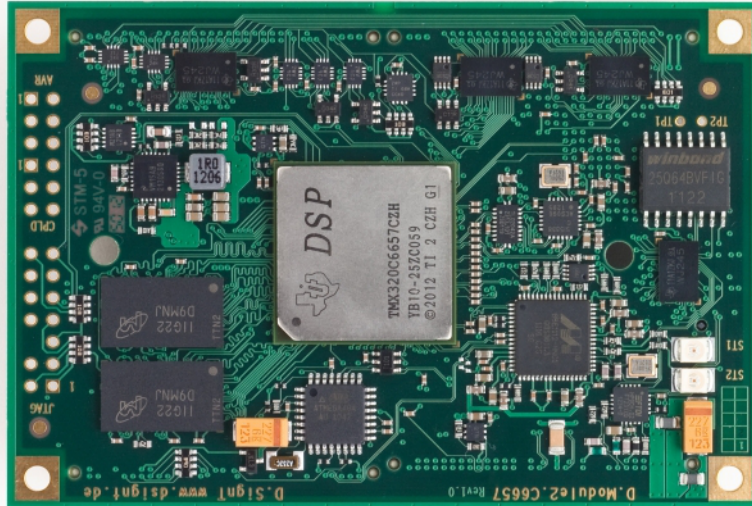


D.Module2.C6657

Hardware Revision 1.0

Document Revision 1.3

2019-12-10



Key Features

- Texas Instruments TMS320C6657 Keystone dual-core 1.25 GHz floating point DSP with Viterbi and Turbo Co-Processors
- 3 M bytes DSP-internal memory, 512 M bytes DDR3 memory, 8 M bytes NOR flash, 64 M bytes NAND flash
- PCIe and Serial Rapid IO transceivers
- Gigabit Ethernet controller, PHY and magnetics, Fiber support
- USB1.1 peripheral
- UART with RS232 / 422 / 485 interface
- D.Module2 bus interface, synchronous (uPP) and asynchronous (EMIF) modes
- I²C, SPI, GPIO, Timer, Fan Control, Temperature Monitor, Real-Time Clock
- 3.3V single-supply
- D.Module2.BIOS programming support for all onboard resources, USB / RS232-based Setup Utility for convenient field-maintenance

Applications

- ultrasonic and eddy-current material inspection
- machine vision
- software defined radio (SDR)
- radar and sonar
- surveillance and security

Description

The D.Module2 series represents the next generation of high-performance, stand-alone DSP boards. These boards are optimized for highest I/O bandwidth to satisfy even demanding applications.

The self-stacking design allows to build complete signal processing systems by stacking the required DSP, I/O, data acquisition, and networking modules. If data preprocessing is needed an FPGA module can be inserted between data acquisition and DSP.

Besides the high-speed peripheral bus the D.Module2.C6657 board provides a variety of interfaces: Ethernet, UART, USB1.1 peripheral controller, user-programmable I/O ports, synchronous serial ports, SPI, I²C, and Gigabit-speed communication interfaces. The high-speed design required special care for signal integrity and EMC. The PCB uses auxiliary GND planes to shield signals and provide controlled

impedance signal paths, the power supply lines are extensively filtered, and the connector pinout provides ample signal return ground connections.

Programming support for all on-board peripherals is provided by the D.Module2.BIOS, a set of functions resident in the module's flash memory, covering initialization, configuration, and data transfer.

The Module Configuration File stores hardware settings and user-defined configuration data, facilitating adjustments to the operating environment without program changes.

A Setup Utility, also resident in the flash memory, provides straightforward field maintenance via USB or RS232: data and program upload, configuration changes, and basic debugging functionality are available without the need for special emulator or programming equipment.

D.Module2.BIOS

The BIOS is a set of API functions, permanently stored in the flash memory. These functions are copied to SDRAM at system start-up and are available to all user programs. BIOS functions cover initialization, configuration, and data transfer functions for the on-board peripherals. The reason to store these functions permanently in the flash memory, rather than providing them as a library, is the close coupling between low-level API functions and hardware: Should one of the module's peripherals need to be substituted during product lifetime, the BIOS will be adapted to the new hardware and the application program will continue to work without any changes.

