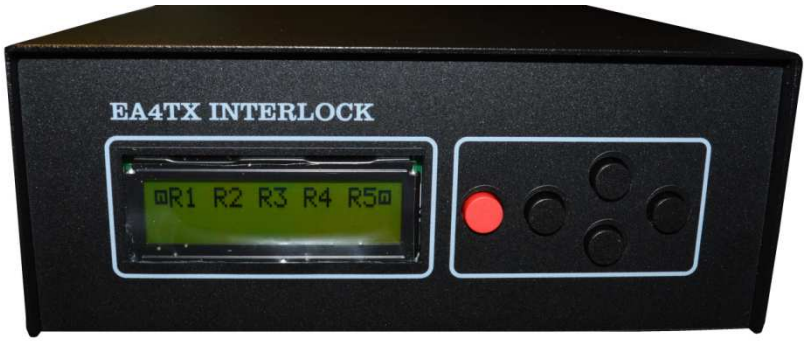
EA4TX InterlockV3



EA4TX Interlock
Users manual

March/2020 **Rev 3.1h**

Introduction

The Interlock is a device intended for use by multioperator contest groups, which allows monitoring and control of up to 5 radios, and avoiding rule violation in M/S or M/2 in so far as number of signals on the air refers.

The interlock connects to each radio through two ways:

- PTT: This is an output signal (TX) from the radio which pulls to ground whenever the radio transmits.
- TX Inhibit: An input signal to the radio which serves to inhibit or disable transmission of that radio

▶ **Note:** Not all radios have a TX inhibit input. Rigs such as some Yaesu (FT1000, 1000MP, 2000, etc) or the Elecraft K3 have a connector for TX inhibit

This way, the interlock monitors the TX status of each radio (PTT signal) and after analyzing priorities and statuses, determines whether it should action the Inhibit in any of them to block transmission

The interlock has 5 levels of priority and the user assigns a level to each radio, this level can be changed during a contest. The maximum priority is level 5 and the minimum priority is level 1. If at a given moment the device detects 2 radios and determines that one of them should be blocked, it uses the priority level for this. The radio with the lowest level will be blocked when the Interlock activates the signal inhibit. In the case of two radios having the same priority level, the last radio to start transmitting will be the one that is blocked.

◆ ***It is very important that you read the manual*** Although the product is designed to be pure plug & play and is very intuitive, it is worthwhile knowing fully the different options, both of hardware and software, to be able to get the most out of it.

About this manual

The manual is divided up in 3 sections

At the end, there are 3 annexes which describe the connections with various different kinds of radios.

Please read the manual carefully before connecting the device. If you have any doubts of problems, please contact:

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EA4TX Interlock V3 Hardware

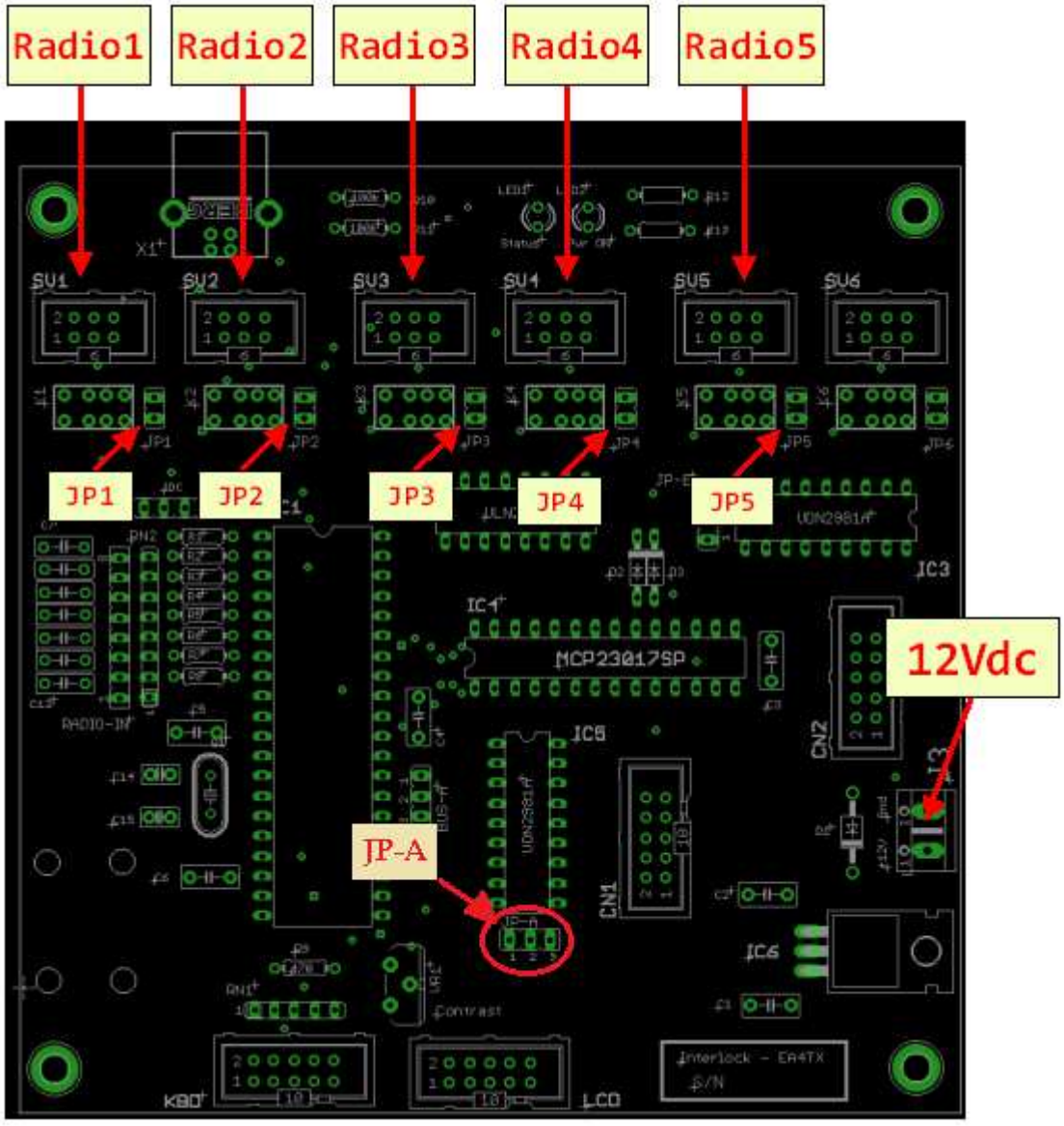
The interlock has the following connections:

- Power cable for 12-14Vdc.
- Interface with 5 radios using DB9 connectors.
- USB connector for firmware updates

The device has the following connections, seen from the inside:

- **X1**: USB port to connect to the PC
- **CN1:**Additional In/Out socket
- **CN2:**Additional In/Out socket
- **J3:**Power input (12-14Vdc)
- **Radio1** to **Radio5**: interfaces for each Radio

Inside view of the device:



1.1 Sockets R1 – R5: DB9 connection for Radio interface

The interlock supports up to 5 radios, two of which (R4 and R5) can be configured as **Inband.**

Each one of these radios has to be connected via the corresponding DB9 socket. Here is the rear view of the device:

Rear view of the interlock

1.2 DB9 pinout

The signals available in this connector are as follows:

- Pin-1: Ground/ Earth
- Pin-2: Signal Inhibit (OUT)
- Pin-3 Connection with Pin 8, idle through a relay
- Pin-4 Not used
- Pin-5 Not used
- Pin-6: Radio PTT entry (IN)
- Pin-7: Auxiliar output signal. Choose between 5 or 12Vdc using JP-A.
- Pin-8: Connected to pin 3, idle through a relay
- Pin-9: Not used

The radios which have a Signal Inhibit (Yaesu, K3) only use 3 signals: Ground, Inhibit, and PTT.

In the radios that don't have an Inhibit input, the method to stop transmission is:

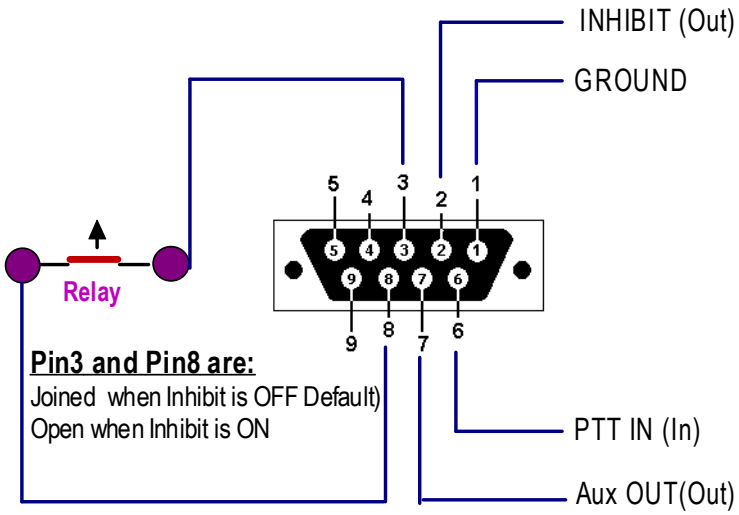
- **SSB**: Routing the microphone signal through the relay at pins 3 and 8 of the DB9. When idle, the pins are connected, but when the block is activated the relay isolates the pins and the radio cannot send any SSB signals (no input Mic)
- **CW**: Routing the CW signal through the relay at pins 3 and 8 on the DB9. When idle the pins are connected but when the block is activated the pins are isolated and so no CW signal can be sent.

The auxiliary signal (Pin 7) can be used for radios configured as IN-BAND (R4 or R5) to activate the switching relay with the Inband station.

📖 Using the JP-A we can select the output level of either 5 or 12V and this level is common for all radios. The configuration is through a bridge which works as follows:

- 1-2: 5V
- 2-3: 12V

The DB9 connector schematic is as follows:



1.3 Jumpers JP-1, JP-2, JP-3, JP-4 and JP-5,

Those jumpers are located close to each of the radio relays. The jumper of the radio is used (jumper close) when the radio doesn't include an Inhibit signal so the Auxiliary PCB is used. In this case, 5V will be present at pin2 when the Inhibit signal is activated.
So, set the jumper when the Auxiliary Box is going to be used on that radio.

1.4 J1: External power

Power input from 12-14Vdc and 150mA.

Configuration

To enter the Interlock program menu, press the red button or F1. The interlock will immediately enter the programming mode, showing option screens as follows

- To go to the next menu, press ⇧ (up arrow).
- To return to the previous menu, press ⇩ (down arrow).
- To go on to the next option, press ⇨ (right arrow).
- To go to the previous option, press ⇦ (left arrow).

To save and exit the programming menu, press the red button again.

🕮 The device will automatically exit the programming menu if no buttons are pressed for 9 seconds.

The menus are as follows:

SET1: M/S o M/2

Allows the user to choose between two modes of operation:

- **M/S**: Maximum 1 signal allowed.
- **M/2**: Maximum 2 signals allowed.

SET2: Radio 1 - Priority

This defines the priority of Radio 1. Possible values: 1 is the lowest priority and 5 is the highest.

