MIP LASER DUST MONITOR LM 3189

USER'S MANUAL

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

CONTENTS

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

1. INTRODUCTION

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

There are two main families of lasers:

- Gas lasers, notably Helium-Neon (He-Ne) lasers, are available in a compact design which includes their hi-voltage power source.
- Newer Semiconductor lasers today feature a red, visible beam and the added benefit of an integral power monitoring diode.

The major benefits of using a laser light source are given below:

- Very compact beam. The intense light beam of the laser is typically only a few millimeters thick. This allows for small holes (10 - 50 mm) in the stack and simplifies installation.
- Good stability and long life. In contrast to designs that use more traditional light bulbs, which need constant compensation due to diminishing incandescence, the laser source is relatively immune. The typical shelf-life of a gas laser is 3 years, and up to 10 years for a semiconductor unit. When a gas laser fails it is easily noticed because it begins to flicker, much like that of a fluorescent tube.
- Relatively high intensity. Since the laser light power is concentrated to a small area, it can penetrate higher dust densities compared to conventional light sources.
- Operates with a known, clearly-defined wavelength. This makes the theoretical calculations and their results more predictable, as opposed to conventional sources that operate over a broad range of wavelengths and whose spectrum changes with age.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

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 a scattering processes within the particle distribution. The net effect can be described by the Lambert-Beer law as described below (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 that 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_0) 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 context, is the optical density, D. The D-value is defined as (eq.3):

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

I and I_0 are defined the same way. It is noted that the D-value is of general nature and does not depend on the measurement length or particle properties.

To account for many different applications and measurement set-ups, the D-value as solved from 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.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

2.3 MASS-VALUE DEFINITION

Dust monitor LM 3189 measures D-values. Usually, a user is more interested in dust or particulate concentration in terms of mass concentration (mg/m^3) rather than D-values. The most reliable method to find out the relation between the D-value and mass concentration is to perform calibration by simultaneous mass-gravimetric sampling. Monitoring and recording the D-value in different particulate concentrations is necessary for more reliable result.

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

This model assumes the distribution consists of identical particles with a 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 0.7 µm and upwards.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

3. INTRODUCTION OF LASER DUST MONITOR LM 3189

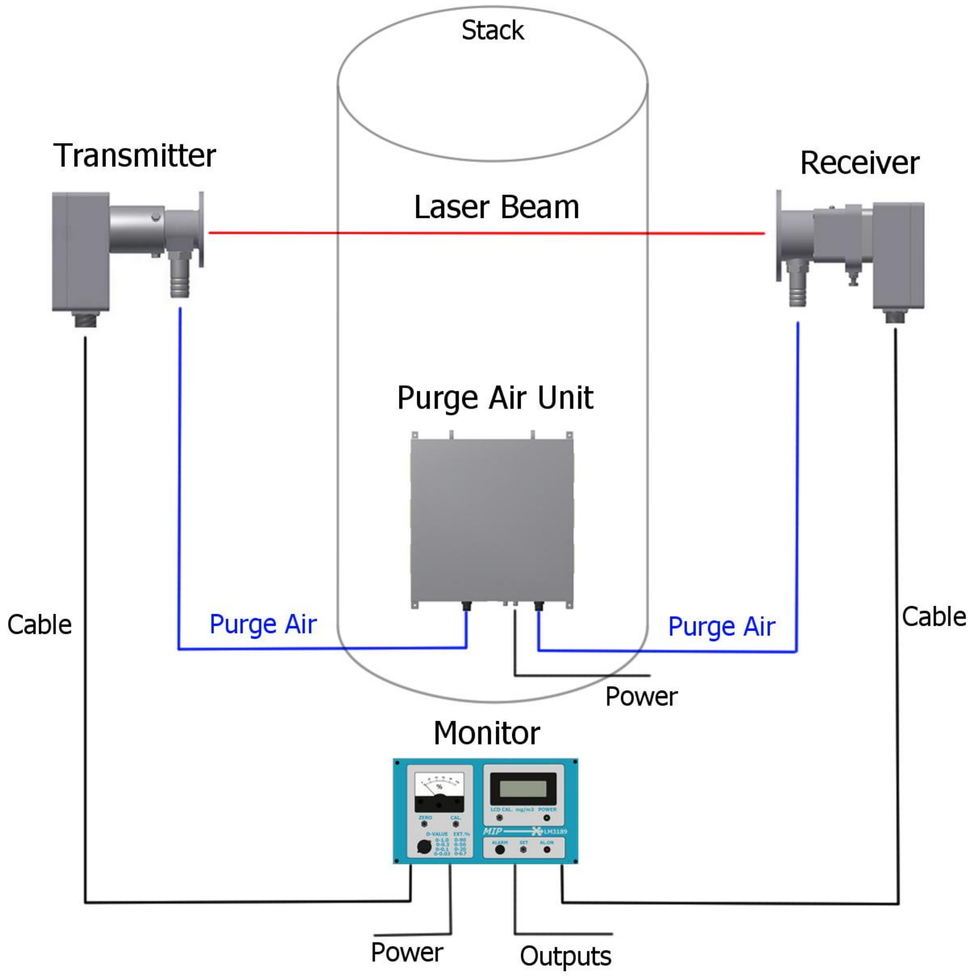


Figure 1.

LM 3189 is a cohesive unit that includes a transmitter, receiver, and monitor (see Figure 1.) LM 3189 features good stability and reliability. It has no moving parts, so it needs minimal maintenance. Its optics need is also minimum and requires less maintenance. LM 3189 has both an analogue and digital display in the monitor unit, from which the user has four selectable measuring ranges. Most of the controls and displays are included in the monitor unit. The opacity monitor's optimal use is for a stack diameter of up to 20 meters. LM 3189 has an excellent beam collimation (0.04 °), so the user does not need to use lenses or mirrors in the transmitter which makes the system reliable and simple. The alignment of the beam is easy because the beam is narrow and the standard wavelength guarantees long-term accuracy and stability. Also, our dust monitor LM 3189 can be transferred to another location without factory calibration.

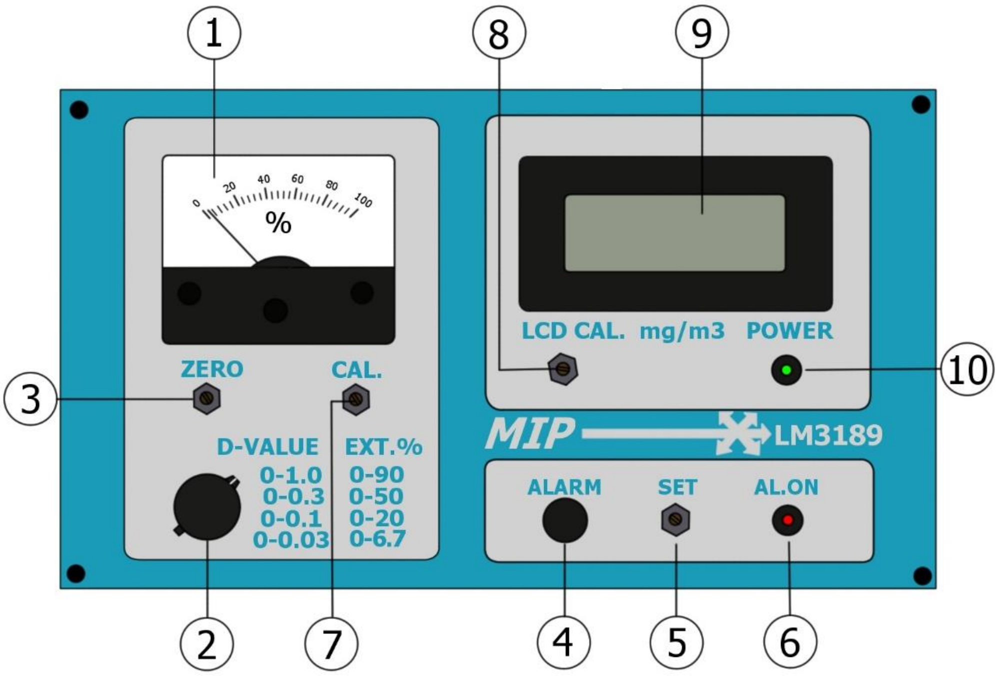
MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

3.1 CONTROLS, DISPLAYS AND SETTINGS

The faceplate of the LM 3189 monitor unit can be seen below. Controls, displays, and settings are indicated by numbers and are described later on in this chapter.



3.1.1 Indicating meter [1]

The indicating meter displays the %-value in a selected D-range. Example: if 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 continuously follows the variation in dust concentration.

3.1.2 Range selector [2]

The range selector enables the user to select a proper monitoring range for various applications. LM 3189 has four ranges of D-values available: 0-0.03 D, 0-0.1 D, 0-0.3 D, and 0-1.0 D. Ranges can be extended up to 0-3.0 D. The corresponding extinction (opacity) %-values are given along the D-value ranges.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

3.1.3 Zero set screw [3]

This is very important adjustment, because it allows for the user after installation to set a zero (D-value) level. When setting the zero, it should be done in as dustless conditions as possible. When the measuring path is clear of any interfering particles, the zero screw is turned until the meter (and display) indicates a 0-reading.

3.1.4 Alarm test button [4]

After pressing this button the monitor displays the set alarm level that activates the alarm relay. Note, 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 lights up when the alarm level is exceeded.

3.1.7 Calibration screw [7]

After the zero level is set, the calibration screw is used to adjust the reading to correspond to a known D-value calibration filter. Normally this is done in the factory and the 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 for setting the relation between the D-value and the digital mass reading. The correct relation can be verified using 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 the 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 lights up whenever the monitor is powered.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

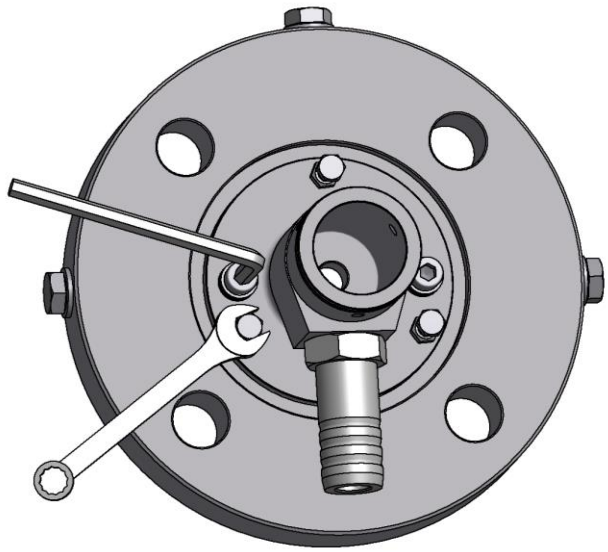
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

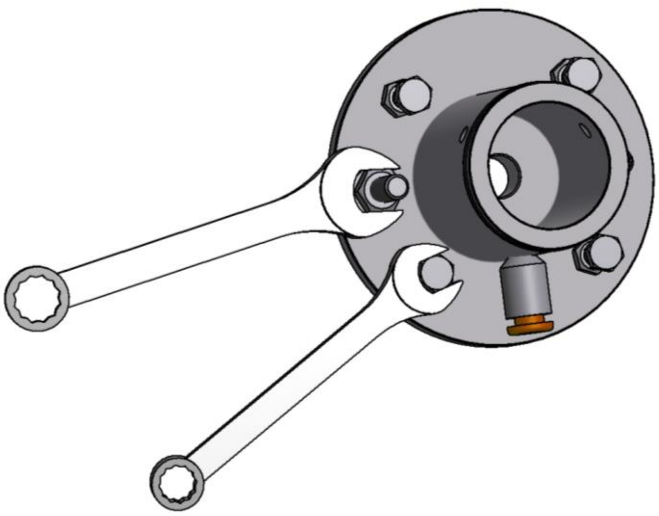
4. INSTALLATION AND CALIBRATION

4.1. INSTALLATION

The installation environment is different in each application. For this reason MIP provides a minimum of installation hardware with the instrument. The transmitters and receivers come with flanges that have elliptic holes for adjustment.



