

# *tLory*

## User Guide

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## Revision History

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April 25, 2019	1.0	All	New

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**Caution**

THE GRANTEE IS NOT RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

**IMPORTANT NOTE : FCC RF Radiation Exposure Statement**

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment.

This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

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# 1. Overview

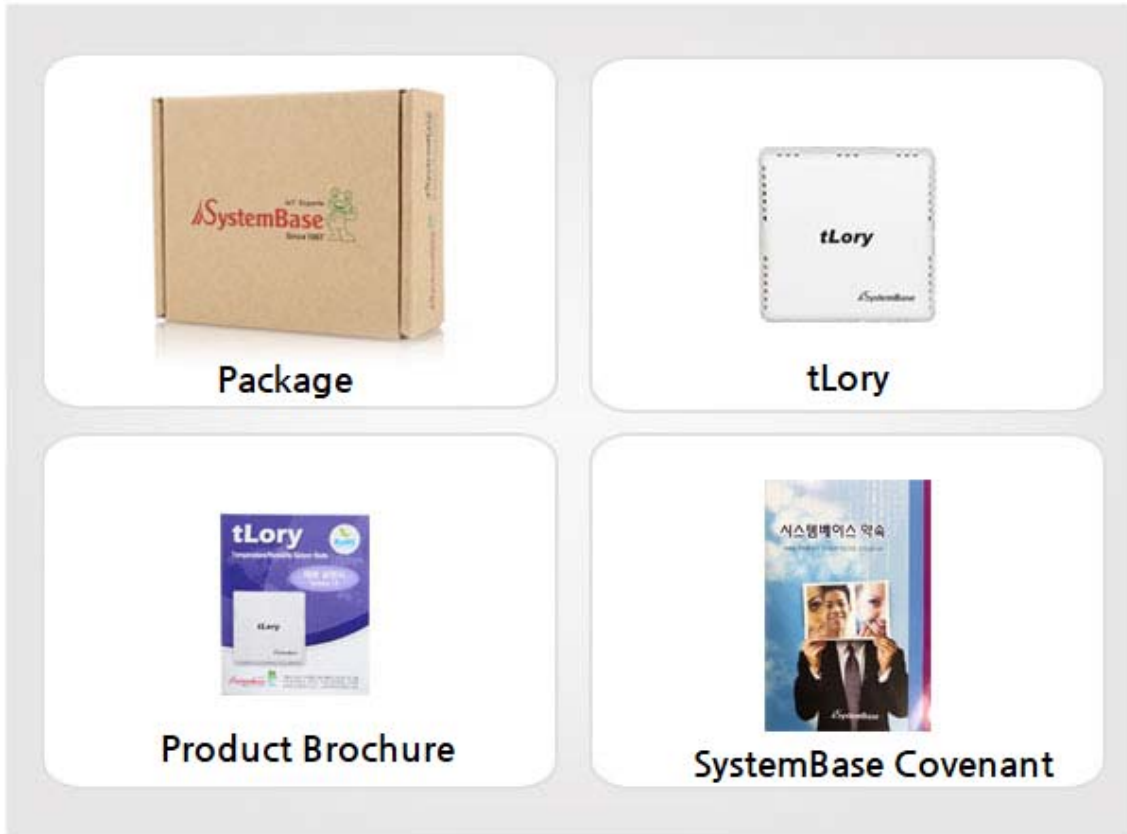
tLory is a device that transmits temperature and humidity information through LoRa. It converts the data into LoRa signals and transfers them to devices that are several kilometers away.

LoRa (wireless communication technology for sensor networks), the next generation communication technology of Low Power Wide Area (LPWA) capable of transmitting small amounts of data over long ranges, enables communications up to 10 km in open terrain.