If the interlock determines that it has to block a radio, it will always block the one with lower priority. If both radios have the same priority, it will block the last one to start transmitting.

SET3: Radio 2 - Priority

This defines the priority of Radio 2. Possible values: 1 is the lowest priority and 5 is the highest.

SET4: Radio 3 - Priority

This defines the priority of Radio 3. Possible values: 1 is the lowest priority and 5 is the highest.

SET5: Radio 4 – Mode

This defines the mode of operation of radio 4. The possible modes are:

- **Disabled**: There is no radio 4, so its status is not checked
- **Normal**: Radio 4 is a normal radio (not an Inband)
- **Inband->R1**: Radio 4 is an Inband radio paired with Radio 1
- **Inband->R2**: Radio 4 is an Inband radio paired with Radio 2
- **Inband->R3**: Radio 4 is an Inband radio paired with Radio 3

SET5b: Radio 4 - Priority

This defines the priority of Radio 4. Possible values: 1 is the lowest priority and 5 is the highest.

SET6: Radio 5 – Mode

This defines the mode of operation of radio 5. The possible modes are:

- **Disabled**: There is no radio 5, so its status is not checked
- **Normal**: Radio 5 is a normal radio (not an Inband)
- **Inband->R1**: Radio 5 is an Inband radio paired with Radio 1
- **Inband->R2**: Radio 5 is an Inband radio paired with Radio 2
- **Inband->R3**: Radio 5 is an Inband radio paired with Radio 3

SET6b: Radio 5 - Priority

This defines the priority of Radio 5. Possible values: 1 is the lowest priority and 5 is the highest.

SET7: USB Port

This determines whether the USB port should be activated or not. The port should **ALWAYS** be left deactivated.

🕮 Even if the device is in *configuration* mode, it will continue supervising signals from the radios and will block whichever one it needs to.

Operation

The interlock detects and decides in tenths of a microsecond if a radio has activated the PTT and decides whether it needs to take action on this or any other active radio.

In order to do this it uses an algorithm which prioritizes jobs with respect to others. So for example it will prioritize when comparing a radio and its Inband partner, since under no circumstance can both of these radios put a signal on the air at the same time.

The order in which the jobs are queued is as follows:

1. Radio 4 is analyzed for being Inband or not. If it has the PTT active, and if its partnered radio (for example R1) is also active.
2. If this is the case, it decides which one should be blocked.
3. The same process is carried out with radio 5: if it's an Inband radio, if the PTT is active, and if its partner radio (eg R2) is also active.
4. If this is the case, it decides which one should be blocked.
5. It will now analyze all the rest of the radio that might be active, since in the previous cases with the Inbands, some of them might be already be blocked.
6. In case it has to block any radio, it will first analyze the priorities of the active radios and block the one with lower priority.
7. Finally, in the case that the remaining radios have equal priority, the one the started transmitting first will continue to transmit.

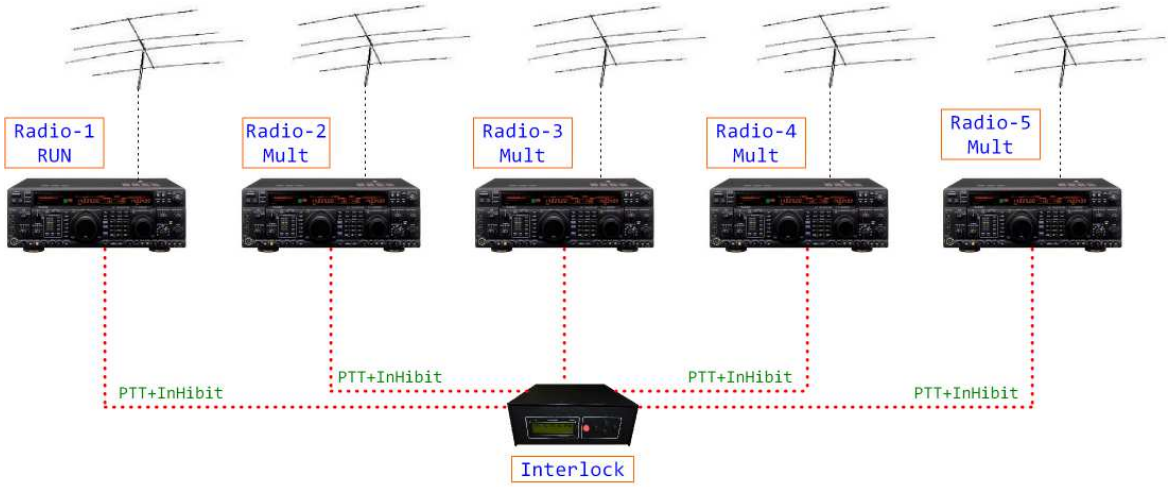
The interlock provides two Operation modes, and this is what determines how many radios on different bands can be active at the same time:

- M/S: One signal allowed at a time
- M/2: Two signals allowed at a time

IMPORTANT NOTE:

The LCD display only refreshes every 0.5 seconds, therefore it's possible that a PTT change may not be showed on the screen although the microprocessor has monitored it perfectly.

