http://www.cubesatkit.com/

CubeSat Kit™ FM430 Flight Module

Hardware Revision: C

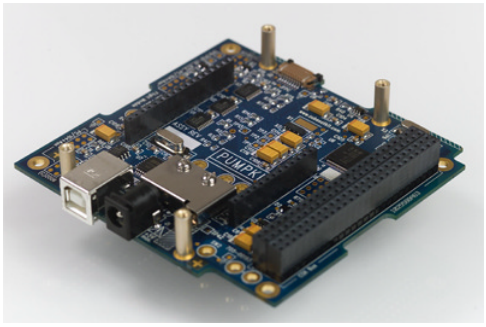
Single Board Computer for Harsh Environments

Applications

- CubeSat nanosatellite C&DH, COM, mass storage and battery / power switching
- General-purpose low-power computing in a PC/104-size form factor

Features

- +5V single supply, 3.3V I/O
- Flight MCU is TI's single-chip 16-bit MSP430 ultralow-power RISC microcontroller with 50-60KB Flash, 2-10KB RAM, 48 I/O pins, 2 USART, 2 SPI, 1 I2C, 12-bit ADC, 12-bit DAC, 3 DMA, multiple timers, on-board temperature sensor & multiple clock sources
- Stackable 104-pin CubeSat Kit Bus connectors includes complete Flight MCU's I/O space, user-assignable signals and more
- On-board low-dropout regulator and reset supervisor for maximum reliability
- Support for a wide range of transceivers
- SD Card socket for mass storage (32MB – 2GB)
- USB 2.0 device interface for pre-launch communications, battery charging and power
- Extensible to multiprocessor architectures, with Flight MCU NMI pin on bus
- Direct wiring for 10A Remove-Before-Flight and Launch switches
- Comprehensive overcurrent, overvoltage & undervoltage (reset) protection
- Independent latchup (device overcurrent) protection on critical subsystems
- Bus override for critical power and data/control paths
- Power consumption can be monitored externally
- Wiring-free module interconnect scheme
- PC/104-size footprint, with +5V and GND on PC/104 J1/J2 connectors
- 6-layer gold-plated blue-soldermask PCB with dual ground planes for enhanced signal integrity
- Compatible with Pumpkin's Salvo™ RTOS and HCC-Embedded's EFFS-THIN SD Card file FAT file system for ease of programming
- Backwards compatible with CubeSat Kit Rev. A and Rev. B FM430 Flight Modules



ORDERING INFORMATION

Pumpkin P/N 710-00252

Option Code	MSP430 Flight MCU	Flash & RAM	CubeSat Kit Bus Connector[1]
/00 (standard)	'F1612	55KB 5KB	non-stackthrough
/01	'F1611	50KB 10KB	non-stackthrough
/02	'F169	60KB 2KB	non-stackthrough
/10	'F1612	55KB 5KB	stackthrough
/11	'F1611	50KB 10KB	stackthrough
/12	'F169	60KB 2KB	stackthrough

Contact factory for availability of optional configurations.
Option code /00 shown.

CAUTION

Electrostatic Sensitive Devices

Handle with Care

[1] Stackthrough connectors are used in CubeSat Kit configurations where the FM430 is not in Slot 0.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Units
Operating temperature [2]	T_A	-40 to +85	ºC
Voltage on **+5V_SYS** bus		-0.3 to +6	V
Voltage on **–FAULT** open-collector output		-0.3 to +6	V
Voltage at external +5V power connector [3]		-20 to +20	V
Voltage on any MSP430 I/O pin		-0.3 to +3.6	V
Diode current at any MSP430 terminal		-2 to +2	mA
DC current through any pin of CubeSat Kit Bus Connector	I_{PIN_MAX}	3	A
DC current through external +5V power connector [4]	I_{EXT_MAX}	4	A
DC current through Remove-Before-Flight or Launch Switches [5]	I_{SW_MAX}	10	A
MSP430 operating frequency	f_{OP_MAX}	7.4	MHz

[2] Does not include any SD card fitted to the FM430. Typical SD card operating temperatures are –20ºC to + 65ºC.
[3] Voltages between 0V and +5.5V are passed through to +5V on the CubeSat Kit Bus.
[4] Limited by a fast-blo 4A fuse.
[5] Make only. Not rated for repetitive make and break cycles of dc current.

