MAINTENANCE AND TROUBLESHOOTING

CHAPTER
9

In This Chapter...

Hardware System Maintenance

Standard Maintenance

No regular or preventative maintenance is required for this product (there are no internal batteries); however, a routine maintenance check (about every one or two months) of your PLC and control system is good practice, and should include the following items:

- Air Temperature – Monitor the air temperature in the control cabinet, so the operating temperature range of any component is not exceeded.
- Air Filter – If the control cabinet has an air filter, clean or replace it periodically as required.
- Fuses or breakers – Verify that all fuses and breakers are intact.
- Cleaning the Unit – Check that all air vents are clear. If the exterior case needs cleaning, disconnect the input power, and carefully wipe the case using a damp cloth. Do not let water enter the case through the air vents and do not use strong detergents because this may discolor the case.

Battery Replacement

The CPU battery is used to retain program V-memory and the system parameters. The life expectancy of this battery is 5 years.

NOTE: *Before installing or replacing your CPU battery, back-up your V-memory and system parameters. You can do this by using DirectSOFT programming software to save the program, V-memory, and system parameters to a personal computer.(File > Save Project to disk.)*

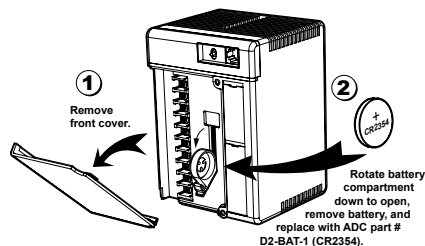To install the D2–BAT–1 (#CR2354) CPU battery in the D4-454 CPUs.

- Press the retaining clip on the battery door down and swing the battery door open.
- Remove old battery and insert the new battery into the coin–type slot with the larger (+) side outwards
- Close the battery door making sure that it locks securely in place.
- Make a note of the date the battery was installed.

WARNING: Do not attempt to recharge the battery or dispose of an old battery by fire. The battery may explode or release hazardous materials.

① Remove front cover.

② Rotate battery compartment down to open, remove battery, and replace with ADC part # D2-BAT-1 (CR2354).

Diagnostics

Your D4-454 PLC performs many predefined diagnostic routines with every CPU scan. The diagnostics can detect various errors or failures in the PLC. The two primary error classes are fatal and non-fatal.

Fatal Errors

Fatal errors are errors which may cause the system to function improperly, perhaps introducing a safety problem. The CPU will automatically switch to Program Mode if it is in Run Mode. (Remember, in Program Mode all outputs are turned off.) If the fatal error is detected while the CPU is in Program Mode, the CPU will not allow you to transition to Run Mode until the error has been corrected.

Some examples of fatal errors are:

- Power supply failure on the CPU base
- Parity error or CPU malfunction
- Particular programming errors

Non-fatal Errors

Non-fatal errors are errors that need your attention, but should not cause improper operation. They do not cause or prevent any mode transitions of the CPU. The application program can use special relay contacts to detect non-fatal errors, and even take the system to an orderly shutdown or switch the CPU to Program Mode if desired. An example of a non-fatal error is:

- Particular programming errors - The programming devices will notify you of an error if one occurs while online.
- DirectSOFT programming software provides the error number and an error message.
- Backup battery voltage low
- All I/O module errors

See the Error Codes Appendix for a complete list of error messages in order by error number. Many error messages point to supplemental V-memory locations which contain related information. Special relays (SP contacts) also provide error indications (refer to the Special Relays Appendix).

V-memory Error Code Locations

The following table names the specific memory locations that correspond to certain types of error messages.

Error Class	Error Category	Diagnostic V-memory
Minor	Battery Voltage	V7746
System	10ms calendar timer	V7747
User-Defined	Error code used with FAULT instruction	V7751
I/O Configuration	Current module ID Code	V7752
		V7753
	Base number/Slot number	V7754
System Error	Fatal Error code	V7755
	Major Error code	V7756
	Minor Error code	V7757
Module	Base Number/Slot number	V7760
Module	Error code	V7762
Grammatical	Address where syntax error occurs	V7763
	Error Code found during syntax check	V7764
CPU Scan	Number of scans since last Program to Run Mode transition	V7765
	Current scan time (ms)	V7775
	Minimum scan time (ms)	V7776
	Maximum scan time (ms)	V7777

Special Relays (SP) Corresponding to Error Codes

The special relay table also includes status indicators which can indicate errors. For a more detailed description of each of these special relays refer to the Special Relays Appendix.

CPU Status Relays	
SP11	Forced Run mode
SP12	Terminal Run mode
SP13	Test Run mode
SP14	Break Relay 1
SP15	Test Stop mode
SP16	Terminal Program mode
SP17	Forced Sop mode
SP21	Break relay 2
SP22	Interrupt enabled
SP25	CPU battery disabled
SP30	Dip switch 1 status
SP31	Dip switch 2 status
SP32	Dip switch 3 status
SP33	Dip switch 4 status

Accumulator Status Relays	
SP60	Acc. is less than value
SP61	Acc. is equal to value
SP62	Acc. is greater than value
SP63	Acc. result is zero
SP64	Half borrow occurred
SP65	Borrow occurred
SP66	Half carry occurred
SP67	Carry occurred
SP70	Result is negative (sign)
SP71	Pointer reference error
SP73	Overflow
SP75	Data is not in BCD
SP76	Load zero

Startup and Real-time Relays	
SP0	First scan
SP1	Always ON
SP3	1 minute
SP4	1 second
SP5	100 millisecond
SP6	50 millisecond
SP7	Alternate scan

Communication Monitoring Relays	
SP120	Module busy Slot 0
SP121	Communication error Slot 0
SP122	Module busy Slot 1
SP123	Communication error Slot 1
SP124	Module busy Slot 2
SP125	Communication error Slot 2
SP126	Module busy Slot 3
SP127	Communication error Slot 3
SP130	Module busy Slot 4
SP131	Communication error Slot 4
SP132	Module busy Slot 5
SP133	Communication error Slot 4
SP134	Module busy Slot 6
SP135	Communication error Slot 6
SP136	Module busy Slot 7
SP137	Communication error Slot 7

System Monitoring Relays	
SP40	Critical error
SP41	Non-critical error
SP43	Battery low
SP44	Program memory error
SP45	I/O error
SP46	Communications error
SP47	I/O configuration error
SP50	Fault instruction was executed
SP51	Watchdog timeout
SP52	Syntax error
SP53	Cannot solve the logic
SP54	Communication error
SP56	Table instruction overrun

I/O Module Codes

Each system component has a code identifier. This code identifier is used in some of the error messages related to the I/O modules. The following tables list these codes.

