

Four Loop Temperature Controller

Four Loop Temperature Controller Module

F4-4LTC



Overview

The F4-4LTC combines the features of four single loop temperature controllers into one inexpensive module. The module has four asynchronous, configurable PID loops, with built-in temperature inputs and control outputs so that precision temperature control is maintained, even while the PLC is in program mode. This module can control temperatures up to $\pm 3276.7^{\circ}\text{C}/^{\circ}\text{F}$ and accepts either thermocouple or RTD inputs. By simply changing a jumper setting, you can choose the one that is best suited for your application. In addition, both versions have solid-state relay outputs for heater or chiller control.

Operation

The temperature is read directly into the F4-4LTC with the on-board RTD or thermocouple inputs. If the temperature is not at the target value (setpoint), then the control outputs are automatically activated. The F4-4LTC also provides automatic tuning of the control loops, so the module can easily adapt to changing temperature and process conditions. And since the F4-4LTC is an intelligent DL405 module, you can easily use simple ladder logic in a DL405 CPU for ramp and soak setpoint changes.

Minimal setup ladder logic is required in the CPU, and since the floating point calculations are performed in the temperature controller, there is little effect on the CPU scan time. The temperature controller also provides alarm and diagnostic capabilities by monitoring Low Alarm, High Alarm, Deviation Alarm, Heater Burn-out, and broken transmitter conditions.

All information from the F4-4LTC can be mapped directly into the DL405 CPU memory. As a result, information is freely accessible through the CPU for coordinated control, operator interface usage, or data collection.

The operating characteristics for each loop are programmed into a user-defined block of V-memory in the DL405 CPU. The temperature controller accesses this memory area to determine the operating parameters for each loop. Each loop that is enabled requires 24 V-memory locations. Since all loop parameters are stored in V-memory, any device capable of reading and writing DL405 V-memory can be used to configure or monitor loops.

The temperature controller reads/writes data within the CPU. This data includes:

Read continually

- Mode word
- Temperature setpoint

Written after loop update

- Output (0.0-100.0% or 0-4095)
- Alarm word
- Process temperature

Read setup/write after auto tune

- Gain
- Reset, Integral time (0-999.9s)
- Rate, Derivative time (0-999.9s)

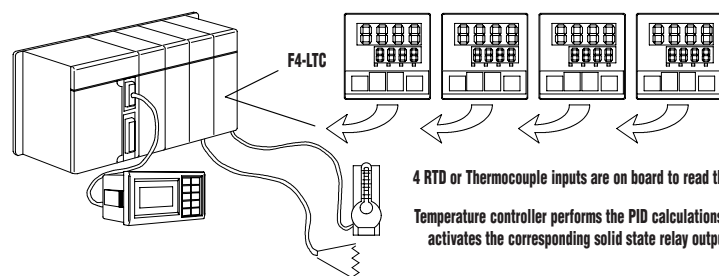
Read for setup

- Temperature Low Alarm
- Temperature High Alarm
- Temperature Deviation Alarm
- Alarm Deadband
- Setpoint Low Limit
- Setpoint High Limit
- Input Type (for Thermocouple)
- PID Control Period
- On/Off Hysteresis

RTD or thermocouple inputs

The F4-4LTC can accept either RTD or Thermocouple inputs. See the specifications table on the following page.

Combines four single loop controllers into one module.



4 RTD or Thermocouple inputs are on board to read the temperature
Temperature controller performs the PID calculations and activates the corresponding solid state relay output.

