T100HRD Autocollimator Data Sheet (21 May 2015)

1.0 Introduction

The T100HRD is a compact digital autocollimator designed for use with a computer. Power input and data output are via a single USB 2.0 connection.

2.0 Manufacturer

Micro-Radian Instruments, 485 W Horton Road, Bellingham, WA 98226 USA

3.0 General Specifications

Beam diameter (nominal)	25 mm
Maximum recommended working distance*	1000 mm
Recommended minimum target mirror size	50 mm diameter
Maximum calibrated measuring range*	±600 arc-seconds
Measurement output rate (user-adjustable)	4000 readings-per-second
Output resolution	0.01 arc-second
Accuracy over entire measuring range (% of full scale)	>99.5%
Cross-coupling over entire measuring range (% of full scale)	<0.2%
Light source	red LED
Power input requirements	+5VDC ±5%, 1 Watt
Weight	498 g
Operating temperature (calibrated)	20°C ±0.2°C
Operating/Storage temperature (maximum rated)	-40°C to +70°C

*Maximum working distance and maximum measuring range are not simultaneously achievable.

4.0 Housing

The standard T100 housing is used. The body and cover are each machined from a solid block of 6061 aluminum and black anodized inside and out. The part number and serial number are permanently engraved on the top surface.

5.0 Electronics

The T100HRD contains digital electronics and outputs data via USB 2.0. The electronics include digital signal processing and a full calibration covering the entire measuring range of the device.   The time average of the data and data units are user-adjustable.

6.0 Cable assembly specifications

Cable connector	USB 2.0
Cable length	3 meters
Cable shielding	internal metal braid
Cable jacket	overall black PVC
Connector pinouts	

Connector pin 1 = +5 VDC ±5% input

Connector pin 2 = USB DM

Connector pin 3 = USB DP

Connector pin 4 = Power ground

7.0 USB output specifications

Maximum measuring range	±600 arc-seconds
Output resolution	0.01 arc-second
Output sampling rates (samples/second)	4000, 1000, 100, 10, 1, 0.1 and 0.01
Output units (user-adjustable)	arc-seconds or micro-radians
BIT output	0 or 1, corresponding to invalid (0) or valid (1) angle data
Output format	comma separated ASCII text

Output sequence for 4000 and 1000 samples/second setting

signed integer-only AZ data,signed integer-only El data,BIT<carriage return>

For example:

+1234,-4321,1<carriage return>

Output sequence for 100, 10, 1, 0.1 and 0.01 samples/second setting

signed AZ data,signed El data,BIT,signal level,head temperature<carriage return>

For example:

+1234.567,-7654.321,1,98,21.5<carriage return>

8.0 BIT (built in test) output

The BIT output indicates whether the current data being sent by the autocollimator is valid or invalid. Invalid data will result if the mirror angle is out of range or if the autocollimator is otherwise not receiving a signal. The BIT output reads 1 when readings are valid and 0 when readings are invalid.

9.0 USB Port Commands

9.1 The following commands can be sent via the USB port to the autocollimator. Command letters are case-sensitive and only the command letter should be sent. Sending an additional character such as carriage return or line feed or an undefined character will be interpreted as an E command and will terminate data transmission.

9.2 To request data from the autocollimator, use one of the following three commands:

Command	Result
A	One reply is sent immediately
B	One reply is sent after a delay of one Output Average period
C	Replies are sent continuously at the rate of the Output Average period

9.3 To change any of the user-adjustable settings, use the following commands. The user-adjustable settings in use at the time that the autocollimator is powered down will be the default settings when the autocollimator is next powered up.

Command	Result
E	Stop data transmission
H	Set data units to Arc-Seconds
I	Set data units to Micro-Radians
O	Sends identification message
a	Set to output 4000 samples/sec (output averaging of 0 second)
b	Set to output 1000 samples/sec (output averaging of 0.001 second)
c	Set to output 100 samples/sec (output averaging of 0.01 second)
d	Set to output 10 samples/sec (output averaging of 0.1 second)
e	Set to output 1 sample/sec (output averaging of 1 second)
f	Set to output 0.1 sample/sec (output averaging of 10 seconds)
g	Set to output 0.01 sample/sec (output averaging of 100 seconds)

9.4 Identification message

The identification message reply from sending the O command includes information specific to the autocollimator. The format of the identification message is as follows:

