# Purpose:

This document describes the Active Error Codes, Charging Error Codes, and behavior of external devices after command responses for the SCS System. It contains the error number, error name, severity category, brief description, any notes, and which sections in the related specification and UI documents the error pertains to. The intent is for this exhibit to serve as a means to tie specifications together and provide design guidance. ***In case of any inconsistency released functional specifications and user interface design documents take precedence***.

# Reference Documents:

* EESP 0071 24-Channel IPG Functional Specification
* SWEX 0085 SCS System MICS Commands Design Document
* SWEX 0087 TETS Communications Description
* MESP 0094 24 Channel SCS System Labeling Specification
* DP 0002-18-7 Torpedo Pocket Programmer User Interface Design Document
* DP 0002-18-8 Torpedo Patient Programmer Charger User Interface Design Document

# Definitions

* CP: Clinician Programmer
* PoP: Pocket Programmer
* PoP: Pocket Programmer
* PPC: Patient Programmer Charger
* xPG: Either an Implantable Programmable Generator (IPG) or an External Programmable Generator (EPG) device

# Active Errors

## Overview and IPG Behavior

xPG devices in the SCS System detect and report errors/fault conditions that must be handled by the external devices (PPC, PoP, and CP). These error/faults are grouped into 3 defined categories of severity based on their effect on the continued operation of the device. The category and error code define how the errors/faults will be handled by an external device.

The xPG will store the latest most severe (by category) error code in the Active Error byte in the xPG status message. An error code of a lower severity category that occurs when a higher severity category error has been recorded in the Active Error byte will not overwrite it. If an error with an equal severity category to the active error is thrown, then this more recent error will become the active error.

There is no active error code for the state where there are no valid programs. This is a side effect of error conditions, but is also a perfectly valid state for the xPG, and language used in error or notification messages and manuals should reflect this.

Certain errors impacting MICS communications may not be immediately reported on the PoP or PPC as MICS communication is unusable. Troubleshooting sections will instruct the patients to try recharging when they cannot connect via MICS, causing these codes to be retrieved and reported by the PPC through the TETS interface.

Note that an error resulting in the loss of MICS communication can only be determined through use of a PPC via a TETS connection. A CP will be unable to connect or try to recover the xPG from this condition.

## Category 1 Active Errors: Severe

Severe conditions are errors or faults that prevent the XPG from providing stimulation to the Patient. Examples include corruption of critical data in non-volatile memory such as: Program Constants, Pulse Constants, Calibrations, Electrode Limits, etc as well as Power ASIC errors, radio errors, and data corruption.

In cases where the PoP can report the error from the xPG, the PoP should display the integer value provided in the Active Error byte in the xPG status message, and not allow this screen to be cleared. In cases where it cannot connect to the xPG, the PoP should behave as described in DP-0002-18-7.

In cases where the PPC can report the error from the xPG, the PPC should indicate that there was a serious error and display the integer value of the Active Error byte from the xPG status message. For severe errors, the only options allowed on the PPC home screen are PPC Info, IPG Info (if available), and for all errors except Power ASIC Errors, Power ASIC Read-back or Analog Errors, or any future Category 1 charging faults, the PPC should still allow IPG charging. The error should be persistent (shown at each PPC power up) to indicate that there is a severe xPG error condition that needs to be resolved.

Some of these severe error conditions may be recovered/resolved/repaired with the use of the CP. Those that cannot will require the explant of the IPG or replacement of the EPG due to hard failures in the device.

## Category 2 Active Errors: Major

Major conditions are errors or faults that will require a CP to resolve, but may allow the xPG to continue to provide stimulation to the Patient in a limited manner. Some errors in this category remove programs from the Program selection list which is available via the Status command. Examples include Single Program Definition corruption, Output channel failure, etc.

The PoP should display the integer value of the error code provided in the Active Error byte in the status message. In general the PoP should allow the Patient to operate as normal with limited Program selections [behave as described in DP 0002-18-7 Torpedo Pocket Programmer User Interface Design Document for “Incomplete Program List Notification”].

The PPC should display a window providing a more detailed description of the error code provided in the Active Error byte in the xPG status message. Once the error window is cleared, the PPC Home Screen should operate as normal. The only area affected should be the list of available programs will be limited to those that are indicated as valid in the status message. The error should be persistent as described in DP 0002-18-8 Torpedo Patient Programmer Charger User Interface Design Document to indicate that there is a major xPG error condition that needs to be resolved.

## Category 3 Active Errors: Minor

Minor conditions are errors or faults that are recoverable by the xPG itself or by interaction of the Patient with a PPC or PoP device. Recovery consists of restarting stimulation via the PoP or PPC.

The PoP should ignore minor errors.

The PPC should behave on an error by error basis depending on the impact.

* Errors with no impact to stimulation (*e.g.* lost channel that isn’t used) should be ignored.
* Errors stopping stimulation (*e.g.* brown out) display a message stating that stimulation was halted and that it is ok to restart if and only if the user hasn’t restarted already.
* Errors that stop stimulation and reset the IPG to defaults (*e.g.* active settings corrupted) should display a message stating that settings have been returned to defaults even if the user has restarted stimulation via the PoP. Once the error window is cleared, the PPC Home Screen should operate as normal. This error should NOT be persistent on the PPC as these errors are all cleared and considered fully recoverable without clinical intervention.

## Table of Active Error Codes

| **COL HEADING** | **Description** |
| --- | --- |
| **E#** | Error number (0 = no active error, 1-250 = specific error condition or event.) This error number is reported as the ‘active error’ in the GET XPG STATUS command response. |
| **NAME** | Error / fault name |
| **CAT.** | Error category (1 = SEVERE, 2 = MAJOR, 3 = MINOR) |
| **DESCRIPTION** | Brief description of error condition |
| **PoP Action** | Action for the PPC to take as well as any changes in capabilities |
| **PPC Action** | Action for the PPC to take as well as any changes in capabilities |
| **Cleared By** | Describes how the error is cleared |
| **Manual** | Released specs and UI documents take precedence over this exhibit. |
| **SPEC / UI Doc REF** | Reference number in IPG functional specification and/or UI doc. |

