Contents
1 – Description ................................................................................................................................. 2
1.1- Introduction and Generalities ................................................................................................. 3
  1-2 LoRa Terminal IDs .................................................................................................................. 3
  1-3 LoRa Terminal, LoRa Gateway and modes .............................................................................. 3
2 - AT command mode ...................................................................................................................... 4
  2.1 Diagnostic/Informational Commands ..................................................................................... 6
    2.1.1 Query device software version : AT+VER ........................................................................... 6
    2.1.2 Query device all parameters : AT+SHW ........................................................................... 6
  2.2 Device Control Commands ...................................................................................................... 8
    2.2.1 Restore factory settings : AT+FAC ..................................................................................... 8
    2.2.2 Reboot device : AT+SRS .................................................................................................. 8
    2.2.3 Exit configuration state:AT+ESC ...................................................................................... 8
  2.3 System Parameter Commands .................................................................................................. 8
    2.3.1 Set the device operation mode : AT+MOD ....................................................................... 8
    2.3.2 Set device debug level: AT+DBL ....................................................................................... 10
    2.3.3 Set device sleep mode : AT+SLE ....................................................................................... 10
  2.4 Set device serial ...................................................................................................................... 11
    2.4.1 Set device serial baudrate: AT+IPR .................................................................................... 11
    2.4.2 Set device serial parity: AT+PAR ....................................................................................... 11
    2.4.3 Set device serial stop bit: AT+STO .................................................................................... 11
    2.4.4 Set serial data interval:AT+ITV ......................................................................................... 12
  2.5 LoRa Network Command ........................................................................................................ 12
    2.5.1 Set NET ID: AT+PID ......................................................................................................... 12
    2.5.2 Set device type: AT+TYP .................................................................................................. 12
    2.5.3 Set node address: AT+NID .............................................................................................. 13
    2.5.4 Set transparent address: AT+TID ..................................................................................... 13
    2.5.5 Set relay address:AT+RID ............................................................................................... 13
    2.5.6 Set carrier frequency :AT+LFR ...................................................................................... 13
    2.5.7 Set transmit power :AT+TPR .......................................................................................... 14
1 – Description
MA100-1020-TERM LoRa series products are wireless data transmission products based on LoRa technology. This document describes the AT command set of both the LoRa terminals (MA100-1020-TERM) and the LoRa gateway (MA100-1020).

This document has been written as a reference document for the AT commands of the device.

If you want a tutorial/example, please see the appropriate Application Note(s).
1.1- Introduction and Generalities

General application overview looks like the below:

For the first case (“RTU/PLC 1-1”), there is only one LoRa terminal, and for purely serial applications (or indeed, mostly serial) “transparent mode” is the easiest setup.

However for the second case (“RTU/PLC 2-…”), there are multiple LoRa terminals. In order to distinguish between data from the terminals, and to direct specific commands to the correct device, transparent mode is very difficult, and AT command mode significantly eases deployment cases.

1-2 LoRa Terminal IDs

Part of the set-up process involves modifying the ID assigned to each LoRa terminal – this ID is used by each terminal on the network to determine if a particular command is directed at it and if not it can be safely ignored. It is also attached to all data sent to the gateway, allowing you to determine the source of the data.

You can apply this as a “secondary network address” - as in, “Send command ‘AT+VER’ to terminal 13654 on gateway 10.0.0.1”. In AT command mode, unsolicited responses will also return the ID of the sending terminal.

The factory default value for ID is 13654.

Where you have more than one(1) LoRa terminal connecting to the same LoRa gateway, you MUST make the ID for each terminal unique – otherwise, you will be unable to determine where any data came from, and neither will you be able to operate LoRa terminal I/O independently (that is, if 2 terminals have the same ID, they will BOTH act on messages, I/O commands and configuration commands sent to that ID).

1-3 LoRa Terminal, LoRa Gateway and modes

Both the LoRa terminal AND the LoRa gateway can be in any of the following modes:

Transparent Mode – data is passed as received directly to the device attached, and data sent to the device passes unchanged over the LoRa network.
AT Command Mode – data from the end-device is interpreted as AT commands (described in this document) to be acted on by the LoRa terminal/gateway. Command responses and unsolicited response codes are emitted by the terminal/gateway as appropriate.

