RCI-1512 LM Telescopic Boom System
Instruction Manual

MAN-1097 Rev E

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1. Important Safety Notice

The RCI-1512 System is a crane device which warns the operator of impending overload conditions and of overhoist conditions which could cause damage to property, crane and personnel.

The system is not a substitute for good operator judgement, experience and safe crane operation. The operator is solely responsible for the safe operation of the crane.

The operator must, prior to operation of the crane, read this manual carefully and thoroughly and shall ensure that all operational instructions and warnings are understood and complied with.

Proper system operation requires the operator to correctly program the RCI System to match the crane setup and working configuration.

The system is equipped with an override key which bypasses alarms and motion cut function at which time the system can no longer warn of impending overload and must only be operated strictly in accordance to the crane manufacturer's setup and operation procedures. Operation of this key is for authorised personnel only who shall be solely responsible for its use.

2. General Description

This Manual contains general information, installation, operation, calibration, maintenance and parts information for the RCI-1512 Rated Capacity Indicator to suit various Telescopic boom mobile cranes.

Drawing (DWG) Numbers, where applicable in the following Sections, are also provided for quick reference.

The RCI-1512 is a fully automatic Rated Capacity Indicator which provides a display of the following functions:

- Boom Length,
- Boom Angle,
- Hook Radius,
- S.W.L. (Safe Working Load),
- Hoist Rope Falls,
- Lift Point (Duty - Configuration),
- Actual hook Load,
- Percentage of SWL (3 coloured lamps - green, amber, and red).

The RCI-1512 display also provides the following features:

- Visual and audible alarms on warning (approach to overload), overload, motion-cut, two-blocking detection, and error detection,
- Self-diagnosis and error codes,
- Data-logging,
- Built-in calibration and fault-finding tools,
- Anti-two-block (overhoist limit) facility.

3. Operating Instructions

The following sections explain how to operate the RCI-1512 and make best use of its capabilities.

3.1. Turning On the RCI-1512

Power to the unit is from the crane battery (nominal 12 or 24 volts dc) through the start-up or ignition key. In some applications an additional switch may be used to enable the operator to switch the unit on/off as required.

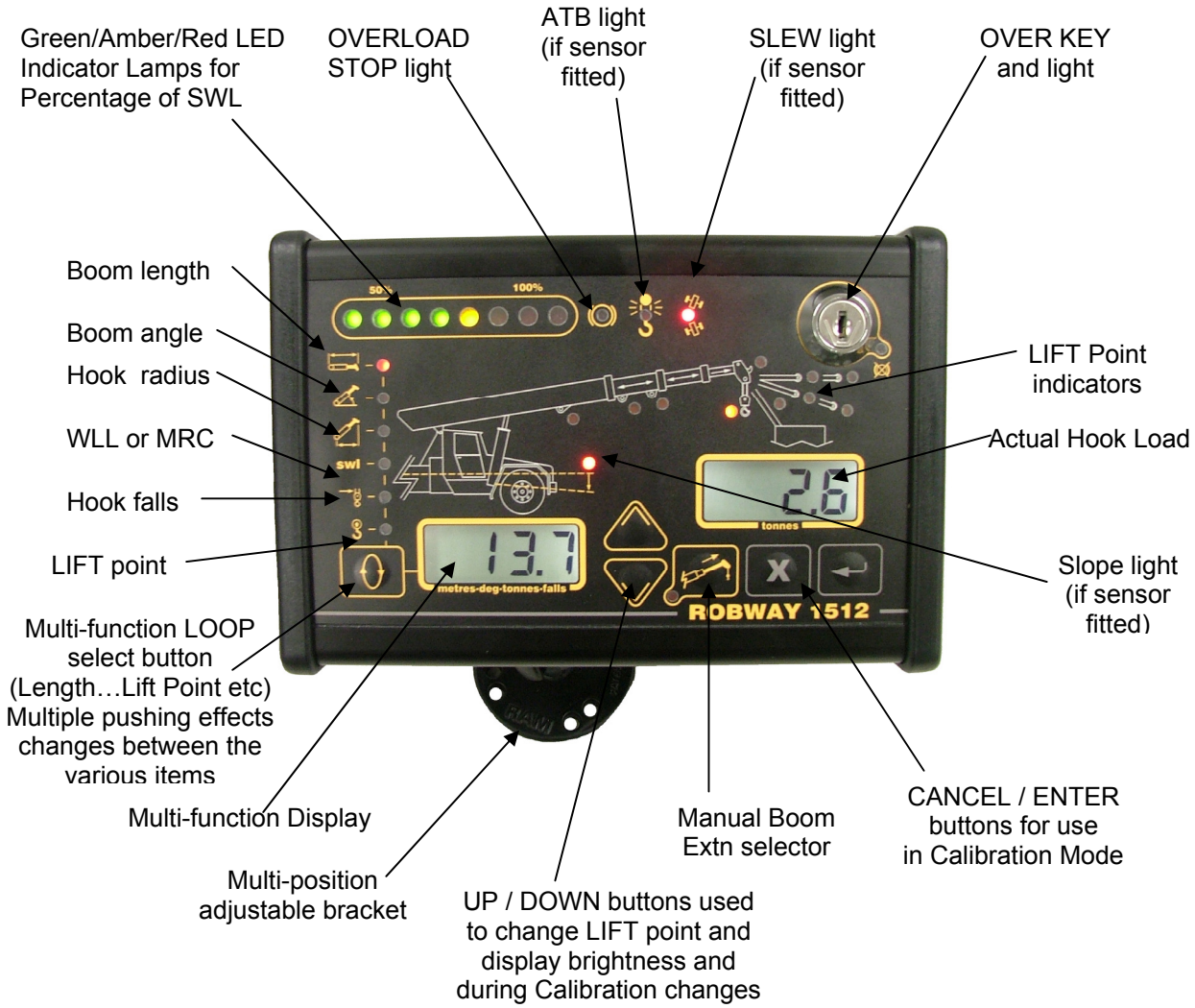
As soon as power is applied to the unit, its display and other indicators should light up and the unit should go through its self-test operation.

Turning OFF the Unit

The unit will stop working as soon as the power is removed from it by switching off any of the switches indicated in Section 3.1 above.

3.2. Operating Screen

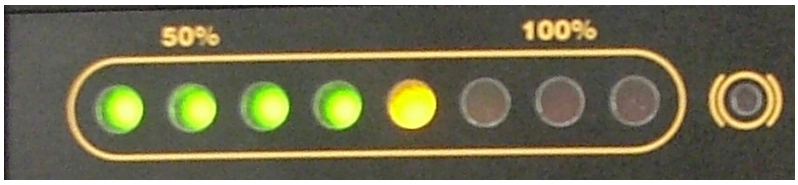
The following is the normal operating screen of the RCI-1512 showing general display functions:



3.3. Display Functions

The RCI-1512 has 2 LCD display windows, various pushbuttons and LED indicators. The display panel can also be grouped into four parts as follows:

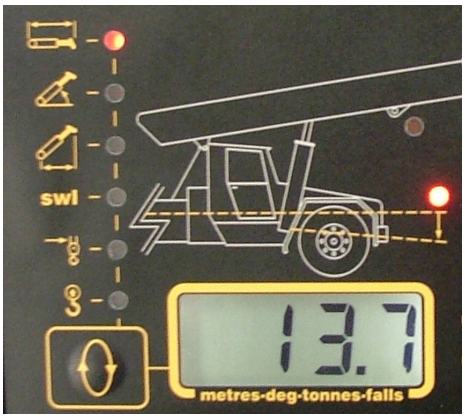
"Approach to Rated Capacity" Indication Lamps



This is the uppermost part of the display which contains eight coloured lamps to indicate "approach to rated capacity". Factory settings are as follows:

- Green (4): 50 to 84%, Amber (2): 85 to 99%, and Red (2): 100 to 110% plus STOP light (can also be motion-cut – if fitted).
- Amber lamps flash when first trip point is reached (i.e. 85% Rated Capacity) plus an intermittent audible alarm.
- Red lamps will flash from 100% of rated capacity plus a continuous audible alarm.
- Red OVERLOAD lamp will stop flashing and will stay ON when the lifted load exceeds 110% of SWL plus a continuous audible alarm. Crane motion controls are also activated at this stage if fitted.

3.4. Multi-function numerical LCD



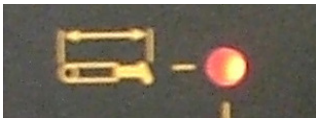
This left hand side LCD display, can be selected to display BOOM LENGTH, BOOM ANGLE, HOOK RADIUS, WLL (SWL or MRC) and FALLS.

This window is also used to display LIFT during LIFT POINT changes while the UP/DOWN buttons are used to cycle between the allowable lift points for the particular model crane.

This window is also used to display ERROR codes when any errors are detected. The error function cannot be manually selected but will be displayed automatically if there are any errors. Please refer to Section 6. "Troubleshooting" for the meaning and description of the error codes.

The selected function is indicated by the lamp next to the labels. The display functions are as follows:

3.4.1. LENGTH



The numerical display shows the BOOM length in metres and is read from the boom length recoil drum.

3.4.2. ANGLE

The numerical display shows the current working angle in degrees which is read from the main boom angle sensor.

3.4.3. RADIUS

The numerical display shows the current working radius in metres.

3.4.4. SWL

The numerical display shows the current maximum safe working load in unit selected tonnes. The WLL (SWL) will depend on the current crane LIFT point, and the maximum linepull and the falls selected of the hook.

3.4.5. FALLS

The numerical display shows the number of falls *(parts of line)* used for the winch selected. To change the falls, press the bottom ‘LOOP’ arrow button until the FALLS light is activated then use the UP/DOWN buttons to select the correct number of FALLS.

3.4.6. LIFT POINT (DUTY)

The ‘crane graphic’ shows the current LIFT POINT (duty or configuration) selected. To change the LIFT POINT, press the bottom ‘LOOP’ arrow button until the bottom LIFT POINT light is activated and ‘LIFt’ is displayed in the LHS LCD display, then use the UP/DOWN buttons to select the actual LIFT POINT being used.

3.4.7. A.T.B. (Anti-Two-Block) Indication LED (if sensor switch is fitted)

This part of the display has two red LED’s which shows the current status of the following functions:

O/RIDE - LED ON when over-ride/bypass key is switched on.
A.T.B. - LED ON when on two-blocking condition.

The RCI-1512 is supplied with a standard Anti-Two-Block (ATB) input for connecting an optional ATB sensor to prevent two-blocking. When the ATB indicator on the front panel is lit, a two-blocking condition has occurred and further hoisting is stopped by activating the motion cut relay, if installed.

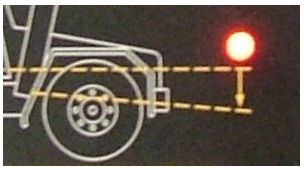
3.4.8. Numerical LCD for Current Load Readout

The RHS LCD shows the HOOK load, in metric tonnes. When the ACTUAL LOAD exceeds the SWL for the current crane configuration the RCI-1512 will activate audible and visual alarms.

If the overload is higher than the SWL % for MOTION CUT OUTPUT, set in calibration mode, the instrument will also activate the motion cut relay, if installed. This will then stop further over-loading of the crane. To bypass or temporarily disable motion cut, the operator must use the over-ride key. When the key is inserted into the display and is turned on the O/RIDE indicator is illuminated as a reminder.

3.4.9. Slew (articulated) angle exceeded warning light

3.4.10. Slope angle exceeded warning light (if sensor/s fitted).

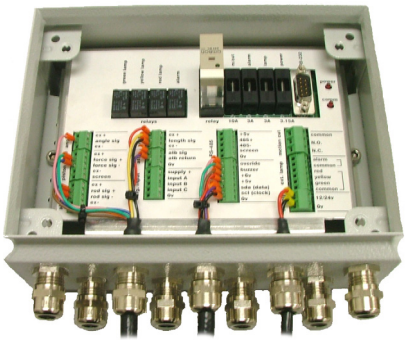


3.4.11. Manual Extension warning light (if sensor fitted).

Otherwise can be manually activated by pushing button, push again if not required.

3.5. Data Logging and Data Downloading

The Data Logger records can be downloaded to a normal PC for review of crane operations. The download is performed using a standard “null-modem cable” (RCI3100, RCI-1550) or special LSI-Robway manufactured cable (RCI-1512). The download file is a text (ASCII) file.



To extract the contents of the data logger from an RCI a number of hardware and software items that are required.

3.5.1. Hardware:

- Laptop or Desktop PC with Windows 95 or later.
- Communications cable with a DB-9 (9 pin) connector for RCI-1550 and RCI3100 or LSI-Robway Communications Cable with a special RCI-type connector for RCI1512
- If necessary: a 9 Pin to 25 Pin Adaptor for the PC side of the cable

3.5.2. Software:

- "HyperTerminal" -a terminal programme issued with every copy of Windows 95 or later.

3.5.3. Procedure:

3.5.3.1. Connect the communications cable from the RCI to a serial port on your computer.

3.5.3.2. In Windows, start HyperTerminal (If HyperTerminal is not installed, install it using your Windows disks or Windows CD).

3.5.3.3. Once HyperTerminal has been started, type in a name for the connection and click OK. Then when prompted for the phone number select the comms port that you plugged the communications cable into under the item "Connect Using". Click OK.

3.5.3.4. When prompted for the comms port properties select the following;- Baud = 9600, Data Bits = 8, Parity = none, Stop Bits = 1 & Flow Control = None. Click OK. HyperTerminal is now ready to receive the data logger contents.

3.5.3.5. From the "Transfer" menu in HyperTerminal, select the item "Capture Text". When prompted for the file name, enter the path and file name (e.g. C:\Logger.txt) for the required destination of the data logger contents.

Click START. In the status bar at the bottom of the window "Capture" should now be highlighted in black writing. HyperTerminal is now setup to save the data logger contents to disk.

3.5.3.6. Now enter calibration mode on the RCI unit. Once in calibration mode, ramp to the function code for downloading the data logger contents. Press ENTER on the RCI unit. The data logger contents should now be scrolling down the screen of your PC. Once the download is complete the RCI should return to normal calibration mode and the PC screen will stop scrolling.

For the RCI-1550 & RCI-3100 only:
When downloading log data, the graphical LCD requests the operator to press the OK button. If this is done, downloading will commence and the message "Downloading" will be displayed. This message will be shown until the download is completed or aborted by the controller. As the data logger can hold a large number of records (even basic systems can hold over 50,000 log entries), downloading may take a substantial amount of time if not performed regularly.

3.5.3.7. From the "Transfer" menu in HyperTerminal select "Capture Text" and then Stop". In the status bar at the bottom of the window "Capture" should no longer be highlighted in black writing and should now be displayed in light grey. The download of the data logger contents is now complete.

3.5.3.8. From the "File" menu in HyperTerminal select "Exit". When prompted to disconnect, click "Yes". Answer the prompt to save the session/connection (You might want to use it again). HyperTerminal should now close down.

3.5.3.9. On the RCI, exit calibration mode and ENSURE that the system is taken out of the over-ride.

NOTE: Before exiting calibration mode it maybe desirable to erase the data logger contents to make all subsequent logs current.

3.5.4. Steps for Importing Data Logger Contents in Microsoft Excel 97:

To make effective use of the data logger contents it maybe desirable to import the contents into a spreadsheet such as Microsoft Excel 97. From within Microsoft Excel 97 many functions and formulae maybe applied to the data (e.g. totalising lifted loads over a certain period) to give the data more meaning.

3.5.4.1. Start Microsoft Excel 97 and from the “File” menu select “Open”.

3.5.4.2. When prompted for the filename, type the path and filename for the data logger file downloaded using HyperTerminal. You can also browse for the file if you cannot remember it exact location. **NOTE:** If you browse for the file be sure to select “All Files” in the “Files Of Type” section in order to select a file with a .txt file extension.

3.5.4.3. Click OPEN. The “Text Import Wizard” will then start. In Step 1of 3 in the wizard select the following: - Original Data Type = Delimited, Start Import Row = 1, File Origin = Windows (ANSI). Click NEXT.

3.5.4.4. In Step 2 of 3 in the wizard make sure no other box is selected apart from the “Tab” box. The “Text Qualifier” has no bearing on the operation. Click NEXT.

3.5.4.5. In Step 3 of 3 in the wizard you can set different columns to be of different data formats. Unless you have a need to change the defaults settings, no operations are required. Click FINISH. The spreadsheet should now be filled out with the logger data setup into individual columns. This spreadsheet can now either be modified and\or saved away for future use or reference. To save the file use the “Save” function from the “File” menu.

3.5.5. RS-232 COMMUNICATION SETTINGS

- Protocol ASCII
- Data Rate 9600 Baud
- Data Bits 8
- Parity None
- Stop Bits 1

4. Installation

4.1. SETTING UP THE CRANE

Lower the crane boom to a safe and convenient position.

4.2. INSTALLING BOOM PARTS

4.2.1. Recoil Drum

The recoil drum contains both the angle sensor and length sensor for telescopic cranes. The payout cable of the drum is also used for wiring the ATB switch/es if required. It is supplied ***for right hand side mounting*** unless ordered specifically for left hand side mounting.

The recoil drum comes complete with mounting bolts, payout wire roller guides and boom tip tie-off bracket.

First remove the recoil drum cover and set aside. Fix the recoil drum and payout cable to the right hand side of the main boom by welding the mounting bolts provided to a suitable location on the side of the boom. Mount the recoil drum on the bolts ensuring that the electrical connection socket is pointing towards the cabin. Ensure the recoil drum is mounted 'squarely' to the boom side panel, this is essential to avoid incorrect payout wire spooling problems.

When the recoil drum is mounted to the left hand side of the boom, the electronic angle sensor must also be adjusted to get it working to its full range. Please refer to drawings DWG 1199, 1239, & 2159 at the rear of this manual for the correct position of the angle sensor.

Select a convenient uninterrupted payout cable alignment along the side of the boom and cut and weld the anchor post provided to a suitable position on the boom head, so that the cable can be clamped into the groove on the post to obtain a temporary line. Select positions for the intermediate cable roller guides provided, one for each telescoping section and one or more for the main boom allowing 3-4m between the drum and the nearest cable roller guide. Measure the distance from the cable to the sides of the boom sections, record lengths and mark the positions for the roller guides. Cut and weld the brackets of the guides to the sides of the boom sections after removing the cable. Refit the cable through the guides and then anchor it to the post using the clamp provided.

When the installation is complete, the recoil spring should be 'maximised' to ensure that maximum available tension is applied to the payout wire to prevent poor spooling onto the recoil drum. If possible, extend the boom fully at zero degrees and pull the recoil drum payout wire fully out by hand until the spring 'locks up'. Allow 2 metres of payout wire to return back onto the drum and cut off the excess. Remake the connection to the boom tip tie-off bracket. Remember to leave sufficient cable length for connection to the anti-2-block switch if one is being fitted.

Notes:
The slip-rings in the LSI-Robway recoil drum are designed for use with LSI-Robway Anti-2-block systems and are not for resistive or inductive circuits such as lights or bells. If you have a particular application that you feel may be applicable to the slip-ring facility, please contact LSI-Robway for further advice.

Please note also that high tensile booms require proper welding procedure specifications. Obtain specialist assistance in these cases.

