

SAMPLE PRODUCT – ALL PARAMETERS SUBJECT TO CHANGE

## FEATURES

- Fully featured evaluation board for the AMS3140-01**
- Enables quick prototyping**
- User defined circuit configuration**
- Easy connection to test equipment and other circuits**
- Differential and single-ended outputs**

## EVALUATION KIT CONTENTS

- AM Evaluation Board**
- AMS3140-01 Module**
- Flash Drive Memory Stick with documentation**
- Heatsink**
- Adapter for optical posts**



Figure 1. The AM Evaluation Board with module

## GENERAL DESCRIPTION

AM Evaluation Kit allows easy experimental measurements with AMS3140-01 module without custom electronics design. It is designed to allow fast setup on optical tables without deep knowledge about electronics or thermal design. AM Evaluation Kit schematic can be used as reference for designing custom circuits.

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## REVISION HISTORY

- 09/12/2021 – Revision 0: Initial Version
- 05/01/2022 – Revision 1: AMS module name changed
- 04/03/2022 – Revision 2: Figures 10, 11 and 12 were completed with pictures.

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage VCC+5V	5.5V
Input current VCC+5V	1A
Storage temperature range	-40°C to 85°C
Storage humidity	10% to 90%
Operating temperature	0°C to 85°C

## ESD CAUTION

**ESD (electrostatic discharge) sensitive device.** Charges devices and circuit boards can discharge without detection. Damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## CONFIGURATION AND HARDWARE LAYOUT

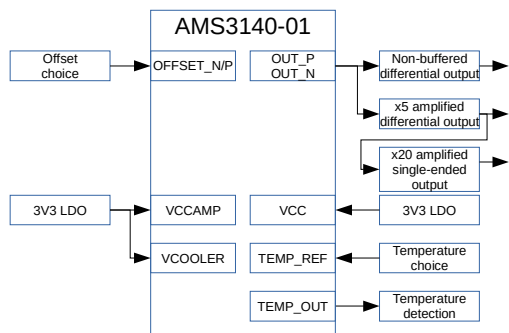


Figure 2. Hardware block diagram

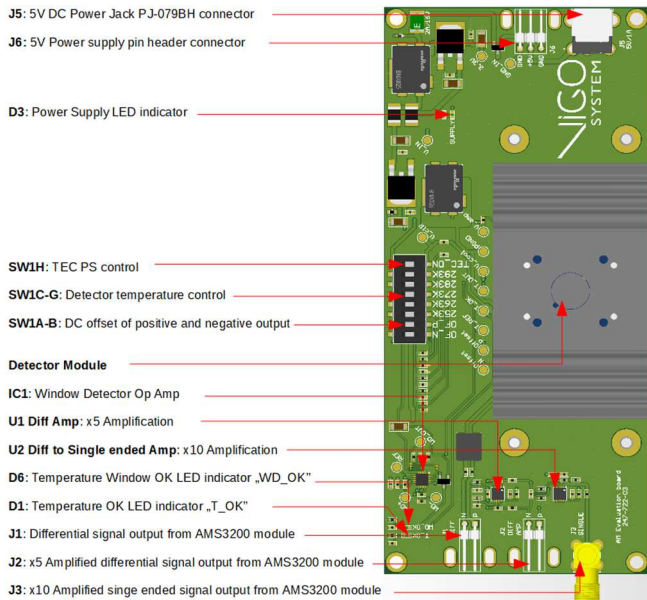


Figure 3. AM Evaluation board layout

## AMS3140-01 CONNECTOR VS. AM EVALUATION BOARD CONNECTOR

Table 1. Comparison of AMS3140-01 connector and mating connector AM Evaluation board J4

AMS3140-01 J1 PIN	AM Evalkit J4 PIN	Pin name
1, 3, 5, 11	3, 9, 11, 13	GND
7	7	OUTPUT_P
9	5	OUTPUT_N
12	4	NC
2	14	TEMP_OUT
4	12	TEMP_OK
6	10	TEMP_REF
13	1	Vamp
8	8	Vcc
10	6	OFFSET_P
14	2	OFFSET_N
MP3, MP4	MP1, MP2	Vcooler
MP1, MP2	MP3, MP4	P_GND

## POWER SUPPLY

AM Evaluation board can be supplied using either J5 or J6. J5 and J6 share common positive supply and common GND.