API Mode – similar to AT command mode, but using a proprietary binary packet protocol

For the use cases pictured above, AT Command Mode allows for:

Case 1: AT commands can read/write I/O pins, as well as send/receive serial data

Case 2: in addition to case 1 abilities, in case 2 we can easily see which of the multiple devices is sending us data, as well as direct data/commands to a specific device.

Because you can set the gateway and terminal into different modes, it can be advantageous to set the terminals to transparent mode and the gateway to AT command mode. In this scenario, the end-device connected to the terminal simply communicates as normal, while the gateway gets origination address and can set destination address on a command-by-command or response-by-response basis.

2 - AT command mode

AT command mode is a multi-function feature. You can use AT commands to configure the LoRa Terminal settings, send and receive serial data, and control/monitor I/O pins.

Generally, the device will already be set into an appropriate mode, however this may not be AT command mode. To enter AT command mode:

• From the transparent mode, send the 3-character command sequence “+++” twice through serial port.

• From the API mode, send “FE 01 21 2A 00 0A” through serial port.

To check the device is in AT command mode, send “AT<CR><LF>” through serial port, if in AT command mode it will return “OK”.

NOTE: All AT command lines should begin with “AT” or “at” and end with “<CR><LF>”.

In general, the AT command takes three forms, as shown in table 3-1.

<table>
<thead>
<tr>
<th>Form</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set</td>
<td>Set parameters</td>
<td>AT+XXX=&lt;...&gt;</td>
</tr>
<tr>
<td>Query</td>
<td>Query current parameter settings</td>
<td>AT+XXX?</td>
</tr>
<tr>
<td>Execute</td>
<td>Execute a command on the remote</td>
<td>AT+XXX</td>
</tr>
</tbody>
</table>

Note:
1. Possible return result after issuing a set command:
   - `<CR><LF>OK<CR><LF>`
   - `<CR><LF>ERROR<CR><LF>`

2. Possible return result after issuing a query:
   `<CR><LF>+XXX:<parameter value><CR><LF>OK<CR><LF>`

3. Executing commands may return OK and/or other specific content.
2.1 Diagnostic/Informational Commands

2.1.1 Query device software version : AT+VER
Show the software version of the current device.

Query:

\[ \text{AT+VER} \]

Query response:

\[ \text{SW VER: F8L10D-N Standard_v1.1.0_Nov 18 2016 11:22:59} \]

2.1.2 Query device all parameters : AT+SHW
Return device parameters.

Query:

\[ \text{AT+SHW} \]

Query response:

\[ \text{Model: F8L10D} \]
\[ \text{Work Mode: TRNS} \]
\[ \text{Com1 Baud: 115200} \]
\[ \text{Com1 Params: 8N1} \]
\[ \text{Debug Level: 2} \]
\[ \text{Radio Speed: 3} \]
\[ \text{Sleep Time: 0} \]
\[ \text{WakeUP Time: 0} \]
\[ \text{Sleep mode: None} \]
\[ \text{ID: 13654} \]
\[ \text{Channel: 24} \]
\[ \text{Emission Power: 3} \]
\[ \text{FEC: 1} \]
\[ \text{Trans Addr: 0} \]
\[ \text{Relay Addr: 1000} \]
\[ \text{Data Frame Int: 20} \]
Device mode: 0
2.2 Device Control Commands

2.2.1 Restore factory settings : AT+FAC
Restore the device parameters to the factory state. All previous settings are discarded and cannot be recovered.

Command:

AT+FAC

Command response:

OK

2.2.2 Reboot device : AT+SRS
Reboot the terminal. All settings and I/O will revert to the same condition as power cycling the terminal.

Command:

AT+SRS

Command response:

OK

2.2.3 Exit configuration state: AT+ESC
Exit AT command mode, return to previous mode, normally transparent mode, but could also be API mode.

Command:

AT+ESC

Command response: none

2.3 System Parameter Commands

2.3.1 Set the device operation mode : AT+MOD
Set new mode:

AT+MOD=<new mode>

Query current mode:

AT+MOD?

Query response:

+MOD:<current mode>

<new mode> and <current mode> valid values :
0 = transparent mode
1 = AT command mode
2 = API mode
Default: 0

Notes:

• For the terminal(s), the set mode will drop to transparent mode one(1) second after reboot.
• Transparent mode – for transparent data transmission, you need to configure the transparent transmission address (destination address).
• API mode – proprietary binary packet mode, for protocol format reference the API document
2.3.2 Set device debug level: AT+DBL
Log level control for debugging of devices.

