



# CELLCRACKER USER GUIDE

## CellCracker User Guide

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## Introduction

CellCracker enables cellular connectivity with minimal development and certification costs.

This product is an LTE cellular M1 radio with support circuitry mounted on a mini-PCIe (mPCIe) carrier card. Cellular connectivity is accomplished by the integrated HL7800 module from Sierra Wireless. The product has PTCRB device level certification as well as FCC certification and is AT&T and T-Mobile End-Product certified; allowing for direct and immediate use in most end products with no further certification.

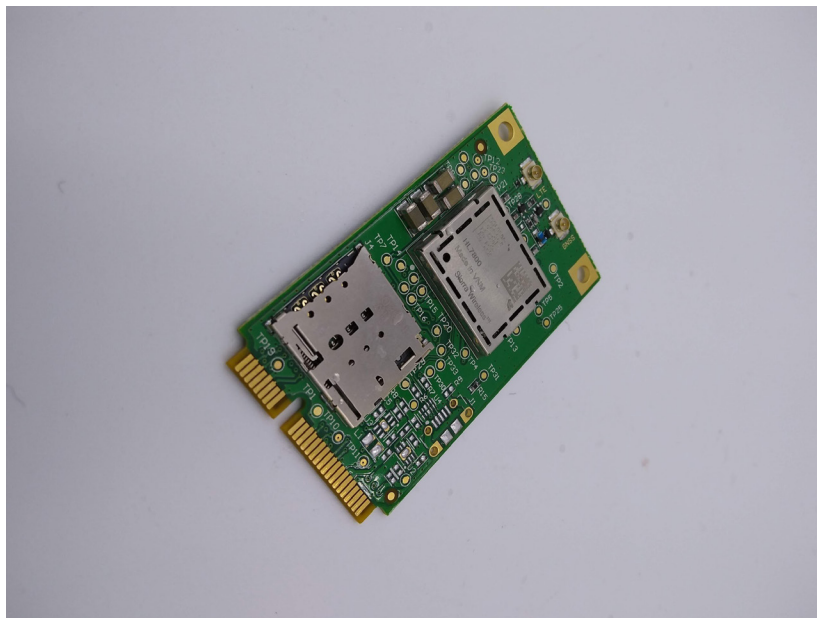
CellCracker provides access to communications interfaces through mini-PCIe connection with a host board. For increased flexibility, this product is also available as a USB only modem with connection through an on-board USB Micro-B connector.

CellCracker supports a variety of SIM card options for greater flexibility in customer applications. The device defaults to the on-board SIM slot (3FF) and supports the use of a host board's SIM via the mini-PCIe connection.

The CellCracker card utilizes the PTCRB certified software version BHL78xx.3.7.2.3 for the HL7800. All information contained in this user guide is in reference to this software version.

**Note:** This datasheet covers the information and features specific to the CellCracker mini-PCIe card. For information on the HL7800 module, please refer to that module's documentation from Sierra Wireless (<https://source.sierrawireless.com/devices/hl-series/hl7800>), as that information is outside of the scope of this datasheet.

Typical verticals: Telematics, Pos Backup, Sensors, Agriculture, Industrial Equipment



