

QC – External Synchronization (SYN) S32

Module of the KLIPPEL ANALYZER SYSTEM (QC Version 7, dB-Lab 212)

Document Revision 1.4

FEATURES

- On-line detection and compensation delays in the measurement chain (e.g. digital audio devices)
- Trigger measurement with incoming synchronization or test signal
- Unique trigger ID (watermark)
- Fast and robust synchronization
- Export test signal sequence and import recorded response (audio file)
- Seamless integration in Klippel QC
- Tolerant towards for clock deviation and acoustic reflections
- Fast and simple setup
- One or multiple syncs in a test sequence

BENEFITS

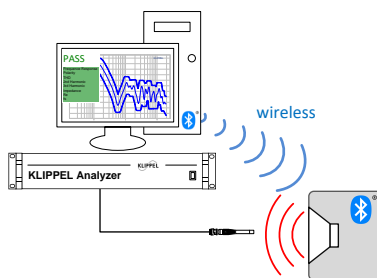
- Handle digital and wireless (e.g. Bluetooth) as well as open-loop test scenarios (e.g. smart speaker)
- Use stand-alone playback & recording devices for testing (exchange audio files)
- Independent of signal amplitude
- Electric or acoustical measurement channels
- Ultra-fast testing despite unknown delays

APPLICATIONS

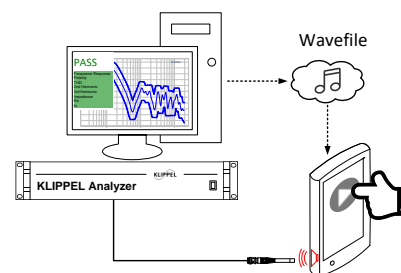
- Digital and wireless devices (USB, Bluetooth® speakers and headphones, ...)
- Stand-alone devices without audio input/output (smart speakers, media players, tablets, smart phones, automobile audio system, ...)

Testing audio devices with digital or wireless interfaces like USB or Bluetooth speakers and headphones generates challenges like unknown or varying delay and clock drifts that impair stable and reproducible testing.

Stand-alone devices such as tablets and smart speakers require the stimulus to be transferred to the device or to a cloud service and played back autonomously (open-loop scenario).



The *External Synchronization (SYN)* add-on for the QC framework of the KLIPPEL Analyzer System provides powerful features to handle those challenges easily. Tests can be triggered and synchronized through the measurement channel directly via the test signal or with dedicated sync signals that contain a unique watermark ID. The SYN can also provide the test signal sequence as an audio file that can be copied to stand-alone playback devices. Additionally, audio file import allows off-line analysis of recorded microphone responses.



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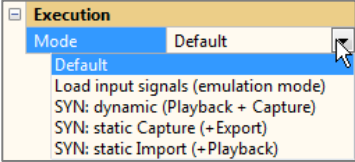
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1 Overview

1.1 Summary	
	<p>The <i>External Synchronization (SYN)</i> provides synchronization through the measurement channel. A synchronization signal (trigger) is detected in the incoming data stream (e.g. signal captured by the microphone). Subsequent measurements and analyses are triggered at the correct points of time.</p> <p>This technique is necessary to perform high-speed measurements by providing synchronous excitation and analysis for</p> <ul style="list-style-type: none"> • audio devices with unknown or variable delay (e.g. Bluetooth speaker) or • audio devices that do not provide an accessible signal input (e.g. tablet computer or media player without AUX input).
1.2 Principle	
	<p>The <i>External Synchronization</i> uses a linear modeling technique (impulse response) to detect a synchronization signal in the incoming data stream. The analysis is performed block-wise and the crest factor of each block’s impulse response is evaluated to find a valid synchronization.</p>
1.3 Activation and Execution Mode Selection	
	<p>The <i>External Synchronization</i> can be activated in <i>Control:Start for each QC test sequence</i>. The defined execution mode applies to the complete test sequence.</p> 
SYN Closed Loop	<p>See application examples <i>USB speaker</i> and <i>Bluetooth speaker</i> below.</p> <p>The closed loop execution mode allows synchronizing through the measurement channel, while keeping the timing between the test steps flexible.</p> <p>This mode is usually applied for devices under test with unknown/changing delay with available signal input and output streams.</p>
SYN Open Loop Modes	<p>See application example <i>Automobile audio system</i> below.</p> <p>The open loop execution modes (Capture, Playback, Export and Import) use either the internal signal generator or the internal data acquisition. Arbitrary definable synchronization requests (“trigger points”) allow a flexible triggering of the analysis at the correct point of time.</p>

