AirPrime XM0110 Development Kit Daughter Board

User Guide

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Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

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Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases: www.sierrawireless.com

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001	October 27, 2010	Creation

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1. Introduction

1.1. Overview

This document is the user guide for the Sierra Wireless XM0110 Development Kit Daughter Board, based on the AirPrime XM0110 GPS module.

This XM0110 Development Kit Daughter Board needs to be plugged on a Q26, WMP1x0 or SL6087 Development Kit (addressed hereafter as the Embedded Module Development Kit) in order to work correctly. The Embedded Module Development Kit provides power supply and control signals to the XM0110 Daughter Board for Development Kit.

Caution: *For basic start up configuration, you can also refer to [2] AirPrime XM0110 Quick Start Guide.*

1.2. Reference Documents

Several documents are referenced throughout this specification. For more details, please consult the listed reference documents. The Sierra Wireless documents referenced herein are provided in the Sierra Wireless documentation package; however, the general reference documents which are not Sierra Wireless owned are not provided in the documentation package.

1.2.1. Sierra Wireless Hardware Documentation

[1] AirPrime XM0110 Product Technical Specifications
     Reference: WM_DEV_XM0110_PTS_003

[2] AirPrime XM0110 Quick Start Guide
     Reference: WM_M&T_XM0110_UGD_001

[3] AirPrime XM0110 Customer Process Guidelines
     Reference: WM_DEV_XM0110_PTS_002

[4] AirPrime XM0110 Low Power Modes Application Note
     Reference: WM_DEV_XM0110_APN_001

1.2.2. Sierra Wireless Software Documentation

[5] AT Commands Interface Guide for Firmware 7.43
     Reference: WM_DEV_OAT_UGD_079

[6] Location AT Command Interface Guide
     Reference: WM_DEV_GPS_UGD_002

[7] Location Plug-In for Open AT® Developer Guide
     Reference: WM_DEV_GPS_UGD_001

1.3.   List of Abbreviations

Abbreviation	Definition
AC	Alternative Current
ADC	Analog to Digital Converter
A/D	Analog to Digital conversion
AGC	Automatic Gain Control
AT	ATtention (prefix for modem commands)
CEP	Circular Error Probable
CLK	CLocK
CMOS	Complementary Metal Oxide Semiconductor
CODEC	COder DECoder
CPU	Central Processing Unit
DAC	Digital to Analog Converter
DAI	Digital Audio Interface
dB	Decibel
DC	Direct Current
DR	Dynamic Range
DTR	Data Terminal Ready
EGNOS	European Geostationary Navigation Overlay System
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	ENable
ESD	ElectroStatic Discharges
ETSI	European Telecommunications Standards Institute
FIFO	First In First Out
FR	Full Rate
FTA	Full Type Approval
GND	GrouND
GPI	General Purpose Input
GPC	General Purpose Connector
GPIO	General Purpose Input Output
GPO	General Purpose Output
GPRS	General Packet Radio Service
GPS	Global Positioning System
GPSI	General Purpose Serial Interface
GSM	Global System for Mobile communications
Hi Z	High impedance (Z)
IC	Integrated Circuit
IDE	Integrated Development Environment
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identification
I/O	Input / Output

Abbreviation	Definition
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LSB	Less Significant Bit
MAX	MAXimum
MIN	MINimum
na	Not Applicable
NF	Noise Factor
NMEA	National Marine Electronics Association
NOM	NOMinal
NTC	Négative Temperature Coefficient
PA	Power Amplifier
PC	Personal Computer
PCB	Printed Circuit Board
PCL	Power Control Level
PFM	Power Frequency Modulation
PLL	Phase Lock Loop
PSM	Phase Shift Modulation
PWM	Pulse Width Modulation
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
RHCP	Right Hand Circular Polarization
RMS	Root Mean Square
RST	ReSeT
RTC	Real Time Clock
RTCM	Radio Technical Commission for Maritime services
RX	Receive
SBAS	Satellite-Based Augmentation System
SCL	Serial CLock
SDA	Serial DAta
SIM	Subscriber Identification Module
SMD	Surface Mounted Device/Design
SPI	Serial Peripheral Interface
SW	SoftWare
PSRAM	Pseudo Static RAM
TBC	To Be Confirmed
TBD	To Be Defined
TP	Test Point
TTFF	Time To First Fix
TVS	Transient Voltage Suppressor
TX	Transmit

Abbreviation	Definition
TYP	TYPical
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
VBATT	Main Supply Voltage from Battery or DC adapter
VSWR	Voltage Standing Wave Ratio
WAAS	Wide Area Augmentation System

1.4.   Glossary

Embedded Module: Sierra Wireless' AirPrime Intelligent Embedded Module, driving XM0110 GPS module as a host processor.

XM0110 DevKit DB: AirPrime XM0110 Development Kit Daughter Board.

2. AirPrime XM0110 Development Kit Daughter Board Block Diagram

The figure below shows the main functions of the board, and the connection between the Embedded Module Development Kit and the AirPrime XM0110 Development Kit Daughter Board.
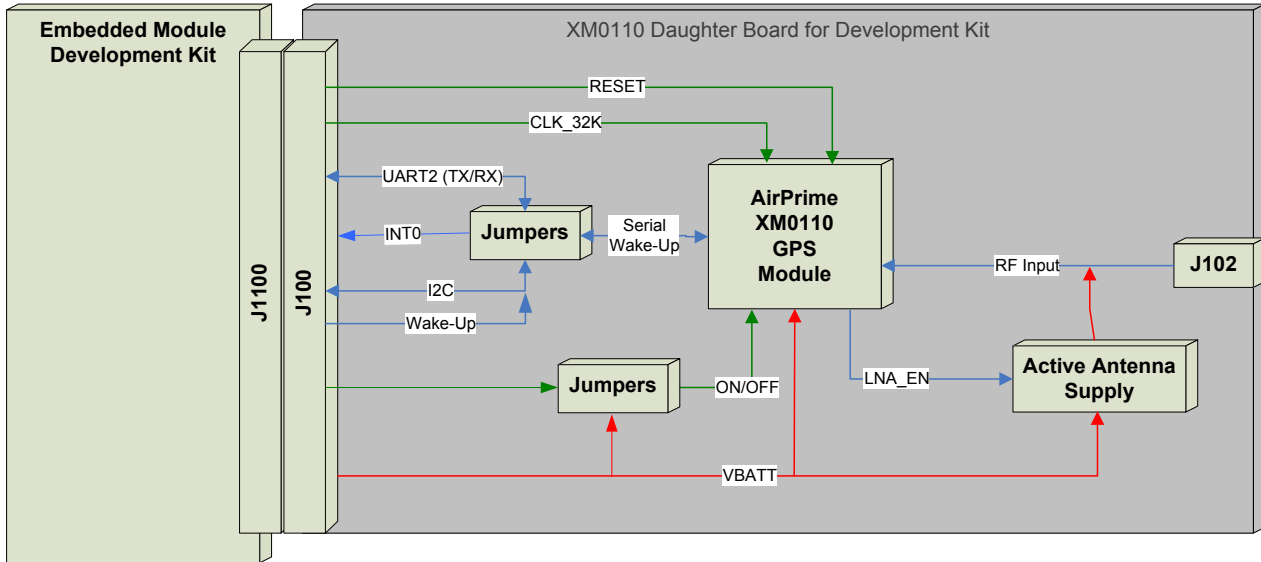
Figure 1.   Diagram of XM0110 Development Kit Daughter Board

