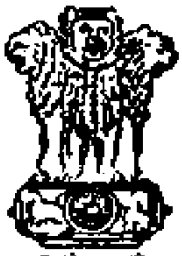

SPECIFICATION
FOR
DATA LOGGER SYSTEM
FOR
RAILWAY S&T INSTALLATIONS

IRS: S: 99/ 2006

APRIL 2006

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Research Designs & Standards Organisation
Lucknow – 226 011

DOCUMENT DATA SHEET			
Designation **IRS:S:99/ 2006**			**Amendment** **3**
Title of Document Data Logger System for Railway S & T Installations.			
Authors: **Shrikant Singh** **Designation: Executive Director / Signal/ RDSO**			
Approved by **Name: Shri G. D. Bhatia** **Designation: Sr. Executive Director/ Signal, RDSO**			
Abstract This document defines Data Logger System for Railway S & T installation.			

DOCUMENT CONTROL SHEET

NAME	ORGANIZATION	FUNCTION	LEVEL
Shrikant Singh	**RDSO**	**Member**	**Prepare**
G.D. Bhatia	**RDSO**		**Approve**

AMENDMENTS

Version	Chapter/ Annexure	Amendment	Effective date
IRS: S: 99/ 2001		FIRST ISSUE	August 2001
IRS: S: 99/ 2001		Amendment 1	12th February 2002
IRS: S: 99/ 2001		Amendment 2	30th September 2004
IRS: S: 99/ 2006		Amendment 3	5th April 2006

Amendment 3 (Details)

Sl.	Clause	Amendment	status	Remarks
1.	1.2	2	Add	To clarify The scope of inspection of Modem & CMU
2.	3.3	3	Modified	Output relay capable to drive 24V Q-Series Relay
3.	3.4	3	Modified	Field gear shall not load >1%
4.	3.7	3	Modified	Forced Cooling to be deleted
5.	3.8	3	Modified	To Print in user friendly mode
6.	3.9	3	Modified	Format to include location name& Channel no.
7.	3.10.1 (vii) & (xvii)	3	Deleted & subsequent clause renumbered	To delete Three position inputs
8.	3.10.2 (iv)	3	Deleted & subsequent clause renumbered	Covered by Digital Input
9.	3.13	3	Add	To include Version control
10.	4.1(vi)	2 & 3	Add	To add modem
11.	4.2.2	3	Modified	RTU Event Capacity Defined
12.	4.2.7.1	1&3	Deleted	To delete synchronization of control office digital clock
13.	4.2.10	3	Modified	Storing capacity to increase upto 10 lac
14.	4.2.12	1&3	Add & Modified	To clarify input variation storing percentage of analog
15.	4.2.17	3	Modified	Power Supply as per spn 144
16.	4.2.18	3	Modified	To make modular & Ergonomic design
17.	4.2.19	2 & 3	Add	To include transmission media
18.	4.2.20	2	Add	Common protocol between RTU & DL
19.	4.2.21	3	Add	Capacity of one cabinet 1024 Digital & 64 Analog
20.	4.2.22	3	Add	Termination of All input Like Wago etc
21.	4.3.1	2 & 3	Modified	Specification of PC for CMU upgraded to state of art & Sub

				clause added
22.	4.3.8	3	Modified	FEP must have capacity to store 10 lac telegrams
23.	4.3.9	1 & 3	Modified	Details of common protocol
24.	5.5	3	Modified	Transmission rate to increase up to 57600 BPS
25.	5.6.1	3	Modified	Sub clause Number given
26.	5.6.2	3	Modified	Sub clause Number given
27.	6.3.1	3	Add	Applied high voltage test added
28.	7.1	3	Add	Sub clause number given
29.	7.2	3	Modified	IR test as per RDSO/SPN/144/2006 & Sub clause added
30.	7.3	3	Modified	Environmental as per RDSO/SPN/144/2006 & Sub clause added
31.	7.4	3	Add	Applied high voltage test as per RDSO/SPN/144/2006 & Sub clause added
32.	10.4	3	Add	Pre-commissioning check list & DOs and DON'Ts
33.	11.1.1	3	Modified	Sub clause given number
34.	11.2	3	Modified	"Additional" ward added
35.	11.4 (c)	2	Delete	Deleted against Cl:4.1.(a) (vi)
36.	11.5 & 11.5.1	3	Delete	Deleted against Cl:4.2.17
37.	Annexure	3	Add	Added as per clause 4.3.9

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

INDIAN RAILWAYS STANDARD SPECIFICATIONS

FOR

DATA LOGGER SYSTEM

(TENTATIVE)

Serial No. S 99/ 2006

0 FOREWORD

0.1 This specification is issued under the fixed serial number followed by the year of adoption as standard or in case of revision, year of latest revision.

0.2 This specification requires reference to the following specifications: -

IRS: S23	Electrical signalling and interlocking equipment
RDSO/SPN/144	Safety and reliability requirement of electronic signalling equipment
IS: 9000	Basic environmental testing procedures for electronic and electrical items

Wherever, reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

1 SCOPE

1.1 This specification covers the technical and operational requirements of data logger equipment, which is installed to monitor the status of the signalling gears

at stations. It also covers minimum configuration of central monitoring unit (CMU).

1.2 Inspection shall be carried out for data logger equipment consisting of RTU, FEP and CMU software. Standard accessories used external to the data logger like PC for CMU, UPS for CMU and modem etc. shall be checked during inspection for their functional performance only required for data logger system as per specification.

2 TERMINOLOGY

2.1 For the purpose of this specification, the terminology given in IRS: S23 and RDSO/ SPN/144 shall apply.

2.2 Input module means an electronic module/ card used to read status of relays (digital input) and/or level of analog signals**.**

2.3 Signal Conditioner means an electronic module or card used to convert analog signals to a suitable level for recording.

2.4 SSI/ Electronic interlocking is a processor based electronic system to control signalling equipments/ functions at any interlocked station.

2.5 Integrated power supply (IPS) is a composite module delivering various AC and DC voltage for signalling equipment.

3 GENERAL REQUIREMENTS

3.1 The system shall chronologically monitor and record the status of various field functions like track circuits, points, signals, operator's push buttons/switches (digital Inputs) and level of various analog signals like DC and AC supply voltages, Axle counter signals etc.

3.2 The equipment shall also have the capability of statistical analysis, predict the faults and generate failure reports. It shall be possible for the user to define fault logics taking digital/analog inputs into consideration and generate reports for such faults.

3.3 The equipment shall be capable of generating audio-visual alarm under defined conditions. In addition, it shall be able to deliver non-vital relay outputs on receipt of command from CMU. At least 8 non-vital relay outputs shall be provided. The non vital relay output shall be in the form of potential free contacts capable of

driving 24V 'Q' series relays These outputs may be used for non-vital functions like radio patching of control circuits etc.

3.4 For digital inputs, potential free contacts shall be used. Analog signals shall be scaled to a suitable limit using signal conditioner before converting to digital signal. While tapping analog input, it shall not load the analog channel/ field gear by more than 1% of rated load.

3.5 The system shall be suitable for working on non electrified, AC electrified and DC electrified areas and where passenger/freight trains hauled by single phase thyristor controlled or three phase induction motor controlled AC locomotives or chopper controlled EMU stock are operated.

3.6 The system shall be capable of working in conjunction with conventional relay interlocking, multi-aspect colour light signalling installations operated by lever frames/ slides & Electronic Interlocking systems. It shall have facility to log data received from Electronic Interlocking through a serial port.

3.7 The system (except commercial PC used for CMU) shall be capable of working in an ambient temperature range of -10^0 C to $+70^0$ C and relative humidity up to 95% at ambient temperature of 40^0 C.Special protection against ingress of dust, moisture etc. shall be provided.

3.8 The data logger shall be capable of being connected to a printer for obtaining a hard copy of the function recorded. It shall be possible to print the following on the connected printer by selecting from user friendly menu

(i) on line events as they are generated.
(ii) to print the exception report
(iii)to print the status of user specified inputs for user definable time period

3.9 The data logger shall record various field functions as indicated in para 3.10 below chronologically in the following format with name of the location at top of every page:

Date, time, channel no., field function, status / value

3.10 The status of various functions shall be recorded in the following way: -

3.10.1 Digital Input:

	Functions	**Status configuration**
i)	Points	Normal or reverse (N or R), locked or

		unlocked
ii)	Signal	ON or OFF (Y, YY, R, G, RI, A marker)
iii)	Track	Occupied/Free
iv)	Level crossing	Locked/Free
v)	Crank handle	Locked/Free
vi)	Axle counter	Occupied /free
vii)	Route	Locked /free
viii)	Route sections	Locked / free
ix)	Push buttons	Pressed/released
x)	SM's key	In/Out
xi)	Slots	Given/ not given; Received / not received
xii)	Insulation of Sig. Cable	Good /bad (through ELDs)
xiii)	Slots (Outgoing)	Locked/ released
xiv)	Slots (Incoming)	Received /Absent
xv)	Switch (2 position)	Normal/ Reverse
xvi)	General Relay	Pickup / drop

3.10.2 Analog inputs

	Functions	**Status configuration**
i)	Axle counter Rx signal at the tag block	Value
ii)	AC power supply (230/ 110V)	Value
iii)	DC supply (12/24/48/60/110 etc.)	Value
iv)	Temperature	Value

The purchaser shall indicate any additional field information required to be recorded.

3.11 The system shall be easily re-configurable to any changes required by user, whenever modifications are carried out in the yard.

3.12 Provision for networking and remote monitoring of several data loggers from the central place shall be provided.

3.13 Implementation of version control and change of software shall be as per RDSO/SPN/144

4 TECHNICAL REQUIREMENTS

4.1 Data logger system consists of:

(a) Data logger equipment which is provided near the signalling gears to be monitored has following modules:

(i) Processor module.
(ii) Input module (digital/ analog)
(iii) Signal conditioning module
(iv) Communication module
(v) Printer 80 Col. Dot matrix (Optional)
(vi) Modem(s)

(b) Central monitoring unit (if provided) with communication facility to retrieve data from data logger(s) provided at station(s). The central monitoring unit shall run the diagnostic software to generate alarm and exception reports.

4.2 Data Logger Equipment*:*

4.2.1 The equipment shall cater for minimum 512 digital inputs (in the form of potential free contacts) and 32 analog inputs. The system shall be expandable up to 4096 digital & 96 analog inputs by expansion/cascading the similar equipment.

4.2.2 The equipment shall have facility to interface with Remote Terminal Unit (RTU). The RTU shall have modules normally identical to that used in Data logger. A RTU shall cater for minimum 32 digital and 8 analog inputs. The RTU shall have its own processor & communication modules. RTU shall have facility to store at least 1 Lac events. RTU should be expandable up to 64 digital inputs and 16 analog inputs. The inputs of RTU can be taken as part of data logger system and the inputs of RTU shall be a part of the total capacity 4096 digital input and analog input capacity of 96. The programming of the individual digital & analog channels shall be controlled by the data loggers. It shall be possible to connect maximum of 4 RTUs. Alternatively, the RTU can exist with separate ID. There shall be no loss of data due to power failure.

4.2.3 RTU shall use standard current loop serial interface for data transmission. It shall be possible to connect RTU up to 3 Km. from main Data logger equipment.

4.2.4 Signal conditioning module shall convert analog signals like 230 VAC, 110 VAC, 110 VDC, 60 VDC, 24 VDC, 12VDC and axle counter RX voltages etc. to suitable level for recording. Normally all AC voltages shall be at commercial frequency of 50 HZ except for Axle counter which is at 5KHZ. When an analog channel is not connected, it shall not pick up any noise.

