Welcome

1 Introduction

In this document all necessary information for making your cable to BRYMEN BM869 (BM867). Information and software distributed "as is" author is not responsible for the consequences of use. Any actions you make are at your own risk. Provided program allows you to use a serial port (COM port) to get data from the multimeter Brymen BM869 (should work with BM867). To use software, you will need make cable (program does not work with standard BU86X cable) cable schematic is not regulated any designs are allowed. The only task of the cable, using a multimeter exchange protocol (description below) get 20 bytes of data and send them via serial port on the computer, further processing be performed by software.

2 cable construction

To receive data from the multimeter you will need a microcontroller, IR led and IR photodiode or IR phototransistor. Also you need to transfer data to a PC via serial port.

For data transmission through serial port it is convenient to use converter USB-UART, note the manufacturer and model are not important, the author used a pl2303 usb uart because it is cheap and it has power output 5V, only minus that it need installed drivers.

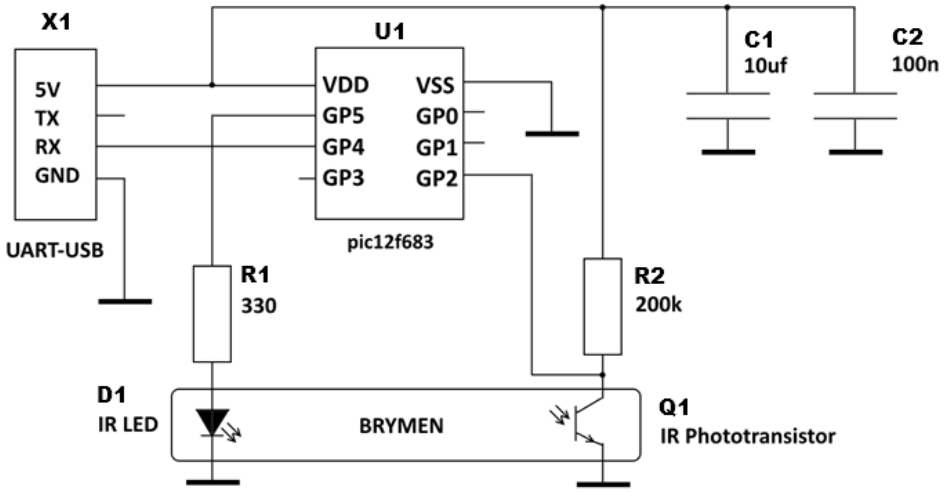
USB UART PL2303

Microcontroller for cable preferably take in SOIC8 package, this will make the device compact, built-in UART module optional, since transmission of data can be implemented by software (soft UART). It is recommended to use standard set of speeds and settings when you transfer data (9600; stop bit 1; parity none). The author use pic12f683 SOIC8 he has embedded quartz crystal resonator, and he is able to give current to 20mA that sufficiently to connect IR led directly to the microcontroller. Let me emphasize again, it makes no difference what the microcontroller to use.

To send commands to the multimeter you will need an IR led, if the selected microcontroller is able to give enough current, the IR led through a current limiting resistor is connected to the microcontroller, if current is not enough, you have to use the transistor.

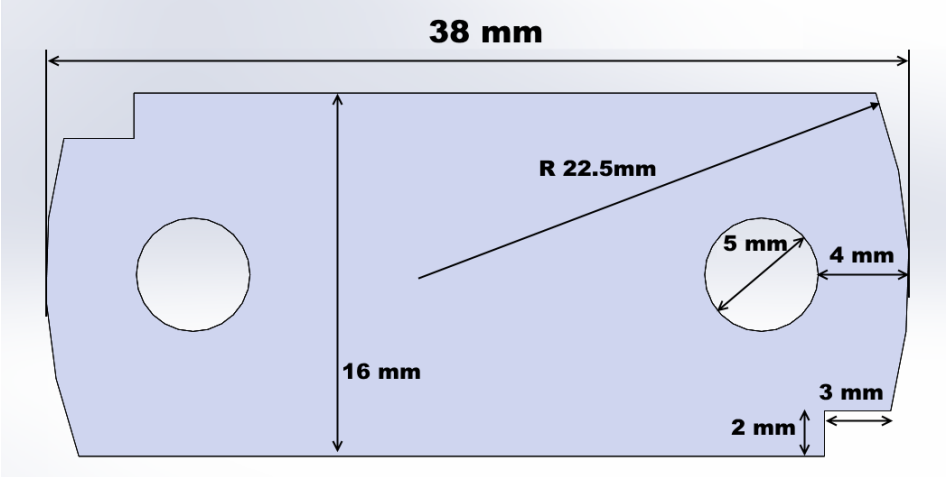
To get data from the multimeter you will need an IR photodiode or IR phototransistor. You can use different schemas, but you should take into account what the output signal will be received. In some embodiments, the resulting data array need to be inverted.

