Installation Guide

Clone the repository, and install the folders in the following way:

Place the folder FreeRTOS-Plus-CLI-vESP32 downloaded from this repository into your Arduino/libraries folder.

your directory structure should look like:

Arduino/
    libraries/
        FreeRTOS-Plus-CLI-vESP32/
                FreeRTOS_CLI.c to FreeRTOS_CLI_vESP32.c
                FreeRTOS_CLI.h to FreeRTOS_CLI_vESP32.h

In your Arduino IDE install the rc-switch(c) library. It should show up in your libraries folder

In you Arduino/Sketches folder copy the RMTRC folder downloaded from the repository
Arduino/
    sketches/
        (your sketches)
        RMTRCv00/
            RMTRCv00.ino
            cli.ino
            etc

Open and compile the Sketch to verify there are no errors.

Connect your ESP32 board and upload the sketch.

Open your Serial Monitor console (baud rate=115200), reset your ESP32 board again, to see the messages displayed

User Guide

The Arduino Serial Monitor is the UI of the RMT Radio Code. Commands are entered in the command line.

When you want to use the “transmit” commands (rcsxmit, xmtxmit) please check the the corresponding PIN is connected to the RF transmitter (or directly croos-connected to the receiver PINs).
If you do not see the startup message in the Serial Monitor, reset the ESP32 board (do not close the Serial Monitor window) and check again the Serial Monitor. You should see a message like this:

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:1216
ho 0 tail 12 room 4
load:0x40078000,len:9720
ho 0 tail 12 room 4
load:0x40080400,len:6352
entry 0x400806b8

Queues created: xQSerialIn, xQrcs_rcvd, xQcode, xQrmtrx,  xQSpooler

Tasks created:
$Spool, $RCSrcv, $Serial, $RMTRx

RMT clock set to: 1000 nsec
Commands registered:
help,  rcsxmit, rcscfg
xrmtxmit, rmtcfg, rmttimingcfg, rmtshow
deltacfg, deltashow


 RMT Radio Code v.00
 based on FreeRTOS+CLI(c), esp-idf(c) API's and RCSwitch(c)

 Input  PINs, for RCSwitch PIN#: 14, for RMTRx PIN#: 27
Output PINs, for rcsxmit : PIN# 16, for rmtxmit: PIN# 17
```

First, type the “help” command, you should should see the following:

```
help  (echo of the command line)

