TOSHIBA inverter G3-Series Devicenet Manual

HIGH PERFORMANCE TRANSISTOR INVERTER
VECTOR DRIVE SERIES

TOSHIBA

TOSVERT-130
TRANSISTOR INVERTER

DEVICENET COMMUNICATIONS INTERFACE MANUAL

December, 1998
Part #43150-001

Introduction

Thank you for purchasing the “DeviceNet Communications Interface Kit” for the Toshiba TOSVERT-130 G3 High-Performance Transistor Inverter. Before using the DeviceNet interface, please be sure to thoroughly read the instructions and precautions contained in this manual. In addition, please make sure that this instruction manual is delivered to the end user of the inverter unit into which the interface kit is installed, and keep this instruction manual in a safe place for future reference or inverter inspection.

This instruction manual outlines the device specifications, profile, installation methods, maintenance procedures and functions of the DeviceNet communications interface.

Usage Precautions

Operating Environment

- Please use the interface board only when the ambient temperature of the inverter unit into which the interface board is installed is within the following specified temperature limits:
  Operation: -10 ~ +40°C (+14 ~ +104°F)
  Storage: -20 ~ +65°C (-4 ~ +149°F)
- Avoid installation locations that may be subjected to large shocks or vibrations.
- Avoid installation locations that may be subjected to rapid changes in temperature or humidity.

Installation • Wiring

- Do not touch charged parts such as the terminal block while the inverter's CHARGE lamp is lit. A charge will still be present in the inverter unit's internal electrolytic capacitors, and therefore touching these areas may result in an electrical shock. Always turn all inverter input power supplies OFF, and wait at least 5 minutes after the CHARGE lamp has gone out before wiring the interface board cables or motor wiring.
- When installing the interface board into the inverter and making wiring connections, make certain that no clippings or wiring leads that could cause device failure fall into the inverter or onto electronic components.
- Do not connect the "V-" terminal of the DeviceNet interface board connector to the inverter's CC or E/GND terminals.
- Whenever making wiring connections or installing/removing the DeviceNet communications interface board or option ROM, be sure to turn all power sources to the inverter unit OFF.
- Route the signal-carrying cables separate from the inverter input/output power wiring.
- To avoid the possibility of electric shock due to leakage currents, always ground the inverter unit's E/GND terminal and the motor to a properly-grounded location.

Other Precautions

- Do not touch or insert a rod or any other item into the inverter while power is applied, as this may lead to electrical shock or inverter damage.
- Commission the disposal of the interface board to a specialist.

Table Of Contents

1. Installation Instructions

The DeviceNet Communications Option ROM enclosed with the DeviceNet kit is compatible only with G3 inverters with V120 or later main software. An error will occur if the option ROM is installed in an inverter with pre-V120 main software. The main software version number is printed on the CPU package (IC1) on the control board. Additionally, this version number can be read from inverter memory by displaying the parameter CPU VERSION in GROUP:UTILITY PARAMETERS. If you are unsure of the software version of your inverter, please contact Toshiba International Corporation for more information.

The DeviceNet option ROM version number is printed on the label attached to the ROM. The option ROM version number can also be read from the inverter's memory and displayed on the LCD panel after initialization by displaying the parameter ROM VERSION in GROUP:UTILITY PARAMETERS. The option ROM version number replaces the standard ROM version number after installation/initialization.

1.1 Before Installation

All parameters will be automatically reset to the factory default values after the option ROM is installed in the inverter. If it is desired to retain the current parameter settings, the user should access the user-changed parameter group to display and record all the parameters and setting values that have been changed from factory defaults. Even if the current settings are saved to non-volatile memory by setting the STANDARD SETTING MODE SELECTION parameter in GROUP:UTILITY PARAMETERS to 5*, they will be erased from memory during initialization of the option ROM.

- *Setting the standard mode selection parameter will be referred to in this manual as performing a **TYPE X RESET**, where X is the parameter setting value*

1.2 Installation Procedure

Installation of the TOSHIBA DeviceNet option ROM and interface board into a TOSVERT-130 G3 inverter should only be performed by a qualified technician familiar with the maintenance and operation of the G3. To install the option ROM and interface board, complete the following steps:

1. Record the option ROM version number located on the label of the option ROM in the following box. The option ROM version is the number immediately following the "V" on the ROM label. For example, if the label indicates "V6402", the option ROM version is 6402. This version number will be used later in the installation process. Option ROM version = [ ].

Record the standard ROM version number prior to option ROM installation. The standard ROM version can be read from parameter ROM VERSION in GROUP:UTILITY PARAMETERS.
Standard ROM version = [ ].

2. **CAUTION!** Verify that all input power sources to the inverter have been turned OFF and are locked and tagged out.

3. **DANGER!** Wait at least 5 minutes for the inverter's electrolytic capacitors to discharge before proceeding to step 4. **Do not touch any internal parts with power applied to the inverter, or for**

at least 5 minutes after power to the inverter has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.

4. Remove the inverter's cover (open the door on units with hinged doors). Verify that the CHARGE LED has gone out before continuing the installation process.
5. Loosen the 4 screws attaching the G3's operation panel support bracket to the control board support bracket and remove the operation panel and support bracket as a unit (refer to Figure 1).

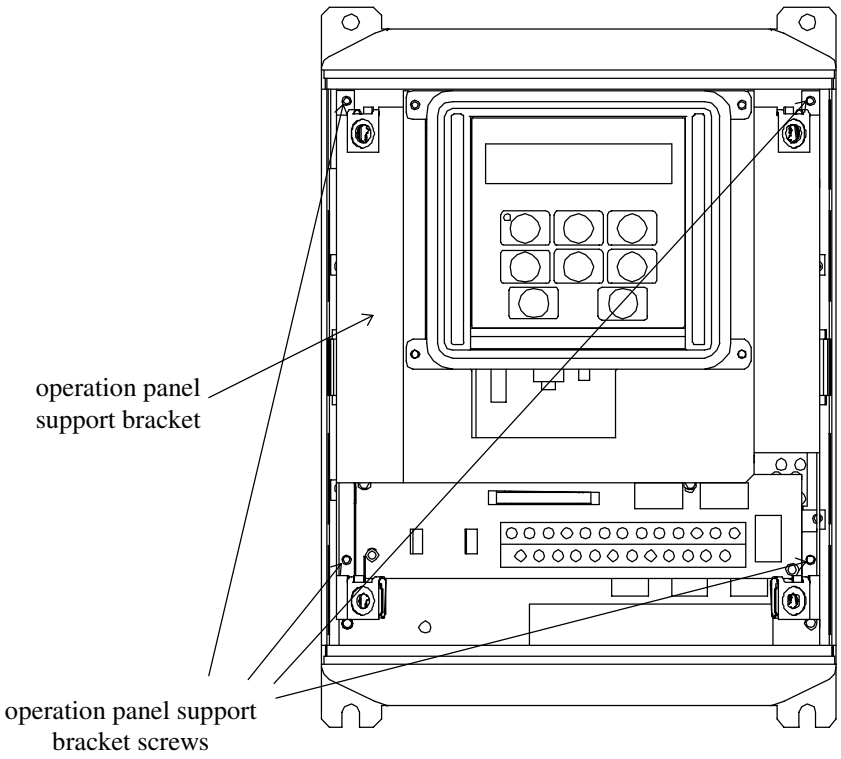


Figure 1: *G3 with front cover removed*

6. **CAUTION!** The option ROM PCB assembly and interface board are static-sensitive devices. Standard electrostatic-sensitive component handling precautions should be observed. Locate the option ROM connector, labeled CN41, on the lower-left side of the control PCB. Line up the connector on the back of the option ROM PCB with CN41. Install the option ROM by pressing gently but firmly on the option ROM PCB until a slight "click" is felt. Verify that the option ROM PCB is seated properly and firmly in CN41. If the option ROM connector does not appear to be mating with CN41 properly, verify that the ROM is oriented properly and that there are no obstructions in either connector.
7. Install the 4 plastic interface board standoffs into the holes provided in the control board support bracket (refer to Figure 2).

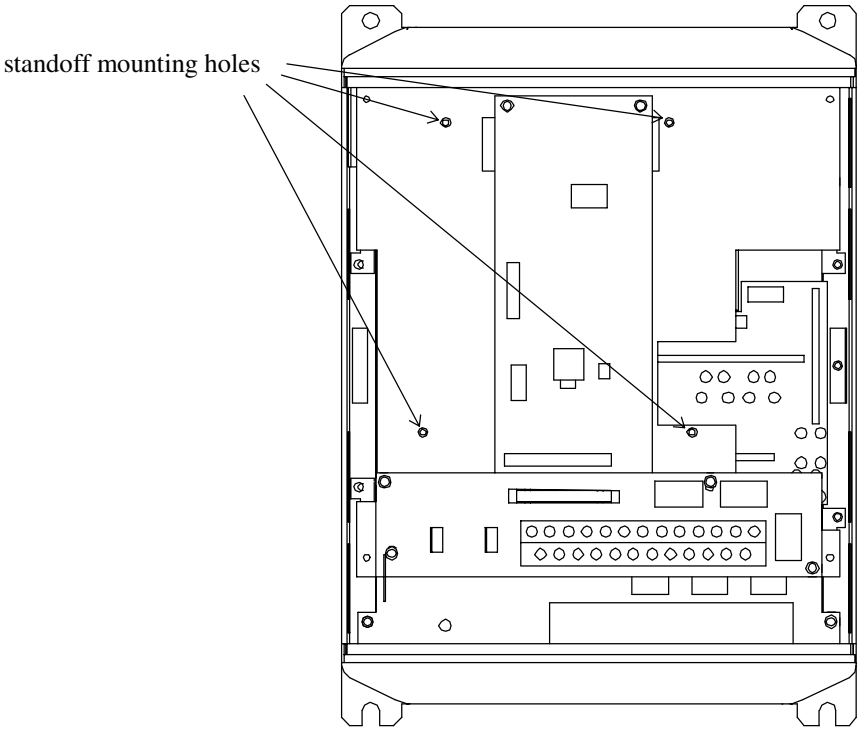


Figure 2: *G3 with front cover and operation panel support bracket removed*

8. Install the DeviceNet cable through the access holes at the bottom of the inverter and route the cable in order to make connections to the interface board connector (CN1). Take care to not route the cable near any sharp edges or in positions where it may be pinched.
9. Connect the DeviceNet cable to the interface board connector (CN1) according to the terminal markings.
10. Install the interface board into the inverter by carefully aligning the 4 plastic supports with the 4 mounting holes provided in the interface board. Ensure that connector CN5A on the back side of the interface board is aligned with connector CN5 on the front side of the control board.
11. Press the interface board firmly onto the standoffs and connector CN5 until the standoff retaining tabs lock.
12. Carefully re-install the operation panel and support bracket and tighten the 4 screws that attach the operation panel support bracket to the control board support bracket.
13. Reinstall the inverter's cover (close and latch the door on units with hinged doors).

DANGER! Do not operate the unit with the cover off / cabinet door open.

