RoboCut-controller (RCC)

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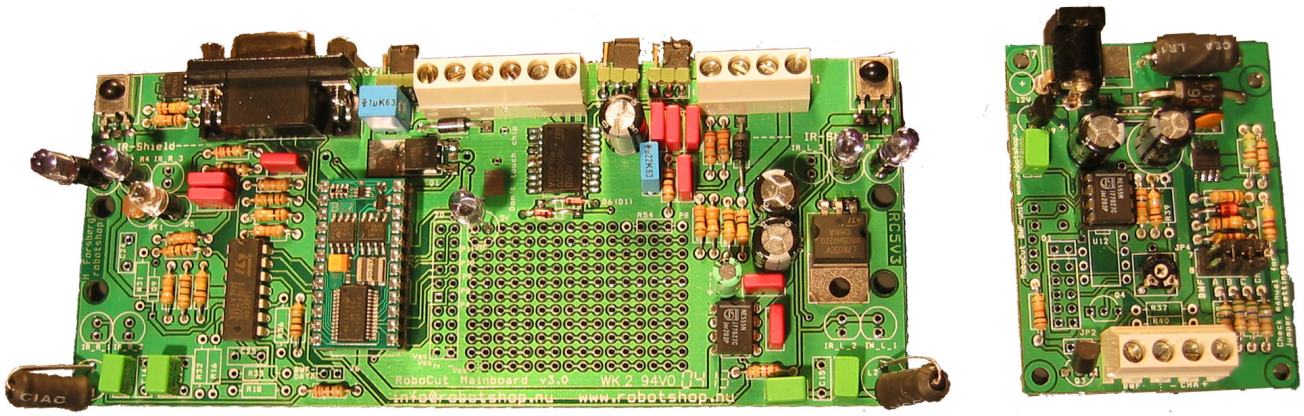
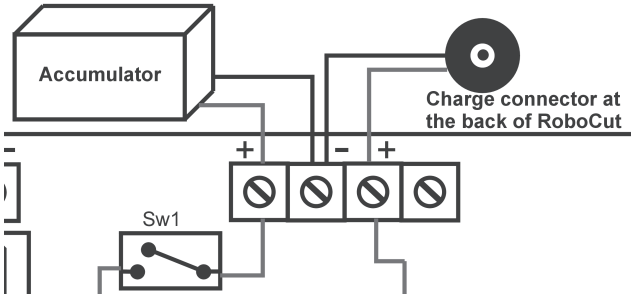
Introduction:
Robots, robots, robots...and all that hardware you nedd to interface to your STAMP!
The RoboCut-Controller (RCC) is a set of two PCB:s originally developed for the autonomous lawnmover robot kit RoboCut http:\\www.robocut.se With this controller you can design a mid-sized robot of the ”rover-typ” ie a robot with two drive wheels and one or two supporting wheels, like the parallax designed BOE-BOT.
The **RCC** gives you not only the motor-control. It also has a built in system for a Buried wire Fence (BWF) to keep your robot inside a specified area or follow a hidden track. The controller also has a two chanel (left/right) Infrared Obstacle detection system. There is also a charger built into the system, and circuitry to detect and monitor the charging process. With this you can easily give your robot self-charging features.



Features:
-Built for any 24-pin BASICStamp or pin compatible
-Can control two DC-motors ON/OFF Forward/Rewerse
-Can control one DC motor ON/OFF
-Buried Wire Fence (BWF), two channels: Right / Left. Can keep the robot inside an area defined by the buried wire or can be use as a track for the robot to follow.
-Infrared Obstacle detection system, left / right and center.
-Built in A/D converter that monitors the accumulator voltage. Useful for selfcharging etc
-Built in charge detection. Useful for e.g. autonomous selfcharging applications etc..
-Three power switches,Main, drive wheels and cutter motor
-Prototype-area
-Buried Wire Fence transmitter and battery charger PCB included

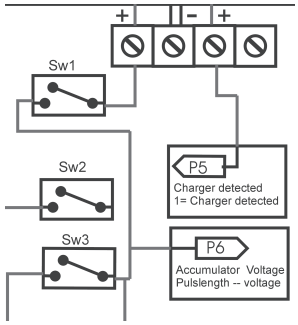
-PowerSupply

The **RCC** is primarily designed for a 12 Volt system, however the pcb kan work with supply in the range from 8 V to 24 VThe system will NOT work at voltage below 8V. This has to do with the D-MOS circuits used in the motor driver circuits. For use with other voltage than 12V se special notice in appendix. The power is connected to the screwterminal as i the illustration to the right. If you are using a accumulator, the charger can be connected as illustrated.