Table 2. Power Supply connectors

Connector number	Manufacturer	Part Number	Mating connector Part Number
J5	CUI Devices	PJ-079BH	PP-050B
J6	Amphenol	68016-403HLF	75915-403LF

The board is protected against reversed polarization power supply by T1 NMOSFET which separates circuit from input power supply. Additionally in series with positive power supply line there is a fuse on PCB.

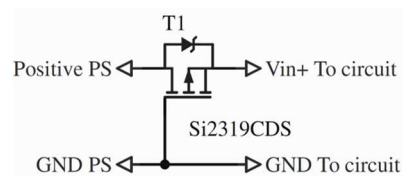


Figure 4. Circuit separation from input power supply

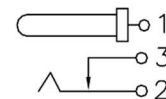
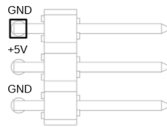


Figure 5. J5 connector scheme

Table 3. J5 connector description

Pin number	Description
1	+5V
2, 3	GND



**Figure 6. J6 connector on board**

**Table 4. J6 connector description**

Pin number	Description
2	+5V
1, 3	GND

D3 indicates if Power Supply is connected or not.

## TEMPERATURE CONTROL OF THE DETECTOR

By default power supply for TEC controller is switched ON and detector temperature is 283K. By changing state of SW1H TEC controller can be switch ON or OFF.

This feature is useful when user want to have 100% certainty that TEC is switched off and the detector has room temperature without active stabilization.

When TEC controller is switched ON user can chose at which temperature the detector would be stabilized. There are few options provided with AM Evaluation board for convenience of the user. User can switch between options by setting manually switch SW1 from SM1C to SW1G.

**Table 5. Set of default states for detector temperature control**

Temp. [K]	Resistance [kΩ]	C	D	E	F	G	H
243	infinity	OFF	OFF	OFF	OFF	OFF	ON
253	35	ON	OFF	OFF	OFF	OFF	ON
263	14.7	OFF	ON	OFF	OFF	OFF	ON
273	7.890	OFF	OFF	ON	OFF	OFF	ON
283	4.7	OFF	OFF	OFF	ON	OFF	ON
293	2.889	OFF	OFF	OFF	OFF	ON	ON

There is no restriction to switch ON multiple switches in SW1C-G set in the same time. The resistors would be connected in parallel and the resultant temperature could be determined from figures from AMS3140-01 user manual.

Please note that in AMS3140-01 module TEC can only be used to cool down the detector not warm it up. Because of that detector temperature is controlled only when ambient temperature is higher than detector temperature. Otherwise detector temperature will follow ambient temperature changes.

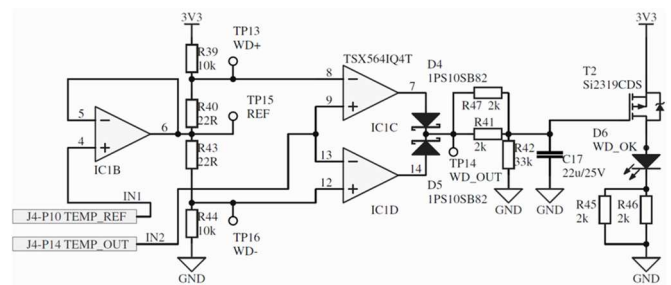
It is available to set TEC controller to control detector temperature at 243K or even lower. The limitation is a maximum temperature difference that TEC element can give under environment conditions. The most significant factor is heatsink temperature. Detector temperature lower than 253K can be achieved by:

- Improving heatsink performance e.g. reducing thermal resistance.
- Cooling down heatsink e.g. by cooled air or by TEC element.