CellCracker mPCIe card LTE modem

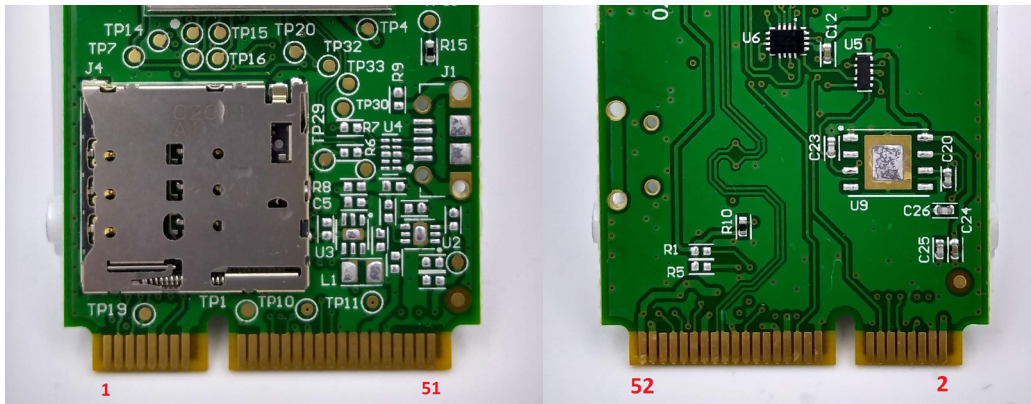


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## References

1. AirPrime HL78xx AT Commands Interface Guide”, (Doc# 41111821)
2. Sierra Wireless HL78xx Product Technical Specification Rev 5, (Doc# 41113770)
3. Antenna Basics for IoT Applications
4. “CMUX feature application note” (document no. 2170036)
5. “AirPrime - HL78XX - Setting up CMUX in a Linux Environment Application Note” (document no. 2174265-1)

## Pin Layout



Pin layout for CellCracker



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## Pin Definitions

Side A				Side B			
Pin #	Name	Type	Description	Pin #	Name	Type	Description
1	WAKE#	Not used		2	3.3V	I	3.3V supply
3	GPIO8	I/O	General purpose input/output	4	GND	GND	Ground connection
5	GPIO7	I/O	General purpose input/output	6	1.5V	Not used	
7	CLKREQ#	Not used		8	UIM2_PWR	O	1.8V UIM2 power supply
9	GND	GND	Ground connection	10	UIM2_DATA	I/O	1.8V UIM2 data
11	VGPIO	O	GPIO voltage output	12	UIM2_CLK	O	1.8V UIM2 clock
13	REFCLK_P	Not used		14	UIM2_RESET	O	1.8V UIM2 reset
15	GND	GND	Ground connection	16	UIM2_VPP	Not used	
Insertion key notch				Insertion key notch			
17	Reserved (UIM_C4)	Not used		18	GND	GND	Ground connection
19	Reserved (UIM_C8)	Not used		20	W_DISABLE	Not used	
21	GND	GND	Ground connection	22	peRST#	Not used	
23	peR0_N	Not used	Reserved for PCM_CLK	24	3.3V	I	3.3V supply
25	peR0_P	Not used	Reserved for PCM_SYNC	26	GND	GND	Ground connection
27	GND	GND	Ground connection	28	1.5V	Not used	
29	GND	GND	Ground connection	30	SMB_CLK	Not used	
31	peT0_N	Not used	Reserved for PCM_IN	32	UART_CTS	Not used	
33	peT0_P	Not used	Reserved for PCM_OUT	34	GND	GND	Ground connection
35	GND	GND	Ground connection	36	USB_D_N	I/O	USB data positive
37	GND	GND	Ground connection	38	USB_D_P	I/O	USB data negative
39	3.3V	I	3.3V supply	40	GND	GND	Ground connection
41	3.3V	I	3.3V supply	42	UART_RTS	Not used	
43	GND	GND	Ground connection	44	UART_RX	Not used	
45	Reserved	Not used		46	UART_TX	Not used	
47	Reserved	Not used		48	1.5V	Not used	
49	Reserved	Not used		50	GND	GND	Ground connection
51	Reserved	Not used		52	3.3V	I	3.3V supply



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## Electrical Specifications

CellCracker follows the PCIe electrical specification. Additional electrical specification information is contained in the following table:

Parameter	Min.	Typ.	Max.
3.3Vaux	3V	3.3V	3.6V
Current on 3.3Vaux during cellular transmit	-	210mA	-
Current on 3.3Vaux during standby	-	100mA	-

*Electrical specifications of CellCracker modem*

The HL7800 module consumes the majority of current on the CellCracker card. For additional information about typical current consumption of the HL7800 module in various power states, please refer to the Sierra Wireless document “Sierra Wireless HL78xx Product Technical Specification Rev 5”, Doc# 41113770.

