

# 1322x Network Node

## Reference Manual

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## Chapter 5

### Schematic, Board Layout, and Bill of Material

## About This Book

This manual describes Freescale's 1322x Network Node evaluation board. The 1322x Network Node contains a Freescale third-generation, low power, 2.4 GHz radio frequency transceiver, with 32-bit ARM7 core based MCU, hardware acceleration for both the IEEE Standard 802.15.4 MAC and AES security, and a full set of MCU peripherals into an 99-pin LGA Platform-in-Package (PiP).

## Audience

This manual is intended for system designers.

## Organization

This document is organized into 5 chapters.

Chapter 1	Safety Information — Highlights some of the FCC requirements.
Chapter 2	1322x Network Node Module Overview and Description — This chapter introduces 1322x Network Node (NN) which is an IEEE, 802.15.4 compliant evaluation board based on the Freescale MC1322x device.
Chapter 3	System Overview and Functional Block Descriptions — This section provides an overview of the Network Node and block diagrams.
Chapter 4	Interface Locations and Pinouts — This chapter provides a description of the interface locations and pinout of the 1322x Network Node circuit board.
Chapter 5	Schematic and Bill of Materials — This chapter provides the schematic, board layout, and Bill of Materials (BOM).

## Revision History

The following table summarizes revisions to this document since the previous release (Rev 1.0).

**Revision History**

Location	Revision
Chapter 1	Updated FCC information.

## Definitions, Acronyms, and Abbreviations

The following list defines the acronyms and abbreviations used in this document.

ADC	Analog to Digital Converter
AES	Advanced Encryption Standard
ARM	Advanced RISC Machine
COG	Chip on Glass
CTS	Clear to Send
DAC	Digital to Analog Converter
DMA	Direct Memory Access
I2C	Inter-Integrated Circuit is a multi-master serial computer bus
ISM	Industrial Scientific Medical 2.4 GHz radio frequency band
JTAG	Joint Test Action Group
LCD	Liquid Crystal Display
LGA	Land Grid Array
MAC	Media Access Controller
MCU	Microcontroller Unit
NEXUS	An embedded processor development tool interface that helps design engineers identify software and hardware-level issues.
NN	Network Node
PCB	Printed circuit board
PiP	Platform in Package
PWM	Pulse-width modulation
RTS	Request to Send
SMA Connector	Sub Miniature version “A” connector
SPI	Serial Peripheral Interface
SSI	Synchronous Serial Interface
TACT Switch	A switch that provides a slight “snap” or “click” to the user to indicate function.
TELCO	Telephone Company
USB	Universal Serial Bus
VCP	Virtual Com Port

# Chapter 1

## Safety Information

### 1.1 FCC Guidelines

This equipment is for use by developers for evaluation purposes only and must not be incorporated into any other device or system. This device may not be sold to the general public. Integrators will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

FCC approval of this device only covers the original configuration of this device as supplied. Any modifications to this product, including changes shown in this manual, may violate the rules of the Federal Communications Commission and make operation of the product unlawful.

### 1.2 FCC Labeling

FCC labels are physically located on the back of the board.

#### 1.2.1 47 C.F.R. Sec. 15.21

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### **1.2.2 47 C.F.R. Sec.15.105(b)**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this equipment must be installed to provide a separation distance of at least 8 inches (20cm) from all persons.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following three conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.
3. This device is susceptible to electrostatic discharge (ESD) and surge phenomenon.

### **1.2.3 47 C.F.R. Sec.15.203**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

## **1.3 Regulatory Approval For Canada**

This Class B digital apparatus complies with Canadian ICES-003 and RSS 210, Issue 7.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

## **1.4 Disposal Instructions**

This product may be subject to special disposal requirements. For product disposal instructions, refer to [www.freescale.com/productdisposal](http://www.freescale.com/productdisposal).



## Chapter 2

# 1322x Network Node Module Overview and Description

### 2.1 Introduction

The 1322x Network Node (NN) is an IEEE 802.15.4 compliant evaluation board based on the Freescale MC1322x device. The heart of the 1322x Network Node is Freescale's MC1322x 99-pin LGA Platform-in-Package (PiP) solution that can be used for wireless applications ranging from simple proprietary point-to-point connectivity to complete ZigBee mesh networking. The MC1322x is designed to provide a highly integrated, total solution, with premier processing capabilities and very low power consumption.

The 1322x Network Node provides a platform to evaluate the MC1322x device, develop software and applications, and demonstrate IEEE 802.15.4 and ZigBee networking capabilities. The Network Node surrounds the core device with capabilities that provide a complete 802.15.4 radio, user interface, debugging capabilities, connection to personal computers (PCs) and other devices, and portability.

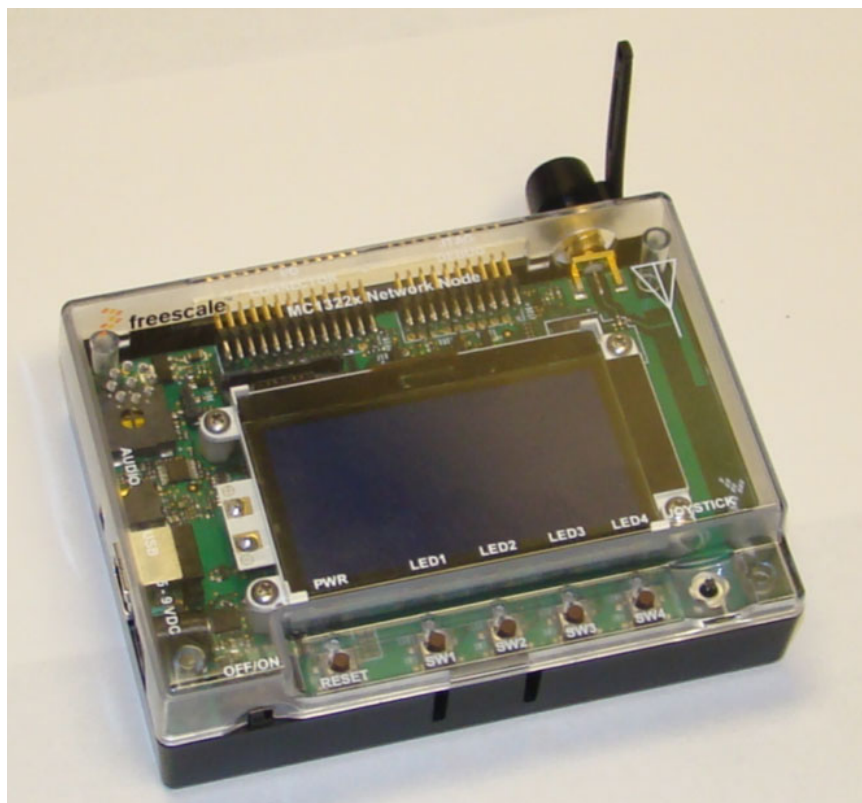


Figure 2-1. 1322x Network Node

## 2.2 Features

The 1322x Network Node provides the following features:

- Full IEEE 802.15.4 compliant wireless node; ZigBee capable with Freescale's BeeStack software stack
- Based on Freescale's third-generation MC1322x ZigBee platform which incorporates a complete, low power, 2.4 GHz radio frequency transceiver, 32-bit ARM7 core based MCU, hardware acceleration for both the IEEE 802.15.4 MAC and AES security, and a full set of MCU peripherals into a 99-pin LGA Platform-in-Package (PiP)
- MC1322x provides a highly integrated, low cost RF node
  - On-board balun and antenna switch in package
  - Typical -95 dBm sensitivity
  - Typical 0 dBm output power, with max approximately +2 dBm
  - SMA connector with external antenna
- USB interface is bus-powered and full-speed compatible to the USB 2.0 and 1.1 specifications
- 128x64 pixel chip-on-glass monochrome, graphic LCD with LED backlight
- Audio subsystem
  - 2.5mm audio jack for microphone and mono earpiece
  - Input amplifier and anti-aliasing filter for an electret microphone
  - Output path to second order analog filter from either 10-bit serial DAC or PWM as output signal sources
  - I2C controlled 32-position linear nonvolatile volume control for audio circuit
  - Audio output amplifier for both earpiece or on-board dynamic speaker (switched by headset jack)
- Two debug / development interfaces
  - 20-pin connector for standard JTAG debug interface
  - 38-pin MICTOR connector for extended NEXUS real-time debug interface
- Power management circuit with on-board regulation for multiple power sources
  - Can be powered from USB interface, DC power jack or two AA batteries
  - On/Off power switch
  - Power-on green LED
- User interface switches and LEDs
  - 4-directional TACT switch with center push for application purposes
  - 4 pushbuttons for application purposes
  - 4 processor controlled red LEDs for application purposes
  - Reset switch
- 26-pin user header for selected General Purpose Input Output signals and data interfaces
- System clock options
  - Default 24 MHz crystal reference oscillator (13 to 26 MHz crystal optional)

- Reference oscillator can be driven from an external source
- Optional 32.768 kHz crystal oscillator for accurate real-time delays

## 2.3 Board Level Specifications

Table 2-1. 1322x Network Node Specifications

Parameter				Units	Notes/Conditions
	MIN	TYP	MAX		
<b>General</b>					
Size (Enclosure: X, Y, Z)			135x100x40	mm	
Size (PCB: X, Y)			125x85	mm	
Layer build (PCB)		0.8 / 0.032		mm / in	4-Layer
Dielectric material (PCB)					FR4
<b>Power</b>					
Voltage supply (DC)	4.4	5	12	V	
Voltage supply (USB)	4.4	5	5.25	V	USB 2.0/1.1 standard specification
Voltage supply (Batteries)		3	3.2	V	
Current consumption			100	mA	
<b>Temperature</b>					
Operating temperature (see note)	-20	+25	+85	°C	The operating temperature is limited to +70°C with the monochrome-graphic LCD module mounted
Storage temperature	-30	+25	+85	°C	
<b>USB interface</b>					USB 2.0 and 1.1 full-speed compatible
<b>Audio</b>					
Audio (Input)		-40		dB	Accepts electret microphone element
Audio (Output)					
Attenuation					
<b>RF</b>					
802.15.4 Frequency range	2405		2480	MHz	All 16 channels in the 2450 MHz band
Range (outdoor / line of sight)		300		Meter	<1% PER for 20-byte packets (point-to-point in communications with 1322X Sensor Reference Board)
<b>RF Transmitter</b>					

