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# UM10001_4

## ISP110x Eval Kit User Manual for the HBCC Package

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*Document information*

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| Keywords | ISP110x, ISP1102, ISP1104, ISP1105, ISP1106, USB, universal serial bus, transceiver. |
| Abstract | The ISP110x eval board helps you to evaluate the features of the ISP110x. This document explains the evaluation of the ISP110x HBCC package.<br><br>*Notes*: ISP110x denotes the ISP1102, ISP1104, ISP1105 and ISP1106 Philips Advanced Universal Serial Bus transceivers, and any future derivatives. |

PHILIPS

*Revision history*

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| 1.0 | Jan 2002 | First release |

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*Note*: ISP110x denotes the ISP1102, ISP1104, ISP1105 and ISP1106 Advanced Universal Serial Bus transceivers.

# 1. ISP110x Eval Board

## 1.1. Objective

The ISP110x evaluation (eval) board helps you to interface a transceiver for various applications.

## 1.2. Description

The ISP110x is a generic Universal Serial Bus (USB) transceiver Integrated Circuit (IC) that is compliant with *Universal Serial Bus Specification Rev. 2.0*. It operates linearly from 3.3 V to 5.0 V of power supply and is backward compatible with the PDIUSBP11A.

Both the PDIUSBP11A and the ISP110x support two types of driver interfaces: the Philips encoded data interface and the USB-IF standard data interface. This compatibility allows greater flexibility in designs and applications.

To facilitate testing, all the pins of the ISP110x are connected to one side of each of the headers H1, H2, H3 and H4. The other side of these headers is connected to the ground. Some pins of the ISP110x, such as MODE, $\overline{OE}$, SUSPND, VMO/FSE0, VPO/VO and SPEED, are pulled up using 4.7 kΩ resistors.

To operate the ISP110x in different types of transceivers, you may use jumpers. For example, for the speed mode, you can select the JP12 and JP13 jumpers or the JP14 or JP15 jumpers and connect to $V_{pu}$ or +3.3 V. Jumpers, such as JP6 to JP11, in addition to their drive characterizing function are configured to accept different capacitors, depending on the requirement. For the board schematic diagram, see Section 5.

The mode of operating the eval board depends on the IC used, as well as some jumpers setting.


*Figure 1-1: ISP110x Eval Kit*

H1, H2, H3 and H4 are the headers on the eval board for the ease of tapping out signals. Table 1-1 shows the signal contents of these headers and their corresponding signal names in the ISP110x product family.

*Table 1-1: Signal Content of Headers and the Corresponding Signal Name in the ISP110x*

| Header | Signal | In | | | |
|---|---|---|---|---|---|
| | | ISP1102 | ISP1104 | ISP1105 | ISP1106 |
| H1 | $\overline{OE}$ | $\overline{OE}$ | $\overline{OE}$ | $\overline{OE}$ | $\overline{OE}$ |
| | RCV | RCV | RCV | RCV | RCV |
| | VP | VP/VPO | VP | VP | VP |
| | VM | VM/VMO | VM | VM | VM |
| | SUSPEND | SUSPEND | SUSPEND | SUSPEND | SUSPEND |
| | SPEED | VBUSDET | VBUSDET | SPEED | SPEED |
| H2 | MODE | n.c.[1] | MODE | MODE | GND |
| | VMO/FSE0 | n.c.[1] | VMO/FSE0 | VMO/FSE0 | VMO |
| | VPO/VO | n.c.[1] | VPO/VO | VPO/VO | VPO |
| H3 | Not used on the eval board; can be ignored | | | | |
| H4 | SOFTCON | SOFTCON | SOFTCON | SOFTCON | SOFTCON |
| | VMO | n.c.[1] | VMO/FSE0 | VMO/FSE0 | VMO |
| | VPO | n.c.[1] | VPO/VO | VPO/VO | VPO |
| | D+ | D+ | D+ | D+ | D+ |
| | D- | D- | D- | D- | D- |

[1] n.c.—denotes no connection.

Table 1-2 shows the jumper settings on the eval board.

