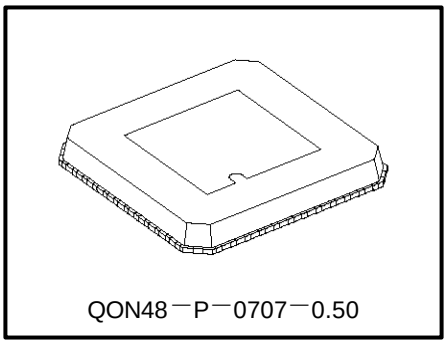
Toshiba Bi-CMOS Integrated Circuit Silicon Monolithic

Preliminary

TB6591FL

DC motor driver

TB6591FL is a motor driver IC for DC which uses LDMOS with low ON-resistor for output transistors.
1 constant current control type bridge dirver circuit and 3 constant voltage control type steppning motor driver circuits for 2phase/1-2phase excitation are included in the IC.



QON48−P−0707−0.50

QON48 Wight： 0.10 g (Typ.)

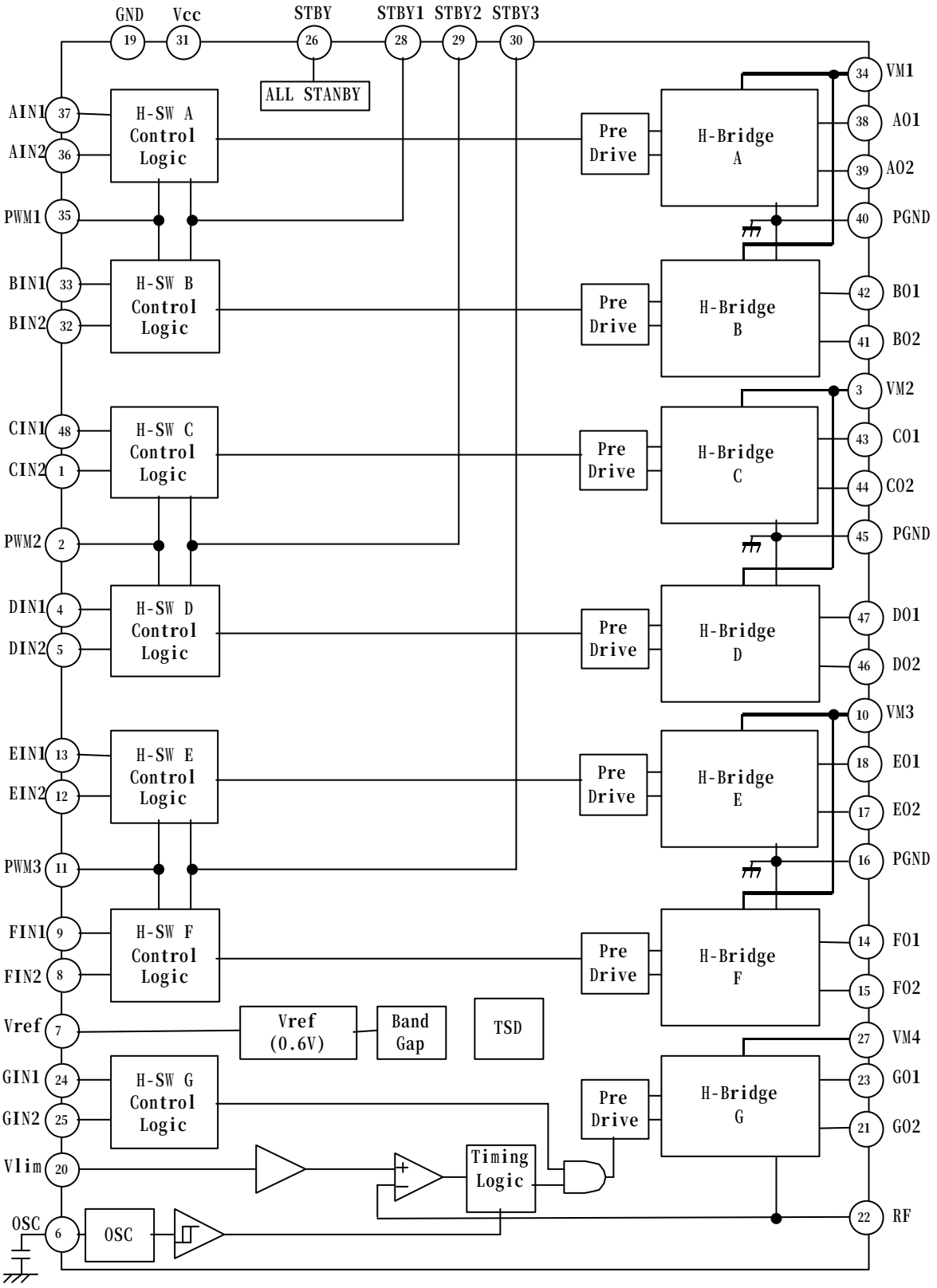
Application

DSC

Feature

- Supply voltage for motor : VM ≦6V (Max.)
- Supply voltage for control : Vcc = 2.7 to 6V
- Output current : Iout ≦ 0.8A (Max.)
- Output transistor with Pch/Nch LDMOS push-pull structure
- Low ON resistor : Ron = 1.5Ω(total/typ. at VM=Vcc=5V)
- Available of controlling by PWM chopping : fosc≦100kHz
- Available of direct PWM control : fpwm≦10kHz(Duty=10% to 90%)
- Built-in power save function
- Built-in thermal shutdown circuit
- Package : QON-48

Block Diagram



Maximum rating (Ta=25℃)

