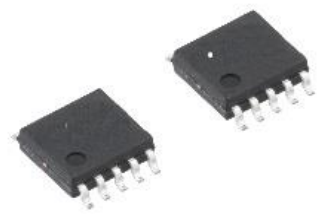
LED lighting power supply IC

MM3760 series



Outline

This IC is a control IC for LED lighting that supports phase dimming, PWM dimming, and DC dimming. Quasi-resonant switching is used to achieve low loss and low noise. In addition, the combination of peak current control and variable OFF time control realizes a non-linear dimming curve, enabling visually smooth dimming. In addition, a dedicated terminal (VOUT) is provided to supply the holding current required for normal operation of the phase dimmer, enabling a reduction in the number of parts.

Features

- Low loss and low noise by quasi-resonant switching
- Smooth dimming characteristics by combining peak current control and variable OFF time control
- Equipped with a phase detection output terminal for holding current control
- Minimum dimming current can be clamped
- Firefly switch compatible (up to 5 units can be connected in parallel)
- Various protection functions (OCP, SWP, UVLO, TSD, ISNS pin open protection)

Main specifications

- Operating voltage range : 10~25.5V
- Maximum current detection voltage : 06V(Typ.)
- Operating current consumption : 3.5mA(Typ.)
- Overcurrent detection voltage : 0.8V(Typ.)
- Firefly switch compatible load resistance : 10kΩ(Typ.)
- SWP short detection voltage : 2.5V(Typ.)

Applications

- Downlight
- ceiling light

Package

- SOP-10A

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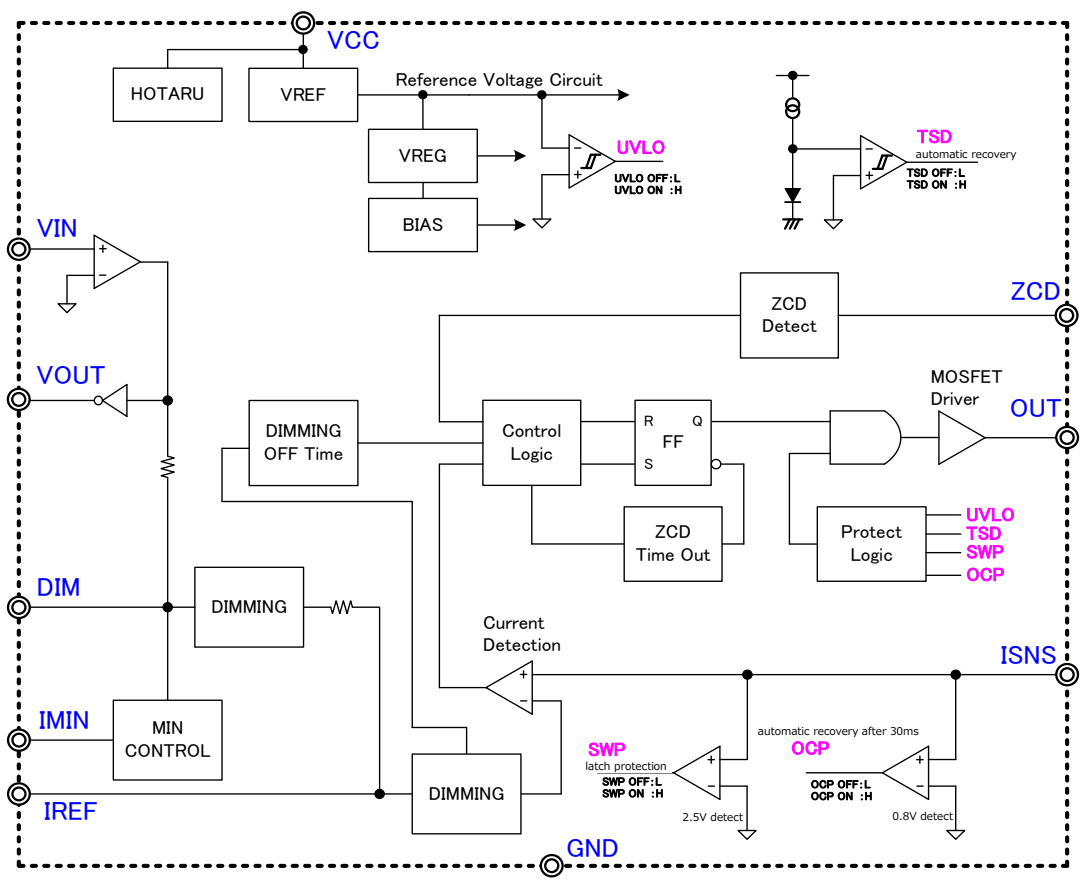
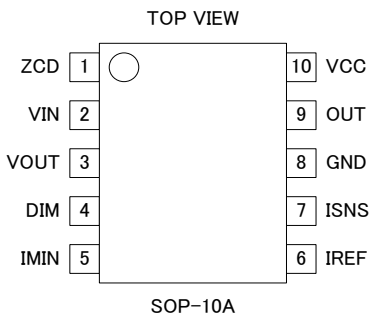
Dec, 2022 Rev.0

Equivalent Circuit Diagram



Pin configrations



Pin explanations□

PIN No.	SYMBOL	FUNCTION
1	ZCD	Zero current detect terminal
2	VIN	Phase detect input terminal
3	VOUT	Phase detect output terminal
4	DIM	Light dimming terminal
5	IMIN	Minimum LED current control terminal
6	IREF	LED current sensing reference voltage terminal
7	ISNS	LED current sensing terminal
8	GND	GND terminal
9	OUT	Gate drive terminal
10	VCC	Power supply terminal

ABSOLUTE MAXIMUM RATINGS

(Ta=25℃ / VCC=15V, unless otherwise specified)

