SCADATRON
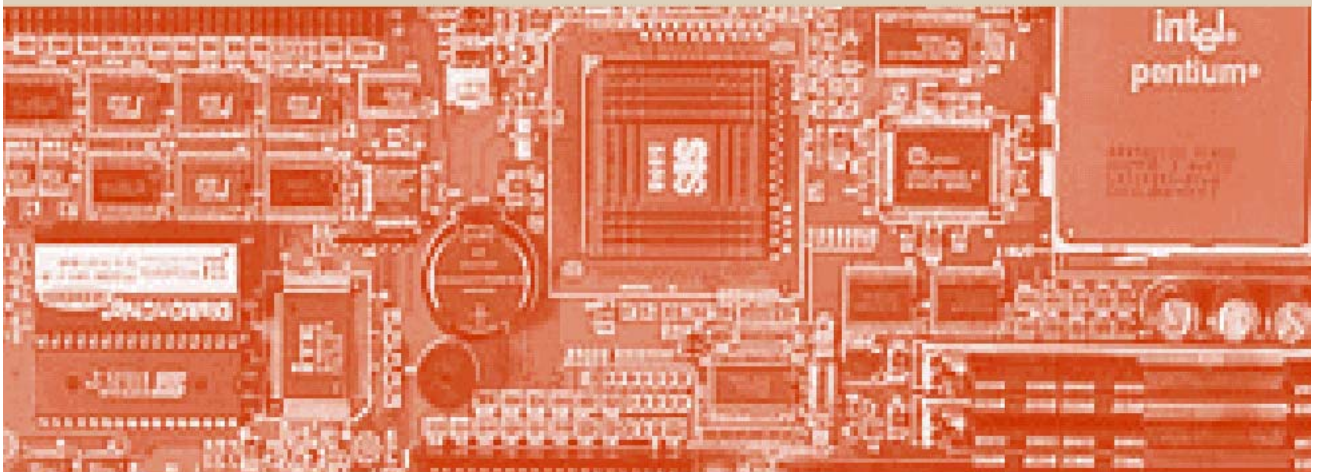## TELEMETRY

SM2000
# SERIES
FRONT END PROCESSOR

SCADATRON TELEMETRY APPLICATION

SCADATRON TELEMETRY is a cost effective / general purpose SCADA system developed in Malaysia and has already been put to work successfully in many application areas. The following are some of the possible application areas:

- Flood Monitoring and Warning System
- Remote Hydrological Data Collection
- Distributed Irrigation Management System
- Public Messaging / Warning System
- Light-House Monitoring System

- Reservoir/Pipeline Monitoring
- Water Quality Monitoring
- Remote Facilities Alarm Monitoring
- Building Automation System
- Dam Monitoring and SCADA System

Virtually any signals can be measured or counted can be sent over Telemetry and SCADA systems. Here are some typical signals: Water tank levels, Liquid flow totals through a pipe, High or low level alarms, Computed gas flow totals, Pipeline pressures & temperatures, Voltages and currents on a transmission system, Switch and alarm positions.

MASTER CONTROL CENTRE (MCC)

REMOTE STATION

REMOTE STATION   REMOTE STATION

MASTER CONTROL CENTRE
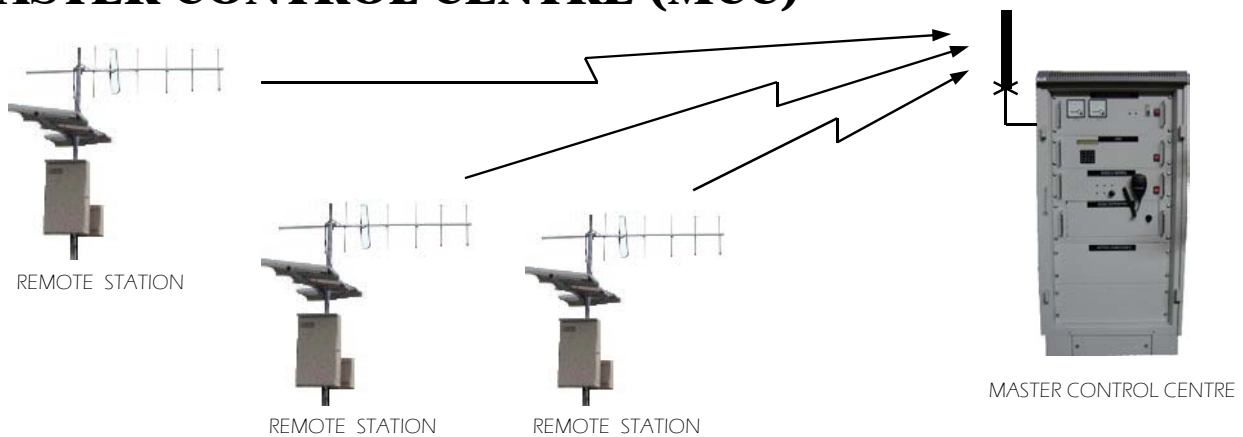
Remote Monitoring System or Telemetry Systems normally consists of a Master Terminal Unit (MTU) to monitor a number of Remote Terminal Units (RTUs) or Remote Alarm Monitoring Units (RAMU). The MTU is located at a Master Control Centre (MCC) in the facilities administration office. Some Master Control Centre (MCC) have large Map Display Boards with visual indicators (Lamps, LED indicators, Plasma display) that are driven by the MTU. The administrator uses the system to monitor the operating status of the facilities and if necessary dispatch personnel to correct problems or adjust system operating parameters.

Some MCC consist of Master Terminal Unit (MTU) (or refer to as Front End Processor /FEP from here on) only and some MCC consist of Front End Processor (FEP) and Man Machine Interface (MMI) computer equipment. The FEP is a communication front end to perform communication task with all the remote stations. It may consists of some local Input/Output module to drive some local alarm indicator or actuator and also equipped with various type of communication equipment. The MMI normally constructed from SCADA (Supervisory Control and Data Acquisition) Software running on workstation for data presentation and storage.

COMMUNICATION

Communication between the MCC and RTU's is normally via VHF/UHF leased-frequency radio link, trunk radio link, or through dial-up Public Switched Telephony Network (PSTN), lease-line, GSM Cellular Network or Satellite Communication System such as INMARSET, ORBCOMM or VSAT.

The utility systems which are under telemetry monitoring are typically spread throughout a municipality, city or county, radio telemetry is the most reliable and cost effective means to tie each of the remote locations back to the control centre or administrative office. By using a common radio channel, a computer at the control centre can query each of the remote locations for the status of the gate position, water levels, pumps, valves, pressures, etc. The computer can also control the operation of each of those components through the same radio channel. In Malaysia, all radio based telemetry systems must obtain a Frequency License from CMC (Communication And Multimedia Commission) and radio type approval from SIRIM.

The Master Control Centre (MCC), and the Remote Terminal Units (RTU) at each of the remote location share the radio channel. One at a time, the computer at the MCC polls for information from each of the remote locations in sequence. In another way, the RTU may also report data or alarms to the MCC without waiting for the MCC to poll for it. Each RTU has a unique Identification Number or address so it knows if the MCC is talking to it. GSM/PSTN telemetry communication network may operate in a similar manner as the radio network.

SM2000 FRONT END PROCESSOR (FEP) - GENERAL

The SCADATRON SM2000 Front End Processor (FEP) or sometimes referred to as Master Terminal Unit (MTU) houses all communication equipment used to interrogate with the remote sites. The FEP act as a Communication Interface or Data Concentrator to collect all data from Remote Stations and send it to the Man Machine Interface (MMI) computer. Data Concentrator are intermediaries of a SCADA communications hierarchy to offload data acquisition activities from the Man Machine Interface (MMI) and to improve channel throughput.

The SM2000 open-architecture Front End Processor (FEP) is constructed with industrialised versions of the PC and a variety of independent software modules. It provides an option to be equipped with Hot Backup Redundancy (HBR) hardware and Software feature, where the off-duty/standby FEP acts as a backup for the on-duty/main FEP. Each main and standby FEP may have common or individual communication equipment for linkage to remote stations. Aside from the principle FEP routines, other baseline modules can be integrated to enhance operations, including closed-loop controls or calculation, data presentation, web publishing and client-server interfaces. An industry standard architecture, coupled with advanced SCADA tools, and unquestionably the largest body of 3rd party hardware and software solutions, provides the optimal environment from a development, computing enterprise, ongoing support, and long term evolutionary perspective.

APPLICATIONS OF FRONT END PROCESSOR
- Update/extend life of current SCADA system
- Offload data acquisition tasks from Master
- Provide channel redundancy to existing Master
- Add calculation and/or closed-loop routines
- Provide emergency MMI in event of Master failure
- De-coupling communication overhead between Master and RTUs
- Support RTUs with foreign protocols with use of gateway routines

FEATURES
- Allows integration of SCADA communications onto enterprise networks
- Powerful platform can offload processing tasks from Master Station
- Capable of updating telemetry value in back-end *(SOL)* database without compromising host CPU utilisation
- Industrial quality components and workmanship for long and reliable operation

FRONT END PROCESSOR

COMPONENTS (GENERAL)
A SM2000 Front End Processor (FEP) can consist of the sub-racks enclosed in 19" rack cabinet:
1. 4U height Front End Processor (FEP) Industrial PC – Central Processing Unit (CPU)
2. 8U height 15" Low power TFT LCD Display Panel
3. 1U height Keyboard drawer type sub-rack
4. 3U height Eurocard board Input / Output Aluminium Sub-rack
5. 3U height VHF/UHF radio and MODEM sub-rack
6. 3U height Leased line MODEM sub-rack
7. 3U height PSTN dial-up MODEM sub-rack
8. 4U height AC/DC Distribution sub-rack with AC lightning protection unit (AC LPU)
9. 4U height Power Supply / Charger sub-rack
10. 3U height Un-interruptible Power Supply (UPS) sub-rack
11. 6U height Battery compartment

# FEP'S PENTIUM 233 MHz MMX CPU SPECIFICATION

PCA-6155 Industrial Grade Computer CPU

The PCA-6155V is a full-size single board CPU card that can release the Pentium processor's full potential and provide unprecedented performance compared to current 64-bit processor boards. The PCA-6155V offers all the functions of an industrial computer on a single board. For maximum performance, the PCA-6155V also supports 512 KB of on-board 2nd level cache.

