| HiperLCS_042413; Rev.1.3; Copyright Power Integrations 2013 | INPUTS | INFO | OUTPUTS | UNITS | HiperLCS_042413_Rev1-3.xls; HiperLCS Half-Bridge, Continuous mode LLC Resonant Converter Design Spreadsheet |
|---|---|---|---|---|---|
| **Enter Input Parameters** | | | | | Design Title |
| Vbulk_nom | 220 | | 220 | V | Nominal LLC input voltage |
| Vbrownout | | | 162 | V | Brownout threshold voltage. HiperLCS will shut down if voltage drops below this value. Allowable value is between 65% and 76% of Vbulk_nom. Set to 65% for max holdup time |
| Vbrownin | | | 204 | V | Startup threshold on bulk capacitor |
| VOV_shut | | | 269 | V | OV protection on bulk voltage |
| VOV_restart | | | 259 | V | Restart voltage after OV protection. |
| CBULK | 280.00 | Warning | 280 | uF | !!! Warning. CBULK is too small. Recommended value should be greater than 0.7 uF/W |
| tHOLDUP | | | 16.0 | ms | Bulk capacitor hold up time |
| | | | | | |
| | | | | | |
| **Enter LLC (secondary) outputs** | | | | | **The spreadsheet assumes AC stacking of the secondaries** |
| VO1 | 18.00 | | 18.0 | V | Main Output Voltage. Spreadsheet assumes that this is the regulated output |
| IO1 | 10.00 | | 10.0 | A | Main output maximum current |
| VD1 | | | 0.50 | V | Forward voltage of diode in Main output |
| PO1 | | | 180 | W | Output Power from first LLC output |
| VO2 | 5.00 | | 5.0 | V | Second Output Voltage |
| IO2 | 0.50 | | 0.5 | A | Second output current |
| VD2 | | | 0.70 | V | Forward voltage of diode used in second output |
| PO2 | | | 2.50 | W | Output Power from second LLC output |
| P_LLC | | | 183 | W | Specified LLC output power |
| | | | | | |
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| | | | | | |
| **LCS Device Selection** | | | | | |
| Device | **LCS705** | Warning | **LCS705** | | !!! Warning. Device may be too large. Select smaller device |
| RDS-ON (MAX) | | | 0.74 | ohms | RDS-ON (max) of selected device |
| Coss | | | 468 | pF | Equivalent Coss of selected device |
| Cpri | | | 40 | pF | Stray Capacitance at transformer primary |
| Pcond_loss | | | 3.5 | W | Conduction loss at nominal line and full load |
| Tmax-hs | | | 90 | deg C | Maximum heatsink temperature |
| Theta J-HS | | | 8.4 | deg C/W | Thermal resistance junction to heatsink (with grease and no insulator) |
| Expected Junction temperature | | | 119 | deg C | Expectd Junction temperature |
| Ta max | 80.00 | | 80 | deg C | Expected max ambient temperature |
| Theta HS-A | | | 3 | deg C/W | Required thermal resistance heatsink to ambient |
| | | | | | |
| | | | | | |
| **LLC Resonant Parameter and Transformer Calculations (generates red curve)** | | | | | |
| Vres_target | 220.00 | | 220 | V | Desired Input voltage at which power train operates at resonance. If greater than Vbulk_nom, LLC operates below resonance at VBULK. |
| Po | | | 188 | W | LLC output power including diode loss |
| Vo | | | 18.50 | V | Main Output voltage (includes diode drop) for calculating Nsec and turns ratio |
| f_target | 100.00 | | 100 | kHz | Desired switching frequency at Vbulk_nom. 66 kHz to 300 kHz, recommended 180-250 kHz |
| Lpar | | | 183 | uH | Parallel inductance. (Lpar = Lopen - Lres for integrated transformer; Lpar = Lmag for non-integrated low-leakage transformer) |
| Lpri | 250.00 | | 250 | uH | Primary open circuit inductance for integrated transformer; for low-leakage transformer it is sum of primary inductance and series inductor. If left blank, auto-calculation shows value necessary for slight loss of ZVS at ~80% of Vnom |
| Lres | 67.00 | | 67.0 | uH | Series inductance or primary leakage inductance of integrated transformer; if left blank auto-calculation is for K=4 |
| Kratio | | | 2.7 | | Ratio of Lpar to Lres. Maintain value of K such that 2.1 < K < 11. Preferred Lres is such that K<7. |
