

SUB-GHZ, REMOTE CONTROL & LOW-POWER IOT

Sub-GHz Remote Control & Low-Power IoT

Coordinate the radio reference, always-on timebase and regional RF path for reliable remote-control, security, smart-metering and low-power IoT platforms.

Radio Reference + Low-Power Timing + Carrier Control + RF Selectivity + Regional Compliance

Remote Control / RKE

Security

Smart Metering

Industrial Telemetry

LoRaWAN

Wi-SUN / Sigfox

Application Scope

Legacy ASK / OOK remotes, security devices, smart meters, LPWAN endpoints, industrial telemetry nodes, mesh field devices and multi-channel gateways operating in regional Sub-GHz bands.

Selection Philosophy

Selection begins with the replaceable circuit function. The radio crystal loop, driven clock input, 32.768 kHz domain, direct-carrier resonator and RF filter are separate positions even when they coexist within one product.

Radio Reference

Platform-specific crystal or supported external clock for the radio synthesizer.

Low-Power Timebase

32.768 kHz RTC, wake scheduling, metering interval and retention timing.

Carrier Resonator

Circuit-specific SAW resonator in selected legacy direct-RF oscillators.

Regional RF Path

315, 433.92, 868, 915 and region-dependent 923 MHz filtering.

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Application Scope & Engineering Domains

Sub-GHz products combine low-power timing, radio-reference and RF-path functions that require different component classes and validation methods.

One wireless product, multiple frequency-dependent nodes. A 32.768 kHz timebase, 26–50 MHz radio reference and 315–923 MHz RF path may all appear in the same design. Their units, interfaces and error budgets are not interchangeable.

Typical Equipment

Remote & Security

Key fobs / RKE
Garage & gate controls
Alarm sensors
Access systems
Legacy ASK / OOK links

Low-Power Field Nodes

Smart meters
LoRa / Sigfox sensors
Wi-SUN mesh nodes
Industrial telemetry
Outdoor monitoring

Infrastructure & Gateways

LoRaWAN gateways
Mesh border routers
Multi-channel concentrators
Regional RF front ends
Host + radio modules

Five Engineering Domains

High-Frequency Reference

Exact-frequency crystal loop or compatible external clock for the radio / MCU.

Low-Frequency Timebase

32.768 kHz passive loop, driven input or internal low-frequency source.

Direct-Carrier Resonator

SAW resonator used only where the RF oscillator topology explicitly requires it.

Regional RF Filtering

Passband, loss, rejection, impedance, power and channel-plan selection.

Integration Boundary

Bare IC, module and host-board functions that remain externally selectable.

Clock Interface

XTAL pins · clipped-sine / CMOS input · bias · enable · startup.

Error Budget

Tolerance · stability · aging · load error · calibration · channel accuracy.

RF Path

Bandwidth · insertion loss · blockers · power · matching · antenna.

Field Environment

Sleep current · cold start · temperature · vibration · lifecycle · compliance.

Frequency-definition note: 315, 433.92, 868, 915 and 923 MHz normally identify RF carrier or regional-band positions. The radio generally uses a lower external reference; a direct-carrier SAW resonator is a separate, circuit-specific exception.

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Select by System Node First

Identify the replaceable function before comparing frequency, product class, electrical performance or package.

System Node	Clock / RF Role	Representative Reference	Typical Device	Selection Focus
Legacy ASK / OOK Carrier Oscillator	Direct RF carrier generation	315 / 433.92 MHz class circuit-dependent	SAW resonator	oscillator topology · exact carrier · load / pulling · startup · temperature
Sub-GHz Transceiver HFXO	Radio synthesizer and MCU reference	26 / 27 / 32 / 38.4 / 39 / 40 / 48 / 50 MHz	AT-cut crystal	CL · ESR · C0 · drive · startup · total ppm · exact frequency
Supported External Clock Input	Driven radio / concentrator reference	32 / 40 MHz class platform-dependent	XO / TCXO	waveform · amplitude / bias · VDD · load · stability · phase noise
RTC / Wake Domain	Always-on timing and reporting interval	32.768 kHz	Tuning-fork crystal / low-current XO	XTAL vs CLKIN · CL · ESR · current · startup · calibration
EU Sub-GHz RF Path	Regional preselection / rejection	863-870 MHz class	SAW filter	sub-band · bandwidth · loss · rejection · impedance · power · duty cycle
US / APAC Sub-GHz RF Path	Regional preselection / coexistence	902-928 MHz class local 915 / 920 / 923 plans	SAW filter	legal region · passband · blockers · transmit power · matching
Industrial / Metering Field Node	Long-life clock and regional RF path	26-50 MHz + 32.768 kHz	Crystal / TCXO / SAW	cold startup · wide temperature · aging · vibration · EMC · lifecycle
Certified Radio Module / Host	Externally accessible host function	Module-dependent	Host clock / external filter only	module BOM boundary · exposed pins · antenna variant · certification

