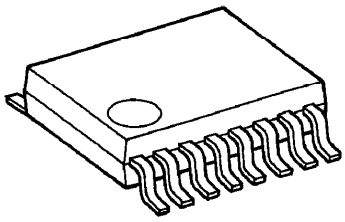
TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB31201FN

PLL FREQUENCY SYNTHESIZER FOR CORDLESS TELEPHONE

FEATURES

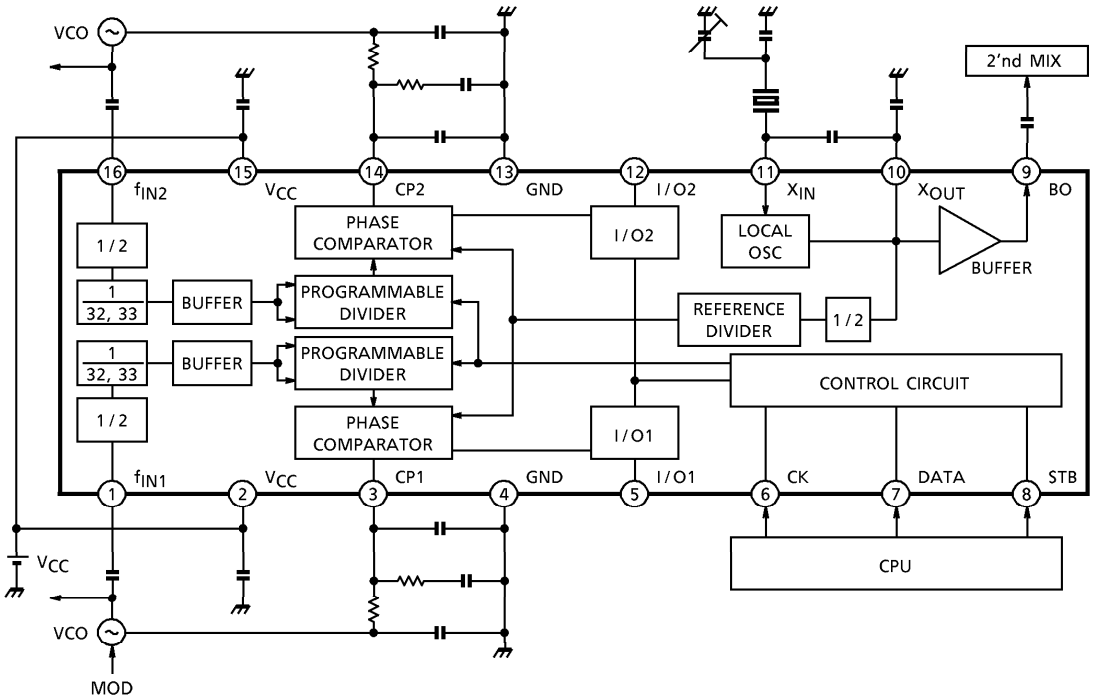
- One packaging two systems prescaler and PLL for receiver and transmitter
- Low operating power supply voltage : V_{CC} = 2.0~5.5V
  (Temperature ≧ – 10°C : V_{CC} = 1.9~5.5V)
- Low current consumption : I_{CC} = 8mA (Typ.)
- Input frequency : f_{IN} = 200~400MHz
- High input sensitivity : V_{IN} = 93~107dBμV
- Charge pump is constant current type, and is able to change output current by serial data
- Reference oscillation circuit is adopted circuit of bipolar, so getting the stable X'tal oscillation circuit
- Available standby control for receiver and transmitter independent of each other
- The very small package : SSOP16pin (0.65mm pitch)



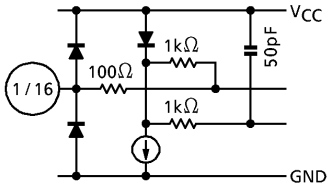
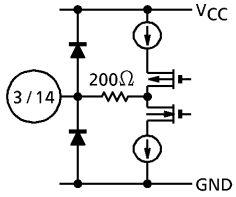
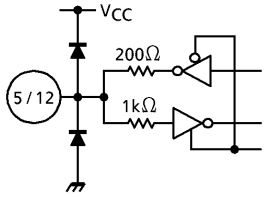
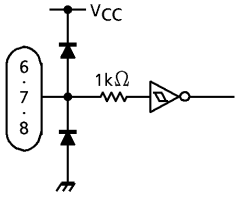
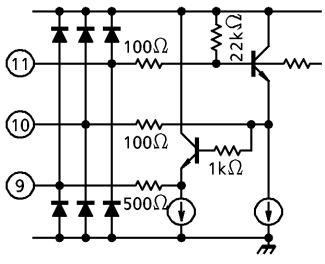
SSOP16-P-225-0.65B

Weight : 0.07g (Typ.)

BLOCK DIAGRAM



PIN FUNCTION (The values of resistor and capacitor are typical.)

