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**“MICRO” ADJUSTABLE SPEED DRIVE INTERFACE**

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**ICC**

**INDUSTRIAL CONTROL COMMUNICATIONS**



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**MDB-100**

**MODBUS RTU / ASCII COMMUNICATIONS INTERFACE**

**FOR THE TOSHIBA VF-S7 SERIES**

**ADJUSTABLE SPEED DRIVE**

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## Introduction

Thank you for purchasing the ICC MDB-100 Modbus RTU / ASCII Communications Interface for the Toshiba VF-S7 Series Micro Adjustable Speed Drive. Before using the MDB-100 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 with which the MDB-100 interface is connected, and keep this instruction manual in a safe place for future reference or drive/interface inspection.

This instruction manual describes the device specifications, wiring methods, maintenance procedures, supported functions and usage methods for the MDB-100 Modbus RTU / ASCII 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 communication and control potential of the MDB-100 interface:

- Toshiba *TOSVERT VF-S7 Series Instruction Manual*
- Toshiba *VF-S7 Industrial Inverter Serial Communications Option Manual*

If you do not have copies of these documents available, please contact Toshiba or your local Toshiba distributor to obtain them.



## Usage Precautions

### ***Operating Environment***

- Please use the MDB-100 only when the ambient temperature of the environment into which the MDB-100 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 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 or motor wiring.
- Route all communication cables separate from the inverter input/output power wiring.
- To avoid the possibility of electric shock due to leakage currents, always ground the inverter unit's E/GND terminal and the motor. To avoid misoperation, do not connect the MDB-100's SHIELD terminal to either of the above-mentioned grounds or any other power ground.
- When making connections between the MDB-100 and S7 drives, do not use cables that exceed 5 meters in length.
- For further drive-specific precaution, safety and installation information, please refer to the appropriate Toshiba documentation supplied with your S7 drive.

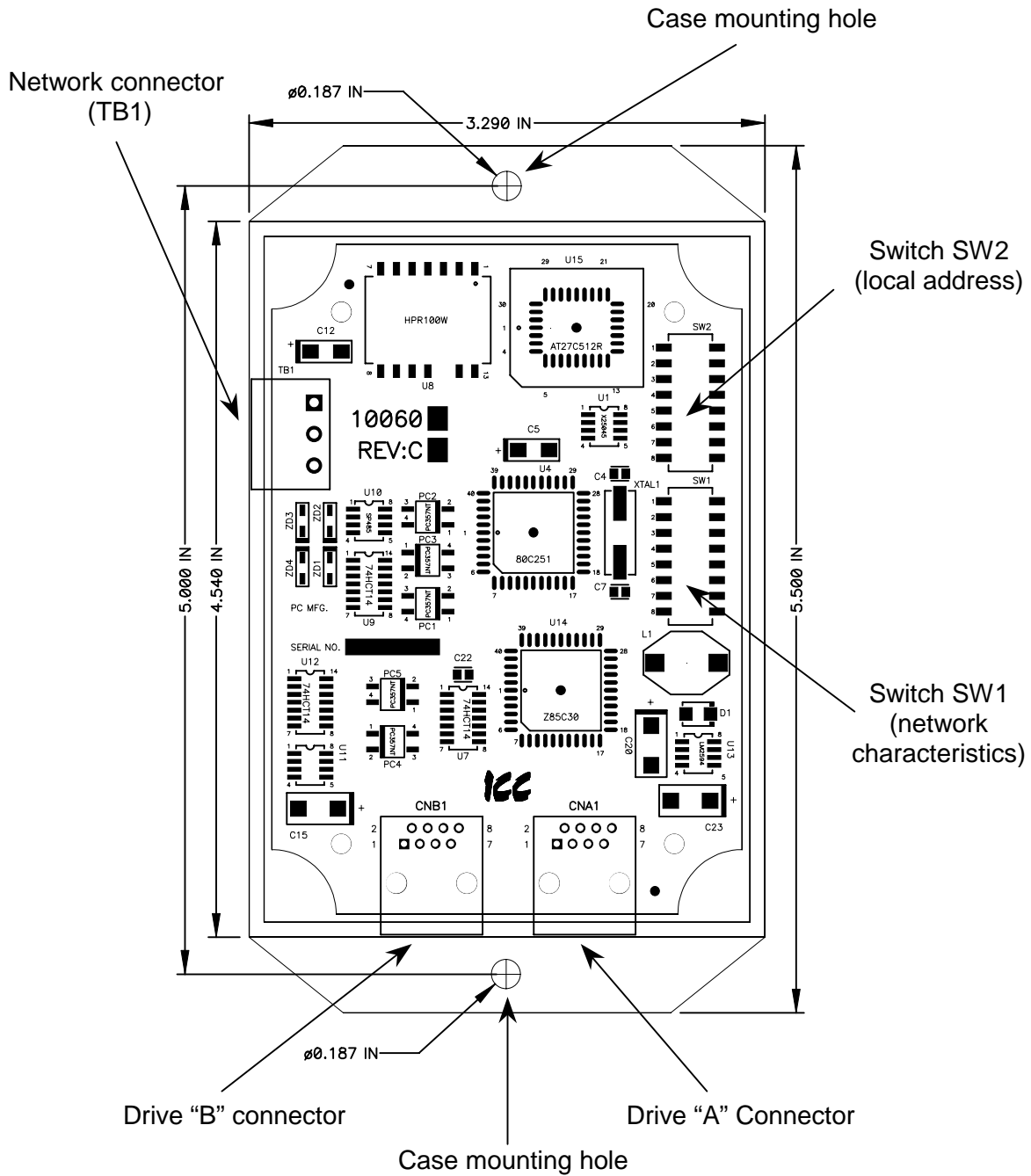
### ***Other Precautions***

- The drive's EEPROM has a life span of 10,000 write cycles. Do not write to the same holding register (other than registers 7A00 ~ 7A02 and FA00 ~ FA02 or write-only coils) more than 10,000 times.
- The MDB-100's EEPROM has a life span of 100,000 write cycles. Do not write to the same MDB-100 configuration register more than 100,000 times.
- Do not touch or insert a rod or any other item into the MDB-100's case while power is applied, as this may lead to electrical shock or device damage.
- Commission the disposal of the MDB-100 to a specialist.
- Do not assign the same network address to more than one MDB-100 station in the same network. For a detailed explanation of station addressing, refer to section 8.
- When the MDB-100 is configured to receive its Modbus RTU / ASCII station address from the drive on Channel A, be sure to reset the MDB-100 if the inverter number parameter on the drive on Channel A is changed. Refer to section 8 for more information.
- Because the MDB-100 derives its control power from the drive connected to Channel A, removing power from that drive will also cause the MDB-100 to lose power, even if power is still applied to the drive connected to channel B.
- When only 1 drive is connected to the MDB-100, it must be connected to Channel A.

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# 1. Interface Package Diagram



Note that the above diagram shows the MDB-100 with its cover removed. However, it is only necessary to remove the cover in order to initially configure the MDB-100. Once configured, the cover should be reinstalled to prevent damage and dust accumulation.

## 2. Feature Summary

The MDB-100 interface provides a wide array of network data access and drive control features. Combined with the flexible data access methods and universal acceptance of the Modbus network, this allows powerful networked control and monitoring systems to be designed. Some of the main features provided by the MDB-100 which allow for this control and configurability are briefly described here:

### **Protocol**

Modbus RTU and ASCII as specified in AEG Schneider Automation specification “*Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev. J*”.

### **Implementation**

Modbus network is optically isolated RS485 half-duplex 2-wire + shield physical layer, allowing connection of up to 32 units (masters and slave MDB-100 units) to a single bus trunk.

### **Network Baud Rates**

Supports all Modbus RTU/ASCII baud rates from 300 baud to 38.4kbaud.

### **Drive Connections**

The MDB-100 provides support for simultaneous connection of 2 VF-S7 drives. Both drives share a common Modbus station address. By supporting 2 drives per interface, the maximum number of drives that can be connected to 1 Modbus network segment without requiring repeaters increases from 31 (31 drives + 1 master) to 62 (31 MDB-100 units + 1 master).

### **Power Supply**

Self-contained. Powered directly from the drive connected to the Channel A communications port. No external power supply devices or connections are required.

### **Isolation**

The MDB-100 has 3 separate isolated circuitry sections. Each drive is fully optically isolated from each other, and both drives are optically isolated from the Modbus network. By using optically isolated connections to the drives and the Modbus network, noise immunity is greatly improved and grounding differential problems become a thing of the past.