1 · Identify the Function

Record whether the node is a passive crystal loop, driven clock input, LF timebase, carrier resonator, RF filter or module-external host position.

2 · Identify the Receiver / Circuit

Use the exact SoC, transceiver, concentrator, module or oscillator schematic together with the relevant pins and reference design.

3 · Apply the Electrical / RF Limits

Define CL / ESR, waveform / VDD or the complete passband, rejection, impedance and RF-power requirements before selecting a product.

Recommended sequence: Platform documentation → functional node → circuit interface → exact frequency or band → performance budget → environment → package → final FCom configuration.

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Frequency & Component Placement Matrix

Each value below is a selection anchor only after it has been mapped to the actual clock, resonator or RF-filter position.

Frequency / Band	Representative System Position	Applicability	Selection Interpretation
32.768 kHz	RTC / wake / protocol sleep domain	Common Low-Power Reference	Use a tuning-fork crystal or low-current clock only where the receiver supports the corresponding loop or CLKIN topology.
26 / 27 MHz	Legacy / multi-band transceiver reference	CC1101 Public Example	TI documents a 26–27 MHz range and cited regional guidance; the configured value, channel plan and complete loop limits control selection.
32 MHz	Integrated Sub-GHz MCU or gateway reference	Public Platform Reference	Illustrated by STM32WL HSE and gateway architectures; passive-loop and external-clock topologies must remain separate.
38.4 / 39 / 40 MHz	Platform-specific HFXO / radio reference	Exact Frequency Required	38.400, 39.000 and 40.000 MHz are not interchangeable. The Silicon Labs BRD4271A example uses exactly 39.000 MHz.
48 / 50 MHz	Selected wireless MCU / modem reference	Platform-Dependent	Confirm oscillation mode, CL, ESR, drive and startup at the exact frequency; FCX-1M spans 24–60 MHz at series level.
315 MHz	Legacy carrier oscillator or RF filter	Circuit-Dependent RF Position	FSR-2016 applies to a documented resonator oscillator; FSF3030-315M-1M-2-50 applies to a matching filter mask.
433.92 MHz	Remote / alarm / telemetry carrier or filter	Circuit-Dependent RF Position	Choose FSR-2016 or FSF3030-433M92-1M71-2.5-50 by circuit function; resonator and filter roles are not interchangeable.
863-870 MHz	EU regional RF preselection path	EU RF Reference	FSF3030-868M-10M-1.9-40 is a portfolio starting point subject to the complete sub-band, power and rejection mask.
902-928 MHz	US / region-dependent 915 MHz RF path	US RF Reference	FSF1109-915M-26M-1.5-50 is a 902–928 MHz starting point, not automatic approval for every local plan.
920 / 923 / 925.8 MHz	Region-specific APAC channel plans	Separate Regional Review	AS923 and local allocations require dedicated passband, rejection, transmit-power and certification review.

26-50 MHz
Platform-specific radio-reference clock positions.

32.768 kHz
Optional RTC, wake and always-on timebase domain.

315 / 433.92 MHz
Legacy carrier-resonator or RF-filter positions.

868 / 915 / 923 MHz
Regional RF paths requiring channel-plan validation.

Reference interpretation: a protocol or regional-band label does not define the external clock, resonator or filter. Confirm the exact circuit function, receiving interface and regional RF mask before selecting an FCom series or fixed P/N.

