VE2DX

From Canada (VE) 2 the World (DX)

CT17B-6BT Bluetooth ICOM CI-V HUB.

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Version 2.1.0

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Date	Name	Comments	Revision
20 July 2020	VE2DX	Release first version	1.1.0
25 January 2021	VE2DX	Added IC-705 Section	1.2.0
31 January 2021	VE2DX	Clarified LED reaction to pairing on PC	1.3.0
1 June 2022	VE2DX	Updated to new design version	1.5.0
1 June 2023	VE2DX	Updates and revision	2.0.0
20 July 2023	VE2DX	Added TrueTTL/TrueCIV technology	2.1.0
18 November 2023	VE2DX	Minor changes	02.02.00

- **Introduction**

CAT technology are common Amateur Radio station automation architecture and protocols that have advance Amateur Radio Stations drastically, especially in the last 20 years even though they were first introduced in the mid 70`s.

The advent of personal computers and later the internet, made for many applications for call logging, that were soon followed by early automations like computer control rotors and antenna selection or even antenna control.

The early arrival of the new Millenium saw a drastic evolution of the Internet for Amateur Radio with the linking of these applications with web-based DX clusters that allowed the application provider to easily integrate Log, antenna control, Digital modes, remote antenna selectors, BandPass filter control within the same unique application.

All of these applications commonly interface with the radio and multiple other devices in the station using CAT (Computer Aided Transceiver), these were at first very crude like in the early ICOM designs of the late 70s. But soon after the tree big Amateur Radio manufacturers (Icom, Yaesu and Kenwwood) started standardizing the CAT designs.

Icom went with a TTL based multi device structured data bus able to handle multiple radios and devices with a simple HEX based protocol this was the creation of CI-V, first introduced in the ICOM IC-735. But this being common bus their approach as always been open to collisions since there was never a proper collision management implemented such as CSMA/CD. This protocol is still in an evolution adding more and more functions within making the use of CI-V a fairly busy environment.

Yaesu, also went with couple variations of a TTL based CAT protocol in a simple one to one environment, and in newer radios oriented their designs on RS232c interfaces.

Kenwood did use TTL at first in their CAT orientation but converted to RS232c in the late 90`s.

All lately moved to USB based CAT still based on their original protocols, some like ICOM also offer Bluetooth and Network based UDP connections still using their original CI-V protocols.

The fact is, as station automations grew more, OEM manufacturers looking to have their devices directly controlled by the radio require acces to radio CAT signals thus these are still available on newer radios for such hook ups.

The Amateur Radio Shack environment being loaded with multiple RF source of different type and frequencies, this environment is prone to inducing these as interferences in control signals like CAT controls.

Proper filtering of power source, ground connections, CAT signals and grounds, is very important to make these signals reliable.

VE2DX Electronic Design Inc. Has been a pioneer since 2020 with our design integrating advance filtering approach into every designs, we create.

TrueTTL is a normal evolution of this approach, combing both proper filtering not only of the signals them self, but of the entire electronic design, this combined with TTL Level management makes for the BEST CAT signals on the market.

The TTL Level management in TrueTTL is the big change in CAT signal management since the introduction of CAT itself.

This goal of this White Paper is to explain TrueTTL, its advantages, theories and its implantation in different manufacturer environment using TrueCAT and TrueCIV.

Unless indicated otherwise, the context of this document includes their implementation in VE2DX Electronics Design Inc. Products.

Disclaimer

The content contained herein is correct as of August 2023, and represents the status quo as of the time it was written. TrueTTL, TrueCAT and TrueCIV may change going forward, as we continually improve designs for our customers.

Goal

Our goal in this white paper is to introduce the reader to our new TrueTTL technology, explain the technical aspect of this approach, the implementation of TrueTTL in CAT environment (TrueCAT) and ICOM CI-V environment (TrueCIV), and the advantages to our customers with the implementation of TrueTTL design on our product offering.

Technical information.

Why TrueTTL.

Improper or weak TTL voltage levels is a common issue in Amateur Radio with DIY projects and even some commercial products, often using 3.3vdc outputs, instead of the expected proper 5vdc TTL/CI-V levels. Even if they are within TTL specifications, the problem with these voltage levels is that it makes then signals more prone to interference and signal loss.

In the new generation of VE2DX 2023 product offering, each port and all power or grounds are ALL RF isolated, all ports are also equipped with voltage levels monitoring and correcting based on VE2DX TrueTTL © 2023 technology.

What are TrueTTL, TrueCIV and TrueCAT.

- **TrueTTL.**

TrueTTL was created in the summer of 2023 by Richard G. Desaulniers Sr., VE2DX, of **VE2DX ELECTRONIC DESIGN INC.** It is a new technology design that combines filters incoming TTL signals from RF interferences also implementing added filtering on every power and ground connections of the design and monitors the incoming control signals for proper TTL voltage levels and corrects them if they are too low, to make TTL signal processing and filtering more efficient and reliable.

Once a signal is detected, it is filtered for possible interferences, then converted to a common working voltage on.

The process can be used in a bidirectional circuit like with ICOM CI-V. The signal is first filtered and if the incoming signal does not have proper or has weak TTL levels, it is converted to the common Internal TTL working voltage and either fed to the device or shared on a common work bus to be used by other IOs or devices attached to the bus at proper filtered and levels.

In a CAT environment, both the Input and Output signal go through the TrueTTL processing, thus making certain that Interferences are cleaned out and that the TTL levels are as expected.

This process eliminates interferences and low level signals and offers the device(s) clean working signal for better data processing.