*Table 1-2: Jumper Settings*

| Jumper | Setting |
|---|---|
| JP1 | Connect to $V_{CC(5.0)}$ |
| JP2 | Short $V_{CC(5.0)}$ to $V_{reg(3.3)}$ |
| JP3 | Connect to $V_{reg(3.3)}$ |
| JP4 | Connect to $V_{CC(I/O)}$ |
| JP5 | Connect to $V_{BUS}$ line |
| JP6 | Different capacitor leads for characterized testing |
| JP7 | Different capacitor leads for characterized testing |
| JP8 | Different capacitor leads for characterized testing |
| JP9 | Different capacitor leads for characterized testing |
| JP10 | Different capacitor leads for characterized testing |
| JP11 | Different capacitor leads for characterized testing |
| JP12 | Pull up on D- |
| JP13 | Pull up on D+ |
| JP14 | Connect to $V_{pu(3.3)}$ |
| JP15 | Connect to $V_{reg(3.3)}$ |

## 2. Mode Selection for Applications

*Table 2-1: Mode Selection*

| IC Products and Packages[1] | MODE (H2–Pin 1 and Pin 2) | Operation Mode |
|---|---|---|
| ISP1102W | No connection | Differential Input Mode (VO/VPO, VM/VMO)—Bidirectional |
| ISP1104W | Short | Single-Ended Input Mode (VO, FSE0) |
| | Open | Differential Input Mode (VPO, VMO) |
| ISP1105W | Short | Single-Ended Input Mode (VO, FSE0) |
| | Open | Differential Input Mode (VPO, VMO) |
| ISP1106W | Short | Differential Input Mode (VPO, VMO) |
| ISP1106DH | Short | Differential Input Mode (VPO, VMO) |

[1] W—HBCC16 package; DH—TSSOP16 IC package.

## 3. Power Supply Configurations

The ISP110x can be used with power supply configurations that can be dynamically changed. Jumpers JP1, JP2, JP3 and JP4 are used to suit the power supply application environment as shown in Table 3-1.

*Table 3-1: Power Supply Configurations*

| Mode | Environment | Connected Voltages | Jumpers Required | Remarks |
|---|---|---|---|---|
| Normal | +5.0 V operation | $V_{CC}$ | JP1 | Connected to a 5 V source (4.0 V to 5.5 V) |
| | | $V_{CC(I/O)}$ | JP4 | Connected to 1.65 V to 3.6 V range of the backend logic circuit (external supply voltage) |
| | +3.3 V operation | $V_{CC}$ | JP3 | $V_{CC}$ and $V_{reg(3.3V)}$ shorted and connected to a 3.3 V source |
| | | $V_{reg(3.3V)}$ | JP2 | |
| | | $V_{CC(I/O)}$ | JP4 | Connected to 1.65 V to 3.6 V range of the backend logic circuit (external supply voltage) |
| Disable | +5.0 V operation | $V_{CC}$ | JP1 | Only connected to a 5 V source (4.0 V to 5.5 V); $V_{CC(I/O)}$ is not connected |
| | +3.3 V operation | $V_{CC}$ | JP3 | $V_{CC}$ and $V_{reg(3.3V)}$ are shorted and only connected to a 3.3 V source |
| | | $V_{reg(3.3V)}$ | JP2 | $V_{CC(I/O)}$ is not connected |
| Sharing | | $V_{CC(I/O)}$ | JP4 | Only $V_{CC(I/O)}$ is connected; $V_{CC}$ and $V_{reg(3.3V)}$ are not connected |

Jumper JP5 is used for the application to disconnect $V_{BUS}$ from $V_{CC}$. This $V_{BUS}$ voltage is driven from the connected $V_{BUS}$ USB cable.

*Note*: The ISP1102, ISP1105 and ISP1106 transceivers have a regulator bypass mode, in which $V_{CC(5.0)}$ can be connected to $V_{reg(3.3)}$ with a maximum voltage drop of 0.3 V (2.7 to 3.6 V). The ISP1104 does not support this mode.

# 4. Function Testing

## 4.1. Function Selection

*Table 4-1: Function Table*

| SUSPND | $\overline{OE}$ | RCV | VP/VM | D+, D- | Remarks |
|---|---|---|---|---|---|
| LOW | LOW | Active | Active | Active | Driving and receiving (differential receiver active) |
| HIGH | LOW | Inactive[2] | Active | Active | Driving during suspend (differential receiver inactive)[3] |
| LOW | HIGH | Active | Active | Hi-Z | Receiving only[1] |
| HIGH | HIGH | Inactive[2] | Active | Hi-Z[1] | Low-power state |

[1] Other USB devices and external pull-up or pull-down resistors determine signal levels on D+, D-.
[2] In the suspend mode (SUSPND = HIGH), the differential receiver is inactive and the output RCV is always LOW. Out-of-suspend ('K') signaling is detected through the single-ended receivers VP and VM.
[3] During suspend, the slew rate control circuit of the low-speed operation is disabled. The D+ and D- lines are still driven to their intended states, without the slew rate control. This is permitted because driving during suspend is used to signal remote wake-up by driving a 'K' signal (one transition from idle to the 'K' state) for a period of 1 ms to 15 ms.

