Toshiba Isolated amplifiers

DCA121x02

DCA121002 / DCA121102

1. Applications

- Industrial Equipment (Servo Drives, Inverters)
- Motor Current Sensing
- Bus Voltage Sensing

2. Description

DCA121x02 is an isolated amplifier that uses an IC with a high-precision ΔΣ A/D converter on the input side and an IC with a high-precision D/A conversion circuit on the output side.

3. Features

- Input Voltage range : ±250 mV
- Propagation delay : 1.60 μs (Typ.)
- Operating temperature range : −40 to 125 °C
- High SNR : 85 dB (Typ.)
- Package : 8pin SOIC Wide body
- Withstand Voltage : 5 kVrms
- High Common-mode transient immunity: 100 kV/μs (Min)
- Scheduled to acquire:

  UL : UL1577, File No. E519997

  cUL : CSA Component Acceptance Service Notice No. 5A, File No. E519997

  VDE : DIN VDE V 0884-17(VDE V 0884-17) (Planning)

  CQC : GB4943.1-2011 (Planning)

Start of commercial production
2026-9

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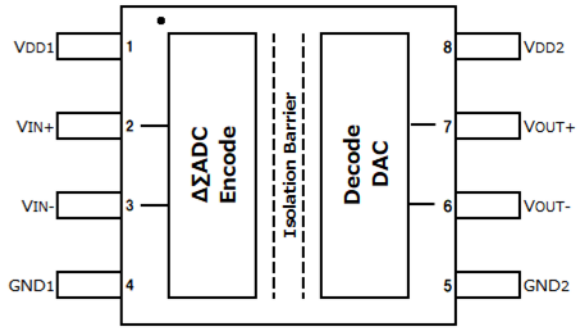
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4. Structural parameter

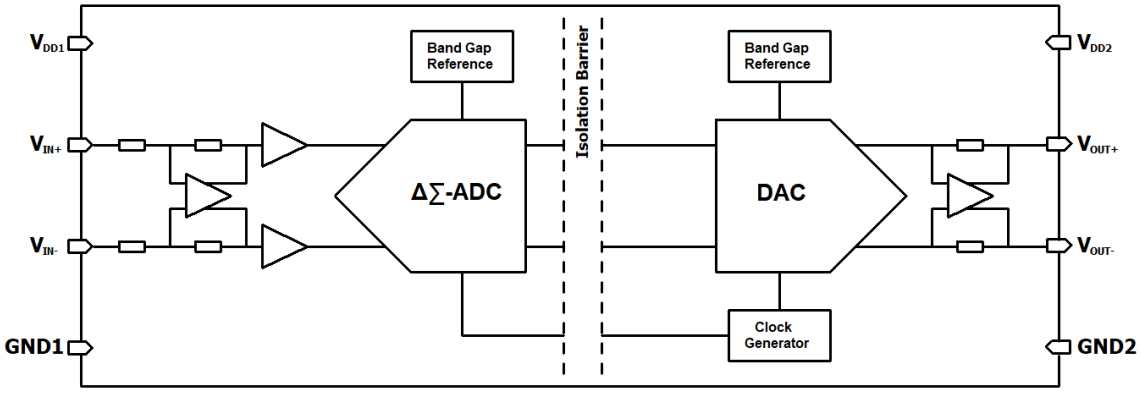
PARAMETER	DIMENSION	UNIT
Height	2.79 (Max)	mm
Creepage distance	8.0 (Min)	
Clearance	8.0 (Min)	

5. Terminal information



PIN NUMBER	NAME	DESCRIPTION
1	V_{DD1}	Power Supply, Input side
2	V_{IN+}	Positive Input
3	V_{IN-}	Negative Input
4	GND1	GND connection for V_{DD1}, side 1
5	GND2	GND connection for V_{DD2}, side 2
6	V_{OUT-}	Negative Output
7	V_{OUT+}	Positive Output
8	V_{DD2}	Power Supply, Output side

