Basic usage and functions of eFuse IC

Outline:

eFuse IC (electronic fuse) controls the on and off of the power supply by built-in MOSFETs, that solves the disadvantages of conventional fuses.

It can be used in the same way as a conventional fuse, and has variety of built-in protection functions by taking advantage of the fact that it is a semiconductor.

This document describes the basic usage, role and behavior of protection functions using TCKE800/805/812 Series as an example.

Protection functions include overcurrent protection, overvoltage protection, short-circuit protection, inrush current suppression, and overheat protection.

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1. Introduction

Today, fuses and polyswitches (resettable fuses and polyfuses) are widely used as safety components for products that prevent overheating and ignition in various electronic devices. Both are protective devices that utilize Joule heat generated by the current exceeding the rated current. In this guide, these are referred to as conventional fuses.

In the case of glass tube fuses and tip current fuses, the built-in metal parts are blown, and in the case of polyswitches, the resistance value rapidly increases due to the thermal expansion of the conductive polymer, thereby preventing the circuit from being protected and the equipment from being damaged by interrupting or limiting the current flow.

However, both have the disadvantages that the accuracy of the operating current is low and the breaking current is unclear, and that it takes time to protect due to the use of Joule heat. Another disadvantage is that a fuse that blows metal can irreversibly break once it operates, requiring replacement of the fuse itself.

eFuse IC (electronic fuse) solves various demerits of the conventional fuse described above by cutting off the energization with MOSFET switches. It can be used in the same way as a conventional fuse, and it can also provide various protection functions other than overcurrent by taking advantage of the IC.

We have developed TCKE800/805/812 series as a eFuse IC. The lineup includes an auto retry type (Auto retry type) that automatically tries to recover after a certain period of interruption in each series, and a latch type (Latch type) that recovers by external signals. In addition to overcurrent, it has built-in overvoltage (except TCKE800 series), short-circuit, overheat protection function, rush current suppression function (slew rate control), and reverse current prevention function to effectively protect circuits and equipment.

This document describes the applications, usage, operation, and main characteristics of these eFuse IC.

2. What is eFuse IC ?

2.1. How to use eFuse IC ?

Toshiba's eFuse ICs incorporate a variety of high-performance, high-precision protective functions that are not possible with conventional fuses. Compared to the functions realized by using discrete passive components or a combination of multiple ICs, this unique benefit contributes to higher quality, lower cost by reducing the number of components, and miniaturization by reducing the mounting area. This product is also effective in reducing maintenance costs and recovery time required for repair because it can be used repeatedly.

図 2.1 Example of using eFuse IC

Toshiba's eFuse ICs also offer high-speed short-circuit protection, high-precision overcurrent protection, high-precision overvoltage clamping, reverse current blocking function, slew-rate control, and thermal shutdown, all of which were not possible with conventional fuses. In addition, Toshiba eFuse ICs have gained the International Safety Standard (IEC 62368-1) certification for their contribution to simplification of robust design, and low-cost maintenance, including repair and maintenance.

2.2. Peripheral circuits of eFuse IC

Examples of eFuse IC peripheral circuits are shown below.

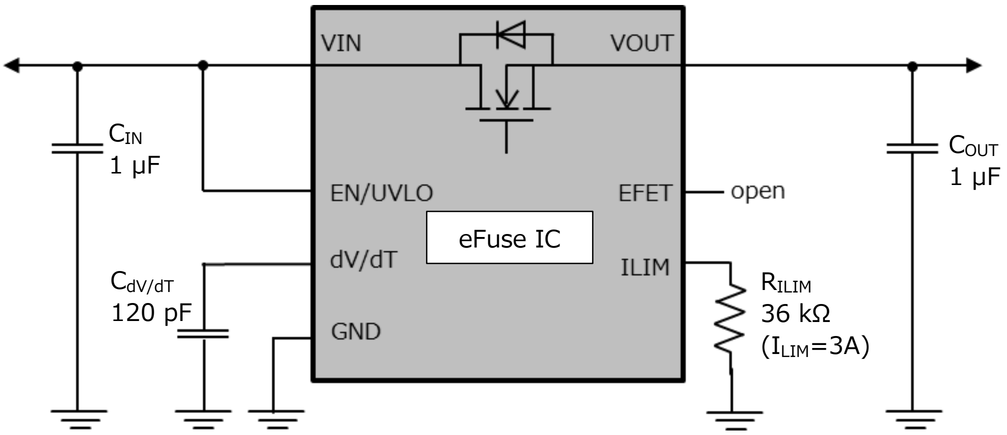


Figure 2.2 Peripheral circuits of eFuse IC

Connect the power supply to the input terminal VIN. During normal operation, almost the same voltage as the VIN voltage is output from the output terminal VOUT through the internal MOSFET.

If the current suddenly decreases, for example, when short-circuiting or overcurrent is protected, high-spike voltages may be generated due to back electromotive force of inductance components such as wirings connected to the input/output terminals of the eFuse IC, causing damage to the eFuse IC and resulting damage. In this case, a positive spike voltage is generated on the input side and a negative spike voltage is generated on the output side.

When designing boards, design patterns so that the length of the wires on the input-side and output-side of the eFuse IC is as short as possible. Also, the GND wiring area should be as wide as possible to reduce the impedance. CIN functions to suppress the peak value against the positive spike voltage generated by the inputs. The peak value VSPIKE of the spike voltage and the capacitance value of the CIN have the following relationships. It can be understood that the spike voltage can be reduced by increasing the CIN.

$$V_{SPIKE}\ (V) = V_{IN} + I_{OUT} \times \sqrt{\frac{L_{IN}}{C_{IN}}}$$

L_{IN}: effective inductance component of the input terminal (H), I_{OUT}: output current (A)
V_{SPIKE}: peak value of spiked voltage generated (V), V_{IN}: power supply voltage during normal operation (V)

Toshiba eFuse IC recommends 1 μF for CIN and COUT, and in most cases this volume is effective enough. Be sure to measure it on the actual PCB board.
If the transient voltage at the input terminal of the eFuse IC exceeds the absolute maximum rating, connect a TVS diode (ESD protection diode) between the input terminal and GND.
For negative spike voltage generated on the output side, SBD (Schottky barrier diode) can be connected to prevent the output potential from dropping below GND.SBD is effective not only for protecting eFuse ICs, but also for protecting ICs and devices connected to the load side. Connect the SBD with the GND as the anode between the output terminal of the eFuse IC and the GND.

As noted above, TVS diodes and SBDs are recommended for eFuse IC because they can provide more robust protective features. The diagram below shows the peripheral circuit diagram when a TVS diode and an SBD are added.

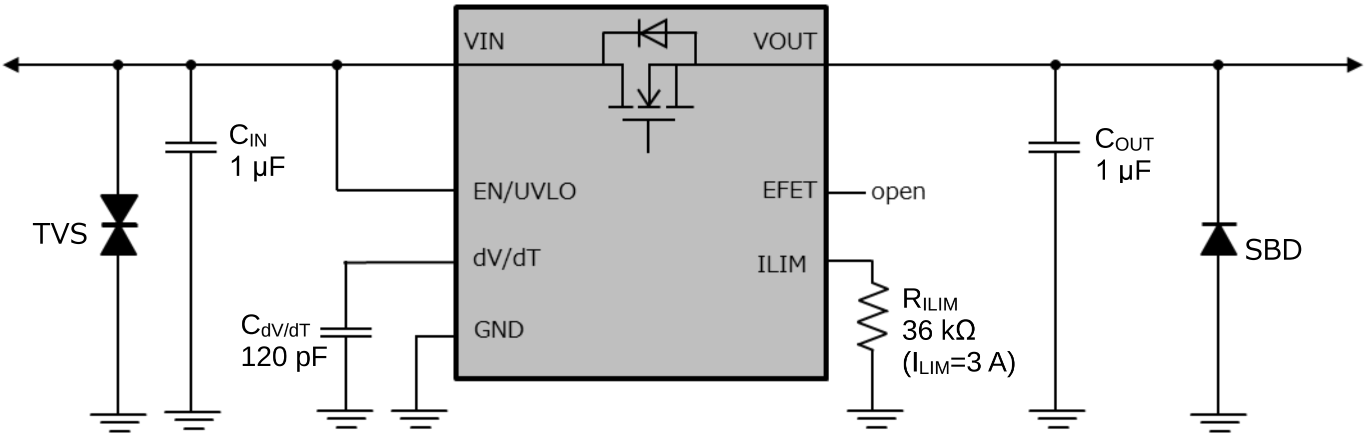


Figure 2.3 Examples of Peripheral Circuits in eFuse IC of Combined Use of TVS and SBD

Our eFuse IC recommends DF2S23P2CTC as the TVS diode and CUHS20S30 as the SBD diode.
Please refer to the link below for details of this product.

