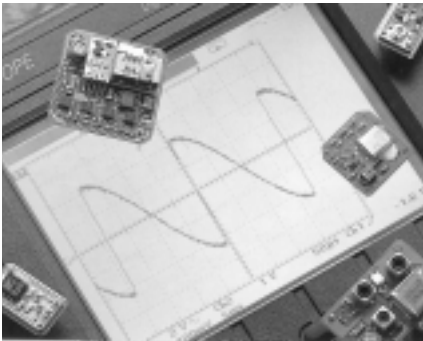


本記事 日本 CQ出版社가 發行 「トランジスタ技術」誌 著作権 協定 依據 提供 資料 .



3

大隅 明/小柳津 泰夫

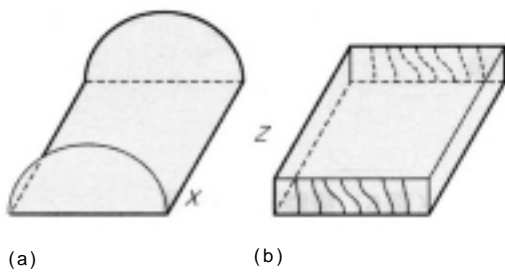
Q가

1880  
가

가

가

1881



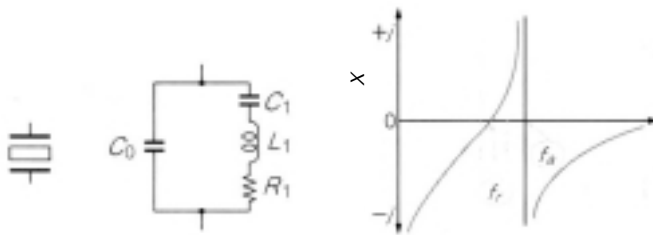
(a)

(b)

1. AT

2. AT

(  $f/ T=0$  )



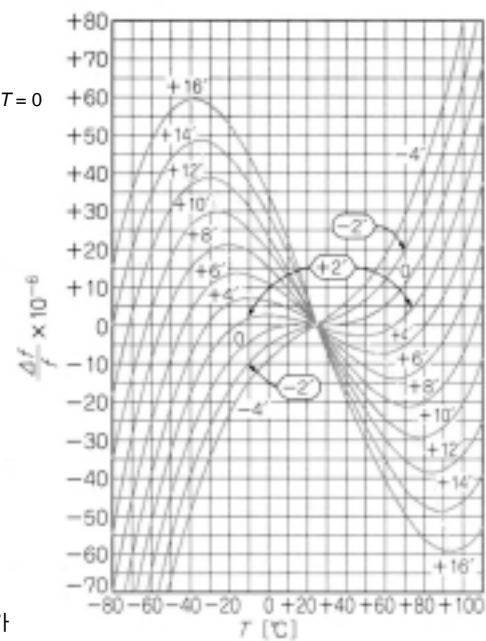
(a)

(b)

가

4.

가



3.

가



가 . Q가

( ),

AT

(角)

(thickness sliding vibration)

AT

(水晶)

1(a) AT

1(b)

AT

( 2) 3

가 100%

(autoclave) (種)

+5 ° X

1

2

가

3(a) IEC JIS

(雙

3(b) 가

$f_s$   $L_1 C_1$

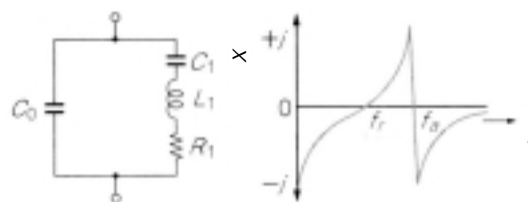
晶)

가

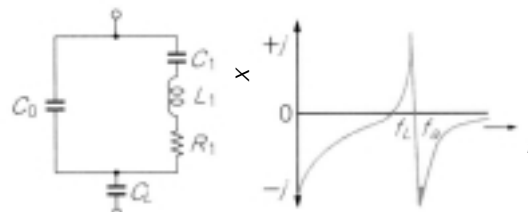
Q가

$$f_s = \frac{1}{2\pi\sqrt{L_1 C_1}}$$

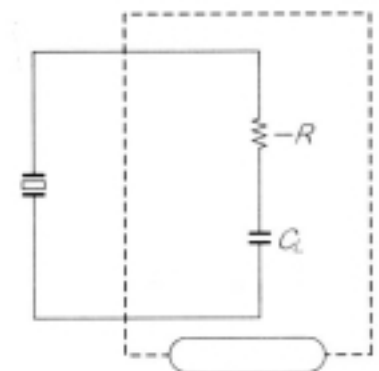
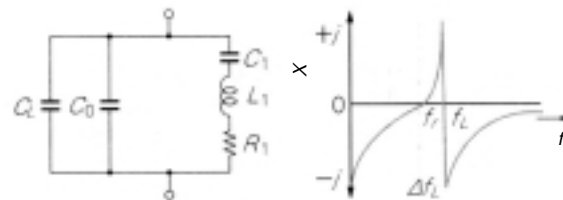
(a)



(b)



(c)



6.