Drawing References:
DWG 2488 (Sheet 1-2 of 2) – “RW-10 Recoil Drum (No ATB), General Arrangement”
DWG 1539 (Sheet 1-2 of 2) – “RW-10 Recoil Drum (with ATB), General Arrangement”
DWG 2159 – “RW-10 (No ATB) Wiring Diagram”
DWG 1239 – “RW-10 (with ATB) Wiring Diagram, General Arrangement”
DWG 1198 (Sheet 1-2 of 2) – “RW-100 Recoil Drum, General Arrangement”
DWG 1199 – “RW-100 Wiring Diagram, General Arrangement”
DWG 0668 (Sheet 1-4 of 4) – “Recoil Drum Installation Instructions”

Recoil drum and typical installation at the boom base section

4.2.2. Pressure Transducers

The RCI-1512 System uses two pressure transducers fitted to the hydraulic luff cylinder/s, one into the bore (force) side and one into the rod (annular) side of the cylinder to monitor the total forward moment force of the boom for load sensing.

4.2.2.1. Bore (Force) Side Transducer

The bore or force side transducer, also known as piston side transducer, must be fitted to the full bore side of the luff cylinder from which “live” pressure is measured. If a lock valve is fitted to the bore side, the transducer must be fitted to the “live” side of the valve.

The bore pressure transducer can also be installed into the hydraulic line such as a high pressure pipe or hose feeding the BOTTOM of the luff cylinder. Ensure it is fitted to DIRECTLY read the internal pressure WITHOUT being influenced by outside check valves or similar.

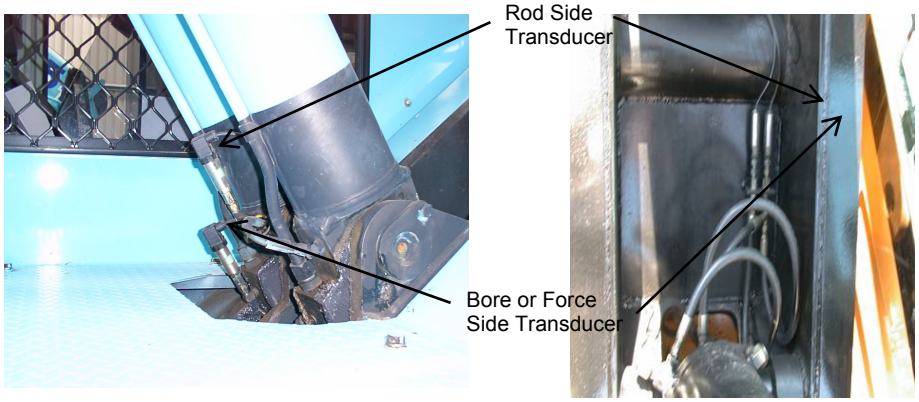
For cranes with two luff cylinders, the two bore sides must be equalised by a high pressure equalising pipe or balance pipe, and only one bore transducer is required to be fitted into this equaliser to measure the “live” pressure from the two luff cylinders.

4.2.2.2. Rod (Annular) Side Transducer

The rod or annular side pressure transducer can be installed into the hydraulic line such as a high pressure pipe or hose feeding the TOP of the luff cylinder. Ensure it is fitted to DIRECTLY read the internal pressure WITHOUT being influenced by outside check valves or similar.

For cranes with two luff cylinders, the rod side need not be equalised as the bore side, i.e. only one rod transducer is required to be fitted into any one of the two luff cylinders.

<u>Drawing Reference:</u>
DWG 1810 – “Pressure Tranducer (5000/10000 PSI) Dimensional Detail”



Typical installation of pressure transducers on the bore (force) side and rod (annular) side of the hydraulic luff cylinder/s

4.2.3. Anti-Two-Block (Optional Item)

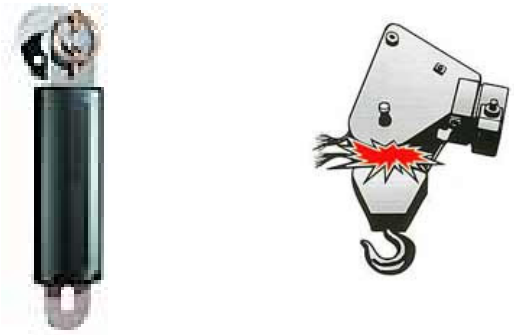
Fix the anti-two-block (ATB) switch mounting bolt by welding it to the boom head preferably so that the bob weight (when suspended from the switch) can be fitted to the static hoist rope below the rope anchor. Check that the switch works correctly as the boom luffs throughout its working range.

Additional switches (for fly-jibs) can be added. Connection is via the bullet-type connectors from the cable. When more than one ATB switch is required (e.g. main & fly), connect the ATB cables of the switches in series via the bullet-type connectors.

Hang the bob weight assembly from the switch eye after cutting the chain to length if desired to suit winch line speed. Repeat the procedure if required for rooster or fly jib.

Drawing References:
DWG 2934 – "Dimensional Detail, BB5 Anti-Two-Block Switch"
DWG 0667 (Sheets 1-2 of 3) – "ATB Switch Installation Details, Telescopic Crane"

Please note that high tensile booms require proper welding procedure specifications. Obtain specialist assistance in these cases.



Model BB-5 anti-two-block (ATB) switch

4.2.4. Cabling (Boom Sensors)

Sensor cables should be fixed firmly to where they are installed and routed along the boom chords through to the crane cabin ensuring freedom of movement around the boom pivot pin.

The cables are normally quite robust. They should be treated with care, however, as even a small amount of damage can be very costly due to down-time or intermittent behaviour. Always support the cable in such a way that there is no "excessive" strain applied, such as tension or flexing. The cable should be strapped to a fixed member that it runs along, unless it is held within a cable tray or trunking. Clip cables at approximately 60mm intervals or where suitable to secure them firmly to the boom. Avoid sharp bends such as around a sharp corner. Where there is to be flexing, the installer must ensure that the bending is reduced to an absolute minimum to avoid fatigue breakage of the conductors.

4.2.5. Connectors

It is recommended that the installer applies a suitable silicone grease (e.g., Dow Corning 4 "Electrical Insulating Compound" or any similar compound) on the plugs and sockets prior to connecting the cables. The silicone grease should be smeared across the connector contact points to increase the water proofing of the connector.

4.3. INSTALLING CABIN PARTS

4.3.1. Display Unit and Key Switch Box

Fit the RCI-1512 Display in a convenient position in the crane cabin such that the operator can view the displays and reach the push buttons comfortably and connect to the Controller Box.

Mount the Controller box in a protected position (suggest inside the cabin). Ensure that the polarity of the power supply is correctly connected.

Standard back plate bracket and kit comprising of bolts and nuts are provided. Special bracket may need to be fabricated on site for suitable mounting in the cabin.

Connect the load, angle, and anti-two-block ATB cables to the display unit. (Refer to RCI-1512 GA Wiring Dwg).

Note: Ensure a good earth connection between the Controller mounting bracket and the cabin metal framing. Failure to do so could result in a non-operational ATB signal and faults due to Radio Frequency Interference.

4.4. WIRING SLEW SWITCH/ES AND MOTION CUT OUTPUT

4.4.1. Slew/Proximity Switch(s) (Optional Items)

The slew switch is used when the crane has different zones of SWL (e.g. over-rear ratings, over-side ratings, etc.). The switch will convey a signal to the display when the crane moves into a zone of different capacity rating. The RCI-1512 system can interface with up to three switches maximum.

The switch is magnetically switched and requires a metal target to switch ON. Fabricate, fix and secure a suitable mounting plate to the switch between the two locknuts supplied. Mount the plate/switch assembly at a suitable location on the revolving upperstructure preferably so that the switch moves and rotates with the upperstructure. The metal target plate must be mounted at a safe and suitable location on the carrier about which the upperstructure rotates.

Alternatively, fix the switch and target plate around the centre post of the crane slew (refer to typical installation photo below).

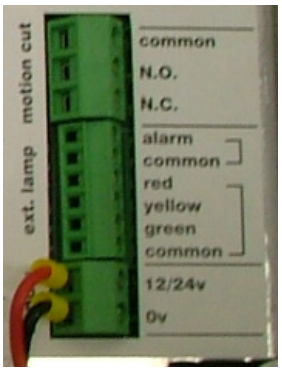
The gap between the switch and target must not exceed 10mm. The switch distance can be adjusted via the locknuts.

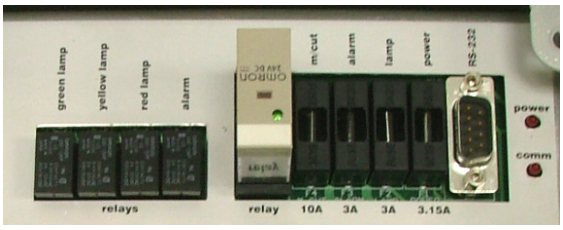
Connect the switch to the RCI-1512 Controller Unit.

Typical installation of slew/proximity switch

4.4.2. Motion Cut Output

The standard RCI-1512 Controller Unit has an in-built relay to output the motion-cut signal. This allows direct connection of the crane's lockout solenoids.





The lockout solenoids on cranes are normally energised when crane is in safe condition (no alarm) and are de-energised when a motion cut condition occurs. Use contact terminals 4 (com) and 5 (NC) of the motion cut relay to wire the supply coil of the lockout solenoids. During motion cut activation, the motion cut relay is de-energised. This opens the relay contacts and also de-energises the lockout solenoids.

Please note that the motion cut cable is not supplied with the RCI-1512 System as a standard component.

5. Calibration

Before any calibration functions can be activated, you must enter CALIBRATION MODE.

5.1. Entering Calibration Mode and Selecting Calibration Functions:

- Make sure that the correct LIFT POINT (crane configuration) and falls (parts of line) are selected,
- Insert the over-ride key switch into the RCI-1512 display and turn it on, make sure that the O/RIDE indicator on the front panel is lit,
- Press and hold the CANCEL  button for about 2 seconds,
- The LHS window should show F-xx, where xx is the last calibration function performed or 00 if this is the first time you entered calibration mode,
- Once calibration mode is entered use the UP/DOWN keys to ramp through the calibration functions,
- When the correct function code is shown in the RHS window press the ENTER  button to select that function,
- To exit calibration mode either select F-00 or press the CANCEL key until the F-xx code is cleared from the LHS window.

5.2. Tools/Items Required for Calibration:

- An accurate angle finder for calibrating boom angle sensor**,**
- An accurate tape meter of at least 30m for verifying radius and some crane dimensions,
- Known test weights that can be lifted for verifying accuracy of load readouts,
- Software configuration sheets and function codes list provided at the back of this manual.

5.3. Map of Calibration (Suggested Order):

3. Set date and time (F-32 to F-34).

4. Verify that raw counts stay within 33-999 for full working range of all sensors (F-07, F-11, F-15, F-19).

5. Review all crane geometry against the supplied Crane Configuration settings for correctness (F-45 to F-59) – refer also to Section 10. “RCI System Crane Configuration Sheet / Duty Listing” at the rear of the manual for factory default settings.

6. Review all SWL % parameters against actual requirements (F-42 to F-44) and change if required – refer also to Section 10 “RCI System Crane Configuration Sheet / Duty Listing” at the rear of the manual for factory default settings.

7. Review the data logger recording points against actual requirements (F-61 to F-67) and change if required – refer also to Section 10 “RCI System Crane Configuration Sheet / Duty Listing” at the rear of the manual.

8. Check Metric/Imperial units switching and set to required unit of measure (F-74).

9. Calibrate low & high boom angle (F-09, F-10).

10. View and check accuracy of the calibrated angle value in degrees on function code (F-08).

11. Calibrate short & long boom length (F-13, F-14).

12. View and check accuracy of the calibrated length value in metres or feet (whichever “unit” is selected on item 8 above) on function code (F-12).

13. Set the number of samples to average to “8” using function code (F-27). Default value is “0” and maximum setting is “25”. Refer to Section 5.5.21. for details.

14. Check that the pressure transducers have been calibrated by viewing function code (F-40). Transducers are normally supplied pre-calibrated from the factory. Refer to Section 5.8. for details.

15. Calibrate load for active (or selected) winch (F-02). Refer to Section 5.9. for details.

16. View and check accuracy of the calibrated load value for the active (selected) winch in tonnes or kips (whichever “unit” is selected on item 8 above) by viewing function code (F-01).

17. Set the rigging SWL (or Boom Stowed SWL While Fully Retracted), if required, using function code (F-73), if required. Refer to Section xx.xx for details.

18. Perform laden boom radius correction, if required, using function code (F-29). Refer to Section 5.5.22. for details.

19. Repeat calibration of active winch (F-02) on all Duties (Crane Configurations). Refer to Section 5.9. for details.

20. Once satisfied with the calibration results, manually record (pen & paper) the calibration data using function code (F-40) and all settings mentioned above. Refer to Section 5.10.1 “Copying & Restoring Calibration Data Function” for details and procedures.

Refer also to Section 5.5.30 “Send Load Moment Data to PC” and Section 5.5.30 “Receive Load Moment Data from PC” for details on recording (copying) and uploading (restoring) load moment calibration data.

5.4. Verifying Operation of Sensors

Before you start calibrating the RCI-1512, you must make sure that the sensors are working correctly and their signals are reaching the RCI-1512.

The RCI-1512 'sees' the crane and its surroundings through sensors. The signals from these sensors are represented as numbers inside the RCI-1512. The range of possible numbers is 0 to 1023 for each sensor.

The RCI-1512 allows the user to view both the UNCALIBRATED or the CALIBRATED signal from a given sensor *(refer to the Section 8.3. “Function Codes” at the rear of this manual)*.

When viewing the UNCALIBRATED signal from a sensor, make sure the number displayed is less than 999 and is more than 32 as you work the sensor through its working range. This is the correct operating range. Also make sure that the numbers displayed in the window are changing in a nice, smooth manner. If you find that the number is too unstable (i.e. changes by more than 10), then you should check the connections to the RCI-1512 (refer to Section 6 “Troubleshooting”).

If the signal is less than 32, suspect a short circuit somewhere on that input channel, e.g. the cable to the RCI-1512 has been crushed and has an internal short circuit in it. Moisture inside the plugs can look like short circuit too.

If the count displayed in the window is 1023, look for an open circuit on that input channel. e.g. disconnected lead.

If the sensors check out then you can continue on and start with the calibration procedure. If you find any problems, check the troubleshooting guide at the end of this manual or seek help from your nearest LSI-Robway distributor.

Please note that while in view mode, that is using either "VIEW UNCALIBRATED ..." or "VIEW CALIBRATED ..." functions, the ENTER key works as a toggle switch to turn that channel ON or OFF. This function allows the user to temporarily turn a sensor off.

To turn a channel back on, you have to re-enter the same VIEW UNCALIBRATED... function and press the ENTER key again.

Remember that you must always end a view function by pressing the CANCEL key.

5.5. Configuring User Variables

LSI-Robway stores the load-charts, crane geometry, default alarm and motion control settings, default data logging parameters, fine-tuning settings, and other useful user variables in the memory of the RCI-1512 at the time of manufacture. As this information may vary from crane to crane, even if they are of the same model, the RCI-1512 allows the installer to change these variables on site. These user variables include dimensions such as slew-offset, maximum falls for main/aux winches, maximum line-pulls, sheave diameters, etc.

The actual values of these variables are printed on a configuration sheet (see Section 10 “RCI System Crane Configuration Sheet / Duty Listing” at the rear of the manual). A copy of this sheet is also supplied separately with the system.

To verify or change the current value of any of these user variables follow the procedure below:

- Enter calibration mode,
- Select the correct function code from the listing (see Section 10 “Function Codes”) then using the UP/DOWN keys ramp to that function code and press ENTER,
- If you want to change the value use the UP/DOWN key to select the new value then press the ENTER key,
- If you only want to verify the current value press the CANCEL key when finished viewing,
- Now you should be back at the F-xx prompt and can continue on with the next operation.

Please note that the value of these variables is very important as they affect the safe operation of the RCI-1512 indicator. Therefore the values of the user variables must be checked and corrected if necessary before proceeding with further calibration or operation.

5.5.1. Exit Calibration Mode (F-00)

Use this function to exit Calibration Mode. Alternatively, exiting calibration mode can also be done by pressing CANCEL button when on a function code other than F-00. Ensure that dashes (----) are shown on the bottom window before pressing CANCEL button to exit.

5.5.2. View Calibrated Load (F-01)

The calibrated load for selected winch can be verified on normal operating mode (operator’s screen). This function is used to view the calibrated load while still in calibration mode. This is useful when just verifying accuracy of the load readout and the calibration has not yet been finalised.

5.5.3. Calibrate Load (F-02)

Please see Section 5.9.1 “Calibrating Load for Active Winch” for details.

5.5.4. View Uncalibrated Angle Input (F-07)

Use this function to view the raw counts (or raw data) of the angle sensor. Please see also Section 5.4 “Verifying Operation of Sensors” for details.

5.5.5. View Calibrated Angle Input (F-08)

The calibrated angle can be verified on normal operating mode (operator’s screen). This function is used to view the calibrated angle (in degrees) while still in calibration mode. This is useful when just verifying accuracy of the angle readout and the calibration has not yet been finalised.

5.5.6. Calibrate Low Angle (F-09)

Please see Section 5.6.1 “Calibrating Low Boom Angle” for details.

5.5.7. Calibrate High Angle (F-10)

Please see Section 5.6.2 “Calibrating High Boom Angle” for details.

5.5.8. View Uncalibrated Boom Length Input (F-11)

Use this function to view the raw counts (or raw data) of the length sensor. Please see also Section 5.4 “Verifying Operation of Sensors” for details.

5.5.9. View Calibrated Boom Length Input (F-12)

The calibrated length can be verified on normal operating mode (operator’s screen). This function is used to view the calibrated length (in metres or feet) while still in calibration mode. This is useful when just verifying accuracy of the boom length readout and the calibration has not yet been finalised.

5.5.10. Calibrate Short Boom Length (F-13)

Please see Section 5.7.1 “Calibrating Short Boom Length” for details.

5.5.11. Calibrate Long Boom Length (F-14)

Please see Section 5.7.2 “Calibrating Long Boom Length” for details.

5.5.12. View Uncalibrated Transducer 1 Input (F-15)

Use this function to view the raw counts (or raw data) of transducer 1 (bore or force side transducer). Please see also Section 5.4 “Verifying Operation of Sensors” for details.

5.5.13. View Calibrated Transducer 1 Input (F-16)

Use this function to view the calibrated transducer 1 (bore or force side transducer) input. Please also Section 5.8 “Calibrating Low End & High End of Transducers” for details.

5.5.14. Calibrate Low End of Transducer 1 (F-17)

Please see Section 5.8.1 “Calibrating the Low End of Transducer 1” for details.

5.5.15. Calibrate High End of Transducer 1 (F-18)

Please see Section 5.8.2 “Calibrating the High End of Transducer 1” for details.

5.5.16. View Uncalibrated Transducer 2 Input (F-19)

Use this function to view the raw counts (or raw data) of transducer 2 (annular or rod side transducer). Please see also Section 5.4 “Verifying Operation of Sensors” for details.

5.5.17. View Calibrated Transducer 2 Input (F-20)

Use this function to view the calibrated transducer 2 (annular or rod side transducer) input. Please see also Section 5.8 “Calibrating Low End & High End of Transducers” for details.

5.5.18. Calibrate Low End of Transducer 2 (F-21)

Please see Section 5.8.3 “Calibrating the Low End of Transducer 2” for details.

5.5.19. Calibrate High End of Transducer 2 (F-22)

Please see Section 5.8.4 “Calibrating the High End of Transducer 2” for details.

5.5.20. Function Codes (F-23 to F-26) – Not Used

These function codes are used for model RCI-4000IS System only.

