



**SDI-12 Band Dendrometer Manual**  
**(DBS60)**

# Contents

<b>1. Introduction</b>	<b>3</b>
<b>2. DBS60 Specifications</b>	<b>4</b>
2.1 Electrical and Mechanical Specifications	4
2.2 Wiring Diagram	4
<b>3. DBS60 SDI-12 Interface Specification Configuration</b>	<b>5</b>
3.1 Configuration Commands & Returns	5
3.1.1 <i>Measurement Command – aM!</i>	5
3.1.2 <i>Measurement Command with CRC – aMC!</i>	5
3.1.3 <i>Concurrent Measurement – aC!</i>	6
3.1.4 <i>Concurrent Measurement with CRC – aCC!</i>	6
3.1.5 <i>Data command – aDO!</i>	6
3.1.6 <i>Change Address – aAb!</i>	7
3.1.7 <i>Address Query Command – ?!</i>	7
3.1.8 <i>Verification Command – aV!</i>	7
3.1.9 <i>Acknowledge Active – a!</i>	8
<b>4. DBS60 Installation</b>	<b>8</b>
4.1 Installation Process	8
4.1.2 <i>Fold One End &amp; Place</i>	8
4.1.3 <i>Wrap Band Around Tree</i>	8
4.1.4 <i>Insert Tape</i>	9
4.1.5 <i>Turn The Head</i>	9
4.1.6 <i>And Fold</i>	9
4.1.7 <i>Allow For Proper Tension</i>	9
4.1.8 <i>Record The Circumference at Installation</i>	9
4.2 Installation Diagram For Guiding The Stainless Steel Band	10
4.3 Maintenance	10

# 1. Introduction

The DBS60 is a Dendrometer Increment Sensor designed for long-term monitoring of stem growth.

A stainless steel tape is used to encircle the tree trunk combined with a rotary position sensor and because no invasive fixing parts are required, no damage is caused to the tree. The DBS60 is designed for long-term environmental use, is housed in UV resistant plastic and is watertight. All metal parts are made from stainless steel and anodised aluminium. The stainless steel band has a linear thermal co-efficient of  $17.3 \times 10^{-6}$  per °C; thermal variations caused by daily or seasonal changes in temperature have no measurable impact on the operation of the DBS60.

Measurement results for both trunk increments and temperature are provided in SDI-12 (V1.3) format.



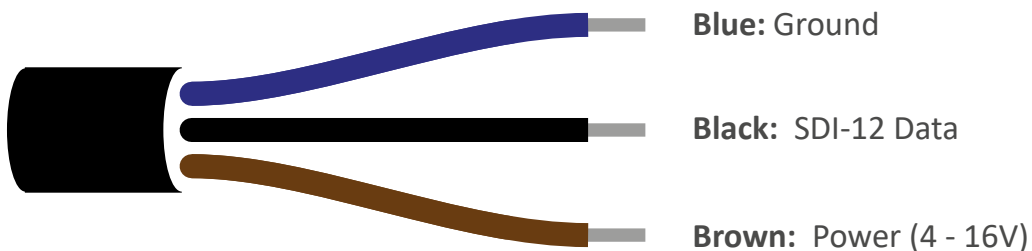
## 2. DBS60 Specifications

---

### 2.1 Electrical and Mechanical Specifications

<b>Increment Sensor Type</b>	Rotary
<b>Range</b>	64mm Circumference
<b>Linearity</b>	2% of full scale
<b>Resolution</b>	1 $\mu\text{m}$
<b>Tape Strength</b>	15 to 20 N in the whole range
<b>Sensor Dimensions Size</b>	<b>Sensor Size:</b> 100x70x100mm <b>Sensor Weight (Including Battery):</b> Approx. 300gms
<b>Operating Range</b>	<b>Temperature:</b> -30 to 60°C <b>Humidity:</b> 0 – 100%
<b>Temperature Sensor Accuracy</b>	$\pm 2$ °C

### 2.2 Wiring Diagram



## 3. DBS60 SDI-12 Interface Specification Configuration

### 3.1 Configuration Commands & Returns

The DBS60 SDI sensor is compatible with SDI-12 version 1.3 as described in the documents on <http://sdi-12.org/archives.php>, except for continuous measurements (aR0 - aR9 or aRC0 - aRC9). The following tables list the relevant Measurement (M), Concurrent (C) and Data (D) commands, when necessary.

The first character of all commands and responses is always a device address. The last character of a command is the “!” character, which terminates each command. After a command is processed and/or the information is returned by the sensor, the sensor signals the response is complete by returning with <CR> <LF>. These last two bytes of a response are a carriage return and line feed.