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Representative Platform & Architecture Matrix

Four public designs illustrate different reference-clock, low-power, regional RF and gateway integration boundaries.

TEXAS INSTRUMENTS

SmartRF04EB + CC1101EM · Multi-Band Transceiver

1

Architecture: a host MCU controls a discrete Sub-GHz transceiver that supports established 315 / 433 / 868 / 915 MHz use cases.

Public clock evidence: the CC1101 datasheet specifies a 26–27 MHz crystal range, ± 40 ppm total tolerance budget, 10–20 pF load range and 100 Ω maximum ESR.

Host MCU → CC1101 · 26 / 27 MHz → Regional RF Path

Selection insight: FCX-1M is reviewed against the complete oscillator-loop limits. An FSF filter is considered separately after the RF mask is defined.

STMICROELECTRONICS

NUCLEO-WL55JC1 / JC2 · Integrated Sub-GHz MCU

2

Architecture: the STM32WL platform integrates the MCU and Sub-GHz radio with regional board variants.

Public clock evidence: ST documents a 32 MHz HSE oscillator and 32.768 kHz LSE crystal. JC1 addresses 868 / 915 / 923 MHz regions; JC2 addresses China 433 / 470–510 MHz.

32.768 kHz LSE → STM32WL · 32 MHz HSE → Regional Antenna

Selection insight: FCX-1M and FCT-1M are reviewed only for exposed crystal loops in a custom derivative and against the current STM32WL electrical limits.

SILICON LABS

WI-SUN-PK6015A + BRD4271A · Wi-SUN Field Node

3

Architecture: the Wi-SUN Pro Kit uses an EFR32FG25 radio board and matching network for the 863–876 MHz range.

Public clock evidence: the official BRD4271A schematic identifies a 39.000 MHz HFXO crystal and a 32.768 kHz LFXO crystal.

32.768 kHz LFXO → EFR32FG25 · 39 MHz → 868 MHz RF Path

Selection insight: configure FCX-1M at exactly 39.000 MHz after loop review; do not substitute 38.4 or 40 MHz. FCT-1M is the LF starting family.

SEMTECH

SX1302 Corecell · Multi-Channel LoRaWAN Gateway

4

Architecture: SX1302 baseband processing works with SX1250 radios; an SX1261 supports Listen-Before-Talk and spectral scan, while an MCU provides the host interface.

Public integration evidence: regional configurations cover major LoRaWAN bands, making the stable radio reference and front-end mask gateway-critical nodes.

