

RFEngineers, Inc.

Watch Dog receiver

User Manual

Document version 1.3

Covers firmware versions 2.2.6 and above

Covers Dashboard for Windows versions 1.5.1 and above

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Introduction

Congratulations!

You've just purchased a unique and highly-versatile FM, AM, and NOAA Weather receiver. Your Watch Dog receiver contains a number of features which aid in continually verifying the quality of your signal and alerting you or your infrastructure to any anomalies. Hence its name.

One major aspect that makes the Watch Dog receiver unique and versatile is its integrated USB serial interface or API, which allows complete machine or computer control of the receiver. A simple Python script can make the Watch Dog receiver do some very cool things. Our customers have already come up with some very clever uses of their own.

Another aspect that makes the Watch Dog receiver unique and versatile is its modular hardware design. All of its internal boards were designed with future upgrades and expandability in mind. We already have a number of items in the works that will allow customers to use the boards in their Watch Dog receivers in some very novel and useful ways.

We truly hope that this receiver will be a meaningful addition to your studio or other infrastructure.

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Watch Dog receiver features

- FM / AM / NOAA Weather receiver
- Class AB balanced speaker output (StudioHub+)
- Class AB single-ended headphone output
- Live RDS decoding and display
- Designed and tested for 24x7x365 operation
- Can be easily configured, controlled, and monitored from a PC or other computer
- Includes FREE *Watch Dog Dashboard for Windows* software
 - Point and click configuration
 - Easily monitor the receiver's various indicators, meters, and live RDS display in real-time
- Watch Dog serial interface / API
 - Able to be monitored and controlled remotely with the right configuration
 - Facilitates using the Watch Dog receiver as part of a larger automation system
 - Build your own software around the Watch Dog serial interface / API
- Fully configurable matrix of alarms and alarm output destinations
 - RSS below threshold alarm
 - SNR below threshold alarm
 - RDS loss alarm
 - Audio loss alarm
 - FM pilot loss alarm
 - NOAA 1,050 Hz alert tone detected
 - Front panel alarm output LEDs x 3
 - Rear panel General Purpose Output (GPO) alarm outputs x 4
 - Facilitates using the Watch Dog receiver as part of a larger automation system
- Tamper-resistant controls
- Embedded 32-bit microprocessor, firmware on modern Real-Time Operating System (RTOS)
- Integrated Hardware Watchdog Timer (WDT) automatically hard reboots the Watch Dog receiver and automatically restores the receiver to its settings safely stored in EEPROM should the receiver ever fail
- Field-upgradable firmware
- Modular, upgradable hardware design
- Designed, assembled, and individually tested in the USA

External connections and LED outputs

Front panel

The front panel of the Watch Dog receiver features 2 audio output jacks, a power indicator LED, and 3 alarm indicator LEDs.

Main (speaker) audio output

RJ-45 connector (configured as *StudioHub+* audio output connection)