| Cres | 33.00 | | 33.0 | nF | Series resonant capacitor. Red background cells produce red graph. If Lpar, Lres, Cres, and n_RATIO_red_graph are left blank, they will be auto-calculated |
| Lsec | | | 5.407 | uH | Secondary side inductance of one phase of main output; measure and enter value, or adjust value until f_predicted matches what is measured ; |
| m | | | 50 | % | Leakage distribution factor (primary to secondary). >50% signifies most of the leakage is in primary side. Gap physically under secondary yields >50%, requiring fewer primary turns. |
| n_eq | | | 5.82 | | Turns ratio of LLC equivalent circuit ideal transformer |
| Npri | 34.0 | | 34.0 | | Primary number of turns; if input is blank, default value is auto-calculation so that f_predicted = f_target and m=50% |
| Nsec | 5.0 | | 5.0 | | Secondary number of turns (each phase of Main output). Default value is estimate to maintain BAC<=200 mT, using selected core (below) |
| f_predicted | | | 107 | kHz | Expected frequency at nominal input voltage and full load; Heavily influenced by n_eq and primary turns |
| f_res | | | 107 | kHz | Series resonant frequency (defined by series inductance Lres and C) |
| f_brownout | | | 82 | kHz | Expected switching frequency at Vbrownout, full load. Set HiperLCS minimum frequency to this value. |
| f_par | | | 55 | kHz | Parallel resonant frequency (defined by Lpar + Lres and C) |
| f_inversion | | | 81 | kHz | LLC full load gain inversion frequency. Operation below this frequency results in operation in gain inversion region. |
| Vinversion | | | 158 | V | LLC full load gain inversion point input voltage |
| Vres_expected | | | 215 | V | Expected value of input voltage at which LLC operates at resonance. |
| | | | | | |
| **RMS Currents and Voltages** | | | | | |
| IRMS_LLC_Primary | | | 2.17 | A | Primary winding RMS current at full load, Vbulk_nom and f_predicted |
| Winding 1 (Lower secondary Voltage) RMS current | | | 8.2 | A | Winding 1 (Lower secondary Voltage) RMS current |
| Lower Secondary Voltage Capacitor RMS current | | | 4.6 | A | Lower Secondary Voltage Capacitor RMS current |
| Winding 2 (Higher secondary Voltage) RMS current | | | 0.4 | A | Winding 2 (Higher secondary Voltage) RMS current |
| Higher Secondary Voltage Capacitor RMS current | | | 0.2 | A | Higher Secondary Voltage Capacitor RMS current |
| Cres_Vrms | | | 98 | V | Resonant capacitor AC RMS Voltage at full load and nominal input voltage |
| | | | | | |
| | | | | | |
| **Virtual Transformer Trial - (generates blue curve)** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| New primary turns | | | 34.0 | | Trial transformer primary turns; default value is from resonant section |
| New secondary turns | | | 5.0 | | Trial transformer secondary turns; default value is from resonant section |
| New Lpri | | | 250 | uH | Trial transformer open circuit inductance; default value is from resonant section |
| New Cres | | | 33.0 | nF | Trial value of series capacitor (if left blank calculated value chosen so f_res same as in main resonant section above |
| New estimated Lres | | | 67.0 | uH | Trial transformer estimated Lres |
| New estimated Lpar | | | 183 | uH | Estimated value of Lpar for trial transformer |
| New estimated Lsec | | | 5.407 | uH | Estimated value of secondary leakage inductance |
| New Kratio | | | 2.7 | | Ratio of Lpar to Lres for trial transformer |
| New equivalent circuit transformer turns ratio | | | 5.82 | | Estimated effective transformer turns ratio |
| V powertrain inversion new | | | 158 | V | Input voltage at LLC full load gain inversion point |
| f_res_trial | | | 107 | kHz | New Series resonant frequency |
| f_predicted_trial | | | 107 | kHz | New nominal operating frequency |
| IRMS_LLC_Primary | | | 2.17 | A | Primary winding RMS current at full load and nominal input voltage (Vbulk) and f_predicted_trial |
