DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC29S00 Series

LOW DROPOUT VOLTAGE REGULATOR WITH ON/OFF FUNCTION

The μPC29S00 series is a low dropout regulator which has 100 mA capable for the output current. This series features ON/OFF function to control output voltage.

The μPC29S00 series is suitable for NEC's single chip microcontroller which have on-chip flash memory. The μPC29S00 series is use of erasing and writing data on its flash memory.

FEATURES

- ON/OFF control function (Active high)
- Output current excess of 100 mA
- Surface mount device package
  : 4-pin plastic SIP (TO-126 Gullwing) (7.8 V output)
  ★ 8-pin plastic SOP (225mil) (7.8 V output, 10 V output)
- High accuracy output voltage : ±2% (7.8 V output)
  –2% to +1% (10 V output)
- On-chip all kinds of protection circuit

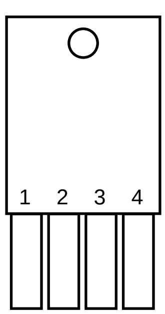
ORDERING INFORMATION

	Part Number	Package	Output Voltage
	μPC29S78H	4-pin plastic SIP (TO-126)	7.8 V
	μPC29S78TA	4-pin plastic SIP (TO-126 Gullwing)	7.8 V
★	μPC29S78GR	8-pin plastic SOP (225 mil)	7.8 V
	μPC29S10GR	8-pin plastic SOP (225 mil)	10 V

PIN CONFIGURATIONS (Marking Side)

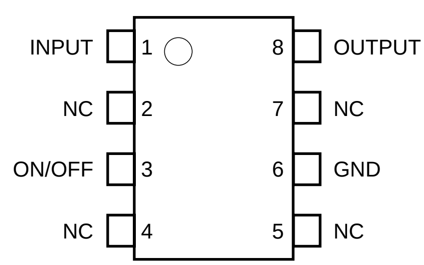
TO-126
- μPC29S78H

TO-126 Gullwing
- μPC29S78TA



1: INPUT
2: ON/OFF
3: GND
4: OUTPUT

8-pin plastic SOP (225mil)
- ★ μPC29S78GR
- μPC29S10GR



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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

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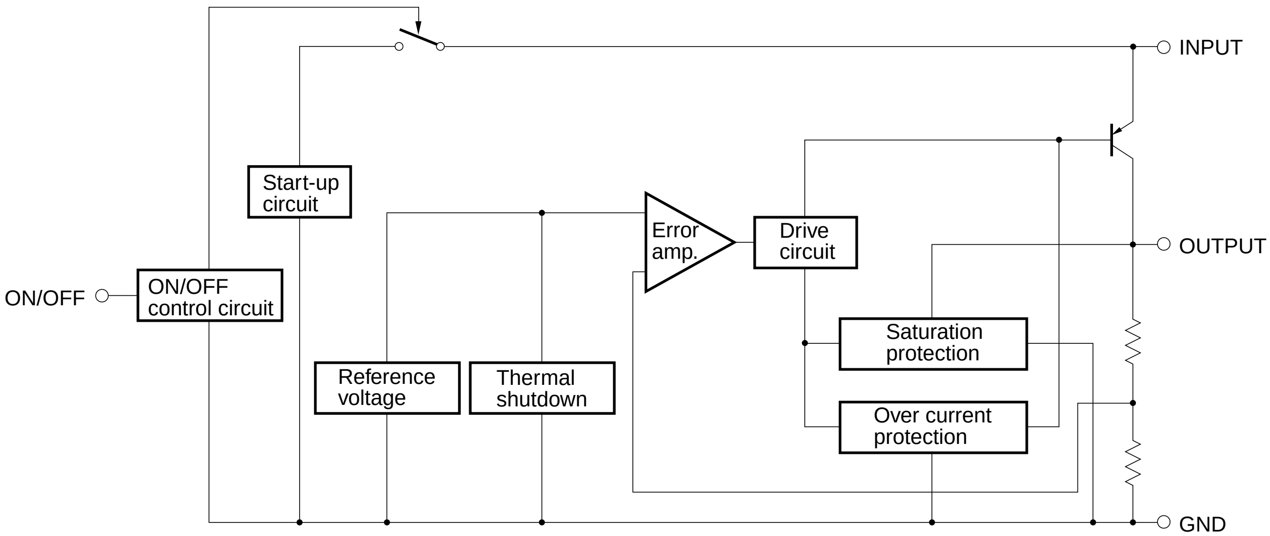
The mark ★ shows major revised points.

