MEASURING ENVIRONMENT

22.05.2013

MIP LASER DUST MONITOR LM 3188

USER'S MANUAL

Marked for following units.

Monitor Unit	**3188799**
Transmitter Unit:	**L956(LM)**
Receiver Unit:	**R815(LM)**
Range:	**0…1.0D (mg /m^3)**
Options:	**- Universal power**

Please note that Monitor unit test cards are end of manual.

MIP Electronics Oy
Palokorvenkatu 2, 04250 Kerava, Finland
Tel: +358 10 322 2631, Fax: +358 9 294 7084
www.mip.fi
Business code: FI1627111-2

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1. INTRODUCTION

1.1 ADVANTAGES AND FEATURES

During the recent years the mass production of different types of lasers has made them economically viable products for a broad range of applications, dust monitors among others.

There are two main families of lasers:

- Gas lasers, notably Helium-Neon (He-Ne) lasers are available in compact design including their hi-voltage power source

- Newer Semiconductor lasers today with red, visible beam and with added benefit of integral power monitoring diode

There are major benefits from using a laser light source whose main features are given below:

- Very compact beam. The intense light beam of the laser is typically only a few millimeters thick. This means that only small holes (10 … 50 mm) are needed in the stack which simplifies the installation

- Good stability and long life. In contrast to designs that use more traditional light bulbs, which need constant compensation, the laser source is relatively immune to aging effect. The typical self-life of gas laser is 3 years, and up to 10 years for semiconductor units. When gas laser fails it is easy to notice as it begins to flicker, much like a fluorescent tube.

- Relatively high intensity. Because the laser light power is concentrated at small area, it can penetrate higher dust densities than conventional light sources.

- Operation with known clearly defined wavelength. This makes the theoretical calculations and their results more predictable as opposed to conventional sources that operate over broad range of wavelengths and whose spectrum changes with age.

Finally, we would like to mention also our latest light source, the superbright LED that has many laser-like features. It offers an economic alternative to “real” lasers in some applications. These superleds are very recent developments and offer the highest recorded output power of LED-lamps. The radiation happens with very narrow wavelength range, around 640 nm (red) and concentrates on a small cone (4°). Our novel stabilizing scheme makes these superleds fully compatible with semiconductor lasers in the short distance measurements (<2m).

1.2 DIFFERENT LASER MODELS

There are currently several different laser dust monitors available from MIP.
Gas laser LM 3086, Semiconductor model LM 3188 and Superled model LX 3188.

The basic models are LM 3086 and LM 3188. Both models function with the same principle measuring directly laser light extinction as optical density. Here is how they differ from each other:

Model	**LM 3086**	**LM 3188**
Technology	Helium-Neon laser	Semiconductor laser
Wavelength	633nm, visible	655 nm, visible
Size (source)	Weather-proof camera housing (600*240*170)	Much smaller housing (145*125*80)
Range	0…0,1 D; 0…0,3 D; 0…1.0 D; 0…3.0 D	0…0,03 D; 0…0,1 D; 0…0,3 D; 0…1,0 D
Beam modulation	None (option: mechanical)	Electronic
Mass density	Optional 0…20g/m^3	Digital LCD 0…2g/m^3

There are further developments from these basic models available as well. Models with automatic zero/calibration (LM 3188AZL/AZH, LM 3195 and LM 3086EPA3) or with integral display unit (LA 3188) are described in their own manuals.

The model LX 3188 is identical in construction with LM 3188-model but utilises the new superled source (640nm) as described earlier.

The complete laser instrument includes three parts: the source unit, the receiver unit and the monitor unit. As these are separately available as spare parts, each of these have their own type marking. The following gives the complete list of units with their differencies from each other:

1) The laser source units

L 308	Red, He-Ne gas laser	LM 3086
L 318	Red, Electr.mod. semiconductor laser	LM 3188
L 318AZL/AZH	Red, Chopped semiconductor laser	LM 3188AZL/AZH
X 318	Red, Electr.mod. superled source	LX 3188

2) The receiver units

R 308	No additional electronics included.	LM 3086
R 318 (LM)	De-modulation electronic included.	LM 3188
R 318AZL/AZH	Sync.detection electronic included.	LM 3188AZL/AZH
R 318 (LX)	De-modulation electronic included.	LX 3188

All models have optically matched semiconductor detector with ∅50mm glass lens.

3) The monitor units

M 308	Range 0…3 D	LM 3086
M 318	Range 0…1 D; LCD display 0…2g/m^3	LX 3188 / LM 3188
M 318AZL	Range 0…1 D; LCD display 0…2g/m^3	LM 3188AZL
M 318AZH	Range 0…3 D; LCD display 0…20g/m^3	LM 3188AZH

All monitor units have analogue meter 0 … 100 % of the selected D-value scale, voltage and current outputs as well as alarm relay. Also controls for zero, span and mass calibration (M 318) are included as well as relay limit settings.

There are some options available for larger area detectors or modified operation ranges for basic unit. Consult factory on these options.

1.3 APPLICATIONS FOR DIFFERENT LASER MODELS

The different laser types, obviously, address different applications. As a guideline following information is based on practical installations:

LM 3086 Red, gas laser works best in relatively high-dust environment (>100mg/m^3). It has become a sort of standard in pulp mill applications, recovery boiler, lime kilns, etc.

LM 3188 Semiconductor laser is used in relatively low-dust environment (< 1g/m^3) or where the space is limited.

LX 3188 Superled model can be used instead of LM 3188 where the measuring length is short enough (<2m) or where the price is of primary importance.

2. THEORY OF OPERATION

When a monochromatic light beam, such as laser beam, traverses through gas that contains particulate matter, the intensity of the beam will decrease by absorption and scattering processes within the particle distribution. The net effect can be described by so called Lambert-Beer law as (eq.1):

$$I = I_0 e^{(-\alpha * x)}$$

Where

I_0 is the source intensity of laser light

I is the measured intensity at the detector

x is the length of the beam passage in particle distribution

α is a constant that depends on particle diameter, laser wavelength and any absorption process present

2.1 OPACITY DEFINITION

Opacity is defined as the property of the stack gases to attenuate visible light due to the presence of particulate in the effluent. The amount of the attenuation depends on the concentration of the light absorbing or scattering particulate and on the length of the measuring path.

The basic definition of opacity requires that an instrument measures light intensity at the source (I_o) and light intensity at the receiver (I) after it has passed the stack effluent. The opacity is expressed as a percent figure Op% (eq.2):

$$OP\% = \left(1 - \frac{I}{I_0}\right) * 100$$

A fully transparent (clear) stack gas has the opacity of 0% and a fully opaque gas has the opacity of 100%.

2.2 D-VALUE DEFINITION

Another concept, useful in this connection, is the optical density, D. The D-value is defined as (eq.3):

$$I = I_0 * 10^{-D}$$

Where I and I_0 are defined as earlier. It is to be noted that D-value is of general nature and does not depend on measurement length or particle properties.

To account for many different applications and measurement set-ups the D-value as solved from the eq. (3), is the basic quantity for the MIP-monitors. Thus the indicator range is scaled in D-values and optical filters with known D-values are readily available to check the proper operation of the instrument.

2.3 MASS-VALUE DEFINITION

The user is, however, normally more interested in dust or particulate concentration in terms of mass concentration (mg/m^3) than D-values. The main problem for given measurement set-up is then to express the measured D-value, as mass concentration. Most reliable method to do this is calibration by simultaneous gravimetric sampling and D-value measuring in different particulate concentrations that are likely to appear in practice. Once the relation between mg/m^3- and D-values is established the problem is solved.

It is also possible to further develop theoretically the equations (1) and (3) together with simple model of particle distribution. The achieved results agree surprisingly to many real, measured dust concentrations and gives valuable information for applicability of laser dust measurement.

This model assumes the distribution consisting of identical particles with diameter of d and density (mass/volume) of ρ. Now, combining equations (1) and (3), there is a relation between D-value and mass concentration (eq.4):

$$M = \frac{0{,}8 * d * \rho * D}{L}$$

Where	d =	particle diameter	[micrometers]
	ρ =	particle density	[grams/cm^3]
	L =	measurement length in dust	[meters]
	D =	measured D-value	[optical density]
	M =	mass concentration of dust	[grams/m^3]

This “mass formula” is valid for particle sizes from 0,7 μm upwards.

3. INTRODUCTION OF LASER DUST MONITOR LM 3188

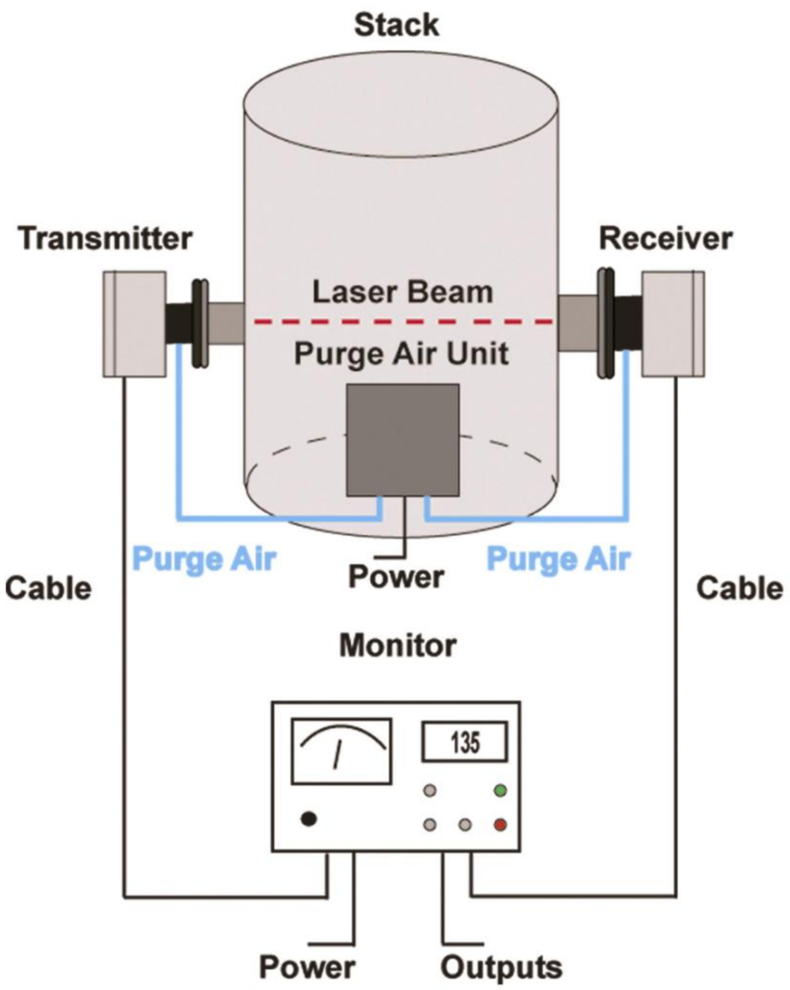


Figure 1.

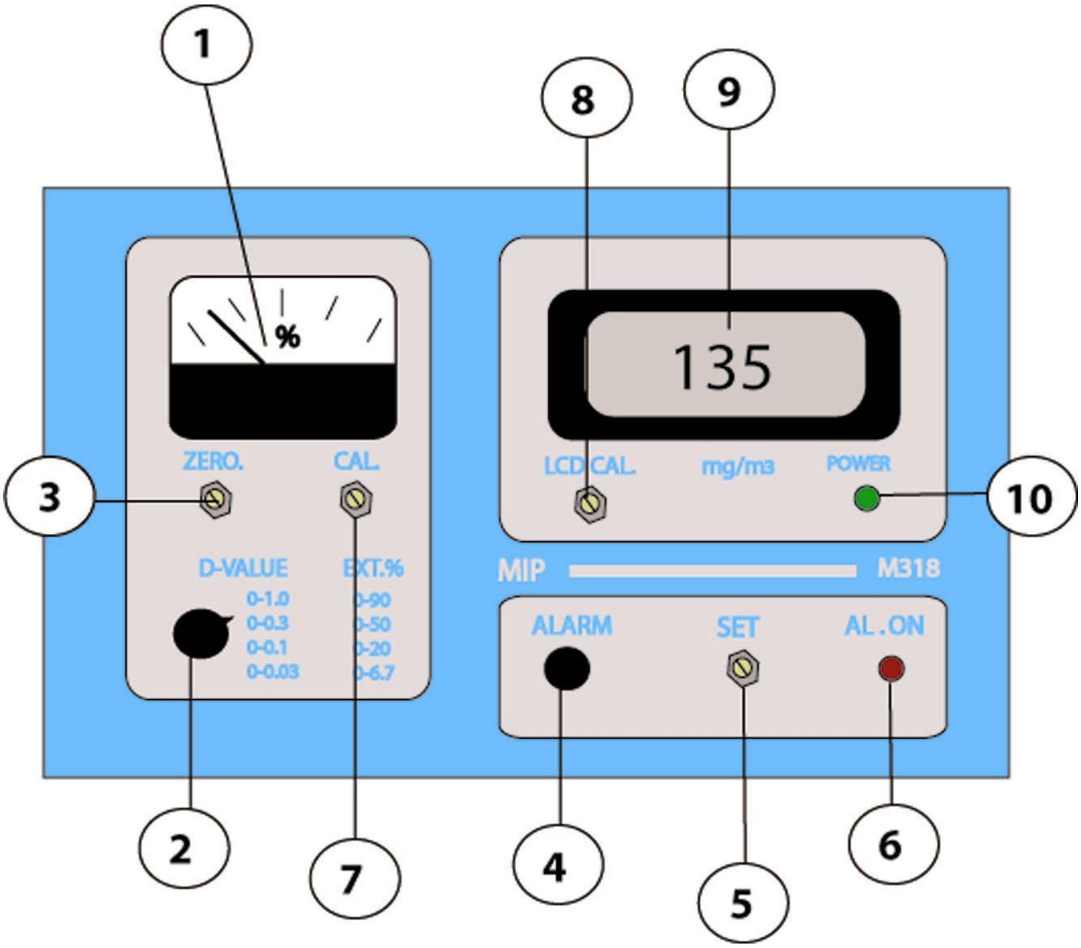
LM 3188 is unity, which includes transmitter, receiver and monitor. (Figure 1.) Opacity monitor's optimal use is for stack up to 20 meters. There are no moving parts, so it has minimal maintenance. It has large operation range (0 … 90 %). Its optic need is minimum so there is less maintenance. LM 3188 has good stability and reliability. LM 3188 has both analogue and digital display in monitor unit. There are 4 operator selectable measuring ranges. Most of controls and displays are included in monitor unit.

