# Chapter 3
# Digital Operator

*This chapter describes the displays and functions of the Digital Operator.*

# Digital Operator Display

The Digital Operator is used for programming, operating, monitoring, and copying the Drive's parameters. To copy parameters, F7 Drives must have the same software version, model, and control method. The various items included on the Digital Operator are described below.

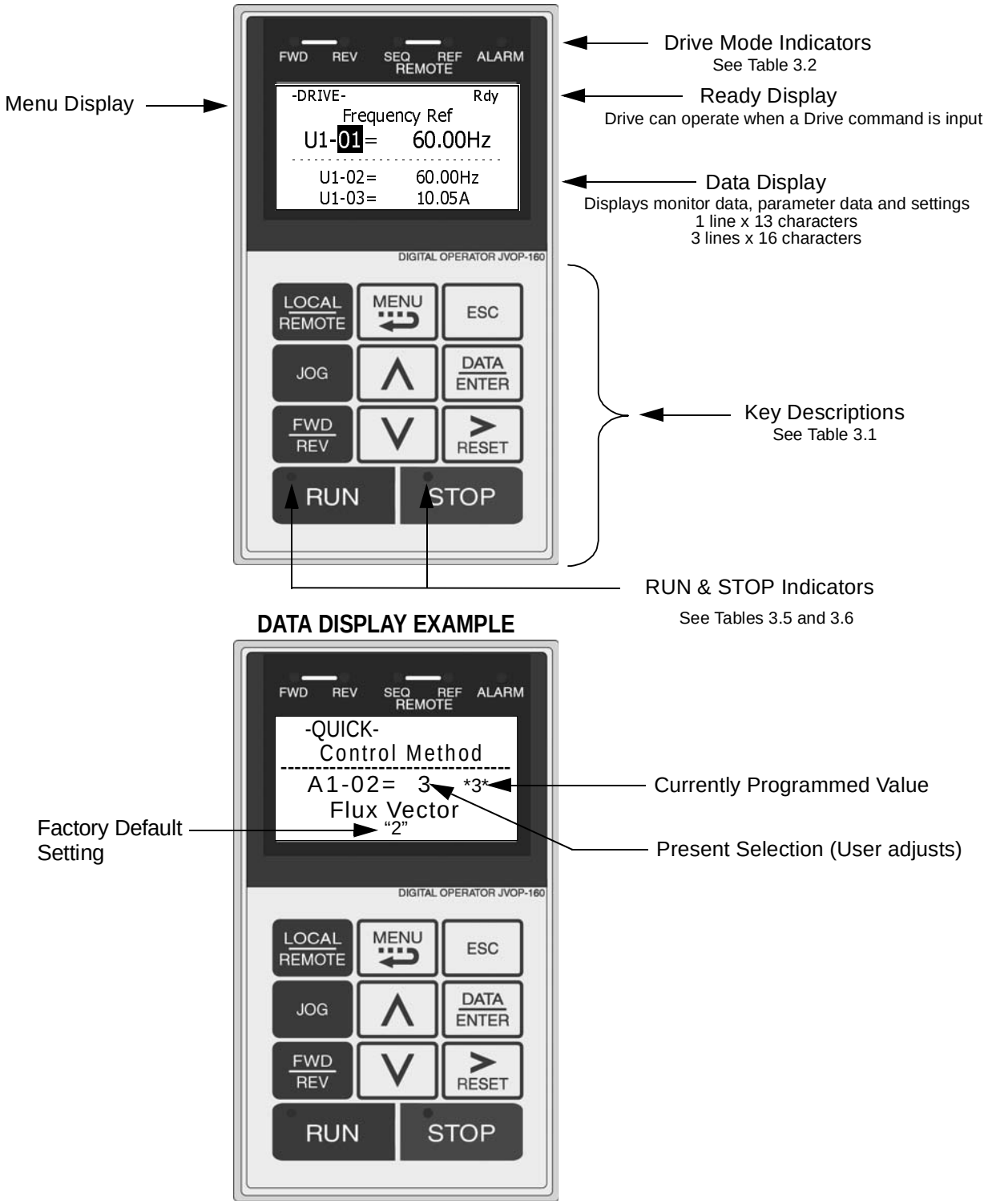


Fig 3.1 Digital Operator Component Names and Functions

# Digital Operator Keys

The names and functions of the Digital Operator Keys are described in Table 3.1.