SPECIFICATIONS

- BIOS: Award 256 KB Flash memory; supports Plug and Play
- Green function: Features power management option via BIOS, activated by keyboard or mouse activity. Supports doze, standby and suspend modes. APM 1.1 compliant
- Serial ports: One RS-232, one RS-232/422/485 interface
- I/O bus expansion: ISA-bus edge (gold finger) connector
- CPU: Intel Pentium processors up to 233 MHz
- 2nd level cache: 512 KB pipeline-burst SRAM
- Enhanced IDE hard disk drive interface: Accommodates up to two large IDE HDDs or other IDE devices. Supports PIO mode 4 and DMA bus-master mode
- Watchdog timer: Can generate a system reset, or IRQ 15. Software enabled/disabled. Time interval is from 1 to 127 seconds. Jumperless with run-time setup
- PC/104 expansion: 104-pin, 16-bit PC/104 module connector
- RAM: -Two 72-pin SIMM sockets. Supports 32-bit FP or EDO DRAM with memory capacity from 2 to 128 MB; Two 168-pin DIMM sockets. Supports 64-bit 3.3 V FP, EDO or SDRAM with memory capacity from 8 to 128 MB
- Keyboard/mouse connector: A 6-pin mini-DIN connector is located on the mounting bracket for easy connection to a keyboard or PS/2 mouse. An on-board keyboard pin header connector is also available
- Local-bus Flat Panel/VGA Interface with On-board PCI SVGA
- Display memory: Shares system RAM 1 ~ 4 MB
- Chipset: SiS 5598 with Built-in VGA ; Supports resolutions up to 1024 x 768. Non-interlaced CRT monitor resolutions up to 1024 x 768 @ 256 colors. True-color and Hi-color display capability
- Solid State Disk : Supports M-Systems' DiskOnChip 2000 Flash Disk, up to 72 MByte or IDE Flash Disk, up to 512MByte
- Power supply voltage: 0 ~ 60 deg.C (32 ~ 140 deg. F)
- Operating temperature: +5 V (4.75 ~ 5.25 V) @ 5 A
- Board size: 185 x 122 mm (13.3" x 4.8")

FEP'S PENTIUM III 500MHz CPU SPECIFICATION
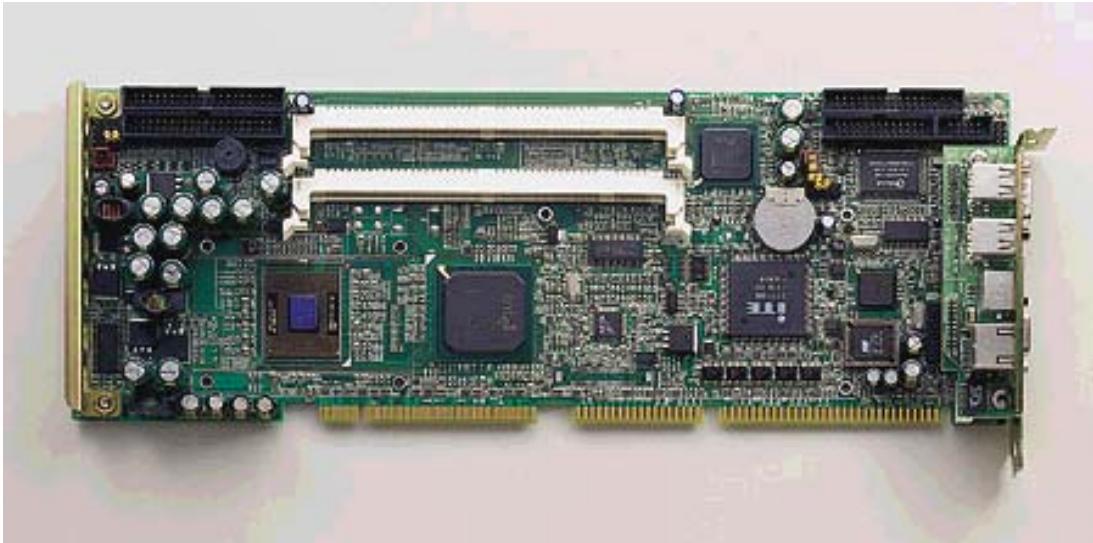
Industrial Grade Low Power Pentium III CPU Card

The PCA-6002 full-sized Single Board Computer is designed with Intel's 815E chipset, and supports Pentium III and Celeron processors for exceptional value. With Intel's low power processor, the PCA-6002 delivers efficient power consumption with less heat dissipation. This cool feature is ideal for applications requiring low-power consumption or fan-less operation.
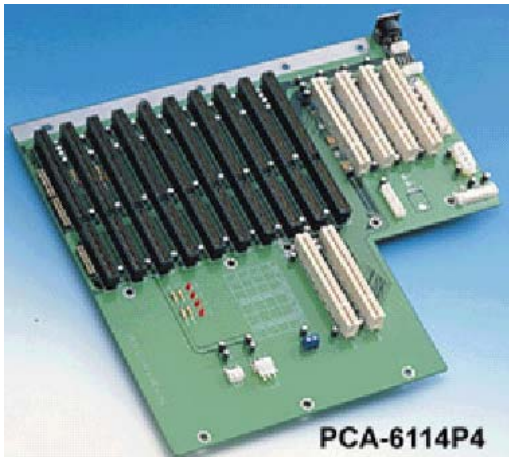
SPECIFICATIONS

- Processor: Intel Pentium III CPU with 256KByte L2 cache
- Maximum Speed: 500 MHz
- Chipset: Intel 815E
- BIOS: Award 4MByte FWH
- Bus: Front Side Bus 100MHz, PCI 32-bit/33MHz, ISA: HISA
- Memory: 128MByte PC-133/100 SDRAM (maximum 512MByte)
- Graphic Controller: Chipset Integrated VGA Controller
- Video RAM: Dynamically shared system memory
- Ethernet Interface: 10/100 Base-T
- EIDE: ATA 100/66/33 mode
- Serial ports: Two RS-232
- Parallel: 1 (SPP/EPP/ECP)
- FDD Port: 1
- PS/2 port: 1
- Watchdog timer: Output: Interrupt, system reset,. Time interval is from 1 to 255 seconds.
- Power requirement: 2A for +5V, 72mA for +12V
- Keyboard/mouse connector: A 6-pin mini-DIN connector is located on the mounting bracket for easy connection to a keyboard or PS/2 mouse. An on-board keyboard pin header connector is also available
- Operating temperature: 0-60 deg C

FRONT END PROCESSOR'S INDUSTRIAL PC CHASSIS

4U height 19" Industrial PC Chassis

PCA-6114P4

Passive Back plane For Industrial PC

Features
• 4U-high 14-slot rackmount chassis
• Versatile power supply options
• Hot-swap 86-CFM cooling fan with filter
• Optional ATX motherboard version

Specification
3.5" Drive Bay: 1 (Front-accessible), 1 (Internal)
5.25" Drive Bay: 3 (Front-accessible)
Cooling Fan 1 (86 CFM/each)
Air filter Yes
Hold-down clamp : Rubber-buffered hold-down clamp
Temperature 0 ~ 50 °C (32 ~ 122 °C), operating
Dimensions (W x H x D): 482 x 177 x 452 mm
Weight 17.5 Kg (38.5 lb)

Power Supply Specification
Power: 260 W (PS-260-610E)
Input: 110/220AC
Output: +5V@25A, +12V@9A, -5V@0.5A, -12V@2A
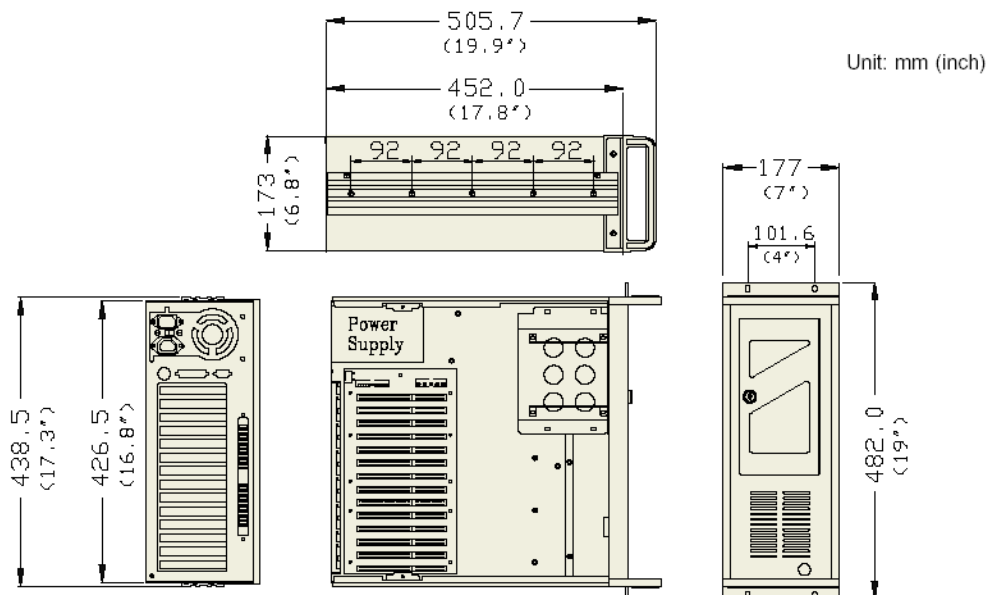Safety: UL/CSA/CE/TUV
Mean Time Between Failure (MTBF): 140,000 hours @ 50 deg C (full load)

Back Plane Specification
Model Name: PCA6114P4 B
Type: Passive Back Plane
Slot Per Segment: 9 ISA, 4 PCI, 1 CPU slot

Unit: mm (inch)

Dimension For SM2000 FEP CPU Chassis

SCADATRON FRONT END PROCESSOR (FEP) ADVANTAGES

- SM2000 FEP is built on a **industrial Grade Computer Platform** which is reliable, open architecture, and spare parts are easily available of the shelve.