Class AB balanced audio output

Independently controllable volume level

See also ***Front panel StudioHub+ connector details*** section below

Headphone audio output

Female 1/8" 3-conductor output jack

Class AB single-ended audio output

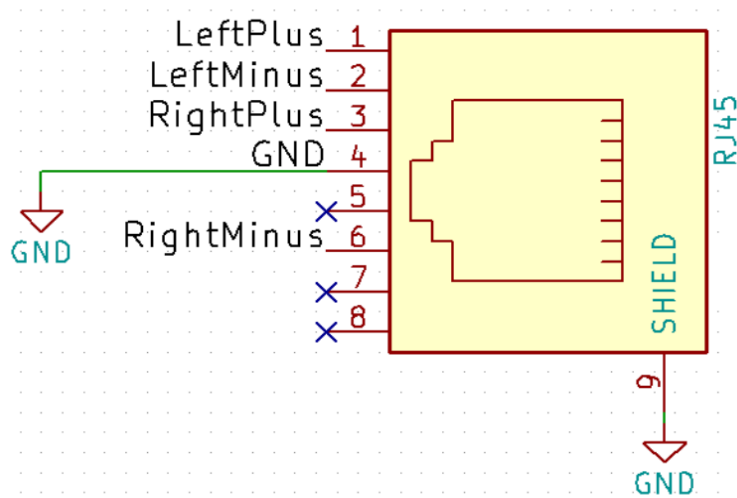
Independently controllable volume level

Alarm indicator LEDs

The 3 LEDs can be mapped to any number of alarm conditions

The 3 LEDs, from left to right, are referred to as alarm outputs A, B, and C

Front panel StudioHub+ connector details



The Watch Dog receiver's front panel RJ45 connector is balanced (differential) audio. It should **NOT** be connected to an unbalanced load without proper matching devices. There are many sources of such matching devices and StudioHub+ adapters available from your favorite supplier.

IMPORTANT NOTE

We strongly advise using Shielded Twisted Pair (STP, not UTP) cable when interconnecting balanced devices in or near a dense RF environment.

Rear panel

The rear panel of the Watch Dog receiver features an antenna connector, USB connector, and a D9 connector (also known as “DB9”).

Antenna input

BNC connector

USB connector

Powering the receiver in stand-alone mode (no PC connected):

Connect the provided USB cable and power supply to the Watch Dog's USB connector

Plug the USB power supply into wall power

Powering and/or configuring & monitoring the receiver with a PC:

Connect the provided USB cable to the Watch Dog's USB connector

Connect the other end of the USB cable to a PC or other computer

D9 connector

Alarm outputs can be sent to one of 4 GPO pins on the D9 connector

These 4 GPO pins are referred to as alarm outputs D, E, F, and G

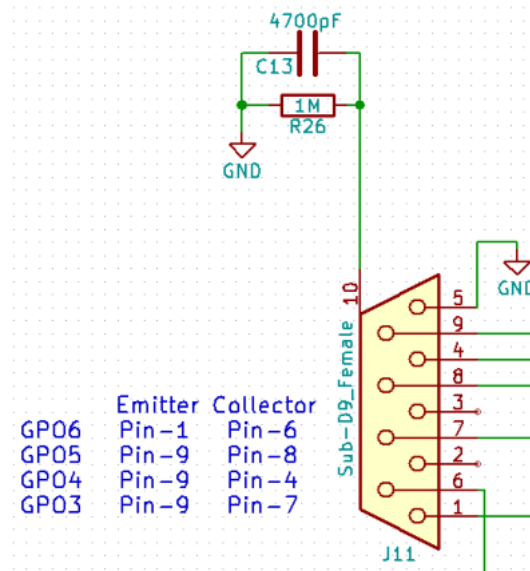
See also ***Rear panel D9 connector details*** section below

Rear panel D9 connector details

Outputs are open-collector Darlington pairs. Each output is opto-isolated via a PS2502L.

Limit collector Voltage to 30VDC max.

See PS2502L datasheet for more details.