Table 3.1 Digital Operator Keys

| Key | Name | Function |
|---|---|---|
| LOCAL / REMOTE | LOCAL / REMOTE | • Switches between operation via the Digital Operator (LOCAL) and the settings in parameter b1-01 (Frequency Reference Selection) and b1-02 (Run Command Selection) (REMOTE).<br>• This key can be enabled or disabled by the setting in parameter o2-01.<br>• The Drive must be in a stopped condition before it can be transferred to “LOCAL” or “REMOTE” mode. |
| MENU | MENU | • Scrolls through the five main menus:<br>• Operation (-DRIVE-), Quick Setting (-QUICK-), Programming (-ADV-), Modified Constants (-VERIFY-), and Auto-Tuning (-A.TUNE-). |
| ESC | ESCAPE | • Returns to the previous display, before the DATA/ENTER key was pressed. |
| JOG | JOG | • Enables jog operation when the Drive is being operated from the Digital Operator (LOCAL). |
| FWD / REV | FWD / REV | • Selects the rotation direction of the motor when the Drive is being operated from the Digital Operator (LOCAL). |
| ∧ | INCREASE | • Increases parameter numbers and set values.<br>• Used to move to the next item or data value. |
| ∨ | DECREASE | • Decreases parameter numbers and set values.<br>• Used to move to the previous item or data value. |
| > RESET | SHIFT/RESET | • Selects the digit to be changed. The selected digit will blink.<br>• Also resets the Drive when a fault has occurred. The run command must be removed before the reset command will be accepted. |
| DATA / ENTER | DATA/ENTER | • Enter menus and parameters as well as to set values. |
| RUN | RUN | • Starts Drive operation when the Drive is being controlled by the Digital Operator (LOCAL). |
| STOP | STOP Key | • Stops Drive operation.<br>• This key can be enabled or disabled when operating from the external terminal or communications by setting user parameter o2-02. |

# Drive Mode Indicators

The definition of the Drive mode indicators are shown in Table 3.2.

| Table 3.2 Drive Mode Indicators | |
|---|---|
| Indicator | Definition |
| FWD | Lit when a forward run command is input. |
| REV | Lit when a reverse run command is input. |
| REMOTE SEQ | See Table 3.3. |
| REMOTE REF | See Table 3.4. |
| ALARM | Lit when a fault has occurred. Flashes when an Alarm has occurred. |

## ◆ REMOTE Sequence (SEQ) Indicator

The status of the “REMOTE” Sequence (SEQ) indicator is shown in Table 3.3. This indicator is always “Off” when the Drive is in the “LOCAL” mode. When the Drive is in the “REMOTE” mode, the SEQ indicator status is dependent on the setting of parameter b1-02 (Run Command Selection). See Table 3.3.

| Table 3.3 REMOTE Sequence (SEQ) Indicator | |
|---|---|
| Indicator Status | Condition |
| On | Parameter b1-02 (Run Command Selection) is set to terminal strip, communications, or an option board as indicated below:<br>b1-02 =1 (Terminals)<br>=2 (Communications)<br>=3 (Option PCB) |
| Off | Parameter b1-02 (Run Command Selection) is set to Digital Operator as indicated below:<br>b1-02=0 (Operator) |

## ◆ REMOTE Reference (REF) Indicator

The status of the “REMOTE” Reference (REF) indicator is shown in Table 3.4. This indicator is always “Off” when the Drive is in the “LOCAL” mode. When the Drive is in the “REMOTE” mode, the REF indicator status is dependent on the setting of parameter b1-01 (Frequency Reference Selection). See Table 3.4.

Table 3.4 REMOTE Reference (REF) Indicator

| Indicator Status | Condition |
|---|---|
| On | Parameter b1-01 (Frequency Reference Selection) is set to terminal strip, communications, option board, or pulse train as indicated below:<br>b1-01 =1 (Terminals)<br>=2 (Communications)<br>=3 (Option PCB)<br>=4 (Pulse Train) |
| Off | Parameter b1-01 (Frequency Reference Selection) is set to digital operator as indicated below:<br>b1-01=0 (Operator) |

## ◆ Run Indicator

The status of the “RUN” indicator is shown in Table 3.5 when the Drive is in either the “LOCAL” or “REMOTE” mode.