Code (Hex)	Component Type		Code (Hex)	Component Type
01	CPU		21	8 pt Input
02	Expansion Unit		28	16 pt Output, F4 series Analog Output
03	I/O Base		2B	16 pt Input, F4 series Analog Input, Interrupt
11	DCM, All CoProcessor Modules		30	32 pt Output, DL series Analog Output
12	Remote Master, Slice Master		3F	32 pt Input, DL series Analog Output
18	High Speed Counter, Magnetic Pulse Input		7F	Abnormal
20	8 pt Output		FF	No module detected

Error Message Tables

The D4-454 CPUs will automatically log any system error codes and any custom messages you have created in your application program with the Fault instructions. (See Chapter 5 for details on the Fault instruction.) The CPU logs the error code, the date, and the time the error occurred. There are two separate tables that store this information.

System Error Table – stores up to 32 errors in the table

Fault Message Table – stores up to 16 messages in the table

When an error or message is triggered, it is put into the first available table location. Therefore, the most recent error message may not appear in the first row of the table. If the table is full when an error occurs, the oldest error is pushed (erased) from the table and the new error is inserted in the row.

The following diagram shows an example of the Fault Message table as shown in DirectSOFT. You can access the error code table and the message table through DirectSOFT's PLC Diagnostic sub-menus. Details on how to access these logs are provided in the DirectSOFT manual.

Error Msg Example

Most recent message appears here, not at the top of the table.

Next message will show up in this row, which is now the oldest message.
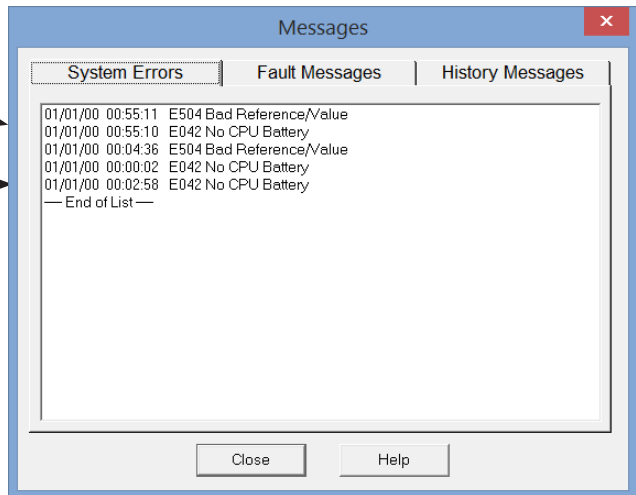
Program Error Codes

The System error log contains 32 of the most recent errors that have been detected. The errors that are trapped in the error log are a subset of all the error messages which the D4-454 system generates.

The following errors are captured in the System error log upon first detection or re-occurrence.

Error Code	Description
E003	Software time-out
E004	Invalid instruction(RAM parity error in the CPU)
E041	CPU battery low
E099	Program memory exceeded
E104	Write Fail
E151	Invalid Command

Error Code	Description
E201	Terminal block missing
E202	Missing I/O module
E203	Blown Fuse
E206	User 24V power supply failure
E250	Communication failure in the I/O chain
E251	I/O parity error
E252	New I/O configuration

These error are captured in the System error log if they exist when the CPU attempts to transition to RUN mode.

Error Code	Description
E401	Missing END statement
E402	Missing LBL
E403	Missing RET
E404	Missing FOR
E405	Missing NEXT
E406	Missing IRT
E412	SBR/LBL › 64
E413	FOR/NEXT › 64
E421	Duplicate stage reference
E422	Duplicate SBR/LBL reference
E423	Nested loops

Error Code	Description
E431	Invalid ISG/SG address
E432	Invalid jump (GOTO) address
E433	Invalid SBR address
E434	Invalid RTC address
E435	Invalid RT address
E436	Invalid INT address
E437	Invalid IRTC address
E438	Invalid IRT address
E440	Invalid Data address
E441	ACON/NCON

CPU Status Indicators

The D4-454 PLCs have indicators on the front to help you determine potential problems with the system. In normal runtime operation only, the RUN and PWR indicators are on. The table below is a quick reference to potential problems.

Indicator	Status	Potential Problems
PWR	OFF	1. Power input voltage is incorrect for selected operating mode, 110/220 VAC select jumper incorrect on CPU terminal strip 2. External power is off or disconnected (check fuses, breakers) 3. Power supply/CPU is faulty 4. Other component such as an I/O module has power supply shorted 5. Power budget exceeded for the CPU being used.
RUN	OFF	1. CPU programming error 2. Key switch in Stop position
	Flashing	CPU is in firmware upgrade mode
CPU	ON	1. Electrical Noise interference 2. CPU defective
BATT	Flashing	Battery voltage is low or Battery is not installed (V7745.12 must be On)
DIAG	ON	1. The CPU internal diagnostics has failed 2. The local bus on the backplane has had a communications error
I/O	ON	1. I/O module failure 2. External power supply failure 3. Configuration error 4. Base expansion unit failure
TXD	OFF	1. The CPU is not transmitting data on the second ports (ports 1, 2, and 3), due to programming error 2. The CPU is not in RUN mode
RXD	OFF	1. External device is not transmitting to CPU secondary ports (ports 1, 2, and 3) 2. Communications cable is defective, or not connected

PWR Indicator

In general there are four reasons for the CPU power status LED (PWR) to be OFF:

1. Power to the unit is incorrect or is not applied.

2. PLC power supply is faulty.

3. Other component(s) have the power supply shut down.

4. Power budget (+5V) for the CPU has been exceeded.

If the voltage to the power supply is not correct, the PLC may not operate properly or may not operate at all. Use the following guidelines to correct the problem.

