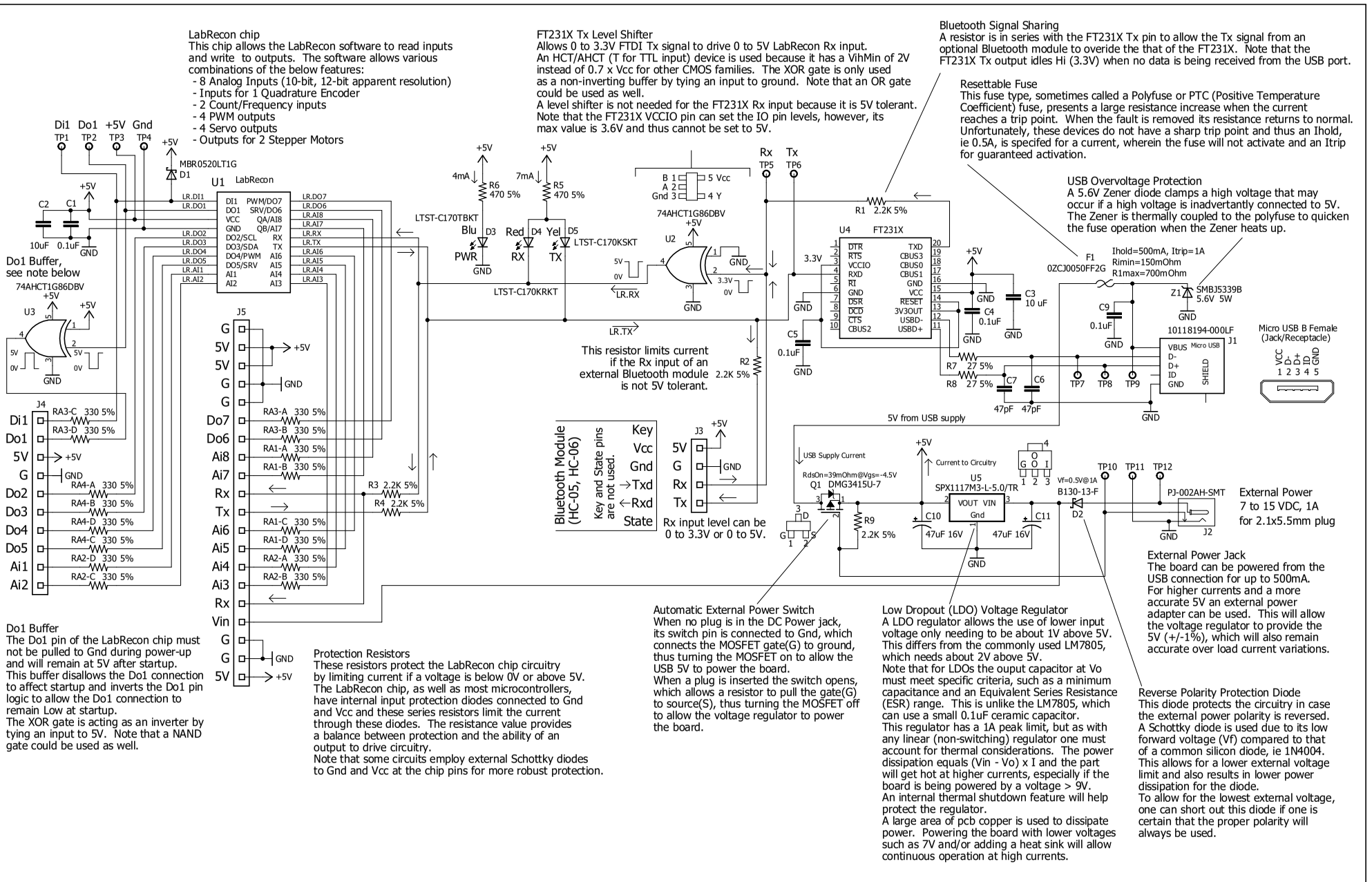
LabRecon chip
This chip allows the LabRecon software to read inputs and write to outputs. The software allows various combinations of the below features:
- 8 Analog Inputs (10-bit, 12-bit apparent resolution)
- Inputs for 1 Quadrature Encoder
- 2 Count/Frequency inputs
- 4 PWM outputs
- 4 Servo outputs
- Outputs for 2 Stepper Motors
FT231X Tx Level Shifter
Allows 0 to 3.3V FTDI Tx signal to drive 0 to 5V LabRecon Rx input.
