# Homework 4: Packaging Specifications and Design

***Due: Friday, February 10, at NOON***

**Team Code Name:** J-Team **Group No.** 10

**Team Member Completing This Homework:** Joshua D Chapman

NOTE: This is the first in a series of four "design component" homework assignments, each of which is to be completed by one team member. The completed homework will count for 10% of the team member's individual grade. It should be a minimum of five printed pages.

**Evaluation:**

| Component/Criterion | Score | Multiplier | Points |
|---|---|---|---|
| Introduction | 0 1 2 3 4 5 6 7 8 9 10 | X 1 | |
| Commercial Product Packaging | 0 1 2 3 4 5 6 7 8 9 10 | X 3 | |
| Project Packaging Specifications | 0 1 2 3 4 5 6 7 8 9 10 | X 2 | |
| PCB Footprint Layout | 0 1 2 3 4 5 6 7 8 9 10 | X 2 | |
| List of References | 0 1 2 3 4 5 6 7 8 9 10 | X 1 | |
| Technical Writing Style | 0 1 2 3 4 5 6 7 8 9 10 | X 1 | |
| | | **TOTAL** | |

**Comments:**

## 1.0 Introduction

The RFID Xpr3ss is a self-checkout center using radio frequency identification (RFID) instead of barcodes. The RFID Xpr3ss will have an LCD screen, a keypad and a scanning platform as its external user interfaces. It will be important to make sure the LCD screen is large enough to read and that the keypad buttons are convenient for anyone to press. Everything should be arranged in a neat way that makes sense to the average customer and is easy for them to use. The RFID antenna will be housed inside the scanning platform. The range of this antenna is important. If the range is too long, it may read things it should not, but if it is too short, the user might have a difficult time scanning an item. The network, RS232, and power cables are external interfaces that will not be used by the customer. These should be hidden and not easily accessible to the average person who might like to pull them out. The RFID Xpr3ss should be packaged in something that is sturdy and will hold up over time. This product has the potential of being used several times per hour, so it should hold up to any abuse it receives. It is possible for the internal components to heat up significantly with continued use. For this reason, it may be necessary to include ventilation in the casing near the potentially hot components.

## 2.0 Commercial Product Packaging

### 2.1 Product #1

NCR Corporation makes a product called *FastLane-Mini* [1]. The FastLane-Mini (figure 2.1) is a self-checkout station that consists of a 15" LDC touch screen, a bar code scanner, a bag holder with a scale, a money accepter and dispenser and a credit card transaction unit. NCR has made and is testing an RFID module to be added to the FastLane, but at this time it will only be used for deactivating security tags [2]. The packaging is a large metal box with everything mounted onto it. The good thing about this package is that it is an all-in-one solution. Everything one would ever need is on this stand. The entire package does not take up a whole lot of space with respect to traditional check out lanes. The disadvantage to the FastLane design is that there exist several payment options when only one is needed per transaction. This is addressed in our design by integrating all the payment options into an account represented on the key Fob. For our application we use RFID to identify products, as opposed to UPC labels.

Figure 2.1
FastLane Mini

Our project will use the same basic layout of components as the NCR FastLane-Mini. The LCD will be placed above the RFID scanner bed in a place that is very easy to view. The keypad for entering a pin number will be located to the right of the LCD, similar to the design of NCR's product. We will not, however, have all the extra peripherals in our design. We will be using RFID only and only accepting one form of electronic payment through an RFID key ring transponder (key Fob). Our project is also intended for more of a desktop design and would affix to an already constructed desk or table.

### 2.2 Product #2

Fujitsu also makes a self-checkout station called the *USCAN1 [3]*. The USCAN1 (figure 2.2) is the closest to our design. The USCAN1 incorporates a touch-screen, a UPC reader, cash and change accepters, a keypad and card swipe, a coupon accepter and cash and change dispensers much like the NCR FastLane-mini. The LCD and keypads are in very convenient locations. A customer can scan items and read the feedback on the screen at the same time. The only flaw in this design is that the cash dispenser is quite low and could cause customers discomfort from bending over.

