RCI-8522 Installation Service Manual
Tension & Load Moment Systems

Installation and User Guide

MAN-1110 Rev A

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1: OVERVIEW

1.1. About This Manual

This service manual describes how to install, calibrate and service the RCI-8522 Crane Safety System.

While the main body of this service manual is common to all RCI-8522 systems, information relating specifically to the crane identified on the front cover is located in the following Appendices:

Appendix A,
Appendix B, General Arrangement Drawing
Appendix C, Software Duty Configuration

Refer to the RCI-8522 Operator Manual to find out how to operate the safety system.

1.1a. Who Should Read This Manual

This manual assumes that you are a trained and qualified Authorised LSI-Robway Channel Partner, with access to the necessary tools in order to perform the tasks described herein.

1.1b. How To Provide Feedback To LSI-Robway

LSI-Robway welcomes your feedback on the accuracy and effectiveness of this document. Please send feedback to mail@lsirobway.com. Please include the title of the manual and version (this information is located in the revision history on p. 84) with your feedback.

1.1c. How This Manual Is Updated.

LSI-Robway will issue new releases of this manual as new material becomes available. Refer to the Document Revision History at the back of the manual.

1.1d. How to Contact LSI-Robway.

Please contact LSI-Robway if you encounter problems or require advice. Contact details are located inside the front cover and please ensure that you can provide the information listed in 8.9 Contacting LSI-Robway on p. 73.

1.1e. Notifications Included in Document

The following notations may be used in this manual:

NOTE

HINTS AND TIPS TO FACILITATE SYSTEM INSTALLATION OR UNDERSTANDING.

CAUTION

PROTECT YOURSELF AGAINST PRODUCT PERFORMANCE ISSUES, PRODUCT FAILURE, AND/OR PROPERTY DAMAGE.

WARNING

PROTECT YOURSELF AGAINST SERIOUS INJURY OR DEATH.

1.2. Glossary

Abbreviations used in this manual are listed below:

ADC	Analog To Digital Converter
ATB	Anti-Two-Block
Aux	Auxiliary lifting point, typically a lower capacity hoist
DGND	Digital Ground
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
GA	General Assembly drawing showing system components and wiring, aka as-built drawing
I/O	Input/Output
NC	Normally Closed (Electrical)
NO	Normally Opened (Electrical)
PIN	Personal Identification Number
RCI	Rated Capacity Indicator
SWL	Safe Working Load (Also known As Working Load Limit)
WA	Work Authority. Used as a specific Software Job Number reference; normally a 6 digit number and may be prefixed WA

2: SAFETY

WARNING

THE SAFETY SYSTEM IS NOT A SUBSTITUTE FOR GOOD OPERATOR JUDGMENT, EXPERIENCE AND SAFE CRANE OPERATION. THE OPERATOR IS RESPONSIBLE FOR THE SAFE OPERATION OF THE CRANE AT ALL TIMES.

WARNING

THE SAFETY SYSTEM MAY BE EQUIPPED WITH AN OVERRIDE KEY THAT BYPASSES ALARMS AND MOTION LIMITER FUNCTIONS. IF THIS OVERRIDE FUNCTION IS USED, THE SAFETY SYSTEM CAN NO LONGER WARN OF IMPENDING OVERLOAD AND THE CRANE MUST BE OPERATED STRICTLY IN ACCORDANCE WITH THE CRANE MANUFACTURER'S SETUP AND OPERATION PROCEDURES.

THE OVERRIDE KEY IS FOR AUTHORIZED PERSONNEL ONLY WHO SHALL BE SOLELY RESPONSIBLE FOR ITS USE.

WARNING

IN CERTAIN SITUATIONS (SUCH AS CRANE SETUP), THE CRANE OPERATOR MAY NEED TO OVERRIDE THE MOTION LIMITERS. AT THESE TIMES, THE SYSTEM CAN NO LONGER WARN OF OVERLOAD AND THE CRANE MUST ONLY BE USED IN STRICT ACCORDANCE TO THE CRANE MANUFACTURER'S SETUP AND OPERATION PROCEDURES.

WARNING

FOLLOW RELEVANT CODES OF PRACTICE AT ALL TIMES.

WARNING

SERVICE EQUIPMENT ONLY WITH AUTHORIZED LSI-ROBWAY PROCEDURES, TOOLS, AND PERSONNEL.

THE SAFE, RELIABLE OPERATIONS OF LSI-ROBWAY SAFETY SYSTEMS REQUIRES THAT THESE SYSTEMS ARE MAINTAINED IN A PROPER MANNER AND SERVICED BY AN AUTHORIZED LSI-ROBWAY DEALER FOLLOWING TRADE OR PROFESSIONAL RECOGNIZED SERVICE PROCEDURES, USING THE CORRECT TOOLS FOR THE PURPOSE.

CAUTION

HIGH TENSILE BOOMS REQUIRE PROPER WELDING PROCEDURE SPECIFICATIONS. OBTAIN SPECIALIST ASSISTANCE WHERE APPLICABLE.

CAUTION

READ AND UNDERSTAND THIS MANUAL BEFORE INSTALLING, CALIBRATING OR TROUBLESHOOTING AN LSI-ROBWAY CRANE SAFETY SYSTEM.

CAUTION

MOTION LIMITERS MAY HAVE BEEN FITTED TO STOP THOSE FUNCTIONS THAT WILL INCREASE THE RADIUS AND HOIST UP IF THE LOAD CHART IS EXCEEDED. THIS FEATURE AIDS SAFE CRANE OPERATION.

CAUTION

CORRECT SYSTEM OPERATION MEANS THAT THE LSI-ROBWAY CRANE SAFETY SYSTEM MUST BE CORRECTLY CONFIGURED TO MATCH THE CRANE'S SETUP AND WORKING CONFIGURATION.

The safe working load capacities in the load charts are provided to LSI-Robway by one of these parties:

- The crane manufacturer.
- Directly from the crane owner or operator.
- Authorised LSI-Robway dealer on behalf of the crane owner or operator.
- LSI-Robway dutifully represents these capacities into the safety system memory.

CAUTION

THE RCI-3522 SYSTEM IS DESIGNED AS AN OPERATOR AID AND IS IN NO WAY A SUBSTITUTE FOR SAFE OPERATING PRACTICES.

CAUTION

CAREFULLY READ AND UNDERSTAND THIS MANUAL BEFORE PROCEEDING.

3: GENERAL DESCRIPTION

3.1. Overview

The LSI-Robway RCI-8522 Safety System is a device that warns the crane operator of impending overload and over-hoist conditions that could cause injury, or damage to property or the crane. This safety system warns the operator of:

- Approach to overload and overload warning (typically 85% and 100%, with visual and audible alarms).
- Overload (typically 105%, with visual and audible alarms, and motion-cut outputs).

3.2. Capabilities

The Operator Screen of the RCI-8522 displays:

- Safe working load (SWL) (max load) with % bar graph
- Total lifted load
- Radius
- Boom angle
- Duty selection
- Number of hoist rope falls
- Error reporting
- Date and time

Visual and audible alarms occur when the crane approaches or exceeds overload conditions.

Calibration and fault-finding tools for service personnel are built-in to the safety system.

3.3. Supported Crane Types

Two crane types and two load measurement systems are supported.

Table 1, Supported Crane Types

CRANE TYPE	LOAD MODELLING	DESCRIPTION
Telescopic	Tension Based	Radius calculated by boom angle and length.
		Load calculated by hoist rope tension.
		Fixed offset jibs and luffing jibs are supported.
	Load Moment	Radius calculated by boom angle and length.
		Load calculated by boom angle, length and luffing ram pressures.
		Fixed offset jibs are supported.
Lattice Boom	Tension Based	Radius calculated by boom angle and length.
		Load calculated by hoist rope tension.
		Fixed offset jibs and luffing jibs are supported.
	Load Moment	Radius calculated by boom angle and length.
		Load calculated by boom angle, length, and luffing rope tensions or pendant tensions.
		Fixed offset jibs are supported.

For load moment systems, luffing ram pressures or boom luffing forces are used to calculate the total load on the boom. This means that for twin-winch systems that do not use a winch select input, the safety system calculates the SWL based on which hoist rope the operator has selected (main or aux).

In addition the total load on the boom is displayed rather than individual winch loads.

3.4. Telescopic Boom Cranes

Tension based load measurement

Tension based load systems measure the hoist rope tension to calculate the actual load on a hook. Hoist rope tension can be measured using different types of sensors including:

- Three-Sheave Dynamometer
- Single-Sheave Dynamometer
- Dead End Tension Cell
- Dead End Load Pin

Figure 1, Typical Tension-based Load System for Mobile Telescopic Crane

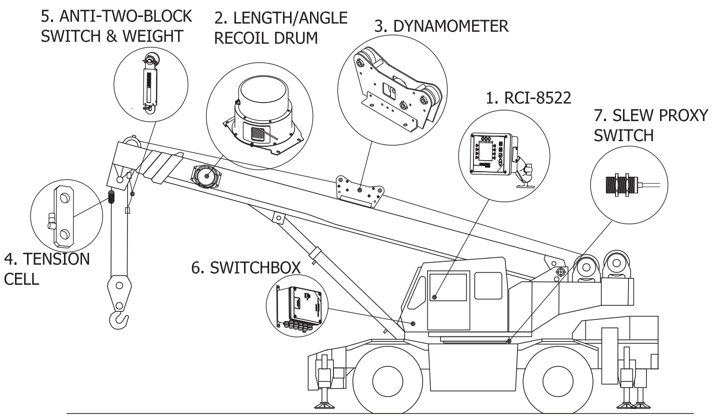


Table 2, Typical Tension-Based System Components for Mobile Telescopic Crane

ITEM	DESCRIPTION
1	RCI Display Unit
2	Recoil Drum Length/Angle
3	Rope tension Line-Rider Dynamometer
4	Tension Cell
5	Anti-Two-Block Switch & Weight (ATB)
6	Switchbox
7	Slew proximity switch

Load moment load measurement

Telescopic cranes use the hydraulic luffing ram piston and rod pressure differential to calculate the load suspended on the various lifting points. Because the pressures are only an indication of the force required to luff the boom it is important to correctly identify which lifting point is being used by proper duty selection in order to correctly calculate the load on the hook.

Figure 2, Typical Load Moment System for Mobile Telescopic Crane

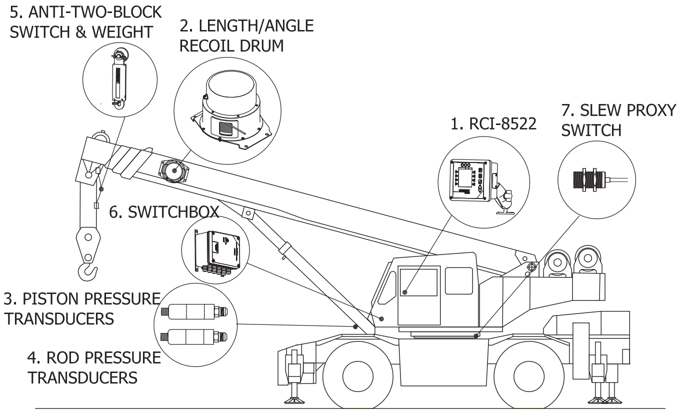


Table 3, Typical Load Moment System Components for Mobile Telescopic Crane

ITEM	DESCRIPTION
1	RCI Display Unit
2	Recoil Drum Length/Angle
3	Piston Pressure Transducer
4	Rod Pressure Transducer
5	Anti-Two-Block Switch & Weight (ATB)
6	Switchbox
7	Slew Proximity Switch

3.5. Lattice Boom Cranes

Tension based load measurement

Tension based load systems measure the hoist rope tension to calculate the actual load on a hook. Hoist rope tension can be measured using different types of sensors including:

- Three-Sheave Dynamometer
- Single-Sheave Dynamometer
- Dead End Tension Cell
- Dead End Load Pin

Figure 3, Typical Tension-based Load System for Lattice Boom Crane

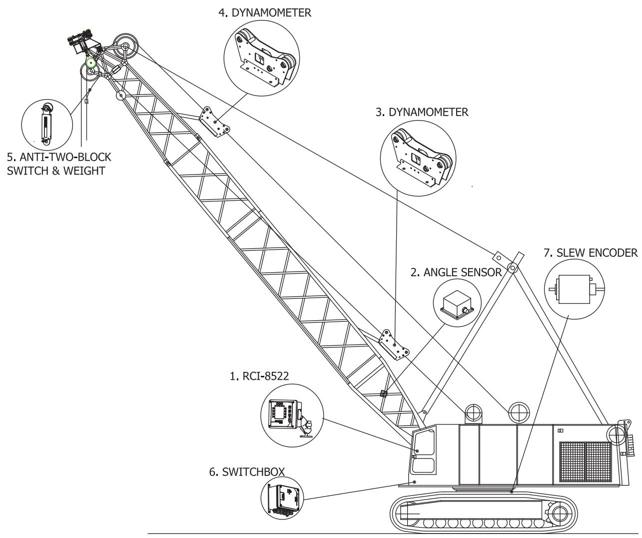


Table 4, Typical Tension-Based Load System Components for Lattice Boom Crane

ITEM	DESCRIPTION
1	RCI Display Unit
2	Angle Sensor Boom/Jib
3	Main Hoist Rope Tension Line-Rider Dynamometer
4	Auxiliary Hoist Rope Tension Line-Rider Dynamometer
5	Anti-Two-Block Switch & Weight (ATB)
6	Switchbox
7	Slew Encoder

Load moment load measurement

Lattice boom load moment systems are similar to telescopic cranes in that the boom luffing forces are used to calculate the load on a hook, however the means of measuring the luffing forces varies from crane to crane. Some of these include:

- Boom pendant tension cells (preferred)
- Boom pendant load pins
- Boom luffing rope tension (can be problematic if large number of parts of line due to friction)
- Luffing rope dead end cell

Figure 4, Typical Load-Moment Load System for Lattice Boom Crane

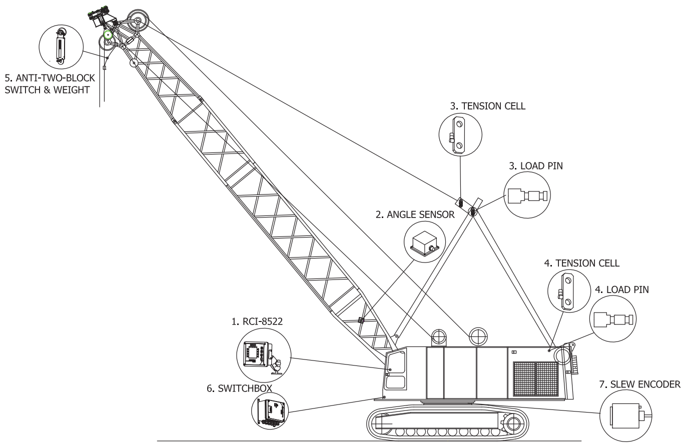


Table 5, Typical Load-Moment Load System Components for Lattice Boom Crane

ITEM	DESCRIPTION
1	RCI Display Unit
2	Angle Sensor Boom/Jib
3	Main Boom Pendant Tension Cell or Rope Sheave Load Pin
4	Main Boom Luffing Rope Dead End Cell or Rope Sheave Load Pin
5	Anti-Two-Block Switch & Weight (ATB)
6	Switchbox
7	Slew Encoder

3.6. Display Unit

Figure 5, Display Unit Example

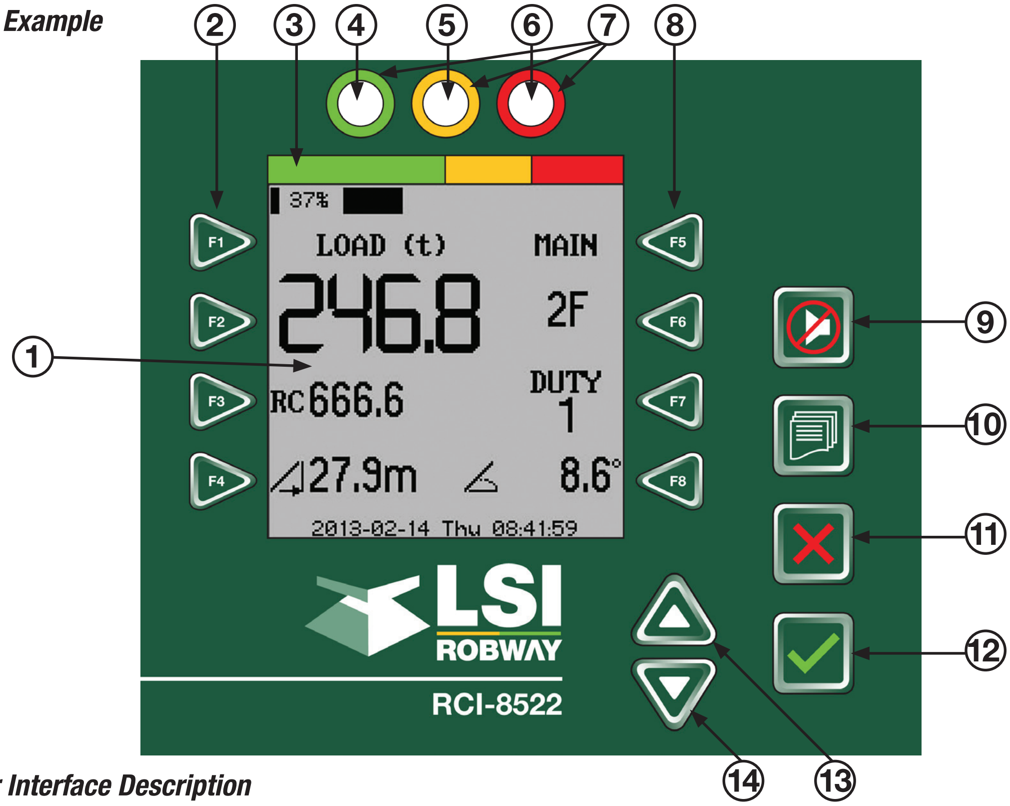


Table 6, RCI8522 User Interface Description

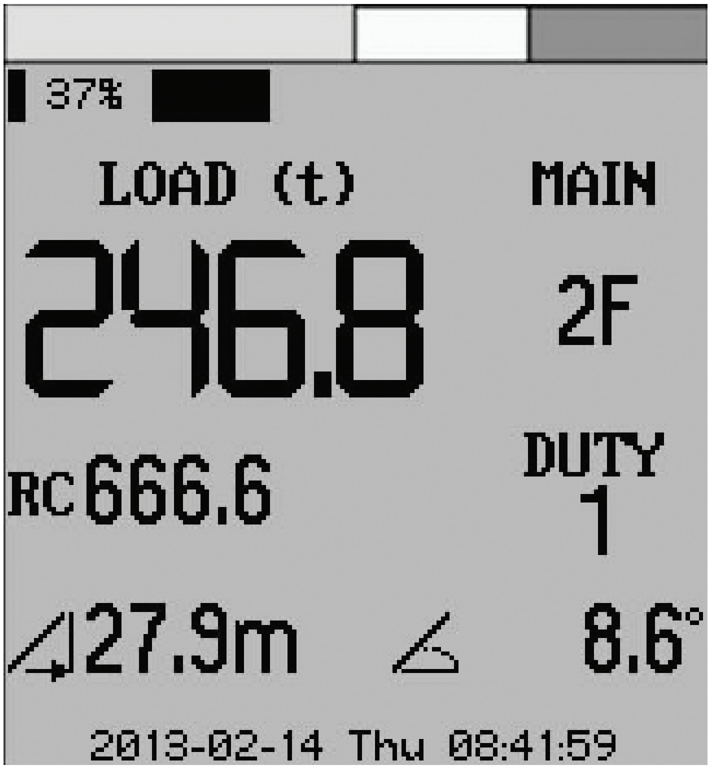
ITEM	ICON	NAME	USE
1		LCD display	Presents information and menu items to the operator.
2 & 8		Function buttons (F buttons)	Press to select the menu item listed next to the button.
3		SWL bar graph	Analog display of the load to SWL as a percentage. Typically the green zone represents 0% to 85%, amber 86% to 100%, red >100% of rated capacity. These ranges can be varied (refer to 6.3d, Corrections and Limits on p. 48).
4		Green light SWL indicator	Indicates that the load is within the green range.
5		Amber light SWL indicator	Indicates that the load is within the amber range.
6		Red light SWL indicator	Indicates that the load is within the red range.
7		Green/Amber/Red SWL indicator	Reference decal for the SWL bar graph.

ITEM	ICON	NAME	USE
9		Mute button	Temporarily mutes the alarm.
10		Menu button	Access the Service Menu.
11		Quit (or Cancel) button	Return to the previous menu without saving changes. Also temporarily mutes the alarm.
12		Enter (or OK) button	Navigate menus, accept the currently displayed message, option or value. Press the Enter button at the Operator Screen to display the Start-up Screen.
13		Up button	Navigate through menu options or edit an existing value (from 0–9 repeatedly until the Enter, Quit or Down buttons are pressed).
14		Down button	Navigate through menu options or edit an existing value (moves cursor left to right until the Enter or Quit buttons are pressed). If at the last position on a line, pressing the Down button wraps the cursor to the start of the line.

3.6a. Accessing the Operator Screen

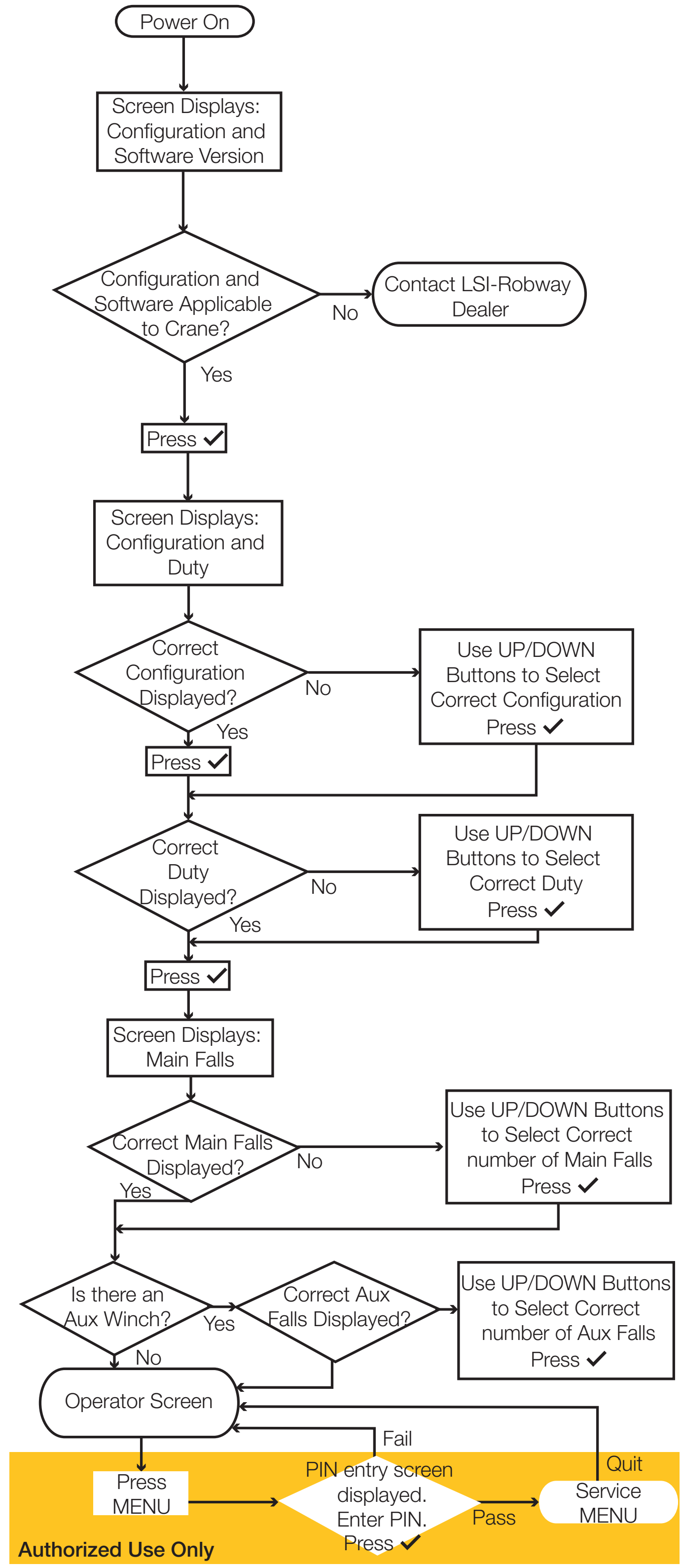
The Operator Screen is the main display that is seen when the safety system is operational and the crane is in use.

Figure 6, Operator Screen Example



3.7. Display Operator Startup Sequence

Figure 7, Display Start-up Sequence Flowchart



4: INSTALLATION

WARNING

THE INSTALLER IS RESPONSIBLE FOR ENSURING THAT THE INSTALLATION OF THE SAFETY SYSTEM COMPLIES WITH LOCAL STANDARDS AND REGULATIONS.
A NON-COMPLIANT INSTALLATION MAY CAUSE HAZARDOUS CONDITIONS RESULTING IN INJURY OR DEATH.

4.1. Overview

This chapter provides a general description about how to install an RCI-8522 Safety System.

For detailed installation information for particular crane installations you must also refer to the following appendices:

Appendix A: General Arrangement Drawings (beginning on p. 69 of this manual)

Appendix B: Duty Listing (beginning on p. 79 of this manual)

Appendix C: Software Configuration (beginning on p. 81 of this manual)

4.2. Before You Begin

WARNING

A CERTIFIED CRANE OPERATOR MUST LOWER THE CRANE BOOM TO A SAFE AND CONVENIENT POSITION AND ENSURE THE CRANE IS IN A SAFE STATE BEFORE INSTALLATION CAN BEGIN.
UNDER NO CIRCUMSTANCES SHOULD ANY CRANE OPERATION BE ATTEMPTED UNLESS BY A CERTIFIED CRANE OPERATOR.

4.3. Service tools

- Multimeter capable of measuring DC volts, current, and resistance
- Side Cutters
- Wire Strippers
- Utility Knife
- Adjustable Spanner 100mm (4”)
- Multi Grip Plug Pliers
- Wrench – Ring/Open-Ender 17mm
- Wrench – Ring/Open-Ender 14mm
- Screwdriver – #2 Phillips (Medium)
- Screwdriver – Flat (Medium)
- Screwdriver – Flat (Small) – use one with a narrow tip to fit into the terminal strips
- An accurate tape measure (that can measure at least 30 meters or 100 feet)
- Known test weights that can be lifted to verify load readout accuracy. Test weights are required to calibrate low and high loads.
- Complete set of System documents
- Lap top computer with SD card interface recommended

4.4. Installation Procedure

The safety system installation should follow a standard procedure. If this procedure is not followed then it may be difficult to achieve a successful calibration in a timely fashion.

Typical Installation Procedure

1. Unpack system components and verify contents against packing list.
2. Familiarize yourself with each system component and understand how it relates to the system GA drawing.
3. Install Cabin components such as operator display and junction box.
4. Install Boom components such as inclinometers or recoil drums and load sensors.
5. Install chassis components such as slew proxy switches or slew encoders.
6. Connect load system limiter outputs to crane controls.
7. Perform sensor checkout.
8. Perform sensor calibrations.
9. Perform load calibrations, can be either tension-based or load moment.

4.5. Power Supply

4.5a. Supply Over-Voltage Protection

The safety system is powered by a 10.5 VDC to 33 VDC supply. The power supply should be permanently connected to switched crane power.

All inputs are transient protected. All internal power rails are current limited and short circuit protected using resettable fuses. No operator adjustments or settings are required internally.

CAUTION

BOTH FUSES ARE SERVICEABLE ITEMS. DO NOT REPLACE FUSES WITH A HIGHER CURRENT RATING AS THIS MAY DAMAGE THE ELECTRONICS IN THE SAFETY SYSTEM IN THE EVENT OF FUTURE OVERVOLTAGE TRANSIENTS.

CAUTION

ALWAYS INSTALL A 3A FAST-ACTING FUSE IN-LINE WITH THE POWER SUPPLY POSITIVE. THIS AVOIDS HAVING TO OPEN THE 8522 TO ACCESS THE INTERNAL SLOW-BLOW FUSE.

Refer to 9.3c, Fuses on p. 66 for fuse specifications.

4.5b. Excitation Voltage Outputs

Both the +15 V output and precision +5.00 V sensor excitation output can tolerate short circuits to ground without damage and not normally result in a blown fuse. Once the fault is removed the safety system will return to normal operation after performing its start-up checks.

If the +15 V output is shorted, the safety system ceases to operate and will restart once the fault is If the +5.00 V sensor excitation is shorted, a system fault is triggered and the safety system will go into motion cut until the fault is removed.

4.6. RCI-8522 Display Unit

The display unit may be flush-mounted in-dash, or on the optional gimbal mount. LSI-Robway recommends using captive nuts installed in the dashboard when installing the display unit in-dash.

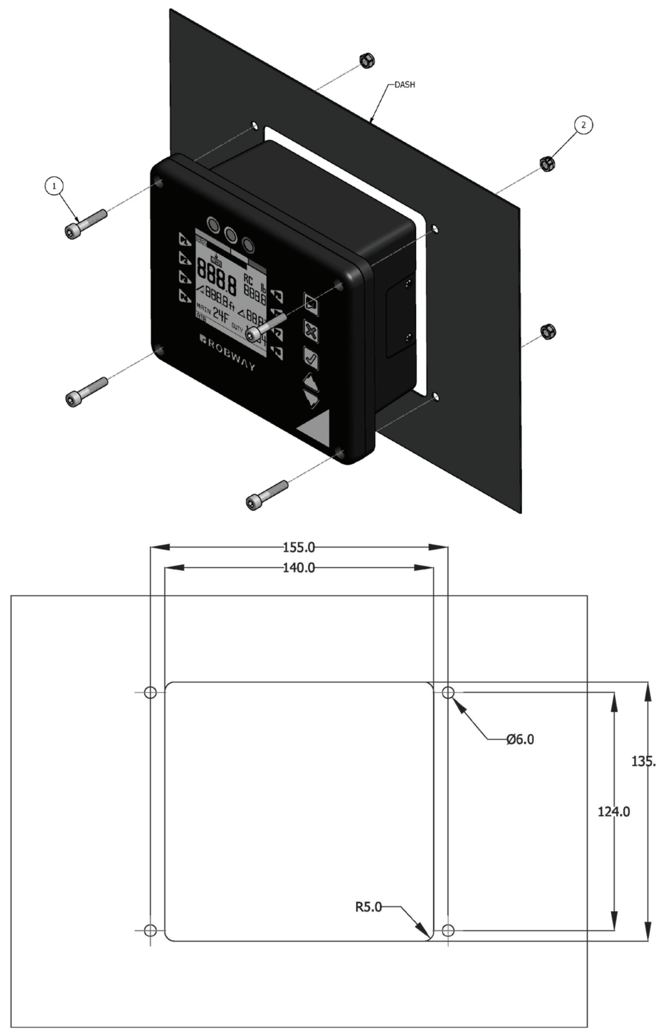
CAUTION

DO NOT EXPOSE THE DISPLAY MODULE TO DIRECT WEATHER.

