EARTH LEAKAGE CURRENT DETECTOR IC SERIES

EARTH LEAKAGE CURRENT DETECTOR IC

BD95850F-LB

Description

This is the product guarantees long time support in Industrial market.
The BD95850F-LB is the monolithic IC integrates earth leakage detection, signal amplification, and overvoltage detection .
Especially, it's suitable for high-sensitivity and high -speed operation use, and, since the operating temperature range is wide, it can be used for various applications.

Key Specifications

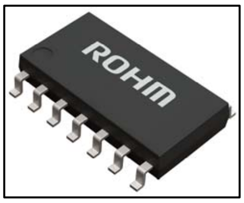
- Operating Supply Voltage Range: 7V to 13V
- Operating Temperature Range: -30°C to +95°C
- Supply Current: 830µA(Typ)
- Trip Voltage(Leakage Detection DC Voltage): 7.5mV
- Output Current Ability : -100µA(Min)

Features

- Long Time Support Product for Industrial Applications
- Small Temperature Fluctuation and High Input Sensitivity
- Wide Operating Temperature Range
- Detection Mode Selectable (1 count method /1.5 count method)

Package

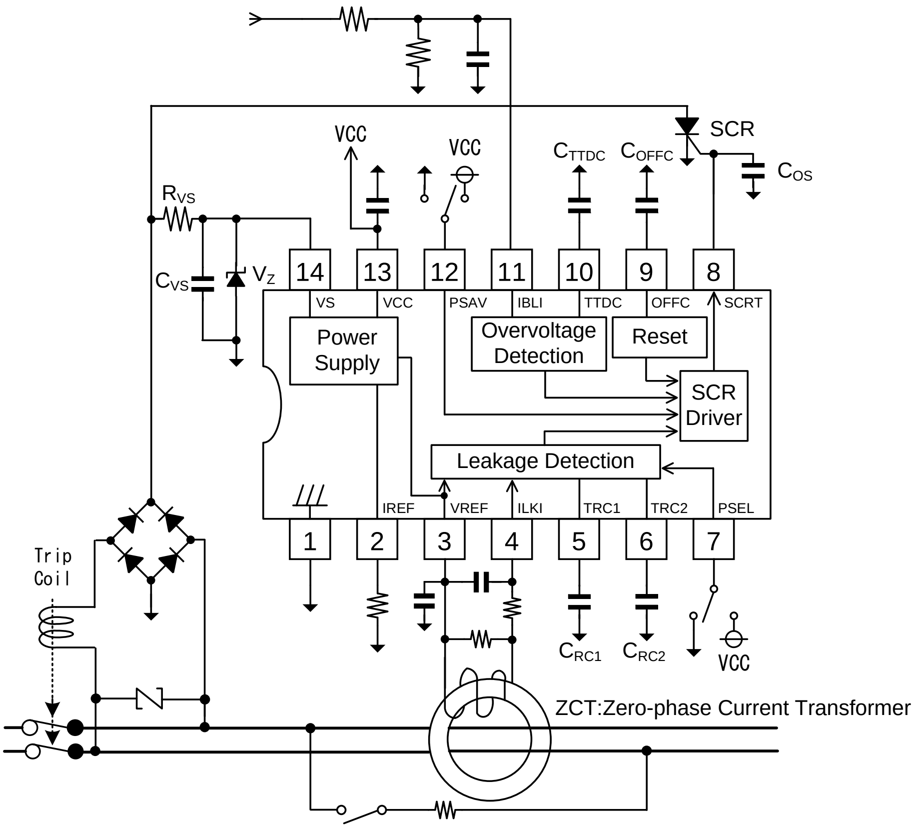
Package	W(Typ) x D(Typ) x H(Max)
SOP14	8.70mm x 6.20mm x 1.71mm



Applications

- Earth leakage circuit breaker
- Earth leakage circuit relay
- Industrial equipment

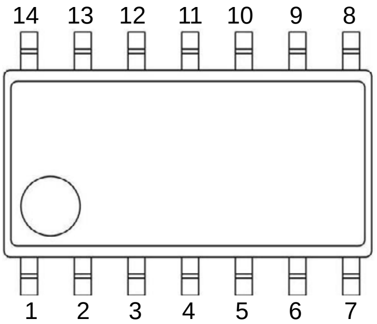
Typical Application Circuit Example



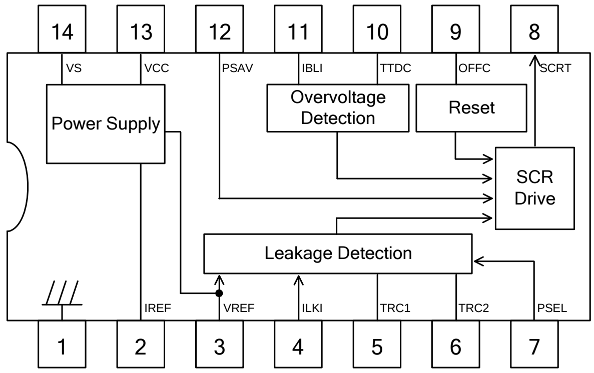
○Product structure：Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

Pin Configurations

SOP14
(TOP VIEW)



Block Diagrams



Pin Descriptions

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	GND	Ground	8	SCRT	Output for driving thyristor
2	IREF	Connect a resistor to set constant current of the internal circuits	9	OFFC	Connect a capacitor to set reset time
3	VREF	Reference voltage output	10	TTDC	Connect a capacitor to set over-voltage detection time
4	ILKI	Input of leakage detection signal	11	IBLI	Input of over-voltage detection signal
5	TRC1	Connect a capacitor for charge current of negative detection	12	PSAV	Enable pin for overvoltage detection function
6	TRC2	Connect a capacitor for charge current of positive detection	13	VCC	Internal power supply
7	PSEL	Logic function switching pin for leakage detection	14	VS	Power supply

Absolute Maximum Ratings

(T_A=25°C)

Parameter	Symbol	Rating	Unit	Condition
Supply Current	I_S	4	mA	
Supply Voltage (Note 1)	V_S	18	V	
Input Voltage	$V_{\Delta IN}$	-1.5 to +1.5	V	across ILKI and VREF
Input Current	$I_{\Delta IN}$	-5 to +5	mA	across ILKI and VREF
Input Current of VREF	I_{VREF}	10	mA	across VREF and GND
Input Voltage	V_{XXXX}	8	V	IREF/REF/IN/TRC1/TRC2/ PSEL/SCRT/OFFC/PSAV/ TTDC/VCC/IBLI
Input Voltage of Overvoltage Detection	V_{IBLI}	-0.3 to +5.0	V	across IBLI and GND
Input Current of Overvoltage Detection	I_{IBLI}	4	mA	across IBLI and GND
Power Dissipation	P_D	0.56 (Note 2)	W	
Operating Temperature	T_{opr}	-30 to +95	°C	
Storage Temperature	T_{stg}	-55 to +150	°C	

(Note 1) Supply voltage is limited by internal clamping circuit . Please refer to maximum current voltage of the electrical characteristic item.
(Note 2) Mounted on 70mm x 70mm x 1.6mm glass epoxy board. Reduce 4.5mW per 1°C above 25°C.
Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Recommended Operating Conditions

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{Sopr}	7 to 13	V

Electrical Characteristic

(unless otherwise specified VS=9V,GND=0V, T_A=25°C)