3. Embedded Module and XM0110 Development Kits
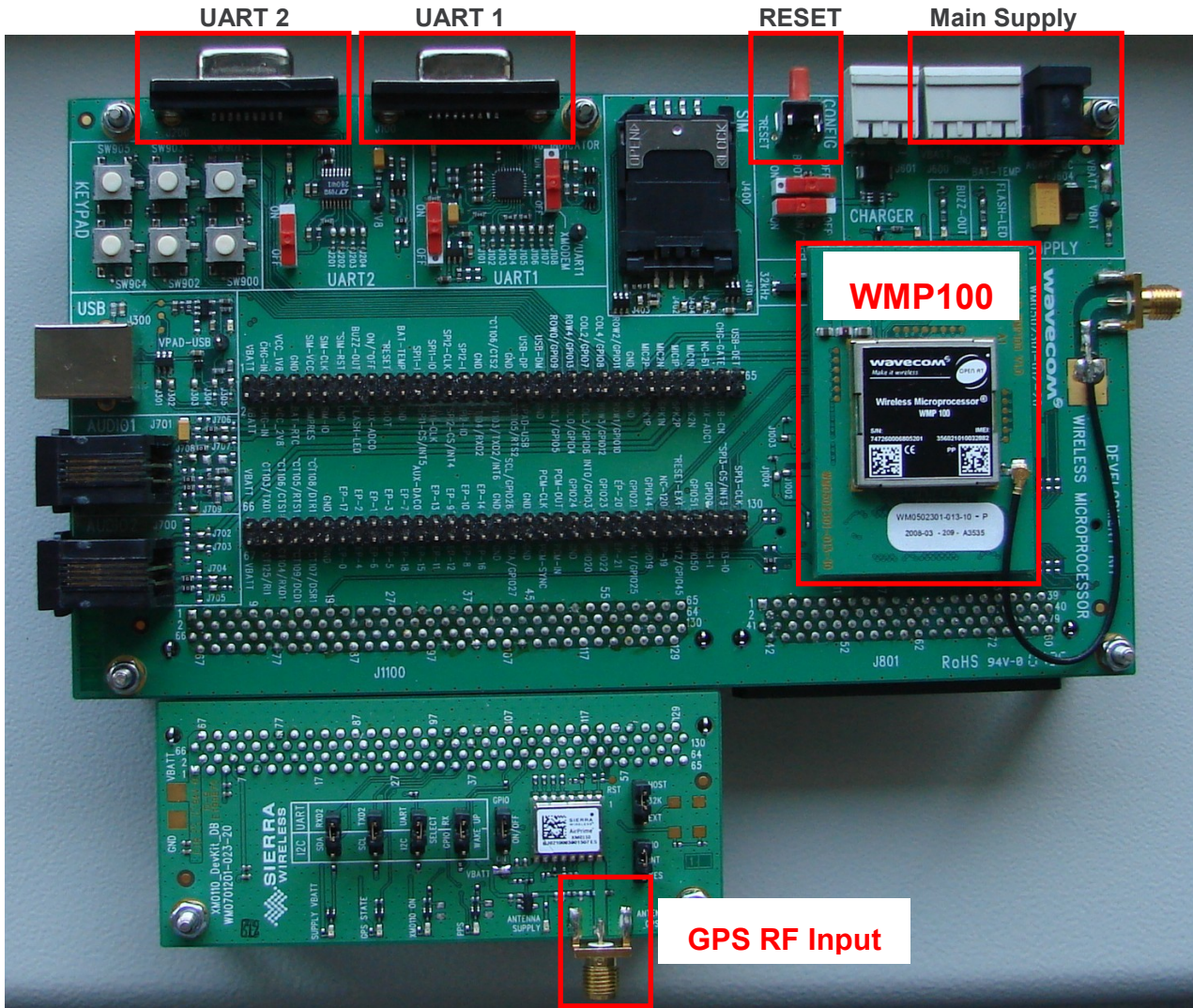
Figure 2.   WMP100 Development Kit + XM0110 Development Kit Daughter Board

Note: For Embedded Module proper setup for operation with AirPrime XM0110, please refer to [2] AirPrime XM0110 Quick Start Guide.
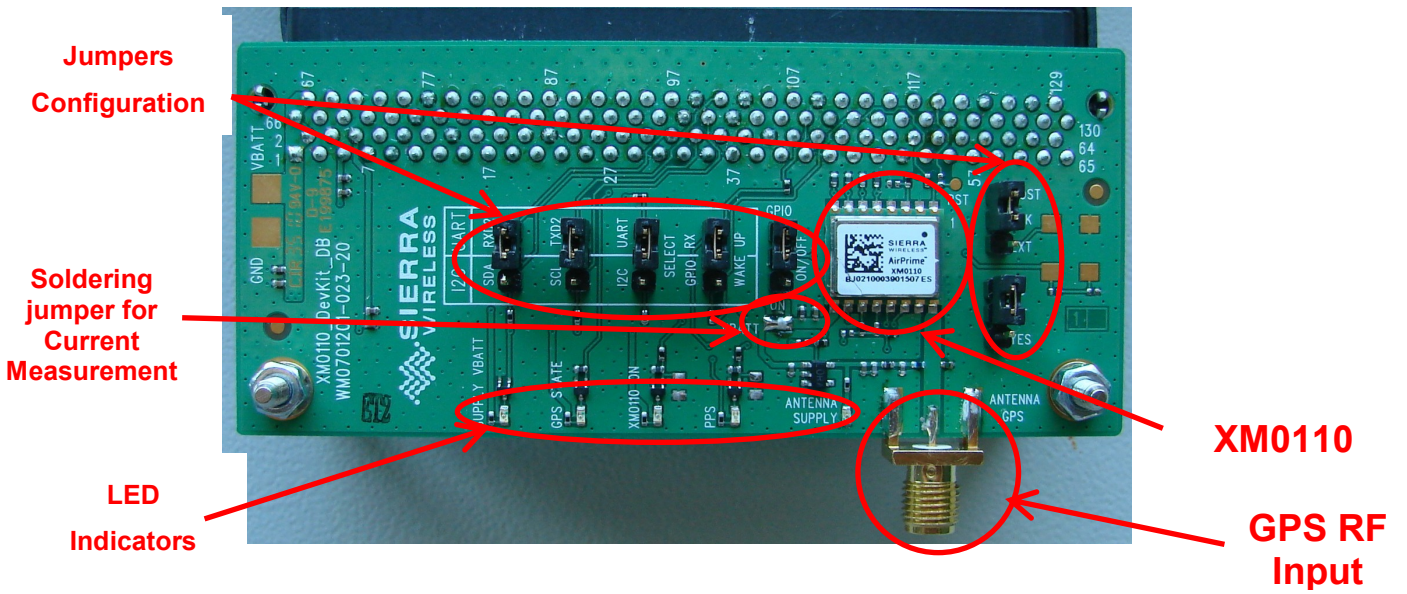
Figure 3.   XM0110 Development Kit Daughter Board
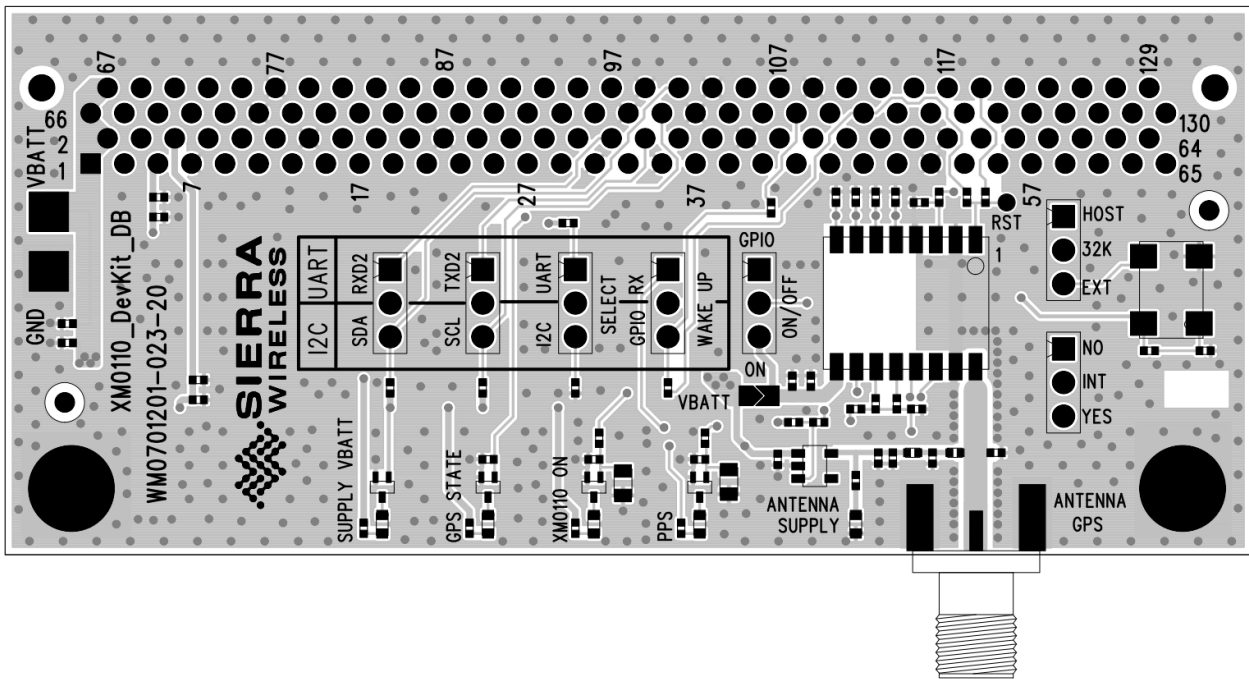
Figure 4.   XM0110 Development Kit Daughter Board Silkscreen
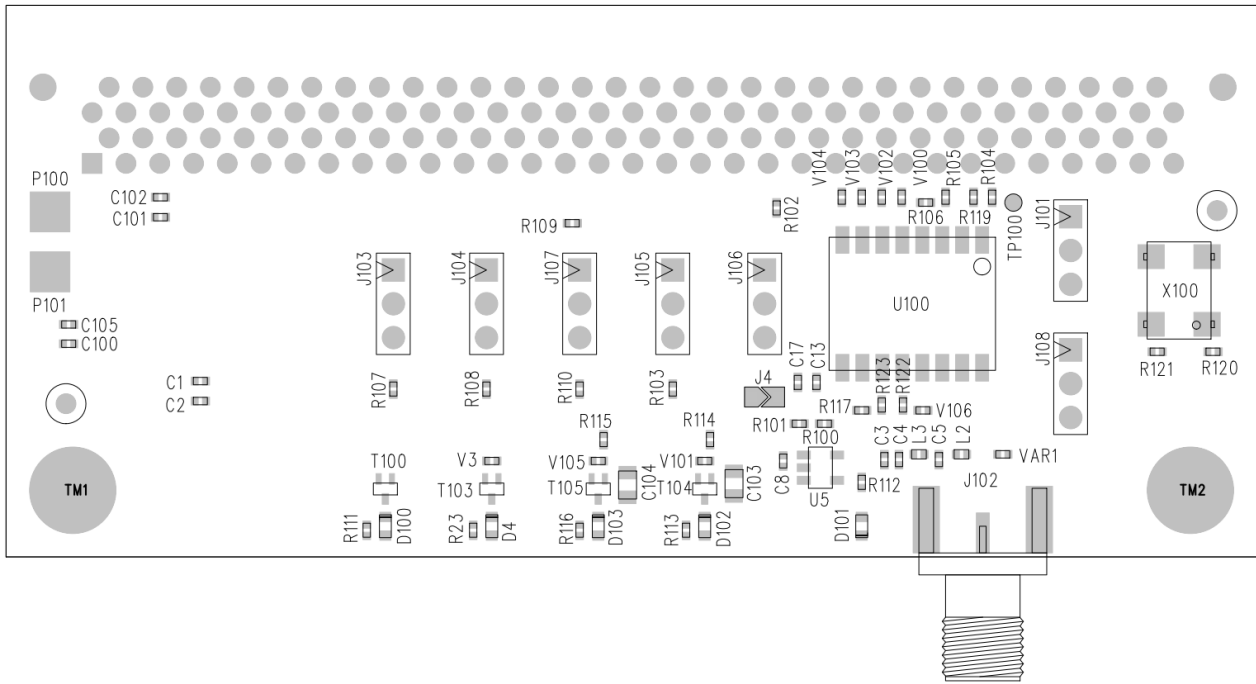
Figure 5.   XM0110 Development Kit Daughter Board Assembly Drawing

4. XM0110 Development Kit Daughter Board Architecture

The following are the components and their features.