5.

3/

,  $Q$  ,

$$Q = \frac{2\pi f_s L_1}{R_1} = \frac{1}{2\pi f_s R_1 C_1}$$

 $C_L$ 

VCXO

4

가

 $C_0/C_1$  .  $C_0$ 

5

7

7(a)

32.768kHz

7(b), (c)

AT

1M ~ 150MHz

SMD

SMD

6

(負性)

 $-R$  $C_L$  $-R$  ( )

SMD

SMD

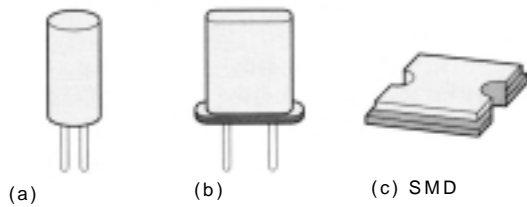
SMD

CX-49F, CX-49G  
(HC-49/U-S)

가

SMD

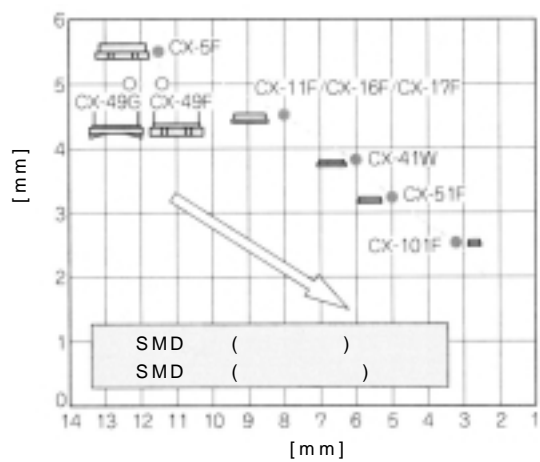
가



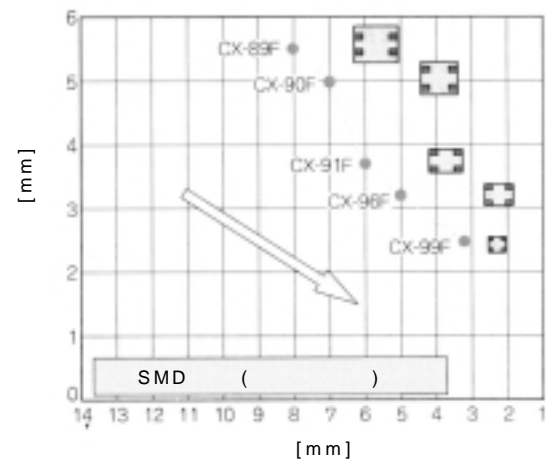
7.

8 가

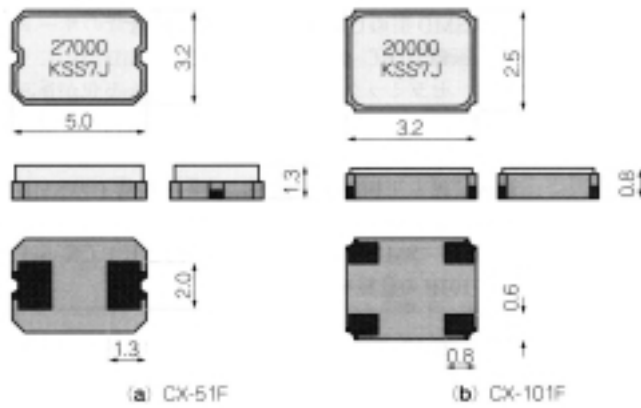
9



8. 가 SMD



9. SMD



	CX-51F	CX-101F
[MHz]	20~47	
[ ]	-10~+60	
(@25 )	$\pm 30, \pm 50, \pm 100 (\times 10^{-6})$	
	$\pm 30, \pm 50, \pm 100 (\times 10^{-6})$	
[pF]	12	
가 [ ]	100	
[mm]	5.0×3.2×1.3	3.2×2.5×0.8

(c)

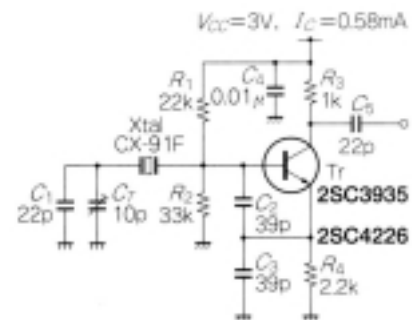
## 10. CX-51F CX-101F

1.

1.		_____ MHz
2.		
3.		_____
4.		_____ $\times 10^{-6}$ MAX. (@25 °C)
5.		_____ $\times 10^{-6}$ ~ _____ °C
6.	가	_____ □ MAX.
7.	(C <sub>L</sub> )	_____ pF
8.		_____ mW
9.	(C <sub>O</sub> )	_____ pF MAX.
10.		_____
11.		_____
12.		_____

11.

