FREE BUILD GUIDES

Two satellite stations

The TinyGS LoRa station and the SDR satellite receiver build guides in one file.

- Part one, the TinyGS satellite ground station
- Part two, the RTL-SDR satellite receiver

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TinyGS satellite ground station build guide

theconsciousness.ai · Free guide · Version 1.2 · November 2026

What you build

You build a receiving station that hears small satellites as they pass over your house, from about $20 in parts. A Heltec WiFi LoRa 32 V3 board listens on 433 MHz, a better antenna replaces the small one in the box, and the open TinyGS network collects what you hear and puts your station on a world map beside every other volunteer receiver.

The board does one job. When a CubeSat or a pico satellite flies within range, its LoRa beacon reaches your antenna, the board decodes the packet, and TinyGS logs it with your station's name. The radio only listens. Transmit stays off unless you hold an amateur license.

This station belongs on theconsciousness.ai because the project's aerospace pillar asks what it takes to run computation and sensing in orbit, the kind of hardware a machine that perceives its surroundings would one day carry. Before anyone flies a payload, they need to hear one. This station is a cheap way to receive real telemetry from real spacecraft, and a first step toward listening to a satellite of your own.

Budget one evening for the build and setup, then let it run while satellites come over.

> **How this guide was made.** Every step comes from the official TinyGS documentation and the tutorials listed at the end, written in our own words, with every source credited. We have not built this exact station ourselves. The guide is free, and every link in it is a plain link that earns nothing.

Parts list

The minimum station is the board plus a USB C cable, about $20 before shipping. The recommended station adds an outdoor 433 MHz antenna. Prices below were read on the sellers' pages on November 12, 2026. Prices change, so check them before you buy.

Part	Price	Where to buy	Needed?
Heltec WiFi LoRa 32 V3, **433 MHz band**	$17.90 to $19.90 plus shipping	Heltec's own store (plain link)	Yes
Same board, EU seller (listing includes an IPEX to SMA pigtail)	€39.90, in stock by backorder	Pileup Communications, Sweden (plain link)	Alternative for Europe
Same board, EU seller (listing includes an IPEX to SMA pigtail)	€22.75, out of stock (2 to 4 weeks)	TinyTronics, Netherlands (plain link)	Alternative for Europe

Part	Price	Where to buy	Needed?
IPEX (U.FL) to SMA female pigtail	a few dollars	Any electronics seller	Needed for an outdoor antenna if your box has none
USB C data cable	a few dollars, or one you own	Any	Yes (not in the box)
HYS 433 MHz omni antenna	check the listing	Linked from the TinyGS parts list (plain link)	Recommended
DIY quarter wave ground plane (1 m of 12 or 14 AWG copper wire, SO239 panel connector with PTFE insulation, four M3 bolts)	a few dollars in parts	Hardware store	Alternative to the HYS antenna
SMA to UHF (PL259) adapter cable, only for the DIY antenna or a Diamond X30A	check the listing	Linked from the TinyGS parts list (plain link)	Only with a UHF antenna

Heltec's own listing names the board, a LoRa antenna, a battery connector and two pin headers. It names no pigtail, while the two European sellers above list one. Check what your box holds before you plan the outdoor antenna.

Buy the 433 MHz version of the board, and confirm the listing you buy from says 433 MHz, because Heltec's own page is not consistent about the band options. TinyGS says more than 90% of active LoRa satellites on its network use the 437 and 400 MHz bands, and a board matched to 868 or 915 MHz will run the firmware but hear little from orbit. Source

TinyGS names the Heltec V3 as its recommended board, ahead of LilyGO boards, because its radio has a temperature compensated crystal (TCXO) that holds frequency. Its April 2026 newsletter says LilyGO T3 boards can have frequency stability issues, and reports one member whose daily packet count rose from about 400 to about 700 after swapping a LilyGO T3 v1.6 for a Heltec board on the same antenna. Newsletter

Heltec has since released a V4 board. We found no TinyGS note confirming V4 support as of November 12, 2026, so this guide sticks with the V3.

Tools

The board build needs no soldering. The pin headers in the box stay in the bag.

- A computer running Linux, Windows or macOS with Google Chrome or Microsoft Edge (the TinyGS web installer needs one of these browsers)
- A USB C cable that carries data, since many charging cables do not
- A phone or laptop with WiFi, to reach the station's setup page
- Your station's latitude and longitude (any map app shows them)

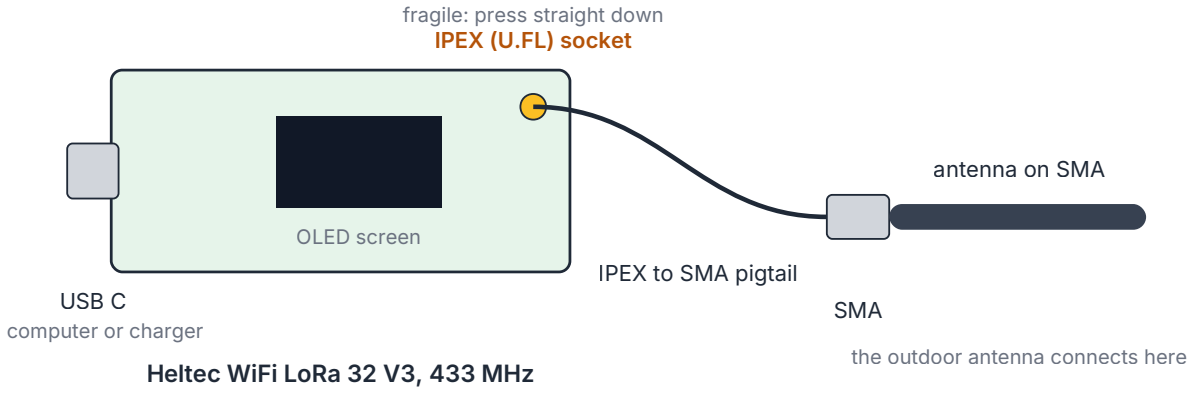
- Soldering iron and solder, wire cutters, pliers, a ruler, epoxy or hot glue, and self amalgamating or mastic tape for the outdoor joint (DIY antenna only)
- A NanoVNA to trim the DIY antenna to frequency (optional)

