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1 Overview

From developing the first set RTU of China in 1982, DFE keeps effort in providing customers with more reliable, flexible, stable, and powerful products. With more than 10000 sets substation RTU and feeder RTU installed in transmission power grid and distribution power grid, DFE is working to provide more reliable, flexible, stable and economic products to customers.

One unit, multiple capabilities

DF1725IED is a typical example derived from above mentioned target. For its flexible, reliable and stable design, DF1725IED can be used as Gateway, Protocol converter, Centralized RTU, Bay Control Unit and FRTU for transmission and distribution substation,RMU,Pole-top Feeder and other Location to improve the utility's performance.

Unified design is intended to reduce the wiring and maintenance costs. The DF1725IED retrieves data from legacy and third party devices such as relays, transfers it to a host or enterprise system, monitors and runs diagnostics of primary equipment, and expands to meet future physical and functional station requirements.

One solution, various applications

The open architecture of the DF1725IED supports adaptation to different applications. Future functional and quantitative extensions are easy to be realized at anytime through hardware or software upgrade for various applications: Transmission automation, Distribution automation, Feeder automation and Smart grids. DF1725IED can also supply fault detection function.

The DF1725IED allows one substation hardware device to be configured for many different functions by adding software modules. New software modules are being frequently released to further enhance the DF1725IED's functionality. These new modules can be easily downloaded into the flash memory.

1.2 System Capacity

As the open architecture, DF1725IED can support huge, medium and small capacity for data points of various applications. Fully flexible rack solutions can be used, 19” rack can plug in 11 I/O boards, 2/3 19” rack can plug in 6 I/O boards, 1/2 19” rack can plug in 4 I/O boards and boards support hot plug-in.

With flexible configuration, DF1725IED system can support:

Min 12 channels for communication with Master station

Min 60 channels for communication with other intelligent devices

Max 24 sub racks integrated and each rack with max 11 I/O boards

16 digital inputs per one DI-16 board

32 digital inputs per one DI-32 board

8 DC analog inputs per one DCAI-8 board

2/8/16 command outputs per one CO-2/8/16 board

6 AC analog inputs per one ACAI board

2 DC analog outputs per one AO-2 board

1.3 Flexible Configuration

DF1725IED meets various requirements by flexible assembling of components.

For a centralized RTU in the substations, it maybe need more than one 1725IED-rack to meet the capacity requirements of the substation, and all 1725IED-racks can be assembled in one or more cabinets. The MCUs can be used as redundant mode.

For distributed RTU in the substation, the 1725IED-rack with MCU-1/MCU-6 and different I/O modules can be used as Bay Control Unit and installed at each bay.

The capacity for the I/O points requirement can be met by flexible configuration in different type of 1725IED-rack (19”, 2/3 19”, 1/2 19”). Once one 1725IED-rack is not enough, the additional 1725IED-racks could be added for extension. In this way, one MCU shall be as the main MCU to communicate with the others. It can be a system to communicate with the external device.

Embedded communication protocols

IEC60870-5-101

IEC60870-5-103

IEC60870-5-104

IEC 61850

DNP 3.0 over serial and TCP/IP

MODBUS

Additional customized protocols are available

1.4 Communications

The DF1725IED supports various communication methods, such as Leased/dial-up telephone line, Power line carrier, Modem, Radio, Spread spectrum radio, Microwave, Ethernet, LAN/WAN, Internet, and Optical fiber, etc.

As the continuous development, DF1725IED which has already been awarded authorized certificate supports multiple protocols. DF1725IED has successfully communicated with other systems via the standard protocols.

1.5 Maintenance and Diagnosis

DF1725IED has self-diagnostic capabilities continuously monitoring operation and detection of memory, CPU, communication faults, and input/output errors and failures with detailed reporting of detected errors to local control system or remote master station.

