CURTIS

A KOHLER COMPANY

Manual

Model **3401T**

Digital Instrumentation

» Software Device Profile: 9.0.0.0 «

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Read Instructions Carefully!

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1 — OVERVIEW

The Curtis Model 3401T is a configurable HMI that displays vehicle information such as speed, direction, and state-of-charge. A color 4.3", 480 × 272 pixel TFT LCD allows vehicle operators to view data in any lighting condition. An LCD heater is optional for operation in cold temperatures.

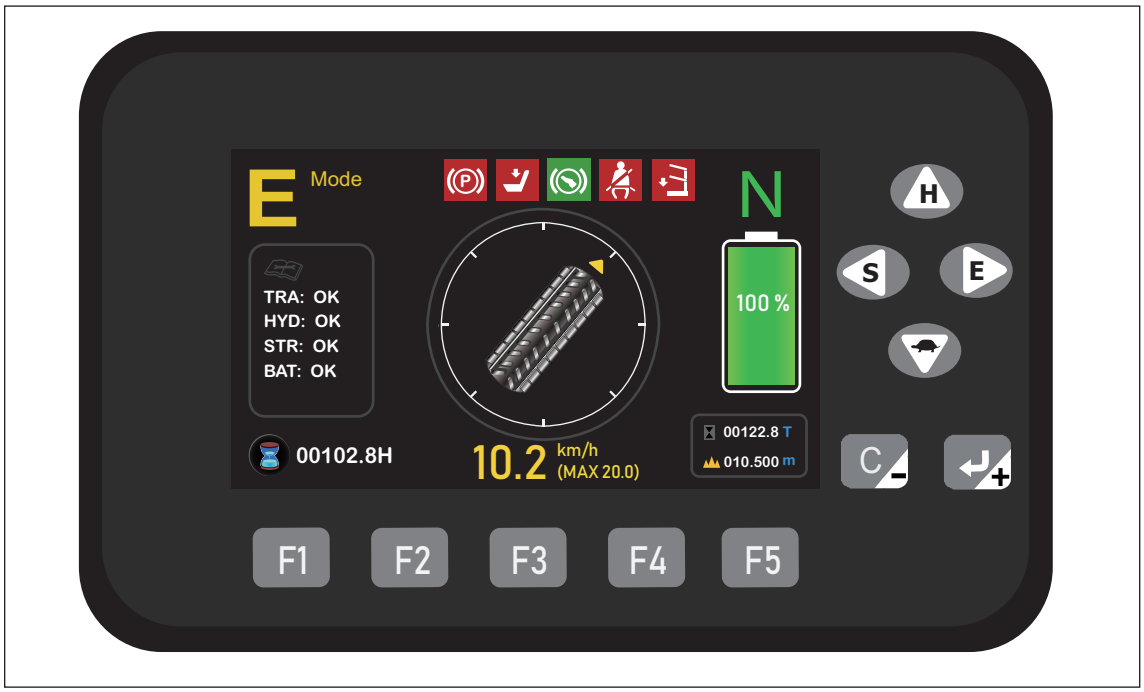
Vehicle operators use buttons to work with the user interface. The buttons make the 3401T ideal for gloved operators and for applications that require precise tactile feedback.

The 3401T's configurability allows various screen elements to be displayed. These elements include gauges, hour meters, warning icons, speedometers, and so on.

The device provides two preset user interfaces: one for counterbalanced forklifts and the other for reach trucks and order pickers. For applications that require a tailor-made user interface, the 3401T is customizable by Curtis engineers.

The 3401T provides four inputs that can be used as switch, analog resistive, analog voltage, and frequency inputs. Another pin can be used as either a switch input or an output driver. The 3401T also transmits and receives data over the CANbus.

Figure 1-1
Curtis Model 3401T



USING THIS MANUAL

The next section describes the 3401T's features. The following list describes the topics that apply to various types of tasks:

- Vehicle operators should read the Using the 3401T chapter.
- Technicians who work on installation and wiring, or who need information on specifications, should read the Installation and Wiring chapter and the Specifications appendix.
- Application developers should be familiar with the following chapters:
  - Programmable Parameters
  - Monitor Parameters
  - CANopen Communications

FEATURES

The following sections describe the 3401T's major features.

Display Elements

The following list describes the device's display elements:

- Gauges represent various types of data. For example, gauges indicate the vehicle speed, BDI percentage and steering angle.
- Icons indicate states such as on/off. For example, icons indicate whether the seat belt is on or lift lockout is active.
- Hour meters provide a resolution of 0.1 hours and a maximum of 99999.9 hours. There are three hour meters: one is for the keyswitch and two are for Curtis devices.
- Speed mode: The 3401T provides buttons for four speed modes. The selected mode is transmitted over the CANbus.
- The message center broadcasts information such as status and instructions. For example, a message is displayed if both forward and reverse signals are active.

Fault Codes and Names

The 3401T displays fault codes and names for Curtis devices. There are a few sources of fault data:

- The preconfigured RPDOs.
- A switch input for Curtis DC pump controllers such as the 1253 and 1253C models.
- A switch input for Curtis DC traction controllers such as the 1243 and 1244 models.

The corresponding fault names of the fault codes are displayed on the Fault Name screen.

Programming

The 3401T can be used to program Curtis devices. You can read and write parameters for the 3401T and for other Curtis devices that are on the CANbus or connected through the serial port. For more information, see View and Edit Parameters.

LCD Heater

Some models include an LCD heater for cold temperatures. The LCD heater extends the minimum operating temperature from −20°C to −40°C.

The model number indicates whether a 3401T model has an LCD heater. See the Model Encodement section in the Specifications appendix.

Miscellaneous Features

The following list describes other major features:

- Designed to meet regulatory requirements. For details, see the Specifications appendix.
- Multilingual support.
- CANopen, J1939 and an adjustable baud rate.
- Password protection for the following functions:
  - Power on. A power-on password can optionally be specified. The power-on password is entered with either the 3401T's buttons or the Curtis Electronic Code Switch (ECS).
  - Programming parameters for the 3401T and for other Curtis devices. There are different passwords for the OEM and User access levels.
  - Resetting the hour meters.
- The following optional features are available with customized models only:
  - A buzzer alarm that can be configured to activate when gauge elements, statuses or internal calculations reach specified values.
  - A 3-axis accelerometer that senses the vehicle's inclination and orientation and calculates its acceleration. The accelerometer measures at least 10G on all three axes.
  - A real-time clock that keeps track of time even if power is removed from the unit. The time is displayed in either the 12-hour or 24-hour format.

To discuss customized models, contact your Curtis distributor or the Curtis sales and support office in your region.

Note: For more information on the 3401T's features, see the data sheet on the Curtis Instruments CAN & Serial Instrumentation page at https://www.curtisinstruments.com/products/can-serial-instrumentation-programmable.

CONVENTIONS

The following topics describe terms and notations used in this manual.

Numeral System Notation

The following table describes how this manual denotes decimal, binary, and hexadecimal numbers.

Note: The letter *n* in the format column represents a digit.

Numeral System	Format	Example
Decimal	Either of the following: • *nnn* • *nnn*d	• 127 • 127d
Hexadecimal	Either of the following: • *nnn*h • 0x*nnn*	• 62Ah • 0x62A
Binary	*nnn*b	1011b

In addition, some CANopen examples have hexadecimal values without notation. Those examples are formatted with a monospace font and with the bytes delimited by spaces, as shown in the following example:

```
21 FF 01 11 22 01 00 00
```

Miscellaneous Conventions

- All voltages listed in this manual are DC voltages.
- *RO* means read-only.
- *RW* means read-write.
- *N/A* means not applicable.

2 — USING THE 3401T

This chapter describes how to use the 3401T's buttons and screens.

BUTTONS

The following table describes the 3401T's buttons. The buttons' functions depend upon which screen is active.

Table 2-1 3401T Buttons

Button	Home Screen	Parameter Menu Screens	Password Screens
	Specifies the high speed mode.	Scrolls up to the previous menu item.	Specifies whether the password is for the User or OEM access level.
	Specifies the turtle speed mode.	Scrolls down to the next menu item.	Specifies whether the password is for the User or OEM access level.
	Specifies the standard speed mode.	Returns to the previous menu. If the menu is the device's top menu, pressing this button returns to the home screen.	Specifies whether the password is for the User or OEM access level.
	Specifies the economy speed mode.	If a menu is selected, opens the menu.	Specifies whether the password is for the User or OEM access level.
	Opens the 3401T's main parameter menu, which does not require a password.	Returns to the home screen from the 3401T's main parameter menu.	Specifies the number 1.
	Opens the 3401T's password-protected parameter menus.	Returns to the home screen from the 3401T's password-protected parameter menus.	Specifies the number 2.
	Opens the parameter menus of other Curtis devices connected through the CANbus or the serial port.	Returns to the home screen from the parameter menus of other Curtis devices.	Specifies the number 3.
	Opens the parameter menus of Curtis devices that support the ESP/SP protocol and are connected through the serial port. The menus have read-only access.	Depends upon how the parameter menu screens were accessed: • If accessed with the F4 button, returns to the home screen. • If accessed with the F2 or F3 button, rapidly increases the selected parameter's value by step sizes of 10, 100, 1000, and 10,000.	Specifies the number 4.
	*No function.*	*No function.*	Specifies the number 5.
	*No function.*	• When a writable parameter is selected, decreases the parameter value. • When a menu is selected, navigates to the previous menu.	• If password characters have been entered, clears the last number. • If password characters have not been entered or have been cleared, returns to the home screen.
	Opens the Fault Name screen. **Note**: This button also exits the Fault Name screen.	• When a writable parameter is selected, increases the parameter value. • If a menu is selected, opens the menu.	Submits the password.

POWER-ON 3401T PASSWORD OR ECS AUTHORIZATION

The 3401T can be configured so that only authorized users can access the device. There are two methods for authorizing access:

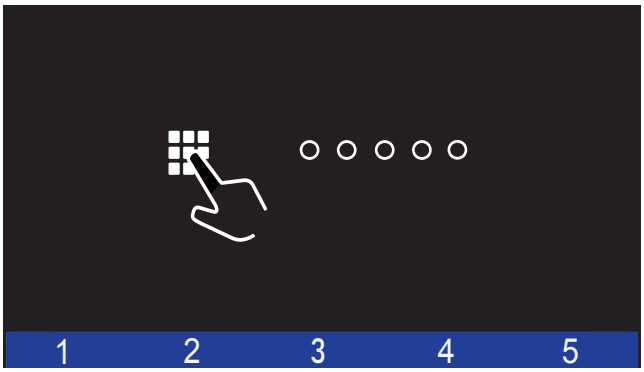
- Enter a password on the 3401T keypad.
- Log onto the Curtis Electronic Code Switch (ECS).

Note: The ECS ensures that only authorized users can operate a vehicle. Users log on by entering a user ID and PIN code or by swiping an RFID tag. For more information on the ECS, see the Input Devices page on the Curtis Instruments website.

The following topics describe the two methods.

Power-On 3401T Password

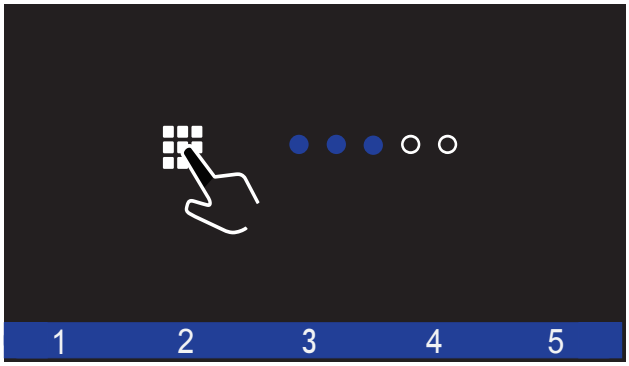
If the 3401T is configured to require a password after the device is powered on, the following screen is displayed:



If this screen is visible, take the following steps:

1. Use the F1–F5 buttons to enter the five-digit password, which consists of the numbers 1–5. Pressing an F1–F5 button enters the number that follows the letter "F": for example, the F2 button enters 2.

