The Powerful, Flexible Solution for Data Acquisition and Analysis

E-MAX Wave
Digital Fault Recorder

Intel Atom™ Processor
Windows 7 Pro™ Operating System
Enhanced Report Screens
Software Auto-Calibration
The Digital Fault Recorder (DFR) monitors voltages, currents and digital (event) inputs in an electrical power system environment to detect and record out-of-limit conditions. When such a condition is sensed, data including a specified prefault period is captured and stored in the recording system. The Recorder transmits the data automatically or on command to one or more locations. The transmission time from each station is minimized to allow several recorders which may have captured data to quickly complete transmission.

The Recorder has non-volatile storage for data retention in the event that communications or system power is interrupted.

All functions are controllable at the Recorder site as well as remotely from any site with compatible equipment and software. The Recorder has security functions to restrict remote access to authorized users.

**Advanced DFR Features**

**Data Sensing and Capture**
Automated software calibration of inputs

**Static, Non-volatile Data Storage Transmission**

**Automated and On Demand Data Transmission**
Data files
Graphic fax capability direct viewing or printing

**Fault Data Summary**
Presented On-Screen immediately after Capture

**Detailed Fault Analysis**
Supported by Array of Analysis Programs
Including Fault Location when activated

**Hardware Features**

32 Analog and 64 Digital Channels

High Noise Immunity Data Conversion

Completely Static, Non-Volatile Memory

Fanless CPU and Supporting Circuitry
ANALOG INPUT CHANNELS

32 Analog Channels, factory configured for 16 voltage and 16 current

Each analog channel uses an auxiliary transformer for isolation and scaling.
Channel to Channel Isolation: 1500 Vrms 1 min. Software sensors are supplied for each channel. Multiphase sensors are available as options.

Analog-to-Digital Conversion
One Sigma-Delta type analog converter is supplied for each eight channels and all channels are sampled simultaneously. Sigma Delta Converters are designed to deliver exceptional noise rejection by use of oversampling which results in at least 6 db better than other converters.

Sampling Frequency:
Equivalent to 5760 Hz. Data cutoff set at 2880 Hz.

Voltages Channels
Input: 67 volts rms nominal

Current Channels
Input: 5A nominal
Maximum: 100 A, 1 sec.

DIGITAL INPUT CHANNELS

64 Digital Channels (4 groups of 16)

The Digital Channels are equipped for performance equal to any Sequence of Events Recorder (SER). This includes individually settable debounce characteristics and programmable automatic inhibit for nuisance contacts.

Input Type: Isolated dry contact Isolation:1500 Vdc

Triggering:
Operation: Each channel settable for N.O and/or N.C Operation
Debounce: Individually settable from 1 to 30 milliseconds
Inhibit: Programmable to stop recording for nuisance contact
Operation - auto reset programmable for daily reset

Field Contact Voltage: Voltage: 48 to 156 V nominal < 3 mA per channel @ 125 Vdc
Auto-Calibration
The DFR software includes automated functions so an operator can quickly and easily calibrate the system. No hardware adjustments are necessary.

Recording Capacity
The Digital Fault Recording System monitors and records 32 analog channels and 64 digital points. Analog inputs are isolated through instrument transformers. Digital inputs are optically isolated and configured for dry contact input.

Voltage Inputs
Voltage Inputs are monitored through transformers, and have an input range from 0 to 250 Vrms.

Current Inputs
Current Inputs are monitored through current transformers, and have a nominal rating of 5 A rms. They will withstand up to 200 A for 1 second without damage.

Resolution  16 bits

Analog Channel Scan Rates
Standard scan rate for the Analog Channels is 5760 samples per channel per second. The frequency response of all Analog Channels is 1500 Hz

Input Voltage Isolation
The Analog Channels are isolated to 1500 Vrms, channel-to-channel and channel-to-ground.

Analog Channel Triggers
Each Analog Channel has three triggers:

Over Trigger
Under Trigger
Rate of Change Trigger

The settable range for the Over and Under Triggers is 0-100% of full scale, and +1% to 50% for the Rate Triggers.

