Nisshinbo Micro Devices Inc.

NJW4790A

SWITCHING POWER SUPPLY CONTROL IC for QUSAI-RESONANT FLY-BACK AC/DC CONVERTER

FEATURES

- Adopts Ringing Choke Converter (self-excited oscillation) method
- Quasi-resonant switching achieves high efficiency and low emissions(EMI)
- Light load mode achieves high efficiency even at light load
- Detects AC voltage and suppresses emission (EMI) characteristic fluctuations
- Power supply voltage (VP pin voltage)range 7.2V to 35V
- Operation start voltage (ON threshold voltage) 11.5V
- Standby voltage (Undervoltage detection threshold voltage) 6.3V
  Operating temperature range -40 to 125°C
- Protection function: Over current protection, Output overvoltage detection, Thermal shutdown
- Package MSOP10(VSP10)

GENERAL DESCRIPTION

The NJW4790A is controller IC for RCC power supplies featuring high efficiency and low emission (EMI) with quasi-resonant switching and light load mode using the COMS process.

The light load mode achieves low power consumption of 75mW or less at no load, and the efficiency improvement by quasi-resonant switching at light to medium loads facilitates designs that meet energy saving standards. (It is possible to correspond to the standards of each country such as CoC Ver5、DoE20943、GB Level VI、ITU-T L.1001.)

It also has a built-in AC voltage detection function and is designed to suppress the fluctuation of the operating frequency due to the input voltage. This reduces changes in emission(EMI) characteristics, simplifies countermeasures, and contributes to design commonality.

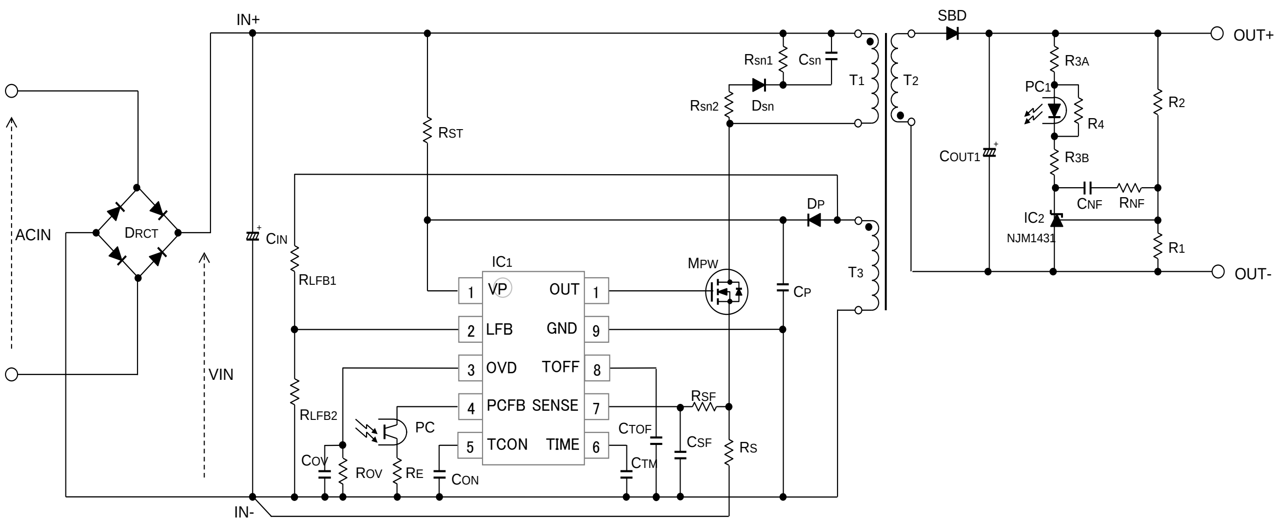
Overcurrent protection can be selectable from droop and foldback that can be adjusted to meet design requirements.

APPLICATIONS

- AC Adapter
- Smart meter power supply
- Industrial equipment power supply

MSOP10(VSP10)
2.9mm×4.0mm×1.1mm

EQUIVALENT CIRCUIT



■ PRODUCT NAME INFORMATION

NJW4790A R (TE2)

Part Number

Package
R: MSOP10(VSP10)

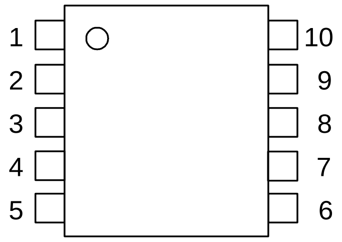
Taping Form

■ ORDER INFORMATION

PRODUCT NAME	PACKAGE	RoHS	HALOGEN-FREE	PLATING COMPOSITION	WEIGHT (mg)	QUANTITY (pcs)
NJW4790AR(TE2)	MSOP10(VSP10)	Yes	Yes	Sn2Bi	21	3000

■ **PIN DESCRIPTIONS**

Top View



MSOP10(VSP10)

Pin No.	Pin Name	I/O	Description
1	VP	Power	Power supply input pin.
2	LFB	I	Feedback detection pin. Current input from the auxiliary winding feedback.
3	OVD	-	Output overvoltage setting pin. Connect a resistor and set the voltage for overvoltage detection on the secondary side.
4	PCFB	I	Photo coupler feedback pin. Current input for photo coupler feedback.
5	TCON	-	Constant-on setting pin. Connect a capacitor and set the on-time during constant-on operation.
6	TIME	-	Timeout setting pin. Connect a capacitor and set the switching between light load mode and normal load mode.
7	SENSE	I	Switching current sense pin.
8	TOFF	-	Off-time setting pin. Connect a capacitor and set the off-time of power transistor.
9	GND	GND	Ground pin.
10	OUT	O	Power transistor gate drive pin.

■ ABSOLUTE MAXIMUM RATINGS

	Symbol	Ratings	Unit
VP Pin Voltage	V_P	45	V
VP Pin Current	I_P	150 *1	μA
OUT Pin Voltage	V_{OUT}	-0.3 to 14 *2	V
LFB Pin Voltage	V_{LFB}	-0.3 to 5.8	V
LFB Pin Input Current	I_{LFB}	100 *3	μA
SENSE Pin Voltage	V_{SENSE}	-0.3 to 5	V
Junction Temperature Range *4	T_j	-40 to 150	°C
Storage Temperature Range	T_{stg}	-50 to 150	°C

*1 When the IC is in standby mode.

*2 When the VP Pin Voltage is 14V or less, it is equal to the VP Pin Voltage.

*3 When the LFB Pin voltage is positive.

*4 Calculate the power consumption of the IC from the operating conditions, and calculate the junction temperature with the thermal resistance.

Please refer to "*Thermal characteristics*" for the thermal resistance under our measurement board conditions.

ABSOLUTE MAXIMUM RATINGS
Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

■ THERMAL CHARACTERISTICS

	Measurement Result	Unit
Thermal Resistance (θja)	2-Layer *5 / 4-Layer *6 234 / 171	°C/W
Thermal Characterization Parameter (ψjt)	2-Layer *5 / 4-Layer *6 51 / 42	°C/W

θja : Junction-to-Ambient Thermal Resistance
ψjt : Junction-to-Top Thermal Characterization Parameter

*5 2-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4).

*6 4-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 4-layer FR-4), (internal Cu area: 74.2 mm × 74.2 mm. Thermal via holes are applied to the substrate in accordance with JEDEC standard JESD51-5.)