Item	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Supply current : during standby	I_{S0}	-	830	940	μ A	PSAV=VCC
Supply current : during leakage detection	I_{S1}	-	840	950	μ A	PSAV=VCC
Supply current : during overvoltage detection	I_{S2}	-	840	950	μ A	PSAV=VCC
Supply current : during SCRT pin is "H"	I_{S3}	-	-	870	μ A	PSAV=VCC
Supply current : during standby	$I_{S0'}$	-	750	860	μ A	PSAV=GND
Supply current : during leakage detection	$I_{S1'}$	-	760	870	μ A	PSAV=GND
Supply current : during SCRT pin is "H"	$I_{S3'}$	-	-	870	μ A	PSAV=GND
I_{S0} Ambient temperature dependence	-	-	-0.07	-	%/ °C	T_A=-30°C to +85°C
Voltage at maximum current	V_{SM}	13.2	14.8	16.4	V	I_S=3mA
Leakage detection DC input voltage	V_T	-	±7.5	-	mV	
ILKI pin input bias current	I_{IH}	-	1	15	nA	V_{ILKI}=VREF
VREF pin output voltage	V_{VREF}	-	2.4	-	V	
ILKI-VREF input clamping voltage	V_{INCL}	-	±0.8	-	V	I_{ILKI}=±3mA
VREF-GND clamping voltage	V_{VREFCL}	-	5.5	-	V	I_{RCL}=5mA
TRC1 pin "H" output current precision	E_{IOH}	-20	-	+20	%	V_O=0V : I_{OH}=-10μA
TRC1 pin threshold voltage	V_{TH}	-	2.4	-	V	
TW1 pulse width precision	E_{TW1}	-15	-	+15	%	C=0.01μF : T_{W1}=2.3ms
TW1 ambient temperature dependence	-	-	-0.08	-	%/ °C	T_A=-30°C to +85°C
TRC2 pin "H" output current precision	E_{IOH}	-20	-	+20	%	V_O=0V : I_{OH}=-10μA
TRC2 pin threshold voltage	V_{TH}	-	2.4	-	V	
TW2 pulse width precision	E_{TW2}	-15	-	+15	%	C=0.0047μF : T_{W1}=1.1ms
TW2 ambient temperature dependence	-	-	-0.08	-	%/ °C	T_A=-30°C to +85°C
V_T ambient temperature dependence	-	-	-4	-	%	T_A=+25°C to +85°C
		-	-2	-	%	T_A=+25°C to -30°C
Overvoltage detection voltage	V_{IBLI}	2.3	2.4	2.5	V	
V_{IBLI} supply voltage dependence	-	-	0.1	-	%/V	
V_{IBLI} ambient temperature dependence	-	-	0.06	-	%/°C	T_A=-30°C to +85°C
IBLI pin input bias current	I_{IBLI}	-	50	300	nA	V_{IN}=VREF
IBLI-GND clamping voltage	V_{IBLICL}	-	6.1	-	V	I_{IN}=1mA
TTDC pin "H" output current precision	E_{IOH}	-20	-	+20	%	V_O=0V : I_{OH}=-8μA
TTDC pin threshold voltage	V_{TH}	-	2.4	-	V	
Delay time pulse width precision	E_{TW4}	-30	-	+30	%	C=1.0μF : T_{W4}=300ms
OFFC pin "H" output current precision	E_{IOH}	-20	-	+20	%	V_O=0V : I_{OH}=-10μA
OFFC pin threshold voltage	V_{TH}	-	2.4	-	V	
Reset timer pulse width precision	E_{TW3}	-30	-	+30	%	C=0.33μF : T_{W3}=55ms
SCRT pin "L" output voltage	V_{OL3}	-	0.02	0.2	V	I_{CL}=200μA
SCRT pin "H" output current	I_{OHc}	-	-300	-200	μ A	T_A=-30°C,VO=0.8V
	I_{OHn}	-	-260	-100	μ A	T_A=+25°C,VO=0.8V
	I_{OHh}	-	-210	-70	μ A	T_A=+85°C,VO=0.8V
I_{OH} hold supply voltage	V_{SOFF}	-	3.7	-	V	

Function Explanation

1.Switching of leakage detection mode

		The input logic to become output SCRT=HIGH
PSEL pin voltage	VCC	Negative input → Positive input (1 count method mode)
	GND	Negative input → Positive input → Negative input (1.5 count method mode)

2.ON/OFF switching of overvoltage detection function

		State of the overvoltage detection function
PSAV pin voltage	VCC	ON
	GND	OFF

3.Reset function

Please connect a capacitor to OFFC pin (Pin.9) to set time in follows for making an IC initial state after a certain period of time.

・When a leakage detection input signal does not continue
・When an overvoltage detection signal does not continue
・After leakage detection or overvoltage detection, SCRT output voltage becomes high

4.Overvoltage detection wait time

After first overvoltage detection, SCRT output voltage becomes “H” when overvoltage is detected after a certain period of time.
Please set the wait time with a capacitor connecting to TTDC pin (Pin.10).

5.Time delay function

As shown below, by applying overvoltage detection function, the leakage detection function can be provided with a time delay function. However, the overvoltage detection function can not be used.

In Figure 1; It is set by a diode between Pin.6 and Pin.10, GND connection of Pin.11.
In Figure 2; It is set by PNP transistor between Pin.6 and Pin.10, GND connection of Pin.11.
In the case of Figure 2, the delay time becomes approximately 60% of Figure 1.

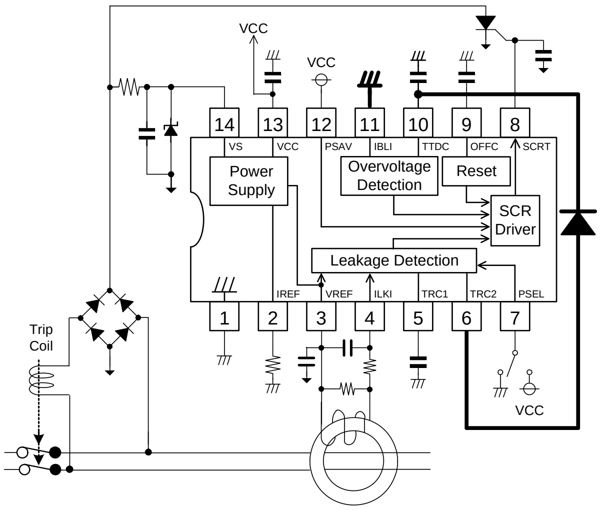


Figure 1. Setting of time delay function 1

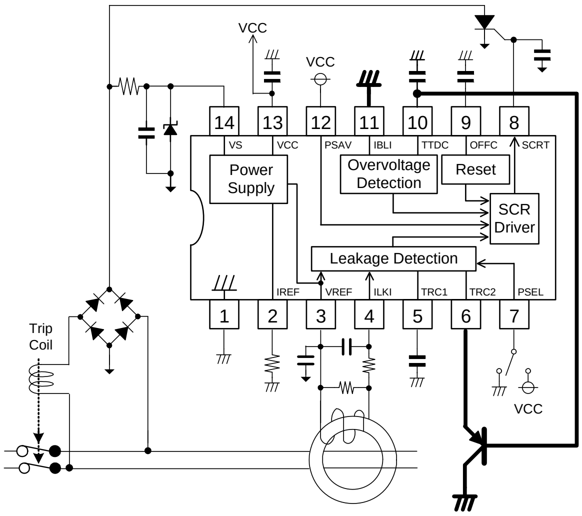


Figure 2. Setting of time delay function 2

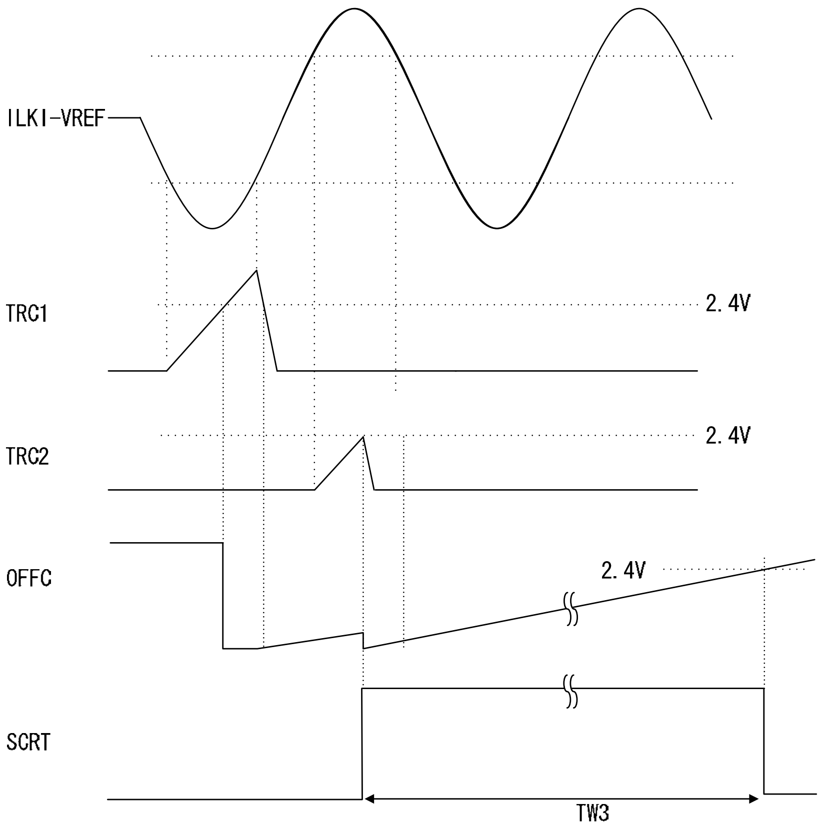
6.IREF terminal

A resistance connecting to this terminal becomes the standard constant current source of this IC. Cause this resistance determines the characteristic of each circuit, it is recommended that a high precision resistance (+-1%) be used.