PIN No.	PIN NAME	FUNCTION		INTERNAL EQUIVALENT CIRCUIT
1	f_{IN1}	Input terminal of RF oscillation signal.		
16	f_{IN2}			
2	V_{CC}	Terminal of power supply. Pin 2 and pin 15 are connected in IC.		
15	V_{CC}			
3	CP1	Output terminal of charge pump. Charge pump is constant current output circuit, and output current is varied by input serial data.		
14	CP2			
4	GND	Terminal of GND. Pin 4 and pin 13 are connected in IC.		
13	GND			
5	I/O1	I/O terminal. Standby control terminal, lock detector output terminal or general output terminal is able to select input data.		
12	I/O2			
6	CK	Input terminal of clock.	Input the serial data for controlling IC.	
7	DATA	Input terminal of serial data.		
8	STB	Input terminal of strobe signal.		
9	BO	Output terminal of buffer amplifier. The signal of local oscillation is provided through the buffer amplifier.		
10	X_{OUT}	Output terminal of local oscillation signal.		
11	X_{IN}	Input terminal of local oscillation signal. In case of external input, connecting it to this terminal.		

DESCRIPTION OF FUNCTION AND OPERATION

1. Entry of serial data

- Serial data used to control the IC is input through three terminals, CK, DATA and STB.

  ① During the rise of a clock pulse, data is fed to the shift register in the IC in order from the LSB.

  ② Upon the reception of all data, the strobe signal (STB) is made "H".

  ③ After the reception of a strobe signal (STB) of the "H" level, the data stored in the shift register is transferred to the latch in the block selected by the group code, whereby the IC is controlled.

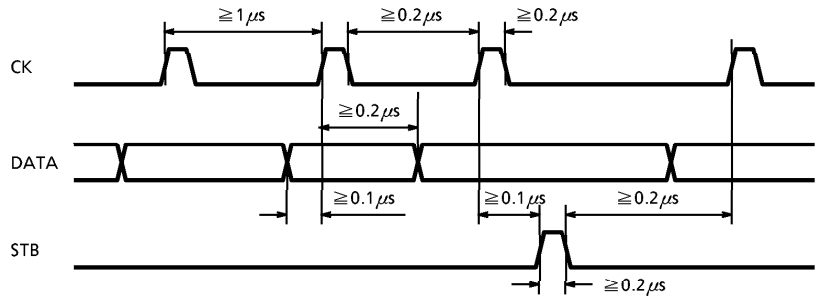
- The three terminals, CK, DATA and STB, contains Schmitt trigger circuits to prevent the data errors by noise, etc.

○ Serial data group and group code

- The IC has control divided into four groups so that they may be controlled independent of one another. Each group is identified by a 2bit group code attached at the data end.

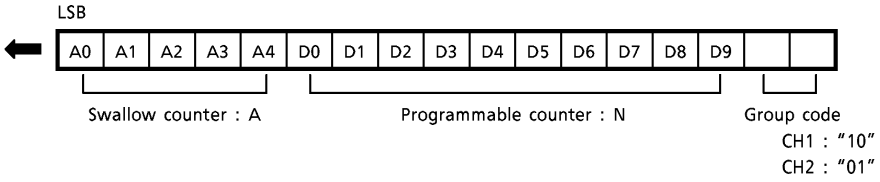
CODE	ITEM
10	Number of divisions by CH1 programmable divider (f_{IN1})
01	Number of divisions by CH2 programmable divider (f_{IN2})
11	Number of divisions by reference divider (X_{IN})
00	Optional control

○ Serial data input timing



2. Programmable dividers (CH1, CH2)

- These programmable dividers are composed of a 5bit swallow counter (5bit programmable divider), a 10bit programmable counter, and a two-modulars prescaler providing 64 and 66 divisions.
- The strategy of a swallow counter is used to set high reference frequency.
- Sending certain data to the swallow counter and the programmable counter allows the setting of any of 2048 to 65534 divisions (multiple of two).
- The programmable counter and swallow counter are set by each channel. Each channel is specified by a group code.



$A = A0 + A1 \times 2^1 + A2 \times 2^2 + A3 \times 2^3 + A4 \times 2^4$
$N = D0 + D1 \times 2^1 + D2 \times 2^2 + D3 \times 2^3 + \cdots\cdots + D9 \times 2^9$
Number of divisions = 2 (32N + A)
2048 ≦ Number of divisions ≦ 65534

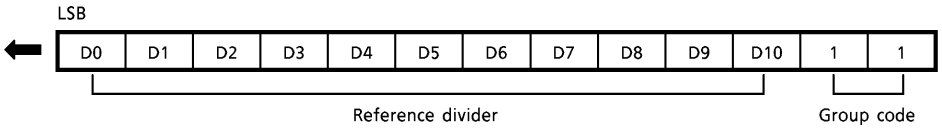
N : Value of N counter
A : Value of A counter

(EX) A Signal of 380MHz is entered into f_{IN1}, being divided into 12.5kHz step. (Reference frequency is 6.25kHz)

$380 \times 10^6 \div (12.5 \times 10^3 \div 2) = 60800$
$60800 = 2\ (32N + A)\ \therefore N = 950,\ A = 0$

3. Reference divider

- This block generates the reference frequency for the PLL.
- The reference divider is composed of a 11bit reference divider and a half fixed divider.
- Sending certain data to the reference divider allows the setting of any of 16 to 4094 divisions (multiple of two).



