

Request #: HUTRR63
Title: Creation of a Haptic Usage Page and Simplified Haptics Controller
Spec Release: 1.12
Received:
Requester: Nathan C. Sherman
Company: Microsoft
Phone: +1.425.882.8080
FAX: +1.425.936.7329
email: nathans@microsoft.com

Current Status: Approved
Priority: Normal
Submitted: 08 Mar 2016
Voting Starts: 08 Apr 2016
Voting Ends: 28 Apr 2016
Required Voter: Apple
Required Voter: Wacom
Required Voter: Intel
Required Voter: Microsoft (Chair)

Chair's Note

Due to the nature of this Review Request, particularly around the use of third-party Vendor ID and Vendor Page "controls," and usage-based Control Association, additional review time has been added. These methods have the potential become a useful pattern for similar innovations in HID.

Summary:

This request is to establish a new Usage Page for simple haptics feedback controls. Such controls do not need the complex model contained in the Physical Input Devices document ([PID 1.01](#)) with its rigorous approach to textured 6D force feedback. The proposed haptics model is simpler, using simple timing, triggers and pre-defined waveform profiles. Creation of the page does permit more complex models to build upon this simple model as needed where PID 1.01 is not appropriate.

Background:

The current Physical Input Device framework defines a protocol for rich control of force-feedback devices, typically joysticks or "rumble packs." However, for many devices, only simple feedback is needed for common feedback such as clicks, buzzes and such that are non-directional, and should be consistent from device to device and vendor to vendor, albeit tuned to the specific hardware.

The Proposal defines a page with facilities to discover and control such simplified haptics feedback mechanisms. This Proposal permits simplified haptics feedback control, with most features being optional, from simple, autonomous click feedback to somewhat more complex models with host-controlled variable intensity and timing. The protocol uses discoverable, pre-defined user-level haptic events.

These haptics controls can be stand-alone, such as a phone vibration unit, or associated with a particular control or set of controls, such as a rigid-surface keyboard. As such, they may be contained within an independent Haptic Controller Application Collection (CA), or contained within an Logical or Physical Collection (CL or CP) within another CA.

Proposal:

Add the following to Table 1: Usage Page Summary:

Page ID = 0x0E
Page Name = Haptics
Section or Document = (next available per technical editor)

Edit the appropriate Reserved range in Table 1 in which the Page 0x0E ID lies to not include Page 0x0E

Create a new section for the Haptics Page, with usage table and add the following to it. Section and table numbering are at technical editor discretion

Table (x): Haptics Page

Usage ID	Name	Type	Section
0x0000	Undefined		
0x0001	Simple Haptic Controller	CA or CL	
0x0002-0x000F	Reserved		
0x0010	Waveform List	NArY	
0x0011	Duration List	NArY	
0x0012-0x001F	Reserved		
0x0020	Auto Trigger	DV	
0x0021	Manual Trigger	DV	
0x0022	Auto Trigger Associated Control	SV	
0x0023	Intensity	DV	
0x0024	Repeat Count	DV	
0x0025	Retrigger Period	DV	
0x0026	Waveform Vendor Page	SV	
0x0027	Waveform Vendor ID	SV	
0x0028	Waveform Cutoff Time	SV	
0x0029-0x0FFF	Reserved		
0x1000	Reserved		
0x1001	WAVEFORM_NONE	SV	
0x1002	WAVEFORM_STOP	SV	
0x1003	WAVEFORM_CLICK	SV	
0x1004	WAVEFORM_BUZZ_CONTINUOUS	SV	
0x1005	WAVEFORM_RUMBLE_CONTINUOUS	SV	
0x1006	WAVEFORM_PRESS	SV	
0x1007	WAVEFORM_RELEASE	SV	
0x1006-0x1FFF	Reserved for standard waveforms		
0x2000	Reserved		
0x2001-0x2FFF	Vendor Waveforms		
0x3000-0xFFFF			

Add to a new description section (per technical editor) after the Usage Page table with the following text:

Simple Haptic Controller Operation

A Simple Haptic Controller is declared by declaring an Application Collection or Logical Collection with the Simple Haptic Controller usage.