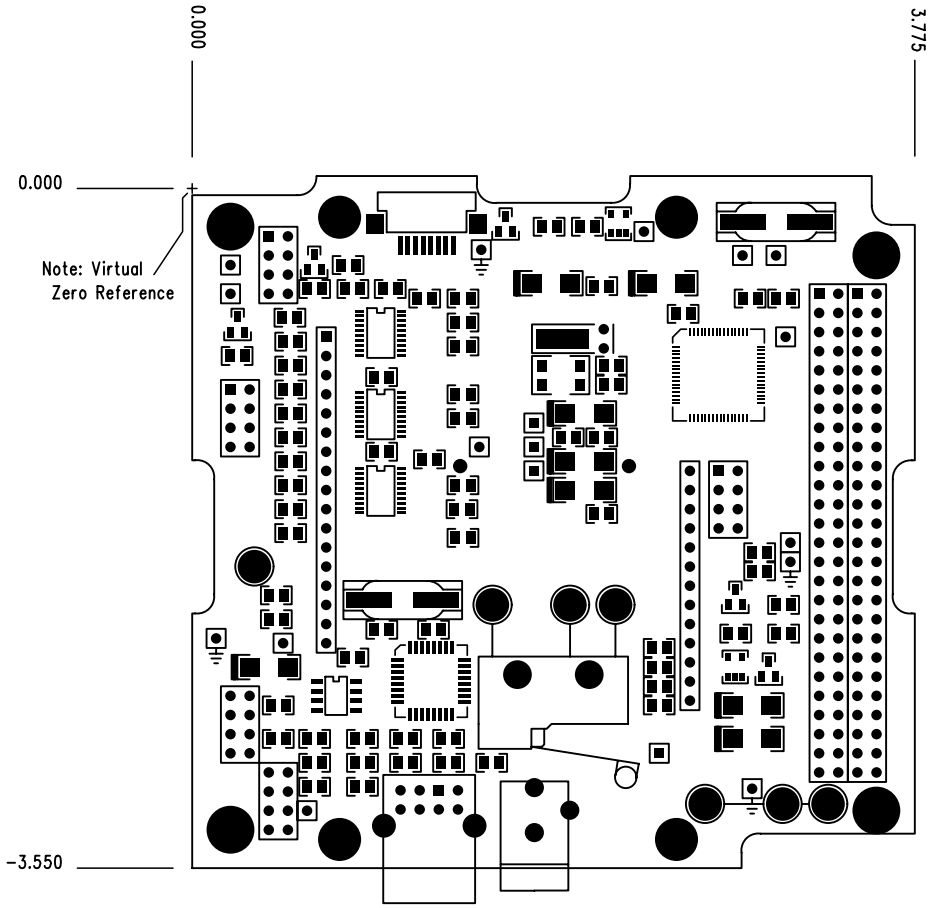
PHYSICAL CHARACTERISTICS

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Units
Mass [6]	Without MHX standoffs and 10mm CubeSat Kit Bus Connector extender (for use with 15mm standoffs)			74		g
	With MHX standoffs and 10mm CubeSat Kit Bus Connector extender (for use with 25mm standoffs)			90		
Height of components above PCB	Without MHX transceiver or 10mm CubeSat Kit Bus Connector extenders fitted				11.4	mm
	With MHX transceiver and 10mm CubeSat Kit Bus Connector extender fitted				24.5	
Height of components below PCB					3.5	mm
PCB width	Corner hole pattern matches PC/104			96		mm
PCB length				90		mm
PCB thickness				1.6		mm
Mating external power jack dimensions	Outer diameter				5.5	mm
	Internal diameter		2.1			
CubeSat Kit Bus Connector terminal pitch	Horizontal or vertical distance to nearest terminal			2.54		mm
Switch terminal hole diameter	For C, NO & NC switch terminals [7]			2.54		mm

[6] With Remove-Before-Flight Switch and cover fitted. No SD Card in socket.

[7] Common, Normally Open and Normally Closed.

SIMPLIFIED MECHANICAL LAYOUT [8]



[8] Dimensions in inches.

ELECTRICAL CHARACTERISTICS

(T = 25ºC, +5V bus = +5V unless otherwise noted)

