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**HIGH PERFORMANCE ADJUSTABLE SPEED DRIVE  
TRUE TORQUE CONTROL DRIVE SERIES**

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**TOSHIBA**



**TOSVERT-130  
TRANSISTOR INVERTER**



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**METASYS N2 COMMUNICATIONS INTERFACE MANUAL**

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March, 1999  
ICC #10209-001

## Introduction

Thank you for purchasing the “Metasys N2 Communications Interface” for the Toshiba G3 Adjustable Speed Drive. This communications interface allows the G3 drive to connect directly to the Johnson Controls Metasys N2 communications network. Before using the Metasys N2 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 drive unit into which the communications interface is installed, and keep this instruction manual in a safe place for future reference or drive inspection.

This instruction manual describes the device specifications, installation and wiring methods, maintenance procedures, I/O point map and functions for the G3 Metasys N2 communications interface.

Please note that use of this communication interface in the G3 drive requires the additional installation of a plug-in communications option ROM. Refer to the installation section of this manual for instructions on how to install this option ROM.

## Usage Precautions

### Operating Environment

- Please use the communications interface only when the ambient temperature of the drive unit into which the interface is installed is within the following specified temperature limits:

Operation: -10 ~ +40°C (+14 ~ +104°F)

Storage: -25 ~ +65°C (-13 ~ +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 drive's CHARGE lamp is lit. A charge will still be present in the drive unit's internal electrolytic capacitors, and therefore touching these areas may result in an electrical shock. Always turn all drive input power supplies OFF, and wait at least 5 minutes after the CHARGE lamp has gone out before wiring the communication cables or motor wiring.
- When installing the communications interface into the drive and making wiring connections, make certain that no clippings or wiring leads that could cause device failure fall into the drive or onto electronic components.
- Proper ground connections are vital for both safety and signal reliability reasons. For proper grounding procedures, please refer to the section in this manual pertaining to grounding (section 2).
- Route the communication cables separate from the drive input/output power wiring.
- To avoid the possibility of electric shock due to leakage currents, always ground the drive unit's E/GND terminal and the motor. To avoid misoperation, do not connect the communication interface's SHIELD terminal to either of the above-mentioned grounds or any other power ground.

### Other Precautions

- The drive's EEPROM has a life span of 10,000 write cycles. Do not write to BO #9, BO #10, or AO #2 ~ AO #13 more than 10,000 times.
- Do not touch or insert a rod or any other item into the drive while power is applied, as this may lead to electrical shock or drive damage.
- Commission the disposal of the communications interface to a specialist.
- Do not assign the same address to more than one drive in the same network.
- Individual device addresses can be set from 1 ~ 255. Address 0 is invalid and will cause the drive to trip "OPTION PCB ERROR".
- When the drive's control power supply is turned on, the drive performs initialization functions for approximately 3 seconds, during which communications capabilities are disabled. Communications capabilities will also be disabled for approximately 3 seconds after momentary control power supply outages or drive resets.

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## 1. Interface Board Installation / Removal

The Metasys Communications Option ROM enclosed with the Metasys kit is compatible only with G3 drives with V120 or later main software. An error will occur if the option ROM is installed in a drive 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 drive memory by displaying the parameter CPU VERSION in GROUP:UTILITY PARAMETERS. If you are unsure of the software version of your drive, please contact Toshiba International Corporation for more information.

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



**IMPORTANT NOTE:** The option ROM included with the Metasys interface kit is for installation into G3 230V/460V 300HP and under units only. Do not install the option ROM into any other 3-series drive. All drive units other than the G3 230V/460V series are shipped from the factory with full communications capability, and installation of the option ROM may cause incorrect operation or drive damage.

This portion of the manual will detail the procedure used to install / remove the interface board and option ROM. If at any time you experience problems during the installation / removal process, please call Toshiba International Corporation for assistance.

### 1.1 Before Installation

All parameters will be automatically reset to the factory default values after the option ROM is installed in the drive. 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 Metasys option ROM and interface board into a TOSVERT-130 G3 drive 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 = .

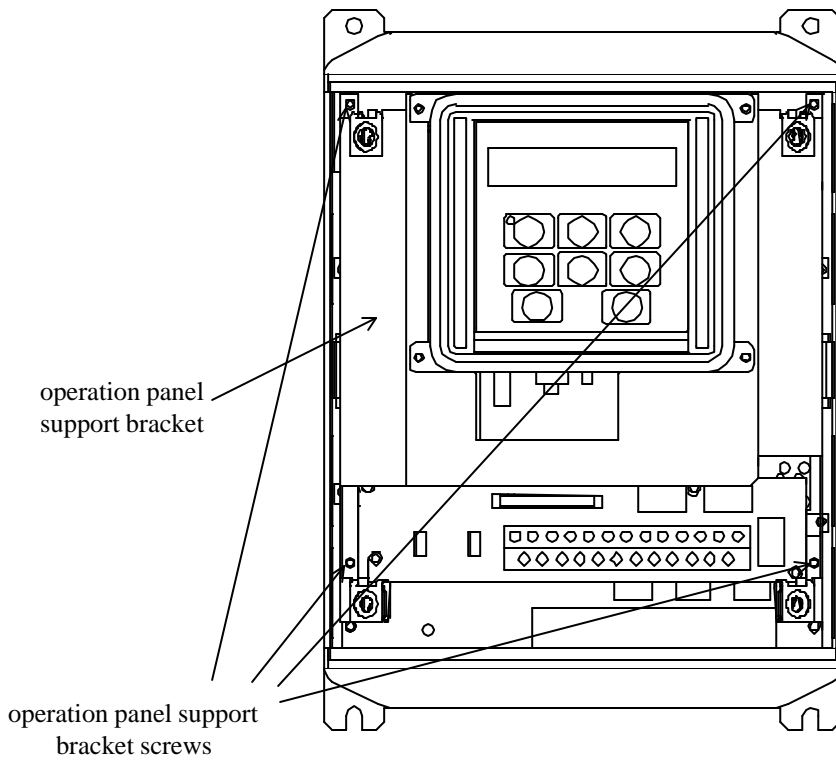
2.  **CAUTION!** Verify that all input power sources to the drive have been turned OFF and are locked and tagged out.