Typical applications for LM 3188 are power plants, cement factories and tunnels.

LM 3188 has excellent beam collimation (0,04 °), so user don't need to use lenses or mirrors in the transmitter. This makes the system reliable and simple. The alignment of the beam is easy because the beam is narrow. Standard wavelength guarantees long-term accuracy and stability. Analyser can be transferred to another location without factory calibration.

3.1 CONTROLS, DISPLAYS AND SETTINGS

The faceplate of the M 318 monitor unit is pictured which is below. Controls displays and settings are indicated by numbers



3.1.1 Indicating meter [1]

Indicating meter, which displays the %-value in selected D-range. If, for instance, the reading is 40 % and the selected D-range is 0…0,3 D, then the measured D-value is
0,3 D • 0,4 = 0,12 D.
The indication follows continuously the variation in dust concentration.

3.1.2 Range selector [2]

Range selector, which enables the user to select a proper monitoring range for various applications. Four ranges: 0 …0,03 D;0 … 0.1; 0 … 0.03 and 0… 1,0 D in D-values are available for M 318. Ranges can be extending up to 0 … 3.0 D. The corresponding extinction (opacity) %-values are given along the D-value ranges.

3.1.3 Zero set screw [3]

This is very important adjustment, which allows after installation to set zero (D-value) level. The zeroing should happen in as dustless condition as possible. When measuring path is clear of any interfering particles, the zero screw is turned until the meter (and display) indicates 0-reading.

3.1.4 Alarm test button [4]

By pressing this button, the monitor shows the set alarm level, which activates the alarm relay. Note, that the level might be over the current selected range and the range selector must be used to find the set level.

3.1.5 Alarm set screw [5]

By activating the alarm test button, and using this screw, the alarm level can be re-adjusted.

3.1.6 Alarm indicator lamp [6]

The alarm indicator lamp lits when the alarm level is exceeded.

3.1.7 Calibration screw [7]

Used after zero level is set to adjust the reading to correspond a known D-value calibration filter. This is normally done in the factory and user should have no need for re-adjustment. This is the main optical calibration adjustment for the monitor.

3.1.8 Mass calibration screw (LCD cal) [8]

This screw is intended for setting up the relation between the D-value and the digital mass reading. The relation can be verified with gravimetric sampling or calculated from mass formula. The factory setting is based on assumption, that D-value of 1,0D corresponds to 800 mg/m^3.

3.1.9 Digital LCD-display [9]

This display shows mg/m^3 –reading of the dust concentration and is independent from the setting of D-value range.

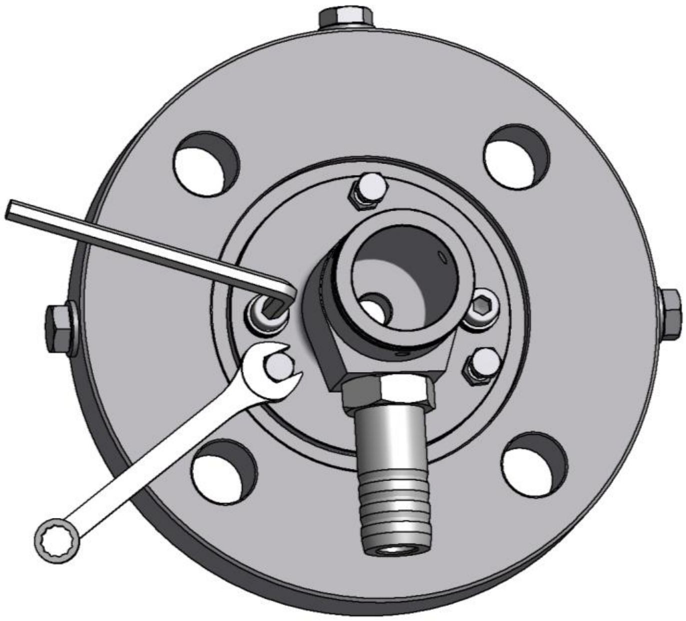
3.1.10 Power indicator lamp [10]

This LED-lamp is lit, whenever the monitor is powered.

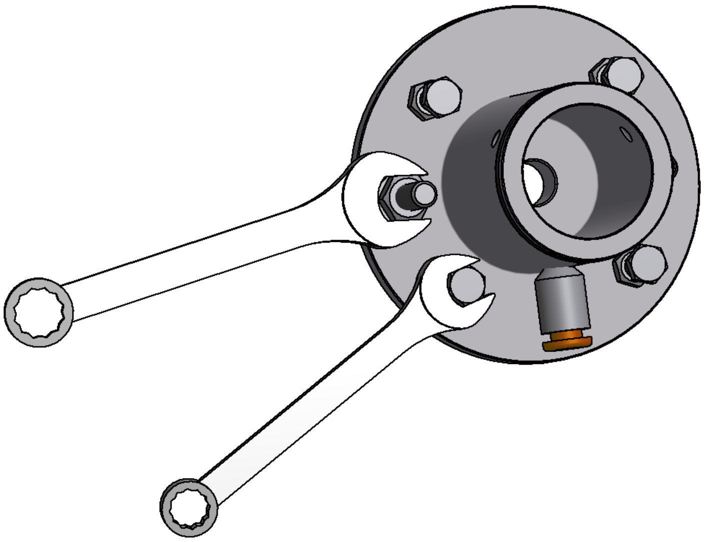
4. INSTALLATION AND CALIBRATION

4.1. INSTALLATION

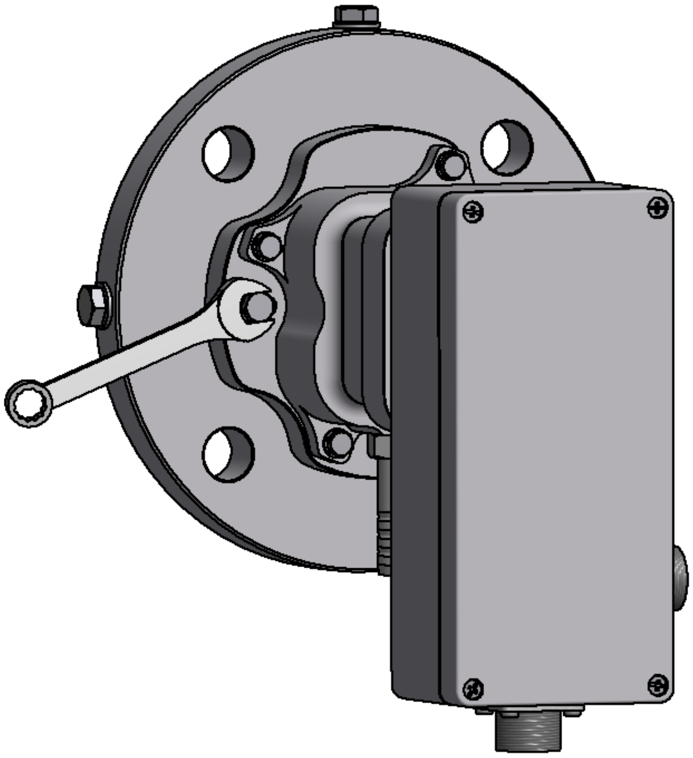
It is clear, that the installation environment is different in each application. That is why we provide only a minimum of installation hardware with the instrument. The gas laser has a specific installation foot and semiconductor lasers as well as all receivers, come with the flanges that have elliptic holes for adjustment.



1:Use 5mm hex key and 8mm wrench to adjust angle and position of the transmitter unit with G 1/2 puge air thread.



2: Use 10mm wrench and 8mm wrench to adjust angle and position of the transmitter unit with M5 purge air thread.



3: Use 10mm wrench to adjust position of the reveiver unit. (Version with upgraded purge air flow pictured).
Main alignment adjustment should be done from transmitters installationg flange as shown on pictures 1 and 2.

As the laser beam is very compact, only small holes (10…50 mm dia) to get beam through, are needed. Normally there is a small under pressure inside the stack, and outside air automatically keeps the holes clean. In case there is overpressure in the stack, but source and receiver can be flange-mounted. Then, using the instrument-air purge system to slightly overcome stack pressure keeps the instrument clean and functional.

The mounting system obviously varies from case to case. Basically there are three different mounting systems:

a) Mounting in the stack itself by L-type supports

b) Mounting on the support structures (or on the floor/roof) around the stack. In this case possible temperature related movement of the stack may require elliptical holes in the stack.

c) Mounting on the flanges welded in the stack. This case provides a solution, when there is overpressure in the stack and gas escape from small holes is not allowed.

A specific problem appears when the dust content is very high. Then you might need to shorten the laser path by horizontal tube inside the stack. As a rule of thumb, 1 m distance is enough for concentrations 1-5 g/m^3. Higher concentrations need shorter path.

There are other environmental factors that can influence the measurement. Here is a check list of the factors that can cause trouble for measuring dust content:

1 [ ] Trying to measure too small concentrations

2 [ ] Using too long distance for very high concentrations

3 [ ] Orientation and vibration problems when using long measuring distances

4 [ ] Interfering other substances, than the measured dust

5 [ ] Other light sources (sun, lighting) affecting the receiver

6 [ ] Dust or dew accumulating to optical surfaces of the laser or receiver

Factors 1 and 2 relates to measuring angle and inherent intensity fluctuation in both LM 3086 and LM 3188, as discussed in connection with mass density estimation. The mass formula can be used to estimate the mass concentration range, based on particle properties and path length.

Factor 3 refers to allowed beam direction changes that can point the beam outside the detector. The beam profile differs in He-Ne and semiconductor lasers. In the He-Ne laser, the critical distance, where beam diameter exceeds the receiver active area, is around 13…18 m. For the semiconductor model this is 25…35m. For critical cases, larger area detectors are available. Consult the factory.

Factor 4. The selected wavelength of the laser is such, that most common 3-atomic gases SO_2, CO_2, H_2O, will not affect the measurements. However, when water exists as liquid droplets or fog, it will be "seen" by the laser as particles. Applications of this kind, such as involving wet scrubbers, should be checked carefully for this kind of trouble.

Factor 5. Sun or other artificial light sources, can add to the laser light and thus falsify the results. For modulated laser beam this is not a problem, as the receiver is tuned to modulation frequency. For unmodulated beam (LM 3086) the receiver should be shielded from external light.

Factor 6.This is a major problem in competing units, but not normally in laser installations, that are installed remote to stack. Both laser and receiver should be provided with dry, clean instrument air to keep slight overpressure inside the units.

4.2 CALIBRATION

With calibration we mean here a broader range of operations including zero set, optical calibration with filters, mass calibration and checking the outputs of the instrument.

Actually zero setting and optical calibration can as well be performed at the laboratory workbench, using the same distance as in actual measurement situation.

Set instrument zero as follows:

- First, after switching the laser and measuring unit on, wait for 2 hours to let the laser output power to stabilize

- Then, using the most sensitive measuring range, set the meter to zero by zero adjust screw at the front plate. Note: Be sure, that while making the zero adjustment, the channel is free from dust, ie. this adjustment corresponds to physical zero dust state.

Calibration means optical calibration for D-value and possibly mass calibration.

Optical calibration is performed as follows:

- Calibration check can be made any time by optical neutral density filters. For instance, by interposing D = 0,3 value filter in the laser beam, while the meter is set for 0 …1,0 D range, the meter should display 30 % more than without the filter. If necessary, the sensitivity can be altered by "cal" adjustment.

The filter set OF 308 offers the possibility for both calibration and linearity checks of the instrument. Optical calibration is eased by the fact, that filters and instrument scale show the same quantity, enabling calibration check, even while the instrument is in operation. Also a field calibration kit FK 308 containing only one filters, is available.

