SMCS - 7490 i08110202

Telehandler

TH306D (S/N: TD21-174)

TH314D (S/N: MYF1-181; MYT1-507)

TH3510D (S/N: TH21-297; TH31-159)

TH357D (S/N: TD61-737; TD71-169)

TH408D (S/N: TH41-178; TH91-962)

TH417D (S/N: MKY1-312; MLZ1-507)

Revision History:

Revision	Summary of Changes
1	Changed wording in System Overview section.

Table 1

Introduction

This Special Instruction provides information for troubleshooting the Load Stability Indicating System (LSI). These troubleshooting guidelines are applicable to the machines listed above. Do not perform any procedure in this Special Instruction until you have read the information and you understand the information.

Note: For LSI calibration and/or LSI sensor installation procedures, refer to the service manual specific to your machine.

Safety Section

WARNING

Do not operate or work on this product unless you have read and understood the instruction and warnings in the relevant Operation and Maintenance Manuals and relevant service literature. Failure to follow the instructions or heed the warnings could result in injury or death. Proper care is your responsibility.

WARNING

Failure to follow all safety guidelines prescribed in this document and by governing authorities and regulatory agencies may result in severe injury or death of personnel or machine damage.

WARNING

Personal injury or death can result from improper maintenance procedures. To avoid injury or death, follow the procedures exactly as stated below.

Definition of Load Stability Indication System

System Overview

The vehicle control system utilizes the LSI system in various different ways to help maintain vehicle forward stability. The system also utilizes other sensors such boom angle sensor and/or operational conditions of the vehicle to determine appropriate LSI system behavior:

- Acceleration, deceleration, and overall speeds of primary boom functions are manipulated by the vehicle control system to help maintain vehicle forward stability.

- Depending on vehicle configuration, the vehicle control system will indicate forward stability - but not prevent some functions - if the boom is retracted.
- Depending on vehicle market, the vehicle control system will indicate forward stability - but not prevent some functions - if the vehicle is in motion.

The LSI system provided Cat D-series vehicles for EU and Australia markets has a system block diagram as depicted below. The system is used to indicate forward stability of the vehicle.

