Status RELEASED
Last Changed: 9th Jan 2009

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Document History

Changes to draft versions do not need to be tracked. Track only those versions that are under Project Control.

Version	Date of Issue	Author	Change & Reason for Change
1.0	10JAN08	NPL	Initial version
1.1	07 Nov 08	NPL	4.0.5.1 Development toolest now defined. 5.0 Site and Modality keys changed to Prev and Next respectively.
1.2	09Jan09	NPL	2.0.2.1. Wireless IC part number updated. 2.0.3 and 2.0.3.1. USB dongle wireless and microcontroller IC part numbers updated.

Contents.

1.0 Introduction

SP Ref.

1.0.1 Scope

2.3

This document contains the design specification for the Hydra wireless remote control handset and USB receiver dongle. Some of the work will be done by outside agents and where this is to be the case there are references in the text. It also includes additional software components that will be necessary to validate the completed subsystem.

1.0.2 References

2.3

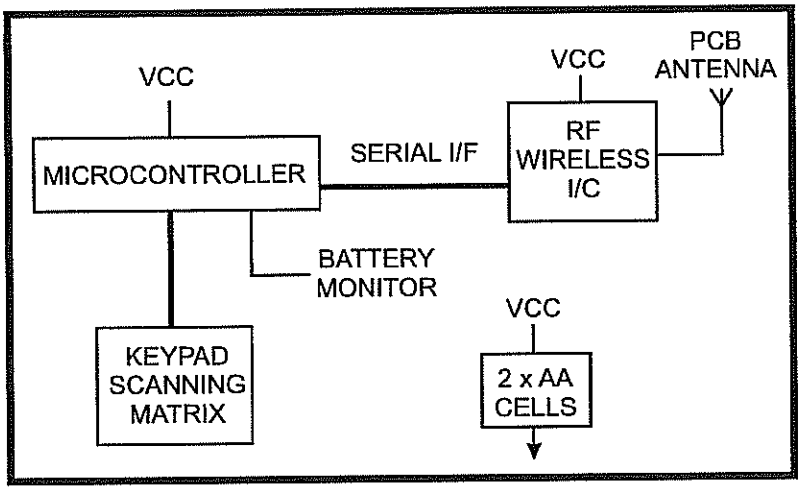
- Remote Control Reference Design nRD24H1 User Guide v1.0, (Nordic Semiconductor)

2.0 Hardware Design Specification

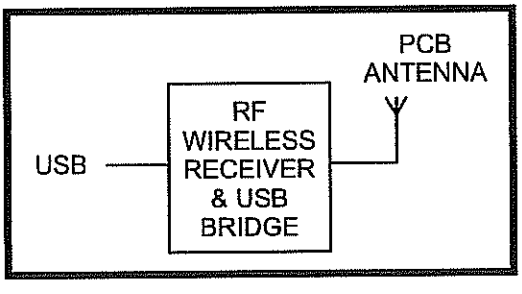
SP Ref.

2.0.1 Block diagrams

2.0.1.1 Wireless RF remote control



2.0.1.2 USB RF dongle



2.0.2 Remote Control Design

All of the components will be on a single PCB.

2.0.2.1 Wireless IC

2.3.b)

The RF wireless IC will be Nordic nRF24L01+. This is specifically designed for low power battery operated systems. The frequency of operation is the worldwide 2.4GHz ISM band. Aerial will be a PCB track. It is essential that the aerial is not covered in any way by any PCB track or pad. Area of at least 15mm

x 15mm (225mm^2) to be left completely devoid of metal, preferably at top/front of PCB. This will include ALL metal/carbon inc. fixings, with the exception of the antenna. The PCB design layout of the RF section will be near identical to the Nordic nRD24H1 RFMODULE – A, as used with the nRD24H1 Remote Control Reference Design.