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Units
Reset voltage	**+5V_SYS** reduced until MCU resets	V_{RESET_MAX}			3.1	V
Maximum external dc voltage	External dc voltage increased until protection circuitry forces disconnect	V_{EXT_TRIP}	0		5.5	V
Voltage drop from external dc power connector to **+5V_SYS** [9]	I_{IN} = 5mA	V_{EXT_DROP}			10	mV
	I_{IN} = 4A			400		
Operating current	LPM0, MCLK = DCO	I_{OP}		2		mA
	LMP4, all control outputs inactive	I_{SLEEP}		36	40	µA
Low-frequency clock frequency	LFXTAL	f_{CLK_LF}	32.768 ± 0.001			kHz
DCO clock frequency	DCOCLK	f_{CLK_DCO}	680	760	840	kHz
High-frequency clock frequency	HFXTAL	f_{CLK_HF}	7.3728 ± 0.0005			MHz
USB bus current [10]	Powered over USB	I_{USB_MAX}			500	mA
Overcurrent trip point for **VCC** supply	Sourced from +5V bus supply -- set by **R78**	I_{TRIP_VCC}		220		mA
Overcurrent trip point for SD Card socket	Sourced from on-board VCC (+3.3V) supply -- set by **R61**	I_{TRIP_SD}		170		mA
Overcurrent trip point for MHX transceiver socket	Sourced from +5V bus supply -- set by **R23**	I_{TRIP_MHX}		820		mA
Time to switch between **+5V_SYS** and **+5V_USB** power sources	Automatic				1	µs

For more information on TI's MSP430 ultralow-power microcontrollers, see the TI datasheets.

USB DEVICE CHARACTERISTICS

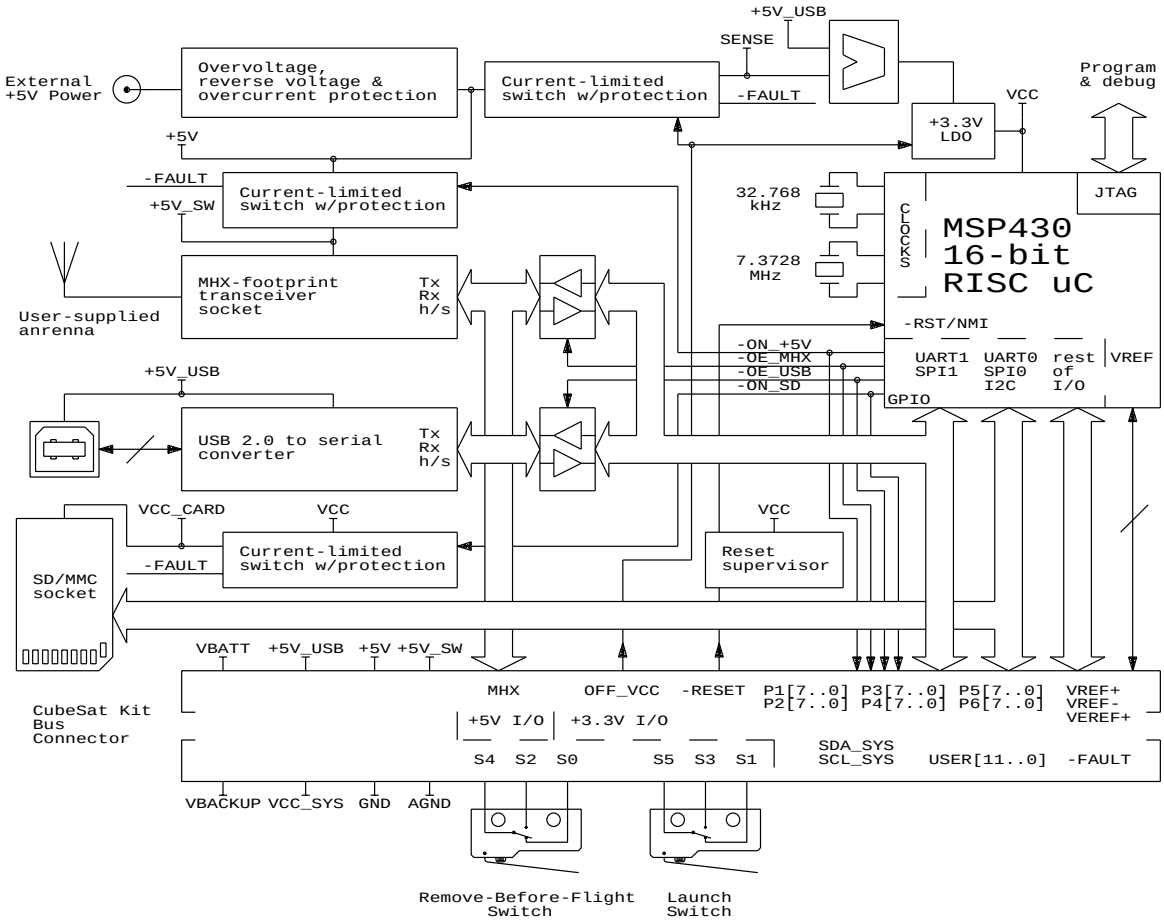
Parameter	Conditions / Notes	Value
Speed [11]	USB 2.0 compatible	Low Speed (1.5Mbps) Full Speed (12Mbps)
Vendor ID (VID)		0403
Product ID (PID)		F020
Reported options	Unique serial number	/0330
Reported serial number	Format: PUdddddd	unique to each unit
Required driver	See CubeSat Kit website	provided by Pumpkin

[9] Measured at +5V system test point TP9. External +5V passes through a fuse and an active overvoltage protection circuit before reaching system +5V. FM430 PCB is implemented with 2oz copper to minimize resistance of power traces.