6. Internal circuit diagram



7. Absolute Maximum Ratings (Note)

Unless otherwise specified, T_a = 25 °C

PARAMETER	SYMBOL	MIN	MAX	UNIT
Operating Temperature	T_{opr}	-40	125	°C
Storage Temperature	T_{stg}	-55	150	°C
Power supply Voltage	V_{DD1}, V_{DD2}	-0.5	6.0	V
Analog input Voltage	V_{IN+}, V_{IN-}	-2.0	V_{DD1}+0.5 (Note1)	V
Transient input Voltage	V_{IN+}, V_{IN-}	-6.0	V_{DD1}+0.5 (Note1)	V
Output Voltage	V_{OUT+}, V_{OUT-}	-6.0	V_{DD2}+0.5 (Note1)	V
Soldering Temperature (10 s)	T_{sol}	-	260	°C
Maximum Withstanding Isolation Voltage (AC, 1 min., R.H. ≤ 60%) (Note3)	BV_S	5000	-	V_{rms}

Note : Even when this product is used within the absolute maximum ratings, its reliability may deteriorate significantly if it is used continuously under high load conditions (high temperature, large current, high voltage application, large temperature change, etc.).
Please confirm our Semiconductor Reliability Handbook (handling precautions and precautions, derating methods and methods) and individual reliability information (reliability test report, estimated failure rate, etc.), and design for appropriate reliability.

Note 1: Maximum voltage must not exceed 6 V.

Note 2: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7and 8 are shorted together.

8. Operating Conditions (Note)

PARAMETER	SYMBOL	MIN	TYP.	MAX	UNIT
Operating Temperature	T_a	-40	-	125	°C
Junction Temperature	T_J	-40	-	150	°C
Power supply Voltage (Input side)	V_{DD1}	3.0	5.0	5.5	V
Power supply Voltage (output side)	V_{DD2}	3.0	3.3	5.5	V
Analog input Voltage (linear area) (Note1)	V_{IN+}, V_{IN-}	-250	-	250	mV

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this data sheet should also be considered.

Note: A ceramic capacitor (0.1 μF) should be connected between pin 1 (V_{DD1}) and pin 4 (GND1) for V_{DD1} and between pin 8 (V_{DD2}) and pin 5 (GND2) for V_{DD2} and should be the layout on the IC as close as possible (less than 10 mm). Otherwise, the IC may not switch properly.

Note 1: Full-Scale Differential Voltage Input Range (FSR) = ±320 mV (typ.)

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9. Electrical Characteristics

Unless otherwise specified, -40 °C ≤ T_a ≤ 125 °C, 3.0 V ≤ V_{DD1} ≤ 5.5 V, 3.0 V ≤ V_{DD2} ≤ 5.5 V, -250 mV ≤ V_{IN+} ≤ 250 mV, V_{IN-} = 0 V. All typical specifications are for T_a = 25 °C, V_{DD1} = 5.0 V, V_{DD2} = 3.3 V.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Input offset voltage	V_{os}	T_a = 25 °C	-0.30	-0.05	0.20	mV
Input offset voltage Temperature Drift	$\lvert dV_{OS}/dT_a \rvert$		-	0.3	2	µV/°C
Input offset voltage Supply voltage Drift	$\lvert dV_{OS}/V_{DD1} \rvert$		-	120	-	µV/V
Input-bias current (V_{IN+}, V_{IN-})	I_{IN+}, I_{IN-}	V_{IN+} = V_{IN-} = GND1	-	-20	-	µA
Equivalent Input resistance (Single phase)	R_{IN}	V_{IN-} = GND1	-	16	-	kΩ
Equivalent Input resistance (Differential)	R_{IND}		-	20	-	kΩ
Gain	G±0.5%	T_a = 25 °C	8.16	8.2	8.24	V/V
Gain Temperature Drift	$\lvert dG/dT_a \rvert$		-	24	-	ppm/°C
V_{OUT} non-linearity (±250mV)	NL		-0.02	-	0.02	%
V_{OUT} non-linearity (±250 mV) Temperature Drift	$\lvert dNL/dT_a \rvert$		-	0.00007	-	%/°C
High-level output voltage	V_{OH}	V_{IN+} = 400 mV, V_{IN-} = GND1, T_a = 25 °C	-	2.624	-	V
Low-level output voltage	V_{OL}	V_{IN+} = 400 mV, V_{IN-} = GND1, T_a = 25 °C	-	0.0009	-	V
V_{OUT} output resistance	R_{OUT}		-	11	-	Ω
V_{OUT} bandwidth (-3 dB)	f_{-3dB}	-250 mV ≤ V_{IN+} ≤ 250 mV, V_{IN-} = GND1, sine wave	200	248	-	kHz
Signal-to-noise ratio	SNR	f = 1 kHz, -250 mV ≤ V_{IN+} ≤ 250 mV, V_{IN-} = GND1, BW = 10 kHz	80	85	-	dB
Total harmonic distortion	THD	f = 1 kHz, -250 mV ≤ V_{IN+} ≤ 250 mV, V_{IN-} = GND1, BW = 10 kHz	-	-83.5	-	dB
Output-noise	Vout	V_{IN+} = V_{IN-} = GND1, BW = 10 kHz	-	0.2	-	mVrms
Input common-mode rejection ratio	$CMRR_{IN}$		-	-93.5	-	dB
Power supply rejection ratio (Note1)	PSRR	f_{ripple} = 10 kHz, -100 mV ≤ V_{ripple} ≤ 100 mV, V_{IN+} = V_{IN-} = GND1	-	-95	-	dB
Common mode transient immunity (Note1)	|CMTI|	V_{CM} = 1 kV, T_a = 25 °C V_{IN+} = V_{IN-} = GND1	100	-	-	kV/µs