2.0.2.2 Microcontroller *2.3.e)i)*

The microcontroller (MCU) will be an Atmel ATmega88. It can operate on any voltage between 1.9V and 3.6V (ideal for direct battery operation) and is very low current. Communication between the MCU and the wireless chip will be SPI serial. The MCU is in system programmable (factory programmed). The MCU will normally be in standby or sleep and be woken up on a button press. The on chip ADC will monitor the battery voltage. Ports (10) on the MCU will be used for the matrix scan of the keyboard mat. A 5x5 matrix is sufficient for 25 keyboard button contacts.

2.0.2.3 Batteries *2.3.e)ii),2.3.e)iii)*

Two AA alkaline manganese batteries (2.85Ah) will be used to power the remote. The estimated current consumption for the remote in sleep mode is 30uA.

Battery life will be at least one year, based on 200days / year, 8 examinations / day and 100 button presses per examination.

2.0.2.4 Range *2.3.b),2.3.e)iv)*

Range in open air will be at least 5M with new batteries. Tests will be carried out to establish lowest battery level for reliable usage.

2.0.2.5

The PCB and all of its associated components are to be RoHS compliant.

2.0.3 USB RF dongle design

The remote USB dongle (stick) will plug directly into a USB 2.0 port on the PC. The PCB will be designed to suit the chosen 'off the shelf' USB dongle case. The PCB design layout will be near identical to the USB dongle as used with the nRD24H1 development kit. The power will be provided by the USB port. A separate connector will be fitted to factory program the dongle. The dongle is compatible with the RF remote control.

2.0.3.1 Wireless IC and USB Microcontroller

The USB wireless IC will be Nordic nRF24L01+. The USB microcontroller will be an SiLabs C8051F321 MCU. The on chip flash is in system programmable.

The frequency of operation is the worldwide 2.4GHz ISM band. Aerial will be a PCB track. It is essential that the aerial is not covered in any way by any PCB track or pad. Area of at least 7mm (width of PCB) x 18mm (126mm^2) to be left completely devoid of metal, at the end furthest away from the USB connector of

PCB. This will include ALL metal inc. fixings, with the exception of the antenna.

2.0.3.2

The PCB and all of its associated components are to be RoHS compliant.

3.0 Mechanical Design Specification

SP Ref.

3.0.1 Mechanical Components

The following is a list of the custom and/or standard components comprising the mechanical design of the wireless remote and includes specific requirements for each component. Ergonomic design for single hand use will be a primary focus. *2.3 a)*

3.0.1.1 – Top and bottom enclosure – conceptual design will be provided by Brooks Stevens. Enclosure will be custom designed, molded plastic parts. Material will have high impact strength, UV stabilizing additive and flame retardant additive to UL94V-0 rating. Color to match VIASYS 0427 (light grey). Exterior texture to match MT11010 (Moldtech standard – fine texture). *2.3*

3.0.1.2 – Battery door cover - will be custom designed, molded plastic part. Material will have high impact strength, UV stabilizing additive and flame retardant additive to UL94V-0 rating. Color to match VIASYS 0427 (light grey). Exterior texture to match MT11010 (Moldtech standard – fine texture).

3.0.1.3 – Keypad - conceptual design will be provided by Brooks Stevens. Keypad will be custom designed, molded elastomer part. Buttons will be labeled using words primarily. Symbols will be used wherever possible. Pad printing on keypad will be protected from wear by durable clear epoxy coating. Color to match PMS 429 (dark grey). Exterior texture to match MT11010 (Moldtech standard – fine texture). Other accent colors may be chosen to provide distinction between groups of keys or to highlight frequently used commands. *2.3*

3.0.1.4 – Translation of keypad – two keypad versions will be offered; one in English and one with symbols for non-English speaking countries. Both keypads will be identical in design except for function indication markings. *2.3d*

3.0.1.5 – Bottom label - custom designed laminated graphic label. Top surface of label will be polyester; a durable, chemical resistant material. Graphics will not require translation. Label will contain all symbols required by safety and regulatory compliance as well as space for serial number labels. Label background colors to be white. Top label surface will have a fine texture consistent with the plastic enclosure texture. Most graphics and symbols will be PMS 432 (charcoal grey).

3.0.1.6 – Battery clips – standard off-the-shelf metal contacts fitted into bottom enclosure half and hard-wired or soldered directly to remote PCB. Manufacturer: TBD.

