
High Reporting Rate Frequency Disturbance Recorder (FDR) Specification



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1. Introduction

This document is to illustrate the technical specifications of the GPS-synchronized High Reporting Rate Frequency Disturbance Recorders (FDRs) that allows the use of FDRs from multi suppliers for the successful implementation of the Network.

2. FDR Overview

An FDR (Frequency Disturbance Recorder) is an embedded microprocessor system with GPS time synchronization and Ethernet communications capability. FDR measures power system voltage ranged from 100V to 140V and 210V to 250V (50Hz to 60Hz) outlets commonly located in offices and at home. It takes voltage measurements on a continual basis and calculates power system frequency and phase angle.

Locally calculated data is time-stamped using a highly accurate GPS clock and streamed to servers in real time. The FNET system enables researchers to study behaviors within interconnected power systems and to propose advanced methods for power system control.

3. Specification

INPUT

Voltage range	100 ~ 140 V
	210 ~ 250 V
Power	< 10 W
Frequency	45 ~ 55 Hz
	55~65 Hz
Connections	Wall Outlet

INTERFACE

Status LED	Power (orange)
	GPS (red)
	Network (green)

Display	LCD display
Ethernet	RJ-45 modular
Protocols	UTK F-NET

ACCURACY

Frequency	± 0.0005 Hz
Phase Angle	± 0.0005 rad
Voltage	< 0.2%

RESOLUTION

Frequency	0.0001 Hz
Phase Angle	0.0001 rad
Voltage	0.001 V

Data Rate

Input voltage sampling	Voltage input is sampled at 1,440 Hz
Output data rate	120/sec

Time Synchronization

GPS	GPS synchronized data collection using UTC time
Connection	BNC
Cable	9 ft; longer cables optionally available
Timebase Error	< 1 μs

Output

Output data rate	14.4 kB/second
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Other specifications

Outputs: frequency, absolute phase angle, UTC time, location, and voltage magnitude at 10 data messages per second

Continuous data transmission with local LCD display

Ethernet-enabled; data are transmitted to the data server through Ethernet cable directly connecting the FDR and the data server, or via the Internet to the FNET servers

ACCESSORIES

Power cable

GPS antenna and cable

Ethernet cable

4 Communication:

FDR supports TCP/IP protocols. The FDR transmits data as ASCII text in the clear; i.e., no encryption is used. Frames are fixed-length. Each frame begins with the byte 0x01 and ends with 0x00. Spaces (0x20) are used to delimit the data. A typical frame would look something like this:

	Start Byte		UnitID		Date		Time		ConvNum		FirstFreq		FinalFreq		Voltage		Angle	Stop Byte	Total
Length	1	1	3	1	6	1	6	1	2	1	7	1	7	1	8	1	6	1	55
Hex	01	20	36 39 32	20	30 35 32 31 31 30	20	31 34 32 32 35 35	20	20 33	20	36 30 2E 30 30 34 33	20	36 30 2E 30 30 34 33	20	31 32 30 2E 37 35 37 30	20	32 2E 31 38 36 33	00	
ASCII			692		052110		142255		3		60.0043		60.0043		120.7570		2.1863		

Each byte is represented in hexadecimal notation. The date field is in MMDDYY format. In this example, the packet was sent on May 21, 2010. The time field is in HHMMSS format where 24-hour UTC time is used. The ConvNum field indicates the 0.1 second interval. In this example, the measurement was made at 14:22:55.3 UTC. The ConvNum field is left-padded with a space (0x20). The location information is transmitted at the beginning of every minute using the FirstFreq field. The first sample of the minute

will contain the latitude in this field. The second sample will contain the longitude, and the third will contain an integer showing the number of GPS satellites the FDR is using.