

*External Sensors with*  
**MC-V Asset Surveyor™**

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External Sensors with MC-V Asset Surveyor

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## Overview of this Manual




- Chapter 1* *Introduction* introduces the ESP and laser range-finder capabilities of Trimble's Asset Surveyor software.
- Chapter 2* *Connections* describes how to physically connect an external sensor or laser range-finder to your Asset Surveyor system.
- Chapter 3* *External Sensors* describes how to interface an external sensor to Asset Surveyor. Examples are provided to assist you with the configuration and use of your particular sensor.
- Chapter 4* *Laser Range-finders* describes how to interface one of the range of supported laser range-finders to Asset Surveyor, for the purpose of automatically capturing feature offsets.

## How to Use this Manual

Please read the main *Datalogging with MC-V Asset Surveyor* manual before proceeding to read this manual.

### Symbols

The following symbols are used in this manual:

	<b>Note</b> - Indicates a general piece of information to which your attention is drawn.
	<b>Caution</b> - Indicates a potential difficulty or troublesome area. You should pay particular attention to such warnings.
	<b>Tip</b> - Indicates a shortcut or other time- or labor-saving hint that can help you to make better use of your Asset Surveyor system.

## Key Symbols

The Asset Surveyor GPS/GIS data collection software uses both *hard* (i.e. physical) keys on a keypad and *soft* (i.e. visual) keys on the datalogger's screen. This manual illustrates these two classes of keys using different symbols:

Hard (physical) keys on the MC-V keypad are indicated as follows:

, , , etc.

Soft keys on the MC-V screen are indicated as follows:

, , , etc.

A soft key is activated by pressing the corresponding function key ( ... ) on the MC-V's keypad.

## Instructions

Throughout this manual, sequences of instructions are given in the following manner:

### 1. First step.

Information that clarifies or further explains the first step.

### 2. Second step.

etc.



## Chapter 1 Introduction

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The Asset Surveyor software is designed to make the capture of geographic features and attributes as accurate and efficient as possible. Some data capture applications require the use of a particular sensor to measure a phenomenon of each feature, or simply a phenomenon which is spatially distributed.

Many sensing devices have an RS232 serial port which can be used to transmit each measurement made by the sensor. Provided the sensor's RS232 protocol meets certain criteria, you can configure the Asset Surveyor software to automatically read and store measurements as they are made by the sensor. This has a number of advantages:

- It is typically much quicker to record the sensor's measurements electronically than to record them manually (e.g. by writing them on paper or keying them into the MC-V as attribute values).
- By storing the sensor's measurements 'direct to digital', Asset Surveyor helps to eliminate the possibility of manual transcription error.
- Some sensors have their own internal memory which can be used for storing measurements. However, it is likely that the MC-V will be able to store many times the amount of data that can be stored in the sensor's memory.
- Asset Surveyor allows you to correlate the sensor's measurements with a GPS position, and optionally with other (manually entered) attribute information. This adds considerable value to each and every sensor measurement.

Asset Surveyor's ability to interface to a range of external sensors is called 'ESP™' (External Sensor Potential).

Although Asset Surveyor can be configured to work with a wide range of external sensors, several laser range-finders are supported as a special type of external sensor. Each shot taken with a laser range-finder is treated as an *offset* which can be applied to the position(s) of a feature. Automated recording of offsets enables:

- More rapid capture of point features, due to the fact that you can stand in one place and 'shoot' a number of features without having to travel to each one with your GPS receiver.
- The capture of features which are impractical or impossible to capture with GPS alone (e.g. features on the far side of a river, features under dense tree canopy or in the shadow of a tall building).

## Chapter 2 Connections

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The MC-V has two serial communications ports, labeled 'COM1:' and 'COM2:'. These ports are located on the top of the MC-V, and both are male DB9 connectors. The 'COM1:' port is used for connection to a GPS receiver, and for connection to a PC for data transfer. The 'COM2:' port is available for connecting either the optional barcode wand or for connecting an external sensor or laser range-finder.



**Note** - It is not possible to use a barcode wand at the same time as using an external sensor or laser range finder.





## Chapter 3 External Sensors

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### 3.1 Introduction

Asset Surveyor can interface to a wide range of external sensors equipped with an RS232 serial port. When Asset Surveyor receives a data message from an external sensor, it can log this data together with an associated GPS position, or it can log the sensor data as an attribute value for a feature.

#### Storage of Sensor Data

If data from a sensor is logged together with a GPS position, each sensor data message is logged as a separate UNINTERPRETED\_SENSOR\_DATA record in the Trimble SSF file format. You can use PFINDER's ASCII output module to output UNINTERPRETED\_SENSOR\_DATA records together with their associated GPS position. To ensure that the GPS position associated with each sensor message is as accurate as possible, Asset Surveyor records two GPS positions to 'bracket' the sensor message (just as it does for quickmarks) and PFINDER uses a GPS time tag which is fixed to each UNINTERPRETED\_SENSOR\_DATA record to compute an interpolated GPS position for that record.

If a sensor message is stored as an attribute of a feature, it is stored in the same way as any other attribute. From that point on, Asset Surveyor and PFINDER treat it as if you had typed it in, and you are free to edit the message if you wish.

Sensor messages are not actually *interpreted* by Asset Surveyor, whether they are stored as UNINTERPRETED\_SENSOR\_DATA records or as the attributes of features. You may need to edit these messages after producing ASCII or GIS output from PFINDER, or it may be possible for you to write a program or script which will transform the raw sensor data into a more readable or usable format once the data has been imported into your GIS, database or CAD package.

## Limitations of Asset Surveyor's ESP Interface

Asset Surveyor may not work with a particular external sensor unless each of the following conditions is met:

- The sensor must emit ASCII (7- or 8-bit) characters; Asset Surveyor does not support the use of an RS232 line to transmit other electronic pulses.
- The sensor must emit distinct messages of no more than 256 characters each. Each 'message' can be as small as a single character.
- The sensor must emit messages which can be delimited either by a recognizable prefix, a recognizable suffix, a maximum length or an elapsed period of time between messages. If the sensor emits messages whose format cannot be described in terms of these factors, Asset Surveyor will not be able to determine where one message ends and the next begins.
- The sensor must not emit messages faster than Asset Surveyor can process them. The actual throughput which can be handled by Asset Surveyor depends on a number of factors, including:
  - The connected GPS receiver,
  - The prevailing GPS conditions (i.e. number of visible satellites),
  - The amount of GPS data being logged,
  - The nature of the messages being received from the external sensor (i.e. the way in which they are delimited, the length of each message, etc.).



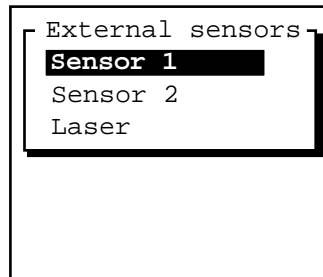
**Tip** - Trimble recommends that before purchasing an external sensor, you should always test the sensor with your Trimble Asset Surveyor/GPS system under a range of conditions to ascertain that the combination performs acceptably.

## 3.2 Configuring an External Sensor



**Tip** - Configuration of the Asset Surveyor external sensor interface requires a reasonable understanding of how your sensor communicates via its RS232 port. You should always allow plenty of time for configuring and testing a sensor with Asset Surveyor before beginning data capture. There are often a number of ways in which to configure the external sensor interface to work with a particular sensor, and usually one way will be better than the others for a given application.

To configure Asset Surveyor to receive data from an external sensor, select 'External sensors' from the 'Configuration' menu; the following menu of sensors will appear:



The Asset Surveyor software supports up to two configurable external sensors, which by default are named 'Sensor 1' and 'Sensor 2'. It also supports a single laser range-finder interface, as described in Chapter 4 of this manual.



**Note** - Although you can pre-configure two external sensors, you can only connect one at a time to the MC-V's 'COM2:' port, and only when you are not using a barcode wand for attribute entry. See Chapter 2, *Connections*, for further details.

If you select one of the two configurable sensor entries from the 'External sensors' menu, Asset Surveyor will display that sensor's configuration form, which looks as follows:

Sensor 1	
Auto connect:	<b>No</b>
Name:	Sensor 1
Channel:	0
Connect:	?
Disconnect:	?
Data request:	?
Intervals	
Point feature:	None
Line/area:	None
Not in feature:	None
Attribute:	None
Data received	
Prefix:	?
Suffix:	?
Max bytes:	?
Timeout:	0.100s
Audible click:	No
Status line:	No
<b>COMMS</b>	

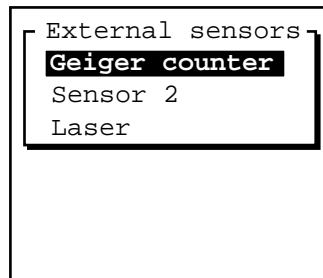
The following sections describe each of these fields in detail:

### Auto Connect

An external sensor can be activated manually, each time data capture commences. If the same external sensor is to be used every time you use your Asset Surveyor system, it may be more convenient to configure this sensor interface to *automatically* connect (i.e. activate) whenever data capture commences. This can be achieved by setting the value of the 'Auto connect' field to 'Yes'.

### Name

Each external sensor can be assigned a more meaningful name than 'Sensor 1' or 'Sensor 2'. If, for example, you configured the first external sensor to interface to a Geiger counter, you might wish to rename it 'Geiger counter'. The menu of external sensors would then look like:



### Channel

The 'Channel' field allows you to allocate a number in the range 0 ... 32767 to this sensor. The channel number will be attached to every UNINTERPRETED\_SENSOR\_DATA data record logged from this sensor, and could be used by PFINDER or other post-processing software to identify the sensor which originated a particular data record.

The default channel number is 0.



**Note** - The channel number is not related to the number of channels in your GPS receiver, and neither is it related to radio frequency channels. It is simply a number which you can assign to data received from a particular external sensor.

### Connect and Disconnect

The 'Connect' field specifies a character string which will be automatically sent by Asset Surveyor to the external sensor when the interface with that sensor is activated. It might be used to reinitialize the sensor, or to set it into the correct mode.

The 'Disconnect' field specifies a character string which will be automatically sent by Asset Surveyor to the external sensor when the interface with that sensor is deactivated. It might be used to switch off the sensor, or reset its mode.



**Tip** - If either the 'Connect' or 'Disconnect' fields have a null value, they will not be sent to the external sensor. If you need to send to the sensor the same character(s) that make up your configured null string, you will have to enter them as hexadecimal codes, as described below.

As with all configurable character strings which can be sent to or received from the external sensor, the 'Connect' and 'Disconnect' fields allow you to include both printable and non-printable ASCII characters. Non-printable ASCII characters can be included in a field's value using a special *escape* character (the backslash character, '\'). When the backslash character is followed by two *hexadecimal* (base 16) digits, it is treated as a single ASCII character with a value equivalent to that two-digit hexadecimal number. For example,

- \01 is the hexadecimal value  $01_{16}$ , or ASCII character 1.
- \4C is the hexadecimal value  $4C_{16}$  or ASCII character 76. This character corresponds to the letter 'L'.
- \FF is the hexadecimal value  $FF_{16}$ , or 255. This is the largest ASCII character that can be specified.

