Small Microwave Sensor (code name : Gnome) UART Interface Manual

2018/9/6

Rev 0.09

Semiconductor Business Unit
Development Division VI

Revision history

Revision	*Date*	Contents
0.01	2018/04/16	Create New
0.02	2018/04/25	Fixed according to submitted sample
0.03	2018/05/08	Fixed typo
0.04	2018/05/11	Change name of Type5 to “Ch-I mean value”
0.05	2018/05/21	Separate Comp_Th and th0, change Type5 as mean of Ch-I and Ch-Q
0.06	2018/05/25	Changed length of Type1 to 4 bytes, without ‘padding’ (before 8 bytes, including 4 bytes of padding)
0.07	2018/06/20	Added alarm (Type11) timer (on?tm/off?tm), send Type11 every 1sec.
0.08	2018/07.24	Changed default of Type1 as ‘wave off’ (no Type1 in default)
0.09	2018/09/06	English only

UART Interface Manual

UART is used to send data taken by the microwave sensor (this unit) such as received 'signal mean value', etc.

UART is also used to give commands such as changing conditions of this unit (so called UART command) to this unit.

The connection conditions of UART are as follows.

- communication speed ： 115200baud
- Data length ： 8bit
- parity： None
- Stop bit： 1bit
- Flow control ： None

- 'Sequence number' and 'Checksum' are added to data transmitted by this unit.
- No sequence number and checksum are required for the UART command received by this unit
- The UART command received by this unit has be terminated by "CR" (= 0x0d i.e. ¥r)

Part 1: Data transmission

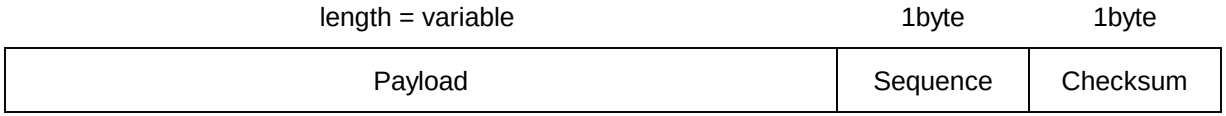
Data format transmitted by this unit is discussed in this part.

- **'Sequence number' and 'Checksum' (both, discussed later) are added in transmitting data sent by this unit.**

- **Partly, there is content that cooperates with the UART command discussed in Part 2 (UART command).**

Data format

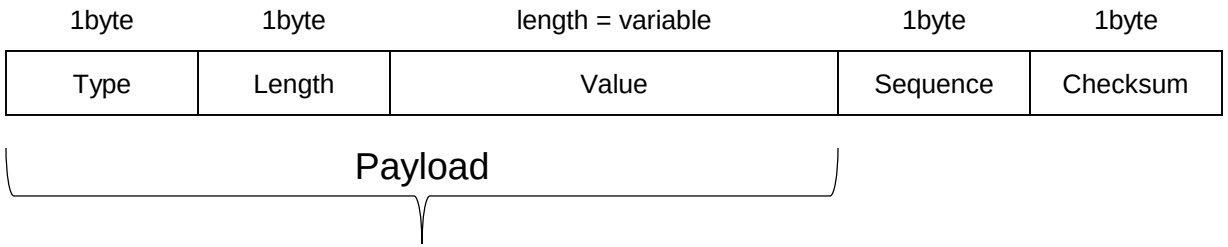
- The data packet sent by this unit consists of Payload, Sequence and Checksum.



- Payload : Transmitting data are encoded in ‘Type’, ‘Length’ and ‘Value’. ‘Value is actual data.
- Sequence: Sequence number (any value from 0x00 to 0x7f)
- Checksum: Checksum (value calculated by algorithm shown later)

Payload

- Transmitting data is encoded in ‘Type’, ‘Length’ and ‘Value’. ‘Value’ is actual sending data.
- For details of each data, see the detailed description of the Payload section.



- Type = 1 : Wavefrom (Ch-I and Ch-Q) DATA (Length = 4bytes , every 2ms in ‘wave 500’, every 10ms in ‘wave 100’)
- Type = 2 : Reserved
- Type = 3 : Reserved
- Type = 4 : Reserved
- Type = 5 : Signal mean value (Length = 2 bytes, every 100ms)
- Type = 6 : Reserved
- Type = 7 : Debug output (Length = variable length)
- Type = 8 : Reserved
- Type = 9 : Reserved
- Type = 10 : Reserved
- Type = 11 : Threshold detection alarm (Length = 2 bytes, every 1sec and changed point)
- Other than above: Reserved

Sequence

- Sequence (sequence number) is added after Payload.

