

Feeder Terminal

REF 542plus

IEC 61850 Protocol Implementation extra
Information for Testing (PIXIT) for
REF 542plus



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1 About this manual

1.1 Read it first!

Before attempting any operation with the REF 542*plus*, read carefully this manual first.

This manual is addressed to field personnel and to anyone who needs to interact with REF 542*plus* and IEC 61850 interface.

1.2 Document information

Revision History

Revision	Date	Note
1VCD600507 C	14 Mar 2007	Corrections based on KEMA remarks
1MRS756360 A	11 May 2007	Changes in layout. ID-number changed from 1VCD600507 to 1MRS756360
1MRS756360 .B	17 Nov 2008	Changes according to release 2.6
1MRS756360 .C	21 Sept 2008	Changes according to release 2.6 SP1

Applicability

This manual is applicable to IEC 61850 interface version ETH V1E.07.

1.3 Safety Information

There are safety warnings and notes in the following text. They are in a different format to distinguish them from normal text.

Safety warning

The safety warnings should always be observed. Non-observance can result in death, personal injury or substantial damages to property. Guarantee claims might not be accepted when safety warnings are not respected. They look like below:



Do not make any changes to the REF 542*plus* configuration unless you are familiar with the REF 542*plus* and its Operating Tool. This might result in disoperation and loss of warranty.

Note

A note contains additional information worth noting in the specific context, and looks like below:



The selection of this control mode requires caution, because operations are allowed both from the HMI and remotely.

2 Abbreviations and Definitions

2.1 Abbreviations

FTP	F ile T ransfer P rotocol
FUPLA	F unctional P rogramming L anguage.
GOOSE	G eneric O bject O riented S ubstation E vent
GPS	G lobal P ositioning S ystem
GSE	G eneric S ubstation E vent
GSSE	G eneric S ubstation S tatus E vent
HMI	H uman M achine I nterface
LCD	L iquid C rystal D isplay
LED	L ight E mitting D iode
MAC	M edia A ccess C ontrol
MICS	M odel I mplementation C onformance S tatement
MMS	M anufacturing M essage S pecification
M/O	M andatory/ O ptional
N	N o
PICS	P rotocol I mplementation C onformance S tatement
PIXIT	P rotocol I mplementation e Xtra I nformation for T esting
SCADA	S upervision, C ontrol and D ata A cquisition
SLD	S ingle L ine D iagram
RHMI	the same as HMI (in case of REF542plus)
XML	e Xtensible M arkup L anguage
Y	Y es

2.2 Definitions

Operational State	the unit is active and it is protecting and controlling the switchgear.
Stand-alone	the unit is not connected to a SCADA system.

3 References

- [1] IEC: IEC 61850 (1-10), Communication Networks and Systems in Substations, Part 1-10; 1st Edition.

4 Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC61850 Communication Card for REF542plus.

Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10.

Each chapter specifies the PIXIT for each applicable ACSI service model as structured in IEC 61850-10.

5 PIXIT for Association Model

Description	Value/ Clarification
Maximum number of clients that can set-up an association simultaneously	5
Lost connection detection time range (default range of TCP_KEEPALIVE is 1 – 20 seconds)	15s
Is authentication supported	N
What association parameters are necessary for successful association	Y Transport selector Y Session selector Y Presentation selector N AP Title N AE Qualifier
What is the maximum and minimum MMS PDU size	Max MMS PDU size: 16000bytes Min MMS PDU size: -
What is the typical startup time after a power supply interrupt	20s, depends on application size

Table 1 PIXIT for Association Model

6 PIXIT for Server Model

Description	Value / Clarification
Which analogue value (MX) quality bits are supported (can be set by server)	Validity: Y Good, Y Invalid, N Reserved, Y Questionable N Overflow Y OutofRange N BadReference N Oscillatory N Failure Y OldData N Inconsistent N Inaccurate Source: Y Process N Substituted N Test N OperatorBlocked
Which status value (ST) quality bits are supported (can be set by server)	Validity: Y Good, Y Invalid, N Reserved, Y Questionable N BadReference N Oscillatory N Failure Y OldData N Inconsistent N Inaccurate Source: Y Process N Substituted N Test N OperatorBlocked
What is the maximum number of data values in one GetDataValues request	Stack does not limit the amount of the data values. MMS PDU is the limit.
What is the maximum number of data values in one SetDataValues request	Stack does not limit the amount of the data values. MMS PDU is the limit.