ITEM	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{CCMAX}	-0.3	30	V
VCC pin input current	I_{CCMAX}	-	10	mA
ZCD Pin Voltage	V_{ZCDMAX}	-0.3	5.5	V
VIN Pin Voltage	V_{VINMAX}	-0.3	5.5	V
VOUT Pin Voltage	$V_{VOUTMAX}$	-0.3	V_{VOUTH}+0.3	V
DIM Pin Voltage	V_{DIMMAX}	-0.3	5.5	V
IMIN Pin Voltage	$V_{IMINMAX}$	-0.3	5.5	V
IREF Pin Voltage	$V_{IREFMAX}$	-0.3	5.5	V
ISNS Pin Voltage	$V_{ISNSMAX}$	-0.3	5.5	V
OUT pin input current	I_{OUTMAX}	-600	700	mA
Power Dissipation (Alone)	Pd_{alone}	-	350(*1)	mW
Power Dissipation (Mounted)	Pd	-	800(*2)	mW
Thermal resistance junction to ambient temperature	$R_{\theta JA}$	-	360(*1)	℃/W
Storage temperature	Tstg	-55	150	℃
Junction temperature	Tj_{MAX}	-	150	℃

Note : Absolute Maximum Ratings are those values beyond which the life of the device may be impaire

*1 : Result of measurement in only package

*2 : Use base condition : 114.3mm×76.2mm, t =1.5mm, Copper leaf 50% more than,
Material=Glass Epoxy

RECOMMENDED OPERATING CONDITIONS

(Ta=25℃ / Ta=25℃, unless otherwise specified)

ITEM	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	$V_{CC\text{-}OPR}$	10	25.5	V
VOUT Pin Voltage	$V_{VOUT\text{-}OPR}$	0	V_{VOUTH}	V
VIN Pin Voltage	$V_{VIN\text{-}OPR}$	0	5	V
DIM Pin Voltage	$V_{DIM\text{-}OPR}$	0	5	V
IMIN Pin Voltage	$V_{IMIN\text{-}OPR}$	0	5	V
ZCD Pin Voltage	$V_{ZCD\text{-}OPR}$	0	5	V
IREF Pin Voltage	$V_{IREF\text{-}OPR}$	0	5	V
ISNS Pin Voltage	$V_{ISNS\text{-}OPR}$	0	5	V
Operating Junction temperature	$Tj_{MAX\text{-}OPR}$	-40	125	℃

Note : Thermal Resistance (junction to ambient temperature) is dependent on the operating conditior and the substrate to be used.
Maximum operating temperature range (Tamax) is calculated from the following equation from maximum operating junction temperature (Tjmax-opr), maximum power consumption (Pd-max) and thermal resistance(Rθja).
Tamax = Tjmax-opr - (Rθja x Pd-max)

Electorical Characteristics

(Ta=25℃ / VCC=15V, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	*3
VCC circuit							
Start-up power supply current	I_{CCOFF}	V_{CC}=9V	0.51	0.86	1.37	mA	A
Power supply current	I_{CCON}	V_{CC}=15V	-	3.5	5.0	mA	A
Load resistance for Hotaru switch	R_{HOTARU}	V_{CC}=9V	6	10	14	kΩ	A
UVLO							
Under voltage lockout (UVLO)	V_{UVLO}	V_{CC}=H→L	8	9	10	V	A
UVLO release	V_{UVLOR}	V_{CC}=L→H	11.5	13.0	14.5	V	A
UVLO hysteresis voltage	$V_{UVLOhys}$	V_{CC}=H→L→H	3.3	4.0	4.7	V	A
Phase Detect							
Phase detect voltage H	V_{VINH}	V_{VIN}=L→H	0.58	0.65	0.72	V	B
Phase detect voltage L	V_{VINL}	V_{VIN}=H→L	0.40	0.45	0.50	V	B
Phase Output							
Output pulse voltage	V_{VOUTH}		4.5	5.0	5.5	V	A
VOUT sink current	$I_{VOUTsink}$	V_{VIN}=0V , V_{VOUT}=2.5V	-	5.7	-	mA	B
VOUT source current	$I_{VOUTsource}$	V_{VIN}=1V , V_{VOUT}=2.5V	-	4.0	-	mA	B
Dimming Input							
DIM output resistance	R_{DIM}		-	180	-	kΩ	B
Off blanking time increase start voltage	$V_{DIMOFFbkstart}$	Guaranteed by design	1.935	2.150	2.365	V	-
Isns detect voltage fall start voltage	$V_{DIMISNSstart}$		3.15	3.32	3.49	V	C
Isns detect voltage fall stop voltage	$V_{DIMISNSstop}$		0.532	0.560	0.588	V	C
Minimum Current Setting							
IMIN source current	$I_{IMINsource}$	V_{IMIN}=0V	4.5	5.0	5.5	uA	A
IREF Output							
IREF voltage	V_{IREF}	V_{DIM}=4.5V	2.70	2.87	3.04	V	C
IREF output resistance	R_{IREF}		90	140	190	kΩ	C