When desired temperature is set e.g. 263K the TEC controller will start cooling and after a short moment two indicators will show the state. “T\_OK” LED indicator will show AMS3140-01 internal indicator state and “WD\_OK” LED indicator will show window comparator detector state (see Figure 3).

Onboard test points TP2 (J4-P14 TEMP\_OUT), TP1 (J4-P14 TEMP\_OK) and TP12 (J4-P10 TEMP\_REF) can be used to determine how TEC controller works. On TP12 reference voltage set by SW1 can be measured and on TP2 detector thermistor voltage can be measured. By observing TP2 and TP12 state of AMS3140-01 onboard TEC controller can be monitored manually. Please note that if voltage on TP12 did not reach TP2 voltage value the built-in temperature regulator in the module did not reach its stable point. This can be caused by to low desired temperature of detector and/or by insufficient heatsink capabilities

## WINDOW COMPARATOR



**Figure 7. Window comparator scheme used on AM Evaluation board**

AM Evaluation board provides window comparator of “TEMP\_REF” (TP12) and “TEMP\_OUT” (TP2) signals. Compared to AMS3140-01 internal simple comparator (“TEMP\_OK” output signal J4-12, TP1) it has window of ±4mV and its LED indicator “WD\_OK” is on only when difference of both input signals are less than that window.

**Table 6. Window comparator transfer table**

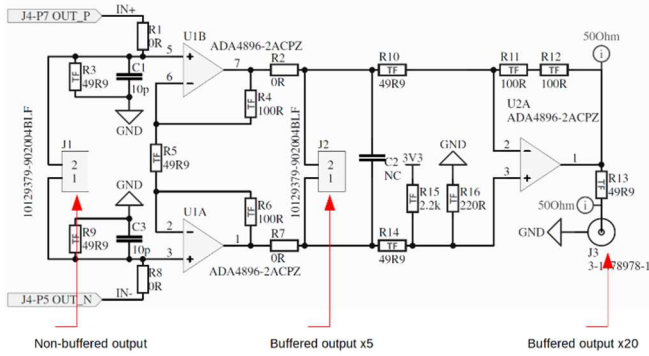
“J4-P10 TEMP-REF” – “J4-P14 TEMP_OUT” [mV]	“WD_OK” state
>2	OFF
-4.97<x<-0.94	ON
<6.05	OFF

The module provides constant responsivity only when detector temperature is stable. After powering on the module the built-in temperature controller starts the cooling process. Before the controller reaches its stable point, parameters (i.e. voltage responsivity) should be considered unknown. In steady state TEMP\_OUT and TEMP\_REF should be equal. Window comparator on AM Evaluation board provides reliable information when detector parameters are stable.

## SIGNAL OUTPUTS

**Table 7. Output signal connectors**

Connector number	Manufacturer	Part Number
J1/J2	Amphenol	10129379-902004BLF
J3	TE Connectivity	3-1478978-1



**Figure 8. Output signal circuit**

Output signal circuits consist of two amplification stages and three outputs. J1 connector provides direct, non-buffered access to differential signal from AMS3140-01 module. First stage amplifier U1A and U1B has x5 differential gain. It amplifies signal from AMS3140-01 module. J2 connector provides buffered and amplified x5 differential signal from AMS3140-01. Second stage amplifier U2A has x4 gain but it amplifies signal from first stage amplifier not direct signal from AMS3140-01 module. J3 provides buffered, amplified x20 single ended signal with convenient SMA connector suitable for RF frequency scopes and spectrum analysers. Note that if receiver with 50Ω input would be connected to J3 the signal will be reduced by half.