help:
 Lists all the registered commands



rcsxmit <...>(24bits value, max = (2^24)-1 = 16777215)
```

transmit a code (a decimal value) using RC-Switch
example: rcsxmit 23456

rcscfg (Protocol)<1..5> (Pulselength usec)<1...400>) (Repeat)<1...16>
configure RC-Switch(c) protocol for transmission
example RC-Switch Protocol 1 configuration: rcscfg 1 350 4

rmtxmit <....>(24bits value, max = (2^24)-1 = 16777215)
transmit a decimal value using RMT peri[pheral
example: rmtxmit 23456

rmtcfg (Protocol)<1..5>
configure RMT preipheral according to RC-Switch(c) Protocols identification
example RMTXmit Protocol 1 configuration: rmtcfg 1

rmttimingcfg <TSynHigh> <TSynLow> <T0High> <T0Low> <T1High> <T1Low> (microseconds)
set timing for RMT transmission signals; also sets SYN pulse timing for the RMT receiver (start receiving signal)
it can be used if the protocols configured with rmtcfg do not provide adequate timing configuration
example: rmttiming 350 10850 350 1050 1050 350

rmtshow
returns current configured protocol parameters (example default Protocol 1):
T0High: 350, T0Low: 1050, T1High: 1050, T1Low: 350, TSynHigh: 350, TSynLow: 10850 (microseconds)

deltacfg <..> (microseconds)
configure Delta, timing tolerance allowed while decoding the received bits in the RMT peripheral
example default setup for protocol 1: deltacfg 50
Note1: 2 * Delta is the allowed bit timing tolerance, default is 50 microseconds.

deltashow
returns current Delta (example default Protocol 1):
Current Delta tolerance:50 (microseconds)

“cross-connection” example

example using using RC-Switch:

rcsxmit 12345 (transmit 12345 using RCSwitch)

RCS ready to xmit uint32_t: 12345 (message from the RCS task showing the code to transmit)

Pulse SYN rcvd, TLow: 10892, (microsec)
Note2: SYN detected with PulseIn

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{392 , 1090} , {436 , 1083} , {384 , 1084} , {380 , 1119} , {383 , 1083} , {382 , 1107}
{383 , 1082} , {385 , 1152} , {386 , 1084} , {381 , 1083} , {1118 , 384} , {1085 , 381}
{385 , 1082} , {384 , 1085} , {383 , 1087} , {391 , 1091} , {388 , 1084} , {383 , 1084}

{1085 , 386} , {1082 , 384} , {1083 , 388} , {384 , 1083} , {388 , 1084} , {1091 , 392}
Note3:
Code received and detected by RMT peripheral,
bit length: 25 (24 code bits + SYN)
oot: 0, amount of bits “out of tolerance”, where out of tolerance = 2 * Delta

RC-Switch(c) Code received: 12345, protocol: 1, bit length: 24
SYN: 10888 (microsec)

RC-Switch(c) Raw data:
{418 , 1092} , {382 , 1086} , {384 , 1085} , {387 , 1087} , {385 , 1082} , {383 , 1087}
{385 , 1084} , {383 , 1091} , {389 , 1091} , {385 , 1084} , {1083 , 384} , {1082 , 385}
{425 , 1085} , {382 , 1083} , {380 , 1120} , {382 , 1092} , {388 , 1111} , {384 , 1083}
{1083 , 431} , {1081 , 385} , {1082 , 381} , {418 , 1086} , {379 , 1085} , {1116 , 392}
Note4:
data as received from RC-Switch(c)

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{419 , 1092} , {385 , 1085} , {384 , 1084} , {387 , 1088} , {385 , 1082} , {383 , 1085}
