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# KM-153103 koala<sup>®</sup> connect (aka Joey<sup>®</sup>)

## DATASHEET

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## Revision History

Revision	Date	Designed by	Approved by	Description
1.0	08 May 2018	ND	GT	Initial draft
1.1	15 June 2018	ND	GT	FCC Certification warning details added

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## 1.1 Highlights

- Complies with Part 15 of the FCC Rules
- Wi-Fi & dual-mode Bluetooth
- Supports custom Bluetooth Low Energy profiles and services
- On-board Wi-Fi + Bluetooth antennas
- Micro access point
- High speed iAP & iAP2 support
- Embedded Wi-Fi and Bluetooth stack
- Use directly with final design or prototype on koala® evm with Clarinox Carrier boards. (KC-0181xx, KC-0081xx)

## 1.2 Product Description



**Figure 1: KM-153103 Koala® Connect Module**

Joey® Wi-Fi® + Bluetooth® modules are compact all-in-one standalone modules featuring Wi-Fi WLAN / Wi-Fi Direct, Bluetooth Classic and Bluetooth Low Energy. When used in conjunction with koala® evm, the Joey® modules provide a stable environment to ease the integration of wireless technologies into a project. The modules feature Texas Instruments' WL183xMOD variants with Wi-Fi and Bluetooth coexistence and STM32F412CG on-board processor to drive the user application in addition to supporting the wireless protocols. Flexibility of wireless technology is provided with version 4.1 Bluetooth Classic, Bluetooth Low Energy, WLAN and Wi-Fi Direct with IEEE802.11a/b/g/n standards supported.

Joey® modules will help shorten the development time, reduce development costs and open the door to new possibilities for wireless device features. Joey® modules may be used stand-alone products with no additional hardware required; or used in conjunction with other hardware. Additional sensors can be connected directly to the module via GPIO, ADC, I2C, SPI and UART.

## 1.2.1 Module Certification Details

KM-153103 Koala® Connect module complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Clarinox Technologies declares that the radio equipment type RF module is in compliance with Directive 2014/53/EU.

The compliance has been verified in the operating frequency band of 2400-2483.5 MHz. Developers and integrators that incorporate the KM-153103 Module in any end products are responsible for obtaining applicable regulatory approvals for such end product.

The KM-153103 has been tested in the 2400 MHz-2483.5 MHz ISM frequency band at 3.3 V with a maximum peak power of 19.7 dBm EIRP across the temperature range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and tolerance.

### 1.2.1.1 Federal Communications Commission (FCC) Statement

This module complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure limits. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

### 1.2.1.2 End Product Labelling

This module is designed to comply with the FCC statement, FCC ID: 2AN5P1531. The host system using this module must display a visible label indicating the following text:

"Contains FCC ID: 2AN5P1531"

## 1.2.2 Important Notice to OEM Integrators

This module is limited to OEM installation ONLY.

This module is limited to installation in mobile or fixed applications, according to FCC Part 2.1091(b).

The separate approval is required for all other operating configurations, including portable configurations with respect to FCC Part 2.1093 and different antenna configurations

For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).

### 1.2.3 Antenna Installation

The antenna must be installed such that 20 cm is maintained between the antenna and users,

The transmitter module may not be co-located with any other transmitter or antenna.

The ATN016008LCD2442MA1 antenna with -1.41 dBi gain was verified in the conformity testing. Radiated transmit power must be equal to or lower than that specified in the FCC Grant of Equipment Authorization for FCC ID: 2AN5P1531. A separate approval is required for all other antenna type, or higher gain antenna.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

### 1.2.4 Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

### 1.2.5 Federal Communication Commission Interference Statement

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 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