## Resetting CellCracker

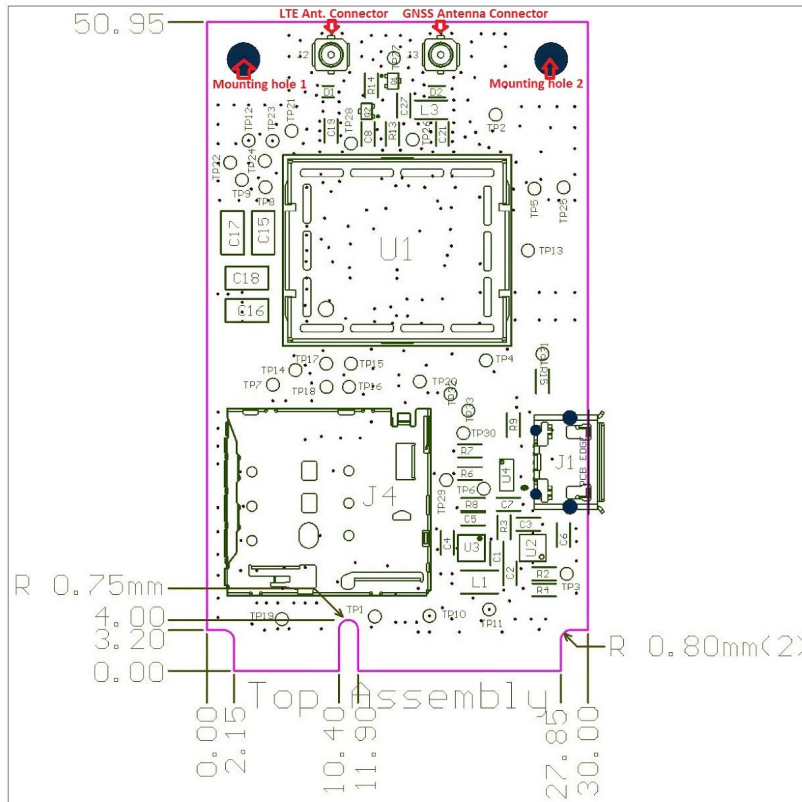
The CellCracker card can be reset by software using AT+CFUN=1,1. For details, refer to “AirPrime HL78xx AT Commands Interface Guide”, Doc# 41111821.

If the modem is unresponsive to AT commands, the CellCracker card can be reset by cycling the 3.3V supply below 0.3V for at least 20 msec before re-applying power. The modem should be ready to receive AT commands 10 seconds after power is re-applied.



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## Mechanical and Environmental Specifications



Mechanical dimensions of CellCracker and component locations

<b>Form Factor</b>	<ul style="list-style-type: none"> <li>• Full mini-PCIe card</li> </ul>
<b>Dimensions</b>	<ul style="list-style-type: none"> <li>• 51mm x 30mm x 4.4mm</li> </ul>
<b>Weight</b>	<ul style="list-style-type: none"> <li>• 6 grams</li> </ul>
<b>Operating Temperature</b>	<ul style="list-style-type: none"> <li>• -25°C to 70°C</li> </ul>



