

# M180LCR Module Serial Interface

Model: M180

PCB Version: 109-18000-00J or later

Firmware Version: 113-18003-060 or later

The M180 LCR module is fully operated through its serial interface by commands. These commands include setting working parameters, controlling measurements, and reading results. The commands and measurement results can be transferred in text format (ASCII coded) and binary format. The text format is particularly suitable for manually operating and results recording, analyzing, and storage. The binary format is suitable for integration with the user's applications. These two formats can be used in combination.

The transmission parameters of the serial interface are 8 data bits, 1 stop bit, no parity, and 115200bps.

## Text Format Commands

Text commands are generally in the following format:

CmdName [=Val]

where CmdName is an identifier of a command. Val is a value that can be assigned to the specified command. The brackets indicate the value is optional since some commands do not need a value.

A text command must be terminated with a carriage return (0x0D) and a line feed (0x0A).

Unless otherwise specified, command identifiers and values are not case sensitive.

For commands that can be assigned values, if the value is "?" or no value is assigned, the current value inside M180 is read.

Table 1 lists M180 text commands and their descriptions. The abbreviations in brackets have the same functions as their corresponding commands.

**Table 1 Text Commands**

Identifier	Descriptions	Value	Remarks/Examples
R	Set the output format to the pre-defined resistance format	None	The pre-defined resistance format is PS, R, COUNT, TS
C	Set the output format to the pre-defined capacitance format	None	The pre-defined capacitance format is PS, C, D, ESR, COUNT, TS
L	Set the output format to the pre-defined inductance format	None	The pre-defined inductance format is PS, L, Q, ESR,

			COUNT, TS
RCL	Set the output format to the pre-defined RCL format	None	The pre-defined RCL format is PS, R, C, L, COUNT, TS
Serial (SER)	Select serial equivalent circuit mode	None	
Parallel (PAR)	Select parallel equivalent circuit mode	None	
Measurement Cycle (MCYCLE)	Set measurement cycle	Decimal number in the range of 10 – 65000. The unit is ms.	mcycle = 500
SOUT	Turn on or off serial result output	ON or OFF	Sout = ON
SoutMode (SMODE)	Select the format of serial result output	ASCII (A) or BINARY (B)	smode = B smode = ASCII
OpenZero (OZ)	Open zeroing	None	
ShortZero (SZ)	Short zeroing	None	
ReadData (RD)	Read the current measurement result	None	When the serial output is turned off, this command reads the result once.
Default	Factory default restore	None	Note: this command does not change the output format and the location code.
Hold	Pause measurement	None	
Run	Start measurement	None	
OutputFormat (OF)	Set the output format of measurement results	See table 2 for available output items. Output items are separated with commas.	of = C, D, ESR, count, TS
LocCode (LC)	Set location code. <b>Note:</b> Location codes are only used in binary commands.	A location code can be any combination of 1 to 8 ASCII characters. Locations codes are case sensitive.	loccode = Sen#001 loccode = ? (read the current location code)
LocCodeEnable (LCE)	Enable or disable location code. When location code is enabled the M180 only responses to binary commands that are with matching location code.	ON or OFF	lce = on
Measurement Count (MCOUNT)	Set the initial value of measurement count	Any decimal number within 10 digits	mcount = 1000
Measurement Time	Set the initial value of measurement time	Any decimal number within 10 digits. The unit is ms	mtime = 0

(MTIME)			
Measurement Number (MNUM)	Set the number of measurements to be performed. After the specified number of measurements is done, the M180 will enter HOLD state.	Any decimal number within 10 digits	This command will also set the initial measurement count to 0 and starts measurement immediately (will exit HOLD if M180 was in HOLD state previously).
Measurement Duration (MDUR)	Set the duration of measurements. After the specified duration is reached the M180 will enter HOLD state.	Any decimal number within 10 digits. The unit is ms.	This command will also set the initial measurement time to 0 and starts measurement immediately (will exit HOLD if M180 was in HOLD state previously).

**Table 2 Output Items**

Output Item	Designator
Resistance	R
Capacitance	C
Inductance	L
Quality factor	Q
Dissipation factor	D
Equivalent serial resistance	ESR
Mod of impedance	Mod
Angle of impedance	Thita
Resistance component of serial impedance	Rs
Reactance component of serial impedance	Xs
Measurement count	Count
Measurement time stamp	TS
Time stamp in HMS format	TS_HMS
Location code	LocCode

**Binary Commands**

Binary commands are transferred in frames. A frame generally takes the following format.