UART and USB functions

- open, close,
- write, blockwrite, write string
- read, blockread, read string

I²C Functions

- open, close
- read, write, combined read-write

Flash Memory Functions

- open, get architecture information
- sector erase
- write, write block
- read, read block
- write Intel-Hex file

Board Functions

- initialize
- bootload
- get hardware and software revision
- DSP configuration and clocking
- external bus configuration and clocking
- delay
- interrupt and GPIO mapping

SPI Functions

- open, close
- configure
- read, write

Absolute Maximum Ratings

Operating Temperature	standard: 0 to +70°C ¹⁾ industrial grade: -40 to +85°C ¹⁾
Humidity	95% r.H., non-condensing
Supply Voltage VCC	3.15 to 3.45V
Input voltage	-0.3 to VCC+0.3V (all IO Signals except PCIe, SRIO, Ethernet, RS232)

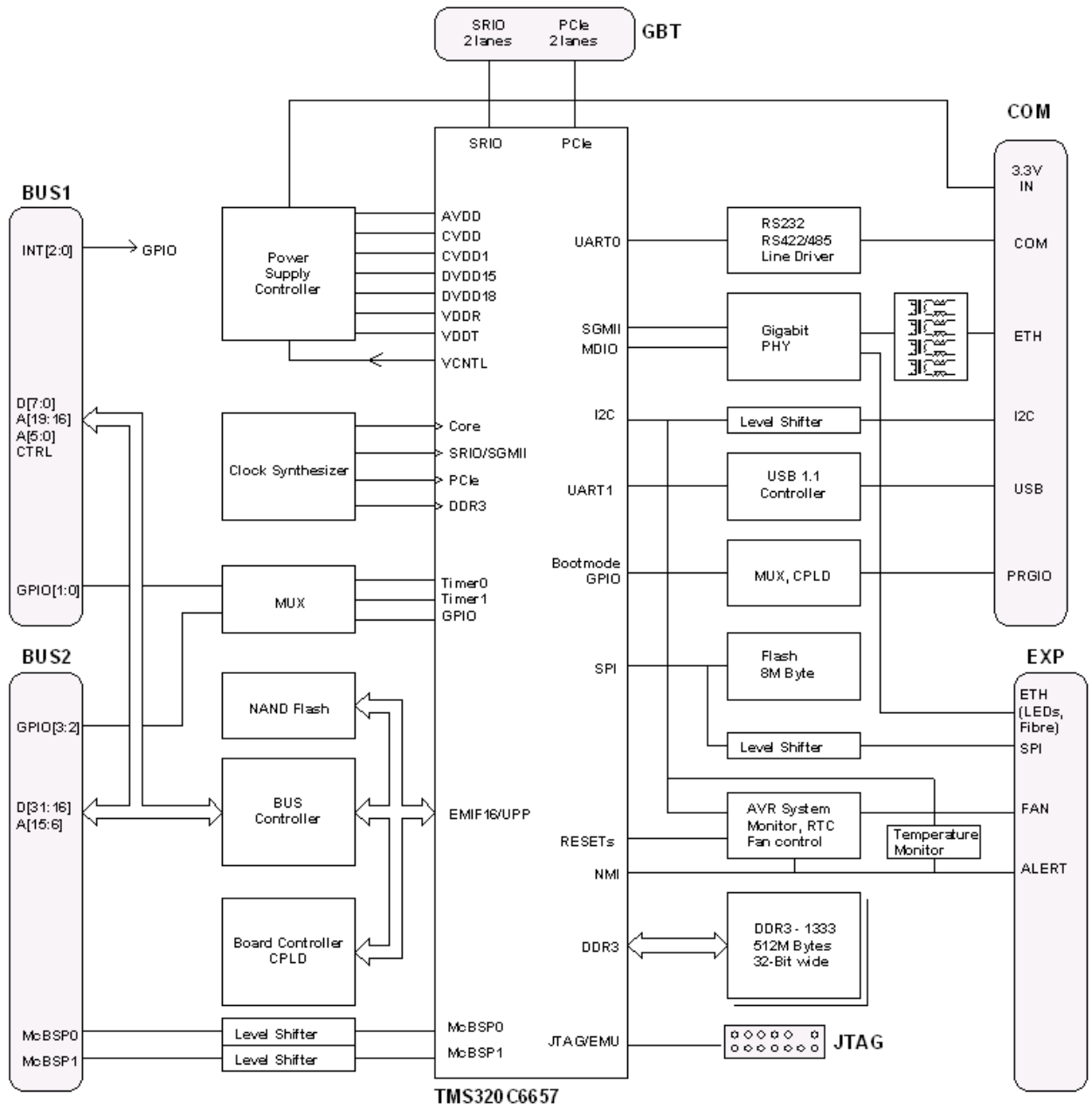
Specifications

DSP	Texas Instruments TMS320C6657, 1.25GHz, dual-core fixed- and floating-point, up to 40 GMAC fixed-point and 20 GFLOP floating point operations per second per core
Memory	32 K bytes level-1 data cache, 32 K bytes level-1 program cache per core 1 M byte DSP-internal direct mapped or level-2 cache memory per core 1 M byte DSP-internal shared memory 512 M bytes DRR3-1333 memory, 32 bits wide 8 M bytes non-volatile SPI NOR flash memory 64 M bytes NAND flash
USB	USB1.1 peripheral controller, supports USB 1.1 and USB 2.0
UART	RS232 and RS422/485 line interface max. 460.Kbps RS232, 20 Mbps RS422/485, RTS/CTS Auto-flow-control
Ethernet	1000Base-T, 100Base-Tx, and 10Base-T, DSP-internal MAC, on-board PHY and magnetics, optional external fibre-optic transceiver
I²C	one port, supports up to 400 Kbits/sec, configurable as master or slave
SPI	one port, up to 50 Mbps, master mode
Timer	two DSP-internal, 64 bit wide, internal or external clocks six DSP-internal, 64-bit wide, internal clock only
Ext. Bus Interface	EMIF-Mode: 16 bit data bus, 20 address lines, 2 pre-decoded chip selects, configurable timing UPP-Mode: synchronous Fifo interface, two ports 16- or 8-bit wide, max. clock: 75MHz 3 external interrupt inputs
Serial Ports	two McBSPs, up to 50 Mbps