4.6a. In-Dash Flush Mount

Ensure that there is adequate clearance (minimum of 100 mm (4 in)) behind the display unit for cable clearance. Refer to 9.1 Display Unit on p. 66.

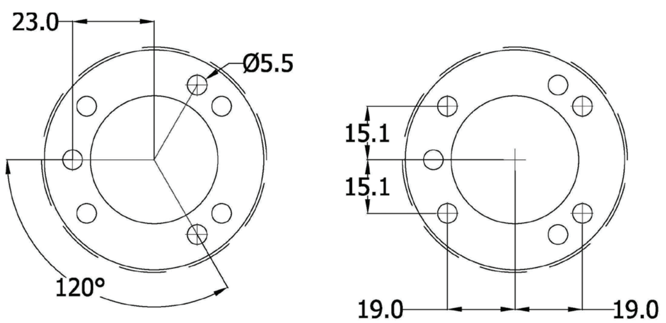
Figure 8, RCI In-Dash Flush Mount



4.5b. Gimbal Mount

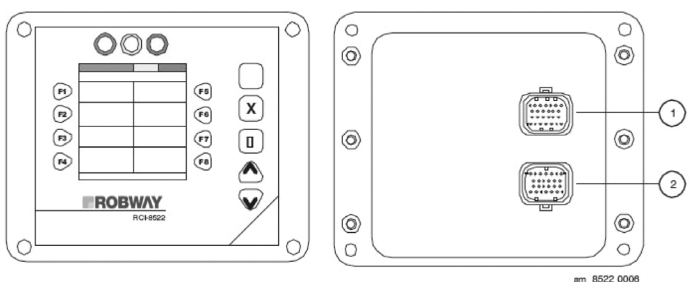
An optional RAM bracket and mounting kit is available. Ensure the display unit is positioned in a convenient position in the cabin and that the crane operator can easily view the display unit and reach the controls.

Figure 9, RCI Gimbal Mount



4.7. Cable Connections

Figure 10, 8522 Display Cable Connections.



ITEM	DESCRIPTION
1	J3 I/O terminal
2	J4 I/O terminal

4.7a. Mating Plugs / Cables

Table 7, Mating Plugs / Cables Part Numbers

QTY.	REF.	DESC.	MFR.	MFR. P/N
1	J3	Plug, 26-way	Tyco	3-1437290-8
1	J4	Plug, 26-way	Tyco	1473416-1
52	J3, J4	Female Crimp Contacts	Tyco	3-1447221-4

Figure 11, J3 and J4 Connector Pin Numbers

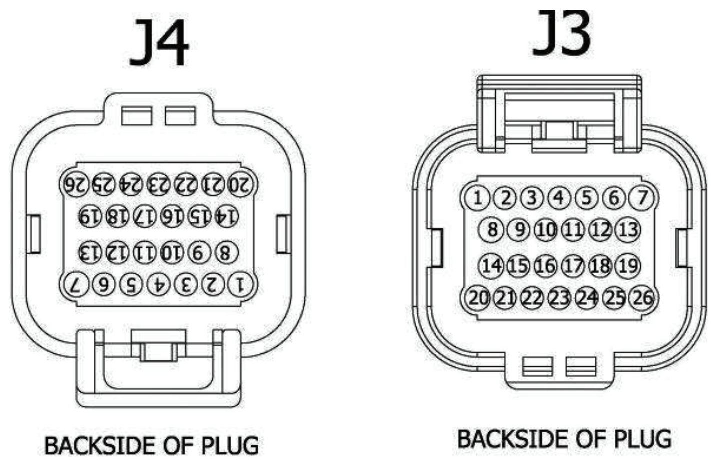


Table 8, 8522 J3 and J4 Connector Pinouts

J3	DESCRIPTION	DIRECTION
1	Supply +	Input
2	CAN Low	Bus
3	CAN High	Bus
4	ATB1+	Input
5	ATB1-	Input
6	ATB2+	Input
7	ATB2-	Input
8	Supply -	Input
9	CAN 120 Ohm Link	Input
10	DGND	Output
11	DIO1	I/O
12	DIO2	I/O

J3	DESCRIPTION	DIRECTION
13	DIO3	I/O
14	DGND	Output
15	DIO4	I/O
16	DIO5	I/O
17	DGND	Output
18	DIO6	I/O
19	DIO7	I/O
20	DIO8	I/O
21	Relay 1 NO	Output
22	Relay 1 COM	Output
23	Relay 1 NC	Output
24	Relay 2 NO	Output
25	Relay 2 COM	Output
26	Relay 2 NC	Output

J4	DESCRIPTION	DIRECTION
1	+15 VEX	Output
2	A4-	Input
3	A3-	Input
4	+5 VEX	Output
5	A2-	Input
6	A1-	Input
7	RED Light	Output
8	A4+	Input
9	A3+	Output
10	+5 VEX	Output
11	A2+	Input
12	A1+	Input
13	Amber Light	Output
14	AGND	Output
15	AGND	Output
16	+5 VEX	Output
17	AGND	Output
18	AGND	Output
19	Green Light Output	Output
20	RS232 TX	Output
21	RS232 RX	Input
22	DGND	Output
23	RS485 High	Bus

J4	DESCRIPTION	DIRECTION
24	RS485 Low	Bus
J4	Description	Direction
25	RS485 120 Ohm Link	Output
26	DGND	Output

4.8. Telescopic Boom Recoil Drum

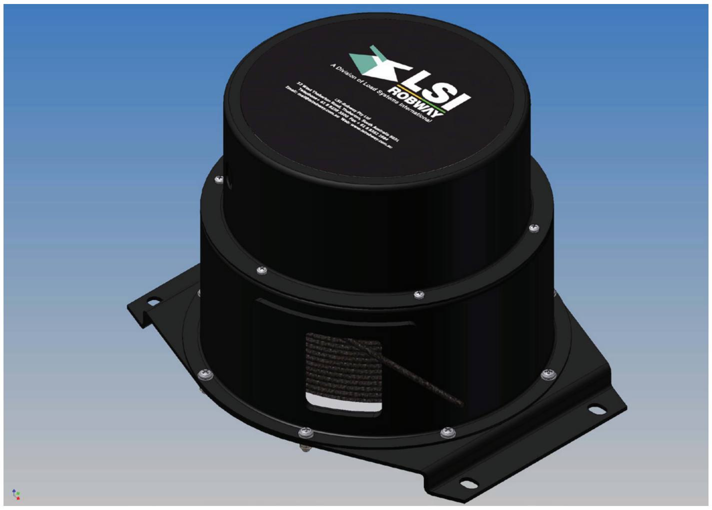
Telescopic cranes use a recoil drum mounted on the base boom section to measure boom extension and normally include an inclinometer to measure boom angle.

In cases where the telescoping boom uses non-proportional boom extensions, a larger cable reel must be installed. The recoil drum is used to measure boom extensions, boom angle, and ATB signal transmission.

LSI-Robway drums are shipped standard for right-hand installation (as viewed from the crane operator's position).

Example recoil drum shown below:

Figure 12, Extension Recoil Drums



4.9. Mounting Location

The preferred recoil drum mounting location is on the right-hand side of the boom which will position the payout cable entry at the bottom of the recoil drum. It is not necessary to change orientation of the inclinometer to monitor a full range of boom angle motion.

The boom angle inclinometer has a range of ±90° or ±45°. If the recoil drum is mounted on the left-hand side of the boom, the orientation of the boom angle sensor must be changed.

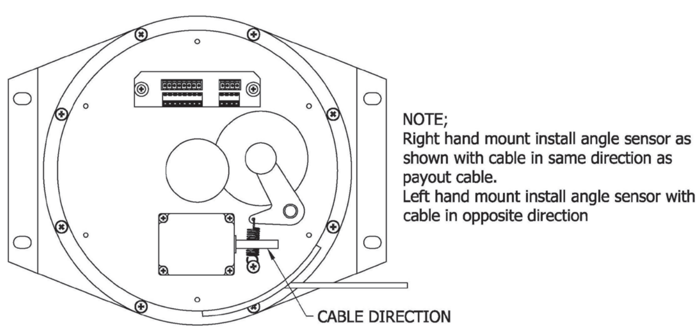
For right-hand mount, the connector must face boom footpin.

For left-hand mount, the connector must point towards the boom tip.

Typical Installation Procedure

1. Remove the recoil drum cover screws and remove the drum cover, taking care not to let the cover hang on the cable connector. Unplug recoil drum cover cable harness if necessary.
2. Remove the two inclinometer fasteners and rotate the sensor clockwise 180°.
3. Re-attach the sensor cable assembly to the terminal strip and re-install the drum cover, securely fastening the drum cover screws.

Figure 13, Angle Sensor



1. Begin with the boom fully retracted. Leave the cable stop on the cable until later.
2. Check that the mounting face is flat, and parallel to the cable pay-out.
3. This position must allow free and uninterrupted pay-out of cable without chafing or binding.
4. Mount the unit with the cable payout parallel to the boom.
5. An anti-condensation filter is located close to the cable entry glands. This should be the lowest point when the reel is mounted.
6. Weldable pads may be supplied to provide stud fixings.
7. Mount a cable anchor pin at the boom tip for securing the free end of the cable.

CAUTION

HIGH TENSILE BOOMS REQUIRE PROPER WELDING PROCEDURE SPECIFICATIONS. OBTAIN SPECIALIST ADVICE WHENEVER APPLICABLE.

8. As shipped from the factory, there are two full turns of preload on the cable reel. This provides initial cable tension.
9. Cable stop must remain installed at this time. Route the loose cable provided through the cable guides installed on each boom section.
10. Securely tie off the cable to the cable anchor. Ensure the minimum recommended cable bend radius of 25mm is not exceeded to minimize risk of broken internal conductors in the payout cable.
11. Extend the boom slowly to its full extent while checking the remaining recoil drum range to ensure that the cable reel will not bind up before full travel is reached or that the potentiometer end-stops are not hit.
12. At full extension, check that there is at least one turn remaining before hitting the potentiometer end-stops.
13. Retract boom or travel to minimum extension, while observing that the reel is working correctly. The reel is now mechanically set.
14. If more tension is required, more pre-load turns may be necessary, but keep in mind the number of turns available.
15. Connect and secure electrical connections for over-hoist system and luffing fly angle sensors.
16. Re-engage the potentiometer gears to mesh with the driver gears.
17. Ensure that all gear-locking screws are secure.

18. Ensure that the boom is fully retracted or the machine is fully home. Turn the pot gear by hand in the direction driven when winding in cable until you feel the end stop. Turn gears forward one quarter (¼) of a turn and allow to mesh.
19. Carefully route the cable from the recoil drum back around the boom pivot to the cab.
20. Securely fix the cable to the boom using adequate fixings such that the cable is not pinched or stretched as the boom moves through its full luffing range.
21. Connect the cable to the control unit when welding is finished.

4.10. Recoil Drum Final Checks

1. Is the end of the payout cable secured at the boom tip while observing the minimum cable bend radius?
2. Is the payout cable fed through all the cable guides?
3. Has the cable stopper been removed?
4. Does the payout cable feed smoothly throughout the boom extension?
5. Is the cover re-installed with all screws tightened?
6. If used, is the M12 cable connector fully screwed-in and no more than finger-tight?

CAUTION

***DO NOT OVERTIGHTEN** AS THIS CAN FORCE THE O-RING OUT OF ITS SEAT, THUS LOSING ITS IP67 PROTECTION LEVEL.*

4.11. Anti-Two-Block System (ATB)

An anti-two-block safety switch may be installed telescopic and lattice boom cranes. In telescopic cranes, the ATB switch signals are transmitted to the safety system via the recoil drum pay-out cable. In lattice boom cranes, the ATB is typically connected to the safety system by manual cable reels to accommodate the varying boom sections.

Twin-winch cranes may be configured with an ATB switch on both the main hoist rope and the auxiliary hoist rope. Typically, these switches are wired in series but may be run to the controller on independent circuits.

4.12. Installation

ATB Switch Installation Procedure

1. Fit the ATB switch mounting pin to the boom head preferably so that the bob weight, when suspended from the switch, can be fitted to the static hoist rope below the rope anchor.

CAUTION

REFER TO APPENDIX A: GENERAL ARRANGEMENT DRAWINGS BEGINNING ON P. 69 FOR BOB WEIGHT SPECIFICATIONS.

2. The mounting pin has two 9 mm (0.354 in) holes and can either be welded on the boom head section (directly or using a steel plate), or screwed by drilling and tapping two holes on suitable location on the boom head.

CAUTION

HIGH TENSILE BOOMS REQUIRE PROPER WELDING PROCEDURE SPECIFICATIONS. OBTAIN SPECIALIST ADVICE WHENEVER APPLICABLE.

3. Check that the switch works correctly as the boom luffs throughout its working range. For twin-winch cranes, an additional switch can be added and mounted at the rooster/aux winch head sheave.

NOTE

CUT CHAIN TO A SUITABLE LENGTH FOR THE WINCH LINE SPEED AND APPLICATION. A THREAD LOCKING DEVICE SHOULD BE APPLIED TO ALL SHACKLES IN THE ATB ASSEMBLIES.

4. Fix the ATB cable(s) through the supplied junction box(es) and carefully route the cable along the boom (or through a boom cable tray) and boom pivot to the cabin.
5. Secure the cable on the boom using adequate straps and fixing such that the cable is not pinched or stretched as the boom moves through its full luffing arc.
6. Wire the cable into the display unit.

> **CAUTION**
>
> ***KEEP THE BOB WEIGHT HOLE FREE OF DIRT AND GREASE.***
> *THESE ELEMENTS CAN STICK THE HOIST ROPE AND TRIGGER FALSE ACTIVATION OF THE ATB SWITCH ALARM AND HOIST-UP MOTION CUT. LSI-ROBWAY RECOMMENDS PERIODIC INSPECTION OF THE ATB SWITCH AND BOB WEIGHT TO ENSURE PROPER OPERATION OF THE ATB SYSTEM.*

4.13. ATB Switch Final Checks

1. Does the ATB switch and cable assembly hang free vertically throughout entire boom luffing range?
2. Does unplugging the ATB switch result in an ATB fault?
3. Does lifting the bob-weight assembly result in an ATB fault?

4.14. Luffing Ram Pressure Transducers

Pressure transducer are fitted into the luffing cylinder(s) of hydraulic luffing cranes (telescopic or box boom). In some cases with twin luffing cylinders (for example, due to uneven boom raising and lowering forces between the two luffing cylinders) it may be necessary to install three pressure transducers: two on each piston side and one on a rod side.

Figure 14, Pressure transducer samples

4.15. Luff Cylinder

4.15a. Annular (rod) side

Install the appropriately marked pressure transducer into the hydraulic line feeding the top of the boom luffing cylinder.

> **CAUTION**
>
> *ENSURE THAT THE TRANSDUCER IS FITTED TO DIRECTLY READ THE INTERNAL PRESSURE WITHOUT BEING INFLUENCED BY OUTSIDE CHECK VALVES (OR SIMILAR).*

4.15b. Force (piston) side

Install the appropriately marked pressure transducer into the hydraulic line feeding the bottom of the boom luffing cylinder.

> **CAUTION**
>
> *ENSURE THAT THE TRANSDUCER IS FITTED TO DIRECTLY READ THE INTERNAL PRESSURE WITHOUT BEING INFLUENCED BY OUTSIDE CHECK VALVES (OR SIMILAR).*

4.15c. Cabling

Firmly fix pressure transducer cables to the crane structure and route them to the controller. Ensure freedom of movement around moving parts, such as the boom pivot pin. Clip cables at approximately 60 cm (24 in) intervals.

4.16. Pressure Transducer Final Checks

1. Is the M12 cable connector fully screwed-in and no more than finger-tight?

> **CAUTION**
>
> ***DO NOT OVERTIGHTEN*** *AS THIS CAN FORCE THE O-RING OUT OF ITS SEAT, THUS LOSING ITS IP 67 PROTECTION LEVEL.*

2. Is the M12 sensor cable and sensor protected from snagging and damage?
3. Is physical protection adequate to prevent damage due to falling objects and personnel using the sensor as a stepping point?
4. Are there any visible signs of hydraulic fluid leakage after several minutes with hydraulics at full pressure, under load?

4.17. Three-Sheave Line-Rider Dynamometer

4.17a. Description

LSI-Robway Dynamometers are three-sheave rope tension sensor with internally mounted beam type load cell. The tensiometer monitors the rope line-pull as the rope passes through the three sheaves (the sheaves must be suited to the diameter of the hoist rope). The load cell outputs an electrical signal proportional to the hoist rope line-pull forces, and the safety system converts this into a hook load weight.

CAUTION

CORRECT CALIBRATION IS CRITICAL TO ACCURATELY DETERMINE THE HOOK LOAD WEIGHT.

Dynamometers may also be used for measuring the boom luffing rope tension for lattice boom load moment systems. The installation procedure is similar but can vary widely depending upon the application.

4.17b. Installation

The dynamometers may be rigidly mounted to the boom tip section, or fitted with an articulating arm assembly at the boom butt section. The articulating arm allows the unit to follow the natural position of the hoist rope relative to the boom.

Figure 15, Line-rider dynamometer samples

Lattice boom cranes

Mounting the dynamometer using an articulated arm on lattice boom cranes requires two cross braces to be fitted to the boom top chords. One is the ‘take-off’ point for the articulating arm and the other to secure timber to create a ‘landing zone’ for the tensiometers, in order to avoid damage to the boom chords orlacing during fast hoist rope working.

Cranes with fly jibs

The fly jib aux winch idler sheave requires using an articulating arm to allow the tensiometer to follow the aux rope natural line over the mast idler sheave. Alternatively, the tensiometer may be mounted on the fly jib tip section, or off the boom butt section using an articulating arm if the aux and main winches are side-by-side.

Cranes without fly jibs

The dynamometer is often rigidly mounted on the boom tip section. Fabricated brackets may be required to attach the tensiometer to the boom top and align it to the hoist rope.

4.18. Tension Cells

4.18a. Description

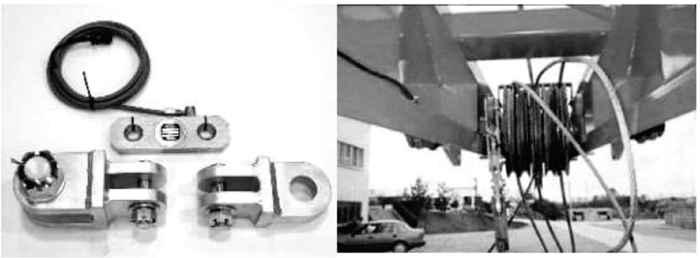
A tension plate type load cell may be fitted at the hoist rope dead end of the boom tip section to sense the hoist line-pull. Tension cells may also be used on lattice boom cranes for load moment systems. LSI-Robway tension cells can be supplied with standard 'side plates' (or 'sister plates') to provide additional protection against extreme twisting during crane operation.

Special fittings such as an 'adapter plate assembly' may be required to fix the tension cell between the boom lug (pad eye) and hoist rope wedge socket. This adapter plate assembly must be specially fabricated (and may be supplied by the customer) to suite the dimensions of the lug and sock at the dead end termination point. The plate should also provide for the existing wedge socket and pin to be reused.

LSI-Robway recommends that the adapter plate assembly be proof load tested by a certification body prior to installation. Alternatively, LSI-Robway can, on request, supply the adapter plate assembly (proof load tested and certified) at additional cost (supply dimensional details of the lug, wedge socket and pin at time of order).

A tension cell with adapter plate, and typical installation on a hoist rope dead end is shown below.

Figure 16, Hoist Rope Dead End



CAUTION

CORRECT CALIBRATION IS CRITICAL TO ACCURATELY DETERMINING THE HOOK LOAD WEIGHT.

4.18b. Sub-zero operation

WARNING

CRANES OPERATING IN SUB-ZERO TEMPERATURES MUST HAVE OVERLOAD PLATES.

LSI-Robway overload plates, also known as sister plates, are designed to allow the plate load cell to react to the imposed forces while providing overload protection. Should a load cell failure occur, the forces will be supported by the overload plates. LSI-Robway overload plates use high tensile strength steel to minimise weight and different sizes and types are available to suit a variety of crane models.

The overload plate assembly may require modification to fit the rope fittings unless fitting knowledge was provided prior to safety system dispatch.

The overload plate assembly is fabricated from Bisalloy 80 (Sumiten 80) plate. The pins are made from 4140 grade materials.

If modifications are made to overload plates, ensure that they meet engineering standards and the end product meets at least the minimum required structural safety factors.

4.19. Single-Sheave Dynamometer

4.19a. Sub-zero operation

A load pin may be fitted in a single sheave and mounted close to the boom tip. The load pin outputs an electrical signal proportional to the line-pull or tension on the hoist rope, which represents the forces exerted on the load pin's sheave by the hoist rope. The load cell outputs an electrical signal proportional to the hoist rope line-pull forces, and the safety system converts this into a hook load weight.

A single sheave dynamometer is installed for each hoist rope.

4.19b. Installation

Carefully route the cable around the boom head, along the boom and into the safety system. Fix the cable using adequate straps and fixings, ensuring that the cable is not pinched or stretched as the boom moves through its full luffing arc.

Ensure that the resultant hoist rope down force on to the load pin does not exceed load pin capacity.

Down force is relative to the hoist rope deflected angle over the load sensing sheave. The formula to determine the down force is:

Down Force = sin(deflected angle) x line-pull (tonnes)

Table 9, Downforce

Example for a 1.5T load pin	Rope deflected angle (wrap angle)		= 2.7°
	Max line-pull is 25 tonnes + test allowance of 15%	25 + 15%	= 32.5
	Down force calculation	sin(2.7°) x 32.5	= 1.5T

Cranes with fly jibs

The fly jib aux winch idler sheave requires using an articulating arm to allow the tensiometer to follow the aux rope natural line over the mast idler sheave. Alternatively, the tensiometer may be mounted on the fly jib tip section, or off the boom butt section using an articulating arm if the aux and main winches are side-by-side.

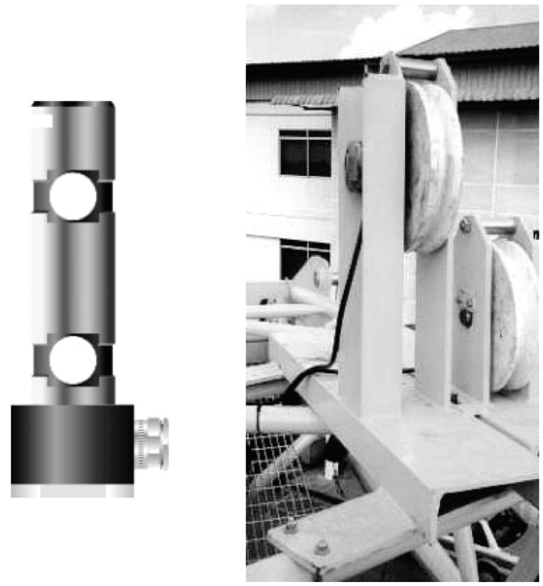
Cranes without fly jibs

The dynamometer is usually rigidly mounted on the boom tip section. Fabricated brackets may be required to attach the tensiometer to the boom top and align it to the hoist rope.

CAUTION

HIGH TENSILE BOOMS REQUIRE PROPER WELDING PROCEDURE SPECIFICATIONS. OBTAIN SPECIALIST ADVICE WHENEVER APPLICABLE.

Figure 17, Load pin and typical installation (tonnes)



4.20. Boom Angle Inclinometer

An IP66 weatherproof inclinometer is supplied for strut boom cranes. This device has a of ±90° or ±45° range and includes an M12 or 3 pin connector.

4.20a. Installation

Main Boom

1. Install the Inclinometer mounting kit on the right hand side of the boom at the boom foot, and position it parallel to the boom center-line. For a tapered boom this will not be parallel to the chords.
2. Mount the inclinometer on the mounting plate with the M12 connector facing the boom foot and parallel to the boom center-line.
3. Due to the sensing range, it may be necessary to align the sensor to the boom center-line. Final sensor calibration will be performed during system calibration.

CAUTION

IF LEFT-HAND MOUNTING IS NECESSARY, THE THE M12 CONNECTOR MUST BE ORIENTED TO FACE THE BOOM TIP.

Luffing Jib

It may be necessary for some cranes to install an inclinometer on a jib section. The same installation guidelines as Main Boom Installation applies. In addition, a luffing jib is often a removable component for differing crane configurations. In this case a junction box is usually installed at the Main Boom tip to facilitate connection.

For cranes with varying Main Boom lengths, a cable reel is typically used to feed the luffing jib inclinometer signal back to the RCI side-by-side.

4.20b. Boom Inclinometer Final Checks

Is the cable connector fully screwed-in and no more than finger-tight?

CAUTION

***DO NOT OVERTIGHTEN** AS THIS CAN FORCE THE O-RING OUT OF ITS SEAT, THUS LOSING ITS IP 67 PROTECTION LEVEL.*

The sensor cable and inclinometer must be protected from snagging and damage. Physical protection must be provided to prevent damage from falling objects and personnel using the inclinometer as a stepping point.

4.21. Dual Axis Tilt Sensor

A dual axis tilt sensor may be supplied to monitor front/rear and side tilt which may be used for warning purposes or to select appropriate load charts.

4.21a. Installation

Dual Axis Tilt Sensor Installation Procedure

Mount the Tilt Sensor such that the bottom face is within +/-1 degrees of level.

NOTE

ANY VARIATION FROM LEVEL WILL ADD OR SUBTRACT CORRESPONDINGLY FROM FULL SCALE IN A GIVEN DIRECTION.

1. Connect the Tilt Sensor output signals to the Analog inputs as shown on the system GA drawing.
2. Ensure the crane is level to within a tenth of a degree as verified by a precision tilt meter.
3. Apply power to the system
4. Short the Zero-Teach input of the tilt sensor to ground for two seconds or use the appropriate interface user menu item.
5. After the RCI is calibrated verify that the tilt reading on the RCI display shows 0.0 degrees.

4.21b. Periodic System Testing

There is no periodic testing or re-calibration required. However the tilt sensor zeroing procedure will need to be performed again if:

- The tilt sensor mounting or location has changed.
- A new tilt sensor is fitted.

4.21c. Tilt Sensor Final Checks

Is the M12 cable connector fully screwed-in and no more than finger-tight?

CAUTION

***DO NOT OVERTIGHTEN** AS THIS CAN FORCE THE O-RING OUT OF ITS SEAT, THUS LOSING ITS IP 67 PROTECTION LEVEL.*

1. Is the tilt sensor installed on a level surface?
2. Has the tilt sensor been zeroed?

4.22. Cabling

CAUTION

THE FOLLOWING INFORMATION CONTAINS GENERAL GUIDELINES. ALL EQUIPMENT MUST BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND FOLLOWING THE RELEVANT INSTALLATION STANDARDS AND CODES OF PRACTICE.

CAUTION

ALL ELECTRICAL CABLING MUST BE INSTALLED BY TECHNICALLY TRAINED PERSONNEL USING TRADE, PROFESSIONAL, OR LOCALLY / INTERNATIONALLY RECOGNIZED STANDARD PROCEDURES.

All cabling used must be either UV-resistant or protected by UV-protective socking or conduit.

Sensor cables should be fixed firmly to the crane and routed along the boom chords (and gantry/A-frame for the force transducer) through to the cabin.

Ensure that there is freedom of movement around the boom pivot pin.

Secure cables at approximately 600 mm (24 in) intervals or where suitable to secure them firmly to the crane. Use only stainless steel cable clips.

4.22a. Cable Routing

Sensor cables should be firmly fixed to the crane and routed along the boom chords (and gantry/A-frame for the force transducer) to the RCI in the cabin or junction box location. Ensure freedom of movement around the boom pivot pin. Clip cables at approximately 600 mm (24 in) intervals or where suitable, to secure the cable to the crane.

Where possible, protect cabling from direct sunlight, abrasion and physical damage.

4.22b. Cable Reels

For cranes with varying Main Boom lengths, a cable reel is typically used to feed the Main Hoist Rope and Auxiliary Hoist Rope ATB switch signals back to the RCI. A junction box may also be included at the Main Boom tip to facilitate an Auxiliary hoist rope reeved on a jib.

4.22c. Compression Glands

Connecters are designed to trap the braid or screen (or armour) within the braid for maximum EMI protection. Failure to terminate the screens in the connectors will void the safety system's EMC compliance, and will place the unit at risk of malfunction due to EMI.

When armoured cable is used, the armour must be trapped in the connector body and the internal cable braid or screen must be terminated in the chassis terminals on the appropriate board connectors. The connector termination of either armour or braid is also essential to protect the inner conductors in the event of lightning or other transient effects. Failure to correctly terminate within the connector may also lead to destruction of the internal circuitry.

Optionally, a switchbox may be provided with the safety system. The switchbox has metal cable glands and an internal grounding plate. The gland types used are designed to trap the braid or screen (or armour) within the braid for maximum EMI protection. Failure to terminate the screens in the glands will void the safety system's EMC compliance, and places the unit at risk of malfunction due to EMI.

CAUTION

DO NOT ROUTE SIGNAL CABLES NEXT TO POWER CABLES.

SEPARATE CABLE TRAYS SHOULD BE USED FOR EACH TYPE OF CABLE TO AVOID EMI.

CAUTION

DO NOT GROUND SCREENED CABLE SHIELDS AT BOTH ENDS.

THEY ONLY NEED TO BE TRAPPED IN THE GLAND AT THE ENCLOSURE.

4.22d. Earthing Requirements

In order for the RCI system to operate reliably and accurately and have maximum protection against nearby lightning strikes the following grounding must be applied:

- Ensure that the crane boom is earthed through a grounding strap or by other means. Verify its integrity.

