Link-Belt
CONSTRUCTION EQUIPMENT

BOOK1246091112BELCAN

PSR Professional Service & Repair Inc.

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P.O. Box 6506
Columbus, GA
31917-6506

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1. PULSE System Overview[1]

This system is an Operator's Aid – NOT a Safety device!

The Pulse system serves several purposes:

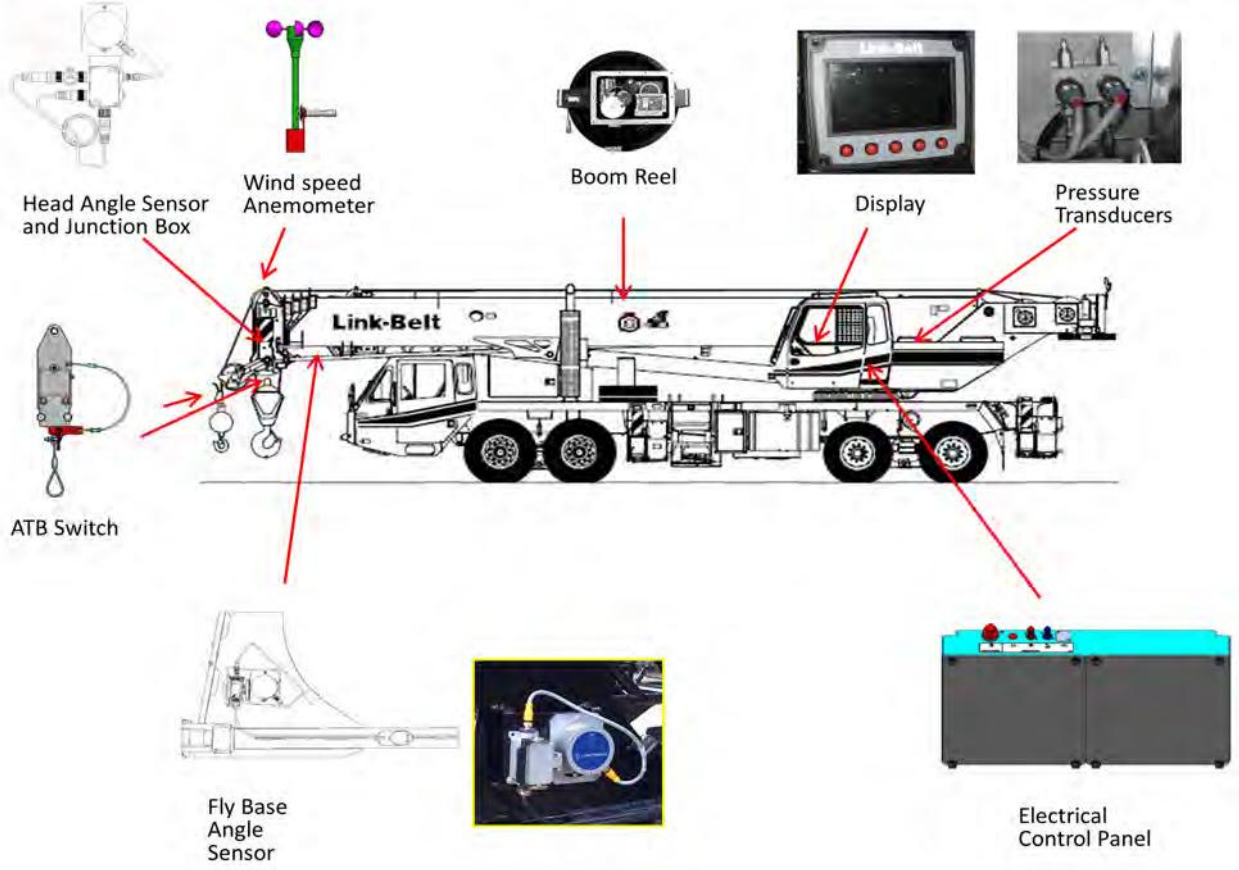
1) Rated Capacity Limiter (RCL)
    a. Monitors crane functions by means of high accuracy sensors and continually compares the load with a copy of the crane capacity chart which is stored in computer memory. If an overload is approached, the system warns the operator by means of audible and visual alarms and is configured to cause function limitation.
    b. Integrated into the Rated Capacity Limiter System is an anti-two block (ATB) warning system. An anti-two block warning system is an electromechanical system designed to alert the operator before the hook block, hook ball, or load contacts the head machinery of the main boom, auxiliary lifting sheave, or fly.
    c. Operator Settable Alarms when properly set provide a method of obstacle avoidance.
2) Extend Mode Controller
    a. Controls the extend modes of pin and latching style booms.
    b. Controls the extend modes for conventional style boom.
3) Provides various diagnostic screens for the RCL and Extend Mode Controller to aid in Troubleshooting.
4) Provides data-logging capabilities.

[1] If problems(s) cannot be solved with the Troubleshooting procedures given in this Troubleshooting

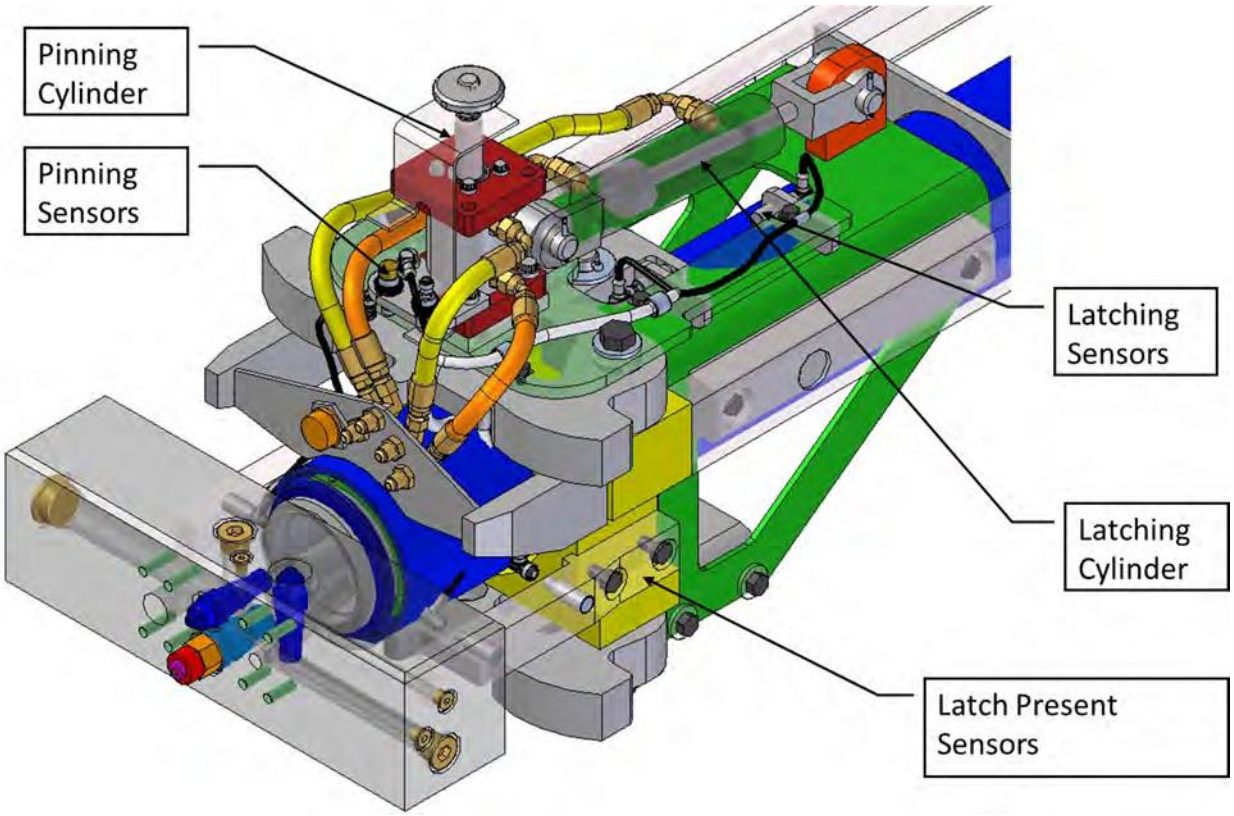
Manual, contact a Link-Belt Distributor. The Link-Belt Distributor will contact the factory if necessary.

2. Component Locations

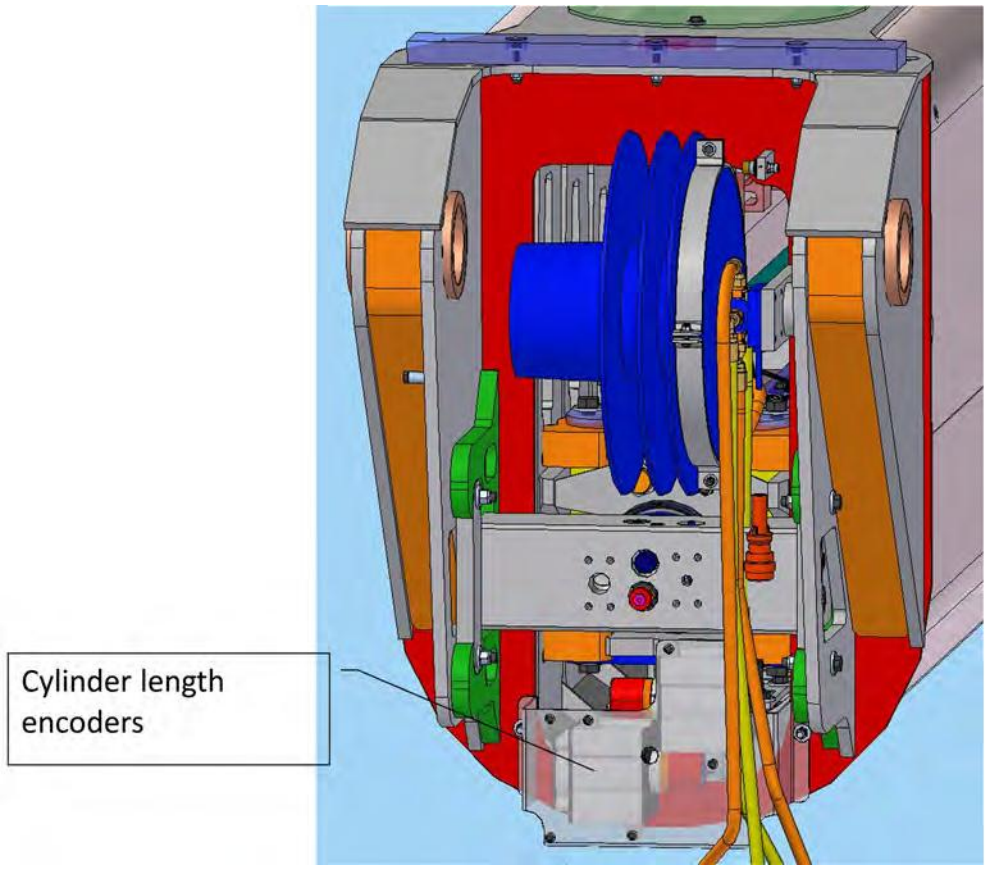
a. Typical Component Locations



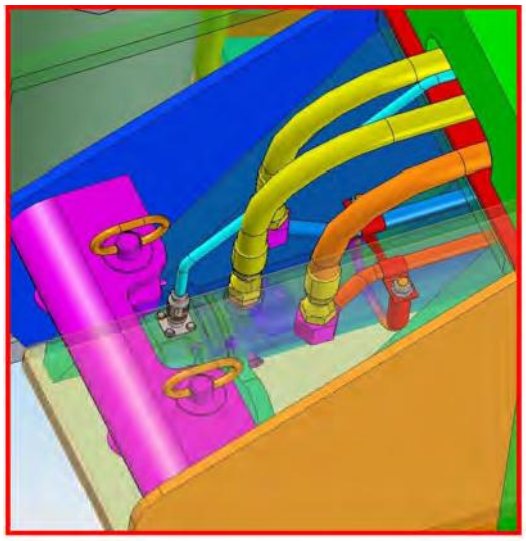
b. Boom Telescope Sensors

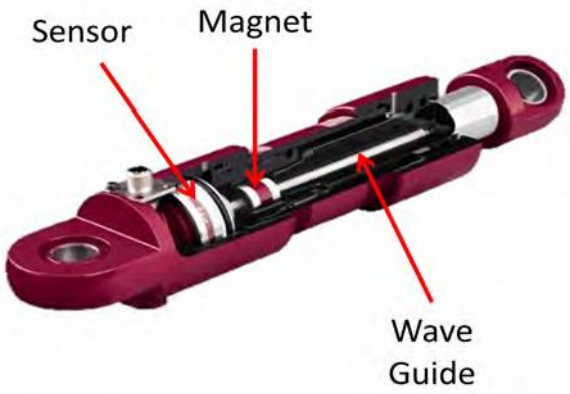


c. Cylinder Length Encoders



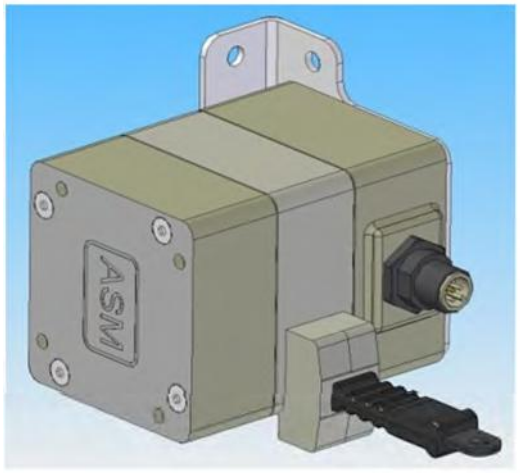
d. Outrigger Sensor (In Cylinder)





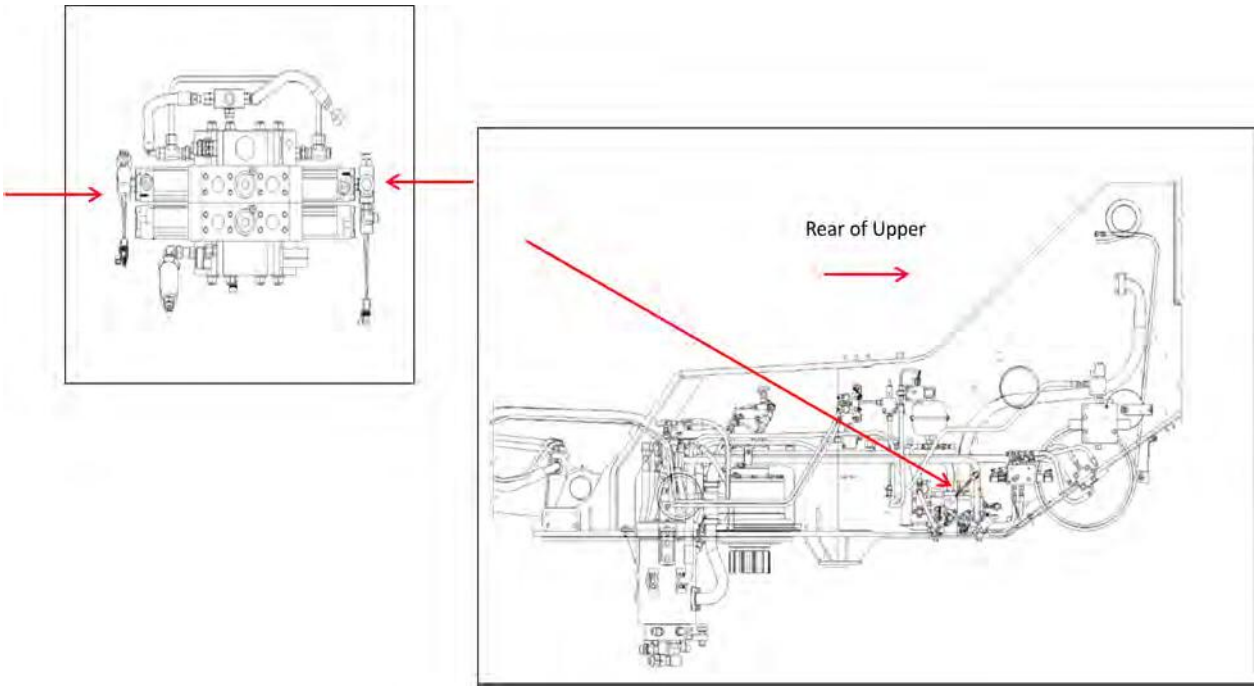
Sensor mounted in the case of the cylinder

e. Outrigger Sensors (Tape Reel)

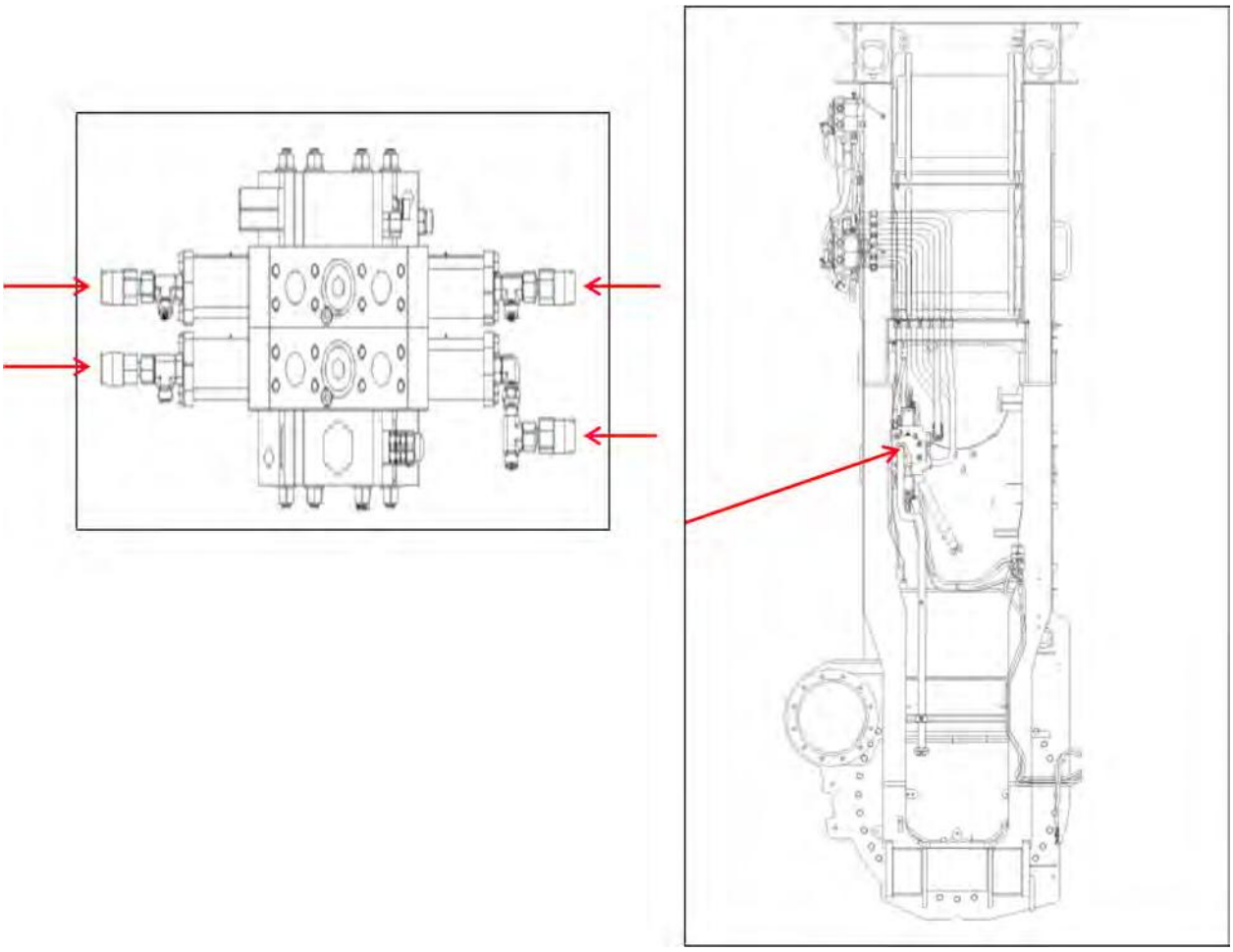


Sensor mounted in the outrigger box

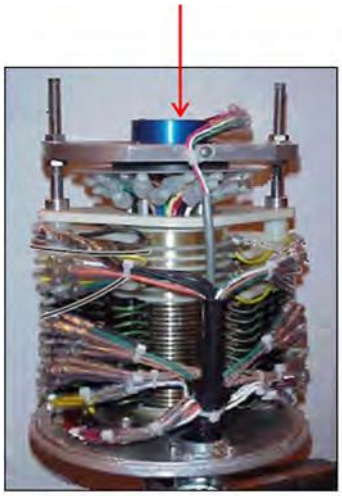
f. Boom Hoist Up/Down Pressure Switches

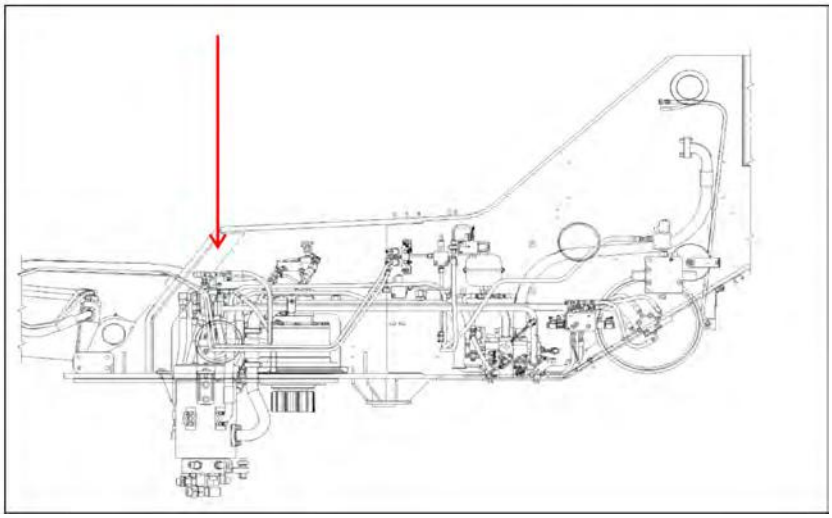


g. Winch Direction Pressure Switches



h. Swing Potentiometer





3. Sensors and Switches

a. Boom Angle Sensor

The boom angle sensor is located in the boom length reel assembly on the left side of the boom. Angle data capture via capacitive gSENS WGC. The boom angle sensor provides an accurate angle reading within ±1 tenth of a degree.