PCIe	2 lanes, Gen2, up to 5 GBaud per lane
SRIO	2 lanes, SRIO 2.1, up to 5 GBaud per lane
Supervisors	Board Temperature, Watchdog, Fan PWM control, Fan tachometer supervisor
RTC	1

GPIO	16, individually programmable (8 if External Bus Interface is configured to uPP mode)
Supply Voltage	VCC 3.3 V \pm 5%
Power Consumption	2A typical, 3A peak
Logic Levels	all signals except ETH, PCIe and SRIO: LVTTTL, high-level min. 2V, max. VCC+0.3V, low level min.-0.2V, max. 0.8V, output drive: external bus interface: \pm 12mA, all others \pm 4mA
Size	86.8 x 58.4 mm, overall height including heatsink: 33mm *)
Weight	68g
Connectors	COM, EXP, BUS1 and BUS2 : Molex 71436-2164 GTP (PCIe and SRIO): Molex 46556-1145 Emulator: standard 14-pin header, 2.54mm pitch

1) The D.Module2.C6657 is shipped with a large heatsink which allows operation in convection-cooled environments up to 55°C environment temperature (65°C for industrial grade boards) . If forced cooling is provided, the board can be operated at environment temperatures up to 70°C (85°C for industrial grade boards), or ordered with a smaller heatsink on request.

Block Diagram



External Bus Interface Modes

The external bus interface can be configured to 16-bit asynchronous EMIF mode, or to uPP mode. UPP is a synchronous fifo interface which allows high-speed data transfers to/from FPGA, A/D and D/A converters. Both modes are exclusive, i.e. EMIF and uPP cannot be used simultaneously.

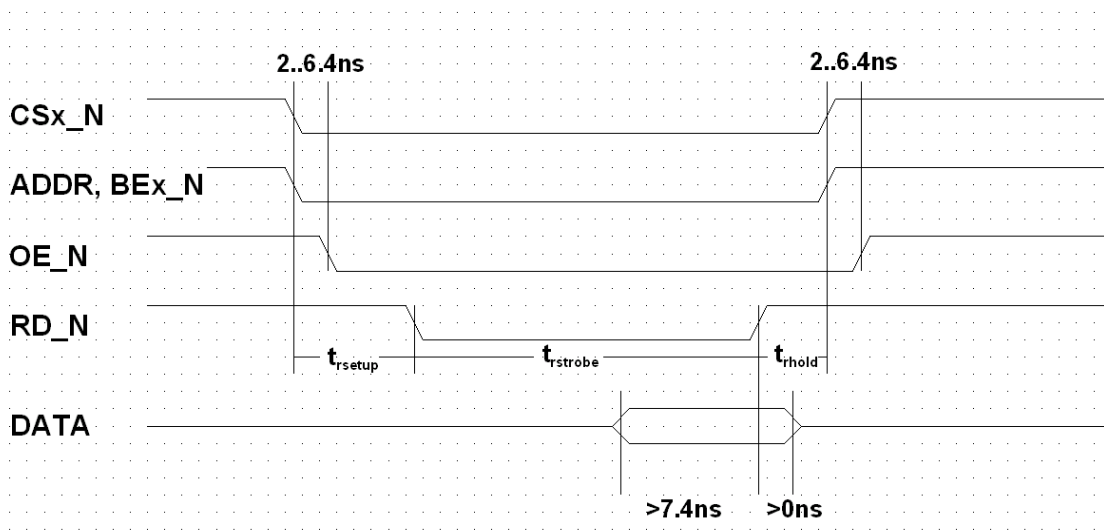
D.Module2 Pin	EMIF Mode	UPP Mode
D0	not used	CHA WAIT
D1	not used	CHB WAIT
D2	not used	CHA ENABLE
D3	not used	CHB ENABLE
D4	not used	CHA START
D5	not used	CHB START
D6	not used	CHA CLK
D7	not used	CHB CLK
D[23:16]	Data low byte	D low byte
D[31:24]	Data high byte	D high byte
A0	A0	not used
A[8:1]	A[8:1]	XD low byte
A[16:9]	A[16:9]	XD high byte
A[19:17]	A[19:17]	not used
WAIT_N	Wait State Request	2TXCLK
BUSCLK	Bus Clock (CPU Clock / 6)	not used
RD_N	Read Strobe	not used
WR_N	Write Strobe	not used
OE_N	Data Bus Driver Enable	not used
CS0_N, CS1_N	Chip Select	not used
BE2_N, BE3_N	Byte Enable (BE2: low, BE3: high)	not used

