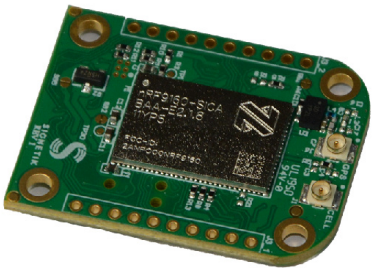
SigCell IoT Cellular Module M1-N1

Overview

- Provides LTE-M/NB-IoT, GPS
- Small form factor (32.8 x 24.5 x 4.5 mm)
- Low profile, single connector or twin connector
- Secure over the air updates for application and modem
- Integrated network stack, including security protocols
- Intelligent master/slave modes
- Passthrough binary/AT modes



Patent Pending

General Description

SigCell adds Cellular and GPS connectivity to your design in a modular fashion. A single point of contact and low profile design allows you to add this module to your design with minimal changes. Options for twin connectors allow for retrofitting into existing systems. SigCell's connector provides various ways to interface external analog and digital sensors via UART, SPI, I2S, ADC, GPIO, and PWM.

SigCell is ready for connection, out of the box. Simple commands are used to connect, send data, and close connections, or the device can be configured for automatic sensor reading and reporting via a cloud-based web interface. Additional support for AT commands is available to access the modem, create connections, and monitor status.

SigCell is IoT ready and communicates securely over TLS/DTLS. The extended temperature ensures robust performance outdoors.

Key Features

SigCell uses dual microcontrollers for intelligent application support. The Signetik + Nordic SiP design guarantees high quality. The design is kept compact (32.8 x 24.5 x 4.5 mm) while still containing the u.FL antenna, SIM, and eSIM capabilities. The firmware on the cellular component and the application firmware is updated OTA, making it worry-free.

The SigCell uses an integrated network stack. SigCell also increases the customization options by using a configurable pinout. Never worry about connecting your devices again with the PSM and eDRX support. Furthermore, tracking is made simple using the GNSS/GPS built-in support.

Not all of your devices are configured for network support? We've got you covered with built-in firmware for standalone sensor reporting.

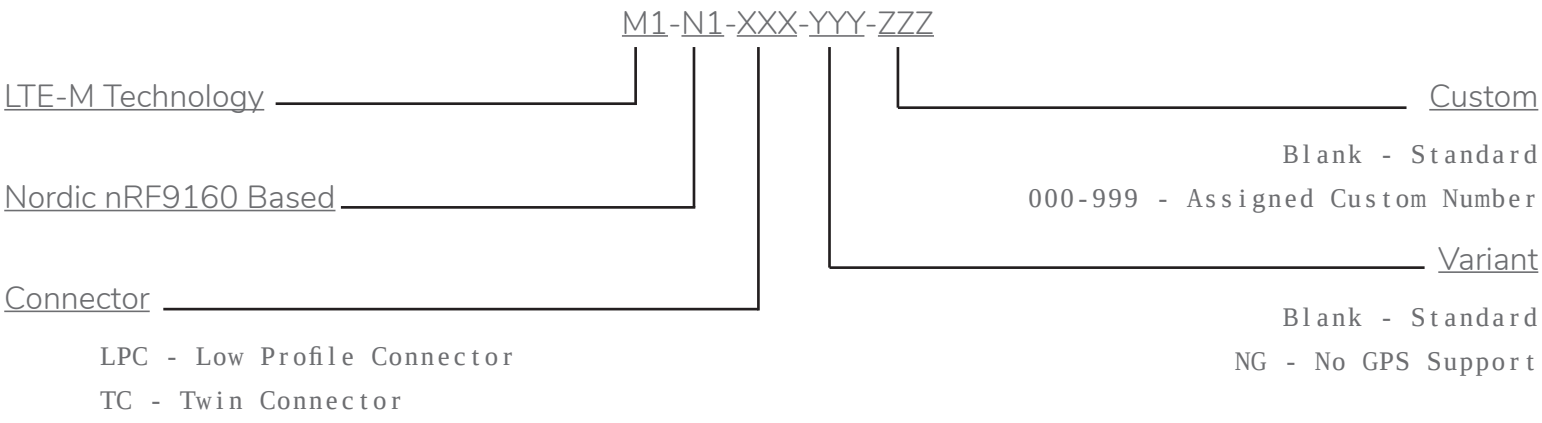
The combination of Signetik and Nordic gives you support channels you can rely on.