WARNING: To minimize the risk of electrical shock, always disconnect the system power before inspecting the physical wiring.

5. First, disconnect the external power.

6. Verify that all external circuit breakers or fuses are still intact.

7. Check all incoming wiring for loose connections. If you're using a separate termination block, check those connections for accuracy and integrity.

8. If the connections are acceptable, reconnect the system power and verify the voltage at the D4-454 power input is within specification. If the voltage is not correct, shut down the system and correct the problem.

9. If all wiring is connected correctly and the incoming power is within the specifications, the PLC internal supply may be faulty.

If the voltage to the power supply is not correct, the CPU may not operate properly, if at all. For a new installation on AC-powered CPU versions, first check the 110/220 VAC select jumper on the terminal strip of the CPU. If the 110 VAC selection shunt is not installed while using 110 VAC, you will see the following symptoms:

- The communication ports will not function
- The CPU will only operate when no modules are installed

If the 110 VAC selection shunt is installed while using 220 VAC, the power supply in the CPU will be damaged. If this has happened, you will need to replace the CPU. The best way to check for a faulty CPU power supply is to substitute a known good one to see if this corrects the problem.

If the jumper is correctly installed for the AC version you are using, then measure the voltage at the terminal strip to ensure it is within the CPU input specs.

It is possible a faulty module or external device using the system 5V can shut down the power supply. This 5V can be coming from the base or from the top port on the CPU. To test for a device causing this problem:

- Turn off power to the CPU.
- Disconnect all external devices (example communication cables) from the CPU.
- Reapply power to the system.

If the power supply operates normally, you probably have either a shorted device or a shorted cable. If the power supply does not operate normally, then test for a module causing the problem by following the steps below:

Turn off power to the CPU.

Remove the CPU from the base, leaving its power cord attached.

Reapply power to the CPU.

If the PWR LED operates normally, the problem is most likely in one of the modules in the local CPU base. To isolate which module is causing the problem, remove one module at a time until the PWR LED operates normally. Put the CPU back in the base prior to testing for a bad module. Follow the procedure below:

- Turn off power to the CPU.
- Remove a module from the base.
- Reapply power to the CPU.

Bent base connector pins on the module can cause this problem, so check the connector. Remember that exceeding the power budget is a common error that will cause the PWR indicator to not come on or to come on intermittently.

Power budgeting problems usually appear during system start-up rather than after a long period of operation. If there is any doubt, it's a good idea to recheck this.

WARNING: The PLC may reset if the power budget is exceeded. If there is any doubt about the system power budget please check it at this time. Exceeding the power budget can cause unpredictable results which can cause damage and injury. Verify the modules in the base operate within the power budget for the chosen base. You can find these tables in Chapter 4, Systems Design and Configuration.

RUN Indicator

If the CPU will not enter the Run mode (the RUN indicator is off), the problem is usually in the application program, unless the CPU has a fatal error. If a fatal error has occurred, the CPU LED should be on. You can use a programming software to determine the cause of the error:

- If you are attempting to enter Run mode with DirectSOFT, make sure the CPU mode switch is in the TERM position and try to enter Run mode.
- If you are using the CPU mode switch to change Run mode and the CPU does not respond, use DirectSOFT to diagnose the problem.
- If the RUN indicator is flashing (blinking), the CPU is in the firmware upgrade mode. You will need to update the firmware using KOYO firmware update tool, available for download on the AutomationDirect website.

Both of the programming devices, DirectSOFT programming software and a Handheld Programmer, will return an error message describing the problem. Depending on the error, there may also be an error code you can use to help diagnose the problem. The most common programming error is "Missing END Statement". All application programs require an END statement for proper termination. A complete list of error codes can be found in the Error Codes Appendix.

CPU Indicator

If the CPU indicator is on, a fatal error has occurred in the CPU. Generally, this is not a programming problem but an actual hardware failure. You can power cycle the system to clear the error. If the error clears, you should monitor the system and determine what caused the problem. You will find this problem is sometimes caused by high frequency electrical noise introduced into the CPU from an outside source. Check your system grounding and install electrical noise filters if the grounding is suspected. If power cycling the system does not reset the error, or if the problem returns, you should replace the CPU.

BATT Indicator

The BATT indicator needs to be enabled with bit V7745.12 = 1. The BATT indicator will flash when the CPU battery voltage is low (2.5V or less) or the battery is not installed in the battery holder. The battery voltage is continuously monitored while the system voltage is being supplied. You should check this indicator periodically to determine if the battery needs replacing. You can also detect low battery voltage from within the CPU program. When the BATT indicator is enabled, special relay SP43 comes on when the battery voltage is low and V7746 indicates the battery voltage in tenths of a volt.

DIAG Indicator

The diagnostics indicator is normally off. It turns on if the CPU detects a failure of its run-time diagnostics. Extreme electrical noise may cause a diagnostics failure, so power cycle the CPU first. If the DIAG indicator still turns on, the CPU is probably faulty. Replace it with a known good one to be sure.