| **AE #** | **NAME** | **CAT.** | **DESCRIPTION / IPG Behavior** | **PoP Action** | **PPC Action** | **Cleared By** | **User Manual Potential Wording** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 00 | (no error) | 0 | No active error | N/A | N/A | N/A | N/A |
| 01 | CRITICAL NV DATA CORRUPTED | 1 | Non-volatile data required for stimulation detected as corrupted. Includes program constants, pulse constants, calibrations, electrode limits. | E 01 | * Display Notification: “An internal error (E01) was detected in your stimulator. Stimulation has been disabled. Please see your clinician." * Allow charging. | Entry into Storage Mode or CP Reset. | E01 - E30: Contact your clinician. |
| 02 | CLOCK ERROR | 1 | System clocks are not operating correctly, stimulation is disabled. | E  02 | * Display Notification “An internal error (E02) was detected in your stimulator. Stimulation has been disabled. Please see your clinician." * Allow charging. | Entry into Storage Mode or CP Reset. | E01 - E30: Contact your clinician. |
| 03 | POWER ASIC ERROR – STIMULATION DISABLED | 1 | A fault was detected with the power ASIC or the interface to the power ASIC. Stimulation has been disabled. | E 03 | * Display Notification “An internal error (E03) was detected in your stimulator. Stimulation has been disabled. Please see your clinician." * Prohibit charging. | Entry into Storage Mode or CP Reset. | E01 - E30: Contact your clinician. |
| 04 | DEPRECATED – Use AE01  [ was CONFIGURATION DEVICE PARAMETERS CORRUPTED] | 1 | N/A | IGNORE | * IGNORE | Entry into Storage Mode | * Patient Manual N/A |
| 05 | XPG IDENTITY PARAMETERS CORRUPTED | 1 | The Stimulator’s identity parameters were detected as corrupt. (These include the MICS transceiver ID, device model number, device serial number, …)  This error may not be communicated via MICS, as MICS communication may not be feasible with this error. | N/A - Will "scroll" because it cannot find IPG as described in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | * MICS N/A – Will show attempted connection as described in DP 0002-18-8 Torpedo Patient Programmer Charger User Interface Design Document. * TETS (attempt charging), Display Notification “An internal error (E05) was detected in your implant. Stimulation has been disabled. Please see your clinician." * Allow charging. | Entry into Storage Mode or CP Reset. | * E01 - E30: Contact your clinician. * Troubleshooting section will address steps to attempt when MICS connection fails. |
| 06 | MICS TRANSCEIVER ERROR | 1 | A fault was detected with the MICS transceiver or the interface to the MICS transceiver.  This error may not be communicated via MICS, as MICS communication may not be feasible with this error. | N/A - Will "scroll" because it cannot find IPG as described in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | * MICS N/A – Will show attempted connection as described in DP 0002-18-8 Torpedo Patient Programmer Charger User Interface Design Document. * TETS (attempt charging), Display Notification “An internal error (E06) was detected in your implant. Stimulation has been disabled. Please see your clinician." * Allow charging. | Entry into Storage Mode or CP Reset. | * E01 - E30: Contact your clinician. * Troubleshooting section will address steps to attempt when MICS connection fails. |
| 07 | POWER ASIC ANALOG SENSE ERROR  **NOTE**: While thermistor does come through power ASIC, it has a separate error code. | 1 | There was an error reading the multiplexed analog signals through the power ASIC.  May not be able to read temperature, rectified voltage level, battery voltage. | E 07 | * Display Notification: “An internal error (E07) was detected in your implant. Stimulation has been disabled. Please see your clinician." * Prohibit charging. | Entry into Storage Mode | * E01 - E30: Contact your clinician. |
| 08 | DEPRECATED  [was BACKGROUND IMPEDANCE HARDWARE ERROR] | 1 | N/A | IGNORE | * IGNORE | Entry into Storage Mode | * Patient Manual N/A |
| 09 | CRITICAL NV HARDWARE FAILURE | 1 | The non-volatile memory device driver reported a hardware failure. | E 09 | * Display Notification: “An internal error (E09) was detected in your implant. Stimulation has been disabled. Please see your clinician." * Allow charging. | Entry into Storage Mode or CP Reset. | E01 - E30: Contact your clinician. |
| 10 | PULSE CYCLE CHECK ERROR | 1 | The timing check for the stimulation cycle period failed. Stimulator automatically goes to stimulation off. | IGNORE | Display "Stimulation may have been halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command. | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 11-29 | (RESERVED) | 1 |  |  |  |  | E01 - E30: See Clinician |
| 30 | INTERNAL SOFTWARE ERROR CATEGORY 1 | 1 | A severe error has been detected that is related to the internal software implementation. The system requires reset before continuing. | E  30 | * Display Notification: “An internal error (E30) was detected in your implant. * Prohibit Charging | Entry into Storage Mode or CP Reset. | * E01 - E30: Contact your clinician. * Use magnet |
| 31 | DEPRECATED  [was POWER ASIC ERROR – STIMULATION NOT DISABLED] | 2 | N/A | IGNORE | IGNORE | CP | Patient Manual – N/A |
| 32 | PROGRAM DEFINITION CORRUPTED | 2 | One or more of the program definitions have been detected as corrupted. | E 32  Then proceed as per handling “incomplete program list error code” in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | “An internal error (E32) was detected in your implant. One or more programs have been disabled. " | CP overwriting the affected program. | E31-50: Your implant may have limited functionality. Some programs may have been disabled on your implant, please contact your clinician for more information |
| 33 | OUTPUT CHANNEL / CAPACITOR FAILURE – PROGRAMS DISABLED | 2 | The output channel or capacitor check diagnostic detected a channel failure. One or more programs using the affected channel were disabled. | E 33  Then proceed as per “incomplete program list error code” in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | “An internal error (E33) was detected in your implant. One or more programs have been disabled. " | CP overwriting the affected program | E31-50: Your implant may have limited functionality. Some programs may have been disabled on your implant, please contact your clinician for more information |
| 34 | CHANNEL IMPEDANCE FAILURE – PROGRAMS DISABLED | 2 | An open circuit was detected between an output channel and the IPG enclosure. One or more programs using the affected channel were disabled. | E 34  Then proceed as per “incomplete program list error code” in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | “An internal error (E34) was detected in your implant. One or more programs have been disabled." | CP overwriting the affected program | Pat manuals: E31-50: Your implant may have limited functionality. Some programs may have been disabled on your implant, please contact your clinician for more information  Clinician Manual: Suggest reprogramming with different contacts. |
| 35 | DEPRECATED  [was CHANNEL OUTPUT CURRENT FAILURE – PROGRAMS DISABLED] | 2 | N/A | IGNORE | IGNORE | CP overwriting the affected program | Pat manuals: N/A. |
| 36- 50 | (RESERVED) | 2 |  |  |  |  |  |
| 51 | PROGRAM ACTIVE SETTINGS CORRUPTED | 3 | One or more of the program active settings have been detected as corrupted. Refers to the patient-adjusted settings for ampl, freq, PW. IPG may be able to clear on own. | IGNORE | Display "All stimulation settings restored to clinician defaults." | Retrieving error via Get xPG Status Command. | Patient Manual will describe this as a minor internal error and instruct patient that it is OK to start stimulation and adjust settings. |
| 52 | DEPRECATED  [was CLOCK ERROR – MINOR] | 3 | N/A | IGNORE | IGNORE | Retrieving error via Get xPG Status Command. | Patient Manual N/A |
| 53 | STIM ASIC RUN ERROR – PULSE GUARD | 3 | Stimulation was stopped due to a pulse guard error from the stim ASIC. IPG will count instances. | IGNORE | Display "Stimulation was halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command. | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 54 | STIM ASIC RUN ERROR – NON-PULSE GUARD | 3 | Stimulation was stopped due to a stim ASIC error other than pulse guard (parity, sequencer, register valid, …) | IGNORE | Display "Stimulation was halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command. | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 55 | STIM ASIC READ-BACK ERROR | 3 | While attempting to set-up registers in the stim ASIC, the read-back verification failed. | IGNORE | Display "Stimulation may have been halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command. | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 56 | DEPRECATED  [was OUTPUT CHANNEL / CAPACITOR FAILURE – NO PROGRAMS DISABLED] | 3 | N/A | IGNORE | IGNORE | Retrieving error via Get xPG Status Command. | Patient Manual N/A |
| 57 | DEPRECATED  [was CHANNEL IMPEDANCE FAILURE – NO PROGRAMS DISABLED] | 3 | N/A | IGNORE | IGNORE | Retrieving error via Get xPG Status Command. | Patient Manual N/A |
| 58 | BROWN-OUT DETECTED | 3 | The IPG’s digital supply voltage dropped unexpectedly while stimulation was active. Stimulation may have been shut down. | IGNORE | Display "Stimulation may have been halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command. | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 59 | WATCHDOG ERROR | 3 | The watchdog timer of the IPG’s microcontroller tripped, indicating a firmware malfunction. If stimulation was active, it was shut down. IPG reports error on restart. If not automatically recovered, IPG does not clear until  PPC connection. | IGNORE | Display "All stimulation settings restored to clinician defaults." | Retrieving error via Get xPG Status Command. | Patient Manual will describe this as a minor internal error and instruct patient that it is OK to start stimulation and adjust settings. |
| 60 | DEPRECATED  [ was IPG STATE CORRUPTED] | 3 | State data was detected as corrupted. IPG automatically goes to stim off, no program selected. Don’t necessarily have to reset the defaults. | IGNORE | Display "Stimulation may have been halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command. | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 61-89 | (RESERVED) for level 3 | 3 |  |  |  |  |  |
| 90 | INTERNAL SOFTWARE ERROR CATEGORY 3 | 3 | A minor error has been detected that is related to the internal software implementation. Stimulation may have been turned off. | IGNORE | Display "Stimulation may have been halted by system. Please restart stimulation." | Retrieving error via Get xPG Status Command | Patient manual will describe this as a minor internal error and state that IPG should be capable of normal operation in future. |
| 91-99 | (RESERVED) for other errors that the PoP might need to display, not Active Errors as described above. | N/A |  |  |  |  |  |
| 100 | STIMULATION SHUT DOWN WITH EXTERNAL MAGNET | 3 | Stimulation was shut down with the external magnet. (Not storage mode.) | IGNORE | Display "Stimulation was stopped by magnet" if and only if stimulation still off and “error” not yet cleared. | IPG clears when Stim restarted and passes checks. | You PPC will notify if it connects to the IPG and detects that stimulation was shut off by a magnet. |

