

MCZ5208SG

LLC Current Resonant Mode Controller

Feature

- Robust 600V direct gate driver
- Vcc(max)=35V
- Active Stand-by function
- Burst mode function
- Soft Starting function
- Operating frequency 500kHz is available
- Over current protection(OCP1)
- Over current protection for peak load(OCP2)
- Capacitive mode protection
- Two-step timer latch function
- Latching protection with external signal is possible
- Low input voltage protection(Vsen)
- Thermal Shutdown
- Halogen free
- Pb free
- RoHS:Yes

Outline

House Name: SOP16



1.絶対最大定格

Absolute Maximum Ratings

1-1.入出力定格

Input Output Ratings

特に指定なき場合は $T_j=25^{\circ}\text{C}$

$T_j=25^{\circ}\text{C}$ unless otherwise specified

項目 Item	記号 Symbol	規格値 Value	単位 Unit
フローティングドライバ電圧 High side floating supply voltage	VB	-0.3 ~ 600	V
制御部電源電圧 Vc1 input voltage	Vc1	-0.3 ~ 35	V
ハイスайдドライバ電源電圧 VB input voltage	VB-VS	-0.3 ~ 13.8	V
ローサイドドライバ電源電圧 Vc2 input voltage	Vc2	-0.3 ~ 13.8	V
Vsen端子電圧 Vsen input voltage	Vsen	-0.3 ~ 10	V
CS0端子電圧 CS0 input voltage	V _{CS0}	-0.3 ~ 5	V
CS1端子電圧 CS1 input voltage	V _{CS1}	-3 ~ 5	V
CS2端子電圧 CS2 input voltage	V _{CS2}	-3 ~ 5	V
AS端子電流 AS input current	I _{AS}	-1 ~ 5	mA
SST端子電流 SST input current	I _{SST}	-1 ~ 10	mA

1-2.熱定格

Thermal Ratings

項目 Item	記号 Symbol	規格値 Value	単位 Unit
許容損失 Total power dissipation	Pt	0.8 (*1)	W
接合部温度 Junction temperature	Tj	150	°C
保存温度 Storage temperature	Tstg	-40 ~ 150	°C
熱抵抗 Thermal Resistance	θ_{ja}	147 (*1)	°C/W

*1 4-layer Board

ガラエポ基板: 114.3mm × 76.2mm, 厚さ: 1.6mm、内面銅箔サイズ: 74.2mm × 74.2mm, 厚さ: 35 μ m

Glass-Epoxy Board : 114.3mm × 76.2mm , Thickness: 1.6mm, Inside copper foil: 74.2mm × 74.2mm, Thickness: 35 μ m

2.推奨動作条件

Recommended operation conditions

項目 Item	記号 Symbol	推奨値 Value	単位 Unit
フローティングドライバ電圧 High side floating supply voltage	VB	-0.3 ~ 480	V
制御部電源電圧 Vc1 input voltage	Vc1	-0.3 ~ 28	V
ハイサイドドライバ電源電圧 VB input voltage	VB-VS	-0.3 ~ Vc2-Vf (*1)	V
ローサイドドライバ電源電圧 Vc2 input voltage	Vc2	-0.3 ~ Vc2 (*2)	V
接合部温度 Junction temperature	Tj	-20 ~ 120	°C

*1 Vf : ブートストラップ用ダイオードのVf

Vf is forward voltage of Boot strap diode.

*2 電気的特性(7ページ)のVc2規格値を参照

Please refer to Driver supply voltage Vc2 of 7 pages of this specification.

注意

Notes

推奨動作条件の範囲を超えて使用すると、信頼性に影響を及ぼす場合があります。

It might influence reliability when using it exceeding the range of recommended operating conditions.

定常的に105°Cを超えてご使用される場合は、必ず事前に当社担当営業部門までご相談下さい。

When it is regularly used exceeding 105°C, please consult to salesman of our company beforehand.

本ICを御使用の際は絶対最大定格を越えないようにしてください。絶対最大定格を超えた場合、ICが破壊する可能性があります。破壊した場合、その破壊モード(オープンモード、ショートモード)は特定できませんので、ヒューズなど物理的な安全対策を施すようお願いします。

Do not use this IC beyond its absolute maximum ratings to prevent the IC from potential damage. Since the kind of destructive mode cannot be identified (open mode, short mode), take safety measures such as fusing.

3.電気的特性

Electrical characteristics

3-1.電気的特性(1/5)

Electrical characteristics (1/5)

特に指定なき場合はV_{c1}=16V, f(0)=100kHz, T_j=25°C
V_{c1}=16V, f(0)=100kHz, T_j=25°C unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
不足電圧保護回路 Under voltage protection						
Vc1動作開始電圧 Vc1 startup threshold voltage	Vc1(start)		12.2	12.9	13.6	V
Vc2動作開始電圧 Vc2 startup threshold voltage	Vc2(start)		9.0	9.6	10.0	V
Vc1動作停止電圧 Vc1 shutdown threshold voltage	Vc1(stop)		8.2	8.7	9.2	V
Vc2動作停止電圧 Vc2 shutdown threshold voltage	Vc2(stop)		6.8	7.3	7.8	V
ハイサイドドライバ動作開始電圧 high side driver start voltage	VB-VS(start)		6.8	7.3	7.8	V
ハイサイドドライバ動作停止電圧 high side driver stop voltage	VB-VS(stop)		4.2	4.9	5.6	V
ハイサイドドライバ動作停止電圧 2 high side driver stop voltage 2	Vc2-VB	Vc2(stop)-VB-VS(stop)	1.8	2.4	3.0	V
待機時消費電流 1 Stand-by current 1	Ic1(stb1)	Vc1=11.5V	300	450	600	μA
待機時消費電流 2 Stand-by current 2	Ic1(stb2)	Vc1=16V Vsen=0V	300	450	600	μA
待機時消費電流 3 (バースト時) Stand-by current 3 (burst mode)	Ic1(stb3)	Vc1=16V VAS=5V	300	450	600	μA
待機時消費電流 4 (ラッチ停止時) Stand-by current 4 (latch stop mode)	Ic1(stb4)	Vc1=16V ラッチ停止時	300	450	600	μA
動作時消費電流 Operating current	Ic1(on)	Vc1=16V Vsen=4V	7.5	9.5	11.5	mA
過熱保護 Thermal shutdown protection						
動作停止温度 Operating stop temperature	TSD		140 (*3)	-	-	°C
動作停止/復帰温度幅 Hysteresis temperature	ΔTSD		-	40 (*3)	-	°C
ラッチ保護 Stop latch section						
ラッチ解除電圧1 Latch reset voltage of Vc1	Vc1 (latch reset)		7.6	8.3	9.0	V
ラッチ解除電圧2 Latch reset voltage of Vc1 2	Vc1 (stop)- Vc1 (latch reset)		0.1	0.4	0.8	V