#### 3.1.1 Measurement Command – aM!

**Example Command Input:** 1M!

**Example Response:** 10012

Parameter	Fixed Character Length	Response Order	Description
1M!	1		Request for sensor measurement (m) at address (a) 1
1	1	1	Returns sensor address (Example: 1)
001	3	2	Returns length of time (in seconds) after which the measured data will be available. If data is available earlier, the sensor sends the address terminated by the <CR> <LF> - service request.
2	1	3	Returns number of variables (Example: 2)

#### 3.1.2 Measurement Command with CRC – aMC!

**Example Command Input:** 1MC!

**Example Response:** 10012

Parameter	Fixed Character Length	Response Order	Description
1MC!	4		Request for sensor measurement at address (a) 1 with CRC data control
1	1	1	Returns sensor address (Example: 1)
001	3	2	Returns length of time (in seconds) after which the measured data will be available. If data is available earlier, the sensor sends the address terminated by the <CR> <LF> - service request.
2	1	3	Returns number of variables (Example: 2)

### 3.1.3 Concurrent Measurement – aC!

**Example Command Input:** 1C!

**Example Response:** 100102

Parameter	Fixed Character Length	Response Order	Description
1C!	3		Request for sensor measurement at address (a) 1
1	1	1	Returns sensor address (Example: 1)
001	3	2	Returns length of time (in seconds) after which the measured data will be available (Example: 1 second)
02	2	3	Returns number of variables (Example: 2)

### 3.1.4 Concurrent Measurement with CRC – aCC!

**Example Command Input:** 1CC!

**Example Response:** 100102

Parameter	Fixed Character Length	Response Order	Description
1CC!	4		Request for sensor measurement at address (a) 1 with CRC data control
1	1	1	Returns sensor address (Example: 1)
001	3	2	Returns length of time (in seconds) after which the measured data will be available (Example: 1 second)
02	2	3	Returns number of variables (Example: 2)

### 3.1.5 Data command – aD0!

**Example Command Input:** 1D0!

**Example Response:** 1+25.256+20.233

Parameter	Fixed Character Length	Response Order	Description
1D0!	1		Request for sensor data (D) at address (a) 1
1	1	1	Returns sensor address (Example: 1)
+25.256	Variable	2	Returns value of circumference [mm]
+20.233	Variable	3	Returns temperature in °C
XYZ	3	4	16-bit CRC - added only if aMC! or aCC! commands were requested for the measurement

### 3.1.6 Change Address – aAb!

**Example Command Input:** 1A2!

**Example Response:** 2

Parameter	Fixed Character Length	Description
1A2!	4	Request to change the sensor address (a) from 1 to a new address of 2
2	1	Responds with the new sensor address. For all subsequent commands, this new address will be used by the target sensor.

### 3.1.7 Address Query Command – ?!

**Example Command Input:** ?!

**Example Response:** 2

**Command ?!:** Be careful - there must be only one sensor on the line! While disconnected from a bus, the Address Query command can be used to determine which sensor is currently being communicated with. Sending this command over a bus will cause a bus contention where all the sensors will respond simultaneously and corrupt the data line. This command is helpful when trying to isolate a failed sensor.

Parameter	Fixed Character Length	Description
?!	2	Retrieving the sensor address. Request for a response from any sensor listening on the data line.
2	1	Responds with attached sensor's address (Example: 2)

### 3.1.8 Verification Command – aV!

**Example Command Input:** 1V!

**Example Response:** 10012

Parameter	Fixed Character Length	Response Order	Description
1V!	3		Request sensor measurement at address (a) 1
1	1	1	Returns sensor address (Example: 1)
001	3	2	Returns length of time (in seconds) after which the measured data will be available (Example: 1 second)
2	1	3	Returns number of variables (Example: 2)

### 3.1.9 Acknowledge Active – a!

**Example Command Input:** 2!

**Example Response:** 2

Parameter	Fixed Character Length	Description
2!	2	Request to check the sensor connection
2	1	Responds with sensor address to confirm connection (Example: 2)

## 4. DBS60 Installation

### 4.1 Installation Process

The DBS60 unit is fixed to the tree trunk with the 12 mm wide stainless steel band (also known as tape). The tape will be cut from the provided spool containing 15 metres of tape.

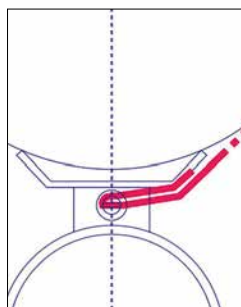
#### 4.1.1 Prepare The Stainless Steel Band

Cut a piece of the provided stainless steel tape 25cm longer than the stem or tree circumference. Be careful to avoid the crumpling of the tape during the entire installation process!