3.0.1.7 – Remote receiver enclosure – standard off-the-shelf USB thumb drive enclosure for enclosing the custom receiver PCB. Manufacturer: TBD.

3.0.2 Overall Mechanical Assembly

The overall assembly of the mechanical components detailed above will be designed to meet current styling guidelines. Since no formal guidelines exist at the time of this writing, the design will be styled after the Tornado (v32, v44 and MediaPort) family of amps and headboxes. The side walls will be curved and the footprint will have rounded corners and smooth curves rather than straight edges. The remote enclosure and keypad will also be designed to compliment the styling of the PV Module and the Respiratory Care cart. The design will utilize components that will be free of hazardous substances (as defined by both China and EU RoHS). The assembly will be resistant to standard cleaning solutions such as isopropyl alcohol. The assembly will be able to withstand multiple drops onto 1" thick hardwood to match IEC 60601-1from a height of 1m without losing functionality. Overall weight of the wireless remote assembly is estimated to be 182g. Overall dimensions of the wireless remote are estimated to be 178mm x 77mm x 25mm. Estimated cost of mechanical components for the wireless remote is $30.

3.0.3 Biocompatibility

3.0.3.1 – Latex statements will be required for the enclosure and the keypad..

3.0.3.2 – The enclosure and keypad must meet the requirements of USP class I.

4.0 Software Design Specification

SP Ref.

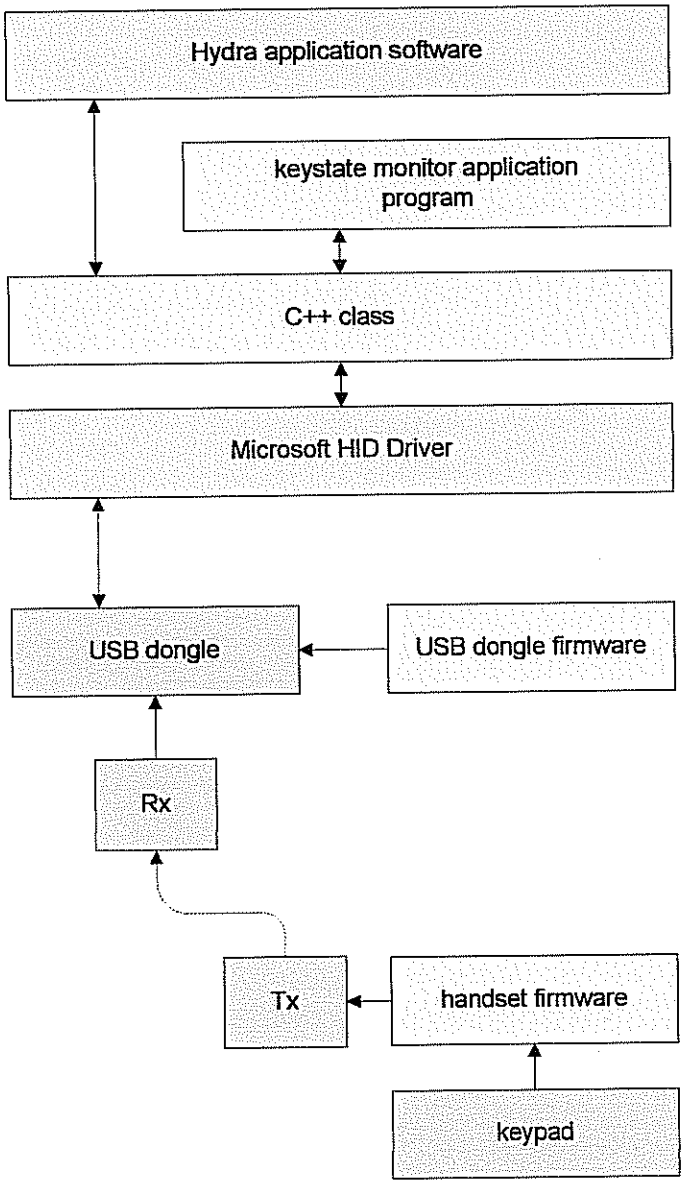
4.0.1 Introduction

2.3

The software is divided into four distinct parts namely the embedded firmware in the handset, the embedded firmware in the USB dongle, the C++ class and the Keystate Monitor application software. The C++ class will eventually form part of the Hydra Application Software and the Keystate Monitor will become an useful tool for manufacturing test.