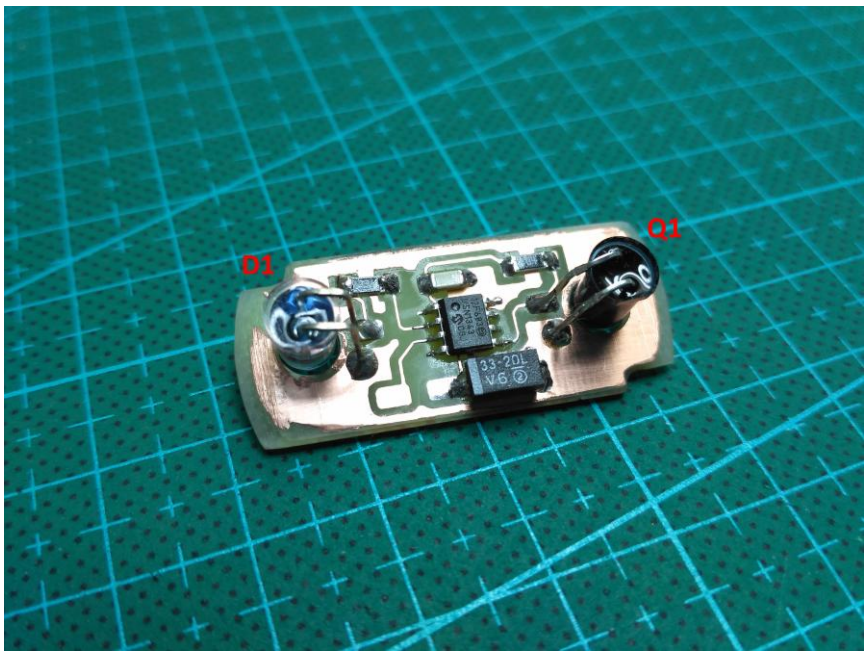
Below is a diagram of the cable used by the author.



X1-USB UART converter PL2303; U1-pic12f683 microcontroller; R1-current limiting resistor calculated on the basis of the nominal supply voltage, the voltage drop on the IR-led and the maximum current; Q1-IR phototransistor; Pull-up resistor R2 denomination under-elected under applied phototransistor Q1, the value of 200K is suitable in most cases; C1, C2 blocking capacitors, their values are not critical.

In the manufacture of boards, use cardboard for get exact sizes, approximate dimensions are listed below.





