



# Digi XBee® RR

RF Module

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## Hardware Reference Manual

## Revision history—90002517

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| Revision | Date         | Description                                                                                                       |
|----------|--------------|-------------------------------------------------------------------------------------------------------------------|
| A        | April 2022   | Initial release.                                                                                                  |
| B        | July 2022    | Added Europe, UK, and Brazil to regulatory conformity summary; added Brazil ANATEL certification.                 |
| C        | August 2022  | Added chip antenna 29000710, re-included EU/UKCA certification section.                                           |
| D        | October 2022 | Added integral antennae 31000005-01 and 31000017-01; added Design notes for PCB antenna and chip antenna devices. |

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# **Digi XBee® RR RF Module Hardware Reference Manual**

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This manual provides information for the XBee RR RF Module hardware.

## Safety instructions

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## Safety instructions

### XBee modules

- The XBee radio module cannot be guaranteed operation due to the radio link and so should not be used for interlocks in safety critical devices such as machines or automotive applications.
- The XBee radio module has not been approved for use in (this list is not exhaustive):
  - medical devices
  - nuclear applications
  - explosive or flammable atmospheres
- There are no user serviceable components inside the XBee radio module. Do not remove the shield or modify the XBee in any way. Modifications may exclude the module from any warranty and can cause the XBee radio to operate outside of regulatory compliance for a given country, leading to the possible illegal operation of the radio.
- Use industry standard ESD protection when handling the XBee module.
- Take care while handling to avoid electrical damage to the PCB and components.
- Do not expose XBee radio modules to water or moisture.
- Use this product with the antennas specified in the XBee module user guides.
- The end user must be told how to remove power from the XBee radio module or to locate the antennas 20 cm from humans or animals.

## Инструкции за безопасност

### XBee модули

- Радио модулът XBee не може да бъде гарантиран за работа поради радиовръзката и затова не трябва да се използва за блокировки в критични за безопасността устройства като машини или автомобилни приложения.
- Радио модулът XBee не е одобрен за използване в (този списък не е изчерпателен):
  - медицински изделия
  - ядрени приложения
  - експлозивна или запалима атмосфера
- В радиомодула XBee няма компоненти, които могат да се обслужват от потребителя. Не премахвайте щита и не модифицирайте XBee по никакъв начин. Модификациите могат да изключат модула от всякаква гаранция и да накарат радиото XBee да работи извън регулаторното съответствие за дадена държава, което води до възможна незаконна работа на радиото.
- Използвайте стандартна ESD защита при работа с XBee модула.
- Внимавайте, докато боравите, за да избегнете електрически повреди на печатната платка и компонентите.
- Не излагайте радиомодулите XBee на вода или влага.

- Използвайте този продукт с антените, посочени в ръководствата за потребителя на модула XBee.
- Крайният потребител трябва да бъде казано как да премахне захранването от радиомодула XBee или да разположи антените на 20 cm от хора или животни.

## Sigurnosne upute

### XBee moduli

- Radio modulu XBee ne može se jamčiti rad zbog radio veze i stoga se ne smije koristiti za blokade u sigurnosnim kritičnim uređajima kao što su strojevi ili automobilske aplikacije.
- XBee radio modul nije odobren za upotrebu u (ovaj popis nije konačan):
  - medicinskih uređaja
  - nuklearne primjene
  - eksplozivne ili zapaljive atmosfere
- Unutar XBee radio modula nema komponenti koje može servisirati korisnik. Nemojte uklanjati štit i ni na koji način modificirati XBee. Izmjene mogu isključiti modul iz bilo kakvog jamstva i mogu uzrokovati rad XBee radija izvan usklađenosti s propisima za određenu zemlju, što može dovesti do mogućeg nezakonitog rada radija.
- Koristite standardnu ESD zaštitu pri rukovanju XBee modulom.
- Budite oprezni tijekom rukovanja kako biste izbjegli električna oštećenja PCB-a i komponenti.
- Ne izlažite XBee radio module vodi ili vlazi.
- Koristite ovaj proizvod s antenama navedenim u korisničkim vodičima za XBee modul.
- Krajnjem korisniku se mora reći kako da isključi napajanje iz XBee radio modula ili da locira antene 20 cm od ljudi ili životinja.

## Bezpečnostní instrukce

### moduly XBee

- Rádiový modul XBee nemůže zaručit provoz kvůli rádiovému spojení, a proto by neměl být používán pro blokování v zařízeních kritických z hlediska bezpečnosti, jako jsou stroje nebo automobilové aplikace.
- Rádiový modul XBee nebyl schválen pro použití v (tento seznam není vyčerpávající):
  - zdravotnické prostředky
  - jaderné aplikace
  - výbušné nebo hořlavé atmosféry
- Uvnitř rádiového modulu XBee nejsou žádné uživatelsky opravitelné součásti. Neodstraňujte štít ani nijak neupravujte XBee. Úpravy mohou vyjmout modul z jakékoli záruky a mohou způsobit, že rádio XBee bude fungovat mimo zákonnou shodu pro danou zemi, což povede k možnému nezákonnému provozu rádia.
- Při manipulaci s modulem XBee používejte standardní ochranu ESD.

- Při manipulaci buďte opatrní, aby nedošlo k elektrickému poškození desky plošných spojů a součástí.
- Nevystavujte rádiové moduly XBee vodě nebo vlhkosti.
- Používejte tento produkt s anténami uvedenými v uživatelských příručkách modulu XBee.
- Koncový uživatel musí být informován, jak odpojit napájení rádiového modulu XBee nebo jak umístit antény 20 cm od lidí nebo zvířat.

## Sikkerhedsinstruktioner

### XBee moduler

- XBee-radiomodul kan ikke garanteres drift på grund af radioforbindelsen og bør derfor ikke bruges til aflåsninger i sikkerhedskritiske enheder såsom maskiner eller bilapplikationer.
- XBee-radiomodul er ikke godkendt til brug i (denne liste er ikke udtømmende):
  - medicinsk udstyr
  - nukleare applikationer
  - eksplosive eller brandfarlige atmosfærer
- Der er ingen komponenter, der kan repareres af brugeren, inde i XBee-radiomodul. Fjern ikke skjoldet eller modificer XBee på nogen måde. Ændringer kan udelukke modulet fra enhver garanti og kan få XBee-radioen til at fungere uden for lovgivningsoverholdelse for et givet land, hvilket kan føre til den mulige ulovlige drift af radioen.
- Brug industristandard ESD-beskyttelse, når du håndterer XBee-modulet.
- Vær forsigtig under håndteringen for at undgå elektrisk beskadigelse af printet og komponenterne.
- Udsæt ikke XBee-radiomoduler for vand eller fugt.
- Brug dette produkt med de antenner, der er specificeret i XBee-modulets brugervejledninger.
- Slutbrugeren skal fortælles, hvordan man fjerner strømmen fra XBee-radiomodul eller placerer antennerne 20 cm fra mennesker eller dyr.

## Veiligheidsinstructies

### XBee-modules

- De werking van de XBee-radiomodule kan niet worden gegarandeerd vanwege de radioverbinding en mag daarom niet worden gebruikt voor vergrendelingen in veiligheidskritieke apparaten zoals machines of autotoepassingen.
- De XBee-radiomodule is niet goedgekeurd voor gebruik in (deze lijst is niet uitputtend):
  - o medische apparaten
  - o nucleaire toepassingen
  - o explosieve of ontvlambare atmosferen

- Er zijn geen door de gebruiker te onderhouden componenten in de XBee-radiomodule. Verwijder het schild niet en wijzig de XBee op geen enkele manier. Modificaties kunnen de module uitsluiten van enige garantie en kunnen ertoe leiden dat de XBee-radio werkt buiten de regelgeving voor een bepaald land, wat kan leiden tot de mogelijke illegale werking van de radio.
- Gebruik industriestandaard ESD-bescherming bij het hanteren van de XBee-module.
- Wees voorzichtig bij het hanteren om elektrische schade aan de printplaat en componenten te voorkomen.
- Stel XBee-radiomodules niet bloot aan water of vocht.
- Gebruik dit product met de antennes die zijn gespecificeerd in de gebruikershandleidingen van de XBee-module.
- De eindgebruiker moet worden verteld hoe de voeding van de XBee-radiomodule moet worden losgekoppeld of hoe de antennes op 20 cm van mensen of dieren moeten worden geplaatst.

## Ohutusjuhised

### XBee moodulid

- XBee raadiomooduli tööd ei saa raadiolingi tõttu garanteerida ja seetõttu ei tohiks seda kasutada ohutuse seisukohalt oluliste seadmete (nt masinad või autorakendused) blokeerimiseks.
- XBee raadiomoodulit ei ole heaks kiidetud kasutamiseks (see loetelu ei ole ammendav):
  - meditsiiniseadmed
  - tuumarakendused
  - plahvatusohtlik või tuleohtlik keskkond
- XBee raadiomoodulis ei ole kasutaja poolt hooldatavaid komponente. Ärge eemaldage kaitset ega muutke XBee mingil viisil. Muudatused võivad mooduli garantiist välja jätta ja XBee raadio töötab väljaspool antud riigi regulatiivseid vastavusi, põhjustades raadio võimaliku ebaseadusliku kasutamise.
- Kasutage XBee mooduli käsitsemisel tööstusharu standardset ESD-kaitset.
- Olge käsitsemisel ettevaatlik, et vältida PCB ja komponentide elektrikahjustusi.
- Ärge jätke XBee raadiomoduleid vee või niiskuse kätte.
- Kasutage seda toodet XBee mooduli kasutusjuhendis kirjeldatud antennidega.
- Lõppkasutajale tuleb öelda, kuidas XBee raadiomoodulilt toide eemaldada või antennid inimestest või loomadest 20 cm kaugusele paigutada.

## Turvallisuushjeet

### XBee moduulit

- XBee-radiomoduulini toimintaa ei voida taata radiolinkin vuoksi, joten sitä ei tule käyttää turvallisuuden kannalta kriittisten laitteiden, kuten koneiden tai autosovellusten,

lukitsemiseen.

- XBee-radiomoduulia ei ole hyväksytty käytettäväksi (tämä luettelo ei ole tyhjentävä):
  - lääketieteelliset laitteet
  - ydinvoimasovellukset
  - räjähdysvaarallisiin tai syttyviin tiloihin
- XBee-radiomoduulin sisällä ei ole käyttäjän huollettavia osia. Älä poista suojusta tai muokkaa XBeetä millään tavalla. Muutokset voivat sulkea moduulin takuun ulkopuolelle ja aiheuttaa sen, että XBee-radio toimii tietyn maan säädöstenmukaisuuden ulkopuolella, mikä johtaa radion mahdolliseen laittomaan käyttöön.
- Käytä alan standardia ESD-suojauksia käsitellessäsi XBee-moduulia.
- Ole varovainen käsitellessäsi, jotta vältät piirilevyn ja komponenttien sähkövauriot.
- Älä altista XBee-radiomoduuleja vedelle tai kosteudelle.
- Käytä tätä tuotetta XBee-moduulin käyttöoppaissa määriteltyjen antennien kanssa.
- Loppukäyttäjälle on kerrottava, kuinka XBee-radiomoduulin virta katkaistaan tai antennit sijoitetaan 20 cm:n etäisyydelle ihmisistä tai eläimistä.

## Consignes de sécurité

### Modules XBee

- Le fonctionnement du module radio XBee ne peut pas être garanti en raison de la liaison radio et ne doit donc pas être utilisé pour les verrouillages dans des dispositifs critiques pour la sécurité tels que des machines ou des applications automobiles.
- Le module radio XBee n'a pas été approuvé pour une utilisation dans (cette liste n'est pas exhaustive) :
  - dispositifs médicaux
  - applications nucléaires
  - atmosphères explosives ou inflammables
- Il n'y a aucun composant réparable par l'utilisateur à l'intérieur du module radio XBee. Ne retirez pas la protection et ne modifiez en aucune façon le XBee. Les modifications peuvent exclure le module de toute garantie et peuvent entraîner le fonctionnement de la radio XBee en dehors de la conformité réglementaire pour un pays donné, ce qui peut entraîner un fonctionnement illégal de la radio.
- Utilisez la protection ESD standard de l'industrie lors de la manipulation du module XBee.
- Soyez prudent lors de la manipulation afin d'éviter des dommages électriques au circuit imprimé et aux composants.
- N'exposez pas les modules radio XBee à l'eau ou à l'humidité.
- Utilisez ce produit avec les antennes spécifiées dans les guides d'utilisation du module XBee.
- L'utilisateur final doit savoir comment couper l'alimentation du module radio XBee ou placer les antennes à 20 cm des humains ou des animaux.

## Sicherheitshinweise

### XBee-Module

- Der Betrieb des XBee-Funkmoduls kann aufgrund der Funkverbindung nicht garantiert werden und sollte daher nicht für Verriegelungen in sicherheitskritischen Geräten wie Maschinen oder Automobilanwendungen verwendet werden.
- Das XBee-Funkmodul ist nicht zugelassen für den Einsatz in (diese Liste ist nicht vollständig):
  - Medizinprodukte
  - nukleare Anwendungen
  - explosive oder brennbare Atmosphären
- Das XBee-Funkmodul enthält keine vom Benutzer zu wartenden Komponenten. Entfernen Sie nicht die Abschirmung oder modifizieren Sie das XBee in irgendeiner Weise. Modifikationen können das Modul von jeglicher Garantie ausschließen und dazu führen, dass das XBee-Funkgerät außerhalb der gesetzlichen Vorschriften für ein bestimmtes Land betrieben wird, was zu einem möglichen illegalen Betrieb des Funkgeräts führen kann.
- Verwenden Sie beim Umgang mit dem XBee-Modul ESD-Schutz nach Industriestandard.
- Seien Sie vorsichtig bei der Handhabung, um elektrische Schäden an der Leiterplatte und den Komponenten zu vermeiden.
- XBee-Funkmodule nicht Wasser oder Feuchtigkeit aussetzen.
- Verwenden Sie dieses Produkt mit den in den Benutzerhandbüchern des XBee-Moduls angegebenen Antennen.
- Dem Endbenutzer muss mitgeteilt werden, wie er das XBee-Funkmodul von der Stromversorgung trennt oder die Antennen 20 cm von Menschen oder Tieren entfernt aufstellt.

## Οδηγίες ασφαλείας

### Μονάδες XBee

- Η μονάδα ραδιοφώνου XBee δεν μπορεί να εγγραφεί τη λειτουργία της λόγω της ραδιοζεύξης και επομένως δεν πρέπει να χρησιμοποιείται για ασφάλειες σε κρίσιμες για την ασφάλεια συσκευές, όπως μηχανήματα ή εφαρμογές αυτοκινήτου.
- Η μονάδα ραδιοφώνου XBee δεν έχει εγκριθεί για χρήση σε (αυτή η λίστα δεν είναι εξαντλητική):
  - ιατροτεχνολογικά προϊόντα
  - πυρηνικές εφαρμογές
  - εκρηκτικές ή εύφλεκτες ατμόσφαιρες
- Δεν υπάρχουν εξαρτήματα που να μπορούν να επισκευαστούν από το χρήστη μέσα στη μονάδα ραδιοφώνου XBee. Μην αφαιρείτε την ασπίδα και μην τροποποιείτε το XBee με κανέναν τρόπο. Οι τροποποιήσεις ενδέχεται να αποκλείουν τη μονάδα από οποιαδήποτε εγγύηση και μπορεί να προκαλέσουν τη λειτουργία του ραδιοφώνου XBee εκτός της συμμόρφωσης με τους κανονισμούς για μια δεδομένη χώρα, οδηγώντας σε πιθανή παράνομη λειτουργία του ραδιοφώνου.
- Χρησιμοποιήστε βιομηχανική προστασία ESD κατά το χειρισμό της μονάδας XBee.

