

Linear Regulator Series

BUxxTD2 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).

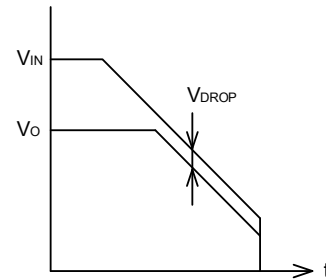


Figure 1. Dropout voltage

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.

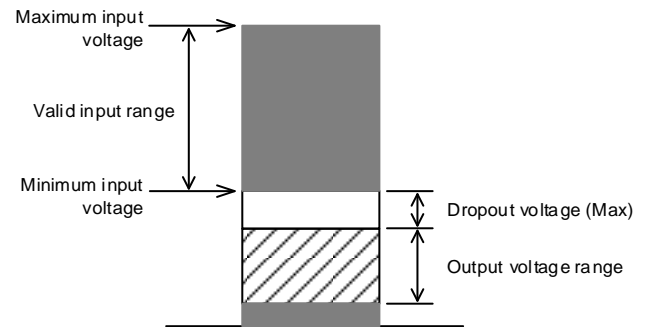


Figure 2. Relation between the input and output voltages

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.

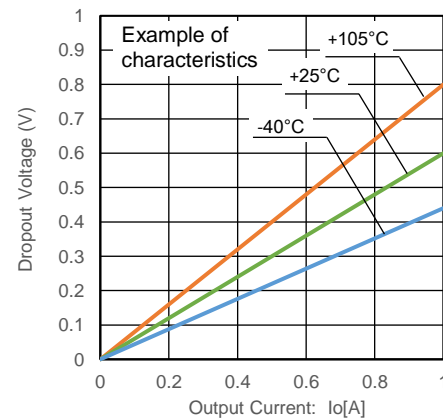
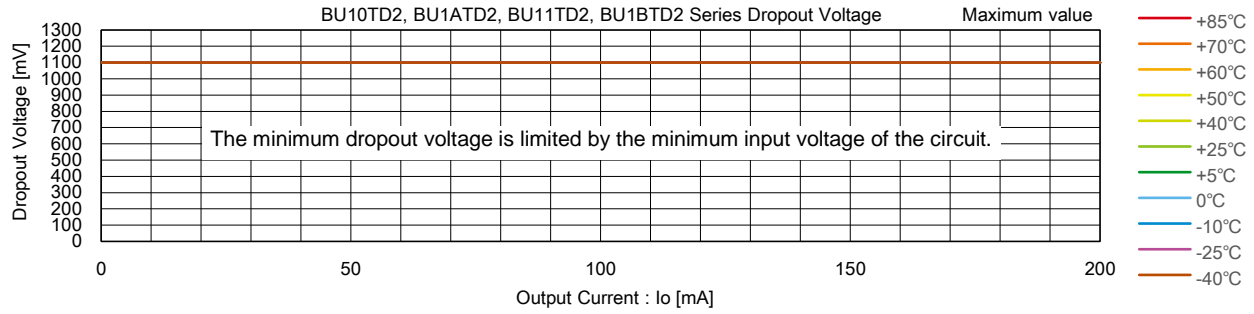


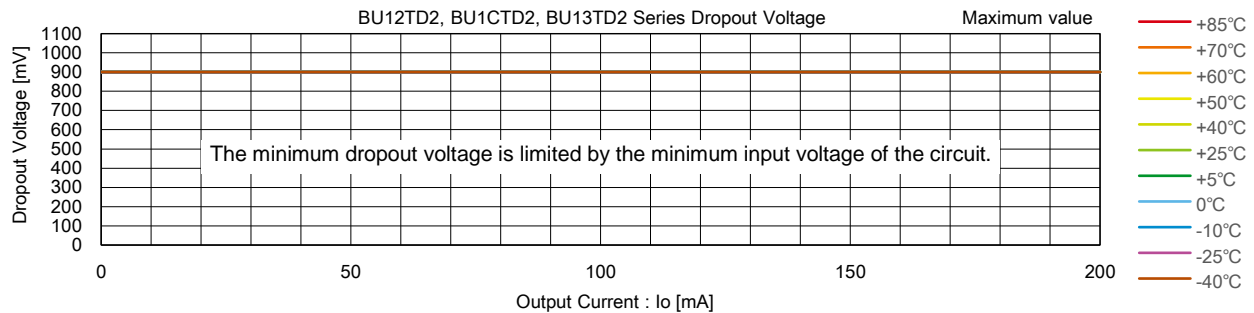
Figure 3. Relation with the output current and temperature

Maximum value, BU10TD2, BU1ATD2, BU11TD2, BU1BTD2



Io [mA]	Dropout Voltage Maximum Value [mV]										
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C
0	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
20	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
40	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
60	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
80	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
120	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
140	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
160	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
180	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
200	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100