- By utilise multiple-port serial communication card, SM2000 can connected **8 type of communication devices simultaneously** which may include UHF/VHF radio MODEM, PSTN MODEM, Leased Line MODEM, GSM/SMS MODEM or Module, Man Machine Interface (MMI) Server Computer, Moving Message Display Board, etc.

- SM2000 has **Proven Communication Driver** for communication with remote stations using long distance VHF/UHF radio communication (distance > 60KM) using radio transceiver of all brand (Motorola, Philips, Kyodo, Tait).

- SM2000 can provide **direct connection** to low orbiting satellite equipment (ORBCOMM) or INMARSAT-C. It can be **installed anywhere in the world!**

- SM2000 comes with a standard set of 101 keys keyboard and 15″ Liquid Crystal Display (LCD) panel interface for **user friendly interface**

- SM2000 has **Historical Data Storage Facilities** which can store data during MMI Computer failure.

- SM2000 support flexible radio communication configuration include Real-Time Data Acquisition, Logged Data Acquisition and **Store-And-Forward (SAF)** Communication technique.

- The SM2000 is **designed for harsh environment** which industrial grade enclosure in 19″ equipment rack with dust protection and power-line surge protection.

- Application software embedded in the SM2000 runs under a powerful and stable **real-time multitasking operating system which is LINUX Redhat**. Modification on FEP's operation can be done in days by our local programmer

- It is fully **Year 2000 compliance**

SM2000 FRONT END PROCESSOR FEATURES

Communication Flexibility
Communication media between the remote stations and master station include:

1. VHF/UHF radio communication link
2. PSTN dial-up line
3. PSTN leased line
4. GSM MODEM / SMS
5. Inmarsat-C Land Mobile
6. Receive data email through ORBCOMM 's Low orbiting satellite
7. Export real time data in email format every hour for web publishing

Multiple Protocol Support
The SM2000 master station communicates with it's remote stations through a rich set of standard protocols (telemetry protocol, industrial standard MODBUS ASCII or RTU, HDLC, X3.28), transparent to the physical communication links used. For communication with any SCADA software which runs on a MMI, it uses a rich set of standard protocols (telemetry protocol, industrial standard MODBUS ASCII or RTU protocol) via a dial-up link or direct RS232C .

SM2000 FRONT END PROCESSOR FEATURES, CONTINUE...

User Friendly Interface
Standard keyboard & large screen LCD is provided for the database viewing and entry purposes. Real-time display of telemetry data is made easy on SM2000 that uses a powerful 32bit-computer platform. The following shows user settable parameter from the master station:

Local System parameter
- Set maximum RTU number
- Set Network address
- Set system date and time (master clock)
- Set scanning rate (from 15 min.. 24 hours)

- Set flood mode / normal mode
- Set automatic scanning reference time
- Set FEP-RTU time synchronisation interval
- Set number of retry and interval between re-try after radio-link failure

Remote Setting Of RTUs' parameters
- Set and retrieve rainfall base level (set to any value within 0-9999mm)
- Set scalar and offset for analogue sensors (for 5m, 10m, 20m ..)
- Set river-bed sea level offset (i.e. 0 m water depth is 22.7m)

- Set and retrieve RTU auto-dump interval
- Start/Stop RTU data logging facilities
- Set and retrieve RTU data logging interval

Local Communication parameters
- Set RTU communication media (RADIO, MODEM, ORBCOMM etc.)
- Set RTU Store-And-Forward (SAF) repeater path (for Radio System Only)
- Set RTU phone number (if PSTN modem is used as communication device)
- Set RTU repeater (store and forward facilities in Radio System)
- Change communication baud rate (1200 or 300Bps for Radio System)

View Database
- View latest remote stations' water level
- View latest remote stations' rainfall
- View latest remote stations' water quality
- View latest remote stations' daily rainfall
- View remote stations' data base on user specified date/time interval

- View status of telemetry data (Valid/Error/ Communication error)
- View alarm status of telemetry data (alert/ warning/danger)
- View remote stations' battery level

Auto/Manual Calling RTU
- Accept RTU automatic send exception data/ alarm
- Settable Interval Automatic Scanning all RTU (with individual Scanning rate)

- User/ Adhoc call single RTU
- User/ Adhoc call all RTUs / Manual Scaning

Supervisory Control
The SM2000 can accept various output commands from the MMI computer to affect supervisory controls function in form of analogue output, digital/relay output. In SCADA application, local output points in FEP or remote output points in RTUs can be controlled by MMI computer running any SCADA software.

Alarm Management
User may configure a set of alarm level /threshold values in the FEP database for alarm monitoring purposes. When alarm signal is detected, the alarm manager inserts an alarm record into the buffer with a real time stamp and an option to print out alarm message. The parameters included are: Alert level, Warning level, Danger level, Minimum reasonable Level (For data validity checking), Maximum reasonable Level (For data validity checking), Alarm masking facilities for station

HOT BACKUP REDUNDANCY (HBR)

One of a general requirement for a critical SCADA System is called Hot Backup Redundancy (HBR) in order to achieve a reliable and un-interrupted operations. Other type of backup include Cold Backup which required manual change-over of the main & standby system.

There are a number of ways to implement hot backup redundancy on SCADATRON Telemetry System:

♦ Man Machine Interface (MMI) redundancy
♦ Communication Network redundancy
♦ Front End Processor (FEP) redundancy
♦ RTUs redundancy

To achieve **MMI Redundancy**, two numbers of MMI Server Computers are configured as Primary Server and Standby Servers. When the system is in operation, both server are identical to the users; there is no differences for the user who can operate one any of the servers. In actual fact, the Primary Server is normally performing communication with the FEP, when the Primary Server failed, the Standby Server will assume total control without any interruption to the SCADA System. In this case, both server have individual communication port for linking to the FEP or FEPs.

A **Redundant FEP** is configured in a SCADA System where failure of the FEP shall not interrupt the data flow from the RTUs to MMI computer. Two numbers of FEPs are configured as Main FEP and Standby FEP. When the system is in operation, only one of the FEP will be active/ on-duty. The standby FEP will closely monitor the active FEP, and it will become active or take over the function when it detect the active FEP is down.

Main & Standby FEPs can be equipped with individual Radio or PSTN MODEM. When the Standby FEP is on-duty, it will use it's set of Standby Radio & Standby MODEM for communication with RTUs. In some case, both main & standby FEP's radio can share one set of antenna if a coaxial relay / switch is used. For PSTN MODEM link, both main & standby PSTN MODEM may be connected to the same telephone line in order to share
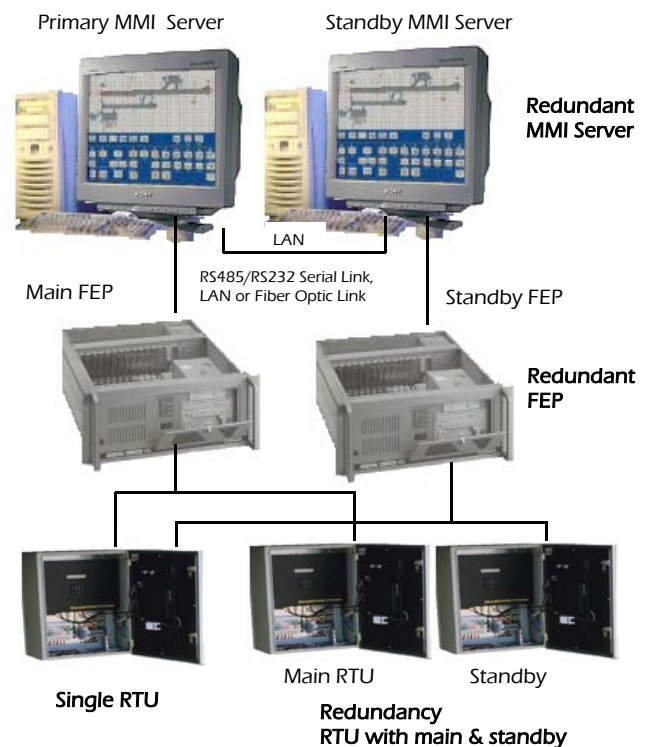
one set of PSTN Telephone Line

When individual communication device is not possible/ fissile due to cost, the main & standby FEP may shared the same communication equipment (such as Inmarsat-C Transceiver/ Land-Mobile) by using a RS232 change-over unit constructed from switched or relays circuitry. This type of system require a Change-Over Unit with User Selection Buttons such as Auto/Manual Main/ Manual Standby.

Communication Redundancy is required if there is a possibilities of failure in the communication network or equipment between the MMI/FEPs and RTUs. If one of the link such as Radio or MODEM of the MMI/FEP is faulty, the other communication link shall be changed-over and resume in operations.
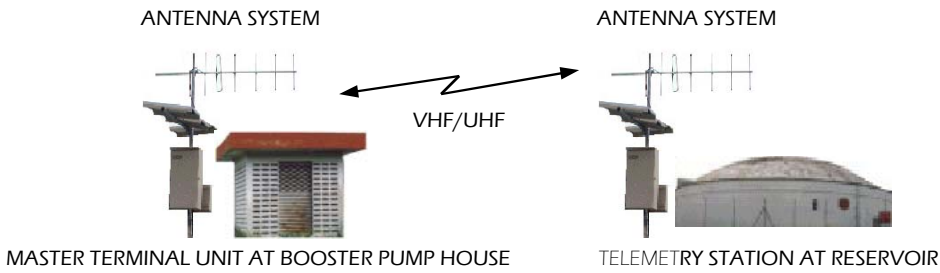
RTUs Redundancy is where two set of redundant RTU's CPUs is installed at site. The main & standby RTU may share one set of common Input/Output modules or both having individual set of Input/Output modules.