-Charging detector

Via the chargerconnection the chargercurrent is fed through a diode to the accumulator, and the charging current is detected as a digital I/O at pin 5 of the BASIC Stamp. Useful when you design a selfcharging system. The robot knows when it has electrical contact with the ”docking station”. Also at manual charging, this information is valuable, to shut down the system while charging.

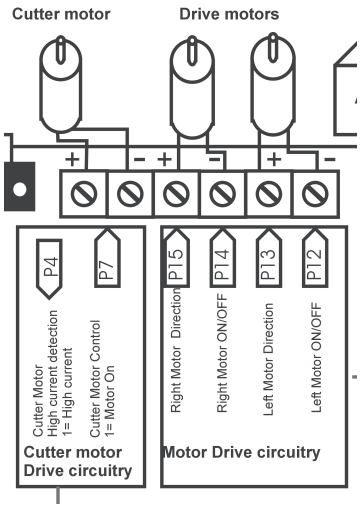


-Charger monitoring

The **RCC** has an onboard A/D converter that contiously monitors the voltage over the accumulator. The A/D converter is a 555-timer circuit which delivers a negative pulse, where the pulslength is propotional to the voltage. This is of big value while charging accumulators of NiMh or NiCd type. These accumulators are charged by a constant current. While forcing constant current through the accumulator, the voltage over the accumulator rises. When the voltage stops rising or even falls slightly, the accumulator is fully charged, and the robot can leave its charging station, or start mowing to tear its ”charger-plug” out.

-MotorControl, Drivemotors

The **RCC** PCB has a double motordriver circuit, designed for control of two DC-motors On/Off and direction.
The circuit uses modern D-MOS technology and has an internal resistans (RDSon) at only 0,3 Ohm
The driver has built in overcurrent and crosscunduction protection, it also has thermal shutdown circuitry and will lockout at undervoltage.



The drivercircuit can handle 2,8A per motor, but, the current PCB layout is only designed to handle the heat from 1A per motor, which sets the max current, continous, to 1 A per motor.
The circuit is controlled through 4 I/O pins from the BASIC Stamp.
P12, P13, P14 and P15

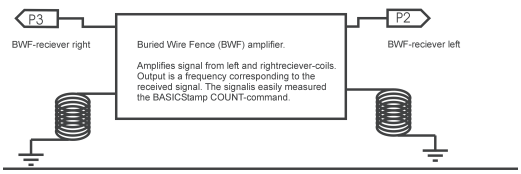
-MotorControl Cutter

The cuttermotor controls by an HEX-FET transistor, this can handle up to 8A.
I/O pin 7 controls the cuttermotor

-Currentmonitor cuttermotor

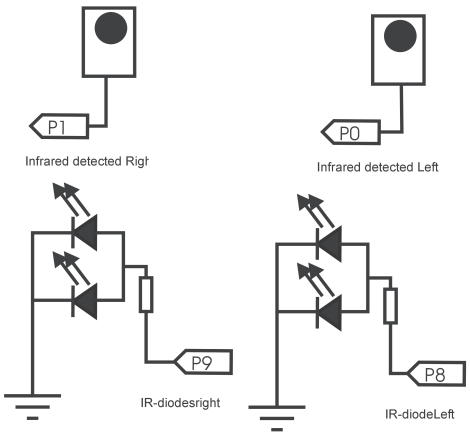
To provide the cuttermotor from overheat, a circuit sets the STAMP I/O pin4 at 3A current

-BWF-detectors, Left/Right



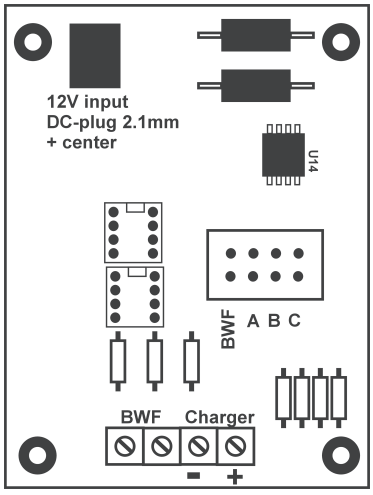
The Buried Wire Fence (BWF) can detect the presence of the buried wire fence at the distance of approximate 30 cm.The system has two separate chanels. Reciever antennas in the lower left resp right corner of the PCB picks up a signal induced by the 38kHz signal in the buried wire.Theese signals are amplified and fed into I/O P2 rep P3. With the STAMP command COUNT the pulses are countedforaspecified time and the result represents the frequency detected. The detected frequency represents the distance to the cable, no precision tool, but very useful.