4.2.1 Filter set for the dust monitors instructions for the use

The dust monitor LM 3188 should be warmed-up and showing a steady D (zero if the measurement path is clear of the dust) before calibration with the filters.

Insert the filter in the laser beam at right angle (90°) beam hitting the center of the filter. The best place for the filter is flush with the receiver R 318 surface. If this is no possible, then as near the receiver as possible.

The indication of the LM 3188 should now increase to D+X, where X is the filter's D-value given in associated filter graphs, at the wavelength 655 nm. Use the filter consistent with the measurement range, ie. Filter that gives clear deflection at the indication, but does not require range switching.

If the increase in the indication differs from he known X-value, the LM 3188 "CAL"-screw can be used to set the calibration right. When the filter is removed, the indicator should return to previous base-value D.

The linearity of the instrument at other ranges can be checked similarly with different filters of the set.

4.2.2 Mass calibration

Mass calibration can happen based on theoretical calculation or on actual sampling procedure.

Theoretical mass calibration is based on the formula [3] between the optical density and mass density of the dust. Then, it is supposed that the average size (diameter) and particle gravity is known reasonably well.

For mass calibration select a known D-value filter (say D = 1,0) and calculate the mass equivalent with formula. Interpose the filter in the beam and adjust "LCD.CAL"-screw, until digital display indicates the calculated value.

Mass concentration with sampling is the preferred method, when there is no knowledge of particle properties or when best of accuracy is demanded. By taking the samples in various concentrations, and at the same time recording the measured D-values, the relation between mass and optical density can be established. Theoretically this would be straight line.

4.2.3 Output check

There are two kinds of outputs. Voltage output (0 …1V) and current output (4 … 20 mA). Both of these are available from instrument terminal block as are the alarm relay contacts. The outputs are directly proportional to analogue meter %-indication. This means, that the same D-value can give you different outputs, depending on the selected range.

Take, for example, D = 0,5 filter and select range 0 … 1,0 D. Now, the meter should indicate 50 % and corresponding voltage output will be 50 % of 1 V or 500 mV and current output should be 4 mA + (50 % • (20 - 4)mA) = 4mA + (0,5 • 16 mA) = 12 mA.

Next, use the same filter and the range 0…3,0 D and the result should now be:

%-indication = 0,5 / 3,0 = 17 %
Voltage output = 17 % • 1 V = 170 mV
Current output = 4mA + (17 % • (20 - 4)mA) = 6,7 mA

Note, that "zero" and "cal" adjustments will affect the outputs, but "LCD-CAL" will not.

Note. If you are using both outputs at the same time, you must use a galvanic isolation in the current output. Voltage output and terminal is at 0V potential, while current output (-)-terminal is at (-15V)-potential.

4.3 QUALITY ASSURANCE PROGRAM

In the factory, we are keeping the track with each instrument delivered and maintain for service purposes individual test cards for each manufactured product. Actually the QAP goes further than that. It records all the people that are involved in the manufacturing procedure, their qualifications and duties. It also identifies all the laboratory instruments, used during the testing of the products, specifies what is documented and how these documents are filed. An empty, individual test sheet is enclosed. It shows what features are tested in the laser monitors. As we normally do not know what kind of dust will be measured by the user, we assume the “standard” particles of 1 micrometers and 1 kg/dm^3. Then we perform mass calibration, based on to these values and assumed measuring path of 1 m. That is why the “normalized” laser meter will give a reading of 800 mg/m^3 with a filter =1.0D, when it leaves the factory. All other points are carefully tested at our laboratory and the meters carefully adjusted for the best linearity with a calibrated filter set.

5. SPECIFICATIONS

Laser Unit L 318

Laser type	Semiconductor laser class II
Optical Power	1,2mW nominal
Wavelength	655nm, visible light
Power stability	± 1%, warm-up 5 minutes
Power supply	±15V, from monitor unit
Operating temperature	-20°C to +60°C (-4°F to 140°F)

Receiver unit R 318

Detection	Optically matched semiconductor detector with ∅ 50mm glass lens.
Power supply	±15V, from monitor unit
Operating temperature	-20°C to +80°C (-4°F to 175°F)

Monitor Unit M 318

Analog display	0…100% linear scale (D-value)
Digital display	0…2000 mg/m^3
Outputs	Voltage 0…1V, 50Ω Current 4,0…20,0mA, 500Ω max. Relay 220 VAC, 1A max.
Power supply	230VAC 14VA 115VAC 14VA (optional)
Operating temperature	0°C to +70°C (32°F to 158°F)

Ranges

Switch position	D-value	Opacity %	Mass value
1	0…0,03D	0… 6,7 %	0 … 24 mg/m^3
2	0…0,1D	0… 20 %	0 … 80 mg/m^3
3	0…0,3D	0… 50 %	0 … 240 mg/m^3
4	0…1,0D	0… 90 %	0 … 800 mg/m^3

* Factory settings
The range values are for particle size 1 micrometer, measuring distance 1 m.
For other type of particles and measuring length, range values varies.

6. WARRANTY CERTIFICATE

BRAND: ***MIP***
TYPE: ***LM 3188***

SERIAL NUMBERS

MONITOR: ____________________________

TRANSMITTER: ____________________________

RECEIVER: ____________________________

MIP Laser Dust Monitors are warranted to be free from defects in materials and workmanship for a period of 12 months from the date of the initial shipment. This warranty does not extend to damage caused by negligent or improper handling in use, storage, or transportation, nor for products from which the original identification markings or labels have been removed, defaced, or altered.

Special contracts or contracts for non-standard products may have modified terms of warranty and, in such cases, the terms as stated in the individual contract must be signed by the duly authorized officer of MIP and will supersede the standard terms. MIP reserves the right to change our warranty policy without any prior notice. Please contact MIP directly with any questions pertaining to your warranty.

MIP will make the final determination as to the cause or existence of the defect and, at our discretion, repair or replace the products that prove to be defective during the warranty period. Products replaced under warranty will be warranted only for the balance of the warranty period of the originally supplied equipment. Additionally, any purchased replacement parts, i.e. laser tubes, power supply modules, etc., are warranted for a six-month (6) period.

This warranty extends only to the original purchaser of the equipment from MIP, and is not transferable. The purchaser must notify MIP within 15 days of first noticing the defect and promptly return the defective product before the expiration of the warranty period. Products returned from persons not employed by the original purchaser will not be evaluated without prior consent from the original buyer.

Products believed by the purchaser to be defective shall be returned to MIP. Transportation, insurance, duties, etc., are to be paid by the purchaser. Repaired or replaced products will be returned to the purchaser by MIP, F.O.B. city of destination, domestic as well as foreign territories. MIP will not be responsible for any duties, levies, taxes, etc., on returned items.

Warranty limitations for light sources:

This warranty does not apply to laser diode, laser tube and led light source failures due to the electrostatic damage, excessive voltage or current, or operation at the temperatures beyond recommended levels.

WARRANTY PROCEDURE

Review the terms of your purchase and the date of shipment to determine the validity of your warranty claim. Warranty claims should only be made for products that are within the terms of the warranty policy. However, out-of-warranty items may be returned for evaluation at no charge.

Prior to returning any unit for repair or evaluation, please contact MIP either by phone at +358-9-294 1773 or by fax at +358-9-294 7084 to obtain authorization to return the unit. For returns in foreign countries where representation is present, please contact your distributor. For customers in the countries where distributorships and/or representation is not available, all claims and corresponded should be addressed to:

MIP Electronics Oy
P.O. Box 46
04251 Kerava
Finland

Please be prepared to furnish the following information when requesting an authorization number:

a. Product model number and serial number
b. Date of shipment/purchase
c. Brief description of problem/failure
d. Name and phone number of contact person at your organization.

Obtain MIP instructions for transportation and packaging, and ship the product (freight and insurance prepaid) with the proper documentation containing the information specified above.

MIP will advise the purchaser of its evaluation results at the earliest possible time. Providing complete information as requested will help to expedite this process. For products outside of their warranty period, an evaluation will be made at and a cost estimate for repair/replacement will be issued. Charges for repair work will be billed at the current repair rate (available upon request from MIP) plus the cost of any additional required parts. Repair work will be warranted for a period of 6 months from the date of shipment.

7. MANUFACTURER´S CERTIFICATE OF CONFORMANCE TO EC-LABELLING PROCEDURE

This is to certify that the following dust measuring/monitoring products, manufactured by MIP Electronics Oy:

Dust monitors LA 3188, LX 3188, LM 3188, LM 3188AZL, LM 3086EPA3, LM3086SE (earlier LM3195)

are constructed/tested according to the following standards and EC-regulations:

23/73/EEC	Electrical safety standard
EN 50081-2	For emission of EM-radiation
EN 50082-2	For emission of EM-radiation

Kerava, Finland

18.09.2004

Jouni Lukkari

Jouni Lukkari
Managing Director

8. CERTIFICATE OF ORIGIN

We hereby confirm that Dust Monitor MIP LM 3188 is manufactured by MIP Electronics Oy, Finland and is Finnish origin.

Manufacturer: MIP Electronics Oy
Country of Origin: Finland
VAT-Code: FI1627111-2
CN-code:

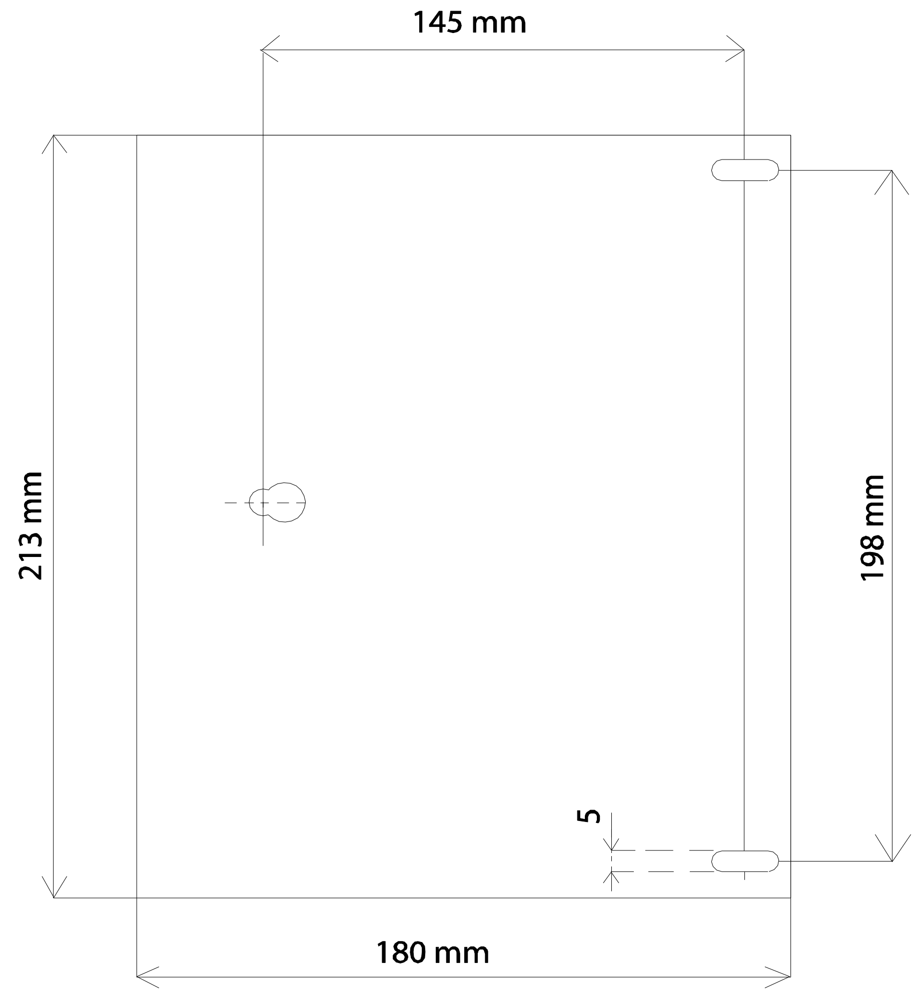
Kerava, Finland

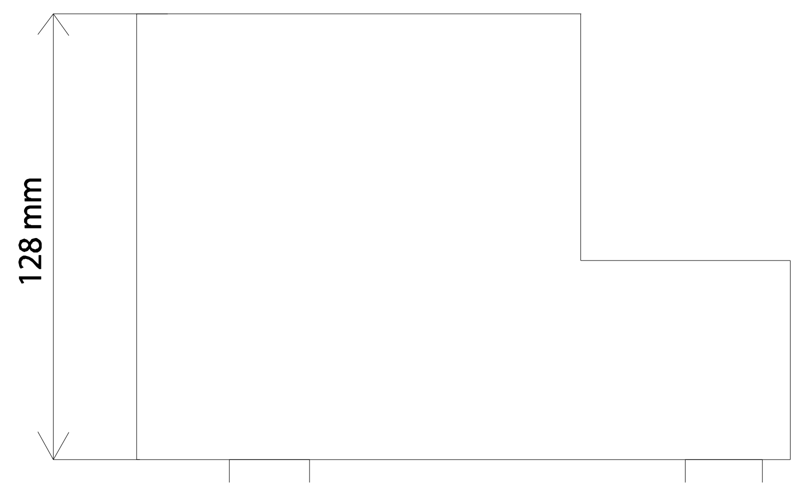
Jouni Lukkari

Jouni Lukkari

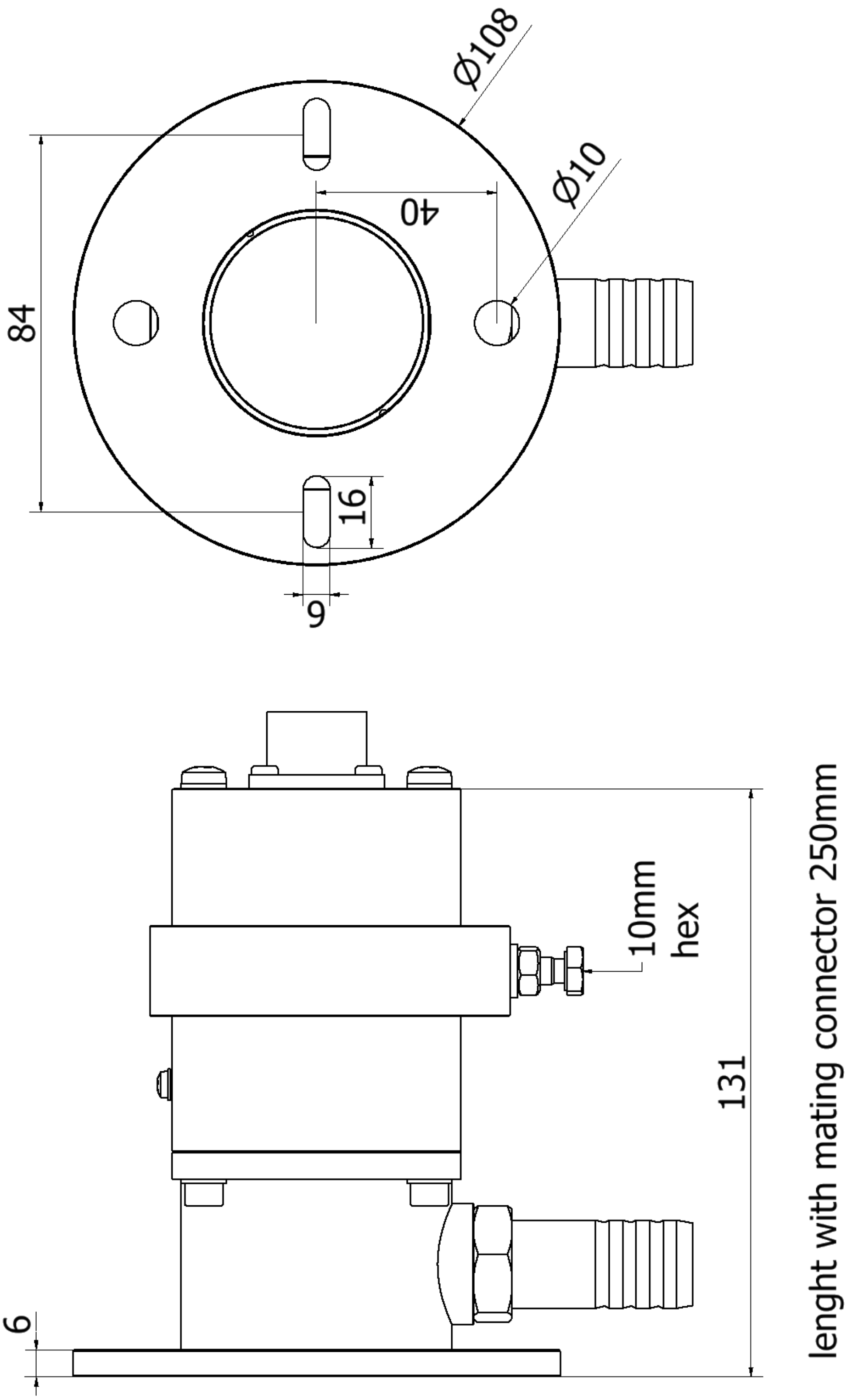
Managing Director

APPENDIX 1: Monitor Unit M 318 mech. drawing



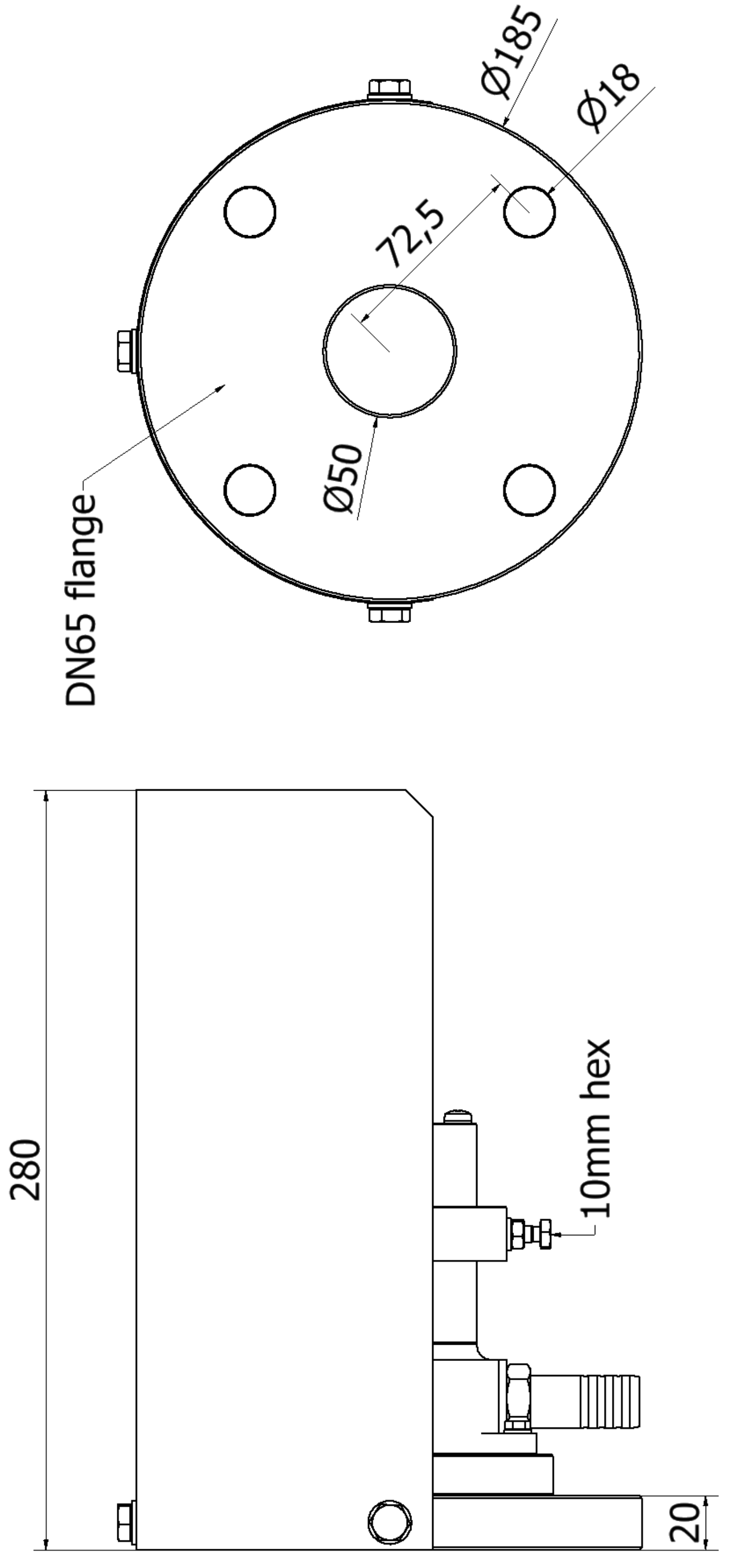


APPENDIX 2: Receiver unit R318 mech. drawing



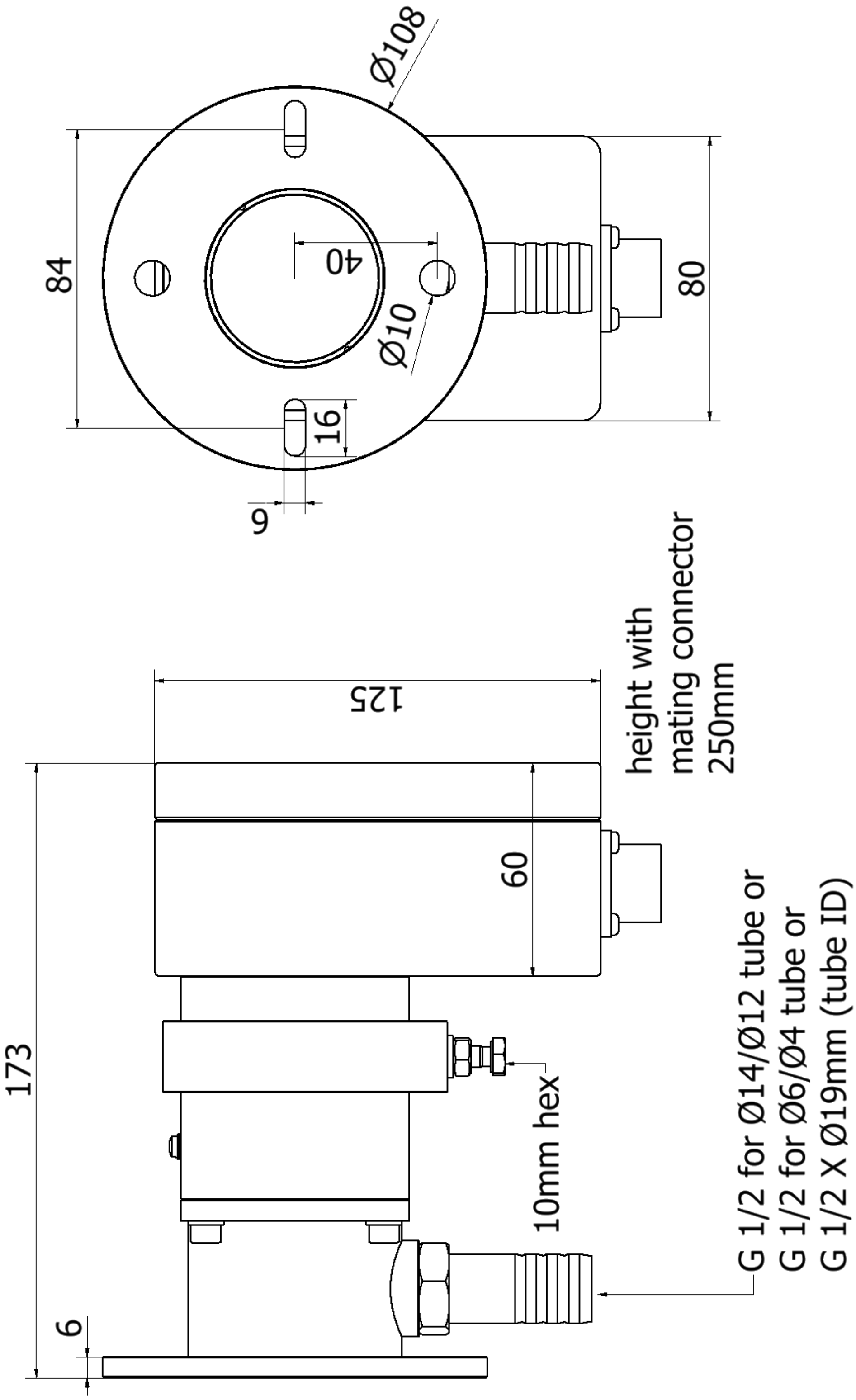
R318 Receiver unit 820-007, 820-008 and 820-009

