



*Thin Film Measurement solution  
Software, sensors, custom development  
and integration*

INLINE MProbe system  
Communication interface

Revision history

Date	Revision	Changes	Owner
09/07/14	1.0	started	LA
09/08/14	1.1	Added commands 54,55,56	LA
11/17/14	1.2	Added commands 57,58. Response to commands 52,53	TH, LA
12/17/14	1.3	Updated commands 57 and 58 to include channel number *	TH, LA
12/28/14	2.0	Added measurement channel to the commands. Reserved for future implementation (1)	LA
01/14/15	2.2	Changed Scale function format and added commands 71 and 72 (set and get measurement recipe)	LA
12/28/15	2.3	Added computer shut-down command (function 120)	LA
03/21/2018	2.4	Added server re-start (function 121) Updated exception codes(8-13)	LA
04/20/2022	2.5	Added commands 90.91.92	LA
04/07/2024	3.0	Updated commands 90-92 and added 93,94	LA

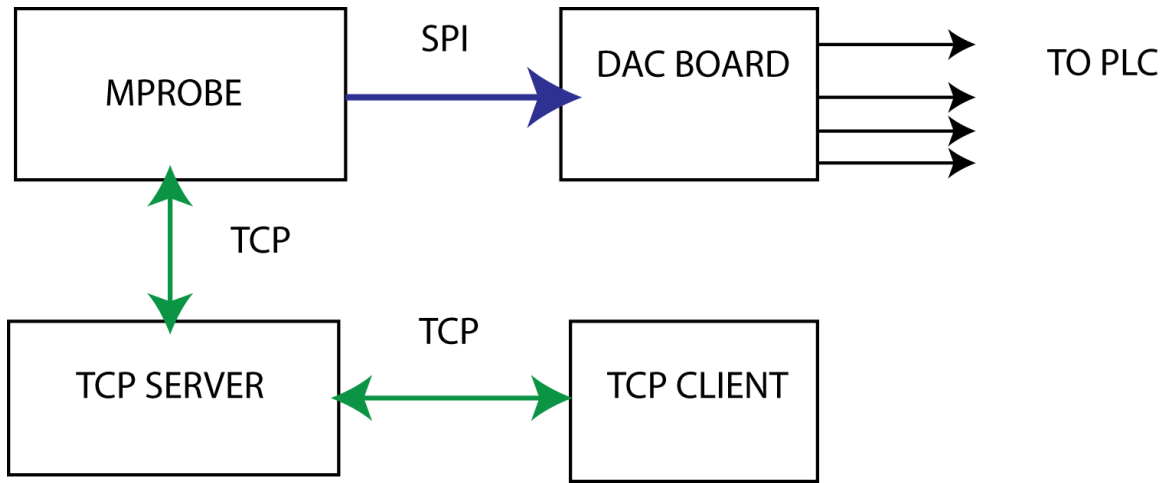
\* Used only in selected commands (measurement, calibration, etc.) Default channel is 0

**General**

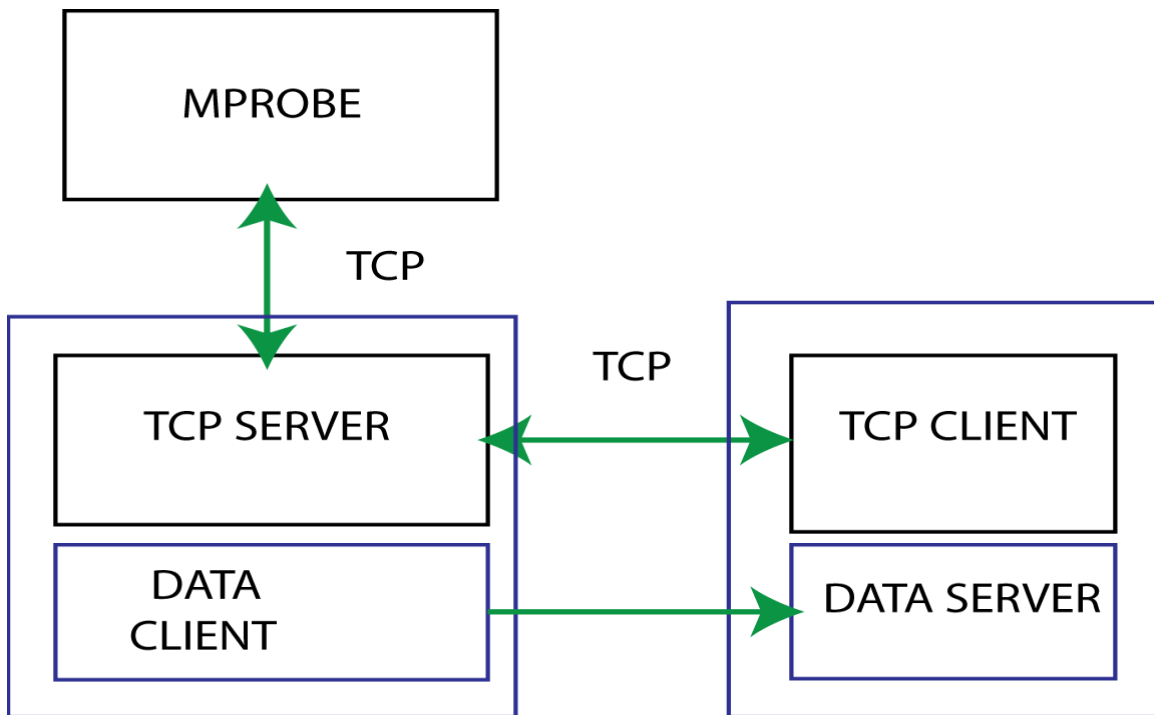
This document describes simplified commands for communication between TCP client (external 3<sup>rd</sup> party software) and MProbe system. TCP client can be located anywhere on the network and implemented on PC of PLC. Default data output is sent in analog form via 4 channel DAC board (each DAC channel correspond to one layer thickness). Communication is using TCP protocol over LAN connection. In cases when USB connected MProbe system is used (old version) – a separate FPGA board is used. (In this case, the IP address of the FPGA board is included in the command line when starting the server). Current MProbe system is using LAN communication interface and no external FPGA board is needed.

