ekg machines blog

Sanitas SBM30 (aka HL868BA) teardown

Source: Sanitas SBM30 (aka HL868BA) teardown **Tag:** abpm 50

The next step of my Ambulatory Blood Pressure Monitor (ABPM) project is to move from a wrist cuff monitor to an upper arm cuff which is far more practical for ABPM. My local Lidl store just had a Sanitas SBM30 upper arm cuff BP monitor on special offer. So I bought one. I was pleasantly surprised to find that it is almost identical to the HL168Y which my previous modification was based on. (Indeed the fine print on the box states that it is identical to the HL868BA).

As it is likely to be a few months before I can post an update on my ABPM project, I've provided some tear down photos and some technical information about this device in case anyone else would like to modify it.

Opening the device:

Before proceeding to open, be aware that this is likely to void your warranty. It may also comprise the reliable operation of the device. So if you require this for medical reasons I would advise you get a separate device for experimentation and clearly label which is which.

At the bottom of the device two screws need to be removed. The top and bottom parts of the case can then be separated. There are 6 plastics clips (is that the right word?) located at the left center and right of the top and bottom.

Once the top is removed, the rubber button contacts can be lifted off. Next remove screws at the top of the LCD holder. Carefully remove the LCD from the white holder. Be careful not to damage the LCD or the cable which attaches it to the PCB. This will expose two more screws under the LCD. Removing those screws allows the white LCD holder to be removed. Now the top of the PCB is exposed. Unfortunately the LCD is permanently connected to the PCB. It will not be easy to reconnect if it is detached for any reason.

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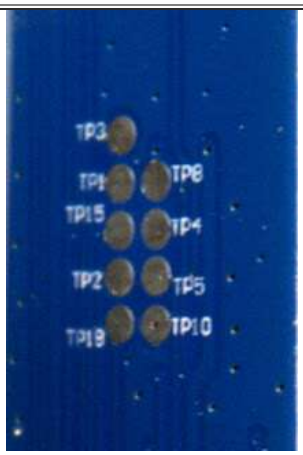
Test pads:

Unlike the HL168Y where the test pads are scattered around the PCB, the test pads on this device are conveniently brought together exposed through a slot in the battery compartment. The pitch is 2.54mm. In theory this should facilitate the construction of a cable to mate with these test pads. Any suggestions on how to accomplish this would be greatly appreciated. Please email jdesbonnet at gmail dot com if you have any suggestions.

Test pads TP8 and TP10 are for power and ground respectively, so any such cable can dispense with the need for batteries. Perhaps the connector can be attached to the battery compartment cover. TP 1 to 4 are directly connected to the front panel buttons. Pulling these low is the same thing as depressing a button. TP15 and TP18 can be used to snoop on read/write traffic to the EEPROM (see earlier posts on how to do this).

TP1	"Mode" button. Pull to 0V to activate.
TP2	"Set" button. Pull to 0V to activate.
TP3	"Memory" button. Pull to 0V to activate.
TP4	"Start" button. Pull to 0V to activate.
TP5	?
TP8	+5V / battery
TP10	0V
TP15	EEPROM I2C bus SCL
TP18	EEPROM I2C bus SDA

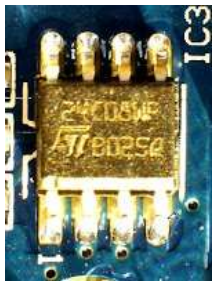


The MCU:

This is similar or identical to the MCU in the HL168Y. The chip marking first line reads 86CX23, the second line HLEEF7. It seems to be a custom chip made by the Health and Life Co (the "HL"). I have no doubt it's based on some standard core. But beyond that I have no clue what's going on inside... nor is it necessary to know for my application.

The EEPROM:

The device uses the EEPROM chip to store blood pressure records and a few configuration variables. This chip is a ST Microelectronics 24C08WP. This is the same 8 kbit (1 kbyte) chip used in the HL168Y. I didn't get a chance to verify if the memory map is the same as that documented for the HL168Y. I would be surprised if it differed. The data can be accessed by passively snooping on the bus SCL and SDA lines (TP15 and TP18). I've documented a way of doing this in this blog post.



The following is a description of the HL168Y (and presumably the HL868BA also) memory map:

Blood pressure records are 8 bytes long starting at address 0x0010 and are always 8 byte block aligned. First record is stored at 0x0010, next at 0x0018 etc.

byte 0	month 1 .. 12
byte 1	day of month 1 .. 31
byte 2 bit 7	Hour of day pm flag. am if clear.
byte 2 bits 3:0	12 hour clock time
byte 3	minutes 0 .. 59

byte 4 bits 7:4	the hundreds decimal digit of systolic BP in mmHg
byte 4 bits 3:0	the hundreds decimal digit of diastolic BP in mmHg
byte 5 bits 7:4	the tens decimal digit of systolic BP in mmHg
byte 5 bits 3:0	the least significant decimal digit of systolic BP in mmHg
byte 6 bits 7:4	the tens digit of diastolic BP
byte 6 bits 3:0	the least significant digit of diastolic BP in mmHg
byte 7	heart rate in bpm (beats per minute)

Locations 0x0000 to 0x000f are reserved for other things. I haven't figured out what they are all for yet.
Location 0x0007 is the number of BP records in memory.

The pneumatics:

The pneumatics comprises a pump, electrically activated release valve, a slow release valve and a pressure sensor (on the PCB). The configuration is identical to that of the HL168Y which I have documented here.

More tear down photos are here:
http://picasaweb.google.com/jdesbonnet/ABPMProject

If you have any questions or information to contribute, please do not hesitate to contact me by email: jdesbonnet at gmail dot com.