GPO3 = Alarm output D

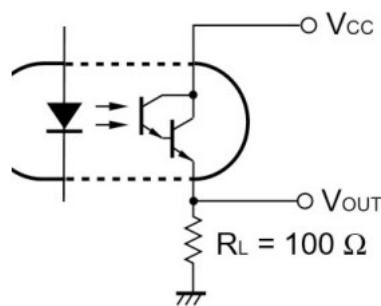
GPO4 = Alarm output E

GPO5 = Alarm output F

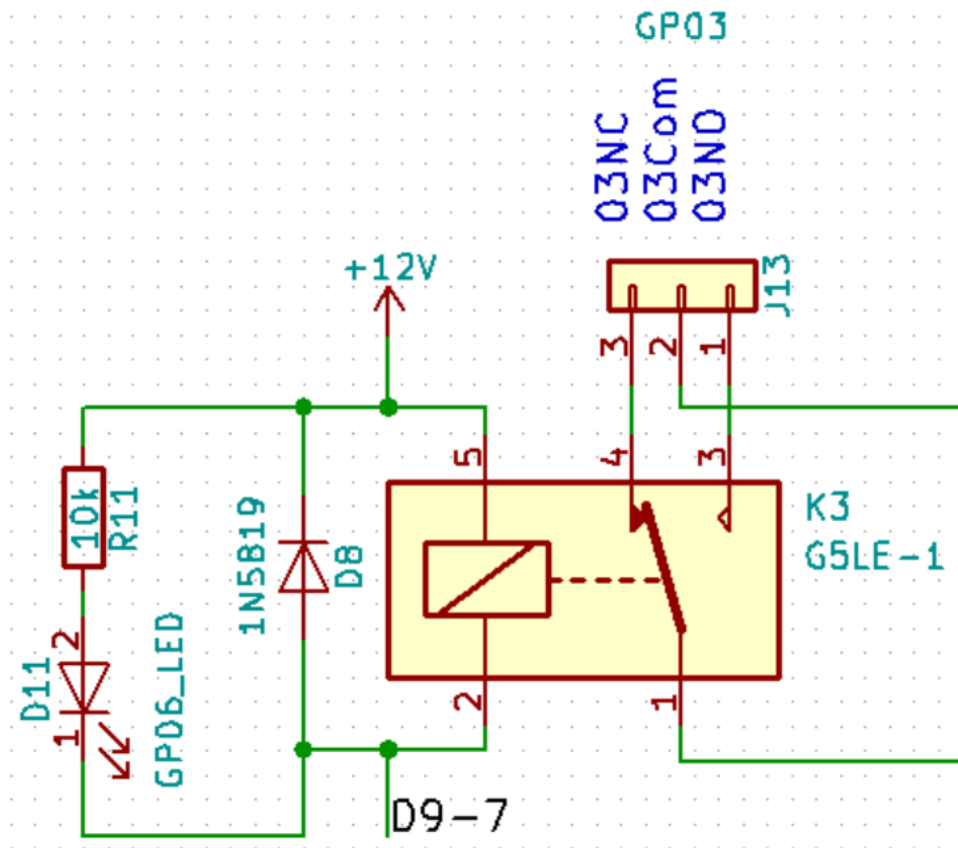
GPO6 = Alarm output G

See *Alarm output assignment* section below for more details on alarm outputs

Test circuit



Typical application



Receiver configuration and monitoring using the Watch Dog Dashboard for Windows

The easiest way to configure the Watch Dog receiver is with the *Watch Dog Dashboard for Windows*.

No Windows? No Problem!

Don't have a computer running Microsoft Windows? No problem! See the *Receiver configuration and monitoring using the USB serial interface / API* section of this manual.



Installing the Watch Dog Dashboard software for Windows

1. Download the latest version of the *Watch Dog Dashboard* from <http://www.RFEngineers.com/WD1>
2. Double-click the downloaded installation file to install the software
3. Start the *Watch Dog Dashboard* by finding it in your Start Menu under *RFE Watch Dog Dashboard*

Connecting to the Watch Dog receiver using the Watch Dog Dashboard software

1. Ensure that the Watch Dog receiver is connected to your PC via the provided USB cable
2. Start the *Watch Dog Dashboard* software
3. Click “Connect to device” – the software should automatically find your Watch Dog receiver and establish a connection

Configuring the Watch Dog receiver using the Watch Dog Dashboard software

General settings

The following receiver configuration parameters are accessible via the **General settings** pane of the Dashboard software:

- Receiver mode (FM, AM, or NOAA Weather)
- Frequency (FM or AM modes) or NOAA Weather channel number
- Main audio output level
- Headphone audio output level
- Stereo/mono audio output (FM mode only)
- FM De-emphasis Time Constant (DTC) (FM mode only)