### **Drive AutoScan Algorithm**

Connections to the drives are automatically established and continuously monitored. No drive configuration needs to be performed to connect the MDB-100 and communicate via the Modbus RTU or ASCII network. Just plug it in – it’s that simple.

### **Programmable Pointer Registers**

32 programmable pointer registers are provided for user definition. By using these registers, frequently-accessed drive parameters that may be scattered throughout the register map can be grouped together and accessed with a single holding register read or write command.

### **Response Delay Function**

A programmable network response delay function is available which forces the MDB-100 to wait a certain minimum time before generating network responses to Modbus commands. This function is useful when equipment such as radio modems (which require a finite time to switch from receive to transmit mode) are used as Modbus network bridges.

### **Network Watchdog**

A network watchdog function is available to detect if communication with the master controller has been interrupted. If an interruption is detected, several different drive actions can be programmed to ensure that the process under control can be safely and automatically driven to a desired state.

### **Modbus Network Connector**

The network interface is a 3-position pluggable terminal block with the following signals provided:

| <b>Pin Number</b> | <b>Function</b>                   |
|-------------------|-----------------------------------|
| 1                 | Modbus network RS485 "A" terminal |
| 2                 | Modbus network RS485 "B" terminal |
| 3                 | Network shield connection point   |

No network termination is provided on the MDB-100. Be sure to install proper RS485 network termination on the MDB-100 units that exist on the extreme endpoints of the network bus. This can be accomplished by placing a 121 $\Omega$  ( $\pm 5\%$ ), 1/2W resistor across the A and B network terminals of those 2 units.

### **Drive Network Connectors**

Uses standard RJ-45 style 8-pin modular connectors. Any standard category-5 ethernet cable (found in most electronics and office-supply stores) 5 meters or less in length can be used to connect the MDB-100 to the drives.




### **Supported Commands**

The MDB-100 presents and receives drive data via Modbus commands 01 (read coil status), 03 (read holding registers), 05 (force single coil), 06 (preset single register) and 16 (preset multiple registers).

### 3. Installing The MDB-100

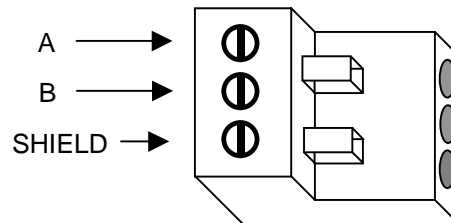
The MDB-100 connects to each drive via the drive's communication port, located on the right-hand side of the drive enclosure under a small snap-on cover. Although no drive parameters need to be configured in order to use the MDB-100, it is advantageous to check that the drive's communication data rate is set to its maximum speed. Because the MDB-100 will communicate to each drive only at the drive's configured data rate, this will provide the fastest response time for drive-to-Modbus network data transfers. For information on checking the drive's communication data rate, refer to the appropriate manual supplied with your drive. Note that each drive's communication data rate settings are independent of the Modbus network data rate, which is configured solely by the Modbus network characteristics switch (refer to section 7). Also note that the data communication parameters of each drive are handled independently; the drive connected to Channel A may simultaneously communicate to the MDB-100 at completely different baud rates, parity settings, etc. than the drive connected to Channel B.

Installation of the MDB-100 Modbus RTU / ASCII interface should only be performed by a qualified technician familiar with the maintenance and operation of the connected drives. To install the MDB-100, complete the following steps:

1.  **CAUTION!** Verify that all input power sources to the drives to be connected 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. Attach the MDB-100 to a sturdy, unmovable object (such as a wall) via the 2 case mounting holes located on the tabs at the top and bottom of the enclosure.
4. Remove the drive's communication port cover, located on the right-hand side of the drive (as viewed when facing the drive), by pressing against the side of the cover while sliding it toward the front of the drive. Do not discard this cover, as it should be reinstalled if the MDB-100 unit is ever disconnected from the drive.
5. Connect the drive's communication port to Channel A of the MDB-100 with the communication cable (communication cable is not included with the MDB-100 kit). When choosing cables for this connection, standard 24 AWG category-5 (CAT 5) unshielded twisted-pair (UTP) 8-conductor cables found in ethernet networks in most office environments can be used. The maximum allowable length for these cables is 5 meters. Although there are many varieties and styles of CAT-5 UTP cables available, ICC strongly recommends using only high-quality cables from reputable manufacturers to guarantee optimal noise immunity and cable longevity. Ensure that each end of the cable is fully seated into the modular connector, and route the 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.



6. Repeat steps 1, 2, 4 and 5 above to connect another drive to Channel B on the MDB-100, if desired.
7. Remove the cover of the MDB-100 by removing the 4 cover screws.
8. Configure the Modbus network characteristics such as baud rate, parity etc. via 8-position DIP switch SW1 (refer to section 7). If the MDB-100's station address is to be configured locally, select the desired station address via 8-position DIP switch SW2 (refer to section 8).
9. Reinstall the cover of the MDB-100.
10. Connect the Modbus network cable (2 signal wires + shield) to the 3-position pluggable terminal block marked "Network" on the left-hand side of the MDB-100. The terminal ordering for the network cable wiring is as shown in Figure 1.



**Figure 1: Modbus RS485 Network Terminal Wiring**

Note that some RS485 equipment manufacturers reference the "A" and "B" terminals reversed from the MDB-100's hardware, and some manufacturers use other labels, such as "+" and "-". If you cannot communicate with the MDB-100 after installation, try switching the "A" and "B" signal wires - swapped signal wires are the most common cause of communication difficulties in new RS485 network installations.

Ensure that the Modbus network cable is tightly screwed into the terminals, and route the cable such that it is located well away from any drive input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.

11. Take a moment to verify that the MDB-100 and all network cables have sufficient clearance from drives, motors, and power-carrying electrical wiring.
12. Turn the power sources to all connected drives ON, and verify that the drives function properly. If the drives do not appear to power up, or do not function properly, immediately turn power OFF. **Repeat steps 1 and 2 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local drive distributor or manufacturer for assistance if the problem persists.

## 4. Equipment 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             | SHIELD terminal connected to isolated network ground via 200Ω resistance.                                  |
| Cooling Method        | Self-cooled  |

## 5. Maintenance And Inspection

Preventive maintenance and inspection is required to maintain the MDB-100 Modbus 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 connected drives, and wait at least five minutes after each drive's "CHARGE" lamp has gone out.



**DANGER!**



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

### Inspection Points

- Check that the Modbus network connector screws and terminal block plug are not loose. Tighten if necessary.
- Check that the drive communication cables are not loose. Reinsert if necessary.
- Visually check all wiring and cables for damage. Replace as necessary.
- Clean off any accumulated dust and dirt.
- If use of the MDB-100 is discontinued for extended periods of time, apply power at least once every two years and confirm that the unit still functions properly.
- Do not perform hi-pot tests on the drives or MDB-100 interface, as they may damage the units.

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 MDB-100 interface is not used immediately after purchase or when it is not used for an extended period of time.

- Avoid storing the MDB-100 in places that are hot or humid, or that contain large quantities of dust or metallic dust. Store the MDB-100 in a well-ventilated location.
- When not using the MDB-100 interface 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 MDB-100 Modbus RTU / ASCII Communications Interface is covered under warranty by ICC 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 or your local distributor.