Because it is difficult remembering the ASCII codes corresponding to special characters like carriage-return and line-feed, and because it is even more difficult converting these values to hexadecimal codes, Asset Surveyor provides a special **CODE** soft key. When you press this soft key, a menu of the first 32 ASCII characters appears:

Code	
<b>nul</b>	<b>\00</b>
soh	\01
stx	\02
etx	\03
eot	\04 ↓

Each line of the menu shows an ASCII character's mnemonic name and the \XX code which is associated with that character. When you select a character code from this menu, Asset Surveyor inserts the \XX code into the field which you were editing when you pressed **CODE**.

The usual **SYMB** soft key will also be available for convenient entry of other printable characters (e.g. punctuation).

### Data Request

The value of the 'Data request' field is a character string which, if non-null, will be periodically sent to the external sensor. This is used to request data from the sensor if it requires an explicit request (many sensors emit data continuously, or when triggered by the user, and for these sensors the 'Data request' field should be left null).

When entering a value for the 'Data request' field, Asset Surveyor will make **SYMB** and **CODE** soft keys available, as described above.

If non-null, the 'Data request' string will be periodically sent to the external sensor as determined by the 'Intervals' fields, described on the following page. *All* data emitted by the external sensor will then be logged by Asset Surveyor.

If the 'Data request' string is null, then whatever data is emitted by the external sensor will be logged at a rate determined by the 'Intervals' fields, described below.

### Intervals

There are three intervals applying to point features, line or area features, and when not recording a feature. These intervals are used for one of two purposes, depending on the value of the previous 'Data request' field:

- *If 'Data request' is non-null*, then depending on the context (whether in a feature or not, and if so, which type of feature), the appropriate interval will be used to periodically send the 'Data request' character string to the external sensor. In this case, any response from the sensor will be logged.
- *If 'Data request' is null*, then data which just arrives from the external sensor unsolicited will be logged at the interval appropriate to the context (whether in a feature or not, and if so, which type of feature).

★	<p><b>Tip</b> - If you have a sensor which emits data unsolicited, you do not need to set up any kind of ‘Data request’ string. It is easy to forget that you <i>do</i> need to set one or more of the ‘Interval’ fields to a value other than ‘None’, otherwise Asset Surveyor will not log any data received from the sensor. <i>When all intervals are ‘None’, Asset Surveyor will not log any data from an external sensor.</i></p>
☒	<p><b>Note</b> -As with all interval fields in Asset Surveyor, these fields can be filled in by pressing <b>ALL</b> or <b>NONE</b>, or by typing an interval in seconds (or some other convenient unit of time).</p>

### Attribute

Data from an external sensor can be stored by Asset Surveyor in one of two ways:

- As independent UNINTERPRETED\_SENSOR\_DATA records. These can be output from PFINDER with interpolated GPS positions, and fed into processing software such as a contouring package. An example of an application which might store sensor data for contouring is a radiation survey where a Geiger counter is passed backwards and forwards over a nuclear waste storage site.
- As attributes of a feature. When sensor data is stored as an attribute, it is tied to a particular geographic feature. It can be output to a GIS along with all of the other attributes of that feature. An example of an application where sensor data should be stored as attributes is a forestry survey where each tree has a number of attributes, one of which is the tree's trunk diameter, which is measured using an electronic tree-caliper.

You specify which of these two methods of sensor data storage you require by configuring the ‘Attribute’ field of the external sensor configuration form.

By default, the ‘Attribute’ field will have the special value ‘None’, which means that sensor data is not to be stored as an attribute, but rather is to be stored as independent UNINTERPRETED\_SENSOR\_DATA records.



You can specify that you wish sensor data to be stored as an attribute by typing the name of the attribute to which you wish to associate this data. For example, the forestry application mentioned above might involve recording the following attributes for each tree:

«Tree»	
Species:	<b>Pine</b>
Diameter:	?
Pruned:	Yes
To height:	3m
Date:	1/6/1994 Wed

To ensure that each measurement from the tree-caliper sensor goes into the 'Diameter' attribute, you should configure the sensor's 'Attribute' field to contain the character string "Diameter".

When a message from an external sensor is received by Asset Surveyor, it is stored as an attribute value provided you are currently capturing a feature which has an attribute of the specified name, and provided:

- This attribute is a character string attribute which is long enough to hold the data, or
- This attribute is a numeric attribute and it is possible to interpret the data from the sensor as a number (which must comply with the ranges permitted for this attribute).

★	<p><b>Tip</b> - Typically it is easiest to use a character string attribute to store sensor data. Remember to make the character string as long as the longest possible message from your sensor.</p>
💣	<p><b>Caution</b> - You must take care to ensure that the character string which you enter into the 'Attribute' field exactly matches an attribute name in your current data dictionary. If it does not, Asset Surveyor will fail to store data from your external sensor into any attribute field. Attribute name-matching is not case sensitive.</p>

☒	<p><b>Note</b> - It is possible that more than one sensor data message may arrive during the capture of a particular feature. Each time a message arrives, Asset Surveyor will overwrite the value stored in the named 'Attribute'. Therefore only the last sensor message per feature will actually be saved (when the feature itself is saved).</p>
☒	<p><b>Note</b> - When 'Attribute' is set to 'None', and Asset Surveyor is storing ESP data as UNINTERPRETED_SENSOR_DATA records, the Asset Surveyor software will attempt to bracket each such record with at least two GPS positions (just as it does for quickmarks). This enables the PFINDER software to compute an interpolated GPS position for each ESP data record, based on the time at which that record was recorded.</p>

### Data Received

The most complex part of configuring an external sensor interface is the description of the data stream which is emitted by the sensor. Data can be received from the sensor in response to a request, in a continuous stream, or when a switch or trigger is pressed on the sensor itself.

In order to correctly separate the messages which are emitted by the sensor, Asset Surveyor allows you to describe how messages are structured using any combination of the following four fields:

- The 'Prefix' field can be used to specify that each message from the sensor is prefixed with a constant sequence of characters. For example, all NMEA-compliant sensors output messages preceded with a '\$' character and one or more characters which identify the specific sensor. Enter the null string if you do not wish to specify a prefix.
- The 'Suffix' field can be used to specify that each message from the sensor ends with a constant sequence of characters. For example, all NMEA-compliant sensors output messages terminated by carriage-return and line-feed characters. Enter the null string if you do not wish to specify a suffix.
- The 'Max bytes' field can be used to limit the length of each message to a specific number of bytes. This length includes the length of any

defined 'Prefix' or 'Suffix' strings, and Asset Surveyor will not allow you to specify a maximum number of bytes which is less than the combined length of the prefix and suffix. Enter the null string (by pressing **NULL**) if you do not wish to specify a maximum number of bytes. The maximum value permitted for the 'Max bytes' field is 242 (this is the limit permitted for UNINTERPRETED\_SENSOR\_DATA SSF records).

- The 'Timeout' field can be used to distinguish separate messages by a certain amount of elapsed time between them. When Asset Surveyor receives a character from the sensor, it starts a timer. If another character is not received from the sensor before the timer expires (i.e. before 'Timeout' seconds have elapsed), Asset Surveyor considers the message is complete, and logs the characters it has received. If a character arrives before the timer expires, the timer is reset and the procedure repeats.

The default value for the 'Timeout' field is 0.1 seconds (100ms); the maximum permitted value is 0.5 seconds and the minimum is 0.0 seconds.



**Caution** - While Asset Surveyor is waiting for a 'Timeout' period, it is unable to communicate with the GPS receiver. You should not specify a large 'Timeout' value unless that is strictly necessary in order to process data from a particular external sensor.

Asset Surveyor uses a combination of the above fields to separate messages from an external sensor.



**Note** - You do not necessarily need to fill in all of these fields. A field is ignored by Asset Surveyor if its value is null.

### Audible Click

If you wish the MC-V to 'click' each time data from an external sensor is received and logged, set the value of the 'Audible click' field to 'Yes'. The click is similar to, but audibly distinct from, the click emitted by the MC-V when it logs a GPS position.

### Status Line

To make the most of the MC-V's screen, you will not usually want a separate status line for an external sensor. However for some applications, it may be crucial to be able to see when data is received from the sensor. In this case, set the 'Status line' field to 'Yes' in order to display a status line for the external sensor being configured.

The sensor's status line appears just above that for GPS (if GPS is running):

SensorName	4 / 6
SV 4 / 6 PDOP 2.4 # 23	

The sensor's status line shows the name of the sensor, followed by two numbers, separated by a slash ('/') character. The first of these is the number of messages received from the sensor and logged since the start or end of the last feature; the second number is the total number of messages received from the sensor and logged since Asset Surveyor started communicating with the sensor.

### COMMS Options

At the bottom of the external sensor configuration form is a **COMMS** soft key. Press this to configure the RS232 communications protocol to be used when Asset Surveyor and the sensor are communicating.


✉	<p><b>Note</b> - The <b>COMMS</b> soft key will not be available when the sensor has already been activated.</p>
---	--

Sensor 1	
Serial port:	<b>COM2</b>
Baud rate:	9600
Data bits:	8
Stop bits:	1
Parity:	None

This RS232 communications configuration form allows you to specify all of the standard RS232 parameters:

- The 'Serial port' field should always be set to 'COM2:'. The 'COM1:' port is used to connect your GPS receiver.
- The 'Baud rate' field is a menu of available baud rates, up to a maximum of 19200 baud.
- The 'Data bits' field is a menu permitting between 7 and 8 data bits to be specified.
- The 'Stop bits' field is a menu permitting 1 or 2 stop bits to be specified.
- The 'Parity' field is a menu permitting values of 'None', 'Odd' and 'Even' to be specified.

The RS232 configuration form requires a reasonable understanding of the RS232 concepts. If you enter any of these fields incorrectly, it is unlikely that Asset Surveyor will be able to communicate with your sensor.

	<p><b>Caution</b> - It is easy to make an error when specifying the RS232 parameters for an external sensor.</p>
---	--

When you have entered values for each field, press **OK** to save the contents of this form and return to the external sensor configuration form.

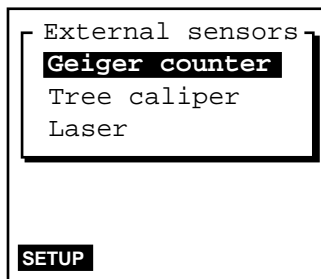
Press **OK** again to save the entire definition of the external sensor, ready for use.

### 3.3 Testing an External Sensor

Asset Surveyor allows you to pre-configure and pre-test an external sensor interface via the 'External sensors' entry in the 'Utilities' menu.

★	<p><b>Tip</b> - You should always test an external sensor interface before attempting to use the sensor for data capture. Configuration of a sensor interface is relatively complicated, and there are usually a number of ways in which the interface can be configured for a particular sensor. Only by testing the interface can you be sure that the sensor and Asset Surveyor will communicate correctly, and that the interaction is workable under field conditions.</p>
---	---

Configuration of an external sensor interface was described in Section 3.2. The examples in the following sections presume that you have already configured two external sensors as follows:

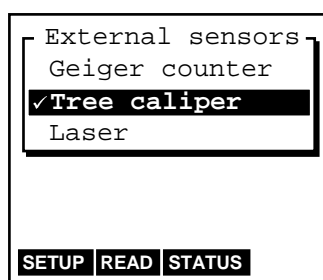


The 'Geiger counter' is a sensor which records radiation levels. It outputs a reading to its RS232 port if requested by Asset Surveyor. The 'Tree caliper' is a sensor which is used to measure the diameter of tree trunks. It emits a reading to its RS232 port whenever you press the 'Measure' button on the caliper itself.