■ ELECTROSTATIC DISCHARGE(ESD) PROTECTION VOLTAGE

	Conditions	Protection Voltage
HBM	HBM : C = 100 pF, R = 1.5 kΩ	±1000 V
CDM	CDM	±1000 V

ELECTROSTATIC DISCHARGE RATINGS
The electrostatic discharge test is done based on ED-4701

■ RECOMMENDED OPERATING CONDITIONS

	Symbol	Ratings	Unit
VP Pin Voltage	V_P	7.2 to 35	V
Operating Temperature	T_a	-40 to 125	°C

RECOMMENDED OPERATING CONDITIONS
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

■ **ELECTRICAL CHARACTERISTICS**

V_P=12V, T_a = 25°C unless otherwise specified.

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
POWER SUPPLY VOLTAGE DETECTION						
ON Threshold Voltage	V_{PR}	VP rising	10.2	11.5	12.8	V
Undervoltage Detection Threshold Voltage	V_{PSTB}	VP falling	5.4	6.3	7.2	V
AUXILIARY WINDING FEEDBACK						
Terminal Current Output LFB Pin Voltage	V_{LFBL}	I_{LFB} = 30μA	-200	-80	10	mV
Terminal Current Input LFB Pin Voltage	V_{LFBH}	I_{LFB} = -10μA	4.8	5.3	5.8	V
Inverted Detection Voltage	V_{LINV}	V_{TOFF} = 1.0V, I_{PC} = 0μA	-100	2	200	mV
PHOTO COUPLER FEEDBACK						
PCFB Pin Voltage	V_{PC}	I_{PCFB} = 100μA	2.5	3.3	3.8	V
ON TIME CONTROL						
OFF Threshold PC Current 1	I_{PC_OFF1}	V_{SENSE} = 0.1V, OUT: High to Low	75	145	205	μA
OFF Threshold PC Current 2	I_{PC_OFF2}	V_{SENSE} = 0.15V, OUT: High to Low	20	72	123	μA
During light load mode TCON Threshold Voltage	V_{TCON}		0.4	0.5	0.6	V
TCON Charge Current 1	I_{TCON1}	During light load mode., V_{TCON} = 0.2V, V_{LFB} = 0.5V	10	20	30	μA
TCON Charge Current 2	I_{TCON2}	During light load mode., V_{TCON} = 0.2V, V_{LFB} = 1.5V	25	40	55	μA
During light load mode VLFB Threshold Voltage	V_{LFBHL}		0.9	1.0	1.13	V
OFF TIME CONTROL						
ON Threshold PC Current 1	I_{PC_ON1}	V_{TOFF} = 1.0V, OUT: Low to High	12	41	78	μA
ON Threshold PC Current 2	I_{PC_ON2}	V_{TOFF} = 1.5V, OUT: Low to High	41	73	113	μA
TOFF Pin Charge Current	I_{TOFF}	V_{TOFF} = 0.2V	10	22	30	μA
Output Delay Time	t_{DELAY_ON}	V_{TOFF} = 3.0V, I_{PC} = 70μA	-	500	2000	ns
LFB Pin Voltage Reversal Detection After OFF Disable Time	t_{LFB_MSK}	V_{TOFF} = 1V, I_{PCFB} = 0μA, LFB pin voltage rise→OUT: Low retention	-	1.6	-	μs
TIME OUT CONTROL						
TIME Pin Charge Current 1	I_{TML}	During light load mode., V_{TIME} = 0.2V	4.0	8.0	12.0	μA
TIME Pin Charge Current 2	I_{TM}	During normal load mode., V_{TIME} = 0.2V	0.4	1.0	1.8	μA

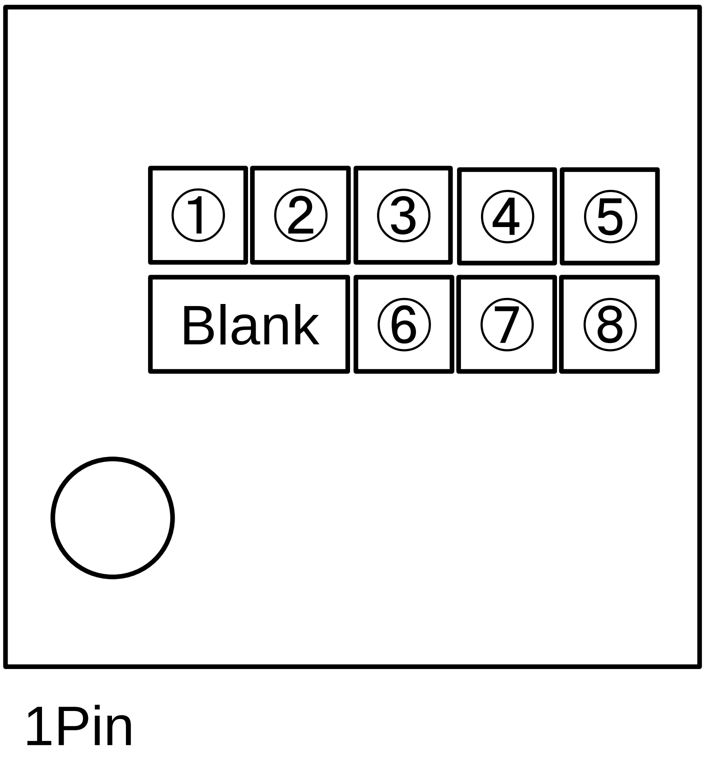
■ ELECTRICAL CHARACTERISTICS

T_a = 25°C unless otherwise specified.

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
OVER CURRENT PROTECTION						
SENSE Pin Threshold Voltage	V_{THSNS}	I_{PCFB} = 0μA, OUT: High to Low	150	200	250	mV
OUTPUT OVERVOLTAGE PROTECTION						
OVD Pin Threshold Voltage	V_{THOVD}		0.9	1.0	1.13	V
OVD Pin Output Current	I_{OVD}	I_{LFB} = 50μA	19.5	25.0	30.5	μA
OUTPUT						
On Resistance	R_{OL}	Output pin is low. I_{OUT} = −100mA	-	2.0	4.0	Ω
Output Voltage 1	V_{OH1}	Output pin is high. V_P = 10V, I_{OUT} = 50mA	8.5	9.0	10.5	V
Output Voltage 2	V_{OH2}	Output pin is high. V_P = 15V, I_{OUT} = 0mA	10.0	11.5	14.0	V
Output Voltage 3	V_{OH3}	Output pin is high. V_P = 15V, I_{OUT} = 50mA	9.0	11.0	13.0	V
GENERAL CHARACTERISTICS						
Quiescent Current 1	I_P	During normal load mode., I_{PCFB} = 100μA, OUT: Low	-	450	600	μA
Quiescent Current 2	I_{PLOW}	During light load mode., I_{PCFB} = 100μA, OUT: Low	-	300	400	μA
Quiescent Current 3	I_{PSTB}	During standby mode., V_P = 7.0V, VP Rising	-	5	12	μA