## 7. Network Characteristics Configuration

The MDB-100 interface board uses an 8-position DIP switch (labeled SW1) to configure the Modbus network communication characteristics. The switch settings are only read during initialization, so if a change is made to any of the switches on SW1, the MDB-100 must be reset in order to enable the new settings. The various configuration settings of switch SW1 are as follows:

### Communication Method:

| SW1 #<br>1 | Function                     |
|------------|------------------------------|
| OFF        | Modbus RTU (factory default) |
| ON         | Modbus ASCII                 |

### Baud Rate:

| SW1 # |     |     | Function                    |
|-------|-----|-----|-----------------------------|
| 4     | 3   | 2   |                             |
| OFF   | OFF | OFF | 300 baud                    |
| OFF   | OFF | ON  | 600 baud                    |
| OFF   | ON  | OFF | 1200 baud                   |
| OFF   | ON  | ON  | 2400 baud                   |
| ON    | OFF | OFF | 4800 baud                   |
| ON    | OFF | ON  | 9600 baud (factory default) |
| ON    | ON  | OFF | 19.2 kbaud                  |
| ON    | ON  | ON  | 38.4 kbaud                  |

### Parity:

| SW1 # |     | Function   |
|-------|-----|--|
| 6     | 5   |  |
| OFF   | OFF | even parity (factory default)                            |
| OFF   | ON  | odd parity   |
| ON    | OFF | no parity (2 stop bits)                                  |
| ON    | ON  | no parity (1 stop bit) - <i>applies only to RTU mode</i> |

### Protocol:

| SW1 #<br>7 | Function   |
|------------|--|
| OFF        | Modicon Modbus (factory default)                     |
| ON         | <i>DO NOT SELECT</i> (reserved for future expansion) |

### Station Number Origin: (refer to section 8)

| SW1 #<br>8 | Function  |
|------------|---|
| OFF        | Drive A's inverter number parameter (factory default) |
| ON         | Switch SW2 address setting                            |



## A Note About Modbus Communication Formats

According to the *Modicon Modbus Protocol Reference Guide*, the specifications for both Modbus ASCII and RTU communication modes are as follows:

### ASCII Mode

**Coding System:** ..... Hexadecimal, ASCII characters 0 ~ 9, A ~ F  
One hexadecimal character contained in each ASCII character of the message

**Bits per Byte:** ..... 1 start bit  
7 data bits, least significant bit sent first  
1 bit for even/odd parity; no bit for no parity  
1 stop bit if parity is used; 2 bits if no parity

**Error Check Field:**... Longitudinal Redundancy Check (LRC)

### RTU Mode

**Coding System:** ..... 8-bit binary, hexadecimal 0 ~ 9, A ~ F  
Two hexadecimal characters contained in each 8-bit field of the message

**Bits per Byte:** ..... 1 start bit  
8 data bits, least significant bit sent first  
1 bit for even/odd parity; no bit for no parity  
1 stop bit if parity is used; 2 bits if no parity

**Error Check Field:**... Cyclical Redundancy Check (CRC)

According to the Modicon Modbus specification, therefore, the number of bits per byte in ASCII mode is 1 start + 7 data + 1 parity + 1 stop (if parity is used), or 1 start + 7 data + 2 stop (if parity is not used). The ASCII data frame is therefore fixed at 10 bits per byte. Similarly, the number of bits per byte in RTU mode is 1 start + 8 data + 1 parity + 1 stop (if parity is used), or 1 start + 8 data + 2 stop (if parity is not used), resulting in an RTU data frame that is fixed at 11 bits per byte.

In addition to these standard specified data frame sizes, the MDB-100 interface offers an optional configuration of providing for only 1 stop bit when no parity is selected in the RTU communication mode. As indicated on the previous page, by setting SW5 and SW6 both to "ON", the RTU data frame size is modified to consist of 1 start + 8 data + 1 stop bit = 10 bits per byte. Please note that this setting is only valid when RTU mode is selected; if SW5 and SW6 are both set to "ON" when ASCII mode is selected, the MDB-100 will halt and will not communicate with the Modbus network.

## 8. Modbus Station Address Selection

The MDB-100 interface provides two different methods for configuring the node's station address. One method uses the inverter number parameter read from the drive connected to Channel A, and the other method uses a locally-configured address, set by DIP switches on the MDB-100 control PCB.

When shipped from the factory, the MDB-100's default configuration is to use the value set in the inverter number parameter (F802) of the drive connected to Channel A as its Modbus network station address. Depending on the software version of the drive connected to channel A, this parameter is adjustable from either 0~31 or 0~63.

Since Modbus addressing allows for station addresses to be set from 1 ~ 247, however, there may be instances where the upper limit of the inverter number parameter setting is not high enough to support a desired address (for example, if you want to set a MDB-100 station to address 95) In these instances, the locally-configured station address can be used, which supports the full Modbus station addressing range of 1 ~ 247.

Note that the Modbus protocol specification states that allowable station addresses are 1 to 247. If a station address is configured with 0 (inverter number or local address) or 248 to 255 (local address only), the MDB-100 will halt and will not communicate with the network. To resolve this situation, correct the station number and reset the MDB-100. Pay particular attention to this point, as the default factory setting of the drive's "inverter number" parameter is 0, which therefore must be changed if it is to be used as the MDB-100's station number.

The selection of whether to use the drive on Channel A's inverter number parameter or the locally-set station address is performed by switch SW1 #8. When SW1 #8 is OFF (factory default setting), the MDB-100's station address is retrieved from drive A's inverter number parameter. When SW1 #8 is ON, the MDB-100's station address is obtained by the binary number set via DIP switch SW2 (factory default address setting = 1).

| SW1 #8 | Meaning   |
|--------|---|
| OFF    | Drive A's inverter number parameter (factory default) |
| ON     | Switch SW2 address setting                            |

The values of switches SW1 and SW2 are read only during MDB-100 initialization. Therefore, if any of these switch settings are changed, the MDB-100 must be reinitialized to be made aware of the change by:

1. Momentarily powering-off drive A (from which the MDB-100 receives power), or
2. Issuing a reset command to the MDB-100 via the Modbus network by writing to holding register 0x6111<sup>NOTE 1, NOTE 2</sup>. Writing data 0x5A5A will reset the MDB-100, writing data 0xFEBA will reset the MDB-100 and return all MDB-100 –specific configuration registers (such as response delay time, loss of communications timeout time etc.) to their factory default values, and writing any other data will cause the MDB-100 to return a Modbus "ILLEGAL DATA VALUE" exception response (exception code 03). Reading from register 0x6111 will always return a value of 0.

| Holding Register | Write Data      | Meaning   |
|------------------|-----------------|---|
| 0x6111           | 0x5A5A          | Reset the MDB-100   |
|                  | 0xFEBA          | Reset the MDB-100 and return MDB-100 configuration registers to factory default values. |
|                  | Any other value | Return "ILLEGAL DATA VALUE" exception   |

**NOTE 1:** Throughout this document, hexadecimal (base 16) numbers will be represented by a preceding "0x" or by a trailing "H" designator, decimal (base 10) numbers will be represented by a trailing subscripted "10" designator, and binary (base 2) numbers will be represented by a trailing "B" designator. Binary numbers will always be written with their most significant bit (MSB) at the left, and their least significant bit (LSB) to the right (next to the "B").

For example,  $0x6111 = 6111H = 24849_{10} = 0110\ 0001\ 0001\ 0001B$ .

**NOTE 2:** The Modbus specification lists two addresses for each holding register (4X reference) and coil (0X reference). These are referred to as the "addressed as" and "known" as values. In all instances, registers and coils are addressed starting at zero; i.e. register 1 is addressed as 0, and coil 15 is addressed as 14, etc. Throughout this document, all addresses given for coils and holding registers will be their "addressed as" values unless otherwise specified. In other words, add 1 to the register/coil address given to obtain its "known as" value. For example, the S7 drive's inverter number parameter is 0802H (=  $0x0802 = 2050_{10}$ .) Therefore, this register would be "known as" 2051. Refer to the Modbus Protocol Reference Guide for a more detailed explanation of this issue.

The station address set via switch SW2 must be set using binary encoding. In this case, SW2 #1 represents bit #0 of the address, and SW2 #8 represents bit #7. When one of the DIP switches of SW2 is turned ON, the corresponding address bit is 1, and when one of the switches is turned OFF, the corresponding address bit is 0.

For example, if an address of  $169_{10}$  is desired, the conversion calculation would be performed as follows:

$169_{10} = 0xA9 = 1010\ 1001B$ , therefore switches SW2 #1, #4, #6 and #8 should be ON, and #2, #3, #5 and #7 should be OFF.