*3 設計保証
Design assurance.

3-2.電気的特性(2/5)

Electrical characteristics (2/5)

特に指定なき場合は $V_{c1}=16V, f(0)=100kHz, T_j=25^{\circ}C$
 $V_{c1}=16V, f(0)=100kHz, T_j=25^{\circ}C$ unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
過電流保護 Over current protection						
CS1(+)検出電圧 Input threshold voltage CS1(+)	VCS1 (+)		0.450	0.500	0.550	V
CS1(-)検出電圧 Input threshold voltage CS1(-)	VCS1 (-)		-0.550	-0.500	-0.450	V
CS2(+)検出電圧 Input threshold voltage CS2(+)	VCS2 (+)		0.450	0.500	0.550	V
CS2(-)検出電圧 Input threshold voltage CS2(-)	VCS2 (-)		-0.550	-0.500	-0.450	V
CS検出電圧差 Difference of input threshold voltage	VCS	VCS1(+)-VCS2(+) VCS1(-)-VCS2(-)	-0.050	0	0.050	V
CS1端子電流 Input bias current	ICS1	V _{CS1} =0V	-120	-100	-80	μA
CS2端子電流 Input bias current	ICS2	V _{CS2} =0V	-120	-100	-80	μA
CSO端子プレチャージ電圧 Input pre-charge voltage	VCSO(pre)	V _{CS2} =0V	0.8	0.9	1.0	V
OCP2動作開始CSO端子電圧 *4 Input voltage to OCP2 ON	VCSO(OCP2)	V _{CS2} =1V	0.9	1.0	1.1	V
CSO端子検出電圧差 Difference of input voltage	VCSO	VCSO(CS2) -VCSO(pre)	0.04	0.10	0.20	V
Timer充電切替CSO端子検出電圧 Input voltage to timer current switching	VCSO(timer)		1.65	1.75	1.85	V
OCP2動作時CSO端子充電電流 *4 Input bias current to OCP2 operation	ICSO(OCP2)	V _{CS2} =1V V _{CSO} =1.2V	-680	-580	-480	uA
di/dt保護 di/dt protection						
di/dt1(+)検出電圧 Input threshold voltage 1(+)	Vdidt1 (+)		0.070	0.100	0.130	V
di/dt1(-)検出電圧 Input threshold voltage 1(-)	Vdidt1 (-)		-0.130	-0.100	-0.070	V

*4 OCP1: CS1による過電流検出

OCP1 is over current detection of CS1 terminal.

OCP2: CS2による過電流検出

OCP2 is over current detection of CS2 terminal.

3-3.電気的特性(3/5)

Electrical characteristics (3/5)

特に指定なき場合は $V_{C1}=16V, f(0)=100kHz, T_j=25^{\circ}C$
 $V_{C1}=16V, f(0)=100kHz, T_j=25^{\circ}C$ unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
ソフトスタート Soft start section						
SSLしきい値 Soft start threshold voltage	Vss		1.35	1.50	1.65	V
SS充電電流1 Soft start charge current 1	Iss(charge)1	V _{SST} =0.6V	-36	-30	-24	μA
SS充電電流2 Soft start charge current 2	Iss(charge)2	V _{SST} =0.6V V _{AS} =3.5V (burst mode)	-66	-60	-50	μA
SS放電電流 Soft start discharge current	Iss(discharge)	V _{SST} =1V Vsen=0V	2.5	3.5	4.5	mA
SST端子開放電圧 SST open voltage	Vss(open)	V _{SST} =open	1.9	2.1	2.3	V
SS周波数 Soft start oscillation frequency	f(ss)	V _{SST} =0.7V, Ct=1670pF, Rt=9.27kΩ (*5)	290	340	390	kHz
動作開始SST電圧 SST voltage to start	Vss(st)		0.5	0.6	0.7	V
動作停止SST電圧 SST voltage to stop	Vss(sp)		0.4	0.5	0.6	V
動作開始/停止SSTヒステリシス電圧 SST hysteresis voltage to start/stop	Vss(st/sp)hys	Vss(st)-Vss(sp)	0.04	0.1	0.2	V
バースト間欠動作時SST保持電圧 SST voltage to burst operation	Vss(bst)	V _{AS} =5V	0.4	0.5	0.6	V
SSTラッチ停止電圧 SST latch stop voltage	Vss(latch)		4.3	4.5	4.7	V
タイマ Protection timer						
Timerしきい値1 Timer threshold voltage 1	Vtimer(set)		3.4	3.5	3.8	V
Timerしきい値2 Timer threshold voltage 2	Vtimer(reset)		0.20	0.35	0.50	V
Timer充電電流1 Timer charge current 1	Itimer(charge)1	V _{SST} =2.5V V _{CS1} =1.0V	-50	-40	-30	μA
Timer充電電流2 Timer charge current 2	Itimer(charge)2	V _{SST} =2.5V, V _{CS2} =1.0V, V _{CS0} =V _{CS0} (OCP2)~V _{CS0} (timer)	-2.5	-1.9	-1.3	μA
Timer充電電流3 Timer charge current 3	Itimer(charge)3	V _{SST} =2.5V, V _{CS2} =1.0V V _{CS0} >V _{CS0} (timer)	-50	-40	-30	μA
Timer放電電流 (Refresh) Timer discharge current (Refresh)	Itimer(refresh)	V _{SST} =2.5V	500	700	950	μA
Timer放電電流 (間欠) Timer discharge current (Discharge)	Itimer(discharge)	V _{SST} =2.5V	4.0	6.5	9.0	μA