Set debug level:

   AT+DBL=<debug level>

Query debug level:

   AT+DBL?

Query response:

   +DBL: <debug level>

<debug level>:
- 0 = No debug messages
- 1 = Critical errors only
- 2 = Critical + Informational errors

Default: 1

2.3.3 Set device sleep mode : AT+SLE
The LoRa terminal has two(2) power saving modes: sleep and deep sleep.

In sleep mode, the terminal can be woken up by either a timer or I/O pin 1.

In deep sleep mode, the terminal can only be woken by I/O pin 1.

Set sleep mode:

   AT+SLE=<sleep mode>

Query sleep mode:

   AT+SLE?

Query response:

   +SLE:<sleep mode>

<sleep mode> :
- 0 = don’t sleep
- 1 = Sleep mode (See also: Chapter 2.6, Device Wake On Radio Mode Commands)
- 2 = Deep sleep mode

Default: 0
2.4 Set device serial

2.4.1 Set device serial baudrate: AT+IPR
Set/query the terminal serial port baud rate.

Set:

\[ AT+IPR=<\text{number}> \]

Query:

\[ AT+IPR? \]

Query response:

\[ +IPR: <\text{number}> \]

<number>:
- 3 = 2400
- 4 = 4800
- 5 = 9600
- 6 = 19200
- 7 = 38400
- 8 = 57600
- 9 = 115200

Default: 9

2.4.2 Set device serial parity: AT+PAR
Set/query serial port parity bit setting.

Set:

\[ AT+PAR=<\text{parity}> \]

Query:

\[ AT+PAR? +PAR: <\text{parity}> \]

<parity>:
- 0 = No parity
- 1 = Even parity
- 2 = Odd parity

Default: 0

2.4.3 Set device serial stop bit: AT+STO
Set/Query the serial port number of stop bits

Set:

\[ AT+STO=<\text{stop bits}> \]

Query:

\[ AT+STO? +STO: <\text{stop bits}> \]

<stop bits>:
- 0 = 1 stop bit
1 = 2 stop bits

Default: 0

2.4.4 Set serial data interval: AT+ITV
Query/set the serial port buffer timeout value. If no further data is received after this time, packetize the data and send it.

Set:

AT+ITV=<mS timeout>

Query:

AT+ITV? +ITV: <mS timeout>

<mS timeout>:

• 1 … 65535 (milliseconds)

Default: 20

2.5 LoRa Network Command

2.5.1 Set NET ID: AT+PID
Set device PAN ID. Devices (terminals and/or gateways) are required to use the same frequency and the same PAN ID in order to communicate. By using a different PAN ID, you can have several logical networks using the same frequency and the same device IDs.

Set:

AT+PID=<PAN ID>

Query:

AT+PID? +PID: <PAN ID>

<PAN ID>:

• 0 … 65535

Default: 13654

2.5.2 Set device type: AT+TYP
Datamax+ LoRa terminals can also support a mesh network by setting the device type. If the device type is 1, the device can relay messages for other devices, and should not be put into sleep mode.
If the device type is 2, the device does not relay messages, sleep mode can be used.

Set:

AT+TYP=<type>

Query:

AT+TYP? +TYP: <type>

<Type>:

• 1 = Router (act as mesh relay node)
• 2 = End Device
Default: 2

2.5.3 Set node address: AT+NID
Query/set the device node ID. The node ID allows you to resolve which data comes from or goes to which device.

Set:
\[
\text{AT+NID=} <\text{ID}>
\]
Query:
\[
\text{AT+NID? +NID: } <\text{ID}>
\]

\(<\text{ID}>\):
- 0..65535

Default: 13654

2.5.4 Set transparent address: AT+TID
The device transparent address is used when the device is in transparent mode and specifies the “default target device” – commands/(unsolicited) responses are sent to/received from the specified node unless otherwise noted/directed.

Set:
\[
\text{AT+TID=} <\text{address}>
\]
Query:
\[
\text{AT+TID? +TID: } <\text{address}>
\]

\(<\text{address}>\):
- 0..65535

Default: 0

2.5.5 Set relay address: AT+RID
DEPRECATED. USE AT+TYP instead.
Previously used when placing nodes in mesh mode to select a relay node by its ID.