| Winding 1 (Lower secondary Voltage) RMS current | | | 8.3 | A | RMS current through Output 1 winding, assuming half sinusoidal waveshape |
| Lower Secondary Voltage Capacitor RMS current | | | 5.0 | A | Lower Secondary Voltage Capacitor RMS current |
| Winding 2 (Higher secondary Voltage) RMS current | | | 7.9 | A | RMS current through Output 2 winding; Output 1 winding is AC stacked on top of Output 2 winding |
| Higher Secondary Voltage Capacitor RMS current | | | 0.3 | A | Higher Secondary Voltage Capacitor RMS current |
| Vres_expected_trial | | | 215 | V | Expected value of input voltage at which LLC operates at resonance. |
| | | | | | |
| **Transformer Core Calculations (Calculates From Resonant Parameter Section)** | | | | | |
| **Transformer Core** | **Auto** | | **EER28L** | | **Transformer Core** |
| Ae | 0.97 | | 0.97 | cm^2 | Enter transformer core cross-sectional area |
| Ve | 7.63 | | 7.63 | cm^3 | Enter the volume of core |
| Aw | 120.00 | | 120.0 | mm^2 | Area of window |
| Bw | 20.90 | | 20.9 | mm | Total Width of Bobbin |
| Loss density | | | 200.0 | mW/cm^3 | Enter the loss per unit volume at the switching frequency and BAC (Units same as kW/m^3) |
| MLT | | | 4.0 | cm | Mean length per turn |
| Nchambers | | | 2 | | Number of Bobbin chambers |
| Wsep | | | 3.0 | mm | Winding separator distance (will result in loss of winding area) |
| Ploss | | | 1.5 | W | Estimated core loss |
| Bpkfmin | | | 116 | mT | First Quadrant peak flux density at minimum frequency. |
| BAC | | | 179 | mT | AC peak to peak flux density (calculated at f_predicted, Vbulk at full load) |
| | | | | | |
| | | | | | |
| **Primary Winding** | | | | | |
| Npri | | | 34.0 | | Number of primary turns; determined in LLC resonant section |
| Primary gauge | 42 | | 42 | AWG | Individual wire strand gauge used for primary winding |
| Equivalent Primary Metric Wire gauge | | | 0.060 | mm | Equivalent diameter of wire in metric units |
| Primary litz strands | 100 | | 100 | | Number of strands in Litz wire; for non-litz primary winding, set to 1 |
| Primary Winding Allocation Factor | | | 50 | % | Primary window allocation factor - percentage of winding space allocated to primary |
| AW_P | | | 51 | mm^2 | Winding window area for primary |
| Fill Factor | | | 31% | % | % Fill factor for primary winding (typical max fill is 60%) |
| Resistivity_25 C_Primary | | | 59.29 | m-ohm/m | Resistivity in milli-ohms per meter |
| Primary DCR 25 C | | | 79.67 | m-ohm | Estimated resistance at 25 C |
| Primary DCR 100 C | | | 106.76 | m-ohm | Estimated resistance at 100 C (approximately 33% higher than at 25 C) |
| Primary RMS current | | | 2.17 | A | Measured RMS current through the primary winding |
| ACR_Trf_Primary | | | 133.07 | m-ohm | Measured AC resistance (at 100 kHz, room temperature), multiply by 1.33 to approximate 100 C winding temperature |
| Primary copper loss | | | 0.63 | W | Total primary winding copper loss at 85 C |
| Primary Layers | | | 2.95 | | Number of layers in primary Winding |
| | | | | | |
| **Secondary Winding 1 (Lower secondary voltage OR Single output)** | | | | | **Note - Power loss calculations are for each winding half of secondary** |
| Output Voltage | | | 5.00 | V | Output Voltage (assumes AC stacked windings) |
| Sec 1 Turns | | | 2.00 | | Secondary winding turns (each phase ) |
| Sec 1 RMS current (total, AC+DC) | | | 8.2 | A | RMS current through Output 1 winding, assuming half sinusoidal waveshape |
| Winding current (DC component) | | | 5.25 | A | DC component of winding current |
| Winding current (AC RMS component) | | | 6.28 | A | AC component of winding current |
| Sec 1 Wire gauge | 40 | | 40 | AWG | Individual wire strand gauge used for secondary winding |
| Equivalent secondary 1 Metric Wire gauge | | | 0.080 | mm | Equivalent diameter of wire in metric units |