The default ip and port of the server are 192.168.1.155, port 1280 (These parameters are defined in the PLCServerStartup.bat file).

A set server properties (such as results filtering strategy, delay between measurements) are defined in the PLC.properties file.



**Fig. 1 MProbe inline – Analog data output to PLC**



**Fig. 2 MProbe Inline – TCP data output**

## Setup of the system.

Setup of the system is to be performed during installation using a PC. During setup, calibration and measurement are performed using TFCompanion software (as in desktop mode). The settings (calibration, film stack, measurement recipe, light intensity, etc.) are saved in the database and files in TFCompanion directory. Calibration can be updated from the TCP client when system is working in the server mode. (using the same calibration sample as original calibration)

## Communication Commands

- a) All request commands start with “/” and terminated with “\r\n”
- b) Big endian convention is used
- c) Responses from the board are not terminated
- d) Write response returns 0 (success), 1 (failed) or <0 (error code)

Operation code (unsigned byte)	Purpose	Request (terminated \r\n)	Details	Response
50	Start measurement	/50[d][n]	D – delay between measurement in ms (unsigned short – 2 bytes), 0 -means no delay n – measurement channel (1 unsigned byte), 0 – mean all channels	/500 –success /501 –failure
51	Stop measurement	/51[a][n]	a =0 – stop immediately a=1 – complete current measurement and stop	/510 – success /511 - failure

			n – measurement channel (1 byte), 0 – mean all channels	
52	Calibrate (step 1)	/52[n]	Measurement of the calibration sample n – measurement channel (1 unsigned byte),	/520 – success /521 - failure
53	Calibrate (step 2)	/53[n]	Measurement of the black absorber n – measurement channel (1 unsigned byte),	/530 – success /531 - failure
54	Get lamp intensity	/54	Returns lamp relative intensity in 0-100% Intensity is regulated by PWM	/54[a] A – relative intensity (1 unsigned byte)
55	Set lamp intensity	/55[a]	Sets relative lamp intensity a – 0 -100% [1 unsigned byte]	/550 – success /551 - failure
56	Get maximum signal	/56	Used to check for possible saturation The maximum signal should, typically, be <95% of the total range	/56[a] a – maximum signal in the used wavelength range in ADC counts [unsigned short (2 bytes)]
57	Set Analog scale	/57[c][a][b]	Scale DAC output to a usable thickness range c- channel number  a – minimum thickness in nm b- maximum thickness in nm a,b – integer (4 bytes) c – 1 byte  Example:	/570-success /571 -failure

			<p>[47][0,57][1][0,0,3,-24]  [0,0,-61,80]  Corresponding to:  /57  [1][1000][50000]  Thickness range:  1000nm to  50000nm (1 to 50 um)</p>	
58	Get analog scale	/58c	Returns the current thickness range c – channel number (1 byte)	/58[c][a][b] a – minimum thickness in nm, b- maximum thickness a,b – integer (4 bytes) c – channel number (1 1 byte)
60	System status request	/60		/60[a][b][c] a,b,c – each 2 bytes a –status 00 – ready/idle 01 –measuring 02 –calculating 03 –exception state 04 – bysy/initializing b – warning: 00 – no warnings 01 – low signal 02 – high signal (maybe saturation) c-exception: 00 – no exception 05 – data acquisition except 06- calculation exception 07 – system problem (unknown exception)
70	Number of connected channels	/70	Returns the number of the currently connected channels. -1 – no channels are connected	/70 [n]. n- number of available channels (unsigned byte)