*5 C_t : FB端子に接続する外付けコンデンサ

C_t is external capacitor connected to FB terminal .

R_t : FB端子に接続する外付け抵抗

R_t is external resistor connected to FB terminal .

3-4.電気的特性(4/5)

Electrical characteristics (4/5)

特に指定なき場合は $V_{C1}=16V, f(0)=100kHz, T_j=25^{\circ}C$
 $V_{C1}=16V, f(0)=100kHz, T_j=25^{\circ}C$ unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
Vsen機能 Vsen section						
Vsenしきい値1(SS-Reset) Vsen threshold voltage 1	Vsen1(ss-reset)	V _{AS} =open	3.35	3.55	3.75	V
Vsenしきい値2(SS-Reset) Vsen threshold voltage 2	Vsen2(ss-reset)	V _{AS} =open	3.05	3.25	3.45	V
Vsenしきい値ヒステリシス1-2 Vsen threshold voltage hysteresis 1-2	Vsen(hys)1-2	Vsen1(ss-reset)- Vsen2(ss-reset)	0.20	0.30	0.50	V
Vsenしきい値3(SS-Reset) Vsen threshold voltage 3	Vsen3(ss-reset)	V _{AS} =0V V _{AS} =3.5V (burst mode)	0.85	1.00	1.15	V
Vsenしきい値4(SS-Reset) Vsen threshold voltage 4	Vsen4(ss-reset)	V _{AS} =0V V _{AS} =3.5V (burst mode)	0.75	0.90	1.05	V
Vsenしきい値ヒステリシス3-4 Vsen threshold voltage hysteresis 3-4	Vsen(hys)3-4	Vsen3(ss-reset)- Vsen4(ss-reset)	0.04	0.10	0.30	V
発振器 Oscillator section						
周波数設定精度 Output frequency	f(0)	Ct=1500pF (*5) Rt=9.73kΩ (*5)	90	100	110	kHz
OCP2動作時発振周波数1 ※3 Output frequency to OCP2 mode 1	f(CS2)1	Ct=1500pF, Rt=9.73kΩ (*5) V _{CS2} =1V, V _{CS0} =1.2V	93	103	113	kHz
OCP2動作時発振周波数2 ※3 Output frequency to OCP2 mode 2	f(CS2)2	Ct=1500pF, Rt=9.73kΩ (*5) V _{CS2} =1V, V _{CS0} =2.0V	310	360	410	kHz
ONデューティー Output duty cycle	duty	Ct=1500pF (*5) Rt=9.73kΩ (*5)	40	45	50	%
FB充電電流 FB charge current	IFB(charge)	V _{FB} =4V	-9.7	-8.2	-6.7	mA
FB充電停止電圧 FB charge stop voltage	VFB(top)		4.45	4.65	4.85	V
FB充電開始電圧 FB charge start voltage	VFB(bottom)	V _{AS} =2.4V	3.3	3.5	3.7	V
FBマスク電圧 FB Masking voltage	VFB(msk)		4.3	4.4	4.5	V
FB充電開始電圧2 FB charge start voltage 2	VFB(bottom)2	V _{AS} =1.5V	2.70	2.95	3.20	V
FB充電開始電圧3 FB charge start voltage 3	VFB(bottom)3	V _{AS} =0V	2.30	2.55	2.80	V
Tss拡大比 *6 Tss expansion ratio	Tss(3)		-	1.7	-	-

*5 C_t : FB端子に接続する外付けコンデンサ

C_t is external capacitor connected to FB terminal .

R_t : FB端子に接続する外付け抵抗

R_t is external resistor connected to FB terminal .

*6 起動時のVGL1発目と2発目のON幅比(設計保証)

second on-time/first on-time of VGL terminal on start-up
 (design assurance)

3-5.電気的特性(5/5)

Electrical characteristics (5/5)

