PDM module User Manual

1.0 Powering up the module

In order to switch on the module, simply plug in the AC adapter in the power supply connector. See *Table 1* for input DC Electrical requirements. After having applied the power, the module will switch on and, while all the internal diagnostic tests are performed, it will turn on the diagnostic output LEDs with green colour. After 20-25 seconds, if no error will occur, the LEDs will be switched off and the module will be ready for photon counting. If an error is encountered, all the internal voltages will be switched off and the diagnostic LEDs will display the problem using the colour code explained in *Table **2***. The module will remain in this situation until the power is removed.

Table 1. DC Input electrical characteristics

	Min	*Typ*	*Max*	*Unit*
Input voltage	5		12	Volt
Input Power			10	Watt

Note: input absolute maximum rating is 16V

Table 2. Diagnostic LED diagram

	TOP LED	**BOTTOM LED**
Vin higher than 13V	Red	Off
Vin lower than 4.5V	Orange	Off
Wrong SPAD Bias Voltage	Orange	Orange
SPAD parameters memory fault	Blinking Orange	Blinking Orange
SPAD working temperature not reached or not stable	Off	Orange
Peltier current saturated	Off	Red
Normal Condition	Green for 20-25 seconds after power-up, then Off	Green for 20-25 seconds after power-up, then Off

Please contact MPD at support@micro-photon-devices.com for support and module repair in case of “Wrong SPAD Bias Voltage”, “SPAD parameters memory fault” and “SPAD working temperature not reached or not stable”

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2.0 Inputs – Outputs

The module has one standard TTL output and one standard TTL gate input. Modules with the additional timing module installed have a second timing output.

TTL OUT:

TTL OUT is designed to drive 50Ω coaxial cables and is internally series terminated as conceptually shown *in Figure 1*. This output is short circuit protected. The TTL output connector is a standard BNC. TTL OUT low level is 0V and TTL OUT high level when driving a 50Ω terminated input is about 3.5V.

NIM OUT:

NIM-standard fast-negative output. Typical NIM pulse amplitude is -800mV on a 50Ω terminated transmission line. The NIM timing output must be connected only to 50Ω terminated coax cables. NIM output connector is a LEMO 50Ω NIM-CAMAC series (ERN.00.250.CTL).

GATE IN:

Gate-in input is designed to accept a standard 5V CMOS signal levels. The gate input is AC terminated: indeed, the impedance is 10k Ω in DC and 50Ω on the rising and falling edges of gate signal. Gate-in input must be considered a high impedance input and not a 50Ω terminated input when setting external signal generators. In *Figure 2* is shown the block diagram of the Gate-In input. Gate-in input has a standard BNC connector. *Gate is active low: disable counting = 0V, enable counting = 5V*. For free running operation it must be left open. The PDM GATE IN input is also not designed to be used as a fast-gated module. In the scientific literature, a fast-gated detector is a detector than can be switched from the OFF state to the ON state very precisely and in very short periods of times, with falling or rising times in the order of few hundreds of ps. In this case the MPD FastGATED SPAD should be purchased. The PDM GATE IN input, indeed, is not designed to accept high repetition external trigger signals and should be used to gate ON or OFF the SPAD with minimum gate ON or GATE OFF times in the orders of few tens of microseconds or longer.

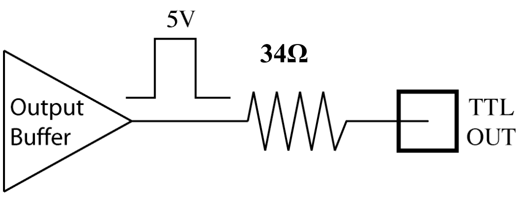

Figure 1: TTL OUT block diagram.

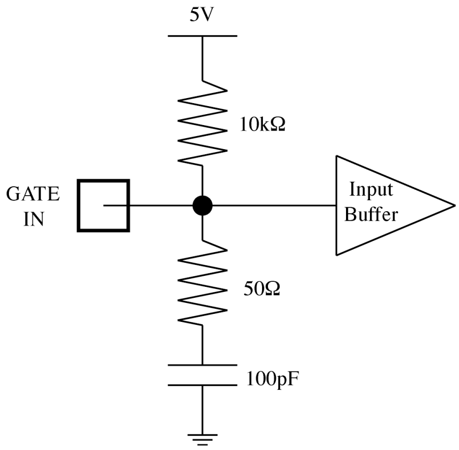

Figure 2 Gate-in Input block diagram.