The diagram below show a typical Hot Backup Redundancy (HBR) System for a SCADA System.

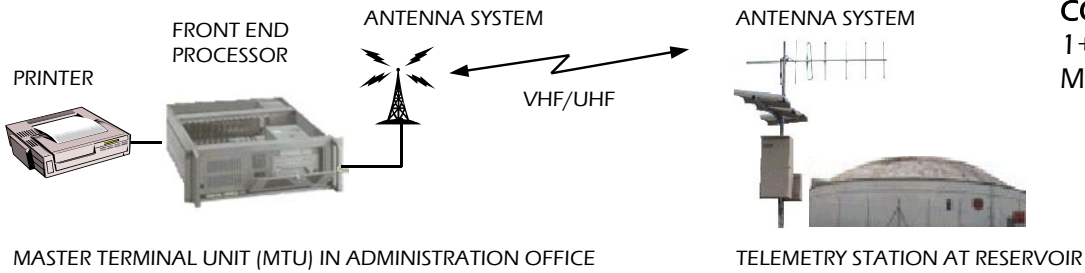Primary MMI Server   Standby MMI Server

Redundant MMI Server

LAN

Main FEP   RS485/RS232 Serial Link, LAN or Fiber Optic Link   Standby FEP

Redundant FEP

Single RTU   Main RTU   Standby

Redundancy RTU with main & standby

SAMPLE ST2000 TELEMETRY SYSTEM TOPOLOGY

CONFIGURATION 1
1+1 PUMP CONTROL SYSTEM

ANTENNA SYSTEM   ANTENNA SYSTEM

VHF/UHF

MASTER TERMINAL UNIT AT BOOSTER PUMP HOUSE   TELEMETRY STATION AT RESERVOIR

CONFIGURATION 2
1+n RESERVOIR MONITORING SYSTEM

PRINTER   FRONT END PROCESSOR   ANTENNA SYSTEM   ANTENNA SYSTEM

VHF/UHF

MASTER TERMINAL UNIT (MTU) IN ADMINISTRATION OFFICE   TELEMETRY STATION AT RESERVOIR

CONFIGURATION 3
1+1+n RESERVOIR MONITORING SYSTEM WITH SAF REPEATER AND SUB-MASTER STATION

MASTER TERMINAL UNIT (MTU) IN ADMINISTRATION OFFICE

ANTENNA SYSTEM

MMI PC

VHF/UHF

RS232C

ANTENNA SYSTEM

VHF/UHF

PRINTER   FRONT END PROCESSOR

TELEMETRY STATION AT RESER-VOIR (ALSO AS SAF REPEATER)

MMI PC

FRONT END PROCESSOR

ANTENNA SYSTEM

ANTENNA SYSTEM

OPTIONAL RADIO SUB-MASTER STATION IN DISTRICT OFFICE

TELEMETRY STATION AT RESERVOIR
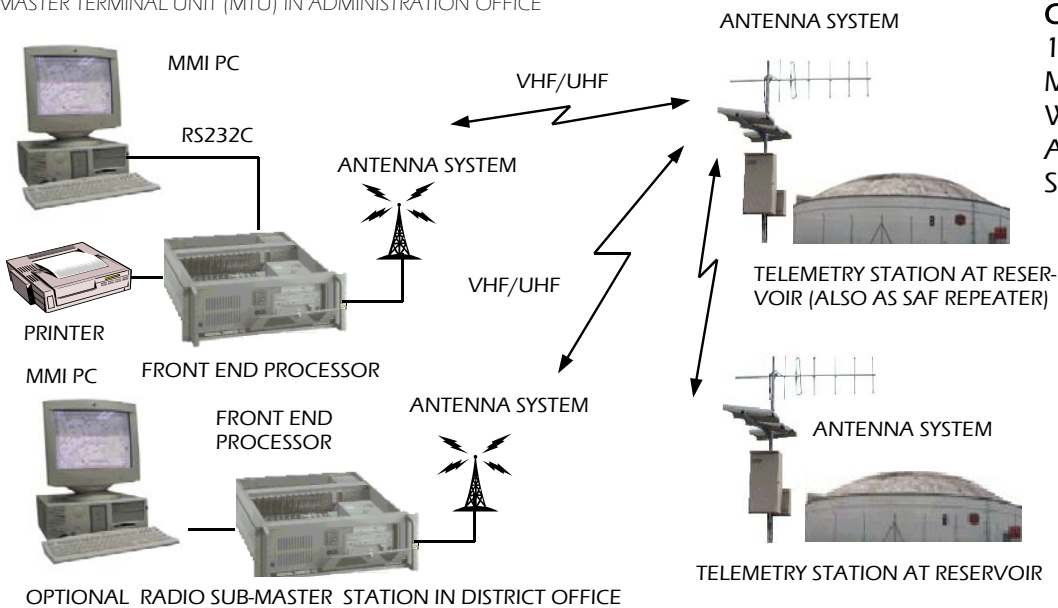
CONFIGURATION 4
1+n RESERVOIR MONITORING & PUMP HOUSE CONTROL SCADA SYSTEM

