AVNET®

AT&T Cellular IoT Starter Kit

Hardware User Guide

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Contents

1 Kit Overview 5
1.1 Kit Info 5
1.2 List of Features 5
1.3 Kit Power 5
1.4 Battery Power 6
2 NXP Semiconductor FRDM-K64F Freedom Development Platform 7
2.1 K64F Features: 7
3 Avnet Cellular Arduino Shield 8
3.1 Shield Block Diagram 9
3.2 Shield Features 10
3.3 LTE Modem (WNC M14A2A) 11
3.3.1 Package 12
3.3.2 Pad Connections 12
3.4 Arduino Shield connectors 16
3.4.1 Shield I/O Assignments 18
3.5 Level Translation 19
3.6 M14A2A Interfaces 19
3.6.1 UART1 19
3.6.2 UART2 20
3.6.3 SPI 20
3.6.4 I2C 21
3.6.5 Other M14A2A I/Os to Connect to Shield 21
3.6.6 USB 2.0 21
3.6.7 SIM Connector 22
3.6.8 Module Reset 22
3.6.9 ADC 23
3.6.10 I2S/PCM 23
3.6.11 RTC Power 23
3.6.12 JTAG 24
3.6.13 Unused M14A2A I/Os 24
3.7 Voltage Regulation 25

3.7.1 VREF 26
3.7.2 SIM VCC 26
3.8 Power Supply Monitor Header 26
3.9 Temperature / Humidity Sensor 26
3.10 Peripheral Module 27
3.11 Mounting holes 27
4 Other Kit Items 28
4.1 SIM Card 28
4.2 Antennas 28

1 Kit Overview

The main purpose of the AT&T Cellular IoT Starter Kit is to enable users to experiment with exporting sensor data into the cloud via a cellular radio. This is accomplished with this kit by:

- Providing a low-cost starter kit to enable development of a cellular connected IoT device
- Utilizing the low-cost WNC M14A2A cellular modem module
- Incorporating the AT&T one SIM starter pack
- Demonstrating AT&T M2X and Flow Designer

The kit contains an Avnet-designed Arduino shield to be placed on the NXP K64F Freedom board which is also included in the kit.

1.1 Kit Info

Part Number:	AES-ATT-M14A2A-IOT-SK-G
Price:	$99.00 USD
Kit URL:	http://cloudconnectkits.org/product/att-cellular-iot-starter-kit
Buy Page:	https://products.avnet.com/shop/en/ema/development-kits/aes-att-m14a2a-iot-sk-g-3074457345630122199

1.2 List of Features

The AT&T Cellular IoT Starter Kit contains the following items:

- NXP K64F Freedom board
- Avnet Cellular Arduino Shield
- AT&T SIM Starter Pack with Data Plan
- Two Pulse Electronics LTE Stealth Blade Antennas
- Two Micro USB cables
- 2.4A USB Wall Charger
- Quick Start Card

1.3 Kit Power

The input supply provided with the kit is a USB-style AC/DC converter, rated at 2.4A, delivering 5V through a USB port. This is sufficient power to feed both the shield and the K64F host board. The AC/DC converter provides 5V through the included Micro USB cable into a Micro USB connector on the shield labelled **5V/DC** in the silkscreen (X5). Powering from the shield's USB 2.0 port is not supported.

Power consumption on the shield is estimated to be 5W worst case (including efficiency drop), so the 2.4A external supply should easily be able to power both shield and host.

Powering the shield from the host (K64F board) is not supported as the K64F board does not have a power source with the necessary capacity to power both boards. The K64F board does deliver 5V through the shield connectors (signal VCC_H_5V0 on the shield), but this source is not used on the shield. VCC_H_5V0 is brought out to header J7. This Host 5V is also connected to a depopulated protection diode (D4) in case a user wants to experiment with powering the shield from a different host (at your own risk).

The K64F board has multiple options for powering from 5V. Each potential 5V source (USB ports, DC jack and shield connectors) is protected by a diode to prevent backfeeding. The result is that if you remove power from the shield but still have a USB cable plugged into the host, the host will remain powered while the shield is powered down. This state will not cause damage. The diodes on the K64F board prevent potential damage from having multiple 5V sources present.

The shield 5V input also connects to a 2-pin jumper (JP2) to optionally source power from the shield to the host board (K64F board in this kit). The default is for the jumper to be installed.

1.4 Battery Power

An external, USB-style battery pack is supported. It is recommended that the supply be capable of sourcing 2A. Use a Micro USB cable to connect the battery to the primary power input jack on the shield.

2 NXP Semiconductor FRDM-K64F Freedom Development Platform

For more information on the host platform, see the following links

http://www.nxp.com/products/software-and-tools/hardware-development-tools/freedom-development-boards/freedom-development-platform-for-kinetis-k64-k63-and-k24-mcus:FRDM-K64F

https://developer.mbed.org/platforms/FRDM-K64F/

2.1 K64F Features:

- Kinetis MK64FN1M0VLL12 MCU
    - 120 MHz
    - 1 MB Flash memory
    - 256 KB RAM
    - Low-power, crystal-less USB
- Dual role USB interface with micro-B USB connector
    - OpenSdav2 and JTAG for hardware debugging
    - UART
- USB 2 Go / USB User Port
- RGB LED
- 6-axis FXOS8700CQ accelerometer and magnetometer
- Two user push buttons
- Ethernet
- GPIOs, UARTs, SPI, I2C

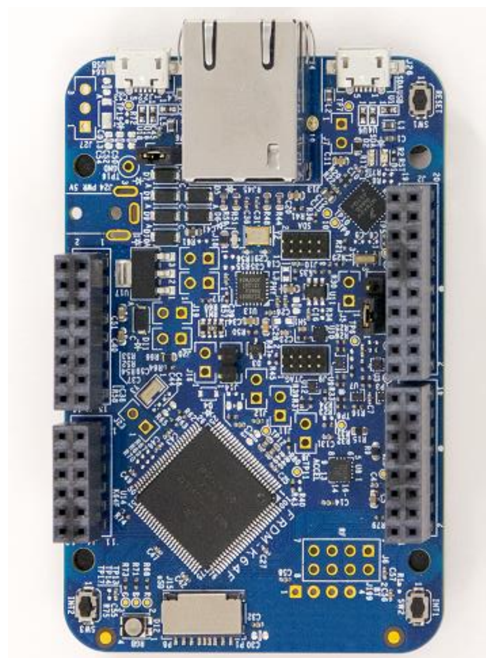


Figure 1 – K64F Board

3 Avnet Cellular Arduino Shield

The following sections provide brief description of each feature provided on the AT&T/WNC Cellular Shield.