   To indicate how many characters have been entered, the corresponding circle in the middle of the screen turns blue when a button is pushed. In the following example, three numbers have been entered:



   Tip: To clear the most recently entered number, press the C button; the corresponding circle turns white.

2. Press the ↵ button to submit the password. If the password is correct, the home screen is displayed.
   If the password screen indicates that the wrong password was entered, press the C or ↵ button to clear the password, then repeat this procedure.

Note: The default power-on password is 12345. Curtis recommends that you change the default password. The password is specified with the PIN Code parameter.

ECS Authorization

If the 3401T is configured to allow only authorized ECS users to access the device, the following screen is displayed when a user is not logged onto the ECS:

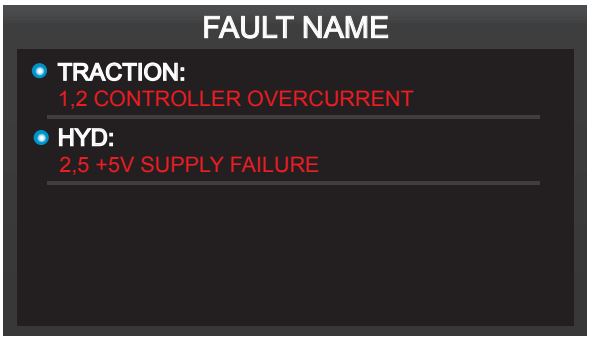
If this screen is visible, log onto the ECS by swiping an RFID tag or entering an ECS user ID and PIN code on the keypad. If the RFID tag or user ID and PIN code are valid, the home screen is displayed.

Note: To log on with the ECS, the 3401T and the ECS must be in the operational NMT state and the ECS's node ID must be specified. If you are logged onto the ECS but the screen shown in the previous image is displayed, the devices might not be in the operational state.

After you log off the ECS, the 3401T displays the screen shown in the above image.

VIEW FAULT NAMES

The Fault Name screen displays the names and fault codes of active faults. In the following example, faults are active for traction and pump controllers:



Take the following steps to access the Fault Name screen:

1. Go to the home screen.
2. Press the button.
3. If there are too many faults to display on one screen, use the and buttons to scroll through the screens.

To exit the Fault Name screen, press the button.

VIEW AND EDIT PARAMETERS

The 3401T enables you to view and edit its parameters and the parameters of Curtis devices connected through the CANbus or the serial port. The 3401T parameters are contained by the menus described in the Programmable Parameters and Monitor Parameters chapters. The parameter menus can be accessed when the home screen is visible.

Parameters have two access levels: User and OEM. The OEM level provides access to more parameters than the User level. The following table describes how the 3401T access levels correspond to the access levels for Curtis programming devices:

Table 2-2 3401T and Curtis Programming Device Access Levels

3401T	Curtis Programming Device
User	Field Intermediate
OEM	OEM Dealer

A password is required to access the 3401T's parameter menus and the read-write parameter menus of other Curtis devices. The access levels have different passwords. When you enter a password, the password is not cleared when the device returns to the home screen; this is for convenience when testing and debugging parameter changes. After you have finished working with parameters, cycle the keyswitch to clear the password.

The following list describes the default passwords for accessing parameter menus:

- User access level: 11111
- OEM access level: 22222

Curtis recommends that you change the default passwords. Passwords are changed with the OEM Menu Password and USER Menu Password parameters on the Password menu.

The following topics describe how to open and use the screens.

Open the 3401T's Main Menu

Take the following steps to open the main menu.

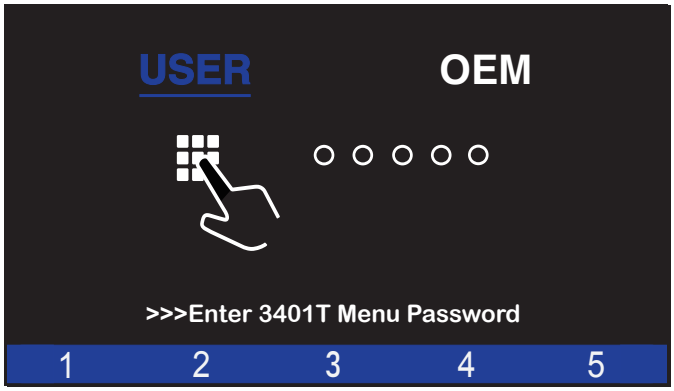
1. Go to the home screen.
2. Press the F1 button. The main menu displays and you can now view and edit parameters.

To exit the menu, press the F1 button.

Open the 3401T's Parameter Menus

You must enter a password to open all of the 3401T's menus, which include the main menu, Program menu, and Monitor menu. Take the following steps to open these menus.

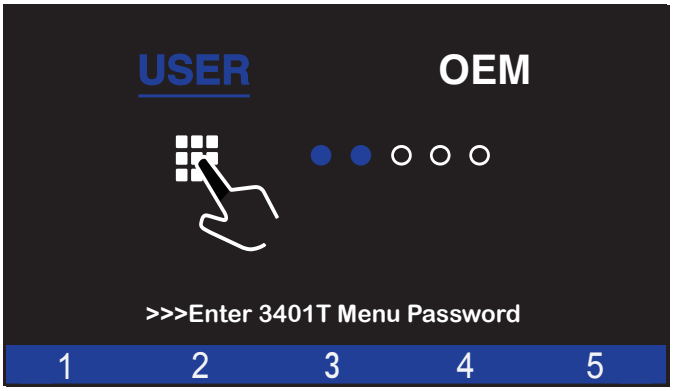
1. Go to the home screen.
2. Press the F2 button. The Password screen displays:



The screen's active access level is highlighted in blue; in the example above, the User access level is active.

3. To change the access level, press the S, E, H, or ▼ button.
4. Use the F1–F5 buttons to enter the five-digit password, which consists of the numbers 1–5. Pressing an F1–F5 button enters the number that follows the letter "F": for example, the F2 button enters 2.

   To indicate how many characters have been entered, the corresponding circle in the middle of the screen turns blue when a button is pushed. In the following example, two numbers have been entered:



   Tip: To clear the most recently entered number, press the C button; the corresponding circle turns white. To exit the password screen, press the C button until the password is cleared, then press the button again.

5. Press the ↵ button to submit the password. If the password is correct, the main menu displays and you can now view and edit parameters.

   If the password screen indicates that the wrong password was entered, press the C or ↵ button to clear the password, then repeat steps 3–5.

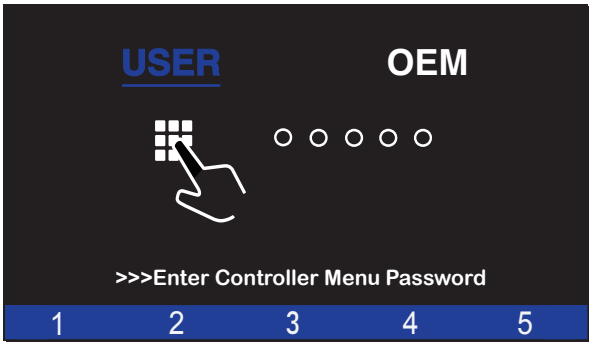
To exit the menu, press the F2 button.

IMPORTANT: After you have finished working with parameters, cycle the keyswitch to clear the password.

Open Parameter Menus for Other Curtis Devices

The 3401T allows you to view and edit parameters of Curtis devices that are connected through the CANbus or the serial port. Take the following steps to open other Curtis devices' menus.

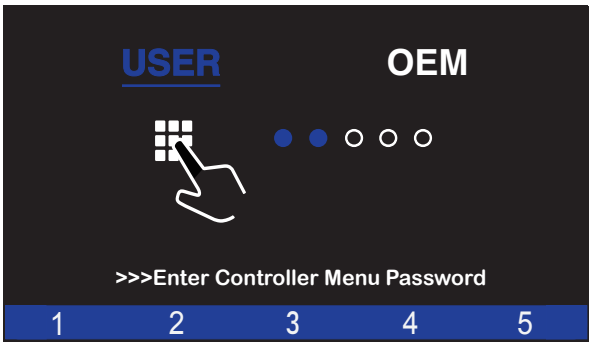
1. Go to the home screen.
2. Press the F3 button. The Password screen displays:



   The screen's active access level is highlighted in blue; in the example above, the User access level is active.

3. To change the access level, press the S, E, H, or button.
4. Use the F1–F5 buttons to enter the five-digit password, which consists of the numbers 1–5. Pressing an F1–F5 button enters the number that follows the letter "F": for example, the F2 button enters 2.

   To indicate how many characters have been entered, the corresponding circle in the middle of the screen turns blue when a button is pushed. In the following example, two numbers have been entered:



   Tip: To clear the most recently entered number, press the C button; the corresponding circle turns white. To exit the password screen, press the C button until the password is cleared, then press the button again.

5. Press the button to submit the password. If the password is correct, the 3401T will list the Curtis devices on the CANbus.
   If the password screen indicates that the wrong password was entered, press the C or button to clear the password, then repeat steps 3–5.
6. If multiple devices are listed, use the and buttons to select the device you want to work with.
7. Press the button. The 3401T downloads the device's menu and then displays the main menu. You can now view and edit parameters.

To exit the menu, press the F3 button.

IMPORTANT: After you have finished working with parameters, cycle the keyswitch to clear the password.

Open Parameter Menus of Devices Connected to the Serial Port

The 3401T provides read-only access to the main and Monitor menus of Curtis devices that support the ESP/SP protocol and are connected through the serial port. Take the following steps to open these menus:

1. Go to the home screen.
2. Press the F4 button. The main menu displays and you can now view parameters.

To exit the menus, press the F4 button.

Using the Parameter Menu Screens

The second column of Table 2-1 describes how to use the 3401T's buttons to navigate the menus and change parameter values.

In addition, the device enables you to rapidly change parameter values by factors of 10, 100, 1000, or 10,000 times the parameter's step size. For example, suppose that you need to increase a parameter's value by 1000 step sizes. Instead of incrementing the value 1000 times, you can increase the value by pressing a few buttons.

Take the following steps to rapidly change the selected parameter's value:

1. Press the F4 button until the screen's upper right corner indicates the factor by which to change the value. The following table lists the indicators:

Indicator	Factor
X1	1 **Note**: x1 is the default, and indicates that the parameter value will be incremented or decremented by one step size.
X10	10
X100	100
X1000	1000
X10000	10,000

2. Perform one of the following steps:
   - To increase the value by the specified factor, press the ↵+ button.
   - To decrease the value by the specified factor, press the C- button.
3. If the value needs further adjustment but by a different factor, repeat this procedure.

PRESET USER INTERFACES — 3401T MODEL

The 3401T model provides applications with preset user interfaces for the following types of vehicles:

- Counterbalanced forklifts
- Reach trucks and order pickers

Figure 2-1 and Figure 2-2 show the home screens of both user interfaces. The home screens consist of the areas indicated with callouts, which are described in Table 2-3.