BLOCK DIAGRAM



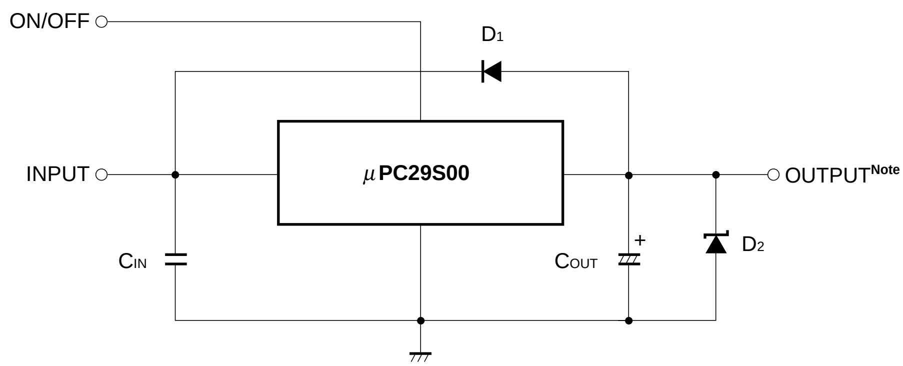
★ ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise specified.)

Parameter	Symbol	Rating		Unit
		μPC29S78H, 29S78TA	μPC29S78GR, 29S10GR	
Input Voltage	V_{IN}	20		V
Internal Power Dissipation	P_T Note	1.2	0.48	W
Operating Ambient Temperature	T_A	–30 to +85		°C
Operating Junction Temperature	T_J	–30 to +150		°C
Storage Temperature	T_{stg}	–55 to +150		°C
Thermal Resistance (Junction to Ambient)	$R_{th\ (J-A)}$	104	260	°C/W

Note $T_A \leq 25$°C, Internally limited
When operating junction temperature rises up to 150°C, the internal circuit shutdown output voltage.

Caution Exposure to Absolute Maximum Ratings for extended periods may affect device reliability; exceeding the ratings could cause permanent damage. The parameters apply independently. The device should be operated within the limits specified under DC and AC Characteristics.

TYPICAL CONNECTION



C_{IN} : 0.1 to 0.47 μF. Be sure to connect to prevent abnormal oscillation. For using capacitors, film capacitors whose voltage and temperature characteristics are excellent are recommended. Take care that some monolithic ceramic capacitor is inferior in the temperature and voltage characteristics. When using the monolithic ceramic capacitor, the C_{IN} needs to be held these capacities in voltage and temperature used.

C_{OUT} : 10 μF or higher. Be sure to connect to prevent oscillation and to improve the transient load stabilization.

Remark Connect the C_{IN} and C_{OUT} to IC pins as close as possible (2 cm or less).

D_1 : Need for $V_O > V_{IN}$

D_2 : Need a shottky barrier diode for $V_O <$ GND.

Note When output is off ($V_{ON/OFF}$ = low level), OUTPUT pin should not be supplied higher voltage than V_{IN} voltage from external.

★ **Caution When using the μPC29S78GR and μPC29S10GR, design your circuit and mounting with consideration for heat radiation.**

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input Voltage	V_{IN}	μPC29S78	8.8		18	V
		μPC29S10	11		18	V
Output Current	I_O		0		100	mA
Operating Ambient Temperature	T_A		–30		+85	°C
Operating Junction Temperature	T_J		–30		+125	°C

Caution If the Absolute Maximum Rating is not exceeded, there is no problem for using recommended operating range or more. Use and evaluate the μPC29S00 Series since the leeway is decreased with the Absolute Maximum Rating. Moreover, the recommended operating range is not prescribed to use when all parameters are maximum value.

ELECTRICAL CHARACTERISTICS

μPC29S78 (V_{IN} = 12 V, I_O = 50 mA, $V_{ON/OFF}$ = 5 V, T_J = 25°C, unless otherwise specified.)