# 2. Features

- Supports low-power and mid and long-range wireless communication of LoRa (Maximum of 10km in open terrain)
- Support industrial operating temperature range from -40 to 85°C
- 3 years of operation on an embedded lithium AA battery dedicated for 3.6V 4800mA (assuming that data is collected every hour)
- Device setup with Dip Switch and LoryView

### 3. Components



COMPONENTS	ORDER NUMBER
tLory(Built-in disposable battery), Quick Manual, SystemBase Covenant	tLory-1010NCL

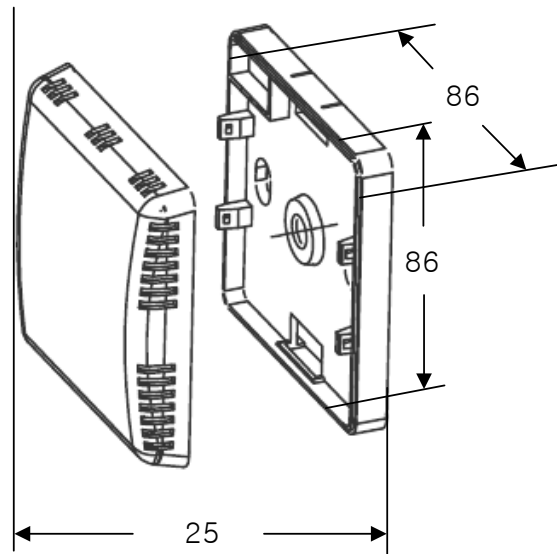
## 4. Hardware



### 4.1 Specification

CATEGORY	SUBCATEGORY	SPECIFICATION
Wireless Interface	Frequency Band	917 ~ 923MHz
	Modulation	LoRa
	Antenna	-1.310 dBi
Operating Environment	Temperature	-40°C ~ +85°C
	Humidity	5~95%, non-condensable
Power		3.6V DC (4800mA lithium AA battery)

## 4.2 Drawing of Device



Unit: mm (Case included)



## 5. How to Connect

A device such as sLory or uLory is required to receive the information on temperature and humidity transmitted from tLory.

Users should connect sLory or uLory to PCs and use LoryView to check the data on temperature and humidity from tLory.

## 6. How to Use

Setting channel, Spreading Factor and power (output) of tLory is required to communicate with other devices in LoryNet via Dip Switch or LoryView.

The default sensing period of tLory is 1 hour and can be changed through LoryView (\*Time error may occur depending on the user environment such as temperature and humidity.)

### 6.1 Switch and Button Setting Table



#### Setting Spreading Factor (DIP Switch 2)

FEATURE	SWITCH	Spreading Factor
Changing Spreading Factor	ON	10
	OFF	9

#### Switching Channel (DIP Switch 3~6)

FEATURE	DIP SW 3	DIP SW 4	DIP SW 5	DIP SW 6	CHANNEL
Switching	ON	ON	ON	OFF	1=917.3MHz

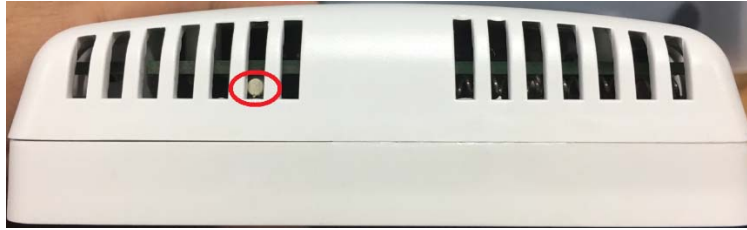
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Channel	ON	ON	OFF	ON	2=917.9MHz
	ON	ON	OFF	OFF	3=918.5MHz
	ON	OFF	ON	ON	4=919.1MHz
	ON	OFF	ON	OFF	5=919.7MHz
	ON	OFF	OFF	ON	6=920.3MHz
	ON	OFF	OFF	OFF	7=920.7MHz
	OFF	ON	ON	ON	8=920.9MHz
	OFF	ON	ON	OFF	9=921.1MHz
	OFF	ON	OFF	ON	10=921.3MHz
	OFF	ON	OFF	OFF	11=921.5MHz
	OFF	OFF	ON	ON	12=921.7MHz
	OFF	OFF	ON	OFF	13=921.9MHz
	OFF	OFF	OFF	ON	19=923.1MHz
	OFF	OFF	OFF	OFF	20=923.3MHz
	ON	ON	ON	ON	