CAUTION

THE CRANE BOOM EARTHING STRAP (OR OTHER EARTHING MEASURE) MUST BE IN PLACE. IF THE CRANE BOOM IS NOT EARTHED, THEN A VOLTAGE POTENTIAL MAY EXIST BETWEEN THE CABLE SHIELDS/ ARMOR AND THE BOOM, WHICH MAY CAUSE ERRATIC LOAD READINGS.

1. When using a switchbox, ensure that the sensor cable shielding is captured in the cable glands and that the cable glands are in good contact with the internal earthing plate.
2. Ensure that the switchbox earth lug is connected to the crane chassis using a minimum ground strap wire of either 12 awg or 2.5mm2 cross-sectional area.
3. The earthing point must be a common ground rail for all interconnected electronic subsystems.

CAUTION

THE CHASSIS, BOOM, OR JIB MUST NOT IN ANY CASE BE USED AS A SIGNAL RETURN OR GROUND PATH.

4.22e. Switchbox

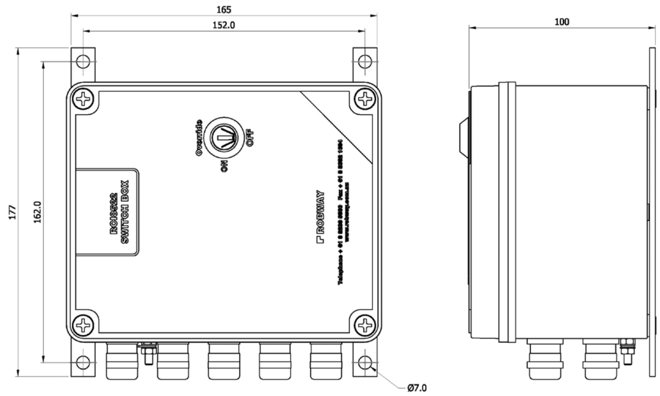
Retrofit systems will typically be supplied with a junction box, commonly referred to as a switchbox. The switchbox contains:

- DIN rail terminals
- Light stack relays
- Override Keyswitch
- Power fuse block
- Cable glands

CAUTION

IF A SWITCHBOX IS NOT SUPPLIED WITH THE SYSTEM, THEN AT MINIMUM A KEYSWITCH AND AN INLINE POWER FUSE MUST BE INSTALLED.

Figure 18, RCI Switchbox Dimensional Details



4.23. Digital Inputs and Outputs

4.23a. Description

To cater for a wide range of applications with limited I/O, the safety system has eight digital I/O channels that can be individually configured as either an input or and output. In addition there are also two ATB inputs (which can be re-configured as other inputs if required), three warning light outputs and two relay outputs. These channels are not isolated from the crane power supply so you must ensure that potential high current ground paths through the safety system are not created.

LSI-Robway recommends that when used as an output, the digital and relay outputs should drive slave relays. The digital output circuitry is current limited, which prevents short-duration short-circuits from damaging the I/O channel. In the case of long-term short circuits, damage to the I/O channel may occur.

Long-term short circuits can occur by incorrect wiring during installation or a short in an output circuit.

Secure cables at approximately 600 mm (24 in) intervals or where suitable to secure them firmly to the crane. Use only stainless steel cable clips.

Digital I/O configured as inputs

Digital inputs can be used for a variety of uses:

1. Proximity switches such as:
   - Crane slew
   - Telescoping boom
   - Stabilizer/outrigger
2. Limit switches such as:
   - High boom angle
   - Low boom angle
3. Switch inputs to select different load charts:
   - Wind speed

Secure cables at approximately 600 mm (24 in) intervals or where suitable to secure them firmly to the crane. Use only stainless steel cable clips.

Digital I/O configured as outputs

When used as digital outputs, the digital channel provides an open collector switched output capable of shunting up to 100 mA to DGND. This output signal may be used to energise slave relays or drive indicator lamps under software control. When a digital output is ON it provides a current shunt to DGND; when a digital output is OFF it is an open circuit.

Digital outputs are normally used to activate a DIN rail mounted relay in the switchbox with contacts rated at 5A. These are not designed to control high power (or many) solenoids, rather they are designed to switch slave relays, which are then used to directly switch high power (or many) solenoids. This relay provides normally open (NO) and normally closed (NC) contacts. Digital outputs can be used for a wide range of uses including:

- External audible alarm,
- Boom up, or down motion cut,
- Minimum radius motion cut,
- Clockwise and counter-clockwise slew motion cut.

A fail-safe approach is used so that digital outputs are normally configured to limit crane movements or reduce SWL unless energized.

4.23b. How To Identify Inputs And Outputs

Refer to Appendix C: Software Configuration for a list of the digital inputs, outputs and relay outputs.

Appendix A: General Arrangement Drawings show the wiring for the digital inputs, digital outputs and relay outputs.

CAUTION

SOME GENERAL ASSEMBLY DRAWINGS COVER A RANGE OF CRANE CONFIGURATIONS, WHICH MAY INCLUDE INPUTS AND OUTPUTS THAT ARE NOT USED ON THIS CRANE.
IGNORE AN INPUT OR OUTPUT IF IT DOES NOT APPEAR ON THE CONFIGURATION SHEET.

CAUTION

ALWAYS CHECK THAT THE WA NUMBER RECORDED IN APPENDIX C: SOFTWARE CONFIGURATION BEGINNING ON P. 81 OF THIS MANUAL MATCHES THE WA NUMBER THAT APPEARS ON THE START-UP SCREEN.

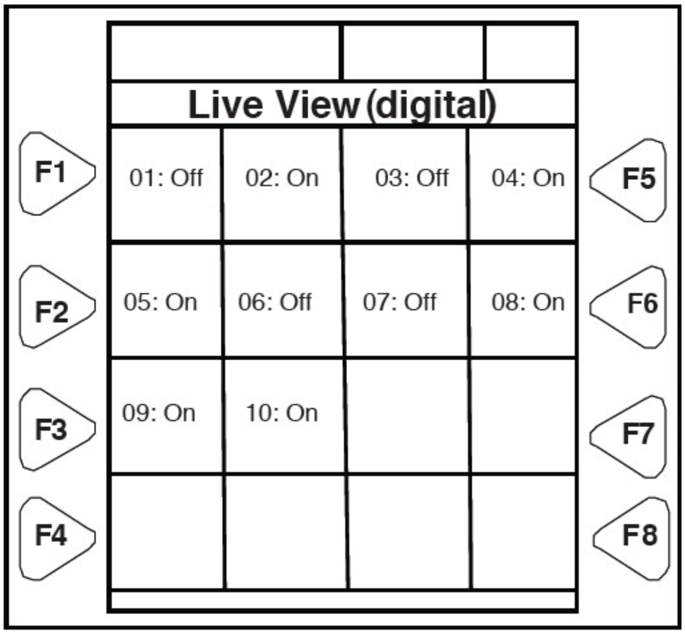
4.23c. Bi-Directional Digital Inputs and Outputs

The safety system has eight software configurable digital I/O channels that may be programmed as either digital input signals or open drain output signals. These channels are configured per application and are specified in Appendix C: Software Configuration.

The safety system has a digital I/O status screen that indicates the state of all the digital I/O, which is helpful during installation and when troubleshooting.

The bi-directional digital I/O status will be either the output state or the input state depending upon whether that particular I/O channel is configured as an output or an input and the current state of that I/O.

Figure 19, Live View (digital)



NOTE

NOTE THAT "09" AND "10" NORMALLY INDICATE ATB 1 AND ATB 2 INPUT STATUS.

Output configuration	Bipolar switch to ground 100 mA max.

Digital I/O configured as inputs

Active inputs will register as a low when connected to RCI-8522 DGND. Digital input channels will register as a high when they are an open circuit or when between 3–30 VDC.

Both the safety system power supply plus and minus inputs have blocking diodes to protect against reverse voltage connection and ground loops. Connecting a safety system input channel to chassis via a proxy or limit switch will not provide a reliable low input signal. The return signal must be connected to the RCI-8522 DGND found on the rear harness connectors.

If the status screen indicates an unexpected digital input state:

Check voltage level at signal source to see if it corresponds to the screen status.

0 VDC = 0 on the status screen.
>2 VDC = 1 on the status screen.

If the source signal is good, trace the wiring back to the display to determine where the signal is lost.

If the switch and wiring are good, the display may have an internal fault.

ATB Input Channels

There are two input channels that are typically used as ATB inputs; however, they may be assigned to other digital input functions if no ATB input is required.

These inputs are activated by switching the input to RCI ground or DGND.

Digital Outputs

When a digital I/O channel is configured as an output it will sink up to 100 mA of current to system ground when active. This may be used to drive higher current slave relays. Each channel is current-limited which means in the case of a wiring or solenoid fault, the channel is protected until the fault is removed.

CAUTION

THESE OUTPUTS ARE NOT FUSE PROTECTED. PROTECTION MUST BE PROVIDED BY EXTERNAL MEANS.

NOTE

A FLOATING OUTPUT MAY BE SEEN AS 0 V, WHICH CAN BE MISLEADING.

NOTE

IF SLAVE RELAYS ARE USED, THEN SNUBBER DIODES MUST BE FITTED.
REFER TO 4.24, SNUBBER DIODES ON RELAYS AND SOLENOIDS ON P. 28.

If the status screen indicates an expected digital output state but the output device is not responding correctly (e.g. relay not energizing):

1. Check voltage level at the display source to see if it corresponds to the screen status.
   A value of 1 on the status screen should result in 0.2 VDC or less on the corresponding output pin.
   A value of 0 on the status screen should correspond to a voltage of >3 VDC corresponding output pin.
   The actual voltage will depend on what is connected to the output terminal. If a relay coil is connected to the output channel driven from crane power then the voltage should go to crane power when the output is switched off.
2. If the display output signal is good, then trace the wiring to the destination to determine where the signal is lost.
3. If the output device and wiring are good, then the display may have an internal fault.
4. Switching the override key on will normally energize all digital outputs.

4.23d. Warning Lamp Outputs

The safety system has three dedicated open-drain outputs for driving external warning lights corresponding to the Green/Yellow/Red load status indicator lamps on the safety system display. These outputs can only sink up to 100 milliamps of current to ground and therefore should be used to drive slave relay coils.

The warning lamp outputs exactly match the green-yellow-red indicator lamps on the display.

If the display lamp is ON, the corresponding output will be a direct shunt to ground (<0.2 VDC).

If the lamp is OFF, the output will be floating. The actual voltage seen on a floating output is dependent upon what the output is driving, such as a relay coil.

In some instances the outputs may be used to drive low power LED warning lights if the current required by each light is less than 100 milliamps.

4.23e. Motion Cut Relay Outputs

The safety system has two internal safety relays. The relays have voltage-free contacts rated to 5A and may be used to energise the coils of external high-power slave relays. The safety relays are typically used for general motion cut (or boom down limit) (RL-1), and hoist up limit (RL-2).

CAUTION

PERMANENT DAMAGE MAY OCCUR IF INCORRECT MOTION CUT CONNECTIONS ARE MADE.

CAUTION

ALL INDUCTIVE LOADS SUCH AS RELAYS AND SOLENOIDS REQUIRE SNUBBER DIODES (E.G. 1N5404 OR 1N4004) FOR TRANSIENT SUPPRESSION.

WARNING

POWER MUST BE DISCONNECTED BEFORE ATTEMPTING CONNECTIONS.

WARNING

NEVER INSERT LARGER CAPACITY FUSES THAN THOSE ORIGINALLY SUPPLIED.

WARNING

OBTAIN SPECIALIST ASSISTANCE IF YOU ARE UNFAMILIAR WITH CRANE ELECTRONICS.

CAUTION

THE LSI-ROBWAY RELAY CONTACT AMPERE RATING MUST NOT BE EXCEEDED WHEN DIRECTLY OPERATING HYDRAULIC OR MECHANICAL SOLENOID DEVICES OR HIGH CAPACITY RELAYS. FOR SUCH DEVICES, USE A SLAVE RELAY.

Note that when the motion cut relay has de-energised, there is an in-built 5 second delay before it can be re-energised (provided the fault condition is cleared and the safety system is not in an alarm state). This feature helps avoid dynamic situations following motion cut, especially if activated during luffing down operations at higher boom angles.

If a hoist-up limit feature is required, then Relay 2 can be wired to de-energise when the ATB switch opens meaning a two-blocking condition is occurring.

Each of these relay outputs have read-back capability, thus a system fault will be triggered if the relay contact state does not match the expected relay state.

Fail-safe principles are followed in all system designs to ensure that the de-energised state provides the highest level of safety.

Both the normally open (NO) and normally closed (NC) contacts are available. When the relays are energised, the common terminal should be switched to the normally open (NO) terminal. This can be with checked with an ohmmeter.

Activating the override key switch will normally energise both relay outputs.

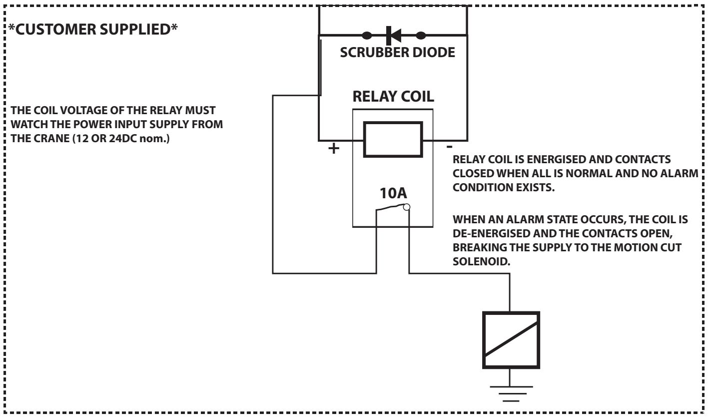
4.24. Snubber Diodes on Relays and Solenoids

CAUTION

ALL INDUCTIVE LOADS SUCH AS RELAYS AND SOLENOIDS REQUIRE SNUBBER DIODES FOR TRANSIENT SUPPRESSION.

Inductive loads must use snubber diodes on the coils (solenoids and relays) paying particular care to ensure correct polarity connection of the snubber diodes. LSI-Robway recommends fitting a 1N5404, 1N4004 or similar diode for back EMF suppression. Back EMG voltage spikes over 200VDC are commonly generated when relays and solenoids de-energise and these spikes can cause damage to other electrical equipment on the crane.

Figure 20, Snubber Diode Installation



4.25. Hoist direction switches

High reeving friction differential from the boom head sheave and hook block sheave between hoist raising and lowering is an effect often seen when 2 or more parts of line are used and may result in the load display changing when hoist direction changes. This can be overcome by calibrating affected winches while hoisting up, then while hoisting down. Direction switch inputs are required for the RCI-8522 so that hoist direction is identified by the software.

Fit direction switches to control linkage for main and aux hoist functions.

Normal convention is that the switch closure should represent a downward hoisting direction and this can be confirmed by referring to Appendix C, Software Configuration beginning on p. 81 of this manual.

Refer to 4.23, Digital Inputs on p. 24 for more information on Digital Inputs.

4.26. Proximity Switches

Proximity switches provided by LSI-Robway are usually inductive type switches, meaning the switch is activated by close proximity to a ferrous metal target. Magnetic Proximity switches are also available in which case a magnetic target must also be installed.

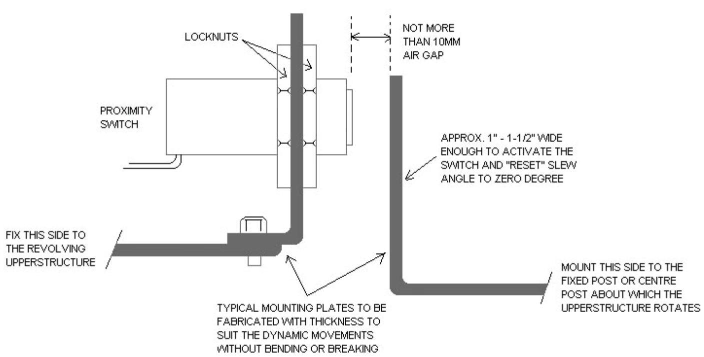
Installation procedure

1. Fabricate a suitable mounting plate for the switch to go between the two locknuts supplied.
2. For slew position applications, mount the plate at a suitable location on the revolving upperstructure preferably so that the switch moves and rotates with the upperstructure (see typical installation below).
3. The gap between the switch and target must not exceed 10mm. The switch distance can be adjusted via the locknuts.

NOTE

THE TARGET PLATE MUST BE MOUNTED AT A SUITABLE LOCATION: I.E. THE FIXED POST OR CENTER POST AROUND WHICH THE UPPER STRUCTURE ROTATES.

Figure 21, Proximity switch typical installation



4.27. Analog Inputs

The Analog section has programmable input gain circuitry and a 12 bit resolution ADC. The input circuitry can be programmed for:

- Four differential input signals
- Eight single ended signals (4-20 milliamp or 0-5VDC) input signals
- Or any combination thereof
- Each channel also has a programmable gain.

NOTE

THESE SETTINGS ARE PRESET AT THE FACTORY IN THE RCI CONFIGURATION FILES AND CANNOT BE MODIFIED ON-SITE.

4.27a. Sensor Excitation

The excitation supply provides power for the sensors. Two outputs are provided (precision +5.00 V or +15 V).

The +5 VEX output can only supply up to 100 milliamps of current.

The +15 VEX output can only supply up to 1 amp of current.

If either of these signals are shorted to ground or loaded down below their limits then the RCI will detect a fault condition and activate motion-cuts until the fault is removed.

5: CALIBRATION

5.1 Overview

This chapter describes all safety system calibration tasks. Personnel unfamiliar with the calibration process should follow the calibration sequence as it is shown in the flow chart in section 5.2, Calibration Flow Chart, on p. 31.

CAUTION

WHEN CALIBRATING A SAFETY SYSTEM, ALL APPLICABLE TASKS DESCRIBED BELOW MUST BE FOLLOWED.

Calibration must only be performed by an authorised LSI-Robway dealer or LSI-Robway trained technicians.

When troubleshooting a problem only re-calibrate a safety system after all other tests have been performed.

The following data is stored in the safety system:

- load charts
- crane geometry
- alarm and motion control settings
- data logging parameters
- finetuning settings
- other variables

As this data varies between cranes and even crane models, this data may have to be changed onsite during installation.

The default values delivered with the safety system are listed in Appendix C: Software Configuration beginning on p. 81 of this manual. Note that LSI-Robway manuals are often not supplied with complete and accurate measurements.

5.1a Sensor Overview

The safety system uses sensors to monitor the crane's working environment. Signals from these sensors are converted to raw counts in the range of 0 - 4095, with a normal operating range of 100–4000.

You can view both the calibrated and uncalibrated signal from a sensor. When observing the uncalibrated signal, ensure that the raw counts stay within 100–4000 as the sensor operates through its operating range. Also ensure that the raw counts increase or decrease in a regular, smooth progression.

If you find that the change is irregular (for example, changes by more than 10) check the connections for that sensor.

If the raw count is less than 50 or more than 4050 it is likely that there is a short circuit on that input channel (for example, the cable has been crushed and has an internal short circuit) or an open circuit on that input channel (for example a broken or disconnected lead). Moisture in plugs can also appear like short circuits.

If a slew zone encoder is installed, verify that its raw counts increment/decrement as the boom slews left/right.

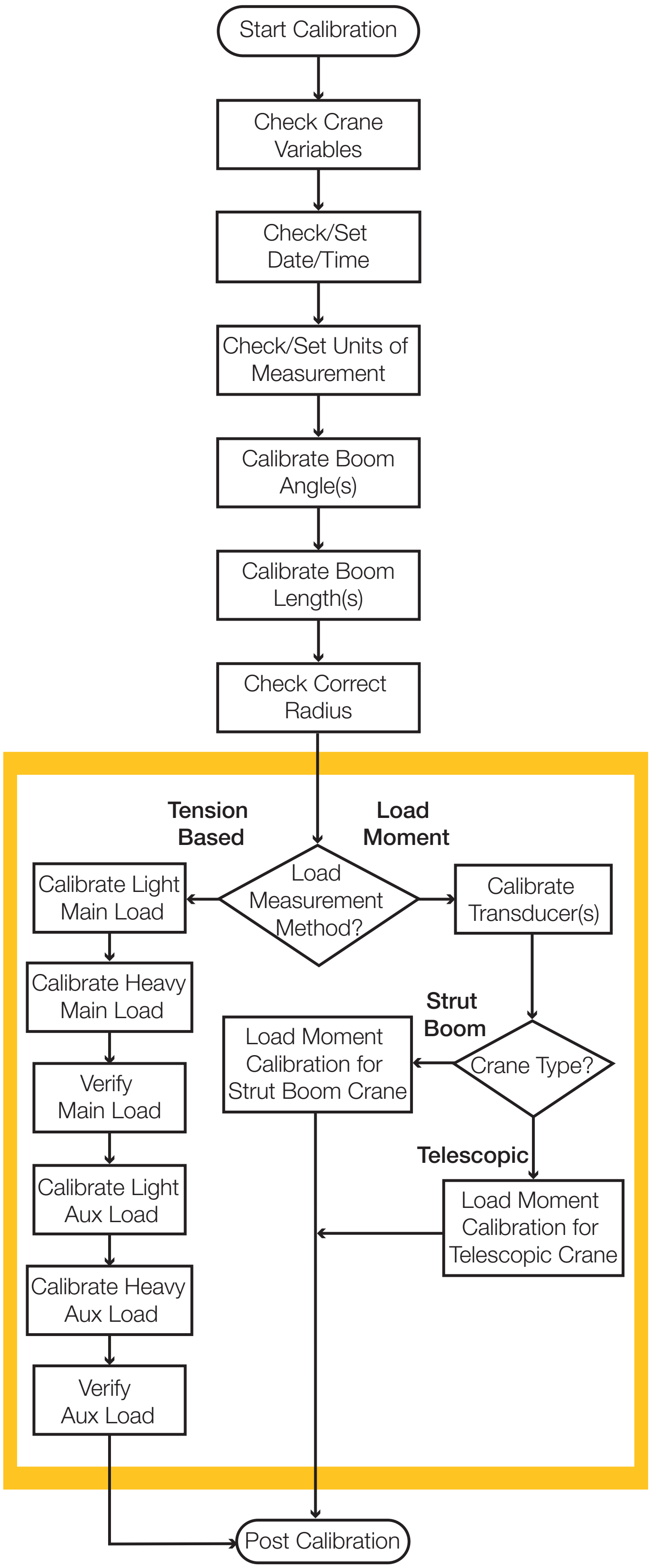
Confirm operation of proximity sensors (where fitted).

If a wind sensor is installed, ensure that the anemometer is free to rotate, and that a measurement is present in the display unit (anemometers are pre-calibrated because checking wind speed readouts against actual prevailing wind speed is normally impractical).

Check the operation of any other sensor and inputs.

5.2 Calibration Flow Chart

Figure 22, Calibration flow chart



5.3 Calibration Procedure

5.3a. Check Crane Variables

To check crane variables

1. Turn the safety system on and access the Operator Menu (refer to 3.6a, Accessing the Operator Screen on p. 11).
2. Access the Service Menu (refer to 6.2, How To Access The Service Menu on p. 42).
3. Review all crane geometry settings against crane configuration data in Appendix C: Software Configuration beginning on p. 81 of this manual (refer to 6.3b, Geometry on p. 46).
4. Check and verify each setting in the system. If a setting/measurement is incorrect then change it to the correct value.
5. Review all safe working load (SWL) % parameters against actual requirements and change if necessary (refer to 6.3d, Corrections and Limits on p. 48). Refer to Appendix C: Software Configuration (beginning on p. 81 of this manual) as required.
6. Review data logger recording points against actual requirements and change if necessary (refer to Section 7, Data Logger, beginning on p. 54).

Refer to Appendix C: Software Configuration beginning on p. 81 of this manual.

5.3b. Check Date And Time

To check or set the date and time

1. From the Service Menu select SETUP > SET DATE AND TIME.
2. To change the values:
   - Buttons to set new values.
   - Press the Enter button to save the change.
   - Repeat until all fields are correct.
3. Press the Quit button to return to the Service Menu.

5.3c. Check Units of Measurement

To check or set the units

1. From the Service Menu select DISPLAY OPTIONS > UNITS OF MEASUREMENT.
2. To change the values:
   - Use the Up and Down buttons to set new measurement values.
   - Press the Enter button to save the change.
   - Repeat until all fields are correct.
3. Press the Quit button to return to the Service Menu.

5.3d. Calibrate Boom Angle

To calibrate boom angle

1. Ensure that the crane is on firm and level ground (to within ±0.1°).
2. From the Service Menu select SENSORS AND SAMPLING > ANGLE > VIEW CALIBRATION.
3. Luff the boom through its full operating range.

(If the raw counts stay within the 100–4000 range, go to Step 4).

If the raw counts are outside this range, the inclinometer inside the recoil drum will need to be rotated. Refer to section 4.9, Mounting Location > Typical Installation Procedure on p. 16.

4. Measure the actual boom angle using an angle finder (to within ±0.1º).
5. Select SENSORS AND SAMPLING > ANGLE > CALIBRATE LOW ANGLE.
6. Enter the angle measurement and press the Enter button.
7. Luff the boom to a high angle.
8. Measure the actual boom using an angle finder (to within ±0.1º).
9. Select SENSORS AND SAMPLING > ANGLE > CALIBRATE HIGH ANGLE.
10. Enter the angle measurement and press the Enter button.
11. To verify that the boom angle is accurately calibrated:
    a. Select SENSORS AND SAMPLING > ANGLE > VIEW CALIBRATION.
    b. Luff the boom and stop at different boom angle points.
    c. Measure boom angle with the angle finder and verify this actual value against the displayed angle.
    d. If they do not match, repeat this process to recalibrate the boom angle.
12. Repeat this process for each angle sensor.

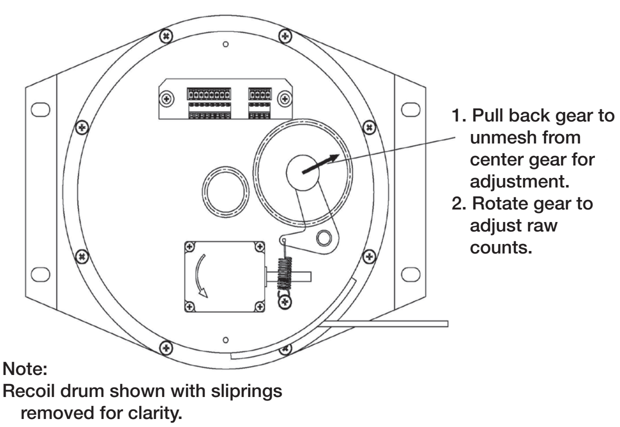
5.3e. Calibrate Boom Length

To calibrate boom length

This procedure only applies to telescopic cranes:

1. Fully retract the boom.
2. From the Service Menu, select SENSORS AND SAMPLING > LENGTH > VIEW CALIBRATION.
3. Remove the recoil drum cover.
4. Pull back the length potentiometer assembly lever to unmesh from center gear, and rotate the gear until 100 raw counts displays (or 4000 if raw counts; decrease appropriately if the boom is extended).

Figure 23, Recoil Drum Potentiometer Adjustment



5. Release the lever and allow the gears to mesh.
6. Fully extend the boom and ensure that raw counts stay within the 100–4000 range.
7. Fully retract the boom.
8. Select SENSORS AND SAMPLING > LENGTH > CALIBRATE SHORT LENGTH.

9. Enter the actual boom length (Fully retracted and fully extended boom lengths are shown in crane load charts and also refer to Appendix B: Duty Listing beginning on p. 79 of this manual).
10. Fully extend the boom.
11. Select SENSORS AND SAMPLING > LENGTH > CALIBRATE LONG LENGTH.
12. Enter the actual boom length.
13. To verify that the reading for boom length is accurately calibrated:
    a. Select SENSORS AND SAMPLING > LENGTH > VIEW CALIBRATION.
    b. Retract the boom and stop at different boom lengths.
    c. Measure boom length and verify this value against the displayed length. If they do not match, recalibrate boom length.

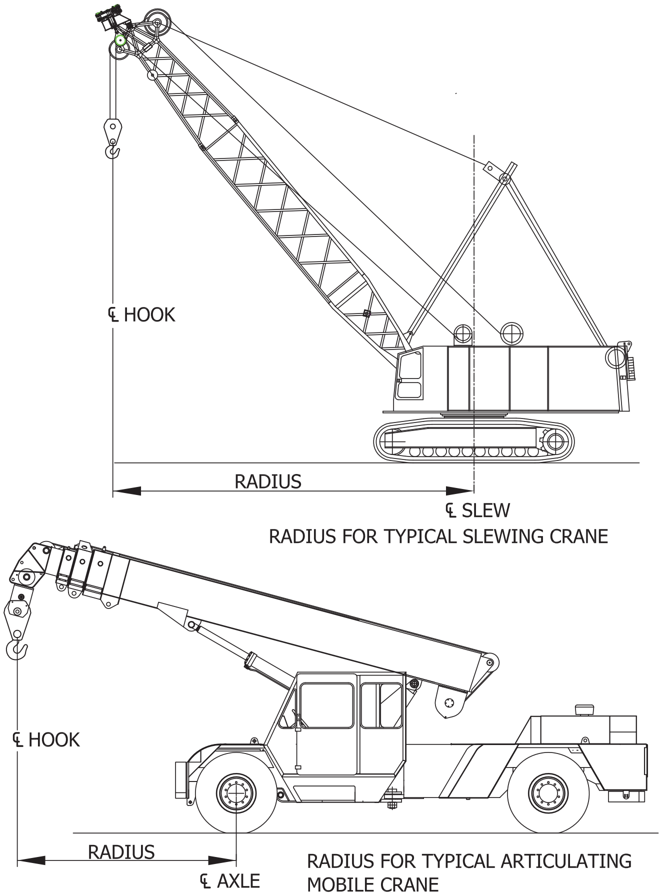
Fully extend and retract the boom a few times to ensure smooth spooling of the recoil cable on the drum. Check calibrated length at each step.

14. Refit the recoil drum cover.
15. Exit the Service Menu and return to the Operator Screen.
16. Repeat this process for all length sensors.

5.3f. Check Radius

Radius is measured horizontally from the center of slew (or from the center of the front axle on mobile articulating cranes) to the center of the hook.

Figure 24, Measuring the radius



To check the radius is correct

1. Press Quit to exit from the Service Menu and return to the Operator Screen.
2. Check the displayed radius against actual radius at low and high boom angles.
3. If the values do not match (within an acceptable tolerance) check crane geometry against the configuration sheet (refer to Appendix C: Software Configuration beginning on p. 81) and confirm that boom angle and length have been correctly calibrated.