- Προσέχετε κατά το χειρισμό για να αποφύγετε ηλεκτρική βλάβη στο PCB και στα εξαρτήματα.
- Μην εκθέτετε τις μονάδες ραδιοφώνου XBee σε νερό ή υγρασία.
- Χρησιμοποιήστε αυτό το προϊόν με τις κεραίες που καθορίζονται στους οδηγούς χρήσης της μονάδας XBee.
- Πρέπει να ενημερωθεί ο τελικός χρήστης πώς να αφαιρέσει την τροφοδοσία από τη μονάδα ραδιοφώνου XBee ή να εντοπίσει τις κεραίες σε απόσταση 20 cm από ανθρώπους ή ζώα.

## Biztonsági utasítások

### XBee modulok

- Az XBee rádiómodul működése nem garantálható a rádiókapcsolat miatt, ezért nem használható biztonsági szempontból kritikus eszközök, például gépek vagy autóiipari alkalmazások reteszelésére.
- Az XBee rádiómodul nem engedélyezett a következő területeken való használatra (ez a lista nem teljes):
  - o orvosi eszközök
  - o nukleáris alkalmazások
  - o robbanásveszélyes vagy gyúlékony légkör
- Az XBee rádiómodulban nincsenek felhasználó által javítható alkatrészek. Ne távolítsa el a pajzsot, és semmilyen módon ne módosítsa az XBee-t. A módosítások kizárhatják a modult a jótállásból, és az XBee rádió működését az adott ország jogszabályi előírásaitól eltérően okozhatják, ami a rádió esetlegesen illegális működéséhez vezethet.
- Az XBee modul kezelésekor használjon ipari szabványos ESD védelmet.
- A kezelés során ügyeljen arra, hogy elkerülje a PCB és az alkatrészek elektromos károsodását.
- Ne tegye ki az XBee rádiómodulokat víznek vagy nedvességnek.
- Használja ezt a terméket az XBee modul használati útmutatójában meghatározott antennákkal.
- A végfelhasználót tájékoztatni kell arról, hogyan távolítsa el az XBee rádiómodul áramellátását, vagy hogyan helyezze el az antennákat az emberektől vagy állatoktól 20 cm-re.

## Istruzioni di sicurezza

### Moduli XBee

- Il funzionamento del modulo radio XBee non può essere garantito a causa del collegamento radio e quindi non deve essere utilizzato per gli interblocchi in dispositivi critici per la sicurezza come macchine o applicazioni automobilistiche.
- Il modulo radio XBee non è stato approvato per l'uso in (questo elenco non è esaustivo):
  - dispositivi medici
  - applicazioni nucleari
  - atmosfere esplosive o infiammabili
- Non ci sono componenti riparabili dall'utente all'interno del modulo radio XBee. Non rimuovere lo scudo o modificare in alcun modo l'XBee. Le modifiche possono escludere il

modulo da qualsiasi garanzia e possono causare il funzionamento della radio XBee al di fuori della conformità normativa per un determinato paese, portando al possibile funzionamento illegale della radio.

- Utilizzare la protezione ESD standard del settore durante la manipolazione del modulo XBee.
- Prestare attenzione durante la manipolazione per evitare danni elettrici al PCB e ai componenti.
- Non esporre i moduli radio XBee all'acqua o all'umidità.
- Utilizzare questo prodotto con le antenne specificate nelle guide per l'utente del modulo XBee.
- L'utente finale deve sapere come togliere l'alimentazione al modulo radio XBee o come posizionare le antenne a 20 cm da persone o animali.

## Drošības instrukcijas

### XBee moduļi

- Radio moduļa XBee darbība nevar tikt garantēta radio savienojuma dēļ, tāpēc to nevajadzētu izmantot bloķēšanai drošības ziņā kritiskās ierīcēs, piemēram, mašīnās vai automobiļos.
- XBee radio modulis nav apstiprināts lietošanai (šis saraksts nav pilnīgs):
  - medicīniskās ierīces
  - kodolprogrammas
  - sprādzienbīstamā vai uzliesmojošā vidē
- XBee radio moduļa iekšpusē nav neviena komponenta, ko lietotājs varētu apkopt. Nenoņemiet vairogu un nekādā veidā nepārveidojiet XBee. Modifikācijas rezultātā modulis var tikt izslēgts no jebkādas garantijas un var izraisīt XBee radio darbību, kas neatbilst noteiktās valsts normatīvajiem aktiem, izraisot iespējamu nelegālu radio darbību.
- Strādājot ar XBee moduli, izmantojiet nozares standarta ESD aizsardzību.
- Rīkojoties, rīkojieties uzmanīgi, lai izvairītos no PCB un komponentu elektriskiem bojājumiem.
- Nepakļaujiet XBee radio moduļus ūdens vai mitruma iedarbībai.
- Izmantojiet šo izstrādājumu ar antenām, kas norādītas XBee moduļa lietotāja rokasgrāmatās.
- Galalietotājam ir jāpaskaidro, kā atvienot XBee radio moduļa strāvu vai novietot antenas 20 cm attālumā no cilvēkiem vai dzīvniekiem.

## Saugos instrukcijas

### XBee moduļi

- Negalima garantuoti, kad „XBee“ radijo modulis veiks dėl radijo ryšio, todėl jo neturėtų būti naudojamas blokuoti saugai svarbiuose įrenginiuose, pvz., mašinos ar automobiliuose.
- XBee radijo modulis nebuvo patvirtintas naudoti (šis sąrašas nėra baigtinis):
  - medicinos prietaisai
  - branduolinės programos
  - sprogioje ar degioje aplinkoje

- XBee radijo modulio viduje nėra komponentų, kuriuos vartotojas galėtų prižiūrėti. Jokiu būdu nenuimkite skydo ir nekeiskite XBee. Dėl modifikacijų moduliui gali būti netaikoma jokia garantija, o „XBee“ radijas gali veikti ne pagal tam tikros šalies norminius reikalavimus, o tai gali sukelti neteisėtą radijo naudojimą.
- Dirbdami su XBee moduliu naudokite pramonės standartinę ESD apsaugą.
- Dirbdami būkite atsargūs, kad nepažeistumėte PCB ir komponentų.
- Saugokite XBee radijo modulius nuo vandens ar drėgmės.
- Naudokite šį gaminį su antenomis, nurodytomis XBee modulio vartotojo vadove.
- Galutiniam vartotojui turi būti paaiškinta, kaip atjungti XBee radijo modulio maitinimą arba nustatyti antenas 20 cm atstumu nuo žmonių ar gyvūnų.

## Sikkerhetsinstruksjoner

### XBee-moduler

- XBee-radiomodulen kan ikke garanteres drift på grunn av radiolinken, og bør derfor ikke brukes til forriglinger i sikkerhetskritiske enheter som maskiner eller bilapplikasjoner.
- XBee-radiomodulen er ikke godkjent for bruk i (denne listen er ikke uttømmende):
  - medisinsk utstyr
  - kjernefysiske applikasjoner
  - eksplosive eller brennbare atmosfærer
- Det er ingen komponenter som kan repareres av brukeren inne i XBee-radiomodulen. Ikke fjern skjoldet eller modifier XBee på noen måte. Endringer kan ekskludere modulen fra enhver garanti og kan føre til at XBee-radioen fungerer utenfor regelverket for et gitt land, noe som kan føre til ulovlig drift av radioen.
- Bruk industristandard ESD-beskyttelse når du håndterer XBee-modulen.
- Vær forsiktig ved håndtering for å unngå elektrisk skade på PCB og komponenter.
- Ikke utsett XBee radiomoduler for vann eller fuktighet.
- Bruk dette produktet med antennene spesifisert i XBee-modulens brukerveiledninger.
- Sluttbrukeren må bli fortalt hvordan man fjerner strømmen fra XBee-radiomodulen eller plasserer antennene 20 cm fra mennesker eller dyr.

## Instrukcje bezpieczeństwa

### Moduły XBee

- Moduł radiowy XBee nie może zagwarantować działania ze względu na łącze radiowe, dlatego nie należy go używać do blokad w urządzeniach o krytycznym znaczeniu dla bezpieczeństwa, takich jak maszyny lub aplikacje motoryzacyjne.
- Moduł radiowy XBee nie został dopuszczony do użytku w (lista ta nie jest wyczerpująca):

- wyroby medyczne
  - zastosowania nuklearne
  - atmosferach wybuchowych lub łatwopalnych
- Wewnątrz modułu radiowego XBee nie ma żadnych elementów, które mogłyby być serwisowane przez użytkownika. Nie zdejmuj osłony ani nie modyfikuj XBee w żaden sposób. Modyfikacje mogą wykluczyć moduł z jakiegokolwiek gwarancji i spowodować, że radio XBee będzie działać niezgodnie z przepisami obowiązującymi w danym kraju, co może prowadzić do nielegalnego działania radia.
  - Podczas obsługi modułu XBee należy stosować standardową ochronę ESD.
  - Podczas obsługi należy zachować ostrożność, aby uniknąć uszkodzeń elektrycznych PCB i komponentów.
  - Nie wystawiaj modułów radiowych XBee na działanie wody lub wilgoci.
  - Używaj tego produktu z antenami określonymi w podręcznikach użytkownika modułu XBee.
  - Użytkownik końcowy musi zostać poinformowany, jak odłączyć zasilanie modułu radiowego XBee lub zlokalizować anteny w odległości 20 cm od ludzi lub zwierząt.

## Instruções de segurança

### Módulos XBee

- • O módulo de rádio XBee não pode ter operação garantida devido ao link de rádio e, portanto, não deve ser usado para intertravamentos em dispositivos críticos de segurança, como máquinas ou aplicações automotivas.
- • O módulo de rádio XBee não foi aprovado para uso em (esta lista não é exaustiva):
  - o dispositivos médicos
  - o aplicações nucleares
  - o atmosferas explosivas ou inflamáveis
- • Não há componentes que possam ser reparados pelo usuário dentro do módulo de rádio XBee. Não remova a blindagem nem modifique o XBee de forma alguma. As modificações podem excluir o módulo de qualquer garantia e fazer com que o rádio XBee opere fora da conformidade regulatória de um determinado país, levando à possível operação ilegal do rádio.
- • Use proteção ESD padrão da indústria ao manusear o módulo XBee.
- • Tome cuidado ao manusear para evitar danos elétricos à PCB e aos componentes.
- • Não exponha os módulos de rádio XBee à água ou umidade.
- • Use este produto com as antenas especificadas nos guias do usuário do módulo XBee.
- • O usuário final deve ser informado sobre como remover a energia do módulo de rádio XBee ou localizar as antenas a 20 cm de humanos ou animais.

## Instrucțiuni de siguranță

### module XBee

- Nu se poate garanta funcționarea modului radio XBee din cauza conexiunii radio și, prin urmare, nu trebuie utilizat pentru interblocări în dispozitive critice pentru siguranță, cum ar fi mașini sau aplicații auto.
- Modulul radio XBee nu a fost aprobat pentru utilizare în (această listă nu este exhaustivă):
  - dispozitive medicale
  - aplicații nucleare
  - atmosfere explozive sau inflamabile
- Nu există componente care să poată fi reparate de utilizator în interiorul modului radio XBee. Nu îndepărtați scutul și nu modificați XBee în niciun fel. Modificările pot exclude modulul din orice garanție și pot face ca radioul XBee să funcționeze în afara conformității cu reglementările pentru o anumită țară, ceea ce duce la o posibilă funcționare ilegală a radioului.
- Folosiți protecția ESD standard în industrie când manipulați modulul XBee.
- Aveți grijă în timpul manipulării pentru a evita deteriorarea electrică a PCB-ului și a componentelor.
- Nu expuneți modulele radio XBee la apă sau umezeală.
- Utilizați acest produs cu antenele specificate în ghidurile utilizatorului modului XBee.
- Utilizatorului final trebuie să i se spună cum să scoată alimentarea de la modulul radio XBee sau să găsească antenele la 20 cm de oameni sau animale.

## Bezpečnostné inštrukcie

### moduly XBee

- Rádiový modul XBee nemôže byť zaručený kvôli rádiovému spojeniu, a preto by sa nemal používať na blokovanie v zariadeniach kritických z hľadiska bezpečnosti, ako sú stroje alebo automobilové aplikácie.
- Rádiový modul XBee nebol schválený na použitie v (tento zoznam nie je úplný):
  - zdravotnícke pomôcky
  - jadrové aplikácie
  - výbušné alebo horľavé atmosféry
- Vo vnútri rádiového modulu XBee sa nenachádzajú žiadne používateľsky opraviteľné komponenty. Neodstraňujte štít ani žiadnym spôsobom neupravujte XBee. Úpravy môžu vyňať modul zo záruky a môžu spôsobiť, že rádio XBee bude fungovať mimo zhody s predpismi pre danú krajinu, čo vedie k novej nezákonnej prevádzke rádia.
- Pri manipulácii s modulom XBee používajte štandardnú ochranu pred ESD.
- Pri manipulácii buďte opatrní, aby ste predišli elektrickému poškodeniu dosky plošných spojov a komponentov.

- Rádiové moduly XBee nevystavujte vode ani vlhkosti.
- Tento produkt používajte s anténami špecifikovanými v používateľských príručkách modulu XBee.
- Koncový používateľ musí byť informovaný o tom, ako odpojiť napájanie rádiového modulu XBee alebo ako umiestniť antény 20 cm od ľudí alebo zvierat.

## Varnostna navodila

### XBee moduli

- Radijskega modula XBee ni mogoče zagotoviti delovanja zaradi radijske povezave in ga zato ne smete uporabljati za zaklepanje v varnostno kritičnih napravah, kot so stroji ali avtomobilске aplikacije.
- Radijski modul XBee ni bil odobren za uporabo v (ta seznam ni izčrpen):
  - medicinskih pripomočkov
  - jedrske aplikacije
  - eksplozivne ali vnetljive atmosfere
- V radijskem modulu XBee ni komponent, ki bi jih lahko popravil uporabnik. Ne odstranjujte ščita in na noben način ne spreminjajte XBee. Spremembe lahko modul izključijo iz kakršne koli garancije in lahko povzročijo, da radio XBee deluje zunaj zakonske skladnosti za dano državo, kar vodi do možnega nezakonitega delovanja radia.
- Pri ravnanju z modulom XBee uporabite standardno industrijsko zaščito pred ESD.
- Pri rokovanju pazite, da se izognete električnim poškodbam tiskanega vezja in komponent.
- Radijskih modulov XBee ne izpostavljajte vodi ali vlagi.
- Ta izdelek uporabljajte z antenami, navedenimi v uporabniških priročnikih modula XBee.
- Končnemu uporabniku je treba povedati, kako odstraniti napajanje z radijskega modula XBee ali naj locira antene 20 cm od ljudi ali živali.

### Módulos XBee

- No se puede garantizar el funcionamiento del módulo de radio XBee debido al enlace de radio y, por lo tanto, no debe usarse para enclavamientos en dispositivos críticos para la seguridad, como máquinas o aplicaciones automotrices.
- El módulo de radio XBee no ha sido aprobado para su uso en (esta lista no es exhaustiva):
  - dispositivos médicos
  - aplicaciones nucleares
  - atmósferas explosivas o inflamables
- No hay componentes reparables por el usuario dentro del módulo de radio XBee. No quite el escudo ni modifique el XBee de ninguna manera. Las modificaciones pueden excluir el módulo de cualquier garantía y pueden hacer que la radio XBee funcione fuera del cumplimiento normativo de un país determinado, lo que puede provocar una operación ilegal de la radio.
- Utilice la protección ESD estándar de la industria al manipular el módulo XBee.

