



***Tmd* series vector inverter Modbus Control Operation Manual**

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1 Scope

This document is intended to define the specifics required for serial communication with the Lenze **Tmd** series drives for control, status monitoring, and programming parameters. A familiarity with normal drive capabilities and operations is assumed. If this is not the case, please refer to the **Tmd** instruction manual as necessary.

Only **Tmd** models with an “L” as the eighth digit in the model number (ex. ESMD371L4TXA) are equipped with RS-485 capabilities. When using this feature the drive can communicate with a personal computer (PC), programmable logic controller (PLC), or other external device that utilizes RS-485 serial communication for control or monitoring. RS-485 half-duplex interface allows up to 32 devices to communicate on the network using a twisted pair of wires. The wires must be terminated at both ends of the network with resistors equal to their characteristic impedance, typically 120Ω. In noisy environments, twisted and shielded wire should be used. Ground the shield at the drive end only. This will further reduce unwanted noise and improve overall communication reliability. In addition, grounding terminal 7 on the **Tmd** is recommended when using serial communications.

2 Modbus® Details

A) **Tmd** series drives running the Modbus communication protocol use the RTU (Remote Terminal Unit) transmission mode and are slaves only. Therefore, the device communicating with the drives must be a Modbus Master. The baud rate is 9600, no parity (two stop bits). There are provisions for Odd parity 1 stop bit and Even parity 1 stop bit as well. The bit sequence is:

| | | | | | | | | | | |
|-------|------|---|---|---|---|---|---|---|------|------|
| | DATA | | | | | | | | | |
| Start | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Stop | Stop |

B) At this time the **Tmd** series drive does not support the broadcast function of the protocol.

C) IMPORTANT NOTE: Modbus 3X and 4X Registers are numbered starting at 1. However, when transmitted to a slave over the serial link, the actual address transmitted is one less. This is because the addresses are numbered starting from 0. The **Tmd** register numbers are also numbered starting from 0. Therefore, **Tmd** register numbers always correspond exactly with the address transmitted. As a result, MODBUS REGISTER NUMBERS ARE ALWAYS ONE GREATER THAN THE **Tmd** REGISTER NUMBERS. WHENEVER THE WORDS “REGISTER #xx” APPEAR, IT SHOULD BE ASSUMED THAT THEY MEAN “**Tmd** REGISTER xx” and the Modbus Register number will be one larger. In some instances we may show both for clarity. For example: “Register #24 (Modbus Register #25) . . .”

D) The function codes supported by the **Tmd** series are:

1) 03 - Read Holding Register (4X references). In general we can read only one register at a time. However, there are a few limited exceptions.

Exception One:

a) Register #24 (Modbus Register #25) Drive Status, can also be read as a group of 6 words.

Exception Two:

The **Tmd** uses a method of reading a group of related registers that may not be consecutive within the drive memory map. When this is done for the registers below, the response from the drive will be for the number of words requested but will not be with consecutive registers.

b) Register #114 (Modbus Register #115), Software version, should be read as a group of 4 words.

2) 04 - Read Input Register (3X references). As with function 03, we read one register at a time except where noted.

3) 06 - Preset Single Register (4X references). Write single register.

4) 16 - Preset Multiple Registers (4X references). Although the function is for multiple registers, we will accept only a single register to be written.

5) Note: Since we do not differentiate between 4X and 3X references, function codes 03 and 04 are treated identically.

E) Exception codes:

01 - Command rejected, Illegal function.

02 - No such register.

03 - Data out of range.

04 - Wrong data format.

06 - Slave device busy.

F) The **Tmd** will most nearly conform to the Modicon® Micro 84 in capabilities. This may be of importance when configuring networks for DDE Servers.

G) Modbus and Modicon are registered trademarks of Schneider Electric. For more information about the Modbus Protocol please refer to the Modicon Modbus Protocol Reference Guide. The 24 hours support telephone number from Schneider Electric is 1-800-468-5342.

3 Universal Registers

Lenze manufactures several drive families. Currently the Lenze **smd** and **Tmd** series support Modbus based communications. Since the different families of drives have quite different parameters and size ranges, the parameter (register) definitions are in many cases quite different. In order to facilitate communication in a network with a mix of drive types, certain Register locations have been made universal among Lenze **smd** and **Tmd** drives. While their locations are consistent, their contents may vary as defined in the following table:

| Register # | Function |
|------------|---|
| 1 | Drive Control (WRITE ONLY). Not all drives will have all control functions. But when the function is available it will be at a defined bit location within Register #1. Drive Family and register Configuration Number dependent. |
| 19 | Drive Family (READ ONLY). This register is CONSISTENT AMONG smd AND Tmd DRIVES: The Tmd value is 71 |
| 21 | Drive Size (READ ONLY). Code to identify Power (HP/KW) and Line Voltage of the drive. Family dependent. The Tmd values are shown following Table 1 in Section 6 |
| 22 | Hardware Configuration word register (READ ONLY). Individual bit flags. |
| 24 | Drive Status (READ ONLY). Various operational variables. |
| 48 | Unlock Control (WRITE ONLY). |
| 49 | Unlock Writing of registers (WRITE ONLY). |
| 50 | Parameter Configuration Number (READ ONLY). |

4 Data Internal and External Representation

A) All registers are 16 bits. The data within these registers can take on the following forms:

- 1) Individual bit commands (16 per register).
Example: Register #1 (Modbus Register #2).
- 2) Individual bit flags (16 per register).
Example: Register #22.
- 3) A concatenation of two 8 bit unsigned integers.
- 4) A 16 bit unsigned integer. This unsigned integer could in turn represent many different types of data with various scaling rules and units, which are defined by the DATA TYPE of the register.