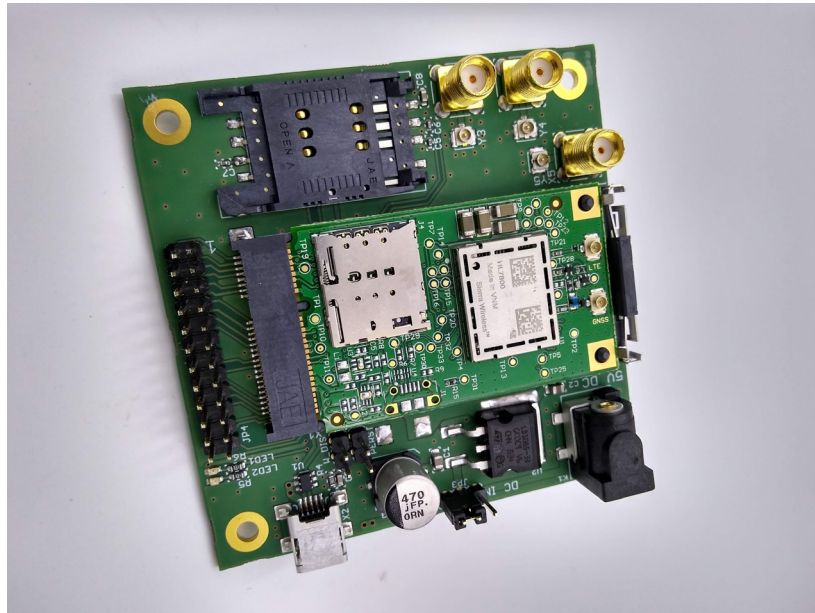


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## Getting Started

Insert a micro (3FF) SIM card into the SIM holder. The SIM holder is the push-push type and will lock in the SIM card when inserted. Then insert the CellCracker into the mPCIe connector on your host PCB. Press down on the opposite end of the card to lock it into place.

Once inserted and power is applied to the mPCIe card, the USB port will enumerate. The default settings are 115200 kpbs, 8bit, no parity, 1 stop bit. Enter “AT” and you should get a response of “OK”.



CellCracker mPCIe card mounted in evaluation board.

## Communicating with Host Devices

The primary communication and control interface for CellCracker is the HL7800’s UART1 connection. UART1 is accessed via a USB-serial bridge through the mPCIe edge connector’s USB interface, where the device provides an AT command interface with the HL7800 modem.

For additional information on the HL7800 module’s serial connections, their electrical characteristics, and configuration, please refer to the Sierra Wireless document “Sierra Wireless HL78xx Product Technical Specification Rev 5”, Doc# 41113770 released February 2022.



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## Communicating with Linux Host

Note: For applications requiring simultaneous access to a combination of cellular data, GNSS data, and the command line interface, please refer to the following Sierra Wireless documents:

- “CMUX feature application note” (document no. 2170036)
- “AirPrime - HL78XX - Setting up CMUX in a Linux Environment Application Note” (document no. 2174265-1)

When connected to a Linux host device, the CellCracker will enumerate as a USB serial device of the form “ttyUSB#” with the # being an integer value specific to the CellCracker’s USB connection. To determine the USB connection used by the CellCracker, send the following command in the Linux terminal:

```
dmesg -w
```

This will cause kernel messages to be printed to the terminal as they are generated. When the CellCracker is connected, you should see an output similar to the following:

```
[2849051.706818] usb 1-5: New USB device found, idVendor=0403, idProduct=6015, bcdDevice=10.00  
[2849051.706828] usb 1-5: New USB device strings: Mfr=1, Product=2, SerialNumber=3  
[2849051.706833] usb 1-5: Product: FT231X USB UART  
[2849051.706837] usb 1-5: Manufacturer: FTDI  
[2849051.706842] usb 1-5: SerialNumber: DT03ZI1I  
[2849051.714105] ftdi_sio 1-5:1.0: FTDI USB Serial Device converter detected  
[2849051.714286] usb 1-5: Detected FT-X  
[2849051.716365] usb 1-5: FTDI USB Serial Device converter now attached to ttyUSB0
```

In this case, CellCracker connected to ttyUSB0, as can be seen in the final message. To send commands on this port, a serial port communications program such as minicom can be used.

## Establishing a PPP Session with a Linux Host

For information on using CellCracker to establish a PPP session with a Linux host, please refer to the Sierra Wireless document “AirPrime HL78xx Establishing a PPP Session with a Linux Host”.





