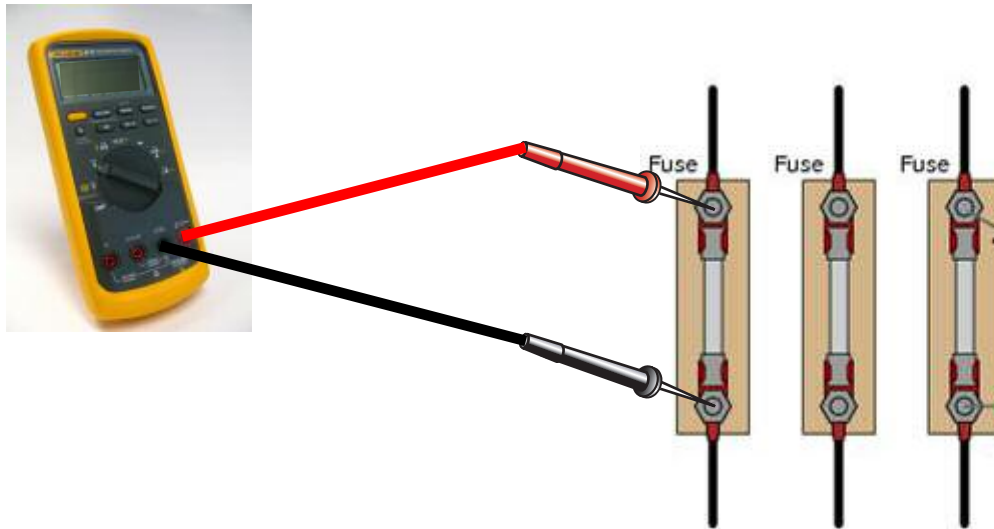# Current Draw Diagnosis

## Why do we use a voltage drop measurement across a fuse to determine the current draw on the circuit that the fuse feeds?



### Who figured this out?

By looking at the picture above you already recognize that a voltage drop (Vd) measurement is being performed across a working fuse. But how is this going to help us determine the current draw of the circuit? Let's find out!

We can thank George Simon Ohm for his theory. He proved that voltage (V), current (A) and resistance (Ω), all have effects on one another – remember "Ohm's Law"?
Well, Engineers use this Law when designing the fuses so they "blow" when current exceeds its rated value. The data that the Current Data Matrix provides utilizes the fuse's material cross sectional diameter (⌀), facilitating the true resistance of the fuse, which together with the voltage drop measurement, allows them to calculate the current draw of the circuit. This is the reason why the chart found in the next couple of pages is so accurate. This chart **MUST BE USED** as indicated since each fuse size has a different cross sectional diameter!

### What advantage does it have?

The key advantage of using this chart is that there are **no math calculations needed** as they have already been done for you. It is that easy! All you need to do is measure the voltage drop (Vd) across each exposed pin of the fuse and the millivolt [mV] reading will tell you the current consumption in the circuit that the fuse feeds.

 **It is accurate to 5% on an OEM quality fuse.**

**How to use the chart to diagnose a Parasitic Current Draw?**
In order to describe how to use the chart, let us start out with the scenario of a car that exhibits a parasitic current draw, which has already been confirmed via an "Energy Management test" using BMW Diagnostic Equipment. The task that we are now facing is finding out where that current draw is located.

1. Before you begin the "Divide and Conquer" process to find the parasitic current, the car must be parked and "sleeping". We can generically estimate **30 minutes** to full sleep in **BN2020** vehicles and up to **60 minutes** on **BN2000** and previous models. This can still vary, so please research the sleep protocol for your model on ISTA. It is also important to remember certain key points such as a "CAS push button that remains lit". This would indicate bus activity and high current draws. A scenario such as this one would require you to wait or diagnose a more serious issue of a bus that will not go to sleep.

    Another good source of information is **SI B61 08 00 Closed-circuit Current Measurement. Process is everything; you may only get one chance to replicate the draw!**

2. Now, take the 100 amp clamp from the IMIB toolbox and place it over the body "B-" cable at the battery. Typically, draws that exceed **80 mA** will set faults and if they are present, you are half way there!

3. Next , isolate the path of current on the voltage distributor on the battery. There are multiple paths for "B+" voltage to travel depending on the model. Everything leaving the voltage distributor is fused and the other cable goes to the front of the car (engine bay). Clamp each one individually until you locate the path of the excess current. Two scenarios are possible:

    a) If the current that is above specs is found on the cable to the front of the car (BST protected), follow the appropriate SSP to reveal if that's the alternator, starter, etc., and isolate the cause.

    b) If the current that is above specs is on one of the feeds for the fuse panel(s), then we will be using the Current Data Matrix and measure the voltage drop across the fuse to isolate the circuit.

