This App/Upgrade note applies to M700, M701, M702 and M600

M700/M600 Initial Configuration

Using an KI-Keypad for Drive Mode, Digital/Analog IO and Communications

This application note will describe using the KI-Keypad to do the initial and basic configuration of the drive mode, as well as the recommended initial Digital and Analog IO configuration on a M700/M600 series drive. A final section on initial communication setup will leave the M700/M600 series drive ready for connection to the motor and further configuration refinement using M Connect hosted on a PC or Laptop.

The need to configure the drive mode first on a M700 series VFD is not obvious to new users. This need arises because the M700 (and M600) series represents a universal solution for a range of three phase motor types, as well as being able to function as the active portion of a low distortion four quadrant Active Front End (AFE).

The M700 ships in the Americas in Open Loop mode defaulted for 60 Hz operation. This represents a perfectly usable state of affairs for use with an induction motor without an encoder fitted. This mode is also useful for a quick validation of the Unidrive-M without a motor fitted, at all.

But realistically, this default configuration will need to be revised from this baseline for a majority of applications. This application note will cover performing those initial revisions with the KI-Keypad. That revision is accomplished by changing the proper register and bit parameter values that are initially set up at mode change or after explicit resetting the M700 back to default values.

KI-Keypad Basic Operation – understand this

The KI-Keypad initially displays the present status (or state) of the VFD / motor combination.
In **Status** mode, none of the lines are flashing. Bothe “Ready” and “Inhibit” are normal status indication, as opposed to “alarm” (warning) indications or “trip” indications.

Configuring a M700 (and M600) series VFD with a KI-Keypad is an iterative sequence of keypad mode change, navigate, view, and edit key parameters values using the buttons on the KI-Keypad.

To use the KI-Keypad to view a parameter value, one must first switch the KI-Keypad from **Status** mode to **Parameter** (navigate) mode. Depressing the “enter / mode” key once will make the switch.
In **Parameter** mode, the upper line of the KI-Keypad is flashing. Then one uses the up / down / left / right arrows to navigate from the present parameter location to the desired parameter location, where one can inspect the parameter value in the lower line.

To revise a parameter value, one must first navigate to that parameter with the KI-Keypad, and then switch the KI-Keypad from **Parameter** mode to **Edit** mode. Depressing the “enter / mode” key once will make the switch. In **Edit** mode, the (now) flashing value to be modified is displayed in the lower line of the KI-Keypad.

See Appendix A for additional details on using the KI-Keypad.

Checking and Setting the Drive mode - do this

Navigate to parameter # 0.048 to and inspect / confirm the drive mode. See Appendix B for basic guidance on which drive model is suitable for which motor type and application.

Note that the M700 and M600 series initialize in menu zero at parameter # 0.010 at power-up, so one needs to navigate up to reach parameter # 0.048. Then navigate to parameter # 0.049 and check and insure parameter # 0.049 displays “All Menus” (1).

To alter the drive mode, first decide if 50 Hz defaults or 60 Hz defaults are appropriate. Usually, in North America, 60 Hz default values are the appropriate choice after the drive mode is changed. This application note is focused on a North American audience, and will describe M700 60 Hz drive mode change behavior. Note that 50 Hz drive mode change is similar, but with minor differences.

Ensure that the drive status displayed is “inhibited”. Either ensures terminal 31 is not asserted, or ensures parameter # 6.015 is “Off”.

Navigate from present location to parameter #0.000 and switch to edit mode.

> To unlock the M700 for drive mode-change and indicate “load 60 Hz defaults” at drive mode change, enter a value of **1254** into #0.000.
>
> To unlock the M700 for drive mode-change and indicate “load 50 Hz defaults” at drive mode change, enter a value of **1253** into #0.000.

Navigate from present location to parameter #0.048 and switch to edit mode. Use the up and down keys to choose the desired mode. The mode will change and the default values will be loaded when the Stop / Reset / Enter (red) key is pressed.

A common issue encountered on the M700 series immediately after defaults are loaded in both RFC-A (with position feedback) and in RFC-S (with position feedback) is a “Trip” with “Encoder 2.11” displayed. This arises because the motor sensor is either not connected and / or incompletely configured.

To suppress this trip one navigates to # 3.040 (P1 Error Detection Level) and changes the value from “0001” to “0000”. One then saves the drive values by navigating back to parameter # 00.000 (# mm.000) and change the value from “No Action” (0000) to “Save parameters” (0001) and press the red “Stop” button.

Be sure to undo the previous step once the encoder feedback is set up as expected, and the motor encoder is connected to the M700, M701 or M702.

The rest of this application note will assume that that the reader is now familiar with using the KI-Keypad to inspect and modify the parameters cited in the rest of this document.

