Alfa Laval Agri	Technical description Activity meter	906508 No. of sheets 20 · Sheet No. 1 Version Reg. No.

Technical description, Activity meter

Dept.	Issued, date	Sign.	Checked	Approved by

1. Purpose

The purpose of this document is that it will be used when:
- writing instructions and market information
- doing application adjustments
- manufacturing
- testing and controlling
- doing installation
- doing service
- designing similar products

2. General information

The Activity meter is an electronic device for finding the activity of cows. It is meant to help the dairy worker to decide if and when a cow is in heat. The device is battery driven (10 years lifetime) and also consists of a magnetic sensor, a micro controller, a radio frequency transmitter and a reed relay.

2.1 Board layout

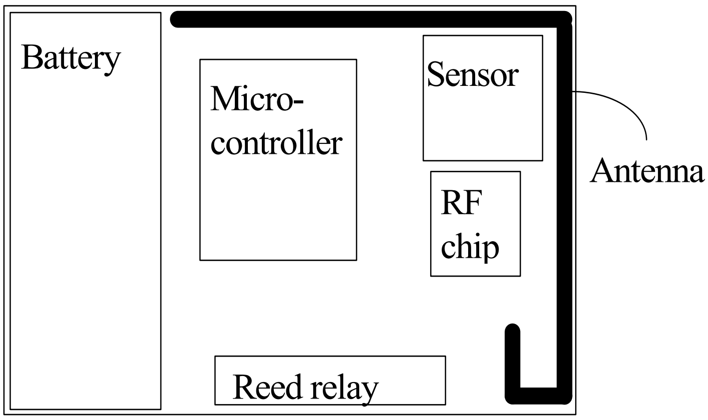

Figure 1 The board is 2 layer, components on one side and the size 49 x 60 mm.

2.2 Features

- Power from a lithium battery, 10 years lifetime without changing battery
- Electromagnetic sensor, sensitive in all directions (3-dimensions)
- Micro controller (HD404364) that can be in four different power consuming modes and use two different system oscillators
- Reed relay for control of On or Off from outside the box
- Radio frequency transmitter that takes little current and works on 3 volt
- Unique Identity on each circuit board
- No mercury and the battery consists of lithium, i.e., good choice for the environment.

3. Abbreviations and definitions

3.1 Abbreviations

AMP	Amplifier
CPU	Central Processing Unit
CRC	Cyclic Redundancy Code
EMC	Electromagnetic Compatibility
ETSI	European Telecommunications Standards Institute
HW-filter	Hardware filter
ID	Identity - A unique number (0 - 65535) for each Activity meter
I/O	Input/Output
LSB	Least Significant Bit
LP-filter	Low Pass filter
MSB	Most Significant Bit
RAM	Random Access Memory
RF	Radio Frequency
ROM	Read Only Memory
SW-filter	Software filter

3.2 Used definitions of data format

Data format	Size
byte	8 bit
NIB	4 bit

4. Functional description

The Activity meter can be separated into six different blocks, see Figure 2. One block, Sensor_Module, that outputs an interrupt signal when the signal from the sensor reaches a pre-defined amplitude. One block, RF_module, that controls the transmission of activity data through RF. One block consists of, and controls, the ID of the Activity meter, ID_Module. The fourth block, Switch, helps to decide if the Activity meter should be On or Off and the fifth block is the battery, which gives the necessary power to the Activity meter. The Main block is the micro controller, it controls everything and is the brain of the activity meter.

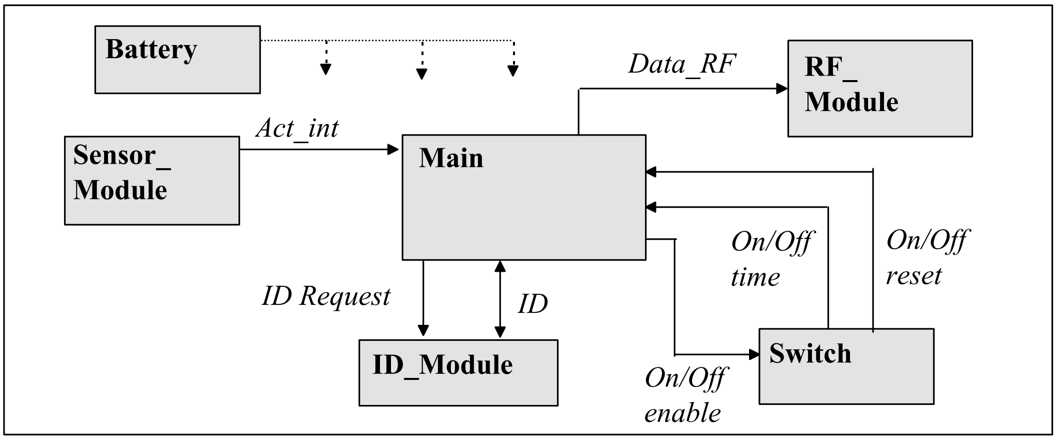

Figure 2 Block diagram of the Activity meter

4.1 Sensor_Module

Figure 3 shows how the sensor module looks like. When the electromagnetic sensor moves it will output a signal. Higher force on the sensor gives higher amplitude of the output signal. This signal then goes through a low-pass filter, to take away unwanted signals that are generated by the coil. The signal then is amplified nearly two times. The amplified signal goes to a comparator where it is compared to a reference signal, Vref. If the signal is higher then the reference signal the output from the comparator, Act_int, goes low otherwise it stays high. The Act_int signal then goes to the microprocessor, as an interrupt input.