Table 2-1. 1322x Network Node Specifications

Parameter				Units	Notes/Conditions
802.15.4 Output power	-30	0	+2	dBm	Over range of Pout from IC control in 2 dB steps. <b>Note:</b> On channel 26, output power should not exceed -5 dBm (power setting 0x0E) to meet FCC Part 15 requirements.
Harmonics 2 <sup>nd</sup> harmonics 3 <sup>rd</sup> harmonics			-30 -30	dBm dBm	Harmonics are compliant to ETSI and FCC regulatory approval standards
<b>RF Receiver</b>					
802.15.4 sensitivity	-92	-95		dBm	<1% PER for 20-byte packets
Proprietary high-speed sensitivity		-80		dBm	<1% PER for a minimum data payload of 400 packets
<b>Regulatory Approval</b>					
FCC					Product is approved accordingly to the FCC part 15 standard
CE (ETSI)					Product is approved accordingly to the EN 300 328 V1.7.1 (2006-10) standard
CE (EMC)					Product is approved accordingly to the EN 301 489-1 V1.6.1 (2005-09) and EN 301 489-17 V1.2.1 (2002-08) standards
<b>Safety</b>					
UL					Product is approved accordingly to the IEC 60950-1 and EN 60950-1, First Edition standards
<b>Environment</b>					
RoHS					Product complies with the EU Directive 2002/95/EC of 27 January 2003
WEEE					Product complies with the EU Directive 2002/95/EC of 27 January 2003

## Chapter 3

# System Overview and Functional Block Descriptions

This section provides an overview of the Network Node and block diagrams.

### 3.1 System Block Diagram

The following is the 1322x Network Node system level block diagram.

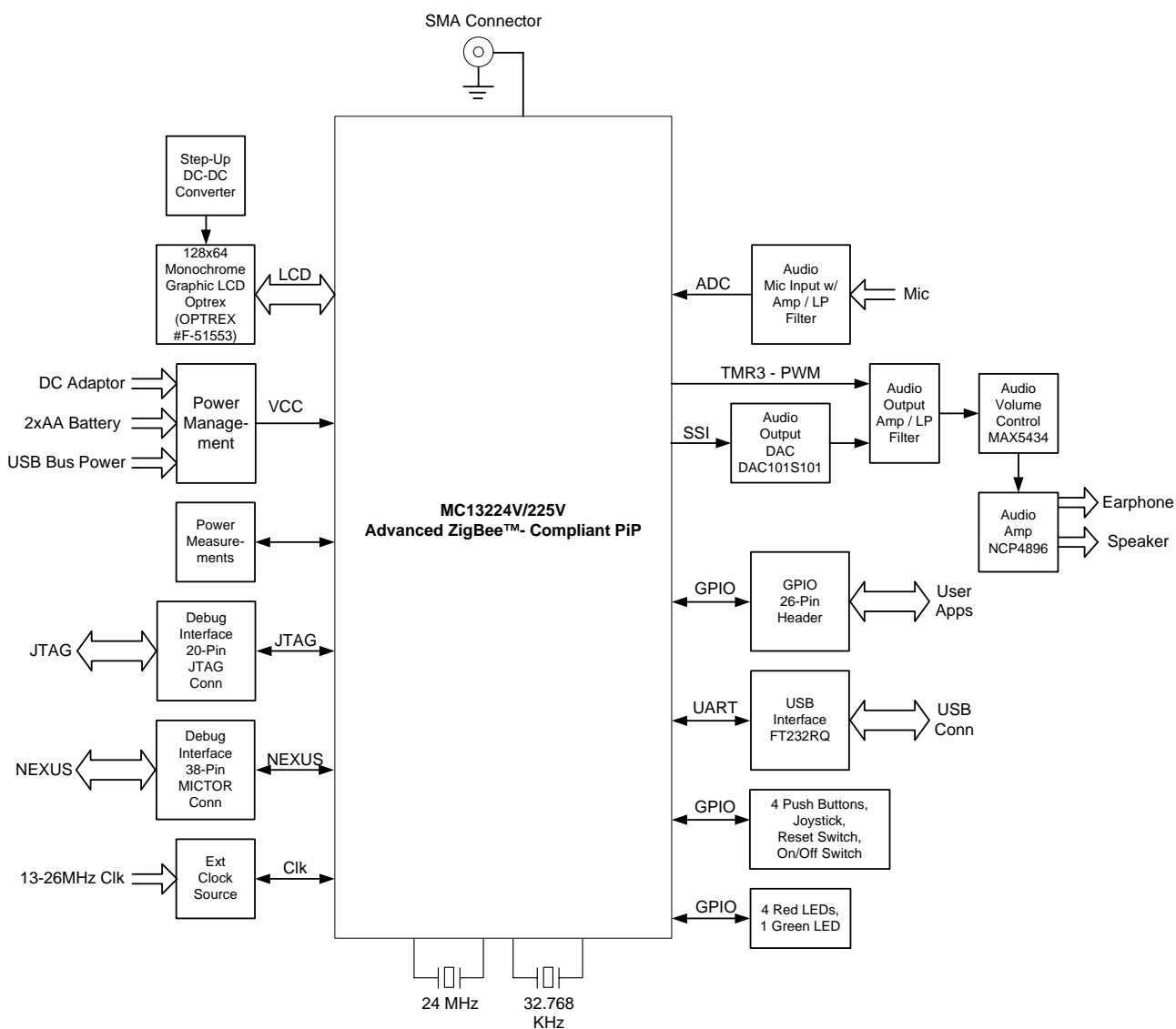


Figure 3-1. 1322x Network Node Block Diagram

## 3.2 System Overview

The heart of the 1322x Network Node is Freescale's MC1322x 99-pin LGA Platform-in-Package (PiP) solution that can be used for wireless applications ranging from simple proprietary point-to-point connectivity to complete ZigBee mesh networking. The MC1322x is designed to provide a highly integrated, total solution, with premier processing capabilities and very low power consumption.

The MC1322x MCU resources offer superior processing power for ZigBee and IEEE 802.15.4 applications. A full 32-bit ARM7TDMI-S core operates up to 26 MHz. A 128 Kbyte FLASH memory is mirrored into a 96 Kbyte RAM for upper stack and applications software. In addition, an 80 Kbyte ROM is available for boot software, peripheral device drivers, standardized IEEE 802.15.4 MAC and communications stack software. A full set of peripherals and Direct Memory Access (DMA) capability for transceiver packet data complement the processor core.

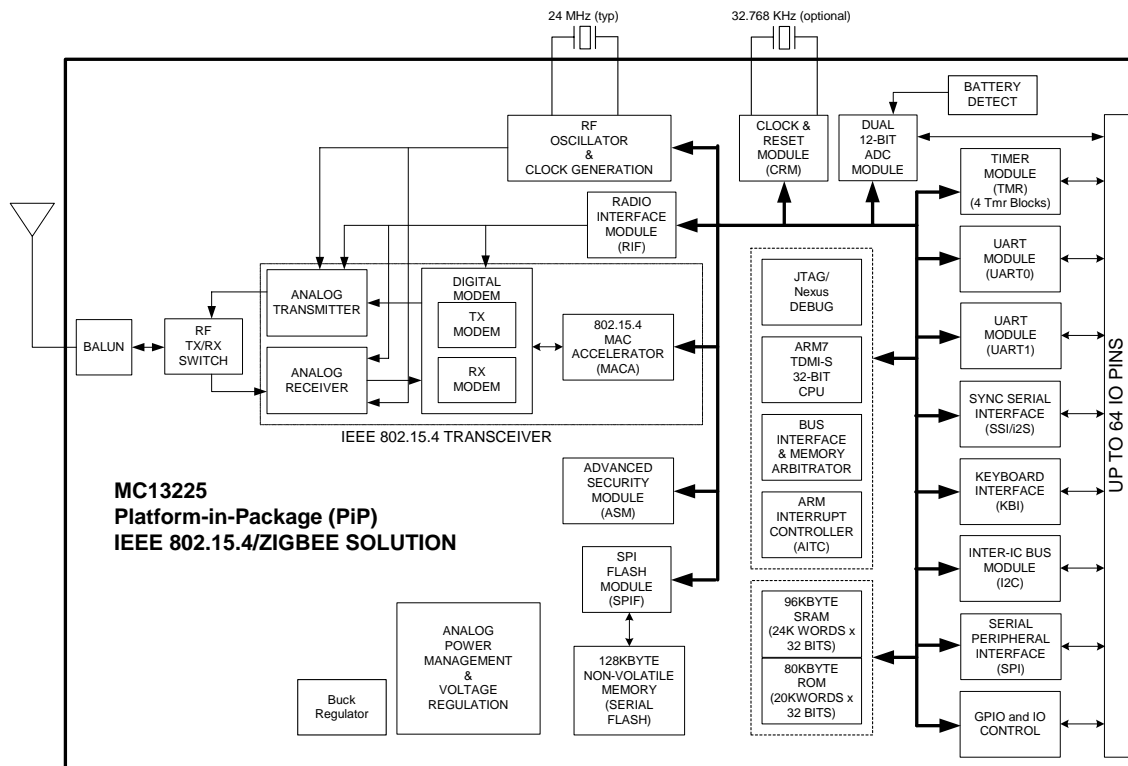
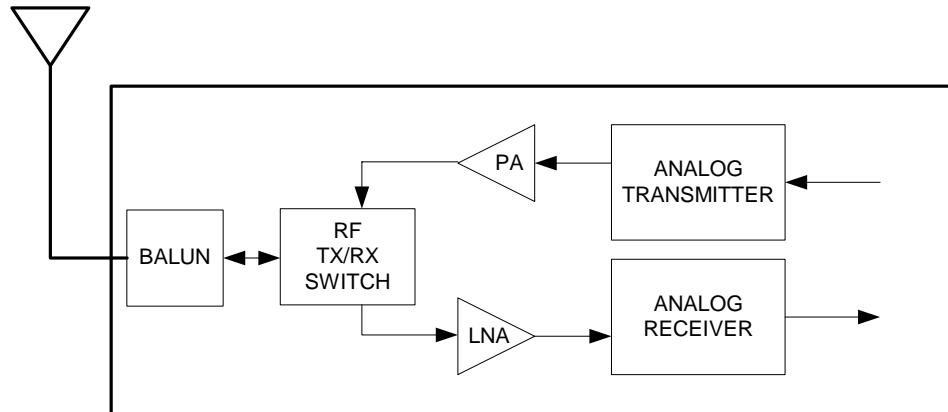


