

Ultra-High Resolution FemtoStepper

100fs Resolution Phase Stepper

Easy-to-Use RF Device & Digital Control



Calibration | Time Transfer | Doppler Shift Compensation | Instrument

Applications

FemtoStepper Features

- | | |
|--------------------------------|--------------------------------|
| • Input Frequency | : 10 MHz |
| • Output Frequency | : 4 x 10MHz (5MHz optional) |
| • PPS capability | : 4 x 1PPS |
| • Phase-Time Step size | : 100fs |
| • Output Frequency Adjustment | : 1E-17 resolution |
| • RS232 standard interface | : 9600 b/s |
| • No calibration required | |
| • Internal Bit Alarm | |
| • Adaptable mechanical outline | : 2U rack mounted chassis |
| | : Instrument with feet |
| • Main Power Supply | : AC input 85-264VAC / 47-63Hz |
| • Backup Power Supply | : DC input 22-28VDC |

Key Application Features :

- Easy to use
- High resolution
- Low noise performance
- Digital Control
- COM standard interface

Key Applications :

- Time Keeping
- Time Lab device
- Time Transfer
- Frequency Drift Compensation
- Doppler Shift Compensation

System Description

The main feature of FemtoStepper is to adjust the output phase or frequency without changing the behavior of the master reference clock. The architecture based on heterodyne technique allows obtaining an extremely high resolution down to 100 femto-seconds. The output is generated from an ultra low-noise crystal oscillator phase-locked to the input improving the phase noise characteristic. The output frequency range is $\pm 1\text{E-}9$ with a fractional resolution of $1\text{E-}17$. The build-in 10MHz signal is used to generate the 1PPS output signal. Through a dedicated command, the 1PPS output can be aligned to a reference 1PPS input signal.

Phase and frequency adjustment function is very useful in applications where users need to compensate the master clock frequency drift (or the Doppler shift in satellite communications system) without changing its internal parameters. Thus, the behavior of the master clock can be assessed during a complete experiment.

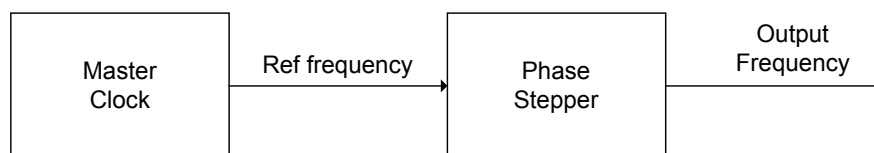


Figure 1- Application Diagram

The output phase or frequency is controlled using a RS232 digital interface through a set of defined commands. Status commands are also included. All commands are checked for correct syntax and valid range before execution.