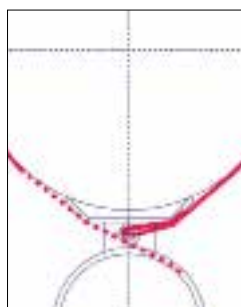
#### 4.1.2 Fold One End & Place

Fold one end of the tape and place on the central pin. Ensure the shorter part is facing the stem/tree trunk.



#### 4.1.3 Wrap Band Around Tree

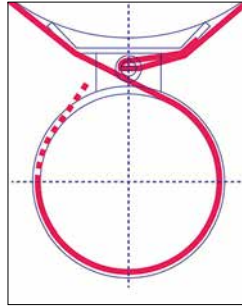
Without crumpling the tape, carefully wrap the tape around the stem/tree and then wrap it around the coil.





#### 4.1.4 Insert Tape

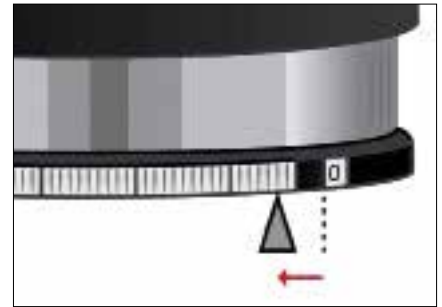
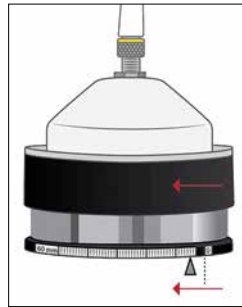
Insert the tape below the binder bar and carefully feed the tape through. Then carefully pull the tape to tension it around the stem/tree circumference. The tape has to remain under tension to accurately detect changes.



#### 4.1.5 Turn The Head

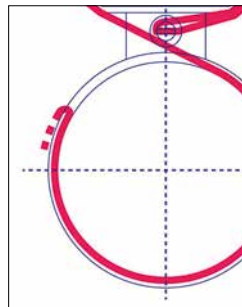
The sensor head naturally snaps to zero.

Turn the head counter clockwise in order to get the sensor triangle position to be at least 5mm away from the mark 0 on the 0-to-60mm scale. This is will be the scale position.



#### 4.1.6 And Fold

With the tape under tension around the tree/stem and the head held at the recommended scale position, fold the tape over the bar to secure everything in place.



#### 4.1.7 Allow For Proper Tension

Double-check the scale position (where the sensor's triangle points to) is greater than 5mm from the 0 mark, as recommended. This scale position will be your offset value in the calculation of absolute circumference, when the first measurement is taken.



#### 4.1.8 Record The Circumference at Installation

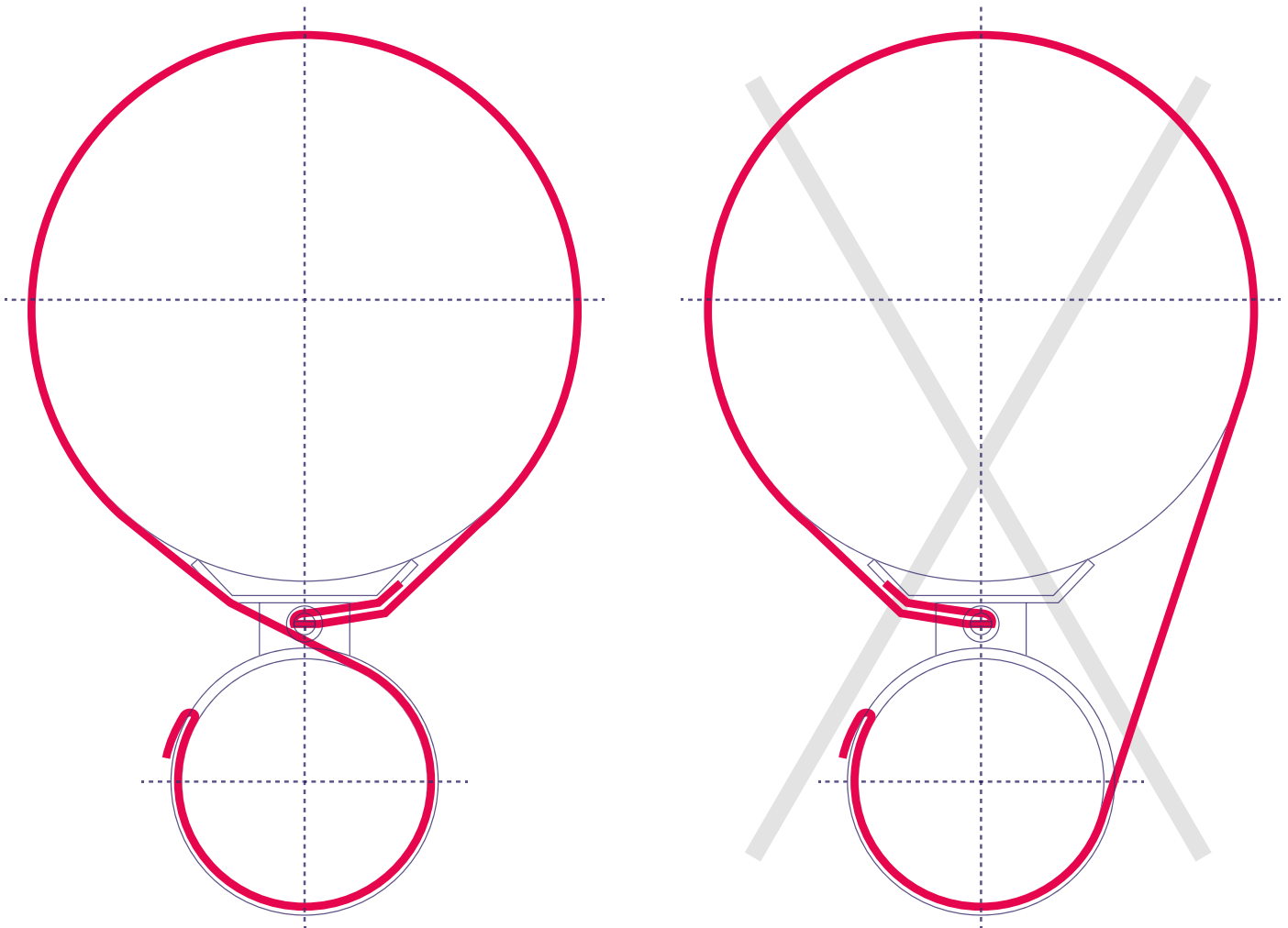
Make sure you physically measure and accurately record the stem/tree circumference at the place and time of installation. This reference point will factor into the calculations so the changes detected will provide absolute measurements.