## Non Active Error Codes Displayed (External Device Errors)

| **E #** | **NAME** | **CAT.** | **DESCRIPTION / IPG Behavior** | **PoP Action** | **PPC Action** | **Cleared By** | **Manual Says** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | NO PROGRAM SELECTED |  | No program currently selected | Flash “P--” |  |  |  |
| - | NO VALID PROGRAMS | N/A | Programs bitmap all zeros. | Flash “P” |  |  |  |
| 91-  96 | (RESERVED) for other errors that the PoP might need to display, not Active Errors as described above. | N/A |  |  |  |  |  |
| 97 | EXID\_ERROR | N/A | PoP External Device ID  not defined or invalid. | E  97 | N/A - PPC will never see PoP error. |  |  |
| 98 | UNEXPECTED\_RESPONSE ERROR | N/A | UNEXPECTED\_RESPONSE ERROR NOTE: Not actual active error code. None of these should ever be seen in the field, as parameters should be validated on programmer/controller device before sent to xPG. Reserved for PoP (and PPC) to show for certain xPG RESPONSEs that it should never see including:  INVALID COMMAND  INVALID PARAM  COMMAND FROM CP ONLY  STIM ALREADY ON,  NO PROGRAM SELECTED, etc | E 98 | Display “Your implant has returned an unexpected response.” | As described for other notifications in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document and DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | E98 - see clinician if problem persists |
| 99 | POP\_ERROR | N/A | General Purpose PoP Error - PoP error detected by PoP, not related to IPG issue. | E 99 | N/A - PPC will never see PoP error. | Power down and restart PoP | TBD |
| 100 | STIMULATION SHUT DOWN WITH EXTERNAL MAGNET | N/A | See above | See above | See above | See above | See above |
| 101- 255 | (RESERVED, CP, PPC, and errors not requiring num display on PoP)  NOTE:  PPC-specific errors, i.e. errors created on PPC like over-temperature, WDT tripped, etc should go somewhere in here (3 digit space) | - | - | IGNORE | - | - | - |
| 110 | No Charge Halt request |  | N/A – just an offset in PPC implementation | IGNORE | IGNORE | N/A | N/A |
| 111 | PPC IPG charging : IPG Over Temperature |  | IPG temperature too warm to start charging or reporting temperature maximum during charging. |  | Stop charging and display “Unable to complete charging. IPG Over Temperature.” | Press OK on notification screen |  |
| 112 | PPC IPG charging : IPG under Temperature |  | IPG temperature too cold to start charging. |  | Stop charging and display “Unable to complete charging. IPG Under Temperature.” | Press OK on notification screen |  |
| 113 | PPC IPG Charging : reserved for charging complete |  |  |  |  |  |  |
| 114 | PPC IPG charging : Loss of Coupling |  | IPG stopped charging due to a drop in VRECT and PCP was unable to get charging to restart. |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(114)” | Press OK on notification screen |  |
| 115 | PPC IPG charging : PPC Over Temperature |  | PPC paddle temperature exceeds limit. |  | Stop charging and display “Unable to complete charging. PPC Over Temperature.” | Press OK on notification screen |  |
| 116 | PPC IPG charging : Start Charging Failure |  | IPG never entered a valid charging state when PPC has boost voltage at maximum or IPG is reporting VRECT at or above the start charging set point. |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(116)” | Press OK on notification screen |  |
| 117 | PPC IPG charging: IPG communication failure – no response to charge status requests. |  | IPG is not responding to charge control status requests. |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(117)” | Press OK on notification screen |  |
| 118 | PPC IPG charging: IPG communication failure – invalid response to charge status requests. |  | IPG responds to charge control status requests with a unknown response. |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(118)” | Press OK on notification screen |  |
| 119 | PPC IPG charging: PPC paddle disconnected. |  | PPC charging paddle disconnected |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(119)” | Press OK on notification screen |  |
| 120 | PPC MICS session disconnected. |  | PPC –IPG MICS session disconnected |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(120)” | Press OK on notification screen then either retry on connect failed screen or cancel and charge via inductive link. |  |
| 121 | PPC IPG charging: IPG reported a charging error. |  | IPG charging error reported |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(121)” | Press OK on notification screen |  |
| 122 | PPC IPG charging: IPG cool down fail. |  | IPG temperature did not cool down to a temperature that will allow charging to be restarted. |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(122)” | Press OK on notification screen |  |
| 123 | IPG Charge Error |  | IPG charging error reported |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(123)” | Press OK on notification screen |  |
| 124 | IPG Charge Abort |  | IPG Charging Abort Error reported. |  | Stop charging and display “Unable to complete charging. Please check coil and try again.(124)” | Press OK on notification screen |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 125 | PPC MICS communications timeout |  | PPC no MICS response from XPG before timeout. Reported by the MICS communications manager. |  | Display "MICS Communications Failed, please try again (125)". | Press OK on notification screen. |  |
| 126 | PPC MICS communications thread no reply |  | PPC no MICS response from MICS communication manager thread before timeout. Reported by the XPG parameter manager thread. |  | Display "MICS Communications Failed, please try again (126)". | Press OK on notification screen. |  |
| 127 | PPC communications thread failed  (See enum ReplyResp) |  |  |  |  |  |  |
| 128 | RESERVED  (See enum ReplyResp.Reply received) |  |  |  |  |  |  |
| 129 | PPC MICS communications thread send failed. |  | PPC MICS communication manager thread reports a transmit error. |  | Display "MICS Communications Failed, please try again (129)". | Press OK on notification screen. |  |
| 130 | Reserved  (See ReplyResp..RePairFailedSearchFailed) |  |  |  | "The paired stimulator is not visible to the programmer." |  |  |
| 131 | Reserved  (See ReplyResp..RePairFailedInvalidExid) |  |  |  | "The paired stimulator does not accept requests from the programmer.", |  |  |
| 132 | Reserved  (See ReplyResp..InvalidRequest) |  |  |  | "Invalid Request, please try again" |  |  |
| N/A | PPC thread errors.  Thread name can be PPC Param manager, MICS Comm Mgr, IPG Battery manager, A2d Manager. |  | 130 reserved for OK |  |  |  |  |
| N/A | ERR\_COMM\_ERROR |  | PPC Serial Port access error |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_ENQUEUE |  | Thread enqueue failure. Queue full |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_UNKNOWN\_REQUEST |  | Thread gets request on queue it does not know how to process. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_TASK\_EVENT\_FAIL |  | Thread is woken up by unknown event |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_TASK\_START |  | Thread start failed. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_TASK\_BROKEN |  | General Thread failed error. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_REQUEST |  | Thread gets request on queue that is invalid for the current state. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_RESPONSE |  | MICS response data does not match command sent. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_PRMGR\_STATE |  | Invalid / corrupted XPG parameter manager state. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_COMMMGR\_STATE |  | Invalid / corrupted MICS communications manager thread state. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_PG\_BATTMGR\_STATE |  | Invalid / corrupted IPG battery manager thread state. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_SERIAL\_STATE |  | Invalid / corrupted serial communications manager state. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_A2D\_EXCEPTION |  | Error reading AD values from AtoD manager thread. |  | Display “PPC Application error, restart device” “thread name”) |  |  |
| N/A | ERR\_PPC\_PWR\_MGR\_STARTUP\_EXCEPTION |  | Invalid / corrupted PPC power manager state. |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_INVALID\_WATCHDOG\_RESPONSE |  | Watchdog thread invalid response data (message or thread ID). |  | Display “PPC Application error, restart device” “thread name” |  |  |
| N/A | ERR\_WATCHDOG\_FAILURE |  | Watchdog thread reset due to a non responding thread. |  | Display “PPC Application error, restart device” “thread name” |  |  |

# Charging Errors

Charging errors are expected to be for the most part nuisance errors, but the patient should be notified. Examples include Pre-Charge Insufficient Battery Voltage Increase and Constant Current Time out. These errors are generally cleared by the Patient restarting charging. The rationale for separating charging errors from the minor active error codes is that the patient should still be able to know about charging errors even if there is already a category 2 active error.

| **COL HEADING** | **Description** |
| --- | --- |
| **E#** | Error number This error number is reported in the ‘charging error’ byte in the GET XPG STATUS command response (or corresponding MICS command response). |
| **NAME** | Error / fault name |
| **DESCRIPTION** | Brief description of error condition |
| **PPC Action** | Action for the PPC to take as well as any changes in capabilities |
| **Cleared By** | Describes how the error is cleared |
| **Manual** | Released specs and UI documents take precedence over this exhibit. |
| **SPEC / UI Doc REF** | Reference number in IPG functional specification and/or UI doc. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CE #** | **NAME** | **DESCRIPTION / IPG Behavior** | **PPC Action** | **Cleared By** | **Manual Says** |
| 0x01 | CHARGING STOPPED – PRE-CHARGE PHASE, INSUFFICIENT VOLTAGE INCREASE | The charging sequence was terminated by the IPG: insufficient voltage increase during the pre-charge phase. | Display "Unable to complete charging. Please check coil and try again." Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x02 | CHARGING STOPPED – PRE-CHARGE PHASE, TIME-OUT | The charging sequence was terminated by the IPG: exceeded allowed time for the pre-charge phase. | Display "Unable to complete charging. Please check coil and try again." Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x03 | CHARGING STOPPED – CONSTANT CURRENT PHASE, INSUFFICIENT VOLTAGE INCREASE | The charging sequence was terminated by the IPG: insufficient voltage increase during the constant-current phase. | Display "Unable to complete charging. Please check coil and try again." Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x04 | CHARGING STOPPED – CONSTANT CURRENT PHASE, TIME-OUT | The charging sequence was terminated by the IPG: exceeded allowed time for the constant-current phase. | Display "Unable to complete charging. Please check coil and try again." Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x05 | CHARGING STOPPED – CONSTANT VOLTAGE PHASE, TIME-OUT | The charging sequence was terminated by the IPG: exceeded allowed time for the constant-voltage phase. | Display "Unable to complete charging. Please check coil and try again." Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x06 | CHARGING STOPPED – TEMPERATURE LIMIT EXCEEDED | The charging sequence was terminated by the IPG: the case temperature exceeded the allowed limit. | Display "Unable to complete charging. Please check coil and try again." Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x07 | THERMISTOR ERROR | There was an error reading the IPG’s case-temperature thermistor. Charging may not be allowed or may be limited. | Display "Internal error. Recharging performance may be limited." Click OK and message goes away. | Restart Charging – Error will re-manifest if truly broken | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x08 | CHARGING STATE ERROR | Charge controller was initiated with insufficient voltage. | Display "Unable to complete charging.  Please check coil and try again."  Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x09 | CHARGING NOT ALLOWED | There is an active error that prevents charging. | Display Notification  “An internal error was detected in your implant.  Please see your clinician." | Clear Active Error - Category 1 Requires CP Reset or Storage Mode | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x0A | CHARGING OVERVOLTAGE ERROR | Charge controller detected an overvoltage condition while trying to charge. | Display "Unable to complete charging.  Please check coil and try again."  Click OK and message goes away. | Restart Charging | Under troubleshooting discuss things user might do differently if the error persists. |
| 0x0B- 0xFF | (RESERVED CHARGING) |  |  |  |  |

# Command Response Codes

## Standard Responses

After BUSY, COMMAND NOT VALID WHILE RAMPING, and COMMAND ACCEPTED the actions should be as defined in the UI documents.

## Responses indicating an error

After some commands-specific responses (enumerated in table below), the active error code should be checked. Examples include FAILED SAVE PROGRAM DEFINITION / DATA CORRUPTED, PROGRAM DEFINITION CORRUPTED, etc.

## Unexpected Responses

Some command responses are conditions that the external devices should never see because of other checks they do well in advance of sending commands. Seeing these unexpected responses should cause the external device to present an error indicating that they have received an unexpected response. Examples include INVALID COMMAND, INVALID PARAM, etc.

## Responses indicating a stim limit

While most of these responses should never be seen by the external devices due to programming constraints (on IPG, set by CP), some responses do indicate a limit in available stimulation parameters. For these responses the PoP and PPC should indicate that they have hit a stim related limit (described in DP 0002-18-7 Torpedo Pocket Programmer User Interface Design Document and DP 0002-18-8 Torpedo Patient Programmer Charger User Interface Design Document). The CP might be more specific as enumerated in the table below. Examples include MOD VIOLATES ELECTRODE CHARGE DENSITY LIMIT and PULSE AMPLITUDE EXCEEDS LIMITS.

