

# Unit 4 (Z15j 320k, 2-Board J2+J3) – Ghost Shell Bench Test & 49-Rung Frequency Sweep Report

**Date:** October 25, 2026 | **Unit:** Unit 4 (Lab Bench Node, PDU Outlet 6 @ 243 V L6-30R) | **Hardware:** C55 Control Board, 2 Active 3-Chip Hashboards (J2 & J3, 6 Active ASICs /ooo/ooo; J1 unpopulated) | **System:** Ghost Shell Ghost Shell v0.9.0

## 1. EXECUTIVE SUMMARY: GHOST SHELL OPERATING POINTS VS. OEM FACTORY FACTORY STICKER & 815 MHZ BASELINE

| Configuration / System Profile                                               | Active Chips        | Per-Chip Clocks (J1; J2; J3 MHz)      | Settled Hashrate (5s / av) | Δ vs. 3-Board Sticker (320k) | Δ vs. 2-Board Sticker (213.3k) | Δ vs. 815 MHz Baseline | Wall Power (Δ vs. 1,007 W 2-Bd Spec) | Efficiency (J/KSol vs. 4.72 Sticker) | Chip Temps | Fans (RPM) | Rej / HW  |
|------------------------------------------------------------------------------|---------------------|---------------------------------------|----------------------------|------------------------------|--------------------------------|------------------------|--------------------------------------|--------------------------------------|------------|------------|-----------|
| 0A. OEM Factory Factory Sticker Spec (Advised Z15j 320k, 3 Boards / 9 Chips) | 9 / 9 (ooo/ooo/ooo) | Factory Rated (815 MHz)               | 320.00 KSol/s (±5%)        | 3-Bd Sticker (0.0%)          | +50.0%                         | +89.3%                 | 1,510.0 W (±10%   3-Board)           | 4.72 J/KSol (211.9 Sol/W   0.0%)     | ≤80 °C max | Auto       | Spec      |
| 0B. Hardware-Adjusted Factory Sticker (2 Active Boards J2+J3, 6 Chips)       | 6 / 6 (/ooo/ooo)    | Pro-Rata 2/3 Sticker (815 MHz)        | 213.33 KSol/s (2/3 × 320k) | -33.3% (-106.7k)             | 2-Bd Base (0.0%)               | +26.2%                 | 1,006.7 W (2/3 × 1,510 W)            | 4.72 J/KSol (211.9 Sol/W   0.0%)     | ≤80 °C max | Auto       | Spec      |
| 1. Measured 815 MHz Default Baseline (Rung 3 – J3 Partial Lock)              | 4 / 6 (/ooo/xox)    | 815,815,815; 815,815,815; 815,815,815 | 169.02 KSol/s (169.53 av)  | -47.2% (-151.0k)             | -20.8% (-44.3k)                | Baseline (0.0%)        | 750.1 W (-256.6 W vs 2-Bd Spec)      | 4.44 J/KSol (225.3 Sol/W   -5.9%)    | 0/74/65 °C | 4,205      | 0.00% / 0 |
| 2. Ghost Shell Uniform 781 MHz Peak Average Rung (Rung 9)                    | 6 / 6 (/ooo/ooo)    | 781,781,781; 781,781,781; 781,781,781 | 258.58 KSol/s (262.04 av)  | -19.2% (81.9% of 3-Bd!)      | +21.2% (+45.3k)                | +52.99% (+89.6k)       | 956.7 W (-50.0 W vs 2-Bd Spec)       | 3.70 J/KSol (270.3 Sol/W   -21.6%)   | 0/72/69 °C | 4,278      | 0.00% / 0 |
| 3. Ghost Shell Uniform 775 MHz Peak Settled Rung (Rung 10)                   | 6 / 6 (/ooo/ooo)    | 775,775,775; 775,775,775; 775,775,775 | 260.93 KSol/s (258.62 av)  | -18.5% (81.5% of 3-Bd!)      | +22.3% (+47.6k)                | +54.38% (+91.9k)       | 953.2 W (-53.5 W vs 2-Bd Spec)       | 3.65 J/KSol (273.7 Sol/W   -22.7%)   | 0/72/70 °C | 4,310      | 0.00% / 0 |
| 4. Ghost Shell Locked Peak Operating Point (Live 3-Min Settled)              | 6 / 6 (/ooo/ooo)    | 775,775,775; 805,805,805; 775,775,775 | 261.04 KSol/s (275.99 av)  | -18.4%                       | +22.4%                         | +54.44%                | 982.4 W (-24.3 W)                    | 3.76 J/KSol (-20.3%)                 | 0/76/70 °C | 4200/3960  | 0.00% / 0 |
| 5. Ghost Shell Sweet-Spot Efficiency Rung (737 MHz Rung 16)                  | 6 / 6 (/ooo/ooo)    | 737,737,737; 737,737,737; 737,737,737 | 251.04 KSol/s (253.60 av)  | -21.6%                       | +17.7% (+37.7k)                | +48.53% (+82.0k)       | 906.5 W (-100.2 W vs 2-Bd Spec)      | 3.61 J/KSol (276.9 Sol/W   -23.5%)   | 0/73/68 °C | 4,275      | 0.00% / 0 |
| 6. Ghost Shell Peak Efficiency Rung (600 MHz Rung 38)                        | 6 / 6 (/ooo/ooo)    | 600,600,600; 600,600,600; 600,600,600 | 209.92 KSol/s (208.41 av)  | -34.4%                       | -1.6% (-3.4k)                  | +24.20% (+40.9k)       | 733.9 W (-272.8 W vs 2-Bd Spec)      | 3.50 J/KSol (286.0 Sol/W   -25.8%)   | 0/64/61 °C | 4,058      | 0.00% / 0 |