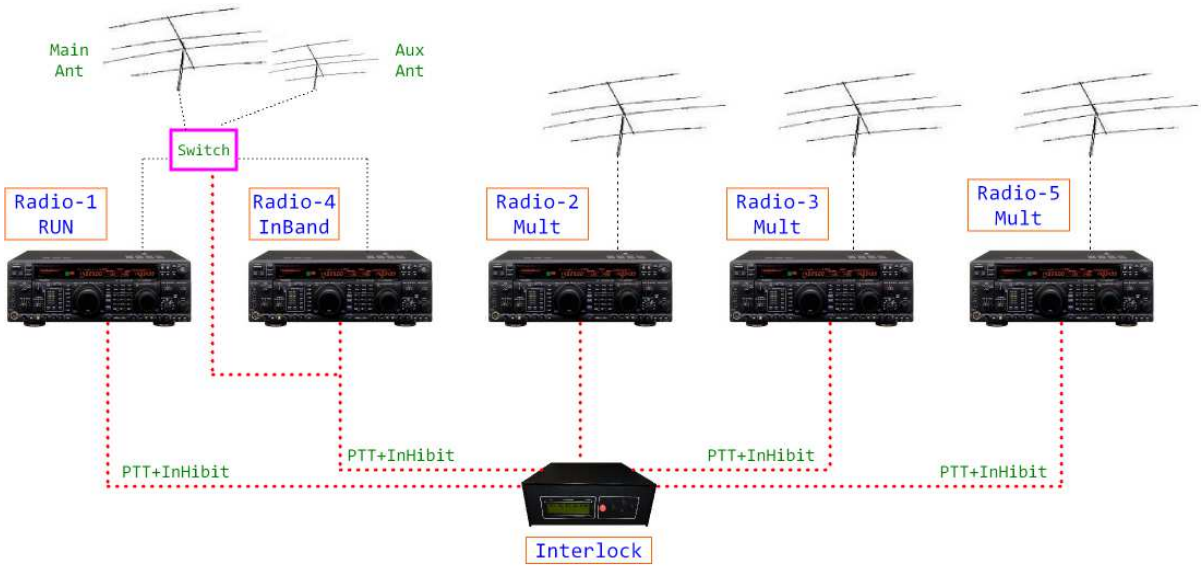
3.1: Example Multi-Single 1 RUN and 4 Multis:



Multi-Single setting: 1 Run + n-Multis

This is an example of a Multi/Single station with 1 RUN station and 4 (or less) multiplier stations

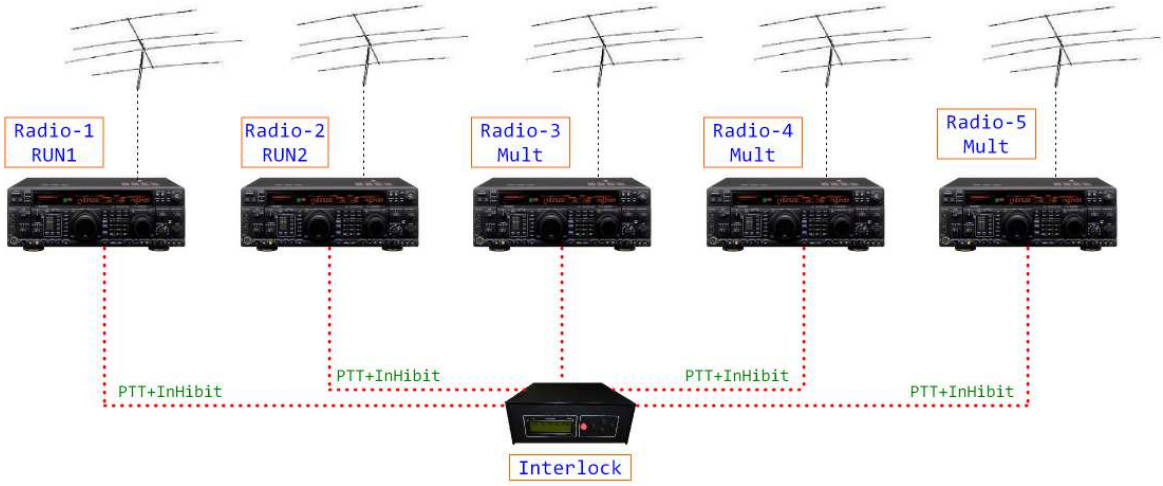
3.2: Example Multi-Single 1 RUN and 1 INBAND and 3Multis:



Multi-Single setting: 1 Run + 1 Inband + 3 Multis

In this other Multi/Single scenario, there is 1 RUN (R1) and its Inband (R4) plus 3 (or less) multiplier stations.

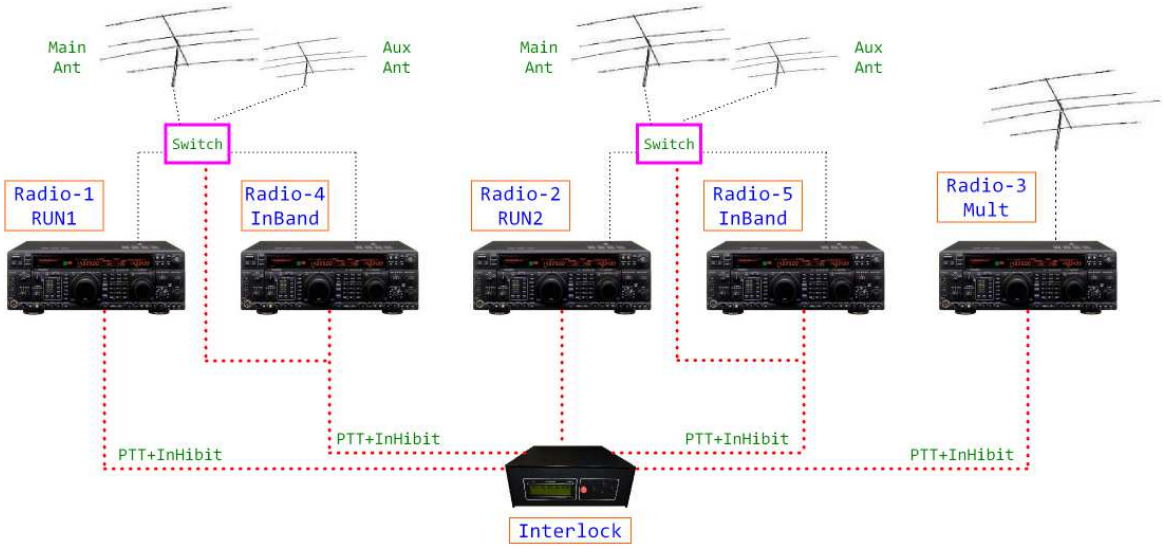
3.3: Example Multi/2 with 2 RUN and 3 Multis:



Multi-2 setting: 2 Run + 3 Multis

Este es un ejemplo de una configuración de una estación Multi/2 con dos radios RUN (R1 y R2) y 3 (o menos) estaciones en modo Multiplicadoras.This is an example of a Multi/2 configuration with 2 RUN radios (R1 and R2) and 3 (or less) multiplier stations

3.2: Example Multi/2 with 2 RUN and their INBAND plus 1 Multis:

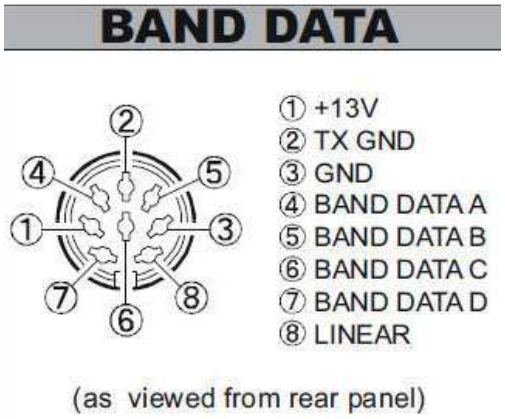


Multi-2 setting: 2 Run + 2 Inband + 1 Multis

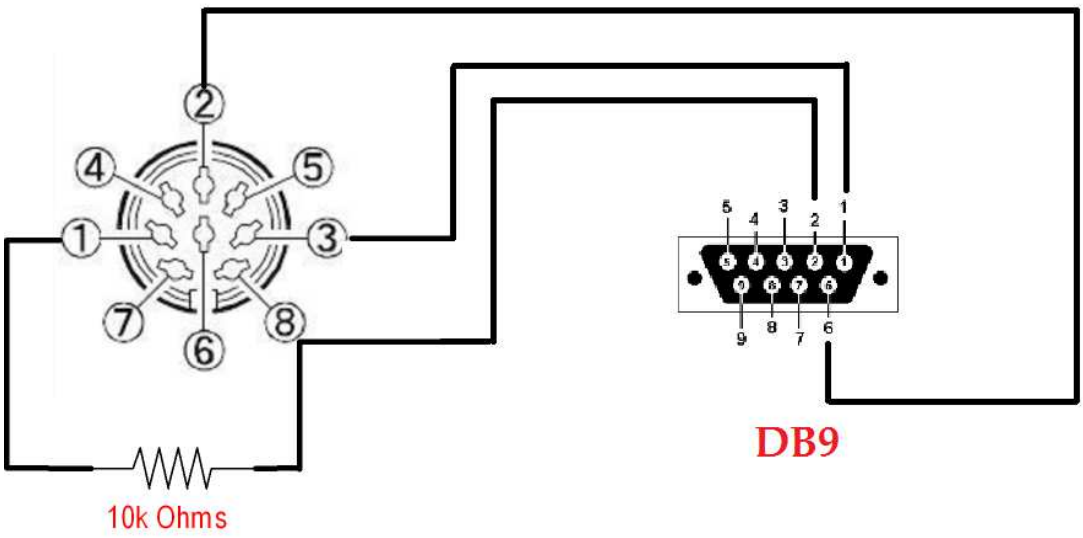
In this final example we have a Multi/2 with 2 RUN (R1 and R2) and their respective Inbands (R4 and R5), plus one multiplier station.

Annex I – Connection for Yaesu radios

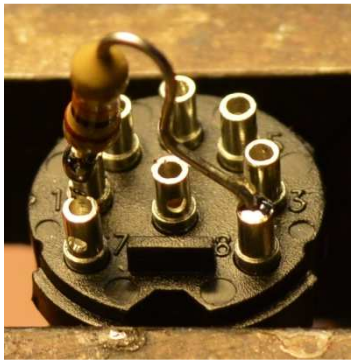
Yaesu radios (FT1000, FT1000MP, 20000, etc) use a DIN connector like this one:



The connection that needs to be made between the interlock interface (DB9) and the DIN connector is as follows:

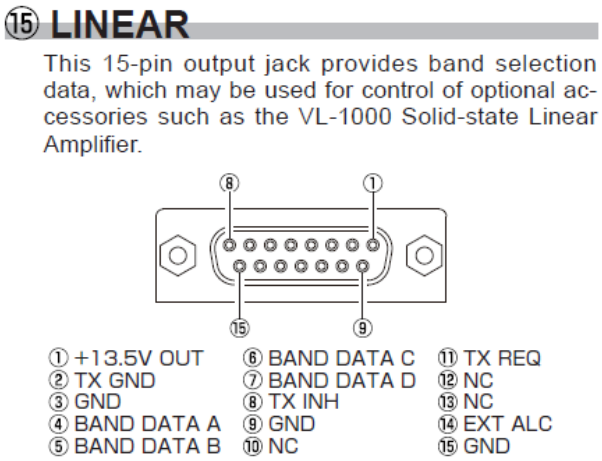


📖 Remember that you need to insert a 10K Ohm resistor between pins 1 and 8 of the connector, as shown in this photo:



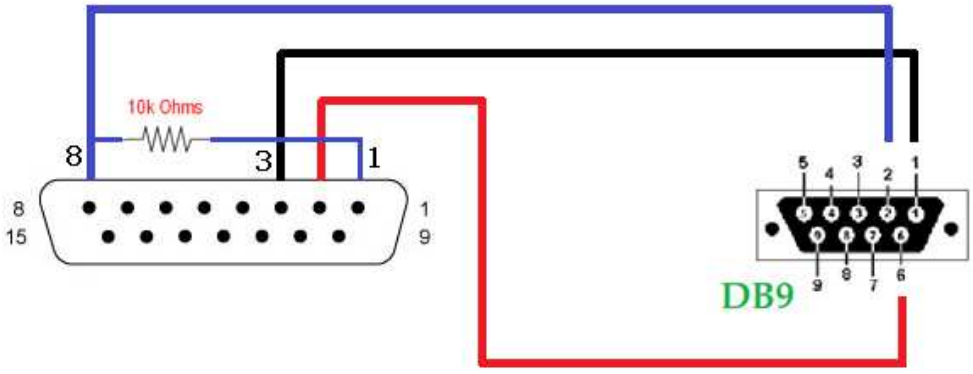
Annex II – Connection for Yaesu FTDX101D/MP

This Yaesu model uses a DB15 female connector.



The pins that are going to be used on this DB15 connector are as follows:

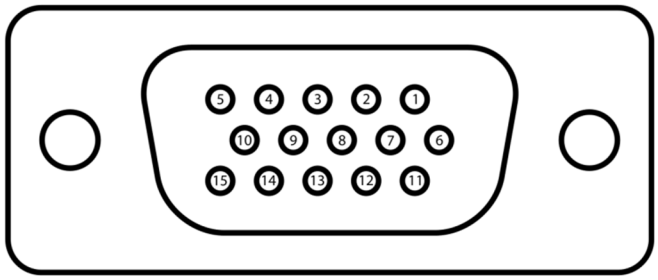
Pin1	+13.5V (pullup)
Pin2	TX Ground
Pin3	Gnd
Pin8	TX Inhibit



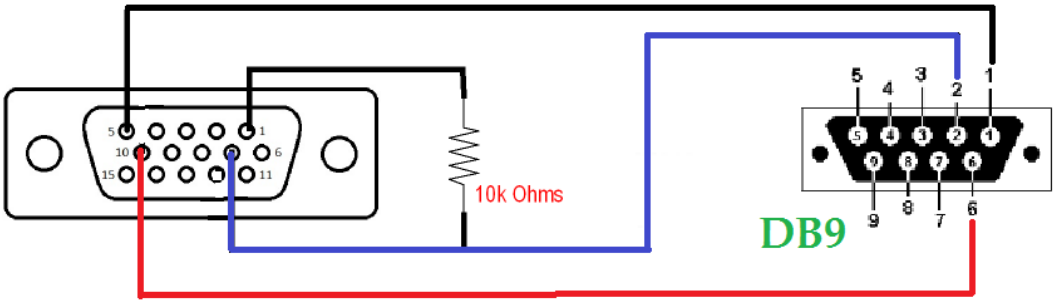
Annex III – Connection for the Elecraft K3

In the K3 we use the ACC connector. The pins used are as follows:

Pin1 FSK IN (pullup a +5V)
Pin5 Gnd
Pin7 TX Inhibit
Pin10 Key Out



The connection that needs to be made between the interlock's DB9 and the ACC is as follows:

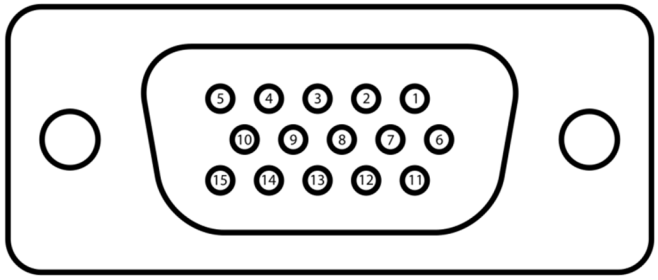


📖 Remember that you need to insert a resistor (10K ohm for example) between pins 1 and 7 of the ACC connector. Additionally, you will need to enter the SETUP menu and change the **CONFIG:TX INH to HI** so that pin 7 works as **TX Inhibit**

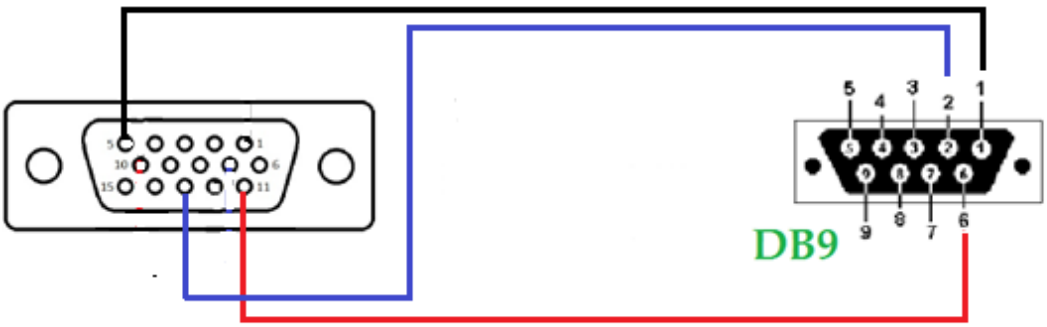
Annex IV – Connection for the Flex 6400/6600