**Power (DIP Switch 7)**

FEATURE	SWITCH	DEVICE
Power	ON	Device turned on
	OFF	Device turned off

**Button**



BUTTON	DESCRIPTION
RST	Turn on the device with 1~6 switch on, Press and hold for more than 3 seconds to reset the device

## 6.2 Operation Mode Setting

Users can change the communication setting of tLory with switch and detailed setting such as sensing cycle via LoryView. Setting tLory via LoryView requires a device such as sLory or uLory.

### Setting via Utility (LoryView)

The utility provided along with tLory is available on <http://www.sysbas.com> where users can download the data from the library of the homepage for the customer convenience. Users can use LoryView for communication and setup, and find the detailed instructions on the use in the LoryView Manuals.

### <Setup Mode>

Users can set tLory to be awake for 1 minute under the Setup Mode because the default time is set to 3 seconds, which are not enough to make changes to setup.

Refer to the table below for Dip Switch while the Power is OFF

	DIP SW 1	DIP SW 2	DIP SW 3	DIP SW 4	DIP SW 5	DIP SW 6
STATUS	ON	ON	ON	ON	ON	ON

When the power is on, the device does not enter into the Sleep Mode for 1 minute, operating at LoRa channel of 20 and with spreading factor of 9. Turning it on under the Setup Mode, the device transmits sensing values to the destinations stored in the table.

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(\*Automatic switch to the Sleep Mode after 1 minute)

Hereafter, users can follow the setting process of (LoryView) for tLory.

※ Setting and entering ACK, users can retake the corresponding setting values, but resetting is required when the value is not returned which indicates that the setting is not normal.

After setting, users should turn off the device, change channel and spreading factors according to the setting of LoRa, and turn it on again.

**<Setting Sensing Cycle>**

ORDER	DESCRIPTION
1	Set Channel, Spreading Factor with Dip Switch
2	Turn on Switch 7 to activate tLory
3	Set LoRa of sLory or uLory in the same way of setting LoRa of tLory
4	<p>- Enter an interval unit in the entry 48 and sensing cycle in the entry 49 (Refer to the General Manuals for table maps rather than the Quick Manuals)</p> <p>* tLory is in the Sleep Mode except when it is sensing as it uses battery. It collects data and goes back to Sleep Mode after the 3-second RX Mode. Therefore, it is necessary to send LoRa packets to set the sensing cycle before the device switches back to the Sleep Mode.</p> <p>- Set the minimum time to 4 seconds or longer since the sensing cycle is 3-second</p> <p>The minimum of sensing cycle is 4 seconds. If it is set to be shorter than 4 seconds, the sensing cycle will be 4 seconds.</p>
5	Enter the ID of the destination device in the entries 50 to 52
6	Enter the table number of the destination device in the entry 53
7	Enter the entry number of the destination table in the entry 54

**<Remote Setting>**

Users can change the setting remotely via LoryView when it is difficult to use switch for the setup of LoRa while tLory is in use (when the installation location is not within easy reach). The device will be activated and operated according to the value set in the table rather than the value set via Dip Switch if the value of Switch Flag in the setting option is set to 1 with reference to LoRa Port Process Table Map.