3.  **DANGER!**  Wait at least 5 minutes for the drive's electrolytic capacitors to discharge before proceeding to step 4. **Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.**

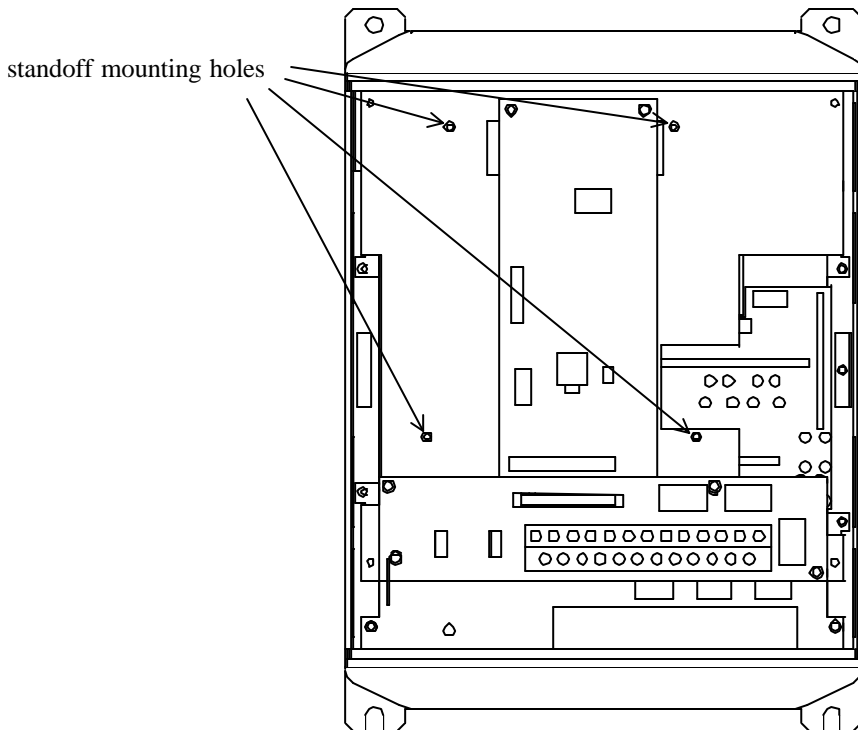
4.  Remove the drive's cover (open the door on units with hinged doors). Verify that the CHARGE LED has gone out before continuing the installation process.
5. Loosen the 4 screws attaching the G3's operation panel support bracket to the control board support bracket, and then remove the operation panel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

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 nylon standoffs into the holes provided in the control board support bracket (refer to Figure 2).
6. Install the N2 network cable through the access holes at the bottom of the drive and route the cable in order to make connections to the interface board connector (TB1). Take care to not route the cable near any sharp edges or in positions where it may be pinched.





**Figure 1:** *G3 with front cover removed*



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



7.  **CAUTION!** The Metasys N2 interface board is a static-sensitive device. Standard electrostatic-sensitive component handling precautions should be observed. Connect the N2 bus cable to the interface board connector (TB1). For more information on making connections to the N2 bus, refer to section 6.1 on page 15.


-  **CAUTION!** Extremely high voltages exist in the area near the interface board and connector (TB1) once installed in the G3. Ensure that no stray wires (such as the shield on the N2 bus cable) come into contact with any internal drive components. Also ensure that the N2 bus cable is not routed in such a manner that it may come into contact with high-voltage drive components, or drive components that may heat up during operation and damage the cable insulation.
8. Install the interface board into the drive by carefully aligning the 4 nylon standoffs 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.
9. Press the interface board firmly onto the standoffs and connector CN5 until the standoff retaining tabs lock. Ensure that CN5 and CN5A are thoroughly interlocked.
10. 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. Once installed, take a moment to verify that all interface board and network components have sufficient clearance from other drive components.
11. Reinstall the drive'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.**

12. Turn all power sources to the drive unit ON, and verify that the drive functions properly. If the drive 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 drive.** Then, verify all connections. Contact Toshiba International Corporation for assistance if the problem persists.
13. 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 drive**, 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.

## 1.3 Removal





Removal of the Metasys interface board from a TOSVERT-130 G3 drive should only be performed by a qualified technician familiar with the maintenance and operation of the G3. In order to protect the interface board connector's reliability, do not repeatedly connect and disconnect the interface. Use the following procedure if it becomes necessary to remove the Metasys interface board from the drive.

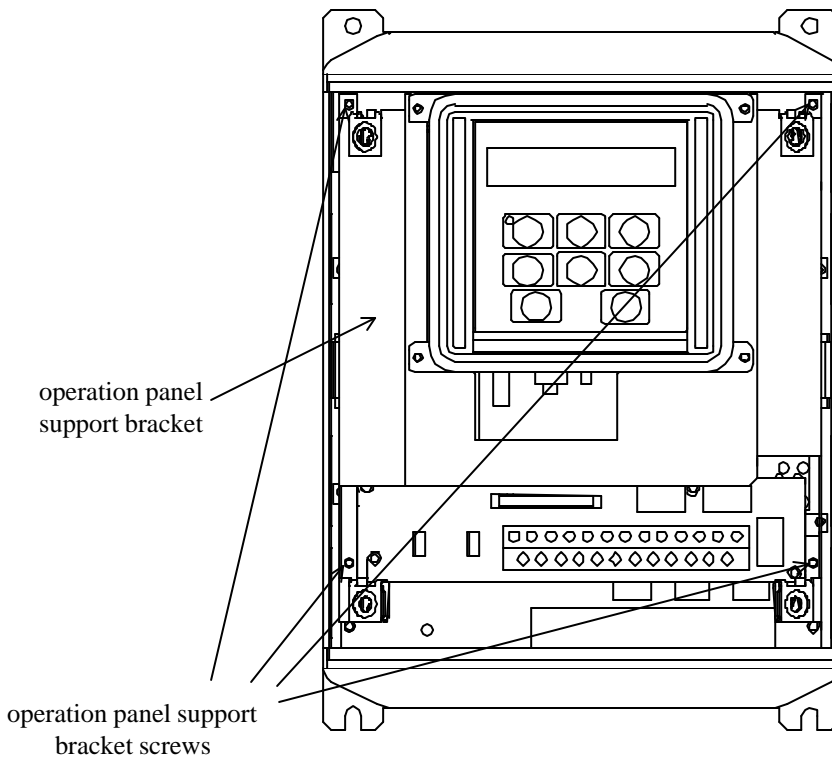
 **CAUTION!** Do not remove the interface board while power is applied to the drive. Removing the interface board with power applied may damage the drive.