Figure 3-2. MC1322x Block Diagram

On-board peripherals include

- Two dedicated UART modules capable of 2Mbps with CTS/RTS support
- SPI port with programmable master and slave operation
- Keyboard interface capability.
- Two 12-bit analog-to-digital converters (ADCs) with 8 input channels
- Four independent 16-bit timers with PWM capability.
- Inter-integrated circuit (I2C) interface
- Synchronous Serial Interface (SSI) with I2S and SPI capability and FIFO data buffering

The RF radio interface provides for low cost and high density as shown in [Figure 3-3](#). An onboard balun along with a TX/RX switch allows direct connection to a single-ended 50-Ω antenna. The integrated PA provides programmable output power typically from -30 dBm to +2dBm, and the RX LNA provides -95 dBm sensitivity. This solution also has onboard bypass capacitors and crystal load capacitors for the smallest footprint in the industry. All components are integrated into the package except the crystal and antenna.



**Figure 3-3. MC1322x RF Interface**

Augmenting the core device on the Network Node are:

- Low-cost 2.4 GHz ISM Band radio
- 2.0 USB connection
- User interface with pushbuttons, LEDs and 128x64 pixel graphic LCD
- Versatile power sources and management
- Debug / development ports
- Audio subsystem
- GPIO connector for system expansion

Users are encouraged to reference the board schematic for the following sections.

### 3.3 Power Management and Measurement

To allow maximum versatility, the Network Node can be powered via a DC source (typically an AC-DC converter; nominally 5 Vdc), the USB node, or an onboard battery pack with 2 AA alkaline batteries.

- The DC source or USB will automatically shutdown the battery supply.
- The DC source and the USB power are regulated to 3.3 V, however, the raw battery pack voltage directly supplies the circuitry
- All sources are isolated via diodes.
- An on/off switch and a power-on LED are provided (see [Section 4.2.2, “On/Off Switch and Power On Indicator”](#)).
- Zero-ohm resistors are provided to allow isolation and measurement of various system components (see [Section 4.2.3, “Power Measurement”](#))

### 3.4 Low-cost 2.4 GHz ISM Band radio

The MC1322x provides an onboard balun, antenna switch, and LNA. The only external component required for the radio is an antenna. The Network Node provides a PCB-mounted SMA that connects to an external antenna for a complete solution. Figure 3-4 shows the RF network external to the MC1322x.

- Typical output power is 0 dBm, with +2 dBm max
- Typical sensitivity is -95 dBm.
- Frequency range is 2405 to 2480 MHz
- Typical range (outdoors, line of sight) is 300 meters

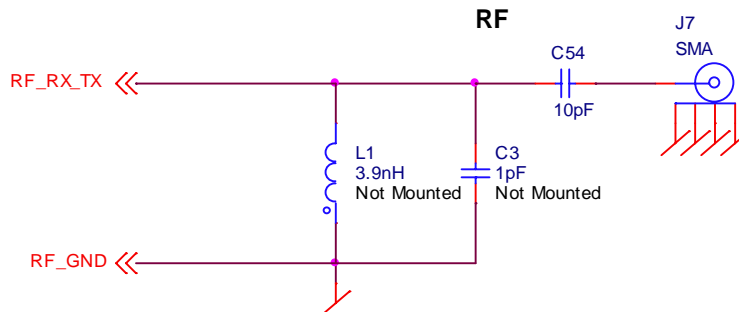


Figure 3-4. Network Node RF Network

Freescale recommends using the provided SMA connector to mount the provided antenna (see [Section 4.3, “RF Circuitry”](#)).

### 3.5 USB Interface

For many applications or demonstrations it is desirable to connect the Network Node to a PC or other device. A USB port is provided with a USB “B” receptacle plug. The port is connected to a FTDI FT232R USB UART device that appears as a Virtual COM port (VCP) to the PC. PC drivers are available with the module.

The USB interface is configured as a "Bus Powered" device and will therefore draw all required power from the USB interface. The device is USB 2.0 full speed compatible.

### 3.6 User Interface

The Network Node provides multiple means for user interface for both debug and demonstration.

- Four individual pushbuttons can be used as input, and a 4-direction tactile joystick switch with center push is wired in parallel with the individual pushbuttons. These pushbuttons have interrupt generation capability.
- Four individual LEDs can be used as indicators for debug or status.



### 3.7 128x64 Pixel Monochrome Graphic LCD Display

The Network Node supports a 128x64 pixel chip-on-glass (COG) STN transmissive monochrome graphic LCD that provides for alpha-numeric or graphic readout. The LCD module is mounted on top of the main circuit board and connects via a flat flex cable (FFC).

- The display is an OPTREX #F-51553GNBJ-LW-AB
- Viewing area is 66.8 (W) × 35.5 (H) mm
- The LCD operates from 5 Vdc generated from the main operating voltage. The LCD module requires a highly regulated 5 V so that the high voltages generated onboard the display are consistent.
- The LCD has white LED backlighting with a typical current of 40 mA when full on. The backlighting is switched by a FET and can be modulated to save current and vary the intensity.
- LCD interface to the MCU is via an 8-bit parallel interface
- The onboard controller is a member of the Epson S1D15605 Series family with an integrated display data RAM

### 3.8 Debug/Development Interfaces

There are two separate debug ports (for pinouts see [Section 4.7, “Debug/Development Connectors”](#)). A 20-pin connector is provided for a standard JTAG debug interface. This a lower cost option that only requires a simple interface cable to connect to the PC and use standard ARM software development tools.

A separate 38-pin Mictor connector is uniquely provided on this module to support the extended capability Nexus real-time debug interface for the ARM processor.

### 3.9 Audio Subsystem

The audio subsystem provides means for simple output sounds/tones or for TELCO voice quality audio.

- A 2.5mm stereo jack is provided to interface to a typical telephone-type headset with an electret microphone and a single earphone.
- Audio input - The audio input is taken from the headset electret microphone (mic).
  - An onboard 10 k-ohm resistor circuit biases the mic for an ~1 Vdc operating voltage.
  - The mic AC signal is filtered and amplified through a active low-pass filter with a voltage gain of about 30 (~30 dB). The filter topology is a multiple feedback (MFB) 3-pole, linear phase design. The target cutoff frequency is 3.6 kHz. The filter is intended as an anti-aliasing filter for sampled data.
  - The input amplifier output is sampled via the onboard MC1322x ADC. The sampling frequency is programmable.
- Audio output source - The audio output can be sourced from both a serial 10-bit DAC and a PWM timer output.
  - The 10-bit serial DAC uses the SSI port to send provide the digital sample data.
  - The PWM timer output is typically modulated to create a Class-D amplifier. Secondly, a simple 50% duty cycle signal can provide simple tones.

- The audio output source is jumper selectable via J10
- Audio output processing - The DAC or PWM out signal is filtered through an active 2-pole LPF. From the filter the signal passes through a passive attenuator, and then is amplified and driven to either an on-board speaker or the headset earphone.
  - The attenuator provides a volume control that is controlled via a software 32 linear tap programmable, non-volatile digital potentiometer. The interface to the potentiometer is the I<sup>2</sup>C port.
  - The onboard speaker is automatically disconnected if a headset is plugged-in.

### 3.10 GPIO Connector

The GPIO connector (J2) provides a number of data interfaces and GPIO for external system expansion, [Section 4.9, “GPIO Connector”](#) gives details.

- A number of the GPIO are shared with the LCD interface. User should take care to avoid conflict and may have to disable LCD to use some GPIO or ports.
- Power supply voltage is provided
  - Current draw should be limited to 50 mA.
  - A separate regulated voltage can be enabled.
- Provision is made to supply an external reference clock if desired.

### 3.11 Clocks

The 1322x Network Mode provides for two system clock sources.

- MC1322x Reference Oscillator - The default frequency for the reference oscillator is 24 MHz and the mounted crystal X1 is a 24 MHz device that meets MC1322x specifications. There are two additional options for the module
  - X1 can be replaced by 13-26 MHz crystal (it must meet MC1322x specifications), however, the onboard PLL must be used in this case. The PCB provides for PLL filter components, but these are not populated.
  - An external clock source can be supplied as the reference source (typically 24 MHz). The frequency must accurate to +/-40ppm. The external clock source is supplied through GPIO Connector J2, and crystal X1 must be removed and capacitor C58 mounted (see [Chapter 5, “Schematic, Board Layout, and Bill of Material”](#), Sheet 1).
  - 32.768 kHz Crystal Oscillator - Provision is also made for an optional secondary 32.768 kHz crystal X2. This oscillator can be used for a low power accurate timebase. The module comes without this crystal and its load capacitors C7 and C12 unmounted (see [Chapter 5, “Schematic, Board Layout, and Bill of Material”](#), Sheet 1).

