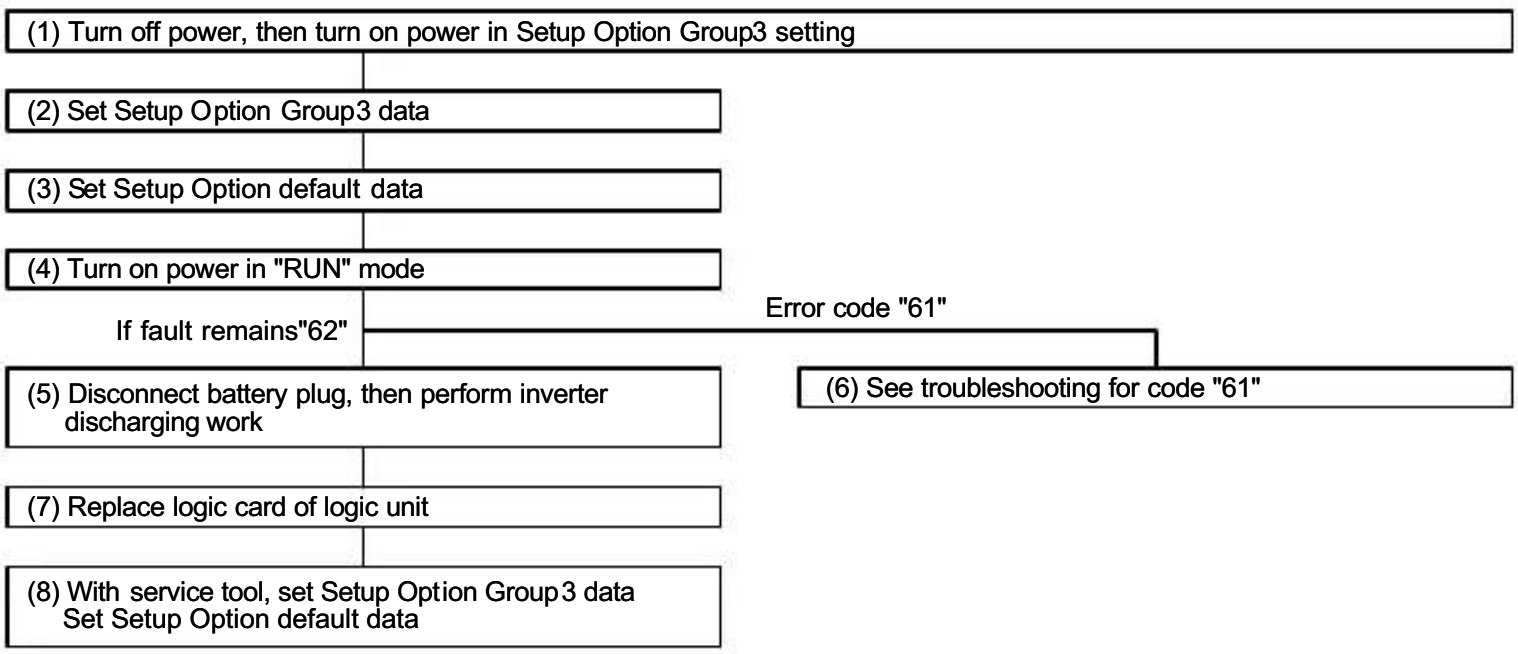


502850

3.39 Logics Fault (62)

Error code: 62	
Situation	Display: "62". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty EEPROM data, faulty logic unit.
Trigger of the error code	ROM/RAM SUM value of logic card is different from check data. EEPROM SUM value of logic card is different from check data.

Checks

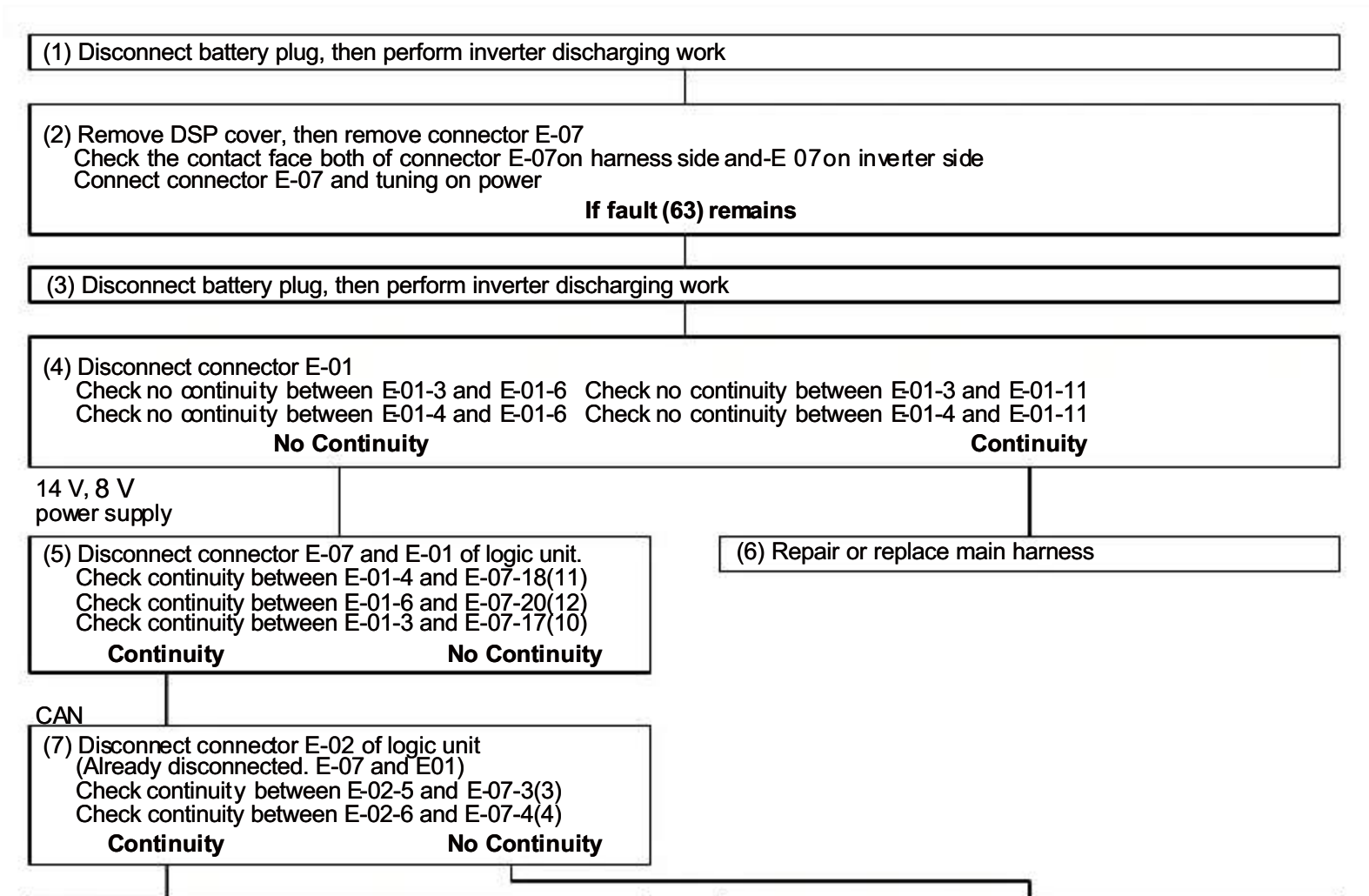


CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

3.40 Traction Inverter R.H., Fault (63)

Error code: 63	
Situation	Display: "63". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except lowering the mast.
Possible cause	Faulty main harness or connector E-07 comes off. (Communication between logic unit and traction inverter.) Faulty logic unit. Display fault
Trigger of the error code	Traction inverter is connected as pump inverter (E-07-9 is connected to GND or installed pump DSP card). ROM SUM value of traction inverter is different from check data. RAM of traction inverter is faulty Communication between logic unit and traction inverter is impossible.

Checks



(8) (Already disconnected. E-01, E-02 and E-07)
Resistance between
E-02-5(3) and E-02-6(4)of harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(9) Repair or replace main harness

(10) Perform CAN check of
~~Pump inverter Fault (65)~~

502852

(11) Connect connector E-07of traction inverter
(Already disconnected. E-02 and E01)
Resistance between E-02-5(3) and E-02-6(4) of
harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(12) Replace DSP card of
traction inverter

(13) Check E-07-8 and E-07-9 that pin is not inserted in
No **Yes**

(14) Disconnect connector E-07
Connect connector E-01 and E-02 to logic unit, then
turn on power again

(15) Repair or replace main harness

(16) Measure voltage between E-07-18(11) and E-07-20(12)
Confirm value is 8 ± 2 V
Measure voltage between E-07-17(10) and E-07-20(12)
Confirm value is from 14 ± 2 V
Normal **Abnormal**

(17) Disconnect battery plug, then perform inverter discharging work

(18) Replace DSP card of traction inverter

(19) Replace power supply card of logic unit
If fault remains

(20) Disconnect E-03, E-04, E-05, E-06, E-07, E-08
Reconfirm step (16) after power on
Normal **Abnormal**

(21) After step (17),
Connect E-07
Reconfirm step (16)
Normal **Abnormal**

(22) Repair or replace main
harness

(23) After step (17),
Connect E-06
Reconfirm step (16)
Normal **Abnormal**

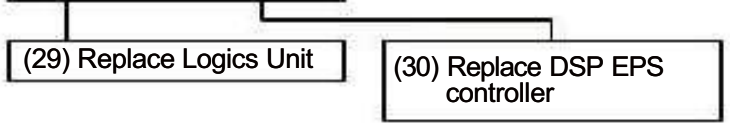
(24) Replace DSP of
Traction inverter Right

(25) After step (17),
Connect E-05
Reconfirm step (16)
Normal **Abnormal**

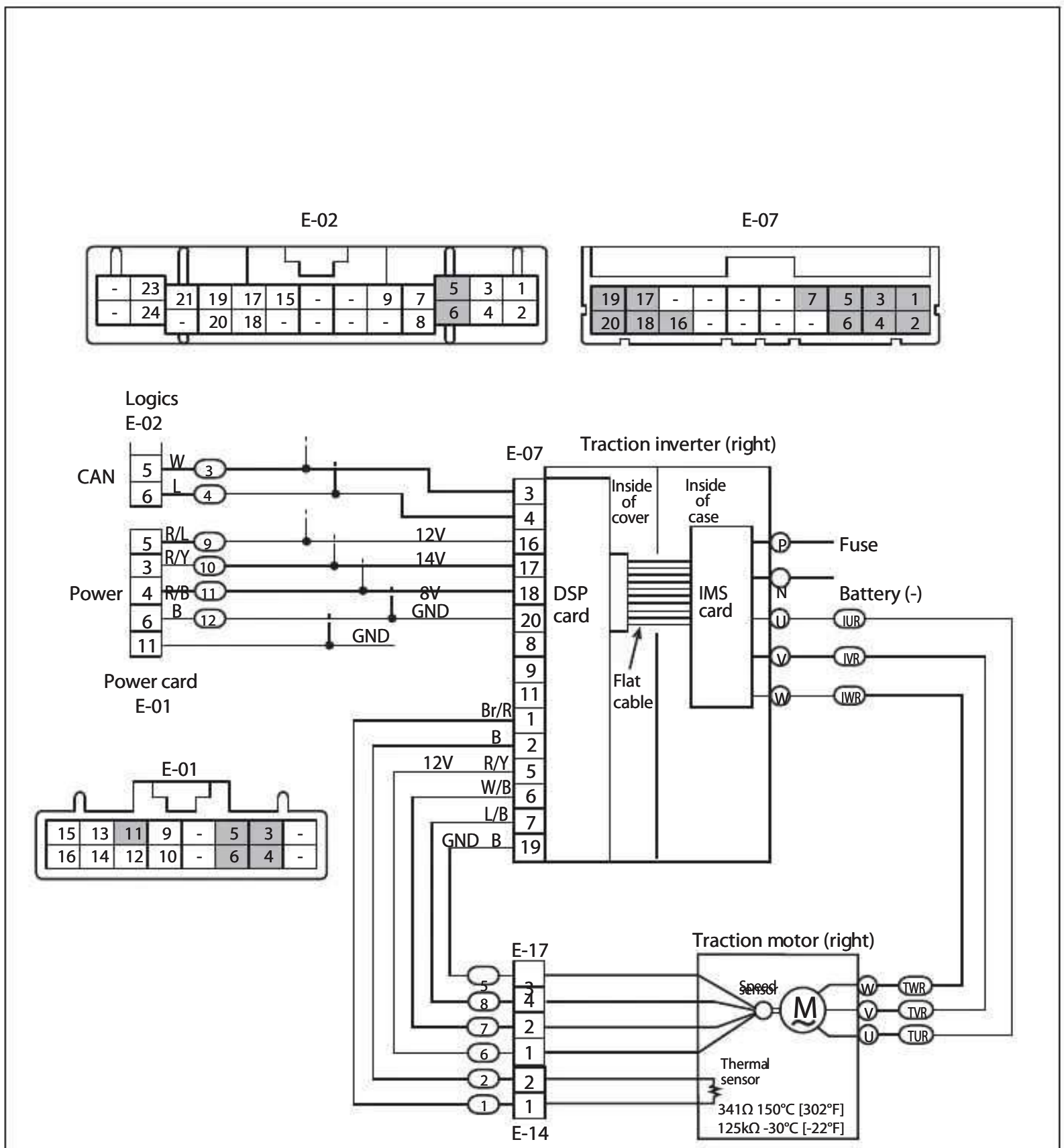
(26) Replace DSP of
Traction inverter Left

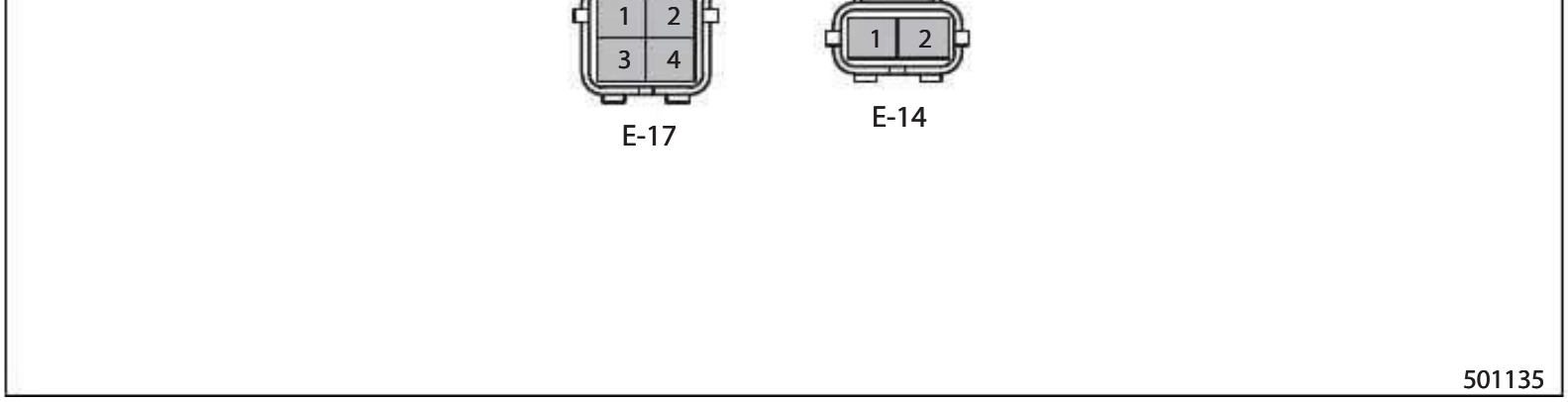
(27) After step (17),
Connect E-08
Reconfirm step (16)
Normal **Abnormal**

(28) Replace DSP of Pump
inverter


(29) Replace Logics Unit
(30) Replace DSP EPS controller

502853


E-02
E-07
Logics
E-02
CAN
Power
Power card
E-01
Traction inverter (right)
E-07
Inside of cover
Inside of case
DSP card
IMS card
Flat cable
Fuse
Battery (-)
12V
14V
8V
GND
Br/R
B
R/Y
W/B
L/B
E-01
E-17
E-14
Traction motor (right)
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]



3.41 Traction Inverter L.H., Fault (64)

Error code: 64	
Situation	Display: "64". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty main harness or connector E-06 comes off. (Communication between logic unit and traction inverter.) Faulty logic unit. Display fault.
Trigger of the error code	Traction inverter is connected as pump inverter. (E-06-9 is connected to GND or installed pump DSP card.) ROM SUM value of traction inverter is different from check data. RAM of traction inverter is faulty. Communication between logic unit and traction inverter is impossible.

Checks

(1) Disconnect battery plug, then perform inverter discharging work

(2) Remove DSP cover, then remove connector E-06
Check the contact face both of connector E-06 on harness side and E-06 on inverter side
Connect connector E-06 and tuning on power
If fault (64) remains

(3) Disconnect battery plug, then perform inverter discharging work

(4) Disconnect connector E-01
Check no continuity between E-01-3 and E-01-6 Check no continuity between E-01-3 and E-01-11
Check no continuity between E-01-4 and E-01-6 Check no continuity between E-01-4 and E-01-11
No Continuity **Continuity**

14V, 8V power supply

(5) Disconnect connector E-06 and E-01 of logic unit
Check continuity between E-01-4 and E-06-18(11)
Check continuity between E-01-6 and E-06-20(12)
Check continuity between E-01-3 and E-06-17(10)
Continuity **No Continuity**

(6) Repair or replace main harness

CAN

(7) Disconnect connector E-02 of logic unit
(Already disconnected. E-06 and E01)
Check continuity between E-02-5 and E-06-3(3)
Check continuity between E-02-6 and E-06-4(4)
Continuity **No Continuity**

(9) Repair or replace main harness

(8) (Already disconnected E-01, E-02 and E-06)
Resistance between
E-02-5(3) and E-02-6(4) of harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(10) Perform CAN check of Pump inverter Fault (65)

(11) Connect connector E-06of traction inverter (Already disconnected. E-02 and E01)

Measure resistance of CAN with connector E-02 disconnected
Resistance between E-02-5(3) and E-02-6(4) of harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(12) Replace DSP card of traction inverter

502854

(15) Measure voltage between E-06-18(11) and E-06-20(12)
Confirm value is 8 ± 2 V
Measure voltage between E-06-17(10) and E-06-20(12)
Confirm value is from 14 ± 2 V
Normal **Abnormal**

(16) Disconnect battery plug, then perform inverter discharging work

(17) Replace DSP card of traction inverter

(18) Replace power supply card of logic unit
If fault remains

(19) Disconnect E-03, E-04, E-05, E-06, E-07, E-08
Reconfirm step (15) after power on
Normal **Abnormal**

(20) After step (16), Connect E-07
Reconfirm step (15)
Normal **Abnormal**

(21) Repair or replace main harness

(22) After step (16), Connect E-06
Reconfirm step (15)
Normal **Abnormal**

(23) Replace DSP of Traction inverter Right

(24) After step (16), Connect E-05
Reconfirm step (15)
Normal **Abnormal**

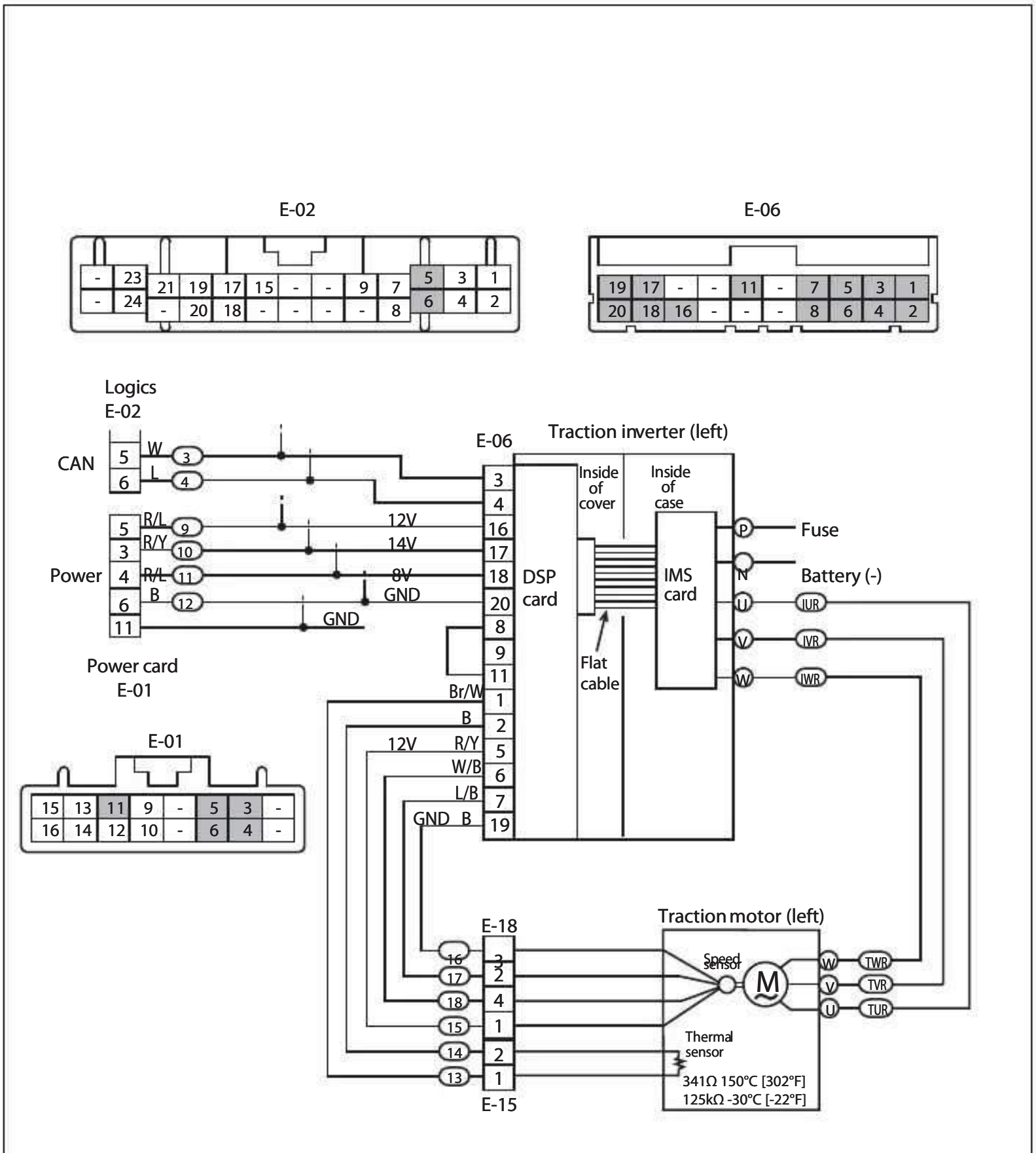
(25) Replace DSP of Traction inverter Left

(26) After step (16), Connect E-08
Reconfirm step (15)
Normal **Abnormal**

(27) Replace DSP of Pump inverter

(28) Replace Logics Unit

(29) Replace DSP EPS controller


E-02
E-06
Logics
E-02
CAN
W
L
Power
R/L
R/Y
R/L
B
GND
12V
14V
8V
GND
Power card
E-01
E-06
Traction inverter (left)
Inside of cover
Inside of case
DSP card
IMS card
Flat cable
P
N
U
V
W
Fuse
Battery (-)
JUR
JVR
JWR
Br/W
B
12V
R/Y
W/B
L/B
GND
B
E-01
E-18
E-15
Traction motor (left)
Speed sensor
M
TWR
TVR
TUR
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]

E-18 E-15

501136

3.42 Pump Inverter Fault(65)

Error code: 65	
Situation	Display: "65". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty main harness or connector E-05 comes off. (Communication between logic unit and traction inverter.) Faulty logic unit. Display fault
Trigger of the error code	Pump inverter is connected as traction inverter. (E-05-9 is connected to GND or installed traction DSP card.) ROM SUM value of pump inverter is different from check data. RAM of pump inverter is faulty. Communication between logic unit and traction inverter is impossible.

Checks

(1) Disconnect battery plug, then perform inverter discharging work

(2) Remove DSP cover, then remove connector E-05
Check the contact face both of connector E-05 on harness side and E-05 on inverter side
Connect connector E-05 and tuning on power
If fault (65) remains

(3) Disconnect battery plug, then perform inverter discharging work

(4) Disconnect connector E-01
Check no continuity between E-01-3 and E-01-6
Check no continuity between E-01-3 and E-01-11
Check no continuity between E-01-4 and E-01-6
Check no continuity between E-01-4 and E-01-11
No Continuity **Continuity**

14V, 8V power supply

(5) Disconnect connector E-05 and E-01 of logics Unit
Check continuity between E-01-4 and E-05-18(11)
Check continuity between E-01-6 and E-05-20(12)
Check continuity between E-01-3 and E-05-17(10)
Continuity **No Continuity**

CAN

(6) Disconnect connector E-02 of logics Unit
(Already disconnected E-05 and E-01)
Check continuity between E-02-5 and E-06-3(3)
Check continuity between E-02-6 and E-06-4(4)
Check continuity between E-05-14 and E-05-15

Continuity No continuity

(7) Repair of replace main harness

(8) Resistance between E-02-5 and E-02-6 of harness side connectors
120 Ω ± 5 % **Other than 120 Ω ± 5 %**

(9) Measure resistance of CAN for Pump inverter
DSP card
Resistance between E-05-3 and E-05-4 of DSP card side connectors
120 Ω ± 5 % **Other than 120 Ω ± 5 %**

(10) Perform CAN check of Display communication
Fault (60)

(11) Replace DSP card of pump inverter

502856

(12) Connect connector E-05 of pump inverter
(Already disconnected E-02 and E-01)
Resistance between E-02-5 and E-02-6 of harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(13) Check E-05-8 that pin is not inserted in
No **Yes**

(14) Replace DSP card of pump inverter

(15) Disconnect connecter E-05
Connect connector E-01 and E-02 to logic unit, then turn on power again

(16) Repair or replace harness

(17) Measure voltage between E-05-18and E-05-20(12)
Voltage should be is 8 ± 2 V
Measure voltage between E-05-17 and E-05-20(12)
Voltage should be is 14 ± 2 V
Normal **Abnormal**

(18) Disconnect battery plug, then perform inverter discharging work

(19) Replace DSP card of left traction inverter

(20) Replace power supply card of logic unit
If fault remains

(21) Disconnect E-03, E-04, E-05, E-06, E-07, E-08
Reconfirm step (17) after power on
Normal **Abnormal**

(22) After step (18),
Connect E-07
Reconfirm step (17)
Normal **Abnormal**

(23) Repair or replace main harness

(24) After step (18),
Connect E-06
Reconfirm step (17)
Normal **Abnormal**

(25) Replace DSP of Traction inverter Right

(26) After step (18),
Connect E-05
Reconfirm step (17)
Normal **Abnormal**

(27) Replace DSP of Traction inverter Left

(28) After step (18),
Connect E-08
Reconfirm step (17)
Normal **Abnormal**

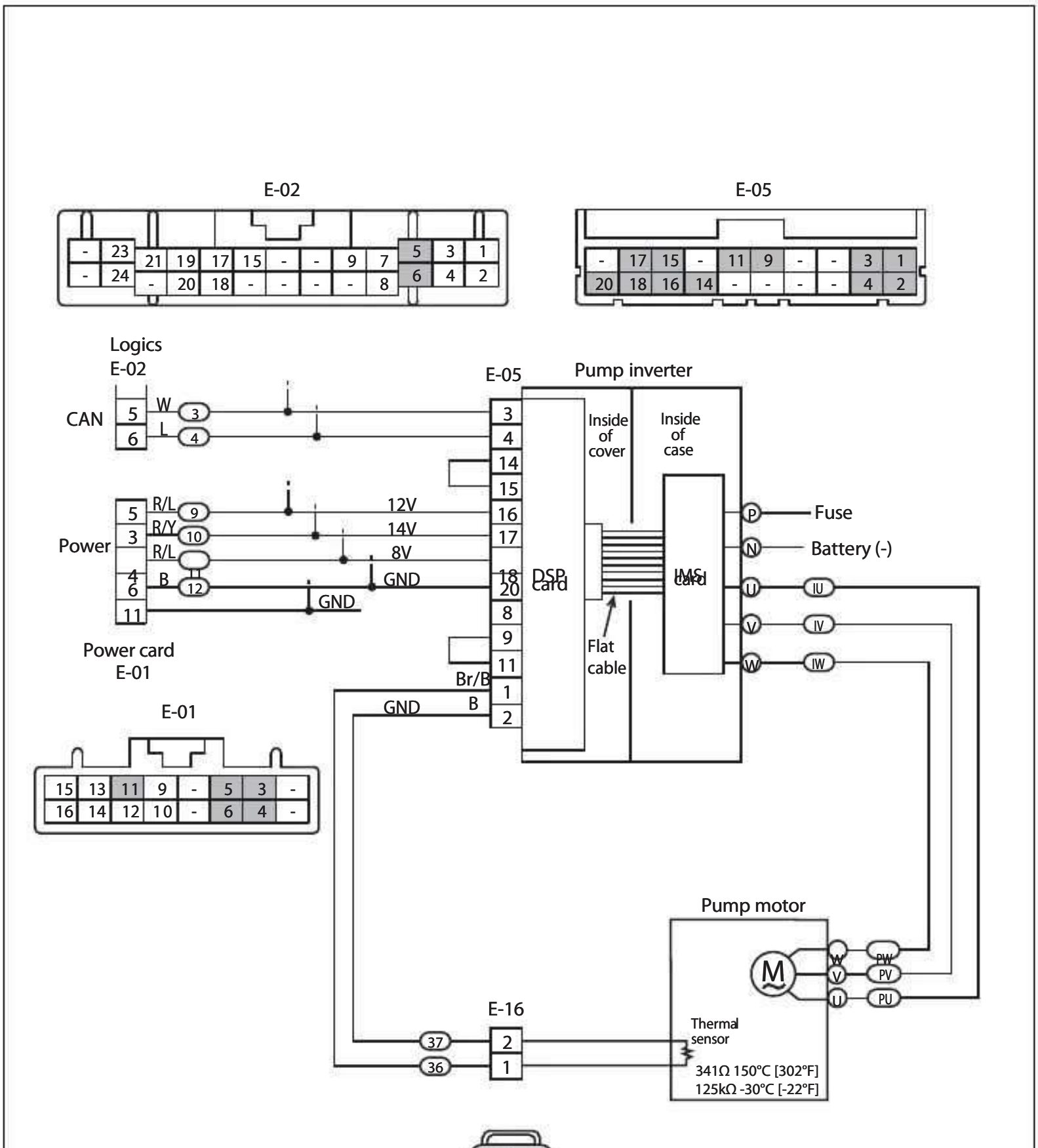
(29) Replace DSP of Pump inverter

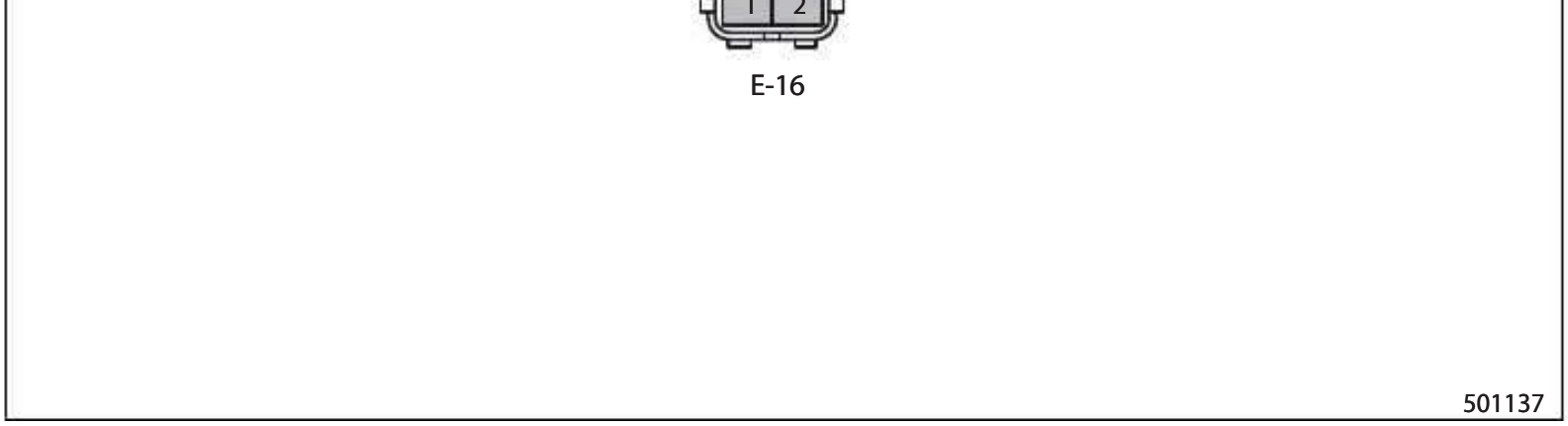
(30) Replace Logics Unit

(31) Replace DSP EPS controller

502857

CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

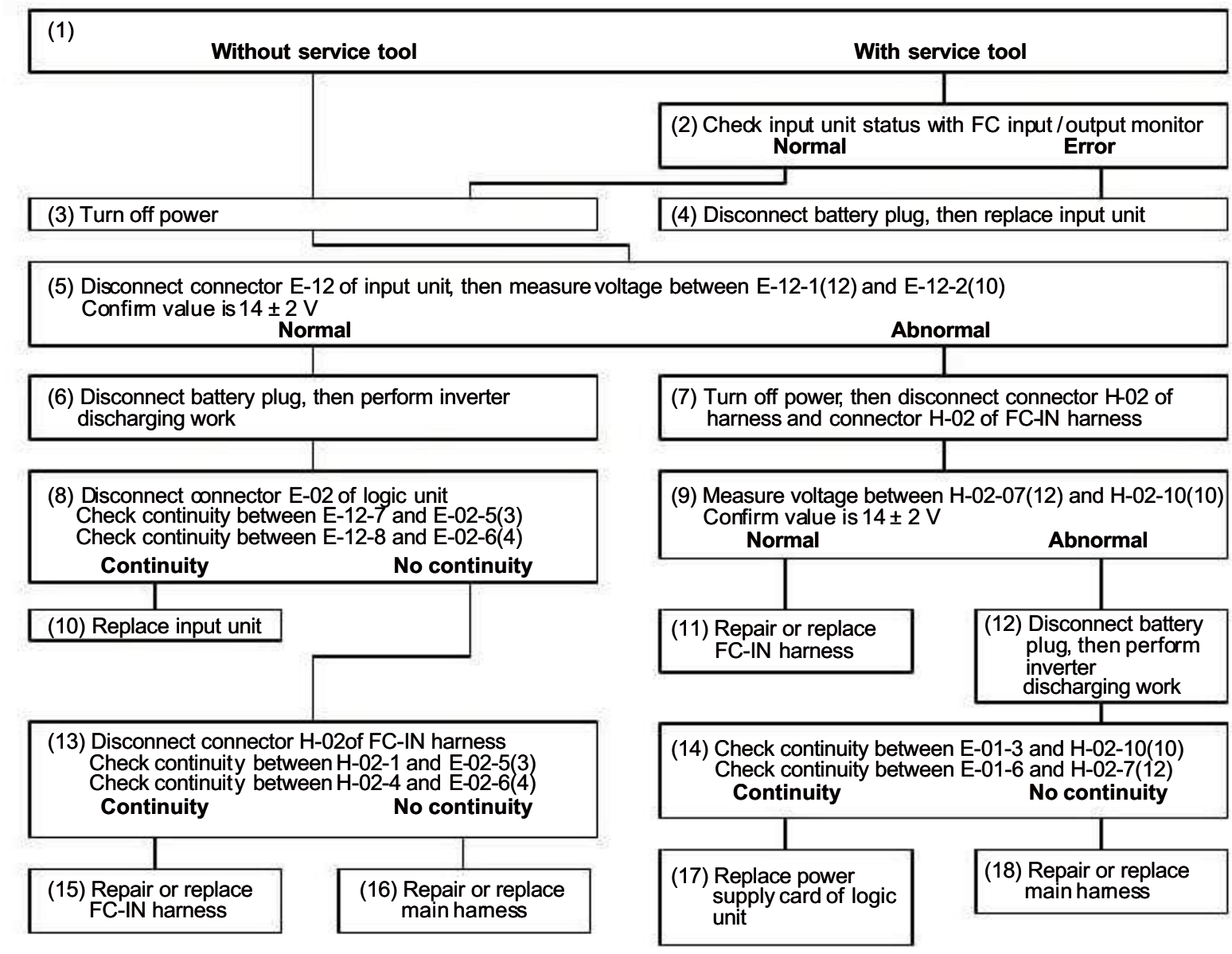




3.43 Input Unit Fault (67)

Error code: 67	
Situation	Display: "67". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty remote input unit, faulty main harness, faulty logic unit.
Trigger of the error code	ROM/RAM SUM value of input unit is different from check data. Communication with input unit is impossible. SUO #43 (Hydraulic Control Selection) is incorrect.

Checks

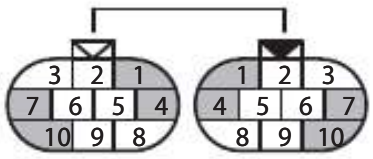


CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

E-12

31	29	27	25	23	21	19	-	-	-	-	-	7	-	-	1
32	30	28	26	24	-	20	18	-	14	-	-	8	-	-	2

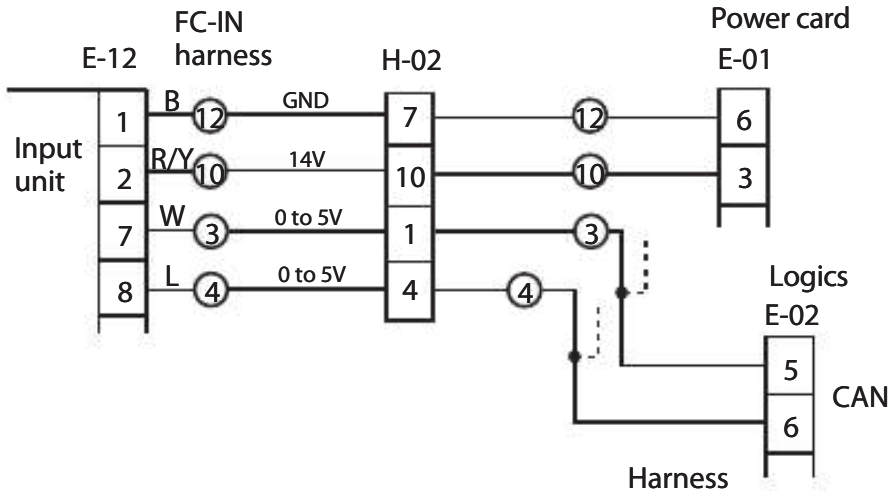
H-02



(female) (male)

E-01

15	13	11	9	-	5	3	-
16	14	12	10	-	6	4	-



E-02

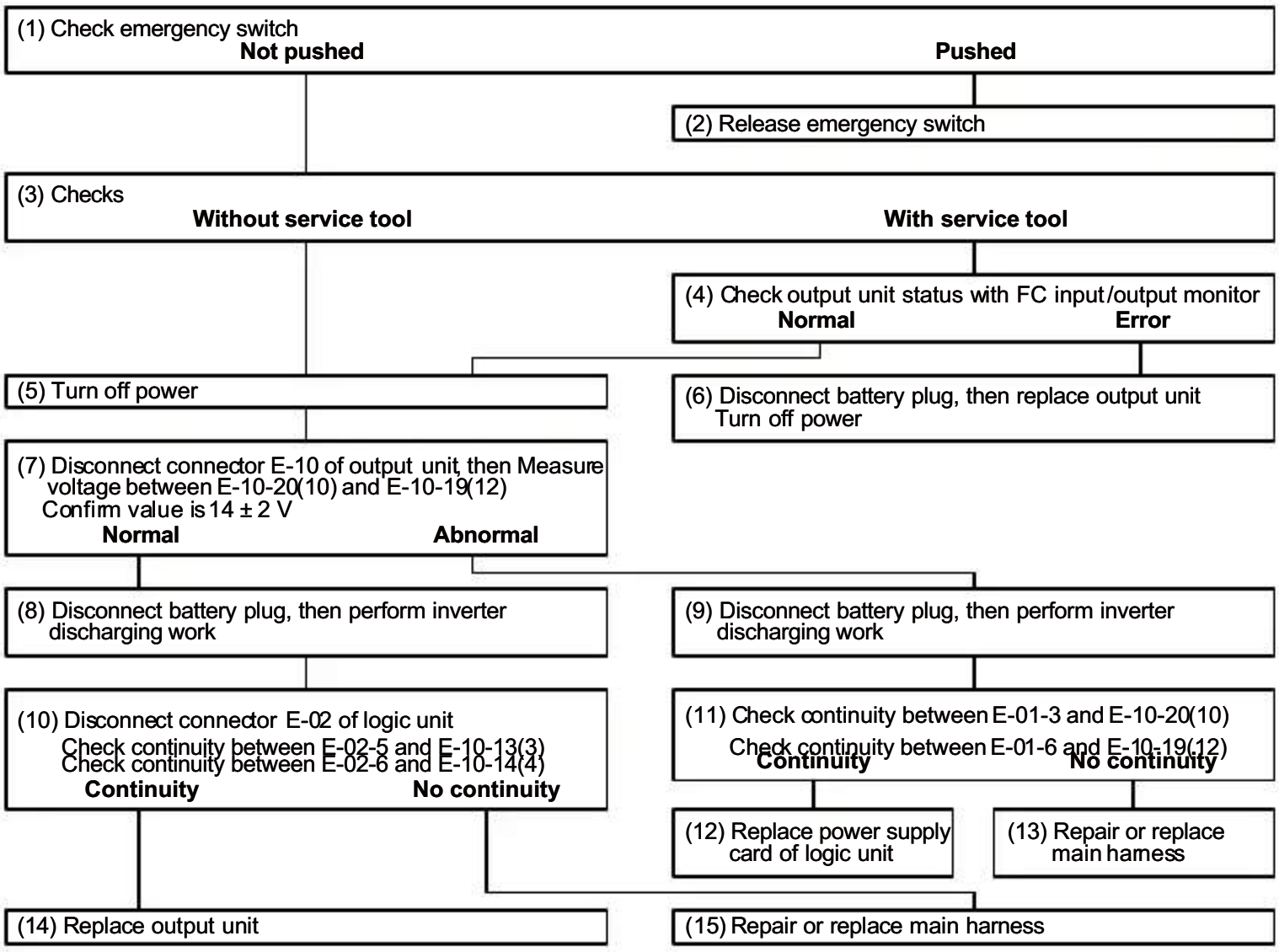
-	23	21	19	17	15	-	-	9	7	5	3	1
-	24	-	20	18	-	-	-	-	8	6	4	2

501152

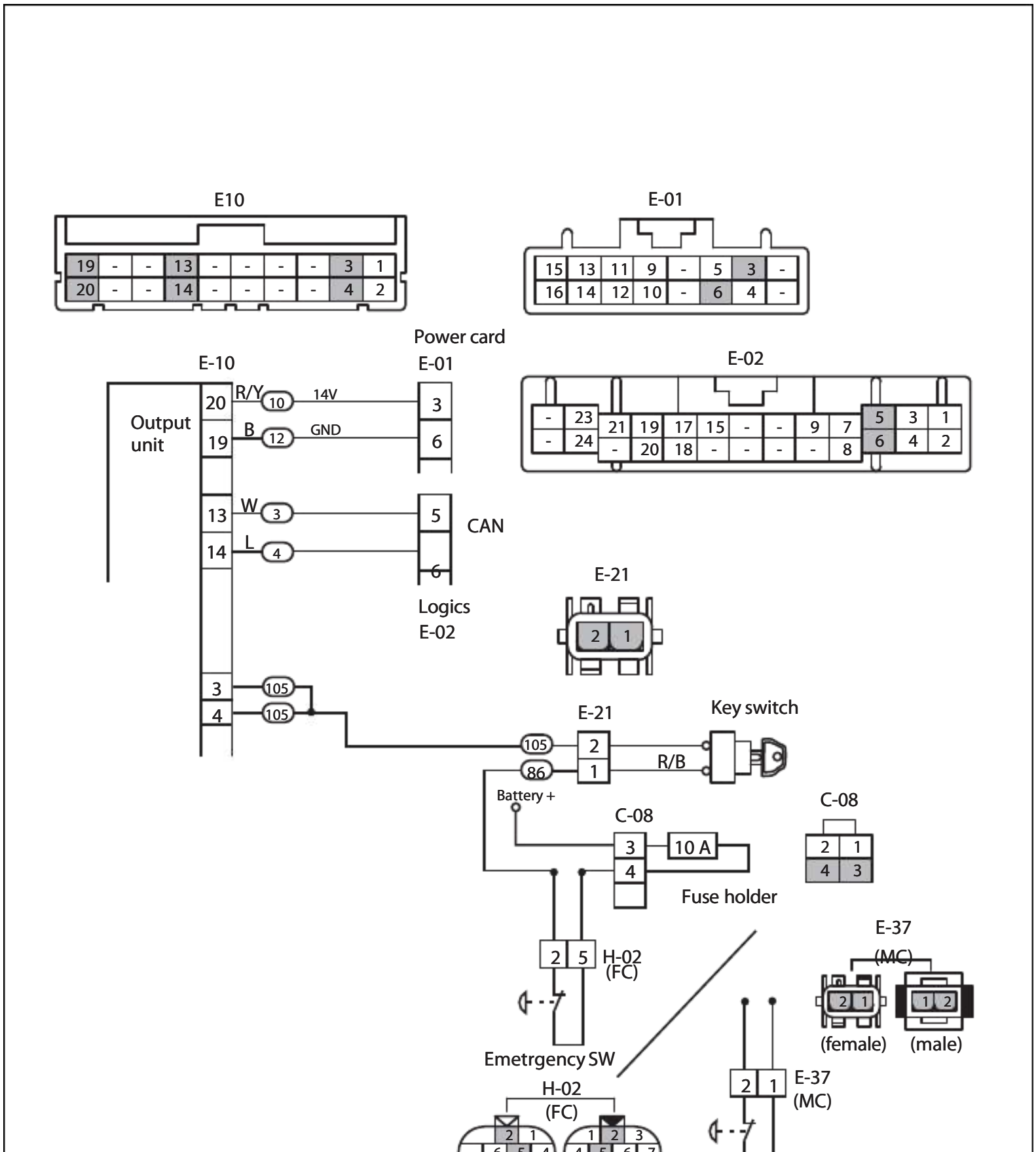
3.44 Output Unit Fault (68)

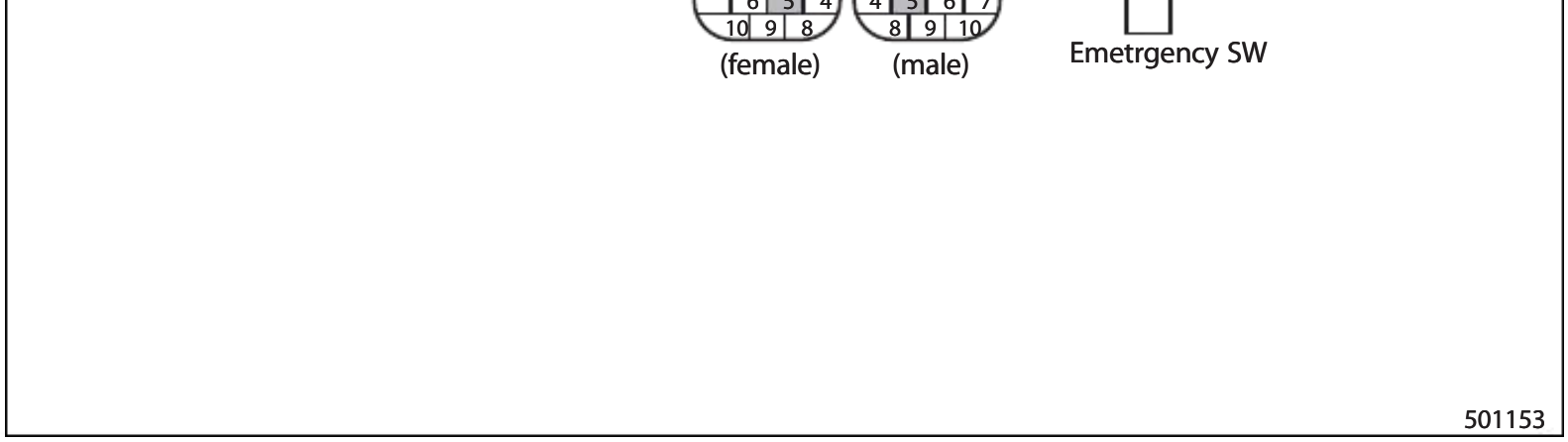
Error code: 68	
Situation	Display: "68". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Emergency switch opened, faulty remote output unit, faulty main harness, faulty logic unit.
Trigger of the error code	Emergency switch is detected. ROM/RAM SUM value of output unit is different from check data. Communication with output unit is impossible. SUO #43 (Hydraulic Control Selection) is incorrect. SUO #50 (Tilt Holizon Function) is incorrect.

