
ASD INTERFACE SERIES



INDUSTRIAL CONTROL COMMUNICATIONS, INC.



ASD-NANOCOM

**MULTIPROTOCOL COMMUNICATIONS INTERFACE
FOR TOSHIBA 7-SERIES ADJUSTABLE SPEED DRIVES**



Introduction

Thank you for purchasing the ICC, Inc. ASD-NANOCOM Multiprotocol Communications Interface for the Toshiba 7-Series Adjustable Speed Drives. Before using the ASD-NANOCOM interface, please familiarize yourself with the product and 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 units in which the ASD-NANOCOM interface is installed, and keep this instruction manual in a safe place for future reference or drive/interface inspection.

The ASD-NANOCOM interface can be installed on Toshiba G7, H7, Q7 and W7 Adjustable Speed Drives.

This instruction manual describes the device specifications, maintenance procedures, supported functions and usage methods for the ASD-NANOCOM Multiprotocol Communications Interface.

In conjunction with this manual, the following manuals are supplied by Toshiba, and are essential both for ensuring a safe, reliable system installation as well as for realizing the full potential of the ASD-NANOCOM interface:

- *G7 Adjustable Speed Drive Operation Manual*
- *H7 Adjustable Speed Drive Operation Manual*
- *Q7 Adjustable Speed Drive Installation and Operation Manual*
- *W7 Adjustable Speed Drive Installation and Operation Manual*
- *7-Series Serial Communications User Manual*

If you do not have copies available of the documents relevant to your installation, please contact Toshiba or your local Toshiba distributor to obtain them, or copies may be downloaded from <http://www.tic.toshiba.com> (subject to availability).



ASD-NANOCOM Multiprotocol Communications Interface User's Manual

Part Number 10572-2.100-000

Printed in U.S.A.

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No complex software or hardware system is perfect. Bugs may always be present in a system of any size. In order to prevent danger to life or property, it is the responsibility of the system designer to incorporate redundant protective mechanisms appropriate to the risk involved.

Usage Precautions

Installation and Wiring

- Proper ground connections are vital for both safety and signal reliability reasons. Ensure that all electrical equipment is properly grounded.
- Route all communication cables separate from high-voltage or noise-emitting cabling (such as ASD input/output power wiring).

ASD Connections

- Do not touch charged parts of the drive such as the terminal block while the drive's CHARGE lamp is lit. A charge will still be present in the drive'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 connecting communication cables.
- Internal drive EEPROMs have a limited life span of write cycles. Observe all precautions contained in this manual and your ASD manual regarding which drive registers safely may and may not be repetitively written to.
- For further drive-specific precaution, safety and installation information, please refer to the appropriate documentation supplied with your drive.

TABLE OF CONTENTS

1.	Feature Summary	6
2.	Installing the Interface	7
3.	RS-485 Connections.....	11
4.	Environmental Specifications	12
5.	Maintenance and Inspection	13
6.	Storage and Warranty	14
6.1	Storage.....	14
6.2	Warranty.....	14
7.	Network Configuration Parameters	15
7.1	Primary Parameter Settings	15
7.2	Additional Parameter Settings	17
7.3	Controlling the Drive from the Network.....	17
8.	Modbus RTU Details.....	18
8.1	Node Addressing.....	18
8.2	Network Characteristics	18
8.3	Supported Functions	19
8.4	Register Addressing	19
8.5	Register Remapping.....	19
8.6	Coil Mappings	20
8.7	Data Mirroring	21
8.8	Timeout Behavior	23
9.	Metasys N2 Details	24
9.1	Node Addressing.....	24
9.2	Network Characteristics	24
9.3	Object Summaries.....	24
9.4	Timeout Behavior	25
9.5	Supported Objects	26
9.6	Object Details.....	28
9.6.1	Analog Input Objects.....	28
9.6.2	Binary Input Objects.....	29
9.6.3	Analog Output Objects.....	30
9.6.4	Binary Output Objects.....	30
10.	Siemens FLN Details	32

10.1	Node Addressing	32
10.2	Network Characteristics	32
10.3	Timeout Behavior	32
10.4	Supported Subpoints	33
10.5	Subpoint Details	35
10.5.1	LAI Subpoints	35
10.5.2	LDI Subpoints	36
10.5.3	LAO Subpoints.....	37
10.5.4	LDO Subpoints.....	37
11.	Notes	39

1. Feature Summary

Primary Network

Half-duplex RS-485 (A / B / Signal Ground / Shield).

Supported Protocols

- Schneider Electric Modbus RTU
- Johnson Controls Metasys N2
- Siemens Building Technologies FLN

User-Selectable Register Processing

Four user-selectable registers can be designated for special processing. The use of these registers is protocol-dependent.

Register Remapping

The Modbus RTU protocol allows all ASD parameters numbered FA00 - FFFF to be accessible as Modbus holding registers both at 0xFA00 – 0xFFFF (64000₁₀ – 65535₁₀) as well as 0x0A00 - 0x0FFF (2560₁₀ – 4095₁₀). This allows master devices that can index only 9999 total holding registers to access all available ASD information.




Selectable Network Timeout Processing

An optional 1s-255s network timeout time can be selected. If a timeout setting is selected, then after the designated period of network inactivity the interface will perform actions to place the drive in a “failsafe” state. The specific action taken is protocol-dependent.

2. Installing the Interface

The ASD-NANOCOM interface has been designed for quick and simple installation. The card is connected to the drive's control board via two 2x13-pin connectors. No additional mechanical support is required, and the only tool required for installation is a small flat screwdriver for wiring the network cable to the drive's RS-485 pluggable terminal block.

Installation of the interface should only be performed by a qualified technician familiar with the maintenance and operation of the ASD in which the interface is installed. To install the ASD-NANOCOM, complete the following steps:

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 the next step. **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.** Verify that the CHARGE LED has gone out before continuing the installation process.
3. Remove the drive's front cover / open the drive's cabinet door (refer to the appropriate drive manual for instructions on how to do this). Take care not to damage or dislodge the keypad-to-drive cable connection.
4. Refer to Figure 1 for an overview of the drive's control board with relevant ASD-NANOCOM interface sections indicated. The ASD comes from the factory with a small jumper board (Toshiba part #55365A) installed in the J4 connector. Remove this jumper board.
5. Insert the ASD-NANOCOM interface into the drive control board's J4/J5 connectors. **Pay particular attention to the interface's orientation, as there is no keying to prevent it from inadvertently being installed upside down.** The header labeled "J4" on the back of the interface must plug into the connector labeled "J4" on the drive's control board, and similarly the "J5" header must plug into the "J5" connector. When properly mounted, the small 10-pin surface mount header on the top side of the interface will be located in the lower left-hand corner. Refer to Figure 2 for a detailed view of a correct installation. Confirm that the interface is fully seated in the J4/J5 connectors.
6. Place both duplex selection jumpers (refer to Figure 1) on the drive's control board in the "HALF" position. Refer to Figure 3 for a detailed view of correctly-positioned duplex selection jumpers.