■ MARKING SPECIFICATION

①②③④⑤: Product code … Refer to Part Marking List
⑥⑦⑧: control number



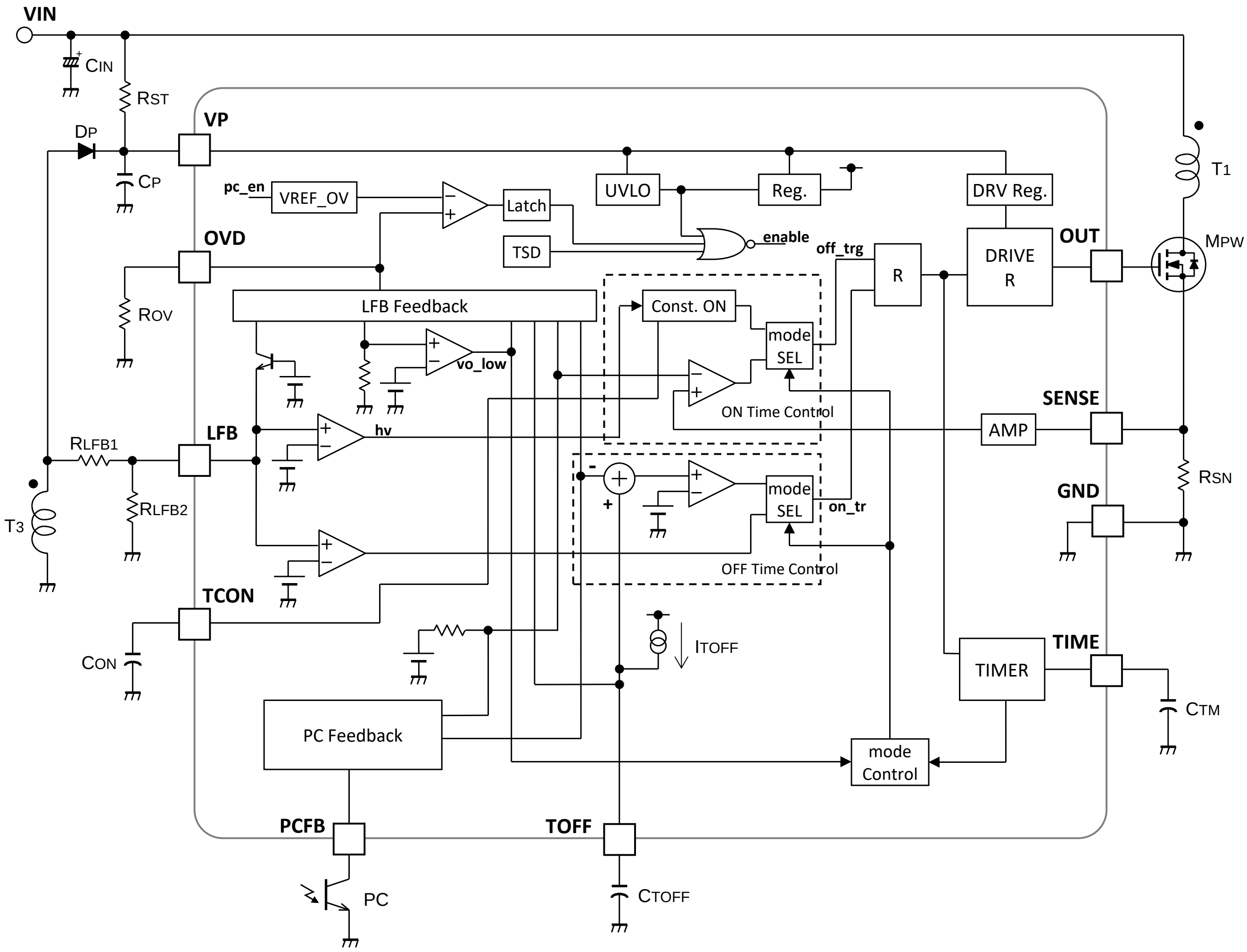
MSOP10(VSP10) **Part Markings**

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

Part Marking List (MSOP10(VSP10))

Product Name	①	②	③	④	⑤
NJW4790AR	4	7	9	0	A

■ BLOCK DIAGRAMS



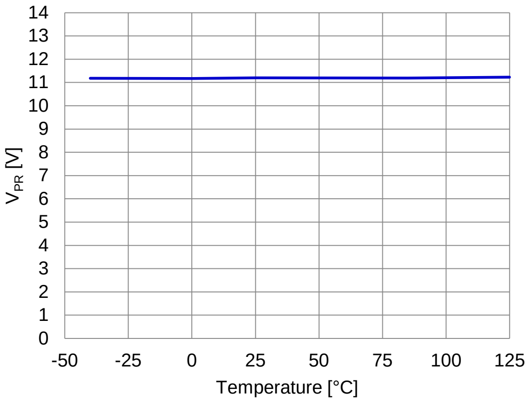
■ TYPICAL CHARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

Power Supply Voltage Monitor

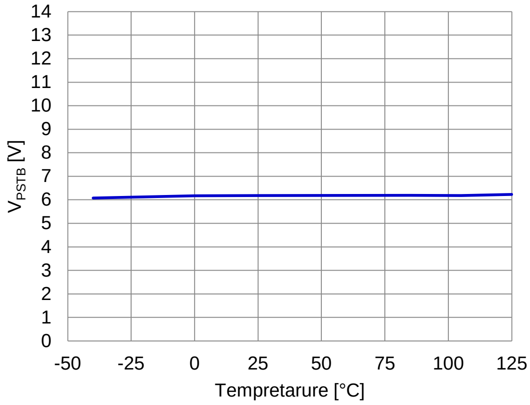
ON Threshold Voltage vs. Temperature

V_{PR} vs. Temperature



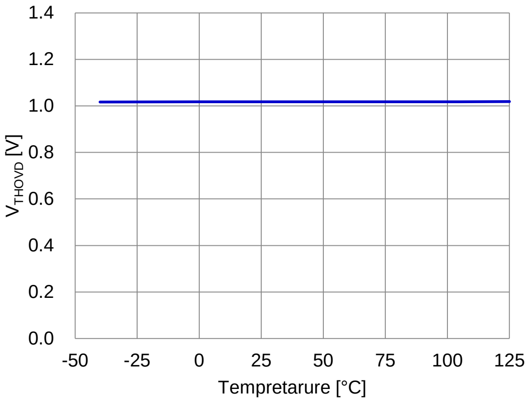
Undervoltage Detection Threshold Voltage vs.Temperature

