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1 Preface and General Information

1.1 How to use these Operating Instructions

- These Operating Instructions are intended for safety-relevant operation on and with the E94ZACAN1 CANopen option module. They contain safety information which must be observed.
- All personnel working on and with the module must have these Operating Instructions available and observe the information and notes relevant for them.
- These instructions are only valid in combination with the Operating Instructions of the corresponding controller. They must always be complete and in a perfectly readable state.



2 Safety Information

2.1 Persons responsible for safety

Operator

- An operator is any natural or legal person who uses the drive system or on behalf of whom the drive system is used.
- The operator or his safety personnel is obliged to ensure
 - the compliance with all relevant regulations, instructions, and legislation.
 - that only skilled personnel works on and with the drive system.
 - that the personnel have the Operating Instructions available for all corresponding works.
 - that all unqualified personnel are prohibited from working on and with the drive system.

Qualified personnel

Qualified personnel are persons who - because of their education, experience, instructions, and knowledge about corresponding standards and regulations, rules for the prevention of accidents, and operating conditions - are authorized by the person responsible for the safety of the plant to perform the required actions and who are able to recognize potential hazards. (Definition for qualified personnel to VDE 105 or IEC 364)

2.2 General safety information

- These safety notes do claim to be complete. In case of questions and problems please contact your Lenze representative.
- At the time of delivery the drive system meets the state of the art and ensures basically safe operation.
- The indications given in these Operating Instructions refer to the stated hardware and software versions of the controller.
- The controller is hazardous if:
 - unqualified personnel work on and with the controller.
 - the controller is used inappropriately.
- Ensure by appropriate measures that neither personal injury nor damage to property may occur in the event of failure of the drive system.
- The drive system must only be operated when no faults occur.
- Retrofitting, modifications, or redesigns are basically prohibited. Lenze must be contacted in all cases.



3 Technical data

3.1 Related documents

- CANopen Application Layer and Communication Profile or CiA Draft Standard 301
- Drive 94 reference manual

3.2 General information

The internationally standardized CAN bus protocol, which had been developed for the European Automobile Industry, is mainly characterized by

- Its resistance against interference and extreme temperatures
- Short transfer times
- Low connection expenses

These advantages have made CAN products interesting for other industries too.

The CANopen communication profile is based on CAN technology.

The CANopen protocol has been developed by the **CiA**(**CON** in **A**utomation) in conformity with the **CAL** (**CON** Application **L**ayer). All mandatory parts of the CiA DS301 protocol, version 4.01 have been implemented in the E94ZACAN1 Module.

3.3 Installation

The E94ZCAN1 CANopen Communication Module is designed to operate with the E94S SimpleServo drive. For proper installation.....

- Remove power from the drive and allow unit to discharge
- Remove blank module cover from Option Bay 1
- Plug in the 20 pin connector into drive
- Plug in the CANopen module
- Use set screws to connect module to drive



3.4 Configuration

Drive 94 supports CANopen communication protocol through its CANopen Communication Module. Upon power up, the drives firmware detects the CAN Module and automatically enables both the CANopen functionality as well as the CANopen configuration menu.

We can utilize SimpleServo LED display and push buttons to both configure the drive for the CAN network, as well as check and set drive parameters. The “UP” (▲) and “DOWN” (▼) buttons are used to navigate through the drives parameters.

Power up the drive and review the display.

run_ Drive is Enabled and in Run mode. Disable the drive by deactivating the Enable input.

d is_ Drive is Disabled and ready to be configured. Press the “ENTER” button (↵) to continue.

StAt Current drive status. From here you use the “UP” (▲) and “DOWN” (▼) buttons to navigate through the drives parameters. Press the “DOWN” (▼) button to continue.

[AnD CAN delay menu. This is the delay in seconds after which a “start remote node” message can be broadcast and its value is between 0 and 5 (seconds). Press the “ENTER” button (↵) to view this number and use the “UP” (▲) and “DOWN” (▼) buttons to change the delay setting. Set the delay back to “0” and press the “ENTER” button (↵) to exit. Press the “DOWN” (▼) button to continue.

