# Purpose & Scope

This document defines the software requirements specifications for the Model 2408 and Model 2412 Implantable Pulse Generator (IPG) and Model 4300 Trial stimulator (EPG) medical devices.

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# References

|  |  |  |
| --- | --- | --- |
| **Ref**  **Number** | **Document ID** | **Document Name** |
| 1 | EESP 0071 | 24-Channel IPG Functional Specification |
| 2 | SWSP 0090 | Clinician Programmer Application Software Functional Spec. |
| 3 | SWEX 0097 | Clinician Programmer User Interface Design Document |
| 4 | SWSP 0103 | Patient Programmer Charger SRS |
| 5 | SWSP 0098 | Pocket Programmer SRS |
| 6 | SWEX 0079 | IPG/EPG Firmware Theory of Operation |
| 7 | SWEX 0084 | SCS System MICS Command Definitions |
| 8 | SWEX 0085 | SCS System MICS Commands Design Document |
| 9 | SWEX 0082 | SCS Patient Programmer Charger MICS Commands |
| 10 | SWEX 0083 | SCS Pocket Programmer MICS Commands |
| 11 | EESP 0091 | 25 Channel EPG Functional Specification |

# Definitions

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| **Acronym or Term** | **Definition** |
| ADC | Analog to Digital Converter |
| API | Application Programming Interface |
| ASIC | Application Specific Integrated Circuit |
| CBC | Charge Balance Correction |
| CP | Clinician Programmer |
| DAC | Digital-to-Analog Converter |
| EPG | External Pulse Generator |
| FIFO | First-In-First-Out buffer |
| IPG | Implantable Pulse Generator |
| ISR | Interrupt Service Routine |
| MDAC | Multiplying Digital-to-Analog Converter |
| MICS | Medical Implant Communication System |
| PoP | Pocket Programmer external device |
| PPC | Patient Programmer Charger external device |
| RTOS | Real Time Operating System |
| SPI | Serial Peripheral Interface bus |
| TETS | Transcutaneous Energy Transfer System |
| xPG | This refers to both the External Pulse Generator and the Implantable Pulse Generator |

# Software Requirements

## EPG Only Requirements

### Button Requirements

Area Path: SCSSystem\Software\EPG Only\Button

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| **ID** | **Title** |
| 979 | When the Quick Stop button is pressed and stimulation is active, the EPG shall stop stimulation. |

### LED Requirements

Area Path: SCSSystem\Software\EPG Only\LEDs

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| **ID** | **Title** |
| 988 | When the battery monitor is at or below the Battery Warning state, the power LED shall flash red at a frequency twice that of the Power Indication, with a duty cycle between 10% and 25%. |
| 989 | When the battery monitor is above the Battery Warning state, the power LED shall give a Power Indication by flashing green at 0.25 Hz or lower, with a duty cycle between 1% and 10%. |
| 990 | When the EPG is generating stimulation, the stimulation LED shall flash at a frequency of 0.25 Hz or lower, with a duty cycle between 1% and 10%. |

### EPG Only

Area Path: SCSSystem\Software\EPG Only

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| **ID** | **Title** |
| 1577 | When performing a Background Impedance Check, the EPG shall measure the impedance between the output channels used in the program. |

### EPG Impedance Requirements

Area Path: SCSSystem\Software\EPG Only\Impedance Measurement

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| **ID** | **Title** |
| 1903 | When a channel is flagged as open circuit, the EPG shall not allow the associated program to be started. |
| 1904 | The EPG shall perform a background impedance check before starting a program. |

## IPG Only Requirements

### Battery Charging Requirements

Area Path: SCSSystem\Software\IPG Only\Battery Charging

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| **ID** | **Title** |
| 521 | If the inductive link becomes disengaged at any point during the charging process, the software shall perform Stop Charging Processing within 5 seconds. |
| 522 | The software shall increment a counter when the hardware indicates that there is a transition from the Pre-Charge Phase to the Constant-Current Phase. |
| 523 | The software shall increment a counter when the hardware indicates that there is a transition from the Constant-Current Phase to the Constant-Voltage Phase. This condition indicates the end of charging. |
| 525 | During charging, the software shall verify that the temperature monitoring subsystem is working properly. If no error is detected, charging is allowed at the C/4 and C/8 rates. Otherwise charging is only allowed at C/8. |
| 527 | When the inductive link is initially detected, if the temperature is greater than or equal to Temperature Abort Threshold or less than or equal to Minimum Temperature Threshold , the software shall not start charging. |
| 532 | While charging in the Pre-Charge phase, the IPG shall sample the battery voltage every 5min ±30s. If the IPG does not detect a battery voltage increase of 25mV or more between samples, it shall perform Stop Charging Processing. |
| 533 | If the IPG is in the Pre-Charge phase for more than 60 minutes, the software shall perform Stop Charging Processing. |
| 534 | While in Constant-Current phase, the software shall sample the battery voltage every 5min ±30s. If the software does not detect a battery voltage increase of 8mV between at least 1 out of 12 samples, the software shall halt the charging process. |
| 535 | If the software detects that it has been in Constant-Current phase for more than 8 hours, the software shall perform Stop Charging Processing. |
| 665 | When the inductive link is initially detected, after the temperature diagnostic check, the IPG shall enable charging at the C/4 rate if allowed. Otherwise the IPG shall enable charging at the C/8 rate. |
| 666 | When the inductive link is engaged, the IPG shall sample the temperature at least every 5 seconds. |
| 668 | When the IPG temperature is initially detected to be greater than Temperature Critical Threshold, the software shall set the charging rate to C/8. |
| 670 | When the IPG temperature is greater than Temperature Abort Threshold, the software shall perform Stop Charging processing. |
| 671 | If the IPG is charging at the C/8 rate and the temperature is less than the Temperature Warning Threshold and the C/4 rate is allowed, then the software shall set the charge rate to C/4. |
| 672 | If the IPG hardware indicates that charging is Complete or indicates Constant-Voltage Phase, the software shall perform Stop Charging Processing. |
| 673 | When the software is performing Stop Charging Processing, the software shall disable the charge controller if it is enabled. |
| 674 | When the software is performing Stop Charging Processing, the software shall return data to the external charger indicating that charging is stopped and inductive power must be turned off. |
| 675 | When the inductive link is initially detected, if the temperature is greater than or equal to Temperature Abort Threshold or less than or equal to Minimum Temperature Threshold, the IPG shall report a Temperature Out Of Range error. |
| 807 | Initiating or re-engaging the inductive link shall cause the IPG to attempt to charge |
| 808 | The IPG shall verify that the temperature monitoring subsystem is working properly. If an error is detected, the IPG shall charge at a rate of C/8. |
| 809 | The IPG shall verify that the temperature monitoring subsystem is working properly. If an error is detected, the IPG shall report an error to the charger. |
| 810 | Charging counters shall accommodate values of at least 10,000 counts. |
| 1005 | The xPG shall check the Thermistor Calibration for corruption before using it. If the check fails, the xPG shall notify the external device. |
| 1006 | The xPG shall check the Thermistor Calibration for corruption before using it. If the check fails, the xPG shall log the error. |
| 1226 | Diagnostic data provided by the system shall include charging temperature data |
| 1651 | The Power ASIC manufacturing trims shall be checked before charging and if they do not match with factory programmed values, the trims will be restored. |
| 1905 | If the inductive link becomes disengaged for more than 10s, the IPG shall retry charging at C8. |
| 1906 | If the IPG is charging at C8, it will periodically attempt to charge at C4 if the temperature circuit check passes and the temperature is below critical. |