14. Turn all power sources to the inverter unit ON, and verify that the inverter functions properly. If the inverter unit does not appear to power up, or does not function properly, immediately turn power OFF. **Repeat steps 2 ~ 4 to remove all power from the inverter.** Then, verify all connections. Contact Toshiba International Corporation for assistance if the problem persists.
15. To perform final verification that the option ROM is installed properly, display the value of the `ROM VERSION` parameter in `GROUP:UTILITY PARAMETERS`. This number should match the option ROM version number that was recorded in step 1. If this parameter value does not match the option ROM version number recorded in step 1, **repeat steps 2 ~ 4 to remove all power from the inverter,** then re-verify that the option ROM is installed properly. If the option ROM appears to be installed properly, but the version numbers still do not match, contact Toshiba International Corporation for further assistance.

2. Removal Instructions

In order to protect the option ROM and interface board connectors' reliability, do not repeatedly connect and disconnect the option ROM or interface board. Use the following procedure if it becomes necessary to remove the DeviceNet option ROM and interface board from the inverter.

CAUTION! Do not remove the option ROM or interface board while power is applied to the inverter. Removing the option ROM or interface board with power applied may damage the inverter.

2.1 Before Removal

The inverter will display an error message if the option ROM becomes dislodged or is removed from its socket. The inverter must be reset to clear this error. Therefore, all parameters will be automatically reset to the factory default values after an option ROM has been removed from the inverter. If it is desired to retain the current parameter settings, the user should access the user-changed parameter group to display and record all the parameters and setting values that have been changed from factory defaults. Even if the current settings are saved using the TYPE 5 RESET function, they will be erased from memory during the re-initialization of the inverter after the option ROM has been removed.

2.2 Removal Procedure

Removal of the TOSHIBA DeviceNet option ROM and interface board from a TOSVERT-130 G3 inverter should only be performed by a qualified technician familiar with the maintenance and operation of the G3. To remove the option ROM and interface board, complete the following steps:

1. **CAUTION!** Verify that all input power sources to the inverter have been turned OFF and are locked and tagged out.
2. **DANGER!** Wait at least 5 minutes for the inverter's electrolytic capacitors to discharge before proceeding to step 3. **Do not touch any internal parts with power applied to the inverter, or for at least 5 minutes after power to the inverter has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.**
3. Remove the inverter's cover (open the door on units with hinged doors). Verify that the CHARGE LED has gone out before continuing the removal process.
4. Loosen the 4 screws attaching the G3's operation panel support bracket to the control board support bracket and remove the operation panel and support bracket as a unit (refer to Figure 3).
5. **CAUTION!** The option ROM PCB assembly and interface board are static-sensitive devices. Standard electrostatic-sensitive component handling precautions should be observed. Release the 4 corners of the interface board from the standoffs by pressing down on the standoff locking tabs with a small flat-headed screwdriver. Be careful to not apply any abnormal stress to the interface board while performing this, as this may damage the interface board or control board connectors.

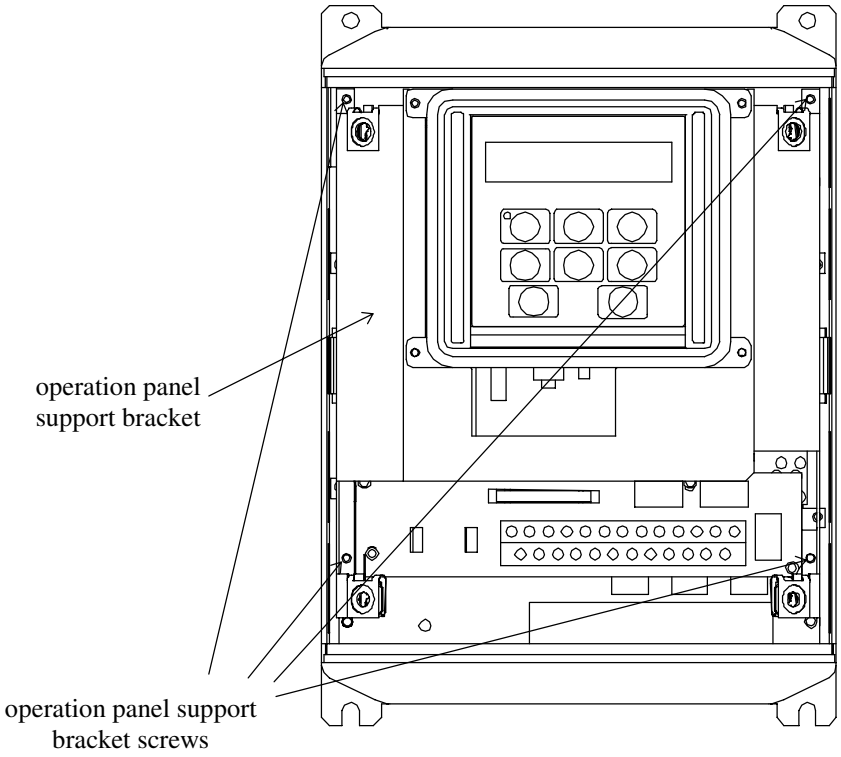


Figure 3: *G3 with front cover removed*

6. Remove the interface board from the inverter.
7. If necessary, disconnect the DeviceNet cable from the interface board connector (CN1), and pull the cable out through the access holes at the bottom of the inverter.
8. Locate the option ROM in the option ROM connector, labeled CN41, on the lower-left side of the control PCB. Gently work the option ROM PCB up and down while pulling on it until the ROM releases from the control PCB option ROM connector.
9. Carefully re-install the operation panel and support bracket and tighten the 4 screws that attach the operation panel support bracket to the control board support bracket.
10. Reinstall the inverter's cover (close and latch the door on units with hinged doors).

DANGER! Do not operate the unit with the cover off / cabinet door open.

11. Turn all power sources to the inverter unit ON, and verify that the inverter functions properly. An error should be displayed when power is applied after the option ROM has been removed. If the inverter unit does not appear to power up, or does not function properly, immediately turn power OFF. **Repeat steps 1 ~ 3 to remove all power from the inverter.** Then, verify all connections. Contact Toshiba International Corporation for assistance if the problem persists.
12. To re-initialize the inverter after the ROM has been removed, perform a TYPE 3 reset. After the initialization sequence, display the value of the `ROM VERSION` parameter in `GROUP:UTILITY PARAMETERS`. This number should match the standard ROM version number that was recorded prior to option ROM installation. If this parameter value does not match the value recorded earlier, contact Toshiba International Corporation for further assistance.

3. DeviceNet Interface Board Equipment Specification

Item	Specification
Operating Environment	Inside, less than 1000m above sea level, do not expose to direct sunlight or corrosive or explosive gasses.
Operating Temperature	-10 ~ +40°C (+14 ~ +104°F)
Storage Temperature	-25°C ~ +65°C (-13 ~ +149°F)
Relative Humidity	20% ~ 90% (without condensation)
Vibration	4.9m/s^2 {0.5G} or less (10 ~ 55Hz)
Grounding	Do not make any external ground connections to the interface board
Cooling Method	Self-cooled

4. Maintenance And Inspection

Preventive maintenance and inspection is required to maintain the DeviceNet interface kit in its optimal condition, and to ensure a long operational lifetime. Depending on usage and operating conditions, perform a periodic inspection once every three to six months. Before starting inspections, always turn off all power supplies to the inverter unit, and wait at least five minutes after the inverter's "CHARGE" lamp has gone out.

DANGER! Do not touch any internal parts with power applied to the inverter, or for at least 5 minutes after power to the inverter has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.

Inspection Points

- Check that the wiring terminal screws are not loose. Tighten if necessary.
- Check that there are no defects in any wire terminal crimp points.
- Visually check the wiring and cables for damage.
- Clean off any accumulated dust and dirt. Place special emphasis on cleaning the ventilation ports of the inverter and all installed PCBs. Always keep these areas clean, as adherence of dust and dirt can cause premature component failure.
- If use of the inverter unit is discontinued for extended periods of time, turn the power on at least once every two years and confirm that the unit still functions properly.
- Do not perform hi-pot tests on the inverter or DeviceNet interface board, as they may damage the unit's internal components.

Please pay close attention to all periodic inspection points and maintain a good operating environment.

5. Storage And Warranty

5.1 Storage

Observe the following points when the DeviceNet interface board is not used immediately after purchase or when it is not used for an extended period of time.

- Avoid storing the interface board in places that are hot or humid, or that contain large quantities of dust or metallic dust. Store the interface board in a well-ventilated location.
- When not using the DeviceNet interface board for an extended period of time, turn the power on at least once every two years and confirm that it still functions properly.

5.2 Warranty

The DeviceNet Communications Interface Kit is covered under warranty for a period of 12 months from the date of installation, but not to exceed 18 months from the date of shipment from the factory. For further warranty or service information, please contact Toshiba International Corporation.

Please perform adequate maintenance and inspection procedures.

6. General Specifications

APPLICATION

TOSVERT-130 G3 inverter, internally mounted.

TERMINATIONS

One 5-pin pluggable gold-plated connector for DeviceNet bus connection.

POWER SUPPLY (ISOLATED TRANSCEIVER PORTION)

SOURCE:	Supplied by DeviceNet network
VOLTAGE:	11 ~ 25 VDC
CURRENT:	111mA (maximum)
MISWIRING PROTECTION:	Per DeviceNet Specification Volume 1, Release 2.0, Section 9.2.2

POWER SUPPLY (NON-ISOLATED CONTROL PORTION)

SOURCE:	Supplied by G3 inverter's internal power supply.
VOLTAGE:	5 VDC ±5%
CURRENT:	225mA (maximum)
MISWIRING PROTECTION:	None

LED INDICATORS

One dichromatic red/green Module Status LED and one dichromatic red/green Network Status LED.

7. DeviceNet Network Specifications

COMPATIBILITY

Group 2 Server Only device utilizing the Predefined Master / Slave Connection Set as outlined in the DeviceNet Specification, Volume 1, Release 2.0, Chapter 7. Unconnected Message Manager (UCMM) incapable. 2 possible configurations which conform to the AC/DC Drive Profile as outlined in the DeviceNet Specification, Vol. 2, Release 2.0, Section 3-9. 1 vendor-specific configuration available. This product has been self-tested by Toshiba International Corporation and found to comply with ODVA Conformance Test Software Version FT 1.0/1.2.

NODE ISOLATION

Isolated at the physical layer.

DATA RATES

125 Kbaud, 250 Kbaud, 500 Kbaud selected via inverter parameter setting.

RESPONSE TIME

Bit-strobe or poll response starts 100μs (typical) after receipt of request.

Explicit messaging response for non-inverter parameter attributes starts 225μs (typical) after receipt of request.

Explicit messaging response for inverter parameter attributes starts 50 ~ 75ms (typical) after receipt of request.

BUS INTERFACE

Phillips 82C250 or equivalent transceiver.

8. Parameter Configuration

DATA RATE

Set via parameter RS232 BAUD RATE in GROUP:COMMUNICATION SETTING PARAMETERS:

- 0 = 125 Kbaud
- 1 = 250 Kbaud
- 2 = 500 Kbaud

This parameter setting is stored in non-volatile memory, and is not configurable via the DeviceNet network.