5.5.21. Number of Sensor Samples to Average (F-27)

This function is used to stabilise the display in the event that the numbers (readouts during normal operating mode) are changing erratically. Function code F-27 will show the number of samples currently being used to average the sensor inputs. This value can be edited by using the Up/Down buttons. Default setting is “0” and the maximum selectable value is “25”. Try different settings until the readouts are stable.

5.5.22. Perform Laden Boom Radius Correction (F-29)

This function code allows the installer to calibrate the system to account for laden boom deflection. As such it should only be used when the displayed load radius is less than the true operating radius of the crane. In such a case the installer should 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 a load, which approaches the SWL, is suspended on the hook. 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. 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.

Laden Radius is provided for telescopic boom cranes to compensate for boom curvature (flexing) under laden conditions.

This should only be performed with fully extended boom at high angle (above 60 degrees) with at least 70% of the appropriate SWL lifted.

Activate this function code and change the displayed value to the actual measured distance from the crane slew centre-line to the hook with the load freely suspended.

5.5.23. Load Chart View Mode (F-30)

This function code can be used to view the load charts programmed in the software. It is not part of the calibration or set-up procedures. It is mainly used by LSI-Robway for software checking.

5.5.24. View Luff Direction (F-31)

This function code is used to view the luff direction of the boom as follows:

2 – St	Boom Stationary
1 – UP	Boom Luffing Up
0 – dn	Boom Luffing Down

5.5.25. Set Year (F-32)

Use this function to set the current year.

5.5.26. Set Day and Month (F-33)

Use this function to set the current day and month.

5.5.27. Set Time (F-34)

Use this function to set the current time. The time displayed is in the format HH:MM. An invalid time will cause an error message to appear. The seconds can't be edited and will always be "00" (hidden). The seconds will begin incrementing once the OK button is pressed.

5.5.28. Send (Download) Logger Contents to PC (F-35)

Please see Section 10 "Data Logging on RCI Systems" at the rear of the manual for details.

5.5.29. Erase Logger Contents (F-36)

Please see Section 10 "Data Logging on RCI Systems" at the rear of the manual for details.

5.5.30. Send Load Moment Data to PC (F-37)

Since Load Moment calibration can be time consuming it is desirable to have a means of recording this information for quick upload to a replacement display or sister crane. This objective is achieved through use of this function code. As for downloading data logger information, any standard PC can be used along with associated terminal emulation software. The communications settings for the PC are as follows:

RS-232 Communication Settings	
Protocol	XMODEM (16 bit CRC)
Data Rate	9600 Baud
Data Bits	8
Parity	None
Stop Bits	1

When starting a download to PC, first set up the PC with the appropriate settings as above. Go to function code (F-37) but do not press the ENTER key yet. Press the appropriate button on the PC screen to start downloading, then press the ENTER key on the RCI-1512 Display to send the data. The message, "SEnd", will appear on the bottom LCD of the Display unit during downloading and disappears when completed.

5.5.31. Receive Load Moment Data From PC (F-38)

This function is the opposite of function code (F-37). It allows load moment calibration that was previously saved to a PC to be uploaded (restored) to the RCI-1512. The communications settings are as shown on function code (F-37).

When starting an upload from PC, first set up the PC with the appropriate settings as above. Go to function code (F-38) and press the ENTER key to start receiving the data. Press the appropriate button on the PC screen to start uploading. The message, "reCU", will appear on the bottom LCD of the Display unit during uploading and disappears when completed.

5.5.32. Clear Load Moment Data for the Current Duty (F-39)

Use this function to clear or erase the load moment data for the current duty selected. This is used when the load moment data on a particular duty has been corrupted. The duty needs to be cleared first of this corrupted data prior to recalibrating it.

5.5.33. Alter Calibration Data (F-40)

This function is used for viewing and for manually copying and restoring the calibration data which must be done after completing the system calibration. Please see Section 5.10 "Copying & Restoring Calibration Data Function" for details and procedures.

5.5.34. Clear All Calibration Data (F-41) – USE EXTREME CAUTION!

Activating this function will clear all the calibration data. This must only be used by LSI-Robway-trained personnel for troubleshooting purposes.

The display will prompt the operator to press ENTER if he wishes to erase the calibration data. Pressing ENTER here will clean out the memory system and default back to hard coded software. Any on-site changes made will be lost.

5.5.35. User Variables (SWL % Alarms, Motion Cut)

Function codes **(F-42 to F-44)** are used to set the Safe Working Load (SWL) percentages for activating Visual and Audible Alarms as well as the Motion Cut control output. The preset or factory default values are based on standard safe parameter settings and may be used. These values can be edited and changed using these functions codes to suit requirements.

5.5.36. User Variables (Crane Geometry, Line Pull/s, & Maximum Falls Setting/s)

Function codes **(F-45 to F-59)** are used to set the actual physical dimensions (geometry), winch line pull/s, and maximum falls setting/s of the crane. Function codes **(F-49 to F51)** only apply to Twin Winch cranes to set the data for the Auxiliary Winch.

The factory default values are based on details and information received at the time of order and supply of system. Any changes to geometry will also require changing of these values using these function codes.

5.5.37. User Variables (Data Logging Setup Parameters)

Function codes **(F-61 to F-67)** are user variables relating to the setup prameters of the internal data logger. Please see also Section 10 “Data Logging on RCI Systems” at the rear of the manual for details.

5.5.38. Minimum Angle Variation Needed to Regard Boom As Luffing (F-68)

This function is used to set the minimum angle variation for the boom to be “sensed” as luffing or moving. It is used by function codes (F-70 to F-72) “Pressure Corrections for Boom Luffing Down/Stationary/Luffing Up” for load readout correction purposes. The factory default setting must not be changed as this could affect the operation of the load correction functions (if used). Consult LSI-Robway for details.

5.5.39. Boom Movement Sampling Period (F-69)

This function is used in conjunction with function code (F-68) and is also used by function codes (F-70 to F-72) “Pressure Corrections for Boom Luffing Down/Stationary/Luffing Up” for load readout correction purposes. The factory default setting must not be changed as this could affect the operation of the load correction functions (if used). Consult LSI-Robway for details.

5.5.40. Pressure Correction for the Boom Luffing Down (F-70)

On some hydraulic systems the load appears to decrease as the boom is luffed down. This is due to friction In the cylinder seal, boom and ram bearings and the effects from the hydraulic circuit itself. Use this function to compensate for this decrease in load. Different positive values should be tried to determine the best correction factor. The correction factor value set in this code is in unit of Mpa (megapascal).

5.5.41. Pressure Correction for the Stationary Boom (F-71)

Not required if calibration of active winch was done while boom was stationary.

5.5.42. Pressure Correction for the Boom Luffing Up (F-72)

On some hydraulic systems the load appears to increase as the boom is luffed up. Use this function to compensate for this increase in load. Different negative values should be tried to

determine the best correction factor. The correction factor value set in this code is in unit of Mpa (megapascal).

5.5.43. Boom Stowed SWL While Fully Retracted (F-73)

This function is used to set a rigging SWL value for the crane to get past the maximum radius without activating the alarms. The value set must not exceed the weight of the empty Main hook block or combined weight of the empty Main & Aux blocks (if twin winch crane). When this function is used, the crane will assume a SWL equal to the weight of the hook block or hook blocks; thus, allowing the boom to go further down to the ground for rigging purposes without alarms as long as no load is lifted on the hooks.

5.6. Calibrating Main Boom Angle

5.6.1. Calibrating Low Boom Angle

- Safely luff the boom down to a low angle, e.g. 30°,
- Enter calibration mode, if not already activated, and select the correct function code (F-09) for calibrating low boom angle,
- Accurately measure the actual boom angle using an angle finder,
- Use the UP/DOWN keys to ramp the display to the required value then press ENTER button to accept this value.

5.6.2. Calibrating High Boom Angle

- Safely luff the boom up to a high angle, e.g. 65°,
- Enter calibration mode, if not already activated, and select the correct function code (F-10) for calibrating high boom angle,
- Accurately measure the actual boom angle using an angle finder,
- Use the UP/DOWN keys to ramp the display to the required value then press ENTER button to accept this value.

Verify that the boom angle is accurately measured by using function code (F-08) VIEW BOOM ANGLE. Luff the boom and stop on different boom angle points. Check boom angle with the Angle Finder and verify accuracy against the displayed angle.

5.7. Calibrating Main Boom Length

5.7.1. Calibrating Short Boom Length

- Retract the main boom fully,
- Enter calibration mode, if not already activated, and select the correct function code (F-13) for calibrating short boom length,
- Refer to the crane manufacturer's load chart and verify fully retracted main boom length,
- Use the UP/DOWN keys to ramp the display to the required value then press ENTER button to accept this value.

5.7.2. Calibrating Long Boom Length

- Extend the main boom fully,
- Enter calibration mode, if not already activated, and select the correct function code (F-14) for calibrating long boom length,
- Refer to the crane manufacturer's load chart and verify fully extended main boom length,
- Use the UP/DOWN keys to ramp the display to the required value then press ENTER button to accept this value.

Verify that the boom length is accurately measured by using function code (F-12) VIEW CALIBRATED BOOM LENGTH INPUT. Fully retract and fully extend the boom and check the displayed length readings on both fully retracted and fully extended boom against the crane load chart values.

5.8. Calibrating Low End & High End of Transducers

Before going on to calibrating the load for active winch on function code (F-02), the transducer/s must be checked for calibration. Transducers are normally supplied pre-calibrated from the factory.

A re-calibration of the pressure transducers will ONLY be required if:

- **A pressure transducer has been replaced or changed from original supply,**
- **The software chip has been replaced or upgraded,**
- **The memory chip (Dallas) has been replaced.**

The following procedures cover the calibration of the Low End and High End of the transducers should this be required.

5.8.1. Calibrating the Low End of Transducer 1 (Bore or Force Side)

- Connect the transducer 1 to the display unit, ensuring no force is applied to the transducer (i.e. disconnected from the hydraulic line and open to atmosphere),
- Enter calibration mode, if not already activated, and select function code (F-17) "Calibrate Low End of Transducer 1",
- Using the UP/DOWN keys, dial up “0.1” on the display. This is the value of the transducer in megapascal (MPa) which is equivalent to 14.7 PSI (atmospheric pressure),
- Press ENTER key to accept this value,
- Proceed to next step, “Calibrating the High End of Transducer 1”.

5.8.2. Calibrating the High End of Transducer 1 (Bore or Force Side)

- Select function code (F-40) “Alter Calibration Data” and press the ENTER key,
- Using the UP/DOWN keys, scroll through the various functions and select “**tr1**” on the display. Press the ENTER key and EDIT the following values:

Lo_r	-	Do NOT edit this value. This is the low raw counts value of the transducer (ref. Section 5.8.1).
Lo_c	-	Do NOT edit this value. This is the calibrated low force value (0.1 MPa) of the transducer (ref. Section 5.8.1).
Hi_r	-	Edit this item and enter the value “980” using the UP/DOWN keys.
Hi_c	-	Edit this item and enter the value “34.5” which is the full capacity of the pressure transducer in MPa.

- Press ENTER key to accept this value,
- Refer to Section 5.10. “Procedures in Editing & Restoring Calibration Data” of this manual for further details and procedures on editing above items.

5.8.3. Calibrating the Low End of Transducer 2 (Annular or Rod Side)

- Connect the transducer 2 to the display unit, ensuring no force is applied to the transducer (i.e. disconnected from the hydraulic line and open to atmosphere),
- Enter calibration mode, if not already activated, and select function code (F-21) "Calibrate Low End of Transducer 2",
- Using the UP/DOWN keys, dial up “0.1” on the display. This is the value of the transducer in megapascal (MPa) which is equivalent to 14.7 PSI (atmospheric pressure),
- Press ENTER key to accept this value,
- Proceed to next step, “Calibrating the High End of Transducer 2”.

5.8.4. Calibrating the High End of Transducer 2 (Annular or Rod Side)

- Select function code (F-40) “Alter Calibration Data” and press the ENTER key,
- Using the UP/DOWN keys, scroll through the various functions and select “**tr2**” on the display. Press the ENTER key and EDIT the following values:

Lo_r	-	Do NOT edit this value. This is the low raw counts value of the transducer (ref. Section 5.8.3).
Lo_c	-	Do NOT edit this value. This is the calibrated low force value (0.1 MPa) of the transducer (ref. Section 5.8.3).
Hi_r	-	Edit this item and enter the value “980” using the UP/DOWN keys.
Hi_c	-	Edit this item and enter the value “34.5” which is the full capacity of the pressure transducer in MPa.

- Press ENTER key to accept this value,
- Refer to Section 5.10. “Procedures in Editing & Restoring Calibration Data” of this manual for further details and procedures on editing above items.

5.9. Calibrating Load

Calibration for Load Moment telescopic cranes requires separate calibration for each duty configuration. When a duty (or part of a duty as we will see shortly) is not calibrated, the display issues the special Error Code 320. A duty is only fully calibrated when the boom has been calibrated for a number of extension lengths (called sections) over the full extension range of the boom. Generally a total of 16 sections are provided for each duty. This means that the total extension length of the boom can be separated into 16 segments, all of which may have a separate load calibration performed.
It is important that the first and last sections are calibrated at the fully retracted and fully extended boom lengths respectively. Hence, generally one would calibrate a fully retracted boom as section 1 and a fully extended boom as section 16. For proportional extending booms, this would normally be sufficient calibration and no other sections would need calibrating. For sequential booms, or booms that use a combination of proportionally and sequentially extending segments, more sections may need to be calibrated at mid-extension lengths in order to increase the accuracy of the load reading.

In addition, if your crane has more than one winch which can support a load on any specific duty, then calibration needs to be performed separately for each winch selection as well (except for the case where the two winches are coincident on a single head sheave).

5.9.1. Calibrating a Duty

5.9.1.1. Select the first LIFT POINT (duty).

5.9.1.2. Calibrate Section 1 as the fully retracted boom (see the following Section 5.9.2 for instructions on how to calibrate a boom section).

5.9.1.3. Calibrate Section 16 as the fully extended boom.

5.9.1.4. If the boom is proportional, calibration of Sections 1 and 16 would normally be sufficient. If load readout is not satisfactory when boom is between the fully retracted and fully extended section, intermediate boom sections may be calibrated to increase accuracy of the load readout. Refer to Section 5.9.3 later in this calibration section for examples.

5.9.1.5. If the boom is sequential, calibrate further sections as each boom segment reaches full extension. Choose your section numbers to give an even spread over the range of boom extension (i.e. if there are four boom segments calibrate the 2nd and 3rd segments as sections 6 and 11). Refer to Section 5.9.3 later in this calibration section for examples.

5.9.1.6. Ensure that as the section number chosen corresponds to an increasing boom length (for example, if you calibrate section 4 at 10.0m DO NOT calibrate section 5 as 9.0 metres – section numbers should hold increasing values of boom length). It is a very good idea to keep a written record.

5.9.1.7. Extend and luff the boom through it’s working range to ensure calibration is adequate, if not, find the inaccurate lengths and fill in calibration sections at the midpoint.

5.9.1.8. Once satisfied, select any further active winches for this duty and repeat steps 5.9.1.2 – 5.9.1.6

5.9.1.9. Once satisfied, select the next duty and repeat steps 5.9.1.2 – 5.9.1.7.

5.9.1.10. Once all duties are calibrated the crane is ready for commissioning.

5.9.2. Calibrating a Boom Section

5.9.2.1. Extend the boom to the desired length for calibrating.

5.9.2.2. Lift the desired test weight to calibrate – it is possible to calibrate with only the fall or hook block or indeed with no attachments on the boom at all. When fall blocks, slings etc. are present, accurately estimate the total weight of all attachments including any desired test weight suspended.

5.9.2.3. Choose a low and a high angle you wish to use as calibration points. These two angles should be as far apart as possible while still ensuring positioning is at legal operating positions in the cranes working range. Also, ensure that the telescopic cylinders are not full compressed or extended, as this will cause unrealistic pressure readings. If your crane has any boom backstop arrangement, ensure the backstops are not engaged at your high angle selection. Angles of 30° and 50° would suffice, a greater spread would however be advantageous. Luff the boom to the first of these angles. It does not matter whether you start at a low or high angle first, however, it is advisable that the last luff movement is UP. Hence, if you calibrated the high angle point and then luffed down to the low angle point, luff up again very slightly when at the low angle to ensure even distribution of pressure between your cylinders.

5.9.2.4. Enter calibration mode and select F-02 “Calibrate load”.

5.9.2.5. When prompted dial in the current loading including hook blocks and slings. Press ENTER to store this load.

5.9.2.6. The prompt will now change to show S-01. This indicates the number for the calibration section you now wish to calibrate. Ramp the display to the desired section number (see previous Section 5.9.1 for instructions on choosing section numbers) and, after ensuring the crane and load are motionless (stable), press ENTER. If there is still some movement in the load, allow time for settling.

5.9.2.7. The bottom display window now responds with either a “-LO-“ or “-HI-” prompt. This indicates that you now need to luff to a new angle that is either lower or higher respectively than the current boom angle. “-LO-“ means luff down and “-HI-“ means luff up. Luff the boom to this new angle (observe the top display window shows the current boom angle as it varies). If you started at a high angle and have now luffed down to a low angle, luff up again very slightly to ensure the pressures in the cylinders are evenly distributed. Check the load is not swinging, then press ENTER.

5.9.2.8. The calibration for this boom section is now complete. Refer to previous Section 5.9.1 for instructions on selecting further boom lengths (or sections) to calibrate and then calibrate these sections as described in steps 1 to 7 above.

5.9.3. Examples on Section Number Selection

Assume the load chart looks like this:

Radius	Boom Length

	10m	15m	20m	25m
3m				
20m				

Proportional Boom

First calibrate:

- Section 1 at 10.0m (fully retracted)
- Section 16 at 25.0m (fully extended)

Test the accuracy of the load over the extension range of the crane. If the accuracy varies, then more sections may be calibrated to improve the performance. This is an iterative process. To calibrate a minimum number of sections, we want to half the distance between calibrated sections with each successive calibration.

Telescope the boom to half extension and perform a calibration there. In our example this means extending to 17.5m boom length. Since this is half boom extension the calibration section which should be chosen should be roughly half the number of sections, ie. section 8 should be used, i.e. calibrate:

- Section 8 at 17.5m extension

Once again test the accuracy of the load over the extension range of the boom. If the accuracy is still not acceptable, calibrate further intermediate lengths of the boom at ¼ and ¾ of full extension. Calibration section numbers used would be at ¼ and ¾ of the total number of sections, hence calibrate:

- Section 4 at 13.75m extension
- Section 12 at 20.25m extension

Continue this process of calibrating smaller boom segments until the load is acceptably accurate.

Sequential Boom

Calibration of a sequential boom is essentially the same as for a proportional boom except that it is probably desirable to calibrate boom lengths which arise when a boom segment has reached full extension.
If the boom has three telescoping segments and the minimum and maximum boom lengths have been calibrated as sections 1 and 16 respectively, then it is probably desirable to calibrate further sections at the points where each boom segment reaches full extension. The section numbers should be chosen to allow for further refinement of calibration if necessary. If we assume that each boom extension segment is 5 metres long then we want to calibrate sections at 5m and at 10m of extension. Since these values represent 1/3 and 2/3 of full extension, choose section numbers similarly proportioned at 1/3 and 2/3 of the total number of sections, i.e. calibrate:

- Section 6 at 15m boom length
- Section 11 at 20m boom length

Using the above section numbers allow some room for calibrating additional sections at points where the calibration is found to be deficient. For example, if noticed that the load was reading low with a 12.0-meter boom then section 3 (or 4) could be calibrated at 12.0m. Remember that it is important the boom length increases as the section number increases!