V_{PSTB} vs. Temperature



Overvoltage detection threshold voltage vs. Temperature

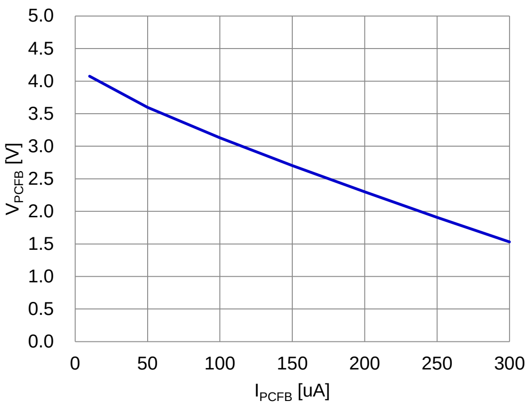
V_{THOVD} vs. Temperature



PCFB Pin characteristics

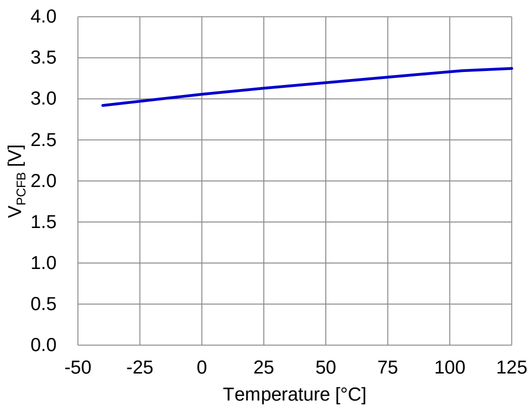
PCFB Pin Voltage vs. PCFB Pin Current

V_{PCFB} vs. I_{PCFB}



PCFB Pin Voltage vs. Temperature

$V_{PCFB}(I_{PCFB}=100\mu A)$ vs. Temperature



■ TYPICAL CHARACTERISTICS

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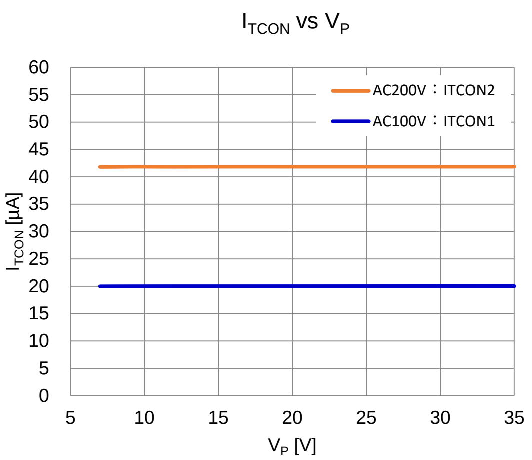
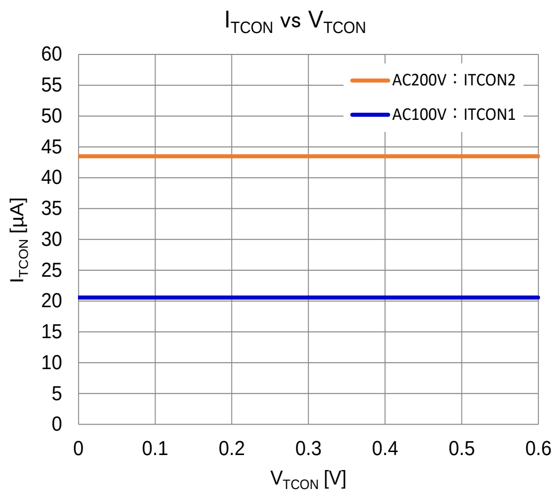
ON Time Control characteristics

TCON Charge Current vs. VP Pin Voltage
at Light Load Mode

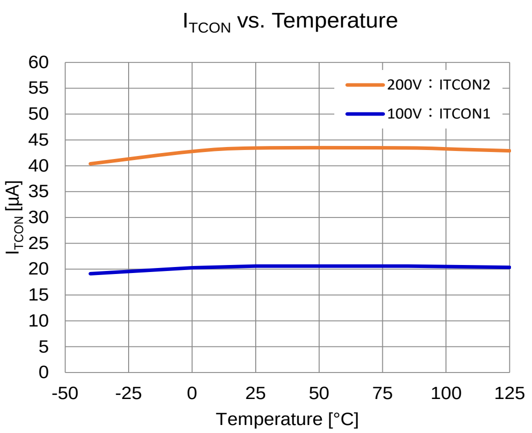


TCON Charge Current vs. TCON Pin Voltage

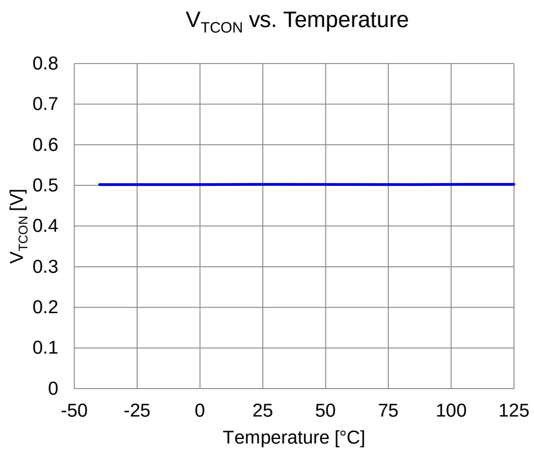


On-time Control characteristics

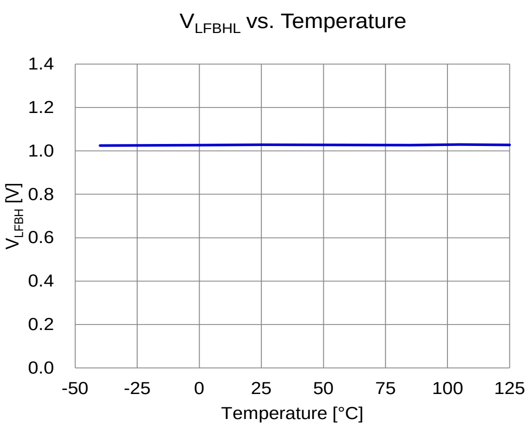
TCON Charge Current vs. Temperature
at Light Load Mode



TCON Threshold Voltage vs. Temperature
at Light Load Mode



LFB Threshold Voltage vs. Temperature
at Light Load Mode



■ TYPICAL CHARACTERISTICS

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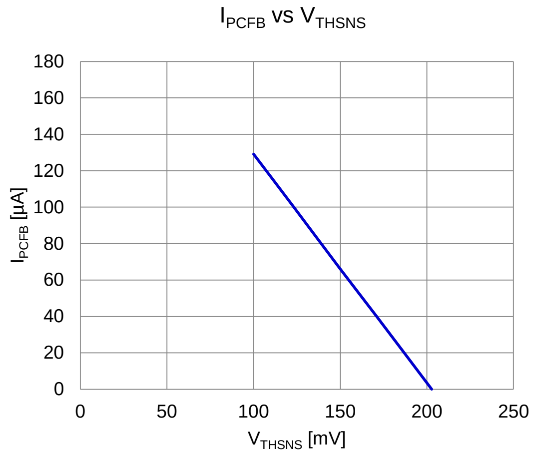
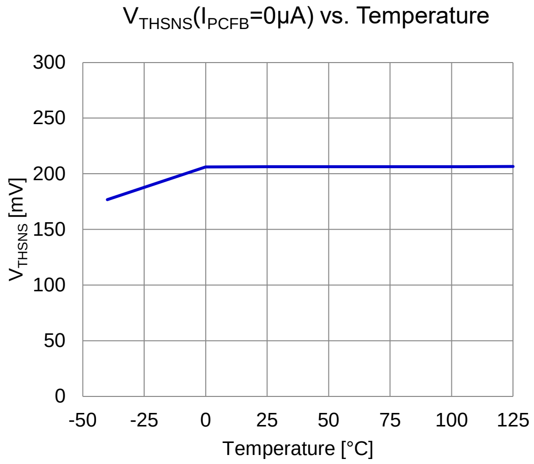
SENSE Pin characteristics