Digital IO Description - features

The M600, M700 and M701 features a total of six 24 Volt DC IO points with a single STO (Safe Torque Off) Input point. These are terminals T24, T25, T26, T27, T28 and T29 with STO at T31. Three of these IO points can be configured as either inputs or outputs (T24, T25 and T26). After default, the first IO point (T24) is set up as an output, the other two as inputs. The other three configurable IO points are strictly input-only.

The M702 features two 24 Volt DC configurable output-only terminals at T4 and T5 and three configurable input-only terminals with two STO inputs. These are terminals T4, T5, T7, T8 and T9 with STO at T11 and T13).

The M600 and M700 series feature a single configurable volt-free relay form-A point output and this is terminals T41 and T42.

Initial Digital IO configuration - do this

After default, Run forward is configured for T26 (T7 for M702) and Run Reverse is configured for T27 (T8 for M702). Terminal T24 (T4 on M702) is configured for “At zero speed” (an output).
On the M700the input T25 as is configured as Reset, input T28 as Analog select and input T29 as Jog forward. These are fine for initial Digital IO configuration and un-needed assignments can be deselected and needed ones configured with M Connect later in the commissioning.
However, a number of points need to be dealt with the AI-Keypad up front.

One needs to determine the “sequencer latching “(# 6.040) behavior needed.
For three wire behavior set # 6.40 to a value of On and for two wire behavior set 6.40 to a value of Off.
Note that for control via a communication link, sequencer latching needs to be de-selected (# 6.40 to a value of Off).

The M600 and M700 series configure the relay out (T41 and T42 to close when the drive is Okay (no trips present). This arises as a result of Relay Output Source # 8.027 = 10.001 (Drive Okay) and Relay Invert # 8.017 = Off. This needs early attention as this is often used with machine Emergency Stop Logic, and may need to be configured early to keep power to the M700.

One variation encountered often enough to be mentioned has Relay Output Source # 8.027 = 10.001 and Relay Invert # 8.017 = On. This configuration results in the relay closure now indicate an “In Fault” condition.

One other common variation has Relay Output Source # 8.027 = 10.003 and Relay Invert # 8.017 = On. This configuration results in the relay closure now indicate a “Not at zero speed” (in motion) condition.

One other matter needs early attention, running in the reverse direction. Run reverse as well as run forward are initially configured after default. But “Bipolar Reference Enable” # 1.010 needs to be On to actually obtain motion in reverse.

Analog IO Description - features

When discussing Analog Input features on a VFD, one is primarily considering the assignment and configuration of where the motor speed target should come from.

Other considerations are assignments and configuration of available analog outputs and any temperature sensors that are interfaces via an analog input.

The M600, M700 and M701 feature a total of three configurable analog inputs and two analog outputs. Analog input 1 features a differential input (T 5 and T6) Analog 2 (T7) is single ended as is Analog 3 (T8). Analog 3 also features the ability to be configured to be connected to a Thermistor (or temperature dependant resistor) to measure motor temperature.

The two Analog outputs are configurable but only operate in a bipolar voltage mode. If, say, a 4-20 mA analog output is required, a SI-I/O will be required.

The M702 does not feature any analog inputs or outputs. In general, the M702 is aimed at applications where the M702 is interfaced via a field-bus connection, such as EthernetIP, Modbus TCP/IP or Real Time Motion over Ethernet (RTMoE).

Initial Analog IO configuration – do this

The M600, M700 and M701 analog input default configuration is three +/-10.0 Voltage inputs. The only early attention required is if one of the three needs to be configured as a “4-20 mA. Input “(Analog 2 normally) or as a thermistor input (Analog 3 only).

For Analog 2 (T7) as a 4-20 mA input set # 7.011 = 4-20 mA (4).
For Analog 3 (T8) as a Thermistor input set # 7.015 = Thermistor (4)

To use Analog 1 (T5 and T6, connected to T3) in voltage mode for the speed reference set # 0.005 to “A1.Pr” and leave Analog 1 at default configuration.

To use Analog 2 (T7 and T3) in current mode for the speed reference set # 0.005 to “A2.Pr” and set # 0.019 to 4- 20 mA (4).

The M702 does not require (nor is it possible to do) any analog input or output configuration. One typically sets # 0.005 to Preset (3) and writes to # 1.021 via the communication link chosen for the project.

Initial Communication configuration - do this

The M701 and M600 feature twin RS-485 ports configured for Modbus RTU at a “Serial Address” of “1“, a Serial Mode of “8 data bits, 2 stop bits, no parity”, at a baud rate of 19200. This is okay for initial connection to a PC or Laptop using a CT Comms Cable (either the USB or Legacy version).

The M700 and M702 both feature twin Ethernet ports and are configured for DHCP enabled and end up at an indeterminate ipv4 address if no DHCP server is present on the network segment (the usual state of affairs). This should be changed to a statically assigned ipv4 address by turning DHCP off and setting the ipv4 address manually as well as the network mask.