[AnD CAN operational mode. This is where you define what mode you want the drive to be in at power up. This parameter is R/W. To view the setting, press the “ENTER” button (↵). Use the “UP” (▲) and “DOWN” (▼) buttons to change the setting. Select setting “1” and press the “ENTER” button (↵) to store your setting and to exit. Press the “DOWN” (▼) button to continue

---0 CAN starts in pre-operational state.

---1 CAN starts in operational mode.

---2 CAN starts in operational mode and is a “quasi master”, meaning that it will send “start remote node” message (described in standard DS301) after a delay specified in CAnD menu.

[AnS CAN network status value. This is a binary representation of the status of the CAN network. This is read only parameter and you can have more than one status active at one time. Press the “ENTER” button (↵) to view status. Press the “ENTER” button (↵) to exit. Press the “DOWN” (▼) button to continue.

---1 Initialization Complete.

---2 CAN bit or frame error occurred.

---4 CAN “error passive” occurred.

---8 Receive queue overrun occurred.

--16 Transmit queue overrun occurred.

--32 Reserved

--64 Reserved

-128 CAN “bus off” error occurred



CAnA CAN network address. This parameter is R/W and can be between 0 and 127. This is the drives address on the **CAN Network**. Press the “ENTER” button (↵) to view address setting. Use the “UP” (▲) and “DOWN” (▼) buttons to change the setting. Press the “ENTER” button (↵) to store your setting and to exit. Press the “DOWN” (▼) button to continue.

CAnb CAN network baud rate. This is R/W parameter. Use the “UP” (▲) and “DOWN” (▼) buttons to change the setting. Select setting “500” and press the “ENTER” button (↵) to store your setting and to exit. Press the “DOWN” (▼) button to continue.

- 1000** 1000Kb baud rate
- _800** 800Kb baud rate
- _500** 500Kb baud rate
- _250** 250Kb baud rate
- _125** 125Kb baud rate
- __50** 50Kb baud rate
- __20** 20Kb baud rate
- __10** 10Kb baud rate

Hx.xx Drive Hardware Revision (ex. H1.01). Read only press the “DOWN” (▼) button to continue.

Fx.xx Drive Firmware Revision (Version F1.12 or greater required for CANOPEN Network). Read only. Press the “DOWN” (▼) button to continue.

OPER Drive Operating Mode. This is a R/W parameter. Use the “UP” (▲) and “DOWN” (▼) buttons to change the setting. Select either CAnV (CANBUS Velocity Mode) or CAnt (CANBUS Torque Mode). Press the “ENTER” button (↵) to store your setting and to exit. Press the “DOWN” (▼) button to continue.

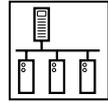
- POS_** Position Mode
- VEL_** Velocity Mode
- tor9** Torque Mode
- CAnU** **CANBUS Velocity Mode**
- CAnt** **CANBUS Torque Mode**
- t-UL** Velocity Limited Torque Mode.

bAUd E94 Drive Baud Rate. This Baud Rate is only for RS232/RS485 communications. It doesn't affect the CANBUS Network. This is R/W parameter. Use the “UP” (▲) and “DOWN” (▼) buttons to change the setting. Select setting “38.4” and press the “ENTER” button (↵) to store your setting and to exit. Press the “DOWN” (▼) button to continue.

- _38.4** 8400 bits per second
- _19.2** 19200 bits per second
- __9.6** 9600 bits per second



- Adr_** E94 Drive address. This address is only for RS232/RS485 communications. It doesn't affect the CANBUS Network. This parameter is R/W and can be between 0 and 31. Press the "ENTER" button (↵) to view address setting. Use the "UP" (▲) and "DOWN" (▼) buttons to change the setting. Press the "ENTER" button (↵) to store your setting and to exit. Press the "DOWN" (▼) button to continue.
- FLtS** E94 Drive Fault History. This parameter is Read only. Press the "ENTER" button (↵) to view. Use the "UP" (▲) and "DOWN" (▼) buttons to scroll through the fault history. Press the "ENTER" button (↵) to exit. Press the "DOWN" (▼) button to continue.
- Ht_ _** E94 Drive Heatsink Temperature. This parameter is Read only and shows heatsink temperature in °C if greater than 40°C. Otherwise the display show "LO" (low). Press the "ENTER" button (↵) to view. Press the "ENTER" button (↵) again to exit. Press the "DOWN" (▼) button to continue.
- EnC_** E94 Drive Encoder Activity. This parameter is Read only and shows primary encoder counts for encoder diagnostics activity. Press the "ENTER" button (↵) to view. Press the "ENTER" button (↵) again to exit. Press the "DOWN" (▼) button to continue.
- HALL** E94 Drive Hall Activity. This parameter is Read only and displays the motors Hall sensor state. Press the "ENTER" button (↵) to view. Press the "ENTER" button (↵) again to exit. Press the "DOWN" (▼) button to continue.
- bUS_** E94 Drive DC Bus Voltage. This parameter is Read only and displays the DC bus voltage value. Press the "ENTER" button (↵) to view. Press the "ENTER" button (↵) again to exit. Press the "DOWN" (▼) button to continue.
- CUrr** E94 Drive Phase Current. This parameter is Read only and displays the current value of the motors phase current (RMS) while the drive is enabled. If the drive is disabled the display will show "diS". Press the "ENTER" button (↵) to view. Press the "ENTER" button (↵) again to exit. Press the "DOWN" (▼) button to continue.



