

# MCZ5203SE

## LLC Current Resonant Mode

### Feature

- Robust 600V direct gate driver
- Vcc(max)=35V
- Soft Starting function
- Over current protection (positive direction)
- Capacitive mode protection
- Timer latch function
- Low input voltage protection(Vsen)
- Thermal Shutdown
- Pb free
- RoHS:Yes

### Outline

House Name: SOP22



# LLC電流共振電源用IC

## 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ブ電圧 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
ハイサイドドライブ電源電圧 VB input voltage	VB-VS	-0.3 ~ 15	V
ローサイドドライブ電源電圧 Vc2 input voltage	Vc2	-0.3 ~ 13.8	V
Vsen端子電圧 Vsen input voltage	Vsen	-0.3 ~ 10	V
OCP端子電圧 OCP input voltage	OCP	-3 ~ 5	V

#### 1-2. 熱定格

##### Thermal 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
許容損失 Total power dissipation	Pt	1.6 (*1)	W
接合部温度 Junction temperature	$T_j$	-20 ~ 150	$^{\circ}\text{C}$
保存温度 Storage temperature	$T_{stg}$	-40 ~ 150	$^{\circ}\text{C}$
熱抵抗 Thermal Resistance	$\theta_{ja}$	75.0 (*1)	$^{\circ}\text{C}/\text{W}$

※1 4-layer Board

ガラスエポキシ基板: 114.3mm×76.2mm, 厚さ: 1.6mm,

内面銅箔サイズ 74.2mm×74.2mm, 厚さ: 35  $\mu\text{m}$

Glass-Epoxy Board : 114.3mm×76.2mm, Thickness: 1.6mm

inside copper foil 74.2mm×74.2mm, Thickness: 35  $\mu\text{m}$

## 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 ~ 25	V
ハイサイドドライバ電源電圧 VB input voltage	VB-VS	-0.3 ~ Vc2-Vf (*2)	V
ローサイドドライバ電源電圧 Vc2 input voltage	Vc2	-0.3 ~ Vc2 (*1)	V
接合部温度 Junction temperature	Tj	-20 ~ 120	°C

\*1 電気的特性(5ページ)のVc2規格値を参照

\*2 Vf : ブートストラップ用ダイオードのVf

#### 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(1/3)

#### Electrical characteristics (1/3)

特に指定なき場合は $V_{c1}=16V, f_0=50kHz, T_j=25^{\circ}C$   
 $V_{c1}=16V, f_0=50kHz, T_j=25^{\circ}C$  unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
不足電圧保護回路 Under voltage protection						
Vc1動作開始電圧 Vc1 startup threshold voltage	Vc1(start)		13.0	13.5	14.0	V
Vc2動作開始電圧 Vc2 startup threshold voltage	Vc2(start)		9.1	9.6	10.1	V
Vc1動作停止電圧 Vc1 shutdown threshold voltage	Vc1(stop)		7.9	8.4	8.9	V
Vc2動作停止電圧 Vc2 shutdown threshold voltage	Vc2(stop)		6.6	7.0	7.4	V
ハイサイドドライバ動作開始電圧 high side driver start voltage	VB-VS(start)		6.9	7.3	7.7	V
ハイサイドドライバ動作停止電圧 high side driver stop voltage	VB-VS(stop)		4.0	5.0	6.0	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		1.2	2.0	2.8	V
起動前消費電流 Startup current	Ic1(St)	$V_{c1}=12.9V$	480	580	680	$\mu A$
消費電流 Operating current	Icc	$V_{c1}=16V$	4.0	6.0	8.0	mA
過電流保護 Over current protection						
ocp(+)検出電圧 Input threshold voltage (+)	Vocp(+)		0.315	0.345	0.375	V
ocp端子電流 Input bias current	Iocp	$V_{ocp}=0V$	-220	-180	-140	$\mu A$
di/dt保護 di/dt protection						
di/dt(+)検出電圧 Input threshold voltage (+)	Vdidt(+)		0.050	0.060	0.070	V
di/dt(-)検出電圧 Input threshold voltage (-)	Vdidt(-)		-0.070	-0.060	-0.050	V

### 3-2. 電気的特性 (2/3)

#### Electrical characteristics (2/3)

特に指定なき場合はVc1=16V, f0=50kHz, Tj=25°C  
Vc1=16V, f0=50kHz, Tj=25°C unless otherwise specified

項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
タイマ Protection timer						
Timer端子しきい値 Timer threshold voltage	Vtimer		2.8	3.0	3.2	V
Timer充電電流 Output charge current	Itimer(charge)	Vtimer=1V	-250	-215	-180	uA
Timer放電電流(refresh) Output discharge current (Refresh)	Itimer(refresh)	Vtimer=1V	1.5	2.0	2.5	mA
Timer放電電流(間欠) Output discharge current (Discharge)	Itimer(discharge)	Vtimer=1V	5	10	15	uA
ソフトスタート Soft start section						
SS端子しきい値 Input threshold voltage	Vss		1.15	1.30	1.45	V
SS充電電流 Output charge current	Iss(charge)	Vss=0.5V	-430	-340	-250	uA
SS放電電流 Output discharge current	Iss(discharge)	Vss=1V Vsen=0V	4.0	8.0	-	mA
SS端子充電飽和電圧	Vss(open)		-	2.6	-	V
SS周波数設定値 SS output oscillation frequency	f(ss)	Vss=0V Ct=1000pF	170	185	200	kHz
Tss拡大比 3rd Saw-tooth Expansion Ratio	Tss(3)		-	1.7	-	
過電圧保護 Over voltage protection						
OVPしきい値 OVP threshold voltage of Vc1	Vc1(ovp)		32.0	33.0	35.0	V
OVPヒステリシス幅 Threshold hysteresis voltage	$\Delta$ Vc1(ovp)		-	1.2	-	V
Vsen機能 Vsen section						
Vsenしきい値(ON/OFF) Input threshold voltage(ON/OFF)	Vsen(on/off)		0.92	1.10	1.28	V
Vsen(ON/OFF)ヒステリシス幅 Input threshold hysteresis voltage	$\Delta$ Vsen(on/off)		-	0.4	-	V
Vsenしきい値(SS-Reset) Input threshold voltage(SS-Reset)	Vsen(ss-reset)		1.33	1.40	1.48	V
Vsen端子電流 Input bias current	Isen	Vsen=0~8.5V	-0.2	0	0.2	uA
FBオープン保護 FB open protection						
FBオープン検出電流 Input threshold current	IFB(open)		-170	-120	-70	uA