Ready device

Ready device with USB-UART converter

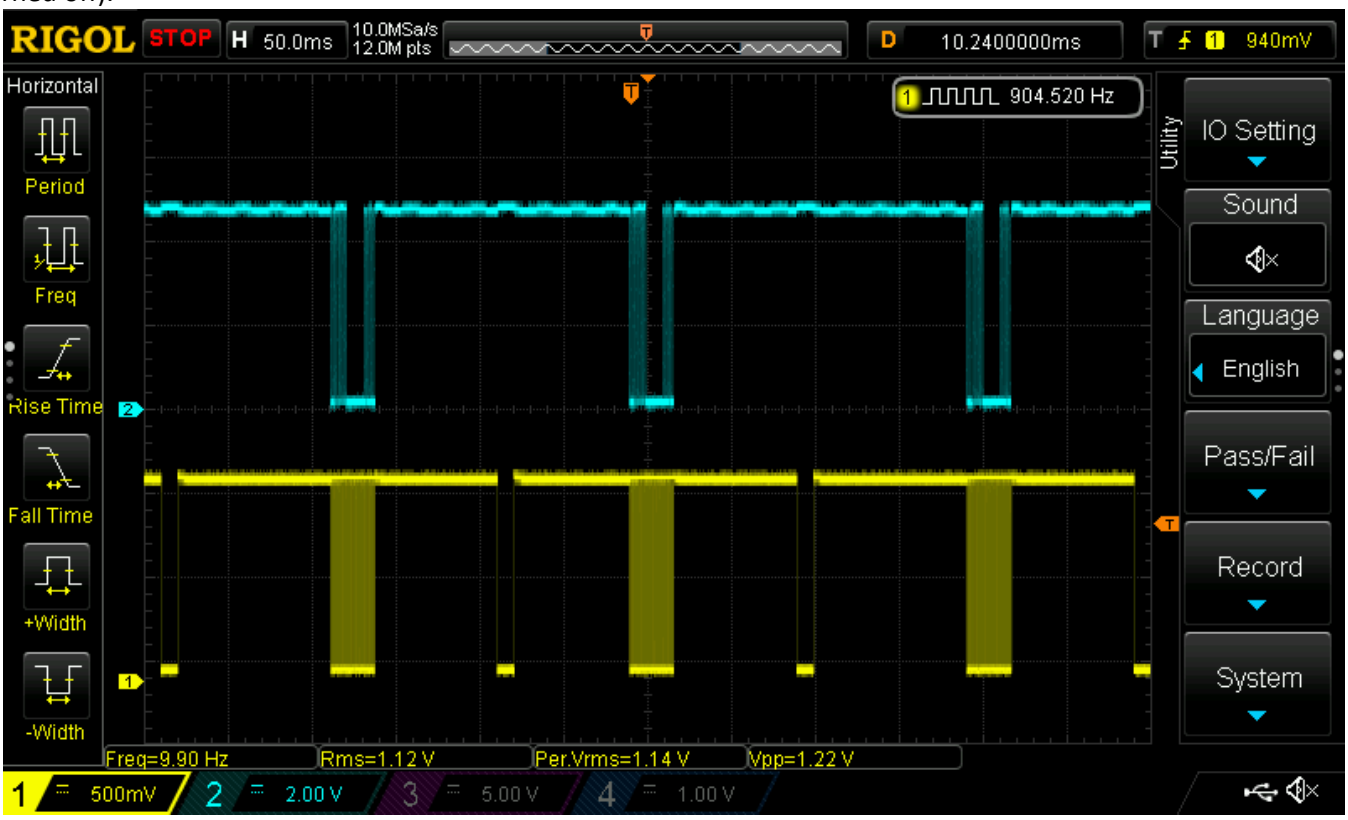
Comments

Applied scheme is powered by USB, a small number of elements allowed the entire device placed on a small board. The resulting signal is negated, however, this is only because plus communication protocol consists of inverted data where a logical unit level corresponds to no signal with multi meter.