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

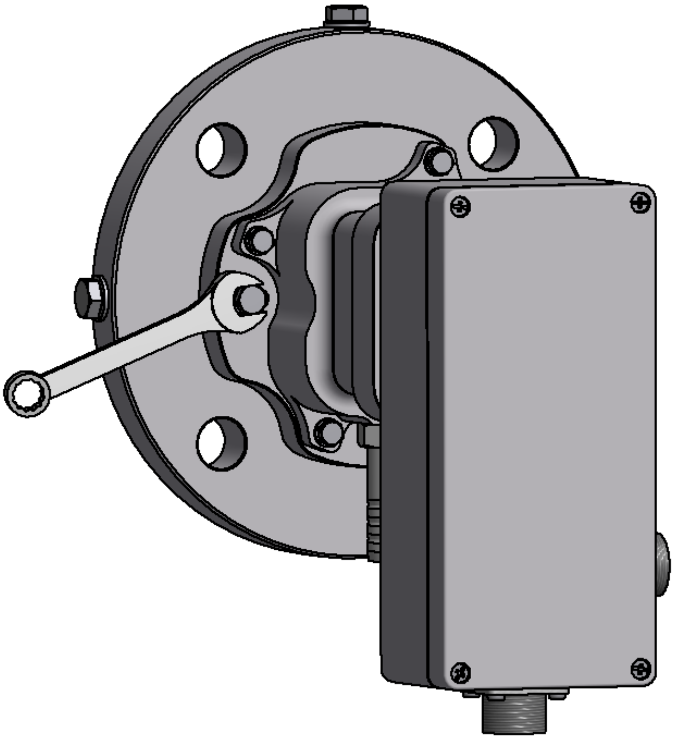


Picture 2: Use a 10mm wrench and 8mm wrench to adjust angle and position of the transmitter unit with M5 purge air thread.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI



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

Since the laser beam is very compact, only small holes are needed (10-50 mm dia) for the beam to go through. Normally there is a slightly lower pressure inside the stack and outside air automatically keeps the holes clean. In case there is a higher pressure inside the stack, the transmitter and receiver can be flange-mounted to the stack. This installation needs the instrument-air purge system, which slightly overcomes the stack pressure keeping the instrument clean and functional.

The mounting system varies from case to case. There are three different mounting systems (see appendix 13 for pictures):

a) Mounting in the stack itself by L-type supports (under pressure stacks)

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 a higher pressure in the stack and gas escaping from small holes is not allowed.

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

Other environmental factors can influence the measurement as well and they are introduced below:

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

1 [ ] Trying to measure too small concentrations

2 [ ] Using too long of a distance for very high concentrations

3 [ ] Orientation and vibration problems when using a long measuring distance

4 [ ] Interference from substances other 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 the measuring angle and the inherent intensity fluctuation in both LM 3086 and LM 3189, 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 about 13-18 m. For the semiconductor model it is about 25-35m. For critical cases, larger area detectors are available. In this case consult the factory.

Factor 4. The selected wavelength of the laser is such that the 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 when wet scrubbers are involved, 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 the modulated laser beam, this is not a problem as the receiver is tuned to modulation frequency. For an 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 which are installed remote to stack. Both laser and receiver should be provided with dry, clean instrument air to maintain a slight overpressure inside the units.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

4.2 CALIBRATION

Calibration includes a broader range of operations including: zero set, optical calibration with filters, mass calibration and checking the outputs of the instrument. Zero setting and optical calibration can also be performed at a laboratory workbench using the same distance as in actual measurement situations.

Setting the instrument to zero:

- First, after switching the laser and measuring unit on, wait for 2 hours to let the laser output power stabilize
- Then, using the most sensitive measuring range, set the meter to zero with the zero adjustment screw on the front plate. **Note: be sure while making the zero adjustment that the channel is free from dust, i.e. this adjustment corresponds to a physical zero dust state.**

We define calibration as the optical calibration of the D-value and possible mass calibration.

Optical calibration is performed as follows:

- Calibration check can be made any time with optical neutral density filters. For instance, by interposing a D = 0.3 value filter in the laser beam, while the meter is set for a range of 0-1.0 D, the meter should display 30% more than without the filter. If necessary, the sensitivity can be altered by a “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 filter, is available.

4.2.1 Filter set for the dust monitors and instructions for use

The dust monitor LM 3189 should be warmed-up and showing a steady D-value (zero if the measurement path is clear of dust) before calibrating with filters.

Insert the filter in the laser beam at a right angle (90°) with the beam hitting the center of the filter. The best place for the filter is flush with the receiver ‘R 3189’ surface. If this is not possible, insert the filter as near to the receiver as possible.

The measurement of the LM 3189 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.

If the increase in the indication differs from the known X-value, the LM 3189 “CAL” screw can be used to correct the calibration. 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 sets.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

4.2.2 Mass calibration

Mass calibration is based on a theoretical calculation or on an actual sampling procedure.

Theoretical mass calibration is based on equation (4), which relates the optical density and mass density of the dust, and it is assumed 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 equation 4. 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 high 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 a straight line.

4.2.3 Output check

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

Take for example the D = 0.5 filter and select a range of 0-1.0 D. Now the meter should indicate 50% and the corresponding voltage output will be 50 % of 1 V, or 500 mV, and the current output should be 4 mA + (50 % • (20 - 4) mA) = 4 mA + (0,5 • 16 mA) = 12 mA.

Next use the same filter and a range of 0-3.0 D. The result should now be:

%-indication = 0.5 / 3.0 = 17 %
Voltage output= 17 % • 1 V = 170 mV
Current output = 4 mA + (17 % • (20 - 4) mA) = 6.7 mA

Notice 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 are at 0V potential, while current output (-) terminal is (-15V) potential.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)
WWW.MIP.FI

4.3 QUALITY ASSURANCE PROGRAM

MIP's Quality Assurance Program (QAP) tracks each instrument delivered and maintains individual test cards of each manufactured product for service purposes. It also records each person that was involved in the manufacturing process and includes their qualifications and duties. QAP also identifies all the laboratory instruments used during the testing of the products and specifies the documentation and how it is filed.

Test sheets can be found at the end of this manual. Test sheets show which features are tested in the laser monitors. Testing is performed with the assumption that the "standard" particles are 1 micrometer and 1 kg/dm^3, since the user's measurement environment is unknown. Mass calibration is performed based on the previously mentioned values and the measuring path is assumed to be 1 m. With these values, the "normalized" laser meter will give a reading of 800 mg/m^3 with a filter =1.0D when it leaves the factory. This instrument is carefully tested in the laboratory and the meters are carefully adjusted for the best linearity with the calibrated filter set.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

5. SPECIFICATIONS

The model LM 3189 is compatible with previous model LM3188.

Laser Unit L 3189

Laser type	Semiconductor laser, safety class IIIR
Optical Power	1,2mW nominal
Wavelength	655nm, visible light
Modulation	Electrical modulation (1kHz)
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 3189

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 3189

Range	1.0D	3.0D
Analog display	0…100% linear scale of D-value	0…100% linear scale D-value
Digital display	0…2000 mg/m^3	0…20.00 g/m^3
Outputs	Voltage 0…1V, 50Ω Current 4,0…20,0mA, 500Ω max. Relay 230 VAC, 8A max.	Voltage 0…1V, 50Ω Current 4,0…20,0mA, 500Ω max. Relay 230 VAC, 8A max.
Power supply	230VAC 14VA 115VAC 14VA (optional) 90-260VAC 40VA (optional)	230VAC 14VA 115VAC 14VA (optional) 90-260VAC 40VA (optional)
Operating temperature	0°C to +70°C (32°F to 158°F)	0°C to +70°C (32°F to 158°F)

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

Ranges

1.0D model:

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

3.0D model:

Switch position	D-value	Opacity %	Mass value
1	0…0,1D	0… 20 %	0 … 0.08 g/m^3
2	0…0,3D	0… 50 %	0 … 0.24 g/m^3
3	0…1,0D	0… 90 %	0 … 0.80 g/m^3
4	0…3,0D	0… 99,9 %	0 … 2.40 g/m^3

* Factory settings

The range values are for a particle size of 1 micrometer and measuring distance 1 m. For other type of particles and measuring length, range values vary.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)
WWW.MIP.FI

6. WARRANTY PROCEDURE

Review the terms of purchase and the date in warranty certificate to determine the validity of warranty claim. Warranty claims should only be made for products that are within the terms of the warranty policy. Out-of-warranty items may be sent to be evaluated and fixed as an additional service. MIP must be notified within 15 days of noticing the defect. Defective product should be sent for determination before the expiration of the warranty period.

Prior to returning any unit for repair or evaluation, please contact MIP either by phone (+358-10-322 2631) or via email (support@mip.fi) to obtain authorization and Returned Material Authorization (RMA) code to return the unit. 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. Pictures from site or mounting place and if known defected part of product
e. Name and phone number of contact person at your organization.

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

MIP will advise the purchaser of its determination results at the earliest possible time. Providing complete information as requested will help to expedite this process. For products outside of their warranty period, determination will be made as a service after purchaser has approved cost estimate for repair/replacement. Charges for repair work will be invoiced 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.