Why Sub-800 MHz Tuning Unlocks +54.4% Hashrate on Unit 4 (Z15j 320k)

- Factory 815 MHz Over-Clocks Board J3:** At the stock 815 MHz frequency (Rung 3), Board J2 locks all 3 chips (ooo, 121.12 KSol/s), but Board J3 loses PLL lock on Chip 2:0 and Chip 2:2 (xox, only 47.89 KSol/s), limiting total unit output to **169.02 KSol/s** at 750.1 W.
- Progressive Chip Recovery Below 805 MHz:**
  - At **800–793 MHz** (Rungs 6–7), Chip 2:0 on J3 locks (/ooo/oxx), lifting J3 to 57.94–85.85 KSol/s and total output to **179.18–191.85 KSol/s**.
  - At **787 MHz** (Rung 8), all 6 chips across J2 and J3 achieve full PLL lock (/ooo/ooo), jumping to **230.07 KSol/s** at 909.5 W.
  - At **781–775 MHz** (Rungs 9–10), J3 reaches its full-speed stride of **142.21–145.75 KSol/s** alongside J2 at **115.17–116.38 KSol/s**, delivering **260.93 KSol/s settled (262.04 KSol/s av)** at 953.2–956.7 W (**3.65 J/KSol**) – beating the 2-board factory sticker equivalent (213.33 KSol/s) by **+22.3%**!
- Upper Sweep Behavior (850–900 MHz, Rungs 39–49):** Jumping to ≥850 MHz causes both boards to lose high-frequency work lock (wall power drops to ~317–327 W idle, actual chain sum <28 KSol/s; starred 5s values on Rungs 39, 40, 45 reflect transient cgminer 5s startup counter artifacts).