Set:
\[
\text{AT+RID=} <\text{number-string}>
\]
Query:
\[
\text{AT+RID? +RID: } <\text{number-string}>
\]

\(<\text{number-string}>\):
- 0..65535

Default: 1000

2.5.6 Set carrier frequency: AT+LFR
Set the frequency used by the terminal.
Set:

\[ AT+LFR=<\text{freq}> \]

Query:

\[ AT+LFR? +LFR: <\text{freq}> \]

\(<\text{freq}>\) the frequency in MHz:
- 410~441
- 470~510
- 850~950
Default: 868

2.5.7 Set transmit power : AT+TPR
Set the power output level for terminal data transmissions in dBm.

Set:

\[ AT+TPR=<\text{power}> \]

Query:

\[ AT+TPR? +TPR: <\text{power}> \]

\(<\text{power}>\): output power in dBm
- 5 .. 20
Default: 20

2.5.8 Set data rate : AT+LRS
The rate of data transmission on-air is divided into 6 levels, the higher the rate selected, the shorter the transmission distance for the same field conditions. Therefore, it is necessary to adjust the value according to the actual application environment.

Set:

\[ AT+LRS=<\text{baud code}> \]

Query:

\[ AT+LRS? +LRS: <\text{baud code}> \]

\(<\text{baud code}>\):
- 1 = 0.3Kbps
- 2 = 0.6Kbps
- 3 = 1.0Kbps
- 4 = 1.8Kbps
- 5 = 3.1Kbps
- 6 = 5.5Kbps

Default: 3
Note: all terminals and gateways on the same network should use the same value for +LRS, otherwise communications WILL FAIL.

2.5.9 Send data (HEX mode): AT+TXH
Send binary data to a node serial port.

Execute:

\[ AT+TXH=<\text{destination address}>,<\text{content}> \]
<destination address> : the address of the node you want to send to, eg 13654
<content>: the data to send, as ASCII HEX digits. There MUST be 2 digits per byte.
For example:
AT+TXH=12245,3838383838380D0A<CR><LF>
The destination node address is ‘12245’ and the content is “888888<CR><LF>”( hex 38 is “8”,
hex 0D is <CR> & 0A is <LF>).

Note : The length of the transmitted data depends on the length of the entire command;
Calculation method: < content > length = AT command length - destination address length - 4;
A maximum length of the AT command is 238 bytes , not including < CR > < LF >;
Command does not respond if the entire command length exceeds 238 bytes.

2.5.10 Send data ( ASCII mode ): AT+TXA
Send ASCII data to the serial port

Execute:
    AT+TXA=<destination address>,<content>

<destination address> : send the address string
<content> : the data string to send

Example:
AT+TXA=12245,1235567789<CR><LF>
The destination node address is 12245, and the content is “1235567789” (no <CR>, no <LF>)

Note: The length of the transmitted data depends on the length of the entire command;
Calculation method: < content > length = AT command length - destination address length - 4;
A maximum length of the AT command is 238 bytes , not including < CR > < LF >;
Command does not respond if the entire command length exceeds 238 bytes.

2.5.11 Test data loop back ( ASCII mode ): AT+TST
Execute:
AT+TST=<destination address>,<content>
After device executes the command and sends test data, the destination device would loop back
the original data. The local device would show data to the serial port.
Note: the same as AT+TXA command.

2.5.12 Receive wireless data
Unsolicited Response Code (URC) sent when new data is sent from the terminal.

URC:
    +RCV:<source address>,<data string>

<source address> : senders node ID (address)
data string : received data string

2.5.13 Presentation mode of the device API mode receive date: AT+DDM
Turn appending of RSSI data to +RCV URC on or off.

Set:
    AT+DDM=<RSSI IND>

Query:
    AT+DDM?
Query Response:

+DDM: <RSSI IND>

<RSSI IND>:

0 = send only node address and data
1 = send node address, data, and RSSI

Default: 0

Note:

1. When in AT mode, the data format is: +RCV:<source address>,<data string>,<RSSI>
2. When in API mode, the data format is specified in the API command manual.

2.5.14 Set data TX done inform: AT+INF

Turn URC when data transmission complete on or off

Set:

AT+INF=<state>

Query:

AT+INF? +INF: <state>

URC:

+STA:TXDONE

<state>:

- 0 (off)
- 1 (on)

Default: 0 (off)

2.6 Device Wake On Radio Mode Command

There are 3 AT commands for Wake On Radio Mode:

- AT+STC – sets the amount of time the node will sleep (in seconds)
- AT+WTC – set the minimum amount of time the device will be awake
- AT+PPT – set the transmitter preamble time

With no LoRa traffic: device will sleep for AT+STC seconds, then wake up for AT+WTC milliseconds, then repeat.