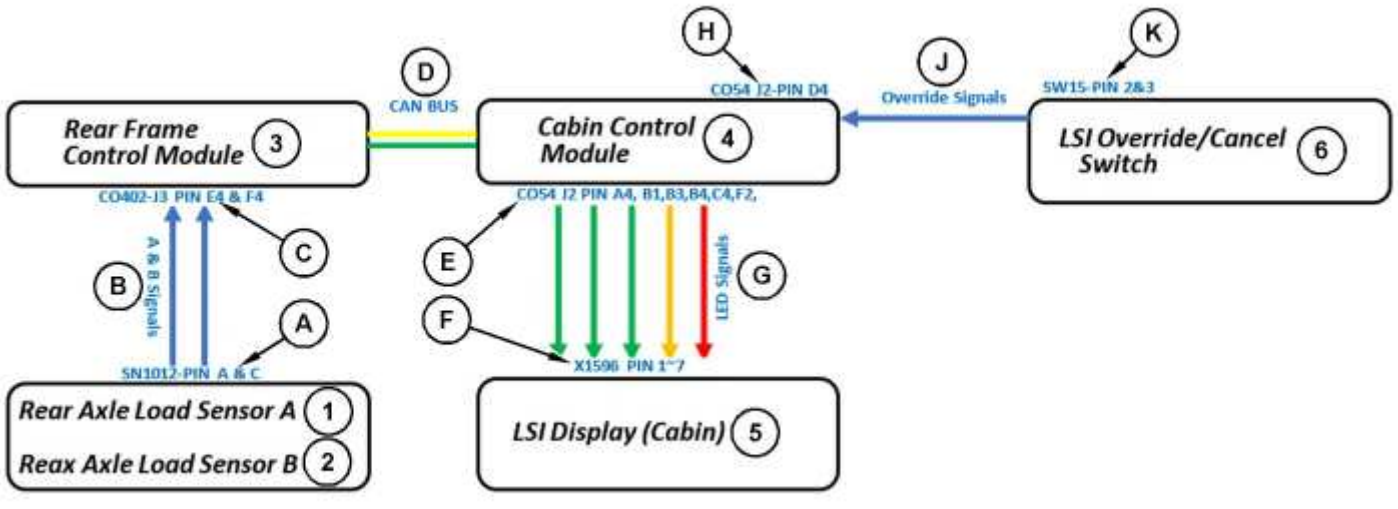

Illustration 1 g06539430

(1) Rear Axle Load Sensor A
(2) Rear Axle Load Sensor B
(3) Rear Frame Control Module
(4) Cabin Control Module
(5) LSI Display (Cabin)
(6) LSI Override/Cancel Switch
(A) SN1012-Pin A and C
(B) A and B Signals
(C) CO402–J3 Pin E4 and F4
(D) CAN BUS
(E) CO54 J2 Pin A4, B1, B3, B4, C4, and F2
(F) X1596 Pin 1 through 7
(G) LED Signals
(H) CO54 J2-Pin D4
(J) Override Signals
(K) SW15–Pin 2 and 3

LSI Display X1596		
Connector Position	Description	To
1	LSI Power	Cabin Module J2-K1
2	LSI GREEN 1	Cabin Module J3-A4
3	LSI GREEN 2	Cabin Module J3-B1
4	LSI GREEN 3	Cabin Module J3-B3
5	LSI GREEN 4	Cabin Module J3-B4
6	LSI ORANGE	Cabin Module J3-C4
7	LSI RED	Cabin Module J3-F2
8	(Not used)	-
9	(Not used)	-
10	(Not used)	-
LSI Cancel Switch SW15		
Connector Position	Description	To
1	Switch IGN	Power Distribution Board XF-9-2
2	LSI Cancel Switch	Cabin Module J2-D4
LSI Sensor SN1012		
Connector Position	Description	To
A	LSI Signal 1	Rear Frame Module J3-E4
B	LSI Power	Rear Frame Module J2-K1
C	LSI Signal 2	Rear Frame Module J3-F4

Table 2

System Operation

The rear axle LSI load sensor provides two input load signals to the vehicle rear frame control module. These signals are an analog current-based input to the rear frame control module.

These two signals provide redundant vehicle load data to the vehicle control system that is transmitted through CAN bus between vehicle control modules.

After the vehicle control system processes the data, the vehicle cab control module sends discrete outputs to the cab LSI display. The outputs to the display light the appropriate LED's to indicate vehicle forward stability.

The vehicle control system also prevents certain functions of the vehicle if critical forward stability limits have been reached. Reaching the critical forward stability limits above 99% forward load stability corresponds to the illumination of the red LED on the LSI display. Prevented functions above 99% forward load stability can be operated, if the restriction is overridden by the operator. The restrictions can be overridden by activating the LSI Override/Cancel switch in the cab.

System Parameters in the Vehicle Control System Related to LSI

Connect the analyzer tool to the vehicle, no access code is required. Using the analyzer, navigate to "Diagnostics" then "Load Stability".

1. Load stability
    a. The calculated load stability of the vehicle from 0 to 100 percent is displayed
    b. 0% indicates a stable condition
    c. 100% indicates an unstable condition
2. Load stability status: **"UNSTABLE"**
    a. Indicates that LSI function cutout is active
    b. Greater than 99% of load stability limit
    c. Red LED on LSI display is illuminated
3. Load stability status: **"STABLE"**
    a. All vehicle functions dependent on the LSI system are available
    b. Less than 99% of load stability limit
    c. Amber, green, or no LED's on LSI display are illuminated
4. LSI cancel switch: **"OPEN"**
    a. LSI cancel switch on cab dash is not depressed/activated
    b. No request to override LSI function cutout is sent to the control system
5. LSI cancel switch: **"CLOSED"**
    a. LSI cancel switch on cab dash is depressed/activated
    b. Request to override LSI function cutout is sent to the control system
6. Load Cell 1 (A) Raw Value
    a. A filtered value for the LSI sensor current on the rear axle, signal 1, is displayed in milliamperes
7. Load Cell 2 (B) Raw Value
    a. A filtered value for the LSI sensor current on the rear axle, signal 2, is displayed in milliamperes

Note: Accuracy of these values can only be certain **after** a successful calibration of the LSI system has occurred. To obtain this value without a successful LSI system calibration, refer to troubleshooting instructions below.