Build the station

The board's LoRa antenna socket is a tiny IPEX (U.FL) snap connector, and it is the one fragile part of the build.

1. Check the box against the listing. Confirm the label or listing says 433 MHz before you go further.
2. For a first test, connect the small LoRa antenna from the box to the board's LoRa socket. Line the IPEX connector up square and press straight down with a fingertip until it clicks. Never pull it off by the cable; lift it with a fingernail under the connector.
3. For an outdoor antenna, snap an IPEX to SMA pigtail onto the same socket instead, and screw the antenna's cable onto the pigtail's SMA end.
4. Fix the pigtail so it cannot tug on the socket. A dab of hot glue or a cable tie to a small board or case does it.
5. Plug the USB C cable into the board and your computer. The small OLED screen may stay blank until the firmware is on.
6. Keep the board indoors; only the antenna and its coax go outside.

Once setup is done, the station runs from USB power around the clock.



The board, an IPEX to SMA pigtail and the antenna connection

Flash TinyGS and set up the station

Three pieces have to line up, a TinyGS account, firmware on the board and the station's settings. Do them in that order.

1. Get a TinyGS account and your station credentials

Since TinyGS's Christmas 2025 release, it accepts sign ups by email invite, with no Telegram needed. Ask an active member for an invite, or (schools and workshops) write to the address on the join tutorial. The Telegram route still works. Join the TinyGS group, open a private chat with @tinygs_personal_bot, and send `/mqtt` for the MQTT user and password your station needs. Send `/weblogin` to the same bot for a login link to the web console.

2. Flash the firmware

1. Open installer.tinygs.com in Chrome or Edge with the board plugged in.
2. Click install and pick the board's serial port when the browser asks. The installer reads the chip and chooses the matching firmware.
3. Wait for it to finish and the board to restart.

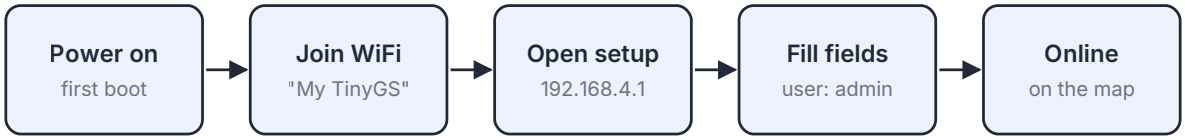
TinyGS calls the installer experimental. If it fails, the fallback is PlatformIO, covered on the TinyGS wiki.

3. Configure the station

On first boot the board opens a WiFi network named "My TinyGS". Join it from your phone or laptop; the setup page should open by itself, and if it does not, browse to 192.168.4.1. The user name is always admin.

Field	What to enter
Groundstation name	A unique name; it shows on the world map
Groundstation password	Your own password for this panel; write it down
SSID and password	Your home WiFi
Time zone	Yours
Latitude and longitude	Your station's position
MQTT server and port	Leave the defaults
MQTT user and pass	The pair from your account or the bot
Board type	Usually detected; set Heltec V3 by hand only if the radio does not start
OLED bright	Below 100, to make the screen last
Enable TX	Leave off unless you hold an amateur license
Automatic tuning	On, so the station follows the next satellite (TinyGS marks it experimental)
Test mode	Off for real reception
Automatic firmware update	On, as TinyGS recommends

Save. The board joins your WiFi, connects to the TinyGS server and starts listening. Source



Setup in five steps

Antenna options

The antenna decides how many packets you catch. The TinyGS wiki says the small antenna in the box "most likely will not give any result" for satellites, though its FAQ notes such antennas have caught distant packets in good conditions. Treat it as a bench test and move to one of these.