Those Flex models includes a DB15 Accessory Connector that will be used. The pins used are as follows:

Pin 5 Gnd
Pin 13 TX Inhibit
Pin 11 Key Out



The connection that needs to be made between the interlock's DB9 and the Accessory Connector is as follows:

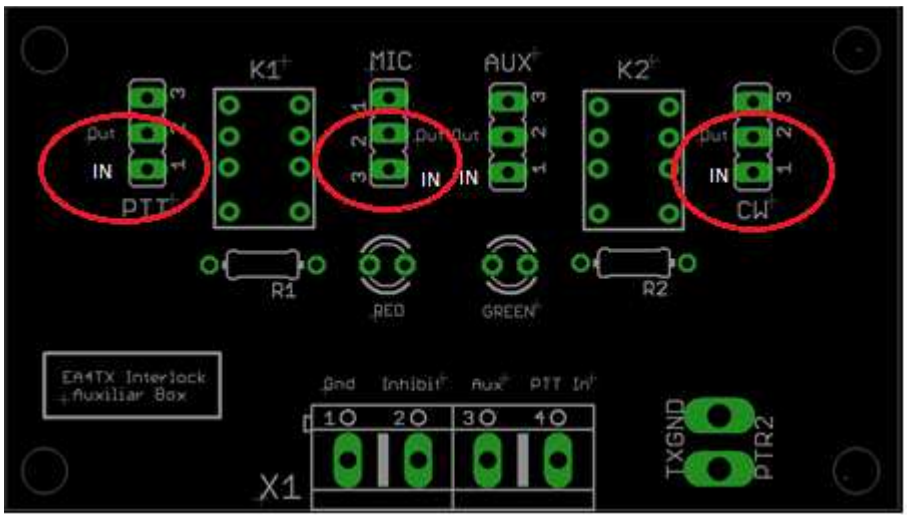


🕮 Those Flex doesn't need the pull-up resistor since it already includes it.

Annex V – Connection via Auxiliary Box

As an additional option, it's available the Auxiliary Box that will help you as interface with transceivers that don't support an Inhibit signal. In those cases, you must pass the Mic, PTT and CW signals via this box. In other words, the Aux Box will be in serie with those signals.
The Box includes 2 relays (2 circuits) and by default each input signal is available at the output; however when the Interlock activate the INHIBIT signal, those relays will be energized and the signals will not be present at the output.

Both relays are activated at the same time by the Inhibit signal (5V); each relay has 2 circuits, so there are 4 signals that can be used: PTT, Microphone, CW and any Auxiliary



Wiring Auxiliary Box with the Interlock:
Use the X1 connector and connect to the DB9 connector of the radio (R1 to R5)

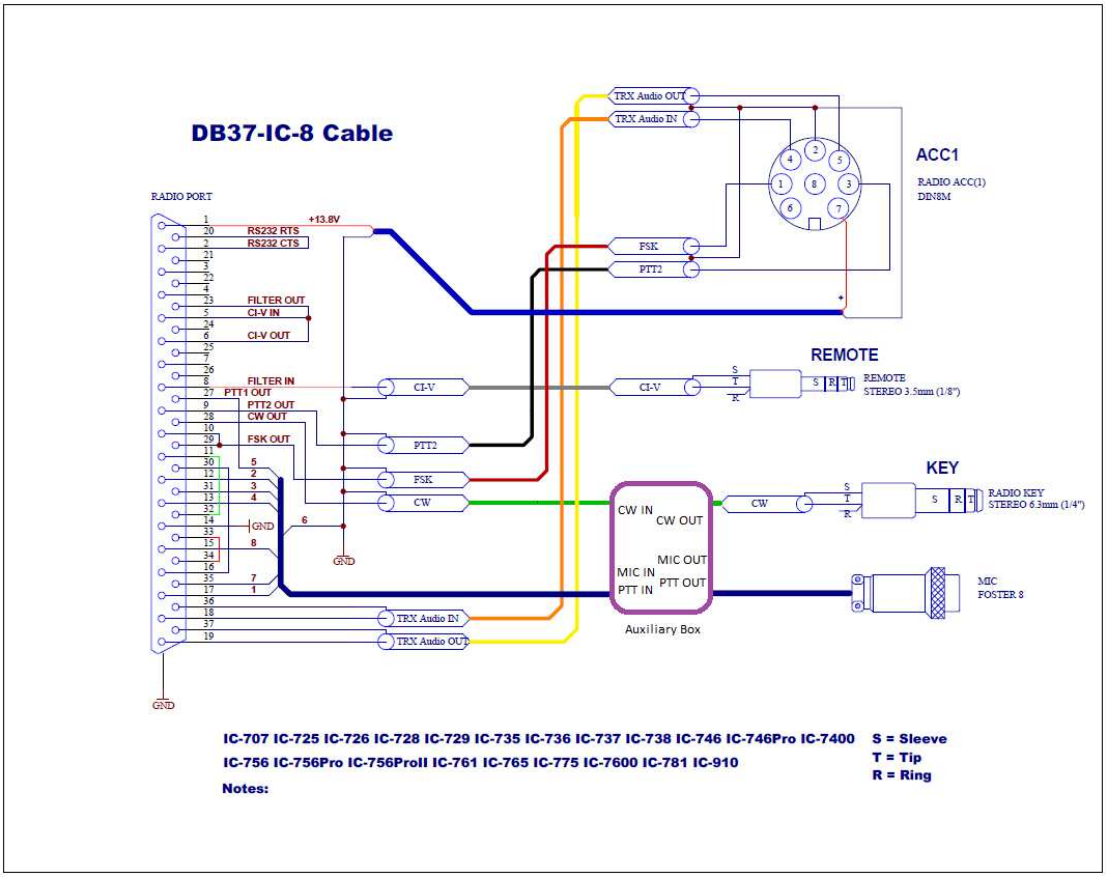
Meaning	X1 Connector	DB9 @ Interlock
Ground	Pin1	Pin1
Inhibit	Pin2	Pin2
Aux	Pin3	Pin7
PTT In	Pin4	Pin6