### Magnet Sensor Requirements

Area Path: SCSSystem\Software\IPG Only\Magnet Sensor

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| **ID** | **Title** |
| 543 | When a magnet is swiped (magnet detected as present, then not present), the magnetic sensor stop feature is enabled, and stimulation is active, the IPG shall stop stimulation. |
| 932 | When a magnet is swiped (magnet detected as present, then not present), the magnetic sensor stop feature is disabled, and stimulation is active, the IPG shall not stop stimulation. |
| 933 | When a magnet is swiped (magnet detected as present, then not present), the magnetic sensor stop feature is enabled, and stimulation is not active, the IPG shall start patient stimulation. |
| 934 | When a magnet is swiped (magnet detected as present, then not present), the magnetic sensor stop feature is disabled, and stimulation is not active, the IPG shall not start patient stimulation. |

### IPG Impedance Measurement Requirements

Area Path: SCSSystem\Software\IPG Only\Impedance Measurement

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| **ID** | **Title** |
| 624 | When a channel is flagged as open circuit, the IPG shall set every program that uses the affected channel as disabled. |
| 776 | When performing a Background Impedance Check, the IPG shall measure the impedance between the IPG's enclosure and each output channel. |

## IPG and EPG Requirements

### Battery Monitoring

Area Path: SCSSystem\Software\IPG and EPG Firmware\Battery Monitoring

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| **ID** | **Title** |
| 1013 | The xPG shall monitor the battery’s voltage. |
| 1015 | The Battery States shall be determined by comparing the current battery voltage against the threshold values found in the general calibration data. |
| 1016 | The General Calibration data will have two sets of threshold values. One set to use when Stimulation is on and the other set to use when Stimulation is off. |
| 1017 | The xPG shall stop any active Test Pulse Programs if the battery enters the “Battery Stim Cutoff” state. |
| 1019 | The xPG shall turn off Stimulation if the xPG is in Stimulation and the battery enters “Battery Stim Cutoff” state. |
| 1020 | The xPG shall enter Storage Mode if the battery voltage is at or is less than the Battery Cutoff Voltage. |
| 1021 | The xPG shall record the number of times that it enters Storage Mode as a result of the battery dropping below its Battery Cutoff Voltage. |
| 1022 | The xPG shall sample the battery’s voltage when it comes out of Storage Mode. |
| 1023 | The xPG shall sample the battery’s voltage at least once every 24 hours while the xPG is not Stimulating or Charging. |
| 1024 | The xPG shall sample the battery’s voltage at least once every 4 hours while the xPG is in Stimulation and the Battery State is either “Battery Full” or “Battery High”. |
| 1025 | The xPG shall sample the battery’s voltage at least once every 1 hour while the xPG is in Stimulation and the Battery State is either “Battery Low” or “Battery Warning”. |
| 1026 | The xPG shall sample the battery’s voltage at least once every 15 minutes while the xPG is in Stimulation and the Battery State is “Battery Critical”. |
| 1027 | The xPG shall sample the battery’s remaining capacity at least once every 5 minutes while the xPG is Charging. |
| 1028 | The xPG shall provide the most recently sampled Battery State on command from an external programming device. |
| 1029 | The xPG shall provide the present Battery Voltage Level on command from an external programming device. |
| 1031 | The xPG shall not move the Battery State to a higher state when the Charger is not engaged. |
| 1032 | The xPG shall not move the Battery State to a lower state when the Charger is engaged. |
| 1225 | Diagnostic data provided by the system shall include background battery monitor voltage data |

### Bootloader

Area Path: SCSSystem\Software\IPG and EPG Firmware\Bootloader

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| **ID** | **Title** |
| 922 | When a command to enter bootloader mode is received, if neither stimulation nor charging is active, the xPG shall enter Bootloader mode. |
| 923 | When the xPG is in Bootloader mode, MICS communications shall be enabled. |
| 931 | When the xPG is in Bootloader mode, if a command to rewrite the xPG applications firmware is received, the xPG shall rewrite the xPG applications firmware. |
| 1845 | When the xPG is powered up, it shall enter Bootloader Mode. |
| 1847 | When the xPG has been in Bootloader Mode for more than 10 (+/-5) seconds and is not communicating with an external device, the xPG shall perform the Application Integrity Check. |
| 1849 | When the xPG completes the Application Integrity Check in Bootloader Mode, and the integrity is verified, the xPG shall enter Idle Mode if the charger is not present. |
| 1850 | When the xPG completes the Application Integrity Check, and the Application Integrity Check fails, the xPG shall enter Shutdown Mode. |
| 1851 | When the xPG is in Bootloader Mode,and it receives a command to Stop Bootloader Mode from an external device, the xPG shall perform an Application Integrity Check. |
| 1852 | The the Application Integrity Check shall include a cyclical redundancy check of the application memory areas of the xPG. |

### Elective Replacement Indicator

Area Path: SCSSystem\Software\IPG and EPG Firmware\Elective Replacement Indicator

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| **ID** | **Title** |
| 935 | The Elective Replacement Indicator shall comprise an Implant Date. |
| 936 | The Elective Replacement Indicator shall comprise an Elective Replacement Interval. |
| 937 | When a command to store the Implant Date is received, the xPG shall set the Implant Date to that in the command. |
| 938 | When a command to store the Elective Replacement Interval is received, the xPG shall set the Elective Replacement Interval to that in the command. |
| 939 | When a command to retrieve the Elective Replacement Indicator is received, the xPG shall return the Implant Date and Elective Replacement Interval to the external device. |