PCFB Pin Current vs. SENSE Pin Threshold Voltage

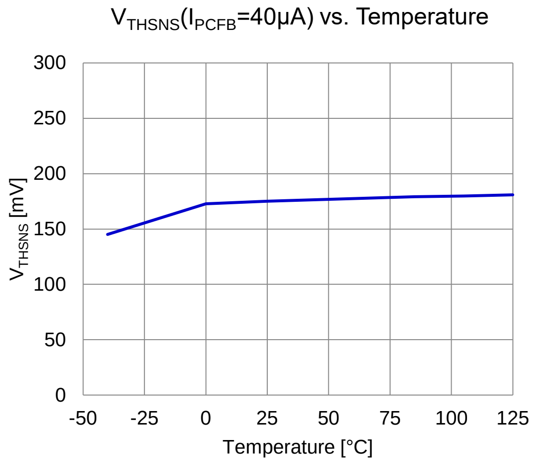


SENSE Pin Threshold Voltage vs. Temperature
at I_{PCFB} = 0μA

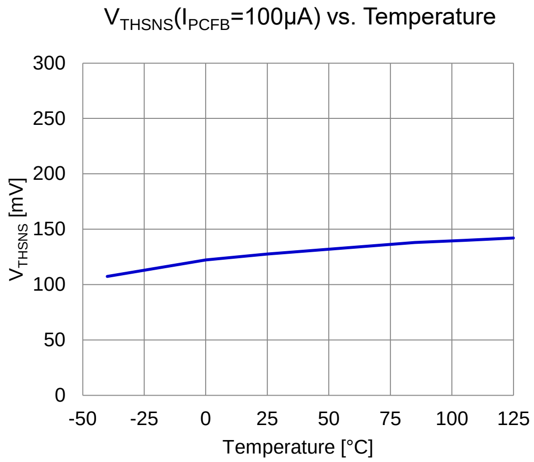


SENSE Pin characteristics

SENSE Pin Threshold Voltage vs. Temperature
at I_{PCFB} = 40μA

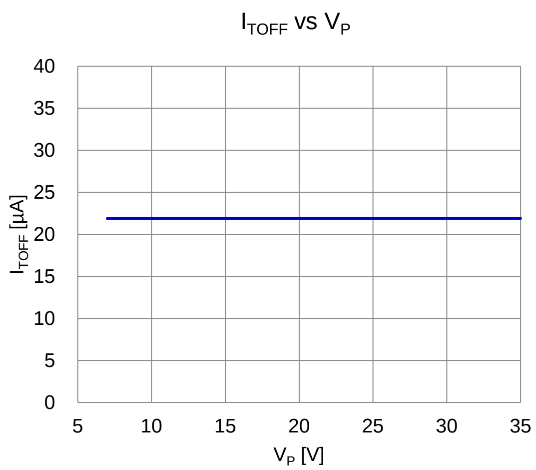


SENSE Pin Threshold Voltage vs. Temperature
at I_{PCFB} = 100μA



OFF Time Control characteristics

TOFF Charge Current vs. VP Pin Voltage



■ TYPICAL CHARACTERISTICS

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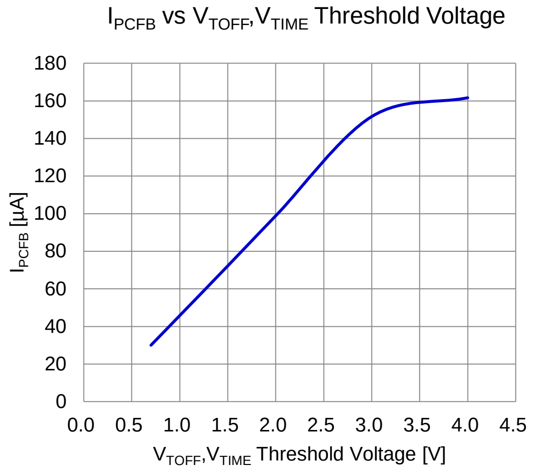
Off-time Control characteristics

PCFB Pin Current vs. TOFF and TIME Pin Threshold Voltage



TOFF Charge Current vs. TOFF Pin Voltage

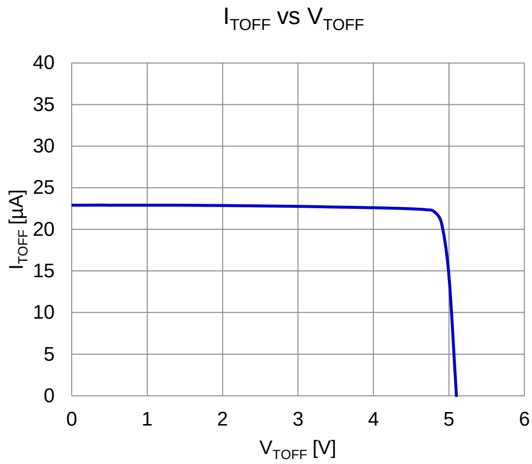


Photo Coupler Current at ON Switching 1

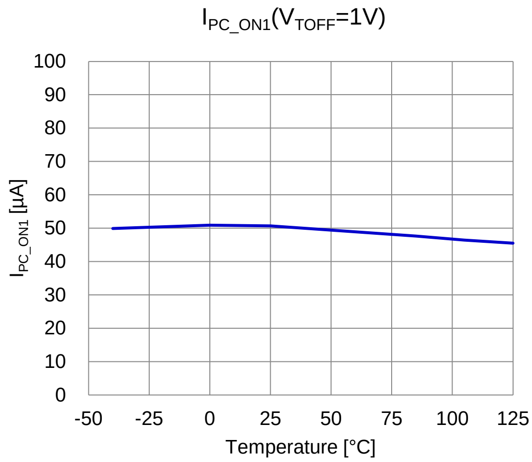
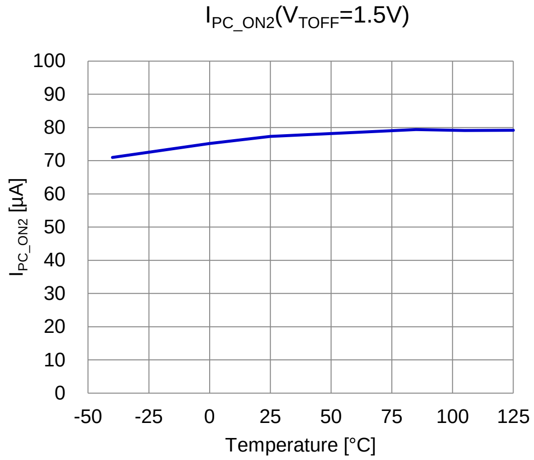
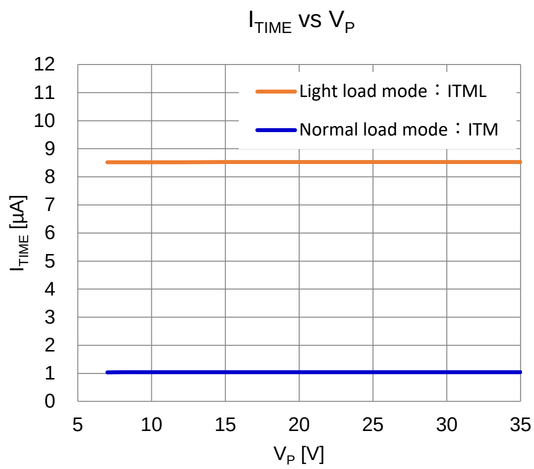


Photo Coupler Current at ON Switching 2

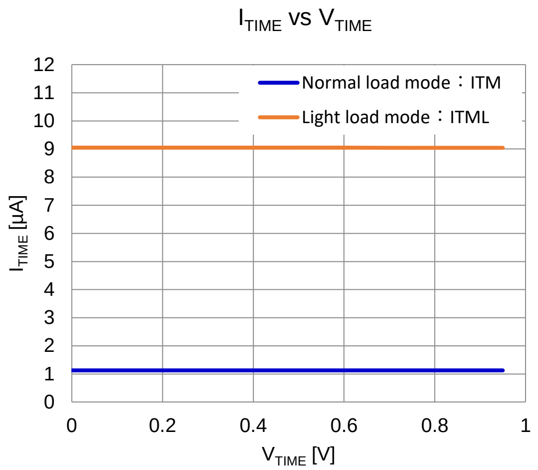


Timeout Setting characteristics

TIME Pin Charge Current vs. VP Pin Voltage



TIME Pin Charge Current vs. TIME Pin Voltage



■ TYPICAL CHARACTERISTICS

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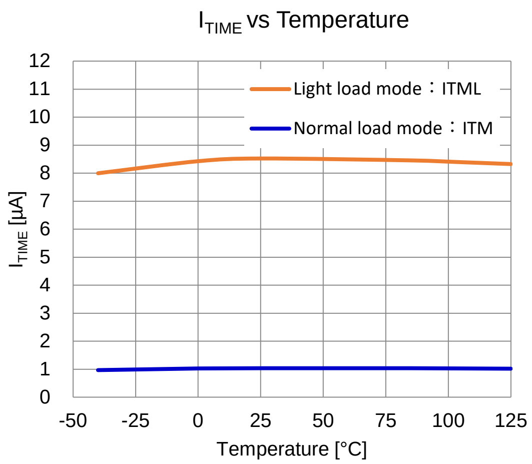
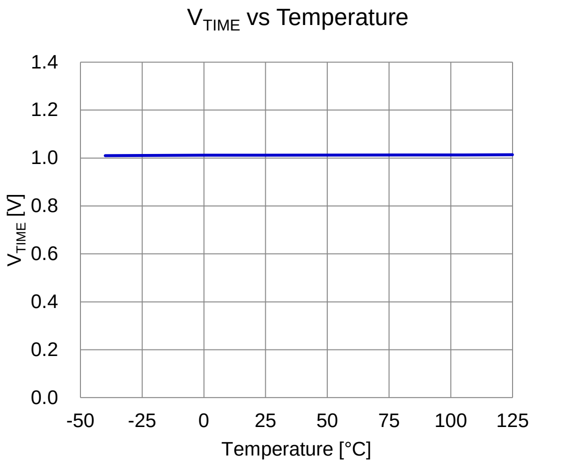
Timeout Setting characteristics

