2. ESTAMPA DE TIEMPO, es el diferencial de tiempo que lleva la señal de control desde que ocurre el evento hasta que se etiqueta la señal que sera recibida por el COES, en el caso de ETESELVA utiliza un reloj satelital en cada subestación. Se verifico la estampa de tiempo dentro de los parámetros establecidos por la norma.
3. SERVIDOR DEL SISTEMA REDUNDANTE, uso de una medio alternativo de procesamiento de las señales en tiempo real, del tipo hot swap. ETESELVA no cuenta con servidor redundante, obtuvo un NO en este rubro.
4. VALIDACIÓN DE SEÑALES Y ESTADOS, comprobación punto a punto de los valores y estados de las señales entre lo real en campo eléctrico y lo mostrado en las pantallas del COES. Se verificaron todos los puntos y toda la validación fue positiva.
5. SINCRONIZACION HORARIA POR GPS, capacidad del sistema de sincronizar sus componentes por reloj satelital mediante protocolo IRIG-B. ETESELVA obtuvo una calificación positiva, todo su sistema se sincroniza por satélite.
6. SEÑALES REQUERIDAS, el OSINERG mediante acta del COES, acordó que ETESELVA debía transmitir 95 señales. El COES recibió 78 señales constantemente, se completan las 17 señales restantes en Febrero del año 2004, enviando ETESELVA el 100% de sus señales al COES a partir de esa fecha.

Copia del documento de evaluación del sistema de transmisión de datos en tiempo real en protocolo ICCP emitido por el OSINERG se anexa.

### 4.4.7 Conclusiones sobre el Equipamiento Existente

a. El sistema de transmisión de datos en tiempo real de ETESELVA y su sistema de comunicaciones cumple con la normativa de operación en tiempo real exigida por el OSINERG. Su evaluación en presencia del perito del OSINERG y COES, así lo reafirman, se anexa copia del documento.
b. El sistema utiliza activos propios y rentados para lograr su objetivo. Es necesario reconocer el costo del sistema inicial, de operación y mantenimiento. La renta de las comunicaciones satelitales son un costo representativo del sistema.
c. La Norma IEEE C.37, ANSI C.37 y IEC 870-4, establecen los estándares de automatización de subestaciones eléctricas, ETESELVA se encuentra comprendido en el acogimiento de estos estándares.
d. El sistema de transmisión de datos en tiempo real de ETESELVA, cumple con sus funciones en forma eficaz, posibilitando la coordinación eléctrica del sistema interconectado nacional.

# ANEXO 01

# Materiales del Sistema

## LISTADO DE MATERIALES
## BOM

## SISTEMA DE TRANSMISIÓN DE DATOS A TIEMPO REAL ETESELVA – COES

### *I. TRANSMISIÓN DE SENALES DESDE LAS INSTALACIONES DE LA LINEA DE TRANSMISIÓN HASTA LAS OFICINAS EN LIMA*

| ÍTEM | CANT | DESCRIPCION |
|---|---|---|
| 1 | 1 | **Unidad Multifunción GE-Harris modelo D25 SE Paramonga Nueva**, para montaje en rack 19", 4 MB RAM, PS: 250VDC / 220VAC, cuatro puertos seriales, con capacidades de 32 entradas digitales 250VDC wetting, 6 entradas directas analógicas: 3CT 5A y 3VT 63,5V<br>Integración en protocolo SPA – Bus al IED SCU REF542 |
| 2 | 1 | **Unidad Multifunción GE-Harris modelo D25 SE Vizcarra**, para montaje en rack 19", 4 MB RAM, PS: 250VDC / 220VAC, cuatro puertos seriales, a enlazarse con la RTU GE-Harris modelo D20 existente en la SSEE |
| 3 | 1 | **Unidad Multifuncion GE-Harris modelo D25 SE Tingo Maria**, para montaje en rack 19", 4 MB RAM, PS: 70-150VDC / 120VAC, cuatro puertos seriales, con capacidades de 96 entradas digitales 120VDC wetting, 12 entradas directas analógicas: 6CT 1A y 6VT 63.5V , 8 entradas analógicas DC 0-20mA<br>Integración en protocolo SPA – Bus al IED (4) SCU REF542 |
| 4 | 4 | GPS ARBITER SYSTEM 1093 PARAMONGA, VIZCARRA, TINGO MARIA, AGUAYTIA |
| 5 | 1 | **Unidad Multifunción GE-Harris modelo D25 SE Aguaytia**, para montaje en rack 19", 4 MB RAM, PS: 70-150VDC / 120VAC, cuatro puertos seriales, con capacidades de 64 entradas digitales 120VDC wetting, 6 entradas directas analógicas: 3CT 1A y 3VT 63.5V<br>Integración en protocolo SPA – Bus al IED (3) SCU REF542 |
| 6 | 2 | Transceiver AUI a 10BaseFL ST marca Allied Telesyn modelo AT-MX40F/ST |
| 7 | 300 | metros Fibra Óptica Monomodo para exteriores |
| 8 | 2 | Bandejas 19" para cuatro conectores ST |
| 9 | 2 | Patch Cord Opticos 1mt con conectores ST |
| 10 | 2 | Unidades de conversión, interrogación F.O. IED´s OSHT 5 ports ST to SMA, spam tree serial. |
| 11 | 5 | DYMEC 5844 serial to FO para Paramonga Nueva, Tingo Maria, Aguaytia |
| 12 | 8 | REF 542 IED Bahia de control para Celdas SE Panu (01), TM (04), AG (03) |
| 13 | 1<br>1<br>1<br>1<br>1<br>1<br>1 | **Integración Software D25**<br>IRIG-B DTA<br>TAP DTA<br>DNP DCA<br>DNP DPA<br>SPA BUS<br>Ethernet node |
| 14 | varios | Cables en general, borneras y accesorios |
| 15 | 1 | Pruebas de Banco en Fabrica |
| 16 | 1 | Ingeniería del sistema |
| 17 | 1 | Desarrollo y Configuración |
| 18 | 1 | Servicio de Montaje y Cableado de Unidades Multifunción GE D25 |
| 19 | 1 | Servicio de Cableado de Telecomunicaciones |
| 20 | 1 | Transporte de personal y Viáticos |
| 21 | 1 | Transporte de equipos y Seguros |
| 22 | 1 | Entrenamiento D25 Y SIST. |

## *II. TRANSMISIÓN DE SEÑALES DESDE LAS OFICINAS DE ETESELVA HASTA EL CENTRO DE CONTROL DEL COES*

| ÍTEM | CANT | DESCRIPCIÓN |
|---|---|---|
| 23 | 1 | **Unidad Multifuncion GE Harris modelo D25 Gateway ICCP**, para montaje en rack 19", dos puertos seriales, dos puertos Ethernet 10BaseTX, 4 MB RAM, PS: 220 VAC, sin capacidades de puntos de entrada y salida. |
| 24 | 1 | **Integración Software D25** |
| | 1 | Protocolo ICCP - una vía |
| | 1 | DNP DCA |
| | 1 | DNP DPA |
| | 1 | Ethernet node |
| | 1 | DNP DCA |
| 25 | varios | Cables, borneras y accesorios |
| 26 | 1 | Desarrollo y Configuración |
| 27 | 1 | Mano de Obra e Ingeniería |
| 28 | 1 | Transporte de equipos y Seguros |
| 29 | 1 | Pruebas de Banco en Fabrica |
| 30 | 1 | Ingeniería del sistema |
| 31 | 1 | Servicio de Montaje y Cableado de Unidad Multifunción GE D25 |
| 32 | 1 | Servicio de Integración de Telecomunicaciones |
| 33 | 1 | Pruebas del protocolo ICCP |
| 34 | 1 | Pruebas de transmisión de señales con COES SINAC |
| 35 | 1 | Garantía 12 meses |
| 36 | 1 | Entrenamiento D25 |