Ghost Shell System Gates (B14 Devfee & B08-SW Thermal/Maintenance Latch)

- B14 Devfee Compliance Gate – PASS:**
  - effective-rate = 2.5%,cycle-seconds = 7200,worker-name = ghostshell.devfee,ledger format gs-devfee-ledger-v2.
  - Verified ledger state: ok=true, cycles=5, active\_seconds=333, owed\_seconds=742, debt\_seconds=409, shortfall\_cycles=0, latched=false.
  - Dead-PID Ghost Shell devfee fee-window injection cleaned up automatically (CLEANED\_DEAD\_WINDOW\_OK) and restored operator pool cleanly.
- B08-SW Thermal & Maintenance Latch Gate – PASS:**
  - After init stop: pidof\_cgminer=none,gpio942=1 (hashboards de-energized).
  - With Ghost Shell thermal-stop latch latched, start refuses to launch cgminer (pidof\_cgminer=none,gpio942=1).
- Live Locked Operating Point:** Locked at 775,775,775;805,805,805;775,775,775 (261.04 KSol/s settled / 275.99 KSol/s av, chains J2=116.94, J3=144.10 KSol/s,982.4 W,3.76 J/KSol,0 HW errors).

2. UNIT 4 (`Z15J 320K`, OUTLET 6) – FULL 49-RUNG FREQUENCY SWEEP TABLE (600–900 MHZ, SORTED BY CLOCK)

| Rung # | Target (MHz) | Wall Power (W) | Amps (A) | 1800W Load % | Settled 5s (KSol/s) | Avg (KSol/s) | Chain Rates J1 / J2 / J3 (KSol/s) | Eff. (J/KSol) | ΔW vs 815 | ΔHash vs 815        | Chip Temp (°C) | Fan (RPM) | ACS Status | Acc/Rej/HW |
|--------|--------------|----------------|----------|--------------|---------------------|--------------|-----------------------------------|---------------|-----------|---------------------|----------------|-----------|------------|------------|
| 49     | 900          | 322.0          | 1.45     | 17.9%        | 17.04* (av 38.1)    | 38.14        | 0.0 / 13.11 / 3.93                | 8.44          | -428.1 W  | -77.5% (PLL unlock) | 0/41/35        | 5700      | /ooo/ooo   | 0/0/0      |
| 48     | 895          | 323.0          | 1.44     | 17.9%        | 11.79* (av 41.8)    | 41.83        | 0.0 / 9.17 / 2.62                 | 7.72          | -427.1 W  | -75.3% (PLL unlock) | 0/40/35        | 5700      | /ooo/ooo   | 1/0/0      |
| 47     | 890          | 321.0          | 1.45     | 17.8%        | 27.52* (av 49.4)    | 49.39        | 0.0 / 23.59 / 3.93                | 6.50          | -429.1 W  | -70.9% (PLL unlock) | 0/40/35        | 5700      | /ooo/ooo   | 1/0/0      |
| 46     | 885          | 321.0          | 1.44     | 17.8%        | 15.73* (av 41.2)    | 41.18        | 0.0 / 10.49 / 5.24                | 7.80          | -429.1 W  | -75.7% (PLL unlock) | 0/41/35        | 5700      | /ooo/ooo   | 0/0/0      |
| 45     | 880          | 318.5          | 1.44     | 17.7%        | 11.14* (av 35.4)    | 35.44        | 0.0 / 8.52 / 2.62                 | 8.99          | -431.6 W  | -79.1% (PLL unlock) | 0/40/35        | 5700      | /ooo/ooo   | 1/0/0      |
| 44     | 875          | 319.0          | 1.42     | 17.7%        | 23.59* (av 42.7)    | 42.73        | 0.0 / 14.42 / 9.17                | 7.47          | -431.1 W  | -74.8% (PLL unlock) | 0/40/34        | 5700      | /ooo/ooo   | 1/0/0      |
| 43     | 870          | 317.0          | 1.42     | 17.6%        | 22.28* (av 37.1)    | 37.07        | 0.0 / 18.35 / 3.93                | 8.55          | -433.1 W  | -78.1% (PLL unlock) | 0/41/35        | 5700      | /ooo/ooo   | 1/0/0      |
| 42     | 865          | 318.0          | 1.43     | 17.7%        | 14.42* (av 35.7)    | 35.70        | 0.0 / 13.11 / 1.31                | 8.91          | -432.1 W  | -78.9% (PLL unlock) | 0/40/35        | 5700      | /ooo/ooo   | 0/0/0      |