## 7. Table Maps

The port process of tLory supports the port process for temperature and humidity to connect sensors with LoRa for data communication. The information in the table must be read and written using LoryNet device ID, destination table number, and entry number in order to activate each port or check the Generation Mode. A table map guides user device

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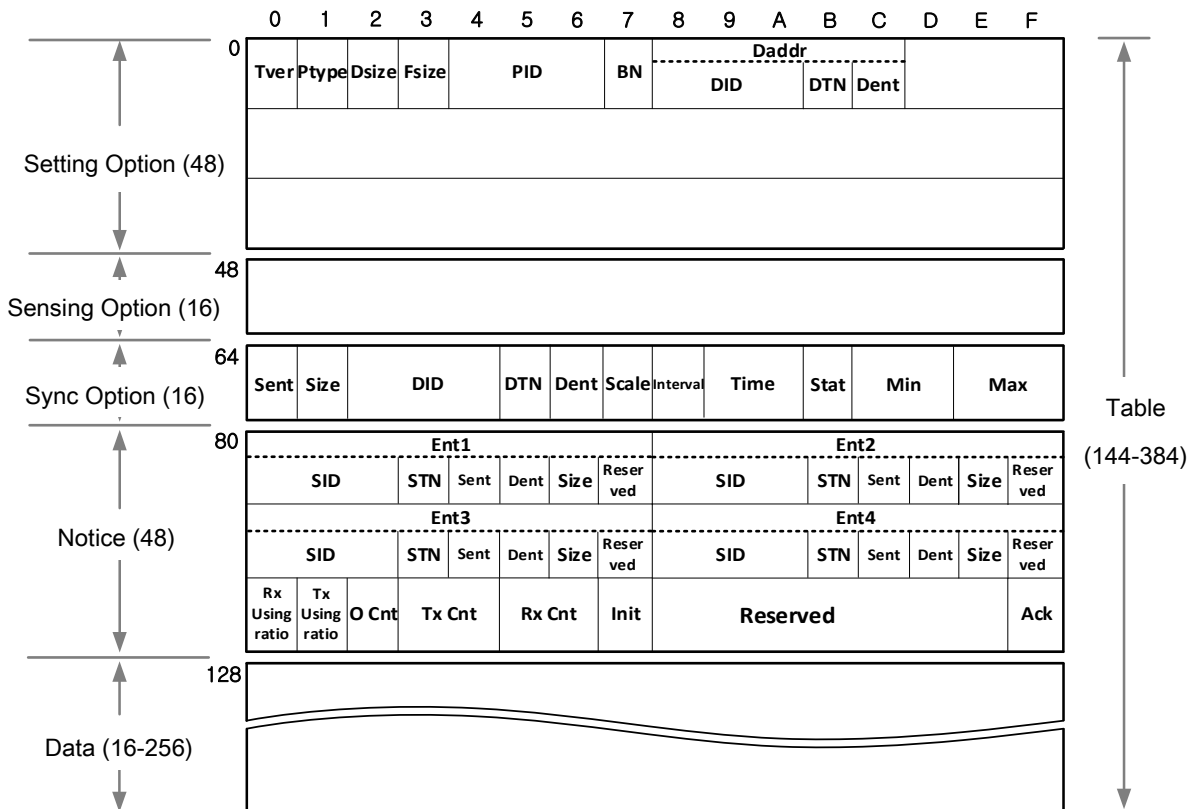
to communicate with any ports and entries of other devices. All ports included in tLory have unique table maps.

Each table number of tLory is as follows:

PORT NAME	TABLE NUMBER	NOTE
Device	1	Main process to control all ports in the device
LoRa	2	Port for LoRa communication
Temperature and Humidity	3	Port for Temperature and humidity sensors

**<Table Map>**

All ports in tLory have identically-structured table maps and communicate by reading and writing unique number of tables and data in the entries of tables. The common table structure of each port is as follows and undefined, empty space can be freely used depending on the characteristics of ports.