- **TrueCIV**

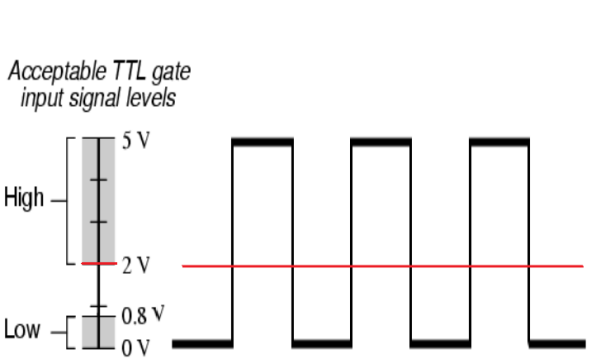
TrueCIV, is the bidirectional application of TrueTTL in an ICOM CI-V environment. It is important to understand the ICOM`s CI-V design and protocol is a multi-device common bus approach that does encounter unmanaged collisions. Thus, it is important in such an environment to have interference free signals at maximum TTL levels since they may encounter collisions from other devices, and the destination device may have to decide between the signals presented to him, this said obviously a routing device is the best approach to handle collision management and **VE2DX ELECTRONIC DESIGN INC.** is working in 2023 on such a solution that WILL include our TrueCIV technology.

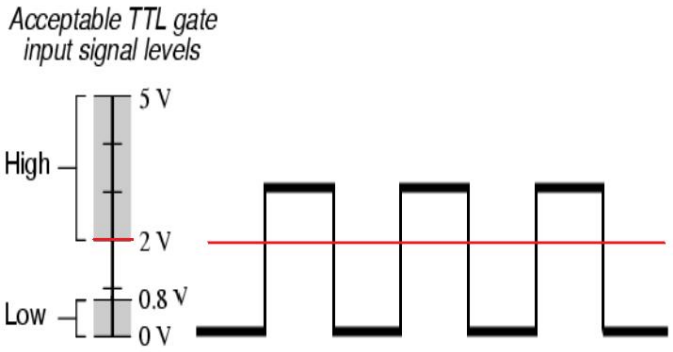
- **TrueCAT.**

TrueCAT, is the application of TrueTTL technology in a Yaesu, Kenwood or other radio environment using one to one interconnection. Unlike with TrueCIV the implementation of TrueCAT is simpler since the IOs are NOT bidirectional, the TX and RX are clearly separated in such an environment. Thus, each signal are handled separately.
TrueCAT can be used for TLL linked devices, but also for RS232c linked devices, in such a situation TrueCAT is used to clean and processed signals in and out of RS232c conversion on the TTL side, making certain it is clear of interferences and converted properly.

- **Application of TrueTTL.**
- **5vdc vs 3.3vdc in TTL environment.**

The graphic below shows a normal CI-V signal vs a 3.3vdc signal in reference to standardized TTL levels;

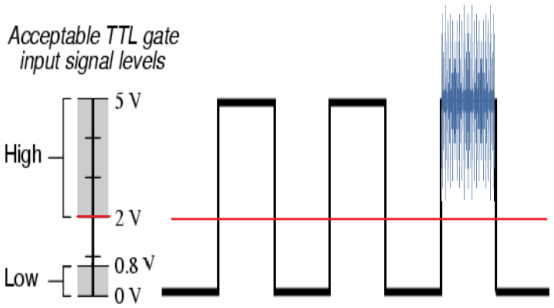


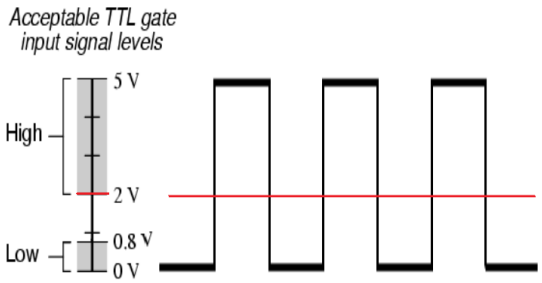
VS


As you can see both are within standardized TTL Level, but at 3.3vdc the signal is much closer to triggering thresholds.

- **TTL handling of interferences.**
  - **5vdc with interference in TTL environment.**

Let's introduce some interferences in the equation on a proper TTL signal and see the result:

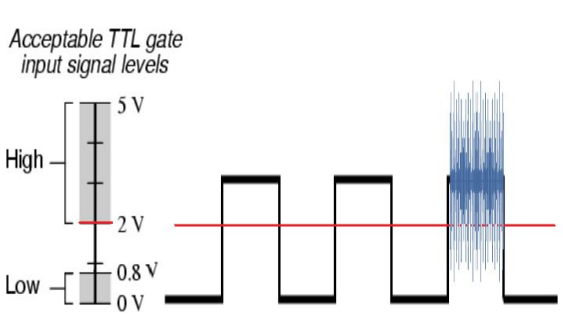


Resulting in


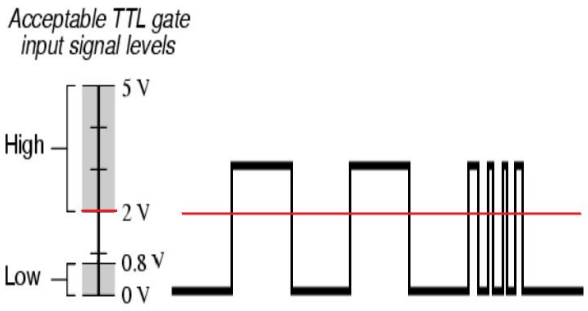
Because the TTL Levels were at 5vdc, the interference did not reach trigger thresholds of the TTL standards, and the device properly decoded the signal, thus the interferences must be larger before the TTL signal is corrupted.

