# USB ENGINEERING CHANGE NOTICE

**Title:** **USB On-The-Go and Embedded Host Testability**

**Applies to:** **USB On-The-Go and Embedded Host supplement Revision 2.0**

## Summary of ECN:

Add new Test Devices VID=0x1A0A PIDs=0x0200, 0x0201 and 0x0202, together with their specifications. Remove original Test Device VID=0x1A0A PID=0xBADD. Add new TEST_MODE selector values 0x06 and 0x07 from the reserved list in Table 9-7 of the USB Revision 2.0 Specification. Add method of setting a further feature bit (with no relation to existing numbering) when device under test is acting as host.

## Reasons for ECN:

These changes are necessary to allow automated compliance testing.

## Impact on Existing Peripherals and Systems:

Compliance testing for existing OTG and EH devices will have to allow for manual procedures to permit the required parameters to be exposed to testing. OTG Rev 1.3 devices, and any existing OTG Rev 2.0 devices will not recognize the new test device or the new TEST_MODE selector values.

## Hardware Implications:

There are no likely hardware implications.

## Software Implications:

The software will need to be modified in order that any device that is compliant with revision 2.0 of the OTG & EH Supplement, must recognize the Test Device and behave accordingly, and must accept requests to set the new feature bits, and behave accordingly.

## Compliance Testing Implications:

Compliance testing will become much faster, by making automated compliance testing possible.

## Specification Changes:

*Add to 1.2 Acronyms and Terms:*

> *PET          Protocol and Electrical Tester. A test unit which is capable of performing the tests specified in the  'Battery Charging, USB On-The-Go and Embedded Host Automated Compliance Plan'.*

*Replace Following Section:*

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**6.4 Test Device Support**

A device with VID=0x1A0A, PID=0xBADD is defined to be a test device, part of the compliance test configuration. An A-device or B-device shall treat a device with this identification as an unsupported device.

An OTG A-device is required to perform HNP within TA_SRP_RSPNS max if it enumerates the B-device and discovers that the test device is attached.  An A-device (OTG or EH) is not required to display an unsupported device message when attached to the test device.  If an OTG A-device does display an unsupported device message, the message shall not delay HNP.  When connected to a test device, an A-device is not allowed to drive a resume signal longer than 30 seconds.

If an OTG A-device has already granted the role of host to the test device once during a session, then the OTG A-device is not required to grant the role of host to test device again during the same session.

**6.4.1 High-speed Electrical Test Mode Support**

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*With:*

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**6.4 Test Device Support**

An A-device, B-device or EH shall recognize, and behave appropriately on encountering, a set of test devices, having VID=0x1A0A, and the PIDs defined in the following sections. It shall also respond correctly to the test mode feature bits defined in Section 6.4.3.

**6.4.1 High-speed Electrical Test Mode Support**

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*After Section 6.4.1.1 insert:*

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### 6.4.2  Protocol and OTG Electrical Test Device Support

A device with VID=0x1A0A, PID=0x0200 is defined to be a test device, required by the compliance test. An A-device, B-device or EH shall recognize this test device and behave accordingly as defined below. The test devices shall continue to be recognized by retail examples of the devices, to permit subsequent audit.

The test device has no endpoints, no class function, and the host shall not perform any class activity after configuration.

#### 6.4.2.1  Behavior of OTG A-device on Enumerating Test Device

An OTG A-device shall configure the test device to configuration 1, within $T_{TST\_CONFIG}$ max of completing the bus reset.

When the OTG A-device under test enumerates the test device it shall set and/or reset its own OTG test mode feature bits as required, making use of information in the device descriptor. – see Section 6.4.3. Currently only one such bit, 'otg_vbus_off', is defined.

The OTG A-device shall then maintain a session for at least $T_{TST\_MAINT}$ min, during which time it shall allow at minimum IA_VBUS_RATED to be drawn, by the Protocol and Electrical Tester (PET), from $V_{BUS}$. The OTG A-device shall perform HNP polling during this period.

If, within this period of $T_{TST\_MAINT}$, the HNP polling finds that Host Request Flag is set, the A-device shall allow the B-device (the PET) to become host, in accordance with the HNP specification timings. After the B-device (the PET) stops acting as a host, the A-device shall become host again, rather than exercising its option of ending the session. This requirement to maintain the session remains in force until the B-device detaches.