## *III. TRANSMISIÓN DE SEÑALES ENTRE LAS SUBESTACIONES ELECTRICAS ETESELVA POR ONDA PORTADORA ANALOGICA*

| ÍTEM | CANT | DESCRIPCION |
|---|---|---|
| 1 | 2 | **Unidad de Onda Portadora ELTB 81 PARAMONGA - VIZCARRA**, para montaje en lineas de alta tensión, con trampa, cables de conexionado, unidad de control, teleproteccion, modem NSK5, comunicaciones 4E&M |
| 2 | 2 | **Unidad de Onda Portadora ELTB 41 TINGO MARIA - AGUAYTIA**, para montaje en lineas de alta tensión, con trampa, cables de conexionado, unidad de control, teleproteccion, modem NSK5, comunicaciones 4E&M |
| 3 | 2 | **Unidad de Onda Portadora ELTB 41 VIZCARRA – TINGO MARIA**, para montaje en lineas de alta tensión, con trampa, cables de conexionado, unidad de control, teleproteccion, modem NSK5, comunicaciones 4E&M |

# ANEXO 02

## Cuadro Económico

## SISTEMA TRANSMISION DATOS Y ICCP ETESELVA

| ITEM | Descripción | US$ |
|---|---|---|
| 1 | Concentrador y equipos de computo | $38,043.84 |
| 2 | ICCP | $54,649.66 |
| 3 | Comunicaciones | $32,604.88 |
| 4 | Routers | rentado |
| 5 | PLC ETL 41 - 81 | $240,000.00 |
| 6 | RTU (4) | $82,199.55 |
| 7 | Cables y accesorios | $7,945.96 |
| 8 | Desarrollo y Configuración | $13,500.00 |
| 9 | Mano de Obra e Ingeniería | $27,610.00 |
| 10 | Transporte Viáticos | $1,930.00 |
| 11 | Seguros | $1,800.00 |
| 12 | Rack e impresora | $3,945.58 |
| 13 | UPS | $1,300.00 |
| 14 | Utilidad | $50,552.95 |
| | Total Incluido IGV | **$556,082.40** |

# Eteselva SRL

## EXAMEN TECNICO DE LOS ESTUDIOS Y DISEÑOS DEL SISTEMA DE TRANSMISION DE ETESELVA SRL

## CONCLUSIONES DE LOS EXAMENES ESPECIALIZADOS


**Equipo de Especialistas:**

- **Ing. Justo YANQUE**
- **Ing. Manuel HARO**
- **Ing. Walter SANCHEZ**
- **Ing. Patricio BRACAMONTE**


**Lima, Octubre del año 2004.**

# 5.- CONCLUSIONES DE LOS EXAMENES ESPECIALIZADOS.

## 5.1 Línea Eléctrica Aguaytía – Paramonga en 220 KV.

De la evaluación desarrollada se tiene las siguientes conclusiones:

- La selección del conductor ha seguido un criterio de estandarización dado que el tramo de línea en la zona corrosiva es muy corto comparado con la longitud total de la Línea, siendo absorbido por las reservas de materiales que se consideran en las instalaciones de este tipo.
- Para mejorar la performance del conductor ACSR en las zonas corrosivas se ha optado por aplicar un galvanizado tipo B, lo cual representa una protección adicional contra los elementos contaminantes que origina la corrosión.
- La configuración geométrica de la torres utilizadas cumplen con los requerimientos de distancias mínimas de seguridad del CNE Vigente en la fecha del proyecto y con los cálculos realizados según normas internacionales /VDE, REA).
- Las prestaciones mecánicas de las torres han sido definidas en función al perfil y los ángulos topográficos de la Línea.
- Los diagramas de carga han sido calculados en base a las prestaciones definidas, para las condiciones más críticas según la zona de utilización de las estructuras.
- De la verificación de las condiciones operativas de los estructuras en las condiciones más desfavorables, se puede concluir que están operando eficientemente dentro de la capacidad mecánica definida para cada una de ellas.

## 5.2 Subestaciones Aguaytía y Tingo María, llegada a Subestación Paramonga.

### a. Conclusiones sobre el Desempeño de las Instalaciones Existentes.

- De la evaluación técnica de las diferentes configuraciones de las Subestaciones, se concluye que desde el punto de vista técnico la configuración de barras en anillo en las Subestaciones Aguaytía 220 kV, Ampliación Tingo María 220 kV y Vizcarra 220 kV ofrecen buena confiabilidad de servicio.
- De la evaluación por mantenimiento se concluye que es más conveniente la configuración en anillo porque durante el mantenimiento de cualesquiera de los interruptores se mantiene la continuidad de la transmisión de energía.
- La configuración de las subestaciones está brindando un servicio eficiente
- En la S.E. Vizcarra todos los interruptores son tripolares, excepto la celda de línea a Paragsha cuyos interruptores son unipolares.
- Los interruptores de las Líneas en las subestaciones Aguaytía, Tingo María y Paramonga Nueva son de operación uni-tripolar.

**b.- Conclusiones a favor de la Demanda y del Mínimo Costo de los Equipos.**

La configuración en anillo de las Subestaciones Eléctricas de Transmisión 220 kV de ETESELVA, permite contribuir con la cobertura de la demanda de energía del Sistema Interconectado Nacional con energía proveniente de la C.T. de Aguaytía, con un alto grado de confiabilidad y con el mínimo costo del equipamiento electromecánico; por lo tanto, cumple con el requerimiento de un Sistema Económicamente Adaptado.

## 5.3 El Aislamiento Eléctrico de Subestaciones y Línea Eléctrica en 220 KV.

a) El aislamiento del Sistema de Transmisión y Transformación Aguaytía-Paramonga Nueva en 220 KV, de ETESELVA, para su implementación en 1998, contó con los estudios necesarios para garantizar la idoneidad de su desempeño:
   - Estudio de la Coordinación del Aislamiento, consagrado principalmente a la determinación de los Niveles Básicos de Aislamiento de los aislamientos internos, y a la aplicación de la protección por pararrayos (apartarrayos)
   - Estudios y Diseños de los Aislamiento Externos, consagrados principalmente a la determinación de la línea de fuga y el tipo de aisladores a ser aplicados a los aislamientos externos de las líneas y subestaciones

b) El examen practicado al Diseño de la coordinación del aislamiento del Proyecto L.T. Aguaytía-Paramonga Nueva y que ha sido revisado en extenso, indica que ha seguido la metodología recomendada por las Normas IEC-71, habiendo inclusive calculado las sobretensiones respectivas con el modelador ATP, lo cual asegura la independencia de criterios que ha preferido mantener dicho Diseño, al no depender de los datos que emanan del análisis del sistema de potencia que es un estudio paralelo.

c) Las aplicaciones de los resultados de los estudios del aislamiento para todo el Sistema de Transmisión y Transformación Aguaytía-Paramonga Nueva de ETESELVA, han permitido especificaciones económicas y eficaces para el equipamiento principal de las subestaciones.

d) Los estudios del aislamiento externo por línea de fuga según el perfil de la ruta, han permitido dotaciones de aisladores de vidrio templado que funcionan normalmente; el tramo de Selva Baja y Alta tiene cerca de 100 Km y es permanentemente afectado por descargas atmosféricas.

## 5.4 Los Sistemas de Comunicaciones y sus prestaciones.

a. El sistema de transmisión de datos en tiempo real de ETESELVA y su sistema de comunicaciones cumple con la normativa de operación en tiempo real exigida por el

OSINERG. Su evaluación en presencia del perito del OSINERG y COES, así lo reafirman, se anexa copia del documento.

b. El sistema utiliza activos propios y rentados para lograr su objetivo. Es necesario reconocer el costo del sistema inicial, de operación y mantenimiento. La renta de las comunicaciones satelitales son un costo representativo del sistema.
c. La Norma IEEE C.37, ANSI C.37 y IEC 870-4, establecen los estándares de automatización de subestaciones eléctricas, ETESELVA se encuentra comprendido en el acogimiento de estos estándares.
d. El sistema de transmisión de datos en tiempo real de ETESELVA, cumple con sus funciones en forma eficaz, posibilitando la coordinación eléctrica del sistema interconectado nacional.

Lima, Octubre del Año 2004.

