

Simulate, Stimulate, Test...



# Multi-Instruments Synchronization with Two WW Tabor AWGs



This tutorial will show how to synchronize two Tabor WW5064/WW1074/WW2074 using Tabor remote control software - ArbConnection, in order to achieve up to 8 synchronized channels.

For synchronizing between two units of other models (one or two channel units requires a dedicated synchronization cable as can be seen in the picture below), this procedure is much simpler. In this case, please look for instructions how to perform synchronization in the user manual of each specific model.



### 1. Connect the two Instruments:

Synchronization is done by connecting both instruments to LAN communication and assigning to each AWG a TCPIP address through its front panel and by connecting the two AWG's as can be seen in the picture below:





Multi-Instrument Synchronization is comprised of four SMB connectors, designated as:

 <u>SCLK-OUT</u>: This SMB connector outputs the programmed sample clock frequency. Output level is 400mVp-p, terminated into 50Ω. Note that correct termination is necessary for this output otherwise you will not see this signal at all. This output generates sample clock waveforms continuously, regardless if the AWG is operating in continuous, trigger, or gated modes.

The sample clock output is used for multiple-instruments synchronization. In master mode, connect this output with an SMB to SMB cable to the SCLK IN on the adjacent slave instrument. You may also use this output to synchronize other components in your system to one master clock.

• <u>SCLK-IN</u>: This SMB connector accepts 300mVp-p to 1Vp-p into 50Ω level signal. Normally, this input is disabled. When enabled, the clock at this input replaces the internal clock generator and the AWG generates waveforms having the external sample clock rate.

When synchronizing your AWG as a slave unit, an SMB to SMB cable is connected from the Master SCLK OUT connector to this SCLK IN connector.

- <u>COUPLE-OUT</u>: This SMB connector outputs the coupling signals to the slave unit. Output level is LVPECL, terminated into 50Ω to 1.3V. For multi-instrument synchronization, connect this output to the COUPLE-IN.
- <u>COUPLE-IN</u>: This SMB connector accepts coupling signals from the master unit. Input level is LVPECL, terminated into 50Ω to 1.3V. For multi-instrument synchronization, connect this input to the COUPLE OUT connector on the master unit.

#### 2. <u>Connect with the MASTER unit through ArbConnection:</u>

Communications Setup	Interface	Startup Options
C Specify an Address	GPIB	C Communicate Only
Previous Session Setup	USB	Reset Instrument & Panels
C Detect Automatically	LAN	C Work Offline
	Model List	
Interface Address	WW2074	Store mode and don't show this box at startup.
	Port	Add Address Remove Addres
	23	Cancel Communicate





• Open 'Log File' to view the commands being sent to the AWG:





• Press the 'X-Instrument Sync' button on under 'Auxiliary'. A new window will open up:





• In the SLAVE table, change the TCPIP address to the one of the SLAVE AWG (make sure the MASTER's address is higher). Press the 'Initiate' button :



• Press the 'Activate' button. You can see the corresponding SCPI commands used to perform this action:

ArbConnection << Tabor Electronics Ltd >> Untitled.cad *		Communication Log file View
File         View         System         Help           Link         WW2074, LAN, TCPIP::192.168.0.199::23::SOCKET		Show Commands Only Clear Commands & Responses
Panels       ×         ✓ Operation       Main         Standard       Amplade         Arbitray/Squence       Master         Modulation       Amplade         Modulation       Amplade         ✓ Auxiliary       O See fat         Ocumer/Timer       Pulse Generator         Hardy Order       O Bett         ✓ Auxiliary       O Bett         ✓ Auxiliary       O Bett	Offset(s)     Offset(s)	Instal Path-C:\PE0GR-Y:2:TA80RE '1148ECDN'1 3: Abd/on_D0a-C:Uservielad TA80R585 Vap020ala/Reamig/Abd/Con\ Company = Real/ame TCPP-192:188.0199:23:SOCKET Try IDN Cod-14h? 

#### 3. Control the two AWGs while in Synchronization mode:

Generally speaking, when controlling two AWGs using the MASTER-SLAVE feature:

- I. Sample clock and output frequency can only be controlled from the master unit's panels.
- II. Both master and slave units must be placed in the same run mode to operate synchronously. For example, units in burst mode will synchronize however, one set to continuous and the other to burst will result in software conflict error.
- III. Both master and slave units must be placed in the same function mode to operate synchronously. For example, both units in sequence mode will synchronize however, one set to Arbitrary and the other to sequence will result in software conflict error.
- IV. Two instrument's synchronization does not operate in modulated waveform mode.

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- V. Trigger signal is applied to the master input and is common to both master and slave units.
- VI. Each instrument can have a unique set of waveforms, active segment, sequence, amplitude and offset parameters.
- VII. Slave channels can be delayed in reference to the master channels by a pre-defined number of sample clocks.