特に指定なき場合は $V_{c1}=16V, f(0)=100kHz, T_j=25^{\circ}C$
 $V_{c1}=16V, f(0)=100kHz, T_j=25^{\circ}C$ unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
AS機能 Active stand-by section						
AS端子開放電圧 AS open voltage	Vas(open)	VAS=open	2.3	2.5	2.7	V
ASリニア動作開始電圧 AS linear ON threshold voltage	Vas(linon)		2.0	2.2	2.4	V
ASリニア動作解除電圧 AS linear OFF threshold voltage	Vas(linoff)		0.8	1.0	1.2	V
ASモード開始電圧 AS mode ON threshold voltage	Vas(on)		0.65	0.80	0.95	V
ASモード解除電圧 AS mode OFF threshold voltage	Vas(off)		0.85	1.00	1.15	V
ASモード開始/解除ヒステリシス AS mode ON/OFF hysteresis voltage	Vas(hys)		0.1	0.2	0.3	V
バーストモード開始電圧 Burst mode start voltage	Vbst(on)		4.3	4.5	4.7	V
バーストモード時動作開始電圧 Start voltage to burst mode	Vbst(off)		3.8	4.0	4.2	V
バースト動作開始/停止電圧 Burst ON/OFF voltage	Vbst(hys)		0.3	0.5	0.7	V
バーストモード解除電圧 Burst mode reset voltage	Vbst(reset)		2.8	3.0	3.2	V
ドライバ電源 MOS driver supply						
ドライバ電源電圧 Driver supply voltage	Vc2	Vc1=16V,Vc2=open	9.8	10.5	11.2	V
ラインレギュレーション Vc2 line regulation	ΔVc2(line)	Vc1=16～31V	－	0.1	0.5	V
ロードレギュレーション Vc2 load regulation	ΔVc2(load)	Ivc2=0～-80mA	－	0.4	1.0	V
MOSドライバ MOS driver						
ソース駆動能力1 Output source current 1	Iout(source)1	Vc2=VB=10V VGL=VGH=0V	-220	-180	-120	mA
ソース駆動能力2 Output source current 2	Iout(source)2	Vc2=VB=10V VGL=VGH=8.5V	-90	-60	-30	mA
シンク駆動能力1 Output sink current 1	Iout(sink)1	Vc2=VB=10V VGL=VGH=10V	340	400	480	mA
シンク駆動能力2 Output sink current 2	Iout(sink)2	Vc2=VB=10V VGL=VGH=1.5V	120	170	220	mA
デッドタイム Dead time	DT	Ct=1670pF (*5) Rt=9.27k Ω (*5)	260	360	460	ns
上下デッドタイム差 Unbalance of dead time	ΔDT	Ct=1670pF (*5) Rt=9.27k Ω (*5)	-70	0	70	ns

*5 C_t : FB端子に接続する外付けコンデンサ

C_t is external capacitor connected to FB terminal .

R_t : FB端子に接続する外付け抵抗

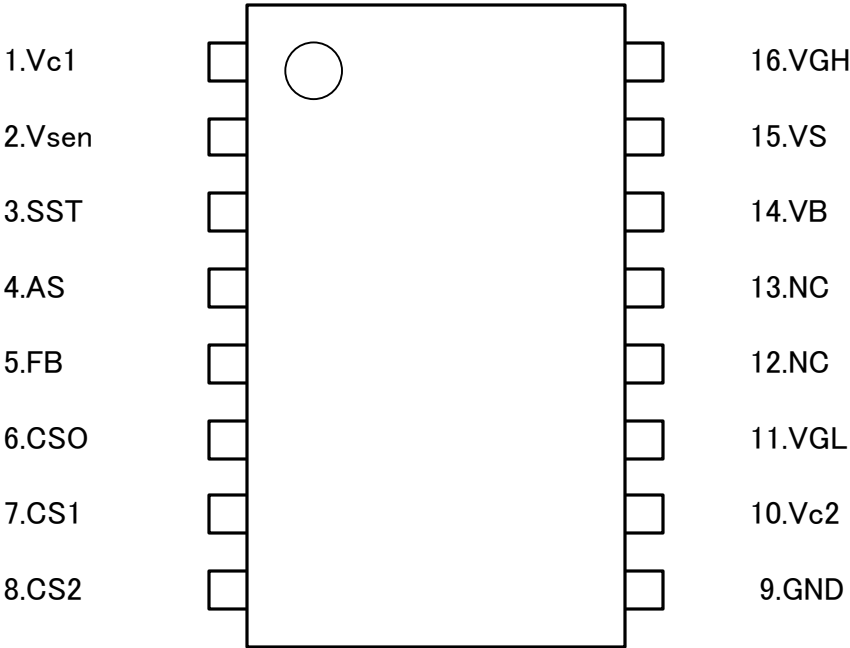
R_t is external resistor connected to FB terminal .