### 1.3.1 Before Removal


The drive will display an error message if the option ROM becomes dislodged or is removed from its socket. The drive 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 drive. 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 drive after the option ROM has been removed.

### 1.3.2 Removal Procedure

1.  **CAUTION!** Verify that all input power sources to the drive have been turned OFF and are locked and tagged out.
2.  **DANGER!**  Wait at least 5 minutes for the drive's electrolytic capacitors to discharge before proceeding to step 3. **Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.**
3.  Remove the drive'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 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).



**Figure 3:** *G3 with front cover removed*

5.  **CAUTION!** The option ROM PCB and Metasys 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.
6. Remove the interface board from the drive.
7. Disconnect the N2 bus cable from the interface board connector (TB1), and pull the cable out through the access holes at the bottom of the drive.
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.



**IMPORTANT NOTE:** Do not remove the option ROM on drive units that were received from the factory with option ROMs pre-installed. Units that are shipped from the factory with option ROMs pre-installed (H3 and 600V G3 units, for example) require these ROMs for correct operation, and removal of the option ROM may cause incorrect operation or drive damage. If you are in doubt about the requirement of an option ROM in your drive unit, contact Toshiba International Corporation for assistance.

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 drive's cover (close and latch the door on units with hinged doors).



**DANGER!**



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

11. Turn all power sources to the drive unit ON, and verify that the drive functions properly. If the drive 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 drive.** Then, verify all connections. Contact Toshiba International Corporation for assistance if the problem persists.
12. To re-initialize the drive 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.

## 2. Grounding

Grounding is of particular importance for reliable, stable operation. Communication system characteristics may vary from system to system, depending on the system environment and grounding method used. A ground connection with an impedance of less than 100Ω should be used. Please be sure to consider the following points for making proper ground connections:

### Grounding method checkpoints

1. Make all ground connections such that no ground current flows through the drive case.
2. Ensure that all grounds are connected to points that are at the same potential as drive grounds.
3. Do not connect the Metasys N2 interface board's SHIELD terminal to a power ground or any other potential noise-producing ground connection (such as the drive's E/GND terminal).
4. Do not make connections to unstable grounds (paint-coated screw heads, grounds that are subjected to inductive noise, etc.)
5. Use copper wire with a cross-sectional area of 2mm<sup>2</sup> or larger, or aluminum wire with a cross-sectional area of 2.6mm<sup>2</sup> or larger for grounding.

## 3. Environmental Specifications

Item	Specification
Operating Environment	Indoors, less than 1000m above sea level, do not expose to direct sunlight or corrosive / 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	5.9m/s <sup>2</sup> {0.6G} or less (10 ~ 55Hz)
Grounding	Use a ground connection with an impedance of less than 100Ω.
Cooling Method	Self-cooled

## 4. Maintenance And Inspection

Preventive maintenance and inspection is required to maintain the Metasys N2 communications interface 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 drive unit, and wait at least five minutes after the drive's "CHARGE" lamp has gone out.



**DANGER!**



**Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive 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 that the crimp points are not scarred by overheating.
- Visually check the wiring and cables for damage.
- Clean off any accumulated dust and dirt. Place special emphasis on cleaning all installed PCBs and the ventilation ports of the drive. Always keep these areas clean, as adherence of dust and dirt can cause premature component failure.
- If use of the drive 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 drive or Metasys N2 interface board, as they may damage the unit's internal components.
- Ensure that the Metasys board has not become loose from the G3's control board by checking that CN5A on the Metasys board is still fully seated in CN5 on the G3's control board.

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 Metasys N2 interface 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 interface board for an extended period of time, apply power at least once every two years and confirm that it still functions properly.

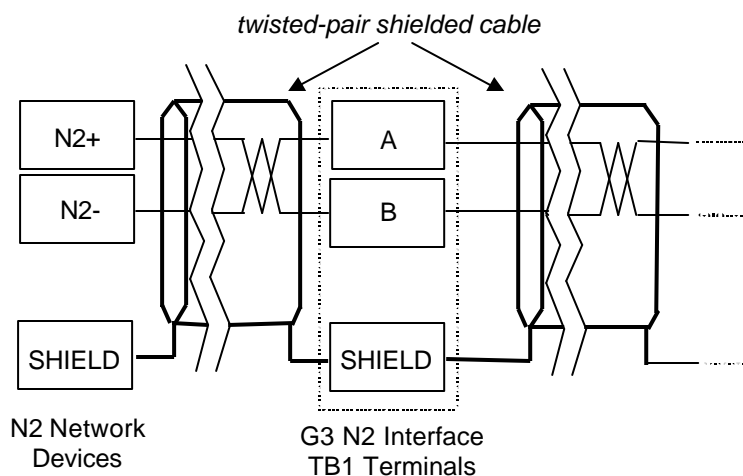
### 5.2 Warranty

The G3 Metasys N2 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.

## 6. N2 Interface Configuration

### 6.1 N2 Network Connections

Each G3 Metasys N2 interface board can be directly connected to the N2 bus by using twisted-pair cable connected as shown in Figure 4. Connect the N2+ wire to terminal “A”, the N2- wire to terminal “B”, and the cable shield to terminal “SHIELD” on the interface board’s TB1 terminal block. Continue this connection scheme throughout the remainder of the network. Always connect each unit in a daisy-chain fashion, without drop lines, star configurations, etc. For further N2 network wiring requirements and procedures, please refer to the appropriate Johnson Controls network installation documentation.



**Figure 4.** N2 Bus Cable Connection

### 6.2 Hardware Configuration

Other than installing the interface board and connecting the N2 network cable, the only other hardware configuration required is whether or not to terminate the N2 network at each individual interface board. A jumper on the interface board (labeled “JP1”) determines whether or not the N2 network is terminated at the interface board (termination is a 121Ω resistor). Only the 2 devices at the extreme ends of the Metasys N2 network should have JP1 set to “TERM”. All other devices should have JP1 set to “OPEN”.

The 8-position DIP switch (labeled SW1) located on the right-hand side of the interface board is not used, and its switch settings are therefore irrelevant.