$D = D0 + D1 \times 2^1 + D2 \times 2^2 + D3 \times 2^3 + \cdots\cdots + D10 \times 2^{10}$
Number of divisions = 2D
16 ≦ Number of divisions ≦ 4094

(EX) With a 21.25MHz X'tal oscillator connected, being divided into 12.5kHz step. (Reference frequency is 6.25kHz)

$21.25 \times 10^6 \div (12.5 \times 10^3 \div 2) = 3400$
$3400 = 2D\ \therefore D = 1700$

4. Optional control

- The optional control below is available.

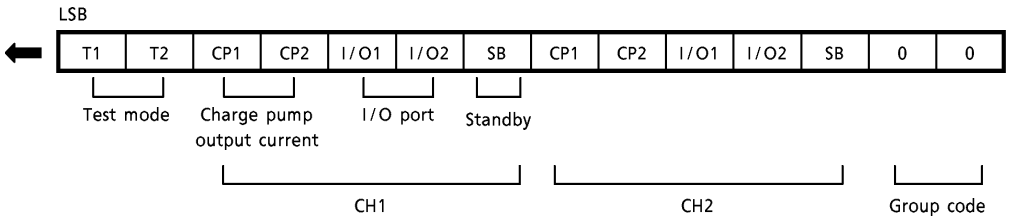
  ① Test mode (Usually set up T1 = "0" T2 = "0").

  ② Control of the charge pump output current for each channel.

  ③ Select of I/O port for each channel.

  - Standby control by external control for each channel. (Input Terminal)
  - Output terminal of lock detector.
  - General output terminal.

  ④ Standby control of each channel.



- Description of options including their control

  ① Test mode (T1, T2)

  Bits "T1, T2" are for test mode. In other than the test mode, set this bit at "0, 0".

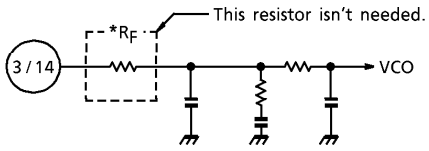
  ② Control of Charge pump output current (CP1, CP2)

  This IC uses a constant current output type charge pump circuit. Output current is varied by serial data "CP1" and "CP2". When charge pump circuit uses constant voltage output type, the IC needs resistor (R_F : This changes voltage to current.) shown in under figure. But this IC doesn't need the resistor, because of a constant current output type charge pump circuit.

CONTROL BIT		CHARGE PUMP OUTPUT CURRENT
CP1	CP2	
0	0	0μA
0	1	±100μA
1	0	±200μA
1	1	±400μA

High speed lock up is possible by switching charge pump output current.

(Note)



③ Select of I/O port (I/O1, I/O2)

Standby control (input mode), lock detector output mode and general output mode of each channel by external control can select by controlling bits "I/O1, I/O2".

CONTROL BIT		I/O TERMINAL (PIN 5, PIN 12)	
I/O1	I/O2	MODE	FUNCTION
0	0	input	Standby control by I/O terminal
0	1	output	Lock detector output
1	0	output	General output "L"
1	1	output	General output "H"

- Standby control by external control (When I/O terminal is input mode.)

  When bits of "I/O1, I/O2" sets "0, 0", I/O terminal (pin 5, pin 12) becomes input mode. Standby control is available by input level.

I/O TERMINAL INPUT	STATE
H	Standby state
L	Normal operation

  (When I/O terminal is output mode, standby control is available by a bit "SB".)

- Lock detector output

  When bits of "I/O1, I/O2" sets "0, 1", I/O terminal (pin 5, pin 12) becomes lock detector output terminal.
  When phase difference detectes by phase comparator, "L" detectes during interval corresponding to phase difference. In the standby mode, "L" (unlock state) is output.

- General output

  When bits of "I/O1, I/O2" sets "1, 1" or "1, 0", I/O terminal (pin 5, pin 12) becomes general output terminal.

④ Standby control

In case of controlling standby mode by serial data, I/O terminal becomes output mode and is controlled by a bit "SB".

"SB" = "1" : Standby mode
"SB" = "0" : Normal operation

(When I/O terminal sets input mode, standby control by I/O terminal has priority.)