- Verizon and AT&T carrier pre-certification
- FCC tested
- Dual microcontrollers for intelligent application support
- High-quality design (Nordic SiP + Signetik)
- Compact: 32.8 x 24.5 x 4.5 mm, u.FL antenna
- SIM, eSIM
- Tri-color LED indicating signal strength and connection state.
- Cellular firmware OTA (FOTA) updates
- Application firmware OTA (FOTA) updates
- Integrated network stack
- Configurable pinout
- PSM and eDRX support
- GNSS/GPS support
- Built-in firmware for standalone sensor reporting
- Reliable support channels (Signetik + Nordic)

Revision History

Revision	Date	Description
0.1.0	5/1/2020	Initial document.
0.2.0	5/29/2020	Updated legal and support section.
0.9.0	6/15/2020	Updated support methods
1.0.0	7/6/2020	Updated mechanical drawings
1.0.1	7/15/2020	Minor textual changes. Nomenclature.
1.0.2	7/20/2020	Change device ordering information and TC manufacturer, and misc. text.
1.0.3	7/23/2020	Updated legal markings.
1.0.4	9/27/2020	Fix LPC pin numbering, TC pin description.
1.0.5	10/17/2020	Improvements to TC pin description.
1.0.6	02/15/2021	SIM card form factor

Device Ordering Information



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Mailing Address:

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Support

Users of Signetik products may receive assistance through the following channels:

- Symmetry Electronics - 1-866-506-8829
- Escalated to Signetik Technical Support
- Email: support@signetik.com

Customers should contact their distributor for support.

Warranty

Warranty information is available at www.signetik.com/legal

Hardware: LPC Pinout

Pin assignment for LPC is shown below.

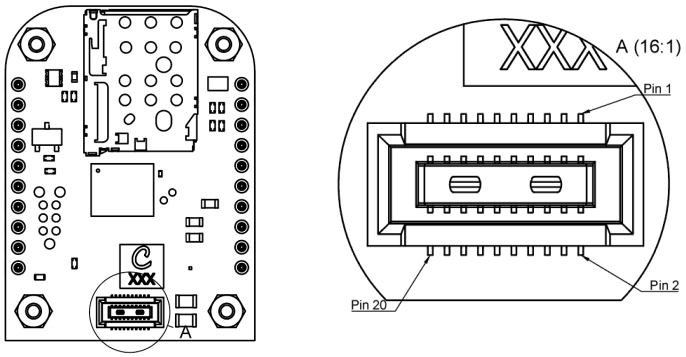


Table 1 - LPC Pin Description

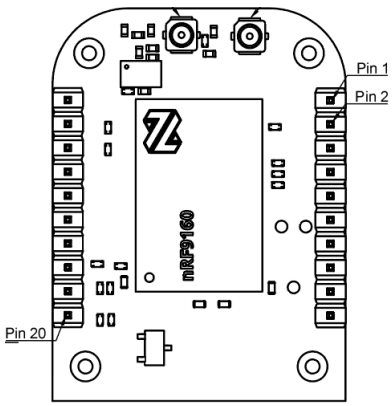
Number	Designation	Name	Direction	Description
1	P1.1	VIN	In	Power
2	P1.2	VIN	In	Power
3	P1.3	VDD nRF	Out	3.3V for accessories
4	P1.4	GND		
5*	P1.5	TXD	Out	UART Transmit
6*	P1.6	RXD	In Out	UART Receive
7*	P1.7	RTS	Out	UART RTS
8	P1.8	PWR_ON	In	Power Enable (w/ pulldown)
9*	P1.9	CTS	In	UART CTS
10*	P1.10	TXD1	Out	UART1 Transmit
11*	P1.11	D1	In/Out	Digital In/Out
12	P1.12	RXD1	In	UART1 Receive
13	P1.13	nRESET	In	Reset
14*	P1.14	AD1	In/Out	Analog/Digital
15*	P1.15	AD2	In/Out	Analog/Digital
16*	P1.16	AD3	In/Out	Analog/Digital
17*	P1.17	AD4	In/Out	Analog/Digital
18*	P1.18	AD5	In/Out	Analog/Digital
19*	P1.19	AD6	In/Out	Analog/Digital
20	P1.20	GND		