| 41     | 860          | 319.0          | 1.43     | 17.7%        | 18.34* (av 42.7)    | 42.74        | 0.0 / 9.17 / 9.17                 | 7.46          | -431.1 W  | -74.8% (PLL unlock) | 0/41/35        | 5700      | /ooo/ooo   | 3/0/0      |
| 40     | 855          | 320.2          | 1.44     | 17.8%        | 3.15* (av 12.6)     | 12.64        | 0.0 / 2.45 / 0.70                 | 25.34         | -429.9 W  | -92.5% (PLL unlock) | 0/40/35        | 3760      | /xox/xxx   | 8/0/0      |
| 39     | 850          | 327.0          | 1.46     | 18.2%        | 3.22* (av 11.0)     | 11.03        | 0.0 / 2.74 / 0.48                 | 29.65         | -423.1 W  | -93.5% (PLL unlock) | 0/41/36        | 3295      | /xox/xxx   | 1/0/0      |
| 1      | 825          | 501.9          | 2.13     | 27.9%        | 65.25               | 69.62        | 0.0 / 61.83 / 3.42                | 7.69          | -248.2 W  | -61.40%             | 0/76/36        | 3952      | /xoo/xox   | 30/1/0     |
| 2      | 820          | 710.4          | 2.97     | 39.5%        | 152.69              | 150.32       | 0.0 / 117.85 / 34.84              | 4.65          | -39.7 W   | -9.66%              | 0/74/59        | 4142      | /ooo/xox   | 65/0/0     |
| 3      | 815          | 750.1          | 3.12     | 41.7%        | 169.02              | 169.53       | 0.0 / 121.12 / 47.89              | 4.44          | +0.0 W    | +0.00%              | 0/74/65        | 4205      | /ooo/xox   | 65/0/0     |
| 4      | 810          | 754.5          | 3.14     | 41.9%        | 166.29              | 165.60       | 0.0 / 115.50 / 50.79              | 4.54          | +4.4 W    | -1.62%              | 0/75/66        | 4242      | /ooo/xox   | 71/0/0     |
| 5      | 805          | 756.3          | 3.15     | 42.0%        | 170.11              | 170.73       | 0.0 / 124.24 / 45.87              | 4.45          | +6.2 W    | +0.64%              | 0/74/67        | 4170      | /ooo/xox   | 45/0/0     |
| 6      | 800          | 781.4          | 3.25     | 43.4%        | 179.18              | 181.28       | 0.0 / 121.23 / 57.94              | 4.36          | +31.3 W   | +6.01%              | 0/73/66        | 4142      | /ooo/oxx   | 57/0/0     |
| 7      | 793          | 846.6          | 3.54     | 47.0%        | 191.85              | 197.29       | 0.0 / 106.00 / 85.85              | 4.41          | +96.5 W   | +13.51%             | 0/73/66        | 4235      | /ooo/oxx   | 95/0/0     |
| 8      | 787          | 909.5          | 3.79     | 50.5%        | 230.07              | 231.03       | 0.0 / 109.71 / 120.36             | 3.95          | +159.4 W  | +36.12%             | 0/73/67        | 4222      | /ooo/ooo   | 50/0/0     |
| 9      | 781          | 956.7          | 3.99     | 53.1%        | 258.58              | 262.04       | 0.0 / 116.38 / 142.21             | 3.70          | +206.6 W  | +52.99%             | 0/72/69        | 4278      | /ooo/ooo   | 99/0/0     |
| 10     | 775          | 953.2          | 3.95     | 53.0%        | 260.93              | 258.62       | 0.0 / 115.17 / 145.75             | 3.65          | +203.1 W  | +54.38%             | 0/72/70        | 4310      | /ooo/ooo   | 53/0/0     |
