TDC 3000 Enhanced Programmable Logic Controller Gateway

Introduction

This publication defines the significant functions of the TDC 3000 Enhanced Programmable Logic Controller Gateway (EPLCG). The EPLCG provides a link between the Local Control Network (LCN) and Programmable Logic Controllers that use Allen-Bradley™ or Modbus™ subsystem protocols.

The EPLCG is one of the modules on the Local Control Network. As Figure 1 indicates, it communicates with other modules on the Local Control Network and with Programmable Logic Controllers, which are connected to one of the EPLCG’s two EIA RS232 ports. In this position in the TDC 3000 System architecture, the EPLCG makes the transition from the transmission technique and protocol of the Local Control Network to the transmission techniques of the Allen-Bradley or Modbus protocols.

Two ports on the EPLCG can serve independent Programmable Logic Controller networks or can be optionally configured to provide redundant communication paths to a PLC network—including Allen-Bradley’s. The two ports are guaranteed to support up to 16 Programmable Controllers (up to 64 Programmable Controllers can be addressed). The EPLCG handles up to 3000 process points (tags).

Programmable Controller Protocols

Programmable Logic Controllers operating on either the AEG-Modicon™ Modbus (RTU) protocol or the Allen-Bradley DF-1 protocol are accommodated by the EPLCG (for both protocols on one EPLCG, each is accommodated by one of the two ports). The EPLCG accomplishes data-form conversions necessary to provide data to the Local Control Network (LCN) and to transfer data from the LCN to the Programmable Logic Controllers.

**Figure 1 — TDC 3000 System with an EPLC Gateway**
**Functions**

- Provides secure communication link between the TDC 3000 Local Control Network and the Programmable Controllers.
- Converts data and protocol between the Local Control Network and the two Programmable Controller ports.
- Scans the Programmable Controller data for alarm conditions.

**Functional Description**

The relationships of the EPLCG functions are shown on Figure 2.

The EPLCG can operate as a single node on the LCN or it can operate as a node pair, with two EPLCGs, one operating and the other serving as its redundant partner, with an exact, up-to-date copy of the database, ready to take over full operation, should the operating member of the pair fail or be taken out-of-service.

The EPLCG provides the data conversion, buffering, and sequencing necessary to provide an efficient interchange of information between the Local Control Network and the Programmable Controllers, and to accomplish the following services.

**System Services**

The EPLCG provides the following system-level services:

- Stores user-defined configuration data, including EPLCG configuration, its relationship to the Programmable Controllers, and data-point (tag) data.
- Organizes and optimizes Programmable Controller scanning tasks on the basis of ports and device addresses.
- Initiates communication over the external networks connected to the two ports to the Programmable Controllers, as defined by the configuration data, and reinitiates communication after an interruption in communication.
- Maintains an image of network and Programmable Controller status for presentation on a Universal Station's Hiway Status display.
- Maintains an image of values for all defined data points.
- Maintains port operational statistics for use by technicians, including error and retry counts, last error codes, view words, port traffic, firmware freetime counters, and number of (Allen-Bradley) reports-by-exception processed.

**Data/Acquisition and Monitoring Services**

The EPLCG provides the following services for acquiring process data:

- Repetitively acquires all defined Programmable Controller data as fast as possible in a free-running mode. A report-by-exception mode is available for the Allen-Bradley protocol.
- Monitors alarm conditions and generates alarms when
so dictated by the acquired data. Provides change-of-state alarms for digital data and value-limit or deviation alarms for analog data.

- Provides a contact-cutout function that suppresses unnecessary alarms from a secondary point, when configured predefined conditions, such as out-of-service equipment, are detected by a primary point.

**Supervisory Control Services**

- Continuously “reads” subsystem output values for defined points to provide feedback to operators about commands issued, and to detect changes by subsystem logic.

- Detects events configured to initiate programs in Application Modules.

- Links input and output points together in a composite point with one tag name, for display and control purposes.

- Provides a “red tag” function to prevent unauthorized changes in output values.