If the 'otg_vbus_off' feature bit gets set during enumeration then, if the PET disconnects before the end of the $T_{TST\_MAINT}$ min period of configured state, the host shall turn off $V_{BUS}$, if it is capable of doing so, and shall not perform any ADP probes for a period defined in Section 6.4.3.2.1.

A host which is not capable of turning off $V_{BUS}$ may, after the $T_{TST\_MAINT}$ configured period, continue to send SOFs, or may suspend the B-device.

#### 6.4.2.2  Behavior of OTG B-device on Enumerating Test Device

During testing, the PET may enumerate an HNP capable B-device under test, and then set the otg_hnp_reqd feature bit. The B-device shall then perform HNP and assume the host role.

The OTG B-device, once acting as a host, shall enumerate the test device within $T_{TST\_CONFIG}$ max of the bus reset, and shall Set_Configuration (0), and shall then suspend within $T_{TST\_SUSP}$ of the Set_Configuration (0), and hand back the host role to the A-device (the PET), in accordance with the HNP specification timings.

#### 6.4.2.3  Behavior of EH on Enumerating Test Device

The EH shall configure the test device to configuration 1, within $T_{TST\_CONFIG}$ max of the bus reset.

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When the EH under test enumerates the test device it shall set and/or reset its own OTG test mode feature bits as required – see below for more detail.

The EH shall then maintain a session for at least T$_{TST\_MAINT}$ min, during which time it shall allow at minimum IA_VBUS_RATED to be drawn from V$_{BUS}$ by the PET.

Before T$_{TST\_MAINT}$ max, it shall end the session, and be prepared to accept SRP requests if implemented.

If the otg_vbus_off feature bit gets set during enumeration then, if the PET disconnects before a T$_{TST\_MAINT}$ min period of configured state, the host shall turn off V$_{BUS}$, if it is capable of doing so, and shall not perform any ADP probes for a period defined in Section 6.4.3.2.1.

## 6.4.3   Test Mode Feature Bits

The test mode feature bits defined in Table 6-8 shall be supported by an A-device, B-device or EH. A USB bus reset received by a device which has any of these feature bits set, shall cause the feature bit to be cleared.

**Table 6-8   Test Mode Feature Bit Definitions**

| Feature Bit Name | Set Feature TEST_MODE wIndex high byte value | bcdDevice Bit Number | Set/Reset | Purpose |
|---|---|---|---|---|
| otg_srp_reqd | 0x06 | - | Set by Set-Feature, cleared by device internally when SRP performed | Force an SRP to be performed. A device which does not support SRP shall STALL this request. |
| otg_hnp_reqd | 0x07 | - | Set by Set-Feature, cleared by device internally when HNP performed | Force an HNP to be performed. A device which does not support HNP shall STALL this request. |
| otg_vbus_off | - | 0 | Set by enumeration, cleared by device internally when V$_{BUS}$ turned off. | Force V$_{BUS}$ off after disconnect. A host not capable of controlling VBUS shall ignore this feature bit. |

### 6.4.3.1   B-Device Test Mode Feature Bits

Two of these bits are defined for use on a B-device under test, and are controlled by using the standard USB request 'Set Feature' with bmRequestType = 0, wValue =  TEST_MODE, wIndex low byte = 0, and wIndex high byte being a value of 0x06 or 0x07, as defined above.

### 6.4.3.1.1   Feature Bit 'otg_srp_reqd'

The feature bit relates to an SRP-capable B-device. When this flag is set by the PET (acting as an A-device and using Set Feature) it shall cause an SRP to be generated by the B-device, within T$_{TST\_SRP}$ after the A-device (the PET) turns off V$_{BUS}$. A B-device not capable of SRP, shall STALL the Set Feature request. Once set, the feature bit shall remain set until the SRP has been attempted, at which point it shall automatically be cleared, or until the device receives a USB bus reset.

*Note: This allows the PET to check the SRP behavior after a session, without requiring user interaction, and allows testing of  the requirements of  5.1.2 Initial Conditions, T$_{B\_SE0\_SRP}$.*

### 6.4.3.1.2 Feature Bit 'otg_hnp_reqd'

The feature bit relates to an HNP-capable B-device. When this flag is set by the PET (acting as an A-device and using Set Feature), the B-device shall set its Host Request Flag within $T_{TST\_HNP}$, and after suspension, if the 'b_hnp_enable' feature bit of the B-device is set, shall perform its part in an HNP handoff, without the need for user intervention. It shall reset and enumerate the PET, setting configuration 0, within $T_{TST\_CONFIG}$ max of completing the bus reset. It shall then suspend and hand back control to the PET, and reconnect within $T_{TST\_HNPEND}$.