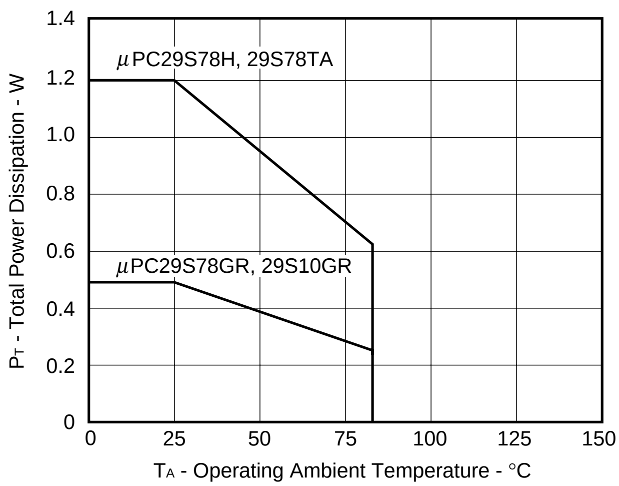
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output Voltage	V_O		7.64	7.8	7.96	V
		8.5 V ≤ V_{IN} ≤18 V, 0 mA ≤ I_O ≤ 50 mA, 0°C ≤ T_J ≤ +125°C	7.56		8.04	
		0 mA ≤ I_O ≤ 100 mA, 0°C ≤ T_J ≤ +125°C	7.56		8.04	
Line Regulation	REG_{IN}	8.8 V ≤ V_{IN} ≤ 18 V		22	75	mV
Load Regulation	REG_L	0 mA ≤ I_O ≤ 100 mA		21	75	mV
Quiescent Current	I_{BIAS}	I_O = 0 mA		3.0	5.0	mA
		I_O = 100 mA		11	25	
Start-up Quiescent Current	$I_{BIAS(s)1}$	V_{IN} = 7.3 V, I_O = 0 mA		10	20	mA
	$I_{BIAS(s)2}$	V_{IN} = 7.3 V, I_O = 100 mA			50	mA
Quiescent Current Change	ΔI_{BIAS}	8.8 V ≤ V_{IN} ≤ 18 V, 0°C ≤ T_J ≤ +125°C			10	mA
Output Noise Voltage	V_n	10 Hz ≤ f ≤ 100 kHz		160		$\mu V_{r.m.s.}$
Ripple Rejection	R·R	f = 120 Hz, 8.8 V ≤ V_{IN} ≤ 13.5 V	42	51		dB
Dropout Voltage	V_{DIF}	I_O = 100 mA, 0°C ≤ T_J ≤ +125°C			1.0	V
Peak Output Current	$I_{O\ peak}$	V_{IN} = 9.8 V	150	250	400	mA
Short Circuit Current	$I_{O\ short}$	V_{IN} = 18 V		250		mA
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA, 0°C ≤ T_J ≤ +125°C		–0.4		mV/°C
ON/OFF Voltage	$V_{ON/OFF1}$	V_{IN} = 12 V, I_O = 10 mA		1.8	2.0	V
	$V_{ON/OFF2}$	V_{IN} = 12 V, I_O = 0 mA	0.8	1.6		V
ON/OFF Current	$I_{ON/OFF1}$	$V_{ON/OFF}$ = 2.7 V, I_O = 0 mA		250	450	μA
	$I_{ON/OFF2}$	$V_{ON/OFF}$ = 5 V, I_O = 0 mA		450	800	μA
Standby Current	$I_{BIAS\ OFF}$	$V_{ON/OFF}$ = 0 V, I_O = 0 mA			10	μA

μPC29S10 (V_{IN} = 12 V, I_O = 50 mA, $V_{ON/OFF}$ = 5 V, T_J = 25°C, unless otherwise specified.)

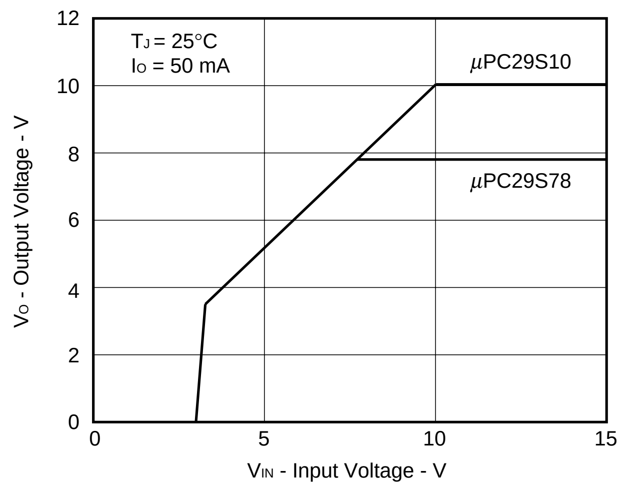
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output Voltage	V_O		9.80	10.00	10.10	V
		11 V ≤ V_{IN} ≤ 18 V, 0 mA ≤ I_O ≤ 50 mA, 0°C ≤ T_J ≤ +125°C	9.70		10.20	
		0 mA ≤ I_O ≤ 100 mA, 0°C ≤ T_J ≤ +125°C	9.70		10.20	
Line Regulation	REG_{IN}	11 V ≤ V_{IN} ≤ 18 V		27	100	mV
Load Regulation	REG_L	0 mA ≤ I_O ≤ 100 mA		18	100	mV
Quiescent Current	I_{BIAS}	I_O = 0 mA		3.3	5.0	mA
		I_O = 100 mA		12	25	
Start-up Quiescent Current	$I_{BIAS(s)1}$	V_{IN} = 9.5 V, I_O = 0 mA		10	20	mA
	$I_{BIAS(s)2}$	V_{IN} = 9.5 V, I_O = 100 mA			50	mA
Quiescent Current Change	ΔI_{BIAS}	11 V ≤ V_{IN} ≤ 18 V, 0°C ≤ T_J ≤ +125°C		1.0	10	mA
Output Noise Voltage	V_n	10 Hz ≤ f ≤ 100 kHz		210		$\mu V_{r.m.s.}$
Ripple Rejection	R·R	f = 120 Hz, 11 V ≤ V_{IN} ≤ 13.5 V	40	48		dB
Dropout Voltage	V_{DIF}	I_O = 100 mA, 0°C ≤ T_J ≤ +125°C		0.4	1.0	V
Peak Output Current	$I_{O\ peak}$	V_{IN} = 12 V	150	250	400	mA
Short Circuit Current	$I_{O\ short}$	V_{IN} = 18 V		180		mA
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA, 0°C ≤ T_J ≤ +125°C		–0.5		mV/°C
ON/OFF Voltage	$V_{ON/OFF1}$	V_{IN} = 12 V, I_O = 10 mA		1.8	2.0	V
	$V_{ON/OFF2}$	V_{IN} = 12 V, I_O = 0 mA	0.8	1.6		V
ON/OFF Current	$I_{ON/OFF1}$	$V_{ON/OFF}$ = 2.7 V, I_O = 0 mA		250	450	μA
	$I_{ON/OFF2}$	$V_{ON/OFF}$ = 5 V, I_O = 0 mA		450	800	μA
Standby Current	$I_{BIAS\ OFF}$	$V_{ON/OFF}$ = 0 V, I_O = 0 mA			10	μA

