

## VEX-SOM

**DM&P Vortex86EX  
400MHz processor with FPU**

Version 4.0

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# Revision History

<b>Revision</b>	<b>Date</b>	<b>Remark</b>
1.0	Aug 14, 2014	First release.
2.0	Sep 9, 2015	New version released
3.0	Nov. 3, 2016	Add Appendix
4.0	Aug 1, 2017	Add Selection Table for I/O Function

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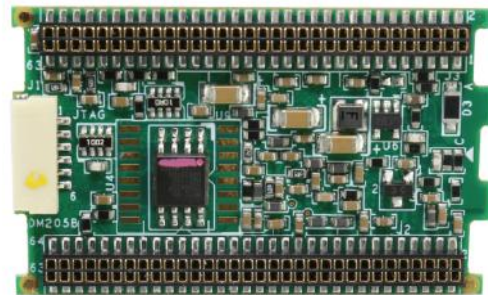
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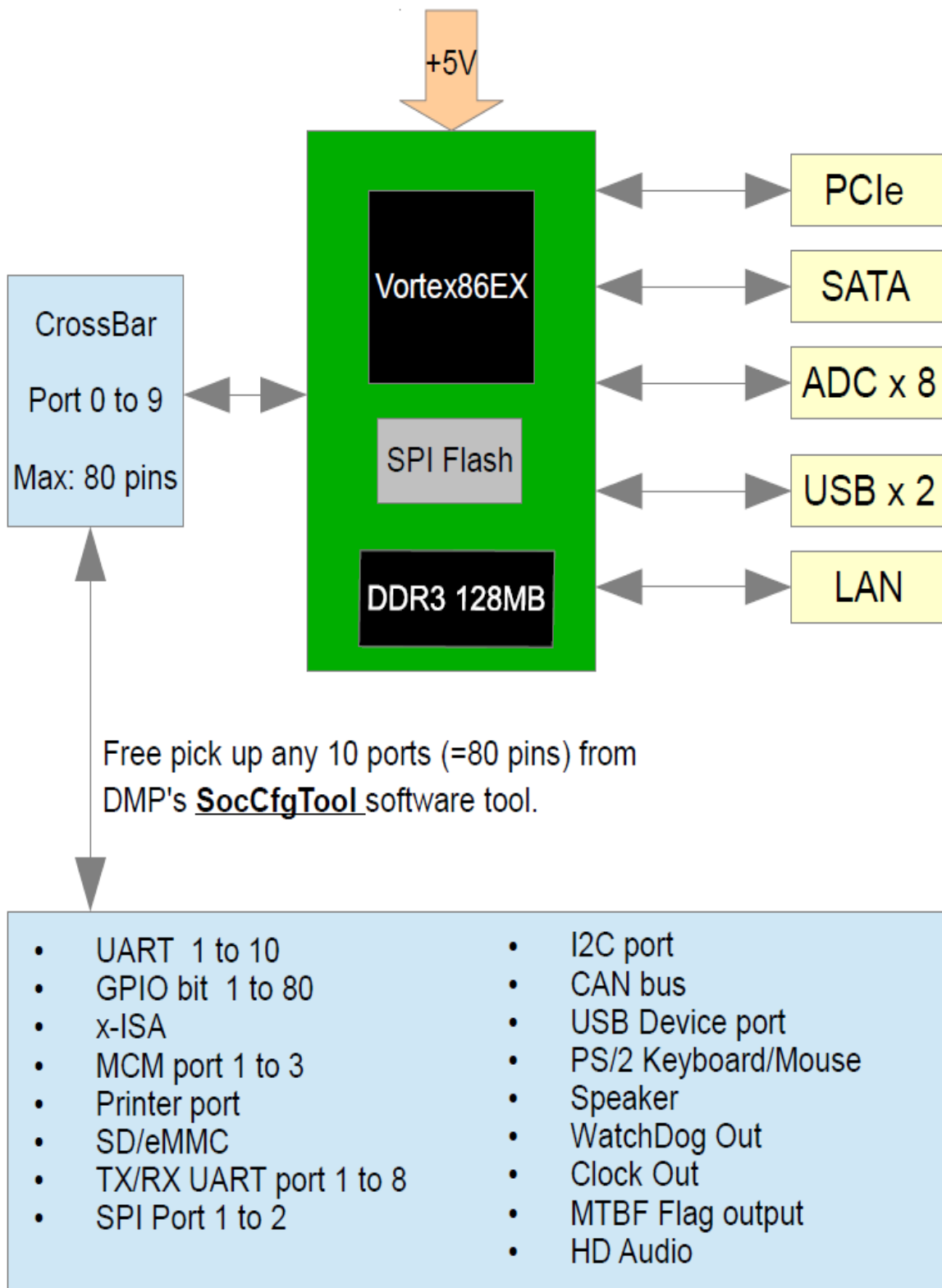
# 1 General Information

## 1.1 Overview

The VEX-SOM is a 45 x 28 mm, 128 pins, single +5V input, System On Module with onboard CPU, DRAM and SPI Flash; also take advantage of Vortex86EX Programmable I/O as a powerful, flexible, tiny and low power module.



## 1.2 Block diagram



For more detail about selecting I/O function, please refer to Chapter 3.2

## 1.3 Specifications

Processor	DM&P SoC CPU Vortex86EX 400Mhz with FPU			
Cache	L1: I/D-Cache 16/16KB, L2:128KB			
System Memory	128M DDR3 Onboard			
Flash Disk Support	128MB Onboard 7.5MB SPI Flash Disk			
I/O Interface	Integrated 10/100Mbps Ethernet x 1 SATA v1.0 x 1 port (Secondary IDE Channel) PCIe v1.1 x 1 port USB v2.0 port x 2 ADC 11-bit 100K/s x 8 channels			
I/O programmable support 10 ports (80 pins)	<b>Function</b>	<b>Description</b>	<b>Maximum</b>	<b>Unit</b>
	GPIO	General Purpose Input/Output	80	bit
	UART	16C550/16C552 compatible	10	port
	TX/RX UART	UART with only TX/RX pin	8	pair
	UART TXDEN	RS485 Auto direction control	8	bit
	x-ISA	selectable for 8/16 bit and all other signals(Only 1 DMA channel)	1	bit/ port
	MCM	Motion control module	3	port
	Printer	Printer Port	1	port
	SD/eMMC	SD/eMMC	1	port
	SPI	Serial Peripheral Interface	2	port
	CAN	Controller Area Network	1	port
	I2C	Inter-Integrated Circuit	1	port
	USB Device	USB Device port, version:1.1	1	port
	LAN LED	Link and Duplex LED for build-in Ethernet	2	bit
	Keyboard	PS/2 Keyboard	1	port
	Mouse	PS/2 Mouse	1	port
	WDTOUT	WatchDog timeout signal	1	bit
CLK OUT	Clock output select from 14.318MHz /24MHz /25MHz ISA Clock	1	bit	