I/O Indicator

If this indicator is on, a problem in the local, expansion, or remote I/O chain has been detected. Any of the problems listed below could be the cause of the I/O LED being on:

- A blown fuse inside an I/O module
- A loose terminal block
- The 24 VDC supply has failed
- The module or Expansion unit has failed
- The I/O configuration check detects a change in the I/O configuration

To aid you in further diagnosing where the I/O error is, each I/O module has LEDs to indicate if an error is present. The discrete I/O modules covered in this manual may have a combination of the following I/O indicators:

Indicator	Error Condition
TB	Loose or missing terminal block
24V	External 24V power supply not providing the correct voltage
FU	Module fuse has blown (check the I/O modules specification sheets to see if the fuse is replaceable)

Many other specialty modules also have indicators. The manuals for those products contain information on the indicators and status LEDs. If the modules are not providing any clues to the problem, run the I/O diagnostics in the DirectSOFT programming software. This will provide the base number, the slot number and the problem with the module. Once the problem is corrected the indicators will reset. An I/O error will not cause the CPU to switch from the run to program mode, however there are special relays (SPs) available in the CPU which will allow this error to be read in ladder logic. The application program can then take the required action such as entering the program mode or initiating an orderly shutdown.

TXD and RXD Indicators

The TXD and RXD indicators on the D4-454 CPU turn ON whenever the CPU either transmits or receives data, respectively. If the indicator(s) remain off when you are expecting communications, there is a problem. If the indicator(s) remain on when you are not expecting communications, there is a problem.

The TXD and RXD indicators turn on when data is transmitted on port 1, 2, and 3 of the D4-454. Therefore, when DirectSOFT programming software or an operator interface such as the DV-1000 is connected, the TXD and RXD are on constantly. If you are trying to detect communications originated by the ladder program itself, it may be useful to disconnect the programing device or operator interface. In this way, only the cable for the communications you are debugging is connected.

Communications Problems

If you cannot establish communications with the CPU, check these items:

- The cable is disconnected.
- The cable has a broken wire or has been wired incorrectly.
- The cable is improperly terminated or grounded.
- The device connected is not operating at the correct baud rate. Make sure link settings match the PLC port settings.
- The device connected to the port is sending data incorrectly, or another application is running on the device.
- A grounding difference exists between the two devices.
- Electrical noise is causing intermittent errors.
- The PLC has a bad communication port and should be replaced.

For problems in communicating with DirectSOFT programming software on a personal computer, refer to the DirectSOFT programming user manual. It includes a troubleshooting section that can help you diagnose PC problems in communications port setup, address or interrupt conflicts, etc.

I/O Point Troubleshooting

Possible Causes

If you suspect an I/O error, there are several things that could be causing the problem.

- I/O configuration error on modules such as: Analog I/O, High Speed Counters, Specialized Communications, etc.
- A blown fuse in your machine or panel
- A loose terminal block
- The auxiliary 24 VDC supply has failed
- The Input or Output Point has failed

Some Quick Steps

When troubleshooting the DL405 PLCs, please be aware of the following facts which may assist you in quickly correcting an I/O problem.

- The output modules cannot detect shorted or open output points. If you suspect one or more faulty points, measure the voltage drop from the common to the suspect point. Remember when using a Digital Volt Meter, leakage current from an output device such as a triac or a transistor must be considered. A point which is off may appear to be on if no load is connected the point.
- The I/O point status indicators are logic-side indicators. This means the LED which indicates the on or off status reflects the status of the point with respect to the CPU. On an output point the status indicators could be operating normally while the actual output device (transistor, triac etc.) could be damaged. With an input point, if the indicator LED is on, the input circuitry is probably operating properly. Verify the LED goes off when the input signal is removed.
- Leakage current can be a problem when connecting field devices to an I/O point. False input signals can be generated when the leakage current of an output device is great enough to turn on the connected input device. To correct this install a resistor in parallel with the input or output of the circuit. The value of this resistor will depend on the amount of leakage current and the voltage applied but usually a 10K to 20K resistor will work. Verify the wattage rating of the resistor is correct for your application.
- Because of the removable terminal blocks on the D4-454, the easiest method to determine if an I/O circuit has failed is to replace the unit if you have a spare. However, if you suspect a field device is defective, that device may cause the same failure in the replacement PLC as well. As a point of caution, you may want to check devices or power supplies connected to the failed I/O circuit before replacing the unit with a spare.
- The fuse blown indicator on an output module will indicate a problem only if an output point is connected to a load and the point is turned on. This indicator works by sensing a voltage drop across the fuse so there must be a voltage applied to the fuse and load applied to output to create the voltage drop before it can be reported by the module.

Testing Output Points

Output points can be set on or off in the D4-454 CPUs. If you want to do an I/O check-out independent of the application program, follow the procedure below:

Step	Action
1	Change the CPU mode switch to TERM.
2	Use DirectSOFT programming software to communicate online to the PLC.
3	Change to Program Mode.
4	Go to address 0.
5	Insert an "END" statement at address 0. (This will cause program execution to occur only at address 0 and prevent the application program from turning the I/O points on or off).
6	Change to Run Mode.
7	Using dataview to set (turn) on or off the points you wish to test. *
8	When you finish testing I/O points delete the "END" statement at address 0.
* For more information refer to PC-DSOFT6-M, DirectSOFT programming software.	

WARNING: Depending on your application, forcing I/O points may cause unpredictable machine operation that can result in a risk of personal injury or equipment damage. Make sure you have taken all appropriate safety precautions prior to testing any I/O points.
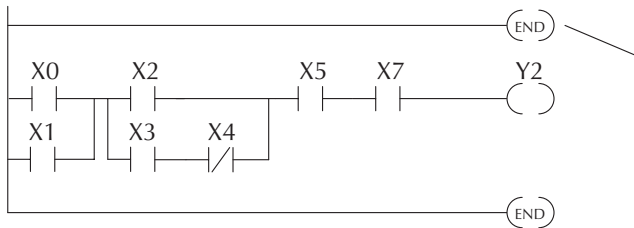
Insert an END statement at the beginning of the program. This disables the remainder of the program.