A line drawing is shown in Figure, Pin-Out is are shown in Figure, and pin name descriptions are listed in Table.

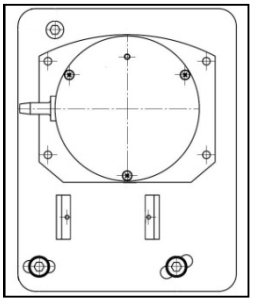


Figure: Boom Angle Sensor

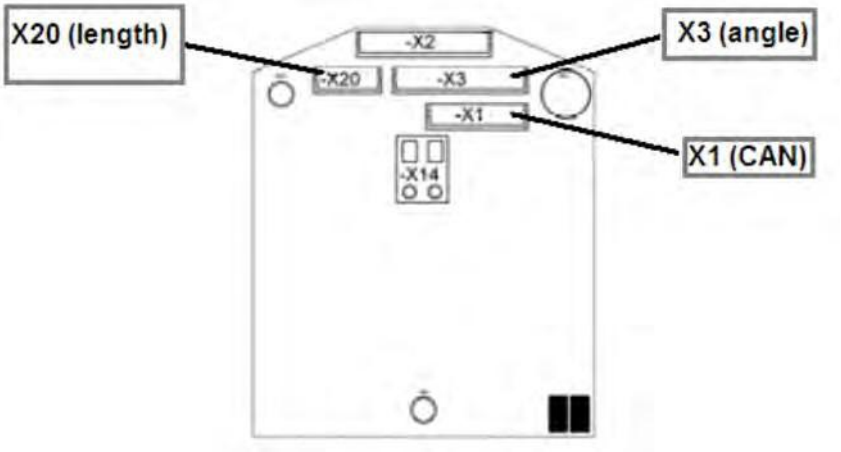


Figure: Boom Angle Sensor Pin-Outs

Table: Pin Name Descriptions

1	CAN +V
2	Not Connected
3	CAN High
4	CAN Low
5	CAN 0V
6	Not Connected
7	Not Connected

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	12 V - Supplied by internal convertor board

CAN Data from Boom Length Reel:

Bus:	RCL / Bus 1
ID:	0x1D1
Field name:	boomAngleSensor

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF41D0
Field name:	boomAngle

Communication Fault:

Name:	AngleComErr
Description:	Boom angle sensor communication lost
Remedy:	Verify boom length reel is properly connected to the CAN bus. Check all CAN bus wiring including termination resistors.

Data Fault:

Name:	AngleDataErr
Description:	Boom angle sensor data is invalid

Boom Length Redundancy Fault:

Name:	AngleReduErr
Description:	Boom angle sensor and head angle sensor don’t agree

b. Boom Length Sensor

The boom length sensor is located in the boom length reel assembly located on the left side of the boom. The boom length sensor uses a 10 turn 10K ohm potentiometer that is driven by a gear drive from the cable drum and is accurate to within ±1 tenth of a foot.

A line drawing is shown in Figure, Pin-Outs are shown in Figure, and pin name descriptions are listed in Table.

Figure: Boom Length Sensor

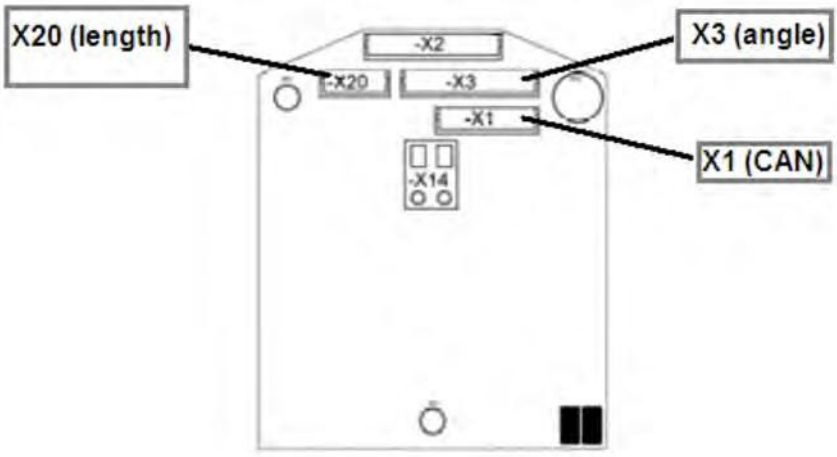


Figure: Boom Length Sensor Pin-Outs

Table: Pin Name Descriptions

Terminal X20	
1	+ (~ 4.8V)
2	Signal
3	- (~ 0.2V)

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	Supplied by internal convertor board

CAN Data from Boom Length Reel:

Bus:	RCL / Bus 1
ID:	0x28F
Field name:	boomLengthSensor

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF58D0
Field name:	boomReelBoomLength

Communication Fault:

Name:	LenComErr
Description:	Boom length sensor communication lost

Data Fault:

Name:	LenDataErr
Description:	Boom Length sensor data is invalid

Boom Length Redundancy Fault:

Name:	LenReduErr
Description:	Boom length sensor and boom controller length don’t agree

c. Cylinder Length Encoders

The cylinder length encoders are located at the base of the base section of the boom. The encoder is mounted to a reeling drum which is attached to the telescope cylinder inside the boom. The cylinder length encoders measure the length of the telescope cylinder as it is extending and retracting boom sections. Acurracy is within ± 1 hundreth of an inch.

A line drawing is shown in Figure, Pin-Outs are shown in Figure, and pin name descriptions are listed in Table.

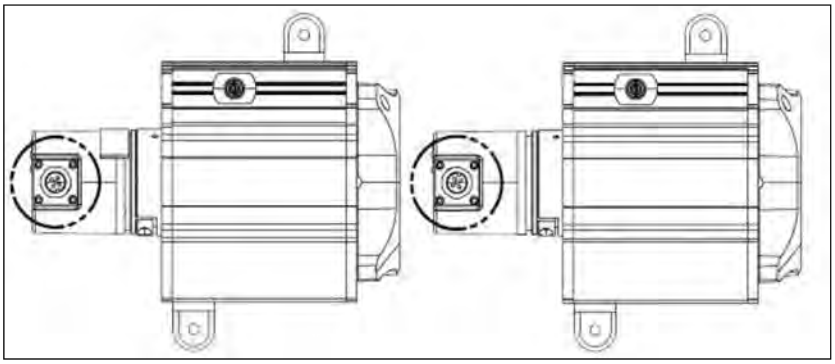


Figure: Cylinder Length Encoder Sensors

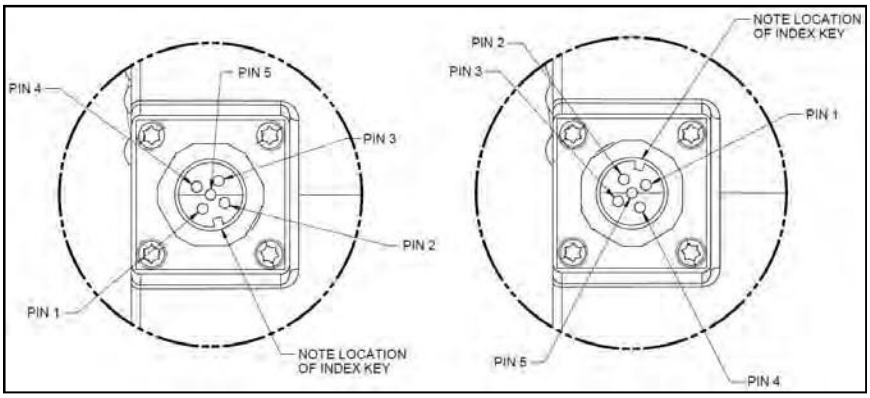


Figure: Cylinder Length Encoder Pin-Outs

Table: Pin Name Descriptions

Pin No.	Name	Description
1	CAN Ground	Ground
2	(+)UB Power Supply	BAT +
3	0V Power Supply	Ground
4	CAN_High (+)	CAN high
5	CAN_Low (-)	CAN low

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	10 -30 VDC
Input current:	65 mA maximum

CAN Data from Encoder 2:

ID:	0x1A0
Field name:	encoder1CylinderPosition
Bus:	RCL/ LTC/ Outrigger

CAN Data from Encoder 1:

ID:	0x1A1
Field name:	encoder2CylinderPosition
Bus:	RCL/ LTC/ Outrigger

d. Piston And Rod Pressure Sensors

The piston and rod pressure sensors are located behind the cab on a hydraulic manifold block on most model cranes. The piston and rod pressure sensors provide a direct hydraulic pressure reading from the boom hoist cylinder to the RCL ECM for load on hook calculations.

A line drawing is shown in Figure, Pin-Outs are shown in Figure, and pin name descriptions are listed in Table.

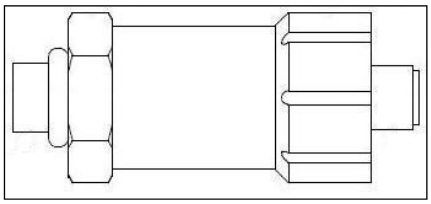


Figure: Piston & Rod Pressure Sensor

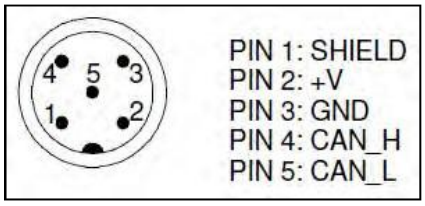


Figure: Piston & Rod Pressure Pin-Outs

Table: Pin Name Descriptions

Pin No.	Name	Description
1	Shield	Shield
2	+V	Power
3	GND	Ground
4	CAN_H	CAN high
5	CAN_L	CAN low

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	10-35 VDC
Input current:	25 mA

CAN Data from Sensor (Head/Piston):

Bus:	RCL / Bus 1
ID:	0x194
Field name:	headPressureSensor

CAN Data from Sensor (Rod):

Bus:	RCL / Bus 1
ID:	0x195
Field name:	rodPressureSensor

CAN Data from RCL ECM (Head/Piston):

Bus:	RCL / Bus 1
ID:	0x18FF43D0
Field name:	headPressure

CAN Data from RCL ECM (Rod):

Bus:	RCL / Bus 1
ID:	0x18FF43D0
Field name:	rodPressure

Communication Fault (Head/Piston):

Name:	HPresComErr
Description:	Piston pressure sensor communication lost

Communication Fault (Rod):

Name:	RPresComErr
Description:	Rod pressure sensor communication lost

e. Outrigger Sensors

The outrigger sensors are located in the outrigger beam box or in the outrigger beam cylinder depending on crane model. The outrigger sensors monitor the length of the outrigger beam and alerts the crane operator via the RCL Display if the crane outrigger configuration is not set correctly. The ASM sensor uses a tape reel attached to the outrigger beam cylinder and the MTS sensor uses a magnet (attached to the cylinder rod) and wave guide to determine length. Both type sensors have measurement accuracy of ± 1 tenth of an inch.

Line drawings are shown in Figures. Pin-Outs and pin name descriptions are shown in Figures and Tables.

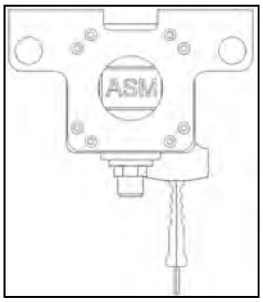


Figure: ASM (External) Sensor

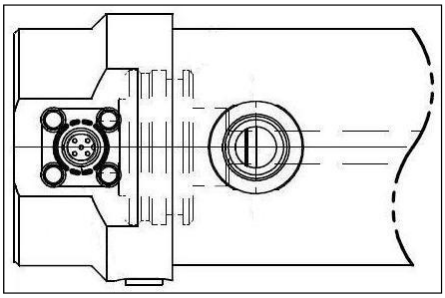
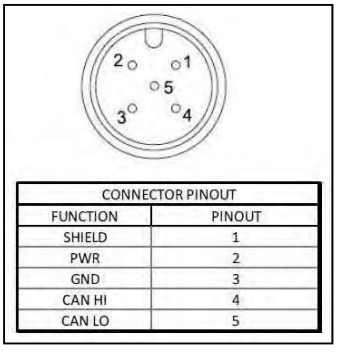


Figure: MTS (Partial Cut-Away Showing In-Cylinder Sensor)

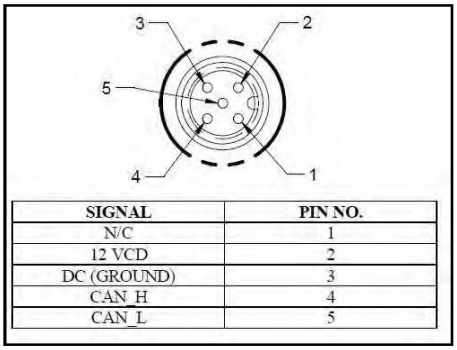


CONNECTOR PINOUT	
FUNCTION	PINOUT
SHIELD	1
PWR	2
GND	3
CAN HI	4
CAN LO	5

Figure: ASM (External) Sensor Pin-Outs

Table: ASM (External) Sensor Pin Name Descriptions

Pin No.	Name	Description
1	Shield	Shield
2	PWR	Power
3	GND	Ground
4	CAN HI	CAN high
5	CAN LO	CAN low



SIGNAL	PIN NO.
N/C	1
12 VCD	2
DC (GROUND)	3
CAN_H	4
CAN_L	5

Figure: MTS (In-Cylinder) Sensor Pin-Outs

Table: MTS (In-Cylinder) Sensor Pin Name Descriptions

Pin No.	Name	Description
1	N/C	Not connected
2	12 VDC	Power
3	DC (Ground)	Ground
4	CAN_H	CAN high
5	CAN_L	CAN low

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters (ASM):

Operating voltage:	8-36 VDC
Input current:	40 mA

Operating parameters (MTS):

Operating voltage:	10-32 VDC
Input current:	n/a

CAN Data from Sensor (Front Left Outrigger):

Bus:	Outrigger / Bus 3
ASM ID:	0x1CFF0080
MTS ID:	0x10FF5380
Field name:	leftFrontBeamLength

CAN Data from Sensor (Front Right Outrigger):

Bus:	Outrigger / Bus 3
ASM ID:	0x1CFF0081
MTS ID:	0x10FF5381
Field name:	rightFrontBeamLength

CAN Data from Sensor (Rear Left Outrigger):

Bus:	Outrigger / Bus 3
ASM ID:	0x1CFF0082
MTS ID:	0x10FF5382
Field name:	leftRearBeamLength

CAN Data from Sensor (Rear Right Outrigger):

Bus:	Outrigger / Bus 3
ASM ID:	0x1CFF0083
MTS ID:	0x10FF5383
Field name:	rightRearBeamLength

CAN Data from RCL ECM (Front Left Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF62D0
Field name:	leftFrontBeamLength

CAN Data from RCL ECM (Front Right Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF62D0
Field name:	rightFrontBeamLength

CAN Data from RCL ECM (Rear Left Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF62D0
Field name:	leftRearBeamLength

CAN Data from RCL ECM (Rear Right Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF62D0
Field name:	rightRearBeamLength

CAN Data from RCL ECM (Front Left Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF63D0
Field name:	leftFrontBeamPosition

CAN Data from RCL ECM (Front Right Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF63D0
Field name:	rightFrontBeamPosition

CAN Data from RCL ECM (Rear Left Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF63D0
Field name:	leftRearBeamPositio

CAN Data from RCL ECM (Rear Right Outrigger):

Bus:	RCL / Bus 1
ID:	0x18FF63D0
Field name:	rightRearBeamPosition

CAN Data from RCL ECM (Outrigger Position):

Bus:	RCL / Bus 1
ID:	0x18FF63D0
Field name:	outriggerBeamPosition
Description:	1 = Full
	2 = Intermediate
	3 = Retracted

Communication Fault:

Name:	FLOutrigComErr
Description:	Front left outrigger sensor communication lost

Communication Fault:

Name:	FROutrigComErr
Description:	Front right outrigger sensor communication lost

Communication Fault:

Name:	RLOutrigComErr
Description:	Rear left outrigger sensor communication lost

Communication Fault:

Name:	RROutrigComErr
Description:	Rear right outrigger sensor communication lost

f. Wind Speed Sensor

The wind speed sensor is a movable wireless sensor (anemometer) that can be mounted to the main boom head or to an erected attachment. The wind speed receiver is located inside the cab behind the RCL Display console or behind the operator's seat depending on crane model. The wind speed sensor/receiver displays actual wind speed in mph or km/h via the RCL Display. This sensor does not reduce maximum load capcity, it sends wind speed information only.

Line drawings of the sensor and receiver card module are shown in Figures. Pin-Outs are shown in Figure, and pin name descriptions are listed in Table.

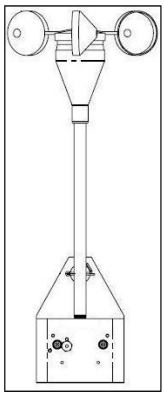


Figure: Wind Speed Sensor

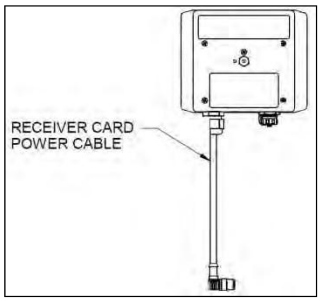


Figure: Receiver Card Module

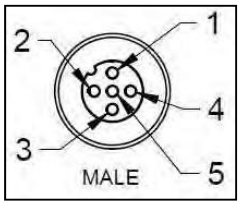


Figure: Receiver Card Module Pin-Outs

Table: Pin Name Descriptions

Pin No.	Pin Name	Description
1	Shield	Shield
2	12V (+)	Power
3	Ground (-)	Ground
4	CAN HI	CAN high
5	CAN LO	CAN low

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage: 10-30 VDC

Input current: n/a

CAN Data from Sensor:

Bus: RCL / Bus 1

ID: 0x405

Field name: windSpeedSensor

Pulse CAN:

Bus: RCL / Bus 1

ID: 0x18FF42D0

Field name: windSpeed

Communication Fault:

Description: If the ECM stops communicating, the RCL Display will show dashes "-- " in place of the wind speed value.

Low Battery:

Description: If the wireless wind speed sensor has below 10% battery remaining, a low battery icon will be shown on the working screen next to the wind speed image.

Remedy: Replace battery

g. Fly Angle Sensor

The fly angle sensor is located on the base section of a hydraulic offset fly. The fly angle sensor provides an angle reading from 2 – 45 degrees via the RCL Display as the fly is moved through its working range.

A line drawing is shown in Figure, Pin-Outs are shown in Figure, and pin name descriptions are listed in Table.

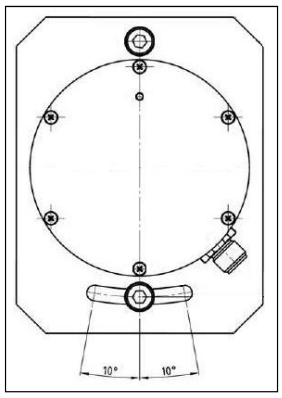


Figure: Fly Angle Sensor

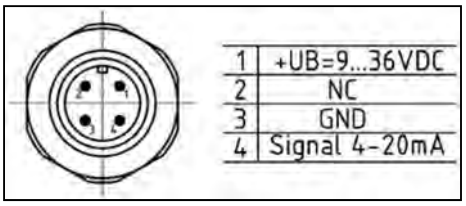


Figure: Fly Angle Sensor Pin-Outs

Table: Pin Name Descriptions

Pin No.	Name	Description
1	+UB=9…36V	Power
2	NC	Not Connected
3	GND	Ground
4	Signal 4-20 mA	Signal

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	9-36 VDC
Input current:	100 mA

Output parameters:

Output current:	4 – 20 mA

CAN Data from Boom Length Reel:

Bus:	RCL / Bus 1
ID:	0x1F8
Field name:	flyAngleSensor

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF43D0
Field name:	externalAngleFly

Communication Fault:

Name:	FlyComErr
Description:	Fly angle sensor communication lost
Remedy:	Verify ATB attachment cable is connected to hydraulic offset fly.

Data Fault:

Name:	FlyDataErr
Description:	Fly angle sensor data is invalid

h. Head Angle Sensor

The head angle sensor is located on the main boom head. Angle data capture via capacitive gSENS WGC. The head angle sensor provides an accurate angle reading within ±1 tenth of a degree.

A line drawing is shown in Figure, Pin-Outs are shown in Figure, and pin name descriptions are listed in Table.

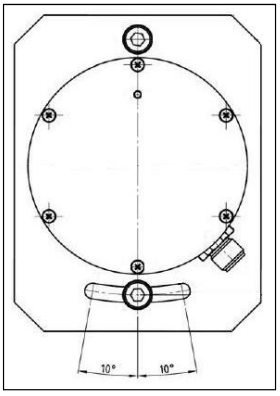


Figure: Head Angle Sensor

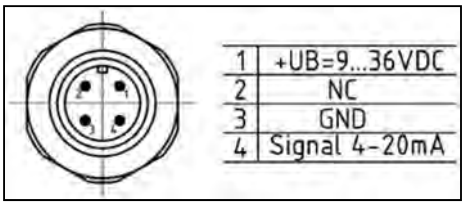


Figure: Head Angle Sensor Pin-Outs

Table: Pin Name Descriptions

Pin No.	Name	Description
1	+UB=9…36V	Power
2	NC	Not Connected
3	GND	Ground
4	Signal 4-20 mA	Signal

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	9-36 VDC
Input current:	100 mA

Output parameters:

Output current:	4 – 20 mA

CAN Data from Boom Length Reel:

Bus:	RCL / Bus 1
ID:	0x1F8
Field name:	HeadAngleSensor

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF43D0
Field name:	ExternalAngleHead

Communication Fault:

Name:	HeadComErr
Description:	Head angle sensor communication lost

Data Fault:

Name:	HeadDataErr
Description:	Head angle sensor data is invalid

Boom Angle Redundancy Fault:

Name:	AngleReduErr
Description:	Boom angle sensor and head angle sensor do not agree

i. Pin And Latch Sensors

The pin and latch sensors are located on the telescope cylinder pinning and latching assembly. The sensors provide a analog input (switched ground) to the boom mode controller ECM.