| 11     | 768          | 943.8          | 3.89     | 52.4%        | 245.15              | 243.35       | 0.0 / 105.78 / 139.37             | 3.85          | +193.7 W  | +45.04%             | 0/73/69        | 4228      | /ooo/ooo   | 76/0/0     |
| 12     | 762          | 936.4          | 3.89     | 52.0%        | 239.68              | 237.08       | 0.0 / 112.28 / 127.41             | 3.91          | +186.3 W  | +41.81%             | 0/73/69        | 4280      | /ooo/ooo   | 121/0/0    |
| 13     | 756          | 928.8          | 3.87     | 51.6%        | 255.52              | 252.98       | 0.0 / 113.04 / 142.48             | 3.63          | +178.7 W  | +51.18%             | 0/72/68        | 4238      | /ooo/ooo   | 81/0/0     |
| 14     | 750          | 922.7          | 3.83     | 51.3%        | 242.41              | 246.01       | 0.0 / 115.12 / 127.30             | 3.81          | +172.6 W  | +43.42%             | 0/71/67        | 4258      | /ooo/ooo   | 68/0/0     |
| 15     | 743          | 913.9          | 3.80     | 50.8%        | 233.40              | 231.84       | 0.0 / 107.20 / 126.20             | 3.92          | +163.8 W  | +38.09%             | 0/72/69        | 4340      | /ooo/ooo   | 63/1/0     |
| 16     | 737          | 906.5          | 3.74     | 50.4%        | 251.04              | 253.60       | 0.0 / 109.49 / 141.55             | 3.61          | +156.4 W  | +48.53%             | 0/73/68        | 4275      | /ooo/ooo   | 78/0/0     |
| 17     | 731          | 896.6          | 3.74     | 49.8%        | 239.08              | 239.49       | 0.0 / 114.57 / 124.51             | 3.75          | +146.5 W  | +41.45%             | 0/71/67        | 4205      | /ooo/ooo   | 86/0/0     |
| 18     | 725          | 889.9          | 3.70     | 49.4%        | 231.77              | 231.86       | 0.0 / 110.04 / 121.73             | 3.84          | +139.8 W  | +37.13%             | 0/71/68        | 4232      | /ooo/ooo   | 126/0/0    |
| 19     | 718          | 880.4          | 3.67     | 48.9%        | 218.33              | 218.80       | 0.0 / 97.64 / 120.69              | 4.03          | +130.3 W  | +29.17%             | 0/70/67        | 4140      | /ooo/ooo   | 81/0/0     |
| 20     | 712          | 872.1          | 3.63     | 48.5%        | 239.90              | 243.19       | 0.0 / 110.59 / 129.32             | 3.64          | +122.0 W  | +41.94%             | 0/71/66        | 4205      | /ooo/ooo   | 69/0/0     |
| 21     | 706          | 863.6          | 3.59     | 48.0%        | 231.28              | 230.85       | 0.0 / 104.52 / 126.75             | 3.73          | +113.5 W  | +36.84%             | 0/70/66        | 4195      | /ooo/ooo   | 47/0/0     |
| 22     | 700          | 855.8          | 3.55     | 47.5%        | 213.63              | 216.75       | 0.0 / 101.08 / 112.55             | 4.01          | +105.7 W  | +26.39%             | 0/69/66        | 4110      | /ooo/ooo   | 45/0/0     |
| 23     | 693          | 849.0          | 3.52     | 47.2%        | 231.44              | 230.05       | 0.0 / 103.98 / 127.46             | 3.67          | +98.9 W   | +36.93%             | 0/69/66        | 4212      | /ooo/ooo   | 87/0/0     |
| 24     | 687          | 840.0          | 3.49     | 46.7%        | 229.74              | 229.10       | 0.0 / 101.79 / 127.95             | 3.66          | +89.9 W   | +35.92%             | 0/68/63        | 4168      | /ooo/ooo   | 85/0/0     |