If this parameter setting is changed, power to the inverter must be cycled or the inverter must be reset for the change to take effect.

Since this parameter also sets the baud rate for the inverter's standard RS232C interface port, if simultaneous RS232C and DeviceNet communications are to take place, the RS232C baud rate used by the serial communicating device must also correspond to this parameter setting (2400, 4800, or 9600 baud).

MAC ID

Set via parameter INVERTER ID NUMBER in GROUP:COMMUNICATION SETTING PARAMETERS

- 0 ~ 63 (parameter can be set from 0 ~ 255: settings of 64 ~ 255 are regarded as 63)

This parameter setting is stored in non-volatile memory, and is not configurable via the DeviceNet network.

If this parameter setting is changed, power to the inverter must be cycled or the inverter must be reset for the change to take effect.

INTERFACE BOARD SELECTION

Set via parameter COMMUNICATION SELECTION in GROUP:COMMUNICATION SETTING PARAMETERS

- 2 = TOSLINE-F10 / DeviceNet / RIO

If this parameter setting is changed, power to the inverter must be cycled or the inverter must be reset for the change to take effect.

COMMAND MODE SELECTION

Set via parameter COMMAND MODE SELECTION in GROUP:UTILITY PARAMETERS

- 3 = communication interface board input valid (if DeviceNet network is intended source of command data).

FREQUENCY MODE SELECTION

Set via parameter FREQUENCY MODE SELECTION in GROUP:UTILITY PARAMETERS

- 3 = communication / 12-bit binary interface board input valid (if DeviceNet network is intended source of frequency command data).

I/O ASSEMBLY INSTANCE SET SELECTION

Since there are 3 separate I/O assembly instance sets possible, a method must be established to select which will be in effect for communication to/from the network. This selection will be done with the G3 parameter TOSLINE-F10 COMMAND INPUT in GROUP:COMMUNICATION SETTING PARAMETERS as follows:

TOSLINE-F10 COMMAND INPUT Setting	Instance Set Selected
0 (factory default)	21 & 71 (AC/DC Drive Profile Extended Speed Control Set)
1	100 & 150 (Toshiba Vendor-Specific Control Set)
2	20 & 70 (AC/DC Drive Profile Basic Speed Control Set)
3	Do not select: drive will trip "OPTION PCB ERROR"

Note that the TOSLINE-F10 COMMAND INPUT parameter setting is read by the DeviceNet interface only on drive initialization (upon power-up or after resetting from a trip). If the value of this parameter is changed, therefore, the drive must be reset in order to validate the new setting.

9. Connection Information

Connection Sizes

Connection Instance	Produced	Consumed
Polled I/O	4 bytes (instances 70 & 71) 8 bytes (instance 150)	4 bytes 8 bytes
Bit-Strobed I/O	4 bytes	8 bytes
Explicit Messaging	20 bytes	20 bytes

Note:

- For the Explicit Messaging connection, this is the maximum message length: shorter messages are also acceptable.
- In the Bit-Strobed I/O connection, the device's strobe bit is not used: consumption of the Bit-Strobe command alone causes the connection to produce.
- In the Polled I/O connection, if the actual consumed data size is less than the connection instance's consumed_connection_size attribute, the following will occur:

  If I/O instance set 20/70 or 21/71 is selected:

  1. The consumed data will be ignored
  2. The Control Supervisor Object's Run1 and Run2 attributes will be set to FALSE (stop condition - refer to section 11.7)
  3. The AC/DC Drive Object's SpeedRef attribute will be set to 0 (refer to section 11.8)
  4. The connection object will produce normally

  If I/O instance set 100/150 is selected:

  1. The consumed data will be ignored
  2. The drive's Run/Stop bit will be set to 0 (stop)
  3. The drive's frequency command will be set to 0
  4. The connection object will produce normally

  If the actual consumed data size is greater than the connection instance's consumed_connection_size attribute, the behavior is the same as listed above except that no data will be produced.

Device Profile

Instance sets 20/70 and 21/71 conform to the AC/DC Drive Profile outlined in the DeviceNet Specification, Vol. 2, Release 2.0, Section 3-9.

Electronic Data Sheet

```
$ DeviceNet Electronic Data Sheet For The Toshiba TOSVERT-130 G3 Inverter
$

[File]
        DescText    = "Toshiba TOSVERT-130 G3 Inverter";
        CreateDate  = 12-03-98;
        CreateTime  = 09:20:00;
        Revision    = 2.0;

[Device]
        VendCode    = 71;               $ Vendor Code
        ProdType    = 2;                $ Product Type
        ProdCode    = 1;                $ Product Code

        MajRev      = 2;                $ Major Rev
        MinRev      = 0;                $ Minor Rev
        VendName    = "Toshiba";
        ProdTypeStr = "AC Drive";
        ProdName    = "TOSVERT-130 G3";
        Catalog     = "TOSVERT-130 G3";
        Comment     = "Vector-Controlled AC Inverter";
        Ucmm        = "0";

[IO_Info]
        Default     = 0x0001;           $ Poll is default
        PollInfo    = 0x0003, 1, 1;     $ Default input=#1, default output=#1
        StrobeInfo  = 0x0003, 1, 4;     $ Default input=#1, default output=#4

$ -------------------------- Input Connections ------------------------------

        Input1      =
        4,                              $ 4 bytes produced
        0,                              $ all bits are significant
        0x0003,                         $ Polled or bit-strobed connection
        "Instance 71 Status",
        6,                              $ Connection path size
        "20 04 24 47 30 03",            $ Assembly obj instance #71 attribute #3
        "Instance 71 Producing Cnxn";

        Input2      =
        8,                              $ 8 bytes produced
        60,                             $ 60 significant bits
        0x0003,                         $ Polled or bit-strobed connection
        "Instance 150 Status",
        6,                              $ Connection path size
        "20 04 24 96 30 03",            $ Assembly obj instance #150 attribute #3
        "Instance 150 Producing Cnxn";

        Input3      =
        4,                              $ 4 bytes produced
        18,                             $ 18 significant bits
        0x0003,                         $ Polled or bit-strobed connection
        "Instance 70 Status",
        6,                              $ Connection path size
        "20 04 24 46 30 03",            $ Assembly obj instance #70 attribute #3
        "Instance 70 Producing Cnxn";

$ -------------------------- Output Connections -----------------------------
        Output1     =
        4,                              $ 4 bytes consumed
        21,                             $ 21 significant bits
        0x0001,                         $ Polled connection only
        "Instance 21 Poll Request",
        6,                              $ Connection path size
        "20 04 24 15 30 03",            $ Assembly obj instance #21 attribute #3
        "Instance 21 Consuming Cnxn";

        Output2     =
        4,                              $ 4 bytes consumed
        27,                             $ 27 significant bits
        0x0001,                         $ Polled connection only
        "Instance 100 Poll Request",
```

```
        6,                              $ Connection path size
        "20 04 24 64 30 03",            $ Assembly obj instance #100 attribute #3
        "Instance 100 Consuming Cnxn";

        Output3     =
        4,                              $ 4 bytes consumed
        18,                             $ 18 significant bits
        0x0001,                         $ Polled connection only
        "Instance 20 Poll Request",
        6,                              $ Connection path size
        "20 04 24 14 30 03",            $ Assembly obj instance #20 attribute #3
        "Instance 20 Consuming Cnxn";

        Output4     =
        0,                              $ strobe bit not used
        0,
        0x0002,                         $ Bit-strobed connection only
        "Strobe Request",
        0,                              $ Connection path size
        "",                             $ No consuming connection path
        "Bit-Strobed Consuming Cnxn";

[ParamClass]

        MaxInst = 12;
        Descriptor = 0x09;            $ Supports param. instances, stored in NV mem
        CfgAssembly = 0;              $ no config. assy.

[Params]

        Param1 =                                            $ acceleration time #1
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0, 2, 2,                                            $ descriptor, data type, data size
        "Accel time #1", "",                                $ name, units
        "Time to accelerate from 0Hz to FMAX",              $ help string
        1, 60000, 100,                                      $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param2 =                                            $ deceleration time #1
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0, 2, 2,                                            $ descriptor, data type, data size
        "Decel time #1", "",                                $ name, units
        "Time to decelerate from FMAX to 0Hz",              $ help string
        1, 60000, 100,                                      $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param3 =                                            $ V/F Pattern
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0, 8, 1,                                            $ descriptor, data type, data size
        "V/F pattern", "",                                  $ name, units
        "Selects volts per hertz relationship",             $ help string
        1, 6, 1,                                            $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param4 =                                            $ feedback selection
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0, 8, 1,                                            $ descriptor, data type, data size
        "Feedback select", "",                              $ name, units
        "0=no FB, 1=process FB, 2=speed FB",                $ help string
        0, 2, 0,                                            $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param5 =                                            $ command mode selection
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0, 8, 1,                                            $ descriptor, data type, data size
        "Command mode", "",                                 $ name, units
        "Selects command input source",                     $ help string
        0, 4, 4,                                            $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param6 =                                            $ frequency mode selection
```

```
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0, 8, 1,                                            $ descriptor, data type, data size
        "Frequency mode", "",                               $ name, units
        "Selects frequency input source",                   $ help string
        0, 4, 4,                                            $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param7 =                                            $ post-compensation output frequency
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0x30, 2, 2,                                         $ descriptor, data type, data size
        "Output frequency", "",                             $ name, units
        "Post-compensation output frequency",               $ help string
        0, 40000, 0,                                        $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param8 =                                            $ input power (kW)
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0x30, 2, 2,                                         $ descriptor, data type, data size
        "Input power", "",                                  $ name, units
        "Power consumed by drive and motor",                $ help string
        0, 65535, 0,                                        $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param9 =                                            $ output power (kW)
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0x30, 2, 2,                                         $ descriptor, data type, data size
        "Output power", "",                                 $ name, units
        "Power supplied to motor by drive",                 $ help string
        0, 65535, 0,                                        $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param10 =                                           $ present fault code
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0x30, 8, 1,                                         $ descriptor, data type, data size
        "Present fault", "",                                $ name, units
        "0 (no fault) if drive is not tripped",             $ help string
        0, 127, 0,                                          $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param11 =                                           $ RX input terminal value
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0x30, 2, 2,                                         $ descriptor, data type, data size
        "RX analog input", "",                              $ name, units
        "Refer to manual for value interpretation",  $ help string
        0, 65535, 32767,                                    $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

        Param12 =                                           $ RX input terminal value
        0,                                                  $ reserved field
        0, "",                                              $ path size, path (null)
        0x30, 8, 1,                                         $ descriptor, data type, data size
        "Output terminals", "",                             $ name, units
        "Refer to manual to interpret bit mappings", $ help string
        0, 255, 0,                                          $ min, max, default data values
         , , , , , , , , ;                                 $ optional, unimplemented fields

[EnumPar]

[Groups]
```

10. Profile

AC Drives

Device Type: 0x02

This device profile section describes standard DeviceNet objects and behavior for the Toshiba TOSVERT-130 G3 AC drive and DeviceNet communications interface.