# ANEXO 03

## Manuales

612
OC
HA

COES SINAC

COMITE DE OPERACION ECONOMICA DEL SISTEMA INTERCONECTADO NACIONAL

TERMOSELVA S.R.L.
21 FEB. 2003
RECIBIDO

Lima, 19 de Febrero del 2,003

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|---|---|---|
| PARA/TO P. BRACAMONTE | DE/FROM O. CACHAY | |
| COMPAÑIA/CO. | COMPAÑIA/CO. | |
| DEPARTAMENTO/DEPT. | TELEFONO/PHONE # | |
| FAX 7420858 ó 4469245 | FAX | |

**COES-SINAC/D-134-2003**

Señor Ingeniero
**Danilo Valenzuela**
Gerente de Fiscalización Eléctrica
**OSINERG**
**Presente**

Asunto: **RESULTADO DE LAS PRUEBAS DE LA CONEXIÓN ICCP DE LAS EMPRESAS DEL SEIN CON EL COES.**

Ref. : Su oficio N°122-2003-OSINERG-GFE

De mi consideración:

Tengo el agrado de dirigirme a usted para informarle acerca de los resultados de las pruebas de aceptación de la conexión vía protocolo ICCP con el COES, llevadas a cabo de acuerdo al Protocolo de Pruebas, que fuera remitido con el oficio COES-SINAC/D-1216-2002, del 6 de diciembre del 2002.

En relación con las pruebas indicadas, le comunicamos que el COES viene recibiendo la información de las veinte empresas consignadas en el listado adjunto; sin embargo, no todas las transferencias de información vía ICCP se dan en condiciones técnicas adecuadas para la Coordinación de la Operación en tiempo real.

El referido Protocolo de Pruebas consideró los aspectos necesarios para la transferencia efectiva de la información en tiempo real, así como los aspectos cualitativos de la misma, tales como si las instalaciones de las empresas estuvieran sincronizadas por sistemas GPS. En tal sentido, las pruebas, consideradas de carácter obligatorio para la aceptación de la conexión vía protocolo ICCP, son las correspondientes a los numerales: 3.2, 3.3 y 4 del Protocolo de Pruebas. Las pruebas restantes consideran aspectos cualitativos también importantes, pero cuyas implicancias vienen siendo materia de análisis.

Considerando lo expuesto, le enviamos el cuadro de resultado de las pruebas de aceptación de la conexión ICCP para la transferencia de información vía ICCP al COES.

Adicionalmente, adjuntamos la relación de empresas integrantes del sistema que a la fecha no han enviado ningún tipo de información, así como la de los clientes libres que se requiere envíen su información.

Sin otro particular, hago propicia la ocasión para saludarlo,

Atentamente,

Ing. JAIME GARCIA MONTES DE OCA
DIRECTOR DE OPERACIONES
COES-SINAC

cc. Empresas Integrantes, DPC, DEV, OI

## RESUMEN DE LAS PRUEBAS DE LA CONEXIÓN ICCP CON EL COES

| | | Tiempo actualización; #3.2 (seg.) | Estampa de tiempo; #3.3 | Servidor redundante | Validación señales y estados; #4 | Sincronizado GPS; #3.3 | # Señales Requeridas | # Señales Recibidas | Aceptación conexión ICCP |
|---|---|---|---|---|---|---|---|---|---|
| 1 | REP Centro Norte | Pendiente | Pendiente | Sí | Sí | Sí | 2009 | 1275 | Pendiente |
| 2 | REP Sur | 4 | Sí | Sí | Sí | Sí | 667 | 380 | Sí |
| 3 | TERMOSELVA | 0.9 | Sí | No | Sí | Sí | 21 | 24 | Sí |
| 4 | ETESELVA | 0.9 | Sí | No | Sí | Sí | 95 | 78 | Sí |
| 5 | EDEGEL | 1 | Sí | No | Sí | Sí | 600 | 493 | Sí |
| 6 | ENERSUR | 16 | Pendiente | No | Sí | No | 335 | 115 | Pendiente |
| 7 | TRANSMANTARO | 24 | Pendiente | No | Sí | Sí | 221 | 139 | Pendiente |
| 8 | EGASA | 4 | Pendiente | No | Sí | Sí | 669 | 201 | Pendiente |
| 9 | REDESUR | 5 | S' | No | Sí | Sí | 166 | 84 | Sí |
| 10 | EGENOR | 4 | Pendiente | Sí | Sí | Sí | 398 | 258 | Pendiente |
| 11 | CAHUA | 8 | S' | No | Sí | No | 184 | 104 | Sí |
| 12 | EEPSA | 3 | S' | No | Sí | - | 86 | 73 | Pendiente |
| 13 | ETEVENSA | 11 | S' | No | Sí | Sí | 85 | 34 | Pendiente |
| 14 | EDELNOR | 2 | S' | No | Sí | Sí | 629 | 391 | Sí |
| 15 | EGEBUR | 1 | S' | No | Sí | Sí | 159 | 129 | Sí |
| 16 | LUZ DEL SUR | 5 | S' | No | Sí | Sí | 1114 | 420 | Sí |
| 17 | ISA PERU | 3 | S' | No | Pendiente | Sí | 261 | 159 | Pendiente |
| 18 | HUANCHOR | 1 | Sí | No | Pendiente | No | 65 | 14 | Pendiente |
| 19 | ELECTROANDES | 3 | Sí | Sí | Sí | Sí | 882 | 324 | Sí |
| 20 | EGEMSA | 0.9 | Sí | No | Sí | Sí | 291 | 85 | Sí |

Lima, 18 de Febrero del 2003

## EMPRESAS QUE AUN NO ENVÍAN SU INFORMACIÓN AL COES

| | | |
|---|---|---|
| 1. SHOUGESA | | En proyecto. Fecha aun no definida. |
| 2. ELECTROPERU | Directa | Proyectado para Junio del 2003 |
| 3. MEGALUZ | Directa | Proyecto en ejecución. Fecha aun no definida. |
| 4. ELECTROSUR-MEDIO | | No se tiene fecha actualizada de conexión ICCP |
| 5. SINERSA | Directa | : Proyecto en ejecución. No indica fecha de culminación. |
| 6. ELECTROSUR | | No se tiene fecha actualizada de conexión ICCP |
| 7. SEAL | | No se tiene fecha actualizada de conexión ICCP |
| 8. SAN GABAN | | Proyectado para Febrero 2003. |
| 9. ELECTRO PUNO | | No se tiene fecha actualizada de conexión ICCP |
| 10. ELECTRO SUR ESTE | | No se tiene fecha actualizada de conexión ICCP |
| 11. ELECTROUCAYALI | | |

## RELACIÓN DE CLIENTES LIBRES DE LOS CUALES SE REQUIERE INFORMACIÓN

| | TOTAL(S) | TOTAL(X) | TOTAL(%X/S) |
|---|---|---|---|
| B-H TINTAYA | 27 | 0 | 0% |
| SOUTHERN | 170 | 61 | 36% |
| ACEROS AREQUIPA | 11 | 5 | 45% |
| DONEMIRUA | [illegible] | [illegible] | [illegible] |
| SINERSA | 27 | 0 | 0% |
| ANTAMINA | [illegible] | [illegible] | [illegible] |
| SHOUGAKO | 66 | 0 | 0% |
| CEMENTO ANDINO | [illegible] | [illegible] | [illegible] |
| MINSUR (SAN RAFAEL) | 33 | 0 | 0% |
| CEMENTO PACASMAYO | [illegible] | [illegible] | [illegible] |
| | 10708 | 5145 | 48% |