### 3-3.電氣的特性(3/3)

#### Electrical characteristics (3/3)

特に指定なき場合はVc1=16V,f0=50kHz,Tj=25°C  
Vc1=16V,f0=50kHz,Tj=25°C unless otherwise specified

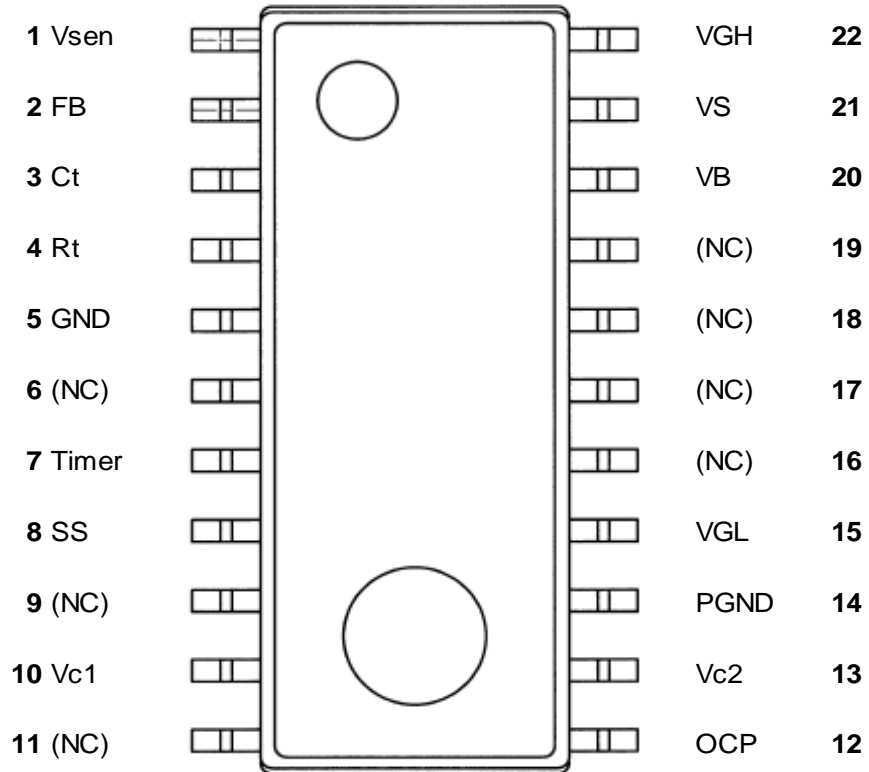
項目 Item	記号 Symbol	条件 Condition	規格値 Ratings			単位 Unit
			MIN	TYP	MAX	
過熱保護 Thermal shutdown protection						
動作停止温度 Operating stop temperature	TSD		140	-	-	°C
動作復帰温度幅 Hysteresis temperature	$\Delta$ TSD		-	40	-	°C
ラッチ保護 Stop latch section						
ラッチ解除電圧 Latch reset voltage of Vc1	Vc1 (latch reset)		6.5	8.0	8.5	V
ラッチ解除電圧 2 Latch reset voltage of Vc1 2	Vc1 (stop)-Vc1 (latch reset)		0.2	0.4	1.3	V
発振器 Oscillator section						
周波数設定精度 Output frequency	f(0)	Ct=1000pF Rt=13.2k $\Omega$	47.9	50.0	52.1	kHz
ONデューティ Output duty cycle	duty	Ct=1000pF f=50kHz	45.0	46.5	48.0	%
最高周波数 Maximum output frequency	fmax	IFB=-3mA Ct=1000pF Rt=13.2k $\Omega$	192	230	268	kHz
Ct放電電流 Ct discharge current	ICt(discharge)	VCt=2V	3.40	4.20	5.10	mA
Ctマスク電圧 Ct Masking threshold voltage	Vct(msk)		2.0	2.1	2.2	V
Rt端子電圧 Output Rt terminal voltage	VRt	IRt=-100uA	2.32	2.52	2.72	V
FB端子電圧 Output FB terminal voltage	VFB	IFB=-200uA	3.80	4.10	4.50	V
FB端子最低電圧 Minimum output voltage of FB terminal	VFB(min)	IFB=-3.5mA	3.20	3.70	4.20	V
ドライブ電源 MOS-FET driver supply						
ドライブ電源電圧 Driver supply voltage	Vc2	Vc2=open	9.4	10.0	10.6	V
ラインレギュレーション Vc2 line regulation	$\Delta$ Vc2(line)	Vc1=16~26V	-	0.1	0.5	V
ロードレギュレーション Vc2 load regulation	$\Delta$ Vc2(load)	Ivc2=0~20mA	-	0.1	0.5	V
MOSドライブ MOS driver						
ソース駆動能力 Output Source current	Iout(source)	Vc2=VB=10V VGL=VGH=0V	-230	-180	-130	mA
ソース駆動能力2 Output Source current2	Iout(source)2	Vc2=VB=10V VGL=VGH=8.5V	-90	-60	-30	mA
シンク駆動能力 Output sink current	Iout(sink)	Vc2=VB=10V VGL=VGH=10V	430	530	630	mA
シンク駆動能力2 Output sink current2	Iout(sink)2	Vc2=VB=10V VGL=VGH=1.5V	130	180	230	mA
上下デッドタイム時間差 Unbalance of dead time	$\Delta$ DT	Ct=1000pF	-50	-	50	ns