Learn more about TVS Diode DF2S23P2CTC → Click Here

Learn more about Schottky barrier diode CUHS20S30 → Click Here

In addition, connect a resistor that determines the limit current ILIM for overcurrent protection to the ILIM pin. In the above example, the current limit is set to 3 A.
Connect a capacitor for slew rate control to suppress inrush current to the dV/dT pin. The EFET terminal is the terminal that drives the gate of the external MOSFET when using the reverse current protection, but the above figure is open because the reverse current protection is not used. Refer to section 3.9 when using the reverse current protection. The EN/UVLO pin controls ON/OFF of the built-in MOSFET, and the threshold voltage of the undervoltage lockout (UVLO) circuit can be set to the optimum value by an external circuit.
The function of each of these pins and how to determine the external elements are described in detail in Chapter 3, so please refer to them.

2.3. Advantages of using eFuse IC

Possible advantages of using the eFuse IC are as follows.

- **Reduction in maintenance costs and time due to no need for replacement**
  Since the built-in MOSFET is turned off to cut off the current, the IC will not be destroyed by a single overcurrent. If the FET is turned on again, the IC can return to normal operation by applying the current as before. Unlike conventional fuses that fuse irreversibly, they can be used repeatedly, eliminating the need to replace parts and reducing the cost and time required for maintenance, such as repair.

- **Realization of robust protection performance by high-precision current and voltage protection functions**
  Conventionally, fuses utilize fusion insulation and thermal expansion, so the current to shut off current cannot be determined strictly. Therefore, there is a risk of breakage because the current rating is selected so that the current rating is a certain range to avoid malfunction with respect to the current assumed in the load. On the other hand, in eFuse IC, the sensing current can be set with an external resistor, allowing the optimum current values to be set with high accuracy. In addition, for TCKE805/812 series, etc., voltage clamps can be applied with high accuracy against overvoltage. These features provide robust protection against current and voltage.

- **Higher reliability thanks to high-speed protection operation**
  With conventional fuses, it takes time for the temperature rise due to the Joule heat to reach the melting point of the fuse material, so there is a time lag from the occurrence of overcurrent to the interruption. During this time, overcurrent continues to flow. However, since the e-Fuse IC can turn off the switch and shut off the current at almost the same time as detecting the overcurrent, the time for the overcurrent to flow can be drastically shortened. This reduces damage to the equipment and improves long-term reliability.

- **Cost reduction and miniaturization through the use of one-package for various protection functions**
  Since the eFuse IC is an IC, in addition to the overcurrent protection function, various functions such as the overvoltage protection function, the inrush current suppression (slew rate control) function, the overheat protection function, and the reverse current prevention function, which cannot be realized by conventional fuses, can be packaged in one package. Compared to the realization of functions by combining discrete passive components and multiple ICs, this technology dramatically reduces the number of components and man-hours, and reduces the mounting area, thus contributing to lower costs and downsizing.

- **Simplification of equipment design by acquiring international safety standards**
  Testing required to comply with internationally recognized safety standards takes time. ICTs and audio/video equipment, which are widely used in commercial equipment such as consumer and industrial equipment, are subject to the IEC62368-1 of International Safety Standards. However, this standard requires that the power supply be shut off quickly and securely in the event of an abnormality in the equipment.
  Since the TCKE800/805/812 series is scheduled to acquire this standard, and testing of equipment related to safety standards can be partially omitted, it contributes to labor saving of equipment design and shortening of design period.

The results of comparing the Toshiba eFuse IC with conventional fuses are shown in Table 2.1 on the next page.

Table2. Comparisons of 1 eFuse IC and Conventional Fuses

	Glass tube Fuse	Chip current Fuse	Poly switch (Resettable Fuse)	Toshiba eFuse IC
Size	3mm×10mm~	1mm×0.5mm~	1mm×0.5mm~	3mm×3mm(WSON10B)
Repeatability	×	×	○	○
Overcurrent protection (Clamping current)	0.1A~ (Rated current) No accuracy	0.2A~ (Rated current) No accuracy	0.3A ~ (I trip) No accuracy	0.5A to 5.0A **Precision 11%**
Overvoltage protection accuracy (Clamp voltage)	None	None	None	**6.04V (typ.) TCKE805 Precision 7%**
Protective speed	No rating (depending on ~ 1s current)	5s @Rated current x 2	No rating (generally slower than a glass tube fuse)	**150ns (typ.)**
Thermal shutdown function	None	None	None	○
On resistance		30mΩ~	20mΩ~	28mΩ (typ.)@Io=5A

At first glance, chip-current fuses and polyswitches are smaller in size, but the eFuse IC has a variety of other protective features that are much larger than when configured with separate components. In addition, some fuses have better values than others, but when compared as a whole, it can be seen that eFuse IC has more advantages.

2.4. TCKE800/805/812 series line-up

The lineup of Toshiba eFuse IC TCKE800/805/812 series is shown in the table below.

Table2.2 List of TCKE800/805/812 Series Products list

Product name	Package	Overvoltage clamp voltage	Return operation
TCKE800NA	WSON10B	No voltage clamp	Auto reset type (Auto Retry)
TCKE805NA	WSON10B	6.04V	
TCKE812NA	WSON10B	15.1V	
TCKE800NL	WSON10B	No voltage clamp	Latch type
TCKE805NL	WSON10B	6.04V	
TCKE812NL	WSON10B	15.1V	

3. Explanation of various functions of the eFuse IC

Details of the various protective functions installed in the eFuse IC are explained using an TCKE800/805/812 as an example.

3.1. Thermal shutdown function

Thermal shutdown function (overheat protection) shuts off the IC and shuts off the output when a large current continues to flow to the output and the junction temperature of the eFuse IC exceeds the set value. The TCKE800/805/812 Series offers two types of automatic recovery from overcurrent, short-circuit, and overvoltage protection operations to normal operation by using this function, and two types of latch types are available: the auto-retry type for automatic recovery by changing the recovery methods from normal operation. In the protection operation, the auto-tri type does not latch and the latch type does latch. However, since the return operation is different, the application circuit is completely the same.

The figure below shows the operation image of the auto-retry type overheat protection function.