## Table of Command Responses

| **COL HEADING** | **Description** |
| --- | --- |
| **RC #** | Response Number |
| **NAME** | Response name |
| **DESCRIPTION** | Brief description of response |
| **PoP Action** | Action for the PPC to take as well as any changes in capabilities |
| **PPC Action** | Action for the PPC to take as well as any changes in capabilities |
| **SPEC / UI Doc REF** | Reference number in IPG functional specification and/or UI doc. |

| **RC #** | **NAME** | **DESCRIPTION / IPG Behavior** | **PoP Action** | **PPC Action** |
| --- | --- | --- | --- | --- |
| 0xFF | COMMAND ACCEPTED | The received command (identified in the response) was processed and performed without error. Any data to be returned as a result of the command completion is present in the response. | N/A Normal PoP Behavior | N/A Normal PPC Behavior |
| 0x00 | INVALID EXID | The External ID contained in the command is for an external device the xPG has not been configured to process commands from. | Flash all 3 boxes at same duration and rate as described for scrolling when searching for an implant as described in DP-0002-18-7 Torpedo Pocket Programmer User Interface Design Document. | Display notification “The IPG is not paired with this PPC.” Treat the PPC as unpaired as described in DP 0002-18-8 Torpedo Patient Programmer Charger User Interface Design Document. |
| 0x01 | INVALID COMMAND | The Token in the received command is invalid/unknown to the xPG. | Should never see this. Read status from xPG, and if there is no active error then display E 98. | Display “The IPG received an invalid command from the PPC.” |
| 0x02 | INVALID PARAM | A parameter provided with the received command has been determined to be invalid and prohibits further processing of the command. | Should never see this. Read status from xPG, and if there is no active error then display E 98. | Display “The IPG received an invalid parameter from the PPC.” |
| 0x03 | BUSY | The xPG cannot execute the received command while in its present operational state. Examples include:   * Selecting program while stim on * Restoring program defaults while stim on * Writing to flash while stim on [CP commands] | Should never see this response, as commands are N/A or stim should be shut off before setting program. Read status from xPG, and if there is no active error then display E 98. | Should never see this response, as commands are N/A or stim should be shut off before sending command that can give this response. Read status from xPG, and if there is no active error then display notification “The PPC received an unexpected response from your implant.” |
| 0x10 | COMMAND NOT VALID WHILE IDLE | The command is not valid when stimulation is not active. (This code generally applies to commands that are used to modify stimulation.) | Should never see this, as PoP should know whether stim is on prior to changing (e.g.) amplitude. Read status from xPG, and if there is no active error then display E 98. | Should never see this, as PPC should know whether stim is on prior to changing (e.g.) amplitude. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x11 | COMMAND NOT VALID WHILE RAMPING | The command is not valid when the xPG is ramping the stimulus amplitude immediately after turning stimulation on. (This code generally applies to commands that are used to modify stimulation parameters) | As per DP-0002-18-7 | As per DP-0002-18-8 |
| 0x12 | COMMAND LOCKED OUT (temporary) | The command is temporarily locked out. (This code generally applies to commands that are used to modify stimulation, resulting in an increase in stimulation energy) | As per DP-0002-18-7 | As per DP-0002-18-8 |
| 0x13 | DEPRECATED  [was COMMAND FROM CP ONLY] | N/A | Should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x20 | PROGRAM NOT VALID | The command cannot be executed because the program definition is not valid. A way to delete a program is to set it not valid. Then when IPG returns valid programs bitmap it will not be listed as available. | Read status from xPG, and if there is no active error then as per DP-0002-18-7 for no program selected. | Read status from xPG, and if there is an active error code display it. If no active error code, then treat as per DP-0002-18-8 for no program selected. |
| 0x21 | PROGRAM DISABLED | The command cannot be executed because the program definition has been disabled, due to a hardware issue. | Read status from xPG, and if there is no active error then treat as per DP-0002-18-7 for no program selected. | Read status from xPG, and if there is an active error code display it. If no active error code, then treat as per DP-0002-18-8 for no program selected. |
| 0x22 | BATTERY TOO LOW | The xPG Stimulation command to turn stimulation on cannot be executed because the battery level is too low for safe stimulation. IPG could have said battery was OK, but then dropped below threshold since having last sent status. | As per DP-0002-18-7 | As per DP-0002-18-8 |
| 0x23 | DEPRECATED – use 0x03 BUSY instead.  [was STIM ALREADY ON] | N/A | Should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x24 | NO PROGRAM SELECTED | The requested command (only in response to stim on) cannot be executed because no program is presently selected. | Get status, and if there is an active error code display it. If no active error code, then treat as per DP-0002-18-7 for no program selected. | Read status from xPG, and if there is an active error code display it. If no active error code, then treat as per DP-0002-18-8 for no program selected. |
| 0x25 | BOOST CONVERTER STARTUP FAILED | Stimulation cannot be started because the high voltage boost converter did not initialize correctly. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is an active error code, display it. If there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x26 | PULSE GUARD CHECK FAILED | Stimulation cannot be started because the pulse guard circuit check failed. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is an active error code, display it. If there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x27 | STIMULATION POWER ON FAILED | Stimulation cannot be started because the stimulation chip failed to power up correctly. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is an active error code, display it. If there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x28 | ACTIVE RECOVERY DISABLED | Stimulation cannot be started because automatic waveform adjustment failed. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is an active error code, display it. If there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x29 | DEPRECATED – use 0x36 MOD VIOLATES ELECTRODE CHARGE DENSITY LIMIT instead  [was PULSE EXCEEDS CHARGE DENSITY LIMIT] | N/A | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x2A | DEPRECATED – Use 0x02 INVALID PARAM instead.  [was SETUP ERROR, INVALID CHANNEL AMPLITUDE PERCENTAGE] | N/A | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x2B | DEPRECATE – USE 0x02 INVALID PARAM instead.  [was STIM OUTPUT CHECK FAILED - UNBALANCED SOURCE / SINK CHANNELS] | While attempting to set-up the stim ASIC for output, an xPG firmware error occurred resulting in a condition where the percentages for electrode channels sourcing and sinking current is not balanced. | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x2C | DEPRECATED – Use 0x02 INVALID PARAM instead.  [was SETUP ERROR, TOO MANY UNCONTROLLED CHANNELS] | N/A | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x2D | DEPRECATED – Use 0x02 INVALID PARAM instead.  [was SETUP ERROR, INVALID TEST PULSE UNCONTROLLED] | N/A | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x2E | SETUP ERROR, BAD STIM ASIC READ-BACK | While attempting to set-up the stim ASIC for output, the verification data read-back of certain registers did not match the set-up data. | Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x2F | SETUP ERROR, BAD POWER ASIC READ-BACK | While attempting to configure the power ASIC, the verification data read-back of certain registers did not match the set-up data. | Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x30 | DEPRECATED – Not used.  [was SETUP ERROR, BACK MICS CHIP READBACK] | N/A. | Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x31 | ALL AMPLITUDES AT MINIMUM | The Decrement Program Amplitude command cannot be executed because all pulse amplitudes are the minimum allowed setting. | As per DP-0002-18-7 (hit limits scenario) | As described in DP-0002-18-8 for minimum parameter value (hit limits scenario.) |
| 0x32 | ALL AMPLITUDES AT MAXIMUM | The Increment Program Amplitude command cannot be executed because all pulse amplitudes are the maximum allowed setting. | As per DP-0002-18-7 (hit limits scenario) | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x33 | PULSE NOT VALID | The command to modify the specified pulse amplitude or pulse width cannot be executed because the pulse in not defined in the program that is running. | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x34 | PULSE WIDTH EXCEEDS LIMITS | The requested pulse width modification command cannot be executed because it would exceed the programmed pulse width limits for the specified pulse. | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x35 | DEPRECATED - Use 0x02 INVALID PARAM instead.  [was INVALID SET PULSE WIDTH] | N/A | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x36 | MOD VIOLATES ELECTRODE CHARGE DENSITY LIMIT | The requested pulse output modification cannot be executed because it would violate the charge density limit for one or more of the selected electrode channels. | As per DP-0002-18-7 for maximum parameter value (hit limits scenario.) | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x37 | MOD VIOLATES ELECTRODE CURRENT DENSITY LIMIT | The requested pulse output modification cannot be executed because it would violate the current density limit for one or more of the selected electrode channels. | As per DP-0002-18-7 for maximum parameter value (hit limits scenario.) | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x38 | PULSE WIDTH FREQUENCY CONFLICT | * The requested pulse width increase cannot be executed because the program cannot be implemented at the specified program frequency. * The requested program frequency increase cannot be executed because the program cannot be implemented with the specified pulse widths. * The requested Test Pulse will not fit in the selected program period. * The requested pulse output requires active recovery, but the KrecsEnabledBitMap in the Pulse Constants is 0 (no krecs enabled). * The requested pulse output requires active recovery, but there are no krecs enabled (KrecsEnabledBitMap in Pulse Constants) that will fit the selected program period. | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x39 | DEPRECATED – Use PULSE WIDTH FREQUENCY CONFLICT  [was FREQUENCY MOD VIOLATES PULSE WIDTH LIMIT] | N/A | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x3A | FREQUENCY MOD NOT ALLOWED | The requested program frequency change is not allowed per the program definition. (This could be because the specified frequency is not allowed or there is no frequency index lower or higher than the present index allowed.) | PoP should never see this. Read status from xPG, and if there is no active error then display E 98. | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x3B | PULSE AMPLITUDE EXCEEDS LIMITS | The requested pulse amplitude change cannot be executed because it would exceed the allowed limits for the specified pulse. | As per DP-0002-18-7 for maximum parameter value (hit limits scenario.) | As described in DP-0002-18-8 for maximum parameter value (hit limits scenario.) |