{388 , 1083} , {383 , 1088} , {390 , 1092} , {386 , 1083} , {1083 , 385} , {1082 , 385}
{426 , 1083} , {384 , 1082} , {381 , 1118} , {384 , 1088} , {388 , 1112} , {387 , 1082}
{1083 , 430} , {1082 , 384} , {1083 , 381} , {418 , 1085} , {381 , 1084} , {1114 , 392}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{419 , 1092} , {385 , 1085} , {384 , 1084} , {387 , 1088} , {385 , 1082} , {383 , 1085}
{388 , 1083} , {383 , 1088} , {390 , 1092} , {386 , 1083} , {1083 , 385} , {1082 , 385}
{426 , 1083} , {384 , 1082} , {381 , 1118} , {384 , 1088} , {388 , 1112} , {387 , 1082}
{1083 , 430} , {1082 , 384} , {1083 , 381} , {418 , 1085} , {381 , 1084} , {1114 , 392}

rmtxmit 12345 (command echoed, transmit code using RMT peripheral)

RMTxmitRC value to xmit: 12345

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {1050 , 350} , {1050 , 350}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{1050 , 350} , {1050 , 350} , {1050 , 350} , {350 , 1050} , {350 , 1050} , {1050 , 350}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {1050 , 350} , {1050 , 350}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{1050 , 350} , {1050 , 350} , {1050 , 350} , {350 , 1050} , {350 , 1050} , {1050 , 350}

Pulse SYN rcvd, TLow: 10849, (microsec)
RMT code: 12345, bit length: 25, oot: 0

RMT data received:
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {1050 , 350} , {1050 , 350}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{1050 , 350} , {1050 , 350} , {1050 , 350} , {350 , 1050} , {350 , 1050} , {1050 , 350}

RC-Switch(c) Code received: 12345, protocol: 1, bit length: 24
SYN: 10851 (microsec)

RC-Switch(c) Raw data:
{350 , 1048} , {349 , 1050} , {350 , 1050} , {350 , 1052} , {348 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1053} , {350 , 1049} , {348 , 1050} , {1050 , 350} , {1050 , 350}
{350 , 1050} , {350 , 1052} , {348 , 1062} , {340 , 1048} , {353 , 1048} , {349 , 1050}
{1050 , 352} , {1082 , 316} , {1050 , 352} , {348 , 1050} , {350 , 1050} , {1052 , 349}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {1050 , 350} , {1050 , 351}
{349 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{1050 , 350} , {1050 , 350} , {1050 , 350} , {350 , 1050} , {350 , 1050} , {1050 , 350}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {1050 , 350} , {1050 , 350}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{1050 , 350} , {1050 , 350} , {1050 , 350} , {350 , 1050} , {350 , 1050} , {1050 , 350}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {1050 , 350} , {1050 , 350}
{350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050} , {350 , 1050}
{1050 , 350} , {1050 , 350} , {1050 , 350} , {350 , 1050} , {350 , 1050} , {1050 , 350}

rcsxmit 12345

RCS ready to xmit uint32_t: 12345

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{389 , 1136} , {387 , 1083} , {381 , 1093} , {383 , 1084} , {384 , 1084} , {418 , 1084}
{381 , 1083} , {385 , 1083} , {389 , 1090} , {388 , 1083} , {1081 , 385} , {1084 , 381}
{384 , 1084} , {385 , 1083} , {383 , 1086} , {383 , 1083} , {392 , 1091} , {398 , 1084}
