COMTRADE Sample Rate Generator

Available for Models 1084, 1088 and 1089

The Arbiter Systems®, Inc. GPS Satellite-Controlled Clock, equipped with the COMTRADE Sample Rate Generator, generates any one of the 48 standard sampling rates for waveform digitization in 50 or 60 Hz systems as defined in IEEE Standard C37.111-1991, Data Exchange (COMTRADE) for Power Systems. Standard COMTRADE Sampling Rates are listed in Tables 1 and 2 (on following page).

The selected sample rate is available as a 5V CMOS-level square wave in both normal (rising edge of clock synchronous with 1PPS) and complemented (falling edge of clock synchronous with 1PPS) polarities. The sampling pulse is synchronized to within ±50ns of 1PPS, and has sample-to-sample jitter less than 1ns.

Principles of Operation

The assembly generates sampling signals which are precisely locked to 1PPS-GPS by phase locking a precision voltage-controlled crystal oscillator (VCXO) to the internal 1kPPS signal present in the clock. This VCXO output signal is then divided down to obtain the desired sampling rate. Synchronization logic is also provided, to ensure that the output divider is synchronized to 1PPS-GPS. By using a precision VCXO, pulse-to-pulse sampling jitter is held to an absolute minimum, and is specified not to exceed 1 ns rms. The output signals have a 50% duty cycle (square wave).

Other Features

This assembly includes four configurable BNC outputs, which are in addition to those available for the standard model clock. Either normal or complemented-polarity COMTRADE sampling frequency signals may be made available at each of these additional outputs. Furthermore, any output not configured for a COMTRADE sampling rate output can be used as a general-purpose configurable output, and can deliver any of the standard signals that are available in the clock.

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Table 1. Sample Rates, $f_{LCM} = 384 \times f_{base}$

Samples/cycle	fs for 60 Hz	fs for 50 Hz
384	23040	19200
192	11520	9600
128	7680	6400
96	5760	4800
64	3840	3200
48	2880	2400
32	1920	1600
24	1440	1200
16	960	800
12	720	600
8	480	400
6	360	300
4	240	200

Table 2. Sample Rates, $f_{LCM} = 3200 \times f_{base}$

Samples/Cycle	fs for 60 Hz	fs for 50 Hz
3200	192000	160000
1600	96000	80000
800	48000	40000
640	38400	32000
400	24000	20000
320	19200	16000
200	12000	10000
160	9600	8000
128	7680	6400
100	6000	5000
80	4800	4000
64	3840	3200
50	3000	2500
40	2400	2000
32	1920	1600
20	1200	1000
16	960	800
10	600	500
8	480	400
4	240	200

Specifications

Performance

Accuracy	± 50ns from 1PPS, max (-10ns, typical)
Jitter	1ns rms, max. pulse to pulse (guaranteed by design, not production tested)

Outputs

Connectors	Four, BNC 50-ohm, configurable
Signals	Normal Polarity COMTRADE Sample Rate, 50% Duty Cycle
	Complemented COMTRADE Sample Rate, 50% Duty Cycle
	All Other Signals Available in 1088B or 1084A/B/C Clocks

Drive Capability

Digital	5V CMOS Buffer, 50 Ohms Impedance
Analog	Opamp Buffer, 600 Ohms Impedance

62

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