Some more address configuration examples (factory default setting = 1):

| Address (Decimal) | Address (Hex) | Address (Binary) | "ON" Switches    | "OFF" Switches  |
|-------------------|---------------|------------------|------------------|-----------------|
| 1 (min)           | 0x01          | 0000 0001B       | #1               | #2 ~ #8         |
| 63                | 0x3F          | 0011 1111B       | #1 ~ #6          | #7, #8          |
| 200               | 0xC8          | 1100 1000B       | #4, #7, #8       | #1 ~ #3, #5, #6 |
| 247 (max)         | 0xF7          | 1111 0111B       | #1 ~ #3, #5 ~ #8 | #4              |

## 9. Modicon Programming

### 9.1 Supported Modbus Commands

The MDB-100 interface supports 5 Modbus commands: command 1 (0x01: read coil status), command 3 (0x03: read holding registers), command 5 (0x05: force single coil), command 6 (0x06: preset single register) and command 16 (0x10: preset multiple registers). Not all registers or coils support all commands (for example, read-only registers cannot be written to with a command 16). For more information, refer to section 10. The following limits represent the maximum number of registers and coils that can be read/written in one packet transaction:

| Command | RTU Mode<br>Read Max | RTU Mode<br>Write Max | ASCII Mode<br>Read Max | ASCII Mode<br>Write Max |
|---------|----------------------|-----------------------|------------------------|-------------------------|
| 1       | 32 coils             | N/A                   | 32 coils               | N/A                     |
| 3       | 125 registers        | N/A                   | 61 registers           | N/A                     |
| 5       | N/A                  | 1 coil only           | N/A                    | 1 coil only             |
| 6       | N/A                  | 1 register only       | N/A                    | 1 register only         |
| 16      | N/A                  | 123 registers         | N/A                    | 59 registers            |

### 9.2 Programmable Pointer Register Function

MDB-100 registers 0x6000 ~ 0x601F and 0x6080 ~ 0x609F are used as programmable pointer and data registers, respectively. Registers 0x6000 ~ 0x601F (32 total) are used to define other register addresses from which you would like to read or write, and registers 0x6080 ~ 0x609F (32 total) are the actual registers used to access the data located at the register addresses defined in registers 0x6000 ~ 0x601F. For example, if you would like to continuously read the data from registers 0xFE03, 0xFE04, 0xFE06, and 0xFD00, the standard register configuration would require 3 read commands to be issued: one reading 2 registers starting at register 0xFE03, one reading 1 register starting at register 0xFE06, and one reading 1 register starting at register 0xFD00. To conserve network bandwidth and speed processing time, however, the programmable pointer registers can be used to allow the same information to be accessed, but by only issuing 1 command which reads 4 registers.

To configure this function, program as many registers as necessary (up to 32) in the range 0x6000 ~ 0x601F with the register numbers of the registers you would like to continuously access. In this example, we would set register 0x6000 to 0xFE03 (the first register number we want to access), register 0x6001 to 0xFE04, register 0x6002 to 0xFE06, and register 0x6003 to 0xFD00. The data located at these drive status registers can then be obtained by accessing the corresponding registers in the range 0x6080 ~ 0x609F (data register 0x6080 corresponds to address register 0x6000, data register 0x6081 corresponds to address register 0x6001, etc.) Therefore, the 4 registers that are to be monitored can now be accessed simply by issuing 1 holding register read command with a length of 4 starting from register 0x6080. The returned



data will be the data obtained from registers 0xFE03, 0xFE04, 0xFE06, and 0xFD00 (in that order).

Note that the settings of the programmable address registers (0x6000 ~ 0x601F) are stored in the MDB-100's nonvolatile EEPROM. Therefore, do not write to any of these registers more than 100,000 times. Typically, these registers would only be written to once, when the interface and Modbus network are first commissioned. When the programmable pointer registers are modified, the changes are made effective in the MDB-100 immediately (the MDB-100 does not need to be reset for the changed values to take effect).

### 9.3 Loss of Communications Timer Function

A configurable "loss of communications" (network watchdog) timer function is provided, which can detect communication losses and perform certain actions if a valid packet is not received and processed within a set time period.

MDB-100 register 0x6100 sets the loss of communication time value (adjustable from 100ms to 60.000s in 1ms increments, factory setting = 10.000s). If a valid (exception-free) reception-response or exception-free broadcast does not take place within this time limit, the timer will expire. If the timer expires, 5 possible actions can occur for each connected drive, as set by the value of registers 0x6101 and 0xE101 (loss of communications action for drive A and drive B, respectively):

| Register<br>0x6101 / 0xE101<br>Setting | Action Taken Upon Timeout |
|--|---------------------------|
| 0 (default)                            | No action: ignore timeout |
| 1                                      | Decelerated stop          |
| 2                                      | Coast stop                |
| 3                                      | Trip "E" (emergency off)  |
| 4                                      | Run a preset speed        |

When a network timeout is detected, the timeout action is performed. When communications are once again reestablished, the timer function is automatically reset and will once again begin to monitor network receptions. However, any actions performed as a result of the timeout occurring will not be reversed by the MDB-100 once communications are reestablished; the Modbus master's application must explicitly modify the affected conditions to fully return the drive to its previous state.

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

For setting 1 (decelerated stop), the drive will stop in a controlled manner if it was running. This action clears bit #10 in the selected drive's communication command bit structure (register 0x7A00 / 0xFA00 - also the same data as write-only coil #10 / #26). Note that the "communication command valid" bit of register 0x7A00 / 0xFA00 (bit #15 of each register, or write-only coil #15 / #31) must already be set by the master application for this timeout action to control the drive.

For setting 2 (coast stop), the drive will coast stop (free run) if it was running. This action clears bit #10 in the selected drive's communication command bit structure (register 0x7A00 / 0xFA00 - also the same data as write-only coil #10 / #26) and sets bit #11 (same as coil #11 / #27). Note that the "communication command valid" bit of register 0x7A00 / 0xFA00 (bit #15 of each register, or write-only coil #15 / #31) must already be set by the master application for this timeout action to control the drive.

For setting 3 (trip "emergency off"), the drive will trip "E". This action clears bit #10 in the selected drive's communication command bit structure (register 0x7A00 / 0xFA00 - also the same data as write-only coil #10 / #26) and sets bit #12 (same as coil #12 / #28). Note that in this case the setting of the "communication command valid" bit of register 0x7A00 / 0xFA00 (coil #15 / #31) is irrelevant; the drive will trip regardless of its value.

Setting 4 (run a preset speed) will modify the settings of bits #0 ~ #3 of the selected drive's communication command bit structure (register 0x7A00 / 0xFA00 - also the same data as write-only coils #0 ~ #3 / #16 ~ #19). The preset speed that is to run is selected by MDB-100 registers 0x6102 (for drive A) and 0xE102 (for drive B). The possible adjustment range for these registers is 0 ~ 15, corresponding to "no action" (0) and each of the drive's 15 possible preset speeds (1 ~ 15). Note that the "communication command valid" and "run/stop" bits of register 0x7A00 / 0xFA00 (bits #15 and #10 of each register, or write-only coil #15 & #10 / #31 & #26) must already be set by the master application for this timeout action to control the drive. **USE EXTREME CAUTION WHEN SELECTING THIS SETTING!** Thoroughly verify that there is no possibility of personal injury or equipment damage due to the inverter running at the selected speed, especially with the possibility that network communications may not be able to be reestablished in a timely fashion (depending on what network condition caused the communications timeout in the first place).

Note that the settings of the timeout time, timeout action and timeout preset speed configuration registers are stored in the MDB-100's nonvolatile EEPROM. Therefore, do not write to any of these registers more than 100,000 times. Also note that when the setting of any one of these configuration registers is changed, the MDB-100 must be reset for the new value to be activated and the change to take effect.

## 9.4 Response Delay Timer Function

Register 0x6110 contains the setting for a response delay timer function. This function is useful for applications where it may not be desirable for the MDB-100 interface to respond immediately to the network after a read/write request, such as when a radio modem that must be switched from receive mode to transmit mode is being used.

The response delay timer is adjustable in 1ms increments from 0s to 2.000s (factory setting = 0s). A response delay of 0s means that there is no delay; response packets will be sent by the MDB-100 as soon as they are available. The delay timer starts when a complete packet is received by the MDB-100, and a response will not be sent until the timer has expired (at a minimum). Note that this time value only sets a minimum response delay value - depending on the quantity and location of registers read / written, much more time may actually be required before a complete response is formulated and ready to be returned to the network.



The response delay timer value is read only upon MDB-100 initialization, requiring the unit to be reset if the value is changed for the new value to take effect. This setting is also non-volatile (written to the MDB-100's EEPROM). Therefore, do not write to this register more than 100,000 times.

## 10. Modbus Programming Interface

### 10.1 Overview

Three types of Modbus data may be accessed via the MDB-100. These are holding registers (4x reference), read-only coils (0x reference) and write-only coils (0x reference). In order to access 2 drives within the allocated holding register map (0x0000 ~ 0xFFFF), each drive is assigned one half of the register space.