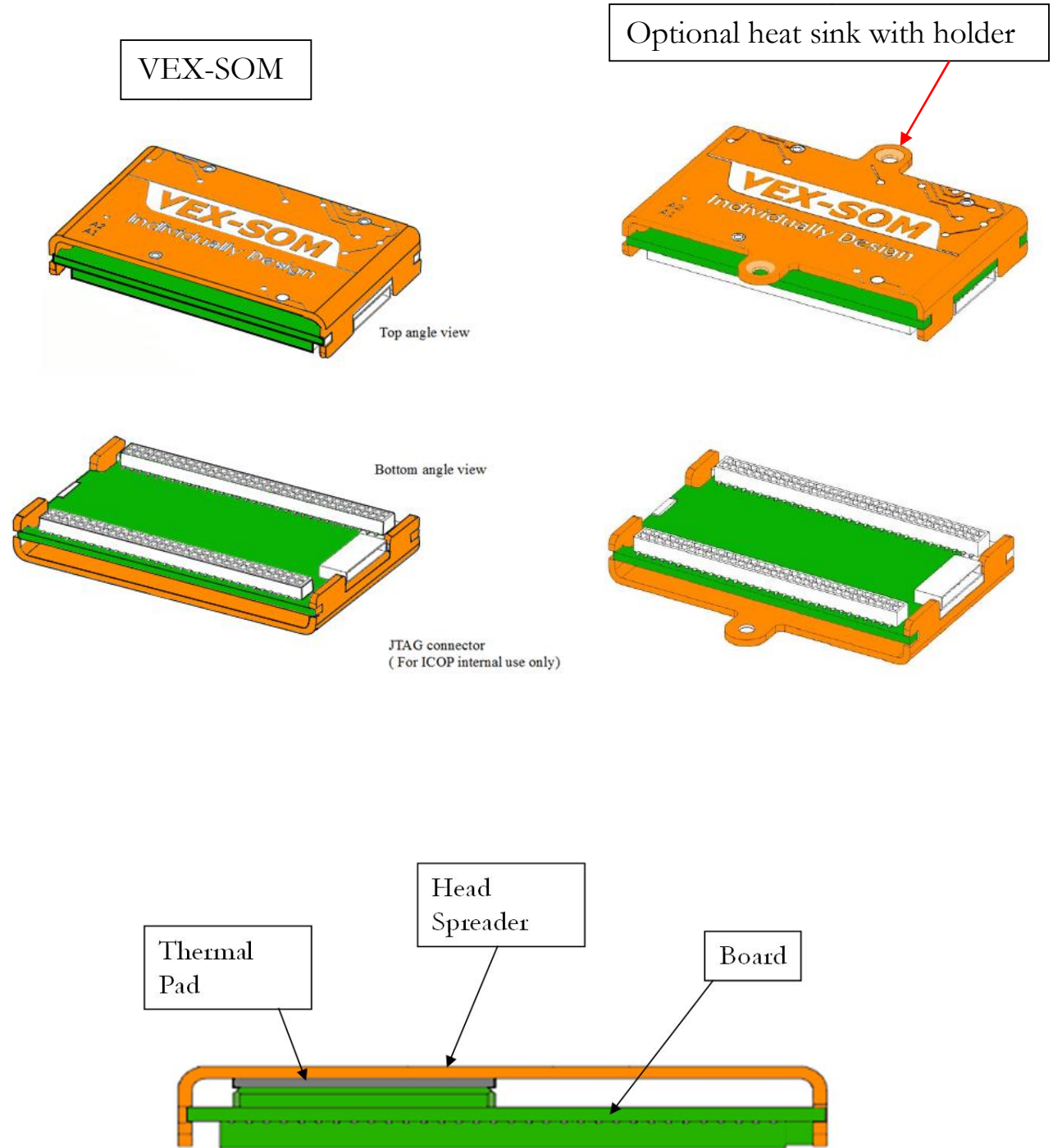
	MTBF	MTBF flag output	1	bit
	HD Audio	High Definition Audio	1	port
Power Requirement	Single Voltage +5V @ 380 mA (typical)			
Weight	10g			
Dimensions	45(L)mm x 28(W)mm x 7(H)mm (1.77 x 1.1 inches)			
Operating Temp.	-20°C ~ +70°C -40°C ~ +85°C (optional)			
Operating System Support	<ul style="list-style-type: none"> <li>- DOS</li> <li>- Linux ( Kernel 2.6.24 or later, i486 mode)</li> <li>- Windows CE 5.0 , CE 6.0 , Compact 7</li> <li>- VxWorks 5.5 &amp; 6.8</li> <li>- QNX 6.3.2</li> <li>- FreeBSD, OpenBSD and NetBSD.</li> <li>- Other real time OS has 486 supports, for example RTOS-32.</li> </ul>			

