Linear Regulator Series

BDxxKA5 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).

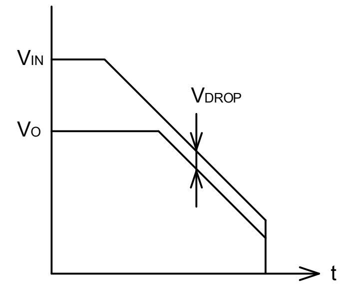


Figure 1. Dropout voltage

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 5 V is generated from 12 V.

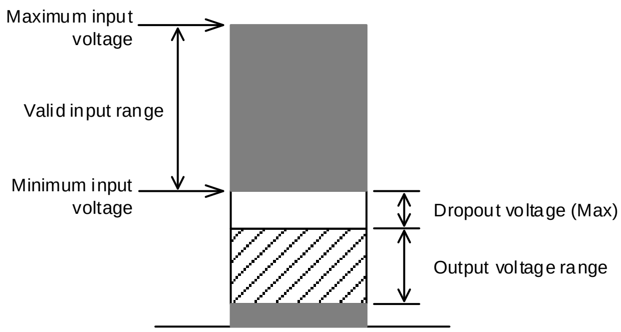


Figure 2. Relation between the input and output voltages

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.

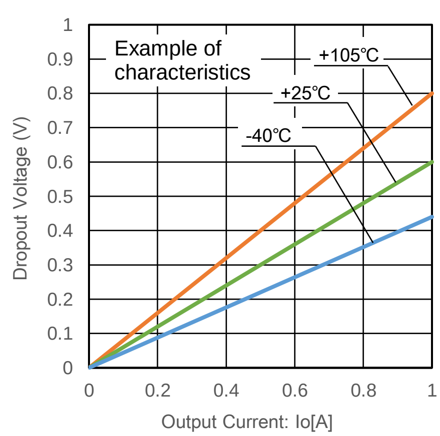
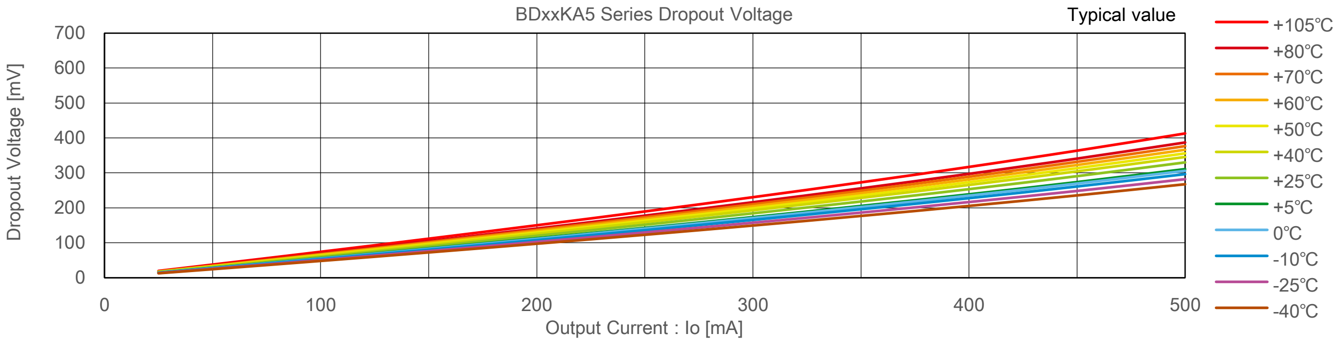


Figure 3. Relation with the output current and temperature

Study of dropout voltage and characteristics

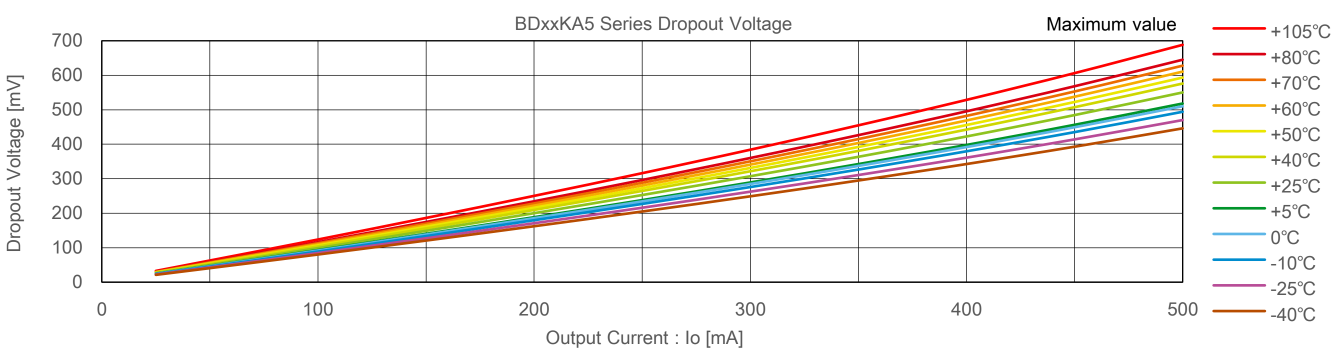
The minimum value of the input voltage is determined by adding the output voltage to the dropout voltage at the load current to be used. At this time, the operation can work as DC, but the control performance is degraded. When there are fluctuations in the load, a large current cannot be supplied in 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.

Typical value



I_O [mA]	Dropout Voltage Typical Value [mV]											
	-40℃	-25℃	-10℃	0℃	+5℃	+25℃	+40℃	+50℃	+60℃	+70℃	+80℃	+105℃
25	13	13	14	14	15	16	16	17	17	18	18	20
50	24	26	27	28	28	30	31	32	33	34	35	38
100	48	51	53	55	56	59	62	64	66	68	70	74
150	72	76	80	83	84	89	93	96	99	102	105	112
200	97	103	108	111	113	120	126	129	133	137	141	150
250	123	130	136	141	143	152	159	163	168	173	178	190
300	149	157	165	171	174	184	193	199	204	210	216	230
350	177	186	196	202	205	218	228	235	242	249	256	273
400	206	217	228	235	239	254	265	273	281	289	297	317
450	236	248	261	270	274	291	304	314	323	332	341	364
500	268	282	296	306	311	330	346	356	366	377	387	413

Maximum value



I_O [mA]	Dropout Voltage Maximum Value [mV]											
	-40℃	-25℃	-10℃	0℃	+5℃	+25℃	+40℃	+50℃	+60℃	+70℃	+80℃	+105℃
25	21	22	23	24	25	26	27	28	29	30	31	33
50	41	43	45	46	47	50	52	54	56	57	59	63
100	80	84	89	92	93	99	103	107	110	113	116	124
150	121	127	134	138	140	149	156	160	165	170	174	186
200	162	171	180	185	188	200	209	216	222	228	235	250
250	205	216	227	234	238	253	265	272	280	288	296	316
300	249	262	276	285	289	307	322	331	341	350	360	384
350	295	311	327	337	342	364	381	392	404	415	426	455
400	343	361	379	392	398	423	442	456	469	482	495	529
450	393	414	435	449	456	485	507	523	538	553	568	606
500	446	470	494	510	518	550	576	593	611	628	645	688

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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