- Tenga cuidado al manipularlo para evitar daños eléctricos en la PCB y los componentes.
- No exponga los módulos de radio XBee al agua ni a la humedad.
- Utilice este producto con las antenas especificadas en las guías de usuario del módulo XBee.
- Se debe indicar al usuario final cómo desconectar la alimentación del módulo de radio XBee o ubicar las antenas a 20 cm de personas o animales.

## Säkerhets instruktioner

### XBee-moduler

- XBee-radiomodulen kan inte garanteras funktion på grund av radiolänken och bör därför inte användas för förreglingar i säkerhetskritiska enheter som maskiner eller biltillämpningar.
- XBee-radiomodulen har inte godkänts för användning i (denna lista är inte uttömmande):
  - medicinsk utrustning
  - kärnkraftstillämpningar
  - explosiv eller brandfarlig atmosfär
- Det finns inga komponenter som användaren kan reparera inuti XBee-radiomodulen. Ta inte bort skölden eller modifiera XBee på något sätt. Ändringar kan utesluta modulen från alla garantier och kan göra att XBee-radion fungerar utanför bestämmelserna för ett visst land, vilket kan leda till att radion kan användas olagligt.
- Använd industristandard ESD-skydd när du hanterar XBee-modulen.
- Var försiktig vid hanteringen för att undvika elektriska skador på kretskortet och komponenterna.
- Utsätt inte XBee radiomoduler för vatten eller fukt.
- Använd den här produkten med antennerna som specificeras i XBee-modulens användarguider.
- Slut användaren måste informeras om hur man kopplar bort strömmen från XBee-radiomodulen eller för att placera antennerna 20 cm från människor eller djur.

# Specifications

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The following tables provide general specifications for the hardware.

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## General specifications

The following table describes the general specifications for the devices.

| Specification                     | XBee RR micro-mount                                                        |
|-----------------------------------|----------------------------------------------------------------------------|
| Operating frequency band          | ISM 2.4 – 2.4835 GHz                                                       |
| Form factor                       | Micro-mount                                                                |
| Dimensions                        | Micro-mount: 1.36 cm x 1.93 cm x 0.241 cm (0.534 in x 0.760 in x 0.095 in) |
| Weight                            | 1.2 g                                                                      |
| Operating temperature             | -40 to 85 °C (industrial)                                                  |
| Antenna options                   | RF pad or U.FL connector                                                   |
| Analog-to-digital converter (ADC) | 4 10-bit analog inputs                                                     |

## Electrical characteristics

The following table lists the electrical characteristics for the XBee RR RF Module.

| Symbol          | Parameter                   | Condition                                   | Min       | Typical | Max       | Units |
|-----------------|-----------------------------|---------------------------------------------|-----------|---------|-----------|-------|
| V <sub>I</sub>  | Input pins                  |                                             | -0.3      |         | VCC +0.3  | V     |
| V <sub>IL</sub> | Input low voltage           |                                             |           |         | 0.3 * VCC | V     |
| V <sub>IH</sub> | Input high voltage          |                                             | 0.7 * VCC |         |           | V     |
| V <sub>OL</sub> | Output low voltage          | Sinking 3 mA VCC = 3.3 V                    |           |         | 0.2 * VCC | V     |
| V <sub>OH</sub> | Output high voltage         | Sourcing 3 mA VCC = 3.3 V                   | 0.8 * VCC |         |           | V     |
| I <sub>IN</sub> | Input leakage current       | High Z state I/O connected to Ground or VCC |           | 0.1     | 100       | nA    |
| RPU             | Internal pull-up resistor   | Enabled                                     |           | 40      | -         | kΩ    |
| RPD             | Internal pull-down resistor | Enabled                                     |           | 40      | -         | kΩ    |

\* XBee power supply should be designed to operate at 1.8V or above.

## Power requirements

The following table describes the power requirements for the XBee RR RF Module.

| Specification                                                        | XBee RR       | XBee RR PRO |
|----------------------------------------------------------------------|---------------|-------------|
| Adjustable power                                                     | Yes           |             |
| Supply voltage                                                       | 1.71 - 3.8 V* |             |
| Max power at 3.3 V (dBm)                                             | 8             | 19          |
| Max power at 1.8 V (dBm)                                             | 7             | 13          |
| TX current at 19 dBm (mA)                                            |               | 193         |
| TX current at 8 dBm (mA)                                             | 32            | 52          |
| RX current (mA)                                                      | 15            |             |
| Sleep current (uA)                                                   | 8             |             |
| * XBee power supply should be designed to operate at 1.8 V or above. |               |             |

## Regulatory conformity summary

| Approval                                                   | XBee RR                   | XBee RR PRO               |
|------------------------------------------------------------|---------------------------|---------------------------|
| Model                                                      | XBRR                      | XBPRR                     |
| United States (FCC part 15.247)                            | FCC ID: MCQ-XBRR          | FCC ID: MCQ-XBPRR         |
| Innovation, Science and Economic Development Canada (ISED) | IC: 1846A-XBRR            | IC: 1846A-XBPRR           |
| Transmit Output Power for BLE                              | +8 dBm                    | +8 dBm                    |
| Transmit Output Power for 802.15.4                         | +8 dBm                    | +19 dBm                   |
| Bluetooth®                                                 | Declaration ID: (pending) | Declaration ID: (pending) |
| Europe (CE)                                                | Yes                       | No                        |
| UK (UKCA)                                                  | Yes                       | No                        |
| Brazil                                                     | ANATEL: 10535-22-03966    | pending                   |

## Serial communication specifications

The XBee RR RF Module supports Universal Asynchronous Receiver / Transmitter (UART) and Serial Peripheral Interface (SPI) serial connections.

### UART pin assignments

| UART pins                               | Device pin number |
|-----------------------------------------|-------------------|
|                                         | Micro-mount       |
| DOUT/DIO13                              | 3                 |
| DIN / $\overline{\text{CONFIG}}$ /DIO14 | 4                 |
| $\overline{\text{CTS}}$ / DIO7          | 24                |
| $\overline{\text{RTS}}$ / DIO6          | 27                |

### SPI pin assignments

## GPIO specifications

XBee RR RF Modules have 15 General Purpose Input / Output (GPIO) ports available. The exact list depends on the device configuration as some GPIO pads are used for purposes such as serial communication.

| GPIO electrical specification        | Value                   |
|--------------------------------------|-------------------------|
| Input pull-up resistor value         | 40 k $\Omega$ (typical) |
| Input pull-down resistor value       | 40 k $\Omega$ (typical) |
| Output voltage for logic 0           | 0.2 x VCC (maximum)     |
| Output voltage for logic 1           | 0.8 x VCC (minimum)     |
| Output source/sink current           | 50 mA (maximum)         |
| Total output current (for GPIO pads) | 200 mA (maximum)        |

## Electro Static Discharge (ESD)

XBee RR RF Module pins are tolerant to human-body model  $\pm 1.5$  kV.

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**Note** Take care to limit all electrostatic discharges to the device.

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# IEEE 802.15.4-specific specifications

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The following tables provide specifications specific to the XBee RR RF Module when using the IEEE 802.15.4 physical layer, for example: XBee 802.15.4, Zigbee, DigiMesh, and so on.

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## Performance specifications

The following table describes the performance specifications for the devices.

| Specification                      | XBee RR                | XBee RR PRO         |
|------------------------------------|------------------------|---------------------|
| Indoor/urban range                 | Up to 60 m (200 ft)    | Up to 90 m (300 ft) |
| Outdoor RF line-of-sight range     | Up to 1200 m (4000 ft) | Up to 3200 m (2 mi) |
| RF Transmit power output (maximum) | 6.3 mW (+8 dBm)        | 79 mW (+19 dBm)     |
| BLE power output                   | 6.3 mW (+8 dBm)        | 6.3 mW (+8 dBm)     |
| 802.15.4 RF data rate              | 250,000 b/s            | 250,000 b/s         |
| BLE data rate                      | 1,000,000 b/s          | 1,000,000 b/s       |
| Receiver sensitivity               | -103 dBm               | -103 dBm            |

**Note** Range figure estimates are based on free-air terrain with limited sources of interference. Actual range will vary based on transmitting power, orientation of transmitter and receiver, height of transmitting antenna, height of receiving antenna, weather conditions, interference sources in the area, and terrain between receiver and transmitter, including indoor and outdoor structures such as walls, trees, buildings, hills, and mountains.

## Networking and security specifications

The following table describes the networking and security specifications for the XBee RR RF Module.

| Specification                | XBee RR                                                         |
|------------------------------|-----------------------------------------------------------------|
| Supported network topologies | Point-to-point, point-to-multipoint, peer-to-peer, and DigiMesh |
| Number of channels           | 16 Direct sequence channels                                     |
| Interface immunity           | Direct Sequence Spread Spectrum (DSSS)                          |
| Channels                     | 11 to 26                                                        |
| Addressing options           | PAN ID and addresses, cluster IDs and endpoints (optional)      |

## Communication interface specifications

The following table provides the device's communication interface specifications.

| Interface options |                                                            |
|-------------------|------------------------------------------------------------|
| UART              | Standard and non-standard UART baud rates up to 921600 b/s |
| SPI               | 4.8 Mb/s (burst)                                           |

## Mechanical drawings

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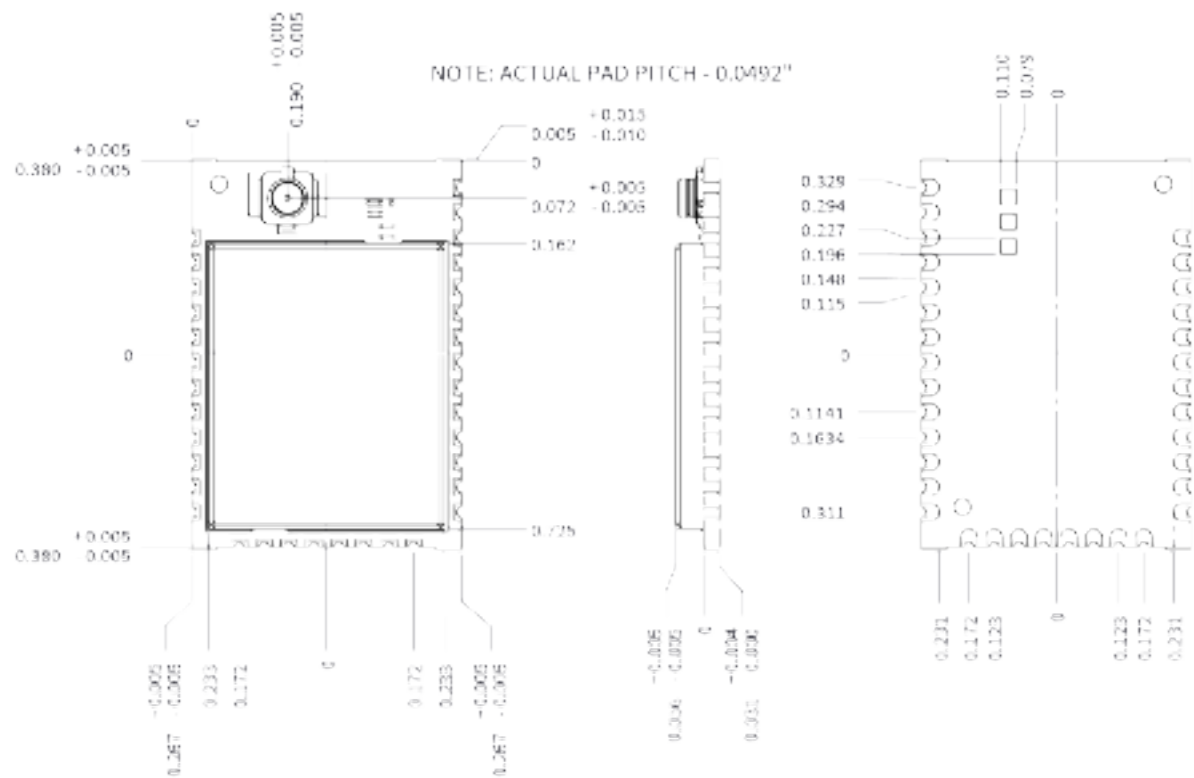
The following mechanical drawings of the XBee RR RF Modules show all dimensions in inches.

|                      |    |
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## Micro antennas

The following mechanical drawings are for the XBee RR RF Module micro antennas.

### Micro (U.FL/RF Pad)



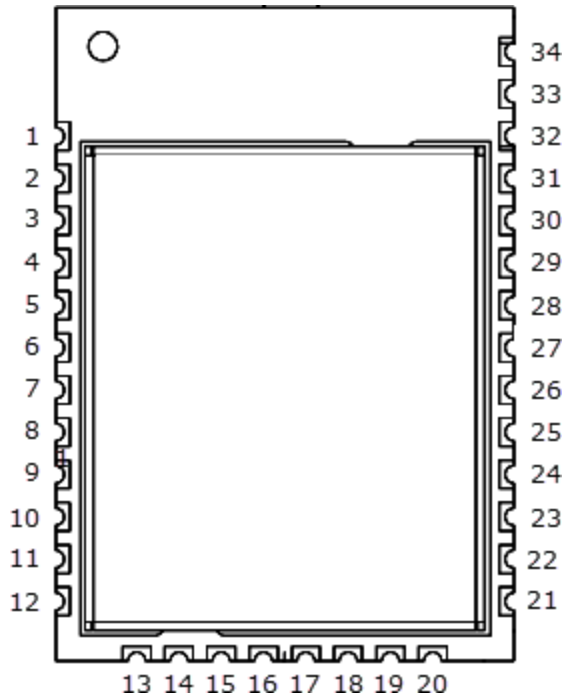
## Pin signals

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## Pin signals for the XBee RR micro module

The following drawing shows the micro pin locations.



