SmartCart525
Shop the way YOU want!

Abstract
SmartCart525 chip is part of the low cost solution to today’s shopping problems utilizing an encrypted, closed form, real time, all-in-one reader and transmitter. Working with the Business Team (SmartCartGroup), the team is dedicated to design and to commercialize a system that accommodates the growing demand of Radio Frequency Identification (RFID) technology while creating a quicker, more convenient shopping experience.

Design Highlights
- Real-time shopping design with coupon and tax calculation ability
- Automatic checkout using built in 32-bit AES Rijndael Hardware Encryption
- Dynamic Public and Private Keys for maximum security

Features
- Fast/slow clocks encryption hardware sharing design. 60% reduction in layout for encryption
- Three types of D-Flip Flops Specialized DFF each optimized for their specific purpose with minimum transistors
- Sized Input/Output registers ensure drive strength and clean signals

Chip Functions
- Take in a 5-bit product ID from RFID receiver to find product price from a lookup table
- Keep a running total price for items to be purchased (allows for addition/removal of items from cart)
- Calculate subtotal, tax, total, and take store coupons into account
- Use Rijndael Encryption to securely transmit 32-bit store card information to store’s central computer

Technical Specifications
- Size: 324.765 µm x 289.89 µm
- Area: 92,875 µm²
- Design Aspect Ratio: 1.13
- Transistor Count: 22,120 transistors
- Transistor Density: 0.238 transistors/µm²
- Transistor Density: 4.20 µm²
- Max Clock Speed: 10MHz with fast clock running at 50MHz

Special Components
- 320 bit SRAM
- 14 x 10 carry-select adder
- 14 x 7 carry-save multiplier
- 32-bit Rijndael Encryption (AES Standard)
- Full 256 bit Rijndael Lookup Table
## Pin Description

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Direction</th>
<th>Pin Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLK</td>
<td>Input</td>
<td>Slow Clock for the non-encryption portion of the chip</td>
</tr>
<tr>
<td>2</td>
<td>CLK2</td>
<td>Input</td>
<td>Fast Clock for the encryption portion of the chip</td>
</tr>
<tr>
<td>3</td>
<td>done</td>
<td>Input</td>
<td>Done</td>
</tr>
<tr>
<td>4</td>
<td>gnd!</td>
<td>Inputoutput</td>
<td>Ground</td>
</tr>
<tr>
<td>5-20</td>
<td>input16Bit&lt;15:0&gt;</td>
<td>Input</td>
<td>16-bit input</td>
</tr>
<tr>
<td>21-30</td>
<td>lastPrice&lt;9:0&gt;</td>
<td>Output</td>
<td>10-bit output of the last price</td>
</tr>
<tr>
<td>31-33</td>
<td>operationCode&lt;2:0&gt;</td>
<td>Input</td>
<td>3-bit input operation code</td>
</tr>
<tr>
<td>34-54</td>
<td>out&lt;20:0&gt;</td>
<td>Output</td>
<td>21-bit output price</td>
</tr>
<tr>
<td>55-86</td>
<td>text_out&lt;31:0&gt;</td>
<td>Output</td>
<td>32-bit final text_out for encryption</td>
</tr>
<tr>
<td>87</td>
<td>vdd!</td>
<td>Inputoutput</td>
<td>1.8V</td>
</tr>
</tbody>
</table>

## Market Needs

- Shopping is wasteful
  - Time spent waiting in line
  - Money spent on hiring extra employees
  - $46 billion annually lost due to retail theft

## Radio Frequency Identification (RFID)

- Like a barcode, but...
  1) Omni-directional as long as the reader is in range
  2) Line of sight is not required and can be detected through ice and dirt
- Projected to be on every product in a few years.
- $8 billion industry by 2008.

## Why SmartCart525?

- Truly Affordable and Secure Next Generation Shopping
- Low production and maintenance Cost, since it is light weight, small, and durable.
- Chip has low power consumption and can easily be implemented on current carts and shopping baskets.
- Highest level of security in the least amount of effort.
- Built in dynamic public and private keys
- Hardware Encryption – hackers cannot even attempt to steal your data
- All computational intensive work is done on the chip, and therefore will not overload the CPU
- Rijndael is the new standard. It will offer increased compatibility, increased flexibility, and faster encryption.