Standards and Rules in Schematics

You can find the standard symbols for schematics here:

https://en.wikipedia.org/wiki/Electronic_symbol and also:

International Electrotechnical Commission:
IEC 60617 - Graphical Symbols for Diagrams,

IEEE Standard American National Standard Canadian Standard Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters).

Nuances

Symbols, used internationally, can be different from what we are used to in the U.S. For example, the resistor symbol commonly used in the U.S. is different from what is used internationally.

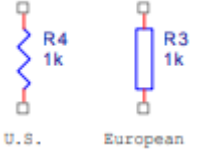


Fig. 1 USA Resistor vs. European

Regardless of symbolic representation of components, the schematic and its derivatives, such as BOM (Bill of Materials) and netlist, must have sufficient information to build a PCBA (Printed Circuit Board Assembly) successfully.

Reference Designators

A - Separable Assembly	J - Connector, Jack, Female
BT - Battery	K - contactor, relay
C - Capacitor	L - Coil, Inductor, Bead
CB - Circuit Breaker	M - Meter
CN - Capacitor Network	P - Connector, Plug, Male
D - Diode	PS - Power Supply
E - Terminal	Q - Transistor
F - Fuse	R - Resistor
G - Generator, Oscillator	RN - Resistor Network

Reference Designators, 2

S(W) - Switch	VR - Voltage Regulator
T - Transformer	W - Wire, Cable
TC - Termocouple	X - Fuse Holder, Socket
TP - Test Point	Y - Crystal
U - Inseparable, IC Package	Z - Miscellaneous

Fortunately, the symbols in KiCAD already have reference designators with not defined numbers shown as ? (R?, C?…).

Some Rules in Creating a Schematic

Use component designators, values, etc, properly and consistently

Obey basic layout and flow rules

Draw pins according to function

Make direct connections wherever reasonable

Design for regular size paper

Label key nets

Keep names reasonably short

Some Rules in Creating a Schematic, 2

Use upper case symbol names

Show decoupling caps next to the appropriate part's pins

Place a dot at every junction, try to avoid 4-way junctions.

Always Use the Same Symbol for the Same Device

Title Block must match the content of the page (Sensors, Microcontroller, Radio Modules…).

Title Block

Title Block is an important part for Document Control and for Engineering departments. It has to include information on:

- Name of the PCBA, designer's name, the date of creation, and the name of the page
- Schematic page number, if you have more than 1 page, in the form of: "page 1 of N", N is the last page
- Revision number - to track the changes
- Document number, matching the PCBA number
- Confidentiality note and other info (Do Not Staff) if necessary

Why HW Needs So Much Attention

Making a prototype of PCBA is the first step in creating a new product. The FW will be based on the HW specifications. The FW engineer has to know what pins of the microcontroller are used for communication with sensors (and what buses the sensors require), what pins are used for indicators (LED), what pins are used as digital inputs, and so on – to properly configure the microcontroller.

FW is easier to change than HW and it changes frequently. The embedded system is a part of a bigger system, and SW engineering will be required to provide data exchange of ES with the host system.

Product Description Document

Overview

Related/Reference Documents

Specifications:

- Agency Approvals (FDA, IEC, UL, CE, FCC)
- Specifications: MTBF, Operator Interface, External Interfaces, Input Power, Weight, Dimensions, Safety, External Interfaces.

How to Accelerate Product Development

Designing a new product is not an easy task. It takes significant amount of time and money, it requires good engineering skills to do the design, build and test prototypes, transfer documents to manufacturing, testing prototypes and certifying production samples, writing proper documentation and so on. Critical factor is time to market – for most businesses.

Fortunately, there are vendors who provide at least partial solutions, they can be big companies such as TI or small shops like Adafruit. They make COTS modules. Let's take a look at COTS modules.

Commercial Off The Shelf Modules

There are many COTS modules on the market now, made by different manufacturers. The modules which can be used in an ES, which I would like to consider are: SBC, SoM, CoM. RF.