5. Reference frequency oscillation circuit and buffer amplifier

This IC has a stable oscillation circuit composed of bipolar.
In case of inputting the external reference frequency directly, use X_{IN} terminal (pin 11).
For the common use of X'tal of the reference frequency oscillation circuit for the PLL and X'tal of local oscillation to 2'nd MIX, output terminal of local oscillation signal with buffer amplifier (pin 9) may be used.
This terminal (pin 9) is provied with a buffer amplifier.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	6	V
Power Dissipation	P_D	560	mW
Operating Temperature	T_{opr}	−30~85	°C
Storage Temperature	T_{stg}	−55~150	°C

ELECTRICAL CHARACTERISTICS
(Unless otherwise specified, V_{CC} = 2.2V, $f_{IN1} = f_{IN2}$ = 400MHz, Ta = 25°C)

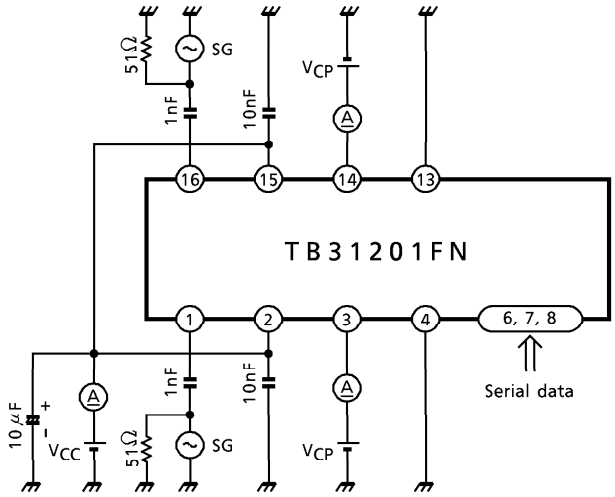
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Power Supply Voltage	V_{CC}		Ta = −30~85°C	2.0	2.2	5.5	V
			Ta = −10~85°C	1.9	2.2	5.5	
Operating Current Consumption	I_{CCO}		CH1 = CH2 = 300MHz, 107dBμV input	5.0	8.0	11.0	mA
Current Consumption	I_{CCQ}		CH1 = CH2 = standby mode	—	0	10	μA
f_{IN} Operating Frequency	f_{IN1}		V_{IN1} = 93dBμV	200	—	400	MHz
	f_{IN2}		V_{IN2} = 93dBμV	200	—	400	
f_{IN} Input Sensitivity	V_{IN1}		f_{IN1} = 200~400MHz	93	—	107	dBμV
	V_{IN2}		f_{IN2} = 200~400MHz	93	—	107	
X_{IN} Operating Frequency	f_{XI}		$V_X = 0.5V_{p-p}$, Sin-wave	5	21.25	25	MHz
X_{IN} Input Voltage	V_{XI}		f_{XI} = 21.25MHz	102	107	112	dBμV
Output Current	I_{OH}		I/O, V_{OH} = 1.7V	—	—	−0.1	mA
	I_{OL}		I/O, V_{OL} = 0.5V	0.15	—	—	
Input Voltage	V_{IH}		STB, DATA, CK, I/O	0.8 × V_{CC}	V_{CC}	V_{CC} + 0.2	V
	V_{IL}		STB, DATA, CK, I/O	−0.2	0	0.2 × V_{CC}	
Input Current	I_{IH}		STB, DATA, CK, I/O, $V_{IH} = V_{CC}$	−0.1	—	1.0	μA
	I_{IL}		STB, DATA, CK, I/O, V_{IL} = 0V	−0.1	—	1.0	
CK Input Frequency	F_{CK}		CK	—	—	1.0	MHz
Charge Pump Output Current	I_{CP1}		"CP1" = 0, "CP2" = 0, V_{CP} = 1.1V	—	0	—	μA
	I_{CP2}		"CP1" = 0, "CP2" = 1, V_{CP} = 1.1V	—	±100	—	
	I_{CP3}		"CP1" = 1, "CP2" = 0, V_{CP} = 1.1V	—	±200	—	
	I_{CP4}		"CP1" = 1, "CP2" = 1, V_{CP} = 1.1V	—	±400	—	
Charge Pump OFF Leak Current	CP_{OFF}		Standby mode, V_{CP} = 1.1V	—	—	±1.0	μA

REFERENCE DATA (Typ.)

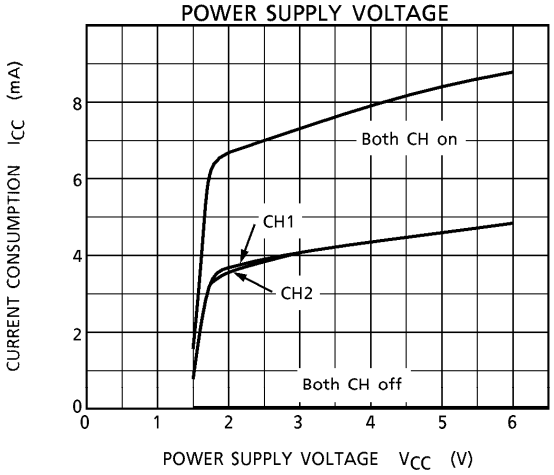
CH1	CH2	CURRENT CONSUMPTION	UNIT
N	N	8.0	mA
N	S	4.5	mA
S	N	4.5	mA
S	S	0	mA