Drive A occupies the area from register 0x0000 to 0x7FFF. This area also contains several network and drive configuration registers (such as the programmable pointer and data registers, network timeout registers, etc.) that reside within the MDB-100 only. The registers which the MDB-100 uses for these functions are not accessible in the drive. Currently, these registers are unoccupied in the drive, and therefore no loss of access to any drive parameters exists. Most of the registers for drive A are mapped to the exact same “communication number” that they are allocated in the S7 drive by Toshiba. Refer to the *VF-S7 Serial Communications Option Manual* for a list of communication numbers. The only exception to this direct mapping are the registers that occupy communication numbers larger than 0x8000. For these parameters, their corresponding Modbus holding registers can be obtained by setting the MSB (bit #15) of their communication number to 0.

For example, the communication number for drive A’s bus voltage parameter is 0xFE04 (1111 1110 0000 0100B). Setting bit #15 to 0, we obtain the binary value 0111 1110 0000 0100B, or 0x7E04. Reading from Modbus holding register 0x7E04 (“known as” 0x7E05), therefore, will return the bus voltage from drive A.

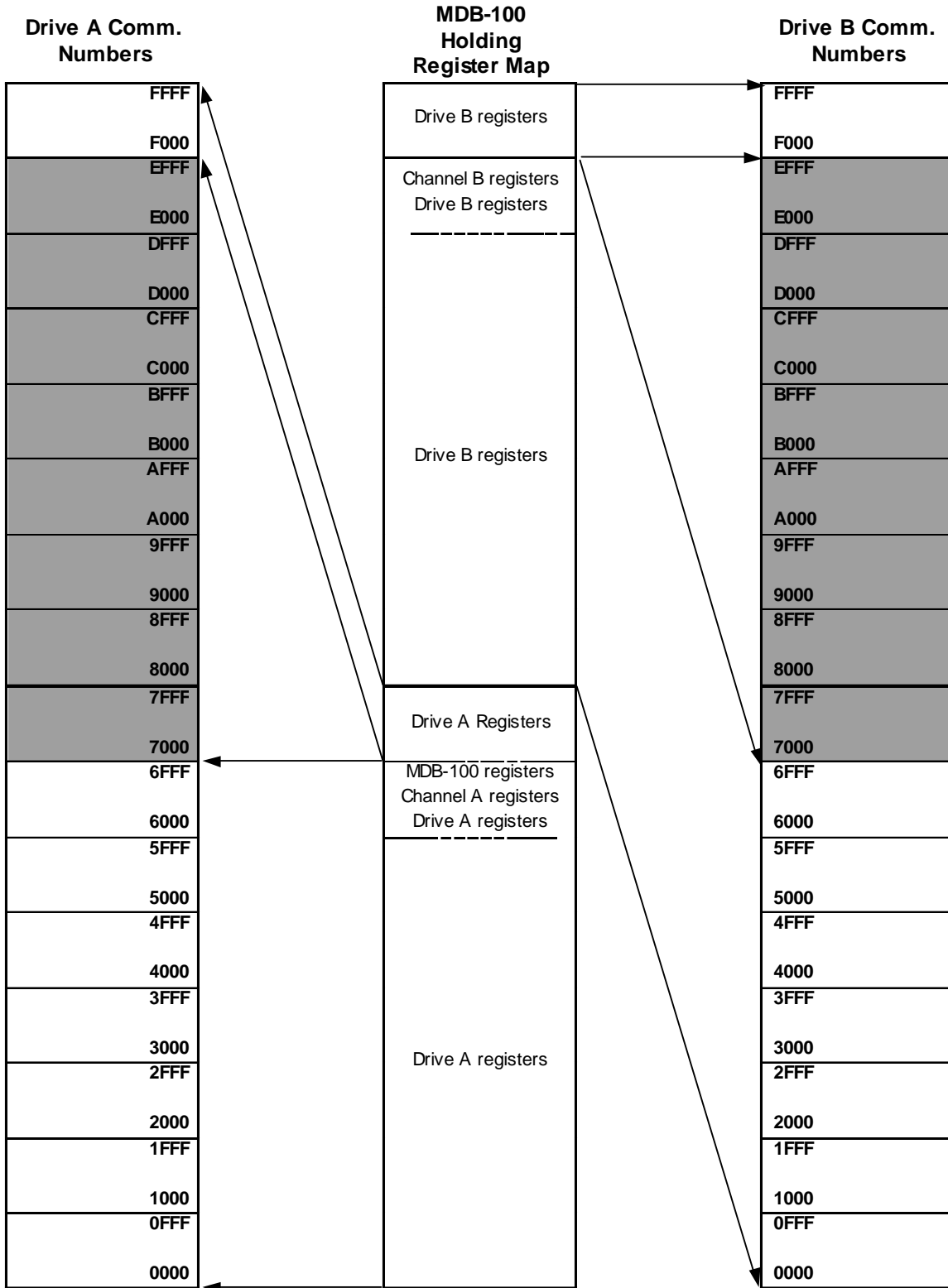
Drive B occupies the area from register 0x8000 to 0xFFFF. This area also contains the MDB-100 –specific drive configuration registers that correspond to those available for drive A. Most of the registers for drive B are not mapped to the exact same “communication number” that they are allocated in the S7 drive by Toshiba. For these parameters, their corresponding Modbus holding registers can be obtained by setting the MSB (bit #15) of their communication number to 1.

For example, the communication number for drive B’s deceleration time #1 parameter is 0x0010 (0000 0000 0001 0000B). Setting bit #15 to 1, we obtain the binary value 1000 0000 0001 0000B, or 0x8010. Writing to Modbus holding register 0x8010 (“known as” 0x8011), therefore, will modify the deceleration time #1 parameter for drive B.

The only exception to this mapping modification requirement for drive B are the registers that occupy communication numbers larger than 0x8000. For these parameters, the communication numbers given in the *VF-S7 Serial Communications Option Manual* correspond exactly to their assigned “addressed as” holding registers (for example, holding register 0xFE10 will access the past trip #1 value from drive B).

Refer to Figure 2 on page 20 for a graphical representation of the holding register mapping that exists in the MDB-100 Modbus interface.

**Figure 2: MDB-100 Holding Register Mapping**



*Note:* Inaccessible (currently unused) areas are shaded.

**Table 1: Holding Register Mapping General Overview**

| <b>Register #</b> | <b>Name / Function</b>   | <b>Factory Setting</b>        | <b>Adjustment Range</b>   |
|-------------------|--|-------------------------------|---|
| 0000 ~ 05FF       | Access drive A   | --                            | --  |
| 6000 ~ 601F       | Non-volatile programmable pointer registers (32 total available)                                 | 0000<br>(all 32)              | Any value other than<br>6000 ~ 601F or<br>6080 ~ 609F   |
| 6080 ~ 609F       | Programmable pointer data registers (each register corresponds to same one in 6000 ~ 601F range) | --                            | Depends on registers pointed to   |
| 6100              | Modbus network loss of communications timeout time   | 10000<br>(10.000s)            | 100 ~ 60000<br>(0.100s ~ 60.000s)   |
| 6101              | Modbus network loss of communications timeout action for Drive A                                 | 0                             | 0= do nothing<br>1= decelerated stop<br>2= coast stop<br>3= trip "E"<br>4= run a preset speed |
| 6102              | Loss of communications preset speed for Drive A (effective only when register 6101 is set to 4)  | 0                             | 0 ~ 15  |
| 6110              | Modbus network response delay time   | 0                             | 0 ~ 2000<br>(0ms ~ 2.000s)  |
| 6111              | Reset/reinitialize MDB-100 interface   | --<br>(read always returns 0) | 0x5A5A: reset only<br>0xFEBA: return<br>MDB-100 config registers to factory setting values    |
| 6112              | MDB-100 firmware version/revision (read-only)  | --                            | Version = MSB<br>Revision = LSB   |
| 6113 ~ 6FFF       | Access drive A   | --                            | --  |
| 7000 ~ 7FFF       | Access drive A communication numbers F000 ~ FFFF   | --                            | --  |
| 8000 ~ E100       | Access drive B communication numbers 0000 ~ 6100   | --                            | --  |
| E101              | Modbus network loss of communications timeout action for Drive B                                 | 0                             | Same as register 6101   |
| E102              | Loss of communications preset speed for Drive B (effective only when register E101 is set to 4). | 0                             | 0 ~ 15  |
| E103 ~ EFFF       | Access drive B registers 6103 ~ 6FFF   | --                            | --  |
| F000 ~ FFFF       | Access drive B   | --                            | --  |

Sections 10.2 to 10.4 specify the communication number → holding register mappings and coil definitions for all current VF-S7 communication numbers. Note that the parameters and coils shown are those available at the time of this manual printing; if new parameters are added by the drive manufacturer and/or parameter adjustment limits are modified, etc., this will not affect the operation of the MDB-100 interface. As all available parameters, adjustment ranges etc. are determined solely by the connected drive, and not the MDB-100, future drive firmware versions will automatically be supported by the MDB-100 with no software upgrades required.