{1083 , 384} , {1084 , 382} , {1083 , 384} , {381 , 1131} , {383 , 1084} , {1084 , 389}

RC-Switch(c) Code received: 12345, protocol: 1, bit length: 24
SYN: 10891 (microsec)

RC-Switch(c) Raw data:
{418 , 1089} , {385 , 1086} , {384 , 1085} , {383 , 1086} , {382 , 1082} , {383 , 1086}

{386 , 1084} , {383 , 1089} , {399 , 1126} , {384 , 1084} , {1083 , 383} , {1084 , 385}
{381 , 1132} , {383 , 1084} , {379 , 1085} , {417 , 1088} , {389 , 1090} , {387 , 1085}
{1083 , 383} , {1082 , 419} , {1083 , 386} , {384 , 1083} , {383 , 1087} , {1087 , 390}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{392 , 1089} , {385 , 1084} , {383 , 1084} , {383 , 1083} , {384 , 1084} , {389 , 1083}
{384 , 1084} , {381 , 1150} , {392 , 1090} , {436 , 1083} , {1084 , 384} , {1084 , 383}
{383 , 1083} , {384 , 1132} , {383 , 1084} , {385 , 1091} , {438 , 1084} , {381 , 1086}
{1116 , 384} , {1083 , 381} , {1102 , 384} , {385 , 1086} , {381 , 1085} , {1089 , 391}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{393 , 1090} , {388 , 1119} , {383 , 1085} , {381 , 1089} , {384 , 1083} , {381 , 1083}
{418 , 1084} , {385 , 1089} , {385 , 1083} , {384 , 1086} , {1084 , 419} , {1083 , 381}
{381 , 1084} , {383 , 1082} , {384 , 1085} , {392 , 1090} , {386 , 1083} , {384 , 1083}
{1082 , 383} , {1083 , 384} , {1084 , 382} , {384 , 1082} , {385 , 1145} , {1087 , 384}

RMT code: 12345, bit length: 25, oot: 0
RMT data received:
{419 , 1090} , {386 , 1084} , {387 , 1084} , {384 , 1085} , {382 , 1082} , {383 , 1085}
{387 , 1084} , {383 , 1086} , {390 , 1136} , {387 , 1083} , {1083 , 383} , {1085 , 384}
{381 , 1132} , {383 , 1083} , {381 , 1083} , {419 , 1084} , {389 , 1091} , {389 , 1085}
{1083 , 382} , {1083 , 419} , {1083 , 386} , {385 , 1082} , {383 , 1084} , {1087 , 390}

deltashow

Current Delta tolerance: 50 (microsec)
Note5: Delta is arbitrarily chosen by the developer. In the following examples it will be shown that even with the same protocol, the timings may differ depending on the transmission quality, and could be modified accordingly.

rmtshow

RMTXmit current settings:
T0High: 350, T0Low: 1050, T1High: 1050, T1Low: 350, TSynHigh: 350, TSynLow: 10850 (microsec)

Note6:
in these examples, using RMT to transmit, you can check minor differences in the pulse bits between RC-Switch and the RMT peripheral, the RMT peripheral provides a more “strict” measure, given it is measure based on a hardware device.

However, when we include a radio link, timings tend to be much different those specified by the protocols, due to noise and signal delays.

Example using 2 different receivers equipped with different antennas

Configuration 1 (worst case)

rmtxmit 23456
RMTxmitRC value to xmit: 23456

RMT code 23456 bit length = 25
RMT data received
{265 , 1159} , {243 , 1157} , {241 , 1141} , {260 , 1150} , {249 , 1156} , {246 , 1126}
{272 , 1143} , {258 , 1139} , {259 , 1156} , {946 , 452} , {248 , 1157} , {942 , 472}
{927 , 450} , {250 , 1163} , {937 , 458} , {941 , 451} , {947 , 445} , {255 , 1123}
{977 , 463} , {237 , 1164} , {237 , 1142} , {258 , 1137} , {262 , 1164} , {236 , 1160}