| | |
|---|---|
| S | Solicitado |
| X | En BD del COES-SINAC |

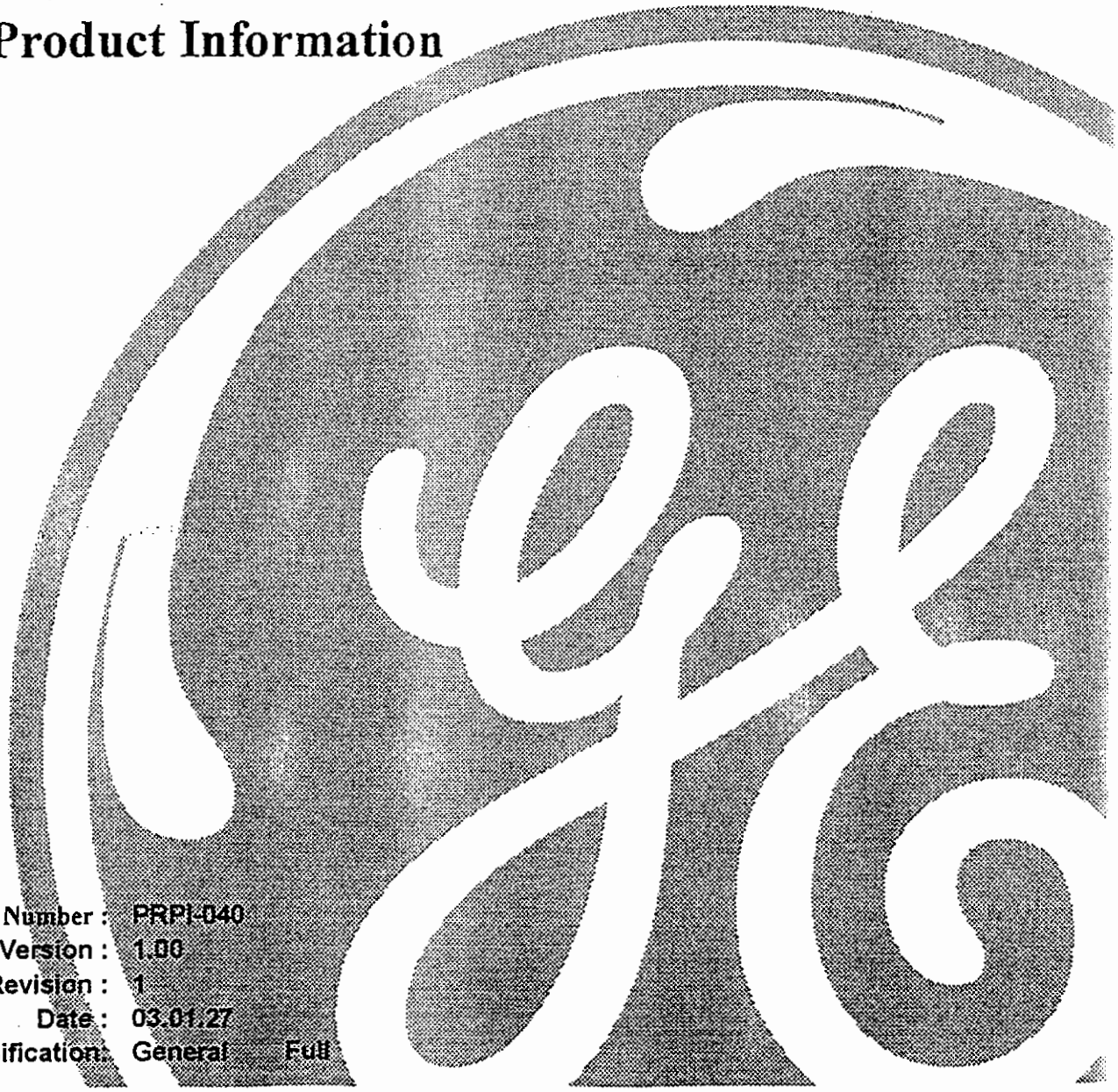
Falta realizar reunión de coordinación para definir el listado de usuarios que en

g

GE Energy Services

# D25 Multifunction IED - Generation 4

## Product Information

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Revision : 1
Date : 03.01.27
Classification: General Full

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## TRADEMARK NOTICES

# Table of Contents

# List of Figures

# List of Tables

# Purpose of this Document

This document describes the capabilities of the D25 Multifunction IED – Generation 4. The document should be used by GE Energy Services' staff and customers to specify, design and test systems which employ the D25 Multifunction IED.

## Distribution of this document

GE Energy Services' Product Management Department will distribute this document to the people outlined on the Document Distribution List. The Document Distribution List is managed by GE Energy Service Product Management Department.

## Control of this document

The master copy of this document is retained under the control of the Product Manager.

All errors or omissions related to this document are to be brought to the attention of the Product Manager.

# Chapter 1: System Overview

## 1.1 Product information

The D25 is an intelligent electronic device that integrates a wide range of electrical substation measurement, status, control and communications functions in one unit. This one device functions as a:

- Programmable logic controller
- Substation LAN node
- IED gateway
- Bay level controller
- Power Meter
- Power quality monitor
- Fault/event (waveform) recorder
- Back-up protection unit

The D25's flexible and scalable architecture makes it an excellent choice for advanced substation applications. The system accommodates a variety of discrete inputs/outputs such as status, SOE, accumulators, AC or DC analog inputs, as well as control outputs.

The ability to communicate is a key design element of the system. The D25 offers a total of 7 available communication ports: Dual serial ports or dual Ethernet LAN ports are used to communicate to a master or substation server. Two additional serial ports are used to interface with downstream devices such as relays utilizing GE's extensive protocol library.

A single RS-422 port is used as a Universal Time Control input. GE Energy Services' WESMAINT RS-232 port is used for PC-based maintenance.

The D25 can also act as fully functional equipment-monitoring node or standalone remote terminal unit (RTU).

The D25 offers all these features and complies with requirements of the IEEE and IEC.

## 1.2 Features

- Single chassis design, capable of supporting multiple feeders.
- 1,2, 2 ½ and 3 Element Metering
- 42 times nominal current detection
- Highly accurate current detection over full 42x dynamic range
- Dynamic Bus Switching
- Highly accurate Synchronizing capabilities
- LogicLinx Soft logic Automation
- Digital Fault recording
- AC And Digital Data Profiling
- Power Quality recording (Harmonics & ITIC Curve)
- Thermal Demand Metering
- Backup Breaker Failure protection
- Backup Definite Time Over-current Protection
- Unbalance Detection
- Alarming
- Oscillography

## 1.3 Benefits

- Reduced capital expenditures - One D25 can perform the functions of several individual devices, while monitoring and controlling up to.6 feeder lines.
- Reduced installation costs – Only one device to wire and configure.
- Reduced maintenance costs – One set of spares, one equipment-training program.
- Enables Reuse of legacy equipment - Provides cost-effective method to retrieve data from legacy. Supports over 100 legacy protocols.
- Increased reliability - Ensures flexibility to monitor primary equipment at substations.
- Protected investment - Offers expandable architecture to meet future physical and functional station requirements.

# Chapter 2: Product Description

## 2.1 Hardware architecture

The Generation 4 D25 system provides the following physical interfaces:

- Up to 96 digital status inputs in groups of 32.
- Up to 32 digital control output pairs, configured as either 32 Trip/Close pairs or 16 Raise/Lower pairs with direct cable connection to interposing relay panels. Other control output module variations are 8 or 16 dual-contact pairs.
- Up to 15 AC analog inputs.
- Up to 16 DC analog inputs.
- Communication interface capability to a variety of external systems in a number of topologies.
- Four ports for communication with external substation IEDs and/or hosts.
- Serial port for maintenance purposes.
- One port for accepting universal time code (UTC) information.
- System fail output.
- Radio keying output.
- Auxiliary control/general purpose output.
- Internal supply for status wetting and interposing relays (or external depending on application).

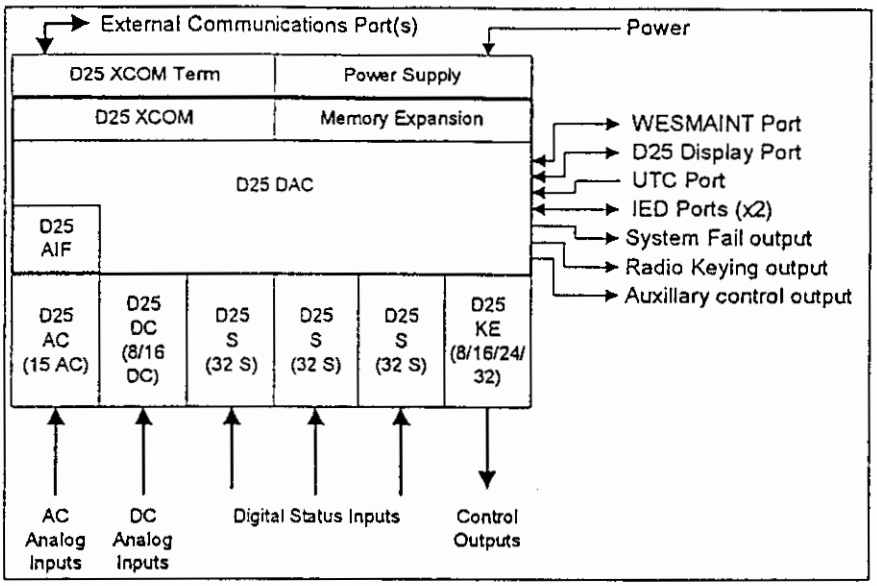


Figure 1 D25 Hardware Architecture

The system is housed in a metal enclosure designed for installation in a 19" rack. All field wiring is attached to the connectors located on the rear panel of the unit. The maintenance port connector, indicator LEDs and Local/Remote switch are located on the front panel. All electronic modules and other components are located inside of the unit.