The DeviceNet interface supports 3 different I/O assembly instance sets. Although all objects, instances and attributes are accessible regardless of the I/O assembly instance set chosen, the data meanings and sizes may change and/or all object attributes may not affect drive operation when the Toshiba-specific I/O assembly instance set is chosen. For example, output instance 100 uses a “frequency command” value to set the drive’s speed. When this I/O assembly instance set is chosen, therefore, attribute 8 of the AC/DC Drive object instance (SpeedRef) will have no effect when written to, and will be undefined when read from. This is due to the fact that the frequency command data has priority over AC/DC drive profile attributes when this vendor-specific I/O assembly instance set is chosen. Similarly, accessing attributes 7 or 8 of the control supervisor object instance (Class Code 0x29) will not return the true values of Running1 and Running2, since these values depend on Run1 and Run2 (AC/DC Drive profile-defined command bits) to indicate the correct states.

Refer to section 8 for instructions on how to select the different I/O assembly instance sets.

The AC/DC drive profile-compliant I/O instance assembly sets make the G3 inter-operable, but not directly interchangeable with competitors’ drives without doing drive configuration through the drive local interface, a network configuration tool or other means of configuration outside the DeviceNet interface.

10.1 Object Model

The Object Model in Figure 4 on page 21 represents the model of the G3 inverter DeviceNet interface. The table below indicates the object classes present, as well as the number of instances present in each class, in the G3 inverter’s implementation of the AC / DC Drives profile per the DeviceNet Specification.

Object Class	# of Instances	Remarks
Identity	1	--
Message Router	1	--
DeviceNet	1	--
Connection	3	1 Explicit Messaging, 1 Poll, and 1 Bit-Strobe
Assembly	2	1 Input, 1 Output per I/O set chosen
Control Supervisor	1	--
AC/DC Drive	1	--
Parameter	12	For setting important drive parameters
Motor Data	1	--

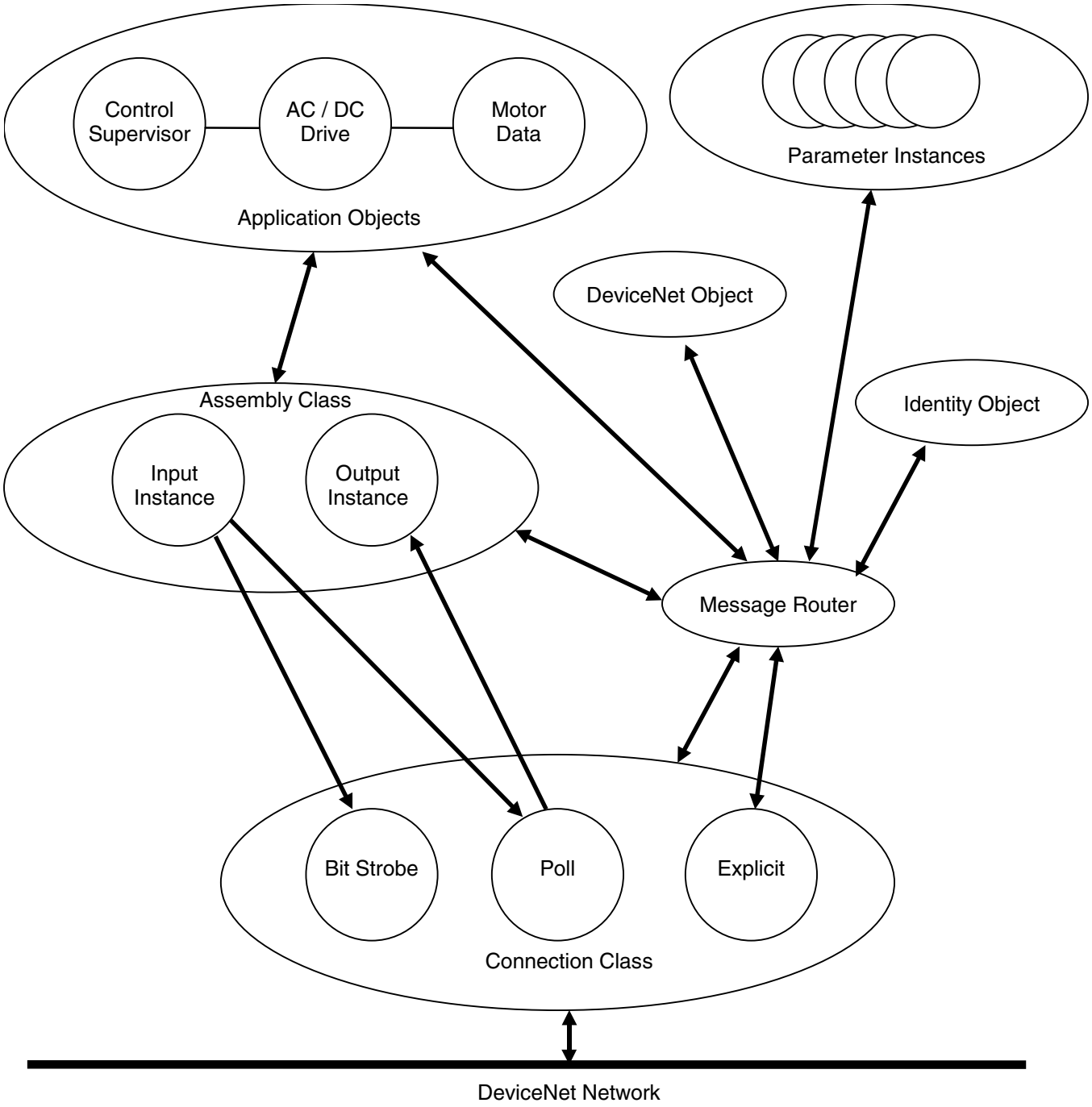


Figure 4: *Object model for G3 inverter*

10.2 Objects That Affect Behavior

The objects in the G3 drive profile affect the device's behavior as shown in the following table:

Object	Effect on Behavior
Identity	Supports the Reset service
Message Router	No effect
DeviceNet	Configures port attributes
Connection	Provides logical ports into and out of the device, sets EPR values
Assembly	Implements drive control via Control Supervisor Object and AC/DC Drive Object
Control Supervisor	Manages drive functions and operational states
AC/DC Drive	Implements drive control
Parameters	No effect (drive parameter configuration only)
Motor Data	No effect

10.3 Object Interfaces

The objects in the G3 drive profile have the interfaces listed in the following table:

Object	Interface
Identity	Message Router
Message Router	Explicit Message Connection
DeviceNet	Message Router
Connection	Message Router
Assembly	Message Router, Bit-Strobed and Polled I/O Connections
Control Supervisor	Message Router, Assembly Object
AC/DC Drive	Message Router, Assembly Object
Parameters	Message Router
Motor Data	Message Router

10.4 I/O Assembly Instances

The following table indicates which I/O Assembly Instances are supported by the G3 DeviceNet interface:

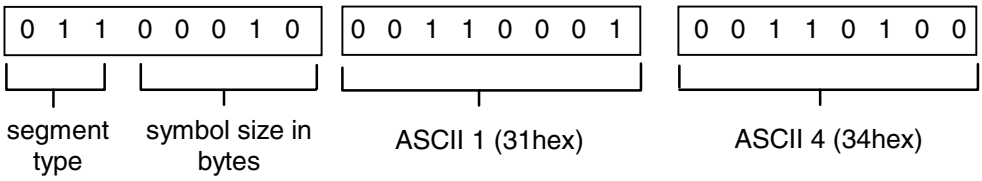
Number		Type	Name
decimal	hex		
20	14	Output	Basic Speed Control Output
21	15	Output	Extended Speed Control Output
70	46	Input	Basic Speed Status Input
71	47	Input	Extended Speed Control Input
100	64	Output	Toshiba-Specific Speed Control Output
150	96	Input	Toshiba-Specific Speed Control Input

If a bit is not used in an I/O Assembly, it is reserved for use in other Assemblies. Reserved bits in Output Assemblies are ignored by the consuming interface board. Reserved bits in Input Assemblies are set to zero by the producing interface board. Reserved bits in the I/O Assembly Data Attribute Format Tables in Section 10.4.2 are shaded.

10.4.1 Connection Paths to I/O Assembly Instances

The I/O Assembly Instances are chosen for I/O Connections and set in the “produced_connection_path” (attribute 14) and “consumed_connection_path” (attribute 16) attributes in the appropriate connection object. AC Drives such as the G3 use the Symbolic Segment Type (see DeviceNet Specification, Volume 1, Revision 2.0, Appendix I) to specify paths to the I/O Assembly Instances in the Motor Control Hierarchy. I/O Assembly Instances are represented by ASCII strings that contain the hex number of the Assembly Instance whose path is to be chosen.

The following example shows the Symbolic Segment used to specify Output Assembly Instance 20 (14 hex):



For the G3’s connection path attribute implementations, refer to Section 11.5.

10.4.2 I/O Assembly Data Attribute Format

The G3's I/O Assembly Data Attributes have the format shown below:

10.4.2.1 AC/DC Drive Profile Output Instance 20

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
20	0						Fault Reset		Run Fwd
	1								
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							

Note: If a negative Speed Reference is sent to the polled I/O connection object, it will be ignored (hold last state). If a negative Speed Reference is sent as part of the output assembly object's data attribute, an "Invalid Attribute Value" error will be returned.

10.4.2.2 AC/DC Drive Profile Input Instance 70

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
70	0						Running 1		Faulted
	1								
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							

10.4.2.3 AC/DC Drive Profile Output Instance 21

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
21	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							

Note that when instances 21 and 71 are selected, NetRef and NetCtrl will have the following effect on G3 parameters `COMMAND MODE SELECTION` and `FREQUENCY MODE SELECTION`:

NetRef	NetCtrl	Local change of `FREQUENCY MODE SELECTION` Possible?	Local change of `COMMAND MODE SELECTION` Possible?
0	0	Yes	Yes
0	1	Yes	No: fixed at 3
1	0	No: fixed at 3	Yes
1	1	No: fixed at 3	No: fixed at 3

Note also that NetCtrl = 0 (for example) does not necessarily mean that control is not originating from the DeviceNet interface; it simply means that local selection is possible. If COMMAND MODE SELECTION is set to 3 locally, the DeviceNet interface will still be the source of drive commands even if NetCtrl is set to 0. This same argument also holds true for NetRef.