TYPICAL CHARACTERISTICS (REFERENCE VALUES)

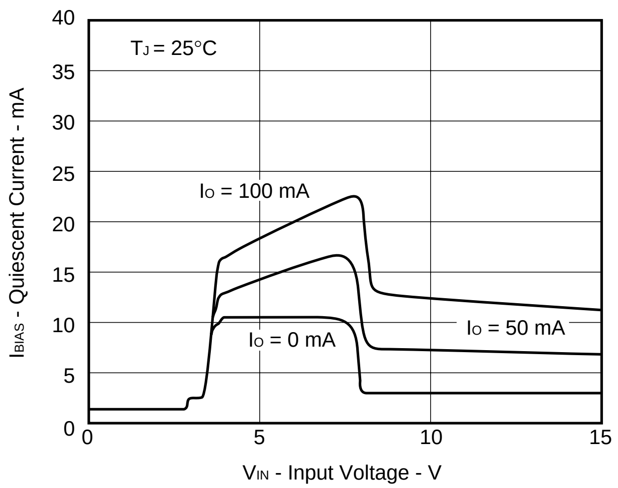
★ P_T vs T_A



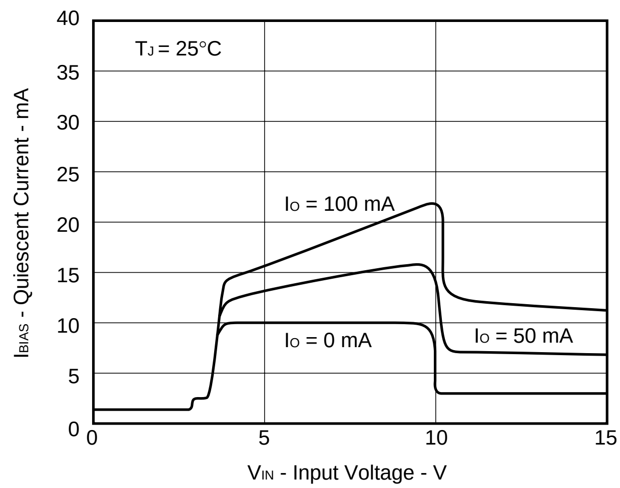
V_O vs V_{IN}



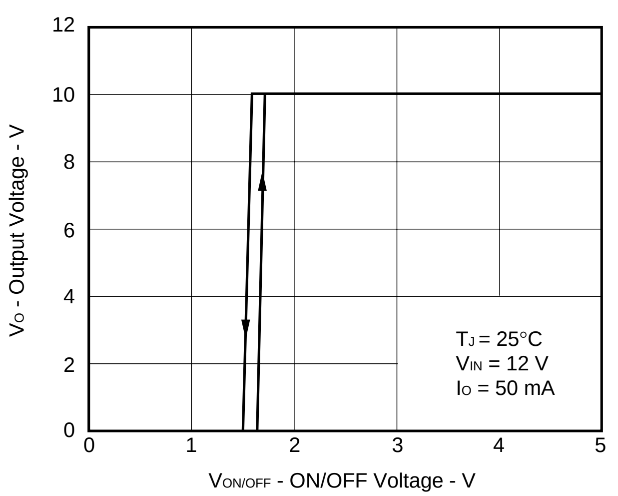
I_{BIAS} ($I_{BIAS(s)}$) vs V_{IN} (μPC29S78)



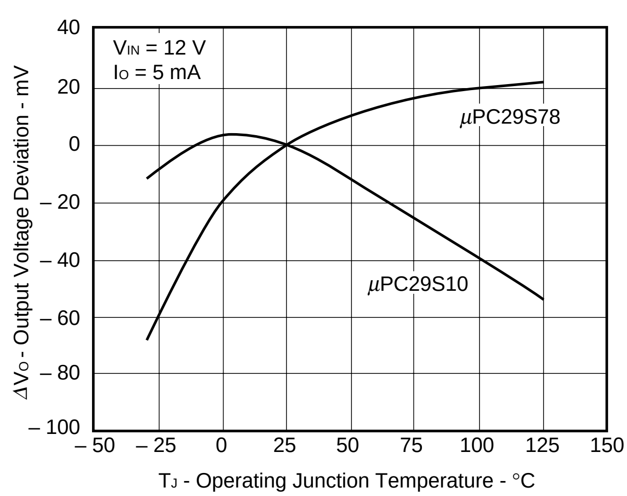
I_{BIAS} ($I_{BIAS(s)}$) vs V_{IN} (μPC29S10)