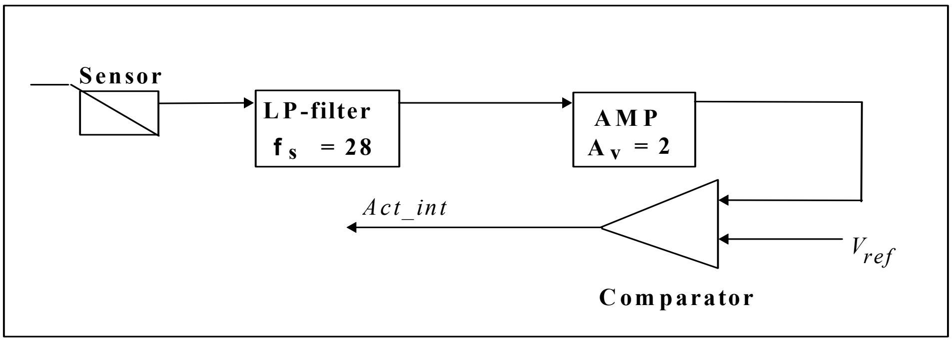

Figure 3 Sensor_Module

4.2 Main (micro controller)

Figure 4 shows the block diagram of the micro controller and the signals to and from the micro controller. *For a description of how the software in the micro controller is built up, see document* XXXXXXX. The micro controller uses two different frequency references, a 4 MHz resonator and a 32 kHz oscillator. When using the 4 MHz resonator the instruction cycle time is 1 μs and when using the 32 kHz oscillator it is 122,07 μs. The faster instruction time is used when sending data through RF. The wake up timer is always running, even when everything else is shut off to save current. This timer wakes up the micro controller with a interval of two seconds by giving an interrupt signal to the interrupt control unit. Also the Act_int signal from the sensor module, see 4.1, can wake up the Micro controller if this interrupt is allowed.

The micro controller is re-seted by the On/Off reset signal, see 4.4 for a description of how the On/Off reset and On/Off time signals is controlled by the switch block.

After a reset the micro controller gets the ID number from the ID_module, see 4.3, and puts it in the RAM. The RAM also consists the registers that controls the micro controller and the data which are being stored.

The ROM consists the program and the I/O control unit controls the input and output of signals to and from the micro controller.

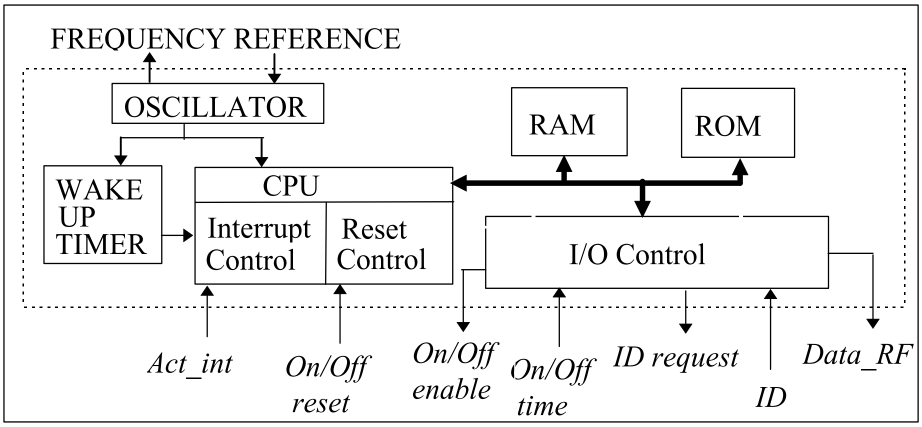

Figure 4 Internal block diagram of micro controller with external signals

The function of the micro controller is described in Figure 5 below. It mostly is in state A. In this state the micro controller is idle, just waiting for an interrupt. There are two kinds of interrupt that can wake up the micro controller, either an interrupt from the sensor module, act_int in Figure 3, or an interrupt from the wake up timer. The wake up timer gives an interrupt once every two seconds. Each hour is divided into 256 “time-slices”, each is 14 seconds long. The micro controller only accepts one interrupt from the sensor module in one time-slice. If there is an interrupt from the sensor module, act_int is active, and it is the first interrupt in this time-slice the micro controller will go to state B.

When the micro controller is in state B we say that an “activity pulse” has occurred, i.e., the activity meter has moved enough for the signal from the sensor to be higher than the reference signal, see Figure 3. In state B the micro controller increments a counter, which is used to count these activity pulses. Figure 6 shows how the incrimination of the counter works. The curve is the filtered and amplified output signal from the electromagnetic sensor. If this signal is higher than the reference voltage, V_{ref}, at least one time within a time-slice, 14 seconds, the counter is incremented.

After the counter has been incremented the micro controller do not allow any more interrupts from the sensor module within this time-slice and then goes back to state A.