10.4.2.4 AC/DC Drive Profile Input Instance 71

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
71	0	At Reference	Ref From Net	Ctrl From Net	Ready	Running2 (Rev)	Running 1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							

10.4.2.5 Vendor-Specific Output Instance 100

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
100	0	Jog mode				Acc/Dec 1/2 Selection	Fwd / Rev Selection	Stop Command	Run / Stop Command
	1			Reset Command	EOFF Command	Coast-stop Command	V/F 1/2 selection	Compulsory DC injection	Feedback enable
	2	Frequency Command (Low Byte)							
	3	Frequency Command (High Byte)							

Bit explanations for the command bytes of output instance 100 are as follows:

Byte	Bit	Function	0	1	Comment
0	0	run command	Stop	run	--
	1	stop command	run enabled	stop	Has priority over the run command (bit 0)
	2	forward / reverse	Reverse	forward	--
	3	accel / decel #1 / #2 selection	#1	#2	
	4	reserved	--	--	Value is ignored
	5	reserved	--	--	Value is ignored
	6	reserved	--	--	Value is ignored
	7	JOG mode selection	normal (acc / dec mode)	JOG mode	Only valid when stopped. JOG RUN FREQUENCY must also be set
1	8	feedback enable	feedback valid	feedback invalid	Feedback must still be selected to be active
	9	Compulsory DC injection braking mode	no compulsory DC injection braking	compulsory DC injection below DC INJECTION START FREQUENCY	Compulsory DC injection below DC INJECTION START FREQUENCY. DC INJECTION START FREQUENCY must still be set.
	A	fundamental parameter switching	V/F #1	V/F #2	--
	B	gate block command (coast stop command)	normal	gate block	--
	C	emergency off command	normal	emergency off	Does not depend on COMMAND MODE SELECTION
	D	reset command (trip clear)	normal	reset	Does not depend on COMMAND MODE SELECTION. Automatically retriggered by the G3. If the reset could not be performed (due to some overload delay time, etc.), this bit must again be set
	E	reserved	--	--	Value is ignored
	F	reserved	--	--	Value is ignored

The units for frequency command (bytes 2 and 3) is 0.01Hz, i.e. 0 to 40000 corresponds to 0.00Hz to 400.00Hz.

10.4.2.6 Vendor-Specific Input Instance 150

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
150	0	Jog mode status		Fault status		Acc / Dec 1/2 status	Fwd / Rev status	Run enable status	Run / Stop status
	1		UV Status		EOFF status	Coast-stop command status	V/F #1/#2 select status	Compuls. DC inject. Status	Feedback enable status
	2	Output Frequency (Low Byte)							
	3	Output Frequency (High Byte)							
	4	Output Current (% drive rated current: 100 = 100%)							
	5	Output Voltage (% drive rated voltage: 100 = 100%)							
	6	IV Input Terminal Value (0x00 ~ 0xFF = 0 ~ 100%)							
	7	ST	RES	S4	S3	S2	S1	R	F

Bit explanations for the status bytes of input instance 150 are as follows:

Byte	Bit	Function	0	1	Comment
0	0	run / stop status	stopped	Running	"1" only during accel/decel or constant-speed run. "0" during DC injection braking
	1	run enable status	run enabled	Stopped	--
	2	forward / reverse status	reverse	Forward	when stopped, indicates most recent rotation direction
	3	accel / decel #1 / #2 selection status	#1	#2	--
	4	Reserved	--	--	Always "0"
	5	Fault status	Faulted	Not faulted	--
	6	Reserved	--	--	Always "0"
	7	JOG mode status	acc / dec mode	JOG mode	--
1	8	feedback enable status	feedback invalid	feedback valid	--
	9	Compulsory DC injection braking	DC injection braking inactive	DC injection braking active	--
	A	Fundamental parameter status	V/F #1	V/F #2	--
	B	coast stop command status	normal	coast stop	--
	C	emergency off status	normal	emergency off	--
	D	Reserved	--	--	Always "0"
	E	main circuit undervoltage (MSV)	normal	MSV	--
	F	Reserved	--	--	Always "0"

The units for output frequency (bytes 2 and 3) is 0.01Hz, i.e. 0 to 40000 corresponds to 0.00Hz to 400.00Hz.

Byte 6 (IV input terminal value) indicates percentage of full-scale input (full-scale input = 10VDC or 20mA).

Byte 7 indicates the status of each of the standard programmable input terminals. If the bit corresponding to a particular terminal is "0", this means that that particular terminal is open (terminal "OFF"). If the bit corresponding to a particular terminal is "1", this means that that particular terminal is shorted to CC (terminal "ON").

10.4.3 Mapping I/O Assembly Data Attribute Components

The following table indicates the I/O Assembly Data Attribute mapping for the G3 AC Drive Output Assemblies:

Data Component Name	Class		Instance Number	Attribute	
	Name	Number		Name	Number
RunFwd	Control Supervisor	0x29	1	Run1	3
Run Rev	Control Supervisor	0x29	1	Run2	4
NetCtrl	Control Supervisor	0x29	1	NetCtrl	5
Fault Reset	Control Supervisor	0x29	1	FaultRst	12
NetRef	AC/DC Drive	0x2A	1	NetRef	4
Speed Reference	AC/DC Drive	0x2A	1	SpeedRef	8

The following table indicates the I/O Assembly Data Attribute mapping for the G3 AC Drive Input Assemblies:

Data Component Name	Class		Instance Number	Attribute	
	Name	Number		Name	Number
Drive State	Control Supervisor	0x29	1	State	6
Running1 (Fwd)	Control Supervisor	0x29	1	Running1	7
Running2 (Rev)	Control Supervisor	0x29	1	Running2	8
Ready	Control Supervisor	0x29	1	Ready	9
Faulted	Control Supervisor	0x29	1	Faulted	10
Warning	Control Supervisor	0x29	1	Warning	11
Ctrl From Net	Control Supervisor	0x29	1	CtrlFromNet	15
At Reference	AC/DC Drive	0x2A	1	AtReference	3
Speed Actual	AC/DC Drive	0x2A	1	SpeedActual	7
Ref From Net	AC/DC Drive	0x2A	1	RefFromNet	29

11. Object Specifications

This section contains the object specifications for all DeviceNet objects supported by the G3 DeviceNet interface. The following table outlines those objects covered:

For data type definitions referred to in these object specifications, refer to the DeviceNet Specification, Volume 1, Release 2.0, Appendix J, Section J-2.1.1.

11.1 Identity Object

Class Code: 0x01

This object provides identification of and general information about the G3 DeviceNet interface.

11.1.1 Identity Object Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of this object.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1
2	Get	Max Instance	UINT	Maximum instance number of an object currently created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.	1
6	Get	Max ID number of class attributes	UINT	The attribute ID of the last class attribute of the class definition implemented in the device.	The number of the last class attribute implemented to simplify auto determination of class's implementation by a remote terminal.	7
7	Get	Max ID number of instance attributes	UINT	The attribute ID of the last instance attribute of the class definition implemented in the device.	The number of the last instance attribute implemented to simplify auto determination of class's implementation by a remote terminal.	8

11.1.2 Identity Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	Vendor	UINT	Identification of vendor by number.	71
2	Get	Device Type	UINT	Indication of general type of product.	2
3	Get	Product Code	UINT	Identification of a particular product of an individual vendor.	1
4	Get	Revision	STRUCT of:	Revision of the item the Identity Object represents.	--
		Major Revision	USINT		2
		Minor Revision	USINT		0
5	Get	Status	WORD	Summary status of device	--
6	Get	Serial_number	UDINT	Serial number of device.	Unique for each board
7	Get	Product Name	SHORT_STRING	Human-readable identification.	TOSVERT-130 G3
8	Get	State	USINT	Present state of the device	--

11.1.3 Identity Object Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.
0x05	Yes	Yes	Reset	Invokes the Reset service for the device (Note 1)

Note 1:
- The Reset service resets only the interface board (not the inverter).
- Before the reset is executed, the option frequency command is automatically set to 0Hz and the option stop bit is set.
- Only an Identity Object Service “Type 0” reset is supported.
- The DeviceNet interface will not attempt to communicate in the Identity Object’s “Major Unrecoverable Fault” state. It will therefore not be able to process a Reset service. The only way to exit from the “Major Unrecoverable Fault” state is to reset the G3 by cycling power to it or otherwise initiating an inverter reset sequence.

11.1.4 Identity Object Specific Services

The Identity Object provides no object specific services.

11.2 Message Router

Class Code: 0x02

The Message Router Object provides a messaging connection point through which a Client may address a service to any object class or instance residing in the G3 DeviceNet interface.

11.2.1 Message Router Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of this object.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1
6	Get	Max Id number of class attributes	UINT	The attribute ID of the last class attribute of the class definition implemented in the device.	The number of the last class attribute implemented to simplify auto determination of class's implementation by a remote terminal.	7
7	Get	Max ID number of instance attributes	UINT	The attribute ID of the last instance attribute of the class definition implemented in the device.	The number of the last instance attribute implemented to simplify auto determination of class's implementation by a remote terminal.	2

11.2.2 Message Router Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
2	Get	Number Available	UINT	Maximum number of connections supported.	3

11.2.3 Message Router Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.

11.2.4 Message Router Specific Services

The Message Router provides no object specific services.

11.3 DeviceNet Object

Class Code: 0x03

The DeviceNet Object provides for the configuration and status of a DeviceNet port.

11.3.1 DeviceNet Object Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of the DeviceNet Object Class Definition upon which the implementation is based.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	2

11.3.2 DeviceNet Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	MAC ID	USINT	Node address (**Note 1**)	INVERTER NUMBER parameter setting (64 ~ 255 = 63)
2	Get	Baud Rate	USINT	Baud rate (**Note 1**)	Set according to RS232 BAUD RATE parameter setting
5	Get	Allocation Information	STRUCT of:		--
		Allocation Choice Byte	BYTE	Refer to DeviceNet Specification, Volume 1, Release 1.3, Section 5.5.4.2	0
		Master's MAC ID	USINT	MAC ID of Master (from allocate)	0xFF

Note 1: Attribute is not settable via the network. Attempting a *Set* service will result in a "Service Not Supported" error.

Note: The G3 does not implement the optional BOI attribute (attribute #3). Standard operation is for when a CAN BUSOFF error occurs, the interface board will completely isolate itself from the bus and trip the inverter. The inverter must then be manually reset to reset the interface board. In order to prevent the CAN controller from experiencing a BUSOFF error due to loss of network power, the network's voltage level is constantly monitored, and if found to be too low for transceiver operation, the interface board will reset itself and wait for bus power to be re-established. Once bus power returns, the interface board will then automatically re-initialize itself.

11.3.3 DeviceNet Object Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.

11.3.4 DeviceNet Object Specific Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x4B	N / A	Yes	Allocate_Master/Slave _Connection_Set	Requests the use of the Predefined Master/Slave Connection Set.
0x4C	N / A	Yes	Release_Group_2 _Identifier_Set	Indicates that the specified connections within the Predefined Master/Slave Connection Set are no longer desired. These connections are to be released (deleted).

11.4 Assembly Object

Class Code: 0x04

The Assembly Object binds attributes of multiple objects, which allows data to or from each object to be sent or received over a single connection. Refer to Section 10.4 for further information.

11.4.1 Assembly Object Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of this object.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1
2	Get	Max Instance	UINT	Maximum instance number of an object currently created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.	150

11.4.2 Assembly Object Instance Attributes

The G3 has 6 assembly instances, with assigned instance IDs 20, 21, 100 (output assemblies) and 70, 71, 150 (input assemblies).