Checks



CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS

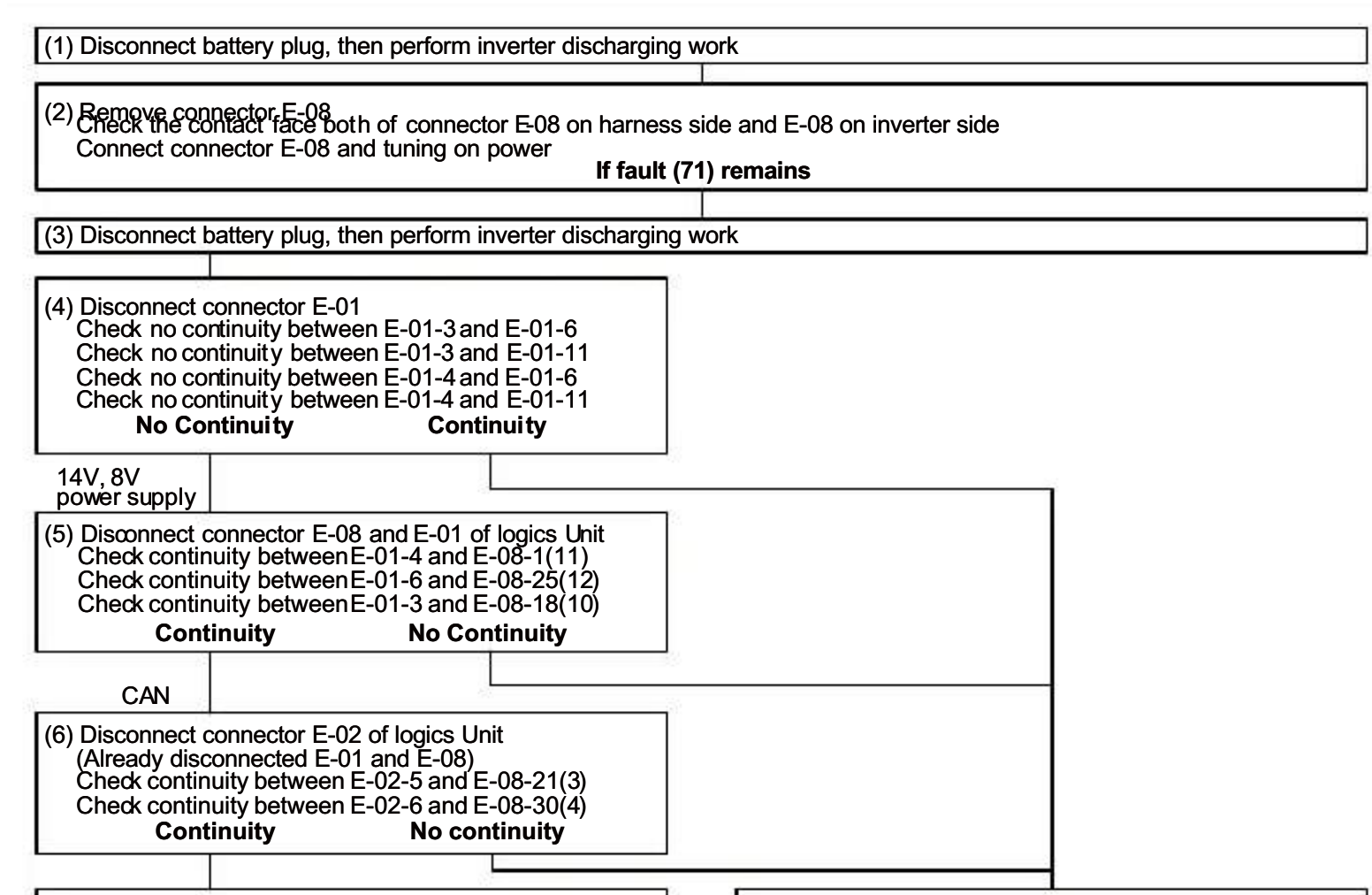




3.45 EPS Controller Fault (71)

Error code: 71	
Situation	Display: "71". All operations inhibited except mast lowering operation. Line steering contactor OPEN. Traveling speed limited to 5 km/h.
Possible cause	Faulty main harness or connector E-08 comes off. (Communication between logic unit and traction inverter.) Faulty logic unit. Display fault. PS Controller fault.
Trigger of the error code	ROM SUM value of pump inverter is different from check data. RAM of pump inverter is faulty. Communication between logic unit and PS controller is impossible. No life signal is inputted.

Checks



(7) Resistance between E-02-5(3) and E-02-6(4) of harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(8) Repair or replace harness

(9) Connect connector E-08 of EPS controller
(Already disconnected E-01 and E-02)
Measure resistance of CAN with connector E-02 disconnected
Resistance between E-02-5(3) and E-02-6 (4) of harness side connectors
60 Ω ± 5 % **Other than 60 Ω ± 5 %**

(10) Perform CAN check of Pump inverter Fault (65)

(11) Replace EPS controller

502860

(12) Disconnect E-08
Check continuity between E-04-53 and E-08-8(28)
Continuity **No Continuity**

(13) Check E-08-9 that pin is not inserted in
No **Yes**

(14) Replace harness

(15) Disconnect connecter E-02
Connect connector E-08 and E-01 to logic unit, then turn on power again

(16) Repair or replace harness

(17) Measure voltage between E-08-18(10) and E-08-25(12)
Confirm value is 8 ± 2 V
Measure voltage between E-08-18(10) and E-08-25(12)
Confirm value is From 14 ± 2 V
Normal **Abnormal**

(18) Disconnect battery plug, then perform inverter discharging work

(19) Replace EPS controller

(20) Replace power supply card of logic unit
If fault remains

(21) Disconnect E-03, E-04, E-05, E-06, E-07, E-08
Reconfirm step (17) after power on
Normal **Abnormal**

(22) After step (18),
Connect E-07
Reconfirm step (17)
Normal **Abnormal**

(23) Repair or replace main harness

(24) After step (18),
Connect E-06
Reconfirm step (17)
Normal **Abnormal**

(25) Replace DSP of Traction inverter Right

(26) After step (18),
Connect E-05
Reconfirm step (17)
Normal **Abnormal**

(27) Replace DSP of Traction inverter Left.

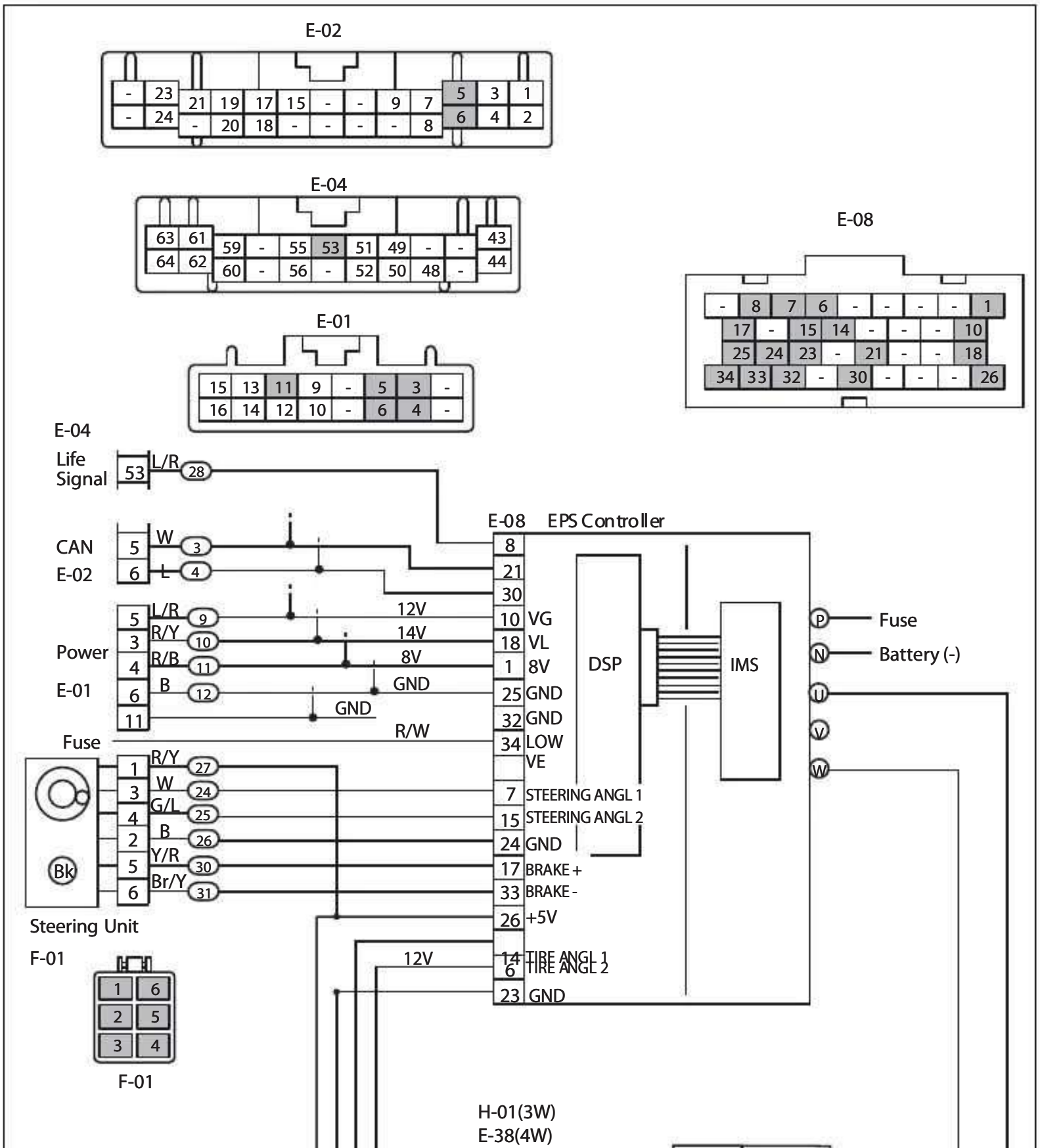
(28) After step (18),
Connect E-08
Reconfirm step (17)
Normal **Abnormal**

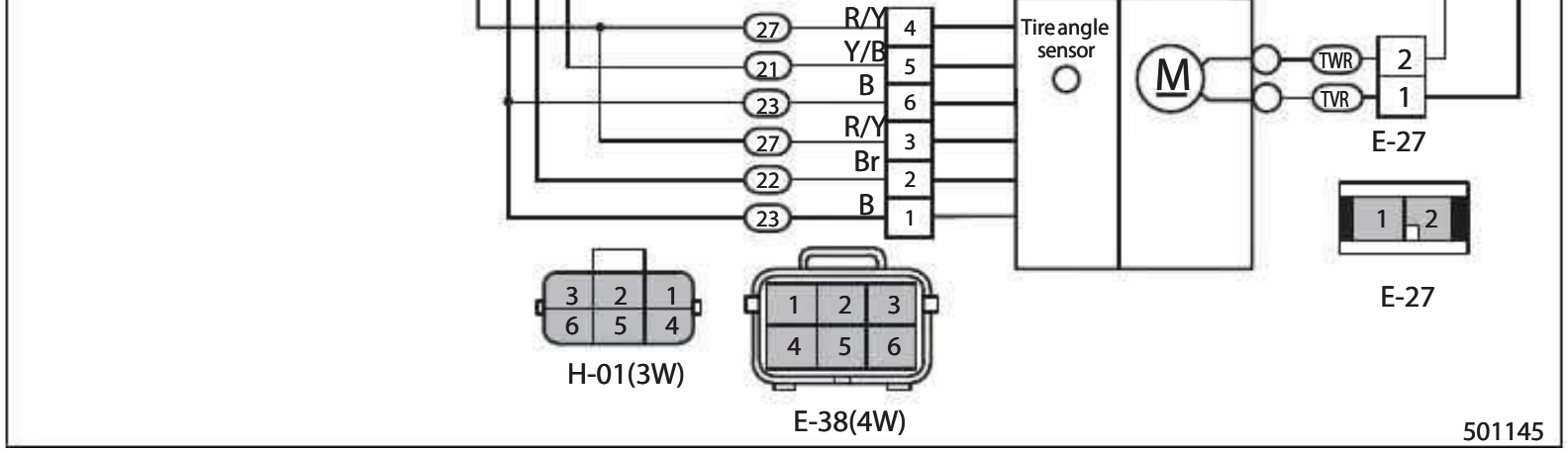
(29) Replace DSP of Pump inverter

(30) Replace Logics Unit

(31) Replace DSP EPS controller

502861

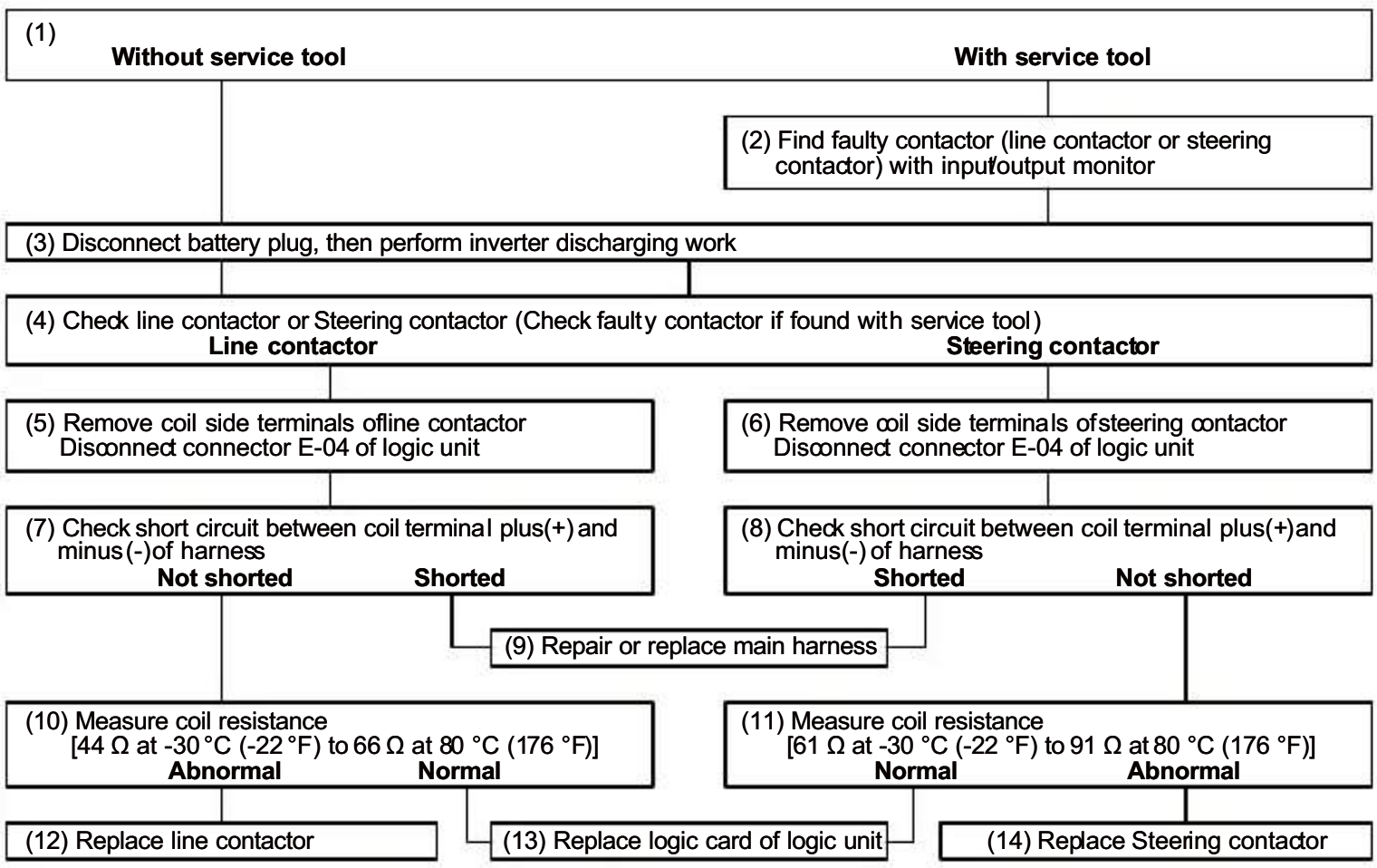

E-02
E-04
E-08
E-01
E-04
Life Signal
53
L/R
28
CAN
E-02
5
6
W
L
3
4
Power
E-01
5
3
4
6
11
L/R
R/Y
R/B
B
9
10
11
12
12V
14V
8V
GND
GND
R/W
Fuse
Steering Unit
F-01
1
3
4
2
5
6
R/Y
W
G/L
B
Y/R
Br/Y
27
24
25
26
30
31
Bk
F-01
E-08 EPS Controller
8
21
30
10 VG
18 VL
1 8V
25 GND
32 GND
34 LOW VE
7 STEERING ANGL 1
15 STEERING ANGL 2
24 GND
17 BRAKE +
33 BRAKE -
26 +5V
14 TIRE ANGL 1
6 TIRE ANGL 2
23 GND
12V
DSP
IMS
P
N
U
V
W
Fuse
Battery (-)
H-01(3W)
E-38(4W)



3.46 Contactor Coil Fault (72)

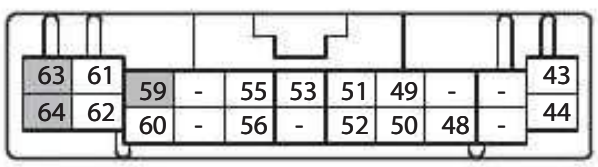
Error code: 72	
Situation	Display: "72". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty line contactor, faulty pump contactor, faulty main harness, faulty logic unit.
Trigger of the error code	By short circuit detection signal of logic card.

Checks




EMG
KEY
Fuse
+
-
Line contactor
63
R/W
105
70
59
W/L
64
Br/R
Logics
E-04
73
+
-
Steering contactor

E-04

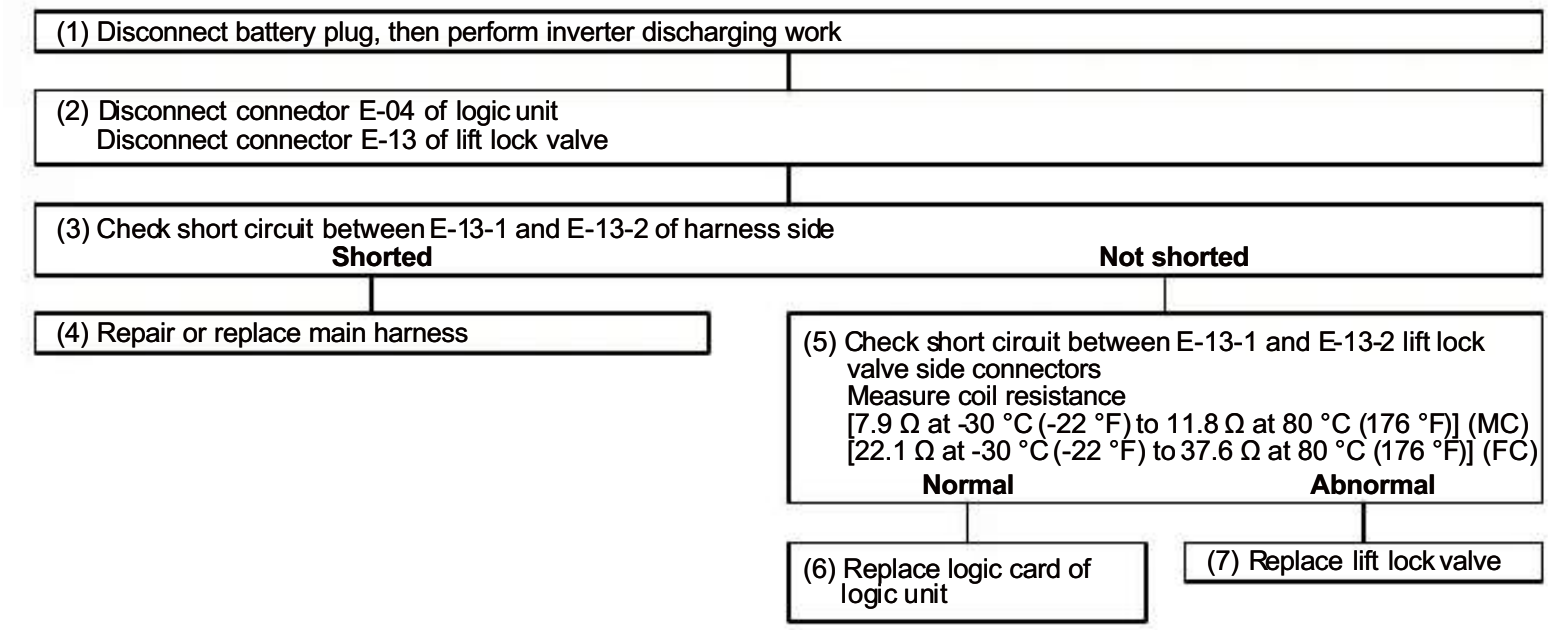

63 61
64 62
59 - 55 53 51 49 - -
60 - 56 - 52 50 48 -
43
44

501154

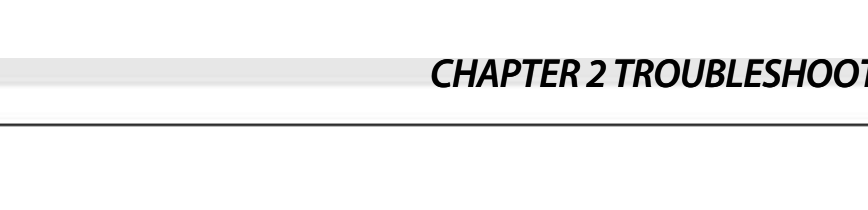
3.47 Hydraulic Lock Solenoid Fault (74)

Error code: 74	
Situation	Display: "74". Pump motor operation inhibited. Normal traction motor operation and power steering operation.
Possible cause	Faulty lift lock valve, faulty main harness, faulty logic unit.
Trigger of the error code	By short circuit detection signal of logic card.

Checks



Key Switch
R/W
Harness B
E-13
Logics
E-04
105
Y
1
Lift
lock
valve
61
W/G
72
B
2


E-04
63
61
59
-
55
53
51
49
-
-
43
64
62
60
-
56
-
52
50
48
-
44

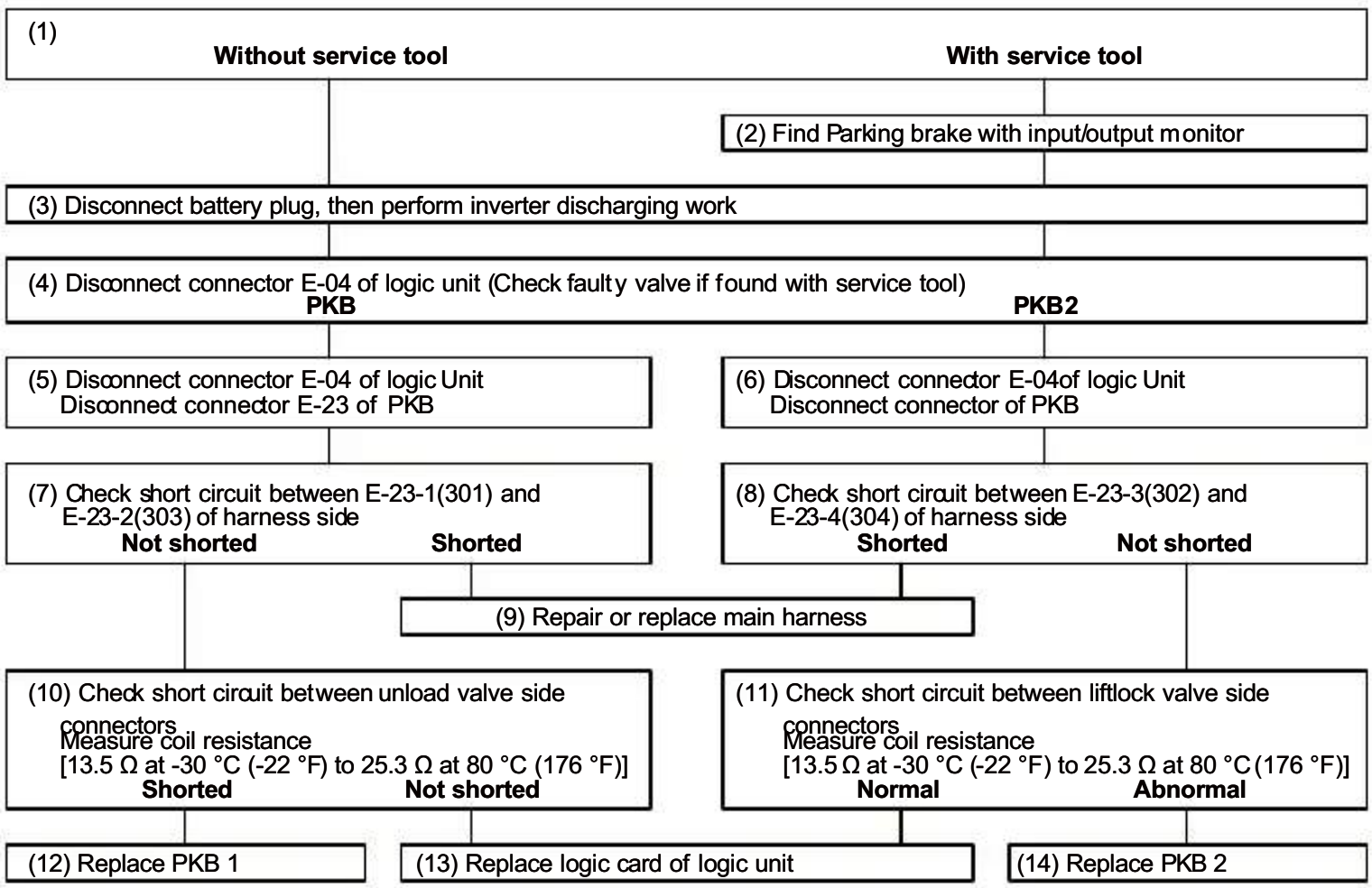
E-13
1
2

501155

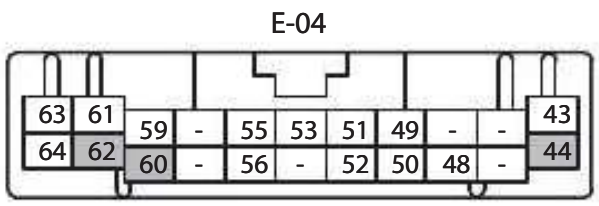
3.48 Parking Brake Fault (75)

Error code: 75	
Situation	Display: "75". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty parking brake coil, faulty main harness, faulty logic unit.
Trigger of the error code	By short circuit detection signal of logic card.

Checks



E-23
4 3 2 1
1 2 3 4
(female)
(male)
Key Switch
Logics
E-04
E-23
60
62
44
R/W
Y/W
R/W
Y/B
105
71
105
71
1
2
3
4
301
303
302
304
PKB1
(L)
PKB2
(R)
PDS buzzer
Key Switch

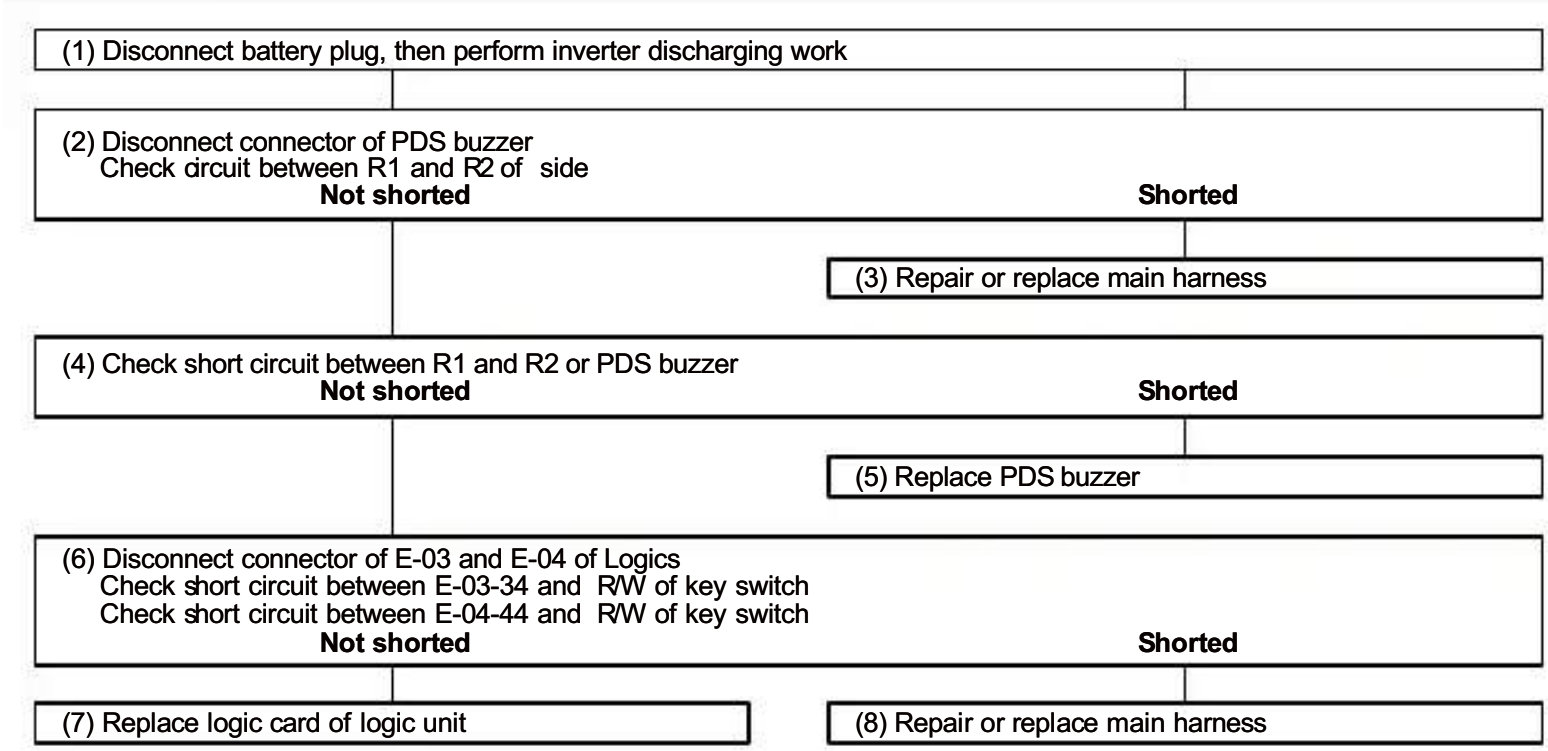

E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44

501569

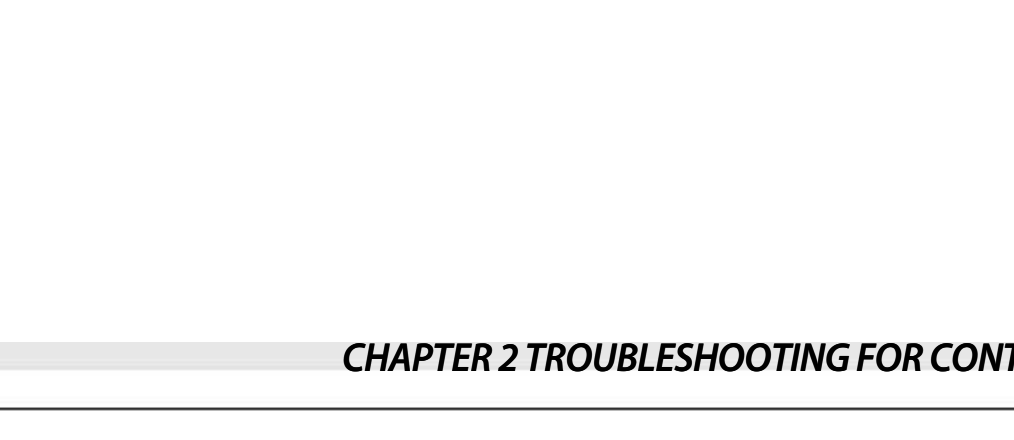
3.49 PDS Buzzer Fault (76)

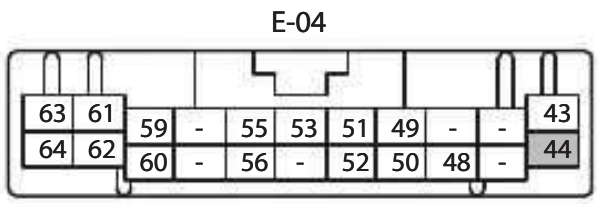
Error code: 76	
Situation	Display: "76". All operations available except for the buzzer.
Possible cause	Faulty PDS buzzer, faulty main harness, faulty logic unit.
Trigger of the error code	By short circuit detection signal of logic card.

Checks



E-03
- - 37 35 33 - - -
- - 38 36 34 32 - 28


Logics
E-03
34
44
Logics
E-04
Rrlay
R/Y
R1
PDS buzzer
R2
L/Y
Rrlay
R/W
Key Switch

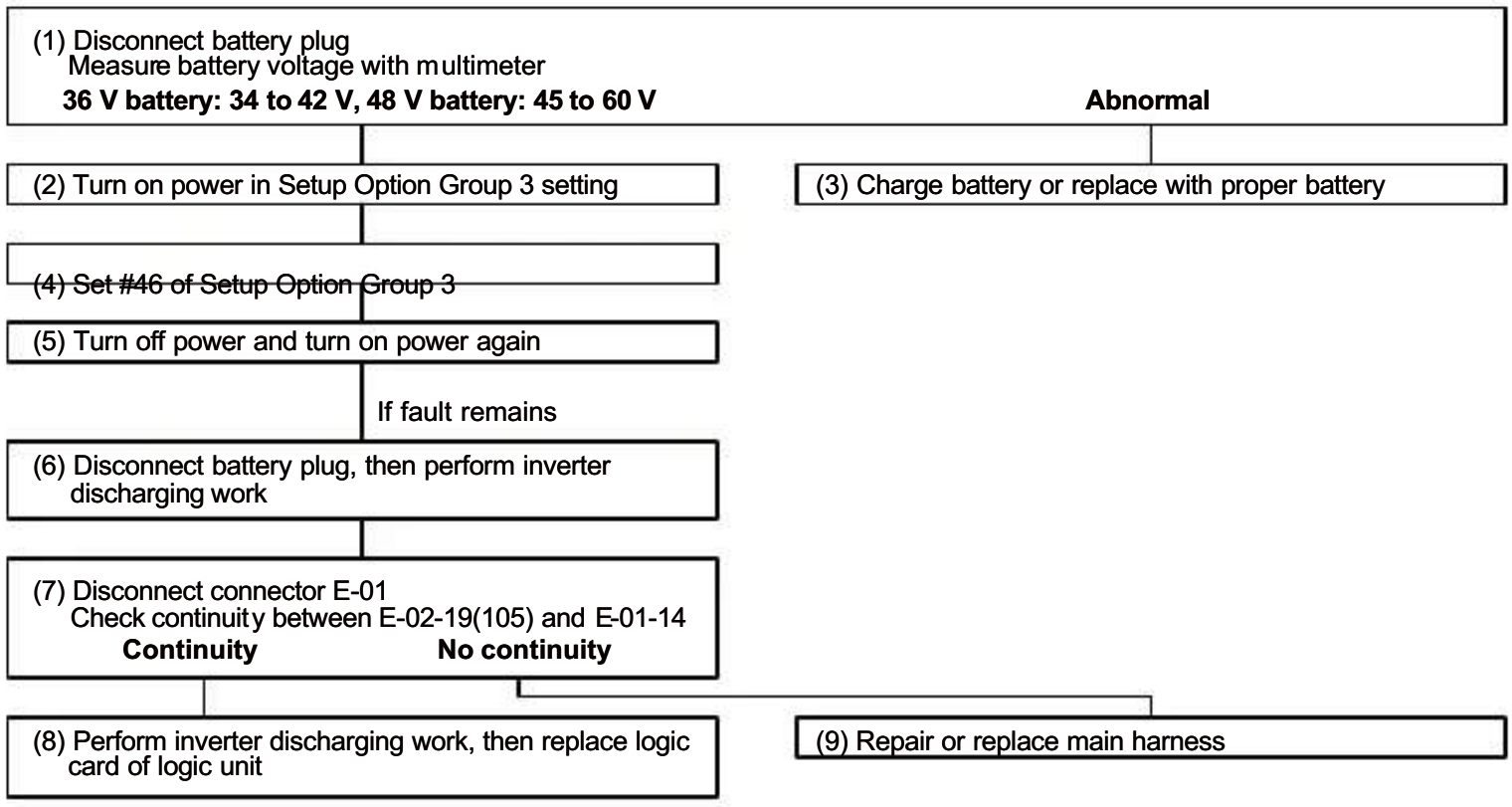

E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44

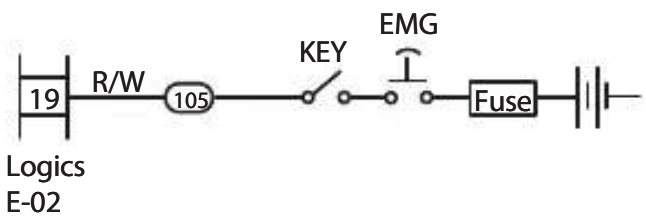
502542

3.50 Battery Voltage Too Low (78)

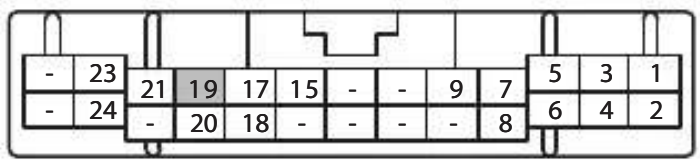
Error code: 78	
Situation	Display: "78". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty or discharged battery, low voltage battery, improper battery voltage setting (Setup Option #41), improper battery voltage adjustment setting (Setup Option #46), faulty main harness, faulty logic unit.
Trigger of the error code	Corrected battery voltage is too low. Battery voltage is corrected by #46 value. 36 V battery: less than 30 V 48 V battery: less than 42 V

Checks




EMG
KEY
19
R/W
105
Fuse
Logics
E-02

E-02

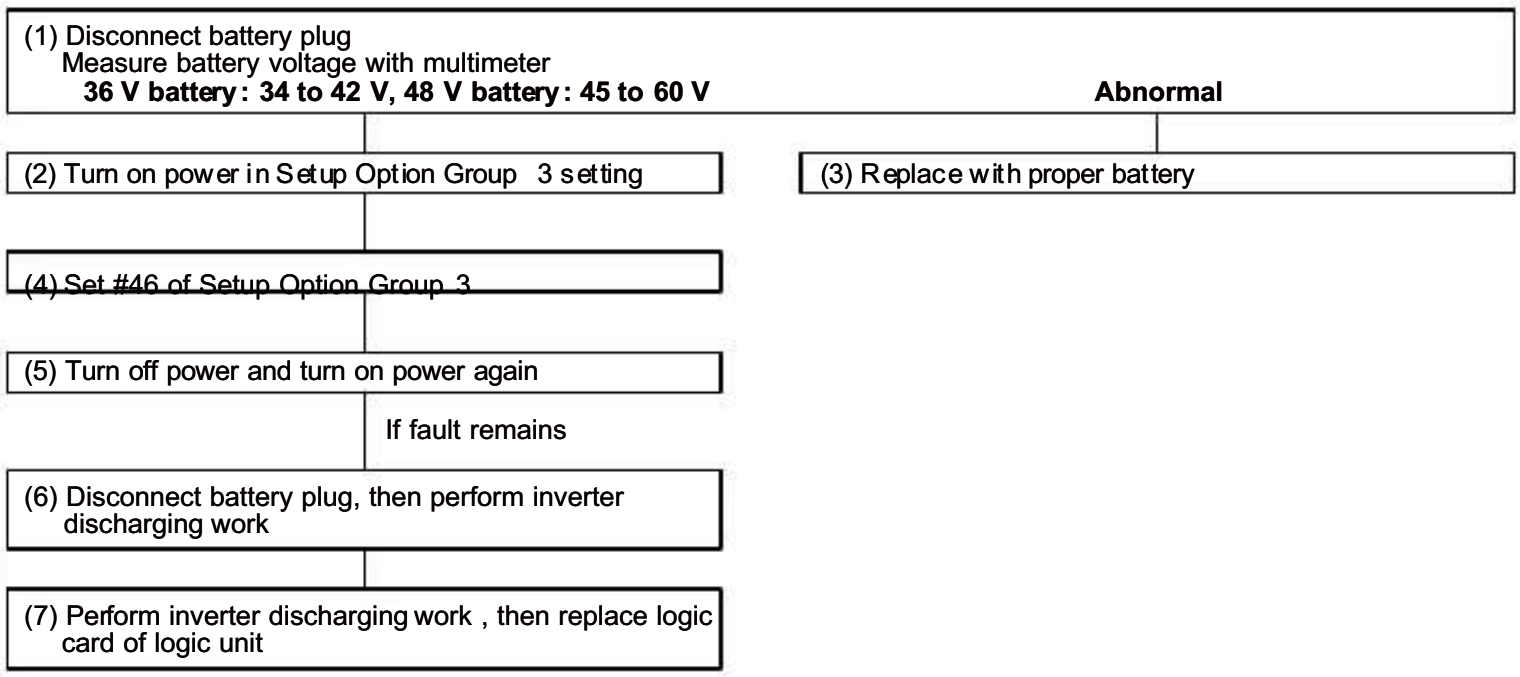

-
23
-
24
21
19
17
15
-
-
9
7
-
20
18
-
-
-
-
8
5
3
1
6
4
2

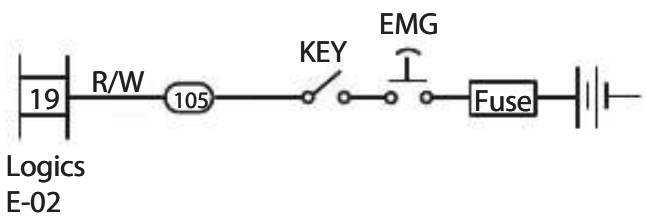
501154

3.51 Battery Voltage Too High (79)

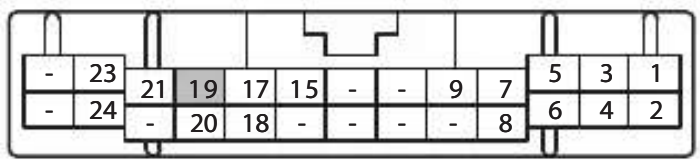
Error code: 79	
Situation	Display: "79". All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Faulty or highly charged battery, high voltage battery, improper battery voltage setting (Setup Option #41), improper battery voltage adjustment setting (Setup Option #46), faulty logic unit.
Trigger of the error code	Corrected battery voltage is too high. Battery voltage is corrected by #46 value. 36 V battery: more than 42 V 48 V battery: more than 60 V

Checks




EMG
KEY
19
R/W
105
Fuse
Logics
E-02

E-02

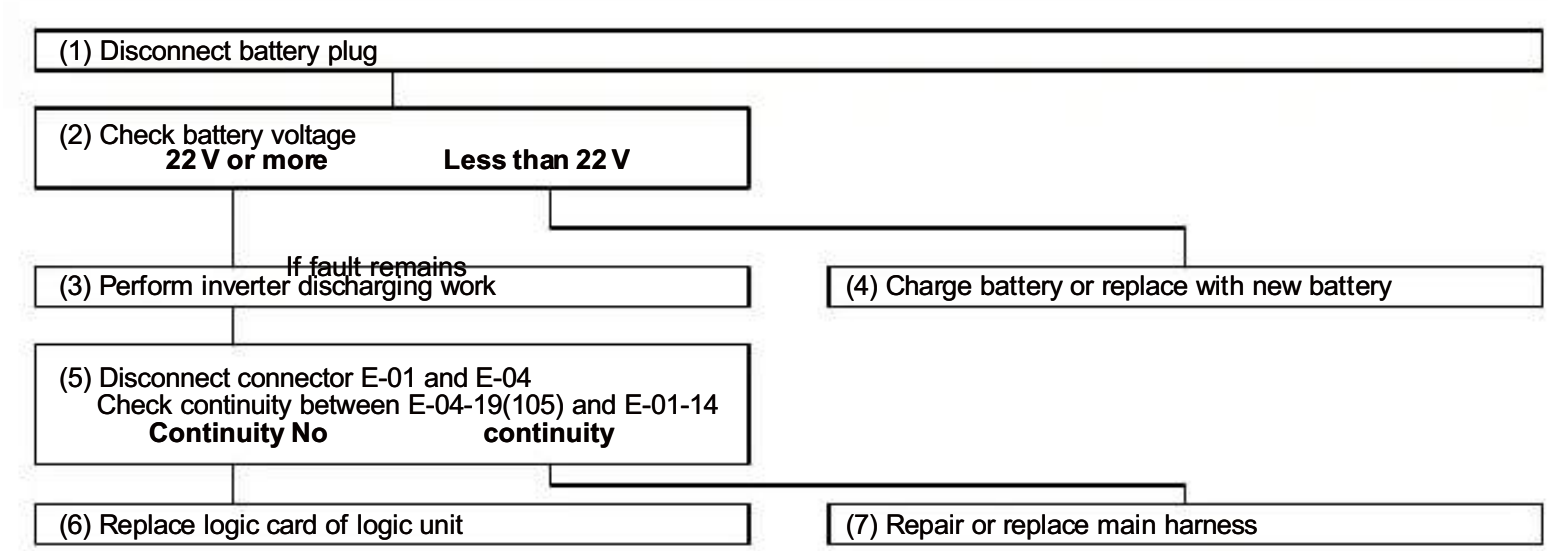

-
23
-
24
21
-
19
20
17
18
15
-
-
-
-
-
9
-
7
8
5
6
3
4
1
2

501154

3.52 Battery Consumption Too Much (Lo)

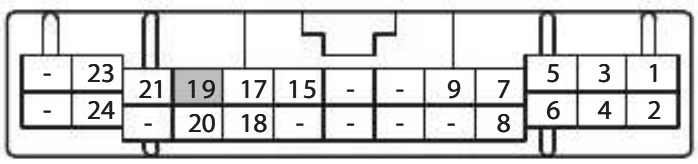
Error code: (Lo)	
Situation	Display: "Lo" flashes. Battery low indicator ON. All truck operations inhibited. Line contactor OPEN and pump contactor OPEN.
Possible cause	Extremely consumed battery, faulty main harness, faulty logic unit.
Trigger of the error code	Corrected battery voltage is less than 22 V. Battery voltage is corrected by #46 value.

Checks



EMG
KEY
19
R/W
105
Fuse
Logics
E-02

E-02

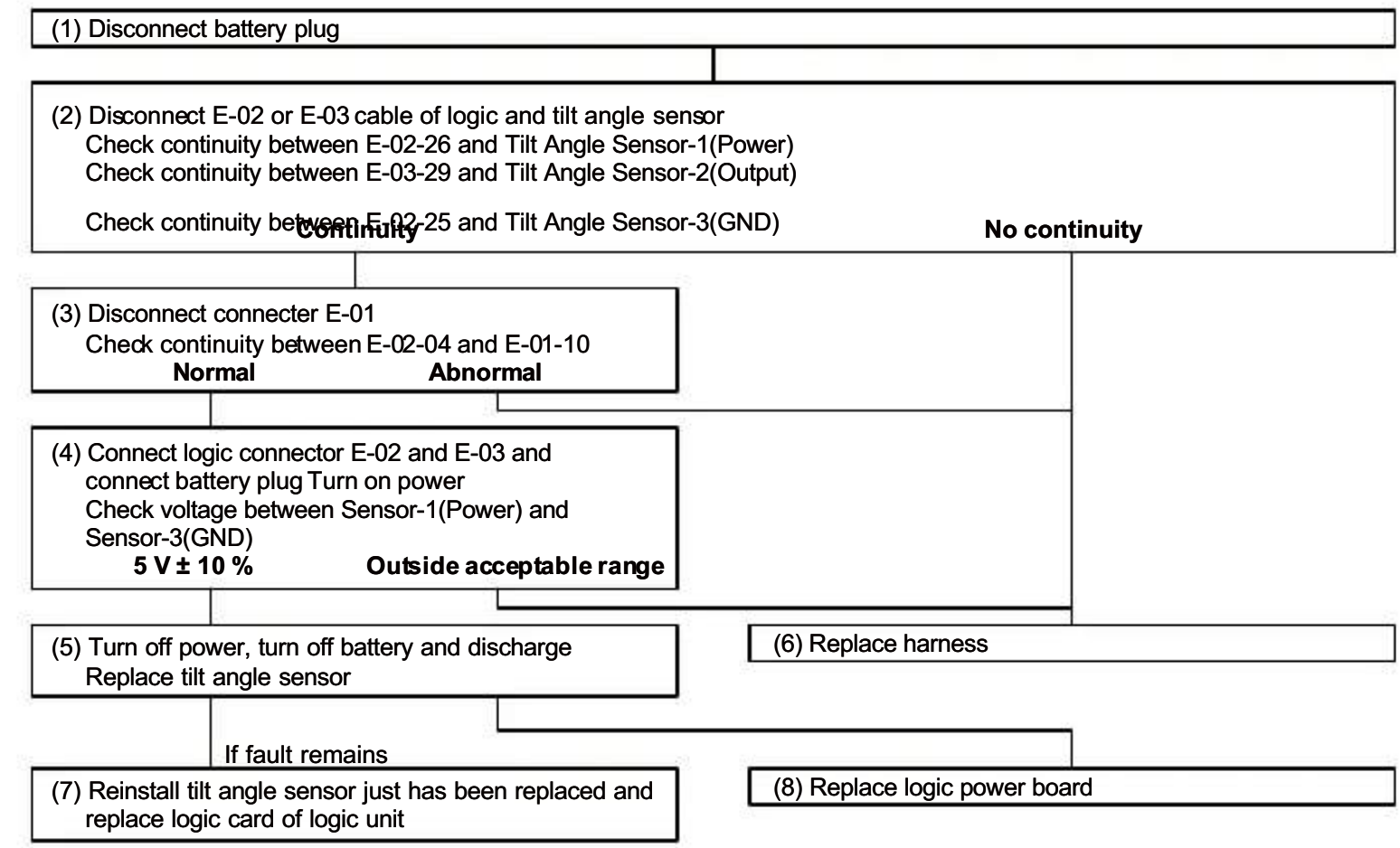

-
23
21
19
17
15
-
-
9
7
5
3
1
-
24
-
20
18
-
-
-
-
8
6
4
2

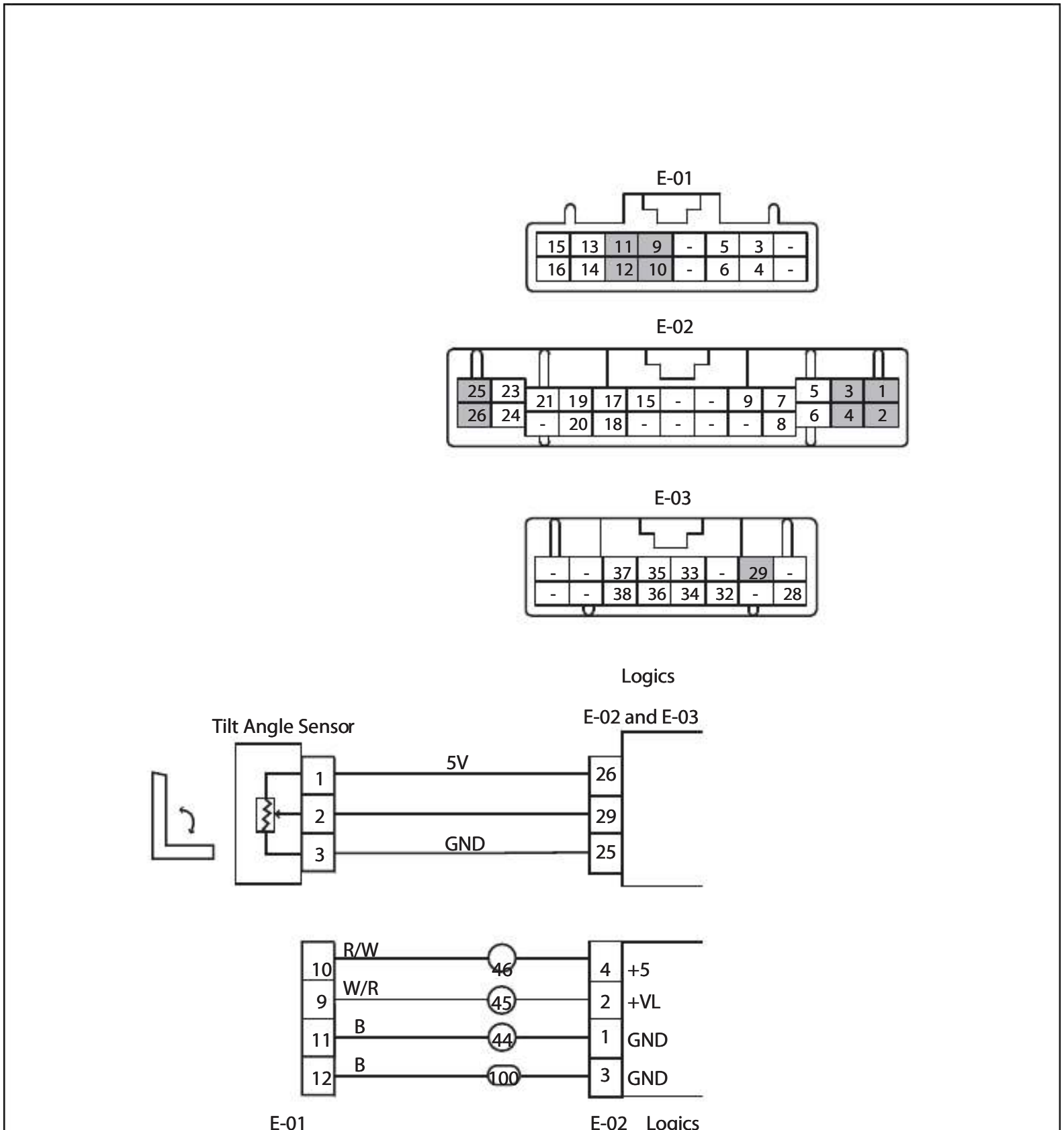
501154

3.53 Tilt Angle Sensor Fault (80)

Error code: 80	
Situation	Tilt mechanism for securing horizontal operation disabled. All other operations are available.
Possible cause	Tilt angel sensor fault, harness fault, logic unit fault
Trigger of the error code	Tilt angle sensoris more than 4.9V, or less than 0.1 V.