### General Stimulation

Area Path: SCSSystem\Software\IPG and EPG Firmware\General Stimulation\\*

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| **ID** | **Title** |
| 542 | The xPG shall load the Stim ASIC manufacturing trim values into the Stim ASIC whenever powering up the Stim ASIC. |
| 556 | In pulses using active recovery, the recovery phase duration shall be the stimulation pulse width times the pulse recovery ratio, krec. |
| 557 | In pulses using active recovery, the recovery phase amplitude shall be the stimulation amplitude divided by the pulse recovery ratio, krec. |
| 558 | When using Automatic Waveform Adjustment, if using active recovery, the xPG shall use as the recovery ratio the largest enabled value of krec that permits all phases of the program to fit within the program period. |
| 597 | The xPG shall verify, either directly or indirectly, that the program cycle is of the correct duration. |
| 609 | Whenever the stimulation ASIC is powered up, the xPG shall monitor for a stimulation ASIC parity error. |
| 610 | When a stimulation ASIC parity error occurs, the xPG shall stop stimulation. |
| 611 | The xPG shall perform readback verification of all data written to the stimulation ASIC. |
| 612 | When readback verification of stimulation ASIC data fails, the xPG shall reset. |
| 617 | The xPG shall program the pulse guard to a duration longer than, but no more than 250 us longer than, the duration of the phase being guarded. |
| 625 | When using Automatic Waveform Adjustment, if using passive recovery, the xPG shall use one charge balance correction (CBC) phase per program, at the end of the program. |
| 626 | When using Automatic Waveform Adjustment, if using active recovery, the xPG shall use one charge balance correction (CBC) phase at the end of the program. |
| 637 | When performing stimulation, the xPG shall use the values of the Output Channel Calibration table to linearly interpolate the MDAC value required for the channel output current. |
| 652 | The high-voltage table shall comprise 64 elements, each element corresponding to one setting of the Stim ASIC boost converter DAC and containing the compliance voltage obtained for that setting. |
| 660 | When the pulse guard trips, the xPG shall stop execution of the program. |
| 677 | When a channel is flagged as open circuit, the xPG shall notify the external device. |
| 678 | When a channel is flagged as open circuit, the xPG shall log the condition. |
| 682 | When using Automatic Waveform Adjustment, all pulses in the program shall use the same charge recovery method. |
| 683 | When using Automatic Waveform Adjustment on a two-pulse program, passive recovery shall be used for frequencies less than or equal to 105 Hz and active recovery otherwise. |
| 684 | When using Automatic Waveform Adjustment on a three-pulse program, passive recovery shall be used for frequencies less than or equal to 75 Hz and active recovery otherwise. |
| 685 | When using Automatic Waveform Adjustment on a four-pulse program, passive recovery shall be used for frequencies less than or equal to 60 Hz and active recovery otherwise. |
| 693 | When using Automatic Waveform Adjustment on a one-pulse program, passive recovery shall be used for frequencies less than or equal to 175 Hz and active recovery otherwise. |
| 694 | When using Automatic Waveform Adjustment, if active recovery is used, all pulses in the program shall use the same recovery ratio, krec. |
| 695 | The xPG shall store a configurable 64-element Frequency Table. |
| 702 | When performing Compliance Voltage Calculation, the xPG shall apply the formula of EESP 0071 section "Compliance Voltage Calculation" to each pulse in the program, and take the largest calculated voltage as the program's compliance voltage setting. |
| 703 | When performing Compliance Voltage Calculation, if no entry in the high voltage lookup table is greater than the program compliance voltage, the xPG shall select the largest entry in the high voltage lookup table. |
| 704 | When performing Compliance Voltage Calculation, the xPG shall configure the high voltage power supply to use the equal or next higher entry in the high-voltage table. |
| 731 | On command from an external device, the xPG shall change the pulse constants to values set by the external device. |
| 732 | The pulse constants shall comprise a Passive Interphase Delay. |
| 734 | The pulse constants shall comprise a Passive Recovery Pulse Width. |
| 736 | The pulse constants shall comprise a Passive Charge Balance Correction Pulse Width. |
| 737 | The pulse constants shall comprise a Passive Charge Balance Correction Holdoff. |
| 738 | The pulse constants shall comprise an Active Interphase Delay. |
| 739 | The pulse constants shall comprise a set of Active Recovery Ratios. |
| 741 | The pulse constants shall comprise an Active Charge Balance Correction Pulse Width. |
| 743 | The configuration device parameters shall comprise a Stim Phase Pulse Width Step Size. |
| 744 | The pulse constants shall comprise a Stim Phase Power Supply Enable/Disable. |
| 746 | The pulse constants shall comprise an Increment Lockout Duration. |
| 747 | The configuration device parameters shall comprise an Amplitude Steps. |
| 770 | The xPG shall enable the pulse guard for every stimulation and recovery phase. |
| 772 | The current density limit table shall have one entry for each channel, giving the maximum current permitted on that channel. |
| 780 | The background impedance measurement parameters shall comprise the stimulation amplitude to be used for measurement. |
| 786 | During a Background Impedance Measurement, any channel that is measured as having an impedance above a threshold value shall be flagged as open circuit. |
| 787 | The background impedance measurement parameters shall allow the measurement to enabled and disabled via the MICS interface. |
| 789 | The background impedance measurement parameters shall be adjustable by an external command. |
| 803 | The output channel calibration table shall comprise four entries per channel for current-source calibration, which will be set at the factory to the MDAC value for +3.0, +6.0, +9.0, +15.0 mA output. |
| 804 | The output channel calibration table shall comprise four entries per channel for current-sink calibration, which will be set at the factory to the MDAC value for -3.0, -6.0, -9.0 and -15.0 mA output. |
| 813 | When a stimulation ASIC parity error occurs, the xPG shall log the error. |
| 815 | In pulses using active recovery, when krec = 5, channels outputting less than 50 µA in the stimulation phase shall output 0 µA in the recovery phase. |
| 816 | In pulses using active recovery, when krec = 4, channels outputting less than 40 µA in the stimulation phase shall output 0 µA in the recovery phase. |
| 817 | In pulses using active recovery, when krec = 3, channels outputting less than 30 µA in the stimulation phase shall output 0 µA in the recovery phase. |
| 820 | If the program cycle verification shows that the program cycle is not of the correct duration, the xPG shall log the error. |
| 821 | If the program cycle verification shows that the program cycle is not of the correct duration, the xPG shall notify the external device. |
| 822 | If the program cycle verification shows that the program cycle is not of the correct duration, the xPG shall stop stimulation at the end of the program cycle. |
| 901 | The Impedance Measurement On Demand parameters shall comprise the Impedance Measurement Amplitude. |
| 908 | When a command to perform Impedance Measurement On Demand is received, if the xPG is running stimulation, the xPG shall not perform impedance measurement and shall notify the external device. |
| 1060 | When readback verification of stimulation ASIC data fails, the xPG shall log the error. |
| 1506 | When performing a Background Impedance Check, the EPG shall measure the impedance between the the channels that are used by the program that is being started |

