

Multi-function Intelligent Electronic Device

BEN600

Ultimate in the field of high voltage monitoring, the **BEN600** can easily spread its measurement points throughout your high voltage universe. Grouped into one structure, it shines by its accuracy, and the variety of measurements and sizes one can configure it for.

- **Multi-Function (DFR or DSM, PQM)**
- **16-bit data acquisition at 10 or 12 kHz**
- **Single speed triggered recording**
- **Centralised, decentralised¹⁾ architecture**
- **Standardised IEC 61850 communications**
- **Up to 32 Analog inputs and 64 Digital inputs.**
- **Up to 200 Derived quantities (virtual channels)**

General

Measuring System

Revolving around a powerful multi-tasks and real time operating system embedded in its core, the easily distributed architecture allows the complete overview of a high voltage environment from a single, extremely dependable and accurate, stand point.

Depending upon your specific requirements it can be configured either as a DFR or as DSM;

A compact **Digital Fault Recorder** with state-of-the-art resolution (16bits) and accuracy (0.1%) can be deployed with minimal intrusion and maximum communication into the protection panels (**Remote Acquisition Units** for 8 voltages and 16 Digitals are as small as 89mm (3.5") high). The system channel capacity allows the monitoring of the widest applications.

Or

A versatile **Dynamic Swing Monitor** allows the combination of any inputs to create derived quantities²⁾ to trigger long duration records for system stability or power flow analysis.

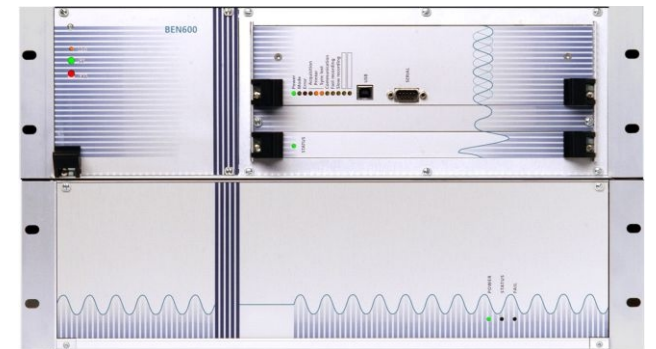
An optional comprehensive **Power Quality Monitor** elaborating and compiling the Power Quality profile of the connected signals and offering them for restitution in a standardized fashion. The BEN cross triggering capability allows fast (DFR) or slow (DSM) signals recordings to happen upon a PQ event, significantly easing identification of its origin.

¹⁾ Up to maximum 3 km

²⁾ Derived quantities may be recorded by the fast **DFR** or slow **DSM**



Application examples

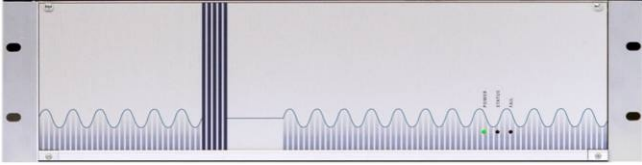


- **Single feeder monitoring**

Speed	Signals	Triggers	Comments
Fast Analog	3U & 3I, V ₀	>I, <U, V ₀ ,	Line fault
Fast Digital	Bkr pos, Prot. trip	Dig Edge or level	
or			
Slow Analog	P, Q, Urms	dP/dt, dQ/dt, dF/dt, Freq, <U	System collapse, Swing, Power flow monitor.
Slow Digital	Bkr pos. Prot. trip	Prot. trip	Proof of service

Complete substation or multiple feeders monitoring (multiple RAU's)

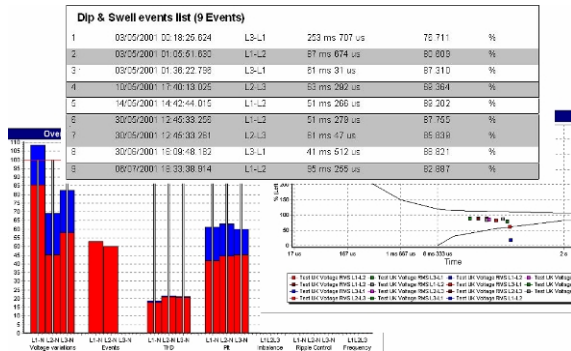
The signals monitored are the same per feeder as the ones for a single feeder, yet all Remote Acquisition Units can be connected to a single Control Unit through optical fibres.