- LTE Modem (WNC M14A2A)
- SIM connector
- Micro USB connector
- Arduino Shield connectors
- DC/DC regulator for Modem VCC – 3.8V
- Antennas (2)
- Pmod x1
- Temp/Humidity Sensor

All components meet or exceed temperature range –25 °C to +75 °C.

3.1 Shield Block Diagram

The following block diagram illustrates the Cellular Shield.

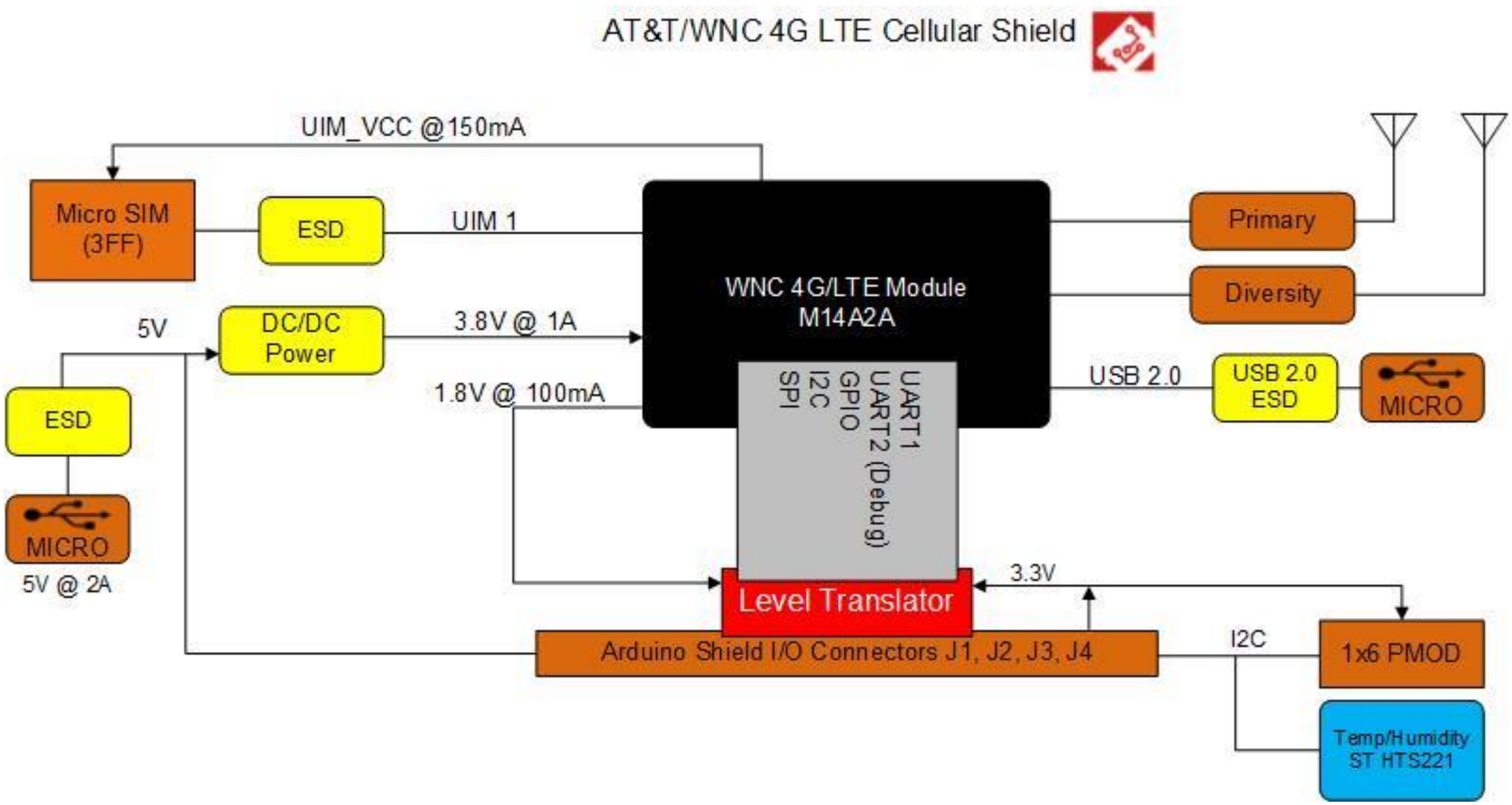


Figure 2 – Cellular Shield Block Diagram

3.2 Shield Features

The image below identifies several of the key features on the Cellular Shield.