4.端子機能説明

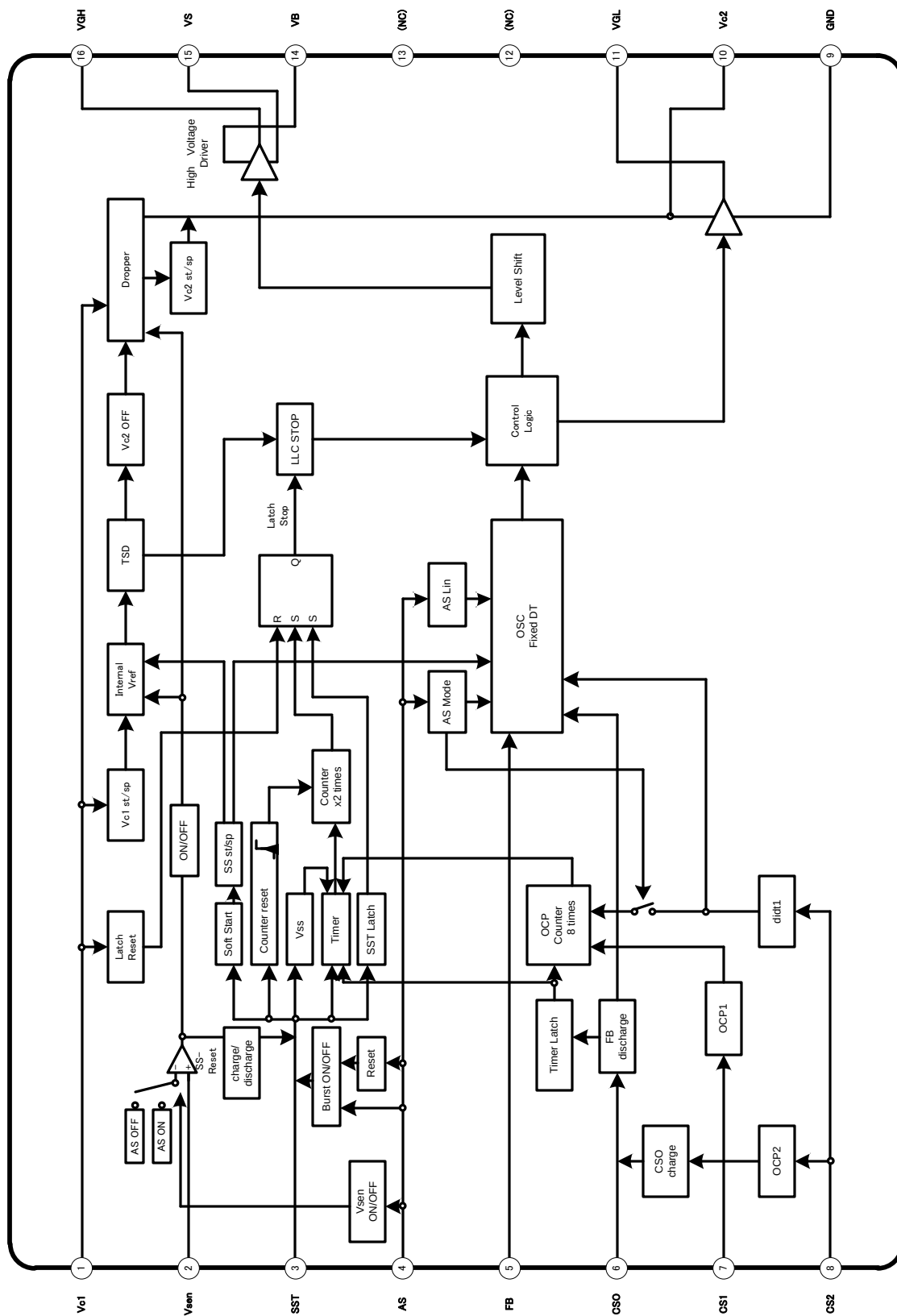
Pin Function

端子番号 PIN No.	記号 symbol	機能 function
1	Vc1	制御回路の電源供給端子 Terminal for a power supply.
2	Vsen	入力監視用端子: 入力低電圧保護、リモートON/OFF、SSリセットを行います。 Terminal to detect Vin, remote ON/OFF, SS-reset.
3	SST	ソフトスタートと異常検出時の間欠動作コンデンサ接続端子 Terminal to control soft-start time and intermittent operations time
4	AS	アクティブスタンバイ切替端子、バースト動作制御端子 Terminal to change active stand-by mode, and to control for burst operation.
5	FB	発振器の周波数設定用端子: Dutyや動作周波数を制御します。 Terminal for frequency and Duty setting.
6	CSO	過電流平均化検出応答調整用端子 Terminal to adjust response of averaging current detection.
7	CS1	過電流検出端子 Terminal to detect over current.
8	CS2	過電流平均化検出およびdi/dt(共振はずれ)検出端子 Terminal to detect averaging current and di/dt mode.
9	GND	GND端子 GND terminal.
10	Vc2	ドライバ用電源出力端子 Output terminal of supply for driver.
11	VGL	ローサイドドライバ出力端子 Terminal of Low side driver output.
12-13	NC	未使用端子 Non connection terminal.
14	VB	ハイサイドドライバの電源端子 Supply terminal for high side driver.
15	VS	ハイサイドドライバの基準電源端子 Terminal of reference for high side driver supply.
16	VGH	ハイサイドドライバ出力端子 Terminal of high side driver output.