Using the DF1000v maintenance software or web server, the system can be conveniently monitored and maintained locally or remotely. It provides all the DF1725IED management, configuration, expansion, and diagnostic functions as below:

- Maintenance for the database parameters
- Edit and view the files in the flash
- View and diagnose the running status
- Edit and view the programmable parameters for all kinds of control interlock application
- Configuration and expansion of DF1725IED I/O modules
- Modify and view the data on EEPROM chips
- Modify the parameters of module database
- View the real-time data of all the I/O modules
- Operation of digital output, analog output
- View the operational status of I/O modules
- Special maintenance functions such

1.6 Time-Synchronization

The DF1725IED can be synchronized by external GPS with accuracy less than 1 ms or by the master station. When GPS is not available, software algorithms are employed to counter inaccuracies and drift resulting from crystal aging or other factors such as temperature, etc.

In the event both GPS and Master Station cannot synchronize MCU within a configurable time period, the MCU will utilize its own internal clock as the system synchronization source with the stability of f f ⅄s Ï nchron

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1.9 Gateway/Protocol Converter Capability

DF1725IED have various ports to support as Gateway or protocol converter to communications with Master Stations and intelligent electronics devices.

The DF1725IED supports communication simultaneous with multiple master stations using various multi-port schemes, common or different communication protocols and at different baud rates. Different master stations can receive the same RTU all the points, and the operation issued by one master station does not affect the operation of other master stations on the device. Each communication port function independently from other ports. Each port shall be unaffected by simultaneous activity on other communication ports.

DF1725IED can be connected to the existing systems and convert their legacy protocol to IEC 60870-5-101/104 or other standard protocol.

1.10 Wide Application for RTU/Gateway/BCU/FRTU

For the flexible design of DF1725IED, it can be suitable for different types application, such as in high voltage Substation Control System, it can be used as Gateway and Bay Control Unit in distributed system; for Transmission and Distribution Substation, it can be used as centralized RTU; for distribution automation, it can be used as Ring Main Unit RTU and Pole Top FTU. It also can work as sub-master RTU connected with slave RTUs.

RTU for Substation ***FRTU for RMU*** ***Pole mounted FTU***

2 DF1725IED Components Technical Specification

2.1 POWER supply card

Input Type and Range

110/220V (85~264V AC, 50 ± 5Hz, 88~360V DC)

48 V DC (36V DC ~ 72V DC)

24 V DC (12V DC ~ 36V DC)

12 V DC (9V DC ~ 16V DC)

Output Voltage and Current: 5V, 3.3V DC and 5 A

Power Rating: 25 W 16W optional

Insulation: 2,000 V AC

Impulse Withstand: 5KV AC

Reverse polarity and surge protection

LED indicator for 5v and 3.3v

Power-D: Apply to Dual mode, parameter same with single mode

2.2 MCU

As the main communication processing unit of the system, MCU takes charge of the management of communication and data processing of all the other function boards. At the same time, it fulfills the communication tasks with different control centers and with different kinds of intelligent devices in the substations, such as protection relays and intelligent meters.

MCU provide independent serial ports, each of which can be configured to work in different baud rates from 110 to 115200 bps and comply with ITUT V.24/V.28 (RS232C).

MCU provide industry standard Ethernet port which self-adapt 10M/100M to enable communication by TCP/IP. Uploading software or even upgrading the whole system software can be done through the maintenance serial ports at site or remotely.

MCU supports data storage in both digital and analog, which includes 2 types of data collection:

1. Record the specified data when changing according to events such as voltage.
2. Record data set at a specified time (DATA LOGGING BY REAL – TIME CLOCK), which can be recorded every 1 second, such as recording current, voltage and kWh every 1 hour, etc.

Both types of data will be saved in memory with date and time of recording (TIME STAMPED) at least 7 days. And these data can be downloaded automatically to be displayed and saved to the database system for further reporting.

Available function card

1725IED_POWER-48V-S card

1725IED_POWER-48V-A card

1725IED_POWER-48V card

1725IED_POWER-24V card

1725IED_POWER-24V-S card

1725IED_POWER-24V-D card

1725IED_POWER-24V-D

1725IED_POWER-110V/220V card
1725IED_POWER-12V-A card (sand blasting face-plate)
1725IED_POWER-24V-W card
1725IED_POWER-24V-A card
1725IED_POWER-48V-W card
1725IED_POWER-48V-D card
1725IED_POWER-110V/220V-W card