✉	<p><b>Note</b> - Although you can pre-configure two external sensors, you can only connect one at a time to the MC-V's 'COM2:' port, and only when you are not using a barcode wand for attribute entry. See Chapter 2, <i>Connections</i>, for further details.</p>
---	--

## Activating a Sensor Interface

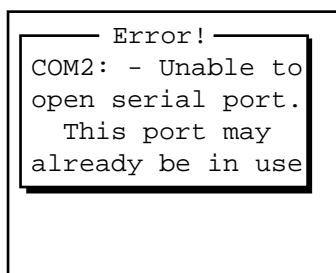
You can manually activate an external sensor by selecting it from the 'External sensors' menu (accessed either from the 'Utilities' menu or via an **EXT** soft key when capturing data). To activate a sensor, highlight its entry in the menu and press **ENTER**. When a sensor is active, a tick (✓) will appear to the left of its name in the 'External sensors' menu. For example, if you wish to activate the 'Tree caliper' sensor, highlight it and press **ENTER**. The 'External sensors' menu will then look as follows:



When a sensor is active (and highlighted), two further soft keys (**READ** and **STATUS**) appear.

When a sensor is activated, Asset Surveyor starts to communicate with it. If you have configured Asset Surveyor to display a status line or to emit an audible click whenever it logs data from the sensor, then you may begin to see or hear Asset Surveyor and the sensor communicating.

If you attempt to activate an external sensor on a serial port which is already in use by GPS, a barcode wand, the laser range-finder interface or another sensor, Asset Surveyor displays the following message



and refuses to activate the new sensor.

## Deactivating a Sensor Interface

You can manually deactivate an active external sensor by again highlighting and selecting it from the 'External sensors' menu. When a sensor is deactivated, the tick (✓) to the left of its name disappears, as do the **READ** and **STATUS** soft keys.

When you exit the 'External sensors' menu and return to the 'Utilities' menu, all active external sensors will be deactivated automatically.

## Configuring a Sensor

The configuration of external sensors is described in detail in Section 3.2.

You can change the configuration of an external sensor while it is active by pressing **SETUP**. The only aspects of an external sensor which cannot be configured while it is active relate to the serial port it is using. Asset Surveyor will not provide a **COMMS** soft key on the sensor's configuration form while the sensor is active. If you wish to change the serial port or reconfigure the RS232 parameters for the sensor, you must deactivate it, configure it, and then re-activate it.

## Reading from a Sensor

If an active sensor emits data unsolicited, you will be unable to manually request data from the sensor; Asset Surveyor will log data as it is received, using the configured logging 'Intervals' for that sensor (see Section 3.2). As an example, most depth-sounders operate in this fashion, emitting one or more readings per second.

If an active sensor emits data only when a trigger or button is pressed on the sensor itself, you will also be unable to manually request data from the sensor using Asset Surveyor. A typical example of a triggered sensor is an electronic tree caliper.

If the sensor emits data only when requested via its RS232 line, Asset Surveyor can obtain data from the sensor by sending the configured 'Data request' string (see Section 3.2). This is sent to the sensor in two circumstances:

- As determined by the configured 'Interval' fields. (When you activate an external sensor from the 'External sensors' entry in the 'Utilities' menu, the 'Not in feature' interval will be used).



- When you press the **READ** soft key.



**Tip** - If the sensor is of the type where you wish to take only one (or very few) reading(s) per feature, and you need to be able to trigger the readings at precise moments, you should configure the sensor with intervals of 'None', and use the **READ** soft key to take readings when required.

## Sensor Status

When an external sensor is active (and highlighted), you can press **STATUS** to pop up a status form for that sensor, e.g.

```

Geiger counter
Records:      12
Display as:   ASCII
512.34,332.13\0D\0A

```

The first field of this form shows the number of data 'records' (or messages) which have been received from the sensor since it was activated, while the third field shows the content of the most recent record (using '\XX' escape sequences to show any non-printable characters).

If the sensor to which you are connected emits purely binary data (i.e. no part of the data is ASCII text), you should change the value of the 'Display as' field from 'ASCII' to 'Binary'. The third field of the form will then display *every* byte of data using a '\XX' escape sequence.



**Note** - The Asset Surveyor software does not know when to expect data from an external sensor. It cannot, therefore, warn you when *nothing* is received from the sensor; its status form only shows you what *has* arrived from the sensor.

## 3.4 Logging Data from an External Sensor

### EXT Soft key

When capturing data to a rover file, you can press **EXT** at any time to pop up the menu of external sensors. You can activate or deactivate a sensor from this menu, and once a sensor interface is active, you can check the status of a sensor, or manually initiate a ‘reading’ from a sensor. You can also reconfigure a sensor from this menu if necessary.

### Automatic Activation of Sensors

If you have pre-configured an external sensor interface and have set the ‘Auto-connect’ configuration field to ‘Yes’, then Asset Surveyor will automatically attempt to activate the sensor interface when you create or reopen a rover data file.

If you have not pre-configured the sensor to automatically connect (i.e. activate), then you can manually activate it via **EXT**.

### Automatic Deactivation of Sensors

If you press **EXT** to access the ‘External sensors’ menu, active sensors will remain active when you exit the ‘External sensors’ menu. When you exit data capture, however, all active external sensors will be automatically deactivated.

### Status, Reading and Configuration

When capturing data, you can check the status of a sensor, manually take a reading from the sensor, or reconfigure the sensor using the methods described for testing the sensor interface in Section 3.3.

### 3.5 Examples

The following sub-sections provide examples of how to configure and use a variety of external sensors. Some of these examples refer to real sensors while others use hypothetical sensors to illustrate different aspects of Asset Surveyor's ESP capability.



**Note** - Trimble provides no specific endorsement of the products named in the following sections. Additionally, Trimble provides no warranty or guarantee as to the ongoing performance of the named sensors with any Trimble GPS system. The named sensors have each been tested by Trimble, but as we have no control over different hardware or software versions, we cannot accept any responsibility for ensuring that these sensors continue to work with Trimble equipment.

#### Criterion Laser Range-finder (used for Measuring Heights)

The Criterion 300 and 400 laser range-finders can be used to automatically record offsets for features, as described in Chapter 4. They can also be used as external sensors for measuring the *heights* of geographical features (e.g. trees, buildings, etc.).

When operating in 'HEIGHT' mode, the Criterion 300 range-finder emits data messages of the following form:

\$PLTIC3 , HT , <height>,<units>*<checksum>	CR	LF
---	----	----

For example, a height of 16.68 meters will be transmitted as:

\$PLTIC3 , HT , 16 . 68 , M*2B	CR	LF
--------------------------------	----	----

You can configure an Asset Surveyor external sensor interface to recognize these messages and to strip off the message 'packaging'. It is not possible for Asset Surveyor to actually verify the checksum ('2B' in the example above), as these vary from message to message.



**Note** - You can configure the Criterion to display and transmit heights in feet, in which case 'F' would appear in the RS232 message example above in place of the letter 'M'.

✉	<p><b>Note</b> - The data messages emitted by the Criterion 400 differ slightly from those emitted by the Criterion 300 in that they begin with the prefix '\$PLTIT' instead of '\$PLTIC3'. If you are using a Criterion 400, be sure to substitute '\$PLTIT' for '\$PLTIC3' when configuring your external sensor interface. The following examples refer specifically to the Criterion 300.</p>
---	---

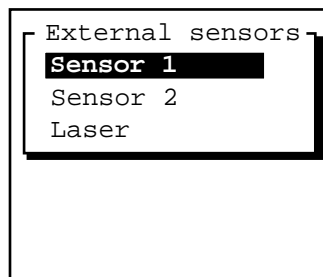
**Data Dictionary Configuration**

In order to make the best use of the heights transmitted by the Criterion range-finders, you should set up a data dictionary with a 'Height' attribute in each feature whose height concerns you. The 'Height' attribute should be a numeric attribute with two decimal places and appropriate maximum and minimum values.

✉	<p><b>Note</b> - The attribute's name does not have to be 'Height'. It is, however, good practice for each attribute's name to reflect the nature of the data which you plan to record into it. The attribute name <i>must</i> be the same for each type of feature whose height you wish to record using your range-finder.</p>
---	--

**Asset Surveyor Configuration**

You should now configure an external sensor interface to receive height data from the Criterion. From the Asset Surveyor 'Configuration' menu, select 'External sensors':



Select 'Sensor 1' from this menu. The configuration form for external sensor number 1 will appear:

```

Sensor 1
Auto connect: No
Name:         Sensor 1
Channel:      0
Connect:     ?
Disconnect:  ?
Data request: ?
Intervals
Point feature: None
Line/area:   None
Not in feature: None
Attribute:   None
Data received
Prefix:      ?
Suffix:      ?
Max bytes:   ?
Timeout:    0.100s
Audible click: No
Status line: No
COMMS

```

Change the fields in this form as indicated below:

```

Sensor 1
Auto connect: Yes
Name: Height sensor
Channel:      0
Connect:     ?
Disconnect:  ?
Data request: ?
Intervals
Point feature: All
Line/area:   All
Not in feature: All
Attribute:   Height
Data received
Prefix: $PLTIC3,HT,
Suffix:      ,M*
Max bytes:   ?
Timeout:    0.100s
Audible click: Yes
Status line: No
COMMS

```

✉ **Note** - By using a prefix of '\$PLTIC3,HT,' and a suffix of ',M\*', you cause Asset Surveyor to peel off the packaging characters which surround the actual height measurement. The checksum, carriage-return and linefeed characters are then ignored by Asset Surveyor.

Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

```

Sensor 1
Serial port:  COM2
Baud rate:   4800
Data bits:   8
Stop bits:   1
Parity:      None

```

Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details. Asset Surveyor will return you to the 'External sensors' configuration menu, but will have renamed the first entry using the name which you specified for the sensor:

```

- External sensors -
  Height sensor
  Sensor 2
  Laser

```

★ **Tip** - After configuring an external sensor interface, it is recommended that you always *test* this interface. Select 'External sensors' from Asset Surveyor's 'Utilities' menu, and activate the 'Height sensor' as described in Section 3.3.

## Using the Criterion to Record Heights

You can use the configured external sensor interface together with a Criterion 300 to record heights as attributes, by following this procedure:

- 1. Create a new rover data file.**

When Asset Surveyor opens this file, it will automatically activate the pre-configured external sensor interface (as the 'Auto-connect' field was set to 'Yes' in the previous section).

Asset Surveyor can now communicate with the Criterion 300 range-finder and you can begin to record heights.

- 2. Start a feature.**

One of your feature's attributes has the name 'Height', and it is this attribute which will be used to store heights recorded by the Criterion 300.

- 3. Enter attribute values for the feature while Asset Surveyor logs GPS positions.**

It's usually easiest to manually enter attributes before taking a recording with an external sensor. By following a set procedure like this you are less likely to forget to record or enter a particular piece of information.