5.10. Copying and Restoring Calibration Data Function

The latest software for the RCI-1512 System features a facility to easily VIEW, COPY, and RESTORE Calibration Data by using function code **F-40 "Alter Calibration Data"**.

5.10.1. Procedures in Recording/Copying Calibration Data:

1. Access Calibration Mode.

2. Activate function code **F-40 (Alter Calibration Data)**.

3. Press ENTER button to select and access the Alter Calibration functions.
4. Function **An1 (Angle Channel)** will be displayed on top window. An1 is the default item that comes up whenever F-40 (Alter Calibration Data) is activated.

   The calibrated value of Angle will be shown on bottom window (e.g., 80.5° as shown in this example).

5. Use the Up/Down Arrow keys to go through all the following items listed below.

Codes	Description
An1	**Angle**
Ln1	**Boom Length**
rd1	Radius
tr1	**Transducer 1**
ld1u	Load 1 Up
ld1d	Load 1 Down
tr2	**Transducer 2**
ld2u	Load 2 Up
ld2d	Load 2 Down

Only the "highlighted" items above must be copied. To copy an item, select the item and press the ENTER key.

6. In the example above, the default item **An1** has been selected.

7. Press ENTER key while on the selected item (e.g. An1) to activate the Edit Codes. There are four (4) Edit Codes as follows:

Edit Codes	**Description**
Lo_r	Raw Counts of Calibrated Data (Low End)
Lo_c	Calibrated Data (Low End)
Hi_r	Raw Counts of Calibrated Data (High End)
Hi_c	Calibrated Data (High End)

8. The first Edit Code is **Lo_r** which refers to the **raw counts or raw data of the calibrated low angle** (e.g., 128 counts as shown in this example).

9. Manually record/copy (with pen & paper) the **Lo_r** value.

10. Use the Up/Down Arrow keys to go through and copy the rest of the edit codes (**Lo_c**, **Hi_r**, and **Hi_c**).

11. Press CANCEL key to return to the item **An1** screen.

12. Select the next item, Ln**1**, and repeat above procedures 6 to 13.

13. Select and repeat the same on functions **tr1** and **tr2**.

14. Ensure that the Edit Codes for the following items have been recorded/copied before exiting Calibration Mode:

    An1
    Ln1
    tr1
    tr2

15. Keep the record for future use (e.g. to re-calibrate the system when calibration data is lost due to faults, or when the Eprom software chip or Dallas memory chip has been replaced with a new one).

16. Download or copy the “Load Moment” data to a PC laptop by using function code F-37. Refer to Section 5.5.30 “Send Load Moment Data to PC” for details and procedures.

5.10.2. Procedures in Editing & Restoring Calibration Data:

1. Access Calibration Mode.

2. Activate function code **F-40 (Alter Calibration Data)**.

3. Press ENTER button to select and access the Alter Calibration functions.
4. Function **An1 (Angle Channel)** will be displayed on top window. **An1** is the default item that comes up whenever F-40 (Alter Calibration Data) is activated.

   The calibrated value of Angle will be shown on bottom window (e.g., 80.5° as shown in this example).

5. Use the Up/Down Arrow keys to go through all the following items listed below:

Codes	Description
An1	**Angle**
Ln1	**Boom Length**
rd1	Radius
tr1	**Transducer 1**
ld1u	Load 1 Up
ld1d	Load 1 Down
tr2	**Transducer 2**
ld2u	Load 2 Up
ld2d	Load 2 Down

6. Only the “highlighted” items above must be restored. To restore an item, select the item and press the ENTER key.

7. In the example shown, the default item **An1** has been selected. Press the ENTER key while on the selected item (e.g. An1) to activate the Edit Codes.

8. Use the Up/Down Arrow keys to go through the list of the four (4) Edit Codes as follows:

Edit Codes	Description
Lo_r	Raw Counts of Calibrated Data (Low End)
Lo_c	Calibrated Data (Low End)
Hi_r	Raw Counts of Calibrated Data (High End)
Hi_c	Calibrated Data (High End)

9. The first Edit Code is **Lo_r** which refers to the **raw counts or raw data of the calibrated low angle** (e.g., 128 counts as shown in this example).

10. Press the ENTER key to access edit mode (i.e. the word “EDIT” comes up on the top window).

11. Use the Up/Down Arrow keys to change the **Lo_r** value with the previously copied data.

12. Press the ENTER key to store this new value to **Lo_r** (e.g. from 128 to 109 as shown in this example).

13. The screen will then return to the **Lo_r** Edit Code screen.

14. Select the next Edit Code and repeat procedures 9 to 15 until all Edit Codes have been edited (i.e. calibration data have been restored).

15. Once all of the Edit Codes for **An1** have been edited, press the CANCEL key to return to the **An1** screen.

16. Repeat procedures 6 to 16 until all of the items have been edited.

17. Ensure that all of the following items have been edited before exiting Calibration Mode:

    An1
    Ln1
    tr1
    tr2

18. Upload or restore the “Load Moment” data from the PC laptop to the display unit by using function code F-38. Refer to Section 5.5.31 “Receive Load Moment Data from PC” for details and procedures.

6. Troubleshooting

The RCI-1512 system incorporates a number of software features that are designed to help the service person quickly identify a fault, **however** it must be stressed that these features cannot identify everything. They can only be used as a guide to identify additional checks that can be made. Some notes are provided below, followed by some example faults and possible causes.

6.1. **Identify the symptoms.** Take time to find out exactly what is happening to indicate a problem. If possible have the problem demonstrated so you can "describe it in your own words". Sometimes what someone else has told you is only part of the story.

6.2. **Leave the calibration alone!** Too many times a re-calibration has been attempted in order to rectify a problem before that problem has been correctly identified. This leads to added confusion as the perspective is generally moved from the real fault to "calibration problems". We have often received a message indicating that our display has "not accepted the calibration data". Most times this is due to a fault in a cable or sensor which was not identified prior to re-calibration. Re-calibration must only be performed when all physical inputs have been verified for correct operation, and in actual fact is rarely ever needed.

6.3. **Do you have your simulator with you?** A simulator is a very quick way to verify if the fault is external to the display and will save you a lot of heartache.

6.4. **Have you read the manual?** When all else fails, read the manual! Your answer may actually be in there.

6.5. **Know what information you need to gather.** If you collect the correct information from the display the job is half done. Before you begin to suspect faults with the system, you must satisfy yourself that the display is correctly configured for the crane environment. In other words, check that the correct duty, falls, winch etc. have been selected. Are all of the sensors connected? In general if sensors have been supplied with the system, they must always be connected. The display will check them continuously and issue an error if that sensor cannot be detected. Check your length, angle and radius against the chart to verify that the equipment is permitted to be in that situation. If there is still a problem once these have been checked, then you will need to check the hardware.

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

YOU MUST USE THE "VIEW UNCALIBRATED...." FUNCTION CODES TO DETERMINE THE CORRECT OPERATION OF THE EXTERNAL SENSORS, NOT THE "CALIBRATED" VALUES. It should be noted here that for load related problems, the **"VIEW UNCALIBRATED TRANSDUCER"** function code must be used, and not **"VIEW CALIBRATED LOAD"**. For correct operation these values must be in the range of 32 to 999 raw counts. Anything outside of this range will produce an error. Refer to Section 5 “Calibration” on how to access these raw counts.

6.7. **Check the obvious.** Once you have found a problem with a sensor for example, check all of the obvious things to do with that sensor such as making sure all of the connectors are tight. Be systematic - make notes about what you have done and what you found. You will find that under pressure you can easily forget what you have checked and it becomes very easy to miss things.

6.8. EXAMPLE PROBLEMS AND POSSIBLE CAUSES

Problems That Produce Error Codes:

6.8.1. Error code 320.

This is indicating that the Duty and/or Winch selected has not been calibrated.

Possible causes:

- Uncalibrated Duty and/or Winch selected.

6.8.2. Error code 101.

This is indicating that the signal from the angle sensor is too low or too high. This should be confirmed by viewing function code (F-07) “VIEW UNCALIBRATED ANGLE INPUT” and noting that the value shown on the LOAD LCD display is less than 33, or higher than 999.

Possible causes:

- Angle sensor incorrectly mounted. This is especially critical for the Electronic Angle Sensor. Refer to Section 4. “Installation” of the manual for installation of the angle sensor.
- The angle sensor signal wire is short circuited to the shield, the angle 0V, or the excitation positive wire.
- The angle sensor is not connected or there is an open circuit in either the angle sensor signal wire or the angle excitation positive wire.
- The angle sensor excitation voltage is shorted. If this is the case it will also affect the length and load channels.
- The angle sensor 0V wire is open circuit.

6.8.3. Error code 110.

This is indicating that the signal from the length sensor is too low or too high. This should be confirmed by viewing function code (F-11) “VIEW UNCALIBRATED BOOM LENGTH INPUT” and noting that the value shown on the LOAD LCD display is less than 33, or higher than 999.

Possible causes:

- The length potentiometer may not have been set up as per the manual. Refer to Section 4. “Installation” of the manual for installation of the angle sensor.
- The length sensor signal wire is short-circuited to the shield, the length 0V, or the excitation positive wire.
- The length sensor is not connected or there is an open circuit in either the length sensor signal wire, the length excitation positive wire, or the length 0V wire.
- The length sensor excitation voltage is shorted. If this is the case, it will also affect the angle and load channels.
- Payout cable may have broken.

6.8.4. Error code 201.

This is indicating that the signal from the pressure transducer 1 (bore or force side) is too low or too high. This should be confirmed by viewing function code (F-15) “VIEW UNCALIBRATED TRANSDUCER 1 INPUT” and noting that the value shown on the LOAD LCD display is lower than 33, or higher than 999.

Possible causes:

- Force transducer signal wires shorted together.
- The signal + is shorted to the shield.
- The excitation - is shorted to the shield.
- The excitation supply is shorted together. This will obviously affect all of the external sensors. Measure the excitation voltage and compare it with the expected value. If this is the cause, the UNCALIBRATED value will generally be non-zero, but below 33.
- The force transducer is disconnected or there is an open circuit in one of the signal wires.
- The signal - is connected to the shield.
- The signal + and the excitation + are swapped.
- The signal - and the excitation - are swapped.

6.8.5. Error code 202.

This is indicating that the signal from the pressure transducer 2 (annular or rod side) is too low or too high. This should be confirmed by viewing function code (F-19) “VIEW UNCALIBRATED TRANSDUCER 2 INPUT” and noting that the value shown on the LOAD LCD display is lower than 33, or higher than 999.

Possible causes:

- Rod transducer signal wires shorted together.
- The signal + is shorted to the shield.
- The excitation - is shorted to the shield.
- The excitation supply is shorted together. This will obviously affect all of the external sensors. Measure the excitation voltage and compare it with the expected value. If this is the cause, the UNCALIBRATED value will generally be non-zero, but below 33.
- The rod transducer is disconnected or there is an open circuit in one of the signal wires.
- The signal - is connected to the shield.
- The signal + and the excitation + are swapped.
- The signal - and the excitation - are swapped.

6.8.6. Error code 240.

This is indicating that an overload has been detected. This error generally accompanies most other errors simply because most other errors will place the display into an overload condition. This being the case, you need to check what other errors are present and correct them first. Once these have been addressed the E240 error generally takes care of itself. The exception is of course, when the equipment has been put into a genuine overload situation which has not been caused by any external faults.

Possible causes:

- A genuine overload condition exists.
- It has been caused by another Error code condition.

6.8.7. Error code 301.

This is indicating that the angle being measured is outside of its allowed range.

Possible causes:

- A genuine violation of the angle limits has occurred.
- The angle sensor mounting may have loosened allowing the sensor to move.
- Wrong duty selected.
- Check the angle displayed against the actual angle of the boom.

6.8.8. Error code 302

This is indicating that the length being measured is outside of its allowed range.

Possible causes:

- A genuine violation of the length limits has occurred.
- The length potentiometer mounting may have loosened allowing the sensor to move.
- Wrong duty selected.
- Check the length displayed against the actual boom length.
- Payout cable may have fallen off the reeling drum.
- Payout cable may have been broken or become tangled.

6.8.9. Error code 304.

This is indicating that the radius being measured is outside of its allowed range.

Possible causes:

- A genuine violation of the radius limits has occurred.
- Wrong duty selected.
- Check as per Error code 301 and 302.

Problems That Do Not Produce Error Codes:

The load does not vary when I lift a weight.

The load cable and/or the load sensor is/are faulty. Check the load cable for faults. If cable is good, check the resistance values of the load cell. This, however, does not give the complete story. Even if the resistances are correct, there is still a chance that a fault on the sensor exists. Replace the load cell.

When the system starts in the morning the displays are erratic, but settle during the day.

This is a common sign of moisture ingress into either the display, the connectors, the sensors or the cable. These should be checked, dried and sealed.

The display does not start.

You should check the power supply. The RCI-1512 has a voltage range of 10 – 40 vdc. If the supply is within range, open the Switchbox and check the fuses.

The unit is on alarm, but no error code on display.

Check for Two blocking condition.
If no Two Blocking condition exist but the ATB LED on display is ON, check the “earth lead” from the display for proper grounding to crane chassis.
If “earth lead” is OK, check the ATB switch and cable for faults.

On start-up the display shows “LCtrl” on top screen and then hangs (boot up not completed).

This is a data logger control error. It happens when the internal data logger has been corrupted; when an upgraded or new software has been installed; or when the memory chip (Dallas IC) has been replaced with a new one.
To fix this error, insert and turn the override (bypass) key ON, then press the ENTER button. The display will show “YES” to confirm. While “YES” is shown on the screen, press the ENTER button again until the display gets into the normal initialisation/ set-up routine and then to normal operating mode.

7. Electrical Specifications

7.1. Power Supply Input (VDC)

Range: 10 VDC - 40 VDC

7.2. Power Consumption

< 1 amp (in full alarm)

7.3. Temperature Range

Operating: -20°C to +70°C

7.4. Digital Inputs

Total of three (3) digital inputs for connecting slew/proximity switches for monitoring different zones of operation, and/or for connecting other types of switches for any special crane requirement/application. Refer to Section 4. “Installation” of the manual for application details.

7.5. Motion Cut Relay Output

One (1) standard motion cut relay output available for wiring to crane lockout solenoids to inhibit crane motion when on overload/alarm condition. The relay fitted in the Switchbox is rated 10A @ 30 VDC. A spare 12 VDC relay is also supplied with the installation kit for use on 12 VDC cranes. Refer to Section 4. “Installation” of the manual for application details.

7.6. Sensors

7.6.1. Pressure Transducers

Capacity:	5000 PSI (34.5 MPa)		
Excitation Voltage:	4.0 VDC regulated (provided by the Display unit)		
Linearity:	0.15% nominal		
Repeatability:	> 0.10%		
Hysteresis:	< 0.10%		
Creep:	< 0.10%		
Output:	2 mV/V nominal		
Isolation:	> 2000 MOhms at 50 VDC		
Overload:	150% (no electrical damage)		
	> 400% (ultimate)		
Temperature Effects:			
	On Zero:	< 0.006% / °C	
	On Span:	< 0.005% / °C	
Compensated Range:	-10°C to +70°C		
Sealing:	IP68 fully encapsulated		
Pin/Wire Connections (5-Way Connector):			
	Pin A	Black	Negative Excitation
	Pin B	White	Negative Signal
	Pin C	Red	Positive Excitation
	Pin D	Green	Positive Signal
	Pin E	Screen	Screen
Expected Resistances (for a standard 350-Ω cell):			
	Red - Black	300 - 600 Ω	
	Red - Green	200 - 400 Ω	
	Red - White	200 - 400 Ω	
	Black - Green	200 - 400 Ω	
	Black - White	200 - 400 Ω	
	White - Green	350 Ω ± 2 Ω	

Shield/Screen to any other wire must be open circuit

7.6.2. Electronic Angle Sensor

Type:	Capacitance-based sensor with no moving parts, ratiometric output
Excitation Voltage:	4.0 VDC regulated (provided by the Display unit)
Operating Range:	+/- 45° (offset mounted to accommodate 0 - 90°)
Accuracy:	+/- 0.2°
Cable Entry:	Mil-spec plug/socket connector (Angle Sensor& Length Sensor are joined in one cable and connector from the Recoil Drum)
Mounting:	Via screws inside the Recoil Drum
Weight:	0.3 kg

Pin/Wire Connections (7-Way Connector, joined with Length Sensor):

Pin A	Red	Positive Excitation
Pin E	White	Angle Signal
Pin C	Black	Negative Excitation

Expected Resistances:

High ohms or open circuit between any of the wires and chassis or shield

7.6.3. Boom Length Sensor

Type:	500-ohm 10-turn potentiometer
Excitation Voltage:	4.0 VDC regulated (provided by the Display unit)
Operating Range:	0-30 metres
Accuracy:	+/- 0.05 metre
Cable Entry:	Mil-spec plug/socket connector (Angle Sensor& Length Sensor are joined in one cable and connector from the Recoil Drum)
Mounting:	Via screws inside the Recoil Drum
Weight:	0.1 kg

Pin/Wire Connections (7-Way Connector, joined with Angle Sensor):

Pin A	Red	Positive Excitation
Pin B	Blue	Length Signal
Pin C	Black	Negative Excitation

Expected Resistances:

High ohms or open circuit between any of the wires and chassis or shield

Proximity Switch

Type:	PNP – N.O. & N.C.
Sensing Range:	10 mm
Operating Voltage:	10 – 30 VDC
Switching Current:	200 mA maximum

Anti-Two-Block Switch (Model BB5)

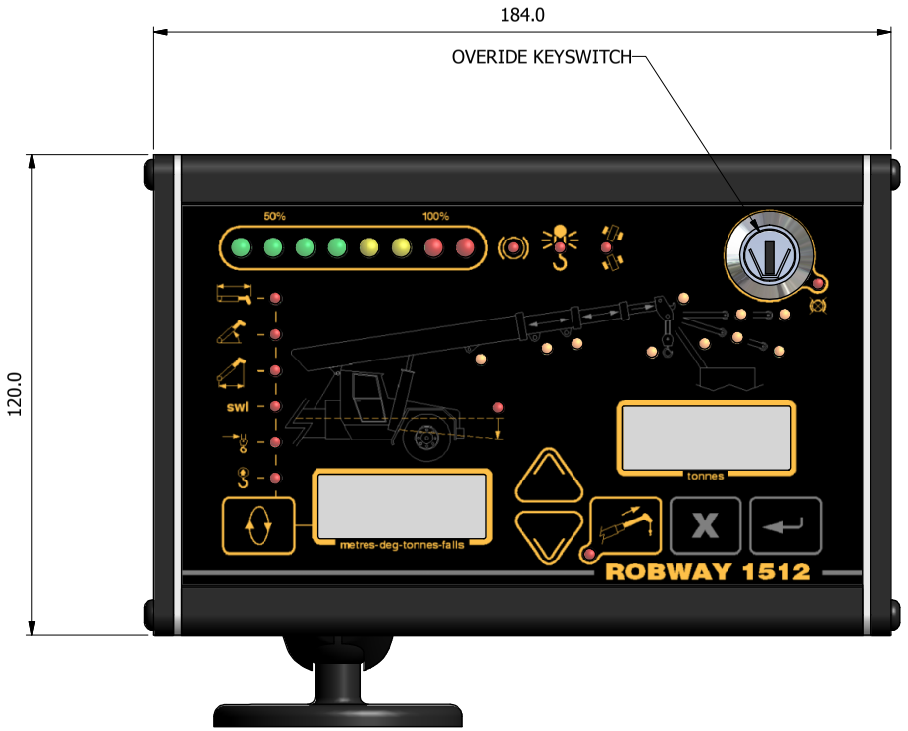
Type:	V4 IP67 sealed, leaf
Contact Rating:	28 VDC/3A
Electrical Life:	10^5 operations
Operating Force:	0.6 N (max)
Release Force:	0.08 N (min)