Recommended for a single node or the first node on a segment: DHCP Enable (#4.02.005) Slot 4 menu 2 parameter 5 to a value of Off IP Address (#4.02.006) Slot 4 menu 2 parameter 6 to a value of 192.168.1.100

Subnet Mask (# 4.02.007) Slot 4 menu 2 parameter 7 to a value of “255.255.255.0

Recommended for a multiple nodes:

DHCP Enable (#4.02.005) Slot 4 menu 2 parameter 5 to a value of Off
IP Address (#4.02.006) Slot 4 menu 2 parameter 6 to a value of 192.168.1.xxx * Subnet Mask (# 4.02.007) Slot 4 menu 2 parameter 7 to a value of “255.255.255.0

* First node on segment, xxx starts at 100, next 101, to the last. Each node must have a unique ipv4 address when done.

Make the configuration active by setting Reset # 4.15.002 to “On” and waiting for the value to self-reset to “Off”. Then save the drive configuration by the previously discussed:

Save the drive values by navigating back to parameter # 00.000 (# mm.000) and change the value from “No Action” (0000) to “Save parameters” (0001) and press the red “Stop” button.

Conclusion

At this point, the M600, M700, M701 or M702 will be in the correct operational mode and ready to connect and interface to the Motor and any motor mounted encoder / sensors.

Connection via a suitable communication link to a PC or Laptop running M Connect, Machine Control Studio or CT Scope should be straightforward.

Finally, the reader should have an understanding of the basic configuration set up after the mode was switched and defaults loaded, and should have an idea where the final revisions need to be made to satisfy the project requirements. Either use the KI-Keypad (and referring to the User Guide) or use M Connect to finish the final of configuration, as well continuing on to the rest of the commissioning.

Resources

Product Manuals are available from both the website and upon request (in electronic form) from Technical Support

1. M700 / M701 User's Guide
2. M600 User's Guide
3. M702 User's Guide
4. Advanced User guidance is available in the form of *.pdf(s) from Technical Support as well as within the help files found in MConnect.

Software is available from both the website and upon request (in electronic form) from Technical Support. Recommended:

1. M Connect
2. CTScope
3. CTSoft
4. Machine Control Studio

Guides can be found on our website: www.controltechniques.com
You can email to techsupport.cta@mail.nidec.com
You can call Technical Support at 952-995-8000, 24/7/365

Appendix A & B Follow

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Appendix A – KI-Keypad details

5 Getting started

This chapter introduces the user interfaces, menu structure and security levels of the drive.

5.1 Understanding the display

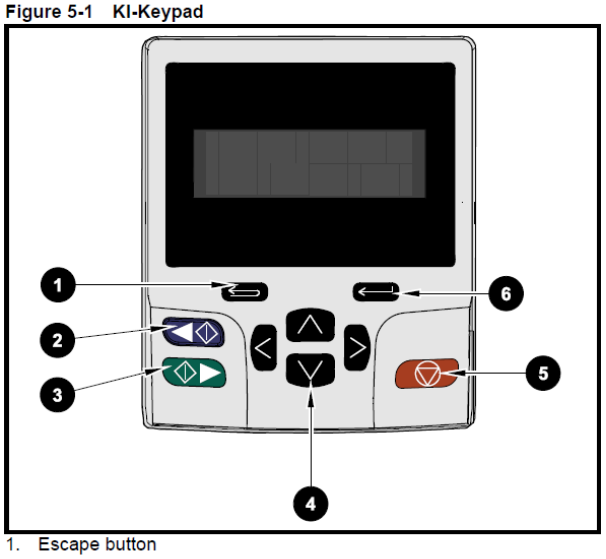
The keypad can only be mounted on the drive.

5.1.1 KI-Keypad

The KI-Keypad display consists of two rows of text. The upper row shows the drive status or the menu and parameter number currently being viewed. The lower row of the display line shows the parameter value or the specific trip type. The last two characters on the first row may display special indications. If more than one of these indications is active then the indications are prioritized as shown in Table .

When the drive is powered up the lower row will show the power up parameter defined by *Parameter Displayed At Power-Up* (11.022).

Figure 5-1 KI-Keypad



1. Escape button
2. Start reverse (Auxiliary button)
3. Start forward
4. Navigation keys (x4)
5. Stop / Reset (red) button
6. Enter button

NOTE

The red stop button is also used to reset the drive.

The parameter value is correctly displayed in the lower row of the keypad display, see table below.