3.0 High count rate correction factor

It is well known that counting events with a detector that, after every detection, is blind for a fixed time, called dead-time ($T_{deadtime}$), causes an error in determining the true average counting rate. This happens because if *n* events are counted in a time window $T_{measure}$ long, the correct observing time is not $T_{measure}$ but $T_{measure}$ reduced by the total blind time. The total blind-time can be easily calculated by multiplying the *n* counted events with $T_{deadtime}$. The actual count rate of the observed phenomena (CR_{actual}) can thus be calculated from the measured count rate ($CR_{measure}$) as follows:

$$CR_{measured} = \frac{n}{T_{measure}} \qquad \text{(Eq. 1)}$$

$$CR_{actual} = \frac{n}{T_{measure} - n \cdot T_{dead-time}} = \frac{CR_{measured}}{1 - CR_{measured} \cdot T_{dead-time}} \qquad \text{(Eq. 2)}$$

Although the correction is straightforward the closer the $CR_{measured}$ is to the reciprocal of the dead-time, the higher is the correction and possibly the distortion to the measurement.

Dead-time correction can also be seen as a deviation from unity of the ratio between the actual incoming photon flux and the measured photon count rate. Given a dead-time, it is possible to calculate this ratio, called correction factor, as a function of the measured count rate (*Figure 3*).

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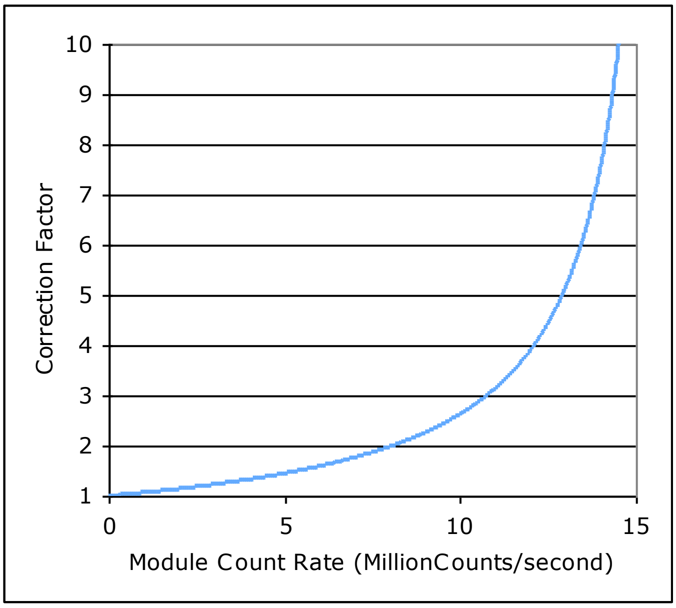

Figure 3. Calculated correction factor for a PDM module with 62ns dead-time.

4.0 Optical Interface

SPAD sensor is placed in the centre of the front panel ± 0.25mm in both x and y directions. SPAD sensor surface is placed 2.6mm ± 0.4mm from the window cap top glass surface.

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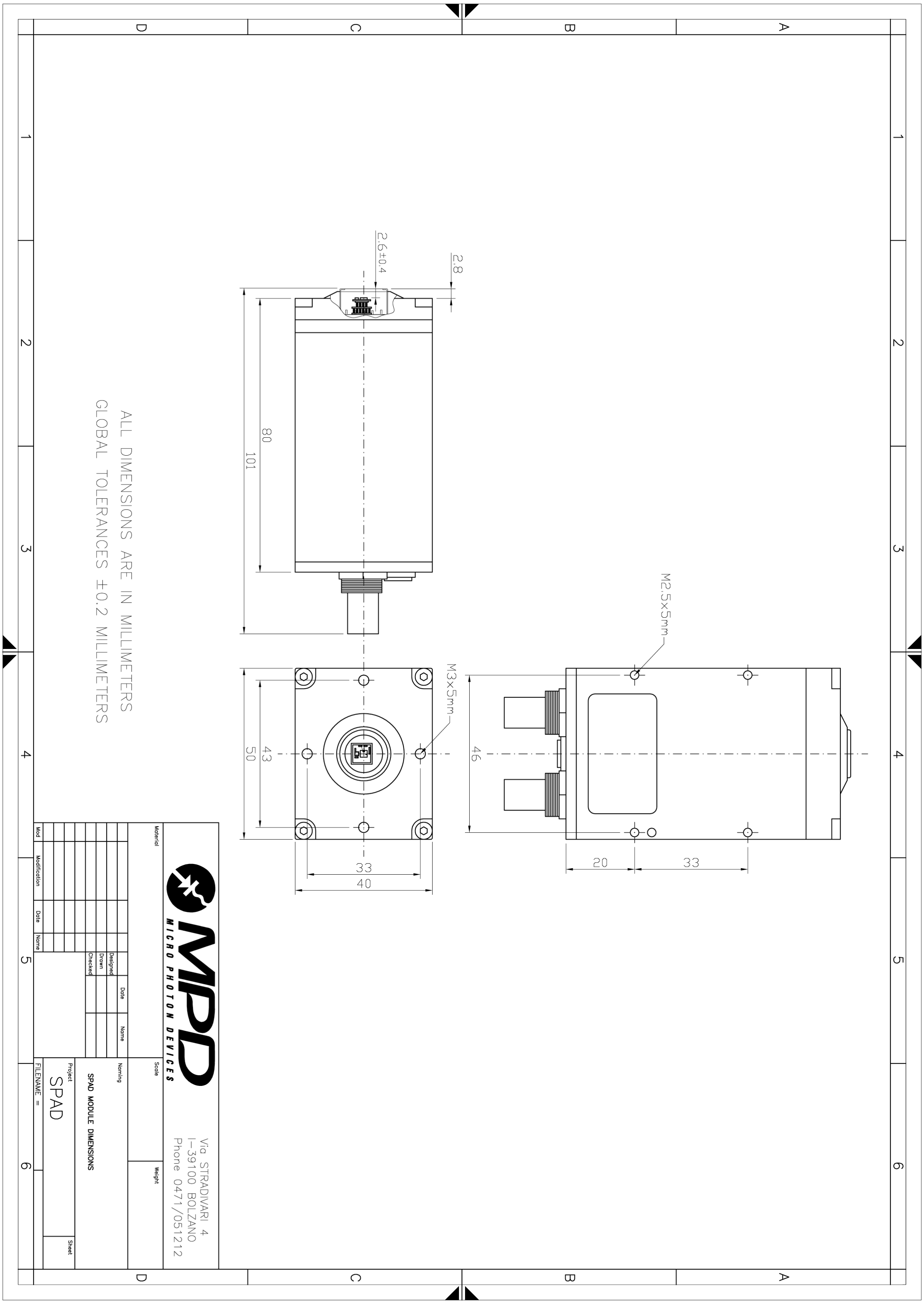