| 0x3C | DEPRECATED – Command n long exists  [was INVALID SET PULSE AMPLITUDE] | The requested pulse amplitude increase cannot be executed because the resulting amplitude change is larger than allowed. | Should never see this, as set command not used. Read status from xPG, and if there is no active error then display E 98. | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x40 | TIMED OUT | The operation requested timed out waiting for hardware to respond. This response includes when an ADC read fails or when background impedance check fails to respond with a value. | Should never see this. Read status from xPG, and if there is no active error then show UNEXPECTED\_RESPONSE ERROR. (E98) | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x55 | CHARGING CONTROL ERROR | An error occurred reading the temperature or battery level. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x60 | DATA CORRUPTED | The requested Get Data command failed, or the requested data was detected as corrupt. | Should never see this. Read status from xPG, and if there is no active error then show UNEXPECTED\_RESPONSE ERROR. (E98) | Should never see this. Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x61 | PROGRAM DEFINITION CORRUPTED | The data integrity check for the program definition data for the requested program failed. IPG should set active error to PROGRAM DEFINITION CORRUPTED | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x62 | PROGRAM ACTIVE SETTINGS CORRUPTED | The data integrity check for the active settings for the requested program failed. IPG should set active error to PROGRAM ACTIVE SETTINGS CORRUPTED. IPG will also return that active settings to default settings. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x63 | PROGRAM CONSTANTS CORRUPTED | The data integrity check for the Program Constants data failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x64 | PULSE CONSTANTS CORRUPTED | The data integrity check for the Pulse Constants data failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x65 | CHANNEL CALIBRATIONS CORRUPTED | The data integrity check for the Channel Calibrations data failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. |  |
| 0x66 | LEAD LIMITS CORRUPTED | The data integrity check for the Lead Limits data failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x67 | STIM ASIC HV CALIBRATIONS CORRUPTED | The data integrity check for the Stim Asic HV Calibrations data failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x68 | RAMP TIME CORRUPTED | The data integrity check for the Ramp Time failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x69 | DEPRECATED  [was DATA CORRUPTION] | The data integrity check for ZZZZ failed. xPG should set active error to CRITICAL NV DATA CORRUPTED. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x6A | DEPRECATED – Not used  [was TEST PULSE DEFINITION CORRUPTED] | The data integrity check for the requested Test Pulse Definition failed. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x70 | FEATURE NOT ENABLED | The requested feature is not presently enabled. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x71 | DEPRECATED - Use 0x02 INVALID PARAM instead.  [was TEST PULSE DEFINITION IS NOT VALID. ] | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x72 | DEPRECATED - Use 0x02 INVALID PARAM instead.  [was TEST PULSE DEFINITION ALLOWS STANDARD RECOVERY PHASE ONLY. ] | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x73 | DEPRECATED – Use 0x03 BUSY instead.  [was COMMAND NOT ALLOWED WHEN TEST PULSE FEATURE IS ENABLED] | The requested command is not permitted when the Test Pulse Feature is enabled. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x74 | DEPRECATED – Use 0x38 PULSE WIDTH FREQUENCY CONFLICT  [was TEST PULSE DOES NOT FIT IN PROGRAM PERIOD | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x75 | DEPRECATED – Use 0x38 PULSE WIDTH FREQUENCY CONFLICT  [was PULSE REQUIRES ACTIVE RECOVERY BUT NO KRECS ARE ENABLED] | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x76 | DEPRECATED – Use 0x38 PULSE WIDTH FREQUENCY CONFLICT  [was PULSE REQUIRES ACTIVE RECOVERY NO ENABLED KRECS WILL FIT PROGRAM PERIOD] | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x77 | WRITE FAILED | The command failed while attempting to write data to memory or registers. Writes to flash shall use more specific error codes from the range below. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x78 | READ FAILED | The command failed while attempting to read data to memory or registers. Reads to flash shall use more specific error codes from the range below. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x79 | DEPRECATED – Not used  [was ILLEGAL CONFIG] | Stimulation software requested an illegal configuration of the channels. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x80 | DEPRECATED – Not used  [was DIAGNOSTIC OUTPUT CHECK FAILED] | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x81 | BACKGROUND IMPEDANCE CHECK FAILED | Pre-stimulation background impedance checks have failed. This shall result in a Category 2 Error being reported. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x82 | BASIC OUTPUT CHECK FAILED | Pre-stimulation basic output checks have failed. This shall result in a Category 2 Error being reported. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x83 | STIM FAILED UNKNOWN SOFTWARE ERROR | Stimulation has failed because of a software logic error. Stimulation cannot be started. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x84 | STIMULATION FAILED – SEVERE ERROR EXISTS | Stimulation has failed because a Category 1 error exists. Stimulation cannot be started if such an error exists. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0x85 | DEPRECATED – Not used  [was STIMULATION FAILED – SEVERE ERROR EXISTS] | N/A | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB0 | FLASH ERROR INVALID ADDRESS | Illegal flash address segment write. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB1 | FLASH ERROR SEGMENT BOUNDARY | Requested flash address write overlaps segment boundary. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB2 | DEPRECATED – Use 0xB0 FLASH ERROR INVALID ADDRESS instead  [was FLASH ERASE ERROR INVALID ADDRESS] | Invalid flash address reported while preparing for erasing segment. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB3 | FLASH ERASE ERROR FLASH CONTROLLER BUSY | Flash controller unexpectedly reported busy while preparing for segment erase. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB4 | FLASH ERASE ERROR FLASH CONTROLLER SETUP | Firmware setup error reported while preparing for segment erase. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB5 | FLASH ERASE ERROR TIMEOUT | Busy bit timeout reported while waiting for segment erase. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB6 | FLASH ERASE ERROR FAIL FLAG | Fail flag set during segment erase. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB7 | FLASH ERASE ERROR ACCESS VIOLATION FLAG | Access violation reported while attempting to erase flash. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xB8 | FLASH ERASE ERROR BAD ERASE | Segment not erased and segment erase reported as completed. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC0 | DEPRECATED – Use 0xB0 FLASH ERROR INVALID ADDRESS instead  [was FLASH WRITE ERROR INVALID ADDRESS] | Invalid flash address error reported while attempting block write. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC1 | FLASH WRITE ERROR FLASH CONTROLLER BUSY | The flash controller reports unexpectedly busy while preparing for block write. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC2 | FLASH WRITE ERROR FLASH CONTROLLER SETUP | A firmware setup error occurred while preparing for block write. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC3 | FLASH WORD WRITE ERROR TIMEOUT | Wait bit timeout occurred while writing word to flash memory. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC4 | FLASH WORD WRITE ERROR FAIL FLAG | Flash fail flag set while writing word to flash memory. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC5 | FLASH WORD WRITE ERROR ACCESS VIOLATION | Access violation reported while writing word to flash memory. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC6 | FLASH BLOCK WRITE ERROR TIMEOUT | Wait bit timeout occurred while writing block to flash memory. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC7 | FLASH BLOCK WRITE ERROR FAIL FLAG | Flash fail flag set while writing block to flash memory. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC8 | FLASH BLOCK WRITE ERROR ACCESS VIOLATION | Access violation reported while writing block to flash memory. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xC9 | FLASH WRITE ERROR BAD WRITE | After segment write completed, the flash destination data did not match the source data. The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| 0xCA – 0xCF | RESERVED – Not used.  [was ERROR PROGRAMMING NV MEMORY] | The requested programming command failed while attempting to save data to the xPG’s non-volatile memory. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |
| ANY ERROR NOT LISTED | ANY ERROR NOT LISTED HEREIN | Undefined and unexpected. | Read status from xPG, and if there is no active error then display E 98. | Read status from xPG, and if there is no active error then display “The PPC received an unexpected response from your implant.” |