Note 1: This parameter is warranted by design.

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PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
V_{DD1}, V_{DD2} Under Voltage Lockout Threshold Voltage	V_{UVLO+}	Threshold when supply voltage is rising	2.6	2.7	2.85	V
	V_{UVLO-}	Threshold when supply voltage is falling	2.4	2.5	2.65	V
Input side supply current (V_{DD1})	I_{DD1}	3.0 V ≤ V_{DD1} ≤ 5.5 V, V_{IN+} = V_{IN-} = GND1	-	10.0	12.5	mA
Output side supply current (V_{DD2})	I_{DD2}	4.5 V ≤ V_{DD2} ≤ 5.5 V, V_{IN+} = V_{IN-} = GND1	-	6.5	8.5	mA
		3.0 V ≤ V_{DD1} ≤ 3.6 V, V_{IN+} = V_{IN-} = GND1	-	6.5	8.5	mA

10. AC Characteristics

Unless otherwise specified, -40 °C ≤ T_a ≤ 125 °C, 3.0 V ≤ V_{DD1} ≤ 5.5 V, 3.0 V ≤ V_{DD2} ≤ 5.5 V, -250 mV ≤ V_{IN+} ≤ 250 mV, V_{IN-} = 0 V. All typical specifications are for T_a = 25 °C, V_{DD1} = 5.0 V, V_{DD2} = 3.3 V.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
V_{IN} to V_{OUT} propagation delay time (10 %-10 %)	t_{PD10}	-250 mV ≤ V_{IN+} ≤ 250 mV, V_{IN-} = GND1, CL = 15 pF	-	0.95	1.26	μs
V_{IN} to V_{OUT} propagation delay time (50 %-50 %)	t_{PD50}		-	1.60	1.95	μs
V_{IN} to V_{OUT} propagation delay time (90 %-90 %)	t_{PD90}		-	2.35	2.85	μs
V_{OUT} rise time	t_r		-	1.45	-	μs
V_{OUT} fall time	t_f		-	1.45	-	μs
Overcurrent high-speed feedback V_{IN} to V_{OUT} propagation delay time DCA121102 only	t_{HSD}	V_{DD1} = 5.0 V, V_{DD2} = 3.3 V, V_{IN+} = 0 mV to ±800 mV, V_{IN-} = GND1, T_a = 25 °C, CL = 15 pF	-	500	700	ns
Time from PU(Note1) to valid output data	t_{PU}		-	-	500	μs

Note1 : PU = Powered up (V_{DD1} ≥ 3.0 V, V_{DD2} ≥ 3.0 V). After V_{DD} is set powered up, normal operation becomes valid 500 μs later.