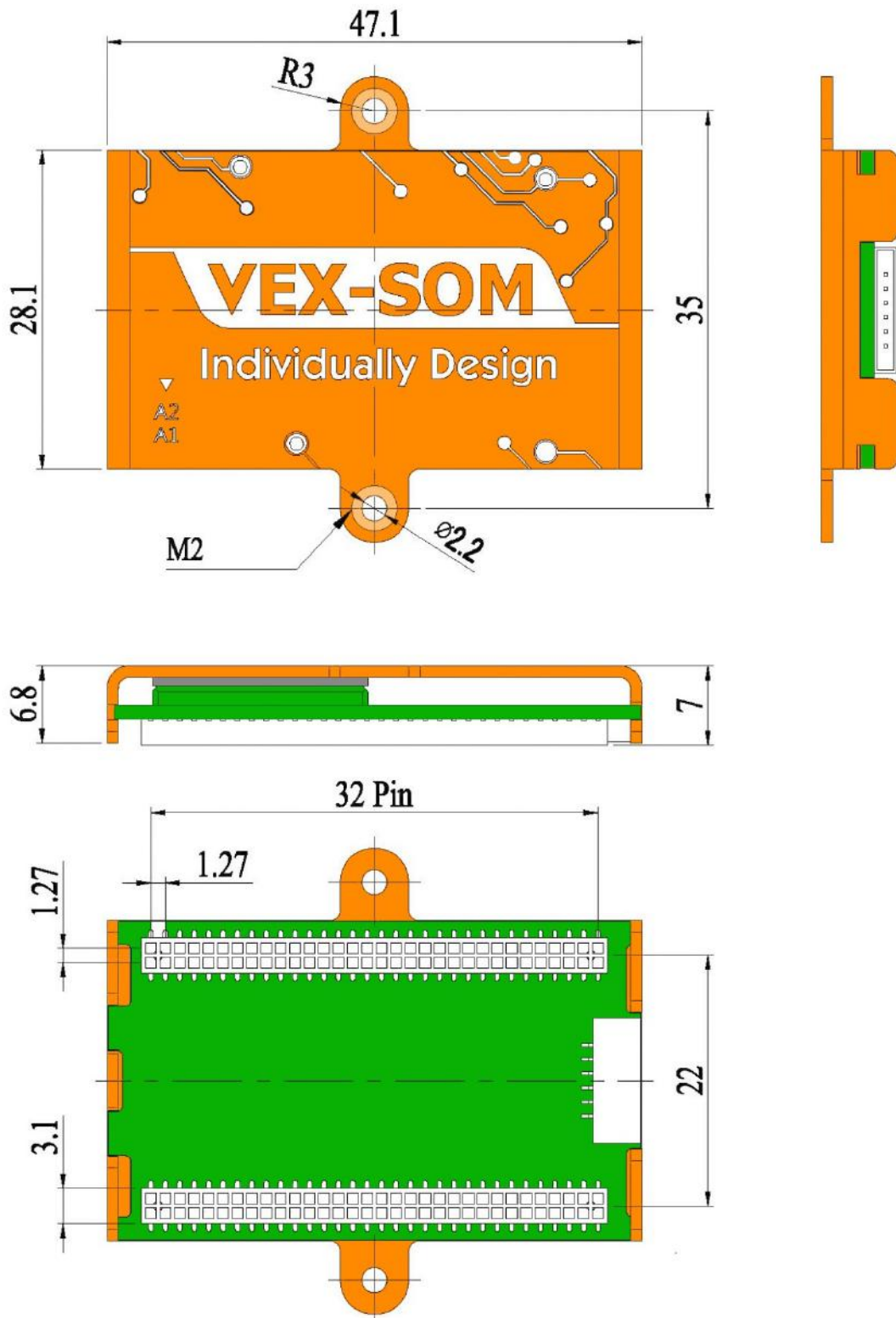
## 1.4 Ordering Information

Product Name	Description
VEX-SOM	Vortex86EX SOM 128 pin CPU Module with 128MB DDR3
VEX-SOM-X	Vortex86EX SOM 128 pin CPU Module with 128MB DDR3, -40°C ~+85°C support
VEX-SOM-DEV	VEX-SOM Development Board*1 MINIPCIE VGA cable*1 GPIO cable*5 Mini PCI VGA Board*1 Mini PCI express to PCI express converter*1 PRINT PORT cable*1 Y cable(1 Male to 2 Female)*1

# 2 Hardware Information

## 2.1 Dimension





Unit: mm

## 2.2 Connectors

### 2.2.1 Connector on Module (Female)

- Vendor: Conn Top Component INC
- Item number : P3N23-232D1BKC000I

### 2.2.2 Matching connector on board (Male)

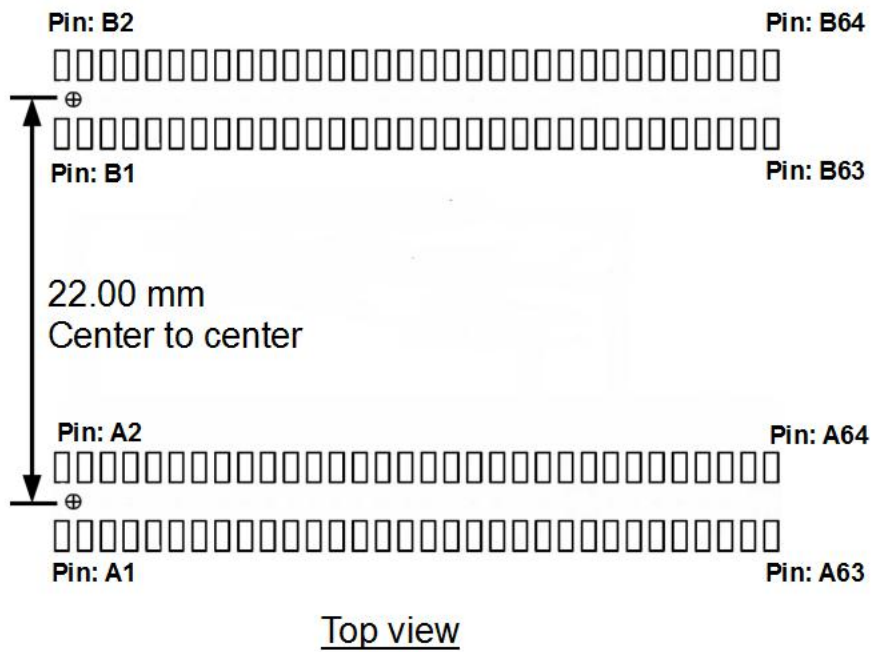
On the carrier board, it needs 2 pcs of matching connectors; there are two options below, and you can choose either one by your convenience.

- Option 1: (Note)  
Vendor: Conn Top Component INC.  
Conn Top item number: number: H3N25-232D1BKC002F  
ICOP item number: number: PH2\*32(1.27)-5.3MM
- Option 2:  
Vendor: Samtec.  
Item number: number: FTSH-132-02-F-DV

Note: Customer can buy “Option 1” connector from ICOP. The item number is PH2\*32(1.27)-5.3MM. For details, please contact ICOP sales.