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
Palokorvenkatu 2
04250 Kerava
Finland

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 LM 3189, LM 3086EPA3, LM3086SE

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

2006/95/EC	Directive on Low Voltage Devices
EN 55011	Electromagnetic Compatibility
IEC/EN 61000-6-2	Electrostatic Discharge

1st of June, 2015 Kerava, Finland

Jouni Lukkari
Managing Director

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

8. CERTIFICATE OF ORIGIN

We hereby confirm that Dust Monitor MIP LM 3189 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:	

1st of June, 2015 Kerava, Finland

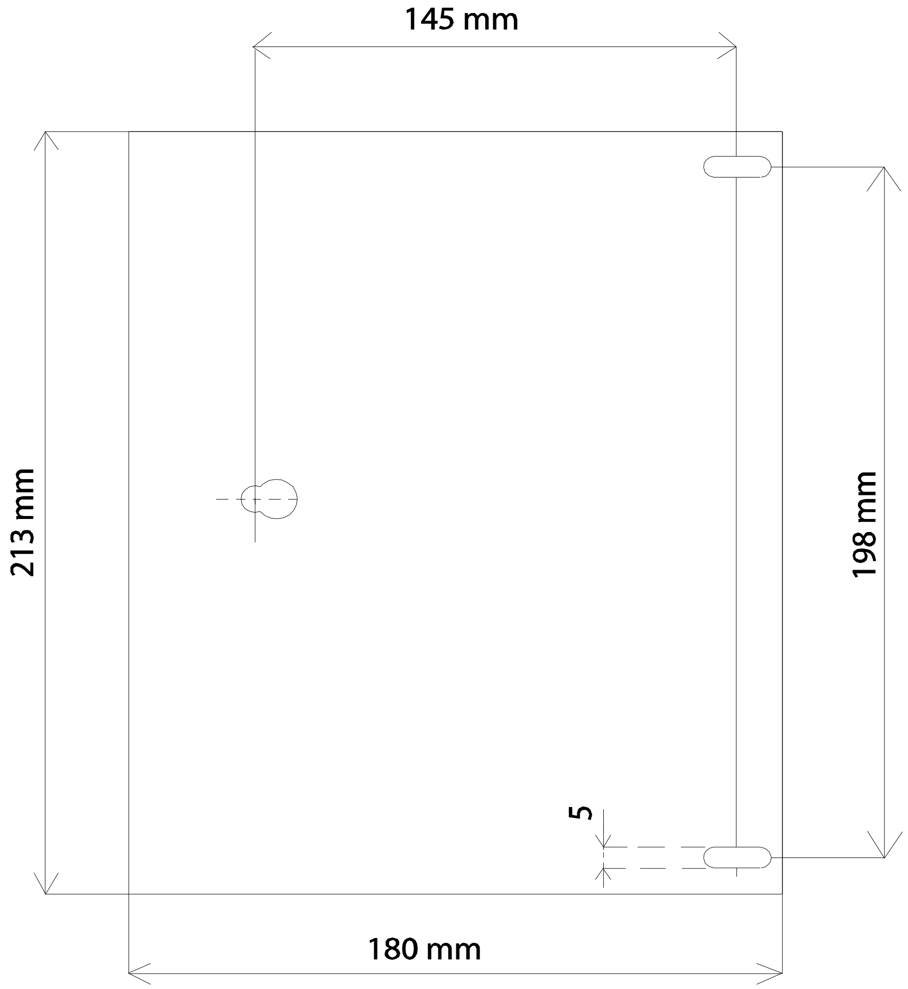
Jouni Lukkari
Managing Director

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 1: Monitor Unit M 3189 mech. drawing

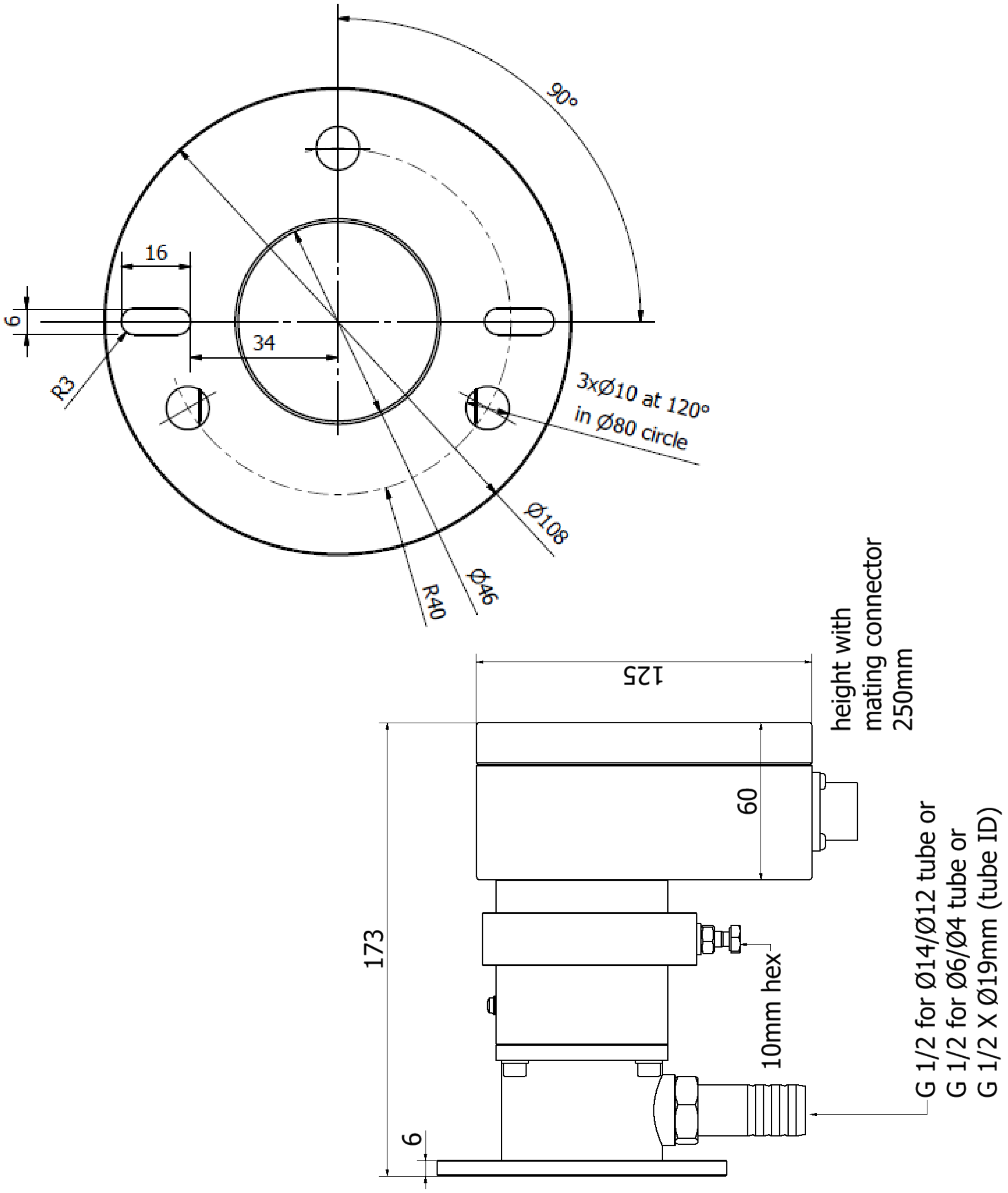


MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 2: Receiver unit R3189 mech. Drawing



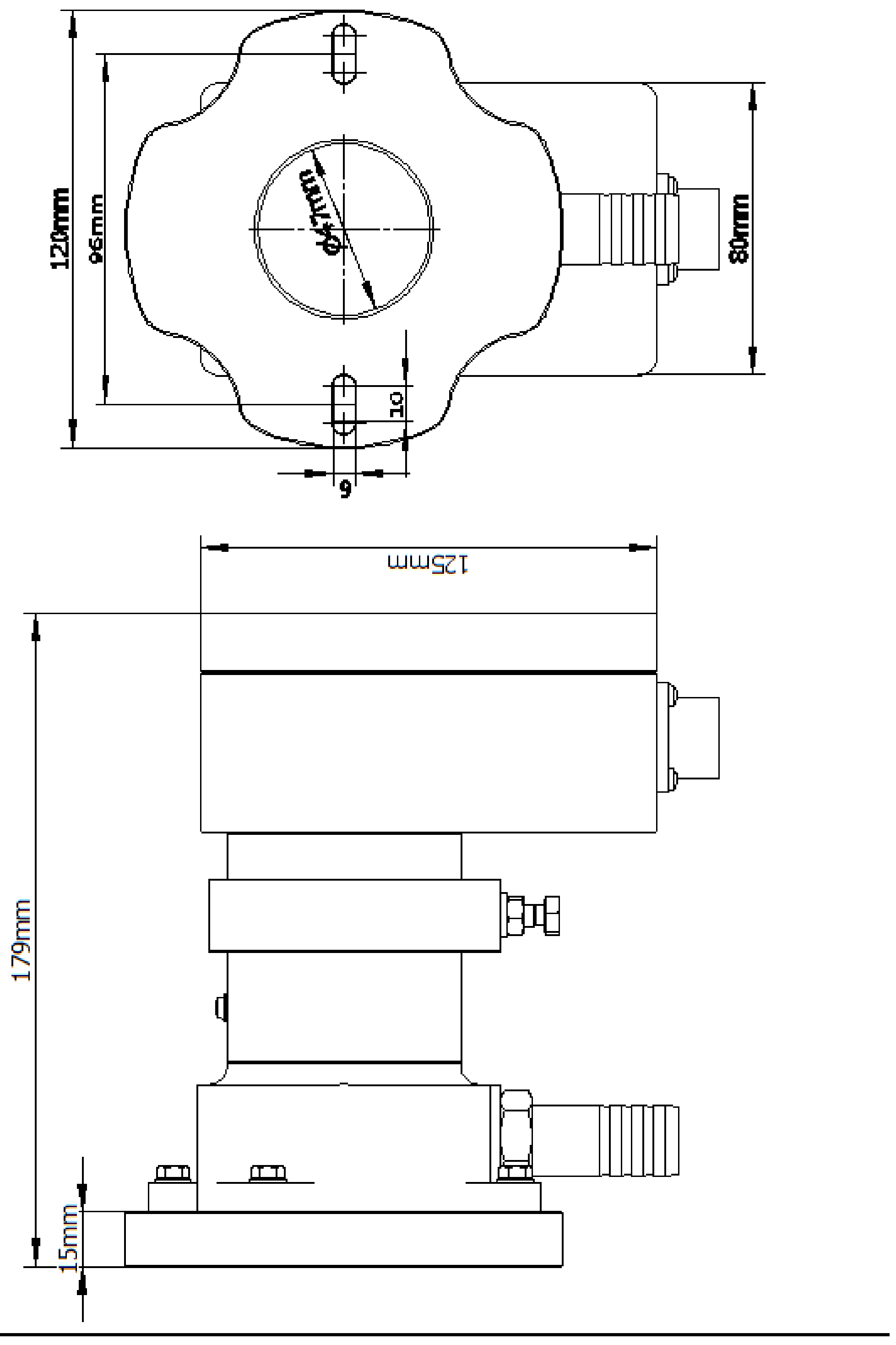
<u>R3189 Receiver unit 820-002, 820-003 and 820-004</u>

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 3a: Receiver unit R3189 mech. drawing



