

TR2000 SERIES


Multi-Function Recorder

True Integrated
Functionality is here.



Look forward to clear skies with
the New Multi-tasking TR-2000 Family

Be Prepared.



Phasor Measurement

Real time panel metering and annunciator

Stability monitor

Battery monitor

Disturbance logger

Chart Recorder Replacement

Disturbance recorder

Power quality monitor

Sequence of events recorder

High speed sampling

Transient fault recorder

On-line switch gear monitor

Energy meter

Plant diagnostic tool

Fault locator

Multi-Function Recorder
TR2100

ROCHESTER SCIENTIFIC COLUMBUS

Introducing the New Multi-tasking TR-2000 Family

Be prepared in today's increasingly competitive and dynamic industry. The Multi-Function Recorder (TR2000) series was designed to be at the leading edge of technology. These recorders represent the next generation of utility analysis monitoring. A farsighted product, which uses the most advanced technology available, yet remains fully compatible with the successful TR-100 and DL-8000 series recorders.

Today's customers expect superior solutions for their needs. Concerned with obtaining optimal power flow via the network, while still retaining

control and reliability, they are demanding not only increased, but integrated functionality to be provided in a cost effective product. Such a product aids asset management and planning, while remaining fully flexible and compatible with existing systems and producing real time answers. The total package is not complete without the superior, reliable support and after sales service, which one can expect from RiS.

Such solutions can only be met by listening to the customer and utilizing advanced technology in a variety of unique and important applications. The bottom-line is that our customers wish to obtain a greater degree of useful information to gain a competitive advantage, retain their customers and lower operational costs.

a solution for your business needs

The TR2000 has many functions aimed at obtaining not just standard data, but more useful information and presenting it in such a way as to aid engineering personnel making rapid decisions. For a relatively small capital outlay the recorder can have a big impact on the effectiveness of the power system, via protection, monitoring, minimal maintenance and asset management. The TR2000 family has a range of models, allowing the customer to choose that which best meets technical requirements and budgetary constraints.

**THE TR2000 PERFORMS
TRANSIENT RECORDING,
PHASOR MEASUREMENT,
DISTURBANCE RECORDING,
SEQUENCE OF EVENTS RECORDING,
POWER QUALITY MONITORING,
AND DATA LOGGING,
SIMULTANEOUSLY**

The TR2000 is a dynamic monitoring system, producing information in an accessible format to enable direct action to be taken, sometimes even before a potential problem becomes a reality. Communication with the recorder can be both local and remote allowing for flexibility of response and the ability to obtain real time information.

A major benefit of the TR2000 is that it aids real time monitoring of a power system. This could enable the increased loading of transmission lines, so a greater amount of control could be obtained over the transmission networks producing substantial resultant savings. In a deregulated environment the TR2000 provides the necessary data to increase revenues.

software overview

The TR2000 is enhanced with a wide range of application software, utilizing Windows95™, Windows98™ and WindowsNT™ and includes functions for communicating, configuring, downloading, displaying and analyzing the TR2000 itself and its records. Special applications are used to report on a range of parameters that define power quality. Automated processes include an Expert System to minimize the amount of engineering time needed to process the data records. A flexible reporting scheme enables the right information to be sent to the right person at the right time and enables the selling of data to Energy Service Providers.



application for use

The TR2000 has a wide variety of functions; and is particularly suitable for use in all of the following applications:

- Generation
- Transmission
- Distribution
- Laboratories
- Thyristor stack monitoring
- Flexible ac transmission system (FACTS) monitoring
- Static VAR compensators monitoring
- Geomagnetically induced currents (GIC)
- DC links
- Lightning studies
- General power system research



key functions

- Very high speed recording sampling at up to 195 kHz (optional)
- Transient fault recorder up to 384 samples per cycle
- Disturbance recorder (2 samples per cycle)
- Disturbance logger (1 sample per 2 cycles, optional)
- Trend recording
- Power quality monitor
- Stability monitor (optional — Synchrophasor measurement)
- Fault locator
- Real time monitor
- Sequence of events recorder
- On line switchgear and battery monitor
- Energy meter with peak demand
- Plant commissioning and diagnostic tool
- Electronic chart recorder

very high speed transient recorder

The high speed option allows for all analog inputs to be sampled synchronously up to 195,000 times per second. Digital inputs can also be sampled at this rate although in most cases they would be recorded at an integer submultiple.