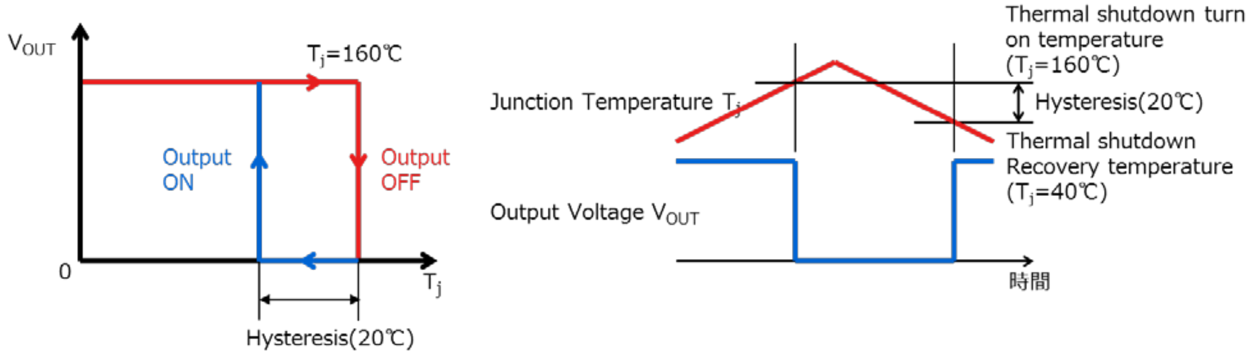


Figure 3.1 Operation of thermal shutdown function

As the junction temperature rises, such as when overcurrent and overvoltage clamp operation continue, the overheat protection function operates. However, after the protection operation, the current no longer flows and the temperature begins to drop. The operating temperature and the return temperature of the overheat protection have hysteresis, and if the temperature drops to this point after a certain period of time, the auto-tri type without latching will return to normal operation. If an abnormality such as overcurrent or overvoltage is not resolved at this time, the overheat protection operation will be activated again. Therefore, the overheat protection and cancellation will be repeated thereafter.

The auto retry type is attempting to recover automatically using this operation. On the other hand, since the latch type latches the protection operation, it does not return to normal operation even if the temperature drops. To recover the latch-type power supply, the control signals of the input voltages and EN/UVLO terminals must be re-inserted externally. Select according to the application and specifications of the equipment to be used.

3.2. Timing chart

The following figure shows the timing chart of the auto retry type.

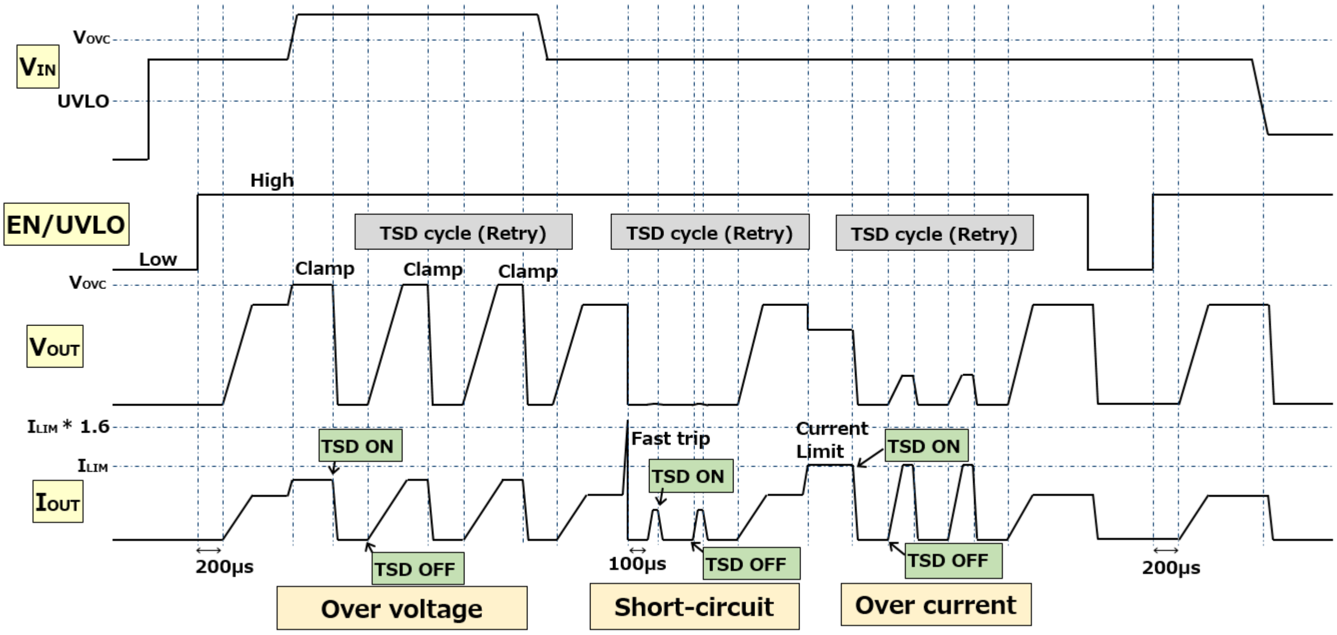


Figure 3.2 Timing Chart (Auto-retry type)

The timing chart of the latch type is shown in the figure below.

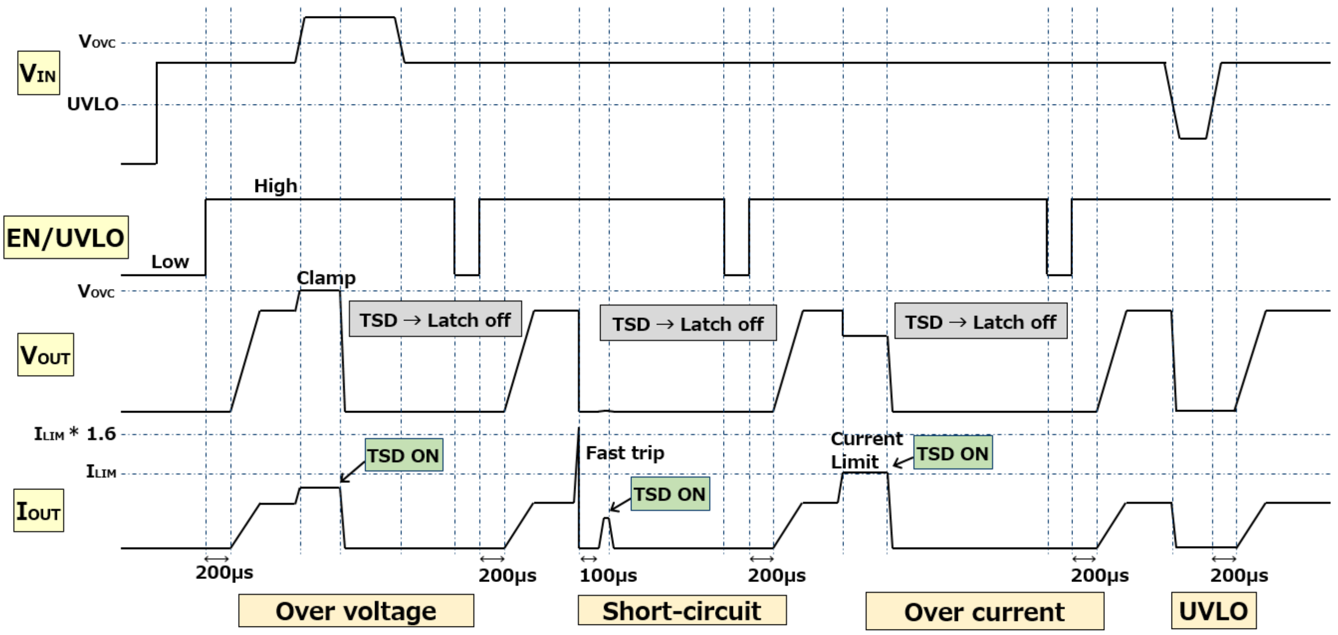


Figure 3.3 Timing Chart (Latch Type)

3.3. Operation of overcurrent protection function

The overcurrent protection function prevents damage to the IC and load by suppressing power consumption in the event of an error. If the output current exceeds the limit current (I_{LIM}) due to a load error or short circuit, the output voltage and output current also decrease, thereby limiting the power consumed by the ICs and the load.

In addition to the short-circuit protection function, which will be described later, it is double-protected against overcurrent, which greatly contributes to the prevention of ignition and smoke.