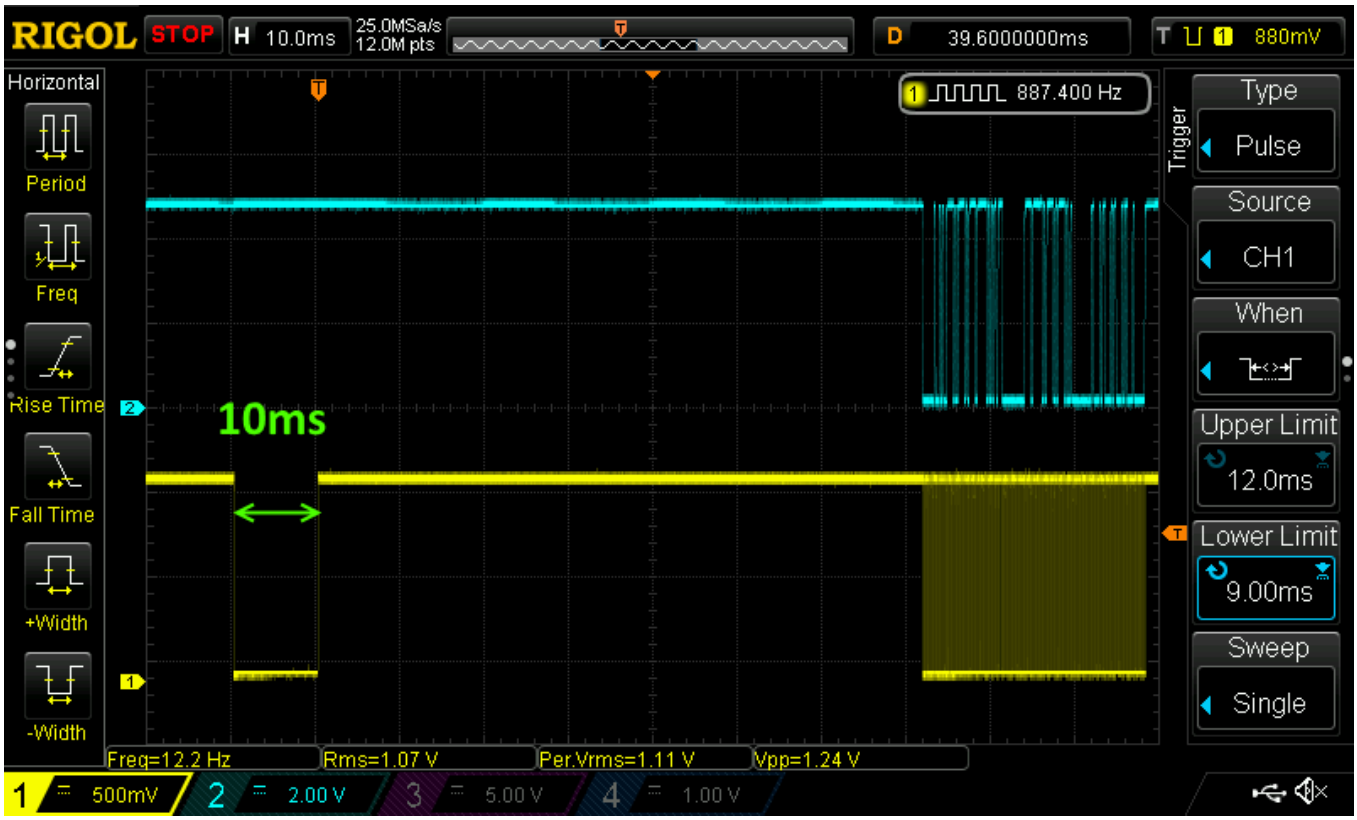
Description of the protocol and algorithm of the device below.

3 transmission protocol description

This section describes data transfer protocol between the cable and the multimeter. All waveform obtained from a device described in paragraph # 2. Yellow waveform is a signal from the transmitter device representation (with IR LED D1) 0V-logical zero (the led is off) 1.2V-logical 1 (led on). The blue waveform is a signal from phototransistor Q1 (microcontroller GP2 pin) 0V logical zero (transmitter of multimeter is on) 5V-logic 1 (transmitter of multimeter turned off).