4 CANopen DS301 Communication Profile Support

4.1 Supported NMT (Network Management) services:

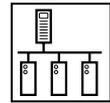
The E94 Drive automatically goes to an Operational state upon reset without waiting for the Start Node command from the NMT master.

- **Start Node** – Upon receiving this service request from the NMT master the drive will resume operation. This only is applicable when the drive is in the Stopped state. The drive resumes its move and its CANopen SDO and PDO services are operational again.
- **Stop Node** – Upon receiving this service request the drive stops its motion and holds its position. (Note: power is still applied to the motor) The drive also disables its CANopen SDO and PDO services.
- **Reset Node** – Upon receiving this service request the drive will reset. If the drive is in motion it executes a quick stop before it resets.
- **Reset Communication** – Resets the CAN communication driver.

4.2 The Heartbeat Error Control Service

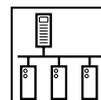
The E94 Drive can be set up as a heartbeat producer. In this mode the drive will periodically send out a heartbeat requests. The heartbeat producer time is stored in index 0x1017 in the object dictionary as a multiple of 1 millisecond.

Value of 0 for the heartbeat producer time disables the heartbeat service.

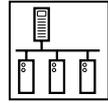


4.3 Communication Objects

OBJECT	NAME	DESCRIPTION
1000h	Device Type	The E94 Drive is not DSP 402 compliant but follows some of the major velocity and torque profiles recommendations. Therefore it uses custom device profile value of 0x00022192.
1001h	Error Register	The following values are allowed: 0 – NO error 1 – over voltage 2 – feedback error 3 – over current 4 – over temperature 5 – external fault detection 6 – over speed 7 – position error excess 8 – bad motor data
1008h	Manufacturer Device Name	Drive 94 uses the 'SS94' device name
1009h	Manufacturer Hardware Version	It is 0x94xx where xx is the current version number
100Ah	Manufacturer Software Version	It is 0x94xx where xx is the current version number
1017h	Producer Heartbeat Time	See 1.2 above
1018h	Identity Object	Vendor ID – 0x00456765 Product Code - 0x0000005E
1400h	1 st receive PDO Parameter (Torque)	Asynchronous PDO with 255 transmission type used only if the drive is in CAN Torque mode. The target torque update is triggered immediately upon receiving of this RPDO. Sub index 01 contains the RPDO COB-ID and has R/W access. The default value of this COB-ID is 0x200 + CAN network node id/address.
1401h	2 nd receive PDO Parameter (Velocity)	Asynchronous PDO with 255 transmission type and used only if the drive is in CAN Velocity mode. The target velocity update is triggered immediately upon receiving of this RPDO. Sub index 01 contains the RPDO COB-ID and has R/W access. The default value of this COB-ID is 0x300 + CAN network node id/address.
1600h	1 st receive PDO Mapping (Torque)	Only the following static mapping is supported: Sub index 01 -> 6040h Control word Sub index 02 -> 6071h Target Torque NOTE: This object is used only in CAN Torque mode
1601h	2 nd receive PDO Mapping (Velocity)	Only the following static mapping is supported: Sub index 01 -> 6040h Control word Sub index 02 -> 60FFh Target Velocity NOTE: This object is used only in CAN Velocity mode