1byte	1byte	length = varialbe	1byte	1byte
Type	Length	Value	Sequence	Checksum

- Sequence: Sequence number (any value from 0x00 to 0x7f)

  It starts from 0x00, increments by 1 for every transmission, and returns to 0x00 if it exceeds 0x7f.

- Sequence increments in Type 1 only in order to enable to check the continuity of waveform data in the receiving side, and sets it to a fixed value of 0 for all other types (Type 4, 5, etc.).

Checking the continuity of Sequence of Type 1 data (which is wave form data) at the receiving side enables to check if Type 1 data (wave form data) is missing.

Checksum

- Checksum enables to integrity check of received data.

1byte	1byte	length = variable	1byte	1byte
Type	Length	Value	Sequence	Checksum

- Checksum : Checksum value calculated by the algorithm in next page.
  Checksum is calculated only for Value.
  Not applicable for Type, Length and Sequence.

Algorithm of Checksum

```
//
//                Calculate xor for all elements of the data buffer

unsigned char calc_check_sum(unsigned char *frame_buf, int len)
{
        int i;
        unsigned char cs = 0xFF;
        for(i = 0; i < len; i++)
        {
                cs ^= frame_buf[i];
        }
        return cs;
}
```

Details of ‘Payload’

In this section, details of the contents encoded in ‘Type’, ‘Length’ and ‘Value’ of the Payload are described.

- Type = 1: waveform (Ch-I · Ch-Q) data (Length = 4bytes , every 2ms in ‘wave 500’, every 10ms ‘wave 100’)

- Type = 2 : Reserved
- Type = 3 : Reserved
- Type = 4 : Reserved

- Type = 5 : Signal mean value (Length = 2 bytes, every 100ms)

- Type = 6 : Reserved
- Type = 7 : Debug output (Length = variable length)
- Type = 8 : Reserved
- Type = 9 : Reserved
- Type = 10 : Reserved

- Type = 11 : Threshold detection alarm (Length = 2 bytes, every 1sec and changed point)

- Other than above: Reserved

Type = 1 : Waveform data

Type	Length	Value			
0x01	0x04	CH－I(U)	CH－I(L)	CH－Q(U)	CH－Q(L)

- Type = 1: Waveform data (Length = 4bytes)

  Type1 data packet contains I and Q two (2) channels of total four (4) bytes (Ch-I, Ch-Q each has two (2) bytes). .
  Data for one channel is represented by 16 bits (singed short), 0x0 is the center (0V in terms of voltage value), the maximum value is 0x7fff, and the minimum value is 0x8000.

  Every 16-bit data is sent in the order of the upper 8 bits (U) and the lower 8 bits (L).

  In default, Waveform data of Type = 1 are not transmitted (i.e. ‘wave off’).
  It can be switched by ‘wave’ command; wave output OFF (wave off) / 500Hz (wave 500) / 100Hz ‘wave 100’, see part 2.

Type = 5 : Signal mean value

Type	Length	Value	
0x05	0x02	mean（U）	mean（L）

- Type = 5 : Mean value in 0.1 sec of CH-I and Ch-Q signal (Length = 2 bytes)
  Mean value is caliculated by;
  ((mean value of Ch-I in 0.1sec) + (mean value of Ch-Q in 0.1sec))／2
  And this value is represented by 16 bits (signed short).

Type = 7: Debug information

Type	Length	Value
0x07	0x01 ～ 0x20	Debug string

- Type = 7: Debug information (character string) (Length = variable: 1 to 0x20)

  Debug information string shall be variable length. ‘Length’ of the Debug information sring is calculated by standard function of strlen(). The string is terminated by ¥r¥n.

  Characters are encoded in ASCII.

  The maximum length of the Debug string is 0x20 (32 characters), and the minimum length is 1.

  (NULL string shall not be sent.)

Type = 11: Threshold detection alarm

Type	Length	Value	
0x0B	0x02	Alarm U	Ararm L

- Type = 11: Threshold detection alarm

  1st byte: Alarm_U = (Alarm_ 0 << 4) + Alarm_ 1
  (total 8 bits = 1 byte)

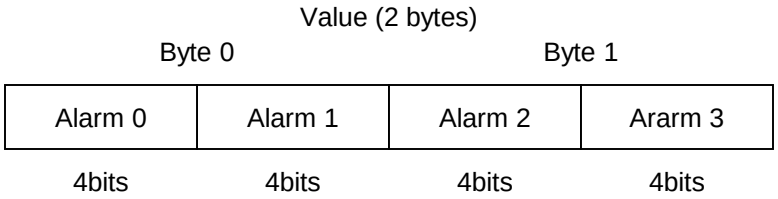
  Alarm 0, Alarm 1 (Alarm 2, Alarm 3 as well) are either 1 (detected) or 0 (not detected).