A B-device not capable of HNP, shall STALL the Set Feature request. Once set, the feature bit shall remain set until the HNP has been occurred and control has been handed back to the PET, at which point it shall automatically be cleared, or until the device receives a USB bus reset.

### 6.4.3.2 A-Device Test Mode Feature Bit

A-device test mode feature bits shall be set by the following method. The PET, when behaving as a B-device, shall specify the bcdDevice field in its Device Descriptor, used as a bitmapped value, each bit potentially defining a test mode feature bit. The default value of 'bcdDevice' is 0x0000. Undefined bits shall be set to zero by the PET. When an A-device enumerates the test device, it shall use the value in the Device Descriptor field bcdDevice to set or reset its own appropriate feature bit, according to the individual bits of 'bcdDevice'. Note that although the name 'bcdDevice' implies a bcd value, it is being used in this case as a bitmapped field.

Only one A-device test mode feature bit (bit 0 - 'otg_vbus_off ' ) is currently defined.

### 6.4.3.2.1 Feature Bit 'otg_vbus_off'

This feature bit only applies to hosts capable of switching off $V_{BUS.}$

The feature bit is set by the A-device itself when it enumerates the test device and finds that bcdDevice, bit 0 = 1. So it will be set while the UUT is behaving as an A-device and is about to configure the B-device, and then maintain a session for $T_{TST\_MAINT}$. If the B-device (the PET) disconnects before $T_{TST\_MAINT}$ min, the A-device shall turn off $V_{BUS}$ within $T_{TST\_VBOFF}$, and then maintain it off, without performing ADP, for $T_{TST\_NOADP}$. At this point in time it shall clear the feature bit automatically, and revert to its normal behavior. If the B-device (the PET) fails to disconnect during $T_{TST\_MAINT}$ max, the feature bit shall automatically be set to zero.

*Note: One purpose of this feature bit is to allow the measurement of $T_{SSEND\_LKG}$ and $I_{VBUS\_LKG\_SRC}$.*

### 6.4.4 Unknown Device Not Supporting HNP

A device with VID=0x1A0A, PID=0x0201 is reserved as a test device, which shall not be on the TPL of any Targeted Host. It may be used by the compliance PET to represent a device which is not supported and which does not support HNP. Vendors should note that the compliance PET may use this, or any other VID/PID combination which is not on the TPL, for the purposes of tests which require compliant behavior when encountering such a device.

### 6.4.5 Unknown Device Supporting HNP

A device with VID=0x1A0A, PID=0x0202 is reserved as a test device, which shall not be on the TPL of any Targeted Host. It may be used by the compliance PET to represent a device which is not supported and which supports HNP. Vendors should note that the compliance PET may use this, or any other VID/PID combination which is not on the TPL, for the purposes of tests which require compliant behavior when encountering such a device.

*Add Following Parameters to Table 5-5:*

| Parameter | Symbol | Min | Max | Units | Ref |
|---|---|---|---|---|---|
| **Testability:** | | | | | |
| Bus reset to configuring test device | T$_{TST\_CONFIG}$ | | 30 | sec | 6.4.2 6.4.3 |
| Maintaining configured session on test device | T$_{TST\_MAINT}$ | 9.9 | 10.1 | sec | 6.4.2 6.4.3 |
| B-device as host, SetConfig to suspend of test device | T$_{TST\_SUSP}$ | | 100 | ms | 6.4.2.2 |
| Session end to SRP from unit under test | T$_{TST\_SRP}$ | | 5 | sec | 6.4.3.1.1 |
| 'otg_hnp_reqd' flag set to Host Request Flag set | T$_{TST\_HNP}$ | | 5 | sec | 6.4.3.1.2 |
| Reconnect after handing back control from HNP caused by 'otg_hnp_reqd' | T$_{TST\_HNPEND}$ | | 5 | sec | 6.4.3.1.2 |
| Time to switch off VBUS after PET disconnects with 'otg_hnp_reqd' set | T$_{TST\_VBOFF}$ | | 5 | sec | 6.4.3.2.1 |
| VBUS off with no ADP after session which sets 'otg_vbus_off' | T$_{TST\_NOADP}$ | 5 | 6 | sec | 6.4.3.2.1 |