When the micro controller is in state A and an interrupt from the wake up timer occurs the micro controller goes to state C.
In state C the time is checked. The time is controlled by a counter, which is incremented every time the micro controller is in state C. Three different things can happen when the micro controller is in state C:

1. We have not reach the end of a time-slice (14 seconds) - means that the micro controller just goes back to state A after the time counter has been incremented.
2. We have reach the end of a time-slice, but less than an hour has elapsed since last time the micro controller was in state D - means that the micro controller allows interrupts from the sensor module before it increments the time counter and goes back to state A.
3. We have reach the end of a time-slice and an hour has elapsed since last time the micro controller was in state D - means that the micro controller goes to state D.

This means that the micro controller will be in state D once per hour. In state D the value in the counter, which is incremented each time we get an activity pulse, will be stored in a register. There are 24 of these registers, which means that the activity meter will be storing the activity data for each hour for the last 24 hours. There is a pointer that points at the register into which the counter value for the last hour will be stored. The old value in this register will be overwritten by the counter value. After the counter value has been stored in the register the counter is reset to zero and the pointer is set to point at the next register, i.e., the register into which the counter value will be stored after the next hour has elapsed. If the pointer points at register 24 before the counter value has been stored it will point at register 1 afterwards. See Figure 7 for a visual explanation of what happens.
After the counter value has been stored in the right register and before the micro controller goes back to state A there will be a transmission of data through RF. See 4.5 for a description of what will be transmitted and how the transmission works.
The time between two transmissions is a bit dependant of the least significant NIB of the CRC - code, which was generated during the last transmission. The reason for this is that if two activity meters are transmitting at the same time it is a very small possibility that they will do so the next hour (next transmission) to. Below it is shown how the time between two transmission depend of the CRC - code.

Least significant NIB of CRC	Time between transmissions
0000	1 hour
0001	1 hour - 2 seconds
0010	1 hour - 4 seconds
0011	1 hour - 6 seconds
0100	1 hour - 8 seconds
0101	1 hour - 10 seconds
0110	1 hour - 12 seconds
0111	1 hour - 14 seconds
1000	1 hour + 16 seconds
1001	1 hour + 14 seconds
1010	1 hour + 12 seconds
1011	1 hour + 10 seconds
1100	1 hour + 8 seconds
1101	1 hour + 6 seconds
1110	1 hour + 4 seconds
1111	1 hour + 2 seconds