  For 1st byte of Value, Alarm 0 is stored as upper 4 bits and Alarm 1 is stored as lower 4 bits as Alarm U.

  0: Alarm OFF
  1: Alarm ON
  Other than above: reserved

  Similar to Alarm 2 and 3 stored in the second byte.

Type = 11: Threshold detection alarm (continued)



As shown in above figure, Alarm 0 to 3 of 4 items, 4 bits each of total 16bits (= 2bytes) are stored in ‘Value’ of Type 11 (Threshold detection alarm)

Each 4bits shows;

0: Alarm OFF

1: Alarm ON

Other than above: reserved

Type = 11: Threshold detection alarm (continued - 2)

In this section explains how Threshold detection alarm (0 to 3) works.

Threshold value is set by UART command th0 to th3 (see UART command th0 to th3 described later)

Command th0 corresponds to Alarm 0, threshold of Alarm 0 is specified by UART command th0, th1 corresponds Alarm1, threshold of Alarm 1 is specified by UART command th1 and so on.

For example of Alarm 0, UART command th0 tells threshold of 500 (e.g. th0 500 is issued), then, Alarm 0 become ‘ON’ when mean value of Ch-I and Ch-Q in 0.1 sec (which is sent by Type5) exceeds 500. (Alarm 1 to 3 as well)

Type11 is sent every 1sec and Type11 is also sent when status of Alarm 0 to Alarm 3 are changed.

Part 2: UART command (receive)

UART is also used to give commands such as changing conditions of this unit (so called UART command) to this unit.

The connection conditions of UART are as follows. (same as data transmission, Part 1)
communication speed ： 115200baud
Data length ： 8bit
parity： None
Stop bit： 1bit
Flow control： None

No sequence number and checksum are required for the UART command received by this unit

The UART command received by this unit shall be terminated by “CR” (= 0x0d i.e. ¥r)

ver ： firmware version

ver

Format

ver¥r

Function

Show firmware version.

Argument

None

wave：switch waveform display

wave 500

Format

wave 500¥r

Function

Switch waveform display output.

Argument

off	:	No waveform output (no Type1 output, default)
500	:	With waveform (Type1) output at 500Hz sampling (every 20 msec)
100	:	With waveform (Type1) output at 100Hz sampling (every 100msec)

(also see description of Type1 in Part 1)

th0 ~ th3 ： threshold 0 to 3

th1 6789

Format

th1 5000¥r

Function

Specify threshold of th0 to th3. (see Type11 for relation of th0 to 3 and Alarm)

Argument

0 ～ 32767 (Decimal number)

Other than above: Error

see ‘Action of alarm (Type11) in detail.

on0tm ~ on3tm ： alarm (Type11) 0 to 3 ON timer

on1tm 50

Format

on1tm 50¥r

Function

Specify ON timer of alarm 0 to 3 in 0.1 sec. (see Type11 for relation of ON timer, threshold and Alarm)

Argument

Decimal number, timer value becomes 1 sec if on?tm 10 is specified.

Other than above: Error

see ‘Action of alarm (Type11)’ in detail.

off0tm ~ off3tm ： alarm (Type11) 0 to 3 OFF timer

off1tm 50

Format

off1tm 50¥r

Function

Specify OFF timer of alarm 0 to 3 in 0.1 sec. (see Type11 for relation of OFF timer, threshold and Alarm)