APPENDIX 3: Receiver unit R318 mech. drawing



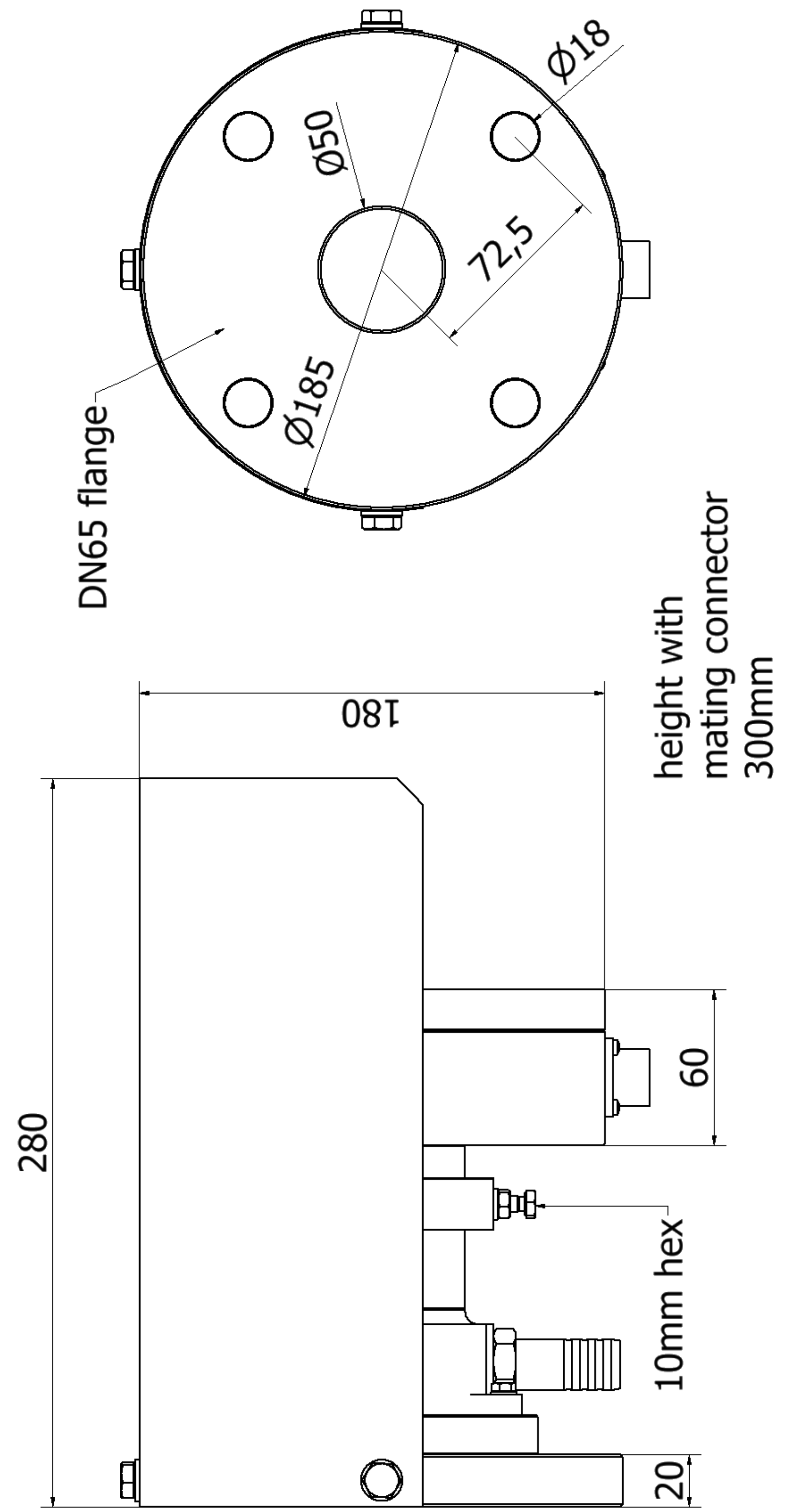
R318 Receiver unit 820-005 and 820-006

APPENDIX 4: Receiver unit R318 mech. drawing



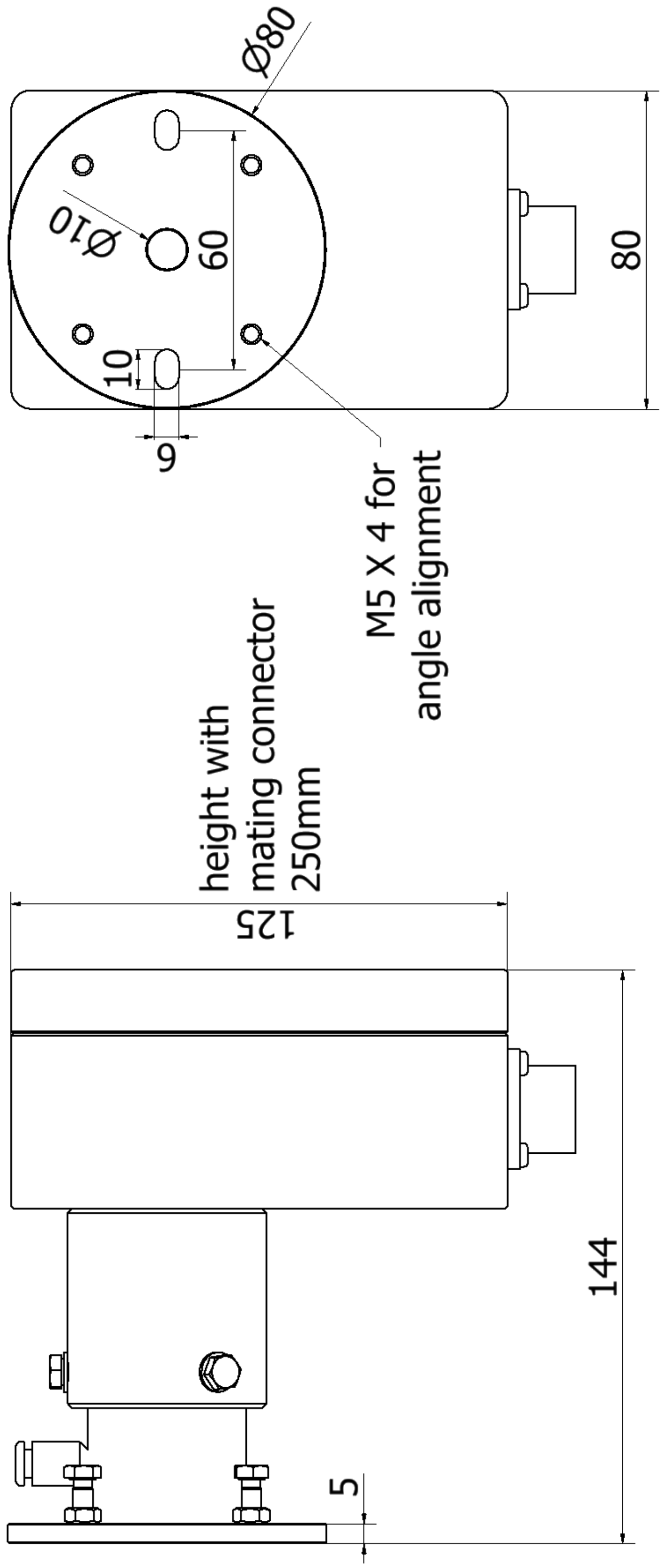
R318 Receiver unit 820-002, 820-003 and 820-004