## 4.2. Driver Interface Selection for the ISP1104; ISP1105; ISP1106

*Table 4-2: Driving Function*

| Mode | VPO/VO | VMO/FSE0 | Data | Interface |
|---|---|---|---|---|
| 0 | LOW | LOW | Differential 0 | Philips Encoded Data Interface |
| | LOW | HIGH | SE0 | |
| | HIGH | LOW | Differential 1 | |
| | HIGH | HIGH | SE0 | |
| 1 | LOW | LOW | SE0 | USB-IF Standard Data Interface |
| | LOW | HIGH | Differential 0 | |
| | HIGH | LOW | Differential 1 | |
| | HIGH | HIGH | Illegal Data | |

*Table 4-3: Driving function using single-ended input data interface ($\overline{OE}$ = L)*

*[for ISP1104 and ISP1105 (MODE = L)]*

| FSE0 | VO | Data |
|---|---|---|
| LOW | LOW | Differential logic 0 |
| LOW | HIGH | Differential logic 1 |
| HIGH | LOW | SE0 |
| HIGH | HIGH | SE0 |

*Table 4-4: Driving function using differential input data interface ($\overline{OE}$ = L)*

*[for ISP1104, ISP1105 and ISP1106 (MODE = H)]*

| VMO | VPO | Data |
|---|---|---|
| LOW | LOW | SE0 |
| LOW | HIGH | Differential logic 1 |
| HIGH | LOW | Differential logic 0 |
| HIGH | HIGH | Illegal state |

*Table 4-5: Receiving function ($\overline{OE}$ = H)*

| D+, D- | RCV | VP[1] | VM[1] |
|---|---|---|---|
| Differential logic 0 | LOW | LOW | HIGH |
| Differential logic 1 | HIGH | HIGH | LOW |
| SE0 | RCV*[2] | LOW | LOW |

[1] VP = VM = 'H' indicates that the sharing mode ($V_{CC(5.0)}$/$V_{reg(3.3V)}$ is disconnected).
[2] RCV* denotes the signal level on output RCV just before the SE0 state occurs. This level is kept stable during the SE0 period.

## 4.3. Driver Interface Selection for the ISP1102

*Table 4-6: Driving function using differential input data interface ($\overline{OE}$ = L)*

*[for ISP1102]*

| VM/VMO | VP/VPO | Data |
|---|---|---|
| LOW | LOW | SE0 |
| LOW | HIGH | Differential logic 1 |
| HIGH | LOW | Differential logic 0 |
| HIGH | HIGH | SE0 |

*Table 4-7: Receiving function ($\overline{OE}$ = H)*

| D+, D- | RCV | VP[1] | VM[1] |
|---|---|---|---|
| Differential logic 0 | LOW | LOW | HIGH |
| Differential logic 1 | HIGH | HIGH | LOW |
| SE0 | RCV*[2] | LOW | LOW |

[1] VP/VPO = 'H' and VM/VMO = 'H' indicate the sharing mode ($V_{CC(5.0)}$ is disconnected).
[2] RCV* denotes the signal level on output RCV just before the SE0 state occurs. This level is kept stable during the SE0 period.

# 5. Schematic of the ISP110x

*Note*: IC U3 and H3 are only applied when the USB_VP and USB_VM signals are required to be inverted. For this transceiver application, it can be ignored.

The following modifications must be done in the schematic:

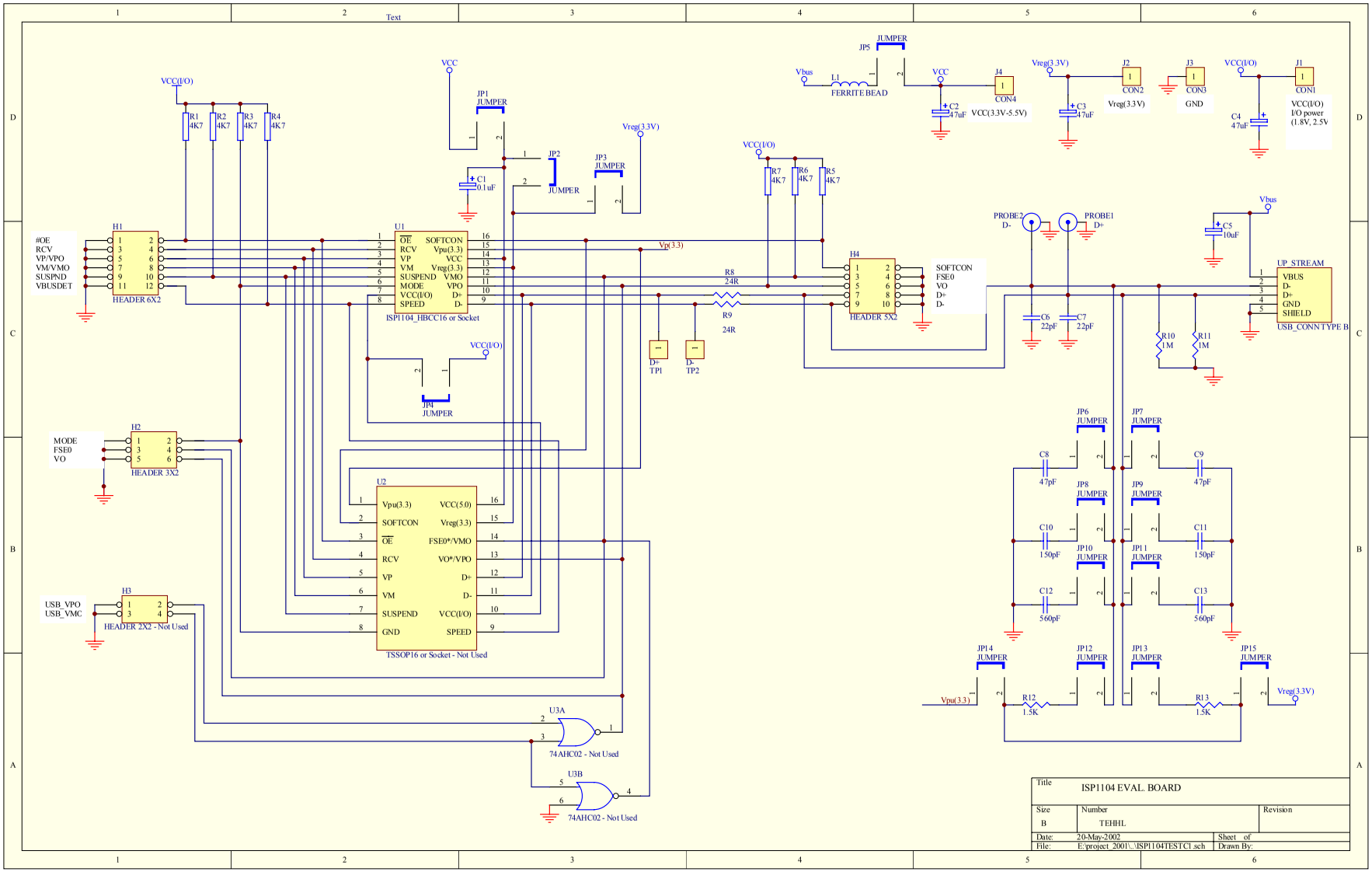
- R8 and R9 must be 33 Ω ± 1%.
- R10 and R11 can be removed.

Depending on the application, Table 5-1 provides guidelines for setting up the ISP110x HBCC16 package.

*Table 5-1: Setting up the ISP110x HBCC16 package*

| *Pin Name* | *ISP1102* | *ISP1104* | *ISP1105* | *ISP1106* |
|---|---|---|---|---|
| *MODE* | No connection | Differential—no jumper | Differential—no jumper | Connect to GND using jumper |
| | | Single-ended—connect to GND using jumper | Single-ended—connect to GND using jumper | |
| *SPEED* | Not applicable | Not applicable | Full-speed—no jumper | Full-speed—no jumper |
| | | | Low-speed—connect to GND using jumper | Low-speed—connect to GND using jumper |
| *VBUSDET*[1] | No jumper; R4 can be removed | No jumper; R4 can be removed | Not applicable | Not applicable |
| *VMO* | No jumper; R6 can be removed | No jumper; R6 can be removed | No jumper | No jumper |
| *VPO* | No jumper; R7 can be removed | No jumper; R7 can be removed | No jumper | No jumper |

[1] The VBUSDET pin is a $V_{BUS}$ output indicator. When $V_{BUS}$ is greater than 4.0 V, output is HIGH; and when $V_{BUS}$ is less than 3.6 V, output is LOW. This feature applies only to the ISP1102 and the ISP1104.