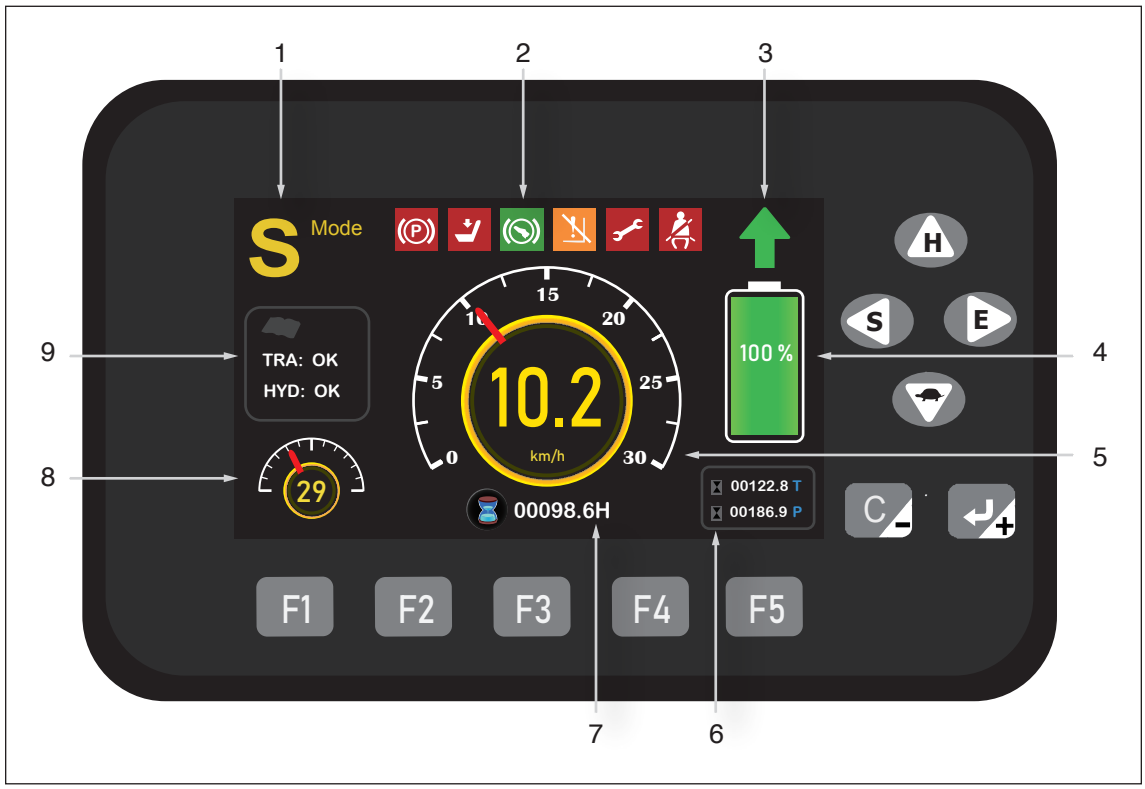


FIgure 2-1

Counterbalanced Forklifts Application

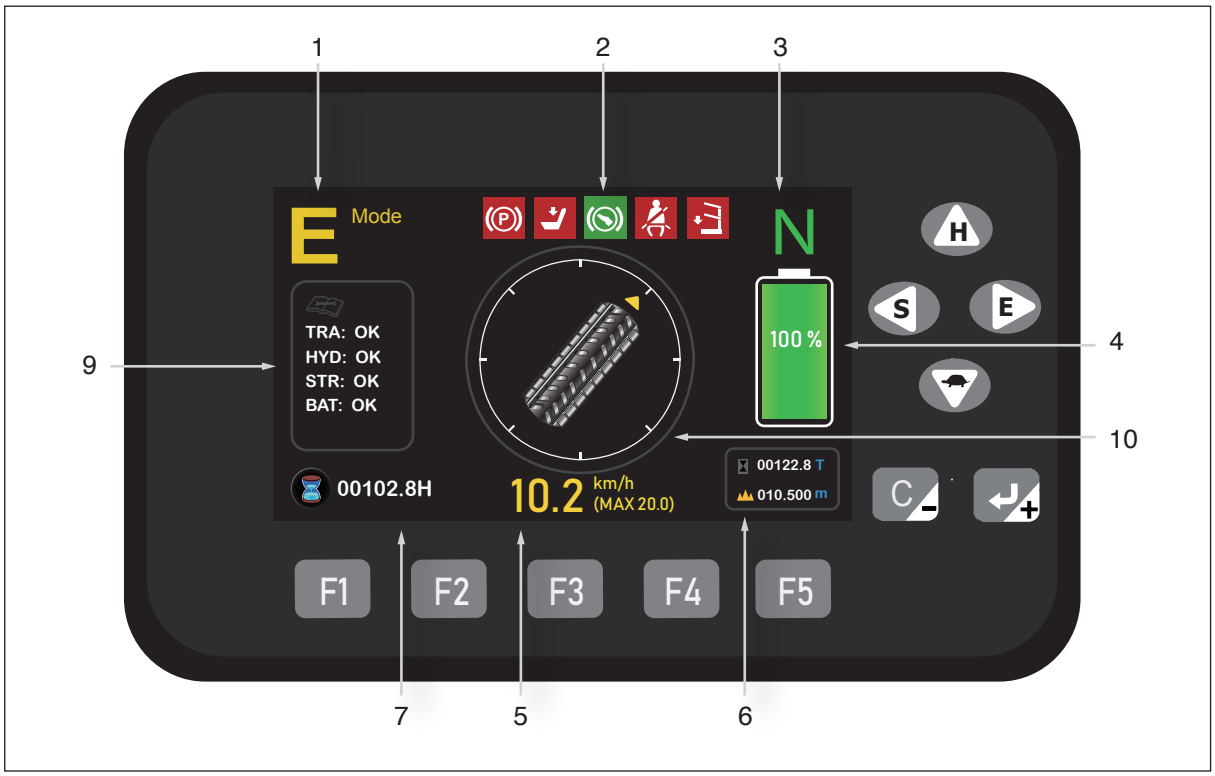


Figure 2-2
Reach Trucks and Order Pickers Application

The following table describes the areas contained by the home screens. Unless otherwise indicated, both home screens include these areas:

Table 2-3 3401T Home Screen Areas

Number	Area
1	Speed mode
2	Signal icons
3	Direction
4	BDI
5	Speedometer
6	Hour meters, cargo weight and lift height
7	Keyswitch hour meter
8	Steering angle (*counterbalanced forklifts application only*)
9	Fault codes
10	Steering angle (*reach trucks and order pickers application only*)

The screens also include a message center, which is not shown in the previous images. When the message center is active, it replaces the area that is normally in the screen's bottom center. For more information, see Message Center.

The following topics describe the home screens' areas.

Speed Mode

The speed mode area indicates the selected mode. The following table describes the icons that indicate the active speed mode and the buttons that specify the modes:

Icon	Speed Mode	Button
	Standard	
	High speed	
	Economy	
	Turtle	

Signal Icons

The signal icons indicate vehicle actions and states:

Icon	Description
	Parking
	Seat
	Seat belt
	Safety pedal
	Guardrail
	Lift lockout
	Fault active **Note**: The fault icon blinks when a fault is detected or when the 3401T is not receiving fault signals from other devices.

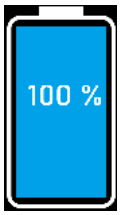
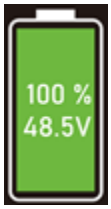
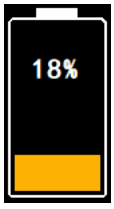
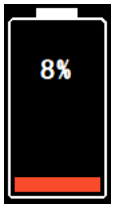
Direction Icons

The following icons indicate the vehicle's direction:

Icon	Description
	Forward
	Backward
	Neutral
	Left turn
	Right turn

BDI

The BDI area uses the following gauges to indicate the battery's state of charge. The battery voltage also may be displayed, as shown in the example below for lead-acid batteries. The gauge colors depend upon the BDI percentage:

Icon	BDI Status	BDI Percentage
The color depends upon the battery type: **Lithium:**  **Lead acid:** 	Okay	20–100%
	Warning	10–19%
	Low	0–9%

The Warning and Low gauges flash when they are active. If the BDI percentage is too low, lift lockout is activated and the icon displays.

Speedometer

The speedometer displays the speed in km/h or mph, depending upon how the device is configured. The speedometer on the reach trucks and order pickers screen may also display a speed limit. The following figures show how the preset user interfaces display the speedometer:

Figure 2-3
Speedometer — Counterbalanced Forklifts

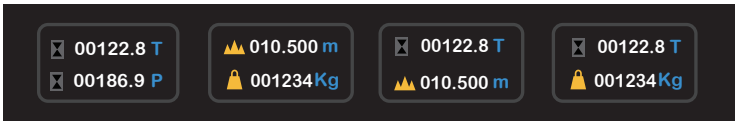
Figure 2-4
Speedometer — Reach Trucks and Order Pickers

Hour Meters, Cargo Weight and Lift Height

The hour meters, cargo weight and lift height area displays up to two of the following items at any given time:

Icon	Hour Meter
00186.9 P	Pump controller hour meter
00122.8 T	Traction controller hour meter
001234Kg	Cargo weight
010.500 m	Lift height

These indicators may be displayed in any combination, such as the combinations in the following examples:



Keyswitch Hour Meter

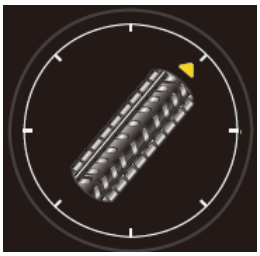
The keyswitch hour meter indicates the number of hours that the 3401T's keyswitch has been on since the hour meter was last reset:

Steering Angle

Both preset user interfaces provide gauges that display the steering angle; however, the gauges have different appearances.

The following example shows the steering angle gauge displayed by the counterbalanced forklifts application:

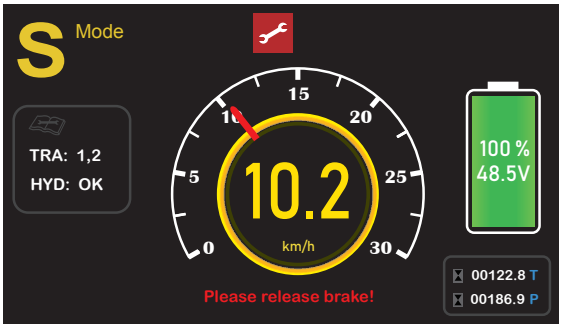
The following example shows the steering angle gauge displayed by the reach trucks and order pickers application:

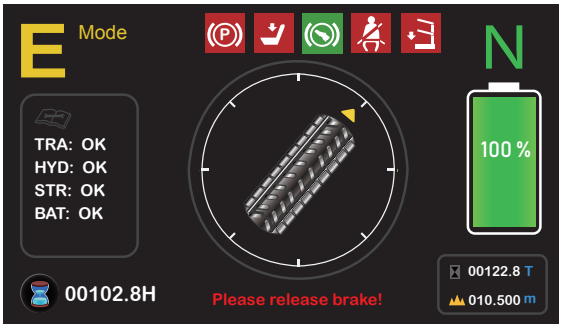


Message Center

The message center broadcasts information such as status and instructions. The 3401T activates the message center, which is hidden by default, when certain conditions occur. For example, a message displays when the system detects that the brake should be released.

When the message center is activated, the message displays in the screen's bottom center. The message center replaces the keyswitch hour meter on the counterbalanced forklifts screen and the speedometer on the reach trucks and order pickers screen:





Fault Codes

The fault codes area indicates whether faults are active for the vehicle system components listed in the following table. The components' indicators are identified with the abbreviations listed in the second column:

Component	Abbreviation
Traction controller	Depends upon whether the vehicle system has one or two traction controllers: • One controller: TRA • Two controllers: – TRA L – TRA R
Pump controller	HYD
Steering controller	STR
Lithium battery	BAT
OEM-defined fault code	OEM

If a component has no active faults, OK is displayed. In the following example, no faults are active for the traction controller, pump controller, and steering controller:

A fault code displays if a component has active faults. In the following example, the steering controller has an active fault identified by the fault code 1, 8:

Note: The 3401T also displays fault names. See View Fault Names.