Checks




E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
E-02
25 23 21 19 17 15 - - 9 7 5 3 1
26 24 - 20 18 - - - - 8 6 4 2
E-03
- - 37 35 33 - 29 -
- - 38 36 34 32 - 28
Logics
E-02 and E-03
Tilt Angle Sensor
1
2
3
5V
GND
26
29
25
R/W
W/R
B
B
10
9
11
12
46
45
44
100
4 +5
2 +VL
1 GND
3 GND
E-01
E-02 Logics

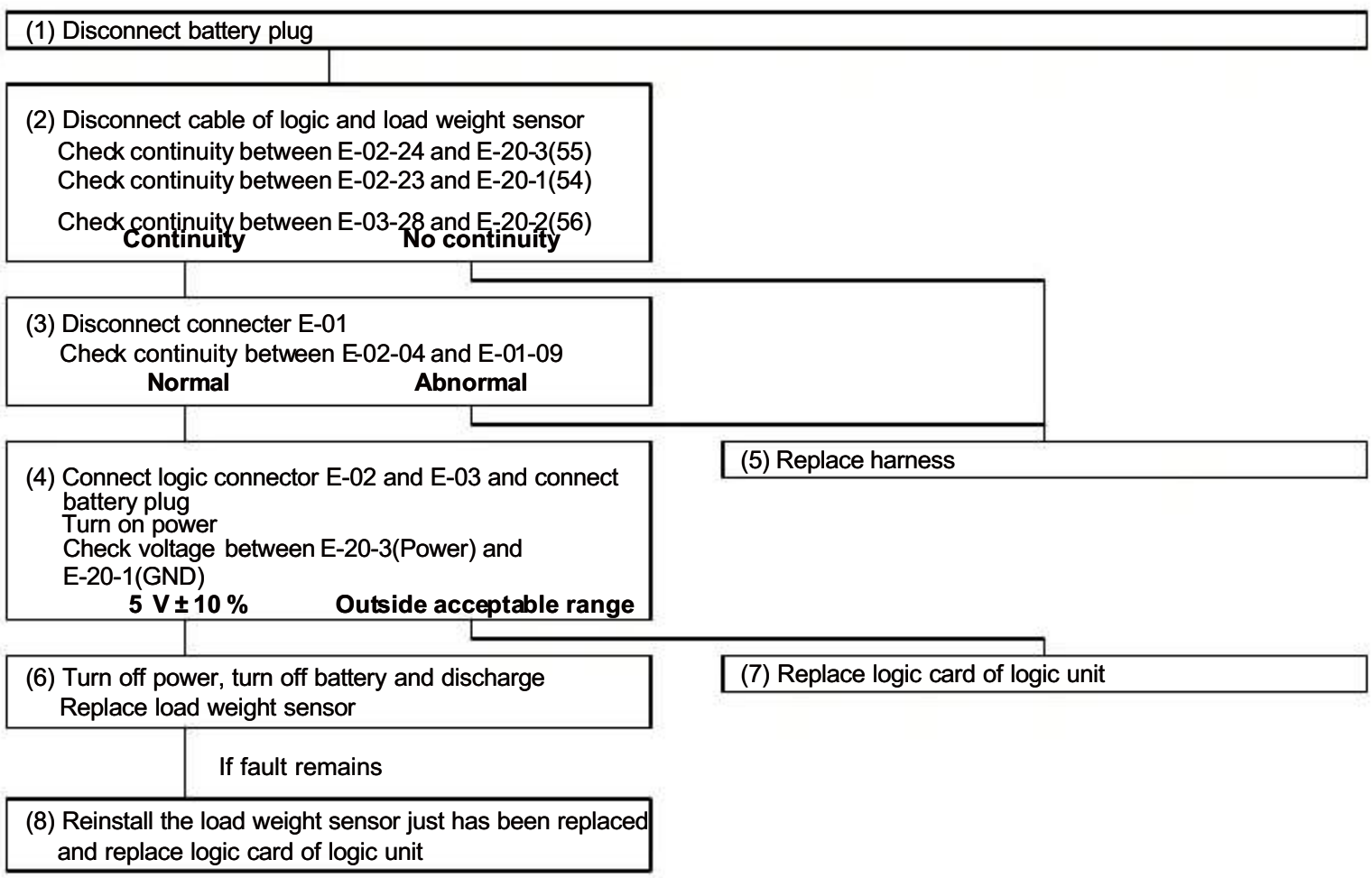
Power card

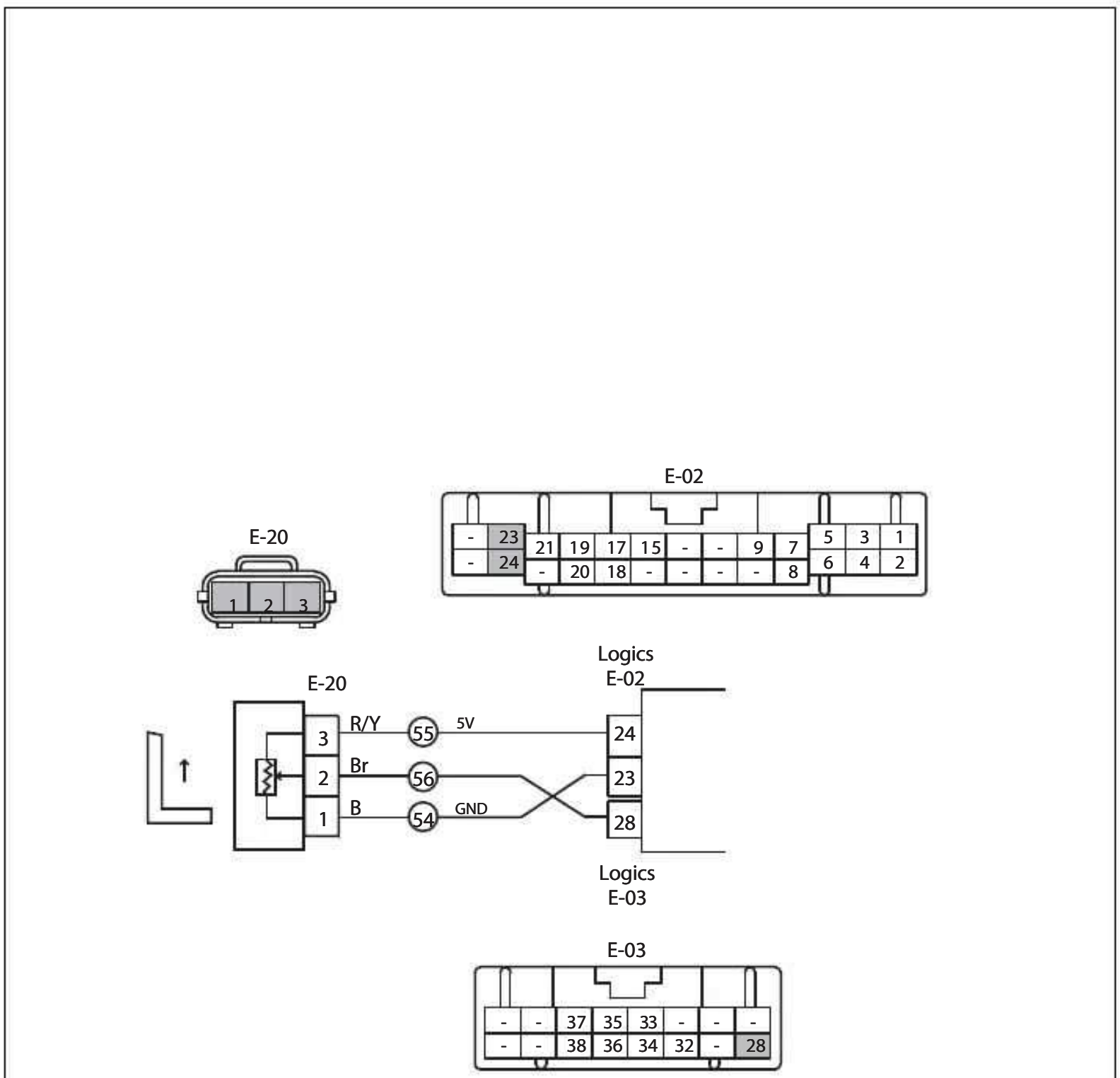
501157

3.54 Load Sensor Fault (81)

Error code: 81	
Situation	Pitch control and tilt mechanism to secure horizontal operation are disabled. All other operations are available.
Possible cause	Load weight sensor fault, harness fault, logic unit fault
Trigger of the error code	Load weight sensoris more than 4.9 V, or less than 01 V.

Checks

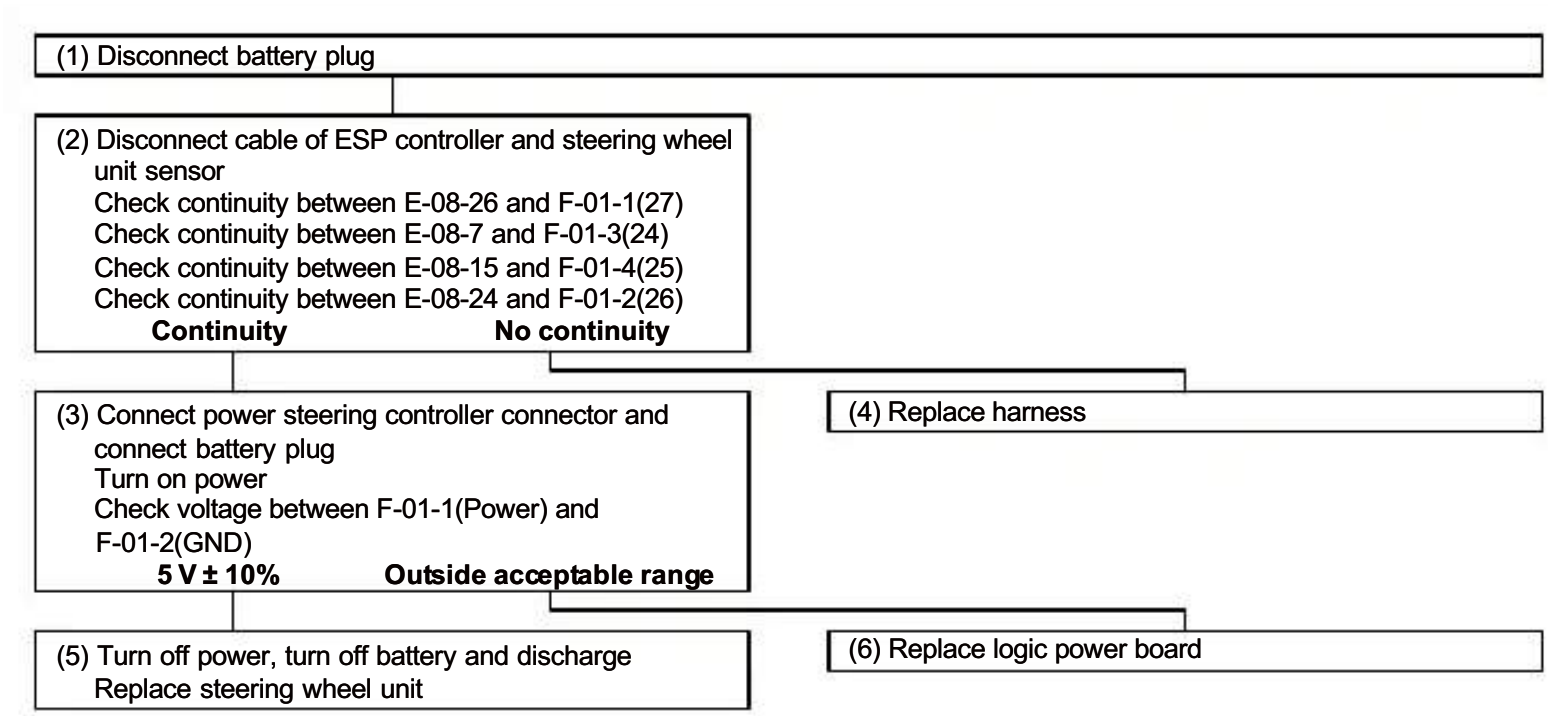


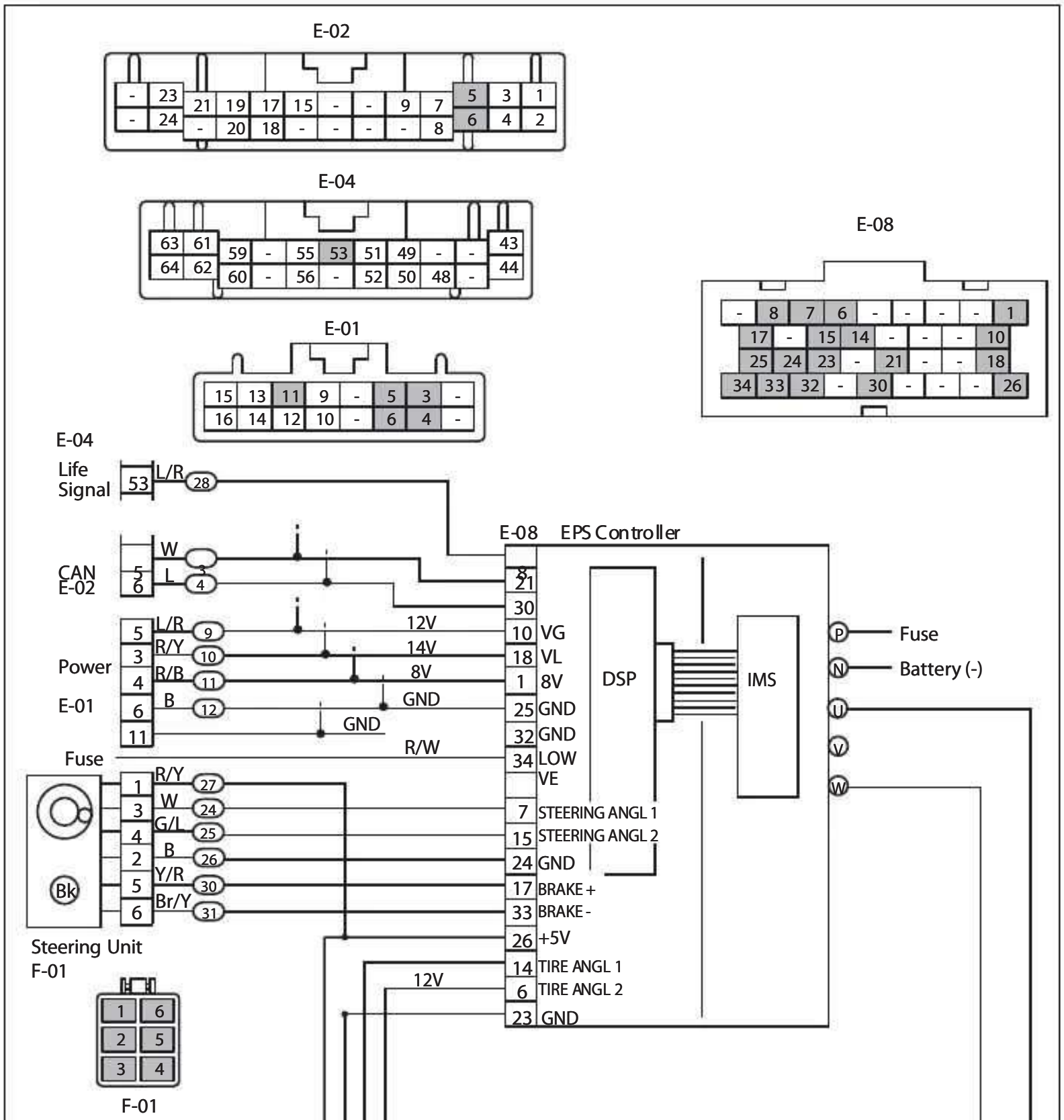

E-02
E-20
1 2 3
- 23
- 24
21 19 17 15 - - 9 7
- 20 18 - - - - 8
5 3 1
6 4 2
Logics
E-02
E-20
3
2
1
R/Y
Br
B
55
56
54
5V
GND
24
23
28
Logics
E-03
E-03
- - 37 35 33 - - -
- - 38 36 34 32 - 28

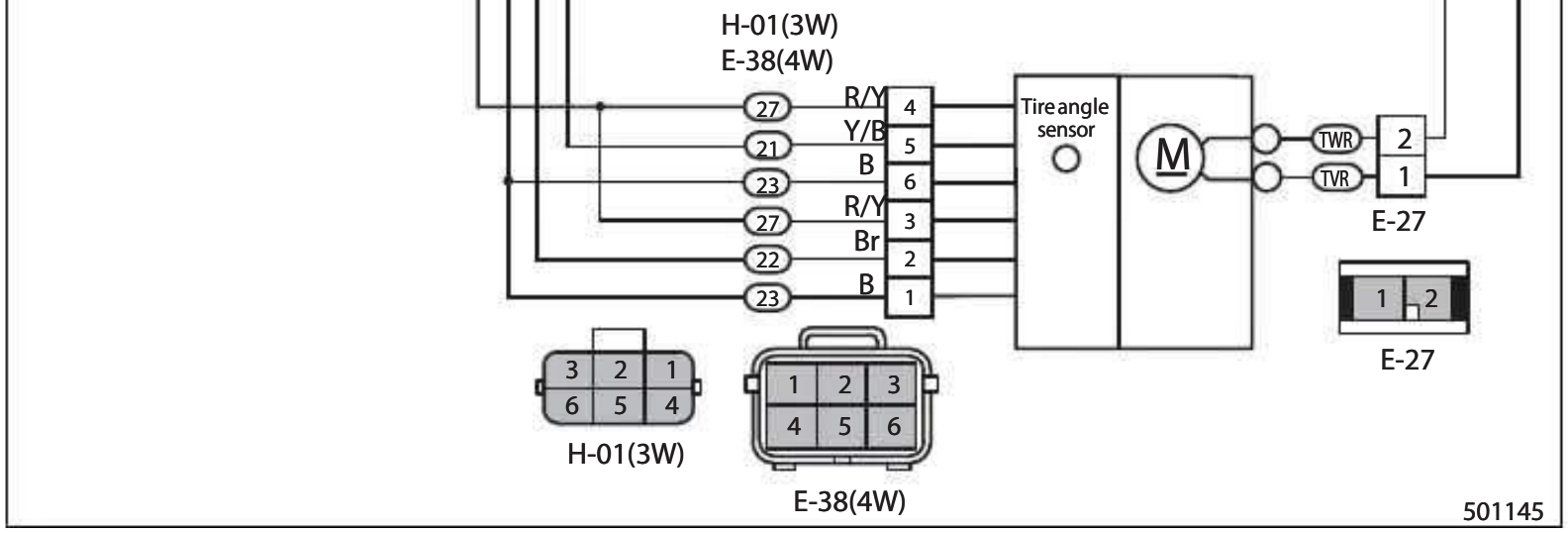
3.55 Handle Sensor Fault (82)

Error code: 82	
Situation	Display: "82". All operations inhibited except mast lowering operation. Line steering contactor OPEN. Travelling speed limited to 5 km/h.
Possible cause	Steering wheel unit fault, harness fault, power steering controller fault
Trigger of the error code	One cycle of steering wheel angle input is not within the range between 4 to 6.67 ms. Steering wheel angle input difference between A and B phase is more than 8 degrees.

Checks




E-02
E-04
E-08
E-01
E-04
Life Signal
53
L/R
28
CAN
E-02
W
L
Power
E-01
L/R
R/Y
R/B
B
Fuse
R/W
Steering Unit
F-01
Bk
F-01
E-08 EPS Controller
DSP
IMS
VG
VL
8V
GND
LOW
VE
STEERING ANGL 1
STEERING ANGL 2
BRAKE +
BRAKE -
+5V
TIRE ANGL 1
TIRE ANGL 2
12V
14V
8V
GND
Fuse
Battery (-)



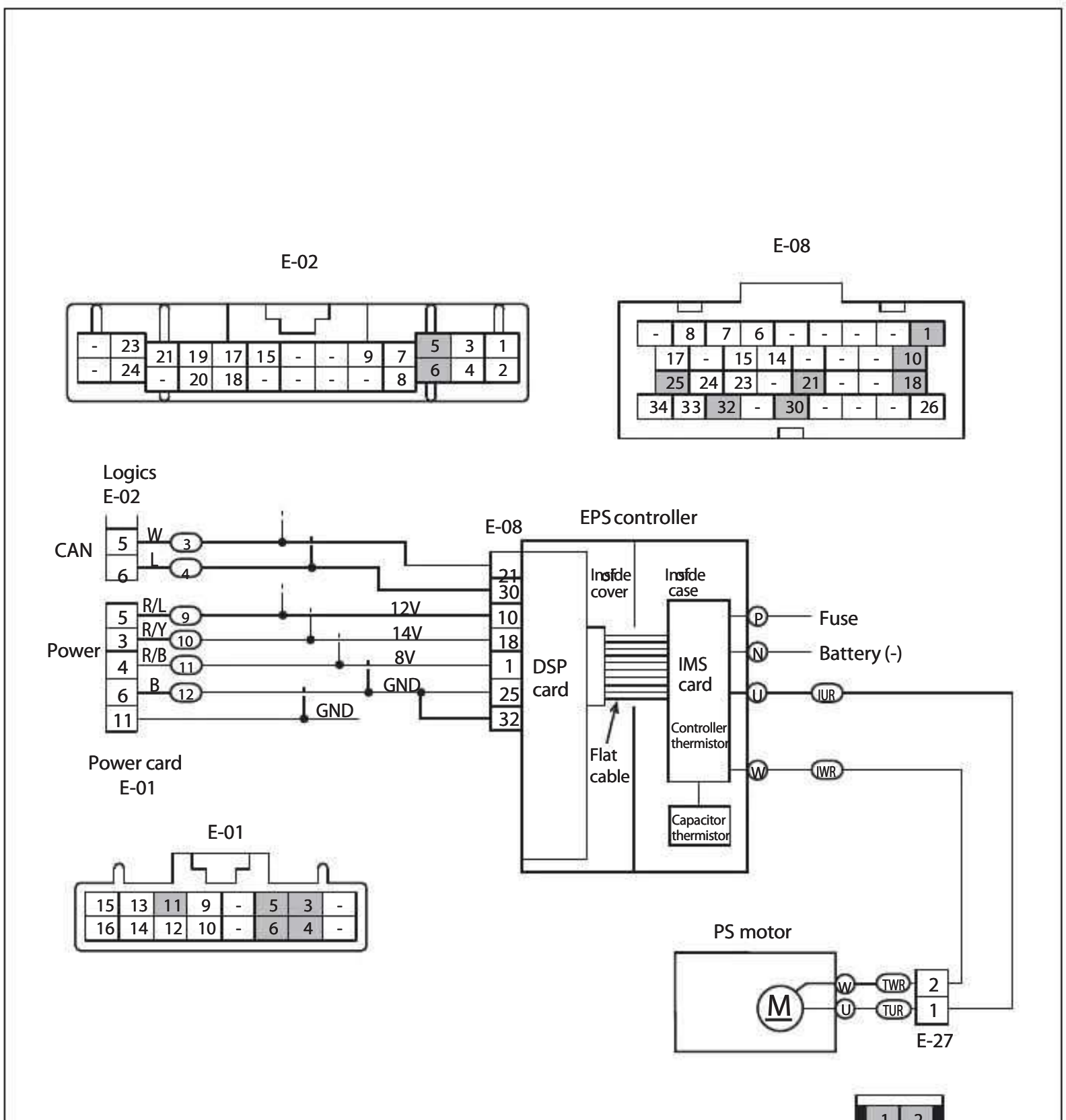
3.56 PS Motor Current Sensor Fault (A4)

Error code: A4	
Situation	Display: "A4". All truck operations inhibited. Line contactor OPEN and ST contactor OPEN. All operations inhibited except mast lowering operation.
Possible cause	Power steering controller.
Trigger of the error code	When turning on power, current sensor value is out of -120A.

Checks

(1) Disconnect battery plug

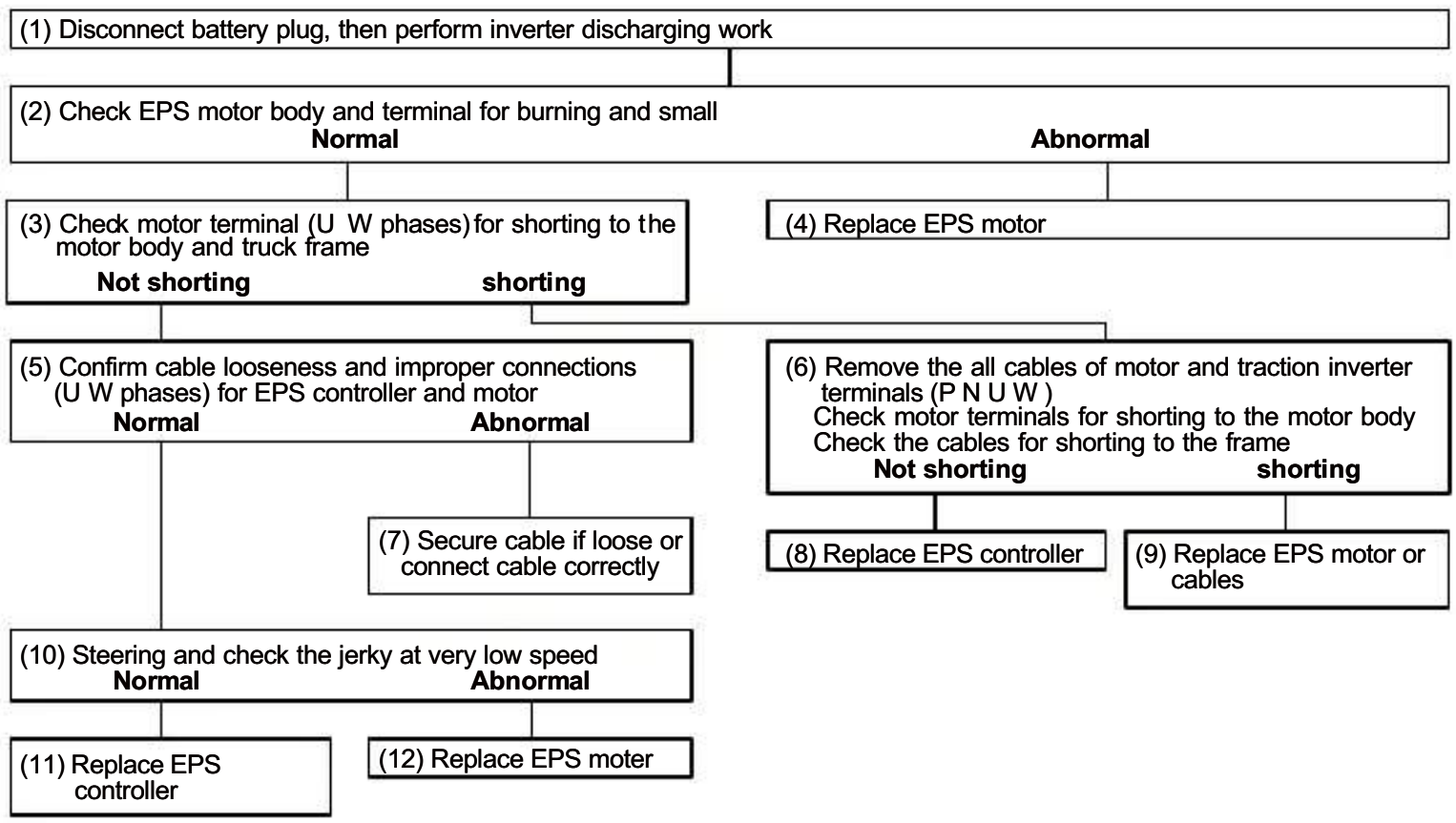
(2) Replace EPS controller

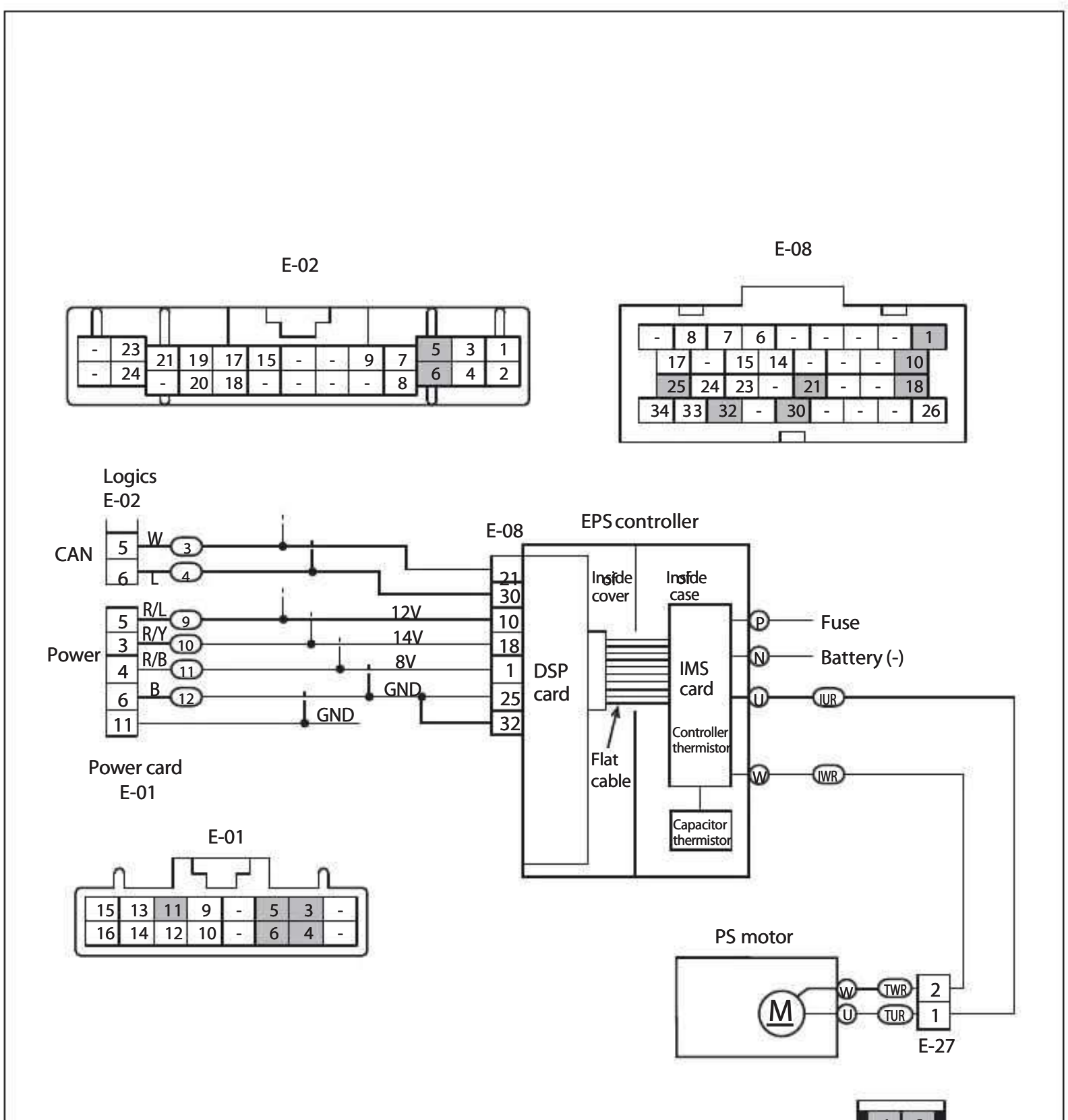

E-02
E-08
Logics
E-02
CAN
W
L
Power
R/L
R/Y
R/B
B
12V
14V
8V
GND
GND
E-08
EPS controller
DSP card
Inside cover
Inside case
IMS card
Controller thermistor
Capacitor thermistor
Flat cable
Fuse
Battery (-)
IUR
IWR
Power card
E-01
E-01
PS motor
TWR
TUR
E-27

3.57 PS Motor Over-current (A5)

Error code: A5	
Situation	Display: "A5". All truck operations inhibited. Line contactor OPEN and ST contactor OPEN. All operations inhibited except mast lowering operation.
Possible cause	Faulty PS motor. (Contain the bearing sensor) Faulty contact or wire breakage of PS motor speed sensor harness. Faulty PS inverter. Faulty contact or wire breakage of DSP flat cable in PS inverter. Faulty DSP card of PS inverter. Faulty main harness.
Trigger of the error code	Motor current is more than 116 A (Moment) or 113 A (1 mS) or 112 A (1.6 mS).

Checks

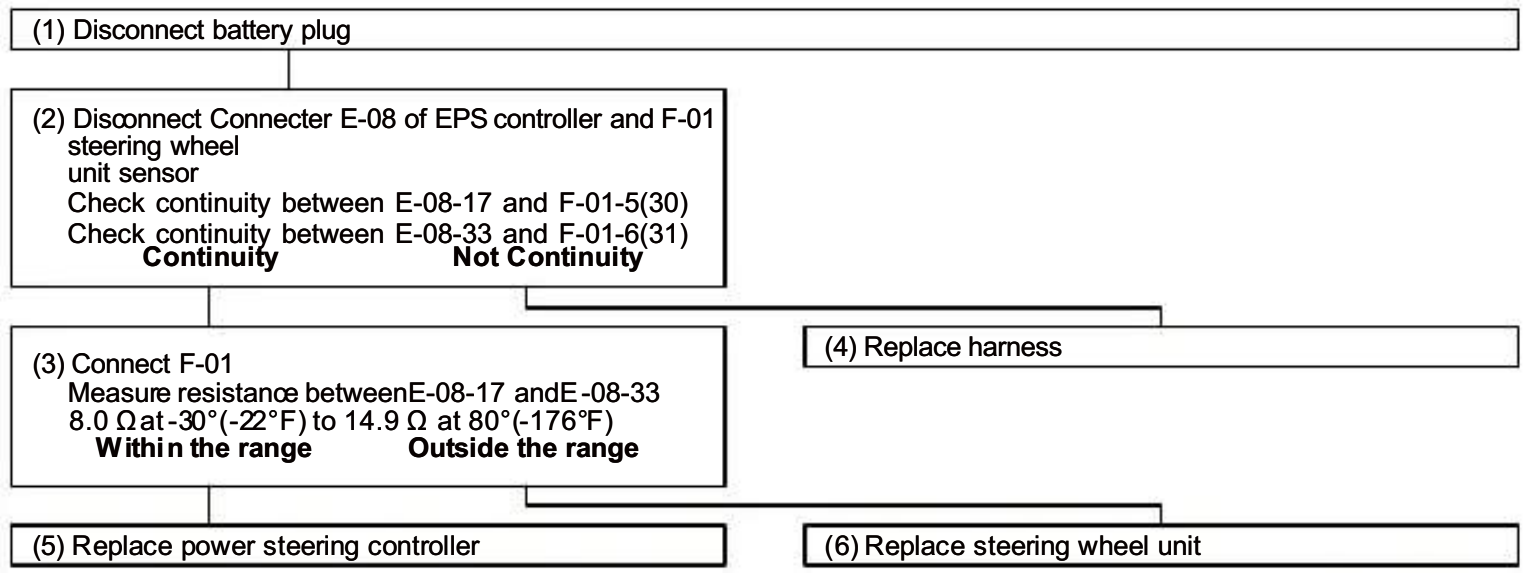



E-02
E-08
Logics
E-02
CAN
Power
W
L
R/L
R/Y
R/B
B
12V
14V
8V
GND
GND
E-08
EPS controller
DSP card
Inside of cover
Inside of case
IMS card
Controller thermistor
Capacitor thermistor
Flat cable
Fuse
Battery (-)
IUR
IWR
Power card
E-01
E-01
PS motor
TWR
TUR
E-27

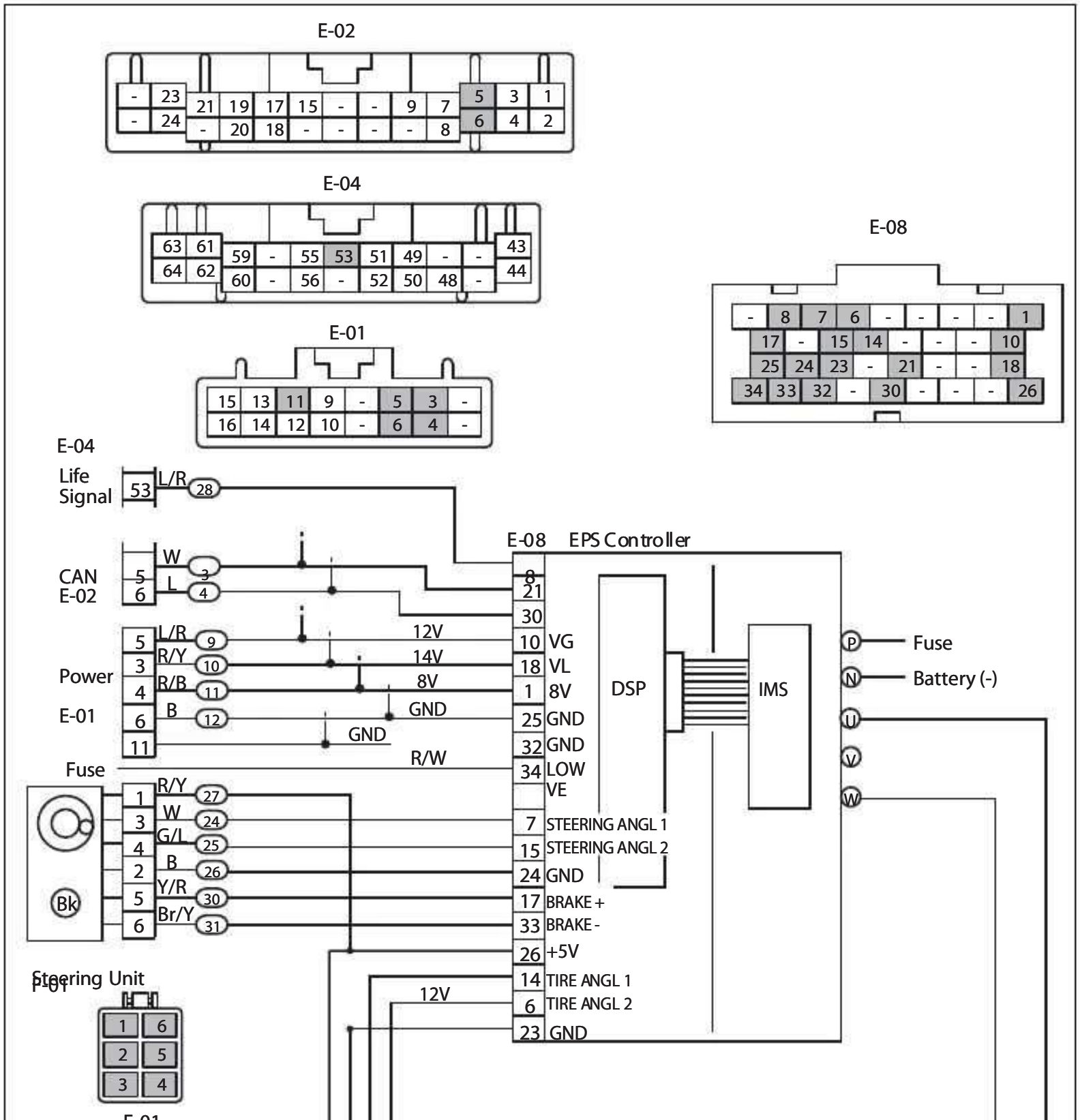
3.58 PS Handle Brake Fault (A7)

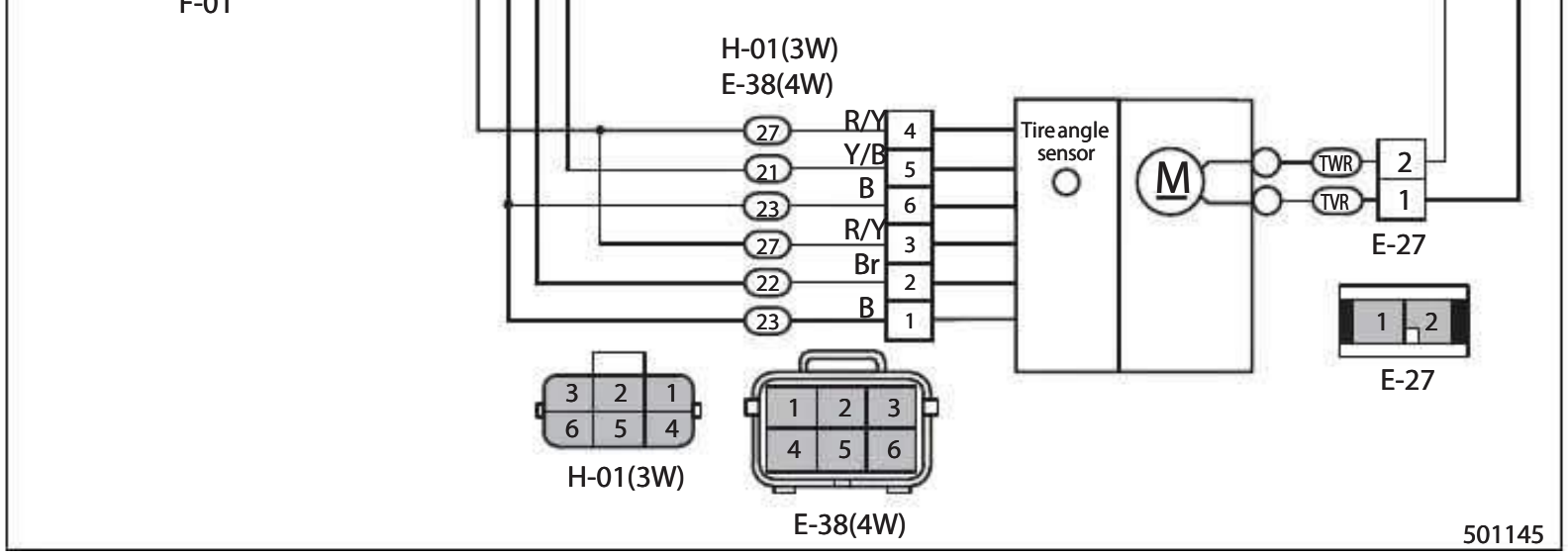
Error code: A7	
Situation	Steering wheel reaction force disabled, and travelling speed limited to 5 km/h.
Possible cause	Steering wheel unit fault, harness fault, power steering controller fault
Trigger of the error code	Steering wheel reaction force brake current FB is 1.2A or more. Steering wheel reaction force brake command value > 0.2A and current FB < 0.16A Overcurrent detected by overcurrent detection circuit.

Checks



502874


E-02
- 23 21 19 17 15 - - 9 7 5 3 1
- 24 - 20 18 - - - - 8 6 4 2
E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44
E-08
- 8 7 6 - - - - 1
17 - 15 14 - - - 10
25 24 23 - 21 - - 18
34 33 32 - 30 - - - 26
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
E-04
Life Signal
53
L/R
28
CAN
E-02
5
6
W
L
3
4
Power
E-01
5
3
4
6
11
L/R
R/Y
R/B
B
9
10
11
12
12V
14V
8V
GND
GND
R/W
Fuse
Bk
1
3
4
2
5
6
R/Y
W
G/L
B
Y/R
Br/Y
27
24
25
26
30
31
Steering Unit
P-01
1 6
2 5
3 4
E-08 EPS Controller
8
21
30
10 VG
18 VL
1 8V
25 GND
32 GND
34 LOW VE
7 STEERING ANGL 1
15 STEERING ANGL 2
24 GND
17 BRAKE +
33 BRAKE -
26 +5V
14 TIRE ANGL 1
6 TIRE ANGL 2
23 GND
12V
DSP
IMS
P
N
U
V
W
Fuse
Battery (-)



3.59 Battery Side Way Exchange Interlock (A8)

Error code: A8	
Situation	Display: "A8". All truck operations inhibited. Line contactor HOLD and ST contactor HOLD. Traction motor and pump motor operation inhibited. If this fault occurs before ST contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Side-mounted interlock switch faulty, harness fault, logic unit fault
Trigger of the error code	Battery interlock switch is ON.

Checks

(1) Disconnect battery plug

(2) Check connection of side- mount battery interlock switchconnector
Normal — **Abnormal**

Normal type

(3) Connect the connector

Side-mount battery

(4) Check for Interference between battery cover andswitch
No interference — **Interference**

(5) Reinstall cover and switch

(6) Disconnect connector E-04 cable of logic and side - mount battery switch
Check continuity between E-04-56 and Interlock SW(Br/B)
Check continuity between E-04-43 and Interlock SW(B)
Continuity — **No Continuity**

Normal type

(7) Replace harness.