RMT code 23456 bit length = 25
RMT data received
{229 , 1168} , {233 , 1147} , {254 , 1179} , {221 , 1152} , {247 , 1131} , {268 , 1182}
{220 , 1168} , {231 , 1166} , {235 , 1142} , {957 , 447} , {252 , 1161} , {939 , 455}
{945 , 476} , {224 , 1148} , {951 , 456} , {943 , 471} , {929 , 467} , {233 , 1160}
{939 , 450} , {251 , 1196} , {203 , 1160} , {241 , 1158} , {242 , 1166} , {233 , 1152}

RC-Switch(c) Code rcvd : 23456, protocol : 1, bit length : 24
SYN : 10958

RC-Switch(c) Raw data :
 {241 , 1160} , {238 , 1153} , {247 , 1175} , {227 , 1173} , {226 , 1184} , {216 , 1171}
{228 , 1144} , {257 , 1147} , {254 , 1178} , {922 , 449} , {249 , 1190} , {909 , 454}
{946 , 445} , {255 , 1187} , {912 , 471} , {929 , 448} , {952 , 468} , {234 , 1163}
{935 , 476} , {224 , 1152} , {253 , 1181} , {222 , 1159} , {238 , 1169} , {233 , 1157}

RMT code 23456 bit length = 25
RMT data received
{241 , 1160} , {240 , 1154} , {247 , 1174} , {225 , 1176} , {225 , 1185} , {215 , 1170}
{230 , 1144} , {256 , 1147} , {252 , 1161} , {938 , 451} , {251 , 1188} , {911 , 453}
{946 , 445} , {255 , 1188} , {912 , 459} , {940 , 448} , {952 , 466} , {234 , 1165}
{935 , 476} , {223 , 1153} , {248 , 1211} , {189 , 1185} , {216 , 1154} , {244 , 1163}

RMT code 23456 bit length = 25
RMT data received
{241 , 1160} , {240 , 1154} , {247 , 1174} , {225 , 1176} , {225 , 1185} , {215 , 1170}
{230 , 1144} , {256 , 1147} , {252 , 1161} , {938 , 451} , {251 , 1188} , {911 , 453}
{946 , 445} , {255 , 1188} , {912 , 459} , {940 , 448} , {952 , 466} , {234 , 1165}
{935 , 476} , {223 , 1153} , {248 , 1211} , {189 , 1185} , {216 , 1154} , {244 , 1163}

Configuration 2 (best case)

rmtxmit 23456
RMTxmitRC value to xmit: 23456

Pulse SYN rcvd, TLow: 10859, (microsec)

RC-Switch(c) Code rcvd : 23456, protocol : 1, bit length : 24
SYN : 10863

RC-Switch(c) Raw data :
 {361 , 1060} , {344 , 1034} , {369 , 1030} , {378 , 1043} , {357 , 1045} , {347 , 1053}
{344 , 1055} , {345 , 1090} , {315 , 1058} , {1031 , 384} , {313 , 1082} , {1016 , 384}
{1015 , 388} , {313 , 1082} , {1018 , 386} , {1015 , 399} , {1000 , 393} , {298 , 1093}
{1009 , 403} , {296 , 1102} , {304 , 1091} , {307 , 1088} , {312 , 1092} , {313 , 1084}

rmtxmit 23456
RMTxmitRC value to xmit: 23456

RMT code 23456 bit length = 25
RMT data received
{341 , 1065} , {334 , 1067} , {332 , 1064} , {336 , 1065} , {333 , 1069} , {332 , 1066}
{333 , 1070} , {329 , 1069} , {330 , 1072} , {1018 , 398} , {303 , 1091} , {1006 , 401}
{999 , 407} , {291 , 1101} , {1000 , 412} , {987 , 407} , {993 , 411} , {287 , 1104}
{998 , 410} , {288 , 1106} , {297 , 1103} , {298 , 1094} , {307 , 1099} , {302 , 1093}

RMT code 23456 bit length = 25
RMT data received
{366 , 1037} , {360 , 1043} , {355 , 1044} , {355 , 1055} , {344 , 1047} , {351 , 1055}
{343 , 1055} , {344 , 1056} , {344 , 1055} , {1035 , 376} , {325 , 1078} , {1019 , 385}
{1014 , 388} , {310 , 1089} , {1011 , 387} , {1011 , 392} , {1008 , 393} , {306 , 1093}
{1007 , 398} , {300 , 1097} , {305 , 1091} , {312 , 1091} , {308 , 1087} , {315 , 1084}