4. If displayed to actual radius is still incorrect, physically measure the various boom geometry offsets (eg. slew offset, main sheave radius, footpin offset etc) and correct these values using the Service Menu. Re-check displayed to actual radius. Refer to Section 6.3b, Geometry on p. 46 for further information.
5. The displayed radius may differ from actual radius due to boom deflection. Unladen and laden boom corrections functions are available, refer to 6.3d, Corrections and limits > Radius correction on p. 49.

For telescopic cranes, also check radius at short and long boom lengths.

Use the tape measure to measure the actual radius.

5.3g. Load Calibration — Tension Based Systems

Ensure that the following items are available:

- The weight of all hook blocks, slings and lifting frames is known.
- A selection of known test weights is available to check load calibration.

WARNING

ENSURE THAT ANY LIFTER LOADS ARE LESS THAN THE CURRENT SWL.

Main winch

To calibrate the light main load:

1. Select the correct winch, duty and falls.
2. Safely lift a known light test load.

The load should be heavy enough to produce approximately 10% of the maximum main winch line-pull.

Add the total weight of any lifting gear or tackle including the hook block, slings and lifting frames to the weight of the known light test load.

If a known light test load is unavailable, use the weight of the raised empty hook block as a light test load.

For cranes where the hook block is considered part of the crane, raise the empty hook block off the ground and use a value of 0.0t as a light load.

3. Select SENSORS AND SAMPLING > LOAD CALIBRATION.

Enter the actual main falls.

4. Select SENSORS AND SAMPLING > MAIN LOAD > VIEW CALIBRATED MAIN LOAD.
5. Ensure that the raw counts are between 100 and 4000.
   If the raw counts are outside this range, refer to 5.1a, Sensor Overview on p. 30.
6. Select SENSORS AND SAMPLING > MAIN LOAD > CALIBRATE LIGHT MAIN LOAD.
7. Enter the value of the total load (including hook block, slings and lifting frames).

To calibrate the heavy main load

1. Safely lift a known heavy test load.

The load should be heavy enough to produce approximately 70% to 90% of the maximum main winch line-pull.

Add the total weight of any lifting gear or tackle, including the hook block, slings and lifting frames to the weight of the known heavy test load.

2. Select SENSORS AND SAMPLING > MAIN LOAD > VIEW CALIBRATED MAIN LOAD.
3. Ensure that the raw counts are between 100 and 4000.

If the raw counts are outside this range, refer to 5.1a, Sensor Overview on p. 30.

4. Select SENSORS AND SAMPLING > MAIN LOAD > CALIBRATE HEAVY MAIN LOAD.
5. Enter the value of the total load (including hook block, slings and lifting frames).

To verify the main load

1. Select SENSORS AND SAMPLING > MAIN LOAD > VIEW CALIBRATED MAIN LOAD.

Lift various known loads and ensure that an accurate load value is displayed.

Auxiliary winch (whip line)

To calibrate the light aux load

1. Select the correct winch, duty and falls.

The load should be heavy enough to produce approximately 10% of the maximum aux winch linepull.

Add the total weight of any lifting gear or tackle including the hook block, slings and lifting frames to the weight of the known light test load.

If a known light test load is unavailable, use the weight of the raised empty hook block as a light load.

For cranes where the hook block is considered part of the crane, raise the empty hook block off the ground/platform and use a value of 0.0t as a light load.

2. Safely lift a known light test load.

Enter the actual aux falls.

3. Select SENSORS AND SAMPLING > LOAD CALIBRATION
4. Select SENSORS AND SAMPLING > AUX LOAD > VIEW CALIBRATED AUX LOAD.
5. Ensure that the raw counts are between 100 and 4000.

If the raw counts are outside this range, refer to 5.1a Sensor Overview on p. 30.

6. Select SENSORS AND SAMPLING > AUX LOAD > CALIBRATE LIGHT AUX LOAD.
7. Enter the value of the total load (including hook block, slings and lifting frames).

To calibrate the heavy aux load

1. Safely lift a known heavy test load.

The load should be heavy enough to produce approximately 70% to 90% of the maximum aux winch line-pull.

Add the total weight of any lifting gear or tackle, including the hook block, slings and lifting frames to the weight of the known heavy test load.

2. Select SENSORS AND SAMPLING > AUX LOAD > VIEW CALIBRATED AUX LOAD.
3. Ensure that the raw counts are between 100 and 4000.

If the raw counts are outside this range, refer to 5.1a, Sensor Overview on p. 30.

4. Select SENSORS AND SAMPLING > AUX LOAD > CALIBRATE HEAVY AUX LOAD.
5. Enter the value of the total load (including hook block, slings and lifting frames).

To verify the aux load

1. Select SENSORS AND SAMPLING > AUX LOAD > VIEW CALIBRATED AUX LOAD.
2. Lift various known loads and ensure that an accurate load value displays.

After load calibration go to 5.5 Post Calibration on p. 40.

5.3h. Load Calibration — Load Moment Systems

A major difference between tension based and load moment based systems is that the load sensors (dynamometers, load pins and tension cells) used in the tension based system only need to be calibrated once (light and heavy loads for each load sensor).

Load moment systems require the individual load sensors to be calibrated and then a load moment calibration is performed for each individual duty (crane configuration) and winch.

Transducer calibration

There are three methods of calibrating transducers and any or a mix of these methods may be used. LSI-Robway suggests using Method 1 for low calibration and Method 3 for high calibration.

CAUTION

YOU MUST CALIBRATE ALL TRANSDUCERS BEFORE PERFORMING LOAD MOMENT CALIBRATION.

To calibrate a transducer (Method 1)

This method uses actual boom forces applied to the transducer (pressure or a load). This is the most accurate method but is very difficult to get a known maximum load on the pressure transducer/tension cell.

1. Ensure that there is a zero or a light load/pressure on the transducer.
2. From the Service Menu select SENSORS AND SAMPLING > TRANSDUCER X > CALIBRATE LOW TRANSDUCER.
3. Enter the actual low value (0.0 when no boom force/pressure on the transducer).
4. Ensure that there is a known heavy (near maximum) boom force or pressure on the transducer.
5. Select SENSORS AND SAMPLING > TRANSDUCER X > CALIBRATE HIGH TRANSDUCER.
6. Enter the actual high value.
7. Repeat for all other transducers.

To calibrate a transducer (Method 2)

This method uses either a LSI-Robway RCI load simulator (for mV/V transducers) or a 4-20mA simulator (for 4-20mA transducers).

Using an RCI load simulator for mV/V transducers:

1. Disconnect the transducer and connect the load simulator to the controller input.
2. Set the load simulator to 0 for low calibration.
3. From the Service Menu select SENSORS AND SAMPLING > TRANSDUCER X > CALIBRATE LOW TRANSDUCER.
4. Enter 0.0.
5. Set the load simulator as follows:
    - For a 2 mV/V transducer set the load simulator to 10 for high calibration.
    - For a 1 mV/V transducer set the load simulator to 5 for high calibration.
6. Select SENSORS AND SAMPLING > TRANSDUCER X > CALIBRATE HIGH TRANSDUCER.
7. Enter the capacity of the transducer (for example, 34.5 for a 5000 PSI pressure transducer, or 15.0 for a 15T tension cell).
8. Disconnect the load simulator and re-connect the transducer.
9. Repeat for all other transducers.

Using a 4-20mA simulator for 4-20mA transducers:

1. Disconnect the transducer and connect the 4-20mA simulator to the controller input.
2. Set the 4-20mA simulator to 4.00mA for low calibration.
3. From the Service Menu select SENSORS AND SAMPLING > TRANSDUCER X > CALIBRATE LOW TRANSDUCER.
4. Enter 0.0.
5. Set the 4-20mA simulator to 20.00mA.
6. Select SENSORS AND SAMPLING > TRANSDUCER X > CALIBRATE HIGH TRANSDUCER.
7. Enter the capacity of the transducer (for example, 40.0 for a 40MPa (400Bar) pressure transducer, or 15.0 for a 15T tension cell).
8. Disconnect the 4-20mA simulator and re-connect the transducer.
9. Repeat for all other transducers.

To calibrate a transducer (Method 3)

1. From the Service Menu select SENSORS AND SAMPLING > TRANSDUCER X > EDIT CALIBRATION.
2. Enter the values from the table below:

Table 10, Transducer Table

TRANSDUCER TYPE:	4-20MA	2MV/V	3MV/V
	Value		
Lo Raw	780	910	910
Lo Cal	0.0	0.0	0.0
Hi Raw	3885	2950	4000
Hi Cal	Capacity of transducer, e.g.:		
	40.0 for 40MPa (400Bar pressure transducer)		
	15.0 for 15T tension cell		

3. Repeat for all other transducers.

Load moment calibration

Successful load moment calibrations may differ for different cranes. Experienced personnel may have different procedures for different crane types. If your method of load moment calibration doesn't work well for a particular crane, consider alternative methods.

Ensure that the first calibrated duty has a good and consistent load reading as this will flow on to the other duties. If first calibrated duty has a poor result, all other duties will also have poor results.

All load moment calibrations must be repeated if crane geometry is changed. Any corrections must be reset to 0.0 before further load moment calibrations are performed. If you are unsure of the results, repeat the load moment calibration. Load moment calibrations are completed with no load on the hook.

Before you begin

- Select the correct duty and falls.
- Ensure all transducers are calibrated.
- Ensure that the displayed radius is accurate. An accurate radius value improves the chances of a successful calibration.
- Check that all pressure correction menu item are set to 0.0 (Corrections and limits > Pressure correction).
- The weight of all hook blocks, slings and lifting frames is known.
- A selection of known test weights is available to check load calibration.

Strut Boom Load Moment Calibration Procedure

1. Access the Service Menu (refer to 6.2 How To Access The Service Menu on p. 42).
2. Select LOAD MOMENT > CALIBRATE LOAD.
3. Luff the boom up to near maximum angle using slow and smooth motions as you approach maximum angle and wait for the boom to settle.
4. Press the Enter button.
5. Enter the hook block weight and press the Enter button. The LCD display will ask you to luff down.
6. Luff down to a near minimum angle using a slow and smooth motion as the near minimum angle is approached.
7. Luff up a little and wait for the boom to settle.
8. Press the Enter button.
9. Select LOAD MOMENT > VIEW CALIBRATED LOAD.

WARNING

WHEN LIFTING ANY LOADS, ENSURE THAT THE LOAD IS LESS THAN THE CURRENT CRANE SWL.

10. Safely lift a known test load and compare the displayed load to known actual load (where actual load includes hook block, chains, slings and lifting frames as well as the lifted load).
11. Check the displayed load at various angles.
    a. If the displayed load is good go to step 12. If the displayed load varies as the boom is luffed, pressure corrections can be entered to display a consistent load reading. Refer to 6.3d Corrections and limits > Pressure Corrections on p. 50 for details on how to use this function.
    b. Once the display load is good while luffing go to step 12.
    c. If the displayed load has an inconsistent error at different radii:
        i. Check radius and geometry settings (refer to 6.3b, Geometry on p. 46).
        ii. Hydraulic luff ram: Check the hydraulics as there may be a hydraulic problem.
        iii. Hydraulic leaks or imbalance between operation of a twin ram boom can affect the displayed load (counter balance valves must be matched).
        iv. If the settings are correct, repeat the load moment calibration.
        v. Contact LSI-Robway if the displayed load remains inconsistent.

d. If the displayed load has a consistent percentage error at different radii (for example, 10 high at all radii):

i. Select SENSORS AND SAMPLING > TRANSDUCER 1 > EDIT CALIBRATION. Change the High calibration value and press the Enter button.

ii. The displayed load will immediately change. (On a crane with two primary load transducers (e.g. transducers fitted to both pendants), then the values for Transducer 1 and Transducer 2 need to be changed by the same amount.

iii. Repeat this process until the displayed load is close to actual load (for example, if actual load is 20t and display load value is 24t, change High calibration until load reads 19t).

iv. Note down the new High calibration value.

v. Remove the load from the hook. Repeat the load moment calibration and lift a known test weight. Repeat the steps in this task until the displayed load value is accurate.

vi. Record the High calibration value.

12. When the displayed load is accurate through all radii and when luffing up and down:

- Record all correction values and reset all values to zero.
- Calibrate other winches as required.

13. When all winches have been calibrated, re-enter all corrections.

14. Go to 5.5 Post Calibration on p. 40.

NOTE

WHEN STRUT BOOM LENGTH IS CHANGED (OR A DIFFERENT JIB CONFIGURATION IS USED), THEN A LOAD MOMENT CALIBRATION IS REQUIRED.

NOTE

ONCE THE FIRST DUTY HAS BEEN CALIBRATED WITH A GOOD RESULT, ALL OTHER DUTIES / WINCHES SHOULD HAVE SIMILAR RESULTS AFTER CALIBRATION. HOWEVER, IT IS RECOMMENDED THAT ***AFTER EACH LOAD MOMENT CALIBRATION HAS BEEN COMPLETED, THAT AT LEAST ONE TEST LOAD IS LIFTED*** *TO ENSURE THAT NO ERRORS WERE MADE DURING CALIBRATION PROCEDURES.*

Telescopic Boom Load Moment Calibration Procedure

Telescopic load moment calibration is required at different boom lengths. The boom is divided into 17 sections with section 1 being fully retracted, section 9 half extended and section 17 fully extended. LSI-Robway recommends that for short boom cranes that at least sections 1, 9 and 17 are calibrated. The number of calibrated sections depends upon the consistency of the displayed load at different boom lengths.

NOTE

THE RCI-8522 HAS A “NEW CALIBRATION” FUNCTION WHICH WALKS THE USER THROUGH THE ENTIRE LOAD MOMENT CALIBRATION FOR EACH DUTY USING THE RECOMMENDED BOOM LENGTHS IN THE CORRECT ORDER.

IF “NEW CALIBRATION” IS SELECTED, THE USER IS AUTOMATICALLY TAKEN THROUGH THE PROCEDURE.

THE CORRECT SEQUENCE IS SHOWN BELOW.

1. Access the Service Menu (refer to 6.2 How To Access The Service Menu on p. 42).
2. Fully retract the boom and luff down to near minimum angle using slow and smooth motions as you approach minimum angle. (Note do not use the physical minimum boom angle, about 5 degrees above.)
3. Luff up a little and wait for the boom to settle.
4. Select LOAD MOMENT > CALIBRATE LOAD.
5. Enter the hook block weight.
6. Select CALIBRATE SECTIONS 1 – 17 > SECTION 1/17 and press the Enter button.

7. Follow the instructions on the display and luff up to near maximum angle using a slow and smooth motion as maximum angle is approached and then wait for the boom to settle. (Note do not use the physical maximum boom angle, about 5 degrees below.)
8. Press the Enter button.
9. Telescope the boom to full extension and luff down to near minimum angle using slow and smooth motions as you approach minimum angle. (Note do not use the physical minimum boom angle, about 5 degrees above.)
10. Luff up a little and wait for the boom to settle.
11. Select CALIBRATE SECTIONS 1 – 17 > SECTION 17/17 and press the Enter button.
12. Follow the instructions on the display and luff up to near maximum angle using a slow and smooth motion as maximum angle is approached and then wait for the boom to settle. (Note do not use the physical maximum boom angle, about 5 degrees below.)
13. Press the Enter button.
14. Retract the boom to half boom length.
15. Luff down to near minimum angle using slow and smooth motions as you approach minimum angle. (Note do not use the physical minimum boom angle, about 5 degrees above.)
16. Luff up a little and wait for the boom to settle.
17. Select CALIBRATE SECTIONS 1 – 17 > SECTION 9/17 and press the Enter button.
18. Follow the instructions on the display and luff up to near maximum angle using a slow and smooth motion as maximum angle is approached and then wait for the boom to settle. (Note do not use the physical maximum boom angle, about 5 degrees below.)
19. Press the Enter button.
20. Select LOAD MOMENT > VIEW CALIBRATED LOAD.
21. Safely lift a known test load and compare the displayed load to the actual load (which should include the hook blocks, chains slings and lifting frames as well as the lifted load).
    a. If the displayed load is good, go to step 23.
    b. If the displayed load varies as the boom is luffed, pressure corrections can be entered to display a consistent load reading. Refer to 6.3 Corrections and limits > Pressure Corrections on p. 50 for details on how to use this function. Once the display load is good while luffing, go to step 23 on p. 40.
    c. If the displayed load varies between the calibrated boom lengths (ie between half extended length and fully extended or retracted length) additional section calibrations at these boom lengths can be completed in accordance with instructions above (if additional sections are being calibrated do not use “New Calibration”).Once the displayed load is good at all boom lengths go to step 23.
    d. If the displayed load has an inconsistent error at different radii:
        i. Check radius and geometry settings (refer to 6.3b, Geometry on p. 46).
        ii. Hydraulic luff ram: Check the hydraulics as there may be a hydraulic problem.
        iii. Hydraulic leaks or hydraulic imbalance between operation of a twin ram boom can affect the displayed load (counter balance valves must be matched).
        iv. If the settings are correct, repeat the load moment calibration.
        v. Contact LSI-Robway if the displayed load remains inconsistent.
    e. If the displayed load has a consistent percentage error at different radii (for example, 10% high at all radii):
        i. Select SENSORS AND SAMPLING > TRANSDUCER 1 > EDIT CALIBRATION.
        ii. Change the High calibration value and press the Enter button. The displayed load will immediately change. (On a crane with two luff rams, if a transducer is fitted to both rams then the values for Transducer 1 and Transducer 2 need to be changed by the same amount.)

iii. Repeat this process until the displayed load is close to actual load (for example, if actual load is 20t and display load value is 24t, change High calibration until load reads 19t).
iv. Note down the new High calibration value.
v. Remove the load from the hook.
vi. Repeat the load moment calibration and lift a known test weight.
vii. Repeat the steps in this task until the displayed load is accurate.
viii. Record the High calibration(s) value.

22. Check the displayed load at various angles and lengths and while luffing up and down:
23. When the displayed load is accurate through all radii and when luffing up and down:
    a. Record all correction values and reset values to zero.
    b. Calibrate other duties and winches using the procedure above.
24. When all duties and winches have been calibrated re-enter all corrections.
25. Go to 5.5 Post Calibration.

5.4 Friction Compensation Hoist Direction

This is not a Menu Item

On some cranes head sheave friction, hook block friction and/or rope friction can be enough to cause a significant difference to the displayed load between winching up and winching down. This normally affects cranes with multiple falls and often there is no difference on the auxiliary as it may only have one fall.

To overcome this, a hoist direction signal can be input to the system and 2 separate calibrations can be done.

Hoist direction is a digital signal fed into a digital input, separate inputs are required for each: main and auxiliary.

Default is normally down (no input used). This is why dyno/HRT software stores load calibrations in locations LD1D (Load One Down) and LD1U (Load One Up). Auxiliary load data is stored in LD2D and LD2U, respectively.

Two calibrations are required for each winch – light load is calibrated as the load is being winched up, then repeated (using the same Menu Items) as the load is being winched down.

Repeat this procedure with a heavy load.

These procedures are also used with the auxiliary hoist if required.

5.5 Post Calibration

Post Calibration Check Procedure

1. Perform functional and operational checks and known load tests to ensure the accuracy of the safety system. If the displayed load is incorrect, you may need to recalibrate the safety system. Operational checks should include checks of all digital inputs and outputs.
2. If load readout decreases as the boom is luffed, apply a load/angle correction factor. Refer to 6.3a Corrections and limits > Load/Angle Correction on p. 48.
3. If required, apply a winch rigging SWL for the main and aux hooks. Refer 6.3.4 Corrections and Limits > Main (or Aux) winch rigging SWL on p. 48.
4. If required, amend the lift threshold setting to ensure duty/falls can be changed with the current hook block weight. Refer 6.3a Corrections and Limits > Alarm Threshold.
5. Verify calibration results.
6. Using pen and paper, record sensor calibration data, refer to Edit Calibration on p. 46 for further information. Sensor calibration data may be recorded in the tables below.
7. Amend software configuration documents (See Appendix C: Software Configuration, beginning on p. 81 of this manual) with any changed settings.
8. Adjust sensor filtering if required.
9. Load moment systems only: Download the load moment file. Refer to section 6.3g, Load Moment > Upload Load Moment Data on p. 52.
10. New installations only: Clear the data log From the Service Menu select DATA LOGGER > ERASE ALL).

Sensor Calibration data suit Load Moment systems:

Table 11, Sensor Calibration

	ANGLE	LENGTH (TELESCOPIC CRANES ONLY)	TRANSDUCER 1	TRANSDUCER 2	ADDITIONAL SENSORS (IF REQUIRED)		
Lo Raw							
Lo Cal							
Hi Raw							
Hi Cal							

6: SERVICE MENU

6.1 Overview

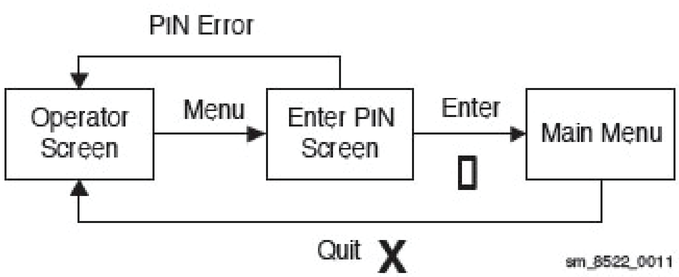
The Service Menu allows trained technicians to view, configure and troubleshoot the safety system.

The type of crane and sensor configuration determines which menu items are included.

Some menu items may be duplicated for multiple components (for example you may see SENSORS AND SAMPLING > TRANSDUCER 1 and SENSORS AND SAMPLING > TRANSDUCER 2).

6.2 How To Access The Service Menu

Figure 25, Accessing the Service Menu



A crane specific PIN number controls access to this menu.

CAUTION

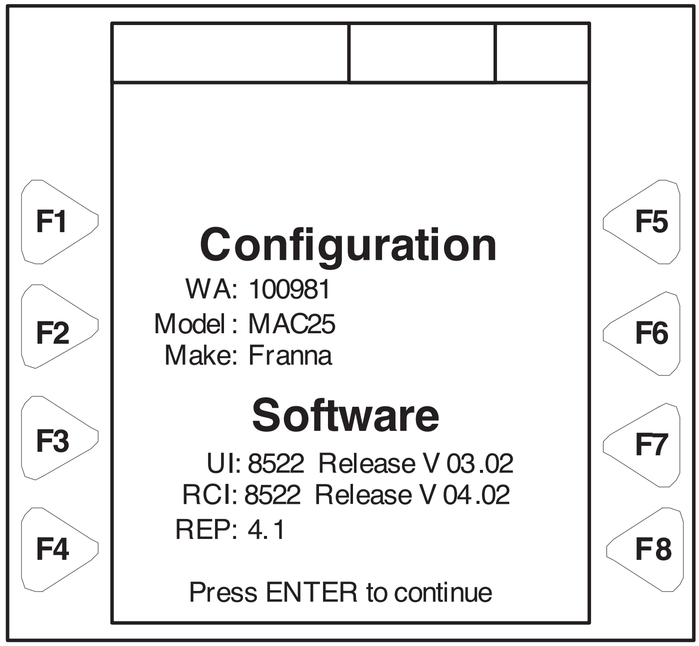
DO NOT SHARE THE PIN WITH CUSTOMER.

ONLY AUTHORIZED LSI-ROBWAY DEALERS SHOULD ACCESS THESE FUNCTIONS. UNAUTHORIZED ACCESS TO THIS MENU MAY RESULT IN THE CRANE BECOMING INOPERABLE OR MAY COMPROMISE THE SAFETY SYSTEM.

To identify the PIN for this crane

1. Press the Enter button at the Operator Screen to display the Start-up Screen.
   a. The PIN is the last four digits of the WA (work authority) number.
   b. Use 0000 or 1000 for demonstration systems setup.

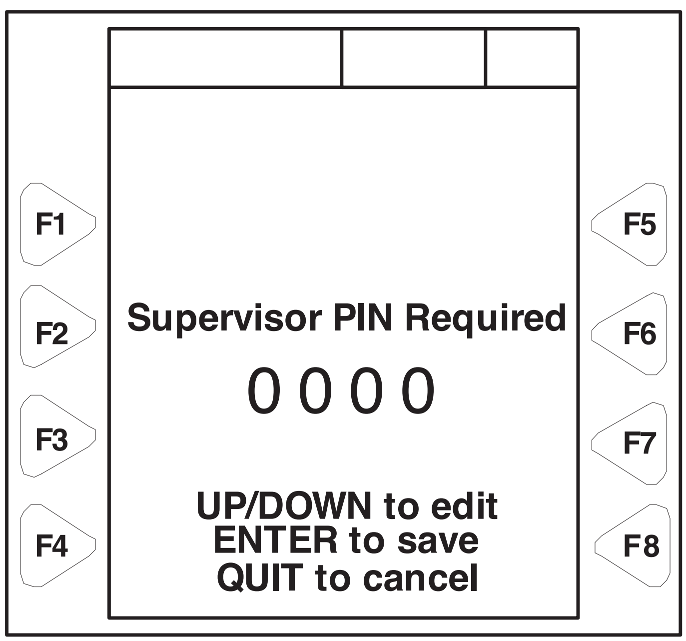
Figure 26, Start-up Screen



sm_8522_0001n

To access the Service Menu

Figure 27, Enter PIN Screen



sm_8522_0001a

1. Access the Operator Screen (refer to 3.6a, Accessing the Operator Screen on p. 11).
2. Press the Menu button to display the Enter Pin Screen (see figure 28).

3. Use the Up arrow to select the first number of the PIN and then press the Down arrow to advance to next digit.
4. Repeat this process to enter the remaining numbers of the PIN.
5. The Service Menu then displays.

To exit from Service Menu items

1. Press the Quit button to return to a previous menu item. Press this button repeatedly to return to the Operator Screen.

6.3 Service Menu Items

Figure 28, Service Menu Tree

RCI-8522 Main Menu

The type of crane determines which menu items display.
Some menu items may display multiple times.

Sensors and sampling

- Main load
  - View calibrated main load
  - Calibrate light main load
  - Calibrate heavy main load
- Aux load
  - View calibrated aux load
  - Calibrate light aux load
  - Calibrate heavy aux load
- Angle
  - View calibration
  - Edit calibration
  - Calibrate low angle
  - Calibrate high angle
  - set/view filtering
- Length
  - View calibration
  - Edit calibration
  - Calibrate short length
  - Calibrate long length
  - set/view filtering
- Transducer
  - View calibration
  - Edit calibration
  - Calibrate low transducer
  - Calibrate high transducer
  - set/view filtering
- Live view (digital)
- Live view (analogue)

Geometry

- Slew offset
- Head sheave (boom head) offset
- Footpin offset
- Piston Diameter
- Rod Diameter
- Lower ram pivot point
  - Horizontal distance to boom footpin
  - Vertical distance to boom footpin
- Upper ram pivot point
  - Vertical distance to boom footpin
  - Horizontal distance to boom footpin

Data logger

- view
- Starting condition
- Stable load setup
- Upload to file
- Print to serial port
- Erase all

Corrections and limits

- Main winch rigging SWL
- Auxiliary winch rigging SWL
- Set rigging length threshold
- Alarm threshold
  - Yellow warning
  - Red alert
  - Motion cut
- Lift threshold
- Load/angle correction
  - Low angle for load correction
  - High angle for load correction
  - load/angle correction factor for main winch
  - load/angle correction for aux winch
- Radius correction
  - Unladen boom
  - Laden boom
- Pressure correction
  - Lifting down
  - Luffing up
- Minimum variations
  - Minimum angle variation (luffing down)
- Sample Periods
  - Angle sample period

Display options

- Units of measurement
  - Mass
  - Length
  - Angle
  - Pressure
- Decimal Digits

Slew/shaft encoder

- View slew encoder
- Counts per 360   slewing of crane
- Slew encoder driection
- Crane gear slew teeth
- Slew shaft encoder gear teeth

Load moment

- View calibrated load
- Calibrate load
  - New calibration
- Erase current duty
- Upload moment data
- Download moment data

Setup

- Set date and time
- Crane setup
  - Configuartion
  - Duty
  - Set falls
- RCI setup
  - Load Display profile
  - Load default RCI profile
  - Save RCI profile
  - Restore RCI profile
  - Edit RCI profile
  - Reload load charts
  - Download load moment file
  - Uoload load moment file
  - Download data log
  - Upgrade controller
  - Upgrade controller

Display

- Master reset

This list shows all possible menu items. Note that RCI-8522 menu items in a specific display software will depend on crane configuration and system configuration.

6.3a. Sensors and Sampling

Main Load	View calibrated main load	Displays the calibrated load on the selected winch (similar to the Operator Screen). This is useful when verifying the accuracy of the load readout where calibration has not been completed. This will also display a negative load which can be useful for trouble-shooting.
	Calibrate light main load	Use to calibrate the light main load.
	Calibrate heavy main load	Use to calibrate the heavy main load.
Aux Load	View calibrated aux load	Displays the calibrated load on the selected winch (similar to the Operator Screen). This is useful when verifying the accuracy of the load readout where calibration has not been completed. This will also display a negative load which can be useful for trouble-shooting.
	Calibrate light aux load	Use to calibrate the light aux load.
	Calibrate heavy aux load	Use to calibrate the heavy aux load.
Angle (menu repeated if more than one angle sensor installed)	View calibration	Displays the raw counts (raw data) from the angle sensor. This is useful when verifying the accuracy of the angle readout where calibration has not been completed.
	Edit calibration	Refer to Edit calibration on p. 46.
	Calibrate low angle	Use to calibrate the low angle.
	Calibrate high angle	Use to calibrate the high angle.
	Set/view filtering	Use to stabilize the display readings if the numbers are changing rapidly. Each sensor can be independently filtered.
Length (menu repeated if more than one length sensor is installed)	View calibration	Displays the raw counts (raw data) from the length sensor. This is useful when verifying accuracy of the length readout where calibration has not been completed.
	Edit calibration	Refer to Edit Calibration on p. 46.
	Calibrate short length	Use to calibrate the short length.
	Calibrate long length	Use to calibrate the long length.
	Set/view filtering	Use to stabilize the display readings if the numbers are changing rapidly. Each sensor may be independently filtered.

Transducer (menu repeated if more than one transducer is installed)	View calibration	Displays the raw count (raw data) of the load transducer and the calibrated transducer value.
	Edit calibration	Refer to Edit calibration on p. 46.
	Calibrate low transducer	(Load moment systems) Use to calibrate the low end of a transducer.
	Calibrate high transducer	(Load moment systems) Use to calibrate the high end of a transducer.
	Set/view filtering	Use to stabilize the display readings if the numbers are changing rapidly. Each sensor may be independently filtered.