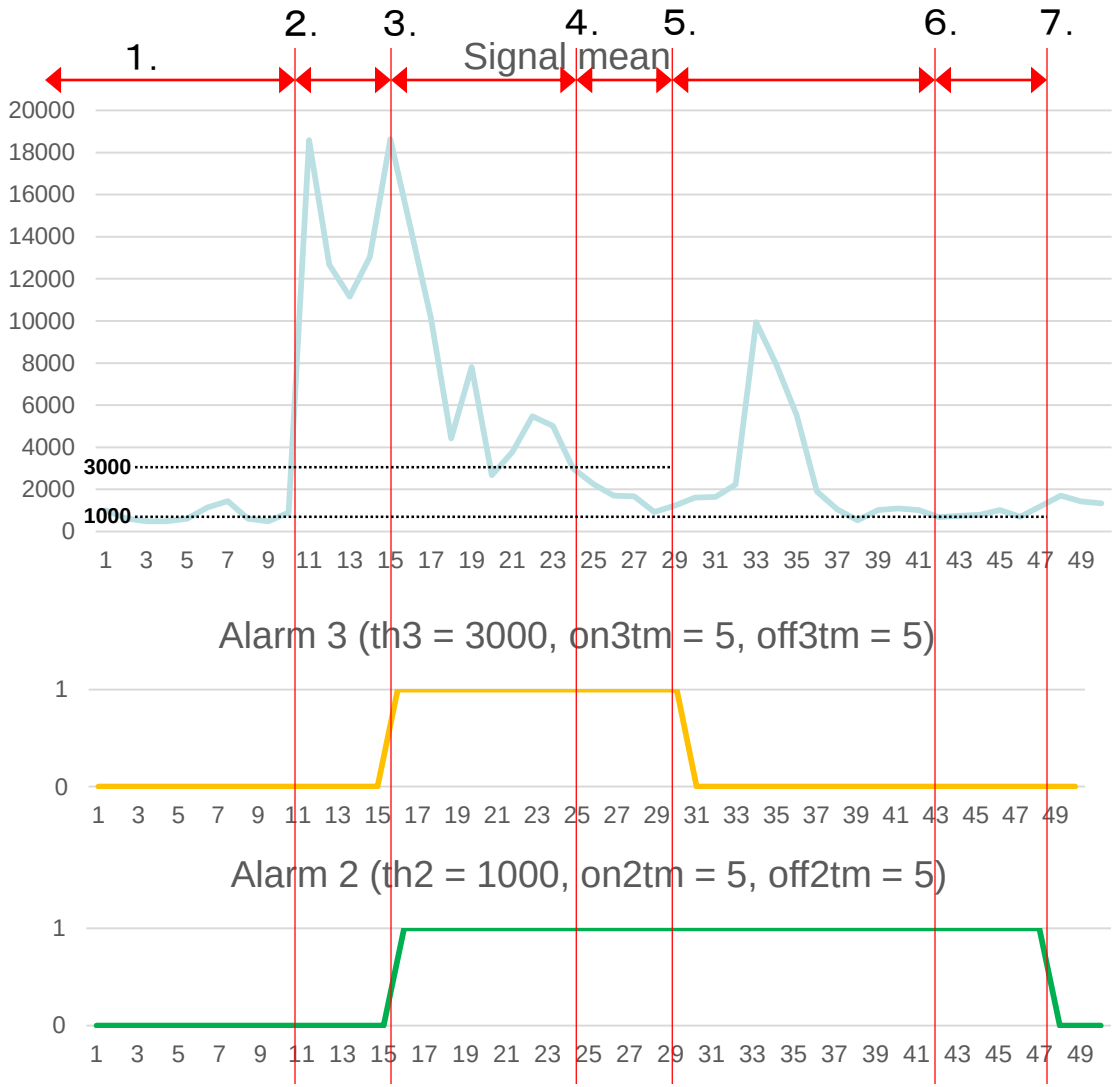
Argument

Decimal number, timer value becomes 1sec if tm?off 10 is specified.

Other than above: Error

see ‘Action of alarm (Type11)’ in detail.

Action of alarm (Type11)



（Time scale = 0.1 sec）

1. Signal mean < 1000
both Alarm 2 and 3 = inactive

2. Signal mean > 3000
both ON timer 2 and 3 starts count.
(Alarm 2 and 3 still inactive)

3. Signal mean > 3000 continue 0.5sec
both Alarm 2 and 3 become active

4. Signal mean < 3000 (> 1000)
OFF timer 3 starts count
(Alarm 3 keeps active)

5. Signal mean < 3000 continue 0.5sec
Alarm 3 become inactive

6. Signal mean < 1000
OFF timer 2 starts count
(Alarm 2 keeps active)

7. Signal mean < 1000 continue 0.5sec
Alarm 2 become inactive

Action of alarm (Type11) - 2

Detailed description of Threshold detection alarm (Type11) based on former page.

X-axis of the chart indicates ‘time’, its number represents 0.1sec. Top chart represents ‘Signal Mean’ (i.e. Type5), second chart represents ‘Alarm2’ and bottom chart representes ‘Alarm3’.