## 1.2.6 Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

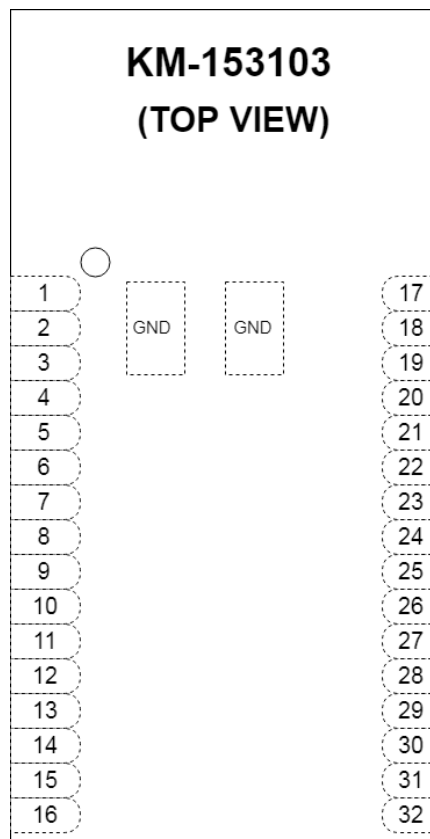


### 1.3 Product Selector

Model	Radio				Interfaces					Power			Package				
	Bluetooth Qualification	Bluetooth Classic and Low Energy	WiFi	Antenna Type	Max Number of Connections	UART	SPI and I2C	GPIO Pins	ADC Channels	Power Supply: 3.3V	Current Draw (Idle)	Current Draw (TX)	I/O Voltage: 1.8V	Solder Pins	Dimensions (W x L x H) mm	Support KC-0181xx Joeyduino Carrier Board	Support KC-0081xx WMI Carrier Board
<b>KM-153103</b>	V4.1	✓	✓	I	6-10	1	1	21	10	✓	60mA	90mA	✓	32	20x34x3	✓	✓
<b>KM-141202</b>	V4.1	✓	x	I	6-10	1	1	23	10	✓	30mA	50mA	✓	32	20x30x3.5	✓	✓

**Table 1: Product Selector**

### 1.4 Module Pinouts



**Figure 2: Module Pinouts**

PIN	FUNCTION	SOURCE/TARGET	PORT DETAILS
P1	AUD_IN	WL1831	AUD_IN (PCM)
P2	AUD_OUT	WL1831	AUD_OUT (PCM)
P3	AUD_CLK	WL1831	AUD_CLK (PCM)
P4	AUD_FSYNC	WL1831	AUD_FSYNC (PCM)
P5	JTAG_TMS	STM32F412	PA13 (JTAG)
P6	JTAG_TCK	STM32F412	PA14 (JTAG)
P7	JTAG_TDI	STM32F412	PA15 (JTAG)
P8	JTAG_TDO	STM32F412	PB3 (JTAG)
P9	JTAG_JNRST	STM32F412	PB4 (JTAG)
P10	JTAG_NRST	STM32F412	NRST (JTAG)
P11	USB_FS_DP	STM32F412	PA12 (USB FS/OTG)
P12	USB_FS_DM	STM32F412	PA11 (USB FS/OTG)
P13	USB_FS_ID	STM32F412	PA10 (USB FS/OTG)
P14	USB_FS_VBUS	STM32F412	PA9 (USB FS/OTG)
P15	USB_FS_SOF	STM32F412	PA8 (USB FS/OTG)
P16	VBAT	STM32F412	VDD (1V8)
P17	GND	STM32F412	VSS (GND)
P18	GND	STM32F412	VSS (GND)
P19	3V3	Power Supply	3V3
P20	3V3	Power Supply	3V3
P21	GPIO_1	STM32F412	PB0 (GPIO)
P22	GPIO_2	STM32F412	PB1 (GPIO)
P23			NC
P24	SPI1_MOSI	STM32F412	PA7 (SPI)
P25	SPI1_MISO	STM32F412	PA6 (SPI)
P26	SPI1_SCK	STM32F412	PA5 (SPI)
P27	SPI1_NSS	STM32F412	PA4 (SPI)
P28	I2C1_SMBA	STM32F412	PB5 (I2C)
P29	I2C1_SCL	STM32F412	PB8 (I2C)
P30	I2C1_SDA	STM32F412	PB9 (I2C)
P31	USART1_TX	STM32F412	PB6 (USART)
P32	USART1_RX	STM32F412	PB7 (USART)

Table 2: Module Pinouts

## 1.5 Hardware Interfaces

SPI	1 (4 pins)
I <sup>2</sup> C	1 (3 pins)
UART	1 (2 pins)
PCM	1 (4 pins)
GPIO pins	16*
ADC channels	6

## 1.6 Bluetooth Signals Hardware Details

WiLink8 Bluetooth module	Microcontroller STM32F412 port
BT EN (Bluetooth Enable)	PC13 (Output)
HCI RTS	PA0
HCI CTS	PA1
HCI RX	PA2
HCI TX	PA3

