

PPG-20
PROGRAMABLE PHASE GENERATOR
USER'S MANUAL

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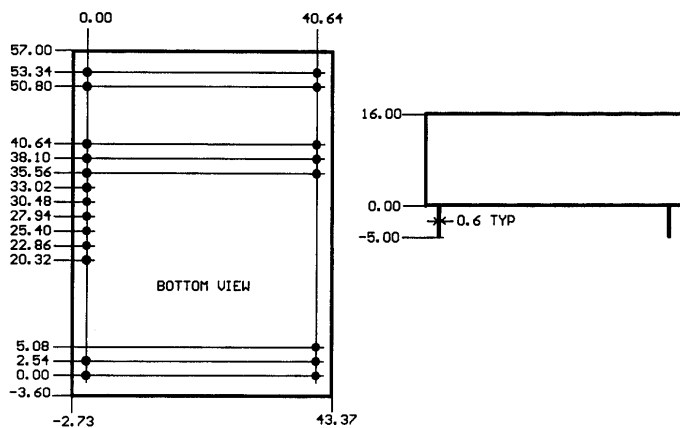
Function Description

Utilizing 32 bits Direct Digital Synthesize technique, PPG-20 can generate two sine waves from 100Hz to 20MHz in 1Hz step with any desired phase difference. Phase control can be made with 0.1 degree of phase resolution when two-channel frequency is set the same frequency. The output signal amplitude can be varied from 0 to 1V in 1mV step. All parameters such as amplitude, frequency and phase can be memorized into the EEPROM and the last saved parameters is recalled when power is on. High frequency accuracy can be obtained in external clock mode with accurate external 10MHz clock.

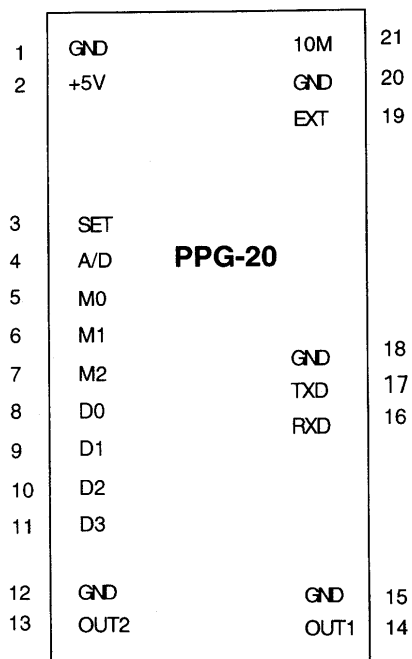
Electrical Specifications

Output impedance	50 Ω
Output frequency range	100Hz ~20MHz
Frequency resolution	1Hz
Phase control range	0° ~359.9°
Phase resolution	0.1°
Absolute phase accuracy	less than $\pm 2^\circ$ <15MHz less than $\pm 5^\circ$ 15MHz~20MHz (0°C~+50°C temperature range)
Frequency accuracy	Internal : ± 20 ppm (Adjustable) (0°C~50°C) External: depends on external clock accuracy
Output level	0~1.0Vp-p(50 Ω termination)
Output level resolution	1mV
Output level accuracy	$\pm 10\%$
Spurious	less than -40dBc
Frequency save times	more than 10,000
Frequency control	Parallel input: 9 control pins. 4 bits BCD input, 1 bit digit/data selection, 1 bit strobe signal, 3-bit mode selection Serial data: TX ,RX data line , 9600BPS, 8 bit, non parity 1 stop bit, ASCII data and carriage return code.
External clock input	10MHz(TTL or CMOS)
Frequency switching time	within 2mS(time from the end of data loading)
Power supply/current	+5V $\pm 5\%$, 400mA
Dimensions	61x46x16mm