# Log Entries

## Logging Codes

Each logging code corresponds to a specific message. The logging codes give additional information regarding errors or regarding actions taken by the system or operator.

### Error Codes

Codes that are between 1000-1999 are for system errors. Most of these errors provide additional information to the active error codes. They also provide a history of what errors have occurred.

### Action Codes

Codes that are between 2000-2999 are for system actions. Most of these entries provide information about what actions the operator has taken on the system. Some entries also provide information as to what actions the system is performing.

### CP Reserved Codes

Codes that are between 3000-3999 are reserved for CP specific logging. The specific meanings of these codes are TBD.

## Timestamp

A 32-bit timestamp is saved with each log entry. The resolution of this timestamp is 1s. The timestamp is a simple counter with 0 being when the system was last reset.

## Log Data

4 bytes of data are included in each log entry. In most cases this data is not used. However, in some cases where the data is used, the data is sometime in

## Logging Code Definitions

| **Logging Code** | **ID** | **Description** | **Data[0]** | **Data[1]** | **Data[2]** | **Data[3]** | **Data Description** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E\_LOG\_ERR\_UNINTENDED\_RESET | 1001 | An unintended reset occurred. |  |  |  |  |  |
| E\_LOG\_ERR\_WATCHDOG\_RESET | 1002 | A watchdog reset occurred. |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_VOLTAGE\_CHECK | 1003 | An error was detected during a voltage check. |  |  |  |  |  |
| E\_LOG\_ERR\_TEMPERATURE\_CHECK | 1004 | An error was detected during a temperature check. |  |  |  |  |  |
| E\_LOG\_ERR\_CLOCK\_VERIFICATION | 1005 | A timing error was detected during clock verification. |  |  |  |  |  |
| E\_LOG\_ERR\_PULSE\_CYCLE\_CHECK | 1006 | A timing error was detected during pulse cycle check verification. |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_DATA\_READBACK | 1010 | A Stimulation Data Read-back error was detected. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_PROGRAM\_CORRUPTED | 1011 | The diagnostic memory check detected corruption of the Stimulation Program Definition. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_ACTIVE\_SETTINGS\_CORRUPTED | 1012 | The diagnostic memory check detected corruption of the Active Stimulation Settings. |  |  |  |  |  |
| E\_LOG\_ERR\_MICS\_ID\_CORRUPTED | 1013 | The diagnostic memory check detected corruption of the MICS identity information. |  |  |  |  |  |
| E\_LOG\_ERR\_PROGRAM\_CONSTANTS\_CORRUPTED | 1014 | The diagnostic memory check detected corruption of the Program Constants. |  |  |  |  |  |
| E\_LOG\_ERR\_PULSE\_CONSTANTS\_CORRUPTED | 1015 | The diagnostic memory check detected corruption of the Pulse Constants. |  |  |  |  |  |
| E\_LOG\_ERR\_CHANNEL\_CALIBRATION\_CORRUPTED | 1016 | The diagnostic memory check detected corruption of the Channel Calibration. |  |  |  |  |  |
| E\_LOG\_ERR\_LEAD\_INFORMATION\_CORRUPTED | 1017 | The diagnostic memory check detected corruption of the Lead Information. |  |  |  |  |  |
| E\_LOG\_ERR\_CONFIG\_DEVICE\_PARAMS\_CORRUPTED | 1018 | The diagnostic memory check detected corruption of the Configurable Device Parameters. |  |  |  |  |  |
| E\_LOG\_ERR\_GENERAL\_CALIBRATION\_CORRUPTED | 1019 | The diagnostic memory check detected corruption of the General Calibration Data. |  |  |  |  |  |
| E\_LOG\_ERR\_SATURN\_TRIM\_LIST\_CORRUPTED | 1020 | The Stimulation System trim list is corrupted. |  |  |  |  |  |
| E\_LOG\_ERR\_PLUTO\_TRIM\_LIST\_CORRUPTED | 1021 | The Power System trim list is corrupted. |  |  |  |  |  |
| E\_LOG\_ERR\_ZARLINK\_TRIM\_LIST\_CORRUPTED | 1022 | The Radio trim list is corrupted. |  |  |  |  |  |
| E\_LOG\_ERR\_PROGRAM\_DATA\_INTEGRITY\_ERROR | 1023 | The Program Data Integrity check failed |  |  |  |  |  |
| E\_LOG\_ERR\_HV\_CALIBRATION\_CORRUPTED | 1024 | The diagnostic memory check detected corruption of the High Voltage Calibration |  |  |  |  |  |
| E\_LOG\_ERR\_BACKGROUND\_IMP\_PARAMS\_CORRUPTED | 1025 | The diagnostic memory check detected corruption of the Background Impedance Parameters |  |  |  |  |  |
| E\_LOG\_ERR\_RAMP\_TIME\_CORRUPTED | 1026 | The diagnostic memory check detected corruption of the Ramp Time |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_BROWNOUT | 1030 | A Brownout was detected during Stimulation. |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_PULSE\_GUARD\_TRIPPED | 1040 | The pulse guard tripped. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_PARITY\_ERROR | 1041 | A stimulation system parity error was detected. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_SEQUENCER\_ERROR | 1042 | A stimulation system sequencing error |  |  |  |  |  |
| E\_LOG\_SATURN\_ADDRESS\_ERROR | 1043 | A stimulation system address error |  |  |  |  |  |
| E\_LOG\_STIM\_REGISTER\_VALID | 1044 | A stimulation system register valid error |  |  |  |  |  |
| E\_LOG\_STIM\_WRITE\_PROTECT\_ERROR | 1045 | A stimulation system write protect error |  |  |  |  |  |
| E\_LOG\_STIM\_SYNC\_ERROR | 1046 | Could not SYNC with the stimulation hardware to perform the operation |  |  |  |  |  |
| E\_LOG\_STIM\_SYNC\_STARTUP\_ERROR | 1047 | Could not start or update the simulation program |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_OPEN\_CIRCUIT\_CONDITION | 1050 | The Impedance Measurement diagnostics detected an Open Circuit Condition. |  |  |  |  |  |
| E\_LOG\_ERR\_FAULTY\_OUTPUT\_CHANNEL | 1051 | The Background Stimulation Output check detected a Faulty Channel. |  |  |  |  |  |
| E\_LOG\_ERR\_FAULTY\_OUTPUT\_CAPACITOR | 1052 | The Output Capacitor check detected a Faulty Capacitor. |  |  |  |  |  |
| E\_LOG\_ERR\_BG\_IMP\_MEASUREMENT\_FAILED | 1053 | Background Impedance Measurement failed |  |  |  |  |  |
| E\_LOG\_ERR\_CHECK\_DENSITIES\_FAILED | 1054 | The Check Densities routine failed |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_POWER\_UP\_FAILED | 1055 | The Stimulation hardware didn't power up or initialize correctly |  |  |  |  |  |
| E\_LOG\_ERR\_BASIC\_OUTPUT\_CHECK\_FAILED | 1056 | Basic output check failed. |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_THERMISTOR\_FAULT | 1060 | The Thermistor Diagnostic detects a fault in the temperature measurement circuit |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_EVENT\_LOG\_CORRUPT | 1070 | The Log Module detected a corrupt Event Log data structure in this Log |  |  |  |  |  |
| E\_LOG\_ERR\_STACK\_EXCEEDED | 1071 | The software has exceeded its stack limitations |  |  |  |  |  |
| E\_LOG\_ERR\_QUEUE\_OVERFLOW | 1072 | The software has detected a queue overflow |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_NORMAL\_UNKNOWN\_ERROR | 1080 | Unknown error has been published |  |  |  |  |  |
| E\_LOG\_RESET\_SYSTEM | 1081 | System restarted after coming out of reset |  |  |  |  |  |
| E\_LOG\_NMI | 1082 | System restarted after receiving unknown interrupt |  |  |  |  |  |
| E\_LOG\_UNKNOWN\_RESET | 1083 | System restarted for unknown reasons |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_ERR\_TEST\_STIM\_RANGE\_CHECK\_FAILED | 1090 | Test Stimulation range check failed. |  |  |  |  |  |
| E\_LOG\_ERR\_RETRIEVE\_PROGRAM\_FAILED | 1091 | Retrieving a program failed. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_AUTO\_WAVEFORM\_FAILED | 1092 | Stim auto-waveform failed. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_COMPLIANCE\_VOLT\_EXCEEDS\_MAX | 1093 | Compliance voltage calculation indicates voltage higher than is available. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_HV\_BOOST\_INIT\_FAILED | 1094 | Stimulation high voltage DAC failed. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_PERIOD\_CHECK\_FAILED | 1095 | Stim period check failed. |  |  |  |  |  |
| E\_LOG\_ERR\_STIM\_PULSE\_WIDTH\_FREQ\_CONFLICT | 1096 | Stim calculated a pulse width – frequency conflict. |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_TIMESTAMP\_LOG\_LOW\_BYTES | 2001 | Embed low bytes of 8 byte external timestamp in log | TBD | TBD | TBD | TBD | Timestamp data is determined by CP developers. It is meant to be used only by the CP as a way to correlate log entries with wall clock time. |
| E\_LOG\_REVIEW\_MARK\_LOG | 2002 | Mark location in log |  |  |  |  |  |
| E\_LOG\_POWER\_UP | 2003 | System is powered up or coming out of a reset |  |  |  |  |  |
| E\_LOG\_CP\_CONNECTED | 2004 | CP has been connected to the system | EXID->LSB | EXID->MiddleByte | EXID->MSB |  |  |
| E\_LOG\_TIMESTAMP\_LOG\_HIGH\_BYTES | 2005 | Embed high bytes of 8 byte external timestamp in log | TBD | TBD | TBD | TBD | Timestamp data is determined by CP developers. It is meant to be used only by the CP as a way to correlate log entries with wall clock time. |
| E\_LOG\_MICS\_CONNECTION | 2006 | MICS has been disconnected by the software |  |  |  |  |  |
| E\_LOG\_MICS\_DISCONNECT | 2007 | MICS has been shutdown |  |  |  |  |  |
| E\_LOG\_MICS\_SHUTDOWN | 2008 | MICS transmit/receive has been aborted |  |  |  |  |  |