2.2.1 MCU-1

CPU

32 bit, ColdFire 5275 microprocessor

Memory

- 64MB DDR RAM
- 4MB Flash
- 1MB SRAM

Communication Ports

1 RS232 maintenance port

2 RS232 ports, 110 to 115200bps, RJ45 connector

2 RS232/485 ports, 110 to 115200bps, RJ45 connector

2 Ethernet ports, RJ45 connector

Synchronization

1 IRIG-B port, RJ45 connector

Clock drift accuracy: 2 ppm

LED indications for MCU

Power, RUN, ERR, GPS, COM, ETH and Status for each I/O board

Available function card

1725IED_MCU-1-A card

1725IED_MCU-1-A card (sand blasting face-plate)

2.2.2 MCU-5

CPU

32 bit, ColdFire 52259 microprocessor

Integrated with LTE function

Memory

- 512KB Flash
- 64KB SRAM

Communication Ports

1 RS232 maintenance port

2 RS232/485 ports, 110 to 115200bps, RJ45 connector

1 Ethernet ports, RJ45 connector

Synchronization

1 IRIG-B port, RJ45 connector

Clock drift accuracy: 2 ppm

LED indications for MCU

Power, RUN, ERR, GPS, COM, ETH and Status for each I/O board

Available function card

1725IED_MCU-5-C card

1725IED_MCU-5-D card

MCU-5-C card: 2G function

MCU-5-D card: 2G/3G/4G function

2.2.3 MCU-6

CPU

32 bit, Freescale MPC8309 Power QUICC

Memory

-16M RAM

-64M NVRAM

2.4 DCAI-8 card

The DCAI-8 DC analog input board is the analog input interface module, which is capable of processing voltage and current inputs continuously and features as below:

A jumper setting is provided to select whether to include Precision Resistor for current inputs or to exclude Precision Resistor for voltage inputs.

Common mode noise rejection: at least 90dB from 0 to 50Hz.

Normal (differential) mode rejection: at least 60 dB at 50Hz.

Computed values such as minimum and maximum values, average values and rates of value changes of analogue inputs store in the flash memory of MCU. These data can be configured to send to Master Station or a printer connected to the MCU.

Analog dead bands can be configurable from 0 to 100% of full scale.

Maintenance free feature.

Force To Zero parameter can be configured from 0 to 100% of full scale to eliminate noise fluctuations around the zero value.

Smoothing factors configurable for analog inputs to ensure that fast transient interference do not cause large fluctuations in actual reported values, avoiding incorrect reporting of limit transgressions.

Low Alarm and High Alarm limits configurable from 0 to 200% of full scale with limit transgression alarms.

Sampling Capacity

8 Voltage/Current (differential mode) inputs.

Voltage: ± 1V, ± 5V, ±10V. optional.

Current: ±10 mA, ±20 mA, 4 - 12 - 20 mA, 4 - 20 mA, etc.

A/D References

1V/5V/10V precise reference voltage, long-term stability

better than 0.02%; software auto calibration, and no manual adjustments required

Sampling Rate 20ms per point and 160ms for 8 Points

Accuracy

0.1% current accuracy references

0.1% voltage accuracy references

Overload Rating

Current: 200% continuous

Voltage: 200% continuous (@ ±5 V)

Available function card

1725IED_DCAI-8 card

1725IED_DCAI-8-A card

2.5 ACAI card

ACAI-3U3I/6I/4U4I/8I module is the peripheral for the 1725IED substation control systems that provides AC analog computing and monitoring. It is compatible for station retrofits and new installations in generation, transmission, and transmission bulk supply and distribution environment.

The ACAI-3U3I/6I/4U4I/8I uses four monolithic A/D converters (ADS8365), each of which includes six 16-bit, 250KHz ADCs (Analog-to-Digital converters) with 6 fully differential input channels grouped into two pairs for high-speed simultaneous signal acquisition. Inputs to the ţ M input

2.6 DI-16 card

2.7 DI-32 card

The 32 digital inputs are organized in two groups of sixteen electrically isolated inputs, each group with one common ground. The digital inputs can use 12V/24V/48V as wetting voltage. Using the DF1000v Maintenance Software, each input can be configured from a downloaded database to be processed as a single-bit input, double-bit input, Binary Coded Decimal (BCD) input or counter input. Each double-bit and single-bit input can be configured as an SOE. Counter input can be configured as Form A, Form B or Form C inputs. BCD can be configured up to 8-digit decimal number without sign and decimal point.

