MIKROELEKTRONIK GMBH
intelligent sensors & measuring systems

M11

CCD Laser Sensor
for distance measurement

Manual

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1. General Description

The M11L-electronic system provides the serial transmission of measurement data values of the M11L displacement sensor series. The RS-232 output is a standard feature for all distance sensors of the M11L-series. The sensor head has a laser diode, sending the focussed laser beam out to the target as shown in Fig.1. The laser beam appears as a "bright point" on the target. The reflected light from the laser point on the target is pictured onto the CCD line sensor element. Depending on the distance of the target, the laser point's image on the CCD-line sensor element appears in different position. The CCD-sensor creates a signal depending on the position of the light point. The readout

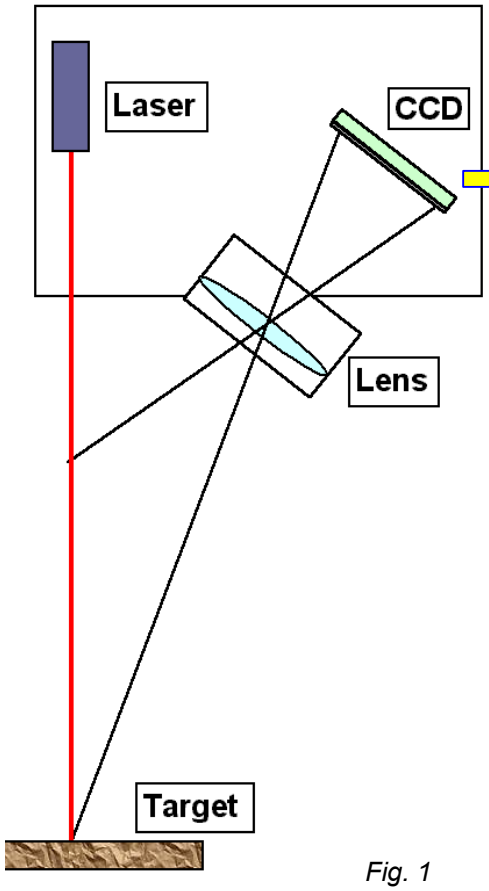


Fig. 1

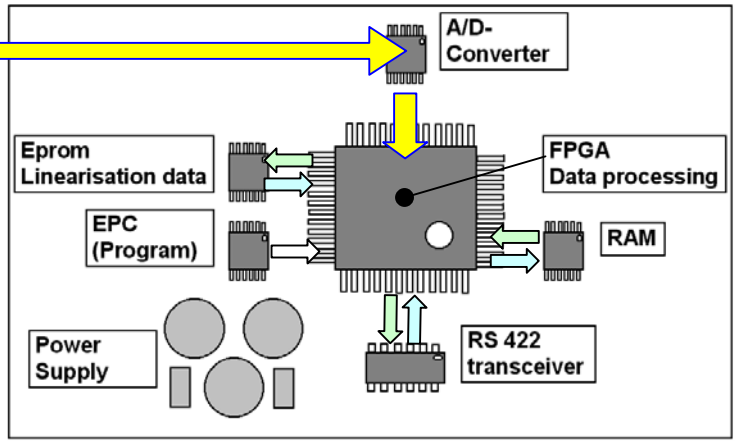


Fig. 2

of the CCD-line sensor is then sent to the A/D-converter on the electronic board in the sensor head. Fig.2 shows the principle function blocks of the sensor head electronic board.

The CCD-line sensor output signal is converted to a digital signal and processed with special algorithms in the FPGA data processor. The distance information is calculated and linearised. The linearisation table is stored in an Eprom in the sensor head.

When the signal processing is complete, distance and intensity informations are sent to the electronic unit over a proprietary high speed symmetrical serial link with 922 kHz clock rate.