Host Interface → SX1302 + SX1250 → FEM / Filter / Antenna

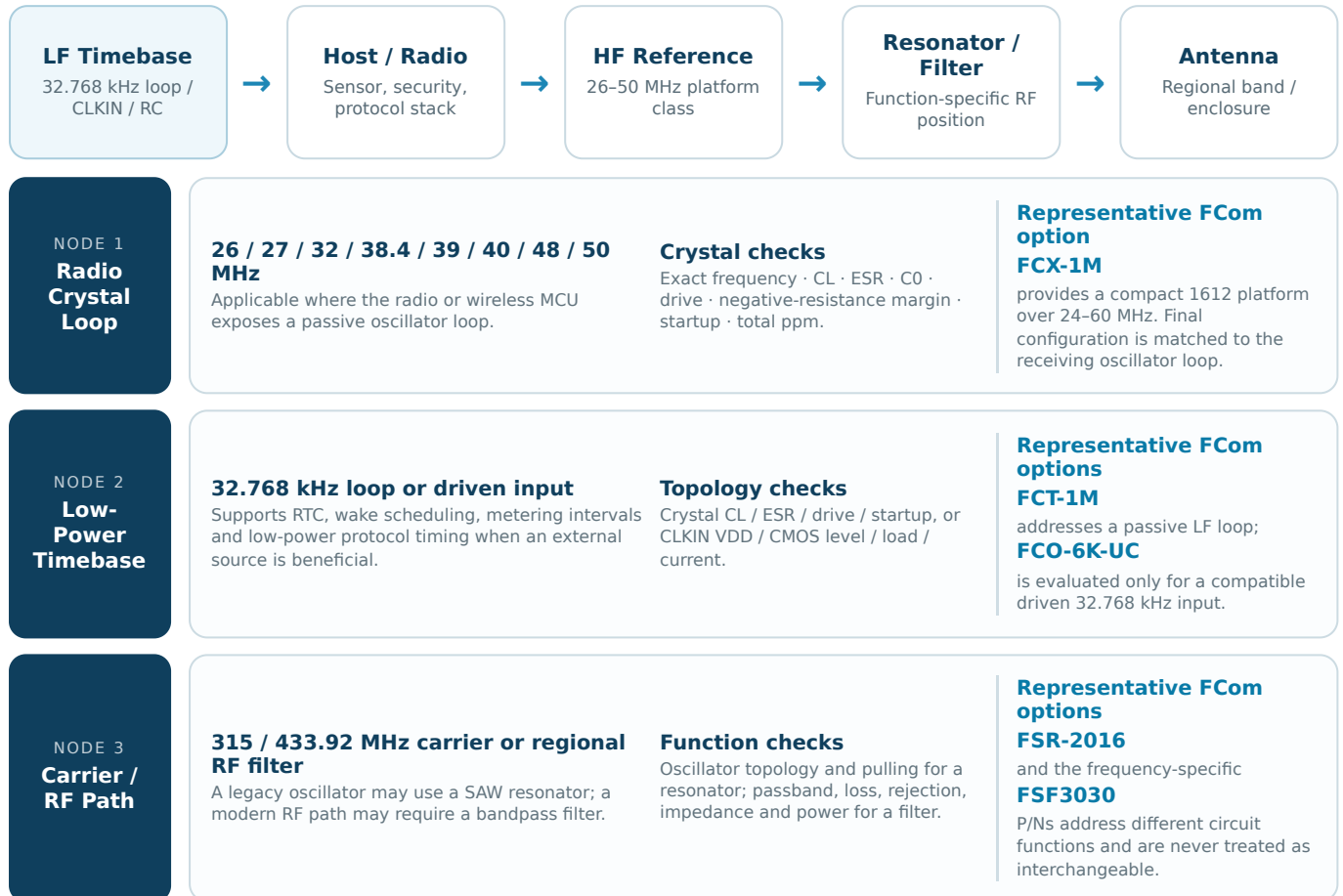
Selection insight: FVT-6S is evaluated only for a compatible external-clock interface. The regional FSF part follows the defined gateway RF mask and power path.

Platform interpretation: these public examples illustrate representative architectures only. They do not indicate FCom adoption, qualification, compatibility or drop-in replacement. Final selection requires the current datasheet, schematic, reference BOM, layout guidance and operating profile.

05

Battery Endpoint + Remote-Control Architecture

Representative placement of the low-power timebase, radio reference and RF component functions in an endpoint or remote-control design.