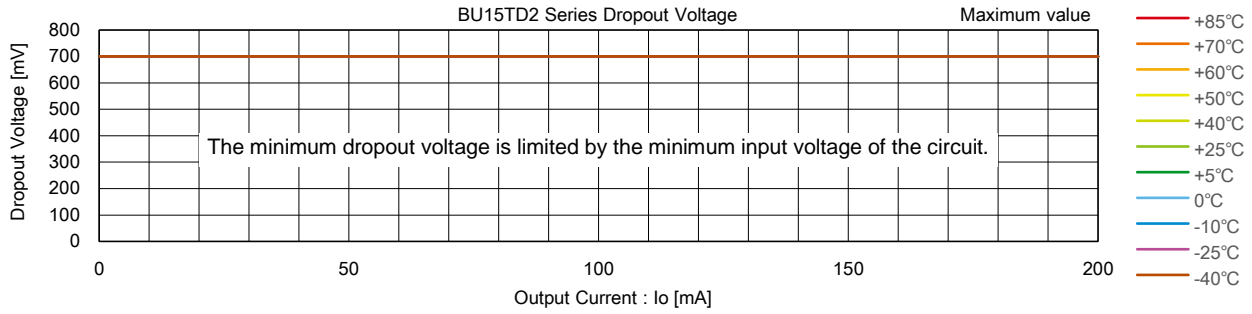
Maximum value, BU12TD2, BU1CTD2, BU13TD2



Io [mA]	Dropout Voltage Maximum Value [mV]										
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C
0	900	900	900	900	900	900	900	900	900	900	900
20	900	900	900	900	900	900	900	900	900	900	900
40	900	900	900	900	900	900	900	900	900	900	900
60	900	900	900	900	900	900	900	900	900	900	900
80	900	900	900	900	900	900	900	900	900	900	900
100	900	900	900	900	900	900	900	900	900	900	900
120	900	900	900	900	900	900	900	900	900	900	900
140	900	900	900	900	900	900	900	900	900	900	900
160	900	900	900	900	900	900	900	900	900	900	900
180	900	900	900	900	900	900	900	900	900	900	900
200	900	900	900	900	900	900	900	900	900	900	900

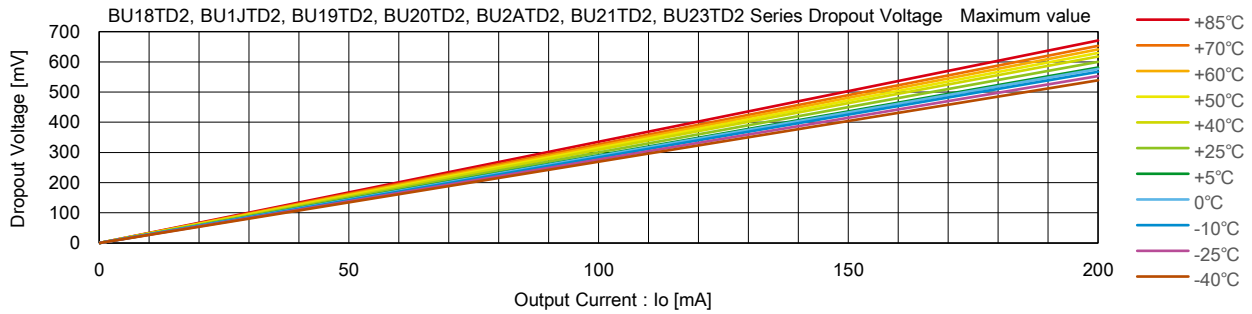
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Maximum value, BU15TD2



Io [mA]	Dropout Voltage Maximum Value [mV]											
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C	
0	700	700	700	700	700	700	700	700	700	700	700	700
20	700	700	700	700	700	700	700	700	700	700	700	700
40	700	700	700	700	700	700	700	700	700	700	700	700
60	700	700	700	700	700	700	700	700	700	700	700	700
80	700	700	700	700	700	700	700	700	700	700	700	700
100	700	700	700	700	700	700	700	700	700	700	700	700
120	700	700	700	700	700	700	700	700	700	700	700	700
140	700	700	700	700	700	700	700	700	700	700	700	700
160	700	700	700	700	700	700	700	700	700	700	700	700
180	700	700	700	700	700	700	700	700	700	700	700	700
200	700	700	700	700	700	700	700	700	700	700	700	700