Table 2 PIXIT for Server Model

Invalid Quality bit usage

Invalid bits are used only if configuration between communication card and mother board does not match with each other or if at run time communication card detects a time out, illegal response or a negative acknowledgment response. If configuration is valid all Data Objects has a good quality at the start up.

Data Objects with static default timestamps

Some of data object status values are defaulted and also have always default time stamp value. Time stamp value is the time of the first received time synchronization value or 01/01/1970_00:00 if time synchronization is not received.

- LD0 all Health attributes.
- LD0 all Mod and Beh attributes
- LD0.LPHD.PhyHealth
- LD0.LPHD.Proxy
- LD1 all Mod attributes
- LD1 all Beh attributes
- LD1.LPHD.Proxy
- LD1. all XCBR.CBOPCap attributes
- LD1 all MaxOpCap attributes
- LD1 all XSWI.SwTyp attributes
- LD1 all XSWI.SwOPCap attributes

Data Objects with default startup values

Some data objects do not get startup value from the IED application. Value is updated only when an event is generated in application.

- LPHD.InOv

Data Objects startup timestamp values

IEC61850 server data model shows the time stamp value to client in the startup. Most of the Data Objects have time stamp attribute using default time stamp value. Time stamp values updates only from real spontaneous events from IED application. Data Object statuses and measurement values are updated from application during startup before allowing communication to client.

7 PIXIT for Data Set Model

Description	Value / Clarification
What is the maximum number of data elements in one data set	250 data attributes
How many persistent data sets can be created by one or more clients	10
How many non-persistent data sets can be created by one or more clients	Not supported service

Table 3 PIXIT for Data Set Model

8 PIXIT for Reporting Model

Description	Value / Clarification
The supported trigger conditions are	integrity Y data change Y quality change Y data update Y general interrogation Y
The supported optional fields are	sequence-number Y report-time-stamp Y reason-for-inclusion Y data-set-name Y data-reference Y entryID Y conf-rev Y
Can the server send segmented reports	Y
Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 §14.2.2.9)	Send report immediately
Multi client URCB approach (compare IEC 61850-7-2 §14.2.1)	Each client has it's own set of URCB's
What is the format of EntryID	Octet string 8, four MSB bytes are used as counter.
What is the buffer size for each BRCB or how many reports can be buffered	25000 bytes per report control block. ~100 single event reports.
Pre-configured RCB attributes that cannot be changed online	<data set name> <configuration revision>

Table 4 PIXIT for Reporting Model

GI and integrity report information:

Most of the data object time stamps are defaulted in the startup. Default time stamp 01/01/1970_00:00 is used for time stamp attributes. Valid time stamp value is updated when first real event occurs in the IED application.

BufOvfl usage information:

BufOvfl is set when buffered report control block buffer is full and new report does not fit to it. Oldest report is discarded and newest has the BufOvfl parameter in report. BufOvfl is cleared in new report when it fits to buffer (older reports have still the BufOvfl set).

Trigger condition information:

It is possible to write data update trigger option to report control block TrgOps attribute event when Data update trigger condition is not supported. Writing this bit does not affect any functionality.

MMS PDU size information:

MMS PDU size is negotiated during Association Service. When client enables buffered reporting it is checked if reporting has been enabled also earlier for same reporting control block. If Client proposes smaller MMS PDU size than in first Association the reporting is not enabled if client tries to do that. Reason is that the server may have longer segmented reports in buffer and the PDU size cannot change.