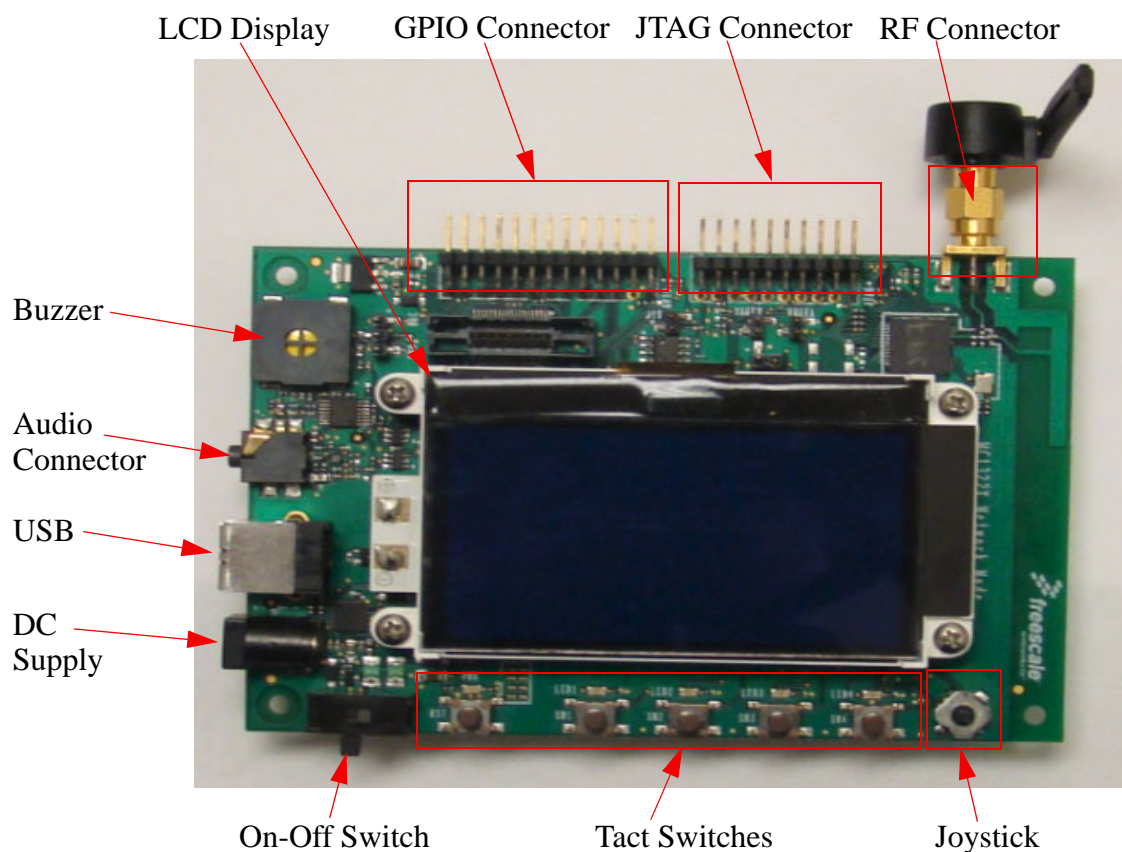
## Chapter 4

# Interface Locations and Pinouts

This chapter provides a description of the interface location and pinout of the 1322x Network Node PCB.

### 4.1 Overview

This chapter provides the locations (as shown in [Figure 4-1](#)) and descriptions of switches, jumpers, and connectors on the 1322x Network Node PCB. Users should reference the figures in the subsequent sections while moving through this chapter and reference the circuit board schematic in [Chapter 5, “Schematic, Board Layout, and Bill of Material”](#), for additional information.



**Figure 4-1. Network Node PCB Top View**

## 4.2 Power Management

The module can be powered from the DC power jack, the USB port, or the battery pack.

### 4.2.1 Supply Sources

Table 4-1 lists the supply sources, connectors, and voltages. Board maximum current draw is rated at 100 mA.

**Table 4-1. Power Supply Sources**

Source	Connector	Min (Volts)	Typical (Volts)	Max (Volts)	Notes
DC Source	J5	4.4	5	12	Use DC only source. The connector is a 2 mm DC power jack; positive center conductor.
USB	J6	4.4	5	5.25	
AA Battery Pack	BC1	~2.0	3	3.2	Two AA cells. Battery pack is automatically disabled by either DC source or USB. Accessible through the door on the bottom of the plastic enclosure.

### 4.2.2 On/Off Switch and Power On Indicator

The following are used with the power management:

- Switch SW7 - 4-pole slide switch disconnects ALL sources
- Green LED D5 - indicates power from any source

### 4.2.3 Power Measurement

It is possible to isolate various circuit blocks to measure current draw via 0-ohm resistors. The resistors are all mounted as default.

Below is a list of the supplies.

- R68 -> VCC (Output from on-board regulator)
- R65 -> VBATT (Supply for 1322x)
- R80 -> V\_DIS (Supply for display circuit)
- R43 -> V\_AUD (Supply for audio circuit)
- R64 -> 3V (Output from on-board regulator for GPIO customer access), or alternately, R66 (not mounted) can enable separate regulator U12.

## 4.3 RF Circuitry

The external antenna is connected via the provided SMA connector (J7).

### NOTE

Only the provided Antenova® antenna (model Titanus) should be used with this module. This RF design has been certified with this antenna.



Figure 4-2. Antenova® Titanus Model Antenna

## 4.4 USB Connector (“B” Receptacle)

The USB connector is designated as J6. Figure 4-3 shows the connector pinout.

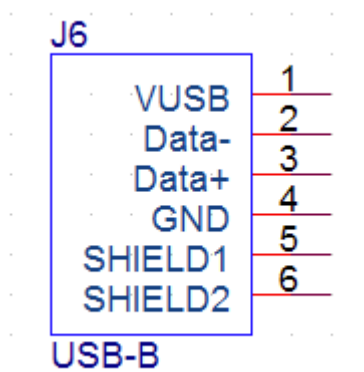


Figure 4-3. USB Connector Pinout

## 4.5 LEDs, Switch, Buttons and Joystick

The Network Node contains a total four red LEDs and one green LED

- The four red LEDs are driven by the MCU and controlled by the software application.
- As previously stated, the green LED is directly connected to the on-board regulator and acts as a "Power On" indication.

As also previously stated, SW7 is an on/off slide switch that connects the power supplies.

There are five pushbuttons total.

- One pushbutton (SW5) is separate and provides a master hardware Reset.
- Four additional pushbuttons are connected to the MCU GPIO for software application. These buttons all have interrupt generation capability

A joystick (SW6) is also provided.

- The joystick is a 4-direction TACT Switch with Center Push.
- The 4-directional TACT switches are connected in parallel with the four user pushbuttons.
- The center push switch is separate and does not have interrupt generation capability

**Table 4-2. Switch and LED Summary**

Item	GPIO Connection	Feature
PWR (green)	VCC	'Power On' indication
LED1 (red)	KBI_1	Application specific
LED2 (red)	KBI_2	Application specific
LED3 (red)	KBI_3	Application specific
LED4 (red)	TX_ON	Application specific
SW1 (pushbutton)	KBI_4	Interrupt functionality. In parallel with SW6 (right).
SW2 (pushbutton)	KBI_5	Interrupt functionality. In parallel with SW6 (down).
SW3 (pushbutton)	KBI_6	Interrupt functionality. In parallel with SW6 (left).
SW4 (pushbutton)	KBI_7	Interrupt functionality. In parallel with SW6 (up).
SW5 (RST)	RESETB	HW reset
SW6 (right)	KBI_4	Interrupt functionality. In parallel with SW1.
SW6 (down)	KBI_5	Interrupt functionality. In parallel with SW2.
SW6 (left)	KBI_6	Interrupt functionality. In parallel with SW3.
SW6 (up)	KBI_7	Interrupt functionality. In parallel with SW4.
SW6 (center)	KBI_0_HST_WK	Host wake up output functionality. No interrupt functionality

## 4.6 LCD Connector

The LCD module is connected to the main circuit board via a 30-conductor flat flex cable (FFC) with 0.5 mm spacing. The main board connector is an FFC, Right Angle Dip, zero insertion force (ZIF), 30 pin connector (J13).

### NOTE

The LCD connector is a ZIF unit. Be sure to release the connector before trying to connect or disconnect the FFC to the LCD.

## 4.7 Debug/Development Connectors

### 4.7.1 ARM JTAG Interface Connector

The MC1322x supports connection to a subset of the defined ARM JTAG connector. The JTAG interface is a standard 2.54mm/0.1inch spacing, 20-pin debug interface (J1). The 20-pin connector is clearly separated from the GPIO pin header (J2) and located at the rear side of the module. The 20-pin connector has Pin 1 marking for correct plug-in of the development cable.

[Table](#) shows the device pins that are connected to the associated JTAG header pin outs if the JTAG connector is used.

**Table 4-3. ARM JTAG 20-Pin Connector Assignments (J1)**

Name <sup>1</sup>	Pin #	Pin #	Name
VCC	1	2	VCC
NC <sup>2</sup>	3	4	GND
TDI	5	6	GND
TMS	7	8	GND
TCK	9	10	GND
RTCK	11	12	GND
TDO	13	14	GND
RESET <sup>3</sup>	15	16	GND
NC	17	18	GND
NC	19	20	GND

<sup>1</sup> NC means No Connect.

<sup>2</sup> MC1322x does not support separate JATG reset TRST.

<sup>3</sup> VCC through a 100k-ohm pullup.

## 4.7.2 Nexus Mictor Interface Connector

The MC1322x also supports connection to a subset of the defined Nexus Mictor connector. The hardware interface is a 38-pin Mictor 0.64mm/0.025inch spacing target connector (J11). [Table 4-4](#) shows the device pins that are connected to the associated Mictor pinouts. The 38-pin MICTOR connector has a "plug security" for avoid reverse plug-in. J11 is located on the bottom side of the main board.