RC-Switch(c) Code rcvd : 23456, protocol : 1, bit length : 24
SYN : 10855

RC-Switch(c) Raw data :
 {371 , 1032} , {364 , 1036} , {362 , 1039} , {354 , 1047} , {357 , 1046} , {352 , 1050}
{349 , 1049} , {349 , 1053} , {353 , 1055} , {1028 , 375} , {326 , 1073} , {1024 , 383}
{1016 , 386} , {312 , 1082} , {1017 , 388} , {1014 , 392} , {1008 , 394} , {303 , 1091}
{1008 , 394} , {305 , 1096} , {309 , 1091} , {313 , 1090} , {312 , 1089} , {317 , 1079}

RMT code 23456 bit length = 25
RMT data received
{372 , 1032} , {365 , 1037} , {361 , 1040} , {359 , 1041} , {357 , 1046} , {351 , 1050}
{350 , 1049} , {349 , 1053} , {346 , 1061} , {1029 , 375} , {325 , 1074} , {1024 , 383}
{1016 , 386} , {312 , 1082} , {1017 , 388} , {1013 , 391} , {1007 , 396} , {304 , 1092}
{1007 , 394} , {305 , 1097} , {304 , 1091} , {310 , 1086} , {316 , 1082} , {317 , 1084}

Note7: please verify the timing differences between both configurations.
The receiver AND the antenna play VERY important roles, do not underestimate them.

Example: reception using an actual remote control

RMT code: 10292984, bit length: 25, oot: 0
RMT data received:
{949 , 409} , {295 , 1132} , {287 , 1154} , {1000 , 371} , {1054 , 372} , {1046 , 381}
{322 , 1138} , {1000 , 401} , {300 , 1174} , {243 , 1156} , {274 , 1148} , {279 , 1140}
{1004 , 410} , {1013 , 399} , {1024 , 402} , {304 , 1133} , {1008 , 393} , {1032 , 383}
{1041 , 388} , {1036 , 389} , {1035 , 397} , {307 , 1124} , {298 , 1131} , {298 , 1138}

RC-Switch(c) Code received: 10292984, protocol: 1, bit length: 24
SYN: 11045 (microsec)

RC-Switch(c) Raw data:
{1112 , 316} , {387 , 1040} , {382 , 1047} , {1091 , 348} , {1074 , 355} , {1067 , 357}
{349 , 1084} , {1057 , 366} , {340 , 1091} , {334 , 1082} , {343 , 1083} , {341 , 1091}
{1048 , 365} , {1057 , 368} , {1056 , 367} , {344 , 1075} , {1065 , 360} , {1042 , 395}
{1044 , 372} , {1046 , 381} , {980 , 438} , {332 , 1097} , {351 , 1071} , {353 , 1081}

RMT code: 10292984, bit length: 25, oot: 0
RMT data received:
{1055 , 358} , {349 , 1079} , {344 , 1086} , {1050 , 353} , {1072 , 353} , {1070 , 355}
{349 , 1088} , {1056 , 360} , {341 , 1097} , {322 , 1098} , {331 , 1089} , {338 , 1080}
{1063 , 366} , {1057 , 368} , {1056 , 377} , {327 , 1102} , {1042 , 378} , {1045 , 379}
{1045 , 384} , {1040 , 385} , {1039 , 385} , {322 , 1111} , {310 , 1114} , {310 , 1126}

RMT code: 10292984, bit length: 25, oot: 0
RMT data received:
{1079 , 334} , {375 , 1054} , {369 , 1055} , {1082 , 348} , {1074 , 355} , {1068 , 356}
{349 , 1085} , {1054 , 366} , {343 , 1089} , {335 , 1083} , {343 , 1082} , {343 , 1080}
{1059 , 365} , {1057 , 368} , {1053 , 368} , {346 , 1075} , {1063 , 362} , {1041 , 395}
{1045 , 363} , {1055 , 381} , {980 , 438} , {332 , 1094} , {351 , 1072} , {355 , 1081}

RMT code: 10292960, bit length: 25, oot: 1
RMT data received:
{1112 , 318} , {388 , 1040} , {382 , 1046} , {1086 , 343} , {1079 , 345} , {1074 , 353}
{360 , 1068} , {1068 , 358} , {355 , 1073} , {352 , 1072} , {352 , 1072} , {352 , 1072}