4.1. AirPrime XM0110 GPS Module

The GPS Module used is the AirPrime XM0110 from Sierra Wireless.

The AirPrime XM0110 is a GPS L1 frequency (1575.42 MHz) module specifically designed by Sierra Wireless to offer the easiest and most optimized GPS feature integration for applications using AirPrime Intelligent Embedded Modules. AirPrime XM0110 was specifically designed for Machine-to-Machine systems deployed all over the world.

AirPrime XM0110 interfaces are:

- Single GPS RF input
- 1V8 to 5V25 power supply
- ON/OFF control input
- 2-wire serial link (UART or I2C) host interface
- 1V8 Digital I/Os (3V6 tolerant input)
  - Host interface Select input
  - Wake-Up input
  - Pulse-Per-Second output
  - External LNA or antenna supply Enable output
- 32.768kHz clock input

The AirPrime XM0110 does not have flash memory. The XM0110 firmware is loaded from Embedded Module at first GPS start-up and retained in RAM until power off or reset.

For more details on XM0110, see [1] AirPrime XM0110 Product Technical Specifications.

4.2. LDO for Active Antenna Supplying

There are 2 type of GPS antenna: Passive antenna and active antenna that integrate an LNA.

The XM0110 Development Kit Daughter Board is designed to use active antenna, so it provides a 3.3V power supply on RF connector. This supply is managed by AirPrime XM0110 firmware (through EXT_LNA_EN signal) and follows activation and deactivation of XM0110 internal RF chain.

Caution: *In a future software delivery a command to activate and deactivate EXT_LNA_EN signal will be integrated, but for now, if this supply is undesirable a SMA RF DC-Blocker must be add on RF connector.*
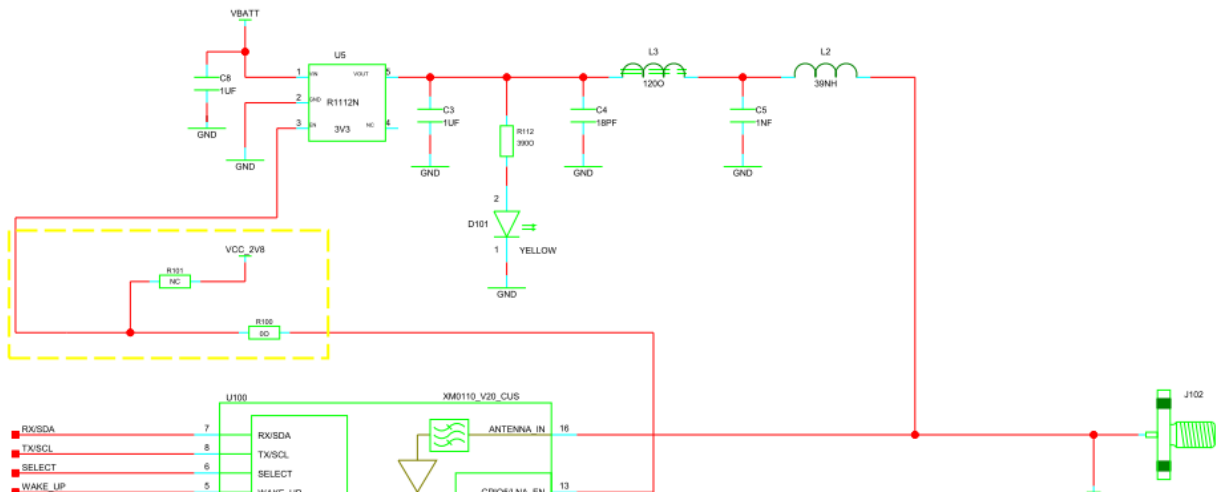
Figure 6.   Power supply for GPS Active Antenna

⟫ 5. Configuration

XM0110 Development Kit Daughter Board uses some resources provided by the Embedded Module Development Kit and shares supply with it. Therefore some resources are not available on the Embedded Module Development Kit when XM0110 Development Kit Daughter Board is plugged.

5.1. Interface Configuration

The AirPrime XM0110 can be driven through 2-Wire UART or I2C interface. One jumper is used to choose an interface type and 2 jumpers are used for switch interface communication signals:

5.1.1. J107: Connected to SELECT pin 6 of XM0110.
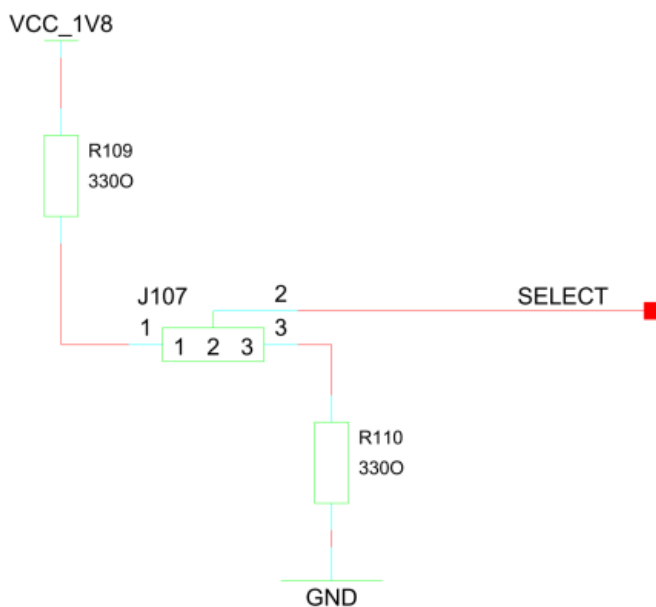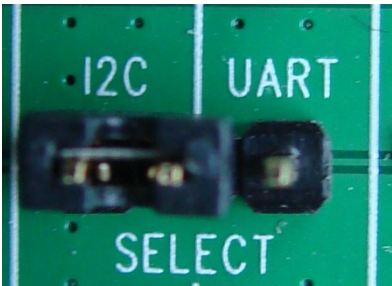
Figure 7.   SELECT Signal Jumper Connection Schematic

Table 1.   Communication Interface selection

	SELECT pin LEVEL	Interface selected
	"0"	I2C

	SELECT pin LEVEL	Interface selected
	"1"	UART

5.1.2. J104: Connected to TX / SCL signal pin 8 of XM0110
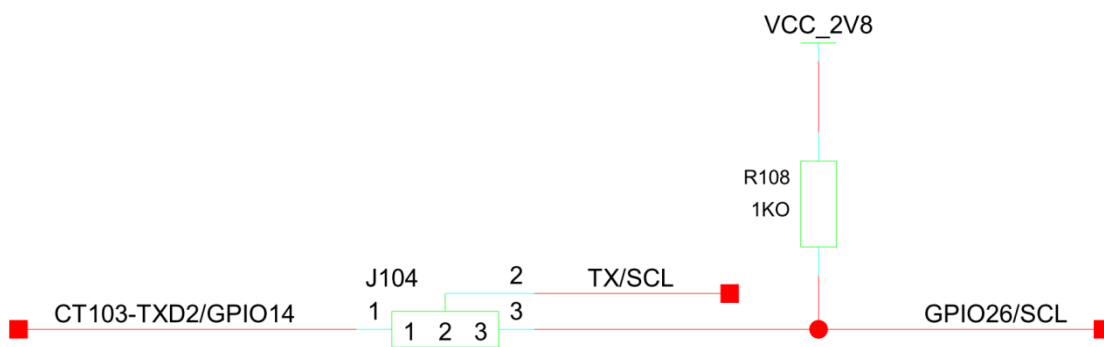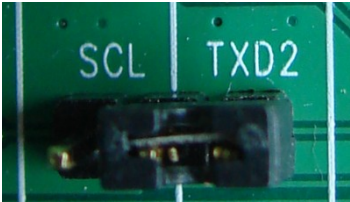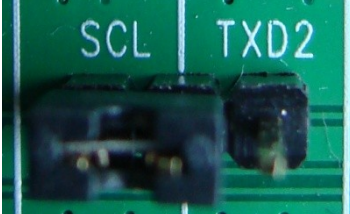
Figure 8.   TX/SCL Signal Jumper Connection Schematic

