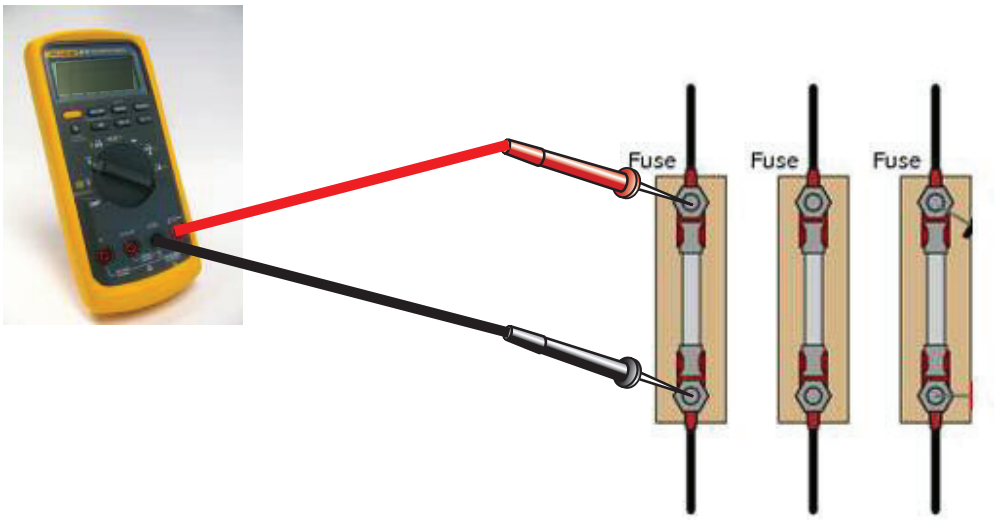
Current Draw Diagnosis

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!

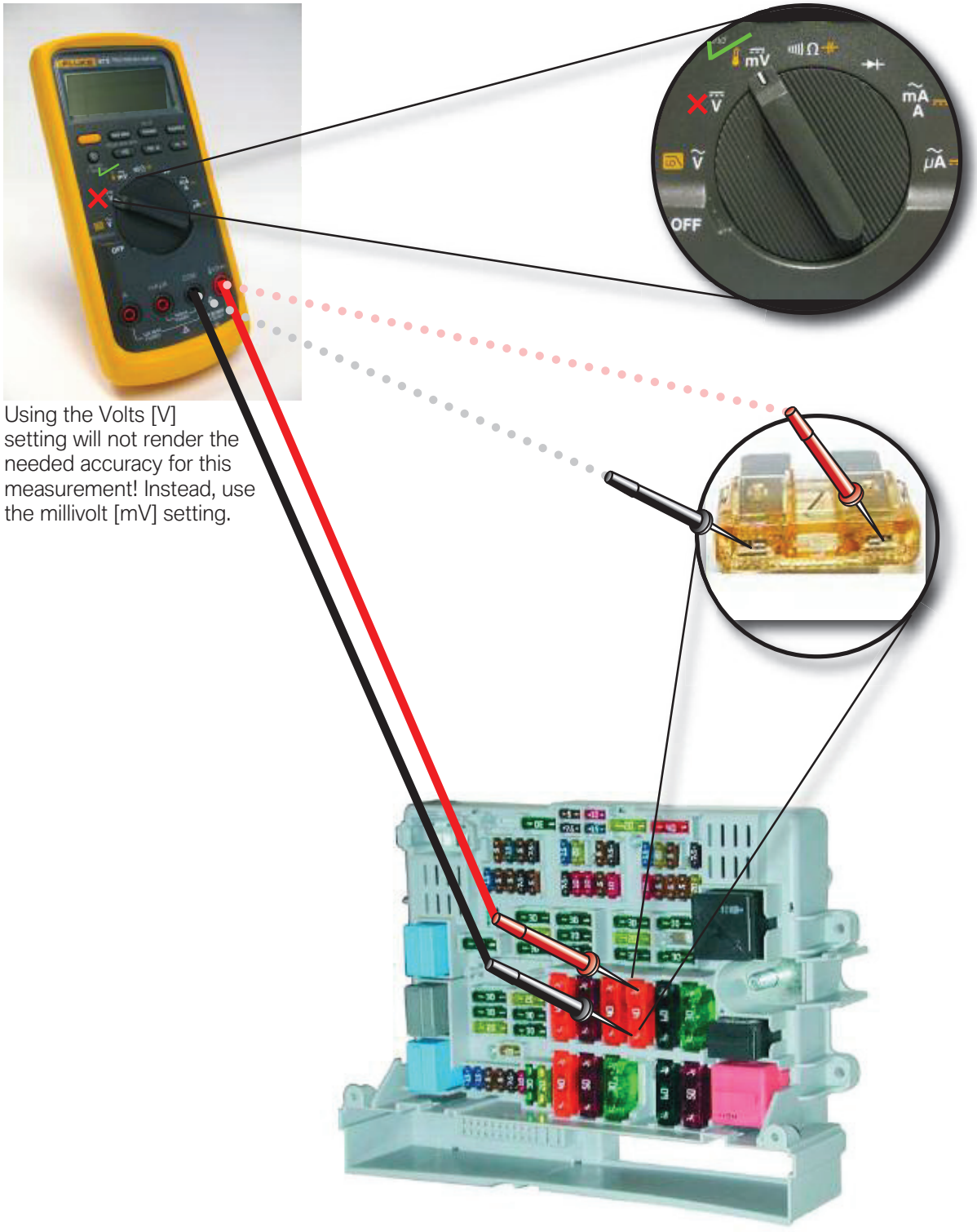
   c) Put one lead on one end of the fuse and the other lead on the opposite end (see graphic on next page).

   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 (2)	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 (1)	12	20	28	13 (3)	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

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