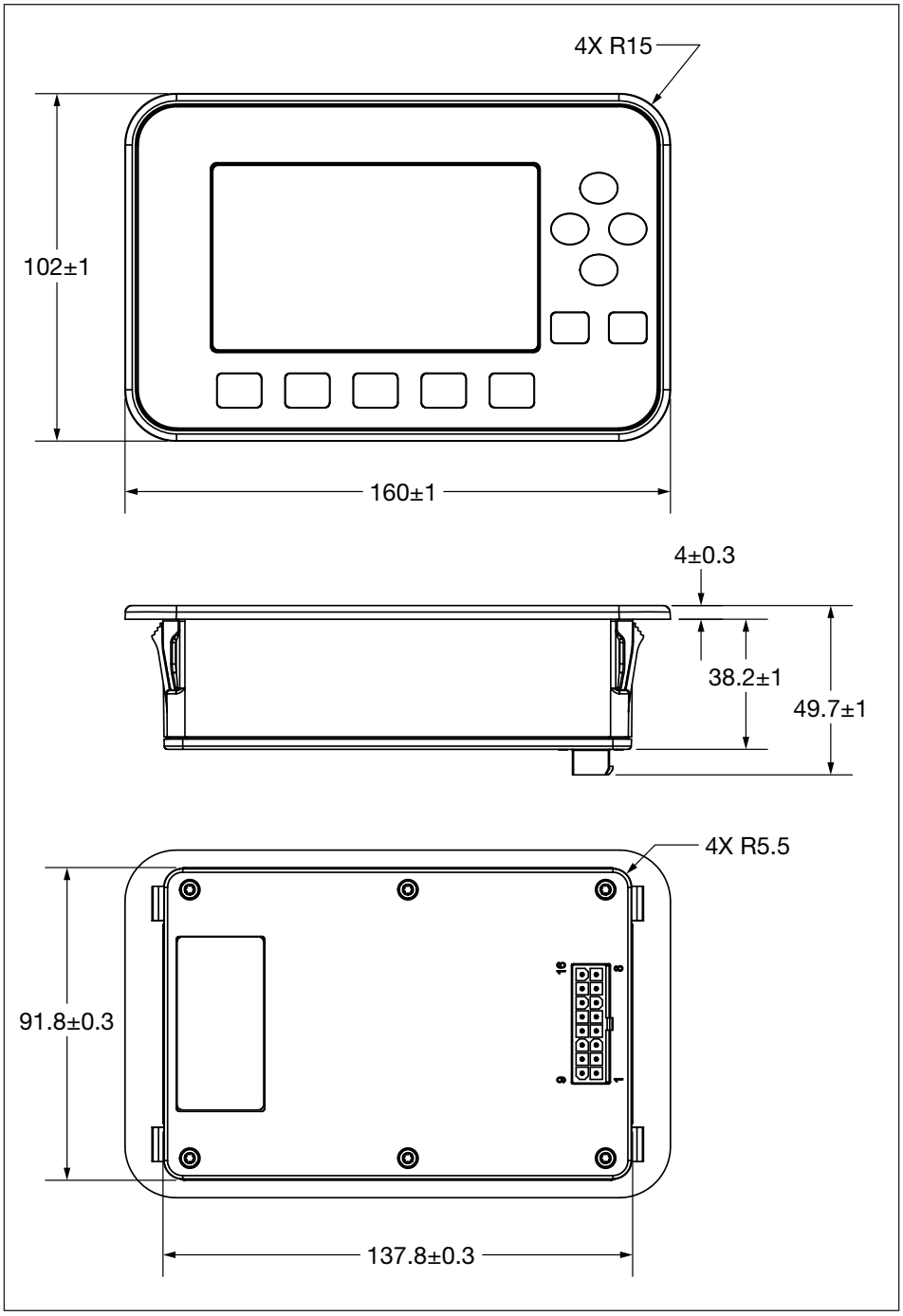
3 — INSTALLATION AND WIRING

This chapter explains how to install and wire the 3401T.

INSTALLING THE 3401T

Install the 3401T in a location that will keep the device clean and dry. The recommended panel cutout is 92.1 (+0.8/0) × 138.1 (+0.8/0)mm, with a panel thickness between 2.0–4.0mm. Figure 3-1 describes the dimensions.

Figure 3-1
Mounting Dimensions



I/O CONNECTOR

The mating connector is a 16-pin Mini-Universal MATE-N-LOK housing from TE Connectivity. The face is sealed to IP65. The rear is sealed to IP65 for electronic components and IP40 for the connector. Curtis recommends that you increase the connector's protection to IP54 by using the parts listed in Table 3-2.

The following tables list the TE Connectivity parts for IP40 and IP54 protection.

Table 3-1 Mating Connector Parts — IP40 Protection

Part	TE Connectivity Part Number
Connector Housing	770583-1
Terminal (18–22 AWG)	770904-*X*

Table 3-2 Mating Connector Parts — IP54 Protection

Part	TE Connectivity Part Number
Connector Housing	794824-1
Terminal (18–22 AWG)	770904-X
Interface Seal	1-1586362-6
Single Wire Seal or Gang Seal	• Single: 794758-1 • Gang: 1-1586359-6
Cavity Plug Seal (for unused terminal positions)	794995-1

I/O PINS

Table 3-3 I/O Pins

Pin	Signal Name	Description
1	SCI Rx	Serial communications — Rx
2	SCI GND	Serial communications — ground
3	CAN_L	CAN low
4	CAN_L Termination	CAN 120Ω termination resistor — low
5	Switch Input1/Analog Input1/Frequency Input 1	Input for switch, analog, or frequency signals.
6	Switch Input3/Analog Input3/HYD Fault Code Input	Input for switch, analog, or hydraulic controller fault code signals.
7	Keyswitch	
8	Switch Input5/MOSFET OUTPUT	Switch input or driver output.
9	SCI Tx	Serial communications — Tx
10	CAN_GND	CAN ground
11	CAN_H	CAN high
12	CAN_H Termination	CAN 120Ω termination resistor — high
13	Switch Input2/Analog Input2/Frequency Input 2	Input for switch, analog, or frequency signals.
14	Switch Input4/Analog Input4/TRA Fault Code Input	Input for switch, analog, or traction controller fault code signals.
15	B–	
16	B+	

WIRING DIAGRAM

Figure 3-2 is a representative wiring diagram for Curtis 3401T models.

Note: The diagram may differ from your application's requirements. However, the controller provides the I/Os and programmable parameters needed to meet almost all requirements. To discuss how to implement your application, contact your Curtis distributor or the Curtis sales and support office in your region.

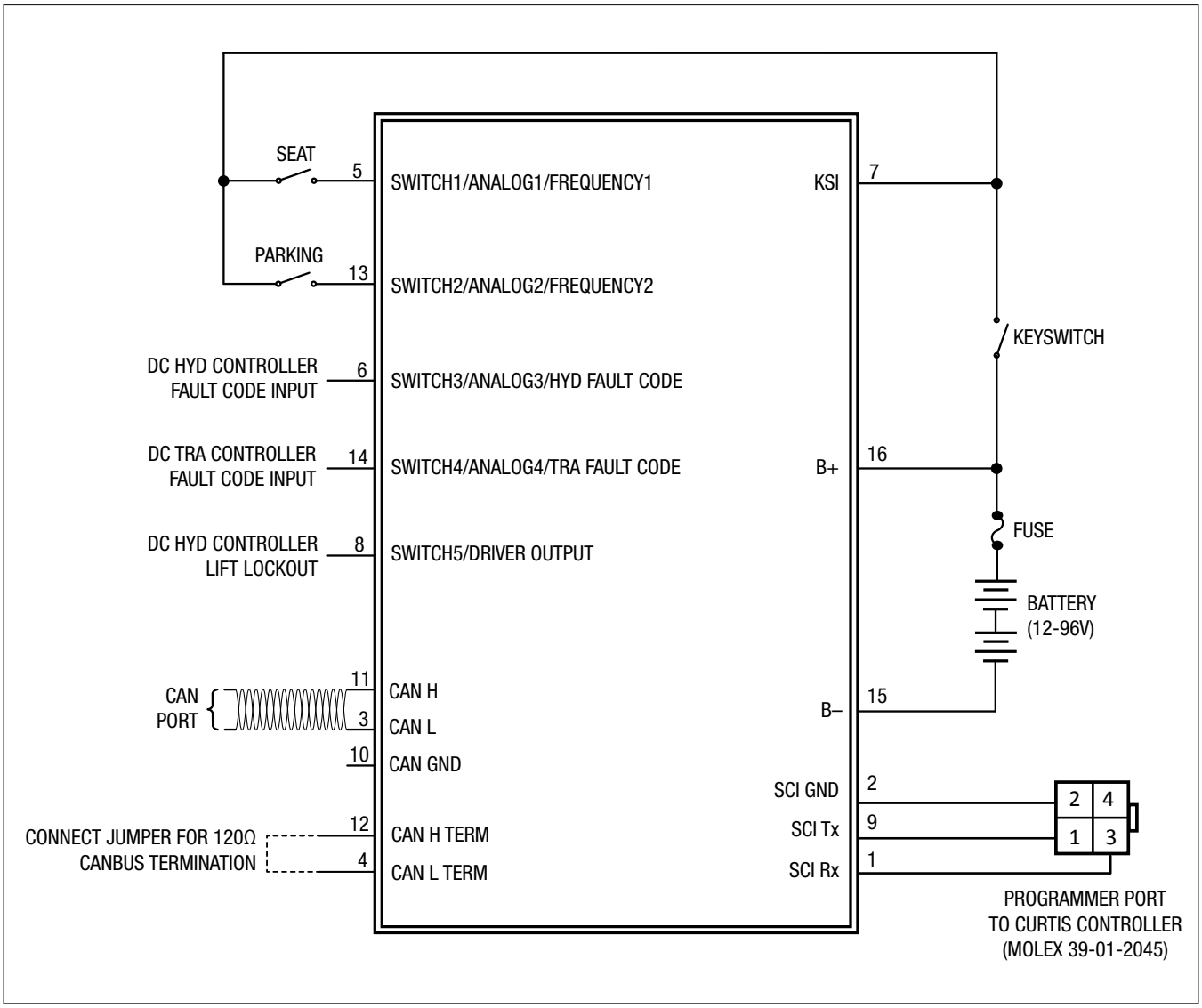


Figure 3-2
Wiring Diagram

OPERATING VOLTAGE

The following table describes the B+ startup and operating voltages:

Minimum	Minimum Startup	Nominal	Maximum
8 VDC	10 VDC	12–96 VDC	120 VDC

Applying B+ voltages above 120V may damage the 3401T and is not recommended. The device is designed to withstand reverse polarity connections continuously.

Note: All voltages listed in this manual are DC voltages.

OPERATING CURRENT

The following tables describe the B+ pin's operating current with the LCD heater off and on:

Table 3-4 Operating Current — LCD Heater Off

B+ Voltage (V)	Keyswitch On (mA)		Keyswitch Off (mA)
	Typical	Maximum	
12	166	207	112
24	80	99	56
36	56	68	40
48	45	53	33
60	39	46	29
72	36	41	27
80	34	39	26
96	33	37	25

Table 3-5 Operating Current — LCD Heater On

B+ Voltage (V)	Typical (mA)	Maximum (mA)
12	760	801
24	682	703
36	650	665
48	634	642
60	615	620
72	596	600
80	584	588
96	566	568

BATTERY CONNECTIONS

Connect the battery to the B+ and B– inputs (pins 16 and 15). Curtis recommends that you include a fuse in the circuit that connects the battery to the B+ input as shown in Figure 3-2. The fuse will protect the power system from external shorts and should be sized according to your application's requirements.

KEYSWITCH

The keyswitch input (pin 7) is active high. Connect the keyswitch input to B+ via a keyswitch.

SWITCH 1–5 INPUTS

The switch 1–5 inputs can be configured for various functions. The following table lists the inputs' pins, functions, and the parameters used to configure the functions:

Switch Input	Pin	Switch	Traction Fault Code	Hydraulic Fault Code	Analog	Frequency	Driver	Parameter
1	5	x			x	x		Sender 1 Type
2	13	x			x	x		Sender 2 Type
3	6	x		x	x			Sender 3 Type
4	14	x	x		x			Sender 4 Type
5	8	x					x	Output Mode

Note: The frequency functions are reserved.

The following sections describe these inputs.

Switch Inputs

The switch 1–4 inputs can be configured as active high (switched to B+) or active low (switched to B–). If pin 8 is configured as switch input 5, the input is active high. The switches' statuses can be used to turn signal icons on or off.