Table 5-1 Keypad display formats

Display formats	Value
IP Address	127.000.000.000
MAC Address	01ABCDEF2345
Time	12:34:56
Date	31-12-11 or 12-31-11
Version number	01.02.02.00
Character	ABCD
32 bit number with decimal point	21474836.47
16 bit binary number	0100001011100101

Table 5-2 Active action icon

Active action icon	Description	Priority
	Alarm active	
	Keypad real-time clock battery low	
	Accessing non-volatile media card	
or	Drive security active and locked or unlocked	
	Motor map 2 active	
	User program running	
	Keypad reference active	

5.2 Keypad operation

5.2.1 Control buttons

The keypad consists of:

- Navigation Keys - Used to navigate the parameter structure and change parameter values.
- Enter / Mode button - Used to toggle between parameter edit and view mode.
- Escape / Exit button - Used to exit from parameter edit or view mode. In parameter edit mode, if parameter values are edited and the exit button pressed the parameter value will be restored to the value it had on entry to edit mode.
- Start forward button - Use to provide a 'Run' command if keypad mode is selected.
- Start reverse button - Used to control the drive if keypad mode is selected and the reverse button is activated. If *Enable Auxiliary Key* (06.013) = 1, then the keypad reference is toggled between run forward and run reverse each time the button is pressed. If *Enable Auxiliary Key* (06.013) = 2, then the button functions as a run reverse key.
- Stop / Reset button - Used to reset the drive. In keypad mode can be used for 'Stop'.

NOTE

Low battery voltage is indicated by low battery symbol on the keypad display. Refer to section 3.14.1 *Real time clock battery replacement* on page 57 for information on battery replacement.

Figure 5-2 overleaf shows an example on moving between menus and editing parameters.

Appendix B – M700 series and M600 drive modes vs motor type

Open Loop modes – Open Loop control for asynchronous (induction) motor with no encoder fitted and operation with a frequency (Hz.) target

Fixed V/F mode

This mode can be used for single and multi-motor induction motor applications.

The voltage applied to the motor is directly proportional to the frequency except at low speed where a voltage boost is provided which is set by the user.

This mode can also be used without a motor connected to verify basic operation when troubleshooting.

Quadratic V/F mode

This mode can be used for single or multiple induction motors running fan or pump applications with quadratic load characteristics.

The voltage applied to the motor is directly proportional to the square of the frequency except at low speed where a voltage boost is provided which is set by the user.

Open loop vector mode

This mode is can be used for induction motors and is limited to single motor applications, but is the easiest mode to configure.

The voltage applied to the motor is directly proportional to the frequency except at low speed where the drive uses measured motor parameters to apply the correct voltage to keep the flux constant under varying load conditions.

RFC-A modes – Rotor Flux Control for Asynchronous (induction) motor and operation with a velocity (rpm) target

Without position feedback (Sensor-less)

This *mode can be used with a single induction motor* and features a velocity loop feeding a torque loop. Sensor-less mode provides closed loop vector control without the need for position feedback by using current, voltages and key operating motor parameters to estimate the motor velocity.

This mode can eliminate instability traditionally associated with open loop control such as operating large motors with light loads at low frequencies (without an encoder).

With position feedback (M600 needs SI-Encoder, M700 does not)

This *mode can be used with a single induction motor* with a feedback device fitted and features a velocity loop feeding a torque loop.

The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed is exactly as demanded. Motor flux is actively and accurately regulated at all times to provide full torque all the way down to zero speed.

RFC-S modes - Rotor Flux Control for Synchronous (permanent magnet brushless) motor and operation with a velocity (rpm) target

Without position feedback (Sensor-less) - M600 only

This *mode can be used with a single brushless Permanent Magnet ((PM) AC synchronous motor* without a feedback device fitted. Usual application is for energy efficiency. Active Flux regulation is not required because the motor is self excited by the permanent magnets which form part of the rotor.

With position feedback - M700 only

For use with a single brushless Permanent Magnet (PM) Servo motor with a feedback device fitted. This includes Linear Actuators / integrated PM brushless Servo Motor combinations and PM brushless Liner Motors. The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed is exactly as demanded. Active Flux regulation is not required because the motor is self excited by the permanent magnets which form part of the rotor. Absolute position information is required from the feedback device to ensure the output voltage is accurately matched to the back EMF of the motor. Full torque is available all the way down to zero speed.

Regen mode – not used directly with a motor

This mode is used to create an **A**ctive **F**ront **E**nd (**AFE**) for one or more VFD(s). This *mode requires additional passive components* and allows regeneration of energy back onto the power line. The **AFE** also provides power factor control for power quality management and greatly reduces unwanted power harmonics.

Note that the mode configured on a motoring VFD connected to an **AFE** reflects the motor mated to that motoring VFD, not the **AFE** mode.

Resources: can be found on our website: www.controltechniques.com
For help contact techsupport.cta@mail.nidec.com, or
call Technical Support at 952-995-8000, 24/7/365