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
3	Get (input instances) Set (output instances)	Data	ARRAY	The data contained in the assembly object. Refer to Section 10.4.	--

11.4.3 Assembly Object Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes (input instances)	Get_Attribute_Single	Returns the contents of the specified attribute.
0x10	N / A	Yes (output instances)	Set_Attribute_Single	Modifies an attribute value.

11.4.4 Assembly Object Specific Services

The Assembly Object for static assemblies provides no object specific services.

11.5 Connection Class

Class Code: 0x05

The Connection Class allocates and manages the internal resources associated with both I/O and Explicit Messaging Connections.

11.5.1 Connection Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of the DeviceNet Connection Object Class Definition upon which the implementation is based.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1

11.5.2 Connection Class Instance Attributes

The Instance IDs utilized by the G3 DeviceNet interface connection objects are shown in the following table:

Connection Instance ID #	Description
1	References the Explicit Messaging Connection into the G3 server device
2	References the Polled I/O Connection
3	References the Bit-Strobed I/O Connection

Note:
- In the Bit-Strobed I/O connection, the device's strobe bit is not used: consumption of the Bit-Strobe command alone causes the connection to produce.
- Output I/O assembly instances 20/21: In the Polled I/O connection, if the actual consumed data size is less than the connection instance's consumed_connection_size attribute, the consumed data will be ignored, the Control Supervisor Object's Run1 and Run2 attributes will be set to FALSE (stop condition - refer to section 11.7), and the AC/DC Drive Object's SpeedRef attribute will be set to 0 (refer to section 11.8), but the connection will otherwise produce normally. If the actual consumed data size is greater than the connection instance's consumed_connection_size attribute, the data will be ignored, no data will be produced, the Control Supervisor Object's Run1 and Run2 attributes will be set to FALSE, and the AC/DC Drive Object's SpeedRef attribute will be set to 0.
- Output I/O assembly instance 100: In the Polled I/O connection, if the actual consumed data size is less than the connection instance's consumed_connection_size attribute, the consumed data will be ignored, the run/stop command will be set to "stop", and the drive's frequency command will be set to 0Hz, but the connection will otherwise produce normally. If the actual consumed data size is greater than the connection instance's consumed_connection_size attribute, the data will be ignored, no data will be produced, the run/stop command will be set to "stop", and the drive's frequency command will be set to 0Hz.

11.5.2.1 Master/Slave Explicit Messaging Connection Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	state	USINT	State of the object	--
2	Get	instance_type	USINT	Indicates either I/O or Messaging Connection	0
3	Get	transportClass_trigger	USINT	Defines behavior of the connection	0x83
4	Get	produced_connection_id	UINT	Placed in CAN identifier Field when the connection transmits	0x0403 + (MAC ID << 3)
5	Get	consumed_connection_id	UINT	CAN identifier field value that denotes message to be received	0x0404 + (MAC ID << 3)
6	Get	initial_comm _characteristics	USINT	Defines the Message Group(s) across which productions and consumptions associated with this connection occur	0x21
7	Get	produced_connection_size	UINT	Maximum number of bytes transmitted across this connection	20
8	Get	consumed_connection _size	UINT	Maximum number of bytes received across this connection	20
9	Get / Set	expected_packet_rate	UINT	Defines timing associated with this connection	2500
12	Get	watchdog_timeout_action	USINT	Defines how to handle inactivity/watchdog timeouts	1
13	Get	produced_connection_path _length	UINT	Number of bytes in the produced_connection_path attribute	0
14	Get	produced_connection_path	Array of USINT	Specifies the Application Object(s) whose data is to be produced by this connection Object	Empty
15	Get	consumed_connection _path_length	UINT	Number of bytes in the consumed_connection_path attribute	0
16	Get	consumed_connection _path	Array of USINT	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object	Empty
17	Get	production_inhibit_time	UINT	Defines minimum time between new data production	0

11.5.2.2 Poll Connection Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	state	USINT	State of the object	--
2	Get	instance_type	USINT	Indicates either I/O or Messaging Connection	1
3	Get	transportClass_trigger	USINT	Defines behavior of the connection	0x82
4	Get	produced_connection_id	UINT	Placed in CAN identifier Field when the connection transmits	0x03C0 + MAC ID
5	Get	consumed_connection_id	UINT	CAN identifier field value that denotes message to be received	0x0405 + (MAC ID << 3)
6	Get	initial_comm _characteristics	USINT	Defines the Message Group(s) across which productions and consumptions associated with this connection occur	0x01
7	Get	produced_connection_size	UINT	Maximum number of bytes transmitted across this connection	4 or 8
8	Get	consumed_connection _size	UINT	Maximum number of bytes received across this connection	4
9	Get / Set	expected_packet_rate	UINT	Defines timing associated with this connection	0
12	Get / Set	watchdog_timeout_action	USINT	Defines how to handle inactivity/watchdog timeouts	0
13	Get	produced_connection_path _length	UINT	Number of bytes in the produced_connection_path attribute	3
14	Get	produced_connection_path	Array of USINT	Specifies the Application Object(s) whose data is to be produced by this connection Object	0x62, 0x34, 0x36 or 0x62, 0x34, 0x37 or 0x62, 0x39, 0x36
15	Get	consumed_connection _path_length	UINT	Number of bytes in the consumed_connection_path attribute	3
16	Get	consumed_connection _path	Array of USINT	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object	0x62, 0x31, 0x34 or 0x62, 0x31, 0x35 or 0x62, 0x36, 0x34
17	Get	production_inhibit_time	UINT	Defines minimum time between new data production	0

11.5.2.3 Bit-Strobe Connection Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	state	USINT	State of the object	--
2	Get	instance_type	USINT	Indicates either I/O or Messaging Connection	1
3	Get	transportClass_trigger	USINT	Defines behavior of the connection	0x82
4	Get	produced_connection_id	UINT	Placed in CAN identifier Field when the connection transmits	0x0380 + (MAC ID)
5	Get	consumed_connection_id	UINT	CAN identifier field value that denotes message to be received	0x0400 + (Master's MAC ID << 3)
6	Get	initial_comm _characteristics	USINT	Defines the Message Group(s) across which productions and consumptions associated with this connection occur	0x02
7	Get	produced_connection_size	UINT	Maximum number of bytes transmitted across this connection	4
8	Get	consumed_connection _size	UINT	Maximum number of bytes received across this connection	8
9	Get / Set	expected_packet_rate	UINT	Defines timing associated with this connection	0
12	Get / Set	watchdog_timeout_action	USINT	Defines how to handle inactivity/watchdog timeouts	0
13	Get	produced_connection_path _length	UINT	Number of bytes in the produced_connection_path attribute	3
14	Get	produced_connection_path	Array of USINT	Specifies the Application Object(s) whose data is to be produced by this connection Object	0x62, 0x34, 0x36 or 0x62, 0x34, 0x37 or 0x62, 0x39, 0x36
15	Get	consumed_connection _path_length	UINT	Number of bytes in the consumed_connection_path attribute	0
16	Get	consumed_connection _path	Array of USINT	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object	Empty (**Note 1**)
17	Get	production_inhibit_time	UINT	Defines minimum time between new data production	0

Note 1: Although the G3 consumes 8 bytes of Bit-Strobe data, the default consumed_connection_path is empty. Consumption of the Bit-Strobe command is used to trigger the production of data only (selected input assembly instance).

11.5.3 Connection Class Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x05	No	Yes	Reset	Used to reset all resettable Connection Objects
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.
0x10	N / A	Yes	Set_Attribute_Single	Modifies an attribute value.

11.5.4 Connection Class Specific Services

The Connection Class provides no object specific services.

11.6 Motor Data Object

Class Code: 0x28

This object serves as a database for motor parameters.

11.6.1 Motor Data Object Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of this object.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1
2	Get	Max Instance	UINT	Maximum instance number of an object currently created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.	1
6	Get	Max Id number of class attributes	UINT	The attribute ID of the last class attribute of the class definition implemented in the device.	The number of the last class attribute implemented to simplify auto determination of class's implementation by a remote terminal.	7
7	Get	Max ID number of instance attributes	UINT	The attribute ID of the last instance attribute of the class definition implemented in the device.	The number of the last instance attribute implemented to simplify auto determination of class's implementation by a remote terminal.	15

11.6.2 Motor Data Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	NumAttr	USINT	Number of attributes supported	9
2	Get	Attributes	Array of USINT	List of attributes supported	1, 2, 3, 6, 7, 8, 9, 12, 15
3	Set / Get	MotorType	USINT	0 - Non-standard motor 1 - PM DC Motor 2 - FC DC Motor 3 - PM Synchronous Motor 4 - FC Synchronous Motor 5 - Switched Reluctance Motor 6 - Wound Rotor Induction Motor 7 - Squirrel Cage Induction Motor 8 - Stepper Motor 9 - Sinusoidal PM BL Motor 10 - Trapezoidal PM BL Motor	7 (A *Set* service with any data other than 7 will generate an "Invalid Attribute Value" error).
6	Set / Get	RatedCurrent	UINT	Rated Stator Current Units: [100mA] Range: 100mA ~ 6553.5A	Inverter Rated Current (**Note 1**)
7	Set / Get	RatedVoltage	UINT	Rated base voltage Units: [V] Range: 90V ~ 600V (230/460V units) 130V ~ 860V (575V units)	(**Note 2**)
8	Set / Get	RatedPower	UDINT	Rated power at rated frequency Units: [W] Range: 100W ~ 999,900W	(**Note 3**)
9	Set / Get	RatedFreq	UINT	Rated electrical frequency Units: [Hz] Range: 2Hz ~ 400Hz	(**Note 4**)
12	Set / Get	PoleCount	UINT	Number of poles in the motor Range: 2,4,6,8,10,12,14,16	(**Note 5**)
15	Set / Get	BaseSpeed	UINT	Nominal speed at rated frequency from nameplate Units: [RPM] Range: 1RPM ~ 9999RPM	(**Note 6**)

Note 1: Although the default value for attribute #6 is the inverter's rated current, modifying attribute #6 does not modify the inverter's rated current.

Note 2: Attribute #7 directly maps to the G3 parameter `MOTOR RATED VOLTAGE` in `GROUP:MOTOR PARAMETERS`. Modifying this attribute modifies the G3 parameter and vice-versa. This setting has a minimum resolution of 5V: any setting within the adjustment range not in intervals of 5V will be automatically truncated to the nearest 5V interval.

Note 3: Attribute #8 directly maps to the G3 parameter `MOTOR RATED CAPACITY` in `GROUP:MOTOR PARAMETERS`. Modifying this attribute modifies the G3 parameter and vice-versa. This setting has a minimum resolution of 100W: any setting within the adjustment range not in intervals of 100W will be automatically truncated to the nearest 100W interval.

Note 4: Attribute #9 directly maps to the G3 parameter `MOTOR RATED FREQUENCY` in `GROUP:MOTOR PARAMETERS`. Modifying this attribute modifies the G3 parameter, but the G3 parameter is read only after an interface board reset. Therefore, if the G3 parameter is modified via the panel or RS232C, the change will not be reflected in this attribute until the inverter is reset or until the interface board

executes a reset service. Although the G3 parameter setting range is 0 ~ 400Hz, the minimum allowable setting for the DeviceNet interface board is 2Hz. If the G3 parameter is set to 0Hz, therefore, the interface board will interpret this as 2Hz. This setting has a minimum resolution of 2Hz: any setting within the adjustment range not in intervals of 2Hz will be automatically truncated to the nearest 2Hz interval.