5.端子配置
Pin assignment

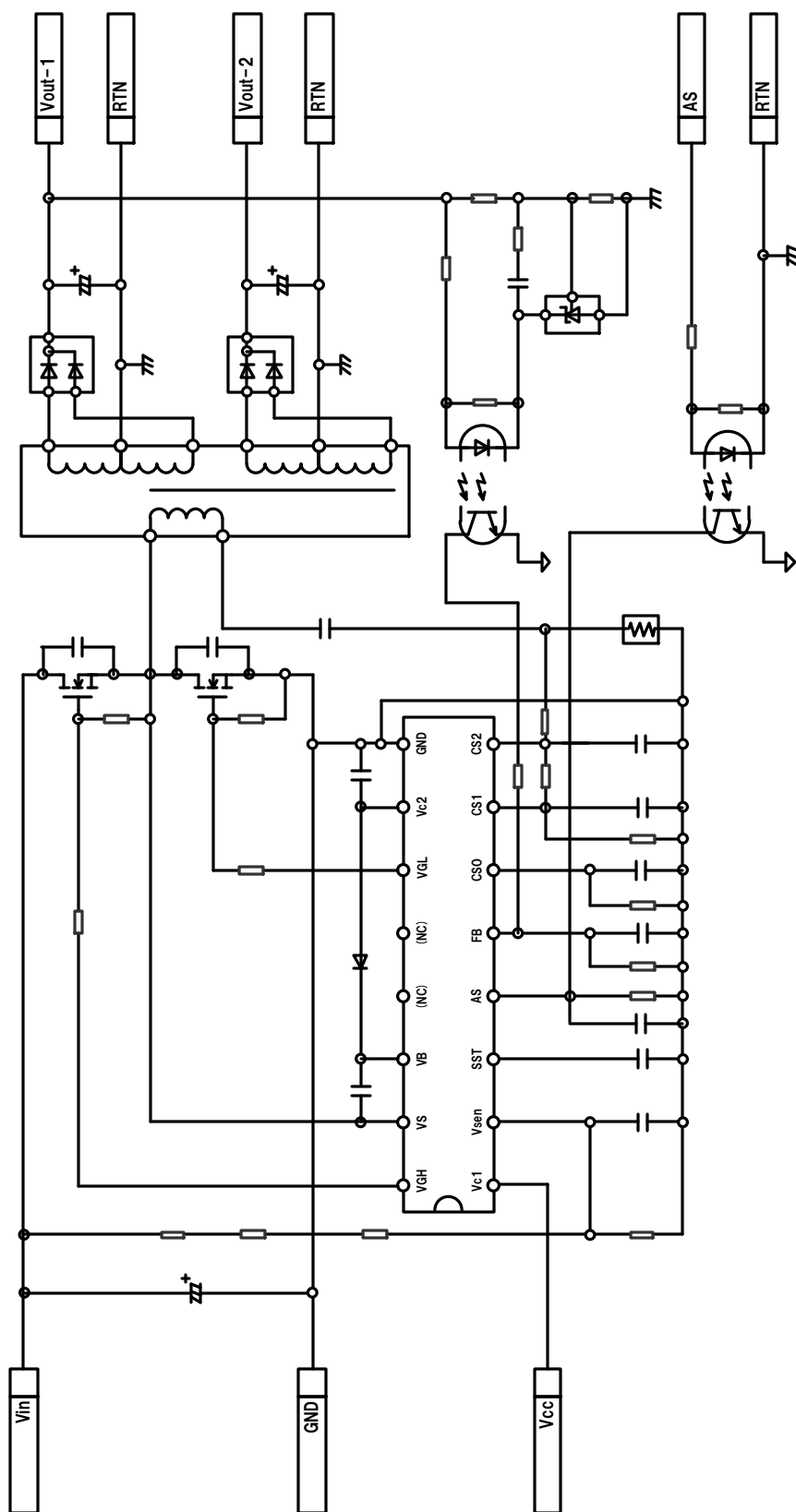


6.ブロック図 Block Diagram



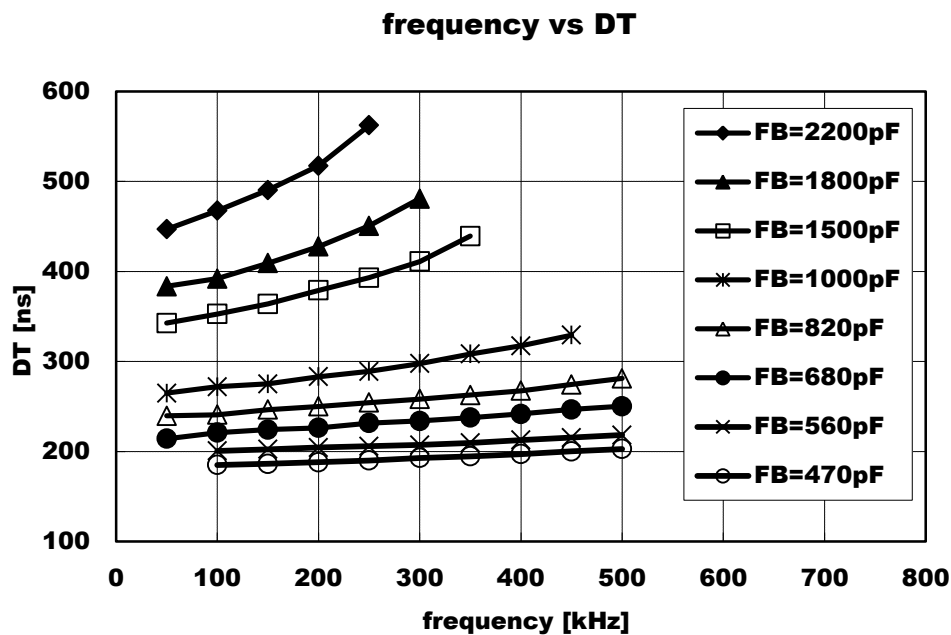
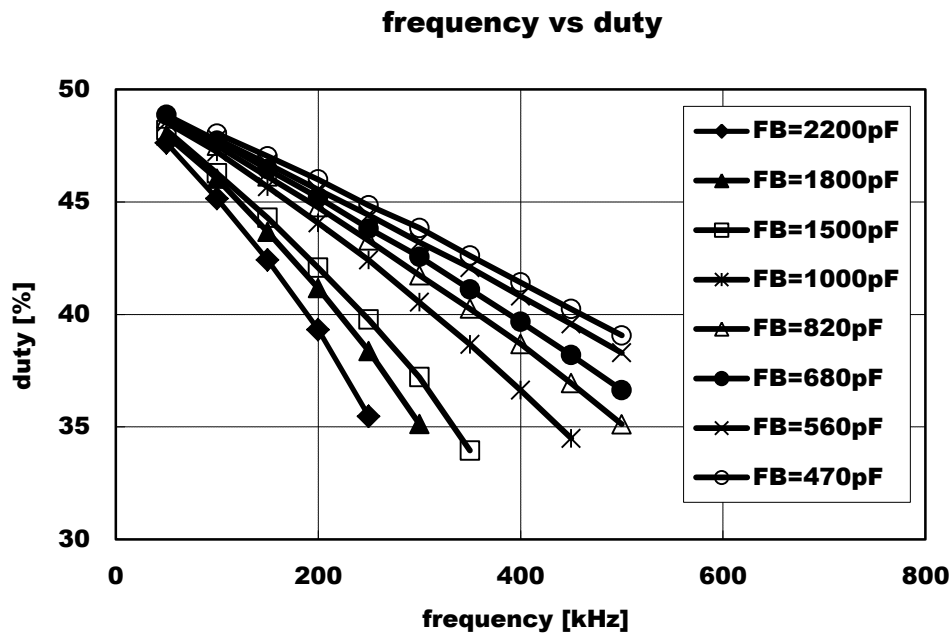
7.代表回路図