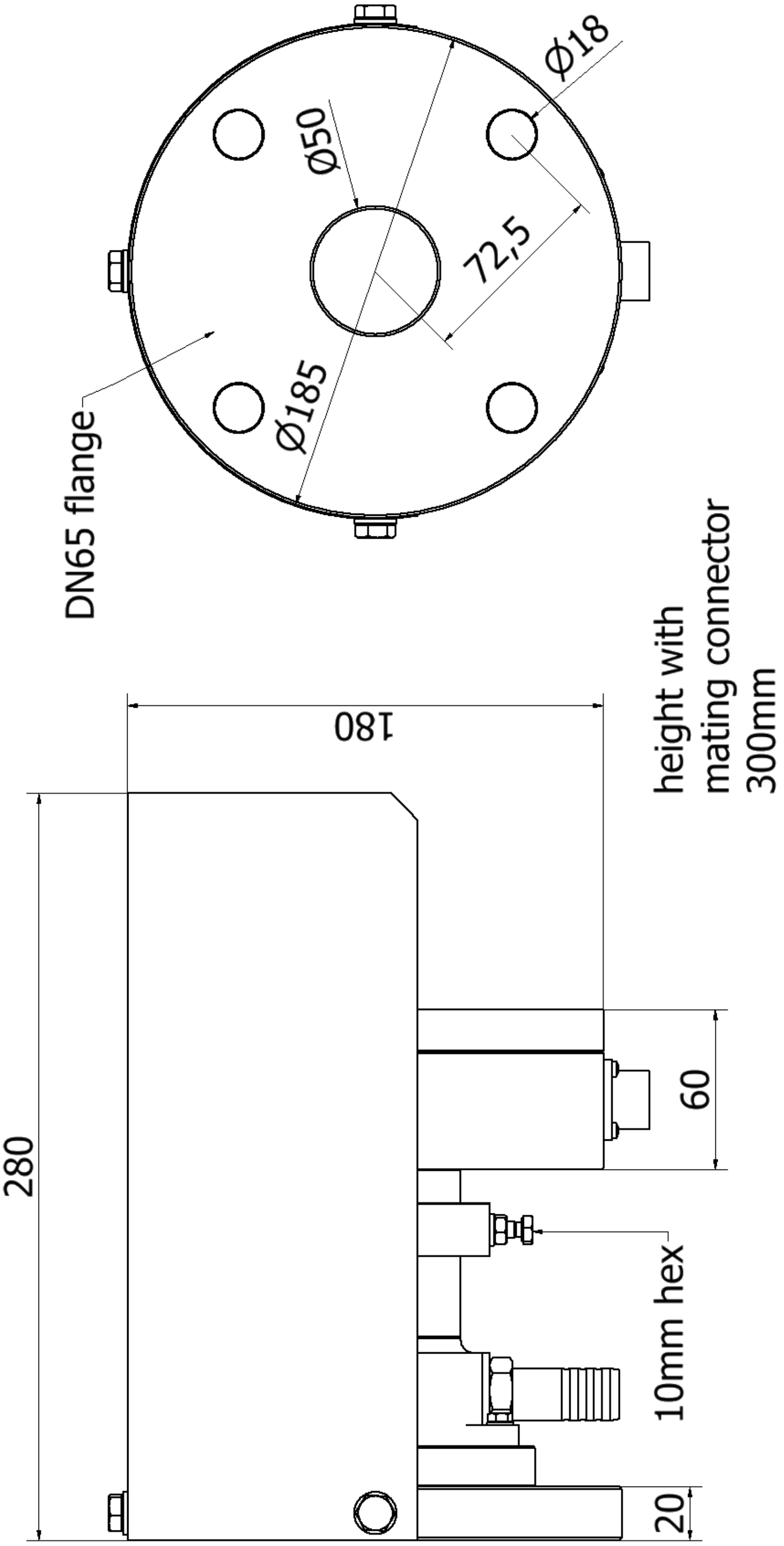
R3189 Receiver unit 820-011

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

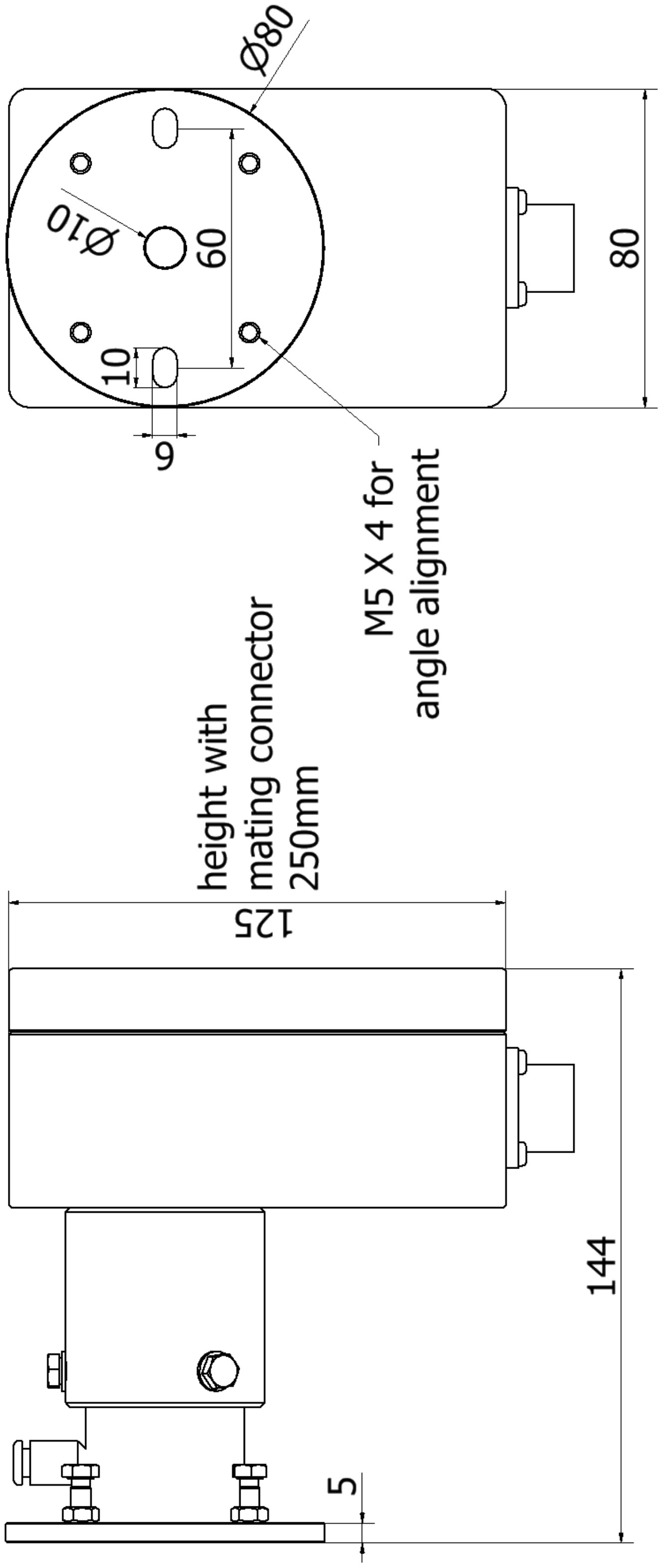
APPENDIX 3b: Receiver unit R3189 mech. drawing



R3189 Receiver unit 820-000 and 820-001

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)
WWW.MIP.FI

APPENDIX 4: Transmitter unit L3189 mech. drawing



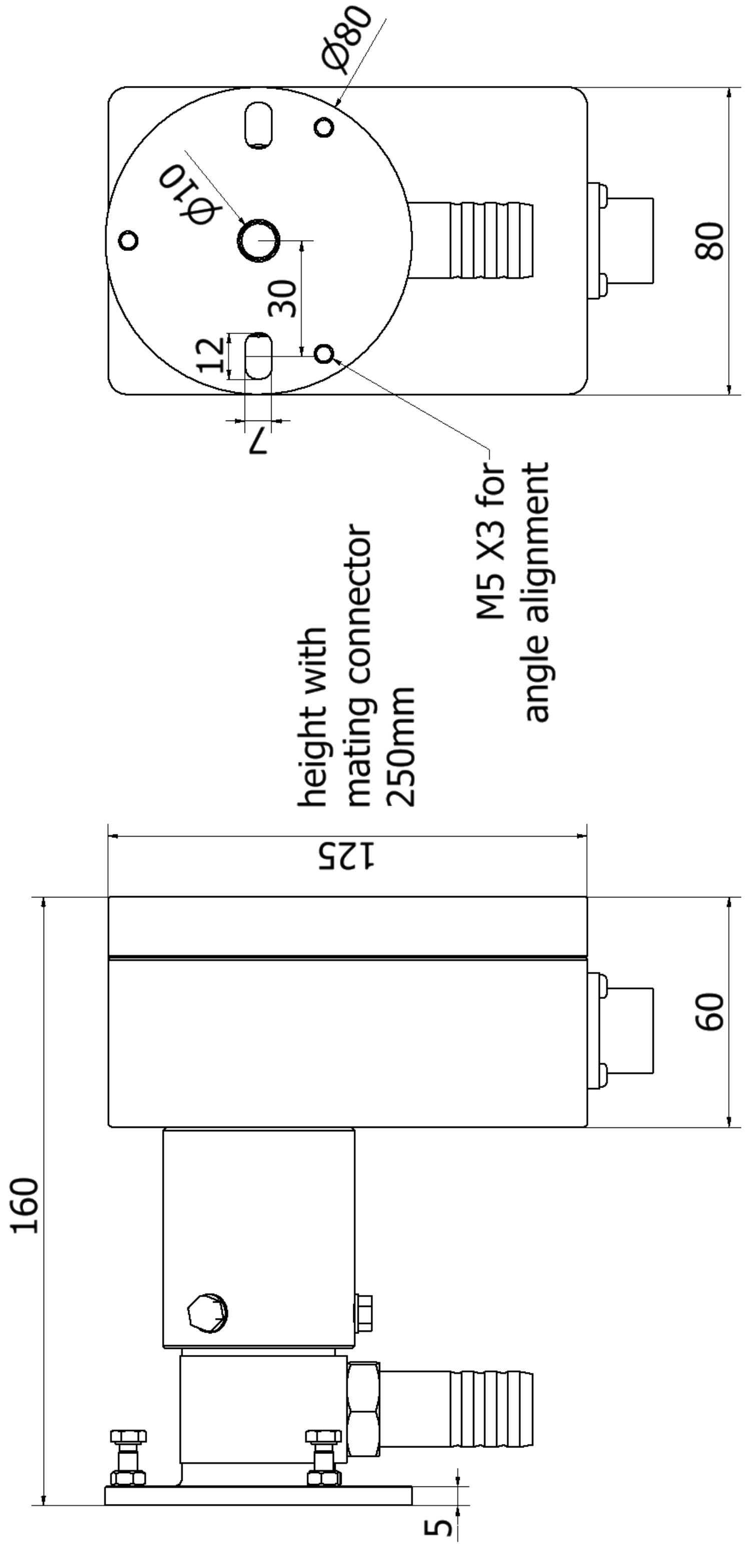
L3189 Transmitter unit 930-005

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 5: Transmitter unit L3189 mech. drawing