(10M ~ 40MHz)



SMD , CX-51F 가

CX-101F

(4)

25

가 1

(1)

가

(5)

. AT

, 3

(2) ( )

2

(3)

가,

가  
(次數)

(6) 가

가

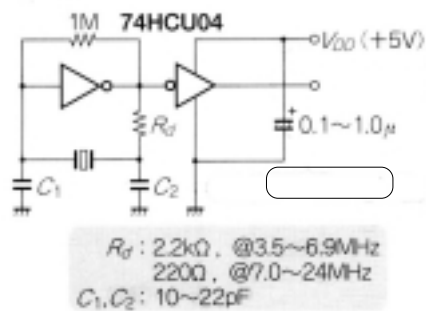
‘JIS C6701( 9)’ 가

가

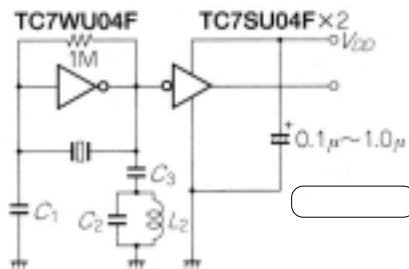
가

(7)

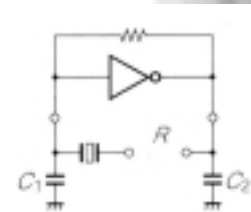
3/



12. CMOS IC



13. CMOS IC



14.

2.

[MHz]	[ ]
3.5 ~ 4.5	1.5 k
4.6 ~ 6.0	1.0 k
6.1 ~ 10.0	750
10.1 ~ 14.0	500
14.1 ~ 20.0	400

가

가

(11)

12p~16pF가

(8)

kHz

MHz

가

(12)

가

가

가

가

(9)

 $C_o$ 

AT

 $C_o$ 

가

(10)

가

11, 13

( )

(1)

가

(2)

( 14)

가

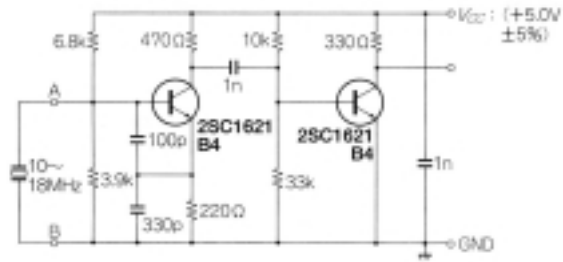
가

2

가

5

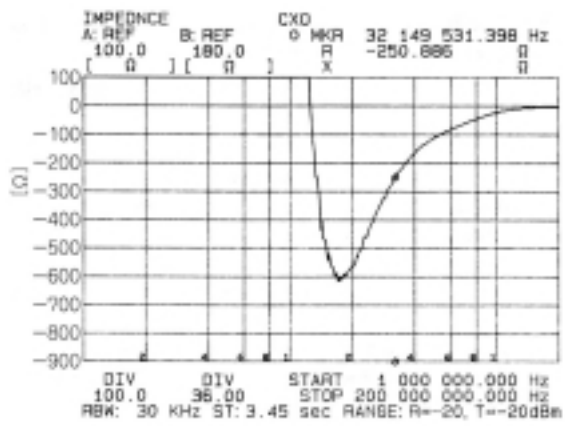
&lt;大隅 明&gt;



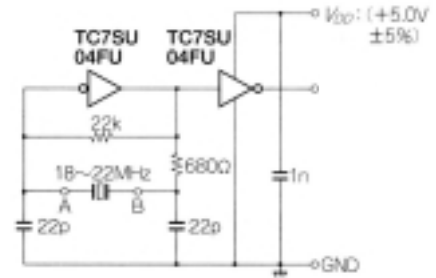
15.



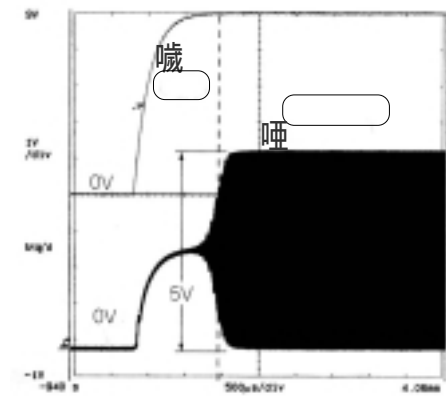
17. 가



19. HCMOS IC



16.



18.

3.