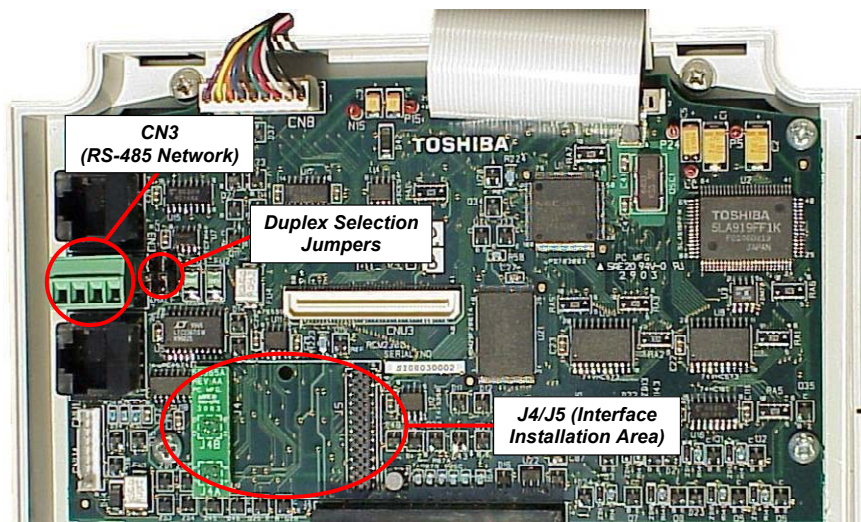


Figure 1: Pre-Installation Overview



Figure 2: Post-Installation Detail View

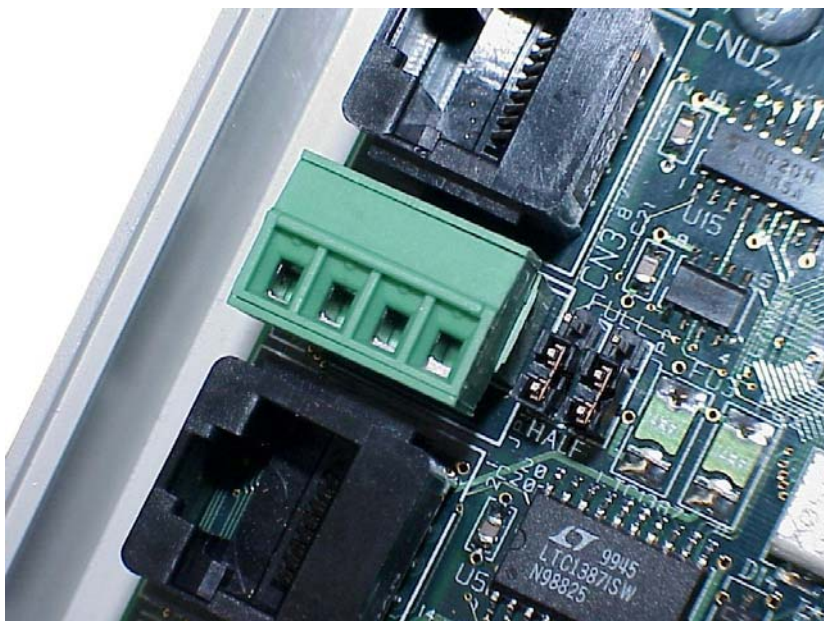


Figure 3: Network Terminal Block (CN3) and Duplex Selection Jumpers

7. Connect the RS-485 network cable to the 4-position pluggable terminal block on the drive's control board labeled CN3 (refer to Figure 1 and Figure 3.) Refer to section 3 of this manual for detailed network connection information. Ensure that the terminal block is fully seated into the terminal block header, and route the network cable such that it is located well away from any drive input power or motor wiring. Also take care to route the cable away from any sharp edges or positions where it may be pinched.
8. Take a moment to verify that the ASD-NANOCOM interface is fully seated in the drive control board's J4/J5 connectors, that the duplex selection jumpers are both in the "HALF" position, that the network cables are properly terminated in CN3, that CN3 is fully seated in its header, and that the RS-485 network cable has sufficient clearance from the drive's input power and output motor wiring. Refer to Figure 4.
9. Reinstall the drive's front cover / close the drive's cabinet door.
10. Turn the power source to the drive ON, and verify that the drive functions properly. If the drive does not appear to power up, or does not function properly, immediately turn power OFF. **Repeat steps 1 and 2 to remove all power from the drive.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

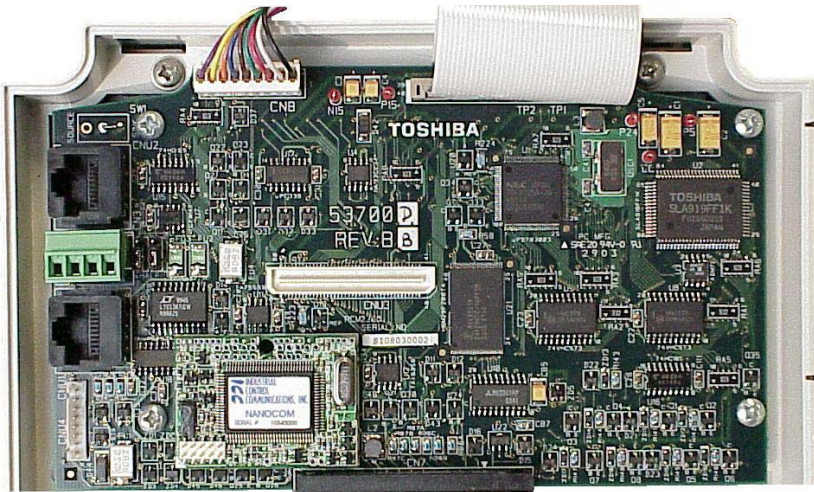


Figure 4: Post-Installation Overview

3. RS-485 Connections

Figure 5 indicates the specific network connections to the RS-485 pluggable terminal block (CN3). In general, there is no universal standardized labeling scheme for RS-485 signal connections, so other equipment on your network may use labels such as “+” and “-” or “S1” and “S2”, etc. In such instances, the correct connection scheme is usually intuitive (e.g. in FLN installations, connection “+” to “A” and “-” to “B”), or typically can be obtained via trial and error by simply swapping the signal wires if no connection can be achieved.

Note that the “Shield” terminal has no internal connection: its purpose is simply to provide a network cable shield chaining location between devices. The shield is then typically connected to ground at one location only.

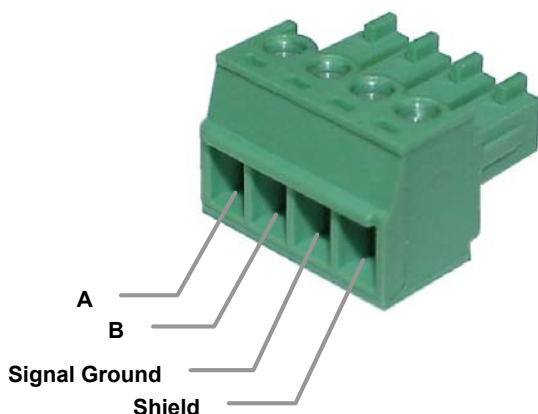


Figure 5: RS-485 Terminal Block (CN3) Connections

4. 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 ~ +50°C (+14 ~ +122°F)
Storage Temperature	-40 ~ +85°C (-40 ~ +185°F)
Relative Humidity	20% ~ 90% (without condensation)
Vibration	5.9m/s ² {0.6G} or less (10 ~ 55Hz)
Cooling Method	Self-cooled

5. Maintenance and Inspection

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

Inspection Points

- Verify that the interface is fully seated in the drive control board's J4/J5 connectors.
- Confirm that the RS-485 network cable is still properly terminated in CN3. Re-terminate if necessary.
- Check that there are no defects in any attached wire terminal crimp points. Visually check that the crimp points are not scarred by overheating.
- Check that the CN3 pluggable terminal block is fully seated in its header. Reseat if necessary.
- Visually check all wiring and cables for damage. Replace as necessary.
- Clean off any accumulated dust and dirt.