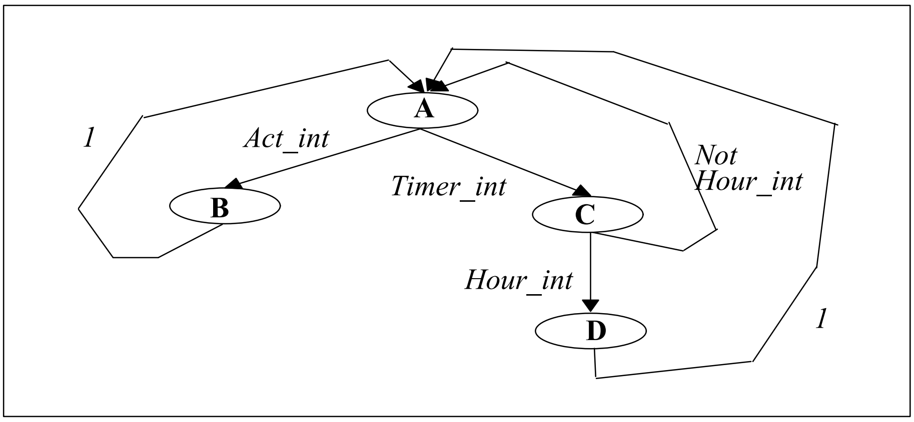

Figure 5 State machine to describe the software in the microcontroller

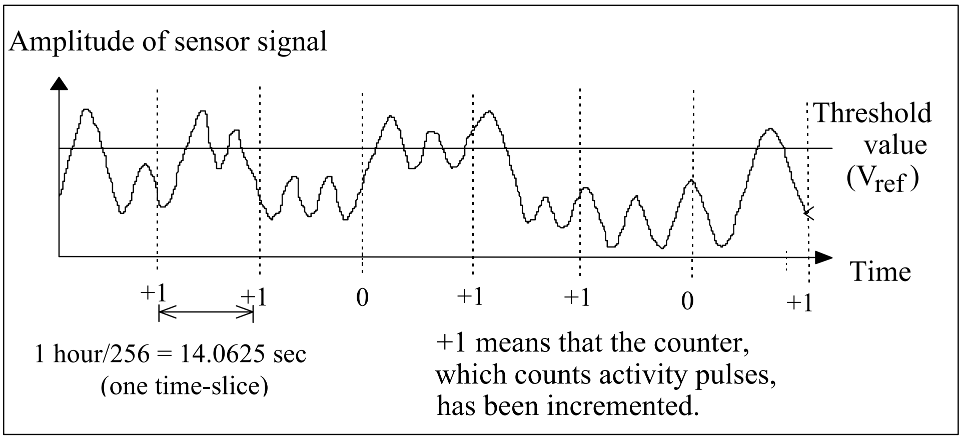

Figure 6 Activity pulse counting in state B

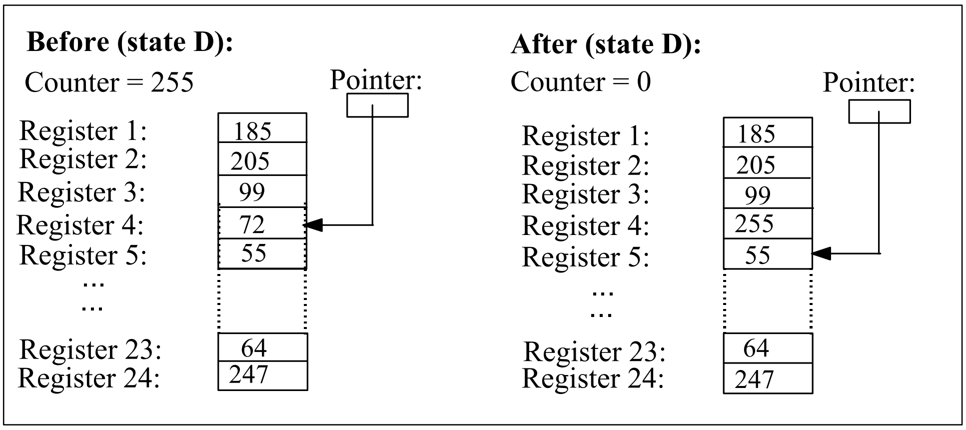

Figure 7 Storing of counter value after one hour has elapsed (in state D)

4.3 ID Module

The ID module mainly consists of ROM chip and some components around it to make sure that the current consumption is as low as possible. The ROM chip is accessed from the micro controller via a single data line, signal *ID* in Figure 2. The signal *ID Request* in Figure 2 sees to it that the ROM chip do not take current when it is not accessed. This signal has to be high when the ROM chip is accessed and low when it is not.

For a description of how the communication between the micro controller and the ROM chip works see the description of the ROM chip, article number 906373 - 01.

The ROM chip consists of a factory-lasered 64-bit ROM that includes a unique 48-bit serial number, an 8-bit CRC, and an 8-bit Family Code (01h), see Figure 8. All of the 64 bits are read by the micro controller, and saved in the RAM, whenever the activity meter switches to On or Off state. The micro controller starts by reading the Family code (LSB first), which always is 01h, then the 48-bit serial number (LSB first) and finally the CRC code (LSB first).

During the reading the micro controller generates a CRC value from the data as it is received. This generated value is compared to the 8-bit CRC code stored in the last eight bits of the ROM chip. If the two CRC values match, the transmission is error-free.

The equivalent polynomial function of this CRC is:

$$CRC = x^8 + x^5 + x^4 + 1$$

The 24 least significant bits (3 bytes) of the 48-bit serial number is used as the ID for the activity meter.

8-bit CRC Code	48-Bit Serial Number	8-Bit Family Code (01h)
MSB LSB	MSB LSB	MSB LSB

Figure 8 Memory map of the ROM chip

4.4 Switch

Figure 9 below shows how the switch looks like. It consists of a reed relay and a hardware filter. When there is a magnet close enough to the reed relay it will close, i.e., this part of the activity meter is controlled externally. The signal from the reed relay is separated into two data lines before it reaches the micro controller.

One of the signals, *On/Off reset*, first goes through a hardware filter and then goes to the reset input of the micro controller. The hardware filter makes sure that signals from the reed relay that are shorter than approximately 10 ms (blows and similar) do not go through to the micro controller reset input. The hardware filter also see to it that the *On/Off reset* signal is active for a period of approximately 50 ms. The reason for this is that the micro controller have do go on from its reset state to be able to decide if the activity meter will be in On or Off state after the reset. How this is decided is described below.

The other signal from the reed relay, *On/Off time*, goes directly to the micro controller. In the micro controller it is measured for how long this signal is active, i.e., for how long the external magnet is close enough to close the reed relay.

What happens when a magnet closes the reed relay is:

1. The micro controller is re-seted by the *On/Off reset* signal
2. The *On/Off reset* signal is inactivated by the hardware filter, which means that the micro controller will exit its reset state
3. After a reset the micro controller measures for how long the *On/Off time* signal is active, to decide whether the activity meter will be in On or Off state.

If the *On/Off time* signal is active, i.e., the magnet is close to the reed relay, for:

- less than approximately 1.5 seconds (quick stroke with the magnet) the activity meter goes to On state
- more than approximately 1.5 seconds (slow stroke with the magnet) the activity meter goes to Off state

If the *On/Off time* signal is active for the time it requires for the activity meter to go to Off state the *On/Off enable* signal will be low for 5 seconds. When the *On/Off enable* signal is low the micro controller can not be re-seted, i.e., the activity meter is not affected by closing of reed relay.

The reason for this is so that the activity meter won't go directly from Off mode to On mode because the reed relay is closed for a short time, after it is opened, when the magnet is removed.