All common attributes such as function/run modes can be set by the Arbconnection MASTER's panels, same as working with only one generator. If you would like to set different attributes to the SLAVE AWG (for example different amplitude & offset for each AWG), this is done by sending SCPI commands. In order to do so, open the Command editor (note that also the MASTER AWG can be controlled by SCPI commands):



• The Command Editor will open up. If you press the Download button, the function call in the Command field will be sent to the instrument. Low-level SCPI commands and queries can be directly sent to the WW series AWGs from the **Command** field and the instrument will respond to queries in the **Response** field. A complete list of the available SCPI commands can be found in each instrument's user manual (Chapter 5).

ArbConnection << Tabor Electronics Ltd >> Untitled.cad *	Communication Log file View
File       View       System       Help         Link       WW2074       LANTCRP=192.168.0.199:23=SOCKET       Image: Command Editor         Panels       X       Operation       Command Editor         Wain       AngRude (V)       Command Editor       Image: Command Editor         AngRude (V)       Command Editor       Command Editor       Image: Command Editor         AngRude (V)       Paremeters       Response       Remove Lire         Modulation       AngRude (V)       Image: Command Editor       Command Editor         Counter/Timer       Paremeters       Response       Remove Lire         History Buller       Oster (I)       System Template: wolkNumbero       Download         System       Coster (I)       System Template: wolkNumbero       Download         Calibration       System Template: wolkNumbero       Coster (I)       System Template: wolkNumbero	Show Commands Only         Class           Commands IP Repondent         Inatal Park-UVER/GBA721X480RE*TVARBCDN*T.3X           And Con, Dake-C. Valer Velad TABORSBS VapDelak/RoamingVahCon/         Company:           Prevame         TCPIP:132.1880.199.23:SOCKET Ty IDN           Cand-167



• In order to see that the outputs of the two AWG are in-synced, use SCPI commands to control the two instruments:



• By default, the active channel is automatically set to MASTER channel 1. Open its output using the SCPI command ':OUTP ON'. The Command editor will auto-complete (as can be seen above) the command you are about to write. Press enter when finished typing the correct command:

ILink Ww2074, LAN TCPP:122.66.0199:23::SOCKT       Penels          • Operation           Within        Standrady        Arbitray/Sequence       Troger        Main        Standrady/Sequence       Troger        Modulation       Arbitray/Sequence       Command Editor       Paramiter       Pulse Generator       Hair Cycle       X-Instrument Synce       System       System       GeneratiFilters       Gallbradon	Show Command: Only [Clear]           Dommand: Regiones           Instal Path-C:PR0GRA-231A00RE*1VAREON*1.3;           AnDCon_Date:/Uservield1A0DRS5VApDetANomingVathCon/ Congray =           Restware:CPIP::192.168.0199:23:S0CKET Try IDN Cond-16/7           Congray=and:Electronics:WW2074.0.301           ModeAWV2074.538 (apploat)           ModeAWV2074.538 (apploat)           ModeAWV2074.538 (apploat)           TCPP::192.168.0199:22:S0CKET in Unit           TCPP::192.168.0199:22:S0CKET in Cond-INST:COUP_SLAVINS 192.168.0198           TCPP::192.168.0199:22:S0CKET in Cond-SUTE 10           TCPP::192.168.0199:22:S0CKET in Cond-SUTE 10           TCPP::192.168.0199:22:S0CKET in Cond-SUTE 10           TCPP::192.168.0199:22:S
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• As can be seen on scope channel 1 of MASTER AWG is on:



 When controlling through ArbConnection, the 4 channels of the SLAVE AWG are now CH5, CH6, CH7 & CH8. Select channel 5 (ch1 in SLAVE AWG) to be the active channel by typing ':INST:SEL 5' and pressing Enter:

File View System Help Link Ww2074, LAN,TCPIP::192.168.0.199::23::SOCK Panels X VO2074 - Main Main	ET I I I I I I I I I I I I I I I I I I I	Show Command: 0nly [Dea] Command: & Responses Inval Park-CYRDGR4-21AB0RE11VARBCDN13 ArbCon_Date-CVUerz-ItaB0RS85VApD atANoamingVebConV Company = RenName: TCIPI-12188.0.193-23-SOCKET Try IDN Cm-Id-107
Standard ArbitarySequence Trigger Modulation Auxiliary Counter/Timer Pulse Cenerator Half Cycle X-Instrument Sync Seneral/Filters Calibration Composers	Command     Add Ero(s) query     Command       INST:SEL5     T     Download       Response     T     Remove Line       Uses     Import     Export     Download       Syntax Template:     INST:SEL-Number>	→Rep-Tabc Electronics, WW2074.03.01 Model-WV2074 Stat option: Resource name TCPF: 12:180.0139:23:300.ET TCPF: 12:08.0139:23:300.ET => Cmd-91P17 TCPF: 12:08.0139:23:300.ET => Cmd-91P3 TCPF: 12:188.0139:23:300.ET => Cmd-91ST TCPF: 13:188.0139:23:300.ET => Cmd-91 TCPF:

• After setting CH5 to be active, by typing ':OUTP ON' you will turn CH1-SLAVE on:



• As can be seen on Scope, you can see the two instruments are in-synced:



- The last call to the active channel was ':INST:SEL 5' so you can set the amplitude & offset of the SLAVE's channel 1 using the ':VOLT \_' & ':VOLT:OFFSET \_' commands. For example if you would like to change the amplitude, offset and waveform shape:
  - I. ':VOLT 2'
  - II. ':VOLT:OFFSET 1'
  - III. ':FUNC:SHAP SQUARE'

ArbConnection << Tabor Electronics Ltd >> Un	ntitled.cad *	Communication Log file View
File View System Help		Show Commands Only Clear
Link WW2074, LAN, TCPIP::192.168.0.199::23::SOCKET	r 🔹 🚽 🗋 🖼 🔛	Commands & Responses
Panels X Operation Main Standard Arbitrary/Sequence Trigger Auctiliary Counter/Timer Pulse Generator Half Cycle X-Instrument Sync Calibration Composens Composens	anel Command Editor Command Editor Command Editor Command Editor Response 0 History Buffer Clear Impot Export Download Close Systax Template V/DLT	Company -         Real-Name (CPIP-192,168,0.199,22:SOCKET Try (DN)           Cnd=14h2





• As can be seen on scope the amplitude, offset and shape have changed accordingly:



#### 4. <u>Set the phase difference between the two AWGs outputs:</u>

After changing the shape of the waveform, you could align the two AWG's outputs by pressing the 'Apply' button as can be seen below:

ArbConnection << Tabo	or Electronics Ltd >> Untitled.cad *			Communication Log file View	X
File View System Help				Show Commands Driv Clear	
Link WW2074, LAN, TCPIP::1	92.168.0.199::23::SOCKET	🔹 🗅 🚔 🖥	<b>#</b>	Commands & Responses	*
Panels × ▼ Operation Main Standard Arbitrary/Sequence Trigger ► Modulation ▼ Auxiliary Counter/Timer Pulse Generator	Amplade (V) : mn = 10=3; max = 10 Parameters Amplade (V) : mn = 10=3; max = 10 Fundon Standard Amplade (V) Sequenced	Contract State Contract State Contract State Contract State Contract Contract Contract Contract Contract Contract Contract Contract Contract Contract Contract Contract Contract Contract Contra	Skin Mode Channel	→ Rep-0 TCPP:132.188.0.199:22-SODKET→ Cmd=INST.SEL 5 TCPP:132.188.0.199:22-SODKET→ Cmd=VST.SEL 5 TCPP:132.188.0.199:22-SODKET→ Cmd=VUTP ON TCPP:132.188.0.199:22-SODKET→ Cmd=VUTP ON TCPP:132.188.0.199:22-SODKET→ Cmd=VUT 2 TCPP:132.188.0.199:22-SODKET→ Cmd=VUT 2 TCPP:132.18	
Half Cycle	Offset (V) Modulated A Burst	O Sync Position (Pts)	CH4	TCPIP::192.168.0.199::23::SOCKET=> Cmd=:Syst:ERR?	
X-Instrument Sync				>Resp=0 TCPIP::192.168.0.199:23:S0CKET=> Cmd=:INST:SEL.1:C0UP:DEL.0	
System	(11)			TCPIP::192.168.0.199:23:SOCKET=> Cmd=:INST:SEL 5:COUP.DEL 0	
General/Filters	X-Instrument Synchronizat	on		TCPIP::192.168.0.199:23:SOCKET=> Cmd=:Syst:ERR?	
Calibration	Master Model	evice Address Phase Officet(s)	Slave list	> Hesp=0 TCPIP::192.168.0.199::23::SOCKET=> Cmd=:INST:SEL.1;COUP:DEL.0	
Composers	Master WW2074 1	32.168.0.199 0	Initiate	TCPIP::192.168.0.199::23::SOCKET=> Cmd=:INST:SEL 5;COUP:DEL 0	
	Slave list				
		se 1660.01390 U	Apply Append Remove Close		
	1 2.00V/ 2 2.00V/ 3	4	66.00\$ 2	200.09/ Auto	



5. The next screenshots demonstrate how to control the MASTER's channel using SCPI commands. Same operations can be done using the ArbConnection panels:





• Setting the phase difference between the two AWGs defines the delay time that one instrument will hold off before it will start generating the output waveform. Minimum resolution is 20 ns and the delay can be programmed from 200ns to 20s.

Please note that there will always be skew between adjacent instruments, which is due to circuit delays and cable length. Always consider the initial skew in your inter-instrument delay calculations. The initial waveform skew on the slave unit is roughly 25ns.



## For More Information

To learn more about Tabor instruments, visit our website Support & Tutorials zone. For more of Tabor's solutions or to schedule a demo, please contact your local Tabor representative or email your request to <u>info@tabor.co.il</u>. More information can be found at our website at <u>www.taborelec.com</u>

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