Data format of the high speed link (sensor head output):

1 Start bit	= L
Data	= DB 0 …DB 11
Status	= F0, F1
Intensity	= IB 0 …IB 9

2 Stopbits = HH

This data is buffered in the electronic unit and sent out over the integrated RS-232 interface and analog outputs. The highly sophisticated signal processing algorithms match the M11L-sensors detection automatic to the surface quality of the target. Rough, corrugated and “dirty” surfaces do not cause bad measurement. On mirroring, dark and highly shining surfaces, the sensor reduces measurement speed. When the reflectivity of the surface is good (white targets and most natural surfaces), the sensor measures at the highest speed.

Automatic Sensing Time Adjustment

The sensor sends out constant laser power. The amount of reflected light received on the sensor element depends on surface reflectivity and distance of the target. On black and shiny targets, the sensor receives only a small portion of the laser light. The electronic system detects low light condition and reduces “speed”, in order to collect more light for the sensing process.

The Electronic System Box

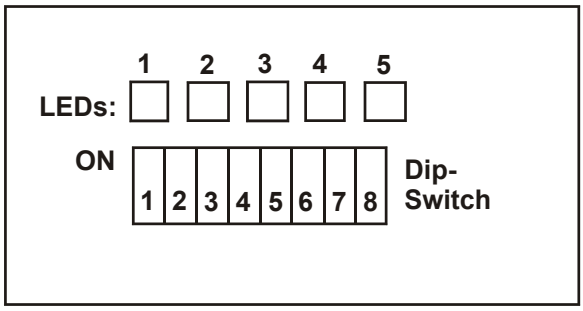
Essential components of the electronic unit are: power supply, switchable filter, D/A converter and a programmable logic device (FPGA), which is processing (filtering) the digital distance information for the analog and RS-232 outputs. Using an integrated crystal oscillator and a precise reference power source, compliance with the technical data is guaranteed. The timing of the signals corresponds to the RS232 standard. Setting the filter allows to reduce noise in the analog output signal. Switching outputs MIN, OK, MAX (active = +24 V DC out) and accordingly LEDs show if the sensor is in range. The Error-LED flashes if no target is found, or if the sensor has been shut off using internal dip switches 1 … 3 (see below).

The dip switches in the electronic unit set capture mode, sampling frequency, transmission mode, control mode, plausibility check and averaging filter (integration time). When the dip switches 1,2 and 3 are set to OFF, the Laser is switched off completely.

2. Internal Adjustments

2.1 Capture mode, Sampling frequency

SW 1	SW 2	SW 3	Intensity threshold	Sampling Fs [kHz]
OFF	OFF	OFF	- adj OFF	Laser OFF
OFF	OFF	ON	-	1 kHz
OFF	ON	OFF	-	5 kHz
OFF	ON	ON	-	10 kHz
ON	OFF	OFF	20 %	-
ON	OFF	ON	30 %	-
ON	ON	OFF	40 %	-
ON	ON	ON	60 %	-
default =				



2.2 Averaging Filter

SW 4	SW 5	Averaging Filter
OFF	OFF	No Average
OFF	ON	Average 2 samples
ON	OFF	Average 4 samples
ON	ON	Average 8 samples

2.3 Plausibility Check

SW 6	SW 7	Plausibility Check
OFF	OFF	No Plausibility Check
OFF	ON	+/- 1 % of range
ON	OFF	+/- 5 % of range
ON	ON	+/- 10 % of range

The plausibility check algorithm compares the deviation of the actual sample point to the previous sample. When the difference is higher than the set threshold, the actual sample is rejected.

2.4 Control mode

SW 8		Remarks
OFF	**Control by Dip-Switches ***	
ON	**Control by PC (RS-232)**	**Do not change!**

*) factory default setting

3. Data format RS-232 output (electronic unit)

3.1 Operation mode, data format

The serial interface of M11L electronic unit is output only. The data format is 8 Bit, No Parity, 1 Stop Bit. 2 Byte (=16Bit) per measurement value are transmitted. The MSB of the 1st Byte marks the High-Byte. The least two Bits of the High-Byte (Bit 0 and Bit 1) contain the encoded status bits F1 and F2.