TIME Pin Charge Current vs. Temperature

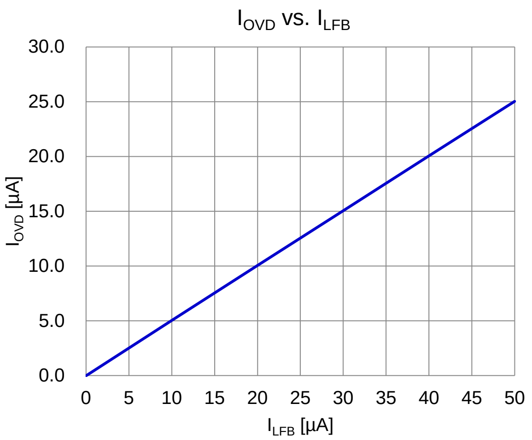


Load Mode Switching Threshold Voltage vs. Temperature

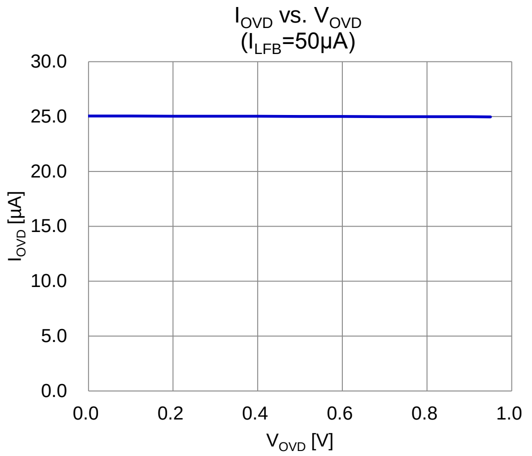


Overvoltage Detection characteristics

OVD Pin Current vs. LFB Pin Current

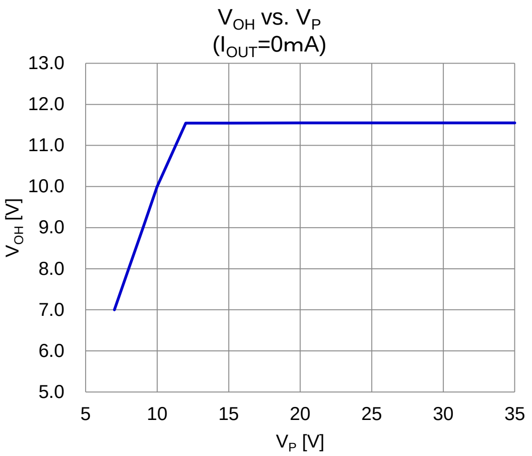


OVD Pin Current vs. OVD Pin Voltage

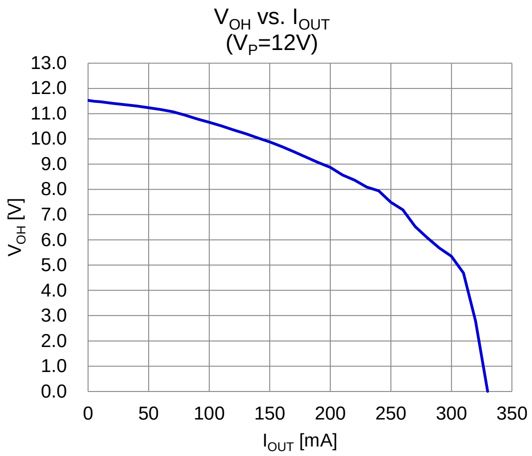


Output characteristics

Output Pin Voltage vs. VP Pin Voltage
at Output “HIGH”



Output Pin Voltage vs. Output Current
at Output “HIGH”

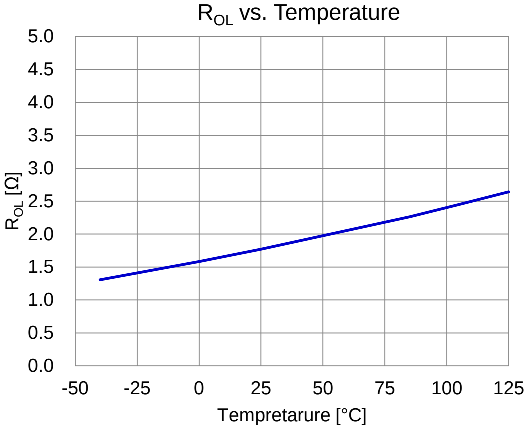


■ TYPICAL CHARACTERISTICS

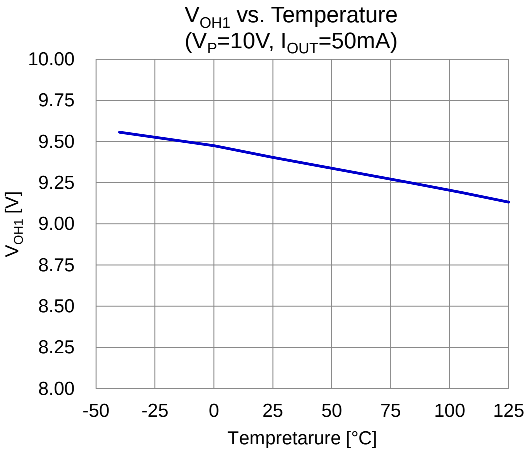
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

Output characteristics

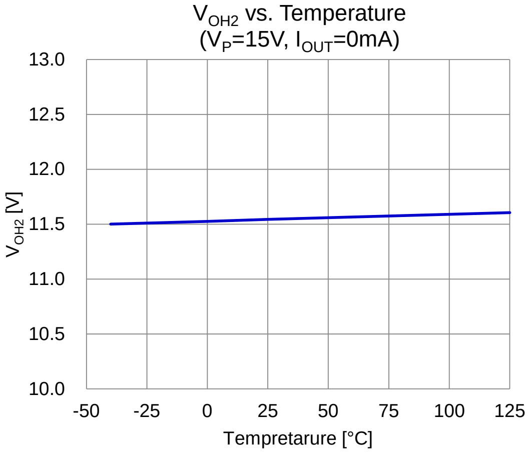
Output Pin ON Resistance vs. Temperature
at Output “LOW”



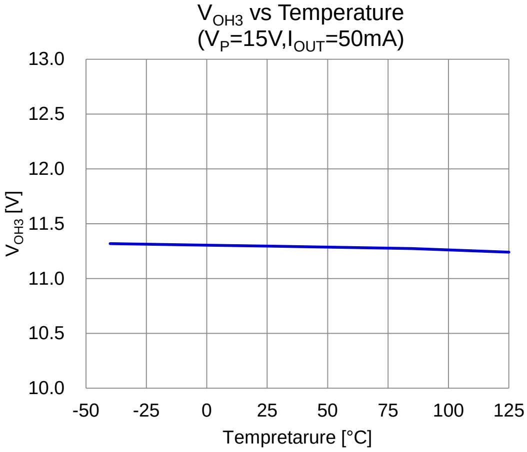
Output Pin Voltage vs. Temperature
at Output “HIGH” 1