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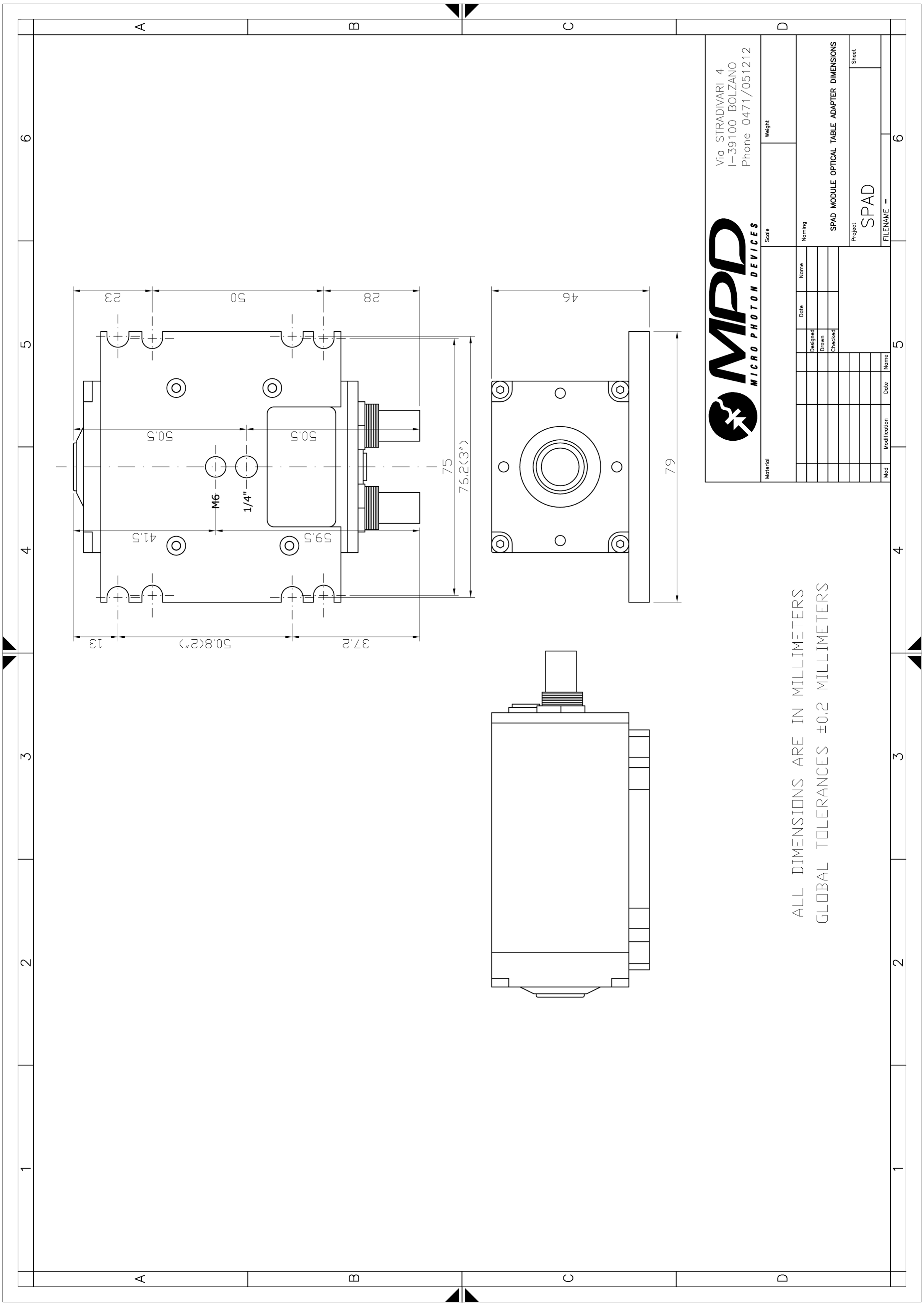