{1066 , 358} , {1065 , 365} , {1053 , 368} , {347 , 1085} , {1039 , 376} , {1037 , 393}
{1025 , 403} , {606 , 832} , {274 , 1140} , {262 , 1156} , {335 , 1085} , {355 , 1069}

Note8:
this is an actual remote transmission. An error occurred in the last reception, and was detected (oot=1). It could even happen that the code is interpreted correctly, even having some errors (oot > 0), it could be out of tolerance but still represent the same type of difference between the HIGH and LOW portions of the bit.
The developer has several options to consider, but the ultimate one is that the code should be recognized as a valid code for the application.

Example: just noise….

Or even actual codes received with a very bad signal/noise ratio (the RMT ended the reception when receiving another SYN or break, and detected 24 “bit shaped” signal variations)

MT code: 16736191, bit length: 25, oot: 19
RMT data received:
{598 , 51} , {871 , 21} , {334 , 22} , {1109 , 36} , {832 , 26} , {969 , 300}
{647 , 37} , {708 , 30} , {281 , 436} , {1607 , 223} , {816 , 1137} , {1418 , 130}
{344 , 162} , {1141 , 149} , {4053 , 699} , {336 , 21} , {274 , 88} , {559 , 882}
{502 , 92} , {1441 , 706} , {875 , 31} , {2050 , 1168} , {782 , 27} , {95 , 54}

Pulse SYN rcvd, TLow: 10849, (microsec)
Pulse SYN rcvd, TLow: 10813, (microsec)
RMT code: 11497455, bit length: 25, oot: 23
RMT data received:
{145 , 123} , {344 , 4402} , {421 , 35} , {244 , 253} , {714 , 405} , {997 , 32}
{1193 , 42} , {247 , 21} , {414 , 2076} , {969 , 18} , {388 , 205} , {408 , 2257}
{2453 , 1068} , {2385 , 646} , {909 , 25} , {425 , 105} , {3618 , 22} , {303 , 30}
{834 , 45} , {307 , 656} , {1121 , 163} , {459 , 31} , {3255 , 25} , {1817 , 1430}

RMT code: 16612582, bit length: 25, oot: 20
RMT data received:
{825 , 44} , {491 , 273} , {1317 , 34} , {1380 , 30} , {1399 , 201} , {328 , 36}
{1042 , 3611} , {824 , 20} , {441 , 715} , {760 , 61} , {358 , 44} , {705 , 69}
{922 , 59} , {643 , 618} , {148 , 1070} , {219 , 1798} , {93 , 33} , {185 , 68}
{318 , 51} , {23 , 843} , {291 , 1124} , {741 , 106} , {1590 , 31} , {393 , 1609}

Pulse SYN rcvd, TLow: 10804, (microsec)
RMT code: 16351179, bit length: 25, oot: 21
RMT data received:
{1733 , 18} , {218 , 38} , {1362 , 55} , {1236 , 449} , {817 , 80} , {320 , 686}
{162 , 3300} , {257 , 137} , {107 , 725} , {184 , 139} , {938 , 44} , {570 , 41}
{161 , 92} , {1453 , 107} , {940 , 881} , {892 , 322} , {1481 , 55} , {323 , 36}
{1304 , 1368} , {283 , 723} , {766 , 183} , {1470 , 1677} , {599 , 58} , {272 , 18}

RMT code: 7560702, bit length: 25, oot: 21
RMT data received:
{276 , 3267} , {1052 , 16} , {335 , 52} , {1392 , 135} , {93 , 716} , {391 , 813}
{1307 , 385} , {191 , 27} , {101 , 1068} , {329 , 73} , {217 , 763} , {1547 , 547}
{588 , 27} , {256 , 35} , {421 , 470} , {506 , 30} , {162 , 35} , {357 , 21}
{957 , 48} , {900 , 48} , {770 , 166} , {710 , 26} , {1239 , 141} , {1069 , 1231}

RMT code: 10222451, bit length: 25, oot: 23
RMT data received:
{1017 , 27} , {1405 , 1705} , {100 , 904} , {610 , 607} , {479 , 30} , {565 , 688}