#### 4.端子機能説明

##### Pin Function

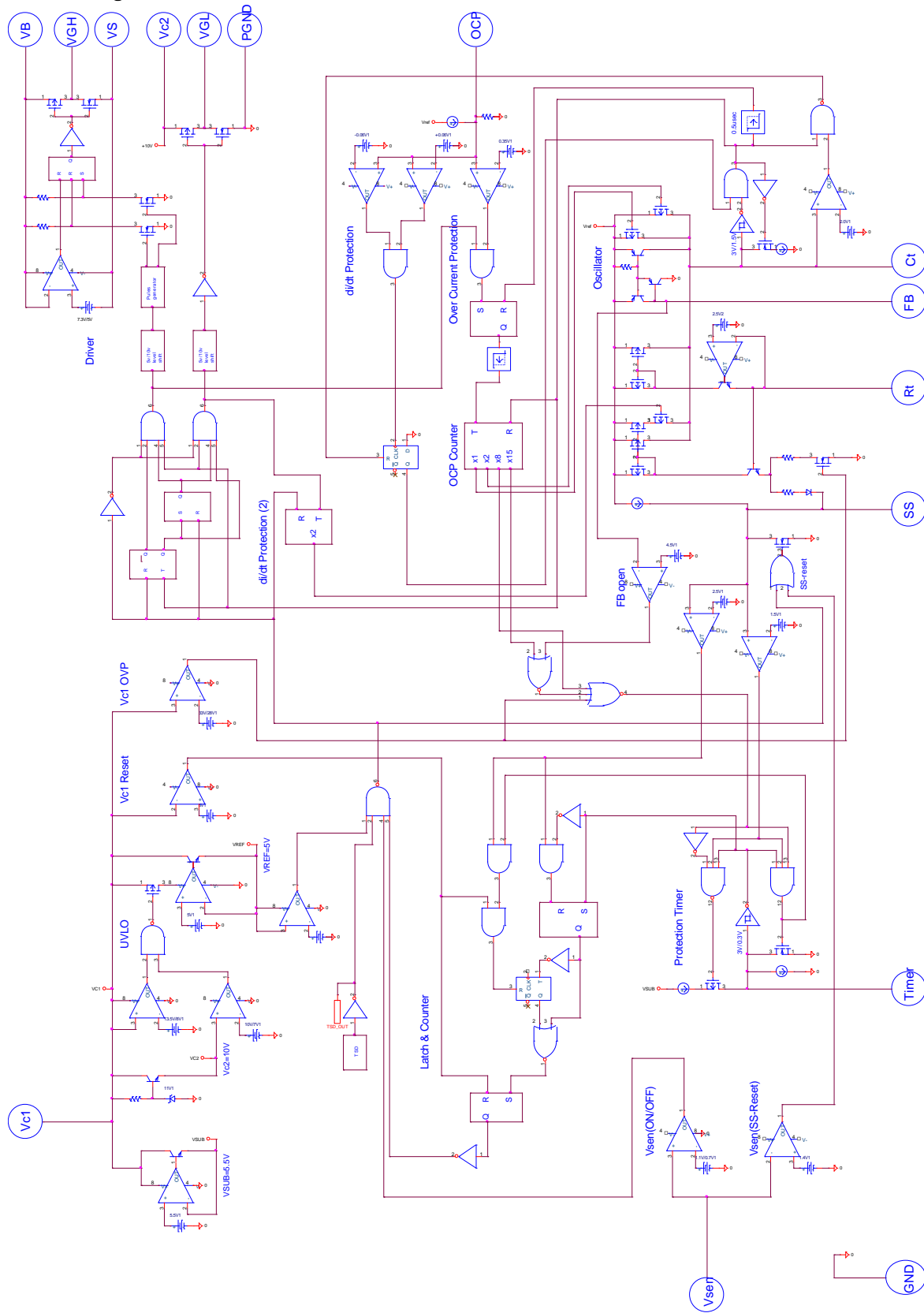
端子番号 PIN No.	記号 Symbol	内容 Description
1	Vsen	入力(ACライン整流後)電圧検出用端子 Terminal for detection of AC line voltage リモートON/OFF、SS端子のリセットを行います。 This is for remote-ON/OFF and SS-Reset .
2	FB	発振器の周波数変調用FB入力端子 Terminal for frequency modulation with FB FB信号のオープン検出機能があります。 This terminal has function to detect FB open.
3	Ct	発振器用コンデンサ接続端子 Capacitor for oscillator 外付けCによりDutyや各動作周波数を決めます。 Capacitor determines switching duty and frequency of each protection action.
4	Rt	発振器の抵抗接続端子 Oscillator frequency setting resistor 外付けRにより最低動作周波数を決めます。 Resistor(Rt) determines the minimum frequency
5	GND	GND端子 Ground terminal
6	(NC)	NC
7	Timer	異常検出時の間欠動作タイマ用コンデンサ接続端子 Capacitor determines the period of abnormal detection . OCP、OVP等の異常時の間欠動作時間を決めます。 This determines the intermittent operation time width while each protection is doing.
8	SS	ソフトスタート用コンデンサ接続端子 Capacitor for a soft start timing 外付けCによりSS動作時間を決定します。 The time width of SS depends on external capacitor.
9	(NC)	NC
10	Vc1	制御回路の電源端子 Supply terminal for the control circuit Vc1 $\geq$ 13.5Vで動作開始、Vc1 $\leq$ 8.4Vで停止します。 Voltage to start is 13.5V and voltage to stop is 8.4V.
11	(NC)	NC
12	OCP	過電流検出およびdidt保護機能(共振はずれ検出)用端子 Terminal for over current detection and didt protection +0.345Vを検出して動作周波数を高くします。 Switching frequency becomes high, when this terminal detects OCP. $\pm$ 0.06Vの立ち下がり電圧でdidt(共振はずれ)を検出して動作周波数を高くします。 Switching frequency becomes high, when this terminal detects didt.
13	Vc2	ドライバ用電源出力端子 Output of a supply for a driver 内部10V電源(ドライバ用電源)の出力端子です。 This is 10V output for driver power supply
14	PGND	下側ドライバ電源端子 GND terminal for low side driver GND端子と同電位にして下さい。 Please connect this terminal to GND of control circuit.
15	VGL	下側ドライバの出力端子 Output of low side driver 下側MOS-FETのゲートを駆動します。 This terminal drive a gate of low side MOS-FET
16	(NC)	NC
17	(NC)	NC
18	(NC)	NC
19	(NC)	NC
20	VB	上側ドライバの電源端子 Supply terminal for high side driver. Vc2端子や外部ダイオードによりブートストラップ回路を作ります。 This terminal,Vc2 terminal and external diode makes boot strap circuit
21	VS	上側ドライバの基準電源端子 High side driver reference 上側MOSのソース及び下側MOSのドレインに接続します。 This point is source of high side MOS-FET and drain of low side MOS-FET
22	VGH	上側ドライバの出力端子 Output of high side driver 上側MOS-FETのゲートを駆動します。 This terminal drive a gate of high side MOS-FET

