Purpose:

Quick technical description of the HC20 PCBA used in HC20 and HBBRIO RF handsets

Overview:

The PCBA is divided into the following sub circuits:

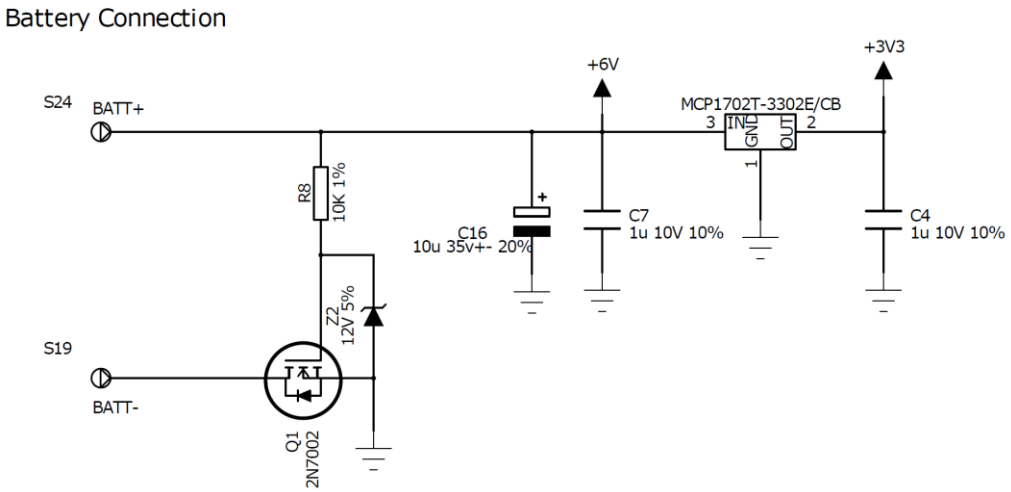
1) Battery connection
2) Micro controller
3) RF transmitter + antenna
4) Key-matrix
5) Programming interface
6) Backlight
7) LED

Ref:

- Circuit diagram for HC20 board – 10907483-C.
- Block Diagram

Sub circuit description

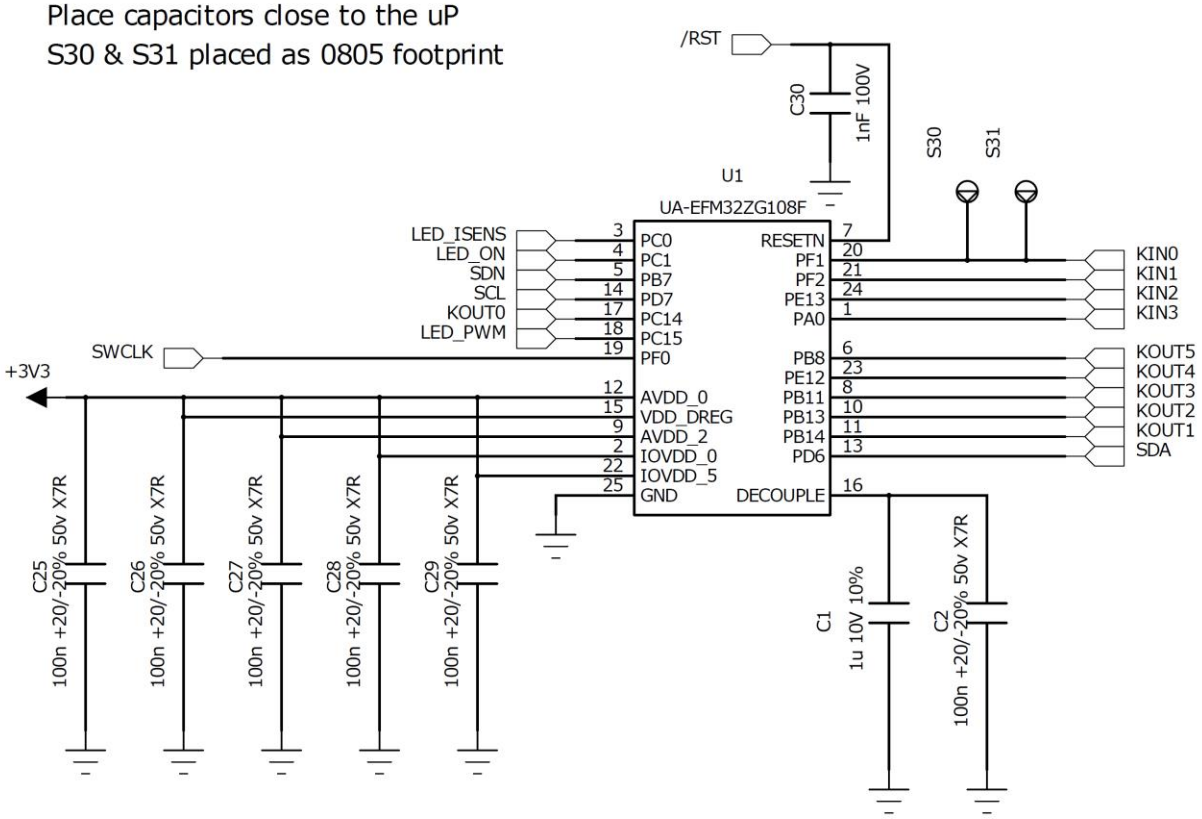
Battery connection



4 x AAA (LR03) batteries are connected in series to S24(+) and S19(-). Q1, Z2 and R8 work as a protection against wrong polarization.
The MCP1702T step down the input voltage to 3.3VDC. Caps are mainly for stabilization.

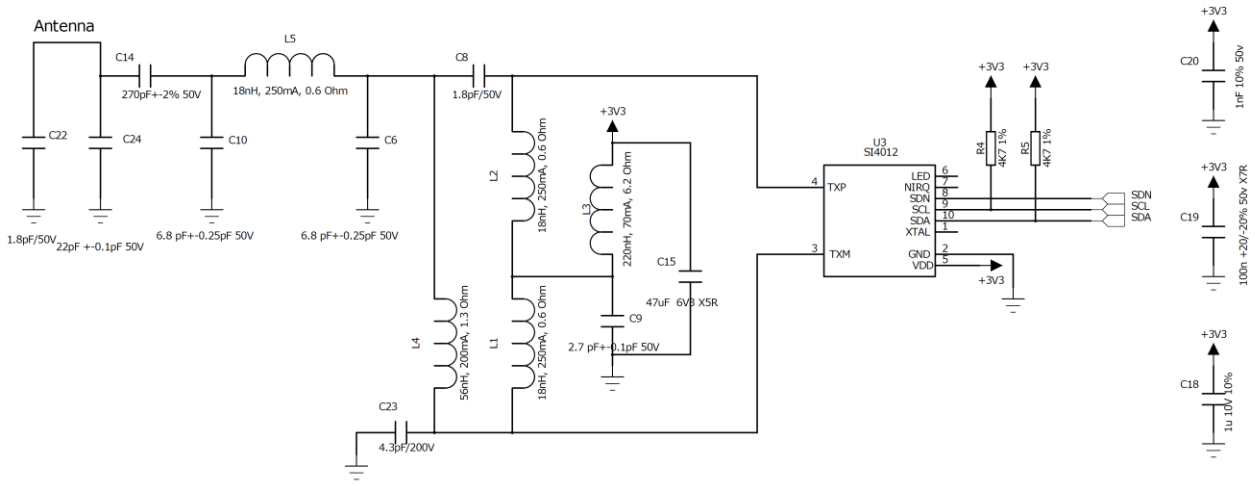
Micro controller

uC For layout!
Pins PC0 and PC1 can be swaped with each other.
Pins PC14 and PC15 can be swaped with each other.
Place capacitors close to the uP
S30 & S31 placed as 0805 footprint



The uC handles all key scan, Backlight and LED operation and of cause setup and data stream to the RF transmitter.
When the handset is not used, the microcontroller (uC) enters a low-power mode where all external clock frequencies are switched off. It wakes up and scans the key matrix to see if a button have been pressed and then power down again.
If a button is pressed down, the uC wakes up and start communicating with the RF transmitter on the I2C bus. It starts by initializing the transmitter and afterwards it start transmitting the actual data packages to the buffer of the RF transmitter.

RF transmitter+antenna

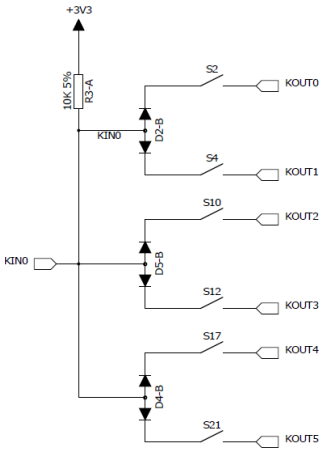


The RF transmitter is actually a SI4010 but preloaded with a specific supplier software and therefor named SI4012.