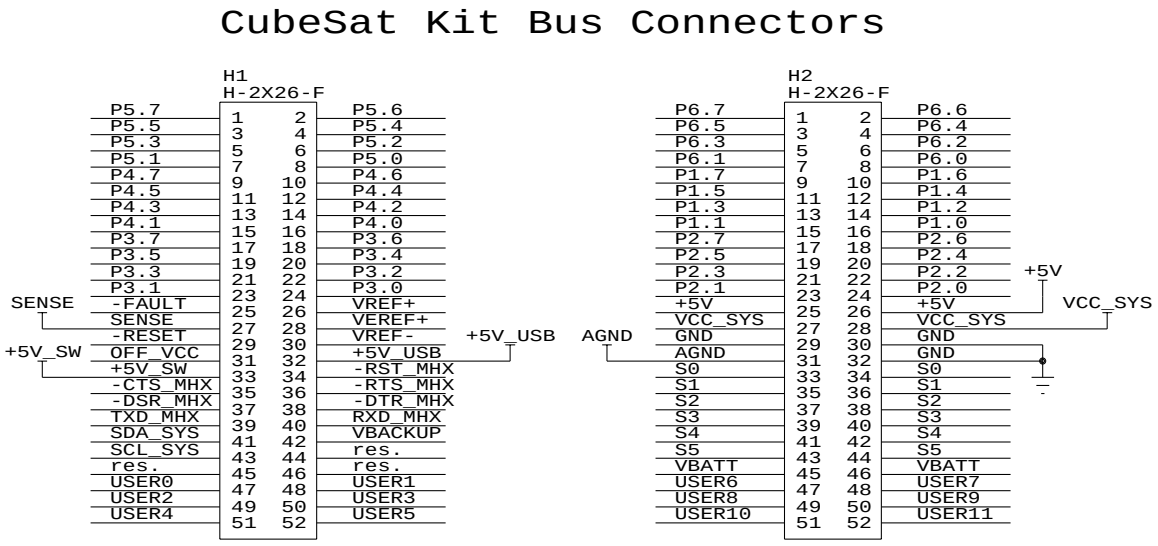
[10] The FM430's USB interface is configured at the factory to report a maximum current of 500mA for a bus-powered device to any attached USB host.

[11] Actual throughput is dependent on coding in and configuration of MSP430 Flight MCU, and is likely to be much lower.

BLOCK DIAGRAM



CubeSat Kit Bus PIN DESCRIPTIONS [12]



CubeSat Kit Bus PIN DESCRIPTIONS – MSP430 I/O Port 1

Name	Pin	I/O	Description
P1.0	H2.16	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 0. See MSP430 datasheet.
P1.1	H2.15	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 1. See MSP430 datasheet.
P1.2	H2.14	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 2. See MSP430 datasheet.
P1.3	H2.13	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 3. See MSP430 datasheet.
P1.4	H2.12	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 4. See MSP430 datasheet.
P1.5	H2.11	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 5. See MSP430 datasheet.
P1.6	H2.10	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 6. See MSP430 datasheet.
P1.7	H2.9	I/O	General-purpose 3.3V I/O. MSP430 Port P1 bit 7. See MSP430 datasheet. **–0E_USB**. Normally configured as an output. Controls FM430's USB interface.

CubeSat Kit Bus PIN DESCRIPTIONS – MSP430 I/O Port 2

Name	Pin	I/O	Description
P2.0	H2.24	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 0. See MSP430 datasheet.
P2.1	H2.23	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 1. See MSP430 datasheet.
P2.2	H2.22	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 2. See MSP430 datasheet.
P2.3	H2.21	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 3. See MSP430 datasheet.
P2.4	H2.20	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 4. See MSP430 datasheet.
P2.5	H2.19	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 5. See MSP430 datasheet.
P2.6	H2.18	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 6. See MSP430 datasheet.
P2.7	H2.17	I/O	General-purpose 3.3V I/O. MSP430 Port P2 bit 7. See MSP430 datasheet.

[12] The fact that the CubeSat Kit Bus has 104 pins (like PC/104) is purely coincidental – the original CubeSat Kit Bus used in the Rev A and Rev B FM430 had only 80 pins.