Figure 2.2
USCAN1

Our project will aim to optimally place integrated components. We do not need to worry about the cash dispenser or many of the other peripherals because the customer will just swipe a store-issued key Fob. This key Fob will be linked to the customer's account and the method of payment previously decided upon will be used. Our project will not be accepting cash. Fujitsu's solution is also a stand-alone unit, while ours will have to be placed on a desktop.

## 3.0 Project Packaging Specifications

The goal of our packaging is to arrange components in the most convenient, easy-to-use fashion. We will have two major parts. The RFID reader will be integrated with an antenna and packaged in a low-profile, pad-like package that is 215 x 215 x 19 mm. An RS232 cable will connect the reader/antenna combo to the main unit. The main unit will be a 300 x 150 x 50 mm plastic box with an LCD screen on the left side and a keypad on the right (see Appendix A). Since the majority of people are right handed, this setup will be the most convenient to the most

people. Our design does not incorporate the exact placement of the main unit and the scanning pad. This leaves room open to the individual retailers to decide where exactly to put the individual units. This placement will be limited by the length of the RS232 line, which is approximately 3' long. The plastic box we get for the main unit will have holes cut into it to accommodate the LDC screen, the keypad, the Ethernet jack, and the RS232 and power cables.

## 4.0 PCB Footprint Layout

The size of our printed circuit board (PCB) (see Appendix C) is only going to be limited by the size of the box that we use for the main unit. With the LCD screen and the keypad, the box needs to be at least 10" x 9" x 2". With the current footprint layout, it looks like we will be well under this size. We chose the surface mount microcontroller because it was readily available, but it is also because it should be fairly simple to work with on the PCB. For the LCD we plan to use a header on the PCB. To aid our efforts of minimizing the board size, we plan to cut the LCD ribbon cable down the middle and arrange the header as 2 x 10, as opposed to its current orientation of 1 x 20. The RJ-45 jack has a few different footprint options, but they are all so similar that we will utilize whichever one is easiest for us to acquire. Taking into consideration our current component and header footprints, as well as additional space allotted for undetermined passive components and routing, we estimate the size of our PCB to be 88 x 56 mm.

## 5.0 Summary

The main goal of our packaging is to make it as simple for the user as possible. We really have no size limitations as this is a desktop design. There also is not a weight restriction as the product would be secured to a fixed structure in an actual retail application. It does have to be slightly rugged to withstand continued use. NCR's FastLane-Mini and Fujitsu's U-SCAN are both examples of self-checkout systems that are successful and currently deployed in retail stores around the country. It would be good for our design to emulate these products in the way they are set up and made simple for the user. We will, however, modify our design to exclude several of the peripherals that these units currently use and implement RFID product and customer identification. It should technically be possible to take our product and expand it to include all the functionality of these two existing solutions. Our RFID Xpr3ss is being used to show the

feasibility of either adding RFID capabilities to the already existing units or using RFID technology exclusively. This would eliminate the need for UPC labels on products and the bulky bar code readers on the existing solutions, as well as increase the efficiency of self-checkout lanes in general.

## List of References

[1] NCR, FastLane-Mini advertisement brochure
http://www.ncr.com/en/products/pdf/hardware/sa_fastlane_mini.pdf

[2] NCR, *Worlds First "Hybrid" Self-Checkout Installed in METRO Group's RFID Innovation Center*, http://www.ncr.com/media_information/2004/aug/pr080904.htm

[3] Fujitsu, USCAN1 Self-Checkout information brochure
http://www.fujitsu.com/downloads/SOL/ftxs/datasheet/U-SCAN1.pdf