The Low-Byte contains the upper 5 Bits of the measurement value. In the LowByte (2nd Byte) the lower 7 bits of the value are transmitted. Bit 7 of each byte identifies the High-Byte (bit7=1) or the Low-Byte (bit7=0). In first place is always transmitted the MSB.

Table 3.2 shows the encoding of OK, MAX, MIN and Error.

There are two possibilities to read the AD-converter: the TxD-mode or the RTS-mode (dip switch 1).

In TxD-mode a measurement value (2 Byte) is transmitted only, when before a data bit has been transmitted on the TxD-line. Consequently a measurement can be carried out only on request. This makes automatic acquisition of synchronous data from the sensor.(Data on request). Using the TxD-mode, however, requires, that an additional data transmission must be made for each measurement. This slows down transmission speed.

The RTS-mode is faster in data transmission. RTS mode requires the “ready-to-send” (RTS) signal from the computer. RTS remains high as long as the computer is ready to receive data. That means, that after a read request to the COM-Port, data is transmitted until the COM-Port is haltet. At high baudrates the COM-buffer could get full. This may happen either at a quick read, or when closing the COM-ports.

3.2 Data format RS 232

Data bits	7	6	5	4	3	2	1	0
Lowbyte	0	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Highbyte	1	DB11	DB10	DB9	DB8	DB7	F2	F1

F2	F1	Status Bits
0	0	OK
0	1	MIN
1	0	MAX
1	1	ERROR

3.4 Software examples

The two examples for TxD-mode and RTS-mode are written in Power-Basic. This simple mode was used, because it can easily be translated into all other programming languages.

----------Example for the TXD-mode----------

```
$com 2000                                   ‘ Open combuffer
comport$=”COM2”
open comport$+”:19200,n,8,1” for random as #1


    do
    print #1,”1”;
            GOSUB DATA INPUT
            GOSUB DATA OUTPUT
    loop
```

‘---------- Example for the RTS-Mode ----------

```
    $com 2000                                   ‘ Open combuffer
    comport$=”COM2
    do
open comport$+”:19200,n,8,1” for random as #1
GOSUB DATA INPUT
close #1
GOSUB DATA OUTPUT
    LOOP
     ‘-------------------------------------------------------------------------------------------------------------------------------------------

    ‘ Data are input and checked on HB or LB.
    DATA INPUT:
    B1%=(ASCII(INPUT$(1,#1)))
    IF B1% < 128% THEN LB%=B1% ELSE HB%=B1%
            B2%=(ASCII(INPUT$(1,#1)))
    IF B2% < 128% THEN LB%=B2% ELSE HB%=B2%
    RETURN
     ‘-------------------------------------------------------------------------------------------------------------------------------------------

    ‘At the data output HB and LB are fit together.
    ‘If bit 11 = High (value is negativ) the 2´complement is formed by D0-10.
    DATA OUTPUT:
IF (HB% and &b01000000) > 0% THEN A$=”-“ ELSE A$=” “
COLOR 14,1:LOCATE 15,3,1
    IF (HB% and &b00000011) = 0% THEN PRINT “   OK   “
    IF (HB% and &b00000011) = 1% THEN PRINT “  MIN   “
    IF (HB% and &b00000011) = 2% THEN PRINT “  MAX   “
    IF (HB% and &b00000011) = 3% THEN PRINT “ Fehler “ :RETURN
    ERGEB% = (HB% and &b00111100)*32% + (LB% and &b01111111)
    if A$=”-“ then ERGEB% = (ERGEB% xor &b11111111111)+1%       forming 2’ Complement
    ERGEB! = 0.005*ERGEB%
    COLOR 10,1:LOCATE 10,38,1
    PRINT USING “\\##.### mm   “;A$,ERGEB!
    Return
```