A line drawing is shown in Figure, Pin-Outs are shown in Figure, and pin descriptions are listed in Table.

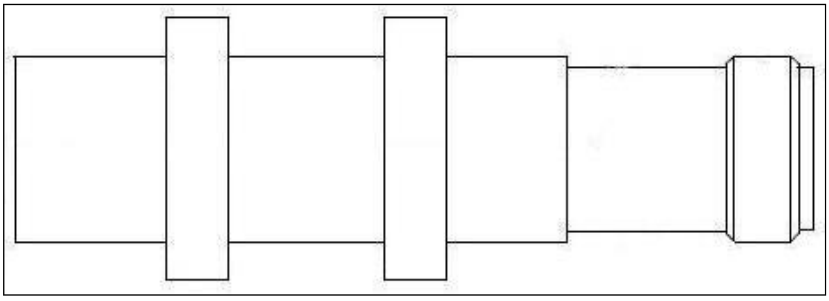


Figure: Pinning & Latching Sensor

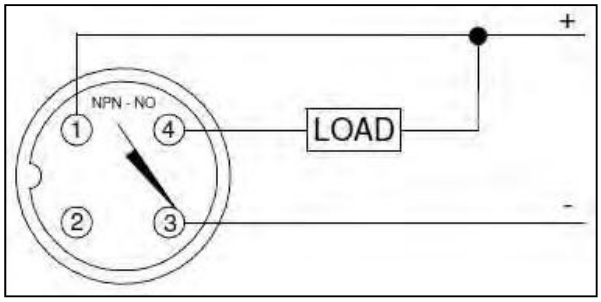


Figure: Pinning & Latching Pin-Outs

Table: Pin (Name) Descriptions

Pin No.	Name	Description
1	12 VDC	Power
2	NC	Not connected
3	Ground	Ground
4	Switched Ground	Signal

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	10-30 VDC
Input current:	5.5 – 9.5 mA, no-load

Output parameters:

Output LED	Yellow - indicating output is energized
Output current:	< or = 200 mA maximum

CAN Data sent from LTC

Bus:	LTC / Bus 2
ID:	0x18FFFB32
Field names:	latchedInputState
	notLatchedInputState

j. Anti-Two Block Attachment Switch

The Anti-two Block (ATB) Attachment Switch is a movable switch that can be located on the auxillary head or any fly attachment that has wire rope sheaves. The ATB switch has an attached 16 pound weight around the wire rope. When the hook block, hook ball, or load contacts the weight and raises it the ATB switch is activated causing the RCL System to initiate a function kickout condition.

A line drawing and schematic are shown in Figure and Figure. Pin-Outs are shown in Figure and connector Pin-Out descriptions are listed in Table.

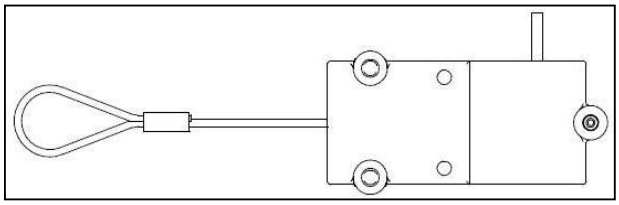


Figure: ATB Switch

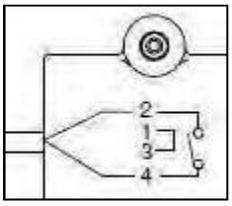


Figure: ATB Switch Schematic

Table: Connector Pin Descriptions

Pin No.	Name	Description
1	N/C	Not Connected
2	ATB Feed	
3	N/C	Not Connected
4	ATB Signal	

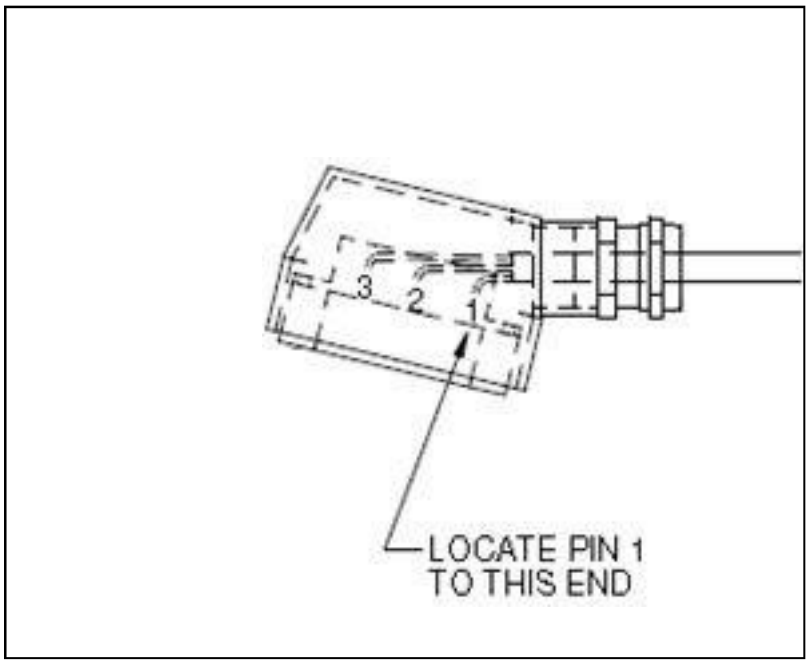


Figure: ATB Mating Switch Connector

Table: Mating Attachment Connector Pin Descriptions

Pin No.	Name	Description
1	ATB Feed	ATB Feed
2	N/C	Shield Drain
3	ATB Signal	ATB Signal

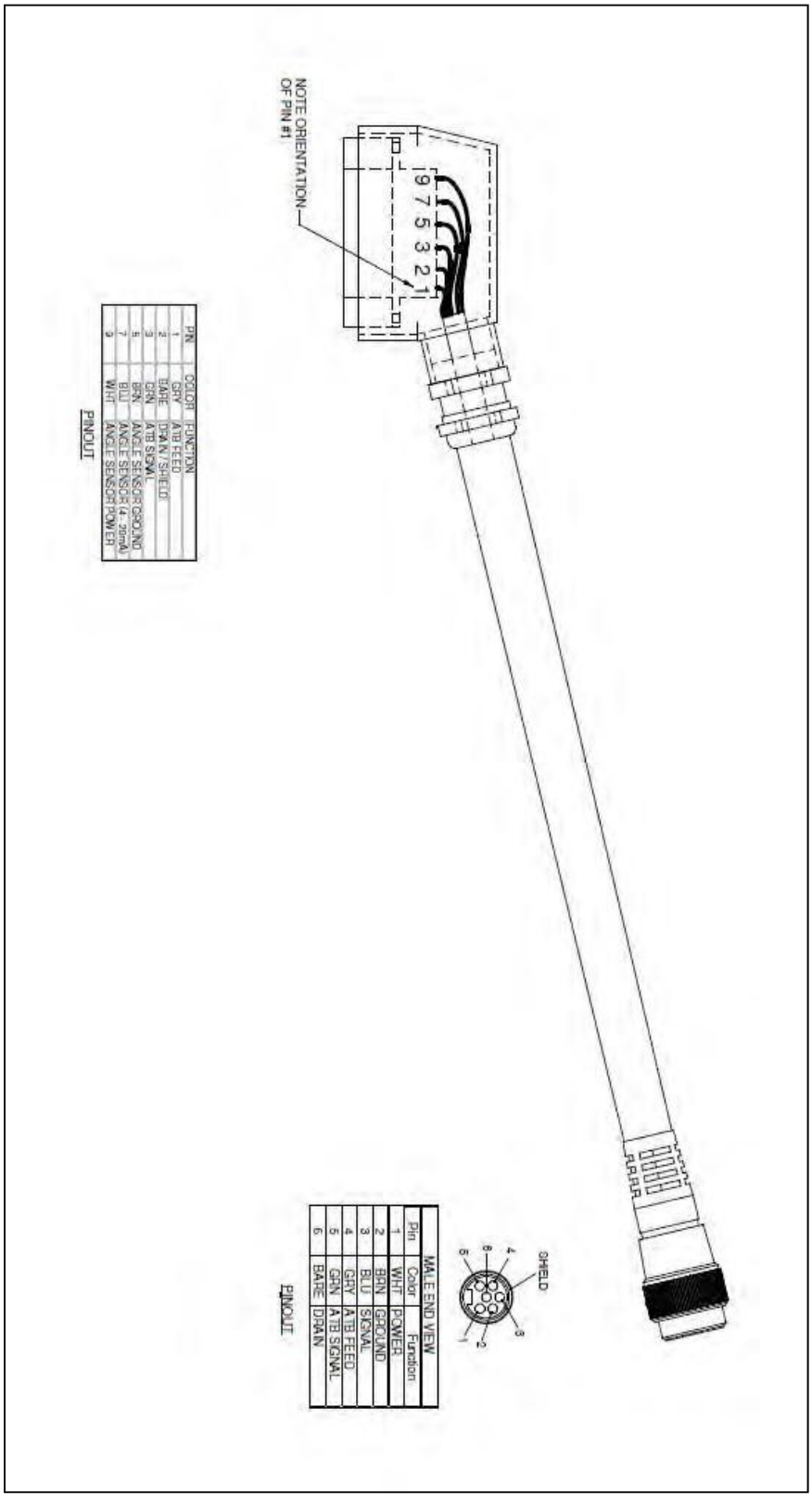


Figure: ATB Hydraulic Fly Attachment Cable

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	Supplied by internal convertor board
Input current:	n/a

CAN Data from Sensor:

Bus:	RCL / Bus 1
ID:	0x18F
Field name:	ATBSwitch

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF48D0
Field name:	ATBEventMessage (not a direct representation of switch state)

Communication Fault:

Name:	ATBComErr
Description:	ATB switch communication lost

Short Circuit Fault:

Name:	ATBShort
Description:	ATB switch short circuit

k. Anti-Two Block Main Switch

The Anti-two Block (ATB) Main Switch is a mounted on the main boom head. The ATB switch has an attached 16 pound weight around the wire rope. When the hook block, hook ball, or load contacts the weight and raises it the ATB switch is activated causing the RCL System to initiate a function kickout condition.

A line drawing and schematic are shown in Figure and Figure. Pin-Outs are shown in Figure and connector Pin-Out descriptions are listed in Table.

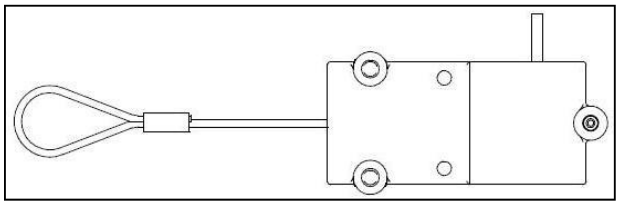


Figure: ATB Switch

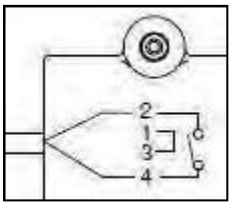


Figure: ATB Switch Schematic

Table: Connector Pin Descriptions

Pin No.	Name	Description
1	Shield	Shield
2	ATB Feed	ATB Feed
3	ATB Signal	ATB Signal

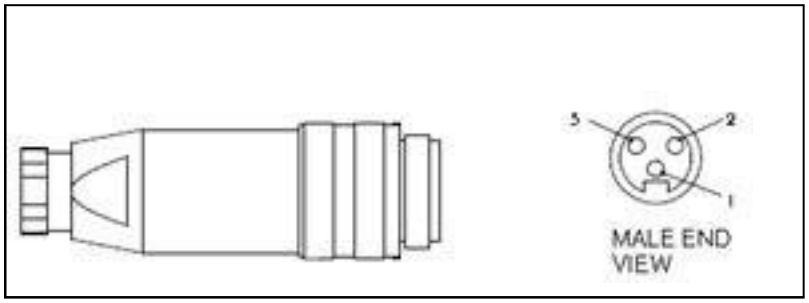


Figure: ATB Connector

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	Supplied by internal convertor board
Input current:	n/a

CAN Data from Sensor:

Bus:	RCL / Bus 1
ID:	0x18F
Field name:	ATBSwitch

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF48D0
Field name:	ATBEventMessage (not a direct representation of switch state)

Communication Fault:

Name:	ATBComErr
Description:	ATB switch communication lost

Short Circuit Fault:

Name:	ATBShort
Description:	ATB switch short circuit

I. Boom Up And Boom Down Pressure Switches

The boom up and boom down pressure switches are located on the boom hoist/telescope control valve assembly. These switches are normally open and provide an indication (switched ground) to the RCL ECM for the boom direction to calculate the correct load moment information.

A line drawing and schematic are shown in Figure and Figure. Pin-Outs are shown in Figure and pin descriptions are listed in Table.

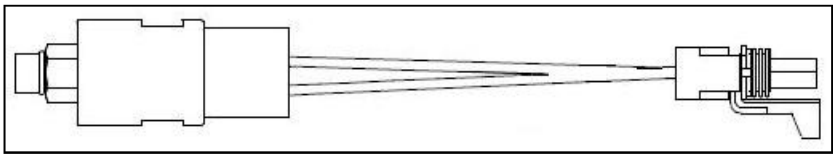


Figure: Boom Up & Down Switch

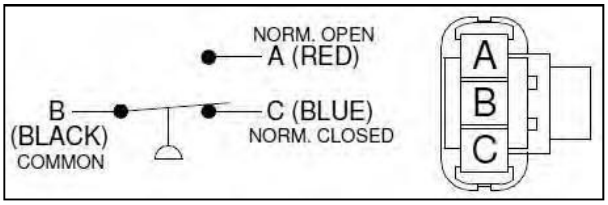


Figure: Boom Up & Down Switch Schematic

Table: Boom Up & Down Switch Pin-Outs

Pin No.	Name	Description
A	Normally Open	N/O
B	Common	Ground
C	Not Used	Not Used

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and switch fault/error information is provided as follows:

Operating parameters:

Operating voltage: 12 VDC

Input current: n/a

m. Drum Rotation Direction Indicator

The Drum Rotation Direction Indicator (DRDI) is used to monitor Winch Up, Winch Down, and Error states. A line drawing is shown in Figure, a schematic is shown in Figure, and display indicators and descriptions are listed in Tables.

Table: Winch Direction Display Indicators

	Winch Up Load Raising
	Winch Down Load Lowering
	Error

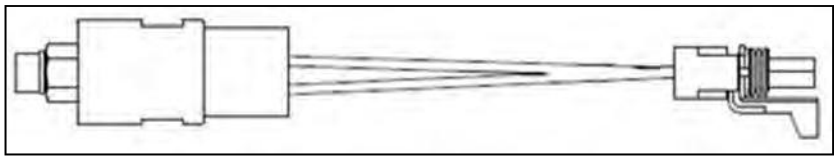


Figure: Front & Rear Winch Direction Switch

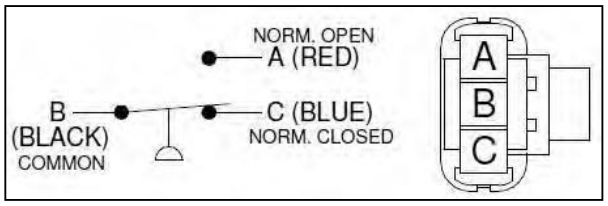


Figure: Front & Rear Winch Direction Switch Schematic

Table: Front & Rear Winch Direction Switch Descriptions

Pin No.	Name	Description
A	Normally Open	N/O
B	Common	Ground
C	Not Used	Not Used

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	12VDC
Input current:	na

Output parameters:

Output current:	na

Pulse CAN (Front):

ID:	0x18FF42D0
Field name:	frontWinchRotationStatus
Valid range:	n/a
Data fault tolerance:	n/a
Redundancy fault tolerance:	n/a

Pulse CAN (Rear):

ID:	0x18FF42D0
Field name:	rearWinchRotationStatus
Valid range:	n/a
Data fault tolerance:	n/a
Redundancy fault tolerance:	n/a

Sensor Errors:

Description:	No faults.
Remedy:	Check wiring, voltage to the sensor. Recalibrate sensor. Possible bad IQAN control module.

n. Bypass Key Switch

The bypass key switch is located on the back of the operator's cab or on the upper frame near the back of the operator's cab. The bypass key switch is to be used only in the event the RCL System has failed and emergency operation is required. The bypass key switch overrides all function kickout conditions.

A line drawing and schematic (including key position) are shown in Figure and Figure. Connector detail is shown in Figure and pin descriptions are listed in Table.

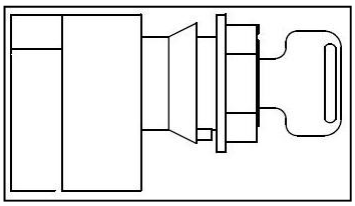


Figure: Bypass Key Switch

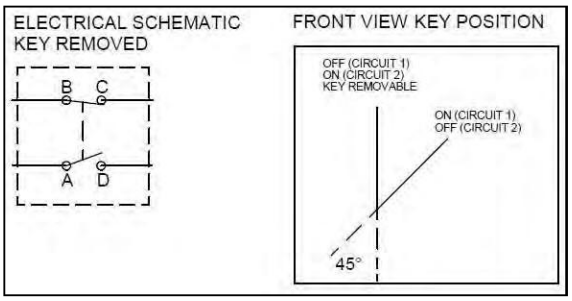


Figure: Bypass Key Switch Schematic and Key Position

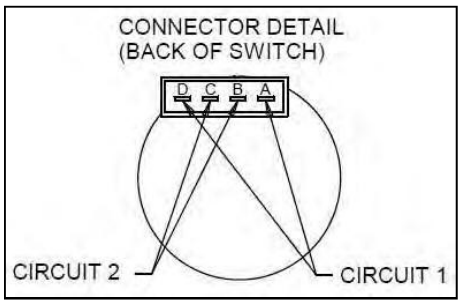


Figure: Bypass Key Switch Connector

Table: Pin Descriptions

Pin No.	Name	Description
A	12 VDC Feed	BAT +
B	Ground	Ground
C	Ground	Switched Ground
D	12 VDC	Override 12 VDC

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage:	12 VDC
Input current:	20 A @ 12-14 VDC

CAN Data from RCL ECM:

Bus:	RCL / Bus 1
ID:	0x18FF48D0
Field name:	bypassMessage

o. Counterweight Switch (if equipped)

Pressing this switch changes the function of the left joystick (or single axis controller, if equipped) from operating the swing/front winch functions to operating the counterweight lock-unlock/counterweight raise-lower functions. Also the RCL Display changes screens to display the location of the counterweight lift cylinder rods to alert the operator of counterweight status.

A line drawing and schematic are shown in Figure and Figure. Pin-Outs are shown in Figure and pin descriptions are listed in Table.

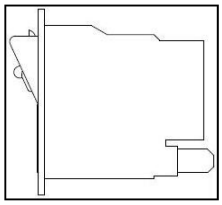


Figure: Counterweight Switch

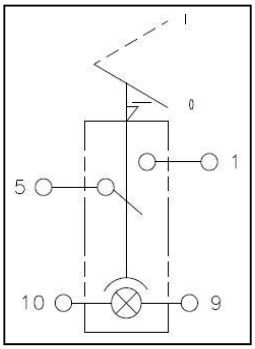


Figure: Counterweight Switch Schematic

Table: Pin Descriptions

Pin No.	Name	Description
1	12 VDC	CTWT Enable
5	12 VDC	Power Feed
9	GND	Ground
10	12 VDC	Switch Light

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters:

Operating voltage: 12 VDC

Input current: 6 A @ 12 VDC

p. Function Lockout Switches

These switches are used to disable hydraulic functions which are operated by the control levers and boom telescope foot pedal. One is located on the control panel and one is in the left hand console.

Control Panel - Press the top part of the switch to disable hydraulic functions and to prevent inadvertent operation of these controls. To allow normal operation of the control levers and boom telescope foot pedal, press the bottom part of the function lockout switch. The bottom part of the switch will illuminate to indicate switch is in the ON position.

LH Console - Lifting the left side console also performs the same duty as the function lockout switch, described above, disabling all hydraulic functions related to the control levers and boom telescope foot pedal.

A line drawing and schematic are shown in Figure. Pin-Outs are shown in Figure and pin descriptions are listed in Table.