**Table 4-4. Nexus 38-Pin Mictor Connector Assignments (J11)**

Name <sup>1</sup>	Pin #	Pin #	Name
NC	1	2	NC
NC	3	4	NC
NC	5	6	RTCK
NC	7	8	NC
VCC (pullup) <sup>2</sup>	9	10	EVTI_B
TDO	11	12	VCC <sup>3</sup>
NC	13	14	RDY_B
TCK	15	16	MDO07
TMS	17	18	MDO06
TDI	19	20	MDO05
RESET <sup>4</sup>	21	22	MDO04
NC	23	24	MDO03
NC	25	26	MDO02
NC	27	28	MDO01
NC	29	30	MDO00
NC	31	32	EVTO_B
NC	33	34	MCKO
NC	35	36	MSEO1_B
NC	37	38	MSEO0_B

<sup>1</sup> NC means No Connect.

<sup>2</sup> VCC through a 100k-ohm pullup.

<sup>3</sup> VCC isolated by a 1k-ohm resistor.

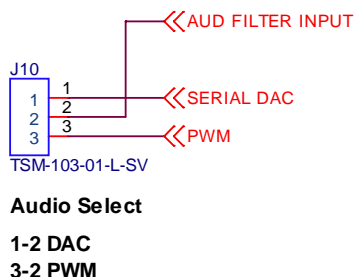
<sup>4</sup> VCC through a 100k-ohm pullup.



## 4.8 Audio Subsystem Connections

The audio subsystem uses the following connections:

- 2.5mm stereo jack J12 - for headset mic and earphone
- Jumper J10 - selects audio output source. See [Figure 4-4](#) for connections.



**Figure 4-4. J10 Audio Output Source Jumper**

## 4.9 GPIO Connector

The GPIO connector (J2) is a standard 2.54mm/0.1inch spacing, 26-pin header. The connector provides access to MCU GPIO, an external clock source connection, a timer output, ADC inputs, the SSI port, a UART port, the SPI port, the I<sup>2</sup>C port, and the serial DAC output. Power is also provided on the connector.

- VCC is the main supply voltage. Current draw should be limited to 50 mA.
- CLKIN can be used to supply an external reference clock (nominally 24 MHz). The onboard crystal must be removed and an ac-coupling capacitor added.
- A number of the GPIO are shared with the LCD interface. Best practice is to disable the LCD data interface to used these signals (see [Table 4-5](#) below).
- The serial DAC output is available at the connector. The DAC output should not be selected as the output audio source (J10) when used offboard.

**Table 4-5. GPIO Connector J2 Pinouts**

Pin	Name	Function	Notes
1	TMR1	Timer I/O or GPIO	Hardwired to LCD control output.
2	CLKIN	Source for external clock to reference oscillator	<ul style="list-style-type: none"> <li>• 13-26 MHz reference clock with &lt;40 ppm accuracy</li> <li>• Onboard crystal must be removed</li> <li>• Enable signal to MC1322x by adding C58, 10pF; see schematic</li> </ul>
3	VCC	Voltage supply from module	3V output from on-board regulation
4	GND	System ground	
5	ADC1	ADC Analog Input Channel or GPIO	
6	ADC2	ADC Analog Input Channel or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.
7	ADC3	ADC Analog Input Channel or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.
8	ADC4	ADC Analog Input Channel or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.

**Table 4-5. GPIO Connector J2 Pinouts (continued)**

9	ADC5	ADC Analog Input Channel or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.
10	DAC_OUT	Serial DAC Output	Jumper J10 selects DAC output as audio output source
11	SSI_TX	SSI Port or GPIO	Hardwired to serial DAC
12	SSI_RX	SSI Port or GPIO	
13	SSI_FSYN	SSI Port or GPIO	Hardwired to serial DAC
14	SSI_BITCLK	SSI Port or GPIO	Hardwired to serial DAC
15	KBI_0_HST_WK		Hardwired to “center” on joystick
16	KBI_4		Hardwired to “right” on joystick and SW1
17	UART2_TX	UART2 or GPIO	
18	UART2_RX	UART2 or GPIO	
19	UART2_RTS	UART2 or GPIO	Hardwired to LCD control output.
20	UART2_CTS	UART2 or GPIO	Hardwired to LCD control output.
21	I2C_SCL	I <sup>2</sup> C Port or GPIO	Hardwired to audio volume circuit. MAX5434L device has I <sup>2</sup> C address 0x50
22	I2C_SDA	I <sup>2</sup> C Port or GPIO	Hardwired to audio volume circuit. MAX5434L device has I <sup>2</sup> C address 0x50
23	SPI_SCK	SPI Port or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.
24	SPI_SS	SPI Port or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.
25	SPI_MOSI	SPI Port or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.
26	SPI_MISO	SPI Port or GPIO	Hardwired to LCD data buffer. Use Jumper J14 to disable.

## 4.10 FLASH Memory Recovery Jumpers and Erase

The MC1322x has an onboard serial FLASH that stores the memory image that gets loaded into RAM at boot. If it becomes necessary to change or update the image in FLASH, there are two possible means of doing so:

- JTAG Debug Port - Using the JTAG debug port and the ARM debug tools, the FLASH image can be changed.
- Load new FLASH image via UART1 port -

### NOTE

The 1322x Network Node provides access for UART1 through the USB connection. If users need to use UART1 with Test Tool running on a PC, they must access the UART through the USB port as a virtual COM port.

- The Freescale BeeKit IDE download provides a software tool called “Test Tool”. This application runs on a PC and can be used with a client running on the MC1322x to test the platform.
- Test Tool also has the capability to load a new image into the FLASH.

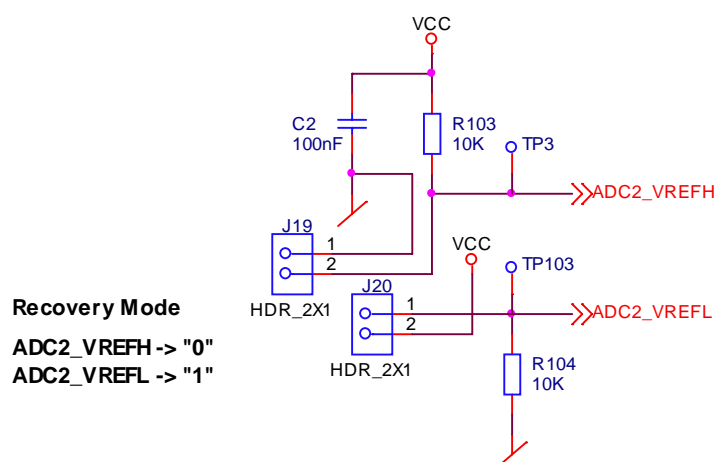
**NOTE**

The FLASH must first be cleared before loading a new image to FLASH.

The 1322x Network Node has two jumper sites (J19 and J20, [Figure 4-5](#)) that must be used to erase the FLASH:

1. Short Jumper J3 Pin 1 to Pin 2 with a shorting bar.
2. Short Jumper J20 Pin 1 to Pin 2 with another shorting bar.
3. Turn on power, push the reset button, and wait a few seconds.
4. Turn off power.
5. Remove the jumper shorting bars.
6. The board is now ready for boot operation.

After the FLASH is erased, the module can be loaded with a new image through the USB port using Test Tool. Refer to the *Test Tool User's Guide* as supplied with Test Tool in the BeeKit Wireless Connectivity Toolkit download.



**Figure 4-5. FLASH Erase Headers**

## 4.11 ADC Voltage References

Two ADC reference voltages are provided:

- The reference voltage for ADC2\_VREFH is tied to VCC which is regulated when the board is supplied from the DC source or the USB port. However, this voltage moves with VCC when power is supplied via the battery source.
- A fixed voltage reference for ADC1\_VREFH is provided (see [Figure 4-6](#)).
  - The fixed voltage is 1.5 Vdc.
  - The LM285M (U17) is programmed via R120 and R121 to provide a constant reference
  - The reference can be enabled via Jumper J18.
  - This reference is useful for battery operation where a known, fixed high reference voltage for the ADC is required.

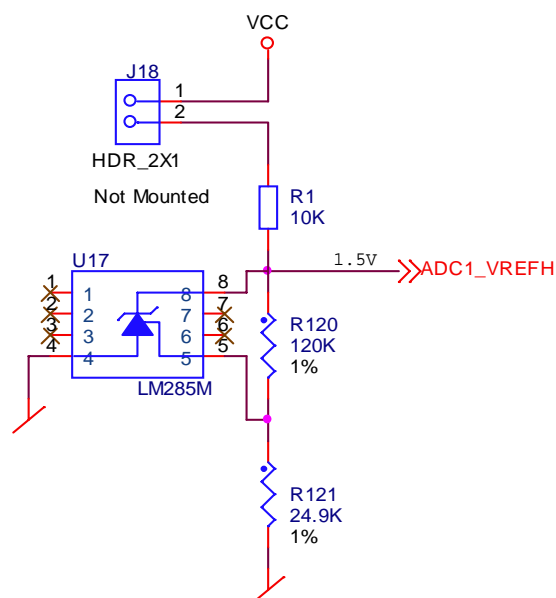


Figure 4-6. ADC Voltage 1.5 Vdc Voltage Reference

## 4.12 Jumper Selection

Table 4-6 lists all the possible jumper selections for the Network Node. The jumpers available on the board are as follows:

- J10 - used to select audio output source
- J14 - used to disable LCD data buffer if GPIO used with connector J2 (GPIO Interface)
- J18 - Sets fixed ADC reference voltage
- J19, J20 - used to clear MC1322x onboard FLASH. See Table 4-6.