Text
VCC(I/O)
R1 4K7
R2 4K7
R3 4K7
R4 4K7
VCC
JP1 JUMPER
C1 0.1uF
JP2 JUMPER
JP3 JUMPER
Vreg(3.3V)
JP5 JUMPER
Vbus
L1 FERRITE BEAD
C2 47uF
VCC(3.3V-5.5V)
J4 CON4
C3 47uF
J2 CON2
Vreg(3.3V)
J3 CON3
GND
C4 47uF
J1 CON1
VCC(I/O) I/O power (1.8V, 2.5V
R7 4K7
R6 4K7
R5 4K7
PROBE2 D-
PROBE1 D+
C5 10uF
Vbus
H1
#OE
RCV
VP/VPO
VM/VMO
SUSPND
VBUSDET
HEADER 6X2
U1
OE SOFTCON
RCV Vpu(3.3)
VP VCC
VM Vreg(3.3)
SUSPEND VMO
MODE VPO
VCC(I/O) D+
SPEED D-
ISP1104_HBCC16 or Socket
Vp(3.3)
R8 24R
R9 24R
H4
HEADER 5X2
SOFTCON
FSE0
VO
D+
D-
C6 22pF
C7 22pF
R10 1M
R11 1M
UP_STREAM
VBUS
D-
D+
GND
SHIELD
USB_CONNTYPE B
D+ TP1
D- TP2
VCC(I/O)
JP4 JUMPER
H2
MODE
FSE0
VO
HEADER 3X2
U2
Vpu(3.3) VCC(5.0)
SOFTCON Vreg(3.3)
OE FSE0*/VMO
RCV VO*/VPO
VP D+
VM D-
SUSPEND VCC(I/O)
GND SPEED
TSSOP16 or Socket - Not Used
JP6 JUMPER
JP7 JUMPER
C8 47pF
C9 47pF
JP8 JUMPER
JP9 JUMPER
C10 150pF
C11 150pF
JP10 JUMPER
JP11 JUMPER
C12 560pF
C13 560pF
JP14 JUMPER
JP12 JUMPER
JP13 JUMPER
JP15 JUMPER
Vpu(3.3)
R12 1.5K
R13 1.5K
Vreg(3.3V)
H3
USB_VPO
USB_VMC
HEADER 2X2 - Not Used
U3A
74AHC02 - Not Used
U3B
74AHC02 - Not Used
Title
ISP1104 EVAL. BOARD
Size
B
Number
TEHHL
Revision
Date: 20-May-2002
Sheet of
File: E:\project 2001\..\ISP1104TESTC1.sch
Drawn By:

## 6. Bill of Materials for the ISP110x Eval Board

*Table 6-1: Bill of Materials for the ISP110x Eval Board*

| Description | Reference | Value | Quantity |
|---|---|---|---|
| Power supply plugs | Con1, Con2, Con3, Con4 | CON | 4 |
| Tantalum capacitors | C6, C7 | 22 pF | 2 |
| Electrolytic capacitor | C1 | 0.1 F | 1 |
| Electrolytic capacitors | C2, C3, C4 | 47 F | 2 |
| Electrolytic capacitor | C5 | 10 F | 2 |
| Tantalum capacitors | C8, C9 | 47 pF | 2 |
| Tantalum capacitors | C10, C11 | 150 pF | 2 |
| Tantalum capacitors | C12, C13 | 560 pF | 2 |
| Probes | D+, D- | — | 2 |
| Header | H1 | 6X2 | 1 |
| Header | H2 | 5X2 | 1 |
| Header | H3 | 3X2 | 1 |
| Header | H4 | 2X2 | 1 |
| Jumpers | JP1 to JP15 | — | 16 |
| Resistors | R1, R2, R3, R4, R5, R6, R7 | 4.7 kΩ | 7 |
| Resistors | R12, R13 | 1.5 kΩ | 2 |
| Resistors | R10, R11 | 1 MΩ | 2 |
| Resistors | R8, R9 | 24 Ω | 2 |
| Ferrite bead | L1 | — | 1 |
| UP_CONN | UP | — | 1 |
| 74AHC02 | U3 | — | 1 |
| ISP1105/06 | U1 or U2 | — | 2 |

## 7. References


- *Universal Serial Bus Specification Rev. 2.0*
- *ISP1102 Advanced Universal Serial Bus transceiver* data sheet
- *ISP1104 Advanced Universal Serial Bus transceiver* data sheet
- *ISP1105/06 Advanced Universal Serial Bus transceivers* data sheet.