Problem Solving

Use the below procedures if one of the following diagnostic codes relating to the LSI is present:

- 33495: Rear Frame Control Module (RFCM) analog ground short to battery
- 8514: LSI not calibrated
- 8516: LSI load cell A out of range
- 8517: LSI load cell B out of range
- 8519: LSI out of calibration
- 8520: LSI load cell A and B disagreement
- 99283: RFCM analog enable output not on

Before troubleshooting the LSI system, perform a visual inspection of the machine and the LSI installation. Specific checks and tests may be necessary to identify the root cause of any subsequent issues.

23116: LSI Override Permanently Selected

Description: The LSI override switch is closed/selected at system power-up or the LSI override switch is closed for more than 30 seconds.

Note: The control system only allows activation for up to 30 seconds without resetting to prevent abuse.

Troubleshoot:

- Check wiring for a short to battery
- Check switch for proper function
- Ensure that momentary function of switch is not defeated
- Release switch momentarily and then reactivate if necessary

33495: RFCM Analog Ground Short to Battery

Description: Boom angle sensor is +99°, lift speed de-rated, load stability assumed to be over 100%.

Troubleshooting:

- Check wiring at rear frame control module
- Replace rear frame module if necessary

8514: LSI not Calibrated

Description: Load stability has not been calibrated or calibration factors are out of range.

Troubleshooting: Perform LSI calibration procedure as outlined in service manual.

8516: LSI Load Cell A Out of Range

Description: LSI sensor signal 1 reading out of range or short to battery.

Troubleshooting: If fault 8514 is **not** indicated, observe both A and B load cell signals in analyzer diagnostics under varying rear axle load.

If fault 8514 is indicated, the value for load cell A must be obtained by using a digital multimeter. Insert the current measuring device, set to DC mA measurement, within the wiring between either pin A or C of the axle LSI load sensor connector and the corresponding rear frame harness. Which pin depends on the vehicle model.

Note: All other connections between the sensor and rear frame harness must be maintained during this measurement.

- Measurement range of LSI sensor is 0 to 65 milliamperes
- Typical sensor output range when applied to a vehicle is between 30 and 60 milliamperes, but is not bound by these values.
- Span of sensor from the 0% stability calibration point to the 100% stability calibration point will be variable. The sensor must be within the range of 2 to 18 milliamperes.

If only load cell A is out of range (fault 8517 is not indicated, 8520 potentially indicated) and load cell B is responding:

- Check wiring between LSI sensor and rear frame module.
- Replace LSI sensor

If A or B load cell signals in analyzer diagnostics do not respond to varying rear axle load (fault 8517 also indicated, but not 8520)

- Check wiring between LSI sensor and rear frame module
- Check rear axle for damage, replace rear axle if necessary
- Check LSI sensor for potential mechanical contact/damage, replace LSI sensor
- LSI load sensor is no longer adhered to the rear axle, replace LSI sensor

If both load cells A and B respond to varying rear axle load, but become out of range during operation (faults 8516 and 8517 indicated, but not 8520):

- LSI sensor incorrectly installed
- Position/attitude/rear axle loading of vehicle during LSI sensor is critical to assuring load cell A and B remain within range during vehicle operation
- Ensure that vehicle is level both longitudinally and laterally when positioning vehicle for LSI sensor installation according to published instructions
- Ensure that vehicle does not have additional weight added as compared to factory delivered configuration
- Ensure that vehicle does not have any attachment connected to the boom
- Replace LSI sensor

8517: LSI Load Cell B Out of Range

Description: If fault 8514 is not indicated, observe both A and B load cell signals in analyzer diagnostics under varying rear axle loads.

Troubleshooting: If fault 8514 is indicated, the value for load cell A must be obtained using a digital multimeter. Insert the current measuring device, set to DC mA measurement, within the wiring between either pin A or C of the axle LSI load sensor connector and the corresponding rear frame harness. Which pin depends on the vehicle model.