All Trigger settings are programmable both locally and remotely.

Operation Limiters
Each Analog Channel has a separate Operation Limiter to restrict data recording to a user configurable length, in the event of a persistent trigger condition. Each Operation Limiter is independent and automatically resets when the trigger condition clears.

Recorded Data
When triggered, the system captures and stores the digitized data for all inputs. The data includes the Recorder Settings in effect at the time of the trigger. The data also includes transformer ratios, trigger settings, calibration values, trigger information, and amplitudes of the triggering quantities.

Simultaneous Sampling of Analog Channels
All Analog Channels are sampled within 500 nanoseconds of each other to maintain channel-to-channel relationships in the recorded data.
Digital/Event Inputs
The Event inputs are sampled at the same rate as the Analog inputs. The Event resolution is 1/5760 seconds.

Event Input Isolation
The Event Channels are isolated to 1500 Vrms, channel-to-channel and channel-to-ground.

Input Contact Rating
Maximum input current at 125 Vdc is 8 mA/channel.

Minimum Event Resolution
Event resolution is better than 1 millisecond.

Data Recording
Each DFR record includes pre-trigger, trigger, and post-trigger data. The DFR records pre-trigger data, user settable up to 99 cycles. Recording continues as long as the fault is present or until the operation limiter is reached. Post-trigger recording time is programmable, up to 99 cycles.

The Recorder has a memory capacity of 64 GB. The system has a function that overwrites the oldest record when memory is full. All records can be retrieved by central stations. Data can be converted to COMTRADE format automatically or on user request. Records can be transferred to removable media or printed through USB ports.

Record Contents:
- Time Scale
  Time of trigger including month, day, hour, minute and second
- Substation Name

  Trigger information is supplied including fault time, date, station name, fault data of current and voltage.

  The Recorder Data Summary shows the trigger source and channel number of the trigger.

  The minimum and maximum value of each channel in system quantities is computed after the completion of the recording cycle. The readings can be printed as the rms value or the instantaneous values of each channel. The program scans the entire record, channel by channel and stores the maximum and minimum values for each channel.

  The complete Min/Max Data Summary shows the max and the min amplitude during the recording period.
Erasure of Records
If the non-volatile memory becomes full, the Recorder overwrites the oldest stored record in order to record new data. An operator can disable this feature to prevent older data from being overwritten.

Downloading of Records
The E-MAX DFR downloads any stored record to multiple Master Stations. All such data transfers are possible without interruption of input monitoring and data capture functions.

Program and Parameter Storage
Program and trigger setting data is stored in non-volatile media. Updating of all parameters and programs can be completed from Master Stations, over a local network or dialup connection, and by a local computer through an Ethernet port on the recorder. The system automatically starts in standby condition, ready to capture data, when power is applied.

Data Retrieval, Viewing and Printout
Data records can be viewed on the local display with the options to print some or all of any selected record and transmit records to a Master Location.

Printer Requirement
The Recorder is provided with software and drivers to enable local printout of calibration and data records.

Report Transmission
The Recorder has immediate background transmittal of an Operations Summary, Recorder Data Summary and/or Recorder Data Summary with Oscillogram to user selected email addresses.

Programming
Changes to the system, trigger settings, and communication parameters can be completed at the DFR on the Touch Screen or remotely over the communications channel.

Data Extraction
Local and Master Station programming is supplied for automatic data extraction to allow transmittal of channels that are out-of-limit and those designated as associated to the triggered Channels (example: all phases of a line group).

In addition, single or multiple channel extraction are possible from the Master Station or laptop computer connected to the Recorder. The user specifies the length, pre-fault and post-fault of the extracted record. Data extraction must not interrupt Recorder monitoring or data capture functions.

Communications Requirements
The Recorder communicates over a LAN with one or more Master Stations using standard communications hardware. Program and setting changes are possible over the communications channel. Maintenance and calibration testing and checking functions are available from the Master Station computers.

Network Requirements
The Recorder includes a 10/100 BaseT network adapter for connection to the network to monitor, capture, and store records as determined by the Triggers during fax operations.
Fault Data Summary
This screen is automatically presented after a fault and is also available for automatic transmission to the addresses set up in the DFR (5 addresses max).