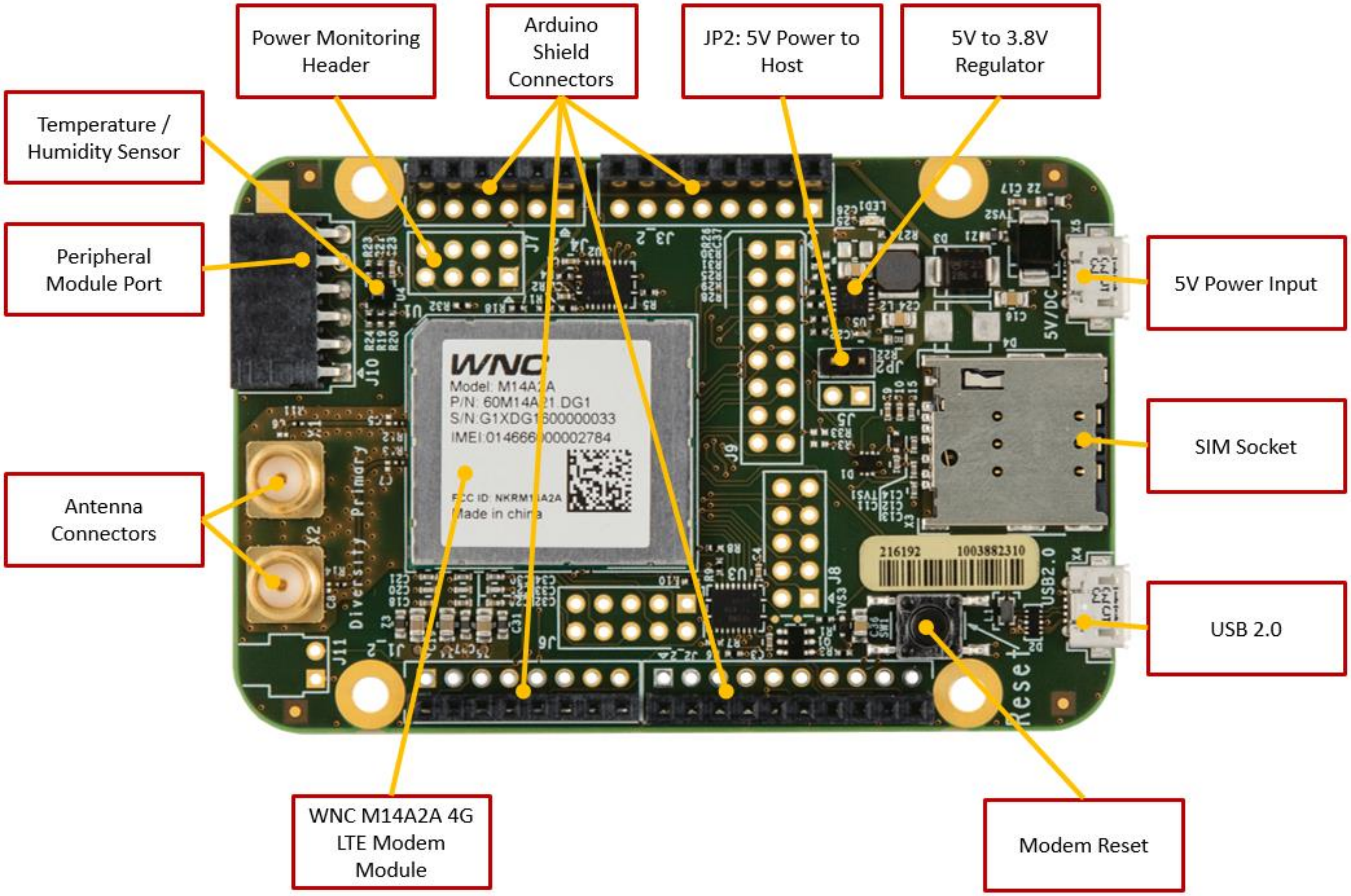


Figure 3 – Avnet Cellular Shield Features

3.3 LTE Modem (WNC M14A2A)

The Cellular Shield includes the Wistron NeWeb Corporation (WNC) M14A2A cellular module.

It includes the following features:

1. 3GPP category support: LTE Cat. 1 with 10/5 Mbps for DL/UL
2. Supports LTE B2/4/12
3. High performance MIPS MicroAptive™ processor

The M14A2A is capable of communicating through the shield connector to the Kinetis processor over multiple interfaces, including:

- UART1
- UART2 (Debug)
- I2C
- GPIO

Additionally, a Micro USB connector on the shield allows a user to use a cable connection to a USB host on another processor.

Note: The M14A2A also has a SPI interface connected to the shield connectors, but the signals do not align with the SPI peripheral pinout on the K64F board.

For more information on the WNC M14A2A, please discuss with your local Avnet sales representative or field engineer.

3.3.1 Package

The M14A2A comes in an LGA package.

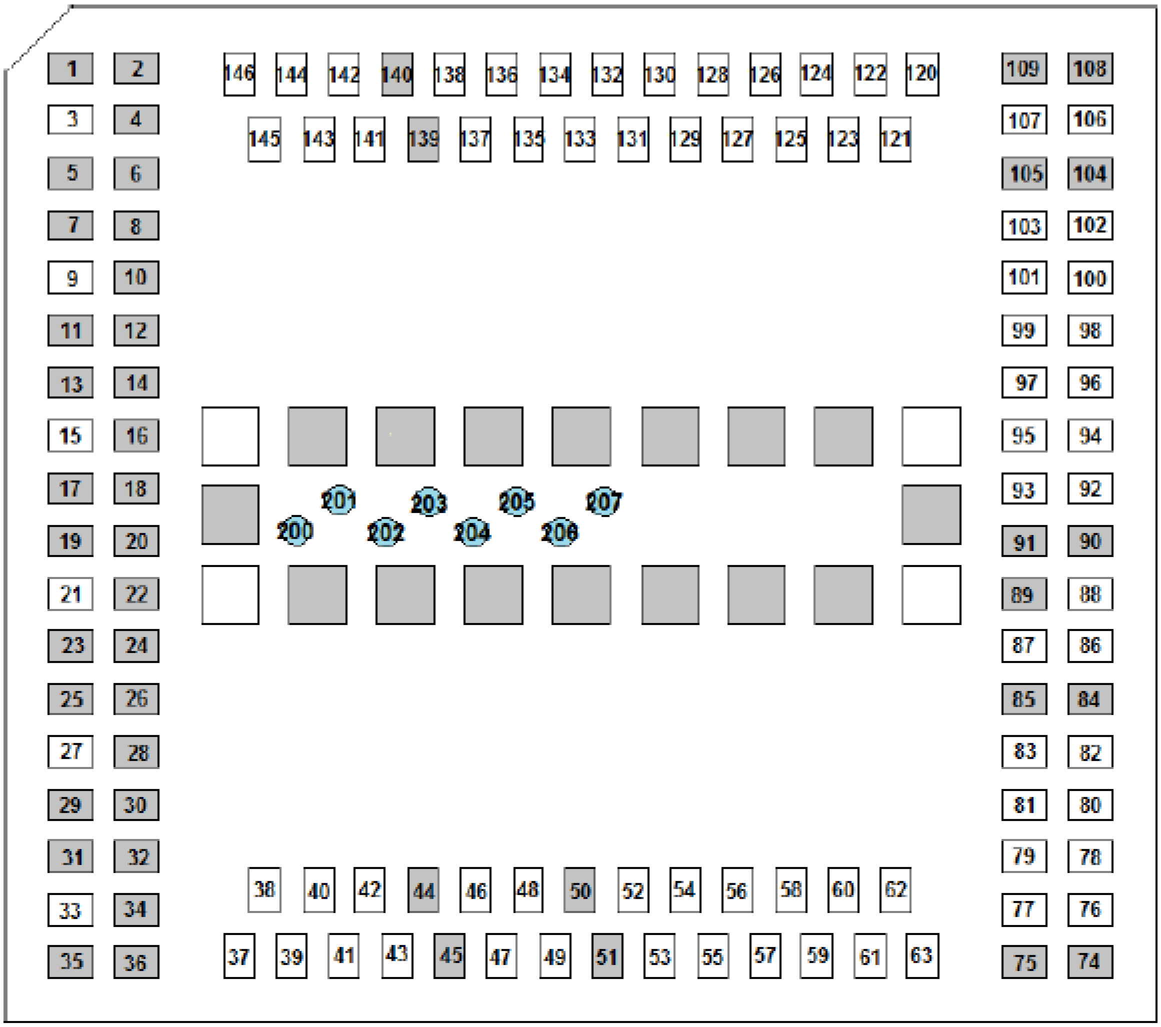


Figure 4 – M14A2A LGA Package Diagram

3.3.2 Pad Connections

Table 1 – M14A2A Connections

M14A2A Pin No	Pin Name	Connection
1	**GND**	**Ground**
2	**GND**	**Ground**
3	NC	no-connect
4	**GND**	**Ground**
5	**GND**	**Ground**
6	**GND**	**Ground**
7	**GND**	**Ground**
8	**GND**	**Ground**