## 7. G3 Parameter Settings

Metasys N2 interface communications are enabled by setting parameter `COMMUNICATION SELECTION` in `GROUP:COMMUNICATION SETTING PARAMETERS` to 2 (Metasys / Modbus / Profibus). None of the Tosline-F10 communication parameter settings apply when using the Metasys N2 interface. When using any communication interface on the G3 drive, the frequency command and command input received from the network can be enabled by setting parameters `FREQUENCY MODE SELECTION` and `COMMAND MODE SELECTION`, respectively, in `GROUP:UTILITY PARAMETERS` to 3. For more information on methods for changing parameter settings, refer to the TOSHIBA [G3 Operation Manual](#).

The following is a list of the parameter settings that are required during setup to enable Metasys N2 communications:

Parameter	Group	Required Value
<code>BLIND FUNCTION SELECTION</code>	<code>GROUP:UTILITY PARAMETERS</code>	1
<code>COMMUNICATIONS PARMS BLIND</code>	<code>GROUP:UTILITY PARAMETERS</code>	1
<code>COMMUNICATION SELECTION</code>	<code>GROUP:COMMUNICATION SETTING PARAMETERS</code>	2
<code>INVERTER ID NUMBER</code>	<code>GROUP:COMMUNICATION SETTING PARAMETERS</code>	any value other than 0

As is the same with all other communication configuration parameters, the drive must be reset after making the parameter changes described above in order for the changed settings to be enabled.

**IMPORTANT:** *The standard factory setting for parameter `INVERTER ID NUMBER` is 0, which is reserved for Johnson Controls' use. If this parameter is not changed prior to enabling Metasys communications, the drive will trip "OPTION PCB ERROR".*

If the G3 drive into which a Metasys N2 communication option board is installed trips "OPTION PCB ERROR" for any reason during initialization or operation, it is incapable of being reset via the Metasys network. When this trip condition occurs, therefore, the drive can only be reset locally via the panel or control terminal block.

If drive control (frequency command input, RUN/STOP, etc.) is to be performed via setting Analog Output and Binary Output points from the N2 network, the following drive parameters must also be set as shown:

Parameter	Group	Value
<code>COMMAND MODE SELECTION</code>	<code>GROUP:UTILITY PARAMETERS</code>	3
<code>FREQUENCY MODE SELECTION</code>	<code>GROUP:UTILITY PARAMETERS</code>	3

Of course, input data can always be monitored from the network regardless of the settings of `COMMAND MODE SELECTION` and `FREQUENCY MODE SELECTION`. Also note that if the `COMMAND MODE SELECTION` or `FREQUENCY MODE SELECTION` parameters are changed while the drive is running, the change will not take effect until the next time the drive is stopped.

## 8. Network Programming Interface

### 8.1 Object Summaries

The G3 Metasys N2 bus interface has a predefined set of analog and binary I/O points used for controlling the drive and for monitoring status items. These points can be summarized as follows:

- Analog input (AI) points are used for monitoring drive status items such as output frequency, current and voltage. The G3 supports 14 different analog input points. All analog input points support low alarm limits, low warning limits, high warning limits, high alarm limits and differential values. Change of state (COS), alarm and warning functions can also be enabled. Analog input points will accept override commands, but will not change their actual values or indicate override active.
- Analog output (AO) points are used for setting and monitoring control points such as the drive's frequency command and configuration parameters. The G3 supports 13 different analog output points. The values of all analog output points can be modified by issuing override commands. Issuing release commands will not cause the analog output points to automatically return to their pre-override values, nor will the analog output points automatically return to their pre-override values after a certain time period of no communication. COS is not supported for AO points.
- Binary input (BI) points are used for monitoring drive status items such as terminal ON/OFF conditions and fault status. The G3 supports 19 different binary input points. All binary input points support COS, alarm enabling and normal/alarm status indications. Binary input points will accept override commands, but will not change their actual values or indicate override active.
- Binary output (BO) points are used for executing drive commands such as RUN/STOP and trip clear. The G3 supports 10 different binary output points. The values of all binary output points can be modified by issuing override commands. Issuing release commands will not cause the binary output points to automatically return to their pre-override values, nor will the binary output points automatically return to their pre-override values after a certain time period of no communication. COS is not supported for BO points.

The device type for the G3 N2 interface is VND. To simplify the definition of points for a Johnson Controls network control unit (NCU), a Data Definition Language (DDL) file is included in section 10 of this manual.

## 8.2 I/O Point Map

NPT <sup>1</sup>	NPA <sup>2</sup>	Units	Point Description	Range / Value
AI	1	Hz	Output frequency	0.00 ~ 400.00
AI	2	%	Output current	0 ~ 255
AI	3	%	Output voltage	0.0 ~ 232.0
AI	4	%	Input voltage	0.0 ~ 255.0
AI	5	%	IV terminal analog input value	0.00 ~ 100.00
AI	6	%	RR terminal analog input value	0.00 ~ 100.00
AI	7	%	RX terminal analog input value	-100.00 ~ 100.00
AI	8	kW	Input power	0.0 ~ 6553.4
AI	9	kW	Output power	-3276.8 ~ 3276.7
AI	10	--	Reserved	--
AI	11	--	Reserved	--
AI	12	--	Present fault	0 ~ 41
AI	13	--	Past fault #1 (newest)	0 ~ 41
AI	14	--	Past fault #2	0 ~ 41
AI	15	--	Past fault #3	0 ~ 41
AI	16	--	Past fault #4 (oldest)	0 ~ 41
BI	1	--	Run / stop status	0=stopped 1=running
BI	2	--	Forward / reverse status	0=reverse 1=forward
BI	3	--	Acceleration/deceleration #1 / #2 selection status	0=accel/decel #1 1=accel/decel #2
BI	4	--	Compulsory DC injection braking mode status	0=inactive 1=active
BI	5	--	Coast stop command status	0=normal 1=coast to stop
BI	6	--	Emergency off status	0=normal 1=emergency off
BI	7	--	Fault status	0=G3 not faulted 1=G3 faulted
BI	8	--	Feedback control enable status	0=feedback invalid 1=feedback valid
BI	9	--	"F" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	10	--	"R" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	11	--	"S1" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	12	--	"S2" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	13	--	"S3" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	14	--	"S4" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	15	--	"RES" input terminal status	0=terminal-CC open 1=terminal-CC shorted