Supported UPP Port configurations:

Port D high (D31..D24)	Port D low (D23..D16)	Port XD high (A16..A9)	Port XD low (A8..A1)
-	CHA 8-bit	-	-
CHA 16-bit high byte	CHA 16-bit low byte	-	-
CHB 8-bit	CHA 8-bit	-	-
CHB 16-bit low byte	CHA 8-bit	CHB 16-bit high byte	-
CHB 8-bit	CHA 16-bit low byte	-	CHA 16-bit high byte
CHB 16-bit low byte	CHA 16-bit low byte	CHB 16-bit high byte	CHA 16-bit high byte

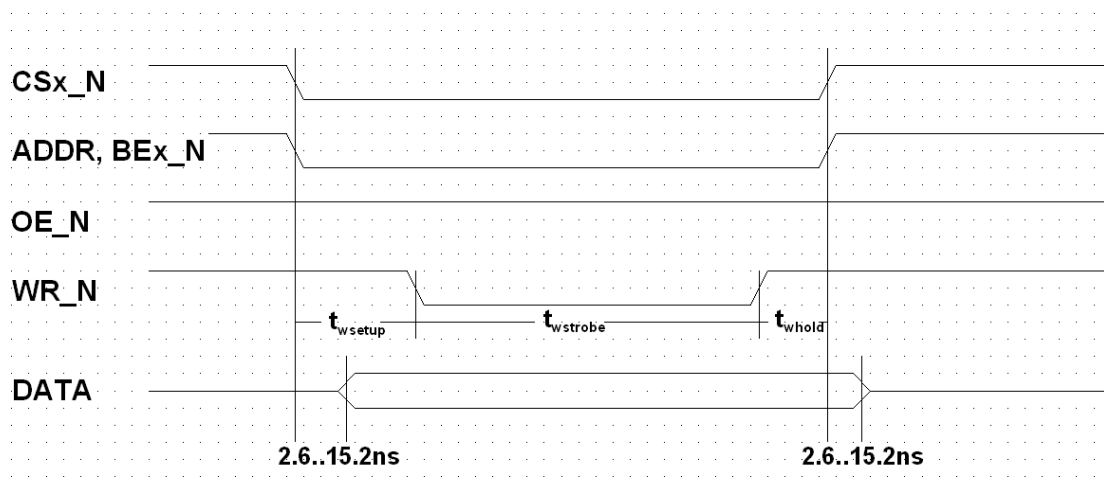
Interface Timings

EMIF Read



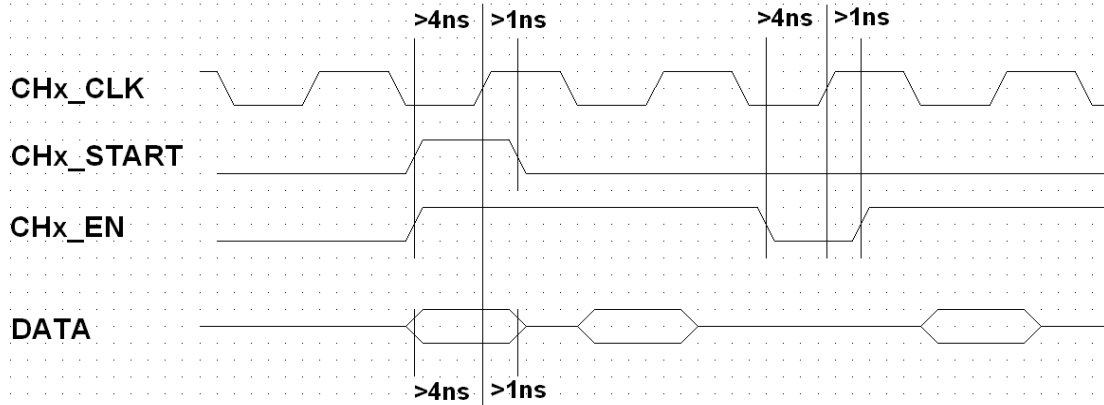
t_{rsetup} , $t_{rstrobe}$, t_{rhold} are programmable in the DSP EMIF16 Async Config Registers