B) Data Types

Data passed in registers across the Modbus communications link are always in INTERNAL units. The drive itself may show the information in alternate DISPLAYED units. For Example: drive speeds are always stored internally as tenths of a Hz but the drive may display that speed in whole Hz by dropping the tenth using programmed conversion factors. The Following are examples of the internal units used on the **Tmd**:

| Type | Unit | Example |
|---------------------------------------|--------|----------------|
| SPEED | .1 Hz | 60Hz = 600 |
| TIME | .1 Sec | 30.0 Sec = 300 |
| <i>See Programming Parameter List</i> | | |

5 Tmd Parameters

Registers #0 through #50 (Modbus Registers #1 to #51) are reserved for configuration and Control. Registers #51 through #255 (Modbus Registers #52 to #256) are reserved for the Drives' Programming Mode Parameters. Programming Mode Parameters are the parameters that can be accessed from the local keypad on the drive. To find the register address for a particular parameter see Table 2 - Programming Parameter List.

The entries in Tables 1 and 2 are based on **Tmd** Drive Software #1.20 (Parameter Configuration = 503). If a later revision of software were to change register definitions, drive operation could be seriously affected. This will be identified for a given drive by examining Register #50 (Parameter Configuration Number). The number displayed at power up on drive display can also identify it. If it is not 503, writing to any register on the drive **MUST NOT BE ATTEMPTED** unless your Controller has been setup to support the new configuration.

6 Tmd Operational Details

A) In order to communicate using MODBUS protocol, the **Tmd** Control source setpoint parameter C01 must be set to one of the following values:

8 – MODBUS protocol. Drive is controlled via terminal programming and monitoring can be accomplished via MODBUS serial interface or keypad. Default speed source is set to be analog input.

9 – same as selection 8 but default speed source is set to c40.

10 – same as selection 8 but drive control is switched to serial.

11 – same as selection 10 but default speed source is set to c40.

B) Network Address – code C09. This parameter must be programmed prior to attempting to operate the serial interface.

C) Parameter c25 – If parameter C01 is set to 8...11 (MODBUS selected). Then the selections in code c25 have following meaning:

0 = 9600,N,2

1 = 9600,N,1

2 = 9600,E,1

3 = 9600,O,1

Prior to attempting to communicate with the drive, Parameter c25 must be appropriately programmed.

D) Unlocking & Locking Controls

1) A write to Register #48 (Unlock Controls) with a value of 0 will unlock controls. This enables the writing of Register #1 – the Drive Control Register.

Note: Code C01 must be set to 10 or 11 in order to unlock serial control.

2) If Register #48 (Unlock Controls) is written with a value that is the Drive's Programming Password, then in addition to Register #1(Drive Control), writing to all other writeable registers is enabled (e.g.: register #76 -- Preset Speed #1). The factory default password for the **Tmd** is 0.

3) Once Register #48 (Unlock Controls) has been written, Controls are unlocked until Register#1 bit 1 (Lock Bit) has been written, Code C01 is changed to value different then 10 or 11, drive is powered down.

4) Writing to Register #1 (Drive Control) with bit 1 set will Lock both Controls and Parameters (prevents writing to any register).

5) When LOCK is asserted, the drive drops out of SERIAL control. After receiving the WRITE message when serial control is locked, drive will return exception code 01.

6) Even though drive might be locked, and thus parameters and control cannot be written, parameters and status can always be read. See section (G) below.

E) Unlocking & Locking Programming Parameters only

1) Writing to any writeable register other than #1 can be enabled by writing the Drive's Programming Password to Register #49 (Unlock Parameters). This would be done when Drive Control (start, forward and reverse) is not required.

2) The Factory Default password is 0.

3) Once Register #49 (Unlock Parameters) has been written, the writing of parameter registers is unlocked until Register #1bit 1 (Lock Bit) has been set.

F) Watchdog Timer

The **Tmd** is equipped with a Serial Link “Watchdog Timer”. If the Modbus Master wishes to control the drive (start, stop, forward, reverse, etc.) it must first “Unlock Controls” (See “D” on page). If the Watchdog Timer is enabled, the Master **MUST PERIODICALLY COMMUNICATE** with the drive or the timer will timeout.

Watchdog timer setup is performed by using parameters n22 and n23.

Code n22 is used to select drive reaction to serial timeout.

- a) Selection 0 – Not active. Watchdog timer is disabled.
- b) Selection 1 – Controller inhibit. If drive doesn't receive valid communication for period longer that time specified in parameter n23, it coast to stop and status display (c61) will show inhibit state ‘Inh’.
- c) Selection 2 – Quick Stop. If drive doesn't receive valid communication for period longer that time specified in parameter n23, it will ramp to stop and status display (c61) will show stop state ‘Stp’.
- d) Selection 3 – Trip fault ‘FC3’. If drive doesn't receive valid communication for period longer that time specified in parameter n23, it trip with fault ‘FC3’.

