

## Linear Regulator Series

# BUxxTA2 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  $V_{IN}$  and  $V_O$  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).

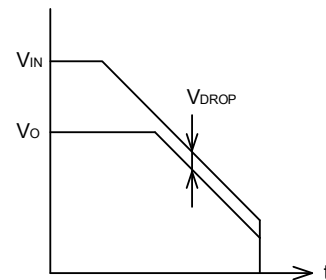


Figure 1. Dropout voltage

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.

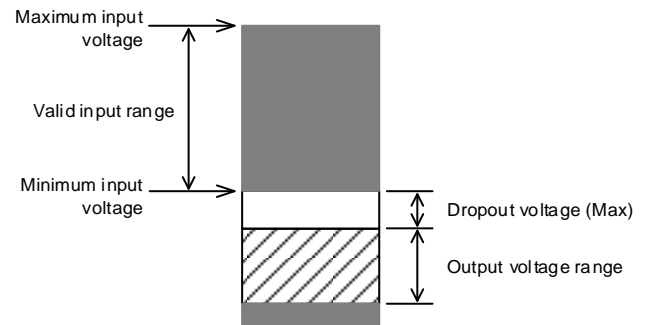


Figure 2. Relation between the input and output voltages

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.

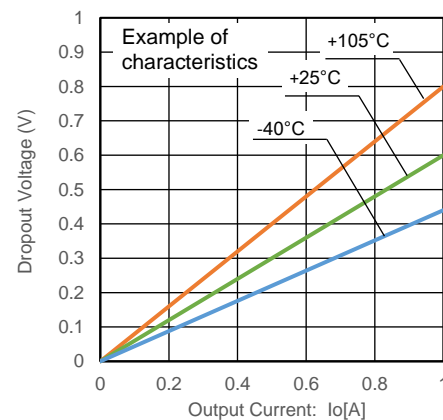
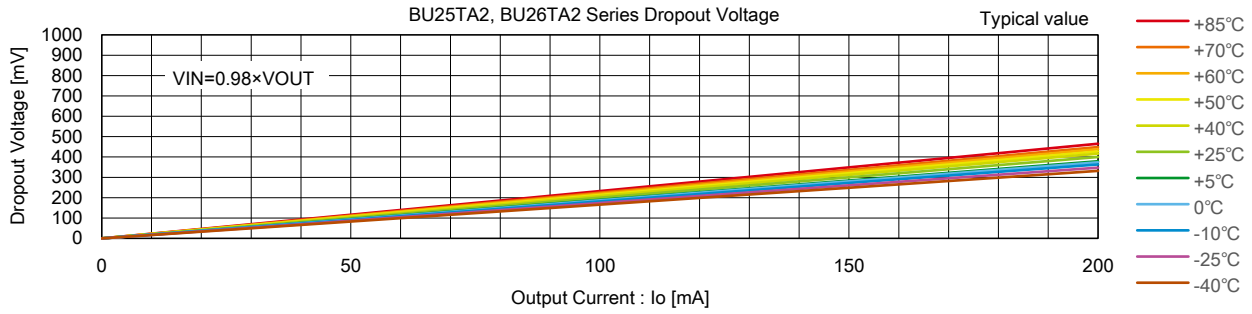


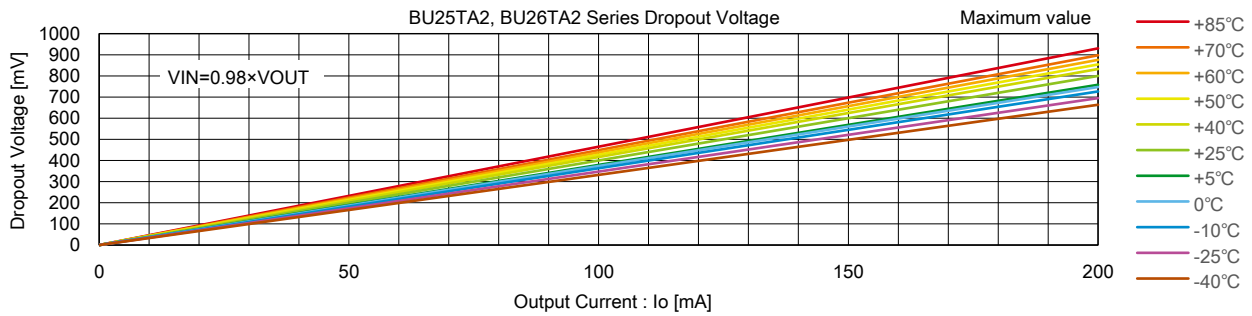
Figure 3. Relation with the output current and temperature