An HCT/AHCT (T for TTL input) device is used because it has a VihMin of 2V instead of 0.7 x Vcc for other CMOS families. The XOR gate is only used as a non-inverting buffer by tying an input to ground. Note that an OR gate could be used as well.
A level shifter is not needed for the FT231X Rx input because it is 5V tolerant. Note that the FT231X VCCIO pin can set the IO pin levels, however, its max value is 3.6V and thus cannot be set to 5V.
Bluetooth Signal Sharing
A resistor is in series with the FT231X Tx pin to allow the Tx signal from an optional Bluetooth module to overide the that of the FT231X. Note that the FT231X Tx output idles Hi (3.3V) when no data is being received from the USB port.
Resettable Fuse
This fuse type, sometimes called a Polyfuse or PTC (Positive Temperature Coefficient) fuse, presents a large resistance increase when the current reaches a trip point. When the fault is removed its resistance returns to normal. Unfortunately, these devices do not have a sharp trip point and thus an Ihold, ie 0.5A, is specifed for a current, wherein the fuse will not activate and an Itrip for guaranteed activation.
USB Overvoltage Protection
A 5.6V Zener diode clamps a high voltage that may occur if a high voltage is inadvertantly connected to 5V. The Zener is thermally coupled to the polyfuse to quicken the fuse operation when the Zener heats up.
Di1 Do1 +5V Gnd
TP1 TP2 TP3 TP4
MBR0520LT1G
D1
U1 LabRecon
DI1 PWM/DO7
DO1 SRV/DO6
VCC QA/AI8
GND QB/AI7
DO2/SCL RX
DO3/SDA TX
DO4/PWM AI6
DO5/SRV AI5
AI1 AI4
AI2 AI3
LR.DI1 LR.DO1 LR.DO2 LR.DO3 LR.DO4 LR.DO5 LR.AI1 LR.AI2
LR.DO7 LR.DO6 LR.AI8 LR.AI7 LR.RX LR.TX LR.AI6 LR.AI5 LR.AI4 LR.AI3
C2 10uF
C1 0.1uF
Do1 Buffer, see note below
74AHCT1G86DBV
U3
J4
Di1 Do1 5V G Do2 Do3 Do4 Do5 Ai1 Ai2
RA3-C 330 5%
RA3-D 330 5%
RA4-A 330 5%
RA4-B 330 5%
RA4-D 330 5%
RA4-C 330 5%
RA2-D 330 5%
RA2-C 330 5%
J5
G 5V 5V G G Do7 Do6 Ai8 Ai7 Rx Tx Ai6 Ai5 Ai4 Ai3 Rx Vin G G 5V
RA3-A 330 5%
RA3-B 330 5%
RA1-A 330 5%
RA1-B 330 5%
RA1-C 330 5%
RA1-D 330 5%
RA2-A 330 5%
RA2-B 330 5%
R3 2.2K 5%
R4 2.2K 5%
4mA
R6 470 5%
7mA
R5 470 5%
LTST-C170TBKT
Blu D3
Red D4
Yel D5
LTST-C170KSKT
PWR
RX
TX
LTST-C170KRKT
74AHCT1G86DBV
U2
LR.RX
LR.TX
Rx TP5
Tx TP6
R1 2.2K 5%
U4 FT231X
DTR TXD
RTS CBUS3
VCCIO CBUS0
RXD CBUS1
RI GND
GND VCC
DSR RESET
DCD 3V3OUT
CTS USBD-
CBUS2 USBD+
3.3V
C3 10 uF
C4 0.1uF
C5 0.1uF
R7 27 5%
R8 27 5%
C7 47pF
C6 47pF
F1 0ZCJ0050FF2G
Ihold=500mA, Itrip=1A
Rimin=150mOhm
R1max=700mOhm
Z1 SMBJ5339B 5.6V 5W
C9 0.1uF
J1 10118194-000LF
VBUS D- D+ ID GND SHIELD
TP7 TP8 TP9
Micro USB B Female (Jack/Receptacle)
VCC D- D+ ID GND
1 2 3 4 5
This resistor limits current if the Rx input of an external Bluetooth module is not 5V tolerant.