N : Normal operation
S : Standby state

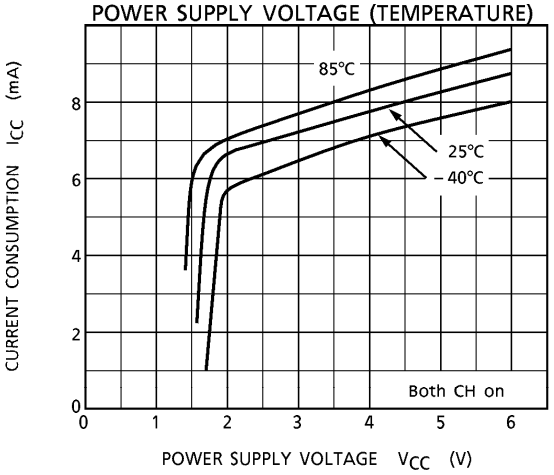
TEST CIRCUIT



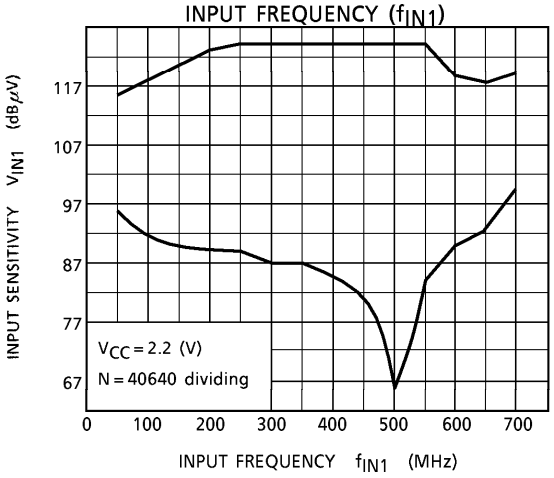
CURRENT CONSUMPTION – POWER SUPPLY VOLTAGE



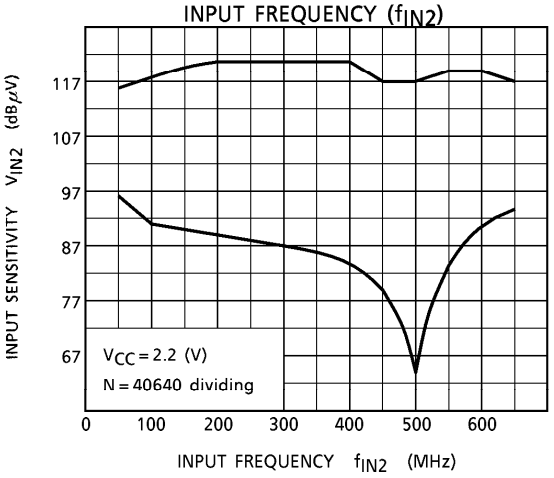
CURRENT CONSUMPTION – POWER SUPPLY VOLTAGE (TEMPERATURE)



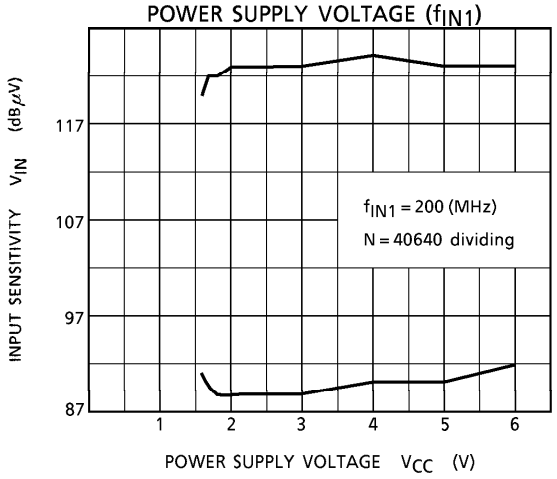
INPUT SENSITIVITY – INPUT FREQUENCY (f_{IN1})



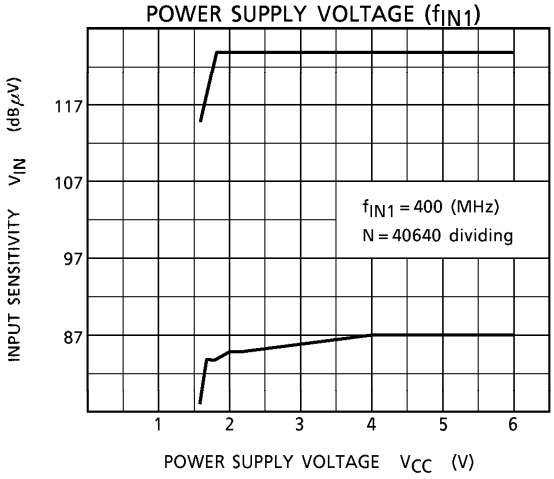
INPUT SENSITIVITY – INPUT FREQUENCY (f_{IN2})