Characterristic	Symbol	Rating	Unit	Remark
Supply voltage for control	Vcc	6	V	Vcc
Supply voltage for motor	VM	6	V	VM
Output voltage	VOUT	6	V	
Output current	Iout	0.8	A	
Input voltage	VIN	-0.2～6	V	IN1,2,PWM,STBY
Power dissipation	PD	0.74	W	Not mounted
Operating temperature	Topr	-20 ～ 85	℃	
Storage temperature	Tstg	-55 ～ 150	℃	

Operating Range (Ta=-20～85℃)

Characteristic	Symbol	Rating			Unit
		Min.	Typ.	Max.	
Supply voltage for control	Vcc	2.7	3	5.5	V
Supply voltage for motor	VM	2.2	3.6	5.5	V
Output current	Iout	---	---	600	mA
PWM chopping frequency for constant current function	fchop	---	---	100	KHz
OSC frequency	fosc	---	---	250	KHz
Direct PWM frequency	fpwm	---	---	100	kHz

Function

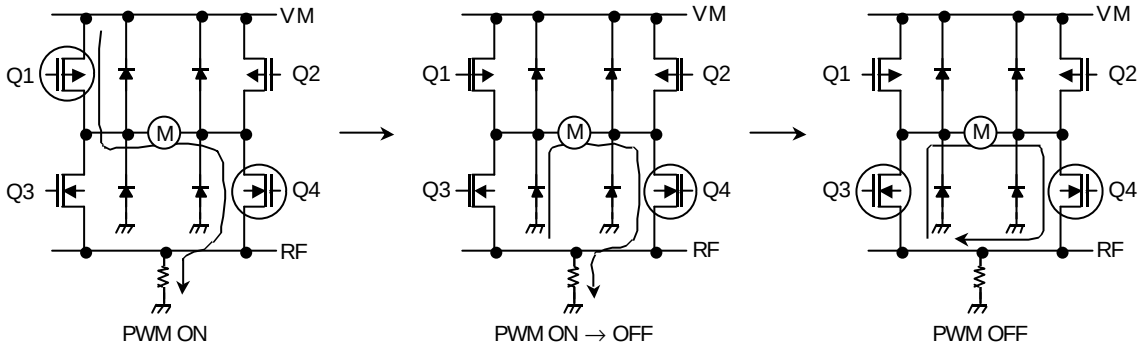
Input				Output		
IN1	IN2	SB	PWM	OUT1	OUT2	Mode
H	H	H	H	L	L	Short brake
			L			
L	H	H	H	L	H	Forward/reverse
			L	L	L	Short brake
H	L	H	H	H	L	Forward/reverse
			L	L	L	Short brake
L	L	H	H	OFF (High impedance)		Stop
			L			
H/L	H/L	L	H	OFF (High Impedance)		Stand-by(Power save) Note)H-SW for A to F
			L			

