Application Note

Linear Regulator Series

BUxxSD5 Series Dropout Voltage

This application note provides design values of the "Dropout voltage" that are necessary for designing circuits. From the operating temperature and output current of the target specification, check the maximum value of the input/output voltage difference in the next page and use it as the circuit design value. The values listed in this material are "design reference values" that are necessary for designing devices, and the values are not guaranteed. Check the latest data sheet for the guaranteed values.

What is dropout voltage

The dropout voltage is the difference between the input and output voltages that is necessary for the stabilizing operation of a linear regulator. When the input voltage approaches the output voltage, stabilizing operation cannot be maintained and the output starts dropping in proportion to the input. The voltage at which this situation starts, i.e., the difference between the input and output voltages that is necessary for the stabilizing operation, is referred to as the dropout voltage (Figure 1).

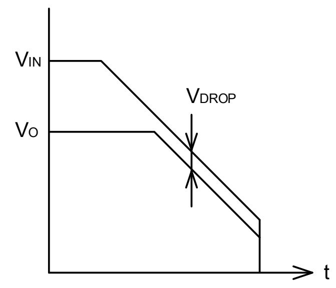

Figure 1. Dropout voltage

Figure 2 shows the relation between the input and output voltages and the dropout voltage. The dropout voltage varies with the circuit configuration of ICs. Compared with a standard linear regulator, an LDO has a smaller dropout voltage. Simply stated, the operation can be performed with the input voltage closer to the output voltage as the dropout voltage is smaller. On the other hand, the dropout voltage is not important in an application where 2.5 V is generated from 5 V.

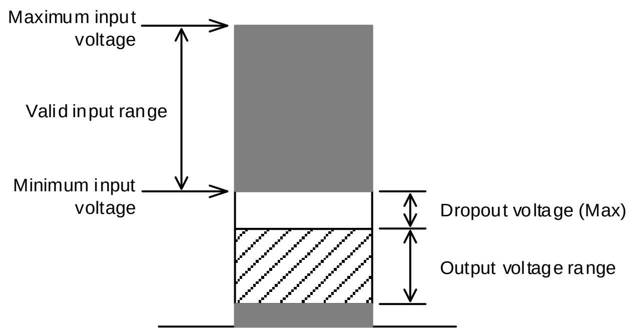

Figure 2. Relation between the input and output voltages

For example, Figure 3 shows the relation between the output current and temperature. It can be said that the dropout voltage is a parameter that varies with the output current and temperature. Therefore, if only the specifications at ordinary temperature are considered in the design, the circuit may not work at high temperature.

Study of dropout voltage and characteristics

The minimum value of the input voltage is determined by adding the output voltage to the dropout voltage at the load current to be used. At this time, the operation can work as DC, but the control performance is degraded. When there are fluctuations in the load, a large current cannot be supplied in a short period of time from input to output, as the dropout voltage is small. In other words, the load responsiveness will slow down. The slowness in responsiveness will also show up as a degradation in the PSRR characteristics. If only the minimum voltage amount of the dropout voltage is secured in order to focus on efficiency, the expected characteristics of the LDO will not be achieved. Increase the input voltage until the high-speed load responsiveness and PSRR performance is achieved, and find a trade-off between efficiency and each characteristic.