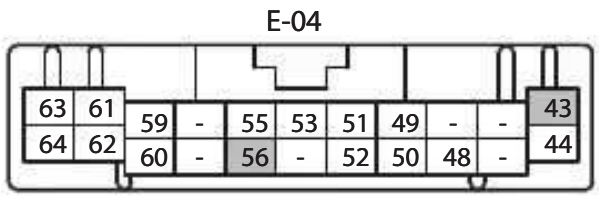
Side-mount battery

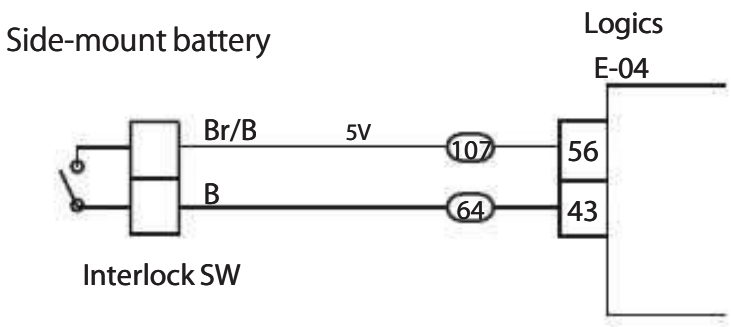
(8) Manually change side-mount battery switch to batteryavailable status and check continuity on interlock switch side
Check continuity of interlock SW connector at both ends
Continuity — **No Continuity**

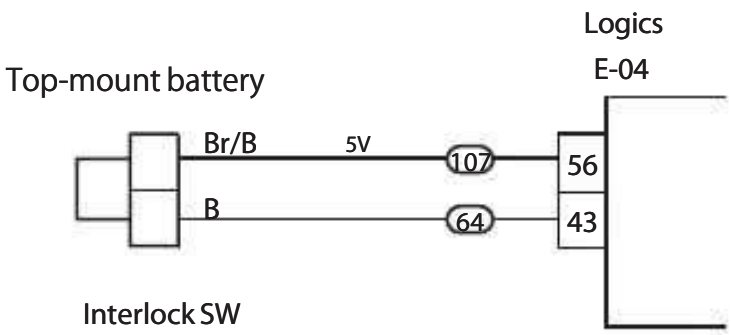
(9) Replace logic card of logic unit

(10) Replace switch

502875





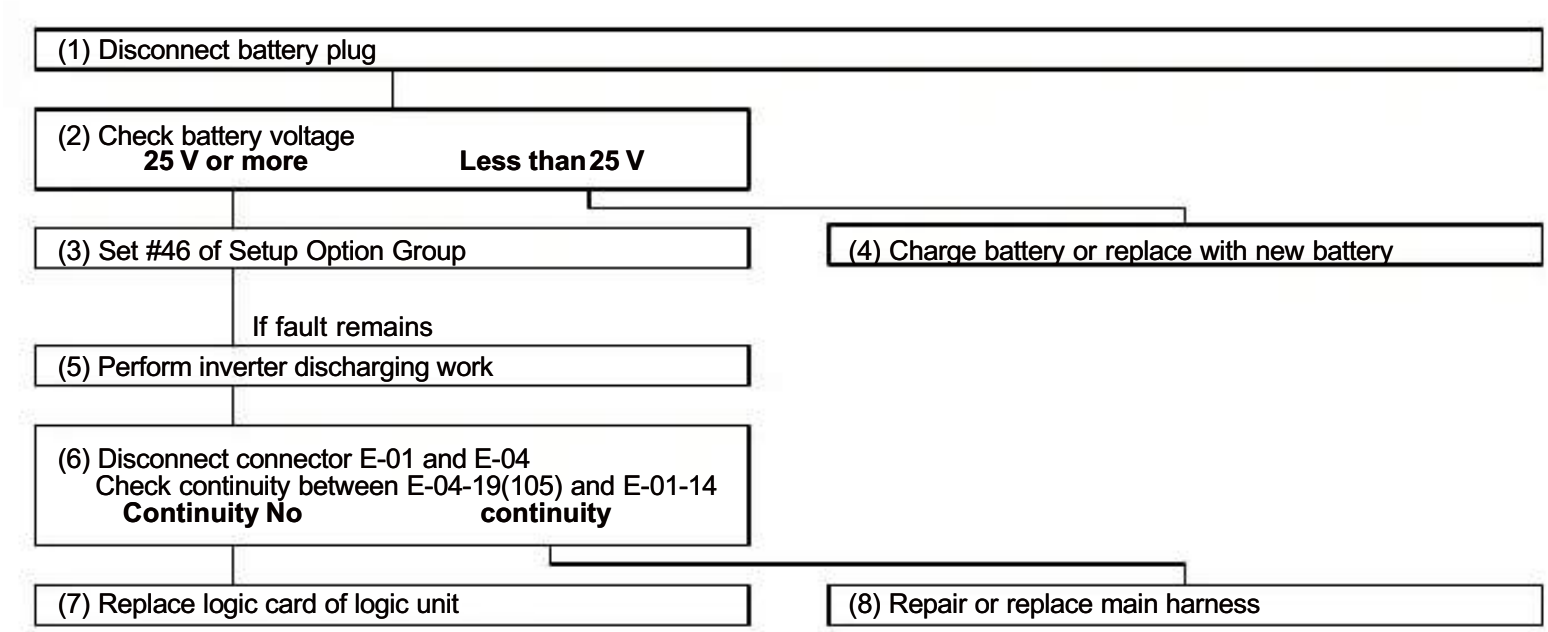


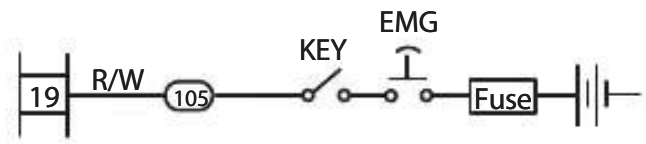
501159

3.60 Battery Consumption Much

Error code: None	
Situation	Battery low indicator flashes. Traction motor operation restricted to "ECONOMY" mode. Normal pump motor and power steering operations.
Possible cause	Consumed battery, improper battery voltage adjustment setting (Setup Option #46), faulty main harness, faulty logic unit.
Trigger of the error code	Corrected battery voltage is less than 25 V. Battery voltage is corrected by #46 value.

Checks

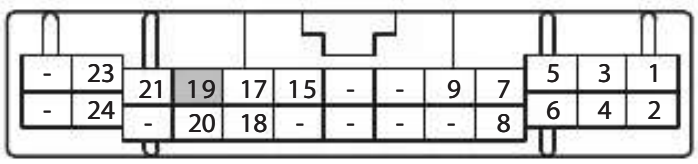




Logics

E-02

E-02

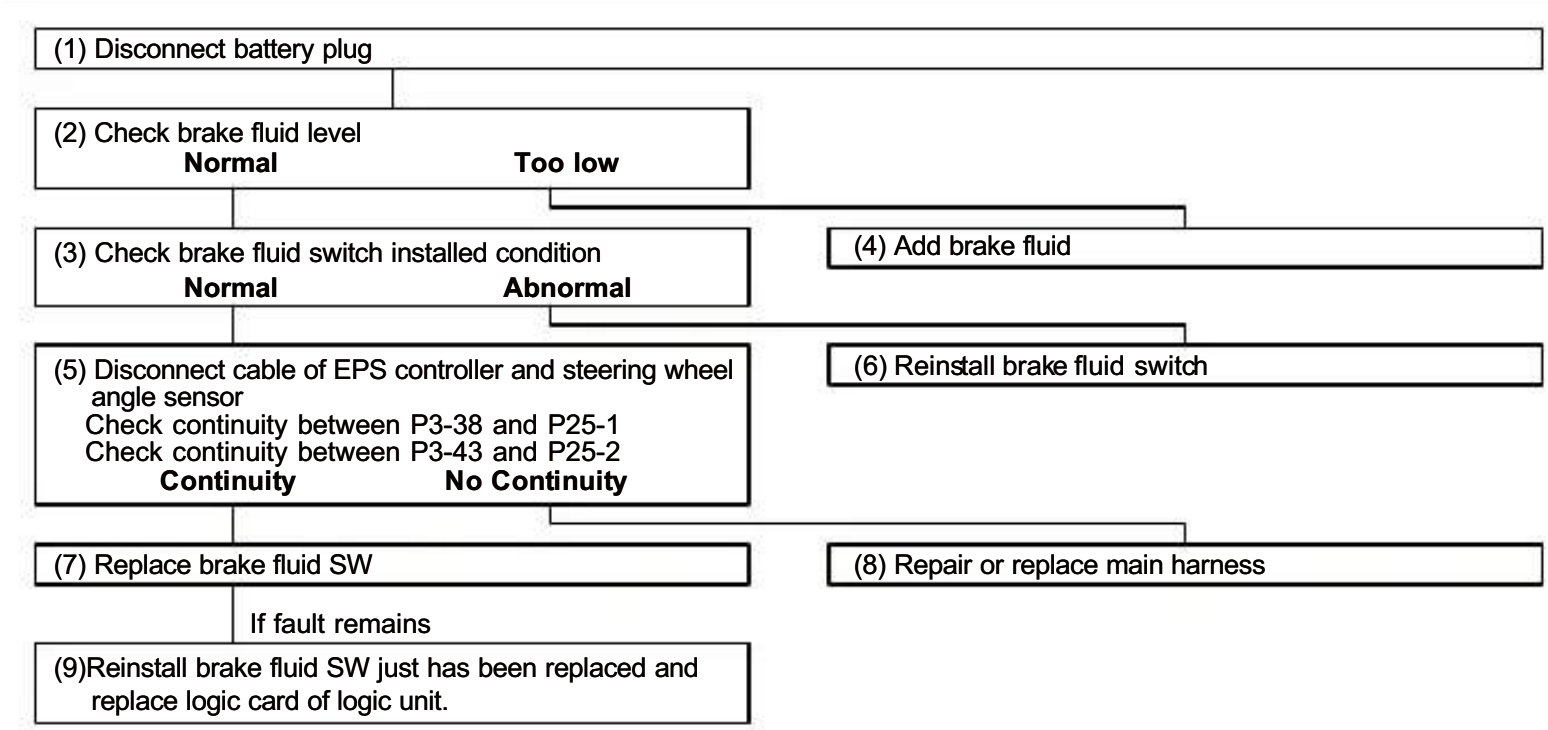


501154

3.61 Brake Oil, Low Level

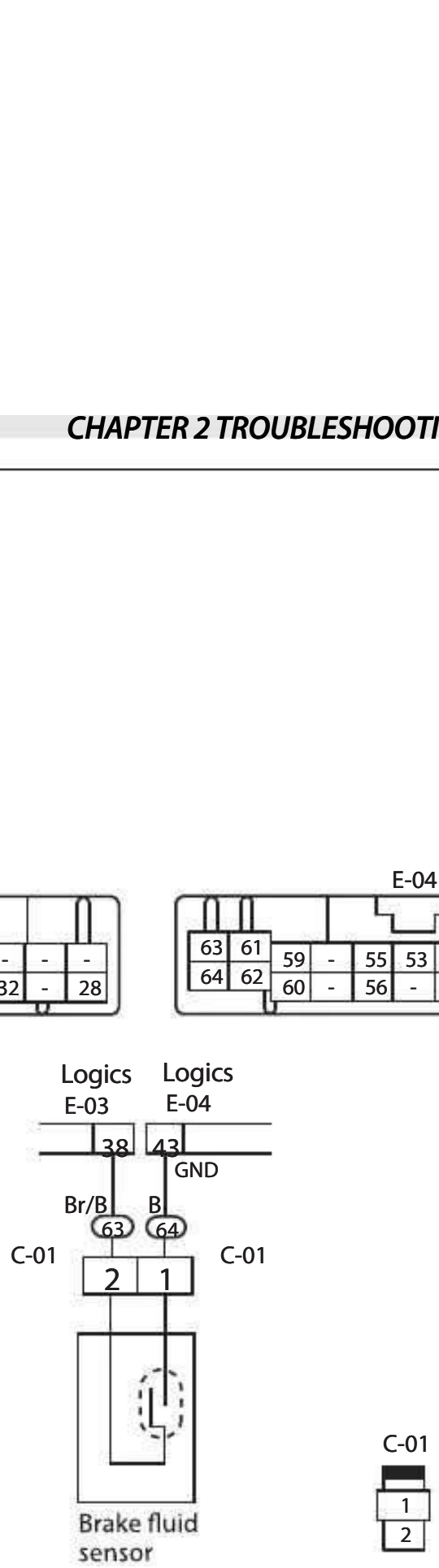
Error code: None	
Situation	Brake fluid icon displayed. All operations available.
Possible cause	Brake fluid switch fault, harness fault, power steering controller fault
Trigger of the error code	Brake fluid SW is ON.

Checks



502877

E-03
- - 37 35 33 - - -
- - 38 36 34 32 - 28
E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44

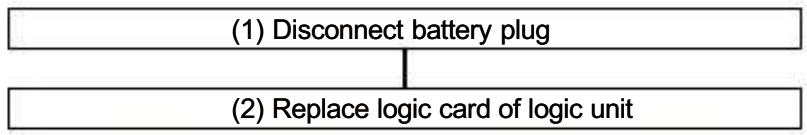

Logics
E-03
Logics
E-04
38
43
GND
Br/B
B
63
64
C-01
C-01
2
1
Brake fluid
sensor
C-01
1
2

501139

3.62 RTC Battery Low

Error code: None	
Situation	Flashing on hour meter.
Possible cause	Battery voltage for calendar IC is low.
Trigger of the error code	Signal from calendar IC.

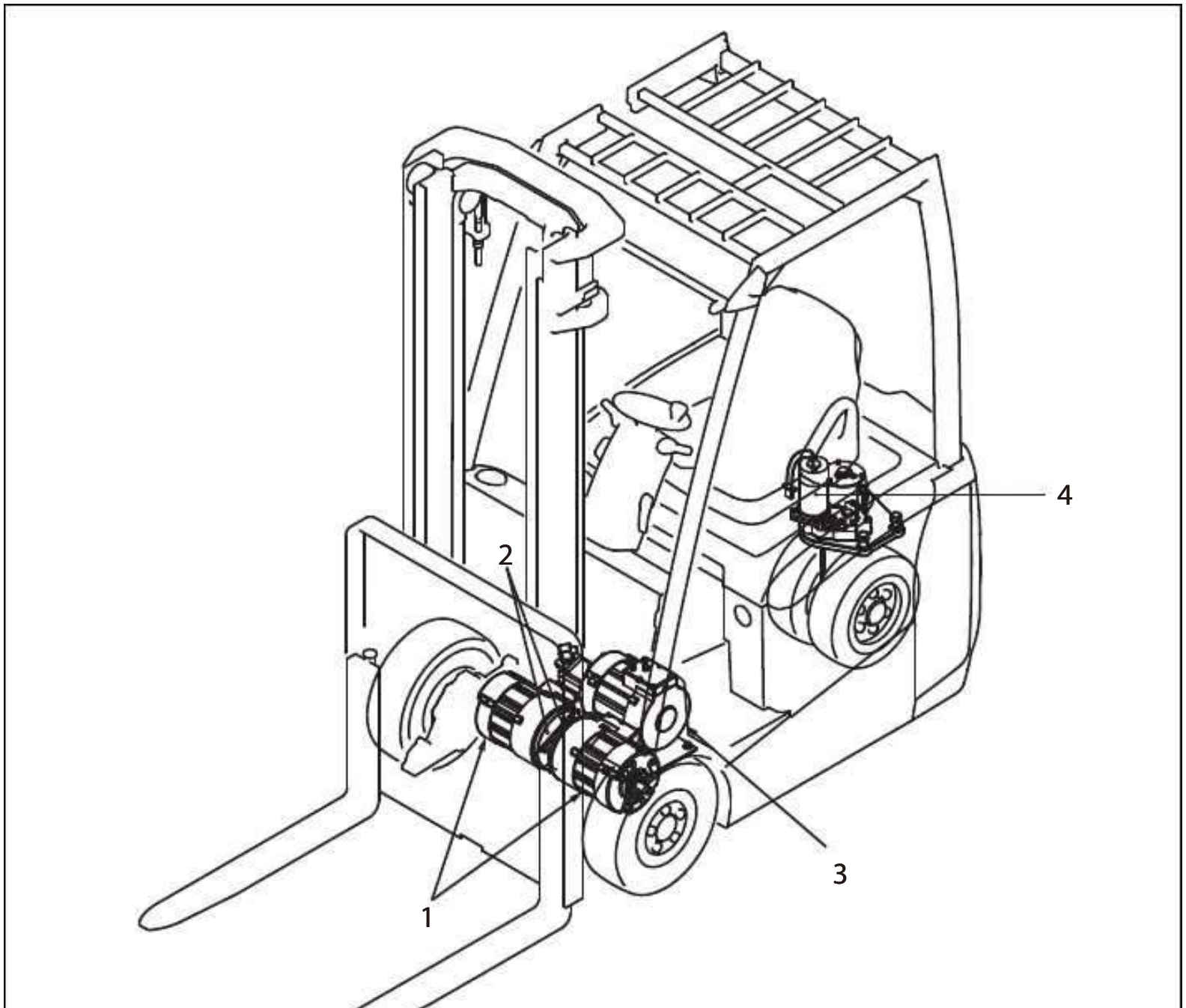
Checks



Chapter 3 MOTOR

1. Motor Installation Positions

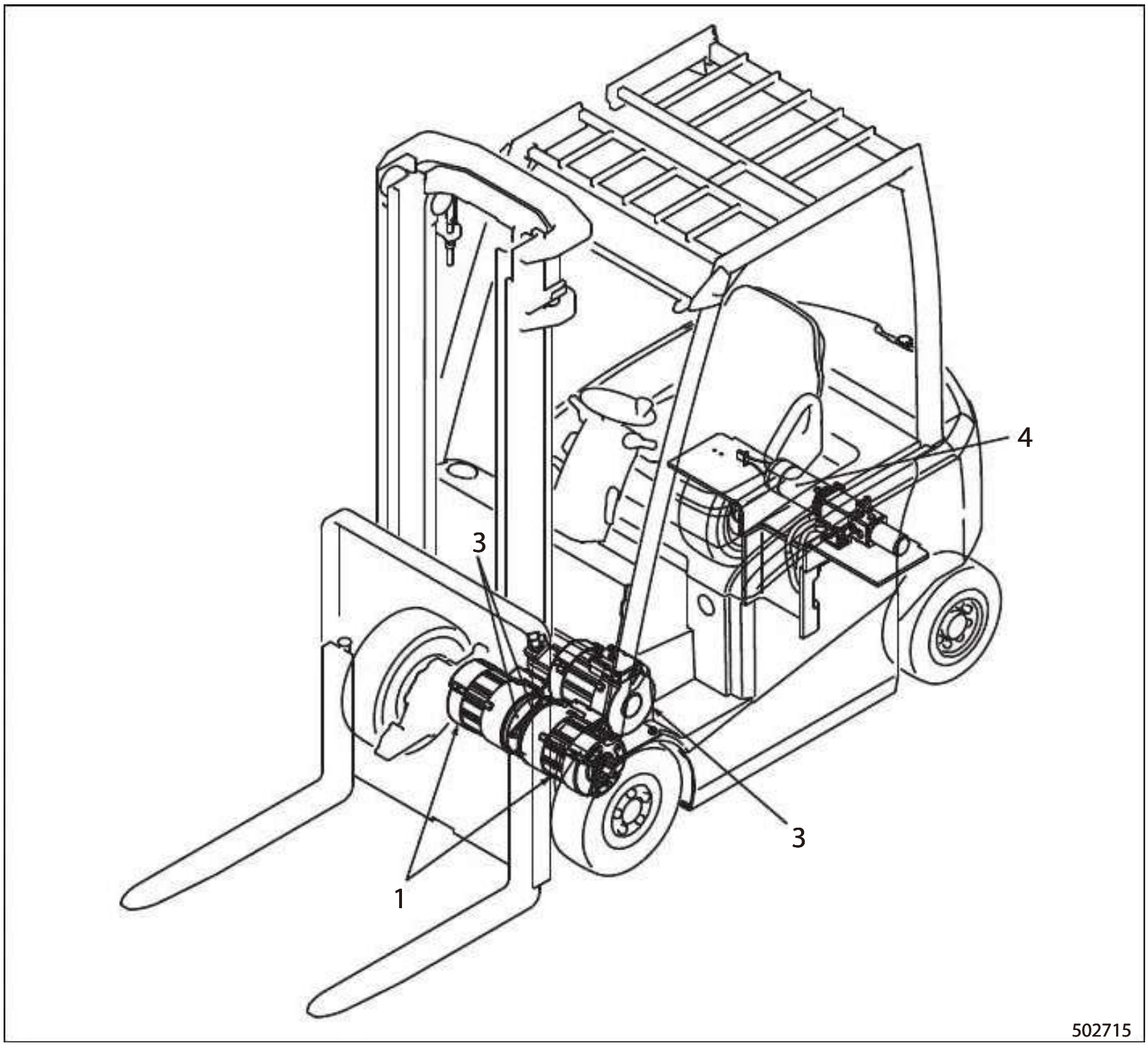
3-Wheel model (3W)



1. Traction motors
2. Electro-magnetic brake
3. Pump motor
4. EPS motor

CHAPTER 3 MOTOR

4-Wheel model (4W)



1. Traction motors
3. Pump motor

2. Electro-magnetic brake

1. Traction motors
3. Pump motor
4. EPS motor

2. Specifications

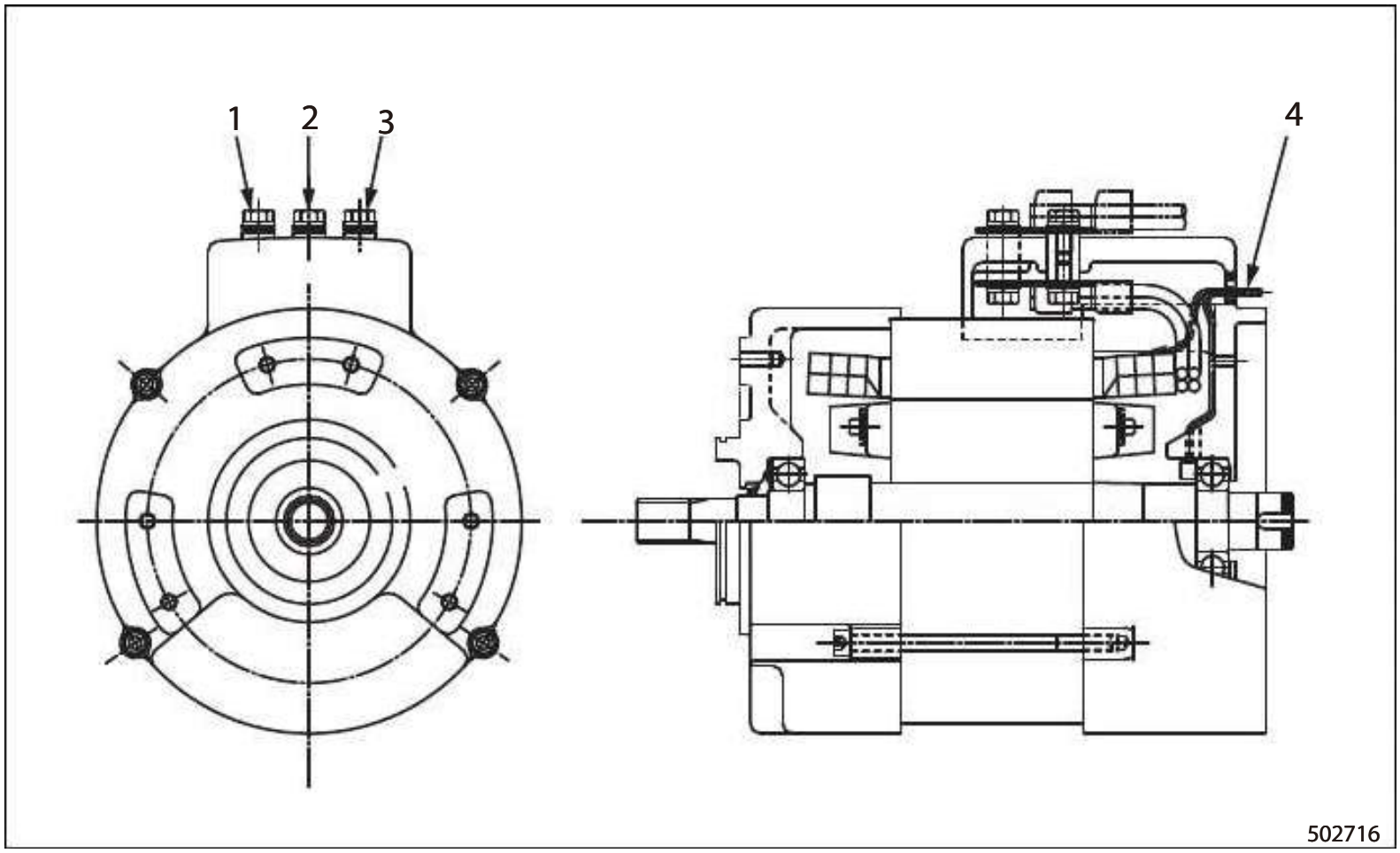
Truck model		Specification	
Traction motor	Type	Induction, three-phase AC	
	Voltage V	48 V	
	Output W	4.5 kW	
	Weight	37 kg (82 lb)	
Pump motor	Type	Induction, three-phase AC	
	Voltage V	48 V	
	Output W	11.5 kW	
	Weight	40 kg (88 lb)	
EPS motor	Type	DC	
	Voltage V	48 V	
	Output W	300 W	600 W

CHAPTER 3 MOTOR

3. Structures

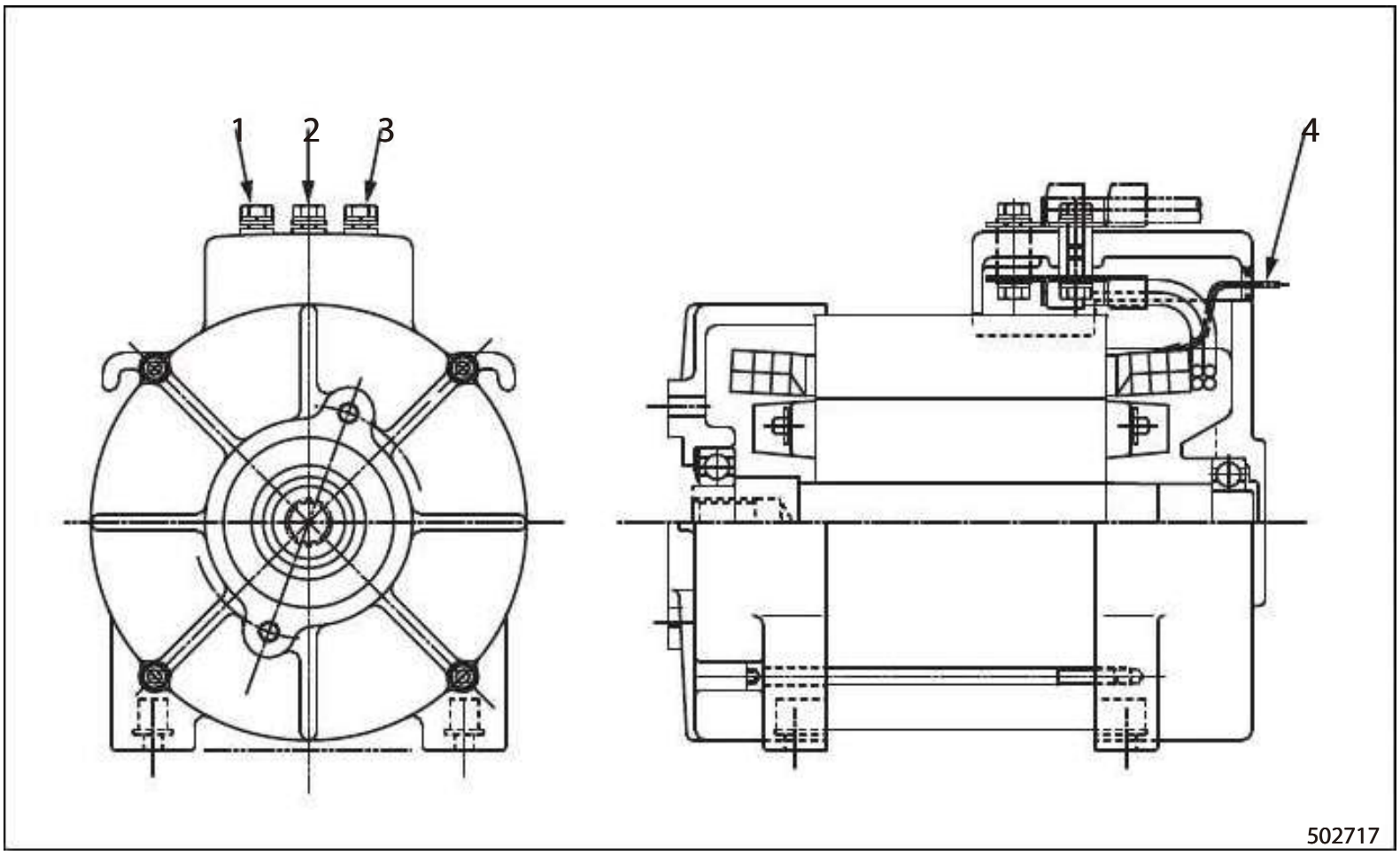
The AC motor model forklift trucks covered by this manual use three-phase induction AC motors as the Traction motors and pump motor. For the feature and speed control of AC motors, see "AC Motor System Basics" in CONTROLLER section.

3.1 Traction motor



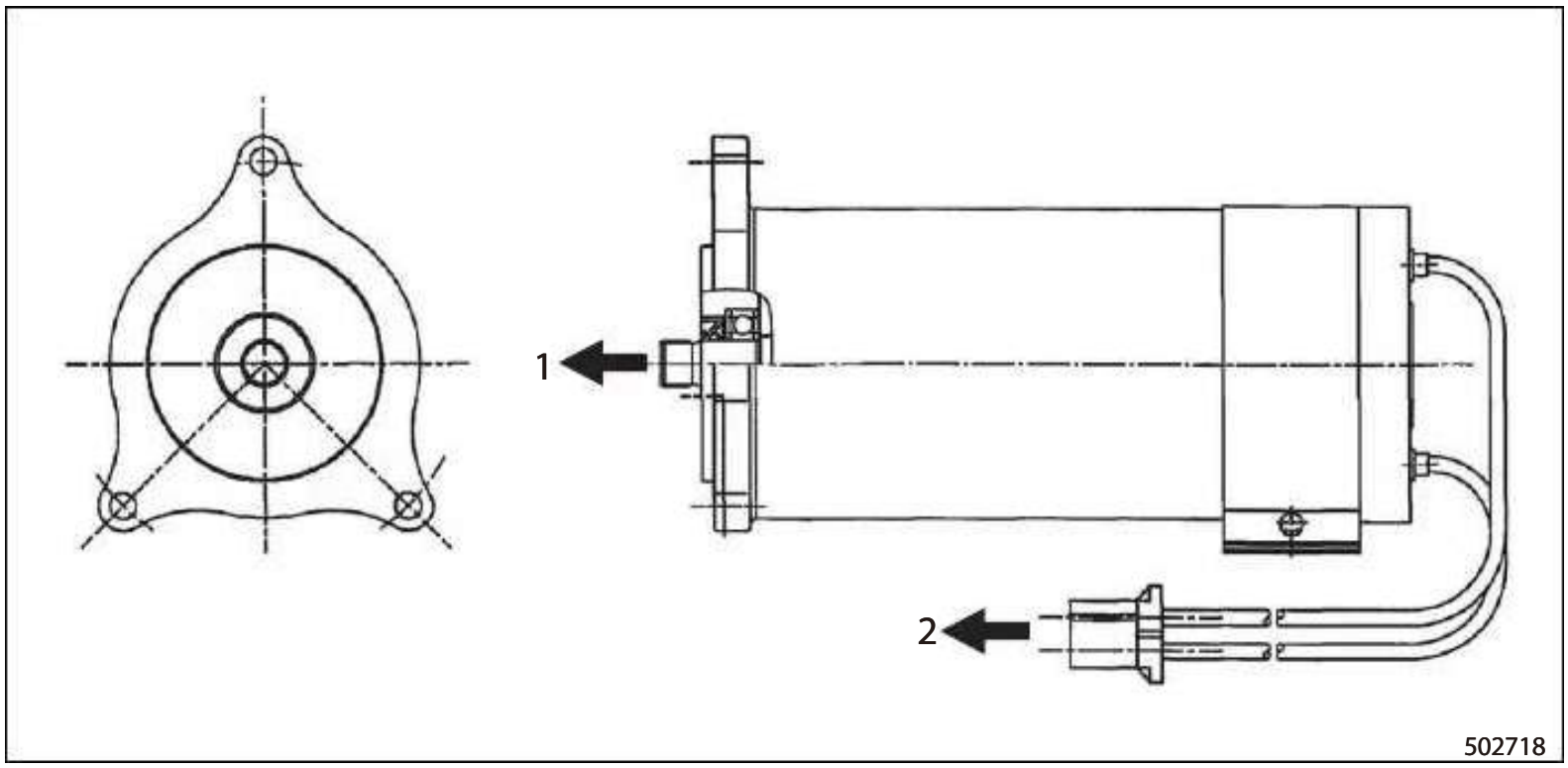
1. W terminal
2. V terminal
3. U terminal
4. Thermal and speed sensor connector

3.2 Pump motor



1. W terminal
2. V terminal
3. U terminal
4. Thermal connector

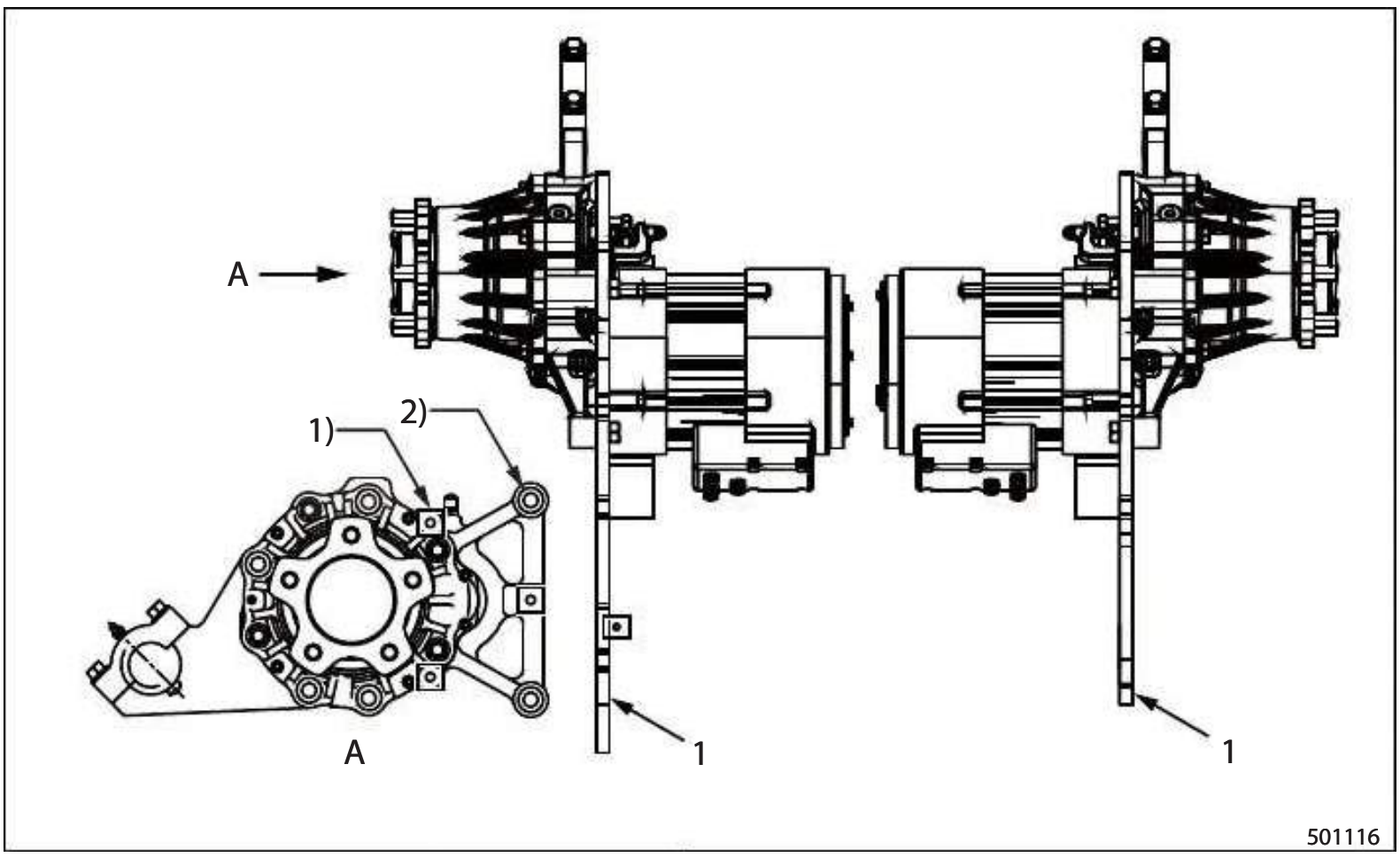
3.3 EPS motor



1. To Rear axle (3 W)
   To EPS pump assembly (4 W)
2. To body harness

EPS motor is the DC motor. The motor moves the rear wheel (wheels) to Steer in accordance with the steering wheel movement.

4. Removing Transfer Assemblies, Traction motors



1. Frame

1) Motor mounting bolts, 3 places
2) Mounting bolt to the body, 6 places

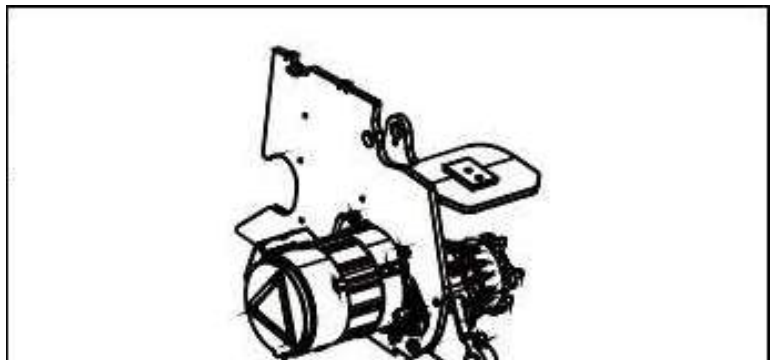
(1) Remove the mast assembly. Refer to "Chassis & Mast Service Manual".

(2) Remove all the electric wirings, solenoid brake cable, and hydraulic lines connected to the motor and transfer.

(3) Hitch a sling to lift the motor. Wind the sling to prevent it from falling.

(4) Place a jack under the transfer, and support the transfer with the jack.

(5) Loosen the bolts that secure the transfer to the frame,



and slightly pull the transfer with the jack away from the frame.
After making sure that the transfer can be pulled out horizontally, remove the bolts that secure the transfer to the frame, and remove the transfer with the jack from the frame.

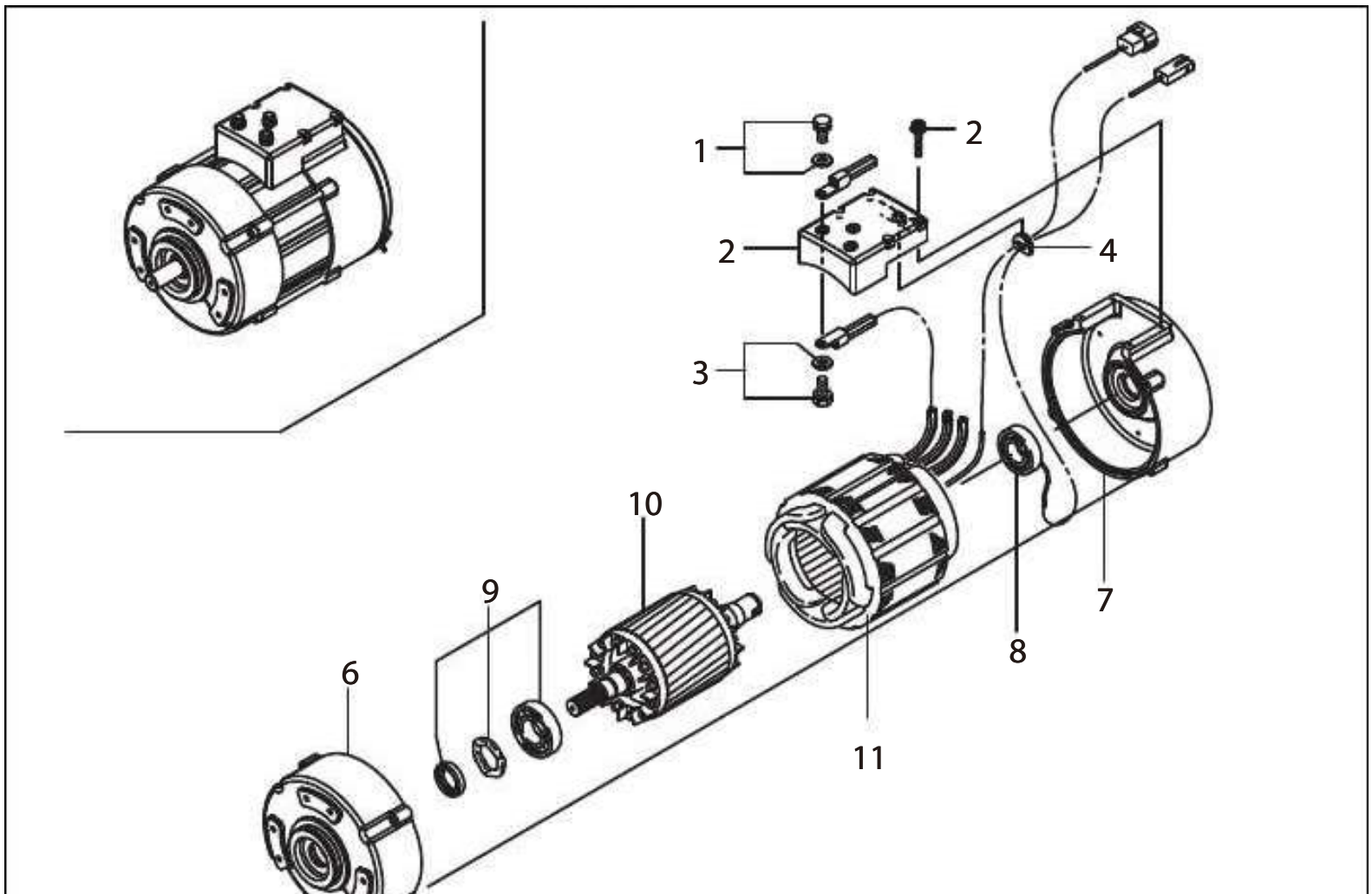
Item	Value
Total weight of transfer, Traction motor	115 kg (253.5 lb)

5. Disassembling Traction motor

⚠ CAUTION

- Ball bearings at both ends are of maintenance free. If it is necessary to remove the bearings when repairing the motor, the bearings and seals must be replaced.
- If a bearing which is to be replaced has only one sealing lip, it should be greased with quality bearing grease when installing it.
- Replace the bearings and seals after approximately 10,000 operating hours.

5.1 Disassembly Sequence



1. Bolt Washer
2. Terminal, bolt
3. Bolt Washer
4. Grommet
5. Cap screw
6. End cover (D)
7. End cover
8. Sensor bearing
9. Oil seal, Wavy washer, Radial ball bearing
10. Rotor
11. Stator

6. Inspecting Traction Motor

6.1 Inspecting Rotor

Inspection for damage

Check the rotor for damage, especially for burning.

If it is damaged, replace it.

Inspection of spline

Check for wear of spline.

If it is extremely worn, replace it.

Inspection of ball bearing

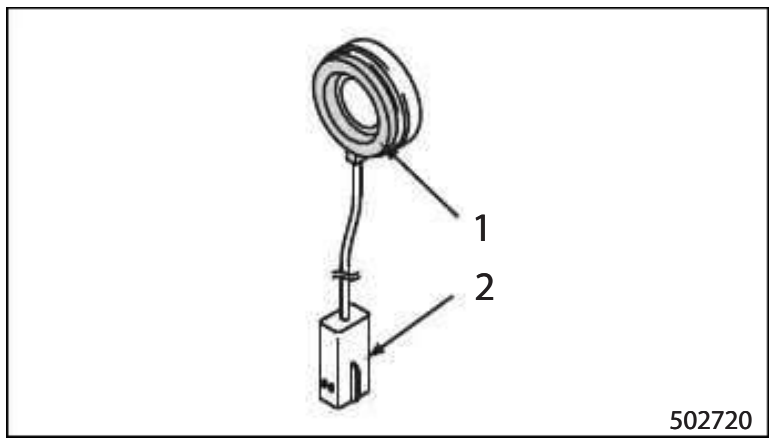
Check fitting part of the bearing in the "cover, end" and the "cover(D), end".

If loose, replace them.

⚠ CAUTION

When replacing the "bearing sensor", be very careful not to damage the sensor. "
If the sensor is damaged, the motor will not operate correctly.

Because the bearing sensor is very sensitive the static electricity, do not touch any terminals in the connector directly.



1. Sensor
2. Connector

6.2 Inspecting Motor

Inspect with the following procedure after assembling.

Abnormal noise check

Operate the motor. Make sure there is no abnormal noise.

⚠ CAUTION

If the motor is tested by itself, fix the motor on a work bench securely. The motor may move suddenly when starting. Test the motor with the slow speed.

(1) Be sure to secure the motor ASS'Y on a work bench.
(2) Use the battery of the forklift truck to carry out testing.
(3) Connect wires as follows.

The right side

- Connect the U1 cable from the chassis to the U1 terminal on the motor.
- Connect the V1 cable from the chassis to the V1 terminal on the motor.
- Connect the W1 cable from the chassis to the W1 terminal on the motor.
- Connect the wire harness from the chassis (water resistant type 4P) to the connector of the speed sensor in the motor (water resistant type 4P).

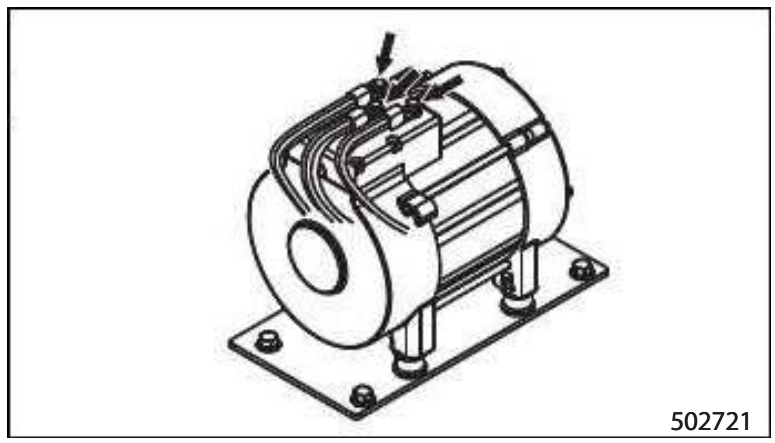
The left side

- Connect the U1 cable from the chassis to the V1 terminal on the motor.
- Connect the V1 cable from the chassis to the U1 terminal on the motor.
- Connect the W1 cable from the chassis to the W1 terminal on the motor.
- Connect the wire harness from the chassis (water resistant type 4P) to the connector of the speed sensor in the motor (water resistant type 4P).

6.3 Inspection of insulation

Measure the insulation between terminals and stator with the Megger.

- Apply the earth probe (negative [-]) of the Megger to the stator.
- Apply the line probe (positive [+]) of the Megger to each terminal. (U, V and W)

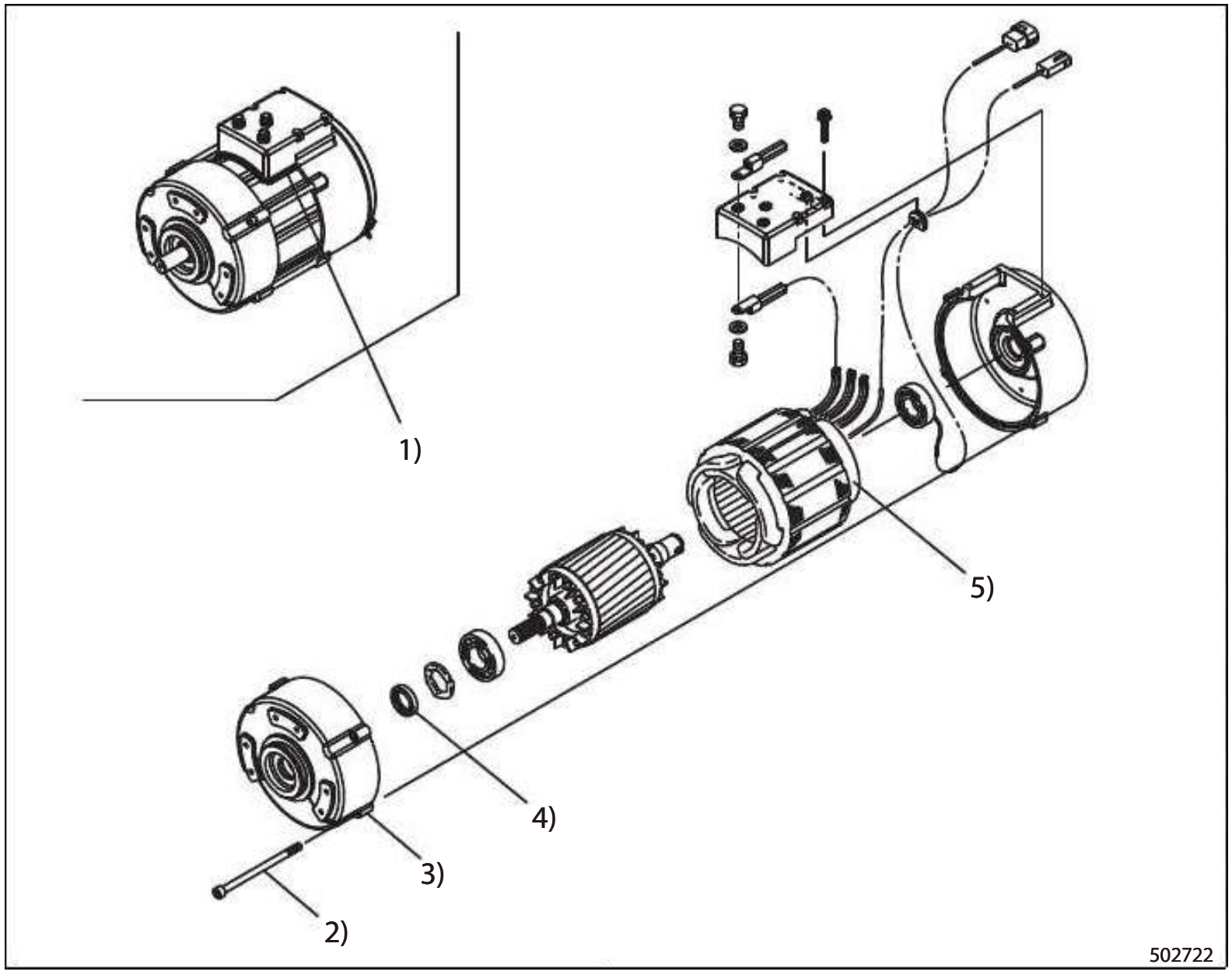


Tool	Specific resistance
Megger	0.5 M or greater (DC500V)

7. Resassembling Traction motor

Follow the disassembling in reverse.

