LiNX
Input Module
HW Description of Operation Rev 1.0

Hardware Description of Operation for the Input Module Variant of the LiNX System

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1 Amendment Record

Author	Date	Revision	Changes
Rob Glassey	15/12/2016	1.0	Initial release

2 Overview

The LiNX Input Module is an accessory for the LiNX system, designed to allow additional inputs to be connected to the system with a minimum of external circuitry. It is intended to interface with simple switched inputs, proportional inputs, and it provides a Sip and Puff control interface.

The input module provides a male DB-9 input connector, a stereo jack input socket, and a "Sip n Puff" input nozzle to attach a tube and mouthpiece.

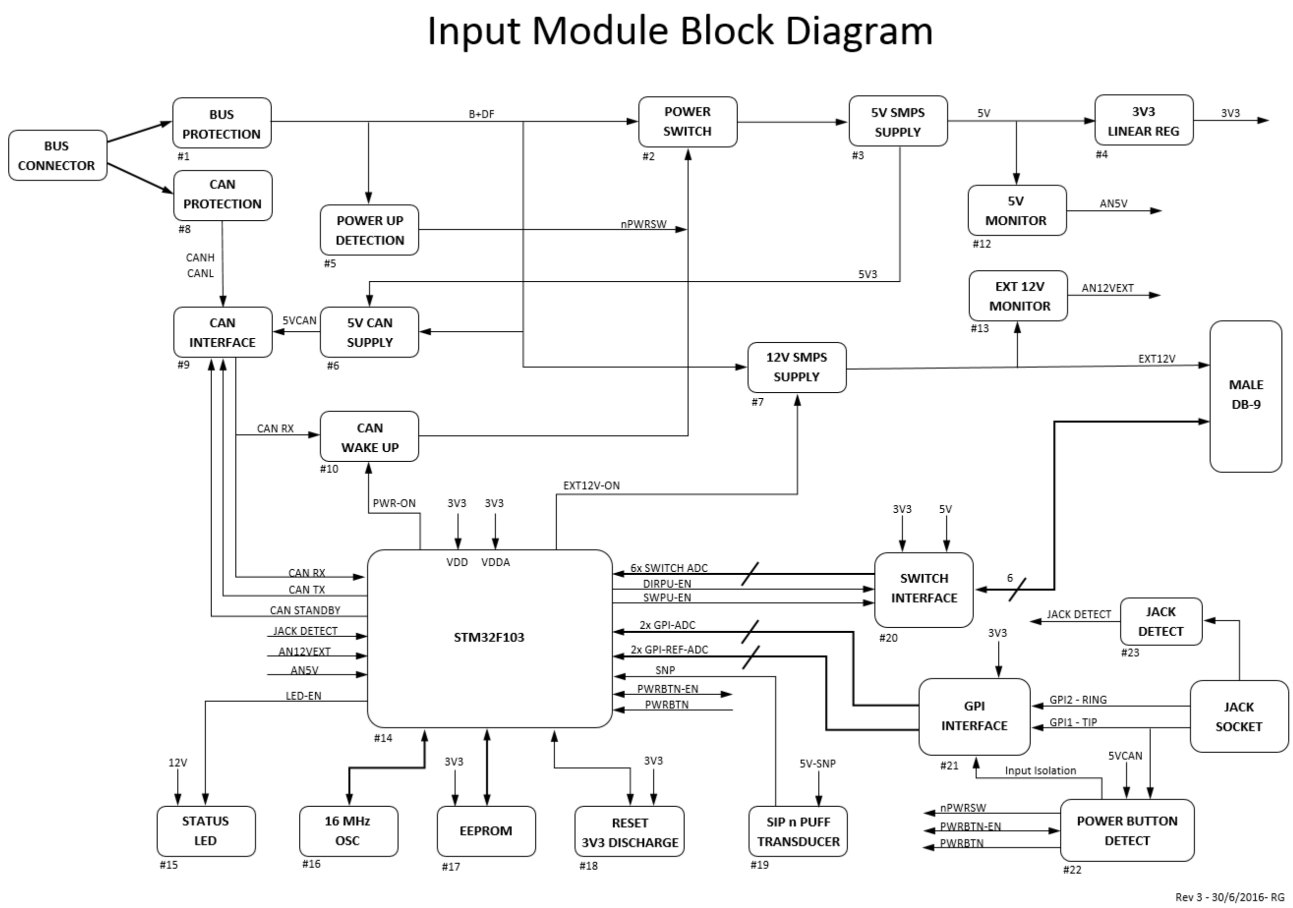
The DB-9 provides inputs for 6 switches to ground. A switchable 4k7 pull-up to 4V is provided on the switch inputs, and a 12V 200mA supply is provided on pin 7. The hardware is also intended to support third party proportional joysticks designed to work with the PG OMNI DB-9 proportional input.