To configure pin 8 as a switch input, set the Output Mode parameter to Switch Input Mode.

The voltage range of the switch inputs is identical to the B+ operating voltage range. The input signals must be within the range of threshold voltages listed in the following table:

Threshold	Minimum	Maximum
Active high	4.0V	Maximum B+ voltage
Active low	*N/A*	1.0V

Fault Code Inputs

Switch inputs 3 and 4 can be used to detect fault codes of Curtis DC controllers. Fault information is displayed in the fault codes area and the Fault Name screen:

- Switch input 3 is for Curtis DC pump controllers such as the 1253 and 1253C models.
- Switch input 4 is for Curtis DC traction controllers such as the 1243 and 1244 models.

Sender Inputs

Switch inputs 1–4 can be used as analog resistive or voltage inputs. The analog signals can be used to display data such as temperature, fuel, and tire pressure. Switch inputs 1 and 2 can also be used as frequency inputs for devices such as speedometers and tachometers.

The frequency functions are reserved. Curtis engineers use these functions to create custom applications. If you need a custom application, contact your Curtis distributor or the Curtis sales and support office in your region.

MOSFET Driver

Switch input 5 can be used as a low side MOSFET driver. The continuous output current is limited to 1A. The driver can be configured for the following output modes:

- Current
- Voltage
- PWM
- Lift lockout

In PWM mode, the PWM frequency is 16 kHz. In lift lockout mode, the MOSFET output indicates On or Off. The Output menu contains parameters that configure the output.

CAN CONNECTIONS

To connect the 3401T to the CANbus, connect CAN Low and CAN High to pins 3 and 11, respectively. Use twisted-pair wiring to minimize the likelihood of picking up a voltage bias on only one signal.

The device contains a 120Ω terminating resistor. To enable the resistor, short pins 4 and 12.

Note: For information on the 3401T's CAN parameters and features, see CAN Menu and CANopen Communications.

SERIAL COMMUNICATION INTERFACE (SCI)

The following table describes specifications for the serial communications interface (pins 1, 2, and 9):

Specification	Value
Logic level	0–5V
Baud rate	Self-adaptive

4 — PROGRAMMABLE PARAMETERS

The programmable parameters allow you to configure the 3401T so that it meets your application's requirements. Curtis programming devices provide a user-friendly way to read and write to the parameters. You can also use the 3401T to read and write to parameters; see View and Edit Parameters.

Restart the device after you change a parameter marked as [PCF]. If the device is not restarted, a Parameter Change fault will occur.

The parameters are grouped into menus. This chapter describes the main menu and the menus contained by the Program menu, and the Monitor Parameters chapter describes the menus contained by the Monitor menu.

The following columns in the parameter description tables contain multiple types of information:

- **Parameter** and **CAN Index**: The parameter name, followed by the CAN index and sub-index. This column also identifies parameters marked as [PCF].

  Note: CAN indexes and sub-indexes are delimited by colons. For example, a parameter with an index of `0x640F` and a sub-index of `0x00` would be represented as `0x640F:00`.
- **Values** and **Raw Values**: The allowed values as displayed in Curtis programming devices, followed by allowed values in raw units suitable for CAN messages.
- **Access Level** and **Default Value**. The parameter's access level for Curtis programming devices, followed by the default value.

  Note: Table 2-2 describes how the Curtis programming device access levels correspond to the 3401T access levels.

Most of the parameters described in this chapter are read-write. If a parameter is read-only, the last line of the Description column will consist of "RO".

MAIN MENU PARAMETERS

The 3401T's main menu contains the following parameters:

MAIN MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Model Number 0x600D:00	–32768 to 32767 –32768 to 32767	32-bit	Field Basic 0	Indicates the model number. RO
Serial Number 0x1018:04	0–999999 0–999999	32-bit	Field Basic 0	Indicates the serial number. RO
CDEV 0x690D:00	–2147483648 to 2147483647 –2147483648 to 2147483647	32-bit	Field Basic 0	Indicates the device profile's version. RO
OS Version 0x690C:00	–2147483648 to 2147483647 –2147483648 to 2147483647	32-bit	Field Basic 0	Indicates the operating system's version. RO
LCD Backlight 0x640F:00	1–10 1–10	32-bit	Field Basic 7	Indicates the brightness of the device's backlight, with 10 indicating the maximum brightness.
Speed Unit 0x6040:00	Enumerated 0–1	32-bit	Field Basic 0	Indicates the speedometer's unit of measurement: 0 = KPH 1 = MPH
Language 0x4802:00	Enumerated 0–2	32-bit	Field Basic 0	Indicates the language in which the 3401T displays information. Values other than 0–2 are reserved: 0 = English 1 = Chinese 2 = Korean *3 = Japanese* *4 = French* *5 = German* *6 = Italian* *7 = Spanish* *8 = Portuguese* *9 = Swedish*
Battery Type 0x690B:00	Enumerated 0–1	32-bit	Field Basic 0	Indicates the battery type: 0 = Lead-Acid 1 = Lithium

SET HOURMETERS MENU

Use the Set Hourmeters menu to specify the password for resetting hour meters. After the password has been entered the Set Hourmeters submenu is displayed. The submenu contains parameters that reset the hour meters.

Note: The default password for resetting hour meters is 12345. Curtis recommends that you change the default password.

Take the following steps to specify the password:

1. Specify the password as the Input Hrm Password parameter value.
2. Set the Confirm Input Password parameter to On. If the password is valid, the Set Hourmeters submenu is displayed.

SET HOURMETERS MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Input Hrm Password 0x6906:00	11111–99999 11111–99999	32-bit	OEM Dealer 55555	Specifies the password for resetting hour meters. **Note**: The default value is not the same value as the actual password.
Confirm Input Password 0x6908:00	Off/On 0–1	32-bit	OEM Dealer Off	Submits the password specified with the Input Hrm Password parameter.
Status of Set Hourmeters 0x6907:00	Enumerated 0–1	32-bit	OEM Dealer Disable	Indicates whether the hour meters can be reset: 0 = Disable 1 = Enable When a valid hour meter password has been specified, the value changes to Enable. RO

Set Hourmeters Submenu

Use the Set Hourmeters submenu to reset hour meters and change the password for resetting them.

SET HOURMETERS SUBMENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Reset KSI Hourmeter 0x646A:00	Off/On 0–1	16-bit	OEM Dealer Off	Resets the keyswitch hour meter.
Reset TRA Hourmeter 0x646B:00	Off/On 0–1	16-bit	OEM Dealer Off	Resets the traction controller hour meter.
Reset HYD Hourmeter 0x646C:00	Off/On 0–1	16-bit	OEM Dealer Off	Resets the pump controller hour meter.
Set KSI Hourmeter 0x642C:00	0–99999.9 hours 0–999999	32-bit	OEM Dealer 0	Sets the time indicated by the keyswitch hour meter.
Change Hrm Password 0x6905:00	11111–99999 11111–99999	32-bit	OEM Dealer 12345	The password for resetting the hour meters.

CAN MENU

The following table describes the parameters on the CAN menu.

Note: The CAN menu also contains the RPDO 1–4 Byte Map and TPDO 1–4 Byte Map menus, which specify the objects for which the PDOs transmit and receive data.

CAN MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
CAN Node ID 0x2000:01	1–127 1–127	16-bit	Field Intermediate 46	Specifies the device's node ID.
CAN Baud Rate 0x2001:01	–1 to 4 –1 to 4	16-bit	Field Intermediate 0	Specifies the 3401T's baud rate: –1 = 100 Kbps 0 = 125 Kbps 1 = 250 Kbps 2 = 500 Kbps 3 = 800 Kbps 4 = 1 Mbps
ECS CAN Node ID 0x3104:00	1–127 1–127	32-bit	Field Intermediate 70	Specifies the node ID for the ECS.

RPDO and TPDO Byte Map Menus

The parameters on the RPDO 1–4 Byte Map and TPDO 1–4 Byte Map menus are used to configure PDOs. RPDOs 1–4 and TPDOs 1–2 are preconfigured to transmit and receive messages; see Preconfigured PDOs. Modify a preconfigured PDO only if the application does not require the PDO's preconfigured functions.

The menus contain parameters with the same names, allowed values, and data sizes. The only differences between parameters of the same name are their CAN indexes and default values. For simplicity's sake, the following table describes the PDO Byte Map menus' parameters and Table 4-1 lists the parameters' CAN indexes and default values.

RPDO AND TPDO BYTE MAP MENU

PARAMETER	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL	DESCRIPTION
Length	0–8 0–8	8-bit	OEM Dealer	Specifies the number of objects mapped to the PDO.
Map 1	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's first mapped object.
Map 2	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's second mapped object.
Map 3	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's third mapped object.
Map 4	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's fourth mapped object.
Map 5	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's fifth mapped object.
Map 6	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's sixth mapped object.
Map 7	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's seventh mapped object.
Map 8	0–FFFFFFFFh 0–FFFFFFFFh	32-bit	OEM Dealer	Specifies the PDO's eighth mapped object.

Table 4-1 PDO Byte Map Menus — CAN Indexes and Default Values

PARAMETER	PDO	CAN INDEX	DEFAULT VALUE
Length	RPDO1	0x1600:00	8
Map 1	RPDO1	0x1600:01	0x66010008
Map 2	RPDO1	0x1600:02	0x66030008
Map 3	RPDO1	0x1600:03	0x66040008
Map 4	RPDO1	0x1600:04	0x66000008
Map 5	RPDO1	0x1600:05	0x66020008
Map 6	RPDO1	0x1600:06	0x64170008
Map 7	RPDO1	0x1600:07	0x66060008
Map 8	RPDO1	0x1600:08	0x66050008
Length	TPDO1	0x1A00:00	4
Map 1	TPDO1	0x1A00:01	0x66070008
Map 2	TPDO1	0x1A00:02	0x660C0008
Map 3	TPDO1	0x1A00:03	0x642C0020
Map 4	TPDO1	0x1A00:04	0x66110008
Map 5	TPDO1	0x1A00:05	0
Map 6	TPDO1	0x1A00:06	0
Map 7	TPDO1	0x1A00:07	0
Map 8	TPDO1	0x1A00:08	0
Length	RPDO2	0x1601:00	7
Map 1	RPDO2	0x1601:01	0x66080008
Map 2	RPDO2	0x1601:02	0x66090008
Map 3	RPDO2	0x1601:03	0x660A0010
Map 4	RPDO2	0x1601:04	0x660D0008
Map 5	RPDO2	0x1601:05	0x660F0008
Map 6	RPDO2	0x1601:06	0x66100008
Map 7	RPDO2	0x1601:07	0x66140008
Map 8	RPDO2	0x1601:08	0
Length	TPDO2	0x1A01:00	2
Map 1	TPDO2	0x1A01:01	0x660B0008
Map 2	TPDO2	0x1A01:02	0x690B0020
Map 3	TPDO2	0x1A01:03	0
Map 4	TPDO2	0x1A01:04	0
Map 5	TPDO2	0x1A01:05	0
Map 6	TPDO2	0x1A01:06	0
Map 7	TPDO2	0x1A01:07	0
Map 8	TPDO2	0x1A01:08	0
Length	RPDO3	0x1602:00	4
Map 1	RPDO3	0x1602:01	0x660E0020
Map 2	RPDO3	0x1602:02	0x66150008
Map 3	RPDO3	0x1602:03	0x66160008
Map 4	RPDO3	0x1602:04	0x66170010
Map 5	RPDO3	0x1602:05	0
Map 6	RPDO3	0x1602:06	0
Map 7	RPDO3	0x1602:07	0
Map 8	RPDO3	0x1602:08	0

Table 4-1 PDO Byte Map Menus — CAN Indexes and Default Values, cont'd

PARAMETER	PDO	CAN INDEX	DEFAULT VALUE
Length	TPDO3	0x1A02:00	0
Map 1	TPDO3	0x1A02:01	0
Map 2	TPDO3	0x1A02:02	0
Map 3	TPDO3	0x1A02:03	0
Map 4	TPDO3	0x1A02:04	0
Map 5	TPDO3	0x1A02:05	0
Map 6	TPDO3	0x1A02:06	0
Map 7	TPDO3	0x1A02:07	0
Map 8	TPDO3	0x1A02:08	0
Length	RPDO4	0x1603:00	2
Map 1	RPDO4	0x1603:01	0x66120020
Map 2	RPDO4	0x1603:02	0x66130020
Map 3	RPDO4	0x1603:03	0
Map 4	RPDO4	0x1603:04	0
Map 5	RPDO4	0x1603:05	0
Map 6	RPDO4	0x1603:06	0
Map 7	RPDO4	0x1603:07	0
Map 8	RPDO4	0x1603:08	0
Length	TPDO4	0x1A03:00	0
Map 1	TPDO4	0x1A03:01	0
Map 2	TPDO4	0x1A03:02	0
Map 3	TPDO4	0x1A03:03	0
Map 4	TPDO4	0x1A03:04	0
Map 5	TPDO4	0x1A03:05	0
Map 6	TPDO4	0x1A03:06	0
Map 7	TPDO4	0x1A03:07	0
Map 8	TPDO4	0x1A03:08	0

BDI MENU

The source of the BDI percentage can be either the 3401T's internal BDI calculations or RPDO1. The parameters on the BDI menu are used for the internal calculations.