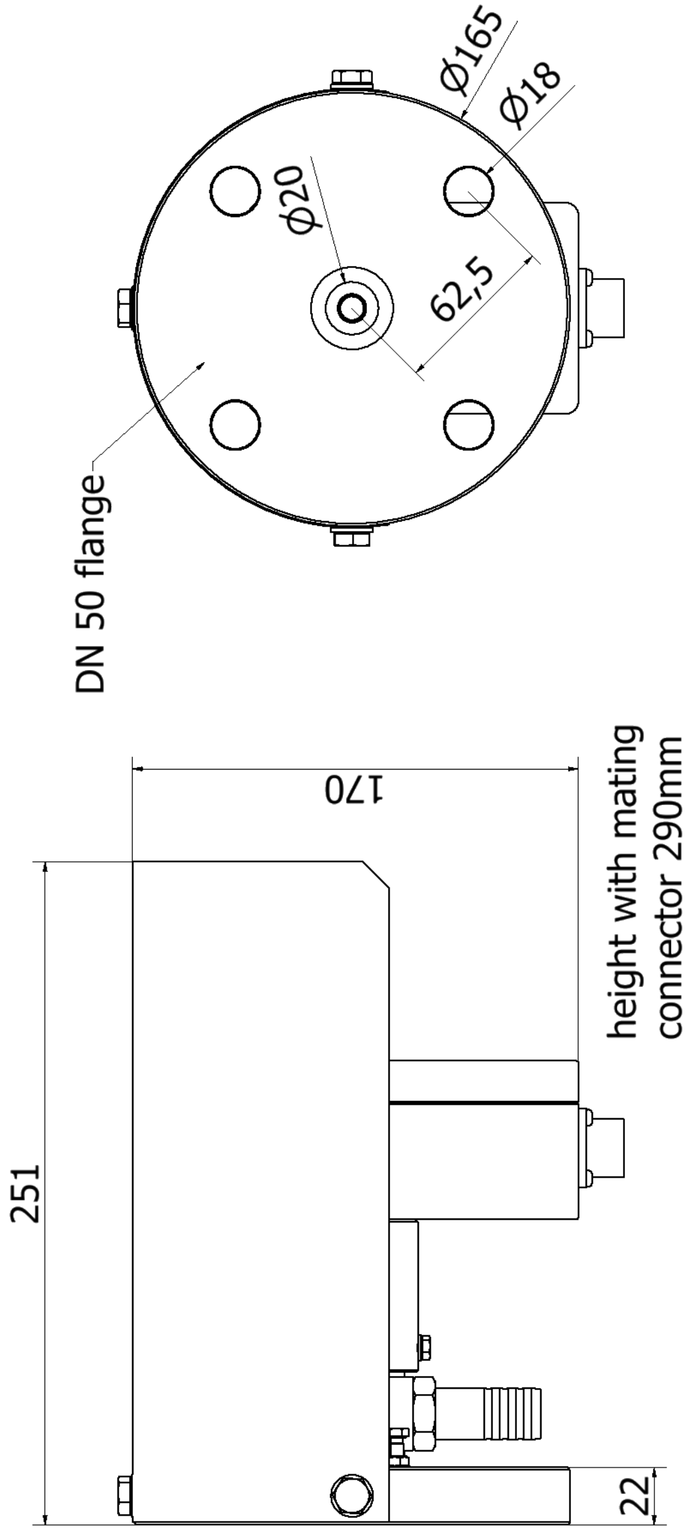
L3189 Transmitter unit 930-003, 930-004, 930-006

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 6: Transmitter unit L3189 mech. drawing

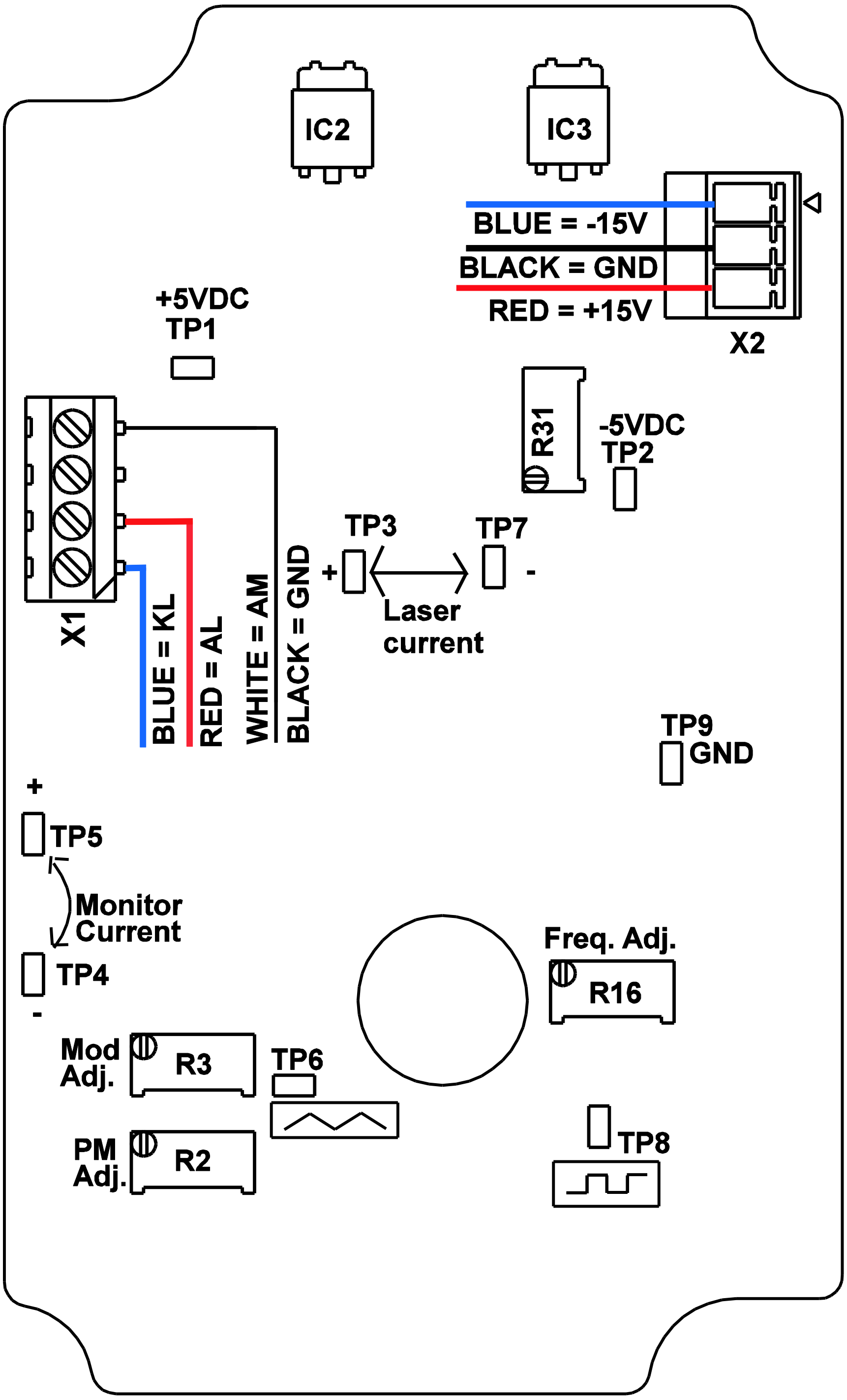


L3189 Transmitter unit 930-001 and 930-002

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

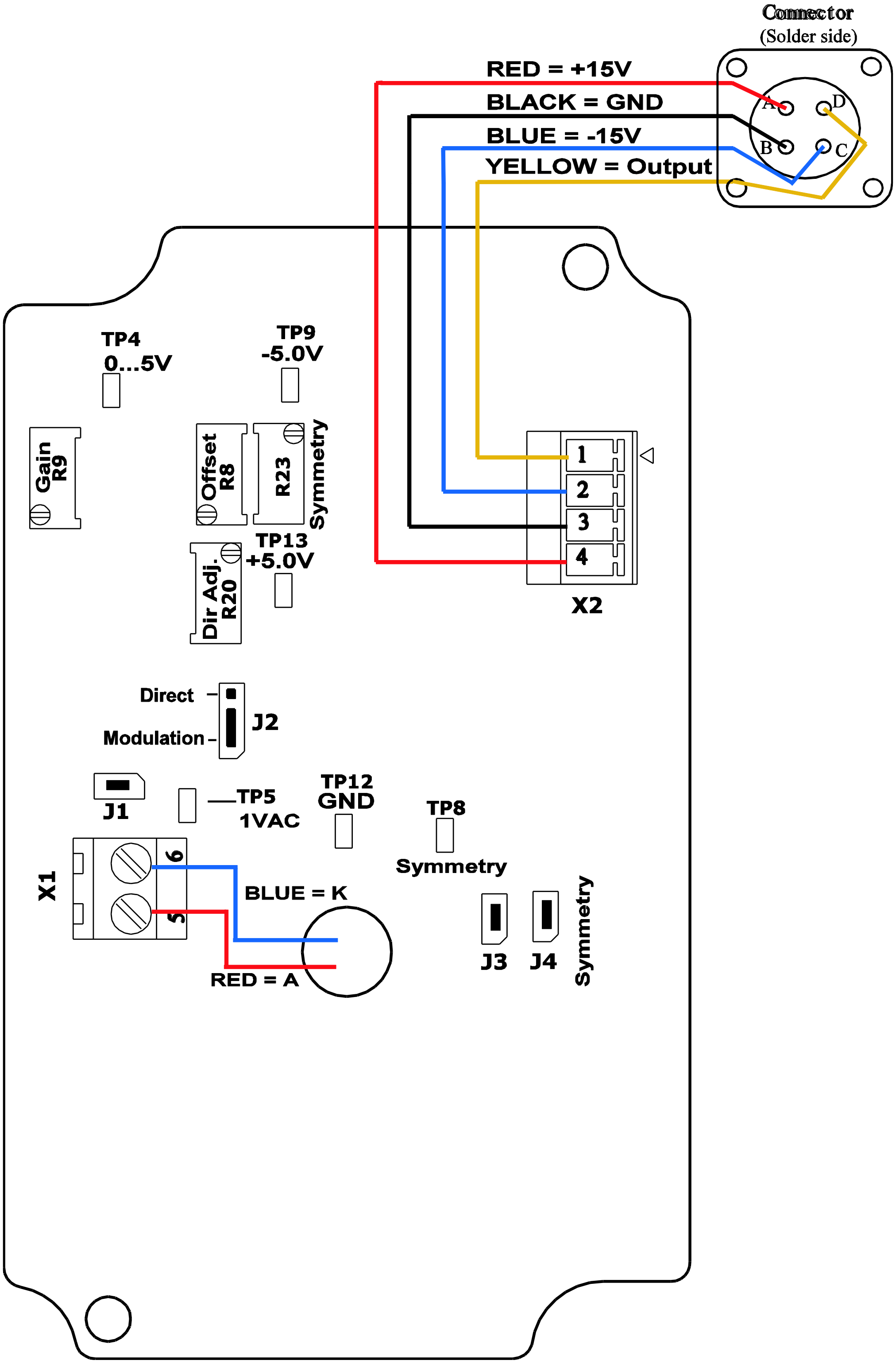
APPENDIX 7: Laser Unit L 3189 PCB-layout



MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

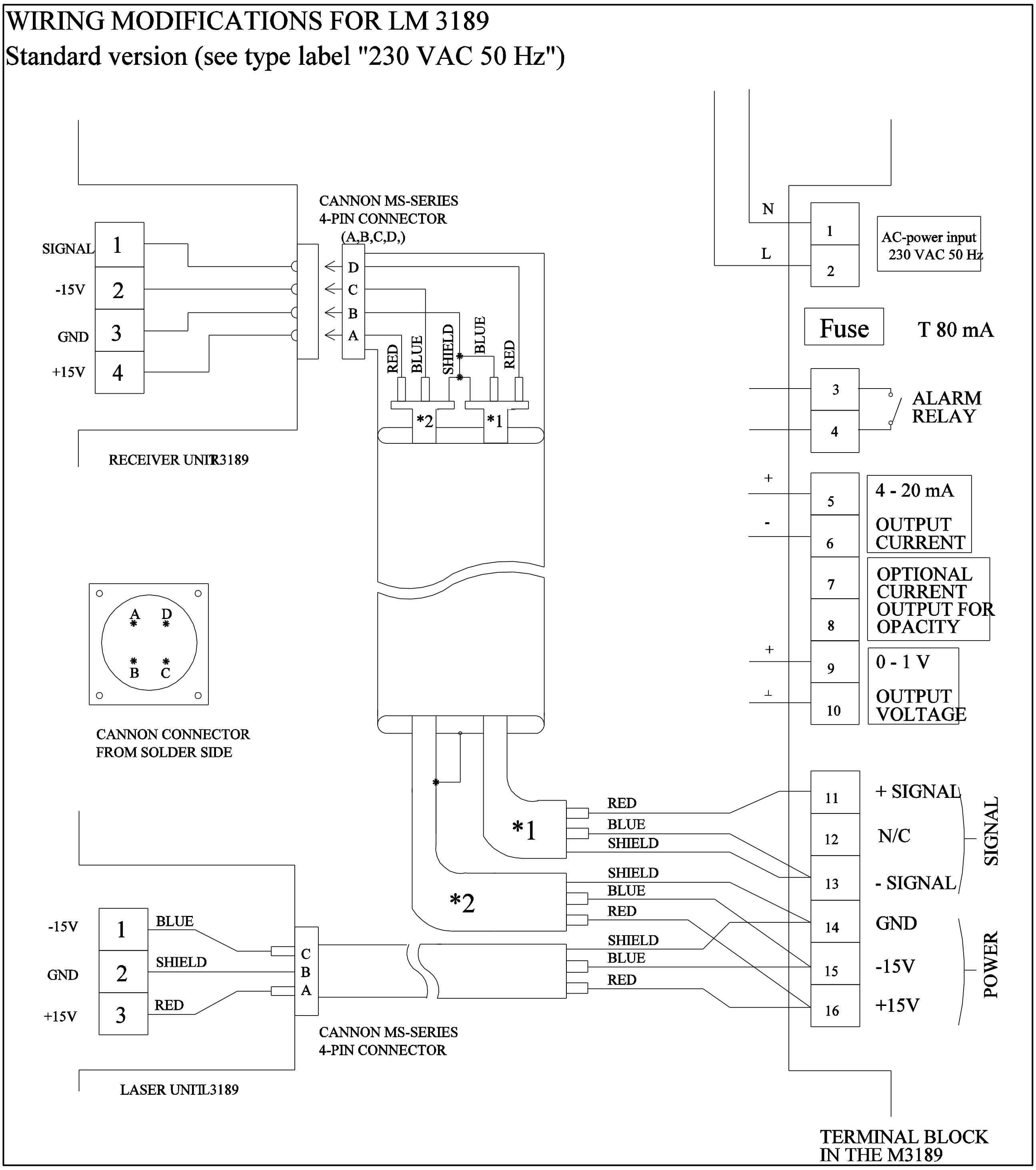
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

APPENDIX 8: Receiver unit R 3189 PCB-layout



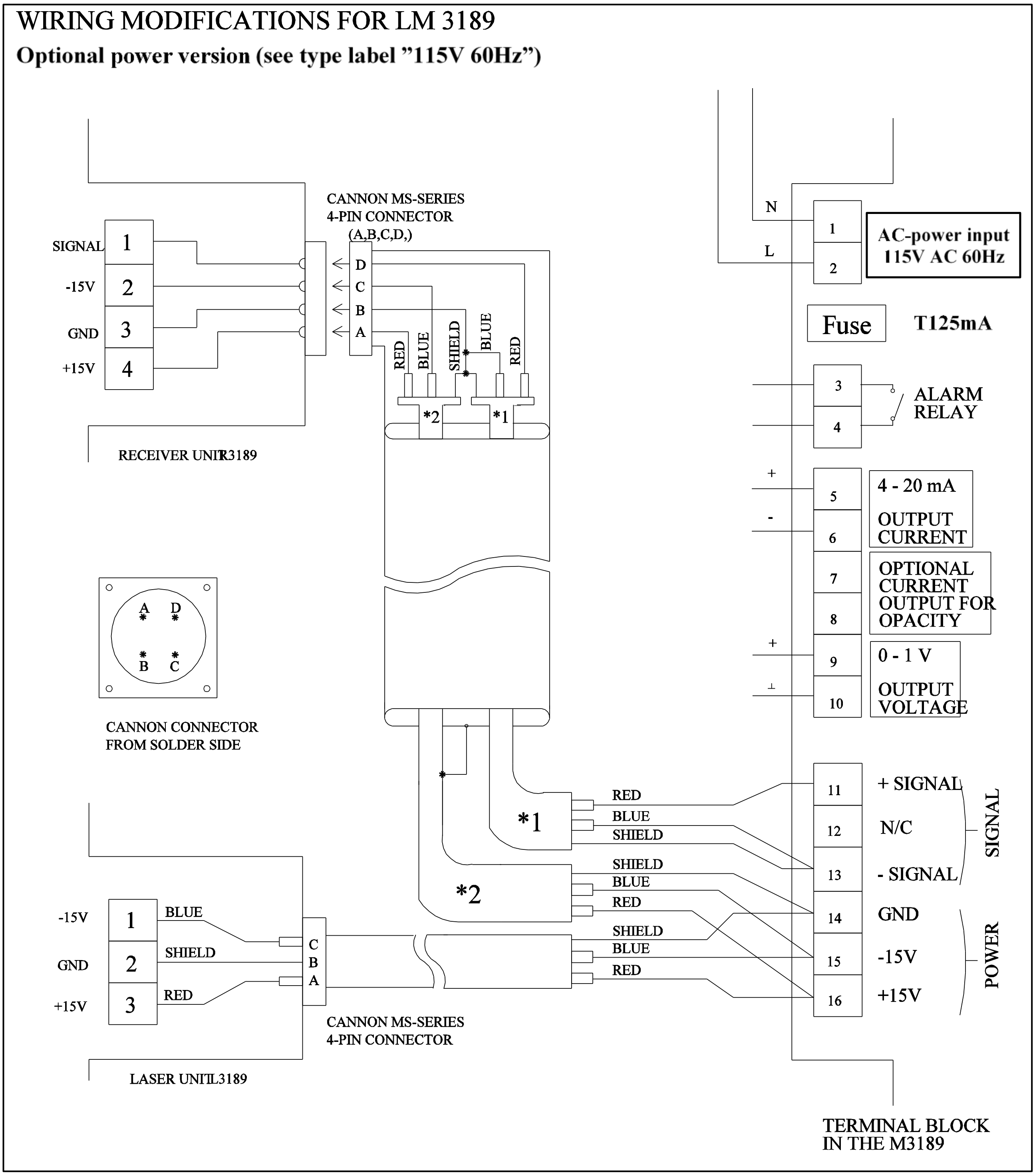
MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)
WWW.MIP.FI

APPENDIX 9: LM 3189 Wiring; 230VAC



MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)
WWW.MIP.FI

APPENDIX 10: LM 3189 Wiring; 115VAC

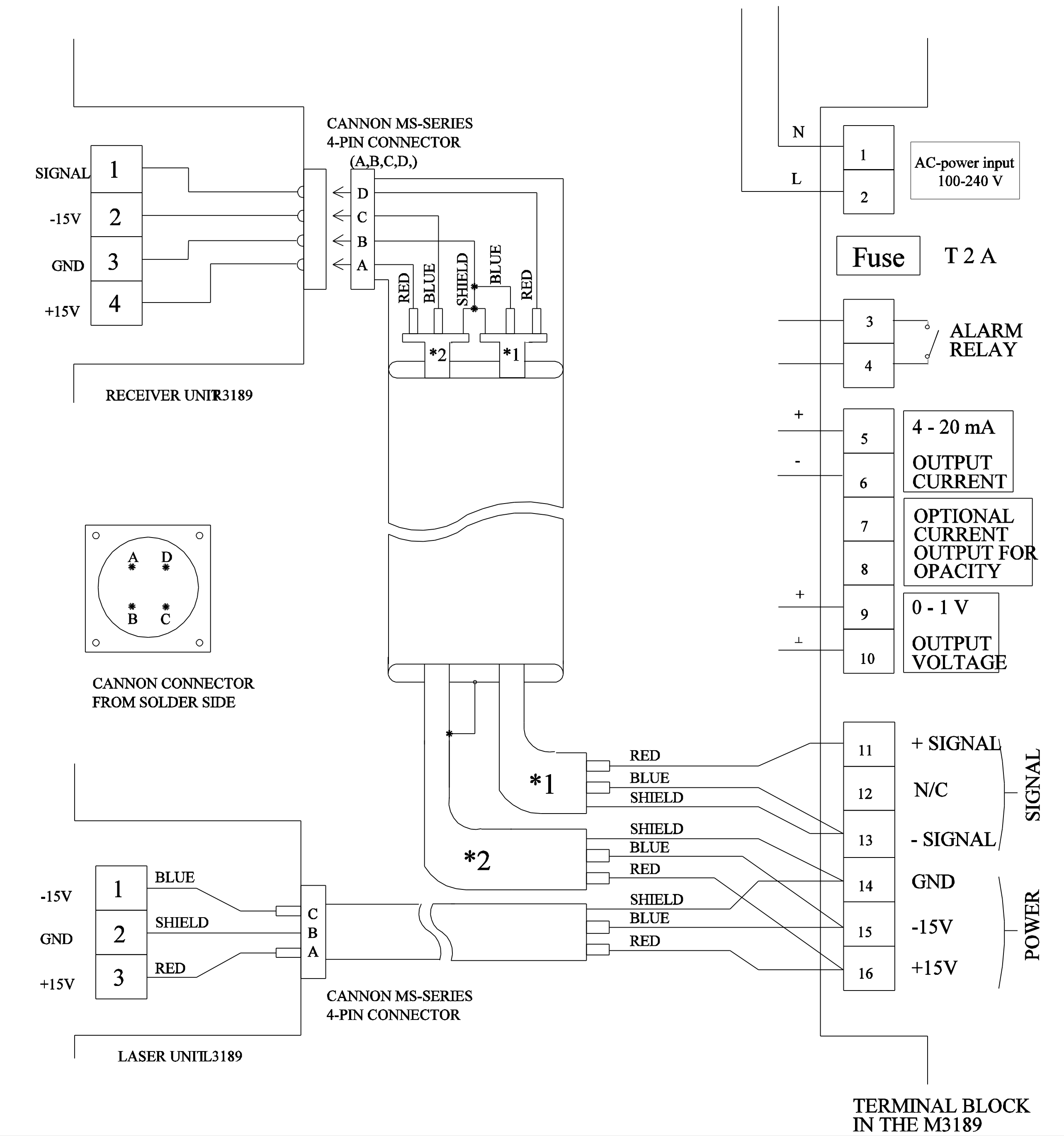


MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)
WWW.MIP.FI

APPENDIX 11: LM 3189 Wiring; universal power option

WIRING MODIFICATIONS FOR LM 3189

Universal power version (see type label "100-240 VAC 47-63 Hz")