Live View (digital)	Use to view the state (open or closed) of the digital switch inputs and the state of digital outputs on or off). The inputs are used in a variety of roles to suit specific applications (such as wiring slew limit switches, proximity switches, external duty selector). Outputs may be used to activate hydraulic solenoids or buzzers (or similar). This display is constantly updated. Use when installing switch inputs and during troubleshooting to observe the input switch status and output state. In Figure 29, channel 09 is ATB.	Live View (analog)	Use to view the calibrated and un-calibrated value of each sensor. Use when installing and troubleshooting sensors. This display is constantly updated.

Figure 29, Live View (Digital)

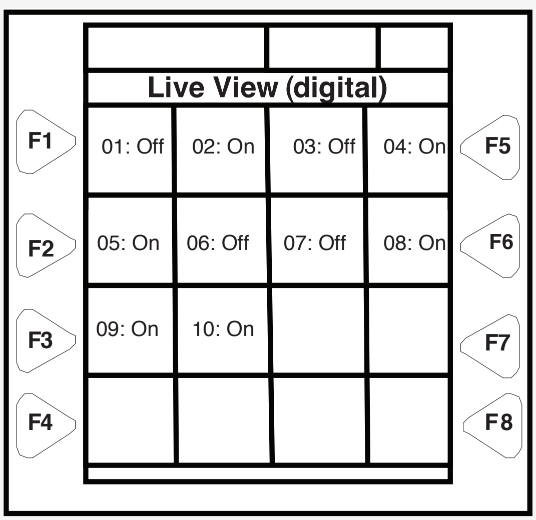
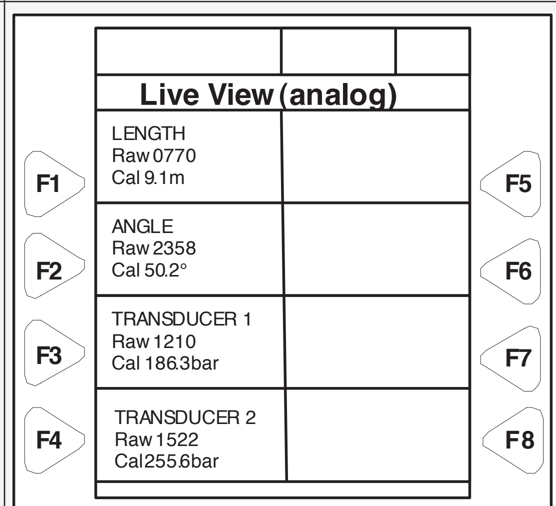


Figure 30, Live View (Analog)



Edit calibration

Calibration values are recorded during the calibration process (i.e. low calibration value with corresponding sensor raw counts, high calibration value with corresponding raw counts). These values are Low Raw, Low Cal, High Raw and High Cal, and these values can be entered manually if calibration data is lost (for example, due to part replacement).

These values are also useful when troubleshooting (where invalid calibrations can be easily identified by experienced technicians). This data can also be restored into the system by manually keying in the values without the need to operate the boom or lift known test loads.

Use this menu item to manually copy and restore calibration data. This process must be performed after completing system calibration. Raw counts are also displayed.

Where applicable, you can also use this function to validate default calibration values (useful when you load a default safety system profile, and the sensor calibration data in that profile is correct). In this case, only the Edit Calibration data for each sensor needs to be validated (instead of physically calibrating each sensor individually).

To validate calibration data, access EDIT CALIBRATION for each sensor and press the √ key until all fields have been accepted and display returns to Sensors and sampling.

Repeat for all other sensors as required.

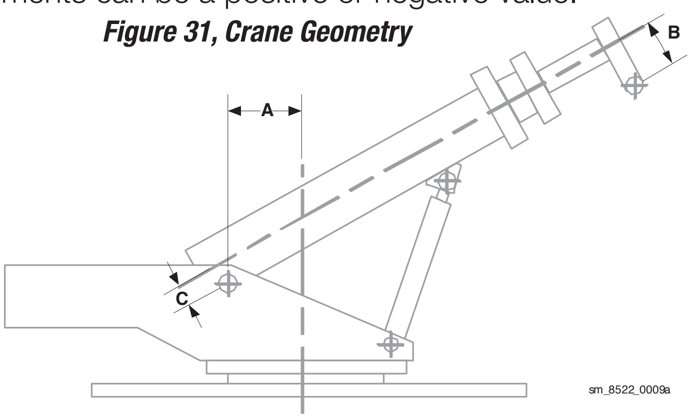
This menu item may also be used to calibrate transducers for load moment systems.

6.3b. Geometry

These menu items define the actual physical dimensions (geometry) of the crane. Geometry settings include slew offset, footpin offset, head sheave radius, head sheave offset, ram pivot points to boom center-line and footpin.
Factory default values are based on information received from the manufacturer at time of order and supply of the system however, crane manufacturers often do not provide complete and accurate measurements. Any values found to be different from the default value must be changed in this menu.

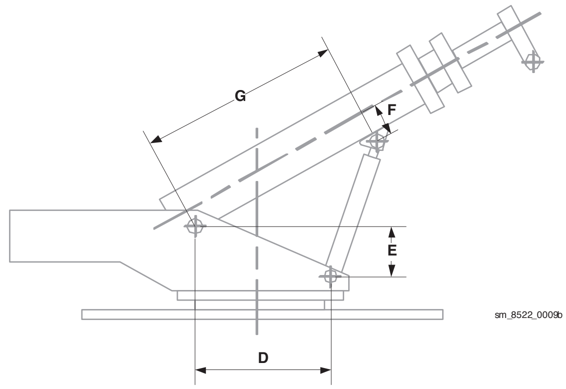
Note that geometry measurements can be a positive or negative value.

Figure 31, Crane Geometry



These values are used by the system to calculate radius	Slew offset	Center of slew to center of footpin (horizontal). Diagram reference: dimension A.
	Head sheave (boom head) offset	Center of head sheave to center-line of boom vertical. Diagram reference: dimension B.
	Footpin offset	Center of footpin to boom center-line. Diagram reference: dimension C.

Figure 32, Crane Geometry



<table>
<tr><td rowspan="2">These dimensions are critical in calculating accurate displayed loads
Diameters must be accurately measured</td><td>Piston diameter</td><td colspan="2" rowspan="2">Internal diameter measurement is required.</td></tr>
<tr><td>Rod diameter</td></tr>
<tr><td rowspan="4">These values are used by the system to calculate the luff ram position</td><td rowspan="2">Lower ram pivot point</td><td>Horizontal distance to boom footpin</td><td>Diagram reference: dimension D.</td></tr>
<tr><td>Vertical distance to boom footpin</td><td>Diagram reference: dimension E.</td></tr>
<tr><td rowspan="2">Upper ram pivot point</td><td>Vertical distance to boom center-line</td><td>Diagram reference: dimension F.</td></tr>
<tr><td>Horizontal distance to boom footpin</td><td>Diagram reference: dimension G.</td></tr>
</table>

6.3c. Data Logger

Customize data logging to suit local needs.

View	View the current data logging configuration.
Starting condition	Not used.
Stable load setup	Stable load configuration.
Load threshold	Set the load threshold for the data logs.
Upload to file	Upload the data log to the SD card.
Print to serial port	Print the data log direct to the RS-232 port.
Erase all	Erase all data log contents and resets the lift counter. Once erased, data log entries cannot be restored.

6.3d. Corrections and Limits

Main winch rigging SWL		Use to set a rigging SWL value for both crane and boom to pass the maximum radius without activating alarms. This may be required when the boom rest is at a lower angle then allowed in the load chart, or when a strut boom needs to be lowered to the ground for reconfiguration. The value must not exceed the weight of the main hook block. When this menu item is used the crane will assume a SWL equal to the weight of the hook block, which allows the boom to go further down to the ground for rigging purposes without triggering alarms (as long as there is no load on the main hook block).
Auxiliary winch rigging SWL		As above but for the aux winch.
Set rigging length threshold		Use to set rigging and normally associated with telescopic cranes though it may apply to lattice boom cranes. The rigging length is the maximum length allowed during rigging operations. If the boom length is less than the rigging length then the system can be placed in the rigging mode. An error displays if rigging mode cannot be accessed because of the rigging length threshold.
Alarm threshold		Factory set defaults which may be changed to suit local requirements.
	Yellow warning	Set the % SWL threshold for yellow warning. Default typically 85%.
	Red alert	Set the % SWL threshold for red alert. Default typically 100%.
	Motion cut	Set the % SWL threshold for motion cut. Default typically 105%.
Load/angle correction		Use in cases where the displayed load changes by a reasonable amount as the boom is luffed up and down through its operating range. This phenomenon is particularly apparent when a single sheave dynamometer is used at the boom tip, or on some larger crawler cranes with back stops. Single sheave dynamometer: if the load increases as the boom luffs down. Other: if the load increases as the crane luffs at higher angles or contacts the back stops.

Load/angle correction (cont'd)	Low angle for load correction [applies to main and aux winch]	Enter the low and high angles (where load starts and stops varying) and the change in load (in tonnes) observed over this range.
	High angle for load correction [applies to main and aux winch]	
	Load/angle correction factor for main winch	
Radius correction	Unladen boom	Use to correct the radius for unladen bloom deflection. Only use this function when the displayed radius is less than the true operating radius of the crane. In such a case, measure the physical load radius at a position where boom deflection is seen to have the maximum effect on the load radius.
		Maximum boom deflection occurs when the boom is fully telescoped and is positioned at approximately 45º-60º. On duties where the winches are both assumed to be reeved over the main boom head, it is necessary to calibrate only for the main winch (winch 1).
		However, when a jib is installed it is possible to calibrate boom deflection for both the main boom head and for the head of the jib. **To calibrate:** Select the desired winch. Fully extend the boom and position it for the worst-case deflection. Measure the physical radius, confirm that it is greater than the displayed radius, and then enter the actual radius against the unladen radius correction in this menu item. Repeat for any winch that is reeved over a jib.
	Laden boom	Use to correct the radius for laden boom deflection. Only use when the displayed radius is less than the true operating radius of the crane with a heavy load and unladen correction has already been employed.
		In this case, measure the physical load radius at a position where boom deflection is seen to have the maximum effect on the load radius with a heavy load on the hook.
		Maximum boom deflection occurs when the boom is fully telescoped and a load, which approaches the SWL, is suspended on the hook.

Radius correction (cont'd)	Laden boom (cont'd)	On duties where both winches are assumed to be reeved over the main boom head, it is necessary to calibrate only for the main winch (winch 1).
		However, when a jib is installed it is possible to calibrate boom deflection both for the main boom head and for the head of the jib.
		To calibrate: Select the desired winch and fully extend the boom. Safely lift a heavy load (near SWL) and position the boom for worst case deflection. Measure the physical radius and confirm that it is greater than the displayed radius and then enter the actual radius against the laden radius correction menu item. Repeat for any winch that is reeved over a jib. Note that "Unladen Boom Radius Correction" must be completed before "Laden Boom Radius Correction".
Pressure correction		Load moment systems using pressure transducers may show differing loads when luffing due to different piston/rod pressures when luffing up and luffing down. Pressure corrections can be used to give a more consistent displayed load, and are normally measured in MPa or Bar. Default settings are always 0.0. The pressure corrections are retained when the boom has stopped luffing.
To correct displayed load: Follow a trial and error approach where a value is entered (for example, Luffing correction down), the boom is luffed, displayed load is checked and then the value is changed until displayed load stays consistent when luffing.		
LSI-Robway recommends starting with 0.5 MPa or 5 Bar. Record values as you change them, and when the displayed load is good, add all pressure correction values to the crane configuration sheet. Record values as you change them, and when the displayed load is good, add all pressure correction values to the crane configuration sheet.		
	Luffing down	Use to correct the displayed load when luffing down.
	Luffing up	Use to correct the displayed load when luffing up.
Minimum variations	Minimum angle variation (luffing boom)	Default setting is normally 0.1°. Use in conjunction with the Pressure correction menu item.
Sample periods	Angle sample period	Default setting is normally 0.5 s. Use in conjunction with the Pressure correction menu item.

6.3e. Display Options

<table>
<tr><td rowspan="13">Units of measurement</td><td colspan="3">Displays mass, length angle, pressure and speed measurement settings.</td></tr>
<tr><td>Measurement</td><td>Value</td><td>Description</td></tr>
<tr><td rowspan="4">Mass</td><td>t</td><td>Metric mass ton (1,000 kg)</td></tr>
<tr><td>kg</td><td>Kilogram</td></tr>
<tr><td>klb</td><td>Kilo pound (1,000lbs)</td></tr>
<tr><td>sT</td><td>Short ton</td></tr>
<tr><td rowspan="2">Length</td><td>m</td><td>Meters</td></tr>
<tr><td>ft</td><td>Feet</td></tr>
<tr><td>Angle</td><td>d</td><td>Degrees</td></tr>
<tr><td rowspan="3">Pressure</td><td>MPa</td><td>Mega-pascals</td></tr>
<tr><td>Bar</td><td>Bar</td></tr>
<tr><td>PSI</td><td>Pounds per square inch</td></tr>
<tr><td rowspan="2">Speed</td><td>mps</td><td>Meters per second</td></tr>
<tr><td></td><td>mph</td><td>Miles per hour</td></tr>
<tr><td>Decimal digits</td><td colspan="3">Use to set the number of digits after the decimal point for all parameters displayed on the Operator Screen.</td></tr>
</table>

6.3f. Slew or Shaft Encoder

These variables ensure accurate counting of the encoder to provide correct slew angle. A proximity switch is normally used to provide a reset position in the event that the crane is slewed when the safety system is switched off.

View slew encoder raw counts	Use to view the raw counts (raw data) of the slew encoder.
Raw counts per 360° slewing of crane	Use to change the number of raw counts generated for one complete revolution of the crane. If the encoder is not counting accurately this value can be changed.
Slew encoder direction	Use to set slew encoder direction. This value can be changed if slew direction is incorrect (possible values are 1.0 or -1.0).
Crane gear slew teeth	Number of teeth on the crane slew gear. This menu item is always paired with Slew shaft encoder gear teeth.
Slew shaft encoder gear teeth	Number of teeth on the shaft encoder gear. This menu item is always paired with Crane gear slew teeth.

6.3f. Load Moment

View calibrated load	Use to view the main calibrated load while in the Service Menu (similar to the Operator Screen). This is useful when verifying the accuracy of the load readout where calibration has not been completed. A negative load may also be displayed.
New calibration	Automatically steps the user through a load moment calibration in the recommended order, from erasing load moment data for current duty through the various section calibrations.
Erase current duty	Telescopic cranes only. Use to erase all Section 1 to 17 load moment data for the current duty only. Always use this function before first calibrating each duty to ensure that previous calibration data has been cleared or for a new system to ensure that no residual data remains. Load moment calibrations for telescopic cranes can be completed at up to 17 different boom lengths where Section 1 is a fully retracted boom, Section 17 is a fully extended boom, Section 9 is a boom that is exactly half extended, Section 5 is a boom that is one quarter extended etc.
Upload load moment data	Use to copy a load moment file from the display to the in-built SD card. As load moment calibration is time consuming this is a means of transferring calibration data for quick download to a replacement display unit or sister crane.
Download load moment data	Use to upload (restore) a load moment file from the in-built SD card to the display. Note that uploaded load moment files may be viewed and edited on a computer using a software configuration program. This can be useful for verifying valid load moment calibrations and also for copying load moment data from one crane configuration to a similar crane configuration (e.g., copy load moment data from the main hook duty to a fixed lug duty). Contact LSI-Robway for more information.

6.3g. Setup

Various items may be uploaded and downloaded to the safety system using the SD card. These include:

- Display profile (user interface menu)
- RCI profile (crane configuration, geometry and calibration settings)
- Load charts (crane load charts)
- Load moment file (crane load moment data)
- Data log (crane operating data log)
- Boot controller (internal controller operating program)
- Boot display (internal display operating program)

Use the Setup menu items listed below to upload and download these files as required.

Set time and date		Set the current date and time. Only valid date and time values are saved.
Crane setup		The following features allow you to change the configuration, duty and falls without having to exit the Service Menu.
	Configuration	Same functionality as the Operator Screen except that the configuration may be changed even if a lift has commenced.
	Duty	Same functionality as the Operator Screen except that the duty may be changed even if a lift has commenced.
	Set falls	Same functionality as the Operator Screen except that the falls may be changed even if a lift has commenced.
RCI setup	Load display profile	Use to reload or update the user interface menu from the SD card into the safety system. Normally performed when a later version of the interface is to be loaded.
	Load default RCI profile	Use to reload default crane configuration, geometry and calibration settings from the SD card. This may be required when default crane values need to be reloaded.
	Save RCI profile	Use to save the current crane configuration, geometry and calibration settings (changed during calibration) to the SD card. Always perform this function after calibration, recalibration, or if any other settings have been changed.
	Restore RCI profile	Use to reload a saved safety profile from the SD card into the safety system. This is normally required when existing crane configuration, geometry and calibration settings need to be restored due to an incorrect subsequent calibration, or if a new safety system has been fitted to the crane.
	Edit RCI profile	Provides details about how to change crane configuration and geometry settings that are not accessible through the user interface menu.
	Reload load charts	Use to reload crane charts from the SD card. Normally used when new or amended load charts need to be loaded.
	Download load moment file	Use to save the load moment file to the SD card.
	Upload load moment file	Use to upload the load moment file from the SD card.
	Download data log	Use to copy the data log to the SD card. The data log is a text file that can be read by any text editor.
	Upgrade controller	Use to reload (or update) the controller operating program from SD card. Normally required when a later version of the program is available.
	Upgrade display	Use to reload (or update) the display operating program from SD card. Normally required when a later version of the program is available.

7: DATA LOGGER

7.1 Description

The safety system records crane operation data to a log file. You can download this log file to an SD card and then read the data log files into a computer for further analysis or to send it to LSI-Robway.

CAUTION

THE SD CARD MUST BE PRESENT IN THE SAFETY SYSTEM AT ALL TIMES WHEN THE CRANE IS OPERATING.

CAUTION

DO NOT ADD, MODIFY, OR DELETE FILES ON THE SD CARD EXCEPT AS INSTRUCTED IN THIS DOCUMENT OR BY DIRECT INSTRUCTION BY LSI-ROBWAY PERSONNEL. UNAUTHORIZED CHANGES TO THE SD CARD MAY COMPROMISE THE OPERATION OF THE SAFETY SYSTEM AND WILL VOID THE WARRANTY.

CAUTION

THE CONTENTS OF THE SD CARD ARE CUSTOMIZED FOR A SPECIFIC CRANE MAKE AND MODEL AND CANNOT BE USED FOR ANY OTHER PURPOSE.

DO NOT USE THE SD CARD TO STORE ANY OTHER TYPE OF INFORMATION.

7.2 Download The Data Log To The SD Card

Data Log Download to SD Card

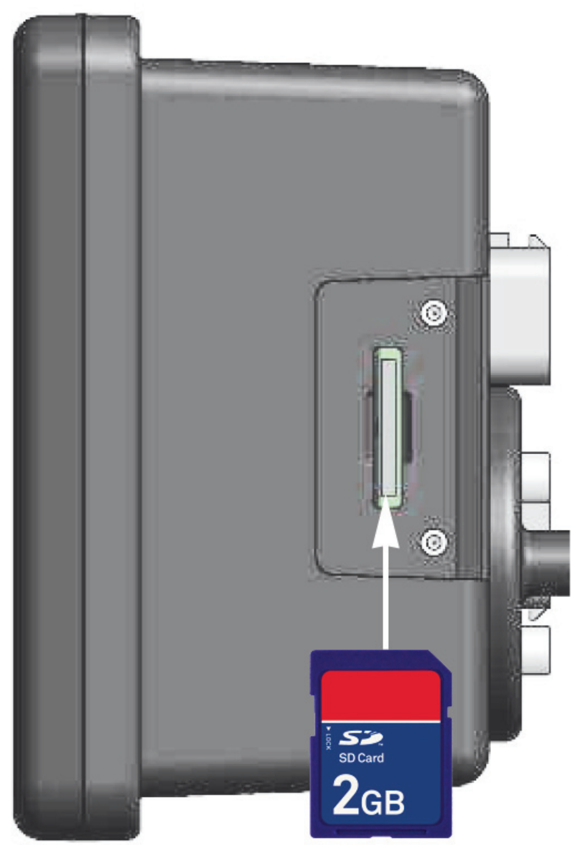
1. Access the Service Menu (refer to 6.2 How To Access The Service Menu on p. 42).
2. 8522 Menu ->Enter PIN ->DATA LOGGER > UPLOAD TO FILE.
3. This copies the binary contents of the data log files to the SD card.
4. Turn the safety system off.
5. This may mean that the crane itself must be powered down.

7.3 Transferring The Log File To A PC

Data Log Transfer from SD card to PC

1. Remove the SD card from the SD card receptacle on the side of the display.
2. Note the orientation of the card.
3. Insert the SD card into the SD card slot on a computer.
4. Copy the crane_date.bin file to the computer.
5. Access the log file using a word processing program or text utility (for example MS Word or Windows Notepad).
6. Delete the log file from the SD card when you have finished analyzing the log file.
7. Insert the SD card into the safety system.
8. Turn the safety system on.

Figure 33, Location of SD Card Slot on Display Unit



7.4 Analyzing The Log File

There are two log files that get transferred to the SD Card:

- Crane Working Life Period Data Log
- Crane Operational Data Log

7.4a Crane Working Life Period Data Log

The Crane Working Life Period data log is a very simple file format which is intended to facilitate estimate of Crane usage against its designed working life as per AS2550.1:2011

The Crane Working Life Period data log stored in the RCI internal memory and can only be erased by a Trained LSI-Robway technician with a terminal interface test set.

Lifts which meet the minimum valid lift criteria are presented in the following format:

8522 Release V04.17

Rep: Trunk

WA: 105094

MAKE: CENTURY

MODEL: P&H 122-20

Customer: 002E, Site: 0001

Table 12, Period Data Log

CHANNEL	TIME STAMP	LOAD (T)	SWL (%)	CALIB ERRORS
001	11/4/2011 8:49:31 AM	4.04	41.0	No
001	11/4/2011 9:16:45 AM	0.68	999.0	Yes
001	11/4/2011 1:31:48 PM	13.36	137.1	No
001	11/8/2011 9:19:54 AM	4.39	25.5	No
001	11/8/2011 9:40:58 AM	18.70	108.4	No
001	11/8/2011 11:03:26 AM	3.47	110.6	No
001	11/8/2011 12:05:18 PM	4.11	106.2	No
001	11/8/2011 12:17:08 PM	0.28	20.0	No
001	1/8/2011 1:00:22 PM	0.21	14.5	No
001	11/8/2011 2:05:58 PM	6.60	78.1	No
001	11/8/2011 2:08:14 PM	5.08	149.4	No
001	1/8/2011 2:09:31 PM	1.47	36.4	No

7.4b Crane Operational Data Log

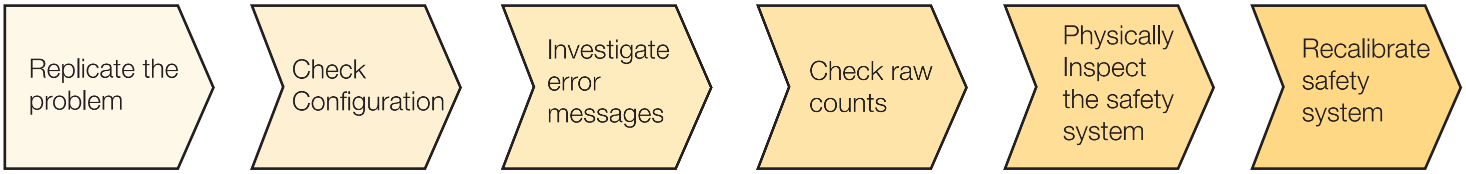
The Crane Operational Data Log is a record of exactly what the crane is doing minute to minute. It records every parameter including load, position, and it can even record wind speed. This information can be viewed or downloaded by the crane owner to see exactly what the crane has been doing.

In the case of an accident, the Operational Data Log gives the crane owner exact, detailed account of how the crane was operated. All tags in this log are explained in Appendix D, Operational Log Tags, beginning on p. 89.

8: TROUBLESHOOTING

8.1 Overview

The following information will help you to systematically identify and resolve safety system problems.



Reproduce the problem	Can you reproduce the problem? What are the symptoms?
Check safety system configuration	Is the safety system correctly configured for the work environment (duty, falls, slew zones)? Check length, angle and radius values against those in the safety system (refer to Appendix C: Software Configuration beginning on p. 81 of this manual). Is the crane permitted to be used this way?
Investigate error messages	What error message(s) do you see on the display? Refer to Section 8.7 on p. 62, and Section 8.8 on p. 63 for error message tables.
Check raw counts	Review the raw counts (for more information refer to 8.8a, Troubleshooting Aids on p. 64).
Physically inspect the safety system components	Physically inspect all components of the safety system. Check all hose connections, check that the safety system components are undamaged and are unaffected by other crane systems.
Review Common Problems (p. 58)	Refer to Section 8.6 on p. 58 for Table 13, Common Problems and Solutions.
Recalibrate the safety system	Do not recalibrate the safety system unless you have worked through all previous troubleshooting options and are satisfied that the physical connections between all components of the safety system are sound.

8.2 Check the Obvious

- Make sure all of the connectors are tight.
- Is the motion cut output connected to an external relay?
- Check terminals/wiring/etc. are connected to existing power.
- Before any connection is made to an existing installation check for power on those connections.

8.3 Do Not Modify the Calibration

It is rare for calibration data to be corrupted.

When a re-calibration has been attempted in order to rectify a problem before that problem has been correctly identified, it leads to added confusion as the perspective is moved from the real fault to “calibration problems”.

If the system had previously been operating correctly and suddenly developed a fault, the culprit is likely to be something external to the display rather than the calibration. One such possibility is that the mounting of the angle sensor has become loose and has allowed the angle sensor to move, hence altering the angle and radius and the SWL. Alternatively, there may be a short circuit in one of the cables caused by excessive flexing or rubbing during use. On an initial installation, the calibration may well be at fault.

If all of the external inputs appear to be operating correctly but the readouts do not show the correct values, then view all of the calibration data and record it.

If in doubt, send a copy of this data to LSI-Robway Pty Ltd, so that it can be analyzed.

If this is not possible, re-calibration may be attempted.

Re-calibration must only be performed when all physical inputs have been verified for correct operation.

If a re-calibration has been performed, record the new data. The new calibration data must always be recorded and a copy sent to LSI-Robway so that records reflect the current status of the display. This will ensure correct information is passed onto the next person needing to attend the site.

8.4 Identify the Symptoms

Identify the end problem.

Work backwards in order to identify the most likely cause of the problem.

If possible, have the problem demonstrated so you can “describe it in your own words”. Sometimes what someone else has told you is not the most accurate representation of the issue.

Check the “raw counts” for each input. Refer to the software configuration sheets In Appendix C, beginning on p. 81 of this manual, on how to access the raw counts.

The raw count shows what the actual inputs are doing (like a signal strength indication). These raw counts are then manipulated in software according to the calibration data stored in the display to produce the readouts on the front panel. If the calibration has been done incorrectly, or the configuration is incorrect, or something else is wrong, then the front panel readouts (e.g. the LOAD or ANGLE values) may provide you with misleading information.

Cycle each sensor through a range, for example luff up and down for the angle sensor and check that the raw counts vary from a low value (around 200) to a high value, around 800.

For correct operation, these raw counts must be in the range 33 to 999 for each sensor used. Anything outside of this range will produce an error.

8.5 Electro-Static Discharge Precautions

The RCI contains sensitive CMOS circuitry. To avoid damage due to static discharge, your body and the components you’re working with (Replacing SD card, Connecting cables) must be at the same electrical potential.

And the easiest way to do this is to make sure that all static charges are drained to ground, an object connected to the Earth, which can harmlessly absorb the static charge.

If any RCI-8522 PCBs are handled, Electro-static discharge precautions should be taken. Contact LSI-Robway for further information. Always keep PCB in antistatic bag, discharge yourself before handling the PCB. Close the lid or cover of enclosures when you finish working.

8.6 Common Problems

Table 13, Common Problems and Solutions

SYMPTOM	CAUSE	REMEDY
BLANK RCI DISPLAY	No power	Check external RCI power fuse, replace after rectifying fault. Check internal RCI power fuse, replace after rectifying fault. NOTE: the internal RCI overvoltage protection mechanism is designed to blow a power fuse in the event of a prolonged overvoltage condition such as alternator load dump. If replacing the internal fuse an identical fuse MUST be used to prevent system damage in the future.
	Low crane supply voltage	Measure system voltage, if below 11 volts fully charge batteries and/or rectify fault before proceeding.
	Dislodged internal RCI cable	Remove four corner screws and six backshell screws. Check internal 50 position ribbon cable and re-seat if necessary.
	RCI internal fault	Replace RCI. Reprogram. Recalibrate.
	Display software upgrade interrupted midstream	Replace RCI. Reprogram. Recalibrate.
RCI IN “SAFE MODE”	Software not loaded properly	Perform master reset and reload software using RS232 Port.
	Software mismatch	Perform master reset and reload software using RS232 Port.
	Incorrect configuration filename on SD card	Correct the filename and retry software upgrade.
	Internal RCI fault	RCI fault. Replace RCI. Reprogram. Recalibrate.
	Internal RCI diagnostics checksum failure	RCI fault. Replace RCI. Reprogram. Recalibrate.
BAD BOOM ANGLE READING	Boom length sensor fault	Check cable connections. Check sensor raw counts. Must be between 50 and 4050. Boom length sensor fault. Check that recoil drum potentiometer is properly positioned within range. The potentiometer should have a half-turn in reserve when boom is fully retracted.
	Wiring fault	Check recoil drum cable connections. Potentiometer excitation voltage should be 5 volts DC. Length signal should vary between 0.1 and 4.9 volts DC.