The following table shows the pin signals and their descriptions for the XBee RR RF Module.

| Pin# | Name                       | Direction | Default state | Description                            |
|------|----------------------------|-----------|---------------|----------------------------------------|
| 1    | GND                        | -         | -             | Ground.                                |
| 2    | VCC                        | -         | -             | Power supply.                          |
| 3    | DOUT /DIO13                | Both      | Output        | UART data out /GPIO.                   |
| 4    | DIN / <u>CONFIG</u> /DIO14 | Both      | Input         | UART data in /GPIO.                    |
| 5    | DIO12                      | Both      |               | GPIO.                                  |
| 6    | <u>RESET</u>               | Input     |               | Device reset.                          |
| 7    |                            |           |               | Connected to Pin 8 with 4.7 K resistor |
| 8    |                            |           |               | Connected to Pin 7 with 4.7 K resistor |
| 9    | <u>DTR</u> /SLEEP_RQ /DIO8 | Both      | Input         | Pin sleep control                      |

| Pin# | Name                                                                | Direction | Default state | Description                                                       |
|------|---------------------------------------------------------------------|-----------|---------------|-------------------------------------------------------------------|
|      |                                                                     |           |               | Line/GPIO.                                                        |
| 10   | GND                                                                 | -         | -             | Ground.                                                           |
| 11   | SPI_ $\overline{\text{ATTN}}$ / $\overline{\text{BOOTMODE}}$ /DIO19 | Output    | Output        | Serial peripheral interface attention<br>Do not tie low on reset. |
| 12   | GND                                                                 | -         | -             | Ground.                                                           |
| 13   | SPI_CLK /DIO18                                                      | Input     | Input         | Serial peripheral interface clock/GPIO.                           |
| 14   | SPI_ $\overline{\text{SSEL}}$ /DIO17                                | Input     | Input         | Serial peripheral interface not select/GPIO.                      |
| 15   | SPI_MOSI/DIO16                                                      | Input     | Input         | Serial peripheral interface data in/GPIO.                         |
| 16   | SPI_MISO/DIO15                                                      | Output    | Output        | Serial peripheral interface data out/GPIO.                        |
| 17   | [reserved]                                                          | -         | Disabled      | Do not connect.                                                   |
| 18   | [reserved]                                                          | -         | Disabled      | Do not connect.                                                   |
| 19   | [reserved]                                                          | -         | Disabled      | Do not connect.                                                   |
| 20   | [reserved]                                                          | -         | Disabled      | Do not connect.                                                   |
| 21   | GND                                                                 | -         | -             | Ground.                                                           |
| 22   | [reserved]                                                          | -         | Disabled      | Do not connect.                                                   |
| 23   | DIO4                                                                | Both      | Disabled      | GPIO.                                                             |
| 24   | $\overline{\text{CTS}}$ /DIO7                                       | Both      | Output        | Clear to send flow control/GPIO.                                  |
| 25   | ON/ $\overline{\text{SLEEP}}$ /DIO9                                 | Both      | Output        | Device status indicator/GPIO.                                     |
| 26   | ASSOCIATE/DIO5                                                      | Both      | Output        | Associate Indicator/GPIO.                                         |
| 27   | $\overline{\text{RTS}}$ /DIO6                                       | Both      | Input         | Request to send                                                   |

| Pin#                                                                                                                                                                                | Name             | Direction | Default state | Description                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------|---------------|---------------------------------------------|
|                                                                                                                                                                                     |                  |           |               | flow control /GPIO.                         |
| 28                                                                                                                                                                                  | AD3/DIO3         | Both      | Disabled      | Analog input/GPIO.                          |
| 29                                                                                                                                                                                  | AD2/DIO2         | Both      | Disabled      | Analog input/GPIO.                          |
| 30                                                                                                                                                                                  | AD1/DIO1/I2C SCL | Both      | Disabled      | Analog input/GPIO/I2C SCL.                  |
| 31                                                                                                                                                                                  | AD0 /DIO0        | Both      | Input         | Analog input / GPIO / Commissioning button. |
| 32                                                                                                                                                                                  | GND              | -         | -             | Ground.                                     |
| 33                                                                                                                                                                                  | RF               | Both      | -             | RF I/O for RF pad variant.                  |
| 34                                                                                                                                                                                  | GND              | -         | -             | Ground.                                     |
| Signal direction is specified with respect to the device. This is a complete list of functionalities. See the applicable software manual for available functionalities.             |                  |           |               |                                             |
| <b>Note</b> There are three RF test points located on the bottom of the device. Do not connect these test points. For more information, see <a href="#">Recommended footprint</a> . |                  |           |               |                                             |
| See <a href="#">Design notes</a> for details on pin connections.                                                                                                                    |                  |           |               |                                             |

## Recommended pin connections

The only required pin connections for two-way communication are VCC, GND, DOUT and DIN. To \_\_\_\_\_ support serial firmware updates and recovery, you must connect VCC, GND, DOUT, DIN, RTS, and DTR. For applications that need to ensure the lowest sleep current, never leave unconnected inputs floating. Use internal or external pull-up or pull-down resistors, or set the unused I/O lines to outputs.

# Design notes

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XBee RR RF Modules do not require any external circuitry or specific connections for proper operation. However, there are some general design guidelines that we recommend to build and troubleshoot a robust design.

- Power supply design .....35
- Board layout .....35
- Antenna performance .....35
- Design notes for RF pad devices .....36
- Copper keepout for test points .....38
- Design notes for PCB antenna devices .....38

## Power supply design

A poor power supply can lead to poor device performance, especially if you do not keep the supply voltage within tolerance or if it is excessively noisy. To help reduce noise, place a 1.0  $\mu\text{F}$  and 8.2 pF capacitor as near as possible to the VCC connection on the XBee RR RF Module (pad 2 for micro and surface-mount, and pin 1 for through-hole). Adding a 10  $\mu\text{F}$  decoupling capacitor is also recommended. If you are using a switching regulator for the power supply, switch the frequencies above 500 kHz. Limit the power supply ripple to a maximum 50 mV peak to peak. For best results, place the lower capacitance capacitors closest to the XBee RR RF Module.

## Board layout

We design XBee RR RF Modules to be self-sufficient and have minimal sensitivity to nearby processors, crystals or other printed circuit board (PCB) components. Keep power and ground traces thicker than signal traces and make sure that they are able to comfortably support the maximum current specifications. There are no other special PCB design considerations to integrate XBee RR RF Modules, with the exception of antennas.

## Antenna performance

Antenna location is important for optimal performance. The following suggestions help you achieve optimal antenna performance. Point the antenna up vertically (upright). Antennas radiate and receive the best signal perpendicular to the direction they point, so a vertical antenna's omnidirectional radiation pattern is strongest across the horizon.

Position the antennas away from metal objects whenever possible. Metal objects between the transmitter and receiver can block the radiation path or reduce the transmission distance. Objects that are often overlooked include:

- Metal poles
- Metal studs
- Structure beams
- Concrete, which is usually reinforced with metal rods
- Batteries
- Tall electrolytic capacitors

If you place the device inside a metal enclosure, use an external antenna. Common objects that have metal enclosures include:

- Vehicles
- Elevators
- Ventilation ducts
- Refrigerators
- Microwave ovens

Use the following additional guidelines for optimal antenna performance:

- Do not place XBee RR RF Modules with the embedded antenna inside a metal enclosure.
- Do not place any ground planes or metal objects above or below the antenna.
- For the best results, mount the device at the edge of the host PCB. Ensure that the ground, power, and signal planes are vacant immediately below the antenna section.

## Design notes for RF pad devices

The RF pad is a soldered antenna connection. The RF signal travels from the RF pad connection (pad 33 on micro modules and pad 36 on surface-mount modules) on the device to the antenna through an RF trace transmission line on the PCB. Any additional components between the device and antenna violates modular certification. The controlled impedance for the RF trace is 50  $\Omega$ .

We recommend using a microstrip trace, although you can also use a coplanar waveguide if you need more isolation. A microstrip generally requires less area on the PCB than a coplanar waveguide. We do not recommend using a stripline because sending the signal to different PCB layers can introduce matching and performance problems.

Following good design practices is essential when implementing the RF trace on a PCB. Consider the following points:

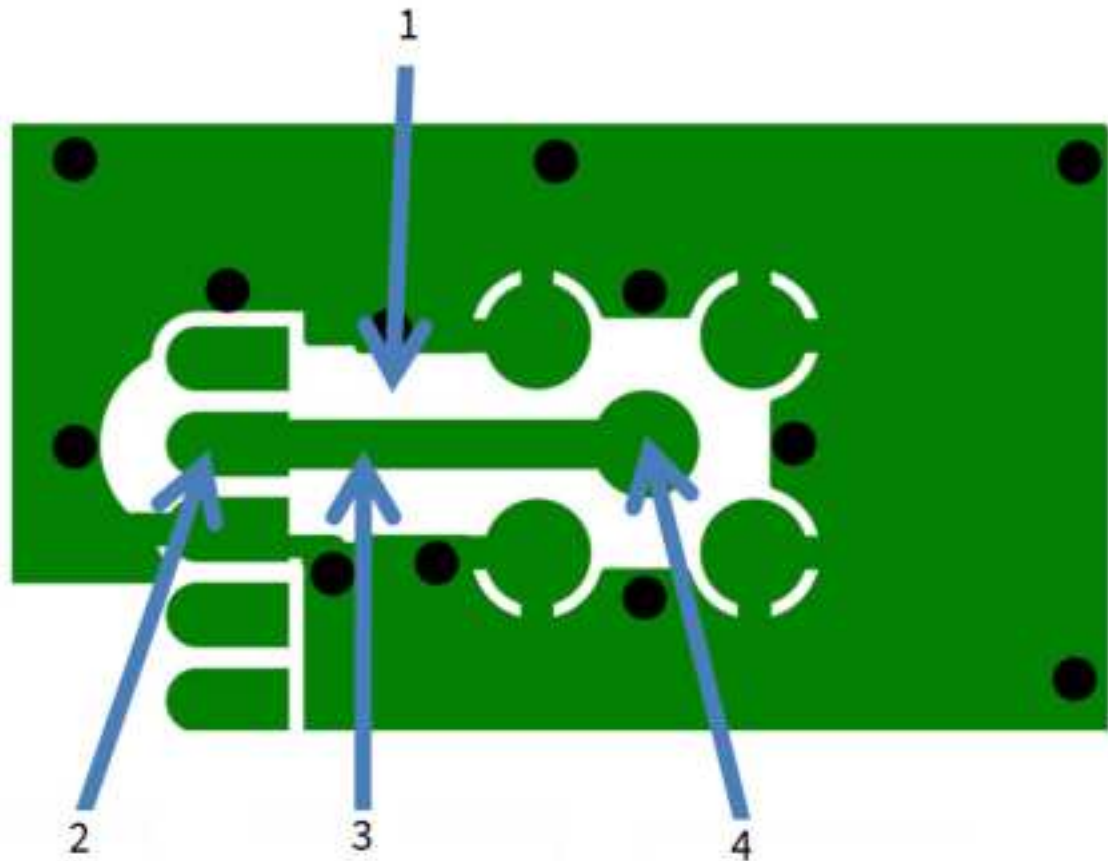
- Minimize the length of the trace by placing the RPSMA jack close to the device.
- Connect all of the grounds on the jack and the device to the ground planes directly or through closely placed vias.
- Space any ground fill on the top layer at least twice the distance **d**, for Micro modules at least 0.028" and for surface mount modules at least 0.050".

Additional considerations:

- The top two layers of the PCB have a controlled thickness dielectric material in between.
- The second layer has a ground plane which runs underneath the entire RF pad area. This ground plane is a distance **d**, the thickness of the dielectric, below the top layer.
- The RF trace width determines the impedance of the transmission line with relation to the ground plane. Many online tools can estimate this value, although you should consult the PCB manufacturer for the exact width.

Implementing these design suggestions helps ensure that the RF pad device performs to its specifications.

The following figures show a layout example of a host PCB that connects an RF pad device to a right angle, through-hole RPSMA jack.

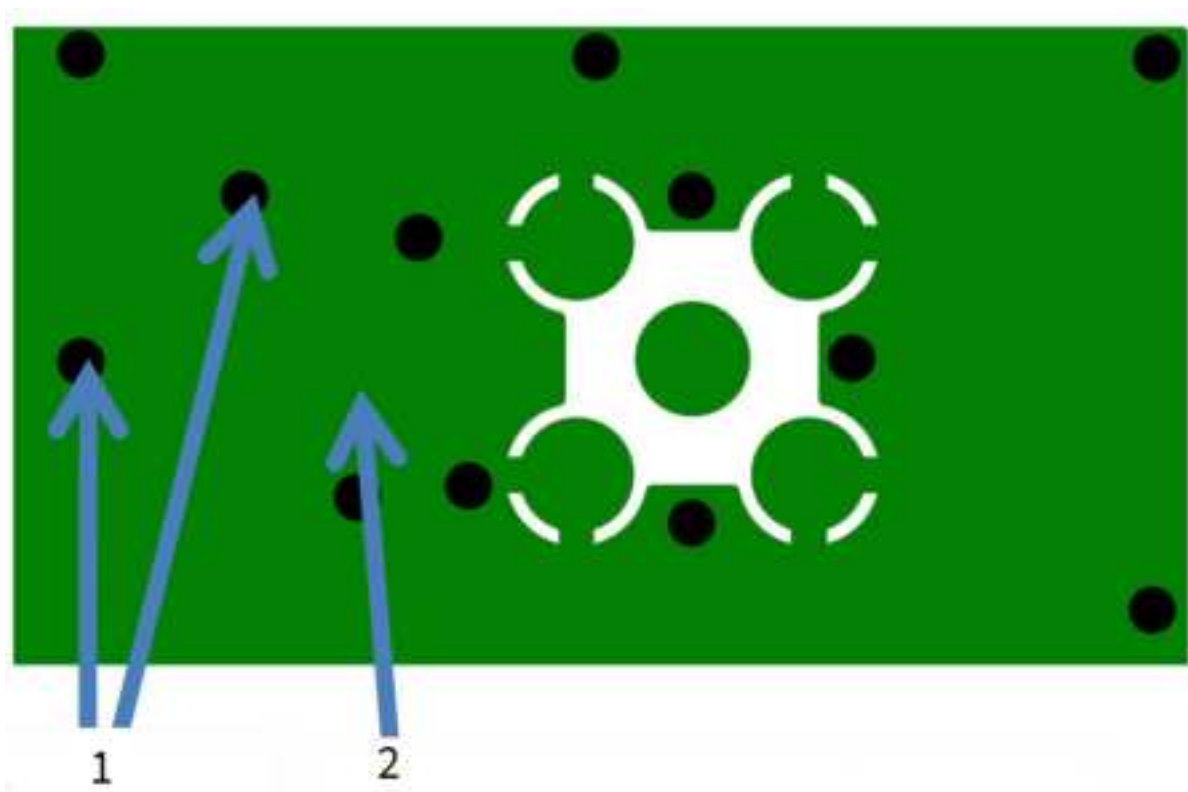


| Number | Description                                                             |
|--------|-------------------------------------------------------------------------|
| 1      | Maintain a distance of at least 2 d between microstrip and ground fill. |
| 2      | RF pad pin.                                                             |
| 3      | 50 $\Omega$ microstrip trace.                                           |
| 4      | RF connection of RPSMA jack.                                            |

This example is on a surface-mount device. The width in this example is approximately 0.045" for a 50  $\Omega$  trace, assuming  $d=0.025"$ , and that the dielectric has a relative permittivity of 4.4. This trace width is a good fit with the device footprint's 0.060" pad width.

**Note** We do not recommend using a trace wider than the pad width, and using a very narrow trace (under 0.010") can cause unwanted RF loss.

The following illustration shows PCB layer 2 of an example RF layout.



| Number | Description                                                               |
|--------|---------------------------------------------------------------------------|
| 1      | Use multiple vias to help eliminate ground variations.                    |
| 2      | Put a solid ground plane under RF trace to achieve the desired impedance. |

## Copper keepout for test points

The following keepouts are required for all surface-mount or micro-mount devices. These keepouts are in addition to the other keepouts if using a PCB antenna.

While the underside of the device is mostly coated with solder resist, we recommended the copper layer directly below the device be left open to avoid unintended contacts. Copper or vias must not interfere with the three exposed RF test points on the bottom of the device as shown in the following diagrams. These devices have a ground plane in the middle on the back side for shielding purposes, which can be affected by copper traces directly below the device.

