SECTION 1

ACCESS.bus

Hardware Specification

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1.0 Introduction

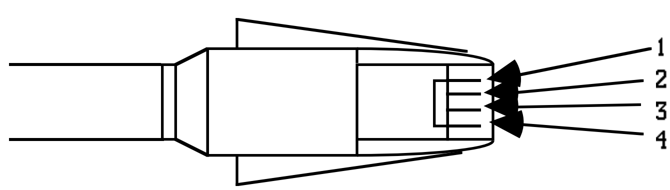
ACCESS.bus provides a simple, uniform way to link a local computer (terminal, PC, or workstation) to a number of low-speed I/O devices such as a keyboard, mouse, tablet or a 3-D tracker. ACCESS.bus uses the Philips "I^2C" (Inter Integrated Circuit) serial bus to provide an efficient cost effective way of connecting multiple devices. The ACCESS.bus protocol described in this specification defines standard messages for device initialization, device identification, address assignment (configuration process), computer attention/reset signals, and a message envelope for device specific reports and control information. Other specifications document device specific protocols for keyboards, locators, and text devices. In the following discussion the host computer is simply called the computer and all the other partners on the bus are called devices. A bus transaction is called a message.

Several references are made to the "I^2C Bus Specification". This document is available from Philips and is widely reproduced in their component data books (*80C51 and Derivative Microcontrollers Data Handbook, Book IC20 1991* available from Philips). The February 1987 version of the I^2C Bus Specification is assumed for reference.

1.1 Cabling and Connectors

ACCESS.bus uses four-pin, shielded MOLEX SEMCONN or AMP SDL, modular-type connectors. The MOLEX version is not keyed. The AMP version will have key "D". This provides compatibility between the AMP connector and the MOLEX part.

FIGURE 1.1: Shielded Modular Male Connector,
Bottom View or Pin Side (Not To Scale)

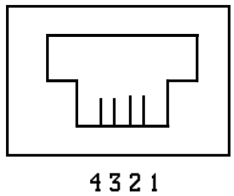


1 - GND (Black)
2 - SDA (Green)
3 - +5V (Red)
4 - SCL (White)

Data and power for the bus are transmitted over low-capacitance, four-wire, shielded cable. The four conductors are used for ground (GND), serial data (SDA), plus five volts (+5V), and serial clock (SCL).

A single bus connector is required at the host computer.

FIGURE 1.2: Female Connector Pin Identification, Front View (Not To Scale)



1 - GND
2 - SDA
3 - +5V
4 - SCL

ACCESS.bus devices that are not "hand-held" shall have two (or more) bus connectors allowing additional devices to be daisy chained. Hand-held devices such as a mouse or bar code wand may be supplied with only one connector, possibly at the end of a captive cable. Tee connections are allowed on the bus.

1.2 Capacitance

Capacitance of the SCL and SDA conductors shall be less than seventy picofarads per meter (70pF/m capacitance between one conductor and other conductors connected to shield). Standard ACCESS.bus cables use #26 wire for power and ground, and #28 wire for clock and data.

1.3 Power

ACCESS.bus computers shall supply 5V +/- 5%. The rise time of the five volt supply should be less than 100 milliseconds to insure power up reset occurs. The power supply must be able to drive decoupling capacitors used at each device. Ten microfarads per device is recommended.

Two ACCESS.bus computers must not be connected without first isolating the two five volt supplies.

ACCESS.bus devices may supply their own power from a separate source if needed. A power up reset circuit must still be provided to reset the device when bus power is applied.

1.4 Current

ACCESS.bus computers (or power supplies) must supply a minimum of fifty milliamperes (50mA) and a maximum of one Amp (1A). Current limiting or overcurrent protection is required. The actual current rating should be determined by the expected usage, and must be clearly stated in the product documentation.

Each piece of ACCESS.bus equipment must have two documented ratings: maximum current in milliamperes ("I") and maximum capacitive load in picofarads ("C").

Table 1: Typical Ratings for ACCESS.bus Equipment

Equipment	Typical Rating
ACCESS.bus host computer	I200 C100
ACCESS.bus cable, 1 meter	I0 C65
ACCESS.bus keyboard	I110 C20
ACCESS.bus mouse	I30 C80

It is recommended the appropriate ratings appear on the device itself.

1.5 Maximum Number of Devices

The maximum number of ACCESS.bus devices normally allowed on the bus is fourteen. Limiting factors are the device addressing range (see Addressing, Base Protocol Specification) and power distribution.

1.6 Configuration

A conforming ACCESS.bus configuration must satisfy the following two conditions:

1. The sum of the current ratings for all devices must not exceed the host computer rating.

2. The sum of the capacitive load ratings must not exceed 800pF (maximum capacitive load with a three milliampere (3mA) current source).

1.7 Cable Length

The maximum total cable length for the entire bus shall be eight meters. This is constrained by both the capacitive loading not to exceed 800pF and the maximum voltage drop to maintain 5V +/-10%.

An I^2C cable extender/repeater may be used to increase the maximum cable length.

1.7.1 Technical Note

In rare circumstances the maximum cable length may need to be reduced in proportion to the amount of current over 100mA consumed from the host computer supply.

> For example: A 100mA configuration can be eight meters (8m) in length, a 200mA configuration may need to be reduced to four meters (4m) to

guarantee worst case operation at 5V +/-10%. Many I^2C microcontrollers are specified to operate at 5V +/-20% or greater avoiding this worst case limitation entirely.

1.8 Cable Shield

The cable shield and case are connected to power and logic ground at a single point in the host computer. The shield shall be kept separate from power and logic ground within ACCESS.bus cables. The shield is isolated from logic ground by a minimum 100K ohms within each device.

1.9 RF Filtering

It is strongly recommended that ACCESS.bus computers provide RF filtering on the bus wires to control conducted emissions.

1.10 Pull-up

Pull-up for the two I^2C lines (SDA and SCL) shall be provided by three milliamperes (3mA) current sources (or switched resistor circuits) inside the computer. The current source (or switched resistor circuit) allows larger values of capacitance to be driven while maintaining a one microsecond rise time.

1.11 Series Resister

A 100 ohm series resistor shall be used between the SDA and SCL pins on each device and the corresponding I^2C bus lines. This resistor smoothes the bus signals and offers additional ESD (electrostatic discharge) protection.

> **Note**: a 200 ohm resistor, as allowed by the I^2C bus specification, should not be used because the bus employs current sources to double the maximum capacitance.

1.12 I^2C Compatibility

Unless otherwise noted in this specification, ACCESS.bus hardware interfaces must be I^2C compatible and conform to all I^2C specifications as published by Philips. Any microcontroller with an I^2C interface may be used as long as it is powerful enough to carry out its device control task without degrading bus performance.