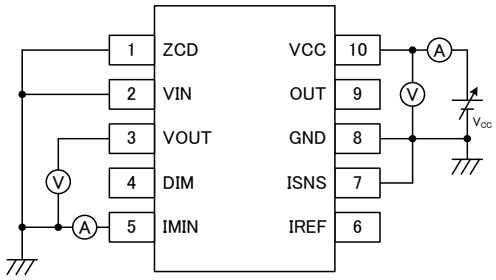
(Ta=25℃ / VCC=15V, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	*3
Zero Current Detect							
Zero current detect delay time	td_{ZCD}		-	100	-	ns	D
Zero current detect time-out	td_{ZCD-TO}	V_{ZCD}=3.0V	-	50	-	us	D
ISNS Input							
Maximun ISNS current detect voltage	$V_{ISNSmax}$	V_{DIM}=4.5V	576	600	624	mV	C
ISNS current detect blanking time	t_{ISNSb}		-	380	-	ns	E
Over current detect voltage	V_{OCP}	V_{DIM}=4.5V	720	800	880	mV	E
Over current detecting restart time	t_{OCP}		-	30	-	ms	E
Short winding protection detect voltage	V_{SWP}		2.25	2.50	2.75	V	E
ISNS source current	I_{ISNS}	V_{ISNS}=0V	-	1.0	-	uA	C
Dimming OFF Timer							
Off branking time	t_{OFFbk}	V_{IREF}=50mV	58.5	65.0	84.5	us	E
Shortest Off branking time	$t_{OFFbkmin}$	V_{DIM}=4.5V	-	-	4.0	us	E
Drive							
On resistance (sink)	R_{ONsink}		-	8	12	Ω	F
On resistance (source)	$R_{ONsource}$		-	10	15	Ω	F
Output rise time	t_{RISE}	Cout=1000pF Guaranteed by design	-	60	120	ns	-
Output fall time	t_{FALL}	Cout=1000pF Guaranteed by design	-	30	70	ns	-
Thermal Shut Down							
TSD detection temp.	T_{DET}	Guaranteed by design	-	170	-	℃	-
TSD release temp.	$T_{RELEASE}$	Guaranteed by design	-	120	-	℃	-

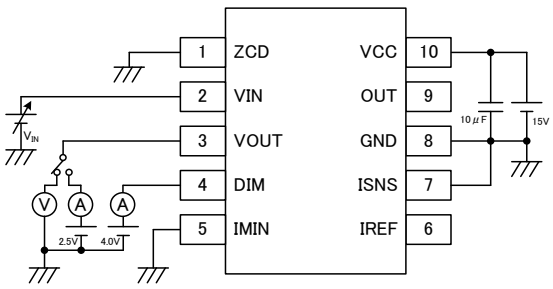
*3 The test circuit symbols.