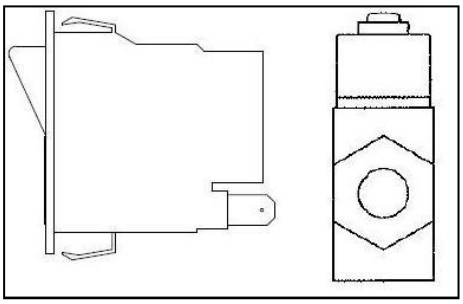


Figure: Function Lockout Switches (Control Panel & LH Console)

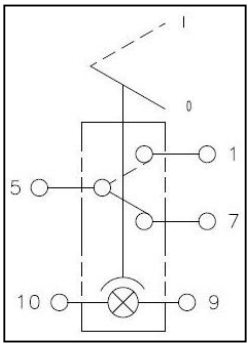


Figure: Function Lockout Switch Schematic (Control Panel)

Table: Function Lockout Switch Pin-Outs

Pin No.	Name	Description
5	12 VDC	12 VDC
1	Ground	Ground
7	Not Connected	Not Connected
10	12 VDC	12 VDC
9	Ground	Ground

Figure: Function Lockout Switch Schematic (LH Console)

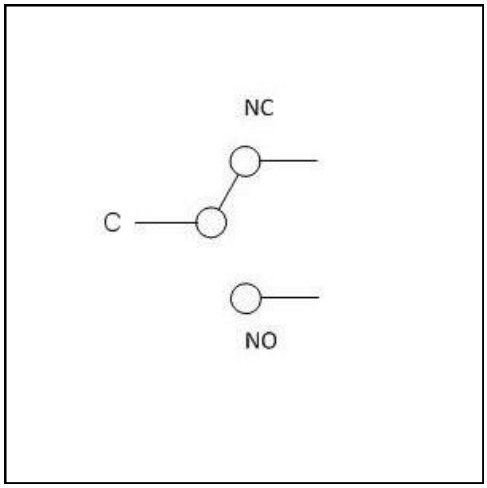


Table: Function Lockout Switch Pin-Outs (LH Console)

Pin No.	Name	Description
C	Common	Ground
NO	Normally Open	12 VDC
NC	Normally Closed	Not Connected

Refer to Section 3 for Troubleshooting flowcharts. Applicable electrical, CAN, and sensor fault/error information is provided as follows:

Operating parameters (Control Panel):

Operating voltage: 12 VDC

Input current: 16 A @ 12 VDC

Output parameters:

Output current: na

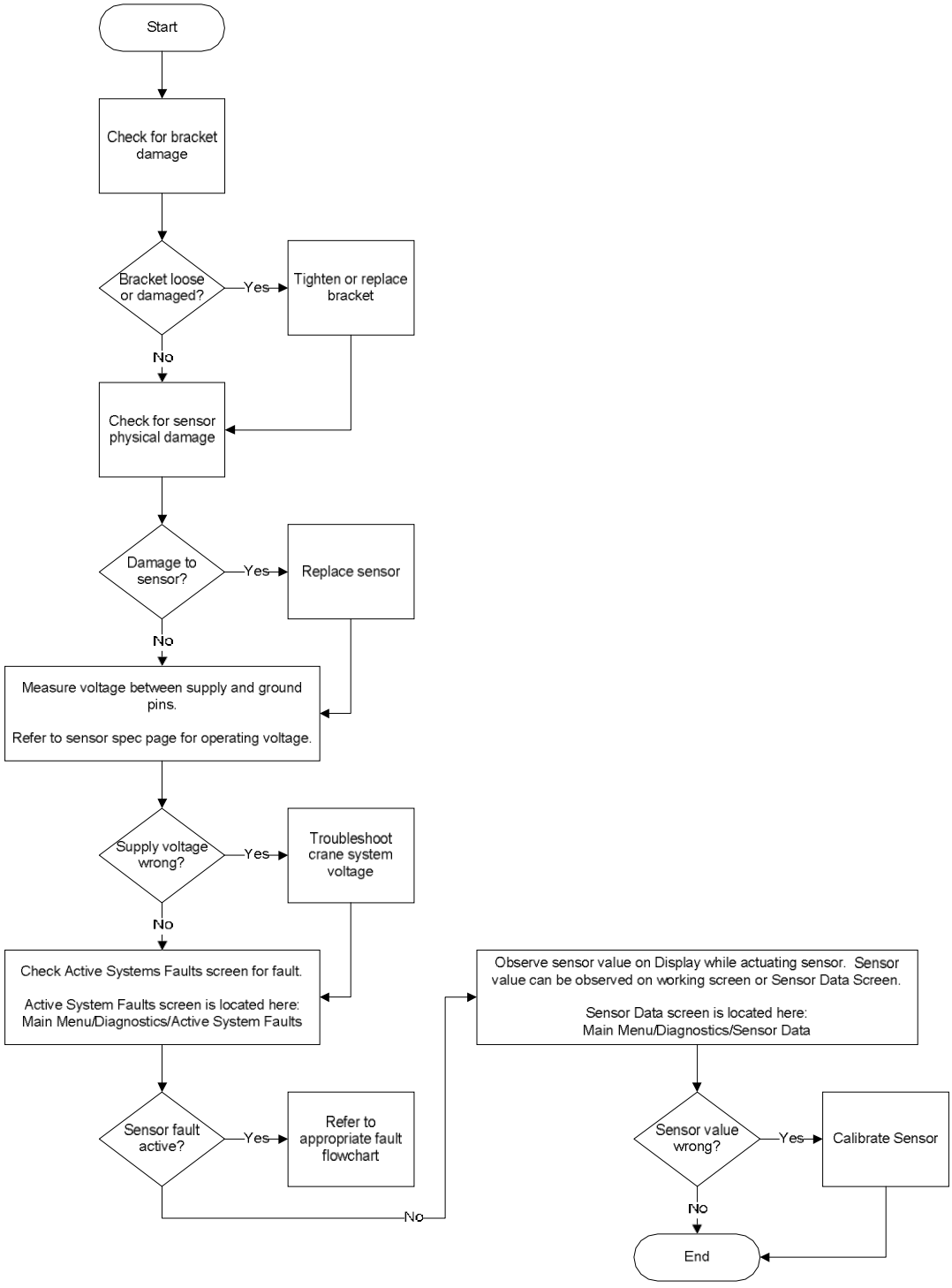
Operating parameters (LH Console):

Operating voltage: 125/250 VDC

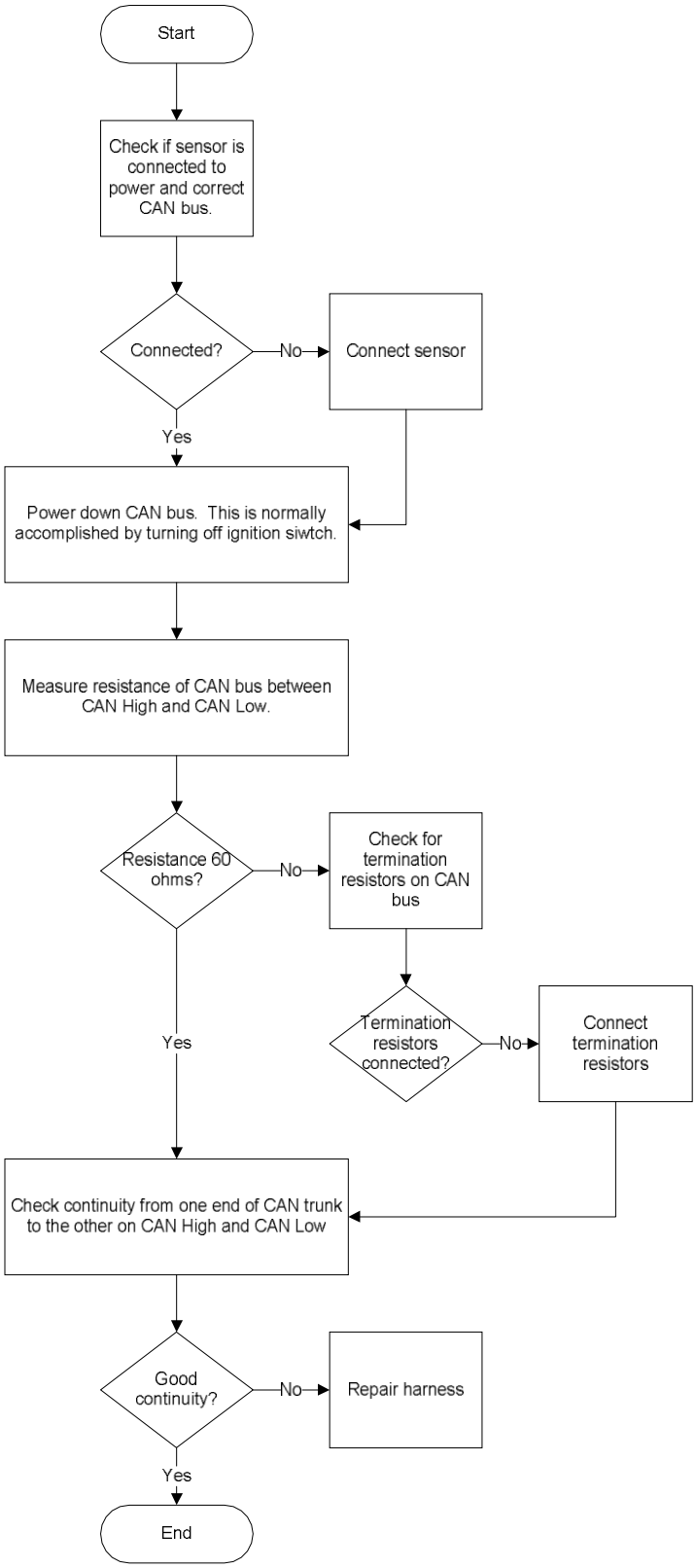
Input current: 1/2A @ 125 VDC, 1/4A @ 250VDC

4. Sensor Troubleshooting Flowcharts

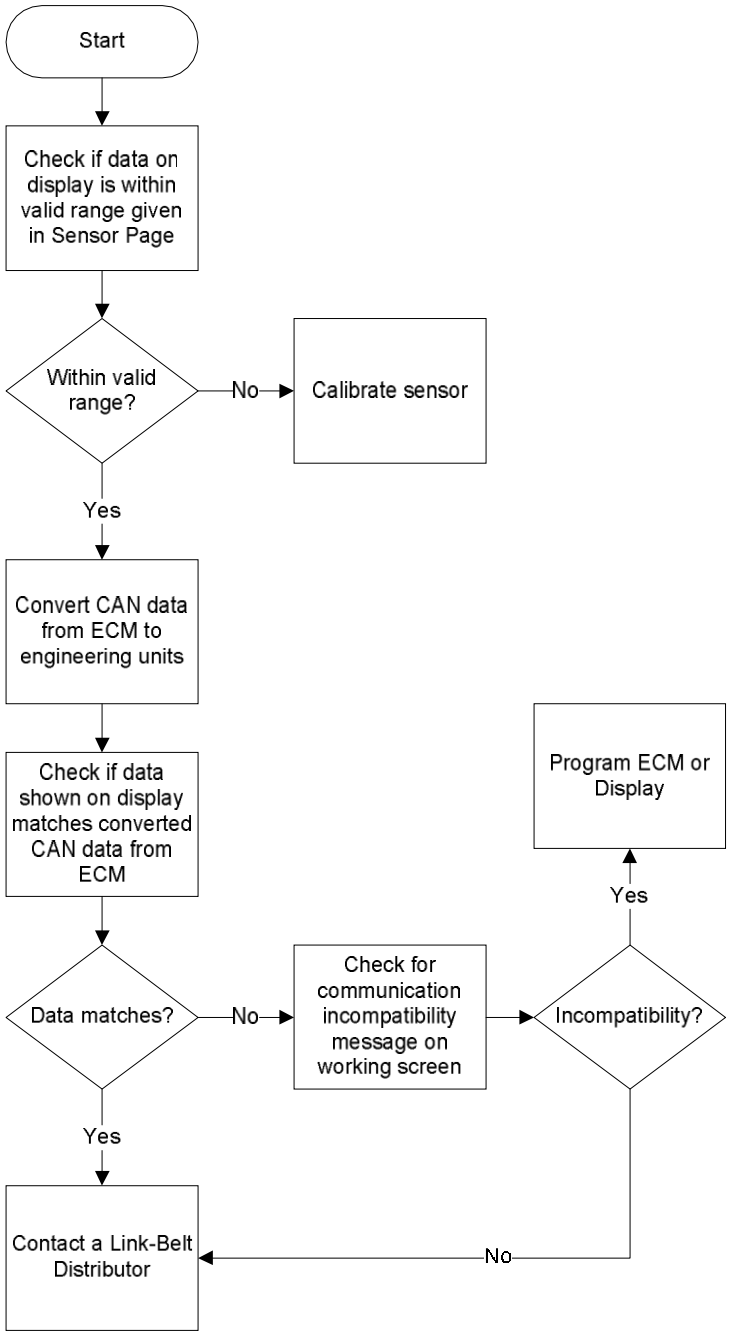
a. Hardware Issues



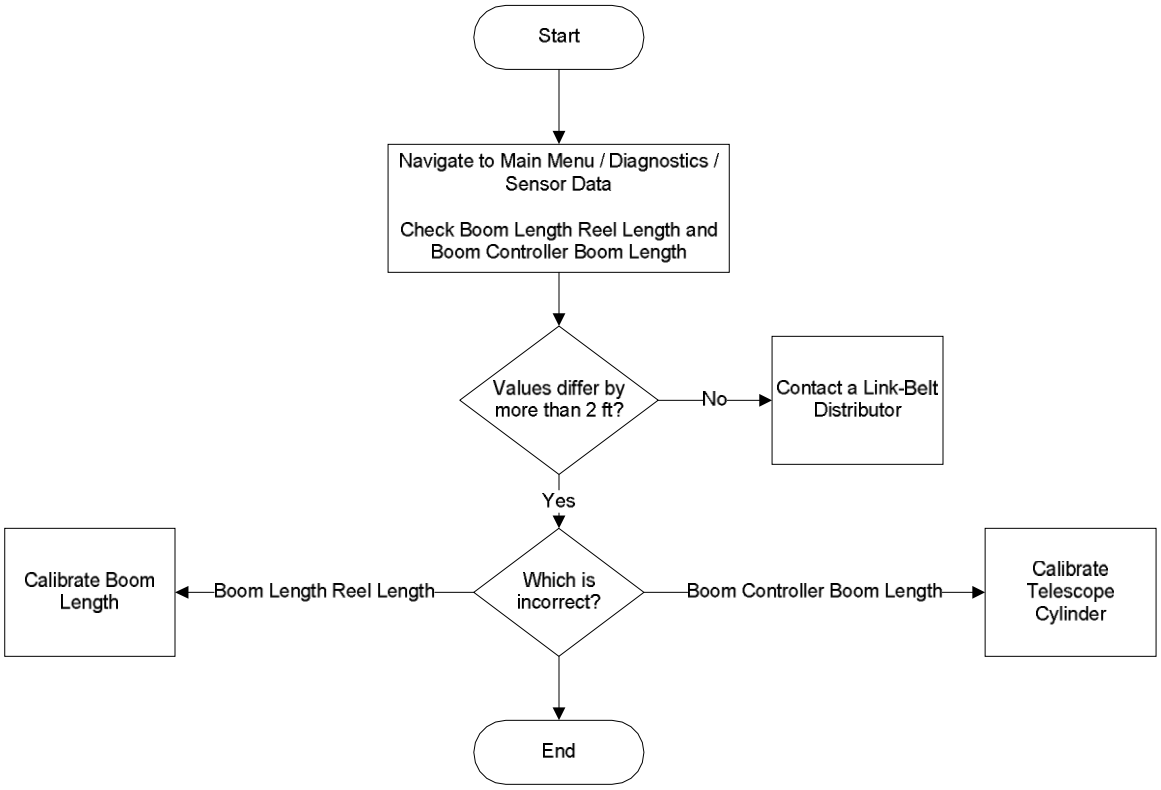
b. Communication Fault



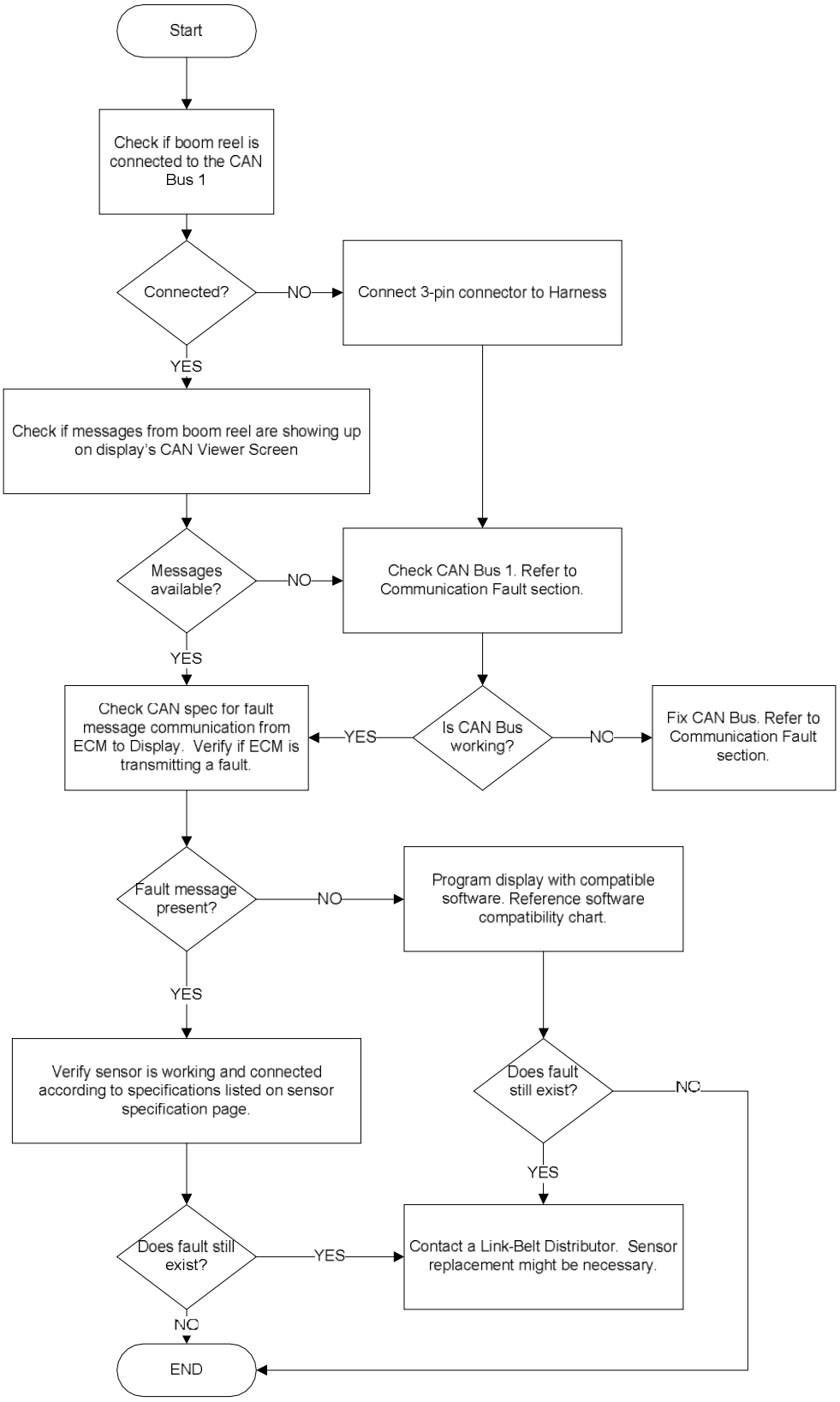
c. Data Fault


Start
Check if data on display is within valid range given in Sensor Page
Within valid range?
No
Calibrate sensor
Yes
Convert CAN data from ECM to engineering units
Check if data shown on display matches converted CAN data from ECM
Data matches?
No
Check for communication incompatibility message on working screen
Incompatibility?
Yes
Program ECM or Display
Yes
Contact a Link-Belt Distributor
No

d. Redundancy Fault



e. Boom Length Reel Communication Issues



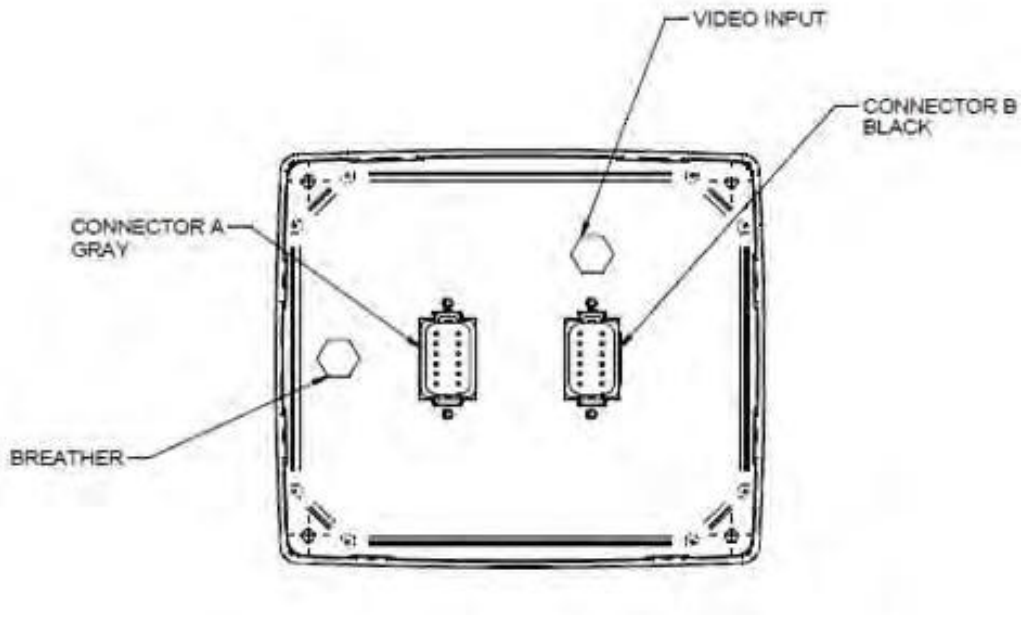
5. Sensor Calibration

Refer to the Link-Belt Pulse Calibration Manual to perform sensor calibrations. If you don't have the calibration manual, contact a Link-Belt Distributor.