CubeSat Kit Bus PIN DESCRIPTIONS – MSP430 I/O Port 3

Name	Pin	I/O	Description
P3.0	H1.24	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 0. See MSP430 datasheet. **-CS_SD/ON_I2C**. Normally configured as an output. Controls SD card interface and off-board I2C isolator.
P3.1	H1.23	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 1. See MSP430 datasheet. **SIMO/SDA**. Normally configured as an output. SPI data out and I2C data.
P3.2	H1.22	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 2. See MSP430 datasheet. **SOMI**. Normally configured as an input. SPI data in.
P3.3	H1.21	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 3. See MSP430 datasheet. **SCLK/SCK**. Normally configured as an output. SPI clock and I2C clock.
P3.4	H1.20	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 4. See MSP430 datasheet.
P3.5	H1.19	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 5. See MSP430 datasheet.
P3.6	H1.18	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 6. See MSP430 datasheet. **RXD/TXD**. Normally configured as an output. Tx data out to transceiver or USB.
P3.7	H1.17	I/O	General-purpose 3.3V I/O. MSP430 Port P3 bit 7. See MSP430 datasheet. **TXD/RXD**. Normally configured as an input. Rx data in from transceiver or USB.

CubeSat Kit Bus PIN DESCRIPTIONS – MSP430 I/O Port 4

Name	Pin	I/O	Description
P4.0	H1.16	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 0. See MSP430 datasheet.
P4.1	H1.15	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 1. See MSP430 datasheet.
P4.2	H1.14	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 2. See MSP430 datasheet.
P4.3	H1.13	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 3. See MSP430 datasheet.
P4.4	H1.12	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 4. See MSP430 datasheet.
P4.5	H1.11	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 5. See MSP430 datasheet. **-ON_SD**. Normally configured as an output. Controls FM430's SD card interface.
P4.6	H1.10	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 6. See MSP430 datasheet. **-ON_+5V**. Normally configured as an output. Controls FM430's +5V_SW circuitry.
P4.7	H1.9	I/O	General-purpose 3.3V I/O. MSP430 Port P4 bit 7. See MSP430 datasheet.

CubeSat Kit Bus PIN DESCRIPTIONS – MSP430 I/O Port 5

Name	Pin	I/O	Description
P5.0	H1.8	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 0. See MSP430 datasheet.
P5.1	H1.7	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 1. See MSP430 datasheet.
P5.2	H1.6	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 2. See MSP430 datasheet.
P5.3	H1.5	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 3. See MSP430 datasheet.
P5.4	H1.4	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 4. See MSP430 datasheet.
P5.5	H1.3	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 5. See MSP430 datasheet.
P5.6	H1.2	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 6. See MSP430 datasheet.
P5.7	H1.1	I/O	General-purpose 3.3V I/O. MSP430 Port P5 bit 7. See MSP430 datasheet.

CubeSat Kit Bus PIN DESCRIPTIONS – MSP430 I/O Port 6

Name	Pin	I/O	Description
P6.0	H2.8	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 0. See MSP430 datasheet. **-RTS/-CTS**. Hardware handshaking for USB (**-RTS**) & MHX (**-CTS**), respectively.
P6.1	H2.7	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 1. See MSP430 datasheet.
P6.2	H2.6	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 2. See MSP430 datasheet.
P6.3	H2.5	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 3. See MSP430 datasheet. **-CTS/-RTS**. Hardware handshaking for USB (**-CTS**) & MHX (**-RTS**), respectively.
P6.4	H2.4	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 4. See MSP430 datasheet.
P6.5	H2.3	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 5. See MSP430 datasheet.
P6.6	H2.2	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 6. See MSP430 datasheet. **-OE_MHX**. Normally configured as an output. Controls FM430's transceiver interface.
P6.7	H2.1	I/O	General-purpose 3.3V I/O. MSP430 Port P6 bit 7. See MSP430 datasheet.

CubeSat Kit Bus PIN DESCRIPTIONS – Analog References

Name	Pin	I/O	Description
VREF+	H1.26	O	MSP430 **VREF+** pin. See MSP430 datasheet.
VREF-	H1.30	I/O	MSP430 **VREF-** pin. See MSP430 datasheet.
VEREF+	H1.28	I	MSP430 **VEREF+** pin. See MSP430 datasheet.

CubeSat Kit Bus PIN DESCRIPTIONS – I2C Bus

Name	Pin	I/O	Description
SDA_SYS	H1.41	I/O	Isolated I2C data. This signal is generated off-board.
SCL_SYS	H1.43	O	Isolated I2C clock. This signal is generated off-board.