TEST CIRCUITS

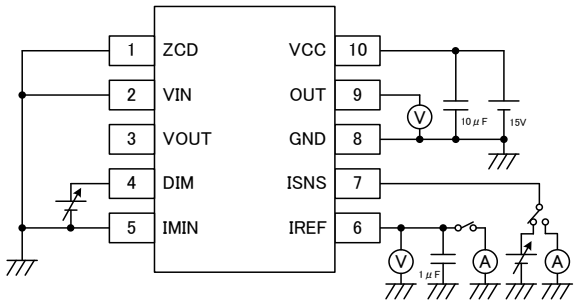
TEST CIRUIT A



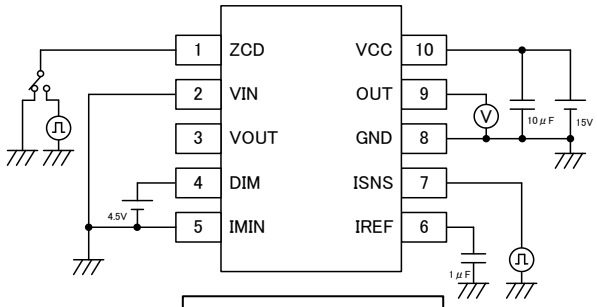
TEST CIRUIT B



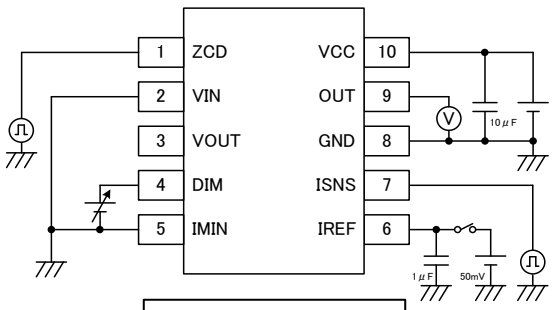
TEST CIRUIT C



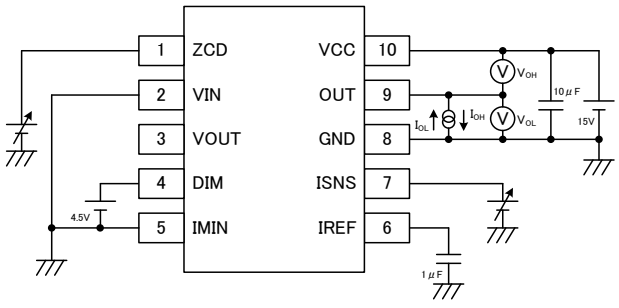
TEST CIRUIT D



TEST CIRUIT E

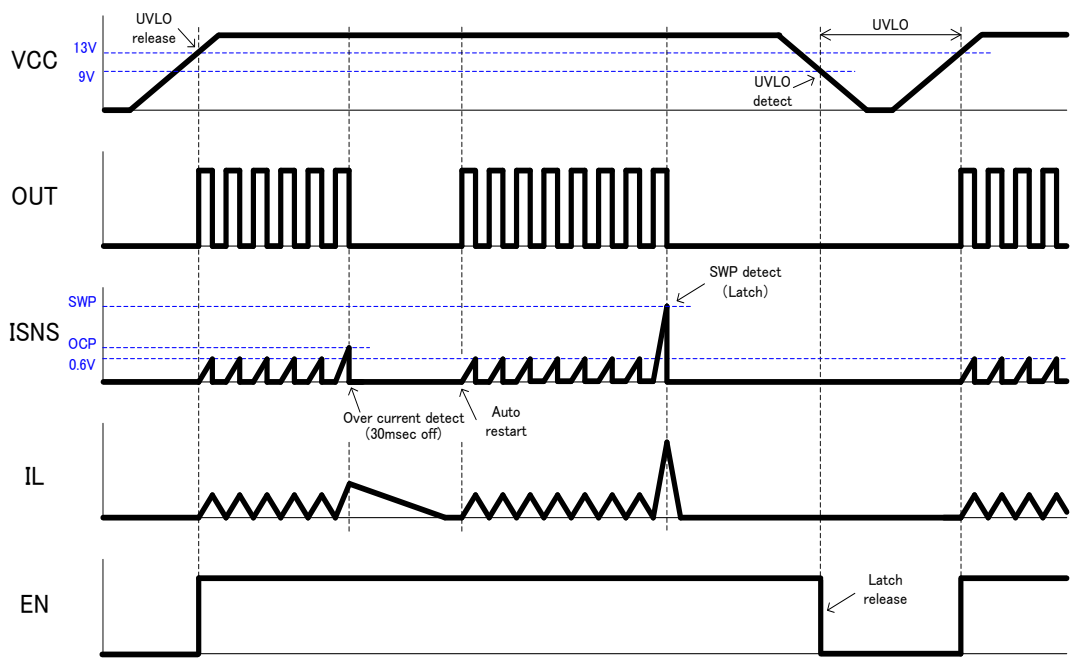


TEST CIRUIT F

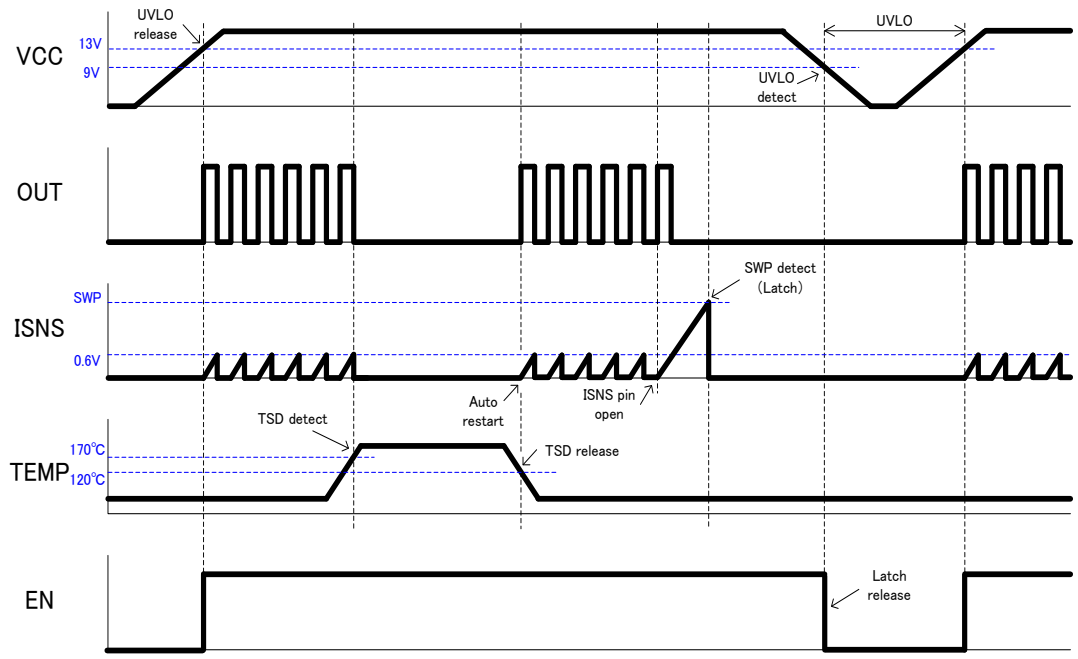


TIMING CHART

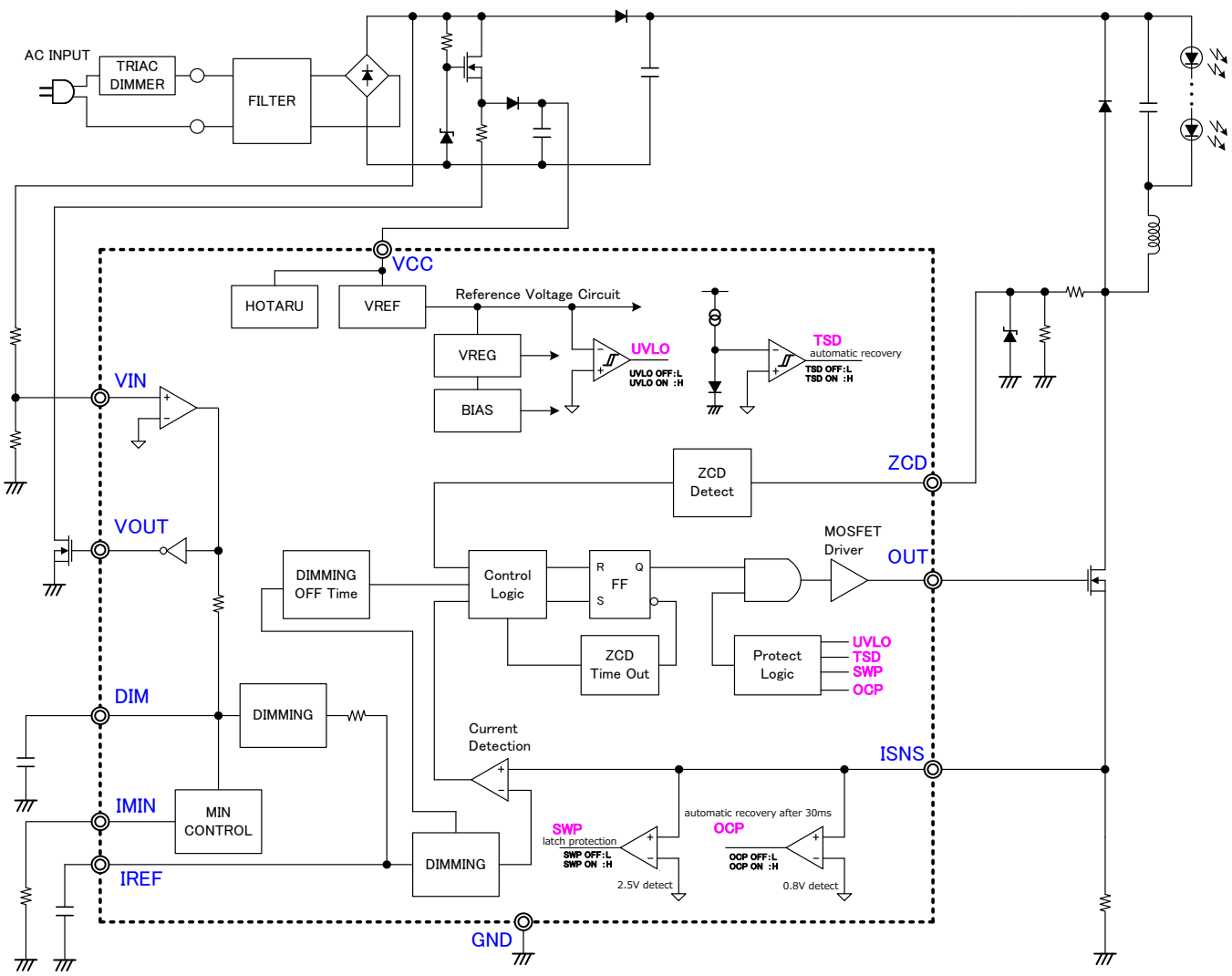
UVLO, Over current detect, and Short winding protection detect operations