4.0.2 Software architecture diagram

2.3



2.3

4.0.3 Operational description of major modules

4.0.3.1 Handset firmware

- The firmware will be based upon the Nordic Semiconductor Reference Design.
- The handset will incorporate the ATMEL ATmega88 microprocessor (which is used in the Nordic Reference Design).
- A more detailed Requirements Specification will be written for the Handset firmware (1004-005-002). 2.3

4.0.3.2 C++ class

- The C ++ class will have a meaningful name e.g. cRemoteControl.
- The cRemoteControl class will be the interface between the application program (e.g. Hydra) and the Microsoft Human Interface Device (HID) driver.
- The cRemoteControl class will have member function(s) which post a Windows message to an application when a key press is detected. 2.3

4.0.3.3 USB dongle firmware

- The Reference Design (from Nordic Semiconductor) has firmware which will work without modification. The USB wireless IC will be Nordic nRF24LU1. This IC contains the wireless RF, USB controller and 8051 MCU which will run the remote control signal reception application firmware.
- The firmware will be modified to return an appropriate Neurocare VID and PID.
- A more detailed Requirements Specification will be written for the dongle firmware (1004-005-002).

4.0.3.4 Keystate Monitor application.

- The Keystate Monitor will be a standalone MFC application program.
- The application will simply show the current state of the Remote Control buttons.
- The application will receive Windows Messages from the cRemoteControl class described above. 2.3
- A more detailed Requirements Specification will be written for the Keystate Monitor (1004-005-002).

4.0.4 Description of all critical constraints (timing, speed, sample rate etc.)

No critical constraints have been identified.

4.0.5 Development tools to be employed

4.0.5.1 Handset firmware

WinAVR 20060125

4.0.5.2 C++ class

Microsoft Visual C++. MFC. Windows Vista.

4.0.5.3 USB dongle firmware

Keil Tools uVision3 IDE, written in C.

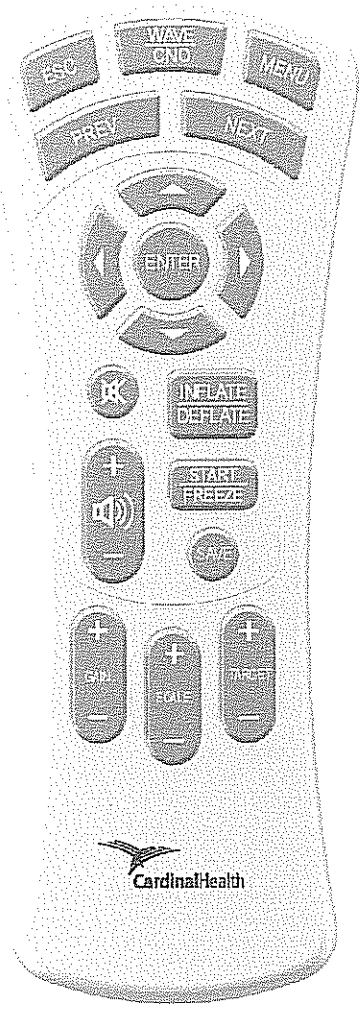
4.0.5.4 Keystate Monitor application.

Microsoft Visual C++. MFC. Windows Vista.

4.0.6 Structure to support translation into foreign languages

Not necessary.

5.0 Appendix A - button functions



The button functions are listed below those which autorepeat are marked (AR):

Start/Freeze
Inflate/Deflate
Enter
Mute
Save

(AR) Volume +/-
(AR) Target +/-
(AR) Gain +/-
(AR) Scale +/-

(AR) Arrow Up
(AR) Arrow Down
(AR) Arrow Left
(AR) Arrow Right

Prev
Next

Wave/CNO
Esc
Menu