CubeSat Kit Bus PIN DESCRIPTIONS – Control & Status

Name	Pin	I/O	Description
-FAULT	H1.25	O	Open-Collector output. Active LOW. Active when an overcurrent fault condition is detected by any of the FM430's three latchup prevention overcurrent switches. With series 4.7kΩ resistor. Normally pulled up externally to **VCC_SYS** or **+5V_SYS**.
SENSE	H1.27	O	Can be used to measure FM430's current consumption. The current used by the FM430 from the +5V supply to generate +3.3V on-board is (**+5V_SYS** – **SENSE**) / 75mΩ. Can also be used to bypass the primary latchup prevention in case of its failure by feeding +5V directly into **SENSE**.
-RESET	H1.29	I	Reset signal to FM430's reset supervisor. Active LOW. Pulled high to FM430's **VCC** via 30kΩ. An active signal will pull Flight MCU's **-RST/NMI** pin LOW, normally causing a reset. Can be used as a non-maskable interrupt to the Flight MCU by configuring it in software.
OFF_VCC	H1.31	I	Control signal to FM430. Active HIGH. When active, turns off all +3.3V electronics powered on the FM430. Pulled low to **GND** via 100kΩ.

CubeSat Kit Bus PIN DESCRIPTIONS – RBF and Launch Switches

Name	Pin	I/O	Description
S0	H2.33 H2.34	–	Switch terminal. Normally connected to RBF Switch normally closed (NC) terminal.
S1	H2.35 H2.36	–	Switch terminal. Normally connected to Launch Switch normally closed (NC) terminal.
S2	H2.37 H2.38	–	Switch terminal. Normally connected to RBF Switch normally open (NO) terminal.
S3	H2.39 H2.40	–	Switch terminal. Normally connected to Launch Switch normally open (NO) terminal.
S4	H2.41 H2.42	–	Switch terminal. Normally connected to RBF Switch common (C) terminal.
S5	H2.43 H2.44	–	Switch terminal. Normally connected to Launch Switch common (C) terminal.

CubeSat Kit Bus PIN DESCRIPTIONS – Power

Name	Pin	I/O	Description
VBATT	H2.45 H2.46	–	Battery voltage. EPS-dependent. Typically +7V to +10V.
+5V_USB	H1.32	–	+5V power USB power. Present whenever FM430 is connected to a USB host.
+5V_SYS	H2.25 H2.26	–	+5V system power. From EPS. All FM430 power is sourced from **+5V_SYS**.
+5V_SW	H1.33	–	+5V power. Derived from **+5V_SYS** system power. Used by transceiver. Under control of the Flight MCU. The current used by the MHX transceiver from the +5V supply is (**+5V_SYS** – **+5V_SW**) / 75mΩ. Can be overridden by feeding **+5V_SYS** directly into **+5V_SW**.
VBACKUP	H1.42	–	Battery backup voltage (e.g. for RTC's). From EPS or other module. Typically +3V to +3.6V.
VCC_SYS	H2.27 H2.28	–	+3.3V system power. Normally generated by EPS. Not normally connected to FM430's local VCC. [13]
AGND	H2.31	–	Analog ground. Connected to digital ground (**GND**) at the FM430 Flight MCU.
GND	H2.29 H2.30 H2.32	–	Digital ground.

CubeSat Kit Bus PIN DESCRIPTIONS – Transceiver Interface

Name	Pin	I/O	Description
-RST_MHX	H1.34	I	+5V reset input to transceiver. Active LOW.
-CTS_MHX	H1.35	O	+5V clear-to-send output from transceiver. Active LOW.
-RTS_MHX	H1.36	I	+5V request-to-send input to transceiver. Active LOW.
-DSR_MHX	H1.37	O	+5V data set ready output from transceiver. Active LOW.
-DTR_MHX	H1.38	I	+5V data transmit ready input to transceiver. Active LOW.
TXD_MHX	H1.39	I	+5V transmit data input to transceiver. Idles HIGH.
RXD_MHX	H1.40	O	+5V receive data output from transceiver. Idles HIGH.

[13] For maximum compatibility with earlier revisions of the FM430, **VCC_SYS** can be driven from the FM430's **VCC** via a 0Ω resistor for those applications where the EPS does not provide +3.3V and only a very small amount of +3.3V is required off-board.