OUTLINE



PIN ASSIGNMENT



PIN DESIGNATION AND DESCRIPTION

Pin#	Designation	Description
1	GND	GND of power supply and signal
2	+5V	Power supply pin. Supply $+5V \pm 5\%$
3	SET	Strobe signal to be set by parallel data Pulled-up internally, the data of A/D, D0-D3 can be read by falling edge.
4	A/D	Select the digit or value of parallel data D0-D3 Select the digit to be changed from the 8-digit frequency data with A/D pin high (open). Set the value of selected digit with A/D pin low (short to GND). Pulled up internally.
5	M0	Input of mode bit 0(2 ⁰) ,Internally pulled up.
6	M1	Input of mode bit 1(2 ¹) ,Internally pulled up.
7	M2	Input of mode bit 2(2 ²) ,Internally pulled up.
8	D0	Input of data bit 0(2 ⁰) of frequency data digit or value data. Pulled up internally
9	D1	Input of data bit 1(2 ¹) of frequency data digit or value data. Pulled up internally
10	D2	Input of data bit 2(2 ²) of frequency data digit or value data. Pulled up internally
11	D3	Input of data bit 3(2 ³) of frequency data digit or value data. Pulled up internally
12	GND	GND of signal
13	OUT2	Output pin of CH2
14	OUT1	Output pin of CH1
15	GND	GND of signal
16	RXD	A synchronous serial RX data, CMOS/TTL. Keep open when not used.
17	TXD	A synchronous serial TX data, CMOS/TTL. Keep open when not used.
18	GND	GND of power supply and signal
19	EXT	External clock enable pin. Connect to H(+5V) to operate in external clock mode. Internally pulled-down, make it open in the internal clock mode.
20	GND	GND of power supply and signal
21	10M	External clock input pin. In the external clock mode, apply an accurate 10MHz external clock to this pin.

How to set parameter

Select the desired parameter setting mode by mode pin .

The relation between setting modes and the parameters are as follows:

Mode 0: Frequency of CH 1 can be independently changed.

Mode 1: Frequency of CH2 can be independently changed.

Mode 2: Amplitude of CH1 can be changed.

Mode 3: Amplitude of CH2 can be changed

Mode 4: Both CH1 and CH2 frequency can be set to same frequency.

The phase difference between outputs is according to the phase parameter.

Mode 5: Phase between CH1 and CH2 can be set.

The frequency set in mode 4 is used.

Setting value in each mode

Mode	Setting item	Range of setting value	Remarks
Mode0	CH1 frequency	0~20000000	1Hz resolution
Mode1	CH2 frequency	0~20000000	1Hz resolution
Mode2	CH1 amplitude	0~1000	1mV resolution
Mode3	CH2 amplitude	0~1000	1mV resolution
Mode4	CH1,2 frequency	0~20000000	1Hz resolution
Mode5	CH1,2 phase difference	0~3599	0.1° resolution

Not only parallel data setting but also serial data setting can be used in order to set the parameter. Setting can be done with both modes at the same time.

1. Setting by Parallel data

1-1. Setting frequency by parallel data

The frequency of each channel can be set with mode 0,1,4. In case of setting 8-digits frequency data, select the digit to be input first, and set the frequency data then. Selection of either the digit or frequency data of BCD SW1 can be made by A/D input. Here explains how to set 15,000,000Hz for example:

(a)Select the parameter to be changed after setting mode by BCD SW2.

(b)With S2 open, set DIP SW 1 to 0(digit of 1Hz) and push S1(short to GND).

(c)Close S2(short to GND), set BCD SW1 to 0(frequency data of 1Hz digit) and push S1.

(d)For 10Hz digit, similarly shown above (b) and (c), set BCD SW1 to 1(10Hz digit) when setting the digit, push S1 and set the frequency data 0.

(e)Set the frequency data from 100Hz digit to 1MHz digit to 0 in the same way.

- (f) In order to set 1MHz digit, open S2, set BCD SW1 to 6, and push S1, and then, close S2, set BCD SW1 to 5, and push S1
- (g) In case of 10MHz digit, with S2 open, set BCD SW1 to 7, and push S1, then close S2 and set BCD SW1 to 1, and push S1.
- (h) Finally the signal with your desired frequency is got.