## 4. DBS60 Installation

---

### 4.2 Installation Diagram For Guiding The Stainless Steel Band

The DBS60 SDI sensor must be installed correctly. Please refer to the diagrams below showing the difference between a correct installation (left) and an incorrect installation (right). Please note the details of leading and folding the tape.



### 4.3 Maintenance

DBS60 unit does not need any special maintenance. Avoid shifting the sensor during operation.

# Warranty & Service Terms

---

## What is Covered

All products manufactured by ICT International are warranted to be free from defects in materials and craftsmanship for a period of one (1) years from the date of shipment from our factory. To be considered for warranty coverage an item must be evaluated either at our factory or by an authorized distributor.

## What is Not Covered

The customer is responsible for all costs associated with the removal, re-installation, and shipping of suspected warranty items to our factory. The warranty does not cover equipment that has been damaged due to the following conditions:

1. Improper use or abuse.
2. Operation of the instrument outside of its specified operating range.
3. Natural occurrences such as lightning, fire etc.
4. Unauthorized modification.
5. Improper or unauthorized repair.

## Who is Covered

This warranty covers the original purchaser of the product or other party who may own it during the warranty period.

## What We Will Do

At no charge we will:

1. Either repair or replace (at our discretion) the item under warranty.
2. Ship the item back to the customer by the carrier of our choice. Different or expedited shipping methods will be at the customer's expense.

## How To Return An Item

1. Please do not send any products back to ICT International until you have filled out an online RMA (Return Merchandise Authorization) and have been advised to return the item by our service team. The form can be found at <http://www.ictinternational.com/support/rma-form/>.

We will use your RMA number for tracking of the service item.

2. Send all RMA sensors and meters back in the following condition: Clean the instruments exterior. Do not modify the sensors or wires, including splicing, cutting wire leads etc.

3. Please write the RMA number on the outside of the shipping container.

4. Return the item with freight pre-paid and fully insured to our factory address shown below. We are not responsible for any costs associated with the transportation of products across international borders.

5. Upon receipt, ICT International will determine the cause of failure. If the product is found to be defective in terms of operation to the published specifications due to a failure of product materials or craftsmanship, ICT International will repair or replace the items free of charge.

## Repairs / Replacement

If it is determined that your product is not covered under warranty, you will be informed and given an estimated repair/replacement cost. The available remedy of defects under this warranty is for the repair or replacement of the original product, and ICT International is not responsible for any direct, indirect, incidental, or consequential damages, including but not limited to loss of income, loss of revenue, loss of profit, loss of wages, loss of time, loss of sales, accrument of debts or expenses, injury to personal property, or injury to any person or any other type of damage or loss.

Ict International, Pty Ltd  
211 Mann St.  
Armidale NSW 2350  
Australia

[www.ictinternational.com.au](http://www.ictinternational.com.au)



*Enabling better global research outcomes in soil,  
plant & environmental monitoring.*