OBJECT	NAME	DESCRIPTION
1800h	1 st transmit PDO Parameter (Torque)	<p>Sub index 01 -> TPDO COB-ID with R/W access. The default value of this COB-ID is 0x180 + CAN network node id/address.</p> <p>Sub index 02 -> TPDO Type. Asynchronous TPDO with 255 transmission type.</p> <p>Sub index 03 -> Inhibit Time in ms with R/W access. The TPDO cannot be transmitted before the time set in this parameter elapses.</p> <p>Value of 0 disables this functionality.</p> <p>Sub index 03 -> Event Timer in ms with R/W access. The TPDO will be sent when the time set in this parameter elapses whether or not an occurrence of the event associated with this TPDO is detected.</p> <p>NOTE: This TPDO is used in CAN Torque Mode only. Inhibit Time & Event Time cannot both be 0 at the same time.</p>
1801h	2 nd transmit PDO Parameter (Velocity)	<p>Sub index 01 -> TPDO COB-ID with R/W access. The default value of this COB-ID is 0x180 + CAN network node id/address.</p> <p>Sub index 02 -> TPDO Type. Asynchronous TPDO with 255 transmission type.</p> <p>Sub index 03 -> Inhibit Time in ms with R/W access. The TPDO cannot be transmitted before the time set in this parameter elapses.</p> <p>Value of 0 disables this functionality.</p> <p>Sub index 03 -> Event Timer in ms with R/W access. The TPDO will be sent when the time set in this parameter elapses whether or not an occurrence of the event associated with this TPDO is detected.</p> <p>NOTE: This TPDO is used in CAN Velocity Mode only. Inhibit Time & Event Time cannot both be 0 at the same time.</p>
1A00h	1 st transmit PDO Mapping (Torque)	<p>Only the following static mapping is supported:</p> <p>Sub index 01 -> 6041h Status word</p> <p>Sub index 02 -> 6077h Torque Actual Value</p> <p>NOTE: This object is used only in CAN Torque mode</p>
1A01h	2 nd transmit PDO Mapping (Velocity)	<p>Only the following static mapping is supported:</p> <p>Sub index 01 -> 6041h Status word</p> <p>Sub index 02 -> 606Ch Velocity Actual Value</p> <p>NOTE: This object is used only in CAN Velocity mode</p>



5. Drive 94 Specific Objects and functionality

When using the CANopen protocol the E94 drive has two modes of operation.

- CAN Velocity Mode
- CAN Torque Mode.

5.1 CAN Velocity mode

The Velocity reference is provided internally through the **Object 60FFh (Target Velocity)** statically mapped in RPDO2. Commands can be sent to the drive through the **Object 6040h (Control Word)** also statically mapped in RPDO2.

Please see the **Object 6040h (Control Word)** description below for the available commands.

The CANopen network master should use the RPDO2 service to provide Target Velocity and Control Commands to the drive.

The E94 Drive uses TPDO2 to send to the master status information through the **Object 6041h Status word** and the current velocity value through the **Object 606Ch Velocity Actual Value**. Please see the **Object 6041h Status word** description below for the available status information.

The drive94V.edc file is provided for usage by the CANopen master when the drive is in CAN Velocity mode.

5.2 CAN Torque mode

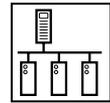
The Torque reference is provided internally through the **Object 6071h (Target Torque)** statically mapped in RPDO1. Commands can be sent to the drive through the **Object 6040h (Control Word)** also statically mapped in RPDO2.

Please see the **Object 6040h (Control Word)** description below for the available commands.

The CANopen network master should use the RPDO1 service to provide Target Torque and Control Commands to the drive.

Drive 94 uses TPDO1 to send to the master status information through the **Object 6041h Status word** and the current velocity value through the **Object 6077h Torque Actual Value**. Please see the **Object 6041h Status word** description below for the available status information.

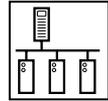
The drive94T.edc file is provided for usage by the CANOpen master when the drive is in CAN Torque mode.



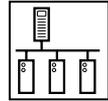
5.3 E94 Drive specific objects

Please see the provided drive94T.eds and drive94V.eds files and the SimpleServo Model 94 Users Manual for a more complete description of all SDO objects and for setup instructions.