M14A2A Pin No	Pin Name	Connection
9	NC	no-connect
10	**GND**	**Ground**
11	**GND**	**Ground**
12	**GND**	**Ground**
13	**GND**	**Ground**
14	**GND**	**Ground**
15	RF_1	Connect to Main Antenna SMA
16	**GND**	**Ground**
17	**GND**	**Ground**
18	**GND**	**Ground**
19	**GND**	**Ground**
20	**GND**	**Ground**
21	RF_2	Connect to Aux Antenna SMA
22	**GND**	**Ground**
23	**GND**	**Ground**
24	**GND**	**Ground**
25	**GND**	**Ground**
26	**GND**	**Ground**
27	NC	no-connect
28	**GND**	**Ground**
29	**GND**	**Ground**
30	**GND**	**Ground**
31	**GND**	**Ground**
32	**GND**	**Ground**
33	NC	no-connect
34	**GND**	**Ground**
35	**GND**	**Ground**
36	**GND**	**Ground**
37	**VCC1**	**3.8V input**
38	**VCC2**	**3.8V input**
39	**VCC3**	**3.8V input**
40	**VCC4**	**3.8V input**
41	**VCC5**	**3.8V input**
42	**VCC6**	**3.8V input**
43	RTC_POWER	Bring out to header J11
44	**GND**	**Ground**
45	**GND**	**Ground**
46	GPIO46	Bring out to I2S header J6
47	GPIO47	Bring out to I2S header J6
48	GPIO48	Bring out to I2S header J6

M14A2A Pin No	Pin Name	Connection
49	GPIO49	Bring out to I2S header J6
50	**GND**	**Ground**
51	**GND**	**Ground**
52	GPIO01	Bring out to I2S header J6
53	GPIO02	Bring out to general purpose header J9
54	GPIO03	Bring out to general purpose header J9
55	GPIO04	Bring out to general purpose header J9
56	NC	no-connect
57	NC	no-connect
58	NC	no-connect
59	NC	no-connect
60	I2C_SDA	Connect through level translator to shield
61	I2C_SCL	Connect through level translator to shield
62	NC	no-connect
63	NC	no-connect
64-73	na	no pad
74	**GND**	**Ground**
75	**GND**	**Ground**
76	NC	no-connect
77	NC	no-connect
78	NC	no-connect
79	NC	no-connect
80	UART1_CTS	Connect through level translator to shield
81	UART1_RTS	Connect through level translator to shield
82	UART1_RX	Connect through level translator to shield
83	UART1_TX	Connect through level translator to shield
84	**GND**	**Ground**
85	**GND**	**Ground**
86	USB_DP	Connect to USB 2.0
87	GPIO87	Bring out to general purpose header J9
88	USB_DN	Connect to USB 2.0
89	**GND**	**Ground**
90	**GND**	**Ground**
91	**GND**	**Ground**
92	NC	no-connect
93	GPIO93	Bring out to general purpose header J9
94	GPIO94	Bring out to general purpose header J9
95	GPIO95	Bring out to general purpose header J9
96	GPIO96	Bring out to general purpose header J9
97	GPIO97	Bring out to general purpose header J9

M14A2A Pin No	Pin Name	Connection
98	NC	no-connect
99	NC	no-connect
100	NC	no-connect
101	NC	no-connect
102	NC	no-connect
103	NC	no-connect
104	**GND**	**Ground**
105	**GND**	**Ground**
106	UART2_RX	Connect through level translator to shield UART TX
107	UART2_TX	Connect through level translator to shield UART RX
108	**GND**	**Ground**
109	**GND**	**Ground**
110-119	na	no pad
120	NC	no-connect
121	NC	no-connect
122	ADC	Bring out to ADC header J5
123	NC	no-connect
124	NC	no-connect
125	SPIM_MOSI	Connect through level translator to shield
126	SPIM_MISO	Connect through level translator to shield
127	SPIM_EN	Connect through level translator to shield
128	SPIM_CLK	Connect through level translator to shield
129	GPIO05	Bring out to general purpose header J9
130	GPIO06	Bring out to general purpose header J9
131	GPIO07	Bring out to general purpose header J9
132	GPIO08	Bring out to general purpose header J9
133	**UIM_VCC**	**Connect to SIM card connector – 1.8V or 3.0V output**
134	UIM_DATA	Connect to SIM card connector
135	UIM_CLK	Connect to SIM card connector
136	UIM_RESET	Connect to SIM card connector
137	UIM_DETECT	Connect to SIM card connector
138	NC	no-connect
141	WWAN_STATE	Connect through level translator to shield
142	POWER_ON_N	Active low. Connect through level translator to shield
143	WAKEUP_OUT	Bring out to general purpose header J9
144	WAKEUP_IN	Connect through level translator to shield
145	RESET_N	Reset, active low, diode protected, connect through level translator to shield
146	**VREF**	**1.8V output**
147-199	na	no pad
200	NC	no-connect

M14A2A Pin No	Pin Name	Connection
201	JTAG_TCK	Bring out to JTAG header J8
202	JTAG_TDI	Bring out to JTAG header J8
203	JTAG_TDO	Bring out to JTAG header J8
204	JTAG_TMS	Bring out to JTAG header J8
205	JTAG_TRST_N	Bring out to JTAG header J8
206	NC	no-connect
207	NC	no-connect

3.4 Arduino Shield connectors

The Cellular Shield I/O connectors follow the mechanical spacing and placement on the Arduino Revision 3 (R3) standard, with the exception that the footprint for a 2-row standard, as seen on the K64F board is used. The reference designators match what is found on the K64F board:

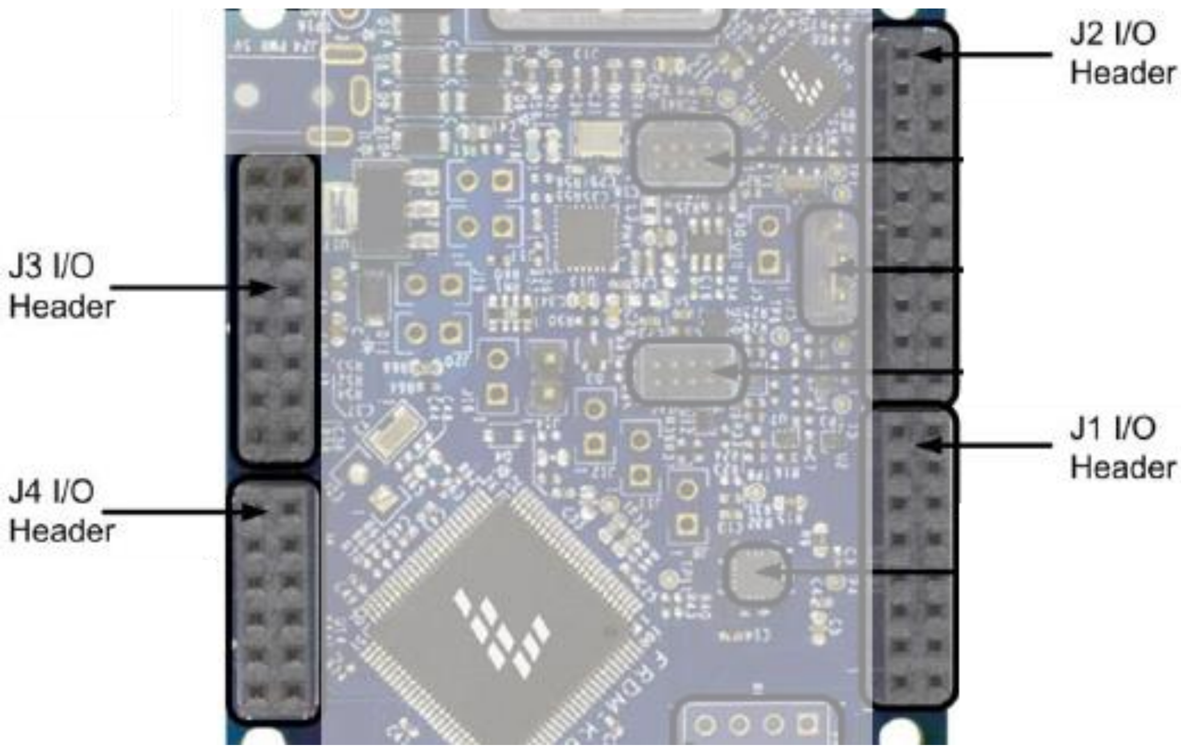


Figure 5 – K64F Arduino R3 Shield Connectors

An Arduino shield uses a stacking system, where a female connector with 10 mm leads is placed on the top-side. The protruding leads from the back-side of the board then become the male connection to the female connectors on the K64F board. Four 2-row footprints on the top-side (J1_2, J2_2, J3_2, and J4_2) have their outer row aligned with four single-row footprints (J1_1, J2_1, J3_1, J4_1). Only the single row connectors on the outer rows are populated. The outer rows contains the R3 compatible signals, and these connect on the shield. The interior rows are not connected on this shield but are provided for pass-through and prototyping access.

The Samtec SSQ family is used for this function. Options selected are:

- Standard insertion force
- Gold flash on contact, Matte Tin on tail
- Single Row
- 10.00 mm lead length

The part numbers and REFDES are shown in the table below.

Samtec Part Number	Cellular Shield REFDES
SSQ-106-03-F-S	J4_1
SSQ-108-03-F-S	J1_1, J3_1
SSQ-110-03-F-S	J2_1

3.4.1 Shield I/O Assignments

The K64F peripheral selection and shield pinout for the Cellular Shield are shown in the table below. The items highlighted in yellow are the intended K64F peripherals that need to be mapped for correct operation.

Table 2 – K64F Pin Mapping to the Cellular Shield

Header	Pin No	K64F					Shield	Pin No	Header
		Pin / Function	GPIO	UART	I2C	SPI			
J1_1	1	K64F (Pin 90)	PTC16	UART3_RX			UART2_TX	1	J1_1
	2	K64F (Pin 91)	PTC17	UART3_TX			UART2_RX	2	
	3	K64F (Pin 57)	PTB9	UART3_CTS_b		SPI1_PCS1	POWER_ON	3	
	4	K64F (Pin 35)	PTA1	UART0_RX			SPIM_MOSI	4	
	5	K64F (Pin 69)	PTB23			SPI2_SIN	WWAN_STATE	5	
	6	K64F (Pin 36)	PTA2	UART0_TX			SPIM_MISO	6	
	7	K64F (Pin 72)	PTC2	UART1_CTS_b		SPI0_PCS2	WAKEUP_IN	7	
	8	K64F (Pin 73)	PTC3	UART1_RX		SPI0_PCS1	HTS221_DRDY	8	
J2_1	1	K64F (Pin 34)	PTC12	UART0_CTS_b			SHLD_RESET_N	1	J2_1
	2	K64F (Pin 76)	PTC4	UART1_TX		SPI0_PCS0	LT_OE	2	
	3	K64F (Pin 93)	PTD0	UART2_RTS_b		SPI0_PCS0	UART1_CTS	3	
	4	K64F (Pin 95)	PTD2	UART2_RX	I2C0_SCL	SPI0_SOUT	UART1_TX	4	
	5	K64F (Pin 96)	PTD3	UART2_TX	I2C0_SDA	SPI0_SIN	UART1_RX	5	
	6	K64F (Pin 94)	PTD1	UART2_CTS_b		SPI0_SCK	UART1_RTS	6	
	7	GND					GND	7	
	8	AREF					NC	8	
	9	K64F (Pin 32)	PTE25	UART4_RX	I2C0_SDA		I2C_SDA	9	
	10	K64F (Pin 31)	PTE24	UART4_TX	I2C0_SCL		I2C_SCL	10	
J3_1	1	NC					NC	1	J3_1
	2	3V3					H2S_3V3	2	
	3	HOST_RESET_N					H2S_RST	3	
	4	3V3					H2S_3V3	4	
	5	5V					H2S_5V	5	
	6	GND					GND	6	
	7	GND					GND	7	
	8	Vin					S2H_5V	8	
J4_1	1	K64F (Pin 55)	PTB2	UART0_RTS_b	I2C0_SCL		SPIM_CLK	1	J4_1
	2	K64F (Pin 56)	PTB3	UART0_CTS_b	I2C0_SDA		SPIM_EN	2	
	3	K64F (Pin 58)	PTB10	UART3_RX		SPI1_PCS0	PMOD_D1	3	
	4	K64F (Pin 59)	PTB11	UART3_TX		SPI1_SCK	PMOD_D2	4	
	5	K64F (Pin 83)	PTC11		I2C1_SDA		PMOD_D4	5	
	6	K64F (Pin 82)	PTC10		I2C1_SCL		PMOD_D3	6	

