

Optimizing? Individualising? Or cheating??

AS-XXL with the AS-i Tuner

"AS-Interface does not work for distances greater than 100 m without a repeater". This was the common statement by everyone and also by the specification. This limit has now been moved with the help of newly designed peripheral units. In the future, the limit will be between 200 and 300 m, according to the situation. Bihl + Wiedemann¹ offers two solutions for this: A bus termination and an active "AS-i Tuner", which adjusts the impedance of a network to the conditions of the local structure and which constantly monitors its functions. This is an unexpected, stunning, but highly welcome innovation.

The reason for the limitation of the network length is rooted in the principle of data transmission in the AS-Interface network. All data between master and slave are transmitted as analogue signals which are modulated on top of the DC-supply voltage. With the special method to signalise all data via current pulses and to transform them at in the inductance of the data decoupling into voltage pulses, the form of the signals is strongly influenced by the impedance of the entire system. All components are accordingly designed for the 100 m network so that a communication with 31 (respectively 62) slaves and the length of 100 m work in any network topology without problems. In networks with more than 100 m, but also if components that differ from the specification are used, communication and configuration errors may increase rapidly.



Fig. 1: AS-i Tuner and AS-i bus termination allow for "AS-i XXL" with a network extension of up to 300 m.

A higher flexibility of the system can be reached by adjusting the impedance with a bus termination. This has been repeatedly discussed, but was afterwards always dismissed as such an adjustment would contradict some basic requirements of the system. Generally, it is dependent on the kind and number of slaves and on the network topology. The interoperability ("any component by any manufacturer wi-

thin one network") and the freedom of topology of AS-nterface ("any network structure") should not have to be sacrificed for an extension. People working frequently with AS-Interface networks already knew that the network length can sometimes be extended a little. 110 or 130 m have proven to be unproblematic in some cases, especially if only a small number of slaves is connected to the network. Those people also know that with only small additional changes the stability may be lost and the error probability may increase dramatically. Thus the 100 m limit has officially never been questioned, "cheating" has not been officially approved.

Many attempts have now shown that a fixed, passive bus termination can alter the network length limit without repeater significantly towards 200 m, if the communication is meticulously checked during configuration of a new network. For this, modern masters² and an analyser³ are available.

Bihl + Wiedemann now take the next step: Besides the (passive) bus termination, the company also offers an (active) self-adjusting AS-i Tuner. In a teach-in-phase, the unit analyses the number of telegram repetitions, i.e. the not detected telegrams, and adjusts its own impedance so that the number of repetitions is minimized. Thus the optimal value can be achieved for each network. The network is "individualised" by the AS-i Tuner so that the 100 m limit can be deliberately exceeded in a controlled manner. The tuner signals with 3 LEDs whether a satisfactory configuration could be reached. A further check with an AS-i Analyser is not necessary then.

Benefits:

The benefits of the AS-i Tuner can be quickly recognised: The transmission values are improved. Each network is individually optimised.

First of all, this enables a controlled extension of AS-i networks. Detailed trials have not found a network topology which failed under full load with 31 certified slaves at network lengths of 200 m. Most topologies were expandable up to 250 m, some to 300 m. This substitutes the use of 1 or 2 repeaters or a complete redesign with more complex solutions. As repeaters can nevertheless be used, a linear extension of up to 600 m is possible. Theoretically, two slaves being installed 900 m apart with the master in their midst can be connected to one network (2 repeaters and 3 tuners). In a star topology, the system can be further extended with several parallel repeaters up to its economic limits. The only limit here is that cascading of two repeaters in a row will no longer be allowed due to the increased signal transmission time.

Due to the controlled adjustment of the network impedance, the user gains additional security for the availability of the network in which repetitions occur: In all critical applications the number of telegram repetitions which are triggered by impedance errors, can be minimised with the AS-i Tuner. The threat of a slave leaving the configuration and triggering a "Config-Error" is decreased. The availability of the application is increased. The use of the AS-i tuner is also interesting in all

cases in which unexpected problems occur, e.g. when using a cable that is not designed according to the specification, a malfunctioning slave, or when the network is extended after its initial installation. It is thus also a service unit.

Details:

Both units - bus termination and tuner - are designed as two-poles in an IP65 housing, i.e. they can be mounted like slaves. They do not require their own power supply but are fed through the network. The bus termination is connected close to the end of the network (in great distance of the power supply). The tuner, in contrast, can be connected to most locations on the network. It offers nearly total freedom of topology. Oftentimes, however, the best results are achieved if it is mounted at large distance to the power supply.

The optimisation of the impedance is done automatically after it is initialised by pushing a button. The criterion is to minimize the number of repetitions for the most disadvantageous slave. The result of this Teach-in phase is saved and reused after each restart. The process can be repeated at any time which enables a renewed alignment if changes occur: After the extension of an application with new slaves or in case of a new branch of the network, after ageing of a component, after redesign of a component, etc.

Its three LEDs (red - yellow - green) constantly signal whether the communication is satisfactory or not. The display is based on the number of telegram repetitions and thus also has another control function: It also registers telegram repetitions which cannot be attributed to the network impedance, but to other disturbances, such as EMV-influences or loose contacts. The functions of the LED display thus extend the impedance alignment and offer additional safety for the user.

The passive bus termination is the simpler and cheaper alternative to the tuner. It has a fixed value and is usually mounted at the end of the network. However, the user will only have safety if he/she checks the result with the help of a master or an analyser.

Safety aspects:

The main criteria of each bus system are data safety and availability. AS-Interface has an outstanding position in this field. Besides the option of integrating larger networks, the AS-i Tuner increases the availability of a network, as already outlined. Therefore, whereas car-tuning may be detrimental to safety, this is not the case for AS-Interface. The AS-i tuner influences the signal on the AS-Interface line towards higher detectability, but it never touches those mechanisms which guarantee data reliability. These mechanisms intervene on the digital layer after the recognition of a telegram and are therefore not concerned by an impedance adjustment. The known, extremely high protection of AS-Interface against telegram errors is kept without restrictions. The AS-i tuner can thus also be used for applications with

Safety-at-Work⁴ components and there also leads to larger networks and an increased availability.

System aspects:

AS-Interface has been designed as an extremely flexible, simple and robust system and is secured through its specification, monitored by the certification process. The limitation of the network to 100 m and the strict limit of electronic parameters were the price for these characteristics. Up to now, extending this limit was a sort of "cheating" - with the risk of an at first undiscovered decreased availability due to telegram repetitions. The passive bus termination now optimises the system in many cases and allows for its extension. Its limits, however, have to be thoroughly monitored if the bus termination is mounted. The larger solution of an AS-i Tuner permits a further extension of the named limits. With the tuner, the question is no longer what will work but what leads to a faultless communication. The AS-i tuner individualises the system and constantly monitors it.

1 www.bihl-wiedemann.de

2 Madelung, O.W.: Problem Doppeladressierung geknackt. SPS Magazin, Heft 12, Dezember 2003, S. 77-79, download file at www.bihl-wiedemann.de

3 Madelung, O.W.: Der "Lauscher" im Netz. (Ein Analyser für AS-Interface), Computer & Automation, Heft 2/2003, download file at www.bihl-wiedemann.de

4 Madelung, O.W.: Supplement to the AS-Interface Handbook (2. edition), German and English; download-file see www.madelung-online.de, 2001