Table 2.   TX/SCL Signal Routing Selection

J104 Jumper Position	WMP1x0/Q26	SL6087
	TX/SCL signal route to TXD2/GPIO14	TX/SCL signal route to TXD2/GPIO14
	TX/SCL signal route to SCL/GPIO26 (A pull-up resistor is present for I²C Connection)	TX/SCL signal route to SCL/GPIO1 (A pull-up resistor is present for I²C Connection)

5.1.3. J103: Connected to RX / SDA signal pin 7 of XM0110
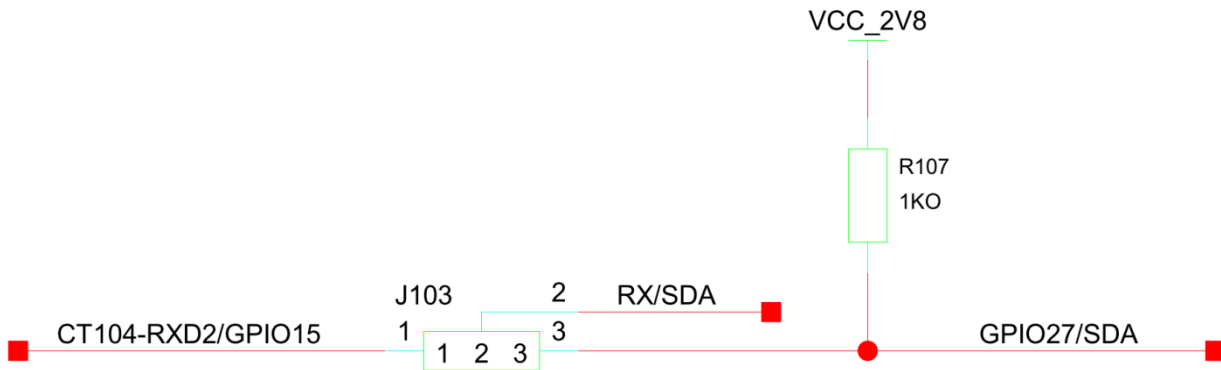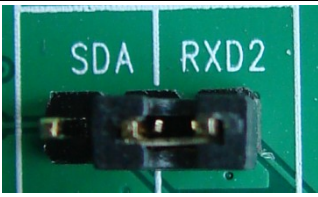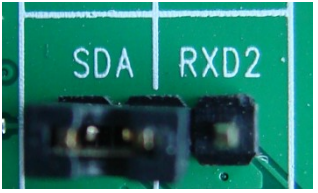
Figure 9.   RX/SDA Signal Jumper Connection Schematic

Table 3.   RX/SDA Signal Routing Selection

J103 Jumper Position	WMP1x0/Q26	SL6087
	RX/SDA signal route to RXD2/GPIO15	RX/SDA signal route to RXD2/GPIO15
	RX/SDA signal route to SDA/GPIO27 (A pull-up resistor is present for I²C Connection)	RX/SDA signal route to SDA/GPIO2 (A pull-up resistor is present for I²C Connection)

5.1.4. J105: Connected to WAKE_UP signal pin 5 of XM0110

Rising edge signal applied on WAKE_UP input signal wake XM0110 GPS module up. When UART interface communication is chosen, to reduce a number of IO used for driven XM0110, WAKE_UP signal is connected to RX signal. A frame with no data is sent to wake XM0110 up. When I2C interface communication is chosen, WAKE_UP signal is connected to a GPIO.
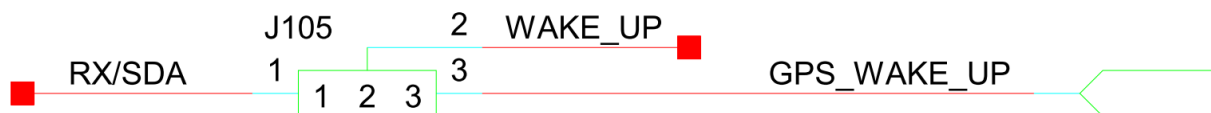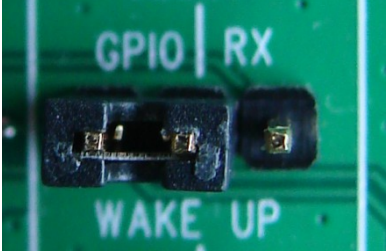
Figure 10.   WAKE_UP Signal Jumper Connection Schematic

Table 4. **WAKE_UP Signal Routing Selection**

J105 Jumper Position	WMP1x0/Q26/SL6087
	WAKE_UP signal is connected to RX/SDA signal
	WAKE_UP signal is connected to GPIO24

5.2. Power Configuration

5.2.1. J106: Connected to ON/OFF signal pin 10 of XM0110

ON/OFF signal is driven by Embedded Module trough a GPIO. In some specific cases, e.g. some specific low power modes, ON/OFF can be tied permanently to ON. For more details, refer to [4] AirPrime XM0110 Low Power Modes Application Note.
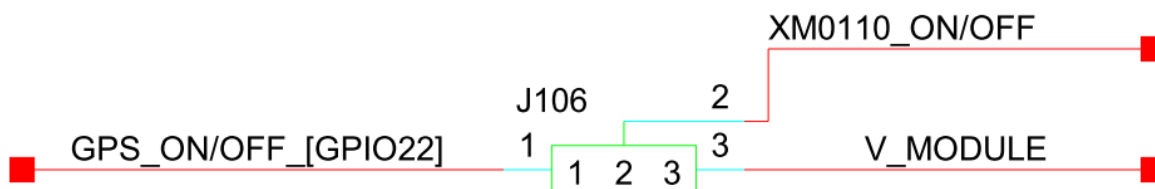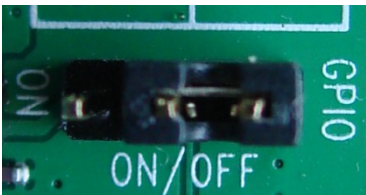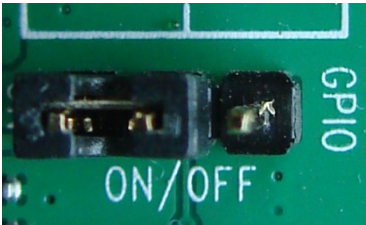
Figure 11. *ON/OFF Signal Jumper Connection Schematic*

Table 5. **ON/OFF Management Configuration**

J105 Jumper Position	WMP1x0/Q26/SL6087
	ON/OFF signal is connected to GPIO22

J105 Jumper Position	WMP1x0/Q26/SL6087
	ON/OFF signal is tied permanently to ON

Customer who would like to drive directly AirPrime XM0110 ON/OFF signal from his own application can remove the jumper and connects a command signal on pin 2 of J106.

Caution: *Customer is responsible to check all electrical characteristics of command signal for ON/OFF (see [1] AirPrime XM0110 Product Technical Specifications). Sierra Wireless disclaims liability for any direct or indirect damages consecutively of use wrong characteristics signal on this pin.*

5.3.   Current Measurement

J4 soldering jumper is placed in serie with XM0110 Main supply. This allows to measure a current directly in input of XM0110:

- With amperemeter in serie or;
- With supply directly on this pad (with soldering jumper removed)

Caution: *In normal condition a jumper is soldered*
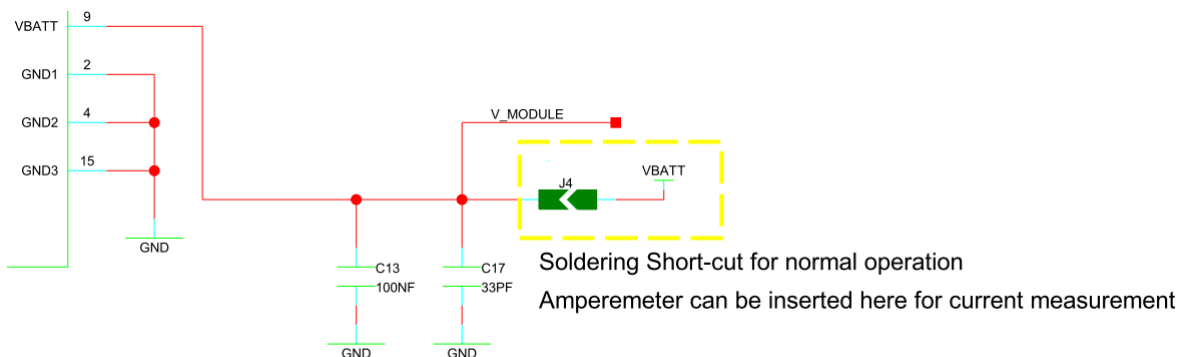
Figure 12.   Soldering jumper for current measurement schematic