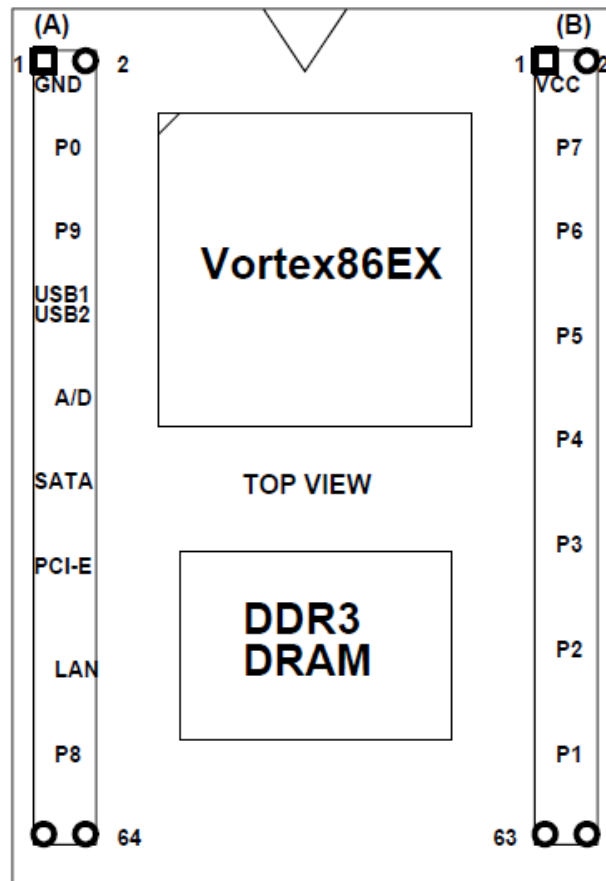
## 2.3 Recommended Layout (for module)

Please keep the whole area empty between two matching connector on your carrier board.



## 2.4 Pin Assignments & Jumper Setting

### 2.4.1 Pin assignment



As the image above, there are two rows of connector on VEX-SOM; Pin A1~A64 is on the left and Pin B1~B64 is on the right. Please see the pin assignments on the next page.

Pin#	Single Name	Pin#	Single Name
A1	RSTDRV	A2	VSS
A3	GP00	A4	GP01
A5	GP02	A6	GP03
A7	GP04	A8	GP05
A9	GP06	A10	GP07
A11	GP90	A12	GP91
A13	GP902	A14	GP93
A15	GP94	A16	GP95
A17	GP96	A18	GP97
A19	VSS	A20	VSS
A21	USBD1-	A22	USBD2-
A23	USBD1+	A24	USBD2+
A25	AGND	A26	AGND
A27	ADC_0	A28	ADC_1
A29	ADC_2	A30	ADC_3
A31	ADC_4	A32	ADC_5
A33	ADC_6	A34	ADC_7
A35	VSS	A36	VSS
A37	SATA_TX-	A38	SATA_RX-
A39	SATA_TX+	A40	SATA_RX+
A41	PE0_TX-	A42	PE0_RX-
A43	PE0_TX+	A44	PE0_RX+
A45	PE0_CLK-	A46	PCIRST-
A47	PE0_CLK+	A48	RESET-
A49	VSS	A50	VSS
A51	LANTX-	A52	LANRX-
A53	LANTX+	A54	LANRX+
A55	VBATT	A56	VCC1.8_OUT
A57	GP80	A58	GP81
A59	GP82	A60	GP83
A61	GP84	A62	GP85
A63	GP86	A64	GP87

Pin#	Single Name	Pin#	Single Name
B1	VCC_IN	B2	VCC_IN
B3	GP70	B4	GP71
B5	GP72	B6	GP73
B7	GP74	B8	GP75
B9	GP76	B10	GP77
B11	GP60	B12	GP61
B13	GP62	B14	GP63
B15	GP64	B16	GP65
B17	GP66	B18	GP67
B19	VSS	B20	VSS
B21	GP50	B22	GP51
B23	GP52	B24	GP53
B25	GP54	B26	GP55
B27	GP56	B28	GP57
B29	GP40	B30	GP41
B31	GP42	B32	GP43
B33	GP44	B34	GP45
B35	GP46	B36	GP47
B37	VSS	B38	VSS
B39	GP30	B40	GP31
B41	GP32	B42	GP33
B43	GP34	B44	GP35
B45	GP36	B46	GP37
B47	GP20	B48	GP21
B49	GP22	B50	GP23
B51	GP24	B52	GP25
B53	GP26	B54	GP27
B55	VSS	B56	VSS
B57	GP10	B58	GP11
B59	GP12	B60	GP13
B61	GP14	B62	GP15
B63	GP16	B64	GP17



## 2.5 Pin Table List

Category	Function	Pin Num.
SYSTEM	RESET-, PCIRST-	2
Programmable Interface*	GP0[7:0], GP1[7:0], GP2[7:0], GP3[7:0], GP4[7:0], GP5[7:0], GP6[7:0], GP7[7:0], GP8[7:0], GP9[7:0], RSTDRV	81
USB Interface	USB1-, USB1+, USB2-, USB2+	4
PCIE Bus Interface	PE0_TX-, PE0_RX-, PE0_TX+, PE0_RX+, PE0_CLK-, PE0_CLK+	6
SATA Interface	SATA_TX-, SATA_RX-, SATA_TX+, SATA_RX+	4
Ethernet Interface	LANTX-, LANRX-, LANTX+, LANRX+	4
ADC Interface	ADC_0, ADC_1, ADC_2, ADC_3, ADC_4, ADC_5, ADC_6, ADC_7	8
Battery Power	VBATT	1
ADC Power	AGND, AGND	2
1.8V Power	VCC1.8_OUT	1
5V Power	VCC_IN, VCC_IN	2
Digital Ground	VSS (13 PINs)	13

\*All GPIO pins are independent and can be configured as inputs or outputs. The output is 3.3V level and input is 5V tolerance. The driving current is 8mA.