* Configurable

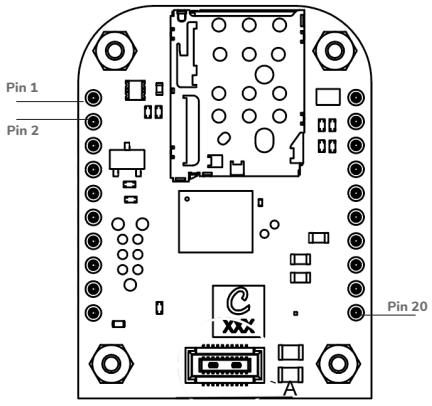
D1, AD1, AD2, AD3, AD4, AD5, AD6 are customizable as input or output.

Hardware: TC Pinout

Pin assignment for TC is shown below.



Top View



Bottom View

Table 2 - TC Pin Description

Num	Designation	Name	Direction	Description
1	J3_1-1	VIN	In	Power
2	J3_1-2*	UART0-TXD	Out	UART Modem to Host
3	J3_1-3*	UART0-RXD	In	UART Host to Modem
4	J3_1-4*	D1	In/Out	Digital In/Out
5	J3_1-5	nRESET	In	Reset modem
6	J3_1-6*	AD6	In/Out	Analog/Digital
7	J3_1-7*	AD5	In/Out	Analog/Digital
8	J3_1-8*	AD4	In/Out	Analog/Digital
9	J3_1-9*	AD3	In/Out	Analog/Digital
10	J3_1-10	GND		
11	J3_2-1	PWR_ON1[1]	In	Power Enable (w/ pulldown)
12	J3_2-2	VDD nRF	Out	3.3V for accessories
13	J3_2-3*	TXD1	Out	UART1 Transmit
14	J3_2-4*	RXD1	In	UART1 Receive
15	J3_2-5*	RTS	Out	UART RTS
16	J3_2-6*	AD2	In/Out	Analog/Digital
17	J3_2-7*	AD1	In/Out	Analog/Digital
18	J3_2-8	NC		No Connect
19	J3_2-9*	CTS	In	UART CTS
20	J3_2-10	GND		

* Configurable. D1, AD1, AD2, AD3, AD4, AD5 are customizable as input or output.