5. 端子配置  
Pin assignment



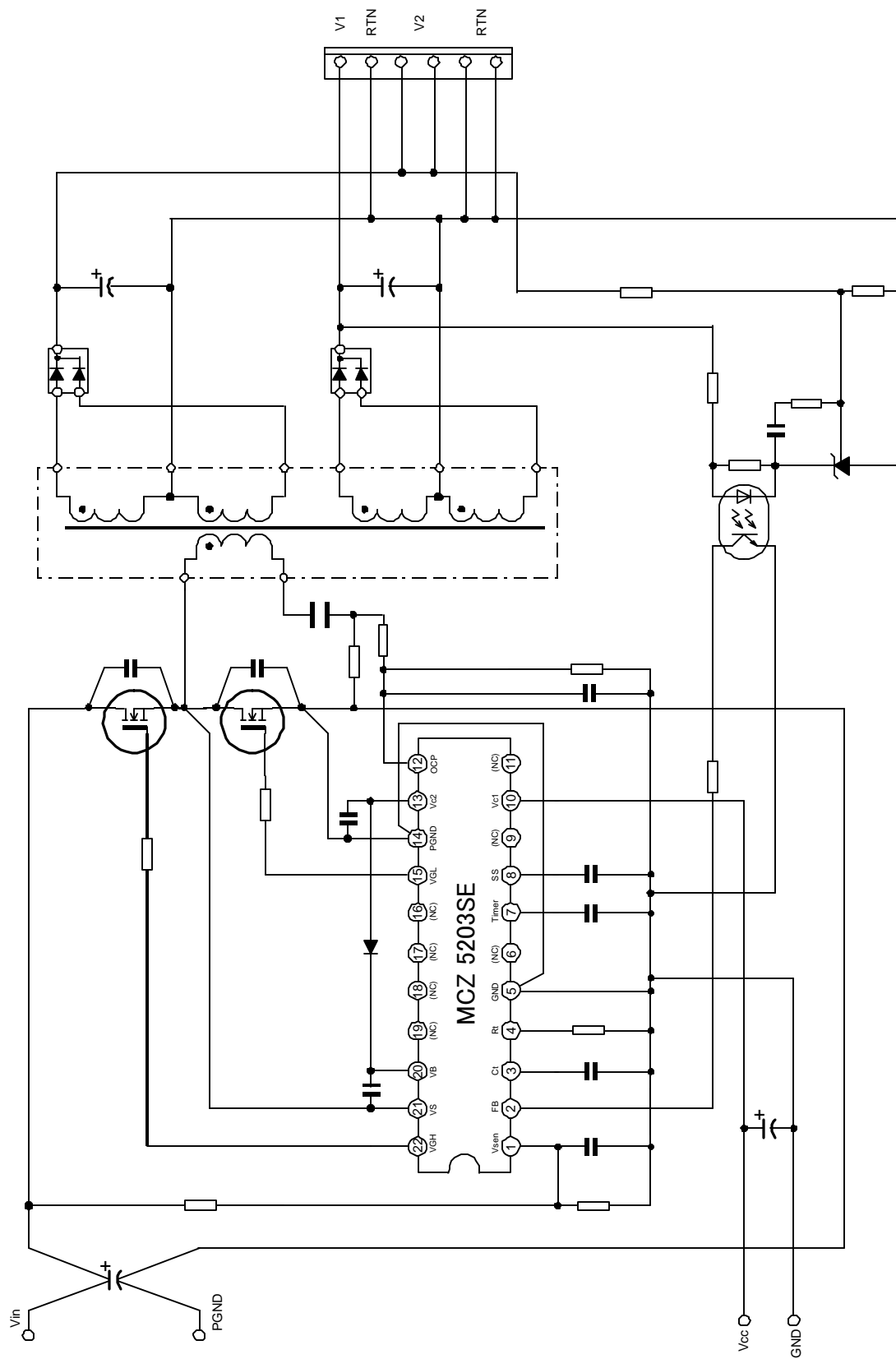


# 6. ブロック図 Block Diagram



# 7.代表回路图

## Example Circuit Diagram



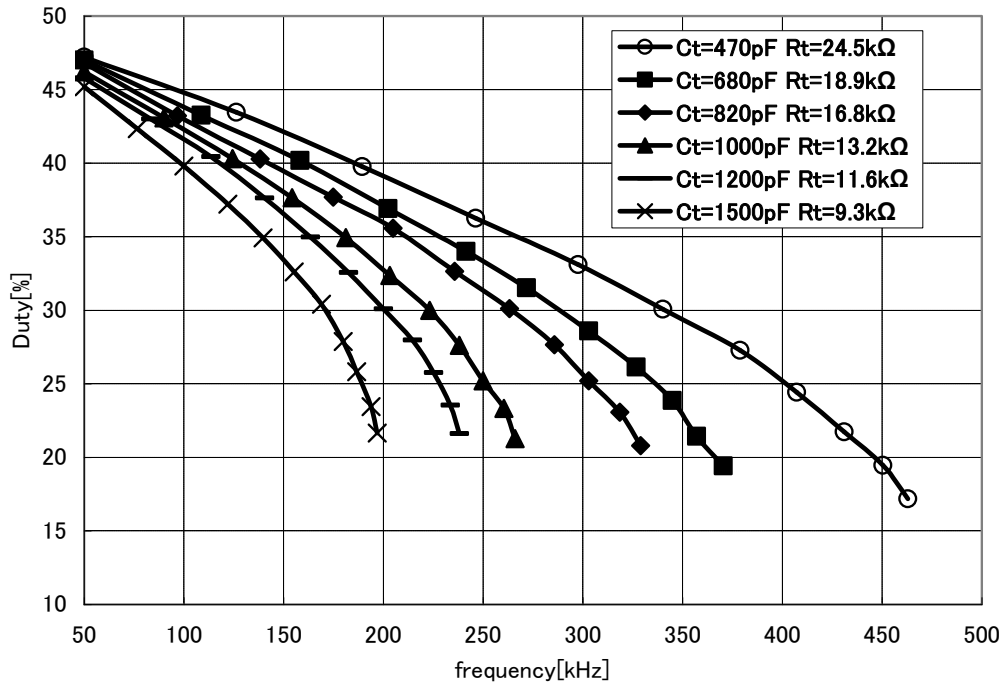