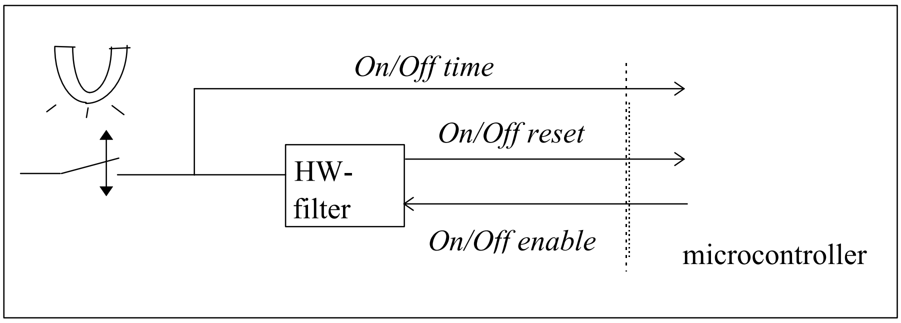

Figure 9 Switch

Directly after the activity meter has gone to On or Off mode it will send a message through RF to confirm which mode it has been put in. The activity meter uses the two most significant bits of the pointer, that points at next register to store activity data in, for this. Figure 10 shows how these bits are used for showing change of mode. If the two bits are zero the message are a normal one, i.e., one of the hourly transmission that take place when the activity meter is On. If the most significant bit is one and the other is zero it tells that the activity meter has been put in Off mode, i.e., the activity meter will go to sleep, there will be no activity measuring or RF transmissions. If the most significant bit is zero and the other is one it tells that the activity meter has been put in On mode, i.e., the activity meter will start to work normally and there will be RF transmissions every hour.

If the magnet is close to the reed relay for 9.5 seconds or more the Activity meter will go to Off Prod mode. This means that the Activity meter will be locked for 15 minutes and then go to Off mode. This is only supposed to be used in production.

MSB LSB	
00xx xxxx	Normal
10xx xxxx	Off mode
01xx xxxx	On mode
11xx xxxx	Off Prod mode

x = don´t care

Figure 10 Using the pointer to tell that the activity meter is in On or Off mode.

4.4.1 HW-filter

Figure 11 shows how the hardware filter in the switch has been implemented.
When the *On/Off enable* signal is low nothing happens when the reed relay, S1, is closed.
When *On/Off enable* is high impedance and the reed relay is closed X1 immediately goes high (V_{CC}*R16/(R16+R18)≈ V_{CC}). X1 will then go from high to low because the condesator C10 is discharged through R15. While X1 is high enough to open the transistor V2 the condensator C9 will discharge through R11. When X1 has fallen to the level where V2 closes C9 will start to charge through R14 and R11.
This means that the time *On/Off reset* will be low is decided by the time it takes for C10 to discharge through R15.
The high to low transition time for X2 (On/Off reset) is decided by the time it takes for C9 to discharge through R11 and the low to high transition time is decided by the time it takes for C9 to charge through R14 and R11.
If the reed relay is closed for a very short while X1 goes directly low (in reality below ground). This means that V2 closes and C9 starts to charge. If X2 has been low (0.2 * V_{CC}) for a shorter period than 0.5 ms the micro controller won’t be re-seted.
As seen in the figure the *On/Off time* signal will be low all the time the reed relay is closed because V3 is open.