1-2 Setting phase by parallel data.

Phase difference between channels can be set with mode 5. In case of setting 4 digits phase data, select the digit to be input first, and set the phase data. Selection of either the digit or phase data of BCD SW1 can be made by A/D input. Range of effective value is from 0 to 3599 in 1 step. So, value can be set from 0 ° to 359.9 ° . Here explains how to set 180.0 ° for example.

- (a) With BCD SW2, set mode to 5.
- (b) With S2 open, set DIP SW to 0(digit of 0.1 °) and push S1(short to GND).
- (c) Close S2(short to GND) , set BCD SW1 to 0(phase data of 0.1 ° digit) and push S1.
- (d) For 1 ° digit, similarly shown above (a),(b),(c), set BCD SW1 to 1(1 ° digit) when setting the digit, and push S1.
- (e) For 10 ° digit, with S2 open, set BCD SW1 to 2 and push S1, and then, close S2, set BCD SW1 to 8, and push S1.
- (f) In order to set 100 ° digit, open S2, set BCD SW1 to 3, and push S1, and then, close S2, set BCD SW1 to 1, and push S1.
- (g) Finally, the signal with your desired phase difference can be got. Even if the data for the digit more than 1000 ° was input, it would be invalid and neglected.

1-3 Setting amplitude by parallel data

Output amplitude of CH1,2 can be set with mode 2,3. In case of setting 4 digits amplitude data, select the digit to be input first, and set the amplitude data, then. Selection of either the digit or amplitude data of BCD SW1 can be made by A/D input. Range of effective value is from 0 to 1000 in 1 step. So, the value can be set from 0V~1000mVp-p. Here explains how to set 1000mVp-p for example.

- (a) Select the parameter you want to change after setting mode with BCD SW2.
- (b) With S2 open, set DIP SW to 0(digit of 1mV) and push S1(short to GND).
- (c) Close S2(short to GND), set BCD SW1 to 0(amplitude data of 1mV digit) and push 1. Thus the amplitude value of 1mV is to be set.
- (d) For 10mV digit, similarly shown above (a),(b),(c), set BCD SW to 1(10mV digit) when setting the digit and push S1. Next close S2 and set BCD SW1 to 0 and

push S1.

- (e) For 100mV digit, set BCD SW1 to 0 as above.
- (f) In order to set 1000mV digit, open S2, set BCD SW1 to 3 and push S1, and then close S2, set BCD SW1 to 1 and push S1.
- (g) Finally the signal with your desired channel amplitude can be got. Even if the data of the digit more than 1000mV was input, it would be invalid and neglected.

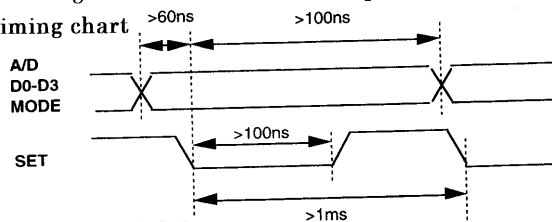
1-4 How to memorize parameter by parallel data

The current parameter can be memorized into the built-in EEPROM semi-permanently by making S2 open and setting BCD SW1 to A(10), then pushing S1.