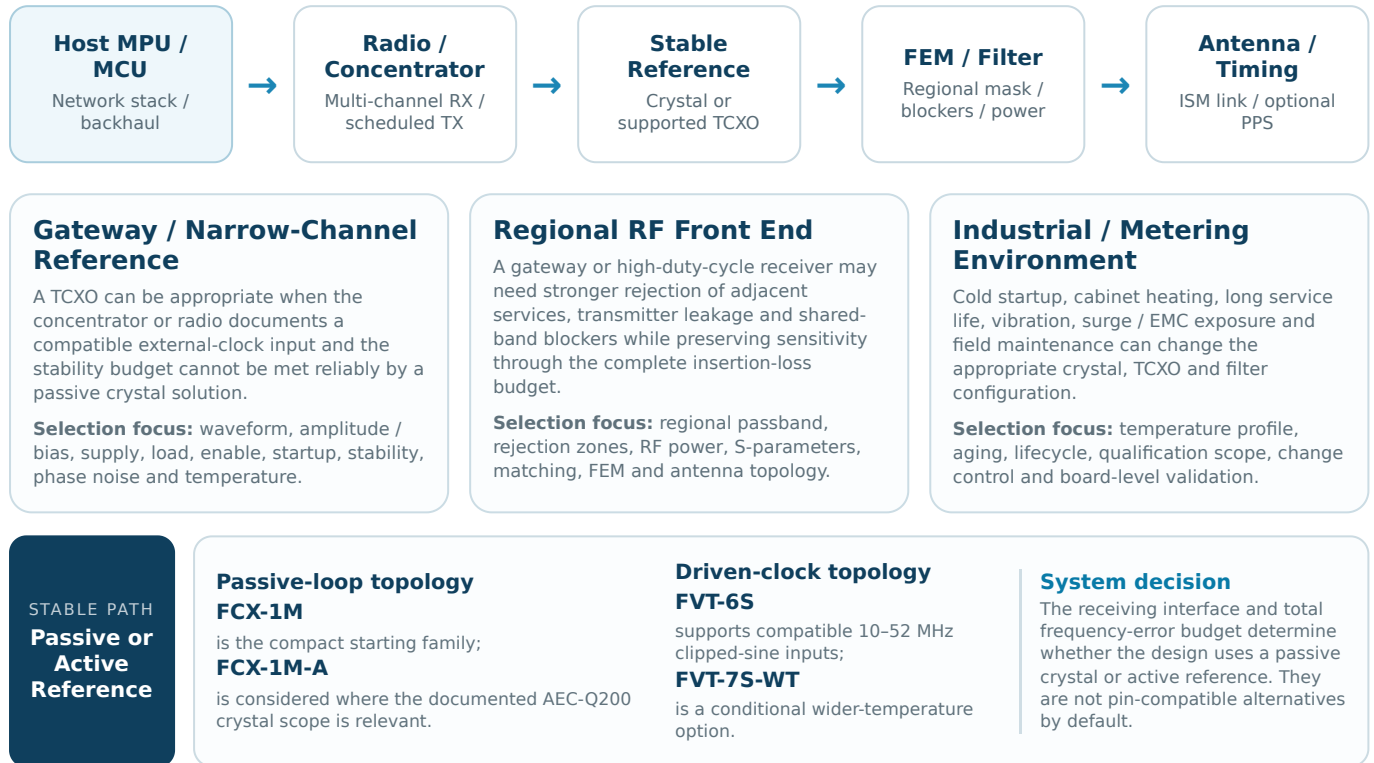


Architecture note: endpoint energy is affected by HF startup, LF run current, calibration cadence, receive duty cycle and reconnect behavior. The lowest-current component is not automatically the lowest-energy system choice.

06

Gateway + Smart-Meter / Industrial Architecture

Representative stable-reference and RF-front-end decisions for higher-duty-cycle infrastructure and long-life field equipment.



Architecture note: a certified radio module may already integrate its crystal, RF matching and antenna. FCom selection then moves to exposed host clocks or documented external RF positions; internal module components are not presented as customer-replaceable parts.

07

FCom Selection Guidance by Design Condition

The options below correspond to defined, externally accessible timing or RF positions. Exact configurations are confirmed after the receiving circuit is documented.

Radio Crystal

24–60 MHz configurable compact crystal platform.

Low-Power Timing

32.768 kHz passive or supported driven-clock path.

Stable Gateway Clock

Conditional TCXO for documented external-clock inputs.

RF Function

Carrier resonator or frequency-specific regional SAW filter.