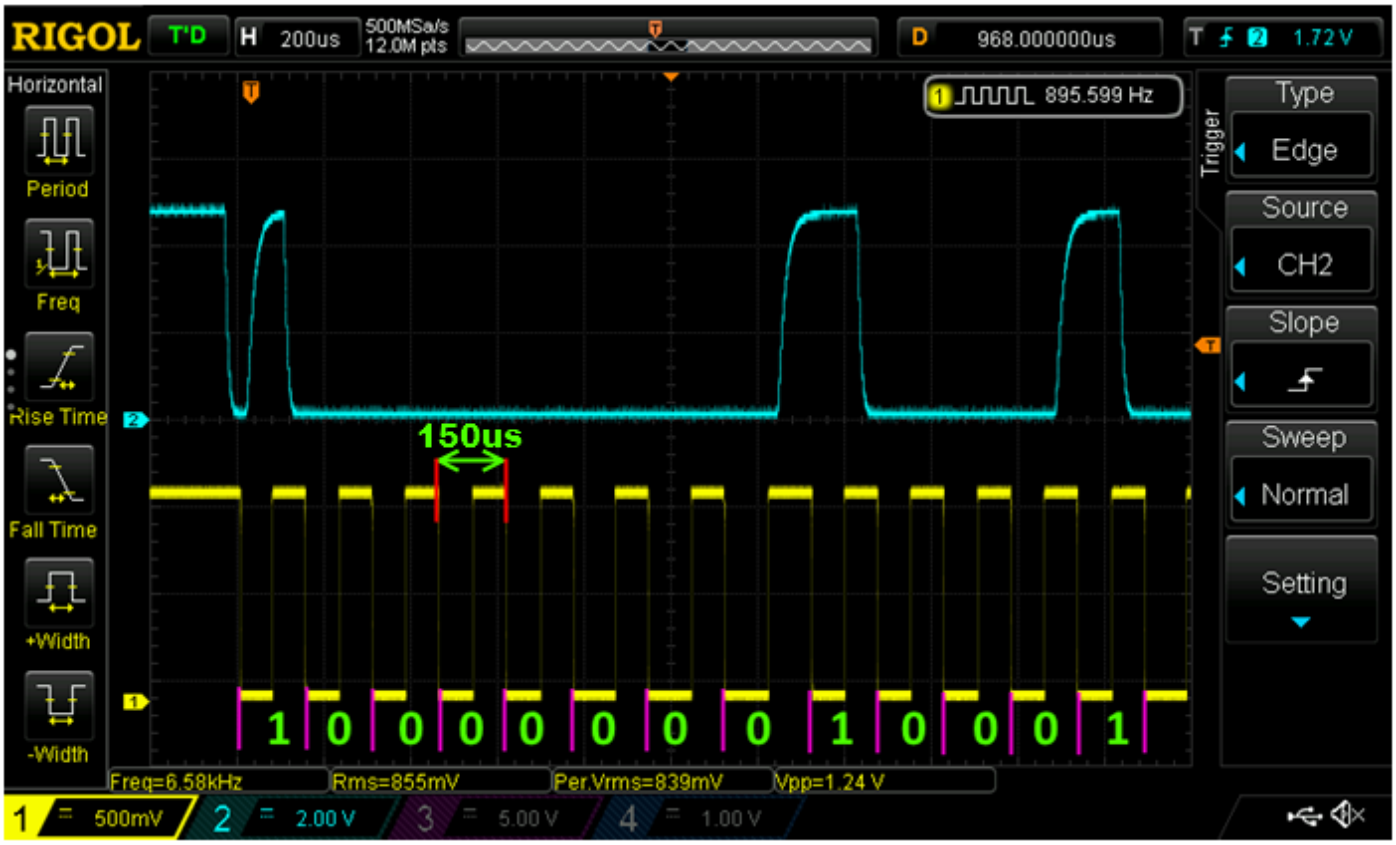


To get data from the multimeter you must kept on the infrared led.



