

CHAPTER 3 AS-i SYSTEM COMPONENTS

3.1 Introduction

In this chapter, the different types of components that construct the AS-i system will be discussed. AS-i master, AS-i slaves, AS-i power supply, AS-i cables and accessories, all of these components must exist in any AS-i network. In the following sections, we will illustrate the functionality of each component.

3.2 AS-i Master

The bus master is the intelligent device which manages data exchanges with the slaves on the bus. It polls to each slave in turn sending out information (their output) and wait the replies (their input). Two types of bus master may be used [8].

3.2.1 The PLC Master

Using the AS-i PLC master card, as shown in Figure 3-1, the controller CPU can directly access the AS-i periphery. The AS-i master and CPU normally communicate via the internal PLC bus which is also used for the exchange of data by other interface connections, e.g. the input / output modules. This ensures a quick exchange of data and compatibility with existing PLC programs. So the user can further use his existing software [7].

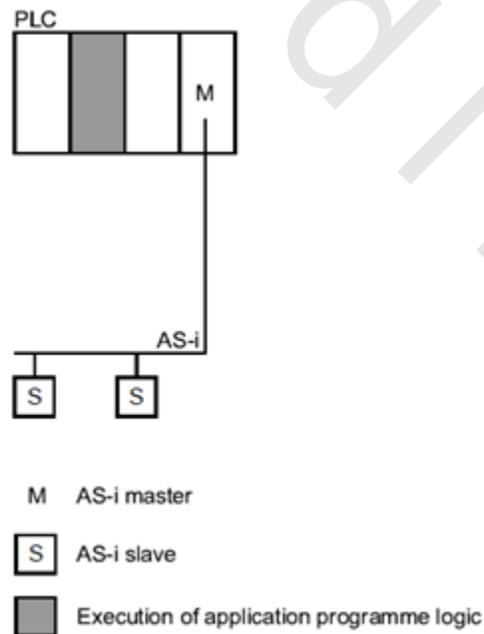


Figure 3-1 AS-i PLC Master

3.2.2 The Gateway Master

AS-i is designed as actuator sensor interface for binary participants. Therefore, couplers (gateways) to higher-level bus systems (e.g. Profibus) specially designed for larger data volumes are available. On the other hand, the gateway consists of an AS-i master which establishes the connection to AS-i and on the other hand of a connection to the higher-level system to which the AS-i data are transferred. Concerning programming, the AS-i master is treated like a participant of the higher-level bus, as depicted by Figure 3-2.

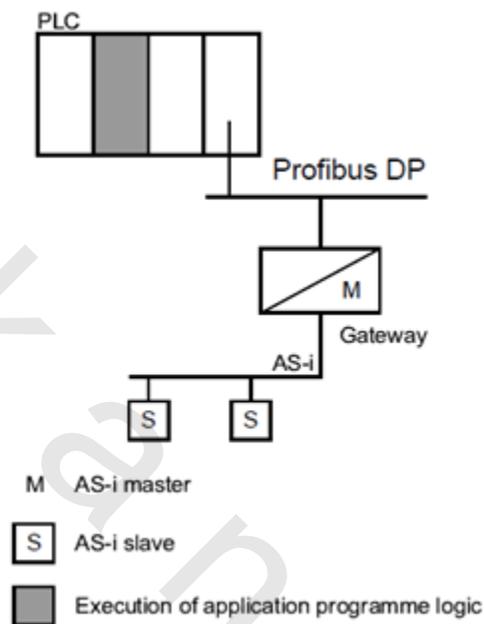


Figure 3-2 AS-i Gateway Master

3.3 AS-i Power Supply

AS-i power supplies supply all participants connected to the yellow AS-i cable. These are usually slaves, connected sensors, intelligent actuators and the repeaters. Both data and power are supplied on the two-wire cable. The DC power carries the AS-i signal. The AS-i signal and the voltage regulating circuitry of the power supply do not get along and must be separated. The theory of filtering designated frequencies is as old as radio, but there is still some art in the sizing and layout of the components.

Typical AS-i media is not shielded. If an application does arise where shielding is required then the shield would be grounded in only one place, as shown in Figure 3-3. AS-interface power supplies with integrated signal decoupling are available from 2 to 8 amps.