- 4. Follow the procedure described in the *Criterion 300/400 Operator's Guide* for recording a height with the Criterion 300.**

The procedure essentially involves taking a distance measurement to the object in question, then taking an angle measurement to the base and top of the object.

- 5. Press the ENTER button on the Criterion's keypad to send the height to your MC-V.**

Provided you have configured your external sensor interface correctly, and have connected and operated the Criterion 300 correctly, you will see a value like '15.4' appear as the 'Height' attribute for your feature.

- 6. Press **OK** to save the feature.**

From this point on, Asset Surveyor will treat the 'Height' attribute as if it had been entered manually. It has no special properties.

### Switching between Recording Laser Offsets and Heights

You can use a Criterion laser range-finder both for measuring offsets *and* for measuring the heights of objects. However, in order for Asset Surveyor to process these different types of data, you must indicate whether the Criterion is being used as an offset sensor or as a height sensor. You do this by alternately activating and deactivating the 'Height sensor' and 'Laser' entries in the 'External sensors' menu (accessible under the **EXT** soft key when capturing data).



**Tip** - Don't configure both the 'Height sensor' and the 'Laser' to auto-connect; if you do this, only the 'Height sensor' will be activated and an error message will appear when Asset Surveyor attempts to automatically activate the 'Laser' interface.



## Intelligent Barcode Wands

You can use a barcode wand to quickly enter attribute values (for menu-type attributes). A barcode wand is available as an option with all Asset Surveyor systems.

You can also use a *smart* barcode wand (a wand with its own built-in intelligence) to swipe and record other barcode types, and you can configure an external sensor interface to read and store these swiped barcodes as attribute values. This may be of particular value in asset management applications where each asset (be it a meter, power pole, street lamp, manhole, etc.) can easily be identified by a unique code and this code can be stamped or fixed onto the asset as a tag featuring a machine-readable barcode).

The intelligent HP Smartwand (HBCR-8300) available as an Asset Surveyor option can be used to swipe barcodes in the following formats:

- Code 39 (also called ‘Code 3 of 9’)
- Interleaved 2 of 5
- UPC/EAN/JAN
- Codabar
- Code 128
- Code 11
- MSI Code

The HP Smartwand emits a message each time a recognized barcode is swiped. This message is emitted at 9600 baud, with 7 data bits and two stop bits and even parity, and consists of the barcode itself (of variable length), followed by carriage-return and line-feed characters. For example, swiping:

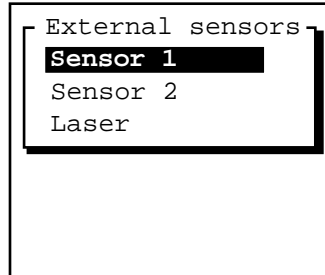


causes the Smartwand to emit the following message (the ‘A’ prefix is part of the scanned barcode):

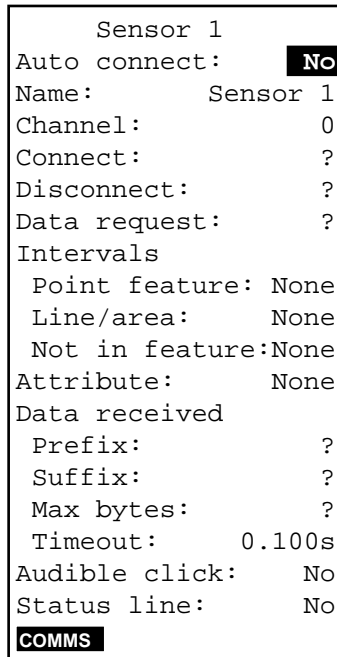
A715535132507	CR	LF
---------------	----	----

You can configure an Asset Surveyor external sensor interface to recognize these messages and store them into an 'ID' attribute as follows:

1. From the Asset Surveyor 'Configuration' menu, select 'External sensors':



2. Select 'Sensor 1' from this menu. The configuration form for external sensor number 1 will appear:



3. Change the fields in this form as indicated below:

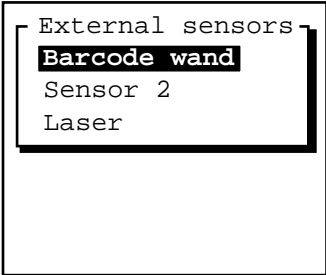
Sensor 1	
Auto connect:	<b>Yes</b>
Name:	Barcode wand
Channel:	0
Connect:	?
Disconnect:	?
Data request:	?
Intervals	
Point feature:	All
Line/area:	All
Not in feature:	All
Attribute:	ID
Data received	
Prefix:	?
Suffix:	\0D\0A
Max bytes:	?
Timeout:	0.100s
Audible click:	Yes
Status line:	No
<b>COMMS</b>	

4. Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

Sensor 1	
Serial port:	<b>COM2</b>
Baud rate:	9600
Data bits:	7
Stop bits:	2
Parity:	Even

5. Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details.

Asset Surveyor will return you to the 'External sensors' configuration menu, but will have renamed the first entry using the name which you specified for the sensor:



## Digital Cameras

Certain digital cameras can be controlled via an RS232 port. A message can be sent to the camera to ‘trigger’ the taking of a photograph, and the camera may respond with a message which can be used subsequently to identify the photographic image which was recorded by the camera.

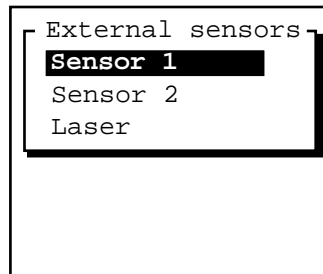
A hypothetical camera communicates at 9600 baud with 8 data bits, 1 stop bit and odd parity. It is triggered either by pressing a button on the camera itself or by sending the ASCII character ‘\*’ to the camera. When the camera is mounted on a vehicle it is typically easier to trigger the camera via an RS232 message. Each time the camera takes a photograph (whether triggered manually or via an RS232 message), it stores the digital image to its internal memory and emits the following message to its RS232 port:

```
$PIC, nn [CR] [LF]
```

where the number nn indicates the number of the stored image (1 to 64).

You can configure an Asset Surveyor external sensor to trigger the taking of a photograph whenever you press the **READ** soft key, and to store the number of the digital image as an attribute called ‘Photo’ as follows:

1. From the Asset Surveyor ‘Configuration’ menu, select ‘External sensors’:



2. Select ‘Sensor 1’ from this menu. The configuration form for external sensor number 1 will appear:

```

Sensor 1
Auto connect: No
Name: Sensor 1
Channel: 0
Connect: ?
Disconnect: ?
Data request: ?
Intervals
Point feature: None
Line/area: None
Not in feature:None
Attribute: None
Data received
Prefix: ?
Suffix: ?
Max bytes: ?
Timeout: 0.100s
Audible click: No
Status line: No
COMMS
    
```

**3. Change the fields in this form as indicated below:**

```

Sensor 1
Auto connect: Yes
Name: Digital camera
Channel: 0
Connect: ?
Disconnect: ?
Data request: *
Intervals
Point feature: None
Line/area: None
Not in feature:None
Attribute: Photo
Data received
Prefix: $PIC,
Suffix: \0D\0A
Max bytes: ?
Timeout: 0.100s
Audible click: Yes
Status line: No
COMMS
    
```

4. Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

Sensor 1	
Serial port:	<b>COM2</b>
Baud rate:	9600
Data bits:	8
Stop bits:	1
Parity:	Odd

5. Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details.

Asset Surveyor will return you to the 'External sensors' configuration menu, but will have renamed the first entry using the name which you specified for the sensor:

External sensors
<b>Digital camera</b>
Sensor 2
Laser

## Echo Sounders

Echo-sounders are widely used to measure the depth of a body of water at a particular point, together with such phenomena as the level of sedimentation and the biomass (quantity of marine life). Most echo sounders emit measurements as they are taken (typically one or more per second).

The most common mapping application for an echo sounder is to map the seabed, and in this case you will configure Asset Surveyor to log each message from the echo sounder as an UNINTERPRETED\_SENSOR\_DATA record (which will not be associated with a feature).

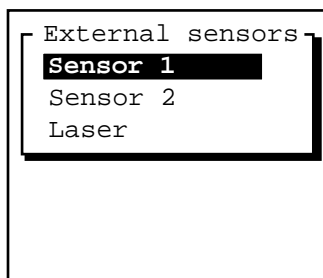
A hypothetical echo sounder might measure the sea's depth and transmit this information once per second at 4800 baud, with 8 data bits, 2 stop bits and no parity. Each measurement is emitted as a message with the following format:

XXXX.X

where XXXX.X is the depth of the sea at the point the measurement was taken. There are no delimiting characters which identify the start or end of each message, so Asset Surveyor will have to rely on timing information and the maximum length of 6 characters to isolate each message.

You can configure an Asset Surveyor external sensor interface to log a depth message from this hypothetical echo sounder every 5 seconds as follows:

1. From the Asset Surveyor 'Configuration' menu, select 'External sensors':



2. Select 'Sensor 1' from this menu. The configuration form for external sensor number 1 will appear:



```

Sensor 1
Auto connect: No
Name:      Sensor 1
Channel:   0
Connect:   ?
Disconnect: ?
Data request: ?
Intervals
Point feature: None
Line/area:   None
Not in feature: None
Attribute:   None
Data received
Prefix:      ?
Suffix:      ?
Max bytes:   ?
Timeout:     0.100s
Audible click: No
Status line: No
COMMS

```

**3. Change the fields in this form as indicated below:**

```

Sensor 1
Auto connect: Yes
Name:      Echo sounder
Channel:   0
Connect:   ?
Disconnect: ?
Data request: ?
Intervals
Point feature: None
Line/area:   None
Not in feature: 5.0s
Attribute:   None
Data received
Prefix:      ?
Suffix:      \0D\0A
Max bytes:   8
Timeout:     0.100s
Audible click: No
Status line: Yes
COMMS

```

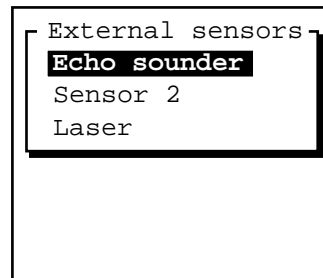
✉	<p><b>Note</b> - By configuring Asset Surveyor to log a measurement every 5 seconds, it is able to discard any intervening messages and is more likely to be able to keep pace with the echo sounder.</p>
★	<p><b>Tip</b> - When logging sensor data for mapping as independent UNINTERPRETED_SENSOR_DATA records, it is often convenient to configure the sensor interface to display a status line. This provides assurance that data is being logged continuously from the sensor.</p>
★	<p><b>Tip</b> - You can maximize the MC-V's ability to process external sensor data by disabling the optional 'Audible click' and the 'Status line', and by minimizing the amount of additional GPS information which is logged at the same time.</p>

4. Press **COMMS** to pop up the configuration form for serial communications (RS232) parameters, and enter the following values:

Sensor 1	
Serial port:	<b>COM2</b>
Baud rate:	4800
Data bits:	8
Stop bits:	2
Parity:	None

5. Press **OK** to save the communications settings, then press **OK** to save the sensor configuration details.

Asset Surveyor will return you to the 'External sensors' configuration menu, but will have renamed the first entry using the name which you specified for the sensor:



**Tip** - You should configure and activate Asset Surveyor's external sensor interface *before* switching on the echo sounder. If you switch on the echo sounder before activating Asset Surveyor's sensor interface, the first measurement from the sensor may be interpreted incorrectly (because Asset Surveyor has no way to distinguish a partial message from a complete one due to the lack of a prefix or suffix on each message).