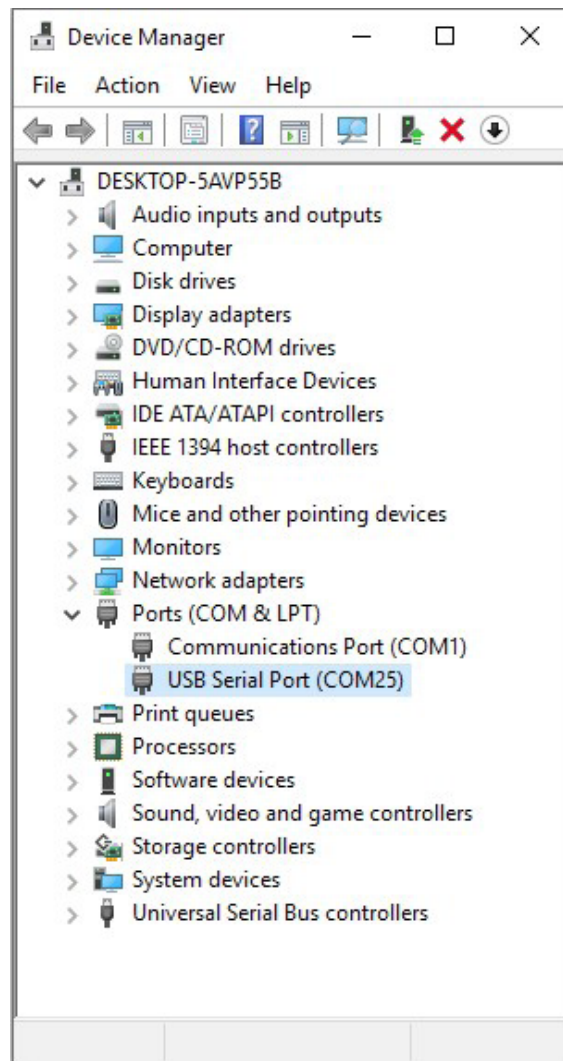
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## Communicating with Windows Host

Note: For applications requiring simultaneous access to a combination of cellular data, GNSS data, and the command line interface, please refer to the following Sierra Wireless documents:

- “CMUX feature application note” (document no. 2170036)

When connected to a Windows host device, the CellCracker will enumerate as a USB serial device of the form “COM#”, with the # being an integer value specific to the COM port that the CellCracker is connected to. Shown below is an example of device enumeration in Windows Device Manager. To send commands on this port, a serial port communications program such as TeraTerm can be used.



Example of device enumeration of UART1 in Windows Device Manager



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## TCP Connection

For information on controlling TCP connections with CellCracker, please refer to section 14.5 of the Sierra Wireless document “AirPrime HL78xx AT Commands Interface Guide”.

## SIM Card Selection

The CellCracker has multiple SIM options: (1) on mPCIe board (default) and (2) on the host PCB. Note, the CellCracker always defaults to the mPCIE board SIM in event of a power cycle.

To use the on host PCB SIM option, use the following AT commands. Note: Multiple COM ports will enumerate and only one port will allow AT command access to the modem.

Ensure the host SIM card is inserted before you start this sequence. Hot swapping SIM cards is not supported. You should get an ‘OK’ response after each command is sent. If you get ‘ERROR’, resend the command.

1. **AT+KGPIOCFG=15,0,2**
2. **AT+KGPIO=15,1**
3. **AT+KGPIOCFG=6,0,2**
4. **AT+KGPIO=6,1**
5. **AT+KGPIOCFG=11,0,2**
6. **AT+KGPIOCFG=11,1**
7. **AT+CFUN=0**
8. **AT+CFUN=1**
9. **AT+CIMI → response will be the IMSI of the SIM card on the host PCB**

To switch back to the on board mPCIe SIM card, issue the following commands:

```
AT+KGPIO=15,0  
AT+CFUN=0  
AT+CFUN=1  
AT+CIMI → response will be the IMSI of the SIM card on the host PCB
```

If ever switching back to the host PCB SIM card, only the following AT commands are required:

```
AT+KGPIO=15,1  
AT+KGPIO=11,0  
AT+KGPIO=11,1  
AT+CFUN=0  
AT+CFUN=1  
AT+CIMI → response will be the IMSI of the SIM card on the host PCB
```