APPENDIX 5: Receiver unit R318 mech. drawing



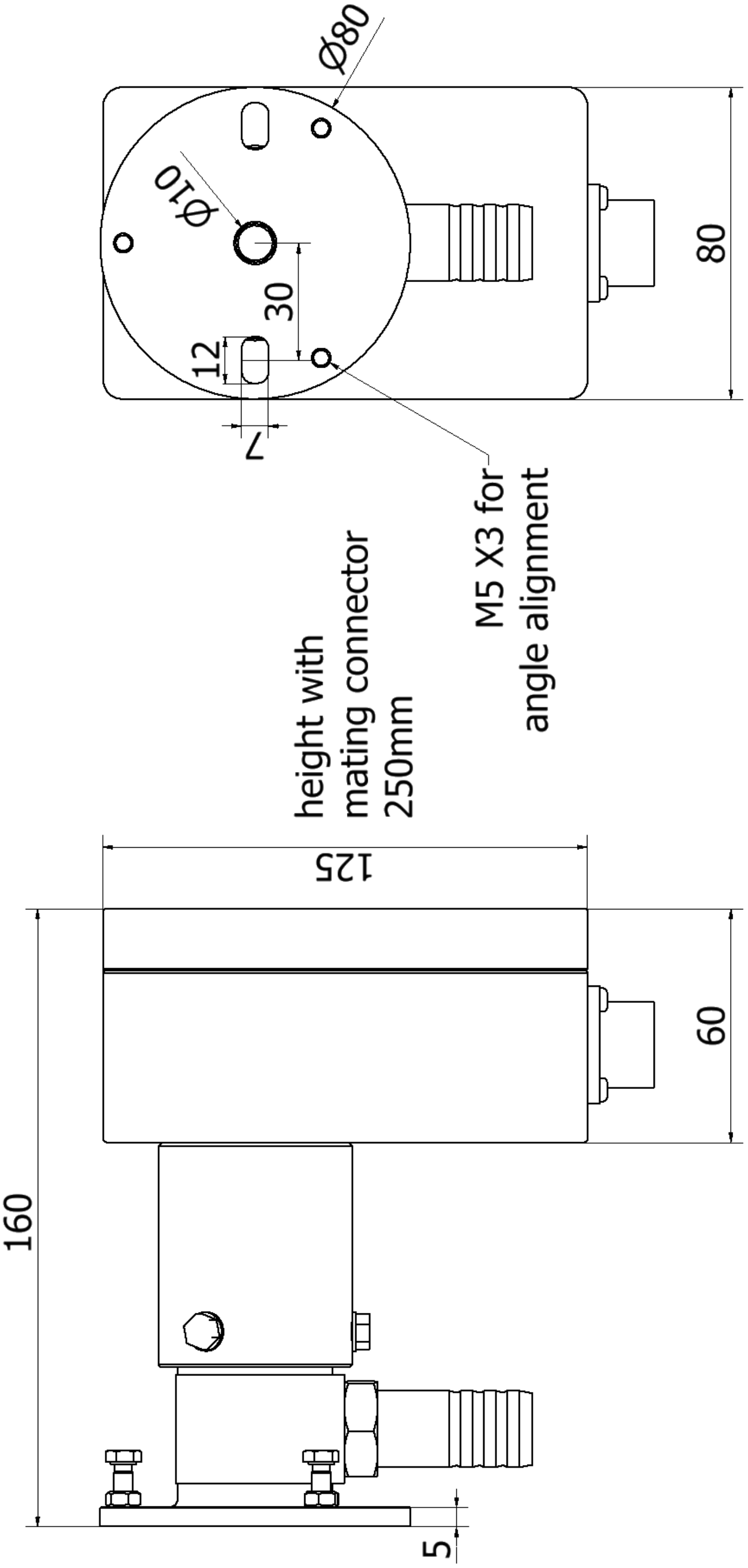
R318 Receiver unit 820-000 and 820-001

APPENDIX 6: Transmitter unit L318 mech. drawing



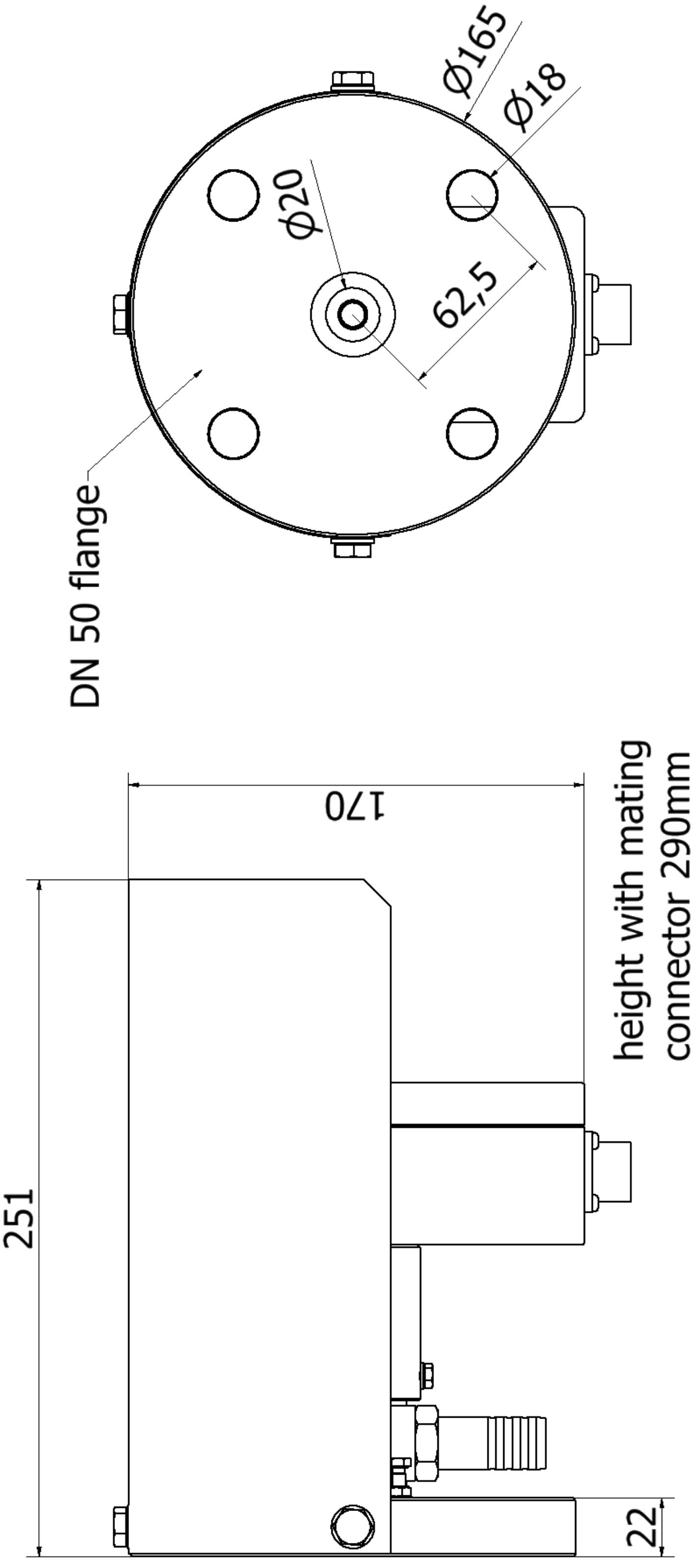
L318 Transmitter unit 830-005

APPENDIX 7: Transmitter unit L318 mech. drawing



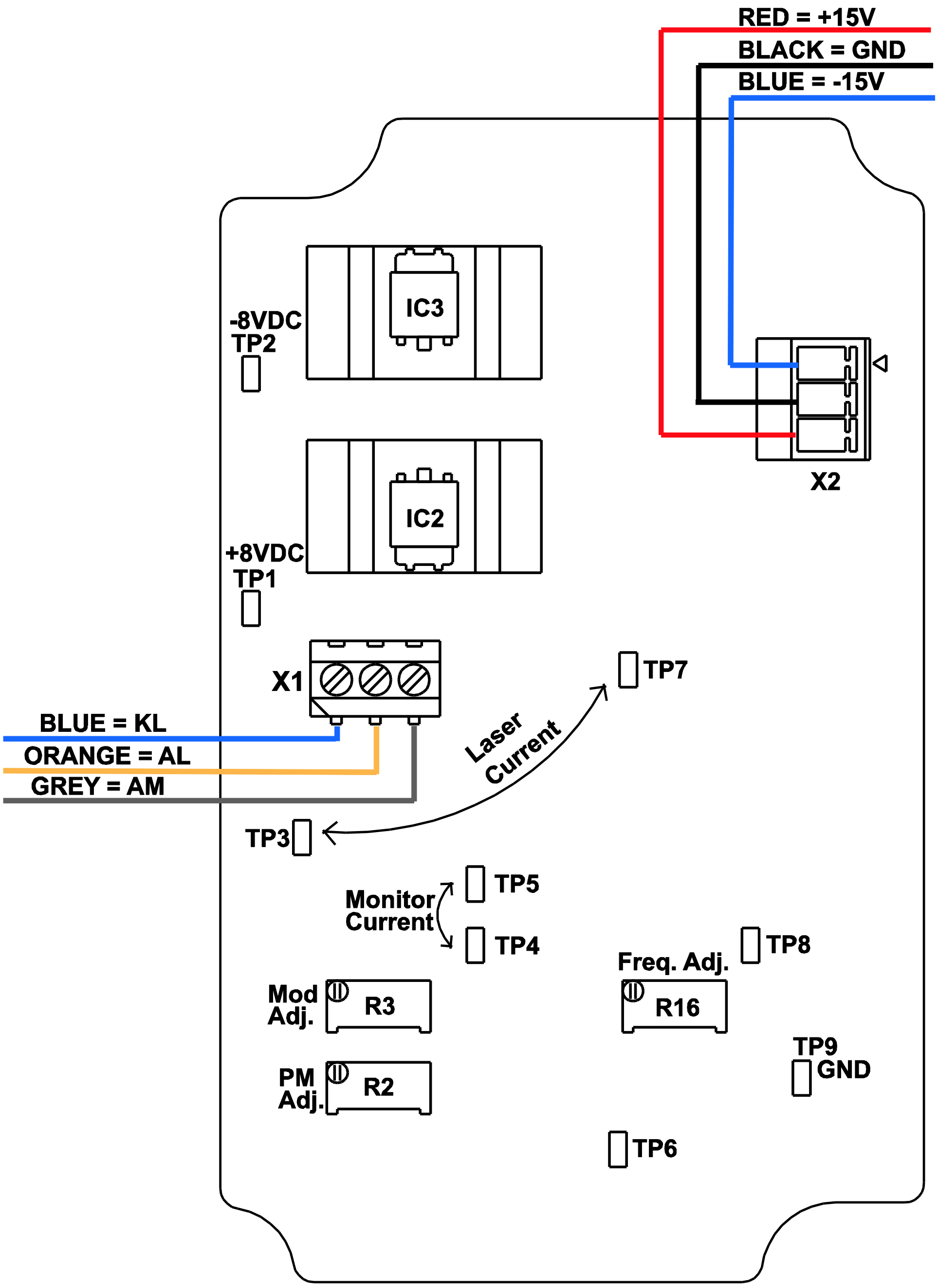
L318 Transmitter unit 830-003 and 830-004