In the case of any discrepancies between the information in the following tables and the drive's documentation, the drive's documentation should always be followed.

Some other important coil and holding register notes:

- Remember that all registers and coils indicated in the following sections are shown with their “addressed as” coil & register numbers. These coil & register numbers are 1 less than their “known as” numbers.
- A value indicated by “\*” in the following tables indicates that the setting is dependent on the connected drive's capacity. Refer to the drive's documentation for these values.
- If frequency command values (registers 0x7A01 / 0xFA01) higher than each respective drive's FH or UL parameters are written, the write will be acknowledged, but the drive will not change its frequency to this invalid value.
- All writes to holding registers use the drive's RAM / EEPROM data write (“W”) command except for registers 0x7A00 ~ 0x7A02 and 0xFA00 ~ 0xFA02, which use the drive's RAM data write (“P”) command.
- If an attempt is made to access non-existent registers or coils, an ILLEGAL DATA ADDRESS exception (code 02) will be returned.
- If an attempt is made to write invalid data to a register or coil, an ILLEGAL DATA VALUE exception (code 03) will be returned.
- If a drive connected to the MDB-100 goes “offline”, all coils will hold their last state, with the exception of read-only coils #115 and/or #131, which will indicate “offline”. Once communication with the drive(s) is reestablished, these coil(s) will again indicate “online”.
- If a drive connected to the MDB-100 goes “offline”, attempts to access any register in that drive's register space will return a Modbus “SLAVE FAILURE” error (code 04), except for the following registers, which will hold their last state:
  1. Communication command (communication number FA00)
  2. Communication frequency command (communication number FA01)
  3. Output frequency (communication number FD00)
  4. Status (communication number FE01)
  5. Output current (communication number FE03)
  6. Output voltage (communication number FE05)
- Note that the MDB-100 does not assign drive register and coil functions; they are entirely drive-dependent, and managed by the drive manufacturer.
- Each drive's write-only coils are mapped to the corresponding drive's communication command parameter (communication number #FA00). Also,

the MDB-100 does not place any restrictions on coils marked as “Reserved”. These coils may be written to at any time. The data or function associated with these coils is entirely defined by the connected drive.

- With the exception of coils #115 and #131, each drive’s read-only coils are mapped to the corresponding drive’s communication status register (communication number #FE01). Also, the MDB-100 does not place any restrictions on coils marked as “Reserved”. These coils may be read from at any time. The data or function associated with these coils is entirely defined by the connected drive.



## 10.2 Holding Registers

| Drive  | Reg. #<br>(hex) | Title | Function                                     | Max<br>(hex:dec) | Min<br>(hex:dec) | Run Mode<br>Modify |
|--------|-----------------|-------|--|------------------|------------------|--------------------|
| A<br>B | 0000<br>8000    | AU1   | Automatic acceleration and deceleration time | 1                | 0                | Yes                |
| A<br>B | 0001<br>8001    | AU2   | Automatic torque boost                       | 3                | 0                | No                 |
| A<br>B | 0002<br>8002    | AU3   | Automatic environment setting                | 2                | 0                | No                 |
| A<br>B | 0003<br>8003    | CMOD  | Command mode selection                       | 1                | 0                | Yes                |
| A<br>B | 0004<br>8004    | FMOD  | Frequency setting mode selection             | 2                | 0                | Yes                |
| A<br>B | 0005<br>8005    | FMSL  | FM terminal function selection               | 1                | 0                | Yes                |
| A<br>B | 0006<br>8006    | FM    | Connected meter adjustment                   | FF:255           | 0                | Yes                |
| A<br>B | 0007<br>8007    | tYP   | Standard setting mode selection              | 6                | 0                | No                 |
| A<br>B | 0008<br>8008    | Fr    | Forward/reverse selection (panel)            | 1                | 0                | Yes                |
| A<br>B | 0009<br>8009    | ACC   | Acceleration time #1 (s)                     | 8CA0:3600        | A:1.0            | Yes                |
| A<br>B | 0010<br>8010    | dEC   | Deceleration time #1 (s)                     | 8CA0:3600        | A:1.0            | Yes                |
| A<br>B | 0011<br>8011    | FH    | Maximum frequency                            | 7D00:320.0       | BB8:30.0         | No                 |
| A<br>B | 0012<br>8012    | UL    | Upper limit frequency                        | FH               | 32:0.5           | Yes                |
| A<br>B | 0013<br>8013    | LL    | Lower limit frequency                        | UL               | 0:0.0            | Yes                |
| A<br>B | 0014<br>8014    | vL    | Base frequency                               | 7D00:320.0       | 9C4:25.0         | Yes                |
| A<br>B | 0015<br>8015    | Pt    | V/F pattern                                  | 3                | 0                | No                 |
| A<br>B | 0016<br>8016    | vb    | Voltage boost                                | BB8:30.0         | 0                | Yes                |
| A<br>B | 0017<br>8017    | OLM   | OL selection                                 | 7                | 0                | Yes                |
| A<br>B | 0018<br>8018    | Sr1   | Preset speed 1                               | UL               | LL               | Yes                |
| A<br>B | 0019<br>8019    | Sr2   | Preset speed 2                               | UL               | LL               | Yes                |
| A<br>B | 0020<br>8020    | Sr3   | Preset speed 3                               | UL               | LL               | Yes                |
| A<br>B | 0021<br>8021    | Sr4   | Preset speed 4                               | UL               | LL               | Yes                |
| A<br>B | 0022<br>8022    | Sr5   | Preset speed 5                               | UL               | LL               | Yes                |

| Drive  | Reg. #<br>(hex) | Title | Function                            | Max<br>(hex:dec) | Min<br>(hex:dec) | Run Mode<br>Modify |
|--------|-----------------|-------|-------------------------------------|------------------|------------------|--------------------|
| A<br>B | 0023<br>8023    | Sr6   | Preset speed 6                      | UL               | LL               | Yes                |
| A<br>B | 0024<br>8024    | Sr7   | Preset speed 7                      | UL               | LL               | Yes                |
| A<br>B | 0100<br>8100    | F100  | Low speed signal output frequency   | FH               | 0:0.0            | Yes                |
| A<br>B | 0101<br>8101    | F101  | Speed reach signal output frequency | FH               | 0:0.0            | Yes                |
| A<br>B | 0102<br>8102    | F102  | Speed reach detection band          | FH               | 0:0.0            | Yes                |
| A<br>B | 0103<br>8103    | F103  | ST signal selection                 | 2                | 0                | Yes                |
| A<br>B | 0104<br>8104    | F104  | RST signal selection                | 1                | 0                | Yes                |
| A<br>B | 0110<br>8110    | F110  | Always active function selection    | 25:37            | 0                | Yes                |
| A<br>B | 0111<br>8111    | F111  | Input terminal selection #1         | 25:37            | 0                | Yes                |
| A<br>B | 0112<br>8112    | F112  | Input terminal selection #2         | 25:37            | 0                | Yes                |
| A<br>B | 0113<br>8113    | F113  | Input terminal selection #3         | 25:37            | 0                | Yes                |
| A<br>B | 0114<br>8114    | F114  | Input terminal selection #4         | 25:37            | 0                | Yes                |
| A<br>B | 0115<br>8115    | F115  | Input terminal selection #5         | 25:37            | 0                | Yes                |
| A<br>B | 0130<br>8130    | F130  | Output terminal selection #1        | 9                | 0                | Yes                |
| A<br>B | 0131<br>8131    | F131  | Output terminal selection #2        | 9                | 0                | Yes                |
| A<br>B | 0200<br>8200    | F200  | Frequency priority selection        | 1                | 0                | Yes                |
| A<br>B | 0201<br>8201    | F201  | VIA reference point #1              | 64:100           | 0                | Yes                |
| A<br>B | 0202<br>8202    | F202  | VIA point #1 frequency              | 7D00:320.0       | 0:0.0            | Yes                |
| A<br>B | 0203<br>8203    | F203  | VIA reference point #2              | 64:100           | 0                | Yes                |
| A<br>B | 0204<br>8204    | F204  | VIA point #2 frequency              | 7D00:320.0       | 0:0.0            | Yes                |
| A<br>B | 0210<br>8210    | F210  | VIB reference point #1              | 64:100           | 0                | Yes                |
| A<br>B | 0211<br>8211    | F211  | VIB point #1 frequency              | 7D00:320.0       | 0:0.0            | Yes                |
| A<br>B | 0212<br>8212    | F212  | VIB reference point #2              | 64:100           | 0                | Yes                |
| A<br>B | 0213<br>8213    | F213  | VIB point #2 frequency              | 7D00:320.0       | 0:0.0            | Yes                |
| A<br>B | 0240<br>8240    | F240  | Start-up frequency                  | 3E8:10.0         | 32:0.5           | Yes                |