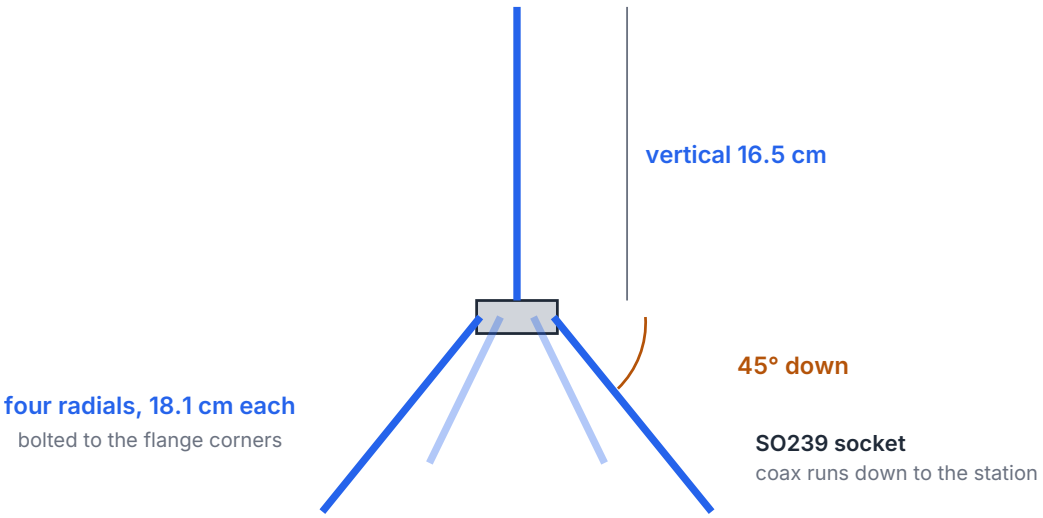
Antenna	Cost	Effort	Connector	Notes
Small antenna from the box	Included	None	Check your box	Bench test only
HYS 433 MHz omni	Check the listing	Mount and route cable	Check the listing	Recommended start; TinyGS calls it a strong price to performance balance and pairs it with an SMA extension cable
DIY quarter wave ground plane	A few dollars	One hour with a soldering iron	SO239	Best learning project; needs an SMA to UHF cable
Diamond X30A	Higher budget	Mast mount	UHF	TinyGS says it gives better horizon coverage; needs an SMA to UHF cable

Build the DIY ground plane (433.5 MHz)

1. Cut one vertical wire and four radials from 12 or 14 AWG solid copper, each 10 to 20% longer than the target.
2. Thread the SO239 onto a spare cable or male connector before you solder; the extra metal acts as a heat sink. Then solder the vertical wire into the center pin.
3. Bolt one radial to each corner hole of the connector flange with M3 bolts.
4. Bend the four radials down to about 45 degrees. That angle brings the antenna close to 50 ohms.

5. Trim the vertical to about 16.5 cm from the connector base to the tip, and the radials to about 18.1 cm from the bolt holes. With a NanoVNA, trim a little at a time; cutting is easy, adding wire back is not.
6. Seal the base of the vertical wire with epoxy or hot glue.

Source

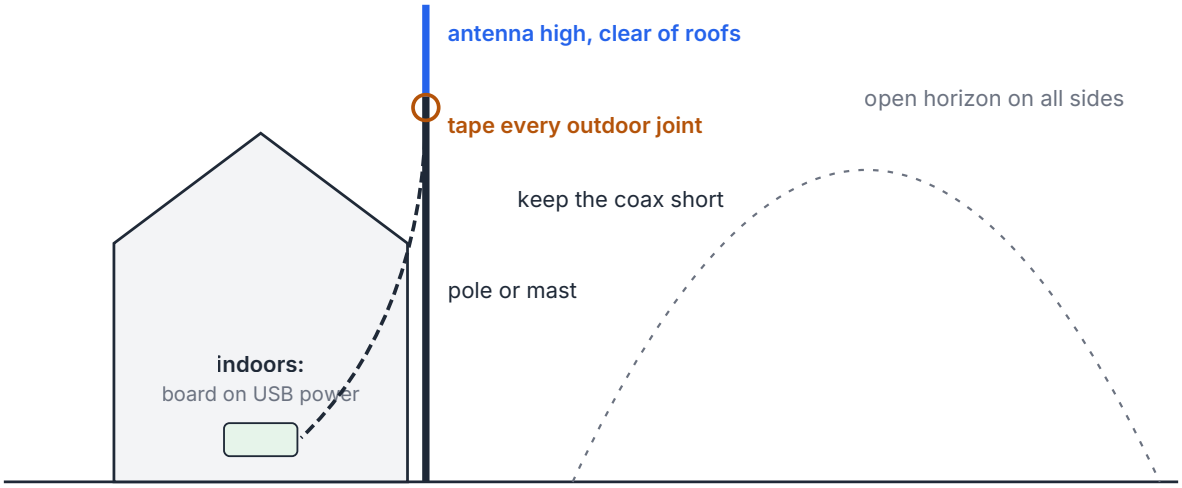


Trim a little at a time. Seal the base of the vertical with epoxy.

The DIY ground plane, seen from the side

Mount it

Put the antenna high and clear, with as much open horizon as you can get, on a pole, mast or balcony rail. Keep the coax run short, and wrap every outdoor connector joint tightly in mastic or self amalgamating tape.

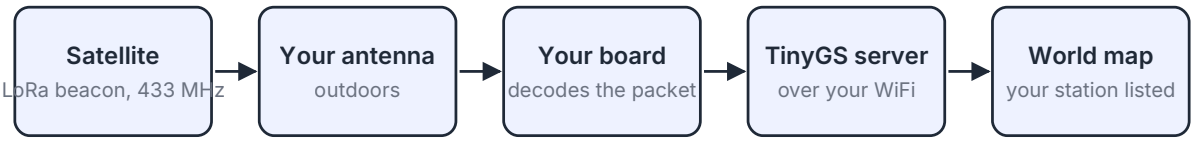


Antenna high and clear, cable short, joints taped

Later, an LNA (low noise amplifier) can lift weak signals. One contributor's tests on the TinyGS wiki found that a filter is a must alongside it, that a 60 dB amplifier gave no advantage, and that an LNA powered by a bias tee killed a LoRa chip over weeks, so add a DC blocker. Get the plain station working first. Source

Your first satellite

Your first packet arrives when a LoRa satellite passes within range and your antenna can see it. Low orbit passes are short, so the station has to be listening at the right minutes; leave it running.