EMIF Write

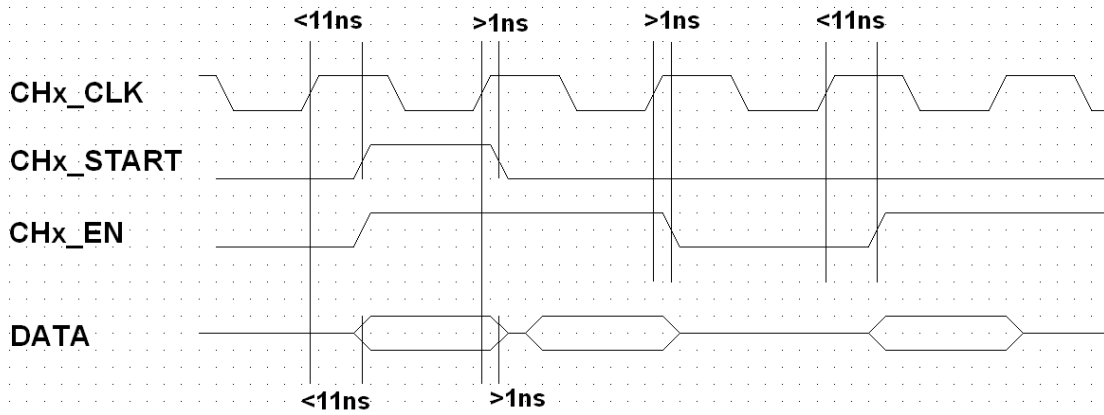


t_{wsetup} , $t_{wstrobe}$, t_{whold} are programmable in the DSP EMIF16 Async Config Registers