APPENDIX 8: Transmitter unit L318 mech. drawing

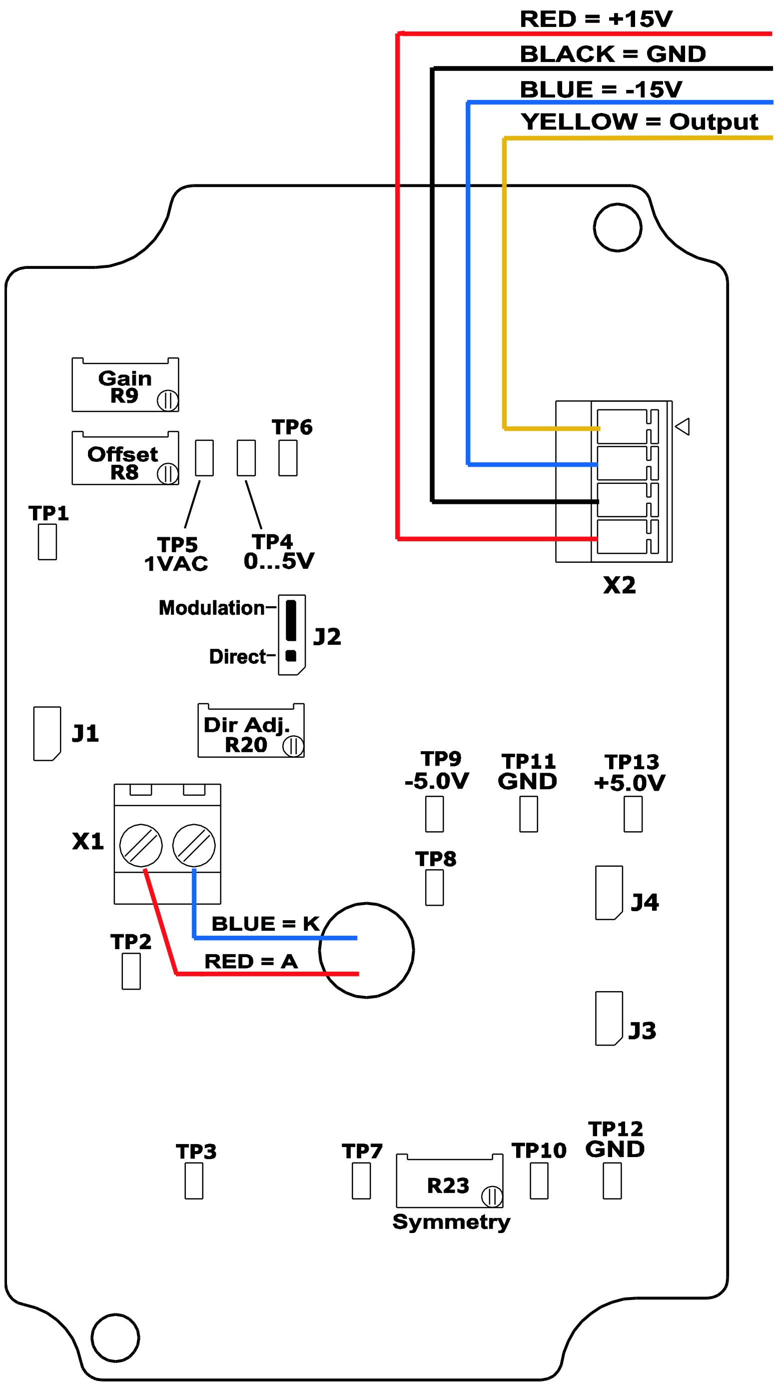


L318 Transmitter unit 830-001 and 830-002

APPENDIX 9: Laser Unit L 318 PCB-layout

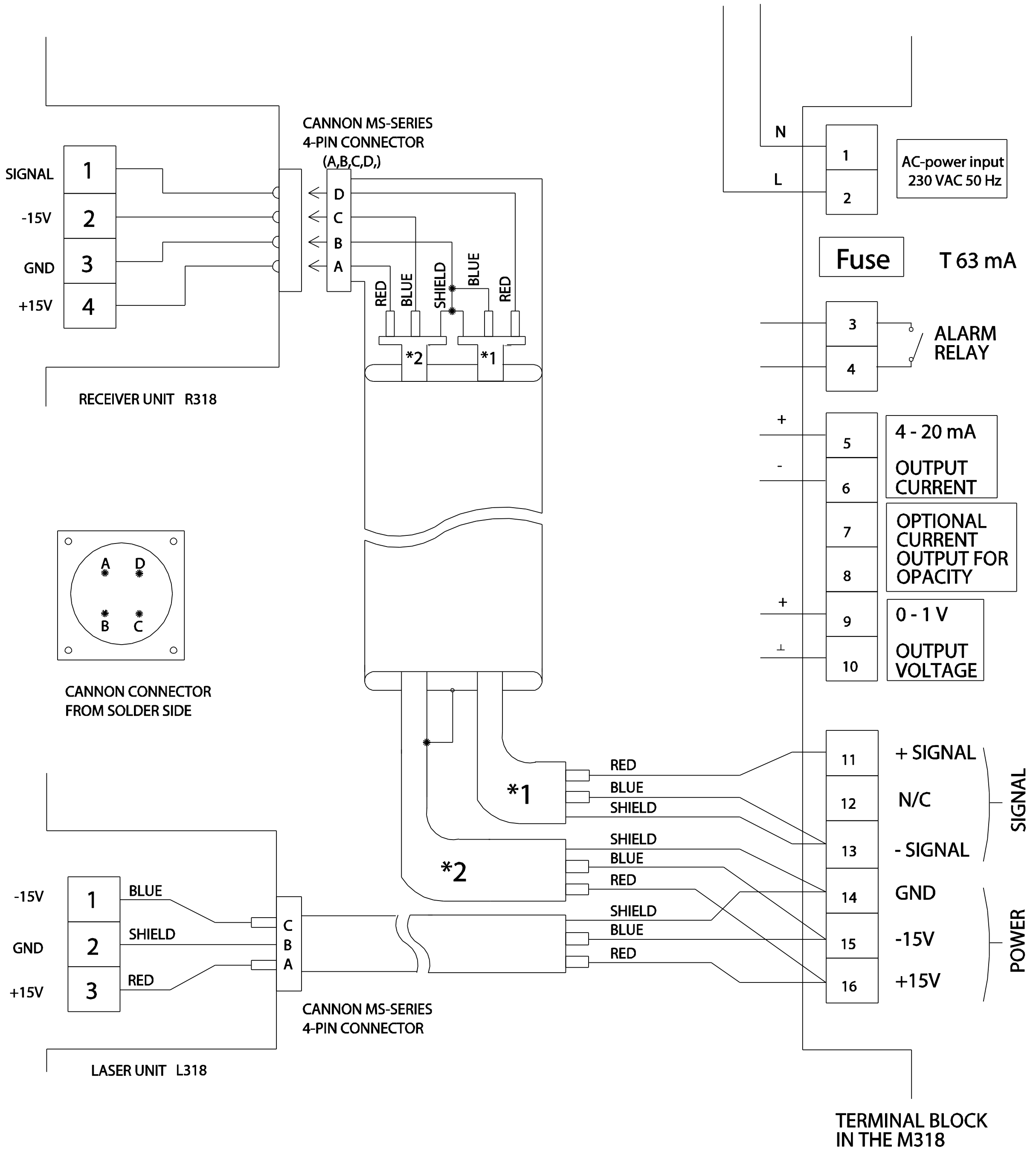


APPENDIX 10: Receiver unit R 318 PCB-layout



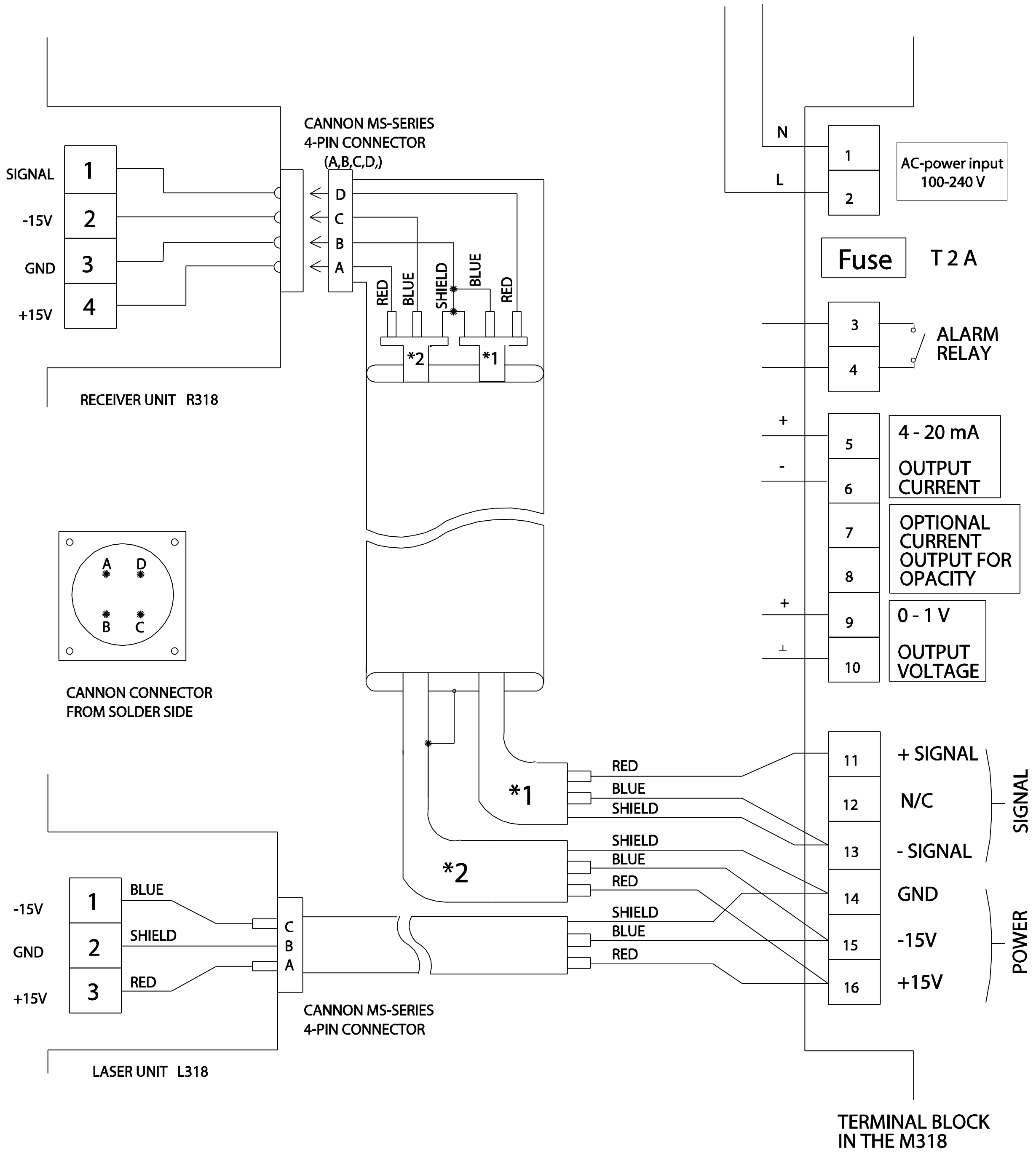
APPENDIX 11: LM 3188 Wiring

WIRING MODIFICATIONS FOR LM 3188
Standard version (see type label "230 VAC 50 Hz")

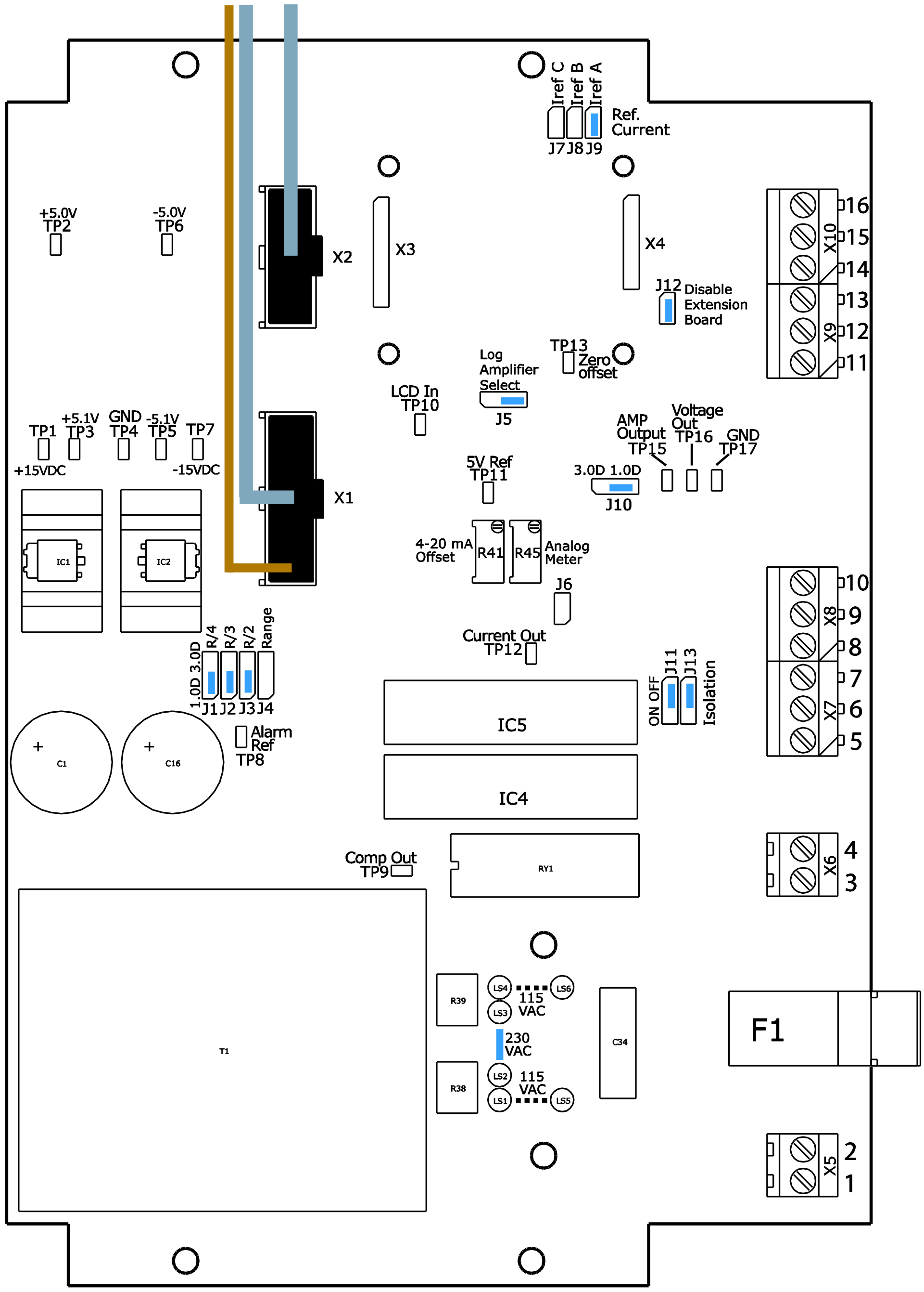


APPENDIX 12: LM 3188 Wiring; universal power option

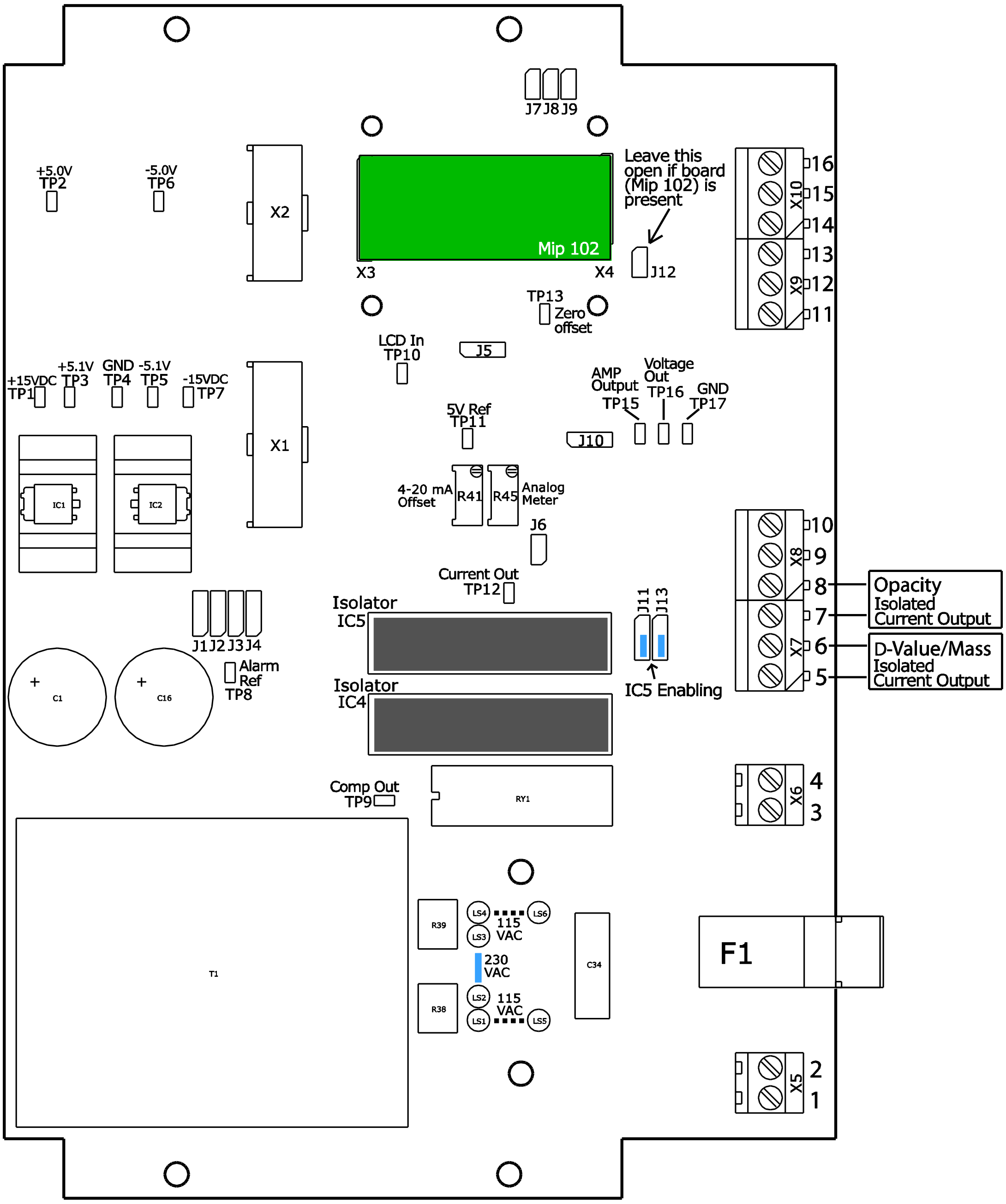
WIRING MODIFICATIONS FOR LM 3188
Universal power version (see type label "100-240 VAC 47-63 Hz")



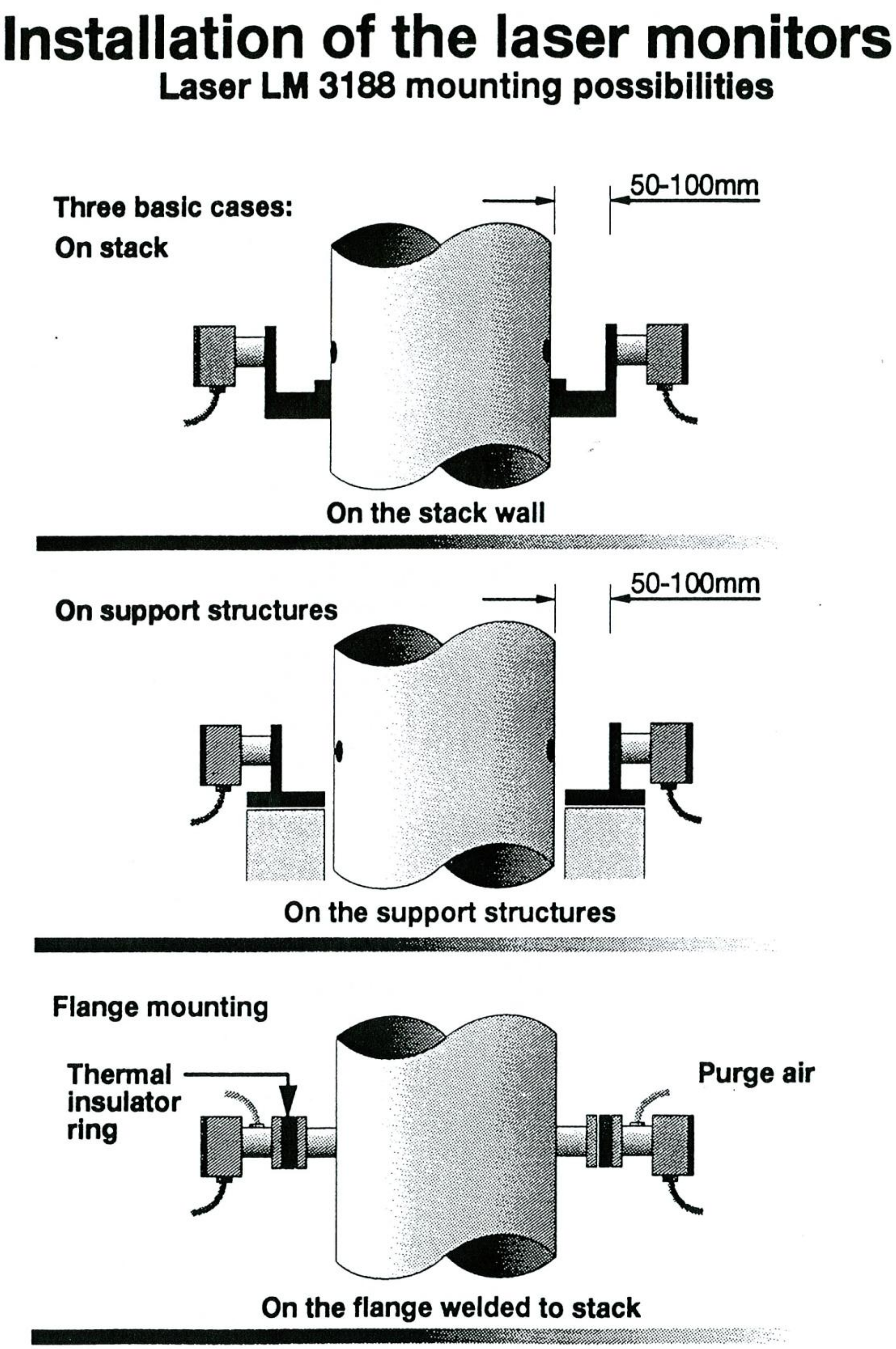
APPENDIX 13: Monitor Unit test points and jumpers