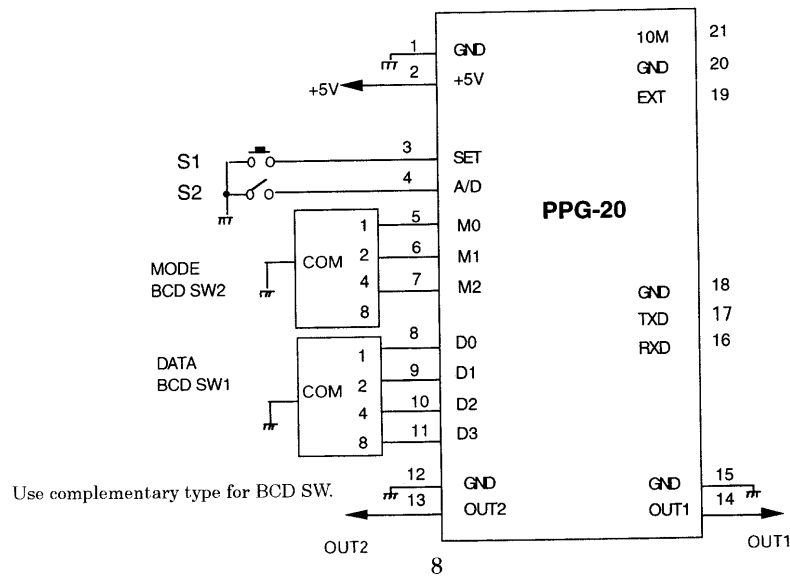
1-5 Caution to set the data consecutively

Since PPG-20 requires some process time when new data is set, Continuous data setting must be followed the timing chart as shown below.

Parallel data timing chart



Circuit example by parallel data



Function Table

A/D	D3	D2	D1	D0	Function
L	L	L	L	L	Setting data 0
L	L	L	L	H	Setting data 1
L	L	L	H	L	Setting data 2
L	L	L	H	H	Setting data 3
L	L	H	L	L	Setting data 4
L	L	H	L	H	Setting data 5
L	L	H	H	L	Setting data 6
L	L	H	H	H	Setting data 7
L	H	L	L	L	Setting data 8
L	H	L	L	H	Setting data 9
H	L	L	L	L	Set 10 ⁰ digit
H	L	L	L	H	Set 10 ¹ digit
H	L	L	H	L	Set 10 ² digit
H	L	L	H	H	Set 10 ³ digit
H	L	H	L	L	Set 10 ⁴ digit
H	L	H	L	H	Set 10 ⁵ digit
H	L	H	H	L	Set 10 ⁶ digit
H	L	H	H	H	Set 10 ⁷ digit
H	H	L	H	L	memory of parameter

H: open L: short to GND

Remarks: D0 ~D3, A/D must be valid at the falling edge of SET signal.

Mode Function table

M2	M1	M0	Mode
L	L	L	Mode0
L	L	H	Mode1
L	H	L	Mode2
L	H	H	Mode3
H	L	L	Mode4
H	L	H	Mode5
H	H	L	Mode 6(not used)
H	H	H	Mode 7(not used)

H: open L: short to GND

2. Setting by serial data

Terminal should be connected to PPG-20 with TTL-RS232C level converter as shown in circuit example below. Terminal communication parameters should be set as follows:

Speed	9600bps
Data	8bits
Parity	None
Stop bit	1 bit
Flow control	None

The following message is returned when PPG20 is power on.

```
PPG-20 PHASE GENERATOR VX.X
M>
```

“M>” is displayed as a prompt. M shows the number 0~7 in current mode. When the data is input correctly, “M>” as a prompt is returned. The entered code is echoed back. When the data received incorrectly or if some errors occurred during the transfer, it returns “INVALID DATA”. In case of setting consecutively, make sure whether M> is returned.

2-1 Setting mode by serial data

Input “MODEX”, for mode setting. As for X, input the number of 0~5. The following table shows the data when setting mode 1.

M	O	D	E	1	CR
4D	4F	44	45	31	0D
hex	hex	hex	hex	hex	hex

2-2 Setting frequency by serial data

Setting any of 0,1,4 for mode command, set mode of your desired frequency of channel. The frequency data has three formats; MHz unit input, KHz unit input and Hz unit input. When the data is input correctly, “M>” as prompt is returned, and output the desired frequency.

MHz unit

The following table shows the data in case setting 20MHz on MHz unit.