○ 3.3vdc with interference in TTL environment.

Now let's apply the same interference to a TTL signal with 3.3vdc levels:



Resulting in



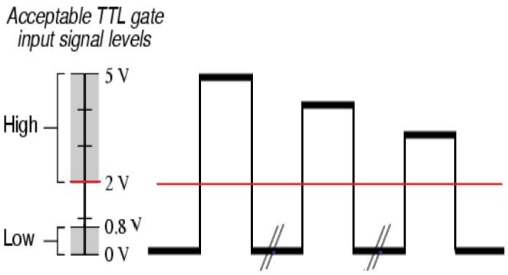
Same test with TTL levels at 3.3vdc clearly shows that multiple peaks in the interference resulted in triggers in the attached device decoding of the signal, this is because the 3.3vdc levels used are closer to the trigger levels in the TTL standards, thus the data is corrupted more easily.

- **TTL handling of signal lost.**

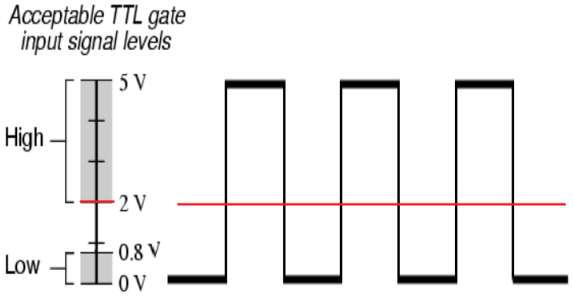
Let’s look at the effect that lower voltage levels may have on the resulting decoded data based on signal loss caused by cable loss or distance.

○ 5vdc TTL handling of signal lost.

On a proper TTL level signal, applying a 2vdc signal lost to the signal, the signal is still within TTL Level standards having no effect on the resulting data:



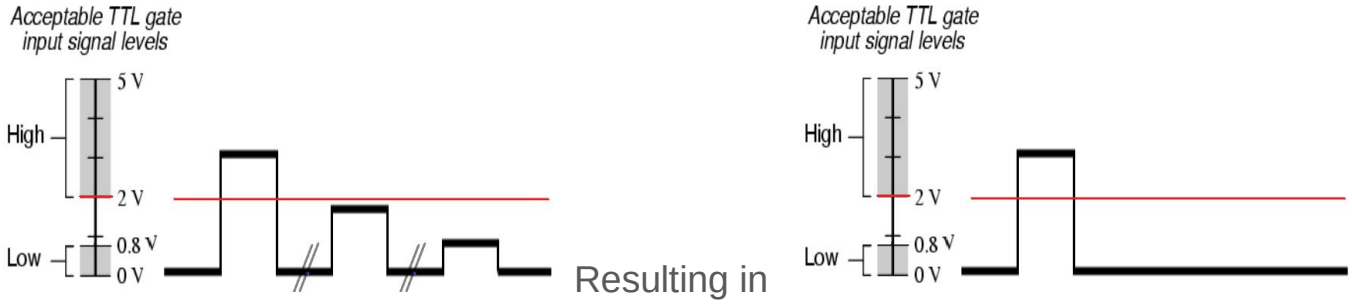
Resulting in



The resulting data was not affected by the signal loss of 2 vdc.

○ 3.3vdc TTL handling of signal lost.

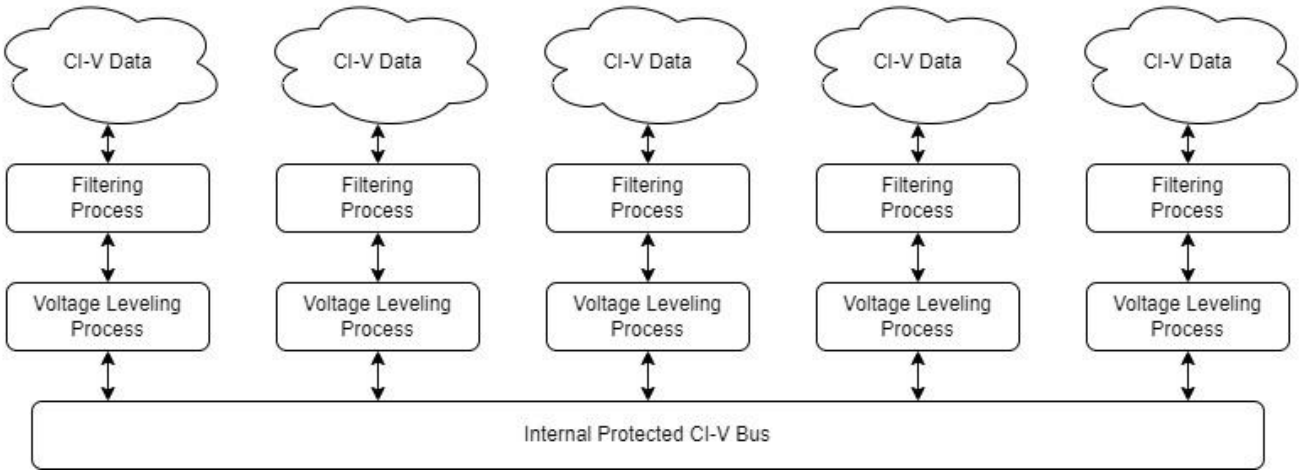
Let`s apply the same signal loss of 2vdc to a 3.3vdc TTL signal:



The 3.3vdc signal being so close to the trigger threshold of TTL, the resulting data is corrupted since the device decoding the TTL signal improperly recognized low level caused by the signal lost. The first pulse in this example is properly decoded by the device, the second one falls into the unknown state of the TTL standards; thus it is NOT detected, and the device thinks it is still LOW, the final pulse is so low that the device thinks this is actually a LOW pulse.