Note 5: Attribute #12 directly maps to the G3 parameter NUMBER OF MOTOR POLES in GROUP:MOTOR PARAMETERS. Modifying this attribute modifies the G3 parameter and vice-versa.

Note 6: Attribute #15 directly maps to the G3 parameter MOTOR RATED RPM in GROUP:MOTOR PARAMETERS. Modifying this attribute modifies the G3 parameter, but the G3 parameter is read only after an interface board reset. Therefore, if the G3 parameter is modified via the panel or RS232C, the change will not be reflected in this attribute until the inverter is reset or until the interface board executes a reset service. Although the G3 parameter setting range is 0 ~ 9999RPM, the minimum allowable setting for the DeviceNet interface board is 1RPM. If the G3 parameter is set to 0RPM, therefore, the interface board will interpret this as 1RPM.

11.6.3 Motor Data Object Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.
0x10	N / A	Yes	Set_Attribute_Single	Modifies an attribute value.

11.6.4 Motor Data Object Specific Services

The Motor Data Object provides no object specific services.

11.7 Control Supervisor Object

Class Code: 0x29

This object models all the management functions for devices within the “Hierarchy of Motor Control Devices”.

11.7.1 Control Supervisor Object Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of this object.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1
2	Get	Max Instance	UINT	Maximum instance number of an object currently created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.	1
6	Get	Max Id number of class attributes	UINT	The attribute ID of the last class attribute of the class definition implemented in the device.	The number of the last class attribute implemented to simplify auto determination of class’s implementation by a remote terminal.	7
7	Get	Max ID number of instance attributes	UINT	The attribute ID of the last instance attribute of the class definition implemented in the device.	The number of the last instance attribute implemented to simplify auto determination of class’s implementation by a remote terminal.	18

11.7.2 Control Supervisor Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	NumAttr	USINT	Number of attributes supported	13
2	Get	Attributes	Array of USINT	List of attributes supported	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 17, 18
3	Set / Get	Run1	BOOL	See Run/Stop Event Matrix (Section 11.7.5).	0
4	Set / Get	Run2	BOOL	See Run/Stop Event Matrix (Section 11.7.5).	0
5	Set / Get	NetCtrl	BOOL	0 = local control enabled 1 = network control only	0
6	Get	State	USINT	0 = Vendor Specific (not implemented) 1 = Startup 2 = Not_Ready 3 = Ready 4 = Enabled 5 = Stopping 6 = Fault_Stop 7 = Faulted	Set according to Control Supervisor State Event Matrix.
7	Get	Running1	BOOL	TRUE = (Enabled and Run1) or (Stopping and Running1) or (Fault_Stop and Running1) FALSE = Other state	Set according to attribute values.
8	Get	Running2	BOOL	TRUE = (Enabled and Run2) or (Stopping and Running2) or (Fault_Stop and Running2) FALSE = Other state	
9	Get	Ready	BOOL	TRUE = Ready or Enabled or Stopping FALSE = Other state	
10	Get	Faulted	BOOL	TRUE = Fault FALSE = No faults present	--
12	Set / Get	FaultRst	BOOL	FALSE → TRUE = Fault reset FALSE = No action	Attribute is automatically reset to FALSE after writing. (**Note 1**)
17	Set / Get	ForceFault / Trip	BOOL	FALSE → TRUE = Force	Drive trips "emergency off". Attribute is automatically reset to FALSE after writing.
18	Get	ForceStatus	BOOL	FALSE = Not forced TRUE = Forced	Once TRUE, remains TRUE until device reinitialization or until attribute #12 (FaultRst) is set.

Note 1: The interface card will also be reset when the drive resets. Dependent on system timing, therefore, a response to setting this attribute may or may not be produced.

11.7.3 Control Supervisor Object Common Services

Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.
0x10	N / A	Yes	Set_Attribute_Single	Modifies an attribute value.
0x05	N / A	Yes	Reset	Resets the drive to the "Startup" state (**Note 2**).

Note 2: The Control Supervisor Object's Reset service resets only the Control Supervisor Object state machine (attribute #6). It does not reset the drive or the interface card. To reset the drive and interface card, access the FaultRst attribute (attribute #12) via either the polled-I/O connection or explicit messaging connection. To reset the interface card only, issue a Reset service to the Identity Object.

11.7.4 Control Supervisor Object Specific Services

The Control Supervisor object provides no object specific services.

11.7.5 Run/Stop Event Matrix

When the G3 is properly configured and an AC/DC drive profile-compliant I/O assembly instance set is chosen, the events Run and Stop are triggered by a combination of the Run1 and Run2 attributes (attributes #3 and #4, respectively) as shown in the following table:

Run1	Run2	Trigger Event	Run Type
0	0	Stop	N / A
0 → 1	0	Run	RunFwd
0	0 → 1	Run	RunRev
0 → 1	0 → 1	No Action	N / A
1	1	No Action	N / A
1 → 0	1	Run	RunRev
1	1→ 0	Run	RunFwd

11.8 AC / DC Drive Object

Class Code: 0x2A

This object models the functions specific to an AC Drive.

11.8.1 AC/DC Drive Object Class Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values	G3 Default Value
1	Get	Revision	UINT	Revision of this object.	If updates that require an increase in this value are made, then the value of this attribute increases by 1.	1
2	Get	Max Instance	UINT	Maximum instance number of an object currently created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.	1
6	Get	Max Id number of class attributes	UINT	The attribute ID of the last class attribute of the class definition implemented in the device.	The number of the last class attribute implemented to simplify auto determination of class's implementation by a remote terminal.	7
7	Get	Max ID number of instance attributes	UINT	The attribute ID of the last instance attribute of the class definition implemented in the device.	The number of the last instance attribute implemented to simplify auto determination of class's implementation by a remote terminal.	27

11.8.2 AC/DC Drive Object Instance Attributes

Attribute ID	Access Rules	Name	DeviceNet Data Type	Description of Attribute	G3 Default Value
1	Get	NumAttr	USINT	Number of attributes supported	12
2	Get	Attributes	Array of USINT	List of attributes supported	1, 2, 3, 4, 6, 7, 8, 9, 17, 22, 23, 27
3	Get	AtReference	BOOL	FALSE = Drive actual not at speed reference. TRUE = Drive actual at speed reference.	Refer to Section 11.8.5
4	Set / Get	NetRef	BOOL	Requests speed reference to be local or from the network: FALSE = Set Reference not DeviceNet Control. TRUE = Set Reference at DeviceNet Control.	(**Note 1**)
6	Set / Get	DriveMode	USINT	0 = Vendor specific mode 1 = Open loop speed control 2 = Closed loop speed control 3 = Torque control 4 = Process (PID) control 5 = Position control	1 (A *Set* service with data other than 1 will generate an "Invalid Attribute Value" error).
7	Get	SpeedActual	INT	Actual drive speed (best approximation) Units: RPM / $2^{SpeedScale}$, where SpeedScale is attribute 22.	(**Note 2**)
8	Set / Get	SpeedRef	INT	Speed reference Units: RPM / $2^{SpeedScale}$, where SpeedScale is attribute 22.	(**Note 3**)
9	Get	CurrentActual	INT	Actual motor phase current Units: 100mA / $2^{CurrentScale}$, where CurrentScale is attribute 23.	(**Note 4**)
17	Get	OutputVoltage	INT	Output Voltage Units: Volts / $2^{VoltageScale}$, where VoltageScale is attribute 27.	(**Note 5**)
22	Set / Get	SpeedScale	SINT	Speed scaling factor. Range: -128 .. 127	0
23	Set / Get	CurrentScale	SINT	Current scaling factor. Range: -128 .. 127	0
27	Set / Get	VoltageScale	SINT	Voltage scaling factor. Range: -128 .. 127	0

Note 1: When I/O assembly instance sets 20/70 or 100/150 are selected, attribute #4 directly maps to the G3 parameter `FREQUENCY MODE SELECTION` in `GROUP:UTILITY PARAMETERS`. Performing a Get service will return TRUE if `FREQUENCY MODE SELECTION` = `3`, and FALSE otherwise. Performing a Set service with data of TRUE will set `FREQUENCY MODE SELECTION` = `3`, and with data of FALSE will set `FREQUENCY MODE SELECTION` = `4`. If this attribute is changed while the inverter is running, the inverter action will not become valid until the inverter is stopped.

When I/O assembly instance set 21/71 is selected, attribute #4 is contained within the scanned assembly data. The behavior of this attribute, therefore, becomes slightly different. Specifically, attributes NetRef and NetCtrl will have the following effect on drive parameters `COMMAND MODE SELECTION` and `FREQUENCY MODE SELECTION`:

NetRef	NetCtrl	Local change of FREQUENCY MODE SELECTION Possible?	Local change of COMMAND MODE SELECTION Possible?
0	0	Yes	Yes
0	1	Yes	No: fixed at 3
1	0	No: fixed at 3	Yes
1	1	No: fixed at 3	No: fixed at 3

Note also that NetCtrl = 0 (for example) does not necessarily mean that control is not originating from the DeviceNet interface; it simply means that local selection is possible. If COMMAND MODE SELECTION is set to 3 locally, the DeviceNet interface will still be the source of commands even if NetCtrl is set to 0. This same argument also holds true for NetRef.

Note 2: The SpeedActual attribute value is calculated using the following formula:

$$\text{SpeedActual} = \text{Int}\left[\frac{\text{Output Frequency (Hz)} \times \text{BaseSpeed} \times 2^{\text{SpeedScale}}}{\text{RatedFreq}}\right],$$

where Output Frequency is the inverter's current output frequency, SpeedScale is attribute #22, BaseSpeed is attribute #15 of the Motor Data Object, and RatedFreq is attribute #9 of the Motor Data Object. Only the rounded integer value of the final result will be transmitted across the network. If the SpeedScale attribute is 0, the units of SpeedActual are RPM. If the SpeedScale attribute is nonzero, the units of SpeedActual are undefined (user-defined).

Note 3: The SpeedRef attribute value is used in the following calculation for the inverter's frequency command:

$$\text{Frequency Command (Hz)} = \frac{\text{SpeedRef} \times \text{RatedFreq}}{2^{\text{SpeedScale}} \times \text{BaseSpeed}},$$

where SpeedRef is attribute #8, SpeedScale is attribute #22, RatedFreq is attribute #9 of the Motor Data Object, and BaseSpeed is attribute #15 of the Motor Data Object. If the SpeedScale attribute is 0, the SpeedRef attribute input units are RPM. If the SpeedScale attribute is nonzero, the SpeedRef attribute input units are undefined (user-defined). The allowable adjustment range for the SpeedRef attribute is 0 ~ 32767.