## Chapter 4 Laser Range-finders

---

### 4.1 Introduction

A laser range-finder can be used, together with a GPS receiver, to quickly capture the position of a geographical feature without having to physically visit it. Sometimes it may be impossible or inconvenient to stand right on a feature, but Asset Surveyor makes it easy and efficient to use a laser range-finder to capture the position of such a feature automatically as an offset.

This chapter describes how to interface each supported laser range-finder to Asset Surveyor, in order to automatically record offsets for features. It provides instructions for configuration of each laser, use in the field, and tips on how to achieve the best performance with your integrated GPS/laser system.

Asset Surveyor version 3 supports the following laser range-finders:

- The Laser Technology Criterion 300.
- The Laser Technology Criterion 400.
- The Laser Atlanta ProSurvey 1000.

Sections 4.6 and 4.7 provide detailed instructions for operating the Criterion and ProSurvey laser range-finders, respectively. These sections include cabling diagrams for use with a Pathfinder Pro XL GPS receiver.

## 4.2 Configuring Asset Surveyor's Laser Interface

If you select 'Laser' from the 'External sensors' configuration menu, Asset Surveyor will display the configuration form for laser range-finders, which looks as follows:

Laser range-finder	
Type:	<b>Criterion 300</b>
Auto-connect:	No

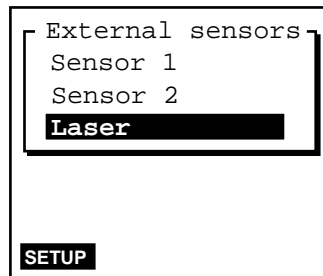
The laser 'Type' can be 'Criterion 300', 'Criterion 400' or 'ProSurvey 1000'. The laser interface can be configured to 'Auto-connect' whenever you create or reopen a rover data file; this can be useful if you often or always use Asset Surveyor together with a laser range-finder.

Having selected the type of laser range-finder, and specified whether or not it should automatically 'connect', no further configuration of the laser range-finder interface is required. Press **OK** to save the laser interface configuration form and return to the menu of external sensors.

### 4.3 Testing the Laser Interface

The Asset Surveyor software allows you to activate and test a laser range-finder via the 'External sensors' entry in the 'Utilities' menu.

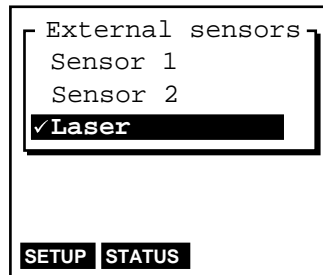
When you select 'External sensors' from the 'Utilities' menu, or press **EXT**, Asset Surveyor pops up the menu of external sensors, containing the 'Laser' entry:



The **SETUP** soft key leads to the configuration form for the highlighted sensor. Configuration of a laser range-finder is described in Section 4.2.

#### Activating the Laser Interface

You can manually activate the laser range-finder by selecting the 'Laser' entry from the 'External sensors' menu (i.e. highlight the 'Laser' entry and press **ENTER**). When the range-finder interface is active, a tick (✓) will appear to the left of the 'Laser' entry in the 'External sensors' menu, e.g.



When the laser range-finder interface is active (and highlighted), a **STATUS** soft key also appears. Once the laser range-finder interface has been activated, Asset Surveyor will accept communications from the laser.

You can configure Asset Surveyor to *automatically* activate a laser range-finder on entry to data capture, as described in Section 4.2. See Chapter 2, *Connections*, for general details of how to connect a laser range-finder to

your MC-V. See also the section covering your particular laser range-finder for cabling and connector diagrams.

### Deactivating the Laser Interface

You can manually deactivate an active laser interface by again highlighting and selecting the 'Laser' entry from the 'External sensors' menu. When the laser interface is deactivated, the tick (✓) to the left of the 'Laser' menu entry disappears, as does the **STATUS** soft key.

When you exit the 'External sensors' menu and return to the 'Utilities' menu, Asset Surveyor will automatically deactivate the laser interface.

### Reading Laser Offsets

You take a reading from a laser range-finder by aiming at a target point and pressing the trigger on the range-finder. You may also need to press a button on the range-finder to send the measurement to the datalogger. Consult the section covering your particular range-finder for further details.

### Laser Status

When the laser range-finder interface is active (and the 'Laser' entry is highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the range-finder:

Criterion	300
<b>Bearing:</b>	21.4°T
Slope dist:	6.230m
Inclination:	0.0°

This form shows the most recent offset received from the laser range-finder. If you take further readings using the range-finder, these will appear on the status form, replacing the previous reading.

You cannot edit the fields in the laser range-finder's status form.





**Note** - If you take a laser measurement in the laser status form when a data file is open, this offset will be recorded to the data file if a point feature is currently open.

## 4.4 Logging Offsets with a Laser Range-finder

### EXT Soft key

When capturing data to a file, you can press **EXT** at any time to pop up the menu of external sensors. The third entry in this menu will always be 'Laser'. You can activate or deactivate the laser range-finder interface from this menu, and once the laser interface is active, you can check the status of the laser or reconfigure the laser interface from this menu if necessary.

### Automatic Activation of the Laser Interface

If you have pre-configured the laser interface and have set the 'Auto-connect' configuration field to 'Yes', then Asset Surveyor will automatically attempt to activate the laser interface when you start a data file.

If you have not pre-configured the laser interface to automatically connect (i.e. activate), then you can manually activate it via **EXT**.

### Automatic Deactivation of the Laser Interface

If you press **EXT** to access the 'External sensors' menu, an active laser interface will remain active when you exit the 'External sensors' menu. When you exit data capture, however, the laser interface will be automatically deactivated.

### Status, Reading and Configuration

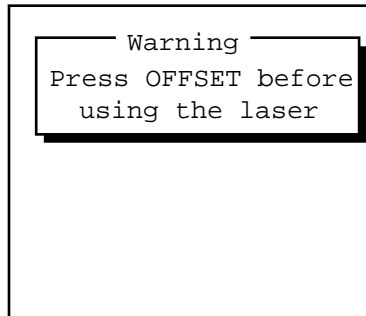
When capturing data, you can check the status of the laser, take a reading from the laser, or reconfigure the laser interface using the methods described for testing the laser interface in Section 4.3.

### Recording Laser Offsets

When the laser range-finder interface is activated inside data capture, data received from the range-finder can be logged to the current data file as an offset for the current feature.

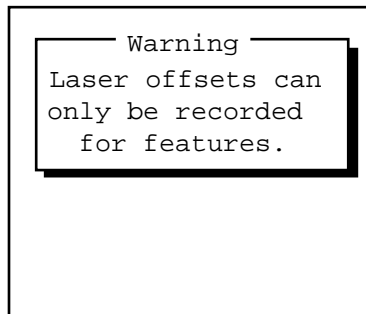
If you activate a laser range-finder within data capture and then take a laser reading, Asset Surveyor will respond in one of three ways:

- If you are capturing a point feature, Asset Surveyor will display the message 'Offset received' on the GPS status line. The offset for the current feature will be updated accordingly. This can be viewed or edited by pressing the **OFFSET** soft key.
- If you are capturing a line or area feature, Asset Surveyor will display the following warning message:



You must press **OFFSET** to pop up the offset entry form before recording an offset for a line or area feature with the laser range finder. You must then manually specify the direction of the offset (to the left or right of your direction of travel) and press **OK** to save the offset.

- If you are not currently capturing a feature at all, Asset Surveyor will display the following warning message:



You can record as many offsets as you like for a feature, but only the last offset you record will actually be stored by Asset Surveyor. A feature only has *one* associated offset.



**Tip** - If you are recording a line feature using an offset (to travel along parallel to the line) and you reach a point where you are forced to use a different offset (e.g. you can no longer travel the same distance from the line feature), you should segment the line feature (using **SEG**) and then enter a new offset for the second segment of the line.

## 4.5 Using a Laser to Update Offsets when Reviewing Data

When reviewing a data file, you can view and/or edit the offsets associated with each feature. You can use a laser range-finder to update the offset associated with a feature using the following procedure:

1. **Activate the laser range-finder under the 'External sensors' entry in the 'Utilities' menu and then review the file.**

You must review the data file in a context where the laser range-finder interface can be activated in order to use a laser range-finder to update a feature's offset.

2. **Highlight the feature whose offset you wish to update in the review list, e.g.**

```

Review «R100509a»
1: Logging started:...
2:                Town
3:                Gas station
4:                Bank
5:                Highway
6:                Car park
SEARCH POS DEL UNDEL
  
```

3. **Press **POS** to display the 'Position' review form for that feature.**

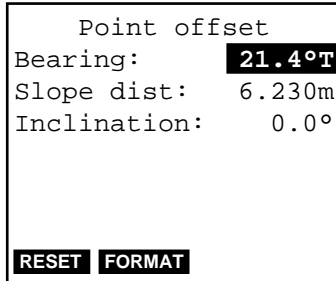
If the feature is a line, Asset Surveyor will require you to select the start or end of the line. If the feature is an area, Asset Surveyor will require you to select the start, centroid or end of the area. For the purposes of updating the feature's offset, it does not matter which of the feature's positions you choose to view.

For example, the 'Position' review form for the 'Bank' feature might be as follows:

```

Averaged position
Feature:                Bank
North: 5742788.71m
East: 2479065.09m
Alt (MSL): 381.27m
Datum: NZGD 1949
Zone: UTM Zone 59
WAYPT OFFSET
  
```

4. The 'Position' review form features an **OFFSET** soft key. Press this soft key to view and/or edit the offset for the feature, e.g.



5. Provided the laser range-finder interface has been previously activated (as described in step 1), you can now record an offset with the laser and this will become the new offset for the feature.

✉	<p><b>Note</b> - When using a laser range-finder to update the offset for a line, area or quickmark feature, you will have to enter a value for the 'Direction' field manually.</p>
---	---

6. Press **OK** to save the modified offset.

⚠	<p><b>Caution</b> - You must take care to return to the <i>exact</i> position from which you first recorded the feature's position (with GPS). It will often be safer to re-record the feature in its entirety (and delete the previously recorded feature) than to try and remember exactly where you stood when you first recorded the feature's offset.</p>
---	--

## 4.6 Laser Technology Criterion 300 and 400

Laser Technology Inc. produce the Criterion range of laser ranging devices. The Criterion 300 and 400 are both suitable for use with Asset Surveyor software as automated offset recording devices. The Criterion 400 differs from the 300 in that it contains specialized software for common forestry mensuration operations.

### Hardware Specifications

The Criterion 300 and 400 hardware specifications are identical.