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## RF/Antenna Connection

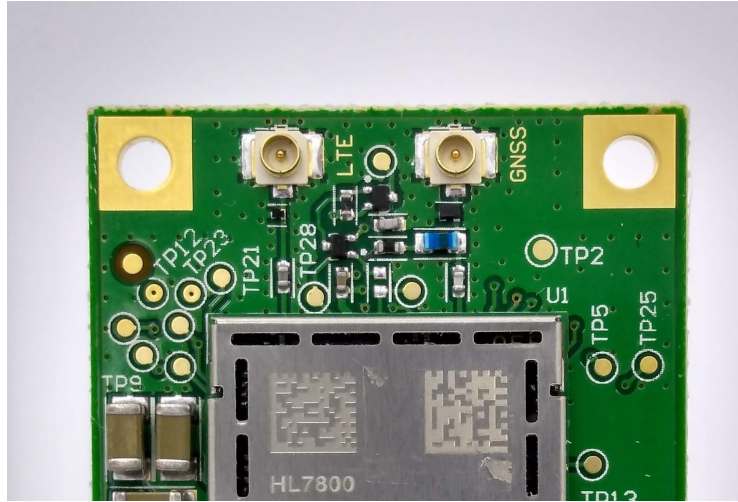


Fig. 3: Antenna connector location

The CellCracker modem has two U.FL antenna connectors: LTE and GNSS.

When developing with the CellCracker modem, please consult with qualified RF experts through all stages of antenna selection, integration, and performance verification. For further information, please contact GotRad for referral to a qualified partner.

Parameter	Min.	Typ.	Max.
$V_{\text{GNSS\_LNA}}$	3V	3.3V	3.6V
$I_{\text{GNSS\_LNA}}$	-	-	50mA

Figure 4: Electrical characteristics of 3.3V supply for active GPS antenna

The GNSS connector is configured for an active antenna by default. 3.3V DC is present at the GNSS RF connector. To disable the active antenna power supply, send the following AT command:

**AT+KGPIO=6,0**

To enable the 3.3V active GNSS antenna power supply, send the following AT command:

**AT+KGPIO=6,1**



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## LTE Connection

The CellCracker modem is designed to provide machine-to-machine LTE data and supports connectivity on a wide range of bands using the Cat-M1 cellular technology. For further information on LTE interface, configuration, supported bands, and performance, please refer to the Sierra Wireless document “AirPrime - HL7800 and HL7800-M - Product Technical Specification – Rev7”.

## GNSS Connection

The CellCracker modem provides a GNSS receiver that supports the GPS L1 and GLONASS L1 FDMA signals. As the GNSS and LTE receivers share the same radio resources, this product is best suited for applications which require infrequent position updates. For further information on GPS interface, specifications, and performance, please refer to the Sierra Wireless document “AirPrime - HL7800 and HL7800-M - Product Technical Specification – Rev7”.

## Carrier Approvals and Device Certifications

<b>Regulatory</b>	<ul style="list-style-type: none"><li>• FCC-US<ul style="list-style-type: none"><li>◦ Module FCC ID N7NHL78M</li></ul></li><li>• ISED-Canada</li><li>• CE/RED-EU</li></ul>
<b>Industry</b>	<ul style="list-style-type: none"><li>• PTCRB<ul style="list-style-type: none"><li>◦ Device ID cc-ftdi-att</li></ul></li><li>• GCF</li></ul>
<b>Carrier Approval</b>	<ul style="list-style-type: none"><li>• AT&amp;T</li><li>• T-Mobile</li></ul>

To operate on cellular networks in the US, mobile network carriers require that end-user devices pass FCC and PTCRB certification. End-user devices must also meet requirements unique to individual carriers, which may require additional certification. The CellCracker modem uses the FCC and PTCRB pre-certified HL7800 module, greatly reducing PTCRB certification cost for end-user host devices. Additionally, the CellCracker modem itself has PTCRB end-product level certification and AT&T Type Approval, which eliminates the need for additional PTCRB certification and AT&T testing when used in an end-user host device. For more information on certification of cellular IoT devices, please refer to the Sierra Wireless document “IoT Product Certifications in North America”.