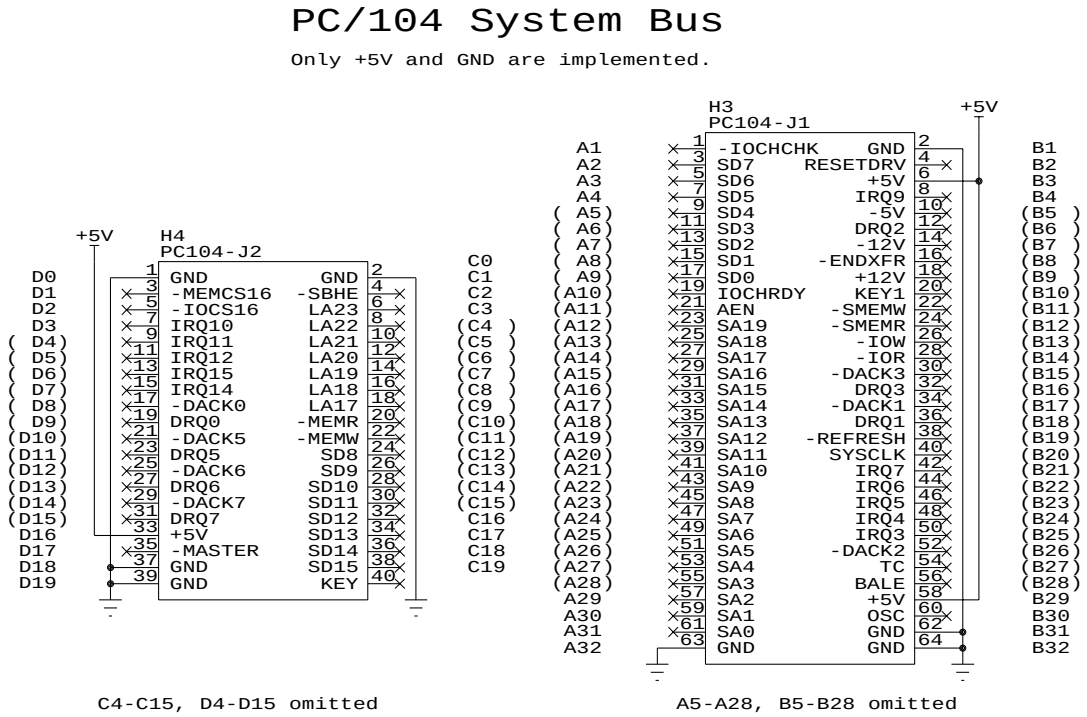
CubeSat Kit Bus PIN DESCRIPTIONS – User-defined

Name	Pin	I/O	Description
USER0	H1.47	I/O	User-defined.
USER1	H1.48	I/O	User-defined.
USER2	H1.49	I/O	User-defined.
USER3	H1.50	I/O	User-defined.
USER4	H1.51	I/O	User-defined.
USER5	H1.52	I/O	User-defined.
USER6	H2.47	I/O	User-defined.
USER7	H2.48	I/O	User-defined.
USER8	H2.49	I/O	User-defined.
USER9	H2.50	I/O	User-defined.
USER10	H2.51	I/O	User-defined.
USER11	H2.52	I/O	User-defined.

CubeSat Kit Bus PIN DESCRIPTIONS – Reserved

Name	Pin	I/O	Description
res.	H1.44	–	Reserved for future use.
res.	H1.45	–	Reserved for future use.
res.	H1.46	–	Reserved for future use.

PC/104 System Bus PIN DESCRIPTIONS



The FM430 implements a subset of the PC/104 specification in the form of two connectors that provide only +5V and GND for PC/104 modules. Only a total of 32 pins are implemented, 16 on J1 and 16 on J2. By adding up to 4 8-pin connectors to the FM430, PC/104 modules can be plugged directly into the FM430 to obtain +5V power and GND. No other connections between the PC/104 bus and the CubeSat Kit Bus are provided.

CONNECTORS

Item	Description	Source	Part Number	Application
1	52-pin non-stackthrough	Samtec[14]	ESQ-126-37-G-D	CubeSat Kit Bus connector for non-stackthrough applications (e.g. FM430 options /00, /01, /02).
2	52-pin stackthrough	Samtec	ESQ-126-39-G-D	CubeSat Kit Bus connector for stackthrough applications (e.g. FM430 options /03, /04, /05).
3	52-pin	Samtec	SSQ-126-22-G-D	CubeSat Kit Bus connector 10mm extension.
4	8-pin non-stackthrough	Samtec	ESQ-104-37-G-D	CubeSat Kit PC/104 power connector for non-stackthrough applications.
5	8-pin stackthrough	Samtec	ESQ-104-39-G-D	CubeSat Kit PC/104 power connector for stackthrough applications.
6	8-pin	Samtec	SSQ-104-22-G-D	CubeSat Kit PC/104 power connector 10mm extension.