How a packet travels from orbit to the map

1. Log in to your station console on tinygs.com with the link from `/weblogin` or your email account. Find your station by name and check it shows as online.
2. Watch the OLED. Out of the box the station listens for Norby, the network's default target. With automatic tuning on, it retunes to the nearest compatible satellite about 5 to 10 minutes before that satellite rises, and if none is overhead it waits.
3. When a packet lands, it appears under your station in the console. The packets page on tinygs.com shows packets from the whole network in real time, so you can see other stations hearing the same satellites.

4. Read what came down. TinyGS decodes packets from the satellites it supports, and the console shows what it decoded.

Two things look like failures and are not. A CRC error means a packet arrived with damaged bytes; it still shows the station is hearing something. Packets marked Unknown are usually ground LoRa traffic that shares the band, not satellites. Source

Write down the date, the satellite and your antenna for the first packet. Change one thing at a time after that (antenna height, cable, position) and compare packet counts over a week. That is the first real experiment this station gives you.

Troubleshooting

Symptom	Likely cause	Fix
Installer finds no board	Charging only USB cable, or a browser other than Chrome or Edge	Swap the cable; use Chrome or Edge
Installer fails partway	The installer is experimental	Retry, then flash with PlatformIO from the TinyGS wiki
No "My TinyGS" network	Firmware not running yet, or the board already joined your WiFi	Reflash; or find the board's address on your router and open it there
Setup page does not open	Phone did not trigger the captive page	Browse to 192.168.4.1 while joined to "My TinyGS"
Lost the panel password		Hold the PRG button for 8 seconds for rescue mode (an open setup network named after your station), or send the letter e over serial at 115200 baud to reset to defaults
Console shows MQTT "failed, rc=-2"	A firewall or ad blocker (Pi hole, for example) blocks the TinyGS server	Add an exception for it
Radio does not start	Board type not detected	Set the board type by hand in the panel
Station stays on Norby	No compatible satellite overhead yet	Wait; check automatic tuning settings in the console
Online for days, no packets	Small antenna from the box, indoor position, or a board for the wrong band	Fit an outdoor antenna; confirm the board is the 433 MHz version
OLED flips between light and dark	Intended, to slow screen wear	Leave it

Sources: TinyGS FAQ, Quick Start. For anything else, the TinyGS Telegram group is where the volunteers who run the network answer.

Next projects

1. Plot your own data. TinyGS documents a programmatic API, still in development, that lets a script control the station and read its data. Chart reception against antenna changes, and send the result to info@theconsciousness.ai if you want it shared as a reader experiment.
2. Add a wideband receiver. Our free RTL-SDR satellite receiver guide pairs an RTL-SDR Blog V4L with a dipole antenna kit and the open SatDump and SatNOGS software to hear weather satellites and the ISS, and to join the SatNOGS network. It covers far more of the spectrum than LoRa; this station teaches the habits it needs.
3. Put a satellite on your desk. AMSAT's open CubeSatSim is a working 1U model with solar panels, sensors and a radio beacon. Your ground station experience carries straight over, since you will be the operator listening to your own spacecraft. See the kits page for where to get it.

Credits and license

TinyGS is a non profit organization run entirely by volunteers. It started on November 28, 2019 as the ESP32 OLED Fossa GroundStation and took the TinyGS name when tinyGS.com launched on February 14, 2021. Its station software is licensed under GPL 3.0. This guide contains none of that code; it sends you to TinyGS's own installer and wiki. If the network helps you, you can support it through the donation page on tinygs.com.

This guide is independent and written by theconsciousness.ai. It is not made, endorsed or reviewed by TinyGS or Heltec Automation.

The guide is free, and every link in it is a plain link that earns nothing.

Tutorials we built on

Source	Date	License	What we used
TinyGS wiki	Ongoing	None stated for text; software is GPL-3.0	Flashing, configuration fields, LNA tests, rescue mode
TinyGS parts list tutorial	May 31, 2026	None stated	Parts, antennas and cables
TinyGS join tutorial	June 3, 2026	None stated	Email invite signup and the Telegram bot
TinyGS ground plane tutorial	Undated	None stated	Ground plane dimensions
TinyGS newsletter	Apr 19, 2026	None stated	Heltec V3 as the recommended board, LilyGO frequency stability

Source	Date	License	What we used
TinyGS FAQ	Ongoing	None stated	Troubleshooting
TinyGS repository on GitHub	Ongoing	GPL-3.0	Board support list, project history
Heltec, Pileup and TinyTronics listings	Nov 12, 2026	Not applicable	Prices and box contents

All wording above is ours; no TinyGS text is copied. Video tutorials were not reviewed for this guide.

Where sources disagree, or only one source exists

1. The wiki and the FAQ differ on whether the small antenna that ships with the board is enough to start. The guide treats it as a test antenna and recommends an upgrade.
2. The wiki's board list names only older Heltec and TTGO boards. The repository's README adds the Heltec V3, and the parts list and the newsletter recommend it. The guide follows the parts list.
3. Heltec's listing names no pigtail in the box; the two European sellers list one. The guide treats it as a part you may need to buy.
4. The ground plane dimensions come from one tutorial. They match the quarter wave formula for 433 MHz, which is why the guide keeps them.
5. Email invite signup is described in one source, the join tutorial from June 2026.
6. Holding PRG for 8 seconds to reset is described in one source.

Images

Every diagram in this guide was drawn for it by theconsciousness.ai. The guide uses no photos or screenshots from TinyGS, Heltec or any other site.