The timing chart of the auto-retry type overcurrent protection clamp operation is shown below.

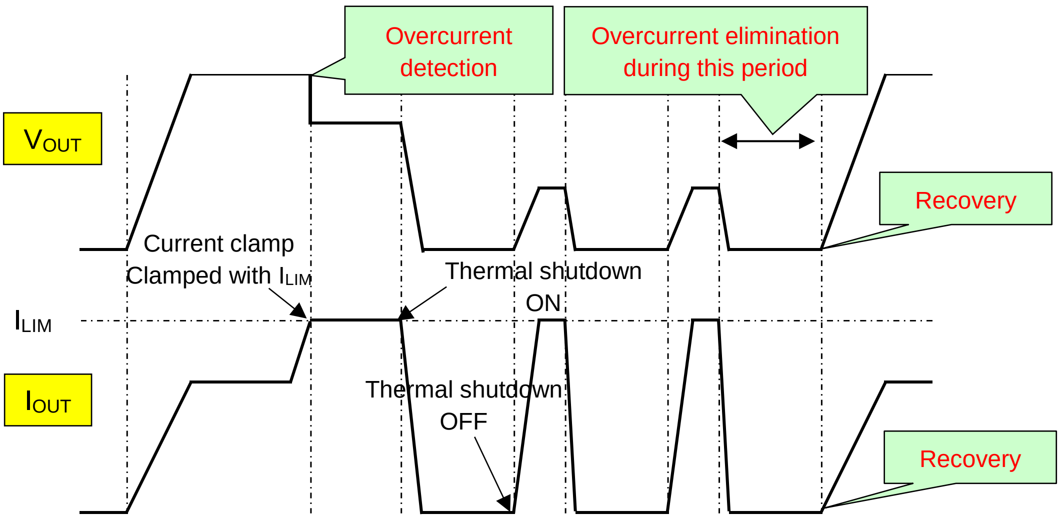


Figure 3.4 Timing chart of overcurrent protection operation (Auto-retry type)

When the output current reaches the I_{LIM} and overcurrent is detected, the current is clamped so that a current greater than the I_{LIM} does not flow. At this time, the output voltage decreases slightly according to the relationship between the output voltage and current described later. If the overcurrent is not resolved at this stage, this state is retained and the temperature of the IC continues to rise, and the overheat protection function will eventually operate. Thereafter, as described in Section 3.1, the recovery cycle is repeated by the following cycles until the overcurrent is eliminated: Operation stop → Temperature drop → Overheat protection release → Current clamp → Overheat protection → Temperature rise → Overheat protection → Operation stop.

Next, the timing chart of the overcurrent protection clamp operation of the latch type is shown in the figure below.

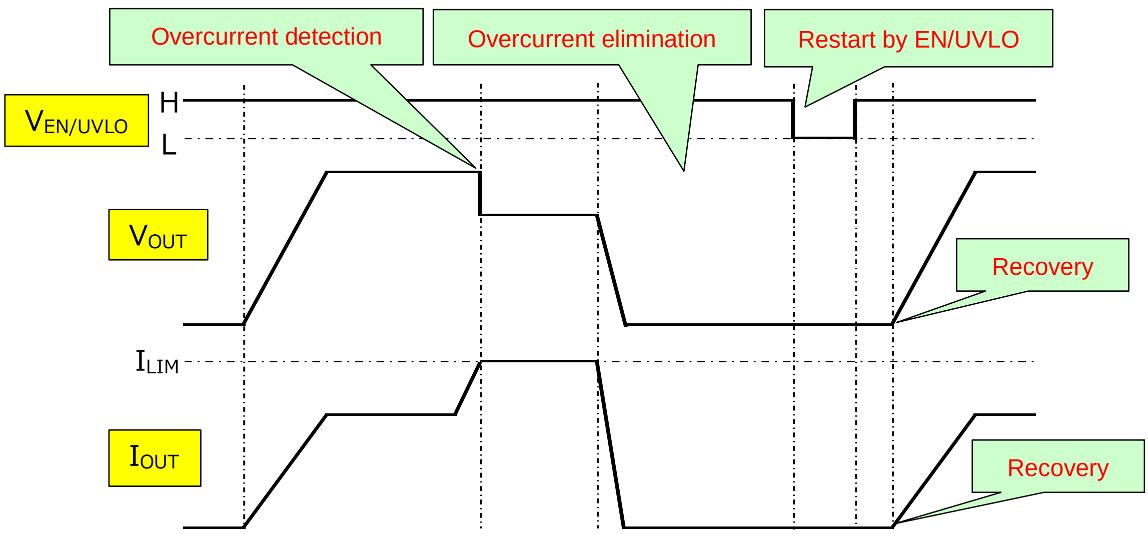


Figure 3.5 Timing chart of overcurrent protection operation (Latch type)

In the case of the latch type, the overheat protection operation is latched, so it is necessary to restart by the control signal of the EN / UVLO pin to recover, and the protection operation continues until it is restarted.

3.4. Setting the overcurrent protection function

The following figure shows the relationship between output voltage and current during overcurrent protection clamp operation.

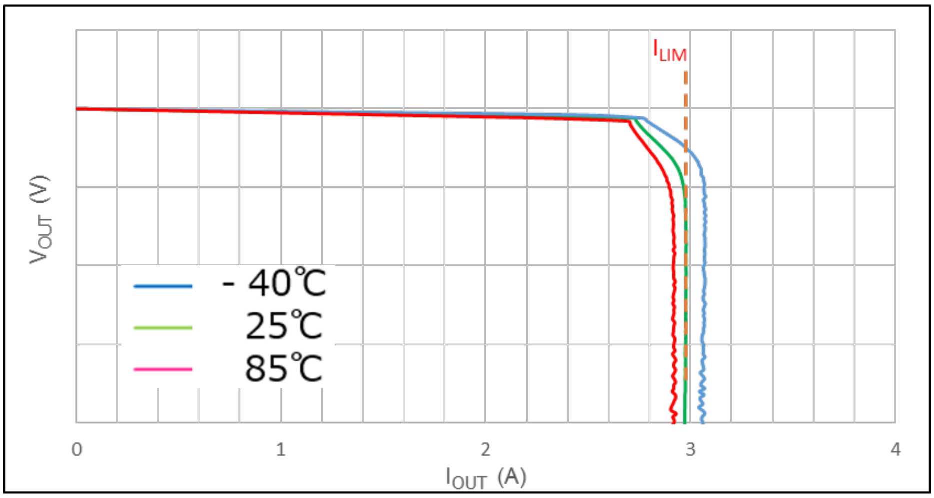


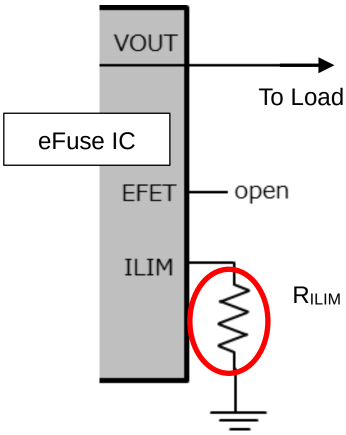
Figure 3.6 Output Voltage-Current Characteristics during Overcurrent Protection Clamp Operation

Toshiba eFuse IC has a variable current limit. By selecting the external resistor R_{ILIM} of the ILIM terminal appropriately, the current limit can be set to the optimum value for each application. The I_{LIM} calculations are the same as those for the TCKE8xxseries, and are as shown below. However, the deviation between the *theoretical value* and the measured value is large when the current is 1A or lower. Be sure to check the resistance value with the actual machine when selecting the resistance value.

$$I_{LIM}(A) = 0.13 + 101.8/R_{ILIM}(k\Omega)$$

R_{ILIM}: ILIM terminal external resistor (kΩ)

The following is a diagram of the peripheral circuitry of the ILIM terminal and the relation between R_{ILIM} and I_{LIM}.