7.1 Resassembly Sequence



1) Apply silicone adhesive (Toray, Dow Corning SE9188) to the clearance between the terminal and stator core.

4) Apply grease on the lip of the oil seal, and apply the THREEBOND [#1104] around the seal.

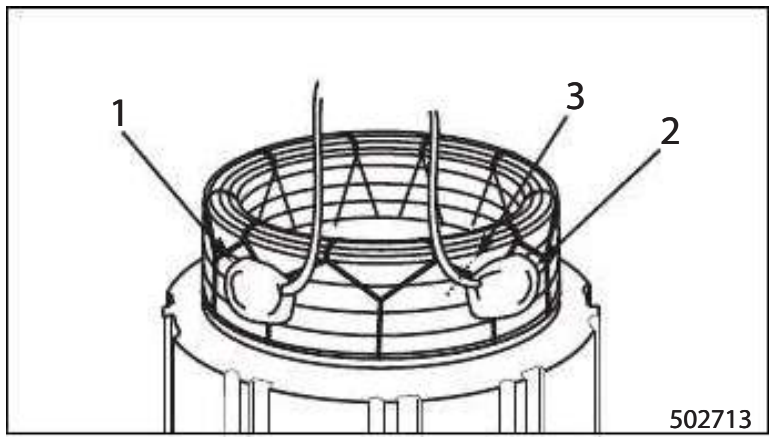
2) 11± 1 N·m (1.12 ± 0.1 kgf·m) [8.11 ± 0.74 lbf·ft]
3) Apply LOCTITE [#648], [#262 or an equivalent product in M8 thread holes.]

5) Secure the temperature sensor using Araldite (epoxy paste adhesive AV/HV1580 or equivalent).

Replacing Temperature Sensor

By cutting off the wire of the current temperature sensor (no need to remove the sensor), a new temperature sensor can be mounted on the opposite side.

Use Araldite (epoxy paste adhesive AV/HV158 or equivalent) to secure the temperature sensor.



1. New temperature sensor
2. Current temperature sensor
3. Cut off

8. Removing Pump Motor

8.1 Suggestions for Removal

⚠ CAUTION

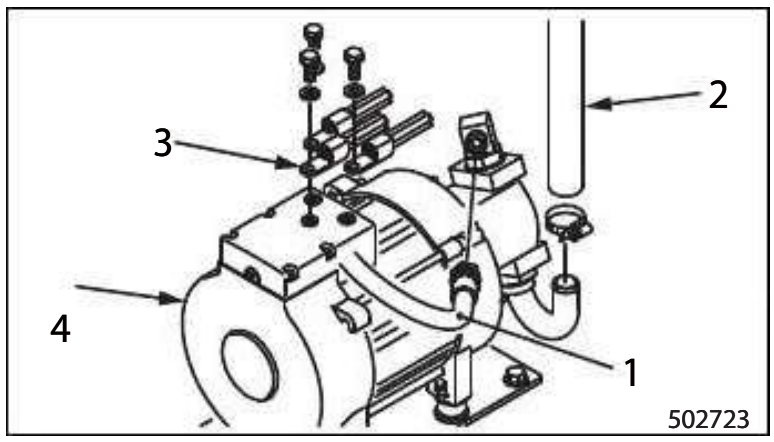
- Record places of the harness connections before removal.
- Turn the key switch to the off position and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.
- When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.

(1) Remove the floor plates.

(2) Disconnect following hoses from the gear pump.
- High-pressure hose (from the control valve)
- Low-pressure hose (from the hydraulic tank)

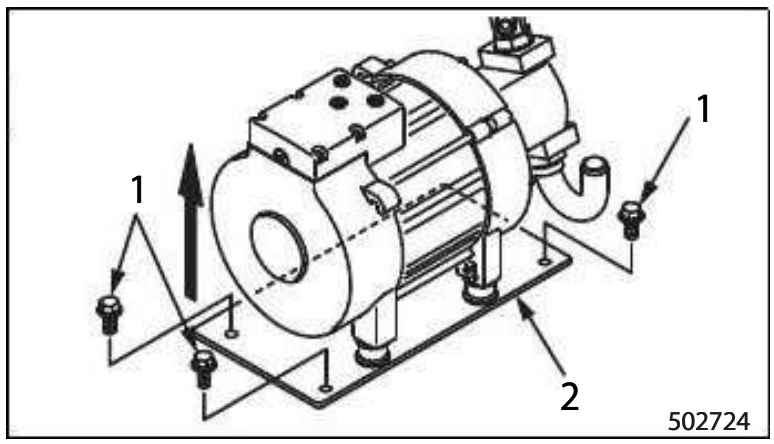
Note: Prepare a drip pan to catch remaining oil inside the hoses.
Plug the hose openings to prevent from leaking.

(3) Disconnect lead wires of the pump motor.



1. High-pressure hose
2. Low-pressure hose
3. Lead wires
4. Pump motor

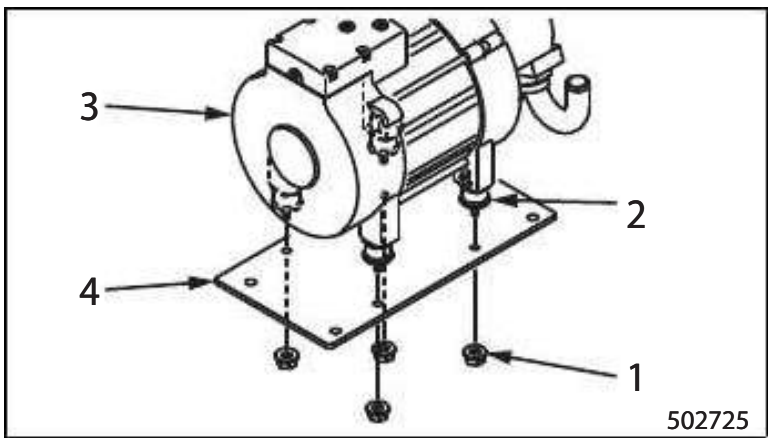
(4) Remove flange bolt for the motor bracket, and hoist the pump motor with the motor bracket.



1. Flange bolt
2. Motor bracket

Tightening torque for flange bolt
38.6 to 47.2 N·m (4.0 to 4.8 kgf ·m) [28.5 to 34.8 lbf·ft]

(5) Remove the flange nuts, and remove the pump motor with cushion and gear pump from the motor bracket.

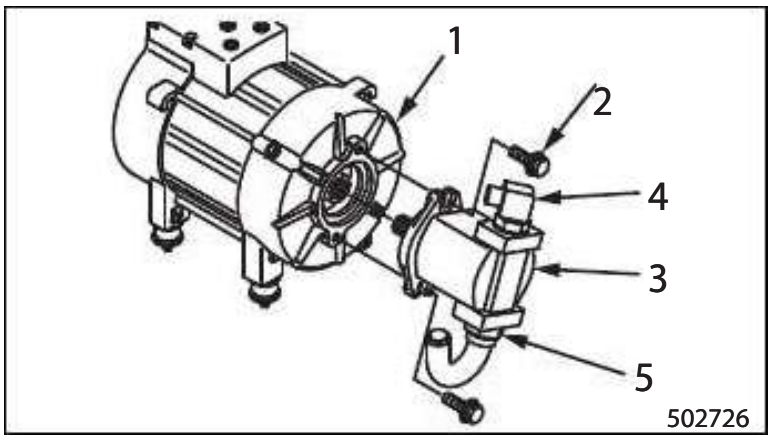


1. Flange nut
2. Cushion
3. Pump motor
4. Motor bracket

Tightening torque for flange nut
10.9 to 13.3 N·m (1.1 to 1.4 kgf ·m) [8.0 to 9.8 lbf·ft]

(6) Remove the washer assembled bolt, and remove the gear pump from the pump motor.

Note: Do not disassemble the gear pump.



1. Pump motor
2. washer assembled bolt
3. Gear pump

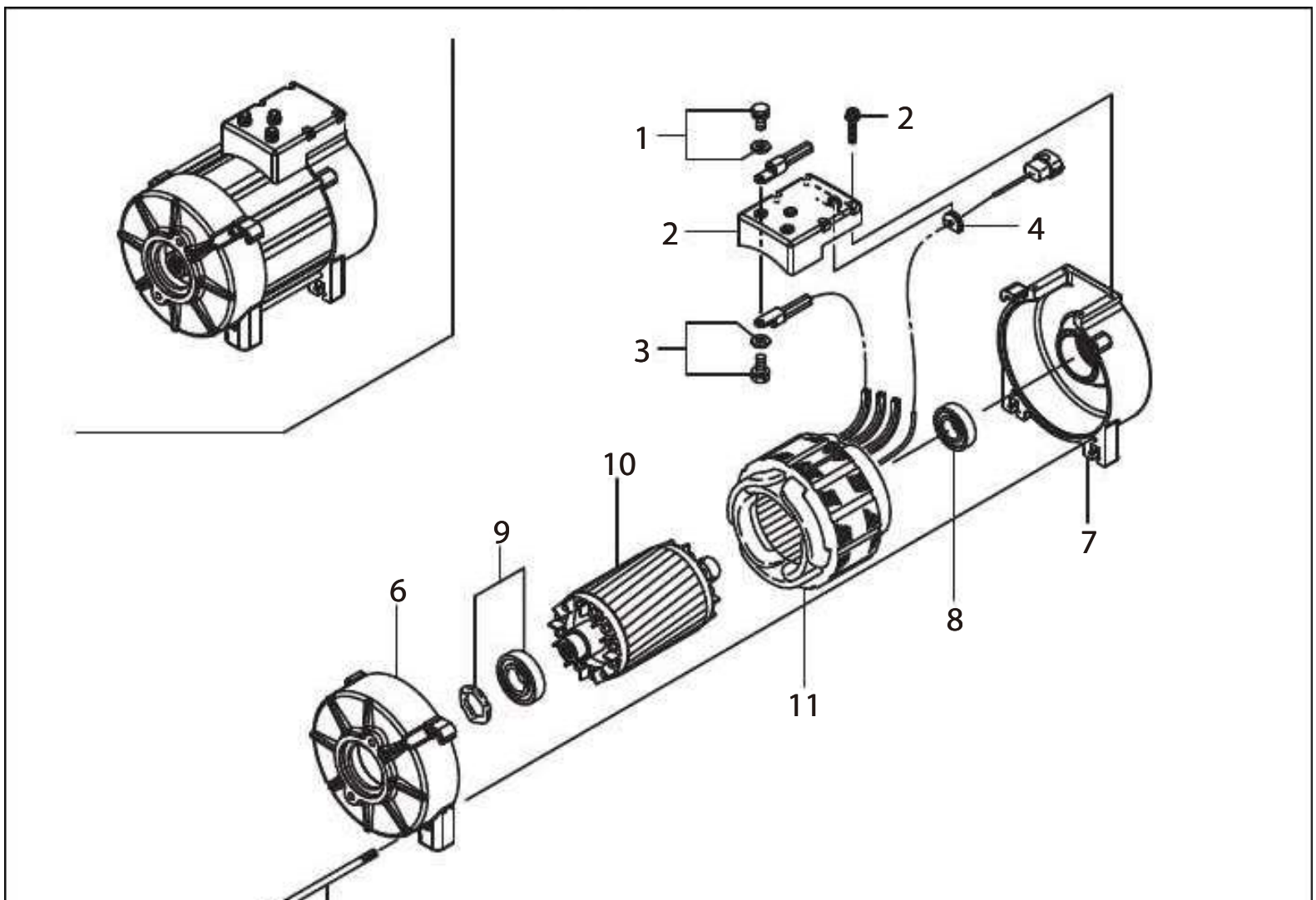
Tightening torque for washer assembled bolt
19.6 to 24.5 N·m (2.0 to 2.5 kgf ·m) [14.5 to 18.1 lbf·ft]

9. Disassembing Pump Motor

⚠ CAUTION

- Ball bearings at both ends are of maintenance free. If it is necessary to remove the bearings when repairing the motor, the bearings and seals must be replaced.
- If a bearing which is to be replaced has only one sealing lip, it should be greased with quality bearing grease when installing it.
- Replace the bearings and seals after approximately 10,000 operating hours.

9.1 Disassembly Sequence



1. Bolt Washer
2. Terminal, bolt
3. Bolt Washer
4. Grommet
5. Cap screw
6. End cover (D)
7. End cover
8. Radial ball bearing
9. Wavy washer, Radial ball bearing
10. Rotor
11. Stator

10. Inspecting Pump Motor

10.1 Inspecting Rotor

Inspection for damage

Check the rotor for damage, especially for burning.

If it is damaged, replace it.

Inspection of spline

Check for wear of spline.

If it is extremely worn, replace it.

Inspection of ball bearing

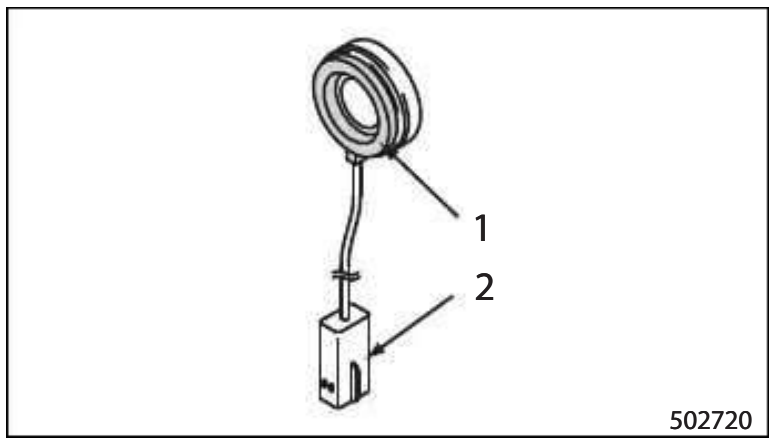
Check fitting part of the bearing in the "cover, end" and the "cover(D), end".

If loose, replace them.

⚠ CAUTION

When replacing the "bearing sensor", be very careful not to damage the sensor. "
If the sensor is damaged, the motor will not operate correctly.

Because the bearing sensor is very sensitive the static electricity, do not touch any terminals in the connector directly.



1. Sensor
2. Connector

10.2 Inspecting Motor

Inspect with the following procedure after assembling.

Abnormal noise check

Operate the motor. Make sure there is no abnormal noise.

⚠ CAUTION

⚠ CAUTION

If the motor is tested by itself, fix the motor on a work bench securely. The motor may move suddenly when starting. Test the motor with the slow speed.

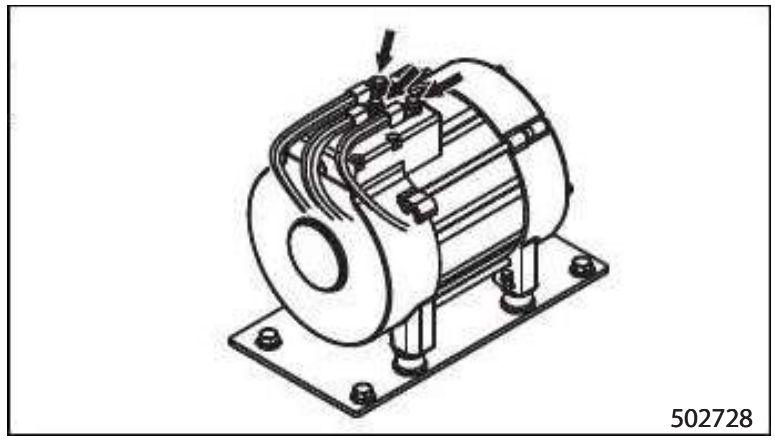
(1) Be sure to secure the motor ASS'Y on a work bench.
(2) Use the battery of the forklift truck to carry out testing.
(3) Connect wires as follows.

- Connect the U2 cable from the chassis to the U2 terminal on the motor.
- Connect the V2 cable from the chassis to the V2 terminal on the motor.
- Connect the W2 cable from the chassis to the W2 terminal on the motor.

10.3 Inspection of insulation

Measure the insulation between terminals and stator with the Megger.

- Apply the earth probe (negative [-]) of the Megger to the stator.
- Apply the line probe (positive [+]) of the Megger to each terminal. (U, V and W)

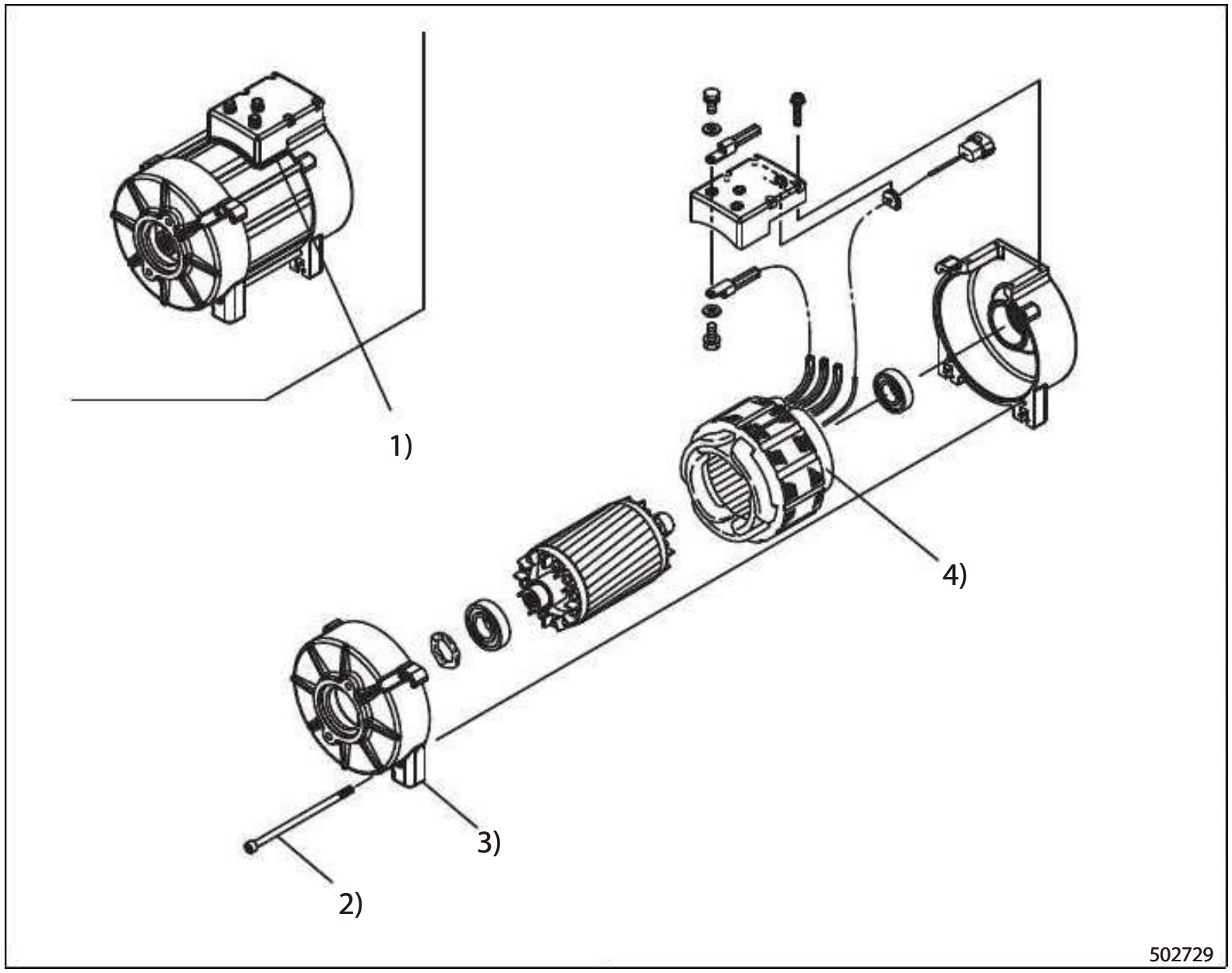


Tool	Specific resistance
Megger	0.5 M or greater (DC500V)

11. Resassembling Pump motor

Follow the disassembling in reverse.

11.1 Resassembly Sequence



1) Apply silicone adhesive (Toray, Dow Corning SE9188) to

3) Apply LOCTITE [#648], [#262] or an equivalent product

the clearance between the terminal and stator core.

2) 11± 1 N·m (1.12 ± 0.1 kgf·m) [8.11 ± 0.74 lbf·ft]

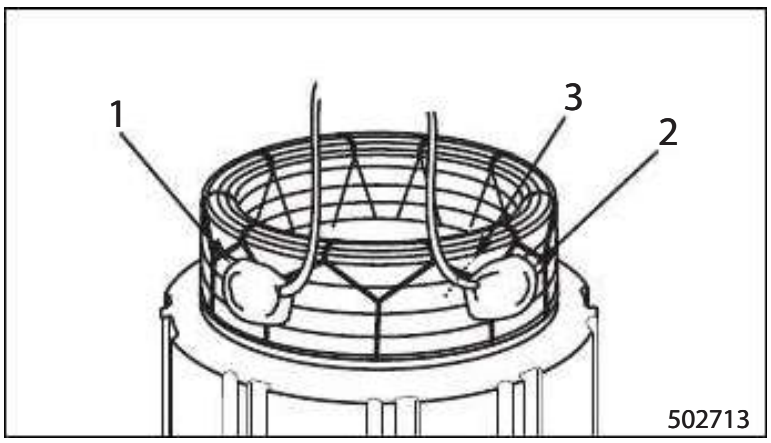
in M8 thread holes.]

4) Secure the temperature sensor using Araldite (epoxy paste adhesive AV/HV1580 or equivalent).

Replacing Temperature Sensor

By cutting off the wire of the current temperature sensor (no need to remove the sensor), a new temperature sensor can be mounted on the opposite side.

Use Araldite (epoxy paste adhesive AV/HV158 or equivalent) to secure the temperature sensor.

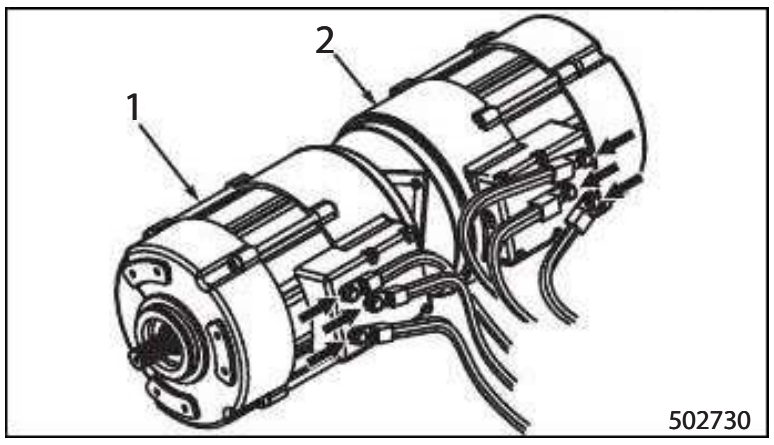


1. New temperature sensor
2. Current temperature sensor
3. Cut off

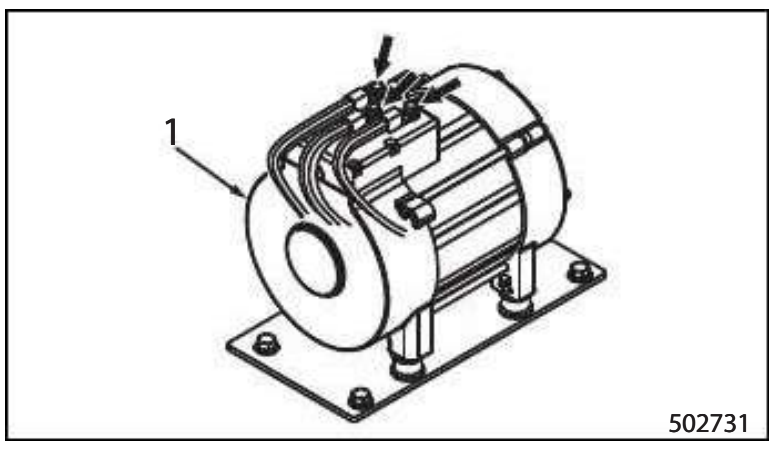
12. Tightening of High-power Cable Terminals

⚠ CAUTION

If the high-power cable terminals of the battery-operated vehicle are not tightened properly, the increased contact resistance causes excessive heat generation, and could cause a fire in the worst case. To prevent accidents and equipment problems, be sure to regularly check the tightening torque of the high-power cable terminals. Do not pull the cables to check connections or during adjustment. If the cable terminal sections are moved, re-tighten the connections.



1. Left Traction motor (3 terminals)
2. Right Traction motor (3 terminals)



1. Pump motor (3 terminals)

13. Removing EPS Motor

13.1 Suggestions for Removal

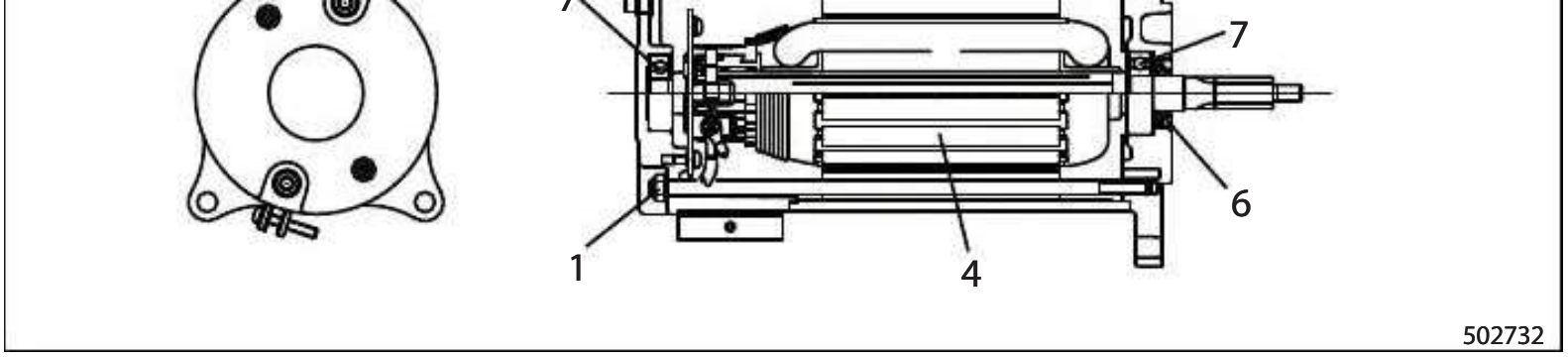
⚠ CAUTION

- Apply wheel chocks to tyres to prevent the truck from moving.
- Turn the key switch to the off position.
- Record places of harness connections before disconnecting.
- Be sure to disconnect the battery plug.
- Be careful not to injure the controllers.

(1) Open the battery cover.
(2) Remove the rear cover and rain cover.
(3) Disconnect harness of the EPS motor.
(4) Remove the EPS motor.

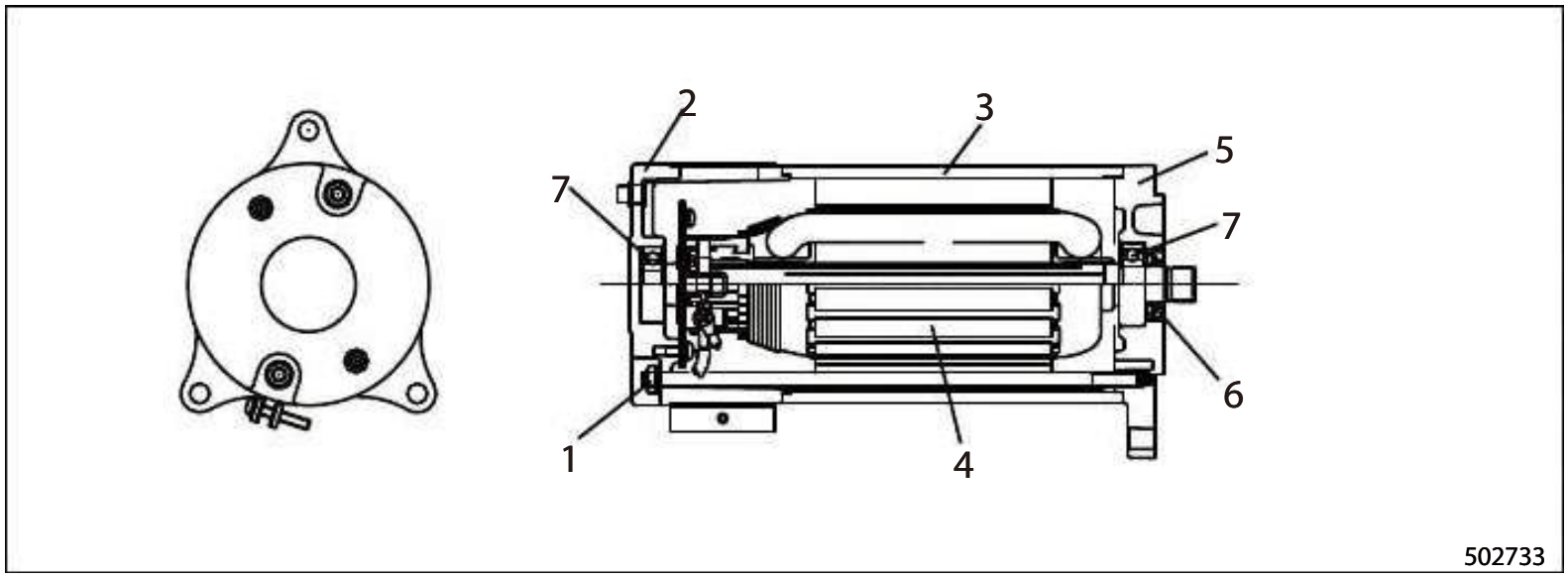
14. Disassembling EPS Motor

3-Wheel model (3 W)



1. Bolt
2. End cover (C)
3. York assembly
4. armature
5. Cover (D)
6. Oil seal
7. Ball bearing

4-Wheel model (4 W)



1. Bolt
2. End cover (C)
3. York assembly
4. armature
5. Cover (D)
6. Oil seal
7. Ball bearing

15. Inspecting EPS Motor

15.1 Inspecting Armature

Inspection for damage

Check the armature for damage, especially for burning.

If it is damaged, replace it.

If the surface of Commutator is damaged, repair or replace it.

Inspection of spline

Check for wear of spline.

If it is extremely worn, replace it.

Inspection of ball bearing

Check fitting part of the bearing in the "cover(C), end" and the cover(D).

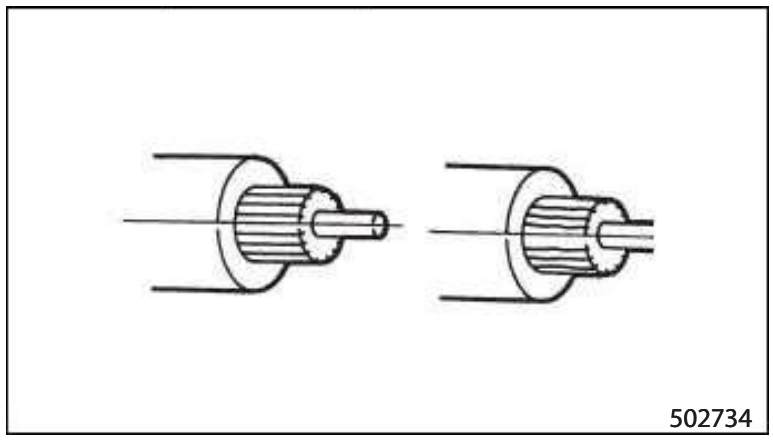
If loose, replace them.

Inspection of commutator

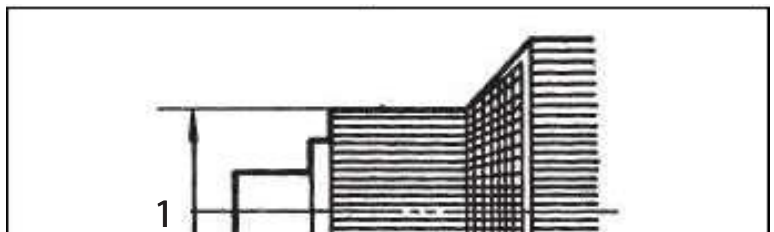
Check the armature for damage especially by high temperature.

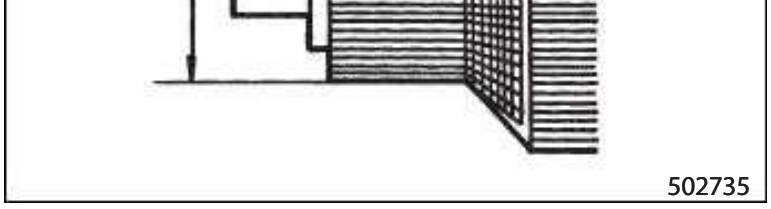
If it is damaged, replace it.

If the surface of Commutator is damaged, repair or replace it.



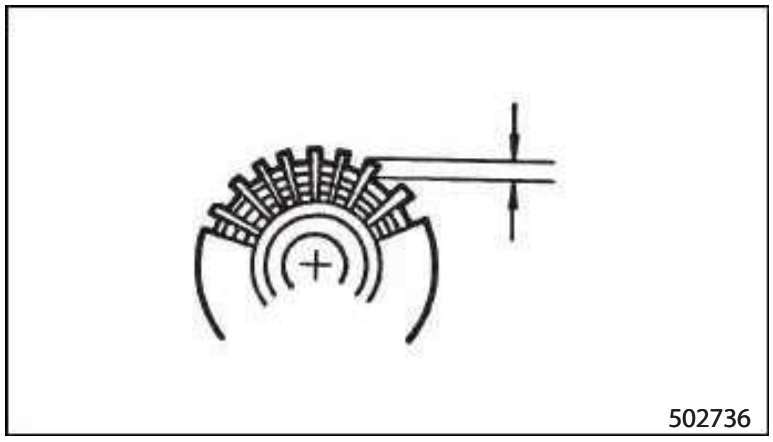
1. Good 2. Not good





1. ϕ D

Item			Standard	Limit
Wear if commutator (ϕ D)	3 W	1.7 to 1.6 ton model	30 mm (1.18 in.)	29 mm (1.14 in.)
		1.8 to 2.0 ton model	40 mm (1.57 in.)	39 mm (1.54 in.)
	4W		40 mm (1.57 in.)	39 mm (1.54 in.)



Item	Standard
Under cut of commutator	0.8 to 0.85 mm (0.032 to 0.034 in.)

How to repair of commutator

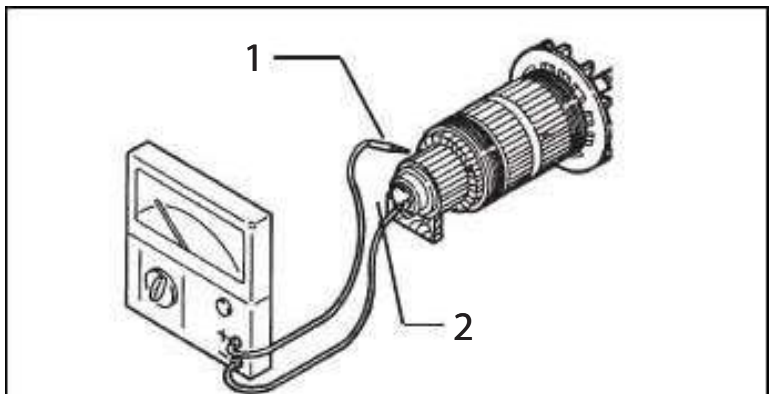
(1) Grind or polish the Commutator.
(2) Undercut the commutator after grinding.
(3) Finish the surface of Commutator with a sand paper (#400).

Inspection of insulation

Check the insulation between Commutator and Armature shaft.

⚠ CAUTION

Clean up the armature by compressed air before checking.

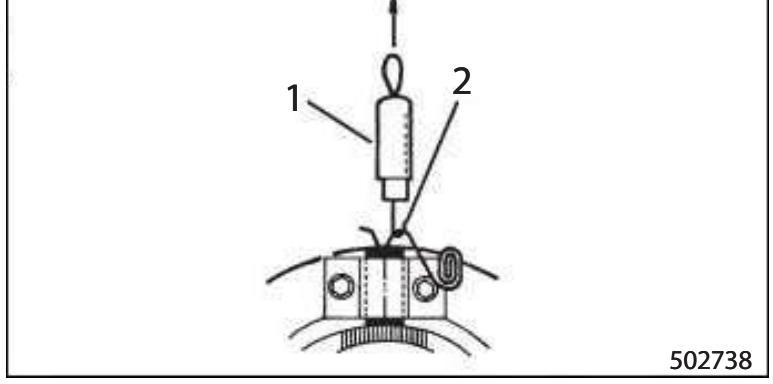


1. Positive 2. Negative

Tool	Specific Resistance
Tester	Infinite at x 1k range
Megger	0.5M or greater (DC500V)

Inspection of force of spring

Hook a spring scale to the brush SPRING and check if both springs have the same tension. Then make sure of equal force on 2 springs.



1. Spring scale 2. Spring

Item			Standard
Force of spring	3 W	1.3 to 1.6 ton model	7N
		1.8 to 2.0 ton model	5N
	4 W		5N

⚠ CAUTION

If the SPRING and/or the brush holder were rusted, replace them.

15.2 Inspecting Motor

Inspect with the following procedure after assembling.

Abnormal noise and spark

Operate the motor. Then make sure that abnormal noise is not heard and sparks of brushes are not seen.

⚠ CAUTION

If the motor is tested by itself, fix the motor on a work bench securely. The motor may move suddenly when starting. Test the motor with the slow speed.

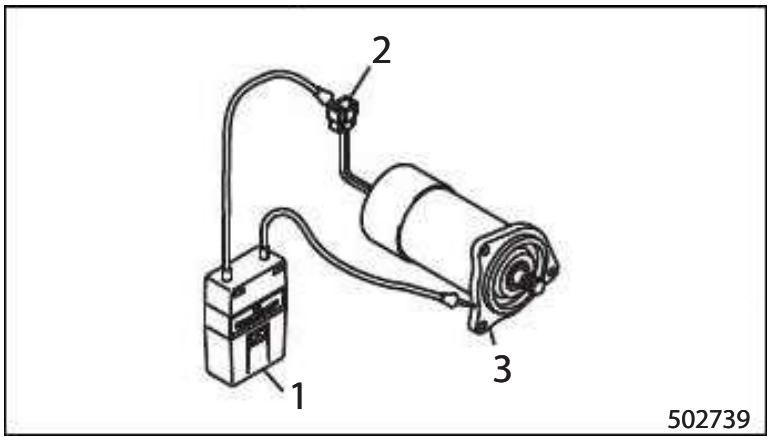
(1) Be sure to secure EPS motor ass'y on a work bench.
(2) Apply 1/4 voltage of the battery (about 12V) to carry out testing.
(3) Connect wires as follows.
- Connect (WHITE) wire to the (positive [+])terminal of the battery

- Connect (WHITE) wire to the (positive [+])terminal of the battery.
- Connect (BLACK) wire to the (negative [-]) terminal of the battery.

Inspection of insulation

Measure the insulation between terminals in the connector and the end cover with the Megger.

(1) Apply the earth probe (negative [-]) of the Megger to the yoke.
(2) Apply the line probe (positive [+]) of the Megger to each terminal of connector plug.



1. Megger
2. Connector
3. End cover

Tool	Specific Resistance
Megger	0.1M or greater (DC500V)

15.3 Inspecting Oil Seal and Permanent Magnet

Oil seal

Check Oil seal for wear and damage. If worn or damaged, replace it.

Permanent magnet

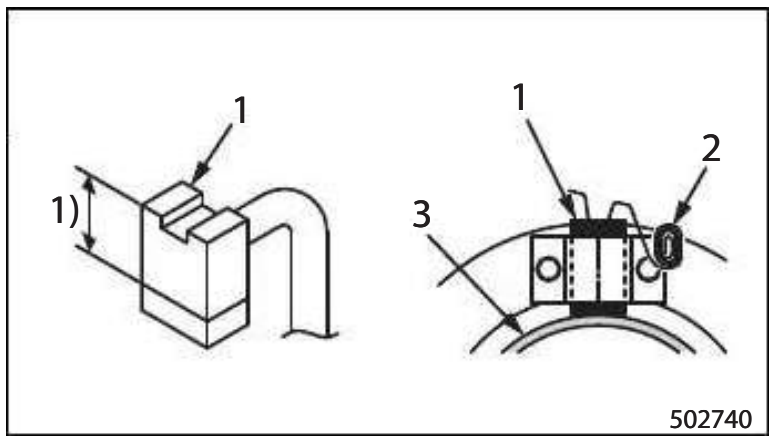
Check permanent magnets in the Yoke for damage or sticking metallic dust. If sticking metallic dust, remove it with compressed air. If damaged, replace the whole motor.

16. Inspecting EPS Motor

16.1 Brush

(1) Measure the thickness of brush.

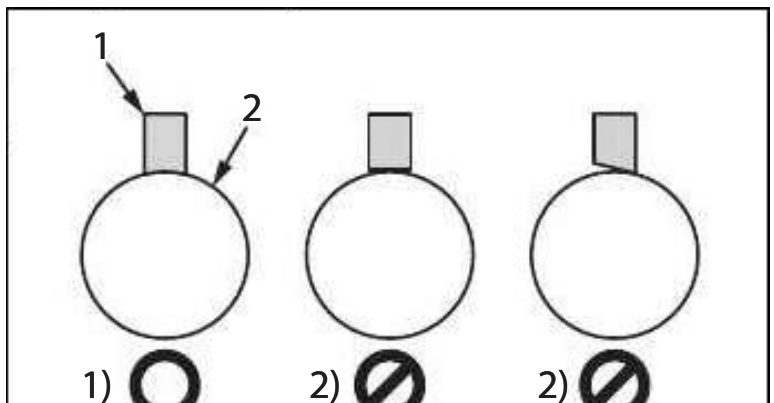
If it is less than the wear limit, replace it.



1. Brush
2. Spring
3. Commutator
1) Thickness of brush

Item			Standard	Limit
Thickness of brush	3 W	1.3 to 1.6 ton model	20 mm (0.79 in.)	9 mm (0.35 in.)
		1.8 to 2.0 ton model	20 mm (0.79 in.)	11 mm (0.43 in.)
	4 W		20 mm (0.79 in.)	11 mm (0.43 in.)

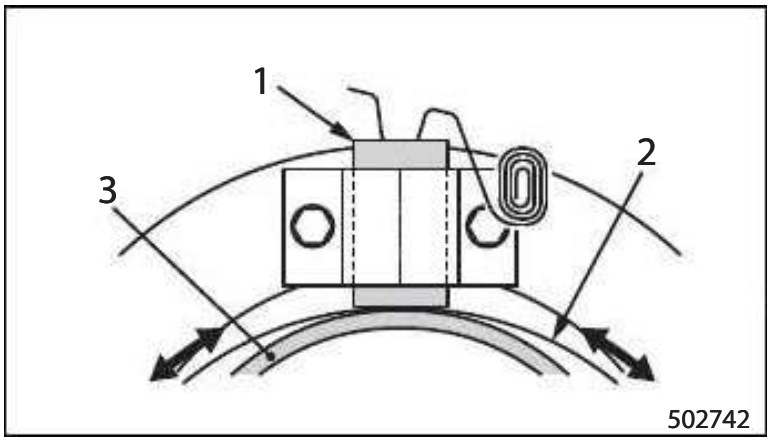
(2) Check the surface of the brush contacting to commutator.



1. Brush
2. Commutator

1) Good
2) Not good

(3) If the condition is not good, insert a sand paper [#400] between the brush and commutator.
(4) Polish the brush surface by moving a sand paper or rotating commutator.
(5) Check the thickness of brush.
(6) Blow the dust out with compressed air and clean the parts.



1. Brush
2. Sand paper

3. Commutator

Tool name	Number
Sand paper	#400

17. Troubleshooting

Symptom	Possible causes	Solution
Motor does not start.	Low supply voltage	Charge battery and improve power supply condition.
	Blown fuse	Replace.
	Excess load	Reduce load.
	Faulty wire connection	Repair, or re-tighten wire connections.
	Broken wire in control device	Repair or replace.
	Broken wire in field device	Repair or replace.
	Broken wire in armature coil	Repair or replace.
Motor starts but does not run at rated speed.	Low supply voltage	Charge battery and improve power supply condition.
	Faulty connection of armature circuit	Repair connections.
Motor produces Abnormal vibrations and noise.	Defective bearings	Replace bearings.
	Loose mounting bolts	Retighten bolts and nuts.
	Contact between armature and field coil	Repair or replace.
Bearing overheats.	Incorrect installation	Correct installation condition.
	Severe external vibration	Remove the cause of vibration, or take appropriate vibration-insulating measures.
	Defective bearings	Replace.
	Oil degradation or shortage in bearings	Replace.

Chapter 4 HOW TO READ CIRCUIT DIAGRAMS

1. Description of Circuit Diagrams

The Circuit diagrams consist of the schematic diagrams and connector diagrams.

1.1 Schematic diagram

All circuits including the power supply and ground are divided into the power circuit, GND circuit and system circuits.

Power circuit diagram

The power circuit diagram indicates the power circuit including the battery, fuse, ignition switch, etc.

GND circuit diagram

The GND circuit diagram indicates the circuits from each electric component to the body ground or from each component to the battery negative terminal.

System circuit diagrams

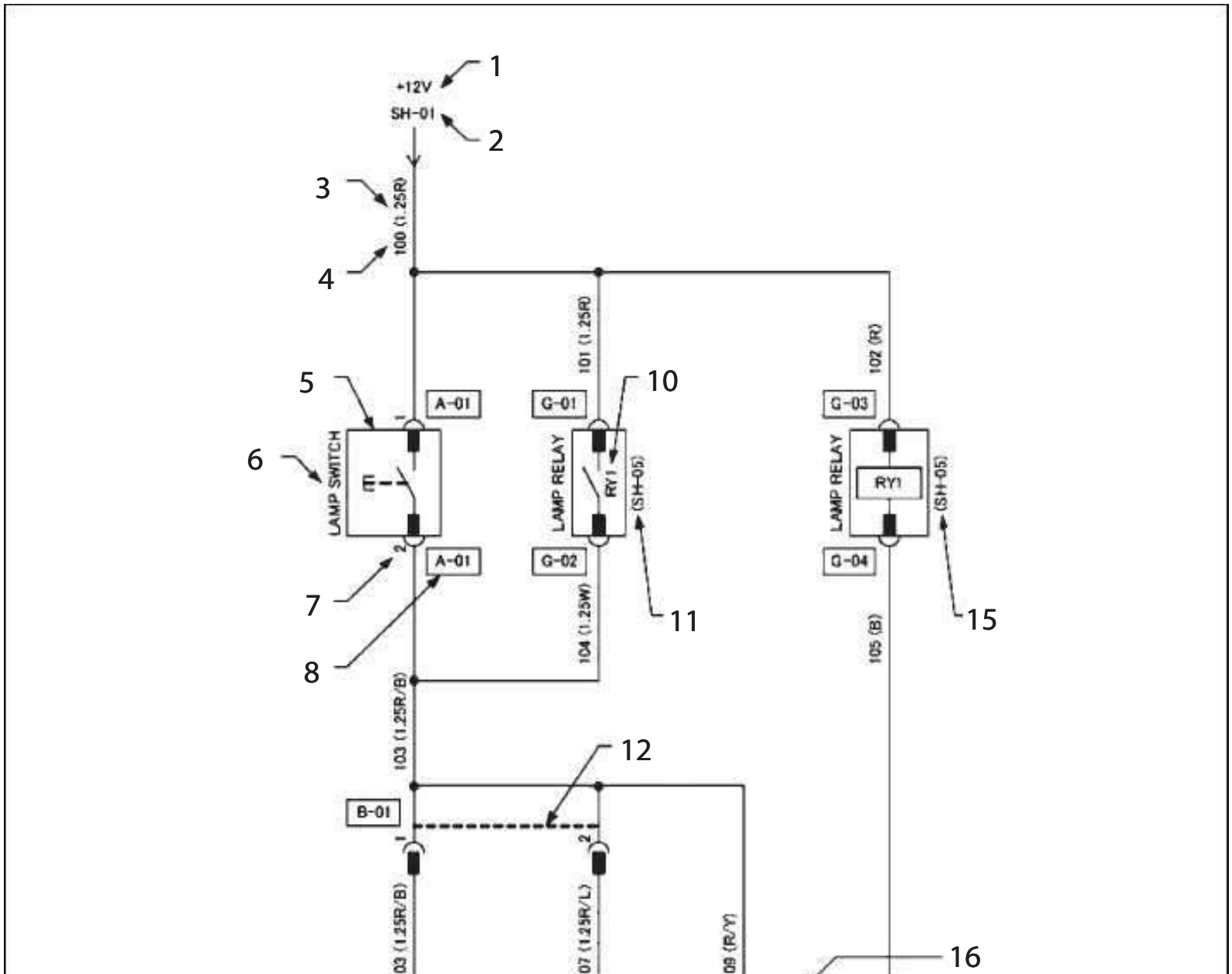
The system circuit diagrams indicate the circuits of each system from fuse to GND (earth) excluding the above power supply and GND circuit portions.