ISNS open detect and Thermal shut down operations



Application Circuits



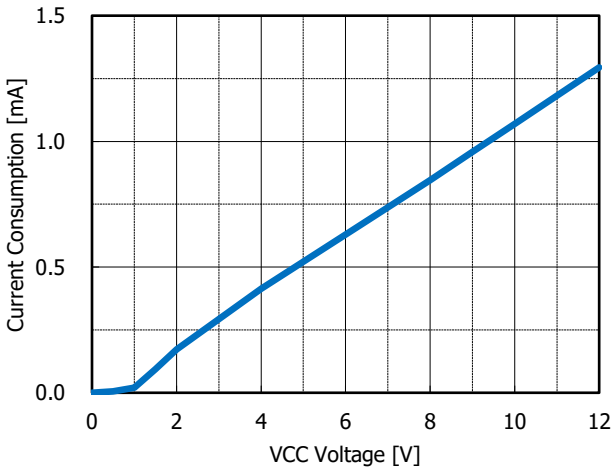
caution： We shall not be liable for any trouble or damage caused by using this circuit .

In the event a problem which may affect industrial property or any other rights of us or a third party is encountered during the use of information described in these circuit, we shall not be liable for any such problem, nor grant a license therefore.

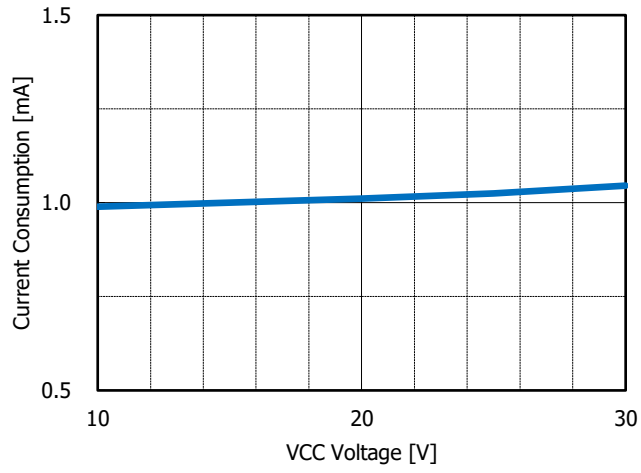
CHARACTERISTIC DATA (for example)

(Ta=25℃ / Ta=25℃, unless otherwise specified)

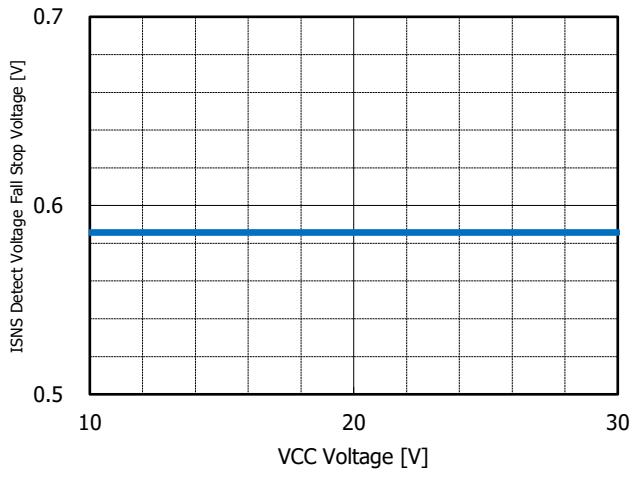
Start-up power supply current - VCC Voltage