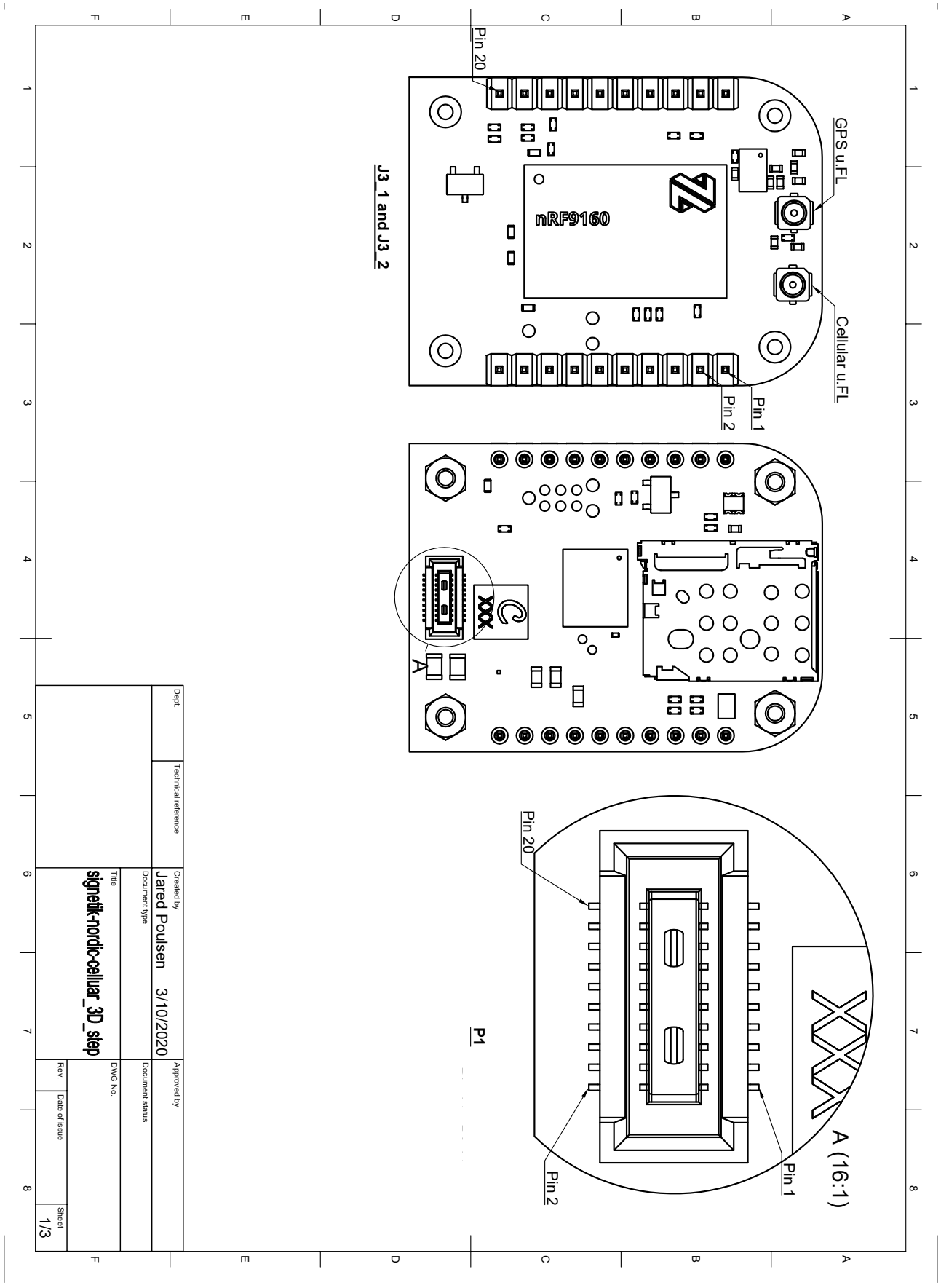
1 Pin 11 must be pulled to the power rail, same as pin 1.