The mechanical design was influenced by several factors. Personal safety and ease of maintenance were the highest priorities. All terminal blocks for AC voltages and currents are protected from accidental contact by mechanical safety shields. The termination module containing the AC analog wiring terminal blocks does not contain any active components. The user is not required to touch or remove any wiring from terminal blocks to remove any of the I/O modules.

To ensure maximum availability, the following features were implemented:

- All modules are removable from the front of the enclosure.
- All screws used for fastening removable components are captive.
- All daughter boards have self-aligning connectors which assure correct insertion.
- All modules of different types are keyed to prevent improper insertion in the wrong location.
- All modules can be removed from the system without disturbing the field wire harnesses.
- All AC current and voltage input modules have quick disconnect connectors for easy removal from the unit.
- Communication ports have standard communication connectors.
- On-board fuses for I/O modules are monitored and alarmed.

A typical rear panel connector layout is shown in the following figure:

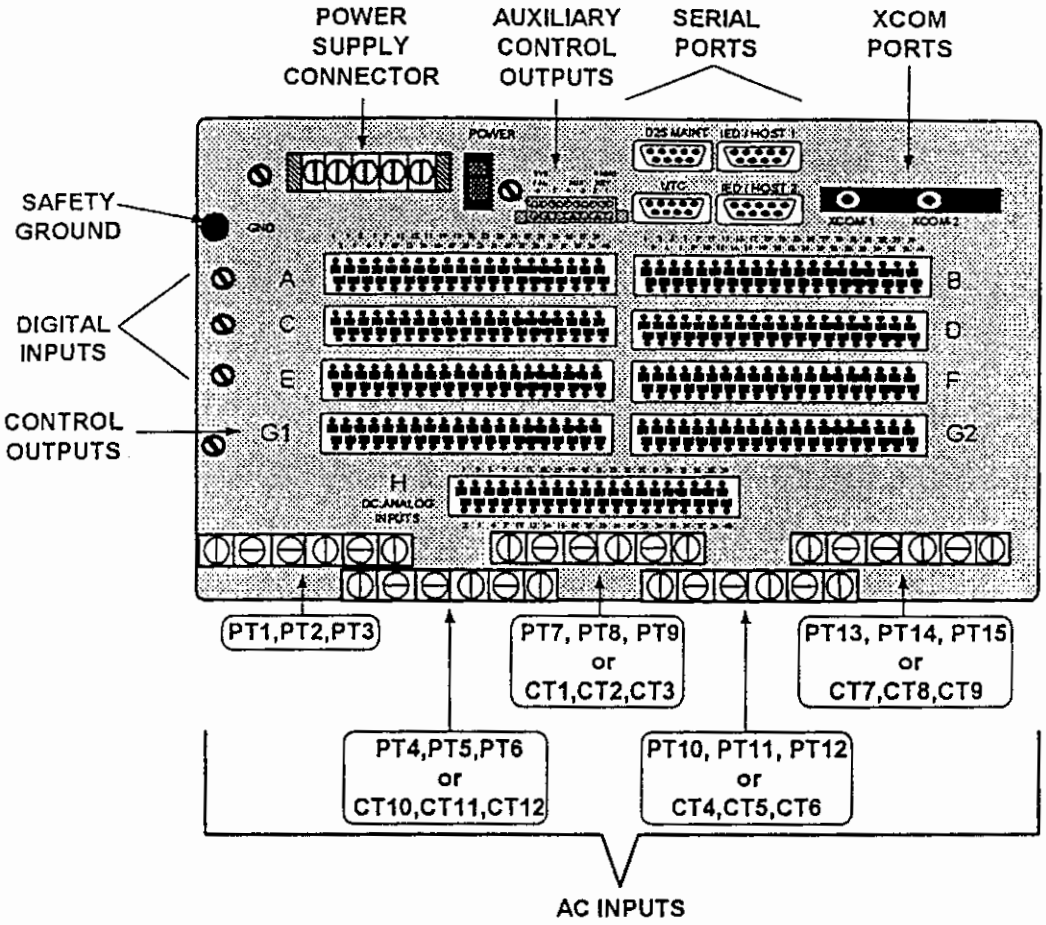


**Figure 2 Typical Rear Panel Connector Layout**

The front panel is hinged to allow easy removal of modules. Located inside of the front panel is a module puller used for the removal and insertion of status, control and DC analog modules. The front panel contains components for the user interface. Indicator LEDs show the status of the power supply, processor health and activity on the four communication ports.

A Local/Remote (Enable/Disable) switch controls the operation of the digital outputs. This switch has a mechanical protector to prevent accidental operation and has a provision for locking the switch in either position. The state of the control enable/disable circuits is annunciated by two LEDs. The health of the control output circuitry is verified by the processor and in case of malfunction; the controls are disabled regardless of the position of the Local/Remote switch.

The front panel with graphical LCD display is illustrated in the following figure. The graphical display is used to display substation mimic and annunciator displays:

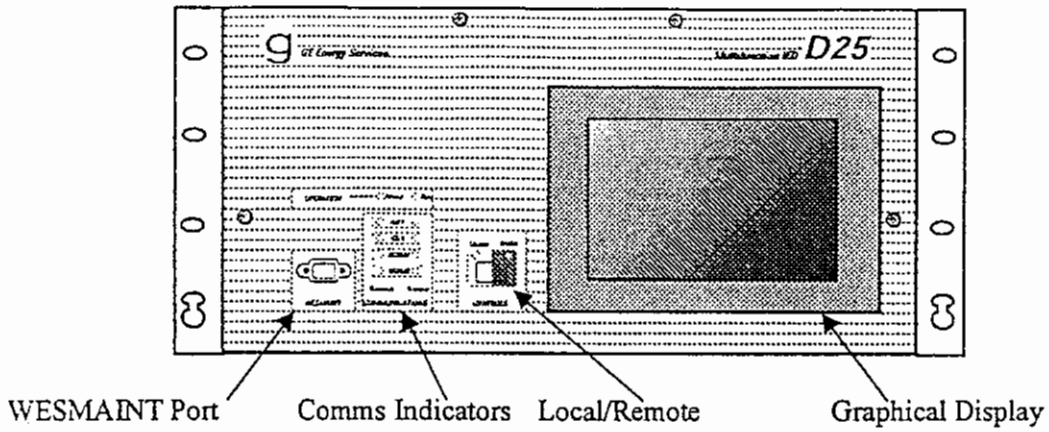


**Figure 3 Front Panel with Graphical LCD Display**

The front panel with LCD alphanumeric display is illustrated in the following figure:

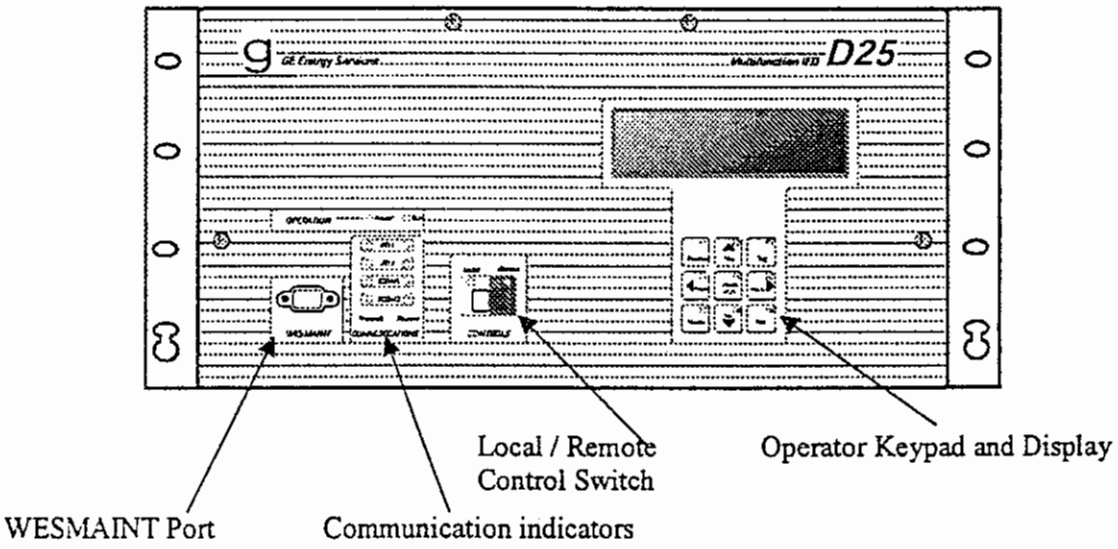


**Figure 4 Front Panel with LCD Alphanumeric Display**

## 2.2 D25 Off-line and On-line diagnostics

For maintenance purposes operators can access the unit locally via the WESMAINT diagnostics. Access is password-protected and enables you to exercise complete control over the D25. One of the features of the WESMAINT utility is a debugging and diagnostic tool called the D25 Monitor. This tool allows you to perform low-level diagnostics of all subsystems of the D25.

A complete system check is performed automatically during the start-up procedure. Start-up routines test the proper operation of the main processor, DSP, I/O processor and communication processor(s). The integrity of RAM memory is checked next, followed by verification of FLASH memory content. Progress and results of the self-diagnostic tests are displayed on WESMAINT.

Run time diagnostic procedures are executed periodically during normal operation of the D25. These run time tests verify:

- Health of all the processors
- Inter-processor communication
- Integrity of the analog reference circuits for AC and DC analog inputs
- Integrity of the control output subsystem.

If any problems are found, the failed subsystem is disabled and an appropriate alarm is activated.

## 2.3 Main Module

The D25 Main (Type III DAC) module contains the processing, storage, control, and core communications capabilities. It ties together all subsystems via on-board interfaces to the following functional blocks:

- WESMAINT port
- D25 display port
- Two serial RS-232/485 communications ports
- Two serial RS-232/485 communications ports or Ethernet channels (XCOM module)
- Universal time code (UTC) input
- System fail output
- Radio keying output
- General purpose auxiliary digital output
- DDSP module (AC analog interface)
- Memory expansion module
- Digital input modules
- Digital output module
- AC analog input modules
- DC analog input module

The D25 Main Module has the following memory:

1. EPROM: 512K for BootROM code.
2. RAM/NVRAM: 2M of battery-backed RAM for configuration, data storage and general application use. The size of the RAM/NVRAM regions can be adjusted through configuration to suit specific system needs. RAM can be expanded by either 2 MB or 4 MB by adding a memory expansion module. The RAM expansion module cannot be allocated as NVRAM and cannot be used for storage of configurations.
3. FLASH: 2M for application code.

The RAM located on the D25 Main module is battery backed up. Data can be stored in memory for a period of at least 1 year with no power applied to the D25. The data retention time is dependent on ambient temperature.

The D25 Main module contains jumpers for each status module's wetting option. Each of the D25 status cards can be set to use either internal or external status wetting without removing them from the D25's enclosure.

## 2.4 AC Analog Value Measurement

Direct AC analog inputs from CTs and PTs are organized in 5 groups of 3 inputs for up to 15 AC analog inputs. Each group of three CTs or PTs can be selected from the following options:

- PTs: 63.5, 69.3, 110, 120, 220 $V_{rms}$
- CTs: 1 $A_{rms}$ or 5 $A_{rms}$

The D25 supports 1, 2, $2^1/_2$ and 3-element metering providing RMS voltage, RMS current, phase angles, frequency, THD, active power, reactive power, apparent power, power factor, power factor angle, voltage unbalance, current unbalance, average current, symmetrical components, import and export energy, and harmonic spectrum data.

### 2.4.1 42 x Current measurement

"Fluxbuster" CT inputs enable the recording of current magnitudes up to 42 times nominal. With these optional inputs, Generation 4 D25s can now record fault waveforms (DFR) and perform definite time protection (DTP) within a wider dynamic range, eliminating clipping that might otherwise occur due to transient DC components caused by line impedance.

## 2.5 DC Analog Value Measurement

The DC analog input card is available as 8 or 16 inputs with the following input options: ± 5 $V_{dc}$, ±1, ±5, ±10 or ±20 mA nominal. The measurement range (full scale) of each input is 120% of nominal.

For applications requiring different input options of the DC analog inputs on the same card, a DC module with scaling adapters is available. On this module, inserting a scaling adapter can individually set each input. The following adapters are available:

| Input Range | Part Number |
|---|---|
| ± 5 $V_{dc}$ | 530-0004 |
| ±1 mA | 530-0050 |
| ±5 mA | 530-0005 |
| ±10 mA | 530-0045 |
| ±20 mA | 530-0052 |

**Table 1 DC Analog Input Adapters**

## 2.6 Control Outputs

The D25 offers a 4-pole control relay module (D25K-4Z), two variations of dual-contact control relay modules (D25KE-4Z), and four variations of 2-pole control relay modules (D25K). Control outputs can be configured, on a per group basis, for Trip/Close (T/C) or Digital Outputs (DO) for applications that require multiple outputs active simultaneously. DO controls can be configured for Latching (ON/OFF), Raise/Lower (R/L) pairs or for programmable pulse duration from 10 to $(2^{31}-1)$ ms in 1 ms increments. The control modules utilize a Master Trip/Master Close bus architecture for trip/close functionality.

Control power is supplied from an external source. The control output relays can be jumpered for Trip/Close or R/L pairs using the rear terminal block without having to remove the control card from the D25's enclosure.

### 2.6.1 D25K-4Z

The D25K-4Z is equipped with 8 relays. These relays switch both sides of the controlled load for additional control security. The relays can be configured in two groups as T/C pairs or Digital Outputs (8 T/C pairs or 4 T/C pairs & 4 DO or 8 DO). Field I/O connects via compression type FACE-40 terminal blocks. The wetting supplies and group selection for T/C and DO contacts is made via a 20-pin compression type terminal block. Two sets of internal fuses (one for the T/C power supply and another for the DO power supply) protect both legs of the external control supplies.

### 2.6.2 D25KE

The D25KE can be equipped with 8, 16, 24 or 32 relays. These relays switch one side of the controlled load. The relays can be configured in four groups as T/C pairs or Digital Outputs. The D25KE connects to the field with FACE-40 connectors or DB-25 connectors (option at the time of order).

### 2.6.3 D25KE-4Z

The D25KE-4Z can be equipped with 16 or 32 relays. These relays switch both sides of the controlled load, effectively providing 8 or 16 control pairs. The relays can be configured in groups as T/C pairs or Digital Outputs. The D25KE-4Z connects to the field with FACE-40 connectors only.

## 2.7 Digital Inputs

The D25 can be equipped with as many as three status input (digital input) modules, each with 32 or 16 optically isolated inputs with 5000 $V_{rms}$ isolation barrier. The inputs are terminated with two Augat FACE-40 compression type connectors on each module. These modules are located below the top shelf and they are the top three I/O modules in the D25. The status input modules do not have to be the same type in the same unit, allowing the user to connect the D25 to systems with up to three different wetting supplies. The wetting supply for all 96 channels can also be supplied from the D25's internal isolated wetting supply on 24 $V_{dc}$ and 48 $V_{dc}$ wetting supply options. The status modules can be used in three modes of operation:

1. Switch closure monitor with internal wetting supply
2. Switch closure monitor with external wetting supply
3. Voltage monitor

The digital inputs are bipolar and isolated from each other. Both positive and negative sides of each input are terminated on the compression terminal block. All status inputs have their common return on the same module.