**In the past, you may have pulled fuses individually until the current consumption dropped. Please avoid this procedure if possible! Why? Because each fuse you pull may reset a control module and temporarily eliminate the concern. Now the diagnosis will not be possible and the car will most likely come back. So, we are going to "sneak up" on the draw.**

4. The Current Draw Matrix:

   a) After you determined which fuse panel contains the draw, access that panel. Sometimes they are difficult to access since you have to get the meter leads at each fuse contact with the fuse in the panel. Remember to leave the fuse in the panel! If the fuse has a small plastic clear cover over the terminals, take a dental pick and remove the cover for diagnosis. Do not forget to reinstall it after you are done!

   b) Move the rotary switch on your DVOM to the **millivolts [mV]** setting.

   **Using the Volts [V] setting will not render the needed accuracy for this measurement!**

   c) Put one lead on one end of the fuse and the other lead on the opposite end (see graphic on next page).

   d) Keep measuring all the fuses in the panel until you get an "elevated" millivolt [mV] reading for that fuse rating (see the chart). This will indicate the parasitic draw you isolated with the amp clamp test.

   e) Now, isolate what is on that circuit to finalize the diagnosis.

| Workshop Hint |
| :---: |
| Some draws only show their "ugly face" in certain situations: when cold; some when hot; some after driving; some after sitting; some after accessory use; etc. This is why it is advisable to gather as much information from the customer as possible , which combined with your skill and tenacity, will make for a successful diagnosis! |

**Vd Measurement @ Fuse for
Current Draw Matrix calculation.**

Using the Volts [V]
setting will not render the
needed accuracy for this
measurement! Instead, use
the millivolt [mV] setting.
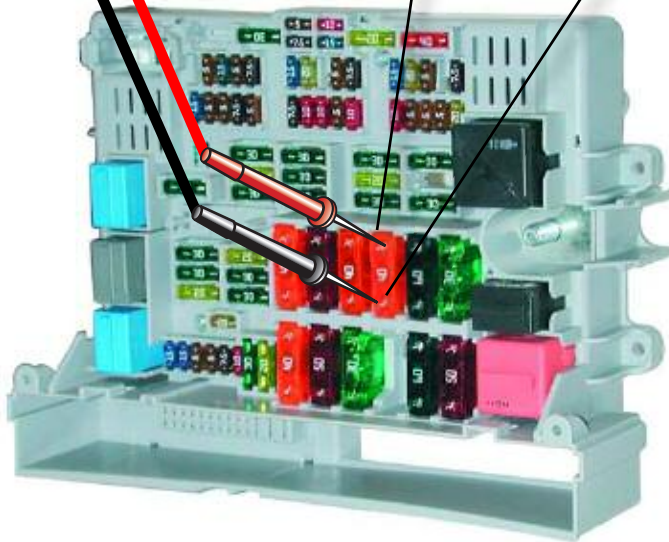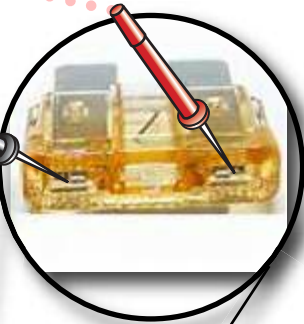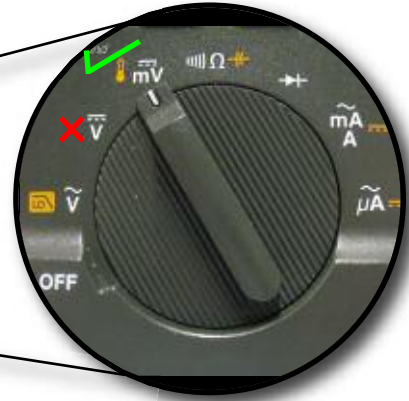
# Current Draw Matrix

The following chart is used to determine the amperage across a circuit by measuring the voltage drop across the fuse and comparing it against the fuse rating.

The Current Draw Matrix shows the measured voltage drop (Vd) across the fuse in the left hand column. It also shows the different fuses (Mini or Standard) with the amperage rating (up to 30 amps).

Lastly, it provides the current draw based on the Vd measurement you just performed.