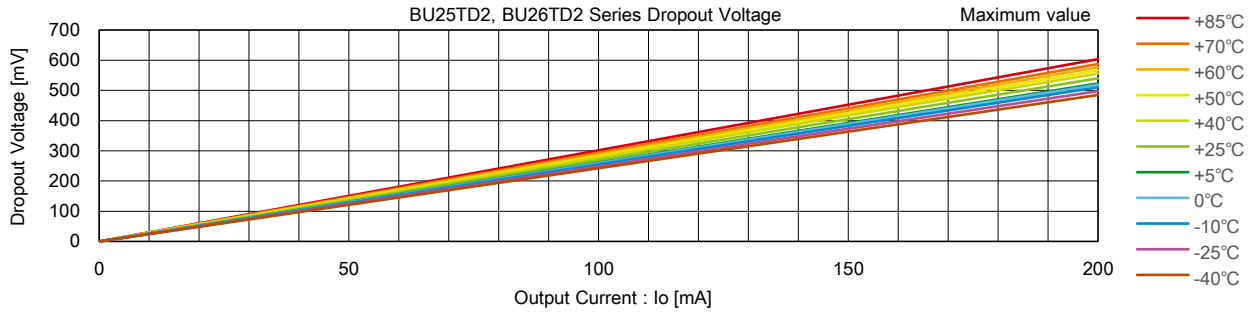
Maximum value, BU18TD2, BU1JTD2, BU19TD2, BU20TD2, BU2ATD2, BU21TD2, BU23TD2



Io [mA]	Dropout Voltage Maximum Value [mV]											
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C	
0	0	0	0	0	0	0	0	0	0	0	0	0
20	54	55	57	58	58	60	62	63	64	65	67	67
40	108	111	113	115	116	120	124	126	128	131	134	134
60	162	166	170	173	174	180	185	189	192	196	201	201
80	216	221	227	231	232	240	247	252	256	261	268	268
100	269	276	284	288	291	300	309	315	321	326	335	335
120	323	332	340	346	349	360	371	378	385	392	402	402
140	377	387	397	404	407	420	432	441	449	457	469	469
160	431	442	454	461	465	480	494	504	513	522	537	537
180	485	498	510	519	523	540	556	566	577	588	604	604
200	539	553	567	576	581	600	618	629	641	653	671	671

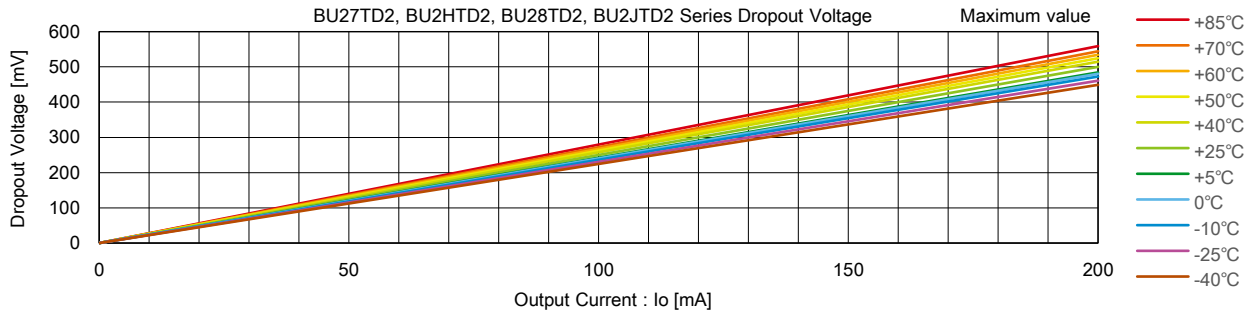
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Maximum value, BU25TD2, BU26TD2



Io [mA]	Dropout Voltage Maximum Value [mV]											
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C	
0	0	0	0	0	0	0	0	0	0	0	0	
20	48	50	51	52	52	54	56	57	58	59	60	
40	97	100	102	104	105	108	111	113	115	118	121	
60	145	149	153	156	157	162	167	170	173	176	181	
80	194	199	204	208	209	216	222	227	231	235	241	
100	242	249	255	259	262	270	278	283	289	294	302	
120	291	299	306	311	314	324	334	340	346	353	362	
140	339	348	357	363	366	378	389	397	404	411	423	
160	388	398	408	415	418	432	445	453	462	470	483	
180	436	448	459	467	471	486	500	510	519	529	543	
200	485	498	510	519	523	540	556	566	577	588	604	