Note 4: The CurrentActual attribute value is calculated from the inverter's output current using the following equation:

$$\text{CurrentActual} = \text{Output Current} \times 2^{\text{CurrentScale}},$$

where CurrentScale is attribute #23. If the CurrentScale attribute is 0, the units of CurrentActual are 100mA. If the CurrentScale attribute is nonzero, the units of CurrentActual are undefined (user-defined). The CurrentActual attribute value is always positive.

Note 5: The OutputVoltage attribute value is calculated from the inverter's output voltage using the following equation:

$$\text{OutputVoltage} = \text{Output Voltage} \times 2^{\text{VoltageScale}},$$

where VoltageScale is attribute #27. If the VoltageScale attribute is 0, the units of OutputVoltage are Volts. If the VoltageScale attribute is nonzero, the units of OutputVoltage are undefined (user-defined). The OutputVoltage attribute value is always positive.

11.8.3 AC/DC Drive Object Common Services

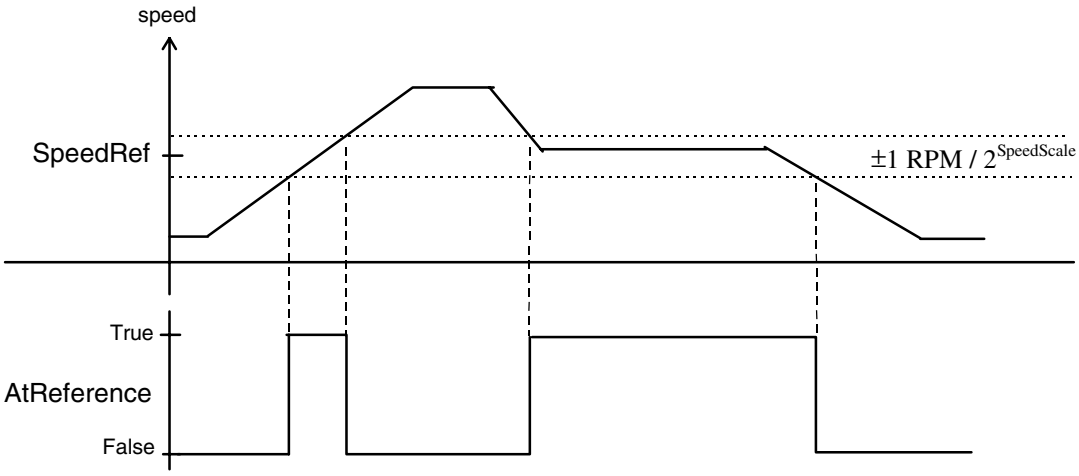
Service Code	Supported		Service Name	Description of Service
	Class	Instance		
0x0E	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute.
0x10	N / A	Yes	Set_Attribute_Single	Modifies an attribute value.

11.8.4 AC/DC Drive Object Specific Services

The AC/DC Drive object provides no object specific services.

11.8.5 AtReference Attribute Behavior

The AtReference attribute (attribute #3) is “TRUE” when SpeedActual (attribute #7) is within ±1 RPM / $2^{SpeedScale}$ of the prescribed speed reference (attribute #8).



11.9 Parameter Objects

Class Code: 0x0F

The G3 inverter implements 12 parameter objects, as indicated in the table below, and makes them available to the network via the explicit messaging connection. These object instances are implemented as parameter stubs (only attributes 1 through 6 of each parameter instance is implemented). Although these parameter objects may share many common characteristics with specific attributes of various object class instances, they are Toshiba-specific, and as such their data limits and engineering units interpretation is dictated only by the values assigned to them in the G3 ASD's control software. For more information, refer to the G3 Operating Manual.

Parameter Name	Get / Set	Parameter Object Instance Number	Notes
Acceleration time #1	Get / Set	1	ACCELERATION TIME #1 in GROUP:FUNDAMENTAL PARAMETERS #1. Refer to Note 1 below. (UINT)
Deceleration time #1	Get / Set	2	DECELERATION TIME #1 in GROUP:FUNDAMENTAL PARAMETERS #1. Refer to Note 1 below. (UINT)
V/F Pattern	Get / Set	3	VOLTS PER HERTZ PATTERN in GROUP:FUNDAMENTAL PARAMETERS #1. Adjustment range is 1 ~ 6. (USINT)
Feedback selection	Get / Set	4	FEEDBACK CONTROL SELECTION in GROUP:FEEDBACK CONTROL PARAMETERS. Adjustment range is 0 ~ 2. (USINT)
Command mode selection	Get / Set	5	COMMAND MODE SELECTION in GROUP:UTILITY PARAMETERS. Adjustment range is 0 ~ 4. (USINT)
Frequency mode selection	Get / Set	6	FREQUENCY MODE SELECTION in GROUP:UTILITY PARAMETERS. Adjustment range is 0 ~ 4. (USINT)
Post-compensation output frequency	Get only	7	0 ~ 40000 = 0.00Hz to 400.00Hz. (UINT)
Input Power (kW)	Get only	8	Refer to Note 2 below. (UINT)
Output Power (kW)	Get only	9	Refer to Notes 2 and 3 below. (UINT)
Present fault code	Get only	10	Refer to Table 1 on page 55 for fault code meanings. (USINT)
RX input terminal value	Get only	11	0000H ~ 7FFFH = -100% ~ 0% 7FFFH ~ FFFFH = 0% ~ 100% (UINT)
Output terminal status	Get only	12	Refer to Table 2 on page 56. (byte)

Note 1: The adjustment range for these parameter objects is 1 ~ 60000, but the multiplier depends on the setting of ACC/DEC TIME UNITS SELECTION in GROUP:UTILITY PARAMETERS as follows:

When ACC/DEC TIME UNITS SELECTION is set for 0.1 sec. units, the multiplier is 0.1. The data adjustment range therefore corresponds to an actual time range of 0.1s ~ 6000.0s.
When ACC/DEC TIME UNITS SELECTION is set for 0.01 sec. units, the multiplier is 0.01. The data adjustment range therefore corresponds to an actual time range of 0.01s ~ 600.00s.

In addition, if the setting of ACC/DEC TIME UNITS SELECTION is changed after setting the ACC/DEC times, the ACC/DEC times will become 10 times or 0.1 times their former value. Therefore, always reset the ACC/DEC time settings after changing the setting of ACC/DEC TIME UNITS SELECTION.

Note 2: For G3-410K and larger units, the multiplier is 0.1 (the monitored data is in 0.1kW units). For all other units, the multiplier is 0.01 (the monitored data is in 0.01kW units).

Note 3: Uses signed data (data values larger than 7FFFH are negative). If the parameter's data is 8000H or larger, the actual value can be obtained by: **actual value = - [FFFFH - (parameter data) + 1]**.

Table 1 : List of Fault Codes

LCD Display Message	Data (Hex)	Explanation
NO ERROR	××00	No error has been recorded since the last inverter reset or trip clear
OVERCURRENT (ACCEL) (PRESS CLEAR)	××01	Overcurrent during acceleration
OVERCURRENT (DECEL) (PRESS CLEAR)	××02	Overcurrent during deceleration
OVERCURRENT (RUN) (PRESS CLEAR)	××03	Overcurrent during constant-speed run
LOAD-END OVERCURRENT (PRESS CLEAR)	××04	Load-end overcurrent detected at start-up (output terminals, motor wiring etc.)
U-PHASE SHORT CKT (PRESS CLEAR)	××05	U-phase armature short circuit
V-PHASE SHORT CKT (PRESS CLEAR)	××06	V-phase armature short circuit
W-PHASE SHORT CKT (PRESS CLEAR)	××07	W-phase armature short circuit
LOST INPUT PHASE (PRESS CLEAR)	××08	Lost input phase (option)
LOST OUTPUT PHASE (PRESS CLEAR)	××09	Lost output phase (option)
OVERVOLTAGE (ACCEL) (PRESS CLEAR)	××0A	Overvoltage during acceleration
OVERVOLTAGE (DECEL) (PRESS CLEAR)	××0B	Overvoltage during deceleration
OVERVOLTAGE (RUN) (PRESS CLEAR)	××0C	Overvoltage during constant-speed run
INVERTER OVERLOAD (PRESS CLEAR)	××0D	Inverter overload
MOTOR OVERLOAD (PRESS CLEAR)	××0E	Motor overload
DBR OVERLOAD TRIP (PRESS CLEAR)	××0F	Dynamic braking resistor overload
OVERHEAT TRIP (PRESS CLEAR)	××10	Inverter overheat
EMERGENCY OFF (PRESS CLEAR)	××11	Emergency off
EEPROM WRITE FAILURE (PRESS CLEAR)	××12	EEPROM failure during write
EEPROM READ FAILURE (PRESS CLEAR)	××13	EEPROM failure during initial read
—	××14	Unused
RAM ERROR (PRESS CLEAR)	××15	RAM error
ROM ERROR (PRESS CLEAR)	××16	ROM error
CPU ERROR (PRESS CLEAR)	××17	CPU error
COMMUNICATION ERROR (PRESS CLEAR)	××18	RS232C timer time-out
GATE ARRAY FAULT (PRESS CLEAR)	××19	Gate array error
CURRENT DETECT ERROR (PRESS CLEAR)	××1A	Output current detection circuit error

LCD Display Message	Data (Hex)	Explanation
OPTION PCB ERROR (PRESS CLEAR)	××1B	Option PCB error
OPTION ROM ERROR	××1C	Option ROM error
LOW CURRENT TRIP (PRESS CLEAR)	××1D	Low current
UNDERVOLTAGE TRIP (PRESS CLEAR)	××1E	Main circuit undervoltage
—	××1F	Unused
OVERTORQUE TRIP (PRESS CLEAR)	××20	Overtorque
EARTH FAULT (SOFT) (PRESS CLEAR)	××21	Earth fault (software)
EARTH FAULT (HARD) (PRESS CLEAR)	××22	Earth fault (hardware)
OPEN FUSE TRIP (PRESS CLEAR)	××23	Open fuse
DBR OVERCURRENT TRIP (PRESS CLEAR)	××24	Dynamic braking resistor overcurrent
DC OVERCURRENT (ACC) (PRESS CLEAR)	××25	Overcurrent in DC section during acceleration
DC OVERCURRENT (DEC) (PRESS CLEAR)	××26	Overcurrent in DC section during deceleration
DC OVERCURRENT (RUN) (PRESS CLEAR)	××27	Overcurrent in DC section during constant-speed run
AUTO-TUNING ERROR (PRESS CLEAR)	××28	Auto-tuning error
INV TYPEFORM ERROR (PRESS READ/WRITE)	××29	Inverter typeform error

Table 2: Output Terminal Status Monitor

Bit	Output Terminal	0	1
bit 0 (LSB)	unused (always 0)	—	—
bit 1	unused (always 0)	—	—
bit 2	FAN	OFF	ON
bit 3	FL	FLB-FLC shorted	FLA-FLC shorted
bit 4	MS relay	OFF	ON
bit 5	OUT (option)	OUTB-OUTC shorted	OUTA-OUTC shorted
bit 6	RCH	RCHA-RCHC open	RCHA-RCHC shorted
bit 7 (MSB)	LOW	LOWA-LOWC open	LOWA-LOWC shorted

12. Notes

TOSHIBA

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