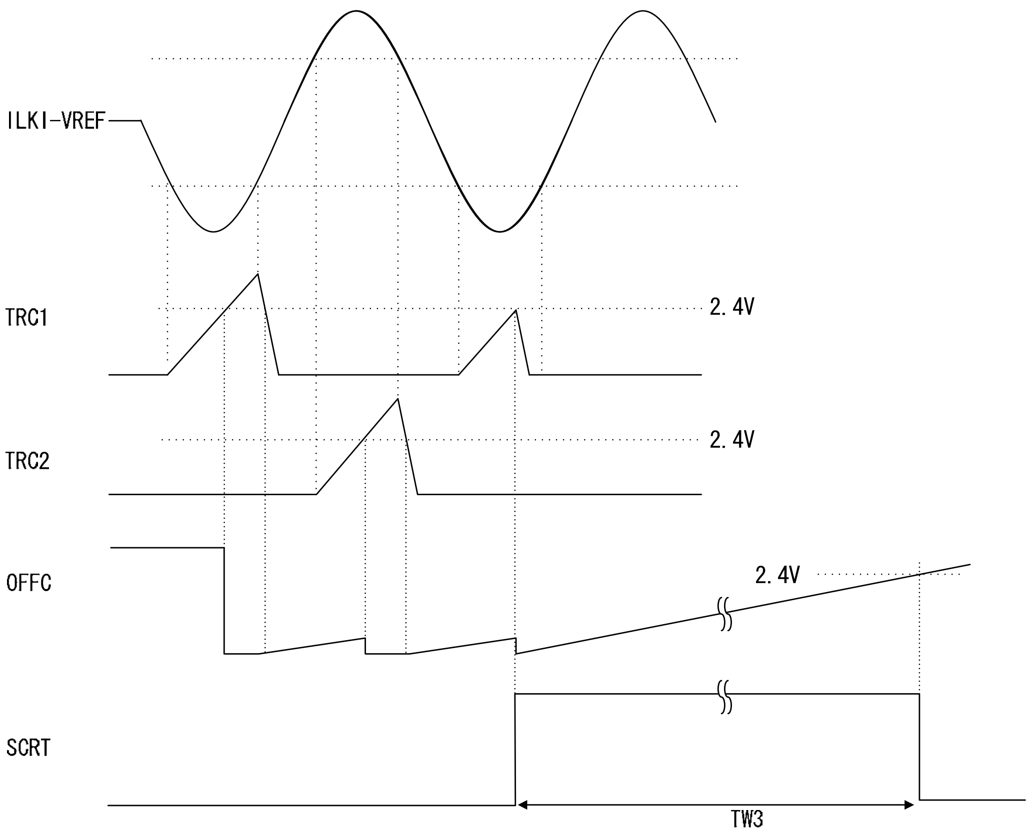
Timing Chart

1. Earth leakage detection

1-1. 1 count method

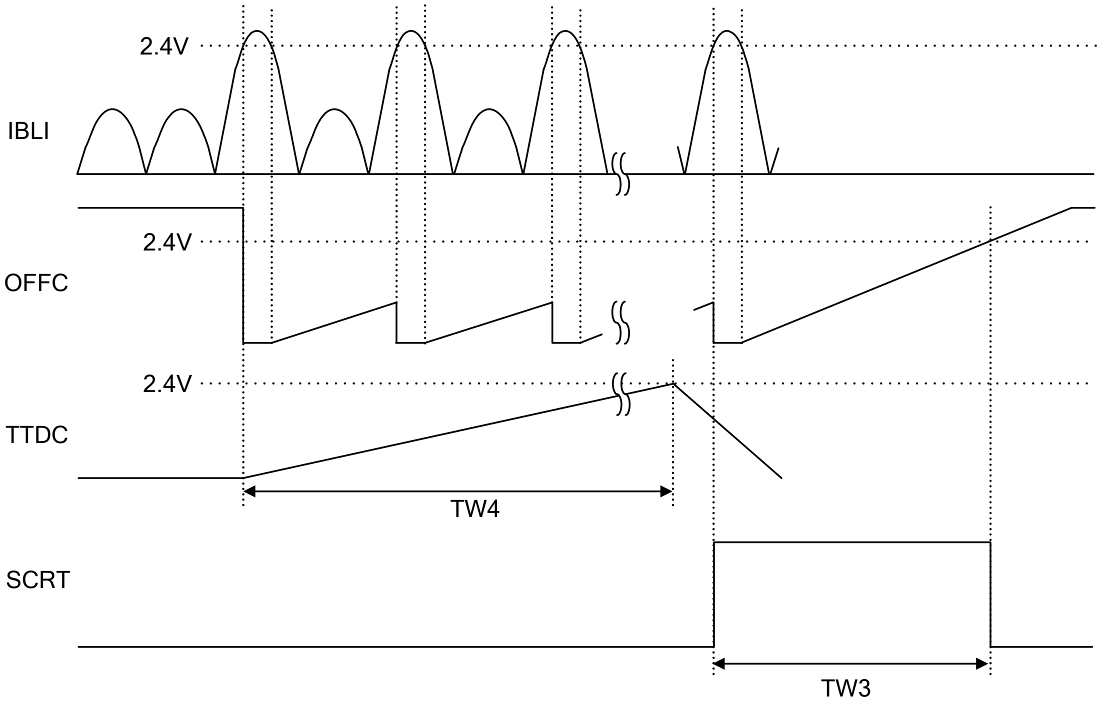


1-2. 1.5 count method



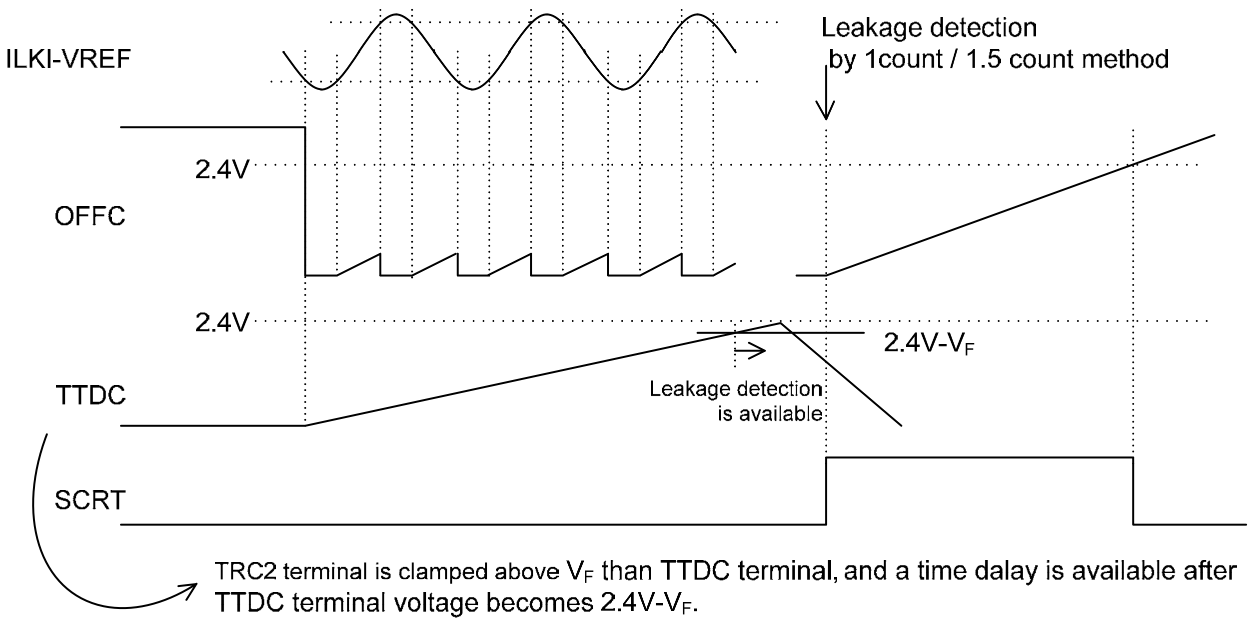
Timing Chart - continued

2.Overvoltage detection



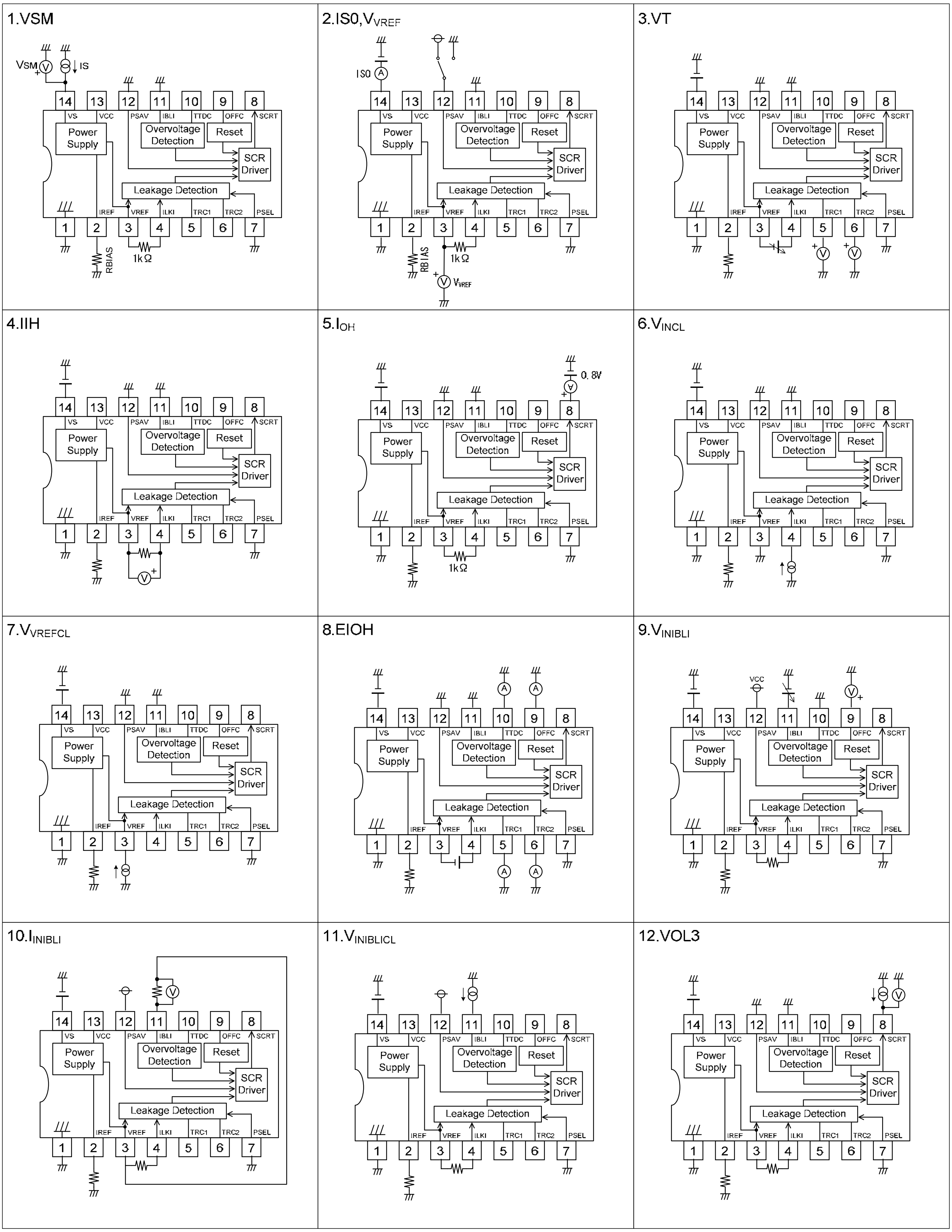
3.A time delay function for leakage detection

After the first leakage detection, SCRT pin becomes “H” after a certain period of time.



Test Circuit

(RBIAS=120kΩ)



Typical Performance Curves (reference data)