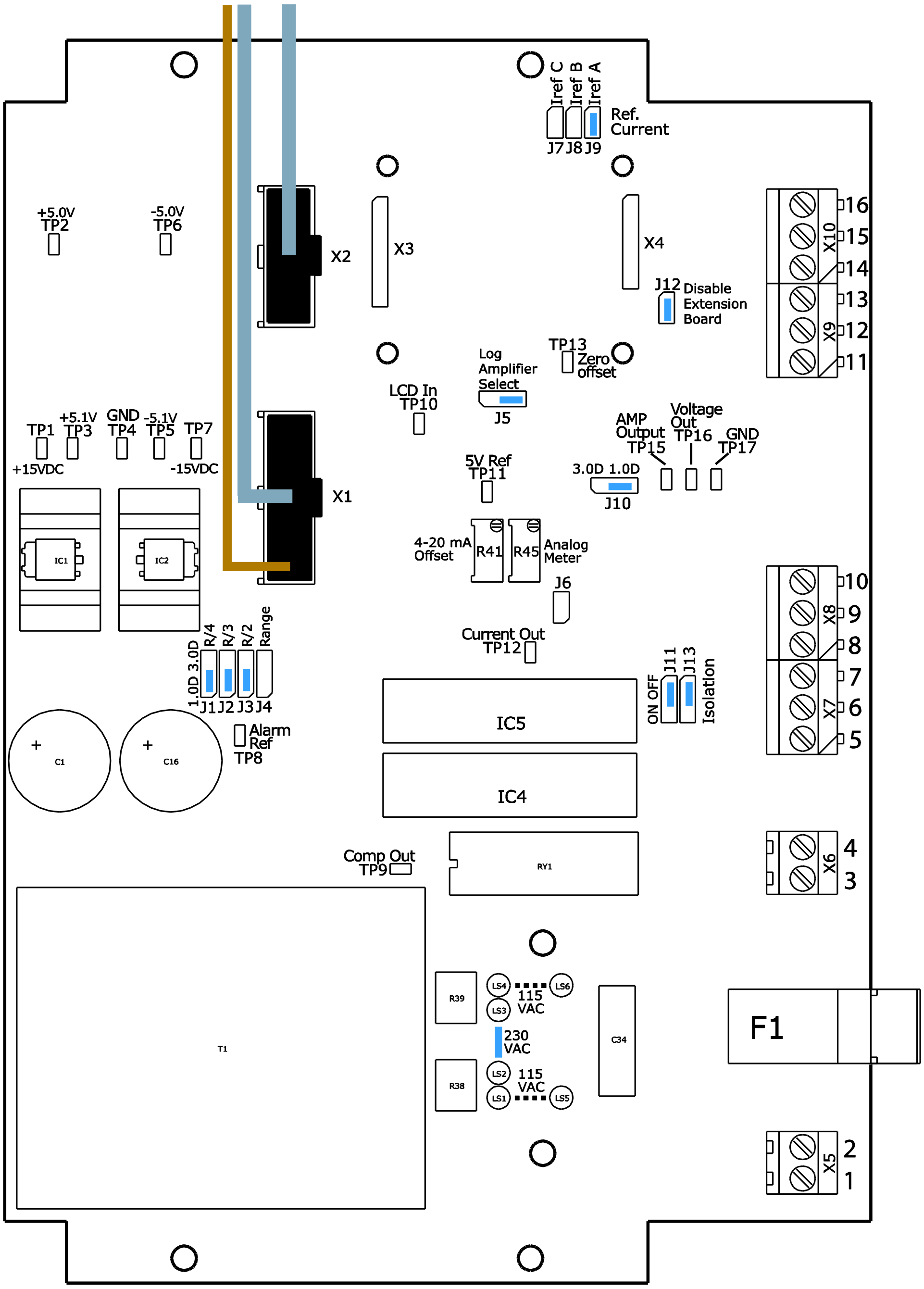


MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 12: Monitor Unit test points and jumpers