Typical value, BU25TA2, BU26TA2



I <sub>o</sub> [mA]	Dropout Voltage Typical 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	33	35	36	37	38	40	42	43	44	45	47	
40	66	70	73	75	76	80	83	85	88	90	93	
60	100	104	109	112	114	120	125	128	131	135	140	
80	133	139	145	150	152	160	167	171	175	180	186	
100	166	174	182	187	190	200	208	214	219	224	233	
120	199	209	218	224	227	240	250	256	263	269	279	
140	232	243	254	262	265	280	291	299	307	314	326	
160	265	278	291	299	303	320	333	342	350	359	372	
180	299	313	327	336	341	360	375	384	394	404	419	
200	332	348	363	374	379	400	416	427	438	449	465	

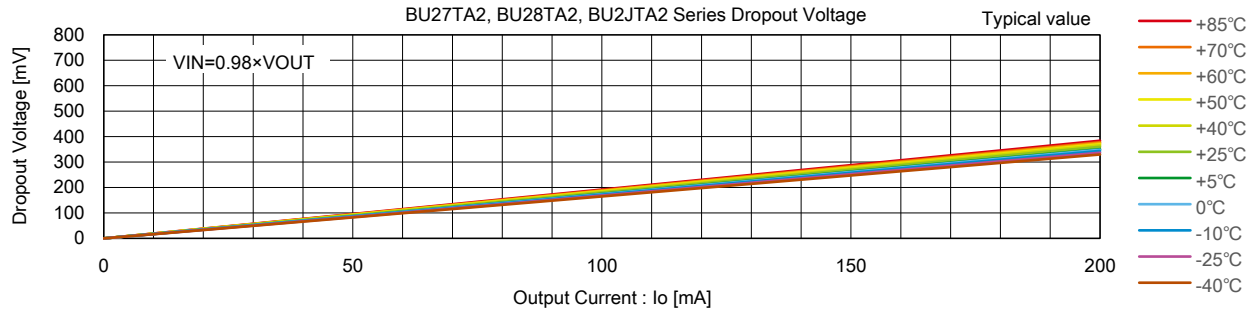
Maximum value, BU25TA2, BU26TA2



I <sub>o</sub> [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	66	70	73	75	76	80	83	85	88	90	93	
40	133	139	145	150	152	160	167	171	175	180	186	
60	199	209	218	224	227	240	250	256	263	269	279	
80	265	278	291	299	303	320	333	342	350	359	372	
100	332	348	363	374	379	400	416	427	438	449	465	
120	398	417	436	449	455	480	500	513	526	539	558	
140	465	487	509	523	531	560	583	598	613	628	651	
160	531	556	581	598	606	640	666	683	701	718	744	
180	597	626	654	673	682	720	749	769	788	808	837	
200	664	695	727	748	758	800	833	854	876	898	930	

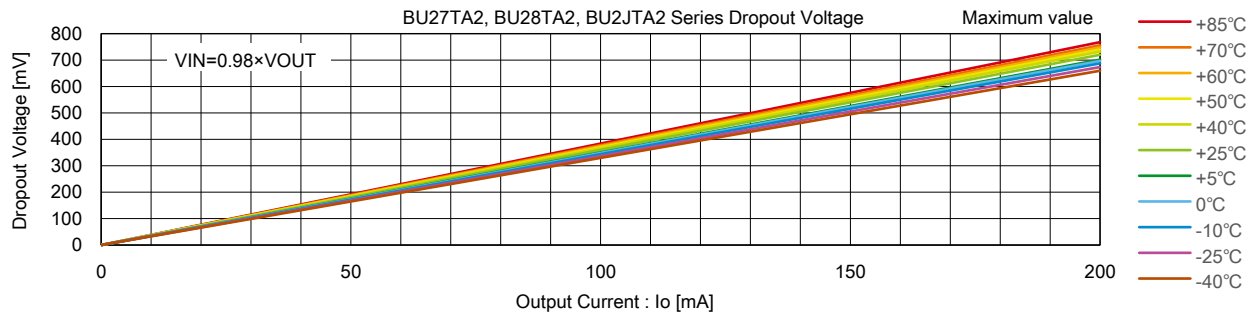
These values are “design reference values” that are necessary for circuit design, and the values are not guaranteed. Check the latest data sheet for the guaranteed values.