Table 3.5 RUN Indicator

| Indicator Status | Condition |
|---|---|
| On | Drive is running. |
| Blinking | Drive is decelerating to a stop. |
| Off | Drive is stopped. |

## ◆ Stop Indicator

The status of the “STOP” indicator is shown in Table 3.6 when the Drive is in either the “LOCAL” or “REMOTE” mode.

Table 3.6 STOP Indicator

| Indicator Status | Condition |
|---|---|
| On | Drive is decelerating to a stop or stopped. |
| Blinking | Drive is in a run condition but the frequency reference is less than the minimum output frequency E1-09, or the Drive is running in “REMOTE” mode and the “STOP” key on has been pressed. |
| Off | Drive is running. |

# Drive Main Menus

The Drive's parameters and monitoring functions are organized into groups called menus that make it easier to read and set parameters. The Drive is equipped with five menus. The five menus and their primary functions are shown in Table 3.7.

Table 3.7 Drive Main Menus

| Main Menu | Primary Functions |
|---|---|
| Operation<br>- DRIVE - | The Drive can run in this menu.<br>Use this menu for monitoring values such as frequency reference or output current, displaying fault history or displaying the fault traces. |
| Quick Setting<br>- QUICK - | The Drive can be programmed in this menu.<br>Use this menu to set/read the most commonly used parameters. |
| Programming<br>- ADV - | The Drive can be programmed in this menu or parameters can be copied into the Digital Operator.<br>Use this menu to set/read every parameter. |
| Modified Constants<br>- VERIFY - | The Drive can be programmed in this menu.<br>Use this menu to set/read the parameters that have been modified from their factory default settings. |
| Auto-Tuning<br>- A.TUNE - | The Drive can be programmed in this menu.<br>Use this menu to Auto-Tune the Drive in order to optimize motor control.<br>The motor parameters are calculated and set automatically after successfully completing Auto-Tuning. |

## ◆ Main Menu Structure

The menu selection display will appear when the MENU key is pressed from a monitor or setting display. While viewing the menu selection display, press the MENU key repeatedly to scroll between the menu selections. Press the DATA/ENTER key to enter the desired menu selection.

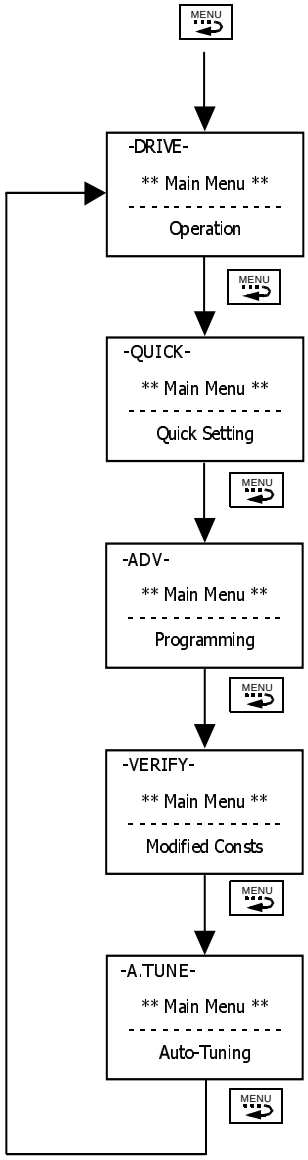


Fig 3.2 Main Menu Structure

## ◆ Operation Menu (-DRIVE-)

This menu is used for setting the frequency reference (Local Mode) or monitoring values such as output frequency and output current. It is also used for displaying the fault history and the fault traces. The Drive must be in this menu in order to run. See parameter b1-08 (Run Command Selection During Program).

### ■U1 Monitor List

Follow the key operations below (Fig 3.3) to access the Operation Menu:

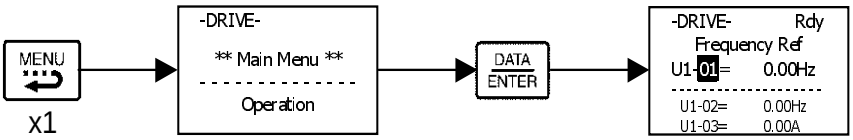


Fig 3.3 U1 Monitor List Access Procedure

Use ∧ and ∨ keys to scroll through the U1 "Monitor" parameter list. See Appendix A for functional description.