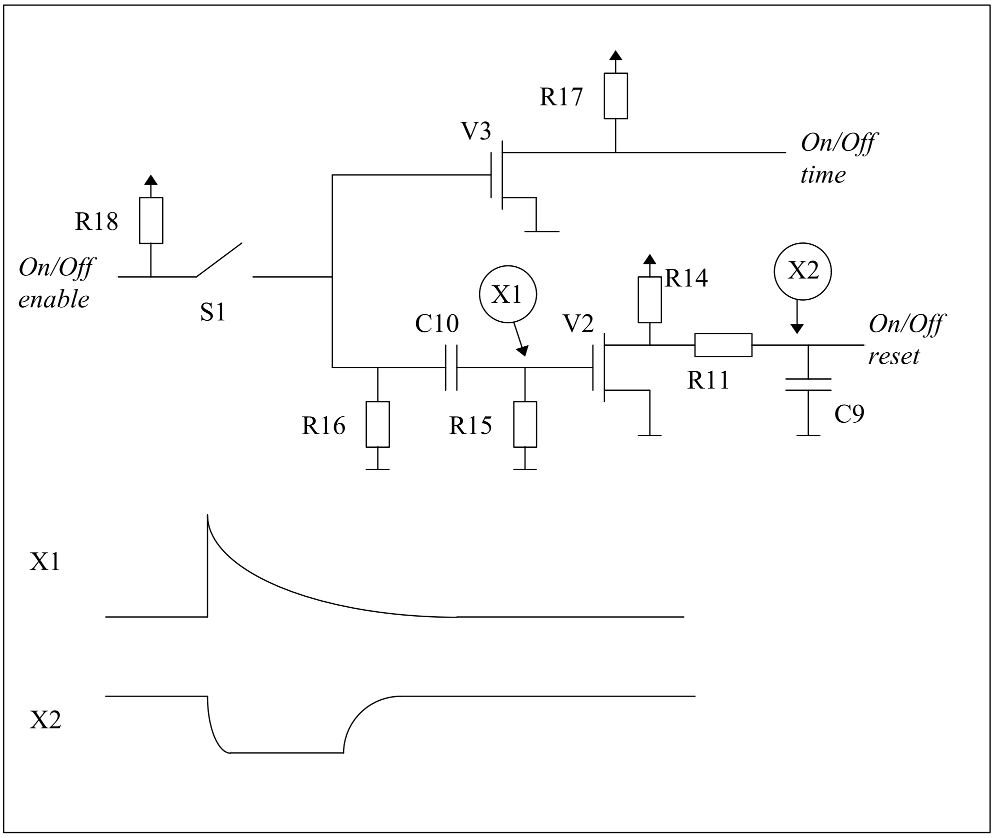

Figure 11 Implementation and function of the hardware filter

4.5 RF Module

The RF module is mainly designed around a transmitter module that generates on-off keyed (OOK) modulation from an external encoder, the micro controller. *Data_RF* in Figure 2 and Figure 4 is the coded signal to be transmitted through RF.
The operating frequency of the RF transmitter differs for different countries, and thereby differ also the article number of the activity meter, see XXX.
The coding used is XXXX, how this coding works is shown in Figure 12.
Also shown in Figure 12 is that the bit-rate of the transmission is 1 kbit/s (500 data bits/s).

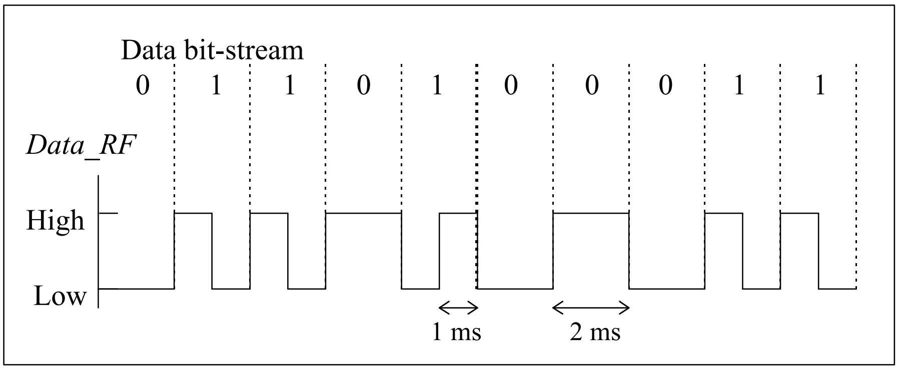

Figure 12 Coding of transmitted data

Each time the activity meter does a transmission, once per hour and after going to On or Off state, it transmits a block that consist of the following (see Figure 13):

- A start pulse, which tells the receiver that a new data block is coming. This means that the *Data_RF* signal is high for 8 ms and then goes low.
- A type field, which tells the receiver that this data block is coming from an activity meter. The RF type field is one byte long and consists of 00h.
- The ID number of the activity meter. This field is three byte long, see 4.3 for a description of how the activity meter gets it ID.
- Register pointer, points at the register into which the data, from the counter that counts activity pulses from the sensor module, will be stored after next hour. This field is one byte long. It also tells the reason for the transmission; if the activity meter has been put in On or Off mode, or if it is a normal hourly transmission, see 4.4.
- The 24 registers of activity data. Each register is one byte long. Register 1 is sent first and so on. With help of the register pointer it is shown into which register the activity data for the last hour is written.
- A CRC code, 2 bytes. It is described below how the CRC is calculated. The CRC-code is necessary for the receiver to be sure that the transmission was error-free.

Start pulse	RF Type	ID	Pointer	Register 1-24	CRC
8 ms	1 byte	3 byte	1 byte	24 byte	2 byte

Figure 13 Transmission block

The data transmission block is 31 byte (248 bits) long. This means that the time each transmission takes is 504 ms with the start pulse included.

The CCR-code used to generate the 2 byte CRC is called CRC-CCITT code, it is an international standard. The generator polynom for this code is:

$$CRC = 1 + x^5 + x^{12} + x^{16}$$

Figure 14 shows how this generator polynom is implemented in the software.

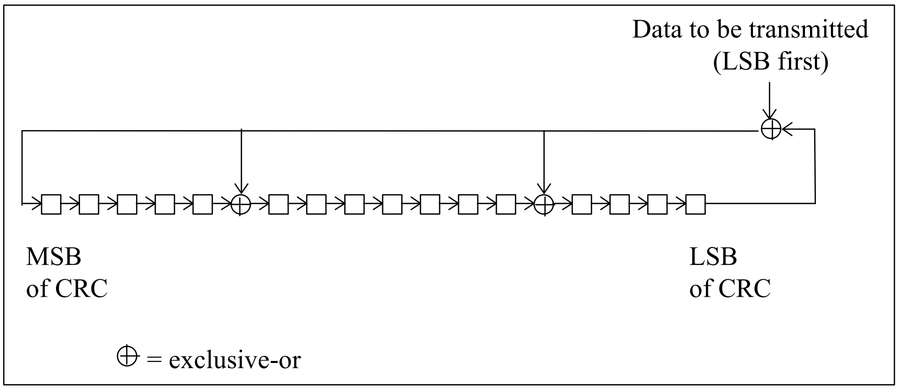

Figure 14 Implementation of CRC-CCITT code

5. Operation

The activity meter can be in two different modes: On or Off.
When the activity meter is in Off mode it is not working, i.e., it do not measure activity and there will be no RF transmissions.
When the activity meter is in On mode it works normally, i.e., it measures activity and sends the data through the RF link once per hour.
To put the activity meter in Off mode the magnet has to be close to the internal reed relay (the position of the reed relay is showed by an arrow on the box) for a longer time than 1.5 seconds. This is the same as a slow stroke with the magnet near the arrow on the box. To confirm that it has gone to Off mode the activity meter sends a special Off-message through RF.
To put the activity meter in On mode the magnet has to be close to the internal reed relay for a shorter time than 1.5 seconds. This is the same as a quick stroke with the magnet near the arrow on the box. To confirm that it has gone to On mode the activity meter sends a special On-message through RF.