Lists

For the purposes of Simple Haptic Controllers, a List is a Logical Collection containing non-zero Ordinals. Lists are declared by naming a Logical Collection with a Named Array usage, and then defining a set of Ordinal Page inputs, outputs or features within that collection. A member of the List is referred to in this document as an *Ordinal*, and the Ordinal contains a value type appropriate for array. As such, Lists may contain Selectors, On-Off Controls, Dynamic Values or other appropriate Usage Types. If a List is specified herein as read-only, then all Ordinals in the List are unchanged if written. If any Ordinal receives a Null value, the Ordinal is unchanged. *Note that Ordinal 0 is Reserved on the Ordinals page and shall not be declared.*

The purpose of a List is to create an *ordered* array of elements. While the HID Specification indicates that collections may contain any number of elements, the order of presentation of the elements is not specified. By using unique Ordinals, the position of elements within a collection of controls is deterministic.

An example of a List can be found in the Graphic Equalizer example in Appendix A.13 of the HID Usage Tables. Below is an example of a Haptic Waveform List

WAVEFORMS

Simple Haptic Controllers shall expose the waveforms that can be triggered, and their durations. This is accomplished with a **Waveform List** and a **Duration List**.

Simple Haptic Controllers shall declare a Waveform List feature with at least one Waveform other than the implicit required WAVEFORM_NONE and WAVEFORM_STOP waveforms (see below). The Waveform List is read-only. Each Ordinal in the Waveform List contains the 16-bit Usage value of a valid waveform from the Haptics Page. Any Ordinal containing a Usage value that is unknown to the Host should not be triggered by the Host.

Required Waveforms

All Simple Haptic Controllers shall support WAVEFORM_NONE in Ordinal 1 and WAVEFORM_STOP in Ordinal 2 of the Waveform List. WAVEFORM_NONE is ignored by the Simple Haptic Controller and is provided as a means to permit writing other values in a report without changing the waveform. WAVEFORM_NONE also permits gaps in the Waveform List. WAVEFORM_STOP cancels any triggered waveform immediately. A Waveform List may contain additional WAVEFORM_NONE or WAVEFORM_STOP Ordinals in any other Ordinal aside from Ordinal 1 and Ordinal 2. The implicit Ordinal 1 and Ordinal 2 are not declared in the Waveform List.

Vendor Waveforms

A range is provided for vendor-specific waveform usages. If these are declared, a Waveform Vendor Page shall also be declared within the Waveform List. To enable use of third-party haptic libraries, a third-party Waveform Vendor ID may also be declared within the Waveform List to override the device Vendor ID. Irrespective of the optional Vendor ID or Vendor Page declared, the vendor waveform usages themselves shall be within the Vendor Waveform range shown in the Haptic Usage Page. Hosts

shall correlate the Waveform Vendor Page and device Vendor ID or third-party Waveform Vendor ID, if provided, to known waveform tables before triggering any vendor-specific waveform. Behavior of vendor-specific waveforms other than Duration is unspecified.

Below is an example Waveform List using Vendor Waveforms from a fictional Vendor ID 0xABCD and their vendor page 0xFFFF0:

```

UsagePage(Haptics)
Usage(Waveform List)
Collection(Logical)
    Usage(Vendor ID) // Waveform Library Vendor = 0xABCD
    Usage(Vendor Page) // Waveform Library Vendor Page = 0xFFFF0
UsagePage(Ordinal)
// COMMENT Usage(Ordinal 1) // WAVEFORM_NONE = 0x1001
// COMMENT Usage(Ordinal 2) // WAVEFORM_STOP = 0x1002
Usage(Ordinal 3) // WAVEFORM_CLICK = 0x1003
Usage(Ordinal 4) // WAVEFORM_BUZZ_CONTINUOUS = 0x1004
Usage(Ordinal 5) // WAVEFORM_RUMBLE_CONTINUOUS = 0x1005
Usage(Ordinal 6) // WAVEFORM_PRESS = 0x1006
Usage(Ordinal 7) // WAVEFORM_RELEASE = 0x1007
Usage(Ordinal 8) // WAVEFORM_VENDOR_1 = 0x2100
Usage(Ordinal 9) // WAVEFORM_VENDOR_2 = 0x2114

ReportCount(9)
ReportSize(16)
Feature(Data, Variable, Absolute, Null)
End Collection()

```

DURATION OF WAVEFORMS

Simple Haptic Controllers shall declare a Duration List feature with the same Ordinals declared in the Waveform List. The Duration List is read-only. The Duration Ordinals contain the duration of each waveform declared in the corresponding Ordinal in the Waveform List. The default units are milliseconds but other units may be applied. The Default Duration of Ordinal 1 and Ordinal 2 are implicitly zero and are not declared.