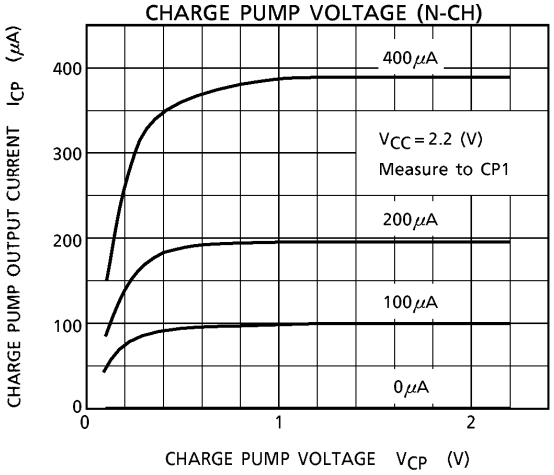
INPUT SENSITIVITY – POWER SUPPLY VOLTAGE (f_{IN1})



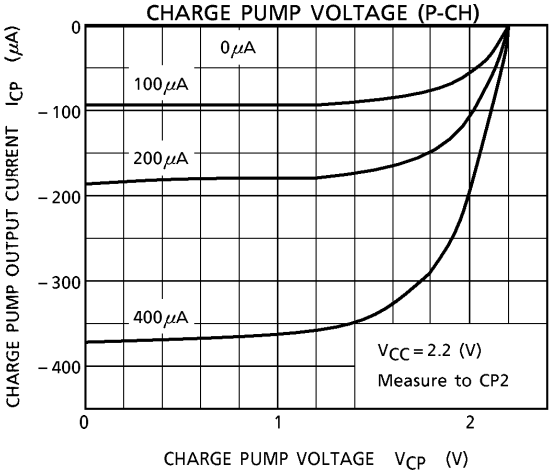
INPUT SENSITIVITY – POWER SUPPLY VOLTAGE (f_{IN1})



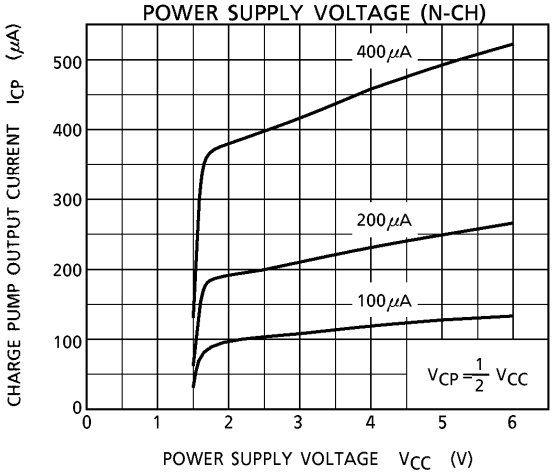
CHARGE PUMP OUTPUT CURRENT – CHARGE PUMP VOLTAGE (N-CH)



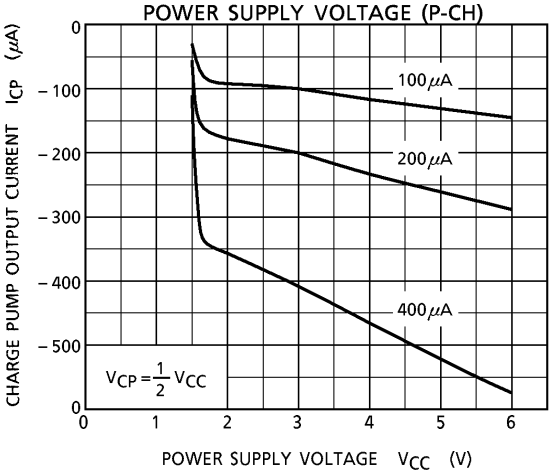
CHARGE PUMP OUTPUT CURRENT – CHARGE PUMP VOLTAGE (P-CH)



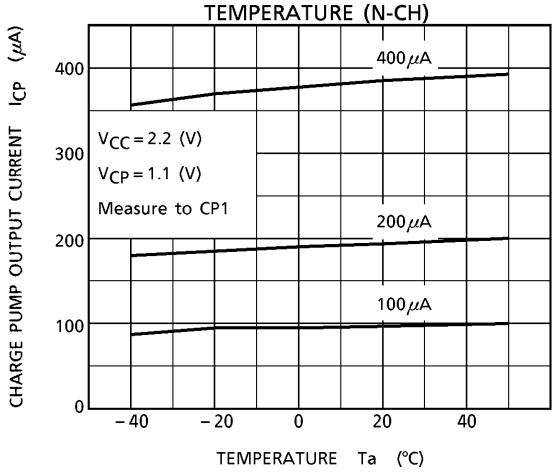
CHARGE PUMP OUTPUT CURRENT – POWER SUPPLY VOLTAGE (N-CH)