3.5 Level Translation

The I/Os on the M14A2A have logic levels set at 1.8V. The Arduino Shield standard is 3.3V, which is what the K64F I/Os are. Therefore, level translation is required.

Two Texas Instruments TXS0108E devices provide the level translation between 1.8V and 3.3V. The output enable (OE) control of both level translators is connected to Shield Connector J2_1.Pin2, which is PTC4 on the K64F board. This allows the host to control when signals are passed or tri-stated to the M14A2A. By default, the OE should be low to disable the level translators while the M14A2A is powering up as the M14A2A has several internally strapped signals. By leaving the level translators disabled, it ensures that the M14A2A's signals are put into the proper state for boot-up. Pull-down resistor R35 is used to keep OE low when the shield is operated standalone or prior to the host driving PTC4.

3.6 M14A2A Interfaces

3.6.1 UART1

The UART1 interface is connected from the M14A2A through a level translator to the Shield. The connections between Host and Shield are done in null modem or crossover style with:

- RX connected to TX
- TX connected RX
- RTS connected CTS
- CTS connected to RTS

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
80	UART1_CTS (UART1)	Clear To Send for UART 1	1.7	1.8	1.9
81	UART1_RTS (UART1)	Request To Send for UART 1	1.7	1.8	1.9
82	UART1_RX (UART1)	Receive for UART 1	1.7	1.8	1.9
83	UART1_TX (UART1)	Transmit for UART 1	1.7	1.8	1.9

Figure 6 – M14A2A UART1 Signals

Table 3 – UART1 Connections

Name	M14A2A pin (1.8V)	Shield Pin (3.3V)
UART1_CTS	80	J2_1.3
UART1_RTS	81	J2_1.6
UART1_RX	82	J2_1.5
UART1_TX	83	J2_1.4

3.6.2 UART2

The UART2 interface is connected from the M14A2A through a level translator to the Shield. RX and TX are crossed-over similar to UART1.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
106	UART2_RX (UART2)	Receive for UART2	1.7	1.8	1.9
107	UART2_TX (UART2)	Transmit for UART2	1.7	1.8	1.9

Figure 7 – M14A2A UART2 Signals

Table 4 – UART2 Connections

Name	M14A2A pin (1.8V)	Shield Pin (3.3V)
UART2_RX	106	J1_1.2
UART2_TX	107	J1_1.1

3.6.3 SPI

The SPI Master interface is connected from the M14A2A through a level translator to the Shield. A mapping to the K64F SPI peripheral was not possible, although wire-jumpering may be a possibility. Note that the M14A2A expects to be the master.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
125	SPIM_MOSI	SPI Master Out Slave In data line	1.7	1.8	1.9
126	SPIM_MISO	SPI Master In Slave Out data line	1.7	1.8	1.9
127	SPIM_EN	SPI master interface enable signal	1.7	1.8	1.9
128	SPIM_CLK	SPI master interface clock	1.7	1.8	1.9

Figure 8 – M14A2A SPI Master Signals

Table 5 – SPI Connections

Name	M14A2A pin (1.8V)	Shield Pin (3.3V)
SPIM_MOSI	125	J1_1.4
SPIM_MISO	126	J1_1.6
SPIM_EN	127	J4_1.2
SPIM_CLK	128	J4_1.1

3.6.4 I2C

The I2C interface is connected from the M14A2A through a level translator to the Shield.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
60	I2C_SDA	I2C Data	1.7	1.8	1.9
61	I2C_SCL	I2C Clock	1.7	1.8	1.9

Figure 9 – M14A2A I2C Signals

Table 6 – I2C Connections

Name	M14A2A pin (1.8V)	Shield Pin (3.3V)
I2C_SDA	60	J2_1.9
I2C_SCL	61	J2_1.10

I2C_SDA and I2C_SCL are both pulled up with 2kΩ resistors on both sides of the level translator:

- R6/R7 on 3.3V side
- R8/R9 on 1.8V side

3.6.5 Other M14A2A I/Os to Connect to Shield

Connect the following M14A2A I/Os through a level translator to GPIO on the Shield:

Table 7 – GPIO Connections

Name	M14A2A pin (1.8V)	Shield Pin (3.3V)	Other
WWAN_STATE	141	J1_1.5	PTB23
POWER_ON_N	142	J1_1.3	Active low, PTB9
WAKEUP_IN	144	J1_1.7	PTC2

3.6.6 USB 2.0

The M14A2A USB 2.0 interface is connected to a Micro USB connector (X4) on the shield. A Semtech RClamp0524P device (D2) is used for ESD protection. Powering the shield from X4 is not supported.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
86	USB_Dp	USB Data Positive	-	-	-
88	USB_Dn	USB Data Negative	-	-	-

Figure 10 – M14A2A USB 2.0 Connections

3.6.7 SIM Connector

A 3FF microSIM connector allows an AT&T SIM card to connect to the M14A2A. The five M14A2A UIM signals are connected to the microSIM connector (X3) and ESD protection (Semtech RCLAMP3304P, D1). A Molex 503960-0694 push-push style connector is used.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
133	UIM_VCC	SIM Card Power	1.7 2.7	1.8 3.0	1.9 3.3
134	UIM_DATA	SIM Card Data Line	1.7 2.7	1.8 3.0	1.9 3.3
135	UIM_CLK	SIM Card Clock Line	1.7 2.7	1.8 3.0	1.9 3.3
136	UIM_RESET	SIM Card Reset Line	1.7 2.7	1.8 3.0	1.9 3.3
137	UIM_DETECT	SIM Card Detect Line	1.7	1.8	1.9

Figure 11 – M14A2A SIM Card Connections

The SIM is powered from the M14A2A.