The high speed recorder is ideally suited to special applications such as lightning studies, monitoring high speed switching in Static VAR compensators (SVCs) and Flexible AC Transmission Systems (FACTS).

transient fault recorder

Analog inputs are sampled at up to 384 samples per cycle with a maximum record length of 30 seconds. The VT & CT waveforms and auxiliary protection contacts are recorded before, during and after a fault clearance. Expert System software is used to analyze this data and report on any abnormalities. Other information can be extracted for fault impedance calculations, power quality and system maintenance.

The transient fault recorder is used for post fault analysis in verifying protection and circuit breaker operations and also fault clearance times. Information about fault type, fault levels and duration are an aid to fault location and clearance. Transient and incipient faults are also quantified, to allow improvements in supply security to be made.

disturbance recorder

Analog inputs are sampled at up to 2 samples per cycle with a maximum recording length of 30 minutes. The disturbance recorder provides information which enables improved understanding of the power network.

Longer term events are monitored by the Disturbance Recorder. Frequency, RMS and phasor information are stored per channel. These are used to compute a wide variety of power system quantities. This function is particularly useful in recording reclose sequences and power and frequency stability events. Additionally, it can be used to extend the pre and post fault times of a transient record.

Triggers for the Disturbance Recorder include low frequency oscillation on the power & frequency signals.

disturbance logger

As an option all of the RMS phasor quantities can be recorded continuously in a 2 week circular buffer. Very subtle events, which do not trigger the Disturbance Recorder, can be recovered and analyzed from the Disturbance Logger.

trend recording

The input and computed quantities are logged as maximum, minimum and average quantities every minute. One years worth of data is saved by the system. This enables historical data at a reduced sampling rate, to be retrieved for trend and power quality analysis. The data can be used to replace circular chart recorders to verify voltage regulation and balancing.

power quality monitor

Power quality can be determined by a set of parameters. Those recorded by the TR2000 series include:

- ➔ Voltage and frequency profiles
- ➔ Voltage dips and surges
- ➔ Loss of supply
- ➔ Harmonic content
- ➔ Flicker
- ➔ Imbalance

Voltage dips are stored in a database and are classified by severity and duration. A 3-D plot identifies any problem equipment or sites. Comparisons of different sites or improvements in performance are possible following system reinforcement or changes in protection settings.

Flexible display options allow this information to be shown in a wide range of styles: text or graphics, histograms, scatter plots, etc. Measurements can be compared with standard values, such as EN50160.

stability monitor

A very powerful feature of the TR2000 series is the ability to trigger on and record differential phasor measurements. Because the inputs are sampled at very regular intervals, the absolute angle of the positive sequence voltage vector can be computed very accurately. This value is compared with the angle from a remote location, normally the far end of a transmission line. Since the two TR2000s are effectively time locked together via an internal GPS receiver or external PPS and serial time code the difference in phase angle is used as a measure of system stability.

fault locator

Based on the information in a transient record of a line fault and a model of the transmission line impedance the distance to fault can be calculated. Source and remote end impedances, remote end infeed and mutual coupling are used to compute a more accurate distance.

The source, remote and line impedances may be entered in sequence component, per phase or per unit

form. The fault distance is computed several times during the period of the fault and the results averaged. The fault impedance is also returned. This can be used with a complex impedance model to locate the source of a fault in a distribution network.

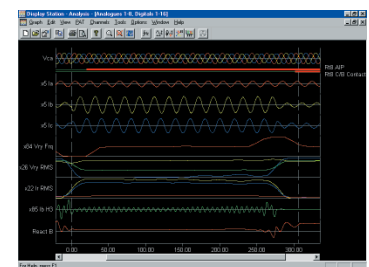
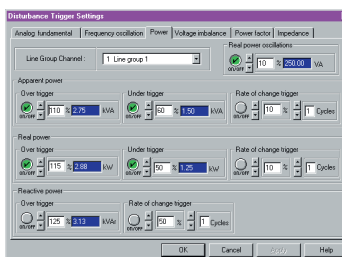
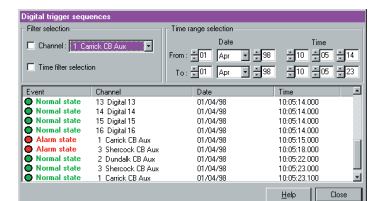
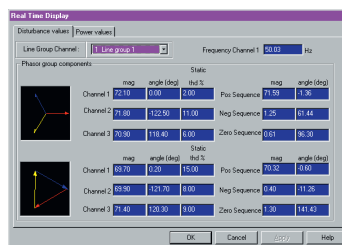
real time monitor

As well as triggering and logging the TR2000 series includes the ability to view analog and digital inputs and computed values in near real time. Measured values and waveforms can be seen remotely. These can replace or act as backup systems for:

- ➔ Waveform oscilloscope
- ➔ Panel meters
- ➔ Annunciator panel
- ➔ Vector display

sequence of events recorder

All transitions on the digital inputs of the TR2000 are recorded and can be displayed independently or with a disturbance or logger record. The time resolution is 1 ms. Input point and time filtering are available to limit the number of events displayed.



an effective aid to asset management and planning

the leading edge of technology

on-line switch gear and battery condition monitoring

Circuit breaker operations are recorded and analyzed by the Expert System. The measurements from each operation are stored in a database and can be used in a number of programmable contact wear formulas.