The Jack socket supports two additional switches, or two resistive 10 way switch units. A configurable power button input is provided on the Tip contact of the jack socket.

The "Sip n Puff" transducer is a proportional pressure transducer used to detect strong and soft "sips" and "puffs". These actions can also be used to control the chair.

3 Block Diagram

A block diagram of the LiNX Input Module is shown in **Error! Reference source not found.**. Each functional block is further decomposed and described in the appropriate section of this document.



4 Description of Operation

4.1.1 #1 Bus Protection

The Input module is protected from reverse polarity using FET in the B- return to minimise voltage drop. There is a PTC on the B- input to protect against the 0V on the DB-9 being shorted to B+ externally. An additional PTC is provided on B+ to provide protection in case 0V on the DB-9 is connect to B- externally, which would defeat the PTC on the B- input. This PTC has a higher current rating to minimise voltage drop. The CAN is not affected by the PTC and FET in B- as the CAN transceiver provides common mode rejection.

The case is connected to B- on the Unibus connector, via a capacitor and bleed resistor, to provide an ESD ground and a chair connection for EMC.

4.1.2 #2 Power Switch

This is the main power switch for the module. It turns on the power to the 5V supply which feeds the 3v3 supply, and provides a 5v3 output for 5VCAN. It is activated by pulling the nPWRSW line low. The nPWRSW line is pulled up to bus voltage via a high impedance.

The power switch can be activated by a CAN wake up message, or the connection of bus power to the module, or by a power button connected to the jack socket. Once powered up, the microprocessor holds the power on by applying the PWR-ON signal to the "CAN wake up" block. The module is powered down when the micro releases the PWR-ON signal and no other signal is holding the nPWRSW line low.

4.1.3 #3 5V Supply

This is based on the MC33063. It is a reuse of the circuit used in the Power Modules and Actuator module, modified to produce 5V3 in addition to a regulated 5V. It is current limited and self-protected against short circuit. The 5V output supplies: the 3v3 regulator, Sip and Puff transducer, LED, and switched input pull-ups. The 5V3 output feeds the 5VCAN supply via a Schottky diode when the module is powered up.

4.1.4 #4 3V3 Supply

Based on the MC33296 used in the Power Modules and Actuator module. This supplies: the microprocessor and related circuitry, the EEPROM (not fitted), and the jack socket control input circuitry (GPI).

4.1.5 #5 Bus Power Up detection

The module is required to power up when the bus becomes live. This is so that the system can become aware of the module when it is plugged in or when the battery is connected.

The "Power up detection" circuit responds to a strong rising voltage transient on B+ and applies a short low level pulse on nPWRSW to turn the module on. The microprocessor then latches the power on as long as is required.

4.1.6 #6 5VCAN Supply

In Standby mode, the 5VCAN supply is derived from the always on B+FR supply. This is a discrete 5V regulator, designed to minimise quiescent current while using a zener reference. This is only able to provide enough current for standby operation.

When the module is active, 5VCAN is supplied via a Schottky diode from the 5V3 provided by the 5V regulator.

4.1.7 #7 12V Power Supply

The 12V supply provides power for the DB-9 12V output. It is independently controlled by the microprocessor and is disabled when the microprocessor is off or in reset.

This supply is permanently connected to B+FR, and has a logic level input to enable the output. Quiescent current is low when it is not enabled.

4.1.8 #8 CAN Protection

The "CAN Protection" block includes CAN chip ESD protection.

4.1.9 #9 CAN Interface

This block is a reuse of the SN65HVD1040 CAN transceiver circuit used in other LiNX products. The Input module does not require a bus termination, in accordance with the UniBus Spec. The CAN chip is always on, powered from 5VCAN, and is held in the low power "Standby" mode when the power to the rest of the circuit is off.

4.1.10 #10 CAN Wake up

The LiNX system can turn on the Input Module via the CAN bus by sending a "Wake Up" message. The CAN transceiver chip cannot respond reliably to short 1 Mbps pulses when in low power standby mode, so the "Wake Up" message is sent at 100 kbps. The 100 kbps "Wake Up" message is passed to a charge pump in the "CAN Wake up" block, which pulls down nPWRSW to turn on the power supplies.

The microprocessor can hold the power on by applying the PWR-ON signal to the CAN wake up switch to hold the nPWRSW signal low.