### MICS Communication

Area Path: SCSSystem\Software\IPG and EPG Firmware\MICS Communication

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| **ID** | **Title** |
| 547 | The xPG shall accept the Stim command, validate its parameters, change the stimulation state accordingly, and reply appropriately. |
| 550 | The xPG shall support the Get Patient Program Run Time command and return the requested patient program cumulative run time. |
| 551 | The xPG shall support the Set Patient Program Run-Time command and set the corresponding program cumulative run-time counter accordingly. |
| 553 | The xPG shall accept, validate, and respond appropriately to the Get Program Names command. |
| 563 | When a command to get the current pulse widths is received, the xPG shall respond with the pulse widths for the currently selected program. |
| 564 | The xPG shall accept, validate, and respond to the Decrease Pulse Width command. |
| 566 | The xPG shall accept, validate, and respond to the Increase Pulse Width command. |
| 568 | The xPG shall accept, validate, and respond to the Increment Program Amplitude command. |
| 569 | The xPG shall accept, validate, and respond to the Decrement Program Amplitude command. |
| 570 | The xPG shall accept, validate, and respond to the Set Pulse Amplitude command. |
| 571 | The xPG shall accept, validate, and respond to the Increment Pulse Amplitude command. |
| 572 | The xPG shall accept, validate, and respond to the Decrement Pulse Amplitude command. |
| 583 | The xPG shall accept, validate, and respond to the Get Program Frequency command. |
| 584 | The xPG shall accept, validate, and respond to the Set Program Frequency command. |
| 585 | The xPG shall accept, validate, and respond to the Increment Program Frequency command. |
| 586 | The xPG shall accept, validate, and respond to the Decrement Program Frequency command. |
| 591 | The xPG shall accept, validate, and respond to the Restore Program Defaults command. |
| 965 | The stimulation frequency shall remain within tolerance while MICS messages are being received by the xPG. |
| 966 | When a command to retune the MICS circuitry is received, the xPG shall retune accordingly. |
| 967 | Each xPG shall have a MICS address. |
| 968 | The xPG shall store pairings for 0 to 2 pocket programmers (PoP). |
| 969 | When the xPG receives a command from a Pocket Programmer (PoP) to which it is not paired, the xPG shall not process the command and shall notify the pocket programmer that it is not paired. |
| 970 | The xPG shall store pairings for 0 to 1 patient programmer/charger (PPC). |
| 971 | When the xPG receives a command from a Patient Programmer/Charger (PPC) to which it is not paired and it is not charging, the xPG shall not process the command and shall notify the PPC that it is not paired. |
| 972 | The xPG shall accept commands from any Clinician Programmer with the Algostim company identifier. |
| 973 | When a command to change the PoP or PPC pairings and configurations is received, the xPG shall change the pairings accordingly. |
| 991 | The xPG shall check its MICS Identity Information for corruption each time it is used to initialize the MICS communication driver. If the check fails, the xPG shall log the error. |
| 993 | The xPG shall check its PoP and PPC pairing information for data corruption before using it. If the check fails, the xPG shall log the error. |
| 994 | The xPG shall check Configurable Device Parameters for data corruption before use. If the check fails, the xPG shall cease to accept commands from patient programmers except while charging, and shall continue to accept commands from clinician programmers. |
| 1057 | When the xPG receives a command from a Pocket Programmer (PoP) to which it is not paired, the xPG shall reject the command. |
| 1058 | When the xPG receives a command from a Patient Programmer/Charger (PPC) to which it is not paired and is not charging, the xPG shall reject the command. |
| 1185 | The xPG shall not allow stimulation if a severe error has not been cleared. |
| 1604 | When the xPG receives a command from a Patient Programmer/Charger (PPC) to which it is not paired and it is charging, the xPG shall only respond if the command is allowed without pairing. |
| 1605 | The xPG shall accept, validate, and respond to the Set xPG Identity command. |
| 1606 | The xPG shall accept, validate, and respond to the Get xPG Identity command. |
| 1607 | The xPG shall reset the xPG if a command to reset the xPG is received and the system is not charging or stimulating. |
| 1608 | The xPG shall go into storage mode when a command to go into storage mode is received. |
| 1609 | The xPG shall accept, validate, and respond to a Get xPG Status command. |
| 1610 | The xPG shall implement data echo commands to test the ability to send and receive data and commands. |
| 1611 | The xPG shall accept, validate, and respond to Get Counters command. |
| 1612 | The xPG shall accept, validate, and respond to Set Counters command. |
| 1613 | The xPG shall implement a diagnostic command to measure the battery voltage on demand. |
| 1614 | The xPG shall implement a diagnostic command to retrieves the last measured battery voltage. |
| 1616 | The xPG shall implement a diagnostic command to retrieve that last measured background impedance check data. |
| 1617 | The xPG shall implement a diagnostic command to read memory to Flash, MICS Chip, FRAM, Power ASIC, and Stimulation ASIC. |
| 1618 | The xPG shall implement a diagnostic command to write memory to Flash, MICS Chip, FRAM, Power ASIC, and Stimulation ASIC. |
| 1619 | The xPG shall accept, validate, and respond to charging control commands. |
| 1620 | The xPG shall accept, validate, and respond to Impedance On Demand commands. |
| 1621 | The xPG shall accept, validate, and respond to Get Background Impedance settings. |
| 1622 | The xPG shall accept, validate, and respond to Set Background Impedance settings. |
| 1623 | The xPG shall accept, validate, and respond to Enter Test Stimulation Mode. |
| 1624 | The xPG shall accept, validate, and respond to Set Test Stimulation Parameter commands. |
| 1626 | The xPG shall accept, validate, and respond to Set Titration Stimulation Parameter commands. |
| 1627 | The xPG shall accept, validate, and respond to Stop Stimulation commands. |
| 1628 | The xPG shall accept, validate, and respond to Get POP Constants command. |
| 1629 | The xPG shall accept, validate, and respond to Get PPC Constants command. |
| 1630 | The xPG shall accept, validate, and respond to Get Program Constants command. |
| 1631 | The xPG shall accept, validate, and respond to Set Program Constants command. |
| 1632 | The xPG shall accept, validate, and respond to Get Pulse Constants command. |
| 1633 | The xPG shall accept, validate, and respond to Set Pulse Constants command. |
| 1634 | The xPG shall accept, validate, and respond to Get Ramp Time command. |
| 1635 | The xPG shall accept, validate, and respond to Set Ramp Time command. |
| 1636 | The xPG shall accept, validate, and respond to Get Lead Constants command. |
| 1637 | The xPG shall accept, validate, and respond to Set Lead Contants command. |
| 1638 | The xPG shall accept, validate, and respond to Get General Calibration command. |
| 1639 | The xPG shall accept, validate, and respond to Set General Calibration command. |
| 1640 | The xPG shall accept, validate, and respond to Get Trim List command. |
| 1641 | The xPG shall accept, validate, and respond to Set Trim List command. |
| 1642 | The xPG shall accept, validate, and respond to Get Stimulation High Voltage calibration command. |
| 1643 | The xPG shall accept, validate, and respond to Set Stimulation High Voltage calibration command. |
| 1644 | The xPG shall accept, validate, and respond to Get Channel Calibration command. |
| 1645 | The xPG shall accept, validate, and respond to Set Channel Calibration command. |
| 1646 | The xPG shall accept, validate, and respond to Get Clinicial Program Data command. |
| 1647 | The xPG shall accept, validate, and respond to Set Clinicial Program Data command. |
| 1648 | The xPG shall accept, validate, and respond to Get Log command. |
| 1649 | The xPG shall accept, validate, and respond to Get Log Range command |
| 1650 | The xPG shall accept, validate, and respond to Append Log command. |