	가	
	SPXO	VCXO
	TCXO	VC-TCXO
	DTCXO	VC-DTCXO
	OCXO	VC-OCXO

가

$$\pm 1 \times 10^{-4} \sim \pm 2 \times 10^{-9}$$

15, 16

가

가

17

가

가  $L_e$  가  $R_e$  가  $C_i$  가 ( )

3/

)  $R_i$ 

$$\omega L_e - \frac{1}{\omega C_i} = 0$$

3

$$f = 1/(2\sqrt{L_e C_i})$$

$$R_e \quad |R_i| \quad (1)$$

$$R_i \quad R_e \quad (2)$$

$$R_i \quad R_e \quad (3)$$

3~10

18

19 HCMOS IC

4

 $R_i$ 

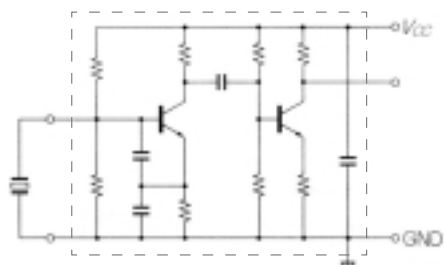
가

Q

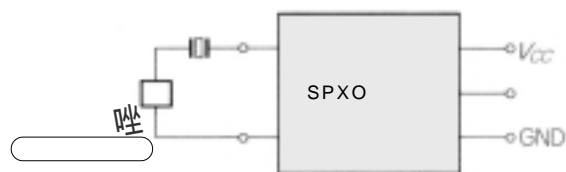
가  $\pm 3 \times 10^{-6} \sim \pm 100 \times 10^{-6}$ 

4.

	[    ]	[ ×10 <sup>-6</sup> ]																
SPXO VCXO	0 ~ +50													±3	±5	±10	±50	±100
	-10 ~ +60														±5	±10	±50	±100
	-20 ~ +70															±10	±50	±100
	-30 ~ +80																±50	±100
	-40 ~ +90																±50	±100
	0 ~ +70															±10	±50	±100
TCXO	0 ~ +50								±0.3	±0.5	±1	±2						
	-10 ~ +60									±0.5	±1	±2	±3					
	-20 ~ +70										±1	±2	±3	±5				
	-30 ~ +80											±2	±3	±5				
	-40 ~ +90											±2	±3	±5				
OCXO	0 ~ +50	±0.002	±0.005	±0.01	±0.02	±0.05												
	-10 ~ +60		±0.005	±0.01	±0.02	±0.05	±0.1											
	-20 ~ +70			±0.01	±0.02	±0.05	±0.1	±0.2										

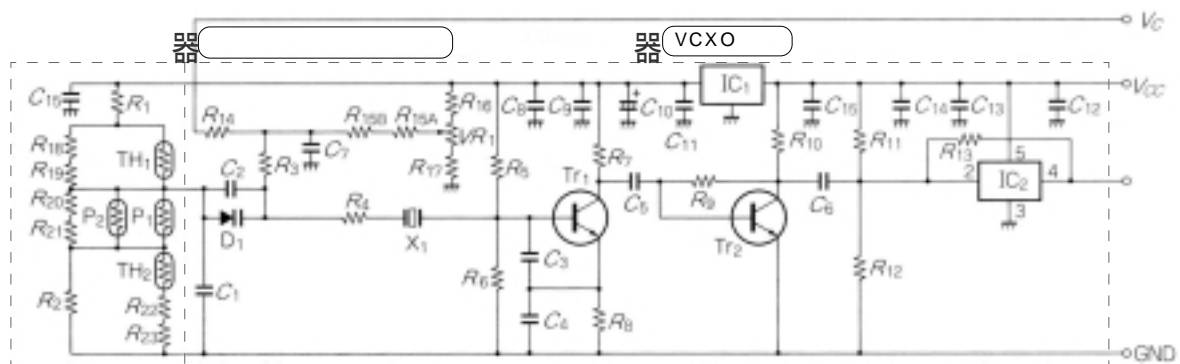


20. SPXO

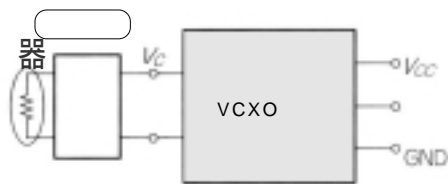


21.

TCXO

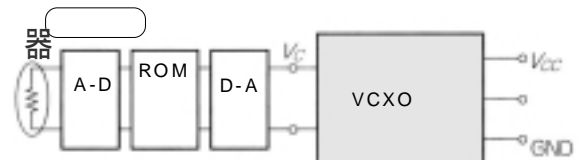


(a) TCXO

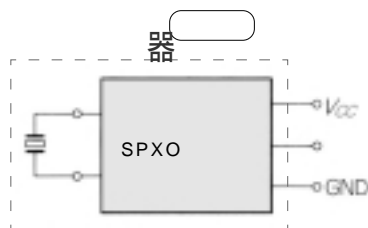


22.

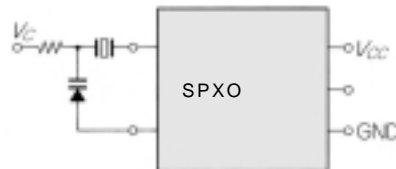
TCXO



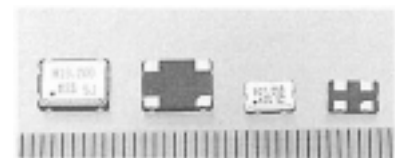
23. DTCXO



24. OCXO

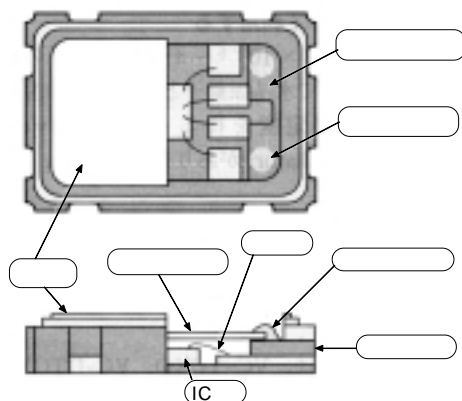


25. VCXO



1. SMD

SPXO



26.