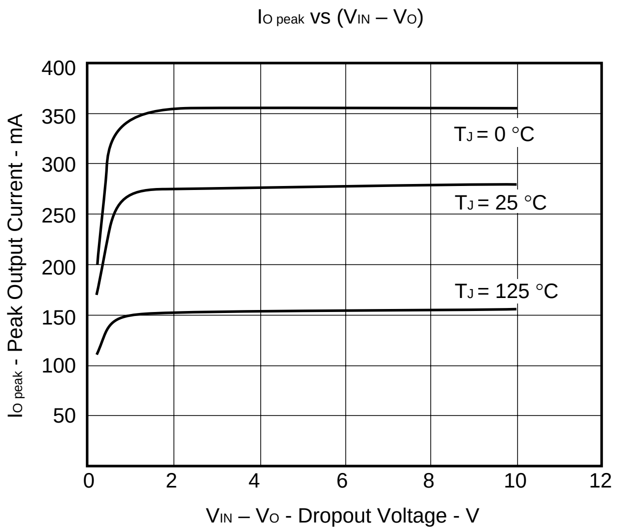


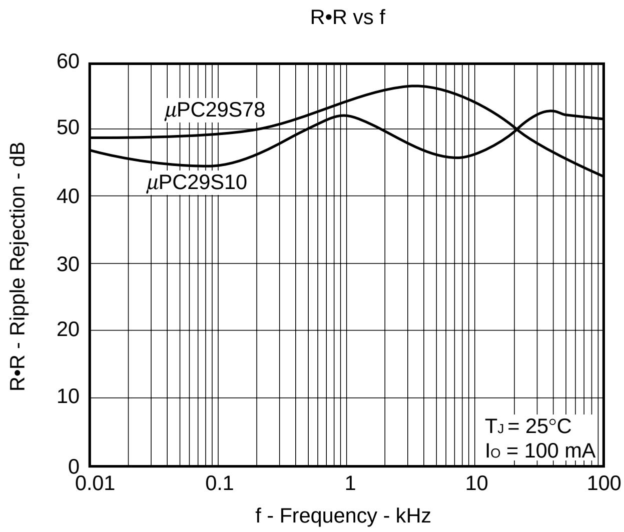
V_O vs $V_{ON/OFF}$

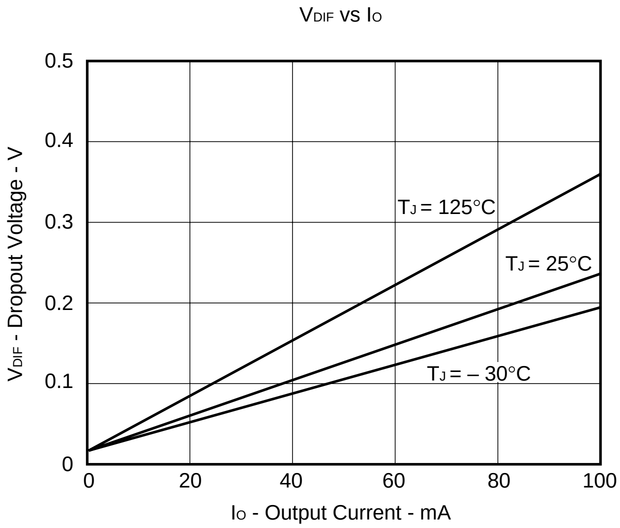


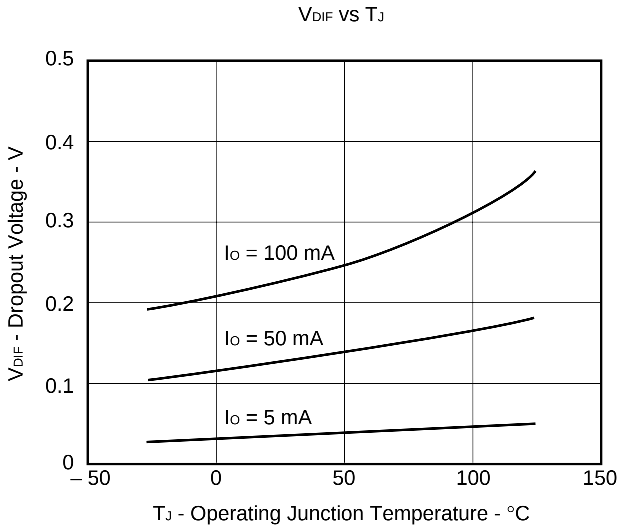
ΔV_O vs T_J




IO peak vs (VIN – VO)
400
350
300
250
200
150
100
50
0
2
4
6
8
10
12
TJ = 0 °C
TJ = 25 °C
TJ = 125 °C
IO peak - Peak Output Current - mA
VIN – VO - Dropout Voltage - V