Table 4-6. Network Node Jumper Selection

Pin Header	Pin Number Connection	Description	Default Setting
J10	1-2	Connect to enable audio path from DAC	Not mounted
	2-3	Connect to enable audio path from PWM	Mounted
J14	1-2	Connect to disable the LCD data bus buffer	Not mounted
J18	1-2	Connect to enable ADC 1.5V reference	Not mounted
J19, J20	1-2, 1-2	Connect both to recover/clear FLASH. See Section 4.10, "FLASH Memory Recovery Jumpers and Erase"	Not mounted

# Chapter 5

## Schematic, Board Layout, and Bill of Material

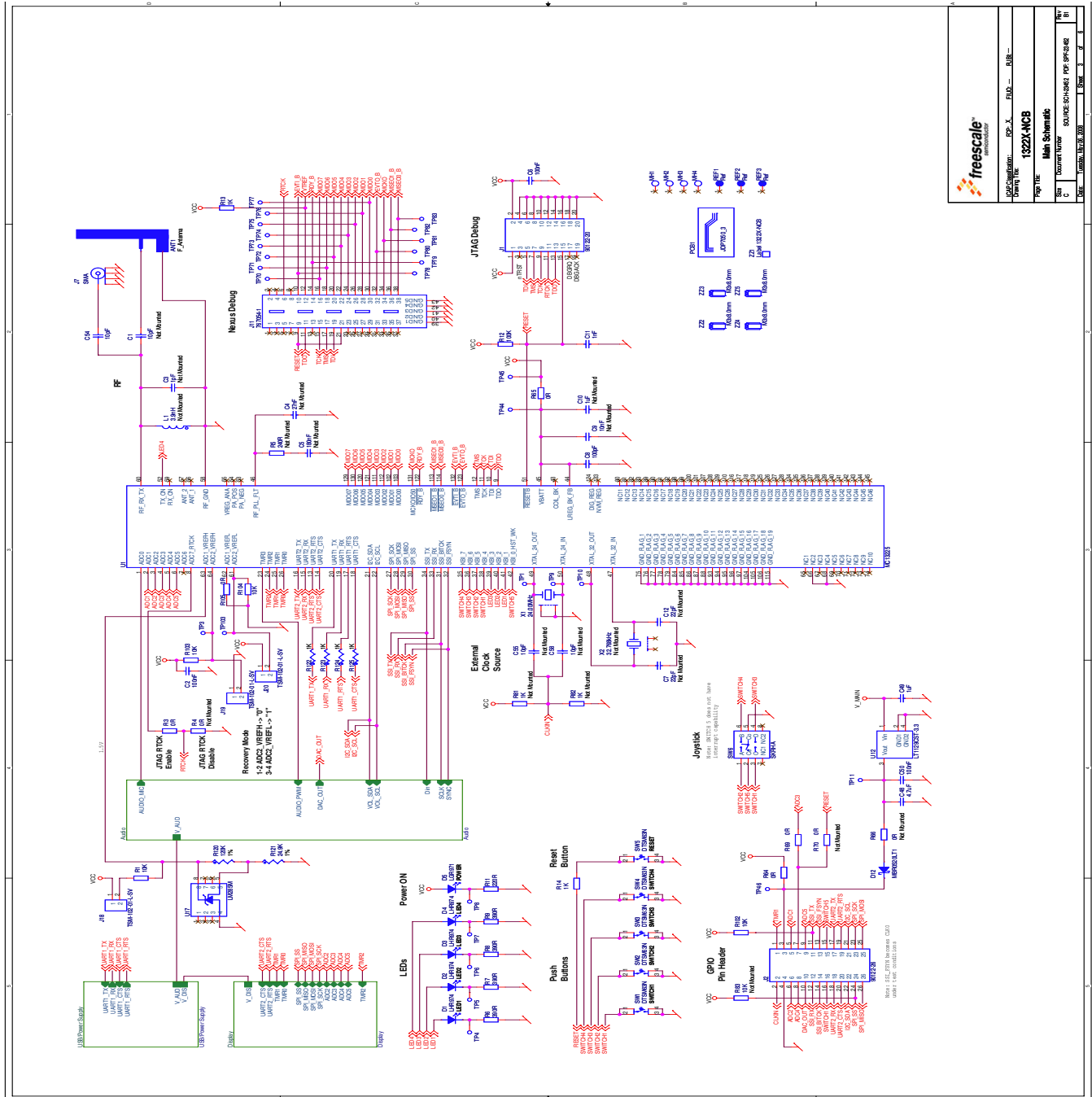
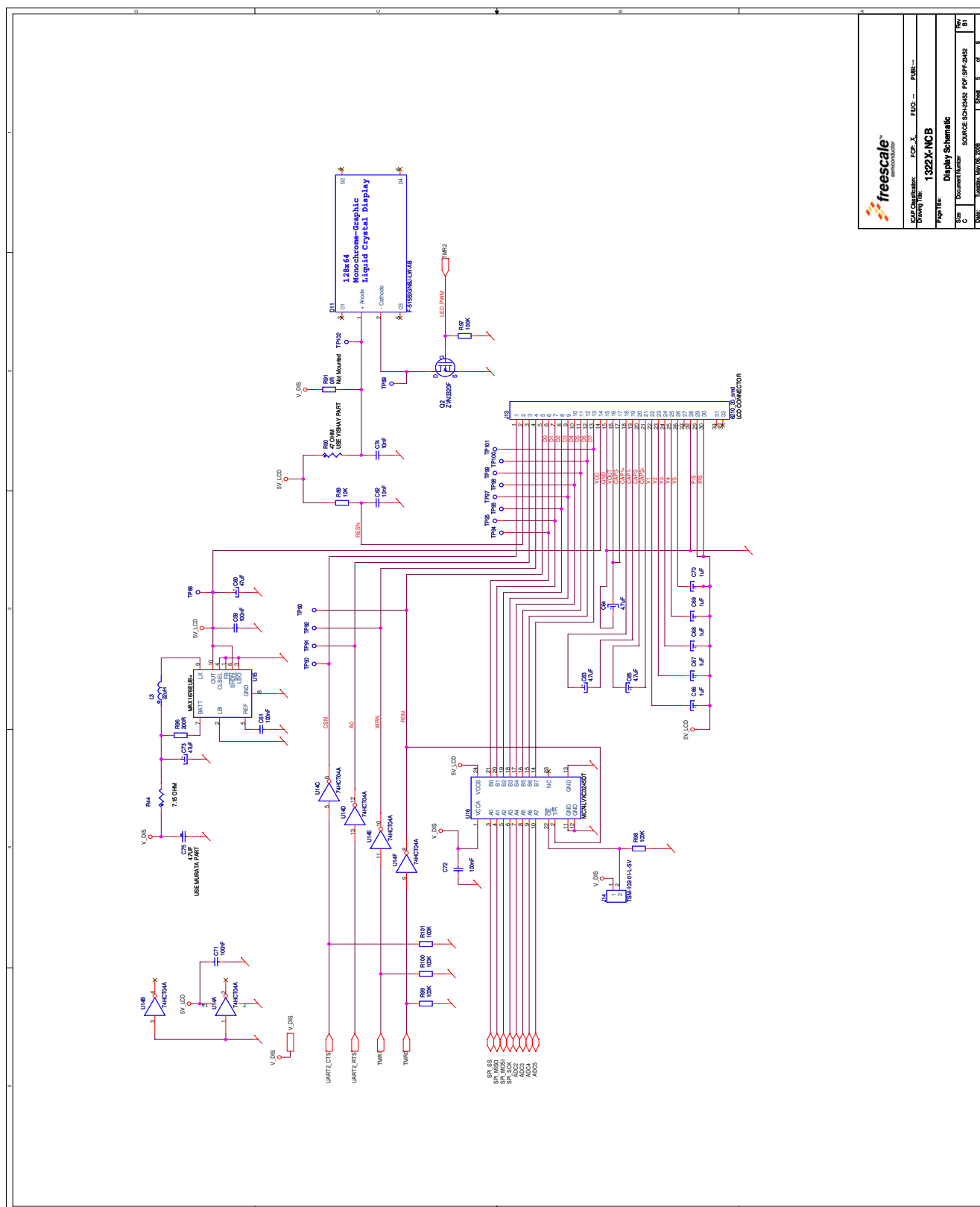


Figure 5-1. Schematic (1 of 4)



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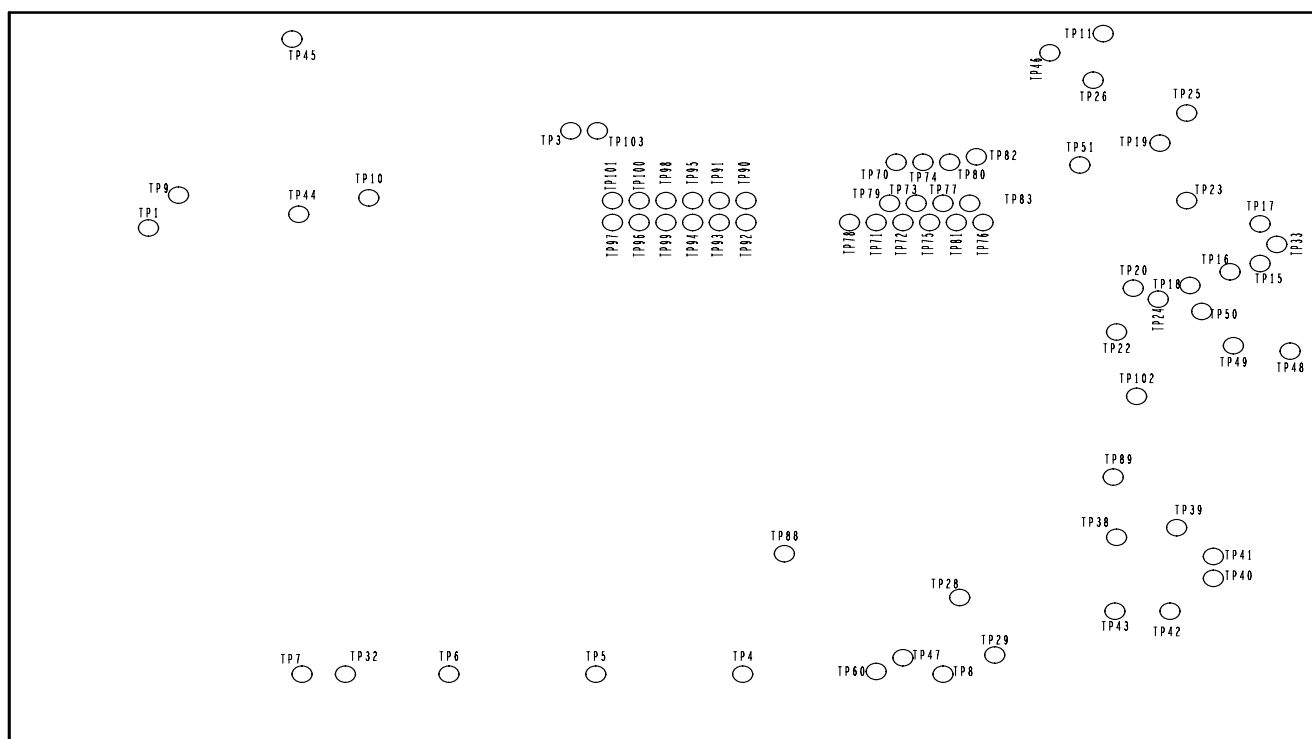
### Figure 5-3. Schematic (3 of 4)