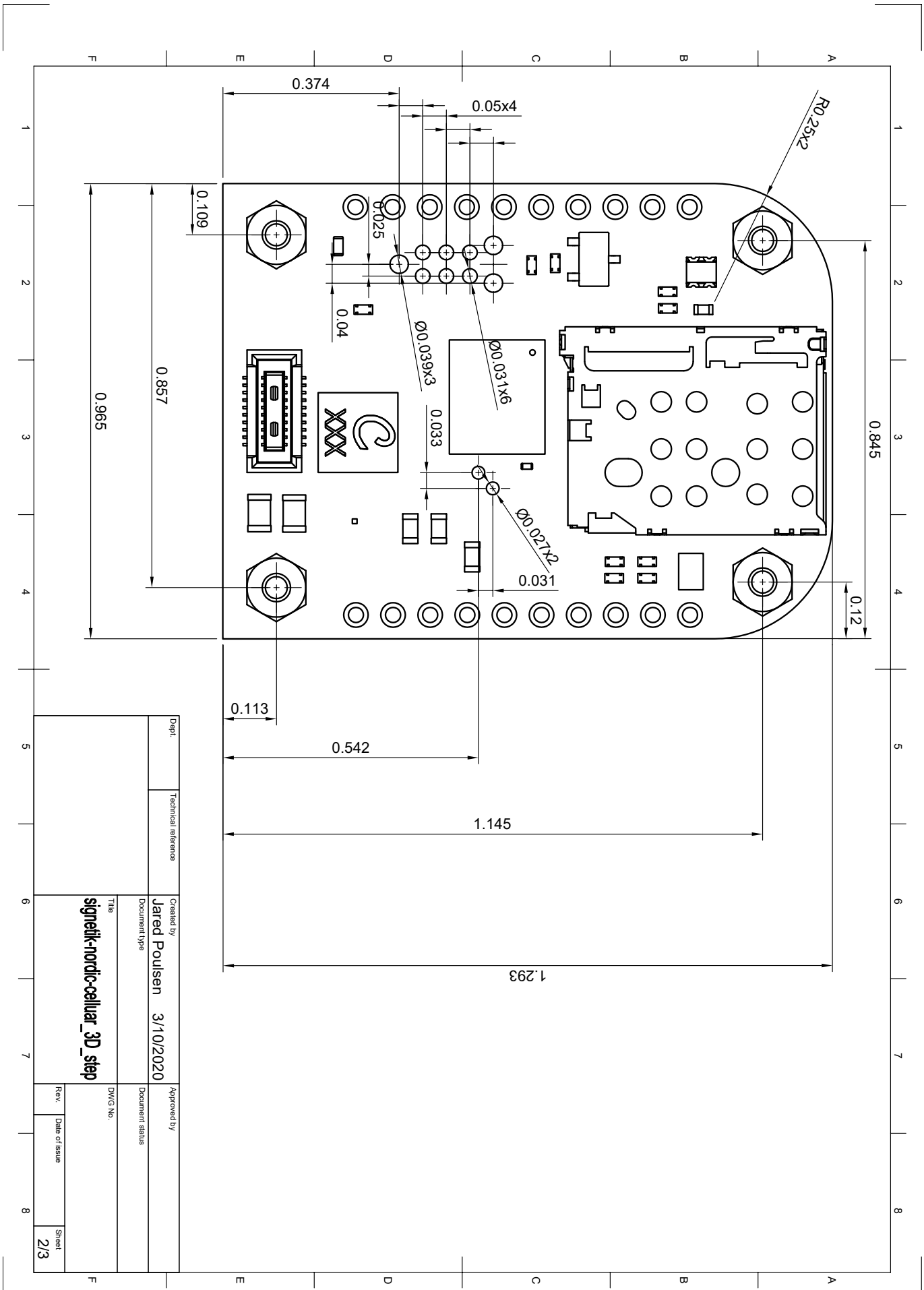
LED

The LED is used to indicate various modes of connectivity.

Indication	Meaning
Red	No Connection
Blue	Connected and Bootstrapping
Yellow	Connected, low signal strength
Green	Connected, medium signal strength
Purple	Connected, strong signal strength