The following modules are available:

- 12 $V_{dc}$ wetting
- 24 $V_{dc}$/5 mA wetting
- 24 $V_{dc}$/10 mA wetting
- 48 $V_{dc}$ wetting
- 120 $V_{dc}$ wetting
- 250 $V_{dc}$ wetting

## 2.8 IED/RTC Module

The IED/RTC module provides two serial communication ports, a D25 Display port, a Universal Time Clock port and three auxiliary control outputs. The module is installed on the top shelf in the D25. All ports are powered from the internal power supply.

### 2.8.1 IED Ports

The IED/RTC module features two identical serial ports. The communication lines are isolated from the outside world by optical isolators with an isolation barrier of 500 $V_{dc}$. The ports use female DB-9 connectors and are software configurable to either RS-232 or RS-485, enabling communication with a host device or an IED device using byte-oriented protocols.

Both ports can be configured for data rates up to 38.4 kbp, support software or hardware flow control and allow for the transmission of break characters.

### 2.8.2 D25 Display Port

The IED/RTC module has a single serial port designated as the D25 Display port. The serial communication lines of this port are not isolated from the outside world. This port uses a female DB-9 connector, and supports half-duplex RS-485 signaling only (designed for multi-drop applications). The display port can be configured for speeds of up to 9.6 kbps; it does not support hardware flow control.

### 2.8.3 UTC Port

The IED/RTC module has a single serial port designated as the Universal Time Clock port. It is designed to accept a time sync signal from third party UTC generators. The serial communication lines of this port are isolated from the outside world by optical isolators with isolation barrier of 500 $V_{dc}$. This port uses a female DB-9 connector for RS-422 standard (differential inputs) or RS-232. This port is designed for input only.

### 2.8.4 Auxiliary Control Outputs

The IED/RTC module supports three auxiliary control output ports. Each of these ports has relay contact output ratings the same as the relay outputs of the Control Output Module. The outputs are dry contacts, and the wetting supply must be externally supplied.

### 2.8.4.1 System Fail Output

System Fail Output becomes active whenever the software functions in an unexpected manner or when power is removed from the D25.

System Fail Output is an integral feature of the IED/RTC module, and provides:

- Form B contact output with a rating of 60 W
- Maximum current - 2 A
- Maximum voltage across the output - 75 $V_{dc}$ /50 $V_{ac}$
- Power for this relay is supplied from the internal power supply
- Contact wetting is supplied from a external source

### 2.8.4.2 Radio Keying Output

The Radio Keying Output emulates "push-to-talk" whenever the D25 is used in a half-duplex radio communications system. The relay activates whenever the RTS line of "channel A" of the Serial XCOM card is asserted.

Radio Keying Output is an integrated feature of the IED/RTC module, and provides:

- Form A contact output with a 60 W rating
- Maximum current through the contacts - 2 A
- Maximum voltage across the output - 75 $V_{dc}$ /50 $V_{ac}$
- Power for this relay is supplied from the internal power supply
- Contact wetting is supplied from a external source

### 2.8.4.3 Auxiliary Control Output

The Auxiliary Control Output supports functions that may be required when use of a normal control output is not practical. This output, under software control provides:

- Form A contact output with a rating of 60 W
- Maximum current through the contacts - 2 A
- Maximum voltage across the output - 75 $V_{dc}$ /50 $V_{ac}$
- Power supplied from the internal D25 power supply
- Contact wetting supplied from a source external to the D25

## 2.9 XCOM Modules

The XCOM Modules are optional modules with two identical communication channels located on the top shelf of the unit. They are powered from the internal power supply and are connected with cables appropriate for communication between the D25 and host device. All XCOM communication modules are designed with common internal interface and can be easily substituted with a different type of XCOM module.

### 2.9.1 Serial XCOM Module

The Serial XCOM module contains two serial ports, which are isolated from the outside world by optical isolators with an isolation barrier of 500 $V_{dc}$. The ports use female DB-9 connectors and are software configurable to either RS-232 or RS-485, enabling communication with a host device or an IED device using byte-oriented protocols.

Both ports can be configured for data rates up to 38.4 kbps, support software or hardware flow control and allow for the transmission of break characters.

| Pin | RS-232 Signal | RS-485 Signal |
|---|---|---|
| 1 | CD | N/C |
| 2 | RX | RX- |
| 3 | TX | TX- |
| 4 | (+12V) | N/C |
| 5 | Com Gnd | Com Gnd |
| 6 | (-12V) | N/C |
| 7 | RTS | TX+ |
| 8 | CTS | RX+ |
| 9 | Earth Gnd | Earth Gnd |

**Table 2 XCOM RS-232 And RS-485 Pin-outs**

### 2.9.2 Ethernet 10BASE2 XCOM Module

The 10BASE2 Ethernet XCOM module contains two identical communication channels. Both channels are powered from the internal power supply. The communication lines are isolated from the outside world by optical isolators with an isolation barrier of 500 $V_{dc}$. The ports use BNC connectors designed for use with a 58 Ω characteristic impedance coaxial cable. The coaxial communication cable requires a 58 Ω terminator at each end.

The 10BASE2 communication interfaces operate at data rates up to 10 Mbps.

### 2.9.3 Ethernet 10BASE-T XCOM Module

The 10BASE-T (twisted pair) Ethernet XCOM module contains two identical communication channels compliant with the IEEE 802.3 standard. Both channels are powered from the internal power supply. The communication interfaces are isolated from the outside world by transformers with an isolation barrier of 500 $V_{dc}$. The ports use RJ-45 connectors and are designed for use with twisted pair cables having a characteristic impedance of 100 Ω.

The 10BASE-T communication interfaces operate at data rate up to 10 Mbps. The rear panel displays a full complement of LED indicators for diagnostic purposes.

The Ethernet 10BASE-T XCOM Module is typically used in star network configuration.

### 2.9.4 Ethernet 10BASE-FL XCOM Module

The 10BASE-FL (optical fiber) Ethernet XCOM module contains two identical communication channels compliant with the IEEE 802.3 standard. Both channels are powered from the internal power supply. The ports use ST type connectors and they are designed for use with multi-mode optical cable AMP 502085-1 or equivalent. The maximum length of optical cable between should not exceed 2000 meters using optical cables with a loss of 1.5 dB/1000m.

The 10BASE-FL communication ports operate at data rate up to 10 Mbps. The rear panel displays a full complement of LED indicators for diagnostic purposes. This module is typically used in a star network configuration.

## 2.10 LED Indicator Module

The LED Indicator Module is mounted on the D25 Front Panel. It houses the WESMAINT interface, D25 processor status and communication LED indicators, Controls Enabled/Disabled switch, LED indicators and an optional D25 Front Panel Display interface. The module also serves as a storage place for two PCB pullers for removing I/O modules from the D25.

## 2.11 DDSP Module

The optional DDSP Module mounts on top of the Main board, and is required for AC analog input measurements. This module contains Dual Digital signal processors (DSPs), DSP memory and the interface to the main processor.

## 2.12 Memory Expansion Module

The optional Memory Expansion Module mounts on top of the Main board and expands the base memory 2 or 4 MB. It can be used for extra data storage by some applications such as Oscillography Waveform Capture (DFR). The module is not required for a basic D25 configuration. This memory expansion module is not battery backed up.

## 2.13 Power Supply

The D25 has a choice of three internal power supplies that convert input power to the voltages and currents required for operation of the unit. All three power supplies provide an integral wetting power supply used for wetting status contacts, control power and/or powering external equipment.

The power supply is installed on the top shelf inside of the D25. Connection to the power supply is via a 5-position barrier terminal block. This terminal block internal interface is an edge card type connector, allowing for easy power supply removal.

Fuses for the power supply input and the wetting supply output are located on either side of the power supply connector.

### 2.13.1 DC Low Voltage Power Supply

Operates on DC low voltage input from 20 $V_{dc}$ to 60 $V_{dc}$. The wetting supply output is rated at 48 $V_{dc}$ @ 0.5 Amp.

### 2.13.2 120V AC/DC Power Supply

Operates on voltage input from 60 $V_{dc}$ to 180 $V_{dc}$ or 85 $V_{ac}$ to 135 $V_{ac}$ 50/60 Hz. The wetting supply output is rated at 24 $V_{dc}$ @ 1 Amp or 48 $V_{dc}$ @ 0.5 Amp.