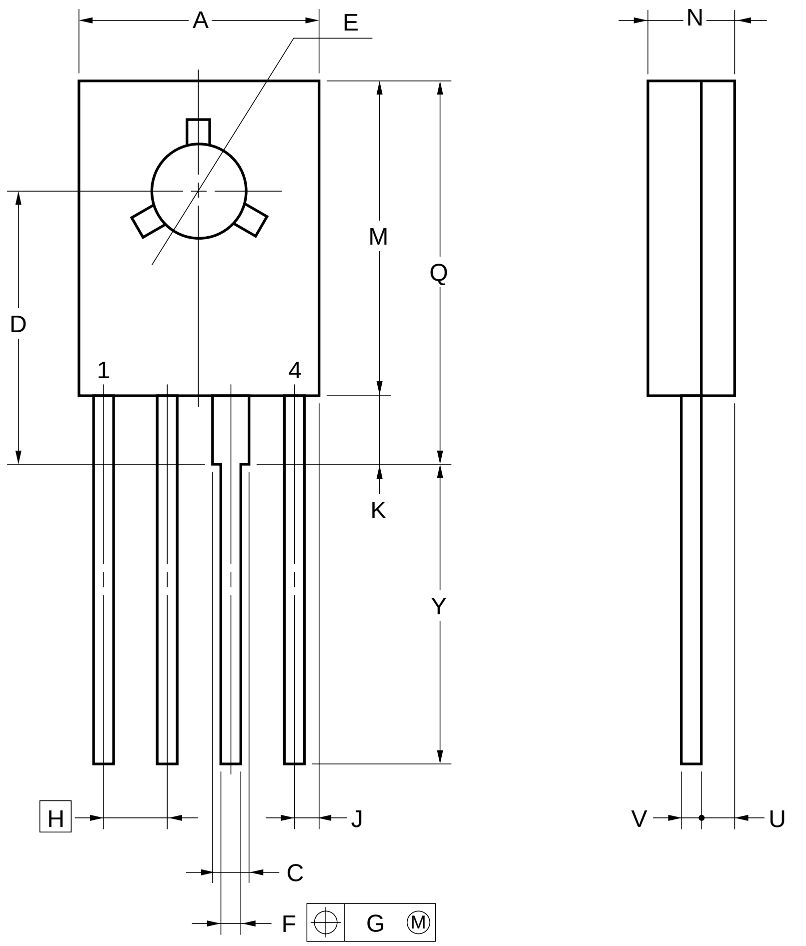

R•R vs f
60
50
40
30
20
10
0
0.01
0.1
1
10
100
μPC29S78
μPC29S10
TJ = 25°C
IO = 100 mA
R•R - Ripple Rejection - dB
f - Frequency - kHz


VDIF vs IO
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
100
TJ = 125°C
TJ = 25°C
TJ = – 30°C
VDIF - Dropout Voltage - V
IO - Output Current - mA


VDIF vs TJ
0.5
0.4
0.3
0.2
0.1
0
– 50
0
50
100
150
IO = 100 mA
IO = 50 mA
IO = 5 mA
VDIF - Dropout Voltage - V
TJ - Operating Junction Temperature - °C