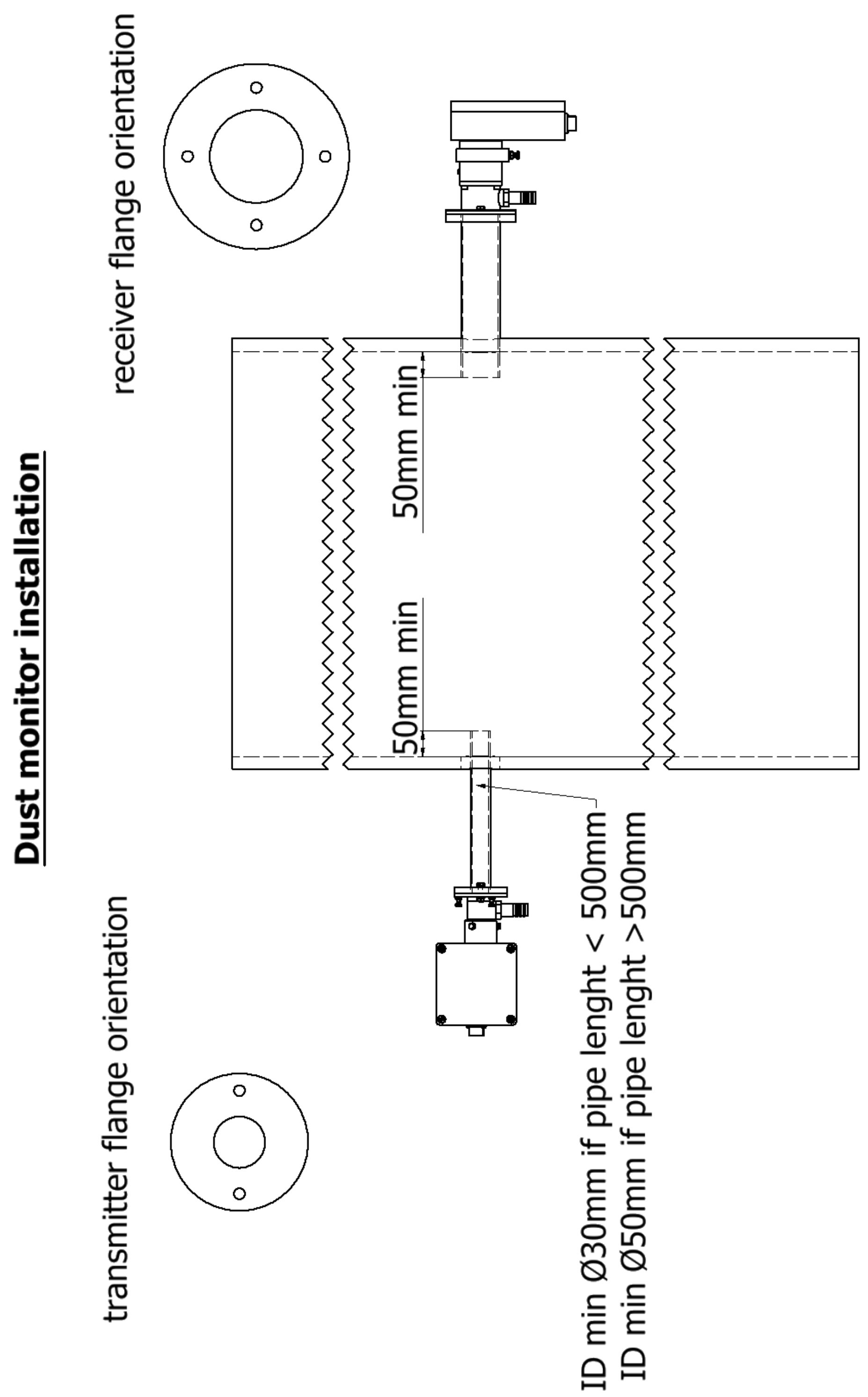
APPENDIX 14: Monitor Unit Options



APPENDIX 15: Installation examples



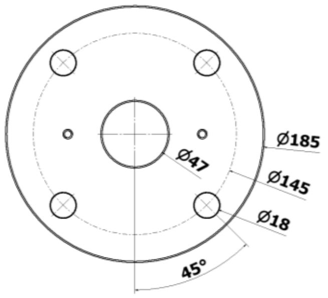
APPENDIX 16: installation



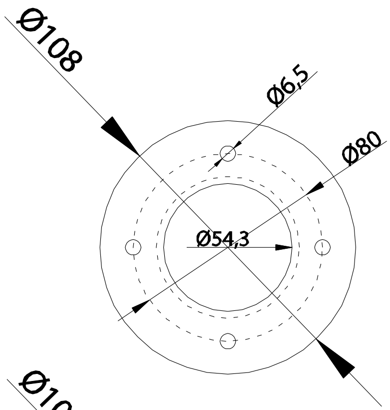
<u>Notice that temperature changes in duct may change height of the duct and that may cause changes to dust monitors height compared to walking bridge or other structures</u>

APPENDIX 17: Mating flange examples

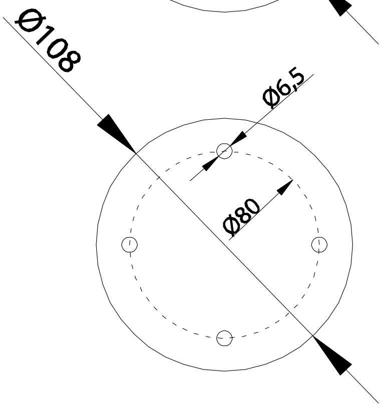
RECEIVER



DN 65 flange for receivers 860-007 to 860-012 or to receiver with rain cover or upgraded purge air flow.

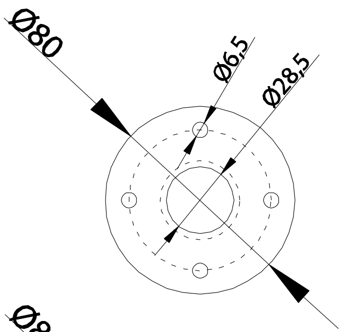


Flange: thickness 8mm or more, Ø6,5mm holes in radius 40mm; angle 90˚ (Unit needs only holes. Two "extra" holes are only for alternative installation direction.).
Centrehole is Ø50mm or more. In this example it's Ø54,3mm (made for Ø60,3*3mm tube).

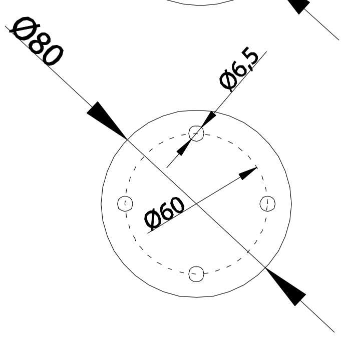


Blind flange for service purpose (same Ø6,5mm hole pattern)

Transmitter



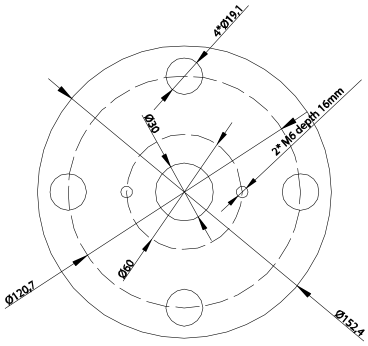
Flange: thickness 8mm or more, Ø6,5mm holes in radius 30mm; angle 90˚ (Unit needs only holes. Two "extra" holes are only for alternative installation direction.).
Centrehole is Ø25mm or more. In this example it's Ø28,5mm (made for Ø33,7*2,6mm tube).



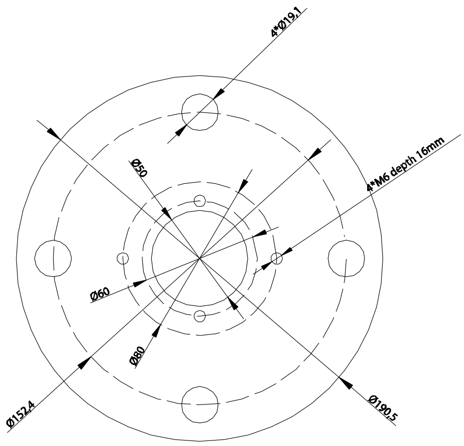
Blind flange for service purpose (same Ø6,5mm holes)

Material for example COR-TEN (EN10155)

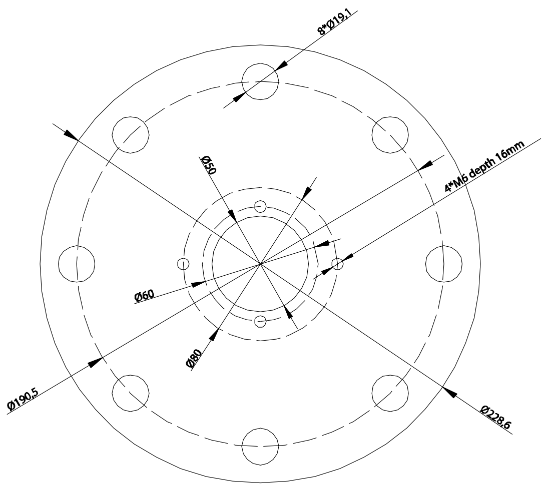
APPENDIX 18: Mating flange adapters



Ansi 2" flange adapter only for transmitter.

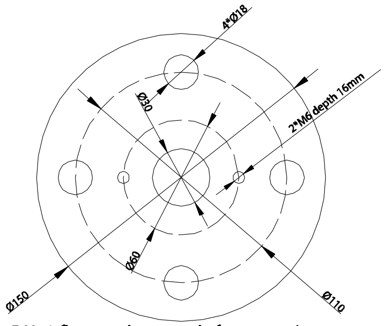


Ansi 3" flange adapter for transmitter/receiver.

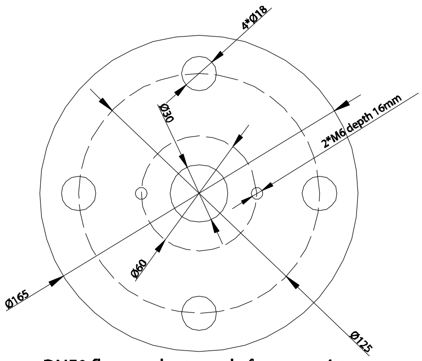


Ansi 4" flange adapter for transmitter/receiver.

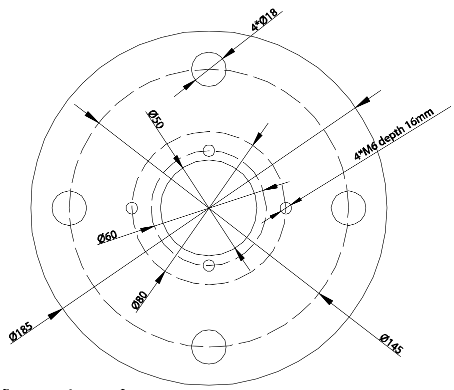
M6 thread deep (16mm) assume that flange thickness is around 20mm.



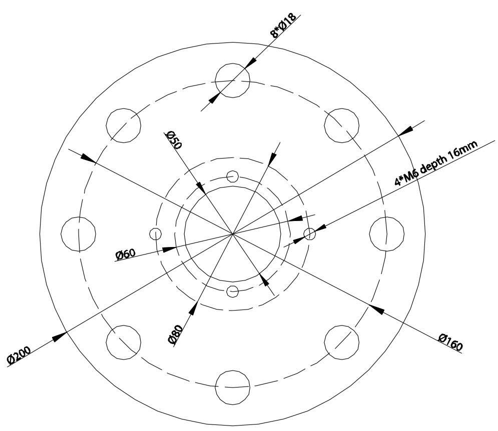
DN40 flange adapter only for transmitter.



DN50 flange adapter only for transmitter.



DN65 flange adapter for transmitter/receiver.



DN80 flange adapter for transmitter/receiver.