There is also a third mode, Off Prod mode, which is only supposed to be used in production. This mode means that the Activity meter will be locked, i.e., not affected by the magnet, for 15 minutes and then will it go to Off mode. To put the Activity meter in Off Prod mode the magnet has to be close for at least 9.5 seconds.

6. Software description

For a description of how the software in the micro controller is built up see document XX.
In this section the RAM memory map of the *micro controller* is shown and the internal data registers are described.

6.1 Micro controller RAM memory map

The micro controller have a 512-digit x 4-bit internal RAM.
Figure 15 below shows RAM memory map in the micro controller. The RAM-mapped register area consists the internal registers for the micro controller, i.e., registers for such things as interrupt handling etc.
The memory register area and the data area are used by the program. 6.2 describes the registers used in the program, the registers starts at address $050.

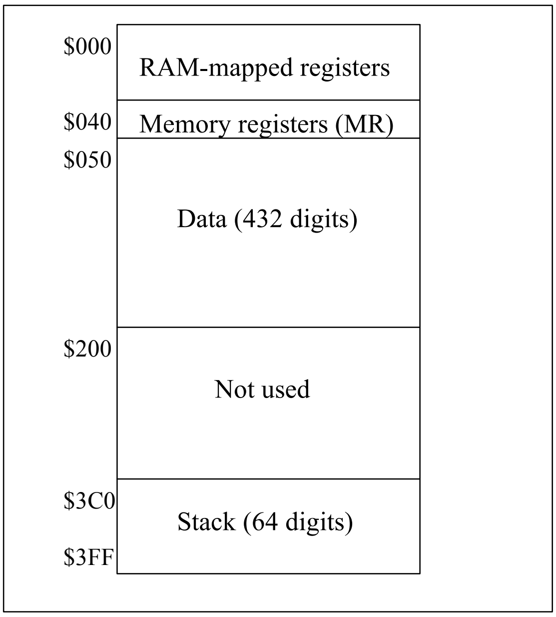

Figure 15 RAM Memory Map

6.2 Data registers

Register	Size	Description
Act0-23	24 * 1 byte	Used to save the activity data. One register for every hour for the last 24 hours.
cAct	1 byte	Used to store the activity data for the hour in progress.
ActPoint	1 byte	Used as a pointer to point at the register (Act0-23) into which the activity data will be written after next hour has elapsed.
CowID	1 byte	Used when reading the identity of the activity meter from the ID ROM chip.

Register Size Description

CowID1-8	8 * 1 byte	Used to store the data that are read from the ID ROM chip. CowID2-4 are used as the 3 byte ID for the activity meter, CowID2 is least significant byte.
IDCount	1 byte	Used in the communication between the micro controller and the ID ROM chip when getting the identity of the activity meter.
IDCRC	1 byte	Used to store the calculated CRC when getting the ID, see 4.3 for a description of how the CRC is calculated.
TimeCoun	1 byte	Counter which counts number of 14 second time-slices since last RF transmission, i.e., used to know when an hour has elapsed.
IntCount	1 NIB	Counter that counts number of 2 second time-slices since this 14 second time-slice started.
SkipFlag	1 NIB	The last time-slice in every hour has to be 16 seconds long. During this time-slice interrupts from the sensor are not allowed; if one of those interrupts would happen in exactly the wrong moment the micro controller could hang-up. So this flags tells when it is the last time-slice.
SendFlag	1 NIB	This flag is set when it is time to send data through RF, i.e., once every hour.
ScrcFlag	1 NIB	Used when calculating how long time will elapse between two transmissions, depending on CRC for last transmission.
OffPFlag	1 NIB	This flag is set when the Activity meter has been ordered to go to Off Prod mode.
OneFlag	1 NIB	Flag to know when a “One” is being sent through RF.
ZeroFlag	1 NIB	Flag to know when a “Zero” is being sent through RF.
StartFlag	1 NIB	Flag to know when the start pulse is being sent through RF.
gBitCoun	1 NIB	Counter to know how many bits of the gSendBuf has been sent through RF.
gSendBuf	1 NIB	Used to store the next data to be sent through RF.
CRC	2 byte	Used to store the CRC that are generated when sending data through RF.
CRCtmp	1 NIB	Helps when generating the CRC.
WAIT	1 NIB	Used to check for how long the reed relay is closed after a reset, i.e., used to decide whether to go to On mode or Off mode.

$\sum$ 368 bit (or 46 byte, or 92 NIB).