#### Dimensions

The laser itself measures 9cm x 17cm x 22cm (3.5" x 6.5" x 8.5"). It weighs 2.72kg (6.0lbs). The optional yoke (for fitting to a unipod or tripod) weighs an additional 0.45kg (1.0lb). The rechargeable battery pack weighs 0.91kg (2.0lbs), and is typically clipped to a belt or carried in a backpack.

#### Laser Details

The laser can typically take measurements up to 450m (1500ft) to most surfaces, and up to 12km (40,000ft) if used in conjunction with a retro-reflector. A foliage filter is available to enhance performance when shooting through light foliage and undergrowth, up to approximately 200m.

The minimum range of the laser is 3m (10ft).

The laser is accurate to  $\pm 9.1$ cm (0.3ft).

#### Compass Details

An electronic fluxgate compass is used to obtain magnetic azimuth measurements. This compass will work when the unit is tilted at up to 15° to the horizontal. The compass is rated at  $\pm 0.5^\circ$  under laboratory conditions. In typical GIS data capture conditions, compass accuracy is typically around  $\pm 1-2^\circ$ . In environments where magnetic interference is high (e.g. in a vehicle), the compass can be considerably less accurate.

### **Inclinometer Details**

A fluid tilt sensor measures vertical angles, which are used to calculate the elevation of target points. The sensor is of a damped resistance fluid type, and can take measurements up to  $\pm 60^\circ$ , accurate to  $0.1^\circ$ .

### **Powering**

The Criterion 300 and 400 range-finders are powered by a rechargeable 9.6V NiCd battery. This battery takes approximately 12-14 hours to charge fully, and the range-finder can be run for 7.5 hours or more on a fully-charged battery.

### **Environmental Limitations**

The Criterion range-finder can be used at temperatures ranging between  $-30^\circ\text{C}$  and  $+50^\circ\text{C}$  ( $-22^\circ\text{F}$  to  $+122^\circ\text{F}$ ). The laser casing is resistant to light rain (but not immersion) and dust.

The Criterion range-finder should be treated as precision optical equipment, and should be handled with care. It will withstand reasonable drop shock, but alignment of the sighting scope should be checked after dropping.

The range-finder should always be transported in its hard carry-case.

### **Accessories**

The Criterion 300 and 400 laser range-finders can be used in four ways:

- As a hand-held instrument,
- As a hand-held instrument with a shoulder rest (stock),
- With the optional yoke and unipod. The unipod includes a bracket onto which your datalogger may be clipped,
- With the optional yoke and a tripod.

For most GIS data capture applications, the Criterion range-finders are a little too heavy to be carried in one hand, and it is difficult to operate both a datalogger and hand-held laser together. It can also be difficult to accurately sight on distant objects when supporting the laser by hand. The best compromise between portability and operability is usually the yoke/unipod.



## Cabling for Use with Asset Surveyor

The Criterion 300 and 400 laser range-finders can be purchased with an optional download cable. The download cable connects to the Criterion's battery, and leads to a 9-pin connector.

The 9-pin connector is cabled as follows:

Criterion Laser (5-pin Lemo)	(9-pin female 'D' type)
5 Ground	5 Ground
4 Transmit	2 Receive
3 Receive	3 Transmit

The 9-pin connector can be plugged directly into the 'COM2:' port of your MC-V.


## Configuration for Use with Asset Surveyor

This section provides instructions for configuring the Criterion laser range-finder itself. See Section 4.2 for details of configuring the Asset Surveyor software to work with a laser range-finder.

### Entering Survey Mode

The Criterion 300 and 400 laser range-finders both support a 'SURVEY' mode of operation. This is the mode in which they will take range, azimuth and inclination measurements and can export these to your MC-V datalogger.

The following instructions describe the procedure to enter 'SURVEY' mode:

	<p><b>Note</b> - Each time you turn the Criterion laser range-finder on, you will have to re-enter 'SURVEY' mode.</p>
---	---

- 1. Turn on the Criterion by pressing the 'POWER' button (the bottom-left button on the back of the unit).**

If you have a Criterion 400, the main menu will appear with the 'TREE' entry visible:

TREE

If you have a Criterion 300, the main menu will appear with the 'HEIGHT' entry visible:

HEIGHT

2. Press the ↑ or ↓ arrow buttons until the 'SURVEY' menu appears:

SURVEY

3. Press the 'ENTER' button to select the 'SURVEY' menu.

The first entry in the 'SURVEY' menu is the 'BASIC MEASUREMENTS' operation:

BASIC  
MEASUREMENTS

4. Press 'ENTER' again to select 'BASIC MEASUREMENTS'.

The following screen will appear:

HD:-----.- FT  
AZ:-----.- DEG

Your Criterion is now ready to be used in conjunction with a datalogger running the Asset Surveyor software, as described later in this chapter.

✉	<p><b>Note</b> - To return to the Criterion's main menu, press the 'EXIT' button repeatedly.</p>
---	--

The following sections, 'Specifying Units', 'Enabling Measurement Errors', 'Entering a Compass Offset' and 'Ensuring Accurate Heights' describe further configuration which may make the Criterion laser range-finder easier to use and/or obtain better results. They may, however, be skipped if you

wish to immediately proceed to test the laser range-finder with your Trimble GPS system.

### Specifying Units

The Criterion laser range-finder allows you to select the units in which distances and angles are displayed on its LCD.



**Note** - The units displayed on the range-finder's LCD do *not* affect the interpretation of data by the Asset Surveyor software. They simply allow you to view distances and angles in whatever units are most suitable for your application.

You can change the Criterion's units as follows:

1. **Return to the range-finder's main menu (by pressing the 'EXIT' button repeatedly).**
2. **Press the ↑ or ↓ arrow buttons until the 'SYSTEM' configuration menu appears:**

SYSTEM

3. **Press the 'ENTER' button to select the 'SYSTEM' menu.**

The first entry in the 'SYSTEM' menu is the 'UNITS DEC.PRECISION' category:

UNITS  
DEC. PRECISION

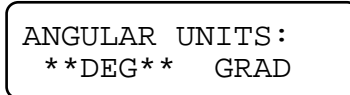
4. **Press 'ENTER' again to select 'UNITS DEC. PRECISION'.**

The following screen will appear:

LINEAR UNITS:  
\*\*ENG\*\* METRIC

The Criterion supports 'ENG' (i.e. English) and 'METRIC' linear distance units (i.e. feet or meters).

5. Use the ← or → arrow buttons to select 'ENG' or 'METRIC' and then press 'ENTER'.
6. Now press the ↓ arrow button to move on to the 'ANGULAR UNITS' screen:



ANGULAR UNITS :  
\*\*DEG\*\* GRAD

The Criterion supports 'DEG' (i.e. degrees) and 'GRAD' (gradians) as angular units.

7. Use the ← or → arrow buttons to select 'DEG' or 'GRAD' and then press 'ENTER'.
8. Press the 'EXIT' button twice to return to the Criterion's main menu.

### Enabling Measurement Errors

Laser Technology Inc. recommend that new users of the Criterion enable measurement error messages. By default, these messages are disabled. Once measurement error messages have been enabled, the range-finder will inform you whenever a measurement is invalid for some reason.

Once you become experienced with the Criterion range-finder, you can disable measurement errors if you wish.

To enable or change the measurement errors setting, follow this procedure:

1. Select the top-level 'SYSTEM' menu from the Criterion's main menu.
2. Press the ↓ arrow button to scroll down to the 'MEASUREMENT ERRORS' entry:



MEASUREMENT  
ERRORS

3. Press the 'ENTER' button.

The following screen will be displayed:

DISPLAY ERRORS? **YES**      NO
------------------------------------

4. Use the ← or → buttons to enable or disable the display of measurement error messages and then press 'ENTER'.
5. Press 'EXIT' twice to return to the Criterion's main menu.

When a measurement error is detected, the Criterion will display an error code on its LCD. The meaning of each code is indicated in the following table.

Message	Cause and Actions
Error 1	The laser range-finder failed to lock onto its target. Either the target was too close or it was out of range. Alternatively, the laser was not held steadily enough.
Error 2	The laser did not receive the minimum required pulses back to determine the range to the target. Hold the instrument steady and on target.
Error 3	The laser was moved off target while taking a reading. Keep the laser steady and on target.
Error 4	The tilt sensor is out of range. The maximum tilt angle permitted is $\pm 60^\circ$ .
Error 5	The fluxgate compass is outside its level range. When taking a compass reading, you must keep the instrument's tilt within a range of $\pm 15^\circ$ .

You must press the 'CLEAR' button to clear the error message.

### Entering a Compass Offset

The Criterion laser range-finders allow you to specify two compass offsets:


- A *Declination Offset*, which can be used to specify the local difference between magnetic North and true North, and
- A *Fixed Offset*, which can be used to ensure accurate alignment of the compass with the laser unit.

Your Criterion laser range-finder will have an accompanying 'Certificate of Calibration', which lists the pre-entered fixed compass offset, if any. It is safest not to modify this value.

You can, however, modify the *declination offset* to take account of local magnetic field variations. You should only do this if you are operating in an area where a local phenomenon such as large mineral deposit or mountain range has a substantial and stable influence on the earth's magnetic field.

Use the following procedure to modify the declination offset:


1. **Select the top-level 'SYSTEM' menu from the Criterion's main menu.**
2. **Press the ↑ or ↓ arrow buttons to scroll down to the 'COMPASS OFFSETS' entry:**



A rectangular box with rounded corners containing the text "COMPASS" on the top line and "OFFSETS" on the bottom line.

3. **Press the 'ENTER' button.**

The following screen will be displayed:





A rectangular box with rounded corners containing the text "DECLINATION DEG" on the top line and "0" on the bottom line, with a horizontal line under the "0".

4. **Use the numeric buttons on the right-hand-side of the Criterion's control panel to enter the local magnetic declination offset (in degrees or gradians, as previously configured).**

The maximum declination permitted by the Criterion laser range-finder is 30°.

5. **Press 'ENTER' to finish entering the declination.**
6. **Press 'EXIT' twice to return to the Criterion's main menu.**

	<p><b>Caution</b> - You will probably wish to use the Criterion laser range-finder separately from your MC-V Asset Surveyor datalogger. If this is the case, you will probably want to configure the laser's DECLINATION so that the bearings displayed by the Criterion are relative to true north. If you do so, you <i>must</i> set Asset Surveyor's 'Magnetic decl.' field to 0°, to avoid the declination being applied twice. If you use your Criterion laser range-finder exclusively with the MC-V Asset Surveyor datalogger, it is best to leave the laser's DECLINATION set to 0 and modify Asset Surveyor's 'Magnetic decl.' field; this enables Asset Surveyor to correctly convert other magnetic bearings to true north (e.g. when navigating, checking the positions of satellites, etc).</p>
	<p><b>Caution</b> - If you specify a local declination offset, you <i>must</i> ensure that you clear or re-specify this offset when you move to a new location.</p>

### Ensuring Accurate Heights

When you take a shot to a target point with the Criterion laser range-finder, the range-finder generates a three-dimensional offset to that target. This is used, in conjunction with a three-dimensional GPS position, to compute the position of the target in three dimensions. In order to obtain an accurate height for the target point, your configured antenna height must take account of the *difference* between the height of the GPS antenna and the height of the laser range-finder.