SoM – System on Module

CoM – Computer-on-Module

SBC – Single Board Computer

RF Modules - Wi-Fi, BTLE, SGRF (SubGHz RF)

SBC-? Smart Bee

TI Sitara AM335X up to 1GHz

512MB DDR3

4GB eMMC Flash

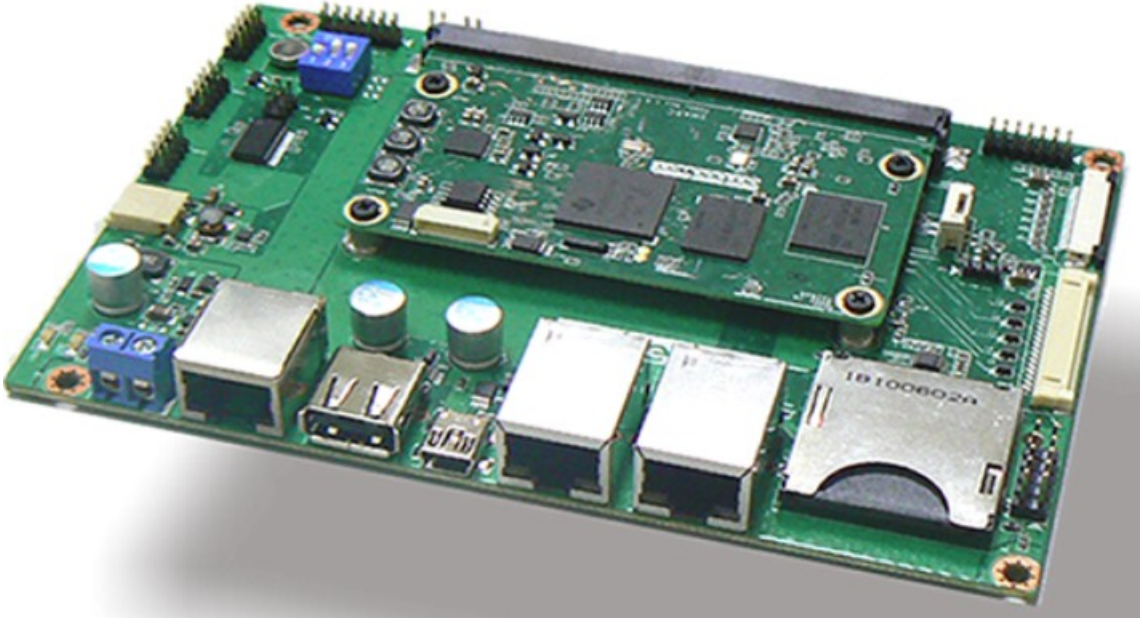
18-bit and 24-bit LVDS LCD

SDHC/SDIO

10/100Mbps Ethernet x 2

COM x 3,

USB 2.0 x 2



The Raspberry Pi 4 Model B

BCM2837 64bit ARMv8 Quad Core running at 1.5GHz, it has up to 4GB RAM,

2.4 GHz and 5.0 GHz WiFi on board,

Bluetooth Low Energy (BLE) 5.0,

Gigabit Ethernet

2 x USB 3.0 ports

2 x USB 2.0 ports

Biggle Bone Black

Processor: AM335x 1GHz ARM® Cortex-A8

512MB DDR3 RAM

4GB 8-bit eMMC on-board flash storage