## 2.6 Signal Description

### System (2pins)

PIN#	Function	TYPE	Description
A48	RESET-	I	<b>System Reset.</b> This pin is used to reset system. When it is asserted low, the board will reset . This pin is low active.
A46	PCIRST-	O	<b>PCI Reset.</b> This pin is used to reset PCI devices. When it is asserted low, all the PCI devices will be reset. This pin is low active,3.3V I/O pad.

### USB interface (4 pins)

PIN#	Function	TYPE	Description
A21	USBD1-	I/O	Universal Serial Bus Controller 0 Port 1. These are the serial data pair for USB Port 1. 15kΩ pull down resistors are connected to DP and DM internally.
A23	USBD1+		
A22	USBD2-	I/O	Universal Serial Bus Controller 0 Port 2. These are the serial data pair for USB Port 2. 15kΩ pull down resistors are connected to DP and DM internally.
A24	USBD2+		

### PCIe interface (6 pins)

PIN#	Function	TYPE	Description
A42	PE0_RX-	I	PCI-E Differential serial data input. +: positive; -:negative
A44	PE0_RX+		
A41	PE0_TX-	O	PCI-E Differential serial data output. +: positive; -: negative
A43	PE0_TX+		
A45	PE0_CLK-	O	PCI-E Differential Clock 100MHz from Internal PLL +: positive; -: negative
A47	PE0_CLK+		

### SATA interface (4 pins)

PIN#	Function	TYPE	Description
A37	SATA_TX-	O	Serial ATA Device Controller TX Port. These are the serial ATA Transmitter pair for Serial ATA Device.
A39	SATA_TX+		
A38	SATA_RX-	I	Serial ATA Device Controller RX Port. These are the serial ATA Receive pair for Serial ATA Device.
A40	SATA_RX+		

## Programmable I/O interface (80 pins)

Pin#	Function	Type	Description
A3~A10	GP0[7:0]	I/O	<b>Programmable Port 0[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Bit Mux</b> select by group.
B57~B64	GP1[7:0]	I/O	<b>Programmable Port 1[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Bit Mux</b> select by group.
B47~B54	GP2[7:0]	I/O	<b>Programmable Port 2[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Bit Mux</b> select by group.
B39~B46	GP3[7:0]	I/O	<b>Programmable Port 3[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Bit Mux</b> select by group.
B29~B36	GP4[7:0]	I/O	<b>Programmable Port 4[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Port Mux</b> select by group.
B21~B28	GP5[7:0]	I/O	<b>Programmable Port 5[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Port Mux</b> select by group.
B11~B18	GP6[7:0]	I/O	<b>Programmable Port 6[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Port Mux</b> select by group.
B3~B10	GP7[7:0]	I/O	<b>Programmable Port 7[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Port Mux</b> select by group.
A57~A64	GP8[7:0]	I/O	<b>Programmable Port 8[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Port Mux</b> select by group.
A11~A18	GP9[7:0]	I/O	<b>Programmable Port 9[7:0]</b> . Pin function is select by Programmable mechanism. This port support Programmable <b>Port Mux</b> select by group.
A1	RSTDRV	O	<b>x-ISA Reset</b> . This signal is reset signal for x-ISA bus. This pin is high active, 3.3V I/O pad.

## LAN interface (4 pins)

Pin#	Function	Type	Description
A51	LANTX-	O	<b>TXN:</b> 10B-T/100BT transmitting output pin/ receiving input pin (negative)
A53	LANTX+	O	<b>TXP:</b> 10B-T/100BT transmitting output pin/ receiving input pin (positive)
A52	LANRX-	I	<b>RXN:</b> 10B-T/100BT receiving input pin/ transmitting output pin (negative)
A54	LANRX+	I	<b>RXP:</b> 10B-T/100BT receiving input pin/ transmitting output pin (positive)

## ADC interface (8 pins)

Pin#	Function	Type	Description
A27~A34	ADC_[7:0]	I	ADC analog input

## ADC power (2 pins)

Pin#	Function	Type	Description
A25,A26	AGND	G	Analogue Ground for ADC

## Battery power (1 pin)

Pin#	Function	Type	Description
A55	VBATT	P	Battery power for RTC (Real Time Clock)

## 5V power input (2 pins)

Pin#	Function	Type	Description
B1,B2	VCC_IN	P	5V Power input.

## 1.8V power output (1 pin)

Pin#	Function	Type	Description
A56	VCC1.8_OUT	P	1.8V Power output. Maximum output: 400mA. For SPI flash disk, LAN transform .... Or other devices on carrier board which need 1.8V.