Continuous Waveforms

A zero Duration indicates a **Continuous Waveform**. A continuous waveform triggered with a Manual Trigger shall be stopped by triggering any waveform other than WAVEFORM_NONE, and WAVEFORM_STOP is recommended before triggering any other waveform. A Continuous Waveform triggered by an Auto Trigger stops after cessation of input activity. The hold time to detect cessation of input activity is not defined but should be short enough to correlate with the cessation of change but long enough to endure continuously during typical continuous user input.

If a Continuous Waveform is declared, a Waveform Cutoff time shall also be declared to ensure that the waveform does eventually cease.

Below is an example Duration List:

```

UsagePage(Haptics)
Usage(Duration List)
Collection(Logical)
    UsagePage(Ordinal)
// COMMENT Usage(Ordinal 1) // WAVEFORM_NONE = 40
// COMMENT Usage(Ordinal 2) // WAVEFORM_STOP = 0 (Continuous)
Usage(Ordinal 3) // WAVEFORM_CLICK = 0 (Continuous)
Usage(Ordinal 4) // WAVEFORM_BUZZ_CONTINUOUS = 100
Usage(Ordinal 5) // WAVEFORM_RUMBLE_CONTINUOUS = 80
Usage(Ordinal 6) // WAVEFORM_PRESS = 55
Usage(Ordinal 7) // WAVEFORM_RELEASE = 70
Usage(Ordinal 8) // WAVEFORM_VENDOR_1
Usage(Ordinal 9) // WAVEFORM_VENDOR_2

```

```

ReportCount(5)
ReportSize(8)
Feature(Data, Variable, Absolute, Null)
End Collection()

```

TRIGGERS

At least one **trigger mechanism** shall exist. This can be a **Manual Trigger** output control or an **Auto Trigger** feature control, or an **Implicit Waveform**.

The Auto Trigger and Manual Trigger contain Waveform Ordinals to play. Both are optional. Setting the Manual Trigger immediately triggers the selected Waveform Ordinal. Setting the Auto Trigger selects the waveform to be triggered with autonomous triggering. Setting Manual Trigger or Auto Trigger to Ordinal 1 (WAVEFORM_NONE) has no effect. If the Auto Trigger is set to Ordinal 2 (WAVEFORM_STOP), then Auto Mode is disabled. If the Manual Trigger is declared and the Auto Trigger is not declared, then the device does not support autonomous triggering. If neither a Manual Trigger nor an Auto Trigger is declared, then the lowest declared Waveform Ordinal is the default **Implicit Waveform** and is autonomously triggered as if it were selected in a declared Auto Trigger. In this case, Haptic events can only be disabled by declaring and setting Intensity to 0. Manual Trigger is an output and Auto Trigger have no default values – it is up to the device manufacturer to determine if Auto Trigger has a WAVEFORM_STOP or other waveform by default. If the host needs to know the Auto Trigger value at any time, it may read the control.

Table (x): Trigger Behavior by Definition

Triggers defined	Behavior
None	Autonomous Trigger of Implicit Waveform (use Intensity to enable/disable)
Manual	Selectable-waveform Manual Trigger only
Auto	Selectable-waveform Autonomous Trigger only
Manual and Auto	Selectable-waveform Manual and Auto Triggers

Ordinal 0 is reserved on the Ordinals page and shall not be declared, is a Null value, and shall be ignored if issued to either Manual Trigger or Auto Trigger.

Auto Mode Trigger Association

Simple Haptic Controllers that support autonomous triggering may need a means to associate the Simple Haptic Controller with one or more other HID input controls in the Application Collection. There are three scenarios supported:

- **No Association:** In this scenario, the Simple Haptic Control is placed in a Simple Haptic Controller Application Collection. The control or events that trigger autonomous haptic events is not associated with any HID control.
- **Limited input trigger:** In this scenario, a read-only **Auto Trigger Associated Control** feature is declared. The Auto Trigger Associated Control contains a *unique* Extended Usage of a HID input control or collection (with HID inputs) within the Application Collection but outside the Simple Haptic Controller collection. If identical controls exist, wrap the associated control in a Logical Collection with a unique usage and indicate that usage. Any input change in the control or

collection will trigger the Auto Mode or Implicit Waveform.