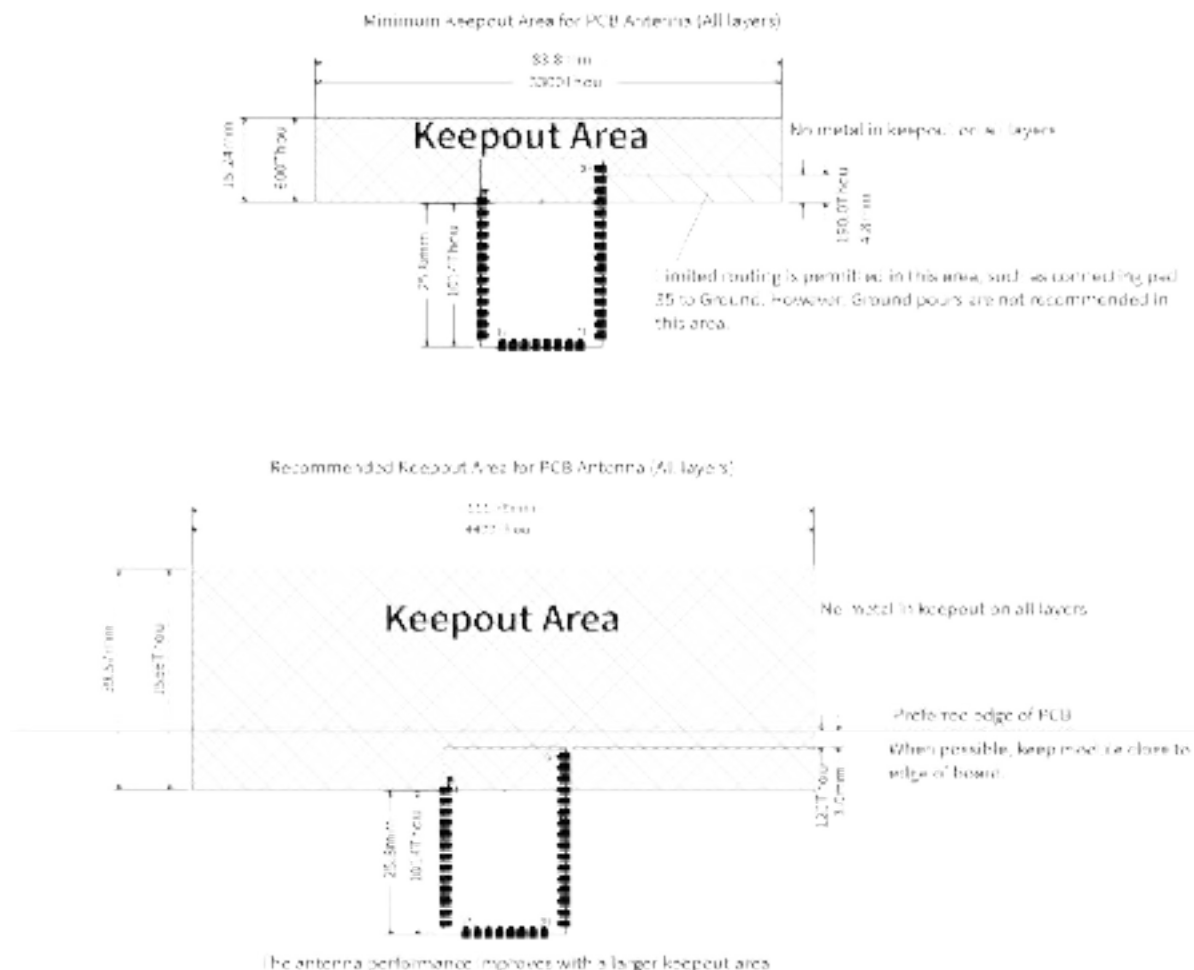
## Design notes for PCB antenna devices

Position PCB antenna devices so there are no ground planes or metal objects above or below the antenna. For best results, do not place the device in a metal enclosure, as this may greatly reduce the range. Place the device at the edge of the PCB on which it is mounted. Make sure the ground, power and signal planes are vacant immediately below the antenna section.

The following drawings illustrate important recommendations when you are designing with PCB antenna devices. For optimal performance on the surface-mount device, do not mount the device on

the RF pad footprint described in the next section, because the footprint requires a ground plane within the PCB antenna keepout area.

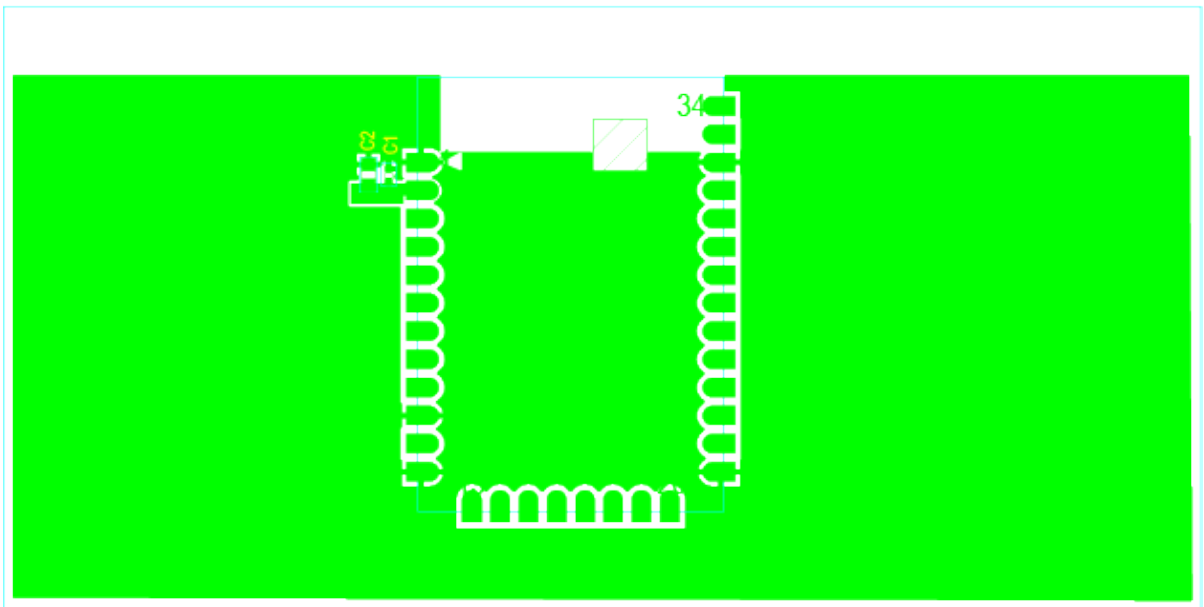
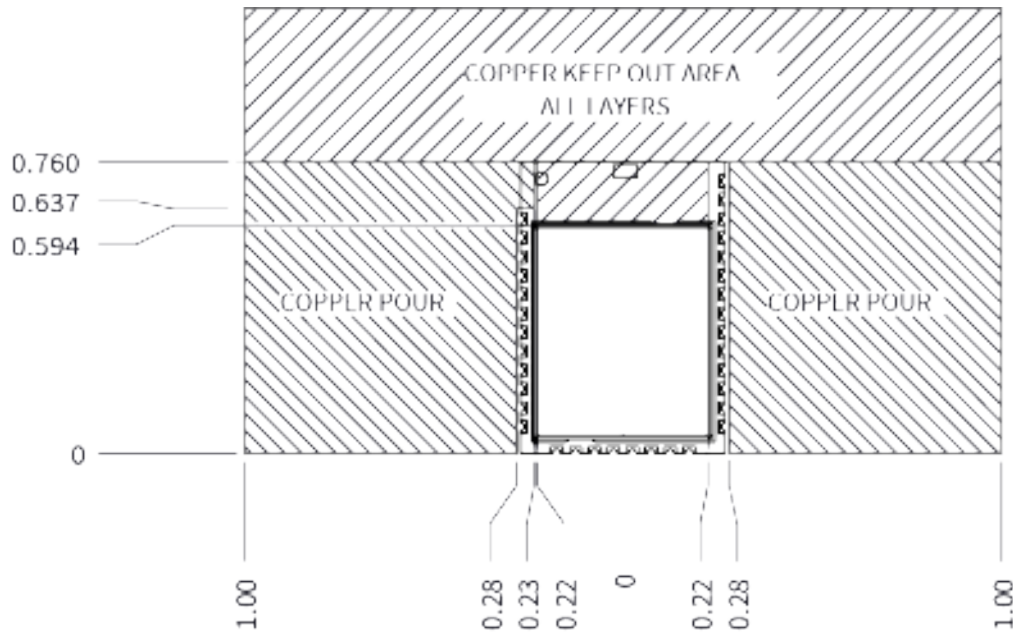
## Surface-mount embedded antenna keepout area



### Notes

1. We recommend non-metal enclosures. For metal enclosures, use an external antenna.
2. Keep metal chassis or mounting structures in the keepout area at least 2.54 cm (1 in) from the antenna.
3. Maximize the distance between the antenna and metal objects that might be mounted in the keepout area.
4. These keepout area guidelines do not apply for chip antennas or external RF connectors.

## Micro chip antenna keepout area

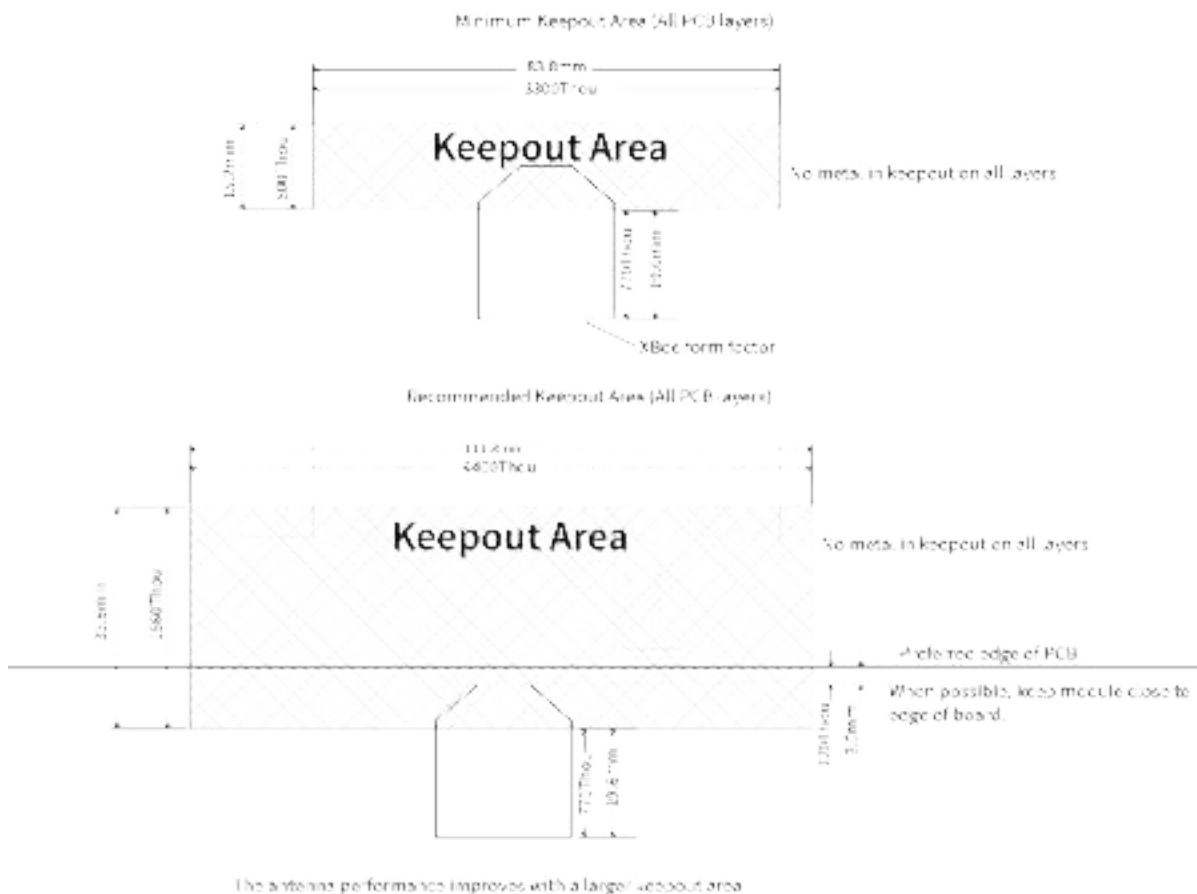


### Notes

1. We recommend non-metal enclosures. For metal enclosures, use an external antenna.
2. Keep metal chassis or mounting structures in the keepout area at least 2.54 cm (1 in) from the antenna.
3. Maximize the distance between the antenna and metal objects that might be mounted in the keepout area.

- Neither a copper pour nor a copper keepout is necessary under the shield area for proper antenna functionality. It is still necessary to follow the recommendations in [Recommended footprint](#) for the PCB layout.
- These keepout area guidelines do not apply for surface-mount embedded antennas or external RF connectors.

## Through-hole embedded antenna keepout area



### Notes

- We recommend non-metal enclosures. For metal enclosures, use an external antenna.
- Keep metal chassis or mounting structures in the keepout area at least 2.54 cm (1 in) from the antenna.
- Maximize the distance between the antenna and metal objects that might be mounted in the keepout area.
- These keepout area guidelines do not apply for external RF connectors.

## Regulatory information

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## United States (FCC)

XBee XBRR and XBee XBPRR Zigbee RF Modules comply with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required.

XBee XBRR and XBee XBPRR DigiMesh RF Modules comply with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required.

To fulfill FCC Certification, the OEM must comply with the following regulations:

1. The system integrator must ensure that the text on the external label provided with this device is placed on the outside of the final product.
2. RF Modules may only be used with antennas that have been tested and approved for use with the modules.

### OEM labeling requirements

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**WARNING!** As an Original Equipment Manufacturer (OEM) you must ensure that FCC labeling requirements are met. You must include a clearly visible label on the outside of the final product enclosure that displays the following content:

---

#### ***Required FCC Label for OEM products containing the XBee XBRR Zigbee RF Modules***

Contains FCC ID: MCQ-XBRR

This device 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.

Contains FCC ID: MCQ-XBPRR

This device 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.

---



**CAUTION!** Changes or modifications not expressly approved by Digi International Inc. could void the user's authority to operate the equipment.

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## FCC-approved antennas (2.4 GHz)

The XBee RR RF Module can be installed using antennas and cables constructed with non-standard connectors (RPSMA, RPTNC, etc.) An adapter cable may be necessary to attach the XBee connector to the antenna connector.

The modules are FCC approved for fixed base station and mobile applications for the channels indicated in the tables below. If the antenna is mounted at least 20 cm (7.87 in) from nearby persons, the application is considered a mobile application. Antennas not listed in the table must be tested to comply with FCC Section 15.203 (Unique Antenna Connectors) and Section 15.247 (Emissions).

The antennas in the tables below have been approved for use with this module. Correct cable loss or power reduction is required when using gain antennas as shown in the tables.

Digi does not carry all of these antenna variants. Contact Digi Sales for available antennas.

1. If using the RF module in a portable application (for example, if the module is used in a hand-held device and the antenna is less than 20 cm from the human body when the device is in operation), The integrator is responsible for passing additional Specific Absorption Rate (SAR) testing based on FCC rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C. The testing results will be submitted to the FCC for approval prior to selling the integrated unit. The required SAR testing measures emissions from the module and how they affect the person.

**XBee RR RF Module**

The following table shows the antennas approved for use with the XBee RR RF Module.