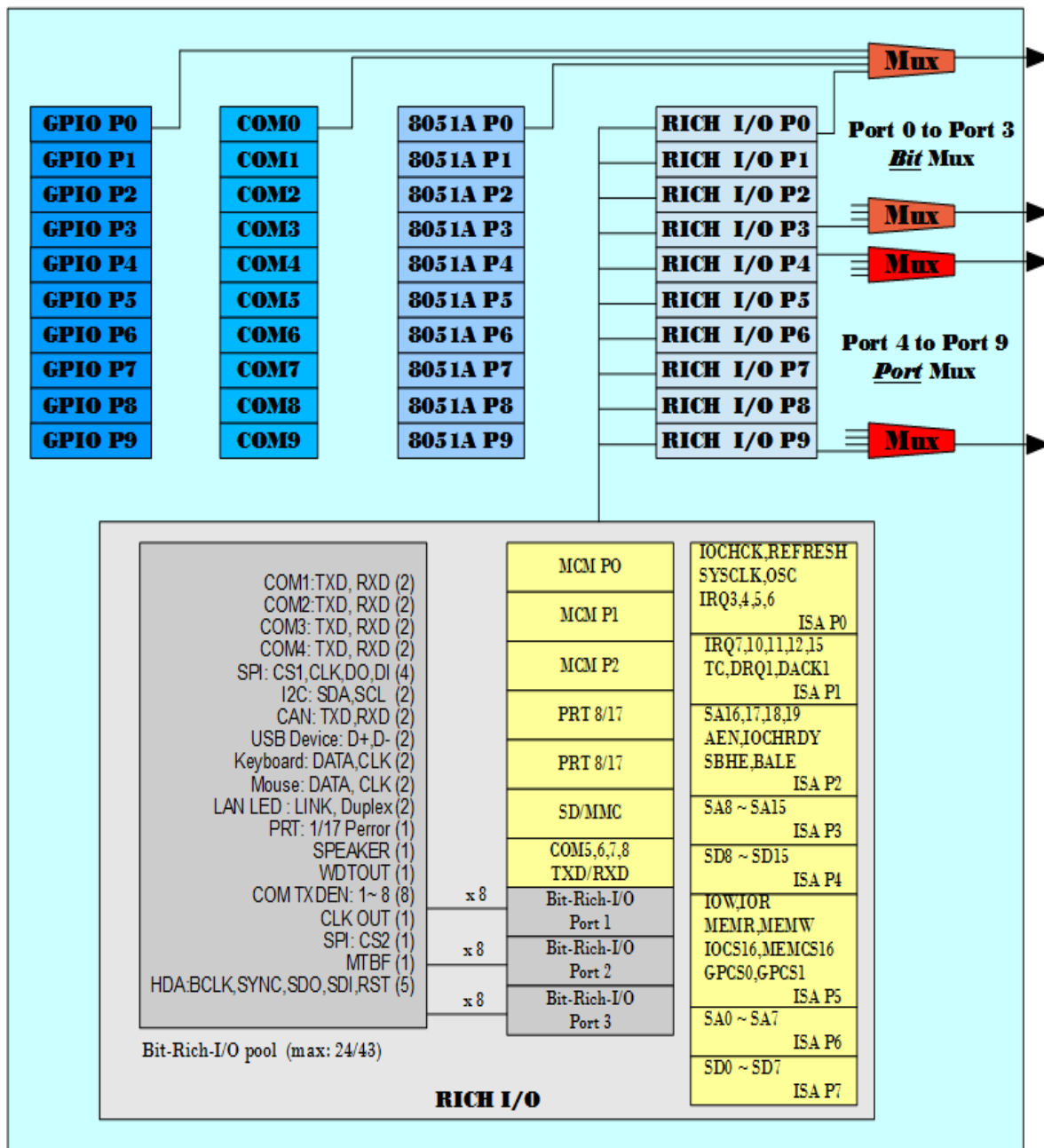
## Digital ground (13 pins)

Pin#	Function	Type	Description
A2,A19,A20,A35,A36,A49,A50, B19,B20,B37,B38,B55,B56	VSS	G	Digital Ground

# 3 Programmable I/O Selection

There are 10 ports which contain 80 pins I/O which are available freely to be assigned by you to meet your demand.

## 3.1 Programmable I/O overview



**GPIO P0~P9****COM0~9****8051A P0~P9**

Above is Port I/O, each port has 8 pins, if you need full-set COM port and 8 bits of GPIO, just simply choose those Port I/O. The 8051A functions are not opened for users because the internal 8051A already simulated 8051A as Keyboard Controller in BIOS.

**Port-Rich I/O**

The yellow color block above is Port Rich I/O; each port is 8 pins.

**Bit-Rich-I/O**

The gray color blocks above is Bit Rich I/O, totally there are 43 pins in Bit-Rich-I/O Pool; you can freely choose maximum 24 pins combine into 3 ports of Bit-Rich I/P Port.

**Port 0 to Port 3**  
***Bit Mux***

Port 0 to Port 3 is Bit Mux, which means every single bit can be selectable from Port I/O, Port Rich I/O or Bit Rich I/O.

For example, bit 0, 2, 4 are Port I/O, bit 1, 3, 5 are Port Rich I/O and bit 6 and 7 are Bit Rich I/O.

**Port 4 to Port 9**  
***Port Mux***

Port 4 to Port 9 are Port Mux, which means the whole port can only be selected to one function. For example, select the whole port for GPIO, but not 4 pins for GPIO and other 4 pins for other function.

## 3.2 Selection Table for I/O Function

As mentioned in this user manual, there are 80 I/O pins which allow you to configure as specific functions you would like to use. In order to the I/O configuration for you, please complete the I/O selection table blow and mail to us.

Function	Description	Requested Numbers	Unit
GPIO	General Purpose Input/Output		Bit
UART	16C550/16C552 compatible		Port
UART (with TX and RX only)	UART with only TX/RX pin		Pair
UART TXDEN	RS485 Auto direction control		Bit
x-ISA	selectable for 8/16 bit and all other signals(Only 1 DMA channel)		Bit/ Port
MCM	Motion control module		Port
Printer	Printer Port		Port
SD/eMMC	SD/eMMC		Port
SPI	Serial Peripheral Interface		Port
CAN	Controller Area Network		Port
I <sup>2</sup> C	Inter-Integrated Circuit		Port
USB Device	USB Device port, version:1.1		Port
LAN LED	Link and Duplex LED for build-in Ethernet		Bit
Keyboard	PS/2 Keyboard		Port
Mouse	PS/2 Mouse		Port
WDTOUT	WatchDog timeout signal		Bit
CLKOUT	Clock output select from 14.318MHz /24MHz / 25MHz ISA Clock		Bit
MTBF	MTBF flag output		Bit
HD Audio	High Definition Audio		Port

## 4 Software Resources

### 4.1 BIOS

VEX-SOM stores the BIOS in the onboard SPI flash. The default BIOS is CoreBoot BIOS for the users who would like to edit/maintain by themselves; user can download the source from [www.coreboot.org](http://www.coreboot.org).

ICOP also provides the CoreBoot BIOS service for VEX-SOM users who need quick boot (0.3 seconds) for their own specific applications. Please check with ICOP Sales for detail.

### 4.2 Software

The Vortex86EX is a x86 compatible CPU, it supports the legacy operating systems which support 486. Below is the support list.

- DOS
- Linux (Kernel 2.6.24 or later, i486 mode)
- Windows CE 5.0, CE 6.0, Compact 7
- VxWorks 5.5 & 6.8
- QNX 6.3.2 (BSP with driver source)
- FreeBSD, OpenBSD and NetBSD.
- Other real time OS has 486 support, for example RTOS-32.



# 5 ADC

## 5.1 ADC overview

The ADC is an 11-bit, 100kS/s analog-to-digital converter. This ADC adopts successive approximation register (SAR) architecture which using a 9-bit charge scaling sub-DAC for MSB and a 2-bit voltage scaling sub-DAC for LSB. The input range is between 0 and VCCA (3.3V).