ANTENNA SYSTEM

ANTENNA SYSTEM

VHF/UHF

RADIO MODEM

TELEMETRY STATION AT FACILITIES UNDER MONITORING

MAN MACHINE IN-TERFACE (MMI) WITH SCADA SOFTWARE

VHF/UHF

ANTENNA SYSTEM

TELEMETRY STATION AT BOOSTER PUMP HOUSE
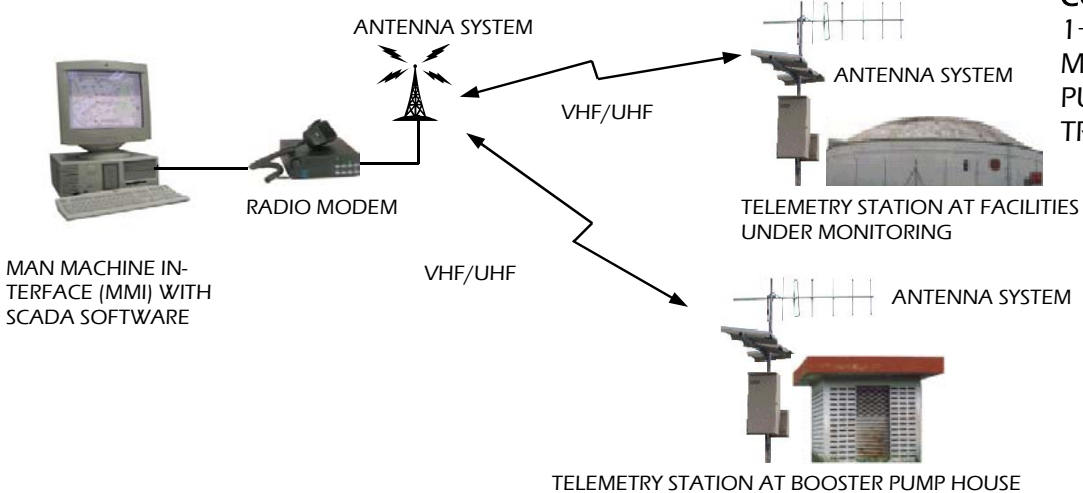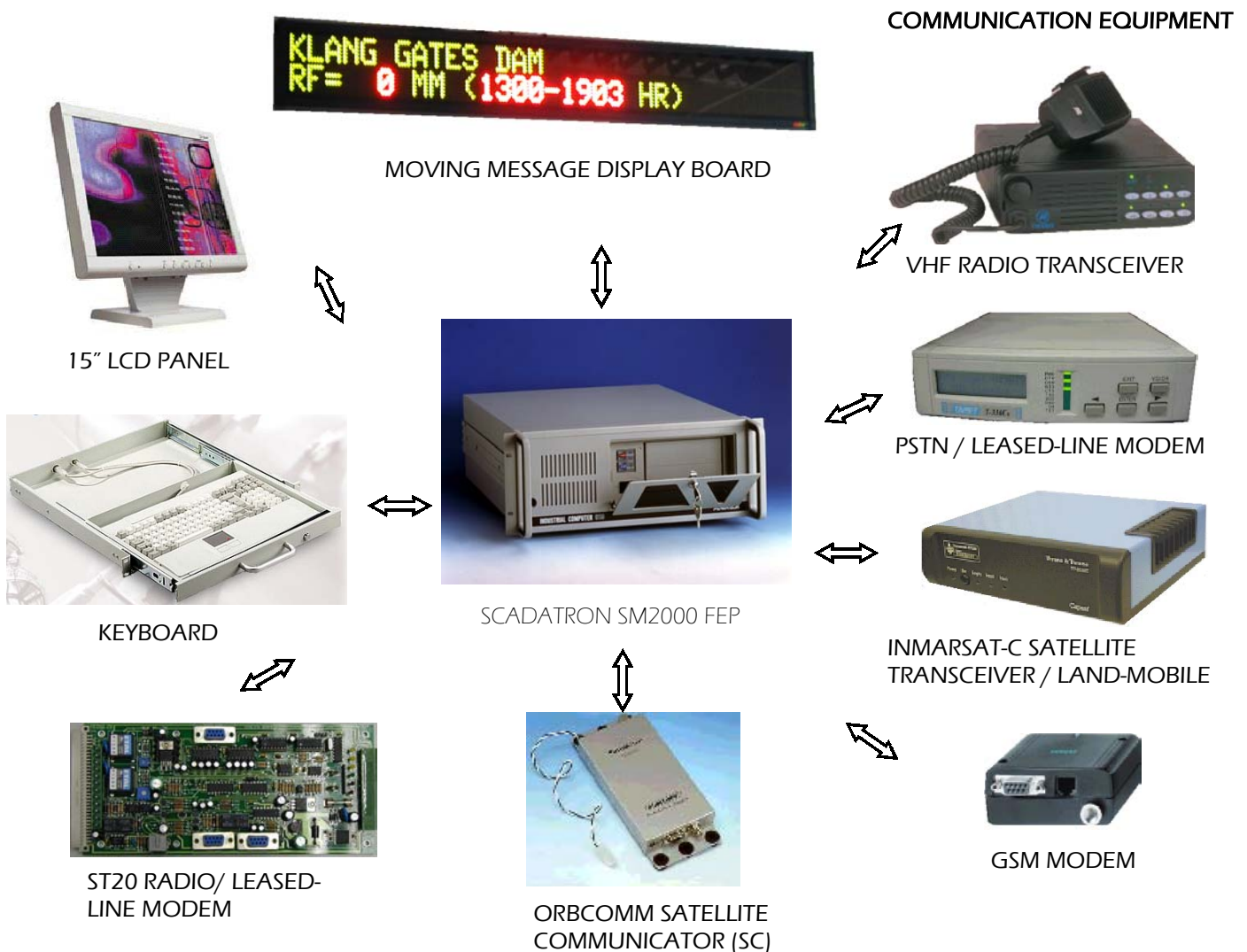
POSSIBLE SM2000 TELEMETRY SYSTEM TOPOLOGY
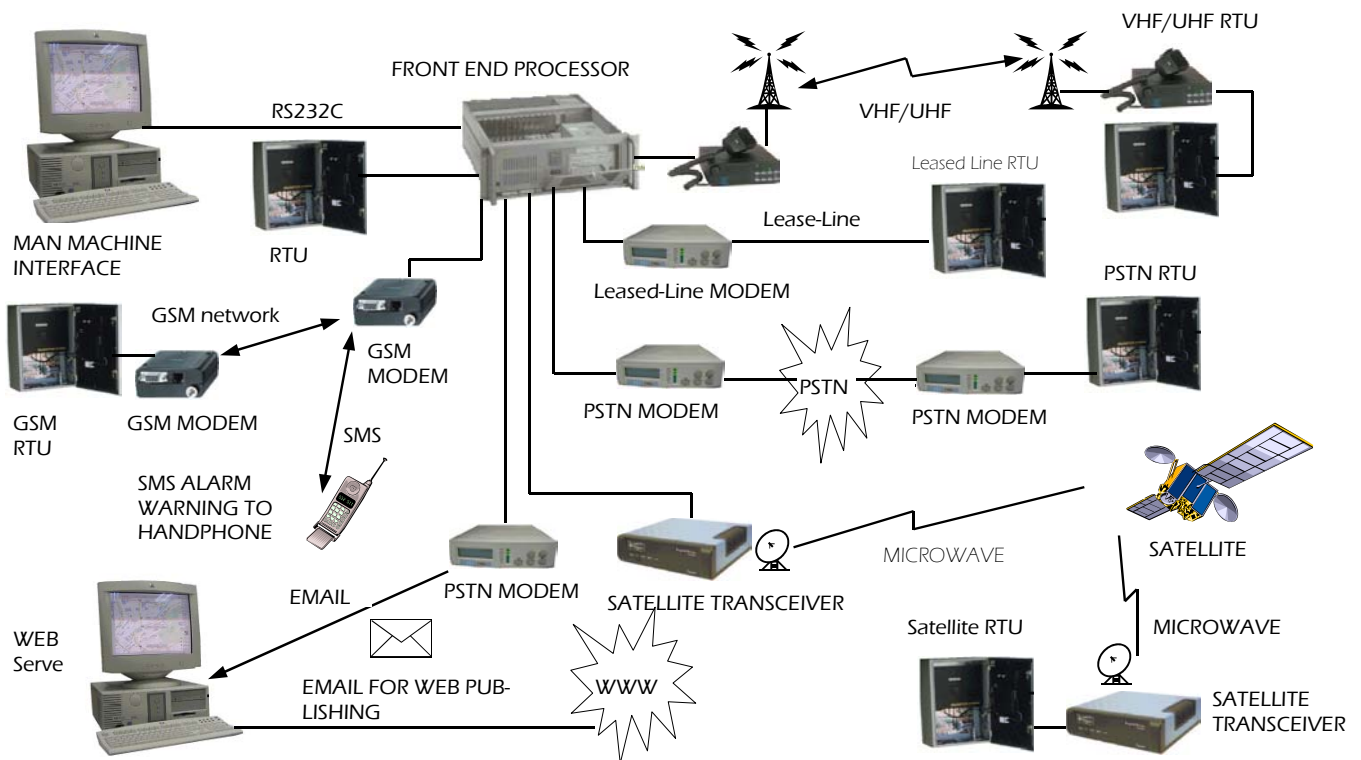
SCADATRON SM2000 Front End Processor (FEP) is flexible in the method by which it used to communicated with the Remote Stations and MMI. As shown on the diagram above, The SM2000 can be fitted in many communication network such as: VHF/UHF Radio network, GSM Cellular network (with or without SMS), Satellite Communication (INMARSAT-C or ORBCOMM Low orbiting Satellite), PSTN MODEM Dial-up Link, Leased-Line MODEM connection or Direct RS232 connection, etc.

SM2000 SHORT MESSAGE SYSTEM (SMS) ALARMING SYSTEM
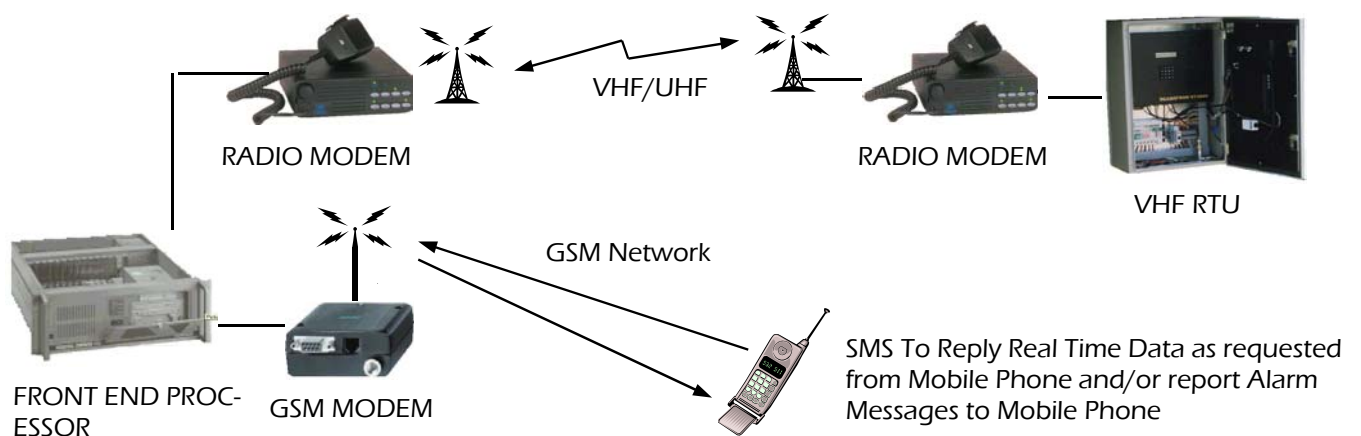
Short Messaging System (SMS) is picking up as one of a popular communication media for remote alarm monitoring system. SCADATRON SM2000 support SMS alarm reporting to mobile phone upon receive any alarm data from any of the remote stations under monitoring. The alarm SMS can be directed to a list of mobile phone numbers configured in the FEP. The SM2000 also support data request from mobile phone; after receive the request SMS, SM2000 will reply SMS with latest status of a particular remote station to the requesting mobile phone.

SM2000 FRONT END PROCESSOR COMMUNICATION EQUIPMENT

MOVING MESSAGE DISPLAY BOARD

COMMUNICATION EQUIPMENT

VHF RADIO TRANSCEIVER

15" LCD PANEL

PSTN / LEASED-LINE MODEM

KEYBOARD

SCADATRON SM2000 FEP

INMARSAT-C SATELLITE
TRANSCEIVER / LAND-MOBILE

ST20 RADIO/ LEASED-
LINE MODEM

ORBCOMM SATELLITE
COMMUNICATOR (SC)

GSM MODEM

The diagram above illustrate the possible type of communication equipment that can be attached to SM2000 FEP. A combination of these communication equipment is possible by using a multi-port serial communication card called PCL-849, installed in the Industrial PC : It provide four individually configurable RS-232 serial communication ports. Each port on the card has a 16554 UART which makes serial I/O more reliable. By buffering data into 64-byte packets before putting it on the bus UARTs drastically reduce the CPU load.