**Figure 5-5. Network Node PCB Component Location (Top View)**



**Figure 5-6. Network Node PCB Test Points (Bottom View)**

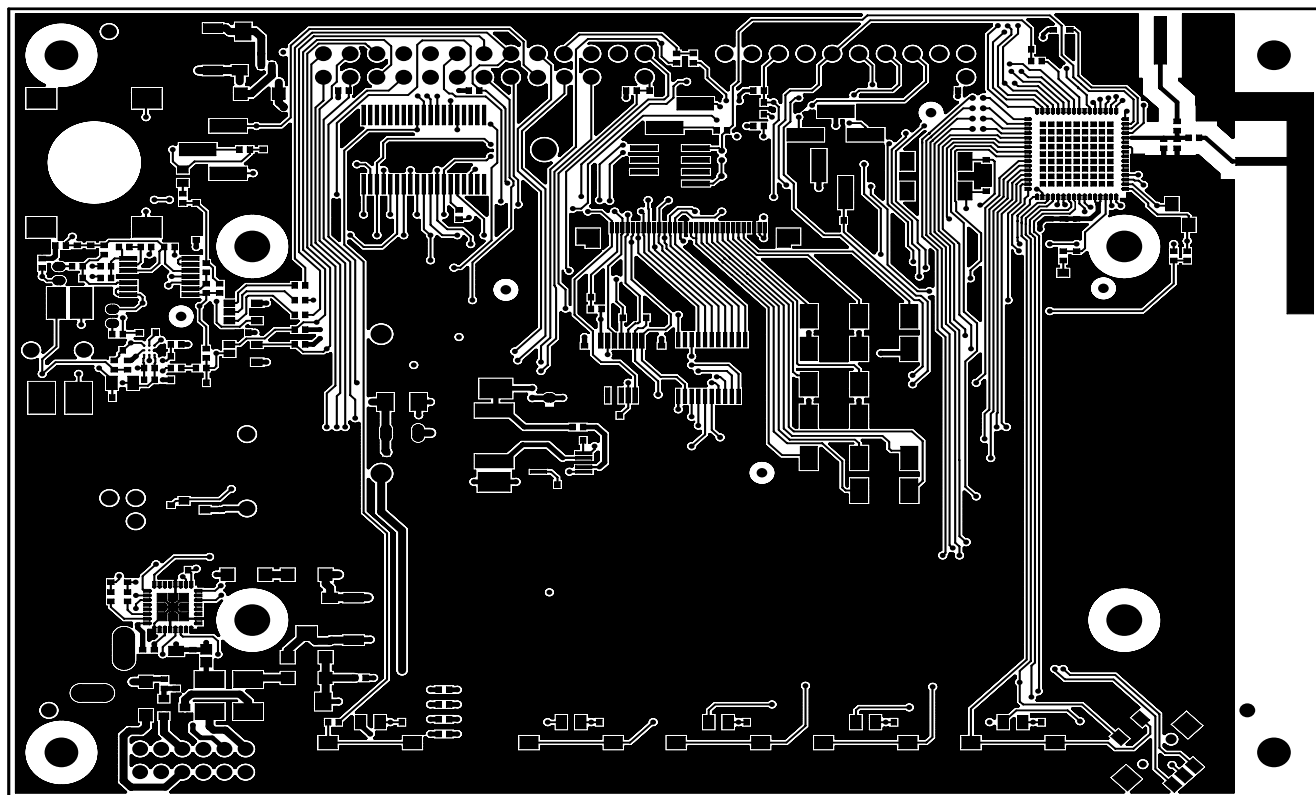


Figure 5-7. Network Node PCB Layout (Top View)

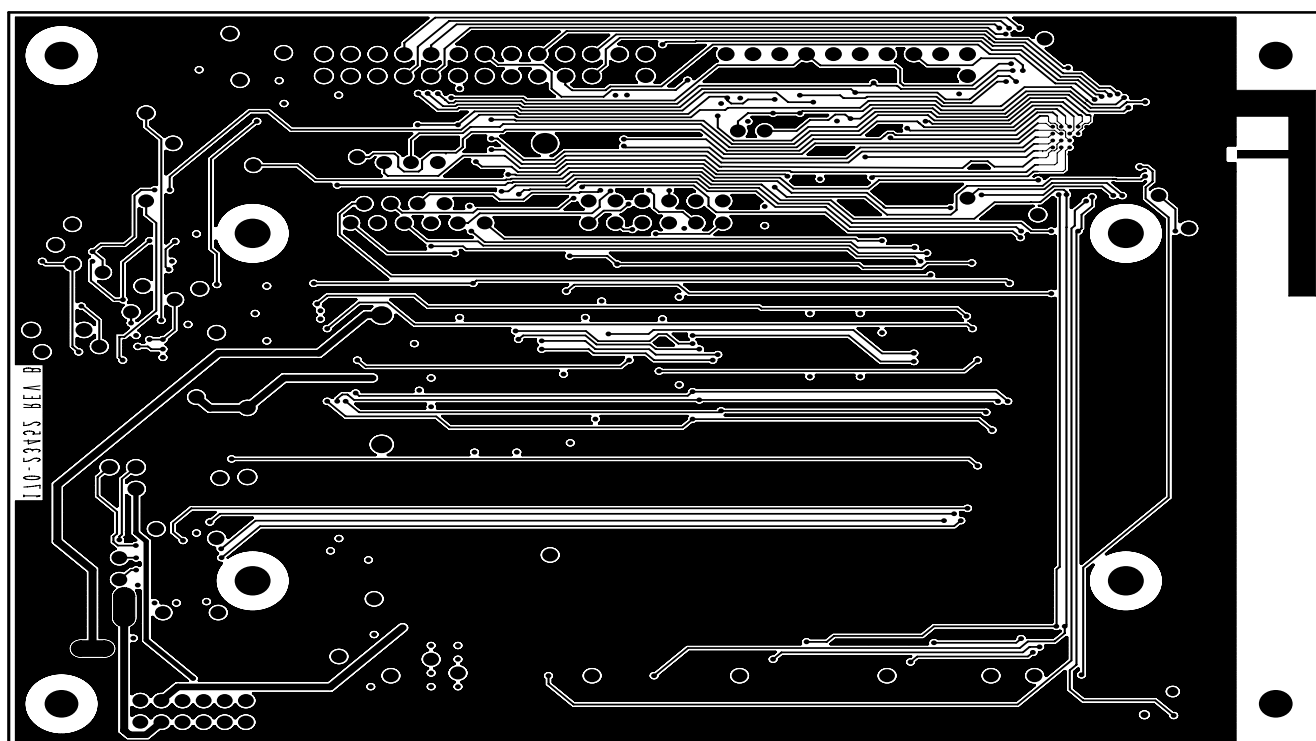


Figure 5-8. Network Node PCB Layout (Bottom View)

Table 5-1. Bill of Materials

Qty	Part Reference	Description	Value	Voltage	Tolerance	Manufacturer	Manufacturer Part Number
1	ANT1	F_Antenna	PCB F Antenna			Not A Part	NOT A PART
1	BUZ1	SMD Speaker	NDT-03C			Star Micronics	NDT-03C
1	C54	Ceramic Capacitor C0G	10pF	50V	5%	Murata	GRM1555C1H100JZ01
0	C1,C55,C58	Ceramic Capacitor C0G	10pF	50V	5%	Murata	GRM1555C1H100JZ01
3	C24,C25,C44	Ceramic Capacitor X5R	1uF	6.3V	10%	Murata	GRM155R60J105KE19B
0	C10	Ceramic Capacitor X5R	1uF	6.3V	10%	Murata	GRM155R60J105KE19B
1	C11	Ceramic Capacitor X7R	1nF	50V	10%	Murata	GRM155R71H102KA01D
2	C14,C15	CAP CER 10UF 6.3V 20% X5R 0603	10uF	6.3V	20%	Panasonic	ECJ1VB0J106M
1	C19	Ceramic Capacitor for smoothing X5R	10uF	10V	10%	Murata	GRM21BR61J106KE19L
15	C2,C6,C13,C21,C22,C27,C35,C38,C40,C41,C50,C59,C61,C71,C72	Ceramic Capacitor X5R	100nF	10V	10%	Murata	GRM155R61A104KA01D
1	C20	Ceramic Capacitor C0G	47pF	50V	5%	Kemet	C0402C470J5GAC
1	C28	Ceramic Capacitor X5R	47nF	10V	10%	Panasonic-ecg	ECJ-0EB1A473K
1	C29	Ceramic Capacitor X7R	4.7nF	25V	10%	Murata	GRM155R71E472KA01
1	C30	Ceramic Capacitor X7R	22nF	25V	10%	Murata	GRM155R71E223KA61D
0	C3	Ceramic Capacitor C0G	1pF	50V	0.25pF	Murata	GRM1555C1H1R0CZ01D
2	C34,C49	Ceramic Multilayer Capacitor X7R NoPb	1uF	16V	15%	Murata	GRM21BR71C105
3	C36,C37,C48	Ceramic Multilayer Capacitor X5R	4.7uF	16V	15%	Phycomp	2222 781 13672
0	C4	Ceramic Multilayer Capacitor X7R	27nF	10V	5%	Vishay	VJ0402Y273JXQCW1BC
2	C42,C43	Ceramic Capacitor C0G	15pF	50V	5%	Murata	GRM1555C1H150JZ01J
1	C45	Ceramic Capacitor X7R	220nF	10V	10%	Murata	GRM188R71A224KA01
1	C46	Ceramic Capacitor C0G	270pF	50V	5%	Murata	GRM1555C1H271JA01
1	C47	Ceramic Capacitor C0G	3.3nF	50V	15%	Murata	GRM155R71H332KA01
0	C5	Ceramic Multilayer Capacitor X7R	180nF	16V	5%	Vishay	VJ0603Y184JXJCW1BC
1	C57	Ceramic Multilayer Capacitor X5R	4.7uF	10V	10%	Murata	GRM219R61A475KE34D