The flexibility and reliability of the DI-32-12/24V/48V as below:

Digital inputs scanned once per 0.9

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-Form A, Form B or Form C pulse accumulator
-Binary coded decimal
-Pulse duration
2.0 mA typical input current
Common ground for each group of 16 channel and each ground is independence of each other
12/24/48 V contact wetting voltage (voltage range: -20% to +30%)
2000VAC insulation
LED indication per point

Available function card

1725IED_DI-32-48V card
1725IED_DI-32-24V card
1725IED_DI-32-12V card

2.8 CO card

The CO module handles DF1725IED control commands. Depending on the application, dual control, direct operate and multiple Raise/Lower controls are supported in CO operations.

Reliability and security are of utmost importance in issuing controls. The CO incorporates interlocking hardware protection techniques and software algorithms to guard against false output selection due to a single component failure, erroneous address or selection decoding.

Its security features as below:

Select-Before-Operate (SBO) functionality to provide highly secure operation which is especially essential in critical situations, such as Trip/Close operations of power circuit breakers; only one point can be operated at a time, and each command involves a series of steps to confirm and validate controls received from the master.

Direct Operate Operation: Only one control point in a DF1725IED can be selected or executed at any given time. In the event DF1725IED receives a “select” (or direct operate) command from the second host station after it receives “select” command from the first host station, the DF1725IED will send a signal to the second the host station to reject the command.

Number of pulses (1-255), interval of pulses (0 ms - 60,000 ms) and width of pulses (0ms-60000ms) are configurable. In case the commands from Master Station include these three parameters, CO card will act accordingly, otherwise it will use preset parameters in RTU.

Control outputs are provided with LEDs to confirm the status of each control relays, protected against transients, surge withstand, and immunity to impulse transients.

Control outputs can be freely configured to one of the two-operation modes - Select Before Operate (SBO) operation or Direct Operate operation.

Control Output Points

Select Before Operate (SBO) output
Direct Operate output
2/8 relays output, 1 NO contact per relay (for CO-2 and CO-8 card)
16 relays output, common pin mode for the output relay (CO-16 only)
Local/Remote switch allowing disabling output relay

Maximum switching voltage 110V DC

Maximum switching power: 240W, 2000VA (30V DC)

Maximum maintaining current: 12A (250V DC) (for CO-2 and CO-8 card)

Maximum maintaining current: 5A (30V DC) (CO-16 only)

2000V AC insulation

LED Indication per point

Available function card

1725IED_CO-8 card

1725IED_CO-8-A card

1725IED_CO-16-A card

1725IED_CO-2 card

2.9 AO-2 card

AO-2 offers analog output function. The technical features as below:

Two analog outputs per AO-2

Automatically switching backup power supply for keeping output while the main DF1725IED power supply in the event of power disconnection.

All analog outputs are equipped with optical isolation to protect against ground loops and power surges.

Output accuracy: 0.2%

Output Channels

2 channels in one AO-2, maximum overload up to 1500 ohm for current output.

- 0 - +5V, 0 - +10V voltage
- 0 - 10mA, 0 - 20mA, 4 - 20mA current

Feedback Current/voltage Scan Rate and Adjustment

Maximum 200ms for two channels

D/A resolution for output & A/D resolution for feedback input

14 bits including sign bit

Available function card

1725IED_AO-2 card

*36 FDUG

7KH *36 FDUG KDQGOHV WLPH GDWH VLJQDO
6DWHOOLWH VLJQDO ZLOO EH UHFHLYHG YLD
DQWHQQD *36 FDUG FDQ V\QFKURQL]H WKH
WLPH RI ') ,(' GHYLFH DQG VHQG WLPH
V\QFKURQL]DWLRQ PHVVDJH WR RWKHU
GHYLFHV
6SHFLILFDWLRQV
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z 336 RXWSXW
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Dongfang Electronics International Engineering Co., Ltd.

Dongfang Electronics Co., Ltd.

Address: 2 Jichang Road, Yantai, Shandong Province, P.R. China, 264000

Tel: +86-535-5520925

Fax: +86-535-5520930

Email: idf@dongfang-china.com

Website: http://www.dongfang-china.com/en

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