4.2.5 Configuration of analog channels may be as under;

Channel	Nominal Voltage DC or AC (RMS)	Voltage Range for no alarm (adjustable)
1	230 AC	207- 253
2	110 AC	99- 121
3	110 AC	99- 121
4	110 DC	99- 121
5	60 DC	55- 69
6	60 DC	55- 69
7	24 DC	22.5-28
8	24 DC	22.5-28
9-16	1.0 AC,5KHz	-

Or as specified by purchaser.

4.2.6 Display shall be provided on the front panel of the data logger to display current status / faults/ alarms along with time stamp. It shall be possible to display faults/ alarms generated up to one week earlier on the panel. At least two row display shall be used with at least 16 characters in each row.

4.2.7 The equipment shall have real time clock for recording time at which the status of the particular information has changed. The real time clock on data logger should get synchronized with the central monitoring unit. The cascaded Data logger(s) shall also synchronize their clocks with the real time clock of master Data logger.

4.2.8 Opto-couplers may be provided to electrically isolate external digital inputs (relay contacts) from the equipment. Self-diagnostics shall be provided in the system. Any fault in the system shall generate error message in the system panel and generate alarm in the CMU.

4.2.9 The hardware structure of the system shall be modular.

4.2.10 Event logging facility for minimum 10 Lac events shall be provided in a Data logger. Data shall be recorded on first in – first out basis so that latest data is available in the system. There should be no loss of data from the data logger memory in case of power supply failure of data logger.

4.2.11 Scanning interval for digital inputs shall be less than 20 milliseconds. Change in status of digital signal shall only be recorded.

4.2.12 Scanning interval for analog signals like DC or AC supply voltage, temperature, axle counter RX voltage etc. shall be less than 1 second. Variation of more than 5% of the nominal value from the last recorded value, provided it has gone 5% beyond the nominal value, shall be recorded.

4.2.13 Accuracy of measurement of analog signals shall be better than 1% within ±40% of nominal value.

4.2.14 The equipment shall have facility to receive serial data from external equipment like Electronic Interlocking, Integrated Power Supply etc. and record it with time stamp.

4.2.15 The software of the system shall be of approved type and written in a structured format so that the purchaser can reconfigure it, if required. The software shall have clear bifurcation between generic software and application software.

4.2.16 At least 6 serial ports shall be provided for communication with other data loggers, CMU, RTU, EI, IPS etc.

4.2.17 Power Supply: The system shall work on 24V DC (+20%, -30%). Railways will provide 24VDC input supply.

4.2.18 19" rack mountable and 3/4/6 U high cabinets made of aluminum of minimum thickness 2mm should be used for housing the PCB cards to achieve modular and ergonomic design for good maintainability. The cabinet should be powder coated. The front and backsides of the cabinets shall have the facility for locking the equipment.

4.2.19 Data Logger shall be capable of working with different transmission media like under ground telecom cable, microwave (Digital or Analog) & OFC. The provision of either in-built modem or external modem is acceptable. The data logger equipment will continuously check the modem status and give the necessary reset as required to eliminate modem hanging condition. The modem will be housed within the data logger cabinet. The data logger shall be compatible to the following media:

(i) Main telecom cable.
(ii) Quad cable.
(iii) Analog channel of OFC, digital microwave or analog microwave.
(iv) 64 KBPS data channel on OFC or digital microwave.

4.2.20 Communication between data logger & RTU shall also be as per communication protocol mentioned in clause 4.3.9.

4.2.21 Cards and terminals required for up to minimum 1024 digital inputs 32 analog inputs, signal conditioning modules etc. shall be accommodated in one rack of 19" width.

4.2.22 For termination of external digital and analog inputs, international quality terminals of WAGO/ Phoenix etc. makes shall be used as per RDSO SPN/144. All wires should be neatly bunched in horizontal and vertical channels.

4.3 CENTRAL MONITORING UNIT (CMU):

4.3.1 SOFTWARE CONFIGURATION

4.3.1.1 The database management system i.e. MS SQL server or Interbase shall be used to cater for basic function of Data loggers at CMU level. Only licensed software shall be used.

4.3.2 HARDWARE CONFIGURATION

4.3.2.1 Central monitoring unit shall be state of art PC (of reputed brand) based system working on commercial supply of 230VAC, 50Hz. The minimum configuration shall be as specified by RDSO from time to time. Presently minimum configuration must be as under:

(i) Pentium 4 or equivalent processor 3 GHz, 256MB RAM, 2 × 20 GB HDD with disk mirroring, 1.44" FDD, SVGA colour monitor (17") sound card with speaker, 56 KBPS modem, key board, optical mouse, 10 / 100T LAN card, CD writer and inkjet printer .

(ii) UPS with minimum 6 hours battery backup for central monitoring unit.

(iii)Software tools.

4.3.2 Central monitoring unit shall have Graphical User Interface (GUI) based software and retrieve data from all Networked data loggers (up to 32) at various stations. It shall store data in standard data base files. The CMU shall also be capable of analyzing the data & generate reports & audio visual alarms on defined conditions. It shall be possible to compress the data and take backup on floppy.

4.3.3 Software used for analysis of data, prediction of faults etc. in central monitoring unit shall be of approved type and written in a structured format so that purchaser can reconfigure it, if required. A copy of software shall be supplied in CD.

4.3.4 It shall be possible to display the status of signalling gears at any selected time in graphic form for any selected station yard on the central monitoring unit.

4.3.5 It shall be possible to retrieve the stored data & simulate train movement on the central monitoring equipment.

4.3.6 It shall be possible to send commands to various Data loggers to activate audio, visual alarm or operate an electromagnetic relay.

4.3.7 It shall be possible to share data available in CMU by other PCs through available local area network where this data can be used for train charting / passenger information purpose.

4.3.8 Front End Processor (FEP) shall be provided to continuously retrieve data from station data loggers. FEP must have capacity to store 10 lac telegrams. It should have 6 ports.

4.3.9 The communication protocol for transmitting data and command between data logger and CMU is given in Annexure.

5 FUNCTIONAL REQUIREMENTS:

5.1 The system shall generate audiovisual alarm in ASM's/ Signal Maintainer's room in the case of power supply failure (battery voltage low) or battery charger defective with acknowledgement facility.

5.2 Each data logger shall have it's own identity code which shall be transmitted along with data packet to central monitoring unit.

5.3 Events recorded at each station shall be continuously transmitted to central monitoring unit. Response time of data transfer shall not exceed 10 sec.

5.4 In case of loss of data, retransmission of data shall take place.

5.5 Data transfer rate shall be 57600 BPS with fallback facility to lower rates.

5.6 EXCEPTION REPORT:

5.6.1 The Data logger equipment shall be capable of generating following exception reports;

i) Battery Low voltage
ii) Battery charger defective
iii) Under wheel flashing of points
iv) Signal lamp failure
v) Blanking of Signals
vi) Route section not released after passage of train due to track circuit failure.
vii) Point Failure – point detection not available after set time period.
viii) Track circuit failure
ix) Fuse Blown OFF
x) Timer not properly set for 120 Sec.
xi) Sluggish relay operation
xii) Signal cable low insulation
xiii) Route not set when operation is valid.
xiv) Push button stuck.
xv) Signal over shoot.
xvi) Wrong operation
xvii) Axle Counter RX low level
xviii) Bobbing of track, point, signal, crank handle, Level X-ing or Ground frame repeater relay
xix) Point repeated operation
xx) Non sequential shunting of tracks

5.6.2 The CMU shall be capable of generating following additional exception reports.

i) Emergency cancellation of route
ii) Panel failure due to power failure
iii) Late start of a train (train operation)
iv) Late operation of signals with respect to local trains (train operation)
v) Route failure online indication with analysis of the stage at which it had failed.
vi) Non-signal movement (train operation)
vii) Total on time of lamp (to assess working life of signal lamp)
viii) Total number of operations of the relay (to assess life of relay)
ix) Emergency Point operation
x) Emergency Route Release
xi) Emergency Sub Route Release
xii) Overlap release
xiii) Emergency Crank Handle release

xiv) Calling on operations
xv) Slot operations
xvi) Historical replay of events in a yard in graphical manner.
xvii) Circuit progression. Railway shall provide logic for the same.
xviii) Any other exception report.

5.7 Exception condition shall be stored in the data logger chronologically and displayed one by one on the front panel through a toggle switch.

5.8 Data loggers of all stations shall send status report to the Central monitoring unit continuously. Status information shall be processed at the central monitoring unit and audio visual alarm generated for the fault / alarm condition

6 TESTS AND REQUIREMENTS

6.1 Conditions of Tests

Unless otherwise specified all tests shall be carried out at ambient atmospheric conditions.

6.2 For inspection of material, relevant clauses of IRS: S 23 and RDSO/SPN/144 shall apply.

6.2.1 Test Equipment

i) Dual beam oscilloscope of 20 MHz bandwidth
ii) Digital multimeters - 3.1/2 digit display with facility of diode & transistor testing with 1% accuracy
iii) EPROM Programmer and UV eraser
iv) Megger (500V)
v) PC
vi) Test jig
vii) Any other test equipment considered necessary.

6.3 Type Tests

6.3.1 The following tests shall constitute type tests:

a) Visual inspection as per Clause 7.1
b) Insulation Resistance tests as per Clause 7.2
c) Card-level functional tests on all the cards.
d) System level functional tests.

e) Environmental/climatic tests as per Clause 7.3
f) Applied High Voltage Test as per Clause 7.4

6.3.2 Any other tests shall be carried out as considered necessary by the purchaser.

6.3.3 Only one equipment shall be tested for this purpose. The equipment shall successfully pass all the type tests for proving conformity with this specification. If the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment/card(s) of the same type and subject it to all tests or to the test(s) in which failure occurred. No failure shall be permitted in the repeat test(s).

6.4 Acceptance Tests

6.4.1 The following shall comprise acceptance tests:

a) Visual inspection (Clause 7.1).
b) Insulation Resistance tests (Clause 7.2).
c) System level functional tests.

6.4.2 Any other tests shall be carried out as considered necessary by the purchaser.

6.5 Routine tests

6.5.1 The following shall comprise the routine tests and shall be conducted by manufacturer on every equipment and the test results will be submitted to the inspection authority before inspection. The application software in proper format shall also be submitted to the inspection authority in advance.

a) Visual inspection (Clause 7.1)
b) Insulation Resistance tests (Clause 7.2)
c) Card level functional test on all the cards.
d) System level functional test.

6.5.2 Any other tests shall be carried out as considered necessary by the purchaser.

7 TEST PROCEDURE

The test procedure shall be based on the system design. The methodologies to be adopted for various tests shall be decided taking into account the system design/configuration.

7.1 Visual Inspection

The equipment shall be visually inspected to ensure compliance with the requirement of Clauses 3 to 5 of this specification. The visual inspection will broadly include –

7.1.1 System level checking:

- Constructional details.
- Dimensional check .
- General workmanship.
- Configuration.
- Mechanical polarisation on cards .

7.1.2 Card level checking:

- General track layout .
- Quality of soldering and component mounting.
- Conformal coating.
- Legend printing.
- Green masking.

7.1.3 Module level checking:

- General shielding arrangement of individual cards.
- Indications and displays.
- Mounting and clamping of connectors.
- Proper housing of cards.