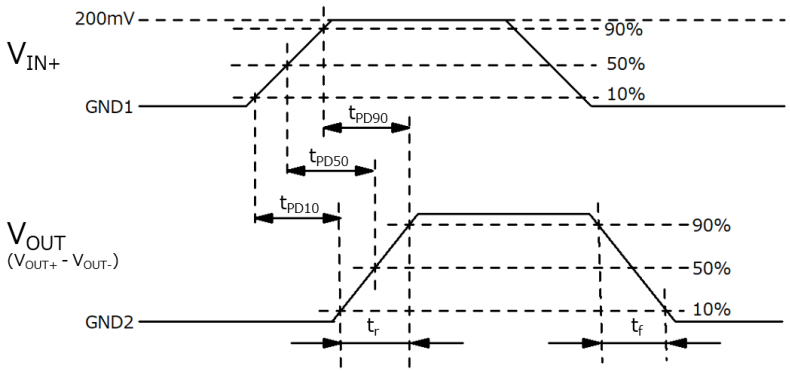


Fig.10.1 DCA121x02 t_{PD}, t_r, t_f Waveforms

11. Functional Description

OPERATING STATUS			OUTPUT SPECIFICATIONS
V_{DD1}	V_{DD2}	OUTPUT	
PU	PU	V_{OUT+}	Normal Operation Outputs voltage corresponding to input voltage
		V_{OUT-}	Normal Operation Outputs voltage corresponding to input voltage
PU	PD	V_{OUT+}	X
		V_{OUT-}	X
PD	PU	V_{OUT+}	Low-level output
		V_{OUT-}	High-level output

PU = Powered up (3.0 V ≤ V_{DDx}), PD = Powered down (V_{DDx} ≤ 2.4 V), X = Don't care

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12. Insulation specifications

PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNIT
Minimum External Clearance	CLR	Shortest terminal-to-terminal distance through air	8	mm
Minimum External Creepage	CPG	Shortest terminal-to-terminal distance across the package surface	8	mm
Distance Through the Insulation	DTI	Minimum internal gap	17	µm
Comparative Tracking Index	CTI		600	V
Material Group	-	According to IEC 60664-1	I	-
Overvoltage Category Per IEC 60664-1	-	Related Mains Voltage ≤ 300 V_{rms}	I-IV	-
	-	Related Mains Voltage ≤ 600 V_{rms}	I-IV	-
	-	Related Mains Voltage ≤ 1000 V_{rms}	I-III	-
DIN EN IEC 60747-17; (VDE 0884-17)				
Maximum repetitive Peak Isolation Voltage	V_{IORM}	AC voltage (bipolar)	1414	V_{PK}
Maximum Transient Isolation Voltage	V_{IOTM}	$V_{TEST} = V_{IOTM}$, t = 60 s (qualification), $V_{TEST} = 1.2 \times V_{IOTM}$, t = 1 s (100 % production)	8000	V_{PK}
Maximum Impulse Voltage	V_{IMP}	IEC 61000-4-5 1.2/50µs waveform	8000	V_{PK}
Maximum surge isolation voltage	V_{IOSM}	Test method per IEC 61000-4-5, 1.2/50 µs waveform, $V_{IOSM} \geq 1.3 \times V_{IMP}$ (qualification)	12800	V_{PK}
Apparent charge measuring voltage	$V_{pd(m)}$	Method A, After Input/Output safety test subgroup2&3, $V_{ini,a} = V_{IOTM}$, $V_{pd(m)} = 1.2 \times V_{IORM}$,t_{ini} = 60 s, t_m = 10 s, Partial discharge < 5 pC	1697	V_{PK}
		Method A, After environmental tests subgroup 1, $V_{ini,a} = V_{IOTM}$, $V_{pd(m)} = 1.6 \times V_{IORM}$ t_{ini} = 60 s, t_m = 10 s, Partial discharge < 5 pC	2263	
		Method B1; At routine test (100% production) and preconditioning (type test) $V_{ini,b} \geq 1.2 \times V_{IOTM}$, $V_{pd(m)} = 1.875 \times V_{IORM}$ $t_{ini,b}$ = 1 s, t_m = 1 s Partial discharge < 5 pC	2652	
Barrier capacitance, input to output	C_{IO}	Vs = 0 V, f = 1 MHz	0.7	pF
Input Capacitance	C_I	V_{IN}	9.4	pF
Isolation Resistance	R_{IO}	V_{IO} = 500 V, T_A = 25 °C	$>10^{12}$	Ω
		V_{IO} = 500 V, 100 °C ≤ T_A ≤ 125 °C	$>10^{11}$	
		V_{IO} = 500 V at T_S = 150 °C	$>10^{9}$	
Pollution Degree	-	-	2	-
Climatic Category	-	-	40/125/21	-
UL 1577				
Maximum Withstanding Isolation Voltage	V_{ISO}	$V_{TEST} = V_{ISO}$, t = 60 s (qualification), $V_{TEST} = 1.2 \times V_{ISO}$, t = 1 s (100 % production)	5000	V_{rms}