NOTE: To prevent erroneous timeout trips, make sure the time set in parameter n23 is appropriate for particular network - default value of 50ms may be too restrictive!

WARNING: Disabling the watchdog timer may cause injury to personnel and/or damage to equipment. The watchdog timer should only be disabled during configuration or diagnosis to prevent nuisance timeout trips.

G) Monitoring Only Operation

- 1) Power up drive
- 2) Set code C01 to selection 8 or 9.
- 3) Simply read **Tmd** Register #24 (Modbus Register #25) or any other readable register.
- 3) No unlocking or watchdog issues apply for monitoring.

H) Normal Control Operation Sequence.

- 1) Power up the drive.
- 2) Set code C01 to selection 10 or 11.
- 3) Close terminal 28.
- 4) Unlock control by writing a password (default 0) to Register #48.
- 3) Control drive operation via various commands to Register #1 (Start, Stop, Reverse direction, etc.) and change the keypad command speed by writing to Register #40.
Note: Drive must be in “NETWORK REFERENCE” (see Register #1 [drive control]) in order to control speed via Register #40.
- 5) If serial timeout is activated (code n22 higher then 0), keep it from timing out by assure that repeated reads of drive status (Register #24 – 6 registers) are performed at reasonable intervals smaller than time set in code n23
- 6) Lock Control when drive operations are complete by writing a 2 to Register #1 (assert bit 1 of Register 1).

I) Start/Stop, Speed Control and Parameter Change Operation Typical Sequence.

- 1) Power up the drive.
- 2) Set code C01 to selection 10 or 11.
- 3) Close terminal 28.
- 2) Unlock Controls and Parameters by writing the current programming password (default 0) to Register #48.
- 4) Control Drive Operation via various commands to Register #1 (Start, Stop, Reverse direction, etc.).
- 5) Set the network speed reference by setting the bit 8 in Register #1
- 5) Control Drive Speed by writing the Speed Commands to Register #40 (Network Speed Command).
- 6) Change the programming parameters (e.g., change the acceleration rate by writing new acceleration rate to register #61)
- 7) If serial timeout is activated (code n22 higher then 0), keep it from timing out by assure that repeated reads of drive status (Register #24 – 6 registers) are performed at reasonable intervals smaller than time set in code n23
- 8) Lock Control when drive operations are complete by writing a 2 to Register #1 (assert bit 1 of Register 1).

TABLE 1 - *Tmd* Drive Control Registers

*See Note [1], for an explanation of the abbreviations used below.

| smd# (HEX representation) | REGISTER NAME | R/W/RS | MESSAGE | | | | | | | | MIN | MAX | | NOTE |
|---------------------------|---|--------|---------|----|----|-----|-----|-----|-----|-----|---------------------|---------------------|--------|------|
| | | | | | | | | | | | | | | |
| 1 (01) | Drive Control | W | SA | 06 | 00 | 01 | DH | DL | CRC | | See Notes | | | [2] |
| | | RS | SA | 06 | 00 | 01 | DH | DL | CRC | | | | | |
| 19 (13) | Drive Family | R | SA | 03 | 00 | 13 | 00 | 01 | CRC | | See Notes | | | [3] |
| | | RS | SA | 03 | 02 | 00 | 42 | CRC | | | | | | |
| 21 (15) | Drive Size | R | SA | 03 | 00 | 15 | 00 | 01 | CRC | | See Notes | | | [4] |
| | | RS | SA | 03 | 02 | 00 | 00 | CRC | | | | | | |
| 22 (16) | Drive H/W | R | SA | 03 | 00 | 15 | 00 | 01 | CRC | | See Notes | | | [5] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 24 (18) | Drive Status (6 register read) (reg. #24 to 29) | R | SA | 03 | 00 | 18 | 00 | 06 | CRC | | See Notes | | | [6] |
| | | RS | SA | 03 | 0C | D1H | D1L | D2H | D2L | | | | | |
| | | | | | | D3H | D3L | D4H | D4L | | | | | |
| | | | | | | D5H | D5L | D6H | D6L | CRC | | | | |
| 24 (18) | Command Speed | R | SA | 03 | 00 | 18 | 00 | 01 | CRC | | 0 | 2400 | 0.1 Hz | [6a] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 25 (19) | Actual Speed | R | SA | 03 | 00 | 19 | 00 | 01 | CRC | | 0 | 2400 | 0.1 Hz | [6b] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 26 (1A) | Load (DH) / Status (DL) | R | SA | 03 | 00 | 1A | 00 | 01 | CRC | | See Notes | | | [6c] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 27 (1B) | Act. Direction (DH)/ Control Mode (DL) | R | SA | 03 | 00 | 1B | 00 | 01 | CRC | | See Notes | | | [6d] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 28 (1C) | Speed Source(DH)/ Speed Ref(DL) | R | SA | 03 | 00 | 1C | 00 | 01 | CRC | | See Notes | | | [6e] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 29 (1D) | Fault (DH)/ Commanded Direction (DL) | R | SA | 03 | 00 | 1D | 00 | 01 | CRC | | See Notes | | | [6f] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 30 (1E) | Motor Voltage | R | SA | 03 | 00 | 1E | 00 | 01 | CRC | | 0 | 800 | 1 V | [7] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| 40 (28) | Serial Speed Command | R | SA | 03 | 00 | 28 | 00 | 01 | CRC | | C10 Min freq. | C11 Max freq. | 0.1 Hz | [8] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |
| | | W | SA | 06 | 00 | 28 | DH | DL | CRC | | | | | |
| | | RS | SA | 06 | 00 | 28 | DH | DL | CRC | | | | | |
| 48 (30) | Unlock Commands | W | SA | 06 | 00 | 30 | DH | DL | CRC | | 0 | 9999 | None | [9] |
| | | RS | SA | 06 | 00 | 30 | DH | DL | CRC | | | | | |
| 49 (31) | Unlock Parameters | W | SA | 06 | 00 | 31 | DH | DL | CRC | | 0 | 9999 | None | [10] |
| | | RS | SA | 06 | 00 | 31 | DH | DL | CRC | | | | | |
| 50 (32) | Register Version | R | SA | 03 | 00 | 32 | 00 | 01 | CRC | | 0 | 65535 | None | [11] |
| | | RS | SA | 03 | 02 | DH | DL | CRC | | | | | | |