## OFFSET CHOICE

The AMS3140-01 module is designed to keep the DC output offset as low value as possible. However in some applications (i.e. direct connection to differential ADC) it may be beneficial to introduce some known value to DC component. This can be done by connecting OFFSET\_P pin to  $V_{cc}$  and OFFSET\_N pin to GND.

This approach can be used to match full scale of differential ADC. If lower offset is required additional resistor may be used and soldered as R26 and R27 on AM Evaluation board. AMS3140-01 module datasheet provides equation for such calculation.

By default DC offset choice switches SW1A/B are set to OFF state and both J4-P7 OUT\_P and J4-P5 OUT\_N are set to the same DC values.

**Table 8. Default DC offset of OUT\_P and OUT\_N measured with 1 MΩ probe. SW1A/B set to OFF.**

Connector	DC offset [mV]
J1-1, J1-2	612
J2-1, J2-2	613
J3	300

By changing switches SW1A/B to ON state the DC offsets on both outputs J4-P7 OUT\_P and J4-P5 OUT\_N are set to have different values. DC offset at J4-P7 OUT\_P was designed to be around 2V and DC offset at J4-P5 OUT\_N was designed to be around 300mV. Values measured on J1 connectors pins are only half of those values because R3 and R9 together with 50Ω output resistance of AMS3140-01 creates resistive divider.

Evaluation board amplifier is prepared to transmit signal from DC signal. Due to the offset change J4-P7 OUT\_P and J4-P5

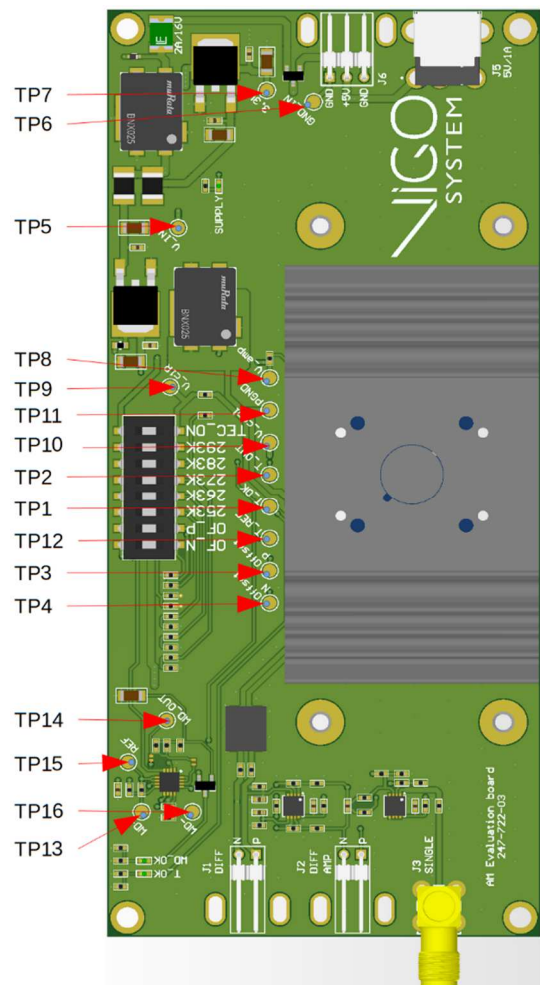
OUT\_N have large difference which cause outputs of amplifiers U1 and U2 (Figure 8) to saturate.

**Table 9. DC offset of OUT\_P and OUT\_N measured with 1 MΩ probe. SW1A/B set to ON**

Connector	DC offset [mV]
J1-1	941
J1-2	124

To fully use DC offset change feature signal should be transmitted from J1 connector to external receiver e.g. ADC. In that case R3, R9, C1, C3 need to be removed. Signal need to be transmitted using special signal transmission line to prevent from interference of external noise. See chapter Signal outputs for more information.