Data presented include:
- Station Name
- Date of Fault
- Time of Fault
- Fault Record Number
- Triggering Sensor
- All Analog and Event Channels Operated
- Fault Data Location and Type

Graphic Data Generation and Transmission
The DFR can be set to generate a TIFF file for automatic transmission and direct viewing at a Remote or Master Station.

Local Data Analysis And Viewing
The DFR can deliver full data presentation and analysis while the system remains on-line. The full Analysis and Display program is available to the operator with the DFR in STANDBY mode. Records can be presented and manipulated on-screen.
Analog Input Options:
1) 8 inputs (4 Voltage Channels, 4 Current Channels) — 2) 16 inputs (8 Voltage Channels, 8 Current Channels)
3) 24 inputs (12 Voltage Channels, 12 Current Channels) — 4) 32 inputs (16 Voltage Channels, 16 Current Channels)

Analog Input Range:
Voltage: 0 to 200 Vac rms or Current: 0 to 100 Amp.

Accuracy:
<1 %, calibrated to .5%

Analog Isolation:
1500 Volts rms

Sampling Rate:
5760 samples/channel/second for 60 Hz systems, 6400 samples/channel/second for 50 Hz systems.

Digital/Event Inputs:
16, 32, 48, 64 inputs
1. Input Configuration N.O. or N.C. (Software Selected)
2. Input Voltage 48 - 150 Vdc
3. Isolation 1500 Vdc (To Ground) and between inputs

Sensors:
Auto-resetting standard
1. Analog Sensors Over-, Under- limits and rate software sensors on each channels
2. Operation Limiters Individual Channel: Software Settable up to 15 minutes per fault after last trigger. Auto Reset
3. Event Sensors Individual Programmable (N.O., N.C., Trigger on ALARM and/or RETURN)
4. External Sensors Contact or voltage input

High Speed Fault Recording:
Prefault Period: Up to 20 seconds. Default setting: 10 cycles.
Postfault Period: Minimum Record Length can be set with System Parameter file .1 - 5 seconds (0.5 sec default).

Resolution:
16 bit

Power Supply:

DFR Processor:
Intel Atom N270 Fanless CPU, 1.6 GHz with 2 GB RAM

Graphic Output:
Optional: Color inkjet and laser printers
Remote output via email, network, or fax transmission.

Data Storage:
Minimum 160 GB SATA Hard Disk drive, Optional Solid State Drive

Clock:
GPS Timing - GPS Receiver or IRIG B Decoder Internal (1KHz or TTL), External GPS Clock, or Internal GPS Clock Decoder
Accuracy: Better than 20 µs. Crystal controlled backup

Communications Capability:
1. To Remote Computers Auto transmission of data files over LAN or Dialup.
Functions with multiple-Master system.
Complete Remote Control
2. Email Automatic reporting to multiple user selected email addresses
3. LAN and WAN Software supports communication via TCP/IP

Software Supplied:
Microsoft Windows 7 Pro
1. Operating System For Digital Faut Recorder, operating with setting, recording, communications and display capabilities.
2. Master Station & Recorder Windows compatible data display and analysis software.
Complete remote control, test and data retrieval, display and screen manipulation.
Remote setting of program and system parameters.
Full data analysis program at the recorder requires a local display, keyboard and mouse.
3. Communications Remote Control Computing Program - Communication Software
10/100/1000 Base TX Network control and data transmission (Ethernet)

Environmental Characteristics:
Operating Temperature 0° To 50° Centigrade
Storage -20° to 65° Centigrade
Relative Humidity 0 to 95% R.H. non-condensing
Surge Withstand Capability: Designed to meet: IEEE C37.90.1 - 2002™

Quality Certification:
ISO 9001:2008

International Standards Compliance

 Relay Safety Immunity
 IEC 60255-2 IEC 61000-4-2
 IEC 60255-4 IEC 61000-4-3
 IEC 60255-5 IEC 61000-4-4
 IEC 61000-4-6

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