### Patient Stimulation

Area Path: SCSSystem\Software\IPG and EPG Firmware\Patient Stimulation\\*

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| **ID** | **Title** |
| 544 | When stopping stimulation, the xPG shall power down the Stim ASIC. |
| 545 | When it receives a command to select a program and patient stimulation is not on, the xPG shall select that program to use the next time patient stimulation is started. |
| 549 | The xPG shall measure the cumulative run time of each patient program. |
| 552 | Each program definition shall comprise a program name. |
| 560 | During ramping, the xPG shall not allow the stimulation active settings to be changed, and shall instead notify the external device that requested such a change. |
| 565 | When a command to decrease pulse width is received and the decrease does not exceed the Pulse Width Lower Limit, the xPG shall decrease the pulse width to the calculated new value. |
| 567 | When a command to increase pulse width is received and the new pulse width is within all applicable limits, the xPG shall increase the pulse width of the pulse in the running program by the Pulse Width Step Size. |
| 574 | When a command to decrease pulse width is received, the xPG shall calculate the new pulse width based on the Pulse Width Step Size. |
| 577 | When a command to decrease pulse amplitude attempts to set the amplitude below the Amplitude Lower Limit, the xPG shall not change the amplitude and shall notify the external device. |
| 578 | When a command to increase pulse amplitude attempts to set the Amplitude Step Index above Amplitude Steps, the xPG shall not change the amplitude and shall report an error. |
| 581 | When a command to decrease pulse width is received, the xPG shall perform a Compliance Voltage Calculation. |
| 582 | When a command to decrease pulse width is received and the pulse width would go below the Pulse Width Lower Limit, the xPG shall not decrease the pulse width and shall report this condition to the external programmer. |
| 587 | When a command to decrease program frequency is received, the xPG shall decrease the frequency of the running program to the next lower entry in the frequency table that is enabled by the Valid Program Frequencies table. |
| 588 | When a command to increase program frequency is received, the xPG shall increase the frequency of the running program to the next higher entry in the frequency table that is enabled by the Valid Program Frequencies table. |
| 589 | When a command to decrease program frequency is received, the xPG shall perform Automatic Waveform Adjustment. |
| 590 | The Increment Rate Lockout time interval shall consist of a duration between 0 and 2 seconds |
| 592 | When a command to restore program defaults is received, the xPG shall set the amplitude, pulse width, and frequency of the corresponding program to the default values specified in the program definition. |
| 593 | When starting patient stimulation, the xPG shall use Automatic Waveform Adjustment. |
| 595 | Before starting patient stimulation, if the battery voltage is at or below the Minimum Safe Stimulation level, the xPG shall not start stimulation and shall notify the external device. |
| 599 | Before starting patient stimulation, the xPG shall verify the data integrity of the active stimulation settings for the selected program. If corruption is detected, the xPG shall not start stimulation and shall not permit the program to be restarted. |
| 600 | Before starting patient stimulation, the xPG shall check whether the stimulation parameters exceed the current density limits on any channel. If they do, the xPG shall not start stimulation and shall notify the external device. |
| 601 | When a command to increase pulse width is received, if any affected channel will then have a charge density above the programmed limit, the xPG shall not increase pulse width and shall notify the external device. |
| 602 | When a command to increase pulse amplitude is received, if any affected channel will then have a charge density above the programmed limit, the xPG shall not increase program amplitude and shall notify the external device. |
| 603 | When a command to increase pulse amplitude is received, if any affected channel would then have a current density above the programmed limit, the xPG shall not increase the amplitude and shall notify the external device. |
| 627 | When performing patient stimulation, when using passive recovery, the xPG shall use the Passive Interphase Delay as the interphase delay. |
| 629 | Before starting patient stimulation, if the selected program is not valid, the xPG shall not start stimulation and shall instead notify the external device. |
| 630 | Before starting patient stimulation, the xPG shall verify the data integrity of the program definition for the selected program. If corruption is detected, the xPG shall not start stimulation and shall notify the external device. |
| 634 | Before starting patient stimulation, the xPG shall check whether the stimulation parameters for the program exceed the charge density limits. If they do, the xPG shall not begin stimulation and shall notify the external device. |
| 635 | When starting patient stimulation, the xPG shall use the most-recently used stimulation parameters for the selected program. |
| 636 | When starting patient stimulation and saved active stimulation settings are not available, the xPG shall use the default settings from the program definition. |
| 638 | When stopping stimulation, the xPG shall stop stimulation after it reaches the end of the program cycle that is running. |
| 639 | When stopping Patient Stimulation, if Background Impedance Measurement is enabled, the xPG shall perform a Background Impedance Measurement. |
| 640 | When a command to increase program amplitude is received, the xPG shall increase the amplitude of all pulses in the program which have an Amplitude Step Index which will not exceed Amplitude Steps. |
| 641 | When a command to increase program amplitude is received and some, but not all, pulses cannot be increased because their Amplitude Step Index would exceed Amplitude Steps, the xPG shall report this to the programmer issuing the command. |
| 642 | When a command to decrease program amplitude is received, the xPG shall perform a Compliance Voltage Calculation. |
| 643 | When a command to increase program amplitude is received, the xPG shall perform a Compliance Voltage Calculation. |
| 644 | When a command to decrease pulse amplitude is received, the xPG shall perform a Compliance Voltage Calculation. |
| 645 | When a command to decrease program amplitude is received, the xPG shall respond to the command with an indication if any of the pulses in the program can not have decreased amplitude because they would be below the Amplitude Lower Limit. |
| 646 | When a command to decrease program amplitude is received, the xPG shall decrease the amplitude of all pulses in the program which will still be at or above the Amplitude Lower Limit, and shall not decrease the amplitude of those that would be below it. |
| 647 | When a command to increase program amplitude is received, if any affected channel would have a charge density above the programmed limit, the xPG shall not increase the program amplitude and shall notify the external device. |
| 648 | When a command to increase program amplitude is received, if any affected channel would then have a current density above the programmed limit, the xPG shall not increase the amplitude and shall notify the external device. |
| 649 | When a command to increase pulse width is received, if the resulting pulse width would be above the Pulse Width Upper Limit, the xPG shall not increase the pulse width, and shall instead report this condition to the programmer. |
| 650 | When a command to increase pulse width is received, the xPG shall perform a Compliance Voltage Calculation. |
| 653 | When a command to increase pulse amplitude is received and the new amplitude is within all applicable limits, the xPG shall increase the pulse amplitude accordingly. |
| 654 | When a command to increase program frequency is received, and there is no next higher entry in the frequency table that is enabled by the Valid Program Frequencies table, the xPG shall not increase the frequency and shall notify the external programmer. |
| 655 | When the program frequency is increased, the xPG shall perform a Compliance Voltage Calculation. |
| 656 | When a command to decrease program frequency is received, if there is no lower frequency in the frequency table, the xPG shall not decrease the frequency and shall instead notify the external programmer. |
| 657 | When a command to decrease program frequency is received, the xPG shall perform Compliance Voltage Calculation. |
| 658 | When a command to increase program frequency is received, if the frequency is changed, the xPG shall begin an Increment Rate Lockout time interval. |