## TEST POINTS



**Figure 9. Test Point locations on AM Evaluation board and their names**

**TP1:** J4-P12 “TEMP\_OK” signal. Can be used to check AMS3140-01 temperature simple comparator state.

**TP2:** J4-P14 “TEMP\_OUT” signal. Represents current temperature of the detector. Can be used to check of AMS3140-01 chip temperature.

**TP3:** J4-P6 “OFFSET\_P” signal. Can be used to connect auxiliary voltage source e.g. DAC for DC offset control of OUT\_P.

**TP4:** J4-P2 “OFFSET\_N” signal. Can be used to connect auxiliary voltage source e.g. DAC for DC offset control of OUT\_N.

**TP5:** AM Evaluation board input positive Power Supply voltage. Can be used to determine if PS passed through T1, fuse F1, ESD diode D2 and common mode filter F2. It also can be used to check if F2 reduces noise from PS line.

**TP6:** AM Evaluation board GND.

**TP7:** 3V3 power supply for AM Evaluation board electronic. It is not connected to AMS3140-01.

**TP8:** 3V3 power supply for both power supplies of AMS3140-01.

**TP9/TP10:** 3V3 power supply for TEC element on AMS3140-01 module. TP9 is separated from TP8 by SW1H. TP9 can be used to check if TEC element has power supply or not. TP10 and TP9 are connected together via R30 = 100mΩ resistor. By checking the voltage on R30 the TEC current can be calculated  $I_{TEC} = V_{R30} / R_{30}$ .

**TP11:** PGND signal which is GND power supply for TEC element. Its connected to GND signal via F3 common mode filter.

**TP12:** J4-P10 “TEMP\_REF” signal. Represents desired temperature of the detector. Can be used to check temperature reference voltage for TEC controller either internal AMS3140-01 module or set on AM Evaluation board.

**TP13/TP16:** Internal signals of Window Comparator.

**TP14:** Window Comparator output signal. Can be used to measure Window Comparator transfer characteristic.

**TP15:** Buffered J4-P10 “TEMP\_REF” signal.

## AM EVALUATION BOARD AMPLIFIERS CIRCUIT CONSIDERATION

The gain of amplifier from Figure 8 can be calculated with equation:

$$G = \left(1 + \frac{2 * R_4}{R_5}\right) * \frac{(R_{11} + R_{12})}{R_{10}}$$

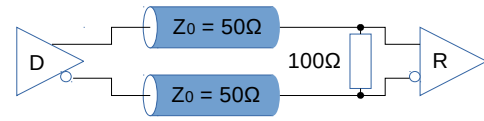
under conditions:  $R_4 = R_6, R_{15} || R_{16} = R_{11} + R_{12}, R_{10} = R_{14}$

Where first part of the equation is a gain from 1<sup>st</sup> stage amplifier and second part is a gain from 2<sup>nd</sup> stage amplifier.

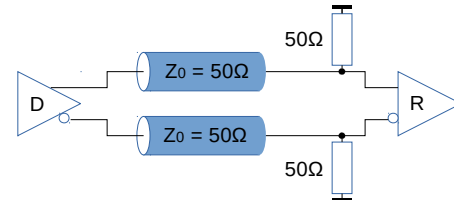
The impedance of both outputs J4-P7 OUT\_P and J4-P5 OUT\_N is fixed to 50Ω. If fast pulsed source of radiation is used and the shape of the rising or falling slope is important, both outputs should be terminated with 50Ω to GND. AM Evaluation board has 50Ω terminations for both output signals J4-P7 OUT\_P and J4-P5 OUT\_N (R3 and R9).

In case of receiving signal directly from J1 or J2 connector through any transmission line the receiver scheme should be chosen from those below. Also in this case R3 and R9 should be removed. Using proper line termination improves electromagnetic compatibility, enables the receiver to see the

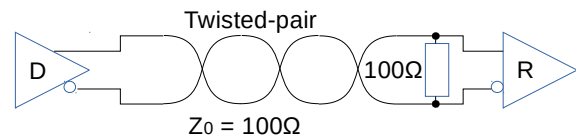
maximum signal power and prevents from signal reflections. There is no exact frequency value that is safe from signal reflections. Everything depends on user system and environment. Systems with long transmission lines can suffer from signal reflections with frequency starting from few kHz.