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13. Safety Limiting Values

PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNIT
Safety Input, Output or Supply Current	I_S	V_{DD1} = V_{DD2} = 5.5 V, T_J = 150 °C, T_a = 25 °C	302	mA
		V_{DD1} = V_{DD2} = 3.6 V, T_J = 150 °C, T_a = 25 °C	462	mA
Safety Input, Output or Total Power	P_S	T_J = 150 °C, T_a = 25 °C	1662	mW
Maximum Safety Temperature	T_S	-	150	°C

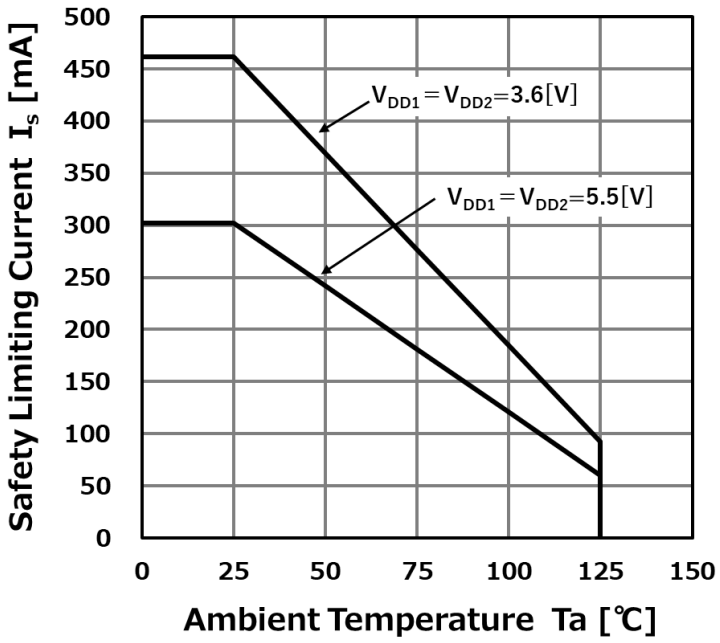


Fig.13.1 Thermal Derating Curve for Safety Limiting Current-T_a

14. Characteristics Curves (Note)

Note : The following characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

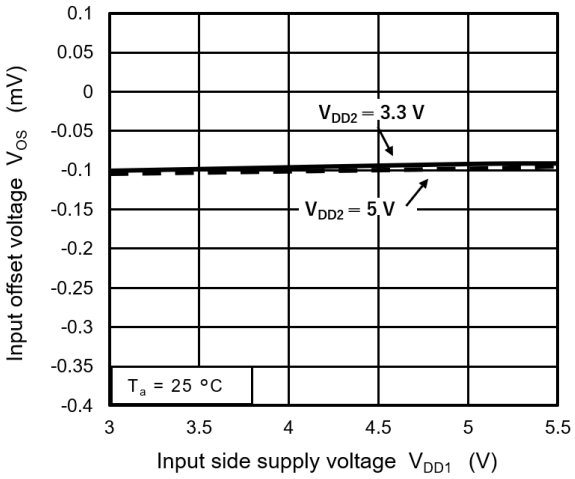


Fig.14.1 V_{OS} - V_{DD1}

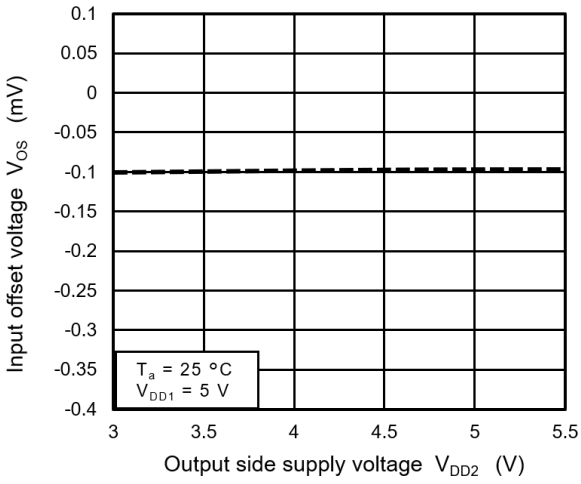