Design Condition	FCom Selection	Representative Series / Portfolio Data	Key Check Before RFQ
Radio IC exposes passive HF XTAL pins	FCX-1M	1612 · 24–60 MHz · best tolerance / stability ± 5 / ± 10 ppm · -40 to $+125^{\circ}\text{C}$ · 18 pF or specified CL · 30–60 Ω ESR.	Exact frequency · CL · ESR · C0 · drive · startup
32.768 kHz receiver exposes an LF crystal loop	FCT-1M	1610 · 32.768 kHz · best tolerance ± 5 ppm · -40 to $+125^{\circ}\text{C}$ · CL 6–12.5 pF · ESR 70–90 k Ω .	Loop topology · CL · ESR · drive · startup
Receiver accepts a low-current driven LF input	FCO-6K-UC	2016 · 32.768 kHz · 1.5 / 1.8 V · CMOS · ± 20 ppm · -40 to $+105^{\circ}\text{C}$ · 1.4–1.8 μA .	CLKIN support · VDD · CMOS level · load · current
Gateway / narrow-channel radio supports active CLKIN	FVT-6S	2016 · 10–52 MHz · 1.8–3.3 V · clipped sine · best stability ± 0.5 ppm · -40 to $+85^{\circ}\text{C}$ · phase-noise references -115 / -135 / -148 dBc/Hz at 100 Hz / 1 kHz / 10 kHz.	Waveform · amplitude / bias · supply · load · phase noise
Automotive or wider-temperature scope is documented	FCX-1M-A / FCT-3M-A / FVT-7S-WT	AEC-Q200 crystal / LF options to $+125^{\circ}\text{C}$; conditional 7050 TCXO option to $+105^{\circ}\text{C}$ with best listed stability ± 50 ppb.	Qualification scope · interface · temperature profile · lifecycle
Legacy oscillator explicitly requires an RF SAW resonator	FSR-2016	2016 · configurable 154–1000 MHz range · listed tolerance ± 50 kHz · -40 to $+85^{\circ}\text{C}$ · 1 dB insertion loss.	Oscillator topology · carrier · load / pulling · startup · mask
Regional RF path requires defined bandpass filtering	FSF3030 / FSF1109 fixed P/Ns	315 MHz: 1 MHz / 2 dB / 50 dB; 433.92 MHz: 1.71 MHz / 2.5 dB / 50 dB; 868 MHz: 10 MHz / 1.9 dB / 40 dB; 915 MHz: 26 MHz / 1.5 dB / 50 dB.	Channel plan · passband · rejection · impedance · RF power

Application-specific boundary: the FSR resonator and FSF filters address different circuit functions. Likewise, a passive crystal and active TCXO are not interchangeable unless the receiving device explicitly supports both interfaces.

ENGINEERING SELECTION SUPPORT

Request an FCom Sub-GHz Timing & RF Review

Provide the target chipset / module, exact clock, resonator or RF-filter node, regional channel plan, electrical / RF limits, temperature, package and project stage.

[Start Engineering Review →](#)

08

Engineering Validation & Minimum RFQ

Sub-GHz selection is defined by the functional node, circuit topology, regional RF plan and end-product environment in addition to frequency.

HF Crystal / Active Clock

- Exact SoC / transceiver / concentrator P/N
- XTAL loop or external CLKIN
- Frequency, CL, ESR, C0 and drive
- Waveform, amplitude / bias, VDD and load for an active clock
- Startup, ppm budget, phase noise and temperature

Low-Frequency / Sleep Domain

- MCU / radio / RTC P/N
- XTAL pins, external CLKIN or internal RC
- 32.768 kHz CL / ESR / drive or VDD / current
- RTC / wake accuracy and calibration cadence
- Sleep current and cold-start objective

RF Resonator / Filter Position

- Oscillator topology or RF signal-path location
- Exact carrier / center and occupied bandwidth
- Passband loss, ripple and rejection zones
- Source / load impedance, matching and RF power
- Harmonics, blockers and antenna topology

Region, Environment & Program

- Legal region, radio standard and channel plan
- Bare IC, module or certified end-product boundary
- Temperature, shock, vibration, humidity and EMC
- Qualification / certification scope
- Samples, schedule, annual volume and lifecycle

Minimum RFQ Information

Information Category	What to Provide
Application / Functional Node	Sub-GHz HFXO, supported external clock, 32.768 kHz loop / CLKIN, direct-carrier resonator, regional RF filter or module-external host position.
Target Device	Exact SoC, transceiver, concentrator, module, host MCU, RTC or oscillator IC and the relevant schematic pins / location.
Clock / Oscillator Topology	Passive resonator loop, clipped-sine / CMOS input, low-frequency loop, internal RC source or SAW-resonator oscillator circuit.
Crystal / XO Requirements	Frequency, package, CL, ESR, C0, drive and ppm budget; or VDD, waveform, bias, load, enable, startup, stability and phase noise.
RF Requirements	Region, center, occupied bandwidth, insertion loss / ripple, rejection mask, impedance, power, S-parameters, matching and antenna architecture.
Program Requirements	Operating environment, qualification / certification, prototype quantity, sample date, validation plan, annual volume, production location and lifecycle.