NOTES:

Note [1]: Following are the abbreviations used in TABLE 1 – **Tmd** Control Registers:

| | |
|-------------|--|
| R | Read |
| W | Write |
| RS | Response |
| SA | Slave Address (typically 01 through F7 hex) |
| CRC | CRC high + CRC low (see CRC calculations section in MODBUS manual) |
| DH | Data High byte |
| DL | Data Low byte |
| B | Byte |
| Tmd# | Tmd Register # (Modbus Register numbers are 1 larger) |

Note [2]: Register #1 (Drive Control):

| | | |
|----------------|----|----------------------------|
| Data Low Byte | 0 | UPDATE BUFFERS |
| | 1 | LOCK SECURITY |
| | 2 | STOP DRIVE (COAST TO STOP) |
| | 3 | START DRIVE |
| | 4 | Unused |
| | 5 | Unused |
| | 6 | SET REVERSE |
| | 7 | SET FORWARD |
| Data High Byte | 8 | NETWORK SPEED REFERENCE |
| | 9 | LOCAL SPEED REFERENCE |
| | 10 | |
| | 11 | |
| | 12 | |
| | 13 | |
| | 14 | |
| | 15 | |

The appropriate bit is set to 1. For example, to stop the drive bit two is set (send 0004H). To start the drive send 0008H. Setting update buffers bit, enables to start the drive using downloaded data. Locking security disables the serial drive control and prevents any further writing to control or parameter registers.

IMPORTANT: During each write to Register #1 only one bit should be set in the drive control word. Drive responds to stop bit only, if more than 1 bit is set. If stop bit is not set, but more than 1 bit is set, drive responds with exception 04.

Note [3]: **Tmd** series drives always return 71 (47H).

Note [4]: On **Tmd** drives this register reads as follows:

| Value | Tmd kW | Tmd Voltage | Value | Tmd kW | Tmd Voltage |
|-------|--------|-------------------------|-------|--------|----------------|
| 00 | 0.55 | 1/N/PE or 3/PE, 230V | 28 | 0.55 | 3/PE, 400/480V |
| 01 | 0.37 | | 29 | 0.37 | |
| 02 | 0.75 | | 30 | 0.75 | |
| 03 | 1.1 | | 31 | 1.1 | |
| 04 | 1.5 | | 32 | 1.5 | |
| 05 | 2.2 | | 33 | 2.2 | |
| 16 | 0.75 | 3/PE, 230V | 34 | 4.0 | |
| 17 | 1.1 | | 35 | 5.5 | |
| 18 | 1.5 | | 36 | 7.5 | |
| 19 | 2.2 | | 44 | 3.0 | |
| 20 | 4.0 | | | | |
| 21 | 5.5 | | | | |
| 22 | 7.5 | | | | |

Note [5]: Register #22 (Drive hardware configuration)
Bits represent specific hardware configuration.

Tmd Series Drive:

| BIT # | SETTINGS | MEANING |
|-------|----------|--------------------------|
| 0 | 1 | Not isolated drive (hot) |
| | 0 | Isolated |
| 1 | 1 | Reserved |
| | 0 | Reserved |
| 2 | Reserved | |
| 3 | 1 | OEM defaults present |
| | 0 | No OEM defaults |

**All other bits (4-15) are unused at this time.*

Note [6]: When reading parameter #24, the group of words requested can be either 1 or 6. This is an exception to the rule of being able to read only one register at a time. If 6 words are requested at parameter #24, the following will be returned:

| | |
|------------------------|---------|
| Command Speed | D1H D1L |
| Actual Speed | D2H D2L |
| Load | D3H |
| Operation Status | D3L |
| Rotational Direction | D4H |
| Control Mode | D4L |
| Speed Command Source | D5L |
| Speed Reference status | D5H |
| Present Fault | D6H |
| Command Rotation | D6L |

Note [6a]: Command Speed (bytes D1H and D1L or Register #25)
 - In tenths of a Hz.
 - Most significant byte is first, followed by Least significant.
 - Example: 02 01 in hex converts to 51.3 Hz in decimal (assumed one decimal place).

Note [6b]: Actual Speed (bytes D2H and D2L or Register #25)

- In tenths of a Hz.
- Most significant byte is first, followed by Least significant.

Note [6c]: Load (byte D3H or Register #26 DH)

- In percent of full load.
- Example: 64 (one byte in hex) ==> 100 (in decimal) ==>100% (drive load).