The modulation scheme is the simplest form of ASK modulation called OOK. The data bit rate is 4 kbit/s (each bit having a length of
250 us). The coding scheme is Manchester so each bit consist of a high period of 125 us and a low period of 125 us. Thus the signal will always have a duty cycle of 50% (constant DC component) regardless of the data content. Data is transmitted in packets. For a more detailed description of the coding and data scheme refer to the “RF-protocol description”.

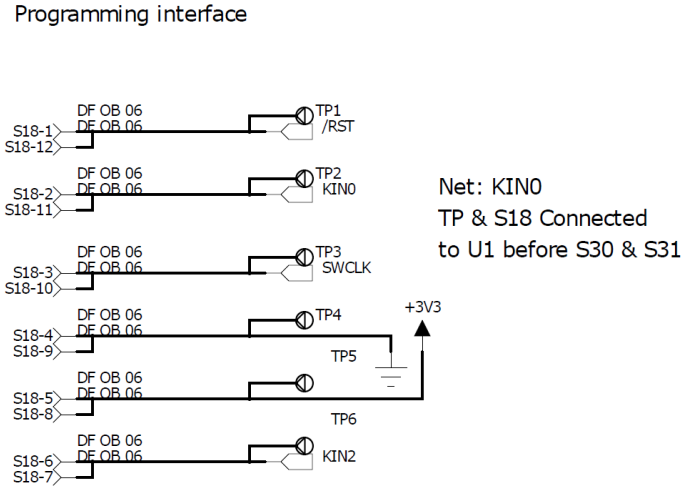
When a button is pressed and the micro controller wakes up from sleep state it starts setting up the RF transmitter. First it send the setup package telling the transmitter the transmitting frequency (433.92MHz), transmit power, modulation type, to use internal oscillator, how the impedance network on the output is configured ect. Second it send a “clear FIFO” command to clear the internal transmit buffer.
When the setup is complete, the microcontroller send the actual data package according to the RF-protocol.