Alarm settings
✕

Alarm output assignments

	<u>LED</u>			<u>Contact</u>			
	A	B	C	D	E	F	G
SNR Monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Audio Monitor	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RDS Monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RSS Monitor	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pilot Monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NOAA Monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Alarm output latch time

0 to 3600 seconds

Monitor parameters

Audio Monitor

Silence timeout
1 to 60 seconds

Audio floor
1 to 1,024

SNR Monitor

Minimum SNR
1 to 63

Low SNR timeout
1 to 60,000 milliseconds

RDS Monitor

Data timeout
1 to 60,000 milliseconds

RSS Monitor

Minimum RSS
1 to 127

Low RSS timeout
1 to 60,000 milliseconds

Pilot Monitor

Pilot loss timeout
1 to 60,000 milliseconds

NOAA 1,050 Hz Monitor

Minimum duration
1 to 60,000 milliseconds

Done

Cancel

Alarm settings

Alarm settings are accessed by clicking the “Alarm settings” button under the **Alarm states** pane of the Dashboard software. The Watch Dog receiver has 6 built-in “monitors” for triggering alarms, based on configurable thresholds and configurable alarm output destinations.

Alarms and monitors

Audio Monitor: Monitors the audio levels of the received (de-modulated) signal

- *Silence timeout* parameter specifies how many seconds of audio loss before entering alarm state.
- *Audio floor* parameter specifies the minimum audio level for considering audio to be present. The number used here is from the same scale as the audio level meters shown on the main Dashboard screen.

RSS Monitor: Monitors the Received Signal Strength (RSS) of the received signal

- *Minimum RSS* parameter specifies the minimum RSS level before entering alarm state.
- *Low RSS timeout* parameter specifies how long the RSS level must be low before entering alarm state.

SNR Monitor: Monitors the Signal to Noise Ratio (SNR) of the received signal

- *Minimum SNR* parameter specifies the minimum SNR level before entering alarm state.
- *Low SNR timeout* parameter specifies how long the SNR level must be low before entering alarm state.

Pilot Monitor: Monitors the presence of the pilot indicator (FM mode only)

- *Pilot loss timeout* parameter specifies how long the pilot indicator must be missing before entering alarm state.

RDS Monitor: Monitors the ongoing flow of RDS data (FM mode only)

- *Data timeout* parameter specifies how long the RDS data must be “stalled” or missing before entering alarm state.

NOAA 1,050 Hz Monitor: Monitors the received audio for presence of the NOAA 1,050 Hz alert tone

- *Minimum duration* parameter specifies how long the alert tone must be present before entering alarm state

Alarm output assignment

The “output” of any “monitor” (the state of any alarm) can be sent to one or more alarm outputs (alarm destinations). For example, the alarm state of the RSS, SNR, and RDS Monitors could be tied to alarm output B (the middle alarm LED on the Watch Dog receiver's front panel) and the alarm state of the RDS Monitor tied to alarm output D (the first of 4 GPO alarm outputs). Any alarm output with more than one monitor tied to it will result in an OR condition: the alarm output will go high if ANY of the monitors go into alarm.

Alarm output latching

An optional alarm latching period can be assigned, from 1-3,600 seconds (1 second to 1 hour). The latching period holds any alarm condition for an additional period of time after the condition clears.

Receiver configuration and monitoring using the USB serial interface / API

All features, and more, are available via the Watch Dog receiver's extensive USB serial interface / Application Programming Interface (API). The USB serial interface / API provides a command-line interface for both power users and users without Windows computers. It is also a powerful interface for automating the use of the Watch Dog receiver in a number of ways. More on that below.

Serial connection settings

Serial connections to the Watch Dog receiver are made at 115,200 baud, 8 data bits, no parity, 1 stop bit (115200 8N1).