Output Pin Voltage vs. Temperature
at Output “HIGH” 2



Output Pin Voltage vs. Temperature
at Output “HIGH” 3

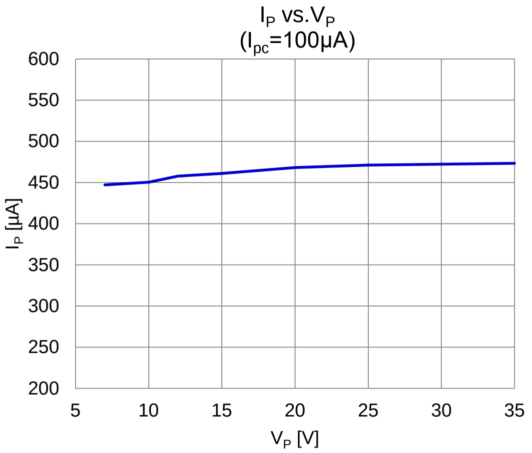


■ TYPICAL CHARACTERISTICS

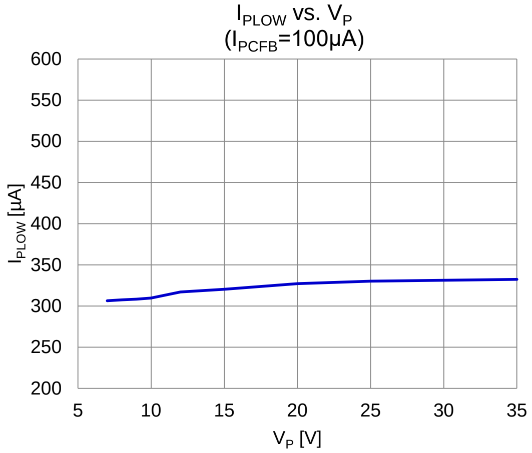
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

General characteristics

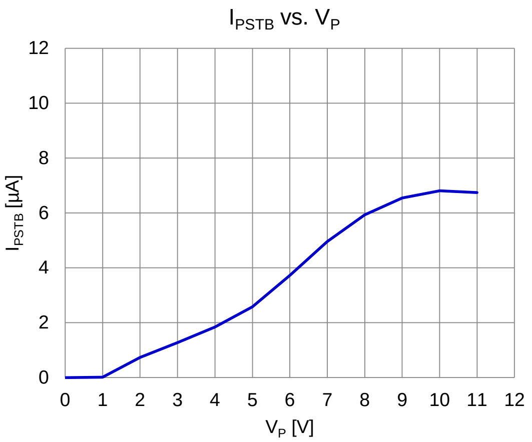
Quiescent Current vs. VP Pin Voltage
at Normal Load Mode



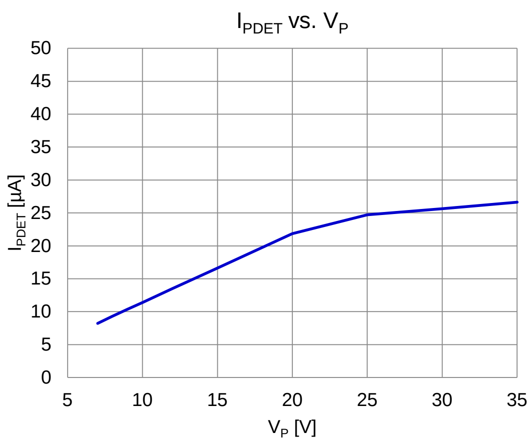
Quiescent Current vs. VP Pin Voltage
at Light Load Mode



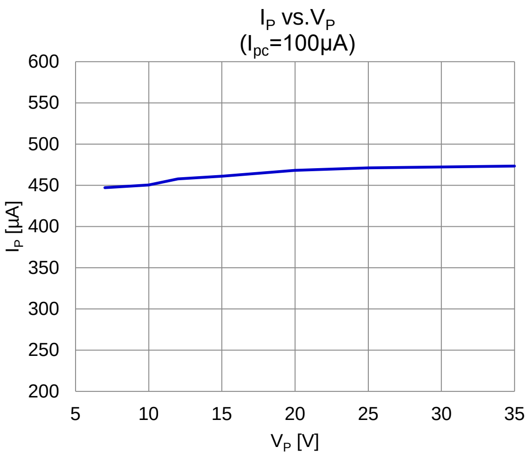
Quiescent Current vs. VP Pin Voltage
at Standby Mode



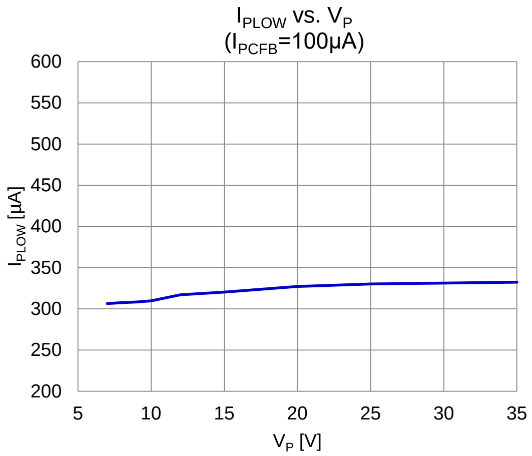
Quiescent Current vs. VP Pin Voltage
after OVP/TSD detection



Quiescent Current vs. Temperature
at Normal Load Mode



Quiescent Current vs. Temperature
at Light Load Mode

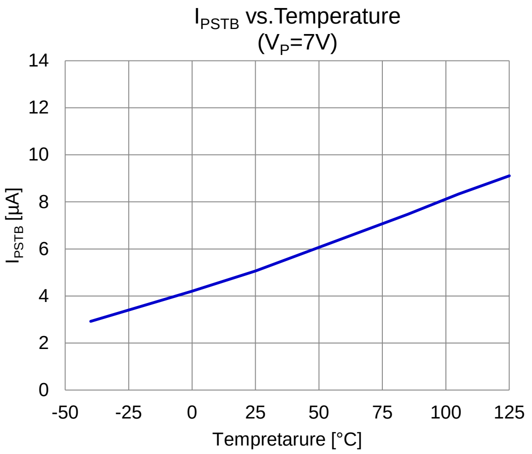


■ **TYPICAL CHARACTERISTICS**

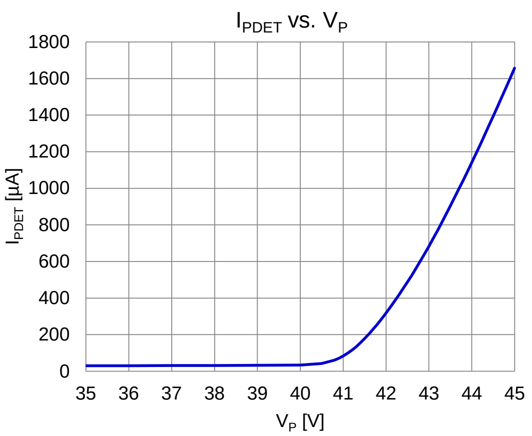
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