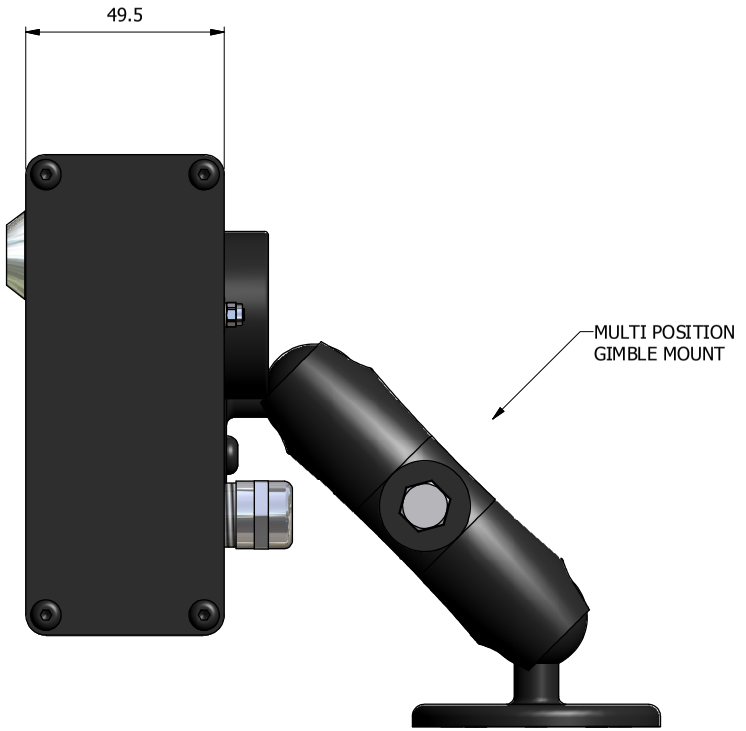
7.6.4. Cables

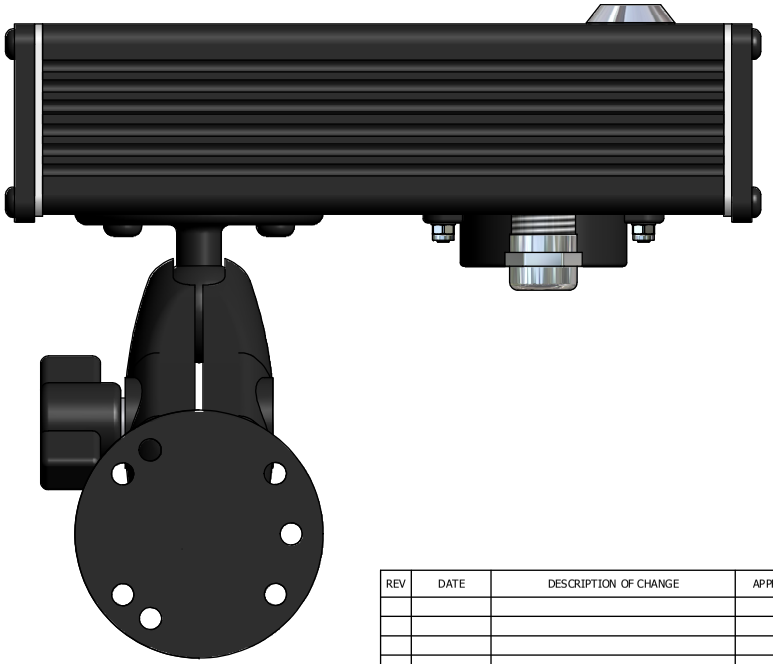
General:	2-, 4-, 6-, & 10-core braided, UV stabilised, PVC sheathed cables
DC Resistance:	38.2 ohms/km @ 20°C (25.45 ohms/km for 2-core cable)
Core Insulation:	V90-HT PVC (designed to comply to AS/NZ 3808:2000)
Electrical Life:	10^5 operations
Cable Integrity:	All cores tested for insulation resistance @ test voltage of 500V
Sheath:	Overall 5V90 UV stabilised PVC
Current Rating:	3 amps
Capacitance:	150 pf/m (core to core)

8. Drawings Part A - System Components

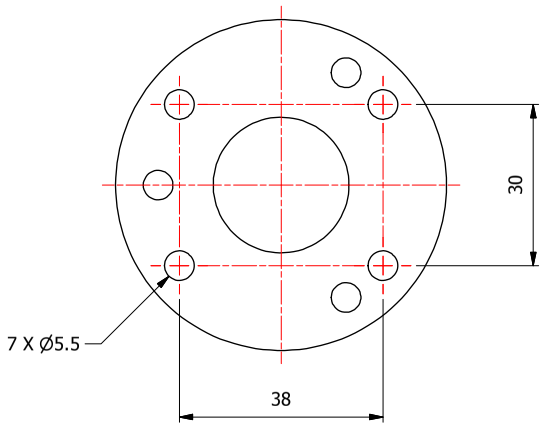
3RD ANGLE







MOUNTING HOLES FOR GIMBLE MOUNT



REV	DATE	DESCRIPTION OF CHANGE	APPRV'D

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

DRAFTING STANDARD: AS1100

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED

DRAWN BY	APPROVED BY	PART OF ASSY
S. CHAMBERS	J. KOVAL	-
7/09/2006	22/04/2007	

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PART No:	PROJECT:
DISRCI1512	RCI-1512 DISPLAY

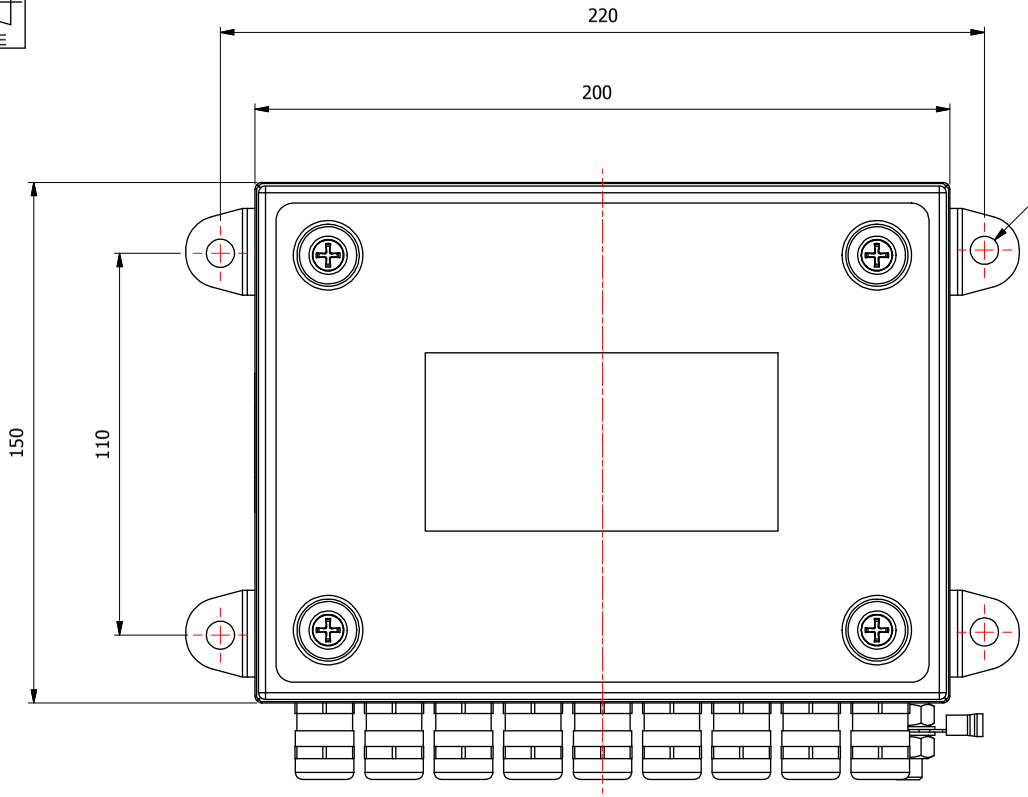
TITLE: DIMENSIONAL DETAIL

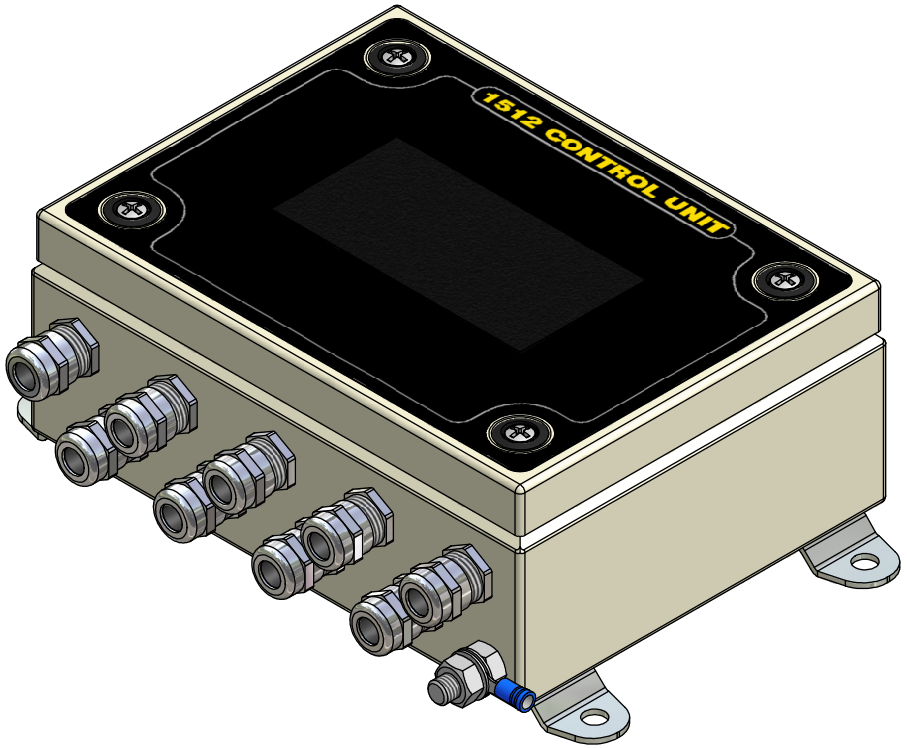
SCALE: N/A

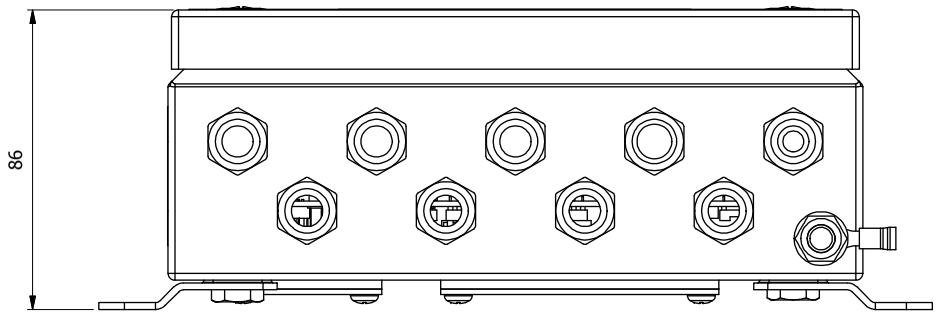
SHEET: 1 OF 1

DRAWING No:	FILE No:	REV
DWG 3454	345401AB.idw	1.1

3RD ANGLE







REV	DATE	DESCRIPTION OF CHANGE	APPRV'D

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

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7/09/2006	14/05/2007	

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PART No:	PROJECT:
CUSRCI1512	RCI-1512 CONTROL UNIT

TITLE: DIMENSIONAL DETAIL

SCALE: N/A

SHEET: 1 OF 1

DRAWING No:	FILE No:	REV
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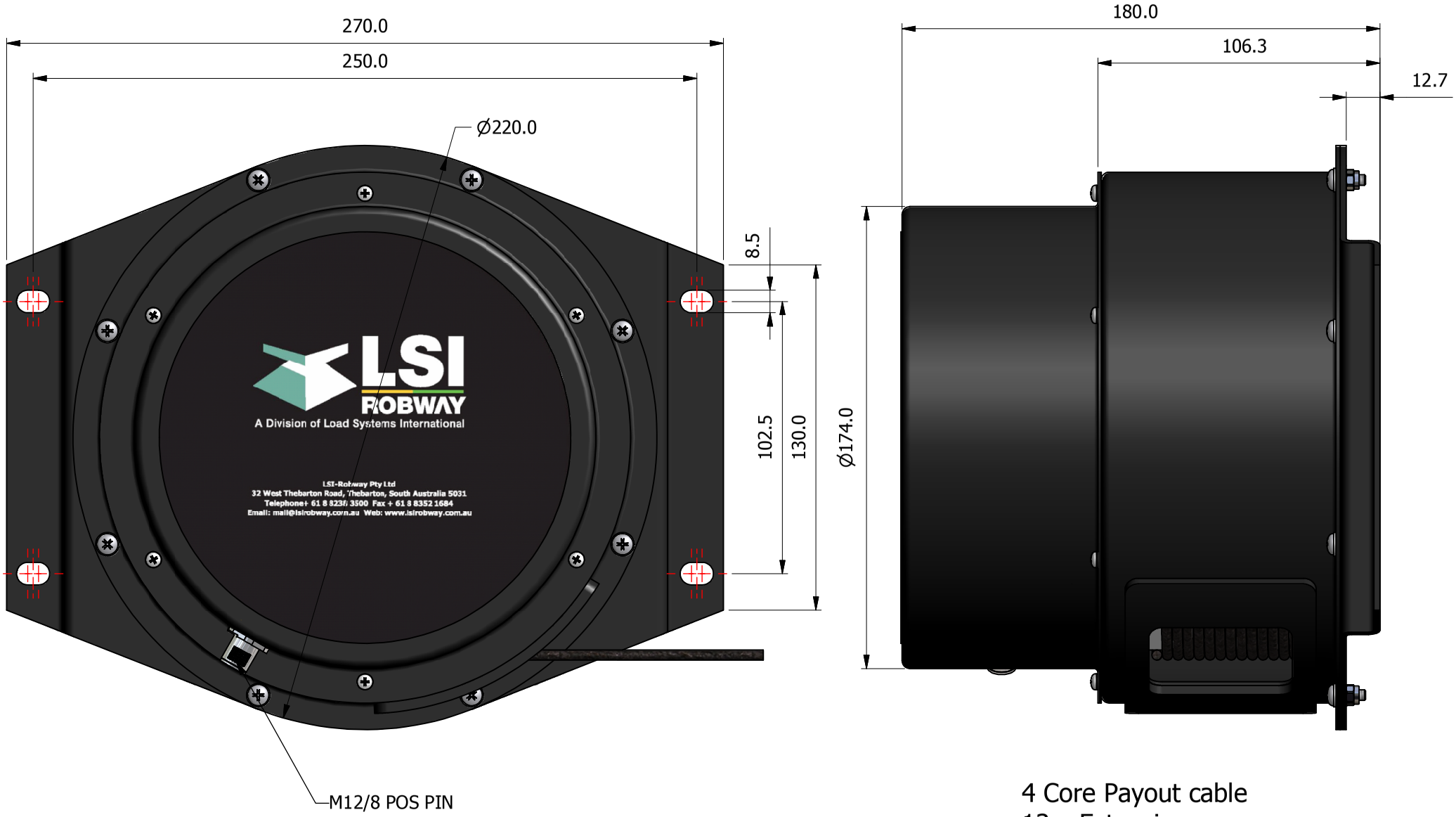

4 Core Payout cable
13m Extension

REV	DATE	DESCRIPTION OF CHANGE	APPRV'D

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

DRAFTING STANDARD: AS1100

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DRAWN BY	APPROVED BY	PART OF ASSY
J.Hart		
18/01/2012		

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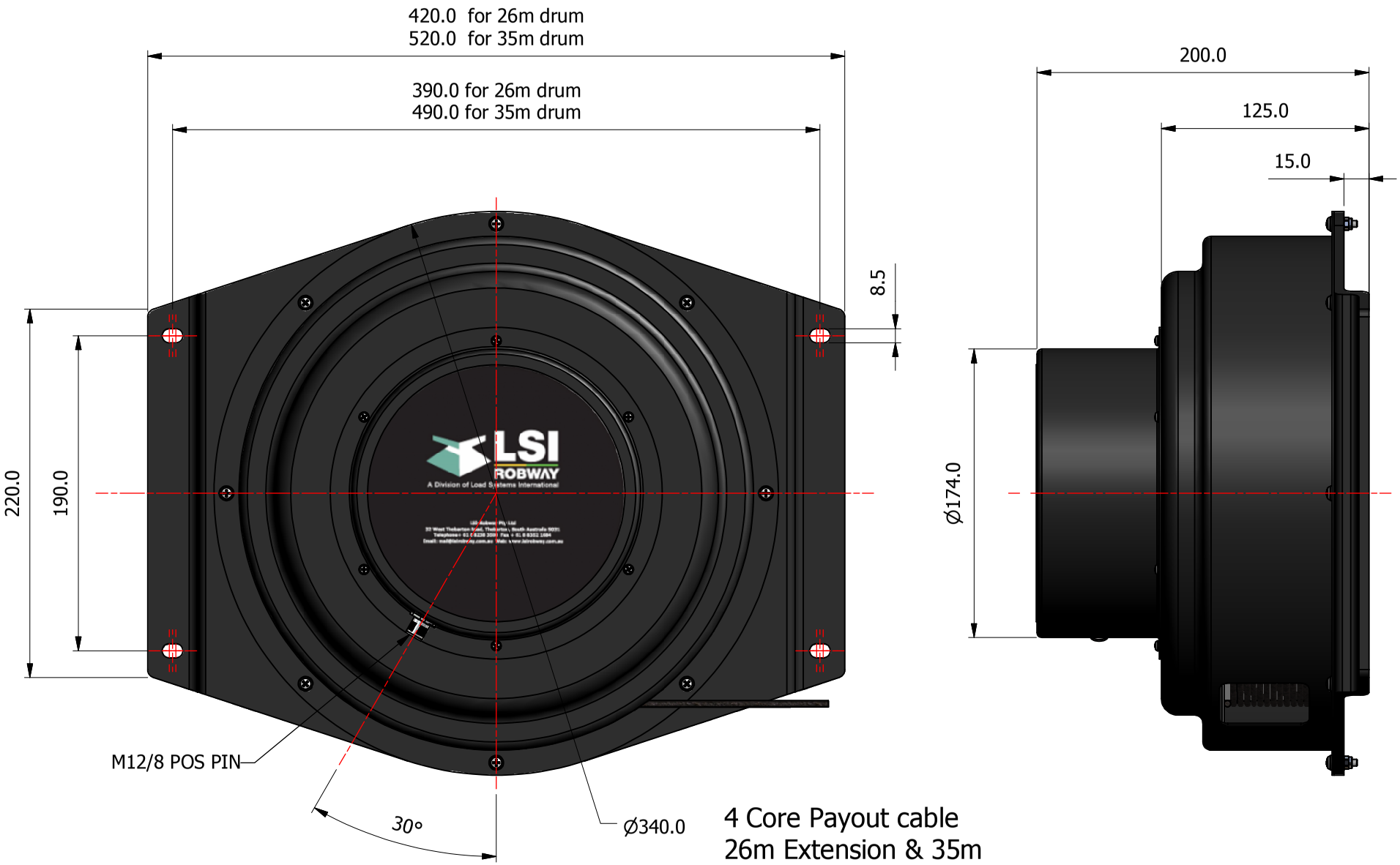
PART No: DRUKOR0413LAB
PROJECT:
TITLE: Overall Dimensions and Mounting Centers
A4
SHEET 1 OF 1
DRAWING No: 4576
FILE No: 457601AA.idw
REV 1.0