**Table 3: Bluetooth Signals Hardware Details**

## 1.7 WiFi Signals Hardware Details

WiLink8 WiFi module	Microcontroller STM32F412 port
WL_EN (Wi-Fi Enable)	PB2 (Output)
WL_IRQ (Wi-Fi IRQ)	PB10 (Interrupt)
SPI MISO	PB14
SPI CLK	PB13
SPI MOSI	PB15
SPI CS	PB12

**Table 4: WiFi Signals Hardware Details**

## 1.8 Block Diagram

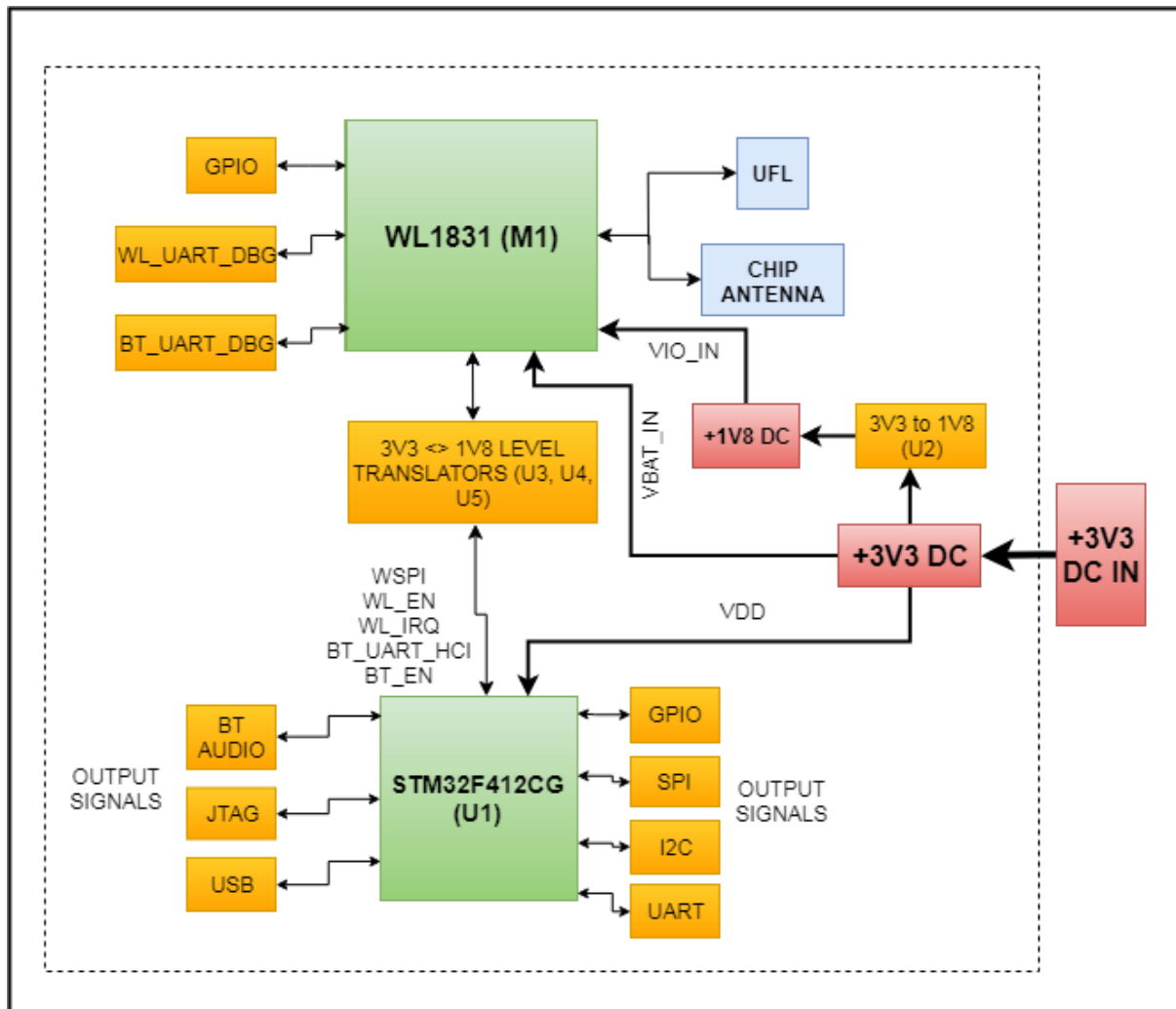


Figure 3: KM-153103 Module Block Diagram

## 1.9 Features

<b>Wi-Fi &amp; Bluetooth module</b>	TI WL1831MOD
<b>Wi-Fi standards</b>	IEEE 802.11a/b/g/n, Wi-Fi Direct Concurrent Operation (Multichannel, Multirole)
<b>Wi-Fi bands</b>	2.4 GHz
<b>Wi-Fi roles</b>	STA, AP, Wi-Fi Direct
<b>Wi-Fi maximum throughput</b>	TCP: 80 Mbps UDP: 100 Mbps
<b>Wi-Fi MIMO</b>	2x2 MIMO
<b>Bluetooth modes</b>	V4.1 BR + EDR (Classic Bluetooth with EDR)