(U1AI) message identifier,autocollimator model and serial number,last calibration date,working distance,autocollimator software revision,output averaging,units,required minimum signal %,calibrated span,special calilbration message

For example:

U1AI,T100HRD s/n 1234,MAR 18 2013,2.0 in,A1.00,0.1 sec,Arc-Sec,20,1200,Special Calibration Message

10.0 Graphical User Interface (GUI)

The autocollimator includes a USB driver and LabView-based GUI suitable for Windows XP, Vista, 7 and 8. All USB port commands can be controlled by the GUI, and data from the autocollimator is displayed numerically and graphically.
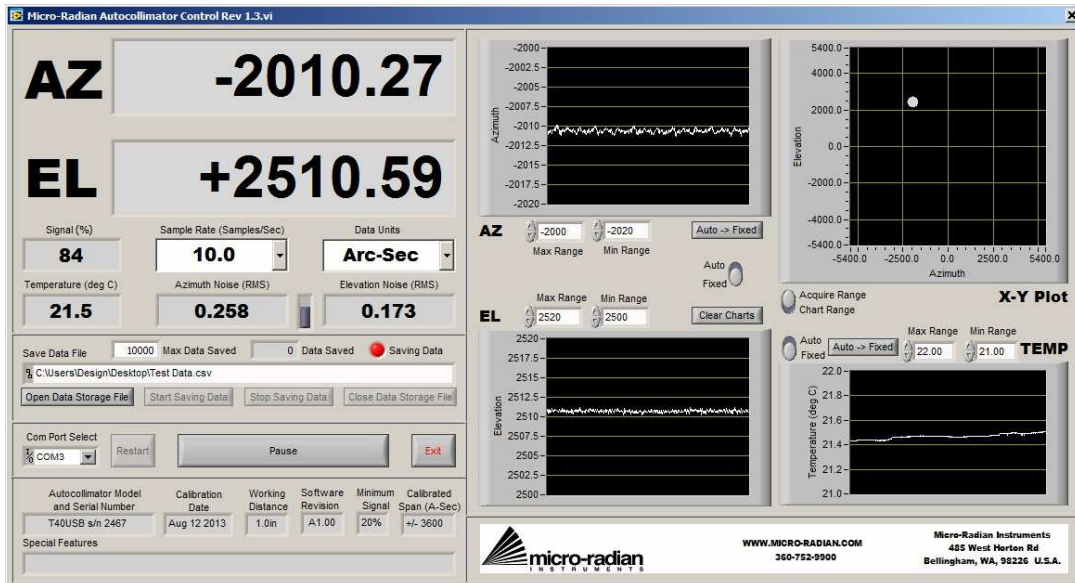
11.0 Modulation and Sampling

The optical head light source is modulated at 4 kHz and the autocollimator samples once per modulation cycle at all times regardless of the user-adjustable settings. This is one sample every 250 microseconds. The modulation source is built-in. No external modulation source is required.

For the USB output, the time period average (moving average) of this oversampled data is user adjustable. For example, the 1 sample/sec setting gives the moving average of the last 1 second of data with a delay of 250 microseconds. The maximum data rate from the USB output is 4000 samples/sec with a 250 microsecond delay.

12.0 Calibration

The autocollimator uses DSP processing and all output data is fully calibrated. Errors in the detector are corrected using a 33x33 point look up table. The table is generated by comparing the autocollimator output to an angle standard calibrated by the Swiss Federal Institute of Metrology (METAS) in Wabern, Switzerland. Once the autocollimator is programmed with the look up table, verification scans are performed to confirm that the corrected outputs match the standard. Verification data and a certificate of traceability to METAS are included with the autocollimator.

The calibration is performed at 20°C ±0.2°C and with a 50mm, >98% reflective mirror. The mirror is flat to 1/10 wave. All calibration measurements are taken with the autocollimator in its 1 sample/sec setting.

13.0 Measurement Orientation and Mounting

The optical head contains no moving parts and can be mounted in any orientation. However, references to azimuth and elevation are correct when the optical head mounting (bottom) surface is parallel to the earth. The optical head is designed to be mounted using three #6-32 threaded holes on its mounting surface.

All measurements from the optical head are of the actual target angle and no compensation is required to convert beam angle to target angle.

14.0 Outline and Mounting (inches)