Example Circuit Diagram



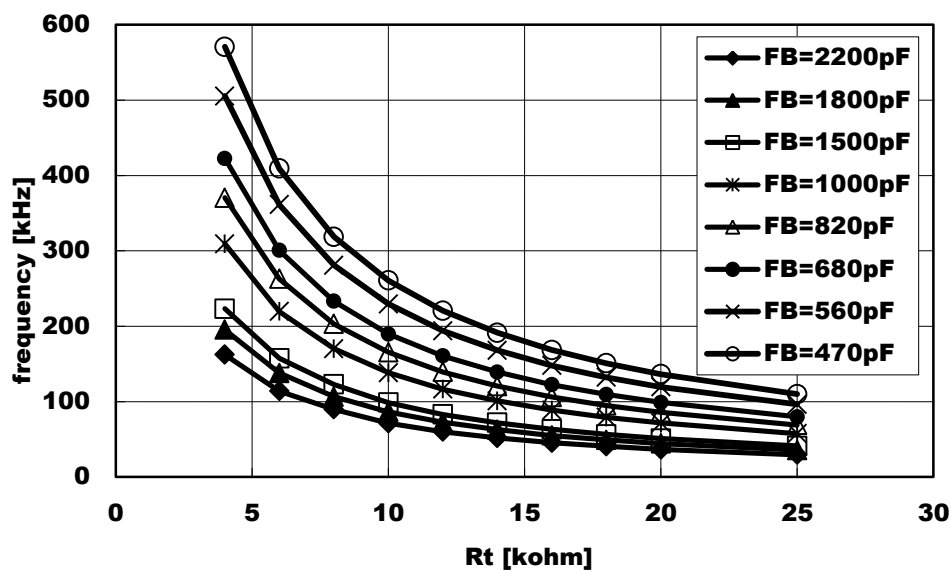
特性図
Characteristics Diagrams

特に指定なき場合はTj=25℃
Tj=25℃ unless otherwise specified

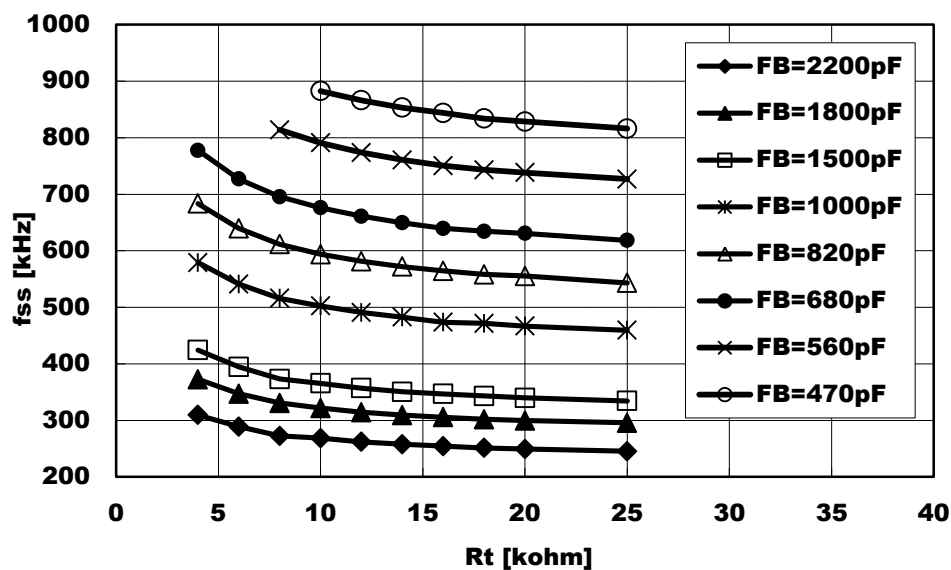


特に指定なき場合はTj=25℃
Tj=25℃ unless otherwise specified

Rt vs frequency



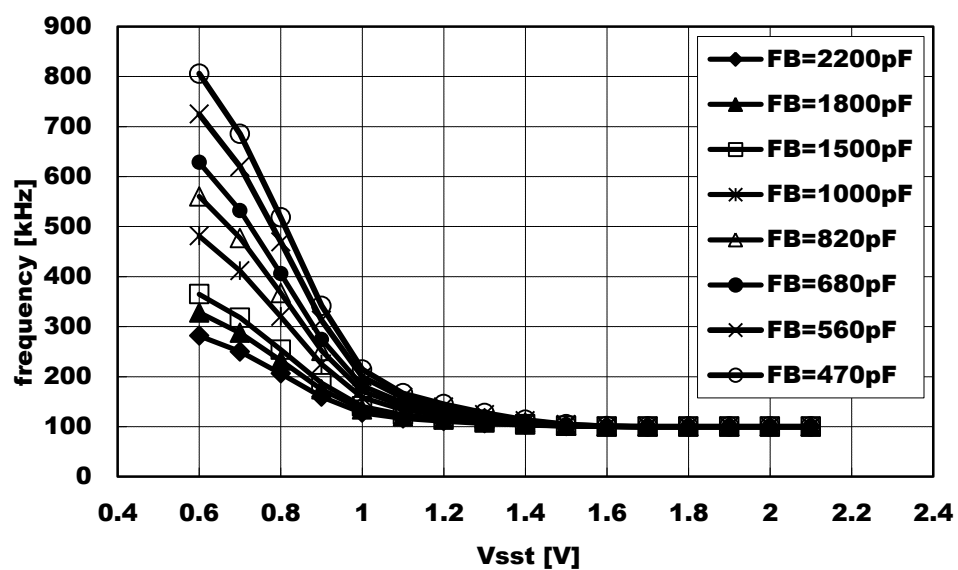
Rt vs fss



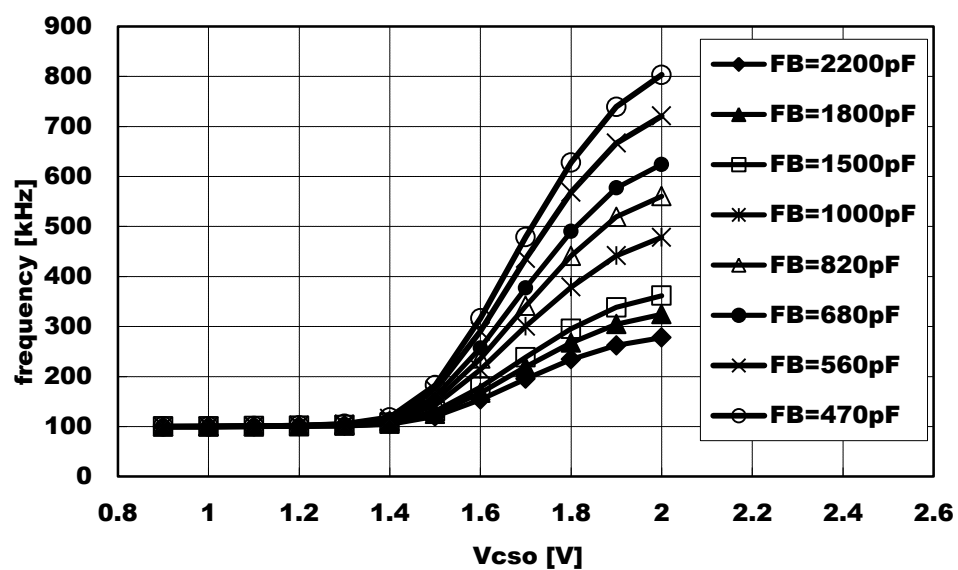
* Rt:FB端子に接続する外付け抵抗

特に指定なき場合はTj=25℃