<b>Output power</b>	v4.1 LE (Bluetooth Low Energy) Wi-Fi: +17.3 dBm (@ 1 Mbps DSSS) Classic Bluetooth: BR: +11.7 dBm (GFSK) EDR: +7.2 dBm Bluetooth LE: +7.0 dBm
<b>Sensitivity</b>	Wi-Fi: -96.3 dBm (@ 1 Mbps DSSS) Classic Bluetooth: -92.2 dBm (GFSK) Bluetooth LE: -92.2 dBm
<b>Antenna</b>	Internal antenna

## 1.10 Microcontroller

### STM32F412CG

Core: ARM® 32-bit Cortex®-M4  
Package: UFQFPN48  
CPU: 100 MHz  
SRAM: 256 Kbytes  
Flash: 1 Mbyte

## 1.11 Software Features

<b>Embedded software</b>	ClarinoxBlue Bluetooth Stack ClarinoxBlue Bluetooth Low Energy Stack ClarinoxWiFi WLAN Stack (all combinations of the above three are possible) Combined IPv4 and limited IPv6 stack Supported Interfaces: <ul style="list-style-type: none"> <li>➤ UART</li> <li>➤ I2C</li> <li>➤ SPI</li> <li>➤ USB</li> </ul>
<b>Wi-Fi Security</b>	WEP 64/128 WPA and WPA2 TKIP and AES/CCMP hardware accelerator LEAP, PEAP, EAT-TLS
<b>Wi-Fi operational modes</b>	Access Point(AP) mode Station mode P2P (Wi-Fi Direct)
<b>Bluetooth Classic Profiles &amp; Protocols</b>	Profiles: <ul style="list-style-type: none"> <li>➤ AVRCP Controller 1.5</li> <li>➤ A2DP Source   Sink 1.3</li> <li>➤ DID 1.3</li> <li>➤ FTP Client   Server 1.1</li> <li>➤ GAVDP Initiator   Acceptor   Delay Reporting Initiator 1.3</li> <li>➤ GOEP 1.1</li> <li>➤ HDP Source   Sink 1.1</li> <li>➤ HFP AG   HF 1.7</li> <li>➤ HID 1.1 General HID Host</li> <li>➤ HSP AG   HS 1.2</li> </ul>

	<ul style="list-style-type: none"> <li>➤ IOP</li> <li>➤ MAP 1.1 Messaging Client Equipment (MCE)</li> <li>➤ MPS 1.0</li> <li>➤ OPP Client   Server 1.1</li> <li>➤ PAN User</li> <li>➤ PBAP Client 1.2</li> <li>➤ Report Protocol   HID Device Role 1.1</li> <li>➤ SPP DevA   DevB 1.2</li> </ul> <p>Protocols:</p> <ul style="list-style-type: none"> <li>➤ AVCTP Controller 1.4</li> <li>➤ AVDTP Source   Sink   Initiator   Acceptor 1.3</li> <li>➤ BNEP</li> <li>➤ GAP (Generic Access Profile)– BR/EDR/LE</li> <li>➤ MCAP Source   Sink</li> <li>➤ OBEX 1.1</li> <li>➤ OBEX over RFCOMM 1.1</li> <li>➤ RFCOMM 1.1</li> <li>➤ SDP (Service Discovery Protocol) Server   Client</li> </ul>
<p><b>Bluetooth Low Energy Profiles &amp; Protocols</b></p>	<p>Profiles:</p> <ul style="list-style-type: none"> <li>➤ ANP Server   Client 1.0</li> <li>➤ BAS Profile over LE</li> <li>➤ BLP Sensor (Server)   Collector (Client)</li> <li>➤ CPP Collector 1.0</li> <li>➤ CSCP Sensor (Server)   Collector (Client)</li> <li>➤ CTS Profile over LE 1.0</li> <li>➤ DIS profile over LE 1.1</li> <li>➤ FMP Target (Server)   Locator (Client)</li> <li>➤ GLP Sensor (Server)   Collector (Client)</li> <li>➤ HIDS Profile over LE</li> <li>➤ HOGP Device (Server) 1.0</li> <li>➤ HRP Sensor (Server)   Collector (Client)</li> <li>➤ HRS Profile over LE</li> <li>➤ HTP Thermometer (Server)   Collector (Client)</li> <li>➤ IAS Profile over LE</li> <li>➤ LNP Sensor (Server)   Collector (Client) 1.0</li> <li>➤ PASP Server</li> <li>➤ PXP Reporter (Server) 1.0</li> <li>➤ RSCP Sensor (Server)</li> <li>➤ TIP Server</li> </ul> <p>Protocols:</p> <ul style="list-style-type: none"> <li>➤ ATT (Attribute Protocol) Client</li> <li>➤ BPP (Basic Printing Profile) 1.2 Printer   Sender</li> <li>➤ BIP (Basic Imaging Profile) 1.2 Image Push Initiator   Image Push Responder   Image Pull Initiator   Image Pull Responder</li> <li>➤ CTN (Calendar, Tasks and Notes Profile)</li> <li>➤ GAP (Generic Access Profile)– BR/EDR/LE</li> <li>➤ GATT (Generic Attribute Profile) over LE Client   Server</li> <li>➤ HCRP (Hardcopy Cable Replacement Profile) 1.2</li> </ul>