PACKAGE DRAWINGS

4 PIN PLASTIC SIP (TO-126)



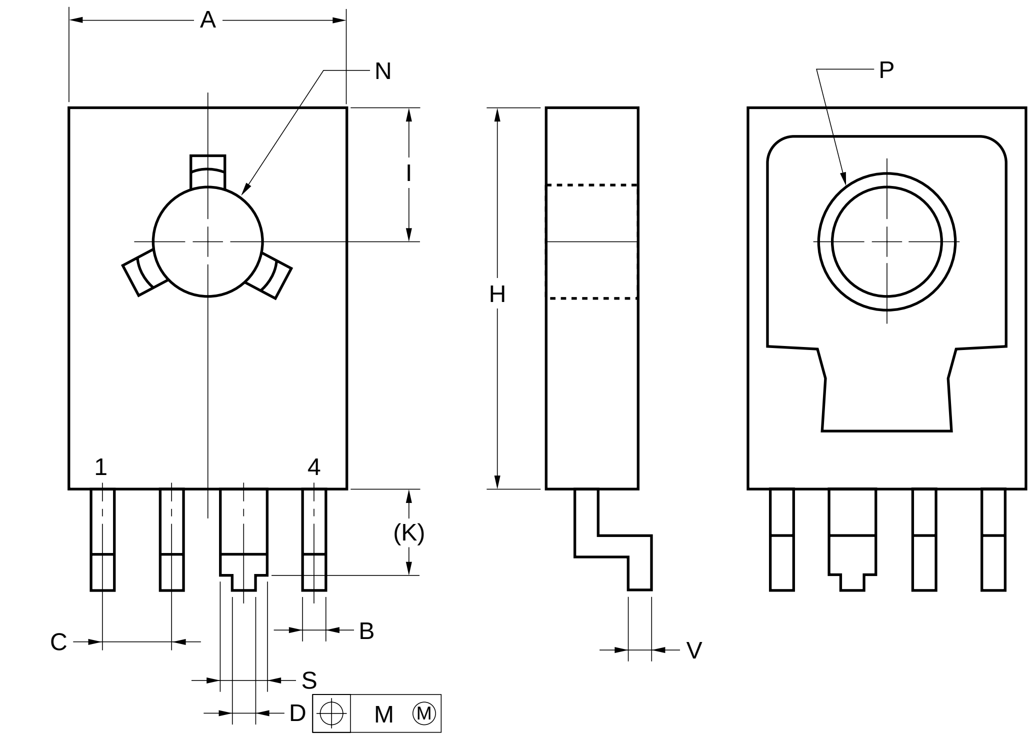
NOTE

Each lead centerline is located within 0.2 mm (0.008 inch) of its true position (T.P.) at maximum material condition.

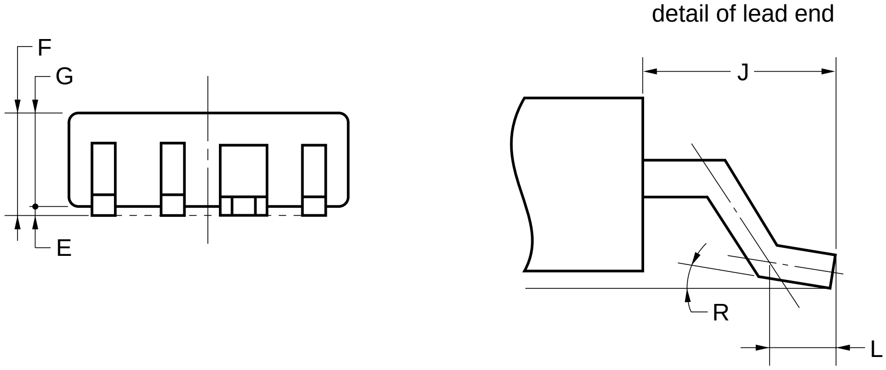
ITEM	MILLIMETERS	INCHES
A	8.5 MAX.	0.335 MAX.
C	1.1 MIN.	0.043 MIN.
D	9.7±0.3	0.382±0.012
E	ϕ3.2±0.1	ϕ0.126±0.004
F	0.65±0.1	$0.026^{+0.004}_{-0.005}$
G	0.2	0.008
H	2.0	0.079
J	1.25 MAX.	0.05 MAX.
K	2.3 MIN.	0.09 MIN.
M	11.5 MAX.	0.453 MAX.
N	2.7±0.2	$0.106^{+0.009}_{-0.008}$
Q	14.5 MAX.	0.571 MAX.
U	1.7 MAX.	0.067 MAX.
V	0.55±0.1	$0.022^{+0.004}_{-0.005}$
Y	13.5±0.7	$0.531^{+0.029}_{-0.028}$