Tj=25℃ unless otherwise specified

Vsst vs frequency



Vcso vs frequency

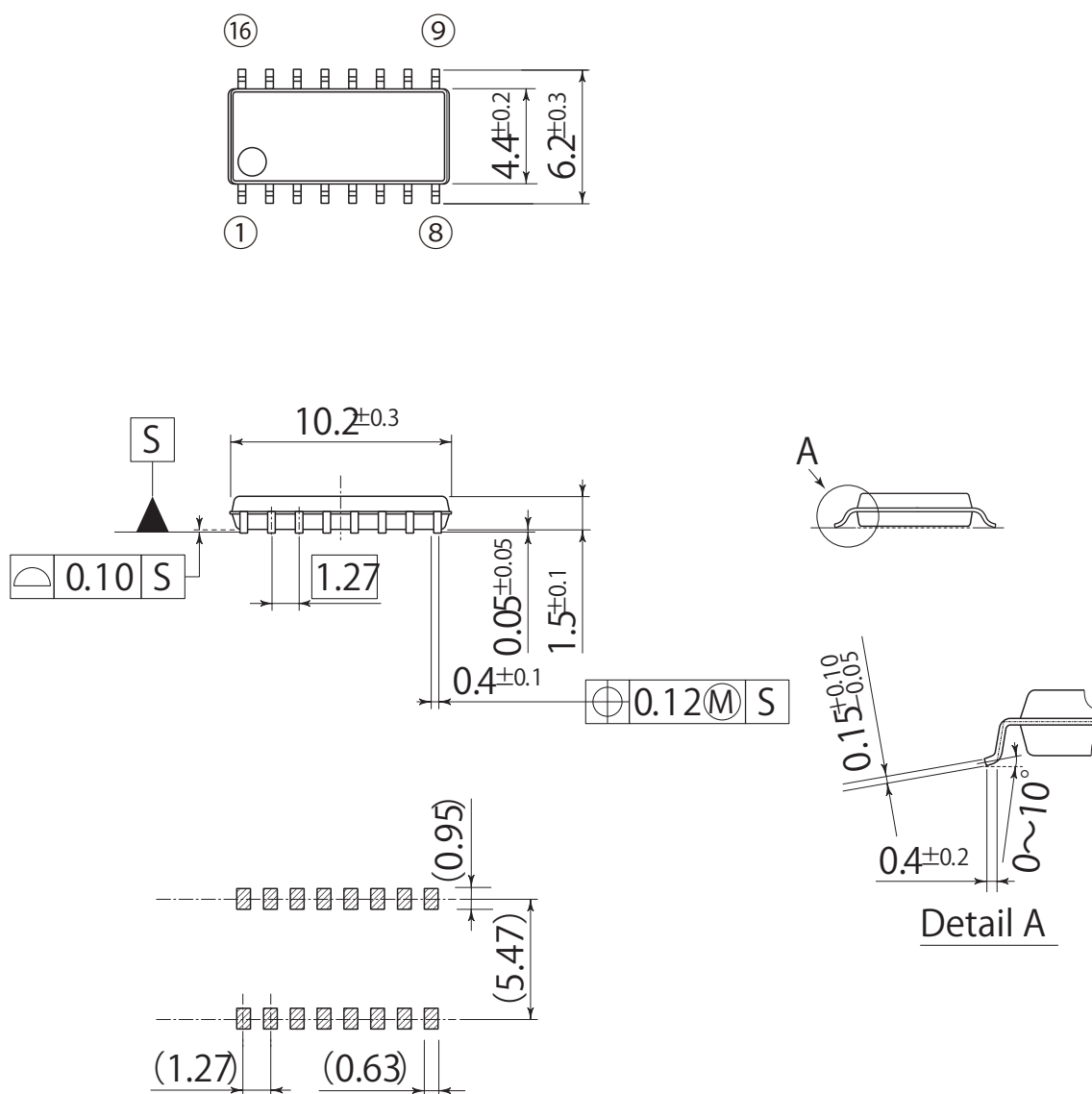


Package Outline-Dimensions

unit : mm
scale: 3/1

L5

JEDEC Code	—
JEITA Code	—
House Name	SOP16



Referential Soldering Pad

- 量産時には、適正化を図って下さい
- Optimize soldering pad to the board design and soldering condition.

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