<b>Bluetooth Security</b>	Secure Simple Pairing 128-bit AES encryption BLE Secure Connection
<b>Max. number of connections</b>	Wi-Fi 2.4 GHz: Up to 8 connections Classic Bluetooth: Up to 7 connections Bluetooth LE: Up to 10 connections
<b>Single/Dual processor Approach</b>	User applications can be implemented on koala <sup>®</sup> connect with Clarinox WiFi / Bluetooth classic and low energy protocol stacks running on the same single CPU. Dual CPU approach is also possible by having Clarinox stacks implemented on koala <sup>®</sup> connect and user application running on a separate CPU. Using Joey <sup>®</sup> in both these approaches enhances IO capability in the system.
<b>Simultaneous Wireless usage</b>	Classic Bluetooth, Bluetooth Low Energy and Wi-Fi technologies can be used simultaneously and gateway functionality (simultaneous roles) amongst these technologies are possible
<b>API Interface</b>	Host to module connection supports Request-Response based implementation UART, I2C, SPI interfaces supported Applications can be simulated using a desktop environment
<b>Supported Wi-Fi modes</b>	AP, Station and P2P modes are supported Simultaneous nodes such as AP and Station are supported
<b>iOS connectivity</b>	iAP & iAP2

## 1.12 Package (Dimensions)

<b>Dimensions (W × L × H)</b>	20 mm x 34 mm x 3 mm
<b>Weight</b>	< 2.0 g
<b>Mounting</b>	Solder edge pins with castellation (visually inspectable)

## 1.13 Environmental Data, Quality & Reliability

<b>Operating temperature</b>	-10 °C to +60 °C
<b>Storage temperature</b>	-40 °C to +85 °C

## 1.14 Electrical Characteristics

<b>Supply voltage</b>	3.3 V	
<b>I/O voltage</b>	1.8 V	
<b>Average Power consumption</b>	0.15W	
<b>Current draw (Bluetooth)</b>	Idle*	33mA
	Bluetooth Stack initialization	33mA
	Searching for devices	60mA
<b>Current draw (Wi-Fi)</b>	WiFi Stack initialization	90mA
	Start interface as Station	90mA
	Idle as Station	60mA
	Connect to Wi-Fi network as Station	110mA
	Start interface as Access Point (AP)	95mA

	Idle as Access Point	60mA
	Connect to device as AP	160mA

\*Idle current is measured after Bluetooth is initialized while no any other functions are carried out.

The current draw values in above table are the total current drawn by the Joey® module when connected to Clarinox Joeyduino Carrier.