- Global input trigger: In this scenario, the Auto Trigger Associated Control feature is not declared. Any HID input in the Application Collection will trigger the Auto Trigger or Implicit Waveform.

Retriggering

A Simple Haptic Controller may declare a **Repeat Count** feature and/or output control. The Repeat Count indicates the number of times to trigger any selected Waveform Ordinal per Auto Trigger or Manual Trigger. Default Repeat Count is zero. Writing a Null Repeat Count has no effect. A repeat trigger is called a **retrigger**. Continuous retrigger is not supported.

By default, the retrigger occurs at the end of the waveform. To modify the pacing of the retrigger in a Repeat Count, a **Retrigger Period** feature and/or output may be declared. If declared, the Retrigger Period defines the time between retriggers. If the Repeat Count is zero, Retrigger Period is ignored. Writing a Null Retrigger Period has no effect. Writing a zero Retrigger Period value resets the retrigger to the corresponding value in the Duration List so that the waveform immediately retriggers when it completes. Default Retrigger Period is zero. Default units of Retrigger Period is milliseconds, but other units may be applied.

If a Repeat Count or Retrigger Period *feature* is declared, it supplies the default value for all triggered waveforms. If a Manual Trigger *output* is accompanied by a Repeat Count or Retrigger Period *output* in the same report, the accompanying value overrides the default value for that single Manual Trigger. Behavior when they are not in the same output report is undefined. Repeat Count and Retrigger Period *are* valid for continuous waveforms.

Issuing Ordinal 0 (WAVEFORM_NONE) to a Manual Trigger or Auto Trigger will have no effect. Any waveform can be immediately canceled by writing Ordinal 1 (WAVEFORM_STOP) to a Manual Trigger. If Ordinal 1 is written to the Auto Trigger, the waveform will be stopped at the next autonomous trigger. If a waveform is triggered, either via receipt of a Manual Trigger, an autonomous trigger or retrigger before the prior waveform has completed, it shall stop the prior waveform and start the new waveform.

Intensity

A Simple Haptic Controller may declare an **Intensity** feature and/or output control. The Intensity indicates the relative intensity of the haptic waveform as a percentage of the designed full strength capability of the transducer(s). Default Intensity is unspecified. Writing a Null Intensity has no effect. If Intensity is set to zero, then the haptic transducer is disabled.

If an Intensity *feature* is declared, it supplies the default value for all triggered waveforms. If a Manual Trigger is accompanied by an Intensity *output* in the same report, the accompanying value overrides the default value. It is recommended that if an Intensity output is declared that an Intensity feature also be declared so that the Host can read the default value. Behavior when Intensity and Manual Trigger are not in the same output report is undefined.

NOTE: For the most consistent experience, hardware designers are encouraged to linearize Intensity according to perceived intensity, not according to power or amplitude.

Usage Definitions:

Simple Haptic Controller

CA or CL – Applied to a collection containing a Haptic Transducer Set to control simple haptics events. The CA is for Haptic Transducer Sets with no association with other HID controls. The CL form is used when contained within another CA.

Waveform List

NArY – Collection containing Ordinals that contain the Usages of supported waveforms. Vendor-specific waveform IDs may also be used. See the Haptics Usage Page table for the enumeration of pre-defined Waveform selector usages that can be placed in the set. The Waveform List is mandatory, there is no default defined.

Standard waveform usage names are generic and are not intended to specify the particular properties of a waveform. It is assumed that the device manufacturer will design and incorporate waveforms appropriate to the resonance, dampening and other properties of the mechanical system with a best effort to provide the intended effect.

Duration List

NArY – Collection of Ordinals containing the default duration for each haptic waveform. Default units are milliseconds.

Auto Trigger

DV – Feature. Ordinal in the Waveform List to trigger autonomously. Default is undefined. If 0, autonomous triggering is disabled.

Manual Trigger

DV – Output. Ordinal in the Waveform List to trigger immediately. May be accompanied by Intensity, Repeat Count and/or Retrigger Period outputs to override feature variants of those controls.

Auto Trigger Associated Control

SV – Feature. Contains the 32-bit Extended Usage of a HID Input or Logical Collection containing at least one HID Input. The Auto Trigger waveform is autonomously triggered when a HID Input in the Auto Trigger Associated Control changes.