Mechanical Outline

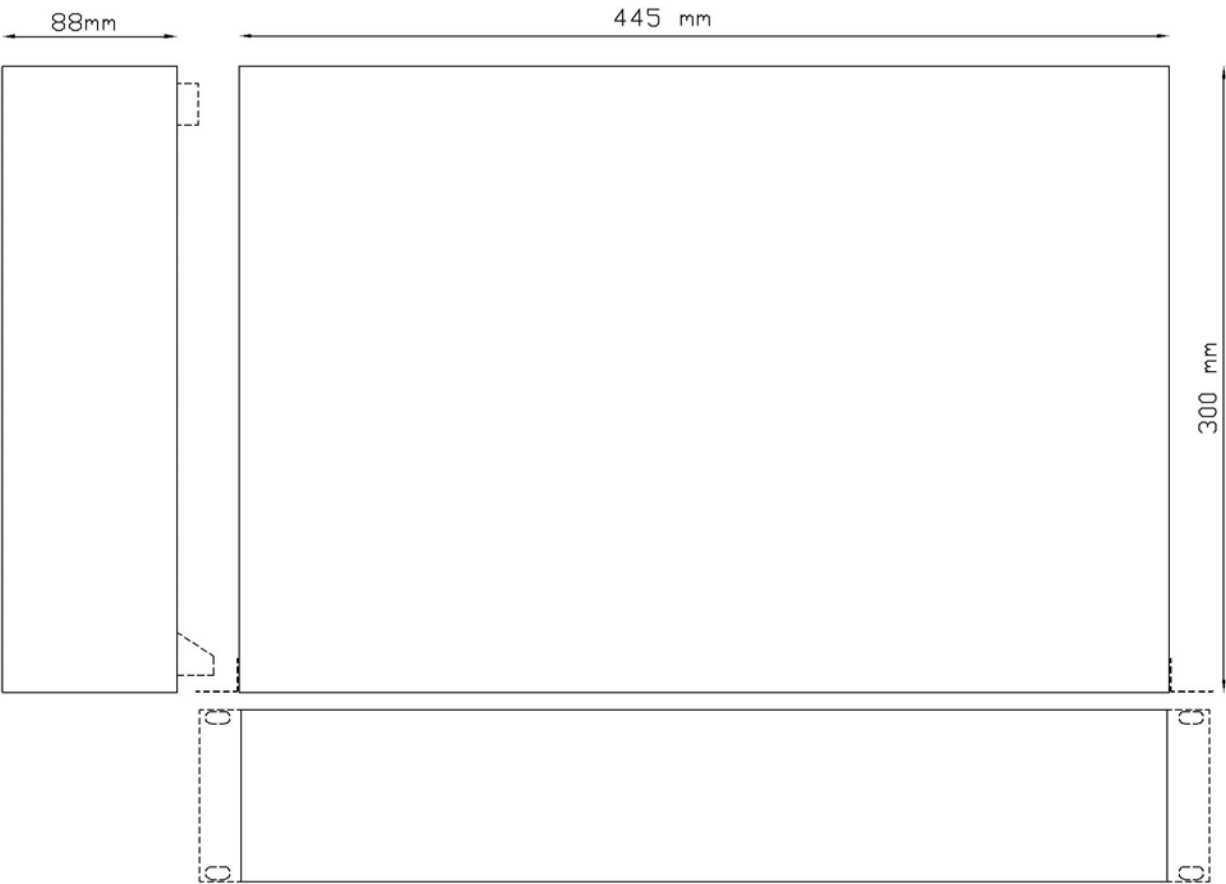


Figure 2- Mechanical Outline

RS-232 Command

The FemtoStepper can accept the following basic ASCII commands: Data is in decimal ASCII code.

Command name	Syntax command	Data field (if any)	Response syntax	Response data (if any)
Identification	ID<CR><LF>	-	TNTMPS-aaa/rr/s.ss<CR><LF>	aaa: 001 rr: revision number s.ss: software version
Serial number	SN<CR><LF>	-	xxxxxx<CR><LF>	xxxxxx : 6 digits serial nbr
Status	ST<CR><LF>	-	yyxx<CR><LF>	yy : always 00 (for future use) xx : HEX ASCII <u>Bit signification :</u> Bit 7 :- Bit 6 : backup power active Bit 5 : primary power active Bit 4 :- Bit 3 : frequency offset not 0 Bit 2 : stepping activity Bit 1 : OOL - Bit 0 : OOL +
Single Phase Step	PSs<CR><LF>	s= + : Positive Step s= - : Negative Step	s<CR><LF>	s: signe s= + : Positive Step s= - : Negative Step
Packet Phase Step	PSsdddddd<CR><LF>	s=+ : Positive Packet Step s=- : Negative Packet Step dddddd: number	sdddddd<CR><LF>	s:signe s=+ : Positive Packet Step s=- : Negative Packet Step dddddd: value
Actual phase offset	PH<CR><LF>	-	sdddddd<CR><LF>	s:signe s=+ : Positive Packet Step s=- : Negative Packet Step dddddd: value From 000000 To 500000
Frequency offset	FAsddddddd<CR><LF>	s= + : Positive offset s= - : Negative offset ddddddd: number	sddddddd<CR><LF>	s= + : Positive offset s= - : Negative offset ddddddd: value in 1E-17 relative frequency offset
Actual frequency offset	FR<CR><LF>	-	sddddddd<CR><LF>	s= + : Positive offset s= - : Negative offset ddddddd: value in 1E-17 relative frequency offset
Align PPSOUT to PPSREF	ALd<CR><LF>	d= 1 : align d= ? : alignment status	d<CR><LF>	d= 0: ready for alignment d= 1: alignment in progress d= 2: no PPSREF
Set PPSOUT delay (rounded to 200ns)	DEddddddddd<CR><LF>	ddddddddd=delay in ns. Max 999999800 ????????? :interrogation	ddddddddd<CR><LF>	ddddddddd=delay in ns. Min 000000000 Max 999999800
Send information every second	BTx<CR><LF>	x= 0 : Stop to send x= 3 : PPSRef position x= 5 : Status	x= 3 : aaaaaaaa sbbb<CR><LF> x= 5 : yyxx<CR><LF>	aaaaaaaa= PPSOUT vs PPSREF delay in ns. sbbb= fine phase comparator value in approx. ns yyxx= see ST command