71	Set measurement recipe	/71[num_bytes][name]	Num_bytes – length of the name – 1 byte Name – recipe name	/71 [0] – success /71 [1] - failure
72	Get measurement recipe	/72	Returns the name of the current measurement recipe	/72[num_bytes][name] num_bytes- length of the name in bytes (1 byte) name – measurement recipe name
80	Send DAC value (test command)	/80 [DAC channel][unsigned short]		
90	Start data client	/90[num_bytes][ip][port]	Num_bytes – length of the message, 1 byte ip – IP address of the server for the client to connect port – server port for connection /90 14 192.168.20.1:7	/90[0] – success /90[1] - failure
91	Set number of measurements in each transmission	/91[num_measurements]	num_measurements – 1 byte. The number of measurements results consolidated in each transmission (default is 1)	/91[0] – success /91[1] - failure
92	Get measured parameters names	/92	Return the names of measurement parameters	/92[num_bytes][names] num_bytes – 1 byte names -comma separated names  Example: /92 [23] [1_thickness,2_thickness]
93	Update layer thickness	/93[num_bytes][parameter_name][float value][unit]	Update the thickness value in the current filmstack	

		[byte][n bytes][4 bytes][byte]		
94	Get thickness unit	/94		Return /94[byte] Byte corresponding to thickness unit
100	Exception response		Send in case of exception during request processing (e.g. wrong length, format, etc.)	/100[error_code] Error_code – 1 byte
120	Shut down computer	/120[1 byte]	Send to shut down the computer (instead of shutting down power) Action byte values: 0 – shut down 1- shut down and reboot	/120[0] success /120[1] – failure
121	Restart server	/121	Send to re-start the server in case of a problem	/120[0] success /120[1] – failure

**Commands 90,91,92 are used only for TCP results output (default output is in analog form)**

### Results data transmission TCP

In case, data client is started (command 90) – the data will be transmitted using this client via TCP communication. By default, each transmission will have results of only one measurement.

The send data format and logic depends on the properties set in the PLC.properties file.

- a. Default behavior (no properties are set)
  - Only measured data is send using function#80. If the data filter and/or MSE filter are enabled and data is rejected – no data is send
  - Function #80 format:  
/80[message length][parameter 1][parameter 2]...[parameter n] [ 0xD,0xA]  
where parameter 1,.. parameter n are measurement results (one measurement) – 4 bytes float each
- b. If property "include\_mse\_data"=true. MSE data is included in the response and function #81 is used
  - Function #81 format:  
/81[message length] [parameter 1][parameter 2]...[parameter n] [MSE] [ 0xD,0xA]  
where parameter 1,.. parameter n are measurement results (one measurement) – 4 bytes float each and MSE is a 4 byte float

If the data filter and/or MSE filter are enabled and data is rejected – no data is send

- c. If property “include\_mse\_exc\_data”=true, warnings, data and MSE are included in the message. Function #82 is used with following format:

/82[message length- 1 byte] [warning 2 bytes][parameter 1][parameter 2]...[parameter n] [MSE] [ 0xD,0xA]

where parameter 1,.. parameter n are measurement results (one measurement) – 4 bytes float each and MSE is a 4 byte float.

The data is always sent, even if it is rejected by the filters.

warning – includes 2 bytes.

warning[0] is general system warning

NO\_WARNING = 0;

LOW\_SIGNAL = 1;

HIGH\_SIGNAL = 2;

LOW\_MEMORY = 3;

warning[1] is rejection warning

NO\_WARNING = 0;

OUTLIER\_DATA=50;

HIGH\_MSE=51

Command 91 can be used to consolidate several measurements results in one transmission. Data is transmitted in the following format

/[num\_bytes (1 byte)][float values (4 bytes each) 1<sup>st</sup> measurement result][:] [float values (4 bytes each) 2<sup>nd</sup> measurement result ][:]... [float values (4 bytes each) n<sup>th</sup> measurement result]

## Alert signal

In case of warning on exception, MProbe will send a message to the TCP client (client should listen for the alert messages from the server).

The message format is similar to command 60

/61[b][c]

[b] is warning id (2 bytes)

[c] is exception id (2 bytes)

b – warning:

00 – no warnings

01 – low signal

02 – high signal (maybe saturation)

03 – low memory

04 – restarting server



c-exception:

00 – no exception

05 – data acquisition exception

06- calculation exception

07 – system problem (unknown exception)

08 - request content exception

09 –feature not supported exception

10 – hardware not responding exception

11 – FPGA board not connected exception

12 – measurement is slow/ freezing exception

13 – restarting server exception