| Sec 1 litz strands | 250 | | 250 | | Number of strands used in Litz wire; for non-litz non-integrated transformer set to 1 |
| Resistivity_25 C_sec1 | | | 14.92 | m-ohm/m | Resistivity in milli-ohms per meter |
| DCR_25C_Sec1 | | | 1.18 | m-ohm | Estimated resistance per phase at 25 C (for reference) |
| DCR_100C_Sec1 | | | 1.58 | m-ohm | Estimated resistance per phase at 100 C (approximately 33% higher than at 25 C) |
| DCR_Ploss_Sec1 | | | 0.35 | W | Estimated Power loss due to DC resistance (both secondary phases) |
| ACR_Sec1 | | | 1.59 | m-ohm | Measured AC resistance per phase (at 100 kHz, room temperature), multiply by 1.33 to approximate 100 C winding temperature. Default value of ACR is twice the DCR value at 100 C |
| ACR_Ploss_Sec1 | | | 0.13 | W | Estimated AC copper loss (both secondary phases) |
| Total winding 1 Copper Losses | | | 0.47 | W | Total (AC + DC) winding copper loss for both secondary phases |
| Capacitor RMS current | | | 0.2 | A | Output capacitor RMS current |
| Co1 | 220.00 | | 220.0 | uF | Secondary 1 output capacitor |
| Capacitor ripple voltage | | | 0.1 | % | Peak to Peak ripple voltage on secondary 1 output capacitor |
| Output rectifier RMS Current | | | 0.4 | A | Schottky losses are a stronger function of load DC current. Sync Rectifier losses are a function of RMS current |
| Secondary 1 Layers | | | 1.10 | | Number of layers in secondary 1 Winding |
| **Secondary Winding 2 (Higher secondary voltage)** | | | | | **Note - Power loss calculations are for each winding half of secondary** |
| Output Voltage | | | 18.00 | V | Output Voltage (assumes AC stacked windings) |
| Sec 2 Turns | | | 4.00 | | Secondary winding turns (each phase) AC stacked on top of secondary winding 1 |
| Sec 2 RMS current (total, AC+DC) | | | 7.8 | A | RMS current through Output 2 winding; Output 1 winding is AC stacked on top of Output 2 winding |
| Winding current (DC component) | | | 5.0 | A | DC component of winding current |
| Winding current (AC RMS component) | | | 6.0 | A | AC component of winding current |
| Sec 2 Wire gauge | 40 | | 40 | AWG | Individual wire strand gauge used for secondary winding |
| Equivalent secondary 2 Metric Wire gauge | | | 0.080 | mm | Equivalent diameter of wire in metric units |
| Sec 2 litz strands | 250 | | 250 | | Number of strands used in Litz wire; for non-litz non-integrated transformer set to 1 |

| | | | | | |
|---|---|---|---|---|---|
| Resistivity_25 C_sec2 | | | 14.92 | m-ohm/m | Resistivity in milli-ohms per meter |
| Transformer Secondary MLT | | | 3.95 | cm | Mean length per turn |
| DCR_25C_Sec2 | | | 2.36 | m-ohm | Estimated resistance per phase at 25 C (for reference) |
| DCR_100C_Sec2 | | | 3.16 | m-ohm | Estimated resistance per phase at 100 C (approximately 33% higher than at 25 C) |
| DCR_Ploss_Sec1 | | | 0.00 | W | Estimated Power loss due to DC resistance (both secondary halves) |
| ACR_Sec2 | | | 3.19 | m-ohm | Measured AC resistance per phase (at 100 kHz, room temperature), multiply by 1.33 to approximate 100 C winding temperature. Default value of ACR is twice the DCR value at 100 C |
| ACR_Ploss_Sec2 | | | 0.23 | W | Estimated AC copper loss (both secondary halves) |
| Total winding 2 Copper Losses | | | 0.23 | W | Total (AC + DC) winding copper loss for both secondary halves |
| Capacitor RMS current | | | 4.6 | A | Output capacitor RMS current |
| Co2 | 670.00 | | 670.0 | uF | Secondary 2 output capacitor |
| Capacitor ripple voltage | | | 0.1 | % | Peak to Peak ripple voltage on secondary 1 output capacitor |
| Output rectifier RMS Current | | | 7.8 | A | Schottky losses are a stronger function of load DC current. Sync Rectifier losses are a function of RMS current |
| Secondary 2 Layers | | | 1.10 | | Number of layers in secondary 2 Winding |