Non-stackthrough connectors are normally fitted only to an FM430 and form an endpoint to the CubeSat Kit Bus connector stack. Stackthrough connectors are normally fitted to all other modules (e.g. EPS modules). The normal stacking height is 15mm between modules. The 10mm extension can be used to increase this distance, e.g. to 25mm. 8-pin connectors are used to provide +5V and GND (only) to PC/104 modules.

This connector information is provided for reference only.

[14] http://www.samtec.com/, 1-800-SAMTEC9.

REPLACEMENT FUSES

The overcurrent fuse F1 protects only against overcurrent conditions drawing too much current from the external +5V dc supply. It is soldered in place. The replacement fuse is LittleFuse 0451004.MRL, 4A, 125V, fast-acting Nano SMF Fuse, and is available e.g. through Digi-Key®. Should replacement be required, it should be replaced by the factory or by a qualified electronics technician.

BACKWARDS COMPATIBILITY

Please note the following when replacing a Rev A or Rev B FM430 Flight Module with a Rev C unit.

- **H4**: The incorrect pinout of the PC/104 connector J2 on Rev A and Rev B is corrected on Rev C.
- **H1**: H1 pins 25 and 27 (**XT2IN** and **XT2OUT** on Rev A, **USER0** and **USER1** on Rev B) have been replaced with **–FAULT** and **SENSE** on Rev C. As long as these pins were not used, the Rev C unit is a drop-in replacement for Rev A and Rev B.
- **Remove-Before-Flight Switch, Launch Switch & H2**: The 4 signals associated with the 6 terminals of the Remove-Before-Flight and Launch switches (called **LS_NC**, **LS_NO**, **RBF_NC** and **RBF_C** on Rev A and Rev B) have been replaced with the more general 6 signals **S0** through **S5**, respectively, and their mapping to the CubeSat Kit Bus connector has changed. Also, on Rev C there is no PCB connection between the Remove-Before-Flight switch's NC terminal / pad and the Launch switch's C terminal / pad. Therefore it is necessary to manually wire the switches to the **S0** through **S3** (RBF NC, LS NC, RBF NO and LS NO, respectively) switch pads on the PCB in a manner that duplicates the functionality of your Rev A or Rev B unit. **S4** (RBF C) and **S5** (LS C) pads and CubeSat Kit Bus Connector terminals are not used. Consult the schematics carefully when making wiring the switches – the visible wiring path will not be the same as previously implemented.
- **VCC_SYS**: **H2** pins 27 & 28 were called **VCC** on Rev A and Rev B, and were connected directly to the FM430's local regulator's output. On Rev C, they are called **VCC_SYS**, and are normally not connected to the FM430's local **VCC**. They can be connected by fitting the 0805-size 0Ω surface-mount resistor **R68** on the FM430. Use Yageo Corporation RC0805JR-070RL or equivalent and employ a qualified electronics technician to install **R68**.

MHX WIRELESS TRANSCEIVER COMPATIBILITY

The FM430 is designed to interface directly to Microhard Corporation's[15] line of MHX OEM wireless transceiver modules, and any other footprint-compatible transceivers. The mechanical interface is through four M2.5 F/F threaded standoffs at a prescribed height above the FM430 PCB. The electrical interface is through the FM430's **H5** connectors, which connect the MHX module to the FM430 via the MHX pins 1-17 and 21-33 only.[16] Because of physical differences between the earlier (e.g. MHX-2400) and later (e.g. MHX-2420) Microhard modules, users wishing to employ the later ones must replace the H5 connectors and threaded standoffs with those shown below. Additionally, the later Microhard modules have increased power requirements, often necessitating a user change to the current-limiting resistor **R23**.[17] Should currents in excess of 1.2A be required, custom user circuitry to feed **+5V_SW** via the CubeSat Kit Bus must be employed – this approach bypasses the FM430's **U12** altogether.

MHX Versions	Mounting height	H5 Connectors	Current Limit	Notes
MHX-910 MHX-2400	13mm	Samtec SSQ-113-01-G-S Samtec SSQ-117-01-G-S	820mA	Standard fitting for Assembly Rev 02.
MHX-425 MHX-920A MHX-2420 MHX-2420 SL etc.	15.6mm	Samtec ESQ-113-37-G-S Samtec ESQ-117-37-G-S	up to 1.2A is possible	Requires customer replacement of standoffs, **H5** connectors and resistor **R23**.

[15] http://www.microhardcorp.com/.

[16] These pins were originally No Connect (NC) on the MHX-2400 and similar modules. Later versions use these pins. The functionality of most of these additional pins is not required to operate these newer MHX modules (e.g. MHX-2420), and hence they are backwards-compatible with the earlier MHX modules.

[17] See Maxim MAX890L datasheet at http://www.maxim-ic.com/for more information on setting current limits.

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