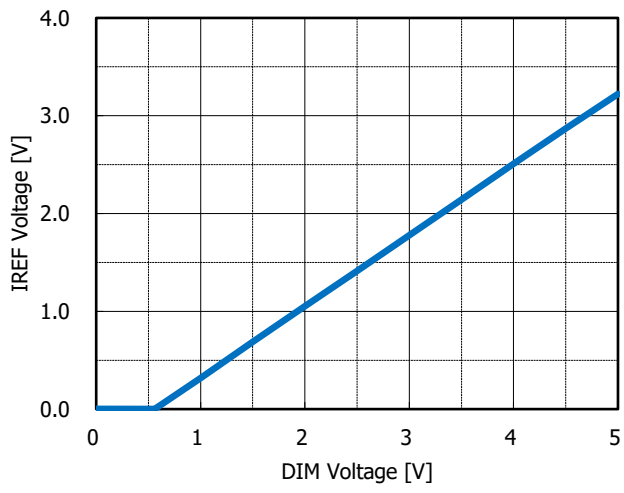
Power supply current - VCC Voltage



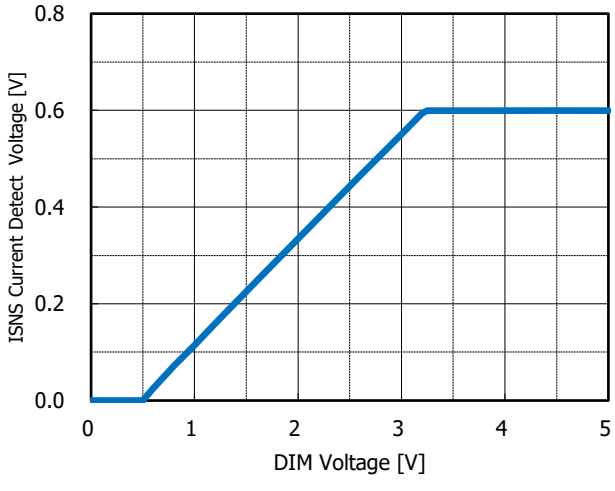
ISNS Detect Voltage Fall Stop Voltage - VCC Voltage



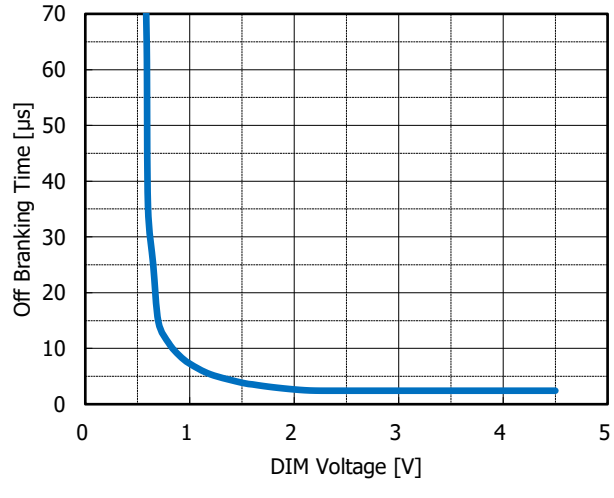
IREF Voltage - DIM Voltage



ISNS Current Detect Voltage - DIM Voltage



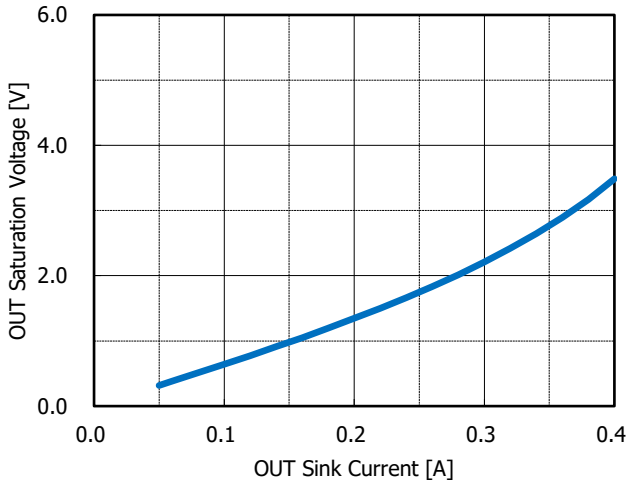
Off Branking Time - DIM Voltage



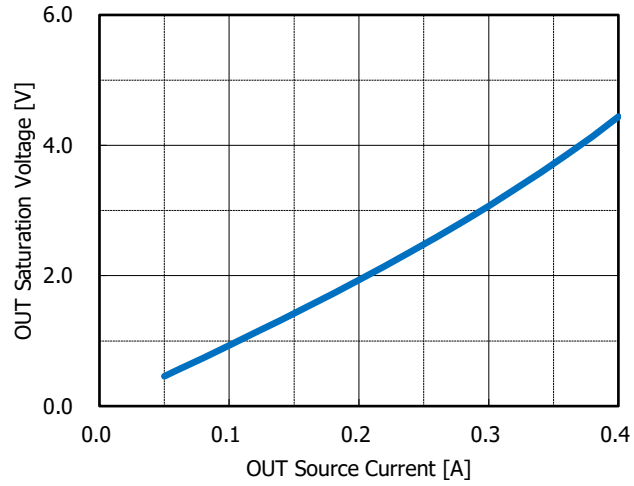
CHARACTERISTIC DATA (for example)

(Ta=25℃ / Ta=25℃, unless otherwise specified)