| **Transformer Loss Calculations** | | | | | **Does not include fringing flux loss from gap** |
| Primary copper loss (from Primary section) | | | 0.63 | W | Total primary winding copper loss at 85 C |
| Secondary copper Loss | | | 0.70 | W | Total copper loss in secondary winding |
| Transformer total copper loss | | | 1.33 | W | Total copper loss in transformer (primary + secondary) |
| AW_S | | | 51.39 | mm^2 | Area of window for secondary winding |
| Secondary Fill Factor | | | 49% | % | % Fill factor for secondary windings; typical max fill is 60% for served and 75% for unserved Litz |
| | | | | | |
| **Signal Pins Resistor Values** | | | | | |
| f_min | | | 82 | kHz | Minimum frequency when optocoupler is cut-off. Only change this variable based on actual bench measurements |
| Dead Time | 500 | | 500 | ns | Dead time |
| Burst Mode | **1** | | **1** | | Select Burst Mode: 1, 2, and 3 have hysteresis and have different frequency thresholds |
| f_max | | | 542 | kHz | Max internal clock frequency, dependent on dead-time setting. Is also start-up frequency |
| f_burst_start | | | 236 | kHz | Lower threshold frequency of burst mode, provides hysteresis. This is switching frequency at restart after a bursting off-period |
| f_burst_stop | | | 270 | kHz | Upper threshold frequency of burst mode; This is switching frequency at which a bursting off-period stops |
| DT/BF pin upper divider resistor | | | 11.78 | k-ohms | Resistor from DT/BF pin to VREF pin |
| DT/BF pin lower divider resistor | | | 224 | k-ohms | Resistor from DT/BF pin to G pin |
| Rstart | | | 10.24 | k-ohms | Start-up resistor - resistor in series with soft-start capacitor; equivalent resistance from FB to VREF pins at startup. Use default value unless additional start-up delay is desired. |
| Start up delay | | | 0.0 | ms | Start-up delay; delay before switching begins. Reduce R_START to increase delay |
| Rfmin | | | 92.9 | k-ohms | Resistor from VREF pin to FB pin, to set min operating frequency; This resistor plus Rstart determine f_MIN. Includes 7% HiperLCS frequency tolerance to ensure f_min is below f_brownout |
| C_softstart | | | 0.33 | uF | Softstart capacitor. Recommended values are between 0.1 uF and 0.47 uF |
| Ropto | | | 1.9 | k-ohms | Resistor in series with opto emitter |
| OV/UV pin lower resistor | 10.50 | | 10.5 | k-ohm | !!! Warning. OV/UV resistor must be between 18 and 25 k-ohms. Too low value results in increased standby losses; Too large value can affect accuracy if OV/UV function |
| OV/UV pin upper resistor | | | 0.88 | M-ohm | Total upper resistance in OV/UV pin divider |
| | | | | | |
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| | | | | | |
| **LLC Capacitive Divider Current Sense Circuit** | | | | | |
| Slow current limit | 7.00 | | 7.00 | A | 8-cycle current limit - check positive half-cycles during brownout and startup |
| Fast current limit | | | 12.60 | A | 1-cycle current limit - check positive half-cycles during startup |
| LLC sense capacitor | | | 47 | pF | HV sense capacitor, forms current divider with main resonant capacitor |
| RLLC sense resistor | | | 50.2 | ohms | LLC current sense resistor, senses current in sense capacitor |
| IS pin current limit resistor | | | 220 | ohms | Limits current from sense resistor into IS pin when voltage on sense R is < -0.5V |
| IS pin noise filter capacitor | | | 1.0 | nF | IS pin bypass capacitor; forms a pole with IS pin current limit capacitor |
| IS pin noise filter pole frequency | | | 724 | kHz | This pole attenuates IS pin signal |
| | | | | | |
| **Loss Budget** | | | | | |
| LCS device Conduction loss | | | 3.5 | W | Conduction loss at nominal line and full load |
| Output diode Loss | | | 5.0 | W | Estimated diode losses |
| Transformer estimated total copper loss | | | 1.33 | W | Total copper loss in transformer (primary + secondary) |