Four Loop Temperature Controller

| General Specifications | |
|-------------------------------|--|
| Module Type | CoProcessor, Intelligent |
| Number of Loops | Four maximum |
| Modules per CPU | Eight maximum, CPU base, any slot |
| I/O Points Required | None |
| V Memory Required | 24V-memory locations per loop |
| Input Type | RTD or Thermocouple |
| Controller Output | Open collector, high-current solid state relays, 5–26.4 VDC @ 0.15 A |
| Converter Type | Charge Balancing, 24-bit |
| Notch Filter | >100dB at 50Hz and 60Hz ($f_{-3db}=13.1$ Hz) |
| Common Mode Rejection | 90dB minimum at DC, 150dB minimum at 50Hz and 60Hz |
| Sampling Rate | Selectable per module 800ms (10Hz filter) 160ms (50Hz filter) |
| Current Transformer | 0.5 A to 50A sense range |
| Minimum Output On Time | 300ms to sense heater current |
| Operating Environment | 0°C to 60°C (32°F to 140°F) 5-95% humidity (non-condensing) |
| Power Requirements | 280mA at +5VDC, (base power) 75mA at +24VDC external $\pm 10\%$ |

| Thermocouple Specifications | |
|-------------------------------|--|
| Temperature Ranges | J, -190/760 °C (-310/1400 °F) E, -210/1000 °C (-346/1832 °F) K, -150/1372 °C (-238/2502 °F) R, 65/1768 °C (149/3214 °F) S, 65/1768 °C (149/3214 °F) T, -230/400 °C (-382/752 °F) B, 529/1820 °C (984/3308 °F) N, -70/1300 °C (-94/2372 °F) C, 65/2320 °C (149/4208 °F) |
| Input Fault Protection | 60Vrms or 50 VDC max |
| Cold Junction | Automatic compensation |
| Input Impedance | 20M Ω DC |
| Resolution | $\pm 0.1^\circ\text{C}$ (relative accuracy) |
| Maximum Inaccuracy | $\pm 3^\circ\text{C}$ exc. thermocouple error |
| RTD Specifications | |
| Temperature Ranges | PT100 -200/850 °C (-328/1562 °F) PT1000 -200/595°C (-328/1103 °F) jPT100 -35/450°C (-36/842 °F) 10 Ω -200/260°C (328/500 °F) 25 Ω -200/260°C (328/500 °F) |
| Input Fault Protection | 50VDC maximum |
| RTD Excitation Current | 200 μA |
| Resolution | $\pm 0.1^\circ\text{C}$ |
| Maximum Inaccuracy | $\pm 1^\circ\text{C}$ |

| Loop Specifications | |
|-----------------------------|---|
| Loop Operating Modes | PID control - computes and controls the outputs based on the PID parameters stored in V memory. If auto tuning is enabled, the module uses PID parameters calculated during the auto tuning process. ON/OFF Control - the outputs turn on, then off based on only the Process Temperature, Setpoint On/Off Hysteresis, and control type (heating or cooling). |
| PID Control Period | Specifies the sample rate and the time period the output is applied to (0.5 to 99.9 seconds) |
| Limit SP | Specify a high and low limit for allowable setpoint changes |
| Scaling | Automatically converts temperature to engineering units |
| Gain | Specify proportional gain of 0.0 to 6553.5. Gain may also be determined automatically by using the auto tuning feature. |
| Reset | Specify reset time of 0 to 65535 seconds. Reset may also be determined automatically by using the auto tuning feature. |
| Anti-windup | Stops the reset action when the PID output reaches 0 or 100%. Bias is automatically adjusted when the process temperature begins to respond. |
| Rate | Specify the derivative time, 0 to 65535 seconds. Rate may also be determined automatically by using the Auto Tuning feature. |
| Alarm Specifications | |
| Deadband | Specifies the temperature deadband on alarms. The alarm will remain active while the temperature is outside the alarm limit minus the deadband. |
| Temperature High | Temperature has risen above the programmed limit. |
| Temperature Low | Temperature has fallen below the programmed limit. |
| Deviation | A Y output or CR may be activated when the high or low temperature is further from the Setpoint than the programmed deviation limit. |
| Broken Transmitter | This alarm is turned on when the RTD or Thermocouple is burned out or missing. |

Check the Power Budget

Verify your power budget requirements

Your I/O configuration choice can be affected by the power requirements of the I/O modules you choose. When determining the types and quantity of I/O modules you will be using, it is important to remember there is a limited amount of power available from the power supply.