**Note** Channel 26 (2480 MHz) will be limited to +3 dBm to meet band edge requirements for FCC and ISSED.

All antenna part numbers followed by an asterisk (\*) are not available from Digi. Consult with an antenna manufacturer for an equivalent option.

| Part number       | Type<br>(description)                                             | Gain<br>(dB) | Application* | Min. separation | Model: XBRR<br>Required antenna cable loss (dB) |                                                        |
|-------------------|-------------------------------------------------------------------|--------------|--------------|-----------------|-------------------------------------------------|--------------------------------------------------------|
|                   |                                                                   |              |              |                 | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)     | Bluetooth low energy<br>technology (when<br>available) |
| Integral antennas |                                                                   |              |              |                 |                                                 |                                                        |
| 29000710          | Chip antenna (micro only)                                         | 0.0          | Fixed/Mobile | 20 cm           | N/A                                             | N/A                                                    |
| 31000005-01       | Integral PCB antenna (surface mount only)                         | 0.0          | Fixed/Mobile | 20 cm           | N/A                                             | N/A                                                    |
| 31000017-01       | Integral PCB antenna (throughhole only)                           | -0.5         | Fixed/Mobile | 20 cm           | N/A                                             | N/A                                                    |
| Dipole antennas   |                                                                   |              |              |                 |                                                 |                                                        |
| A24-HASM-450      | Dipole (Half-wave articulated RPSMA - 4.5")                       | 2.1          | Fixed        | 20 cm           | 0.52                                            | 0.52                                                   |
| A24-HABSM*        | Dipole (Articulated RPSMA)                                        | 2.1          | Fixed        | 20 cm           | 0.52                                            | 0.52                                                   |
| 29000095          | Dipole (Half-wave articulated RPSMA - 4.5")                       | 2.1          | Fixed/Mobile | 20 cm           | 0.52                                            | 0.52                                                   |
| A24-HABUF-P5I     | Dipole (Half-wave articulated bulkhead mount U.FL. w/ 5" pigtail) | 2.1          | Fixed/Mobile | 20 cm           | 0.52                                            | 0.52                                                   |
| A24-HASM-525      | Dipole (Half-wave articulated RPSMA                               | 2.1          | Fixed        | 20 cm           | 0.52                                            | 0.52                                                   |

| Part number                                               | Type (description)                         | Gain (dB) | Application* | Min. separation | Model: XBRR<br>Required antenna cable loss (dB) |                                                        |
|-----------------------------------------------------------|--------------------------------------------|-----------|--------------|-----------------|-------------------------------------------------|--------------------------------------------------------|
|                                                           |                                            |           |              |                 | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)     | Bluetooth low energy<br>technology (when<br>available) |
|                                                           | - 5.25")                                   |           |              |                 |                                                 |                                                        |
| <b>Omni-directional (Collinear Dipole Array) antennas</b> |                                            |           |              |                 |                                                 |                                                        |
| A24-F2NF                                                  | Omni-directional (Fiberglass base station) | 2.1       | Fixed/Mobile | 20 cm           | N/A                                             | N/A                                                    |
| A24-F3NF                                                  | Omni-directional (Fiberglass base station) | 3.0       | Fixed/Mobile | 20 cm           | N/A                                             | N/A                                                    |
| A24-F5NF                                                  | Omni-directional (Fiberglass base station) | 5.0       | Fixed        | 20 cm           | 0.72                                            | N/A                                                    |
| A24-F8NF                                                  | Omni-directional (Fiberglass base station) | 8.0       | Fixed        | 2 m             | 3.72                                            | N/A                                                    |
| A24-F9NF                                                  | Omni-directional (Fiberglass base station) | 9.5       | Fixed        | 2 m             | 5.22                                            | N/A                                                    |
| A24-F10NF                                                 | Omni-directional (Fiberglass base station) | 10.0      | Fixed        | 2 m             | 5.72                                            | N/A                                                    |
| A24-F12NF                                                 | Omni-directional (Fiberglass base station) | 12.0      | Fixed        | 2 m             | 7.72                                            | N/A                                                    |
| A24-W7NF                                                  | Omni-directional (Fiberglass base station) | 7.2       | Fixed        | 2 m             | 2.92                                            | N/A                                                    |
| A24-M7NF                                                  | Omni-directional (Mag-mount base station)  | 7.2       | Fixed        | 2 m             | 2.92                                            | N/A                                                    |
| A24-F15NF                                                 | Omni-directional (Fiberglass base station) | 15.0      | Fixed        | 2 m             | 10.72                                           | 1.22                                                   |

| Part number    | Type<br>(description)              | Gain<br>(dB) | Application* | Min. separation | Model: XBRR<br>Required antenna cable loss (dB) |                                                        |
|----------------|------------------------------------|--------------|--------------|-----------------|-------------------------------------------------|--------------------------------------------------------|
|                |                                    |              |              |                 | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)     | Bluetooth low energy<br>technology (when<br>available) |
| Panel antennas |                                    |              |              |                 |                                                 |                                                        |
| A24-P8SF       | Flat Panel                         | 8.5          | Fixed        | 2 m             | 7.32                                            | N/A                                                    |
| A24-P8NF       | Flat Panel                         | 8.5          | Fixed        | 2 m             | 7.32                                            | N/A                                                    |
| A24-P13NF      | Flat Panel                         | 13.0         | Fixed        | 2 m             | 11.82                                           | 1.58                                                   |
| A24-P14NF      | Flat Panel                         | 14.0         | Fixed        | 2 m             | 12.82                                           | 2.58                                                   |
| A24-P15NF      | Flat Panel                         | 15.0         | Fixed        | 2 m             | 13.82                                           | 3.58                                                   |
| A24-P16NF      | Flat Panel                         | 16.0         | Fixed        | 2 m             | 14.82                                           | 4.58                                                   |
| A24-P19NF      | Flat Panel                         | 19.0         | Fixed        | 2 m             | 17.82                                           | 7.58                                                   |
| Yagi antennas  |                                    |              |              |                 |                                                 |                                                        |
| A24-Y6NF       | Yagi (6-element)                   | 8.8          | Fixed        | 2 m             | 5.52                                            | N/A                                                    |
| A24-Y7NF       | Yagi (7-element)                   | 9.0          | Fixed        | 2 m             | 5.72                                            | N/A                                                    |
| A24-Y9NF       | Yagi (9-element)                   | 10.0         | Fixed        | 2 m             | 6.72                                            | N/A                                                    |
| A24-Y10NF      | Yagi (10-element)                  | 11.0         | Fixed        | 2 m             | 7.72                                            | N/A                                                    |
| A24-Y12NF      | Yagi (12-element)                  | 12.0         | Fixed        | 2 m             | 8.72                                            | N/A                                                    |
| A24-Y13NF      | Yagi (13-element)                  | 12.0         | Fixed        | 2 m             | 8.72                                            | N/A                                                    |
| A24-Y15NF      | Yagi (15-element)                  | 12.5         | Fixed        | 2 m             | 9.22                                            | N/A                                                    |
| A24-Y16NF      | Yagi (16-element)                  | 13.5         | Fixed        | 2 m             | 10.22                                           | N/A                                                    |
| A24-Y16RM      | Yagi (16-element, RPSMA connector) | 13.5         | Fixed        | 2 m             | 10.22                                           | N/A                                                    |

| Part number               | Type (description)   | Gain (dB) | Application* | Min. separation | Model: XBRR<br>Required antenna cable loss (dB) |                                                  |
|---------------------------|----------------------|-----------|--------------|-----------------|-------------------------------------------------|--------------------------------------------------|
|                           |                      |           |              |                 | 802.15.4 Based Protocols (Ex: Zigbee)           | Bluetooth low energy technology (when available) |
| A24-Y18NF                 | Yagi (18-element)    | 15.0      | Fixed        | 2 m             | 11.72                                           | 1.22                                             |
| <b>Patch antenna</b>      |                      |           |              |                 |                                                 |                                                  |
| Taoglas<br>FXP74.07.0100A | 2.4 GHz band antenna | 4         | Fixed        | 20 cm           | 2.82                                            | N/A                                              |

**XBee RR-PRO RF module**

The following table shows the antennas approved for use with the XBee RR-PRO RF Module.

**Note** Channel 26 (2480 MHz) will be limited to +3 dBm to meet band edge requirements for FCC and ISSED.

All antenna part numbers followed by an asterisk (\*) are not available from Digi. Consult with an antenna manufacturer for an equivalent option.

| Part number       | Type (description)                                | Gain (dB) | Application* | Min separation | Model: XBPRR<br>Required antenna cable loss (dB) |                                                        |
|-------------------|---------------------------------------------------|-----------|--------------|----------------|--------------------------------------------------|--------------------------------------------------------|
|                   |                                                   |           |              |                | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)      | Bluetooth low<br>energy technology<br>(when available) |
| Integral antennas |                                                   |           |              |                |                                                  |                                                        |
| 29000710          | Chip antenna<br>(micro only)                      | 0.0       | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |
| 31000005-01       | Integral PCB<br>antenna (surface<br>mount only)   | 0.0       | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |
| 31000017-01       | Integral PCB<br>antenna<br>(throughhole only)     | -0.5      | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |
| Dipole antennas   |                                                   |           |              |                |                                                  |                                                        |
| A24-HASM-450      | Dipole (Half-wave<br>articulated RPSMA -<br>4.5") | 2.1       | Fixed        | 20 cm          | N/A                                              | N/A                                                    |
| A24-HABSM*        | Dipole (Articulated<br>RPSMA)                     | 2.1       | Fixed        | 20 cm          | N/A                                              | N/A                                                    |
| 29000095          | Dipole (Half-wave<br>articulated RPSMA -          | 2.1       | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |

| Part number                                               | Type (description)                                                | Gain (dB) | Application* | Min separation | Model: XBPRR<br>Required antenna cable loss (dB) |                                                        |
|-----------------------------------------------------------|-------------------------------------------------------------------|-----------|--------------|----------------|--------------------------------------------------|--------------------------------------------------------|
|                                                           |                                                                   |           |              |                | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)      | Bluetooth low<br>energy technology<br>(when available) |
|                                                           | 4.5")                                                             |           |              |                |                                                  |                                                        |
| A24-HABUF-P5I                                             | Dipole (Half-wave articulated bulkhead mount U.FL. w/ 5" pigtail) | 2.1       | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |
| A24-HASM-525                                              | Dipole (Half-wave articulated RPSMA - 5.25")                      | 2.1       | Fixed        | 20 cm          | N/A                                              | N/A                                                    |
| 31000019-01                                               | Integral Dipole (USB Adapter Only)                                | 0.87      | Fixed only   | 20 cm          | N/A                                              | N/A                                                    |
| <b>Omni-directional (Collinear Dipole Array) antennas</b> |                                                                   |           |              |                |                                                  |                                                        |
| A24-F2NF                                                  | Omni-directional (Fiberglass base station)                        | 2.1       | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |
| A24-F3NF                                                  | Omni-directional (Fiberglass base station)                        | 3.0       | Fixed/Mobile | 20 cm          | N/A                                              | N/A                                                    |
| A24-F5NF                                                  | Omni-directional (Fiberglass base station)                        | 5.0       | Fixed        | 20 cm          | 0.22                                             | N/A                                                    |
| A24-F8NF                                                  | Omni-directional (Fiberglass base station)                        | 8.0       | Fixed        | 2 m            | 3.22                                             | N/A                                                    |
| A24-F9NF                                                  | Omni-directional                                                  | 9.5       | Fixed        | 2 m            | 4.22                                             | N/A                                                    |

| Part number           | Type (description)                            | Gain (dB) | Application* | Min separation | Model: XBPRR<br>Required antenna cable loss (dB) |                                                        |
|-----------------------|-----------------------------------------------|-----------|--------------|----------------|--------------------------------------------------|--------------------------------------------------------|
|                       |                                               |           |              |                | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)      | Bluetooth low<br>energy technology<br>(when available) |
|                       | (Fiberglass base station)                     |           |              |                |                                                  |                                                        |
| A24-F10NF             | Omni-directional<br>(Fiberglass base station) | 10        | Fixed        | 2 m            | 5.22                                             | N/A                                                    |
| A24-F12NF             | Omni-directional<br>(Fiberglass base station) | 12        | Fixed        | 2 m            | 7.22                                             | N/A                                                    |
| A24-W7NF              | Omni-directional<br>(Fiberglass base station) | 7.2       | Fixed        | 2 m            | 2.22                                             | N/A                                                    |
| A24-M7NF              | Omni-directional<br>(Mag-mount base station)  | 7.2       | Fixed        | 2 m            | 2.22                                             | N/A                                                    |
| A24-F15NF             | Omni-directional<br>(Fiberglass base station) | 15.0      | Fixed        | 2 m            | 10.22                                            | 0.44                                                   |
| <b>Panel antennas</b> |                                               |           |              |                |                                                  |                                                        |
| A24-P8SF              | Flat Panel                                    | 8.5       | Fixed        | 2 m            | 3.54                                             | N/A                                                    |
| A24-P8NF              | Flat Panel                                    | 8.5       | Fixed        | 2 m            | 3.54                                             | N/A                                                    |
| A24-P13NF             | Flat Panel                                    | 13.0      | Fixed        | 2 m            | 8.54                                             | 1.7                                                    |
| A24-P14NF             | Flat Panel                                    | 14.0      | Fixed        | 2 m            | 9.54                                             | 2.7                                                    |

| Part number                                                                                                                                                                                                                                                                                                    | Type (description)                    | Gain (dB) | Application* | Min separation | Model: XBPRR<br>Required antenna cable loss (dB) |                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------|--------------|----------------|--------------------------------------------------|--------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                |                                       |           |              |                | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)      | Bluetooth low<br>energy technology<br>(when available) |
| A24-P15NF                                                                                                                                                                                                                                                                                                      | Flat Panel                            | 15.0      | Fixed        | 2 m            | 10.54                                            | 3.7                                                    |
| A24-P16NF                                                                                                                                                                                                                                                                                                      | Flat Panel                            | 16.0      | Fixed        | 2 m            | 11.54                                            | 4.7                                                    |
| A24-P19NF                                                                                                                                                                                                                                                                                                      | Flat Panel                            | 19.0      | Fixed        | 2 m            | 14.54                                            | 7.7                                                    |
| <b>Yagi antennas</b>                                                                                                                                                                                                                                                                                           |                                       |           |              |                |                                                  |                                                        |
| A24-Y6NF                                                                                                                                                                                                                                                                                                       | Yagi (6-element)                      | 8.8       | Fixed        | 2 m            | 3.22                                             | N/A                                                    |
| A24-Y7NF                                                                                                                                                                                                                                                                                                       | Yagi (7-element)                      | 9.0       | Fixed        | 2 m            | 4.22                                             | N/A                                                    |
| A24-Y9NF                                                                                                                                                                                                                                                                                                       | Yagi (9-element)                      | 10.0      | Fixed        | 2 m            | 5.22                                             | N/A                                                    |
| A24-Y10NF                                                                                                                                                                                                                                                                                                      | Yagi (10-element)                     | 11.0      | Fixed        | 2 m            | 6.22                                             | N/A                                                    |
| A24-Y12NF                                                                                                                                                                                                                                                                                                      | Yagi (12-element)                     | 12.0      | Fixed        | 2 m            | 7.22                                             | N/A                                                    |
| A24-Y13NF                                                                                                                                                                                                                                                                                                      | Yagi (13-element)                     | 12.0      | Fixed        | 2 m            | 7.22                                             | N/A                                                    |
| A24-Y15NF                                                                                                                                                                                                                                                                                                      | Yagi (15-element)                     | 12.5      | Fixed        | 2 m            | 7.22                                             | N/A                                                    |
| A24-Y16NF                                                                                                                                                                                                                                                                                                      | Yagi (16-element)                     | 13.5      | Fixed        | 2 m            | 8.22                                             | N/A                                                    |
| A24-Y16RM                                                                                                                                                                                                                                                                                                      | Yagi (16-element,<br>RPSMA connector) | 13.5      | Fixed        | 2 m            | 8.22                                             | N/A                                                    |
| A24-Y18NF                                                                                                                                                                                                                                                                                                      | Yagi (18-element)                     | 15.0      | Fixed        | 2 m            | 10.22                                            | 0.44                                                   |
| <b>Patch antenna</b>                                                                                                                                                                                                                                                                                           |                                       |           |              |                |                                                  |                                                        |
| Taoglas<br>FXP74.07.0100A                                                                                                                                                                                                                                                                                      | 2.4 GHz band<br>antenna               | 4         | Fixed        | 20 cm          | N/A                                              | N/A                                                    |
| * If using the RF module in a portable application (for example - if the module is used in a handheld device and the antenna is less than 20 cm from the human body when the device is in operation): The integrator is responsible for passing additional SAR (Specific Absorption Rate) testing based on FCC |                                       |           |              |                |                                                  |                                                        |

| Part number                                                                                                                                                                                                                                                                                                                  | Type (description) | Gain (dB) | Application* | Min separation | Model: XBPRR<br>Required antenna cable loss (dB) |                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------|--------------|----------------|--------------------------------------------------|--------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                              |                    |           |              |                | 802.15.4 Based<br>Protocols (Ex:<br>Zigbee)      | Bluetooth low<br>energy technology<br>(when available) |
| rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C. The testing results will be submitted to the FCC for approval prior to selling the integrated unit. The required SAR testing measures emissions from the module and how they affect the person. |                    |           |              |                |                                                  |                                                        |

## RF exposure

If you are integrating the XBee into another product, you must include the following Caution statement in OEM product manuals to alert users of FCC RF exposure compliance:



**CAUTION!** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance are not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

## FCC notices

**IMPORTANT:** XBee XBRR and XBee XBPRR Zigbee RF Modules have **not** been certified by the FCC for use (integrated) with other radio products. The customer integrating the Digi XBee RF module is responsible for the FCC certifications of their product.