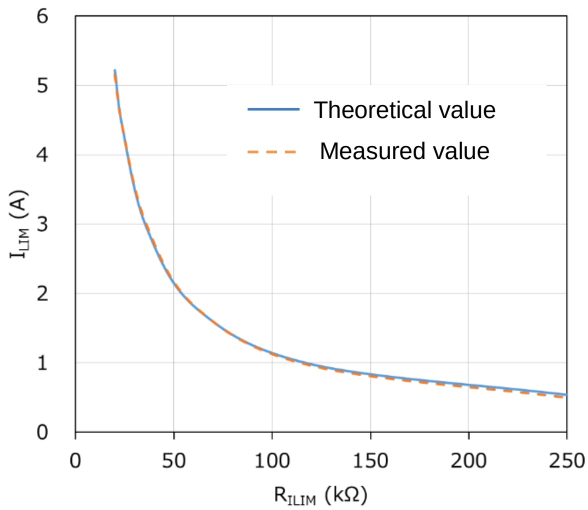


Figure 3.7 ILIM Terminal External Circuits

Figure 3.8 R_{ILIM}-I_{LIM} Characteristics

For reference, the resistance value of R_{ILIM} and I_{LIM} at that time are shown in Table 3.1 on the next page.

Table 3.1 Reference table of R_{ILIM} and I_{LIM}

R_{ILIM} (kΩ)	I_{LIM} (A) (typ.)	condition
20	5.15	V_{IN}-V_{OUT}=1 V
24	4.38	
36	3.00	
62	1.78	
120	0.96	
250	0.5	
0	0.64	
OPEN	0.64	

3.5. Short Circuit protection

The short-circuit protection function prevents excessive current from flowing by stopping operation when the power supply line or load is short-circuited due to some kind of abnormality. In TCKE800 / 805/812 series, if the output current is 1.6 times the current limit (I_{LIM}) for a very short period of time, the output is judged to be short-circuited and this function operates.

Toshiba eFuse IC employs an ultra-high-speed short-circuit protecting circuit (Fast trip function). Simulation results are shown to suppress the current to near zero at 150 ns (typ.) from the occurrence of the short-circuit.

The following figure shows the operating waveforms of the simulated Fast trip function.

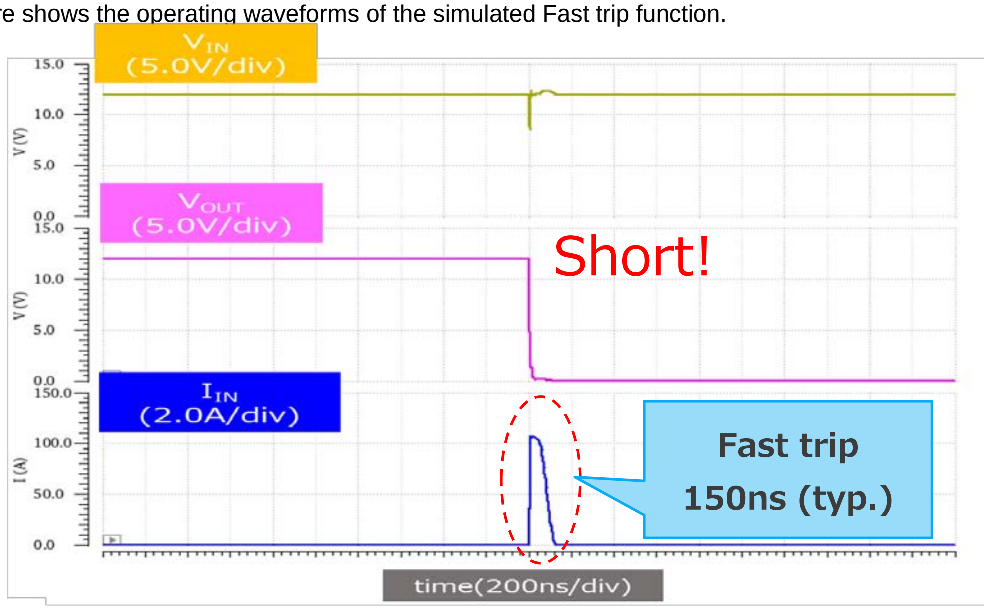


Figure 3.9 Output voltages and output current waveforms during fast trip operation

The short-circuit protection circuit performs the return operation 100 μs after Fast trip. If the short-circuit continues, the protection operation starts again. The latch type does not attempt to recover thereafter, but continues to be protected until it is restarted by the control signal. The auto-retry type attempts to recover until the short-circuit condition is resolved by using the thermal shutdown cycle.

3.6. Overvoltage protection function

The overvoltage clamp function clamps the output voltage with a limited voltage and prevents overvoltage from being applied to the load without outputting any more voltage. This function is available on the TCKE805/812 series and is not included in the TCKE800 series. The limit voltages are set to 6.04 V (typ.) for the TCKE805 series and 15.1 V (typ.) for the TCKE812 series. The diagram below shows the relation between the input voltage and the output voltage of TCKE800/805/812 series.

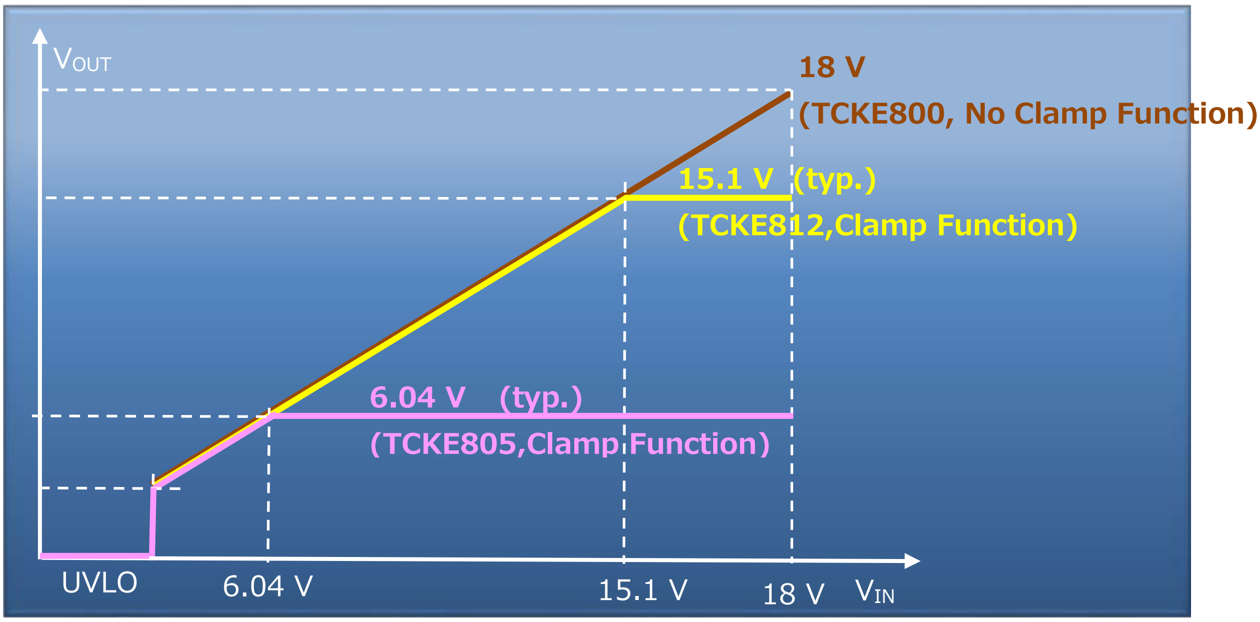


Figure3.10 Overvoltage Characteristics (V_{IN} vs V_{OUT}) of TCKE800/805/812

Similar to the overcurrent protection and short circuit protection, the auto retry type will attempt to recover from the overvoltage, but the latch type will retain this state until it is restarted.