特性図

Characteristics Diagrams

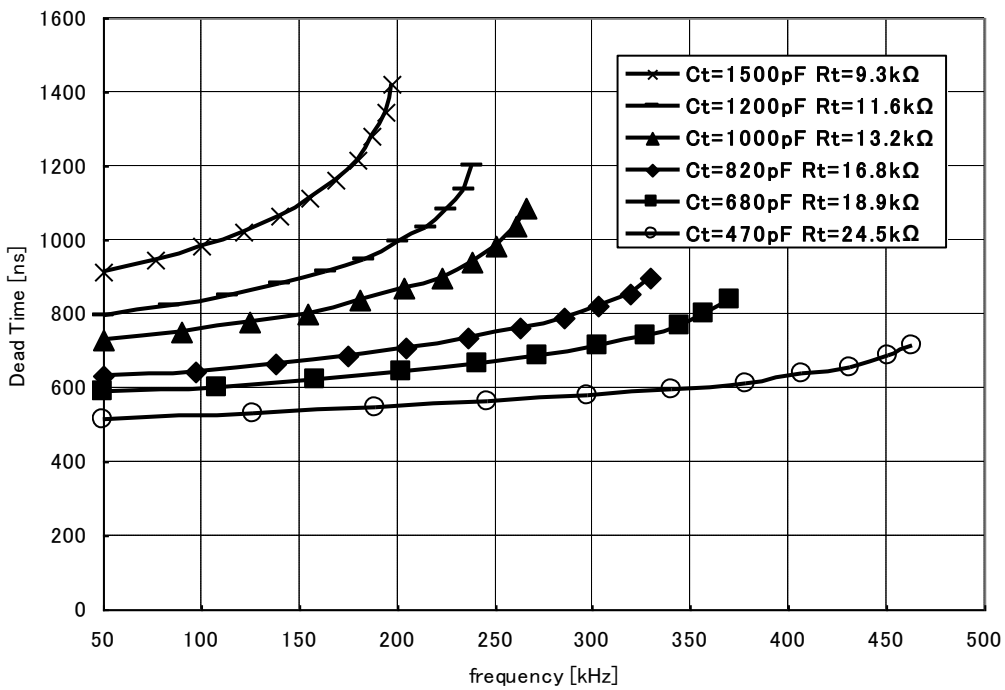
特に指定なき場合は $T_j=25^\circ\text{C}$

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

Frequency vs Duty