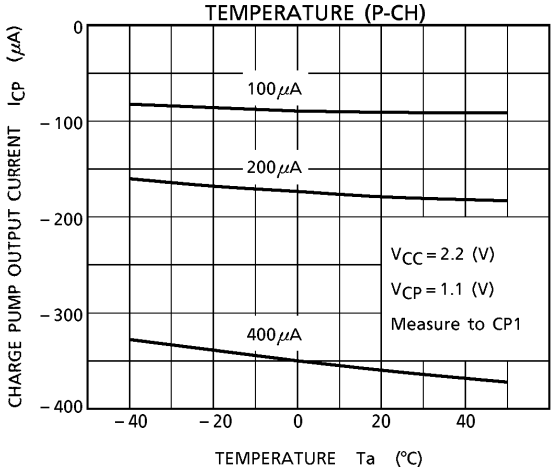
CHARGE PUMP OUTPUT CURRENT – POWER SUPPLY VOLTAGE (P-CH)

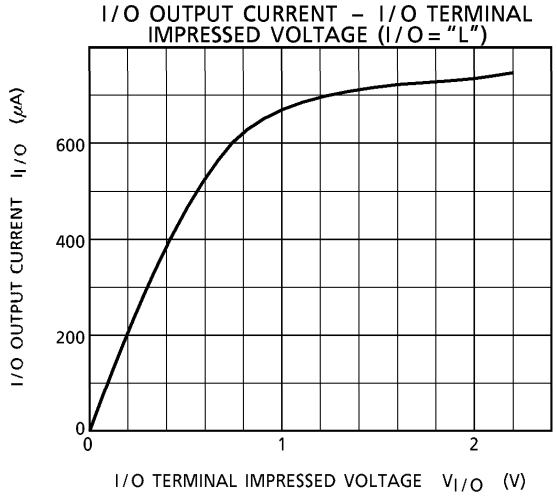


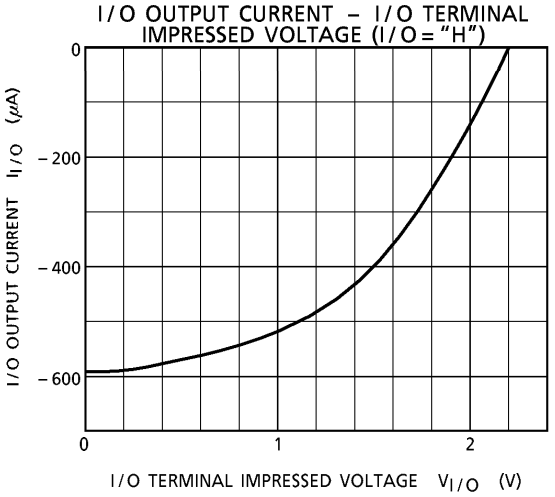
CHARGE PUMP OUTPUT CURRENT – TEMPERATURE (N-CH)



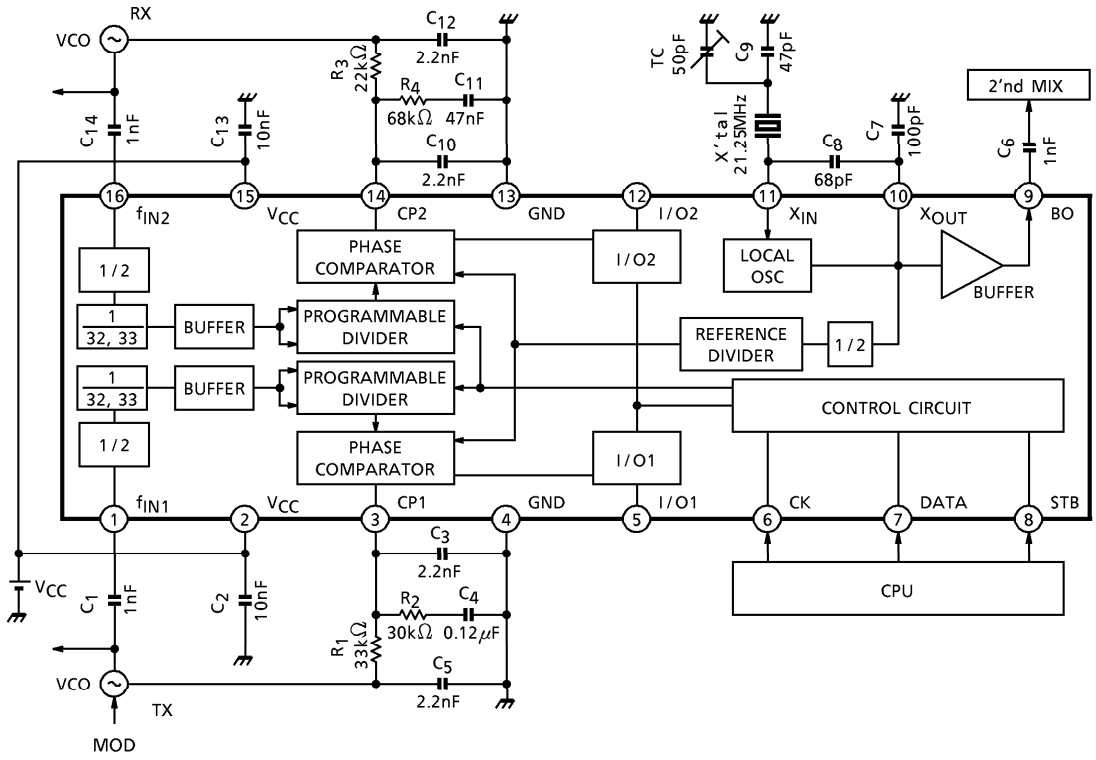
CHARGE PUMP OUTPUT CURRENT – TEMPERATURE (P-CH)