BDI MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Nominal Voltage 0x6400:00	Enumerated 0–2	32-bit	Field Intermediate 0	Specifies the battery's nominal voltage: 0 = 12/48/80V 1 = 24/60/96V 2 = 36/72V The BDI algorithm requires that the nominal voltage is correctly specified.
Charge Full 0x6420:00	1.500–2.500V 1500–2500	32-bit	Field Intermediate 2.350V	Specifies the battery cell voltage above which the battery is considered charged. Charge Full must be at least 0.200V above Charge Empty.
Charge Empty 0x6421:00	1.500–2.500V 1500–2500	32-bit	Field Intermediate 2.100V	Specifies the battery cell voltage above which the battery is considered as starting to charge. Charge Empty must be at least 0.200V below Charge Full and at least 0.010V above Discharge Full.
Discharge Full 0x641E:00	1.500–2.500V 1500–2500	32-bit	Field Intermediate 2.040V	Specifies the battery cell voltage at which the state of charge is considered 100%. Discharge Full must be at least 0.120V more than Discharge Empty and must be between the following values: • Charge Empty – 0.010V • OCR Reset – 0.030V
Discharge Empty 0x641F:00	1.500–2.500V 1500–2500	32-bit	Field Intermediate 1.730V	Specifies the battery cell voltage at which the state of charge is considered 0%. Discharge Empty must be at least 0.120V less than Discharge Full.
OCR Reset 0x6422:00	1.500–2.500V 1500–2500	32-bit	Field Intermediate 2.090V	Specifies the battery cell voltage above which the BDI percentage is reset to 100%. OCR Reset is checked only once; the check occurs when the 3401T is powered up. OCR Reset must be at least 0.030V above Discharge Full and at least 0.010V less than Charge Empty.
Integration Rate 0x6423:00	2–600 minutes 2–600	32-bit	Field Intermediate 30 minutes	Specifies the minimum time for the BDI algorithm to decrease the BDI percentage from 100% to 0% or increase the percentage from 0% to 100%.
Lift Lockout 0x6424:00	0.0–20.0% 0–200	32-bit	Field Intermediate 10.0%	Specifies the BDI percentage below which lift lockout is activated.

PASSWORD MENU

The Password parameters specify the passwords for powering on the 3401T and for viewing and editing parameters.

Note: The passwords' ranges of values are 11111–55555. However, passwords can only consist of the digits 1 through 5.

PASSWORD MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
OEM Menu Password 0x6011:00	11111–55555 11111–55555	32-bit	OEM Dealer 22222	Specifies the password for accessing parameter menus that have the OEM access level.
USER Menu Password 0x600F:00	11111–55555 11111–55555	32-bit	Field Intermediate 11111	Specifies the password for accessing parameter menus that have the User access level.
PIN Code 0x6010:00	11111–55555 11111–55555	32-bit	Field Intermediate 12345	Specifies the password for powering on the 3401T. **Note**: The PIN Code Source parameter indicates whether a password is required.

MAINTENANCE MENU

The 3401T provides three countdown maintenance monitors. The Maintenance parameters specify intervals for and reset the monitors.

Note: The parameters on the Maintenance menu of the Monitor menu indicate how much time remains on the maintenance monitors.

MAINTENANCE MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Maintenance Interval 1 0x643E:00	0.0–3276.7 hours 0–32767	32-bit	Field Intermediate 999.9 hours	Specifies the countdown interval for maintenance monitor 1.
Maintenance Interval 2 0x6444:00	0.0–3276.7 hours 0–32767	32-bit	Field Intermediate 999.9 hours	Specifies the countdown interval for maintenance monitor 2.
Maintenance Interval 3 0x644A:00	0.0–3276.7 hours 0–32767	32-bit	Field Intermediate 999.9 hours	Specifies the countdown interval for maintenance monitor 3.
Reset Maintenance Interval 1 0x6471:00	Off/On 0–1	16-bit	Field Intermediate Off	Resets maintenance monitor 1.
Reset Maintenance Interval 2 0x6472:00	Off/On 0–1	16-bit	Field Intermediate Off	Resets maintenance monitor 2.
Reset Maintenance Interval 3 0x6473:00	Off/On 0–1	16-bit	Field Intermediate Off	Resets maintenance monitor 3.

ODOMETERS MENU

The 3401T provides three odometers. The Odometers parameters reset the odometers.

Note: The parameters on the Odometers menu of the Monitor menu indicate the odometer data.

ODOMETERS MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Reset Odometer 1 0x646E:00	Off/On 0–1	16-bit	Field Intermediate Off	Resets odometer 1 to 0.
Reset Odometer 2 0x646F:00	Off/On 0–1	16-bit	Field Intermediate Off	Resets odometer 2 to 0.
Reset Odometer 3 0x6470:00	Off/On 0–1	16-bit	Field Intermediate Off	Resets odometer 3 to 0.

SENDERS MENU

The Senders parameters specify the types of data received by the switch 1–4 inputs.

SENDERS MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Sender 1 Type 0x6300:00	Enumerated 0–3	32-bit	Field Intermediate 0	Configures the switch 1 input: 0 = Switch Input 1 = Resistor Input 2 = Voltage Input 3 = Frequency Input *(reserved)*
Sender 2 Type 0x6301:00	Enumerated 0–3	32-bit	Field Intermediate 0	Configures the switch 2 input: 0 = Switch Input 1 = Resistor Input 2 = Voltage Input 3 = Frequency Input *(reserved)*
Sender 3 Type 0x6302:00	Enumerated 0–3	32-bit	Field Intermediate 3	Configures the switch 3 input: 0 = Switch Input 1 = Resistor Input 2 = Voltage Input 3 = HYD Fault Input (Curtis DC pump controller)
Sender 4 Type 0x6303:00	Enumerated 0–3	32-bit	Field Intermediate 3	Configures the switch 4 input: 0 = Switch Input 1 = Resistor Input 2 = Voltage Input 3 = TRA Fault Input (Curtis DC traction controller)

OUTPUT MENU

The Output Mode parameter specifies how pin 8 (Switch Input5/MOSFET OUTPUT) is used. The Driver Output Setting parameter and the parameters on the following submenus apply when the pin is used as a driver:

- Ramp
- Initial
- Current Limit
- Dither
- PI

OUTPUT MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Output Mode 0x6620:00	Enumerated 0–5	16-bit	OEM Dealer 4	Specifies the function for pin 8: 0 = Turn Off 1 = PWM Mode 2 = Voltage Mode 3 = Current Mode 4 = Lift Lock Mode 5 = Switch Input Mode
Driver Output Setting 0x66F0:00	0.0–100.0% 0–1000	16-bit	OEM Dealer 0.0%	Specifies the output when pin 8 is used as a driver. How the parameter is used depends upon the Output Mode: • PWM mode: The actual duty cycle. • Voltage mode: The product of this value and the Nominal Voltage parameter is the actual output voltage. • Current mode: The product of this value and the Maximum Current parameter is the actual output current.

Ramp Menu

The following table describes the parameters on the Ramp menu.

RAMP MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Ramp Up Time 0x6650:00	0–10000ms 0–10000	16-bit	OEM Dealer 8ms	Specifies the time it takes to go from minimum to maximum output current.
Ramp Down Time 0x6660:00	0–10000ms 0–10000	16-bit	OEM Dealer 8ms	Specifies the time it takes to go from maximum to minimum output current.

Initial Menu

The following table describes the parameters on the Initial menu.

INITIAL MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Initial PWM Duty 0x6670:00	0.0–100.0% 0–1000	16-bit	OEM Dealer 0.0%	Specifies the PWM duty cycle when the driver output is in its initial stage.
Initial Time 0x6680:00	0–10000ms 0–10000	16-bit	OEM Dealer 0ms	Specifies the initial stage time of the driver output, in 8ms steps.

Current Limit Menu

The parameters on the Current Limit menu specify the driver's minimum and maximum currents. These parameters apply only when the driver is operating in Current mode.

CURRENT LIMIT MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Maximum Current 0x6630:00	0–1000mA 0–1000	16-bit	OEM Dealer 1000mA	Specifies the maximum output current.
Minimum Current 0x6640:00	0–1000mA 0–1000	16-bit	OEM Dealer 0mA	Specifies the minimum output current.

Dither Menu

The parameters on the Dither menu configure the driver's dither pulses. These parameters apply only when the driver is operating in Current mode.

DITHER MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Dither Period 0x66A0:00	2–1000ms 2–1000	16-bit	OEM Dealer 1000ms	Specifies the time between dither pulses for each output, in 2ms steps. A Dither Period of 4–200ms provides a frequency range of 250–5 Hz.
Dither Amount 0x6690:00	0–100% 0–32767	16-bit	OEM Dealer 0%	Specifies how much dither is added or subtracted, in 10mA steps, for each output.

PI Menu

The 3401T has a proportional/integral current controller, which is configured by the parameters on the PI menu.

PI MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Kp 0x66B0:00	1–100% 20–2048	16-bit	OEM Dealer 8%	Specifies the proportional gain factor of the current PI controller.
Ki 0x66C0:00	1–100% 20–2048	16-bit	OEM Dealer 20%	Specifies the integral gain factor of the current PI controller.

MISC MENU

The following table describes the parameters on the Misc menu.

MISC MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL DEFAULT VALUE	DESCRIPTION
Mode Saving 0x4800:00	Off/On 0–1	32-bit	Field Intermediate On	Specifies whether the speed mode is saved when the 3401T is powered down. On indicates that the speed mode is saved.
PIN Code Source 0x3102:00	Enumerated 0–2	32-bit	Field Intermediate None	Specifies whether a password is required when the 3401T is powered up and whether the 3401T or the ECS is used to enter the password: 0 = None. A password is not required. 1 = Internal. The 3401T is used. 2 = External. The ECS is used. This value can be selected only when the 3401T and the ECS are in the operational NMT state and the ECS node ID is specified.
HYD Controller Enable 0x6900:00	Off/On 0–1	32-bit	Field Intermediate On	Specifies whether fault codes for the hydraulic controller are displayed. On = displayed.
Programmer Protocol 0x6902:00	Enumerated 0–1	32-bit	Field Intermediate ESP/SP	Specifies the protocol used for Curtis programming devices: 0 = ESP/SP. For the serial version of the 1313 handheld programmer. 1 = CIT. For the Curtis Integrated Toolkit™ (CIT) and the CANbus version of the 1313 handheld programmer.
Vehicle Config 0x6909:00	1–65535 1–65535	32-bit	OEM Dealer 1	Specifies the type of vehicle that is being used with the 3401T. The correct value must be entered in order to view fault names. If you are not sure of the correct value, contact your Curtis distributor or the Curtis sales and support office in your region.