Mechanical Data

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Technical reference
Created by
Jared Poulsen
3/10/2020
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Document status
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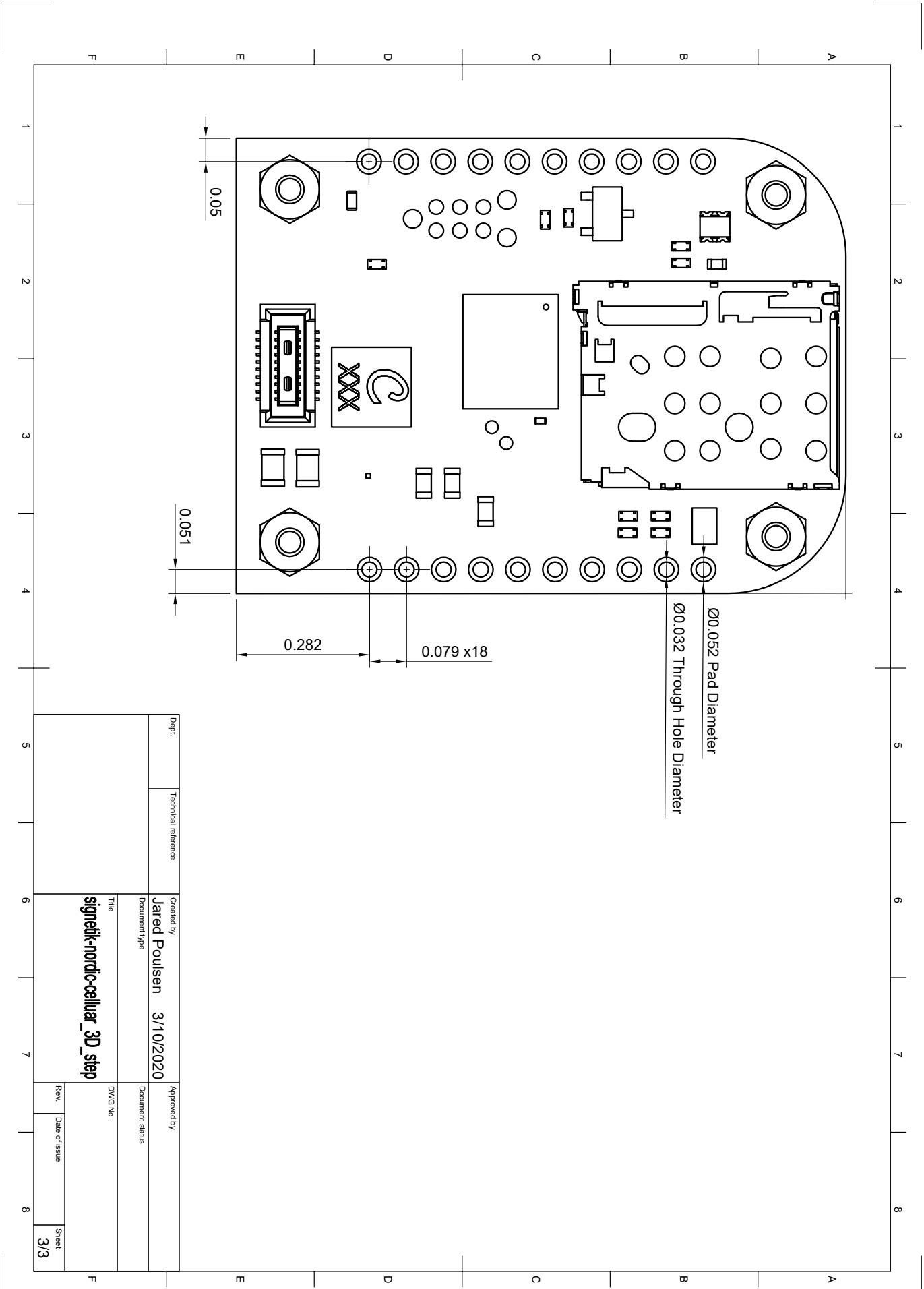
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Title
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Connectors

SigCell support a low-profile connector (LPC) and twin-connectors (TC). The connectors on SigCell are as follows.

```
LPC: Hirose DF40HC(2.5)-20DS-0.4V(51)
TC: Harwin M22-2511005
```

The mating connectors are as follows.

```
LPC: Hirose DF40C-20DP-0.4V(51)
TC: Harwin M22-7131042
```

IMPORTANT: SigCell must be ordered using part number suffix -LPC or -TC to select the populated connector.

SIM Form Factor

SigCell uses 4FF SIM (Nano-SIM)

Mounting

PEMs may be installed on a main board to allow securing SigCell -LPC to an add-on or motherboard.

```
SMTSO-M1.6-2.5
```

Signetik has a supplier for these. Please contact Signetik for the supplier information.