Table 3.8 U1 Monitor List

| Monitors | | | |
|---|---|---|---|
| U1-01 | Frequency Reference | U1-21 | ASR Input |
| U1-02 | Output Frequency | U1-22 | ASR Output |
| U1-03 | Output Current | U1-24 | PI Feedback Value |
| U1-04 | Control Method | U1-25 | DI-16 H2 Input Status |
| U1-05 | Motor Speed | U1-26 | Output Voltage Reference (Vq) |
| U1-06 | Output Voltage | U1-27 | Output Voltage Reference (Vd) |
| U1-07 | DC Bus Voltage | U1-28 | CPU Number |
| U1-08 | Output Power | U1-29 | kWh (Lower 4 digits) |
| U1-09 | Torque Reference | U1-30 | MWh (Upper 5 digits) |
| U1-10 | Input Terminal Status | U1-32 | ACR(q) Output |
| U1-11 | Output Terminal Status | U1-33 | ACR(d) Output |
| U1-12 | Drive Operation Status | U1-34 | OPE Detected |
| U1-13 | Cumulative Operation Time | U1-35 | Zero Servo Pulse Count |
| U1-14 | Software Number | U1-36 | PID Input |
| U1-15 | Terminal A1 Input Voltage | U1-37 | PID Output |
| U1-16 | Terminal A2 Input Voltage | U1-38 | PID Setpoint |
| U1-17 | Terminal A3 Input Voltage | U1-39 | Modbus Error Code |
| U1-18 | Motor Secondary Current (Iq) | U1-40 | Cooling Fan Elapsed Time |
| U1-19 | Motor Excitation Current (Id) | U1-44 | ASR Output with or without Filter |
| U1-20 | Output Frequency after Soft-start | U1-45 | Feed Forward Control Output |
| Note: Some monitors are not available for all Control Modes (A1-02). | | | |

## ■U2 Fault Trace List

After viewing the “Monitor” parameter list, follow the key operations below (Fig 3.4) to access the “Fault Trace” parameter list.

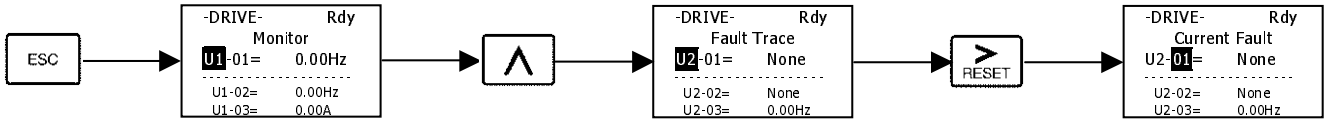


Fig 3.4 U2 Fault Trace List Access Procedure

Use ∧ and ∨ keys to scroll through the U2 “Fault Trace” parameter list.

| Table 3.9 U2 Fault Trace List | |
|---|---|
| **Fault Trace Parameters** | |
| U2-01 | Current Fault |
| U2-02 | Previous Fault |
| U2-03 | Frequency Reference at Fault* |
| U2-04 | Output Frequency at Fault* |
| U2-05 | Output Current at Fault* |
| U2-06 | Motor Speed at Fault* |
| U2-07 | Output Voltage at Fault* |
| U2-08 | DC Bus Voltage at Fault* |
| U2-09 | Output Power at Fault* |
| U2-10 | Torque Reference at Fault |
| U2-11 | Input Terminal Status at Fault* |
| U2-12 | Output Terminal Status at Fault* |
| U2-13 | Drive Operation Status at Fault* |
| U2-14 | Cumulative Operation Time at Fault* |
| * Represents fault condition prior to current fault state.<br>Note: Fault trace is not executed at CPF00, CPF01, CPF03, UV1, and UV2. | |

## ■U3 Fault History List

After viewing the “Fault Trace” parameter list, follow the key operations below (Fig 3.5) to access the “Fault History” parameter list.