SDR satellite receiver build guide

theconsciousness.ai · Free guide · Version 1.2 · November 2026

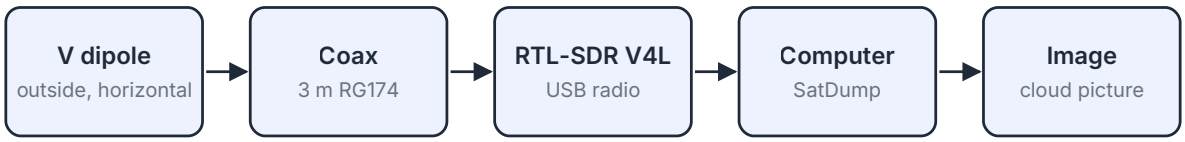
What you build

You build a radio receiver that pulls weather images straight from a Russian Meteor satellite and hears packets from the International Space Station, for $47.95 in parts plus a computer you already own. The receiver is an RTL-SDR Blog V4L, a USB software defined radio, with the RTL-SDR Blog dipole kit set up as a V dipole for 137 MHz. On a laptop, the open source SatDump program turns a single pass into a picture of the clouds over your region.

A second stage turns the same radio into an always on station. Add a Raspberry Pi and the SatNOGS client, and your receiver joins the SatNOGS network, where anyone can schedule satellite observations through it and the recordings land in a public archive.

This receiver belongs on theconsciousness.ai because the project's aerospace pillar asks what it takes to sense and compute in orbit, the hardware a perceiving machine would carry off the planet. Weather satellites are the oldest working example of a spacecraft that observes the Earth and sends the result down to anyone listening. Receiving one teaches the chain every CubeSat project depends on, from orbit prediction and Doppler to antenna pattern, demodulation and decoding.

This guide is the wideband companion to our TinyGS LoRa ground station guide. TinyGS hears one kind of signal on one band; this receiver tunes across the VHF and UHF bands where most CubeSats and weather satellites transmit.



The signal chain for stage one

How this guide was made. Every step comes from the official documentation of each project and the tutorials listed at the end, written in our own words, with every source credited. We have not built this exact station ourselves. The guide is free. Links marked "Amazon, affiliate link" earn theconsciousness.ai a commission at no extra cost to you. As an Amazon Associate I earn from qualifying purchases. Links marked "plain link" earn nothing.

Parts list

Stage one costs $47.95 for the V4L dongle and dipole kit bundle from RTL-SDR Blog. Stage two adds a Raspberry Pi. Prices below are the makers' own prices, read on their sites on November 12, 2026, except where marked. Amazon prices are not shown, so check them on Amazon.

Part	Price	Where to buy	Needed?
RTL-SDR Blog V4L dongle with multipurpose dipole kit	$47.95 at the RTL-SDR Blog store	RTL-SDR Blog store (plain link). Not stocked on Amazon USA yet	Yes
V4L dongle alone	$37.95 at the RTL-SDR Blog store	Same (plain link)	If you buy the antenna separately
Multipurpose dipole kit alone (two telescopic pairs, 60 cm RG174 base cable, 3 m RG174 extension, tripod, suction mount)	$17.95 at the RTL-SDR Blog store	Same store, or Amazon USA (Amazon, affiliate link)	Yes, unless bundled
A computer with a free USB port (Windows, macOS or Linux)	Owned		Yes, stage one
Raspberry Pi 4, 2 GB	$67.50 from October 1, 2026 (report)	Official Raspberry Pi resellers	Stage two
Pi power supply, microSD card, Ethernet cable	Not checked	Any	Stage two
RTL-SDR Blog Wideband LNA V2 (bias tee powered)	$19.95 at the RTL-SDR Blog store	Same store, or Amazon USA (Amazon, affiliate link)	Later upgrade

For buyers in Europe, RTL-SDR Blog's store says it can no longer ship directly to the EU from its webstore and sends EU buyers to its official AliExpress and eBay stores. It also lists V4L stock as limited because of manufacturing delays.

The guide uses the V4L because RTL-SDR Blog ended the V4 because its tuner chip, the R828D, is out of production, and the V4L replaces it with the R828S. Hackster reports that the R828S has two inputs instead of three, so the V4's extra input filtering is not possible, with the small upside of slightly better sensitivity. The V4L needs updated drivers, and on old ones it shows "no signal". RTL-SDR Blog says it is working with software makers to support it natively. RTL-SDR Blog V4L page, Hackster report

Check before you buy. Neither SatDump nor SatNOGS names the V4L as supported in its documentation, and SDRStore's SatDump guide tells readers to confirm SatDump compatibility before buying. The code shows that RTL-SDR Blog's own driver library added V4L support in March 2026. SatDump's Windows build scripts compile that same library, but SatDump's latest stable release (1.2.2) dates from November 2024, before that support existed. On Linux and macOS,

SatDump uses the rtl-sdr library installed on your system. So this guide has you install RTL-SDR Blog's current driver first, the route RTL-SDR Blog gives for programs that do not support the V4L yet. If you want a receiver with no driver step, ask in the SatDump or SatNOGS community which dongle they recommend today.