Operational Status (byte D3L or Register #26 DL)

| | |
|----|--------------------------------|
| 0 | FAULT LOCKOUT |
| 1 | FAULT |
| 2 | START PENDING |
| 3 | MOTOR CALIBRATION NOT DONE |
| 4 | STOP |
| 5 | LOWER TRANSISTORS SWITCHING ON |
| 6 | MOTOR CALIBRATION ENABLED |
| 7 | RUN AT 0Hz |
| 8 | RUN |
| 9 | ACCEL |
| 10 | DECEL |
| 11 | DECEL OVERRIDE |
| 12 | DC BRAKE |
| 13 | FLYING START |
| 14 | SLOW CURRENT LIMIT |
| 15 | FAST CURRENT LIMIT |
| 16 | OFF |
| 17 | INHIBIT |

Note [6d]: Actual Rotational Direction (Register #24 byte D4H or Register #27 DH)

| | |
|---|---------|
| 0 | FORWARD |
| 1 | REVERSE |

Control Mode (Register #24 byte D4L or Register #27 DL)

| Control Mode | Speed Source | Control Source | Program Source |
|--------------|--------------|----------------|----------------|
| 0 | Analog | Terminal | Keypad |
| 1 | Code c40 | Terminal | Keypad |
| 2 | Analog | Terminal | LECOM |
| 3 | LECOM | LECOM | LECOM |
| 4 | Analog | Terminal | Remote Keypad |
| 5 | Code c40 | Terminal | Remote Keypad |
| 6 | Analog | Remote Keypad | Remote Keypad |
| 7 | Code c40 | Remote Keypad | Remote Keypad |
| 8 | Analog | Terminal | Modbus |
| 9 | Code c40 | Terminal | Modbus |
| 10 | Analog | Modbus | Modbus |
| 11 | Code c40 | Modbus | Modbus |

Note [6e]: Speed Command Source (Register #24 byte D5H or Register #28 DH)

| | |
|---|--------------|
| 0 | ANALOG FREQ |
| 1 | PRESET c40 |
| 2 | PRESET 1 |
| 3 | PRESET 2 |
| 4 | PRESET 3 |
| 5 | MOP SPEED |
| 6 | SERIAL SPEED |

Speed Reference Status (Register #24 byte D5L or Register #28 DL)

| | |
|---|-----------------------|
| 0 | SERIAL REFERENCE |
| 1 | LOCAL SPEED REFERENCE |

Note [6f]: Present Fault (Register #24 byte D6H of Register #29 DH)

| Value | Description | Value | Description |
|-------|--|--------|--------------------------------|
| 0 | No Fault | 18 | EPM Fault ("F1") |
| 1, 2 | Output Transistor Fault ("OC1") | 19 | Internal Fault 2 ("F2") |
| 3 | Earth Fault ("OC2") | 20 | Internal Fault 3 ("F3") |
| 4 | RESERVED | 21, 22 | Internal Fault 5 ("F5") |
| 5 | Overtemperature Fault ("OH") | 23 | Internal Fault 6 ("F6") |
| 6 | Flying Restart Fault ("rF") | 24 | Internal Fault 7 ("F7") |
| 7 | Overvoltage Fault ("OU") | 25 | Internal Fault 8 ("F8") |
| 8 | Undervoltage Fault ("LU") | 26 | Internal Fault 9 ("F9") |
| 9 | Motor Overload Fault ("OC6") | 27 | Identification Fault ("bF") |
| 10 | OEM Data Fault ("GF") | 28 | A/D Converter Fault ("Ad") |
| 11 | Configuration Fault ("CFG") | 29 | Remote Keypad Fault ("JF") |
| 12 | Dynamic Brake Overheating Fault ("dF") | 30 | Loss of 4-20 mA Signal ("Sd5") |
| 13 | Single Phase Fault ("SF") | 31 | Communication Fault ("FC5") |
| 14 | External Fault ("EEr") | 32 | Internal Fault 4 ("F4") |
| 15 | Control Fault ("CF") | 33 | Loss of motor phase ("LP1") |
| 16 | Automatic Start Inhibited ("LC") | 34 | Internal Fault 10 ("Fo") |
| 17 | Incompatibility Fault ("cF") | | |

Commanded Rotational Direction (Register #24 byte D6L or Register #29 DL)

| | |
|---|---------|
| 0 | FORWARD |
| 1 | REVERSE |

Note [7]: Register #30 - Motor Volts. Output voltage to the motor expressed in Volts.

Note [8]: Register #40 -- Serial Speed. This register enables to set the serial speed to desired value.

- In tenths of a Hz.
- Most significant byte is first, followed by Least significant.
- CONTROL OF THE DRIVE SPEED VIA THE SERIAL LINK IS NORMALLY DONE USING THIS PARAMETER. This register can be written only after enabling parameter writes.
- To use this speed – speed reference must be set to SERIAL REFERENCE by setting bit 8 in control register #1

Note [9]: Register #48 (Unlock Commands) unlocks commands by using 0000 for the password. If the correct Programming mode password is entered then the appropriate programming parameters can also be accessed (see the full parameter protocol specification if access to programming parameters is required).