	<p>This execution mode is usually applied for devices with inaccessible signal input. For media players the sequence is exported and copied to the device’s storage. The playback of the stimulus sequence is completely asynchronous to the analysis in that case. The timing of the complete sequence must be defined before the measurement.</p>
<p>Synchroniza- tion Requests</p>	<p>If a SYN execution mode is active, every compatible measurement task may define synchronization requests, which starts a synchronization search in the input signal before the measurement. Several request templates provide a flexible, yet easy configuration.</p>

2 Examples

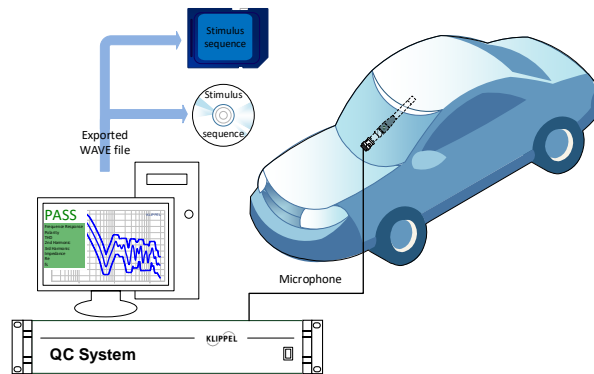
2.1 USB Speaker

	<p>The stimulus is played back with a USB audio device with unknown delay. The synchronization is performed dynamically through the acoustical measurement channel. Subsequent measurements use the detected delay to trigger the analysis in the quasi-synchronous playback process.</p> <p>For test signal playback, the speaker audio device is directly used as output sound device.</p> <p>Optionally, additional hardware like 2nd microphone, temperature/humidity sensor, footswitch, etc. may be used.</p>
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2.2 Bluetooth Speaker

	<p>This setup is similar to the USB speaker example above, but the test signals are transferred wirelessly via Bluetooth.</p>
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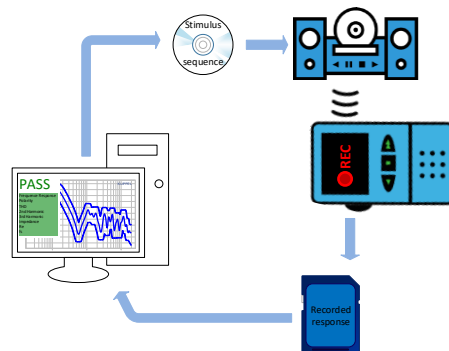
2.3 Automobile audio system



If the device under test (in this example an automobile audio system) does not provide an accessible auxiliary signal input, the stimulus sequence must be transferred offline to the audio system.

This requires Open Loop Modes by using static delays between the measurements. The stimulus sequence is generated and exported by the QC system and copied to a suitable medium (e.g. CD or memory card). The playback is performed autonomously by the device under test. The playback of the sync signal triggers the analysis at the correct point of time.

2.4 Handheld Recording Device



For measurements with handheld recording devices that

- do not provide a signal output or
- are used for mobile recordings distant from the analyzing system

the measured response shall be analyzed offline. While recording, the microphone signal is stored in the device’s memory. The audio file is imported by the QC software for analysis.

Note: The stimulus sequence may be exported to a WAVE file or directly played back.