## 7.1 Device Process Table Map

Entry	Size	Name	RW	Range (Default)	Description	
0	1	Version	R	X : 1~15 Y : 0~15	Firmware version of table (X.Y)	
1	1	Process Type	R	0~4 (4)	Process type	
2	1	Data Size	R	0~16 (6) 1 = 16 Byte	Size of area of data	
3	1	FIFO size	R	1~255 (8) 1 = 16 Byte	Size of FIFO used by process	
4	3	Privilege ID	RW	1~0xffffe (0xffffe)	Administrator ID with right to write in the setting, sensing and sync options	
7	1	Bridge Table No	RW	0~64 (2)	Select data processing method if there is no route to a destination 0 = Ignore rockets 1~99 = Request to pass rockets to ports and to its final destination	
8	3	DID	RW	1~0xffffe (0)	Not used in tLory	
11	1	DTN	RW	0~32 (0)		
12	1	Dent	RW	0~32 (0)		
13	3	SID	R	1~0xffffe	Your source ID	
16	1	LoRa	R	0~32 (1)	Number of LoRa ports	
17	31				Reserved	
48	16				Reserved	
64	16				Reserved	
80	3	Ent1	SID	R	0~0xfffff	Device number of another user
83	1		STN	R	0x00~0xff	Table number of another user
84	1		Dent	R	0x00~0xff	Table entry address of another user
85	1		Size	R	0x00~0xff	Size of changed entry
86	2		Reserved	R	-	Reserved space
88	3	Ent2	SID	R	0~0xfffff	Device number of another user
91	1		DTN	R	0~0xff	Table number of another user
92	1		Dent	R	0~0xff	Table entry address of another user
93	1		Size	R	0~0xff	Size of changed entry

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94	2		Reserved	R	-	Reserved space
96	3	Ent3	SID	R	0~0xfffff	Device number of another user
99	1		DTN	R	0~0xff	Table number of another user
100	1		Dent	R	0~0xff	Table entry address of another user
101	1		Size	R	0~0xff	Size of changed entry
102	2		Reserved	-	-	Reserved space
104	3	Ent4	SID	R	0~0xfffff	Device number of another user
107	1		DTN	R	0~0xff	Table number of another user
108	1		Dent	R	0~0xff	Table entry address of another user
109	1		Size	R	0~0xff	Size of changed entry
110	2		Reserved	-	-	Reserved space
112	1	Usage rates of FIFO input		R	0~100	Usage rates of FIFO input (%)
113	1	Usage rates of FIFO output		R	0~100	Usage rates of FIFO input (%)
114	1	Over_Cnt		R	0~255	Number of FIFO overrun
115	2	Tx Cnt,		R	0~0xffff	Number of rocket transmission
117	2	Rx Cnt,		R	0~0xffff	Number of rocket reception
119	1	Init		R	1	<p>Entries indicating the initialization of each layer</p> <p>Bit 0: Application layer</p> <p>Bit 1: Table layer</p> <p>Bit 2 : Route layer</p> <p>Bit 4: Link layer</p> <p>The bit 0 indicates that it is not initialized while the bit 1 means the completion of initialization. (The default value is 0x00 after the activation)</p>
127	1	Ack		R	1	Indicate the reception of Ack if it is not 0
128	1	Save		R/W	1byte	Save table value in Flash
129	1	Restart		R/W	1byte	Restart the device
130	8	FW Update		R/W	8Byte	It is set in case of request for updates from PC. The table entry number and update information of ACK that PC will receive during the update are recorded in the area
138	4	SW DATE		R	unsigned value	YYYY (uint16_t) + M(uint8_t) + D(uint8_t)



					Display tLory firmware date
142	67	Update Data	R/W	68Byte	Record firmware update data