I/O OUTPUT CURRENT – I/O TERMINAL IMPRESSED VOLTAGE (I/O = "L")
I/O OUTPUT CURRENT $I_{I/O}$ (μA)
600
400
200
0
0
1
2
I/O TERMINAL IMPRESSED VOLTAGE $V_{I/O}$ (V)


I/O OUTPUT CURRENT – I/O TERMINAL IMPRESSED VOLTAGE (I/O = "H")
I/O OUTPUT CURRENT $I_{I/O}$ (μA)
0
– 200
– 400
– 600
0
1
2
I/O TERMINAL IMPRESSED VOLTAGE $V_{I/O}$ (V)

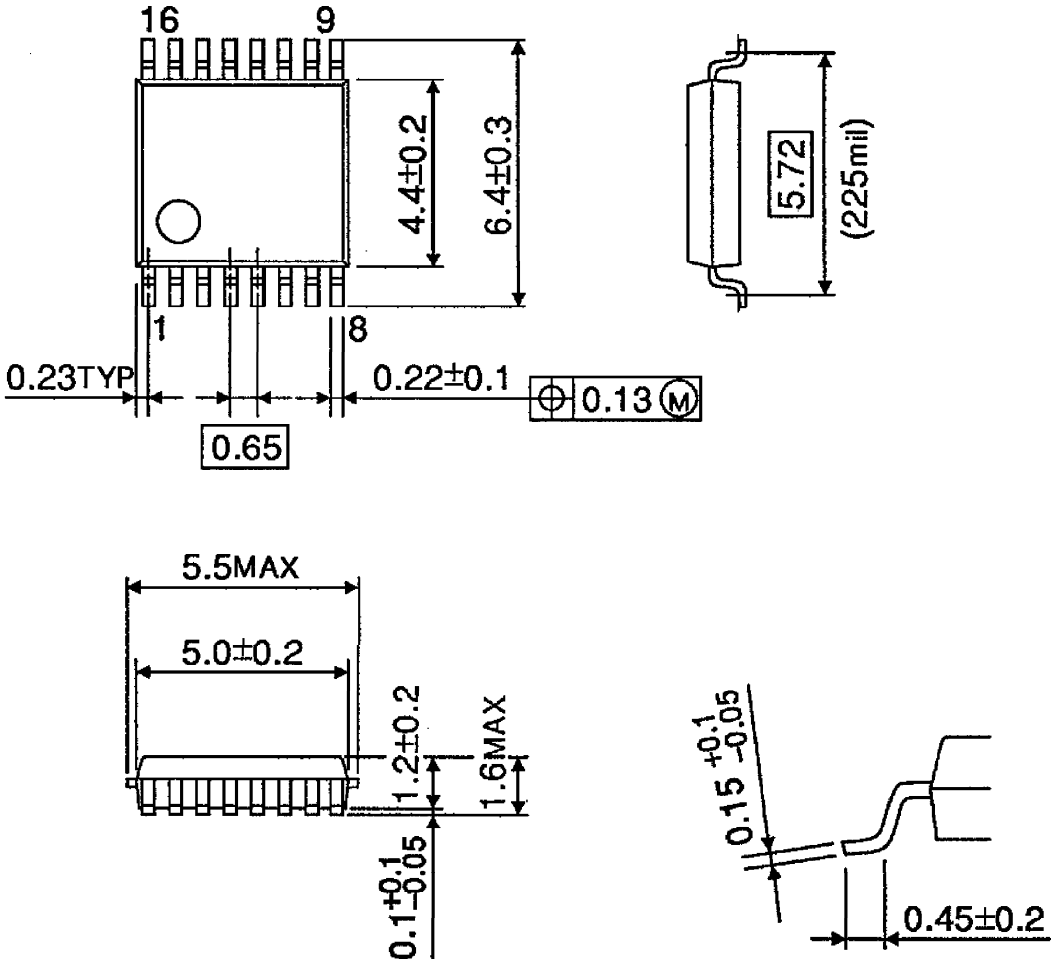
APPLICATION CIRCUIT



PACKAGE DIMENSIONS

SSOP16-P-225-0.65B

Unit : mm



Weight : 0.07g (Typ.)

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000707EBA

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