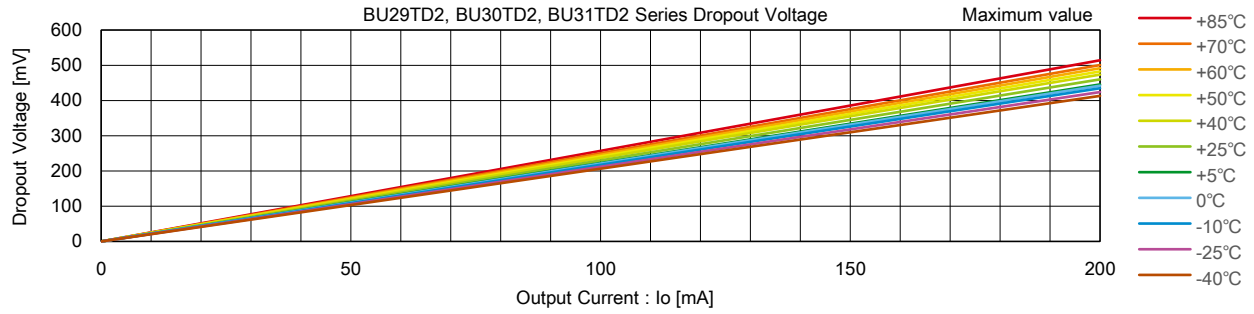
Maximum value, BU27TD2, BU2HTD2, BU28TD2, BU2JTD2



Io [mA]	Dropout Voltage Maximum Value [mV]											
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C	
0	0	0	0	0	0	0	0	0	0	0	0	
20	45	46	47	48	48	50	51	52	53	54	56	
40	90	92	95	96	97	100	103	105	107	109	112	
60	135	138	142	144	145	150	154	157	160	163	168	
80	180	184	189	192	194	200	206	210	214	218	224	
100	225	230	236	240	242	250	257	262	267	272	279	
120	269	276	284	288	291	300	309	315	321	326	335	
140	314	323	331	336	339	350	360	367	374	381	391	
160	359	369	378	384	387	400	412	420	427	435	447	
180	404	415	425	432	436	450	463	472	481	490	503	
200	449	461	473	480	484	500	515	525	534	544	559	

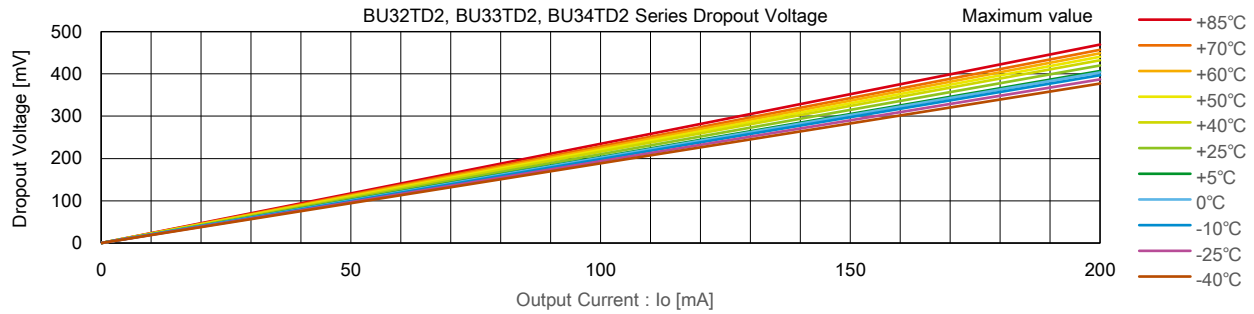
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Maximum value, BU29TD2, BU30TD2, BU31TD2



Io [mA]	Dropout Voltage Maximum Value [mV]											
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C	
0	0	0	0	0	0	0	0	0	0	0	0	
20	41	42	43	44	45	46	47	48	49	50	51	
40	83	85	87	88	89	92	95	97	98	100	103	
60	124	127	130	133	134	138	142	145	147	150	154	
80	165	170	174	177	178	184	189	193	197	200	206	
100	207	212	217	221	223	230	237	241	246	250	257	
120	248	254	261	265	267	276	284	290	295	300	309	
140	289	297	304	309	312	322	331	338	344	350	360	
160	330	339	348	354	356	368	379	386	393	401	411	
180	372	382	391	398	401	414	426	434	442	451	463	
200	413	424	435	442	446	460	474	483	492	501	514	

Maximum value, BU32TD2, BU33TD2, BU34TD2



Io [mA]	Dropout Voltage Maximum Value [mV]											
	-40°C	-25°C	-10°C	0°C	+5°C	+25°C	+40°C	+50°C	+60°C	+70°C	+85°C	
0	0	0	0	0	0	0	0	0	0	0	0	
20	38	39	40	40	41	42	43	44	45	46	47	
40	75	77	79	81	81	84	86	88	90	91	94	
60	113	116	119	121	122	126	130	132	135	137	141	
80	151	155	159	161	163	168	173	176	180	183	188	
100	189	194	198	202	203	210	216	220	224	229	235	
120	226	232	238	242	244	252	259	264	269	274	282	
140	264	271	278	282	285	294	303	308	314	320	329	
160	302	310	318	323	325	336	346	352	359	366	376	
180	339	348	357	363	366	378	389	397	404	411	423	
200	377	387	397	404	407	420	432	441	449	457	469	

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