### Using the Criterion with Asset Surveyor

As mentioned previously, the practical accuracy of the fluxgate compass in typical field trials is around  $\pm 1-2^\circ$ . This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100-200m, the average positional error when using the Criterion range-finder is approximately 2m (in addition to the error of your GPS measurement).



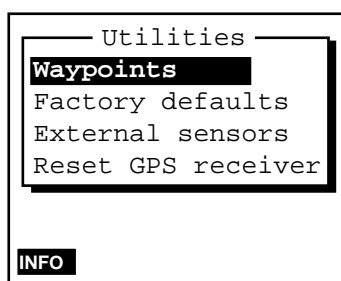


Connect the Criterion to its battery pack. Connect one end of the Criterion's download cable to the battery pack and plug the other end into the MC-V's 'COM2:' port.

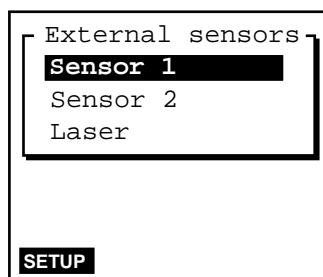
## Testing

When you first connect the Criterion 300 or 400 to your Trimble GPS system, you should test that it is correctly configured and that all components are working correctly.

The best way to achieve this is using the 'External sensors' entry in Asset Surveyor's 'Utilities' menu:

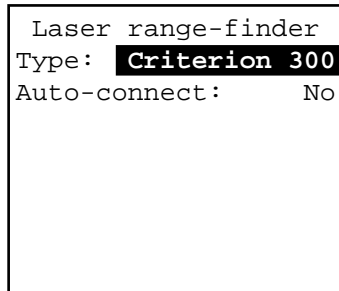


Select 'External sensors' and the menu of available sensors appears:




## Configuring Asset Surveyor

You should firstly configure the special 'Laser' sensor to work with the Criterion 300 or 400. To do this, press the **SETUP** soft key. The 'Laser range-finder' configuration form appears:



Set the 'Type' field to either 'Criterion 300' or 'Criterion 400'. If you will generally be using a Criterion range-finder when capturing data, and if you will typically *not* be using any other type of external sensor, then set the 'Auto-connect' field to 'Yes'.

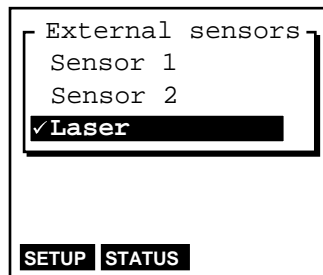


**Caution** - The RS232 protocols used by the Criterion 300 and 400 range-finders are different. You must specify the correct range-finder in the 'Type' field, otherwise Asset Surveyor will fail to communicate with your range-finder.

Press **OK** to save these settings and return to the 'External sensors' menu.

### Activating the Laser Interface

You can indicate to the Asset Surveyor software that you wish it to accept input from the laser range-finder by selecting the 'Laser' entry from the 'External sensors' menu. When you do this, the 'Laser' entry will be ticked, to indicate that the range-finder interface has been activated:



Once the range-finder interface has been activated (and so long as the 'Laser' entry in the menu is highlighted), one further **STATUS** soft key appears. Once the range-finder interface has been activated, Asset Surveyor

will accept communications from it. You can configure Asset Surveyor to *automatically* activate the laser range-finder interface when you start data capture by setting the 'Auto-connect' field to 'Yes', as described above.

If you attempt to activate the laser range-finder interface and the MC-V's 'COM2:' serial port is already in use by another sensor, Asset Surveyor displays the following message

```

  Error!
  COM1: - Unable to
  open serial port.
  This port may
  already be in use
  
```

and refuses to activate the range-finder interface.

### Checking the Laser Interface

When the laser range-finder is active (and highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the range-finder:

```

  Criterion 400
  Bearing:           ?
  Slope dist:       ?
  Inclination:      ?
  
```


**FORMAT**

You can press **FORMAT** to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser range-finder. If you take further readings using the range-finder, these will appear on the status form, replacing the previous reading.

You can take a reading with the Criterion range-finder and transmit it to Asset Surveyor as follows:


1. Follow the instruction sequence described earlier in this chapter to set the Criterion into 'SURVEY' mode.
2. Aim at a suitable target point at least 7m (20ft) away.
3. Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger, releasing it when you hear the laser acquiring lock on the target.

	<p><b>Tip</b> - Readings from the Criterion's compass and inclinometer are continually averaged as long as you hold the trigger. To maximize the accuracy of these measurements, you should pull and hold the trigger for up to 10 seconds.</p>
---	---

4. Hold the instrument completely still and on target until all sounds end.

The distance and azimuth to the target point will be displayed on the Criterion's LCD, e.g.

HD: 40.89 M  
AZ: 330.3 DEG

	<p><b>Caution</b> - You can press the ↑ and ↓ arrow buttons to view other values such as the vertical angle, slope distance, etc. <b>You must return to the screen showing HD and AZ before performing step 5 (below), otherwise the Criterion will not send the full measurement details to Asset Surveyor.</b></p>
---	--

5. Press the 'ENTER' button on the Criterion to transmit this measurement to Asset Surveyor.

If you were viewing the laser range-finder **STATUS** form, you would see the measurement arrive on the MC-V's screen:

```

Criterion 400
Bearing:      300.7°T
Slope dist:  40.890m
Inclination:  1.3°

FORMAT

```

Asset Surveyor displays the distance measurement in the currently configured 'Distance' units. The magnetic laser azimuth (bearing) is converted to a true North azimuth. If the configured 'North ref' is 'True', it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with a 'M' suffix).

✉	<p><b>Note</b> - If the configured 'Magnetic decl.' is 'Auto', Asset Surveyor's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination will be used for this conversion.</p>
★	<p><b>Tip</b> - You can press the Criterion's 'ENTER' button multiple times to send the same measurement to Asset Surveyor repeatedly. Use this technique to re-send a measurement if you discover that you had not connected all equipment or configured Asset Surveyor before taking the measurement with the laser.</p>

## Capturing Data

### Activating the Laser Interface

Within data capture, the laser range-finder interface can be activated in one of two ways:

- Automatically, if you had pre-configured the 'Laser' sensor's 'Auto-connect' field to 'Yes'.
- Manually, via the **EXT** soft key.

### Checking the Laser Interface

You can also use **EXT** to access the 'External sensors' menu to reconfigure the laser range-finder interface, or to check that the laser and Asset Surveyor are communicating correctly, as described above.

### Recording an Offset

Whenever you are capturing a point feature, you can use the Criterion laser range-finder to record an offset to the feature. You can record an offset to a line, area or quickmark feature only when you have pressed the **OFFSET** soft key to pop up the offset entry form for that feature.



**Tip** - You can turn off the Criterion when it is not being used to save its battery (e.g. when walking between features or when entering attributes). The range-finder can be used within seconds of turning it back on.

## 4.7 Laser Atlanta ProSurvey 1000

The ProSurvey 1000 produced by Laser Atlanta is a lightweight, hand-held laser device, suitable for use with Asset Surveyor for the automated recording of offsets.

### Hardware Specifications

#### Dimensions

The laser itself measures 8.4cm x 25.4cm x 27.9cm (3.3" x 10" x 11"). It weighs 1.9kg (4.25lbs), excluding the power cord. The casing is made from cast aluminum.

#### Laser Details

The laser can typically take measurements from 1.5m to 760m (5ft to 2500ft) to 'uncooperative' surfaces. For 'cooperative' targets (e.g. a reflector), the range of the laser is extended to 3050m (10000ft).

The laser is accurate to  $\pm 15.2\text{cm}$  (6").

#### Compass Details

A magnetic fluxgate compass is used to obtain azimuth measurements. The compass is rated at  $\pm 0.5^\circ$  under laboratory conditions. In typical GIS data capture conditions, the compass tends to accurate to around  $\pm 1-2^\circ$ . In environments where magnetic interference is high (e.g. in a vehicle), the compass can be considerably less accurate.

#### Inclinometer Details

A built-in inclinometer measures vertical angles, which are used to calculate the elevation of target points. The inclinometer is accurate to  $0.3^\circ$ .

#### Powering

The ProSurvey 1000 range-finder can be powered by either a rechargeable 12V NiCd battery or a 12V DC power source at 0.4 amps.

The standard ProSurvey 1000 battery charger takes approximately 15 hours to fully charge a battery (i.e. overnight).

## Environmental Limitations

The ProSurvey 1000 range-finder can be used at temperatures ranging between -30°C and +60°C (-22°F to +140°F). Relative humidity should not exceed 95%, non-condensing.

The ProSurvey should be stored at between -40°C and +80°C (-40°F to +176°F)

The range-finder should always be transported in its hard carry-case.

## Cabling for Use with Asset Surveyor

The ProSurvey 1000 laser range-finder can be purchased with an optional download cable. This cable provides a 9-pin connector which can be plugged directly into the 'COM2:' port of your MC-V.

## Configuration for Use with Asset Surveyor

This section provides instructions for configuring the ProSurvey 1000 laser range-finder itself. See Section 4.2 for details of configuring the Asset Surveyor software to work with a laser range-finder.

## EEPROM Configuration

The ProSurvey 1000 contains an electrically erasable and programmable ROM chip (or EEPROM), which is used to hold a wealth of configurable settings. You can view and modify these settings using the LAEEPROM program, which can be obtained from Laser Atlanta.

For operation with Asset Surveyor, it is critical that three of the EEPROM settings be correctly configured. These are:

- `range_mode`, which *must* be set to `Range (averaged)`,
- `rs232_output_mode`, which *must* be set to `ASCII range output (on trig release)`, and
- `range_opcode`, which *must* be set to `New ProSurvey format`.

If any of these settings is incorrect, the ProSurvey 1000 will not output information about each laser shot in a form that can be interpreted by Asset Surveyor. The most likely symptom is that Asset Surveyor will emit a warning beep each time the laser's trigger is released.



In addition, Trimble recommends that you set the `hud_mode` EEPROM setting to `Bearing`, so that you can watch the laser's compass bearing stabilize in the head-up display before taking each shot.

### Calibration of the ProSurvey 1000

Whenever you use the ProSurvey 1000 after storing it for a period, or in a new environment, you should *calibrate* the ProSurvey's compass. This is particularly important if you feel that the site in which you are working is 'hostile' in the sense of there being local magnetic field distortions (e.g. a vehicle, pipe-line, overhead or underground power cable, etc.). The purpose of calibration is to distribute compass error smoothly through a 360° circle.

Calibration of the compass is quick and extremely simple. Follow the instructions below:

**1. Press the compass calibration control on the side of the ProSurvey 1000.**

This control is a black indented button on the right side of the unit (looking from the back), above and in front of the laser trigger.

You will be prompted in the head-up display to point the ProSurvey 1000 in approximate directions starting at 0° (due North), then turning clockwise to 45° (North East) and working around to 315° (North West) in increments of 45°.

**2. Point in the indicated direction, wait for a few seconds to allow the compass to stabilize, and squeeze the laser's trigger.**

After each squeeze of the trigger, the head-up display will indicate the next point of the compass.

**3. After aiming in the 315° direction and squeezing the trigger, the rear panel of the ProSurvey 1000 will indicate a 'Noise' value, ranging from 0 to 9.**

The higher the value, the better the calibration. If the 'Noise' value is below 5, you should perform the calibration again.