가  $\pm 0.3 \times 10^{-6} \sim \pm 5 \times 10^{-6}$ 

TCXO

(Temperature Compensated Crystal Oscillator)

. TCXO

( 21)

 $C_L$ 

( 22)

가

VCXO(Voltage Controlled Crystal Oscillator)

가

SPXO

(Simple Packaged Crystal Oscillator) (

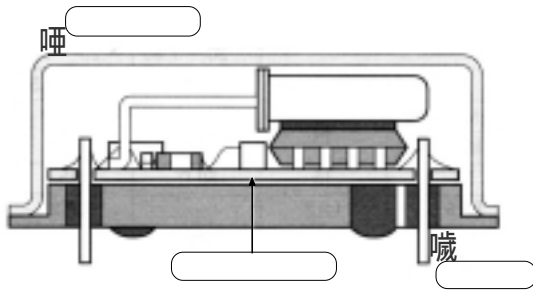
20)



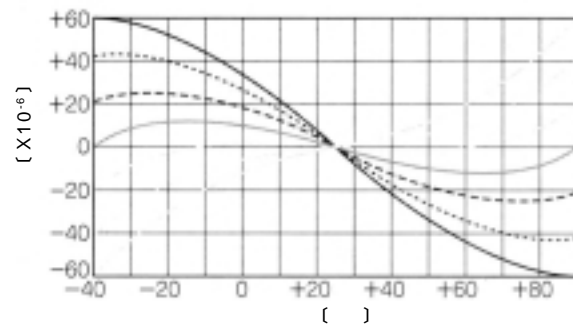
3/

## 5. SMD [FXO (株)]

			FXO-31F	FXO-31FH	FXO-31FT	FXO-31FL	FXO-32F	FXO-32FL	FXO-34F	FXO-34FL	FXO-37F	FXO-37FL	
	$f$	MHz	1.8 ~ 50				8 ~ 32	50 ~ 100	8 ~ 32		50 ~ 100	100 ~ 125	50 ~ 100
	$df$	$\times 10^{-6}$	$\pm 100$				$\pm 30$		$\pm 30$		$\pm 100$		
	$t_o$	$^{\circ}\text{C}$	$-10 \sim +70$				$-10 \sim +60$		$-30 \sim +85$		$0 \sim +70$		
	$t_x$	$^{\circ}\text{C}$	$-55 \sim +125$				$-20 \sim +80$		$-30 \sim +85$		$-20 \sim +80$		
	$V_{DD}$	V	$+5 \pm 0.5$			$+3.3 \pm 0.3$	$+5 \pm 0.25$	$+3.3 \pm 0.165$	$+5 \pm 0.25$	$+3.3 \pm 0.165$	$+5 \pm 0.25$	$+3.3 \pm 0.15$	
	$I_{DD}$	mA max	25	25(1.8 ~ 15 MHz)		20	12	8	12	10	50		25
			—	30(15.1 ~ 32 MHz)		—	—	—	—	—	—	—	—
			—	45(32.1 ~ 50 MHz)		—	—	—	—	—	—	—	—
	$C_L$	pF	15	50		20	15				25	15	
	IC	TTL	LS10	10		5	2	1	2	1	10	5	
	$V_{OV}$	Vmin	4.5				2.97		4.5	2.97	4.0		2.8
	$V_{OL}$	Vmax	0.5			0.4	0.5						
(symmetry)	$D$	%	40 ~ 60										
	—	V	2.5		1.4	1.65	2.5	1.5	2.5	1.65	2.5		1.65
	$t_r/t_f$	ns max	10		6		12	16	12	16	7		
	—												



27.

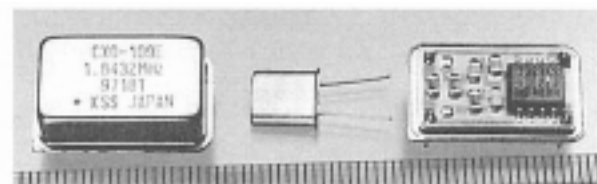


28. SPXO

ROM . DTCXO  
(Digital processing Temperature Compensated  
Crystal Oscillator)가 ( 23).

가  $\pm 0.002 \times 10^{-6} \sim \pm 0.2 \times 10^{-6}$

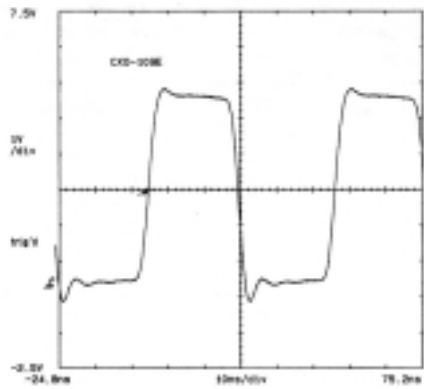
OCXO(Oven  
Controlled Crystal Oscillator)가 ( 24).