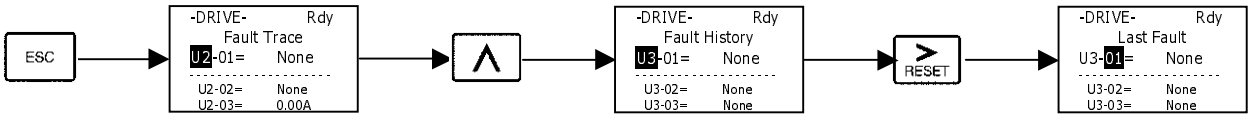


Fig 3.5 U3 Fault History Access Procedure

Use ∧ and ∨ keys to scroll through the U3 “Fault History” parameter list.

| Table 3.10 Fault History List | |
|---|---|
| **Fault History Parameters** | |
| U3-01 | Last Fault |
| U3-02 | Fault Message 2 |
| U3-03 | Fault Message 3 |
| U3-04 | Fault Message 4 |
| U3-05 | Elapsed Time 1 |
| U3-06 | Elapsed Time 2 |
| U3-07 | Elapsed Time 3 |
| U3-08 | Elapsed Time 4 |
| U3-09 | Fault Message 5 |
| U3-10 | Fault Message 6 |
| U3-11 | Fault Message 7 |
| U3-12 | Fault Message 8 |
| U3-13 | Fault Message 9 |
| U3-14 | Fault Message 10 |
| U3-15 | Elapsed Time 5 |
| U3-16 | Elapsed Time 6 |
| U3-17 | Elapsed Time 7 |
| U3-18 | Elapsed Time 8 |
| U3-19 | Elapsed Time 9 |
| U3-20 | Elapsed Time 10 |
| Note: Fault trace is not executed at CPF00, CPF01, CPF03, UV1, and UV2. | |

# Quick Setting Menu (-QUICK-)

This menu is used to set/read the most commonly used parameters in the Drive. Follow the key operations in Fig 3.6 to access the Quick Setting Menu:

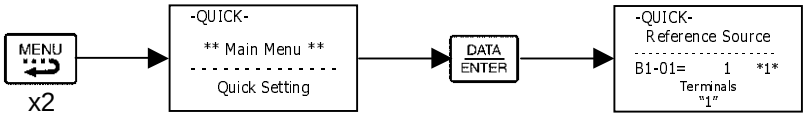


Fig 3.6 Quick Setting Parameter Access Procedure

Use ∧ and ∨ keys to scroll through the "Quick Setting" parameter list.

Table 3.11 Quick Setting Parameter List

| Parameter Number | Parameter Name |
|---|---|
| A1-02 | Control Method Selection |
| b1-01 | Frequency Reference Selection |
| b1-02 | Run Command Selection |
| b1-03 | Stopping Method Selection |
| C1-01 | Acceleration Time 1 |
| C1-02 | Deceleration Time 1 |
| C6-02 | Carrier Frequency Selection |
| d1-01 | Frequency Reference 1 |
| d1-02 | Frequency Reference 2 |
| d1-03 | Frequency Reference 3 |
| d1-04 | Frequency Reference 4 |
| d1-17 | Jog Reference |
| E1-01 | Input Voltage Setting |
| E1-03 | V/F Pattern Selection |
| E1-04 | Maximum Output Frequency |
| E1-05 | Maximum Output Voltage |
| E1-06 | Base Frequency |
| E1-09 | Minimum Output Frequency |
| E1-13 | Base Voltage |
| E2-01 | Motor Rated Current |
| E2-04 | Number of Motor Poles |
| E2-11 | Motor Rated Output |
| F1-01 | PG Pulses / Revolution |
| H4-02 | Terminal FM Gain Setting |
| H4-05 | Terminal AM Gain Setting |
| L1-01 | Motor Overload Protection Selection |
| L3-04 | Stall Prevention Selection During Decel |
| Note: Refer to Appendix A for control method dependent parameters. | |

# Programming Menu (-ADV-)

This menu is used to set/read every parameter in the Drive. Follow the key operations below (Fig 3.7) to access the Programming Menu.