Noise Troubleshooting

Electrical Noise Problems

Noise is one of the most difficult problems to diagnose. Electrical noise can enter a system in many different ways and falls into one of two categories, conducted or radiated. It may be difficult to determine how the noise is entering the system but the corrective actions for either of the types of noise problems are similar.

- Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through an I/O circuit, a power supply connection, the communication ground connection, or the chassis ground connection.

- Radiated noise is when the electrical interference is introduced into the system without a direct electrical connection, much in the same manner as radio waves.

Reducing Electrical Noise

While electrical noise cannot be eliminated it can be reduced to a level that will not affect the system.

- Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible. Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. A loose wire can act as a large antenna, introducing noise into the system, so, tighten all connections in your system. Loose ground wires are more susceptible to noise than the other wires in your system. Review Chapter 2 Installation, Wiring, and Specifications if you have questions regarding how to ground your system.

- Electrical noise can enter the system through the power source for the PLC and I/O circuits. Installing an isolation transformer for all AC sources can correct this problem. DC sources should be properly grounded, except for Class II power supplies. Switching DC power supplies commonly generate more noise than linear supplies.

- Place input and output wiring in separate wireways or wiring bundles. Keep AC and DC wiring separated as well. Never run I/O wiring parallel or close proximity to high voltage wiring.

- To improve noise immunity, you may optionally install the factory provided shunt between logic ground (LG) and chassis ground (G) on the CPU terminal strip to the left.

Optional CPU jumper connects logic ground and chassis ground
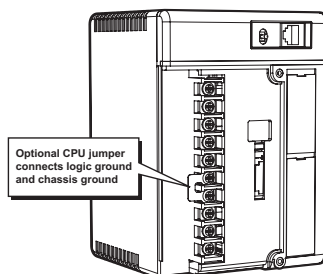
Machine Startup and Program Troubleshooting

The DL405 PLCs provide several features that can help you debug your program before and during machine startup. This section discusses the following topics which can be very helpful.

- Program Syntax Check
- Duplicate Reference Check
- Special Instructions
- Run Time Edits
- Forcing I/O Points

Syntax Check

Even though DirectSOFT programming software provides error checking during program entry, you may want to check a program that has been modified. For example, you can use the PLC Diagnostics menu option within DirectSOFT to select Syntax Check (PLC -> Diagnostics -> Syntax Check). This check will find a wide variety of programming errors.
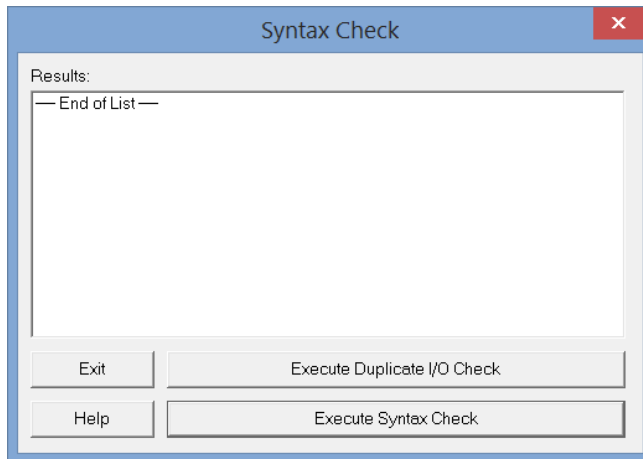
Diagnostic Window when no syntax error is found:

If you get an error, see the Error Codes Section for a complete listing of programming error codes. Correct the problem and continue running the Syntax check until the End of List message appears.

Duplicate I/O Check

You can check for multiple uses of the same output coil. For example, you can use the PLC Diagnostics menu option within DirectSOFT to select Execute Duplicate I/O Check (PLC -> Diagnostics -> Execute Duplicate I/O Check).

Diagnostic Window indicating a duplicate coil was found:
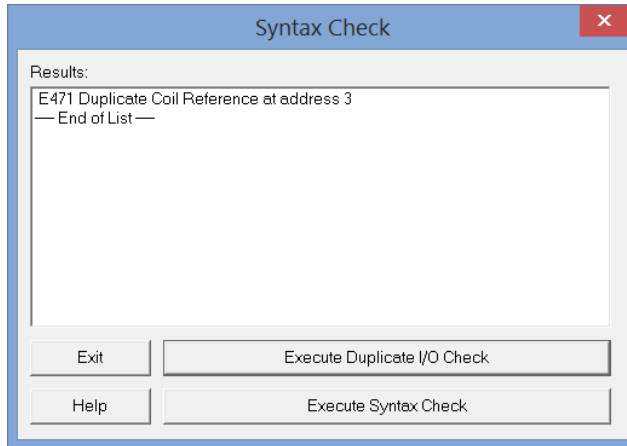
If you get a Duplicate Reference error, correct the problem and continue running the Duplicate Reference check until no duplicate references are found.

NOTE: You can use the same coil in more than one location, especially in programs that use the Stage instructions and / or the OROUT instructions. The Duplicate Reference check will find these outputs even though they may be used in an acceptable fashion.

Special Debug Instructions

There are several instructions that can be used to help you debug your program during machine startup operations.

- END
- PAUSE
- STOP

END Instruction: If you need a way to quickly disable part of the program, just insert an END statement prior to the portion that should be disabled. When the CPU encounters the END statement, it assumes that is the end of the program. The following diagram shows an example.