4 Core Payout cable
26m Extension & 35m Extension

DRUKOR0426LAB/DRUKOR0435LAB

REV	DATE	DESCRIPTION OF CHANGE	APPRV'D

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

DRAFTING STANDARD: AS1100

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DRAWN BY	APPROVED BY	PART OF ASSY
J.CHOI		
19/01/2012		

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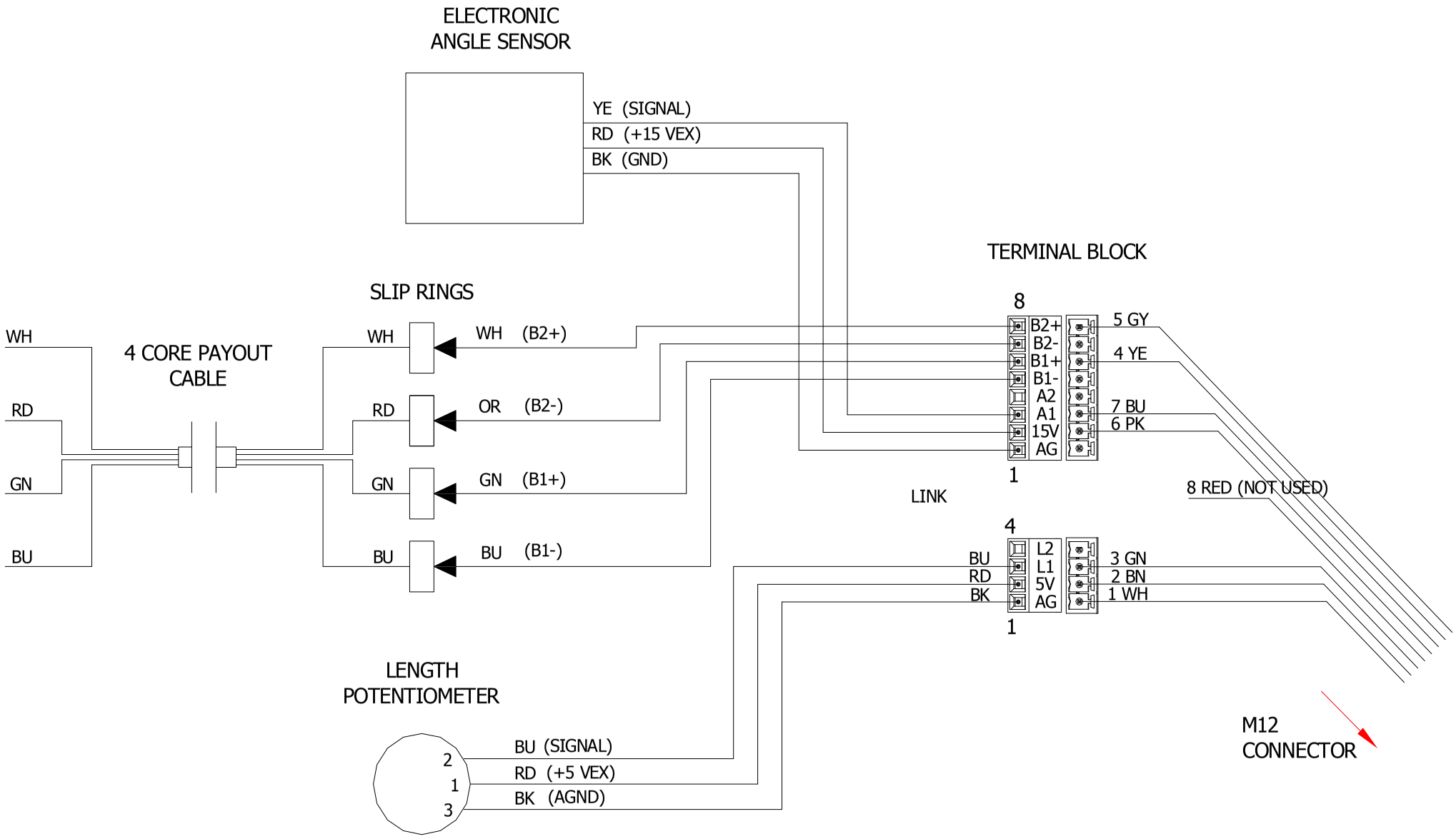
PART No:	PROJECT:	
-		
TITLE: OVERAL SIZE & MOUNTING DETAILS		A4
		SHEET 1 OF 1
DRAWING No: 4577	FILE No: 457701AA.idw	REV 1.0



REV	DATE	DESCRIPTION OF CHANGE	APPRV'D

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

DRAFTING STANDARD: AS1100

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED

DRAWN BY	APPROVED BY	PART OF ASSY
J.CHOI	J.HART	
20/01/2012	31/01/2012	

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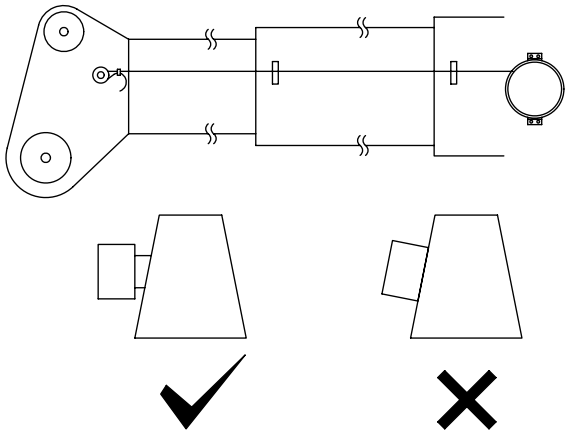
FAX: +61 8 8352 1684

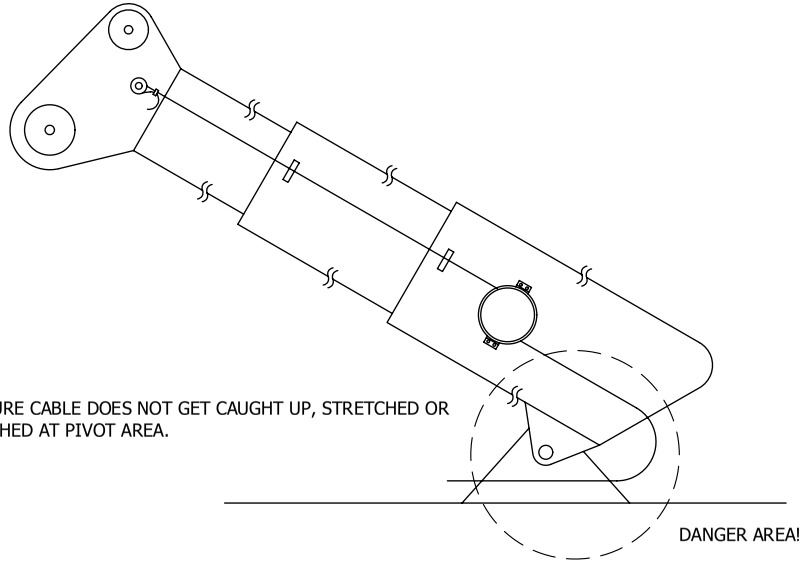
PART No: DRUKOR0426LAB
PROJECT: RECOUL DRUM
TITLE: TOP ASSY,26m RECOIL DRUM, LENGTH, ANGLE & 4 CORE PAYOUT CABLE
A4
SHEET 6 OF 6
DRAWING No: 4581
FILE No: 458101AA.idw
REV 1.0

STEP 1

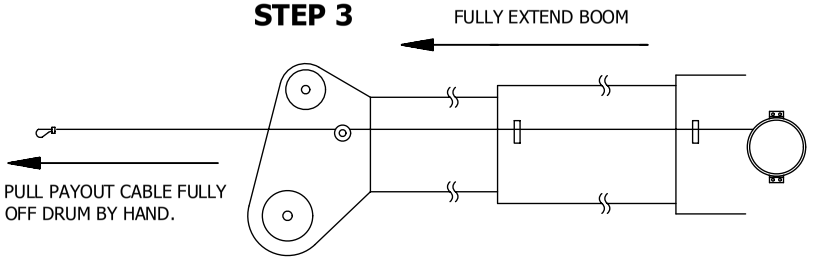


ENSURE THAT THE RECOIL DRUM IS MOUNTED VERTICALLY AND THAT THE DIRECTION THE CABLE IS PULLED OFF THE DRUM IS IN LINE WITH THE BOOM. IF IT COMES OFF AT AN ANGLE THERE IS RISK THAT IT WILL SLIP OFF THE SIDE OF THE DRUM.

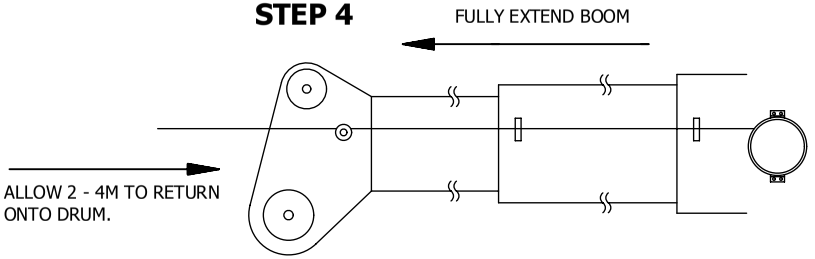
STEP 2



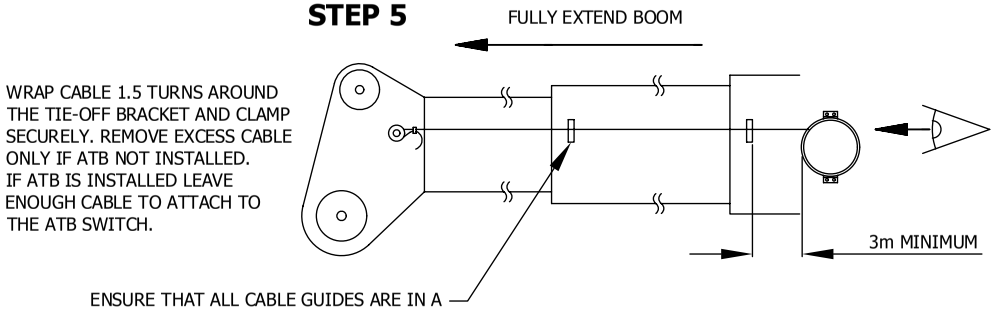
STEP 3



STEP 4



STEP 5



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
S. CHAMBERS	J. KOVAL
31/10/2007	1/11/07

PART OF ASSY
—

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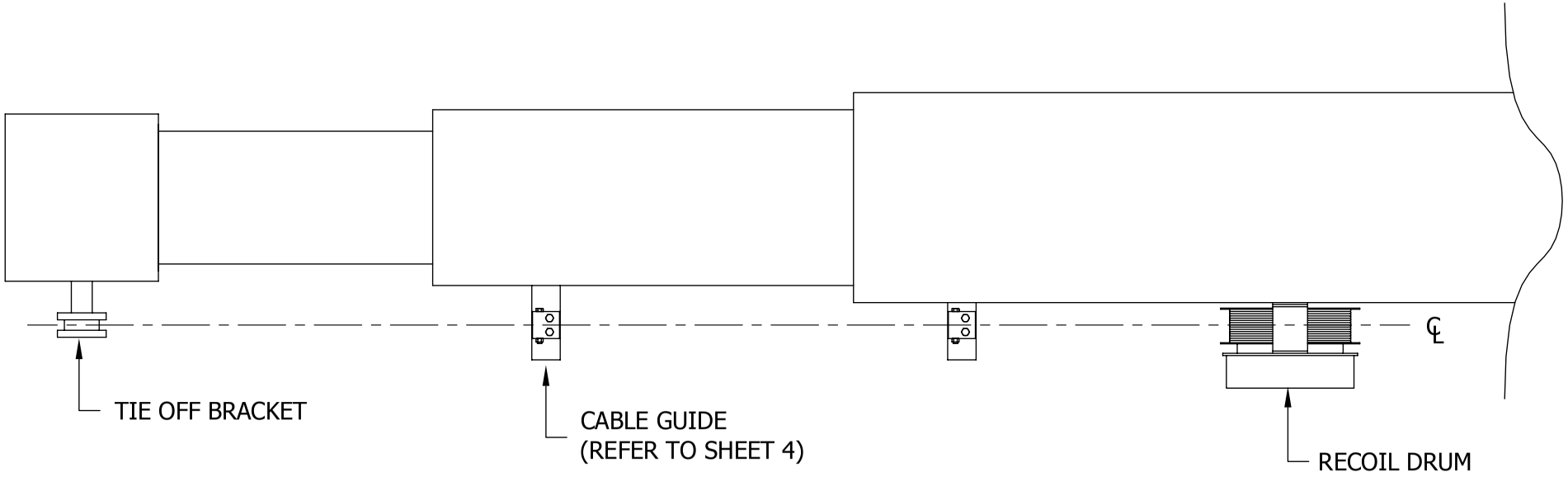
PART NO.:	PROJECT:
-	RECOIL DRUM

TITLE: INSTALLATION DETAILS

SCALE N/A

SHEET 1 OF 4

DRAWING No:	FILE No:	REV
DWG 3718	371801AA.DWG	1.0



NOTE:
TO ENSURE CABLE FLEETS EVENLY OVER DRUM WIDTH. THE CENTRE OF THE CABLE GUIDES MUST BE FITTED ON THE CENTRE LINE OF THE CABLE DRUM AS SHOWN.

WARNING:
IF THE ABOVE NOTE IS NOT SATISFIED, THE CABLE MAY OVER SPILL SIDES OF THE DRUM FLANGE.

REV	DATE	DESCRIPTION OF CHANGE	APPR'D

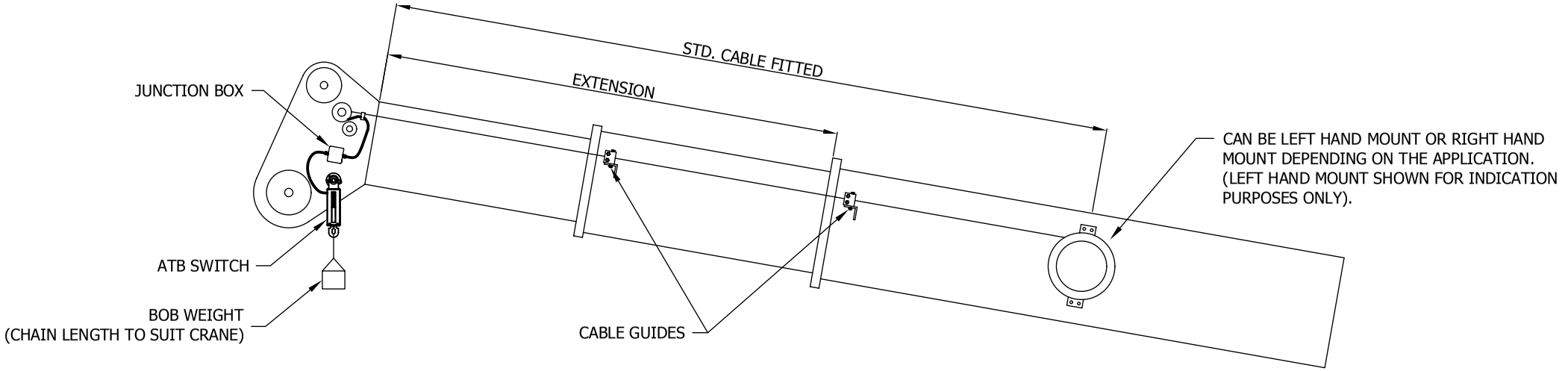
TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED

DRAFTING STANDARD: AS1100

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED

DRAWN	APPROVED	PART OF ASSY
S. CHAMBERS	J. KOVAL	—
31/10/2007	1/11/07	

PART NO.: -	PROJECT: RECOIL DRUM	
TITLE: INSTALLATION DETAILS		SCALE N/A
		SHEET 2 OF 4
DRAWING No: DWG 3718	FILE No: 371801AA.DWG	REV 1.0



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	PART OF ASSY
S. CHAMBERS	J. KOVAL	—
31/10/2007	1/11/07	

PART NO.: -

PROJECT: RECOIL DRUM

TITLE: INSTALLATION DETAILS

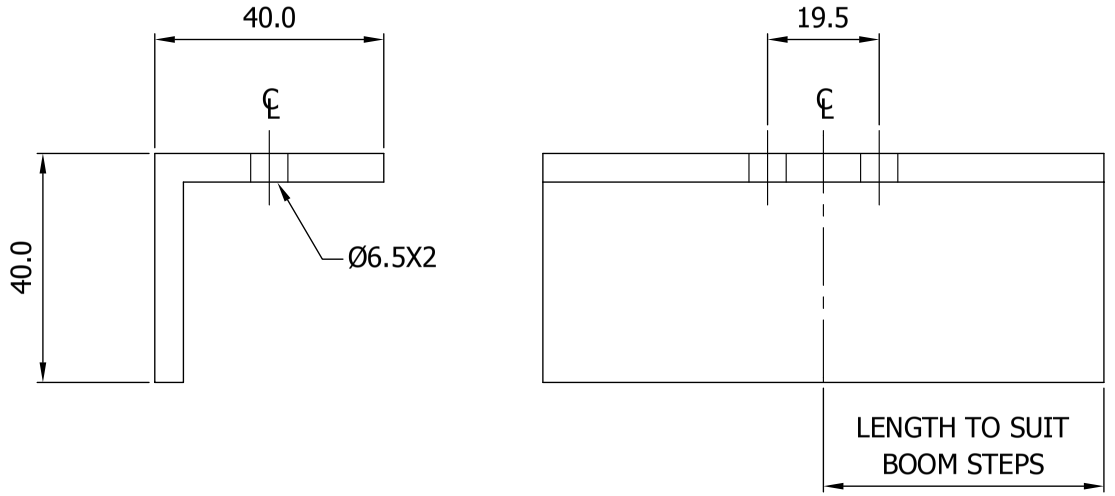
SCALE N/A

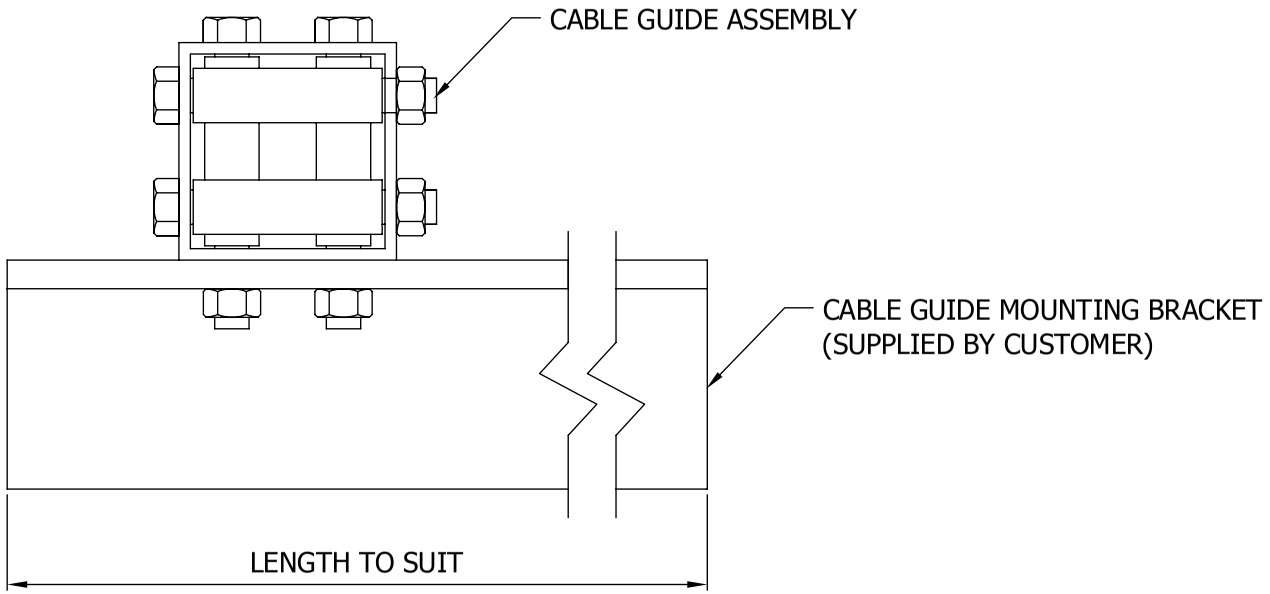
SHEET 3 OF 4

DRAWING No: DWG 3718

FILE No: 371801AA.DWG

REV 1.0





NOTES:

1. RECOMMENDED MATERIAL 40X40X5mm RIGHT ANGLED STEEL PLATE.
2. WELD THE MOUNTING BRACKET TO THE CRANE BOOM. ENSURING THAT THE LOCATION MEETS THE CRITERIA OUTLINED ON SHEET 2.
3. BOLT THE CABLE GUIDE ASSEMBLY TO THE MOUNTING BRACKET.