**Table 3 General format of binary commands**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	
1	Frame size	2	Counted from frame ID to the end of a frame (not including the sync character)
3	Command ID	1	
4	Data	Variable	

This format observes three rules.

- 1) The frame ID must not be the sync character (0xFE). It can not be 0 either.
- 2) If any other byte in a frame has the value of 0xFE, a 0x00 byte must be inserted right after it in transmission.
- 3) All multi-byte data fields are transferred in little endian order unless stated otherwise.

**Note:** The 0x00 inserted after a 0xFE data byte at sending is not counted into the frame size, which means the number of bytes actually sent may be more than the number of bytes specified by the frame size. At receiving, the 0x00 inserted after 0xFE must be removed to obtain the correct data.

For example, sending the following bytes will read the working parameters of an M180.

0xFE, 0xE4, 0x04, 0x00, 0x01, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30, 0x30

**Location Code** To meet the requirements of multi-point measurement, each M180 has a location code that can be set by users. The code consists of 1 to 8 displayable ASCII characters. A host uses the location code in binary commands to address the target M180 in a multi-point measurement scenario. An M180 will respond to commands only when their location code matches its own location code.

**Universal Location Code** The string “00000000” is the universal location code which can be used in broadcasting. M180 will response to any commands with universal location code.

The binary output of measurement results of an M180 also contains its location code so as to differential itself from others at a host.

The table below lists the available binary commands.

**Table 4 Binary Commands Summary**

No.	Command Function	Frame Size	Command ID	Remarks
1	Read working parameters	14	0x01	
2	Set working parameters	18	0x02	
3	Open zeroing	14	0x03	

4	Short zeroing	14	0x04	
5	Read measurement result	14	0x05	
6	Factory default restore	14	0x06	Location code and output format will not change
7	Set location code	24	0x07	
8	Pause measurement (enter HOLD)	14	0x08	
9	Start measurement (exit HOLD)	14	0x09	
10	Set the initial value of measurement count	18	0x0A	
11	Read current measurement count	14	0x0B	
12	Set the initial value of measurement time	18	0x0C	
13	Read current measurement time	14	0x0D	
14	Set the number of measurements to be performed. After the specified number of measurements is done, the M180 will enter HOLD state.	18	0x0E	This command will also set the initial measurement count to 0 and starts measurement immediately (will exit HOLD if M180 was in HOLD state previously).
15	Set the duration of measurements. After the specified duration is reached the M180 will enter HOLD state.	18	0x0F	This command will also set the initial measurement time to 0 and starts measurement immediately (will exit HOLD if M180 was in HOLD state previously).

## 1. Read Parameters from M180

Command format:

**Table 5 Read parameter command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x01
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Read the current working parameters from M180.

Returned data format:

**Table 6 Returned parameters**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4

1	Frame size	2	18
3	Command ID	1	0x02
8	Location code	10	1 – 8 character ASCII string ended with 0
14	M180 parameter byte 1	1	Bit[2:0] – Reserved Bit[3] – Equivalent circuit mode 0 – Serial 1 – Parallel Bit[7:4] – Reserved
15	M180 parameter byte 2	1	Bit[3:0] – Reserved Bit[4] – Serial data output enable 0 – Disabled 1 – Enabled Bit[5] – Serial data format 0 – Text 1 – Binary Bit[6] – Location code enable 0 – Ignore location code 1 – Check location code Bit[7] – Reserved
16	Measurement cycle	2	Integer within range 10 – 65535. The unit is ms

## 2. Set parameters to M180

Command format:

**Table 7 Set parameter command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x02
8	Location code	10	1 – 8 character ASCII string ended with 0
14	M180 parameter byte 1	1	Bit[2:0] – Reserved Bit[3] – Equivalent circuit mode 0 – Serial 1 – Parallel Bit[7:4] – Reserved
15	M180 parameter byte 2	1	Bit[3:0] – Reserved Bit[4] – Serial data output enable 0 – Disabled 1 – Enabled Bit[5] – Serial data format 0 – Text 1 – Binary

			Bit[6] – Location code enable 0 – Ignore location code 1 – Check location code Bit[7] – Reserved
16	Measurement cycle	2	Integer within range 10 – 65535. The unit is ms

Function: Set the working parameters of M180.

Returned data format: None

### 3. Open Zeroing

Command format:

**Table 8 Open zeroing command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x03
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Perform open-zeroing once. Please make sure the measurement front end is open during zeroing.

Returned data format: None

### 4. Short Zeroing

Command format:

**Table 9 Short zeroing command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x04
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Perform short-zeroing once. Please make sure the measurement front end is short during zeroing.