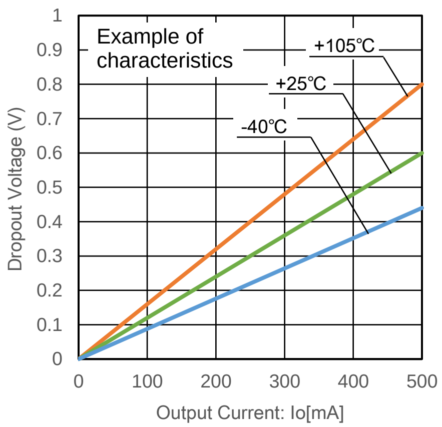

Figure 3. Relation with the output current and temperature

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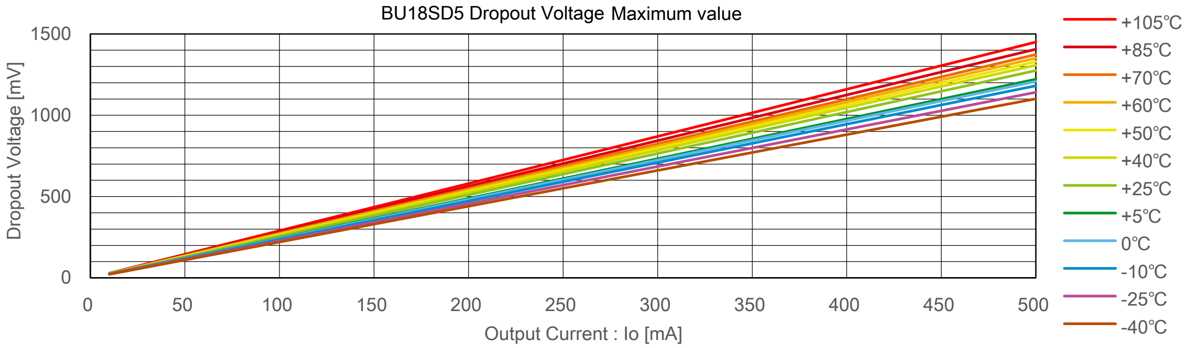
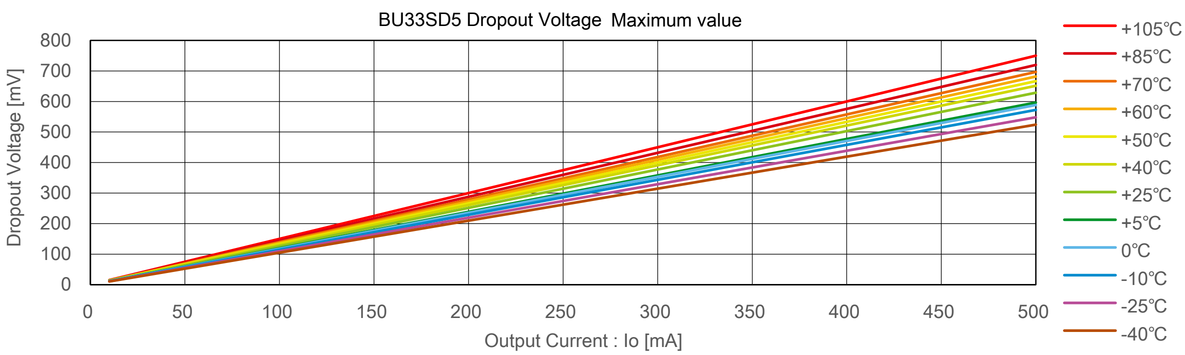
Maximum value, BU18SD5



I_O [mA]	Dropout Voltage Maximum Value [mV]											
	-40℃	-25℃	-10℃	0℃	+5℃	+25℃	+40℃	+50℃	+60℃	+70℃	+85℃	+105℃
10	22	23	24	24	24	25	26	27	27	27	28	29
50	110	114	118	121	122	127	131	133	135	137	141	145
100	220	228	236	242	244	255	262	266	270	275	281	290
150	330	342	354	362	366	382	392	399	405	412	422	435
200	441	457	473	483	489	510	523	532	541	549	563	580
250	551	571	591	604	611	637	654	665	676	687	703	725
300	661	685	709	725	733	765	785	798	811	824	844	870
350	771	799	827	846	855	892	915	931	946	961	984	1015
400	881	913	945	966	977	1020	1046	1064	1081	1099	1125	1160
450	991	1027	1063	1087	1099	1147	1177	1197	1216	1236	1266	1305
500	1101	1141	1181	1208	1221	1275	1308	1330	1352	1373	1406	1450

Maximum value, BU33SD5



I_O [mA]	Dropout Voltage Maximum Value [mV]											
	-40℃	-25℃	-10℃	0℃	+5℃	+25℃	+40℃	+50℃	+60℃	+70℃	+85℃	+105℃
10	10	11	11	12	12	13	13	13	14	14	14	15
50	52	55	57	59	60	63	65	67	68	70	72	75
100	105	110	114	118	119	126	130	133	136	139	144	150
150	157	164	172	177	179	189	195	200	205	209	216	225
200	210	219	229	235	239	251	261	267	273	279	288	300
250	262	274	286	294	298	314	326	333	341	348	360	375
300	314	329	343	353	358	377	391	400	409	418	432	450
350	367	384	401	412	418	440	456	467	477	488	504	525
400	419	439	458	471	477	503	521	533	545	558	576	600
450	472	493	515	530	537	566	586	600	614	627	648	675
500	524	548	572	588	597	629	651	667	682	697	720	750

These values are “design reference values” that are necessary for circuit design, and the values are not guaranteed. Check the latest data sheet for the guaranteed values.

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