The chart on the opposite page indicates the power supplied and used by each DL405 device. The adjacent chart shows an example of how to calculate the power used by your particular system. These two charts should make it easy for you to determine if the devices you have chosen fit within the power budget of your system configuration.

If the I/O you have chosen exceeds the maximum power available from the power supply, you can resolve the problem by shifting some of the modules to an expansion base or remote I/O base (if you are using remote I/O).

Warning: It is extremely important to calculate the power budget correctly. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Use ZIPLinks to reduce power requirements

If your application requires a lot of relay outputs, consider using the ZIPLink AC or DC relay output modules. These modules can switch high current (10A) loads without putting a load on your base power budget. Refer to Wiring System for DL405 PLCs later in this section for more information.

This logo is placed next to I/O modules that are supported by the ZIPLink connection systems.

See the I/O module specifications at the end of this section.



Calculating your power usage

The following example shows how to calculate the power budget for the DL405 system. The example is constructed around a single 8-slot base using the devices shown. It is recommended you construct a similar table for each base in your system.

| A | | | | |
|----------|---|--------------------|----------------------|-----------------------------------|
| | Base Number 0 | Device Type | 5 VDC (mA) | External 24 VDC Power (mA) |
| B | CURRENT SUPPLIED | | | |
| | CPU/Expansion Unit /Remote Slave | D4-454 CPU | 3700 | 400 |
| C | CURRENT REQUIRED | | | |
| | SLOT 0 | D4-16ND2 | +150 | +0 |
| | SLOT 1 | D4-16ND2 | +150 | +0 |
| | SLOT 2 | F4-04DA | +120 | +100 |
| | SLOT 3 | D4-08NA | +100 | +0 |
| | SLOT 4 | D4-08NA | +100 | +0 |
| | SLOT 5 | D4-16TD2 | +100 | +0 |
| | SLOT 6 | D4-16TD2 | +100 | +0 |
| | SLOT 7 | D4-16TR | +1000 | +0 |
| D | OTHER | | | |
| | BASE | D4-08B-1 | +80 | +0 |
| | Handheld Programmer | D4-HPP-1 | +320 | +0 |
| E | Maximum Current Required | | 2820 | 100 |
| F | Remaining Current Available | | 3700-2820=880 | 400-100=300 |
| | 1. Using a chart similar to the one above, fill in column 2. 2. Using the tables on the opposite page, enter the current supplied and used by each device (columns 3 and 4). Pay special attention to the current supplied by the CPU, Expansion Unit, and Remote Slave since they differ. Devices which fall into the "Other" category (Row D) are devices such as the Base and the Handheld programmer, which also have power requirements, but do not plug directly into the base. 3. Add the current used by the system devices (columns 3 and 4) starting with Slot 0 and put the total in the row labeled "maximum current required" (Row E). 4. Subtract the row labeled "Maximum current required" (Row E), from the row labeled "Current Supplied" (Row B). Place the difference in the row labeled "Remaining Current Available" (Row F). 5. If "Maximum Current Required" is greater than "Current Supplied" in either column 3 or 4, the power budget will be exceeded. It will be unsafe to use this configuration and you will need to restructure your I/O configuration. Note the auxiliary 24VDC power supply does not need to supply all the external power. If you need more than the 400mA supplied, you can add an external 24VDC power supply. This will help keep you within your power budget for external power. | | | |