NPT <sup>1</sup>	NPA <sup>2</sup>	Units	Point Description	Range / Value
BI	16	--	"ST" input terminal status	0=terminal-CC open 1=terminal-CC shorted
BI	17	--	"FL" output contacts status	0=FLB-FLC shorted 1=FLA-FLC shorted
BI	18	--	"RCH" output contacts status	0=RCHA-RCHC open 1=RCHA-RCHC shorted
BI	19	--	"LOW" output contacts status	0=LOWA-LOWC open 1=LOWA-LOWC shorted
AO	1	Hz	Frequency command	0.00 Hz ~ 400.00 Hz
AO	2	Sec	Acceleration time #1	0.01 ~ 600.00 / 0.1 ~ 6000.0
AO	3	Sec	Deceleration time #1	0.01 ~ 600.00 / 0.1 ~ 6000.0
AO	4	%	Stall protection current level	10 ~ 215
AO	5	--	Command mode selection	0 ~ 4
AO	6	--	Frequency mode selection	0 ~ 4
AO	7	--	Proportional gain	0.01 ~ 2.55
AO	8	--	Integral gain	0.01 ~ 360.00
AO	9	Hz	PID lower limit frequency	0 ~ MAXIMUM OUTPUT FREQUENCY
AO	10	%	PID deviation upper limit	0 ~ 50
AO	11	%	PID deviation lower limit	0 ~ 50
AO	12	Sec	Loss of communications timeout time	0.100 ~ 60.000
AO	13	--	Loss of communications timeout action	0 ~ 4
BO	1	--	Run / stop command	0=stop 1=run
BO	2	--	Forward / reverse selection	0=reverse 1=forward
BO	3	--	Acceleration/deceleration #1 / #2 selection	0=accel/decel #1 1=accel/decel #2
BO	4	--	Compulsory DC injection braking mode selection	0= no compulsory DC injection braking 1= compulsory DC injection braking below DC INJECTION START FREQUENCY
BO	5	--	Gate block (coast stop) command	0=no gate block 1=gate block
BO	6	--	Emergency off command	0=no action 1=emergency off
BO	7	--	Fault reset command	0=no action 1=reset
BO	8	--	Feedback control enable selection	0=feedback valid 1=feedback invalid
BO	9	--	Feedback control selection	0=no feedback 1=PID feedback control
BO	10	--	PID deviation limit selection	0=PID deviation limit disabled 1=PID deviation limit enabled

**[NOTE 1]:** NPT = Network Point Type.

**[NOTE 2]:** NPA = Network Point Address.

## 8.3 Individual Object Descriptions

This section gives a brief overview of each object, including any notable behavior or settings. For those parameters outlined here that directly map to internal G3 configuration parameters, refer to the G3 Operation Manual for further information regarding their usage or behavior.

### 8.3.1 Analog Input Objects

AI #1.....Indicates the drive's output frequency in Hz.

AI #2.....Indicates the drive's output current in % (100% = drive rated current).

AI #3.....Indicates the drive's output voltage in % (100% = drive voltage class).

AI #4.....Indicates the drive's input voltage in % (100% = drive voltage class).

AI #5.....Indicates the signal level currently being applied to the G3's IV analog input terminal. This can be used to monitor such items as feedback sensor outputs and other process variables.

AI #6.....Similar to AI #5, this object indicates the signal level currently being applied to the G3's RR analog input terminal.

AI #7.....Similar to AI #5, this object indicates the signal level currently being applied to the G3's RX analog input terminal.

AI #8.....Indicates the G3's present input power usage (power consumed by the drive/motor system).

AI #9.....Indicates the G3's present output power (power consumed by the motor).

AI #10.....Reserved. Data read from this object has no meaning in G3 applications.

AI #11.....Reserved. Data read from this object has no meaning in G3 applications.

AI #12.....Indicates the present drive fault code (refer to section 9 for fault code meanings). Under normal drive operation (no faults), this value will be 0.

AI #13 ~ AI #16.....Indicate the last 4 faults that occurred (refer to section 9 for fault code meanings). AI #13 contains the fault code for the most recent saved fault and AI #16 contains the fault code for the oldest saved fault. When a new fault occurs, the fault codes traverse down the fault stack, and the oldest fault is discarded.

## 8.3.2 Binary Input Objects

BI #1 .....Indicates whether the drive is running or stopped.

BI #2 .....Indicates whether the drive is running in the forward or reverse direction.

BI #3 .....Indicates whether the drive is currently using acceleration time #1 and deceleration time #1 or acceleration time #2 and deceleration time #2 when accelerating and decelerating.

BI #4 .....Indicates the status of compulsory DC injection braking. When using compulsory DC injection braking, the G3 will apply DC injection braking to the motor whenever the output frequency drops below the value of parameter DC INJECTION START FREQUENCY in GROUP:PROTECTION FUNCTION PARAMETERS. This differs from standard DC injection braking in that with standard DC injection braking, the G3 will apply DC injection braking only when a stop command is given and the output frequency drops below the value set in parameter DC INJECTION START FREQUENCY.

BI #5 .....Indicates whether or not a coast-stop command was given to the G3.

BI #6 .....Indicates whether or not the G3 is currently faulted "EMERGENCY OFF".

BI #7 .....Indicates whether or not the G3 is currently faulted (any fault).

BI #8 .....Indicates whether feedback control is enabled or not. Note that this BI object does not necessarily indicate that feedback is active; in order to use feedback control, parameter FEEDBACK CONTROL SELECTION in GROUP:FEEDBACK CONTROL PARAMETERS (BO #9) must also be enabled. This BI object only indicates the enable selection status of BO #8.

BI #9 .....Indicates the current status of the "F" input contact terminal.

BI #10 ....Indicates the current status of the "R" input contact terminal.

BI #11 ....Indicates the current status of the "S1" input contact terminal.

BI #12 ....Indicates the current status of the "S2" input contact terminal.

BI #13 ....Indicates the current status of the "S3" input contact terminal.

BI #14 ....Indicates the current status of the "S4" input contact terminal.

BI #15 ....Indicates the current status of the "RES" input contact terminal.

BI #16 ....Indicates the current status of the "ST" input contact terminal.

BI #17 ....Indicates the current status of the "FL" output contacts.

BI #18 ....Indicates the current status of the "RCH" output contacts.

BI #19 ....Indicates the current status of the "LOW" output contacts.

## 8.3.3 Analog Output Objects

**IMPORTANT:** Most of the AO objects detailed in this section map directly to G3 configuration parameters (parameters accessible via the G3's keypad). When these parameters are changed (from either the keypad or N2 network), they are stored in the G3's non-volatile EEPROM. The G3's EEPROM has a life span of 10,000 write cycles per parameter; therefore do not write to any of these AO objects more than 10,000 times.