Intensity

DV – Feature or Output. Percentage of maximum intensity to apply to the waveform. If declared as a feature, applies to all waveforms. If declared as an output, applies to the Waveform ordinal specified by a Manual Trigger in the same output report. Default is unspecified. Null values are ignored.

Repeat Count

DV – Feature or Output. Count of retriggered waveform firings per trigger. Default is zero. Null values are ignored.

Retrigger Period

DV – Feature or Output. Period before a retrigger occurs. Default units are milliseconds. Setting to 0 uses the Duration in the Duration List. Default is zero. Null values are ignored.

Waveform Vendor Page

SV – Read-only Feature. Vendor Page in which the vendor-specific waveform usages are defined. No default. If vendor-specific waveforms are declared, Waveform Vendor Page is required. Writes to Waveform Vendor Page shall be ignored.

Waveform Vendor ID

SV – Read-only Feature. Vendor ID of the vendor whom the Waveform Vendor Page is defined. Default is the USB Device Vendor ID. Writes to Waveform Vendor ID shall be ignored.

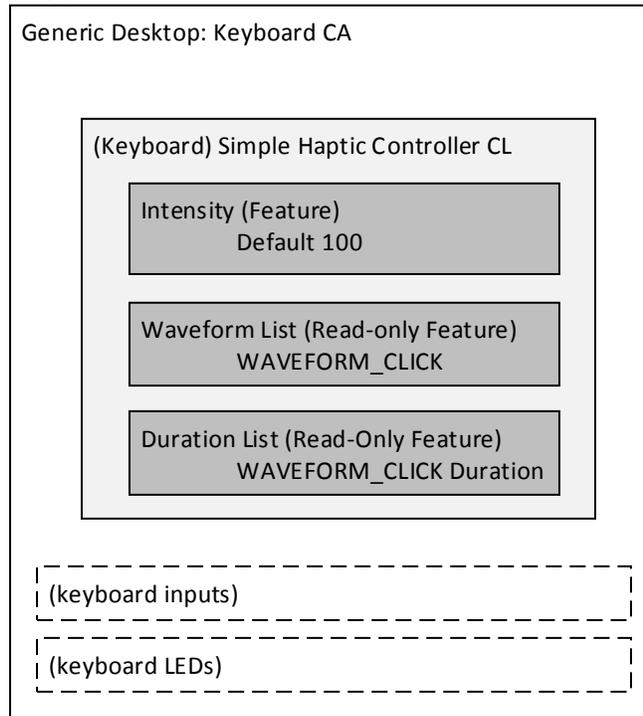
Waveform Cutoff Time

DV – Feature. Maximum time for a continuous waveform or set of retriggered waveforms before being automatically cut off. If any continuous waveform is declared (Duration = 0), Waveform Cutoff time is required. Default units are seconds. No default.

Sample Collections

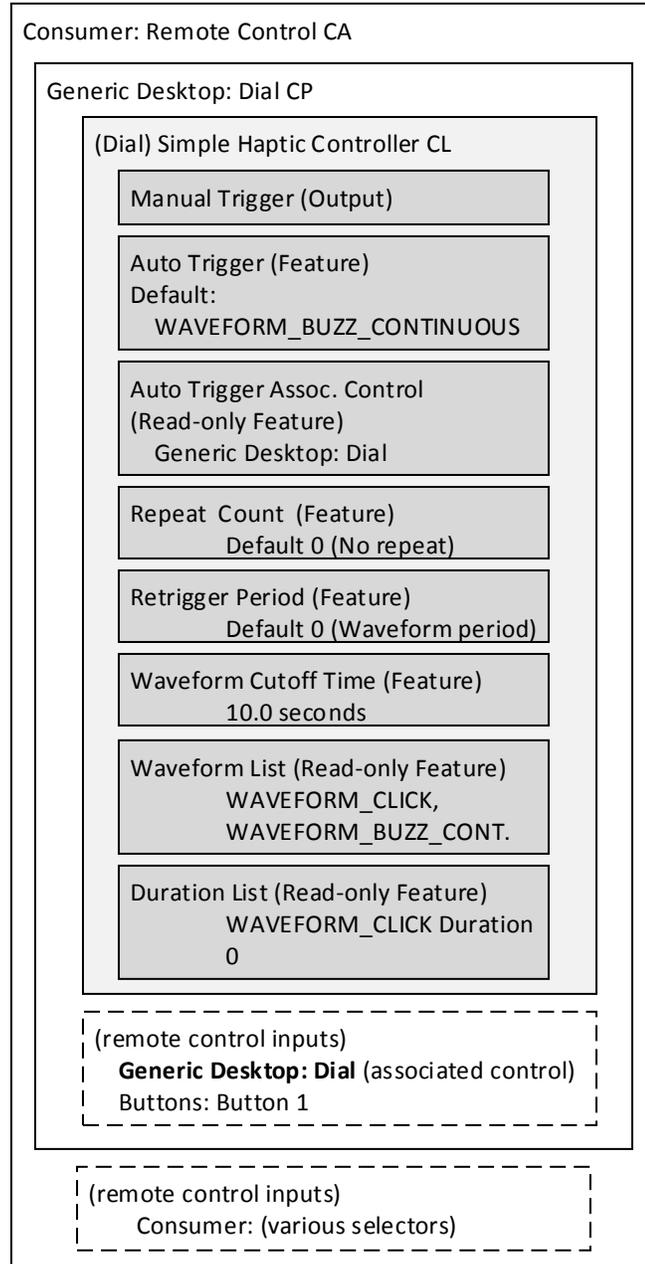
Example 1: A Keyboard with an implicit waveform, automatic trigger on any keypress, manual trigger not supported, adjustable intensity, disabled by setting Intensity to 0.