4.1.11 #12 5V Monitor

This is a voltage divider from the 5V switched supply so that it may be monitored by the microprocessor. The pressure sensor runs off 5V, and its output is ratiometric with the 5V rail.

Monitoring 5V also serves as a check of the 3v3 rail to ensure that ADC readings are valid.

4.1.12 #13 12V Monitor

This is a voltage divider from the 12V supply so that it may be monitored by the microprocessor. The 12V supply is provided to external devices via the DB-9. It should be monitored to ensure the correct function of external devices. Two series resistors to 12V guard against short circuit faults.

4.1.13 #14 Microprocessor

The Input module is based on the 64 pin STM32F103RET microprocessor. Power supply filtering is provided. The BOOT0 line is held low so that the microprocessor boots from internal memory. A JTAG programming interface is provided with a footprint on the PCB for a JTAG connector.

4.1.14 #15 Status LED

A white LED is powered from the 5V supply with a series resister, and is activated by Q200A pulling the cathode low. Q200A is driven by the LED-EN signal from the micro.

4.1.15 #16 Oscillator

The clock for the microprocessor is a 16 MHz crystal.

4.1.16 #17 EEPROM

An optional 16kbit EEPROM may provide additional storage via an I2C interface, however this is not fitted. Currently all non-volatile data is stored in FLASH memory.

4.1.17 #18 3v3 Discharge

A 3v3 discharge circuit is provided on the Reset (NRST) line to prevent 3v3 from bouncing back during power down, due to the drop in micro current when it resets. This is to prevent the micro from latching the power supply again when it comes out of reset when the voltage bounces back.

4.1.18 #19 Sip n Puff Transducer

This is based on the MPXV7007GP pressure sensor. It runs off 5V and provides a ratiometric output with a half rail offset for zero pressure. Pressure range is -7 to +7 kPa. A voltage divider scales this to a 0-3V3 range suitable for the microprocessor ADC. The sensor has very limited drive capability so the values of the divider resistors must be sufficiently high. The zero pressure voltage varies from unit to unit and this is calibrated in production.

4.1.19 #20 Switch Interface

The switch interface provides protection, level shifting and pull-ups for 6 switches on the DB-9 connector. 4 inputs are normally used for switched directional control, and the two general switch inputs may be used for Mode, Stop, Inhibit, limit switches, detecting the presence of the DB-9, or any other switched function.

The switched inputs are active low and can be used with simple switches or buttons to 0V.

The interface provides a configurable 4V, 4k7 pull up for each input. The pull-ups for the four directional inputs are controlled by the DIRPU-EN signal. The pull-ups for the remaining 2 general inputs are controlled by the SWPU-EN signal. Control of the pull-ups is split between directional control and general switches so that the direction control can be used for proportional inputs without a pull-up.

All inputs support 0-5V analogue inputs. A switchable level shifter is included on the FWD, REV and LEFT inputs (DB-9 pins 1,2,3) to support OMNI compatible levels of 6V+/-1.2V for proportional speed and direction inputs with a 6V reference on pin 3. With the level shift ON, these inputs support up to 9V with a linear response and can detect higher error voltages. The level shift is active when the OMNI signal is high.

All inputs are protected by diodes to 3v3 within the divider chain. All inputs are 30V tolerant.

4.1.20 #21 Jack Detect (Jack socket)

The microphone ring of the jack socket is used as a jack detect as this would normally be shorted to the ground ring by a mono or stereo jack. The mic ring is the outermost contact in the socket. [The ground contact is typically further in on older sockets, so that position must be reserved for ground to allow general compatibility of microphone headsets with other sockets.]

4.1.21 #22 Power Button Detect

It is required to be able to turn the system on using a button on the Jack socket. This would typically be a mono plug so the power button function is on the Tip contact.

The power button detect circuit is powered from the continuously-on 5VCAN supply. It is enabled with the PWRBTN-EN signal, which is latched by Q402A and Q402B when the module is in standby. When the power button is pressed, the detect circuit applies a low level to the nPWRSW line. The button state can then be read as a digital signal on the PWR-BTN microprocessor input.

FETs Q400 and Q401 provide high voltage protection for the ADC inputs by ensuring that the source is little more than the threshold voltage below 5VCAN.

Q400 is switched off when the power button is active so the powered down 3v3 does not draw power from the button circuit and turn the module on.

4.1.22 #23 GPI Interface (Jack socket)

This uses a simple resistor divider to detect 34 ohm resistance bands up to 680 ohms. To do this the voltage applied to the top of the divider is supplied from the ADC reference voltage (3.3V), and the voltage at the centre of the divider is measured (GPIx-ADC).