**Figure 10. Differential transmission line with one termination resistor near receiver**



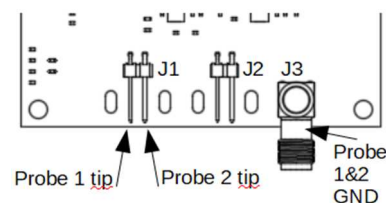
**Figure 11. Differential transmission line with termination resistors near receiver on each of receivers inputs**



**Figure 12. Twisted pair as differential transmission line with one termination resistor near receiver**

However in most typical applications signal termination is not necessary. If only slowly changing radiation sources are used and/or signal paths are short, outputs may be left unterminated. Connecting outputs to high impedance has one additional benefit: bigger dynamic range of output voltages, since output signal is not divided by 2.

Differential signal from connectors J1 and J2 can be observed using scope with differential probe. In case when differential probe is not available the differential signal still can be observed using scope and two standard probes. In that case each probe should be connected to one of the pins: pin J1-1 and J1-2 and the probes GND of probes should be connected to GND of the board e.g. J3 connector housing.



**Figure 13. Probing differential signal using two probes**

## ROUTING ON OPTICAL TABLE

The Evaluation kit consist of adapter for mounting on optical table. Its mechanical drawings is shown on Figure 16. This element is symmetrical and can be connected in two ways. For convenience adapter has two types mounting holes: metric M4 and #8-32 UNC on opposite long sides. Suggested equipment: Thorlabs “[Optical Posts: Ø1/2" and Ø12 mm](#)”.