## 7.2 LoRa Port Process Table Map

Entry	Size	Name	RW	Range (Default)	Description
0	1	Version	R	X : 1~15 Y : 0~15	Firmware version of table (X.Y)
1	1	Process Type	R	0~4 (0)	Process type
2	1	Data Size	R	0~16 (1) 1 = 16 Byte	Size of area of data
3	1	FIFO size	R	1~255 (16) 1 = 16 Byte	Size of FIFO used by process
4	3	Privilege ID	RW	1~0xfffffe (0xfffffe)	Administrator ID with right to write in the setting, sensing and sync options
7	1	Bridge Table No	RW	0~64 (2)	Select data processing method if there is no route to a destination 0 = Ignore rockets 1~99 = Request to pass rockets to ports and to its final destination
8	3	DID	RW	1~0xfffffe (0)	Not used in tLory
11	1	DTN	RW	0~32 (0)	
12	1	Dent	RW	0~32 (0)	
13	1	CHN	R/W	1~20 (20)	Number of LoRa channels 1=917.3MHz, 2=917.9MHz 3=918.5MHz, 4=919.1MHz 5=919.7MHz, 6=920.3MHz 7=920.7MHz, 8=920.9MHz 9=921.1MHz, 10=921.3MHz 11=921.5MHz, 12=921.7MHz 13=921.9MHz, 14=922.1MHz 15=922.3MHz, 16=922.5MHz 17=922.7MHz, 18=922.9MHz 19=923.1MHz, 20=923.3MHz
14	1	BW	R	9	Value of LoRa Bandwidth 9=500KHz
15	1	SF	R/W	7~12 (9)	Value of LoRa Spreading Factor
16	1	PWR	R/W	0~10 (10)	Value of LoRa power output

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17	1	Mode	R/W	0~2 (0)	Transmission mode: 0=Slave, 1=CSMA, 2=Slave/CSMA	
18	1	Switch Flag	R/W	0 ~ 1(0)	LoRa Setup Set 0 = Dip switch 1 = Value set in LoRa Table	
19	29				Reserved	
48	16				Reserved	
64	16				Reserved	
80	3	Ent1	SID	R	0~0xfffff	Device number of another user
83	1		STN	R	0x00~0xff	Table number of another user
84	1		Dent	R	0x00~0xff	Table entry address of another user
85	1		Size	R	0x00~0xff	Size of changed entry
86	2		Reserved	R	-	Reserved space
88	3	Ent2	SID	R	0~0xfffff	Device number of another user
91	1		DTN	R	0~0xff	Table number of another user
92	1		Dent	R	0~0xff	Table entry address of another user
93	1		Size	R	0~0xff	Size of changed entry
94	2		Reserved	R	-	Reserved space
96	3	Ent3	SID	R	0~0xfffff	Device number of another user
99	1		DTN	R	0~0xff	Table number of another user
100	1		Dent	R	0~0xff	Table entry address of another user
101	1		Size	R	0~0xff	Size of changed entry
102	2		Reserved	-	-	Reserved space
104	3	Ent4	SID	R	0~0xfffff	Device number of another user
107	1		DTN	R	0~0xff	Table number of another user
108	1		Dent	R	0~0xff	Table entry address of another user
109	1		Size	R	0~0xff	Size of changed entry
110	2		Reserved	-	-	Reserved space
112	1	Usage rates of FIFO input	R	0~100	Usage rates of FIFO input (%)	
113	1	Usage rates of FIFO output	R	0~100	Usage rates of FIFO input (%)	
114	1	Over_Cnt	R	0~255	Number of FIFO overrun	
115	2	Tx Cnt,	R	0~0xffff	Number of rocket transmission	

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117	2	Rx Cnt,	R	0~0xffff	Number of rocket reception
119	1	Init	R	1	<p>Entries indicating the initialization of each layer</p> <p>Bit 0: Application layer</p> <p>Bit 1: Table layer</p> <p>Bit 2 : Route layer</p> <p>Bit 4: Link layer</p> <p>The bit 0 indicates that it is not initialized while the bit 1 means the completion of initialization. (The default value is 0x00 after the activation)</p>
127	1	Ack	R	1	Indicate the reception of Ack if it is not 0
128	2	dBm	RW	0 ~ -148	Reception sensitivity of RF of LoRa (dBm)
130	126				Reserved

## 7.3 Temperature and Humidity (Sensor) Port Process

### Table Map

Entry	Size	Name	RW	Range (Default)	Description
0	1	Version	R	X : 1~15 Y : 0~15	Firmware version of table (X.Y)
1	1	Process Type	R	0~4 (2)	Process type
2	1	Data Size	R	0~16 (1) 1 = 16 Byte	Size of area of data
3	1	FIFO size	R	1~255 (8) 1 = 16 Byte	Size of FIFO used by process
4	3	Privilege ID	RW	1~0xfffffe (0xfffffe)	Administrator ID with right to write in the setting, sensing and sync options
7	1	Bridge Table No	RW	0~64 (2)	Select data processing method if there is no route to a destination