7.2 Insulation Resistance Test

7.2.1 Insulation Resistance Test shall be conducted as per RDSO/SPN/144

7.3 Environmental / climatic tests

7.3.1 Environmental / climatic tests shall be conducted as per RDSO/SPN/144

7.4 Applied High Voltage Test

7.4.1 Applied High Voltage Test shall be conducted as per RDSO/SPN/144

8 QUALITY ASSURANCE

8.1 All materials & workmanship shall be of good quality.

8.2 Since the quality of the equipment bears a direct relationship to the manufacturing process and the environment under which it is manufactured, the manufacturer shall ensure Quality Assurance Program of adequate standard.

8.3 Validation and system of monitoring of QA procedure shall form a part of type approval. The necessary Plant, Machinery and Test instruments as given below shall be available with the manufacturer.

8.3.1 Plant & Machinery:

i) Ultrasonic cleaner/Aqueous cleaner for automatic cleaning
ii) Burn in chamber
iii) Anti-static assembly
iv) EPROM Programmer and UV Eraser
v) Microprocessor development system
vi) Computer aided design system

8.3.2 All test instruments as given in Cl. 6.2.1 shall be available with the manufacturer.

8.4 Along with the prototype sample for type test, the manufacturer shall submit the Quality Assurance Manual.

9 PACKING

The equipment and its sub assemblies shall be packed in thermocole boxes and the empty spaces shall be filled with suitable filling material. Before keeping in the thermocole box, the equipment shall be wrapped with bubble sheet. The equipment shall be finally packed in a wooden case of sufficient strength so that it can withstand bumps and jerks encountered in a road/ rail journey.

10 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

Following documents should be supplied along with the system:

10.1 Mechanical drawings of each sub-system/ rack.

10.2 Trouble shooting chart.

10.3 Installation and Maintenance Manual.

10.4 Pre-commissioning check list, DOs and DON'Ts of data logger system including RTU, CMU & FEP in the User's manual.

11 INFORMATION TO BE SUPPLIED BY THE PURCHASER

11.1 Total number of digital and analog inputs to be monitored calculated as under.

11.1.1 The tenderer should give number of digital inputs required by calculating the inputs from the list given below:

a) All ECRs,
b) All HRs, HHRs, DRs or equivalent
c) All point operating relays NWRs, RWRs or equivalent
d) All point indicating NWKRs, RWKRs or equivalent
e) All buttons and knob relays
f) All track and axle counter relays
g) All timer repeater relays
h) Intermediate interlocking relays which tenderer need to monitor through data-logger e.g. UCR, ASR, JSLR etc. or equivalent
i) All relays related with emergency operations e.g. route cancellation, overlap cancellation, point operation under emergency, crank handle release, gate release etc.
j) CH, GF, LX release and indication relays.
k) All relays related with block instruments with or without axle counters and SM key.
l) Any other relay required to be monitored.

11.1.2 Details of Analog inputs to be monitored in local area.

Type of input	**No. of channels required**
230 V AC	
110 V AC	
12 V AC	
110 V DC	
60 V DC	
24 V DC	
18 V DC	
12 V DC	
Axle counter evaluator input voltages (RX) (unit-wise)	

Any other voltage	

11.1.3 Whether RTU is required for monitoring of the equipments at distant place, no. of digital and analog inputs required in RTU.

Details of analog inputs to be monitored from RTU should be given in the format as given below:

Type of input (Digital/Analog)	**No. of channels**	**Approximate distance from data-logger**

11.2 Additional exception reports (other than those mentioned in para 5.6) to be generated.

11.3 List of functions (in addition those mentioned in para 3.10) to be monitored.

11.4 (a) Central monitoring equipment (CMU) required – Yes/ No.

(b) FEP required – Yes/NO

If YES, indicate whether it is to be provided at the same station or at a remote place like control office etc.

11.5 Whether printer is required with data logger (at the station) : Yes/ No

Annexure

Communication Protocol for Data Logger Network

A.1 Scope

This Document completely details out the communication methods and protocols for the data logger. These methods and protocols are independent of the hardware of the data logger. The communication methods and protocols have been designed to bring out the maximum throughput from the network.

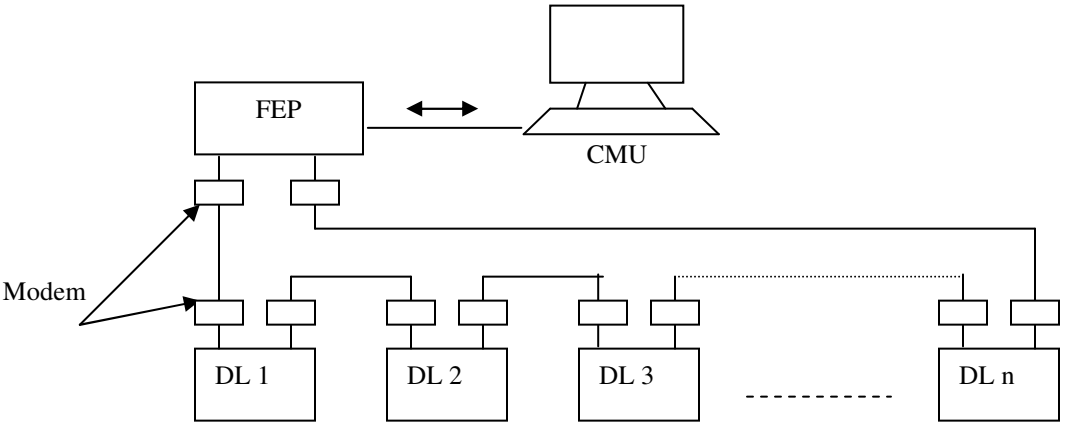
A.1.1 Overview

The data structure protocol for communication between the data loggers and CMU is explained in paras A.4, A.5 and A.6 of this Annexure.

A.2 Network

A.2.1 Topology

Ring Network topology has been adopted in this network. In Ring configuration the Data loggers are connected serially one to another. If 'n' number of Data loggers are in network then the first Data logger is connected to the second Data logger and second Data logger to third Data logger so on up to the 'nth' Data logger. Then the first and 'n th ' Data loggers will be connected to the Front End Processor (FEP) individually to make the network as closed ring. Each Data logger is connected with other Data loggers in either direction with 4 wire leased line modems. FEP is also connected through the modems to the first and last Data loggers. Since this type of configuration gives individual one to one communication between Data loggers, so event data can be placed into network immediately and simultaneously by all the Data loggers.



Data Logger System Network

Direction A is data flow from Data logger n , n-1,…..1 - FEP.
Direction B is data flow from Data logger 1 , 2 ,……n - FEP.

A.2.2 Port

(i)	Mode:	Asynchronous
(ii)	Baud:	57600 bps
(iii)	Character Length:	8 bits
(iv)	Parity:	none
(v)	Stop bits:	1

A.3 Message Formats

Two types of message formats have been implemented. One for Commands from CMU to any Data Logger / FEP and other is for event packets transmission in the network.

A.3.1 Commands.

Between CMU and Data Logger / FEP

CMU Data Logger /FEP

(a) Request Respond

Request ⟶ Accept request

Accept response ⟵ Send response

(b) Send all get Reply

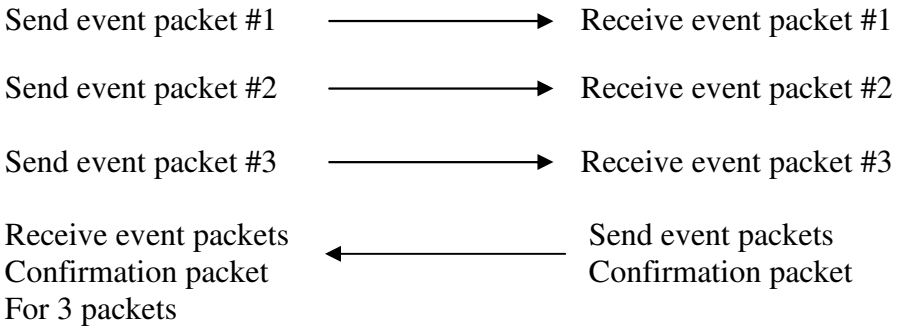
Broad cast request ⟶ Accept Broadcast request

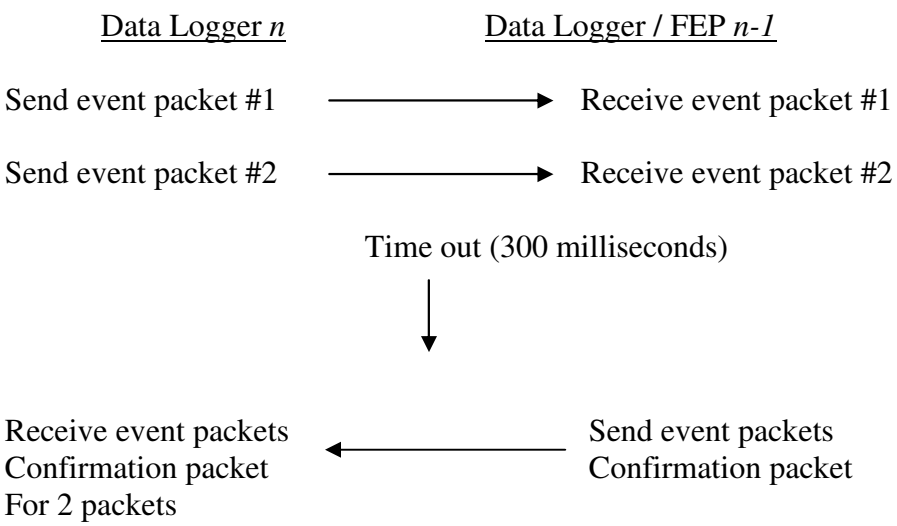
Accept reply ⟵ Reply from all

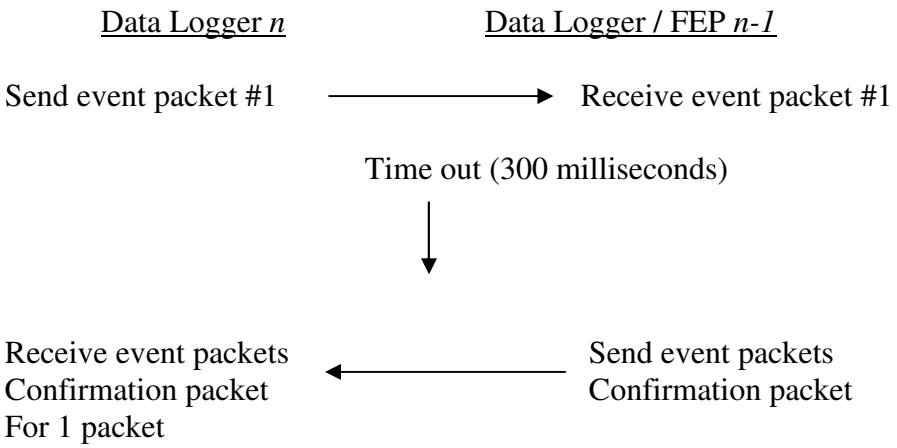
A.3.2 Event Packets.

Between two Data Loggers or Data Logger and FEP.