Exact Frequency Matters

38.4, 39 and 40 MHz are distinct references. Software and synthesizer configuration normally assume the documented value.

Resonator and Filter Are Different

A resonator participates in an oscillator; a filter sits in the RF path. They require different circuit and validation data.

Regional Labels Are Not Universal

A 915 MHz starting point does not automatically cover every 902-928 MHz or AS923 implementation.

Frequency alone does not define the final part: the receiving interface, oscillator topology, regional RF mask, power budget, environment and integration boundary determine the appropriate FCom series or frequency-specific P/N.

09

Engineering FAQ & Application Review

Common Sub-GHz timing and RF questions, representative public references and the information required for FCom engineering review.

Are 315 / 433.92 / 868 / 915 MHz oscillator frequencies?

Usually not. They identify carrier or regional RF positions. A lower reference normally drives the radio synthesizer; a direct-carrier SAW oscillator is a separate architecture.

Why does the CC1101 example show both 26 and 27 MHz?

TI documents a 26–27 MHz range and cited regional guidance. The configured value, channel plan and total error budget determine the exact crystal.

Can a 39 MHz radio crystal be replaced by 38.4 or 40 MHz?

No. They are distinct reference frequencies. The BRD4271A public schematic uses 39.000 MHz, and the design must follow the documented value.

When should a TCXO replace a passive crystal?

Only when the receiver supports a compatible external clock input and the stability budget justifies it. Waveform, bias, supply, load and startup must be verified.

Is an external 32.768 kHz source always required?

No. An internal RC source may be available. The external timebase is selected when RTC accuracy, sleep timing, calibration overhead or energy objectives justify it.

Is a SAW resonator the same as a SAW filter?

No. A resonator participates in an oscillator; a filter provides band selection and rejection in the RF signal path.

Can one 915 MHz filter serve US915 and every AS923 plan?

Not automatically. Regional allocation, occupied bandwidth, rejection zones, power and matching must be reviewed for the complete path.

Why are some FCom entries series names and others complete P/Ns?

Crystals, oscillators and resonators are configured by frequency and electrical options. The listed FSF filters are frequency-specific fixed P/Ns.

Representative Public Technical References

- Texas Instruments:** CC1101 Datasheet — radio bands, 26–27 MHz oscillator range, tolerance, CL, ESR and regional reference guidance.
- Texas Instruments:** SmartRF04DK User Manual — evaluation-board, host-interface and RF-test architecture.
- STMicroelectronics:** NUCLEO-WL55JC product page — integrated STM32WL platform and regional board variants.
- STMicroelectronics:** NUCLEO-WL55JC Data Brief — 32 MHz HSE, 32.768 kHz LSE and development-board context.
- Silicon Labs:** WI-SUN-PK6015A — EFR32FG25 kit for the 863–876 MHz range.
- Silicon Labs:** BRD4271A Schematic — exact 39.000 MHz HFXO and 32.768 kHz LFXO positions.
- Semtech:** SX1302 Corecell reference-design architecture with SX1250 radios and SX1261 Listen-Before-Talk / scan function.
- Semtech:** Lora-net SX1302 HAL — packet-forwarder and regional configuration context.

FCom product specification note: configurable product information in this guide is presented at series or representative-configuration level. Exact ordering codes, guaranteed limits and availability are confirmed against the applicable FCom product specification and quotation.

ENGINEERING REVIEW

Sub-GHz, Remote Control & Low-Power IoT Review

Provide the target chipset / module, replaceable clock, resonator or RF-filter node, regional channel plan, electrical / RF requirements, temperature, package and project stage. FCom can recommend the most relevant configuration for system validation.

[Request Engineering Review →](#)
[FCom Solutions](#)

This guide provides representative application and product-selection guidance. Final component selection is confirmed against the latest target-device documentation and the applicable FCom product specification, followed by validation on the complete board, RF path, antenna and end product.