**IMPORTANT:** 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: Re-orient or relocate the receiving antenna, Increase the separation between the equipment and receiver, Connect equipment and receiver to outlets on different circuits, or Consult the dealer or an experienced radio/TV technician for help.

**IMPORTANT:** OEMs must test final product to comply with unintentional radiators (FCC section 15.107 and 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules. See also the section of this user guide for information related to FCC publication 996369.

**IMPORTANT:** The RF module has been certified for remote (fixed) and base radio applications. If the module will be used for portable applications, the device must undergo SAR testing. Please consult with a capable lab.

## FCC publication 996369 related information

In Publication 996369 section D03, the FCC requires information concerning a module to be presented by OEM manufacturers. This section assists in answering or fulfilling these requirements.

### 2.1 General

No requirements are associated with this section.

### 2.2 List of applicable FCC rules

This module conforms to FCC Part 15.247.

### 2.3 Summarize the specific operational use conditions

Certain approved antennas require attenuation for operation. For the XBee RR, see [The following table shows the antennas approved for use with the XBee RR RF Module.](#) For the XBee-PRO RR, see [XBee RR-PRO RF module.](#)

Host product user guides should include the antenna table if end customers are permitted to select antennas.

## **2.4 Limited module procedures**

Not applicable.

## **2.5 Trace antenna designs**

While it is possible to build a trace antenna into the host PCB, this requires at least a Class II permissive change to the FCC grant which includes significant extra testing and cost. If an embedded trace antenna is desired, simply select the XBee module variant with the preferred antenna.

## **2.6 RF exposure considerations**

For RF exposure considerations see [RF exposure](#) and [FCC-approved antennas \(2.4 GHz\)](#).

Host product manufacturers need to provide end-users a copy of the “RF Exposure” section of the manual: [RF exposure](#).

## **2.7 Antennas**

A list of approved antennas is provided for the XBee RR product. For the XBee RR, see [The following table shows the antennas approved for use with the XBee RR RF Module..](#) For the XBee-PRO RR, see [XBee RR-PRO RF module](#).

## **2.8 Label and compliance information**

Host product manufacturers need to follow the sticker guidelines outlined in [OEM labeling requirements](#).

## **2.9 Information on test modes and additional testing requirements**

Contact a Digi sales representative for information on how to configure test modes for the XBee RR product.

## **2.10 Additional testing, Part 15 Subpart B disclaimer**

All final host products must be tested to be compliant to FCC Part 15 Subpart B standards. While the XBee RR unit was tested to be compliant to FCC unintentional radiator standards, FCC Part 15 Subpart B compliance testing is still required for the final host product. This testing is required for all end products, and XBee RR Part 15 Subpart B compliance does not affirm the end product’s compliance. See [FCC notices](#) for more details.

## **Over-voltage detection**

Over-voltage detection sends out a modem status of **0x0D** indicating that the voltage supply limit has been exceeded. The device will still operate but limits the RF power level **PL** setting to a value of **3** when the operating voltage reaches 3.8 volts or higher to meet regulatory RF power requirements. While the device is in this mode of operation it will be forced into API mode for the over-voltage modem status to be sent out the serial port every 15 seconds when API mode is set to 1 or 2.

## ISED (Innovation, Science and Economic Development Canada)

### Labeling requirements

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product enclosure must display the following text.

#### For model XBRR, XBee RR RF MMT

Contains Model XBRR, IC: 1846A-XBRR

The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators. ICES-003 is the same as FCC Part 15 Sub. B and Industry Canada accepts FCC test report or CISPR 22 test report for compliance with ICES-003.

L'intégrateur est responsable de la conformité de son produit aux normes IC ICES-003 et FCC Part 15, Sub. B - Radiateurs Involontaires. ICES-003 est identique à FCC Part 15 Sub. B et Industrie Canada accepte le rapport de test FCC ou le rapport de test CISPR 22 pour la conformité à la norme ICES-003.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### For PRO model XBPRR, XBee RR RF MMT

Contains Model XBPRR, IC: 1846A-XBPRR

The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators. ICES-003 is the same as FCC Part 15 Sub. B and Industry Canada accepts FCC test report or CISPR 22 test report for compliance with ICES-003.

L'intégrateur est responsable de la conformité de son produit aux normes IC ICES-003 et FCC Part 15, Sub. B - Radiateurs Involontaires. ICES-003 est identique à FCC Part 15 Sub. B et Industrie Canada accepte le rapport de test FCC ou le rapport de test CISPR 22 pour la conformité à la norme ICES-003.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### RF Exposure



**CAUTION!** This equipment is approved for mobile and base station transmitting devices only. Antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.



**ATTENTION!** Cet équipement est approuvé pour la mobile et la station base dispositifs d'émission seulement. Antenne(s) utilisé pour cet émetteur doit être installé pour fournir une distance de séparation d'au moins 20 cm à partir de toutes les personnes et ne doit pas être situé ou fonctionner en conjonction avec tout autre antenne ou émetteur.

## Transmitters with detachable antennas

This radio transmitter (IC: 1846A-XBRR, 1846A-XBPRR) has been approved by Industry Canada to operate with the antenna types listed in [FCC-approved antennas \(2.4 GHz\)](#) with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (IC: 1846A-XBRR, 1846A-XBPRR) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

## Detachable antenna

Under Industry Canada regulations, this radio transmitter may operate using only an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

## Europe (CE/UKCA) for model: XBRR

The XBee RR RF Module has been tested for use in several European countries. For a complete list, refer to [www.digi.com/resources/certifications](http://www.digi.com/resources/certifications).

If XBee RR RF Modules are incorporated into a product, the manufacturer must ensure compliance of the final product with articles 3.1a and 3.1b of the Radio Equipment Directive. A Declaration of Conformity must be issued for each of these standards and kept on file as described in the Radio Equipment Directive.

Furthermore, the manufacturer must maintain a copy of the XBee RR RF Module user guide documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user guide.

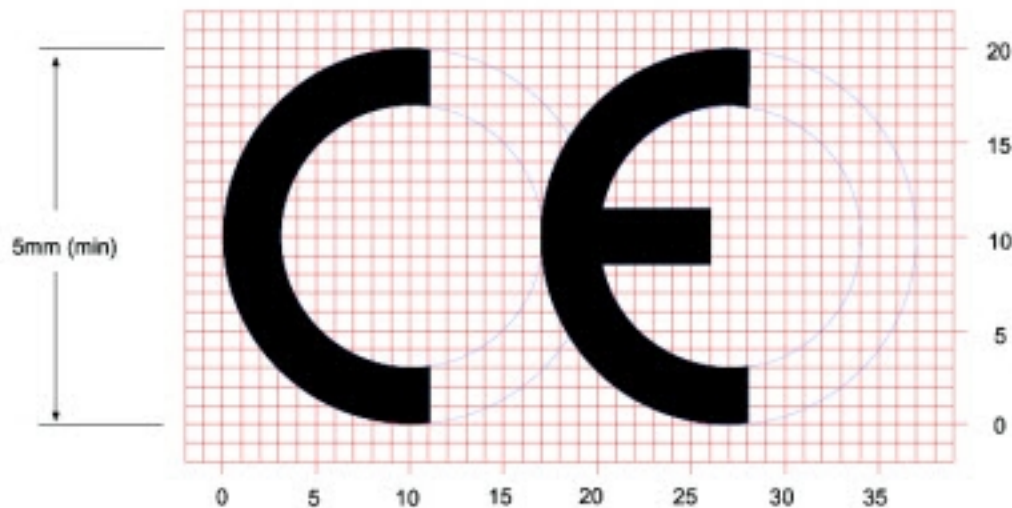
## Maximum power and frequency specifications

### CE and UKCA OEM labeling requirements

The CE and UKCA markings must be clearly visible and legible when you affix it to the product. If this is not possible, you must attach these marks to the packaging (if any) or accompanying documents.

#### ***CE labeling requirements***

The “CE” marking must be affixed to a visible location on the OEM product. The following figure shows CE labeling requirements.



The CE mark shall consist of the initials “CE” taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

**UK Conformity Assessed (UKCA) labeling requirements**

See [guidance/using-the-ukca-marking](#) for further details.

You must make sure that:

- if you reduce or enlarge the size of your marking, the letters forming the UKCA marking must be in proportion to the version set out below
- the UKCA marking is at least 5 mm in height – unless a different minimum dimension is specified in the relevant legislation
- the UKCA marking is easily visible, legible (from 1 January 2023 it must be permanently attached)
- the UKCA marking can take different forms (for example, the colour does not have to be solid), as long as it remains visible, legible and maintains the required proportions.

**Important note**

Digi customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. Refer to the radio regulatory agency in the desired countries of operation for more information.

**Declarations of conformity**

Digi has issued Declarations of Conformity for the XBee RF Modules concerning emissions, EMC, and safety. For more information, see [www.digi.com/resources/certifications](http://www.digi.com/resources/certifications).

**Antennas**

The following antennas have been tested for use with the XBee RR RF Module. All antenna part numbers followed by an asterisk (\*) are not available from Digi. Consult with an antenna manufacturer for an equivalent option.

- Dipole (2.1 dBi, Omni-directional, Articulated RPSMA, Digi part number A24-HABSM)
- Chip antenna (micro form factor only) (0.0 dBi)

## Brazil ANATEL

The XBee XBRR ZigBee, DigiMesh and 802.15.4 radio modules comply with the requirements of ANATEL to be used in Brazil. The customer's product is subject to testing for conformity to the same Brazilian standards.

### Modelo: XBee XBRR

Atendimento à Regulamentação Anatel

Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados.

Este produto está homologado pela ANATEL, de acordo com os procedimentos regulamentados pela Resolução 242/2000, e atende aos requisitos técnicos aplicados.

Para maiores informações, consulte o site da ANATEL [www.anatel.gov.br](http://www.anatel.gov.br).



# XBIB-C development boards

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This section describes the XBIB-C development boards and how to interact with them.

|                                    |    |
|------------------------------------|----|
| XBIB-C Micro Mount reference ..... | 63 |
| Attach the XBee RR RF Module ..... | 67 |

## XBIB-C Micro Mount reference

This picture shows the XBee-C Micro Mount development board and the table that follows explains the callouts in the picture.

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**Note** This board is sold separately.

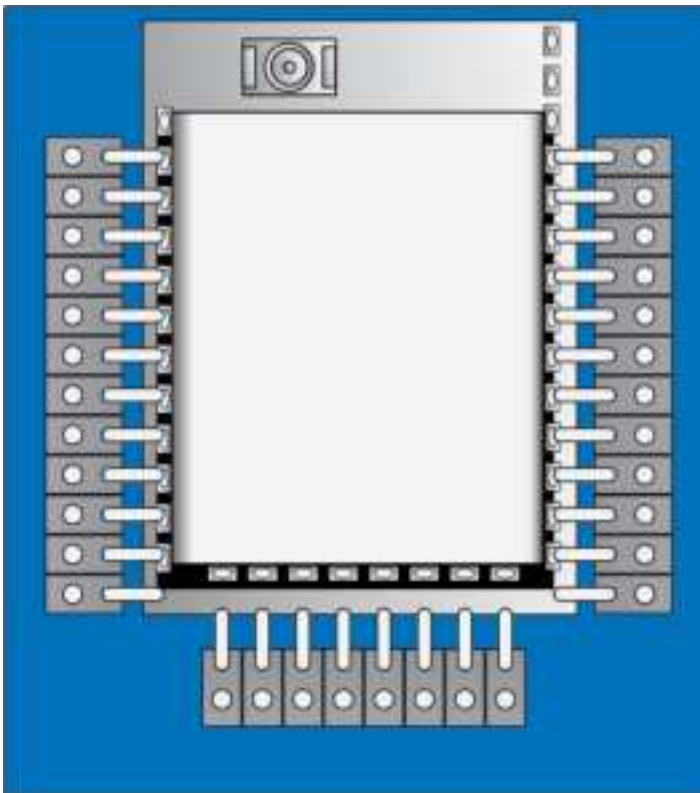
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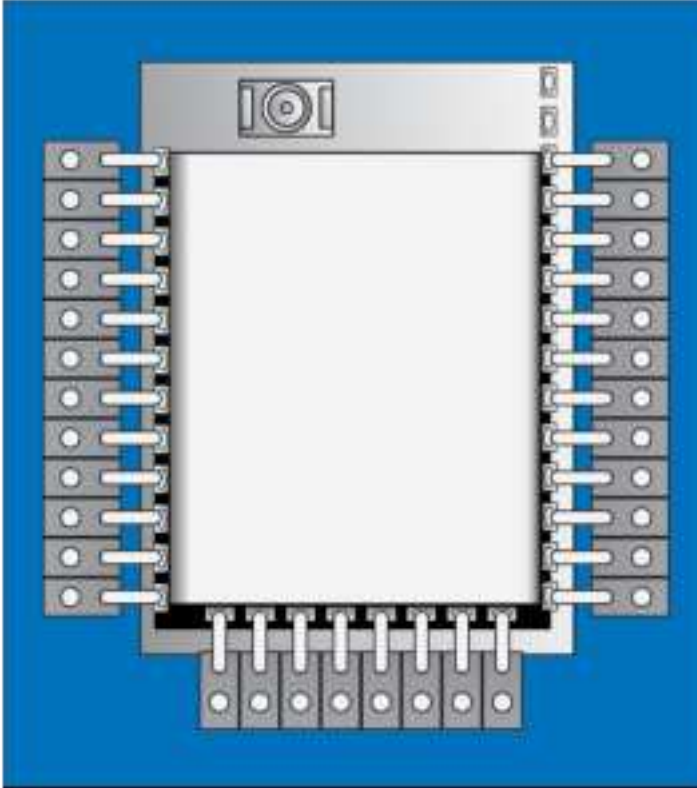
**WARNING!** Connecting one pin off will destroy the unit under test! Always disconnect USB and power before changing one unit for another. See the following images for examples.