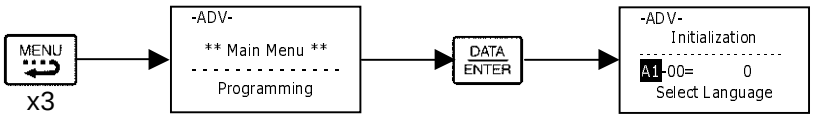


Fig 3.7 Programming Menu Access Procedure

Use ∧, ∨, and RESET keys to scroll through the "Programming" parameter group list. For complete parameter listing see appendix A.

| Table 3.12 Programming Parameter Group List | |
|---|---|
| **Parameter Group Functions** | |
| A1 Initialization | F2 AI-14 Setup |
| A2 User Parameters | F3 DI-08, 16 Setup |
| b1 Sequence | F4 AO-08, 12 Setup |
| b2 DC Injection Braking | F5 DO-02, 08 Setup |
| b3 Speed Search | F6 Communications Option Setup |
| b4 Delay Timers | H1 Digital Inputs |
| b5 PID Control | H2 Digital Outputs |
| b6 Reference Hold | H3 Analog Inputs |
| b7 Droop control | H4 Analog Outputs |
| b8 Energy Saving | H5 Serial Communications Setup |
| b9 Zero Servo | H6 Pulse I/O Setup |
| C1 Accel/Decel | L1 Motor Overload |
| C2 S-Curve Accel/Decel | L2 Power Loss Ridethru |
| C3 Motor-Slip Compensation | L3 Stall Prevention |
| C4 Torque Compensation | L4 Reference Detection |
| C5 ASR Tuning | L5 Fault Restart |
| C6 Carrier Frequency | L6 Torque Detection |
| d1 Preset Reference | L7 Torque Limit |
| d2 Reference Limits | L8 Hardware Protection |
| d3 Jump Frequencies | n1 Hunting Prevention |
| d4 Sequence (MOP & Trim Control) | n2 AFR Tuning |
| d5 Torque Control | n3 High Slip Braking |
| d6 Field-Weakening | n5 Feed Forward |
| E1 V/F Pattern | o1 Monitor Select |
| E2 Motor Setup | o2 Key Selections |
| E3 V/F Pattern 2 | o3 COPY Function |
| E4 Motor Setup 2 | T1 Auto-Tuning |
| F1 PG Option Setup | - |
| Note: Refer to Appendix A for control method dependent programming parameter groups. | |

## ◆ Modified Constants Menu (-VERIFY-)

This menu is used to set/read the parameters that have been modified from their original factory default settings. Follow the key operations below (Fig 3.8) to access the Modified Constants Parameter Menu.

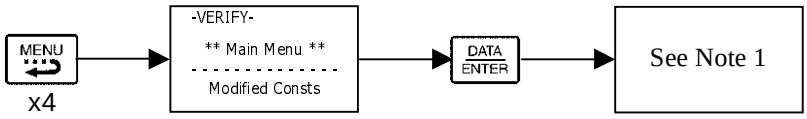


Fig 3.8 Modified Constants Menu Access Procedure

Note 1: If there are no parameters that have been modified from their original factory default settings, then the display will state “None Modified”. Otherwise, use ∧ and ∨ keys to scroll through the “Modified Constants” list.

## ◆ Auto-Tuning Menu (-A.TUNE-)

This menu is used to Auto-Tune the Drive in order to calculate the required motor parameters to optimize motor performance. Ideally, perform Auto-Tuning with the motor uncoupled from the load.
When the motor cannot be disconnected from the load, perform static or terminal resistance Auto-Tuning. To set motor parameters by hand calculation, contact your Yaskawa representative. Follow the key operations below (Fig 3.9) to access the Auto-Tuning Menu.

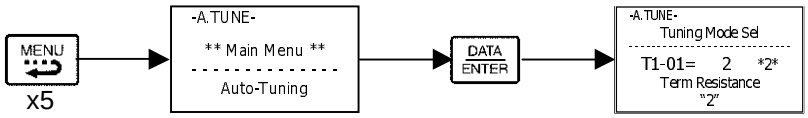


Fig 3.9 Auto-Tuning Menu Access Procedure

Use [∧] and [∨] keys to scroll through the “Auto-Tuning” parameter list. Depending on the Control Method (A1-02) setting, only certain Auto-Tuning parameters will be accessible. See table below.