Ethernet, USB host and OTG,

TF card, serial, JTAG, HDMI D type,

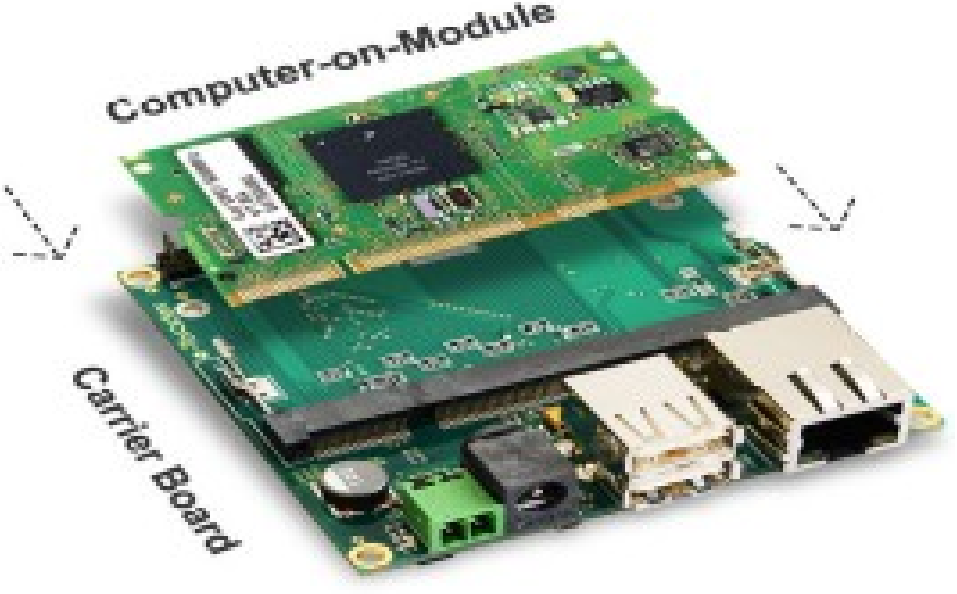
eMMC, ADC, I2C, SPI, PWM and LCD

2x 46 pin headers

ESP32 WiFi & Bluetooth Module

WiFi HT40
Bluetooth/BLE 4.2
Dual-core Tensilica LX6 MCU:
MCU has a 240 MHz frequency,
520KB* of SRAM,
4MB* of Flash
Price - $4.00

How to Make a Computer from CoM



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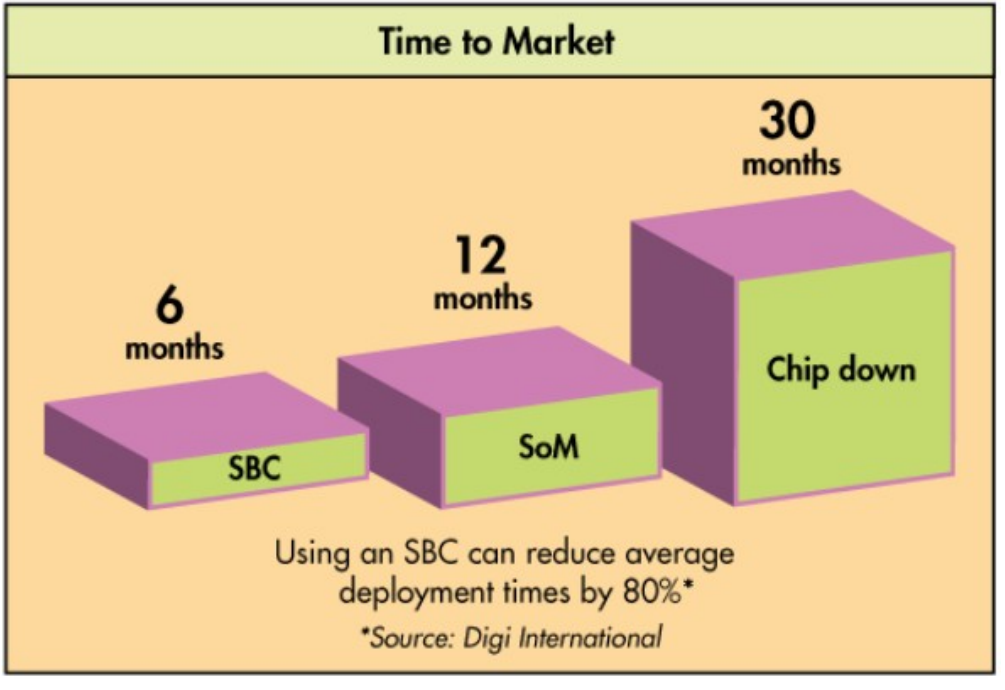

Summary

COTS modules significantly reduce time to market.

Modules are tested, certified and reliable.

Modules are ideal platforms for rapid, highly focused product Design and Development.

Now it is a Quiz time!

Good luck!