Normal Program   New END disables X10 and Y1
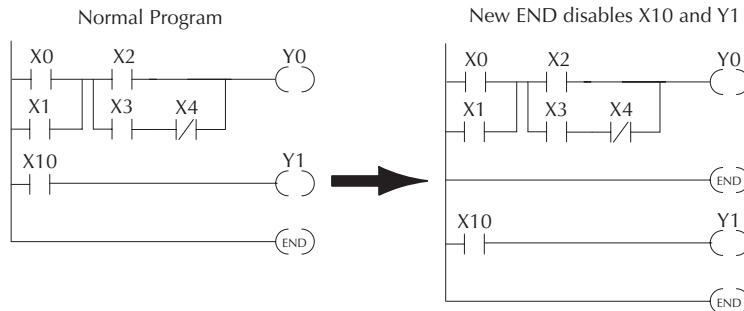
PAUSE Instruction: This instruction provides a quick way to allow the inputs (or other logic) to operate while disabling selected outputs. The output image register is still updated, but the output circuits are not. For example, you could make this conditional by adding an input contact or CR to control the instruction with a switch or a programming device. Or, you could just add the instruction without any conditions so the selected outputs would be disabled at all times.

Normal Program   PAUSE disables Y0 and Y1
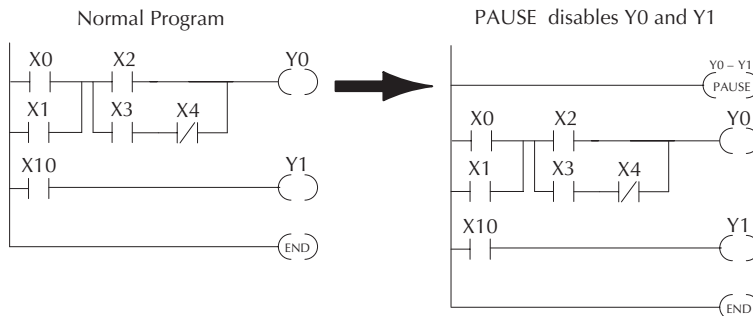
STOP Instruction: Sometimes during machine startup you need a way to quickly turn off all the outputs and return to Program Mode. You can use the STOP instruction. When this instruction is executed the CPU automatically exits Run Mode and enters Program Mode. Remember, all outputs are turned off during Program Mode. The following diagram shows an example of a condition that returns the CPU to Program Mode.

Normal Program

STOP puts CPU in Program Mode
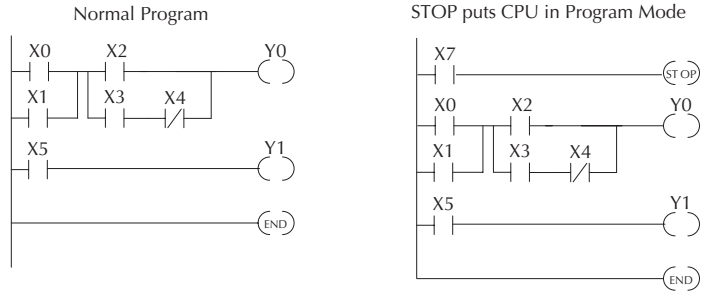
In the example shown above, you could trigger X7 which would execute the STOP instruction. The CPU would enter Program Mode and all outputs would be turned off.

Run Time Edits

The D4-454 CPU allows you to make changes to the application program during Run Mode. These edits are not "bump-less." Instead, CPU scan is momentarily interrupted (and the outputs are maintained in their current state) until the program change is complete. This means if the output is off, it will remain off until the program change is complete. If the output is on, it will remain on.

WARNING: Only authorized personnel fully familiar with all aspects of the application should make changes to the program. Changes during Run Mode become effective immediately. Make sure you thoroughly consider the impact of any changes to mi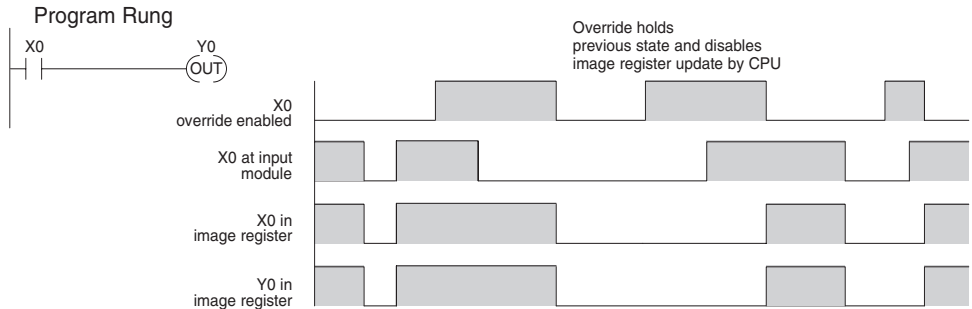nimize the risk of personal injury or damage to equipment. There are some important operational changes during Run Time Edits.

1. If there is a syntax error in the new instruction, the CPU will not enter the Run Mode.

2. If you delete an output coil reference and the output was on at the time, the output will remain on until it is forced off with a programming device.

3. Input point changes are not acknowledged during Run Time Edits, so, if you're using a high-speed operation and a critical input comes on, the CPU may not see the change.

Not all instructions can be edited during a Run Time Edit session. The following list shows the instructions that can be edited.

Mnemonic	Description
TMR	Timer
TMRF	Fast timer
TMRA	Accumulating timer
TMRAF	Accumulating fast timer
CNT	Counter
UDC	Up / Down counter
SGCNT	Stage counter
STR, STRN	Store, Store not (Boolean)
AND, ANDN	And, And not (Boolean)
OR, ORN	Or, Or not (Boolean)
STRE, STRNE	Store equal, Store not equal
ANDE, ANDNE	And equal, And not equal
ORE, ORNE	Or equal, Or not equal
STR, STRN	Store greater than or equal Store less than (Comparative Boolean)
AND, ANDN	And greater than or equal And less than (Comparative Boolean)

Mnemonic	Description
OR, ORN	Or greater than or equal or less than (Comparative Boolean)
LD	Load data (constant)
LDD	Load data double (constant)
ADDD	Add data double (constant)
SUBD	Subtract data double (constant)
MUL	Multiply (constant)
DIV	Divide (constant)
CMPD	Compare accumulator (constant)
ANDD	And accumulator (constant)
ORD	Or accumulator (constant)
XORD	Exclusive or accumulator (constant)
LDF	Load discrete points to accumulator
OUTF	Output accumulator to discrete points
SHFR	Shift accumulator right
SHFL	Shift accumulator left
NCON	Numeric constant

Forcing I/O Points

There are many times, especially during machine startup and troubleshooting, that you need the capability to force an I/O point to be either on or off. Before you use a programming device to force any data type, it is important to understand how the D4-454 CPUs process the forcing requests.