Key-matrix

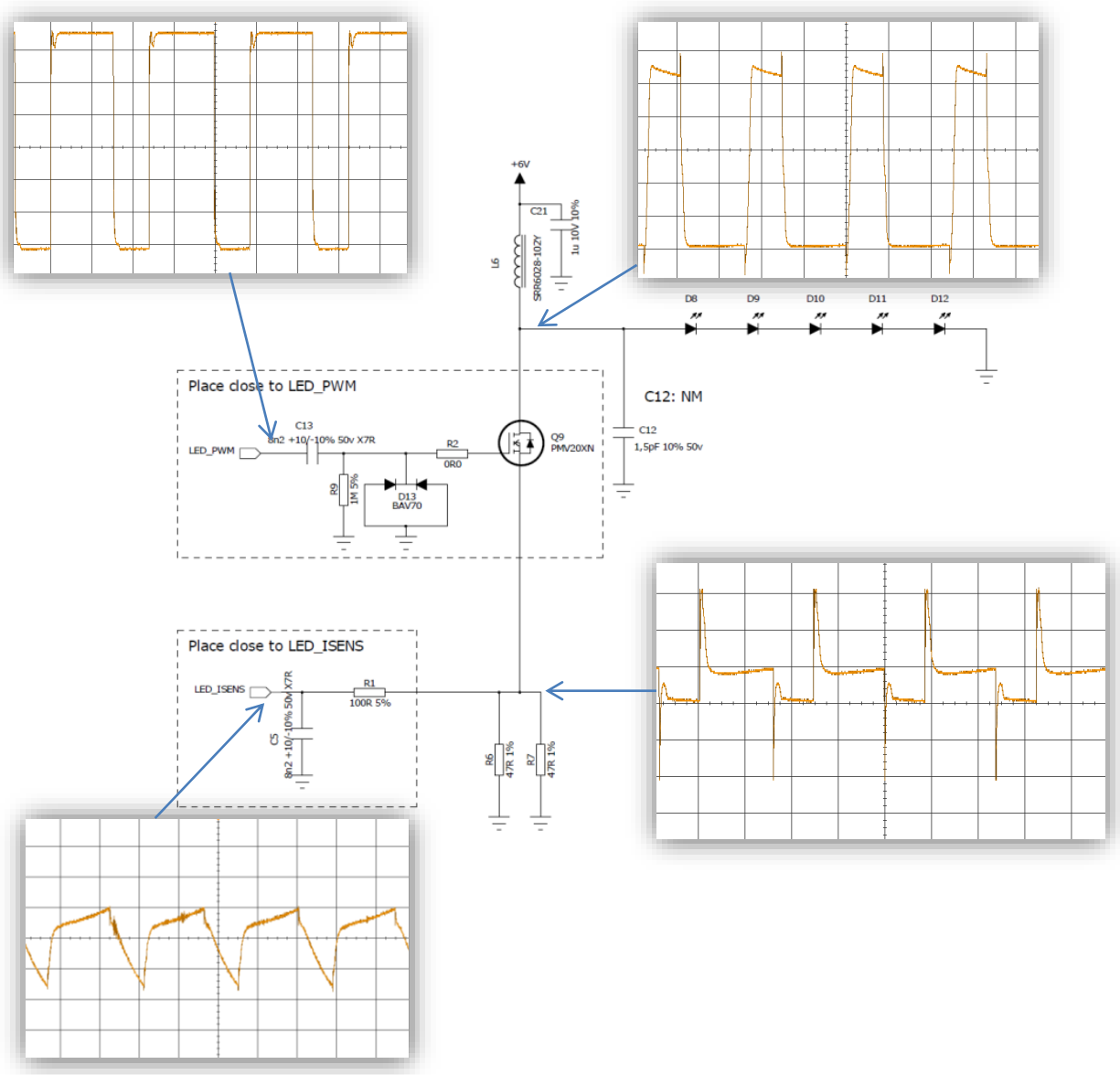


The key-matrix (example above) detects if a key is pressed. The uC has KOUTx set to 0. In turn it threstates KINx and listen. KINx is per default “HIGH” (above 0.7xVcc). If KINx is detected as being less than 0.3xVcc it measures KOUTx and thus detects which key is pressed. This information tells the software which data package to transmit.

Programming interface



Backlight

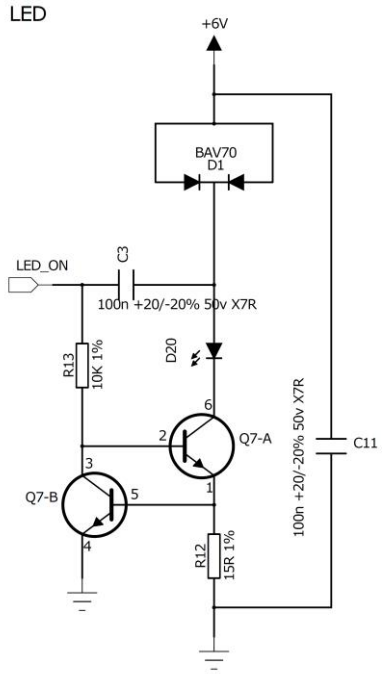


The backlight is controlled by the microcontroller (uC). When the backlight is turned off the LED_PWM is high and because of the capacitor C13 the gate on Q9 will be pulled down by R9. A voltage of 6V will be on the diodes. This is not enough to make the diodes light up and only a small current will run through them.

When the backlight is turned on the uC will put out a variable PWM frequency based on the feedback LED_SENSE. When LED_PWM goes LOW it will turn off Q9. This will enable the inductor L6 to build up a charge across the LEDs. The PWM will stay low for a predefined timeslot that is adapted to the green diodes. Doing this timeslot the voltage on the diodes is high enough to turn them ON and the current is approximately 20mA.
Once the LOW timeslot is over the LED_PWM will go high. This will turn on Q9 and discharge the inductor through R6 and R7. This discharge current is measured through LED_SENSE and compared to a predefined level inside the uC. When the level is reached, the LED_PWN will go LOW and the diodes will light up again.

The LED_PWM frequency is maximum 400KHz and can be as low as 40kHz.

LED



The circuitry for the torch/transmit indicatior LED is a constant current generator. It is controlled by the u-controller that generates a 100kHz PWM signal with 50% duty-cycle. The LED is turned on ether when the handset is transmitting (HBBRIO) or when a specific button is pressed (HC20).
C3 boost the voltage for the diode to approximately 8.2VDC. The current, and thereby the light intensity, is defined by Vbe on Q7-b and R12.