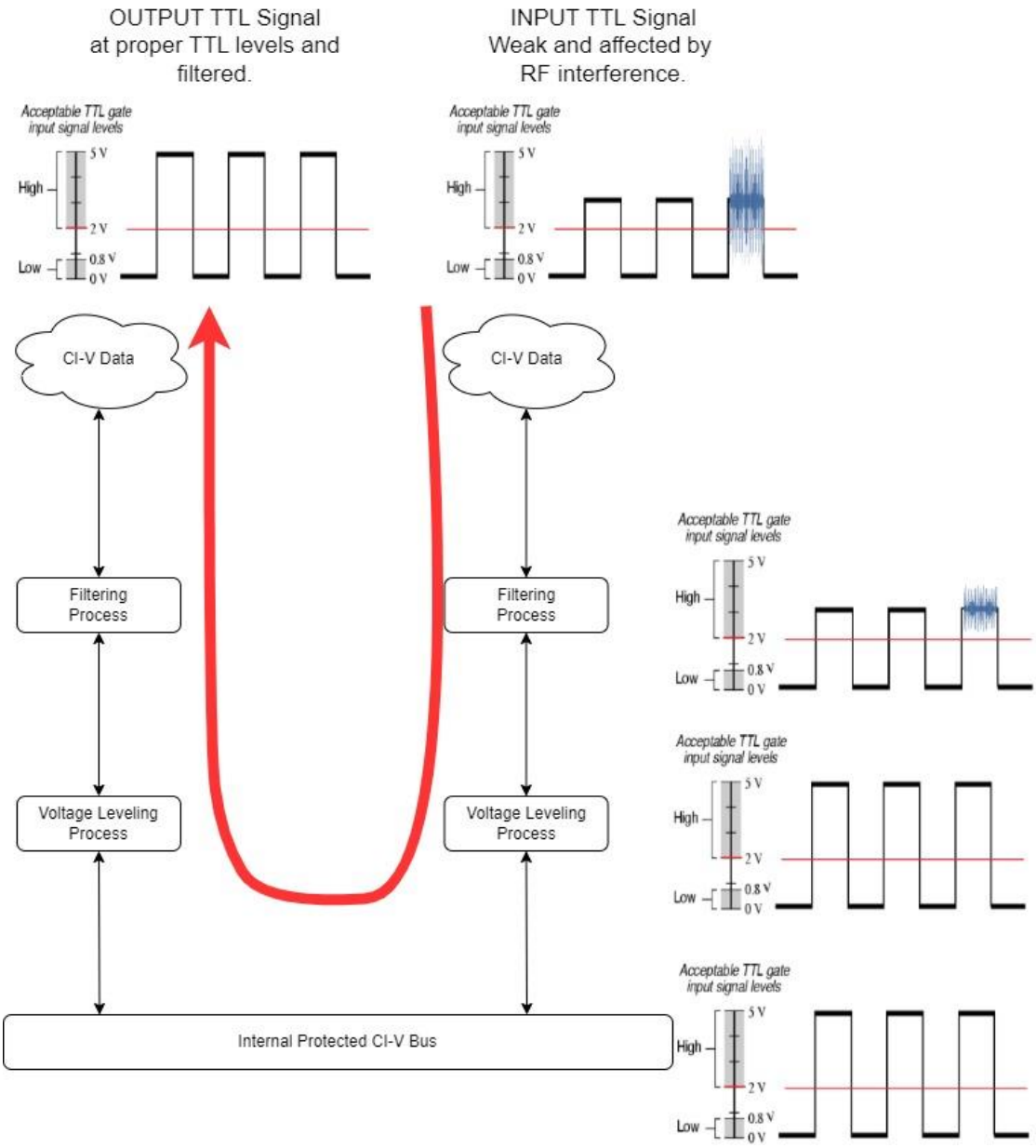
- **TrueCIV; TrueTTL applied to CI-V.**
    - **Real life application of TrueCIV.**

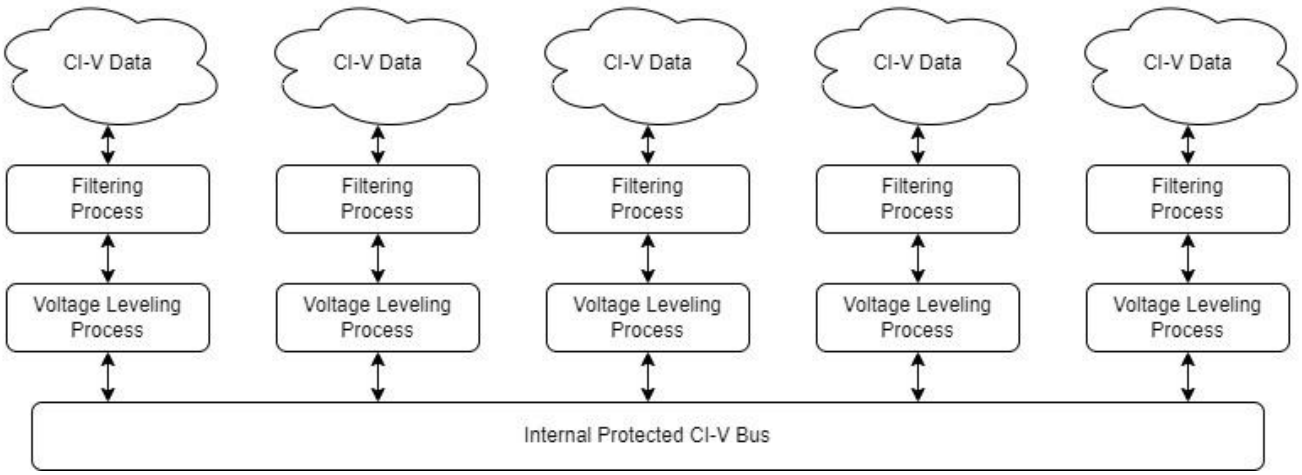
In the example below, we are showing a TrueCIV implementation in a CI-V Hub environment. This design used by **VE2DX ELECTRONIC DESIGN INC.** In our newer generation CT17B design since July 2023, isolates every data entry point forcing each signal to go through the filtering and level correction stages of the process, both in the Input or the Output functions of these IO ports.