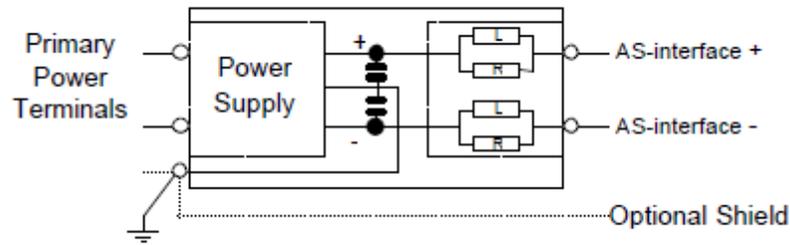


Figure 3-3 AS-i Power Supply

The original AS-i power supply provided voltages in the 30VDC range. The actual specification was 29.5 to 31.6 volts DC. The reason for being higher than the industry standard nominal 24VDC was to compensate for the voltage drop on the line. The goal was to be able to supply the end device with 24VDC (+10%/-15%). The approximate value of the resistance (R) is 39Ω , the inductance (L) is $50\ \mu\text{H}$ and the capacitance (C) is not specified but must be appropriate with the power supply design [10].

3.4 AS-i Cables

The AS-i flat cable is unshielded. It carries the data signals and 24 VDC power to supply the sensors and actuators on the system. The cable has a DC resistance of approximately $4.1\ \Omega/1000\ \text{feet}$. The outer sheath is colored yellow and its section is $1.5\ \text{mm}^2$ as shown in Figure 3-4. This cable is of special profile to eliminate any risk of polarity inversion when connecting devices to it. A black version of this cable with same characteristics is also available for distribution of 24 V auxiliary supplies.

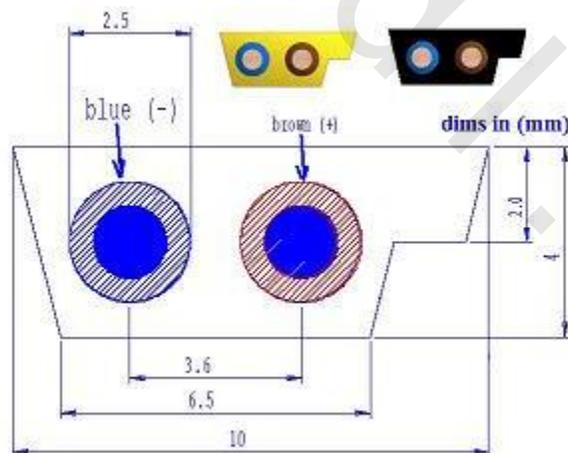


Figure 3-4 AS-i Cables

The insulating sheath has a self-healing property whereby, should an ID connector be removed, the cable will "self-seal". This feature means that connectors can be removed and repositioned at will, without having to use a new cable. The cable and ID connectors have been designed so that a whole AS-i system can be cabled rapidly and easily

modified or extended, depending upon the needs of the system. For aggressive environments, the TPE variant of these yellow and black cables provides good resistance to oils and gasoline vapors [8].

3.5 AS-i I/O Modules

AS-interface was designed as a decentralized system, thus allowing the conventional PLC with its large rack and high number of input /output cards to become a thing of the past. The AS-i I/O modules can replace the conventional PLC I/O cards with the same functionality. The communication to the PLC is handled in the usual way via an AS-i master. The modules in an AS-i network are divided into two types, the smart line modules and the field application modules [7].

3.5.1 Smart Line Modules

Smart line modules are suitable for use in control cabinets. The modules can be digital or analogue, depend on the type of the signal connected to the module, as shown in Figure 3-5. The smart line modules have the following characteristics [7]:

- 1) Robust DIN rail mounting
- 2) Addressing socket on the front
- 3) Combicon terminals for quick replacement
- 4) Screw terminals, insulation displacement terminals or cage clamps
- 5) All status LEDs clearly visible on the front
- 6) Peripheral fault indication



Figure 3-5 AS-i Smart Line Modules

3.5.2 Field Application Modules

The easy AS-i bus technology for the distribution of binary and analogue signals reduces so far the usual high number of parallel cables, so the field application modules are modified to replace the conventional remote PLC I/O cards. An example is shown in Figure 3-6 [7].



Figure 3-6 Field Application Module SIEMENS Type

The modules can be 4 input or 4 output or 2input/2output. The signal is connected to the module via M12 connector and analogue modules which support signal ranges 0...20 mA/4...20 mA (inputs or outputs), 0...10V (inputs or outputs), PT100 inputs only [6].