4. Cable Assignment

4.1 Assignment of 25pin SUB-D output connector

Pin	Function	Type / voltage range
1	**distance output**	**Analog output + / - 10V***
2	Error	Switching output + 24V, 10 mA
3	Master I/O	Set to GND = Laser OFF
4	TXD	RS-232 serial data output
5	range OK	Switching output +24V
6	4 … 20 mA	Current output
7	RXD	RS-232 serial data input
8	**0V DC supply**	**GND**
14	**Analog ground**	**AGND**
16	MAX	Switching output +24V, 10 mA
17	Input sensor 2	- do not connect -
18	RTS	Ready to send from PC
19	MIN	Switching output +24V, 10 mA
20	**Intensity output**	0 ... 10 V
21	**voltage supply**	input + 10 … + 28V DC

* **factory default = +/- 10 V** optional outputs are built to order: 0 … 5 V; 0 … 10 V; + / - 5 V

4.2 Connection cable for the serial data transmission to the PC

PC 9 pin SUB-D	Function	Sensor 25pin SUB-D
1	**DCD**	**-**
2	**RXD**	**4**
3	**TXD**	**7**
4	**DTR**	**-**
5	**GND**	**8**
6	**DSR**	**-**
7	**RTS**	**18**
8	**CTS**	**-**

4.3 Sensor Head Connection Cable

The length of the cable from sensor head is not critical, yet the cable **must** be a shielded twisted pairs network cable. Data outputs must be wired to twisted pairs as given in the table below. Colors are not mandatory, symmetrical signals must be transmitted in a twisted pair wire.

D-Sub 9	signal	Remarks / color
1	**RS244 out (922kHz) -**	**blue – white**
2	**GND**	**green – white**
3	**RS244 in (115,2kHz) -**	**yellow - white**
4	**RS244 in (115,2kHz) +**	**yellow**
5	**Case**	**Screen**
6	**RS244 out (922kHz) +**	**blue**
7	**Do not connect**	**green**
8	**GND**	**brown - white**
9	**+ U_B**	**brown**