R2 2.2K 5%
Bluetooth Module (HC-05, HC-06)
Key and State pins are not used.
Key Vcc Gnd →Txd ←Rxd State
J3
5V G Rx Tx
Rx input level can be 0 to 3.3V or 0 to 5V.
5V from USB supply
USB Supply Current
RdsOn=39mOhm@Vgs=-4.5V
Q1 DMG3415U-7
R9 2.2K 5%
Current to Circuitry
U5 SPX1117M3-L-5.0/TR
VOUT VIN Gnd
C10 47uF 16V
C11 47uF 16V
Vf=0.5V@1A
B130-13-F
D2
TP10 TP11 TP12
PJ-002AH-SMT
J2
External Power
7 to 15 VDC, 1A
for 2.1x5.5mm plug
Do1 Buffer
The Do1 pin of the LabRecon chip must not be pulled to Gnd during power-up and will remain at 5V after startup.
This buffer disallows the Do1 connection to affect startup and inverts the Do1 pin logic to allow the Do1 connection to remain Low at startup.
The XOR gate is acting as an inverter by tying an input to 5V. Note that a NAND gate could be used as well.
Protection Resistors
These resistors protect the LabRecon chip circuitry by limiting current if a voltage is below 0V or above 5V. The LabRecon chip, as well as most microcontrollers, have internal input protection diodes connected to Gnd and Vcc and these series resistors limit the current through these diodes. The resistance value provides a balance between protection and the ability of an output to drive circuitry.
Note that some circuits employ external Schottky diodes to Gnd and Vcc at the chip pins for more robust protection.
Automatic External Power Switch
When no plug is in the DC Power jack, its switch pin is connected to Gnd, which connects the MOSFET gate(G) to ground, thus turning the MOSFET on to allow the USB 5V to power the board.
When a plug is inserted the switch opens, which allows a resistor to pull the gate(G) to source(S), thus turning the MOSFET off to allow the voltage regulator to power the board.
Low Dropout (LDO) Voltage Regulator
A LDO regulator allows the use of lower input voltage only needing to be about 1V above 5V. This differs from the commonly used LM7805, which needs about 2V above 5V.
Note that for LDOs the ouput capacitor at Vo must meet specific criteria, such as a minimum capacitance and an Equivalent Series Resistance (ESR) range. This is unlike the LM7805, which can use a small 0.1uF ceramic capacitor.
This regulator has a 1A peak limit, but as with any linear (non-switching) regulator one must account for thermal considerations. The power dissipation equals (Vin - Vo) x I and the part will get hot at higher currents, especially if the board is being powered by a voltage > 9V.
An internal thermal shutdown feature will help protect the regulator.
A large area of pcb copper is used to dissipate power. Powering the board with lower voltages such as 7V and/or adding a heat sink will allow continuous operation at high currents.
Reverse Polarity Protection Diode
This diode protects the circuitry in case the external power polarity is reversed.
A Schottky diode is used due to its low forward voltage (Vf) compared to that of a common silicon diode, ie 1N4004. This allows for a lower external voltage limit and also results in lower power dissipation for the diode.
To allow for the lowest external voltage, one can short out this diode if one is certain that the proper polarity will always be used.
External Power Jack
The board can be powered from the USB connection for up to 500mA.
For higher currents and a more accurate 5V an external power adapter can be used. This will allow the voltage regulator to provide the 5V (+/-1%), which will also remain accurate over load current variations.
LabRecon
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