6. RCL Display

a. Overview (HED 7”)

Funtional Description: RCL Display screen for Pulse System



Figures: RCL Display Front and Back

Table: Pin- Out Descriptions

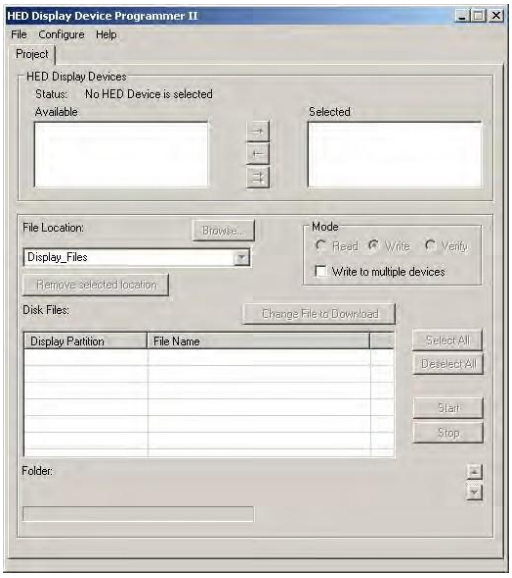
RCL Display Electrical Pin-Out		
Port	Pin	Function
A	1	USB DM
	2	USB DP
	3	USB GND
	4	Analog Input (Unswitched battery)
	5	Digital Input (Switch-to-battery) 00
	6	Digital Input (Switch-to-battery) 01
	7	CAN Shield
	8	USB Power
	9	CAN 1 L
	10	CAN 1 H
	11	GND
	12	Switched Battery
B	1	Digital Input (Switch-to-battery) 06
	2	Digital Input (Switch-to-battery) 07
	3	Digital Input (Switch-to-battery) 08
	4	Digital Input (Switch-to-battery) 09
	5	Digital Input (Switch-to-battery) 02
	6	Digital Input (Switch-to-battery) 03
	7	Digital Input (Switch-to-battery) 04
	8	Digital Input (Switch-to-battery) 05
	9	CAN 2 L
	10	CAN 2 H
	11	CAN Shield
	12	Digital Input (Switch-to-battery) 10

b. Programming

The following steps describe how to connect a PC to the RCL Display and write program files to it.

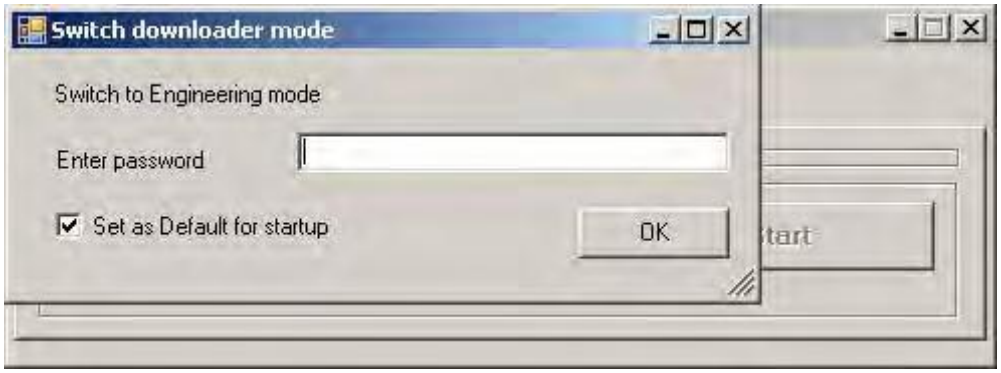
- **Before beginning**
  - Turn on the PC and have the required files available.
    - Contact a Link-Belt Distributor to collect thefile(s) if necessary. Supply the following information: crane type, RCL version, LTC version, current display version.
    - Unzip the file(s) if necessary.
    - Place the “romfs.jffs2” file (and/or any others if needed) in the “C:\HED_Display_Files\Files_Digital” folder on the PC. A shortcut to this folder may exist on the Desktop already. The display programmer looks for files in this folder by default.
  - Have a USB cable ready for connecting the PC to the RCL Display. This is a standard A-to-B USB cable (printer cable).
- **Configuring Programming Software**
  - Start the “HED Programmer II” application on the PC.
  - The programmer may start in either of the following modes shown below:

A. Service Mode



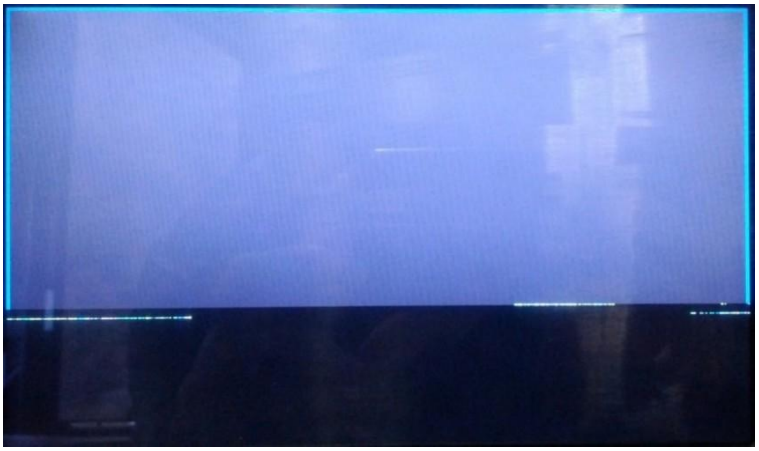
B. Engineering Mode

- If the programmer is in Service Mode, switch to Engineering Mode through the following steps
    - Select “Configure” from the top menu. Then select “Engineering Mode” from the drop-down menu.
    - A new dialogue window will appear.

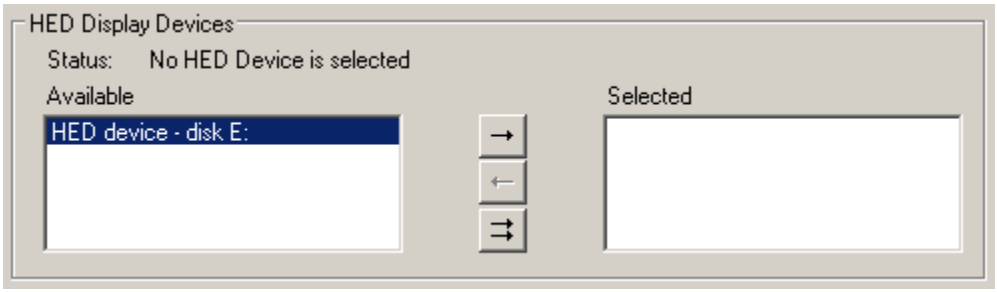


    - Check the box “Set as Default for startup”.
    - Enter the password “fullmode345” and click “OK”.
    - Unit should now be in Engineering Mode.
- Now that the programmer is in Engineering Mode, and begin preparing the display for programming.

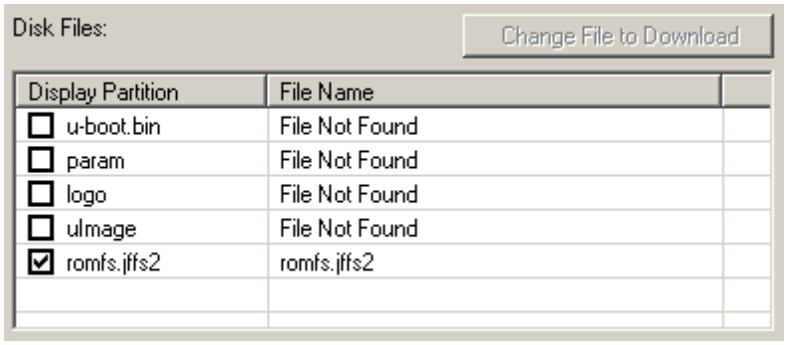
- **Entering Programming mode on the RCL Display**
    - Turn the crane ignition key off.
    - Connect USB cable to both PC and display.
    - Turn the crane ignition key on.
    - An empty drive folder window may pop up on the PC. Close this window.
    - The display will take several seconds to power on. When the display appears as in the image below, it is in Programming Mode.



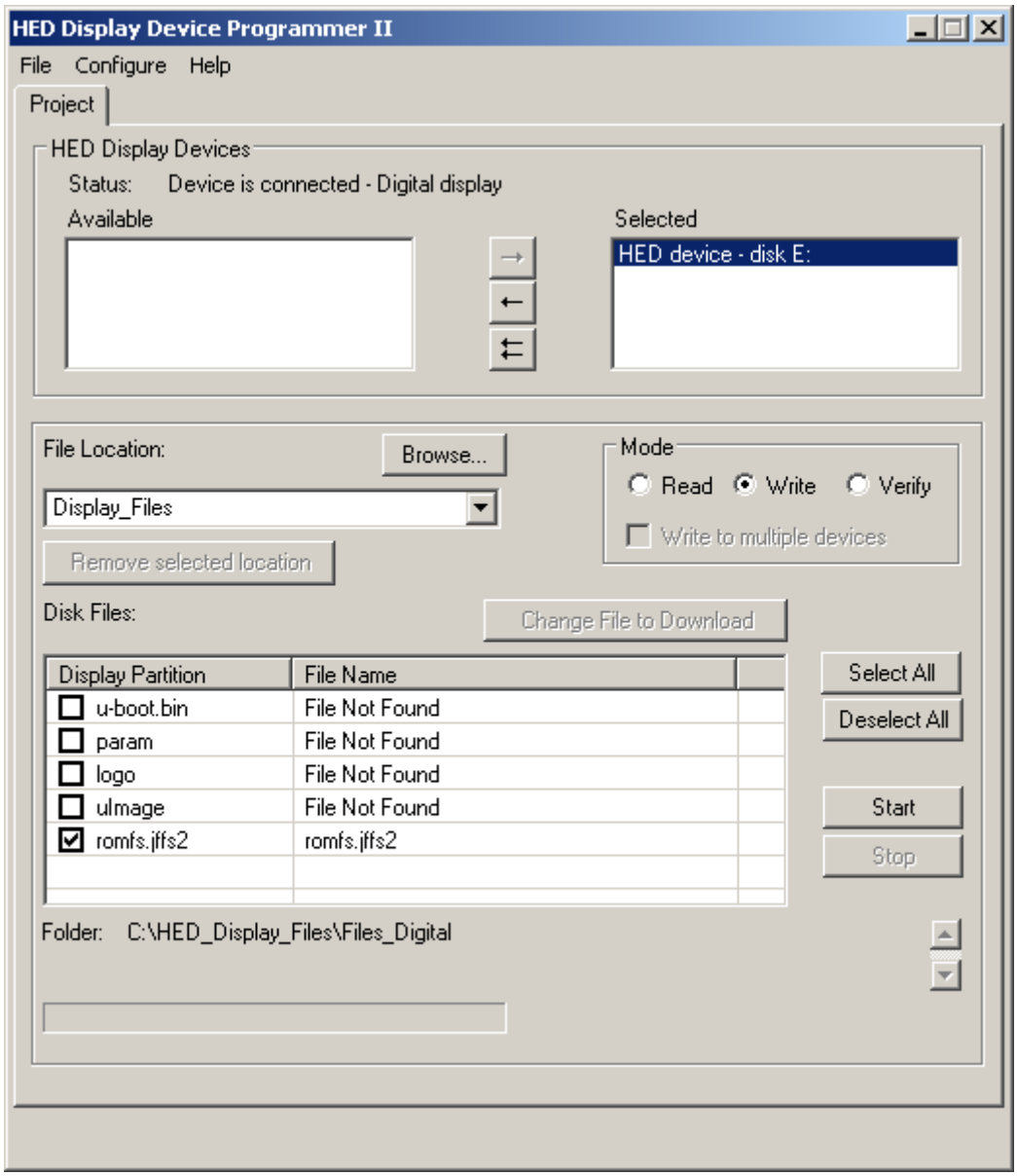
- **Programming the RCL Display**
    - The programmer should automatically detect the display and list it in the Available devices box.



- Select the “HED device” from the “Available” box and click on the → (right arrow) button to move it to the “Selected” box.
- Take notice of what drive letter the “HED Display” is assigned. In the above example, the display has been assigned “disk E:”. This drive letter may be needed later on when disconnecting the display.
- Double check that the correct file(s) has been placed in the “C:\HED_Display_Files\Files_Digital” folder, or folder shortcut.
- The “Disk Files” section shows whether each file is available or unavailable for programming. Check the box to the far left on any files to be programmed.

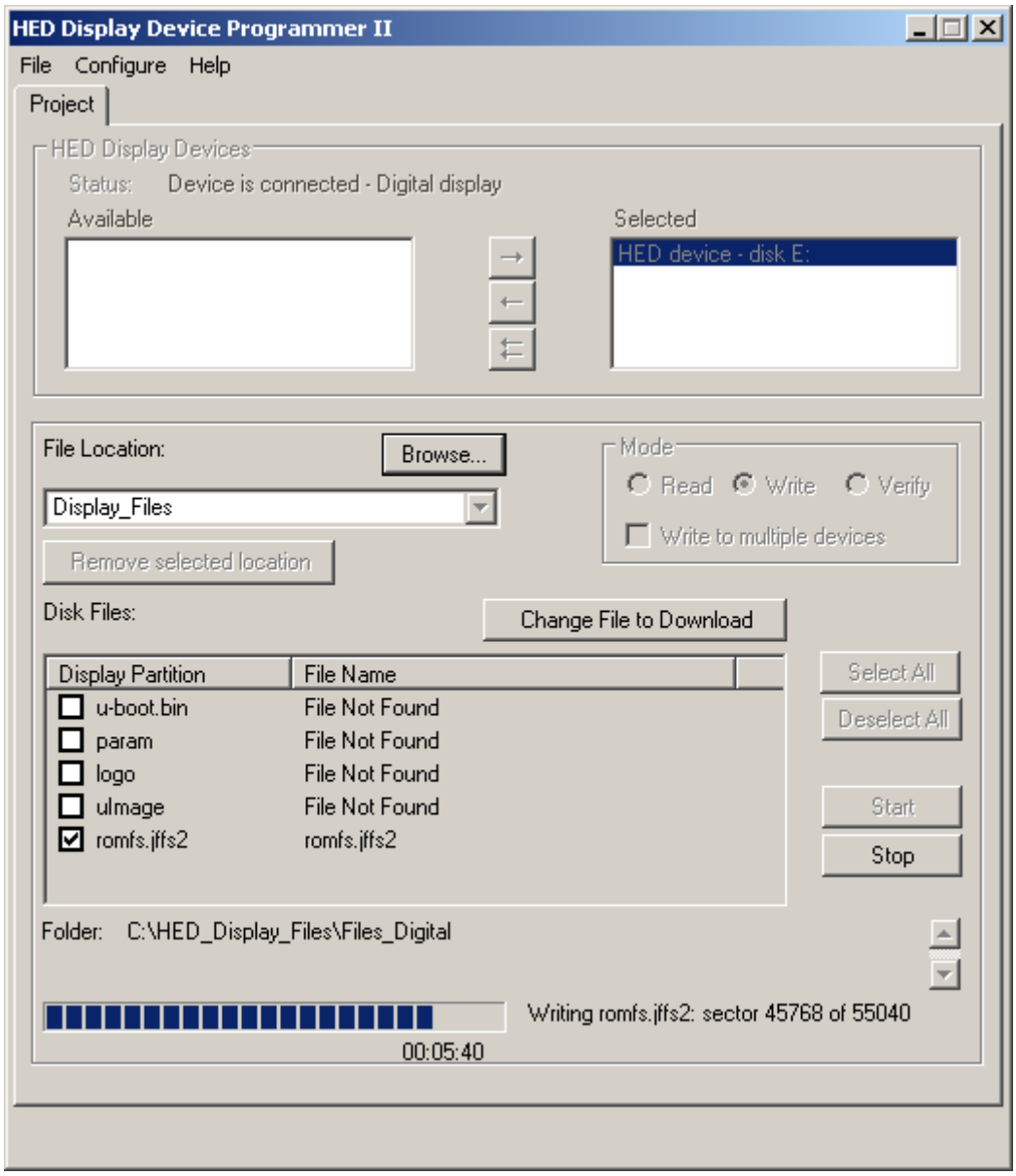


- Verify that the programmer window appears as below.



- Unit should now be ready to program the display. Click the “Start” button.

- The programmer will take several minutes to write and verify the file on the display. View its progress on the bottom of the window.



- When the programmer has finished verifying and reads “Request complete” next to the progress bar, the display has been successfully programmed.

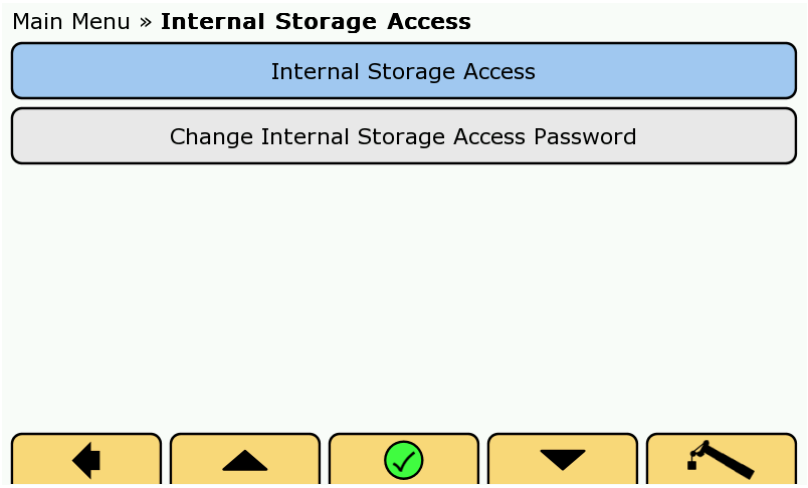
- **Safely disconnect the RCL Display from the PC**
    - On the PC, in the bottom right of the screen in the icons near the clock, click on the green and gray device-removal icon. A list with all removable drives should appear. Click on “Safely remove USB Storage Device”. If more than one device appears, always select the drive letter that matches the one used in the programmer’s “HED Display Devices” section.

    - Disconnect the USB cable.
    - Turn the crane ignition key off.
    - Temporarily disconnect display power by removing the RCL Display fuse, or through use of the Battery Disconnect Switches. Reconnect display power. The display should now be off.
    - Turn the crane ignition key on.
    - The display is now ready to use.

c. Internal Storage Access

The following steps describe how to connect a PC to the RCL Display, gain access to the data logger files, and safely disconnect the display when finished.

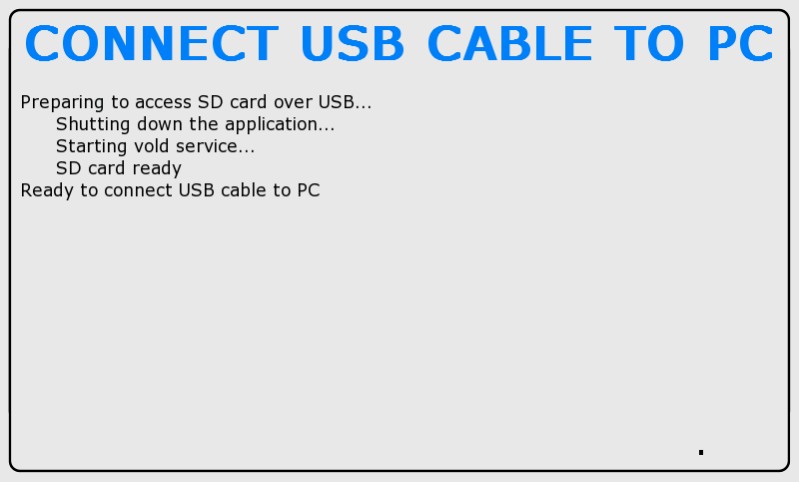
- **Before beginning**
  - Have a USB cable ready for connecting the PC to the display. This is a standard A-to-B USB cable (printer cable).
  - Do not connect the USB cable to the display yet.
  - Turn on the crane ignition key if you have not already done so.
- **Entering Internal Storage Access mode on the RCL Display**
  - Navigate to the “Password Entry” keypad
  - Enter the main menu and stay out of any submenus (confirm the top of the screen reads “Main Menu” only). Simultaneously press the far left, middle, and far right display buttons. The password entry screen should appear. Otherwise repeat as necessary.
  - Enter the password “**99999**” (Note that this password has only five digits instead of the maximum of six.)
  - The Internal Storage Access menu should appear:



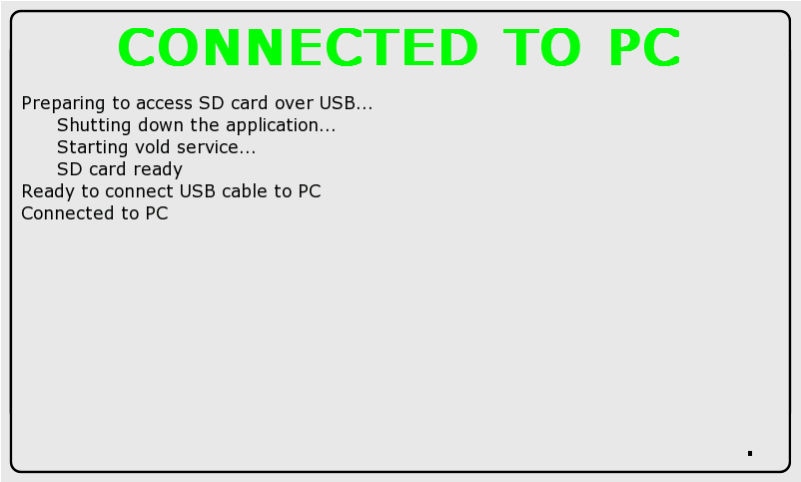
  - Select “Internal Storage Access” from the menu to enter this mode.

- **Connecting a PC to the RCL Display**
    - The Internal Storage Access screen should be shown.
    - Follow the instructions displayed at the top of the screen in large text
- DO NOT CONNECT USB CABLE: The display is preparing its internal memory for connection with the PC.

- CONNECT USB CABLE TO PC: It is now safe to connect the PC to the display through the USB cable.