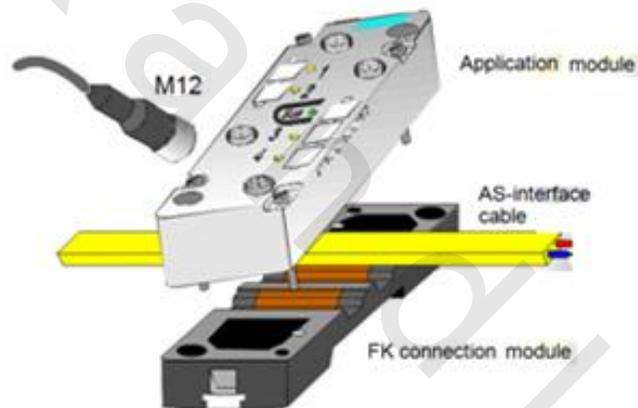


Figure 3-7 How to install an AS-i module

To connect an AS-i module to the network, as shown in Figure 3-7, the following steps have to be executed [6]:

- 1) Fix the connection module (FK connecting module) to the equipment. You can either screw the module on or snap it onto a DIN rail.
- 2) Insert the AS-i cable and secure it mechanically with the guides
- 3) Screw on the application module. Special pressure pads underneath the application module press the AS-i cable onto the contact blades in the connection module. This establishes electrical contact.
- 4) Connect the standard sensors/actuators using M12 connectors.

3.6 AS-i Sensors and Actuators

3.6.1 AS-i Sensors

Two types of sensors families are modified: namely, inductive proximity detectors and photoelectric detectors. Furthermore, analogue sensors like pressure and temperature sensors exist in the AS-i family as shown in Figure 3-8.

3.6.2 AS-i Actuators

Actuators can be motor starters and speed variators. Rotational directions and start / stop functions of the drives are to be controlled via AS-i. It is only necessary to lay the 380 V supply, the AS-i cable and if required, the additional black 24 V cable to the drive as shown in Figure 3-9 [7].



Figure 3-8 Different Types of AS-i Sensors



Figure 3-9 Connection of the AS-i actuator to an AS-i network

3.7 AS-i Accessories

In addition to numerous masters, slaves and other components; an extensive range of accessories is another strong point of an AS-i network. It comprises addressing units, flat cable lower parts, flat cable insulation displacement connectors, jumpers, mounting accessories and many other useful small components.

These accessories are not only required to set up an AS-i system, for example addressing units, but also to establish a network topology by taking into consideration the conditions on site (for example flat cable insulation displacement connectors). In addition, they make operation or installation of an AS-i network easier [7].

3.7.1 AS-i Addressing Unit

In principle AS-i slaves can be addressed in two ways: by means of a separate addressing unit or by means of software in the AS-i master as shown in Figure 3-10. No matter which way the user chooses, at the end it is always the same commands that are sent to the slave to allocate a fixed address [7].



Figure 3-10 AS-i Addressing Unit

In most cases, a hand-held addressing unit is used to program the slaves. This is not only very convenient but it also simplifies installation and set-up. The hand-held addressing unit features the following functions:

- 1) Addressing standard slaves and slaves supporting the extended addressing mode
- 2) Indicating all AS-i slaves connected to the bus
- 3) Reading and writing slave data and slave parameters
- 4) Indicating peripheral faults of a slave

3.7.2 Insulation Displacement Connectors

This insulation displacement connector, shown in Figure 3-11 enables the user to connect different AS-i participants, e.g. intelligent sensors, to the flat cable [7].



Figure 3-11 FC Insulation Displacement Connector

3.7.3 Sealing of the Flat Cable

To prevent short circuits, the flat cable end should be protected against humidity and direct contact. Figure 3-12 shows different types of flat cable sealing [7].



Figure 3-12 Different Types of Flat Cable Sealing

3.7.4 Repeater

One of the important accessories is the repeater shown in Figure 3-13. It can extend the cable length from 100m to 300m as a maximum of two repeaters can be used in a network.



Figure 3-13 Repeater in AS-i network

AS-i slaves can be fitted in both sides of the repeater and an AS-i power supply is required at each side of the repeater.

3.7.5 Extender

Extender shown in Figure 3-14 can duplicate the length of the AS-i segment from 100 to 200 meters and hence reduce the costs of the network infrastructure for large networks. If it is connected in combination with a repeater then a maximum AS-Interface network of length 600m can be achieved, if the master is located in the middle of the network [6].



Figure 3-14 Extender in an AS-i network

3.8 Summary

The AS-i network consists of many types of components. Each one has its own role in the network. One of the most important advantages of the AS-i system is the interchangeability of the system so, different modules from different manufacturers (e.g. Siemens, IFM...etc.) can be connected in a network without extra modifications.