OBJECT	NAME	TYPE	
6040h	Control Word	WORD	The drive can execute the following commands: 2 – Quick Stop 3 – Enable Drive 4 – Disable Drive 5 – Fault Reset 6 - Continue
6041h	Status Word	WORD	Two bytes status is provided with the following meaning: Bit 0 - RUN indication Bit 1 - Velocity in speed window Bit 3 - Drive at fault Bit 5 - Zero velocity reached Bit 8 - Under voltage Bit 11 - Regen indication Bit 13 - Current limit reached
6071h	Target Torque	Float	This object provides the Torque reference in Amperes (A) to the DSP. NOTE: This object is used only in CAN Torque mode
6077h	Torque Actual Value	Float	This object represents the actual Torque value in Amperes (A) retrieved from the DSP. NOTE: This object is used only in CAN Torque mode
60FFh	Target Velocity	Float	This object provides the Velocity reference in RPM to the DSP. NOTE: This object is used only in CAN Velocity mode
606Ch	Velocity Actual Value	Float	This object represents the actual Velocity value in RPM retrieved from the DSP. NOTE: This object is used only in CAN Velocity mode



OBJECT	NAME	TYPE
6402h	TorqueConst	Float
6403h	VoltageConst	Float
6404h	Inductance	Float
6405h	Resistance	Float
6406h	MaxPhaseCurrent	Float
6407h	TerminalVoltage	WORD
6408h	RotorInertia	Float
6409h	MaxVelocity	Float
640Ah	HallCode	WORD
640Bh	NumberPoles	WORD
640Ch	Encoder	WORD
640Dh	CurrentLimit	Float
640Eh	PeakCurrentLimit	Float
640Fh	InvertAnalogInput	BYTE
6410h	CurrentAnalogInput	Float
6411h	VelocityAnalogInput	Float
6412h	AccDecFlag	BYTE
6413h	AccelLimit	Float
6414h	DecelLimit	Float
6415h	StepRevolution	WORD
6416h	StepInputType	BYTE
6417h	AnalogOutput	BYTE
6418h	CurrentScale	Float
6419h	VelocityScale	Float
641Ah	AnalogBand	WORD
641Bh	AnalogOffset	WORD
641Ch	ZeroSpeed	WORD
641Dh	SpeedWindow	WORD
641Eh	AtSpeed	WORD
641Fh	PosErr	Float
6420h	MaxErrTime	WORD
6421h	VelPGain	WORD
6422h	VellGain	WORD
6423h	PosPGain	WORD
6424h	PosIGain	Float
6425h	DGain	WORD
6426h	VFFGain	Float
6427h	ILimit	WORD
6428h	FaultReset	BYTE
6429h	FeedbackLoss	BYTE
642Ah	In2Func	BYTE



OBJECT	NAME	TYPE
642Bh	In2Polarity	BYTE
642Ch	InBounceDelay input1	WORD
642Dh	InBounceDelay input2	WORD
642Eh	OutFunc output1	BYTE
642Fh	OutFunc output2	BYTE
6430h	OutPolarity output1	BYTE
6431h	OutPolarity output2	BYTE
6432h	Eset	UNSIGNED WORD
6433h	FeedbackType	UNSIGNED WORD
6434h	PwmIndex	UNSIGNED BYTE
6435h	GearRatioTop	UNSIGNED WORD
6436h	GearRatioBottom	UNSIGNED WORD
6437h	ReferenceType	UNSIGNED BYTE
6438h	MotorTempSensorResistance	UNSIGNED WORD
6439h	MotorTempSensorEnable	UNSIGNED BYTE
6440h	RegenDutyCycle	UNSIGNED WORD
6441h	EncoderRepeatSource	UNSIGNED BYTE
6442h	TorqueVelocityLimit	FLOAT
6443h	SeGearRatioTop	SIGNED WORD
6444h	SeGearRatioBottom	UNSIGNED WORD
6445h	SeEnable	UNSIGNED BYTE
6446h	SelGain	FLOAT
6447h	SePosErr	UNSIGNED WORD
6448h	SeMaxErrTime	FLOAT
6449h	VelocityRegWnd	SIGNED WORD
6450h	LowPeakCurrentLimit	FLOAT
6451h	CANOperationalState	UNSIGNED BYTE
6452h	CANStartNodeDelay	UNSIGNED BYTE

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