AO #1 ...Used to set the drive's frequency command (note that the G3 will only use this value as its active frequency command if AO #6 or parameter FREQUENCY MODE SELECTION in GROUP:UTILITY PARAMETERS is set to 3). Although the adjustment range for this object is 0.00Hz ~ 400.00Hz, the actual frequency command will be internally limited by the values of parameters UPPER LIMIT FREQUENCY, LOWER LIMIT FREQUENCY and MAXIMUM OUTPUT FREQUENCY in GROUP:FUNDAMENTAL PARAMETERS #1.

AO #2 ...Accesses the G3's ACCELERATION TIME #1 parameter in GROUP:FUNDAMENTAL PARAMETERS #1. As indicated, the adjustment range and resolution depend on the setting of parameter ACC/DEC TIME UNITS SELECTION in GROUP:UTILITY PARAMETERS. The value of ACC/DEC TIME UNITS SELECTION is read by the Metasys interface only on drive initialization; therefore, if the setting of ACC/DEC TIME UNITS SELECTION is changed, be sure to reset the drive to validate the changed setting and provide correct network data interpretation.

AO #3 ...Accesses the G3's DECELERATION TIME #1 parameter in GROUP:FUNDAMENTAL PARAMETERS #1. As indicated, the adjustment range and resolution depend on the setting of parameter ACC/DEC TIME UNITS SELECTION in GROUP:UTILITY PARAMETERS. The value of ACC/DEC TIME UNITS SELECTION is read by the Metasys interface only on drive initialization; therefore, if the setting of ACC/DEC TIME UNITS SELECTION is changed, be sure to reset the drive to validate the changed setting and provide correct network data interpretation.

AO #4 ...Accesses the G3's STALL PROTECTION CURRENT LEVEL parameter in GROUP:PROTECTION FUNCTION PARAMETERS.

AO #5 ...Accesses the G3's COMMAND MODE SELECTION parameter in GROUP:UTILITY PARAMETERS. For Metasys network commands to affect the G3's actual operation, this object must be set to a value of 3. Note that if this parameter is changed while the G3 is running, the changed value will not take effect until the drive is stopped.

AO #6 ...Accesses the G3's FREQUENCY MODE SELECTION parameter in GROUP:UTILITY PARAMETERS. For the frequency command (AO #1) set via the Metasys network to affect the G3's actual operation, this object must be set to a value of 3. Note that if this parameter is changed while the G3 is running, the changed value will not take effect until the drive is stopped.

AO #7 ...Accesses the G3's process (PID) control PROPORTIONAL GAIN parameter in GROUP:FEEDBACK CONTROL PARAMETERS.

AO #8....Accesses the G3's process (PID) control INTEGRAL GAIN parameter in GROUP:FEEDBACK CONTROL PARAMETERS.

AO #9....Accesses the G3's PID LOWER LIMIT FREQUENCY parameter in GROUP:FEEDBACK CONTROL PARAMETERS. Note that the adjustment range of this object depends on the setting of MAXIMUM OUTPUT FREQUENCY in GROUP:FUNDAMENTAL PARAMETERS #1. The value of MAXIMUM OUTPUT FREQUENCY is read only on drive initialization; therefore, if the setting of MAXIMUM OUTPUT FREQUENCY is changed, be sure to reset the drive to validate the changed setting and provide correct N2 network data limit checking.

AO #10..Accesses the G3's PID DEVIATION UPPER LIMIT parameter in GROUP:FEEDBACK CONTROL PARAMETERS.

AO #11..Accesses the G3's PID DEVIATION LOWER LIMIT parameter in GROUP:FEEDBACK CONTROL PARAMETERS.

AO #12 and AO #13.....The N2 interface provides a configurable "loss of communications" timer function, which can detect communication losses and perform certain actions if a valid N2 packet is not received and processed within a set time period.

AO #12 sets the loss of communication time value (adjustable from 100ms to 60.000s in 1ms increments, factory setting = 1.000s). If a valid (error-free) N2 reception-response cycle does not take place within this time limit, the timer will expire. If the timer expires, 5 possible actions can occur, as set by the value AO #13 (loss of communications timeout action):

AO #13 Setting	Action Taken Upon Timeout
0 (default)	No action: ignore timeout.
1	Flash "COMM" (communications warning indicator) on LCD display only.
2	Flash "COMM " on LCD display, stop G3 with decelerated stop.
3	Trip "OPTION PCB ERROR". Note that the G3 must be reset locally in this case.
4	Flash "COMM " on LCD display, set AO #1 (frequency command) to 400.00Hz ( <b>CAUTION!</b> ). Note that the actual internal frequency command will be limited by the UPPER LIMIT FREQUENCY parameter in GROUP:FUNDAMENTAL PARAMETERS #1.

Setting 0 is the default setting; when a communications timeout occurs, no action will be taken (function is disabled).

For setting 1 (flash "COMM " on LCD display only), this condition will continue until the next error-free N2 packet is received and responded to. The warning condition will then be removed and the timer value reset.

For setting 2 (flash "COMM " on LCD display, stop drive with decelerated stop), the "COMM " warning will act as described in setting 1, but BO #1 (run/stop command) will also be set to 0 (stop). Note that the drive stop



condition will not be reset when an error-free N2 network packet is once again received and responded to. Also note that although BO #1 is set to 0, this will cause the G3 to actually stop only if AO #5 or parameter `COMMAND MODE SELECTION` in `GROUP:UTILITY PARAMETERS` is set to 3 (communication interface input valid). The G3 will then remain stopped until commanded otherwise by the NCU.

Setting 3 does not depend on the `COMMAND MODE SELECTION (AO #5)` or `FREQUENCY MODE SELECTION (AO #6)` parameters. Note that the "OPTION PCB ERROR" fault can only be cleared locally at the drive.

Setting 4 will cause the Metasys N2 interface to automatically change the option frequency command (AO #1) to 400.00Hz upon a timeout occurrence. Note that the actual internal frequency command will be limited by the `UPPER LIMIT FREQUENCY` parameter in `GROUP:FUNDAMENTAL PARAMETERS #1`. If the G3 was running at the time of the communications loss, it will then accelerate to and continuously run at the upper limit frequency; otherwise it will remain stopped even though the value of AO #1 has been modified. Similar to the stop command issued to the G3 by the N2 interface with setting 2 (see above), the value of AO #1 will not automatically return to its pre-timeout value once proper network communications are re-established. The NCU must specifically modify the value of AO #1 once communications are re-established to cause the G3 to run at the desired frequency once again. Note that in order for this setting to actually affect the G3's operating frequency, AO #6 or parameter `FREQUENCY MODE SELECTION` in `GROUP:UTILITY PARAMETERS` must be set to 3 (communication interface input valid).