Integration Period information:

If client tries to set integration period smaller than 1000ms the one second value is anyway used and Response+ is used.

9 PIXIT for Control Model

Description	Value / Clarification
What control modes are supported	Y status-only Y direct-with-normal-security N sbo-with-normal-security N direct-with-enhanced-security Y sbo-with-enhanced-security
Is Time activated operate (operTm) supported	N
What is the behavior when the test attribute is set in the SelectWithValue and/or Operate request	No functionality
What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request	No functionality
Is "operate-many" supported	N
Is pulse configuration supported	N
What check conditions are supported	Y synchrocheck Y interlock-check
What service error types are supported	N instance-not-available N instance-in-use Y access-violation N access-not-allowed-in-current-state N parameter-value-inappropriate N parameter-value-inconsistent N class-not-supported N instance-locked-by-other-client N control-must-be-selected Y type-conflict N failed-due-to-communications N constraint failed-due-to-server-constraint
What additional cause diagnosis are supported	Y Unknown Y Blocked-by-switching-hierarchy Y Select-failed Y Invalid-position Y Position-reached N Parameter-change-in-execution N Step-limit N Blocked-by-Mode Y Blocked-by-process Y Blocked-by-interlocking Y Blocked-by-synchrocheck Y Command-already-in-execution N Blocked-by-health Y 1-of-n-control Y Abortion-by-cancel Y Time-limit-over N Abortion-by-trip Y Object-not-selected
Selection of objects	One object at time can be selected

Description	Value / Clarification
Command checking	<ul style="list-style-type: none"> - command checking based on client identification - ctIVal is forwarded to IED and the value is checked in application - other command control structure attribute are stored and used for responses
Internal command timeout	30s to negative response

Table 5 PIXIT for Control Model

Control Service Information:

The command termination is made according the state of the Pos.stVal. When the command indication comes, the command direction is compared against the known state of the object. If the Pos object is already in the right position the positive command termination is issued when the response from Main Unit (REF542plus Mother Board running the Protection and Control Application) is generated immediately.

If the command direction indicates the real change of the position (that is typically the case) the Pos.stVal is monitored and positive command termination is given when the state transition is reached or negative command termination is generated when a fixed timeout of 30s is reached.

Negative command termination is generated if the Main Unit generates NACK. What kind of choices exists in the interlocking schema is highly dependent on the Protection and Control Application running in the Main Unit.

It is always up to Main Unit to handle the local/remote positions.

One DPC object at a time can be selected for the operation through the Ethernet card. The identification of client is based on MMS session dynamic data. Following fields in command service structures are not used during the sequence, this is mainly because the facts cannot be really comprehensively mapped to the Protection and Control Application (FUPLA) variables:

Test

- Check
- ctINum
- origin.orIdent / origin.orCat

The selection is active 30s, during which time the operate should be given. When the operation is given additional 70s is reserved for the command termination.

The interlock check is always performed - independent from the interlock check bit in the select/operate command.

LastAppError:

When command service notices an error situation, the error value in LastAppError information report is set always to 1 (error).

10 PIXIT for Time and Time Synchronization Model

Description	Value / Clarification
What quality bits are supported	ClockNotSynchronized, ClockFailure
What is the behavior when the time synchronization signal/messages are lost	REF542plus supports 4 SNTP Time Servers. For the behavior see below explanation.
SNTP Request Interval	16 seconds

Table 6 PIXIT for Time and Time Synchronization Model

SNTP Time Synchronization Behavior:

The behavior depends on the particular status as explained in the following:

- Ethernet board startup just happened. The Ethernet board will read the absolute time from the main Unit and will set its internal clock accordingly.
- The SNTP module of the Ethernet board is looking for an SNTP server to start the synchronization. During this phase no time data are produced. The Ethernet board will periodically read the absolute time from the relay and will set its internal clock module accordingly.
- The Ethernet board has started synchronizing to an SNTP server. The accurate SNTP algorithm is acquiring the data needed to reach full accuracy. The Ethernet board will use the data provided by every single SNTP time update for synchronizing both its internal clock and the Main Unit clock.
- The SNTP module is working at full accuracy. Once every second the SNTP Client running in the Ethernet board will use the current SNTP time to resynchronize both its internal clock and the Main Unit clock.
- The SNTP module is working at full accuracy. The SNTP server in use is lost, which means one of the following:
 - It stops responding.
 - It sends a “kiss’o’death” message.
 - It becomes unsynchronized.

The Ethernet board will either use the data provided by every single SNTP time update for synchronizing both its internal clock and the Main Unit clock (if a server is available) or read periodically the absolute time from the relay and set its Internal Clock accordingly (if no other usable server exists).

- SNTP disabled by Configuration (i.e. IRIG-B on the Main Unit is used). The Ethernet board will periodically read the absolute time from the relay and will set its internal clock module accordingly.

11 PIXIT for File Transfer Model

Description	Value / Clarification
What is structure of files and directories?	Configuration Files are stored in the root (c:\). The User can choose appropriate file name for the Configuration File (i.e. Motor_1.cid). The Disturbance Recorder file is stored in following c:\comtrade directory.
Is the IETF FTP protocol also implemented	Y
Directory names are separated from the file name by	\
The maximum file name size including path (recommended 64 chars)	Not defined.
Are directory/file name case sensitive	N
Maximum file size	Maximum file size is not defined. Free space varies and size depends completely on configuration. Anyway the maximum file size is limited by maximum number of data elements and number of clients (see PIXIT for Data Set Model).

Table 7 PIXIT for File Transfer Model (FTP)

Description	Value / Clarification
Files and directory structure?	Open point has to be filled which files and which directories are present. It is not constant over the time
Which files are protected?	The files "image.bin", ".ecm" and ".cid" are protected. Via MMS it is not possible to delete or rename them.
Is the IETF FTP protocol also implemented	Y
In the server response the directory names are separated from the file name by	\
Does the server accept service requests with both (/ and \) delimiter characters?	Y
Server supported character in the Get-ServerDirectory service as single character of the FileName to get the content of root	*
The maximum FileName size including sequence of paths (recommended 64 chars)	≤ 255 octets
Are FileName case sensitive	N

Description	Value / Clarification
The allowed characters for FileName and directory names in the services	Alphabetic (lower and upper case) Numbers - Underscore . (used as suffix delimiter) / and \ Used as directory delimiter * (only used in GetFileDirectory as single character to get the content of the root)
Are wildcards like * or ? in FileNames supported?	N (only in the special case for GetServerDirectory, see above)
Does the directory answer contain the whole file name and path (directory + FileName)?	Y Example: COMTRADE/RE010002.cfg COMTRADE/RE010002.dat
How do the disturbance record file names look like?	For each disturbance recorder, .cfg and .dat COMTRADE files are generated, with name: RExxxxyy.cfg (configuration file) RExxxxyy.dat (data file) where: xxx = fieldbus address (for Ethernet Board, xxx is the last byte of IP address, in decimal format) yyy = fault number, module 1000
Is it possible to delete any disturbance record file from the IED?	Y
How are the disturbance records deleted from IED?	A client has to delete COMTRADE files. The server overrides old files.
Are the disturbance records are deleted through firmware or configuration changes?	N
The maximum size for a Filename is	32 octets
The maximum size of the suffix is	3 octets
Maximum file size	Maximum file size is not defined. Free space varies and depends completely on configuration. Anyway the maximum file size is limited by maximum number of data elements and number of clients (see PIXIT for Data Set Model).

Table 8 PIXIT for File Transfer Model (IEC61850 services)

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