# MECHANICAL DIMENSIONS

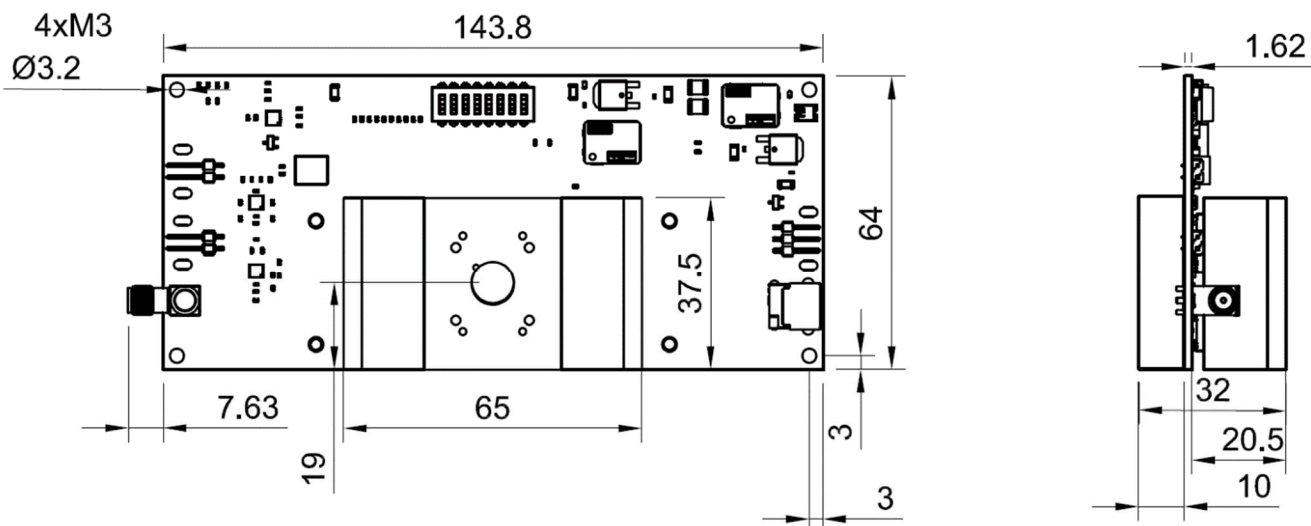


Figure 14. Dimensions of AM Evaluation kit Front and Side

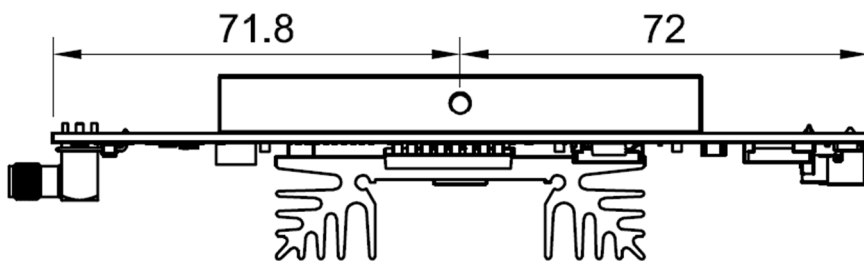


Figure 15. Dimensions of AM Evaluation kit Bottom

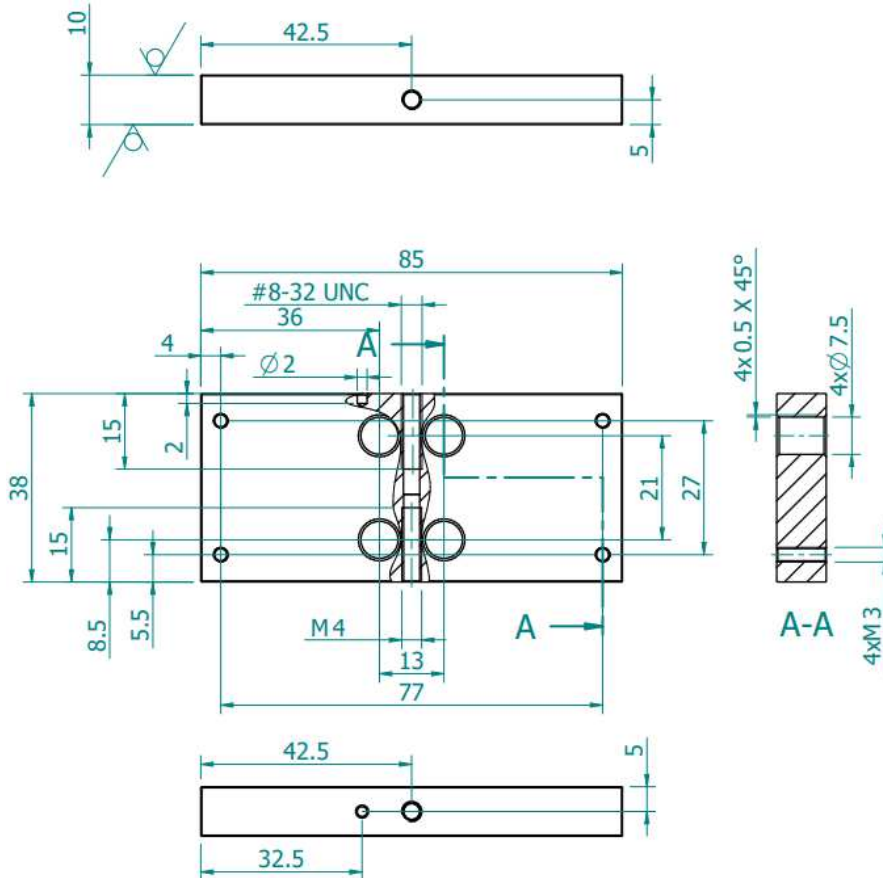


Figure 16. Dimensions of adapter for optical posts