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

6. Storage and Warranty

6.1 Storage

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

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

6.2 Warranty

The interface is covered under warranty by ICC, Inc. 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 Industrial Control Communications, Inc. or your local distributor.

7. Network Configuration Parameters

Because the ASD-NANOCOM interface supports several different protocols, some amount of configuration must be performed prior to inclusion on the chosen network. This configuration is performed by setting certain drive parameters, some of which dictate the characteristics of the network communication, and some of which serve to facilitate the transfer of data between the drive's control board and the interface itself.

Throughout this section, take special note that the values of the communication-related parameters are only validated upon drive power-up initialization. Therefore, if any of these parameters are changed, be sure to cycle the drive's incoming power to validate the changes.

Also note that the exact location of the indicated drive parameters may be different among the various drive families. For example, on the Q7 drive family most of these parameters are located in the `Program...Comm Settings` group.

7.1 Primary Parameter Settings

The primary parameters are used by the ASD-NANOCOM interface to configure itself on the RS-485 network. These parameters are as follows:

```
ASD Number
Ext Comm Cfg #1
Ext Comm Cfg #2
Ext Comm Cfg #3
Ext Comm Cfg #4
Ext Comm Cfg #5
Ext Comm Cfg #6
Ext Comm Cfg #7
Ext Comm Cfg #8
```

These parameters are used as follows:

ASD Number or Inverter Number: Sets the drive's station number on the network. Although this parameter is adjustable from 0-255, not every value is a valid entry. Refer to the protocol-specific sections of this manual (sections 8 through 10) for details pertaining to the allowable station number assignment range for each supported protocol.

Ext Comm Cfg #1: Selects the RS-485 protocol. Allowable values are:

```
Modbus RTU ..... 0
Metasys N2 ..... 1
Siemens FLN ..... 2
```


All other values will result in an INVALID PROTOCOL error indication (refer to Ext Comm Cfg #4).

Ext Comm Cfg #2: Selects the Modbus RTU network characteristics (baud rate, parity and stop bits). Refer to section 8 for more information.

Ext Comm Cfg #3: Defines an optional network timeout timer. Allowable values are as follows:

0 timer disabled
1-255 1s-255s timer selected

If the network timer is disabled, then no special processing will occur based on the interval between received network packets: the interface will simply continue to wait for the next incoming packet that it may take action on.

Upon initial power-up and after each timeout occurrence, the network timer will not start until a complete packet has been received by the interface and responded to. Once started, a complete packet must be received within the timeout time setting to prevent the timer from expiring. As the timeout timer is principally intended to monitor network health, received packets do not need to be directed at any specific interface: even if an interface detects a packet intended for a different interface on the network, it will consider the network “healthy” and therefore reset its timeout timer.

The resultant behavior when a network timeout occurs is protocol-dependent. Refer to the sections of this manual pertaining to the specific protocols for further details.

Ext Comm Cfg #4: This parameter is a read-only error code. If the ASD-NANOCOM interface experiences any fatal errors during initial configuration or operation, then this parameter can be inspected to determine the specific error code to aid in troubleshooting the problem. An example of a fatal error would be if the Modbus RTU protocol is selected but the ASD Number parameter is set to 0. A list of possible error codes is provided in Table 1.

Table 1: ASD-NANOCOM Error Codes

Error Code	Meaning
0	NO ERROR (normal operation)
1	INVALID EQUIPMENT
2	INVALID PROTOCOL
3	INVALID ADDRESS
4	INVALID NETWORK SETTINGS
5	RESOURCE ALLOCATION ERROR

Ext Comm Cfg #5 ~ Ext Comm Cfg #8: These four parameters designate user-selectable drive parameter numbers for special processing. Their use is different for each protocol, so refer to the protocol-specific sections of this manual for further details.

7.2 Additional Parameter Settings

Although the drive parameters outlined in section 7.1 provide the majority of the RS-485 network configuration, there are several other communication-related parameters that must be set appropriately to ensure reliable communication between the drive and the ASD-NANOCOM interface itself. Verify that the following drive communication-related parameters are set as indicated:

RS485 Baud Rate..... Although any setting will work properly, it is recommended to set this value to 38400. This setting will provide the maximum bandwidth utilization between the drive and the ASD-NANOCOM interface.

RS485 Timeout Time..... Set to 0s.

RS485 Response Time..... Set to 0.00s.

RS485 Master Output..... Set to "Normal" or "No Slave".

7.3 Controlling the Drive from the Network

If drive control (frequency command input, RUN/STOP, etc.) is to be performed via the RS-485 network, then the following ASD parameters must also be set as shown:

Command Mode set to "Use RS232/485"

Frequency Mode..... set to "Use RS232/485"

As an alternative to setting the Command Mode and Frequency Mode selection parameters, the override (priority) bits may be activated in the RS-485 command word (parameter FA04) instead. The specific method of activating these bits depends on the protocol being used. For more information on the proper use of the override bits, refer to the appropriate Toshiba documentation regarding the drive's command mode and frequency mode control hierarchy.

8. Modbus RTU Details

8.1 Node Addressing

ASD parameter `ASD Number or Inverter number` (depending on the drive family) selects the Modbus node address. Valid addresses are 1 – 247. **NOTE** that the factory default value for this parameter is 0, and must therefore be changed to a valid Modbus node address, or an INVALID ADDRESS error indication will result.

8.2 Network Characteristics

ASD parameter `Ext Comm Cfg #2` selects the Modbus RTU network characteristics (baud rate, parity and stop bits). Refer to Table 2 to determine the association between this parameter's value and the resultant network characteristics.

Table 2: Modbus Network Configuration

Parameter Value	Baud Rate	Parity	Stop Bits
0	2400	Odd	1
1	2400	Even	1
2	2400	None	1
3	4800	Odd	1
4	4800	Even	1
5	4800	None	1
6	9600	Odd	1
7	9600	Even	1
8	9600	None	1
9	19200	Odd	1
10	19200	Even	1
11	19200	None	1
12	38400	Odd	1
13	38400	Even	1
14	38400	None	1
15	2400	None	2
16	4800	None	2
17	9600	None	2
18	19200	None	2
19	38400	None	2

Any other value for `Ext Comm Cfg #2` will result in an INVALID NETWORK SETTINGS error indication.

Note that the Modbus network characteristics indicated in Table 2 are unrelated to the ASD parameters RS485 Baud Rate and Parity. The RS485 Baud Rate and Parity parameters affect only the communication between the drive's control board CPU and the ASD-NANOCOM interface.

8.3 Supported Functions

The interface can act as a Modbus RTU slave according to the *Modicon Modbus Protocol Reference Guide (PI-MBUS-300 Rev. J)*. Supported Modbus functions are indicated in Table 3. Broadcasts (address field=0) for functions 5, 6, 15 and 16 are supported.

Table 3: Supported Modbus Functions

Function Code	Function
1	Read coils
3	Read multiple registers
5	Write coil
6	Write single register
15	Force multiple coils
16	Write multiple registers

8.4 Register Addressing

To access a drive parameter, simply access the corresponding Modbus holding register. Note that all Toshiba documentation lists drive registers in hexadecimal (hex) format, so conversion to decimal may be required. For example, let's say we would like to access the drive's "maximum frequency" parameter. "Maximum frequency" is drive parameter 0011 (which is equivalent to 0x0011 or 0011₁₆), so converting this to decimal results in a value of 17₁₀. Therefore, accessing Modbus holding register 17 ("known as" 40017) will access the "maximum frequency" parameter.