Tools

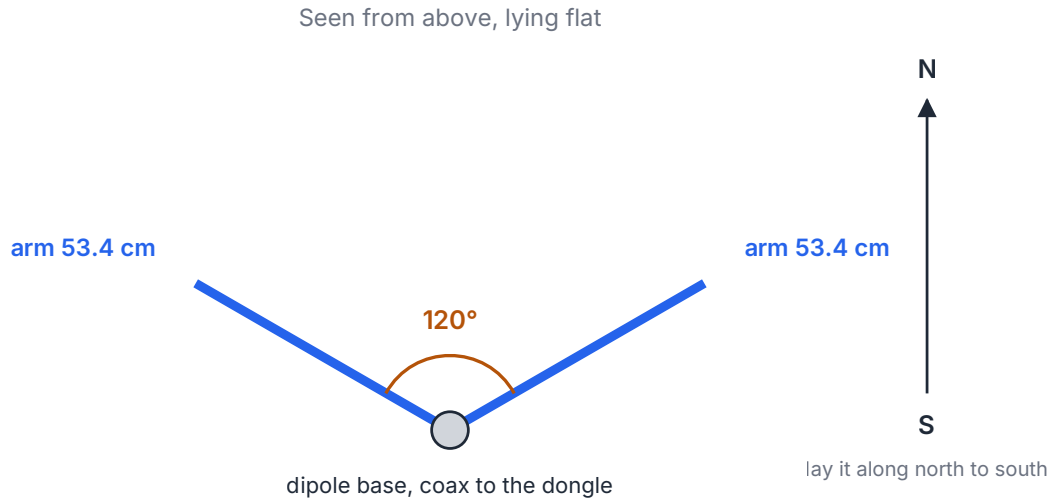
No soldering in stage one.

- A tape measure and a protractor, or a phone level app that shows angles
- A place outside with open sky to the north and south, such as a balcony rail, a garden pole or a flat roof
- Cable ties or tape to fix the tripod or suction mount
- A satellite pass predictor; SatDump has one built in
- A microSD card reader and a way to reach the Pi's command line (a keyboard and screen, or SSH from your computer), both for stage two

Build the antenna and receiver

The dipole kit becomes a V dipole tuned for 137 MHz, the band Meteor satellites use for images.

1. Screw the two large telescopic elements into the dipole base.
2. Extend each element to about 53.4 cm, roughly two and a half sections. Both arms must be the same length.
3. Open the arms to an angle of about 120 degrees between them, in a flat V.
4. Lay the V horizontal, not standing up, oriented north to south. Polar orbiting satellites cross the sky on north to south tracks, and this layout favors them.
5. Mount it outside with the tripod or suction mount, as high and clear of buildings as you can, and away from LED bulbs, USB chargers, monitors and Ethernet cables.
6. Run the 3 m RG174 extension inside, connect it to the base cable, and screw the SMA end onto the V4L dongle.
7. Plug the dongle into your computer.



The V dipole for 137 MHz, seen from above

The V lies flat because the satellites send circular polarization, and a horizontal V gives up about 3 dB on them in exchange for cutting vertically polarized ground signals by about 20 dB. Less ground noise means less overload. RTL-SDR Blog dipole guide

For the ISS at 145.825 MHz, shorten each arm a little. The dipole kit guide lists about 42 cm per side for 162 MHz and 60 cm for 115 MHz, so 145 MHz sits between them. Use an online dipole calculator for the exact length.

Software setup with drivers, SatDump and SatNOGS

Stage one, drivers and SatDump on your computer

1. Install the V4L driver. The V4L shows "no signal" on old drivers. On Windows, replace rtlsdr.dll in your SDR program's folder with the one from the RTL-SDR Blog driver release (x64 or x86 to match the program). On Linux, remove old rtl-sdr packages, build the current driver library, and blacklist the dvb_usb_rtl28xxu TV driver before rebooting. On macOS, RTL-SDR Blog points to SDR++. Source
2. Check the radio works on a strong local FM station in SDR++ or SDR# before you try a satellite.
3. Install SatDump, the stable release first, from its repository. On Windows, put RTL-SDR Blog's current rtlsdr.dll in SatDump's folder too.
4. Add the RTL-SDR as a source in SatDump's recorder.
5. Set the radio to a sample rate of 1.024 or 2.048 MSPS, with manual gain at a moderate value and the bias tee off.
6. Pick the Meteor LRPT pipeline that matches the satellite's current mode. Meteor commonly uses 72 ksym/s, but check the current mode before a pass.
7. Turn on baseband recording for your first passes, so you can decode the same pass again with other settings.

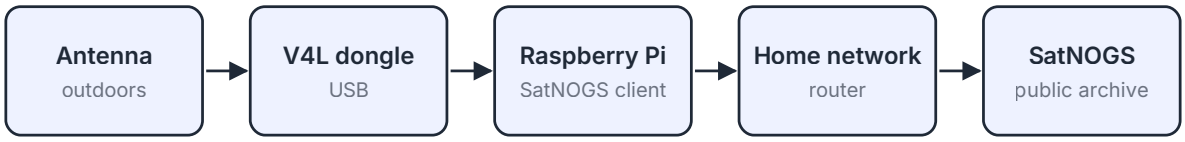
8. Check the pass list, update orbital data, confirm your location, and choose a pass with a high maximum elevation. Start recording just before the satellite rises.

Steps 3 to 8 follow SDRStore's SatDump beginner guide (May 2026).