A quick option for mounting is to use plastic or metal screws of size M2. Sources are as follows.

```
https://www.amazon.com/XunLiu-Phillips-Metric-Plastic-Machine/dp/B07LDG1SDH
```

Modes of Operation

SigCell supports three modes of operation to cover most IoT applications. The first two modes, Sensor Master and Sensor Slave provide applications with not only a modem, but also intelligent core processing to interface to sensors and optionally provide AI of the sensor data, before reporting. Sensor Master mode is designed to interface to various sensors, such as I2C chips while Sensor Slave mode is designed to retrofit into existing systems that already have a processor and sensors and need an easy way to post sensor data. Finally, Modem mode provides a simple modem, with no intelligence, but simply processes commands from the existing core system.

Sensor Master Mode

This mode allows the developer to connect sensor chips, such as I2C chips, to SigCell, either as a prototype by wiring into one of the SigSense add-ons, or by creating a custom SigSense add-on board to put this chip, or more, onto a PCB.

Sensor interface configuration is provided by a configuration block which is loaded from the SigNet server. SigNet can be used out of the box but can also be replaced with a customer's server application by using the proper API. This API is documented in the SigNet user's guide

The configuration block is defined by the SigNet Device Configuration document.

SigCell pins are automatically configured based on the configuration block. In Master Mode, UART0 is reserved for console input/output and UART1 is reserved for direct modem interaction. If UART0 and UART1 are not in the configuration block, they are connected to unused pins and inaccessible. However, they can be put in the configuration block and then made available on any pins the application desires.

Sensor Slave Mode

This mode allows the developer to easily add SigCell to an existing system, without having to manage the low-level reporting and connectivity. By sending simple ASCII "reports" to SigCell, along with some configuration details, the system can offload sensor data and allow SigCell to manage the reporting. See Signetik's IoT API document.

Modem Modes

There are two modem modes currently supported. AT Command Mode and Signetik Binary

AT Command Mode

AT command mode is used when the application has its own microcontroller or microprocessor and an AT command interface is desired. This mode exposes the UART such that AT commands can be sent according to the nrf9160 AT command set. See https://infocenter.nordicsemi.com/pdf/nrf91_at_commands_v1.0.pdf for more information. NOTE: In this modem, the user must provide the IP stack using PDP. This is more suitable for an OS such as Linux.

Signetik Binary Mode

Signetik binary mode provides the stack on SigCell and makes it easy to manage IP sockets in an efficient manner. The binary connection is either UART or SPI. The binary protocol can be implemented by the host, however, it is much more efficient to use the supplied C API to manage connections.

In Signetik binary mode, the developer would provide call the following functions as part of an SPI or UART driver:

Initialize the modem callbacks.

```
void modem_init(struct modem_state_s *state, uart_send_f uart_send, uart_recv_f uart_
recv);
```

Continually check for receive data from UART or SPI (will call uart_recv_f)

```
int modem_check_socket_receive(struct modem_state_s *state, int timeout_ms);
```

Send and receive IP data.

```
int modem_udp_open(struct modem_state_s *state, char *ip, uint16_t port, int timeout_ms);
void modem_udp_close(struct modem_state_s *state, int sock);
int modem_tcp_open(struct modem_state_s *state, char *ip, uint16_t port, int timeout_ms);
void modem_send(struct modem_state_s *state, int sock, char *buffer, int length);
int modem_recv(struct modem_state_s *state, int sock, uint8_t *buffer, int length);
…
```

More details can be found in the Signetik Binary Mode API documentation.

Specifications

Overview

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Voltage Input	2.5	3.3	5.5	V
Ven	Power Enable	V_{CC}	3.3	V_{CC} + 0.5	V
I_{CC}	Current Input	15 uA[1]		600 mA[2]	
I_{CC} (avg)	Current Input		430 mA[3]		
T	Operating Temperature	-40		85	°C
	RX Sensitivity (LTE-M)		-108		dBm
	RX Sensitivity (NB-IoT)		-114		dBm
	Modem Frequency Range	700		2200	MHz
	Modem Throughput (LTE-M)		300/375		kbps

1 Sleep Mode
2 Transmitter Active
3 eDRX reporting once per hour, with nominal distance (transmitter using 300, reporting taking 5 seconds)

More details TBD