Feature:

- Transmission speeds up to 921.6 Kbps
- Independent/shared I/O addresses, IRQ settings for each of 4 serial ports
- Wide IRQ selection: 3, 4, 5, 6, 7, 9, 10, 11, 12 or 15
- Supports standard DOS COM1, COM2, COM3, COM4
- Supports DOS/Windows 3.1 (PC-ComLIB), Windows 95, Windows NT
- Supports surge protection: 2000 V_{DC}
- LED indicators on each port indicate data flow
- On-board interrupt status register for greater throughput

PCL-849 4-PORTS RS232C
SERIAL CARD

SM2000 EVENT / ALARM PRINT LOGGED ON LINE PRINTER

```
Wednesday June 30/06/1999   12:30:00
Date       Time     Station       A.RF/mm    D.RF/mm   WL1/m    WL2/m    Status
-------------------------------------------------------------------------------------
01/04/1999  08:00:00  001 G. Gagau 1     0000       0000       12.34     ---      Normal
01/04/1999  09:00:00  002 G. Gagau 2     0004       0004       01.55     ---      Normal
01/04/1999  10:00:00  003 Kg. Papui      0064       0064       22.34     ---      Normal
01/04/1999  11:00:00  004 Kuala P.       0078       0078       12.34     ---      Normal
01/04/1999  12:00:00  001 G. Gagau 1     0103       0103       15.34     ---      Normal
01/04/1999  13:00:00  002 G. Gagau 2     ****       ****       **.**     *.**     Failed
01/04/1999  14:00:00  003 Kg. Papui      0120       0056       15.34     ---      Normal
01/04/1999  15:00:00  004 Kuala P.       0123       0055       10.56     ---      Normal
01/04/1999  16:00:00  001 G. Gagau 1     0123       0020       13.45     ---      Normal
01/04/1999  17:00:00  002 G. Gagau 2     0123       0119       02.34     ---      Normal
01/04/1999  18:00:00  003 Kg. Papui      0123       0003       15.04     ---      Normal
01/04/1999  19:00:00  004 Kuala P.       0123       0000       12.00     ---      Normal
01/04/1999  20:00:00  001 G. Gagau 1     0133       0010       14.34     ---      Normal
01/04/1999  21:00:00  002 G. Gagau 2     0234       0111       08.57     ---      Normal
01/04/1999  22:00:00  003 Kg. Papui      0127       0004       12.40     ---      Normal
01/04/1999  23:00:00  004 Kuala P.       0144       0021       12.34     ---      Normal
02/04/1999  00:00:00  001 G. Gagau 1     0150       0017       14.34     ---      Normal
02/04/1999  01:00:00  002 G. Gagau 2     0234       0000       10.78     ---      Normal
02/04/1999  02:00:00  003 Kg. Papui      0188       0061       11.23     ---      Normal
02/04/1999  03:00:00  004 Kuala P.       0159       0015       11.34     ---      Normal
02/04/1999  04:00:00  001 G. Gagau 1     0180       0030       14.34     ---      Normal
02/04/1999  05:00:00  002 G. Gagau 2     0234       0000       11.52     ---      Normal
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Sample Printout of Event Logging / Data Record from SM2000 FEP

```
Date       Time     Station       Alarm Description / Monitoring Data        Status
-------------------------------------------------------------------------------------
01/04/2002  00:00:00  001 Proton City    V1: 414.5V, V2 : 415.0V, V3: 414.5V, KWH: 145   Normal
01/04/2002  08:01:00  001 Proton City    CB1 Trip                                 Alarm
01/04/2002  08:01:01  001 Proton City    CB2 Trip                                 Alarm
01/04/2002  09:11:01  001 Proton City    CB1 Normalised                           Normal
01/04/2002  09:11:01  001 Proton City    CB2 Normalised                           Normal
01/04/2002  18:41:00  001 Proton City    Telecom Charger Failed                   Alarm
01/04/2002  18:41:00  001 Proton City   Protection Charger Failed                 Alarm
01/04/2002  18:51:10  001 Proton City    Telecom Charger Normalised               Normal
01/04/2002  18:51:21  001 Proton City   Protection Charger Normalised      Normal
01/04/2002  19:22:10  001 Proton City   Fire Alarm                                Alarm
01/04/2002  19:23:00  001 Proton City    Door Opened                              Alarm
02/04/2002  00:00:00  001 Proton City    V1: 414.2V, V2 : 415.1V, V3: 414.2V, KWH: 255   Normal
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Sample Printout of Alarm Logging from SM2000 FEP

ST20 FREQUENCY SHIFT KEYED (FSK) RADIO / LEASED LINE MODEM
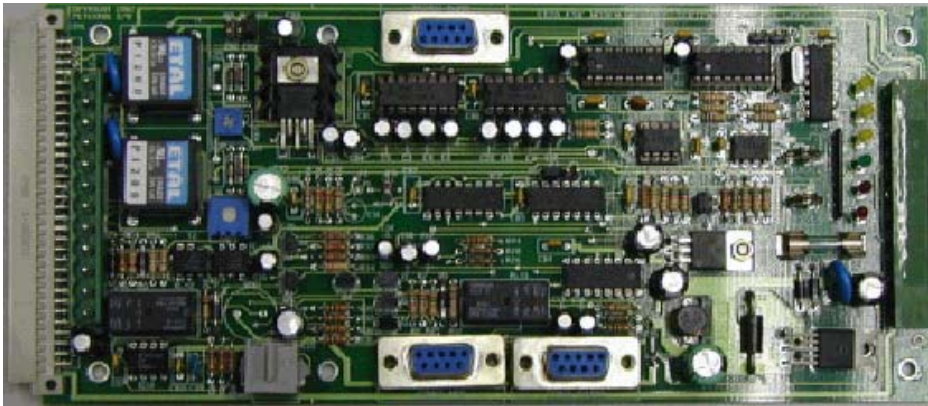
PCB Layout of ST20 FSK MODEM Card with the size of a 3U Eurocard

The SCADATRON ST20 Frequency Shift Keyed (FSK) MODEM card provides a majority of the functions required of a medium speed FSK modem in a small card. The ST20 is both a Leased Line MODEM and FSK Radio MODEM. In Leased Line Mode, it support direct connection to E&M line of a remote repeater station. It's DC supplies operation and low power consumption makes the device ideally suited for use in battery operated equipment applications.

Features

♦ single chip FSK modem meets ITU/CCITT V.23 standard
♦ forward channel (transmit/receive) at 600/1200 baud
♦ backward channel (transmit/receive) at 75 baud
♦ full duplex operation up to 1200 baud transmit and receive in 4 wire mode
♦ Receive and transmit signal gain/level adjustment
♦ Function as leased Line MODEM for 2 wire or 4-wire mode operation
♦ Function as radio MODEM for direct connection to most radio transceiver available
♦ Onboard transmit time protection circuitry (10 seconds, factory adjustable)
♦ Support MODEM hardware handshaking signalling (RTS, CTS, DCD)
♦ 600:600 ohm isolation transformer for 2-wire or 4 wire mode operation
♦ Wide input voltage range 11V .. 30V DC
♦ With voice / data change-over circuitry in Radio MODEM Mode
♦ Microphone and speaker connection for Radio MODEM or leased Line MODEM
♦ Built-in surge protection circuitry with removable fuse
♦ LED Indicators to shows communication status of MODEM
♦ 3U Eurocard form factor enable slot in to 3U rack with DIN41612 back plane

Modes of operation of ST20

The ST20 is an FSK (Frequency Shift Keying) modem that is designed to implement the ITU V.23 standards, which define mark and space frequencies, and the maximum data rate that can be transmitted for a given mark/space pair.

Automatic Gain Control

Automatic gain control will initially be set to maximum gain when no signal is received. The gain will then be reduced in steps (up to 16, if high level is received) on each consecutive mark received.

PHOTO GALLERY OF SM2000 FEP INSTALLATION

SM2000 FEP equipped with UHF Radio, PSTN MODEM, lease line MODEM, ORBCOMM satellite network as communication link to remote stations

Detail view of the SM2000 FEP Industrial Computer 19" rack and LCD display panel displaying alarm / event / data with time stamp

Another SM2000 FEP with VHF RTU and PSTN MODEM as communication link.

A VHF radio Sub-master Station using SM2000 FEP in a 13U height 19" equipment rack.

REMOTE MONITORING VIA ORBCOMM

The following is the some of the feature highlights for SCADATRON Telemetry Remote Monitoring via ORBCOMM:

Satellite Communicator

- Uses 36 small Low earth orbiting satellite (LEOS) by ORBCOMM orbiting 825 Kilometers above the earth
- Remote two-way communications monitoring systems
- Low cost satellite communications, especially in remote locations
- Units use economical VHF electronics and simple antenna design and small package offer installation flexibility.
- Low power electronics enable extended operations using batteries, solar panels or available power.
- A complete ORBCOMM Monitoring system offered by SCADATRON consists of a ST2000 CPU, appropriate sensor, a Satellite Communicator (SC) with antenna, and power source.
- The ST2000 CPU provides continuous, onsite monitoring and data logging. Monitored data can be downloaded periodically over the satellite link. Initial service offerings available in several "windows of communications" available in a 24 hour period.
- Operational parameters can also be adjusted remotely over the link.
- The ORBCOMM System offers significant advantages over other, traditional remote monitoring solutions. Among these are lower installation cost; two-way satellite link; lower power requirements; optional position data.
- ORBCOMM is the world's first, wireless, two-way data and message communications system providing worldwide transmitted by the satellites is moved through earthbound "Gateway Earth Stations", and from there to the ORBCOMM Network Control Center.
- Data can be sent and received by the end user using a personal computer equipped with a dial-up modem.
- ORBCOMM Messaging System operation is similar in concept to cellular phone service, but is strictly for data communications. No voice capability is available.
- ORBCOMM is a federally licensed carrier. All FCC requirements are met by ORBCOMM, making universal application possible anywhere in the United States, and in many foreign countries. coverage.
- The global system includes up to 36 MicroStar Satellites
- Data is communicated to earth gateways via narrow band VHF frequencies.
- Satellite Communicators (SC) are small, lightweight devices capable of accessing the system and transferring data. They transmit at 2400 BPS and receive at 4800 BPS. These devices integrate together with data collection and monitoring equipment to provide full transfer capability to and from the ORBCOMM system, and thus to the end user.