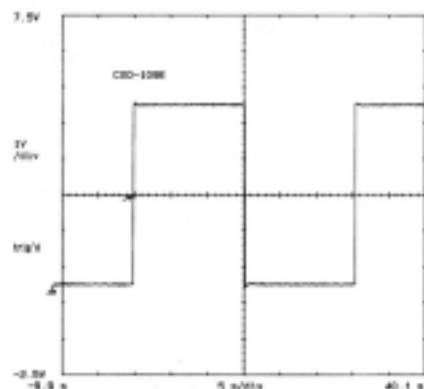
2. SPXO

VCXO VC-OCXO  
(PLL)

25 VCXO .  
VC-TCXO, VC-DTCXO



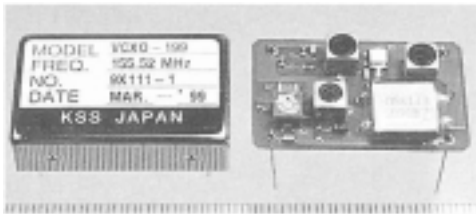
29.  
(f=19MHz, 50pF)



30.  
(f=32.768kHz, 50pF)

6. [CXO ]

			CXO-072D	CXO-106B	CXO-108	CXO-109E	CXO-109H	CXO-199	CXO-203
	$f$	MHz	4.9~20.8	40~100	80~200	0.001~80	0.5~50	30~160	0.032768
	$df$	$\times 10^{-6}$	$\pm 5$	$\pm 100$			$\pm 20$		$\pm 80$
	$t_e$	$^{\circ}\text{C}$	0~+60	-10~+70					-10~+50
	$t_s$	$^{\circ}\text{C}$	-30~+85	-20~+85				-20~+80	-20~+85
	$V_{DD}$	V	+5 $\pm$ 0.25	+5 $\pm$ 0.5	-5.2 $\pm$ 0.25	+5 $\pm$ 0.25		-5.2 $\pm$ 0.25	+5 $\pm$ 0.5
	$I_{DD}$	mA max	20	60		25(0.001M~20MHz) 60(20.1M~80MHz)	45	40	0.15
	$C_L$	pF	—	20	—	50	15	50 $\Omega$	15
	IC	TTL	2	AS10	10KH ECL	LS 5	LS 2	—	LS 2
	$V_{OW}$	Vmin	2.4	3.0	-1.02~-0.74	4.5		0 dBm	4.5
	$V_{OX}$	Vmax	0.4	0.5	-1.95~-1.60	0.5		—	0.5
(symmetry)	$D$	%	40~60					—	—
	—	V	1.4	1.3	-1.29	2.5		—	2.5
	$t_r/t_f$	ns max	10	5	3.5	10		—	300
	—	—							



3. VCXO

26 IC

FXO { (株) }

FXO

0.01μF

CMOS TTL IC 가

3

5

FXO-61F 3.2×5.0×1.

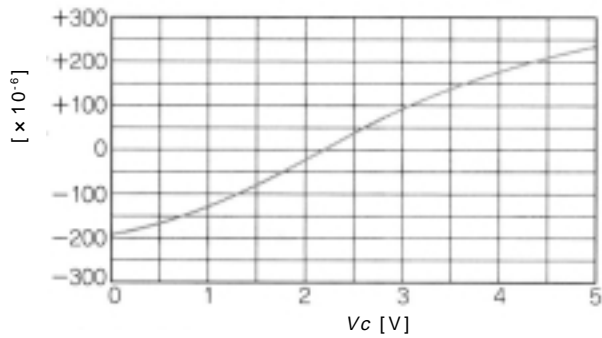
SPXO  
SMD ( 1)