5.4. Clock Source Configuration

5.4.1. J101: Connected to CLK_32K signal pin 10 of XM0110
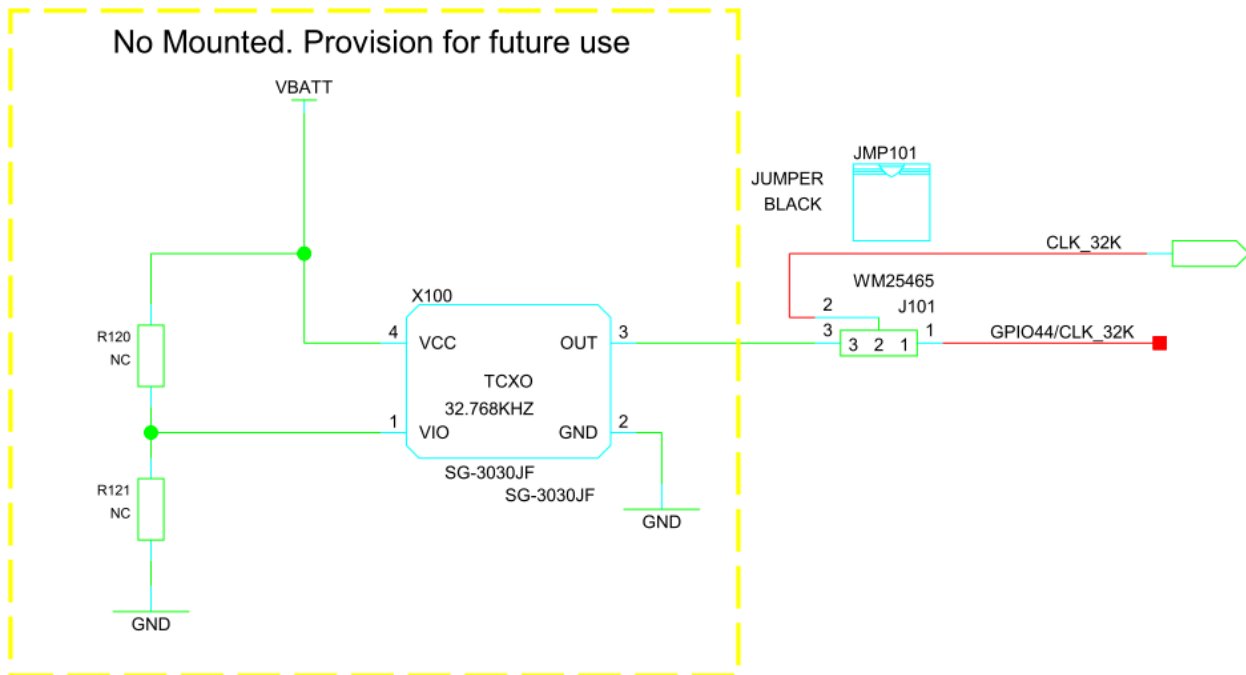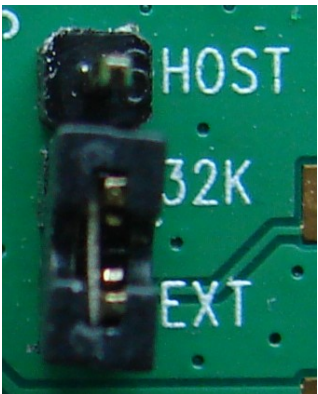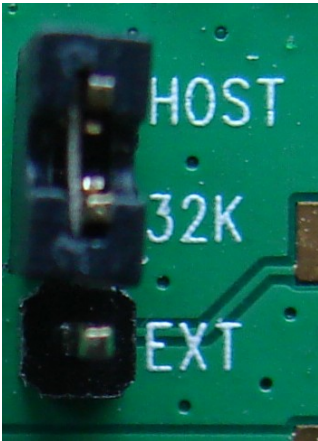
Figure 13. CLK_32K Signal Jumper Connection Schematic

Table 6.   CLK_32K Routing Configuration

J101 Jumper Position	WMP1x0	Q26/SL6087
	CLK_32K clock signal is provided by External oscillator (Not mounted, reserved for future application test).	CLK_32K clock signal is provided by External oscillator (Not mounted, reserved for future application test).

J101 Jumper Position	WMP1x0	Q26/SL6087
	CLK_32K clock signal is provided by Host through GPIO44	CLK_32K clock signal is provided by Host through GPIO0

Customer who would like to drive directly XM0110 CLK_32K signal from his own application can remove the jumper and connect a 32.768 kHz signal on pin 2 of J101.

Caution: *Customer is responsible to check all electrical characteristic of command signal for CLK_32K (see [1] AirPrime XM0110 Product Technical Specifications). Sierra Wireless disclaims liability for any direct or indirect damages consecutively of use wrong characteristics signal on this pin.*

5.5. Interruption Configuration

5.5.1. J108: Connection to interrupt Embedded Module
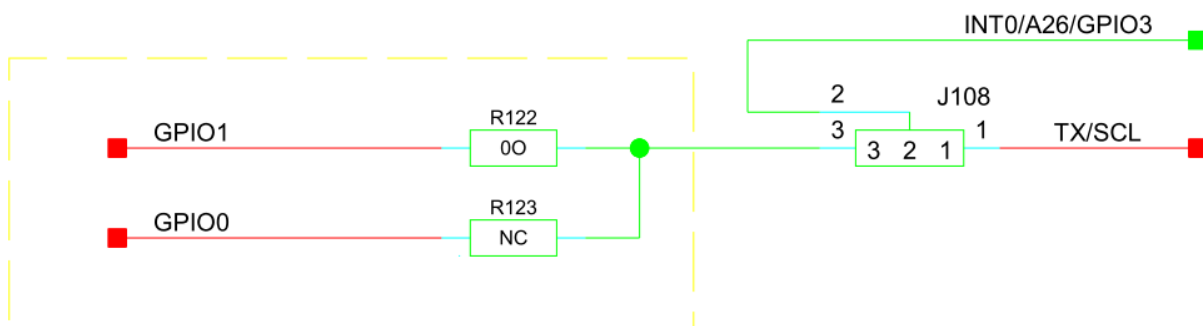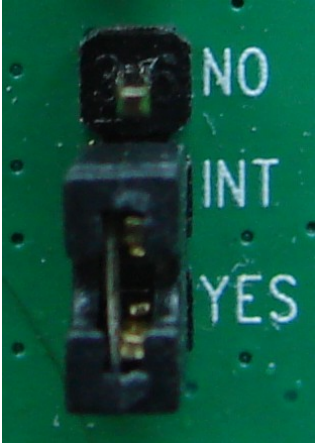
Figure 14.   Interruption Signal Jumper Schematic

Table 7.   Interruption Jumper Routing Configuration

J108 Jumper Position	WMP1x0/Q26/SL6087
	GPIO1 signal is connected to INT0/A26/GPIO3 signal. Reserved for future use
	TX/SCL signal is connected to INT0/A26/GPIO3 signal

Note: This signal is used to wake-up Embedded Module if Embedded Module sleep mode is activated (see [4] AirPrime XM0110 Low Power Modes Application Note). If Customer does not need such feature in his design, he can remove the jumper and release INT0 input.

5.6.   System Connection

XM0110 Development Kit Daughter Board is connected to Embedded Module Development Kit with a 130-pin Connector. Schematic and pins assignment are described below.
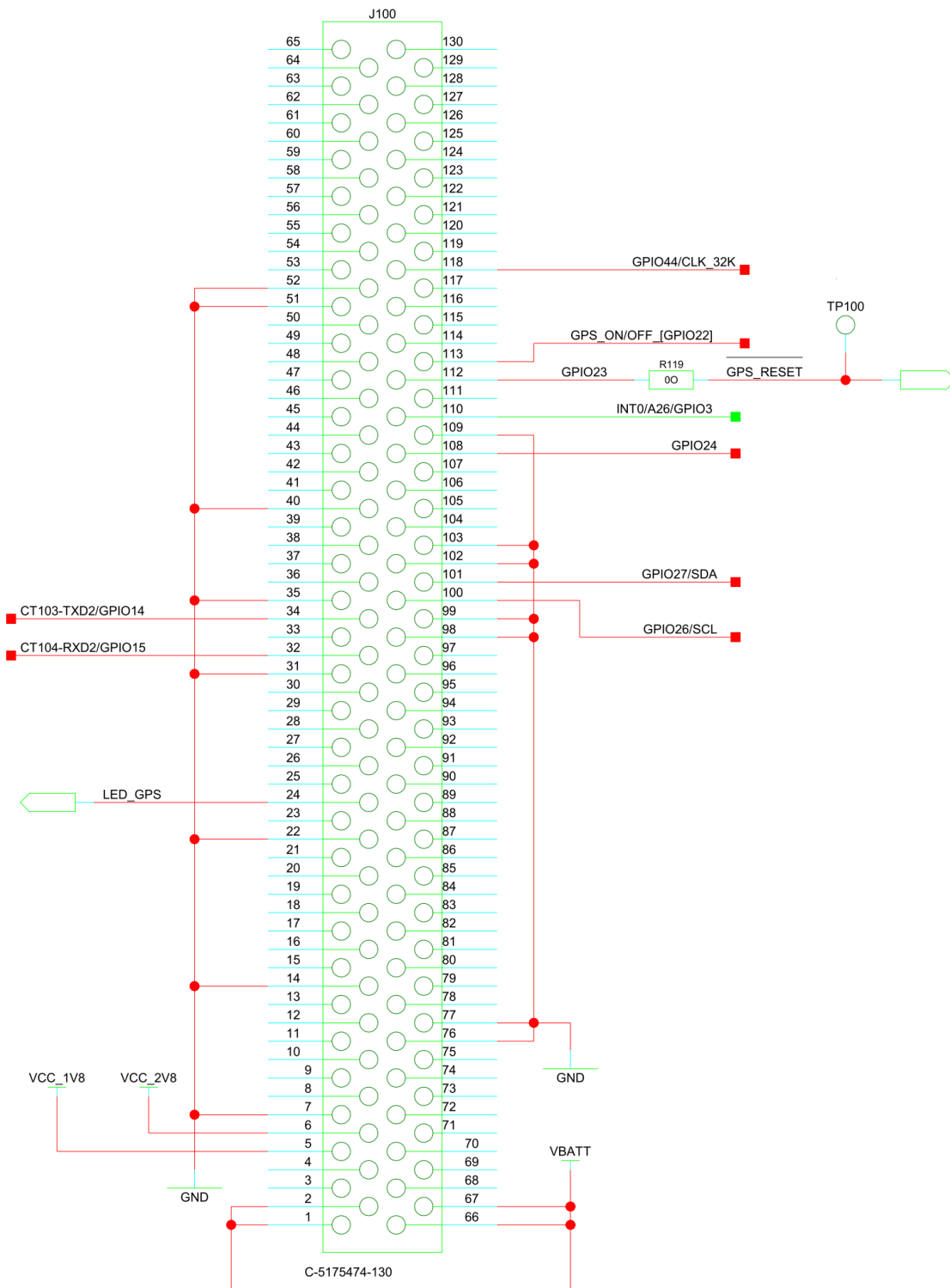
Figure 15.   J100 schematic