Below is an example of how to use this Matrix:

| Vd | Mini | Mini | Mini | Standard | Standard | Standard | Standard | Standard | Standard |
|----|------|------|------|----------|----------|----------|----------|----------|----------|
| Fuse rating | 5 A | 7.5 A | 10 A | 5 A | 10 A | 15 A | 20 A | 25 A | 30 A |
| mV | Current Draw [mA] | | | | | | | | |
| 0.1 | 6 | 10 | 14 | 7 | 13 | 23 | 30 | 47 | 62 |
| 0.2 | 12 | 20 | 28 | 13 | 27 | 45 | 61 | 94 | 123 |
| 0.3 | 18 | 30 | 43 | 20 | 40 | 68 | 91 | 141 | 185 |
| 0.4 | 24 | 40 | 57 | 26 | 54 | 91 | 122 | 188 | 246 |
| 0.5 | 30 | 50 | 71 | 33 | 67 | 113 | 152 | 235 | 308 |

**As the example shows, there is a voltage drop of 0.2mV (1) across a Standard 5 Amp fuse (2).**

**By performing this voltage drop it tells us that the current consumption through this circuit is 13mA (3).**

**This Matrix applies to OEM fuses only!**

| Vd | Mini | Mini | Mini | Std. | Std. | Std. | Std. | Std. | Std. |
|---|---|---|---|---|---|---|---|---|---|
| Fuse rating | 5 | 7.5 | 10 | 5 | 10 | 15 | 20 | 25 | 30 |
| mV | Current Draw [mA] | | | | | | | | |
| 0.1 | 6 | 10 | 14 | 7 | 13 | 23 | 30 | 47 | 62 |
| 0.2 | 12 | 20 | 28 | 13 | 27 | 45 | 61 | 94 | 123 |
| 0.3 | 18 | 30 | 43 | 20 | 40 | 68 | 91 | 141 | 185 |
| 0.4 | 24 | 40 | 57 | 26 | 54 | 91 | 122 | 188 | 246 |
| 0.5 | 30 | 50 | 71 | 33 | 67 | 113 | 152 | 235 | 308 |
| 0.6 | 36 | 60 | 85 | 40 | 80 | 136 | 183 | 281 | 370 |
| 0.7 | 42 | 70 | 99 | 46 | 94 | 158 | 213 | 328 | 431 |
| 0.8 | 48 | 80 | 114 | 53 | 107 | 181 | 244 | 375 | 493 |
| 0.9 | 54 | 90 | 128 | 59 | 120 | 204 | 274 | 422 | 554 |
| 1 | 60 | 100 | 142 | 66 | 134 | 226 | 305 | 469 | 616 |
| 1.1 | 66 | 110 | 156 | 73 | 147 | 249 | 335 | 516 | 677 |
| 1.2 | 72 | 120 | 171 | 79 | 161 | 272 | 366 | 563 | 739 |
| 1.3 | 78 | 130 | 185 | 86 | 174 | 294 | 396 | 610 | 801 |
| 1.4 | 84 | 140 | 199 | 92 | 187 | 317 | 427 | 657 | 862 |
| 1.5 | 90 | 150 | 213 | 99 | 201 | 340 | 457 | 704 | 924 |
| 1.6 | 96 | 160 | 227 | 106 | 214 | 362 | 487 | 751 | 985 |
| 1.7 | 102 | 169 | 242 | 112 | 228 | 385 | 518 | 797 | 1047 |
| 1.8 | 108 | 179 | 256 | 119 | 241 | 407 | 548 | 844 | 1109 |
| 1.9 | 114 | 189 | 270 | 125 | 254 | 430 | 579 | 891 | 1170 |
| 2 | 120 | 199 | 284 | 132 | 268 | 453 | 609 | 938 | 1232 |
| 2.1 | 126 | 209 | 298 | 139 | 281 | 475 | 640 | 985 | 1293 |
| 2.2 | 132 | 219 | 313 | 145 | 294 | 498 | 670 | 1032 | 1355 |
| 2.3 | 138 | 229 | 327 | 152 | 308 | 521 | 701 | 1079 | 1417 |
| 2.4 | 144 | 239 | 341 | 158 | 321 | 543 | 731 | 1126 | 1478 |
| 2.5 | 150 | 249 | 355 | 165 | 335 | 566 | 762 | 1173 | 1540 |
| 2.6 | 156 | 259 | 369 | 172 | 348 | 589 | 792 | 1220 | 1601 |
| 2.7 | 162 | 269 | 384 | 178 | 361 | 611 | 823 | 1267 | 1663 |
| 2.8 | 168 | 279 | 398 | 185 | 375 | 634 | 853 | 1313 | 1725 |
| 2.9 | 174 | 289 | 412 | 192 | 388 | 656 | 884 | 1360 | 1786 |
| 3 | 180 | 299 | 426 | 198 | 401 | 679 | 914 | 1407 | 1848 |
| 3.1 | 186 | 309 | 441 | 205 | 415 | 702 | 944 | 1454 | 1909 |
| 3.2 | 192 | 319 | 455 | 211 | 428 | 724 | 975 | 1501 | 1971 |
| 3.3 | 198 | 329 | 469 | 218 | 442 | 747 | 1005 | 1548 | 2032 |