Serial connection programs

Popular programs for making a serial connection (terminal connection) to the Watch Dog receiver include *Putty* (Mac OS X and Microsoft Windows) and *Minicom* (Linux). Plenty more information is available on these programs by doing a quick search of the Web.

```
COM26 - PuTTY
HELP
MODE          Get current receiver mode
MODE FM       Set receiver mode to FM
MODE AM       Set receiver mode to AM
MODE WX       Set receiver mode to WX
FREQ          Get current frequency
FREQ <X>      Set frequency
               - For FM mode, X must be between 64.0 and 108.0 MHz (6400 to
10800)
               - For AM mode, X must be between 520 and 1710 kHz (520 to 171
0)
               - For WX mode, X must be an NOAA Weather Radio channel number
(1 to 7)
RSS           Display current Radio Signal Strength (RSS)
SNR           Display current Signal-to-Noise Ratio (SNR)
MULT         Display current Multipath value (FM mode only)
PILOT        Display current Pilot indicator value (FM mode only)
VOL          Get current volume level
VOL <X>      Set volume level to X (0-10, 0=MUTE)
VERSION      Get firmware version
FACTORYRESET Reset all settings to factory defaults

SNRMONOUT    SNR Monitor: Get current alarm output settings
SNRMONOUT <X> SNR Monitor: Set alarm output settings
               - X is a 7-bit mask where the leftmost bit represents
alarm output A and the rightmost bit represents
alarm output G
               i.e. SNRMONOUT 0001110 enables alarm outputs D, E, and F

AUDMONOUT    Audio Monitor: Get current alarm output settings
AUDMONOUT <X> Audio Monitor: Set alarm output settings
               - X is a 7-bit mask where the leftmost bit represents
```

Using the USB serial interface / API

Once connected to the Watch Dog receiver via USB serial connection, simply type *HELP* to get a full and detailed listing of the various commands made available via the serial interface / API.

Example USB serial interface / API commands

1. Send “MODE” to query the receiver's current mode
2. Send “MODE FM” to switch the receiver to FM mode
3. Send “FREQ 89100” to tune the receiver to 89.1 MHz
4. Send “RSS” to get the current Received Signal Strength (RSS) reading
5. Send “AUDMONOUT 0010000” to tie the Audio Monitor alarm output to alarm output C

Example USB serial interface / API use cases

There are a number of use cases for the Watch Dog receiver's USB serial interface / API. These include:

- Don't have Microsoft Windows / Don't want Microsoft Windows
 - The serial interface is a great alternative to using the *Watch Dog Dashboard for Windows*
 - You can connect to the Watch Dog receiver using any computer with a USB port and a serial terminal program
- Control by another machine / computer
 - The Watch Dog receiver can be easily controlled by a computer program running on a computer with a USB connection to the receiver
 - Using a simple Python program, you could, for example, have a computer change the Watch Dog receiver's frequency every 10 seconds, starting at 88.0 MHz and going up to 108.0 MHz in increments of 0.1 MHz before repeating; recording the time, frequency, and a sample of the RSS and SNR meters from the Watch Dog at each frequency. This data could then be easily plotted on a graph, either later or in real-time.
 - You could also connect the Watch Dog receiver to an existing Internet-reachable PC via USB at a tower site and then remotely control the Watch Dog from its serial interface. You could also collect remote instrument readings this way (RSS, SNR, multipath, etc)
 - The alarm states of the Watch Dog receiver can even be continually polled remotely with the right configuration
 - Another use could be reading the live RDS information over the serial interface and displaying it on a monitor or saving it to a log file

Some of those ideas sound really cool! But also overwhelmingly technical!

Do one or more of the above ideas sound interesting to you, but you aren't sure how to get started? Do you have your own unique use in mind for the Watch Dog receiver but just aren't quite sure how to get started with it? No problem! Send us an email at support@RFEngineers.com or visit our web contact page at <http://www.RFEngineers.com/contact.html> and we'll likely be able to get you pointed in the right direction.