Note: All other connections between the sensor and rear frame harness must be maintained during this measurement.

Expected Results:

- Measurement range of LSI sensor is 0 to 65 milliamperes
- Typical sensor output range when applied to a vehicle is between 30 to 60 milliamperes, but is not bound by these values
- Span of sensor from the 0% stability calibration point to the 100% stability calibration point will be variable. The sensor must be within the range of 2 to 18 milliamperes

Repair: If only load cell B is out of range (fault 8516 is not indicated, 8520 potentially indicated) and load cell A is responding:

- Check wiring between LSI sensor and rear frame module
- Replace LSI sensor

If both A and B load cell signals in analyzer diagnostics, do not respond to varying rear axle loads (fault 8516 also indicated, but not 8520)

- LSI sensor incorrectly installed, replace LSI sensor
- Position/attitude/rear axle loading of vehicle during LSI sensor is critical to ensuring that load cell A and B remain within range during vehicle operation

- Ensure that vehicle is level both longitudinally and laterally when positioning vehicle for LSI sensor installation according to published instructions
- Assure vehicle does not have additional weight added as compared to factory delivered configuration
- Assure vehicle does not have any attachment connected to the boom

8519: LSI Out of Calibration

Description: LSI verification test failed. During initial calibration of the LSI system, LSI load cell A and B signals are recorded in the control system at the most stable position of the calibration sequence (boom fully retracted and raised). When an LSI verification test is later initiated with the vehicle placed in the most stable position, if either load cell A or B is not within ±0.6 of those previously stored values, fault 8519 will be indicated.

Troubleshooting: Check placement and configuration of vehicle for required most stable position for calibration. Ensure that vehicle is level longitudinally and laterally. Ensure that any vehicle dynamics due to positioning of the boom subside before initializing the LSI verification test.

Repair: Repeat the LSI calibration procedure.

8520: LSI Load Cell A and B Disagreement

Description: Load cell A and B signals differ by more than 25% for more than 3 seconds. Dynamic operations of the vehicle that cause extreme momentary torsion in the rear axle structure can cause momentary disagreement between the two load cell signals.

- Operation of the vehicle should not exceed 25% disagreement between the two signals for more than 3 seconds.
- Check wiring between LSI sensor and rear frame module
- Check rear axle for damage
- Replace rear axle if necessary
- Check LSI sensor for potential mechanical contact/damage
- Replace LSI sensor
- See also faults 8516 and 8517

99283: RFCM Analog Enable Output Not On

- Replace rear frame module

DSN Support

In case the above detailed troubleshooting does not lead to a solution or repair for a LSI-related problem, submit a support request to the DSN system, to receive additional support from the product group.

Complete the form below and submit as an attachment with the DSN request.

LSI Data Record Sheet			
Machine Details			
Model		Ambient Temperature	
Serial Number		Failure Report Date	
Operating Hours		LSI Sensor S/N	
Software Details (Menu: Diagnostics -> Versions)			
Cabin Module Software Version		Rear frame module software version	
Cabin module constant data version		Rear frame module hardware version	
Cabin module hardware version			
DTC codes (Menu: Help)			
Active Code		In Active/Logged Codes	
"		"	
"		"	
"		"	
LSI Sensor Data (Menu: Diagnostics -> Load Stability			
Note: position the machine in the 0% stability position. (Boom Fully Raised)			
Load Stability Status	STABLE / UNSTABLE		
LSI Cancel Switch Status	OPEN / CLOSED		
Load Stability	%		
Load Cell 1 (A) Raw Value - Analyzer	mA		
Load Cell 1 (A) Raw Value – AMP Meter*	mA		
Load Cell 2 (B) Raw Value - Analyzer	mA		
Load Cell 2 (B) Raw Value – AMP Meter*	mA		
*Note: Insert a digital multimeter (current measuring device set to DC mA measurement) within the wiring between either pin A or C of the axle LSI load sensor connector and the corresponding rear frame harness (which pin depending on the vehicle model) – note all other connections between the sensor and rear frame harness must be maintained during this measurement			

Illustration 2 g06539530

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