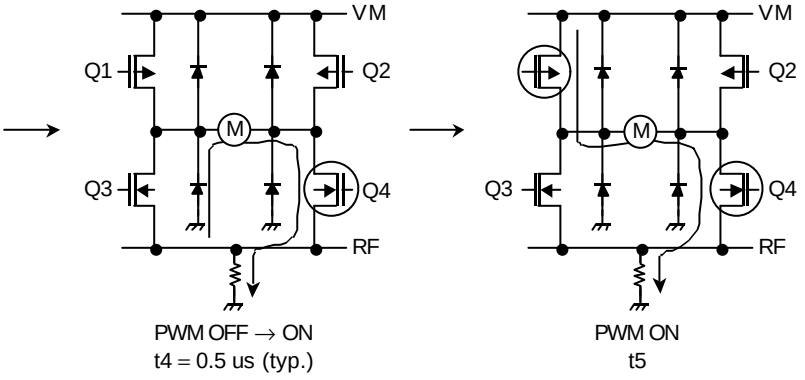
Operation Description

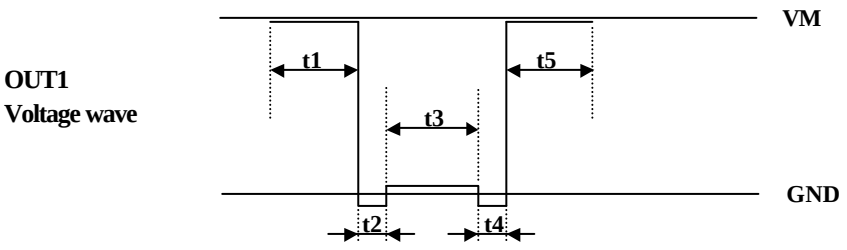
・H-SW A to F

Direct PWM control function

Speed can be controlled by inputting the high-level or low-level PWM signal to the pin PWM. When PWM control is provided, normal operation and short brake operation are repeated. To prevent penetrating current, dead time t2 and t4 is provided in the IC.







• H-SW G

<OSC circuit>

A voltage (V_{OSC}) that is charged to or discharged from the capacitor is calculated as follows:

$$V_{OSC}=\frac{1}{C_{OSC}}\int i\,dt$$

Where a time when V_{OSC} = 0.8 V is t1, and a time when V_{OSC} = 1.2 V is t2:

$$\Delta V_{OSC} = I\,(t1 - t2)/C_{OSC}$$

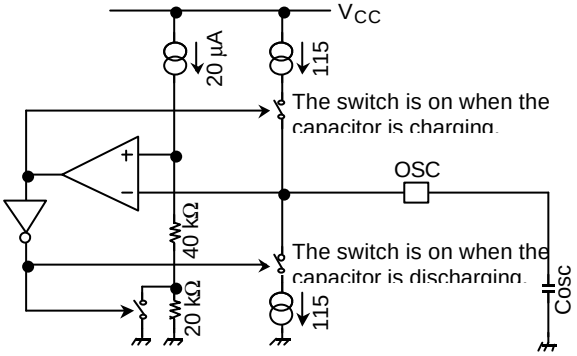
$$\frac{1}{t1-t2} = \frac{1}{\Delta V_{OSC}\cdot C_{OSC}}$$