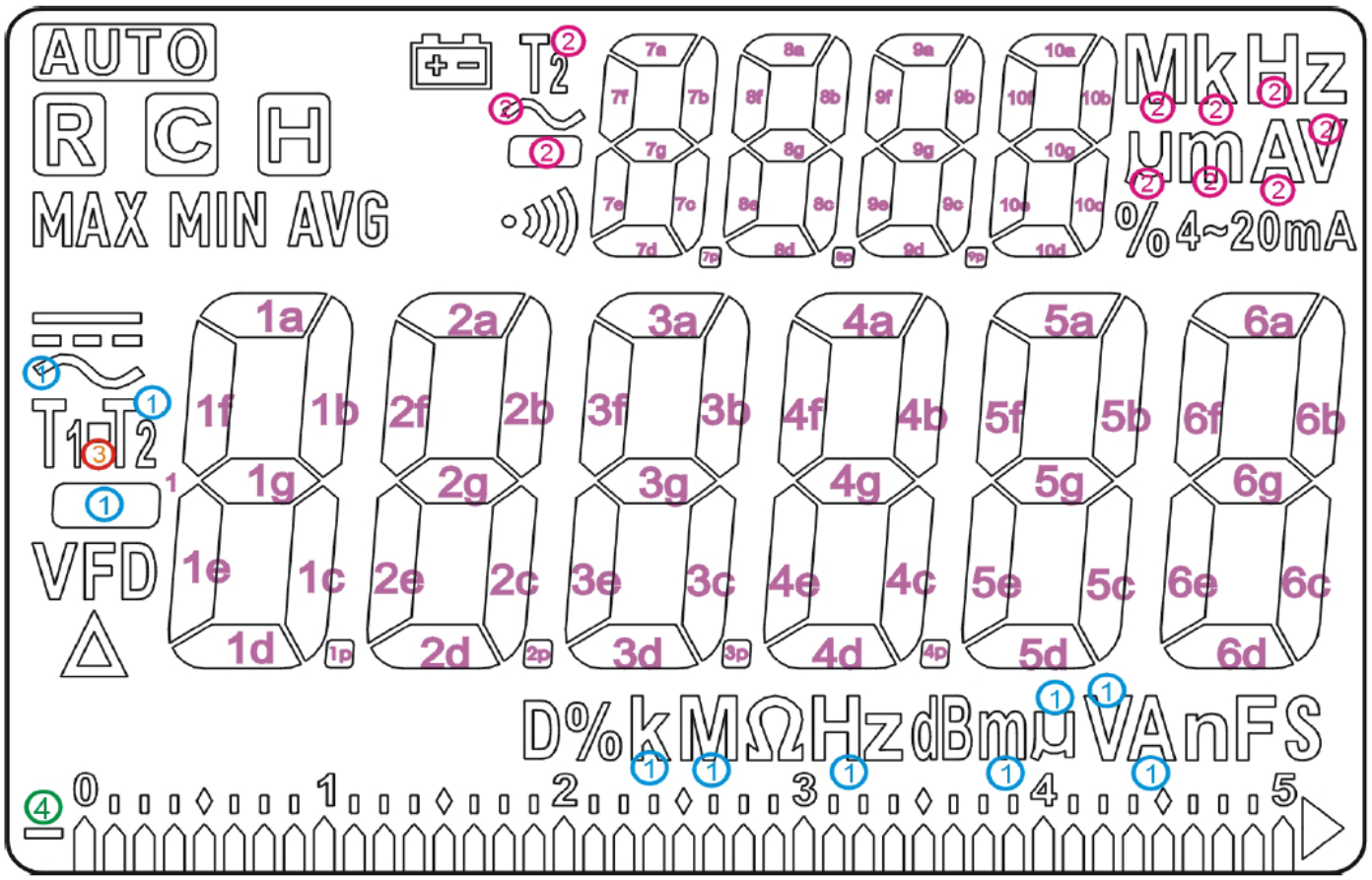
To start a transmission, you must initialize the transfer signal with duration of 10 ms (turn off IR led for 10ms then turn it on).

After initialization signal meter will begin to prepare data for transmission. Once the meter is ready for the transfer, it briefly change signal to logical zero (IR led of multimeter turning on), then you need to immediately begin receiving data. The time for a response from the multimeter varies, so after the initialization for the successful reception of data you should track a response from the multimeter. It happens that the multimeter is not responding, so is recommend add response timeout 250-300ms after which sync signal is repeated.



Data receiving is done by clocking led D1 you should submit 160 ticks with a period of 150us. At rising edge (before turning on LEDs D1) is necessary to read the data from the receiver (phototransistor Q1). No signal from the multimeter (IR led of the multimeter turned off) equivalent of logical 1, signal presence (IR led of the multimeter off) logical zero. On blue oscillogram is output signal from Q1 (microcontroller pin GP2), when IR led of the multimeter turned on the phototransistor pull the microcontroller pin to ground.)

After receiving all 160 data bits, you must wait for 20-50 MS and can start again.The obtained data describe the state of the display every bit equal to 1 corresponds to turned on segment on LCD display. Below are tables describing the display segments.



Byte No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
1	AVG	MIN	MAX	⎓	H	C	R	AUTO
2	▭ ①	VFD	▭ ④	bar scale	T2 ①	▭ ③	T1	~ ①
3	1b	1g	1c	1d	1a	1f	1e	△
4	2b	2g	2c	2d	2a	2f	2e	1p
5	3b	3g	3c	3d	3a	3f	3e	2p
6	4b	4g	4c	4d	4a	4f	4e	3p
7	5b	5g	5c	5d	5a	5f	5e	4p
8	6b	6g	6c	6d	6a	6f	6e	V ①
9	🔋	T2 ②	~ ②	▭ ②	%4~20mA	A ②	m ②	u ②
10	7b	7g	7c	7d	7a	7f	7e	)))
11	8b	8g	8c	8d	8a	8f	8e	7p
12	9b	9g	9c	9d	9a	9f	9e	8p
13	10b	10g	10c	10d	10a	10f	10e	9p
14	A ①	n	F	S	V ②	Hz ②	k ②	M ②
15	D%	k ①	M ①	Ω	u ①	m ①	dB	Hz ①
16	don't care							
17								
18								
19								
20								