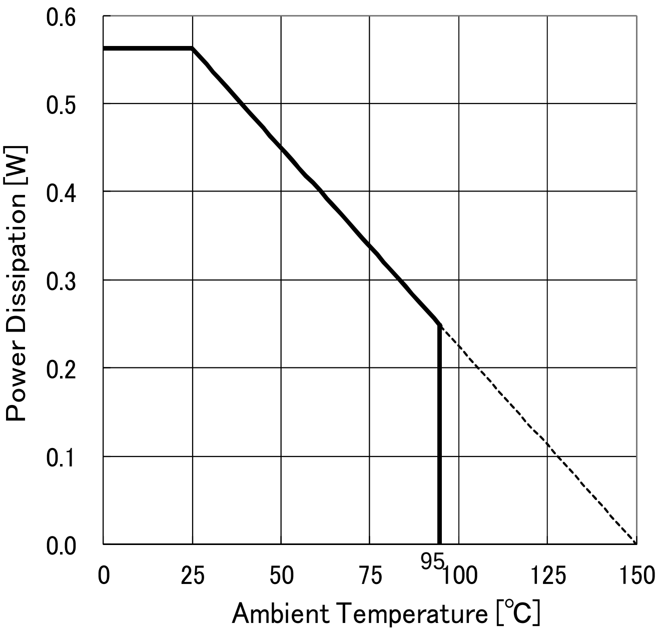


Figure 1.
Derating Curve

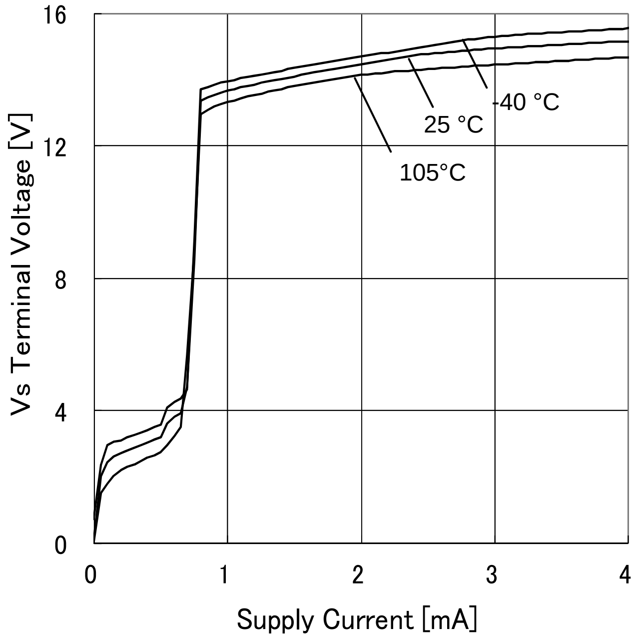


Figure 2.
Supply Voltage - Supply Current

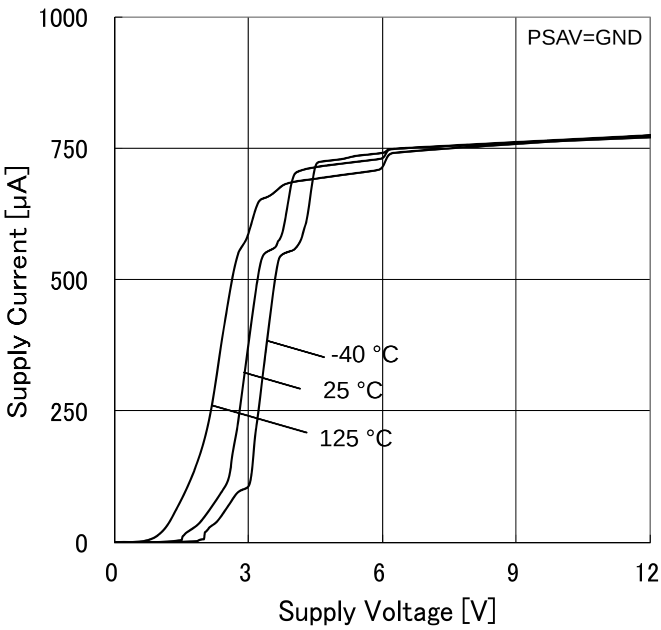


Figure 3.
Supply Current - Supply Voltage
During Standby

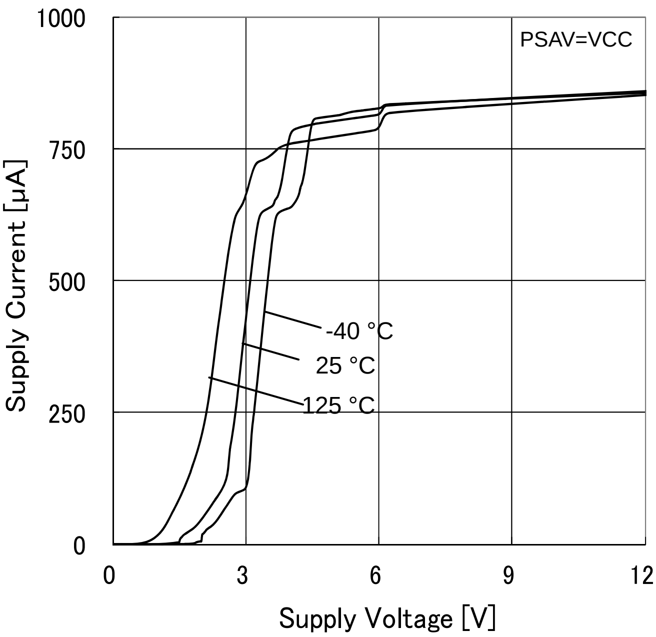


Figure 4.
Supply Current - Supply Voltage
During Standby

Typical Performance Curves (reference data) - continued

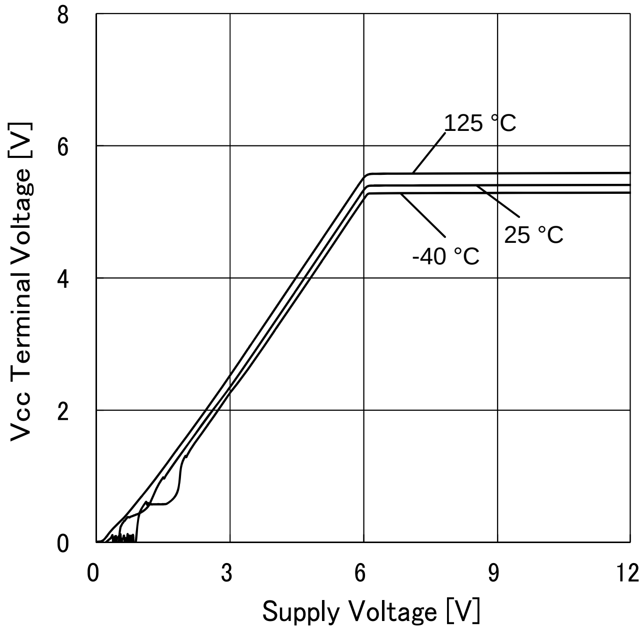


Figure 5.
VCC pin Voltage - Supply Voltage

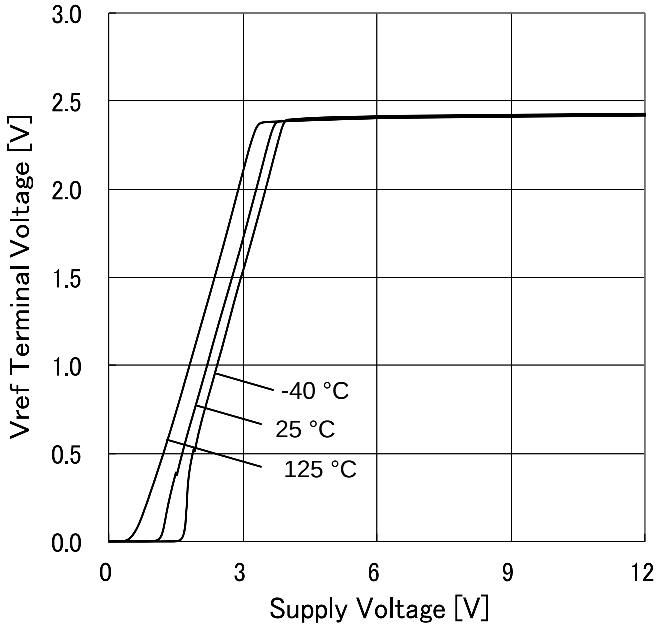


Figure 6.
VREF pin Voltage - Supply Voltage

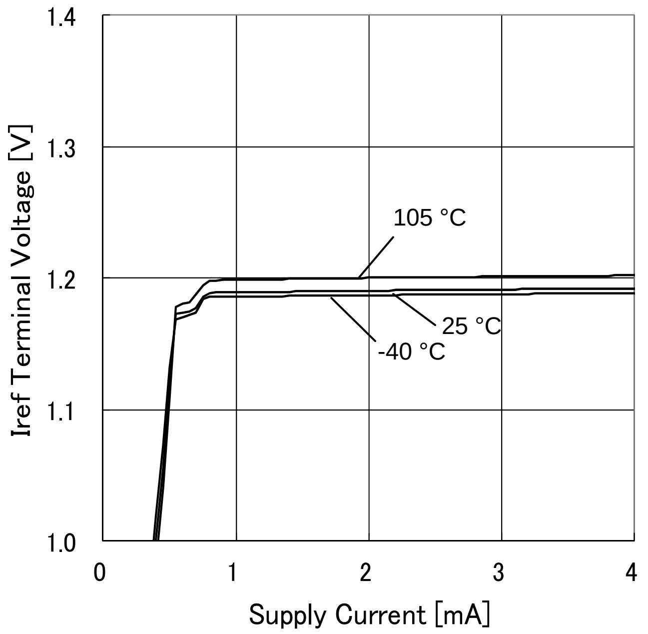


Figure 7.
IREF pin Voltage - Supply Voltage

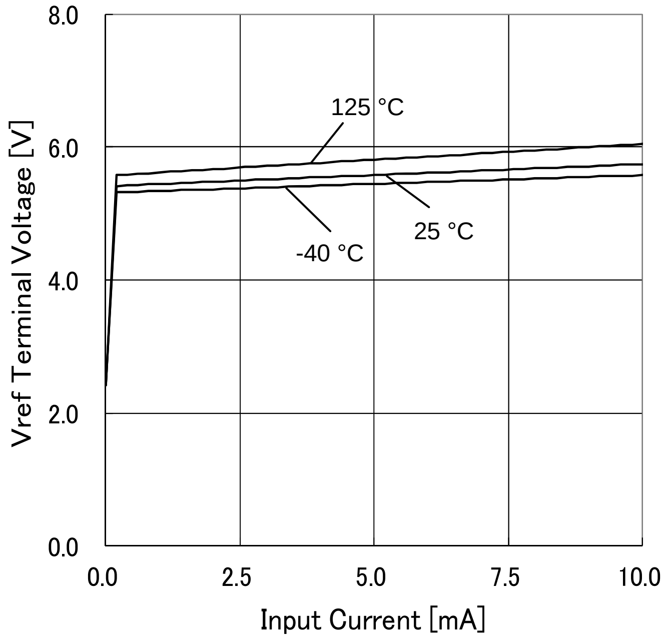


Figure 8.
VREF pin Clamping Voltage - Input Current

Typical Performance Curves (reference data) - continued

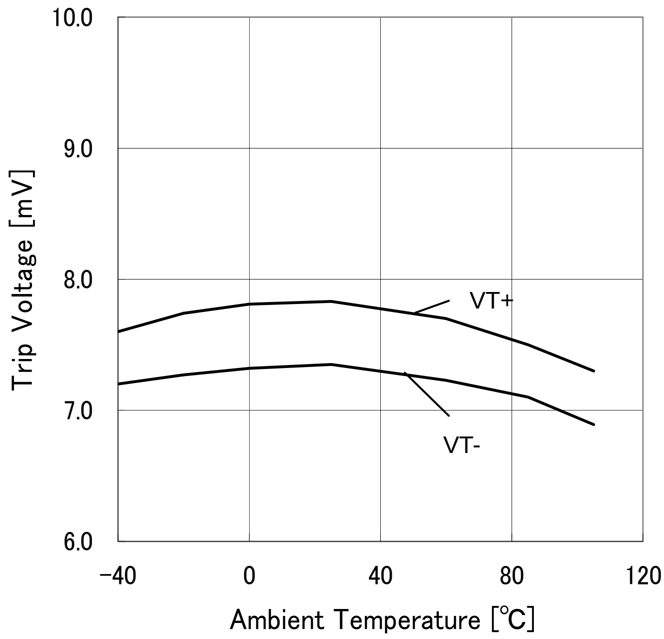


Figure 9.
Trip Voltage – Ambient Temperature

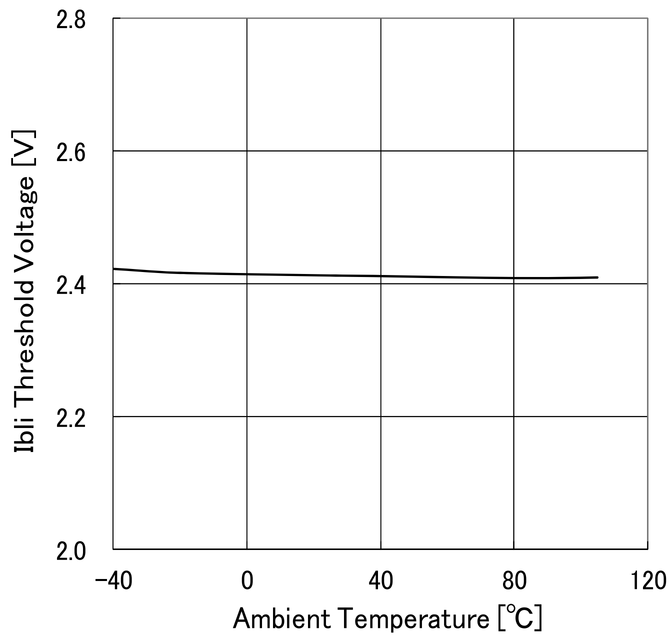


Figure 10.
Overvoltage Detection Threshhold Voltage
- Ambient Temperature

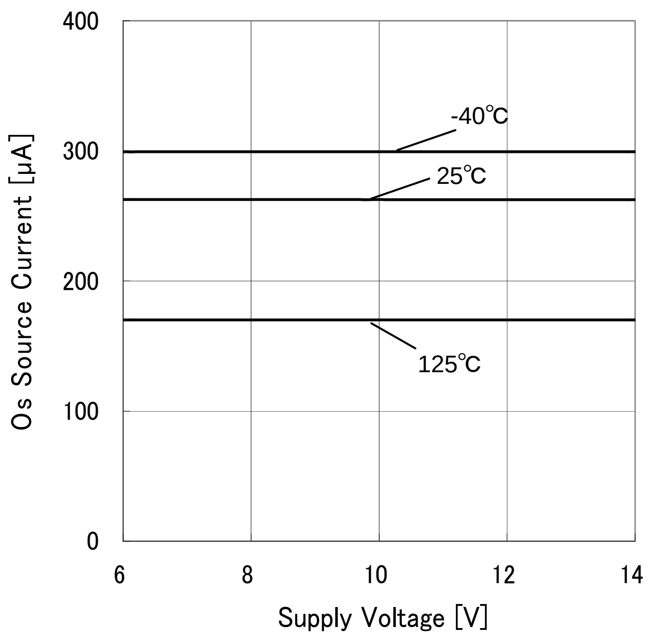