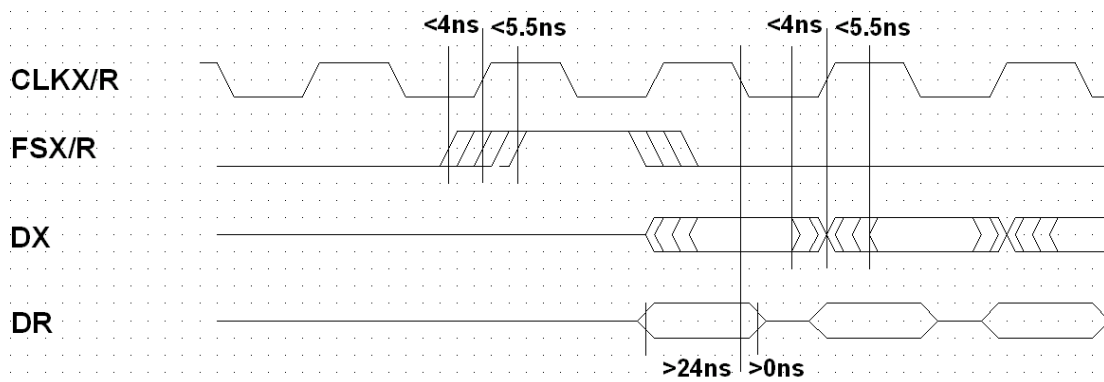
uPP Receive

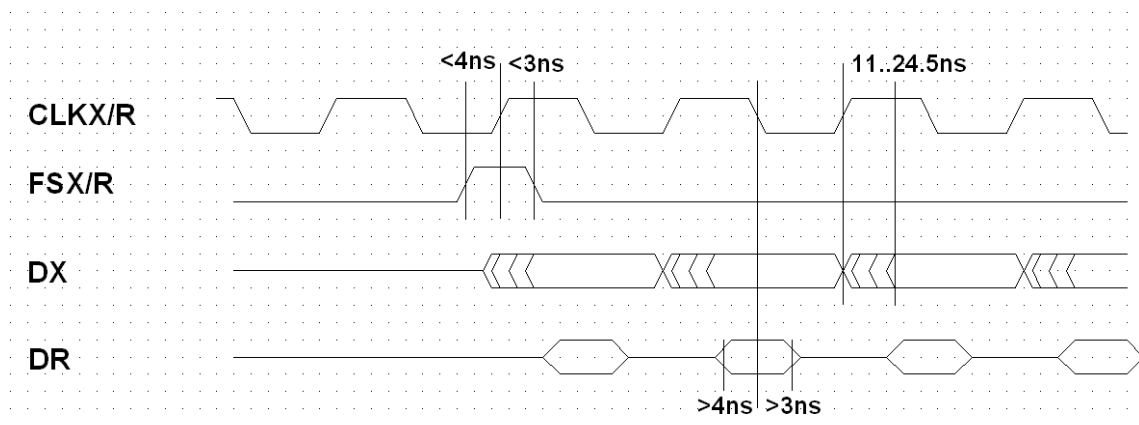


uPP Transmit



McBSP, internal CLK and FS



McBSP, external CLK and FS**SPI, I2C, GPIO**

The level shifters used on the D.Module2.C6657 add a propagation delay of 5ns. Please add this delay to the timings given in the TMS320C6657 data sheet SPRS814.

PCIe, SRIO

These interfaces are direct connections to the DSP. For timing information please refer to the TMS320C6657 data sheet SPRS814.

Signal Description and Connector Pinout

3.3V Supply IN, 0V Supply IN	Power Supply Input
3.3V OUT, 0V OUT	Power Supply to Peripheral Boards
SETUP_N, IN0_N, IN1_N	Configuration Inputs: normal system startup / Setup Mode / Recovery Mode
RESIN_N	System Reset Input
USB_D+, USB_D-, USB_GND, USB_VBUS	USB Interface
UART_RXD/A, UART_CTS/B, UART_TXD/Y, UART_RTS/Z	RS232 / RS422
ETH_TX+/TP0+,ETH_TX-/TP0- ETH_RX+/TP1+,ETH_RX-/TP1- ETH_TP2+,ETH_TP2- ETH_TP3+,ETH_TP3-	Ethernet Interface 100Base-Tx, 1000Base-T (Copper)
ETH_LED1, ETH_LED2	Ethernet external LEDs
ETH_FIN+, ETH_FIN- ETH_FOUT+, ETH_FOUT ETH_FSD	Ethernet optional external Fibre-optic Transceiver (replaces Copper Interface)
SCL, SDA	I ² C Interface
PRGIO0..PRGIO15	bit-wise programmable GPIO
RESOUT_N	External Bus Interface Reset Output
BUSCLK	External Bus Interface Clock Output
INT0_N..INT2_N	External Bus Interface Interrupt Inputs
BE2_N..BE3_N	External Bus Interface Byte Enable Outputs (BE2_N: D{23:16} , BE3_N: D{31:24})
CS0_N, CS1_N	External Bus Interface Chip Select Outputs
WR_N, RD_N	External Bus Interface Read and Write Strobe Outputs
OE_N	External Bus Interface Output Enable (data bus driver enable)
WAIT_N	External Bus Wait Request Input (master clock input in UPP Mode)
A0..A19	External Bus Interface Address Outputs (A1..A16: port XD in UPP Mode)
D0..D7	External Bus Interface Data (Control signals in UPP Mode, not used in EMIF Mode)
D16..D31	External Bus Data (port D in UPP mode)
GPIO0..GPIO3	External Bus GPIO, routable to DSP Timer, DMA Trigger, GPIO
CLKS0, CLKR0, CLKX0, FSR0, FSX0, DATR0, DATX0	McBSP Interface Port 0
CLKS1, CLKR1, CLKX1, FSR1, FSX1, DATR1, DATX1	McBSP Interface Port 1
SPI_SIMO, SPI_SOMI, SPI_CLK, SPI_SS	SPI Interface
RTC_BAT	real-time clock backup battery input
FAN_PWM0, FAN_TACHIN	external fan PWM output and tacho input
SYS_ALERT	system alert failure output, NMI input, active low, open drain
PCIe_PETp0, PCIe_PETn0, PCIe_PERp0, PCIe_PERn0 PCIe_PETp1, PCIe_PETn1, PCIe_PERp1, PCIe_PERn1	PCIe Interface
PCIe_REFCLKp, PCIe_REFCLKn	PCIe Reference Clock (input or output)
PCIe_SIDE0, PCIe_SIDE1	PCIe Sideband GPIO signals
SRIO_RX0P, SRIO_RX0N, SRIO_TX0P, SRIO_TX0N, SRIO_RX1P, SRIO_RX1N, SRIO_TX1P, SRIO_TX1N	SRIO Interface
SGND	Signal Return GND