General characteristics

Quiescent Current vs. Temperature
at Standby Mode



VP Pin Clamp Current vs. VP Pin Clamp Voltage



■ **REVISION HISTORY**

Date	Revision	Changes
Jan 24, 2025	Ver. 1.0	Initial release

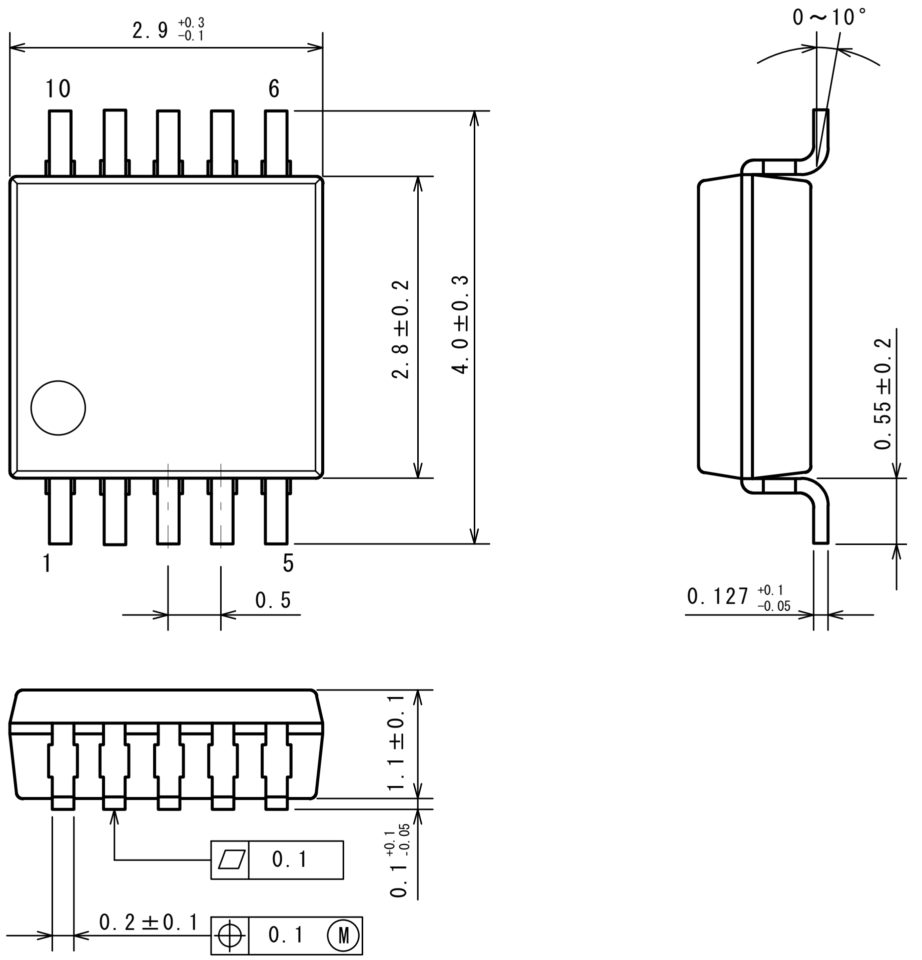
Nisshinbo Micro Devices Inc.

MSOP10 MEET JEDEC MO-187-DA (VSP10)

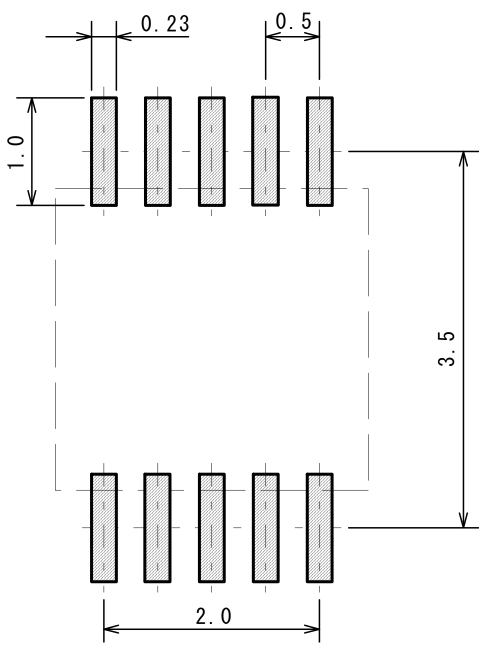
PI-MSOP10-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Nisshinbo Micro Devices Inc.

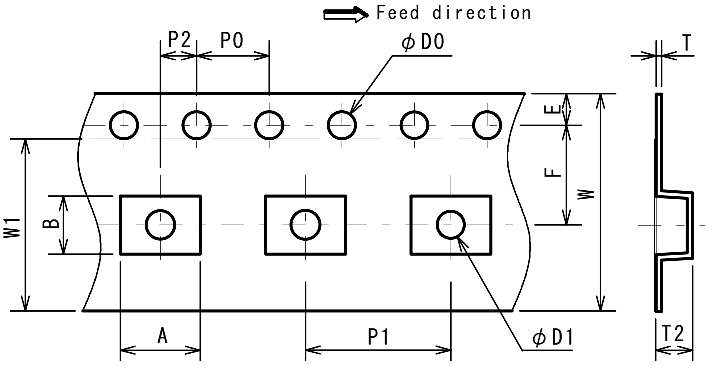
MSOP10 MEET JEDEC MO-187-DA (VSP10)

PI-MSOP10-E-B

■ PACKING SPEC

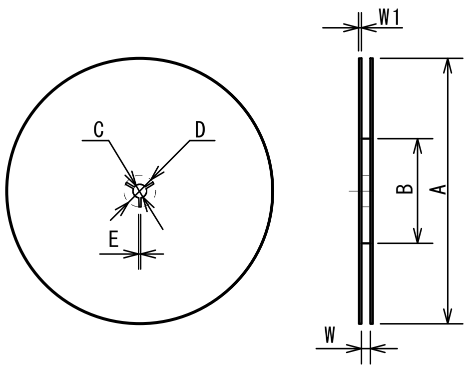
UNIT: mm

TAPING DIMENSIONS



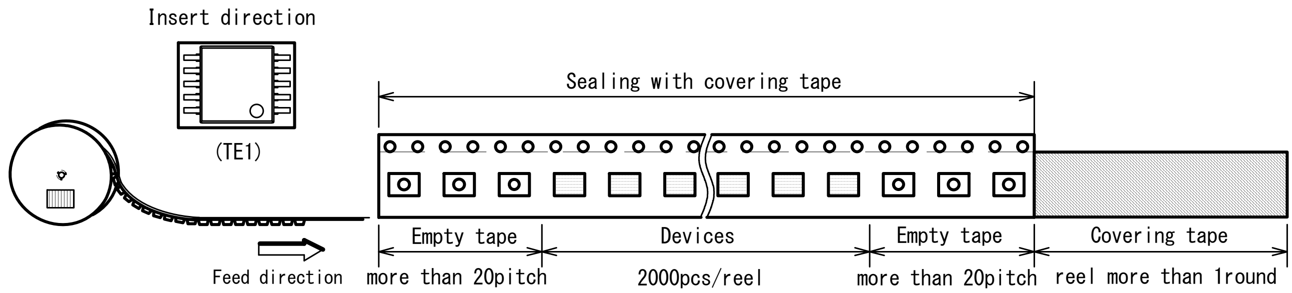
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	2.0 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

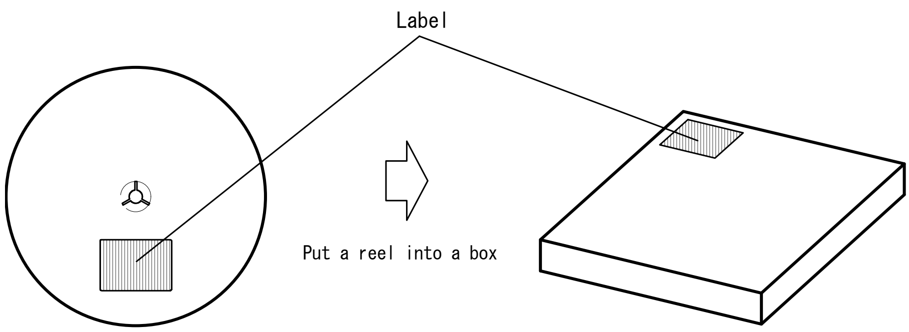


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



PACKING STATE



Nisshinbo Micro Devices Inc.

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