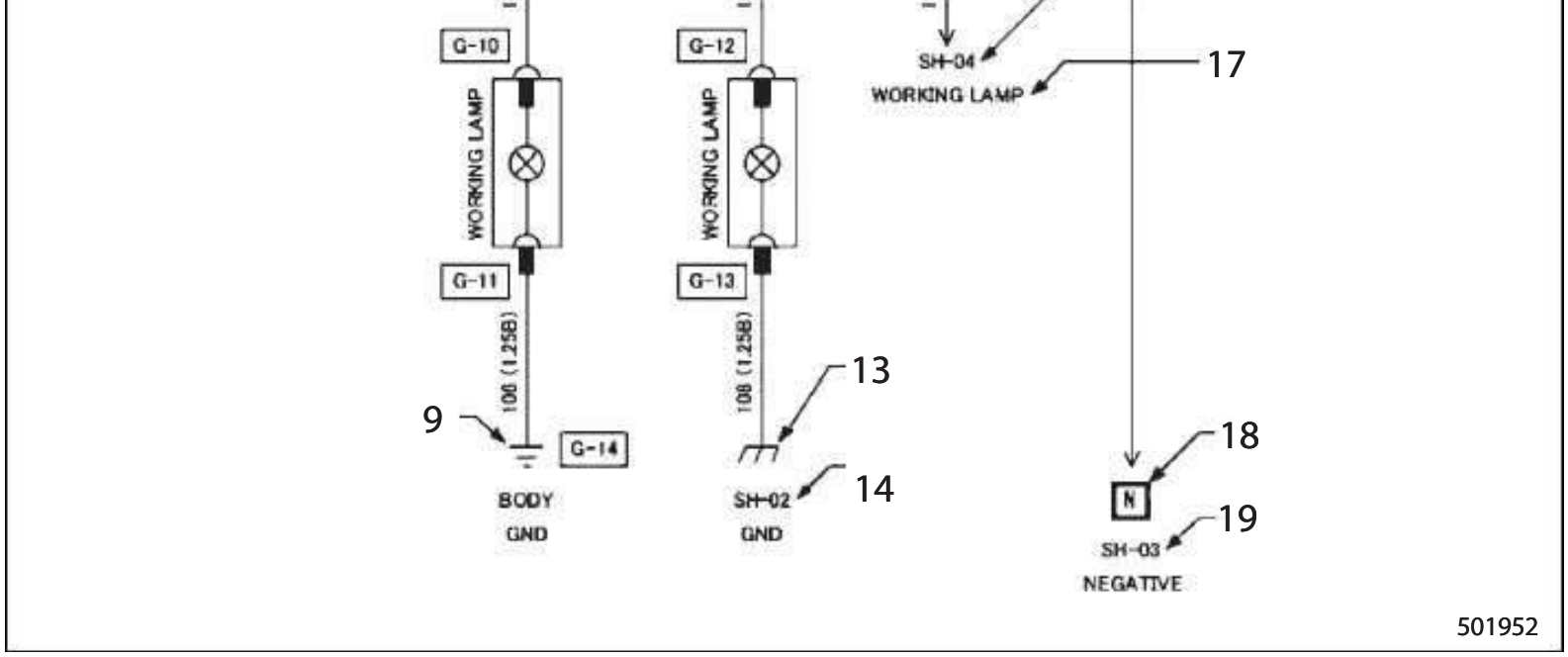
1.2 Connector Diagrams

The connector shapes, terminal shapes and terminal arrangements of all connectors in the circuit diagrams are indicated.

2. How to Read Circuit Diagrams

The circuit of each system from fuse to GND (earth) is indicated. The circuits indicate the direction of signal flow. In figures, it flows from top (positive) to bottom (negative).





4-2

CHAPTER 4 HOW TO READ CIRCUIT DIAGRAMS

1. Departure equipment name
2. Departure sheet number
3. Cable diameter & color (Description(2))
4. Circuit number
5. Boundary (Description(4))
6. Equipment name
7. Terminal number of connector
8. Connector number (Description(3))
9. Indicate connection with body GND
10. Equipment number
11. Used place of relay coil (Description(1))
12. Indicate same connector
13. Indicate connection with GND circuit
14. Sheet number of GND circuit
15. Used place of relay contact (Description (1))
16. Destination sheet number
17. Destination equipment name
18. Indicate connection with Negative circuit
19. Sheet number of Negative circuit

2.1 Symbols

Symbols are used in the figures for easy reading of circuit diagrams.

General Symbols

(1) General use symbols

SYMBOL	NAME
	GND (HARNESS)
	GND (BODY)

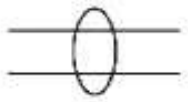
SYMBOL	NAME
N	NEGATIVE

(2) Conductors and coupling parts

SYMBOL	NAME

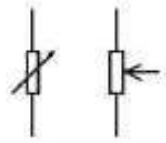
SYMBOL	NAME

	CONNECTOR (SOCKET/PLUG)
	TERMINAL (SOCKET)
	TERMINAL (PLUG)
	TERMINAL

	TWIST WIRE
	SHIELD WIRE
	BRANCHING

(3) Standard passive parts

SYMBOL	NAME
	RESISTOR

SYMBOL	NAME
	VALIABLE RESISTOR

(4) Semiconductors and electronic tubes

SYMBOL	NAME
	DIODE
	LED

SYMBOL	NAME
	AUTO LIGHT SENSOR (PHOTO DIODE)

(5) Generation and conversion of electric energy

SYMBOL	NAME
	GENERATOR

SYMBOL	NAME
	STEPPING MOTOR

M 3~	THREE-PHASE INDUCTION MOTOR
M	DC MOTOR

	BATTERY

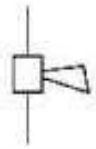
(6) Swithes, control and protective devices

SYMBOL	NAME
	SWITCH (N.O)
	SWITCH (N.C)
	TWO POSITION SWITCH
	EMERGENCY SWITCH
E	PUSH-BUTTON SWITCH
	SWITCH (AUTO RETURN)

SYMBOL	NAME
	OIL PRESSURE SWITCH
	MAGNETIC CONTACTOR
	FUSE
	THERMISTER
	MAGNETIC COIL
	PROXIMITY SENSOR

(7) Indicators, lamps and signal devices

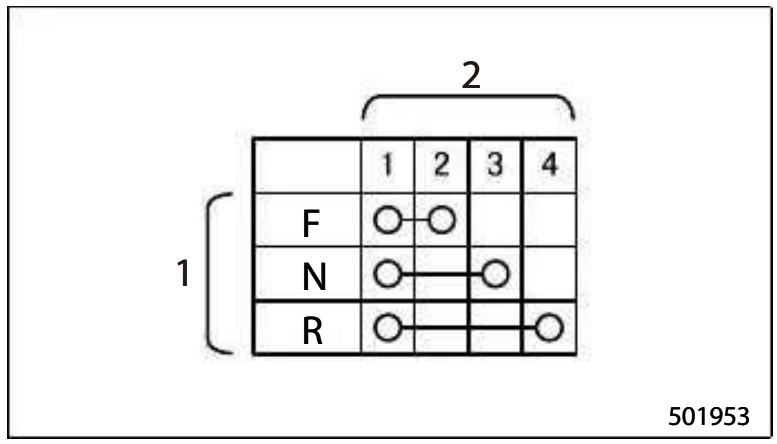
SYMBOL	NAME
	LAMP
	BUZZER

SYMBOL	NAME
	HORN

Special Symbols

The following symbols are used when the representation by general symbols is difficult.

This diagram shows that No. 1 and No. 3 terminals are connected when the switch position is placed in N position.



1. Switch position 2. Terminal

2.2 Sheet Symbol

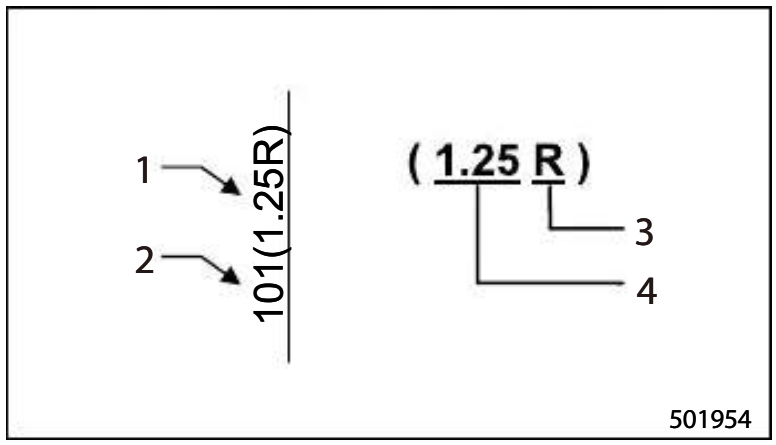
A sheet symbol is provided in each circuit diagram sheet so that the relationship between diagrams can be clarified. The sheet symbol consists of "SH" and two digit numbers, for example, “SH-01" or “SH-02."

2.3 Connecting Lines

(1) There are two thicknesses of the line which connect between elements in the circuit diagram. Each line is used as follows:

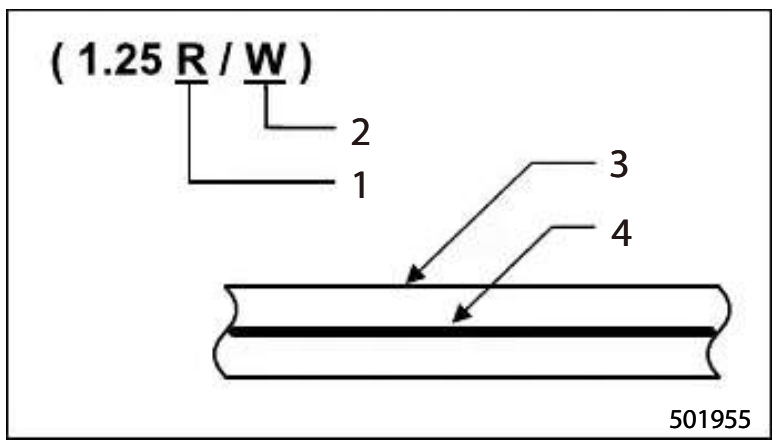
- Thick line: Connecting lines for the electric wires size of 20 mm^2 (0.78 in^2) or above.
- Thin line: All other connecting lines except the above.

(2) Connecting lines are represented by the circuit number, wire diameter and wire color. For the connecting lines of 0.5 mm^2 (0.02 in^2) wire size, the wire diameter is omitted.



1. Wire diameter, wire color
2. Circuit number
3. Wire color
4. Wire diameter

(3) here are two types of wires: the one having only one color and the one having a colored stripe (combination of two colors).



1. Base color
2. Strip color
3. Base color
4. Stripe color

Color Codes

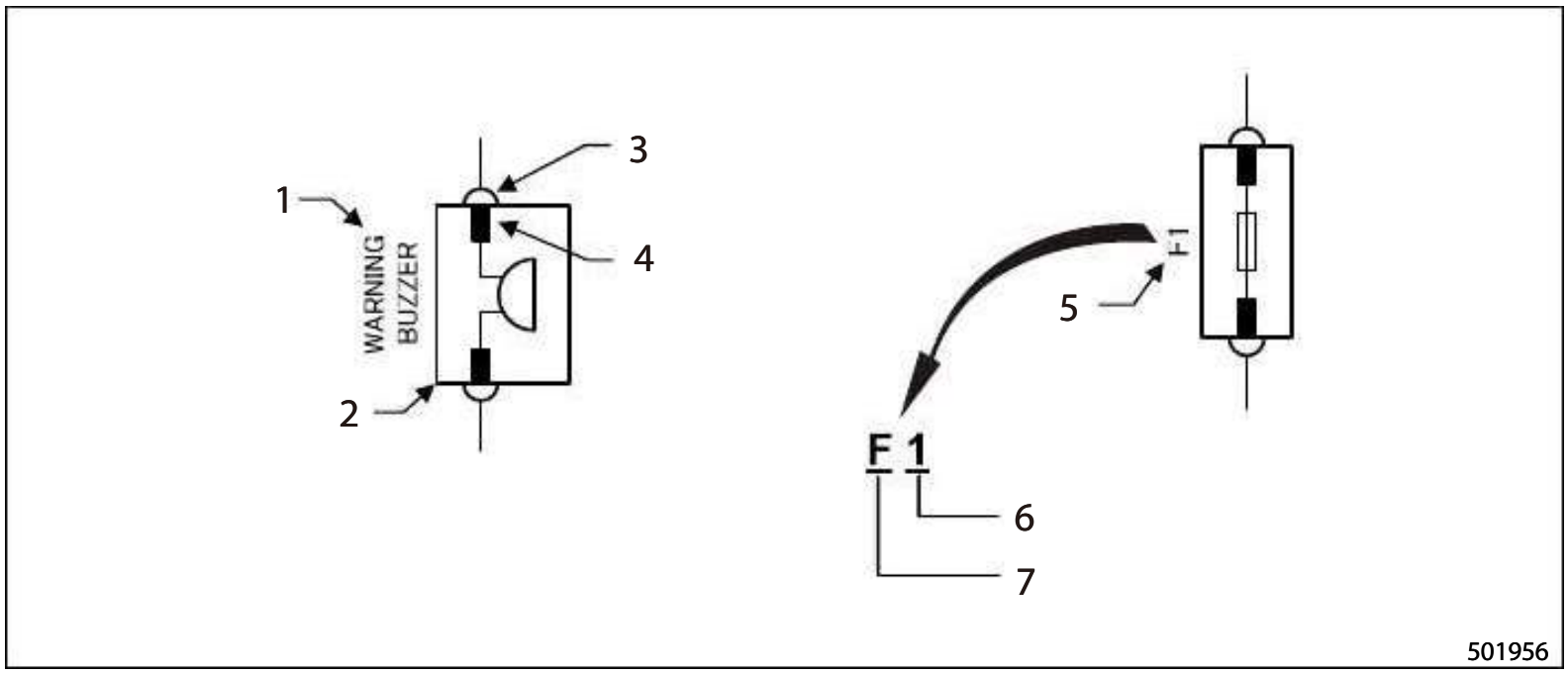
Symbol	Color	Symbol	Color	Symbol	Color
B	Black	Br	Brown	P	Pink
W	White	L	Blue	Sb	Sky blue

W	White	L	Blue	Sb	Sky blue
R	Red	Lg	Light green	V	Purple
G	Green	O	Orange		
Y	Yellow	Gr	Gray		

2.4 Equipment

(1) Equipment is represented by a box. The symbol of connector that belongs to the equipment is indicated inside the box.
(2) The items listed under the item category symbol have a specific symbol (equipment number) for classification of items and identification of identical items.

Equipment number system



1. Equipment name
2. Box
3. Connector for harness
4. Connector belongs to equipment
5. Equipment number
6. Classification number (serial number)
7. Item category symbol

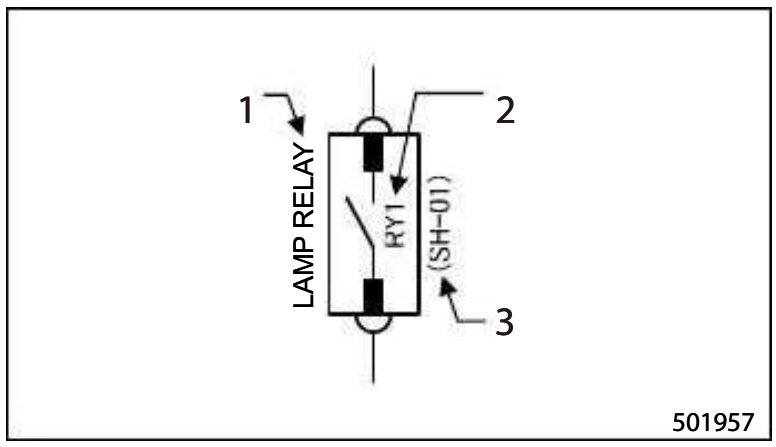
Item category symbol

Symbol	Item	Symbol	Item
F	Fuse	MC	Contactor
SBF	Slow-blow fuse	R	Resistor
FLW	Fusible link	C	Capacitor

RY	Relay	D	Diode

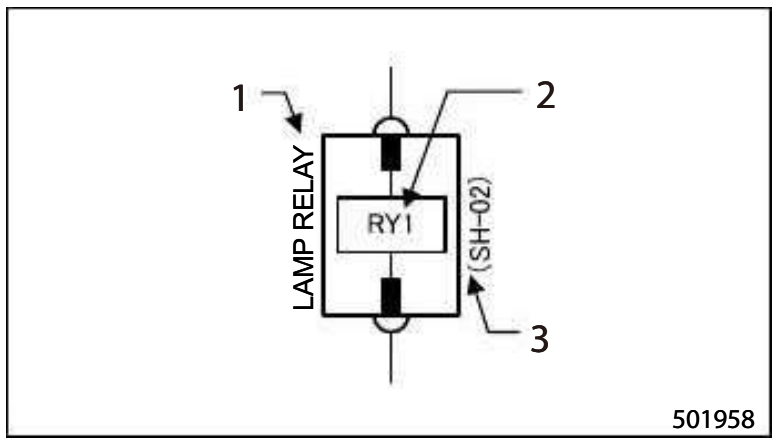
2.5 Relay Contactor and Coil

(1) For the relay contactor (contactor), the sheet symbol in which its coil is represented is provided so that you can find its coil easily. However, when the coil is represented in the same sheet, the sheet symbol is omitted.



1. Equipment name
2. Equipment number
3. Sheet symbol where coil is represented

(2) For the relay coil (contactor coil), the sheet symbol in which its contact is represented is provided so that you can find the location of contacts. However, when the contact is represented in the same sheet, the sheet symbol is omitted.



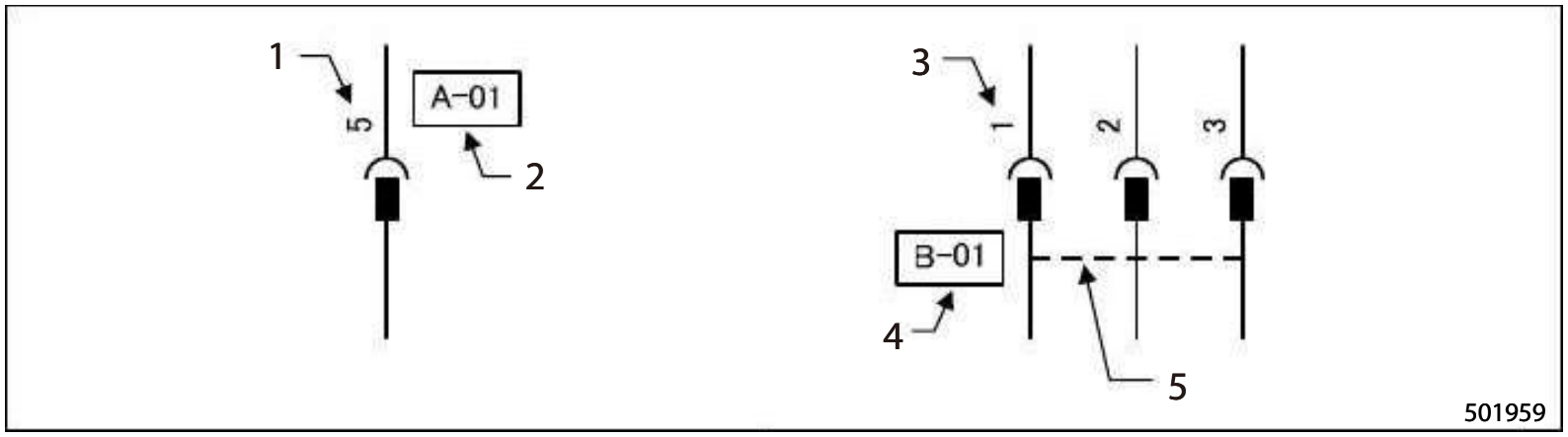
1. Equipment name
2. Equipment number
3. Sheet symbol where the contact is represented

2.6 Connectors

(1) The connectors are represented by the connector number for identification. The connector number is enclosed with a box.
(2) The same connector number is allocated to a plug connector (male connector) and its mating socket connector (female connector) as a pair.

(3) The connector terminal number is indicated next to the connector symbol. However, for the terminals such as round shape terminal, plug terminal and flat shape terminal, etc., the terminal number is indicated.

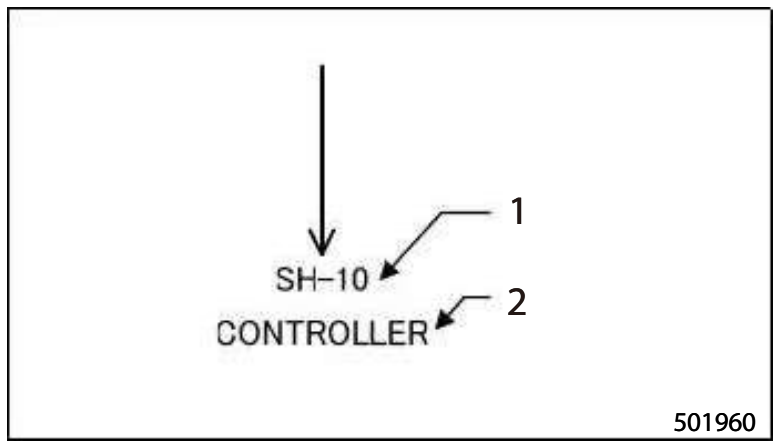
(4) When the connectors located side by side are the identical but have a different number, the line between the connectors are indicated by a dotted line.



1. Terminal number
2. Connector number
3. Terminal number
4. Connector number
5. Indicates that the connector is the same.

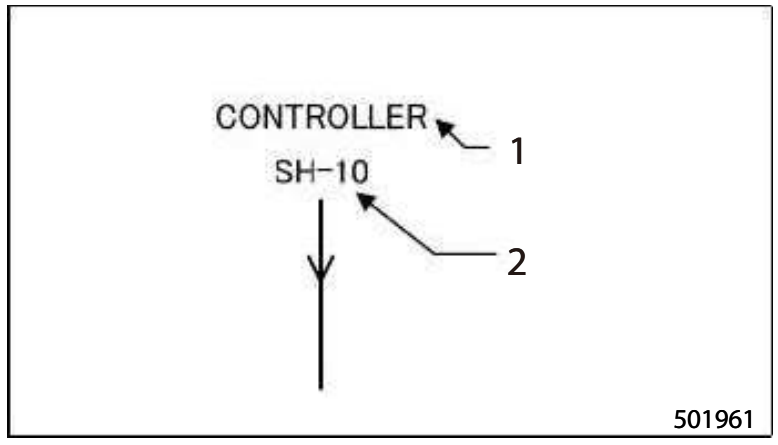
2.7 Indication of Connecting Line

(1) When a connecting wire crosses to other sheet, it is indicated by the arrow with the sheet symbol next to it. Also, the name of destination equipment is indicated for better understanding.



1. Destination sheet symbol
2. Destination equipment name

(2) Also a connecting wire from other sheet is also indicated by the arrow with the sheet symbol next to it. Also, the name of sender equipment is indicated for better understanding.

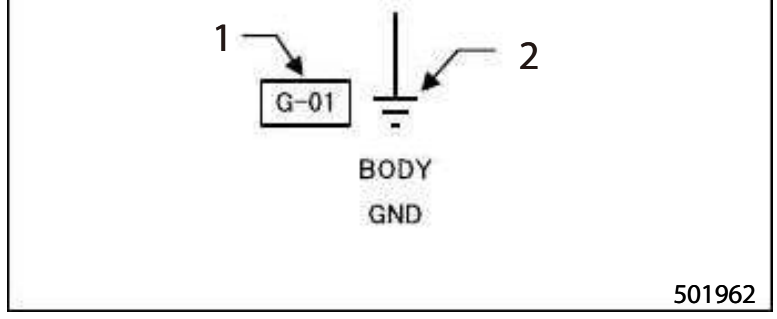


1. Sender equipment name
2. Sender sheet symbol

2.8 Indication of GND (Earth)

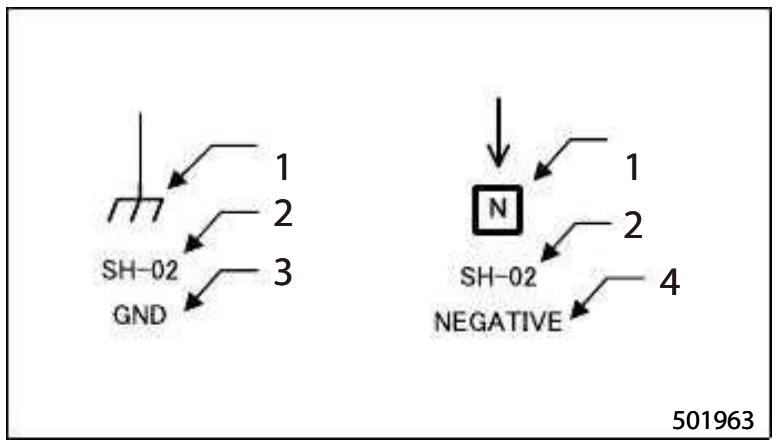
The GND (earth), depending on the connection type, is represented as shown below.

(1) When connecting directly to the body.



1. Terminal connector number
2. Graphic symbol

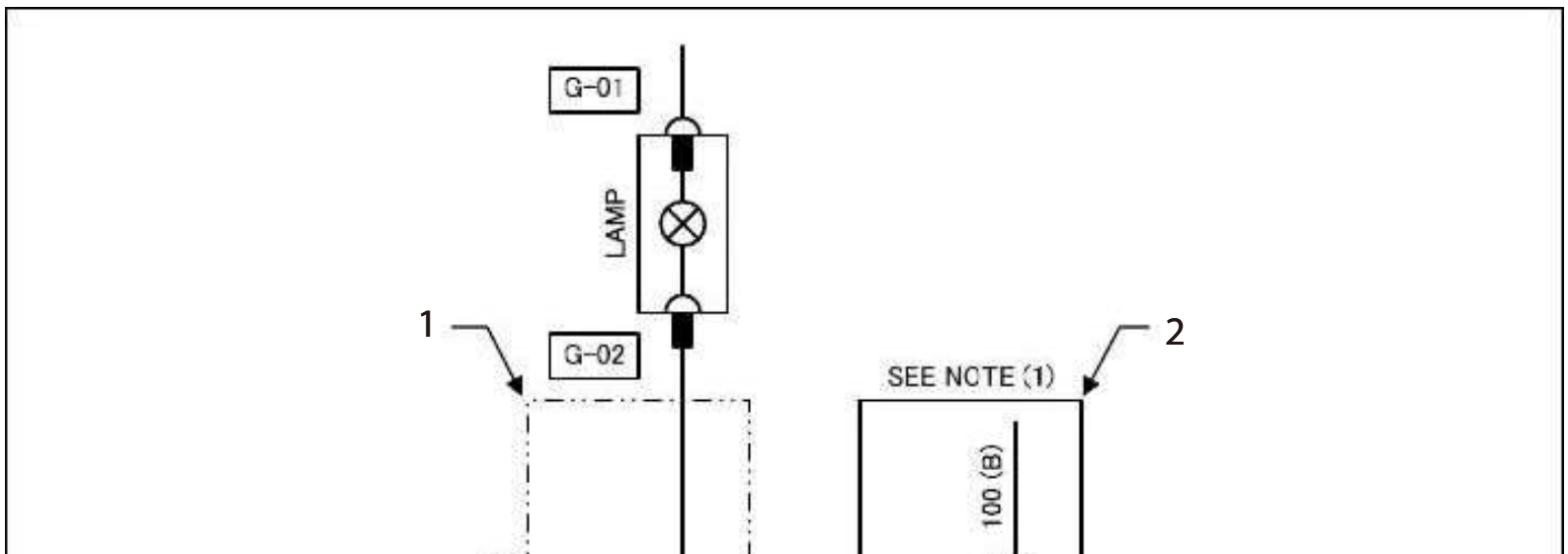
(2) When connecting to body or battery negative terminal through GND circuit and negative circuit.

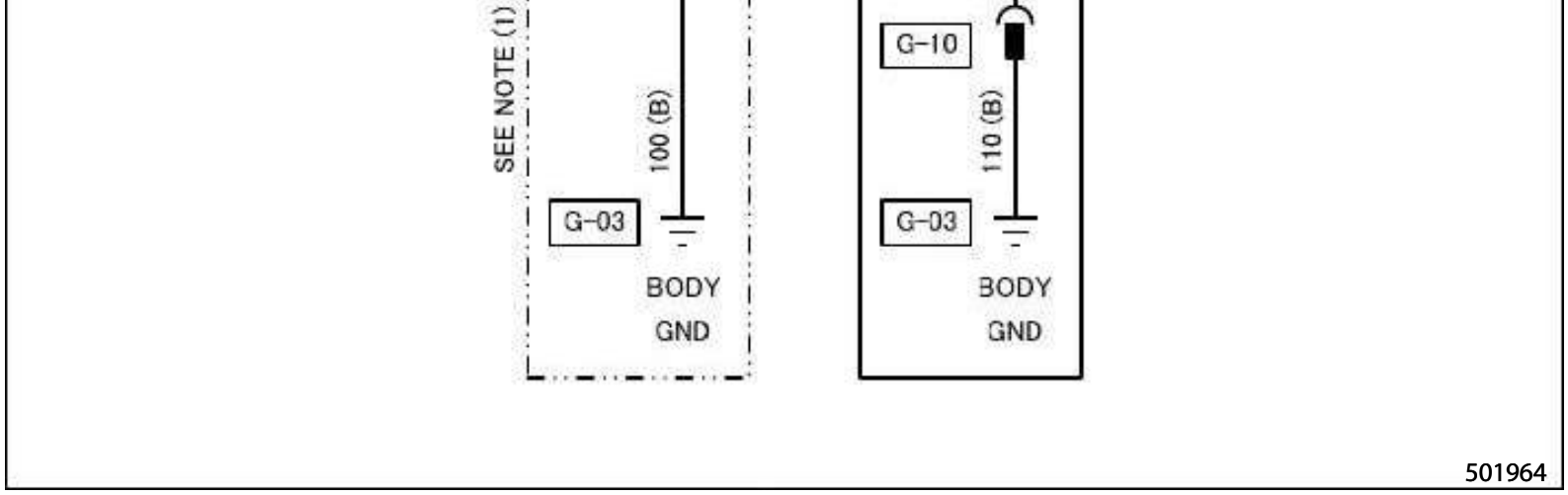


1. Graphic symbol
2. Destination sheet symbol
3. This indicates the connection to GND circuit
4. This indicates the connection to negative circuit.

2.9 Indication of Another Specification

When there is another specification, the portion of circuit, for which another specification is available, is enclosed with an alternate long and two short dashes line, and the circuit of another specification is enclosed by a thick solid line.



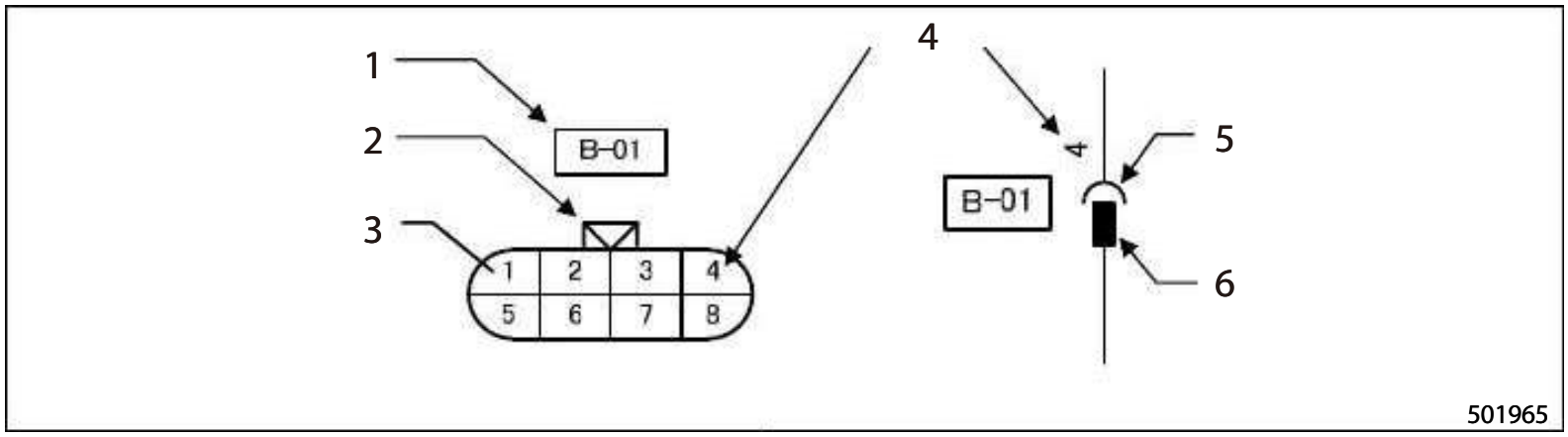


1. The circuit portion which differs depending on the specification.
2. The circuit of another specification.

3. How to Read Connector Diagrams

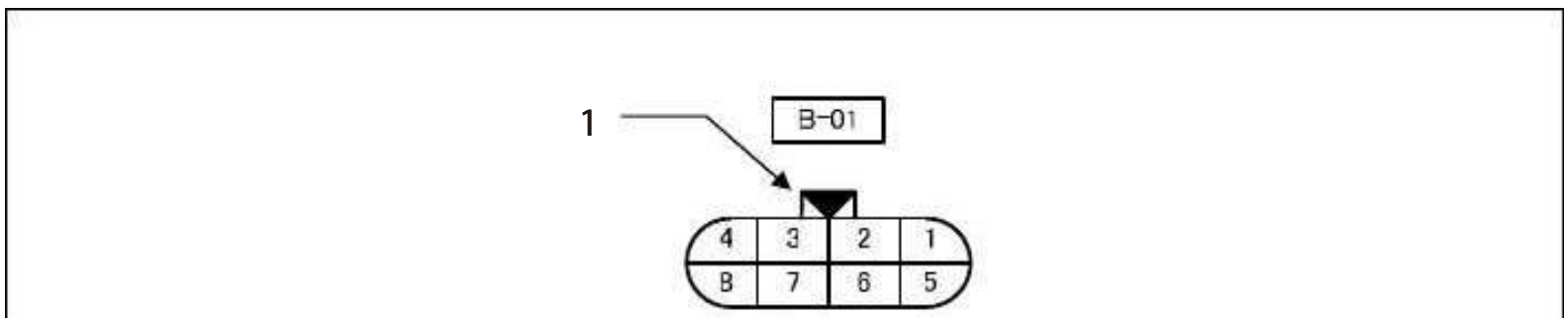
For all connectors included in the circuit diagrams; the connector shapes, terminal arrangements and terminal shapes (plug or socket) are indicated.

Socket terminal (female terminal)



1. Connector number
2. Lock
3. Terminal arrangement terminal number
4. This indicates No.4 terminal of B-01 connector
5. Socket terminal
6. Plug terminal

Plug terminal (male terminal)



502710

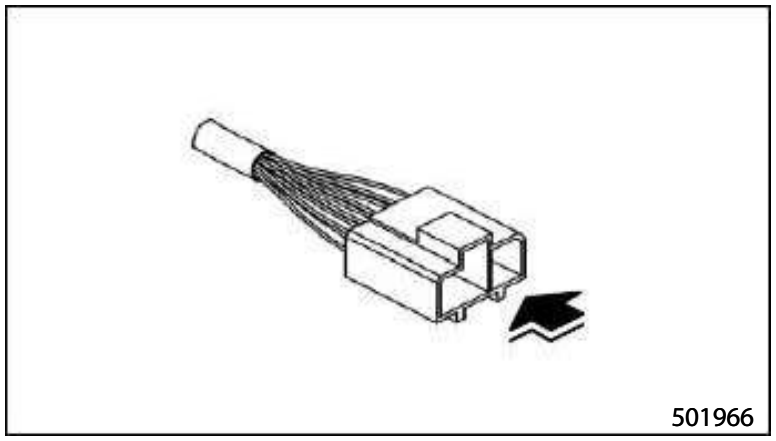
1. Lock (Blackened)

(1) The connector diagram is a view from its mating face.

(2) For the connectors that are connected to the equipment, only wire harness side connector is indicated.

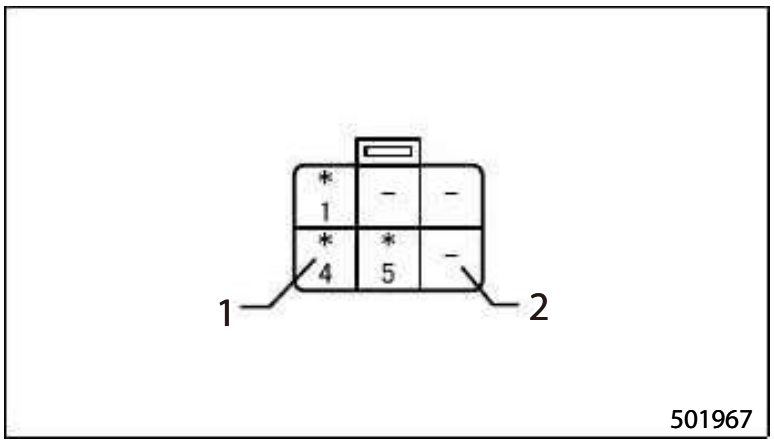
(3) For intermediate connectors, the connector diagram of both plug terminal (male) and socket terminal (female) are indicated.

(4) The lock portion of the plug terminal (male) is represented by blackening to distinguish from the socket terminal (female).



501966

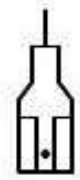
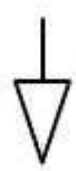
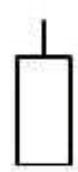
(5) Unused terminals are represented by the terminal number "-" Also, the terminal number marked with * indicates a gold-plated terminal.



501967

1. Gold-plated terminal 2. Unused terminal

(6) The terminal shapes are simplified as shown below.

Type	Round shape terminal	"U" shaped end terminal	Plug terminal (Plug)	Plug receptacle terminal (Socket)	Flat shape terminal
Actual shape					
Simplified representation					

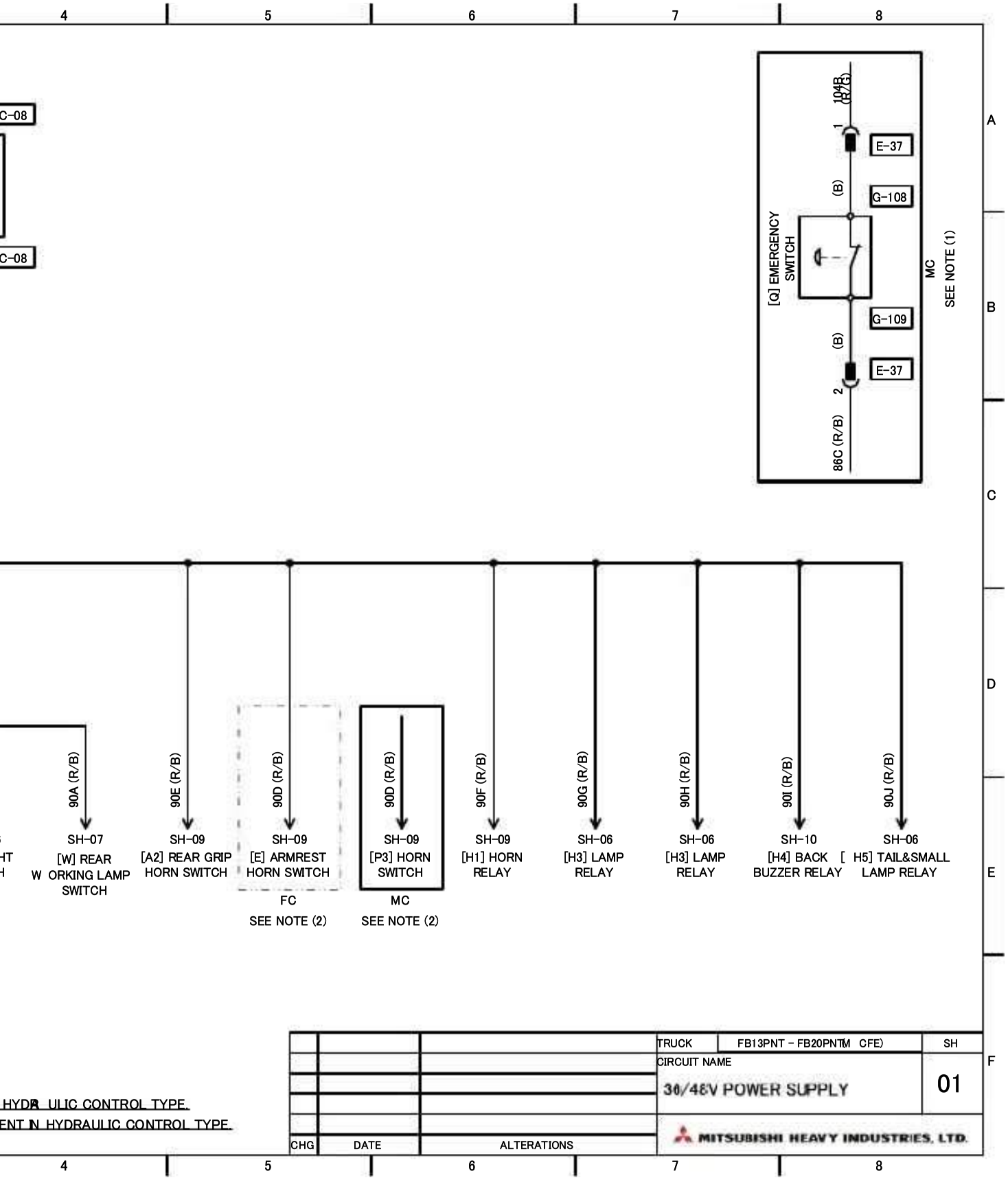
Chapter 5 CIRCUIT DIAGRAM

CIRCUIT DIAGRAM

	FB13PNT - FB20PNT
ME	LUNA (MCFE)

CHG	CIRCUIT NAME	SH	CHG	CIRCUIT NAME
	C ONNECTOR	41		
	C ONNECTOR	42		
	C ONNECTOR	43		
		44		
		45		
		46		
		47		
		48		
		49		
		50		

CHG	DATE	ALTERATIONS	TRUCK	FB13PNT - FB20PNT (MCFE)	SH
			CIRCUIT NAME		
			CONTENTS		A1
0	2011.07.01	Release	MITSUBISHI HEAVY INDUSTRIES, LTD.		



5-2

TRUCK

DEVELOPMENT NAM

SH	CHG	CIRCUIT NAME	SH
01		48V POWER SUP LY	21
02		48V KEY POWER S UPPLY	22
03		CONTROL POWER SUPPLY	23
04		CONTROL POWER SUPPLY	24
05		NEGATIVE CIRCU IT	25
06		LAMP	26
07		LAMP	27
08		LAMP	28
09		HORN	29
10		WARNING BUZZER & BACK BUZZER	30
11		MOTOR CONTRO	31
12		MOTOR CONTRO	32
13		LOGICS UNIT	33
14		LOGICS UNIT	34
15		INPUT UNIT	35
16		OUTPUT UNIT	36
17		CAN CIRCUIT	37
18		SPARE POWER S PPLY	38
19		CONNECTOR	39
20		CONNECTOR	40

[A2] STROBE LAMP SH-07 105R (R/W)

[H2] PDS BUZZER RELAY SH-10 105F (R/W)

[H2] PDS BUZZER RELAY SH-10 105G (R/W)

[H4] BACK BUZZER RELAY SH-10 105S (R/W)

[NO USE] E-25 8 105T (R/W)

[B3] EPS CONTROLLER SH-11 105H (R/W)

[I2] LOGICS SH-03 105L (R/W)

[G] LINE CONTACTOR SH-14 105N (R/W)

[U] PKB FORCED RELEASE CONNECTOR SH-14 105O (R/W)

[U] PKB FORCED RELEASE CONNECTOR SH-14 105P (R/W)

[P2] LIFT LOCK SOLENOID SH-14 105Q (R/W)

CHG	DATE	ALTERATIONS

MITSUBISHI HEAVY INDUSTRIES, LTD.