5.7.   J100 Pin out

Table 8.   J100 Pinout

Pin Number	Signal Name	I/O	I/O Type	Description
1	VBATT	Supply	3.3 to 5.2V	Main Input
2	VBATT	Supply	3.3 to 5.2V	Main Input
3	N/C			Not connected
4	N/C			Not connected
5	VCC_1V8	Supply	1.8V	1.8V digital supply input
6	VCC_2V8	Supply	2.8V	2.8V digital supply input
7	GND			Ground
8	N/C			Not connected
9	N/C			Not connected
10	N/C			Not connected
11	N/C			Not connected
12	N/C			Not connected
13	N/C			Not connected
14	GND			Ground
15	N/C			Not connected
16	N/C			Not connected
17	N/C			Not connected
18	N/C			Not connected
19	N/C			Not connected
20	N/C			Not connected
21	N/C			Not connected
22	GND			Ground
23	N/C			Not connected
24	LED_GPS	Input	2V8	Applicative LED GPS Status indicator
25	N/C			Not connected
26	N/C			Not connected
27	N/C			Not connected
28	N/C			Not connected
29	N/C			Not connected
30	N/C			Not connected
31	GND			Ground
32	CT104/RXD2	I/O	1V8 (Tol. 3V6)	Receive Serial Data Connected to RX/SDA through J103 (UART Mode)
33	N/C			Not connected
34	CT103/TXD2	Output	1V8	Transmit Serial Data Connected to TX/SCL through J104 (UART Mode)
35	GND			Ground
36	N/C			Not connected
37	N/C			Not connected

Pin Number	Signal Name	I/O	I/O Type	Description
38	N/C			Not connected
39	N/C			Not connected
40	GND			Ground
41	N/C			Not connected
42	N/C			Not connected
43	N/C			Not connected
44	N/C			Not connected
45	N/C			Not connected
46	N/C			Not connected
47	N/C			Not connected
48	N/C			Not connected
49	N/C			Not connected
50	N/C			Not connected
51	GND			Ground
52	GND			Ground
53	N/C			Not connected
54	N/C			Not connected
55	N/C			Not connected
56	N/C			Not connected
57	N/C			Not connected
58	N/C			Not connected
59	N/C			Not connected
60	N/C			Not connected
61	N/C			Not connected
62	N/C			Not connected
63	N/C			Not connected
64	N/C			Not connected
65	N/C			Not connected
66	VBATT	Supply	3.3 to 5.2V	Main Input
67	VBATT	Supply	3.3 to 5.2V	Main Input
68	N/C			Not connected
69	N/C			Not connected
70	N/C			Not connected
71	N/C			Not connected
72	N/C			Not connected
73	N/C			Not connected
74	N/C			Not connected
75	N/C			Not connected
76	GND			Ground
77	GND			Ground
78	N/C			Not connected
79	N/C			Not connected

Pin Number	Signal Name	I/O	I/O Type	Description
80	N/C			Not connected
81	N/C			Not connected
82	N/C			Not connected
83	N/C			Not connected
84	N/C			Not connected
85	N/C			Not connected
86	N/C			Not connected
87	N/C			Not connected
88	N/C			Not connected
89	N/C			Not connected
90	N/C			Not connected
91	N/C			Not connected
92	N/C			Not connected
93	N/C			Not connected
94	N/C			Not connected
95	N/C			Not connected
96	N/C			Not connected
97	N/C			Not connected
98	GND			GROUND
99	GND			GROUND
100	SCL	I/O	Open drain	I2C Serial Clock Connected to TX/SCL through J104 (I2C Mode)
101	SDA	I/O	Open drain	I2C Serial Data Connected to RX/SDA through J103 (I2C Mode)
102	GND			GROUND
103	GND			GROUND
104	N/C			Not connected
105	N/C			Not connected
106	N/C			Not connected
107	N/C			Not connected
108	GPIO24	Input	1V8 (Tol. 3V6)	Connected to WAKE_UP through J105 (I2C Mode)
109	GND			GROUND
110	INT0/GPIO3	Output	1V8	Connected to TX/SCL through J108 (I2C Mode)
111	N/C			Not connected
112	GPS_RESET	Input	1V8 (Tol. 3V6)	Connected to GPIO23 through R119
113	ON/OFF	Input	1.0 to 5.2V	Connected to GPIO22 through J106
114	N/C			Not connected
115	N/C			Not connected
116	N/C			Not connected
117	N/C			Not connected
118	CLK_32K	Input	0.9 to 3.6Vpp	Connected to CLK_32K through J101

Pin Number	Signal Name	I/O	I/O Type	Description
119	N/C			Not connected
120	N/C			Not connected
121	N/C			Not connected
122	N/C			Not connected
123	N/C			Not connected
124	N/C			Not connected
125	N/C			Not connected
126	N/C			Not connected
127	N/C			Not connected
128	N/C			Not connected
129	N/C			Not connected
130	N/C			Not connected

6. LED Indicators and Test Point

There are 5 LED indicators on the AirPrime XM0110 Development Kit Daughter Board that provide information on board status. All elements are defined in the subsections below.
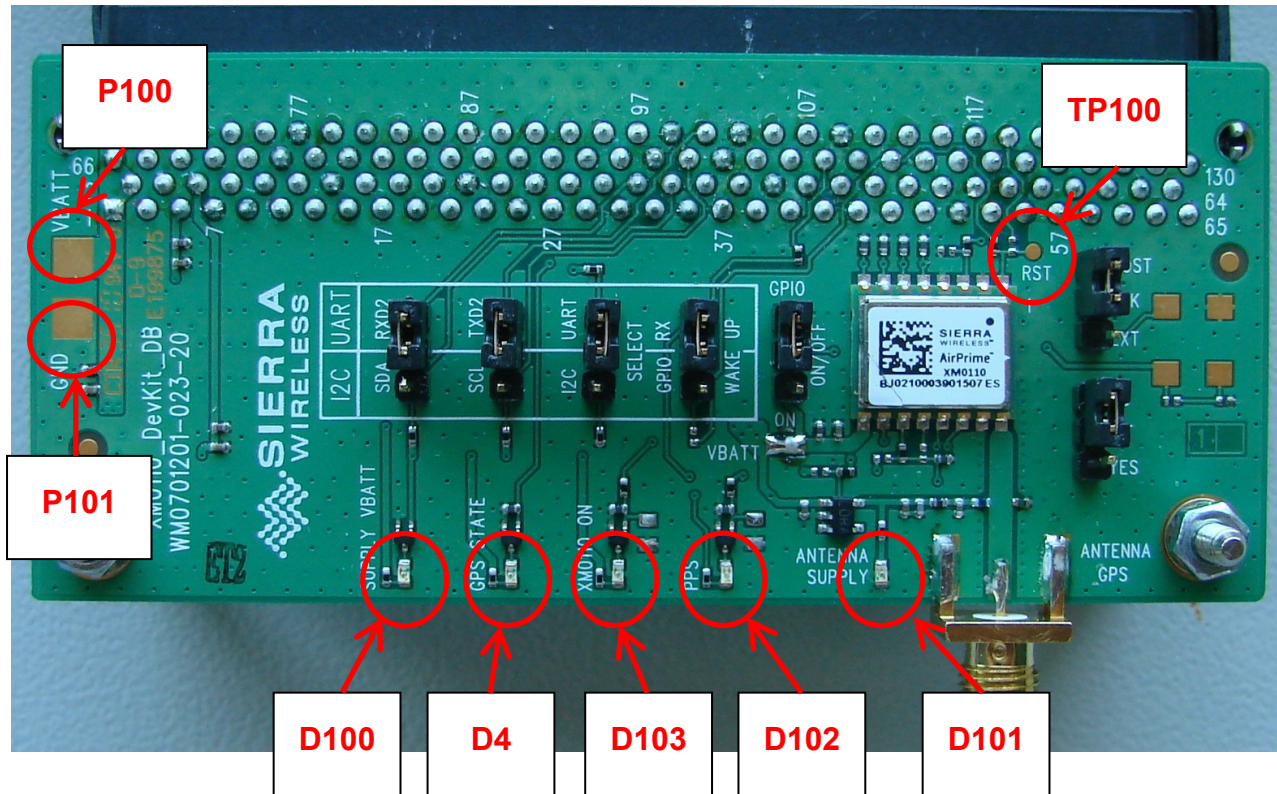

Figure 16.   LED Indicators and Test Point

6.1.   D100: (GREEN) Power Supply Indicator

D100 LED is supplied by VBATT but LED supply is enabled by VCC_2V8. So when D100 is turned on, to mean a VBATT and VCC_2V8 are present.
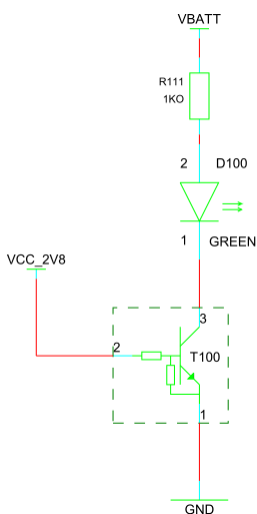
Figure 17.   D100 Power Supply LED schematic

6.2. D4: (BLUE) GPS STATUS Indicator.

D4 LED is supplied by VBATT but LED supply is controlled by GPIO managed by software application. See software documentation for explanation of on or flashing LED.