Via this approach if a signal is weak and/or damaged, it can be corrected before it is shared on the other ports of the hub.

In the next image, the reception of a low level TTL signal with interferences on the third pulse is shown on the right side. As you go down the right side following the RED arrow you can see how the different stages of the TrueCIV process are first filtering down the Interferences so they are NOT viewed as data, and then converted to the Internal Common Bus to proper TTL levels, to then be shared with the other ports and the output is now free of the interference and at proper TTL levels on the rigth side.


OUTPUT TTL Signal
at proper TTL levels and
filtered.
INPUT TTL Signal
Weak and affected by
RF interference.
Acceptable TTL gate
input signal levels
5 V
High
2 V
0.8 V
Low
0 V
CI-V Data
Filtering
Process
Voltage Leveling
Process
Internal Protected CI-V Bus


CI-V Data
CI-V Data
CI-V Data
CI-V Data
CI-V Data
Filtering Process
Filtering Process
Filtering Process
Filtering Process
Filtering Process
Voltage Leveling Process
Voltage Leveling Process
Voltage Leveling Process
Voltage Leveling Process
Voltage Leveling Process
Internal Protected CI-V Bus

CI-V protocol is a very simple ASCII protocol that can run at different speeds, obviously all devices being used together MUST run at the same speed, the speed on your computer can vary as you wish to make your application react faster, but the CI-V bus and the ICOM or Non-ICOM device must always be set to 9600 bauds the speed translation and buffering is handled by the CT17B-6BT .

On the Hardware side the CI-V is based on a very simple TTL (0 - +5VDC) hardware. It is a duplex hardware protocol, meaning that the RX and TX are merged together on the same communication line.

The ICOM CT-17 was the original ICOM manufactured unit in the late 70s and early 80s. It was made with 4 CI-V ports and a DB25 interface for the computer, it also needed an external 12VDC power source. It made for major evolutions with PCs of Ham Radio station automations.

Description:

The **CT17B series** is an evolution of the original ICOM CT-17, it comes in multiple variations with 5, 6, 10, 11 and 12 ports. There are two major variants;

- **CT17B Five ports family**

The 5 ports units made up of the **CT17B-5**, is a 5 port CI-V unit, CT17B-6USB a 5 CI-V ports CI-V and 1 port USB, and the CT17B-6BT which is basically the same except it communicates via Bluetooth and the CT17B-6BT has 5 CI-V ports, and 1 X Bluetooth port.

- **CT17B Ten ports family**

The 10 ports-based **CT17B** family made up of the **CT17B-10** a 10 ports CI-V only hub, the **CT17B-11USB** made of the 10 ports CI-V hub with an added USB port and finally the **CT17B-12DualUSB** a **CT17B-10** with two USB ports.

Interesting fact about all the 10 CI-V port units (**CT17B-10, CT17B-11USB, CT17B-12DualUSB**) they have a Jumper under the unit (JP1). This JP1 Jumper is used to split (if the user wants to!) the unit into two separate – 5 units.

Thus, if **JP1** is IN on a **CT17B-11USB** it as ALL 11 ports talking to each other. With **JP1 OUT** then the unit is turned into a **CT17B-5** and a **CT17B-6USB** into a single case and all CI-V communications made on one side of the **CT17B** are distinct from the others.

This new feature makes the **CT17B** even more flexible.

