# APPLICATION SPECIFIC STANDARD PRODUCT (ASSP)

## Cirtec Neurostimulator ICs

| PART # | CSI020 | CSI021 | CSI040 | Saturn1 | Saturn2 |
|---|---|---|---|---|---|
| **CHANNEL SPECIFICATIONS** | | | | | |
| Number of independent channel outputs | 32[1] | 4 | 16 | 26[2] | 26[2] |
| Maximum single channel output current (mA) | 12.7 | 6.12 | 25.4 | 15 | 15 |
| Current amplitude resolution (µA) | 100 | 3 | 25 | 15 | 15 |
| Maximum compliance voltage (V) | 18 | 18 | 18 | 18 | 23[3] |
| Typical electrode series capacitance (µF) | 0.1 – 1.0 | 0.1 – 1.0 | 0.1 – 1.0 | 0.1 – 1.0 | 0.1 – 1.0 |
| Current digital-to-analog converter resolution (bits) | 7 | 8 | 7 | 18[4] | 18[4] |
| **PULSE CAPABILITIES[5]** | | | | | |
| Nominal system clock (kHz) | 100 | 100 | 100 | 1000 | 1000 |
| Maximum pulse frequency (kHz) | 14.25 | 12.5 | 50 | 50 | 50 |
| Pulse width range (µs) | 20 – 1000 | 10 – 2550 | 2.5 – 1280 | 1 – 1500 | 1 – 1500 |
| Pulse width resolution (µs) | 10 | 10 | 2.5 | 1.0 | 1.0 |
| Inter-phase delay between sink pulse and source pulse (µs) | 20 – 65500 | 10 – 2550 | 2.5 – 1280 | 1 – 65535 | 1 – 65535 |
| Inter-pulse between sink/source periods (ms) | 0.02 – 655 | 0.01 – 20.4 | 0.0025 – 6400 | 2 – 131070 | 2 – 131070 |
| Current sink to source amplitude ratio | 1:8 – 8:1 | 4:1 | 1:1 – 8:1 | Unrestricted | Unrestricted |
| Integrated clock | Yes | No | No | Yes | Yes |
| Integrated channel arbitration | Yes | No | No | No | No |
| Arbirary waveform capability | No | No | No | Yes | Yes |
| Active charge balancing | Yes | Yes | Yes | Yes | Yes |
| Passive charge balancing | Yes | Yes | Yes | Yes | Yes |
| Charge balance correction | No | No | No | Yes | Yes |
| **THERAPY CAPABILITIES** | | | | | |
| Stimulation type | Bipolar | Monopolar | Monopolar or Bipolar | Monopolar or Bipolar | Monopolar or Bipolar |
| Integrated therapy control | Yes | Yes | Yes | Yes | Yes |
| Fully independent pulse timing | No | Yes | Yes | Yes | Yes |
| Burst stimulation | Yes | No | Yes | Yes | Yes |
| DC stimulation | No | No | Yes | Yes | Yes |
| Pulse skipping | No | No | Yes | Yes | Yes |
| Amplitude ramping – increasing | No | Yes | Yes | No | Yes |
| Amplitude ramping – decreasing | No | No | Yes | No | Yes |
| **POWER, CONTROL, SIZE** | | | | | |
| Minimum supply operating voltage (V) | 3.5 | 2.4 | 2.4 | 2.4 | 2.4 |
| HV boost voltage (V) | External | External | External | 4 – 24 | 4 – 24 |
| Sleep mode current consumption (µA) | 15 | < 1 | < 1 | < 2 | <2 |
| Dynamic current consumption (µA)[6] | 40 | 150 | 600 | 500 | 100 |
| Integrated battery charge controller | Yes | No | No | No | No |
| Multiple IC synchronization | No | Yes | No | No | No |
| SPI frequency (MHz) | 1 | 1 | 1 | 8 | 8 |
| Package (mm) | QFN72 (10x10) | QFN20 (4x4) | QFN72 (10x10) | TQFN100 (11.5x11.5) | |
| **DEVELOPMENT SUPPORT** | | | | | |
| Evaluation Kit Available | No | Yes | Yes | No | No |
| Complete IPG Available | Yes | No | No | Yes | No |

[1]Safety arbitration prevents channel overlapping
[2]Includes 2 "Enclosure" Channels
[3]Programmable from 4V to 23V
[4]Waveform DAC (8b) into Multiplier DAC (10b)
[5]Timing Parameters are based on Nominal clock and can be scaled
[6]Excluding HV supply currents

# APPLICATION SPECIFIC STANDARD PRODUCT (ASSP) (CONT.)

## Cirtec Neural Sensing IC

| CHANNEL SPECIFICATIONS | CSI080 |
|---|---|
| Number of independent electrode inputs | 8 |
| Number of independent differential channels | 4 |
| Analog Input Dynamic Range (mV) | +/-2 |
| Analog Input Referred Noise (nVrms) | 300 |
| Analog Input Impedance (M$\Omega$) | 3 |
| Analog Signal Gain (V/V) | 100 – 400 |
| Analog Signal Bandwidth (Hz) | 400 |
| High-Pass Filter Corner (Hz) | 3 – 30 |
| ADC Sample Rate (sps) | 500 – 2000 |
| ADC Resolution (bits) | 16 |
| ADC Integral Non-Linearity (bits) | 5 |
| ADC Differential Non-Linearity (bits) | +/-0.5 |
| Common Mode Rejection (dB) | 70 |
| Power Supply Rejection (dB) | 100 |
| **POWER, CONTROL, SIZE** | |
| Analog supply operating voltage (V) | 1.7 – 1.9 |
| Digital supply operating voltage (V) | 1.7 – 1.10 |
| Dynamic current consumption (µA) | 900 |
| Real-Time Stimulation Blanking | Yes |
| Blanking Fast-Recovery | Yes |
| SPI frequency (MHz) | 1 |
| Package (mm) | QFN40 (5x5) |
| **DEVELOPMENT SUPPORT** | |
| Evaluation Kit Available | TBD |
| Complete IPG Available | No |

## Cirtec Power Management IC

| POWER MANAGEMENT FEATURES | Pluto |
|---|---|
| Battery supply voltage (V) | 1.9 – 4.2 |
| Primary battery protection | Yes |
| Battery recharge | Yes |
| Recharge output voltage (V) | 4.7 – 5.5 |
| Recharge fuel gauge | Yes |
| Rechargeable battery protection | Yes |
| Wireless power interface | Yes |
| Maximum wireless input voltage (V) | 13.2 |
| Voltage converter type | Buck/Boost |
| Converter output voltage (V) | 2.65 – 2.85 |
| Converter efficiency (typical) | 88% |
| Regulated digital supply outputs | 5 |
| Digital supply voltage | 2.4 – 2.6 |
| Regulated analog supply outputs | 1 |
| Analog supply voltage | 2.4 – 2.6 |
| Brownout Detector | Yes |
| **SUPPORT FEATURES** | |
| Wireless communication monitor | Yes |
| Wireless monitor type | ASK |
| Thermistor interface | Yes |
| Magnetic switch interface | Yes |
| MCU interface | SPI |
| SPI frequency (MHz) | 5 |
| **PACKAGING** | |
| Package (mm) | QFN68 (8x8) |