Data Logger *n* Data Logger / FEP *n-1*

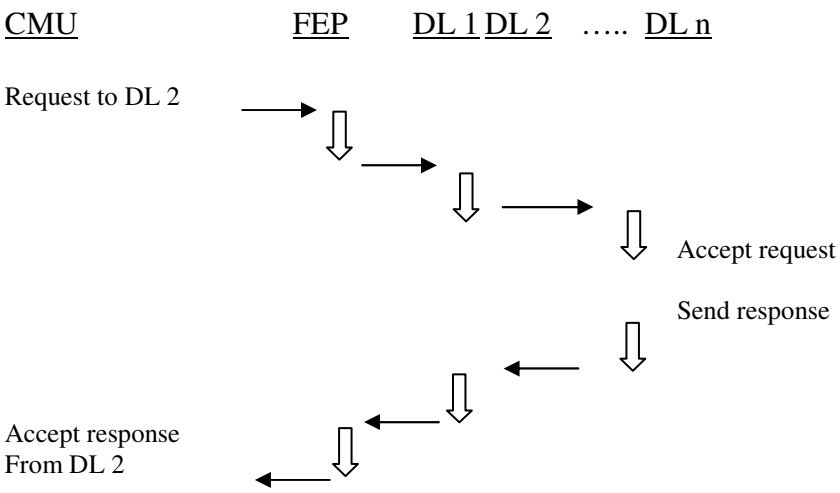






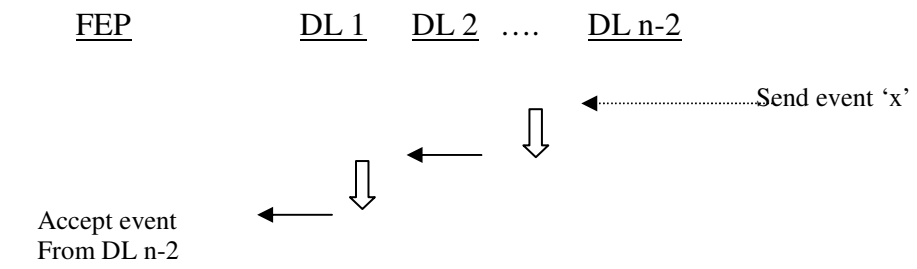
A.3.3 Command and Event Flow

A.3.3.1 Command flow for request-respond

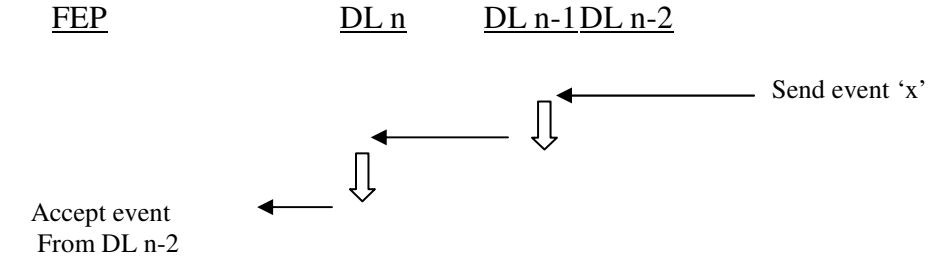


A.3.3.2 Packet flow for event data in two directions

Direction I



Direction II



⇩ = Retransmission to the next Data Logger in the other direction.

A.3.3.3 Event Packets Communication:

The event packets created in the DL will be sent immediately in both the directions. The event packets received from one direction is retransmitted to the other direction. The event packet is maintained in the buffer till it is acknowledged.

On failure of acknowledgement the event packets are tried again for transmission after the time out of 3 Seconds.

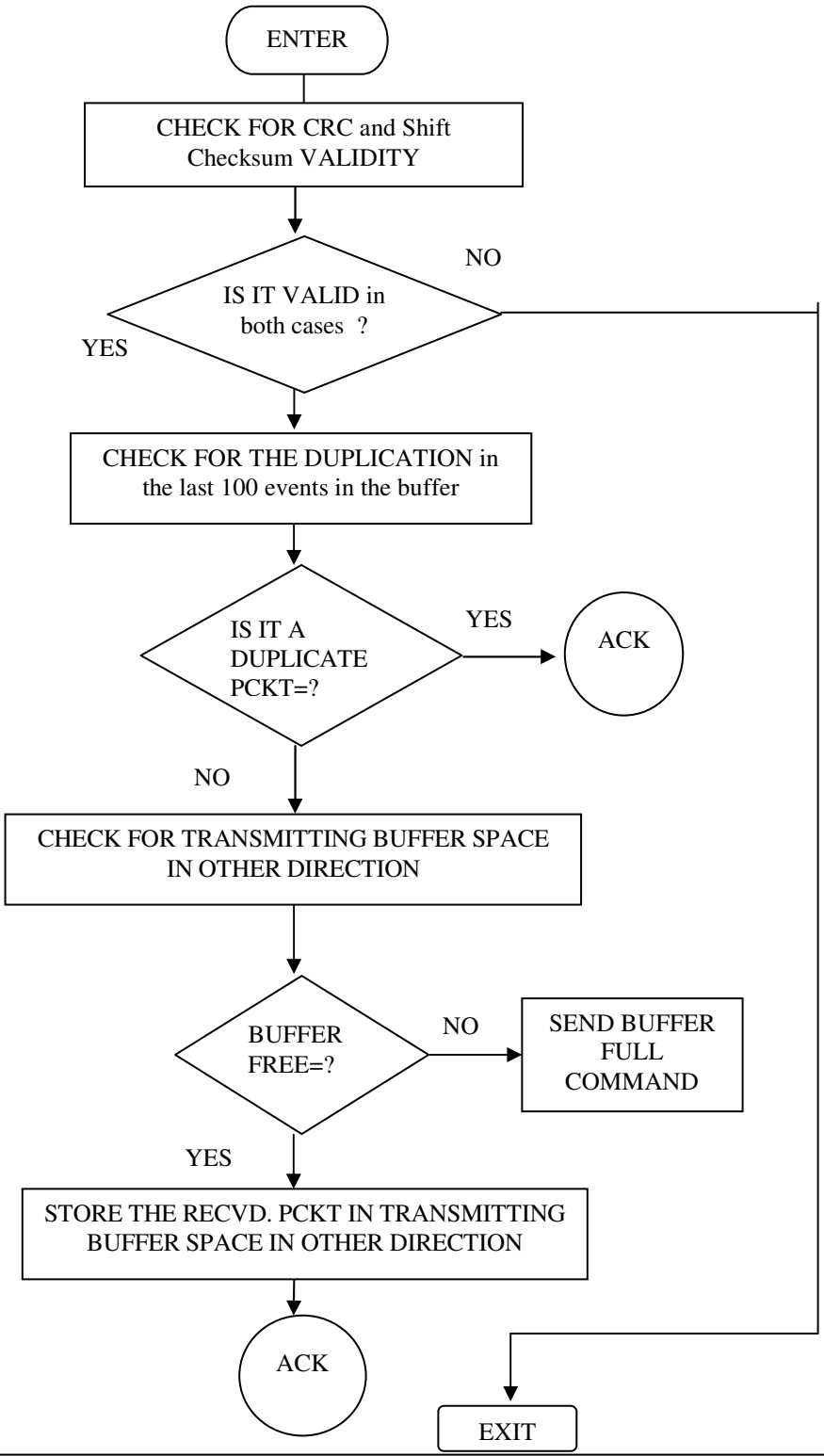
This is repeated and tried for three times with the same time-out of 3 Seconds. If acknowledgment is not received even after three trials, then time-out will be changed to 120 Seconds, thereafter it will be tried every 120 Seconds till it is acknowledged.

The acknowledgement for the event packets are sent for every three event packets received or if the time between received packet exceeds 300 milliseconds.

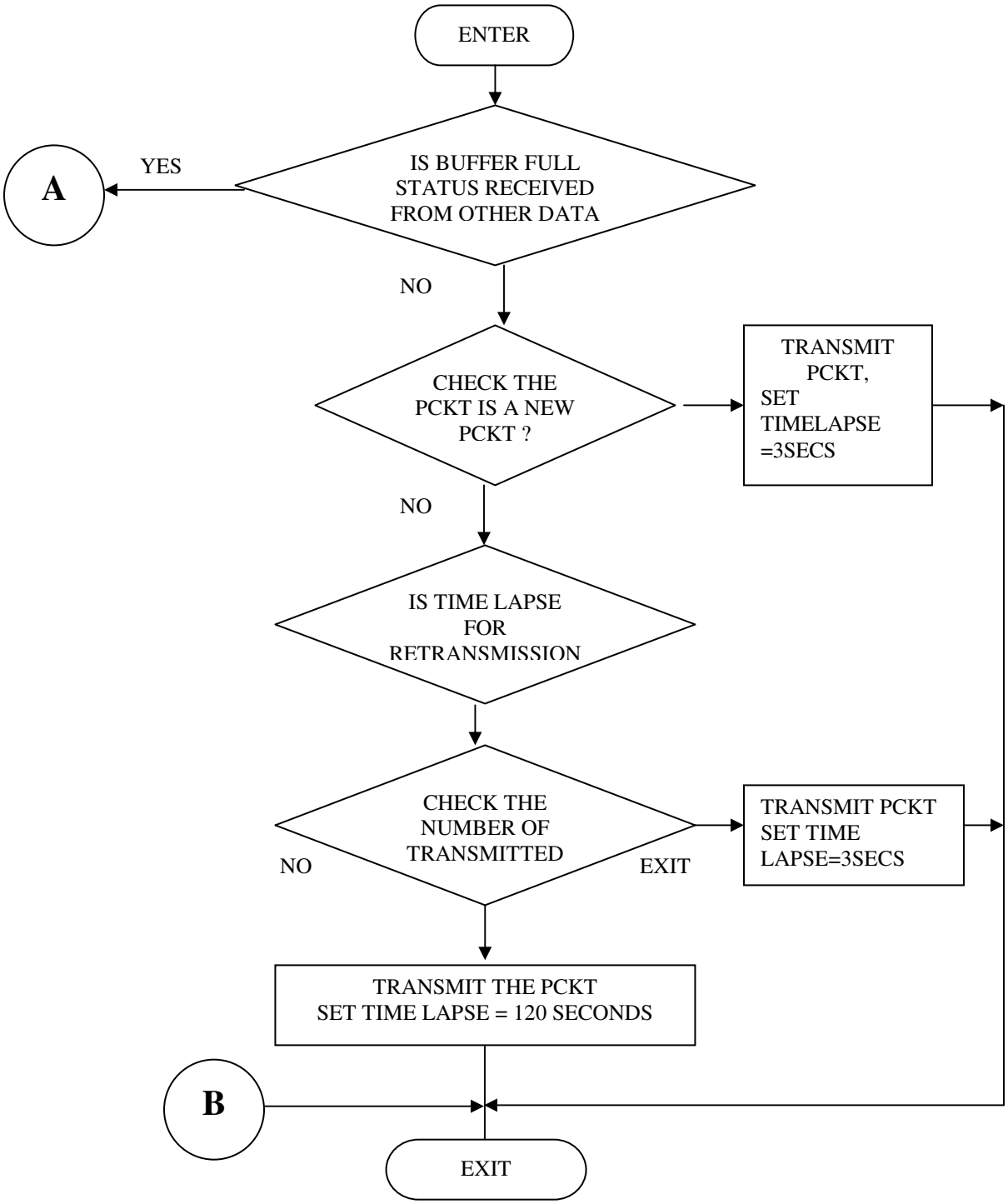
On receiving any event packet it is validated for CRC and Shift Checksum. If validity fails, no action is performed. For valid packets Data Logger will check for any duplication within the last 100 packets. If it is a duplicate packet then acknowledgement will be given but it will not be transmitted in the other direction. If it is a new packet then it will be placed in the buffer if space is available and acknowledge is sent back. If space is not available then buffer full command is sent back. Once the space is available then buffer free command is sent to reinitiate the packets transmission.