Input signal range: 0V~VCCA (3.3V)

Operating voltage range: 2.93V~3.63V

## 5.2 ADC Characteristic

Parameter	Symbol	Description	Min.	Typ.	Max.	Unit
<b>DC ACCURACY</b>						
Resolution			-	11	-	Bits
Integral Nonlinearity	INL	Input is ramp signal	-2	-	2	LSB
Differential Nonlinearity	DNL	Input is ramp signal	-1	-	1	LSB
<b>ANALOG INPUT</b>						
Input Voltage Range		Single-ended inputs	-	VCCA	-	V
Input Capacitance				102.4		pF
<b>CONVERSION RATE</b>						
Input Clock	Fck	Input clock frequency	-	-	1.6	MHz
Sample Frequency	Fs	$F_{ck} = F_s \times (T_c + T_A)$ $F_{ck} = 1.5\text{MHz} / 15$	-	-	100	kHz
Conversion Time	T <sub>c</sub>			12		Cycle
Acquisition Time	T <sub>A</sub>			4		Cycle
<b>DYNAMIC CHARACTERISTICS (Fs=100kHz)</b>						
Signal-to-Noise plus Distortion Ratio	SNDR	@Fin=50kHz	61.96	-	-	dB
Effective Number of Bit	ENOB	$ENOB = (SNDR - 1.76) / 6.02$	10	-	-	Bit
<b>POWER REQUIREMENT</b>						
Analog Supply Voltage	VCCA		2.97	3.3	3.63	V
Digital Supply Voltage	VCCD		2.97	3.3	3.63	V
Digital Supply Voltage	VCCDC	Clean digital power	2.97	3.3	3.63	V

## 5.3 ADC Sample code

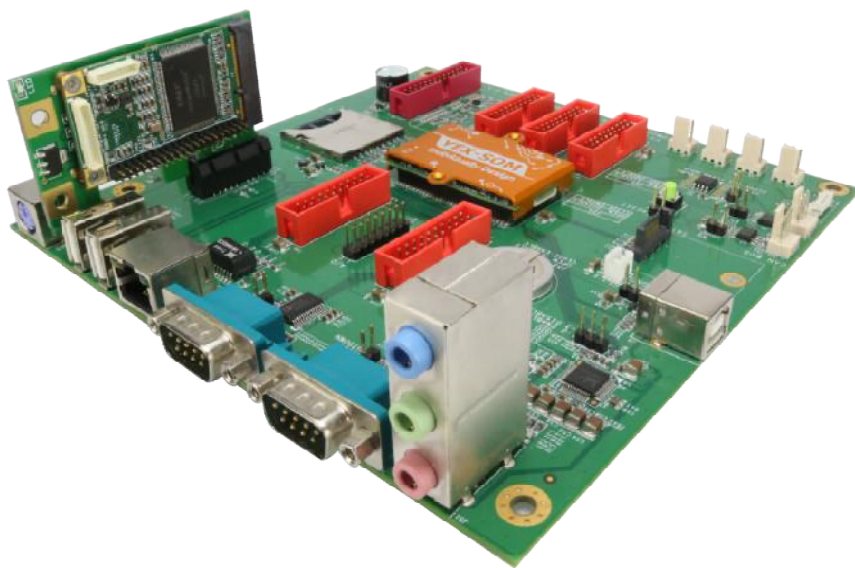
Please get the ADC sample code from your ICOP sales contact.

# 6 Evaluation Board

The whole VEX-SOM Evaluation kit includes

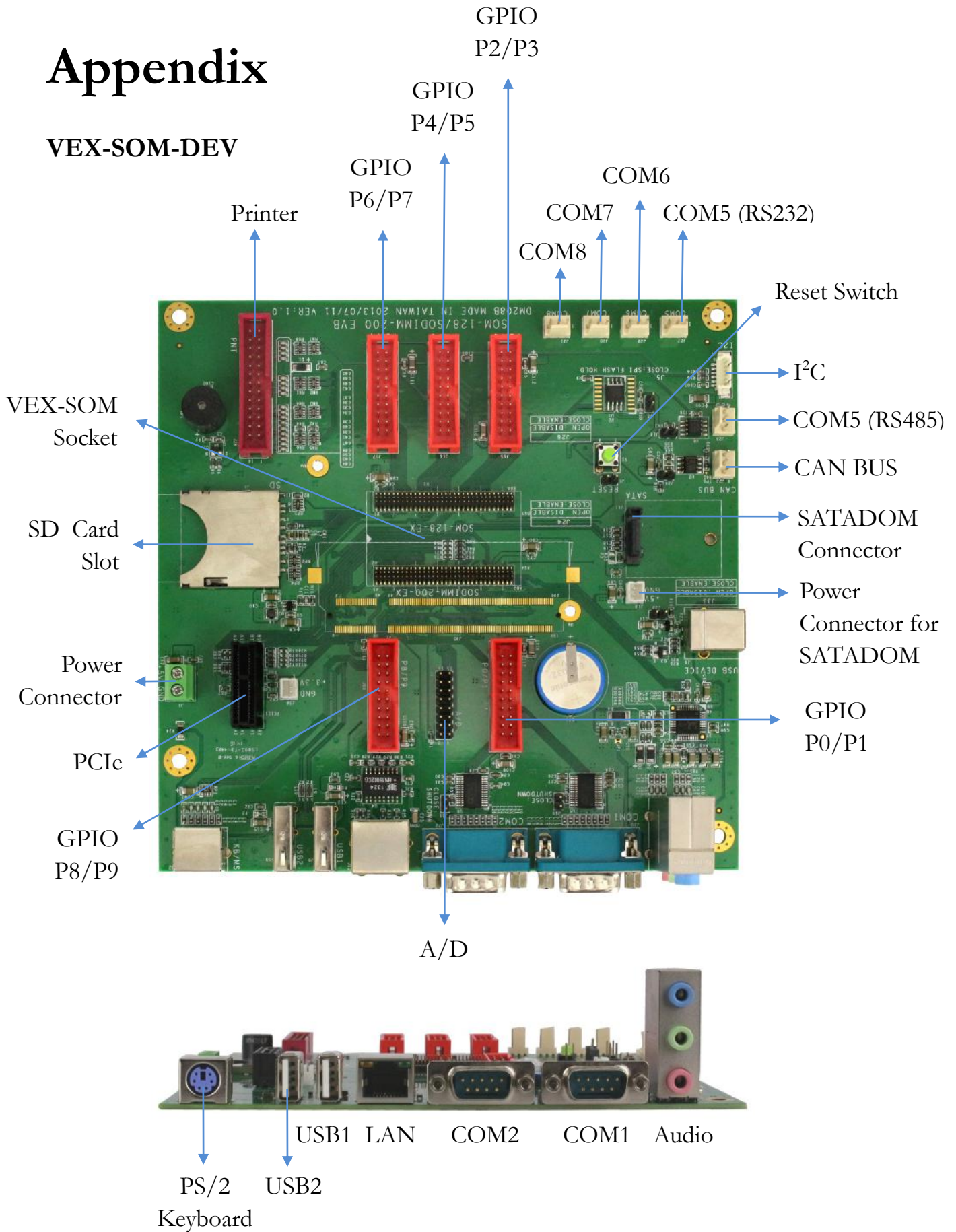
- VEX-SOM Development Board x1
- MINIPCIE VGA cable x1
- GPIO cable x5
- Mini PCI VGA Board x1
- Mini PCI express to PCI express converter x1
- PRINTET PORT cable x1
- Y cable x1