The accumulated number of operations, arcing current and arcing time all contribute to wear of the main contacts. An added feature of the TR2000 is that by selecting one of the three standard formulas the optimum service time for each of switchgear can be determined.

The TR2000 series can also monitor the breaker trip coil currents and battery voltage. Trip coil profiling is a diagnostic tool used to highlight any degradation in the operation of circuit breakers.

energy meter

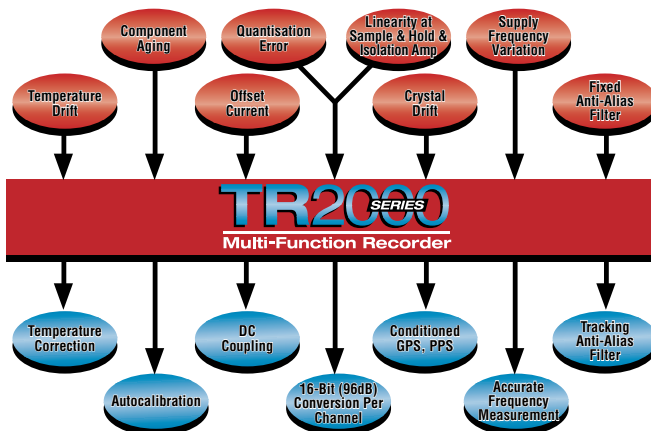
The power values from the logger are used to compute energy demand over a variable interval. Peak demand and power factor can be tracked to help minimize energy cost for large consumers.

plant commissioning and diagnostic tool

The extensive set of functions within Display Station Analysis (DSA) allow it to be used in the installation and commissioning of power plant. Test records can be taken either manually or automatically and analyzed with DSA to check for correct operation of switchgear, transformers, etc. These records can be archived and used for comparison during future diagnostic checks.

effective solutions

Effective solutions to potential sources of measurement error are incorporated in the design of the TR2000 series. Possible errors and their related solution are shown below:



purchasing information

user programmable sampling up to 384 samp/cyc

MODEL	DESCRIPTION
TR2100	8 Analog / 16 Digital Inputs
TR2110	16 Analog / 32 Digital Inputs
TR2120	24 Analog / 48 Digital Inputs
TR2130	32 Analog / 64 Digital Inputs

user programmable sampling up to 195 kHz

MODEL	DESCRIPTION
TR2200	8 Analog / 16 Digital Inputs
TR2210	16 Analog / 32 Digital Inputs
TR2220	24 Analog / 48 Digital Inputs
TR2230	32 Analog / 64 Digital Inputs



TR2000 SERIES

Multi-Function Recorder

specifications

inputs

no. of channels	8, 16, 24 or 32 Analog 16, 32, 48 or 64 Digital larger systems available
voltage inputs	63.5 or 110V RMS nominal
current inputs	1A or 5A RMS nominal typical
over range	1.9 times (voltage) Selectable for current (x1 –x20)
frequency response	DC – 1/2 sampling rate
accuracy	Better than 0.1% of full scale. Inputs are temperature compensated and can be auto-calibrated (no pots required)
digital inputs normally open or closed	24 / 48 / 125 / 250 V dc wetted contact
digital debounce	0 – 10ms in 1ms increments

recording (transient)

recording resolution	16 bits. 65536 levels (15 plus sign)
sample rate	TR2100 – up to 384 samples per cycle COMTRADE rates supported TR2200 – up to 195 kHz Analog and digital can have different rates
pre-fault time	2 – 500 cycles
post-fault time	Fault length will extend as long as a trigger condition exists. Minimum is 8 – 100 cycles
safety window	Recording time after active trigger: 4–16 cycles
maximum record length	Maximum size 1 – 30 sec. This prevents memory filling with a continuous trigger
synchronization	All analog channels sampled together and time tagged to better than +/- 100 ns.

