T40S Autocollimator Data Sheet (9 January 2017)

1.0 Introduction

The T40S is a compact analog autocollimator designed for use in analog servo systems. The T40S measures simultaneously in 2 axes and provides analog voltage outputs that are scaled to angle. To minimize the size, the power supplies and modulation source are not included and must be provided externally.

2.0 Manufacturer

Micro-Radian Instruments, 485 W Horton Road, Bellingham, WA 98226 USA (CAGE 50223)

3.0 General Specifications

Beam diameter (nominal)	17 mm
Maximum recommended working distance	25 mm
Recommended minimum target mirror size	25 mm diameter
Maximum calibrated measuring range	±3600 arc-seconds (±1 degree)
Maximum output cutoff frequency	25 kHz
Noise (rms, typical)	20 mV @ 190 Hz cutoff frequency
Output resolution (noise limited)	8 arc-seconds @ 190 Hz cutoff frequency
Accuracy over entire measuring range (% of full scale)	98%
Cross-coupling over entire measuring range (% of full scale)	<0.2%
Light source	red LED
Input requirements	+15 VDC @ 5 mA typical
	-15 VDC @ 5 mA typical
	+5 VDC @ 25 mA typical
	50 kHz square wave, 50% duty cycle, TTL levels
Weight	3.78 oz
Operating temperature (calibrated)	20°C ±0.2°C
Operating temperature (maximum rated)	-40°C to +50°C
Storage temperature (maximum rated)	-51°C to +85°C

4.0 Housing

The standard T40 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 bottom surface.

5.0 Electronics

The T40S contains analog-only electronics. There is ESD protection on all signal inputs and outputs which include a 100 ohm series resistor. This should be considered if load impedances are different from the loads used in calibration. Micro-Radian uses 10K ohm load resistors for all analog output measurements.

The LED light source is powered directly from the +5 VDC power supply. Changing the +5 VDC supply voltage directly changes the LED optical power output and thus the analog signal outputs.

6.0 Cable assembly specifications

Cable connector	uD-15
Cable length	2.95 ±.1 inches (or as specified by customer)
Cable shielding	none
Cable jacket	overall black PVC

Connector pinouts

- Connector pin 1 = EEPROM clock
- Connector pin 2 = EEPROM data
- Connector pin 3 = 50 kHz clock
- Connector pin 4 = BIT output
- Connector pin 5 = +15 VDC input
- Connector pin 6 = X angle + output
- Connector pin 7 = Y angle - output
- Connector pin 8 = X angle - output
- Connector pin 9 = +5 VDC return
- Connector pin 10 = Signal return
- Connector pin 11 = +5 VDC input
- Connector pin 12 = -15 VDC input
- Connector pin 13 = Temperature output
- Connector pin 14 = Y angle + output
- Connector pin 15 = ±15 VDC return

7.0 Analog output specifications

Output measuring range	±3600 arc-seconds (±1 degree)
Output scale factor	±10 VDC ±5% for ±3600 arc-seconds
Output resolution (noise limited)	8 arc-seconds @ 190 Hz cutoff frequency
BIT output	±5 VDC, corresponding to valid (+5 VDC) or invalid (-5 VDC) data
Temperature output	1uA/°K current output

8.0 EEPROM

An on-board 256 byte Microchip 24C02C serial EEPROM is included to store serial number or other information at the customer's request.

9.0 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 analog BIT output reads +5 VDC when readings are valid and -5 VDC when readings are invalid. The BIT function is implemented by comparing the total received illumination with a voltage derived directly from the -15 VDC power supply. Changing the -15 VDC supply output will change the point where the BIT is triggered. The signal measured by the BIT circuit is filtered by a 16 Hz low-pass filter, which sets its response time.

10.0 Temperature output

Internal temperature is provided by an Analog Devices AD590. The scale factor is 1uA/°K. The temperature sensor is powered by the +15 VDC. The temperature provided is not calibrated and is designed to monitor temperature change and drift. It should not be used to measure absolute temperature.

11.0 Modulation and Sampling

The T40S requires an external modulation source. The modulation source must provide a 50 kHz square wave, 50% duty cycle, TTL levels. Varying the duty cycle will change the calibration. The T40S samples once per modulation cycle and the output cutoff frequency is set at the factory. Any value up to 25 kHz is permissible, although high frequency measurements will be accompanied by high noise. The lowest possible cutoff frequency is recommended and additional external averaging can be done to further reduce noise.

12.0 Calibration

The T40S calibration consists of setting the analog scale factor close to ±10 VDC for ±3600 arc-seconds. No additional calibration is performed. The scale factor is generated and verified by comparing the autocollimator outputs to an angle standard calibrated by the Swiss Federal Institute of Metrology (METAS) in Wabern, Switzerland. A test report and a certificate of conformance are included with the autocollimator. The actual analog scale factor generated will be indicated on the test report.

All tests are performed at 20°C ±0.2°C and with a 50mm, >98% reflective mirror. The mirror is flat to 1/10 wave.

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 #4-40 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)