### 2.13.3 240V AC/DC Power Supply

Operates on voltage input of 150 $V_{dc}$ to 350 $V_{dc}$ or 187 $V_{ac}$ to 265 $V_{ac}$ 50/60 Hz. The wetting supply output is rated at 24 $V_{dc}$ @ 1 Amp or 48 $V_{dc}$ @ 0.5 Amp.

# Chapter 3: Documentation

This chapter lists all released documents related to the D25 product line. Ask for the latest available version of the documents from GE Energy Services.

| Document Name | Release | Document Number |
|---|---|---|
| D25 Maintenance and Installation Guide | General | 994-0023 |
| D25 Brochure | General | PRBR-034 |

Table 3 D25 Product Literature

# Chapter 4: D25 Technical Specifications

## 4.1 Electrical Specifications

| | | |
|---|---|---|
| **Power Requirements** | Input Options | ⎓ 20-60 $V_{dc}$ (not available with graphical display)<br>≂ 60-150 $V_{dc}$/85-135 $V_{ac}$ 50/60 Hz (CE)<br>≂ 150-350 $V_{dc}$/187-265 $V_{ac}$ 50/60 Hz (CE) |
| | Maximum Power consumption | 65W |
| | Maximum inrush current on cold start (peak Amps) | 18 |
| | Maximum inrush current under dynamic conditions of 5 seconds on and 1 second off (peak Amps) | 45 |
| **CPUs and Memory** | Main Processor | Motorola 68360 @ 25 MHz |
| | DDSP Processors | 2 X Analog Devices 2187 @ 50 MHz |
| | I/O Processor | Motorola 68HC11 @ 4 MHz |
| | Program Memory | 512K of EPROM<br>2M of Flash |
| | Clock Drift | 2 ppm (7.2 ms/hour) @ 25EC |

| | | |
|---|---|---|
| | Data Memory | Standard NVRAM 2 MB<br>Optional RAM expansion to 4M |
| **Communication Ports** | Maintenance Port | WESMAINT II+ DB-9-F, RS-232 @ 9600bps |
| | D25 Display Port | DB-9-F, RS-485 @ 9600bps |
| | UTC Time Port | DB-9-F, RS-232/RS-422 |
| | Standard Serial Communication Ports (2) | DB-9-F, RS-232/485 up to 38400bps<br>software configurable |
| | Optional Communication Ports (2) | DB-9-F, RS-232/485 up to 38400bps, software configurable<br>Or<br>Ethernet/802.3<br>10BASE2, 10BASE-T or 10BASE-FL |
| **AC Analog Value Measurement** | Configuration Options | Direct AC analog inputs from CTs and PTs. Supports up to six 3-phase circuits |
| | Analog Inputs | 15 AC analog inputs organized in groups of three (3) inputs, Transformer isolated |
| | Sampling Rate | 64 samples per Power Line Cycle |
| | A/D Resolution | 13 bits plus sign |
| **AC Voltage Inputs** | Nominal PT input options | 63.5 $V_{rms}$,<br>69.3 $V_{rms}$,<br>110 $V_{rms}$,<br>120 $V_{rms}$, or<br>220 $V_{rms}$, |
| | Measurement Range | 0% to 250% of nominal |
| | Overload Voltage | 250% of nominal continuous<br>350% of nominal for one (1) minute |
| | Burden | Less than 0.1 VA @ nominal input |
| | Accuracy | See AC Data Accuracy for details |

| | | |
|---|---|---|
| **AC Current Inputs** | Nominal CT input options | 1 $A_{rms}$ or 5 $A_{rms}$, |
| | Measurement Range | 2% to 1600% of nominal for value measurement; 2% to 4200% (asymmetrical) of nominal for DFR and protection. |
| | Thermal Overload | 4 times nominal - continuous<br>30 times nominal - 10 seconds<br>100 times nominal - 1 second<br>10 minute duty cycle for inputs greater than 4 times nominal. |
| | Burden | 16x 1A & 5A CT-Less than 0.2VA @ nominal input.<br>42x 1A CT – Less than 0.05 VA @ nominal input.<br>42x 5A CT – Less than 0.1 VA @ nominal input. |
| | Accuracy | See AC Data Accuracy for details. |
| **General AC Features** | RMS Data | RMS magnitudes and phase angles for measured inputs. Supports L-L or L-N PT connections with calculation of L-L or L-N magnitudes and phase angles. |
| | Metering | Electrical Power<br>Supports 1, 2, 2½ and 3 element metering providing active, reactive, and apparent power; power factor per phase and circuit totals. Also provides displacement power factor angle per phase. |
| | Power Quality | THD and harmonic spectrum data to the 21st harmonic for each AC input. |
| | Electrical Energy | Import and export accumulators for kWh, kVAh, kVArh. |
| | Unbalance Detection | Symmetrical component circuit unbalance detection and maximum deviation from average methods. |
| | Alarming | High and low alarms on any analog data with qualifications of |

| | | |
|---|---|---|
| | | one power cycle or more. |
| | Line Frequency | 50/60 Hz |
| | Oscillography | Waveform and event recording on up to 15 AC analog channels simultaneously with concurrent capture of up to 250 digital input points<br>Analog sample rate: 64 samples/cycle<br>Record length: 240 cycles with programmable pre- and post-capture times |
| | Protection | 3-step definite time over-current protection and breaker failure protection on all configured circuits |
| **DC Analog Value Measurement** | Analog Inputs | 16 DC analog optically isolated differential inputs |
| | Sampling Rate | 40 samples/second @ 50 Hz; 50 samples per second @ 60 Hz; 2 samples are averaged before captured in the database (effective reporting rate is 20 samples/sec @ 50 Hz, 25 samples/sec @ 60 Hz. |
| | A/D Resolution | 14 bits plus sign |
| **DC Voltage** | Nominal Input Range | ±5 $V_{dc}$ |
| | Measurement Range | ±6 $V_{dc}$ |
| | Overload Voltage | ±30 $V_{dc}$ (NM) continuous<br>±200 $V_{dc}$ (CM) continuous |
| | Input Impedance | More than 10 MΩ |
| | Accuracy | ±0.05% of full scale |
| | Temperature Coefficient | ±15 ppm/°C |
| **DC Current** | Nominal Input Range Options | ±1 mA<br>±5 mA<br>±10 mA, or<br>±20 mA |
| | Input Burden | 5K to 250 Ω (1 to 20 mA) |
| | Accuracy | ±0.10% of full scale |
| | Temperature Coefficient | ±30 ppm/°C |

| | | |
|---|---|---|
| **Digital Inputs** | General | Up to 96 optically isolated (5000 $V_{rms}$), organized in cards of 32 inputs. 16 inputs/card are also available. |
| | Digital Input on Options | One of: 12, 24, 48, 120, 250 $V_{dc}$ ±20%, bipolar inputs |
| | Burden | 2 to 6 mA, maximum power dissipation is 0.5W per input |
| | Contact Debounce | Three-level programmable software filtering for debounce and chatter |
| | Configurable Input Types | Digital input<br>Sequence of Events with time-tagging accuracy of 1 ms<br>Change of State<br>Up to 8 digital inputs as Pulse Accumulator |
| | On-Board Wetting Supply (not available with graphical display) | 24 $V_{dc}$ or 48 $V_{dc}$ (depends on supply ordered), isolated, external wetting optional |
| **Digital Outputs (D25KE)** | Standard Digital Outputs | 8, 16, 24 or 32 relay outputs switch one side of the controlled load; single component failure protection and detection preventing false control of any coil driver output; select-check-before execute security; master trip/master close bus scheme. |
| | Configurable Output Types | Latching (On/Off)<br>Trip/Close<br>Raise/Lower<br>Programmable pulse duration from 5 to $(2^{31}-1)$ ms in 1 ms intervals. |
| | Output Relay Contacts | 1 Form A |
| | Maximum Switching Power | 60 W or 125 VA (resistive) |
| | Maximum Switching Voltage | 75 $V_{dc}$ or 50 $V_{ac}$ (DB-25)<br>120 $V_{dc}$ (FACE-40) |
| | Maximum Switching Current | 2 A |
| | Maximum Carrying Current | 2 A |