### **USE EXTREME CAUTION WHEN SELECTING THIS SETTING!**

Thoroughly verify that there is no possibility of personal injury or equipment damage due to the drive running at the upper limit frequency setting, especially with the possibility that network communications may not be able to be re-established in a timely fashion (depending on what network condition caused the communications timeout in the first place).

Note that the values of AO #12 and AO #13 are non-volatile (stored in the G3's EEPROM). Therefore, do not write to these objects more than 10,000 times. In addition, although these values may be changed via the N2 network, the N2 interface uses the values read upon initialization until the G3 is reset again. Therefore, the G3 must be reset after either of these values has been changed in order for them to take effect and provide the desired operation.

## 8.3.4 Binary Output Objects

**IMPORTANT:** BO #9 and BO #10 map directly to G3 configuration parameters (parameters accessible via the G3's keypad). When these parameters are changed (from either the keypad or N2 network), they are stored in the G3's non-volatile EEPROM. The G3's EEPROM has a life span of 10,000 write cycles per parameter; therefore do not write to either of these BO objects more than 10,000 times.

Note that the actions detailed for BO #1 ~ BO #8 will affect the G3's actual operation only if AO #5 or parameter `COMMAND MODE SELECTION` in `GROUP:UTILITY PARAMETERS` is set to 3.

BO #1....Run / stop command.

BO #2....Selects forward or reverse run direction.

BO #3....Selects whether the G3 will use acceleration time #1 and deceleration time #1 or acceleration time #2 and deceleration time #2 when accelerating and decelerating. This change can occur dynamically while the drive is running.

BO #4....Selects whether or not to use compulsory DC injection braking. When using compulsory DC injection braking, the G3 will apply DC injection braking to the motor whenever the output frequency drops below the value of parameter `DC INJECTION START FREQUENCY` in `GROUP:PROTECTION FUNCTION PARAMETERS`. This differs from standard DC injection braking in that with standard DC injection braking, the G3 will apply DC injection braking only when a stop command is given and the output frequency drops below the value set in parameter `DC INJECTION START FREQUENCY`.

BO #5....Issues a gate block (coast stop) command. This immediately ceases the output of both frequency and voltage to the motor.

BO #6....Causes the G3 to trip "EMERGENCY OFF".

BO #7....Resets the G3 when faulted. This action will cause the G3 to lose communication with the N2 network for approximately 3 seconds while the system initializes. When done initializing, the N2 interface will be in the "offline" state, and will respond with a Metasys "N00" error to all N2 commands until the NCU sends an "identify device type" command.

BO #8....Enables or disables process (PID) feedback control. Note that this object does not activate (turn on) feedback control; it only enables or disables feedback control once it has already been activated. To activate feedback control, BO #9 (parameter `FEEDBACK CONTROL SELECTION` in `GROUP:FEEDBACK CONTROL PARAMETERS`) must be set to 1. Once that has been completed, BO #8 can be used to disable and enable feedback control dynamically. The reason for this distinction is for those applications that require frequent activation/deactivation of PID control. Since BO #9 directly maps to the G3's `FEEDBACK CONTROL SELECTION` parameter, which is stored in the G3's EEPROM, BO #9 must not be written to more than a total of 10,000 times. In these applications, therefore, BO #8 can be used to effectively enable and disable PID control; because the value of BO #8 is not stored in non-volatile EEPROM, it can safely be written to an unlimited number of times.

BO #9....Activates/deactivates (turns on/off) process (PID) control. Maps to the G3's `FEEDBACK CONTROL SELECTION` parameter in `GROUP:FEEDBACK`

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CONTROL PARAMETERS. Refer to the discussion regarding BO #8 for more details.

BO #10..Accesses the G3's PID DEVIATION LIMIT SELECTION parameter in  
GROUP:FEEDBACK CONTROL PARAMETERS.

## 9. Drive Fault Codes

LCD Display Message	Fault Code	Explanation
NO ERROR	0	No error has been recorded since the last drive reset or trip clear
OVERCURRENT (ACCEL) (PRESS CLEAR)	1	Overcurrent during acceleration
OVERCURRENT (DECEL) (PRESS CLEAR)	2	Overcurrent during deceleration
OVERCURRENT (RUN) (PRESS CLEAR)	3	Overcurrent during constant-speed run
LOAD-END OVERCURRENT (PRESS CLEAR)	4	Load-end overcurrent detected at start-up (output terminals, motor wiring etc.)
U-PHASE SHORT CKT (PRESS CLEAR)	5	U-phase IGBT short circuit
V-PHASE SHORT CKT (PRESS CLEAR)	6	V-phase IGBT short circuit
W-PHASE SHORT CKT (PRESS CLEAR)	7	W-phase IGBT short circuit
LOST INPUT PHASE (PRESS CLEAR)	8	Lost input phase (option)
LOST OUTPUT PHASE (PRESS CLEAR)	9	Lost output phase (option)
OVERVOLTAGE (ACCEL) (PRESS CLEAR)	10	Overvoltage during acceleration
OVERVOLTAGE (DECEL) (PRESS CLEAR)	11	Overvoltage during deceleration
OVERVOLTAGE (RUN) (PRESS CLEAR)	12	Overvoltage during constant-speed run
INVERTER OVERLOAD (PRESS CLEAR)	13	Drive overload
MOTOR OVERLOAD (PRESS CLEAR)	14	Motor overload
DBR OVERLOAD TRIP (PRESS CLEAR)	15	Dynamic braking resistor overload
OVERHEAT TRIP (PRESS CLEAR)	16	Drive overheat
EMERGENCY OFF (PRESS CLEAR)	17	Emergency off
EEPROM WRITE FAILURE (PRESS CLEAR)	18	EEPROM failure during write
EEPROM READ FAILURE (PRESS CLEAR)	19	EEPROM failure during initial read