3 Requirements

3.1 Hardware	
	No additional hardware is required.
3.2 Software	
	<p>The SYN applies to QC operations only and is available for <i>Klippel QC</i> version 4 or higher or dB-Lab QC in R&D framework from version 210.</p> <p>The execution modes can be selected in the <i>Control:Start</i> task. The following measurement tasks are able to request synchronization:</p> <ul style="list-style-type: none"> • <i>Sound Pressure (SPL)</i> • <i>Air Leak Detection (ALD)</i> • <i>Equalization & Alignment (EQA)</i> • <i>Spectrum Analysis (SAN)</i> • <i>Multitone Distortion (MTD)</i> • <i>Signal Test</i>
3.3 License	
	A license and a USB license dongle are required to activate the SYN.

4 Parameters					
CATEGORY EXECUTION (CONTROL:START)					
Parameter	Description	Available feature options			
External Synchronization	Allows the selecting a SYN execution mode to define synchronization requests	<ul style="list-style-type: none"> • SYN: Closed Loop (Playback + Capture) • SYN: Open Loop Capture (+Wave Export) • SYN: Open Loop Wave Import (+Playback) 			
CATEGORY EXECUTION (MEASUREMENT TASKS)					
External Synchronization	Request and parameterize the synchronization performed before the measurement.	<ul style="list-style-type: none"> • No synchronization request • Template: sync2stimulus (stimulus, with 50% repetition) • Template: low-frequency DUT (2 s pink noise sync signal) • Template: mid-frequency DUT (0.5 s pink noise signal) • Template: high-frequency DUT (0.1 s white noise signal) • Custom (enables custom parameters *) 			
*Custom parameters (available for custom synchronization requests)					
		Min	Default	Max	Unit
*Sync Request	Defines the synchronization signal type	<ul style="list-style-type: none"> • Sync2Stimulus • Pink noise sync signal • White noise sync signal 			
*ID (only for pink/white noise)	Unique identifier for noise synchronization signals	1	taskID	1e5	

*Sample rate tolerance	Activates sample rate tolerance for the synchronization. For sync2stim, the end of the stimulus is repeated. If the sample rate tolerance is active, synchronization a sample rate deviation of +/- 10% is detected.	<ul style="list-style-type: none"> • off • on 			
*Crest limit	crest factor limit of impulse response for a valid synchronization	10	25		dB
*Level (only for pink/white noise)	peak level ratio of synchronization signal and measurement stimulus		-3	0	dB
*Time (only for pink/white noise)	Duration of synchronization signal	0.1	0.5	5	s
Max. Sync Tries	Number of synchronization tries. Only available in Closed Loop Modes.	1	3		
High pass	High pass for synchronization process		200		Hz
*Input routing	Input routing for synchronization process	Same as measurement			
*Output routing	Output routing for synchronization	Same as measurement			
*Expert parameters	Activation of expert parameters to allow fine tuning of synchronization and processing	<p>ExtSync.MaxTol (maximum tolerance in dB to force selecting the incidence of direct sound, typically -3 .. -6 dB)</p> <p>ExtSync.AnaSyncRatio (ratio analysis block size to synchronization signal duration, typically 1.5 .. 3)</p> <p>ExtSync.Timeout (timeout for synchronization, typically 5 .. 60 s)</p> <p>ExtSync.SrtRatio (ratio of repeated part to complete stimulus, typically 0.1 .. 0.9)</p> <p>ExtSync.WaitBeforeSync (time in seconds the sync search is delayed)</p>			

* only visible with a custom synchronization request

5 Results	
The main benefit of the SYN module is the triggering of the analysis at the correct point of time. Beside the alignment of analysis and measurement several result parameters are available in the user and log output.	
Parameter	Description
SYN Delay	Detected delay between playback and capture process. This is the delay that is compensated in subsequent measurements.
SYN Crest Factor	Detected crest factor (detection threshold) of successful synchronization
SYN Sample rate factor	Detected sample rate deviation between capture and playback processes.

Find explanations for symbols at:

<http://www.klippel.de/know-how/literature.html>

Last updated: May 26, 2021