3.6.8 Module Reset

A reset button (SW1) is provided that can ground M14A2A pin 145 to assert RESET_N. However, under normal conditions, it is recommended that this not be used. The M14A2A requires a careful sequence of signalling to start up properly, so it is recommended that the software design examples be followed. Asserting RESET_N when other control signals are in the wrong state could lock up the M14A2A. The M14A2A requires a 100 ms minimum low time, so an RC circuit (R32, C36) connected to ground and VREF (1.8V) filters reset.

The RESET_N signal can be controlled through shield J2.2, which is PTC12. This allows a Host GPIO to reset the module. This signal feeds the gate of MOSFET Q1A, which acts as an inverting level translator. To reset the M14A2A, the host drives PTC12 to the high state. To de-assert reset, PTC12 must be driven low or tri-stated.

Table 8 – Reset

Name	M14A2A pin (1.8V)	Shield Pin (3.3V)	Other
RESET / PTC12	145	J2_1.1	PTC12

3.6.9 ADC

The M14A2A has an internal ADC which is exposed through M14A2A pin 122, which is connected to a depopulated header (J5). This feature was not tested on the Cellular Shield.

3.6.10 I2S/PCM

The M14A2A's four I2S/PCM pins are connected to header J6. This was not tested, although the header and connections were designed to be compatible with the following I2S development board's J3 connector from Maxim Integrated:

https://www.maximintegrated.com/en/products/digital/microcontrollers/MAXAUDINT001.html

The M14A2A interface is 1.8V I/O, so configure the MAXAUDINT001 for 1.8V I/O as well.

Table 9 – I2S Header Connections

Header Pin	Name	Connection
1	GND	GND
2	MCLK	M14A2A.Pin52
3	GND	GND
4	I2S_BCK	M14A2A.Pin49
5	GND	GND
6	I2S_LRCK	M14A2A.Pin46
7	GND	GND
8	I2S_DATA_OUT	M14A2A.Pin47
9	GND	GND
10	I2S_DATA_IN	M14A2A.Pin48

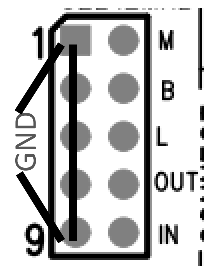


Figure 12 – I2S Header footprint

3.6.11 RTC Power

M14A2A Pin 43 is connected to header J11 and may provide battery-backed power to the internal real-time clock on the M14A2A. This was not tested.

3.6.12 JTAG

The M14A2A JTAG signals are not meant for public use but were connected to a depopulated header (J8) for potential internal testing purposes.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
201	JTAG_TCK	JTAG/EJTAG clock	1.7	1.8	1.9
202	JTAG_TDI	JTAG/EJTAG input data	1.7	1.8	1.9
203	JTAG_TDO	JTAG/EJTAG output data	1.7	1.8	1.9
204	JTAG_TMS	JTAG/EJTAG test mode select	1.7	1.8	1.9
205	JTAG_TRST_N	EJTAG reset; emulation JTAG is used to debug and run software on embedded MIPS processors. Only driven high when in use	1.7	1.8	1.9

Figure 13 – M14A2A JTAG Connections

3.6.13 Unused M14A2A I/Os

The following unused M14A2A I/Os are brought out to a depopulated headers.

Table 10 – M14A2A Unused I/Os

M14A2A Pin No	Pin Name
53	GPIO02
54	GPIO03
55	GPIO04
87	GPIO87
93	GPIO93
94	GPIO94
95	GPIO95
96	GPIO96
97	GPIO97
129	GPIO05
130	GPIO06
131	GPIO07
132	GPIO08
143	WAKEUP_OUT

3.7 Voltage Regulation

There is a single regulator on the board providing 3.8V at 1A to the WNC cellular module. The WNC module is the only load on the 3.8V supply and specifies a worst case current consumption of 800mA. 3.8V is the recommended operating voltage of the WNC module. Power is provided by the ADP2120 – http://www.analog.com/ADP2120. A green LED indicates when 3.8V is good.

The 3.8V output has filtering and capacitor bypass, as shown below. Note the following rails that are filtered together:

- VCC1 and VCC2
- VCC3
- VCC4, VCC5, and VCC6

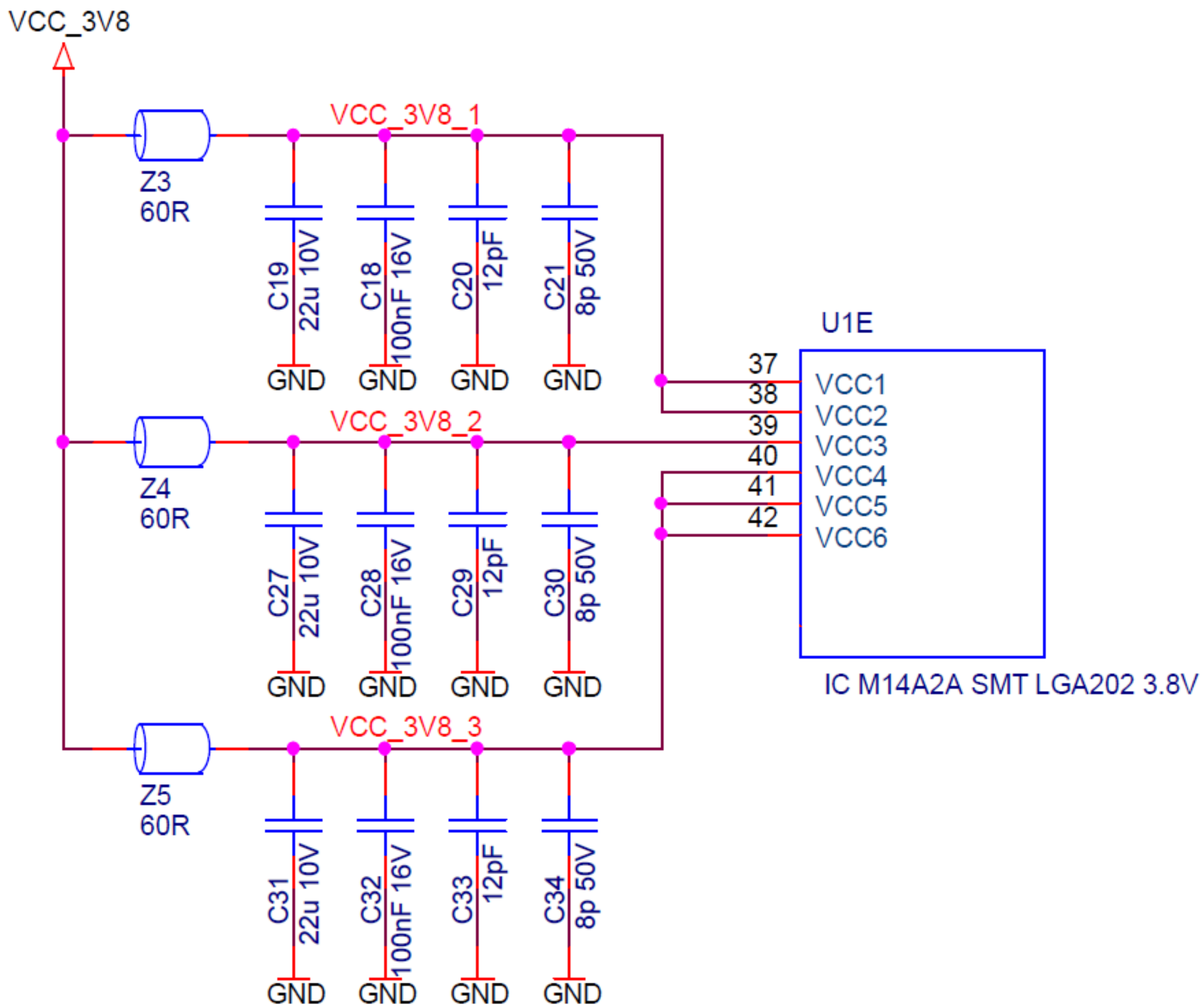


Figure 20 – 3.8V Filtering and Bypassing

The M14A2A also sources two voltages: VREF and SIM VCC, as described below.

3.7.1 VREF

1.8V @ 100 mA. This reference is generated by the M14A2A and is used for the level translators that translate between the shield's 3.3V I/O and the M14A2A's 1.8V I/O. This is net VCC_1V8_VREF on the schematic.

3.7.2 SIM VCC

This is UIM_VCC. UIM stands for User Identity Module, which is the SIM Card. This can be either 1.8V or 3.0V. This is available on M14A2A Pin 133 and is connected to the microSIM connector. This is net VCC_UIM_SIM on the schematic.

3.8 Power Supply Monitor Header

Shield footprint J7 provides easy access to the following voltage rails. The header is pinned out as shown in the diagram below, pin 1 is denoted by the square pad and silkscreen arrow.

Table 11 - J7 Power Supply Monitor Header Pinout

2 – USB 2.0 Vbus	1 - Vin
4 – UIM VCC	3 – Vcc (3.8V)
6 – Host 3.3V	5 – Vref (1.8V)
8 – GND	7 – Host 5V

3.9 Temperature / Humidity Sensor

An on-board ST Micro HTS221 temperature and humidity sensor (U4) is provided to create accurate sample measurements to use in cloud-based examples. The HTS221 Vdd is connected to 3.3V provided by the host through the shield connectors on net VCC_H_3V3. The I2C interface is connected to the I2C1 interface on K64F J4 Pins 5 and 6. The HTS221 DRDY signal is connected to shield I/O J1_1.8, which is PTC3. A pull-up to 3V3 on the HTS221 CS pin permanently enables this sensor. Zero-ohm resistors R23 and R24 allow the HTS221 SCL and SDA to be disconnected from the shield connectors.

Table 12 – Sensor Connections

Name	Shield Pin (3.3V)	Other
K64F_I2C_SCL	J4_1.6	Shared with Pmod
K64F_I2C_SDA	J4_1.5	Shared with Pmod
HTS221_DRDY	J1_1.8	

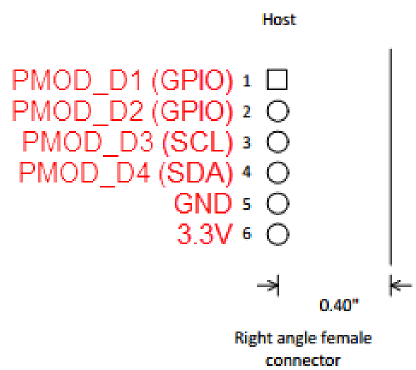
3.10 Peripheral Module

Adding a Pmod to the shield allows add-on sensors to be connected easily. A single 1x6 Pmod (Samtec SSW-106-02-T-S-RA) is connected to four signals as well as Ground and 3.3V. Pmod pins 3 and 4 are connected on the same I2C lines as the HTS221 but with series 0Ω resistors (populated by default) to allow the Pmod to be isolated if necessary. K64F GPIOs J4 Pins 3 and 4 are connected to Pmod Pins 1 and 2. Pmod 3.3V comes from the host, through shield connector J3, pins 2 and 4.

Table 13 – Pmod Connections

Name	Shield Pin (3.3V)	Other
PMOD_D1	J4_1.3	PTB10
PMOD_D2	J4_1.4	PTB11
PMOD_D3	J4_1.5	Shared with HTS221, I2C1_SDA
PMOD_D4	J4_1.6	Shared with HTS221, I2C1_SCL

The pinout and spacing for the Pmod is shown below.



3.11 Mounting holes

Four plated mounting holes are provided which align with the holes on the K64F board.

4 Other Kit Items

4.1 SIM Card

An AT&T SIM Card is provided in the kit that provides 300 MB of data and 300 SMS text messages.

4.2 Antennas

The Cellular shield includes vertical through-hole SMA jacks for LTE antennas, including one antenna for the primary (M14A2A Pin 15) and one for the diversity (M14A2A Pin 21).

The SMA connectors are Samtec SMA-J-P-H-ST-TH1.

Pin No.	Signal Name	Description	Voltage Levels (V)		
			Min.	Typ.	Max.
15	RF_1	Main Antenna	-	-	-
21	RF_2	Aux Antenna	-	-	-

Figure 14 – RF Connections for Antennas

The Avnet AT&T Cellular IoT Starter Kit contains two (2) Pulse Electronics SB698SMA3 StealthBlade LTE Antennas with a custom cable length of two feet (61.0 cm) RG-316 cable. For more information on this antenna, please see:

http://productfinder.pulseeng.com/product/SB698SMA3
http://productfinder.pulseeng.com/products/datasheets/SB698SMAXX.pdf