SYMPTOM	CAUSE	REMEDY
BAD BOOM ANGLE READING (cont'd)	Incorrect configuration	Check programmed boom length sensor parameters.
	Length sensor not calibrated	Perform boom length calibration procedure.
	Broken potentiometer	Damage can occur with over or under extension. Replace potentiometer.
BAD BOOM LENGTH READING Telescopic cranes	Boom length sensor fault	Check cable connections. Check sensor raw counts. Must be between 50 and 4050. Check that recoil drum potentiometer is properly positioned within range. The potentiometer should have a half-turn in reserve when boom is fully retracted.
	Wiring fault	Check recoil drum cable connections. Potentiometer excitation voltage should be 5 volts DC. Length signal should vary between 0.1 and 4.9 volts DC.
	Incorrect configuration	Check programmed boom length sensor parameters.
	Length sensor not calibrated	Perform boom length calibration procedure.
	Broken potentiometer	Damage can occur with over or under extension. Replace potentiometer.
BAD BOOM LENGTH READING Lattice boom cranes	Incorrect duty/ hook selected	Select correct BAD BOOM Duty / hook.
	Incorrect RCI configuration	Contact LSI-Robway service.
BAD PRESSURE TRANSDUCER READING	Pressure Sensor Fault	Check sensor raw counts. Must be between 750 and 3900. Replace pressure sensor if incorrect. Pressure sensor fault. Independently check pressure sensor using handheld 4-20 mA sensor tester.
	Wiring fault	Check 15VDC supply to sensor and 4-20 milliamp return current.
	Pressure Transducers not calibrated	Use Enter Cal Data to manually set pressure transducer scaling factors.
BAD RADIUS READING	Bad boom angle reading	See "Bad Boom Angle Reading."
	Bad boom length reading	See "Bad Boom Length Reading."

SYMPTOM	CAUSE	REMEDY
BAD RADIUS READING (cont'd)	Incorrect crane geometry	Verify crane geometry settings.
LIGHT STACK NOT OPERATING	Valid two-block condition	Check positions of main and auxiliary hoist-rope hook blocks.
	Bad cable connection(s)	Verify that ATB switch wiring harness plugs bad cable connection(s) are fully seated. Check cabling and connections.
	Incorrect duty selected	Verify that main and/or auxiliary ATB switches are installed as per the selected duty.
	Faulty slip rings	Replace recoil drum.
ANTI-TWO-BLOCK PROBLEM	Valid two-block condition	Check position of main and auxiliary hoist-rope hook blocks.
	Bad cable connection(s)	Verify that ATB switch wiring harness plugs are fully seated. Check cabling and connections.
	Incorrect duty selected.	Verify that main and/or auxiliary ATB switches are installed as per the selected duty.
	Faulty slip rings	Replace recoil drum.
RED INDICATOR AND CONTINUOUS ALARM BEEPING	System in override	Turn off override.
	Wiring fault	Check override key-switch wiring.
BAD LOAD READING OR UNABLE TO CALIBRATE LOAD. Tension-based systems 4-20 milliamp sensors	Faulty load sensor	Check sensor raw counts. Must be between 750 and 3900. Replace load sensor if incorrect. Independently check load sensor using handheld two-wire 4-20 mA sensor tester.
	Wiring fault	Check cabling and connections. Check 15VDC supply to sensor and 4-20 milliamp return current.
	Load sensor not calibrated	Calibrate load.
BAD LOAD READING OR UNABLE TO...	Faulty load sensor	Check sensor raw counts. Must be between 50 and 4050. Replace load sensor if incorrect. Check sensor resistances against sensor datasheet.
	Wiring fault	Check cabling and connections. Check 5VDC supply to load sensor.
	Load sensor not calibrated	Calibrate load.

SYMPTOM	CAUSE	REMEDY
BAD LOAD READING Load moment systems	Load moment calibration incorrect	Recalibrate system.
	Bad radius reading	See “Bad Radius Reading.”
	Bad boom angle reading	See “Bad Boom Angle Reading.”
MOTION-CUT OUTPUT FAULTY	Wiring fault	Check digital I/O live view service screen for expected output condition. Check slave relay and/or solenoid operation.
	RCI internal safety relay fault	Check Digital I/O Live View service screen for expected output condition. If incorrect, replace RCI, Reprogram, Recalibrate.
	System in safe mode	See “RCI in Safe Mode.”
INCORRECT SWL	Bad slew proxy sensor	Check digital I/O live view service screen for expected slew input condition.
	Wiring fault	Check digital I/O live view service screen for expected slew input condition.

8.7 Run-Time Error Messages

Error messages appear on the bottom section of the display. If there are multiple errors, each error message will cycle through the display. In most cases, an error means that the crane cannot be operated.

The error message displays until the error condition is fixed.

These types of errors are typically generated by wiring, sensor, or calibration faults and can often be remedied on site by a LSI-Robway Trained Service Technician.

Table 14, Run-Time Error Messages

ERROR	DESCRIPTION	POSSIBLE CAUSE, SEE COMMON PROBLEMS
ATB	Anti-Two-Block condition	See “ATB Problem.”
ERR-ANG	Range (angle)	High or low boom angle limit exceeded.
ERR-HGT	Range (height)	Boom tip height exceeds allowable range. See “Bad Boom Length Reading,” p. 59. See “Bad Boom Angle Reading,” pp. 58-59.
ERR-LEN	Range (length)	See “Bad Boom Length Reading,” p. 59.
ERR-RAD	Range (radius)	See “Bad Radius Reading,” pp. 59-60.
ERR-SLEW	Range (slew)	Possible slew zone detection problem. See “Incorrect SWL,” p. 61.
ERR-SENSR-Angle	Boom angle sensor	See “Bad Boom Angle Reading,” pp. 58-59.
ERR-SENSR-Length	Length sensor	See “Bad Boom Length Reading,” p. 59.
MCUT	Motion cut limiter active	The hook load exceeds safe working load.
OVERLOAD	Red alarm (overload)	Load exceeds safe working load for the selected duty. Possible slew zone detection problem. See “Incorrect SWL,” p. 61.
OVR	Override ON	System safety functions are disabled. Proceed with Caution.
LM-UNCALI	System not calibrated	(Load moment systems only.) Load moment calibration has not been completed.

8.8 RCI Diagnostic Fault Messages

The following RCI diagnostic fault messages may indicate an RCI which has not been correctly aprogrammed or commissioned.

Table 15, Diagnostic Fault Messages

ERROR MESSAGE	DESCRIPTION	ACTION
No display repository!\\ Restart...	Can be caused by no SD card or if the User Interface outpaces the controller functio	Verify correct SD card installed and acknowledge the message.
Comms error:\\client timeout	May be caused by a transient condition	Replace RCI if message recurs.
Error:\\No SD card	SD Card not installed.	Verify correct SD card installed and restart system.
Error:\\Not calibrated	Selected duty has not been calibrated	Service Call.
No startup repository	RCI programming blank	Program RCI and follow complete calibration procedure.
No data repository	RCI programming blank	Program RCI and follow complete calibration procedure.
Error:\\No load chart	RCI programming blank	Program RCI and follow complete calibration procedure.
Error:\\File missing or read/write error	RCI programming blank	Program RCI and follow complete calibration procedure.
Error:\\No LM data	RCI Not commissioned	Program RCI and follow complete calibration procedure

The following diagnostic messages typically indicate that an RCI system has an internal fault that cannot be remedied on site. The RCI must be returned to LSI-Robway for service.

Table 16, Diagnostic Fault Messages (Internal Fault Related)

ERROR MESSAGE	DESCRIPTION	ACTION
Comms error:\\no client	RCI Internal bus fault.	Replace RCI.
Error:\\Controller inaccessible	RCI Internal bus fault.	Replace RCI.
Error:\\Internal problem	RCI Internal bus fault.	Replace RCI.
Comms error:\\invalid server response	RCI Internal bus fault.	Replace RCI.
Comms error:\\server abort	RCI Internal bus fault.	Replace RCI.

8.8a Troubleshooting Aids, Live View Analog

A raw count is the binary data converted from the raw voltage output of an Analog sensor. Raw counts are converted to engineering units which are displayed and processed by the RCI based on the RCI system configuration.

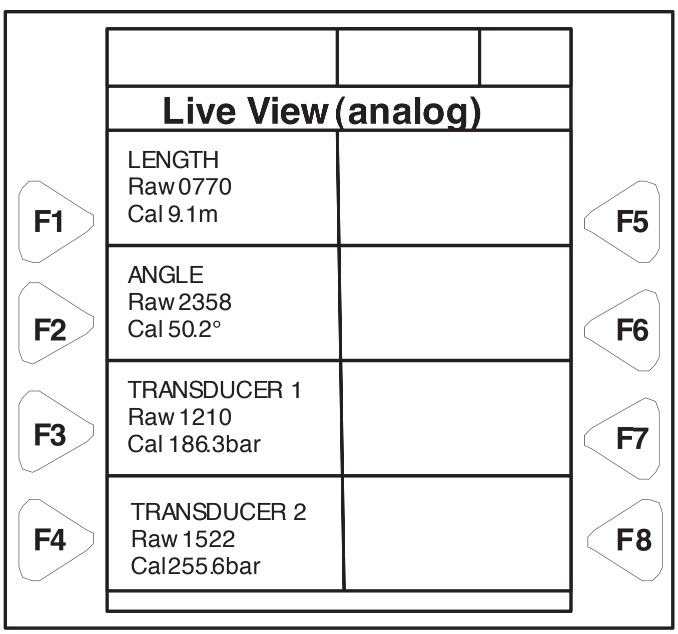
If an undetectable sensor fault is present the calculated engineering units value may be incorrect. Looking at the raw counts can help to isolate the problem.

To look at the raw counts

1. Replicate the problem (where possible and it is safe to do so).
2. Access the Service Menu (refer to 6.2 How To Access The Service Menu on p. 42).
3. Select SENSORS AND SAMPLING > LIVE VIEW (ANALOG).

The Live View Analog screen displays the raw counts and calibrated engineering units for each parameter. Any sensor or system faults will appear on the bottom line of this screen.

Figure 34, Live View Analog Screen



sm_8522_0001x

The RCI has two levels of fault detection on the Analog inputs:

Level 1: Sensor Raw counts. Must be between 40 and 4050 raw counts otherwise the input will be flagged as a fault. This is commonly caused by an open circuit in the sensor cabling.

Level 2: Engineering Units. The sensor may appear functional but is reading outside the allowable range. This will vary depending upon sensor range and duty selection. For example if the maximum boom angle is 67 degrees and the inclinometer reads 75 degrees it will pass the level 1 test but fail the Level 2 test.

8.8b Troubleshooting Aids, Live View Digital

In order to quickly determine if a digital signal input or output fault is due to bad sensor or cabling versus an RCI fault or configuration error a Digital I/O Live View screen is provided. This screen gives in realtime what the state of all digital inputs and outputs are.

Note that the RCI DIO1 - DIO8 are bi-directional. This means that any one of these I/O signals can be independently configured to act as either an input or as an output. You must refer to the system configuration documents in Appendix C, beginning on p. 81 of this manual to determine whether each is an input or an output.

If a DIO input is shorted to ground it will appear as “On”. If the DIO input is floating or driven above 2.5 volts the input will appear as a “Off”.

If a DIO output is “On” the I/O will be shorted to ground. If “Off” the output will be floating.

If R1 or R2 is “On” the RCI internal safety relay is energised. If R1 or R2 is “Off” the safety relay is deenergised.

If ATB1 or ATB2 is “On” the ATB switch is closed. If “Off” then the ATB switch is open or the cable is open circuit.

Figure 35, Live View Digital Screen

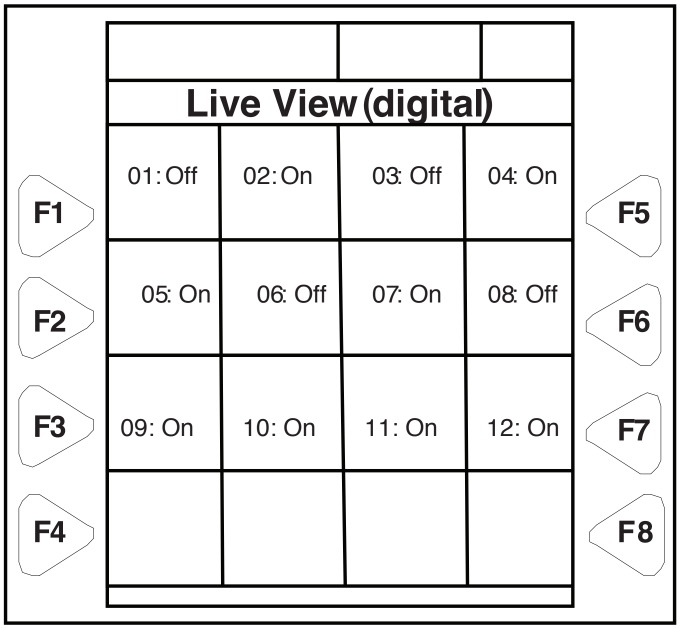


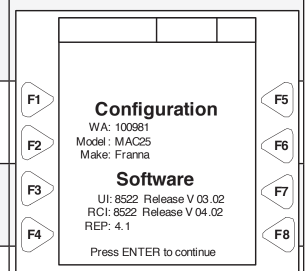
Table 17, I/O Digital Channel Description

I/O CHANNEL	DESCRIPTION	LOGIC
DIO1 - DIO8	Bi-directional Digital I/O	Input: On = 0V Off = floating
09 (ATB1)	ATB1 Input	On = Safe Off = Two-blocking or open circuit
10 (ATB2)	ATB2 Input	On = Safe Off = Two-blocking or open circuit

8.9. Contacting LSI-Robway

Have the following information available if you need to contact LSI-Robway.

Table 18, Critical Information to Supply to LSI-Robway

INFO	DESC.	WHERE TO FIND THIS INFO
WA number	Software job number	Start-up Screen.
Model	Crane model number	
Make	Crane manufacturer	
UI release	User interface version	
RCI release	Controller version	
REP release	Configuration version	

Ensure that you can accurately describe the problem and what has been done to try and resolve the issue.

9: SPECIFICATIONS

These specifications are common to all RCI-8522 systems.

Always consult the crane specific information for additional crane system specific information:

- Appendix A, Appendix A: General Arrangement Drawings
- Appendix B, Appendix B: Duty Listing
- Appendix C, Appendix C: Software Configuration

Specifications are subject to change without notice.

9.1. Display Unit

Dimensions	(WxHxD) 175 mm x 145 mm x 85 mm 6.8 in x 5.7 in x 3.3 in	
Weight	1.0 kg 2.2 lb	
Housing	ASA-PC	
Membrane keypad	Vinyl overlay with polycarbonate backing	
SD card access point	Side of front panel	
Mounting	Flush	Integral flange
	Gimbal	RAM bracket

9.2. Environmental

IEC 529	IP65
NEMA	4x
Operating temperature -	20°C to +65°C -4°F to +149°F
Humidity	0 – 99% non-condensing
Shock	IEC 600068-2-27 Half sinus, 1000 g (1 ms)
Vibration	IEC 600068-2-6 5 – 500 Hz, 20 g, 10 mm
UV	UV resistant

9.3. Electrical

9.3a. Power Supply

Type	Switching DC-DC
Input range	10.5–33 V
Input current	500 mA @ 24VDC
Reverse voltage protection	60 V blocking Schottky in both power input and ground return
Absolute maximum input	36 V Crowbar circuit fuse protected

9.3b. Voltage Inputs

Number	4 differential, or 8 single ended Software configurable
Type	Single ended or differential Software configurable
Range	0 – 20 mV 0 – 5 V 4 – 20 mA
Resolution	12 bits
Accuracy	±0.1% of full scale
Protection	Tranzorb RC network

9.3c. Fuses

3A automotive blade type	Located in the switchbox Littlefuse 297003
1.5A slow-blow 5x20	Located internally Bussman (BK/GMD-1.5-R)

9.3d. Digital I/O

Number	8
Type	Bi-directional, Software configurable.
Input configuration	Switch to system ground
Input low threshold	0.7 V

9.3d. Digital I/O (cont'd)

Output configuration	Open drain to system ground
Output type	Bipolar transistor
Output sink current	100 milliamps, current limited.

9.3e. Safety Relay Output

Number	2 internal safety relays Diagnostic read back capability

9.3f. Sensor Excitation

+5.000 V	Current source capability	100 mA
	Accuracy	±1%
+15 V	Current source capability	500 mA

9.3g. Serial I/O

RS-232	1 channel
RS-485	1 channel
CAN	Type J1939

9.3h. Electrical Interface

External connection facility	Analog / digital I/O power CAN bus, RS485, RS232	2 x 26 cable harness jacks housing
	Second CAN bus connector (optional)	M12-5 female connector
	Second RS485 connector (optional)	M12-5 female connector

9.3i. Microprocessor

Type	Philips LPC2292 60 MHz	
Clock (approx.)	45 MIPS	
Max. cycle time	40 ms	
Memory size and type	Program memory	256 KB internal flash
	Application data variables and stack	16 KB internal SRAM
	Non-volatile	128 KB FRAM 256 KB serial flash 8 MB flash
	Heap RAM	128 KB external SRAM

9.3k. Data Transfer

Program, calibration and configuration.

Boot loader	Allows the upload of application via RS-232 or SD card
SD card slot	Program and application data upload. Removable data logging media download and collection of up to 1 GB (dependent on SD card and FAT type). SD card must support MMC interface.
Data transfer	JTAG SD card, MMC interface RS-232 port Boot load programming Program and application data via SD card

9.4. Supervisory

Watchdog	Independent operation from microprocessor Hardware interlock to general motion-cut relay
Power fail	Input power-fail detection. Generates interrupt to microprocessor to go to safe state with imminent input power loss.

9.5. Data Logging

Memory	External flash	8 MB
	Internal black box flash	256 KB
	SD card	FAT 12/16/32
	RS-232	Up to 57600 bps
Download options	SD card removal	
	Size/Type	Up to 16 MB serial flash
Onboard black box	Interface	Serial connection to SPI via solder bridges
	RS-232 and/or direct memory read after removal of solder bridges	Allows data retrieval in the event of total system failure

9.6. Timekeeping

Type	RTC, non-volatile
Crystal	Tuning fork 32.768 kHz ± 200 ppm
Accuracy	+/- 1 minute per month

9.7. Diagnostics

Sensor inputs	Short and open circuit detection
Limiter outputs	(2) Relay read-back
Program	Checksum or CRC
Configuration	Accomplished in diagnostic block
Data verification	Concept Background block not available to standard BSCT configuration
Implementation	Frequency of system diagnostics Manual initiation.
System voltages	Window comparator

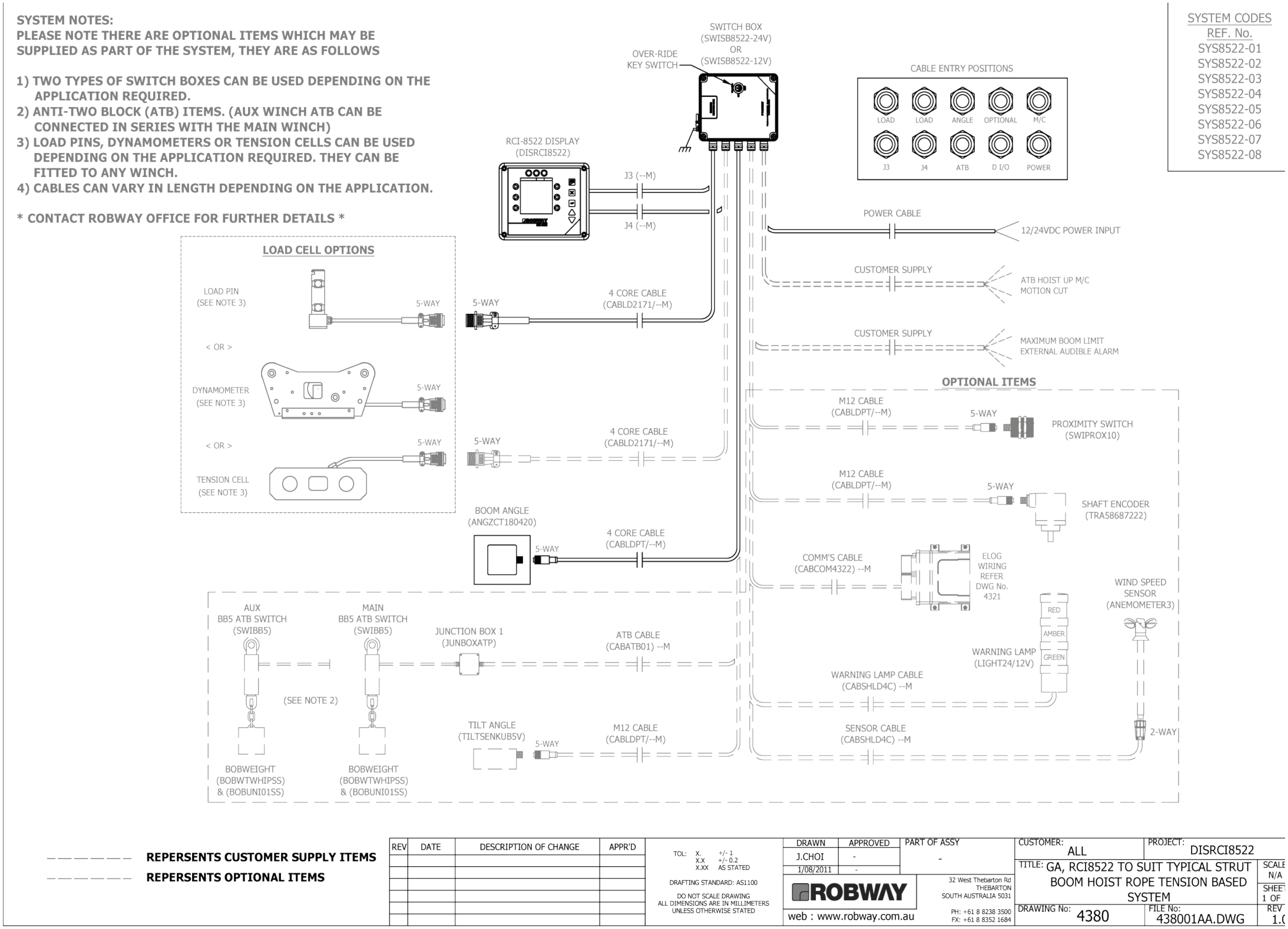
9.8. User Interface

LCD	160 x 160 pixel monochrome display
Keypad	12 buttons (membrane keypad)
LED indicators	Green, yellow and red
Alarm	Audible alarm

9.9. Anti-Two-Block Input

Number	2
Type	Requires switch to system ground

APPENDIX A: GENERAL ARRANGEMENT DRAWINGS


SYSTEM NOTES:
PLEASE NOTE THERE ARE OPTIONAL ITEMS WHICH MAY BE SUPPLIED AS PART OF THE SYSTEM, THEY ARE AS FOLLOWS
1) TWO TYPES OF SWITCH BOXES CAN BE USED DEPENDING ON THE APPLICATION REQUIRED.
2) ANTI-TWO BLOCK (ATB) ITEMS. (AUX WINCH ATB CAN BE CONNECTED IN SERIES WITH THE MAIN WINCH)
3) LOAD PINS, DYNAMOMETERS OR TENSION CELLS CAN BE USED DEPENDING ON THE APPLICATION REQUIRED. THEY CAN BE FITTED TO ANY WINCH.
4) CABLES CAN VARY IN LENGTH DEPENDING ON THE APPLICATION.
* CONTACT ROBWAY OFFICE FOR FURTHER DETAILS *
SWITCH BOX (SWISB8522-24V) OR (SWISB8522-12V)
OVER-RIDE KEY SWITCH
CABLE ENTRY POSITIONS
LOAD
LOAD
ANGLE
OPTIONAL
M/C
J3
J4
ATB
D I/O
POWER
SYSTEM CODES
REF. No.
SYS8522-01
SYS8522-02
SYS8522-03
SYS8522-04
SYS8522-05
SYS8522-06
SYS8522-07
SYS8522-08
RCI-8522 DISPLAY (DISRCI8522)
J3 (--M)
J4 (--M)
POWER CABLE
12/24VDC POWER INPUT
CUSTOMER SUPPLY
ATB HOIST UP M/C MOTION CUT
CUSTOMER SUPPLY
MAXIMUM BOOM LIMIT EXTERNAL AUDIBLE ALARM
LOAD CELL OPTIONS
LOAD PIN (SEE NOTE 3)
5-WAY
< OR >
DYNAMOMETER (SEE NOTE 3)
5-WAY
< OR >
TENSION CELL (SEE NOTE 3)
5-WAY
5-WAY
4 CORE CABLE (CABLD2171/--M)
5-WAY
4 CORE CABLE (CABLD2171/--M)
OPTIONAL ITEMS
M12 CABLE (CABLDPT/--M)
5-WAY
PROXIMITY SWITCH (SWIPROX10)
M12 CABLE (CABLDPT/--M)
5-WAY
SHAFT ENCODER (TRA58687222)
BOOM ANGLE (ANGZCT180420)
5-WAY
4 CORE CABLE (CABLDPT/--M)
COMM'S CABLE (CABCOM4322) --M
ELOG WIRING REFER DWG No. 4321
WIND SPEED SENSOR (ANEMOMETER3)
RED
AMBER
GREEN
WARNING LAMP (LIGHT24/12V)
WARNING LAMP CABLE (CABSHLD4C) --M
AUX BB5 ATB SWITCH (SWIBB5)
MAIN BB5 ATB SWITCH (SWIBB5)
JUNCTION BOX 1 (JUNBOXATP)
ATB CABLE (CABATB01) --M
(SEE NOTE 2)
TILT ANGLE (TILTSENKUB5V)
5-WAY
M12 CABLE (CABLDPT/--M)
SENSOR CABLE (CABSHLD4C) --M
2-WAY
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
REPERSENTS CUSTOMER SUPPLY ITEMS
REPERSENTS OPTIONAL ITEMS
REV
DATE
DESCRIPTION OF CHANGE
APPR'D
TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
DRAWN
APPROVED
J.CHOI
-
1/08/2011
-
PART OF ASSY
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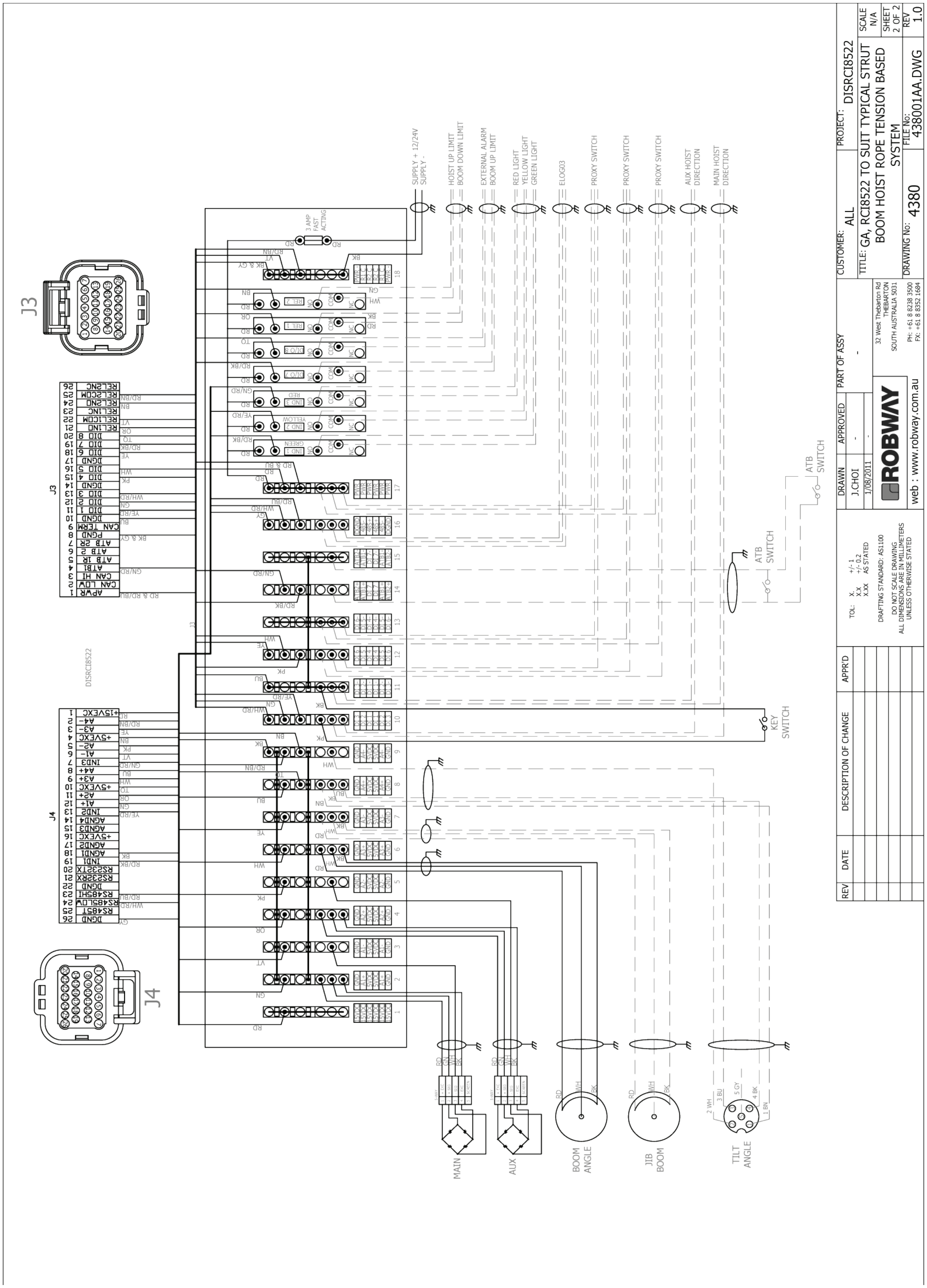
ROBWAY
32 West Thebarton Rd THEBARTON SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500
FX: +61 8 8352 1684
web : www.robway.com.au
CUSTOMER: ALL
PROJECT: DISRCI8522
TITLE: GA, RCI8522 TO SUIT TYPICAL STRUT BOOM HOIST ROPE TENSION BASED SYSTEM
SCALE N/A
SHEET 1 OF
DRAWING No: 4380
FILE No: 438001AA.DWG
REV 1.0