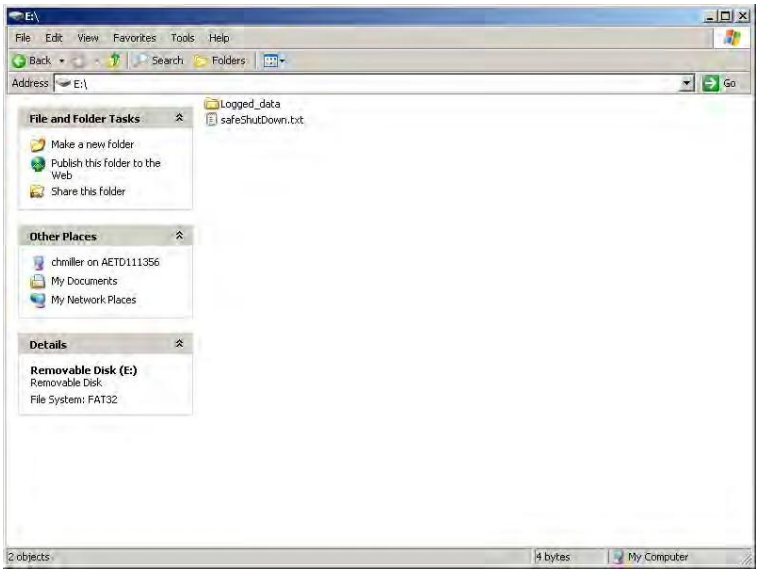
- CONNECTED TO PC: The display has successfully connected to the PC



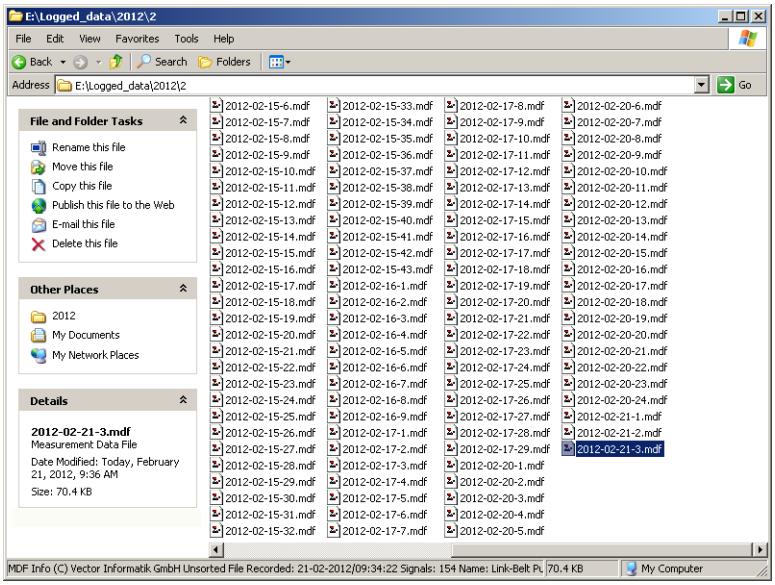
- **Accessing the RCL Display's data logger files**
  - On the PC, go to "My Computer" and locate the new drive.

Note: In this example, the display is listed as "Removable Disk (E:)" and has a different icon than the PC's local disk.

  - Enter the new drive.
  - Enter the "Logged_data" folder.



- The data logger files are separated into folders first by the year (E.g. “2012”), and then month (E.g. “2” for February) of creation. Enter the desired year and month folders.



Note: The data logger files are named by the year, month, and day that they were created. Each file name ends with a number that increases by +1 each time the crane ignition switch was turned-on that day, followed by the “.mdf” file extension.

- The data logger files and folders can be removed or copied from the display to the PC. Note: Do not rename or rearrange any of the original files or folders on the display.

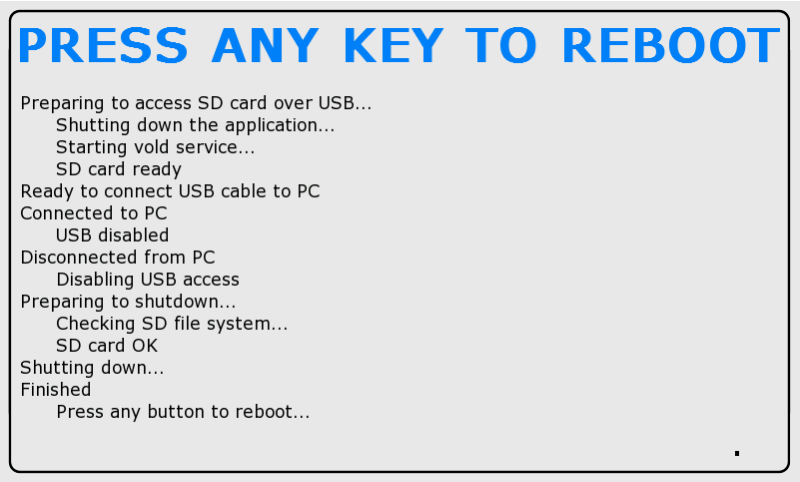
- **Safely disconnect the RCL Display from the PC**

  - Close the display drive folder if it is still open.

  - On the PC, in the bottom right of the screen in the icons near the clock, click on the green and gray device-removal icon. A list with all removable drives should appear. Click on “Safely remove USB Storage Device” (if more than one device appears, always select thecorrect drive letter).

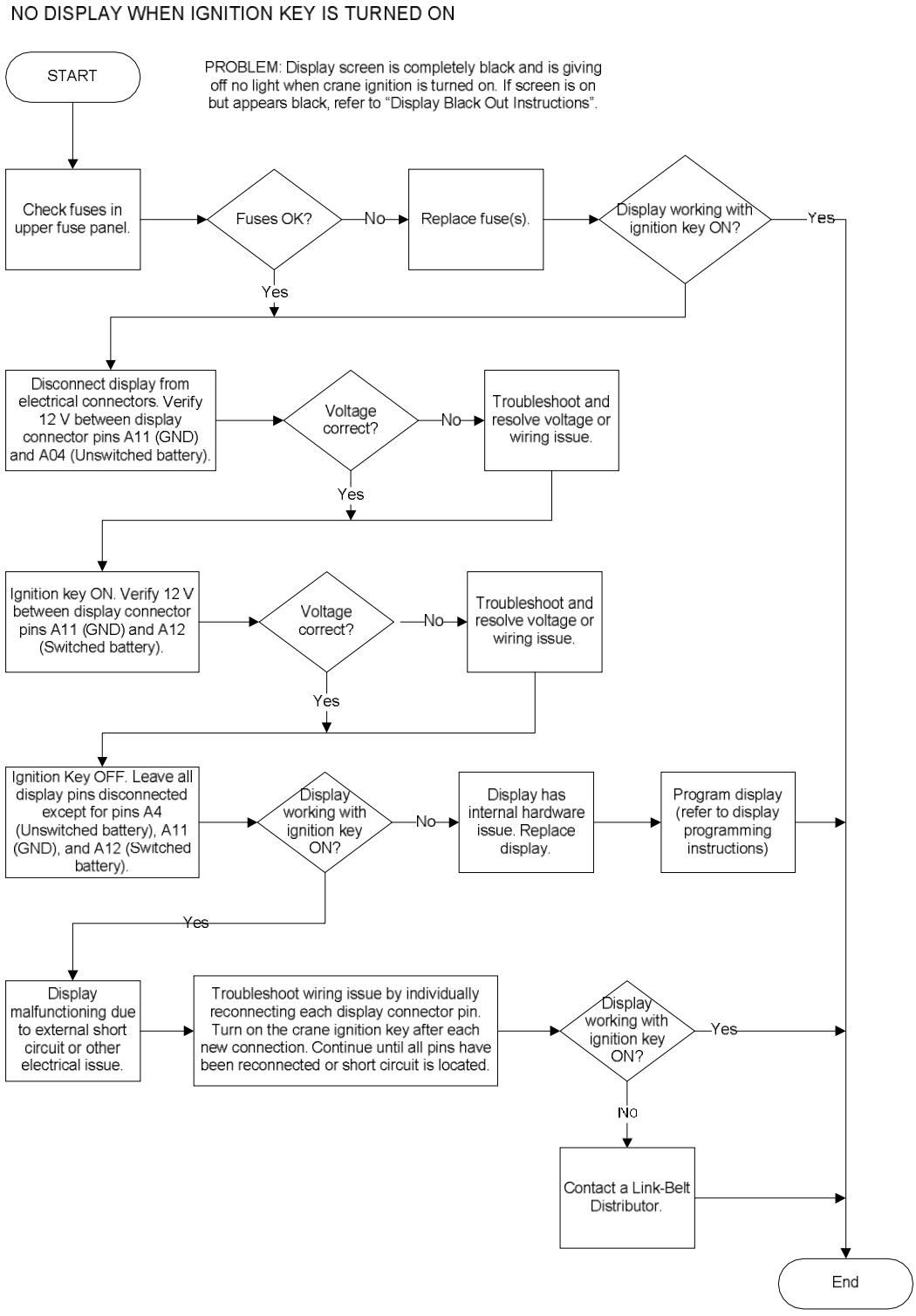
  - Disconnect the USB cable.

  - Wait for the “PRESS ANY KEY TO REBOOT” screen to appear.

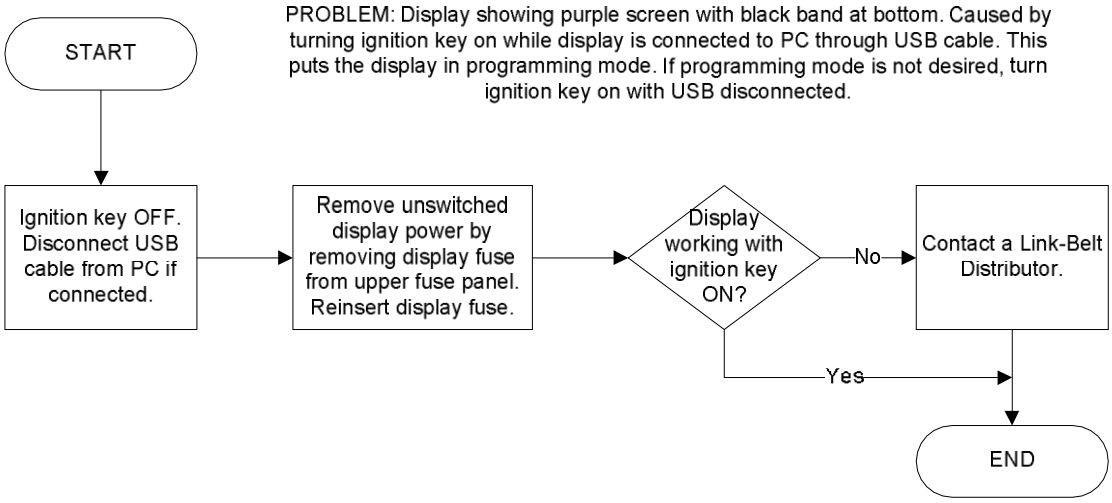


- **Press one of the display buttons to reboot the display.**
    - The display will now exit Internal Storage Access mode and boot into the main working screen.

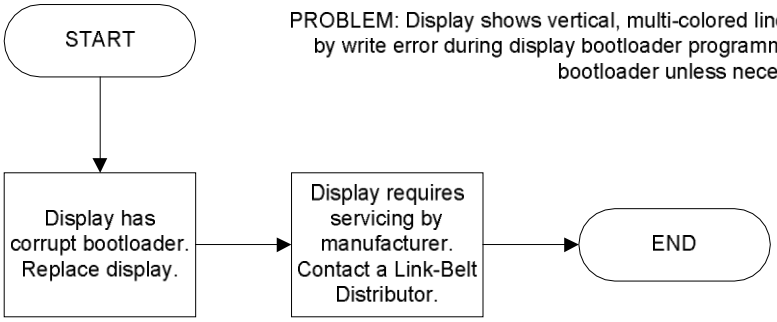
d. RCL Display Issue Flowcharts



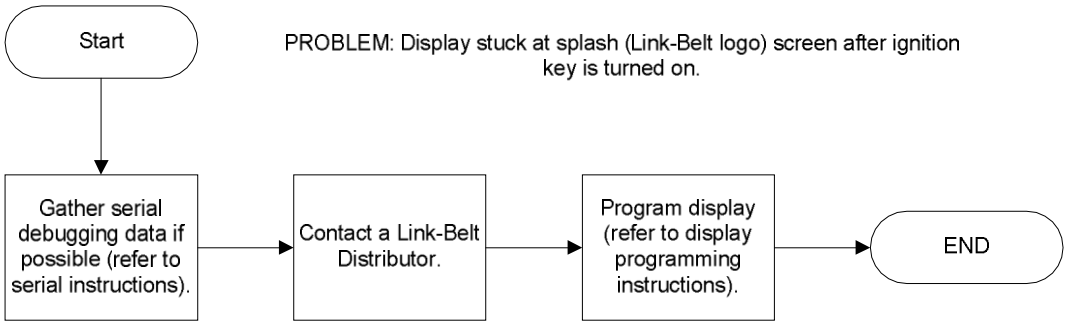
PURPLE SCREEN WHEN IGNITION KEY IS TURNED ON



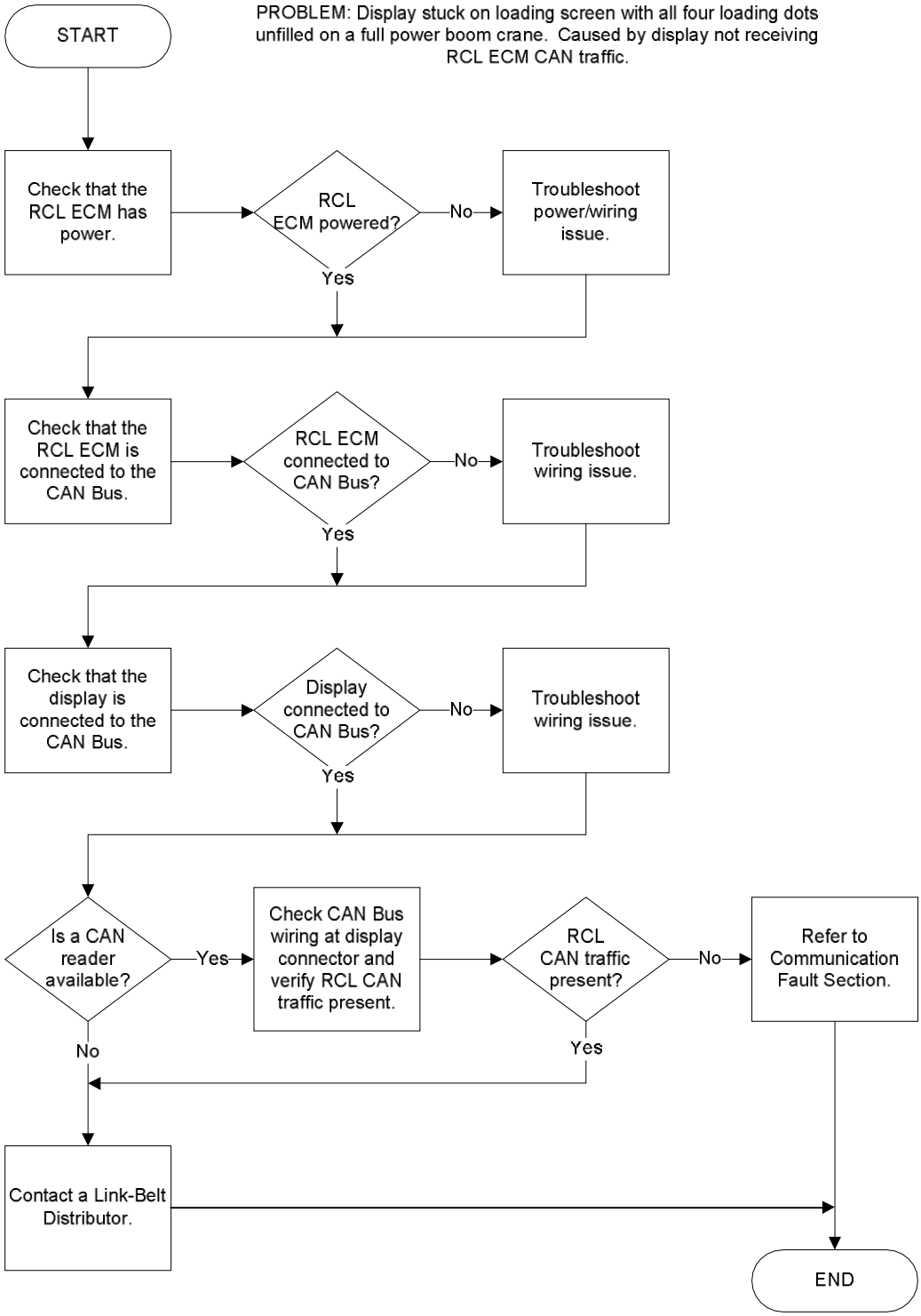
RAINBOW SCREEN AFTER PROGRAMMING DISPLAY



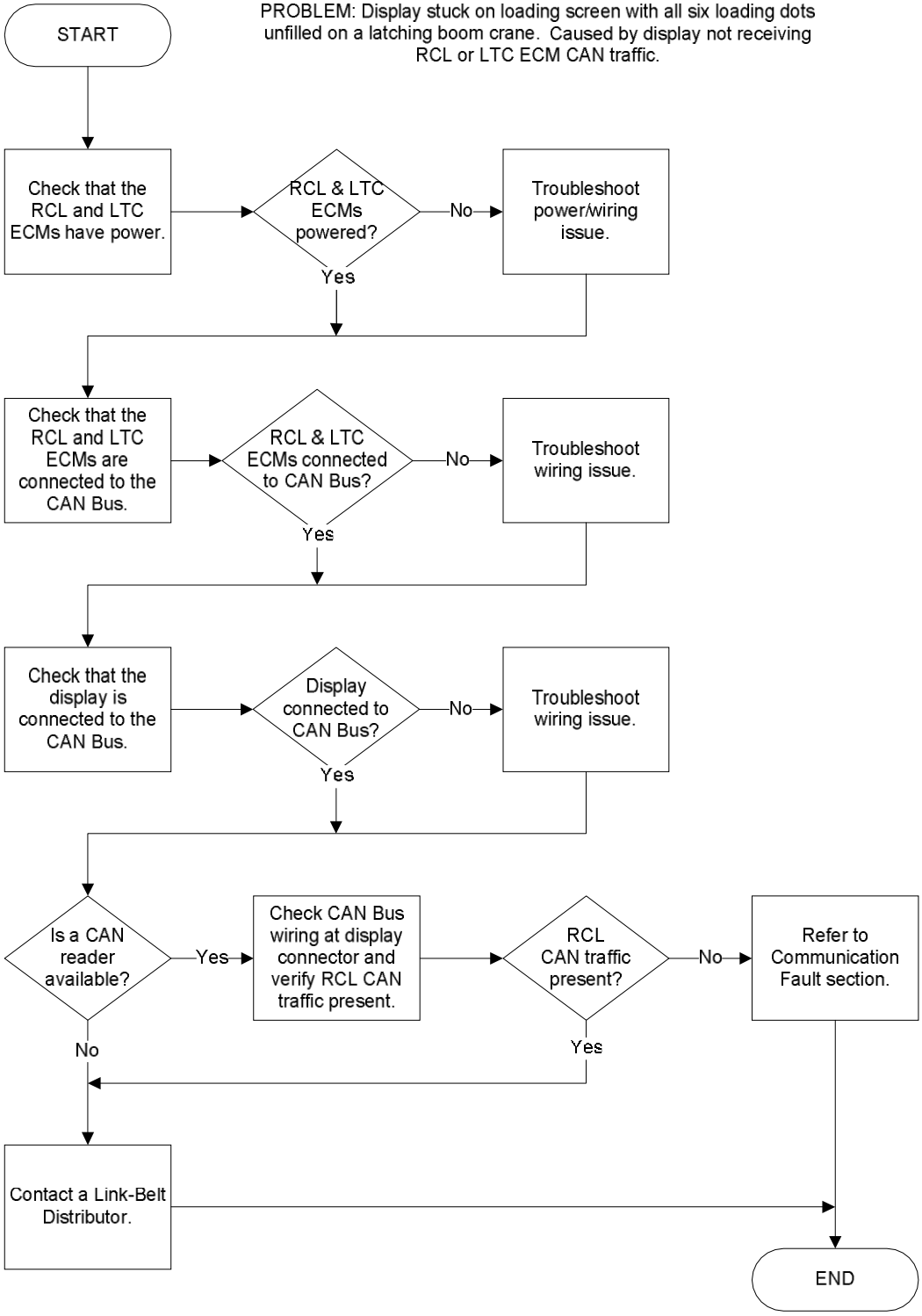
SPLASH SCREEN REMAINS AFTER IGNITION KEY IS TURNED ON



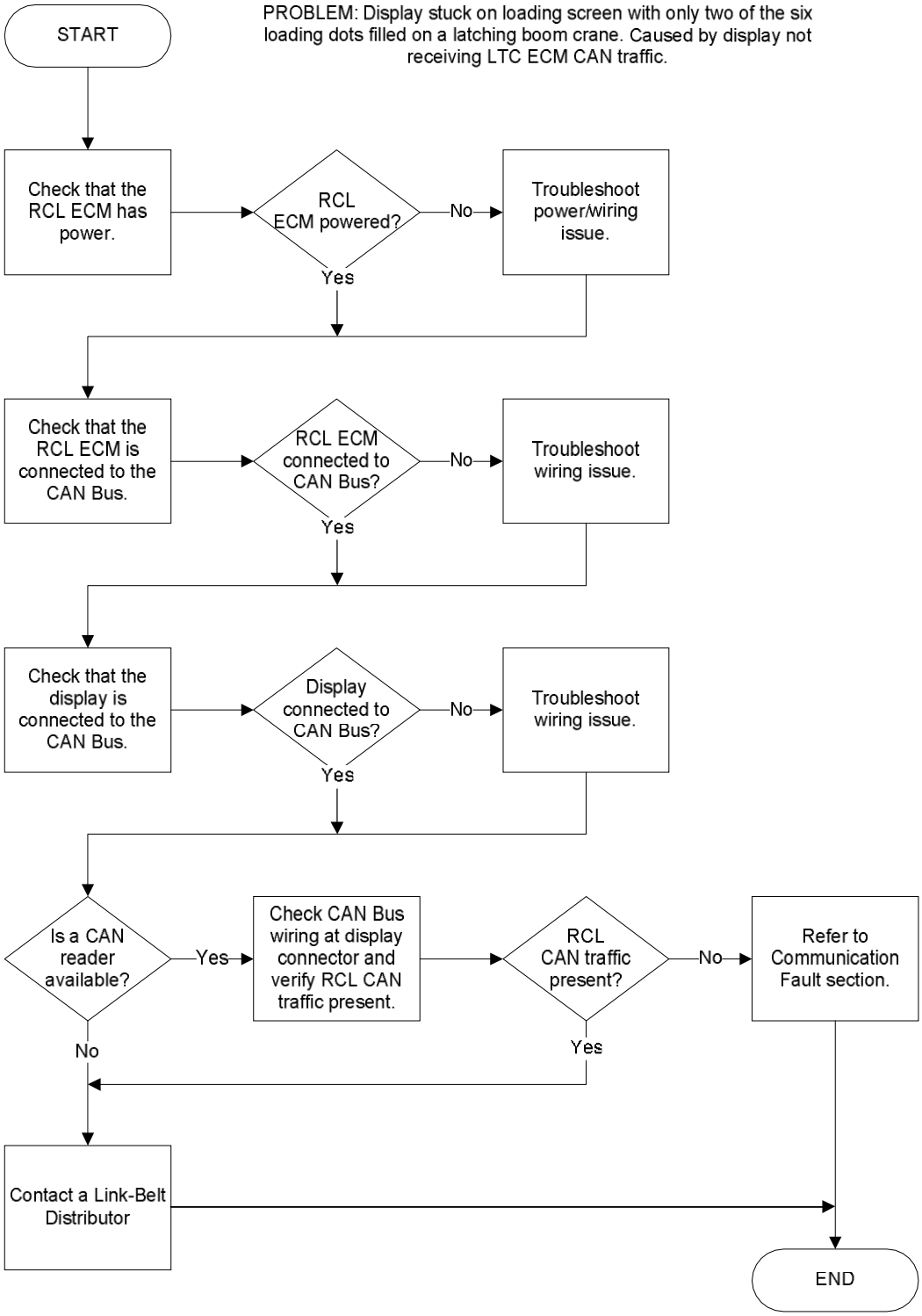
NO LOADING SCREEN DOTS ON FULL POWER BOOM CRANE