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
S. CHAMBERS	J. KOVAL
31/10/2007	1/11/07

PART OF ASSY
—

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PART NO.: -

PROJECT: RECOIL DRUM

TITLE: INSTALLATION DETAILS

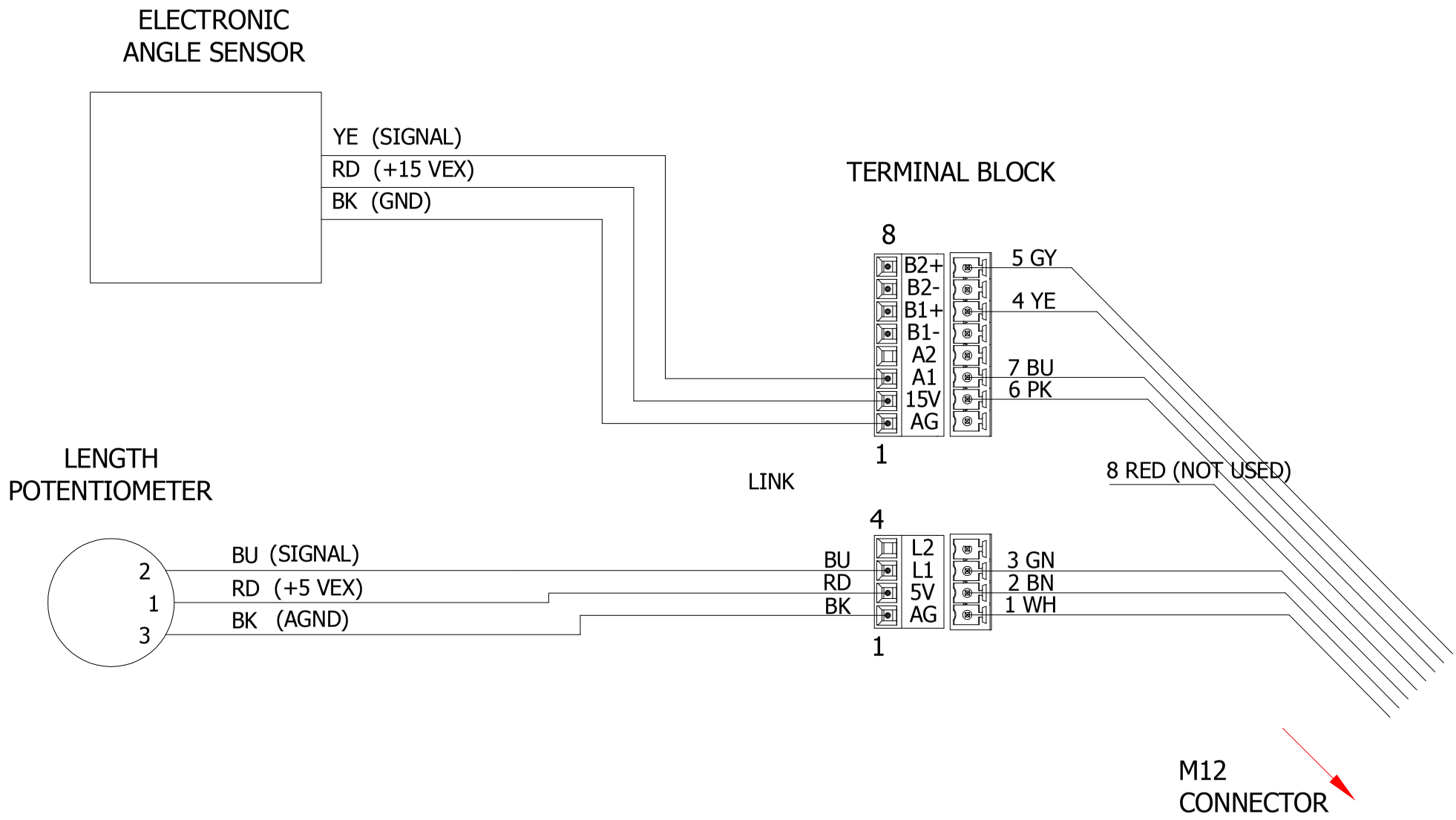
SCALE N/A

SHEET 4 OF 4

DRAWING No: DWG 3718

FILE No: 371801AA.DWG

REV 1.0



REV	DATE	DESCRIPTION OF CHANGE	APPRV'D

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

DRAFTING STANDARD: AS1100

DO NOT SCALE DRAWING
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UNLESS OTHERWISE STATED

DRAWN BY	APPROVED BY	PART OF ASSY
johnh		
24/01/2013		

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PART No: DRUKOR0113LA-1R

PROJECT:

TITLE: TOP ASSY, 13m RECOIL DRUM, LENGTH, ANGLE & SINGLE WIRE PAYOUT

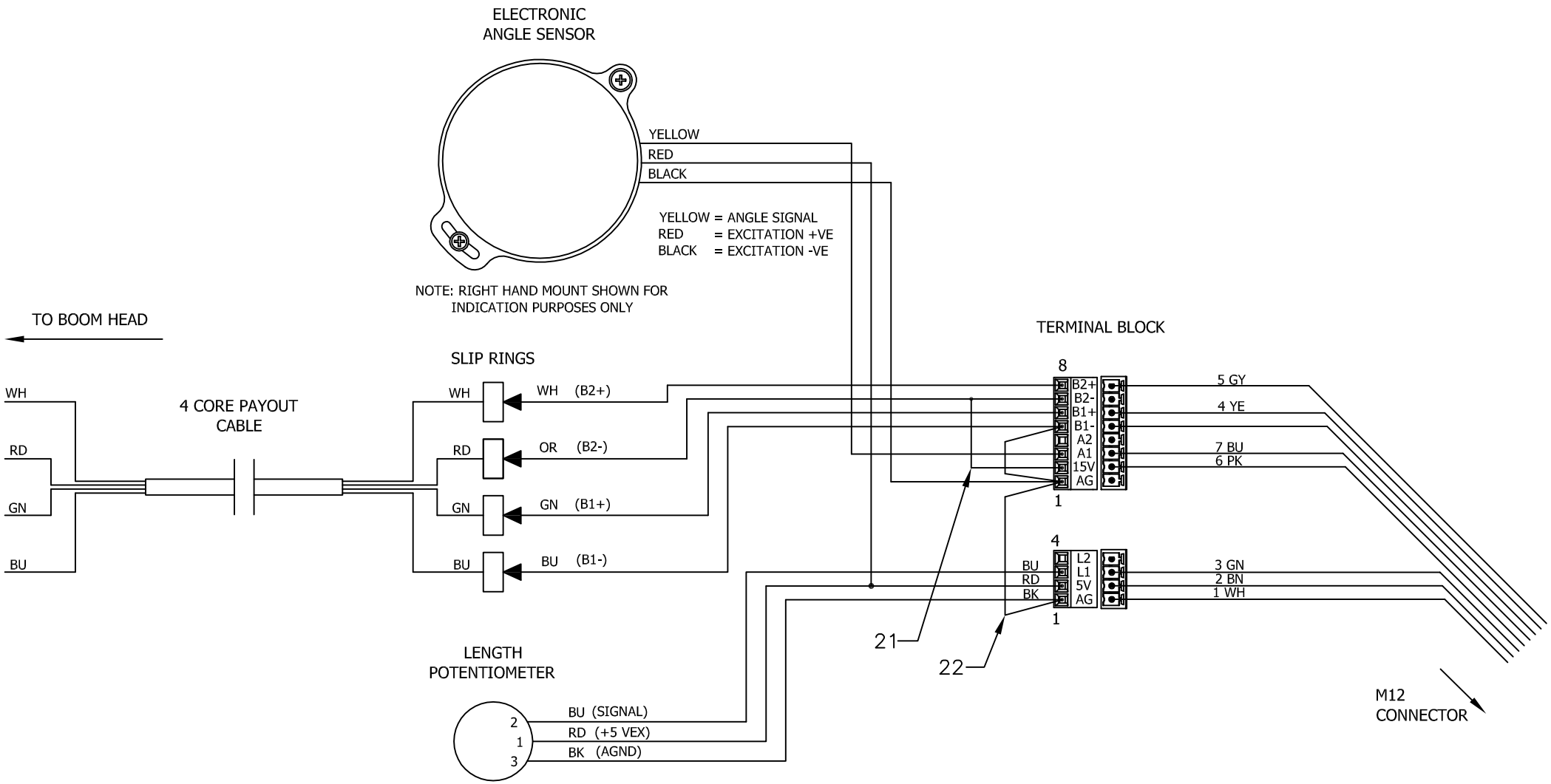
A4

SHEET 6 OF 6

DRAWING No: 4772

FILE No: 4772-A.idw

REV A



DRUKOR0413LAB-1
DRUKOR0426LAB-1
DRUKOR0430LAB-1

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	PART OF ASSY
j.hart	-	-
-	-	

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PART NO:	PROJECT:
	-

TITLE: WIRING DETAILS

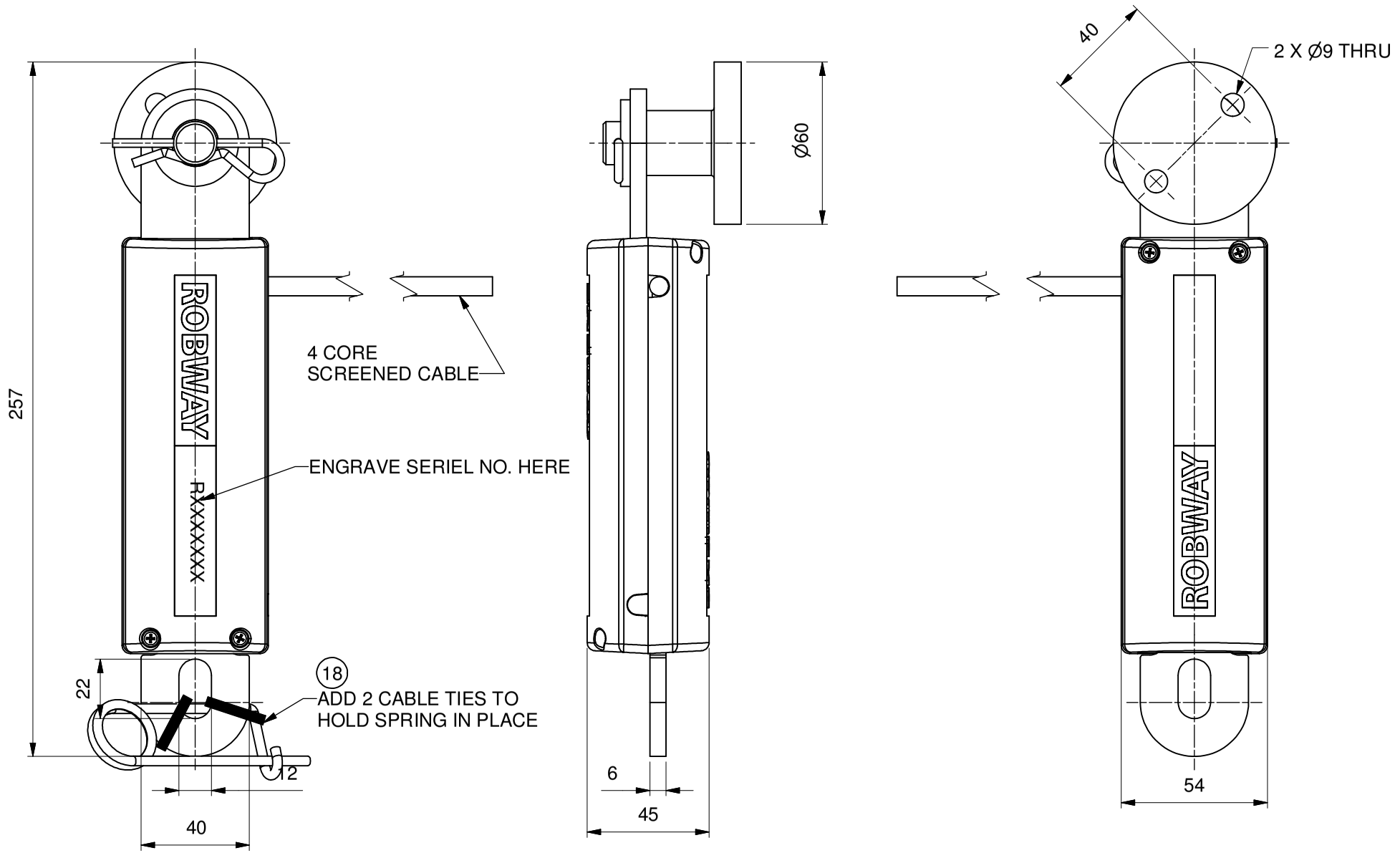
SCALE N/A

SHEET 1 OF 1

DRAWING No:	FILE No:	REV
4579	4579-B.DWG	B

3RD ANGLE

Parts List				
ITEM	QTY	DESCRIPTION	DWG No.	PART NUMBER
18	2	CABLE TIES		TIE200BK



REV	DATE	DESCRIPTION OF CHANGE	APPRV'D
1.1	16/07/10	EXPLORED VIEW ADDED REFER PCR#322	A.A.
1.2	14/01/2011	REFER TO PCR#366	A.A.
1.3	24-1-14	REFER TO ECN 543	J.H

TOL: X. +/-1
X.X +/-0.2
X.XX +/-0.02

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED

DRAWN BY	APPROVED BY	PART OF ASSY
S. CHAMBERS	A. CANLAS	-
19/04/2005	19/04/2005	

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FAX: +61 8 8352 1684

PART No:	PROJECT:
SWIBB5	BB5 ATB SWITCH

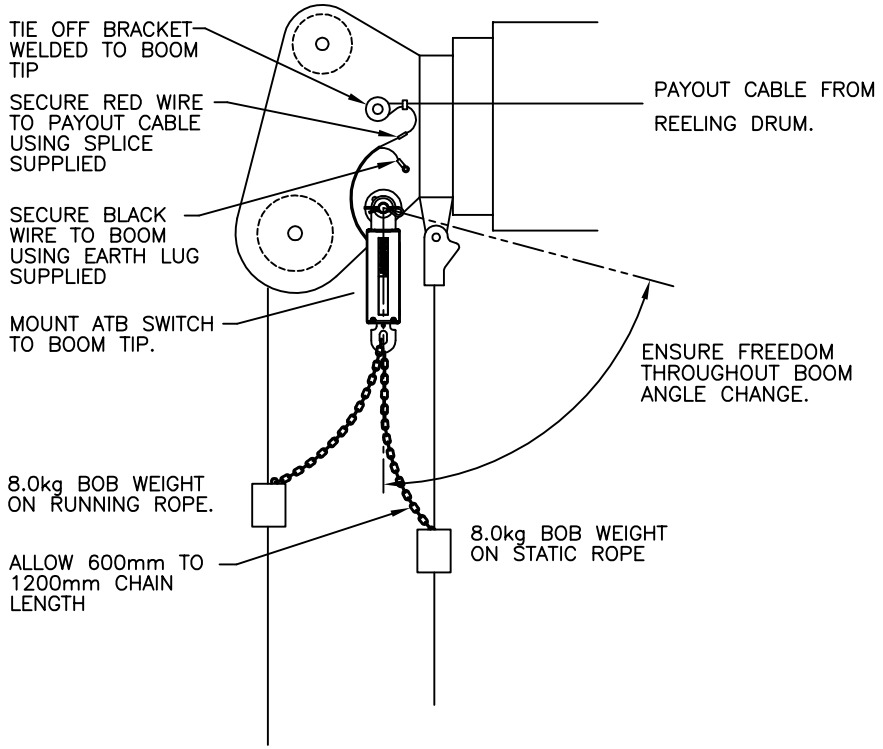
TITLE: ASSY, BB5 DIMENSIONAL DETAIL

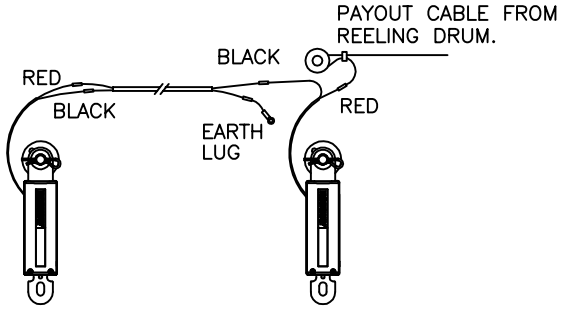
SCALE: N/A

SHEET: 1 OF 2

DRAWING No:	FILE No:	REV
2934	293401AD.idw	1.3

TELESCOPIC BOOM SINGLE CORE PAYOUT CABLE APPLICATION





ATB SWITCH CONNECTION FOR MAIN AND FLY

REV	DATE	DESCRIPTION OF CHANGE	APPR'D
1.1	03/08/05	REFER TO DR#421	A.C.

TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED

DRAWN	APPROVED	PART OF ASSY
S. CHAMBERS	A. CANLAS	—
10/07/01	10/07/01	

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PART No:	PROJECT:
—	—

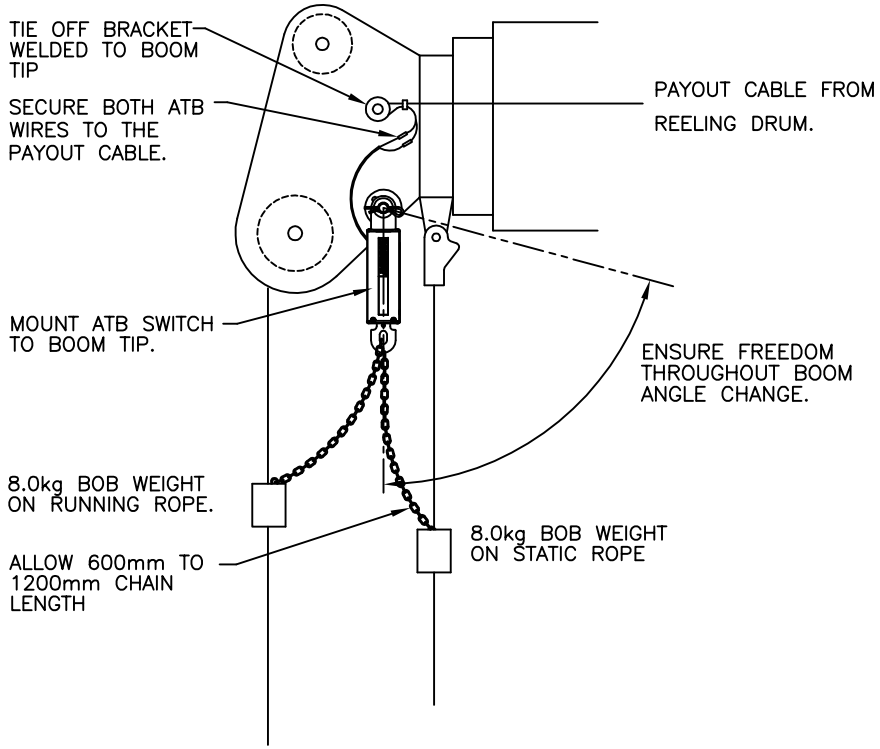
TITLE: ATB SWITCH INSTALLATION DETAILS

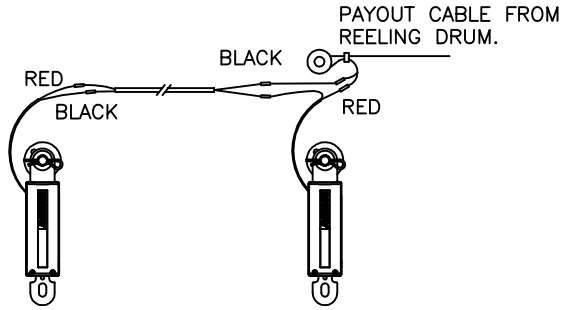
SCALE N/A

SHEET 1 OF 3

DRAWING No:	FILE No:	REV
DWG 0667	066701AB.DWG	1.1

TELESCOPIC BOOM TWO CORE PAYOUT CABLE APPLICATION





ATB SWITCH CONNECTION FOR MAIN AND FLY

REV	DATE	DESCRIPTION OF CHANGE	APPR'D
1.1	03/08/05	REFER TO DR#421	A.C.

TOL: X. +/- 1
X.X +/- 0.2
X.XX AS STATED

DO NOT SCALE DRAWING
ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS OTHERWISE STATED

DRAWN	APPROVED	PART OF ASSY
S. CHAMBERS	A. CANLAS	—
10/07/01	10/07/01	

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FAX +61 8 8352 1684

PART No:	PROJECT:
—	—

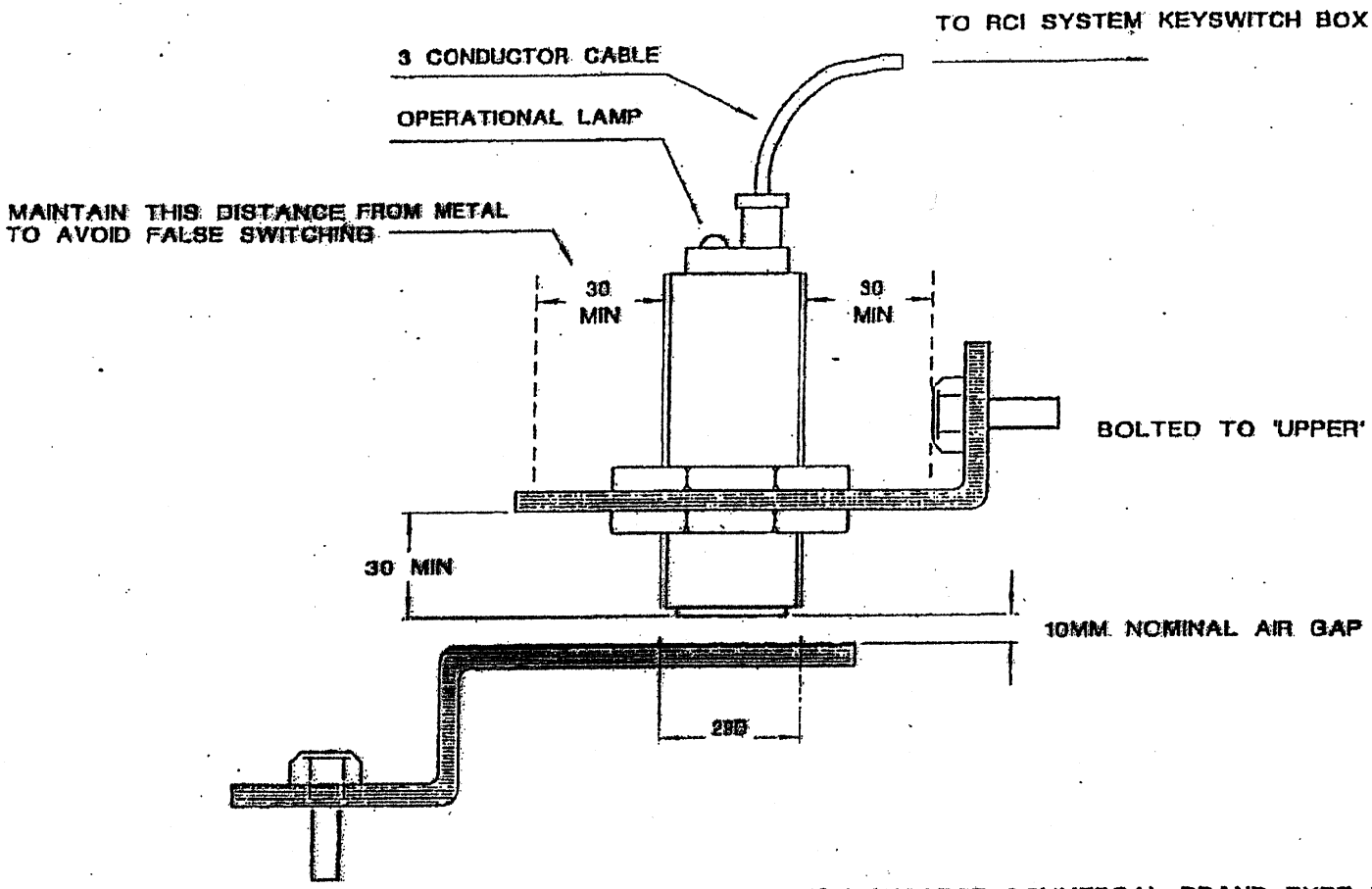
TITLE: ATB SWITCH INSTALLATION DETAILS

SCALE N/A

SHEET 2 OF 3

DRAWING No:	FILE No:	REV
DWG 0667	066701AB.DWG	1.1

RCI SLEW SWITCH MOUNTING (WHERE REQUIRED)



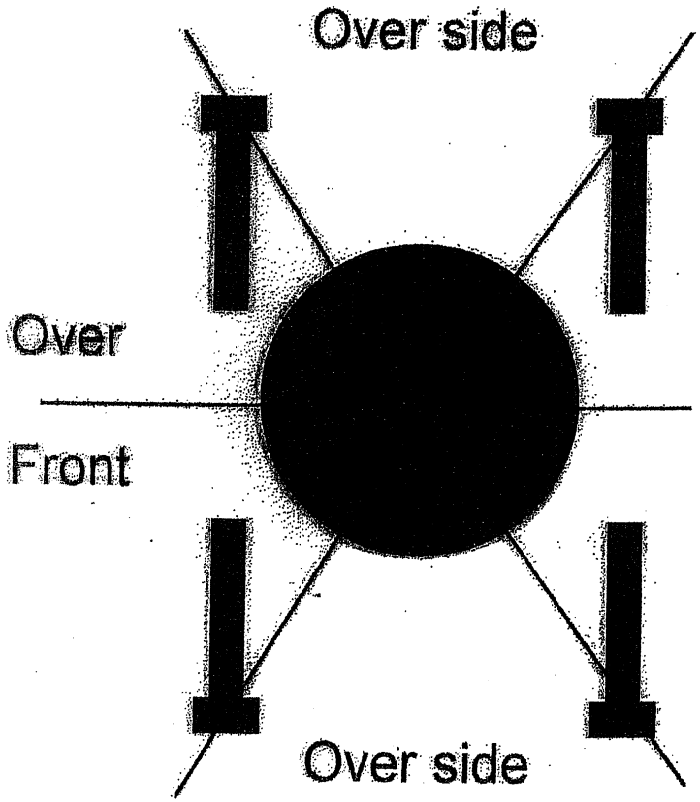
NOTE 1 SUGGEST SCHMERSAL BRAND TYPE IFL 10-30-10ZTPKG

NOTE 1 PROXIMITY SWITCH MAY BE MOUNTED HORIZONTAL

DRAWN: IAW	CHECKED:	DATE: 9.11.93
CUSTOMER: RCI MANUALS		FAB/ASSY/INFO
RCI SLEW SWITCH MOUNTING		
		DWG: 930050
FILE No: 930050		REV No:

ROBWAY SAFETY SYSTEMS P/L

Typical Slew/Proximity Switch Application



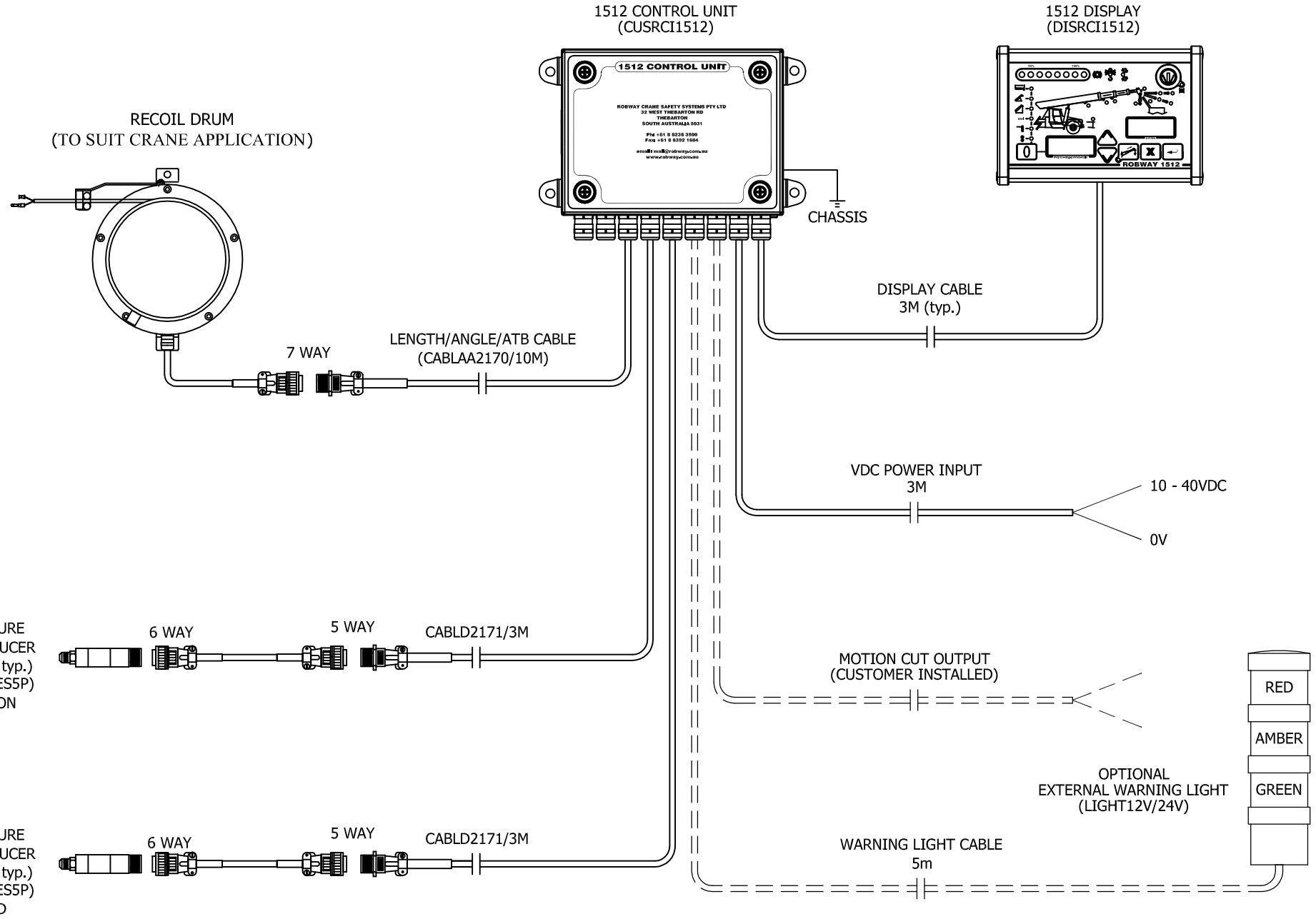
Switch 1 — opens when over-front

Switch 2 — opens when over-side

Therefore a truth table is;

sw1	sw2	condition
c	c	over-rear
c	o	over-side
o	o	over-front
broken cables		over-front, least capacity.

9. Dp_ugleq N_pr @+ Qwqrck Amknmlclrq



REV	DATE	DESCRIPTION OF CHANGE	APPR'D
1.1	11/05/07	UPDATE APPLICATION DETAIL	S.C
1.2	24/10/2008	REFER TO PCR#146	S.C
1.3	8/11/2010	REPLACED LIGHTEXT12/24	-
1.4	08/02/2011	REFER TO PCR#378	L.L.

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	PART OF ASSY
S.CHAMBERS	S.CHAMBERS	—
09/02/07	09/02/07	

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PART NO.:	PROJECT:
-	-

TITLE: RCI-1512 GENERAL ARRANGEENT FOR TYPICAL TELESCOPIC BOOM HYDRAULIC LOAD MOMENT SYSTEM

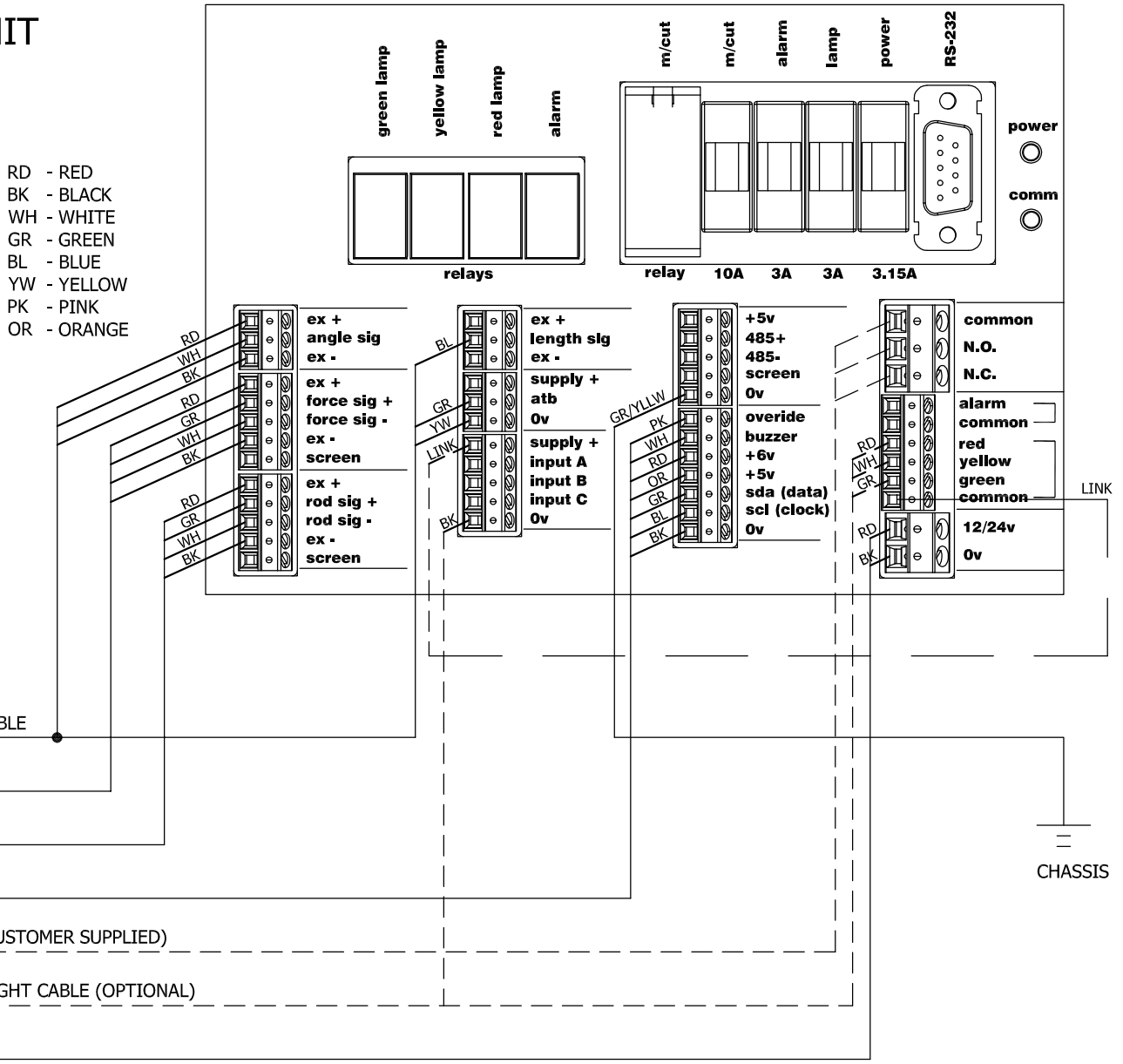
SCALE N/A

SHEET 1 OF 2

DRAWING No:	FILE No:	REV
3558	355801AE.DWG	1.4

RCI-1512 CONTROL UNIT WIRING DETAIL

INTERNAL VIEW



NOTE:
WARNING LIGHT WIRING
USED FOR ROBWAY SUPPLIED
PATLITE ONLY

REV	DATE	DESCRIPTION OF CHANGE	APPR'D
1.1	11/05/07	UPDATE APPLICATION DETAIL	S.C
1.2	24/10/2008	REFER TO PCR#146	S.C
1.3	8/11/2010	REPLACED LIGHTEXT12/24	-
1.4	08/02/2011	REFER TO PCR#378	L.L.

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	PART OF ASSY
S.CHAMBERS	S.CHAMBERS	—
09/02/07	09/02/07	

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SOUTH AUSTRALIA 5031
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PH: +61 8 8238 3500
FX: +61 8 8352 1684

PART NO.:	PROJECT:
-	-

TITLE: RCI-1512 GENERAL ARRANGEENT FOR TYPICAL TELESCOPIC BOOM HYDRAULIC LOAD MOMENT SYSTEM

SCALE N/A

SHEET 2 OF 2

DRAWING No:	FILE No:	REV
3558	355801AE.DWG	1.4