Note [I0]: Register #49 (Unlock Parameters) unlocks Programming Parameters for writing when the proper Programming Password is entered. Whenever a parameter writing session (where #49 was activated) is to be ended, register #1 bit 1 (Lock Security) must be asserted. This disables the watchdog and prevents further write access to Parameter Registers.

Note [I1]: Register Version is the number to identify if current version of software has any register changes relative to previous versions: a register has been added or deleted, a register's min/max limits have changed, a register's function has been changed, or a register's default value has been changed. Generally it is the programming parameters that are changed. Typically the Control Registers (**Tmd** Register #1 through #50) are quite stable.

7 smd Programming Parameters Details

ATTENTION!

PARAMETER LIST PRESENTED BELOW IS VALID ONLY FOR **Tmd** SOFTWARE REVISION 1.20
FOR REVISIONS, REFER TO APPROPRIATE **Tmd** MANUAL.

SA -- (1byte) drive address (1-247)
RA -- (1byte) register address
CRC -- (2bytes) Cyclic Redundancy Check

READING:

Message structure for reading 1 word: (most of parameters)

| | | | | | | | |
|-----------|----|----|----|----|----|-----|-----|
| Request: | SA | 03 | 00 | RA | 00 | 01 | CRC |
| Response: | SA | 03 | 02 | DH | DL | CRC | |

Message structure for reading 4 word: (Reg. #89 Software Version)

| | | | | | | | | |
|-----------|----|----|----|-----|-----|-----|-----|-----|
| Request: | SA | 03 | 00 | RA | 00 | 04 | CRC | |
| Response: | SA | 03 | 08 | D1H | D1L | D2H | D2L | D3H |
| | | | | D3L | D4H | D4L | CRC | |

Sample contents of received data bytes (D1..D4 → 'TMD 1.20')

WRITING:

Message structure for writing 1 word: (all parameters)

| | | | | | | | |
|-----------|----|----|----|----|----|----|-----|
| Request: | SA | 06 | 00 | RA | DH | DL | CRC |
| Response: | SA | 06 | 00 | RA | DH | DL | CRC |

TABLE 2 - PROGRAMMING PARAMETER LIST

| smd Register Number (hexadecimal representation) | Parameter No.* | Parameter Name | Range of Adjustment (values representing selection) | Factory Default |
|---|---------------------------------|---|---|--|
| 51 (33H) | C01 | Setpoint and Control Source | Speed Source Control Source Program Source 0 Analog Terminal Keypad 1 Code c40 Terminal Keypad 2 Analog Terminal LECOM 3 LECOM LECOM LECOM 4 Analog Terminal Remote key 5 Code c40 Terminal Remote key 6 Analog Remote key Remote key 7 Code c40 Remote key Remote key 8 Analog Terminal Modbus 9 Code c40 Terminal Modbus 10 Analog Modbus Modbus 11 Code c40 Modbus Modbus | 0 |
| 52 (34H) | C02 | Load Lenze setting | 0 No action/loading complete 1 Load 50 Hz Lenze settings 2 Load 60 Hz Lenze settings 3 Load OEM settings (if present) | 0 |
| 53 (35H) 54 (36H) 55 (37H) 56 (38H) | CE1 CE2 CE3 CE4 | Configuration – digital inputs E1, E2, E3, E4 | 1 Activate fixed setpoint 1 (JOG1) 2 Activate fixed setpoint 2 (JOG2) 3 DC Braking (DCB) 4 Direction of rotation 5 Quick stop 6 CW rotation 7 CCW rotation 8 UP 9 DOWN 10 TRIP set 11 TRIP reset 12 Accel/decel 2 | CE1 = 1 CE2 = 2 CE3 = 3 CE4 = 4 |
| 57 (39H) | Not Used | | | |
| 58 (3AH) | RESERVED | | | |
| 59 (3BH) | C09 | Network address | 1 – 247 | 1 |
| 60 (3CH) | C10 | Minimum output frequency | 0.0 – 240 Hz | 0.0 Hz |
| 61 (3DH) | C11 | Maximum output frequency | 7.5 – 240 Hz | 50.0 Hz |
| 62 (3EH) | C12 | Acceleration time 1 | 0.0 – 999 sec | 5.0 sec |
| 63 (3FH) | C13 | Deceleration time 1 | 0.0 – 999 sec | 5.0 sec |
| 64 (40H) | C14 | Operating mode | 0 Linear with Auto Boost 1 Square law with Auto Boost 2 Linear with constant V_{min} boost 3 Square law with constant V_{min} boost 4 Vector speed control 5 Vector torque control 6 Enhanced linear characteristic with Auto-Boost 7 Enhanced linear characteristic with constant V_{min} boost | 2 |
| 65 (41H) | C15 | V/f reference point | 25.0 – 999 Hz | 50.0 Hz |
| 66 (42H) | C16 | V_{min} boost | 0 – 40 % | 4.0 % |