| Vd | Mini | Mini | Mini | Std | Std | Std | Std | Std | Std |
|---|---|---|---|---|---|---|---|---|---|
| Fuse rating | 5 A | 7.5 A | 10 A | 5 A | 10 A | 15 A | 20 A | 25 A | 30 A |
| mV | Current Draw [mA] | | | | | | | | |
| 3.4 | 204 | 339 | 483 | 225 | 455 | 770 | 1036 | 1595 | 2094 |
| 3.5 | 210 | 349 | 497 | 231 | 468 | 792 | 1066 | 1642 | 2156 |
| 3.6 | 216 | 359 | 512 | 238 | 482 | 815 | 1097 | 1689 | 2217 |
| 3.7 | 222 | 369 | 526 | 244 | 495 | 837 | 1127 | 1736 | 2279 |
| 3.8 | 228 | 379 | 540 | 251 | 509 | 860 | 1158 | 1782 | 2340 |
| 3.9 | 234 | 389 | 554 | 258 | 522 | 883 | 1188 | 1829 | 2402 |
| 4 | 240 | 399 | 568 | 264 | 535 | 905 | 1219 | 1876 | 2464 |
| 4.1 | 246 | 409 | 583 | 271 | 549 | 928 | 1249 | 1923 | 2525 |
| 4.2 | 252 | 419 | 597 | 277 | 562 | 951 | 1280 | 1970 | 2587 |
| 4.3 | 258 | 429 | 611 | 284 | 575 | 973 | 1310 | 2017 | 2648 |
| 4.4 | 264 | 439 | 625 | 291 | 589 | 996 | 1341 | 2064 | 2710 |
| 4.5 | 270 | 449 | 639 | 297 | 602 | 1019 | 1371 | 2111 | 2772 |
| 4.6 | 276 | 459 | 654 | 304 | 616 | 1041 | 1401 | 2158 | 2833 |
| 4.7 | 282 | 469 | 668 | 310 | 629 | 1064 | 1432 | 2205 | 2895 |
| 4.8 | 288 | 479 | 682 | 317 | 642 | 1086 | 1462 | 2252 | 2956 |
| 4.9 | 294 | 488 | 696 | 324 | 656 | 1109 | 1493 | 2298 | 3018 |
| 5 | 300 | 498 | 711 | 330 | 669 | 1132 | 1523 | 2345 | 3080 |
| 5.1 | 306 | 508 | 725 | 337 | 683 | 1154 | 1554 | 2392 | 3141 |
| 5.2 | 312 | 518 | 739 | 343 | 696 | 1177 | 1584 | 2439 | 3203 |
| 5.3 | 318 | 528 | 753 | 350 | 709 | 1200 | 1615 | 2486 | 3264 |
| 5.4 | 324 | 538 | 767 | 357 | 723 | 1222 | 1645 | 2533 | 3326 |
| 5.5 | 330 | 548 | 782 | 363 | 736 | 1245 | 1676 | 2580 | 3387 |
| 5.6 | 336 | 558 | 796 | 370 | 749 | 1268 | 1706 | 2627 | 3449 |
| 5.7 | 342 | 568 | 810 | 376 | 763 | 1290 | 1737 | 2674 | 3511 |
| 5.8 | 348 | 578 | 824 | 383 | 776 | 1313 | 1767 | 2721 | 3572 |
| 5.9 | 354 | 588 | 838 | 390 | 790 | 1335 | 1798 | 2768 | 3634 |
| 6 | 360 | 598 | 853 | 396 | 803 | 1358 | 1828 | 2814 | 3695 |
| 6.1 | 366 | 608 | 867 | 403 | 816 | 1381 | 1858 | 2861 | 3757 |
| 6.2 | 372 | 618 | 881 | 409 | 830 | 1403 | 1889 | 2908 | 3819 |
| 6.3 | 378 | 628 | 895 | 416 | 843 | 1426 | 1919 | 2955 | 3880 |
| 6.4 | 384 | 638 | 909 | 423 | 857 | 1449 | 1950 | 3002 | 3942 |
| 6.5 | 390 | 648 | 924 | 429 | 870 | 1471 | 1980 | 3049 | 4003 |
| 6.6 | 396 | 658 | 938 | 439 | 883 | 1494 | 2011 | 3096 | 4065 |
| 6.7 | 402 | 668 | 952 | 442 | 897 | 1517 | 2041 | 3143 | 4127 |