Wiring SSB:
- Disconnect the Microphone connector form the transceiver.
- Use a male connector and connect the original Mic connector to this point
- Now route the Mic and PTT signals via Aux Box. Use the PTT and MIC points marked (IN points)
- Now connect each Out signal to a new cable that ends with female Mic connector that will be used to be connected into the transceiver

Wiring CW:
- Disconnect the CW connector (6.35mm) from the transceiver
- Use a female Jack connector and connect the CW connector to it.
- Now route the CW signal from the Tip into the Aux Box (CW In)

- Connect the out signal (@ Aux Box) to a new cable that ends with a Jack. This Jack will be connected to the transceiver (CW)

Auxiliary Box mounted in an enclosure



In this case, the Auxiliary has been set in series with the Mic, PTT and CW signals coming from microHAM device. When the Interlock will "Inhibit" the relays located at the Auxiliary Box will be activated so those signals will be braked, and no signal will be present at the Mic connector or Key In at the transceiver.

Annex VI – Connections for other radios

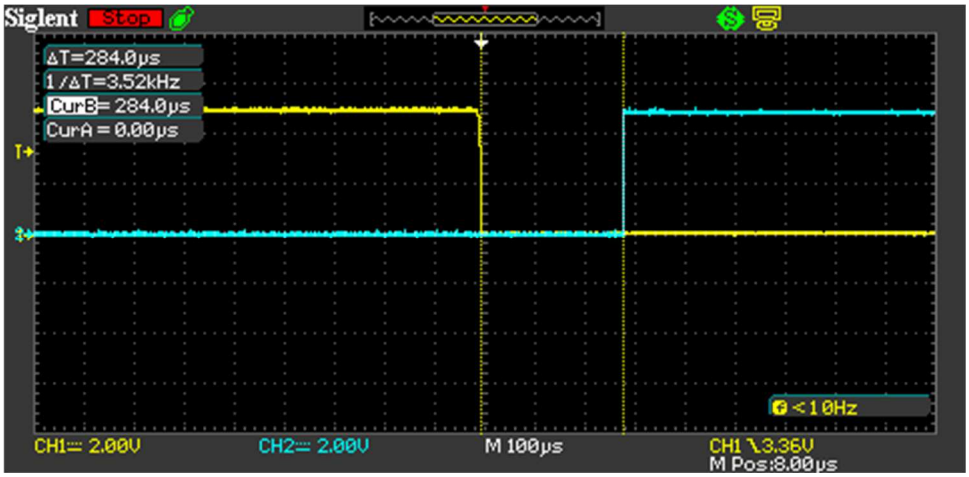
In radios that do not have an Inhibit input, what we do is route the Mic signal (in SSB) or the CW signal (CW Mode) through pins 3 and 8 on the DB9 connector.

As already indicated in the *Hardware section* (Page 6) the interlock has one relay per radio present between pins 3 and 8 on each connector. When idle the pins are connected but when the block is activated for that radio, the contact between the two pins is opened.

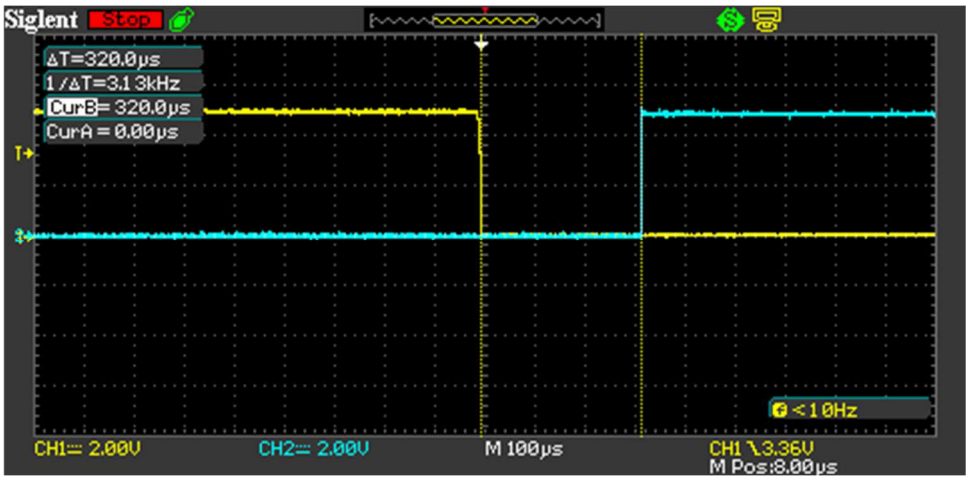
By routing the microphone or the Morse key signals through pins 3 and 8, when idle the radio works normally but when the interlock activates the relay, the radio cannot transmit since the input signal is cut off.

Annex VII – Response times

The response time measured from when a PTT signals activated in a radio, it's analysis and if required, blocking a Radio, takes between 200 to 400 microseconds and depends on the position of the radio. The analysis starts at Radio1 and ends at Radio 5.



DeltaT = 0.284 milliseconds



DeltaT = 0.320 milliseconds

In these 2 graphs we can see response times of 284μs and 320μs respectively.

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