TRUCK FB13PNT – FB20PNTM CFE)

CIRCUIT NAME 36/48V KEY POWER SUPPLY

02 SH

5-3

BATTERY 48V

2 (70B) 2 H-09 1 H-09 1 (70B)

2 (70B) [B4] PUMP INVERTER SH-11

[B4] PUMP INVERTER SH-11 12 (60B) G-134 12 (60B) F1 325A BUS BAR [G] LINE CONTACTOR G-114 1 (70B)

[B3] EPS CONTROLLER SH-11 94A (5R) G-48 94B (5R) [G] STEERING CONTACTOR MC2 BUS BAR F2 40A BUS BAR (SH-14) MC1 G-49 (R) G-49 (R) (SH-14)

[E] EMERGENCY SWITCH

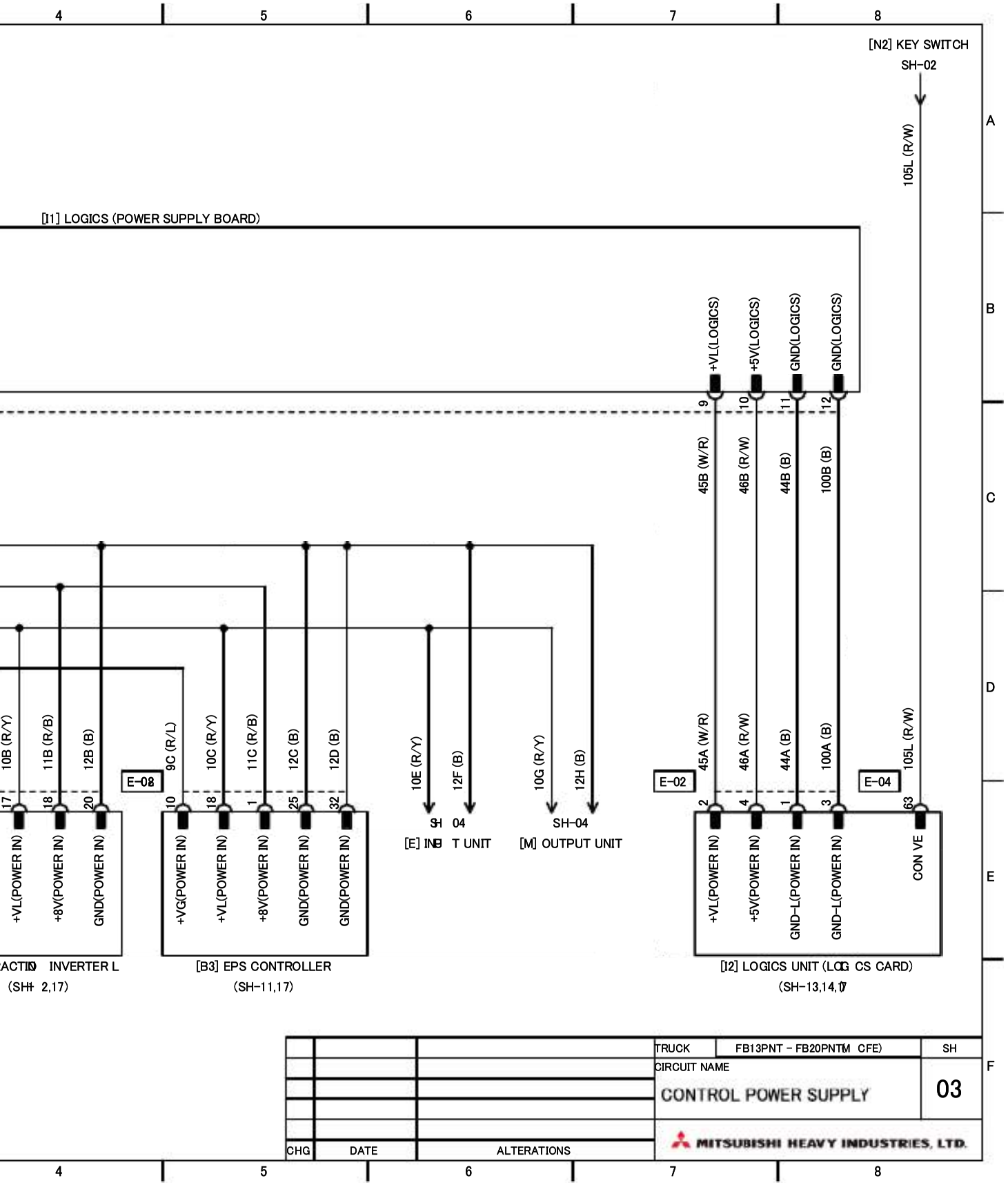
[H2] PDS BUZZER RELAY SH-10 86B (R/B) 86C (R/B) 2 H-02 A077 (W) G-55 G-56 A080 (W/L) 5 H-02 104B 104A (R/G) 4 [G] FUSE BOX F4 10A 3

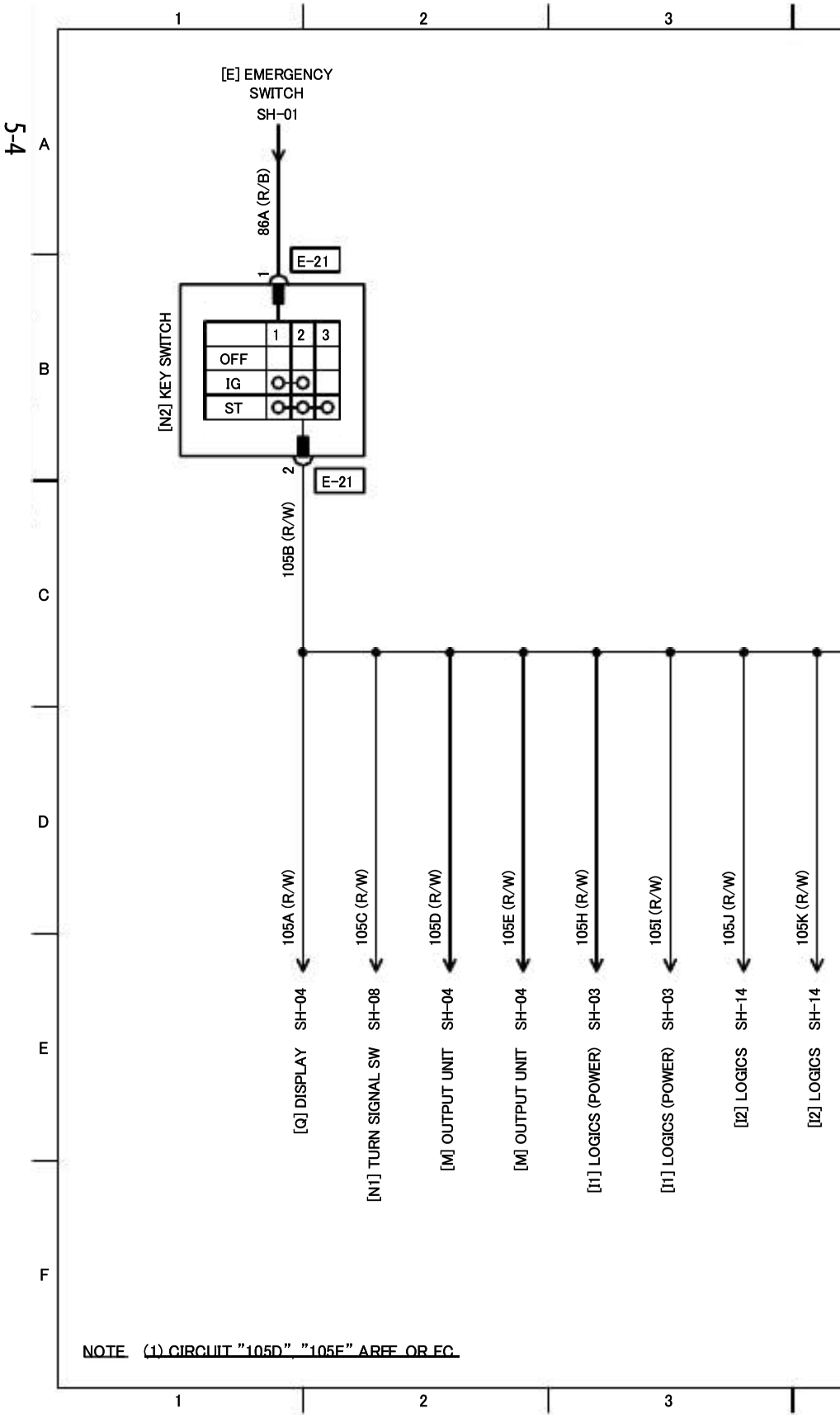
FC SEE NOTE (1)

[N2] KEY SWITCH SH-02 86A (R/B)

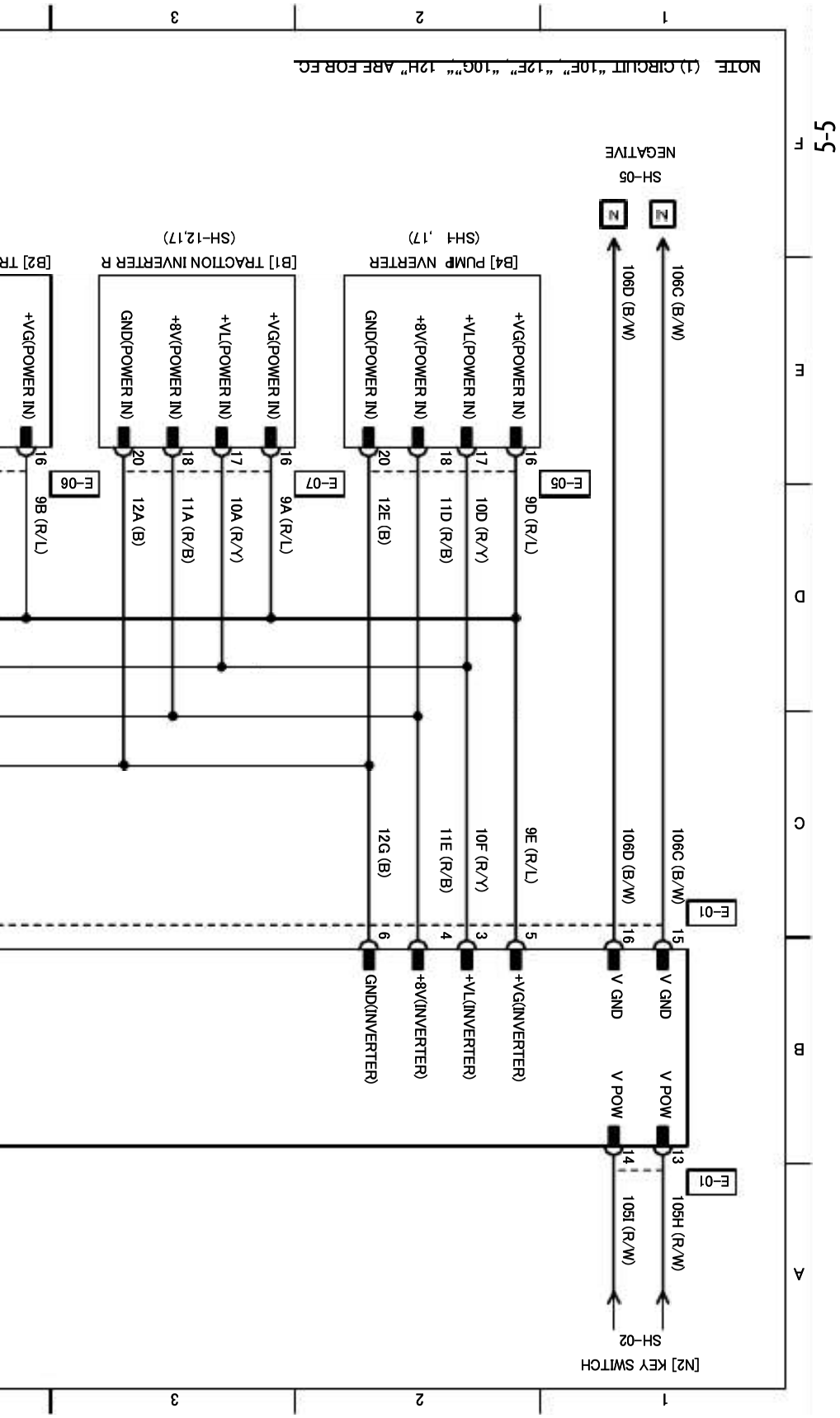
[N1] LIGHT SWITCH SH-06 90B (R/B) 90C (R/B) 2 F3 10A 1

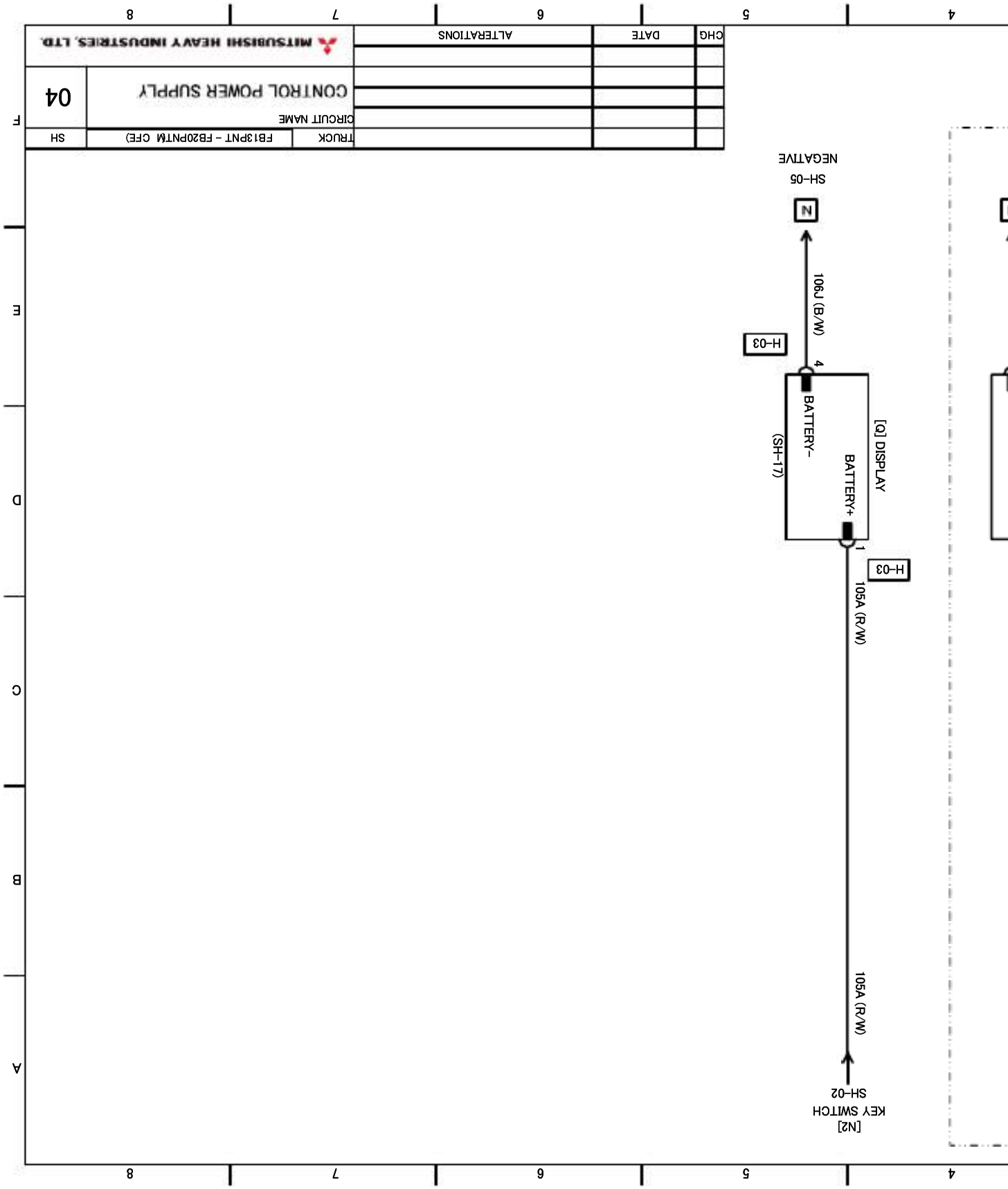
NOTE (1).EMERGENCY SWITCH CIRCUIT IS DIFFERENT IN
(2).HORN SWITCH CIRCUIT IS DIFFERENT

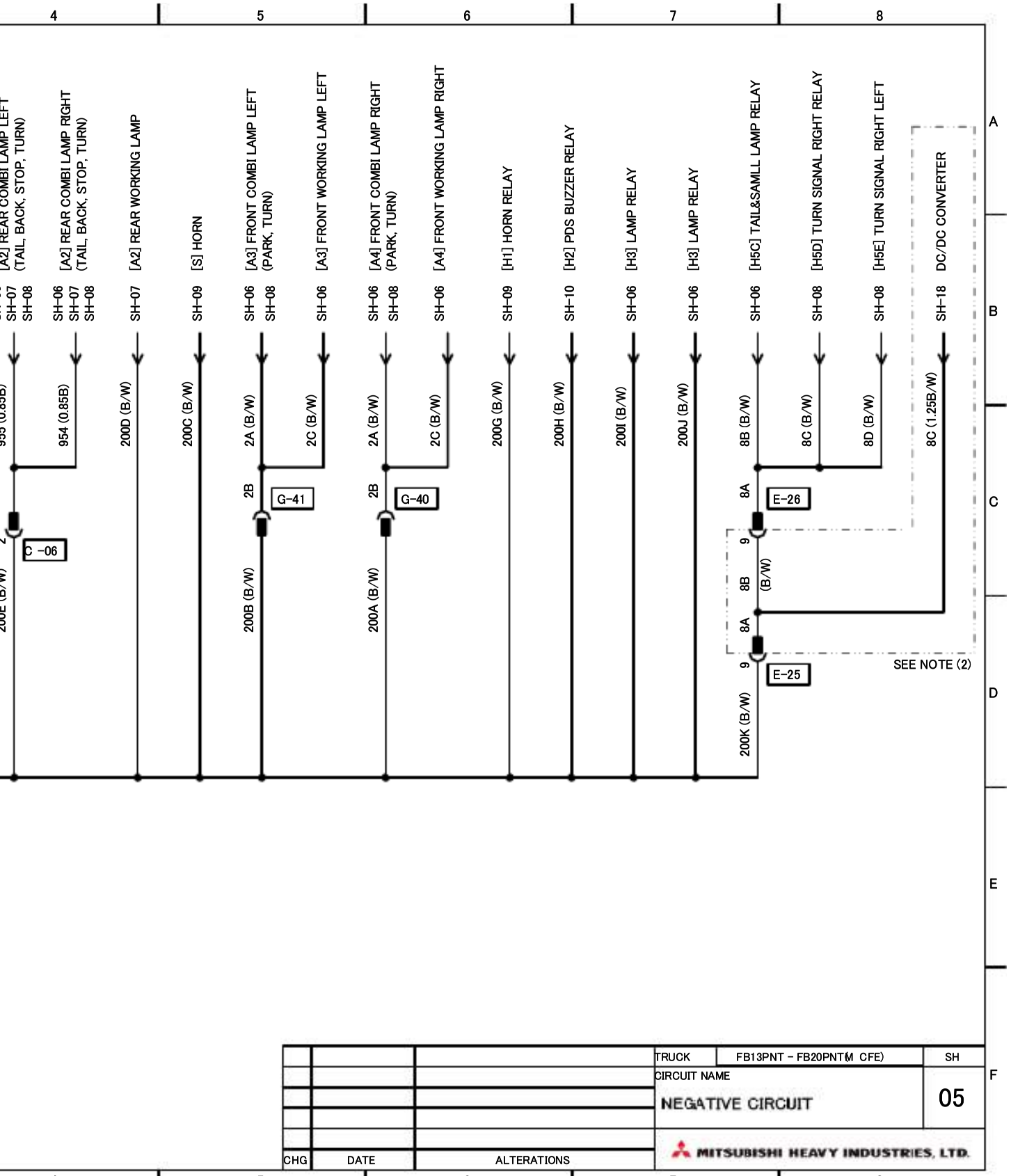


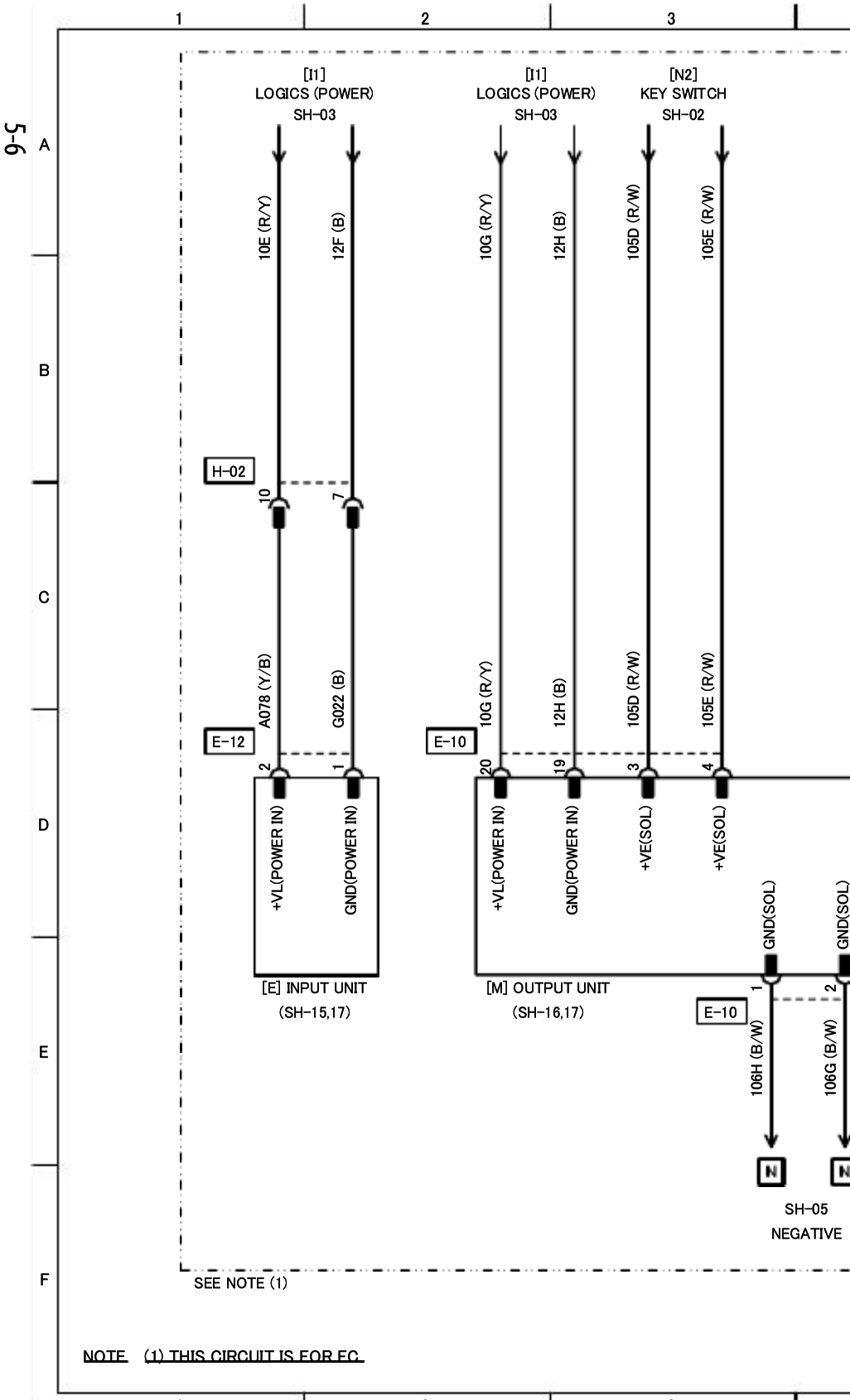


NOTE (1) CIRCUIT "105D", "105E" ARE OR EC

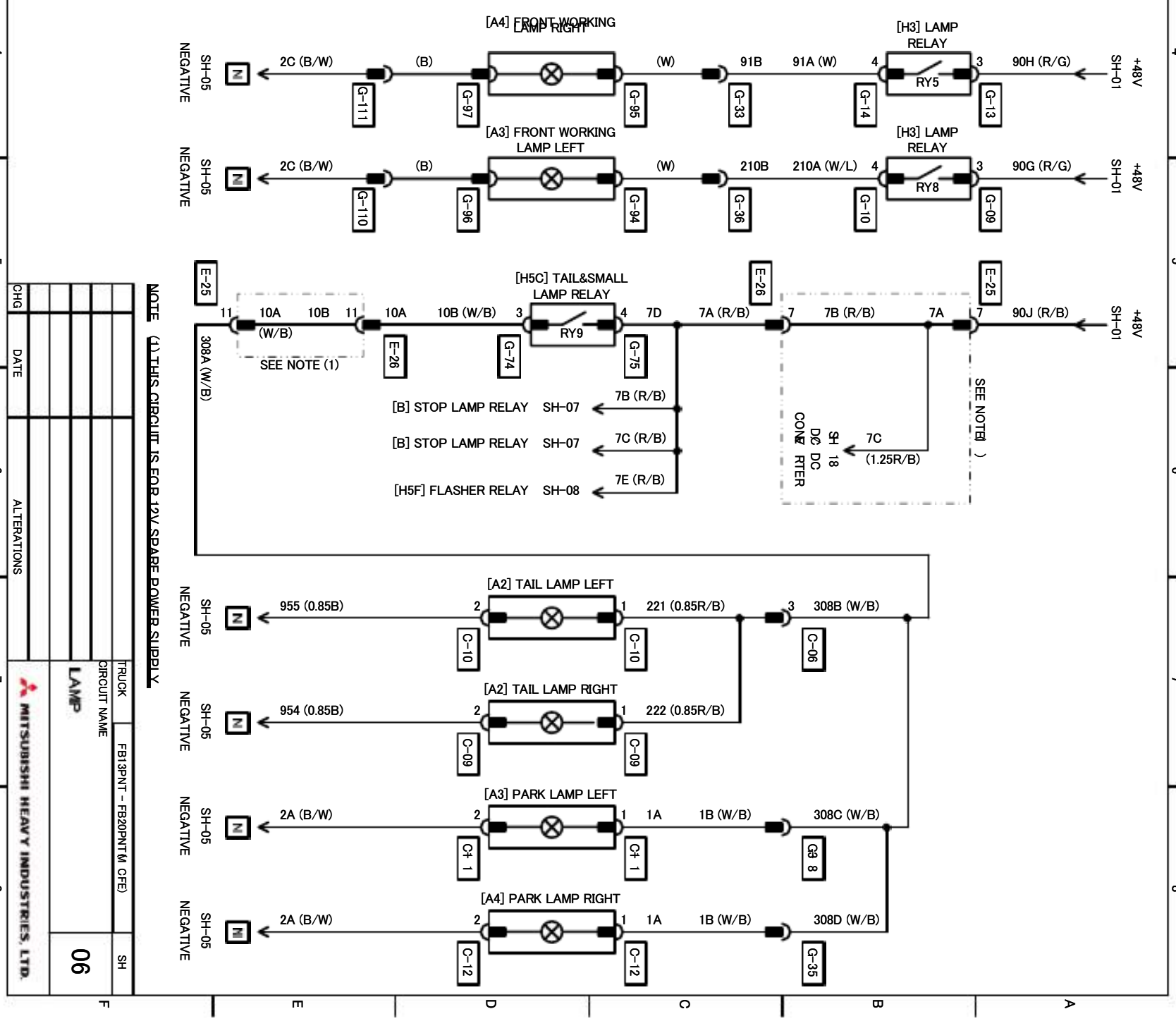

NOTE (1) CIRCUIT "10E", "12E", "10G", "12H" ARE FOR EC.
[N2] KEY SWITCH
SH-02
105I (R/W)
105H (R/W)
E-01
106C (B/W)
106D (B/W)
V GND
V POW
9E (R/L)
10F (R/Y)
11E (R/B)
12G (B)
+VG(INVERTER)
+VL(INVERTER)
+8V(INVERTER)
GND(INVERTER)
[B4] PUMP NVERTER
(SH4 ,17)
[B1] TRACTION INVERTER R
(SH-12,17)
[B2] TR
9D (R/L)
10D (R/Y)
11D (R/B)
12E (B)
9A (R/L)
10A (R/Y)
11A (R/B)
12A (B)
9B (R/L)
E-05
E-07
E-06
+VG(POWER IN)
+VL(POWER IN)
+8V(POWER IN)
GND(POWER IN)
NEGATIVE
SH-05
5-5


[N2]
KEY SWITCH
SH-02
105A (R/W)
[Q] DISPLAY
BATTERY+
BATTERY-
(SH-17)
106J (B/W)
H-03
NEGATIVE
SH-05
CONTROL POWER SUPPLY
04
CIRCUIT NAME
TRUCK
FB13PNT - FB20PNTM CFE)
SH
MITSUBISHI HEAVY INDUSTRIES, LTD.
CHG
DATE
ALTERATIONS

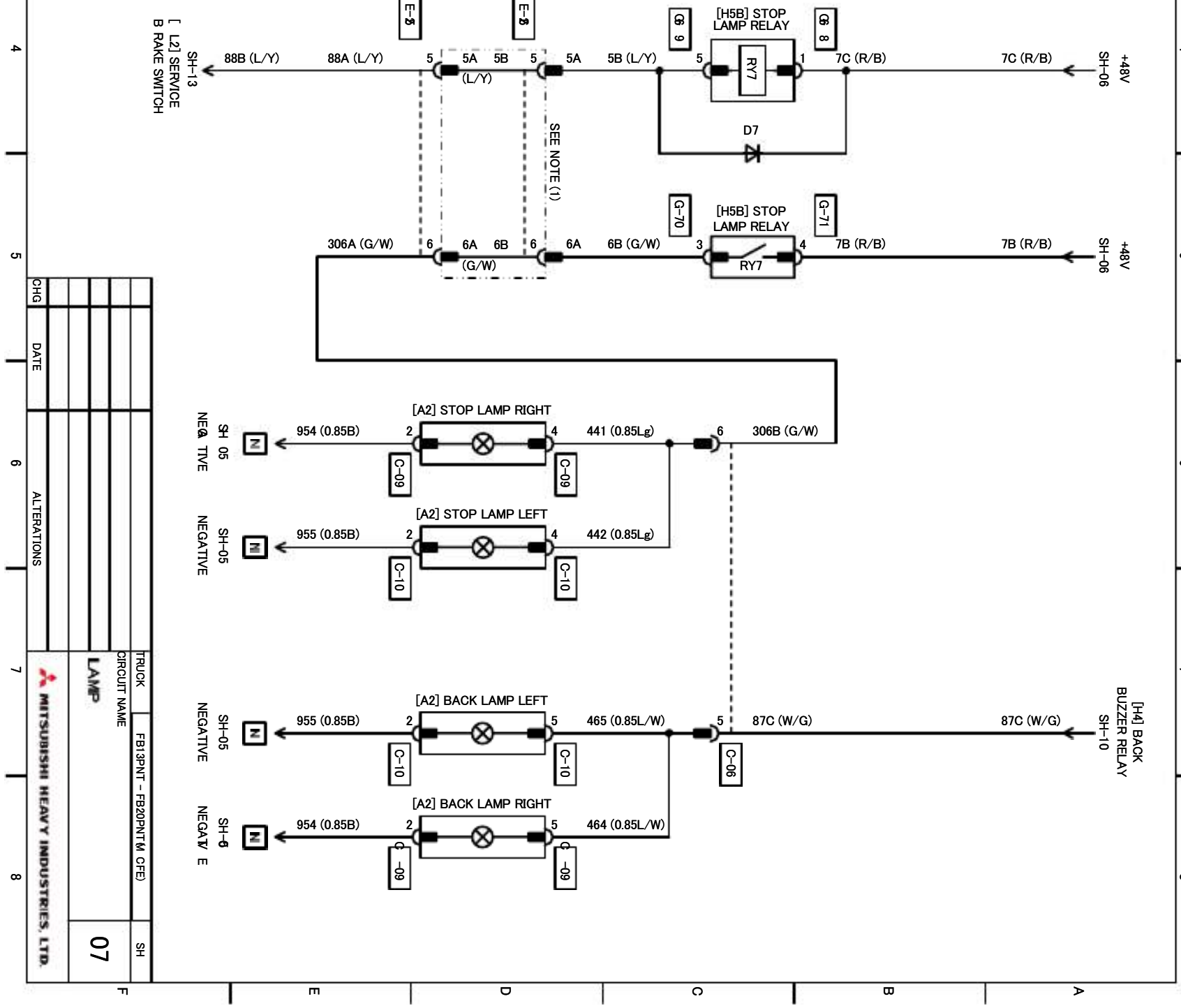


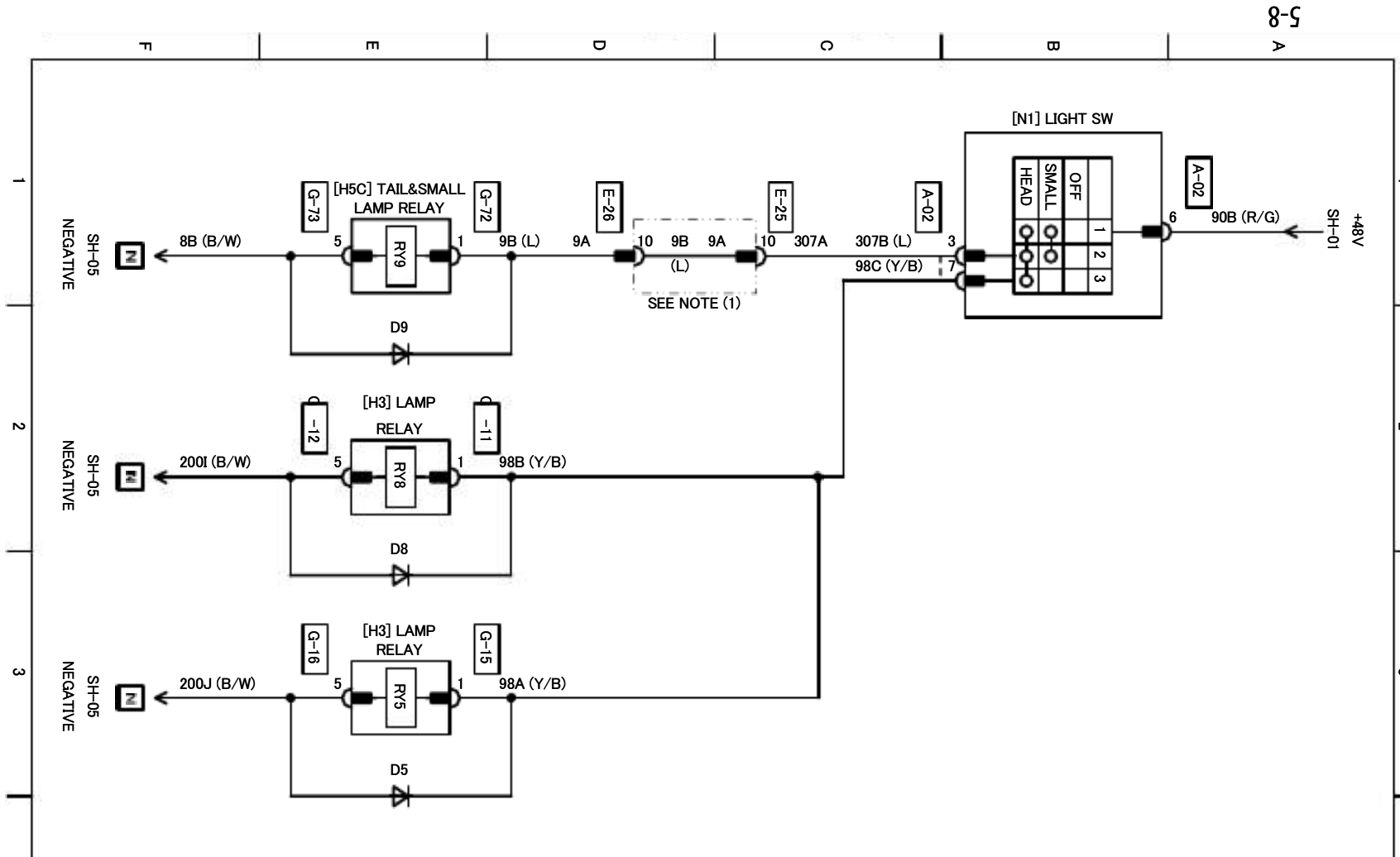


NOTE (1) THIS CIRCUIT IS FOR EC


[A4] FRONT WORKING LAMP RIGHT
[H3] LAMP RELAY
RY5
[A3] FRONT WORKING LAMP LEFT
[H3] LAMP RELAY
RY8
[H5C] TAIL&SMALL LAMP RELAY
RY9
SEE NOTE (1)
SEE NOTE(2)
[B] STOP LAMP RELAY SH-07
[B] STOP LAMP RELAY SH-07
[H5F] FLASHER RELAY SH-08
[A2] TAIL LAMP LEFT
[A2] TAIL LAMP RIGHT
[A3] PARK LAMP LEFT
[A4] PARK LAMP RIGHT
NEGATIVE
+48V
NOTE (1) THIS CIRCUIT IS FOR 12V SPARE POWER SUPPLY.
CHG
DATE
ALTERATIONS
TRUCK
FB13PNT - FB20PNT(M CFE)
CIRCUIT NAME
LAMP
MITSUBISHI HEAVY INDUSTRIES, LTD.
06
SH

5-7
SH-11 [B4] PUMP INVERTER
106A (B/W)
106B (B/W) SH-15 [E] ARMREST FNR SWITCH
106C (B/W) SH-03 [I1] LOGICS (POWER)
106D (B/W) SH-03 [I1] LOGICS (POWER)
106E (B/W) SH-13 [L1] PARKING BRAKE SWITCH
106G (B/W) SH-04 [M] OUTPUT UNIT
106H (B/W) SH-04 [M] OUTPUT UNIT
106F (B/W) SH-13 [L2] SERVICE BRAKE SWITCH
106I (B/W) SH-13 [N1] FNR LEVER
106J (B/W) SH-04 [Q] DISPLAY
200F (B/W)
200L (B/W) SH-10 [F] BACK BUZZER
SH-06
NOTE (1) CIRCUIT "106B", "106G", "106L" ARE FOR EC.
(2) THIS CIRCUIT IS FOR 12V SPARE POWER SUPPLY.


[H5B] STOP LAMP RELAY
RY7
D7
SEE NOTE (1)
+48V SH-06
SH-13 [L2] SERVICE B RAKE SWITCH
88B (L/Y)
88A (L/Y)
5A (L/Y)
5B (L/Y)
7C (R/B)
306A (G/W)
6A (G/W)
6B (G/W)
7B (R/B)
[A2] STOP LAMP RIGHT
[A2] STOP LAMP LEFT
954 (0.85B)
955 (0.85B)
441 (0.85Lg)
442 (0.85Lg)
306B (G/W)
[A2] BACK LAMP LEFT
[A2] BACK LAMP RIGHT
465 (0.85L/W)
464 (0.85L/W)
87C (W/G)
[H4] BACK BUZZER RELAY SH-10
NEGATIVE
SH-05
TRUCK
FB13PNT - FB20PNTM CFE)
CIRCUIT NAME
LAMP
MITSUBISHI HEAVY INDUSTRIES, LTD.
07
SH
DATE
ALTERATIONS
CHG


5-8
[N1] LIGHT SW
HEAD
SMALL
OFF
[H5C] TAIL&SMALL LAMP RELAY
RY9
D9
SEE NOTE (1)
[H3] LAMP RELAY
RY8
D8
RY5
D5
+48V SH-01
90B (R/G)
8B (B/W)
9B (L)
9A
9B (L)
307A
307B (L)
98C (Y/B)
200I (B/W)
98B (Y/B)
200J (B/W)
98A (Y/B)
NEGATIVE SH-05

NOTE (1) THIS CIRCUIT IS FOR 12V SPARE POWER SUPPLY

[N] KEY SWITCH SH-02

[W] REAR WORKING LAMP SWITCH

[A2] REAR WORKING LAMP

[A2] STROBE LAMP

SH-05 NEGATIVE

+48V SH-01

90A (R/B)

105R (R/W)

103A (G/B)

103B

3A (G/B)

3B

200D (B/W)

4B

4A (B/W)

4C

4D (B/W)

1B

1A (R/W)

[NO USE]

C-07

G-65

G-62

G-04

G-03

G-67

G-64

NOTE (1) THIS CIRCUIT IS FOR 12V SPARE POWER SUPPLY

[E] TURN SIGNAL LEFT RELAY

RY4

SEE NOTE (1)

92A (L/R)

93A (R/G)

1A (R/G)

1B (R/G)

11B (Y/B)

G-82

G-83

[A2] REAR TURN SIGNAL LAMP RIGHT

[A4] FRONT TURN SIGNAL LAMP RIGHT

[A2] REAR TURN SIGNAL LAMP LEFT

[A3] FRONT TURN SIGNAL LAMP LEFT

954 (0.85B)

404 (0.85G/B)

92B

2A (B/W)

3A

3B (R)

92C

955 (0.85B)

405 (0.85G/B)

93B

93C

C-09

C-06

C-12

G-34

C-10

C-1

G-3

CHG	DATE	ALTERATIONS

MITSUBISHI HEAVY INDUSTRIES, LTD.

TRUCK	FB13PNT – FB20PNT (M CFE)	SH
CIRCUIT NAME	LAMP	08

FOR M.C.

[A2] REAR GRIP HORN SWITCH

[H1] HORN RELAY

[S] HORN

[H1] HORN RELAY

SH-05 NEGATIVE

200G (B/W) 5 RY6 1 300C

300B (W/B) 6 5A 5B (W/B)

2B (R/B) 2A 2 90E (R/B)

+48V SH-01

G-08 G-07 C-07 G-66 G-63 C-07

D6

200C (B/W) 89B (Y/L) 89A (Y/L) 3 RY6 4 90F (R/B)

G-02 G-01 G-05 G-06

R1 10Ω C1 1μF

CHG						
DATE						
ALTERATIONS						
				TRUCK	FB13PNT – FB20PNT (M CFE)	SH
				CIRCUIT NAME	HORN	09

MITSUBISHI HEAVY INDUSTRIES, LTD.

[N1] TURN SIGNAL SW

[N2] KEY SWITCH SH-02

105C (R/W)

[H5D] TURN SIGNAL RIGHT RELAY

[H5E] TURN SIGNAL LEFT RELAY

SH-05 NEGATIVE

8C (B/W) 5 RY3 1 4B (W/R) 4A 4 4B (W/R) 4A 4 96A 96B (W/R) 97B (W/L) 5 2

8D (B/W) 5 RY4 1 2B (W/L) 2A 2 2B (W/L) 2A 2 97A

D3

D4

SEE NOTE (1)

E-25 E-26 A-02 G-77 G-76 G-81 G-80

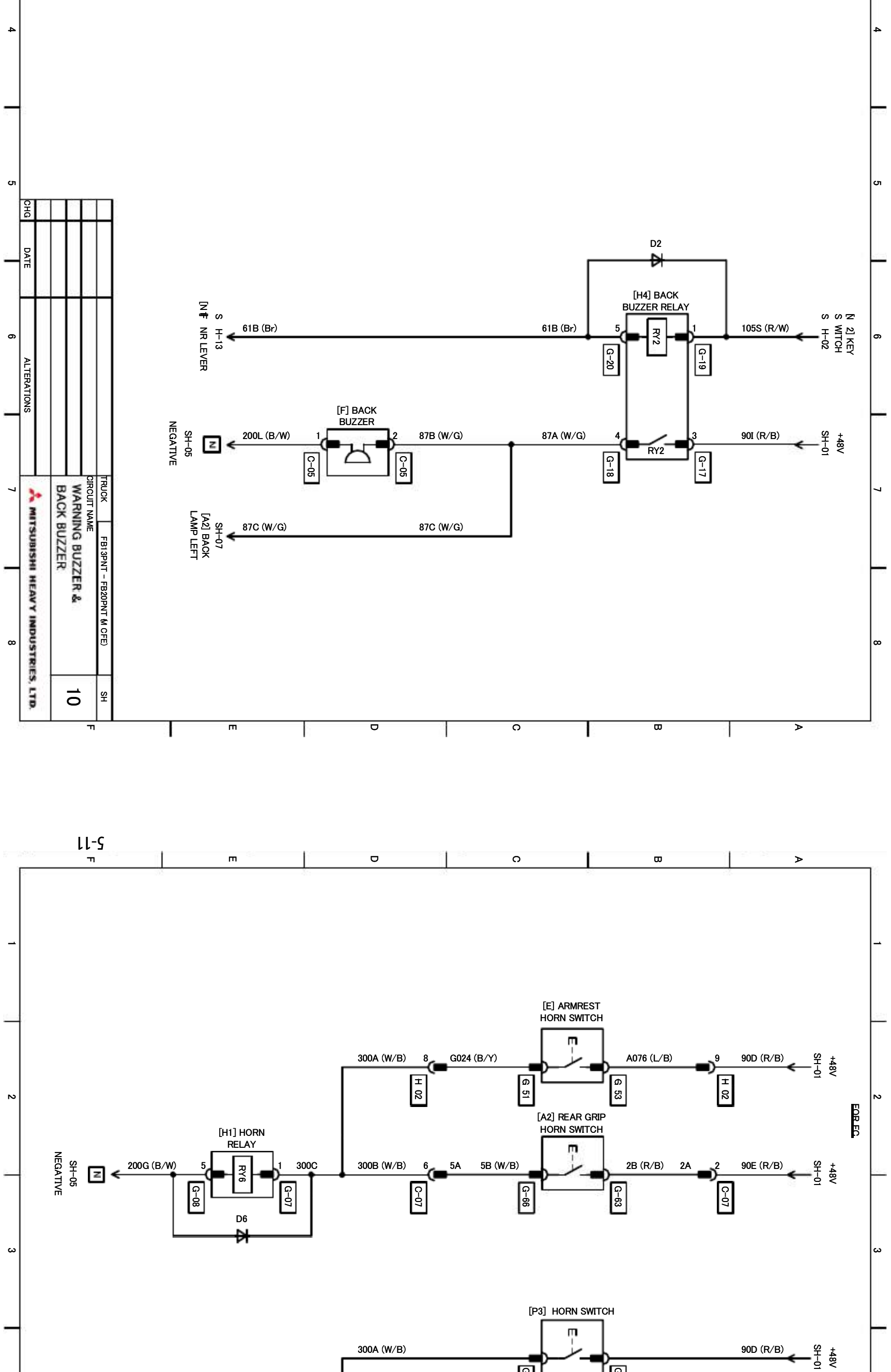
[D] TURN SIGNAL RIGHT RELAY

[H5F] FLASHER RELAY

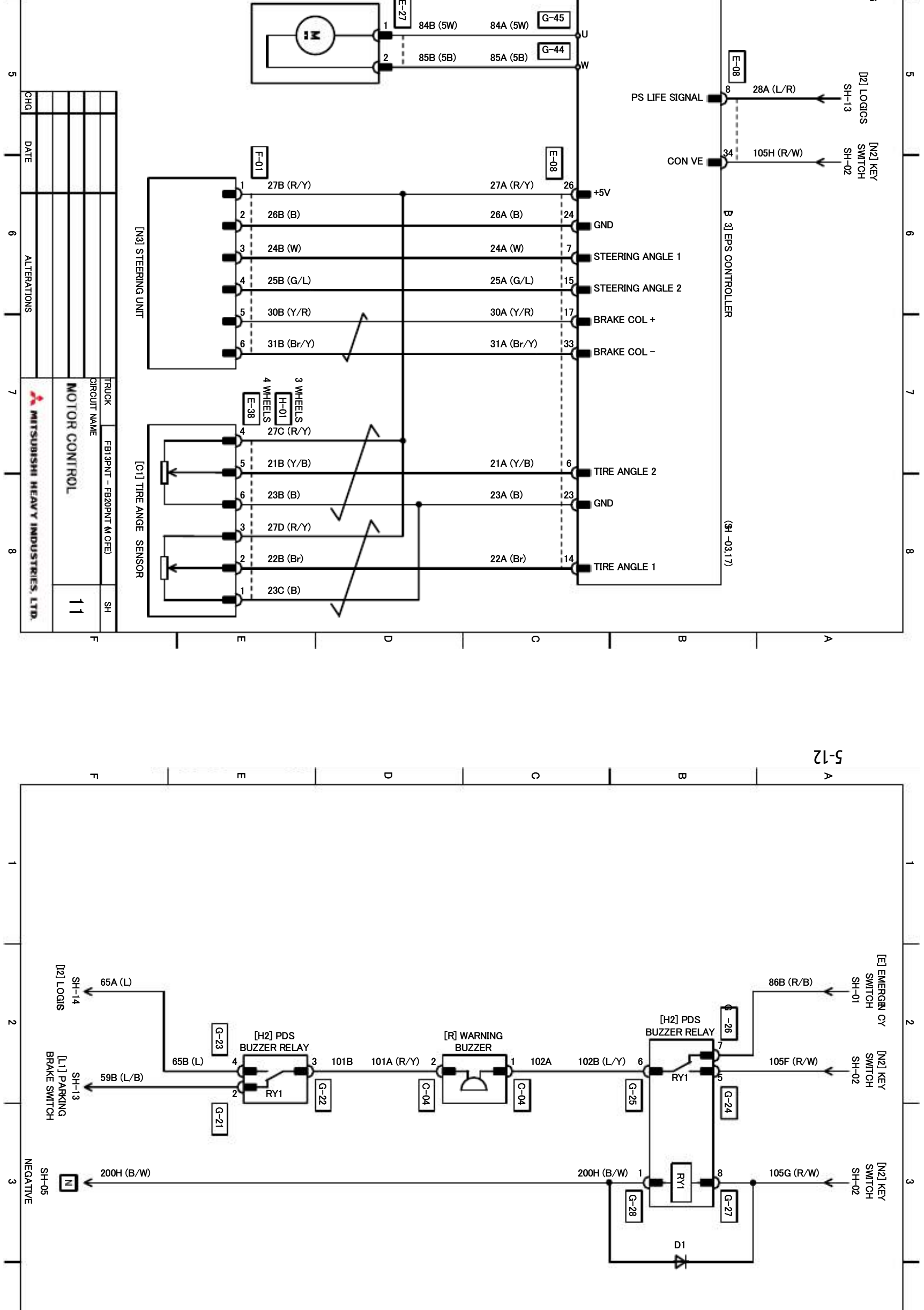
+48V SH-06

3 3A 3B 3 (L/R) 3A 3B (L/R) 3 RY3 4 11A (Y/B) 11C (Y/B) 7E (R/B)

NOTE (1) THIS CIRCUIT IS FOR M.C.


[N 2] KEY SWITCH S H-02
105S (R/W)
[H4] BACK BUZZER RELAY
D2
RY2
G-19
G-20
61B (Br)
61B (Br)
S H-13 [N F NR LEVER
[F] BACK BUZZER
200L (B/W)
87B (W/G)
87A (W/G)
90I (R/B)
+48V SH-01
SH-05 NEGATIVE
C-05
C-05
G-18
G-17
87C (W/G)
87C (W/G)
SH-07 [A2] BACK LAMP LEFT
TRUCK
FB13PNT - FB20PNT (M CFE)
CIRCUIT NAME
WARNING BUZZER & BACK BUZZER
10
SH
MITSUBISHI HEAVY INDUSTRIES, LTD.
CHG
DATE
ALTERATIONS

[E] ARMREST HORN SWITCH
300A (W/B)
G024 (B/Y)
A076 (L/B)
90D (R/B)
+48V SH-01
H 02
G 51
G 53
H 02
[A2] REAR GRIP HORN SWITCH
[H1] HORN RELAY
200G (B/W)
300C
300B (W/B)
5A
5B (W/B)
2B (R/B)
2A
90E (R/B)
SH-05 NEGATIVE
RY6
G-08
G-07
C-07
G-66
G-63
C-07
D6
[P3] HORN SWITCH
300A (W/B)
90D (R/B)
FOR EC


[G] STEERING CONTACTOR SH-01
G-46
94A (5R)
P
G-43
95A (5L)
N
[C2] EPS MOTOR
E-27
1
84B (5W)
84A (5W)
G-45
U
2
85B (5B)
85A (5B)
G-44
W
E-08
PS LIFE SIGNAL
8
28A (L/R)
[I2] LOGICS SH-13
CON VE
34
105H (R/W)
[N2] KEY SWITCH SH-02
F-01
E-08
[N3] STEERING UNIT
27B (R/Y)
27A (R/Y)
26
+5V
26B (B)
26A (B)
24
GND
24B (W)
24A (W)
7
STEERING ANGLE 1
25B (G/L)
25A (G/L)
15
STEERING ANGLE 2
30B (Y/R)
30A (Y/R)
17
BRAKE COL +
31B (Br/Y)
31A (Br/Y)
33
BRAKE COL −
[B 3] EPS CONTROLLER
(SH -03,17)
3 WHEELS
4 WHEELS
E-38
H-01
27C (R/Y)
[C1] TIRE ANGE SENSOR
21B (Y/B)
21A (Y/B)
6
TIRE ANGLE 2
23B (B)
23A (B)
23
GND
27D (R/Y)
22B (Br)
22A (Br)
14
TIRE ANGLE 1
23C (B)
CHG
DATE
ALTERATIONS
MITSUBISHI HEAVY INDUSTRIES, LTD.
TRUCK
CIRCUIT NAME
MOTOR CONTROL
FB13PNT－FB20PNT (M CFE)
SH
11

[E] EMERGENCY SWITCH SH-01
86B (R/B)
G-26
[H2] PDS BUZZER RELAY
[R] WARNING BUZZER
[N2] KEY SWITCH SH-02
105F (R/W)
RY1
G-23
65A (L)
[I2] LOGICS SH-14
65B (L)
101B
101A (R/Y)
102A
102B (L/Y)
G-25
G-24
59B (L/B)
[L1] PARKING BRAKE SWITCH SH-13
G-22
C-04
G-21
200H (B/W)
105G (R/W)
G-28
G-27
D1
SH-05 NEGATIVE

CHG	DATE	ALTERATIONS

MITSUBISHI HEAVY INDUSTRIES, LTD.

TRUCK	FB13PNT – FB20PNT (Ⅱ FE)	SH
CIRCUIT NAME	MOTOR CONTROL	12

[J2] TRACTION MOTOR RIGHT

SENSOR BEARING

E-14 E-17

1B (Br/R) 2B (B) 5B (R/Y) 6B (B) 7B (W/B) 8B (L/B)

C2

G-131 G-132 G-133

6 (20B) 7 (20B) 8 (20B)

[B1] TRACTION INVERTER RIGHT (SH-03,17)

E-07

1A (Br/R) MOTOR THERMAL +
2A (B) MOTOR THERMAL –
5A (R/Y) ROTARY SENSOR +12V
6A (B) ROTARY SENSOR GND
7A (W/B) ROTARY SENSOR A
8A (L/B) ROTARY SENSOR B

G-125 G-126 G-127 G-143

6 (20B) 7 (20B) 8 (20B) 16 (60B)

G-139

14 (60B)

E-06

19B (B) GND
11

8 MODE 1

19A (B)

SH 03,17)

NOTE (1) CONNECTOR OF TIRE ANGLER NSOR IS DIFFERENT IN WHEEL TYPE.