Table 1 : Serial commands summary

SPECIFICATIONS**ELECTRICAL**

Type	FemtoStepper
	Standard version
10MHz input frequency	10MHz
10MHz input amplitude	+9dBm to +15dBm
10MHz input impedance	45Ω to 55 Ω
Number of 10MHz outputs	4 x10MHz (Option code : ' 5M' : 4 x 5MHz)
10MHz output amplitude	+11dBm to +15dBm
10MHz output impedance	45Ω to 55Ω
10MHz output connector	SMA female
10MHz output to output isolation	≥ 50dB
10MHz output phase noise 5MHz (typical -6dBc from 10MHz figures)	-90dBc / 1Hz -110dBc / 10Hz -130dBc / 100Hz -140dBc / 1KHz -150dBc / 10KHz -150dBc / 100KHz
Frequency Stability (with a relative frequency adjustment ≤1E-12)	3×10^{-13} / 1s 4×10^{-14} / 10s 7×10^{-15} / 100s 4×10^{-15} / 1'000s 2×10^{-15} / 10'000s
Relative frequency offset resolution	1E-17
Phase step resolution on 10MHz output	0.1 ps
Maximum frequency offset range	$\pm (1 \times 10^{-9} - 1 \times 10^{-17})$
Temperature sensitivity (input reference to outputs)	≤ 20ps / °C
1PPS input amplitude	TTL compatible level
1PPS input impedance	45Ω to 55Ω
Number of PPS outputs	4x 1PPS
1PPS output amplitude	≥ 2.3V
1PPS output impedance	45Ω to 55Ω
1PPS output pulse width	18μs to 22μs
1PPS output rise time	≤ 5ns
Phase offset between outputs	≤ 10ns
Phase stepping command	By RS232
Frequency offset command	
Status command	
Bit alarm	Front panel indicator

ENVIRONMENT

Type	FemtoStepper	
	Temperature	Relative Humidity
Operating	20 to 30°C	10% - 85%
Recommended operating	25°C ± 1%	50% ± 10%
Storage	-25 to 55°C	
Transportation	-25 to 70°C	

POWER REQUIREMENTS

Type	FemtoStepper
	Standard version
Input Range	85-264 VAC or 22-28 VDC
Frequency	47 – 63 HZ
Power Consumption @25°C	< 40W after warm-up
Connector Type	230VAC IEC plug

PHYSICAL:

Type	FemtoStepper
	Standard version
Size	445 x 300 x 88 mm (2U)
Weight	6.0 Kg
	Front connector Rack (Option R)

Ordering Information