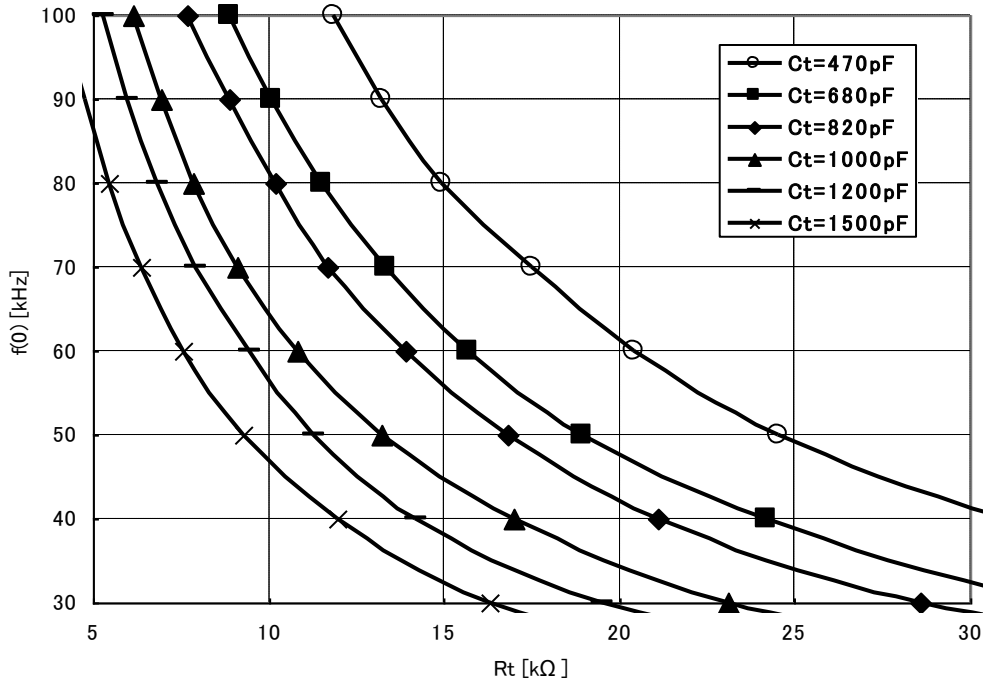


Frequency vs Deadtime

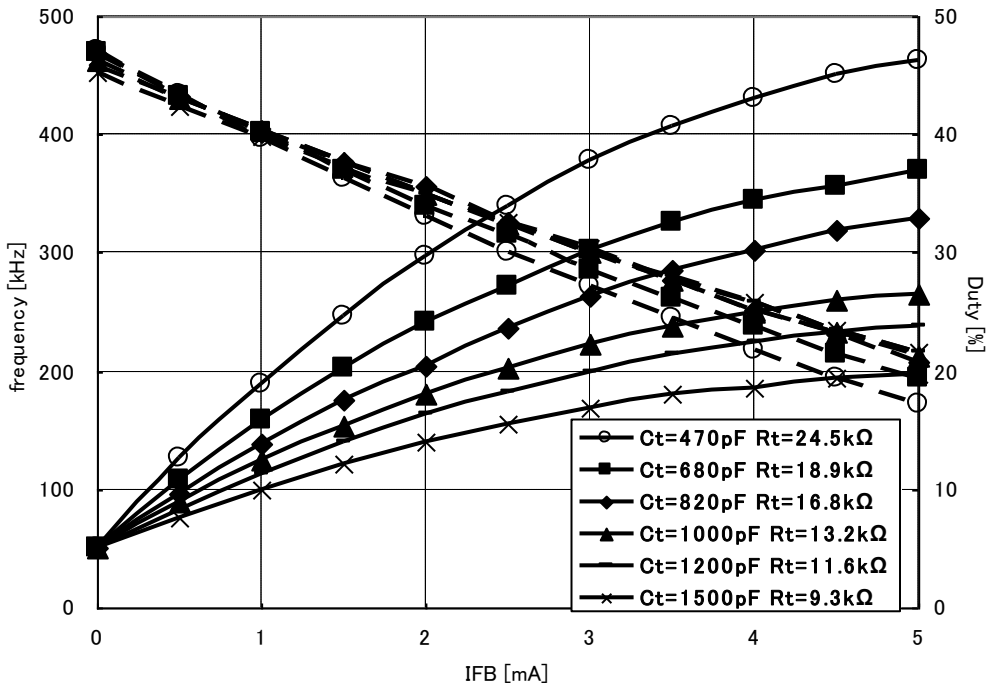


特に指定なき場合はTj=25°C  
 Tj=25°C unless otherwise specified

Rt vs f(0)