[J1] PUMP MOTOR

G-119 G-120 G-121

9 (30B) 10 (30B) 11 (30B)

E-16

36B (Br/B) 37B (B)

SH-01 NEGATIVE

2 (70B) 2 (70B)

G-115 95B (5L)

G-140 15 (60B) SH-12 [B2] TRACTION INVERTER LEFT

G-47 106A (B/W) SH-05 NEGATIVE

G-47 200F (B/W) SH-05 NEGATIVE

G-47

G-116 G-117 G-118

9 (30B) 10 (30B) 11 (30B)

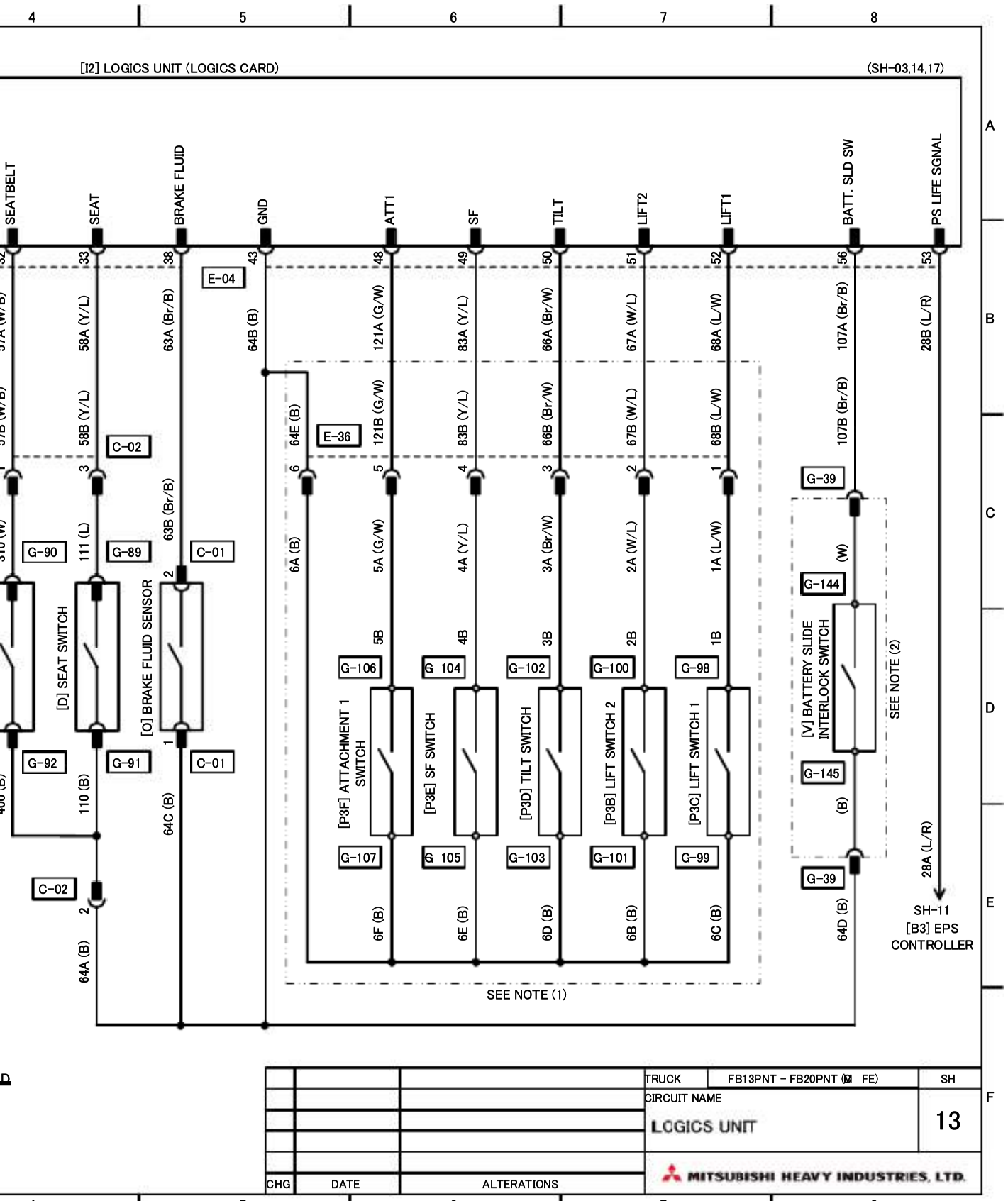
E-05

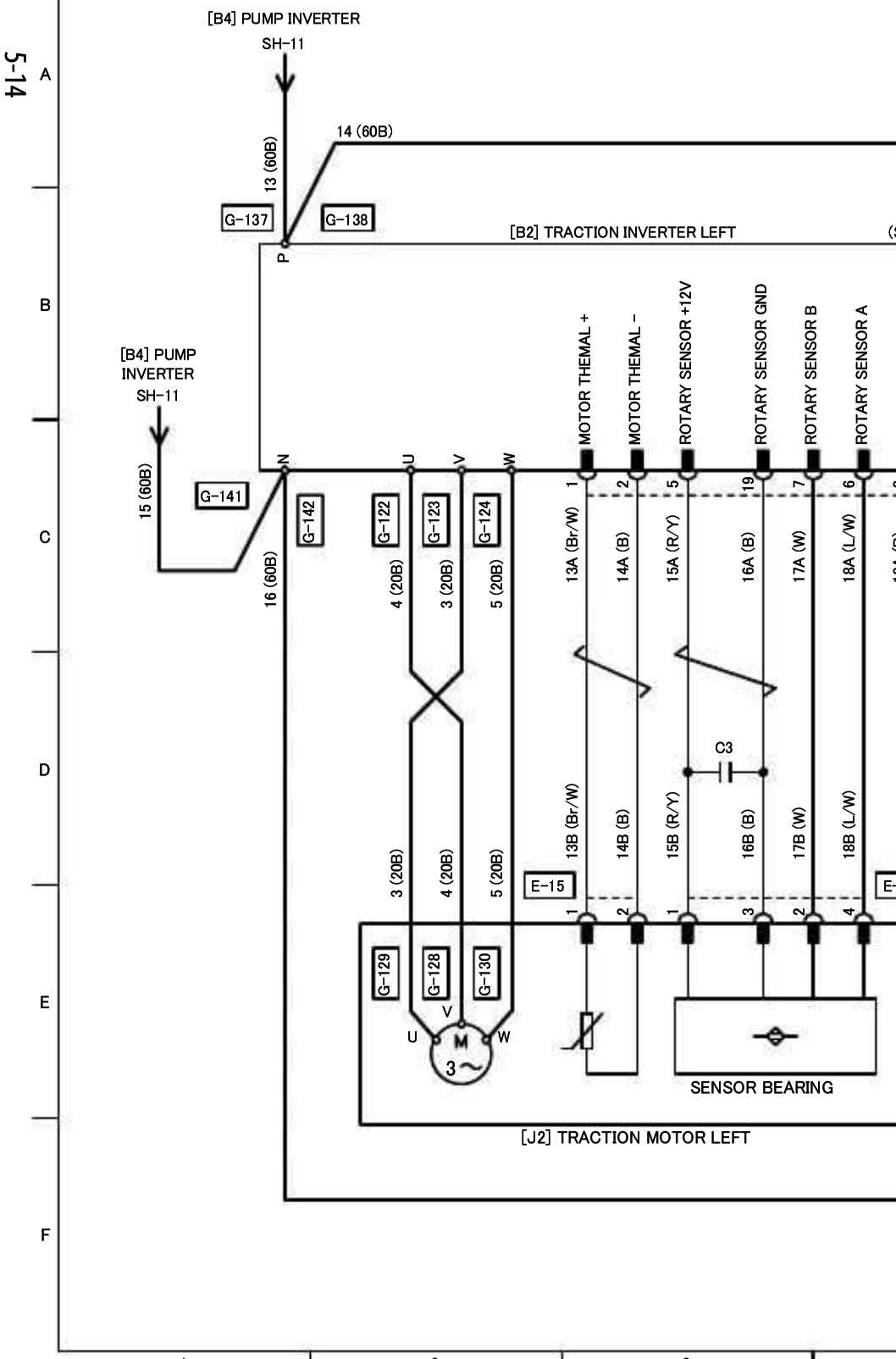
36A (Br/B) MOTOR THERMAL +
37A (B) MOTOR THERMAL –
38A (B) MODE 2
38B (B) GND

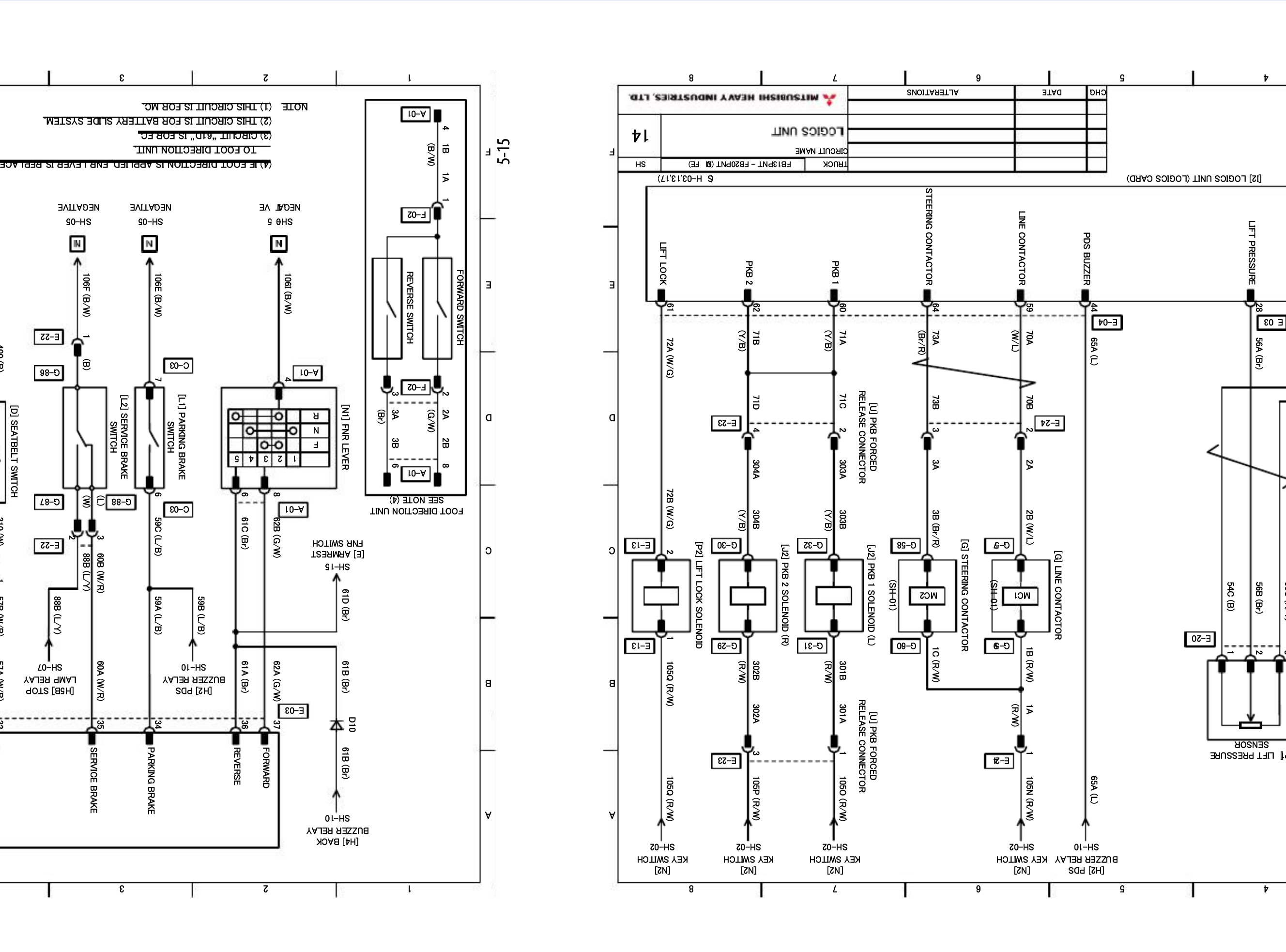
[B4] PUMP INVERTER (SH-03,17)

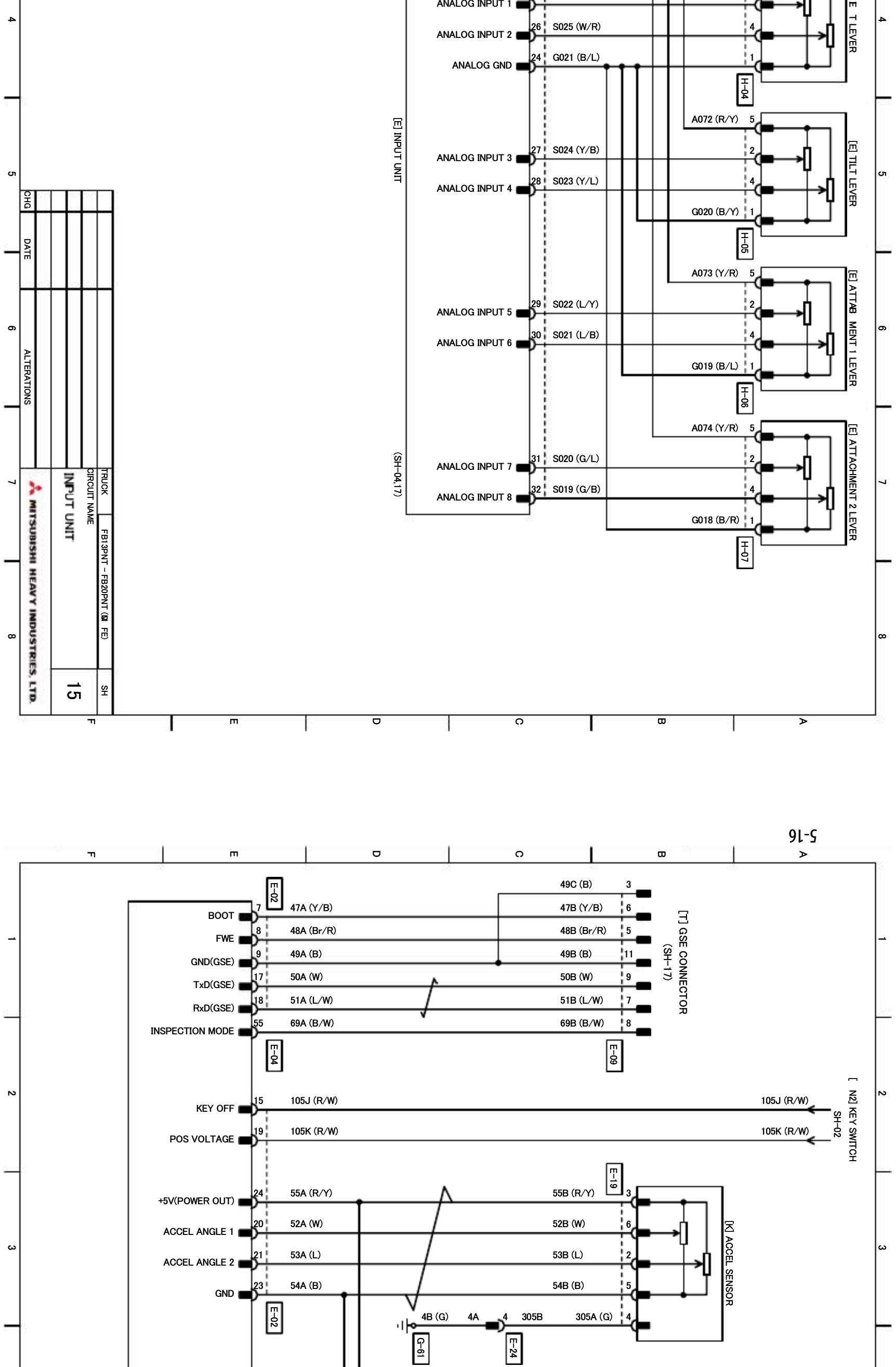
G-135 12 (60B) SH-01 FUSE F1

G-136 13 (60B)


[I2] LOGICS UNIT (LOGICS CARD)
(SH-03,14,17)
SEATBELT
SEAT
BRAKE FLUID
GND
ATT1
SF
TILT
LIFT2
LIFT1
BATT. SLD SW
PS LIFE SGNAL
E-04
C-02
E-36
G-39
G-90
G-89
C-01
[D] SEAT SWITCH
[O] BRAKE FLUID SENSOR
G-144
G-106
G 104
G-102
G-100
G-98
[P3F] ATTACHMENT 1 SWITCH
[P3E] SF SWITCH
[P3D] TILT SWITCH
[P3B] LIFT SWITCH 2
[P3C] LIFT SWITCH 1
[V] BATTERY SLIDE INTERLOCK SWITCH
SEE NOTE (2)
G-92
G-91
G-145
G-107
G 105
G-103
G-101
G-99
G-39
SH-11
[B3] EPS CONTROLLER
SEE NOTE (1)
TRUCK
FB13PNT - FB20PNT (M FE)
SH
CIRCUIT NAME
LOGICS UNIT
13
CHG
DATE
ALTERATIONS
MITSUBISHI HEAVY INDUSTRIES, LTD.


[B4] PUMP INVERTER
SH-11
13 (60B)
14 (60B)
G-137
G-138
[B2] TRACTION INVERTER LEFT
[B4] PUMP INVERTER
SH-11
15 (60B)
G-141
G-142
16 (60B)
G-122
G-123
G-124
4 (20B)
3 (20B)
5 (20B)
MOTOR THEMAL +
MOTOR THEMAL -
ROTARY SENSOR +12V
ROTARY SENSOR GND
ROTARY SENSOR B
ROTARY SENSOR A
13A (Br/W)
14A (B)
15A (R/Y)
16A (B)
17A (W)
18A (L/W)
C3
E-15
13B (Br/W)
14B (B)
15B (R/Y)
16B (B)
17B (W)
18B (L/W)
G-129
G-128
G-130
U
V
W
M
3~
SENSOR BEARING
[J2] TRACTION MOTOR LEFT


[12] LOGICS UNIT (LOGICS CARD)
LOGICS UNIT
14
MITSUBISHI HEAVY INDUSTRIES, LTD.
LIFT PRESSURE
PDS BUZZER
LINE CONTACTOR
STEERING CONTACTOR
PKB 1
PKB 2
LIFT LOCK
[U] PKB FORCED RELEASE CONNECTOR
[G] LINE CONTACTOR
[G] STEERING CONTACTOR
[J2] PKB 1 SOLENOID (L)
[J2] PKB 2 SOLENOID (R)
[P2] LIFT LOCK SOLENOID
[H2] PDS BUZZER RELAY
KEY SWITCH
[N2]
[H4] LIFT PRESSURE SENSOR
FOOT DIRECTION UNIT
SEE NOTE (4)
[E] ARMREST FNR SWITCH
[N1] FNR LEVER
[L1] PARKING BRAKE SWITCH
[L2] SERVICE BRAKE SWITCH
[D] SEATBELT SWITCH
[H4] BACK BUZZER RELAY
[H2] PDS BUZZER RELAY
[H5B] STOP LAMP RELAY
FORWARD SWITCH
REVERSE SWITCH
FORWARD
REVERSE
PARKING BRAKE
SERVICE BRAKE
NEGATIVE
NOTE (1) THIS CIRCUIT IS FOR MC.
(2) THIS CIRCUIT IS FOR BATTERY SLIDE SYSTEM.
(3) CIRCUIT "61D" IS FOR EC.
(4) IF FOOT DIRECTION IS APPLIED, FNR LEVER IS REPLACE TO FOOT DIRECTION UNIT.



CHG		TRUCK	FB13PNT - FB20PNT (Ⅲ FE)
DATE		CIRCUIT NAME	SH
ALTERATIONS		INPUT UNIT	15
		MITSUBISHI HEAVY INDUSTRIES, LTD.	

NOTE (1) THIS CIRCUIT IS FOR EC.

[M] OUTPUT UNIT

6A (G/R) 26 SOL PWM 3-/4-

[P2] ATTACHMENT 1A SOLENOID
9B (G/W) 2 E-30 1 7B (Br/R) 7A (Br/R) 27 SOL PWM 5+

[P2] ATTACHMENT 1B SOLENOID
9C (G/W) 2 E-34 1 8B (Br/W) 8A (Br/W) 28 SOL PWM 6+

9A (G/W) 29 SOL PWM 5-/6-

[P2] ATTACHMENT 2A SOLENOID
12B (W/G) 2 E-31 1 10B (Br/B) 10A (Br/B) 30 SOL PWM 7+

[P2] ATTACHMENT 2B SOLENOID
12C (W/G) 2 E-35 1 11B (L/W) 11A (L/W) 31 SOL PWM 8+

12A (W/G) 32 SOL PWM 7-/8-

(SH-04,17)

CHG	DATE	ALTERATIONS	TRUCK	FB13PNT - FB20PNT (EX FE)	SH
			CIRCUIT NAME	OUTPUT UNIT	16

MITSUBISHI HEAVY INDUSTRIES, LTD.

A091 (L/W) 3 61D (Br) H-02 [12] LCG ICS SH-03

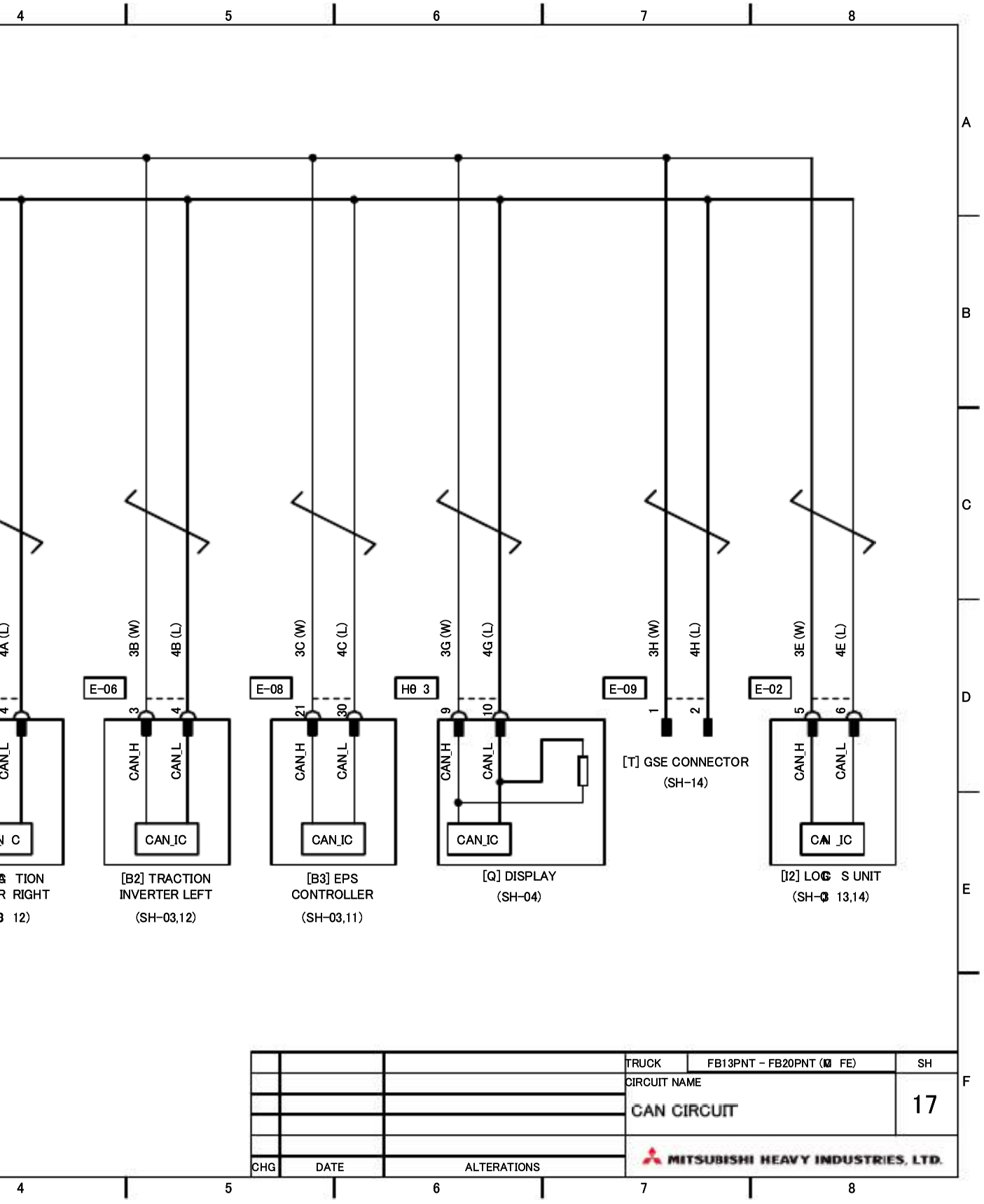
[E] ARMREST
FNR SWITCH
R N F G F N R
B-01 E-12

106B (B/W) 6 H-02 G028 (B) 3 B-01 N NEGATIVE SH-05

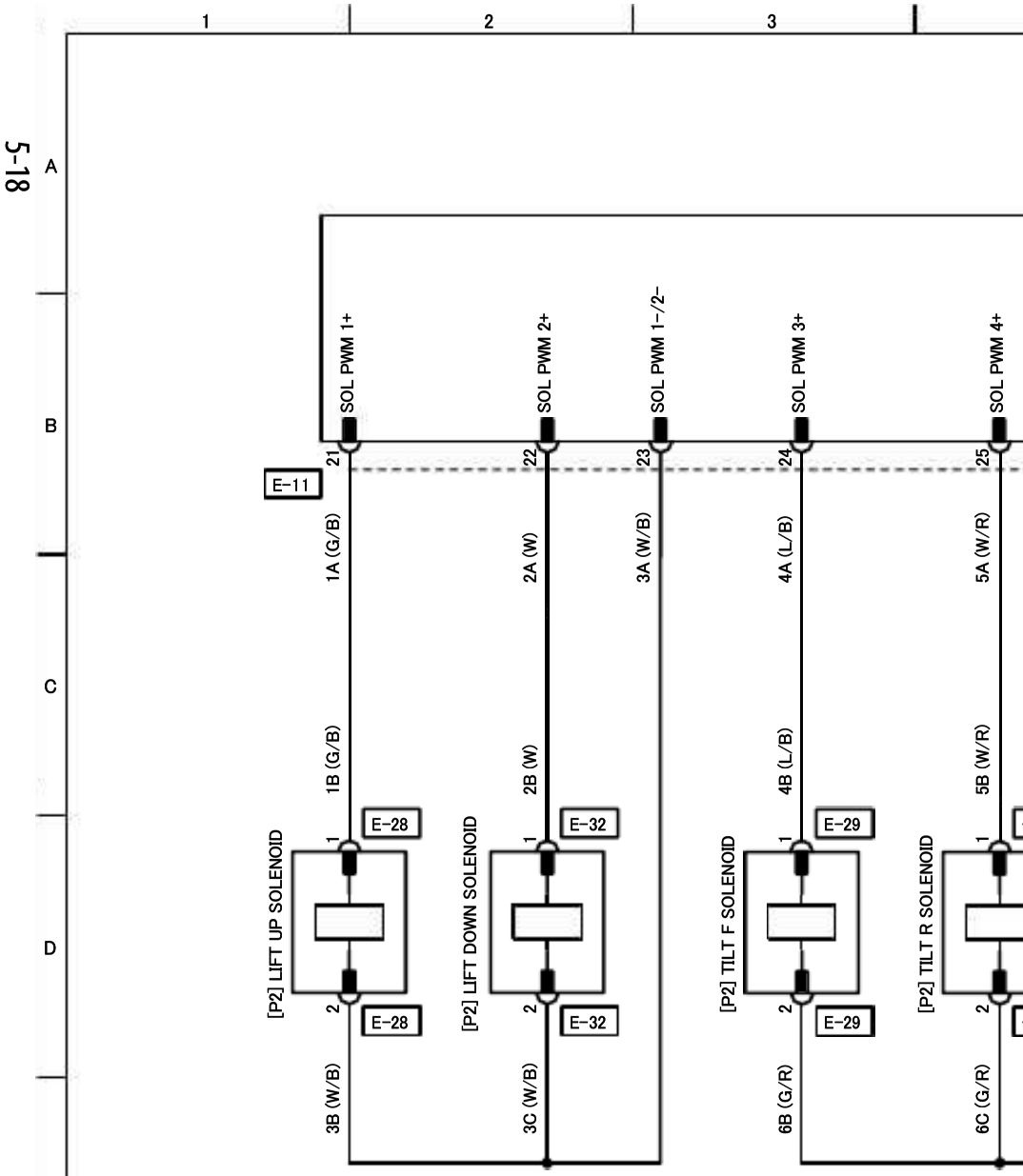
2 A088 (G/R) 18 DIGITAL INPUT 4
1 A089 (G/W) 19 DIGITAL INPUT 5
4 A090 (L/W) 20 DIGITAL INPUT 6

G-52 [E] ALS SWITCH G-54
A079 (Y/G) 21 DIGITAL INPUT 7
G025 (B/W) 14 SWITCH GND

E-12
ANALOG 5V 23 A084 (L/R) 5
25 S026 (W/Y) 2 [E]



			TRUCK	FB13PNT - FB20PNT (M FE)	SH
			CIRCUIT NAME	CAN CIRCUIT	17
CHG	DATE	ALTERATIONS	MITSUBISHI HEAVY INDUSTRIES, LTD.		



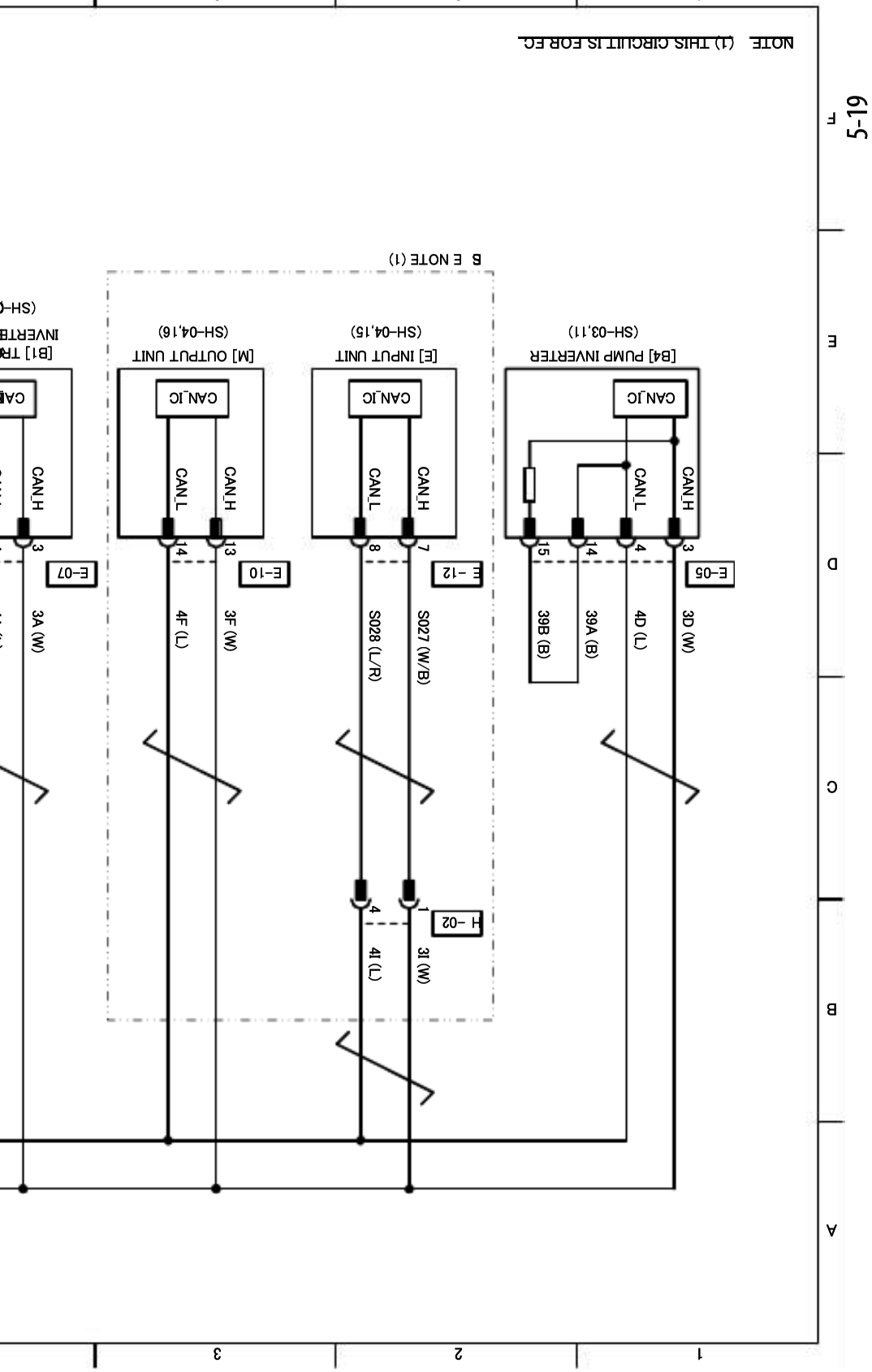
NOTE (1) THIS CIRCUIT IS FOR FC.

CHG	DATE	ALTERATIONS

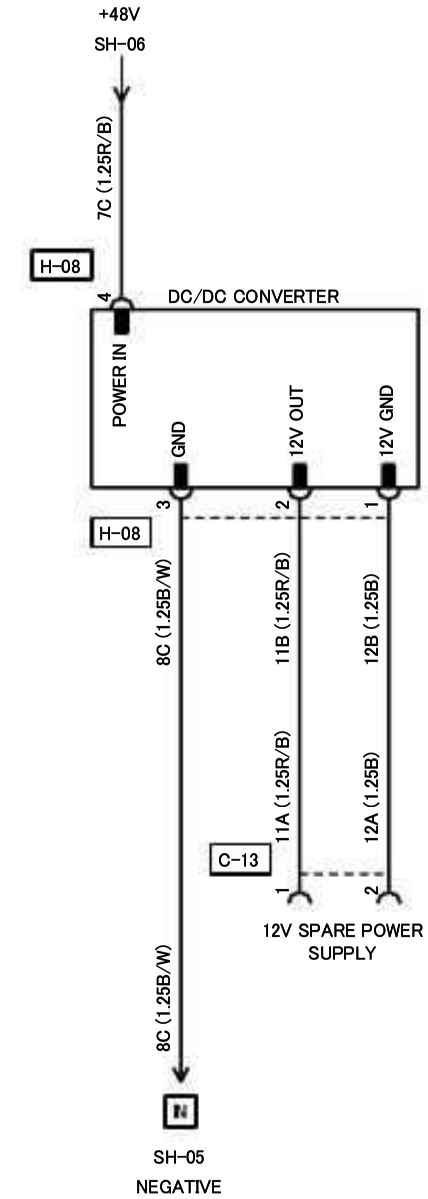
MITSUBISHI HEAVY INDUSTRIES, LTD.

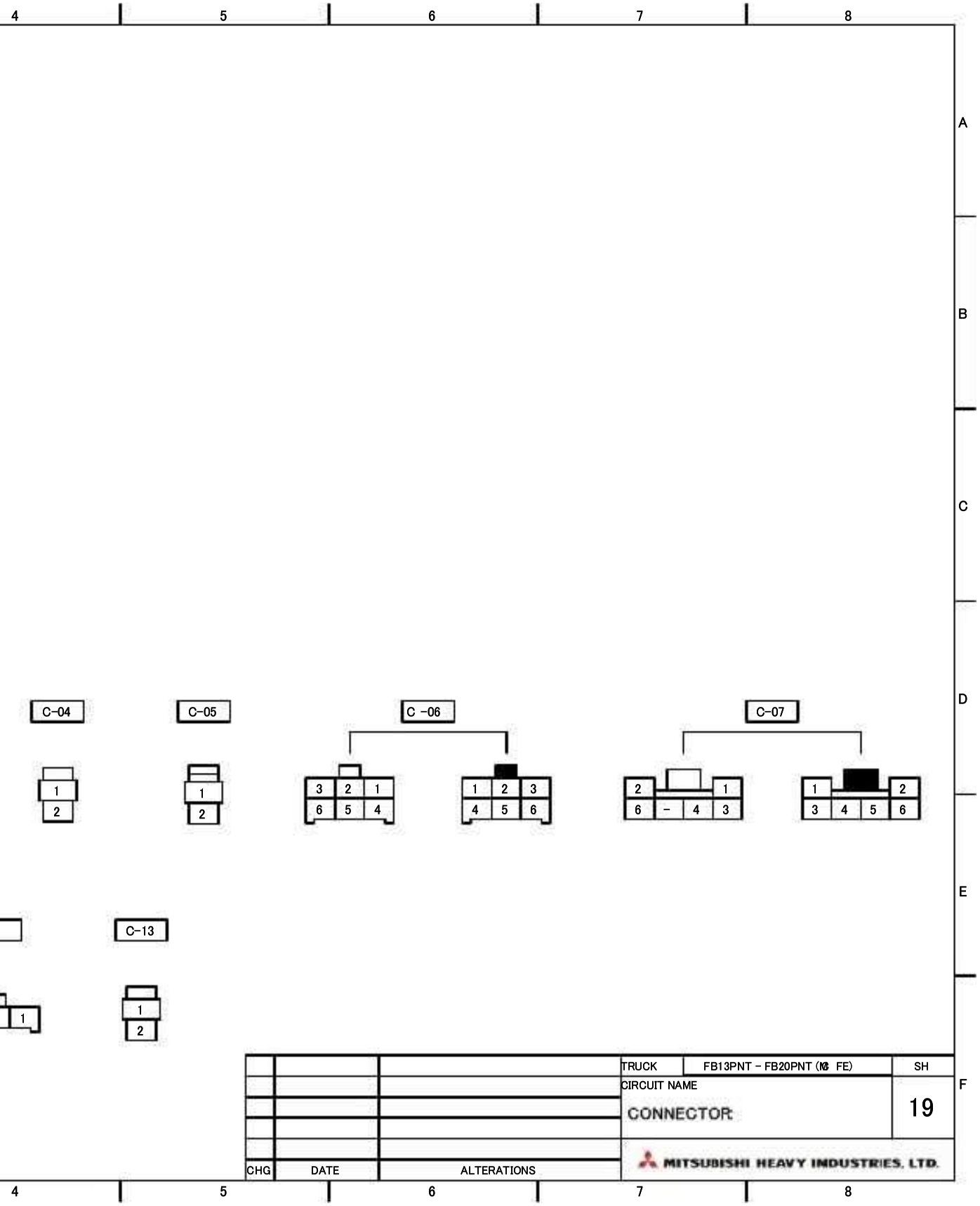
TRUCK	FB13PNT – FB20PNT (Ø FE)	SH
CIRCUIT NAME	SPARE POWER SUPPLY	18

NOTE (1) THIS CIRCUIT IS FOR EC.

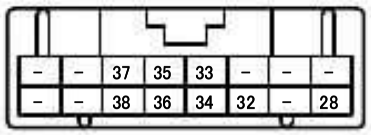


5-19

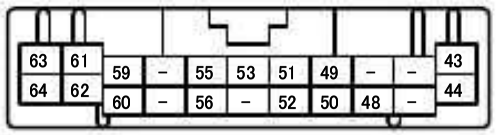

+48V
SH-06
7C (1.25R/B)
H-08
4
DC/DC CONVERTER
POWER IN
GND
12V OUT
12V GND
3
2
1
H-08
8C (1.25B/W)
11B (1.25R/B)
12B (1.25B)
C-13
11A (1.25R/B)
12A (1.25B)
1
2
12V SPARE POWER SUPPLY
8C (1.25B/W)
N
SH-05
NEGATIVE


C-04
C-05
C -06
C-07
C-13
TRUCK
FB13PNT - FB20PNT (M8 FE)
SH
CIRCUIT NAME
CONNECTOR
19
CHG
DATE
ALTERATIONS
MITSUBISHI HEAVY INDUSTRIES, LTD.

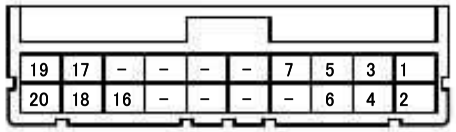
E-03



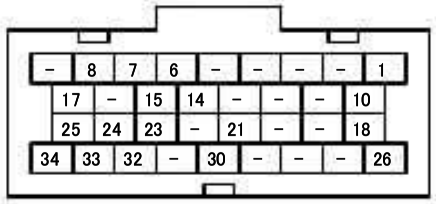
E-04



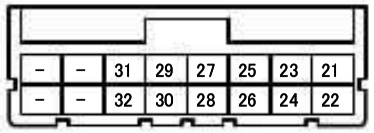
E-07



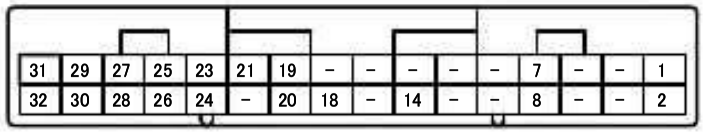
E-08



E-11



E-12



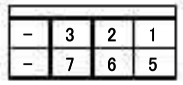
E-18

			TRUCK	FB13PNT – FB20PNT (MC FE)	SH
			CIRCUIT NAME		
			CONNECTOR		20
			MITSUBISHI HEAVY INDUSTRIES, LTD.		
CHG	DATE	ALTERATIONS			

GROUP A

A-01

A-02



GROUP B

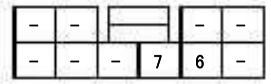
B-01

GROUP C

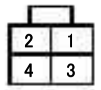
C-01

C -02

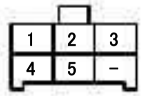
C-03



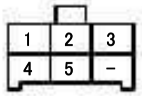
C-08



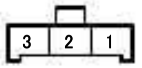
C-09



C-10



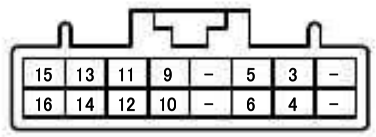
C-11



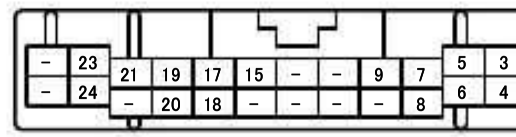
C-2

GROUP E

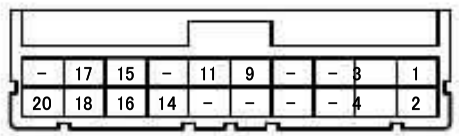
E-01



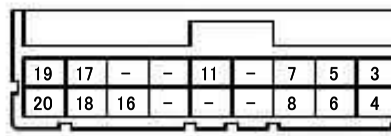
E-02



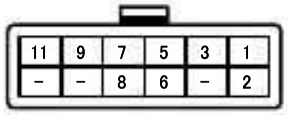
E-05



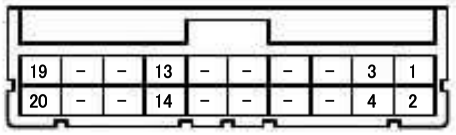
E-06



E-09



E-10



E-13

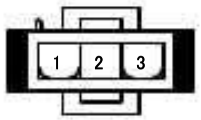
E-14

E-15

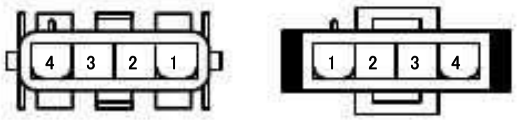
E-16

E-17

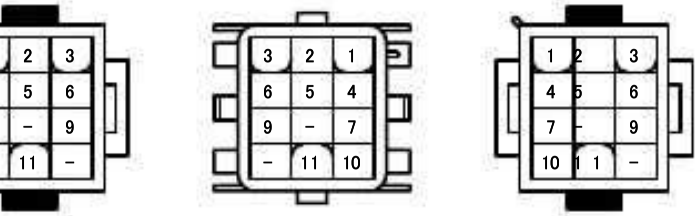
E-22



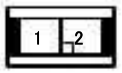
E-23



E-26



E-27

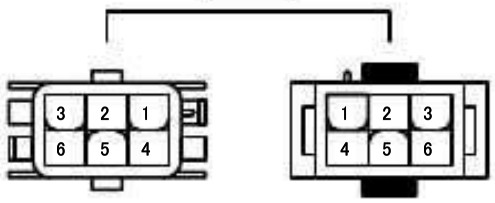


E-28

E-34

E-35

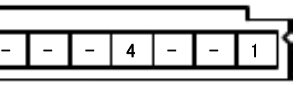
E-36



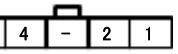
			TRUCK	FB13PNT – FB20PNT (MC FE)
			CIRCUIT NAME	
			CONNECTOR	21
			MITSUBISHI HEAVY INDUSTRIES, LTD.	
CHG	DATE	ALTERATIONS		

GROUP E

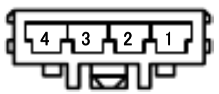
H-03



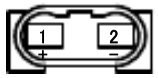
H-07



H-08

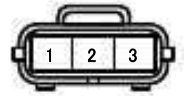


H-09

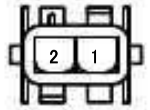


E-19

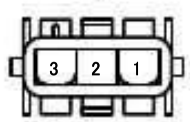
E-20



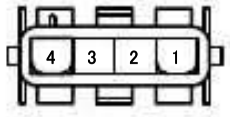
E-21

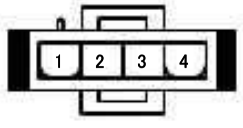


E

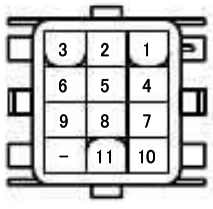


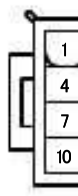
E-24





E-25





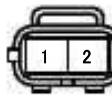
E-29

E-30

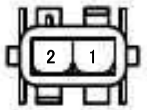
E-31

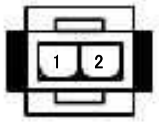
E-32

E-33



E-37





E-38

CHG	DATE	ALTERATIONS	TRUCK	FB13PNT – FB20PNT (MC FE)	SH
			CIRCUIT NAME		
			CONNECTOR		22

MITSUBISHI HEAVY INDUSTRIES, LTD.

G-33 to 41

G-43 to 46

G-47 8

G-49

G-61

G-62 to 64

G-65 67

G-68 to 83

G-84

G -85

G-98 to 107

G-108,109

G-110,111

G-112

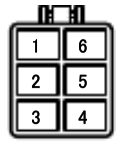
G -113

G-134 to 143

G-144,145

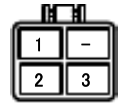
GROUP F

F-01



DTM06-6S
部番未定

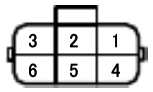
F-02



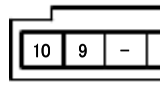
DT06-4S
97C42-04601

GROUP H

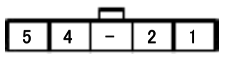
H-01



H-02



H-04

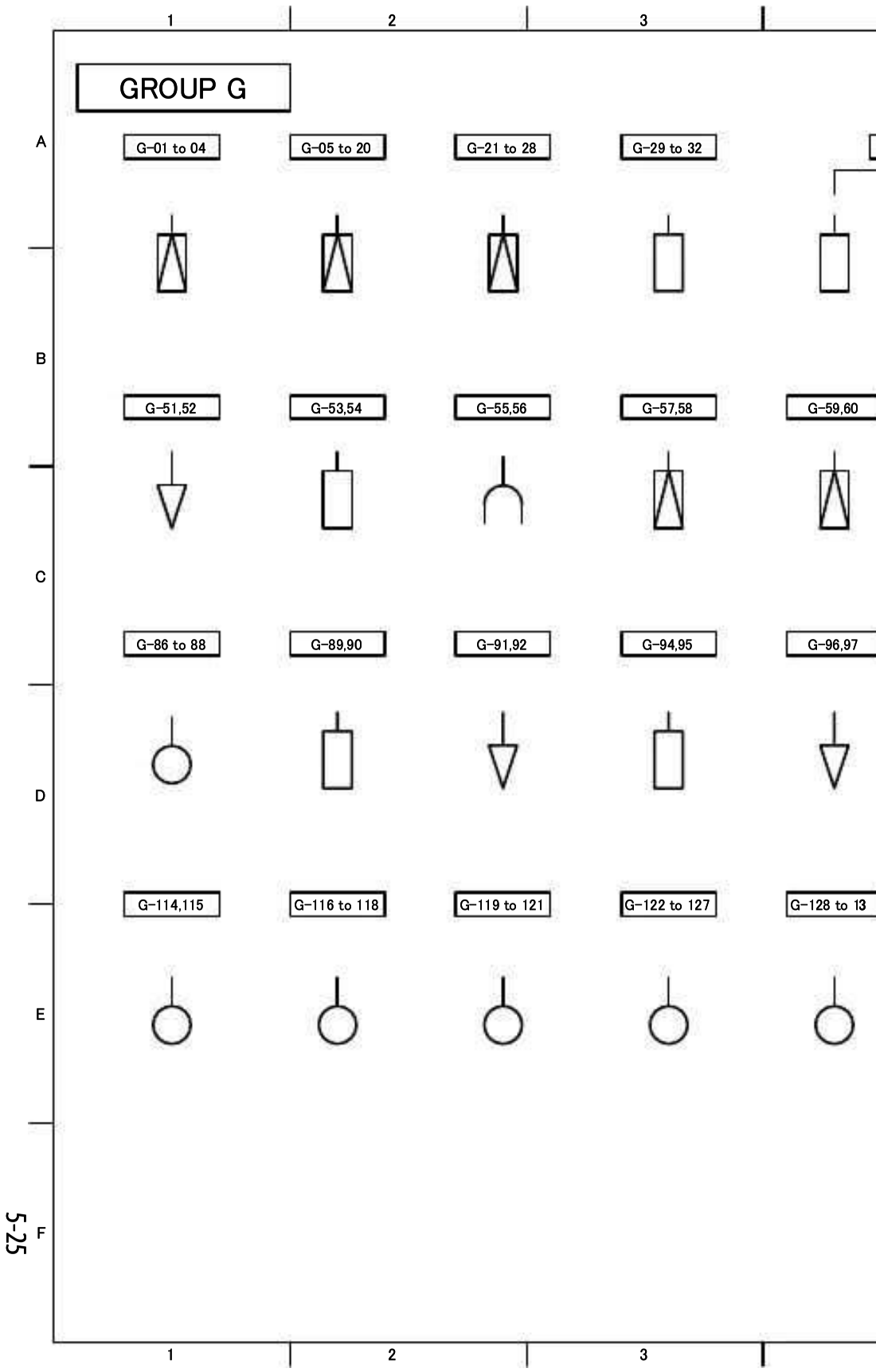


H-05

H-06

CHG	DATE	ALTERATIONS	TRUCK	FB13PNT – FB20PNT (MC FE)	SH
			CIRCUIT NAME		
			CONNECTOR		23

MITSUBISHI HEAVY INDUSTRIES, LTD.


1
2
3
GROUP G
A
B
C
D
E
F
G-01 to 04
G-05 to 20
G-21 to 28
G-29 to 32
G-51,52
G-53,54
G-55,56
G-57,58
G-59,60
G-86 to 88
G-89,90
G-91,92
G-94,95
G-96,97
G-114,115
G-116 to 118
G-119 to 121
G-122 to 127
G-128 to 13

IN Forklift Trucks

99759-5M300

SUBISHI
LIFT TRUCKS

MIT
FORK