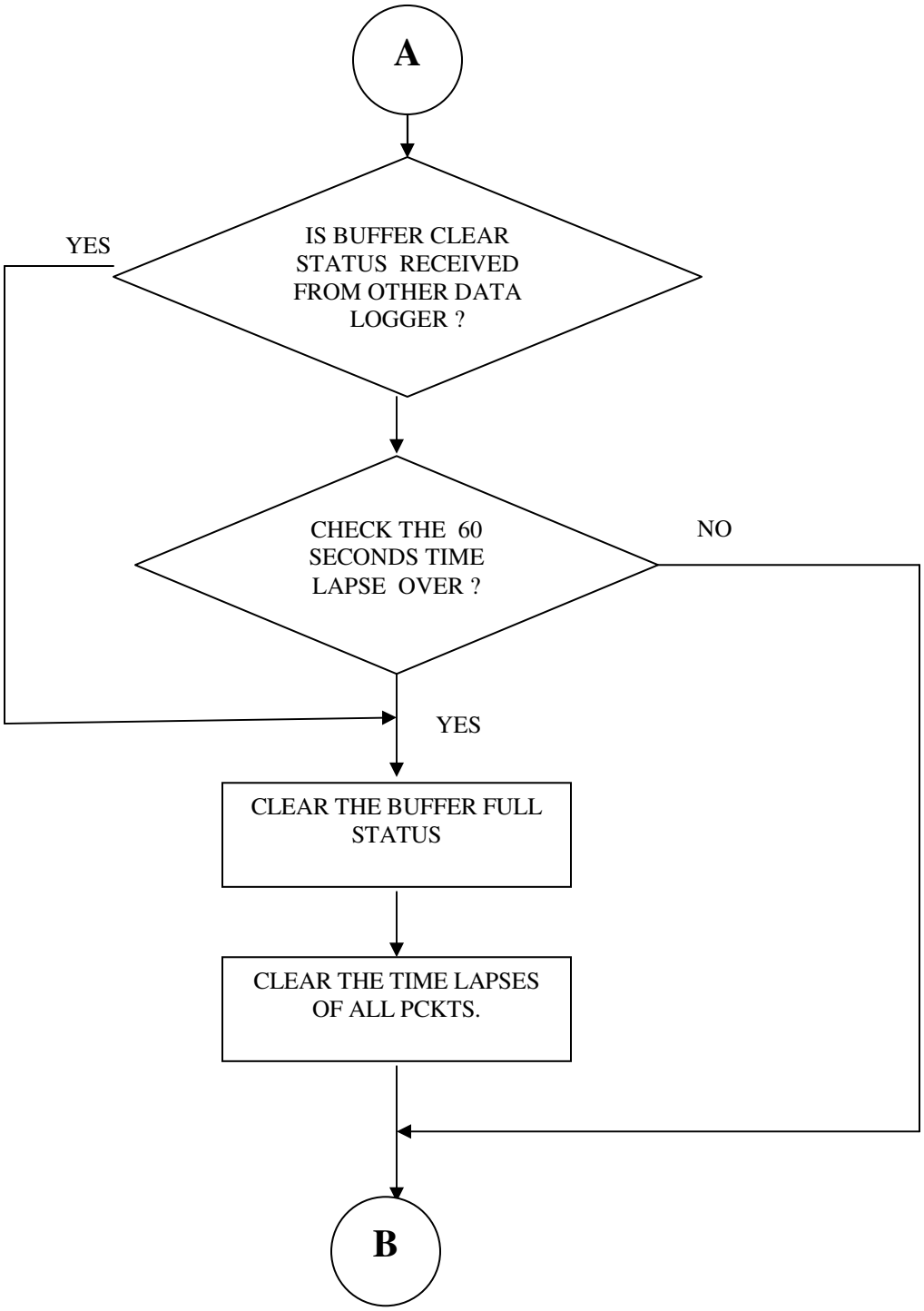
Once buffer-full command is received back for packet transmission then the Data logger will set itself to buffer full status and wait for a time lapse of 60 Seconds. On receiving the status of buffer free, the Data Logger will clear the buffer-full status and time lapses counts to initiate the transmission of packets.
At FEP, the received event packets from both the directions are buffered. These data will be sent to CMU whenever request received from CMU. Till then it is stored in buffer.
These processes are illustrated with flow diagrams given below.

A.3.3.4 Received Event Packet Processing

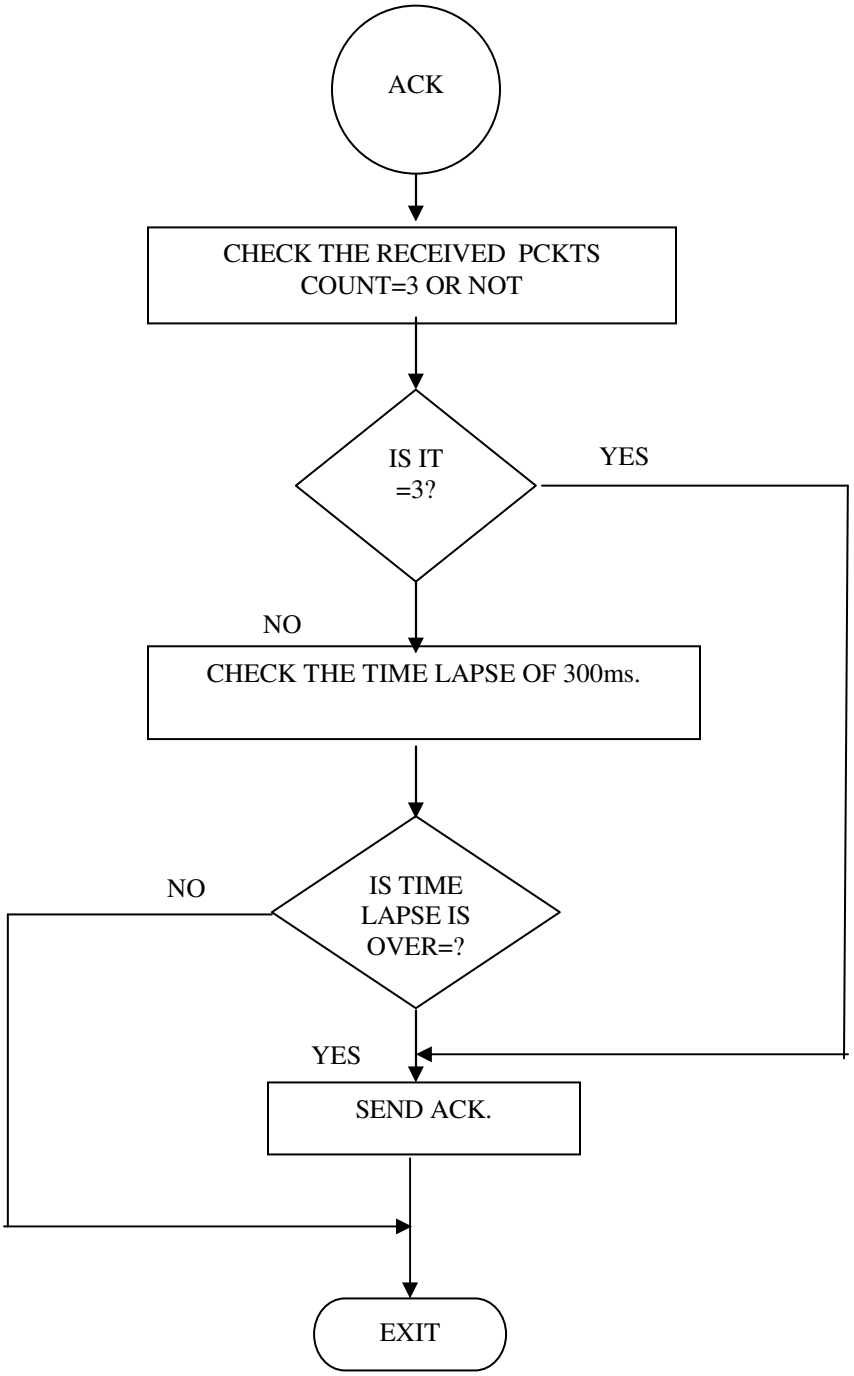


A.3.3.5 Event Packet Transmission Process




A
IS BUFFER CLEAR STATUS RECEIVED FROM OTHER DATA LOGGER ?
YES
CHECK THE 60 SECONDS TIME LAPSE OVER ?
NO
YES
CLEAR THE BUFFER FULL STATUS
CLEAR THE TIME LAPSES OF ALL PCKTS.
B

A.3.3.6 Acknowledgement Process for Event Packet

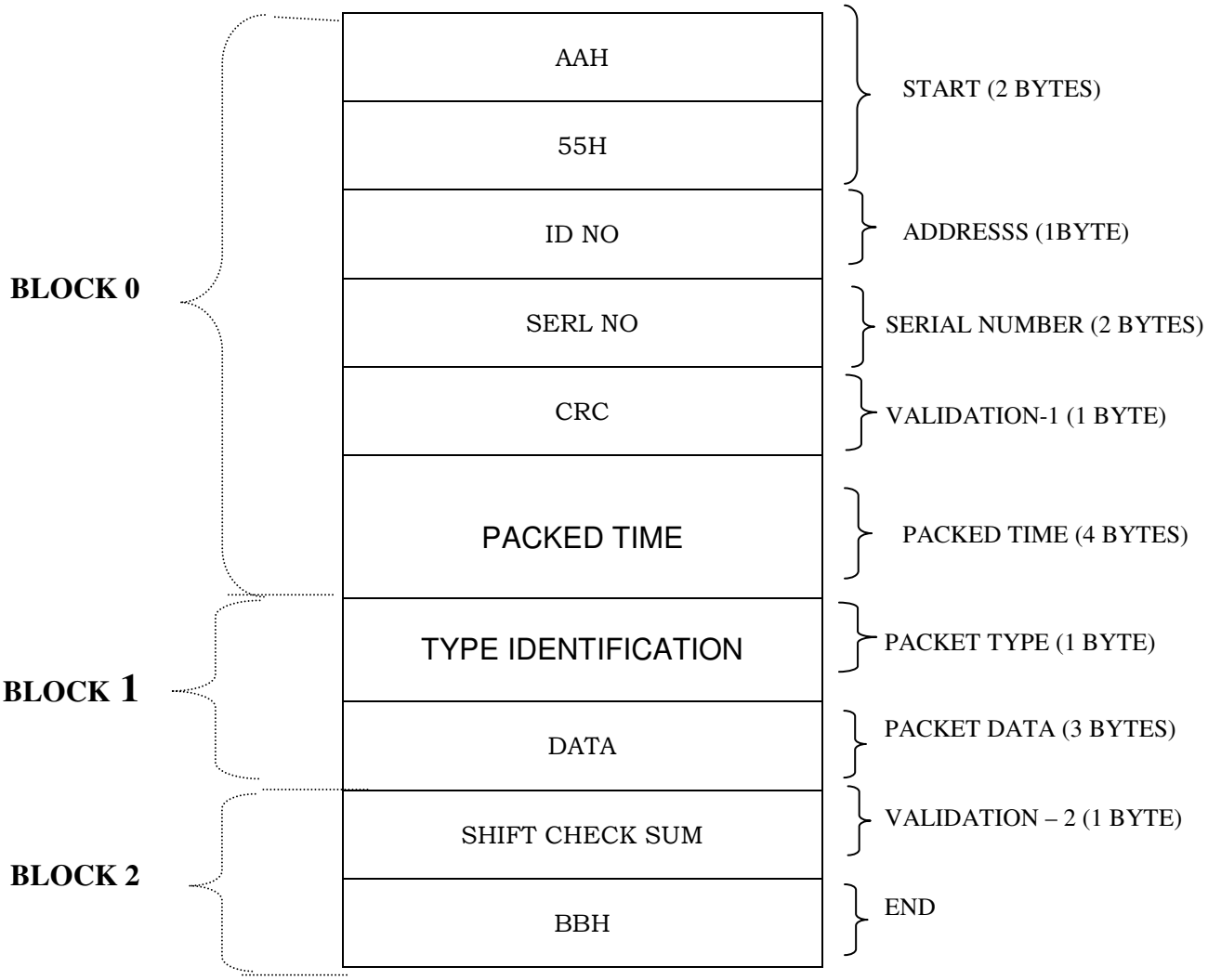


A.3.3.7 Commands Communication:

Commands always originated from the CMU to facilitate control actions on any one or all the Data Logger/s in the network. Buffer full and Buffer free commands are the only commands originated by Data Loggers for control of event packets flow. The commands always work in the Request and Response style.