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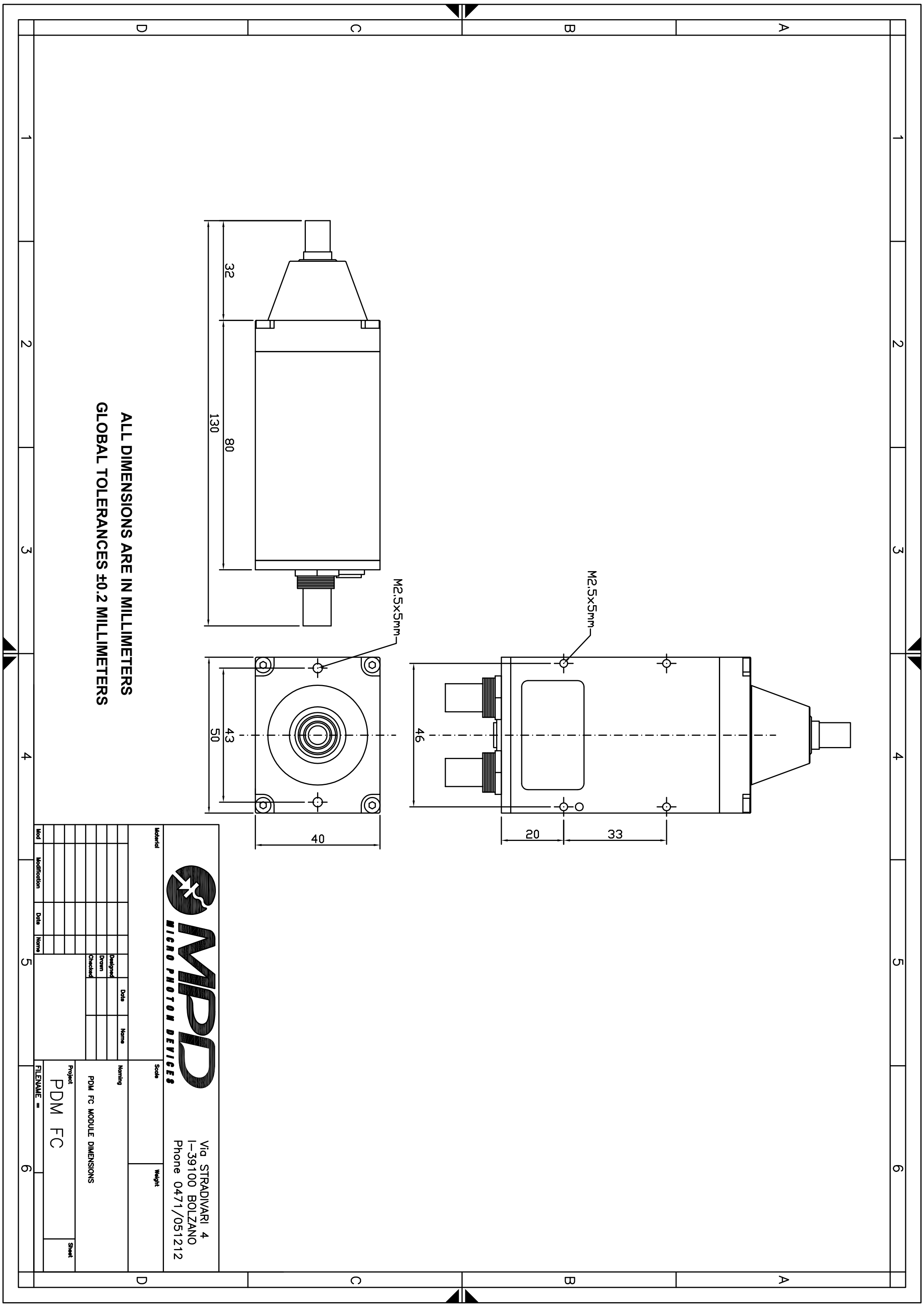

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