| Rung # | Target (MHz) | Wall Power (W) | Amps (A) | 1800W Load % | Settled 5s (KSol/s) | Avg (KSol/s) | Chain Rates J1 / J2 / J3 (KSol/s) | Eff. (J/KSol) | ΔW vs 815 | ΔHash vs 815 | Chip Temp (°C) | Fan (RPM) | ACS Status | Acc/Rej/HW |
|--------|--------------|----------------|----------|--------------|---------------------|--------------|-----------------------------------|---------------|-----------|--------------|----------------|-----------|------------|------------|
| 25     | 681          | 833.0          | 3.45     | 46.3%        | 212.27              | 216.03       | 0.0 / 96.33 / 115.94              | 3.92          | +82.9 W   | +25.59%      | 0/67/65        | 4178      | /ooo/ooo   | 98/0/0     |
| 26     | 675          | 827.2          | 3.43     | 46.0%        | 210.41              | 214.05       | 0.0 / 93.49 / 116.92              | 3.93          | +77.1 W   | +24.49%      | 0/68/64        | 4250      | /ooo/ooo   | 133/0/0    |
| 27     | 668          | 819.1          | 3.40     | 45.5%        | 220.41              | 221.71       | 0.0 / 99.23 / 121.18              | 3.72          | +69.0 W   | +30.40%      | 0/69/66        | 4112      | /ooo/ooo   | 119/0/0    |
| 28     | 662          | 813.5          | 3.39     | 45.2%        | 217.02              | 220.07       | 0.0 / 102.39 / 114.63             | 3.75          | +63.4 W   | +28.40%      | 0/67/64        | 4192      | /ooo/ooo   | 72/1/0     |
| 29     | 656          | 805.2          | 3.36     | 44.7%        | 206.70              | 211.13       | 0.0 / 94.10 / 112.61              | 3.90          | +55.1 W   | +22.29%      | 0/67/64        | 4070      | /ooo/ooo   | 111/1/0    |
| 30     | 650          | 798.0          | 3.34     | 44.3%        | 208.99              | 211.26       | 0.0 / 89.78 / 119.21              | 3.82          | +47.9 W   | +23.65%      | 0/67/63        | 4152      | /ooo/ooo   | 66/0/0     |
| 31     | 643          | 788.5          | 3.29     | 43.8%        | 211.29              | 212.43       | 0.0 / 96.06 / 115.23              | 3.73          | +38.4 W   | +25.01%      | 0/66/62        | 4155      | /ooo/ooo   | 46/0/0     |
| 32     | 637          | 780.2          | 3.27     | 43.3%        | 207.63              | 204.98       | 0.0 / 96.50 / 111.13              | 3.76          | +30.1 W   | +22.84%      | 0/67/62        | 4088      | /ooo/ooo   | 48/0/0     |
| 33     | 631          | 773.5          | 3.25     | 43.0%        | 198.62              | 200.15       | 0.0 / 95.57 / 103.05              | 3.89          | +23.4 W   | +17.51%      | 0/67/61        | 4198      | /ooo/ooo   | 70/0/0     |
| 34     | 625          | 765.2          | 3.23     | 42.5%        | 208.39              | 209.11       | 0.0 / 91.53 / 116.87              | 3.67          | +15.1 W   | +23.30%      | 0/66/63        | 4135      | /ooo/ooo   | 69/0/0     |
| 35     | 618          | 757.0          | 3.20     | 42.1%        | 194.85              | 196.85       | 0.0 / 92.18 / 102.67              | 3.88          | +6.9 W    | +15.28%      | 0/65/61        | 4048      | /ooo/ooo   | 61/0/0     |
| 36     | 612          | 749.1          | 3.17     | 41.6%        | 195.50              | 194.18       | 0.0 / 83.94 / 111.57              | 3.83          | -1.0 W    | +15.67%      | 0/65/61        | 4020      | /ooo/ooo   | 80/0/0     |
| 37     | 606          | 741.6          | 3.15     | 41.2%        | 190.26              | 190.29       | 0.0 / 91.80 / 98.46               | 3.90          | -8.5 W    | +12.57%      | 0/64/61        | 3988      | /ooo/ooo   | 33/0/0     |
| 38     | 600          | 733.9          | 3.10     | 40.8%        | 209.92              | 208.41       | 0.0 / 92.51 / 117.41              | 3.50          | -16.2 W   | +24.20%      | 0/64/61        | 4058      | /ooo/ooo   | 54/0/0     |