Advanced Vehicle Diagnosis

| Vd | Mini | Mini | Mini | Std | Std | Std | Std | Std | Std |
|---|---|---|---|---|---|---|---|---|---|
| Fuse rating | 5 A | 7.5 A | 10 A | 5 A | 10 A | 15 A | 20 A | 25 A | 30 A |
| mV | Current Draw [mA] | | | | | | | | |
| 6.8 | 408 | 678 | 966 | 449 | 910 | 1539 | 2072 | 3190 | 4188 |
| 6.9 | 414 | 688 | 981 | 456 | 923 | 1562 | 2102 | 3237 | 4250 |
| 7 | 420 | 698 | 995 | 462 | 937 | 1584 | 2133 | 3284 | 4311 |
| 7.1 | 426 | 708 | 1009 | 469 | 950 | 1607 | 2163 | 3330 | 4373 |
| 7.2 | 432 | 718 | 1023 | 475 | 964 | 1630 | 2194 | 3377 | 4434 |
| 7.3 | 438 | 728 | 1037 | 482 | 977 | 1652 | 2224 | 3424 | 4496 |
| 7.4 | 444 | 738 | 1052 | 489 | 990 | 1675 | 2255 | 3471 | 4558 |
| 7.5 | 450 | 748 | 1066 | 495 | 1004 | 1698 | 2285 | 3518 | 4619 |
| 7.6 | 456 | 758 | 1080 | 502 | 1017 | 1720 | 2315 | 3565 | 4681 |
| 7.7 | 462 | 768 | 1094 | 508 | 1030 | 1743 | 2346 | 3612 | 4742 |
| 7.8 | 468 | 778 | 1108 | 515 | 1044 | 1766 | 2376 | 3659 | 4804 |
| 7.9 | 474 | 788 | 1123 | 522 | 1057 | 1788 | 2407 | 3706 | 4866 |
| 8 | 480 | 798 | 1137 | 528 | 1071 | 1811 | 2437 | 3753 | 4927 |
| 8.1 | 486 | 807 | 1151 | 535 | 1084 | 1833 | 2468 | 3800 | 4989 |
| 8.2 | 492 | 817 | 1165 | 541 | 1097 | 1856 | 2498 | 3846 | 5050 |
| 8.3 | 498 | 827 | 1179 | 548 | 1111 | 1879 | 2529 | 3893 | 5112 |
| 8.4 | 504 | 837 | 1194 | 555 | 1124 | 1901 | 2559 | 3940 | 5174 |
| 8.5 | 510 | 847 | 1208 | 561 | 1138 | 1924 | 2590 | 3987 | 5235 |
| 8.6 | 516 | 857 | 1222 | 568 | 1151 | 1947 | 2620 | 4034 | 5297 |
| 8.7 | 522 | 867 | 1236 | 575 | 1164 | 1969 | 2651 | 4081 | 5358 |
| 8.8 | 528 | 877 | 1251 | 581 | 1178 | 1992 | 2681 | 4128 | 5420 |
| 8.9 | 534 | 887 | 1265 | 588 | 1191 | 2015 | 2712 | 4175 | 5482 |
| 9 | 540 | 897 | 1279 | 594 | 1204 | 2037 | 2742 | 4222 | 5543 |
| 9.1 | 546 | 907 | 1293 | 601 | 1218 | 2060 | 2772 | 4269 | 5605 |
| 9.2 | 552 | 917 | 1307 | 608 | 1231 | 2082 | 2803 | 4316 | 5666 |
| 9.3 | 558 | 927 | 1322 | 614 | 1245 | 2105 | 2833 | 4362 | 5728 |
| 9.4 | 564 | 937 | 1336 | 621 | 1258 | 2128 | 2864 | 4409 | 5789 |
| 9.5 | 570 | 947 | 1350 | 627 | 1271 | 2150 | 2894 | 4456 | 5851 |
| 9.6 | 576 | 957 | 1364 | 634 | 1285 | 2173 | 2925 | 4503 | 5913 |
| 9.7 | 582 | 967 | 1378 | 641 | 1298 | 2196 | 2955 | 4550 | 5974 |
| 9.8 | 588 | 977 | 1393 | 647 | 1312 | 2218 | 2986 | 4597 | 6036 |
| 9.9 | 594 | 987 | 1407 | 654 | 1325 | 2241 | 3016 | 4644 | 6097 |
| 10 | 600 | 997 | 1421 | 660 | 1338 | 2263 | 3047 | 4691 | 6159 |

NOTES PAGE