recording (disturbance)

sample rate	2 x supply frequency (100/120 Hz)
pre-fault	10 sec. to 10 min.
post-fault time	Fault length will extend as long as a trigger point condition exists Minimum value is 30 sec. – 5 min.
maximum record	Absolute maximum size 1 – 30 length min.
computed values	Voltage & current, real power, reactive power, apparent power, power factor, total harmonic distortion and frequency (x2) Positive, negative & zero sequence components

recording (disturbance logging) – optional

sample rate	1/2 x supply frequency (25/30 Hz)
recording time	2 weeks (circulating buffer)
computed values	As above

recording (trend)

sampling interval	1 minute – data can be retrieved at up to a 60 minute interval
record length	52 weeks (circulating buffer)
stored parameters	Maximum, minimum & average voltage, current, frequency (*2), power, flicker, harmonics & imbalance. Digital data in SER format at user defined time resolution.

triggering (transient)

analog channels	Over/under RMS level (or DC), Rate-of-Change and THD per analog input. 2 positive, zero and negative sequence triggers per 8 analog inputs. 2 over, under and R-o-C frequency triggers per chassis. 1 differential frequency trigger per chassis
accuracy	0.5%
digital channels	Normal to alarm state and return to normal state. Edge or level sensitive
programmability	Triggering on any number of analog or digital channels
cross trigger	Allows unlimited number of recorder channels with precise time sync From disturbance triggers

triggering (disturbance)

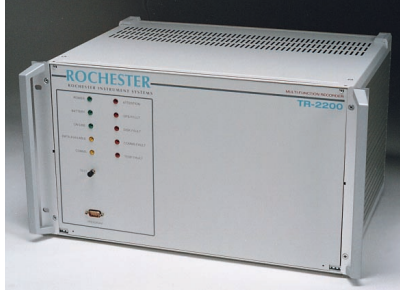
analog channels	Under/over level of fundamental and R-o-C Frequency & ROCOF Power & frequency oscillation Imbalance & impedance Cross trigger from transient recorder
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system timing

time source	GPS receiver with 1 PPS output for phasor measurement
accuracy	Normally better than +/- 60 ns
back up clocks	Dual, 32,768 Hz. crystal oscillators
range	Time and date. Year 2000 compliant. (including leap year and day of year)
synchronization	1 pulse per second on optical port Any number of systems can be linked together
serial time code	Time code input or output for synchronization of linked systems

communications

serial ports	Up to 4 x RS232 type
default setting	19200 baud, 8 bits, 1 stop, no parity Rates can be set up to 115 kbaud
modem	Hayes compatible type internal or external, fax compatible (33.6 kbaud)
phone line sharing	External unit to share a single phone line with a station phone
network connection	10Base2 (50 Ω coax & BNC)
network protocol	TCP IP



TR2000 SERIES

Multi-Function Recorder

specifications continued

data storage

buffer storage	32 MB RAM (up to 128 MB optional)
program storage	4 MB flash ROM (up to 64 MB optional)
permanent storage	3.5" hard disk – 6 Gbytes

front panel display

LED indicators	Power OK (Green) Battery OK (Green) System on line (Green) Data available (Amber) Communication in progress (Amber) Communication failure (Red) Loss of time sync (Red) Disk fault (Red) Temperature fault (Red) Attention (Red)
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status relays

max. number of outputs	32
contact rating	10 W max. 0.5 A max. 300 V dc / 240 V ac max. N/O contacts available

power supply

input voltage options	88 – 300 V dc 85 – 264 V ac
power requirement	60VA (16 channel) 70VA (32 channel)

voltage withstand

isolation	Channel to channel Channel to ground 2.5 kV RMS for 1 minute (as per IEC 255-5, IEEE C37.90)
impulse voltage withstand	5 kV 1.2/50 μ s. 0.5 Joule (as per IEC 255-5, IEEE C37.90)
surge withstand	2.5 kV, 1 MHz damped sine wave (as per IEC 255-22-1)
RFI	as per IEC 801-3 & IEC 801-6
ESD	as per IEC 801-2

enclosure

cabinet	Steel 19" rack mounting cabinet 8 & 16 channel – 6U 24 & 32 channel – 8U Wall mount and portable options
weight	15 kg

environment

operating temperature	-10 to 55°C 14 to 131°F
relative humidity	0 – 97% non condensing

options

internal

Modem card
Network card
GPS real time clock card
Synchrophasor software (Differential Phasor Measurements)
Disturbance Logger software

external

Range of wall mounting enclosures
Interface equipment for current channels
(wedding ring CTs, clamp CTs, shunt resistors)
Telephone line sharing unit
Hall effect CTs for DC battery supply
GPS antenna

display station software

Display Station, Display Station Analysis and Power Analysis Toolkit
Expert System
Voltage Dip database
Switchgear Maintenance database
Harmonic Profiling
Data Logger
Distance to Fault

Detailed quotations and technical information available on request.



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