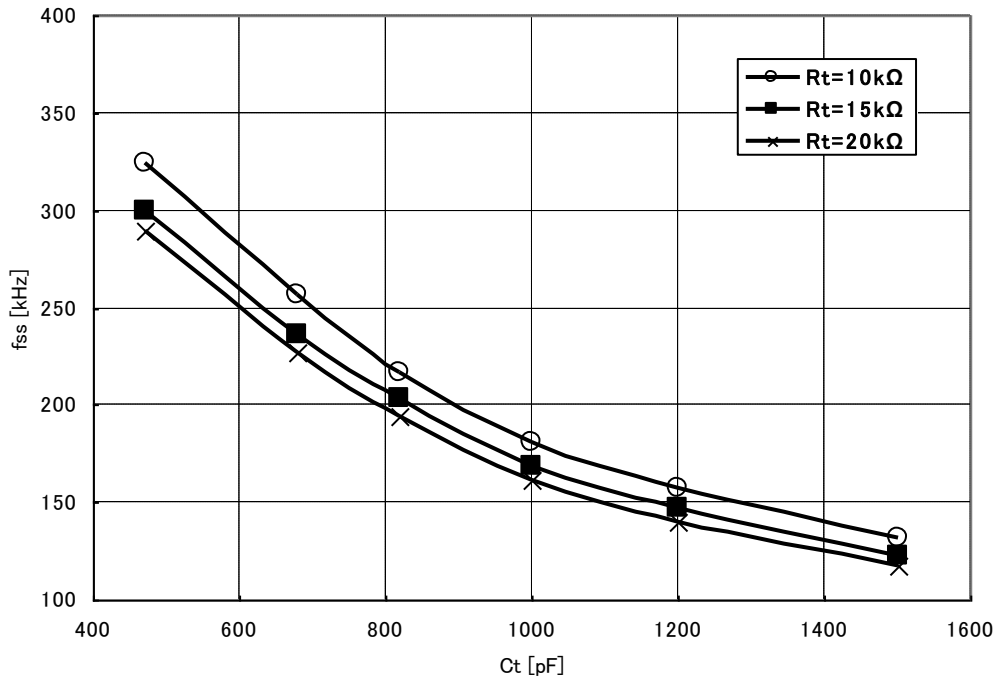


IFB vs Frequency and Duty



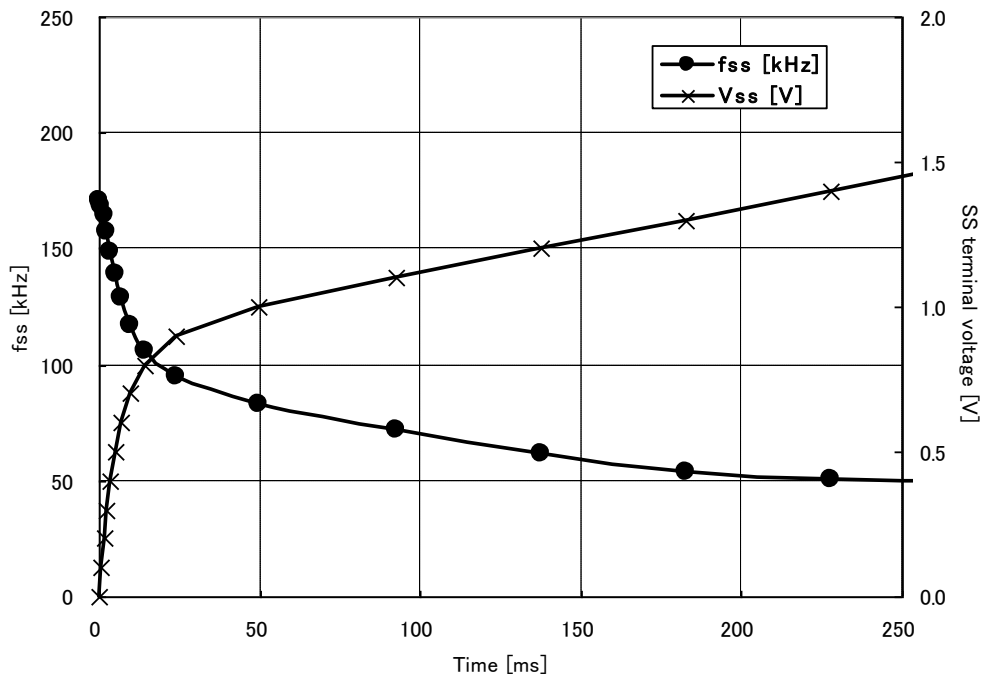
特に指定なき場合はTj=25°C  
Tj=25°C unless otherwise specified

Ct vs fss



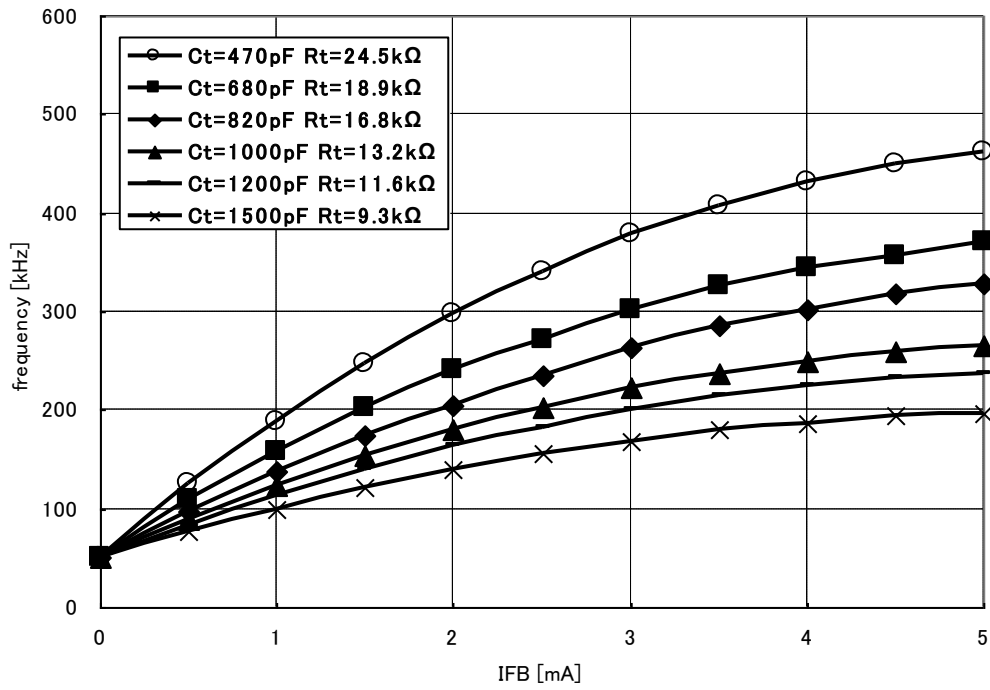
SS time vs frequency and terminal voltage