Power Quality Monitor

Detection, capture and restitution of PQ events and trends in a standardized fashion. PQ profiling at an interface between distribution and load, or between utilities at the transmission level.

Type of Event	
Sags (Dips)	✓
Swells	✓
Long duration variations	✓
Voltage distortion	✓
Harmonics	✓
Flicker	✓
Frequency variations	✓
Unbalance	✓



General Technical data

Analog Inputs

Voltagess	5, 20, 140 & 300 Vrms
Currents	50, 200 Arms on 0.1Ω shunt ³⁾ (100A*1s std) (special 4-20mA range)

The current shunts may be internal to the CAU or external to a AVAU.
 Bandwidth (±0.5dB): DC to 0.38 x Fs (Fs ≥10kHz)
 DC to 0.3 x Fs (Fs = 5 or 6 kHz)
 Cut-off frequency (-3dB): 0.49 x Fs (Fs ≥10kHz)
 0.32 x Fs (Fs=5 or 6 kHz)
 Attenuation: 90dB min above 0.54xFs
 Common mode rejection: 74dB min (140V range)
 Signal/Noise ratio: 82dB min
 Time skew between channels: 5µs max
 Cross talk between channels: <-84dB
 Insulation resistance: >100MΩ
 Common mode isolation (IEC255-5): 2.5kV RMS
 Oscillatory waves (IEC61000-4-12)⁴⁾: 2.5kV
 Surge withstand capability (IEC 61000-4-5) CM 4kV
 DM 1kV
 Fast transient capability (IEC 61000-4-4) CM 4kV
 DM 2kV

Digital Inputs

Vnom	Vil min	Vil max	Vih min	Vih max
24-36	-70 V	5V	17 V	70 V
48-60	-80 V	10 V	34 V	80 V
110-130	-160 V	25 V	80 V	160 V
220-250	-300 V	45 V	160 V	300 V

³⁾ Other shunt values available
⁴⁾ Performance criteria: A

Time skew between channels: 25µs max
 Insulation resistance: >100MΩ
 Common mode isolation (IEC255-5): 2.5kV RMS
 Oscillatory waves (IEC61000-4-12)⁴⁾: 2.5kV
 Surges withstand capability (IEC 61000-4-5)⁴⁾: CM 4kV
 DM 1kV
 Fast transient capability (IEC 61000-4-4)⁴⁾: CM 2.5kV
 DM 1kV

Acquisition Characteristics

Sampling speed	Fast: 1-12kHz (or) Slow:1-120Hz
Accuracy	0.1% on V — 0.2% on I
Resolution	16 bits optimised per input ranges
Memory Capacity	Std. 64Mb
Mass storage (optional)	FlashDisk of specified capacity
Time resolution	Record tagged to 0.1 ms
Skew between different BEN's	<20µs with IRIG-B/J+1pps pulse
Absolute time precision	<50µs with IRIG-B/J+1pps pulse or 5 ms (typical) if external pulse or IRIG-B only.
Absolute time drift	10 ppm. max without external synchro.

Triggers and Derived Quantities (virtual channels)

Physical analog channels	
Virtual (derived) quantities: RMS, P, Q, F, Sequence components, Unbalance	Level, Rate Of Change, Adaptive Rate Of Change
Digital channels	Edge

- Threshold resolution: 0.1%
- Tpost: 0.02 to 1300s (resolution: 10ms)
- Tmax: 0.05 to 3000s (resolution: 10ms)
- Tnhhibit: 0 to 24h (resolution: 10ms)
- Rate of change: Time window: 10 to 1000ms

RMS value:

Accuracy: see analog input
 Response time: 60ms typ

Frequency:

Range: ±8Hz around nominal value
 Accuracy: 2mHz (±2Hz around nominal value)
 Response time: 240ms min (adjustable)

Power (dP/dt, dQ/dt):

Accuracy: 0.4%
 Response time: 40ms typ
Phase angle: (only in DSM mode)
 Accuracy: 0.1°
 Response time: 175ms typ

Zero-sequence:

Accuracy: 0.15% on voltage inputs, 0.25% on current inputs
 Response time: 50ms typ

Positive/Negative sequence:

Accuracy: 0.2% on voltage inputs, 0.3% on current inputs
 Response time: 60ms typ

Unbalance:

Accuracy: 0.25% on voltage inputs, 0.35% on current inputs,
 Response time: 60ms typ

Input / Outputs

in	Real time clock synchro	Modulated IRIG-B/J, pulse Serial IRIG-J + 1pps Synch pulse input
i/o	PC direct	EIA-232, USB
i/o	Modem	V24
i/o	Ethernet	10Base-FL, 100Base-FX
out	Printer	Centronics

Isolation resistance: >100MΩ
 Common mode isolation: 1kV RMS
 Fast transient capability (IEC61000-4-4): CM 2kV
 Ethernet: 10Base-FL or 100-BaseFX,
 Effective throughput: 100KB/s

Synch pulse input: Vih: 15 or 80V,
 Twidth: 5ms min
 Period: 1, 5 or 15 min, 1 or 24 h

i/o	Calibration	1 x EIA-232 per Acquisition controller.
out	Relays	8 potential free contacts (optional 8 additional)

Contacts rated (NO/NC): 250VRMS - 5A (resistive load), 110V - 0.5A DC
 Delay from start bus: 15ms
 Minimum alarm duration: 100ms
 Isolation resistance: >100MΩ
 Common mode isolation (IEC 255-5): 2.5kV RMS
 Oscillatory waves (IEC61000-4-12): 2.5kV
 Surges withstand capability (IEC61000-4-5): CM 4kV
 Fast transient capability (IEC61000-4-4): CM 2kV

Power Supply

Model	Vin
SENS 941-04	48 - 60 VDC
SENS 941-01	110 - 220 VDC or 125 - 220 VAC

Tolerance on input voltage: ±20%
 Isolation resistance: >100MΩ
 Common mode isolation (IEC255-5): 2.5kV RMS
 Oscillatory waves (IEC61000-4-12)⁴⁾: 2.5kV
 Conducted disturbances (IEC61000-4-6)⁴⁾: 10V/m
 Surges withstand capability (IEC61000-4-5)⁴⁾: CM 4kV
 DM 2kV
 Fast transient capability (IEC61000-4-4)⁴⁾: CM 4kV
 DM 2kV
 Electromagnetic emissions: EN 55011 class A

Environment

Operating: 5 to 55 degrees °C without disk
 5 to 45 degrees °C with disk
 5 to 40 degrees °C with battery option
 Storage: -10 to 65 degrees °C
 Humidity: 10 to 90% non-condensing
 Vibration (IEC 68-2-6): 4.9m/s²
 Electrostatic discharge (IEC 61000-4-2)⁴⁾: class 4
 Radiated Electromagnetic field (IEC 61000-4-3): class 3

Hardware

Control Unit

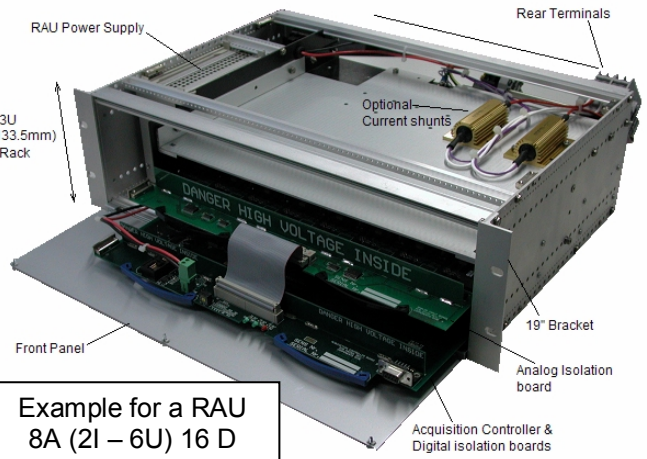
Built on an industrial Compact PCI bus and one 250 Mips CPU card; compact in size (3U high)

Data Acquisition Units

Up to 4 Data Acquisition Units can be assembled in the configuration. The AU's exists in the following versions:

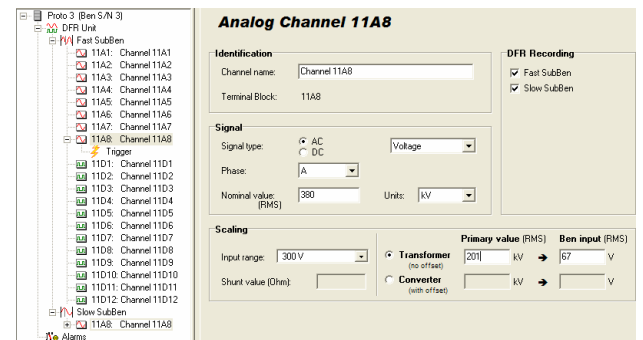
- All Voltage Acquisition Unit (AVAU)
 For 8 analog voltages and 16 digital inputs
- Current Acquisition Unit (CAU)
 For up to 8 analog currents (the remaining channels are voltages) and 16 digital inputs
- All Digital Acquisition Unit (ADAU)
 For 32 digital inputs
- Remote Acquisition Unit (RAU)
 An assembly of AVAU's and/or CAU's and/or ADAU's remotely located from the Control Unit. It includes its own power supply and optical fibre interfaces for the connection to the Control Unit.

⁴⁾ Performance criteria: A



Software

Configuration



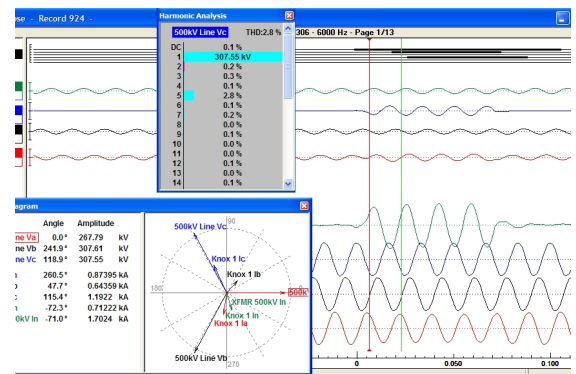
The CONFIGURATION software offers a comprehensive Windows™ environment for the definition and tuning of the BEN600 basic functionality and settings.

- identification of terminals
- scaling
- types of recording and triggers
- settings
- relay functions
- circuits and communications
- Diagnostic of the remote recorder to the board level

Analysis and communication

Thanks to the true multitasking capabilities of the Analysis Centre Software, all communication are performed in the background while the user works with analysis or other functions. The use of high transfer baud rates (up to 115200 Bps) and powerful data compression algorithms considerably reduces communication time.

Once retrieved, the records are then introduced in the analysis software database which allows file classification with user defined classes (and comments), record names, DFR serial number, triggering date and time, record weight,...File sharing on a LAN is also supported.



The BEN32 Master Station software allows the data collection by various means and a multi-facetted analysis for a complete power system event overview, analysis and reporting.

- 32 bit application for faster access to data
- Records Database
- Multitask software (doing communication, analysis, reporting simultaneously)
- Single software for analysing, communicating, updating of parameters, reporting, ...
- Windows™ 2000/XP operating systems
- Ethernet or serial communications
- Instant record opening
- Fast scrolling and zoom function
- Easy creation of user defined layout with drag and drop operation on record channels
- User's annotations superimposed on signal trace
- Amplitude modification with channel stretching handles
- Time and waveform amplitude delta measurement by means of two cursors
- Display the digital event information in a sequence of event recorder format
- COMTRADE import/exports
- Multiple analysis windows for parallel analysis of two records at the same time whether from the same BEN, from different BEN's or from any device providing COMTRADE compatible files
- In-screen annotations
- Extended printout capabilities allowing the user to print whole or partial records with the desired resolution
- Comprehensive on-line help

BEN 32 software remains fully downward compatible with any existing BEN recorder.

BENLOC: High Precision Fault Locator Software.

- Single ended fault locator
- Possibility to adjust the calculation at every step
- Calculation of the fault location for successive faults states within one record
- Identification of the most accurate location according to the fault states
- Comprehensive report
- High accuracy (typical <2%)

Scope of Delivery

Please contact your sales office for details as we offer complete systems on customer requirements.

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