Technical Data

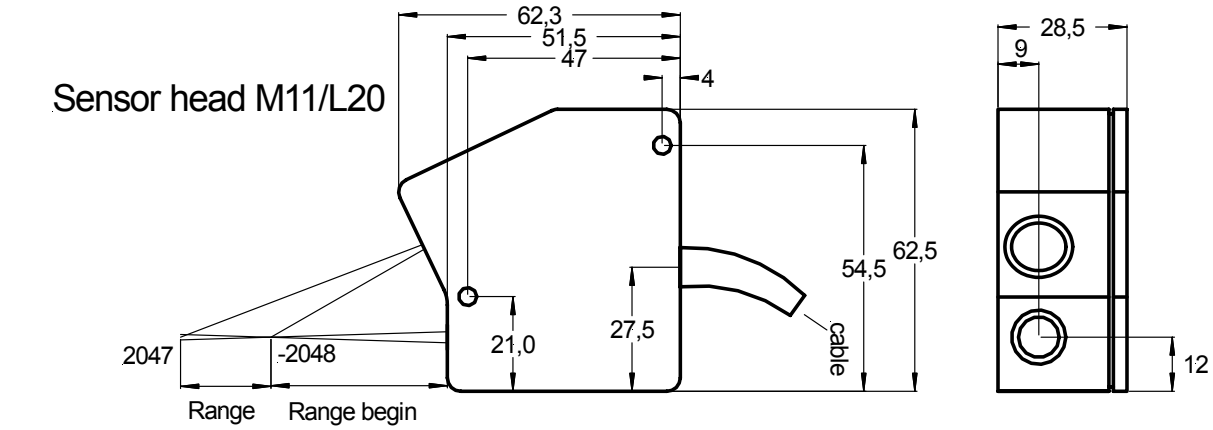
Model		M11L/20	M11L/50	M11L/100	M11L/150
Range [mm]		20	50	100	150
Begin range [mm]		40	55	75	1350
Linearity error * [mm]		0,01	0,025	0,05	0,15
Resolution * [mm]		0,005	0,0125	0,025	0,04
Spot diameter [mm]		0,9	1,0	1,1	2
Light source		Laser, wavelength 670nm, red visible			
Sampling frequency		500Hz … 10kHz, depends on light amplitude			
Protection class		2 (1mW)			3R (3mW)
Analog output	Distance output	±10V (optional 0 ... 10V / 0 ... 5V) 4 ... 20mA / RS 232 (optional 0 ... 20mA)			
	Output impedance	approx. 0 Ohms (10mA max.)			
	Angular error	30° inclination (Axis A): approx. 0,5% on white object **			
	Reaction time	200 µs *			
	Frequency bandwith	DC ... 10 kHz, depending on range and target **			
	Temperature drift	0,02% of range / K			
	Intensity output **	0 … 10V			
Switching outputs with LED	MIN	+24V, AMB[1] < Object < AMB+10% MB[2], LED yellow			
	OK	+24V, AMB+10% MB < Object < EMB[3]-10% MB,LED green			
	MAX	+24V, EMB-10% MB < object < EMB, LED orange			
	Error output	+24V / 100mA, LED rot			
Ambient light		20.000 LUX on object			
Life time		50.000h for Laser-Diode			
Isolation voltage		200V DC, 0V to case			
Max. Vibration		5 g up to 1 kHz			
Operating temperature		0° … +50°C			
Storage temperature		-20° … +70°C			
Humidity		up to 90% RH			
Protection class		IP64			
Supply Voltage		+24V DC / 280mA (10 … 28 V DC)			
Connector		25-pin D-Sub connector			
Cable length sensor – electronic unit		2 m (max. 20 m***)			

* measurement on white target
** sensor controls measurement depending on available reflected light from object
*** see cable specifications given in 4.3

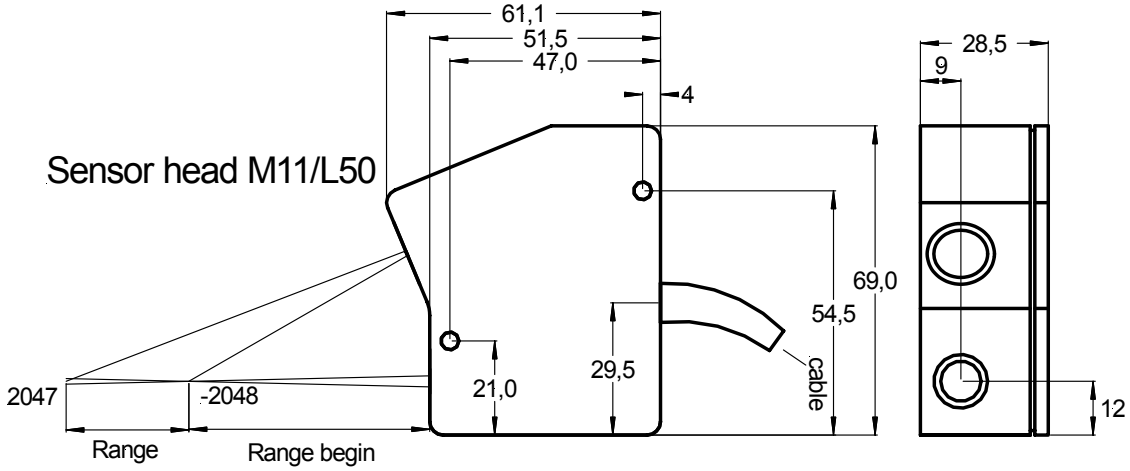
1) AMB: begin of range
2) MB: range
3) EMB: end of range

Drawings

Sensor head M11/L20



Sensor head M11/L50



Sensor head M11/L100