A.4 EVENT PACKET

A.4.1 EVENT PACKET FORMAT



Event packet consists three blocks as shown in the above frame format.

i) Block 0
ii) Block 1
iii) Block 2

A.4.1.1 BLOCK 0: The size of the BLOCK 0 is 10 bytes. The structure of Block 0 is common for any type of event packet and it is having the following five fields.

Field Name	Size in bytes
START	**2**
ID Number	**1**
Serial No.	**2**
CRC	**1**
Packed Time	**4**

START: $AA and $55 are the start of the event packet.

ID NO: This is used for the identification of various devices like FEP, DATALOGGER and RTU.

The ID numbers allotted for each device is listed below.

DEVICE	ID RANGE
FEP	00H
RTU	01H - 40H
DATALOGGERS	41H – 7FH

Note: The ID numbers range from 80H to FFH are reserved.

Serial Number: It is the sequence number of packet. With this CMU will identify that it is receiving all the packets or not. Serial no will start from 0000H, when ever a packet is created count will be incremented by one, and will roll over to 0000H after reaching FFFFH.

CRC : This is a validation byte provided for the 11 bytes in the data packet from ID No to DATA fields.

Calculation of CRC byte:

Calculation of CRC byte using Microprocessor is time-consuming process. So look up table technique is being used. The lookup table will be prepared for all the combinations of words (16 bits each word). The total possible combinations are 65536 (0000H to FFFFH). So total 64K bytes of lookup-table is needed.

Calculation of the CRC byte for all 11 bytes as follows:

	MSB	**LSB**	**RESULT**
1	ID No	Serial No MSB	CRC1
2	CRC1	Serial No LSB	CRC2
3	CRC2	Time-1	CRC3
4	CRC3	Time-2	CRC4
5	CRC4	Time-3	CRC5
6	CRC5	Time-4	CRC6
7	CRC6	Type identifier	CRC7
8	CRC7	Data-1	CRC8
9	CRC8	Data-2	CRC9
10	CRC9	Data-3	CRC10

The CRC10 will be the CRC field in event packet.

Time-1, Time-2, Time-3 and Time-4 are 4 bytes of packed Time filed from MSB to LSB respectively.

Data-1, Data-2 and Data-3 are 3 bytes of DATA field from MSB to LSB respectively.

First word will be framed by taking ID no as MSB and Serial No MSB as LSB. For this word the CRC byte will be taken from CRC lookup table is mentioned as CRC1 in the above table.

Second word will be framed by taking this resultant CRC byte (CRC1) as MSB and Serial No LSB as LSB. For this word the CRC byte will be read from CRC lookup table is mentioned as CRC2 in the above table.

This process will be repeated for 10 times as shown in the above table, the resultant byte (CRC10) is the final CRC. This will be placed in the event packet as CRC.

PACKED TIME:

Time will be stored in the Packed Form. This is a long word size and time will be calculated in multiples of 1/64 second. This long word will hold time for one year and even/odd year identification. In the long word least 31 bits will represent the time. The 32nd bit will be used to represent the year status, '1' for odd year and '0' for even year.

The equation to build packed time from the real time is given below.

Packed time = (Days x 24 x 60 x 60 x 64) + (Hr x 60 x 60 x 64)+(Mt x 60 x 64) + (Sec x 64).

Here Days = Number of completed days till present date
Hr = Hours
Mt = Minutes
Sec = Seconds

Example: Consider 12th March 2003, 21:16:24

Days = 70
Hr = 21
Mt = 16
Sec = 24

Packed Time=(70*24*60*60*64+21*60*60*64+16*60*64+24*64)
= 391973376 decimal / 175D0A00 hexa

A.4.1.2 BLOCK 1:

Block 1 size is 4 bytes. The values in the BLOCK 1 will vary depending upon the type of event packet. BLOCK1 is having the following fields.

a) TYPE IDENTIFIER (1 bytes)
b) DATA (3 bytes)

TYPE IDENTIFIER (TI):

This is a byte-sized value and it indicates packet type. Each packet will have a unique type identifier. The below table shows various type identifiers.

TI	Details	USAGE
00H	Digital Record	Compulsory
01H	Analog Record	Compulsory
02H	Time Difference	Compulsory
03H	Time Write Low	Compulsory
04H	Communication Status Packets	Optional

05H	Health Record	Compulsory
06H	Periodical All Inputs Status	Compulsory
07H	All Inputs Status at Reset	Compulsory
08H	Reserved	
09H	Configuration Record	Optional
0AH	Time Write High	Compulsory
0BH	Reserved	
0CH	Reserved	
0DH	Digital Fault	Optional
0EH	Analog Fault	Optional
0FH	Reserved	
10H	Digital Chattering On	Compulsory
11H	Digital Chattering Off	Compulsory
12H	Modem Link Status	Compulsory
13H	Reserved	
14H	Reserved	
15H	Reserved	
16H	Reserved	
17H	Reserved	

DATA:

This field is having 3 bytes and the structure of these bytes will vary depending upon packet. All the packets are explained in the following sections.

A.4.1.3 BLOCK 2:

BLOCK 2 size is 2 bytes. The structure of Block 2 is common for any type of event packet and it is having the following two fields.

Field Name	**Size in bytes**
Shift Checksum	**1**
End (BBh)	**1**

SHIFT CHECKSUM:

This is also a validation byte provided for the 11 bytes in the data packet from ID No to DATA fields excluding CRC.

Calculation of SHIFT CHECKSUM byte:

In the calculation process, each byte in the record structure (leaving the CRC byte) will be rotated to left by one bit and then these bytes will be summed up to form the 'Shift checksum byte'.

It is explained in the given below example.

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11	Byte12
48H	00H	31H	10H	90H	00H	C2H	13H	87H	FFH	FFH	31H

Byte 4 is CRC which is excluded in calculation.

CALCULATION

	Actual value (in Hex)	Actual value (in Binary)	Rotated by 1 value (in binary)	Shifter by 1 value (in hex)
Byte 1	48H	0100 1000	1001 0000	90H
Byte 2	00H	0000 0000	0000 0000	00H
Byte 3	31H	0011 0001	0110 0010	62H
Byte 5	90H	1001 0000	0010 0001	21H
Byte 6	00H	0000 0000	0000 0000	00H
Byte 7	C2H	1100 0010	1000 0101	85H
Byte 8	13H	0001 0011	0010 0110	26H
Byte 9	87H	1000 0111	0000 1111	0FH
Byte 10	FFH	1111 1111	1111 1111	FFH
Byte 11	FFH	1111 1111	1111 1111	FFH
Byte 12	31H	0011 0001	0110 0010	62H

Shift checksum or Resultant byte = 2DH

END : It is the Event packet END identifier.

A.4.2 DIGITAL RECORD :

This record will be created to indicate the change in status of the digital input.

Occurrence: This record will be created whenever a digital input changes its state (From ON to OFF or OFF to ON). Its record ID is **00H.**

BLOCK 0
BLOCK 1 **TI - 00H (1Byte)**
INPUT NUMBER(2Bytes)
STATUS OF INPUT (1Byte)
BLOCK 2

INPUT NUMBER: 1 TO 4096
STATUS OF INPUT : 00h PICK UP
FFh DROP

A.4.3 ANALOG RECORD :

This record will be created whenever there is variation in the any of analog inputs.

Occurrence: This record will be created whenever the difference of previous recorded channel value and present scanned channel value of a particular input crosses the configured tolerance limit.

BLOCK 0
BLOCK 1 **TI - 01H (1Byte)**
CHANNEL VALUE(2Byte)
CHANNEL NUMBER (1Byte)
BLOCK 2

A.4.3.1 CHANNEL VALUE : 0 TO 4095 (Value 4095 is equivalent to Maximum possible Channel value for that input). The nominal voltages and their corresponding maximum voltages are shown in the below table.

Nominal voltage	**Maximum voltage**	**Maximum value**
230V AC	**330V AC**	**4095**
110V AC	**170V AC**	**4095**
110V DC	**170V DC**	**4095**
60V DC	**90V DC**	**4095**
24V AC	**50V DC**	**4095**
24V DC	**50V DC**	**4095**
18V DC	**50V DC**	**4095**
12V DC	**25 VDC**	**4095**
150mv	**150 mv**	**4095**
3V or 2V, 5KHZ	**3000mv**	**4095**
6V DC	**10V DC**	**4095**

A.4.3.2 CHANNEL NUMBER: 1 TO 96

The temperature record will also be created with the same analog record ID with channel number as 00h. The channel value MSB made 00 and LSB gives the temperature measured.

A.4.4 TIME DIFF ID:

To notify the difference between the packed time and with RTC chip time.
Occurrence: This record will be created whenever there is a difference in packed time and RTC chip time. The data logger compares the chip time with the packed time periodically and to record the difference if any

BLOCK 0
BLOCK 1 **TI - 02H (1B)**
STATUS BYTE (1B)
DIFFERNCE TIME VALUE (2B)
BLOCK 2

STATUS BYTE:

00H if RTC Time > Packed Time
FFH if RTC Time < Packed Time

DIFFERNCE TIME VALUE: RTC Time ~ Packed Time

A.4.5 TIME WRITE :

This record will be created whenever time set command was sent from CMU.

Occurrence: This record is created whenever time was set from CMU, two records were created, one for lower 3 bytes and another for upper 3 bytes of packed time that has been sent from the CMU. These two records differ in record Id, for the lower 3 bytes it is 03H. For the higher three bytes it is **0AH.**

BLOCK 0
BLOCK 1 TI - 03h / 0Ah (1Byte)
Set Time (3Byte)
BLOCK 2

A.4.6 Communication Status Packets:

These records were created to log network status for later analysis. the network communication health status.

Occurrence: These records will be created for every 68 minutes approximately.

BLOCK 0
BLOCK 1 TI - 04H (1B)
PACKETS COUNT (2B)
SERIAL NUMBER (1B)
BLOCK 2

A.4.6.1 PACKET COUNT:

Transmitted packets (or) Received packets (or) Pending packets (or) Duplication packets (or) Fail packets for two network ports.

A.4.6.2 SERIAL NUMBER: It specifies the type of Packets count.

Serial Number	Details
01h	Transmitted Packets Count (Direction-A)
02h	Receive Fail Packets Count (Direction-A)
03h	Pending Packets Count (Direction-A)
04h	Received Packets Count (Direction-A)
05h	Transmitted Packets Count (Direction-B)
06h	Receive Fail Packets Count (Direction-B)
07h	Pending Packets Count (Direction-B)
08h	Received Packets Count (Direction-B)

0dh	Duplication Packets Count (Direction-A)
0eh	Duplication Packets Count (Direction-B)

A.4.7 HEALTH RECORD:

This record will be created to notify the health of data logger to the CMU.
Occurrence: This record will be created for every one minute if any other record is not created.