Table 5-1. Bill of Materials

Qty	Part Reference	Description	Value	Voltage	Tolerance	Manufacturer	Manufacturer Part Number
2	C60,C73	Low ESR Tantal Capacitor	47uF	16V	+/-10%	Avx	TPSD476K016R150
3	C63,C64,C65	Aluminum Electrolytic Capacitor low ESR CV-GX	4.7uF	35V	20%	Sanyo	35CV4.7GX
5	C66,C67,C68,C69,C70	Aluminum Electrolytic Capacitor	1uF	50V	20%	Nic Components	NACE 1R0 M 50V 4x5,5 TR13
0	C7,C12	Ceramic Capacitor C0G	22pF	50V	5%	Murata	GRM1555C1H220JZ01J
1	C75	CAP CER 4.7UF 6.3V 10% X5R 0603	4.7uF	6.3V	10%	Venkel Company	C0603X5R6R3-475KNE
2	C8,16	Ceramic Capacitor C0G	100pF	50V	5%	Murata	GRM1555C1H101JZ01
3	C56,C62,C74	Ceramic Capacitor X7R	10nF	25V	10%	Murata	GRM155R71E103KA01D
0	C9	Ceramic Capacitor X7R	10nF	25V	10%	Murata	GRM155R71E103KA01D
4	D1,D2,D3,D4	SMD Red toped	LHR974			Osram	Q62702P5182
1	D5	SMD Green toped	LGR971			Osram	Q65110P5179
6	D6,D7,D8,D9,D10,D12	SMD Power Schottky Rectifier	MBR0520 LT1	20V		On Semiconductor	MBR0520LT1G
1	J10	Single Row Straight Pin Header SMD	TSM-103-01-L-SV			Samtec	TSM-103-01-L-SV
1	J11	Mictor, Centerline Matched Impedance Connector	767054-1			Amp	767054-1
1	J12	2.5mm Audio stereo jack with switch	STX-2550-5NTR			Kycon	STX-2550-5NTR
1	J13	FFC Right Angle Dip Zif 30 pin Connector	6210_30_smd			Avx	08 6210 030 340 800
4	J14,J18,J19,J20	Single Row Straight Pin Header SMD	TSM-102-01-L-SV			Samtec	TSM-102-01-L-SV
0	J18,J19,J20	HDR 1X2 SMT 78.7MIL SP 235H AU	HDR_1X2			Samtec	TMM-102-01-S-S-SM
0	L1	HF Chip coil	3.9nH		5%	Murata	LQG15HS3N9S02D
1	L2	Chip Ferrite Bead	500mA			Murata	BLM11P600Sxx
1	L3	SMD power inductor	22uH		20%	Coilcraft	DO1608C-223LC
1	Q1	P-channel MOSFET	ZXM61P0 2F	20V		Zetex	ZXM61P02F
1	Q2	N-Chanel Enhancement MOSFET	ZVN3320 F	200V		Zetex	ZVN3320FTA

Table 5-1. Bill of Materials

Qty	Part Reference	Description	Value	Voltage	Tolerance	Manufacturer	Manufacturer Part Number
15	R3,R33,R43, R50,R51,R64 ,R65,R68,R6 9,R80,R84,R 105,R109,R1 10,R111	Fixed resistor RC31	0R	50V	2%	Philips	2322 705 91002
0	R4,R32,R34, R66,R70,R91	Fixed resistor RC31	0R	50V	2%	Philips	2322 705 91002
2	R11,R30	Fixed resistor RC31	220R	50V	2%	Philips	2322 705 50221
10	R12,R23,R24 ,R26,R42,R9 7,R98,R99,R 100,R101	Fixed resistor RC31	100K	50V	2%	Philips	2322 705 50104
3	R13,R14,R25	Fixed resistor RC31	1K	50V	2%	Philips	2322 705 50102
0	R81,R82	Fixed resistor RC31	1K	50V	2%	Philips	2322 705 50102
4	R56,R57,R10 6,R107	Fixed resistor RC31	4.7K	50V	2%	Philips	2322 705 50472
9	R1,R15,R40, R44,R87,R89 ,R102,R103, R104	Fixed resistor RC31	10K	50V	2%	Philips	2322 705 50103
1	R44	Fixed resistor RC31	7R15		1%	Koa Speer	RK73H1ETTP7R15F
0	R83	Fixed resistor RC31	10K	50V	2%	Philips	2322 705 50103
1	R20	Fixed resistor RC31	200K	50V	2%	Yageo America	RC0402JR-07200KL
1	R29	Fixed resistor RC31	47K	50V	2%	Philips	2322 705 50473
0	R5	Fixed resistor RC31	240R	50V	2%	Philips	2322 705 50241
3	R58,R59,R67	Fixed resistor RC31	27K	50V	2%	Philips	2322 705 50273
4	R6,R7,R8,R9	Fixed resistor RC31	390R	50V	2%	Philips	2322 705 50391
1	R60	Fixed resistor RC31	8.2K	50V	2%	Philips	2322 705 50822
1	R61	Fixed resistor RC31	13K	50V	2%	Philips	2322 705 50133
1	R85	Fixed resistor RC32	11K	50V		Koa Speer	RK73H1ETTP1102F
1	R86	Fixed resistor RC33	1.8K	50V		Koa Speer	RK73H1ETTP1801F
1	R88	Fixed resistor RC34	51K	200V		Koa Speer	RK73H1ETTP5102F
1	R96	RESISTOR	200 OHM			Vishay/dale	CRCW0402200RJNED
1	R90	RES MF 47 OHM 1/4W 5% 1206	47 OHM		5%	Bourns	CR1206-JW-470ELF
1	R120	RES MF 120K 1/16W 1% 0402	120K		1%	Koa Speer	RK73H1ETTP1203F

Table 5-1. Bill of Materials

Qty	Part Reference	Description	Value	Voltage	Tolerance	Manufacturer	Manufacturer Part Number
1	R121	RES MF 24.9K 1/16W 1% 0402	24.9K		1%	Koa Speer	RK73H1ETTP2492F
4	R122,R123,R124,R125	RES MF 1.0K 1/16W 5% 0402	1K		5%	Vishay Intertechnology	CRCW04021K00JNED
2	RT1,RT2	Polyswitch Overcurrent Protection Device	500mA	13.2V		Tyco Electronics	microSMD050F
5	SW1,SW2,SW3,SW4,SW5	SMD Tact Switch 2.6N (7.0mm)	DTSM63N			Diptronic	DTSM-63N-V-B
1	SW6	4-directional TACT switch with center push SMD	SKRHA			Alps	SKRHAAE010
1	SW7	Miniature Slide Switch 4 pole	MFP461N-RA			Knitter-switch	MFP461N-RA
1	U1	ZigBee Wireless Transceiver and ARM7 processor	MC13225			Freescale	MC13225
1	U10	USB UART, PB-free	FT232R			Ftdi	FT232RQ
1	U13	Digitally Controlled Potentiometer, 50Kohm	MAX5434			Maxim	MAX5434LEZT+T
1	U14	Hex inverter	74HCT04A			On Semiconductor	MC74HCT04ADTR2G
1	U15	Low supply current Step-up DC-DC Converter with shutdown	MAX1676			Maxim	MAX1676EUB+-ND
1	U16	Low Voltage CMOS Octal Bidirectional Transceiver	74LCX245			On Semiconductor	MC74LVXC3245DTG
1	U2	Dual Low voltage Op-Amp	MC33202			On Semiconductor	MC33204DTBG
1	U4	10-bit Low Power DAC with rail to rail output	DAC101S101			National Semiconductor	DAC101S101CIMK-NoPB
1	U6	Audio class AB amplifier, 1,0W	NCP4896			On Semiconductor	NCP4896FCT1G
2	U9,U12	LDO voltage regulator 3V3	LT1129CS T-3.3			Linear Technology	LT1129CST-3.3
1	U17	IC VREG ADJ 1.24-5.3V 20MA SOIC8	LM285M			National Semiconductor	LM285M/NOPB
1	X1	Crystal SMD	24.00MHz		+10ppm	Ndk	NX3225SA-24MHz (for OA/AV and Bluetooth) / S1-3085-1510-9

Table 5-1. Bill of Materials

Qty	Part Reference	Description	Value	Voltage	Tolerance	Manufacturer	Manufacturer Part Number
0	X2	Crystal SMD	32.768kHz		+20ppm	Abracon	ABS25-32.768-12.5-2-T
1	D11	128x64 pixel monochrome display w. LED backlight	F-51553G NBJ-LW-A B			Optrex	F-51553GNBJ-LW-AEN
1	BC1	PCB Battery Holder 2xAA	2462			Keystone	2462
1	J1	Dual Row Right Angle pin header 0.38um gold	90122-20			Molex	90122-0770
1	J2	Dual Row Right Angle pin header 0.38um gold	90122-26			Molex	90122-0773
1	J5	DC Power Jack PCB, 2mm	DJ-005			Taitek	2DC-0005-D100
1	J6	USB-series "B" receptacle	USB-B			Amp	292304-1
1	J7	Straight SMA Receptacle for PCB edge mounting (0.79mm PCB)	SMA			Johnson Components	142-0701-881