**EPLCG Data Points**

The types of data points listed below can be configured for an EPLCG. Configuration data and process data for each of these points resides in one of up to eight emulated Data Hiway Ports (DHPs) in the EPLCG.

DHPs can be thought of as subdivisions of the EPLCG. Functionally, they are virtually identical to DHPs that operate as individual boxes on Honeywell Data Hiways. Each DHP in an EPLCG provides 30 memory slots, so an EPLCG has $8 \times 30 = 240$ such slots. The numbers of points per slot are defined in the following list.

- **Digital Input point**
  Reads the status of a discrete Programmable Controller digital input. Sixteen points per slot.

- **Digital Output point**
  Reads and writes the status of a Programmable Controller digital-output memory location. Eight points per slot.

- **Digital Composite Point**
  A digital input and a digital output, combined under one tag name, for display and control purposes.

- **Analog Input point**
  Reads a Programmable Controller analog input (register) value. Six points per slot.

- **Analog Output point**
  Reads and writes a Programmable Controller analog output value (register). Four points per slot.

- **Analog Composite point**
  An analog input and an analog output, combined under one tag name, for display and control purposes.

- **Counter point**
  Reads the accumulated value from a counter and can be commanded to write a value to the counter. Eight points per slot.

**Alarm Scanning**

The EPLCG monitors the input data for user-defined alarm conditions. Up to 50 critical process alarms may be specified by the process engineer to be scanned each 1/2 second by the EPLCG. The remaining alarms receive normal handling. Alarm types include

- High and low limit or deviation alarms for analog input points.

- Change-of-state alarms for digital input points.

- Command-disagree alarms for digital composite points.

- Preset-value-reached alarms for counter points.

**EPLCG Operates on Standard Hiway Gateway Software**

The EPLCG appears to the TDC 3000 software to be a Hiway Gateway with a Data Hiway on which up to eight Data Hiway Ports reside. No changes to the HG software are made to accommodate the EPLCG.

The standard process network display for Data Hiways depicts the emulated DHPs in the EPLCG just as if they were physical boxes on a real Data Hiway. The EPLCG behaves so that these displays indicate the normal Data Hiway functions, including periodic swapping of hiway cables, and the functions of the Hiway Traffic Director.

Data in the emulated DHPs is saved (checkpointed) and restored through the process network display in the same manner as if they were on a real Data Hiway.

EPLCGs with K2LCN processor boards operate on TDC 3000 software release 320 and later.

**Options**

Each EPLCG can be backed up by a redundant EPLCG to assure maximum dependability. The backup EPLCG is kept up-to-date with relevant information from the primary EPLCG so that the backup...
can take over at any time with virtually no disruption in system operation. The redundant communication option can provide subsystem (Modicon or Allen-Bradley) cable-communication redundancy.

Modification kits are available to convert from a PLCG to an EPLCG and from a PLCG redundant pair to an EPLCG redundant pair, with or without the redundant communication feature for Allen-Bradley PLCs.

PLCGs with 68000-type microprocessors or with 68020-type microprocessors can be upgraded to EPLCGs. There is little, if any, difference in performance between these two versions. These versions are available to support compatibility with existing TDC 3000/PLCG systems. Software release R210M1 or beyond is mandatory for the enhanced 68020 version.

**Model Numbers**

**MP-NEPLC1**
Single EPLCG, with EPLCI I/O subsystem interface board (for use with Modbus, Allen-Bradley, or mixed protocols)

**MP-REPLC1**
EPLCG redundant pair, with EPLCI I/O subsystem interface boards (for use with Allen-Bradley protocol and redundant communications only)

**MP-REPLC2**
EPLCG redundant pair, with PLCI I/O boards and relay panel to the I/O Subsystem (for use with Modbus with or without redundant communications, or Allen-Bradley without redundant communications)

**Physical Description**

The Enhanced PLC Gateway is available in a dual node electronics package. For additional information about this type of enclosure, see the latest *System Technical Data* in the *System Summary* binder.