| Drive  | Reg. #<br>(hex) | Title | Function                           | Max<br>(hex:dec) | Min<br>(hex:dec) | Run Mode<br>Modify |
|--------|-----------------|-------|------------------------------------|------------------|------------------|--------------------|
| A<br>B | 0241<br>8241    | F241  | Run frequency                      | FH               | 0:0.0            | Yes                |
| A<br>B | 0242<br>8242    | F242  | Run frequency hysteresis           | FH               | 0:0.0            | Yes                |
| A<br>B | 0250<br>8250    | F250  | DC injection starting<br>frequency | FH               | 0:0.0            | Yes                |
| A<br>B | 0251<br>8251    | F251  | DC injection current               | 64:100           | 0                | Yes                |
| A<br>B | 0252<br>8252    | F252  | DC injection time                  | C8:20.0          | 0:0.0            | Yes                |
| A<br>B | 0260<br>8260    | F260  | Jog run frequency                  | 7D0:20.0         | 0:0.0            | Yes                |
| A<br>B | 0261<br>8261    | F261  | Jog stop control                   | 2                | 0                | Yes                |
| A<br>B | 0270<br>8270    | F270  | Jump frequency #1                  | UL               | LL               | Yes                |
| A<br>B | 0271<br>8271    | F271  | Jump frequency band #1             | BB8:30.0         | 0:0.0            | Yes                |
| A<br>B | 0272<br>8272    | F272  | Jump frequency #2                  | UL               | LL               | Yes                |
| A<br>B | 0273<br>8273    | F273  | Jump frequency band #2             | BB8:30.0         | 0:0.0            | Yes                |
| A<br>B | 0274<br>8274    | F274  | Jump frequency #3                  | UL               | LL               | Yes                |
| A<br>B | 0275<br>8275    | F275  | Jump frequency band #3             | BB8:30.0         | 0:0.0            | Yes                |
| A<br>B | 0280<br>8280    | F280  | Preset speed 1                     | UL               | LL               | Yes                |
| A<br>B | 0281<br>8281    | F281  | Preset speed 2                     | UL               | LL               | Yes                |
| A<br>B | 0282<br>8282    | F282  | Preset speed 3                     | UL               | LL               | Yes                |
| A<br>B | 0283<br>8283    | F283  | Preset speed 4                     | UL               | LL               | Yes                |
| A<br>B | 0284<br>8284    | F284  | Preset speed 5                     | UL               | LL               | Yes                |
| A<br>B | 0285<br>8285    | F285  | Preset speed 6                     | UL               | LL               | Yes                |
| A<br>B | 0286<br>8286    | F286  | Preset speed 7                     | UL               | LL               | Yes                |
| A<br>B | 0287<br>8287    | F287  | Preset speed 8                     | UL               | LL               | Yes                |
| A<br>B | 0288<br>8288    | F288  | Preset speed 9                     | UL               | LL               | Yes                |
| A<br>B | 0289<br>8289    | F289  | Preset speed 10                    | UL               | LL               | Yes                |
| A<br>B | 0290<br>8290    | F290  | Preset speed 11                    | UL               | LL               | Yes                |
| A<br>B | 0291<br>8291    | F291  | Preset speed 12                    | UL               | LL               | Yes                |

| Drive  | Reg. #<br>(hex) | Title | Function                                    | Max<br>(hex:dec) | Min<br>(hex:dec) | Run Mode<br>Modify |
|--------|-----------------|-------|---|------------------|------------------|--------------------|
| A<br>B | 0292<br>8292    | F292  | Preset speed 13                             | UL               | LL               | Yes                |
| A<br>B | 0293<br>8293    | F293  | Preset speed 14                             | UL               | LL               | Yes                |
| A<br>B | 0294<br>8294    | F294  | Preset speed 15                             | UL               | LL               | Yes                |
| A<br>B | 0300<br>8300    | F300  | PWM carrier frequency (kHz)                 | *                | 16:2.2           | Yes                |
| A<br>B | 0301<br>8301    | F301  | Auto-restart (motor speed search)           | 3                | 0                | Yes                |
| A<br>B | 0302<br>8302    | F302  | Regeneration power ride-through control     | 1                | 0                | Yes                |
| A<br>B | 0303<br>8303    | F303  | Retry selection: number of times            | A:10             | 0                | Yes                |
| A<br>B | 0304<br>8304    | F304  | Regenerative braking selection              | 1                | 0                | Yes                |
| A<br>B | 0305<br>8305    | F305  | Overvoltage stall protection                | 1                | 0                | Yes                |
| A<br>B | 0306<br>8306    | F306  | Output voltage adjustment                   | 78:120           | 0                | Yes                |
| A<br>B | 0307<br>8307    | F307  | Line voltage compensation                   | 1                | 0                | No                 |
| A<br>B | 0400<br>8400    | F400  | Auto-tuning                                 | 2                | 0                | No                 |
| A<br>B | 0401<br>8401    | F401  | Slip frequency gain                         | FF:255           | 0                | Yes                |
| A<br>B | 0402<br>8402    | F402  | Motor constant 1: R1 gain                   | FF:255           | 0                | No                 |
| A<br>B | 0403<br>8403    | F403  | Motor constant 2: R2 gain                   | FF:255           | 0                | No                 |
| A<br>B | 0404<br>8404    | F404  | Motor constant 3: M gain                    | FF:255           | 0                | No                 |
| A<br>B | 0405<br>8405    | F405  | Load inertia                                | 3                | 0                | Yes                |
| A<br>B | 0406<br>8406    | F406  | Auto torque boost no load current           | 1E:30            | 0                | Yes                |
| A<br>B | 0407<br>8407    | F407  | Auto torque boost maximum boost             | 1E:30            | 0                | Yes                |
| A<br>B | 0500<br>8500    | F500  | Acceleration time #2                        | 8CA0:3600        | 1:0.1            | Yes                |
| A<br>B | 0501<br>8501    | F501  | Deceleration time #2                        | 8CA0:3600        | 1:0.1            | Yes                |
| A<br>B | 0502<br>8502    | F502  | Acceleration & deceleration pattern #1      | 2                | 0                | Yes                |
| A<br>B | 0503<br>8503    | F503  | Acceleration & deceleration pattern #2      | 2                | 0                | Yes                |
| A<br>B | 0504<br>8504    | F504  | Acceleration & deceleration pattern #1 & #2 | 1                | 0                | Yes                |

| Drive  | Reg. #<br>(hex) | Title | Function  | Max<br>(hex:dec) | Min<br>(hex:dec) | Run Mode<br>Modify |
|--------|-----------------|-------|---|------------------|------------------|--------------------|
| A<br>B | 0505<br>8505    | F505  | Acceleration & deceleration pattern #1 & #2 switching frequency | UL               | 0:0.0            | Yes                |
| A<br>B | 0600<br>8600    | F600  | Motor overload protection level                                 | 64:100           | *                | Yes                |
| A<br>B | 0601<br>8601    | F601  | Stall protection level  | C8:200           | *                | Yes                |
| A<br>B | 0602<br>8602    | F602  | Fault trip saving   | 1                | 0                | Yes                |
| A<br>B | 0603<br>8603    | F603  | Emergency stop selection  | 2                | 0                | Yes                |
| A<br>B | 0604<br>8604    | F604  | Emergency stop DC injection time                                | C8:20.0          | 0:0.0            | Yes                |
| A<br>B | 0605<br>8605    | F605  | Open phase detection parameter                                  | 2                | 0                | Yes                |
| A<br>B | 0700<br>8700    | F700  | Parameter setting disable selection                             | 2                | 0                | Yes                |
| A<br>B | 0701<br>8701    | F701  | Unit selection  | 3                | 0                | Yes                |
| A<br>B | 0702<br>8702    | F702  | Frequency units multiplication factor                           | 4E20:200.0       | 64:0.01          | Yes                |
| A<br>B | 0800<br>8800    | F800  | Communication speed   | 3                | 0                | Yes                |
| A<br>B | 0801<br>8801    | F801  | Parity  | 2                | 0                | Yes                |
| A<br>B | 0802<br>8802    | F802  | Inverter number   | 1F:31            | 0                | Yes                |
| A<br>B | 0803<br>8803    | F803  | Communication error trip time                                   | 64:100           | 0                | Yes                |
| A<br>B | 7A00<br>FA00    | FA00  | Communication command   | FFFF:65535       | 0                | Yes                |
| A<br>B | 7A01<br>FA01    | FA01  | Communication frequency command                                 | FH               | 0:0.0            | Yes                |
| A<br>B | 7A02<br>FA02    | FA02  | Panel frequency command   | FH               | 0:0.0            | Yes                |