Figure 11.
SCRT pin Source Current - Supply Voltage

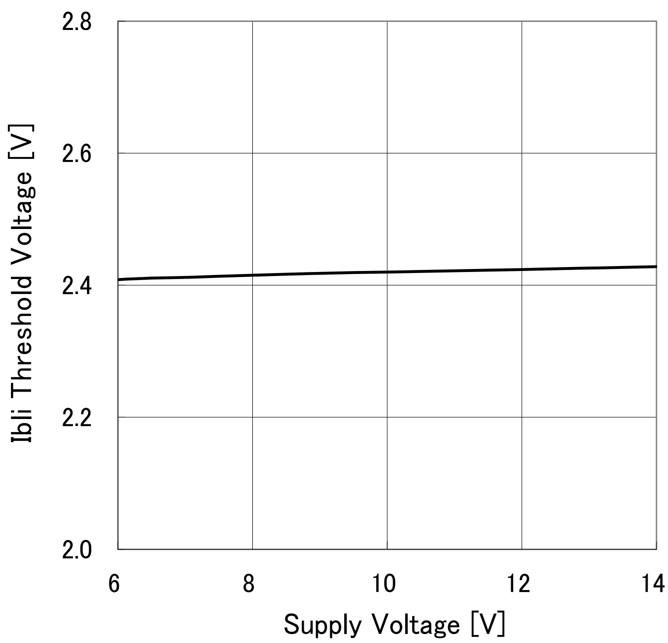


Figure 12.
Overvoltage Detection Threshhold Voltage
- Supply Voltage

Typical Performance Curves (reference data) - continued

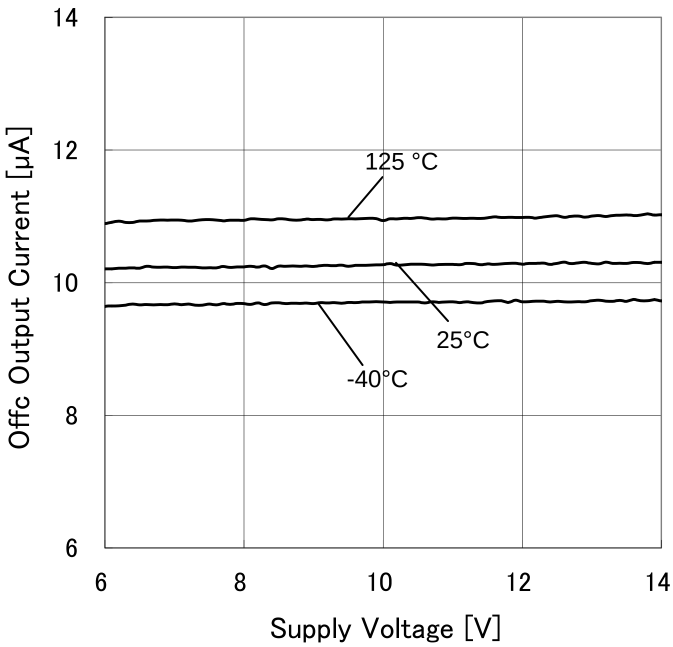


Figure 13.
OFFC pin Source Current - Supply Voltage

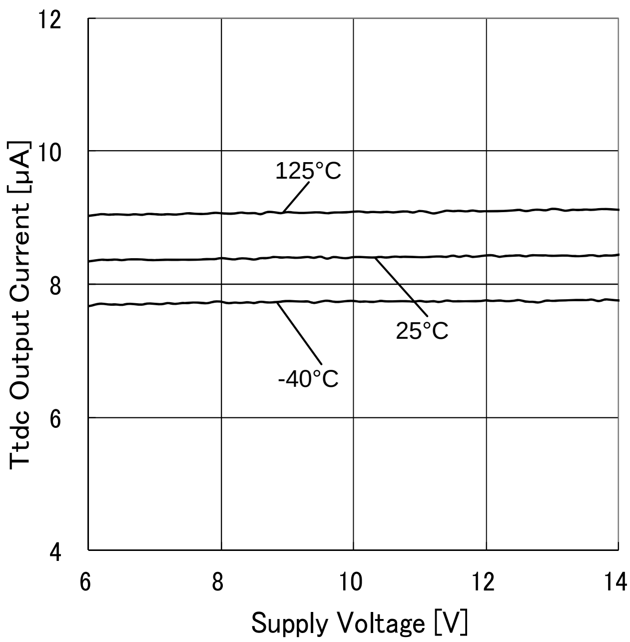


Figure 14.
TTDC pin Source Current - Supply Voltage

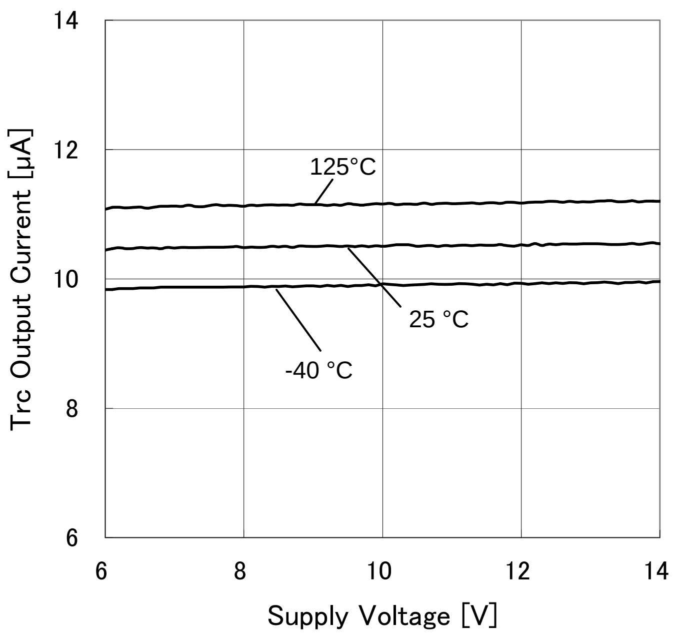


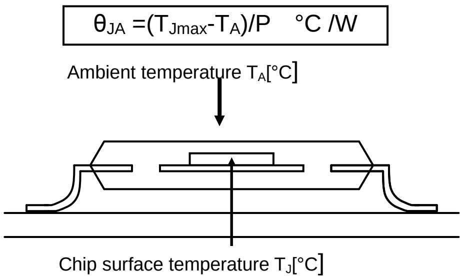
Figure 15.
TRC1/2 pin Source Current - Supply Voltage

Power Dissipation

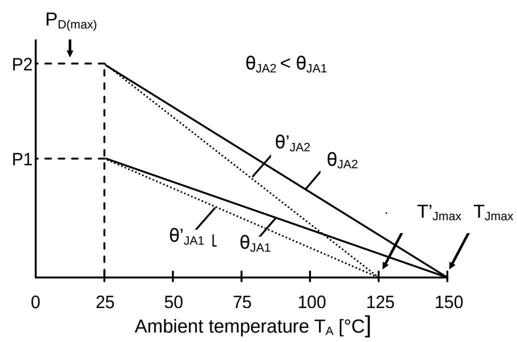
Power dissipation(total loss) indicates the power that can be consumed by IC at T_A=25°C (normal temperature).IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing process, and consumable power is limited. Power dissipation is determined by the temperature allowed in IC chip (maximum junction temperature) and thermal resistance of package (heat dissipation capability). The maximum junction temperature is typically equal to the maximum value in the storage temperature range. Heat generated by consumed power of IC radiates from the mold resin or lead frame of the package. The parameter which indicates this heat dissipation capability(hardness of heat release)is called thermal resistance, represented by the symbol θ_{JA}°C/W. The temperature of IC inside the package can be estimated by this thermal resistance. Figure 16(a) shows the model of thermal resistance of the package. Thermal resistance θ_{JA}, ambient temperature T_A, junction temperature T_{Jmax}, and power dissipation P_D can be calculated by the equation below

$$\theta_{JA} = (T_{Jmax} - T_A) / P_D \quad °C/W \quad \cdots\cdots \quad (I)$$

Derating curve in Figure 16(b) indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature. This gradient is determined by thermal resistance θ_{JA}. Thermal resistance θ_{JA} depends on chip size, power consumption, package, ambient temperature, package condition, wind velocity, etc even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition. Figure 17(a) show a derating curve for an example of BD95850F-LB .