J3
J4
DISRCI8522
SUPPLY + 12/24V
SUPPLY -
HOIST UP LIMIT
BOOM DOWN LIMIT
EXTERNAL ALARM
BOOM UP LIMIT
RED LIGHT
YELLOW LIGHT
GREEN LIGHT
ELOG03
PROXY SWITCH
PROXY SWITCH
PROXY SWITCH
AUX HOIST DIRECTION
MAIN HOIST DIRECTION
3 AMP FAST ACTING
ATB SWITCH
ATB SWITCH
KEY SWITCH
MAIN
AUX
BOOM ANGLE
JIB BOOM
TILT ANGLE
REV
DATE
DESCRIPTION OF CHANGE
APPR'D
TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
DRAWN
J.CHOI
1/08/2011
APPROVED
PART OF ASSY
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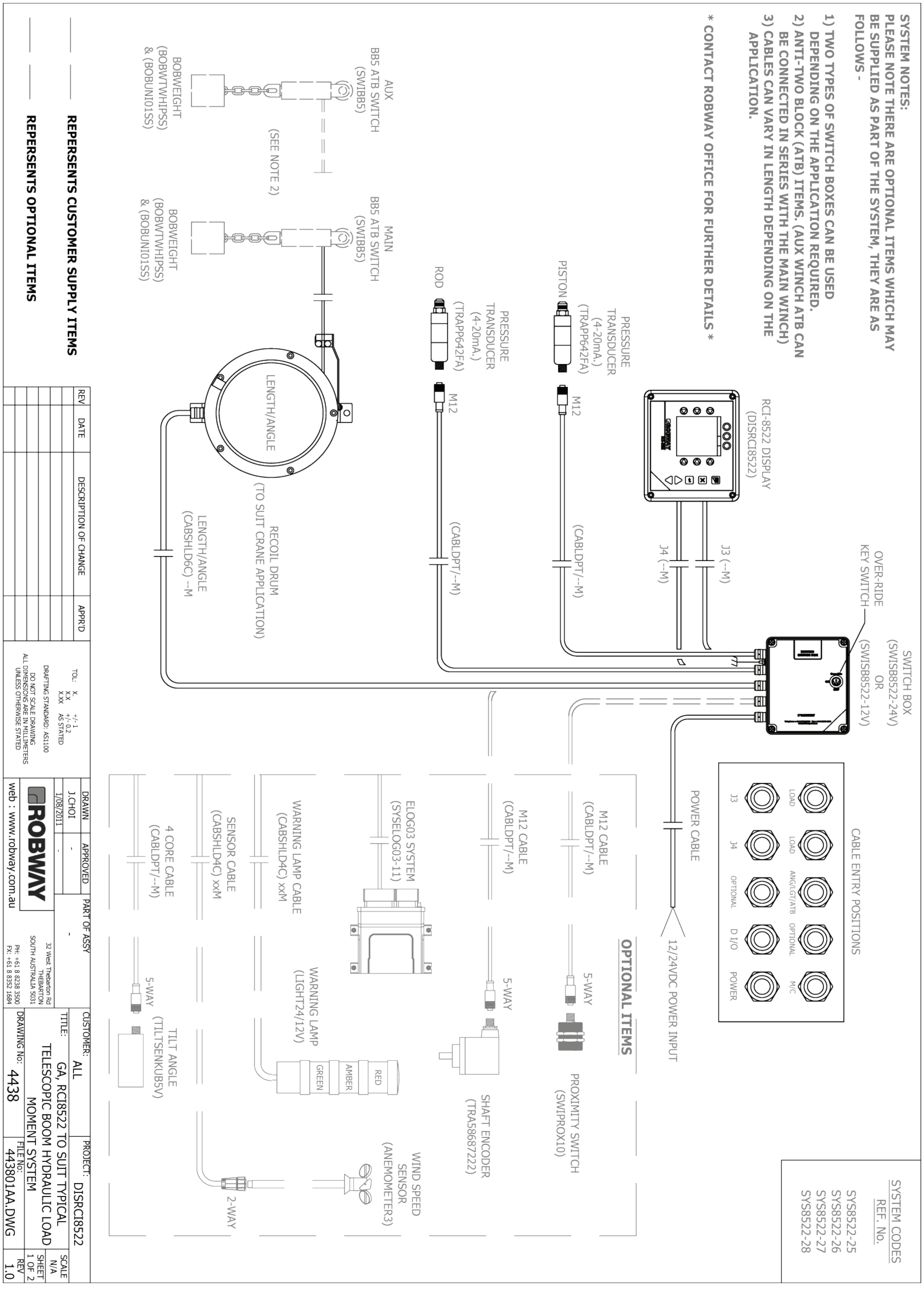
SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500
FX: +61 8 8352 1684
CUSTOMER: ALL
PROJECT: DISRCI8522
TITLE: GA, RCI8522 TO SUIT TYPICAL STRUT BOOM HOIST ROPE TENSION BASED SYSTEM
DRAWING No: 4380
FILE No: 438001AA.DWG
SCALE N/A
SHEET 2 OF 2
REV 1.0


SYSTEM NOTES:
PLEASE NOTE THERE ARE OPTIONAL ITEMS WHICH MAY BE SUPPLIED AS PART OF THE SYSTEM, THEY ARE AS FOLLOWS -
1) TWO TYPES OF SWITCH BOXES CAN BE USED DEPENDING ON THE APPLICATION REQUIRED.
2) ANTI-TWO BLOCK (ATB) ITEMS. (AUX WINCH ATB CAN BE CONNECTED IN SERIES WITH THE MAIN WINCH)
3) CABLES CAN VARY IN LENGTH DEPENDING ON THE APPLICATION.
* CONTACT ROBWAY OFFICE FOR FURTHER DETAILS *
AUX BB5 ATB SWITCH (SWIBB5)
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
(SEE NOTE 2)
MAIN BB5 ATB SWITCH (SWIBB5)
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
PISTON
ROD
PRESSURE TRANSDUCER (4-20mA.) (TRAPP642FA)
PRESSURE TRANSDUCER (4-20mA.) (TRAPP642FA)
M12
M12
RCI-8522 DISPLAY (DISRCI8522)
LENGTH/ANGLE
RECOIL DRUM (TO SUIT CRANE APPLICATION)
LENGTH/ANGLE (CABSHLD6C) --M
(CABLDPT/--M)
(CABLDPT/--M)
J4 (--M)
J3 (--M)
OVER-RIDE KEY SWITCH
SWITCH BOX (SWISB8522-24V) OR (SWISB8522-12V)
CABLE ENTRY POSITIONS
LOAD
LOAD
ANG/LGT/ATB
OPTIONAL
M/C
J3
J4
OPTIONAL
D I/O
POWER
POWER CABLE
12/24VDC POWER INPUT
OPTIONAL ITEMS
M12 CABLE (CABLDPT/--M)
5-WAY
PROXIMITY SWITCH (SWIPROX10)
M12 CABLE (CABLDPT/--M)
5-WAY
SHAFT ENCODER (TRA58687222)
ELOG03 SYSTEM (SYSELOG03-11)
WARNING LAMP CABLE (CABSHLD4C) xxM
WARNING LAMP (LIGHT24/12V)
RED
AMBER
GREEN
SENSOR CABLE (CABSHLD4C) xxM
WIND SPEED SENSOR (ANEMOMETER3)
2-WAY
4 CORE CABLE (CABLDPT/--M)
5-WAY
TILT ANGLE (TILTSENKUB5V)
SYSTEM CODES
REF. No.
SYS8522-25
SYS8522-26
SYS8522-27
SYS8522-28
REPERSENTS CUSTOMER SUPPLY ITEMS
REPERSENTS OPTIONAL ITEMS
REV
DATE
DESCRIPTION OF CHANGE
APPR'D
TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
DRAWN
J.CHOI
1/08/2011
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PART OF ASSY
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32 West Thebarton Rd
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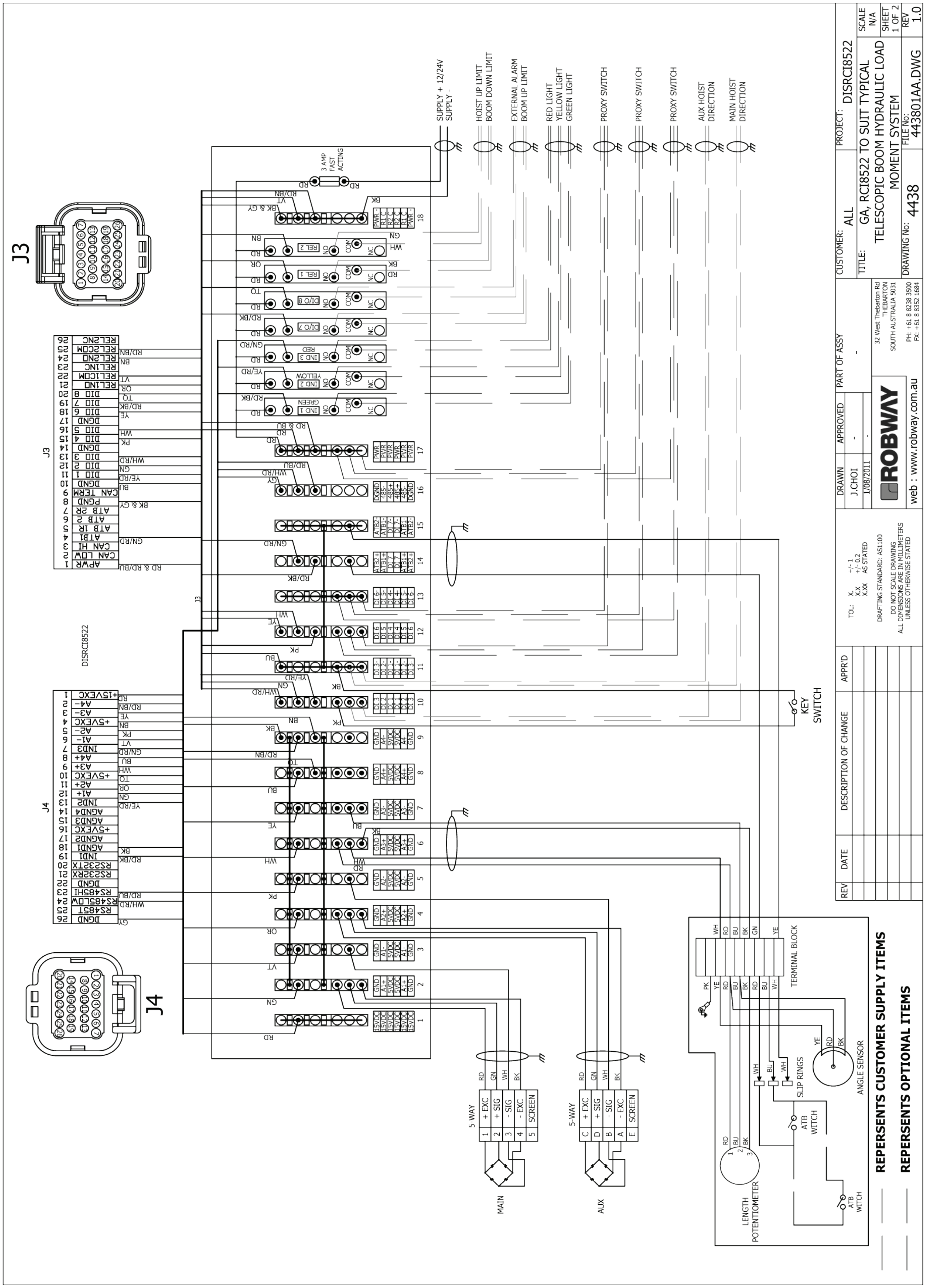
SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500
FX: +61 8 8352 1684
CUSTOMER:
ALL
PROJECT:
DISRCI8522
TITLE:
GA, RCI8522 TO SUIT TYPICAL TELESCOPIC BOOM HYDRAULIC LOAD MOMENT SYSTEM
DRAWING No:
4438
FILE No:
443801AA.DWG
SCALE
N/A
SHEET
1 OF 2
REV
1.0


J3
J4
DISRCI8522
SUPPLY + 12/24V
SUPPLY -
HOIST UP LIMIT
BOOM DOWN LIMIT
EXTERNAL ALARM
BOOM UP LIMIT
RED LIGHT
YELLOW LIGHT
GREEN LIGHT
PROXY SWITCH
PROXY SWITCH
PROXY SWITCH
AUX HOIST DIRECTION
MAIN HOIST DIRECTION
3 AMP FAST ACTING
KEY SWITCH
TERMINAL BLOCK
ANGLE SENSOR
SLIP RINGS
ATB WITCH
LENGTH POTENTIOMETER
5-WAY
MAIN
AUX
REPERSENTS CUSTOMER SUPPLY ITEMS
REPERSENTS OPTIONAL ITEMS
CUSTOMER: ALL
PROJECT: DISRCI8522
TITLE: GA, RCI8522 TO SUIT TYPICAL TELESCOPIC BOOM HYDRAULIC LOAD MOMENT SYSTEM
DRAWING No: 4438
FILE No: 443801AA.DWG
SCALE N/A
SHEET 1 OF 2
REV 1.0
DRAWN J.CHOI
1/08/2011
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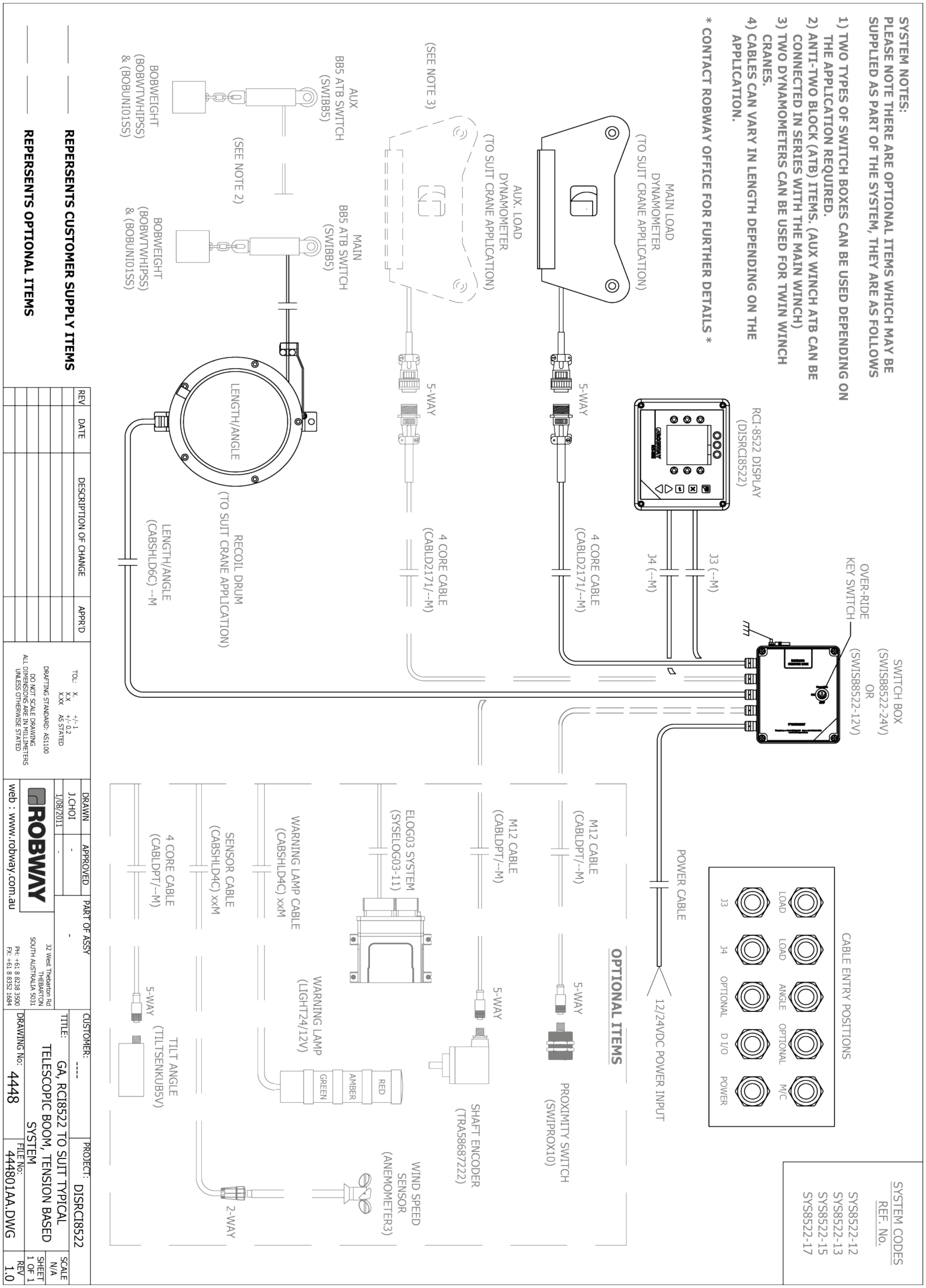
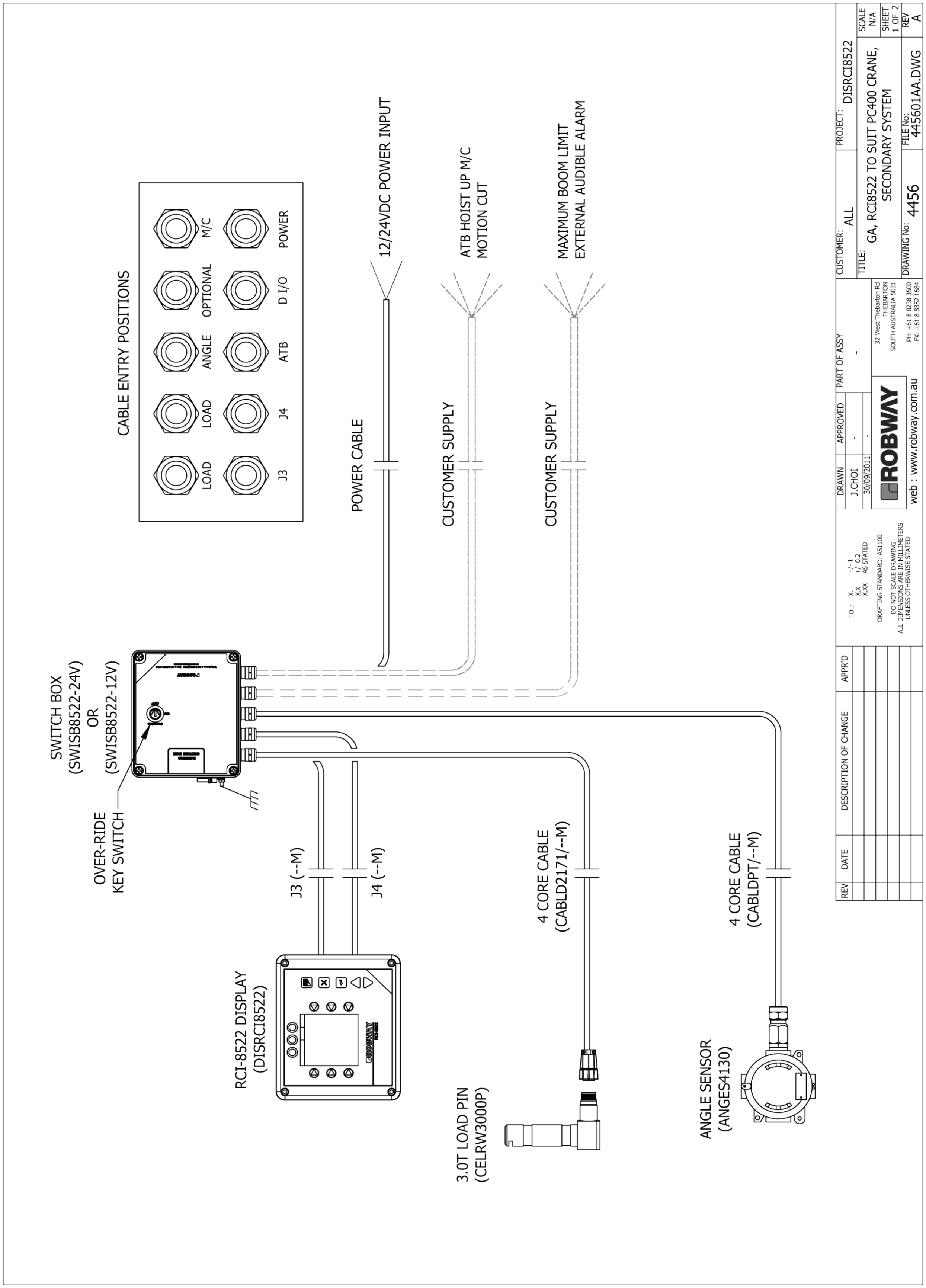
web : www.robway.com.au


SYSTEM NOTES:
PLEASE NOTE THERE ARE OPTIONAL ITEMS WHICH MAY BE SUPPLIED AS PART OF THE SYSTEM, THEY ARE AS FOLLOWS
1) TWO TYPES OF SWITCH BOXES CAN BE USED DEPENDING ON THE APPLICATION REQUIRED.
2) ANTI-TWO BLOCK (ATB) ITEMS. (AUX WINCH ATB CAN BE CONNECTED IN SERIES WITH THE MAIN WINCH)
3) TWO DYNAMOMETERS CAN BE USED FOR TWIN WINCH CRANES.
4) CABLES CAN VARY IN LENGTH DEPENDING ON THE APPLICATION.
* CONTACT ROBWAY OFFICE FOR FURTHER DETAILS *
MAIN LOAD DYNAMOMETER (TO SUIT CRANE APPLICATION)
AUX. LOAD DYNAMOMETER (TO SUIT CRANE APPLICATION)
(SEE NOTE 3)
AUX BB5 ATB SWITCH (SWIBB5)
MAIN BB5 ATB SWITCH (SWIBB5)
(SEE NOTE 2)
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
REPERSENTS CUSTOMER SUPPLY ITEMS
REPERSENTS OPTIONAL ITEMS
5-WAY
5-WAY
RCI-8522 DISPLAY (DISRCI8522)
4 CORE CABLE (CABLD2171/--M)
4 CORE CABLE (CABLD2171/--M)
J3 (--M)
J4 (--M)
OVER-RIDE KEY SWITCH
SWITCH BOX (SWISB8522-24V) OR (SWISB8522-12V)
LENGTH/ANGLE
RECOIL DRUM (TO SUIT CRANE APPLICATION)
LENGTH/ANGLE (CABSHLD6C) --M
POWER CABLE
12/24VDC POWER INPUT
CABLE ENTRY POSITIONS
LOAD LOAD ANGLE OPTIONAL M/C
J3 J4 OPTIONAL D I/O POWER
SYSTEM CODES
REF. No.
SYS8522-12
SYS8522-13
SYS8522-15
SYS8522-17
OPTIONAL ITEMS
M12 CABLE (CABLDPT/--M)
5-WAY
PROXIMITY SWITCH (SWIPROX10)
M12 CABLE (CABLDPT/--M)
5-WAY
SHAFT ENCODER (TRA58687222)
ELOG03 SYSTEM (SYSELOG03-11)
WARNING LAMP CABLE (CABSHLD4C) xxM
WARNING LAMP (LIGHT24/12V)
RED
AMBER
GREEN
SENSOR CABLE (CABSHLD4C) xxM
WIND SPEED SENSOR (ANEMOMETER3)
2-WAY
4 CORE CABLE (CABLDPT/--M)
5-WAY
TILT ANGLE (TILTSENKUB5V)
REV DATE DESCRIPTION OF CHANGE APPR'D
TOL: X. +/- 1 X.X +/- 0.2 X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
DRAWN J.CHOI 1/08/2011
APPROVED -
PART OF ASSY -
ROBWAY
32 West Thebarton Rd THEBARTON SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500 FX: +61 8 8352 1684
web : www.robway.com.au
CUSTOMER: ----
PROJECT: DISRCI8522
TITLE: GA, RCI8522 TO SUIT TYPICAL TELESCOPIC BOOM, TENSION BASED SYSTEM
SCALE N/A
DRAWING No: 4448
FILE No: 444801AA.DWG
SHEET 1 OF 1
REV 1.0



CABLE ENTRY POSITIONS
LOAD
LOAD
ANGLE
OPTIONAL
M/C
J3
J4
ATB
D I/O
POWER
12/24VDC POWER INPUT
ATB HOIST UP M/C
MOTION CUT
MAXIMUM BOOM LIMIT
EXTERNAL AUDIBLE ALARM
POWER CABLE
CUSTOMER SUPPLY
CUSTOMER SUPPLY
SWITCH BOX
(SWISB8522-24V)
OR
(SWISB8522-12V)
OVER-RIDE
KEY SWITCH
J3 (--M)
J4 (--M)
4 CORE CABLE
(CABLD2171/--M)
4 CORE CABLE
(CABLDPT/--M)
RCI-8522 DISPLAY
(DISRCI8522)
3.0T LOAD PIN
(CELRW3000P)
ANGLE SENSOR
(ANGES4130)
REV
DATE
DESCRIPTION OF CHANGE
APPR'D
TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED
DRAWN
J.CHOI
30/09/2011
APPROVED
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PART OF ASSY
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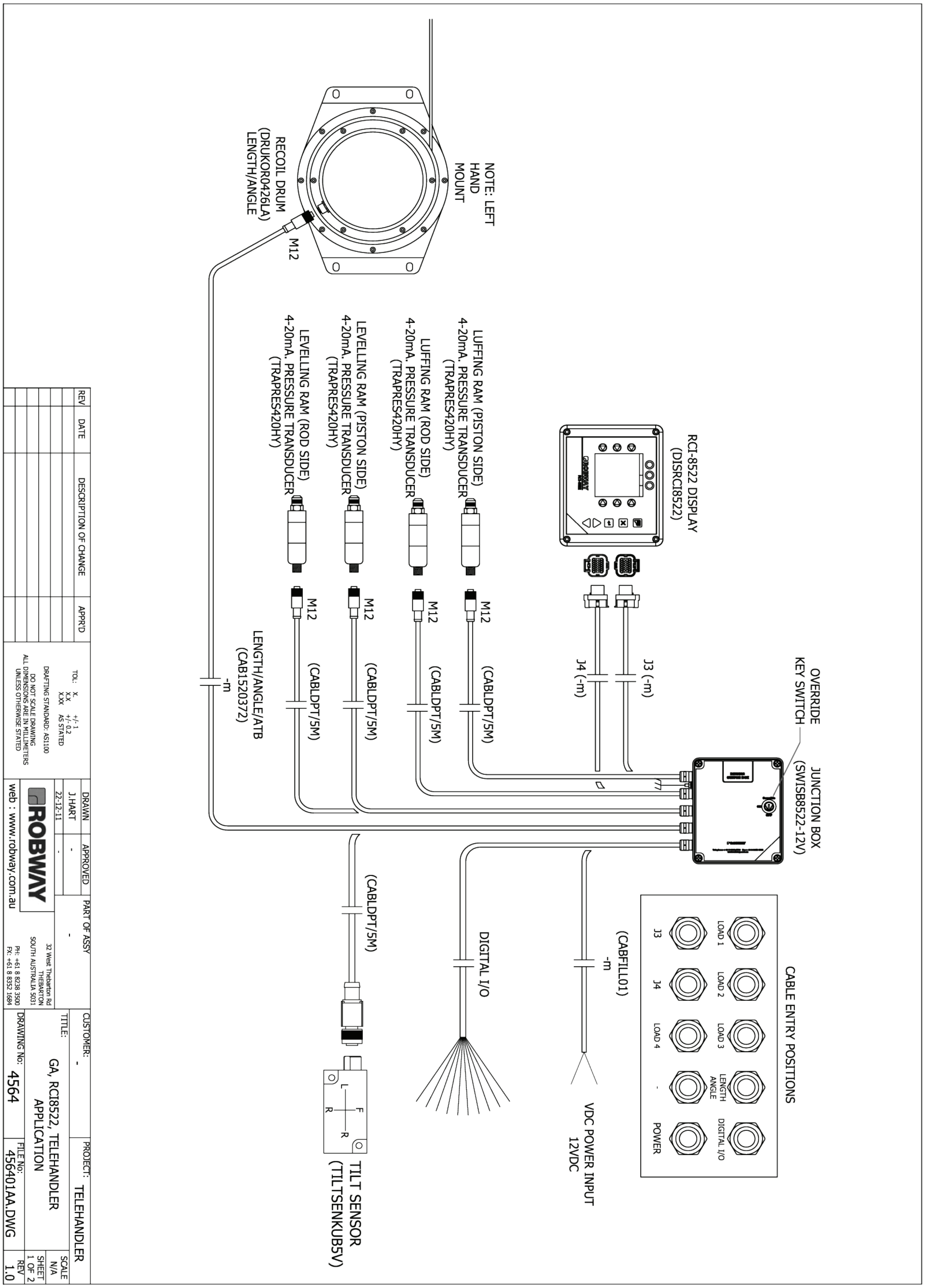
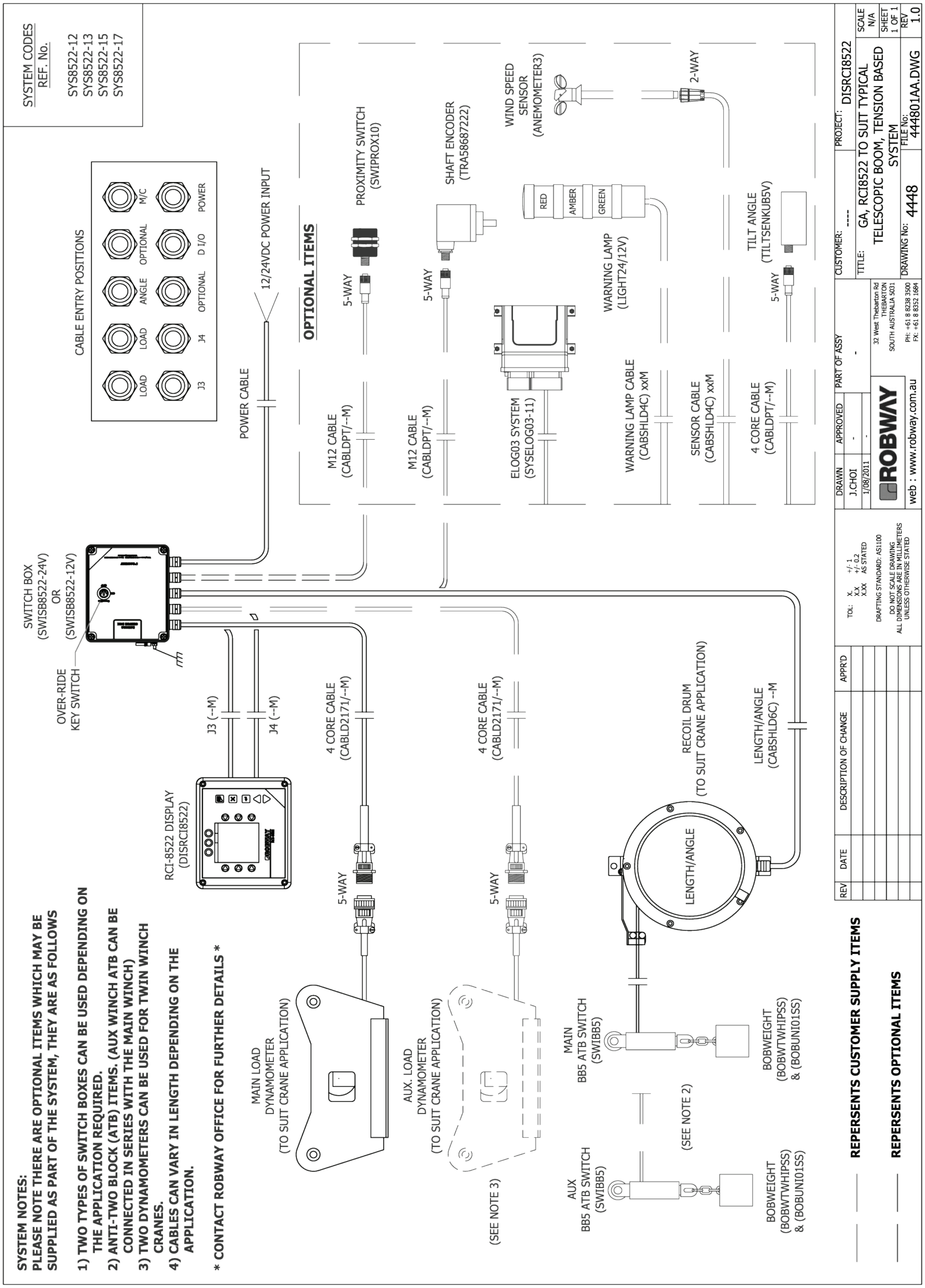
THEBARTON
SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500
FX: +61 8 8352 1684
CUSTOMER:
ALL
PROJECT:
DISRCI8522
TITLE:
GA, RCI8522 TO SUIT PC400 CRANE,
SECONDARY SYSTEM
DRAWING No:
4456
FILE No:
445601AA.DWG
SCALE
N/A
SHEET
1 OF 2
REV
A