With LoRa traffic: device will stay awake until LoRa traffic ceases plus a further AT+WTC milliseconds, go to sleep, then repeat.

Gateway preamble time should be set to match the sleep time of the terminals.

Terminal preamble time only needs to be set when using the mesh features.

2.6.1 Set device period sleep time: AT+STC

Set the device sleep mode length to the specified number of seconds.

Set:

AT+STC=<sleep time>
Query:

AT+STC?

Query Response:

+STC: <sleep time>

<sleep time>: 0 … 5 seconds,  
Default:0

Note: a sleep time of 0 (zero) indicates “do not sleep”

2.6.2 Set device wake time: AT+WTC
Set the minimum wake time of the device in mS (milliseconds)

Set:

AT+WTC=<wake time>

Query:

AT+WTC?

Query Response:

+WTC: <wake time>

<wake time>: 0 … 65535 (milliseconds)  
Default:0

Note: You should set the wake time BEFORE putting the device into sleep mode with AT+STC

2.6.3 Set device preamble period time: AT+PPT
The sending node preamble should be set equal to the receive node sleep time – this ensures a sleeping device will see any pending packets on wakeup.

Set:

AT+PPT=<preamble time>

Query:

AT+PPT?

Query Response:

+PPT: <preamble time>

<preamble time>: 0 … 5 (seconds)  
Default:0

2.7 Device IO pins command

NOTE:

1. The return value from IO pins should be read in AT command mode or API mode.
2. When sleeping, IO configuration not allowed.
3. The “n” in the commands below should be replaced with the I/O pin number (1 .. 5)

2.7.1 Set local IO pin mode: AT+DMn
Set the mode of the terminal I/O pin.
Note: this command is only usefully used when directly connected to the terminal, or sent as a remote AT command in API mode.

Set:
\[ \text{AT+DMn}=<\text{mode}> \]

Query:
\[ \text{AT+DMn}? \]

Query response:
\[ +\text{DMn}:<\text{mode}> \]

<mode>:
0 = Disabled
1 = ADC
2 = GPIO input
3 = GPIO output low
4 = GPIO output high

Default: 0

Note:
1. D1 and D2 allowed modes are 0, 2, 3, 4 (no ADC on these pins!)
2. D3, D4 and D5 allowed modes are 0, 1, 2, 3, 4

SEE ALSO: AT+NSn for remote mode control

2.7.2 Query local IO pin value : AT+DVn
Query:
\[ \text{AT+DVn}? \]
Query response:
\[ +\text{DVn}:<\text{value}> \]

Get local IO pin value (ADC, GPIO value)

SEE ALSO: AT+NVn for remote pin reading

2.7.3 Set IO pin data acquisition time interval : AT+DTn
Set:
\[ \text{AT+DTn}=<\text{seconds}> \]

Query:
\[ \text{AT+DTn}? \]
Query response:
\[ +\text{DTn}:<\text{seconds}> \]

<seconds>:
0 .. 65535 (seconds)

Default: 0

Note:
1. Should be used for IO pins in ADC mode or DI mode.
2. Reporting stops when device enters sleep mode.
3. The collected data will send to the transparent address node.
4. ADC value returned can be calculated from the formula.

2.7.4 Query a remote device IO pin value: AT+NVn
Query:

\[ AT+NVn=<\text{node address}> \]

Query Response:

\[ +NVn=<\text{node address}>,<\text{pin}>,<\text{mode}>,<\text{value}> \]

<node address>: The required node address

2.7.5 Set a remote device IO pin mode: AT+NSn

Set:

\[ AT+NSn= <\text{node address}>,<\text{IO mode}>,<\text{interval}> \]

Set Response:

\[ +NSn: <\text{node address}>,<\text{pin}>,<\text{state}> \]

Parameter description:

<node address>: the required node address

<IO mode>:
- 0 = Disabled
- 1 = ADC
- 2 = GPIO input
- 3 = GPIO output low
- 4 = GPIO output high

interval: IO mode 1\text{2} : set the report value 0\text{~}65535 second

State: 0 = Success
1 = Failure