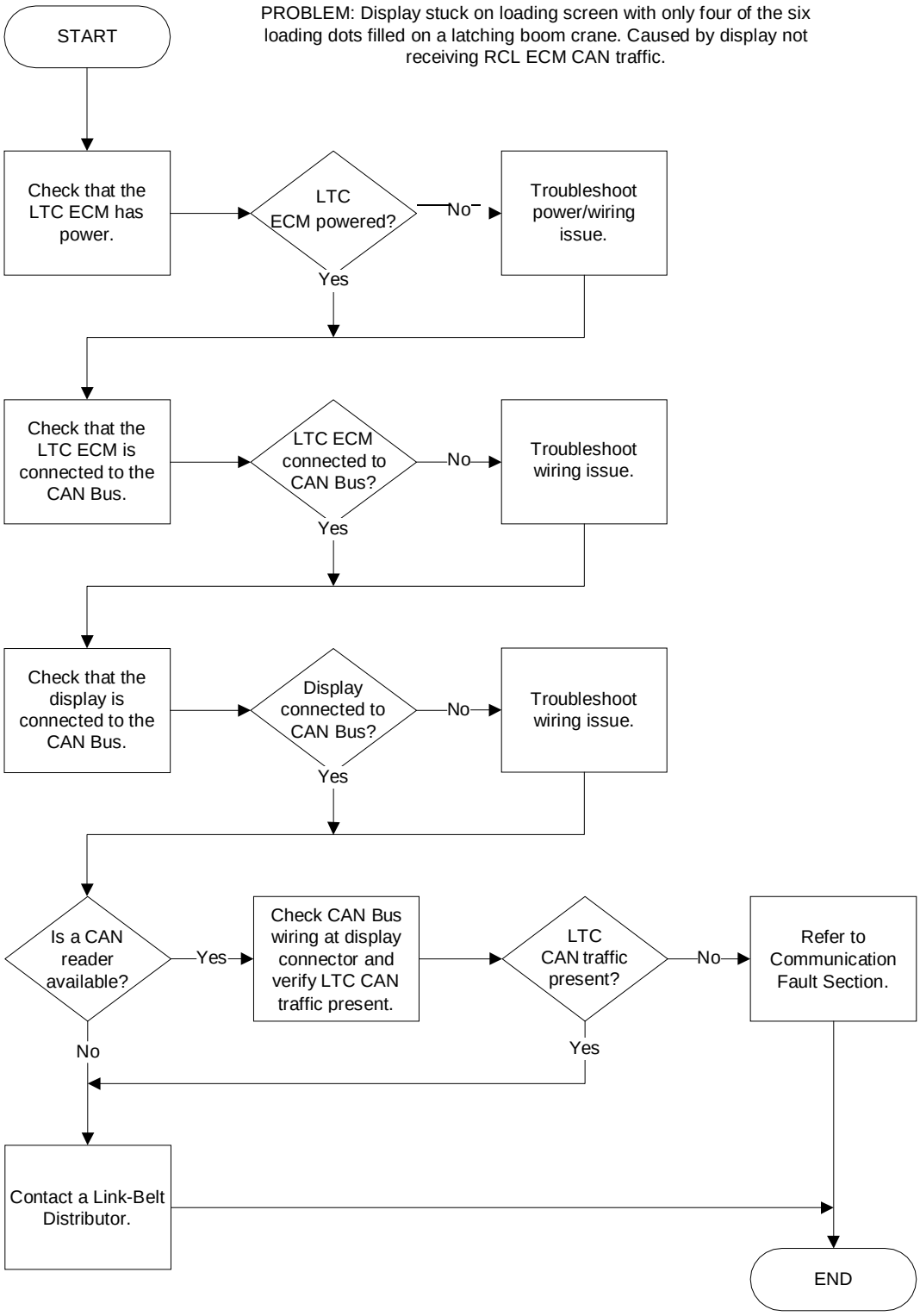
NO LOADING SCREEN DOTS ON LATCHING BOOM CRANE



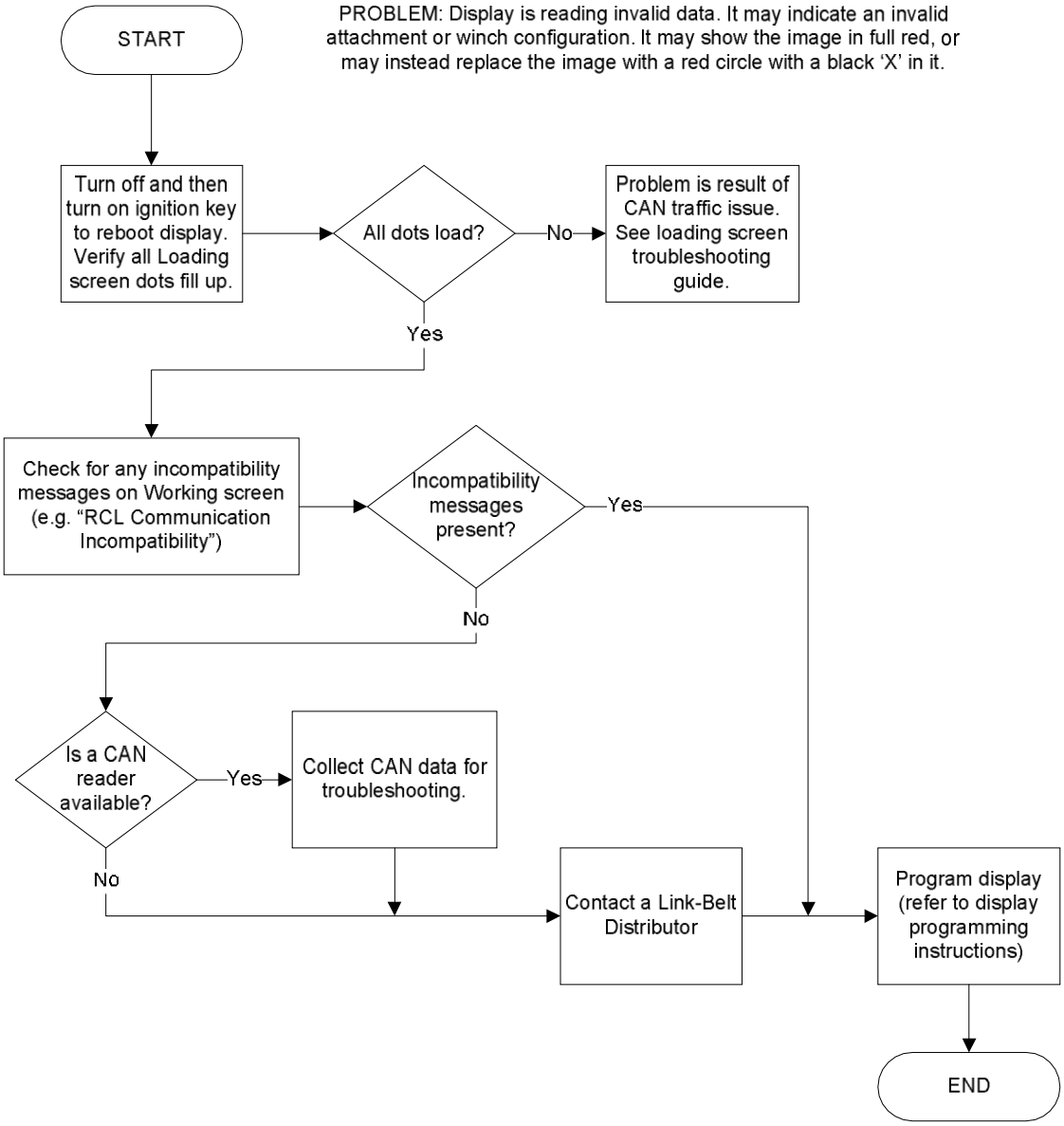
2/6 LOADING SCREEN DOTS ON LATCHING BOOM CRANE



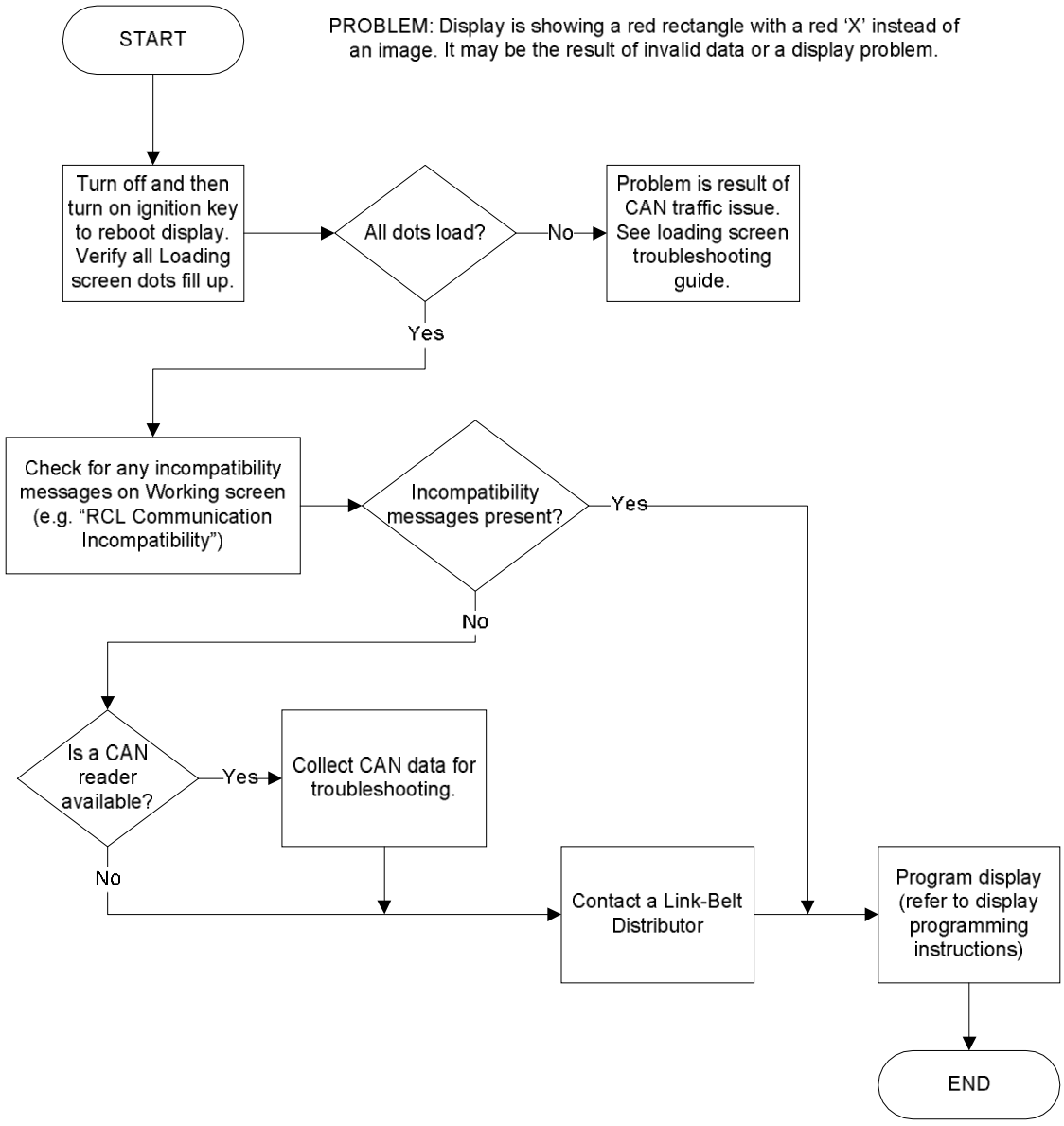
4/6 LOADING SCREEN DOTS ON LATCHING BOOM CRANE



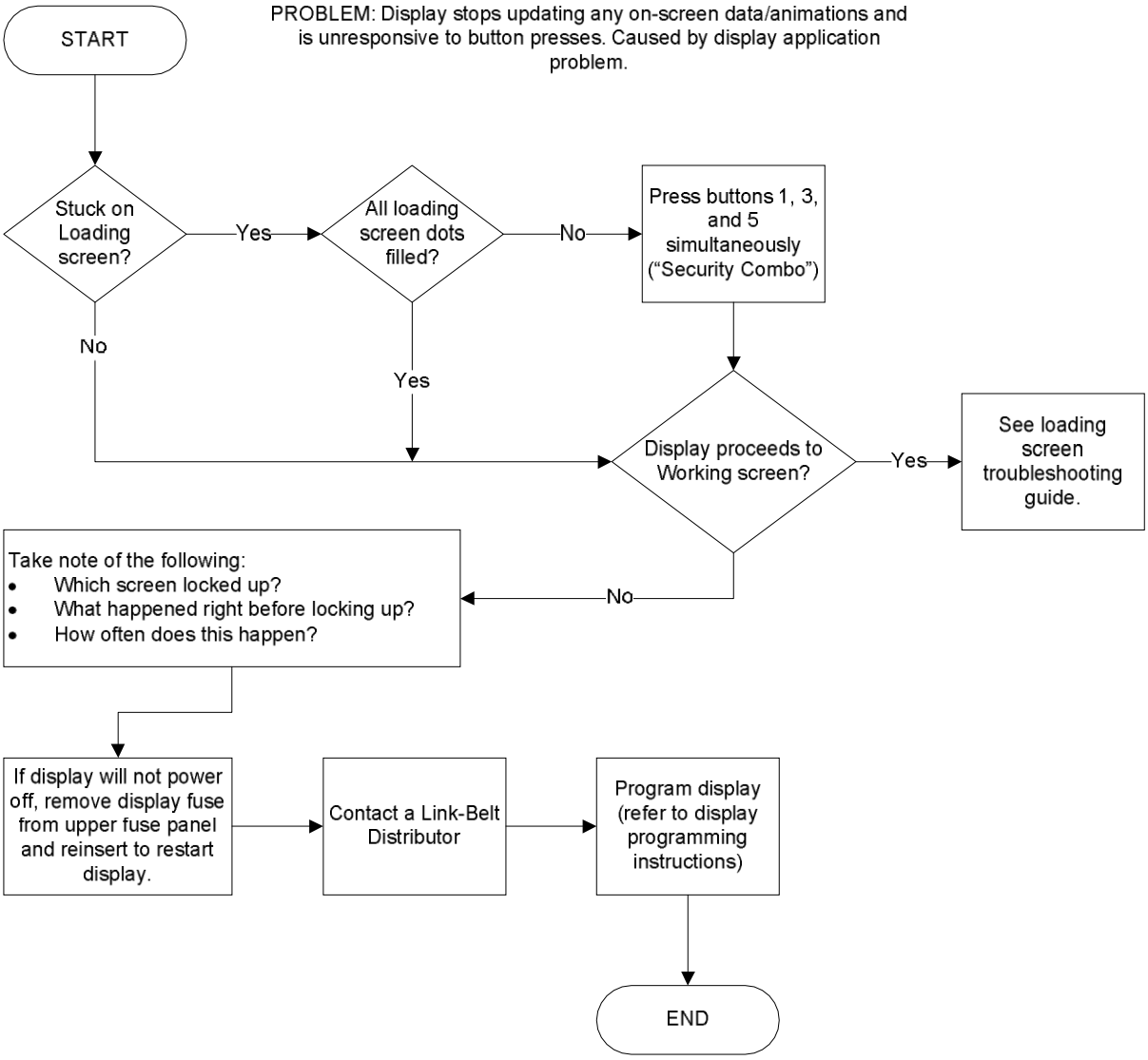
INVALID DATA



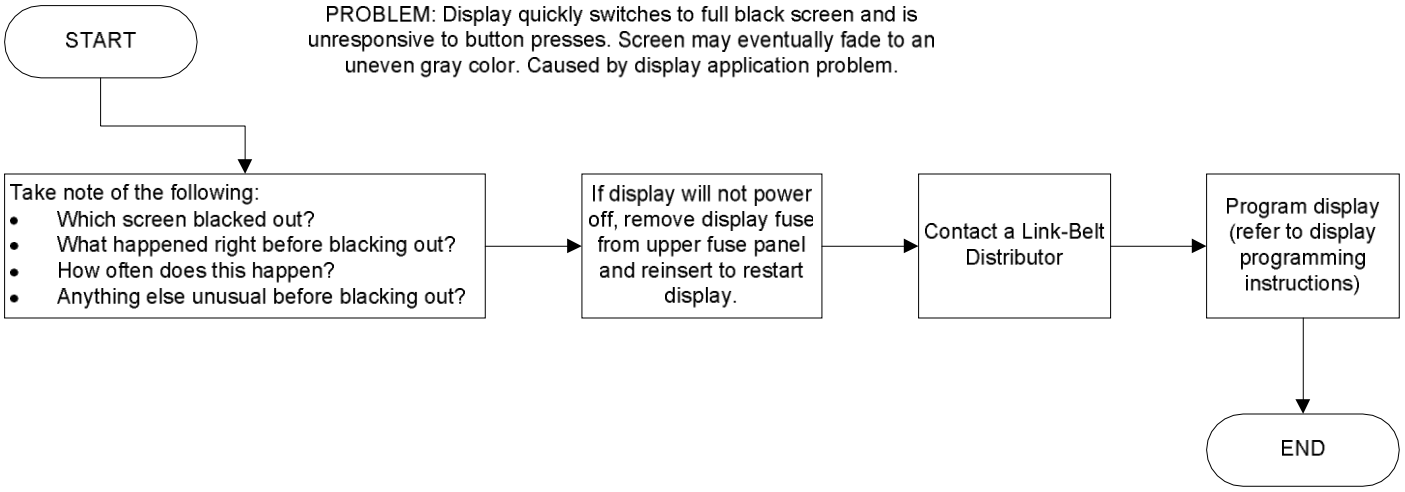
MISSING IMAGE



LOCKED UP DURING OPERATION



BLACKED OUT DURING OPERATION



7. Kickouts

a. Two Block Event

Working Screen Message

“Two Blocking”

Description

A two block event occurs when the hook block, hook ball, or load comes in contact with the anti-two block switch (via the weight wrapped around the wire rope) at the head of the boom, auxiliary sheave, or the fly, depending on the lift point. This is to prevent damage to the boom or fly, and/or wire rope.

Remedy

To remedy a two block condition the load (and associated lifting equipment) must be lowered to prevent contacting the anti-two block weight. This can be accomplished by lowering the load or retracting the boom.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)

b. Capacity Overload

Working Screen Message

“WARNING! Overload”

Description

A capacity overload occurs when the load lifted meets 100% of the rated capacity.

Remedy

To remedy a capacity overload, the load lifted must be reduced or the capacity must be increased. The capacity can generally be increased by decreasing the boom length, or increasing the boom angle.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)
- Placing the Auger (if equipped) in the working position

c. Invalid Configuration

Working Screen Message

“Invalid Configuration”

Description

An invalid configuration condition occurs when the currently selected crane configuration is not allowed as listed in the Crane Rating Manual.

Remedy

To remedy an invalid configuration, refer to the Crane Rating Manual and configure the crane in an allowed configuration.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

d. Low Angle

Working Screen Message

“Minimum Boom Angle”

Description

A low angle condition occurs when the boom gets too close to a component on the lower of the crane, which has the potential to cause damage to the crane.

Remedy

To remedy a low angle condition, raise the boom or swing the boom away from the lower.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

e. System Fault

Working Screen Message

"# System Faults" – # is the number of currently active system faults

Description

A system fault kickout occurs when there is one or more active faults

Remedy

To remedy a system fault kickout, each active fault must be corrected.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

f. RCL Communication Incompatibility

Working Screen Message

“RCL Communication Incompatibility”

Description

A RCL Communication Incompatibility occurs when the CAN messages that the RCL ECM and RCL Display use to communicate with each other are not compatible.

Remedy

To remedy a RCL Communication Incompatibility, the software on the RCL ECM and/or RCL Display must be upgraded or downgraded to a version which ensures each device is using compatible CAN messages.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

g. LTC Communication Incompatibility

Working Screen Message

“LTC Communication Incompatibility”

Description

A LTC Communication Incompatibility occurs when the CAN messages that the RCL ECM, RCL Display, and LTC use to communicate with each other are not compatible.

Remedy

To remedy a LTC Communication Incompatibility, the software on the RCL ECM, RCL Display, and/or LTC must be upgraded or downgraded to a version which ensures each device is using compatible CAN messages.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

h. Crane Type Incompatibility

Working Screen Message

“Crane Type Incompatibility”

Description

A crane type incompatibility occurs when the RCL ECM, RCL Display, and LTC are not all running software for the same crane type (P9, N3, N4, etc.).