BUS 1

Pin	Signal	Signal	Pin
1	3.3V OUT	3.3V OUT	2
3	0V OUT	0V OUT	4
5	RESOUT_N	BUSCLK	6
7	INT0_N	SGND	8
9	INT1_N	INT2_N	10
11	SGND	BE2_N	12
13	OE_N	BE3_N	14
15	RD_N	SGND	16
17	WR_N	WAIT_N	18
19	SGND	CS0_N	20
21	A0	CS1_N	22
23	A1	SGND	24
25	A2	A3	26
27	SGND	A4	28
29	A5	A16	30
31	A17	SGND	32
33	A18	A19	34
35	SGND	D16	36
37	D17	D18	38
39	D19	SGND	40
41	D20	D21	42
43	SGND	D22	44
45	D23	D24	46
47	D25	SGND	48
49	D26	D27	50
51	SGND	D28	52
53	D29	D30	54
55	D31	SGND	56
57	GPIO0	GPIO1	58
59			60
61			62
63			64

COM

Pin	Signal	Signal	Pin
1	0V Supply IN	0V Supply IN	2
3	0V Supply IN	0V Supply IN	4
5	3.3V Supply IN	3.3V Supply IN	6
7	3.3V Supply IN	3.3V Supply IN	8
9	SETUP_N	IN0_N	10
11	RESIN_N	IN1_N	12
13	USB_VCC	USB_D+	14
15	USB_GND	USB_D-	16
17	SGND	SGND	18
19	UART_CTS / B	UART_RTS / Z	20
21	UART_RXD / A	UART_TXD / Y	22
23	SGND	SGND	24
25	ETH_TP3+	ETH_TP2+	26
27	ETH_TP3-	ETH_TP2-	28
29	ETH_GND	ETH_GND	30
31	ETH_RX+/TP1+	ETH_TX+/TP0+	32
33	ETH_RX-/TP1-	ETH_TX-/TP0-	34
35	SGND	SGND	36
37	SCL	SDA	38
39		SGND	40
41	SGND		42
43	PRGIO0	SGND	44
45	PRGIO1	PRGIO2	46
47	SGND	PRGIO3	48
49	PRGIO4	PRGIO5	50
51	PRGIO6	SGND	52
53	PRGIO7	PRGIO8	54
55	SGND	PRGIO9	56
57	PRGIO10	PRGIO11	58
59	PRGIO12	SGND	60
61	PRGIO13	PRGIO14	62
63	SGND	PRGIO15	64

BUS 2

Pin	Signal	Signal	Pin
1			2
3			4
5			6
7	GPIO2	GPIO3	8
9	D0	D1	10
11	D2	D3	12
13	SGND	D4	14
15	D5	D6	16
17	D7	SGND	18
19			20
21	SGND		22
23			24
25		SGND	26
27			28
29	SGND	A6	30
31	A7	A8	32
33	A9	SGND	34
35	A10	A11	36
37	SGND	A12	38
39	A13	A14	40
41	A15	SGND	42
43			44
45	SGND	DATR0	46
47	CLKR0	FSR0	48
49	DATX0	SGND	50
51	CLKX0	FSX0	52
53	SGND	DATR1	54
55	CLKR1	FSR1	56
57	DATX1	CLKX1	58
59	FSX1	RESOUT_N	60
61	0V OUT	0V OUT	62
63	3.3V OUT	3.3V OUT	64