Figure 18. D4 GPS Status Led Schematic

6.3. D103: (YELLOW) XM0110 ON Indicator.

D103 LED is supplied by VCC_2V8 but LED supply is controlled by the XM0110 ON/OFF signal. If J103 is positioned for controlling ON/OFF by GPIO then D103 follow the state of this GPIO. If J103 is positioned for turn-on permanently AirPrime XM0110 then D103 is permanently on.
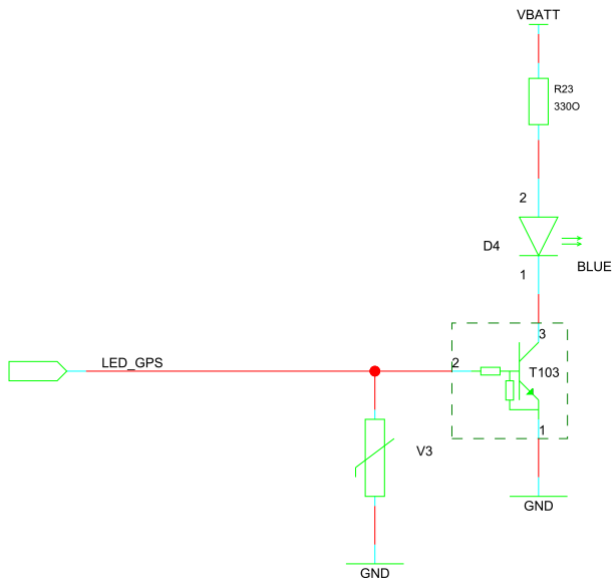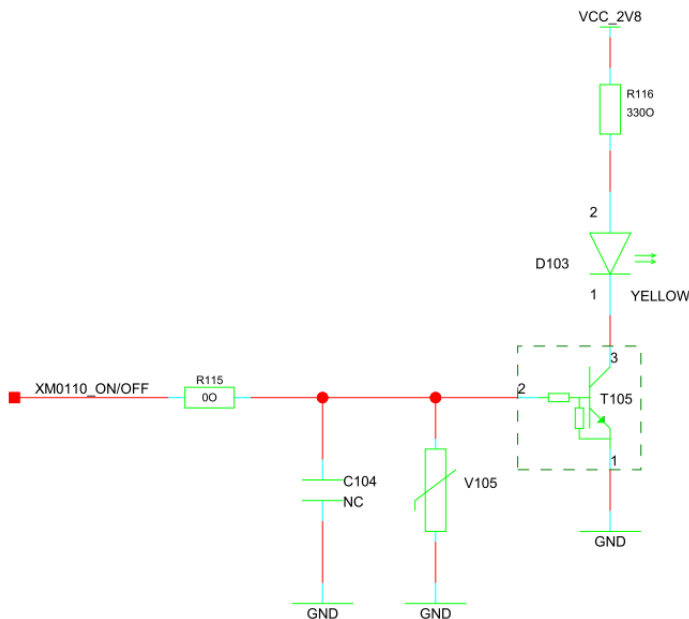
Figure 19. D103 XM0110 ON Schematic

6.4. D102: (YELLOW) PPS Indicator (blinking).

D102 LED is supplied by VCC_2V8 but LED supply is controlled by PPS output signal from AirPrime XM0110. This signal is under AirPrime XM0110 firmware control. The PPS signal will provide pulse output only once GPS acquisition reaches sufficient accuracy to provide a reliable period. In particular, this requires a GPS fix to be obtained. Until such conditions are achieved, no signal will be output at PPS pin.
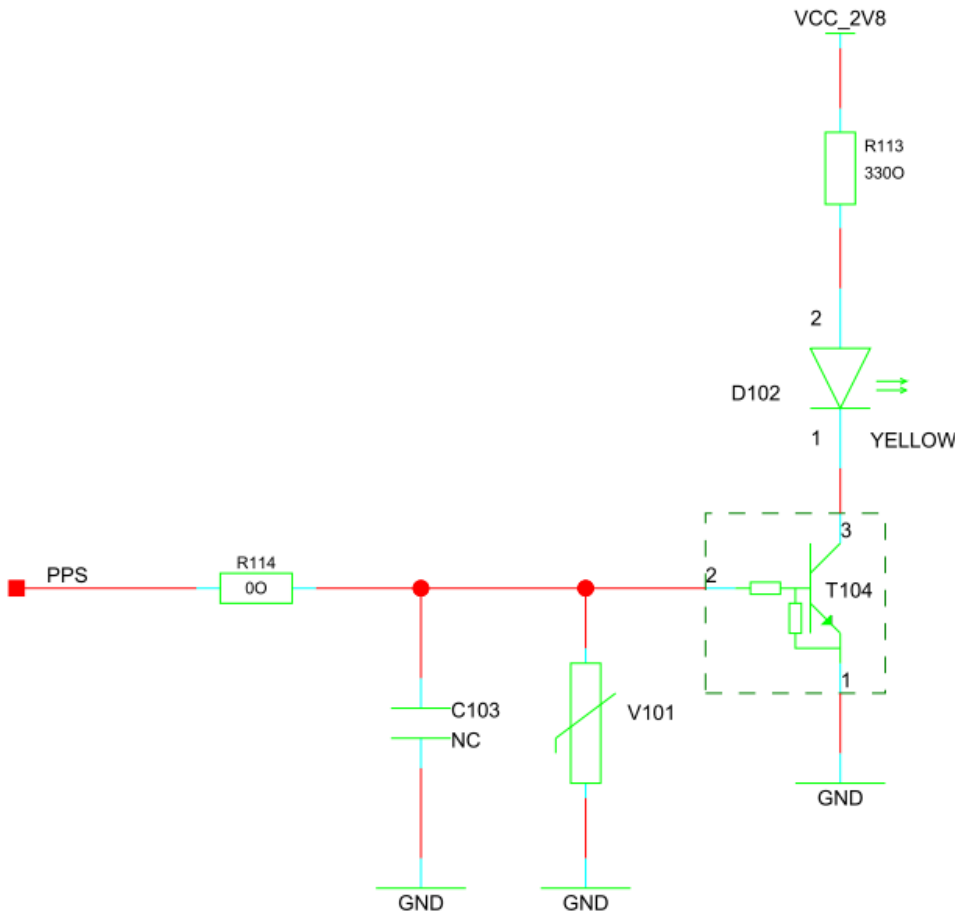

Figure 20.   D102 PPS signal indicator schematic

6.5. D101: (YELLOW) Active antenna power supply ON Indicator.

D101 LED is supplied by active antenna power supply provided by U5 LDO. LDO enable is controlled by LNA_EN signal from XM0110. This signal is under AirPrime XM0110 firmware control. See Software documentation for more information.
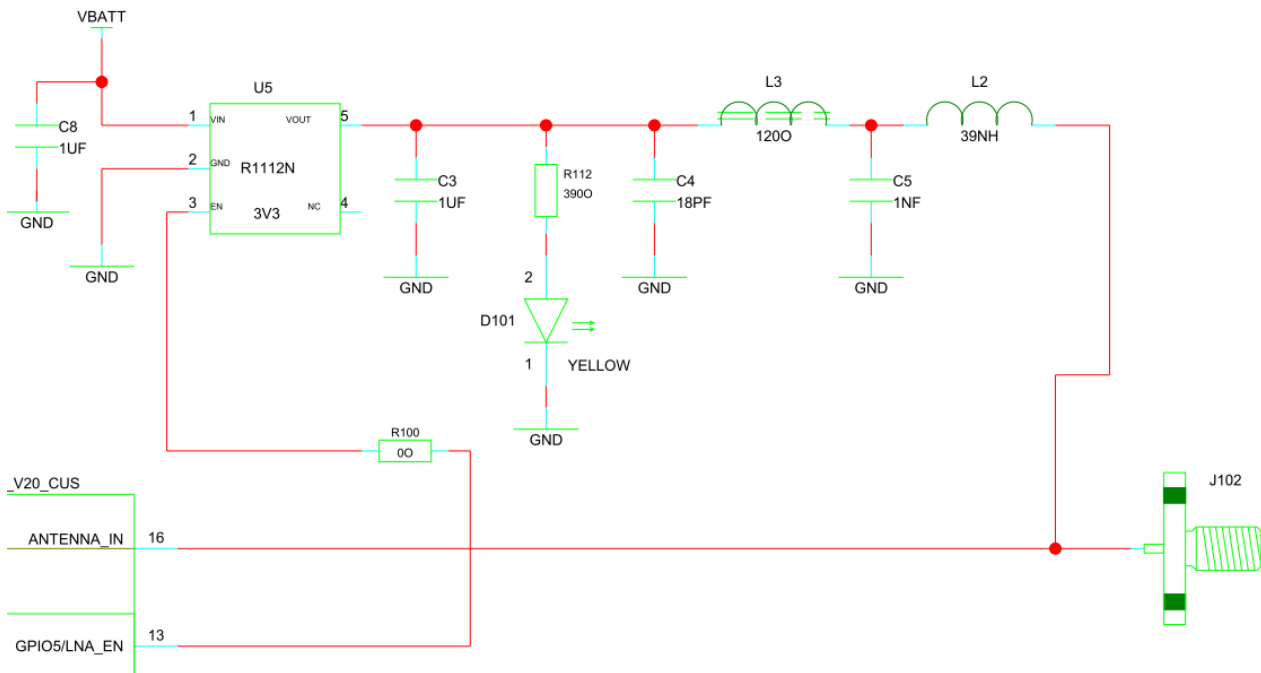
Figure 21.   D101 Active Antenna Power Supply Indicator