- **CT17B RFI protection**

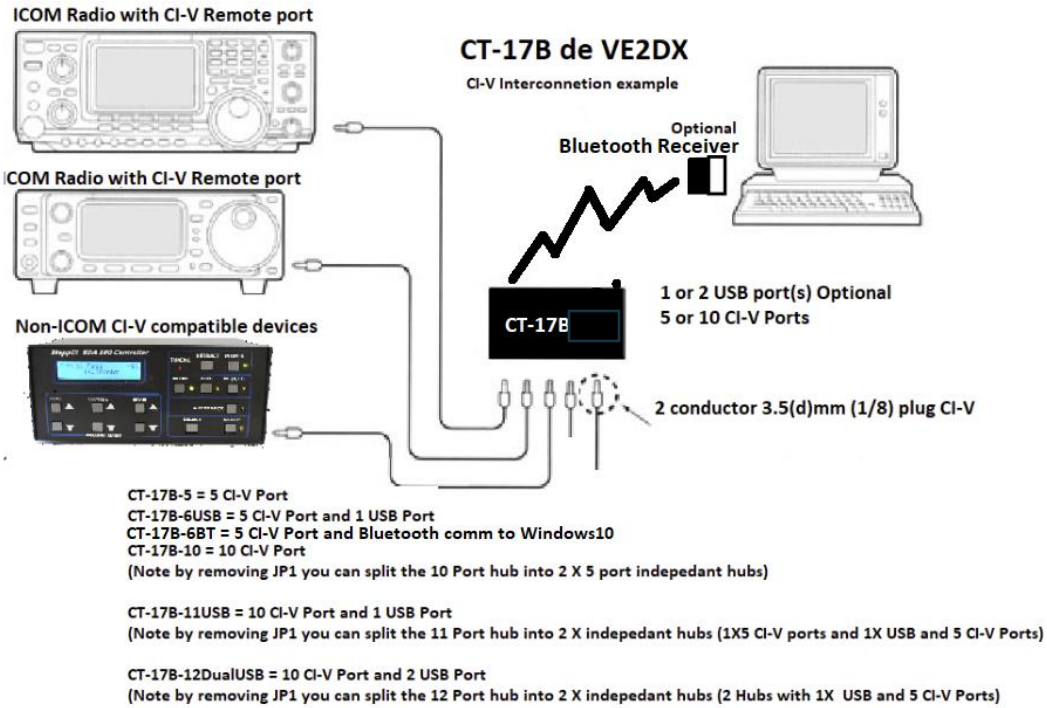
One very important factor with our design was RFI, Ham radio stations have to deal with RFI often, and we wanted to help with our design, to do so we isolated every port with proper RFI filtering. This will NOT block EVRYTHING, but it should prevent most common issues.

And with the CT17B-6BT and CT17B-6BT having the option to Bluetooth link your station to your PC this COMPLETLY isolates the RF from the PC side of the shack!

- **CT17B 3D SLA Printed enclosures**

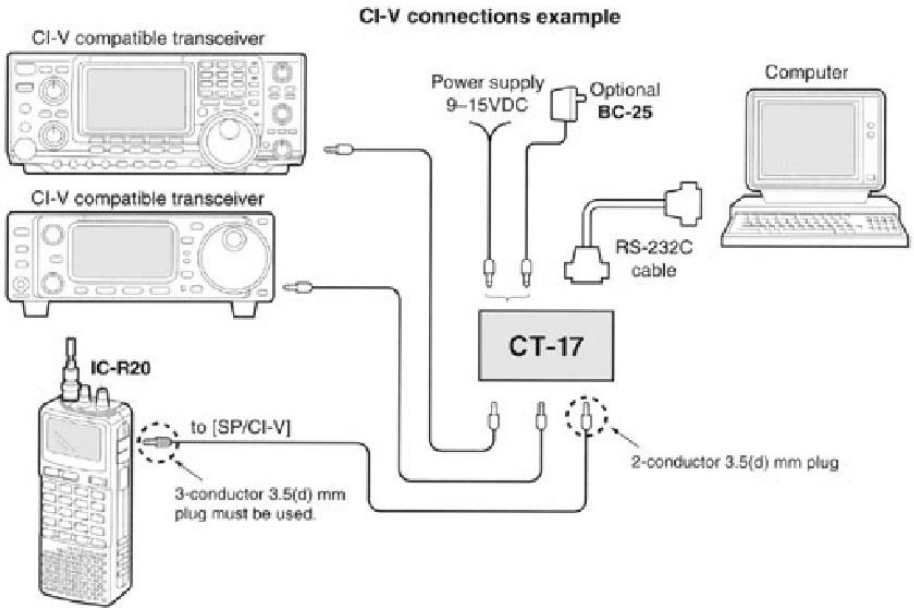
One of the nice things about our design is the 3D SLA printed enclosures, this helped us turn around on the fly adjust our design like the added JP1 on the 10 ports units. another change we made last minute was adding **magnets** to the back of the enclosure that will help the end user with the flexibility of attaching the **CT17B** on the radio itself.

- **CT17B-6BT Interconnection diagram**



- **CT17B-6BT Interconnection to IC-705 diagram**

- **ICOMs CT-17 Interconnection diagram**



Setting up the CT17B

- ## CT17B CI-V Port to Windows10

! Warning !

Before plugging in ANY devices CI-V or USB port, you MUST make certain that all equipment and power sources are turn OFF.

(Radios, Power supplies, accessories, PC, etc...)

1- Turn off all your ICOM radios, non-ICOM CI-V compatible devices and Power supply's.

2- Plug a mono 1/8 audio cable from the ICOM REMOTE connector on the back of the radio to the **CT17B** Hub.

3- Making certain all devices and radios are turned off, do the same from the back of all your devices to the **CT17B,** plugging it into the PROPER CI-V port (on most ICOM radios this is identified as REMOTE).