Stage two, join SatNOGS with a Raspberry Pi

1. Sign up at network.satnogs.org, verify your email, add a ground station and create an API key. New stations start with a Testing flag.
2. Put Raspberry Pi OS on the Pi, and plug in the dongle and antenna.
3. Run the normal SatNOGS install command from the command line, `curl -sfL https://satno.gs/install | sh -s --`. The satnogs-setup menu comes up during the install.
4. In the basic options, enter the API token, station ID, latitude, longitude and elevation; set the SDR device to `driver=rtlsdr`, antenna RX and sample rate 2.048e6.
5. Set the gain. In an SDR program, start at zero and raise the gain until the noise floor just starts to rise. Close the SDR program afterward, since it blocks the dongle. Enter that value as SATNOGS_RF_GAIN under Advanced Setup, then Radio.
6. Exit the menu to apply the changes. This can take a few minutes.
7. Schedule a first observation and post good results in the SatNOGS community forum. The Testing flag comes off once others agree the station works.

Sources: SatNOGS Setup (edited July 2026), Get Started, Omnidirectional Station How To (2021, for the gain method).



Stage two puts your station on the SatNOGS network

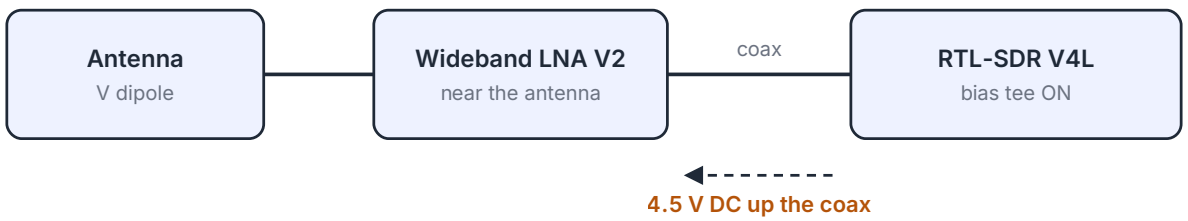
Antenna options

The V dipole is the cheapest antenna that works for weather images. SatNOGS's own guide warns that a fixed omnidirectional antenna makes CubeSat data difficult to receive, so plan an upgrade if you join the network.

Antenna	Cost	Best for	Notes
V dipole from the kit	In the $47.95 bundle	Meteor images, ISS APRS	Horizontal, 120 degrees, about 53.4 cm arms for 137 MHz

Antenna	Cost	Best for	Notes
V dipole plus Wideband LNA V2	$19.95 at the RTL-SDR Blog store	Long cable runs, weak passes	Powered by the dongle's bias tee; SatNOGS warns an LNA can overload the radio
Turnstile or quadrifilar helix (QFH)	DIY or bought	A permanent SatNOGS station	Circular polarization; the SatNOGS antenna page lists designs
RTL-SDR Blog L band patch set	$59.95 at the RTL-SDR Blog store	Inmarsat and Iridium at 1.5 to 1.6 GHz	Amazon USA (Amazon, affiliate link); a later step

Watch the bias tee. The V4L's bias tee supplies 4.5 V. RTL-SDR Blog warns against switching it on into an antenna that shorts DC unless an LNA sits between them. Turn it on only with the LNA connected. Source



Turn the bias tee on only with the LNA connected.
Never switch it on into an antenna that shorts DC.

Wiring the LNA

Your first satellites

Start with what is on the air in November 2026. Most older tutorials built around NOAA 15, 18 and 19 no longer apply. NOAA-18 was shut down in June 2025, and NOAA-15 and NOAA-19 were scheduled for shutdown in August 2025. Source

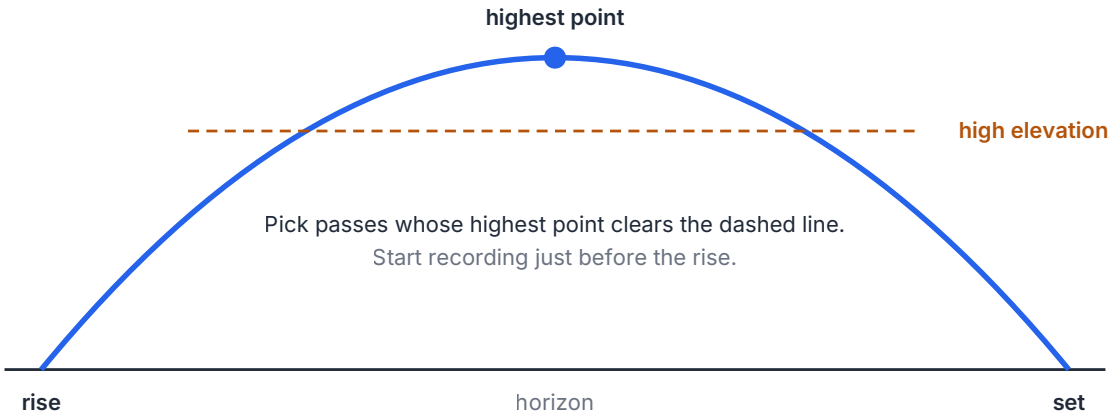
Target	Frequency	What you get	Notes
Meteor-M N2-4	LRPT near 137.1 or 137.9 MHz	Cloud images of your region	SatNOGS lists it as operational with 72k and 80k LRPT modes; check the current mode before a pass. SatNOGS DB
ISS APRS digipeater	145.825 MHz FM	Short data bursts relayed by the station	AMSAT calls it the most common ISS mode
ISS SSTV events	145.800 MHz FM	Pictures sent from orbit	Occasional

Target	Frequency	What you get	Notes
ISS voice repeater	437.800 MHz FM downlink	Voice from licensed operators	Listen only

ISS frequencies come from AMSAT.

Here is a first Meteor pass, step by step.