The full reference materials includes schematic (OrCAD), layout (Allegro), Gerber file, and layout guide will be provided after you purchase the VEX-SOM Evaluation Kit.

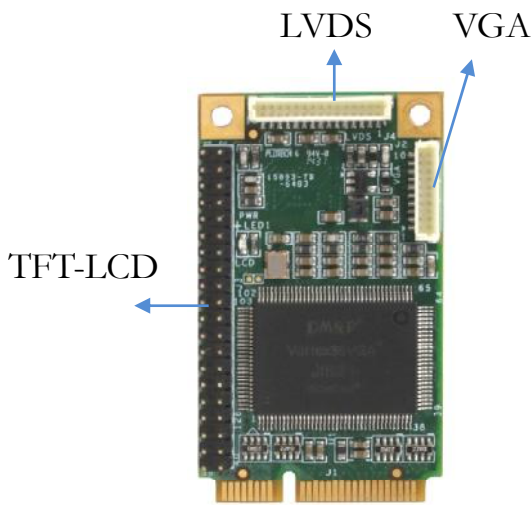


# Appendix

## VEX-SOM-DEV



**MINIPCIE-9160**



Chipset: Vortex86VGA

Interface support: VGA, TFT/LCD, and 24-bit LVDS

Maximum Resolution: 1024 x 768 @ 60Hz

VESA DDC Support

Operating Temperature: -20°C ~ +70°C

**TFT-LCD  
(Optional)**

Pin#	Single Name	Pin #	Single Name
1.	VDD	2	VDD
3	G4	4	G5
5	G6	6	G7
7	R0	8	R1
9	R2	10	R3
11	R4	12	R5
13	R6	14	R7
15	VSS	16	/
17	/	18	/
19	/	20	VSS
21	B0	22	B1
23	B2	24	B3
25	B4	26	B5
27	B6	28	B7
29	G0	30	G1
31	G2	32	G3
33	VSS	34	VSS
35	DEN	36	XCLK
37	ADJ	38	HSYNC
39	VDDEN	40	VSUNC

**24-bit LVDS  
(Optional)**

Pin#	Single Name
1	VCC3
2	VCC3
3	Y0P
4	Y0M
5	GND
6	Y1P
7	Y1M
8	GND
9	Y2P
10	Y2M
11	GND
12	CLKOUTP
13	CLKOUTM
14	Y3P
15	Y3M

**VGA  
(Default)**

Pin#	Single Name
1	ROUT
2	GND
3	GOUT
4	GND
5	BOUT
6	GND
7	HSYNC
8	GND
9	VSUNC
10	GND

## PCIE2MINIPCIE-1X005

(Adapter for MINIPCIE-9160)

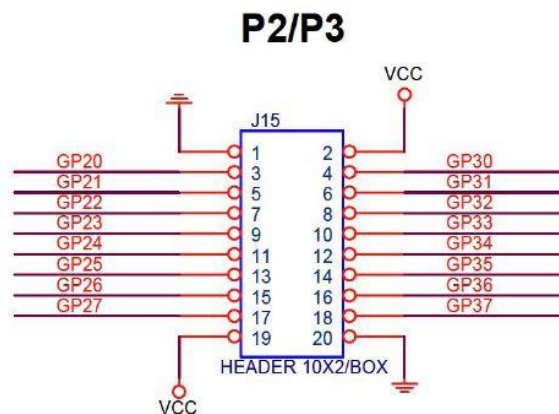


### Before Test

Please be noted that VEX-SOM is preloaded with the default BIOS, only the following functions are able to work:

- |   |                                |               |
|---|--------------------------------|---------------|
| (1) Line-In, Line-Out and MIC-In                                | (2) LAN                        | (3) USB1&2    |
| (4) Keyboard/Mouse  | (5) SD                         | (6) SPI Flash |
| (7) CAN   | (8) I <sup>2</sup> C           | (9) SATA      |
| (10) PCIe   | (11) A/D                       |               |
| (12) COM1&2 (Standard COM)                                      | (13) COM5, 6, 7, 8 (TxRx Only) |               |
| (14) GP20 to 27 (from J15, GPIO P2/3, see the left image below) |                                |               |
| (15) Printer  |                                |               |

\*\*COM5 is able to switch to RS485.



# Warranty

This product is warranted to be in good working order for a period of one year (12 months) from the date of purchase. Should this product fail to be in good working order at any time during this period, we will, at our option, replace or repair it without additional charge except as set forth in the following terms. This warranty does not apply to products damaged by misuse, modifications, accident or disaster. Vendor assumes no liability for any damages, lost profits, lost savings or any other incidental or consequential damage resulting from the use, misuse of, originality to use this product. Vendor will not be liable for any claim made by any other related party. Return authorization must be obtained from the vendor before returned merchandise is accepted. Authorization can be obtained by calling or faxing the vendor and requesting a Return Merchandise Authorization (RMA) number. Returned goods should always be accompanied by a clear problem description. Should you have questions about warranty and RMA service, please contact us directly.

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