* Drives programming code number

| smd Register Number (hexadecimal representation) | Parameter No.* | Parameter Name | Range of Adjustment (values representing selection) | Factory Default |
|--|-----------------------|------------------------------------|---|------------------------|
| 67 (43H) | C17 | Frequency threshold | 0.0 – 240 Hz | 0.0 Hz |
| 68 (44H) | C18 | Chopper frequency | 0 4 kHz 1 6 kHz 2 8 kHz 3 10 kHz | 2 |
| 69 (45H) | RESERVED | | | |
| 70 (46H) | C21 | Slip compensation | 0.0 – 40.0 % | 0.0 % |
| 71 (47H) | C22 | Current limit | 30 – 200 % | 200 % |
| 72 (48H) | C24 | Accel boost | 0.0 – 20.0 % | 0.0 % |
| 73 (49H) | C34 | Configuration – analog input | 0 0...10 V 1 0...5 V 2 -10...+10 V 3 0...20 mA 4 4...20 mA 5 4-20 mA monitored | 0 |
| 74 (4AH) | RESERVED | | | |
| 75 (4BH) | C36 | Voltage - DC injection brake (DCB) | 0.0 – 50.0 % | 4.0 % |
| 76 (4CH) | C37 | Fixed setpoint 1 (JOG1) | 0.0 – 240 Hz | 20.0 Hz |
| 77 (4DH) | C38 | Fixed setpoint 2 (JOG2) | 0.0 – 240 Hz | 30.0 Hz |
| 78 (4EH) | C39 | Fixed setpoint 3 (JOG3) | 0.0 – 240 Hz | 40.0 Hz |
| 79 - 80 (4FH - 50h) | Not Used | | | |
| 81 (51H) | C46 | Frequency setpoint | 0.0 – 240 Hz | |
| 82 (52H) | C47 | Torque setpoint | 0 – 400 % | 100 % |
| 83 (53H) | RESERVED | | | |
| 84 (54H) | C50 | Output frequency | 0.0 – 240 Hz | Read only |
| 85 (55H) | RESERVED | | | |
| 86 (56H) | C52 | Motor voltage | 0 – 255 % | Read only |
| 87 (57H) | C53 | DC bus voltage | 0 – 255 % | Read only |
| 88 (58H) | C54 | Motor current | 0 – 255 % | Read only |
| 89 (59H) | C56 | Drive load | 0 – 255 % | Read only |
| 90 (5AH) | C57 | Motor torque | 0 – 400 % | Read only |
| 91 (5BH) | RESERVED | | | |
| 92 (5CH) | C61 | Heatsink temperature | 0 – 255 C | Read only |
| 93 (5DH) | C65 | Vector speed loop gain | 0.0 – 100 | 30.0 |
| 94 (5EH) | C66 | Vector speed stability | 0.0 – 100 | 30.0 |
| 95 (5FH) | Not Used | | | |
| 96 - 99 (60H - 63H) | RESERVED | | | |
| 100 (64H) | C77 | I_{max} gain | 0.00 – 16.0 | 0.25 |
| 101 (65H) | C78 | Integral action time | 12 – 9990 ms | 65 ms |

* Drives programming code number

| smd Register Number (hexadecimal representation) | Parameter No.* | Parameter Name | Range of Adjustment (values representing selection) | Factory Default |
|--|-----------------------|---|---|------------------------|
| 102 (66H) | C84 | Motor stator resistance | 0.00 – 64.0 ohms | 0.00 ohms |
| 103 (67H) | C86 | Motor rated power | 0.00 – 99.9 kW | |
| 104 (68H) | C87 | Motor rated speed | 300 – 65000 RPM | 1390 RPM |
| 105 (69H) | C88 | Motor rated current | 0.0 – 480 A | 0.0 A |
| 106 (6AH) | C89 | Motor rated frequency | 10 – 999 Hz | 50 Hz |
| 107 (6BH) | C90 | Motor rated voltage | 0 – 600 V | 0 V |
| 108 (6CH) | C91 | Motor cosine phi | 0.40 – 1.00 | 0.80 |
| 109 (6DH) | C92 | Motor stator inductance | 0.0 – 2000 mH | 0.0 mH |
| 110 (6EH) | C93 | Drive identification | | |
| 111 (6FH) | C94 | User password | 0 – 999 | 0 |
| 112 - 113 (70H - 71H) | RESERVED | | | |
| 114 (72H) | C99 | Software version | Read 4 words (format 'TMD 1.20') | Read only |
| 115 (73H) | c01 | Acceleration time 2 | 0.0 – 999 sec | 5.0 sec |
| 116 (74H) | c03 | Deceleration time 2 | 0.0 – 999 sec | 5.0 sec |
| 117 (75H) | c06 | Holding time – automatic DC injection brake | 0.0 – 999 sec | 0.0 sec |
| 118 (76H) | c08 | Analog output scaling | 0.0 – 999 | 100.0 |
| 119 (77H) | RESERVED | | | |
| 120 (78H) | c11 | Configuration – analog output (62) | 0 None 1 Output frequency 0-10 V 2 Output frequency 2-10 V 3 Load 0-10 V 4 Load 2-10 V 5 Dynamic Braking | 0 |
| 121 (79H) 122 (7AH) | c17 c18 | Configuration – digital outputs (A1, A2) | 0 Ready 1 Fault 2 Motor is running 3 Motor is running – CW rotation 4 Motor is running – CCW rotation 5 Output frequency = 0 Hz 6 Frequency setpoint reached 7 Threshold (C17) exceeded 8 Current limit reached | c17 = 0 c18 = 1 |
| 123 (7BH) | c20 | I ² t switch-off | 30 – 100 % | 100 % |
| 124 (7CH) | c25 | LECOM baud rate | 0 9600 bps (9600,8,N,2 if C01 = 8...11) 1 4800 bps (9600,8,N,1 if C01 = 8...11) 2 2400 bps (9600,8,E,1 if C01 = 8...11) 3 1200 bps (9600,8,O,1 if C01 = 8...11) | 0 |
| 125 (7DH) | Not Used | | | |
| 126 (7EH) | RESERVED | | | |
| 127 (7FH) | c40 | Frequency setpoint command | 0.0 – 240 Hz | 0.0 Hz |