Triangular wave oscillation waveform (f_{OSC}) is calculated:

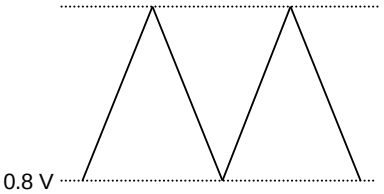
$$f_{OSC}=\frac{1}{2(t1-t2)}=\frac{I}{2\cdot\Delta V_{OSC}\cdot C_{OSC}}$$

$$f_{OSC}=\frac{1}{2(t1-t2)}=\frac{1}{2\cdot\Delta V_{OSC}\cdot C_{OSC}/I}$$

$$=\frac{1}{2\times 0.4/115\,\mu A\times C_{OSC}}=\frac{1}{6.957\times 10^{3}\times C_{OSC}}$$



Oscillator block

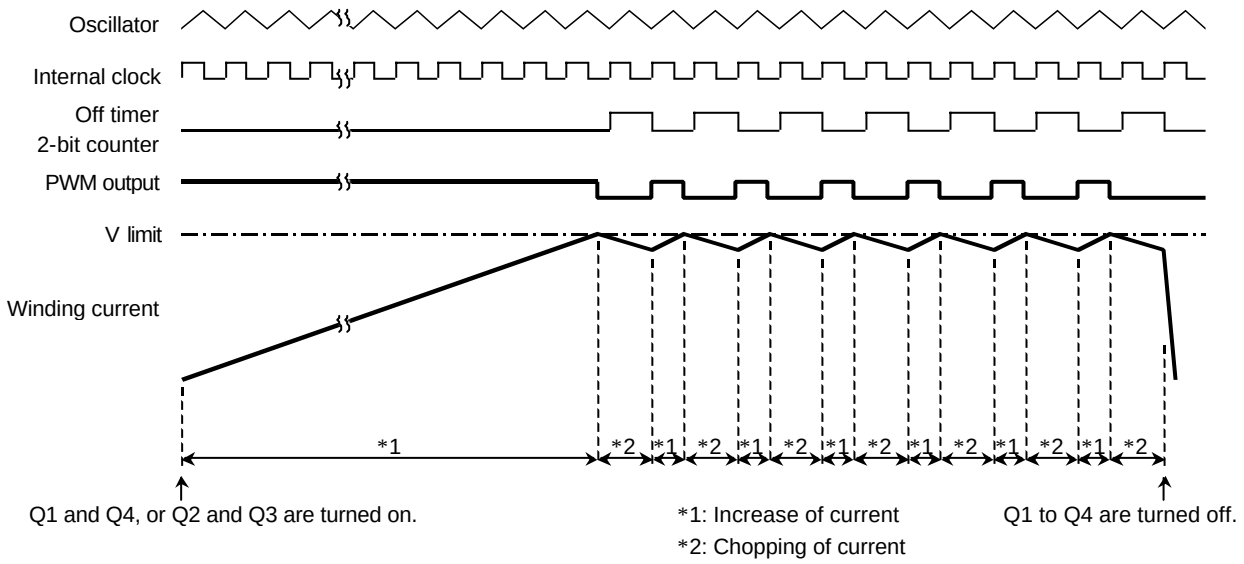


Vosc waveform

• Chopping control

The winding current flows while an output drive transistor is turned On. When the V_{RF} reaches the limit voltage level (Vlimit), the comparator detects it and turns off the output drive transistor.

The oscillator output is squared to generate an internal clock. The off timer starts on the rising edge of the internal clock and is active for two internal clocks. When the off timer stops, the PWM goes high.