WARNING: Only authorized personnel fully familiar with all aspects of the application should make changes to the program. Make sure you thoroughly consider the impact of any changes to minimize the risk of personal injury or damage to equipment.

There are two types of forcing available with the D4-454 CPUs. (Chapter 3 provides a detailed description of how the CPU processes each type of forcing request).

- **Regular Forcing:** This type of forcing can temporarily change the status of a discrete bit. For example, you may want to force an input on, even though it is really off. This allows you to change the point status that was stored in the image register. This value will be valid until the image register location is written to during the next scan. This is primarily useful during testing situations when you need to force a bit on to trigger another event.

- **Bit Override:** Bit override can be enabled by a menu option in the DirectSOFT programming software.. You can use Bit Override with X, Y, C, T, CT, and S data types. Bit override basically disables any changes to the discrete point by the CPU. For example, if you enable bit override for X1, and X1 is off at the time, the CPU will not change the state of X1. This means that even if X1 comes on, the CPU will not acknowledge the change. Therefore, if you used X1 in the program, it would always be evaluated as off, in this case. If X1 was on when the bit override was enabled, then X1 would always be evaluated as on.
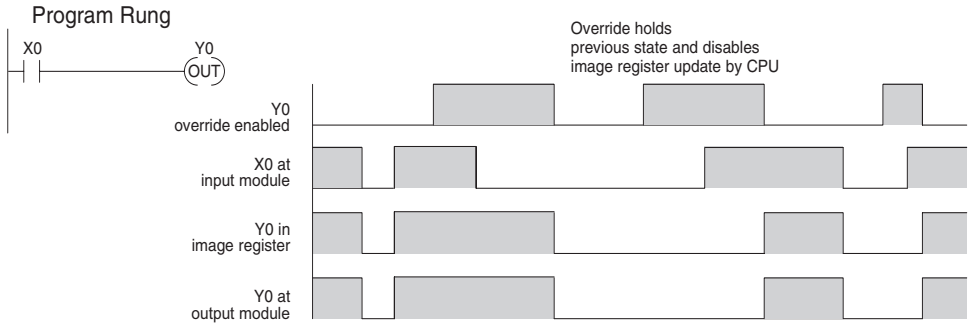
There is an advantage available when you use the Bit Override feature. The Regular Forcing is not disabled because the Bit Override is enabled. For example, if you enabled the Bit Override for Y0 and it was off at the time, the CPU would not change the state of Y0. However, you can still use a programming device to change the status. If you use the programming device to force Y0 on, it will remain on and the CPU will not change the state of Y0. If you then force Y0 off, the CPU will maintain Y0 as off. The CPU will never update the point with the results from the application program or from the I/O update until the Bit Override is removed from the point.
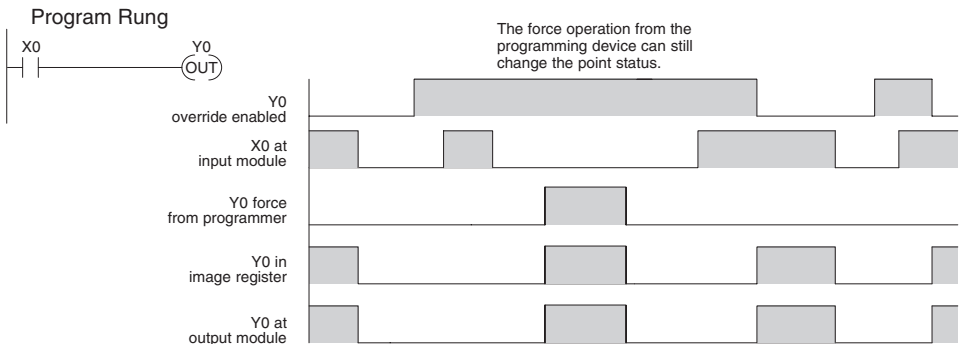
The following diagrams show how the bit override works for both input and output points. The example uses a simple rung, but the concepts are similar for any type of bit memory.

Program Rung

Override holds previous state and disables image register update by CPU

X0 — Y0 (OUT)

- X0 override enabled
- X0 at input module
- X0 in image register
- Y0 in image register

The following diagram shows how the bit override works for an output point. Notice the bit override maintains the output in the current state. If the output is on when the bit override is enabled, then the output stays on. If it is off, then the output stays off.

Program Rung

Override holds previous state and disables image register update by CPU

X0 — Y0 (OUT)

- Y0 override enabled
- X0 at input module
- Y0 in image register
- Y0 at output module

The following diagram shows how you can use a programming device in combination with the bit override to change the status of the point. Remember, bit override only disables CPU changes. You can still use a programming device to force the status of the point. Plus, since bit override maintains the current status, this enables true forcing. The example shown is for an output point, but you can also use the other bit data types.

Program Rung

The force operation from the programming device can still change the point status.

X0 — Y0 (OUT)

- Y0 override enabled
- X0 at input module
- Y0 force from programmer
- Y0 in image register
- Y0 at output module

Bit Override Forcing

It is possible to Force a bit On/Off by using the Override Editor or using Data View. Remember that when using the Bit Override feature, the CPU will retain the forced value until you disable the Bit Override or until you remove the force. The image register will not be updated with the status from the input module. Also, the solution from the application program will not be used to update the output image register.