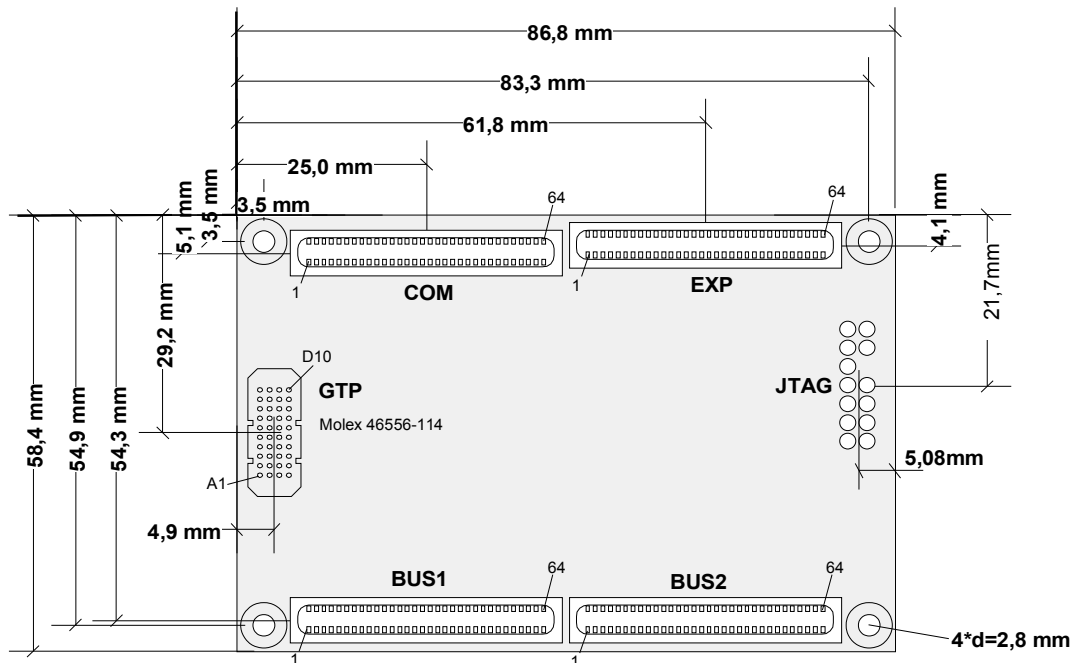
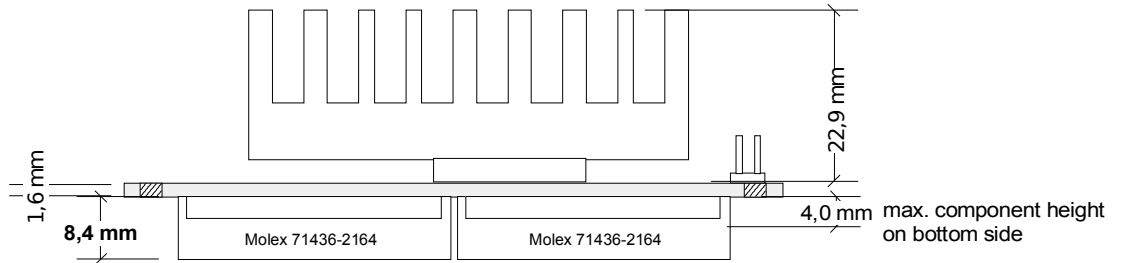
EXP

Pin	Signal	Signal	Pin
1	SGND	ETH_FIN+	2
3	ETH_LED1	ETH_FIN-	4
5	ETH_LED2	SGND	6
7	ETH_FSD	ETH_FOUT+	8
9	SGND	ETH_FOUT_	10
11			12
13		SGND	14
15			16
17	SGND		18
19			20
21		SGND	22
23			24
25	SGND		26
27	FAN_PWM0		28
29	TAN_TACHIN	SGND	30
31	SYS_ALERT		32
33	SGND		34
35			36
37		SGND	38
39			40
41	SGND		42
43			44
45		SGND	46
47		SPI_SIMO	48
49	SGND	SPI_SOMI	50
51	RTC_BAT	SPI_CLK	52
53		SGND	54
55		SPI_SS	56
57	SGND		58
59			60
61		SGND	62
63	CLKS0	CLKS1	64

GTP

	A	B	C	D
1	SGND	SGND		SGND
2	PCIe_PETp0 (DSP: PCIERXP0)	SGND	SGND	SRIO_RX1P
3	PCIe_PETn0 (DSP: PCIERXN0)	PCIe_PETp1 (DSP: PCIERXP1)	SRIO_RX0P	SRIO_RX1N
4	SGND	PCIe_PETn1 (DSP: PCIERXN1)	SRIO_RX0N	SGND
5	PCIe_PERp0 (DSP: PCIETXP0)	SGND	SGND	SRIO_TX1P
6	PCIe_PERn0 (DSP: PCIETXN0)	PCIe_PERp1 (DSP: PCIETXP1)	SRIO_TX0P	SRIO_TX1N
7	SGND	PCIe_PERn1 (DSP: PCIETXN1)	SRIO_TX0N	SGND
8	PCIe_REFCLKp	SGND	SGND	
9	PCIe_REFCLKn	PCIe_SIDE0	SGND	
10	SGND	PCIe_SIDE1		SGND

Mechanical Dimensions



COM, EXP, BUS1, BUS2, GTP connectors on bottom side, JTAG on top side
 Module Top View: COM, EXP, BUS1, BUS2 and GTP connectors seen through the PCB

Ordering Information

D.Module2.C6657	Dual-Core DSP module with TMS320C6657
D.Module2.C6657i	Industrial grade dual-Core DSP module with TMS320C6657
DK.C6657	Complete stand-alone development kit with in-circuit emulator
DK.C6657-FMC	Development package with D.Module2.C6657, D.Module2.6SLX45T FPGA daughter card, D2.Base-FMC carrier board, and in-circuit emulator
DS.TCPIP-DM6657	Ethernet Development Support Package for D.Module2.C6657



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