LCD Display Message	Fault Code	Explanation
¾	20	Unused
RAM ERROR (PRESS CLEAR)	21	RAM error
ROM ERROR (PRESS CLEAR)	22	ROM error
CPU ERROR (PRESS CLEAR)	23	CPU error
COMMUNICATION ERROR (PRESS CLEAR)	24	RS232C timer time-out
GATE ARRAY FAULT (PRESS CLEAR)	25	Gate array error
CURRENT DETECT ERROR (PRESS CLEAR)	26	Output current detection circuit error
OPTION PCB ERROR (PRESS CLEAR)	27	Communication interface card error (check that INVERTER ID NUMBER is not 0)
OPTION ROM ERROR	28	Option ROM error / option ROM not detected
LOW CURRENT TRIP (PRESS CLEAR)	29	Low current
UNDERVOLTAGE TRIP (PRESS CLEAR)	30	Main circuit undervoltage
¾	31	Unused
OVERTORQUE TRIP (PRESS CLEAR)	32	Overtorque
EARTH FAULT (SOFT) (PRESS CLEAR)	33	Earth fault (software)
EARTH FAULT (HARD) (PRESS CLEAR)	34	Earth fault (hardware)
OPEN FUSE TRIP (PRESS CLEAR)	35	Open fuse
DBR OVERCURRENT TRIP (PRESS CLEAR)	36	Dynamic braking resistor overcurrent
DC OVERCURRENT (ACC) (PRESS CLEAR)	37	Overcurrent in DC section during acceleration
DC OVERCURRENT (DEC) (PRESS CLEAR)	38	Overcurrent in DC section during deceleration
DC OVERCURRENT (RUN) (PRESS CLEAR)	39	Overcurrent in DC section during constant-speed run
AUTO-TUNING ERROR (PRESS CLEAR)	40	Auto-tuning error
INV TYPEFORM ERROR (PRESS READ/WRITE)	41	Drive typeform error

## 10. NCU DDL File

Below is a Data Definition Language (DDL) file for the G3 Metasys direct N2 bus interface which can be input to an N2 Network Controller Unit (NCU).

An electronic version of this file can be downloaded via the internet from <http://www.iccdesigns.com>.

```
*****
** Toshiba G3 Adjustable Speed Drive **
** REV. 1 03.08.1999 DH Initial File Entry **
*****
CSMODEL "G3", "VND"

AITITLE "Analog Inputs"
BITITLE "Binary Inputs"
AOTITLE "Analog Outputs"
BOTITLE "Binary Outputs"

CSAI "AI1",N,N,"OUT FREQ","HZ"
CSAI "AI2",N,N,"CURRENT","%"
CSAI "AI3",N,N,"OUT VOLT","%"
CSAI "AI4",N,N,"INP VOLT","%"
CSAI "AI5",N,N,"IV INPUT","%"
CSAI "AI6",N,N,"RR INPUT","%"
CSAI "AI7",N,N,"RX INPUT","%"
CSAI "AI8",N,N,"INP POWR","kW"
CSAI "AI9",N,N,"OUT POWR","kW"
CSAI "AI10",N,N,"RESERVED",""
CSAI "AI11",N,N,"RESERVED",""
CSAI "AI12",N,N,"NOW FLT","CODE"
CSAI "AI13",N,N,"1ST FLT","CODE"
CSAI "AI14",N,N,"2ND FLT","CODE"
CSAI "AI15",N,N,"3RD FLT","CODE"
CSAI "AI16",N,N,"4TH FLT","CODE"

CSBI "BI1",N,N,"RUN STAT","STOP","RUN"
CSBI "BI2",N,N,"F/R STAT","REV","FWD"
CSBI "BI3",N,N,"ACC STAT","#1","#2"
CSBI "BI4",N,N,"INJ STAT","OFF","ON"
CSBI "BI5",N,N,"CST STAT","NORMAL","COAST"
CSBI "BI6",N,N,"E STAT","NORMAL","E"
CSBI "BI7",N,N,"FLT STAT","NORMAL","FAULT"
CSBI "BI8",N,N,"FB STAT","DISABL","ENABL"
CSBI "BI9",N,N,"F TERM","OPEN","CLOSED"
CSBI "BI10",N,N,"R TERM","OPEN","CLOSED"
CSBI "BI11",N,N,"S1 TERM","OPEN","CLOSED"
CSBI "BI12",N,N,"S2 TERM","OPEN","CLOSED"
CSBI "BI13",N,N,"S3 TERM","OPEN","CLOSED"
CSBI "BI14",N,N,"S4 TERM","OPEN","CLOSED"
CSBI "BI15",N,N,"RES TERM","OPEN","CLOSED"
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CSBI "BI16",N,N,"ST TERM","OPEN","CLOSED"  
CSBI "BI17",N,N,"FL OUTP","FLB-C","FLA-C"  
CSBI "BI18",N,N,"RCH OUTP","OPEN","CLOSED"  
CSBI "BI19",N,N,"LOW OUTP","OPEN","CLOSED"

CSAO "A01",Y,Y,"FREQ CMD","HZ"  
CSAO "A02",Y,Y,"ACCEL #1","SEC"  
CSAO "A03",Y,Y,"DECEL #1","SEC"  
CSAO "A04",Y,Y,"STALL","%"  
CSAO "A05",Y,Y,"CMD MODE","-"  
CSAO "A06",Y,Y,"FRQ MODE","-"  
CSAO "A07",Y,Y,"P GAIN","-"  
CSAO "A08",Y,Y,"I GAIN","-"  
CSAO "A09",Y,Y,"PID LL","Hz"  
CSAO "A010",Y,Y,"FB DEV U","%"  
CSAO "A011",Y,Y,"FB DEV L","%"  
CSAO "A012",Y,Y,"LOSS SEC","SEC"  
CSAO "A013",Y,Y,"LOSS ACT","-"

CSBO "B01",Y,Y,"RUN/STOP","STOP","RUN"  
CSBO "B02",Y,Y,"FWD/REV","FWD","REV"  
CSBO "B03",Y,Y,"ACC 1/2","#1","#2"  
CSBO "B04",Y,Y,"DC INJCT","DISABL","ENABLE"  
CSBO "B05",Y,Y,"CST CMD","-","COAST"  
CSBO "B06",Y,Y,"E CMD","-","TRIP E"  
CSBO "B07",Y,Y,"RESET","-","RESET"  
CSBO "B08",Y,Y,"FB SEL","VALID","INVALID"  
CSBO "B09",Y,Y,"FB ENABL","DISABL","ENABLE"  
CSBO "B010",Y,Y,"FB DEV","DISABL","ENABLE"

11. Notes

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