2	0	M	CR
32	30	4D	0D
hex	hex	hex	hex

The data less than 100KHz is set at “0” automatically.

KHz unit

The following table shows the data in case setting 20000KHz on KHz unit.

2	0	0	0	0	K	CR
32	30	30	30	30	4B	0D
hex	hex	hex	hex	hex	hex	hex

The data less than 100Hz is set at "0" automatically

Hz unit

The following table shows the data in case setting 20000000Hz on Hz unit.

2	0	0	0	0	0	0	0	CR
32	30	30	30	30	30	30	30	0D
hex	hex	hex	hex	hex	hex	hex	hex	hex

2-3 Setting the phase by serial data

Set mode to 5 in mode command. Phase value can be set from 0 to 3599 in 1step. It means that the phase difference is from 0~359.9° in 0.1 step. So, if the value more than 3599 was set, "INVALID DATA" would be returned. Here explains how to input 180.0° for example.

1	8	0	0	CR
31	38	30	30	0D
hex	hex	hex	hex	hex

2-4 Setting amplitude by serial data

The mode is set in 2 or 3 by mode command. Output amplitude can be set from 0 to 1000 in 1 step. It means that the output is from 0mV to 1000mV. So, if the value more than 1000 was set, "INVALID DATA" would be returned. Here explains how to set 1000mV for example.

1	0	0	0	CR
31	30	30	30	0D
hex	hex	hex	hex	hex

2-5 How to memorize the parameter by serial data

In order to memorize the current parameter into the built-in EEPROM, enter "SAVE" command as shown below. "EEPROM SAVED" message is returned, if the command is received correctly. This command can be used regardless of the mode.

S	A	V	E	CR
53	41	56	45	0D
hex	hex	hex	hex	hex

2-6 How to read-out the parameter in serial mode

The current parameter can be read with "READ" command.

First set mode in which you want to read parameter, then issue read command as shown below.

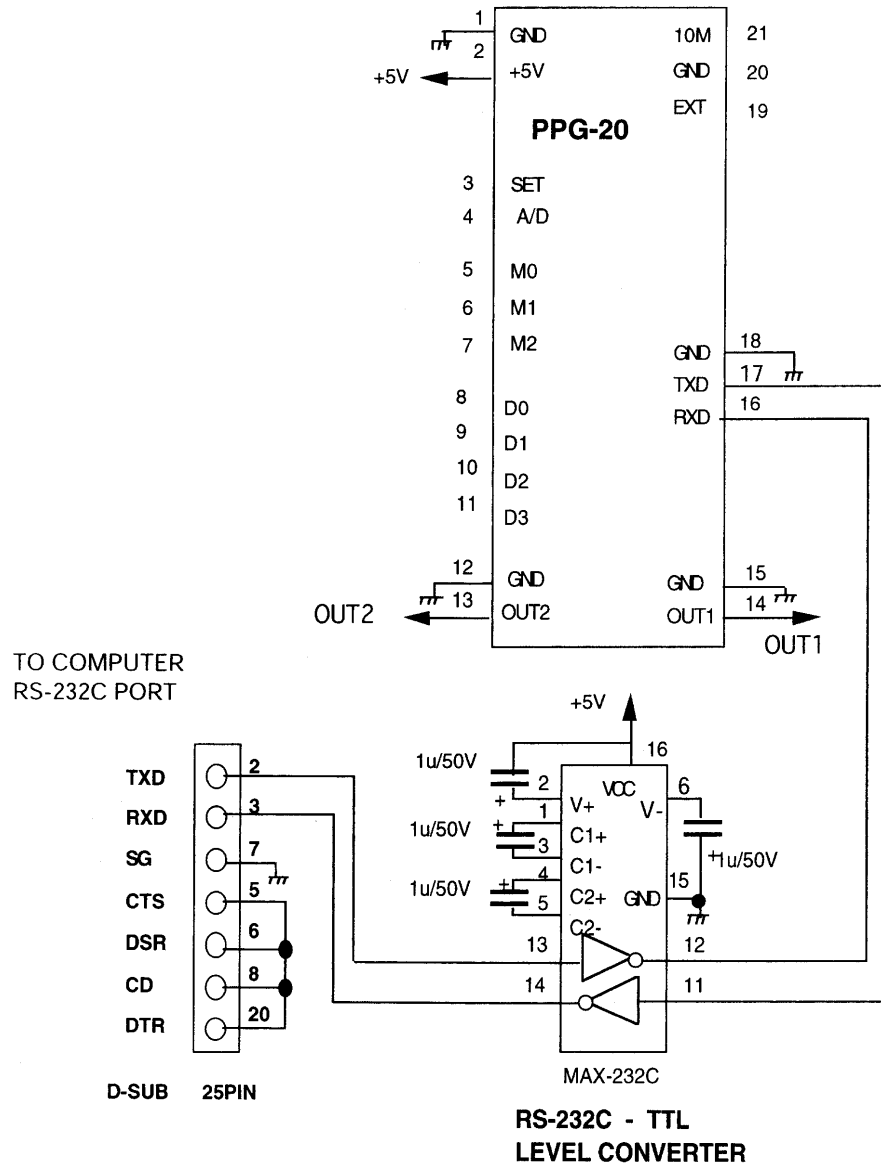
R	E	A	D	CR
52	45	41	44	0D
hex	hex	hex	hex	hex