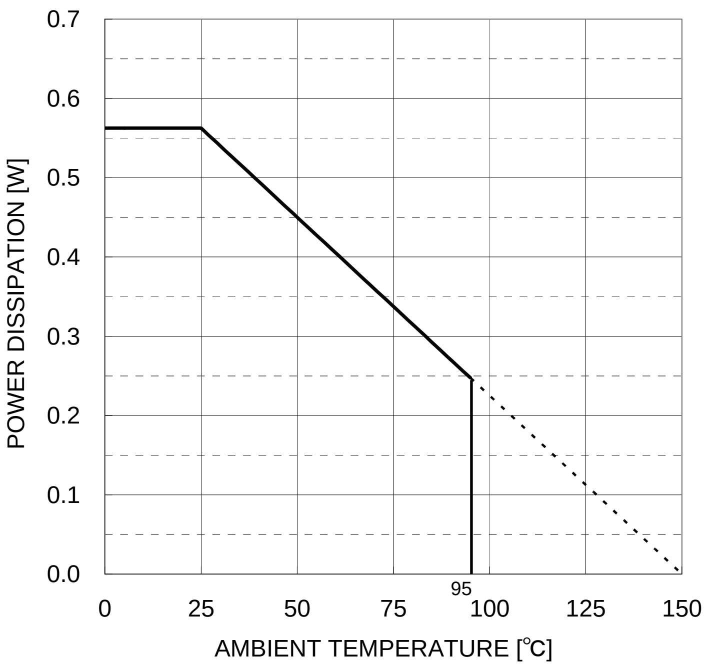


(a) Thermal Resistance



(b) Derating Curve

Figure 16. Thermal Resistance and Derating Curve



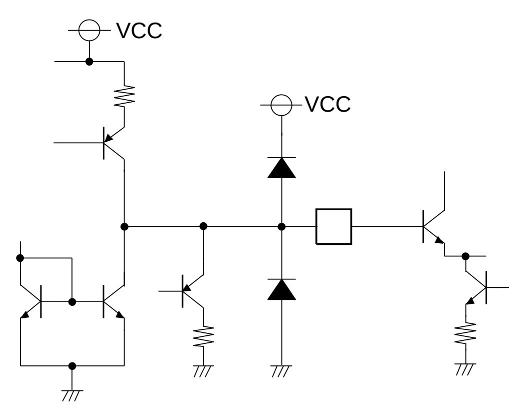
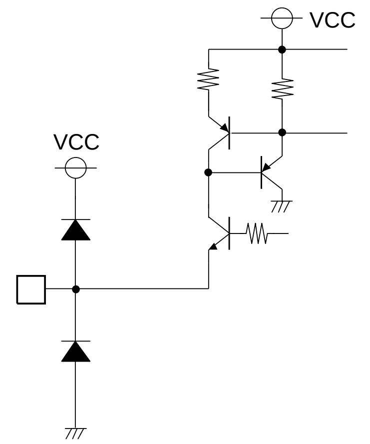
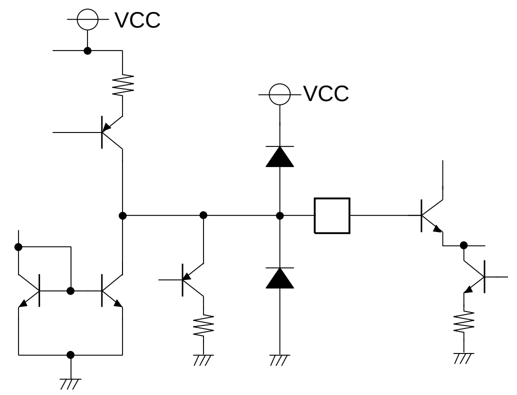
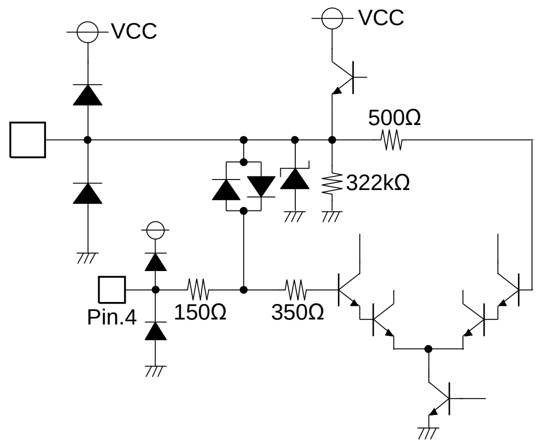
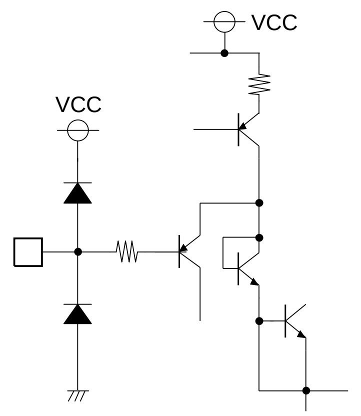
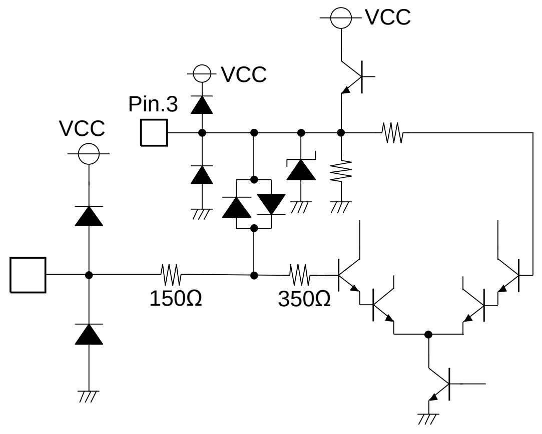
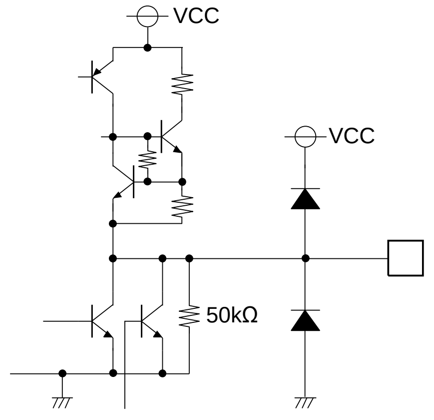
(a) BD95850F-LB

	Derating Curve Slope	Unit
BD95850F-LB	4.5	mW/°C

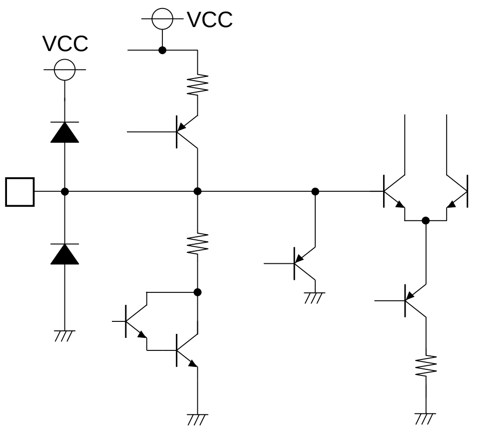
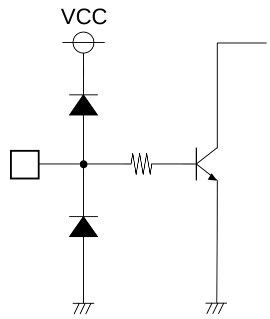
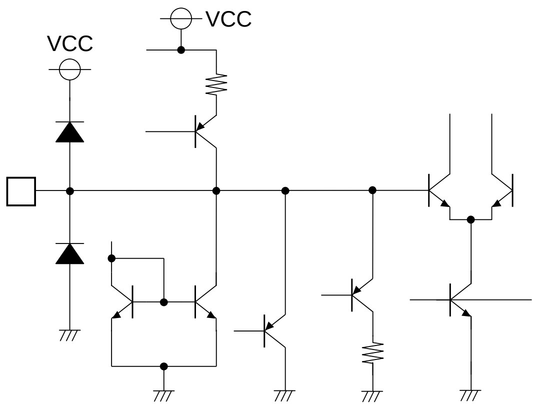
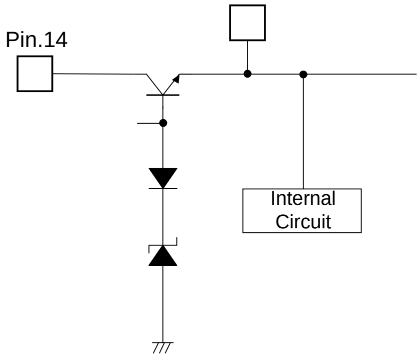
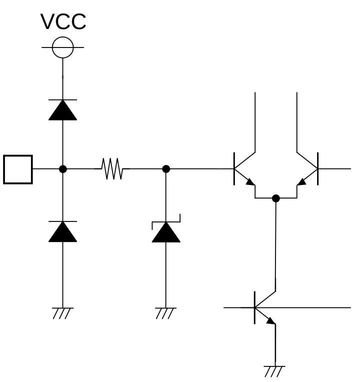
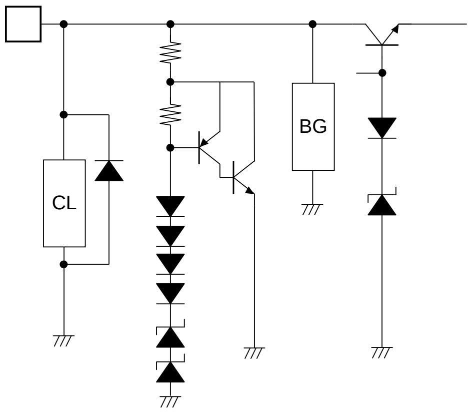
When using the unit above T_A=25°C, subtract the value above per degree℃
Power dissipation is a value when glass epoxy board 70mm×70mm×1.6mm (cooper foil area below 3%) is mounted.