가  
5.0×7.0×1.8mm

3/

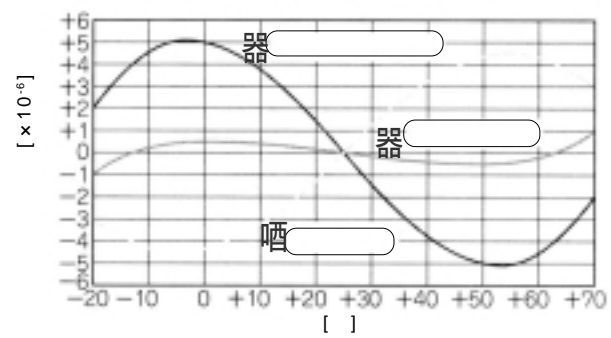
## 7. VCXO/VC-CXO

			VC-CXO-072E	VC-CXO-072G	VC-CXO-072H	VCXO-078B	VCXO-105N	VCXO-190	VCXO-199
	$f$	MHz	11 ~ 34		27 ~ 60	32 ~ 100	1.5 ~ 33	14 ~ 29	30 ~ 160
	$df$	$\times 10^{-4}$	$\pm 40$				$\pm 30$	$\pm 30$	$\pm 40$
	$t_o$	$^{\circ}\text{C}$	$-20 \sim +70$			$-10 \sim +60$	$-20 \sim +70$	$-10 \sim +60$	$-10 \sim +75$
	$t_s$	$^{\circ}\text{C}$	$-40 \sim +85$			$-40 \sim +75$	$-40 \sim +85$	$-30 \sim +80$	$-20 \sim +80$
	$V_{DD}$	V	$+5 \pm 0.25$						
가	$I_{DD}$	mA max	20	25		40	27	15	40
	$df$	$\times 10^{-4}$	$\pm 100$	$\pm 150$	$\pm 100$	$\pm 70$	$\pm 100$	$\pm 50$	$\pm 120$
	$V_C$	V	$+2.5 \pm 2.5$	$+2.5 \pm 2.0$	$+2.5 \pm 2.5$	$+2.5 \pm 2.0$		$+2.5 \pm 2.5$	
	$C_L$	pF	—	15		—	15		50 $\Omega$
	IC	TTL	1	LS 2	AS 2	1	—	LS 2	—
	$V_{OH}$	Vmin	3.0	4.5		3.0	4.5		0 dBm
	$V_{OL}$	Vmax	0.4	0.5		0.4	0.5		—
	$D$	%	40 ~ 60			30 ~ 70	40 ~ 60		—
	—	V	1.4	2.5		1.4	2.5		—
	$t_r/t_f$	ns max	10	5		10		5	—
	—	—							



31. VC-CXO-072G

가



32. TCXO

-

2mm FXO-31F 30%

( 2 )

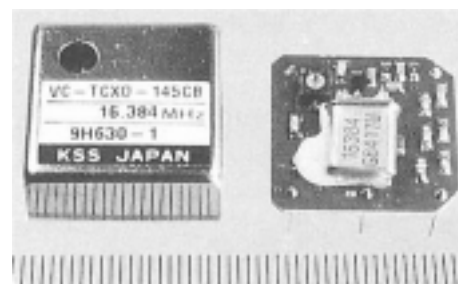
13.08 x 20.8 x

8.26mm

27

UM-1

IC



4. TCXO

가 가

SPXO

가

10MHz

80MHz

. AT

10MHz

가

28

AT (

3

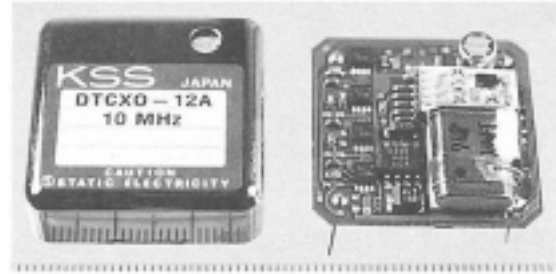


## 8. VC-TCXO-145CB

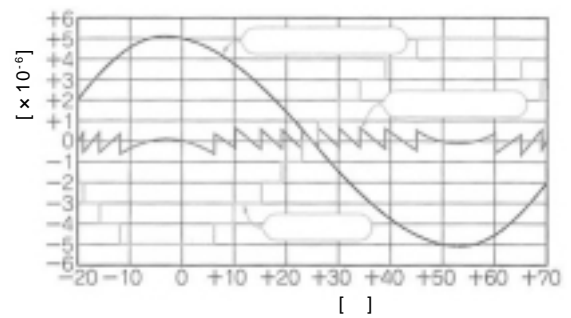
VC-TCXO-145CB	
	2 MHz ~ 30 MHz
	-10℃ ~ +60℃
	-40℃ ~ +80℃
	$\pm 1 \times 10^{-6}$ max./-10℃ ~ +60℃
	$\pm 1 \times 10^{-6}$ max./year
	$\pm 0.2 \times 10^{-6}$ max./+5.0 V $\pm 5\%$
	$\pm 10 \times 10^{-6}$ min./+2.5 V $\pm 2.0$ V ( )
	$\pm 3 \times 10^{-6}$ max./ (對 )
	+5.0V $\pm 5\%$
	20 mA max.
	$V_{OV} : +4.5$ V min. $V_{OL} : +0.5$ V max. ( $V_{CC} = +5.0$ V)
	CMOS (15pF)
	40 ~ 60% @ +2.5 V ( )
	10 k $\Omega$ min.

## 9. DTCXO-12A

DTCXO-12A	
	1 MHz ~ 32 MHz
	-40 ~ +85℃
	-35 ~ +85℃
	$\pm 0.1 \times 10^{-6}$ max./-35 ~ +85℃
	$\pm 0.5 \times 10^{-6}$ max./year
	$\pm 0.05 \times 10^{-6}$ max./5 V $\pm 5\%$
	$\pm 0.7 \times 10^{-6}$ min.
	30 mA max./5 V
	CMOS
	45 ~ 55 %/1 ~ 15 MHz
	30 ~ 70 %/15 ~ 32 MHz
	-80 dB max.