Packaged in a dual node module, the Enhanced PLC Gateway consists of a high-density K2LCN board, a Programmable Controller Interface board, power supply, (optional) relay panel, and fan assembly. Each of these items is an Optimum Replaceable Unit for maintenance purposes.

The dual node module can be mounted in an Operator Console or in a system cabinet.

The Local Control Network is connected to the EPLCG through coaxial connectors on KLCN CA and KLCN CB I/O boards. EPLCGs are connected to the PLC subsystem network via RS232 ports on the EPLCI I/O boards (or on the relay panel) through multiconductor cables.
EPLCG Specifications

Physical Characteristics (dual node module)

<table>
<thead>
<tr>
<th>Approximate Dimensions</th>
<th>Approximate Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>Dual-Node Module with</td>
</tr>
<tr>
<td>Width</td>
<td>Single Node 14.6 kg (32 lb)</td>
</tr>
<tr>
<td>Depth</td>
<td>Two Nodes 18 kg (40 lb)</td>
</tr>
<tr>
<td>18.8 cm (7&quot;)</td>
<td>48.3 cm (19&quot;)</td>
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<tr>
<td>53.3 cm (21&quot;)</td>
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Power Options

Strap-selected ac-Voltage Options

120, 220, 240 Vac +10%, -15%

Frequency Options

50 Hz or 60 Hz, +3%, -6%

EPLCGs operate without disruption through an interruption in the input ac voltage of up to 40 msec duration.

Summary of Operating Characteristics

EPLCG

Point Handling Capacity

Up to 3000 points-per-EPLCG or EPLCG pair. Maximums per point type are:

- Digital inputs 3000
- Digital Outputs 1920
- Digital Composite (1 in and 1 out) 1280
- Analog Inputs 1440
- Analog Outputs 960
- Analog Composite (1 in and 1 out) 576
- Critical alarms 50

Other Data Types

Event-initiated processing triggers 600
Point contact cutout capability 500

Data Acquisition Performance

The principal performance factor is the rate at which the Programmable Logic Controllers respond to scan requests by the EPLCG. For each EPLCG port, the point-scanning rate is equal to or better than 500 points per second, depending on configuration. If digital points predominate in the point mix, the scan rate per port can exceed 6000 points per second.

Output Performance

At 19,200 baud, the output rate for each EPLCG port can range from 12 to 42 points per second, depending on configuration (see the Note on page 7).
EPLCG Specifications (continued)

Configuration Capability

Maximum Number of EPLCGs per LCN 20, or 20 redundant pairs*
Communication Networks (each port) EIA RS232C, dc isolated, no handshaking
Modems Short haul, 4-wire only
Speed Selections (each port) 50, 150, 300, 1200, 2400, 4800, 9600, 19,200 baud
Protocols (per port on nonredundant EPLCGs)
  Modicon Half duplex, Modbus, RTU mode
  Allen-Bradley Full-duplex, DF-1 with PLC-2 emulator mode

Commands Available

Modbus
  01 Read Coil
  02 Read Discrete
  03 Read Holding Register
  04 Read Input Register
  05 Write (single) Coil (see note)
  06 Write (single) Holding Register (see note)

Allen-Bradley “basic commands” 01 Unprotected Read
  05 Unprotected Bit Write (see note)
  08 Unprotected (single) (word) Write (see note)

Allen-Bradley PLC5 commands 0F ASCII Mode Word Read/Write and Bit Write

Accepts Modbus exception responses 01 through 07.

Note: Single point outputs are interleaved with scan requests in the next available port buffer. The output rate per port, at 19,200 baud, can range from 12 to 42 points per second depending on the configuration. The EPLCG reduces its read request block size from 64 words to 8 words (only while an output is pending), improving output rate by as much as three times. Output requests from other LCN nodes are stacked in a request buffer and are output in the order they are received at the above rate.

*Total HG pairs, NIM pairs, and EPLCG pairs per LCN ≤ 20.
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