OUT Saturation Voltage - OUT Sink Current

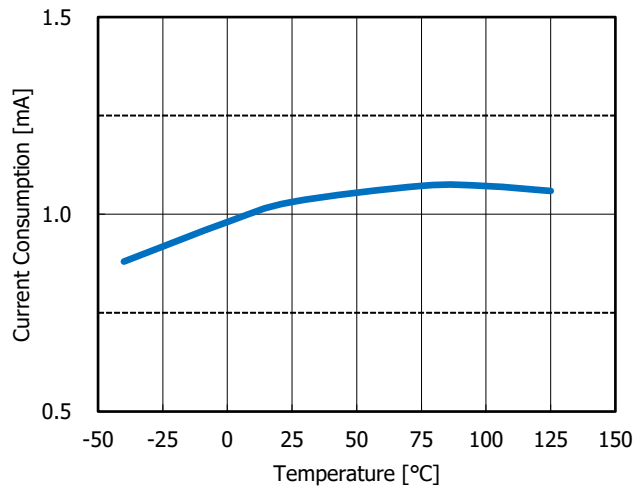


OUT Saturation Voltage - OUT Source Current

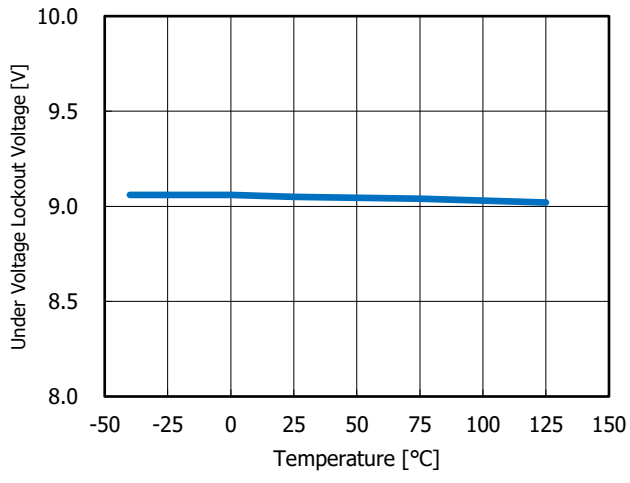


(VCC=15V / VCC=15V, unless otherwise specified)

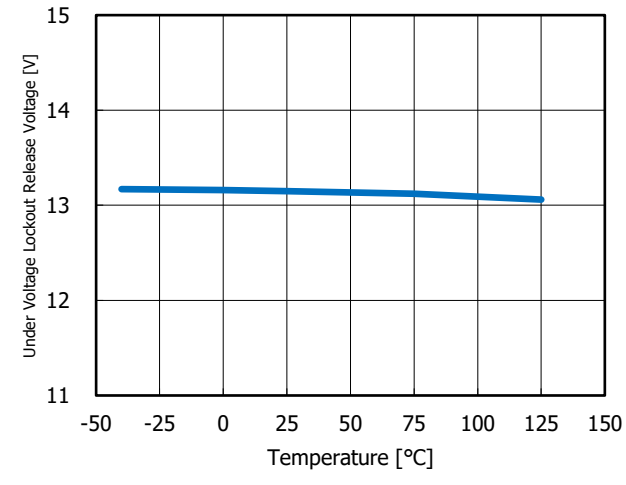
Power supply current - Temperature



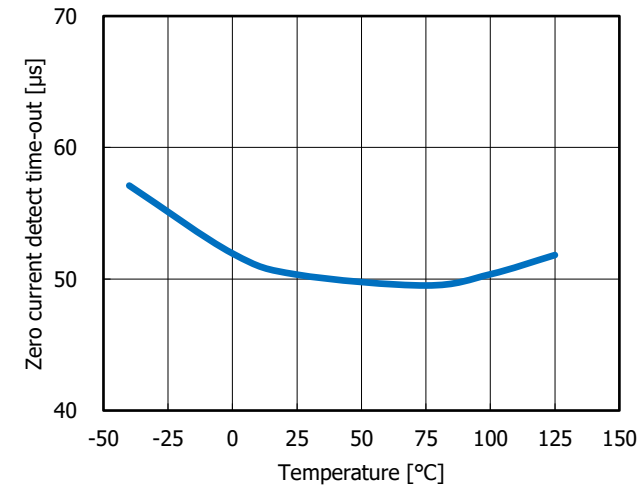
Under Voltage Lockout Voltage - Temperature



Under Voltage Lockout Release Voltage - Temperature



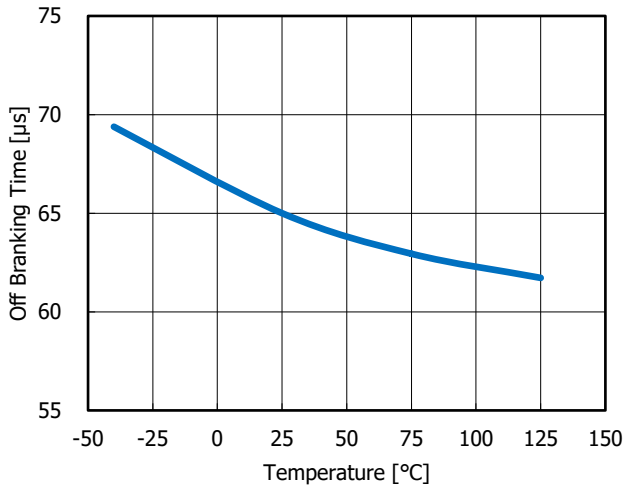
Zero Current Detect Time-out - Temperature



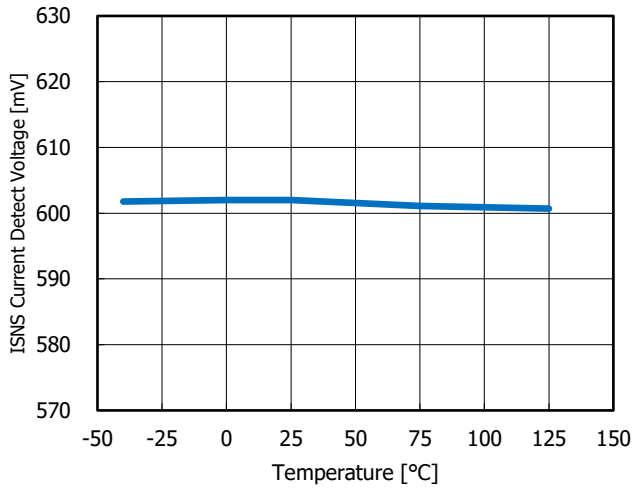
CHARACTERISTIC DATA (for example)

(VCC=15V / VCC=15V, unless otherwise specified)