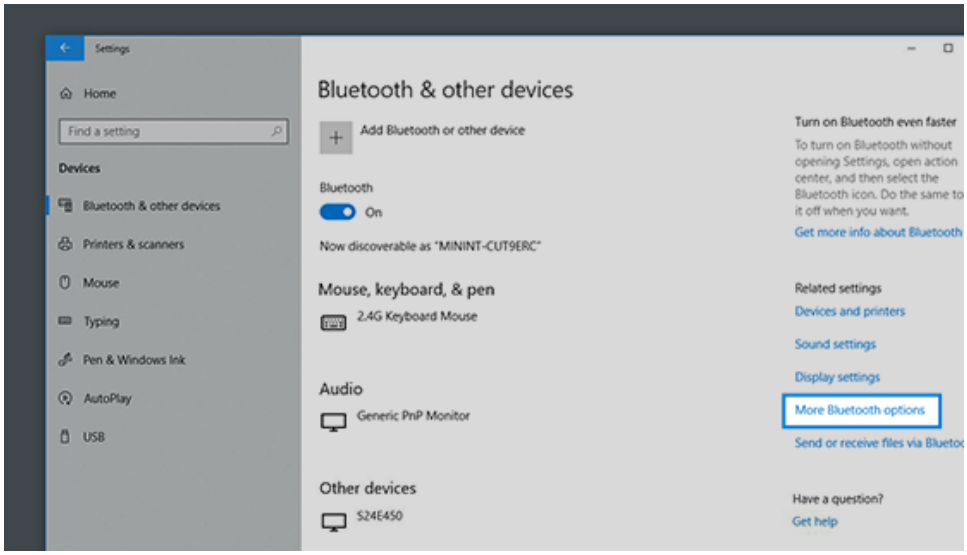
4- **Before plugging in your CT17B-6BT Bluetooth, you need to understand that for COMPLETE radio isolation you should NOT be using your PC USB ports to power the CT17B-6BT Bluetooth if your intent is to isolate the PC and RF of your shack via the CT17B-6BT Bluetooth link. Instead, you should be using a 12VDC to USB 5VDC low noise converter and use the station 12VDC power source or use a simple AC to USB transformer, do note that these can be RF Noisy!**

4b- Power on your CT17B-7DM.

4c- look on the CI-V port side of the CT17B-6BT you will see a BLUE PAIRING LED and a RED POWER LED. ***The* RED POWER LED *should be ON, If Not check your power source.***

Note: there are 3 LEDs on the newer CT17B-6BT devices, the Power LED on the left of the device, The Yellow CI-V LED is in the center and the BLUE Blootooth PAIRING LED is on the LEFT side.

5- On your Windows10 command line type “BLUETOOTH”, windows 10 should offer you the Bluetooth section of the Parameters panel.



5A- Make certain the Bluetooth is ACTIVATED.

5B- Click on the + sign next to “Add Bluetooth or Other Devices”

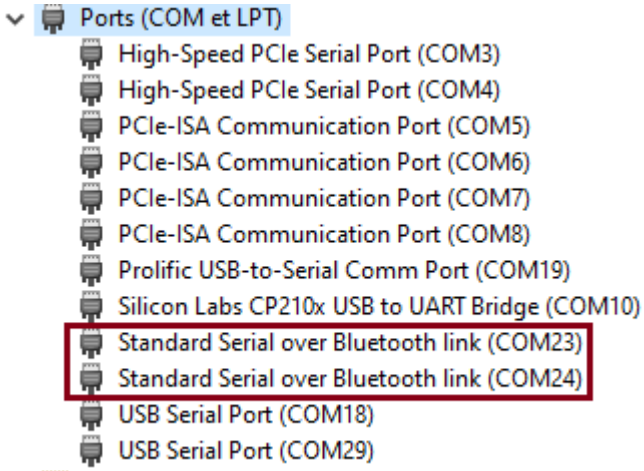
5c- on the next Black screen click on “Bluetooth”.

5d- This step can take a few minutes, you will see an unknow device come up and after a while this device will change name to “VE2DX CT17B-7DM”, select this device and PAIR with it, Windows10 will then ask for a password it is “1234”

6- Open “Control Panel” and select “device manager”

6a- In “Device Manager” expand the ”Bluetooth” section. Confirm that you see the VE2DX CT17B-7DM. ***If not go back to Section 10.***

7- In “Device Manager” expand “Ports (Com & LPT)” section



NOTE: The COM Port numbers will likely be different

7b- Note that all the existing Com ports and their “COM” names. you will see TWO new com ports

7c- They are identified as “Standard Serial over Bluetooth link”

! Important !

NOTE: Even after the CT17B-6BT is paired to the PC, the BLUE LED will still be OFF until the application in the PC is LINKED to the Bluetooth Serial port.

! Warning !

WIERD Windows10 VERY CONFUSING info follows!

FOR SOME BIZARRE REASON, Windows 10 when pairing with a Bluetooth serial port will create TWO SERIAL PORTS! An INCOMING serial port (Normally but not always!... the first one!) and an OUTGOING serial port (Normally but not always!... the second one!)

!!!You can only use the OUTGOING serial port!!!

Note: More advance users can use the advance port configuration to change the COM port ID, but you MUST make certain the selected port is not already in use.

! Warning !

Virtual ports used with SDR or other applications like Com0Com can cause port conflict and confusion.

That's it! You're now ready to play, using your radio control or logging application you can now control your equipment.

- **CT17B CI-V Port ICOM IC-705**

! Warning !

Before plugin in ANY devices CI-V or USB port, you MUST make certain that all equipment and power sources are turn OFF.

(Radios, Power supplies, accessories, PC, etc...)

1- Turn off all your ICOM radios, non-ICOM CI-V compatible devices and Power supply's.

2- Plug a mono 1/8 audio cable from the ICOM REMOTE connector on the back of the radio or other OEM CI-V compatible devices to the **CT17B** Hub.

3- Making certain all devices and radios are turned off, do the same from the back of all your devices to the **CT17B**.

4- **Before plugging in your CT17B-6BT Bluetooth, you need to understand that for COMPLETE radio isolation you should NOT be using your power source as the ICOM IC-705 to power the CT17B-6BT Bluetooth. Instead, you should be using any low noise Micro-USB Power Supply, you could also use one of your PC USB ports if they are on the same ground as the other CI-V devices.**

4b- Power on your CT17B-6BT using a Micro-USB cable to either a power source or a PC.