3.7. Inrush current reduction

When the output is turned on, an inrush current flows to charge the capacitor connected to the load side. If this current is too large, the overcurrent protection circuit may malfunction, making it impossible to start up, or the output voltage may overshoot.
To prevent this, this function controls the slew rate when the output voltage rises by limiting the inrush current.
The following figure shows the rise of the output voltage (V_{OUT}) and the inrush current when the inrush current is limited by this function. As shown below, the output current at the start-up is gradually increasing. As shown below, the output current at the start-up is gradually increasing.

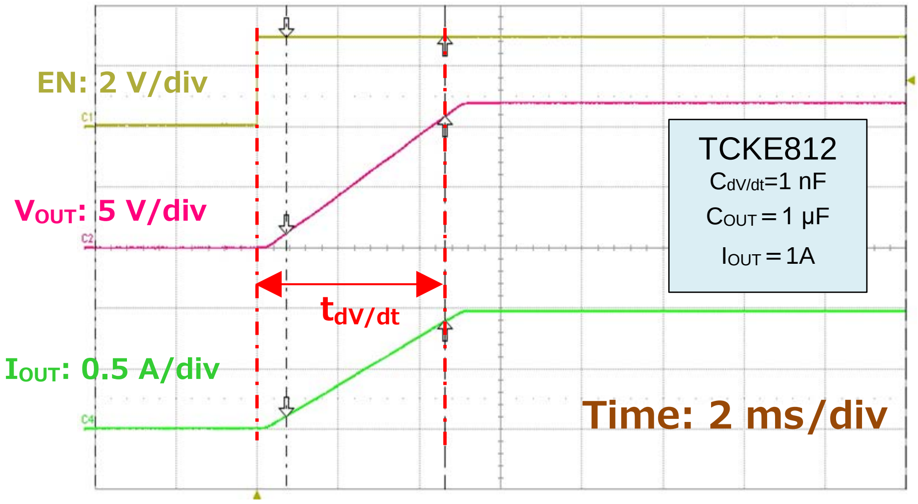


Figure 3.11 Inrush current reduction(slew rate control) function

3.8. Setting of slew rate control for inrush current reduction

Toshiba eFuse IC has a variable inrush current function. The external capacitor at the dV/dT terminal can be used to appropriately set the rise time ($t_{dV/dT}$) of the output voltage. The formula for the rise time is as follows:

$$t_{dV/dT}\ (s) = 0.36 \times 10^{6} \times V_{IN} \times \left(C_{dV/dT} + 50 \times 10^{-12}\right) + 3 \times 10^{-4}$$

V_{IN}: input voltage (V), $C_{dV/dT}$: external capacitance of dV/dT terminal (F)

The following chart shows the peripheral circuit diagram of the dV/dT terminal and graphs showing the relation between $C_{dV/dT}$ and $t_{dV/dT}$.

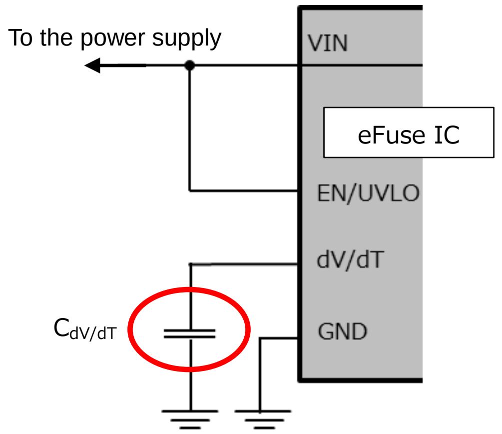


Figure 3.12 External Circuits dV/dT Terminal

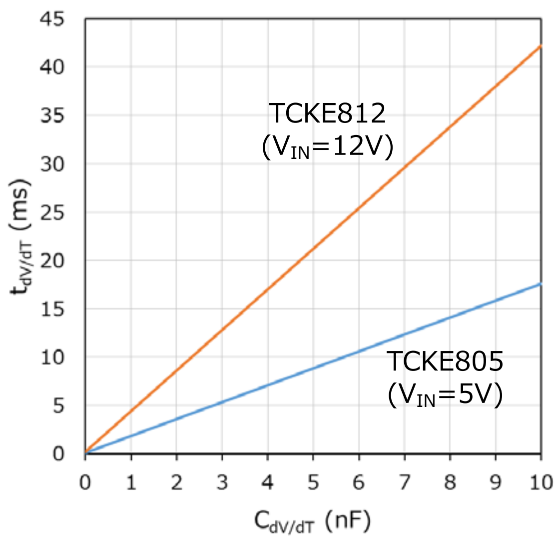


Figure 3.13 $C_{dV/dT}$-$t_{dV/dT}$ characteristics

3.9. Reverse current blocking

As an option, Toshiba eFuse IC can prevent reverse current flow by attaching an N-channel MOSFET to the EFET terminal. The reverse current blocking function prevents reverse current from the output side to the input side when the operation of the eFuseIC is stopped, for example, by turning off the power supply of the VIN or controlling the input side by the EN/UVLO terminal.

The circuit for using the reverse current blocking function is shown in the figure below.

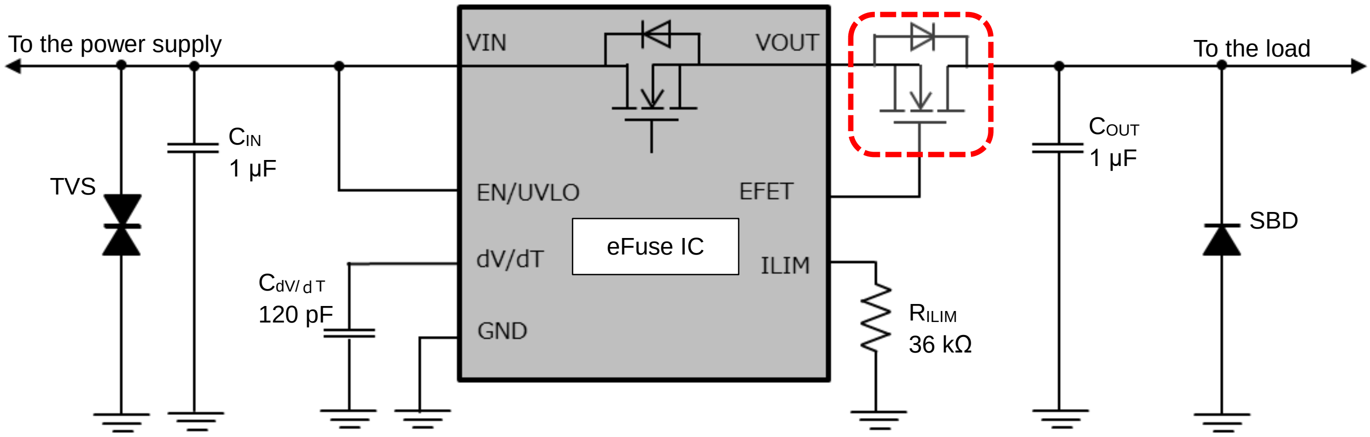


Figure 3.14 Examples of eFuse IC Peripheral Circuits with Reverse current blocking Function

Our SSM6K513NU is recommended as an external Nch MOSFET to prevent reverse current. SSM6K513NU main characteristics are as follows:

- Drain-Source voltage: V_{DSS} = 30 V
- Gate-Source Voltage: V_{GSS}= 20 V
- Drain current: I_D= 15 A
- Drain-Source on-resistance: $R_{DS(ON)}$=8 mΩ (typ.)@V_{GS}=4.5 V

When using other products, select a product with as low on resistance as possible, with sufficient V_{DSS} and I_D margins for the power supply voltage and the load current that is expected to be used.