| 659 | When a command to increase program frequency is received during an Increment Rate Lockout time interval, the xPG shall not increase program frequency, and shall instead notify the external device. |
| 676 | Before starting patient stimulation, if the selected program is not enabled, the xPG shall not start stimulation and shall instead notify the external device. |
| 687 | When performing patient stimulation, when using passive recovery, the xPG shall use the Passive Recovery Pulse Width as the recovery phase pulse width |
| 688 | When performing patient stimulation, when using passive recovery, the xPG shall use the Passive CBC Pulse Width as the duration of the charge balance correction (CBC) phase |
| 690 | When performing patient stimulation, when using active recovery, the xPG shall use the Active Interphase Delay as the interphase delay. |
| 691 | When performing patient stimulation, when using active recovery, the xPG shall use the Active CBC Pulse Width as the charge balance correction (CBC) phase duration. |
| 706 | Each patient program shall comprise of one to four pulses. |
| 707 | The xPG shall store 0 to 10 program definitions. |
| 708 | Each program definition shall comprise a Valid/Invalid indicator. |
| 709 | Each program definition shall comprise an Enabled/Disabled indicator. |
| 710 | Each program definition shall comprise an indication, for each entry in the frequency table, that indicate whether the frequency is permitted for the program. |
| 711 | Each program definition shall comprise a default frequency of the program. |
| 713 | When running a patient program with multiple pulses, the pulses shall be executed sequentially. |
| 715 | Each patient program shall be assigned a single frequency at any time. |
| 716 | All pulses in a patient program shall repeat at the program's frequency. |
| 717 | Each pulse definition shall comprise a Valid/Invalid indication. |
| 718 | Each pulse definition shall comprise a pulse name. |
| 719 | Each pulse definition shall comprise a Stimulus Amplitude Lower Limit |
| 720 | Each pulse definition shall comprise a Stimulus Amplitude Step Size. |
| 721 | Each pulse definition shall comprise a default Amplitude Step Index. |
| 723 | Each program definition shall comprise storage for pulse definitions. |
| 724 | Each pulse definition shall comprise a Pulse Width Lower Limit. |
| 725 | Each pulse definition shall comprise a Pulse Width Upper Limit. |
| 726 | Each pulse definition shall comprise a default Pulse Width. |
| 727 | Each pulse definition shall comprise a 26-entry array of signed amplitude percentages. |
| 728 | The magnitude of each entry in the amplitude percentage array shall be the percentage of the stimulation amplitude that will be allocated to the corresponding Stim ASIC output channel. |
| 729 | Channel numbers shall be mapped 1-to-1 and in sequence to the corresponding Stim ASIC output channels. |
| 733 | A positive entry in the amplitude percentage array shall indicate that the corresponding output channel shall source current. A negative entry shall indicate that the corresponding channel shall sink current. |
| 748 | Before starting patient stimulation, the xPG shall verify the data integrity of the pulse constants. If corruption is detected, the xPG shall not start stimulation and notify the external device. |
| 749 | Before starting patient stimulation, the xPG shall verify the data integrity of the current density limit table. If corruption is detected, the xPG shall not start stimulation and notify the external device. |
| 750 | Before starting patient stimulation, the xPG shall verify the data integrity of the master frequency table. If corruption is detected, the xPG shall not start stimulation and notify the external device. |
| 751 | Before starting patient stimulation, the xPG shall verify the data integrity of the channel calibration table. If corruption is detected, the xPG shall not start stimulation and notify the external device. |
| 752 | When starting patient stimulation, the xPG shall perform a Compliance Voltage Calculation. |
| 753 | When starting patient stimulation, as it starts stimulation, the xPG shall perform Ramping. |
| 754 | The Ramp Duration shall have a range from 0 to 8 seconds, in 1 second increments. |
| 755 | During ramping, if the Ramp Duration is non-zero, the xPG shall increase the stimulation amplitude from zero current to full amplitude in a linear fashion. |
| 756 | During ramping, if the Ramp Duration is non-zero, the ramp shall have at least one intermediate step between zero and full amplitude. |
| 757 | When a command to increase pulse amplitude is received, the xPG shall perform a Compliance Voltage Calculation. |
| 758 | During ramping, if the Ramp Duration is zero, the xPG shall jump directly from no output to full-amplitude output. |
| 760 | When a command to decrease pulse amplitude attempts to set the amplitude within the permissible range, the xPG shall change the pulse amplitude accordingly. |
| 761 | When a command to increase program frequency is received, the xPG shall perform Automatic Waveform Adjustment. |
| 762 | When a command to increase program frequency is received, if Automatic Waveform Adjustment determines that the new period would be too short for the program, the xPG shall not change the frequency and shall notify the external device. |
| 764 | When a command to increase program amplitude is received, if any pulse amplitude is changed, the xPG shall begin an Increment Rate Lockout time interval. |
| 765 | When a command to increase pulse amplitude is received, if the amplitude is changed, the xPG shall begin an Increment Rate Lockout time interval. |
| 766 | When a command to increase program amplitude is received during an Increment Rate Lockout time interval, the xPG shall not increase program amplitude, and shall instead notify the external device. |
| 767 | When a command to increase pulse amplitude is received during an Increment Rate Lockout time interval, the xPG shall not increase pulse amplitude, and shall instead notify the external device. |
| 768 | When a command to increase pulse width is received, if the pulse width is changed, the xPG shall begin an Increment Rate Lockout time interval. |
| 769 | When a command to increase pulse width is received during an Increment Rate Lockout time interval, the xPG shall not increase pulse width, and shall instead notify the external device. |
| 773 | Before starting patient stimulation, the xPG shall verify the data integrity of the charge density limit table. If corruption is detected, the xPG shall not start stimulation and shall notify the external device. |
| 806 | When it receives a command to select a program and patient stimulation is on, the xPG shall notify the external device that this command cannot be executed. |
| 1037 | When a command to increase pulse width is received, the xPG shall perform Automatic Waveform Adjustment. |
| 1038 | When a command to decrease pulse width is received, the xPG shall perform Automatic Waveform Adjustment. |
| 1039 | Before starting patient stimulation, if the stimulation parameters exceed 15 mA on any channel, the xPG shall not start stimulation and shall notify the external device. |
| 1040 | Before starting patient stimulation, if the sum of all channel amplitudes exceeds 30 mA, the xPG shall not start stimulation and shall notify the external device. |
| 1041 | When a command to increase program amplitude is received, if any affected channel would then have a current above 15 mA, the xPG shall not increase the amplitude and shall notify the external device. |
| 1042 | When a command to increase program amplitude is received, if the sum of all channel amplitudes is above 30 mA, the xPG shall not increase the amplitude and shall notify the external device. |
| 1043 | When a command to increase pulse amplitude is received, if any affected channel would then have a current above 15 mA, the xPG shall not increase the amplitude and shall notify the external device. |
| 1044 | When a command to increase pulse amplitude attempts to set the pulse amplitude above 30 mA, the xPG shall not change the amplitude and shall report an error. |
| 1045 | When a command to increase program amplitude is received and no pulses can be increased because their Amplitude Step Index would exceed Amplitude Steps, the xPG shall not increase the program amplitude and shall notify the external device. |
| 1056 | When a command to decrease program frequency is received, if there is no lower frequency enabled in the Valid Program Frequencies table, the xPG shall not decrease the frequency and shall instead notify the external programmer. |
| 1230 | The xPG shall persist active program settings across resets and power cycles. |
| 1231 | The xPG shall reset a program's active settings to the default values when the program is saved. |