| E\_LOG\_MICS\_ABORT | 2009 | MICS has been shutdown |  |  |  |  |  |
| E\_LOG\_MICS\_INITIALIZED | 2010 | MICS driver has been initialized |  |  |  |  |  |
| E\_LOG\_MICS\_CONNECTION\_LOST | 2011 | MICS connection has been lost |  |  |  |  |  |
| E\_LOG\_MICS\_RADIO\_FAILURE | 2012 | MICS radio failure |  |  |  |  |  |
| E\_LOG\_MICS\_RADIO\_READY | 2013 | MICS radio is ready |  |  |  |  |  |
| E\_LOG\_MICS\_LINK\_READY | 2014 | MICS link is ready |  |  |  |  |  |
| E\_LOG\_MICS\_MAC\_CMND\_TIMEOUT | 2015 | MICS MAC Command Timeout |  |  |  |  |  |
| E\_LOG\_MICS\_WATCHDOG\_TIMEOUT | 2016 | MICS Watchdog Timeout |  |  |  |  |  |
| E\_LOG\_MICS\_HK\_ABORT\_LINK | 2017 | MICS Housekeeping Abort Link |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_CHARGING\_INITIATED | 2020 | Charging of the battery has been initiated | CHARGING\_RATE |  |  |  | 0=High Charge Rate, 1=Low Charge Rate |
| E\_LOG\_CHARGING\_COMPLETED | 2021 | Battery has been charged to full capacity |  |  |  |  |  |
| E\_LOG\_CHARGING\_INTERRUPTED | 2022 | Battery charging has been interrupted prior to being fully charged |  |  |  |  |  |
| E\_LOG\_CHARGER\_DETECTED | 2023 | Charger has been detected |  |  |  |  |  |
| E\_LOG\_CHARGER\_REMOVED | 2024 | Charger has been removed |  |  |  |  |  |
| E\_LOG\_CHARGING\_ABORT\_TEMP | 2025 | Charging has been aborted due to high temperature |  |  |  |  |  |
| E\_LOG\_CHARGING\_ABORT\_VOLTAGE | 2026 | Charging has been aborted due to insufficient voltage rise |  |  |  |  |  |
| E\_LOG\_CHARGING\_ABORT\_ERROR | 2027 | Charging has been aborted due to error |  |  |  |  |  |
| E\_LOG\_TETS\_DETUNED | 2028 | Charging has been disconnected from the system |  |  |  |  |  |
| E\_LOG\_STIM\_STOPPED\_LOW\_BATT | 2029 | Stimulation was stopped due to low battery |  |  |  |  |  |
| E\_LOG\_STIM\_STOPPED\_PWR\_DOWN | 2030 | Stimulation was stopped due to power down |  |  |  |  |  |
| E\_LOG\_STIM\_STOPPED\_ERROR | 2031 | Stimulation was stopped due to an error |  |  |  | ACTIVE\_ERROR\_CODE | Active Error Code according to SWEX 0091. |
| E\_LOG\_CHARGING\_ABORT\_OVER\_VOLTAGE | 2032 | Charging was stopped due to overvoltage error |  |  |  |  |  |
| E\_LOG\_CHARGING\_CRITICAL\_TEMP | 2033 | Charging was switched to C8 because of critical temperature |  |  |  |  |  |
| E\_LOG\_SWITCH\_CHARGING\_MODE | 2034 | Charging was switched to the mode specified | CHARGING\_RATE |  |  |  | 0=High Charge Rate, 1=Low Charge Rate |
|  |  |  |  |  |  |  |  |
| E\_LOG\_STIM\_STOPPED\_CLOSE\_SESSION | 2040 | Stimulation was stopped to radio session closing |  |  |  |  |  |
| E\_LOG\_PAIRING\_CHANGED\_MICS | 2041 | Pairing information was changed via radio |  |  |  |  |  |
| E\_LOG\_PAIRING\_CHANGED\_TETS | 2042 | Pairing information was changed via charging system |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_CAL\_DATA\_CORRUPTION\_REPAIRED | 2050 | Calibration data restored from backup |  |  |  |  |  |
| E\_LOG\_CONST\_DATA\_CORRUPTION\_REPAIRED | 2051 | Program or Pulse constants data has been repaired |  |  |  |  |  |
| E\_LOG\_HVCAL\_DATA\_CORRUPTION\_REPAIRED | 2052 | High Voltage Calibration data was restored from backup |  |  |  |  |  |
| E\_LOG\_GENCAL\_DATA\_CORRUPTION\_REPAIRED | 2053 | General Calibration data was restored from backup |  |  |  |  |  |
| E\_LOG\_XPGINFO\_DATA\_CORRUPTION\_REPAIRED | 2054 | System Information Data was restored from backup copy |  |  |  |  |  |
| E\_LOG\_STIM\_TRIM\_LIST\_REPAIRED | 2055 | Stimulation configuration trim list data was restored from backup |  |  |  |  |  |
| E\_LOG\_RADIO\_TRIM\_LIST\_REPAIRED | 2056 | Radio configuration trim list data was restored from backup |  |  |  |  |  |
| E\_LOG\_DEFAULT\_BACKROUND\_IMPEDANCE\_PARAMS | 2057 | Default background impedance parameters have been restored |  |  |  |  |  |
| E\_LOG\_POWER\_TRIM\_LIST\_REPAIRED | 2058 | Power configuration trim list data was restored from backup |  |  |  |  |  |
| E\_LOG\_CDP\_REPAIRED | 2059 | Configurable device parameters was restored from backup |  |  |  |  |  |
| E\_LOG\_RAMP\_TIME\_REPAIRED | 2060 | Ramp time was restored from backup |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_COMMAND\_UNHANDLED | 2070 | The command received was not supported |  |  |  |  |  |
| E\_LOG\_PATIENT\_STIM\_STOPPED | 2071 | Stimulation was stopped |  |  |  |  |  |
| E\_LOG\_PATIENT\_STIM\_STARTED | 2072 | Patient stimulation was started |  |  |  |  |  |
| E\_LOG\_TITRATION\_STARTED | 2073 | Trial stimulation was started |  |  |  |  |  |
| E\_LOG\_TEST\_STIM\_STARTED | 2074 | Test stimulation was started |  |  |  |  |  |
| E\_LOG\_STORAGE\_MODE | 2075 | System was commanded into storage mode |  |  |  |  |  |
| E\_LOG\_SELECT\_PROGRAM | 2076 | Patient Program was selected | Program Number |  |  |  | The program number selected. |
| E\_LOG\_INCR\_PRGM\_AMPLITUDE | 2077 | Program amplitude was incremented |  |  |  |  |  |
| E\_LOG\_SET\_PULSE\_AMPLITUDE | 2078 | Pulse amplitude was set |  |  |  |  |  |
| E\_LOG\_SET\_PRGM\_FREQUENCY | 2079 | Program frequency was set |  |  |  |  |  |
| E\_LOG\_RESTORE\_PROGRAM\_DEFAULTS | 2080 | Active Program Settings were restored to default values |  |  |  |  |  |
| E\_LOG\_RESET\_XPG | 2081 | System was commanded to reset |  |  |  |  |  |
| E\_LOG\_IMPEDANCE\_ON\_DEMAND | 2082 | Impedance measurement was requested |  |  |  |  |  |
| E\_LOG\_CLEAR\_LOG | 2083 | Log was requested to be cleared |  |  |  |  |  |
| E\_LOG\_TITRATION\_PARAMS | 2084 | Trial Stimulation parameters were modified |  |  |  |  |  |
| E\_LOG\_SET\_TEST\_PARAMS | 2089 | Test Stimulation parameters were modified |  |  |  |  |  |
| E\_LOG\_DECR\_PRGM\_AMPLITUDE | 2090 | Program amplitude was decremented |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_MAGNET\_STIM\_STARTED | 2100 | Patient stimulation was started via magnet |  |  |  |  |  |
| E\_LOG\_MAGNET\_STIM\_STOPPED | 2101 | Patient stimulation was stopped via magnet |  |  |  |  |  |
| E\_LOG\_MAGNET\_PWR\_DOWN | 2102 | System is about the powered down via magnet |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_STIM\_STOPPED\_TETS | 2110 | Stimulation is stopped via charging system command |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_READ\_ERROR\_LOG | 2120 | Error log was read |  |  |  |  |  |
| E\_LOG\_READ\_EVENT\_LOG | 2121 | Event log was read |  |  |  |  |  |
| E\_LOG\_QUERY\_PPC\_CONSTANTS | 2122 | PPC Constants were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PROGRAM\_NAMES | 2123 | Program names were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PROGRAM\_CONSTANTS | 2124 | Program constants were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_XPG\_IDENTITY | 2125 | System Identity information was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_GENERAL\_CALIBRATION | 2126 | General calibration parameters were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_CURRENT\_TO\_VOLT\_CNTR | 2127 | Charging went from current mode to voltage mode counter was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_CHARGE\_COMPLETE\_CNTR | 2128 | Charging was done to completion counter was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_STORAGE\_MODE\_CNTR | 2129 | Storage mode counter was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_CHANNEL\_CALIBRATION | 2130 | Channel calibration values were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_HV\_CALIBRATION | 2131 | High Voltage calibration values were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_TRIM\_LISTS | 2132 | Trim list values were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_VBAT\_DIAG | 2133 | Battery diagnostic information was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_BG\_IMPEDANCE\_DIAG | 2134 | Background impedance diagnostic information was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_OUTPUT\_CAP\_DIAG | 2135 | Output capacitor check diagnostic information was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_THERMISTOR\_DIAG | 2136 | Thermistor diagnostic information was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PROGRAM\_DEF | 2137 | Program definition was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PULSE\_CONSTANTS | 2138 | Pulse constants were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_CDP | 2139 | Configuration device parameters were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PULSE\_WIDTHS | 2140 | Pulse widths were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PRGM\_FREQUENCY | 2141 | Program frequency was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_POP\_CONSTANTS | 2142 | POP Constants were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_LEAD\_LIMITS | 2143 | Lead limits were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_CP\_DATA | 2144 | Clinician Programmer data was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_RAMP\_TIME | 2145 | Ramp Time was queried |  |  |  |  |  |
| E\_LOG\_QUERY\_TITRATION\_STIM | 2146 | Trial Stimulation parameters were queried |  |  |  |  |  |
| E\_LOG\_QUERY\_PRGM\_RUN\_TIME | 2147 | Program run time was queried |  |  |  |  |  |