DL405 CPU power supply specifications and power requirements

| Specification | AC Powered Units | 24 VDC Powered Units |
|---------------------------------------|--|--|
| Part Numbers | D4-454, D4-EX (expansion base unit), D4-RS (remote slave unit) | D4-454DC-1, D4-EXDC (expansion base unit) |
| Voltage Withstand (dielectric) | 1 minute @ 1,500 VAC between primary, secondary, field ground, and run relay | |
| Insulation Resistance | > 10MΩ at 500VDC | |
| Input Voltage Range | 85-132 VAC (110V range) 170-264 VAC (220V range) | 20-28 VDC (24VDC) with less than 10% ripple |
| Maximum Inrush Current | 20A | 20A |
| Maximum Power | 50VA | 38W |

Power Requirements

| Power Supplied | | | | | |
|--|---|---|--|--|---|
| <i>CPUs/Remote Units/ Expansion Units</i> | <i>5 VDC Current Supplied in mA</i> | <i>24V Aux Power Supplied in mA</i> | <i>CPUs/Remote Units/ Expansion Units</i> | <i>5V Current Supplied in mA</i> | <i>24V Aux Power Supplied in mA</i> |
| D4-454 CPU D4-454DC-1 | 3100 3100 | 400 NONE | D4-EX D4-EXDC D4-RS H4-EBC | 4000 4000 3700 3470 | 400 NONE 400 400 |
| Power Consumed | | | | | |
| <i>Power-consuming Device</i> | <i>5V Current Consumed</i> | <i>External 24VDC Current Required</i> | <i>Power-consuming Device</i> | <i>5V Current Consumed</i> | <i>External 24VDC Current Required</i> |
| <i>I/O Bases</i> | | | <i>Analog Modules (continued)</i> | | |
| D4-04B-1 D4-06B-1 D4-08B-1 | 80 80 80 | NONE NONE NONE | F4-16AD-1 F4-16AD-2 F4-04DA-1 F4-04DA-2 F4-04DAS-1 F4-08DA-1 F4-08DA-2 F4-16DA-1 F4-16DA-2 F4-08RTD F4-08THM-n F4-08THM | 75 75 70 90 60 90 80 90 80 80 120 110 | 100 100 75+20 per circuit 90 60 per circuit 100+20 per circuit 150 100+20 per circuit 25 max. NONE 50 60 |
| <i>DC Input Modules</i> | | | <i>Remote I/O</i> | | |
| D4-16ND2 D4-16ND2F D4-32ND3-1 D4-64ND2 | 150 150 150 300 max. | NONE NONE NONE NONE | H4-ERM100 H4-ERM-F D4-RM | 320(300) 450 300 | NONE NONE NONE |
| <i>AC Input Modules</i> | | | <i>Communications and Networking</i> | | |
| D4-08NA D4-16NA | 100 150 | NONE NONE | H4-ECOM100 D4-DCM F4-MAS-MB | 300 500 235 | NONE NONE NONE |
| <i>AC/DC Input Modules</i> | | | <i>CoProcessors</i> | | |
| D4-16NE3 | 150 | NONE | F4-CP128-1 | 305 | NONE |
| <i>DC Output Modules</i> | | | <i>Specialty Modules</i> | | |
| D4-16TD1 D4-16TD2 D4-32TD1 D4-32TD2 D4-64TD1 | 200 400 250 350 800 | 125 NONE 140 120 (4A max including loads) NONE | H4-CTRIO D4-16SIM F4-4LTC | 400 150 280 | NONE NONE 75 |
| <i>AC Output Modules</i> | | | <i>Programming</i> | | |
| D4-08TA D4-16TA | 250 450 | NONE NONE | D4-HPP-1 (Handheld Prog.) | 320 | NONE |
| <i>Relay Output Modules</i> | | | <i>Operator Interface</i> | | |
| D4-08TR F4-08TRS-1 F4-08TRS-2 D4-16TR | 550 575 575 1000 | NONE NONE NONE NONE | DV-1000 | 150 | NONE |
| <i>Analog Modules</i> | | | C-more Micro-Graphic | 210 | NONE |
| F4-04AD F4-04ADS F4-08AD | 150 370 75 | 100 120 90 | | | |