## 1.15 Applications

Internet of Things (IoT)	Consumer Electronics, Home Automation, Wearables
Industrial IoT	Industrial Automation
Health	Medical/Health devices

## 1.16 Pin Compatible Wireless Variants

<b>KM-153103-1831</b>	2.4 GHz Wi-Fi and Bluetooth
<b>KM-153103-1837</b>	5 GHz and 2.4 GHz Wi-Fi and Bluetooth
<b>KM-153103-1801</b>	2.4 GHz Wi-Fi only
<b>KM-153103-1807</b>	5 GHz and 2.4 GHz Wi-Fi only

## 1.17 Supporting Products

<b>KC-0181xx</b>	Joeyduino Carrier / Breakout Board for Joey® modules
<b>KC-0081xx</b>	WMI Carrier / Breakout Board for Joey® modules
<b>KM-9805xx</b>	Sensor Board with 9D sensor and haptic driver



## 1.18 Placement Details

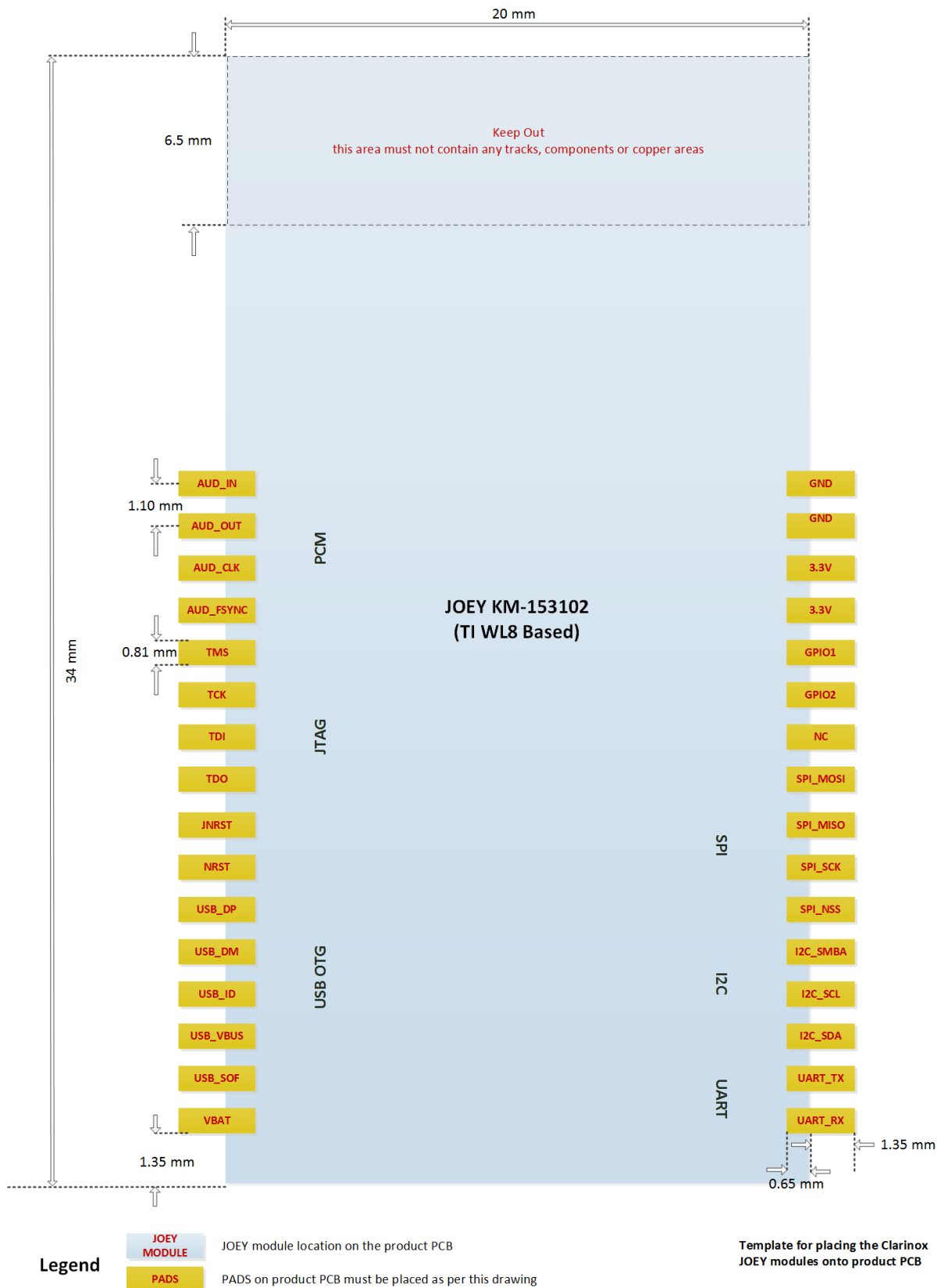


Figure 4: Placement Details