6.6.   TP100: GPS RESET Test-point.

TP100 is a test-point for GPS_RESET signal provides from Embedded Module to XM0110 RESET pin (#1).

Figure 22.   TP100 RESET Test-Point schematic

6.7.   P100: VBATT Pad for TEST / P101 GND Pad test.

In case XM0110 Development Kit Daughter Board is not supplied by Embedded Module Development Kit, 2 pads connected to VBATT and GND are available for supplying it.

Caution:	*VCC_2V8 and VCC_1V8 are needed for LED supply, SELECT resistor pull up and I²C resistors pull up. Check on the schematic before applying external supply.*
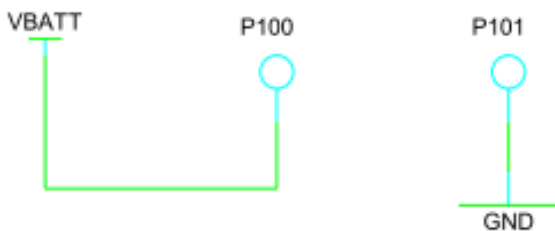
Figure 23.   P100 and P101 supply test pad schematic

7. Schematics
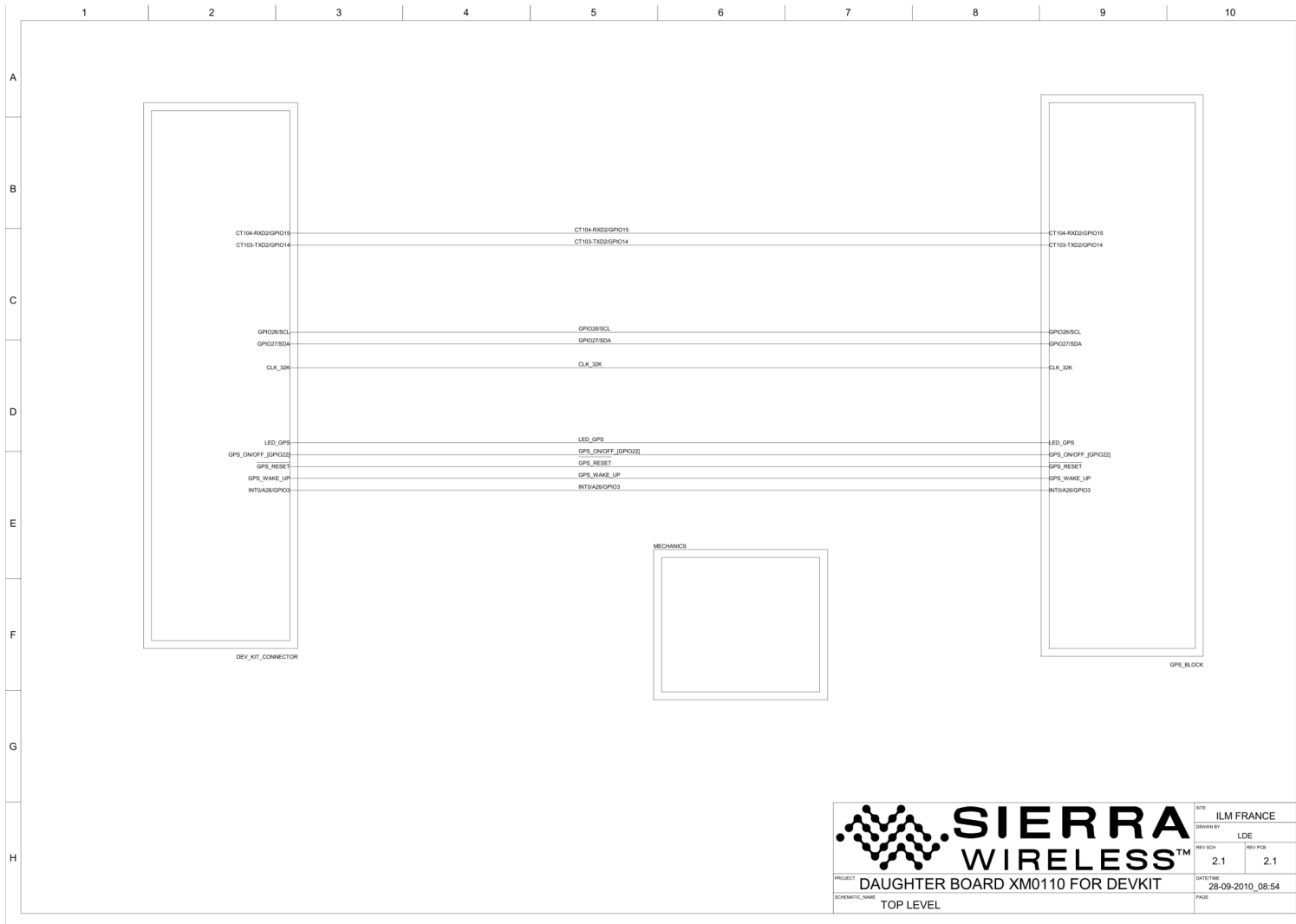
CT104-RXD2/GPIO15
CT103-TXD2/GPIO14

GPIO26/SCL
GPIO27/SDA
CLK_32K

LED_GPS
GPS_ON/OFF_[GPIO22]
GPS_RESET
GPS_WAKE_UP
INT0/A26/GPIO3

MECHANICS

DEV_KIT_CONNECTOR

GPS_BLOCK

SITE
ILM FRANCE

DRAWN BY
LDE

REV SCH	REV PCB
2.1	2.1

PROJECT
DAUGHTER BOARD XM0110 FOR DEVKIT

DATE/TIME
28-09-2010_08:54

SCHEMATIC_NAME
TOP LEVEL

PAGE

DAUGHTER BOARD XM0110 FOR DEVKIT
DEVKIT CONNECTOR

CLK Source	Jumper
	J101
From WMP/Q26	1-2
Future use	2-3

R100	R101	
0 Ohm	No Mount	Active Antenna Power supply managed by XM0110
No Mount	0 Ohm	Active Antenna Power supply Permanently ON

Soldering Short-cut for normal operation

Amperemeter can be inserted here for current measurement

	SITE	ILM FRANCE		
SIERRA WIRELESS™	DRAWN BY	LDE		
	REV SCH	2.1	REV PCB	2.1
PROJECT DAUGHTER BOARD XM0110 FOR DEVKIT	DATE/TIME	18-10-2010_09:44		
SCHEMATIC_NAME XM0110	PAGE			

XM0110 ON/OFF Management	Jumper
	J106
Managed by software	1-2
Always ON*	2-3

*: XM0110 internal LDO is enabled,
but GPS power management is driven by software

These connections are a provision for future use

WMP/Q26/SL	Jumper
WAKE-UP by XM0110	J108
Communication Interface Activity (TX)	1-2
Dedicated Signal*	2-3

*: Provision for future use

Interface	Jumper			
	J107	J103	J104	J105
UART	1-2	1-2	1-2	1-2
I2C	2-3	2-3	2-3	2-3

SIERRA WIRELESS™

SITE	ILM FRANCE
DRAWN BY	LDE

REV SCH	REV PCB
2.1	2.1

PROJECT
DAUGHTER BOARD XM0110 FOR DEVKIT

DATE/TIME
18-10-2010_10:18

SCHEMATIC_NAME
INTERFACE SELECT AND LEDS

PAGE

	1	2	3	4	5	6	7	8	9	10

PCB
PCB=V1.0
CODEWM=WM25666

L1
L2
L3
L4

$e1 = 42$ um
$e2 = 35$ um
$e3 = 35$ um
$e4 = 42$ um

FR4
Copper

2_LAYERS

PCB

P1
P2

TM1
GND
TM2
GND

ENT1
ECROU1

ENT2
ECROU2

MIRE & HOLE

SIERRA
WIRELESS™

SITE
ILM FRANCE
DRAWN BY
LDE
REV SCH
2.1
REV PCB
2.1
PROJECT
DAUGHTERBOARD XM0110 for DevKit
DATE/TIME
28-09-2010_08:46
SCHEMATIC_NAME
Mechanics
PAGE