## Status Monitoring Parameters (read-only)

| Drive  | Comm #<br>(hex) | Function                                |
|--------|-----------------|---|
| A<br>B | 7D00<br>FD00    | Current output frequency                |
| A<br>B | 7E00<br>FE00    | Output Frequency (saves trip frequency) |
| A<br>B | 7E01<br>FE01    | Status (saves trip status)              |
| A<br>B | 7E02<br>FE02    | Current frequency command               |
| A<br>B | 7E03<br>FE03    | Output current display                  |
| A<br>B | 7E04<br>FE04    | Bus voltage                             |
| A<br>B | 7E05<br>FE05    | Output voltage                          |
| A<br>B | 7E06<br>FE06    | Input terminal data                     |
| A<br>B | 7E07<br>FE07    | Output terminal data                    |
| A<br>B | 7E08<br>FE08    | CPU version                             |
| A<br>B | 7E09<br>FE09    | EEPROM version                          |
| A<br>B | 7E10<br>FE10    | Past trip 1                             |
| A<br>B | 7E11<br>FE11    | Past trip 2                             |
| A<br>B | 7E12<br>FE12    | Past trip 3                             |
| A<br>B | 7E13<br>FE13    | Past trip 4                             |
| A<br>B | 7E14<br>FE14    | Cumulative run time                     |

## Trip Data Codes

| Display | Data      | Trip Type                                   |
|---------|-----------|---|
| nErr    | 0000      | No trip                                     |
| OC1     | 0001      | Overcurrent during acceleration             |
| OC2     | 0002      | Overcurrent during deceleration             |
| OC3     | 0003      | Overcurrent during constant-speed run       |
| OCL     | 0004      | Load-end short circuit trip during start-up |
| OCA     | 0005      | Phase short circuit                         |
|         | 0006      | reserved                                    |
|         | 0007      | reserved                                    |
| EPH1    | 0008      | reserved                                    |
| EPH0    | 0009      | Loss of output phase                        |
| OP1     | 000A      | Overvoltage during acceleration             |
| OP2     | 000B      | Overvoltage during deceleration             |
| OP3     | 000C      | Overvoltage during constant-speed run       |
| OL1     | 000D      | Inverter overload trip                      |
| OL2     | 000E      | Motor overload trip                         |
| OLr     | 000F      | DBR overload                                |
| OH      | 0010      | Overheat trip                               |
| E       | 0011      | Emergency stop                              |
| EEP1    | 0012      | EEPROM fault: write error                   |
|         | 0013      | reserved                                    |
|         | 0014      | reserved                                    |
| Err2    | 0015      | RAM fault                                   |
| Err3    | 0016      | ROM fault                                   |
| Err4    | 0017      | CPU fault                                   |
| Err5    | 0018      | Communication interruption error            |
|         | 0019~0024 | reserved                                    |
| OCr     | 0025      | Dynamic braking resistor trip               |
|         | 0026~0027 | reserved                                    |
| Etn     | 0028      | Auto-tuning error                           |
| EtYP    | 0029      | Inverter typeform error                     |

## 10.3 Write-Only Coils

|         | Coil # | S7 ASD Function               | OFF     | ON                   |
|---------|--------|-------------------------------|---------|----------------------|
| Drive B | 31     | Command source                | Local   | Network              |
|         | 30     | Frequency command source      | Local   | Network              |
|         | 29     | Fault reset                   | N/A     | Reset                |
|         | 28     | Emergency OFF command         | N/A     | Trip "E"             |
|         | 27     | Coast stop command            | N/A     | Coast stop           |
|         | 26     | Run / stop command            | Stop    | Run                  |
|         | 25     | Forward / reverse selection   | Forward | Reverse              |
|         | 24     | Jog command                   | N/A     | Jog                  |
|         | 23     | DC injection braking          | N/A     | DC injection command |
|         | 22     | Accel / decel #1/#2 selection | #1      | #2                   |
|         | 21     | Reserved                      | --      | --                   |
|         | 20     | Reserved                      | --      | --                   |
|         | 19     | Preset speed 4                | OFF     | ON                   |
|         | 18     | Preset speed 3                | OFF     | ON                   |
|         | 17     | Preset speed 2                | OFF     | ON                   |
|         | 16     | Preset speed 1                | OFF     | ON                   |
| Drive A | 15     | Command source                | Local   | Network              |
|         | 14     | Frequency command source      | Local   | Network              |
|         | 13     | Fault reset                   | N/A     | Reset                |
|         | 12     | Emergency OFF command         | N/A     | Trip "E"             |
|         | 11     | Coast stop command            | N/A     | Coast stop           |
|         | 10     | Run / stop command            | Stop    | Run                  |
|         | 9      | Forward / reverse selection   | Forward | Reverse              |
|         | 8      | Jog command                   | N/A     | Jog                  |
|         | 7      | DC injection braking          | N/A     | DC injection command |
|         | 6      | Accel / decel #1/#2 selection | #1      | #2                   |
|         | 5      | Reserved                      | --      | --                   |
|         | 4      | Reserved                      | --      | --                   |
|         | 3      | Preset speed 4                | OFF     | ON                   |
|         | 2      | Preset speed 3                | OFF     | ON                   |
|         | 1      | Preset speed 2                | OFF     | ON                   |
|         | 0      | Preset speed 1                | OFF     | ON                   |





## 10.4 Read-Only Coils

| Coil # | S7 ASD Function                 | OFF                      | ON                   |
|--------|---------------------------------|--------------------------|----------------------|
| 131    | Drive B online / offline status | Offline                  | Online               |
| 130    | Reserved                        | Always "0"               |                      |
| 129    | Reserved                        | Always "0"               |                      |
| 128    | Reserved                        | Always "0"               |                      |
| 127    | Reserved                        | Always "0"               |                      |
| 126    | Run / stop status               | Stopped                  | Running              |
| 125    | Forward / reverse status        | Forward                  | Reverse              |
| 124    | Jog status                      | Not jogging              | Jogging              |
| 123    | DC injection braking status     | Not DC injection braking | DC injection braking |
| 122    | Accel / decel #1/#2 status      | #1                       | #2                   |
| 121    | Reserved                        | Always "0"               |                      |
| 120    | Reserved                        | Always "0"               |                      |
| 119    | Reserved                        | Always "0"               |                      |
| 118    | Reserved                        | Always "0"               |                      |
| 117    | Reserved                        | Always "0"               |                      |
| 116    | Reserved                        | Always "0"               |                      |
| 115    | Drive A online / offline status | Offline                  | Online               |
| 114    | Reserved                        | Always "0"               |                      |
| 113    | Reserved                        | Always "0"               |                      |
| 112    | Reserved                        | Always "0"               |                      |
| 111    | Reserved                        | Always "0"               |                      |
| 110    | Run / stop status               | Stopped                  | Running              |
| 109    | Forward / reverse status        | Forward                  | Reverse              |
| 108    | Jog status                      | Not jogging              | Jogging              |
| 107    | DC injection braking status     | Not DC injection braking | DC injection braking |
| 106    | Accel / decel #1/#2 status      | #1                       | #2                   |
| 105    | Reserved                        | Always "0"               |                      |
| 104    | Reserved                        | Always "0"               |                      |
| 103    | Reserved                        | Always "0"               |                      |
| 102    | Reserved                        | Always "0"               |                      |
| 101    | Reserved                        | Always "0"               |                      |
| 100    | Reserved                        | Always "0"               |                      |

Drive B

Drive A







122



A series of 20 horizontal lines for writing, spaced evenly down the page.



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