* Drives programming code number

| smd Register Number (hexadecimal representation) | Parameter No.* | Parameter Name | Range of Adjustment (values representing selection) | Factory Default |
|--|-----------------------|-------------------------------|---|------------------------|
| 128 (80H) | c42 | Start condition | 0 Start after LOW-HIGH change at 28 1 Auto start if 28 = HIGH 2 Flying restart (auto start disabled) 3 Auto start if terminal 28 = HIGH, with flying restart | 1 |
| 129 (81H) | c43 | Flying restart selection | 0 Search range: C11...0 Hz 1 Search range: last frequency...0 Hz | 0 |
| 130 (82H) | Not Used | | | |
| 131 (83H) | c48 | Motor auto-calibration | 0 Calibration not done 1 Calibration enabled 2 Calibration complete | Read only via Modbus |
| 132 (84H) | Not Used | | | |
| 133 (85H) | c60 | Mode selection for c61 | 0 Monitoring only 1 Monitoring and editing | 0 |
| 134 (86H) | c61 | Present fault | Status/error message (see table 3) | Read only |
| 135 (87H) | c62 | Last fault | Error message (see table 3) | Read only |
| 136 (88H) | c63 | Last but one fault | Error message (see table 3) | Read only |
| 137 (89H) | c64 | Last but two fault | Error message (see table 3) | Read only |
| 138 (8AH) | c70 | Configuration – TRIP reset | 0 TRIP reset by LOW-HIGH signal at 28 or mains switching or LOW-HIGH signal at digital input "TRIP reset" 1 Auto TRIP reset | 0 |
| 139 (8BH) | c71 | Auto TRIP reset delay | 0.0 – 60.0 sec | 0.0 |
| 140 (8CH) | c73 | Input voltage selection | 0 Low 1 High | |
| 141 (8DH) | c78 | Operating time counter | | Read only |
| 142 (8EH) | c79 | Mains connection time counter | | Read only |
| 143 (8FH) | RESERVED | | | |
| 144 (90H) | c82 | S-ramp integration time | 0.0 – 50.0 sec | 0.0 sec |
| 145 - 152 (91H - 98H) | RESERVED | | | |
| 153 - 154 (99H - 9AH) | Not Used | | | |
| 155 (9BH) | L25 | Skip frequency 1 | 0.0 – 240 Hz | 0.0 Hz |
| 156 (9CH) | L26 | Skip frequency 2 | 0.0 – 240 Hz | 0.0 Hz |
| 157 (9DH) | L28 | Skip frequency bandwidth | 0.0 – 10.0 Hz | 0.0 Hz |
| 158 - 159 (9EH - 9FH) | RESERVED | | | |
| 160 (A0H) | n20 | LECOM power up state | 0 Quick stop 1 Inhibit | |

| smd Register Number (hexadecimal representation) | Parameter No.* | Parameter Name | Range of Adjustment (values representing selection) | Factory Default |
|--|-----------------------|------------------------|--|------------------------|
| 161 (A1H) | n22 | Serial time out action | 0 Not active 1 Controller inhibit 2 Quick stop 3 Trip fault "FC3" | |
| 162 (A2H) | n23 | Serial fault time | 50 – 65535 msec | 50 msec |

TABLE 3: Fault decoding

| Value | Description | Value | Description |
|-------|--|--------|--------------------------------|
| 0 | No Fault | 18 | EPM Fault ("F1") |
| 1, 2 | Output Transistor Fault ("OC1") | 19 | Internal Fault 2 ("F2") |
| 3 | Earth Fault ("OC2") | 20 | Internal Fault 3 ("F3") |
| 4 | RESERVED | 21, 22 | Internal Fault 5 ("F5") |
| 5 | Overtemperature Fault ("OH") | 23 | Internal Fault 6 ("F6") |
| 6 | Flying Restart Fault ("rF") | 24 | Internal Fault 7 ("F7") |
| 7 | Overvoltage Fault ("OU") | 25 | Internal Fault 8 ("F8") |
| 8 | Undervoltage Fault ("LU") | 26 | Internal Fault 9 ("F9") |
| 9 | Motor Overload Fault ("OC6") | 27 | Identification Fault ("bF") |
| 10 | OEM Data Fault ("GF") | 28 | A/D Converter Fault ("Ad") |
| 11 | Configuration Fault ("CFG") | 29 | Remote Keypad Fault ("JF") |
| 12 | Dynamic Brake Overheating Fault ("dF") | 30 | Loss of 4-20 mA Signal ("Sd5") |
| 13 | Single Phase Fault ("SF") | 31 | Communication Fault ("FC5") |
| 14 | External Fault ("EeR") | 32 | Internal Fault 4 ("F4") |
| 15 | Control Fault ("CF") | 33 | Loss of motor phase ("LP1") |
| 16 | Automatic Start Inhibited ("LC") | 34 | Internal Fault 0 ("F0") |
| 17 | Incompatibility Fault ("cF") | | |