8.5 Register Remapping

The ASD-NANOCOM interface allows access to holding register indexes from 1₁₀ - 65535₁₀. This directly provides access to all ASD parameters from 0001₁₆ - FFFF₁₆. For example, the drive's RS-485 frequency command is located at parameter FA05 (64005₁₀). However, some Modbus master devices are capable of indexing only a maximum of 9999 holding registers (1₁₀ - 9999₁₀ or 0001₁₆ - 270F₁₆). Directly accessing holding register 64005 in order to set a

drive frequency command would therefore not be possible from these master devices. To solve this problem and allow integration with all Modbus masters, the ASD-NANOCOM interface implements “register remapping”.

Inspection of the Toshiba serial communications manual reveals that the drive's parameters are divided into two distinct regions within the full 0x0000 ~ 0xFFFF ASD register map: the “lower address” range covers from 0x0000 to 0x09FF, and the “upper address” range covers from 0xFA00 to 0xFFFF (not all values within those ranges access valid ASD registers, of course). While all of the parameters residing in the “lower address” range are directly accessible by “register limited” masters, none of the parameters residing in the “upper address” range are. Via register remapping, the ASD-NANOCOM interface automatically maps all “upper address” ASD parameters into the contiguous region immediately following the “lower address” range. To take advantage of this feature, simply drop the initial “F” on any parameter index in the “upper address” range and the resultant Modbus register request will automatically access the correct internal ASD parameter.

For example, if we again wish to write a frequency command to the drive (register FA05), we would change the FA05₁₆ to 0A05₁₆ and then convert this index to decimal to obtain the resultant Modbus register (2565₁₀). Therefore, writing to holding register 2565 will issue a new frequency command to the drive. Of course, it is also possible to access the “upper address” parameters at their original locations, so the RS-485 frequency command will be accessed the same whether writing to holding register 2565₁₀ or 64005₁₀.

8.6 Coil Mappings

The ASD-NANOCOM interface provides read/write support for Modbus coils. Accessing coils does not reference any new physical data: coils are simply indexes into various bits of Modbus holding registers. What this means is that when a coil is accessed, that coil is resolved by the interface into a specific holding register, and a specific bit within that holding register. The pattern of coil-to-register/bit relationships can be described as follows:

Coils 1...16 map to holding register #1, bit0...bit15 (bit0=LSB, bit15=MSB)
Coils 17...32 map to holding register #2, bit0...bit15, and so on.

Arithmetically, the coil-to-register/bit relationship can be described as follows: For any given coil, the holding register in which that coil resides can be determined by:

$$\text{holding register} = \left\lfloor \frac{\text{coil} + 15}{16} \right\rfloor \quad \dots \text{Equation 1}$$

Where the bracket symbols “ $\lfloor _ \rfloor$ ” indicate the “floor” function, which means that any fractional result (or “remainder”) is to be discarded, with only the integer value being retained.

Also, for any given coil, the targeted bit in the holding register in which that coil resides can be determined by:

$$\text{bit} = (\text{coil} - 1) \% 16 \quad \dots \text{Equation 2}$$

Where “coil” $\in [1 \dots 65535]$, “bit” $\in [0 \dots 15]$, and “%” is the modulus operator, which means that any fractional result (or “remainder”) is to be retained, with the integer value being discarded (i.e. it is the opposite of the “floor” function).

From these equations, it can be seen that the largest holding register number that can be accessed via this coil-to-register mapping method is 4096 (which contains coil 65535).

For clarity, let's use Equation 1 and Equation 2 in a calculation example. Say, for instance, that we are going to write to coil #41019. Using Equation 1, we can determine that coil #41019 resides in holding register #2564, as $\lfloor 2564.625 \rfloor = 2564$. Then, using Equation 2, we can determine that the bit within holding register #2564 that coil #41019 targets is $(41019-1)\%16 = 10$, as $41018\%16 = \text{mod}(2563 \text{ r } 10) = 10$. Therefore, writing to coil #41019 will write to holding register #2564, bit #10.

As a side note to this example, if we convert holding register #2564 to its hexadecimal equivalent, we obtain $0A04_{16}$. Applying our knowledge of register remapping discussed in section 8.5, we know that this holding register accesses ASD parameter FA04, which is the drive's RS485 command word. Bit #10 of this command word is the “run/stop” bit, and writing to coil #41019, therefore, will allow us to command the drive to run and stop.

8.7 Data Mirroring

By using a technique called “data mirroring”, certain drive parameters are handled by the interface with special processing that allows network accesses to these parameters to have priority handling. This priority handling minimizes the access latency incurred when reading a parameter from or writing a parameter to the drive by maintaining copies of the parameter values within the interface itself. By default, the following ASD parameters are always mirrored:

- FA04 (RS-485 command word)
- FA05 (RS-485 frequency command)
- FD00 (output frequency)
- FE01 (status 1)

In addition to the above parameters, up to 4 additional drive parameters can be designated by the user to be mirrored. This can be beneficial by improving network response time when an application regularly accesses parameters other than the four mirrored parameters indicated above.

To designate a drive parameter as mirrored, simply enter its Modbus holding register number into Ext Comm Cfg #5 ~ Ext Comm Cfg #8. The factory default values of parameters Ext Comm Cfg #5 ~ Ext Comm Cfg #8 are 0, which means “not designated”. As an example, let’s say that our application requires that we constantly be monitoring ASD parameters “output voltage” (FE05) and “status 2” (FE41). To mirror these parameters, we would first convert their parameter numbers to decimal to determine the holding register numbers ($FE05_{16} = 65029_{10}$ and $FE41_{16} = 65089_{10}$), and then enter these decimal numbers into two of the Ext Comm Cfg parameters. In this case, we can enter a value of 65029 into parameter Ext Comm Cfg #5 and a value of 65089 into Ext Comm Cfg #6. Upon completing this (and cycling power to the drive), ASD parameters FE05 and FE41 will now be mirrored. This means that network accesses to Modbus holding registers 65029 and 65089 (and 3589 and 3649 by virtue of register remapping as detailed in section 8.5) will now be faster than if these registers were not being mirrored.

There are several issues to note regarding data mirroring:

- ASD parameters that are being mirrored do not have any data checking processing available. Therefore, a Modbus “success response” will be returned to the network master even if the written data value was invalid (out of range, for example). Therefore, use caution with values written to command-type registers that are being mirrored. In all cases, a mirrored register will return its current value when read, so a write confirmation can be performed by reading a command register after a write, and confirming that the read value equals the previously-written value.
- When entering “upper address” range parameter numbers (i.e. parameters with indexes of FA00 - FFFF) into Ext Comm Cfg #5 ~ Ext Comm Cfg #8, either the “actual” (Fxxx) or remapped (0xxx) parameter number may be entered with equal results. Using our previous example of mirroring ASD parameters FE05 and FE41 as a demonstration of this, we could have entered either 65029 or 3589 into Ext Comm Cfg #5, and either 65089 or 3649 into Ext Comm Cfg #6 and obtained the same results (“output voltage” and “status 2” would be mirrored).
- Ext Comm Cfg #5 ~ Ext Comm Cfg #8 do not need to be used in any particular order. For example, if only one user-defined parameter was to be mirrored, its parameter number could be entered into any of the Ext Comm Cfg #5 ~ #8 parameters with equal results.
- Recall from the discussion regarding parameter Ext Comm Cfg #3 in section 7.1 that if a timeout time is selected and a timeout event occurs, then all user-selectable mirrored command registers (i.e. those registers that affect drive control or configuration) will be automatically written with a “failsafe” value of 0. Refer to section 8.8 for more information.