Typical value, BU27TA2, BU28TA2, BU2JTA2



$I_o$ [mA]	Dropout Voltage Typical 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	33	34	34	35	35	36	37	37	37	38	38	38
40	66	67	69	70	70	72	73	74	75	76	77	77
60	99	101	103	105	105	108	110	111	112	113	115	115
80	132	135	138	139	140	144	146	148	150	151	154	154
100	165	168	172	174	175	180	183	185	187	189	192	192
120	198	202	206	209	210	216	220	222	224	227	230	230
140	231	236	241	244	246	252	256	259	262	265	269	269
160	264	269	275	279	281	288	293	296	299	302	307	307
180	297	303	309	314	316	324	329	333	337	340	346	346
200	330	337	344	348	351	360	366	370	374	378	384	384

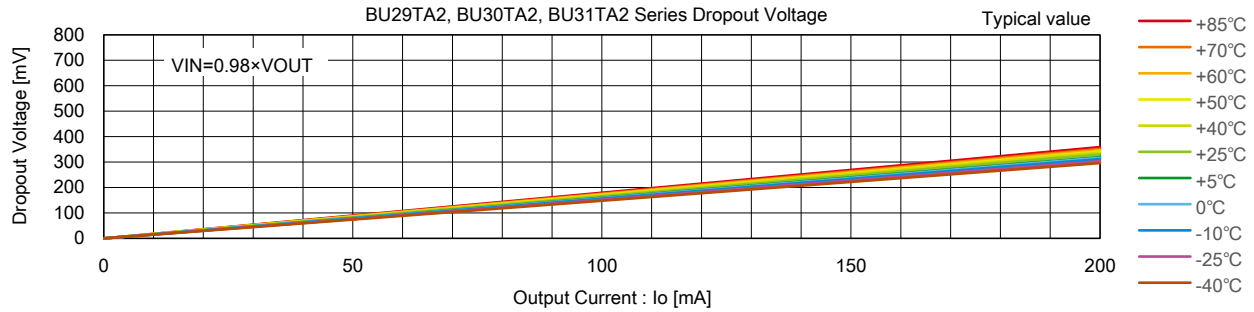
Maximum value, BU27TA2, BU28TA2, BU2JTA2



$I_o$ [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	66	67	69	70	70	72	73	74	75	76	77	77
40	132	135	138	139	140	144	146	148	150	151	154	154
60	198	202	206	209	210	216	220	222	224	227	230	230
80	264	269	275	279	281	288	293	296	299	302	307	307
100	330	337	344	348	351	360	366	370	374	378	384	384
120	396	404	413	418	421	432	439	444	449	454	461	461
140	462	472	481	488	491	504	512	518	524	529	538	538
160	528	539	550	557	561	576	586	592	598	605	614	614
180	594	606	619	627	631	648	659	666	673	680	691	691
200	660	674	688	697	701	720	732	740	748	756	768	768

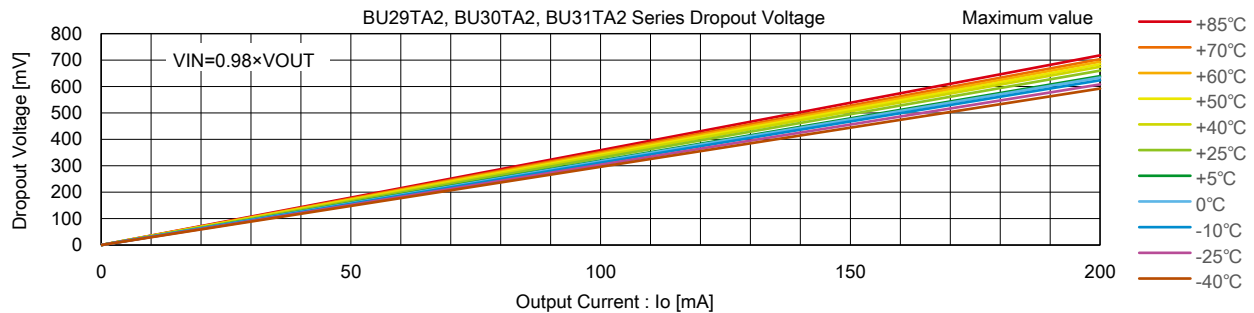
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Typical value, BU29TA2, BU30TA2, BU31TA2



I <sub>o</sub> [mA]	Dropout Voltage Typical 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	30	30	31	32	32	33	34	34	35	35	36	36
40	59	61	62	63	64	66	67	68	69	70	72	72
60	89	91	94	95	96	99	101	103	104	106	108	108
80	118	122	125	127	128	132	135	137	139	141	144	144
100	148	152	156	158	160	165	169	171	173	176	179	179
120	178	182	187	190	192	198	202	205	208	211	215	215
140	207	213	218	222	224	231	236	239	243	246	251	251
160	237	243	249	254	256	264	270	274	277	281	287	287
180	266	274	281	285	288	297	304	308	312	317	323	323
200	296	304	312	317	320	330	337	342	347	352	359	359