Please refer here for Nch MOSFET selection.→ Click Here

The EFET terminal outputs the internally boosted voltage V_{IN}+4.9V (typ.). If this function is not used, open the terminal.

3.10. Under voltage lockout (UVLO)

This function stops the operation of the eFuse IC when the input voltage is low and prevents malfunction of the load. TCKE8 series will not operate unless the input voltage is 4.15 V (typ.) Or higher. Since this voltage has hysteresis at the rising and falling edges, it stops operation at a voltage 5% lower (about 3.95 V) than the rising 4.15 V at the falling edge.
The following are examples of uses for this function.

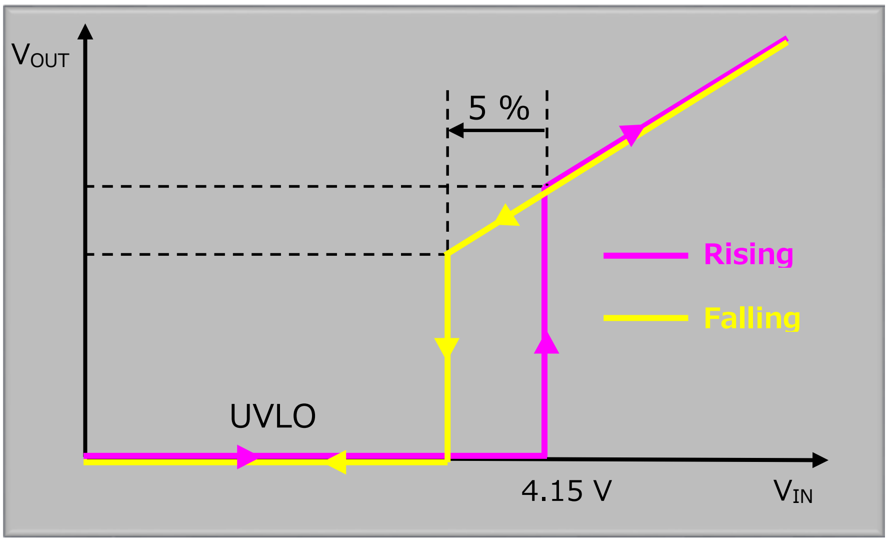


Figure 3.15 Under voltage lockout operation

3.11. EN/UVLO terminal function

TCKE8xxseries is equipped with EN/UVLO terminal, and this terminal can be used to control the operation of the whole eFuse IC. It is also possible to set the operating voltage of the under voltage lockout function to the optimum value by externally attaching a resistor.

The following are examples of uses for this terminal.

(1) When the operation voltage of the under voltage lockout function is not changed or the operation control is not performed.

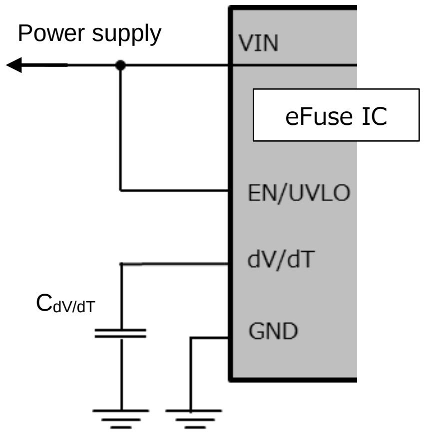


Figure 3.16 Connections of EN/UVLO terminals (Direct VIN connection)

Connect the EN/UVLO terminal directly to the VI terminal. This eliminates the need for pull-up resistors in the TCKE8series. The EN/UVLO terminal is designed to be breakdown-voltage 18V, and the VI terminal and the EN/UVLO terminal can be directly connected. This helps reduce the number of parts.

(2) When the operation voltage of the under voltage lockout function is not changed and the operation control is performed from the outside.

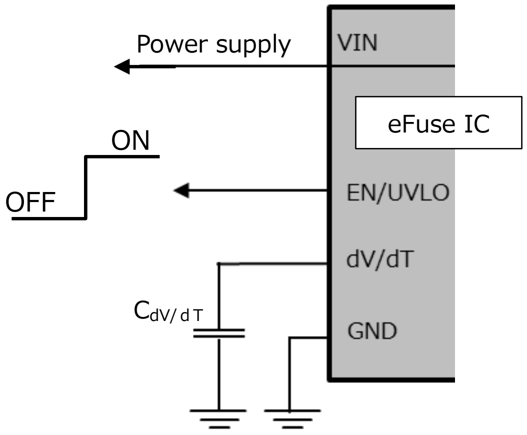


Figure3.17 Connecting Examples of EN/UVLO Terminals (External Control)

Connect external control signals directly into the EN/UVLO terminal. Since the on/off threshold voltages of the EN/UVLO terminals are hysteretic, set the "H" level of the control signal to be 1.1 V (typ.) or higher and the "L" level of the control signal to be 0.96 V (typ.)or lower.

If the EN/UVLO terminal is open (indefinite), the eFuse IC operation may become abnormal. Be careful not to open this terminal even when it is at the "L" level.

(3) When the operation voltage of the under voltage lockout function is not changed and the operation is controlled by the short-circuit switch with the VIN terminal.

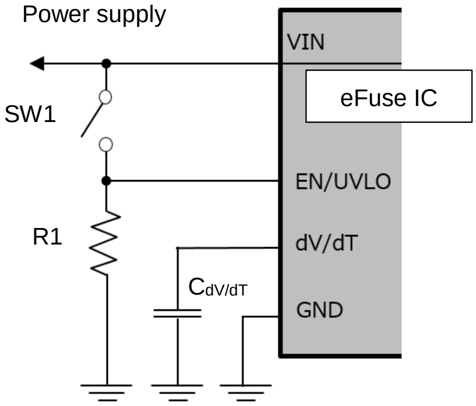
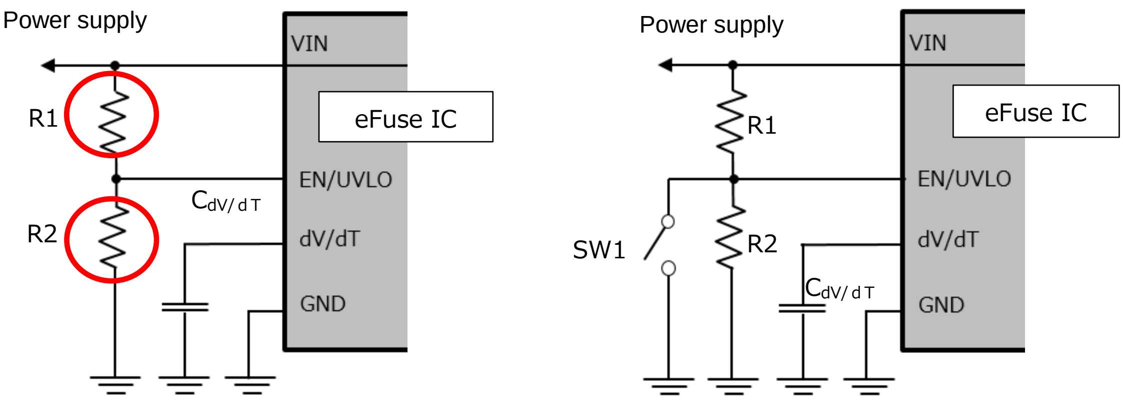


Figure 3.18 Connection examples of EN/UVLO terminals (connected by VIN and switches)

Switches can be directly connected to the V IN so that the operation can be controlled. A pull down resistor is required to prevent the EN/UVLO terminal from being opened when the SW1 is opened. The value of the pull down resistor may be any value that does not cause the EN/UVLO terminal to become indefinite. However, when the SW1 is conducting, consider the current flowing through R1, and check the value with the actual device to determine the value of the pull down resistor.

