TH2000 USB repeater Application note

- 1 Describe TH2000 USB repeater IC
 - 1.1 TH2000 is a USB repeater IC for extending length of USB connection. It follows USB1.1 specification.
 - 1.2 When the Low Speed (LS) USB device is connected to USB ROOT HUB or HUB by way of TH2000 USB repeater, the LSO will be set to logic 1 and the FSO will be clear to logic 0. When the High Speed (HS) USB device is connected to USB ROOT HUB or HUB by way of TH2000 USB repeater, the LSO will be clear to logic 0 and the FSO will be set to logic 1. If FSO and LSO both equal logic 1, that means error. If FSO and LSO both equal logic 0, that means no USB device connect to its downstream port.
 - 1.3 When FSI is set to logic 1, the DUSIP will be set to logic 1. When LSI set to logic 1, the DUSIN will be set to logic 1.
 - 1.4 If the USB connection goes into suspend state, the SUSDTO will clear to logic 0.
 - 1.5 When time out occur on the USB connection, the TIMDTO will be clear to logic.
 - 1.6 The USB connection's relation between FSUSE, FSDSE, LSUSE and LSDSE

| | TH2000 upstream port | | TH2000 downstream | |
|--------|----------------------|---------|-------------------|---------|
| | | | port | |
| | FS mode | LS mode | FS mode | LS mode |
| SE0 | FSUSE=1 | FSUSE=Z | FSDSE=1 | FSDSE=Z |
| occur | LSUSE=Z | LSUSE=1 | LSDSE=Z | LSDSE=1 |
| Normal | FSUSE=0 | FSUSE=Z | FSDSE=0 | FSDSE=Z |
| | LSUSE=Z | LSUSE=0 | LSDSE=Z | LSDSE=0 |

- 1.7 Its original upstream port and downstream port should both go into the idle state. When the USB HOST tries to configure the USB device, it will send a SYNC filed (KJKJKJKK). And TH2000 will enable output buffer of the downstream port. At this time, NSUS=0 (suspend) and USSE0DET (SE0 does not equal 0)
- 1.8 When EOP occur, USSE0DET will change its value in this order 0→ 1→ 0. And it will reset all the TH2000's internal register value to disable both the output buffers of its upstream port and downstream port and the reset will continue until all its internal registers have cleared their value.
- 1.9 When the USB device go into suspend state, any changes on the USVM or DSVM will set the output enabled.

- 2 There are 2 recommended circuits to extend USB's connection USB boost cable and SuperX USB cable.
 - 2.1 The USB boost cable extends 16 feet for USB 1.1 devices connect to HUB or Root HUB. It connects up to 5 cables in series for up to additional 80 feet. The recommended circuit sees Figure 1.
 - 2.2 The SuperX USB cable maxim length is 150 feet for USB 1.1 devices connect to HUB or Root HUB. The SuperX USB cable consist Base unit and Remote connected together by a standard Category-5 network cable. The recommended circuit sees Figure 2 and 3.
- 3 Control flow
 - 3.1 Initialize USB repeater

When USB repeater's upstream port connect to the HUB, the USB repeater must be initialized. There are 2 transaction mode of USB 1.1 device –Low speed (LS) mode and Full speed (FS) mode. The LS transaction mode is 1.5Mbps and connect pull-up resistor to the signal D-of device's upstream port. The FS transaction mode is 12Mbps and connect pull-up resistor to the signal D+ of device's upstream port. After connection, the USB repeater will connect pull-up resistor to signal D+ or D- of its upstream port depend on the transaction mode of USB device which was connected to its downstream port.

- 3.2 Configure USB HOST depend on USB device
 - 3.2.1 At the beginning, both the upstream port and downstream port are into the input state. The USB host should try to configure the device first. So, the first data will be sent from USB HOST (PC) to USB device. After the differential data is transmitted from USB HOST to USB repeater's upstream port, the USB repeater's downstream port will be changed to output state.
 - 3.2.2 At the end of packet, the USB HOST will send a EOP, i.e. SE0 for approximately 2 bit times followed by a J state for a bit time. After receiving EOP, the USB repeater will disable both the upstream output and downstream output buffer.
 - 3.2.3 Now, the USB device should feedback data to USB HOST for configuration and the USB repeater's downstream port will be changed to input state and upstream port will be changed to output state. As the same, after receiving EOP, the USB repeater will disable both its upstream port and downstream port output buffer.
- 3.3 Detect the suspend state

If the upstream port continues in the idle state for more than 3 ms, than it

will be considered as suspend. When USB connection go into suspend state, the USB repeater and the USB device which is connected to the USB repeater's downstream port should not consume current more than 500uA.

3.4 Detect of babble

Babble is characterized by SOP followed by the presence of USB bus activity past the end of frame. The USB HUB will disable the downstream port that detects the babble. The USB repeater will reset itself for configuration by host after detecting babble.