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					0 = Ignore rockets 1~99 = Request to pass rockets to ports and to its final destination	
8	3	DID	RW	1~0xffffe (0)	Not used in tLory	
11	1	DTN	RW	0~32 (0)		
12	1	Dent	RW	0~32 (0)		
13	1	Port_Ea	RW	0 ~ 32 (1)	Number of sensor ports	
14	34	Reserved				
48	1	Scale	RW	1~0xff (0x48)	Interval unit: ASCII code 'D'(0x44)=day, 'H'(0x48)=time, 'M'(0x4D)=minute, 'S'(0x53)=second	
49	1	Interval	RW	1~255 (1)	Sensing cycle: 1~255, 0=Not used	
50	3	TH_DID	RW	1~0xffffe (0xffffe)	Destination device ID	
53	1	TH_DTN	RW	0~32 (3)	Destination device table number	
54	1	TH_Dent	RW	0~32 (80)	Destination table entry address	
55	9				Reserved	
64	16				Reserved	
80	3	Ent1	SID	R	0~0xffff	Device number of another user
83	1		STN	R	0x00~0xff	Table number of another user
84	1		Dent	R	0x00~0xff	Table entry address of another user
85	1		Size	R	0x00~0xff	Size of changed entry
86	2		Reserved	R	-	Reserved space
88	3	Ent2	SID	R	0~0xffff	Device number of another user
91	1		DTN	R	0~0xff	Table number of another user
92	1		Dent	R	0~0xff	Table entry address of another user
93	1		Size	R	0~0xff	Size of changed entry
94	2		Reserved	R	-	Reserved space
96	3	Ent3	SID	R	0~0xffff	Device number of another user
99	1		DTN	R	0~0xff	Table number of another user
100	1		Dent	R	0~0xff	Table entry address of another user
101	1		Size	R	0~0xff	Size of changed entry
102	2		Reserved	-	-	Reserved space
104	3	Ent4	SID	R	0~0xffff	Device number of another user
107	1		DTN	R	0~0xff	Table number of another user
108	1		Dent	R	0~0xff	Table entry address of another user

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109	1		Size	R	0~0xff	Size of changed entry
110	2		Reserved	-	-	Reserved space
112	1	Usage rates of FIFO input		R	0~100	Usage rates of FIFO input (%)
113	1	Usage rates of FIFO output		R	0~100	Usage rates of FIFO input (%)
114	1	Over_Cnt		R	0~255	Number of FIFO overrun
115	2	Tx Cnt,		R	0~0xffff	Number of rocket transmission
117	2	Rx Cnt,		R	0~0xffff	Number of rocket reception
119	1	Init		R	1	<p>Entries indicating the initialization of each layer</p> <p>Bit 0: Application layer</p> <p>Bit 1: Table layer</p> <p>Bit 2 : Route layer</p> <p>Bit 4: Link layer</p> <p>The bit 0 indicates that it is not initialized while the bit 1 means the completion of initialization. (The default value is 0x00 after the activation)</p>
127	1	Ack		R	1	Indicate the reception of Ack if it is not 0
128	1	Flag		R	0~1	Value of temperature 1:Above zero, 0:below zero
129	1	Temperature		R	0~0xff	Value of temperature of sensor(constant value and Hex)
130	1	Temperature		R	0~0xff	Value of temperature of sensor(decimal value and Hex)
131	1	Humidity		R	0~0xff	Value of humidity of sensor (constant value and Hex)
132	1	Humidity		R	0~0xff	Value of humidity of sensor (decimal value and Hex)
133	1	LowBat		R	0~1	Low Battery Flag 0:Normal, 1:Low Battery
134	122					Reserved