NOTE: LEFT HAND MOUNT
RECOIL DRUM (DRUKOR0426LA) LENGTH/ANGLE
M12
RCI-8522 DISPLAY (DISRCI8522)
LUFFING RAM (PISTON SIDE) 4-20mA. PRESSURE TRANSDUCER (TRAPRES420HY)
LUFFING RAM (ROD SIDE) 4-20mA. PRESSURE TRANSDUCER (TRAPRES420HY)
LEVELLING RAM (PISTON SIDE) 4-20mA. PRESSURE TRANSDUCER (TRAPRES420HY)
LEVELLING RAM (ROD SIDE) 4-20mA. PRESSURE TRANSDUCER (TRAPRES420HY)
M12
(CABLDPT/5M)
LENGTH/ANGLE/ATB (CAB15203?2) -m
J3 (-m)
J4 (-m)
OVERRIDE KEY SWITCH
JUNCTION BOX (SWISB8522-12V)
CABLE ENTRY POSITIONS
LOAD 1
LOAD 2
LOAD 3
LENGTH ANGLE
DIGITAL I/O
J3
J4
LOAD 4
-
POWER
(CABFILL01) -m
VDC POWER INPUT 12VDC
DIGITAL I/O
(CABLDPT/5M)
TILT SENSOR (TILTSENKUB5V)
L
F
R
REV
DATE
DESCRIPTION OF CHANGE
APPR'D
TOL: X +/- 1
X.X +/- 0.2
X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
DRAWN J.HART 22-12-11
APPROVED -
PART OF ASSY -
ROBWAY
web : www.robway.com.au
32 West Thebarton Rd THEBARTON SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500 FX: +61 8 8352 1684
CUSTOMER: -
PROJECT: TELEHANDLER
TITLE: GA, RCI8522, TELEHANDLER APPLICATION
DRAWING No: 4564
FILE No: 456401AA.DWG
SCALE N/A
SHEET 1 OF 2
REV 1.0


SYSTEM NOTES:
PLEASE NOTE THERE ARE OPTIONAL ITEMS WHICH MAY BE SUPPLIED AS PART OF THE SYSTEM, THEY ARE AS FOLLOWS
1) TWO TYPES OF SWITCH BOXES CAN BE USED DEPENDING ON THE APPLICATION REQUIRED.
2) ANTI-TWO BLOCK (ATB) ITEMS. (AUX WINCH ATB CAN BE CONNECTED IN SERIES WITH THE MAIN WINCH)
3) TWO DYNAMOMETERS CAN BE USED FOR TWIN WINCH CRANES.
4) CABLES CAN VARY IN LENGTH DEPENDING ON THE APPLICATION.
* CONTACT ROBWAY OFFICE FOR FURTHER DETAILS *
SYSTEM CODES
REF. No.
SYS8522-12
SYS8522-13
SYS8522-15
SYS8522-17
CABLE ENTRY POSITIONS
LOAD
LOAD
ANGLE
OPTIONAL
M/C
J3
J4
OPTIONAL
D I/O
POWER
12/24VDC POWER INPUT
POWER CABLE
OPTIONAL ITEMS
M12 CABLE
(CABLDPT/--M)
5-WAY
PROXIMITY SWITCH
(SWIPROX10)
M12 CABLE
(CABLDPT/--M)
5-WAY
SHAFT ENCODER
(TRA58687222)
ELOG03 SYSTEM
(SYSELOG03-11)
WARNING LAMP
(LIGHT24/12V)
RED
AMBER
GREEN
WIND SPEED
SENSOR
(ANEMOMETER3)
WARNING LAMP CABLE
(CABSHLD4C) xxM
SENSOR CABLE
(CABSHLD4C) xxM
2-WAY
4 CORE CABLE
(CABLDPT/--M)
5-WAY
TILT ANGLE
(TILTSENKUB5V)
SWITCH BOX
(SWISB8522-24V)
OR
(SWISB8522-12V)
OVER-RIDE
KEY SWITCH
RCI-8522 DISPLAY
(DISRCI8522)
J3 (--M)
J4 (--M)
4 CORE CABLE
(CABLD2171/--M)
5-WAY
4 CORE CABLE
(CABLD2171/--M)
5-WAY
MAIN LOAD
DYNAMOMETER
(TO SUIT CRANE APPLICATION)
AUX. LOAD
DYNAMOMETER
(TO SUIT CRANE APPLICATION)
(SEE NOTE 3)
RECOIL DRUM
(TO SUIT CRANE APPLICATION)
LENGTH/ANGLE
LENGTH/ANGLE
(CABSHLD6C) --M
MAIN
BB5 ATB SWITCH
(SWIBB5)
AUX
BB5 ATB SWITCH
(SWIBB5)
(SEE NOTE 2)
BOBWEIGHT
(BOBWTWHIPSS)
& (BOBUNI01SS)
BOBWEIGHT
(BOBWTWHIPSS)
& (BOBUNI01SS)
REPERSENTS CUSTOMER SUPPLY ITEMS
REPERSENTS OPTIONAL ITEMS
REV
DATE
DESCRIPTION OF CHANGE
APPR'D
TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED
DRAWN
J.CHOI
1/08/2011
APPROVED
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PART OF ASSY
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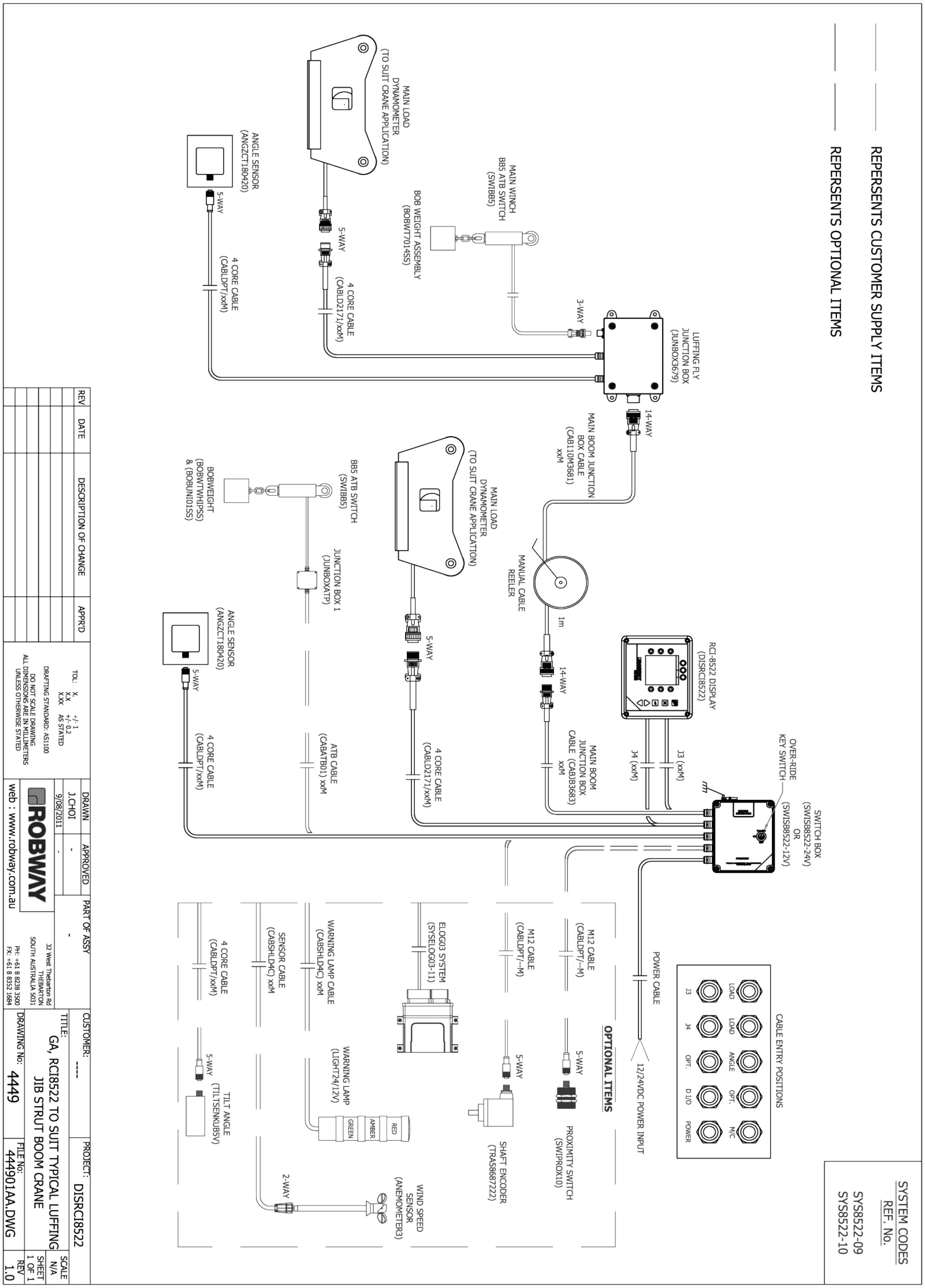
FX: +61 8 8352 1684
CUSTOMER:

PROJECT:
DISRCI8522
TITLE:
GA, RCI8522 TO SUIT TYPICAL TELESCOPIC BOOM, TENSION BASED SYSTEM
DRAWING No:
4448
FILE No:
444801AA.DWG
SCALE
N/A
SHEET
1 OF 1
REV
1.0


REPERSENTS CUSTOMER SUPPLY ITEMS
REPERSENTS OPTIONAL ITEMS
MAIN LOAD DYNAMOMETER (TO SUIT CRANE APPLICATION)
ANGLE SENSOR (ANGZCT180420)
MAIN WINCH BB5 ATB SWITCH (SWIBB5)
BOB WEIGHT ASSEMBLY (BOBWT7014SS)
5-WAY
4 CORE CABLE (CABLDPT/xxM)
4 CORE CABLE (CABLD2171/xxM)
3-WAY
LUFFING FLY JUNCTION BOX (JUNBOX3679)
14-WAY
MAIN BOOM JUNCTION BOX CABLE (CAB110M3681) xxM
BB5 ATB SWITCH (SWIBB5)
BOBWEIGHT (BOBWTWHIPSS) & (BOBUNI01SS)
JUNCTION BOX 1 (JUNBOXATP)
MANUAL CABLE REELER
1m
RCI-8522 DISPLAY (DISRCI8522)
ATB CABLE (CABATB01) xxM
MAIN BOOM JUNCTION BOX CABLE (CABJB3683) xxM
J3 (xxM)
J4 (xxM)
OVER-RIDE KEY SWITCH
SWITCH BOX (SWISB8522-24V) OR (SWISB8522-12V)
POWER CABLE
12/24VDC POWER INPUT
CABLE ENTRY POSITIONS
LOAD LOAD ANGLE OPT. M/C
J3 J4 OPT. D/O POWER
OPTIONAL ITEMS
M12 CABLE (CABLDPT/--M)
PROXIMITY SWITCH (SWIPROX10)
SHAFT ENCODER (TRA58687222)
ELOG03 SYSTEM (SYSELOG03-11)
WARNING LAMP CABLE (CABSHLD4C) xxM
WARNING LAMP (LIGHT24/12V)
RED AMBER GREEN
SENSOR CABLE (CABSHLD4C) xxM
2-WAY
WIND SPEED SENSOR (ANEMOMETER3)
TILT ANGLE (TILTSENKUB5V)
SYSTEM CODES REF. No.
SYS8522-09
SYS8522-10
REV DATE DESCRIPTION OF CHANGE APPR'D
TOL: X +/- 1 .XX +/- 0.2 .XXX AS STATED
DRAFTING STANDARD: AS1100
DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
DRAWN J.CHOI 9/08/2011
APPROVED -
PART OF ASSY -
ROBWAY
web : www.robway.com.au
32 West Thebarton Rd THEBARTON SOUTH AUSTRALIA 5031
PH: +61 8 8238 3500 FX: +61 8 8352 1684
CUSTOMER: ----
PROJECT: DISRCI8522
TITLE: GA, RCI8522 TO SUIT TYPICAL LUFFING JIB STRUT BOOM CRANE
DRAWING No: 4449
FILE No: 444901AA.DWG
SCALE N/A
SHEET 1 OF 1
REV 1.0

APPENDIX B: DUTY LISTINGS

Duty Listing to suit Franna AT-15, Single Winch, Telescopic Boom Crane

DUTY	DESCRIPTION	BOOM RANGE (M)
1	Main Boom Only	5.66-13.86
2	Main Boom – Lifting from Rhino Hook	5.95-14.15
3	4.05 Manual Extension Erected	9.7-17.9
4	4.05 Manual Extension Erected – Lifting from Rhino Hook	10.0-18.2
5	Manual Extension Retracted, Jib at 0º offset	8.3-16.5
6	4.05 m Manual Extension Extended, Jib at 0º offset	12.3-20.5
7	Lifting from Inner Lug	3.65-7.75
8	Lifting from Outer Lug	4.7-8.8
9	Man Basket Lifts – Manual Extension Retracted	5.66-13.86
10	Man Basket Lifts – 4.05m Manual Extension Extended	9.7-17.9

Notes:

Rhino hooks and lug duties are rated independently of parts of line.

Weight of man basket is not displayed. (Man basket should be calibrated as a light load of 0 tonnes)

Duty Listing to suit Ozzy 15M, Single Winch, Telescopic Boom Crane

IBF010-004-1-2

Outriggers Fully Extended & Jacks Down

DUTY	BOOM LENGTH (M)
1	6.35-13.85

APPENDIX C: SOFTWARE CONFIGURATION

DISRCI8522 SOFTWARE CONFIGURATION SHEET

Customer **WA Number**

Crane Make **Crane Model** **Crane s/n**

SYSTEM TYPE SUPPLIED

☐ Fixed Boom	☐ Hoist Rope	☐ Single Winch	☐ Live Mast	☐ Wind speed	☐ Metric
☐ Telescopic	☐ Load moment	☐ Twin winch	☐ A-Frame	☐	☐ SAE

TENSION-BASED LOAD CELL POSITION

MAIN	☐ Dyno	☐ Hoist Rope Deadend	☐ Sheave Load Pin	☐
AUX	☐ Dyno	☐ Hoist Rope Deadend	☐ Sheave Load Pin	☐

LOAD-MOMENT SENSOR POSITION (enter number of each)

☐ Main Luff RAM PT	☐ Main Pendants	☐ Luff Rope Deadend	☐	☐
☐ Jib Luff RAM PT	☐ Jib Pendants	☐ Luff Rope Deadend	☐	☐

(The following tables are filled in with suggested default wiring)

ANALOG INPUTS

Input	Parameter	Sensor Information			8522 I/O Setup			
		Sensor Model	Sensor Span	Input Span with Engineering Units	Single-ended	20 milivolt	0-5 Volt	4-20 mA
A0+	Load 1 or Piston							
A0-								
A1+	Load 2 or Rod							
A1-								
A2+	(main boom angle)						X	
A2-	(main boom length)						X	
A3+								
A3-								

Note A0+ and A1+ used for 4-20 milliamp sensors. A0± and A1± used for bridge loadcells.

DIGITAL OUTPUTS

Output	Signal Description	Signal Destination	Output Condition	NO or NC Contact
Relay 0	Motion Cut		De-energised = motion cut Energised = normal operation	NO
Relay 1	ATB motion cut		De-energised = motion cut Energised = normal operation	NO
Indicator 0	Green	Light Stack	0 volts = ON Floating = OFF	
Indicator 1	Yellow	Light Stack	0 volts = ON Floating = OFF	
Indicator 2	Red	Light Stack	0 volts = ON Floating = OFF	

DIGITAL INPUTS

Input Channel	Parameter	Sensor Model	Input Logic State	Fail-safe State
ATB 0	Main ATB	BB5	0 = Normal 1 = ATB Active	Open = ATB Active
ATB 1				

DIGITAL I/O

I/O	Input	Output	Parameter	Sensor Model	Logic State	I/O Condition	Fail-safe State
DIO-0	X		Override	Keyswitch	0 = Overridden 1 = Normal	0V = Overridden Open = Normal	Open = Normal
DIO-1		X	External Alarm		0 = OFF 1 = ON	Floating = OFF 0V = ON	
DIO-2	X		Slew Proxy				
DIO-3							
DIO-4							
DIO-5							
DIO-6							
DIO-7							

Note Input Register. 0V on the I/O pin is seen as a logical '0' in the input register. Anything over 2 volts on the input is seen as a logical '1' in the input register.

Note Output Register. Logical 0 turns off the open-drain output, logical 1 turns on the open drain output to ground.

SERIAL I/O

I/O	Input	Output	Description	Device(s)
RS232			Terminal Interface	
RS485		X	Elog Data	

CANbus

Device Make	Device Model	Input	Output	CAN ID	CAN Protocol	Data rate	Description

CRANE CONFIGURATION

	Supplied	Changed To	
SWL % for YELLOW light and Intermittent Audible			%
SWL % for RED light and Continuous Audible			%
SWL % for motion cut and Continuous Audible			%
SWL % for External Audible Alarm			%
Slew offset (3 on fig. 1) Negative if foot-pin is behind centre of rotation			ft
Maximum Main Winch Linepull			klbs
Maximum Falls For Main Winch			
Main Sheave Radius			ft
Not Used			
Boom Head Offset			ft
Foot-Pin Offset Negative if foot-pin below boom centre line			ft
Foot-Pin Height			ft
Horizontal Offset (4 on Telescopic Crane Figure)			ft
Vertical Offset (5 on Telescopic Crane Figure)			ft
Ram Piston Diameter			ft
Rod Diameter			ft
Ram pivot point (top) to center line of boom			ft
Boom foot pin to Ram pivot point (top) along boom axis			ft
Stable Load Time time during which load must stay stable in order to log			Secs
Stable Load Variation Amount of load variation allow in a stable load			klbs
Reset Time time below log threshold before cycle completes			Secs
Low Load Lift Counter – SWL percentage to record			%
Medium Load Lift Counter - SWL percentage to record			%
High Load Lift Counter – SWL percentage to record			%
Logging Percentage - Loads logged if SWL % > value			%
Pressure Correction For The Boom Luffing Down			PSI
Pressure Correction For The Stationary Boom			PSI

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Pressure Correction For The Boom Luffing Up			**PSI**
Tilt Sensor Conversion Factor			
Rigging Mode Time Out			**Min.**
Cylinder Pressure Limit			**PSI**

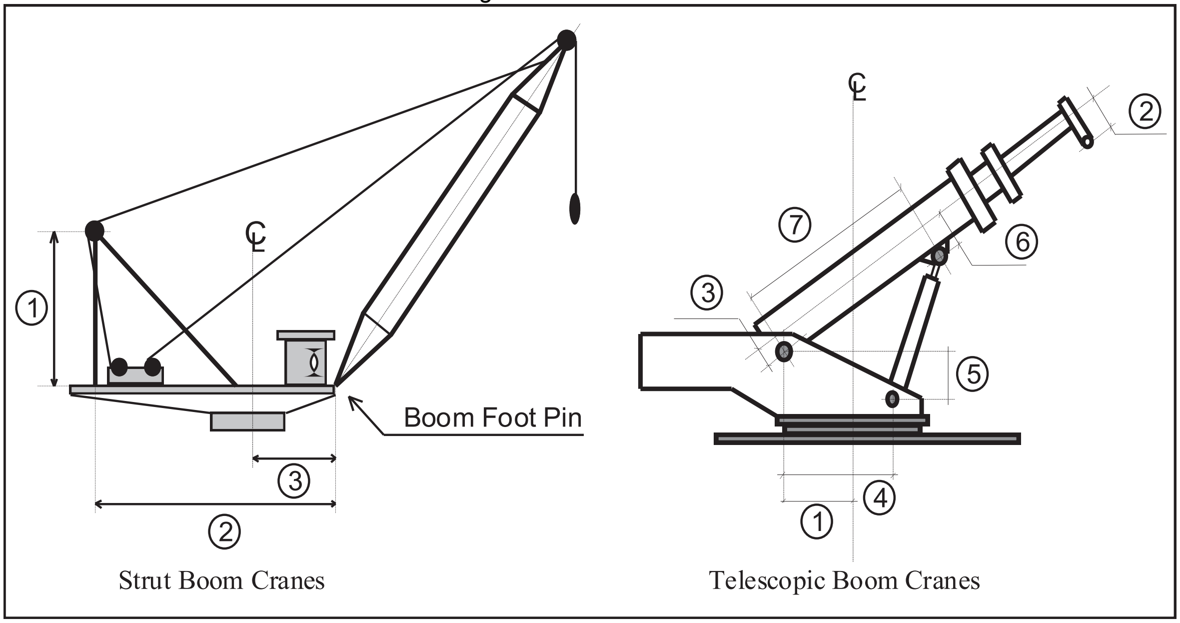
Transducer Gain Default Setting

Transducer 1 Gain			**mV/V**
Transducer 2 Gain			**mV/V**

IMPORTANT
Check ALL Configuration Values Shown Above For Accuracy Before Operating.

Crane Dimensions

Refer to configuration sheet for more information



Strut Boom Cranes

1	**VERTICAL OFFSET**		VERTICAL DISTANCE BETWEEN THE BOOM FOOT PIN AND CENTRE OF A-FRAME SHEAVE
2	**HORIZONTAL OFFSET**		HORIZONTAL DISTANCE BETWEEN THE BOOM FOOT PIN AND CENTRE OF A-FRAME SHEAVE
3	**SLEW OFFSET**		HORIZONTAL DISTANCE BETWEEN BOOM FOOT PIN AND CENTRE OF SLEW

Telescopic Boom Cranes

1	**SLEW-OFFSET**		HORIZONTAL DISTANCE BETWEEN BOOM FOOT PIN AND CENTRE OF SLEW

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2	**BOOM HEAD OFFSET**		PERPENDICULAR DISTANCE FROM CENTRE OF MAIN BOOM SHEAVE TO CENTRE-LINE OF BOOM (negative if main boom sheave above boom centre line)
3	**FOOT-PIN OFFSET**		PERPENDICULAR DISTANCE FROM BOOM FOOT-PIN TO CENTRE-LINE OF BOOM (negative if boom foot pin is below boom centre line)
4	**HORIZONTAL OFFSET**		HORIZONTAL DISTANCE FROM BOOM FOOT-PIN TO LOWER RAM PIVOT PIN
5	**VERTICAL OFFSET**		VERTICAL DISTANCE FROM BOOM FOOT-PIN TO LOWER RAM PIVOT PIN
6			PERPENDICULAR DISTANCE FROM UPPER RAM PIVOT POINT TO CENTRE LINE OF BOOM
7			DISTANCE FROM BOOM FOOT-PIN TO UPPER RAM PIVOT POINT ALONG BOOM CENTRE LINE

Please note that for **LOAD MOMENT** systems **ALL** of the above are required.
For **DYNAMOMETER** type systems only **1, 2 and 3** are required.

Custom Requirements Validation Checklist

Item	Description	Req's Met	Req's Tested
1			
2			
3			
4			
5			
6			
7			
8			
9			

1. Programmer to tick column 'Req's Met' when all items have been implemented and tested
2. Final software tester to tick column 'Req's Tested' when all items have been through ally tested by person other than initial programmer

SPECIAL NOTE

This system has been prepared using information available at time of order and MUST BE VERIFIED on site at time of commissioning.

ROBWAY MUST BE ADVISED of any changes to the user configurable options carried out on site. As we have no control or means of verifying the correctness of on site data inputs we accordingly disclaim any responsibility for malfunctions or accidents arising from incorrectly entered data.

Notifications of changes should be sent to

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Version	Date	Description	Author

APPENDIX D: OPERATIONAL LOG TAGS

LSI-Robway Data Logger - Operational Log

The following explanation and information will identify the data logger and its logging information.

Tags are subject to change without notice. The following information was taken from Revision A.

TAG	INFORMATION TYPE	TAG DESCRIPTION
Record type	Log	Logging conditions like ATB, override, peak load, stable load, range errors, sensor error
	Parameters	Parameter update, to observe crane position like angle, length, radius, slew. Used to detect crane position before error occurs.
	RCI state	Reset -Indicates power reset Comms reset - controller and display comm. established Stopped – controller in stop mode example during crane confirmation screen needs acknowledgement, download data logger Pre-operational – a state before controller becomes operational confirmation occurred Operational-rci operational
Description	Pre-operational	A state before controller becomes operational confirmation occurred
	Operational	RCI operational
	Stopped	Controller in stop mode example during crane confirmation screen needs acknowledgement, download data logger.
	Reset	Indicates power reset
	Comms reset	Controller and display comm. established
	Start	Start of logging condition of channel-1 main, channel-2 aux.
	Lift	“Lift” can be actual lift or any logging condition generating a log record.
	End	
	Updated	Parameter update, to observe crane position such as angle, length, radius, slew. Used to detect crane position before error occurs.
Channel	1	Main Channel
	2	Aux Channel
Time stamp	MM/DD/YYYY hr:mm:ss	Time of RCI, user settable in password-protected Pin Menu>Setup>Set Date/Time
Machine (hex)	0000	Machine ID if customer has access to the optional LSI-Robway Operator ID system
Driver (hex)	0000	Drive ID if customer has access to the optional LSI-Robway Operator ID system

TAG	INFORMATION TYPE	TAG DESCRIPTION
Configuration name & duty	ABG 1080, Duty:1	Crane configuration name and duty number selected.
Radius (m)	Numbers	Boom radius in meter and aux radius in meter for channel 1 and channel 2 respectively. (Units selectable from log viewer tool)
Angle (d)	Numbers	Boom angle and jib angle for channel 1 and channel 2 respectively horizontal to ground.
Length (m)	Numbers	Boom length, jib length for channel 1 and channel 2 respectively.
Slew	Numbers	Crane chart if over front or over rear depending on load charts.
Wind (km/h)	Numbers	Self-explanatory.
Height (m)	Numbers	Self-explanatory.
SWL (t)	Numbers	SWL for main and aux winch, channel 1 and channel 2 respectively
Load (t)	Numbers	Load for main and aux winch, channel 1 and channel 2 respectively
Falls	Refer to user selection	Falls for main winch and aux winch, channel 1 and channel 2 respectively
Engine hours (h)	Numbers	Engine hours if engine hours monitoring system availed.
Events	Error	Any error events like ATB, override, radius error, angle error, overload, sensor errors, etc.
	Stable	Stable events logged in this record.
	Stable & peak	Both events (new stable and new peak) are logged in this record.
Current Load (t)	Numbers	During error events RCI logs current load in separate field for User quick look.
Current SWL (%)	Numbers	During error events RCI logs current SWL% in separate field for user quick look.
Peak Load (t)	Numbers	During “Stable&Peak” event RCI logs peak load in separate field.
Peak SWL (%)	Numbers	During “Stable&Peak” event RCI logs peak SWL% in separate field.
Stable Load (t)	Numbers	During “Stable&Peak” and during “Stable” event RCI logs stable load (t) in separate field.
Stable SWL (%)	Numbers	During “Stable&Peak”, and “Stable” event RCI logs Stable SWL (%) in separate field.
Mcut	State; ON or OFF	Motion cut activated, conventionally related to boom down limit. “ON”-means motion cut activated; “OFF” means motion cut has not been activated.
Overload	State; ON or OFF	Overload condition
ATB	State; ON or OFF	ATB condition

TAG	INFORMATION TYPE	TAG DESCRIPTION
Override	State; ON or OFF	Override condition; “ON” means override is activated; “OFF” means override is not active, override will override the motion limiting outputs, hence knowing state of override is very important.
Range-wind	State; ON or OFF	Range error wind; “ON” means if wind speed feature is availed then, wind error is activated; “OFF” mean Wind is within acceptable range.
Range-angle	State; ON or OFF	Range error angle; “ON” can be low angle limit or high angle limit; high or low angle limit can be determined from angle value on the record. Angle “OFF” means neither low angle limit nor high angle limit is activated.
Range-length	State; ON or OFF	Range error length; “ON” means Low Length limits or High length limit activated; “OFF” means length is within application specific limit range.
Range-radius	State; ON or OFF	Range error radius; “ON” means maximum radius in most case or min radius is reached, “OFF” means radius is within load chart range.
Range-height	State; ON or OFF	Range error height; “ON” height limit reached and “OFF” means within height limit range.

REVISION HISTORY

Version	Date	Summary of Change	Approved By
0.5		New combined manual covering RCI-8522 installation and calibration for all crane types.	Draft
0.6		Koval revisions.	Draft
0.7		Restricted formatting changes.	Draft
0.8		Vogels Revisions	Draft
0.9		Reformat, LSI-Robway name changes, revisions	Draft
0.10		Vehicle loader info deleted. Chapter 10 deleted.	Draft
0.11		Pictures Added	Draft
0.12		Formatted to LSI standard	Draft
1.0	05/15/13	Initial Release	J. Hart

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