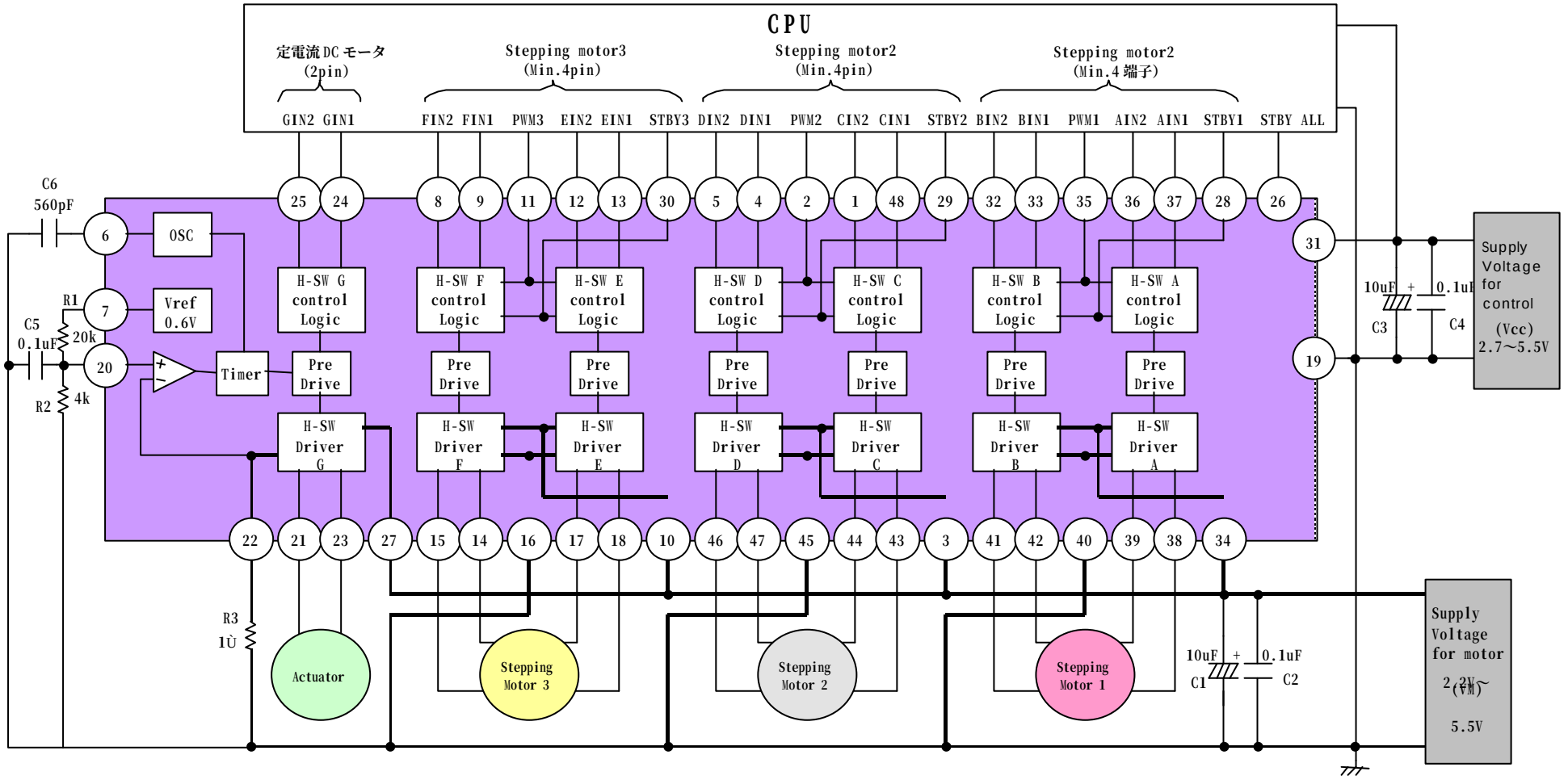


• Pull down resistance:200kohm is included for input terminal(IN1,IN2,STBY).