5 — MONITOR PARAMETERS

The Monitor menu contains read-only parameters that indicate real-time data. You can use this data when you are configuring or troubleshooting the application.

Note: For descriptions of the columns in this chapter's parameter description tables, see Programmable Parameters. The parameter descriptions do not include the Default Value column.

HOURMETERS MENU

The following table describes the parameters on the Hourmeters menu.

HOURMETERS MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL	DESCRIPTION
Hourmeter 1 0x6800:00	0–99999.9 hours 0–999999	32-bit	Field Intermediate	Indicates how many hours are on the keyswitch hour meter.
Hourmeter 2 0x6801:00	0–99999.9 hours 0–999999	32-bit	Field Intermediate	Indicates how many hours are on the traction controller hour meter.
Hourmeter 3 0x6802:00	0–99999.9 hours 0–999999	32-bit	Field Intermediate	Indicates how many hours are on the pump controller hour meter.

MAINTENANCE MENU

The following table describes the parameters on the Maintenance menu.

MAINTENANCE MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL	DESCRIPTION
Maintenance 1 0x6803:00	0–3276.7 hours 0–32767	16-bit	Field Intermediate	Indicates the remaining time on maintenance monitor 1.
Maintenance 2 0x6804:00	0–3276.7 hours 0–32767	16-bit	Field Intermediate	Indicates the remaining time on maintenance monitor 2.
Maintenance 3 0x6805:00	0–3276.7 hours 0–32767	16-bit	Field Intermediate	Indicates the remaining time on maintenance monitor 3.

ODOMETERS MENU

The following table describes the parameters on the Odometers menu.

ODOMETERS MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL	DESCRIPTION
Odometer 1 0x6806:00	0–9999999 0–9999999	32-bit	Field Intermediate	Indicates the value of odometer 1.
Odometer 2 0x6807:00	0–9999999 0–9999999	32-bit	Field Intermediate	Indicates the value of odometer 2.
Odometer 3 0x6808:00	0–9999999 0–9999999	32-bit	Field Intermediate	Indicates the value of odometer 3.

SENDERS MENU

The parameters on the Senders menu indicate the raw AD data for switch inputs 1–4.

SENDERS MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL	DESCRIPTION
Sender 1 0x6312:00	0–4095 0–4095	32-bit	Field Intermediate	Indicates the raw AD data for switch input 1.
Sender 2 0x6314:00	0–4095 0–4095	32-bit	Field Intermediate	Indicates the raw AD data for switch input 2.
Sender 3 0x6318:00	0–4095 0–4095	32-bit	Field Intermediate	Indicates the raw AD data for switch input 3.
Sender 4 0x631A:00	0–4095 0–4095	32-bit	Field Intermediate	Indicates the raw AD data for switch input 4.

OUTPUT MENU

The following table describes the parameters on the Output menu. These parameters are used when pin 8 is configured as a MOSFET driver.

OUTPUT MENU

PARAMETER CAN INDEX	VALUES RAW VALUES	DATA SIZE	ACCESS LEVEL	DESCRIPTION
PWM Duty 0x6700:00	0.0–100.0% 0–1000	16-bit	Field Intermediate	Indicates the PWM percentage when pin 8 is configured as a driver.
Current 0x66E0:00	0–1000mA 0–1000	16-bit	Field Intermediate	Indicates the output current when the Output Mode parameter specifies Current Mode.

6 — CANopen COMMUNICATIONS

The 3401T complies with the CAN in Automation (CiA) CANopen 301 specification. This chapter describes the 3401T's CANopen features.

Some familiarity with CANopen is a prerequisite. For CANopen information, see the following pages on the CiA web site:

- Overview: https://www.can-cia.org/canopen/
- Specifications: https://www.can-cia.org/groups/specifications/

BYTE AND BIT SEQUENCE ORDER

CANopen message byte sequences are transmitted with the least significant byte first (little-endian format).

Note: This manual uses the LSB 0 Numbering convention when referring to byte and bit numbers.

For example, the following table shows an SDO that writes the data 04E2h to the object with the index and sub-index 334C-01h:

0	1	2	3	4	5	6	7
Control Byte	Index		Sub-index	Data			
2Bh	4Ch	33h	01h	E2h	04h	00h	00h

Strings are read from left to right. The following example shows how the 3401T transmits an SDO segment for the string "Curtis":

0	1	2	3	4	5	6	7
Control Byte	Data						
00h	43h = "C"	75h = "u"	72h = "r"	74h = "t"	69h = "i"	73h = "s"	

Bit sequences are transmitted from the most significant to the least significant bit (big-endian format). The following example shows how the 3401T transmits the bits for the value 2Bh:

7	6	5	4	3	2	1	0
0	0	1	0	1	0	1	1

NODE IDS

The 3401T's node ID is specified with the CAN Node ID parameter. The default node ID is 0x2E.

If the Curtis Electronic Code Switch (ECS) is on the CANbus, the ECS CAN Node ID parameter specifies its node ID. Both parameters are on the CAN menu.

BAUD RATE

The baud rate is specified with the CAN Baud Rate parameter on the CAN menu. The default baud rate is 125 Kbps.

MESSAGE COB-IDS

CAN messages are identified by 11-bit COB-IDs. The device does not support 29-bit COB-IDs.

EXPEDITED SDOS

The least significant byte of an expedited SDO is known as the *control byte*. The following table describes the control byte fields:

7	6	5	4	3	2	1	0
Command Specifier			0b	*n*		*e*	*s*

The following list describes the control byte:

- The *Command Specifier* field indicates the SDO's transfer type, which is described in the following table:

Transfer Type	Value
Write data to a device	001b
Confirm a write	011b
Request data from a device	010b
Device responds with requested data	010b
Abort SDO	100b

- Bit 4 is always 0b.
- The values of bits 0–3 depend upon whether the SDO transfers data. If the SDO does **not** transfer data, these bits are always 0b. If the SDO transfers data, the bit values are as follows:
  - *n* indicates the number of unused data bytes.
  - *e* = 1b, which indicates the message contains data.
  - *s* = 1b, which indicates that the *n* field specifies the number of unused data bytes.

The following table lists the control byte values for the various transfer types:

Transfer Type	Control Byte
Write data to a device	Depends upon the data size: • 1 byte = 2Fh • 2 bytes = 2Bh • 3 bytes = 27h • 4 bytes = 23h
Confirm a write	60h
Request data from a device	40h
Device responds with requested data	Depends upon the data size: • 1 byte = 4Fh • 2 bytes = 4Bh • 3 bytes = 47h • 4 bytes = 43h
Abort SDO	80h

PDOs

TPDOs 1–2 and RPDOs 1–4 are preconfigured to transmit and receive data used by the 3401T's preset user interfaces. The following topics describe PDO considerations and the preconfigured PDOs.

Note: TPDO3 and TPDO4 are reserved.

PDO COB-IDs

The following table lists the bits that define a PDO COB-ID:

Bit(s)	Description
31	Indicates whether the PDO is enabled. 0b indicates enabled.
30	*Reserved*. Always 0.
29	Indicates whether the COB-ID is 11 or 29 bits. The device supports only 11-bit COB-IDs, so the value is always 0.
11–28	Bits that would be set for 29-bit COB-IDs. For the 3401T, these bits = 0.
7–10	The PDO's function code. The function codes are listed below: • RPDO1: 0100b • RPDO2: 0110b • RPDO3: 1000b • RPDO4: 1010b • TPDO1: 0011b • TPDO2: 0101b • TPDO3: 0111b • TPDO4: 1001b
0–6	The device's node ID.

For example, if the device's node ID is 2Eh and RPDO1 is enabled, the RPDO1 COB-ID is 22Eh

PDO Timing

The PDOs are asynchronous and are periodically transmitted and received. The 3401T does not support synchronous PDOs. The following list describes the PDOs' event times:

- RPDOs: 60,000ms (1 minute). If the 3401T does not receive data within one minute, the LCD will display *.* to indicate that data is not being received.
- TPDOs: 40ms

Preconfigured PDOs

Several of the preconfigured PDOs include bytes that indicate fault codes for various devices. For example, there are bytes for the fault codes of traction and pump controllers. The four most significant bits indicate a fault code's first digit and the four least significant bits indicate the second digit. 0h indicates that the device does not have an active fault.

For example, if the pump controller's fault code is 92, the corresponding byte's value is 92h.

The following topics describe the preconfigured PDOs.

RPDO1

Byte(s)	Description
0	The fault code for the right traction controller.
1	The fault code for the pump controller.
2	The following bits specify statuses and the display of hour meters. When a status is active, its corresponding icon displays. Unless otherwise noted, 1b = active: • 0: Parking status • 1: Seat status (0b = active) • 2: Seatbelt status • 3: Traction and pump hour meters and cargo weight and lift height indicators. RPDO2, byte 0, bits 5–7 specify which combination of hour meters and indicators are displayed. • 4: The "T" blinks on the traction hour meter. • 5: The "P" blinks on the pump hour meter. • 6: Safety pedal status • 7: Guardrail status (reach trucks and order pickers screen only)
3	The following bits indicate various types of data: • 0: Whether the right traction controller's fault code is from pin 14 (Switch Input4/Analog Input4/TRA Fault Code Input) or the CANbus. 0b = pin 14. • 1: Whether the left traction controller's fault code is from pin 14 (Switch Input4/Analog Input4/TRA Fault Code Input) or the CANbus. 0b = pin 14. • 2: Whether the pump controller's fault code is from pin 6 (Switch Input3/Analog Input3/HYD Fault Code Input) or the CANbus. 0b = pin 6. • 3: Whether the seatbelt status is from a switch input or the CANbus. 0b = switch input. • 4: Whether the parking status is from a switch input or the CANbus. 0b = switch input. • 5: Whether BDI data is from the 3401T or from the CANbus. 0b = 3401T. • 6: Whether the steering angle is displayed on the counterbalanced forklifts screen. 1b = displayed. • 7: Whether the seat status is from the 3401T or the CANbus. 0b = 3401T.
4	The fault code for the left traction controller.
5	The speedometer data. **Note:** RPDO3, byte 5, bit 6 specifies how the speed is scaled. For example, suppose that this byte specifies FFh. If the RPDO3 bit is 0b, the speedometer displays 25.5 km/h, otherwise it displays 51.0 km/h.
6	The wheel angle (counterbalanced forklifts screen). The range of values is A6h–5Ah, which represents –90° to +90°.
7	The BDI percentage. The range of values is 0–100, which represents 0–100%.

TPDO1

Byte(s)	Description
0	The following bits indicate various types of data: • 0–1: The speed mode: – 00b: High – 01b: Standard – 10b: Economy – 11b: Turtle • 2: Lift lockout status. 0b = inactive. • 3: Parking status. 0b = inactive. • 4: *Reserved* • 5: *Reserved* • 6: Seatbelt status. 0b = inactive. • 7: Safety pedal status. 0b = inactive.
1	The BDI percentage. The range of values is 0–100, which represents 0–100%.
2–5	The keyswitch hour meter data. The range of values is 0–F423Fh, which represents 0–99999.9 hours.
6	Whether the vehicle is locked. 0b = locked, 1b = unlocked. The vehicle status is locked if either of the following conditions is active: • The PIN Code Source parameter specifies Internal but the power-on password has not been entered. • The PIN Code Source parameter specifies External but a user has not logged onto the ECS.
7	*Reserved*.