- The use of user-selectable mirroring is entirely optional, and therefore is not required for proper network and drive operation, nor does it affect Modbus mapping or addressing in any way. It is simply an added feature that may help improve network efficiency in some applications.

8.8 Timeout Behavior

If a timeout time is selected via `Ext Comm Cfg #3`, then after the designated period of network inactivity the RS-485 frequency command (ASD parameter FA04), RS-485 command word (ASD parameter FA05), and all user-selectable mirrored command registers (`Ext Comm Cfg #5 ~ Ext Comm Cfg #8`) will be automatically written with a “failsafe” value of 0.

9. Metasys N2 Details

9.1 Node Addressing

ASD parameter `ASD Number or Inverter number` (depending on the drive family) selects the Metasys N2 node address. Valid addresses are 1 – 255.

NOTE that the factory default value for this parameter is 0, and must therefore be changed to a valid N2 node address, or an INVALID ADDRESS error indication will result.

9.2 Network Characteristics

No configuration is necessary. The network characteristics are predetermined according to the Metasys N2 specification.

9.3 Object Summaries

The interface contains a predefined set of analog and binary I/O points used for configuring, controlling and monitoring the drive. The interface supports analog input, analog output, binary input and binary output object types.

- **Analog input (AI)** objects are used for monitoring analog status items. AI objects 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. An AI object will accept an override command, but will not change its actual value or indicate override active. Most AI objects are statically defined, but two are available for user-configuration to access any available drive parameter.
- **Analog output (AO)** objects are used for setting and monitoring analog control and configuration items. An AO value can be modified by issuing an override command. Issuing a release command will not cause the AO to automatically return to its pre-override value, nor will the AO automatically return to its pre-override value after a certain time period of no communication. Most AO objects are statically defined, but two are available for user-configuration to access any available drive parameter.
- **Binary input (BI)** objects are used for monitoring discrete (digital) status items. BI objects support COS, alarm enabling and normal/alarm status indications. A BI object will accept an override command, but will not change its actual value or indicate override active. All BI objects are statically defined.
- **Binary output (BO)** points are used for setting and monitoring discrete control and configuration items. A BO value can be modified by issuing an

override command. Issuing a release command will not cause the BO to automatically return to its pre-override value, nor will the BO return to its pre-override value after a certain time period of no communication. All BO objects are statically defined.

The Metasys device type for the gateway is VND.

9.4 Timeout Behavior

If a timeout time is selected via `Ext Comm Cfg #3`, then after the designated period of network inactivity the frequency command (AO #1) and ASD command word-related objects (AO #2 and BO #1 ~ BO #7) will be automatically written with a “failsafe” value of 0.

9.5 Supported Objects

Table 4 provides a listing of the Metasys objects supported by the interface.

Table 4: Supported Objects

NPT ¹	NPA ²	Units	Description	Range/Value
AI	1	Hz	Output frequency	0.00 ~ 400.00
AI	2	%	Load current	0.00 ~ 327.67
AI	3	%	Output voltage	0.00 ~ 327.67
AI	4	kW	Input power	0.00 ~ 655.35
AI	5	kWh	System energy	0.00 ~ 42.9x10 ⁶
AI	6	%	RR analog input	0.00 ~ 100.00
AI	7	%	VI / II analog input	0.00 ~ 100.00
AI	8	--	Fault code	0 ~ 255
AI	9	--	Ext Comm Cfg #5 reference	0 ~ 65535
AI	10	--	Ext Comm Cfg #6 reference	0 ~ 65535
BI	1	--	Run / stop status	0 = stopped 1 = running
BI	2	--	Forward / reverse status	0 = forward 1 = reverse
BI	3	--	Fault status	0 = not faulted 1 = faulted
BI	4	--	"F" programmable input terminal status	0 = OFF 1 = ON
BI	5	--	"R" programmable input terminal status	0 = OFF 1 = ON
BI	6	--	"ST" programmable input terminal status	0 = OFF 1 = ON
BI	7	--	"RES" programmable input terminal status	0 = OFF 1 = ON
BI	8	--	"S1" programmable input terminal status	0 = OFF 1 = ON
BI	9	--	"S2" programmable input terminal status	0 = OFF 1 = ON
BI	10	--	"S3" programmable input terminal status	0 = OFF 1 = ON
BI	11	--	"S4" programmable input terminal status	0 = OFF 1 = ON
BI	12	--	"OUT1" programmable output terminal status	0 = OFF 1 = ON
BI	13	--	"OUT2" programmable output terminal status	0 = OFF 1 = ON
BI	14	--	"FL" programmable output terminal status	0 = OFF 1 = ON
AO	1	Hz	Frequency command	0.00 ~ 400.00
AO	2	--	Preset speed selection	0 ~ 15
AO	3	--	Ext Comm Cfg #7 reference	0 ~ 65535
AO	4	--	Ext Comm Cfg #8 reference	0 ~ 65535
BO	1	--	Run / stop command	0 = stop 1 = run
BO	2	--	Forward / reverse selection	0 = forward 1 = reverse
BO	3	--	Emergency off command	0 = no action 1 = emerg. off

NPT ¹	NPA ²	Units	Description	Range/Value
BO	4	--	Fault reset command	0 = no action 1 = reset
BO	5	--	Feedback enable/disable selection	0 = enable 1 = disable
BO	6	--	Frequency priority	0 = OFF 1 = ON
BO	7	--	Command priority	0 = OFF 1 = ON
BO	8	--	Output terminal Data Out 1	0 = OFF 1 = ON
BO	9	--	Output terminal Data Out 2	0 = OFF 1 = ON
BO	10	--	Output terminal Data Out 3	0 = OFF 1 = ON

NOTE 1..... NPT = Network Point Type

NOTE 2..... NPA = Network Point Address

9.6 Object Details

This section gives a brief overview of each object, including any notable behavior or settings. Further information may be obtained by referring to the appropriate drive operation manual and *7-Series Serial Communications User Manual*. While most of the available objects are predefined, two analog input and two analog output objects are available that can be user-configured to access any available drive parameters. This allows a customized application to be easily developed.

9.6.1 Analog Input Objects

- AI #1..... Output frequency in Hz. ASD parameter FD00.
- AI #2..... Load current in % (100% = drive's rated current). ASD parameter FE03.
- AI #3..... Output voltage in % (100% = drive's rated voltage). ASD parameter FE05.
- AI #4..... Input power consumption (drive + motor) in kW. ASD parameter FE29.
- AI #5..... System energy consumption (drive + motor) in kWh. ASD parameter FE69.
- AI #6..... Indicates the signal level currently being applied to the ASD's RR analog input terminal. This can be used to monitor such items as feedback sensor outputs and other process variables. Expressed in % (100% = input rated value). ASD parameter FE35.
- AI #7..... Similar to AI #6, this object indicates the signal level currently being applied to the ASD's VI/II analog input terminal. ASD parameter FE36.
- AI #8..... Indicates the present fault code. Under normal operation (no faults), this value will be 0. ASD parameter FC90.
- AI #9..... In addition to the predefined analog input objects (AI #1 ~ AI #8), two user-defined AI objects are available (AI #9 and AI #10). To define which ASD parameters are to be associated with these AI's, enter their parameter numbers (in decimal) into parameters Ext Comm Cfg #5 and Ext Comm Cfg #6. Parameter Ext Comm Cfg #5 corresponds to AI #9 and Ext Comm Cfg #6 corresponds to AI #10.