1. In SatDump, pick a Meteor pass with a high maximum elevation.
2. Start recording just before it rises.
3. Watch the waterfall. The signal grows as the satellite climbs and drifts in frequency because of Doppler shift.
4. Let the pipeline decode, then open the result in SatDump and save the image.
5. Gaps or noise in the picture mean the signal dropped. Raise the antenna, shorten the cable, or move away from electronics, and try the next high pass.



Choosing a pass

Keep a log of the time, elevation, gain and result of every pass. It is the start of a dataset about your own station.

Troubleshooting

Symptom	Likely cause	Fix
Dongle detected, no signal at all	Old drivers; the V4L needs the updated library	Install RTL-SDR Blog's current drivers
SatDump cannot find the device (Windows)	USB driver not set	SDRStore's guide uses Zadig with WinUSB on "Bulk-In Interface 0"; pick the device carefully, Zadig can overwrite other USB drivers

Symptom	Likely cause	Fix
Device busy	Another SDR program has it open	Close SDR++, SDR# or CubicSDR before decoding
Waterfall bright and noisy everywhere	Gain too high	Lower the gain
Signal visible, no image	Wrong pipeline, mode or sample rate	Match the pipeline to the satellite's current mode
Image has gaps	Signal dropped during the pass	Higher passes, higher antenna, shorter cable
Nothing on Meteor's frequency	Wrong time or a low pass	Update orbital data; check the pass prediction and your location
SatNOGS error "soapysdr::device::make() no match"	Library too old for the dongle	Update librtlsdr; a 2024 SatNOGS forum thread fixed a V4 this way
Local noise ruins observations	LED bulbs, USB chargers, monitors, HDMI or DVI cables, Ethernet near the antenna	Switch them off one at a time during a pass to find the source

Sources: SatDump beginner guide, RTL-SDR Blog V4L guide, SatNOGS forum thread, Omnidirectional Station How To.

Next projects

1. Build a TinyGS LoRa station. From about $20 in parts, a Heltec board receives CubeSat telemetry on 433 MHz and logs it on the TinyGS world map. Your SDR can show the same signals on its waterfall. See our free TinyGS ground station guide.
2. Add a weather dish. The site's weather satellite dish kit adds KrakenRF's Discovery Dish to the same V4L for images from GOES geostationary satellites. See the kits page.
3. Put a satellite on your desk. AMSAT's open CubeSatSim puts a working 1U model with a radio beacon on your table, and this receiver is how you hear it. The kits page has the details.

Credits and licenses

- SatDump is free software under GPL-3.0. The guide sends readers to the official project to download it. This guide contains none of its code.
- SatNOGS is a Libre Space Foundation project. Its wiki is under CC BY-SA 3.0, which means any text copied or adapted from it would make that part of our PDF share alike. We wrote every step in our own words and link to the wiki instead.

- RTL-SDR Blog guides state no content license, so their wording and photos are all rights reserved. Facts such as frequencies and antenna lengths are free to use; we paraphrase and link.
- RTL-SDR Blog, SatNOGS and SatDump are named only to say what the build uses. No logos appear. This guide is independent and is not affiliated with or endorsed by RTL-SDR Blog, the Libre Space Foundation or the SatDump project.
- Everything in this guide is receive only. Listening to satellites is legal in most countries; readers should check local rules.
- The guide is free. The links marked "Amazon, affiliate link" for the dipole kit, the Wideband LNA V2 and the L band patch set can earn a commission. As an Amazon Associate I earn from qualifying purchases. Every other link earns nothing.

Tutorials we built on

Source	Date	License	What we used
RTL-SDR Blog V4L page	2025 to 2026	None stated	Why the V4L exists, driver needs, bias tee warning
RTL-SDR Blog store page	Nov 12, 2026	Not applicable	Prices, stock, EU shipping
Hackster report	See article	Not applicable	R828D and R828S tuner change
RTL-SDR Blog driver library	March 2026	GPL-2.0	Date V4L support was added
RTL-SDR Blog dipole kit guide	2018, updated	None stated	V dipole lengths, angle and orientation for 137 MHz
SDRStore SatDump beginner guide	May 30, 2026	None stated	Install order, Windows driver, troubleshooting list
SatNOGS wiki	Ongoing	CC BY-SA 3.0	Client install, antenna advice, noise hunting (paraphrased only)
SatDump on GitHub	Ongoing	GPL-3.0	Pipelines, release dates and Windows build scripts
AMSAT ISS page	Ongoing	None stated	ISS frequencies
SatNOGS forum thread	2024	Forum post	V4 library fix

Video tutorials were not reviewed for this guide.

Where sources disagree, or only one source exists

1. Older tutorials, including SatNOGS how to pages from 2021, still teach NOAA APT. Those satellites were shut down in 2025. This guide uses Meteor instead.
2. Sources list both 72k and 80k LRPT and both 137.1 and 137.9 MHz. The guide tells readers to check the current mode before a pass.
3. SDRStore uses Zadig with WinUSB; RTL-SDR Blog describes replacing the rtlsdr.dll file. The guide gives both, the file swap for the V4L driver and Zadig if SatDump cannot find the device.
4. No documentation names the V4L as supported in either program. The guide says so plainly and gives RTL-SDR Blog's driver route.
5. The V4 SatNOGS fix rests on one forum thread.

Images

Every diagram in this guide was drawn for it by theconsciousness.ai. The guide uses no photos or screenshots from RTL-SDR Blog, SatNOGS, SatDump or any other site.