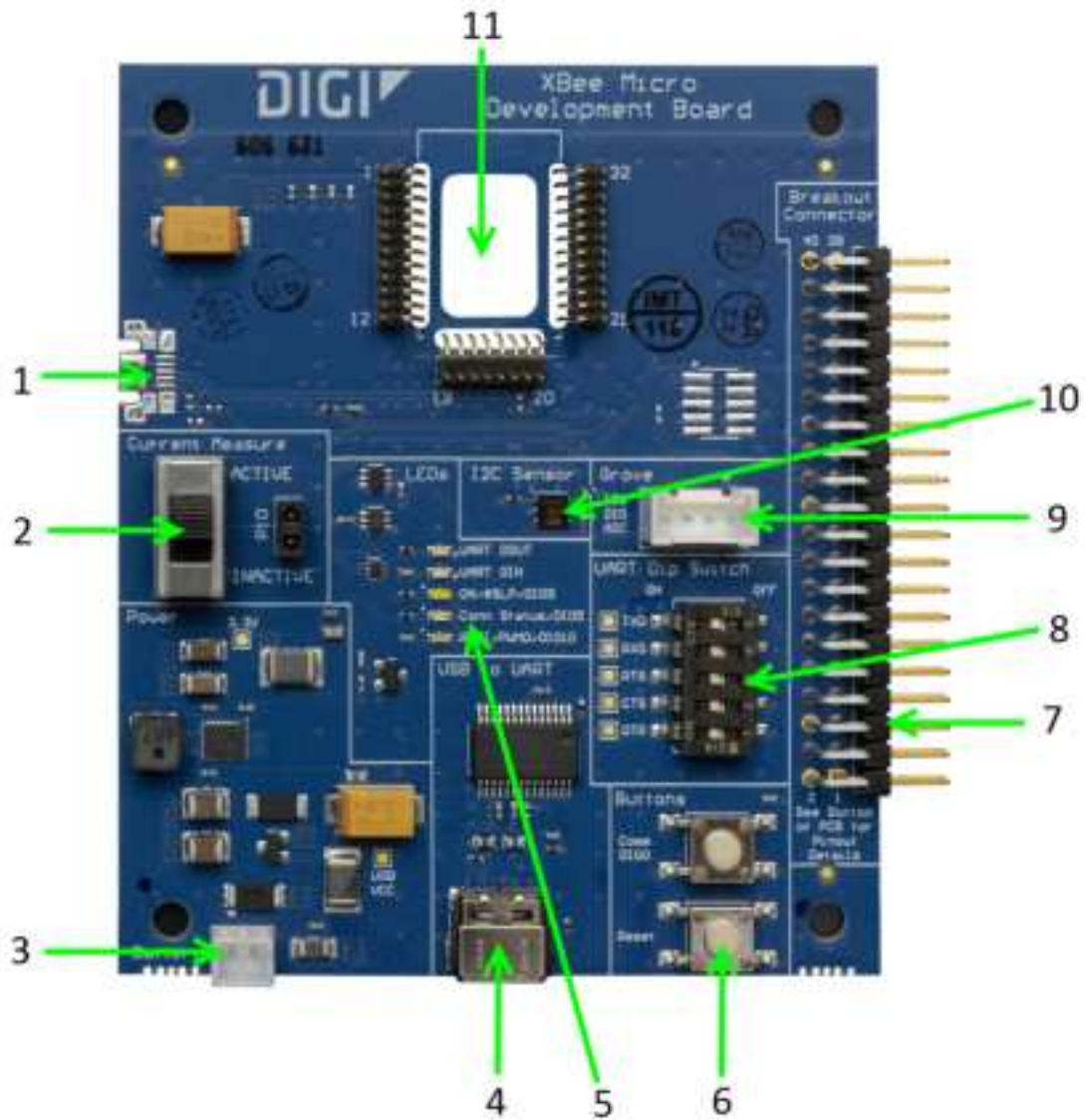
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### Incorrect



## Correct





| Number | Item                        | Description                                                                                                                                                                                                                                                                                                                                         |
|--------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Secondary USB (USB MICRO B) | Secondary USB Connector for possible future use. Not used.                                                                                                                                                                                                                                                                                          |
| 2      | Current Measure             | Large switch controls whether current measure mode is active or inactive. When inactive, current can freely flow to the VCC pin of the XBee. When active, the VCC pin of the XBee is disconnected from the 3.3 V line on the development board. This allows current measurement to be conducted by attaching a current meter across the jumper P10. |
| 3      | Battery Connector           | If desired, you can attach a battery to provide power to the development board. The voltage can range from 2 V to 5 V. The positive terminal is on the left.                                                                                                                                                                                        |
| 4      | USB-C Connector             | Connects to your computer. This is connected to a USB to UART conversion chip that has the five UART lines passed to the XBee device. The UART Dip Switch can be used to disconnect these UART lines from the XBee.                                                                                                                                 |
| 5      | LED indicator               | Red: UART DOUT (modem sending serial/UART data to host)<br>Green: UART DIN (modem receiving serial/UART data from host)<br>White: ON/SLP/DIO9<br>Blue: Connection Status/DIO5<br>Yellow: RSSI/PWM0/DIO10                                                                                                                                            |
| 6      | User Buttons                | Comm DIO0 Button connects the Commissioning/DIO0 pin on the XBee Connector through to a 10 $\Omega$ resistor to GND when pressed.<br><br>RESET Button Connects to the RESET pin on the XBee Connector to GND when pressed.                                                                                                                          |
| 7      | Breakout Connector          | This 40-pin connector can be used to connect to various XBee pins as shown on the silkscreen on the bottom of the board.                                                                                                                                                                                                                            |
| 8      | UART Dip Switch             | This dip switch allows the user to disconnect any of the primary UART lines on the XBee from the USB to UART conversion chip. This allows for testing on the primary UART lines without the USB to UART conversion chip interfering. Push Dip switches to the right to disconnect the USB to UART conversion chip from the XBee.                    |
| 9      | Grove Connector             | This connector can be used to attach I2C enabled devices to the development board. Note that I2C needs to be available on the XBee in the board to use this functionality.<br>Pin 1: I2C_CLK/XBee DIO1<br>Pin2: I2C_SDA/XBee DIO11<br>Pin3: VCC<br>Pin4: GND                                                                                        |
| 10     | Temp/Humidity Sensor        | This as a Texas Instruments HDC1080 temperature and humidity sensor. This part is accessible through I2C. Be sure that the XBee that is inserted into the development board has I2C if access to this sensor is desired.                                                                                                                            |
| 11     | XBee Socket                 | This is the socket for the XBee (Micro form factor).                                                                                                                                                                                                                                                                                                |

## Attach the XBee RR RF Module

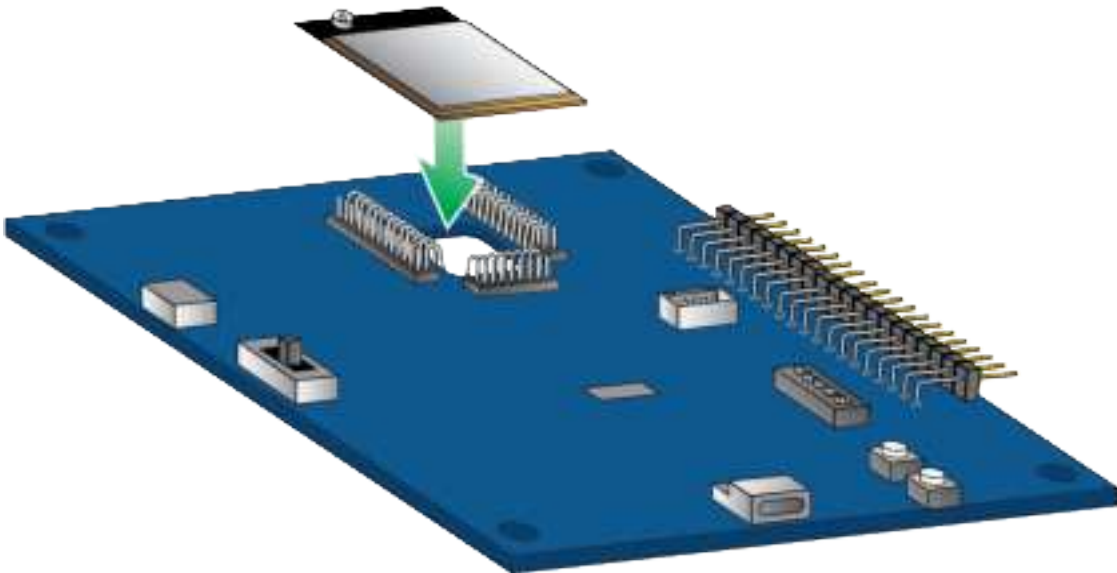
It is important to attach the device to the board correctly.



**WARNING!** Make sure the board is NOT powered when you plug in the XBee RR RF Module. Never insert or remove the XBee RR RF Module while the power is on!

Make sure the XBee RR RF Module is oriented correctly and not upside down when you attach it to the board.

### Micro



# Manufacturing information

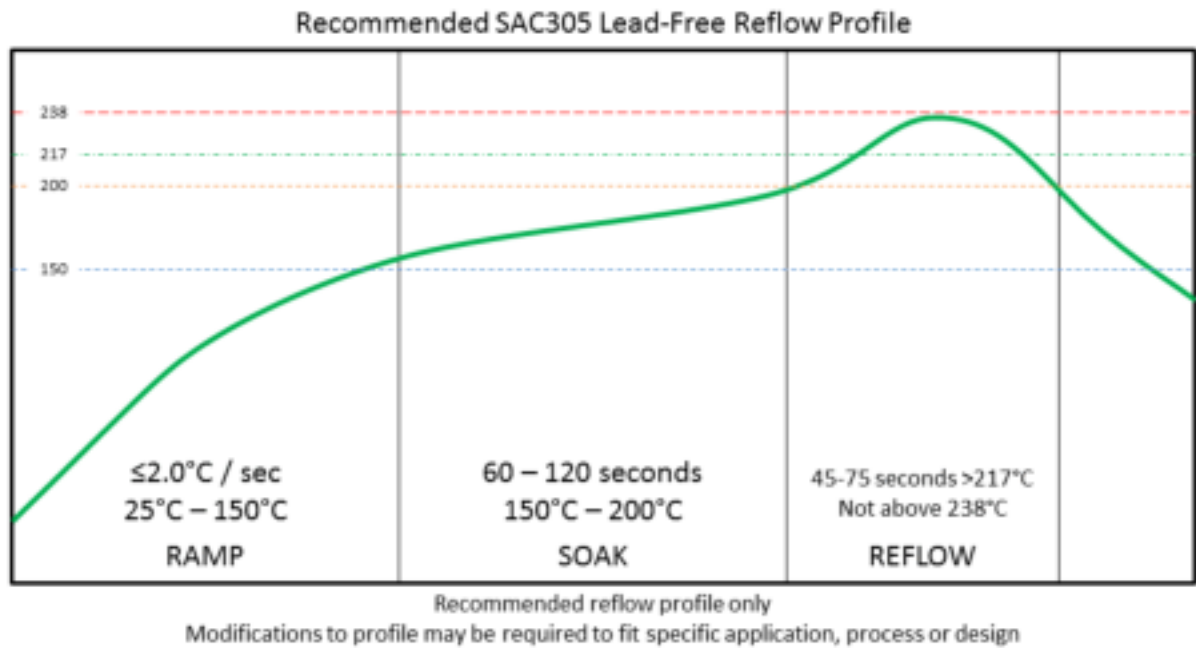
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The micro XBee RR RF Module is designed for surface-mounting on the OEM PCB. It has castellated pads to allow for easy solder attaching and inspection. The pads are all located on the edge of the device so there are no hidden solder joints on these devices.

|                                       |    |
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## Recommended solder reflow cycle

The following diagram shows the recommended solder reflow cycle.



The device reflows during this cycle, and must not be reflowed upside down. Be careful not to jar the device while the solder is molten, as parts inside the device can be removed from their required locations.

Hand soldering is possible and should be done in accordance with approved standards.

## Handling and storage

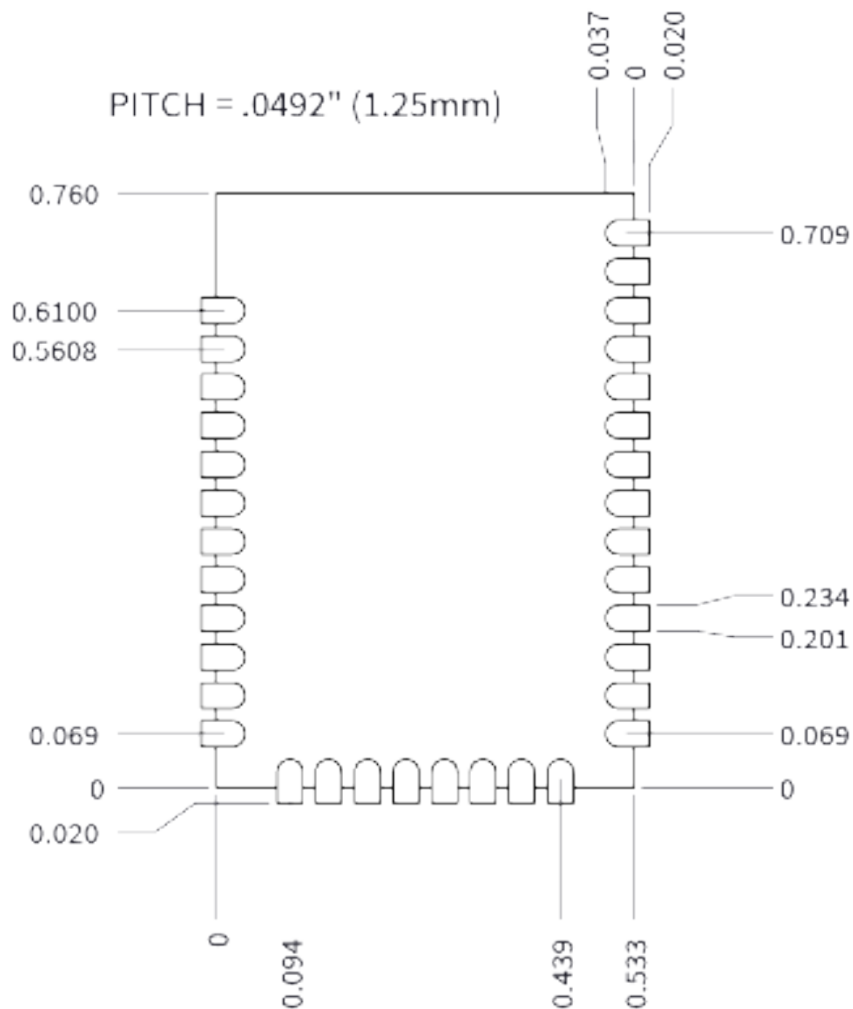
The XBee RR RF Modules are level 3 Moisture Sensitive Devices. When using this kind of device, consider the relative requirements in accordance with standard IPC/JEDEC J-STD-020.

In addition, note the following conditions:

- Calculated shelf life in sealed bag: 12 months at <40 °C and <90% relative humidity (RH).
- Environmental condition during the production: 30 °C /60% RH according to IPC/JEDEC J-STD - 033C, paragraphs 5 through 7.
- The time between the opening of the sealed bag and the start of the reflow process cannot exceed 168 hours if condition b) is met.
- Baking is required if conditions b) or c) are not met.
- Baking is required if the humidity indicator inside the bag indicates a RH of 10% more.
- If baking is required, bake modules in trays stacked no more than 10 high for 4-6 hours at 125 °C.

## Recommended footprint

We recommend that you use the following PCB footprints for surface-mounting. The dimensions without brackets are in inches, and those in brackets are in millimeters.

**Micro recommended footprint**

Match the solder footprint to the copper pads, but it may need to be adjusted depending on the specific needs of assembly and product standards. Recommended stencil thickness is 0.15 mm/0.005". Place the component last and set the placement speed to the slowest setting.

**Flux and cleaning**

Digi recommends that a "no clean" solder paste be used in assembling these devices. This eliminates the clean step and ensures unwanted residual flux is not left under the device where it is difficult to remove.

In addition the following issues can occur:

- Cleaning with liquids can result in liquid remaining under the shield or in the gap between the device and the OEM PCB. This can lead to unintended connections between pads on the device.
- The residual moisture and flux residue under the device are not easily seen during an inspection process.

Factory recommended best practice is to use a “no clean” solder paste to avoid these issues and ensure proper device operation.

## Reworking

Never perform rework on the device itself. The device has been optimized to give the best possible performance, and reworking the device itself will void warranty coverage and certifications. We recognize that some customers choose to rework and void the warranty. The following information serves as a guideline in such cases to increase the chances of success during rework, though the warranty is still voided.

The device may be removed from the OEM PCB by the use of a hot air rework station, or hot plate. Be careful not to overheat the device. During rework, the device temperature may rise above its internal solder melting point and care should be taken not to dislodge internal components from their intended positions.