Fig.14.2 V_{OS} - V_{DD2}

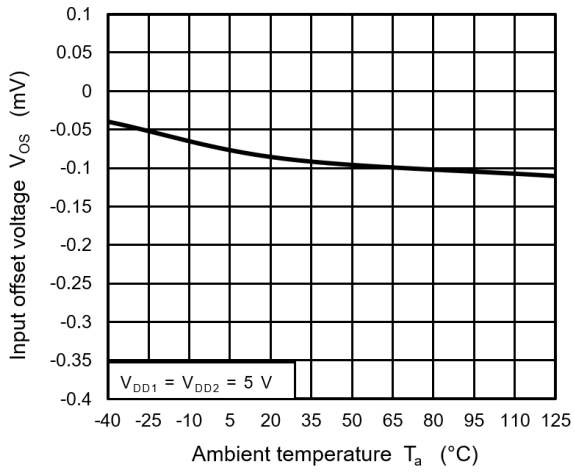


Fig.14.3 V_{OS} - T_a

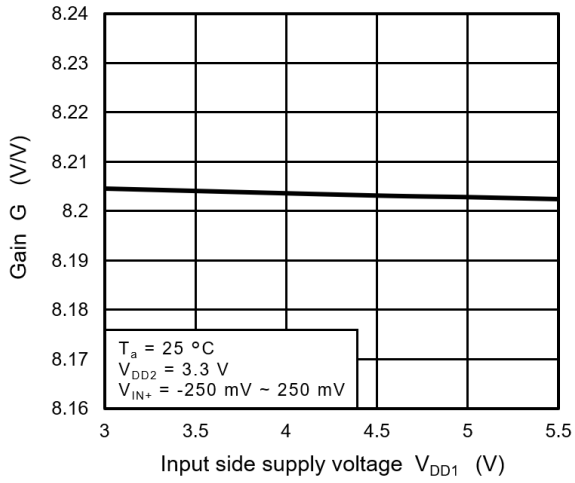


Fig.14.4 G - V_{DD1}

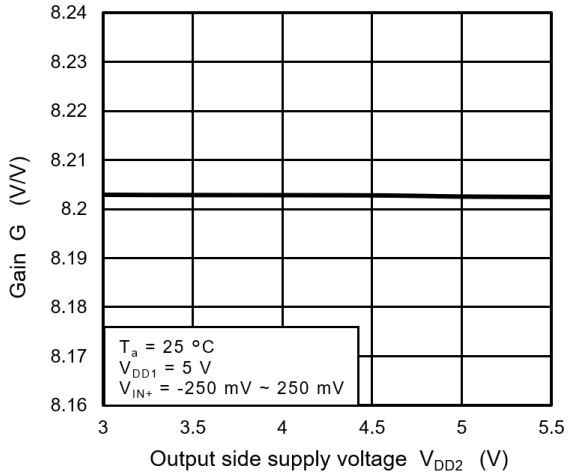


Fig.14.5 G - V_{DD2}

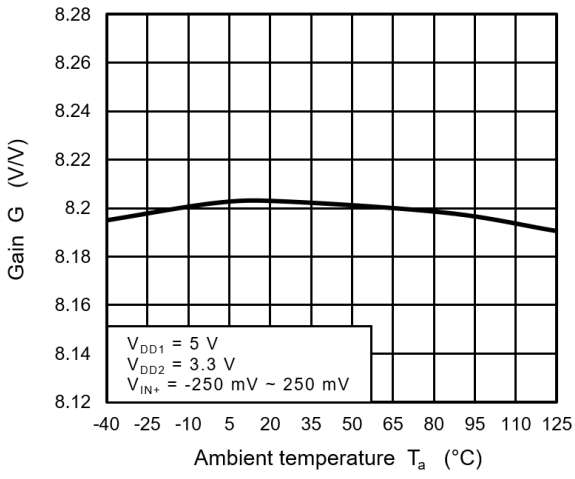


Fig.14.6 G - T_a

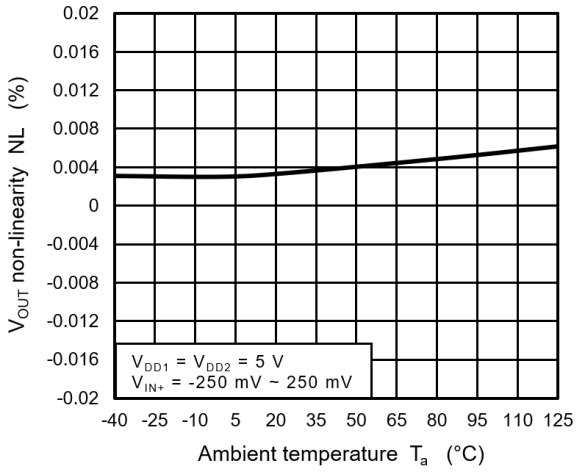


Fig.14.7 NL - T_a

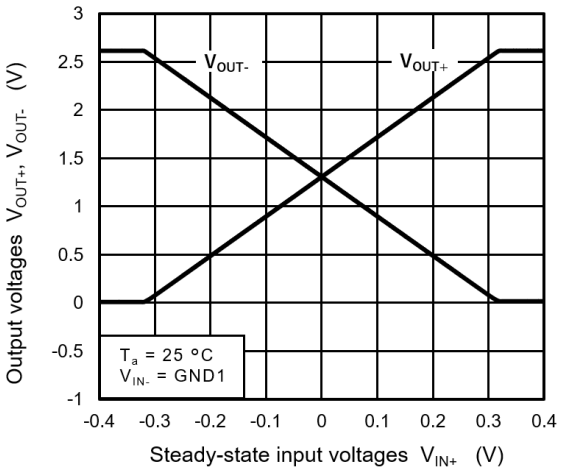


Fig.14.8 V_{OUT} - V_{IN+}

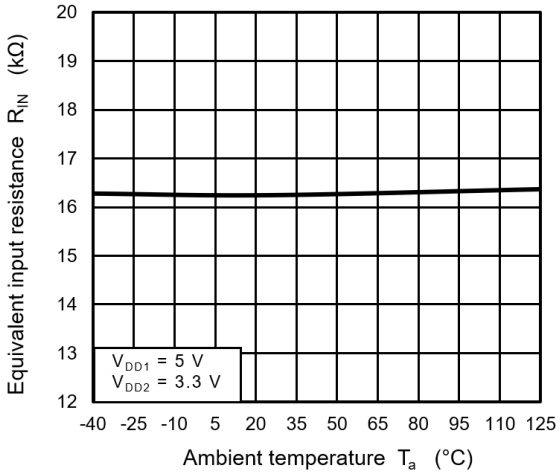


Fig.14.9 R_{IN} - T_a

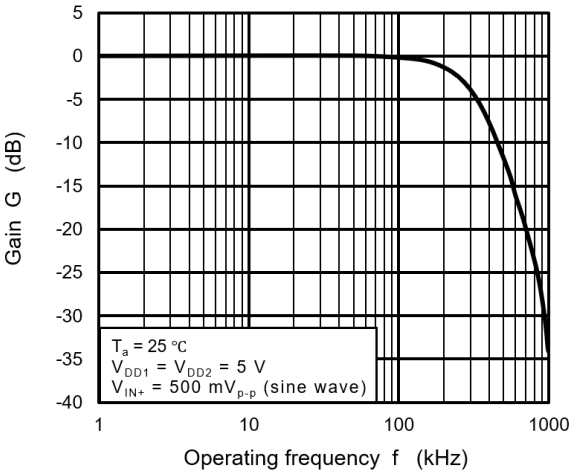


Fig.14.10 G [dB] – f

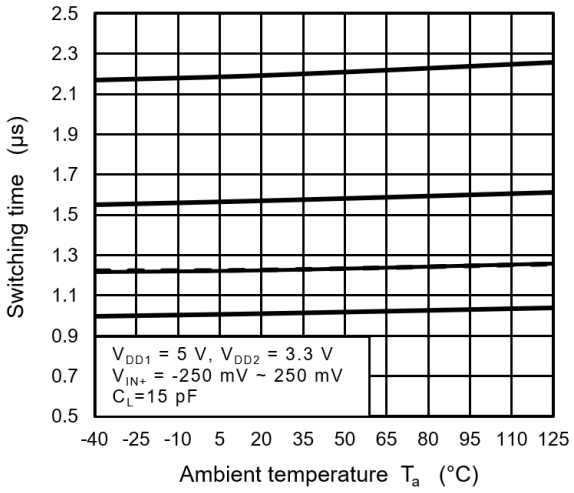


Fig.14.11 Switching Time - T_a

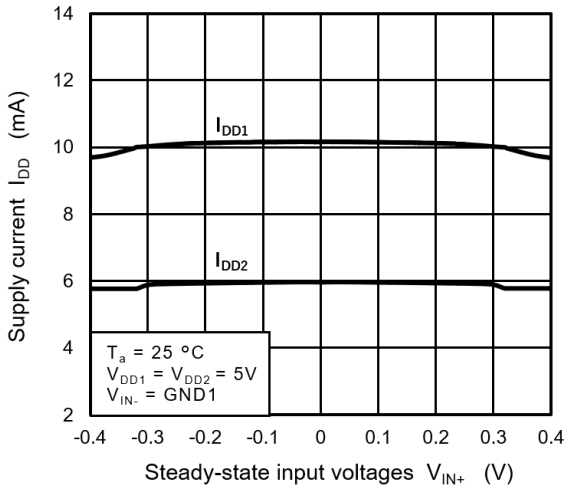
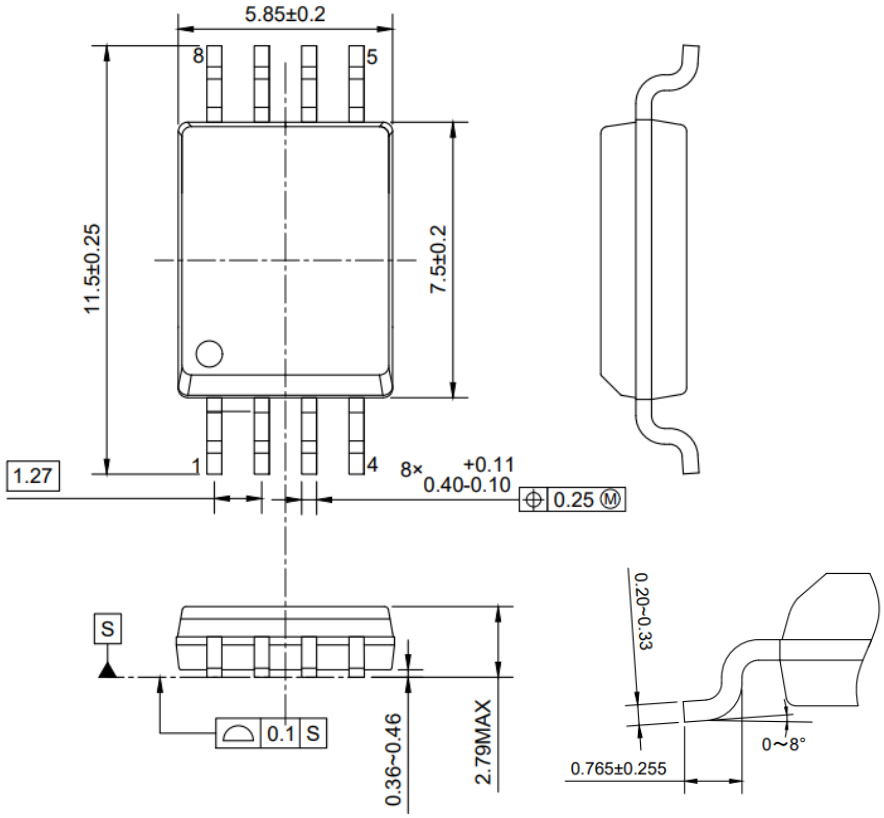