7. Component description

B1	This is the electromagnetic sensor. It is a coil with a magnetic ball inside. When the magnetic ball moves a voltage is generated in the coil; faster movement of the ball gives higher amplitude of the generated voltage. The frequency of the signal from the sensor is around 12 Hz.
C1	Used together with R6 and N1 as LP-filter for signal from sensor.
C2-3	For 4 MHz resonator.
C4-5	For 32 kHz crystal.
C6	Helps to keep the voltage during RF transmissions. Tantalum is used because low leakage current is a demand.
C7-8	Avstörningskondensatorer.
C9-10	Used in the HW-filter around the on/off switch. C10 together with R15 decides how long the reset signal to the micro controller will be. C9 together with R11 makes sure that a very short closing of the reed relay do not reset the micro controller.
C11-C12	Avstörningskondensatorer.
C13	Used for signal to RF transmitter.
C14-C18	For matching-filter for antenna.
D1	The micro controller, see document *AT 950234* for a description of why this micro controller was chosen.
D2	The ID-chip.
E1	RF transmitter module.
G1	Battery. Capacity: 1800 mAh, voltage: 3V.
L1-L3	For matching-filter for antenna.
N1	Operational amplifier. Chosen because of the low leakage current. Used together with R3-R6 as amplifier of sensor signal and together with C1 and R6 as LP-filter.
N2	Used as comparator.
P1	Ceramic resonator - 4 MHz.
P2	Crystal - 32 kHz.
R1-2	Sets the zero-level for the sensor to 1 volt.
R3-6	Amplifier for the sensor signal, together with N1.
R7-8	Sets the threshold value for the comparator.
R9-10	Used in ID module, necessary for low leakage current and for communication between D1 and D2.
R11,14-18	Used in the HW-filter around the reed relay, see 4.4.1 for a description of how the HW-filter works
R12	For 4 MHz resonator.
R13	Pull-down for *Data_RF* signal.
R19-27	Pull-up for micro controller.
S1	Reed relay.
V1	Used to make sure that the leakage current in ID module is low.
V2-3	Used in the HW-filter around the reed relay.
V4-V7	Diodes used for ESD-protection for RF transmitter. **Note !** Either are V4 and V7 equipped with BAT 18-04 or are V4, V5, V6 and V7 equipped with BAT 18. The protection and function will be the same.

8. Electrical Characteristics

8.1 Technical data

Absolute maximum ratings

Storage temperature	-30°C - +85°C
(for the battery keep the storage temperature within 0°C ~ 40°C)	
Supply voltage	7.0 VDC
Soldering	230°C for 10 sec.

When wave soldering the battery keep the dipping time below 5 seconds.

Operating ratings

Temperature range	-20°C - +70°C
Supply voltage	2.7 - 3.3 VDC

8.2 EMC

The board is designed to meet the requirements in appropriate ETSI Directive, for emission and immunity. Also designed to meet directives for other countries where it will be used (i.e. other frequencies the 433.92 MHz).

8.3 Radio

The board is designed to meet the requirements in appropriate ETSI Directive, for short range radio. Also designed to meet directives for other countries where it will be used (i.e. other frequencies the 433.92 MHz).

8.4 Power consumption

The maximal current consumption of the board is, according to worst case calculation, **19,78 µA**. It should be noted that this really is worst case for all components and the likelihood that all components will take maximum current is very small. The typical values for the components are normally much lower.
Measured current consumption on one board was **8,65 µA**.
The capacity of the battery is 1800 mAh. This means that the battery will last for more than 10 years with a current consumption of 20 µA and more than 20 years with a current consumption of 10 µA.
The self discharge of the battery is about 0.5 % in room temperature (+20 °C) and about 5 % when the temperature is around + 70 °C.
See document XXXXXX - XX for more about current consumption for activity meter.

9. Manufacturing and test

- It is of great importance that the Reed switch is activated my a magnet immediately after the battery is soldered in place, else is the current consumption too high affecting the life time.
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- Det är mycket viktigt att en magnet sätt mot tungelementet omedelbart efter det att batteriet har lötts fast, annars kommer onödig ström att dras ur batteriet.
- Om man har magnet mot tungelement minst 9.5 sekund kommer aktivitetsmätaren låsas i 15 minuter, dvs inte påverkas av magneten, och sedan gå till Off mode. Detta är tänkt att användas på så sätt att magnet finns vid tungelementet då man kör våglödning. På detta sätt kommer minimal ström att gå åt under monteringen.

- För att testa sensorn vid gravering:

1. Sätt Aktivitetsmätare i On - mode genom att ha magnet närvarande kortare tid än 1.5 sekunder. Aktivitestmätaren sänder ut On - meddelande (ActPoint = 64).
2. Vänta minst 5 sekunder.
3. Skaka på aktivitetsmätaren.
4. Sätt Aktivitetsmätaren i Off - mode genom att ha magnet närvarande minst 2 sekunder (måste vara kortare än 9 sekunder). Aktivitetsmätaren sänder ut Off - meddelande (ActPoint = 128). Act0 registret skall nu innehålla 1 (ej noll), för att veta att sensor fungerar.

- Man kan även tänka sig att man kontrollerar uteffekten från RF sändaren vid graveringen.