| Transformer estimated total core loss | | | 1.5 | W | Estimated core loss |
| Total transformer losses | | | 2.9 | W | Total transformer losses |
| Total estimated losses | | | 11.4 | W | Total losses in LLC stage |
| Estimated Efficiency | | | 94% | % | Estimated efficiency |
| PIN | | | 194 | W | LLC input power |
| | | | | | |
| **Secondary Turns and Voltage Centering Calculator** | | | | | **This is to help you choose the secondary turns - Outputs not connected to any other part of spreadsheet** |
| V1 | | | 18.00 | V | Target regulated output voltage Vo1. Change to see effect on slave output |
| V1d1 | | | 0.50 | V | Diode drop voltage for Vo1 |
| N1 | | | 6.00 | | Total number of turns for Vo1 |
| V1_Actaul | | | 18.00 | V | Expected output |
| V2 | | | 5.00 | V | Target output voltage Vo2 |
| V2d2 | | | 0.70 | V | Diode drop voltage for Vo2 |
| N2 | | | 2.00 | | Total number of turns for Vo2 |
| V2_Actual | | | 5.47 | V | Expected output voltage |
| | | | | | |
| | | | | | |
| **Separate Series Inductor (For Non-Integrated Transformer Only)** | | | | | **Not applicable if using integrated magnetics - not connected to any other part of spreadsheet** |
| Lsep | | | 67.00 | uH | Desired inductance of separate inductor |
| Ae_Ind | | | 0.53 | cm^2 | Inductor core cross-sectional area |
| Inductor turns | | | 30 | | Number of primary turns |
| BP_fnom | | | 139 | mT | AC flux for core loss calculations (at f_predicted and full load) |

| | | | | | |
|---|---|---|---|---|---|
| Expected peak primary current | | | 7.0 | A | Expected peak primary current |
| BP_fmin | | | 298 | mT | Peak flux density, calculated at minimum frequency fmin |
| Inductor Litz gauge | | | 40 | AWG | Individual wire strand gauge used for primary winding |
| Equivalent Inductor Metric Wire gauge | | | 0.080 | mm | Equivalent diameter of wire in metric units |
| Inductor litz strands | | | 125.00 | | Number of strands used in Litz wire |
| Inductor parallel wires | | | 1 | | Number of parallel individual wires to make up Litz wire |
| Resistivity_25 C_Sep_Ind | | | 29.8 | m-ohm/m | Resistivity in milli-ohms per meter |
| Inductor MLT | | | 7.00 | cm | Mean length per turn |
| Inductor DCR 25 C | | | 62.6 | m-ohm | Estimated resistance at 25 C (for reference) |
| Inductor DCR 100 C | | | 83.9 | m-ohm | Estimated resistance at 100 C (approximately 33% higher than at 25 C) |
| ACR_Sep_Inductor | | | 134.3 | m-ohm | Measured AC resistance (at 100 kHz, room temperature), multiply by 1.33 to approximate 100 C winding temperature |
| Inductor copper loss | | | 0.63 | W | Total primary winding copper loss at 85 C |
| | | | | | |
| | | | | | |
| **Feedback section** | | | | | |
| VMAIN | **Auto** | | 18.0 | | Output voltage rail that optocoupler LED is connected to |
| ITL431_BIAS | | | 1.0 | mA | Minimum operating current in TL431 cathode |
| VF | | | 1.0 | V | Typical Optocoupler LED forward voltage at IOPTO_BJTMAX (max current) |
| VCE_SAT | | | 0.3 | V | Optocoupler transistor saturation voltage |
| CTR_MIN | | | 0.8 | | Optocoupler minimum CTR at VCE_SAT and at IOPTO_BJT_MAX |
| VTL431_SAT | | | 2.5 | V | TL431 minimum cathode voltage when saturated |
| RLED_SHUNT | | | 1.0 | k-ohms | Resistor across optocoupler LED to ensure minimum TL431 bias current is met |
| ROPTO_LOAD | | | 4.70 | k-ohms | Resistor from optocoupler emitter to ground, sets load current |
| IFMAX | | | 222.13 | uA | FB pin current when switching at FMAX (e.g. startup) |
| IOPTO_BJT_MAX | | | 0.85 | mA | Optocoupler transistor maximum current - when bursting at FMAX (e.g. startup) |
| RLED_SERIES_MAX | | | 6.34 | k-ohms | Maximum value of gain setting resistor, in series with optocoupler LED, to ensure optocoupler can deliver IOPTO_BJT_MAX. Includes -10% tolerance factor. |
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