For example, if the drive's peak current (ASD parameter FE31) is to be monitored in AI #9, then convert the parameter number to decimal ($0xFE31 = 65073_{10}$) and enter the result (65073) into Ext Comm Cfg #5. After cycling power, AI #9 will then provide access to peak current. Note that because any available ASD parameter can be accessed via this method, AI #9 and AI #10 are dimensionless and

have multiplier values of 1 (i.e. the object's data will be the raw value as maintained internally to the drive).

The factory default values of parameters `Ext Comm Cfg #5` and `Ext Comm Cfg #6` are 0, which means "not designated". When these drive parameters are "not designated", their corresponding AI object values will always be 0.

AI #10 ... Refer to the explanation for AI #9 above. The data accessed via this object is defined by the decimal ASD parameter value entered into `Ext Comm Cfg #6`.

9.6.2 Binary Input Objects

BI #1Indicates whether the drive is running or stopped. ASD parameter FE01, bit #10.

BI #2Indicates whether the drive is running in the forward or reverse direction. ASD parameter FE01, bit #9.

BI #3Indicates whether or not the drive is currently faulted.

BI #4Indicates the status of the "F" programmable input terminal. ASD parameter FE06, bit #0.

BI #5Indicates the status of the "R" programmable input terminal. ASD parameter FE06, bit #1.

BI #6Indicates the status of the "ST" programmable input terminal. ASD parameter FE06, bit #2.

BI #7Indicates the status of the "RES" programmable input terminal. ASD parameter FE06, bit #3.

BI #8Indicates the status of the "S1" programmable input terminal. ASD parameter FE06, bit #4.

BI #9Indicates the status of the "S2" programmable input terminal. ASD parameter FE06, bit #5.

BI #10 ...Indicates the status of the "S3" programmable input terminal. ASD parameter FE06, bit #6.

BI #11 ...Indicates the status of the "S4" programmable input terminal. ASD parameter FE06, bit #7.

BI #12 ...Indicates the status of the "OUT1" programmable output terminal. ASD parameter FE07, bit #0.

BI #13 ...Indicates the status of the "OUT2" programmable output terminal. ASD parameter FE07, bit #1.

BI #14 ...Indicates the status of the "FL" programmable output terminal. ASD parameter FE07, bit #2.

9.6.3 Analog Output Objects

AO #1... Sets the drive's RS-485 frequency command. Note that the drive will only use this value as its active frequency command if the `Frequency Mode` parameter is set to "Use RS232/485", or if the "frequency override" bit (BO #6) is ON. Although the adjustment range for this object is 0.00Hz ~ 400.00Hz, the actual frequency command will be internally limited by the `Upper Limit Frequency` and `Lower Limit Frequency` parameters. ASD parameter FA05.

AO #2... Preset speed selection. A value of "0" means "no preset speed selected", while values of 1 ~ 15 correspond to preset speeds #1 ~ #15. To run a selected preset speed, the drive must be configured to be using RS-485 commands (parameter `Command Mode` set to "Use RS232/485" or BO #7 ON) and a RUN command must be active (BO #1). ASD parameter FA04, bits #0 ~ #3.

AO #3... In addition to the predefined analog output objects (AO #1 and AO #2), two user-defined AO objects are available (AO #3 and AO #4). To define which ASD parameters are to be associated with these AO's, enter their parameter numbers (in decimal) into parameters `Ext Comm Cfg #7` and `Ext Comm Cfg #8`. Parameter `Ext Comm Cfg #7` corresponds to AO #3 and `Ext Comm Cfg #8` corresponds to AO #4.

For example, if the drive's deceleration time #1 (ASD parameter 0010) is to be set via AO #3, then convert the parameter number to decimal ($0 \times 0010 = 16_{10}$) and enter the result (16) into `Ext Comm Cfg #7`. After cycling power, AO #3 will then provide access to deceleration time #1. Note that because any available ASD parameter can be accessed via this method, AO #3 and AO #4 are dimensionless and have multiplier values of 1 (i.e. the object's data will be the raw value as maintained internally to the drive).

The factory default values of parameters `Ext Comm Cfg #7` and `Ext Comm Cfg #8` are 0, which means "not designated". When these drive parameters are "not designated", their corresponding AO object values will always be 0, and they will not access any drive parameters.

AO #4... Refer to the explanation for AO #3 above. The data accessed via this object is defined by the decimal ASD parameter value entered into `Ext Comm Cfg #8`.

9.6.4 Binary Output Objects

Note that the drive will only use the commands indicated in BO #1, BO #2 and BO #5 if the `Command Mode` parameter is set to "Use RS232/485", or if the "command override" bit (BO #7) is ON.

- BO #1Run/stop command. ASD parameter FA04, bit #10.
- BO #2Forward/reverse command. ASD parameter FA04, bit #9.
- BO #3Forces the drive to fault "Emergency Off". ASD parameter FA04, bit #12.
- BO #4Resets the drive when it is faulted. ASD parameter FA04, bit #13.
- BO #5Enables 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. ASD parameter FA04, bit #5.
- BO #6RS-485 frequency priority selection. Allows the frequency command from the RS-485 network to be used by the drive without having to set the `Frequency Mode` parameter. Refer to the Toshiba documentation regarding "Command Mode and Frequency Mode Control" for detailed information pertaining to the frequency source hierarchy and the use of overrides. ASD parameter FA04, bit #14.
- BO #7RS-485 command priority selection. Allows commands (BO #1, BO #2, BO #5 and AO #2) from the RS-485 network to be used by the drive without having to explicitly set the `Command Mode` parameter. Refer to the Toshiba documentation regarding "Command Mode and Frequency Mode Control" for detailed information pertaining to the command source hierarchy and the use of overrides. ASD parameter FA04, bit #15.
- BO #8Output terminal `Data Out 1`. Any programmable output terminals that are configured to output `Data Out 1 (NO)` or `Data Out 1 (NC)` will follow the value (or the inverted value) of this BO. ASD parameter FA50, bit #0.
- BO #9Output terminal `Data Out 2`. Any programmable output terminals that are configured to output `Data Out 2 (NO)` or `Data Out 2 (NC)` will follow the value (or the inverted value) of this BO. ASD parameter FA50, bit #1.
- BO #10 ...Output terminal `Data Out 3`. Any programmable output terminals that are configured to output `Data Out 3 (NO)` or `Data Out 3 (NC)` will follow the value (or the inverted value) of this BO. ASD parameter FA50, bit #2.

10. Siemens FLN Details

The Siemens FLN protocol is only applicable to the Q7 drive family.

10.1 Node Addressing

ASD parameter `ASD Number` selects the FLN node address. Valid addresses are 0 – 98. **NOTE** that the factory default value for `ASD Number` is 0.

10.2 Network Characteristics

No configuration is necessary. The network characteristics are predetermined according to the FLN specification.

10.3 Timeout Behavior

If a timeout time is selected via `Ext Comm Cfg #3`, then after the designated period of network inactivity frequency command (`#28`) and ASD command word-related objects (`#30` and `#33 ~ #39`) will be automatically written with a “failsafe” value of 0.