5. DTCXO



33. DTCXO



6. OCXO

0.8MHz  
CT DT  
2 3  
AT 가  
10~30MHz AT  
IC  
CXO-109E  
1kHz~10MHz IC  
29  
19MHz , 30  
32.768kHz  
6

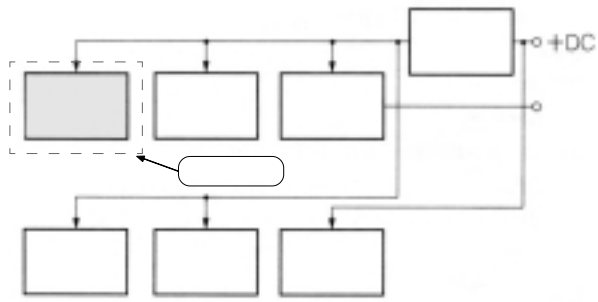
HCMOS, AS TTL, 10KH-ECL IC  
50 0dBm

VCXO ( 3)

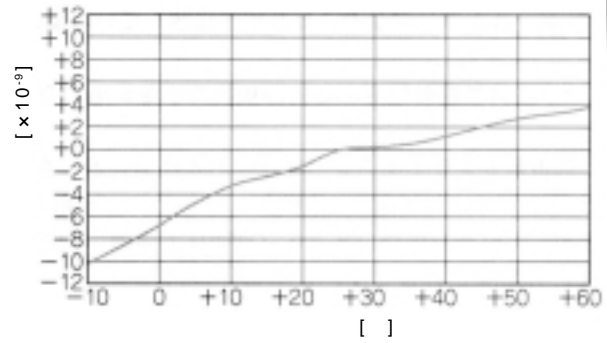
VCXO-190 SMD  
SPXO  
, UM-1 IC

가 , UM-1 가

3/



34. OCXO



35. OCXO-108B(@5MHz)

31 VC-CXO-072G  
가  
7  
VCXO-105N,  
VC-CXO-072H VCXO-  
199 HCMOS AS TTL IC  
가 50 0dBm

TCXO( 4)

. TCXO

(VCXO)

HCMOS TTL

32

가가

8 VC-TCXO-145CB

DTCXO( 5)

DTCXO

(VCXO)

A-D  
ROM D-A

HCMOS TTL

33

가

ROM

ROM

33

가

 $\pm 0.1 \times 10^{-6}$ 

9 DTCXO-12A

OCXO( 6)

. OCXO

HCMOS TTL

34

+70

AT

SC

## 10. OCXO-108B

OCXO-108B	
5 MHz	
-20 ~ +70 °C	
0 ~ +60 °C	
$\pm 1.5 \times 10^{-8}$ max./0 ~ +60 °C	
$\pm 2 \times 10^{-8}$ max./year	
$\pm 5 \times 10^{-9}$ max./+12.0 V $\pm 5\%$	
$\pm 1 \times 10^{-7}$ min.	
	+12.0 V $\pm 5\%$
	500 mA max.
	TTL
	TTL ( $\dots$ = 2)
30	$\pm 2 \times 10^{-8}$

35

10 OCXO-108B

11

가

가

가

( )

(1)

(2)

(3) 가 , , 가

(4) ,

(5)

(6)

( )

(1) 가

(2) 가

(3)

(0.

2 ~ 0.5A)

OCXO

가 0.5A OCXO

1

5V

0.5V

가

4.

5V OCXO

가

가

0.1 ~ 100

 $\mu\text{F}$ 

가 IC

가

IC

VCXO

가

VCXO

가

가

가

3/

11.

1.		_____ MHz
2.		
(1)		$\pm$ _____ $\times 10^{-6}$ max.
		- _____ ~ + _____ $^{\circ}\text{C}$
(2)		$\pm$ _____ $\times 10^{-6}$ max.
		+ _____ VDC $\pm$ _____ %
(3)		$\pm$ _____ $\times 10^{-6}$ max.
		_____ $\Omega$ , _____ pF $\pm$ _____ %
(4)		$\pm$ _____ $\times 10^{-6}$ max./
3.	가	$\pm$ _____ $\times 10^{-6}$ min.
4.		$\pm$ _____ ~ $\pm$ _____ $\times 10^{-6}$
		+ _____ V $\pm$ _____ V
5.		
(1)		(TTL, HCMOS),
		2 _____ dB, 3 _____ dB
(2)		_____ V rms, _____ Vpp
		Voh _____ V, Vol _____ V
(3)		_____ $\Omega$ , _____ pF
		LS-TTL _____,
		HCMOS _____
6.		+ _____ VDC $\pm$ _____ % _____ mA max
7.		
(1)		- _____ ~ + _____ $^{\circ}\text{C}$
(2)		- _____ ~ + _____ $^{\circ}\text{C}$
(3)		_____ mm,
		_____ ~ _____ Hz
(4)		_____ cm
8.		
9.		
10.		

TTL 가  
가  
가  
가

EMC가  
가

가

가 가

TTL

가 . <小柳津 泰夫>