BLOCK 0
BLOCK 1 **TI - 05H (1B)**
DUMMY BYTES (3BH)
BLOCK 2

DUMMY BYTES**:** 00H

A.4.8 Periodical All Inputs Status:

In these records the status of all the digital inputs will be sent. So as the CMU can synchronize with the latest input status.

Occurrence: These records are created for every 34 minutes approximately and also on request of the CMU. The number of records created will depend upon the number of inputs configured. In each record, status of 16 inputs will be sent. Each inputs status can be 0 or 1(‘0’ for pickup and ‘1’ for drop). If the number of inputs configured is 512, 32 records will be created. The configuration should be in the multiples of 512 inputs. The 1st record will have inputs of 1 to 16, 2nd record will have 17 to 32 and so on up to the total number of inputs.

BIT	B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
IP NO	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

BLOCK 0
BLOCK 1 TI - 06H (1B)
STATUS (2B)
SERIAL NUMBER(1B)
BLOCK 2

STATUS: Status of a set of 16 inputs

SERIAL NUMBER: 00h-FFh

For the first 1 to 16 inputs 00h is given as serial number and continued up to FFh for the inputs 4096.

A.4.9 All Inputs Status At RESET:

These records have been created at the time of Data Logger Reset. This is identical to the **Periodical All Inputs Status** except the type identifier.

Occurrence: These records will be created when ever the data logger resets.

BLOCK 0
BLOCK 1 TI - 07H (1B)
STATUS (2B)
SERIAL NUMBER(1B)
BLOCK 2

A.4.10 Configuration Record:

This record will be created to store the all configurations of the Data Logger.

Occurrence: This record will be created whenever data logger is reset/powered on. This record will also be sent for every 34 minutes along with the Periodical all input status packets.

BLOCK 0
BLOCK 1 **TI - 09H (1B)** **CONFIGURATION BYTES (3B)**
BLOCK 2

CONFIGURATION BYTES:

Byte1: Higher nibble (B7-B4) contain version value
Lower nibble will give Revision value.

Byte2: Bit 7 is to differentiate data logger from relay hut.
If it is '1' , it is a Data logger
If it is '0' , it is a relay hut.

Bit 6 is not used.
Bit 5 is not used.

Bit 4 is to indicate whether analog channels are enabled or not.
If '0' , analog channels are disabled.
If '1' , analog channels are enabled.

Bit 3 is not used .

Bits B2,B1, B0 will indicate the digital inputs configuration.

B2	B1	B0	Number of digital inputs configured
0	0	0	512
0	0	1	1024
0	1	0	1536
0	1	1	2048
1	0	0	2560
1	0	1	3072
1	1	0	3584
1	1	1	4096

Byte3: Reserved

A.4.11 DGTLFALT_RECID:

This record will be created whenever the digital fault sequence occurs.
No specific data format is defined since the digital fault sequence is dependent on local PC.

Occurrence: This record is created, whenever the predefined sequence of operations will occur.

BLOCK 0
BLOCK 1 **TI - 0DH (1Byte)** **DATA (3Bytes)**
BLOCK 2

A.4.12 ANLGFALT_RECID:

This record will be created to indicate that the analog channels exceeded configured safe limits.

Occurrence: This record is created whenever an analog channel crosses the configured minimum or maximum channel limits.

This record identical to analog record except type identifier.

BLOCK 0
BLOCK 1 **TI - 0EH (1Byte)** **CHANNEL VALUE (2Bytes)** **CHANNEL NUMBER (1Byte)**
BLOCK 2

CHANNEL VALUE: 0 TO 4095.

CHANNEL NUMBER: 1 TO 64

B7- '1' THEN FAULT IS DUE TO EXCEEDING MAX. VALUE
'0' THEN FAULT IS DUE TO FALLING BELOW MIN. VALUE
B6 TO B0 – INDICATE THE CHANNEL NUMBER.

A.4.13 CHTRON_RECID:

This record is created whenever any relay is chattering.

Occurrence: This record will be created whenever digital input changes from NORMAL state to CHATTERING state.
A digital input is said to be in chattering state, if its status changes by 8 times or more in 4 seconds. Normal state is the state where the input status does not change so.

BLOCK 0
BLOCK 1 **TI - 10H (1Byte)** **INPUT NUMBER (2Bytes)** **INPUT STATUS (1Bytes)**
BLOCK 2

INPUT NUMBER : 01 TO 4096

INPUT STATUS: No significance

A.4.14 CHTROFF_RECID:

This record is created whenever any relay is normalized from chattering.

Occurrence: This record will be created whenever digital input changes from CHATTERING state to NORMAL state.

BLOCK 0
BLOCK 1 **TI - 11H (1Byte)** **INPUT NUMBER (2Bytes)** **INPUT STATUS (1Byte)**
BLOCK 2

INPUT NUMBER : 01 TO 4096

INPUT STATUS:

00H- PICKUP
FFH- DROP

A.4.15 Modem Link Status

This record will be created whenever the modem establishes or losses the link with the other modem.

Occurrence: This record will be created whenever 'Carrier Detect' bit of the modem changes its state.

BLOCK 0
BLOCK 1 **TI - 12H (1Byte)** **CD STATUS (1Byte)** **PORT NUMBER (1Byte)** **00H (1B)**
BLOCK 2

PORT NUMBER :

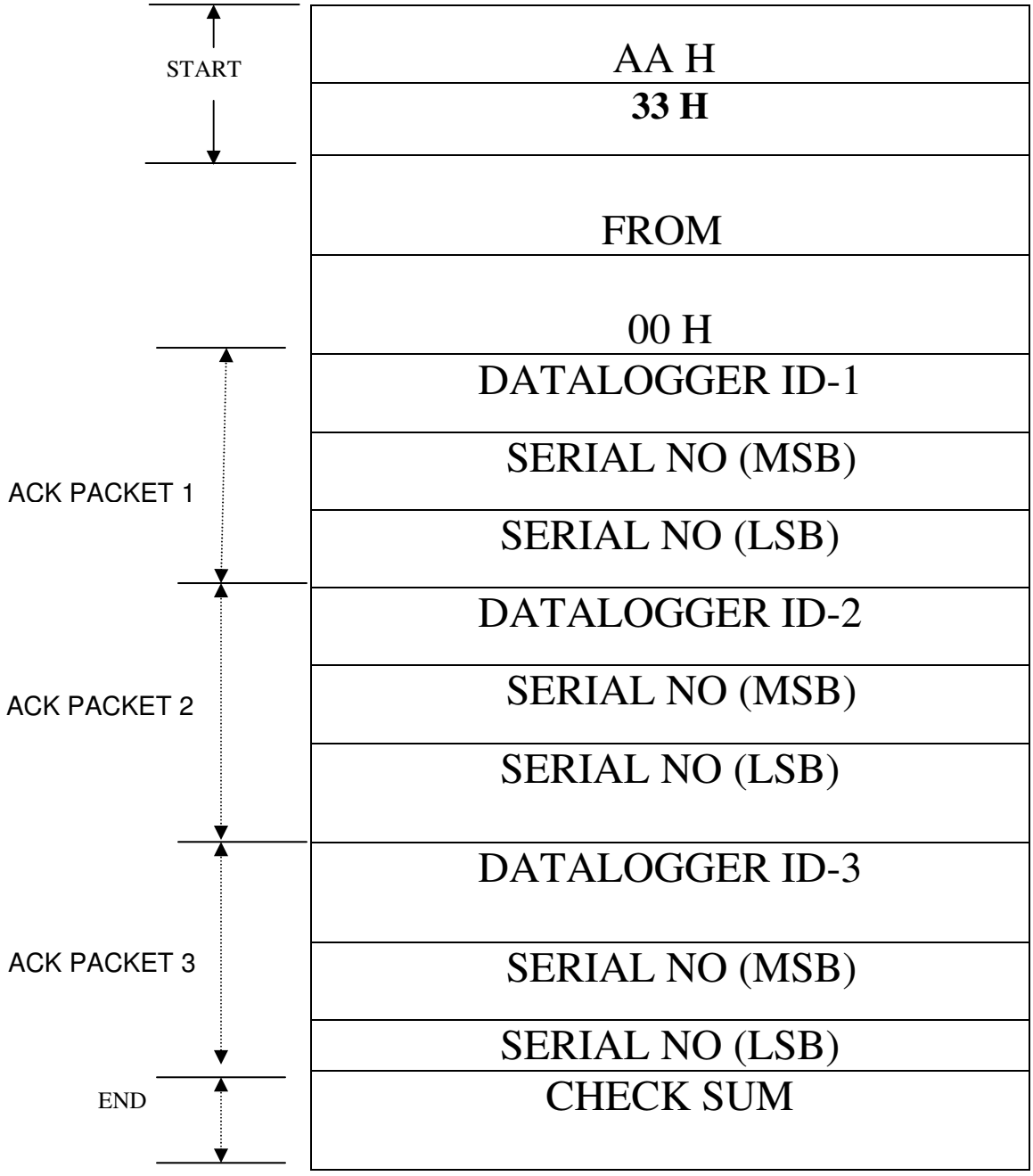
01H- Direction A
02H- Direction B

CD STATUS :

00h- 'CD' NOT EXISTING
FFh- 'CD' EXSISTING

A.5 ACKNOWLEDGEMENT PACKET

The Acknowledgement packet structure is given below.



START: AAH, 33H are the start identifiers.

FROM: Indicates the data logger ID from which the acknowledgement is sent.

DATALOGGER ID-1: Signifies the DL-ID in the first event packet received.

DATALOGGER ID-2: Signifies the DL-ID in the second event packet received.

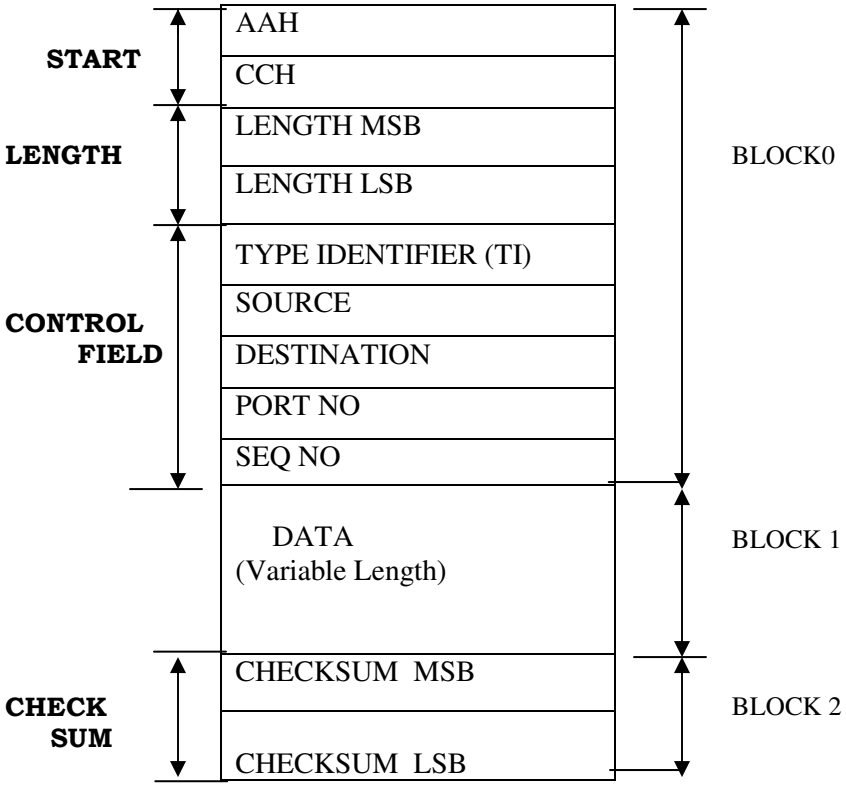
DATALOGGER ID-3: Signifies the DL-ID in the third event packet received.