Figure 17. Derating Curve

I/O Equivalence Circuit

Pin.1 [GND]		Pin.5 [TRC1]	
Pin.2 [IREF]		Pin.6 [TRC2]	
Pin.3 [REF]		Pin.7 [PSEL]	
Pin.4 [IN]		Pin.8 [SCRT]	

I/O Equivalence Circuit - continued

Pin.9 [OFFC]		Pin.12 [PSAV]	
Pin.10 [TTDC]		Pin.13 [VCC]	
Pin.11 [IBLI]		Pin.14 [VS]	

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply terminals.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. The absolute maximum rating of the Pd stated in this specification is when the IC is mounted on a 70mm x 70mm x 1.6mm glass epoxy board. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. **Recommended Operating Conditions**
   These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. **Rush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. **Operation Under Strong Electromagnetic Field**
   Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. **Inter-pin Short and Mounting Errors**
    Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

Operational Notes – continued

11. Unused Input Terminals

Input terminals of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input terminals should be connected to the power supply or ground line.

12. Regarding the Input Pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

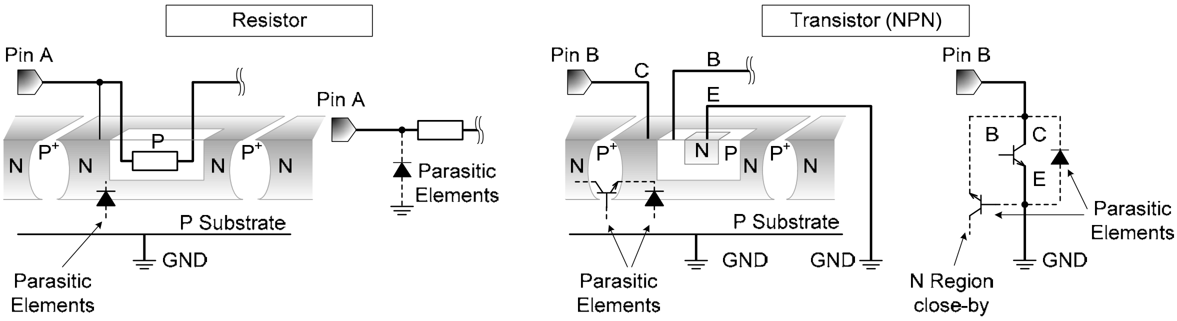
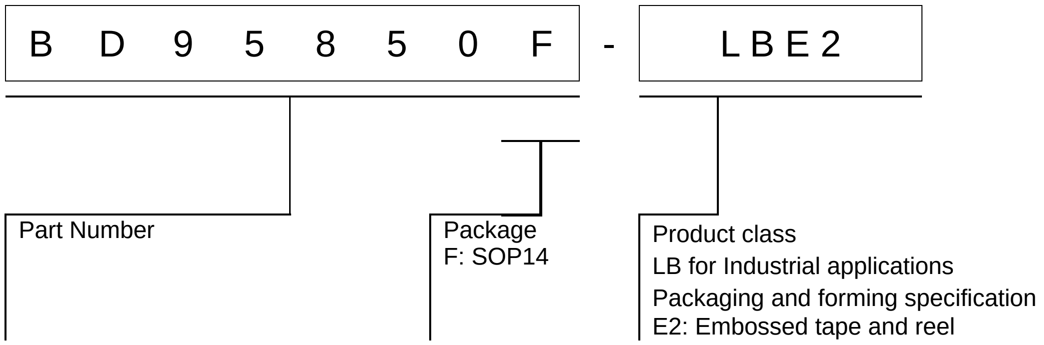
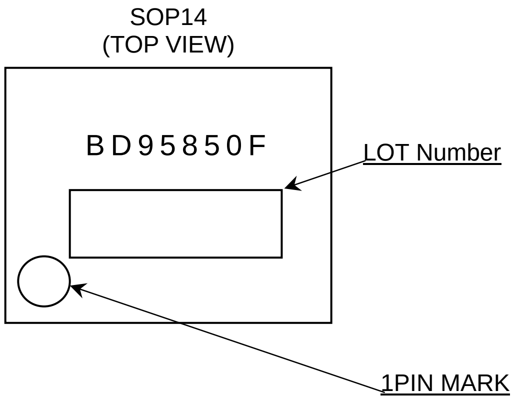


Figure 18. Example of monolithic IC structure

Ordering Information

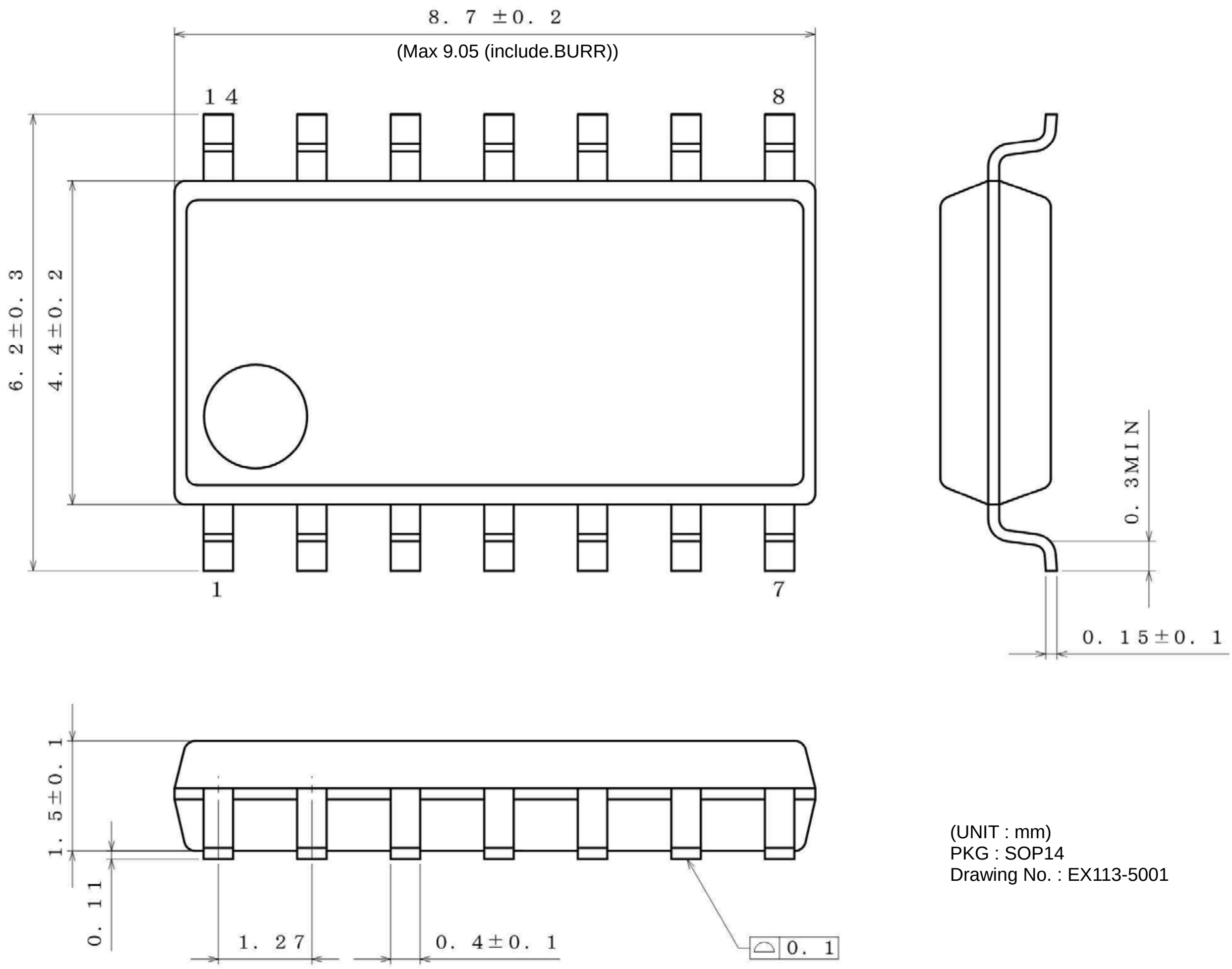


Marking Diagram



Physical Dimension, Tape and Reel Information

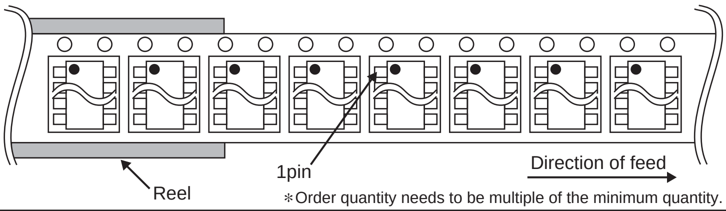
Package Name	SOP14



(UNIT : mm)
PKG : SOP14
Drawing No. : EX113-5001

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



*Order quantity needs to be multiple of the minimum quantity.

Revision History

Date	Revision	Changes
13.Jun.2014	001	New Release

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment [Note 1], aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:

2. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the information contained in this document.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.