| E\_LOG\_READ\_MEMORY\_REQUESTED | 2148 | Direct memory read was performed |  |  |  |  |  |
| E\_LOG\_QUERY\_BG\_IMPEDANCE\_PARAMS | 2149 | Background impedance parameters were queried |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_SET\_XPG\_IDENTITY | 2201 | System Identity Information changed |  |  |  |  |  |
| E\_LOG\_SET\_GENERAL\_CALIBRATION | 2202 | General calibration data changed |  |  |  |  |  |
| E\_LOG\_RESET\_CURRENT\_TO\_VOLT\_CNTR | 2203 | Charging mode change counter was reset |  |  |  |  |  |
| E\_LOG\_RESET\_CHARGE\_COMPLETE\_CNTR | 2204 | Charging completed counter was reset |  |  |  |  |  |
| E\_LOG\_RESET\_STORAGE\_MODE\_CNTR | 2205 | Storage mode counter was reset |  |  |  |  |  |
| E\_LOG\_SET\_CHANNEL\_CALIBRATION | 2206 | Channel calibration was changed |  |  |  |  |  |
| E\_LOG\_SET\_HV\_CALIBRATION | 2207 | High Voltage calibration was changed |  |  |  |  |  |
| E\_LOG\_SET\_STIM\_TRIM\_LIST | 2208 | Stimulation configuration trim list was changed |  |  |  |  |  |
| E\_LOG\_SET\_RADIO\_TRIM\_LIST | 2209 | Radio configuration trim list was changed |  |  |  |  |  |
| E\_LOG\_SET\_PROGRAM\_DEFINITION | 2210 | Program definition was changed | Program Number |  |  |  | The Program Number being changed. |
| E\_LOG\_SET\_PROGRAM\_CONSTANTS | 2211 | Program constants were changed |  |  |  |  |  |
| E\_LOG\_SET\_PULSE\_CONSTANTS | 2212 | Pulse constants were changed |  |  |  |  |  |
| E\_LOG\_SET\_CDP | 2213 | Config device parameters were changed |  |  |  |  |  |
| E\_LOG\_SET\_LEAD\_LIMITS | 2214 | Lead limits were changed |  |  |  |  |  |
| E\_LOG\_SET\_CP\_DATA | 2215 | Clinician Program data was changed |  |  |  |  |  |
| E\_LOG\_SET\_RAMP\_TIME | 2216 | Ramp Time was changed |  |  |  |  |  |
| E\_LOG\_RESET\_PROGRAM\_TIME | 2217 | Program Time was reset |  |  |  |  |  |
| E\_LOG\_WRITE\_MEMORY\_REQUESTED | 2218 | Direct write to memory was requested |  |  |  |  |  |
| E\_LOG\_SET\_BG\_IMPEDANCE\_PARAMS | 2219 | Background Impedance Parameters were changed |  |  |  |  |  |
| E\_LOG\_ACTIVE\_ERROR | 2220 | System Error was detected |  |  |  |  |  |
| E\_LOG\_CHARGING\_ERROR | 2221 | Charging Error was detected |  |  |  | CHARGE\_ERROR\_CODE | Charge Error Code according to SWEX 0091. |
| E\_LOG\_SET\_POWER\_TRIM\_LIST | 2222 | Power configuration trim list was changed |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_DIAGNOSTIC\_VRECT\_AND\_TEMP | 2300 | Diagnostic log of vrect during charging | Recharge Power | Recharge Power |  |  | The recharge power being detected by the implant. |
| E\_LOG\_DIAGNOSTIC\_TEMPERATURE | 2301 | Diagnostic log of temperature data during charging | Input | Input | Bias | Bias | The input and bias parameters being used to calculate temperature. |
| E\_LOG\_DIAGNOSTIC\_BATTERY\_ADC | 2302 | Diagnostic log of battery adc counts during charging | ADC Counts | ADC Counts |  |  | The battery level in ADC counts. |
|  |  |  |  |  |  |  |  |
| E\_LOG\_MICS\_CANTCLEARIRQ | 2303 | The MICS ISR was unable to clear an interrupt bit. Data contains (lsb) after processing irq stat2 register, after processing irq stat 1 register, before processing irq stat 2 register, before processing irq stat 1 register (msb) |  |  |  |  |  |
| E\_LOG\_MICS\_SPIFAIL | 2304 | The MICS driver failed to write to a register via SPI. Data contains (lsb) read register value, written register value, register address (msb) |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_VLO\_CALIBRATION\_FREQUENCY | 2305 | //!< The MSP430 VLO was calibrated and is running at the specified frequency |  |  |  |  |  |
| E\_LOG\_SW\_TIMER\_RESET | 2306 | The software timer caused the system to reset |  |  |  |  |  |
| E\_LOG\_MICS\_TOOMUCH | 2307 | More data than is allowed was received when in session |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_MICS\_COMMAND\_RECEIVED | 2400 | A MICS Command was received, token is logged. |  |  |  |  |  |
| E\_LOG\_MICS\_RESPONSE\_SENT | 2401 | A MICS Response was sent, token is logged. |  |  |  |  |  |
| E\_LOG\_MICS\_PACKET\_DUMPED | 2402 | A MICS Packet was dumped |  |  |  |  |  |
| E\_LOG\_MICS\_INVALID\_EXID | 2403 | A MICS Command was received from an unpaired programmer |  |  |  |  |  |
| E\_LOG\_MICS\_INVALID\_TOKEN | 2404 | A MICS Command with an invalid token was received |  |  |  |  |  |
| E\_LOG\_MICS\_CHECKSUM\_FAILED | 2405 | A MICS Command was received, but the checksum failed. |  |  |  |  |  |
| E\_LOG\_MICS\_TIMEOUT | 2406 | A MICSPAD Timeout occurred waiting for an intermediate block |  |  |  |  |  |
| E\_LOG\_MICS\_SESSION\_DUMPED | 2407 | A MICS Session was closed by the MICS PAD. |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_TETS\_BYTE\_RECEIVED | 2450 | A byte was received over TETS, data has byte |  |  |  |  |  |
| E\_LOG\_TETS\_COMMAND\_RECEIVED | 2451 | A valid TETS command was received, data has command number |  |  |  |  |  |
| E\_LOG\_TETS\_RESPONSE\_SENT | 2452 | A response is being sent over TETS |  |  |  |  |  |
| E\_LOG\_TETS\_BYTE\_SENT | 2453 | A byte was sent over TETS, data has byte |  |  |  |  |  |
| E\_LOG\_TETS\_COMMAND\_REJECTED | 2454 | TETS command was rejected because message not formatted correctly |  |  |  |  |  |
| E\_LOG\_TETS\_TIMEOUT | 2455 | A timeout occurred while sending or receiving data bytes |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| E\_LOG\_DEBUG | 2500 | Internal debugging message |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| RESERVED FOR CP | 3XXX | These are reserved for CP use only. |  |  |  |  |  |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision Level** | **Revision Description** | **ECN**  **No#** | **Effective**  **Date** |
| 1.1 | Initial Revision | 1199 | 11/30/10 |
| 1.2 | * Added many new response codes for new version of IPG emulator including Test Pulse feature * Added RC# 0x28, 0x29, 0x2A, 0x2B….0x2E * Added RC# 0x63….0x67, 0x6A, 0x70….0x76 | 1254 | 05/13/11 |
| 1.3 | * Removed references to incomplete program notification in AE 31-34 * Accounted for the IPG sending a command response not listed in this document | 1266 | 06/14/11 |
| 1.4 | * Removed references to incomplete program notification in AE 31-34 * Accounted for the IPG sending a command response not listed in this document * Consolidating timing errors * Added flash error * Ensured consistency between SWEX 0085 in regards to response codes * Deprecated AE 04, AE 31, AE 52, AE 56, AE 57 due to consolidation of active error codes. * Added AE 30 and AE 90 for internal software errors. * Clarified watchdog behavior. * Deprecated RC 0x2B, 0x35, 0x39, 0x3C, 0x50-0x54, 0x6A, 0x71, 0x72, 0x73, 0x74, 0x75, 0x76, 0x79, 0xB2, 0xC0 * Clarified error code description when stimulation is shutdown via magnet. * Changed 0x39 descriptions to PULSE WIDTH FREQUENCY CONFLICT. * Added 0x40 TIMED OUT for hardware timeout error responses * Added AE 08 BACKGROUND IMPEDANCE HW ERROR * Added chip-specific response codes 0x2F and 0x30 for Power ASIC and MICS chip read back errors. * Added RC 0x68 RAMP TIME CORRUPTED, * Reinstated RC 0x78 Read Failed * Moved 0xCA-0xCF to RESERVED as there are already response codes for NV RAM failures * Added 0x80 DIAGNOSTIC OUTPUT CHECK FAILED * Added 0x81 BACKGROUND IMPEDANCE CHECK FAILED * Added 0x82 BACKGROUND IMPEDANCE CHECK HARDWARE FAILURE * ADDED 0x83 BASIC OUTPUT CHECK FAILED * Added 0x84 STIMULATION FAILED – UKNOWN SOFTWARE ERROR * Added 0x85 STIMULATION FAILED – SEVERE ERROR EXISTS * Added log entries to specification to define logging codes * Removed references to requirements as traceability will not be necessary in this document | 1577 | 11/02/12 |
| 1.5 | * Added charging errors 0x08 CHARGING STATE ERROR and 0x09 CHARGING NOT ALLOWED. * Added back and reworded response code 0x55 CHARGING CONTROL ERROR | 1583 | 11/12/2012 |
| 1.6 | * Added new category 1 error – AE09 Critical NV Hardware Error. * Added new category 1 error – AE10: Pulse Cycle Check Error * Added new category 2 error – AE35: Output Current Error * Added new logging codes: 1006, 1024, 1025, 1053, 1054, 1055, 1072, 1083, 2033, 2034, 2300, 2301, 2302 * Added new charging error code – CE0A: Charging overvoltage error. | 1668 | 02/15/13 |
| 1.7 | * Deprecated AE08 – no longer used * Deprecated AE35 – no longer used * Added new response codes AE25 – AE 28 – Used for stimulation. * Deprecated RC30, RC80, RC85 – no longer user * Updated RC60 – Used for general data corruption * Added several log entries regarding MICS, Stimulation, and TETS * Added definition for POP * Removed duplicated entry for E126. | 1766 | 05/20/13 |
| 1.8 | * Added under temperature (112), abort (124), IPG charge error (123), and reserved no charge halt request (110) * Added additional logging enumeration types 1046, 1047, 2306, 2307, and 2500 * Fixed instance where IPG is referenced and changed these references to ‘stimulator’ * Corrected typo for active error 09 * Removed reference numbers for PPC thread active errors due to collisions with PPC-enumerated errors. * Removed background impedance hw check failure response code. * Added unknown sw error response code. * Reinstated response codes 0x25, 0x26, and 0x27. | 1919 | 09/10/13 |