10.4 Supported Subpoints

The interface contains a predefined set of FLN subpoints used for configuring, controlling and monitoring the drive (refer to Table 5).

Table 5: Supported Subpoints

Point #	Point Type	Subpoint Name	Factory Default	Units	Slope	Intercept	On Text	Off Text
01	LAO	ADDRESS	99	–	1	0	–	–
02	LAO	APPLICATION	2736	–	1	0	–	–
03	LAI	OUTPUT FREQ	0	HZ	0.01	0	–	–
04	LAI	LOAD CURRENT	0	PCT	0.01	0	–	–
05	LAI	OUTPUT VOLT	0	PCT	0.01	0	–	–
06	LAI	INPUT POWER	0	KW	0.01	0	–	–
07	LAI	KWH	0	KWH	0.01	0	–	–
08	LAI	RR INPUT	0	PCT	0.01	0	–	–
09	LAI	VI.II INPUT	0	PCT	0.01	0	–	–
10	LAI	FAULT CODE	0	–	1	0	–	–
11	LAI	COMM CFG 5	0	–	1	0	–	–
12	LAI	COMM CFG 6	0	–	1	0	–	–
13	LDI	RUN.STOP	0	–	1	0	RUN	STOP
14	LDI	FWD.REV	0	–	1	0	REV	FWD
15	LDI	FAULT STATUS	0	–	1	0	FAULT	NORM
16	LDI	F TERMINAL	0	–	1	0	ON	OFF
17	LDI	R TERMINAL	0	–	1	0	ON	OFF
18	LDI	ST TERMINAL	0	–	1	0	ON	OFF
19	LDI	RES TERMINAL	0	–	1	0	ON	OFF
20	LAO	OVRD TIME	1	HRS	1	0	–	–
21	LDI	S1 TERMINAL	OFF	–	1	0	ON	OFF
22	LDI	S2 TERMINAL	OFF	–	1	0	ON	OFF
23	LDI	S3 TERMINAL	OFF	–	1	0	ON	OFF
24	LDI	S4 TERMINAL	OFF	–	1	0	ON	OFF
25	LDI	OUT1	OFF	–	1	0	ON	OFF
26	LDI	OUT2	OFF	–	1	0	ON	OFF
27	LDI	FL	OFF	–	1	0	ON	OFF
28	LAO	FREQ CMD	0	HZ	0.01	0	–	–

Point #	Point Type	Subpoint Name	Factory Default	Units	Slope	Intercept	On Text	Off Text
29	LDO	DAY.NGT	DAY	–	1	0	NIGHT	DAY
30	LAO	PRESET SPEED	0	–	1	0	–	–
31	LAO	COMM CFG 7	0	–	1	0	–	–
32	LAO	COMM CFG 8	0	–	1	0	–	–
33	LDO	RUN.STOP CMD	STOP	–	1	0	RUN	STOP
34	LDO	FWD.REV CMD	FWD	–	1	0	REV	FWD
35	LDO	EMER. OFF	OFF	–	1	0	ON	OFF
36	LDO	FAULT RESET	OFF	–	1	0	ON	OFF
37	LDO	PID ENABLE	ON	–	1	0	OFF	ON
38	LDO	FREQ PRIO	OFF	–	1	0	ON	OFF
39	LDO	CMD PRIO	OFF	–	1	0	ON	OFF
40	LDO	DATA OUT 1	OFF	–	1	0	ON	OFF
41	LDO	DATA OUT 2	OFF	–	1	0	ON	OFF
42	LDO	DATA OUT 3	OFF	–	1	0	ON	OFF
99	LAO	ERROR STATUS	0	–	1	0	–	–

Notes:

- Points not listed are not used in this application.
- All points have the same value for English units and SI units.

10.5 Subpoint Details

This section gives a brief overview of each subpoint, including any notable behavior or settings. Further information may be obtained by referring to the *Toshiba Q7 Series Operation Manual* and *7-Series Serial Communications User Manual*. While most of the available objects are predefined, two LAI and two LDO subpoints are available that can be user-configured to access any available drive parameters. This allows a customized application to be easily developed.

10.5.1 LAI Subpoints

- #3.....Output frequency in Hz. ASD parameter FD00.
- #4.....Load current in % (100% = drive's rated current). ASD parameter FE03.
- #5.....Output voltage in % (100% = drive's rated voltage). ASD parameter FE05.
- #6.....Input power consumption (drive + motor) in kW. ASD parameter FE29.
- #7.....System energy consumption (drive + motor) in kWh. ASD parameter FE69.
- #8.....Indicates the signal level currently being applied to the ASD's RR analog input terminal. This can be used to monitor such items as feedback sensor outputs and other process variables. Expressed in % (100% = input rated value). ASD parameter FE35.
- #9.....Similar to #8, this object indicates the signal level currently being applied to the ASD's VI/II analog input terminal. ASD parameter FE36.
- #10.....Indicates the present fault code. Under normal operation (no faults), this value will be 0. ASD parameter FC90.
- #11.....In addition to the predefined LAI subpoints (#3 ~ #10), two user-defined LAI subpoint are available (#11 and #12). To define which ASD parameters are to be associated with these LAI's, enter their parameter numbers (in decimal) into parameters `Ext Comm Cfg #5` and `Ext Comm Cfg #6`. Parameter `Ext Comm Cfg #5` corresponds to #11 and `Ext Comm Cfg #6` corresponds to #12.

For example, if the drive's peak current (ASD parameter FE31) is to be monitored in #11, then convert the parameter number to decimal ($0xFE31 = 65073_{10}$) and enter the result (65073) into `Ext Comm Cfg #5`. After cycling power, subpoint #11 will then provide access to peak current. Note that because any available ASD parameter can be accessed via this method, subpoints #11 and #12 are dimensionless

and have multiplier values of 1 (i.e. the object's data will be the raw value as maintained internally to the drive).

The factory default values of parameters `Ext Comm Cfg #5` and `Ext Comm Cfg #6` are 0, which means "not designated". When these drive parameters are "not designated", their corresponding subpoint values will always be 0.

#12 Refer to the explanation for #11 above. The data accessed via this object is defined by the decimal ASD parameter value entered into `Ext Comm Cfg #6`.

10.5.2 LDI Subpoints

#13 Indicates whether the drive is running or stopped. ASD parameter FE01, bit #10.

#14 Indicates whether the drive is running in the forward or reverse direction. ASD parameter FE01, bit #9.

#15 Indicates whether or not the drive is currently faulted.

#16 Indicates the status of the "F" programmable input terminal. ASD parameter FE06, bit #0.

#17 Indicates the status of the "R" programmable input terminal. ASD parameter FE06, bit #1.

#18 Indicates the status of the "ST" programmable input terminal. ASD parameter FE06, bit #2.

#19 Indicates the status of the "RES" programmable input terminal. ASD parameter FE06, bit #3.

#21 Indicates the status of the "S1" programmable input terminal. ASD parameter FE06, bit #4.

#22 Indicates the status of the "S2" programmable input terminal. ASD parameter FE06, bit #5.

#23 Indicates the status of the "S3" programmable input terminal. ASD parameter FE06, bit #6.

#24 Indicates the status of the "S4" programmable input terminal. ASD parameter FE06, bit #7.

#25 Indicates the status of the "OUT1" programmable output terminal. ASD parameter FE07, bit #0.

#26 Indicates the status of the "OUT2" programmable output terminal. ASD parameter FE07, bit #1.

#27 Indicates the status of the "FL" programmable output terminal. ASD parameter FE07, bit #2.