1~8 digit parameter of ASCII code can be returned by read command .

2-7 Help menu

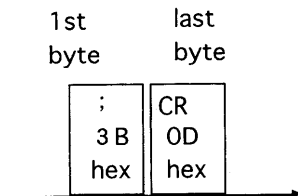
When the "HELP" command is input, an summary of function explanation is displayed. This command can be used regardless of the mode.

Circuit example by serial data



■ How to adjust the internal reference clock

The following command adjust the frequency of the internal reference clock on frequency adjustable mode of serial data.



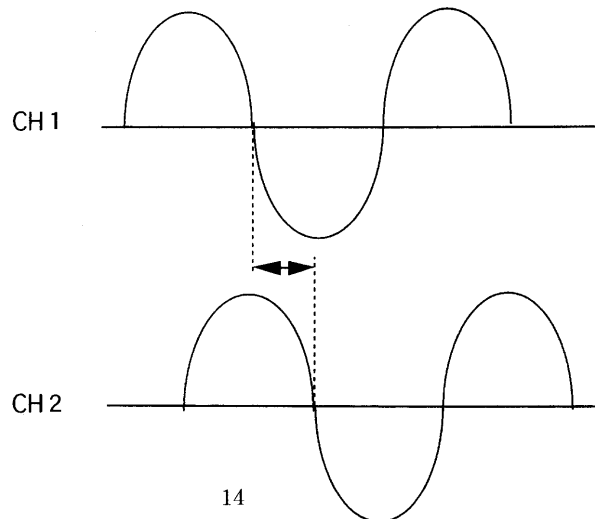
As the frequency is changed by entering the following code, adjust it keeping watch the frequency readout from a frequency counter. For the end, input any other code except the below.

- | | |
|-------------------------------------|----------|
| To step the frequency up finely | "u"75hex |
| To step frequency up coarsely | "U"55hex |
| To step the frequency down finely | "d"65hex |
| To step the frequency down coarsely | "D"45hex |

The new data is memorized into the built-in EEPROM when it exists.

■ The output phase differential drawing

The relation between the value and the signal of the phase difference is shown in the figure below.



■ Cautions

(1) The value of output level specified with 50 Ω termination.

When no termination is connected, the output voltage will be twice of the set value.

(2) When less than 100Hz frequency is required, use high impedance load.

(3) Use the same length of coaxial cable to the loads in application where absolute phase difference is critical.

(4) Selection of internal or external clock is not valid while power is on.

When change of clock mode is required, PPG20 must be reset by power off and on.

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