

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

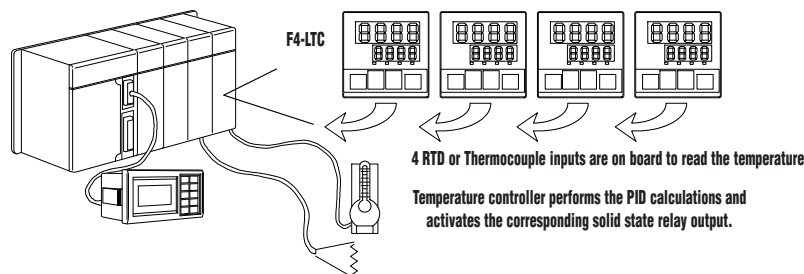
Written after loop update

- 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)

Combines four single loop controllers into one module.



Read for setup

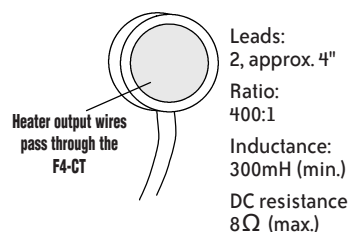
- Temperature Low Alarm
- Temperature High Alarm
- Temperature Deviation Alarm
- Alarm Deadband
- Setpoint Low Limit
- Setpoint High Limit
- Input Type (for Thermocouple)
- PID Control Period
- On/Off Hysteresis

RTD or thermocouple inputs

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

Current transformer

The F4-CT detects the presence of current flow and is very useful in detecting heater burnout conditions. One F4-CT is included with the 4-loop Temperature Controller Module. The F4-4LTC has four inputs that can be used with these current transformers:



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, 5-26.4VDC @ 0.15A
Converter Type	Charge Balancing, 24-bit
Notch Filter	>100dB at 50Hz and 60Hz ($f_{-3dB}=13.1\text{Hz}$)
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	0.5A 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 $\pm 10\%$
Manufacturer	FACTS Engineering

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 of 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 page 6-57 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	D4-440 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	D4-08ND3S	+100	+0
SLOT 4	D4-08ND3S	+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	+80	+0
Handheld Programmer	D4-HPP	+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 3 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 24 VDC 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	125 VDC Powered Units
Part Numbers	D4-450, D4-440, D4-430, D4-EX (expansion base unit), D4-RS (remote slave unit)	D4-450DC-1, D4-440DC-1, D4-EXDC (expansion base unit), D4-RSDC (remote slave unit)	D4-450DC-2, D4-440DC-2
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 (110 range) 170-264 VAC (220 range)	20-28 VDC (24 VDC) with less than 10% ripple	90-146 VDC (125 VDC) with less than 10% ripple
Maximum Inrush Current	20 A	20 A	20 A
Maximum Power	50 VA	38 W	30 W

Power Requirements

Power Supplied					
CPUs/Remote Units/ Expansion Units	5 VDC Current Supplied in mA	24V Aux Power Supplied in mA	CPUs/Remote Units/Expansion Units	5V Current Supplied in mA	24VAux. Power Supplied in mA
D4-430 CPU	3700	400	D4-EX	4000	400
D4-440 CPU	3700	400	D4-EXDC	4000	NONE
D4-440DC-1 CPU	3700	NONE	D4-EXDC-2	3700	NONE
D4-440DC-2 CPU	3700	NONE	D4-RS	3700	400
D4-450 CPU	3100	400	D4-RSDC	3700	NONE
D4-450DC-1 CPU	3100	NONE	H4-EBC	3470	400
D4-450DC-2 CPU	3100	NONE	H4-EBC-F	3300	400
Power Consumed					
Power-consuming Device	5V Current Consumed	External 24VDC Current Required	Power-consuming Device	5V Current Consumed	External 24VDC Current Required
I/O Bases			Analog Modules (continued)		
D4-04B-1	80	NONE	F4-16AD-1	75	100
D4-06B-1	80	NONE	F4-16AD-2	75	100
D4-08B-1	80	NONE	F4-04DA-1	70	75+20per circuit
DC Input Modules			F4-04DA-2	90	90
			F4-04DAS-1	60	60 per circuit
			F4-04DAS-2	60	60 per circuit
			F4-08DA-1	90	100+20 per circuit
			F4-08DA-2	80	150
			F4-16DA-1	90	100+20 per circuit
			F4-16DA-2	80	25 max.
			F4-08RTD	80	NONE
			F4-08THM-n	120	50
			F4-08THM	110	60
AC Input Modules			Remote I/O		
D4-08NA	100	NONE	H4-ERM	320	NONE
D4-16NA	150	NONE	H4-ERM-F	450	NONE
AC/DC Input Modules			D4-RM	300	NONE
D4-16NE3	150	NONE	Communications and Networking		
F4-08NE3S	90	NONE	H4-ECOM100	300	NONE
DC Output Modules			H4-ECOM	530	NONE
D4-08TD1	150	35	H4-ECOM-F	670	NONE
F4-08TD1S	295	NONE	D4-DCM	500	NONE
D4-16TD1	200	125	F4-MAS-MB	235	NONE
D4-16TD2	400	NONE	FA-UNICON	NONE	65
D4-32TD1	250	140	CoProcessors		
D4-32TD1-1	250	140 (15V)	F4-CP128-1	305	NONE
D4-32TD2	350	120 (4A max including loads)	Specialty Modules		
D4-64TD1	800	NONE	H4-CTRIO	400	NONE
AC Output Modules			D4-INT	100	NONE
D4-08TA	250	NONE	D4-HSC	300	NONE
D4-16TA	450	NONE	F4-16PID	160	NONE
Relay Output Modules			F4-8MPI	225	170
D4-08TR	550	NONE	D4-16SIM	150	NONE
F4-08TRS-1	575	NONE	F4-4LTC	280	75
F4-08TRS	575	NONE	Programming		
D4-16TR	1000	NONE	D4-HPP-1 (Handheld Prog.)	320	NONE
Analog Modules			Operator Interface		
F4-04AD	85	100	DV-1000	150	NONE
F4-04ADS	270	120	C-more Micro-Graphic	210	NONE
F4-08AD	75	90			