The override editor is found in the PLC menu. Select PLC, Setup and Overrides. You can enter the desired bit(s) to override in the editor by pressing the Add button. To force a bit, select the bit in the list, select the Force On button and confirm the action. Follow the same steps to Force Off and to Remove.
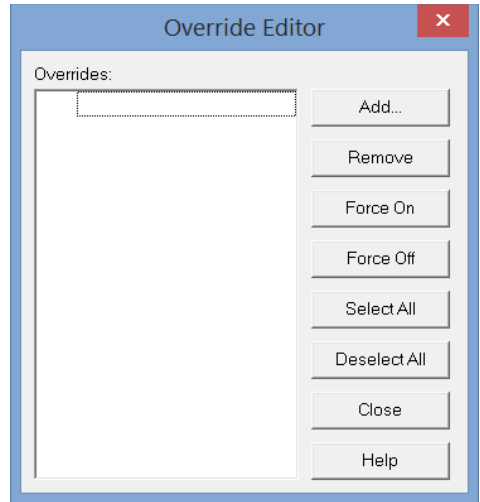

To override a bit using Data View, first open a data window from the Debug menu. Select Debug, Data View, New. Type the bit address under the Element column of the Data window. If the Edits column is not available, click on the Select Mode button at the top left of the Data View window to view the Override Bits buttons. It may be necessary to expand the Data View windows in order for the buttons to be visible.
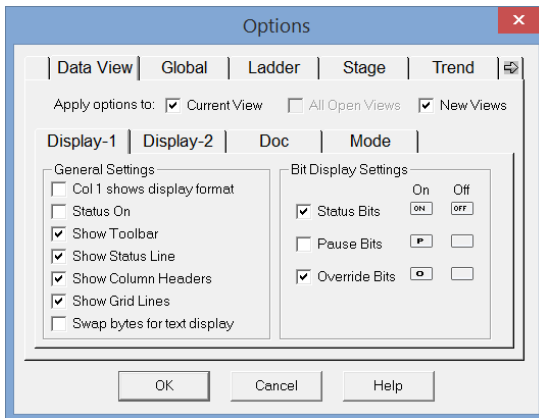
If the Override buttons do not show up in the Data View window after adding a bit in the Element column, use the Options dialog to enable the Override bits. Right click on the Data View window and select Options from the list. The Options dialog will be displayed with the Data View tab in view. Select the Override Bits under the Bit Display Settings and the Override buttons will become available in the Data View window.

To set an Override Bit, double-click on the respective Override button with the letter "O".
Double-clicking on the Blank button will turn the Override feature Off. The letter "O" in the status column indicates the Override Bit is set for that bit.
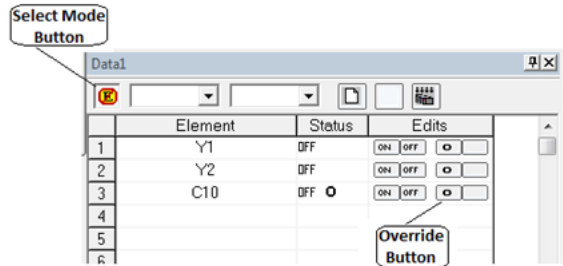
NOTE: *For more information on using and setting up Data View, refer to the DirectSOFT programming software user manual, PC-DSOFT6-M, Chapter 10. A PDF copy of the DirectSOFT user manual is available in the Help folder under the DirectSOFT 6 installation folder.*
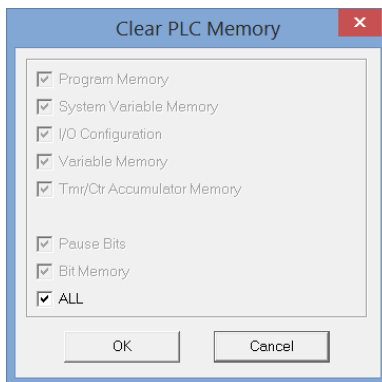
Reset the PLC to Factory Defaults

NOTE: Resetting to factory defaults will not clear any password stored in the PLC.

Resetting a DirectLogic PLC to Factory Defaults is a two-step process. Be sure to have a verified backup of your program using "Save Project to Disk" from the File menu before performing this procedure. Please be aware that the program as well as any settings will be erased and not all settings are stored in the project. In particular you will need to write down any settings for Secondary Communications Ports and manually set the ports up after resetting the PLC to factory defaults.

Step One – While connected to the PLC with DirectSOFT, go to the PLC menu and select; "Clear PLC Memory". Check the "ALL" box at the bottom of the list and press "OK".

Step Two – While connected with DirectSOFT, go the PLC menu and then to the "Setup" submenu and select; "Initialize Scratch Pad" and press "Ok".
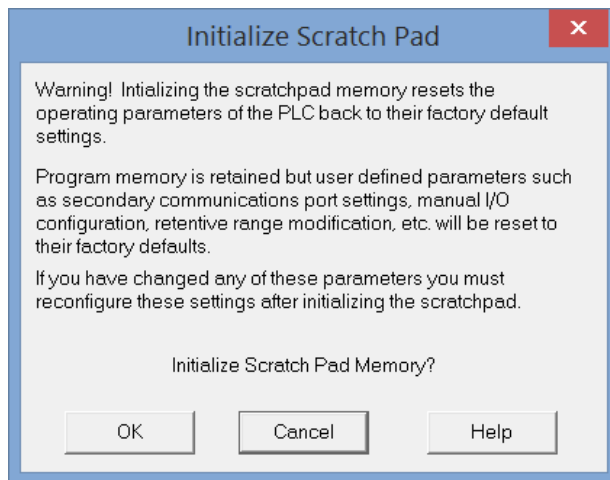

NOTE 1: All configurable communications ports will be reset to factory default state. If you are connected via Port 2 or another configurable port, you may be disconnected when this operation is complete
NOTE 2: Retentive ranges will be reset to the factory settings.
NOTE 3: Manually addressed IO will be reset to factory default settings.

The PLC has now been reset to factory defaults and you can proceed to program the PLC.