Electrical characteristic（Ta=25℃, Vcc=3.0V, VM=5V）

No	Characteristic		Symbol	Test Condition	Min.	Typ.	Max.	Unit
1	Supply current		Icc(STOP)	Stop mode		1	(1.2)	MA
			Icc(BRK)	Brake mode		1	(1.2)	
			Icc(W)			1	(1.2)	
			Icc(STB)	Stand-by mode		---	10	UA
			IM(STB)				1	UA
2	Input circuit	Input voltage	VIH		Vcc -0.4		Vcc +0.2	V
			VIL		-0.2		0.4	
		Hysteresis voltage	VIN(HIS)	Not tested		0.2		
		Input current	IIH	VIN=3V	10	15	20	UA
			IIL	VIN=0V			1	
3	Stand-by circuit	Input voltage	VIHS		Vcc -0.4	—	Vcc +0.2	V
			VILS		-0.2	—	0.4	
		Input current	IIHS	VIN(STBY)=3V	10	15	20	UA
			IILS	VIN(STBY)=0V	—	—	1	
4	Output saturation voltage		Vsat(U+L)	Io=0.2A	—	0.28	(0.4)	V
				Io=0.6A	—	0.84	(1.2)	
5	Output leak current		IL(U)	VM=Vout=6V			1	UA
			IL(L)	VM=6V,Vout=0V			1	
6	Diode forward voltage		VF(U)	IF=0.6A		1		V
			VF(L)			1		
7	Internal reference voltage		Vref	No load	(0.57)	0.6	(0.63)	V
			Vref load	Vref(no load) – Vref(20kohm load)		2	(5)	mV
8	Input offset for constant current detection comp.		RF comp	RRF=1ohm, Vlimit=0.1V	(-5)		(+5)	mV
9	Thermal shutdown circuit	Operating temperature	TSD(ON)	Not tested	---	170	---	℃
		Hysteresis	TSD(His)		---	20	---	

Application example



Note) Connect capacitor (C1, C2, C3, C4, C5) as close to the IC as possible.

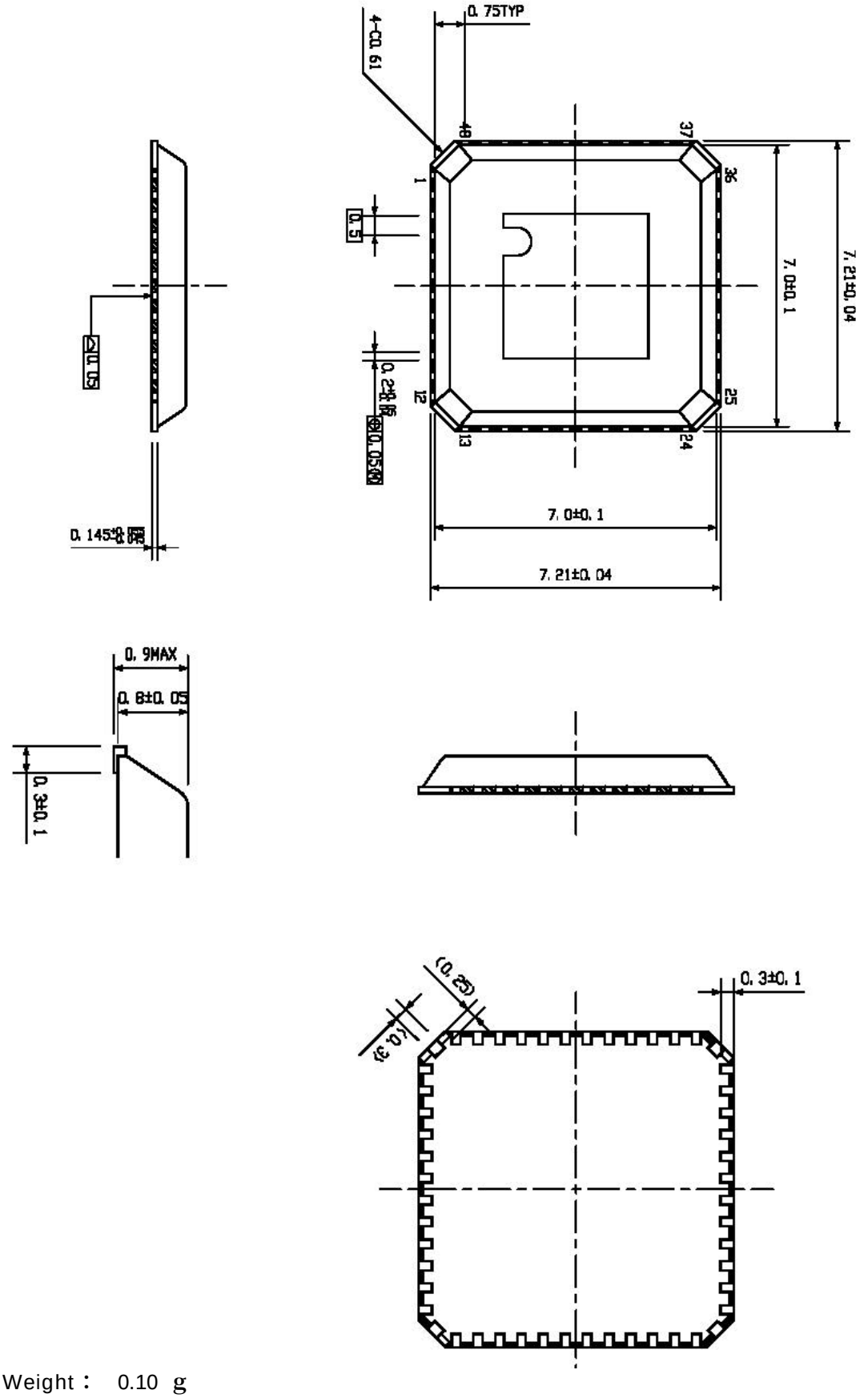
Note) Constant current value is determined by following equation → Io(const.)=Vlimit / R3