ORBCOMM Satellite

ORBCOMM Earth Station


Network Control Center

End User receive data via email

ORBCOMM SATELLITE LINK

The ORBCOMM System uses Low-Earth Orbit (LEO) satellites instead of terrestrial fixed site relay repeaters to provide worldwide geographic coverage. The system is capable of sending and receiving two-way alphanumeric packets, similar to two-way paging or e-mail. The best application of ORBCOMM system is when there is no means of reliable terrestrial communication in a particular remote station. ORBCOMM Satellites Act as "orbiting packet routers" built to "grab" small data packets from ground communicators and relay them through a Gateway Earth Station (GES) to a Gateway Control Center (GCC) in Network Control Center (NCC).
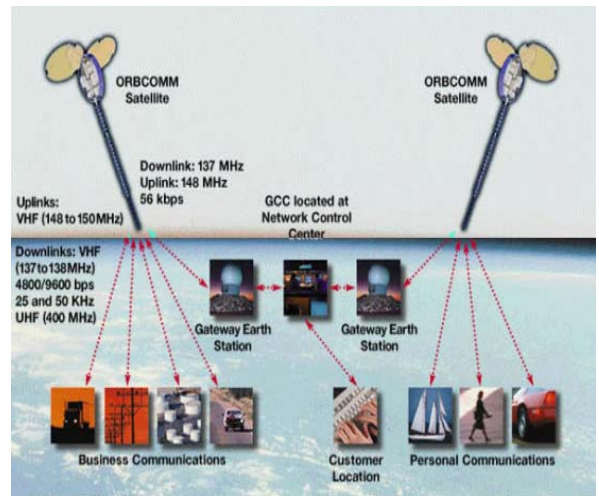
TELEMETRY SYSTEM CONFIGURATION USING ORBCOMM LOW ORBITING SATELLITE SYSTEM

1. ST2000 RTU acquire data from respective sensor and send data in packet format into the a Subscriber Communicator (SC) connected to it's RS232C serial port at a prefixed interval.
2. The SC after detect a ORBCOMM Satellite passing and confirmed the Gateway Earth Station (GES) at sight will automatically send the data message through up-link to the ORBCOMM Low Orbiting Satellite (LEO) through it's VHF antenna.
3. ORBCOMM Low Orbiting Satellite after received the data packet will then down-link the data to the ORBCOMM Gateway Earth Station (GES) in Kijal, Terengganu, Malaysia.
4. Data message received in GES will be transferred to Network Control Center (NCC) in Petaling Jaya through CELCOM fiber/microwave link.
5. Network Control Center (NCC) will then send data in form of email to Internet Service provider (ISP) email account.
6. Telemetry Master Station periodically connect to Internet Service Provider (ISP) though dial-up or leased-line to retrieve email from mail server.
7. The Front End Processor (FEP) in Central Monitoring Station (CMS) then process the email received and extract telemetry data, display the data and store in database.

The satellite transceiver used by ST2000 RTU to transfer data to ORBCOMM satellite is called Subscriber Communicator (SC). One of the SC available in the market now is manufactured by Panasonic shown on the picture below.

Subscriber Communicator

REMOTE MONITORING VIA INMARSAT-C

The following is some of the feature highlights for SCADATRON Telemetry Remote Monitoring e via INMARSAT-C:
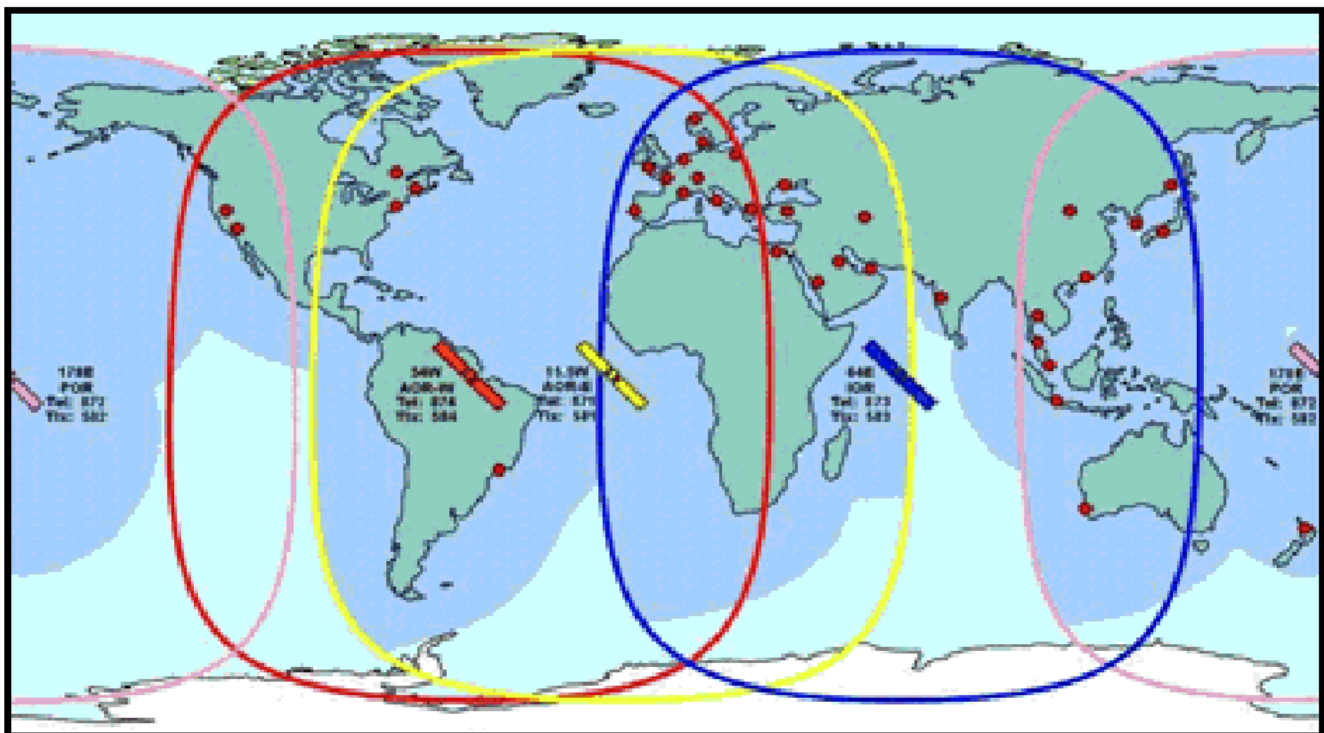

INMARSAT Satellite

- A complete INMARSAT-C Remote Monitoring system offered by SCADATRON consists of a ST2000 CPU, appropriate sensor, a Satellite Transceiver / Land Mobile Unit with antenna, and power source.
- The ST2000 CPU provides continuous, onsite monitoring and data logging. Monitored data can be downloaded periodically over the satellite link.
- Operational parameters can also be adjusted remotely over the link.
- Inmarsat-C is a commercial geostationary system. Satellites in geostationary systems maintain orbits that coincide with the Earth's rotation allowing them to remain essentially fixed above a geographic location.
- The Inmarsat system maintains a satellite in each of four ocean regions: Atlantic Ocean East, Atlantic Ocean West,Pacific Ocean, and Indian Ocean. These satellites provide coverage throughout most of the world

Land Earth Station

- The Land Earth Stations (LES) and the Network Coordination Stations (NCS) manage and coordinate Inmarsat-C telecommunications. The Land Earth Stations are land-based receiving and transmitting stations that coordinate national and international fixed communication network.
- One Network Coordination Station resides in each of the four ocean regions to monitor and control communication traffic within each region.
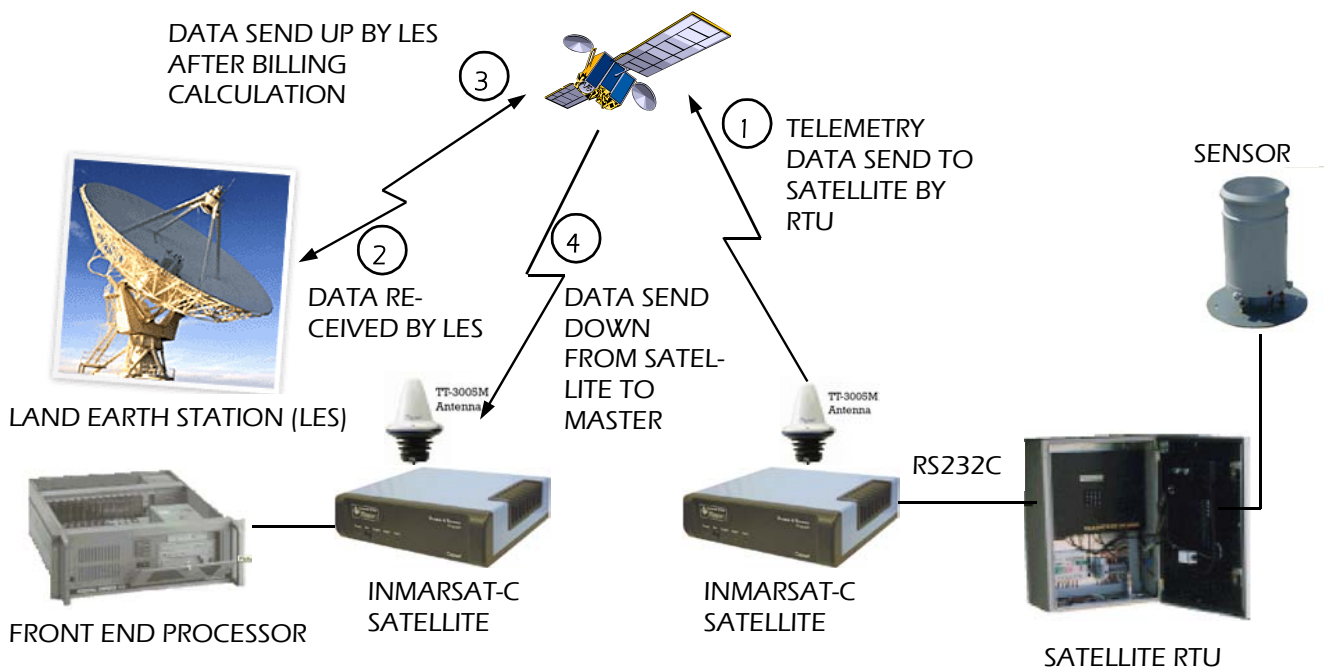