-IR obstacle detectors Left/Right



The **RCC** has an infrared obstacle detection system. This two chanel system, left/right, is built around Infrared LED:s and IR-sensors. The sensors are tuned for IR-light at 940nm oscillating at 38,5 kHz. The sensors gives a digital signal to P0 resp P1 when 38,5 kHz IR-light is detected. The signal in inverted, i.e. a zero represents light detected. The IR-LED:s at the left and right upper corners of the PCB are connected to P8 resp P9. With the STAMP command FREQOUT you can send a short pulse of IR-light, then see if the corresponding IR-sensor detects any light. If light is detected, there is an obstacle in front of the sensor/detector arrangement, and the robot can turn to avoid collision. Since there are IR-arrangements in both the left and the right corner, your robot can make smart manouvers to avoid obstacles. The left IR-LED:s are paralleled with an IR-LED placed in the center of the PCB. By sending IR-pulses and check right and left detectors in a special pattern, the STAMP can also ”see” small obstacles in center/front of the robot.

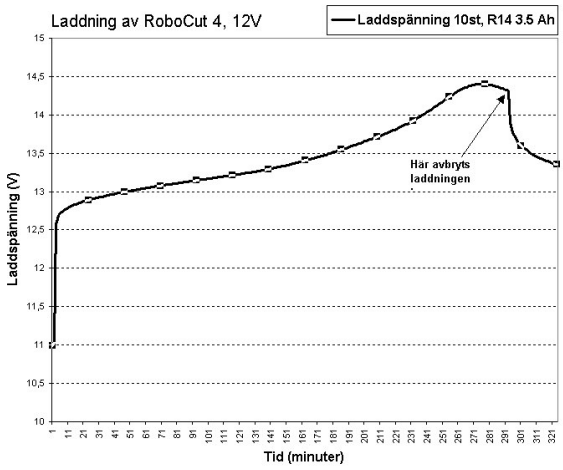
BWF-transmitter



The BWF transmitter and charger are on a separate PCB.
The BWF transmitter sends an oscillating 12V signal to the buried wire. The buried wire must form a loop, surrounding the working area of the robot. The wire is then connected to two poles of the screw terminal.
The BWF-transmitter has a jumper that sets the signal strength in two levels high and low. High with the jumper on. The BWF system can also bee used as a ”hidden track” for the robot to follow. The STAMP program then controls direction of the robot in a way that tries to keep the BWF-wire between the two BWF antennas in the two lower corners of the PCB. In this operation it might be necessary to lower the level of the BWF signal, this can be done by adding an external resistor in series with the BWF-wire.

-Switching charger circuitry

The separate BWF PCB also includes an charging device. This can supply constant current in four levels, to charge your 12V NiMh or NiCd accumulator. When charging NiMh and NiCd a constant current is fed through the accumulator. During charging, the voltage over the accumulator rises, when the accumulator is fully loaded the voltage-rise stops or even falls slightly. At this stage charging must be terminated since the supplied charging current will be converted to heath that might destroy the accumulator. The key issue here is the level of the constant current. If this is 1/10:th of the accumulators capacity, the generated heat will not damage the accumulator, charging at this rate is specified as 0.1C . In the RoboCut case, the 2004 version accumulator is at 12 V 4.5 Ah. 0.1 C in this case equals 450mA. The charger on the BWF PCB has adjustable current setting.



NO jumper = 220 mA
1 jumper = 440 mA
2 jumpers = 660 mA
3 Jumpers = 880 mA

The main PCB of the **RCC** has an A/D converter that monitors the voltage over the accumulator. This gives you very interesting opportunities to give your robot autonomous or semi autonomous charging behaviour. If you create a charging station with the charger-connection designed with some sort of docking features, the robot can navigate to the charger (the Buried Wire Fence can be used for this navigation!) , dock into the charger ,STAMP I/O pin 5 will indicate ”contact” and stop the robot, start monitoring the charging process and let the STAMP decide when fully loaded, then back up from the charging station, and go ”back to work” or whatever you decide. It’s all in the code!

Schematic overwiev RoboCut PCB

I/O references to BASIC Stamp 2 or pin kompatible device