$C_t=1000\text{pF}$   $R_t=13.2\text{k}\Omega$   $C_{ss}=4.7\mu\text{F}$

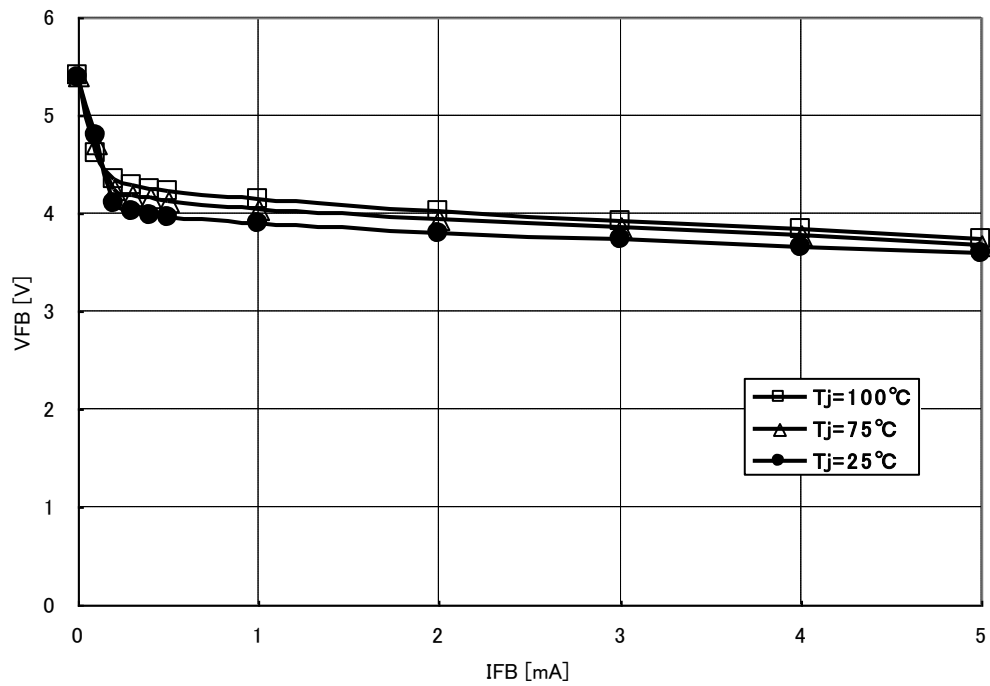


特に指定なき場合はTj=25°C  
Tj=25°C unless otherwise specified

IFB vs Frequency



IFB vs VFB

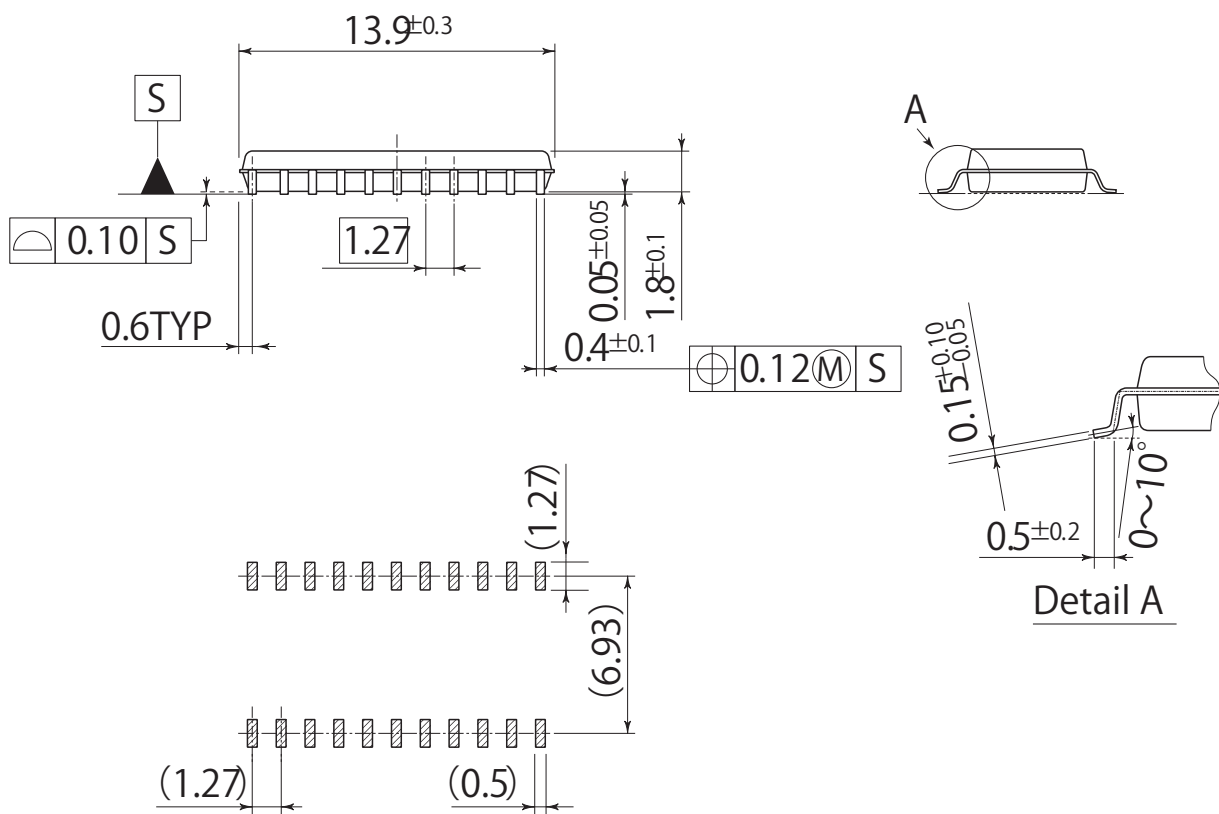
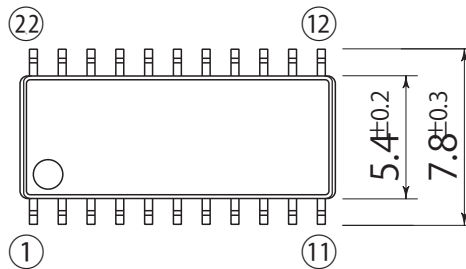


# Package Outline-Dimensions

unit : mm  
scale: 3/1

L7

JEDEC Code	-
JEITA Code	-
House Name	SOP22



## 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.

- 本資料の記載内容は、改良のため予告なく変更することがあります
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U182(2019.02)

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