Unit Of global beam coverage for Inmarsat A,B,C,D,E,M   Inmarsat Phone Coverage

- Pacific Ocean Region
- Atlantic Ocean Region – West
- Alantic Ocean Region – East
- Indian Ocean Region

SCADATRON TELEMETRY INMARSAT-C SATELLITE LINK

DATA SEND UP BY LES
AFTER BILLING
CALCULATION

③

① TELEMETRY
DATA SEND TO
SATELLITE BY
RTU

SENSOR

②

DATA RE-
CEIVED BY LES

④

DATA SEND
DOWN
FROM SATEL-
LITE TO
MASTER

LAND EARTH STATION (LES)

TT-3005M
Antenna

TT-3005M
Antenna

RS232C

FRONT END PROCESSOR

INMARSAT-C
SATELLITE

INMARSAT-C
SATELLITE

SATELLITE RTU

The Satellite Link configuration diagram above shows two segment of data transmission. The first segment shows telemetry data is transmitted from Remote Station's RTU toward the IN-MARSAT-C satellite and repeated down to the Land Earth Stations (LES). After managed by the Network Coordination Stations (NCS) in LES, the second segment shows data is transmitted from Land Earth Stations (LES) back to the satellite and repeated down to the Central Monitoring Station (CMS) satellite transceiver to be received and recorded by the Front End Processor (FEP).

THRANE & THRANE SATELLITE TRANSCEIVER/ LAND MOBILE

The Thrane & Thrane Land Mobile TT-3020C supports all Inmarsat communication modes, including e-mail, position reporting, fax, telex, x.25, and mobile-to-mobile communications, mobile-to-land fax services, the standard PU/PA programming formats, as well as an advanced reporting format with multiple DNID's, independent reporting timers and global ocean area pre-programming.


INMARSAT-C SATELLITE TRANSCEIVER

The TT-3020C, Transceiver can be supplied with our compact omni-directional TT-3005M, Antenna, integrating both Inmarsat-C and GPS operation into one single unit. The transceiver also includes a number of parallel control ports, standard NMEA 0183 nav/data interface and an advanced ArcNet local network interface for connection of up to several ArcNet printers and alarm panels. The TT-3020C supports PC base Capsat® Manager Program for fleet tracking and fleet management.

The Inmarsat-C satellite communications system offers global access to the Inmarsat-C service using the omni-directional Inmarsat-C/12-channel GPS antenna. It is also compliant with the latest Inmarsat-C specifications for non-SOLAS distress calling and international fisheries standards.

# LOG DATA RETRIEVE FROM RTU TO FRONT END PROCESSOR
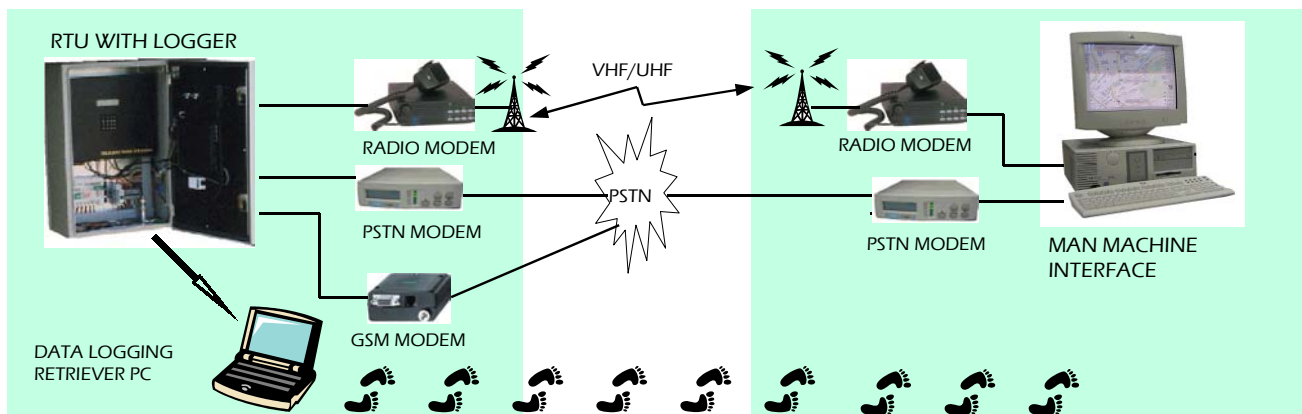
Logged Data can be retrieved via PSTN/GSM/Radio MODEM or directly via data retriever notebook carried to site

SCADATRON SM2000 can support both real time data acquisition and data logging from Remote Terminal Unit (RTU) over most of the available communication network. For data logging acquisition, no data shall be lost over the transmission network to Central Station due to intermittence in communication provided that Acknowledge (ACK) and Negative Acknowledge (NACK) is used.

When the SM2000 Front End Processor is configured to retrieve data logging data from the remote station, instead of requesting latest data from the remote station, the SM2000 FEP request for any stored data in the data logger memory portion of the Remote Terminal Unit (RTU). If there is no stored data, the RTU reply "No Data" and the communication end. If there is some data, the RTU will reply the earliest stored data and wait for further command. After the FEP received the new data and verified good, it will command the RTU to "Advance Data Pointer And Reply Next Data". If the FEP do not receive a good data, it will send a command "Do Not Advance Data Pointer And Reply Current Data Again". The mechanism continue in such manner until all the data in the memory of RTU is transferred to the FEP.

For information: Data can be logged into the RTU based on time (from 1 second, 1 minute to 24 hours), state of change of input (any of 16-bits digital inputs) or rainfall tips/ pulse event triggered. SCADATRON's RTU has a integrated 128K non-volatile SRAM memory for continuos data logging up to 362 days based on 4 measurement parameters and hourly time base logging . It reduced to 90 days for data logging every 15 minutes. Logged data format is in DD/MM/YYYY HH:MM:SS, location id and 4 other measured value such as cumulative rainfall/totalised pulse, daily rainfall/pulse intensity, 16 bits digital input status, sensor measured data in engineering values.
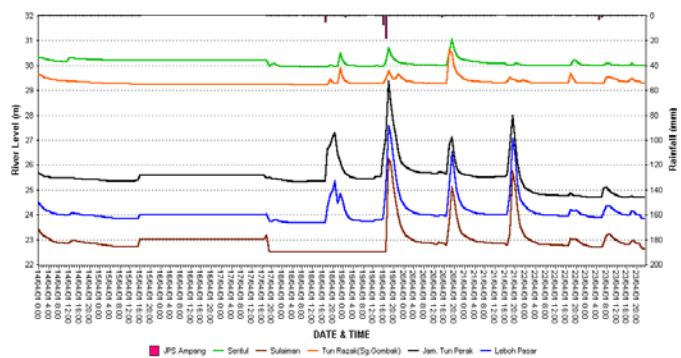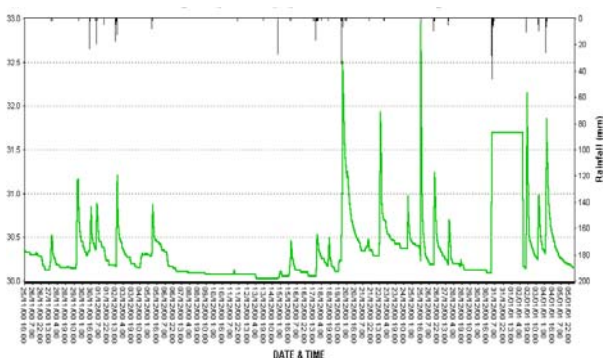
Optional graphical data presentation software is available to show data logging water level hydrograph and rainfall bar chart after retrieved from individual RTU station or from different RTU stations.

What is Telemetry ?

Telemetry is the mechanism by which information is interchanged with remotely separated locations to a device on which the reading can be indicated or recorded for the purpose of monitoring and/or control though communication network (Radio, Leased Line, PSTN, Satellite, Direct-linked etc.). The term "tele" means "at a distance" and "metry" refers to measurement: measurement at a distance. All of these measurements are first converted to digital data (ones and zeroes); they are arranged into "data packets" to be transferred by the communication media to the data collection center.

What is SCADA ?

The acronym SCADA, means Supervisory Control and Data Acquisition. It is comprised of one or more computers, providing an interface to the physical communication network (and hence to the RTUs), and an operator interface to the data obtained from RTUs. This data may be massaged, stored for later retrieval, analysed and transferred to other computer systems. A SCADA system often provides a control interface for sending data to RTUs. This can be by way of operator commands, automatic sequences reactive to data from RTUs, or information received from other computer systems. SCADA systems have provided the means for controlling and monitoring remote devices for several decades.

WHY USE SCADATRON ?

Scadatron is designed and manufactured locally in Malaysia. The quality is assured because it is designed to satisfy local and overseas market. Scadatron is designed by system experts after years of experience in telemetry systems and SCADA application with the know how in software & hardware design of Embedded Controller for critical control & monitoring requirement. Experience in communication equipment and media helps us to provide the best linkage solutions for most of our client needs.

Epeteknik is committed to give full support on the Scadatron software or hardware packages to the customer satisfaction. The experts in Epeteknik have the capability to recommend the best system to suit the client requirement based on their experience in this field. Besides, they also have the capability to customise-design to cater for any possible upgrading work which utilise existing equipment and so reducing the cost involved.

Every Scadatron system comes with complete operations & maintenance manuals and a summarised operation instruction page. The philosophy of the company is not to supply a system which can only be maintained by the manufacturer but to supply a system which can be maintained by the users themselves.