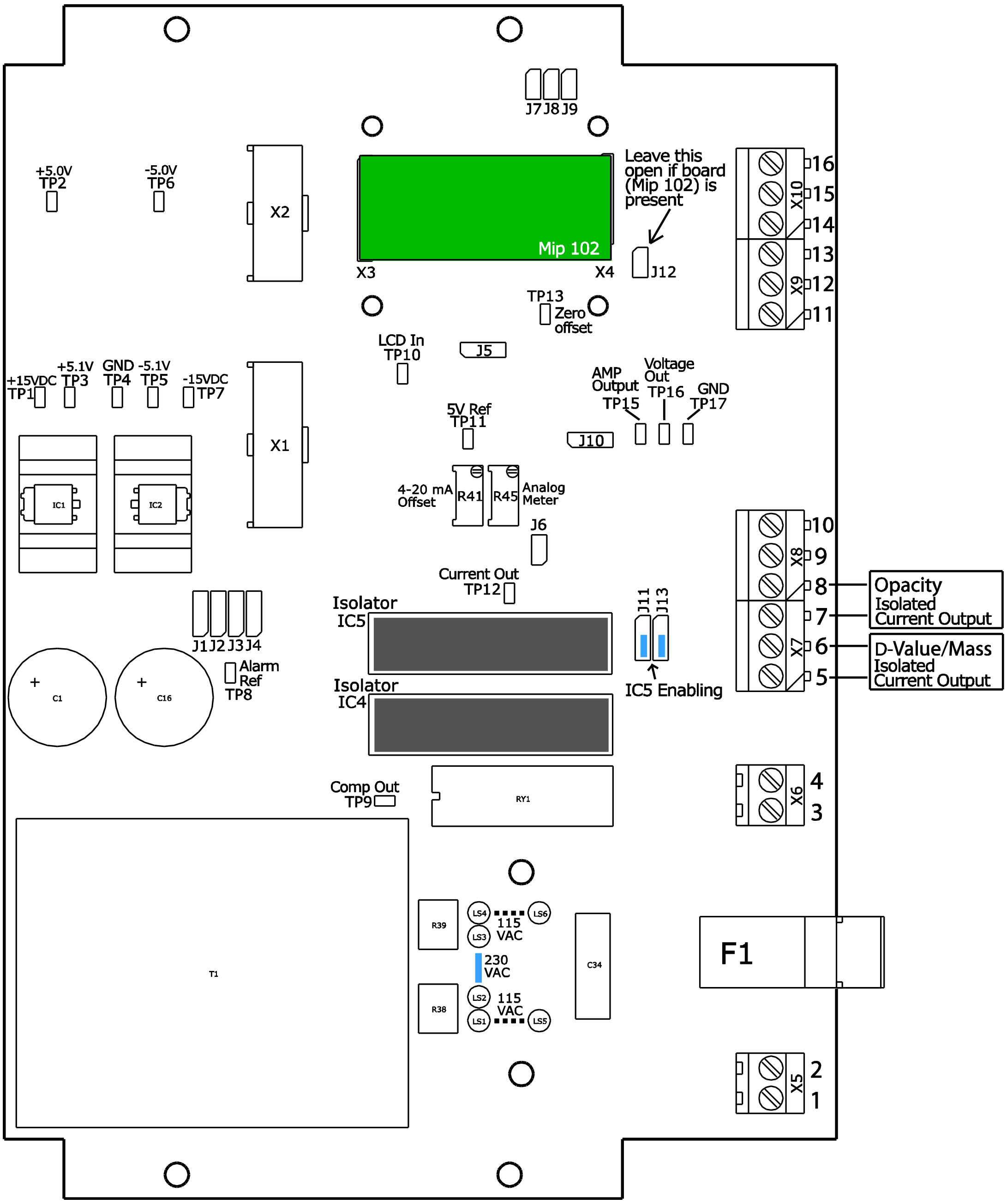


MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 13: Monitor Unit Options

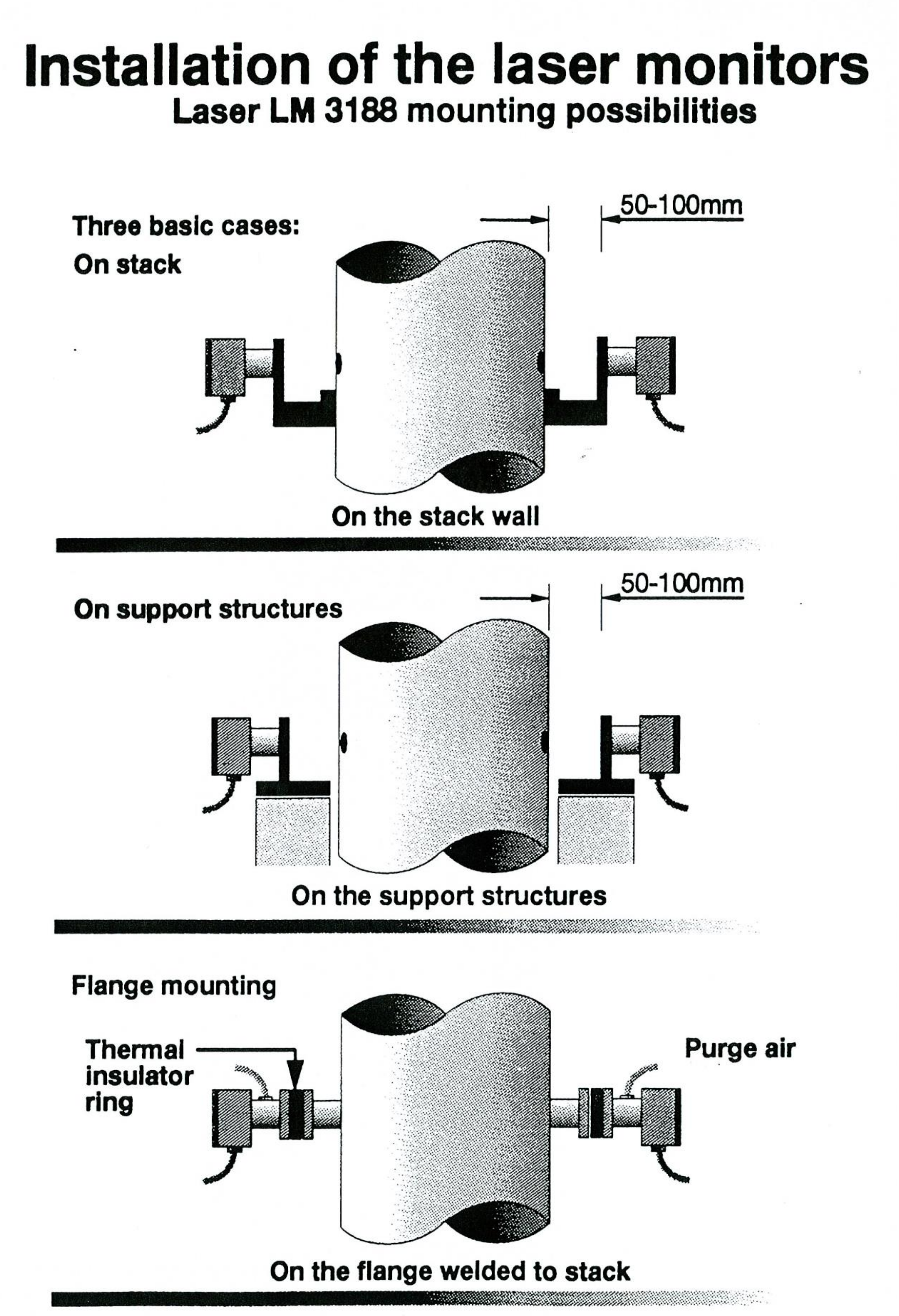


MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

APPENDIX 14: Installation examples

LM 3189 is compatible with LM 3188

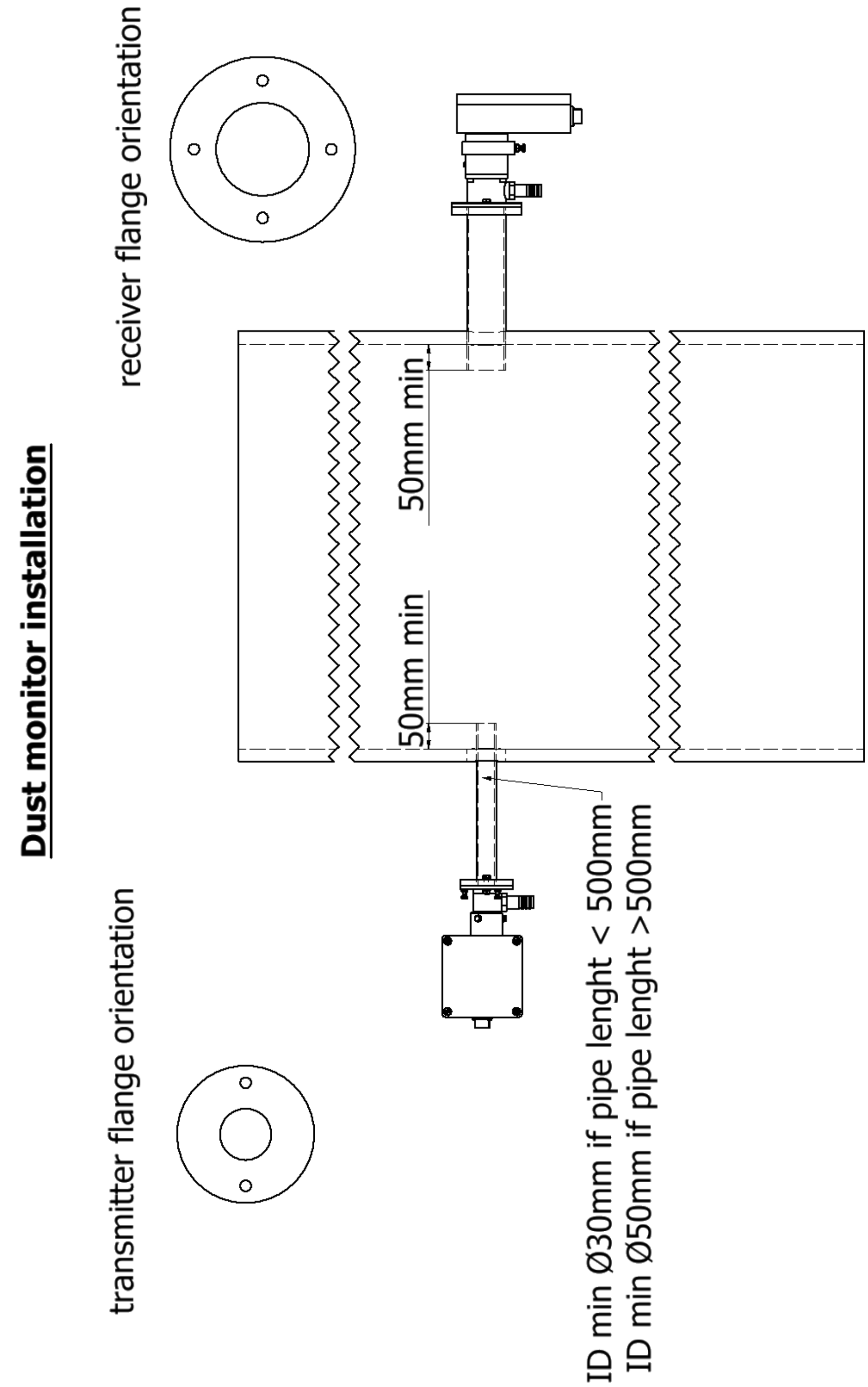


MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

APPENDIX 15: 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>

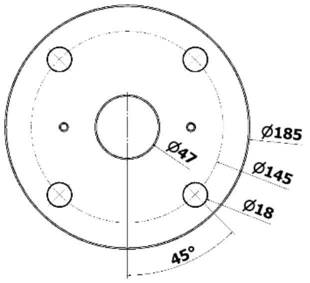
MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

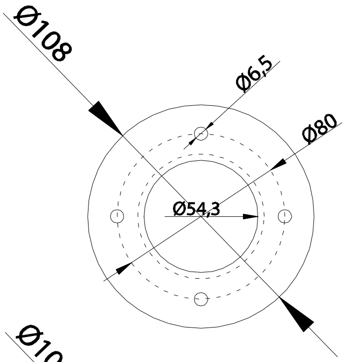
WWW.MIP.FI

APPENDIX 16: Mating flange examples

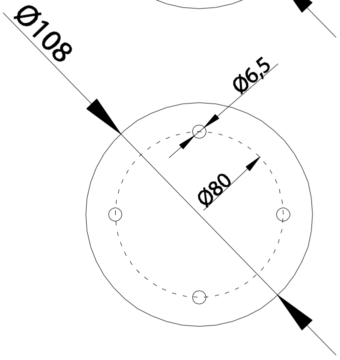
Receiver



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

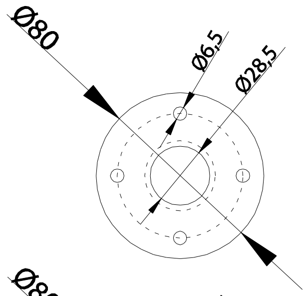


Flange: thickness 8mm or more, Ø6,5mm holes in radius 40mm; angle 90˚ (Unit needs only holes. Two "extra" holes are only for alternative installation direction.).
Centrehole is Ø50mm or more. In this example it's Ø54,3mm (made for Ø60,3*3mm tube).

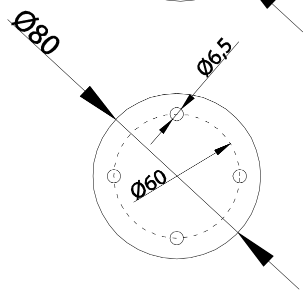


Blind flange for service purpose (same Ø6,5mm hole pattern)

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)

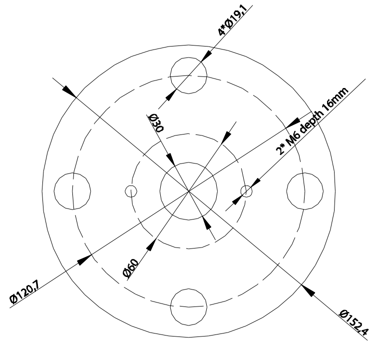
Material for example COR-TEN (EN10155)

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

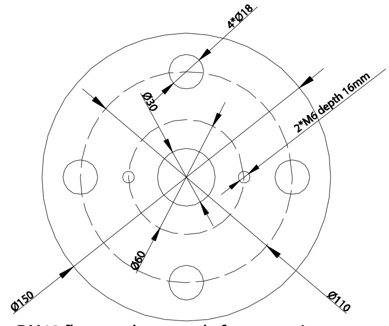
VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI

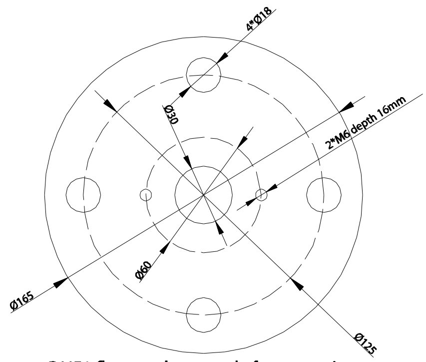
APPENDIX 17: Mating flange adapters



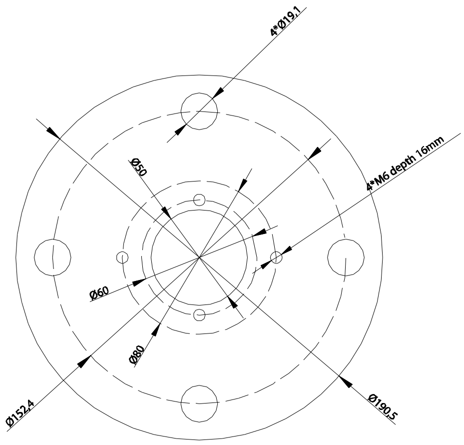
Ansi 2" flange adapter only for transmitter.



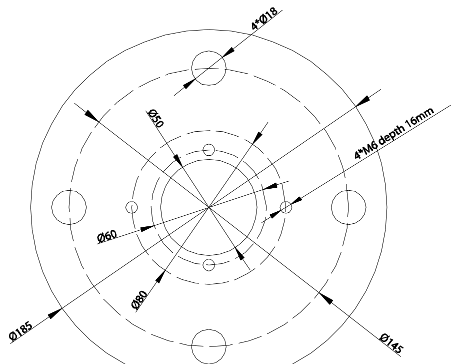
DN40 flange adapter only for transmitter.



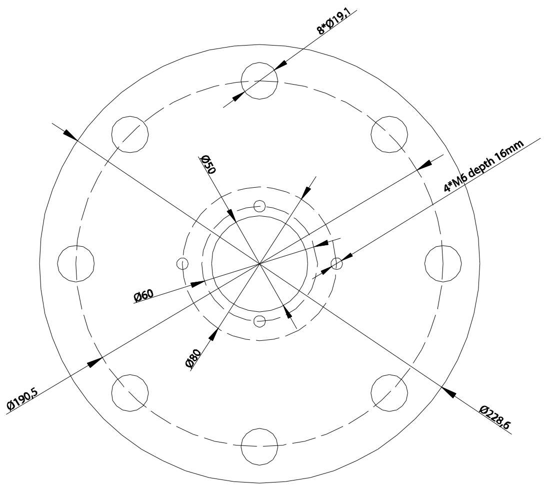
DN50 flange adapter only for transmitter.



Ansi 3" flange adapter for transmitter/receiver.

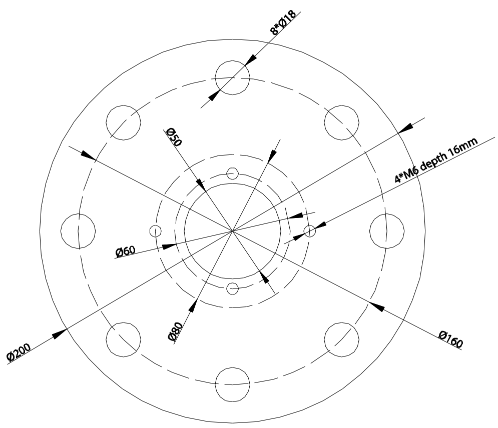


DN65 flange adapter for transmitter/receiver.



Ansi 4" flange adapter for transmitter/receiver.

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



DN80 flange adapter for transmitter/receiver.

MIP Electronics Oy
Palokorvenkatu 2
FI-04250 KERAVA
FINLAND

VAT-ID: FI16271112 (Y-tunnus: 1627111-2)

WWW.MIP.FI