SERIAL NO: Signifies the serial number in the received event packet.

CHECKSUM: Signifies the validation Byte for this acknowledgement packet. It is the 2's complement of modulo sum of the 11 bytes from "FROM" field to Serial Number LSB of third event packet.

The length of the frame is always fixed to 14 bytes in spite of the number of event packets received are less than 3 also. In that case the other acknowledges are filled with '00h'.

A.6 Command Format



A.6.1 BLOCK0:

START: Every command frame will be started with these two identifiers. The identifiers are

1. AAH
2. CCH

LENGTH: The LENGTH is represented in two bytes as 16-bit value. It defines the no. of bytes in between Type identifier(TI) and Checksum Lsb
Inclusive of both.

CONTROL FIELD:

A. TYPE IDENTIFIER, B. SOURCE, C. DESTINATION, D. PORT NO,
E. SEQ NO

A. TYPE IDENTIFIER(TI):

Type Identifier will represent different commands. Also it represent the acknowledgement by OR with 40h for the command received.

Type Identifier Range	Details
00h - 7Fh	Reserved
80h - BFh	Commands
C0h - FFh	Acknowledgements

B. SOURCE:

This byte signifies from where the command is originated.

C. DESTINATION:

This byte indicates the destination to where the command has to reach.

For above two control bytes the identifications are

i. CMU: The identification for CMU was FFh
ii. FEP: Identification for FEP was 00h
iii. DL: Identification range was 41h to 7Fh

For any command, If the destination byte is 'FFH', then that command will be treated as a Global command.
Whenever a data logger receives a command, it will check the destination byte for FFH, if it is FFH, then it will serve the command and will send it to next data

logger.

If the destination byte is not FFH, then the data logger will check it with it's own ID. If it found to be equal then it will serve the command. If it is not equal, then it will send that command to the next data logger.

D. PORT NO:

FEP is having 3 Ports in 3 directions. CMU can send the command in any direction/s by placing '1' in the relevant bit/s in the field.

Byte structure:

Bit pos	B7	B6	B5	B4	B3	B2	B1	B0
Value	0	0	0	0	0	Port3	Port2	Port1

- 1 – Selection of port
- 0 – Ignoring of port

E. SEQUENCE NO:

This byte is generated by the CMU. And CMU anticipates the same byte should be echoed in the acknowledgement command, other wise CMU treats acknowledgement as invalid.

Type-Identifiers:

Type-Identifier	**Command**	**Description**
80H	Link check	For checking link in b/w CMU & DL.
81H	Data Request	Request DL for Data in Stand alone mode. Ignored in network ports.
82H	Upload result	Ack. To the above Data Request Command.
83H	Read Time	Read time from DATA LOGGER
84H	Write Time	Writing time into DATA LOGGER
85H	Buffer Free	Buffer free between Data Loggers
86H	Reserved	
87H	Reserved	
88H	Reserved	
89H	Reserved	
8AH	Reserved	
8BH	All I/P Status	Request For Creating All inputs Records
8CH	Modem reset	Request For Modem Reset (Res)
8DH	Reserved	
8EH	Reserved	
8FH	Buffer full	Buffer full between Data Loggers
90H	Set transmitting pointer	For setting the Transmitting pointer of the required port to the required record.

91H	Receive relay status	Requesting 1-8 relay status from data logger
92H	Send relay status	Sending 1-8 relay status to the data logger
93H	Receive relay status	Requesting 9-16 relay status from data logger
94H	Send relay status	Sending 9-16 relay status to the data logger
95H	Reserved	

Link check:

BLOCK 0 TI – 80H RECORD LENGTH = 07H
BLOCK 1 **{No DATA BYTE is available}**
BLOCK 2

Acknowledgement for Link Check:

BLOCK 0 TI – C0H RECORD LENGTH = 07H
BLOCK 1 {No DATA BYTE is available}
BLOCK 2

Data Request:

BLOCK 0 TI – 81H RECORD LENGTH = 07H
BLOCK 1 **{No DATA BYTE is available}**
BLOCK 2

This command is used to receive event records of the Data Logger in to local PC.

Acknowledgement for DATA REQUEST:

BLOCK 0 TI – C1H RECORD LENGTH = N+07H
BLOCK 1 (N Bytes) **{Length is Variable}**
BLOCK 2

In the acknowledgement frame Data Logger can send event data of 10 records maximum to local PC. Event packets are identical with 12 bytes in length as specified in event packet format without Start, Shift Checksum and End identifier.

If data is not available N becomes 0.
Number of Bytes is: N

UpLoad Result:

BLOCK 0 TI – 82H RECORD LENGTH = 07H
BLOCK 1 **NO DATA BYTES**
BLOCK 2

After successful event data transfer from data logger CMU will send this command.

TIME READ:

BLOCK 0 TI – 83H RECORD LENGTH = 07H
BLOCK 1 {No DATA BYTE is available}
BLOCK 2

Acknowledgement for TIME READ:

BLOCK 0 TI – C3H RECORD LENGTH = 0DH
BLOCK 1 (6 bytes) Byte 1-4 : Packed Time Byte 5: Year MSB (Hex) Byte 6: Year LSB (Hex)
BLOCK 2

TIME WRITE:

BLOCK 0 TI – 84H RECORD LENGTH = 0DH
BLOCK 1 (6 bytes) Byte1-4 : Packed Time Byte 5: Year MSB (HEX) Byte 6: Year LSB (HEX)
BLOCK 2

Acknowledgement for TIME WRITE:

BLOCK 0 TI – C4H RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Byte 1: STATUS BYTE
BLOCK 2

STATUS BYTE: 00 Time Write Success
01 Time Write Fail

BUFFER FREE:

BLOCK 0 TI – 85H RECORD LENGTH = 07H
BLOCK 1 No Data
BLOCK2

This command will be sent between data loggers, to intimate other data logger that its buffer is free now and it can take event data.

ALL INPUT STATUS:

BLOCK 0 TI – 8BH RECORD LENGTH = 07H
BLOCK 1 {No DATA BYTE is available}
BLOCK2

Acknowledgement for ALL INPUT STATUS:

BLOCK 0 TI – CBH RECORD LENGTH = 07H
BLOCK 1 (1Byte) Byte1: Success 00
BLOCK2

This command will be sent whenever all digital input status need to be updated in CMU. This command will trigger all input event packets to be generated and the command will be acknowledged with above frame.

MODEM RESET:

BLOCK 0 TI – 8CH RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Bit0-Modem in direction-A Bit1-Modem in direction-B
BLOCK2

If the bit is '1' Modem will be reset.

Acknowledgement for MODEM RESET:

BLOCK 0 TI – CCH RECORD LENGTH = 07H
BLOCK 1 (1Byte) Byte1: Success 00
BLOCK2

BUFFER FULL:

BLOCK 0 TI – 8FH RECORD LENGTH = 07H
BLOCK 1 No Data
BLOCK2

This command will be sent between data loggers, to intimate other data logger that its buffer is full and it cannot take any more event data at present.

SET TRAN POINTER:

BLOCK 0 TI – 90H RECORD LENGTH = 10H
BLOCK 1 (9 bytes) Byte1: Port No (1...2) Bytes2 &3: SEQ No Byte4 to 7: Packed Time Byte8: DL ID Byte9: Search status.
BLOCK2

In bi directional ring communication, when there is a break in one direction, transmission of event packets in that direction gets stop. But in other direction the event packets continue to reach CMU. Once the broken communication link is restored, all pending event packets start flooding continuously towards the CMU. This increases network traffic. Also these packets have been already reached the CMU in other redundant communication path. In order to stop the flow of packets, the pointer in the data logger can be adjusted to the requested event packet. Thus stopping the old events packets flow. This command will move the pointer in the forward direction for the above said condition.

Like wise the pointer need to be moved in backward direction for the need of transmission of old event packets which are available in non-volatile memory. Thus by this command the pointer can be moved back and then old event packets starts transmitted.

Port No: 01H- Network Port in Direction-A
02H- Network Port in Direction-B

SEQ Number, Packed Time & DL ID are the parameters to match the event packet.

Search status : 00H- Forward search.
01H-Backward search.
02H-Set the Tran pointer to the beginning address of the event packets Database.

Acknowledgement for SET TRAN POINTER:

BLOCK 0 TI – D0H RECORD LENGTH = 11H
BLOCK 1 (8 bytes) Byte1: Status Byte2: Port No (1...2) Bytes3 &4: SEQ No Bytes5 to 8: Packed Time Byte9: DL ID Byte10: Search status.
BLOCK2

STATUS: 00-SUCCESS
01-SEARCH FAIL.
02- SEARCH FAIL DUE TO INVALID PARAMETERS.
03- SEARCH FAIL DUE TO RECORDS DATA BASE IS IN PURGING.

All Other parameters are echoed back.

GET RELAY STATUS(1-8):

BLOCK 0 TI – 91H RECORD LENGTH = 07H
BLOCK 1 { NO DATA BYTE }
BLOCK2

Acknowledgement for GET RELAY STATUS:

BLOCK 0 TI – D1H RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Byte: Bits 0-7 represent the status of 1-8 relays respectively. If any bit is 1 then the respective relay is picked up and if any bit is 0 then that particular relay is in dropped condition.
BLOCK2

SET RELAY STATUS (1-8):

BLOCK 0 TI – 92H RECORD LENGTH = 08H
BLOCK 1 1. Bits 0-7 represent the status of 1-8 relays respectively. If any bit is 1 then that respective relay should be picked up and if any bit is 0 then that particular relay should be dropped.
BLOCK2

Acknowledgement for SET RELAY STATUS:

BLOCK 0 TI – D2H RECORD LENGTH = 07H
BLOCK 1 (1 Byte) Byte1: Status
BLOCK2

STATUS: 00-Success,
Non-Zero: Fail.

GET RELAY STATUS(9-16) :

BLOCK 0 TI – 93H RECORD LENGTH = 07H
BLOCK 1 { NO DATA BYTE }
BLOCK2

Acknowledgement for GET RELAY STATUS:

BLOCK 0 TI – D3H RECORD LENGTH = 08H
BLOCK 1 (1 Byte) Byte: Bits 0-7 represent the status of 9-16 relays respectively. If any bit is 1 then the respective relay is picked up and if any bit is 0 then that particular relay is in dropped condition.
BLOCK2

SET RELAY STATUS(9-16):

BLOCK 0 TI – 94H RECORD LENGTH = 08H
BLOCK 1 1. Bits 0-7 represent the status of 9-16 relays respectively. If any bit is 1 then that respective relay should be picked up and if any bit is 0 then that particular relay should be dropped.
BLOCK2

Acknowledgement for SET RELAY STATUS:

BLOCK 0 TI – D4H RECORD LENGTH = 07H
BLOCK 1 (1 Byte) Byte1: Status
BLOCK2

STATUS: 00-Success,
Non-Zero: Fail.

A.6.2 BLOCK1:
DATA:
Block 1 is for data, where length is variable.

A.6.3 BLOCK2:
CHECK SUM:
This checksum is 16-bit value, and it is placed in the Block2.
This is calculated as sum of all the bytes starting from RL MSB to last byte stored in BLOCK1.