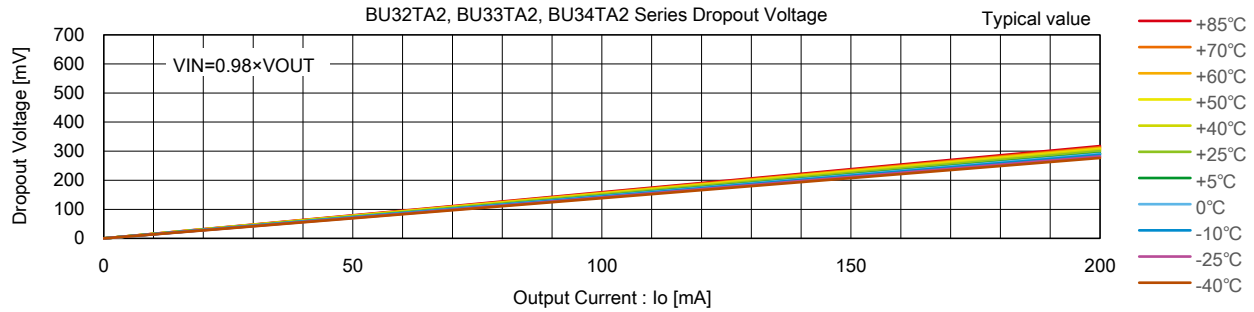
Maximum value, BU29TA2, BU30TA2, BU31TA2



I <sub>o</sub> [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	59	61	62	63	64	66	67	68	69	70	72	72
40	118	122	125	127	128	132	135	137	139	141	144	144
60	178	182	187	190	192	198	202	205	208	211	215	215
80	237	243	249	254	256	264	270	274	277	281	287	287
100	296	304	312	317	320	330	337	342	347	352	359	359
120	355	365	374	380	383	396	405	410	416	422	431	431
140	415	425	436	444	447	462	472	479	486	492	502	502
160	474	486	499	507	511	528	540	547	555	563	574	574
180	533	547	561	571	575	594	607	616	624	633	646	646
200	592	608	623	634	639	660	674	684	694	703	718	718

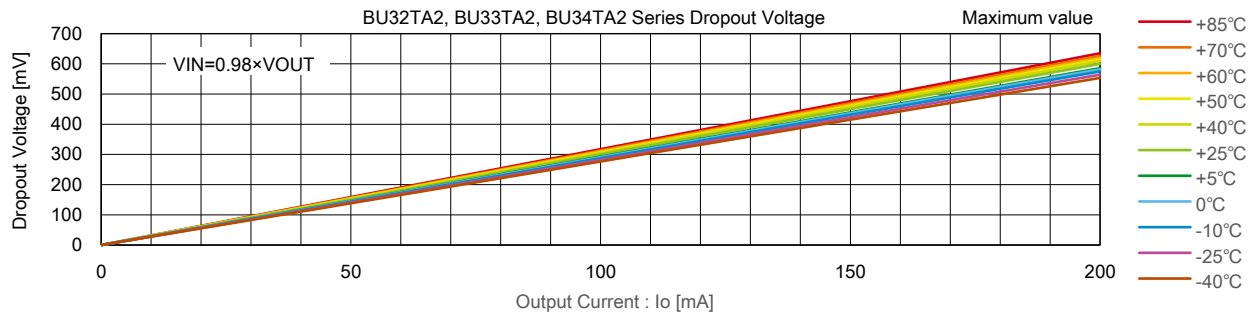
These values are “design reference values” that are necessary for circuit design, and the values are not guaranteed. Check the latest data sheet for the guaranteed values.

Typical value, BU32TA2, BU33TA2, BU34TA2



I <sub>o</sub> [mA]	Dropout Voltage Typical 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	28	28	29	29	29	30	30	31	31	31	32	
40	55	56	57	58	59	60	61	61	62	63	63	
60	83	85	86	87	88	90	91	92	93	94	95	
80	111	113	115	116	117	120	122	123	124	125	127	
100	138	141	144	146	146	150	152	154	155	157	159	
120	166	169	172	175	176	180	183	184	186	188	190	
140	194	197	201	204	205	210	213	215	217	219	222	
160	221	226	230	233	234	240	243	246	248	250	254	
180	249	254	259	262	264	270	274	277	279	282	286	
200	277	282	287	291	293	300	304	307	310	313	317	

Maximum value, BU32TA2, BU33TA2, BU34TA2



I <sub>o</sub> [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	55	56	57	58	59	60	61	61	62	63	63	
40	111	113	115	116	117	120	122	123	124	125	127	
60	166	169	172	175	176	180	183	184	186	188	190	
80	221	226	230	233	234	240	243	246	248	250	254	
100	277	282	287	291	293	300	304	307	310	313	317	
120	332	338	345	349	351	360	365	369	372	376	381	
140	387	395	402	407	410	420	426	430	434	438	444	
160	443	451	460	466	469	480	487	492	496	501	508	
180	498	508	517	524	527	540	548	553	558	564	571	
200	553	564	575	582	586	600	609	615	620	626	635	

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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