P4HP-200B-1

4 PIN PLASTIC SIP (TO-126 GULLWING)

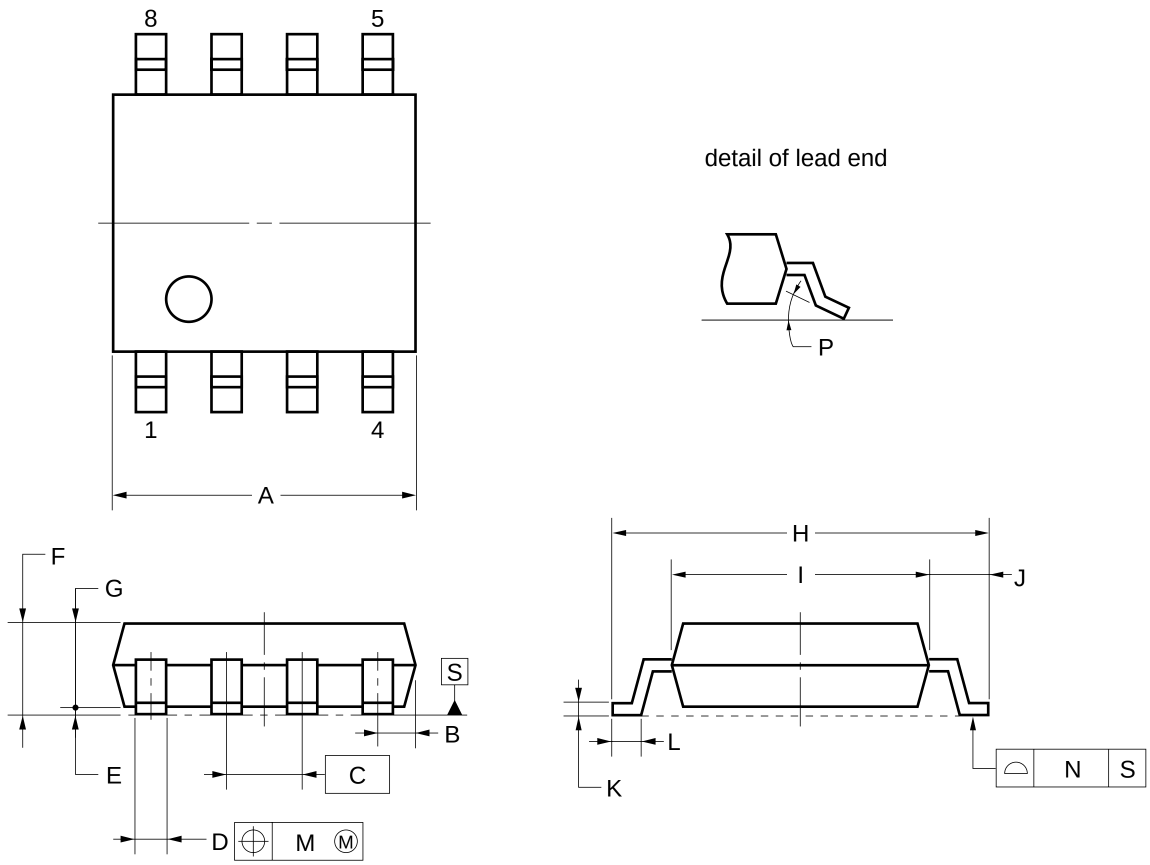


detail of lead end



ITEM	MILLIMETERS
A	8.0±0.2
B	0.65±0.1
C	2.0±0.3
D	0.65±0.1
E	0.25±0.15
F	3.2 MAX.
G	2.7±0.1
H	11.0±0.2
I	3.8
J	3.0±0.5
K	2.5
L	1.3±0.3
M	0.18
N	3.2±0.1
P	ϕ4.0
R	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
S	1.25±0.1
V	0.55±0.1

8 PIN PLASTIC SOP (225 mil)



NOTE

Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	$5.2^{+0.17}_{-0.20}$
B	0.78 MAX.
C	1.27 (T.P.)
D	$0.42^{+0.08}_{-0.07}$
E	0.1±0.1
F	1.59±0.21
G	1.49
H	6.5±0.3
I	4.4±0.15
J	1.1±0.2
K	$0.17^{+0.08}_{-0.07}$
L	0.6±0.2
M	0.12
N	0.10
P	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$

S8GM-50-225B-5

RECOMMENDED SOLDERING CONDITIONS

When soldering these products, it is highly recommended to observe the conditions as shown below. If other soldering processes are used, or if the soldering is performed under different conditions, please make sure to consult with our sales offices.

For more details, refer to our document "**SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL**" **(C10535E)**.

Surface mount devices

μPC29S78TA: 4-pin plastic SIP (TO-126 Gullwing)

Process	Conditions	Symbol
Infrared ray reflow	Peak temperature: 235°C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210°C or higher), Maximum number of reflow processes: 2 times.	IR35-00-2
VPS	Peak temperature: 215°C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200°C or higher), Maximum number of reflow processes: 2 times.	VP15-00-2
Wave soldering	Solder temperature: 260°C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120°C or below (Package surface temperature).	WS60-00-1
Partial heating method	Pin temperature: 300°C or below, Heat time: 3 seconds or less (Per each side of the device).	–

Caution Apply only one kind of soldering condition to a device, except for "partial heating method", or the device will be damaged by heat stress.

★ **μPC29S78GR, 29S10GR: 8-pin plastic SOP (225 mil)**

Process	Conditions	Symbol
Infrared ray reflow	Peak temperature: 235°C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210°C or higher), Maximum number of reflow processes: 3 times.	IR35-00-3
VPS	Peak temperature: 215°C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200°C or higher), Maximum number of reflow processes: 3 times.	VP15-00-3
Wave soldering	Solder temperature: 260°C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120°C or below (Package surface temperature).	WS60-00-1
Partial heating method	Pin temperature: 300°C or below, Heat time: 3 seconds or less (Per each side of the device).	–

Caution Apply only one kind of soldering condition to a device, except for "partial heating method", or the device will be damaged by heat stress.

Through-hole device

μPC29S78H: 4-pin plastic SIP (TO-126)

Process	Conditions
Wave soldering (only to leads)	Solder temperature: 260°C or below, Flow time: 10 seconds or less.
Partial heating method	Pin temperature: 300°C or below, Heat time: 3 seconds or less (per each lead).

Caution For through-hole device, the wave soldering process must be applied only to leads, and make sure that the package body does not get jet soldered.

CAUTION ON USE

When using the μPC29S00 series at the input voltage which is lower than in the recommended operating condition, the big quiescent current flows through device because the transistor of the output paragraph is saturated (Refer to I_{BIAS} ($I_{BIAS(s)}$) vs V_{IN} curves in **TYPICAL CHARACTERISTICS**). The μPC29S00 series has saturation protection circuits, but they sometimes need about 50 mA current. Therefore the power supply on the input needs the enough current capacity to pass this quiescent current when the device start-up.

REFERENCE DOCUMENTS

QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES	C11531E
SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL	C10535E
SEMICONDUCTORS SELECTION GUIDE	X10679E

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