(4) To change the operating voltage of the under voltage lockout function

By adding an external resistor to the EN/UVLO terminal, the operating voltage of the under voltage lockout function can be changed to an optimum value. An example of the circuit is shown in the figure below.



a) In case of no operation control b) in case of operation control

Figure 3.19 Connections of EN/UVLO terminals (VIN resistive division)

a) is an example of the circuit when the operation control is not performed by the EN/UVLO terminal, and **b)** is an example of the circuit when the operation control is performed.

As shown in the drawing, operation is stopped when the input voltage drops by controlling the operation of the EN/UVLO terminal with the voltage obtained by dividing the input voltage by external resistors. The operating voltage of the under voltage lockout function can be set to the optimum value by properly selecting the external resistance. However, the voltage cannot be set to 4.15 V or less.

The equation for setting V_{IN}_UVLO$_{(fall)}$ by controlling the external resistors R1 and R2 of the EN/UVLO terminal is as follows.

$$V_{IN}\_UVLO_{(fall)}(V) = \frac{R1 + R2}{R2} \times V_{ENF}(V)$$

V_{ENF}: EN threshold (falling) 0.96 V (typ.)

As described above, the control voltage of the EN/UVLO terminal is hysteretic, and therefore the voltage to be activated at the time of rising changes. The start-up voltage V_{IN}_UVLO(rise)is calculated by the following equation.

$$V_{IN}\_UVLO_{(rise)}(V) = \frac{R1 + R2}{R2} \times V_{ENR}(V)$$

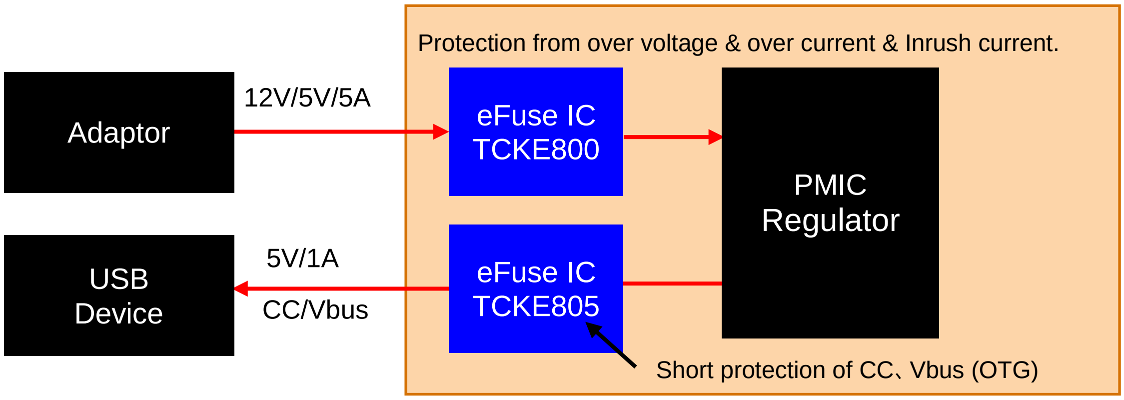
V_{ENR} : EN Threshold Voltage (rising) 1.1 V (typ.)

As shown in b) above, the switch can be connected in parallel with R2 to control the operation. In this case, contrary to the case of (3), the eFuse IC stops operating at the time of SW1 conduction. At this time, R1 is the current limiting resistor. Be careful when selecting the resistors for R1 and R 2.

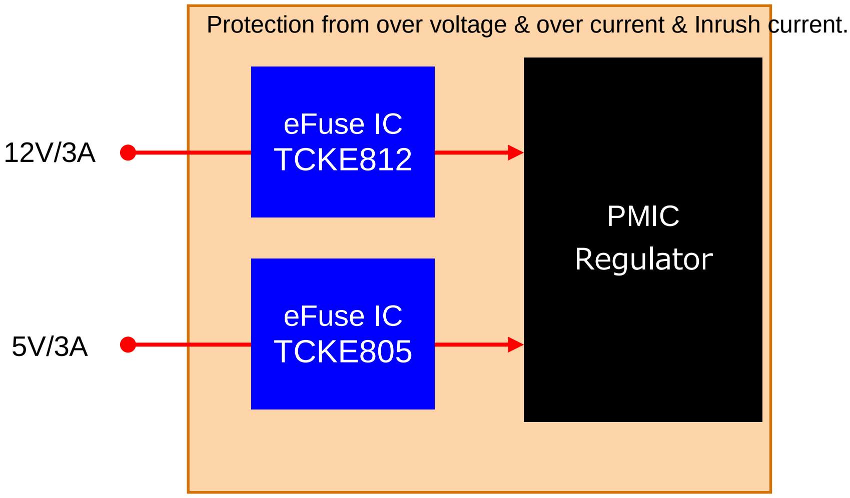
4. eFuse IC application example

The application examples of eFuse IC are introduced below.

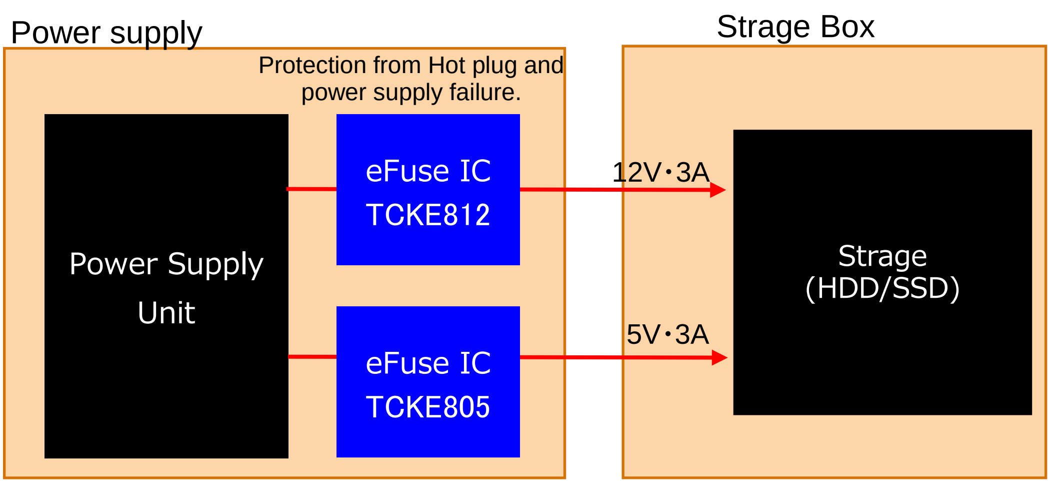
- NBPC/Smartphone/Wearables



- SSD/HDD



- Server



5. Conclusion

So far, we have explained the eFuse IC's usage and various protection functions using the Toshiba eFuse IC TCKE800/805/812 series as an example.

The eFuse IC not only cuts off a large current, but can also protect the IC and set from various abnormal conditions such as overvoltage and overheating. We also have convenient functions such as suppressing inrush current and preventing malfunctions at low voltage.

These functions contribute to greatly improve the reliability of the product. Also, if you can think of using a discrete component or other passive element to achieve the same function as the eFuse IC, it will be a great effect on the miniaturization of the device and the reduction of the design and manufacturing cost. You can understand. We hope that you will use this eFuse IC with reference to this document to achieve higher performance, smaller size, and lower total cost of your equipment.

Finally, we are planning and developing eFuse IC products that change the clamp operation of overvoltage protection to the shutdown operation with the same usage and operation as the TCKE800/805/812 series. We plan to expand the lineup to expand the range of choices that match the specifications of the equipment you are using, and we would appreciate your patronage of our eFuse IC.

6. Related Links

- ■Product Line Ups（Catalog） Click
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- ■FAQ of eFuse ICs Click
- ■Application Note Click

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