{925 , 64} , {106 , 19} , {386 , 69} , {745 , 482} , {1834 , 698} , {1568 , 1113}
{213 , 25} , {208 , 574} , {289 , 36} , {995 , 712} , {787 , 4012} , {2098 , 27}
{150 , 33} , {245 , 18} , {1013 , 2991} , {526 , 784} , {975 , 277} , {55 , 48}

RMT code: 13487615, bit length: 25, oot: 21
RMT data received:

{932 , 40} , {956 , 199} , {305 , 691} , {701 , 1715} , {214 , 82} , {606 , 38}
{319 , 819} , {949 , 194} , {671 , 560} , {488 , 35} , {309 , 521} , {340 , 367}
{752 , 15} , {413 , 30} , {44 , 488} , {119 , 75} , {1502 , 1387} , {499 , 346}
{109 , 40} , {225 , 26} , {281 , 207} , {288 , 52} , {152 , 16} , {367 , 39}

RMT code: 6163135, bit length: 25, oot: 24
RMT data received:
{72 , 243} , {66 , 30} , {96 , 1739} , {4388 , 43} , {1695 , 402} , {1518 , 151}
{442 , 381} , {144 , 1153} , {730 , 1659} , {974 , 1200} , {90 , 957} , {1902 , 3451}
{1024 , 112} , {929 , 2090} , {670 , 97} , {1637 , 4513} , {774 , 527} , {34 , 929}
{2054 , 1011} , {2049 , 107} , {542 , 21} , {596 , 210} , {468 , 29} , {567 , 22}

RMT code: 1953651, bit length: 25, oot: 22
RMT data received:
{114 , 320} , {263 , 700} , {781 , 1524} , {414 , 56} , {1180 , 58} , {659 , 200}
{210 , 300} , {965 , 141} , {1176 , 341} , {180 , 110} , {676 , 1039} , {394 , 922}
{3287 , 874} , {918 , 34} , {255 , 45} , {1668 , 610} , {522 , 773} , {913 , 460}
{1670 , 120} , {2178 , 35} , {630 , 1675} , {1371 , 1467} , {887 , 270} , {1659 , 96}

RMT code: 1953651, bit length: 25, oot: 22
RMT data received:
{114 , 320} , {263 , 700} , {781 , 1524} , {414 , 56} , {1180 , 58} , {659 , 200}
{210 , 300} , {965 , 141} , {1176 , 341} , {180 , 110} , {676 , 1039} , {394 , 922}
{3287 , 874} , {918 , 34} , {255 , 45} , {1668 , 610} , {522 , 773} , {913 , 460}
{1670 , 120} , {2178 , 35} , {630 , 1675} , {1371 , 1467} , {887 , 270} , {1659 , 96}

Pulse SYN rcvd, TLow: 10856, (microsec)
RMT code: 13840127, bit length: 25, oot: 22
RMT data received:
{514 , 33} , {140 , 47} , {377 , 787} , {46 , 35} , {390 , 1542} , {481 , 876}
{513 , 198} , {977 , 25} , {1193 , 1389} , {796 , 1222} , {1179 , 25} , {161 , 318}
{1024 , 62} , {394 , 275} , {325 , 106} , {66 , 349} , {1658 , 123} , {659 , 193}
{2810 , 546} , {891 , 124} , {1519 , 40} , {776 , 180} , {567 , 24} , {734 , 105}

RMT code: 15204349, bit length: 25, oot: 23
RMT data received:
{177 , 38} , {706 , 288} , {231 , 27} , {250 , 2500} , {1566 , 1681} , {499 , 293}
{412 , 64} , {293 , 204} , {937 , 483} , {806 , 95} , {615 , 38} , {386 , 111}
{243 , 17} , {674 , 599} , {1422 , 55} , {4921 , 474} , {2532 , 91} , {2036 , 617}
{794 , 258} , {234 , 33} , {1889 , 21} , {249 , 17} , {568 , 4646} , {541 , 75}

RMT code: 15204349, bit length: 25, oot: 23
RMT data received:
{177 , 38} , {706 , 288} , {231 , 27} , {250 , 2500} , {1566 , 1681} , {499 , 293}
{412 , 64} , {293 , 204} , {937 , 483} , {806 , 95} , {615 , 38} , {386 , 111}
{243 , 17} , {674 , 599} , {1422 , 55} , {4921 , 474} , {2532 , 91} , {2036 , 617}
{794 , 258} , {234 , 33} , {1889 , 21} , {249 , 17} , {568 , 4646} , {541 , 75}