### Self-Test

Area Path: SCSSystem\Software\IPG and EPG Firmware\Self-test\\*

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| **ID** | **Title** |
| 944 | When starting stimulation, the xPG shall verify, either directly or indirectly, that the pulse guard is functioning correctly. |
| 961 | If a problem with the pulse guard is detected, the xPG shall log the error. |
| 962 | If a problem with the pulse guard is detected, the xPG shall notify an external device. |
| 963 | If a problem with the pulse guard is detected, the xPG shall not start stimulation. |
| 995 | The xPG shall check the Output Channel Calibration for corruption before using it. If the check fails, the xPG shall disable stimulation. |
| 996 | The xPG shall check the Output Channel Calibration for corruption before using it. If the check fails, the xPG shall notify the external device. |
| 997 | The xPG shall check the Output Channel Calibration for corruption before using it. If the check fails, the xPG shall log the error. |
| 998 | The xPG shall check the High-Voltage Supply Calibration for corruption before using it. If the check fails, the xPG shall disable stimulation. |
| 999 | The xPG shall check the High-Voltage Supply Calibration for corruption before using it. If the check fails, the xPG shall notify the external device. |
| 1000 | The xPG shall check the High-Voltage Supply Calibration for corruption before using it. If the check fails, the xPG shall log the error. |
| 1001 | The xPG shall check the Battery Monitor Calibration for corruption before using it. If the check fails, the xPG shall disable stimulation. |
| 1002 | The xPG shall check the Battery Monitor Calibration for corruption before using it. If the check fails, the xPG shall notify the external device. |
| 1003 | The xPG shall check the Battery Monitor Calibration for corruption before using it. If the check fails, the xPG shall log the error. |
| 1007 | When performing a Temperature Measurement Verification, the IPG shall verify the expected voltage across each component in the thermistor circuit. If any are out of range, the IPG shall log the error. |
| 1008 | When performing a Temperature Measurement Verification, the IPG shall verify the expected voltage across each component in the thermistor circuit. If any are out of range, the IPG shall notify the external device. |
| 1014 | The xPG shall maintain a Battery State based on the battery’s voltage. |

### Storage Mode

Area Path: SCSSystem\Software\IPG and EPG Firmware\Storage Mode

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| **ID** | **Title** |
| 984 | When a command to enter storage mode is received, the xPG shall enter Storage Mode. |
| 985 | The xPG shall count the number of times it has exited Storage Mode. |

### Test Stimulation

Area Path: SCSSystem\Software\IPG and EPG Firmware\Test Stimulation

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| **ID** | **Title** |
| 838 | Each Test Pulse Definition shall comprise a CBC Pulse Width. |
| 839 | Each Test Pulse Definition shall comprise a Passive Recovery Pulse Width. |
| 840 | Each Test Pulse Definition shall comprise a Recovery Ratio. |
| 842 | Each Test Pulse Definition shall comprise an Interphase Delay. |
| 844 | Each Test Pulse Definition shall comprise a Stimulus Phase Pulse Width. |
| 845 | Each Test Pulse Definition shall comprise 26 Channel Amplitude Percentages, each corresponding to a channel on the Stim ASIC. |
| 846 | Each Test Pulse Definition shall comprise a Test Pulse Amplitude. |
| 847 | Each Test Program Definition shall comprise a Test Pulse Sequence consisting of 0 to 4 Test Pulses. |
| 848 | Each Test Program Definition shall comprise a Frequency Index. |
| 850 | Each Test Program Definition shall comprise a Compliance Voltage Value. |
| 854 | Before beginning test stimulation, if the battery level is at or below the Minimum Safe Stimulation level, the xPG shall not start stimulation and shall notify the external device. |
| 856 | Before starting test stimulation, if any of the test pulses about to be run exceed the current density limit, the xPG shall not start stimulation, and shall notify the external device. |
| 857 | When starting test stimulation, if the charge density, current density, battery level checks permit stimulation to be started, and the stimulation ASIC is powered up, the xPG shall Initiate (start stimulation) test stimulation. |
| 858 | When initiating a change to test stimulation program, if the xPG is actively running test stimulation, the xPG shall wait until the stimulation cycle is complete then immediately switch to the new test program. |
| 859 | When Initiating (starting stimulation) a test stimulation, if the xPG is not actively running test program and the stimulation ASIC is powered up, the xPG shall immediately start the new test program without ramping. |
| 860 | The xPG shall Terminate (stop stimulation, but leave the stimulation ASIC powered up) test stimulation when a command to stop stimulation is received. |
| 861 | The xPG shall Terminate (stop stimulation) and Disable (power down stimulation ASIC) if the battery monitor level fall below the the Minimum Safe Stimulation Level. |
| 862 | The xPG shall terminate (stop stimulation) and Disable (power down stimulation ASIC) test stimulation if the MICS communication session is lost. |
| 863 | When Terminating (stopping stimulation, but leaving the stimulation ASIC powered up) test stimulation, the xPG shall wait until the current stimulation cycle is complete, then stop the test program. |
| 864 | When a command to Enable (ensure stimulation ASIC is powered up and initialized) test stimulation is received, and the xPG is not performing other stimulation-related functions, the xPG shall Enable test stimulation. |
| 865 | When test stimulation is Enabled, if test stimulation is Disabled (the stimulation ASIC is powered down and stimulation is not on), the xPG shall power up and initialize the stim ASIC. |
| 866 | When a command to Disable (power down stimulation ASIC) test stimulation is received, and test stimulation is Enabled (stimulation ASIC powered up, but not stimulating), the xPG shall Disable test stimulation. |
| 867 | When test stimulation is Disabled, if test stimulation is Enabled (the stimulation ASIC is powered up and stimulation is not on), the xPG shall power down the stim ASIC. |
| 870 | The xPG shall Terminate (stop stimulation) and Disable (power down stimulation) when a command to Disable test stimulation is received while stimulating. |
| 881 | Each Test Pulse Definition shall comprise an Active/Passive Recovery Selection. |
| 886 | When running a test program, the xPG shall emit each test pulse in the program in sequence. |
| 889 | When running a test program, the xPG shall use the test program's Frequency Index to determine the frequency of the program. |
| 1096 | When the xPG exits Test Mode, any test pulse definitions shall be removed. |
| 1097 | Test stimulation may be terminated (stop stimulation, but leave stimulation ASIC powered up) by setting the number of pulses to zero. |