In this example, threshold of ‘Alarm3’ is 3000 (th3 3000), ON timer is 5 (on3tm 5) and OFF timer is 5 (off3tm 5) Threshold of ‘Alarm2’ (th2 1000), ON timer is 5 (on2tm 5) and OFF timer is 5 (off2tm 5).

1. From beginning to time 9 (i.e. 0.9sec), both ‘Alarm2’ and ‘Alarm3’ is ‘0’ (inactive) because ‘Signal Mean’ is less than 1000 in this period.

(Continue to next page)

Action of alarm (Type11) – 3

(continued from former page)

2. Time 10 (i.e. time = 1.0 sec), ON timer (both on2tm and on3tm) start count because ‘Signal Mean’ exceeds 3000 which is threshold of ‘Alarm3’ (th3 3000), but both ‘Alarm2’ and ‘Alarm3’ keeps ‘0’, their count don’t exceed ‘5’.

3. At time 15, both ‘Alarm2’ and ‘Alarm3’ become ‘1’ (active) because ‘Signal Mean’ keeps bigger than 3000 in time period 10 to 15 (i.e. 1.0 to 1.5 sec), ON timer exceeds their count value of ‘5’.

4. At time 25 (i.e. 2.5 sec), OFF timer (off3tm) starts count because ‘Signal Mean’ gets below 3000, but ‘Alarm3’ keeps active, because its count is set to ‘5’.

(continue to next page)

Action of alarm (Type11) – 4

(continued from former page)

5. At time 25 (i.e. 2.5 sec), OFF timer of ‘Alarm3’ stats count because ‘Signal Mean’ gets less than 3000. At time 30 (i.e. 3.0 sec), ‘Alarm3’ become ‘0’ (inactive) because ‘Signal Mean’ kept range of 1000 to 3000 in time period 25 to 30 (i.e. 2.5 to 3.0 sec),

6. ’Alarm2’ keeps ‘1’ (active) as ’Signal Mean’ keeps exceed 1000 in time period 30 to 42. ‘Alarm3’ doesn’t become ‘1’ (active) because ON timer (on3tm) doesn’t exceed count ‘5’ while ‘Signal Mean’ exceeds 3000 in time period 33 to 36.

7. ’Alarm2’ become ‘0’ (inactive) as OFF timer (off2tm) counts ‘5’ at time 47 because ‘Signal Mean’ keeps less than 1000 in time period 42 to 47.

送信データ一覧　Transmission data list

DATA　Type	Length	説明　Description	Frequency	PAGE
Type 1	4	信号波形データ（Ch－I・Ch－Q） Signal waveform data (Ch-I · Ch-Q)	2ms (wave 500) 10ms (wave 100)	P.11
Type 2	--	Reserved		--
Type 3	--	Reserved		--
Type 4	--	Reserved		--
Type 5	2	信号平均値 Signal mean value	100ms	P.12
Type 6	--	Reserved		--
Type 7	可変 Variable	デバグ出力 Debug output	--	P.13
Type 8	--	Reserved		--
Type 9	--	Reserved		--
Type 10	--	Reserved		--
Type 11	2	しきい値検出アラーム Threshold detection alarm	1sec	P.14

UARTコマンド一覧

Command	説明 Description	PAGE
ver	Show firmware version	P.18
wave	Select waveform output	P.19
th? (? = 0 to 3)	Threshold 0 to 3 of Type11 alarm	P.20
on?tm	Alarm (Type11) on timer	P.21
off?tm	Alarm (Type11) off timer	P.22

（付録）コンパレーター動作：Comp_Th、Comp_Out
（Appendix）Comparator ： Comp_Th、Comp_Out

Comp_Th 端子（AD入力）でしきい値を設定し、信号平均値（Type5出力値）と比較した結果を、Comp_Out へ出力する機能（コンパレーター機能）を有する。

This unit has ‘Comparator’ function that threshold is specified by input ‘Comp_Th and the threshold is compared to Signal mean value (described in Type5) and output ‘Comp_Out’.

この機能は、th0 ～ th3 で指定する Alarm 機能（Type11）とは独立している。

This function can be used individually with Alarm function of th0 to th3.

Comp_Th 端子で指定するしきい値は、0V ～ 3.3V を 0 ～ 32767 で評価し、信号平均値（Type5 出力値）と比較する。

Input voltage of 0V to 3.3V read from Comp_Th is encoded into 0 to 32767 and compared to Signal mean value (described in Type5).