In case of the application example above, Vlimit and Io(const) are shown as below.

Vlimit=Vref(=0.6V) x R2/R1 + R2(=0.167) = 0.1V, Io(const)=0.1V / RF(=1ohm) = 0.1A

Package Dimensions

QON48-P-0707-0.50

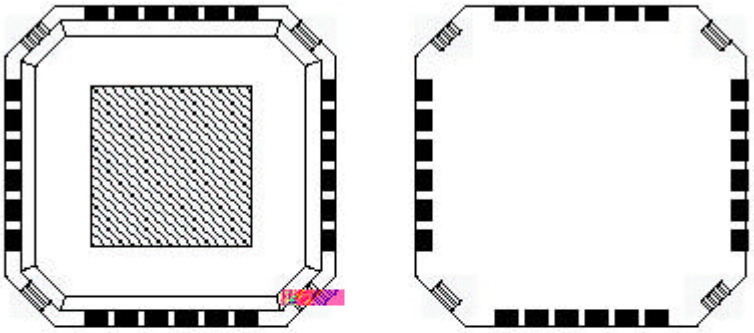


Weight： 0.10 g

Requests Concerning Use of QON

Outline Drawing of Package

(Upper surface) (Lower surface)



When using QON, please take into account the following items.

Caution

(1) Do not carry out soldering on the island section in the four corners of the package (the section shown on the lower surface drawing with diagonal lines) with the aim of increasing mechanical strength.

(2) The island section exposed on the package surface (the section shown on the upper surface drawing with diagonal lines) must be used as (Note 6) below while electrically insulated from outside.

Note 6: Ensure that the island section (the section shown on the lower surface drawing with diagonal lines) does not come into contact with solder from through-holes on the board layout.

- When mounting or soldering, take care to ensure that neither static electricity nor electrical overstress is applied to the IC (measures to prevent anti-static, leaks, etc.).
- When incorporating into a set, adopt a set design that does not apply voltage directly to the island section.