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Returned data format: None

5. Read data (in binary format)

Command format:

**Table 10 Read data command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x05
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Read the current measurement data from M180. The data is output in binary format.

Returned data format:



**Table 11 Returned data format**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	62
3	Command ID	1	0x05
4	Location code	10	1 – 8 character ASCII string ended with 0
14	R	4	Float number. The unit is ohm ( $\Omega$ )
18	C	4	Float number. The unit is micro farad ( $\mu F$ )
22	L	4	Float number. The unit is micro henry ( $\mu H$ )
26	Quality factor	4	All are float numbers. The unit of impedance is ohm ( $\Omega$ ). The unit of impedance angle is degree ( $^{\circ}$ ).
30	Dissipation factor	4	
34	Equivalent serial resistance	4	
38	Mod of impedance	4	
42	Angle of impedance	4	
46	Resistance component of serial impedance	4	
50	Reactance component of serial impedance	4	
54	Measurement count	4	32bit unsigned integer
58	Measurement time	4	32bit unsigned integer. The unit is ms

## 6. Factory Default Restore

Command format:

**Table 12 Factory default restore command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x06
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Perform factory default restore. Note that this command will not change the output format and location code settings.

Returned data format: None

## 7. Set Location Code

Command format:

**Table 13 Set location code command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	24
3	Command ID	1	0x07
4	Old location code	10	1 – 8 character ASCII string ended with 0
14	New location code	10	1 – 8 character ASCII string ended with 0

Function: Set the location code of an M180. Note: the default location code is “NotCoded”.

Returned data format: None

## 8. Pause Measurement (enter HOLD)

Command format:

**Table 14 Pause measurement command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x08
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Suspend measurement and enter HOLD state. To resume measurement, a Start Measurement command must be sent. Sending a Set Measurement Number command or a Set Measurement Duration command can also bring the M180 out of HOLD and restart measurements.

Returned data format: None

## 9. Start Measurement (exit HOLD)

Command format:

**Table 15 Start measurement command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x09
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Bring M180 out of HOLD state and start measurements.

Returned data format: None

## 10. Set Measurement Count Initial Value

Command format:

**Table 16 Set measurement count command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x0A
4	Location code	10	1 – 8 character ASCII string ended with 0
14	Initial value of measurement count	4	32 bit unsigned integer

Function: Set the initial value of measurement count.

Returned data format: None

## 11. Read Measurement Count

Command format:

**Table 17 Read measurement count command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x0B
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Read the current measurement count from M180

Returned data format:

**Table 18 Returned data format**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x0B
4	Location code	10	1 – 8 character ASCII string ended with 0
14	Current measurement count	4	32 bit unsigned integer

## 12. Set Measurement Time

Command format:

**Table 19 Set measurement time command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x0C
4	Location code	10	1 – 8 character ASCII string ended with 0
14	Initial value of measurement count	4	32 bit unsigned integer. The unit is ms

Function: Set the initial measurement time of M180

Returned data format: None

## 13. Read Measurement Time

Command format:

**Table 20 Read measurement time command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	14
3	Command ID	1	0x0D
4	Location code	10	1 – 8 character ASCII string ended with 0

Function: Read the current measurement time from M180.

Returned data format:

**Table 21 Returned data format**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x0D
4	Location code	10	1 – 8 character ASCII string ended with 0
14	Current measurement time	4	32 bit unsigned integer. The unit is ms

#### 14. Set Measurement Number

Command format:

**Table 22 Set measurement number command**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x0E
4	Location code	10	1 – 8 character ASCII string ended with 0
14	Measurement number	4	32 bit unsigned integer greater than 0

Function: Set the number of measurements to be performed. It resets the measurement count and starts measurement right away if the M180 was in HOLD. After the number of measurement is done the M180 will enter HOLD.

Returned data format: None

#### 15. Set Measurement Duration

Command format:

**Table 23 Set measurement duration**

Offset	Field	Size	Value
-1	Sync character	1	0xFE
0	Frame ID	1	0xE4
1	Frame size	2	18
3	Command ID	1	0x0F
4	Location code	10	1 – 8 character ASCII string ended with 0
14	Measurement duration	4	32 bit unsigned integer. The unit is ms. This number should be greater than measurement cycle, or this command has no effect.

Function: Set the duration of measurements to be performed. It resets the measurement time and starts measurement right away if the M180 was in HOLD. After the duration of measurement is done the M180 will enter HOLD.

Returned data format: None

Version	Date	Summary
v01	2024.11.15	First release