10.5.3 LAO Subpoints

#28.....Sets the drive's RS-485 frequency command. Note that the drive will only use this value as its active frequency command if the `Frequency Mode` parameter in `Program...Utility Group` is set to "Use RS232/485", or if the "frequency override" bit (#38) is ON. Although the adjustment range for this object is 0.00Hz ~ 400.00Hz, the actual frequency command will be internally limited by the `Upper Limit Frequency` and `Lower Limit Frequency` parameters. ASD parameter FA05.

#30.....Preset speed selection. A value of "0" means "no preset speed selected", while values of 1 ~ 15 correspond to preset speeds #1 ~ #15. To run a selected preset speed, the drive must be configured to be using RS-485 commands (parameter `Command Mode` set to "RS232/485" or #39 ON) and a RUN command must be active (#33). ASD parameter FA04, bits #0 ~ #3.

#31.....In addition to the predefined LAO subpoints (#28 and #30), two user-defined LAO subpoints are available (#31 and #32). To define which ASD parameters are to be associated with these LAO's, enter their parameter numbers (in decimal) into parameters `Ext Comm Cfg #7` and `Ext Comm Cfg #8`. Parameter `Ext Comm Cfg #7` corresponds to #31 and `Ext Comm Cfg #8` corresponds to #32.

For example, if the drive's deceleration time #1 (ASD parameter 0010) is to be set via #31, then convert the parameter number to decimal ($0x0010 = 16_{10}$) and enter the result (16) into `Ext Comm Cfg #7`. After cycling power, #31 will then provide access to deceleration time #1. Note that because any available ASD parameter can be accessed via this method, #31 and #32 are dimensionless and have multiplier values of 1 (i.e. the object's data will be the raw value as maintained internally to the drive).

The factory default values of parameters `Ext Comm Cfg #7` and `Ext Comm Cfg #8` are 0, which means "not designated". When these drive parameters are "not designated", their corresponding subpoint values will always be 0, and they will not access any drive parameters.

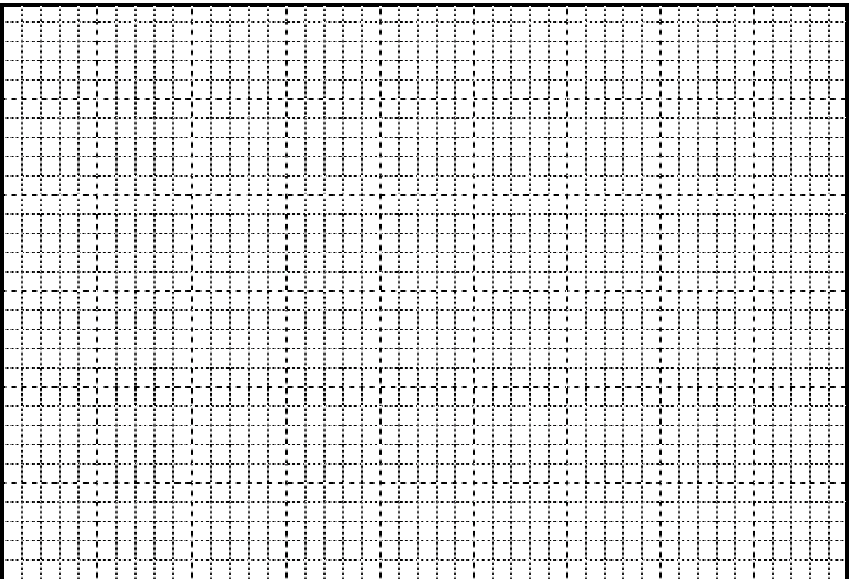
#32.....Refer to the explanation for #31 above. The data accessed via this object is defined by the decimal ASD parameter value entered into `Ext Comm Cfg #8`.

10.5.4 LDO Subpoints

Note that the drive will only use the commands indicated in subpoints #33, #34 and #37 if the `Command Mode` parameter in `Program...Utility Group` is set to "RS232/485", or if the "command override" bit (#39) is ON.

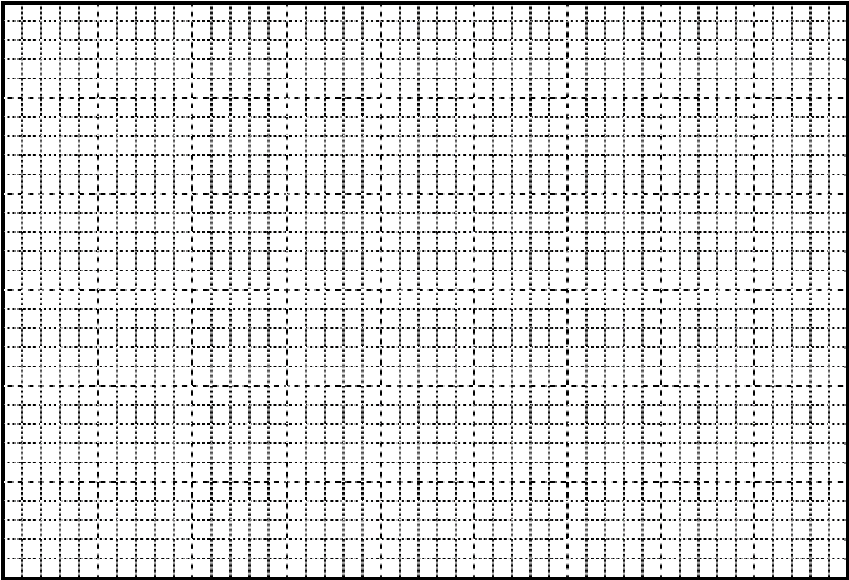
- #33 Run/stop command. ASD parameter FA04, bit #10.
- #34 Forward/reverse command. ASD parameter FA04, bit #9.
- #35 Forces the drive to fault "Emergency Off". ASD parameter FA04, bit #12.
- #36 Resets the drive when it is faulted. ASD parameter FA04, bit #13.
- #37 Enables or disables process (PID) 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. ASD parameter FA04, bit #5.
- #38 RS-485 frequency priority selection. Allows the frequency command from the RS-485 network to be used by the drive without having to set the `Frequency Mode` parameter. Refer to the Toshiba documentation regarding "Command Mode and Frequency Mode Control" for detailed information pertaining to the frequency source hierarchy and the use of overrides. ASD parameter FA04, bit #14.
- #39 RS-485 command priority selection. Allows commands (#30, #33, #34, and #37) from the RS-485 network to be used by the drive without having to explicitly set the `Command Mode` parameter. Refer to the Toshiba documentation regarding "Command Mode and Frequency Mode Control" for detailed information pertaining to the command source hierarchy and the use of overrides. ASD parameter FA04, bit #15.
- #40 Output terminal `Data Out 1`. Any programmable output terminals that are configured to output `Data Out 1 (NO)` or `Data Out 1 (NC)` will follow the value (or the inverted value) of this BO. ASD parameter FA50, bit #0.
- #41 Output terminal `Data Out 2`. Any programmable output terminals that are configured to output `Data Out 2 (NO)` or `Data Out 2 (NC)` will follow the value (or the inverted value) of this BO. ASD parameter FA50, bit #1.
- #42 Output terminal `Data Out 3`. Any programmable output terminals that are configured to output `Data Out 3 (NO)` or `Data Out 3 (NC)` will follow the value (or the inverted value) of this BO. ASD parameter FA50, bit #2.

11. Notes



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Printed in U.S.A