RPDO2

Byte(s)	Description
0	The following bits indicate hour meter data: • 0–1: The hour meter for the data in bytes 1–3: – 00b: Keyswitch hour meter – 01b: Traction controller hour meter – 10b: Pump controller hour meter – 11b: *Reserved*. • 2: Whether the hour meter data is obtained from the 3401T or the CANbus. 0b = 3401T. • 3: Whether both forward and backward signals are active. 1b = active. If active, the message center displays a message. • 4: Whether the operator should release the brake. 1b = active. If active, the message center displays a message. • 5–7: Specifies which combination of hour meters and cargo weight and lift height indicators are displayed: – 000: Traction and pump hour meters. – 001: Traction hour meter and lift height. – 010: Traction hour meter and cargo weight. – 011: Pump hour meter and lift height. – 100: Pump hour meter and cargo weight. – 101: Lift height and cargo weight – >101: *Reserved*.
1–3	The data for the hour meter specified with bits 0–1 of byte 0: • Byte 1 indicates the data's last two numbers. The data ranges from 0–63h, which represents 0–9.9. • Bytes 2–3 indicate the data's first four numbers. The data ranges from 0–270Fh, which represents 0–9999. For example, if byte 1 specifies 63h and bytes 2–3 specify 270Fh, the hour meter displays 99999.9 hours.
4	The following bits indicate whether various types of data are displayed. 1b = display: • 0: Lithium battery fault code. • 1: Forward direction arrow. • 2: Backward direction arrow. **Note:** If bits 1 and 2 are both 1b, the neutral icon displays (reach trucks and order pickers screen only). • 3: Left direction arrow. • 4: Right direction arrow. • 5: Steering controller fault code. • 6: OEM fault code (reach trucks and order pickers screen only). • 7: Battery voltage.
5	The fault code for the steering controller.
6	The fault code for the lithium battery.
7	An OEM-specific fault code.

TPDO2

Byte(s)	Description
0	The following bits indicate whether an hour meter is being reset. 1b = reset: • 0: Keyswitch hour meter • 1: Traction controller hour meter • 2: Pump controller hour meter • 3–7: *Reserved*.
1–4	Battery type. 0h indicates lead-acid, 1h indicates lithium.
5–7	*Reserved*.

RPDO3

Byte(s)	Description
0–3	*Reserved.*
4	The speed limit (reach trucks and order pickers screen only). **Note:** RPDO3, byte 5, bit 6 specifies how the speed limit is scaled.
5	The following bits specify how the steering wheel angle is displayed and how speeds are scaled on the reach trucks and order pickers screen: • 0–2: Whether the steering angle is displayed as a circle or semicircle. If a semicircle is specified, the bits also specify the semicircle's location within the steering angle area: – 000b: Circle – 001b: Semicircle on the top – 010b: Semicircle on the bottom – 011b: Semicircle on the left – 100b: Semicircle on the right – Other values: *Reserved* • 3–4: The default wheel angle if RPDO3 does not receive data before its timeout expires: – 00b: 0° – 01b: 90° – 10b: 180° – 11b: –90° • 5: Whether the steering angle indicator displays an arrow. 0b = displayed. • 6: How displayed speeds are scaled: – 0: The speed data is divided by 10 – 1: The speed data is divided by 5 • 7: *Reserved*
6–7	The wheel angle for the reach trucks and order pickers screen. The data ranges from FF4Ch–00B4h, which represents –180° to 180°.

RPDO4

Byte(s)	Description
0–3	Lift height. The data ranges from 0–1869Fh, which represents 0–99.999m.
4–7	Cargo weight. The data ranges from 0–1869Fh, which represents 0–99999 kg.

STANDARD CANOPEN OBJECTS

The following table describes objects required by the CANopen standard:

Name	Index	Sub-Index	Description	Read / Write	Values Data Size
Device Type	1000h	00h	Indicates whether a device follows a standard CiA device profile. The 3401T does not follow a standard CiA profile, so the value is 0.	RO	0 32-bit
Error Register	1001h	00h	Indicates if a fault is active: 0 = No active fault 1 = One or more active faults	RO	0–1 16-bit
Manufacturer Status Register	1002h	00h	*Reserved.*	*N/A*	*N/A*
Manufacturer Device Name	1008h	00h	Initiates a segmented SDO that uploads the model name and number as an ASCII string.	RO	String
Manufacturer's Hardware Version	1009h	00h	Initiates a segmented SDO that uploads the hardware version as an ASCII string.	RO	String
Manufacturer Software Version	100Ah	00h	*Reserved.* **Note:** The CDEV and OS Version parameters indicate the software version. See Main Menu Parameters.	*N/A*	*N/A*
Emergency COB ID	1014h	00h	Indicates the Emergency Message COB-ID: • 0: The COB-ID consists of the emergency message function code (0001b) and the node ID. • Non-zero: The COB-ID consists of the emergency message function code (0001b) and the specified value. The COB-ID's four most significant bits represent the emergency message function code.	RO	0–16777215 32-bit
Emergency Message Inhibit Time	1015h	00h	Sets the minimum time that must elapse before another emergency message can be sent.	RW	4–100 (which represents 16–400ms) 32-bit
Heartbeat Rate	1017h	00h	Specifies the cyclic rate of the device's heartbeat messages.	RW	100–1000 16-bit
Identity Object	1018h	Provides information on the device.			
		00h	Indicates the size of the object.	RO	0–127 8-bit
		01h	Indicates the CiA-assigned identifier of Curtis Instruments. The identifier is 4349h.	RO	0–2147483647 32-bit
		02h	Indicates the device's product code.	RO	0–2147483647 32-bit
		03h	Indicates the device's Curtis CAN protocol version. The upper 2 bytes contain the major version and the lower 2 bytes contain the minor version.	RO	0–2147483647 32-bit
		04h	Indicates the device's serial number.	RO	0–2147483647 32-bit

APPENDIX A — CURTIS PROGRAMMING DEVICES

Curtis programming devices provide programming, diagnostic, and test capabilities for Curtis devices. Two programming devices are available for the 3401T:

- 1313 handheld programmer
- Curtis Integrated Toolkit™ (CIT)

CIT has the advantage of a large, easy-to-read screen. On the other hand, the 1313 handheld programmer is more portable, making it convenient for working in the field.

The programming devices include the following features:

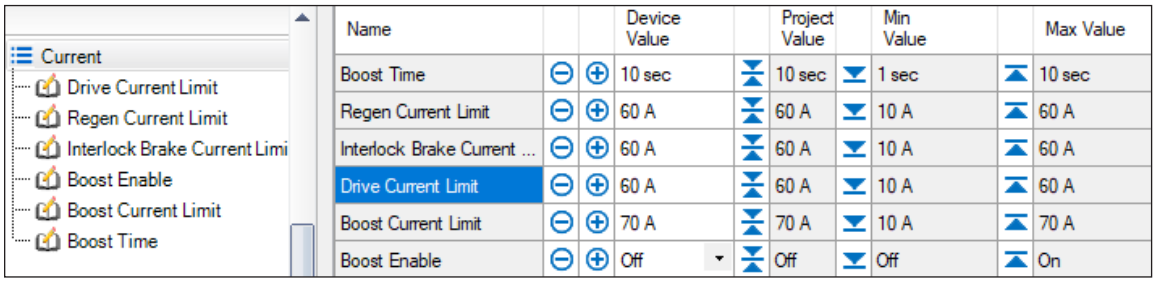
- Parameter adjustment. Save and restore the values of programmable parameters.
- Monitoring: Display real-time values during vehicle operation. These values include data for inputs and outputs.
- Diagnostics and troubleshooting: Display active faults and the fault history, and clear the fault history.
- Flashing: Update firmware of Curtis devices.

The programmers are available for the following access levels. The bullets are sorted from the highest to lowest access level:

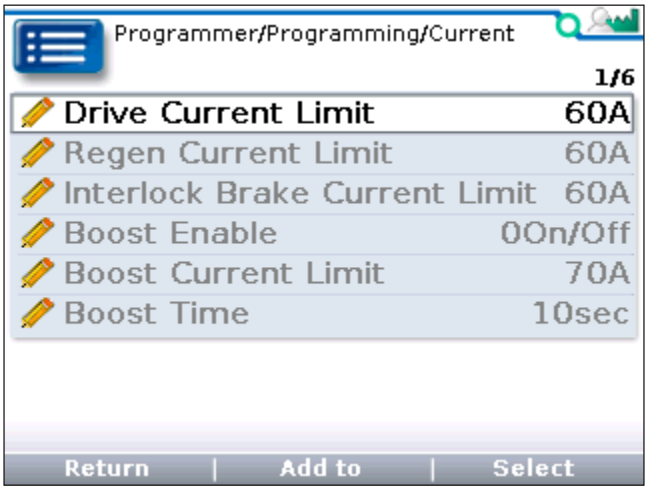
- OEM Factory
- OEM Dealer
- Field Advanced
- Field Intermediate
- Field Basic

A Curtis programmer can perform the actions available at or below its access level. For example, a Field Basic programmer can only perform actions available for the Field Basic access level, while an OEM Factory programmer can perform all actions available for any of these access levels.

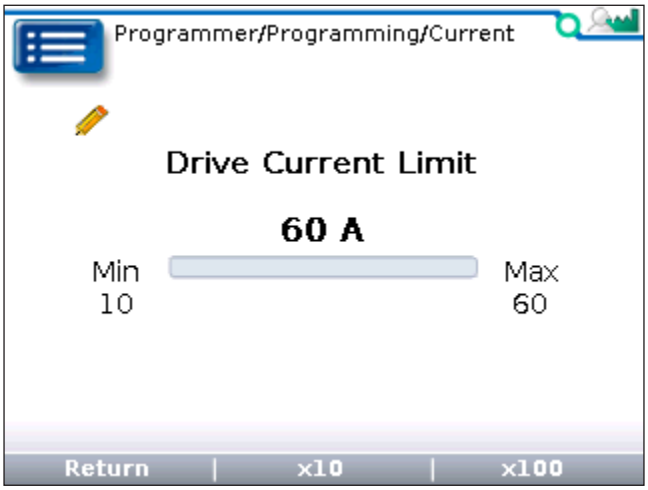
The following example shows the Current menu in the CIT Programmer application. You can view or edit a parameter by selecting it on the left-hand side. You can also view and edit all of a menu's parameters in one window by selecting the menu as shown below:



The following example shows the same menu in the Curtis 1313 handheld programmer:



To edit a parameter with the 1313 programmer, select the parameter:



For more information on Curtis programming devices, see the Curtis Instruments Programming page at https://www.curtisinstruments.com/products/programming.

APPENDIX B — SPECIFICATIONS

Nominal Voltage	12–96 VDC
Minimum Voltage	8 VDC
Maximum Voltage	120 VDC
Operating Current	• **Keyswitch on**: 33–207mA • **Keyswitch off**: 25–112mA • **LCD heater on**: 566–801mA
Dimensions (W × L × H)	160 x 102 x 49.7 mm
Operating Temperature	• **With the LCD heater**: –40°C to +70°C • **Without the LCD heater**: –20°C to +70°C
Storage Temperature	–40°C to +85°C
Humidity	Designed to the following requirements: • **Soak**: EN 60068-2-78 • **Cyclic**: EN 60068-2-30
Ingress Protection	Designed to the requirements of EN 60529: • Face is sealed to IP65. • Rear is sealed to IP65 for electronic components and to IP40 for the connector. Optional parts can increase the connector's protection to IP54.
Salt Spray (Fog)	Designed to the requirements of ASTM B 117 as per SAE J1810.
Shock	Designed to the requirements of EN 60068-2-27.
Vibration	Designed to the following requirements: • **General**: EN 60068-2-6 • **Random**: EN 60068-2-64 • **Resonance**: EN 60068-2-6
Safety	Designed to the requirements of EN 61010-1: 2010, Part 1. General safety requirements for measurement, control and laboratory use.
CE	Designed to the following requirements: • **EMC:** EN 12895:2015+A1:2019 • **Low Voltage Directive (LVD):** EN 60204-1:2018, 2014/35/EU • **RoHS:** RoHS directive 2015/863/EU (RoHS 3)
UL	UL recognized component as per UL 583.
Model Encodement	The model number encodement is 3401T-*ZYYY* where: • *Z* indicates whether the model includes the optional LCD heater: – 5 = not included – 7 = included • *YYY* is a sequential number code.

Note: *Regulatory compliance of the complete system with the 3401T installed is the responsibility of the OEM.*