4c- look on the CI-V port side of the CT17B-6BT you will see a red POWER LED, It should be ON, ***if Not check your power source.***

Note: there are 3 LEDs on the newer CT17B-6BT devices, the Power LED on the left of the device and the CI-V Data Yellow LED in the center and the Blue Bluetooth PAIRING LED to the right.

5- Power on your ICOM IC-705.

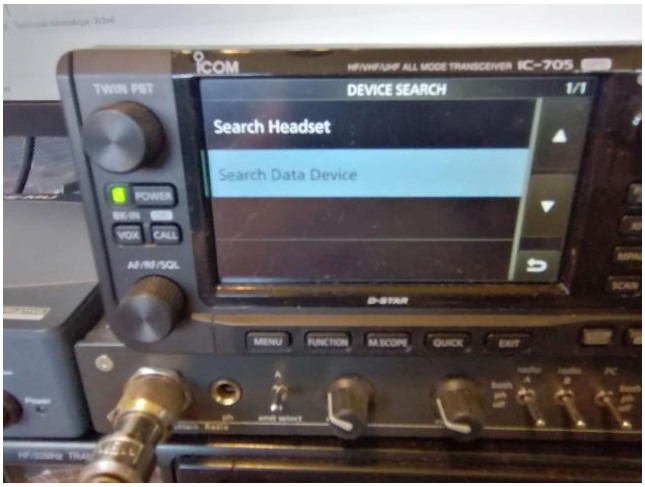
6- Press Menu button.

7- In the menu page 1 press the SET Button

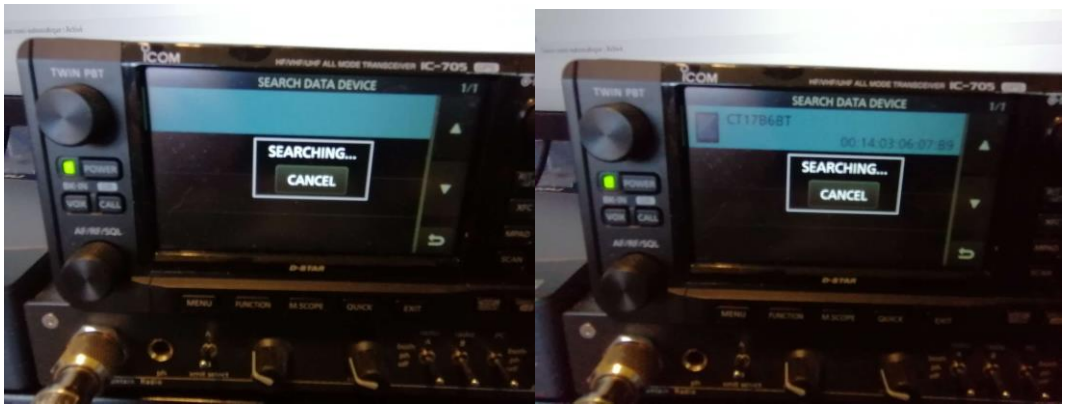
8- Locate and select the “Bluetooth Set” button.

9- Locate and select the “Pairing/Connect” button.

10- Locate and select “Search Data Device” button.



11- You will notice after 30s to 2m, that a new device ided as “VE2DX CT17B-7DM” will come up in your list.



12- Select “VE2DX CT17B-7DM” and answer yes to the “Connect?” question.

13- You will now get a message saying “Connecting...”

14- Your next message will be to enter the “PIN Code” hit OK button, and enter 1234 using the on-screen keyboard,

15- the ICOM IC-705 and VE2DX CT17B-6BT will now get connected.

16- This is the resulting screen.

Note : Now, your Bluetooth Blue Pairing LED in ON Solid.

Note: some images used in this manual show examples using the CT17B-6BT , the results of the CT17B-6BT process will be the same except for the identification of the device!

Now we need to properly configure your IC-705 to echo the CI-V commands via the Bluetooth Data Port.

17- Press Menu button.

18- In the menu page 1 press the SET Button.

19- In the “SET” menu locate the “Connectors” button and press it.

20- In the “Connectors” Menu locate the CI-V button and press it.

21- In the “CI-V" Locate the “CI-V Transceive” button and make certain it is set to ON.

21- now locate the “CI-V USB Echo Back” and make certain it is set to ON.

Note: this last step is important in case you link your ICOM IC-705 to you PC applications via the IC-705 USB Port.

22- Go back to the “SET” menu locate and select the “Bluetooth Set” button.

23- Locate and select the “Data Device Set” button.

24- Select the “SerialPort Function” button.

! This next step is very IMPORTANT !

25- Make certain that the "**CI-V (Echo Back OFF)**" is selected.

You are done you can now exit the SETUP Menu and start having fun!

Tips

1- Multiple ICOM radios can run on the same CI-V Hub and be linked together using the CI-V Transceive option, if CI-V Transceive is enabled then all compatible radios (example 735, 756Pro, etc...) will be linked and change frequencies together.

2- The CI-V Transceive option is often needed to be enable on the radio for non-ICOM devices to be able to be link to the radio.

3- Some devices like the WX0B bandmaster first generation need to have the CI-V address configure to match the radio being tracked.

△ IMPORTANT △

4- Audio cables being used to link the CT17B hub to Radios or Non-ICOM devices MUST be mono cable and not stereo. In most installations this does not make any difference, but we did encounter some problems caused by stereo cables were the TTL lines were grounded. The CT17B is designed to prevent this but not all ICOM and/or NON-ICOM radio or devices are.

73 De Richard VE2DX 😋