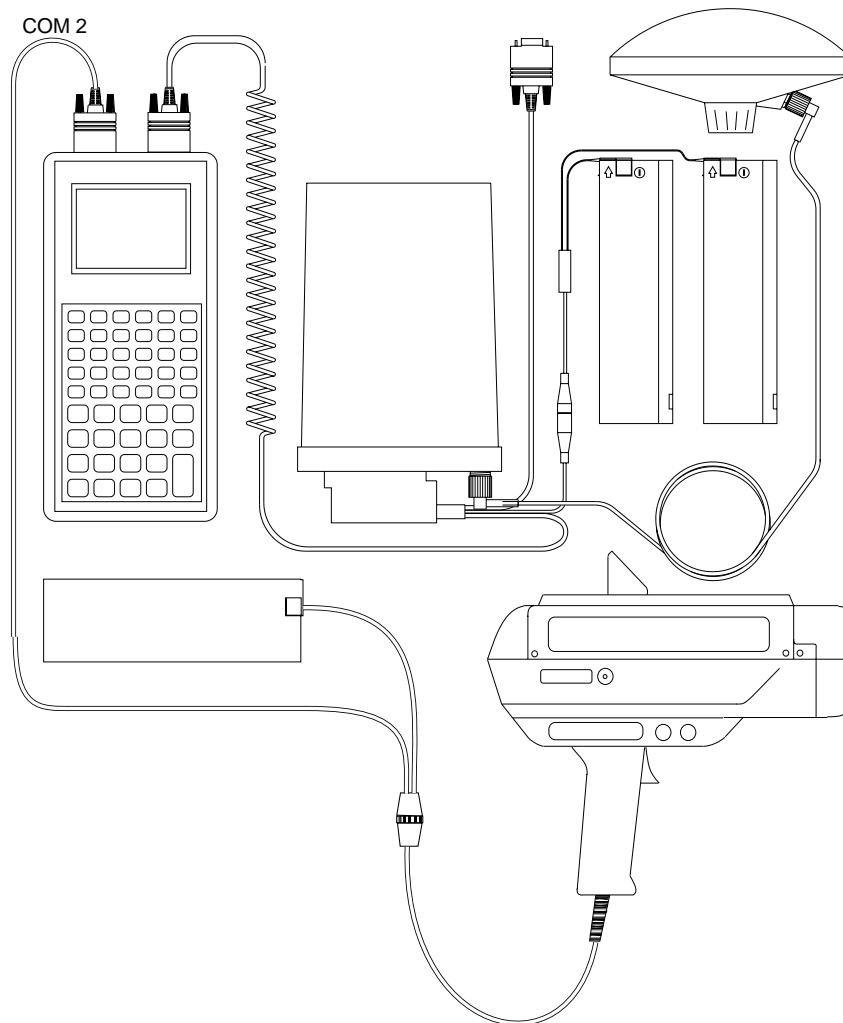
✉	<p><b>Note</b> - The calibration procedure does not modify the compass's idea of where magnetic north is. It simply distributes local distortion of the earth's magnetic field evenly through a 360° circle. This is important to ensure that compass readings are locally consistent. If you wish to account for an error in the compass's determination of magnetic north, you should do this by entering a new value for the 'Magnetic decl.' field in Asset Surveyor's 'Units and display' configuration form.</p>
---	--

### Using the ProSurvey 1000 with Asset Surveyor

As mentioned previously, the practical accuracy of the fluxgate compass in typical field use is around  $\pm 1-2^\circ$ . This yields a steady reduction in accuracy as the distance between the laser and a target point increases. At a distance of 100-200m, the average positional error when using the ProSurvey 1000 is approximately 2m (in addition to the error of your GPS measurement).

### Cabling for the Pro XL

If you have a Pro XL GPS receiver, you should connect the ProSurvey 1000 laser range-finder to your receiver and datalogger as shown in Figure 4-2.



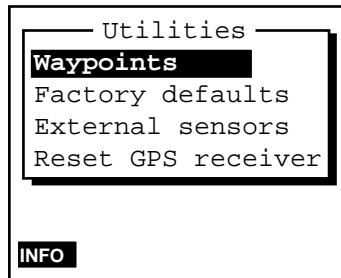
**Figure 4-2 ProSurvey 1000 Laser Range-finder Cabling Diagram**

Connect the ProSurvey 1000 to its battery pack, and plug the 9-pin connector into the MC-V's 'COM2:' port.

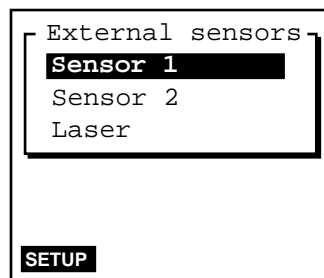
## Testing

When you first connect the ProSurvey 1000 to your Trimble GPS system, you should test that it is correctly configured and that all components are working correctly.

Select the 'Utilities' entry from Asset Surveyor's 'Main menu':

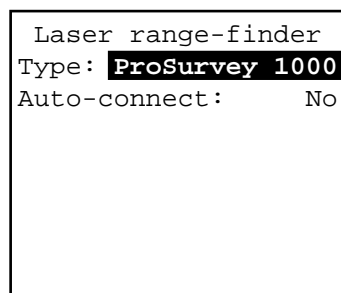


Select 'External sensors' from the 'Utilities' menu. The menu of available sensors appears:



## Configuring Asset Surveyor

You should firstly configure the special 'Laser' sensor to work with the ProSurvey 1000. To do this, press the **SETUP** soft key. The 'Laser range-finder' configuration form appears:

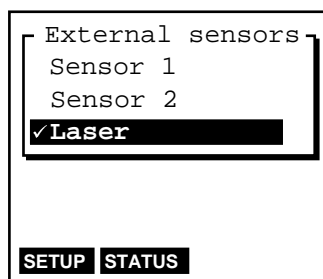


Set the 'Type' field to 'ProSurvey 1000'. If you will generally be using the ProSurvey 1000 range-finder when capturing data, and if you will typically *not* be using any other type of external sensor, then set the 'Auto-connect' field to 'Yes'.

Press **OK** to save these settings and return to the 'External sensors' menu.

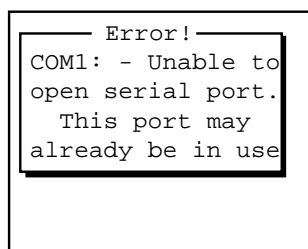
### Activating the Laser Interface

You can indicate to the Asset Surveyor software that you wish it to accept input from the laser range-finder by selecting the 'Laser' entry from the 'External sensors' menu. When you do this, the 'Laser' entry will be ticked, to indicate that the range-finder interface has been activated:



Once the range-finder interface has been activated (and so long as the 'Laser' entry in the menu is highlighted), one further **STATUS** soft key appears. Once the range-finder interface has been activated, Asset Surveyor will accept communications from it. You can configure Asset Surveyor to *automatically* activate the laser range-finder interface when you start data capture by setting the 'Auto-connect' field to 'Yes', as described above.

If you attempt to activate the laser range-finder interface and the MC-V's 'COM2:' serial port is already in use by another sensor, Asset Surveyor displays the following message



and refuses to activate the range-finder interface.

### Checking the Laser Interface

When the laser range-finder is active (and highlighted in the list of external sensors), you can press **STATUS** to pop up a status form for the range-finder:


ProSurvey 1000	
Bearing:	<b>?</b>
Slope dist:	?
Inclination:	?
<b>FORMAT</b>	

You can press the **FORMAT** soft key to toggle between displaying slope distance/inclination and horizontal/vertical distance.

This form shows the most recent offset received from the laser range-finder. If you take further readings using the range-finder, these will appear on the status form, replacing the previous reading.

You can take a reading with the ProSurvey 1000 and transmit it to Asset Surveyor as follows:

1. **Turn on the ProSurvey 1000, and optionally calibrate it (as described earlier).**
2. **Aim at a suitable target point. Wait for the bearing in the head-up display to stabilize.**

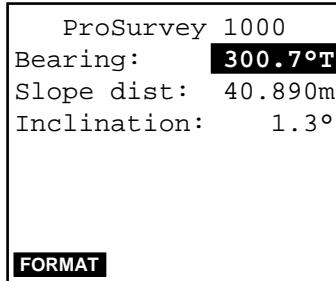
	<p><b>Caution</b> - <i>If you do not wait until the bearing in the head-up display settles down before pulling the laser's trigger then the compass measurement may be seriously inaccurate.</i></p>
---	--

3. **Keeping a steady hold on the instrument, aim through its scope and carefully pull the trigger.**

The distance to the target point will now be displayed on the ProSurvey 1000's head-up display. The bearing and inclination are displayed on the LED.

4. **Release the trigger. When you do this, the ProSurvey 1000 sends its measurement to the MC-V.**

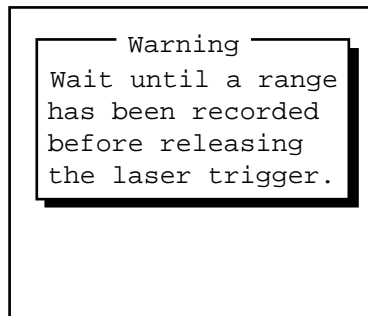
If you were viewing the laser range-finder **STATUS** form, you would see the measurement arrive on the MC-V's screen:



Asset Surveyor displays the distance measurement in the currently configured 'Distance' units. The laser azimuth (bearing) is converted to a true North azimuth. If the configured 'North ref' is 'True', it is immediately displayed as a true North bearing (with a 'T' suffix); otherwise it is displayed as a magnetic North bearing (with a 'M' suffix).

✉	<p><b>Note</b> - If the configured 'Magnetic decl.' is 'Auto', Asset Surveyor's internal magnetic declination model is used to convert the magnetic laser bearing to a true north bearing. Otherwise, the manually entered declination will be used for this conversion.</p>
⚠	<p><b>Caution</b> - The ProSurvey 1000 always emits compass bearings relative to magnetic north. You <i>must</i> either specify your local magnetic declination or set the 'Magnetic decl' field to 'Auto', otherwise Asset Surveyor will not correctly convert the magnetic compass bearings to true north.</p>

The ProSurvey 1000 takes a few seconds to take a laser distance reading (although the bearing and inclination can be read almost immediately). If Asset Surveyor receives a message from the ProSurvey 1000 which lacks a distance measurement, the following warning message is displayed:



## Capturing Data

### Activating the Laser Interface

Within data capture, the laser range-finder interface can be activated in one of two ways:

- Automatically, if you had pre-configured the 'Laser' sensor's 'Auto-connect' field to 'Yes'.
- Manually, via the **EXT** soft key.

### Checking the Laser Interface

You can also use the **EXT** to access the 'External sensors' menu to reconfigure the laser range-finder interface, or to check that the laser and Asset Surveyor are communicating correctly, as described above.

### Recording an Offset

Whenever you are capturing a point feature, you can use the ProSurvey 1000 laser range-finder to record an offset to the feature. You can record an offset to a line, area or quickmark feature only when you have pressed the **OFFSET** soft key to pop up the offset entry form for that feature.



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