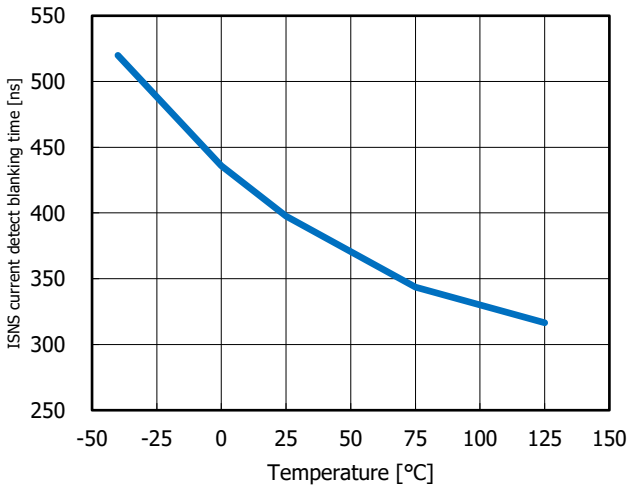
Off Branking Time - Temperature



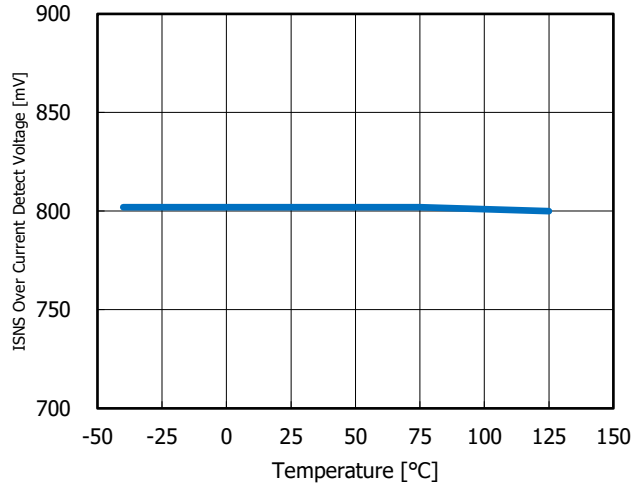
ISNS Current Detect Voltage - Temperature



ISNS Current Detect Blanking Time - Temperature

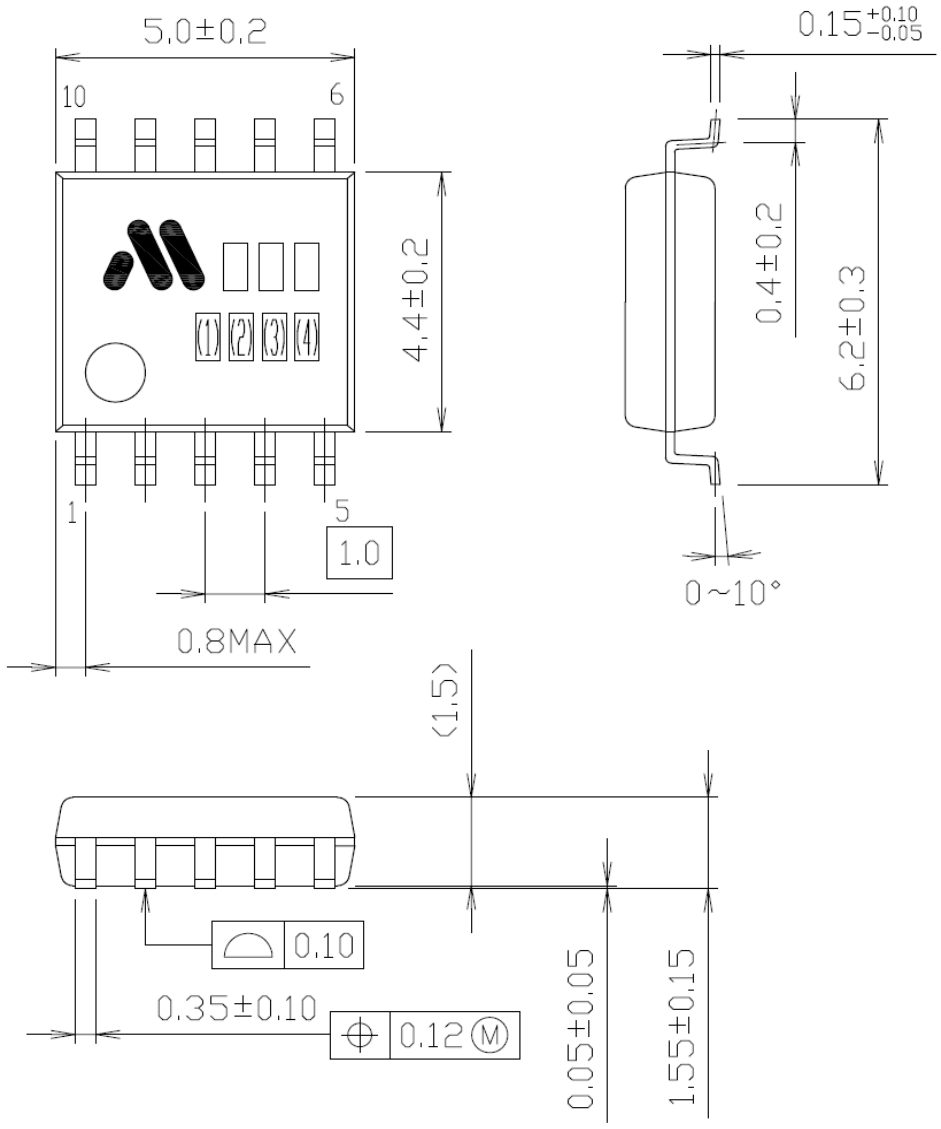


ISNS Over Current Detect Voltage - Temperature



Demensions

UNIT | mm



Marking Contents