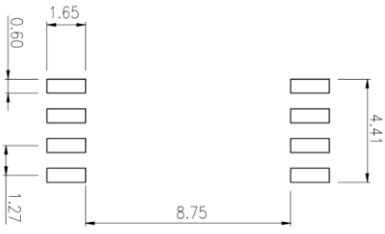


Fig.14.12 I_{DD} - V_{IN+}

15. Package Information

Package Name	SOIC8-W (P-SOP8-0806-1.27-001)
Implementation category	Surface Mount
Pin Number	8
Package Dimension Width × Length × Height (mm)	5.85 (Typ.) × 11.50 (Typ.) × 2.79 (Max)
Package Dimension (mm) / Land Pattern Example (mm)	Package Dimension  Land Pattern Dimensions (for reference only)  Note : Land Pattern Dimensions ・All linear dimensions are given in millimeters unless otherwise specified. ・This drawing is based on JEITA ET-7501 Level3 and should be treated as a reference only. TOSHIBA is not responsible for any incorrect or incomplete drawings and information. ・You are solely responsible for all aspects of your own land pattern, including but not limited to soldering processes. ・The drawing shown may not accurately represent the actual shape or dimensions. ・Before creating and producing designs and using, customers must also refer to and comply with the latest versions of all relevant TOSHIBA information and the instructions for the application that Product will be used with or for.

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16. Ordering guide (Note)

Model	Over Current High-Speed Feedback Function	Package
DCA121002	N/A	SOIC8-W (P-SOP8-0806-1.27-001)
DCA121102	Available	SOIC8-W (P-SOP8-0806-1.27-001)

Note: All specifications are identical except for the Overcurrent High-Speed Feedback Function.

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