Figure (x): Example 1 Keyboard with Haptic Feedback



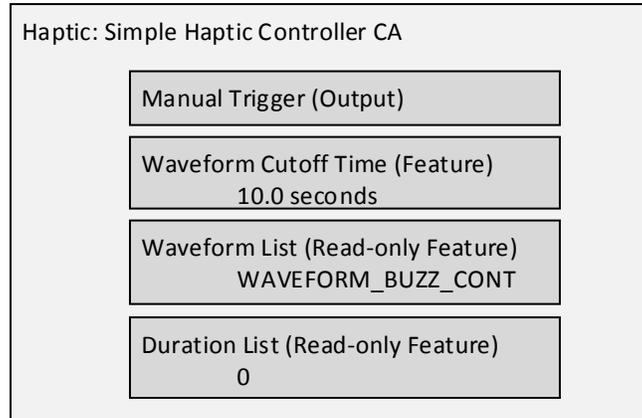
Example 2: Remote control with a rotary dial with generic buttons, consumer selectors, multiple waveforms, manual and automatic trigger supported, click or buzz, autonomous trigger supported on motion (not button), retrigger supported, variable intensity not supported, disabled by setting Auto Trigger to WAVEFORM_OFF.

Figure (x): Example 2 Remote Control with Haptic Dial



Example 3: Generic haptic vibration controller, single waveform, host-controlled, continuous waveform, fixed intensity (e.g., phone vibration)

Figure (x): Example 3 Generic Haptic Vibration Controller



Response:

<Added by HID Chair upon closing the Request>

Notes on Approval Procedure:

HID WG On Line Voting Procedures

1. Votes are on a per company basis.
2. Each Review Request shall have attached a Required Voter List that is the result of recruiting by the HID Chair and submitter of members of the USB IF. Required Voter List must include the HID Chair plus 2 companies (other than the submitter) plus any others designated by the HID Chair at the Chair's discretion. The Required Voter List ensures that a quorum is available to approve the Request.
3. Impose a 7-calendar-day posting time limit for new Review Requests. HID Chair or designate must post the RR within 7 calendar days. HID Chair or designate must work with the submitter to make sure the request is valid prior to posting. Valid review request must include all fields marked as required in the template. A new template will be adopted that requires at least the following fields: Change Text, Required Voter List, Review Period End Date and Voting End Date, Submittal Date, Submitter, Review Request Title and RR Number.
4. If a RR approval process stalls, the HID Chair may call a face-to-face meeting or conference call to decide the issue. Submitter may request that this take place.
5. Impose a minimum 15-calendar-day review period on a posted RR prior to the voting period. At HID Chair discretion, changes to the RR may require this review period to restart.
6. The Chair will accept votes via documentable means such as mail or e-mail during the 7 calendar days after the close of the review period. If a Required Voter does not vote during the period, then there is no quorum and the Chair may pursue the absent required voter and extend the voting period. The Chair may designate a substitute for the absent voter and extend the voting period if necessary.