**Appendix A: Project Packaging Illustrations**

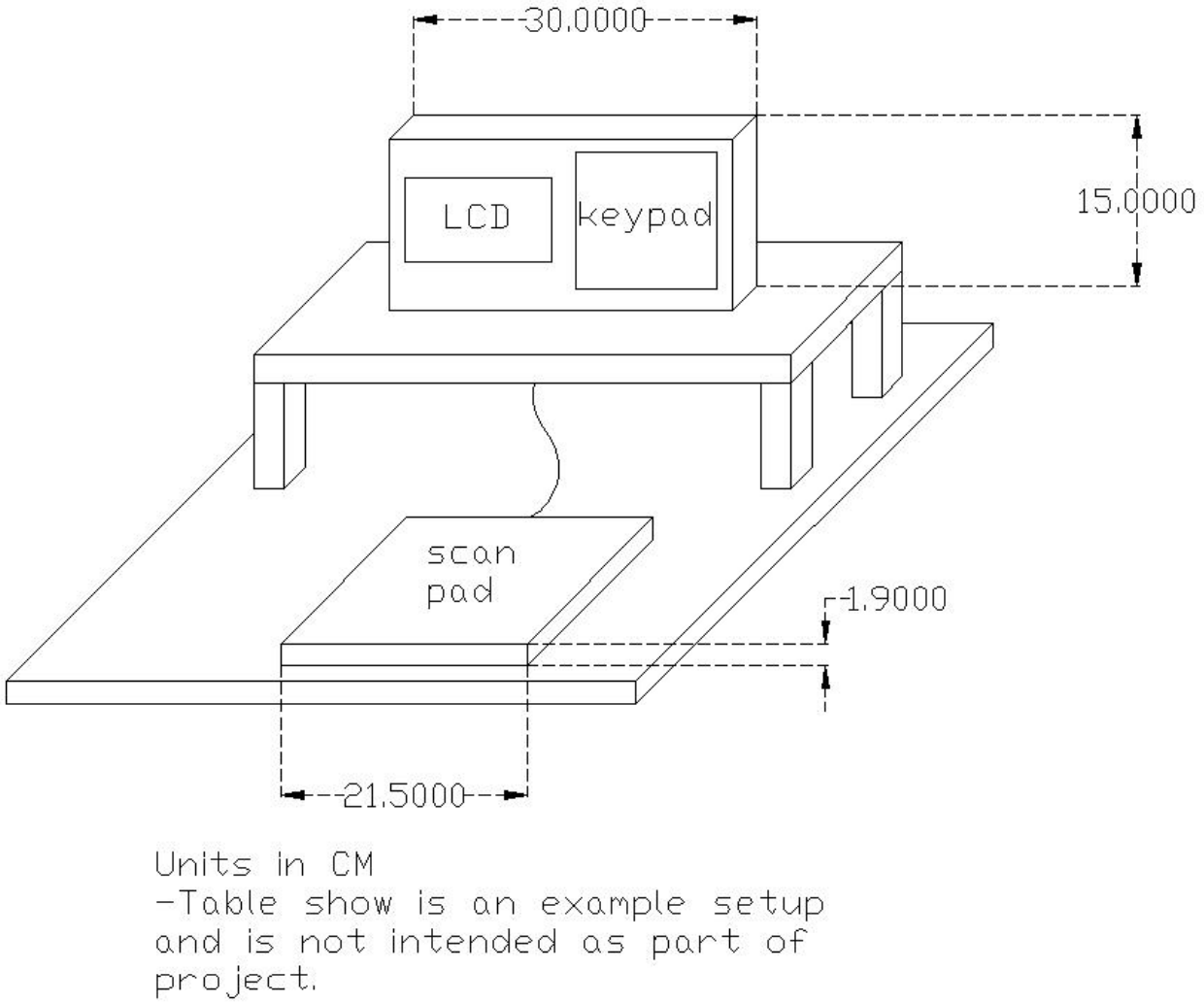


Figure 1 – CAD drawing of RFID Xpr3ss

## Appendix B: Project Packaging Specifications

| **Item** | **Tooling Required** | **Estimated Weight** | **Cost (US Dollar)** |
|---|---|---|---|
| Project Box | Holes cut for LCD, Keypad and external connections | Approx 0.75 lb | $20.00 |
| PCB | None | Approx 0.25 lb | $30.00 |
| LCD module | None | Not given<br>Approx 0.5 lb | $118.00 |
| Keypad | None | Not given<br>Approx 0.5 lb | $ 112.00 |

**Total Estimated Packaging Cost =** $280.00
**Total Estimated Unit Weight =** 2 lbs

## Appendix C: PCB Footprint Layout