### Titration Stimulation

Area Path: SCSSystem\Software\IPG and EPG Firmware\Titration Stimulation

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| **ID** | **Title** |
| 1101 | When a command to Enable titration stimulation is received, and the xPG is not performing other stimulation-related functions, the xPG shall Enable titration stimulation. |
| 1102 | When titration stimulation is Enabled, the xPG shall power up and initialize the stim ASIC. |
| 1103 | When a command to Disable titration stimulation is received, and titration stimulation is Enabled, the xPG shall Disable titration stimulation. |
| 1104 | When titration stimulation is Disabled, the xPG shall power down the stim ASIC. |
| 1105 | Each titration program shall comprise a pulse sequence consisting of 0 to 4 titration Pulses. |
| 1106 | Each titration program shall comprise a Frequency index. |
| 1108 | When the xPG exits Titration Mode, any Titration pulse definitions shall be removed. |
| 1109 | Each titration pulse definition shall comprise a stimulation phase pulse width |
| 1110 | Each titration pulse definition shall have 26 channel amplitude percentages, each corresponding to a channel on the stim ASIC. |
| 1111 | Each Titration Pulse Definition shall comprise a pulse amplitude. |
| 1112 | Before beginning titration stimulation, if the battery level is at or below the minimum safe stimulation level, the xPG shall not start stimulation but shall notify the external device. |
| 1113 | Before starting titration stimulation, if any of the pulses about to be run exceed the charge density limit, the xPG shall not start stimulation, but shall notify the external device. |
| 1114 | Before starting titration stimulation, if any of the pulses about to be run exceed the current density limit, the xPG shall not start stimulation, but shall notify the external device. |
| 1115 | When starting titration stimulation, if the charge density, current density, and battery level checks permit stimulation to be started, the xPG shall initiate titration stimulation. |
| 1116 | When initiating a change to titration stimulation program the update shall take effect at the end of the current program cycle. |
| 1118 | The xPG shall Terminate titration stimulation when a command to stop titration is received. |
| 1119 | The xPG shall Terminate titration stimulation if the battery monitor detectes a battery level below the Minimum Safe Stimulation level. |
| 1120 | The xPG shall Terminate titration stimulation if the MICS communications session is lost. |
| 1121 | When terminating titration stimulation, the xPG shall wait until the current stimulation cycle is complete, then stop the test pulse or test program. |
| 1122 | The xPG shall Disable titration stimulation if the battery monitor detectes a battery level below the Minimum Safe Stimulation level |
| 1123 | The xPG shall disable titration stimulation if the MICS communications session is lost. |
| 1124 | The xPG shall terminate titration stimulation when a command to disable titration stimulation is received while stimulating. |
| 1125 | Titration stimulation may be terminated by setting the number of pulse to zero. |
| 1127 | Automatic waveform adjustment shall be used for titration program stimulations. |
| 1170 | When running a titration program, the xPG shall emit each titration pulse in the program in sequence. |
| 1187 | When performing titration stimulation, when using passive recovery, the xPG shall use the Passive Interphase Delay as the interphase delay. |
| 1189 | When performing titration stimulation, when using passive recovery, the xPG shall use the Passive CBC Pulse Width as the duration of the charge balance correction (CBC) phase |
| 1190 | When performing titration stimulation, when using active recovery, the xPG shall use the Active Interphase Delay as the interphase delay. |
| 1191 | When performing titration stimulation, when using active recovery, the xPG shall use the Active CBC Pulse Width as the charge balance correction (CBC) phase duration. |

### Watchdog

Area Path: SCSSystem\Software\IPG and EPG Firmware\Watchdog

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| **ID** | **Title** |
| 915 | The xPG shall use internal watchdog hardware to detect abnormal program execution during stimulation. |
| 916 | The IPG shall use internal watchdog hardware to detect abnormal program execution during charging. |
| 917 | When a reset occurs due to the watchdog, the xPG shall stop stimulation. |
| 918 | When a reset occurs due to the watchdog, the xPG shall restart stimulation without receipt of a command to start stimulation from an external device. |
| 919 | When a reset occurs due to the watchdog, the xPG shall log that an unintended reset has occured. |
| 920 | When a reset occurs due to the watchdog, the xPG shall log that a watchdog error has occured. |
| 921 | When a reset occurs due to the watchdog, the xPG shall stop stimulation. |

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# Revision History

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| --- | --- | --- | --- |
| **Revision Level** | **Revision Description** | **ECN**  **No#** | **Effective**  **Date** |
| 1.1 | Initial Release of Document | 1504 | 07/31/12 |
| 1.2 | Updated after internal reviews. The following changes have been made:   * Eliminate Requirement 579, 580, 594, 598, 631, 824, 825, 826, 827, 828, 829, 942, 945, 946, 947, 948, 949, 981, 992 – Abandoned, Rejected, or Duplicates * Eliminated Requirements 783, 784, 785, 788, 794, 795, 796, 1074 – Manufacturing Requirements * Added requirement 700, 778, 1061-1077, 1223, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1269 * Reword for clarification requirements 543, 569, 614, 624, 639, 810, 862, 863, 864, 865, 866, 867, 870, 881, 889, 921, 932, 933, 934, 944, 955, 956, 957, 1096, 1097,1185 | 1614 | 01/08/13 |
| 1.3 | * Added requirement 1506 for EPG impedance check * Remove requirement 1269 | 1678 | 02/25/13 |

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| 1.4 | * Reword for clarification requirements: 614, 615, 616, 706, 714, 735, 737, 740, 742, 745, 799, 801, 806, 921, 926, 963, 971, 973, 994, 1040, 1042, 1058, * Eliminated the following requirements due to obsolescence: 546, 573, 576, 604, 618, 619, 620, 628, 661, 686, 689, 692, 701, 775, 778, 791, 792, 793, 799, 855, 903, 904, 905, 907, 912, 929, 943, 953, 954, 958, 959, 960, 974, 975, 1188, 1227 * Added the following requirements: 1604, 1605-1650, 1651 * Removed reference to TETS Specification | 1764 | 05/09/13 |
| 1.5 | * Two charging related requirements below were added (1905, 1906) * Several impedance measurement requirements were eliminated due to obsolescence: 1061, 781, 782, 902, 906, 909, 911, 913 * Two new area paths were created to allow special handling of IPG vs. EPG impedance measurements.  These are ../IPG Only/Impedance Measurement and ../EPG Only/Impedance Measurement * Two new impedance related requirements were created (1903, 1904) * Removed Output Capacitor Check requirements due to obsolescence: 621, 622, 679, 680, 790, 1062, 1223, 1578, 1615 * Removed Brownout detection, 605,606,607,608 | 1928 | 09/23/13 |

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| 1.6 | * Eliminated the following requirements due to obsolescence: 667, 538, 1117, 940, 941, 950, 951, 952, 1229, 955, 956, 957, 608, 596, 613, 628, 823, 662, 798, 800, 801, 814, 605, 606, 607, 924, 927, 548, 561, 811 * Reworded for clarification of requirements: 532, 534, 807, 527, 675, 917, 918, 921, 1127, 590, 815, 816, 597, 612, 626, 1852, 1015, 1016, 527, 743, 747, 1057, 1058, 1121 | 2032 | 11/01/13 |
| 1.7 | * Updated requirement 534 to be consistent with upstream documents | 2082 | 11/20/13 |