Table 3.13 Auto-Tuning Parameter List

| Auto-Tuning Parameters | Control Method | | | |
|---|---|---|---|---|
| | V/F | V/F w/PG | OLV | Flux Vector |
| T1-01 Tuning Mode Selection | O | O | O | O |
| T1-02 Motor Rated Power | O | O | O | O |
| T1-03 Rated Voltage | X | X | O | O |
| T1-04 Rated Current | O | O | O | O |
| T1-05 Rated Frequency | X | X | O | O |
| T1-06 Number of Poles | X | X | O | O |
| T1-07 Rated Speed | X | X | O | O |
| T1-08 PG Pulses/Rev | X | X | X | O |
| O = Accessible | | | | |

After setting Auto-Tuning parameters according to motor nameplate specifications, press [∧] so that the following screen appears on the Digital Operator.

```
-A.TUNE-                    Rdy
        Auto-Tuning
- - - - - - - - - - - - - - - - - - - -
        0Hz/ 0.00A
      Tuning Ready ?
      Press RUN key
```

Press the RUN key on the Digital Operator to start Auto-Tuning. The motor will automatically run. During this process the motor parameters will be automatically set in the Drive according to the measured values.

# Example of Changing a Parameter

Table 3.14 provides an example of how to change parameter “C1-02” (Deceleration Time 1) from 30 seconds to 40 seconds.

Table 3.14 Changing a Parameter in the Programming Menu

| Step Number | Digital Operator Display | Description |
|---|---|---|
| 1 | -DRIVE- Rdy<br>Frequency Ref<br>U1-01= 0.00Hz<br>U1-02= 0.00Hz<br>U1-03= 0.00A | The Drive is first powered up. |
| 2 | -DRIVE-<br>** Main Menu **<br>Operation | Press the MENU key to scroll to “Operation” menu. |
| 3 | -QUICK-<br>** Main Menu **<br>Quick Setting | Press the MENU key to scroll to “Quick Setting” menu. |
| 4 | -ADV-<br>** Main Menu **<br>Programming | Press the MENU key to scroll to “Programming” menu. |
| 5 | -ADV-<br>Initialization<br>A1-01= 0<br>Select Language | Press the DATA/ENTER key to enter “Programming” menu. |
| 6 | -ADV-<br>Accel/Decel<br>C1-01= 1.0sec<br>Accel Time 1 | Press the INCREASE key until C1-01 (Accel/Decel) is displayed. |
| 7 | -ADV-<br>Accel Time 1<br>C1-01= 30.0sec<br>(0.0~6000.0)<br>“30.0sec” | Press the SHIFT/RESET key to move flashing digit to the right. |

| Table 3.14 Changing a Parameter in the Programming Menu (continued) | | |
|---|---|---|
| Step Number | Digital Operator Display | Description |
| 8 | -ADV-<br>Decel Time 1<br>C1-02= 30.0sec<br>(0.0~6000.0)<br>"30.0sec" | Press the INCREASE key to display C1-02 (Decel Time 1). |
| 9 | -ADV-<br>Decel Time 1<br>C1-02= 0030.0sec<br>(0.0~6000.0)<br>"30.0sec" | Press the DATA/ENTER key to access setting display. |
| 10 | -ADV-<br>Decel Time 1<br>C1-02= 0030.0sec<br>(0.0~6000.0)<br>"30.0sec" | Press the SHIFT/RESET key to move the flashing digit to the right. |
| 11 | -ADV-<br>Decel Time 1<br>C1-02= 0030.0sec<br>(0.0~6000.0)<br>"30.0sec" | Press the SHIFT/RESET key to move the flashing digit to the right. |
| 12 | -ADV-<br>Decel Time 1<br>C1-02= 0040.0sec<br>(0.0~6000.0)<br>"30.0sec" | Press the INCREASE key to increase the set data. |
| 13 | -ADV-<br>Entry Accepted | Press the DATA/ENTER key to enter the set data. "Entry Accepted" is displayed for 1.0 sec after the data setting has been confirmed. |
| 14 | -ADV-<br>Decel Time 1<br>C1-02= 40.0sec<br>(0.0~6000.0)<br>"30.0sec" | The screen returns to the C1-02 display. |
| 15 | -DRIVE-<br>** Main Menu **<br>Operation | Press the MENU key to scroll to "Operation" menu. |
| 16 | -DRIVE- Rdy<br>Frequency Ref<br>U1-01= 0.00Hz<br>U1-02= 0.00Hz<br>U1-03= 0.00A | Press the DATA/ENTER key to enter "Operation" menu. |