Remedy

To remedy a Crane Type Incompatibility, the RCL ECM, RCL Display, and/or LTC, must be programmed with software intended for the same crane type.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

i. Auger Boom Length Limit

Working Screen Message

“Maximum Boom Length”

Description

An auger boom length limit kickout occurs when the boom length exceeds a limit while the auger is in the working position.

Remedy

To remedy an auger boom length limit kickout, retract the boom within the working auger boom length limit.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

j. Platform Boom Length And Radius Limit

Working Screen Message

"WARNING! Overload"

Description

A Platform Boom Length and Radius Limit kickout occurs when the boom length and radius exceeds a limit while the work platform is erected.

Remedy

To remedy a platform boom length and radius limit kickout, retract the boom or reduce the radius.

Kickout Overrides

The following overrides will disable this kickout.

- Bypass mode
- Rigging mode
- Press and hold cancel alarm button for 5 seconds
- Travel mode
- Fly Setup mode (if equipped)
- Manual mode (latching booms only)

k. Fly Setup Mismatch

Working Screen Message

“Fly Setup Mismatch”

Description

A fly setup mismatch kickout occurs when the fly setup sensor is activated when not in fly setup mode.

Remedy

To remedy a fly setup mismatch, fully retract the boom and enter fly setup mode within the attachment menu.

Kickout Overrides

The following overrides are still active.

- Fly Setup mode (if equipped)

I. Bypass Mode

Working Screen Message

“Bypass”

Description

Bypass mode is activated by turning the bypass key switch on the crane to the bypass position. Bypass mode “deactivates” the RCL portion of the Pulse system and all kickouts are disabled.

To Deactivate

To deactivate Bypass mode, turn the bypass key switch on the crane to the working position.

Kickouts

The following kickouts are still active.

- None

m. Manual Mode

Working Screen Message

“Manual”

Description

Manual mode is activated by engaging the boom telescope manual control box.

To Deactivate

To deactivate Manual mode disengage the boom telescope manual control box.

Kickouts

The following kickouts are still active.

- Two Block Event
- Fly Setup Mismatch (if equipped)

n. Rigging Mode

Working Screen Message

“Rigging”

Description

Rigging mode is activated by choosing Rigging in the Outrigger submenu under Crane Configuration.

To Deactivate

To deactivate Rigging mode, choose another outrigger option.

Kickouts

The following kickouts are still active.

- Fly Setup Mismatch (if equipped)

o. Travel Mode

Working Screen Message

“Travel”

Description

Travel mode is activated by choosing Travel in the Outrigger submenu under Crane Configuration.

To Deactivate

To deactivate Travel mode, choose another outrigger option.

Kickouts

The following kickouts are still active.

- Fly Setup Mismatch (if equipped)

p. Auger Working

Working Screen Message

“No Capacity! Auger In Use”

Description

To select the auger in Working mode, choose Working in the Auger submenu under Crane Configuration.

To Deactivate

To take the Auger out of Working mode, choose another option in the Auger submenu.

Kickouts

The following kickouts will are still active.

- Two Block Event
- Invalid Configuration
- Low Angle
- System Fault
- RCL Communication Incompatibility
- LTC Communication Incompatibility
- Crane Type Incompatibility
- Auger Boom Length Limit (if equipped)
- Fly Setup Mismatch (if equipped)

8. Load And Radius

a. Load On Hook And Radius

Load on Hook

Items that affect Load on Hook

1. Crane Configuration – must be configured correctly
    - Fly mode
    - Boom mode
    - Lift point
    - Stowed fly
    - Aux head
    - Parts of line
    - Auger (if available)
    - Platform (if available)

2. Sensor Inputs – Must have no faults and value must be correct
    - Boom length
    - Boom angle
    - Fly angle (if fly is erected)
    - Piston pressure
    - Rod pressure
    - Telescope Cylinder(s) length
        - Length given by LTC (via CAN) on Latching Boom Cranes
        - Calculated by RCL ECM on Full-Power Boom Cranes
    - Head angle

3. Section lengths
    - Latching Boom Crane – shown on working screen
        - Calculated by LTC and broadcast on CAN bus
            - CAN ID: 0x18FFFC32
            - CAN Fields:
                - t1ExtendPercentLatching
                - t2ExtendPercentLatching
                - t3ExtendPercentLatching
                - t4ExtendPercentLatching
                - t5ExtendPercentLatching
                - t6ExtendPercentLatching
                - t7ExtendPercentLatching
                - t8ExtendPercentLatching

- Full-Power Boom Crane – not shown on display at all, only on CAN bus
  - Calculated by RCL ECM via Inputs
    - Inputs
      - Boom mode
      - Boom length
    - Broadcast on CAN to be shown on display
      - CAN ID: 0x18FF44D0
      - CAN Fields:
        - t1ExtendPercentFullPower
        - t2ExtendPercentFullPower
        - t3ExtendPercentFullPower
        - t4ExtendPercentFullPower
        - t5ExtendPercentFullPower
        - t6ExtendPercentFullPower
        - t7ExtendPercentFullPower
        - t8ExtendPercentFullPower

4. Friction – if all other is good, friction may need to be recalibrated. Refer to the Link-Belt Pulse Calibration Manual.
   - Inputs
     - Boom length
     - Boom angle
     - Piston pressure
     - Rod pressure
     - Hoist cylinder direction (up, down, or static)
       - hoist cylinder direction is determined by boom up and down switches

Radius - Distance from centerline of rotation to the centerline of the load, parallel to the horizon

Items that affect Radius

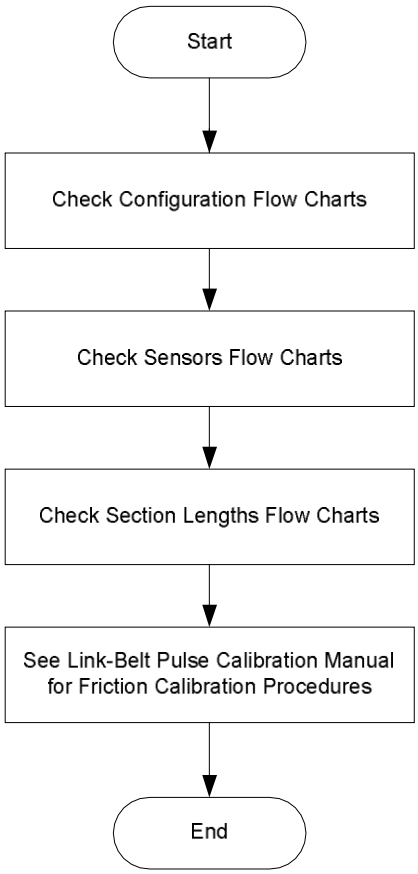
1. Crane Configuration – must be configured correctly
   - Fly mode
   - Boom mode
   - Lift point
   - Aux head
   - Parts of line
   - Platform

2. Sensor Inputs – Must have no faults and value must be correct
   - Head angle
   - Boom length
   - Boom angle
   - Fly Angle (if fly is erected)

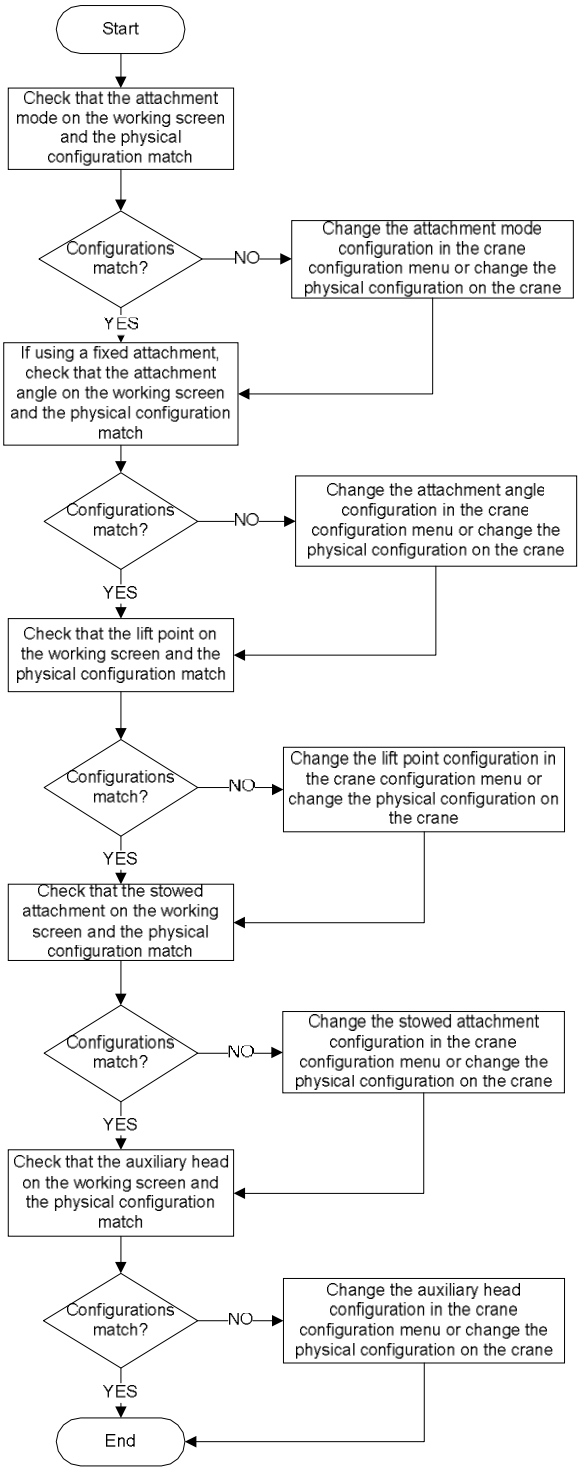
b. Flowcharts

i. Load Flowcharts

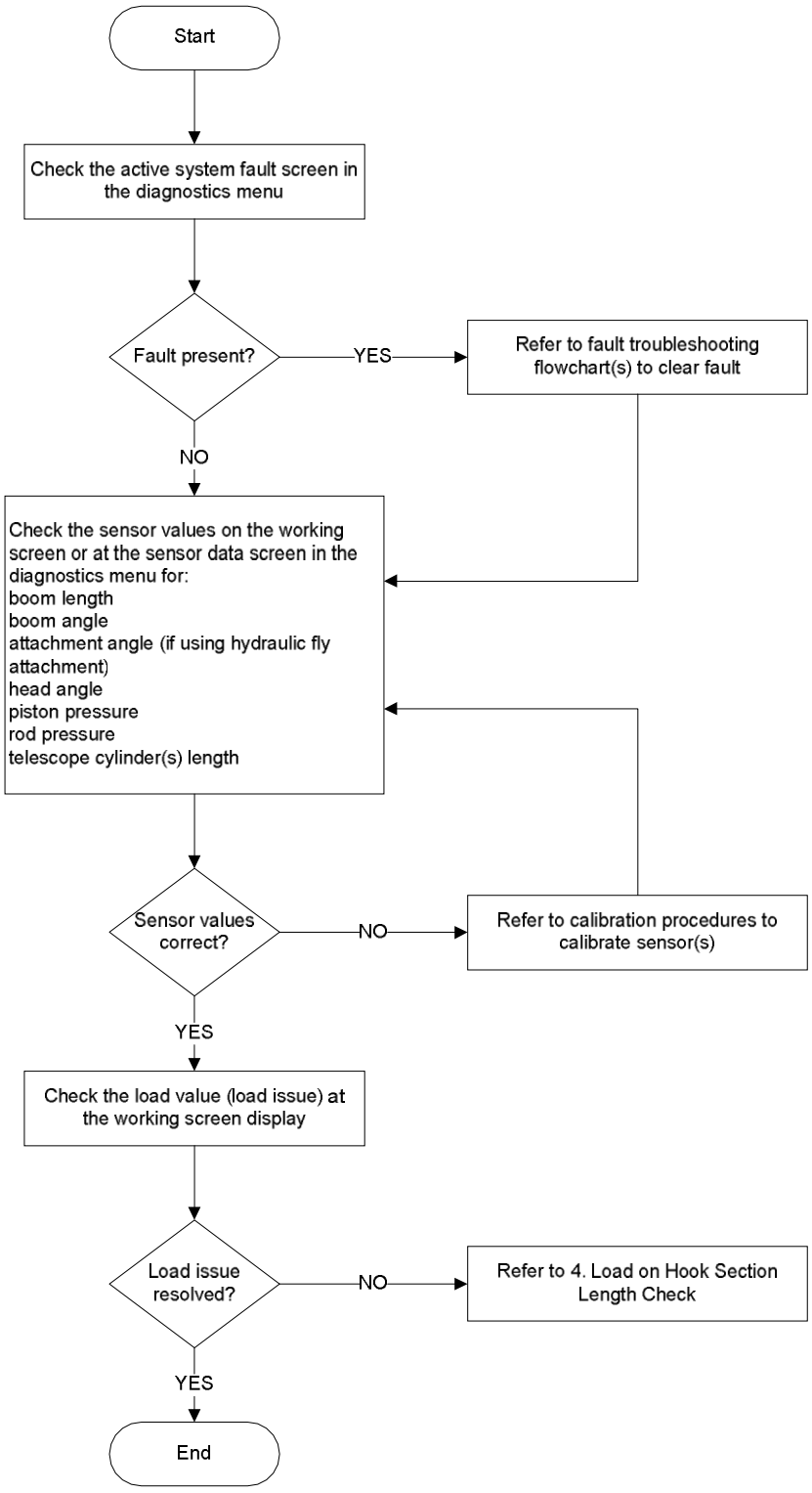
1. Load Road Map



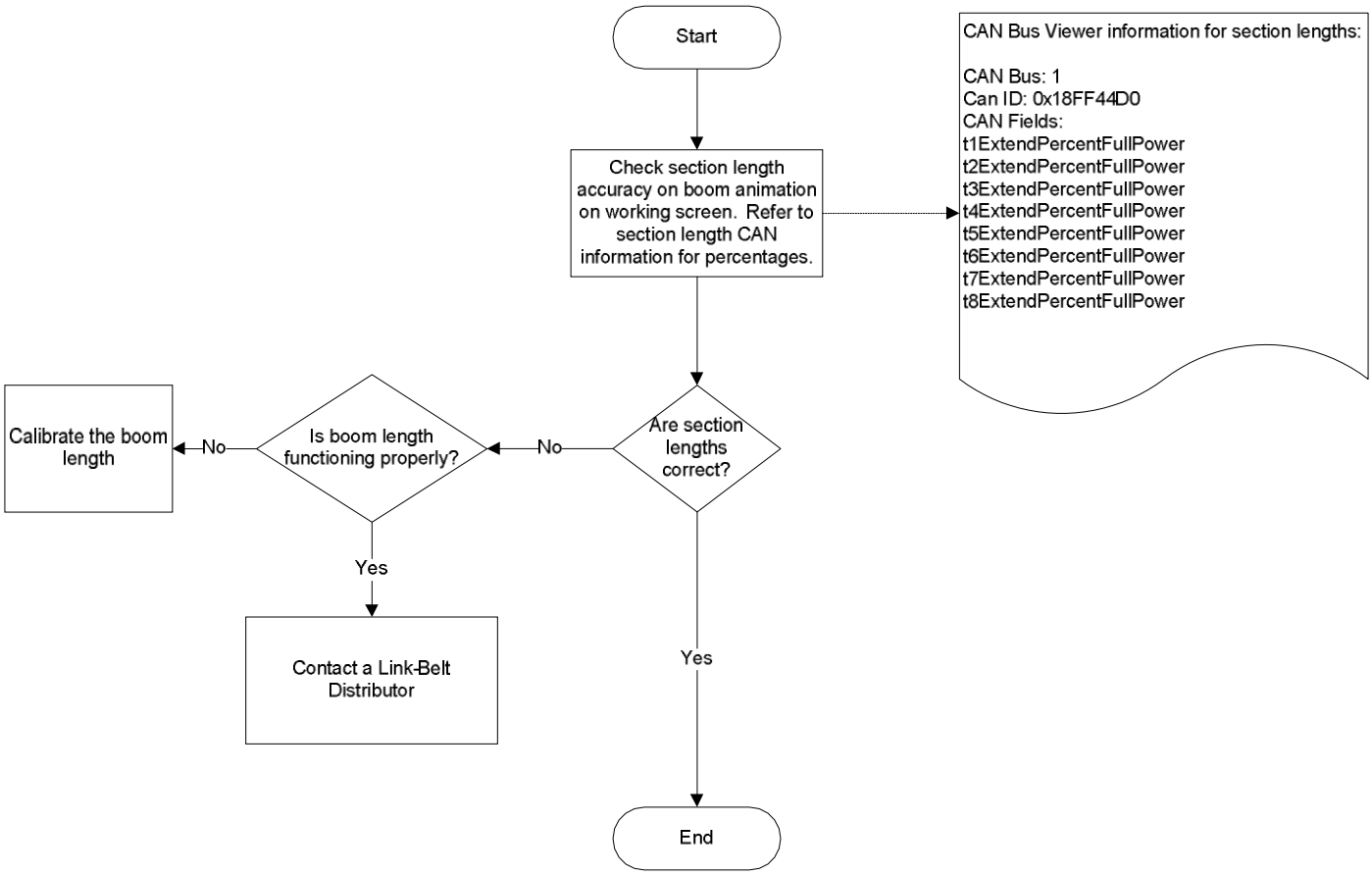
2. Load On Hook Configuration Check



3. Load On Hook Sensor Check

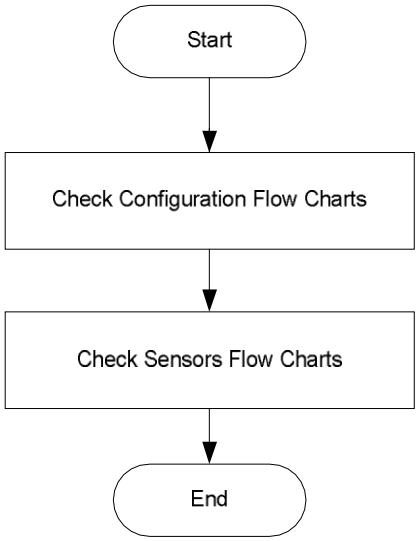


4. Load On Hook Section Length Check

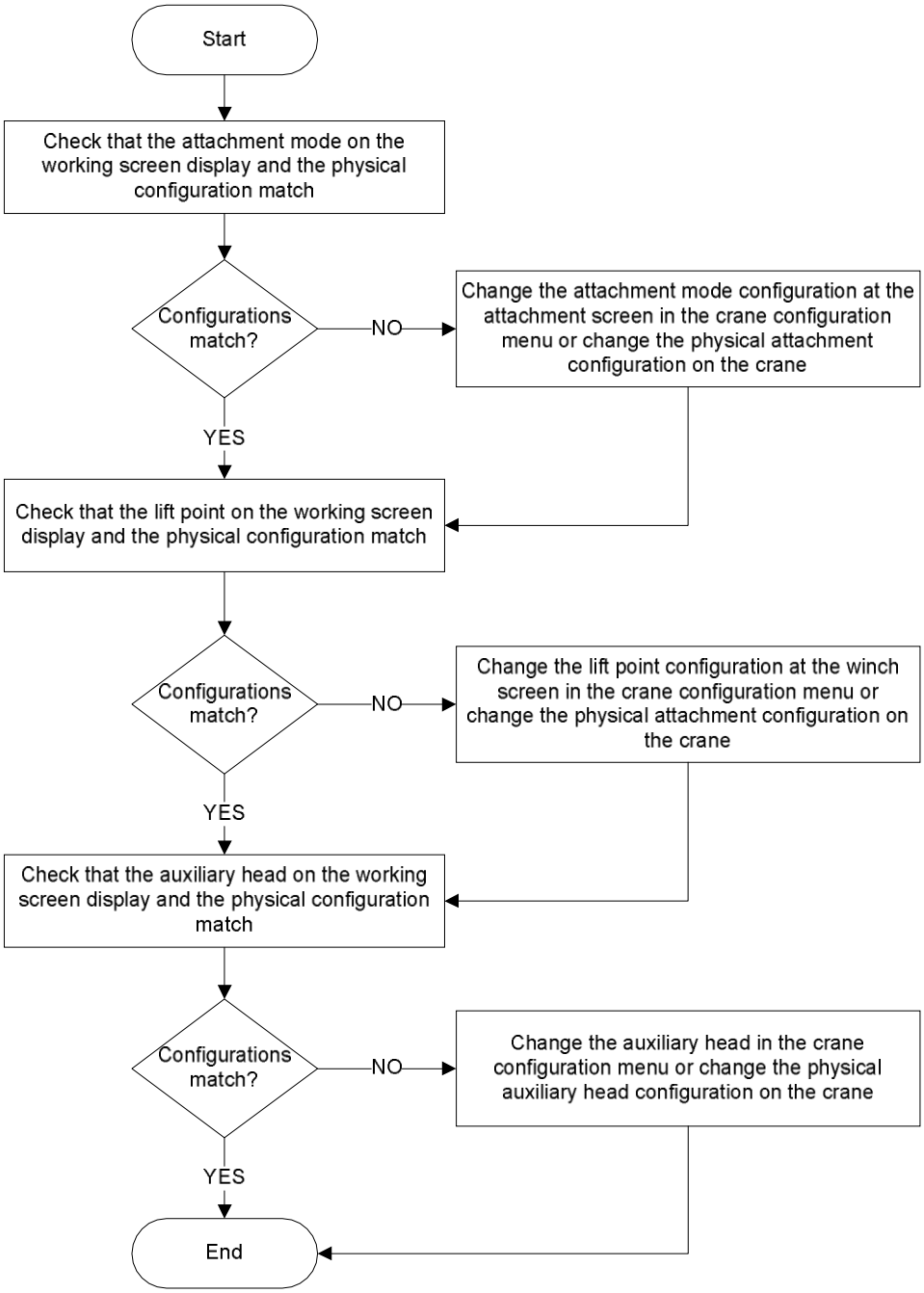


ii. Radius Flowcharts

1. Radius Road Map



2. Radius Configuration Check



3. Radius Sensor Check